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Performance testing and rating of factory-made refrigeration systems — Automatic commercial ice makers and storage bins

Essais et détermination des caractéristiques de performance des systèmes de réfrigération de fabrication industrielle — Générateurs de glace automatiques et compartiments de conservation pour le commerce

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Foreword

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Performance testing and rating of factory-made refrigeration systems — Automatic commercial ice makers and storage bins

1 Scope

1.1. This standard establishes testing procedures and methods of rating the performance of factory-made automatic ice-makers as defined in 3.1 and ice storage bins as defined in 3.4.

1.2. This standard does not apply to ice-making devices intended to be incorporated in household appliances.

1.3. Ice may be produced in irregular shapes, flakes, ribbons, or wafers as well as uniformly shaped ice of not over approximately 100g in weight.

2 Normative references

- IEC 60335-1, 1991, *Safety of household and similar electrical appliances – Part 1: General requirements, Third Edition.*
- IEC 60335-2-24, 1993, *Safety of household and similar electrical appliances – Part 2: Particular requirements for refrigerating appliances, ice-cream appliances and ice-makers.*

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3 Terms and definitions

For the purposes of this International Standard, the following definitions apply.

3.1 Automatic ice-maker. A factory-made assembly (not necessarily shipped in one package) consisting of a condensing unit and ice-making section operating as an integrated unit, with means for making and harvesting ice up to a maximum of 2500 kg/24 h at the standard rating conditions. It may also include means for storing or dispensing ice, or both.

3.1.1 Self-contained model. A model in which the ice making mechanism, storage compartment and condensing unit are in an integral cabinet.

3.1.2 Split system ice-maker. A model in which the ice-making mechanism and condenser or condensing unit are in separate sections.

3.1.3 Cubes-type ice-maker. The word “cube” is not a reference to a specific shape or size. It is a method of distinguishing equipment that has alternate freezing and harvesting periods from continuous operation as used in production of flake or similar ice.

3.1.4 Modular-type ice-maker. Ice-maker without storage means.

3.2 Blow-Down. Refers to the dissipation of a certain percentage of water to control the clarity of ice or to prevent scaling.

3.3 Bin meltage water. Refers to water from ice that is melting in the bin.

3.4 *Ice storage bin.* A factory-made assembly (not necessarily shipped in one package) which consists of a non-refrigerated compartment for storage of ice.

3.5 *Published ratings.* A statement of the assigned values of those performance characteristics, under stated rating conditions, by which a unit may be chosen to fit its application. These values apply to all units of like nominal size and type (identification) produced by the manufacturer. As used herein, the term "published ratings" includes the rating of all performance characteristics shown on the unit or published in specifications, advertising or other literature controlled by the manufacturer, at stated rating conditions.

3.5.1 *Standard rating.* Ratings based on tests performed at standard rating conditions.

3.5.2 *Application rating.* Ratings based on tests performed at other than standard rating conditions.

3.6 *Rating conditions.* Any set of operating conditions under which a single level of performance results, and which causes only that level of performance to occur.

3.6.1 *Standard rating conditions.* Rating conditions used as the basis of comparison of performance characteristics.

3.6.2 *Application rating conditions.* Ratings based on tests performed at conditions other than standard rating conditions.

3.7 *Separate storage compartment.* A compartment for storage of ice which is separate from the ice making mechanism.

3.8. *Quality of harvested ice.* The percentage of ice contained in the harvested ice (as per 5.5.4.1, and Annex B).

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4 General mechanical and physical requirements

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4.1 The machine and its parts shall be constructed with adequate strength and rigidity for normal conditions of handling, transport and use.

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4.2. Moving parts, which may constitute an accident hazard, shall be effectively guarded when the machine and associated refrigerating system are installed and operating.

4.3 Pipes and connections to moving or resiliently mounted parts shall be arranged so as not to foul or transmit vibrations to other parts. All other pipes and connections shall be anchored and free length shall be provided to prevent failure due to fatigue.

4.4 There shall be no sharp edges or corners liable to cause injury under normal conditions of use.

4.5 Doors/lids under normal conditions of use shall be smooth and positive in action and designed to function properly without undue wear.

4.6 Materials shall be durable and not favour the development of mould or emit odors. They shall also be resistant to corrosion appropriate to their location and function.

4.7 Internal and external finishes shall be resistant to wear and capable of being cleaned effectively and hygienically. Finishes shall not crack, chip, flake, rub off or soften under normal conditions of use or during cleaning.

4.8 The design and construction of all parts of the refrigerating system subject to internal pressure shall take into account the maximum working pressure to which they will be subjected when the machine is in operation or at rest.

5 Testing and rating requirements

5.1 *General conditions.* Automatic ice-makers shall be tested for rating in accordance with Annex A. The

calorimeter test (Annex B) need not be performed on cube-type ice-makers. Automatic ice-makers shall be tested using all components supplied with the machine and installed according to the manufacturer's installation instructions.

5.2 Electrical conditions. All standard rating tests shall be performed at the nameplate rated voltage(s) or frequency or at the mean of the rated voltage range(s) $\pm 2,0\%$ and at the rated frequency $\pm 1,0\%$. For automatic ice-makers with dual nameplate frequency ratings, standard rating tests shall be performed at both frequencies, or at the lower of the two frequencies, if only a single standard rating is to be published. For automatic ice-makers with dual nameplate voltages, standard rating tests shall be performed at both voltages, or at the lower voltage of the two, if only a single standard rating is to be published.

5.3 Requirements for split systems. All standard ratings for split systems shall be determined with at least 7.6m of interconnection tubing on each line, of the size recommended by the manufacturer. The line sizes, insulation and details of installation shall be in accordance with the manufacturer's published literature.

5.4 Method of testing for bins. Ice storage bins shall be tested for rating in accordance with Annex C and installed in accordance with the manufacturer's instructions. Where units are intended to be used with legs, the legs shall be fitted.

5.5 Standard ratings.

5.5.1 General. Standard ratings shall be established at the standard rating conditions specified in 4.5.3 and by the test methods specified in A2. All standard ratings shall be verified by tests as specified in 4.1.

5.5.2 Ratings for cube machines. For machines with adjustable size ice cube settings, standard ratings require the publication of ratings for the largest size cube setting and for the smallest size cube setting. Ratings for any other intermediate size cube settings may be published as application ratings. The ice cube size dimensions shall accompany all published ratings.

5.5.3 Standard rating conditions. The conditions of test for standard ratings are as follows:

Ambient temperature..... 32°C

(For a split-system unit, the condenser air inlet temperature shall be 32°C with an indoor ambient temperature of 32°C.)

Water inlet temperature..... 21°C

Water inlet pressure 200 ∇ 30 kPa.(measured as close as possible to the inlet port of the unit.)

5.5.4 Values of standard ratings. Standard ratings shall include:

5.5.4.1 Ice harvest rate. The amount of 0°C ice harvested, stated in kg / 24h, (corrected to 335 kJ/kg per 5.1), stated in multiples of one. Cube-type ice-makers are considered as producing 100% quality ice.

5.5.4.2 Condenser water use rate. The amount of water used by the condensing unit (if water cooled), stated in L/10kg of ice, as determined in 5.5.4.1, stated in multiples of one. Condenser water shall be the same temperature as potable water for standard ratings.

5.5.4.3 Potable water use rate. The amount of potable water used in making ice, including blow down and for defrosting, stated in L/10kg of ice, as determined in 5.5.4.1, stated in multiples of 0,1.

5.5.4.4 Energy consumption rate. Total energy input rate, stated in kWh/10kg of ice as determined in 5.5.4.1, stated in multiples of 0,1. For split systems, total energy input shall include condensing unit energy.

5.5.4.5 Bin ratings for self-contained ice-makers. For self-contained ice-makers, the theoretical storage capacity and the theoretical storage effectiveness of the ice storage bin shall be determined in accordance with Annex C. For these models, the internal volume is the volume calculated up to the intended shut-off level. The

intended shut-off level is defined as the height of the thermostat bulb; the bottom of the curtain or the height of the optical sensor, depending upon the mechanism used to shut off the ice-maker.

5.5.4.6 Bin ratings for stand alone bins. For stand alone bins, the theoretical storage capacity and the theoretical storage effectiveness of the ice storage bin shall be determined in accordance with Annex C. For these models, the internal volume is the volume calculated up to the top of the bin.

5.6 Application ratings. Ratings at conditions other than those specified in 5.5.3 shall be published as application ratings and shall be based on data determined by the methods of test prescribed in clause 5.1 through 5.4. Application ratings shall include at least one of the following conditions:

1. Ambient temperature 25°C
Water inlet temperature 15°C
Water inlet pressure 200∇30kPa
2. Ambient temperature 43°C
Water inlet temperature 32°C
Water inlet pressure 200∇30kPa

Where machines are intended for use in an ambient temperature range of 10°C to 43°C, ratings shall include both conditions.

5.7 Minimum data requirements for published ratings. The minimum data required for published ratings shall include those performance characteristics of 5.5.2 and 5.5.4 if applicable. Wherever application ratings are published or printed they shall include or be accompanied by the standard ratings, clearly designated as such, including a statement of the conditions at which the ratings apply.

5.8 Tolerances.

5.8.1 Automatic ice-makers. To comply with this standard, published ratings shall be based on data obtained in accordance with the provisions of Clause 5 of this standard and shall be such that any production unit, when tested, does not exceed the tolerance indicated in Table 1 below.

Table 1. Tolerances

Ice production rate (kg/24 hr)	Tolerances		
	Ice harvest rate	Energy consumption rate	Water use rate (if applicable)
≤ 100	≥ 90%	≤ 110%	≤ 110%
> 100	≥ 95%	≤ 105%	≤ 110%

5.8.1.1 Verification of tolerances shall be assessed on a single test unit.

5.8.1.1 Verification of tolerances shall be assessed on the average of three test units if the first test unit is found to be outside one or more of the tolerances indicated in Table 1.

5.8.1. Ice storage bins. The bin theoretical storage capacity shall not be lower than 97% of its published rating and theoretical storage effectiveness not less than 95% of its published rating.

6 Data to be published

The minimum data required for published ratings shall include the following:

Ice harvest rate at standard rating conditions (kg per 24 h)

Condenser water use rate (litres per 10kg of ice)

Potable water use rate (litres per 10kg of ice)

Energy consumption rate (kWh per 10 kg of ice)

Bin theoretical storage capacity (self-contained or free-standing storage bin only) (kg)

Cube size setting (see 5.5.2)

7 Marking and nameplate data

7.1 Marking automatic ice makers and storage bins shall be provided with a durable nameplate, firmly attached and in a location accessible for reading (IEC 60335-1, clause 7.14).

7.2. *Nameplate data.* The nameplate shall display the manufacturer's name, model number, serial number, international number of refrigerant used or blend of gas, mass of refrigerant used (kg), information on power source(s) for which the machine is intended and all markings and nameplate or trademark data laid down by safety code standards, including IEC 60335-1 and IEC 60335-2-24.

8 Instructions for use and maintenance

8.1 Every appliance shall be accompanied on delivery by instructions for its use and maintenance. These instructions shall include, in particular, information as to:

- a). the installation requirements (best location, leveling, connection – if required – for blow down water, defrost water, connections to energy source);
- b). the overall space required in use, with sketches showing the appliance with the means of access open and closed;
- c). for appliances, which are intended to be built-in, the recess dimensions together with any additional ventilation requirements;
- d). the operating conditions (starting and stopping procedures);
- e). the instructions for use of the various controls [such as thermostat(s), indicator lights, air circulation and defrosting control(s)];
- f). the limit values of the range of ambient temperature for which the appliance is designed and the fact that the performance may be affected by such factors as the location of the appliance, ambient temperature and the frequency of door opening. If appropriate, a warning shall be given that the setting of the thermostat or other temperature control devices might have to be varied to allow for these factors;
- g). the care required for best performance;
- h). the action to be taken when the appliance is switched off and taken out of service temporarily or for an extended period, for example, emptied, defrosted, cleaned and dried, and the door(s) or lid(s) propped ajar;
- i). the necessity that, for doors or lids fitted with locks and keys, the keys should be kept out of the reach of children and not in the vicinity of the appliance, in order to prevent children from being locked inside. When disposing of the appliance, all locks must be removed and rendered inoperable.

9 Voluntary conformance

While conformance with this standard is voluntary, conformance shall not be claimed or implied for products or equipment within its Scope (Clause 1) unless such claims meet all of the requirements of the standard.

Annex A (normative)

Testing Method for Determining Performance

A.1 Instrumentation and apparatus

A1.1 Test room

A1.1.1 Ambient temperature. With the test unit at rest and the test facility in operation, the vertical ambient temperature gradient in any metre of vertical distance from 50 mm above the floor or supporting platform to a height of 2 m or to a height of 0,3 m above the top of the cabinet, whichever is greater, shall not exceed 1,0°C per metre (See 5.5.3, 5.6, 5.6.1, and 5.6.2).

A1.1.2 Air circulation. With the test unit at rest, ambient air movement, created by any source external to the unit, shall not impinge upon the air inlet openings with a velocity greater than 0,25 m/s.

A1.2 Temperature measuring instruments

A1.2.1 Types. Temperature measurements shall be made with instruments of any type having the specified accuracies and readability (A1.2.2) at the temperatures of use.

A1.2.2 Accuracy and readability each shall be within ∇ 0,50°C unless otherwise specified.

A1.2.3 The instrument shall be calibrated by comparison with a certified temperature standard in the range of use or shall itself be certified as to its accuracy (ISO 17025).

A1.3 Electrical instruments

A1.3.1 Accuracy and readability each shall be within ∇ 1,0% of the quantity measured.

A1.3.2 Measurement of input power shall be made with an integrating watt-hour measuring device readable meter to 0,01 kWh.

A1.4 Water flow measuring instruments

A1.4.1 Flow measurements shall be made by one or more of the following methods having an accuracy and readability each of ∇ 2,0% of quantity measured:

- a) Liquid quantity, measuring either weight or volume versus time.
- b) Integrating type liquid flow meter.

A1.5 Ice weighing instruments

A1.5.1 Unless otherwise specified, ice made by the unit shall be weighed on an instrument having an accuracy and readability each of ∇ 1,0% of the quantity measured.

A1.5.2 The intercepted ice sample shall be obtained and weighed in one of the following containers of predetermined weight (insulated if desired).

- a) Perforated pan, bucket, or wire basket, for cube-type ice.
- b) Non-perforated pan or bucket, for non-cube-type ice.

A.2 Test methods

A2.1 The specified voltage ∇ 2,0% during the test.