



SLOVENSKI STANDARD

SIST EN 441-12:2000

01-december-2000

Refrigerated display cabinets - Part 12: Measurement of the heat extraction rate of the cabinets when the condensing unit is remote from the cabinet

Refrigerated display cabinets - Part 12: Measurement of the heat extraction rate of the cabinets when the condensing unit is remote from the cabinet

Verkaufskühlmöbel - Teil 12: Messung der Kälteleistung für Kühlmöbel mit getrennt aufgestelltem Verflüssigungssatz

Meubles frigorifiques de vente - Partie 12: Mesure de la puissance frigorifique utile des meubles dont le groupe de condensation est séparé du meuble

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Ta slovenski standard je istoveten z: **EN 441-12:1997**

ICS:

97.130.20 Hladilne naprave za trgovine Commercial refrigerating appliances

SIST EN 441-12:2000

en

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EUROPEAN STANDARD

EN 441-12

NORME EUROPÉENNE

EUROPÄISCHE NORM

May 1997

ICS 97.130

Descriptors: furniture, refrigerators, food preservation, food storage, commerce, tests, testing conditions, power measurements, calorific power

English version

**Refrigerated display cabinets - Part 12:
Measurement of the heat extraction rate of the
cabinets when the condensing unit is remote from
the cabinet**

Meubles frigorifiques de vente - Partie 12:
Mesure de la puissance frigorifique utile des
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This European Standard was approved by CEN on 1997-04-26. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

The European Standards exist in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Foreword

This European standard has been prepared by Technical Committee CEN/TC 44 "Household refrigerating appliances and commercial refrigerated cabinets" the Secretariat of which is held by UNI.

This European standard has been drafted on a proposal of CECOMAF (European Committee of Manufacturers of Refrigeration Equipment).

This European standard is composed of several parts:

- Part 1: Refrigerated display cabinets - Terms and definitions
- Part 2: Refrigerated display cabinets - General mechanical and physical requirements
- Part 3: Refrigerated display cabinets - Linear dimensions, areas and volumes
- Part 4: Refrigerated display cabinets - General test conditions
- Part 5: Refrigerated display cabinets - Temperature test
- Part 6: Refrigerated display cabinets - Classification according to temperatures
- Part 7: Refrigerated display cabinets - Defrosting test
- Part 8: Refrigerated display cabinets - Water vapour condensation test
- Part 9: Refrigerated display cabinets - Electrical energy consumption test
- Part 10: Refrigerated display cabinets - Test for the absence of odour and taste
- Part 11: Refrigerated display cabinets - Installation, maintenance and user's guide
- Part 12: Refrigerated display cabinets - Measurement of the heat extraction rate of the cabinets when the condensing unit is remote from the cabinet

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CEN/TC 44 held a meeting in Milan on 1990/11/26-27 and agreed to submit EN 441 Parts 1 to 11 for enquiry through the CEN Central Secretariat (see resolution N.9 in document CEN/TC 44 N.35 rev.1). The comments received by the Secretariat on the six month enquiry were discussed by CEN/TC 44 in Milan on 1992/11/04-06 and were the base for the preparation of this Part 12 (see resolution N.14 in document CEN/TC 44 N.46). After amending, this part was accepted by CEN/TC 44 on 1994/05/25 in Milan (see resolution N.22 in document CEN/TC 44 N.57). 12-2000

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 1997, and conflicting national standards shall be withdrawn at the latest by November 1997.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

1.1 This European Standard specifies terminology, general mechanical and physical requirements, test conditions as well as installation, maintenance and user's guide for refrigerated display cabinets for the sale and/or display of food products.

This standard does not cover refrigerated vending machines or cabinets intended for use in catering or similar non retail applications.

1.2 This Part of EN 441 specifies heat extraction rate measurements and conditions for refrigerated display cabinets when the condensing unit is remote from the cabinet and used with compression-type or indirect-type refrigerating system.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

- EN 441-4 Refrigerated display cabinets - Part 4: General test conditions
- EN 441-5 Refrigerated display cabinets - Part 5: Temperature test
- ISO 817 Organic refrigerants - Number designation
- <https://standards.iteh.ai/catalog/standards/sist/5e2d1c87-490c-48f9-94ea-7c8c8f1f0088/sist-en-441-12-2000>

3 Test procedure

3.1 General test conditions

The cabinet shall be installed in the test room and the test shall be prepared and carried out during the temperature test, in accordance with EN 441-4 and EN 441-5.

The condensing unit shall be connected to the cabinet in accordance with 3.2 or 3.3 and the operating controls set to the manufacturer's instructions.

The refrigerant inlet and outlet temperatures shall be measured using temperature sensors directly inserted into the pipe or inserted into pockets or clamped between the piping and a copper recovery half-sleeve on the inlet and outlet pipe-lines positioned no further than 150 mm from the cabinet exterior (see figures 1 and 3).

Where thermocouples or similar devices are utilised the sensor cables shall be arranged such that external influences on the connection cables are eliminated by the use of insulation.

Temperature sensors, connecting wires and pipelines shall be insulated from the outlet of the cabinet up to at least 150 mm beyond the measuring points.

A flow measuring device (flowmeter) shall be installed on or into the liquid inlet supply line to the cabinet in order to measure the liquid mass flow or volume flow rate of refrigerant.

A liquid sight glass shall be installed in the liquid piping upstream of the flowmeter in order to verify the vapour free state of the refrigerant being supplied to the cabinet during the period of the test.

A temperature sensor shall be installed as stated above at 150 mm \pm 10 mm upstream of the liquid flowmeter, with the piping being insulated at least 150 mm upstream and from the sensor to the inlet of the flowmeter.

A measurement of pressure shall be carried out at the cabinet outlet for compression type systems and both inlet and outlet for indirect type systems at less than 150 mm from the cabinet.

The heat extraction rate necessary for the cabinet shall be determined from temperature, pressure and flow rate readings which allow a resultant accuracy of \pm 6 %.

3.2 Specific test conditions for cabinets intended for connection to compression-type refrigerating system

The condensing unit remotely located from the cabinet shall be connected to the cabinet in accordance with figure 1.

The condensing unit selected for the test shall be capable of operating as follows:

- with the refrigerant at the saturated evaporating pressure or temperature in service at the cabinet outlet specified by the manufacturer,
- supplying the liquid refrigerant vapour free at the cabinet inlet (see the two sight glasses in figure 1) at a sensible temperature within the range of +25 °C to +45 °C, or supplying subcooled liquid when specified.

In both conditions, the liquid temperature shall be stated.

NOTE 1: Minimum condensing temperatures in the region of +30 °C to +35 °C are encountered with water-cooled condensers.

NOTE 2: The heat extraction rate of the compressor can be adjusted by having the condensing temperature increased, which may bring the liquid temperature to +45 °C.

NOTE 3: An oil separator may be installed at the discharge of compressor to minimise the oil content of the refrigerant

3.3 Specific test conditions for cabinets intended for connection to indirect-type refrigerating system

The indirect-type refrigerating system shall be connected to the cabinet intended for this system in accordance with figure 3.

The refrigerating system shall be capable of supplying secondary refrigerant fluid at the temperature and flow rate specified by the manufacturer.

4 Determination of heat extraction rate

4.1 Cabinets intended for compression-type refrigerating system

The heat extraction rate is determined as follows (see figures 1 and 2):

$$\Phi_0 = q_m(h_8 - h_4)$$

where:

Φ_0 is the heat extraction rate required in kilowatts;

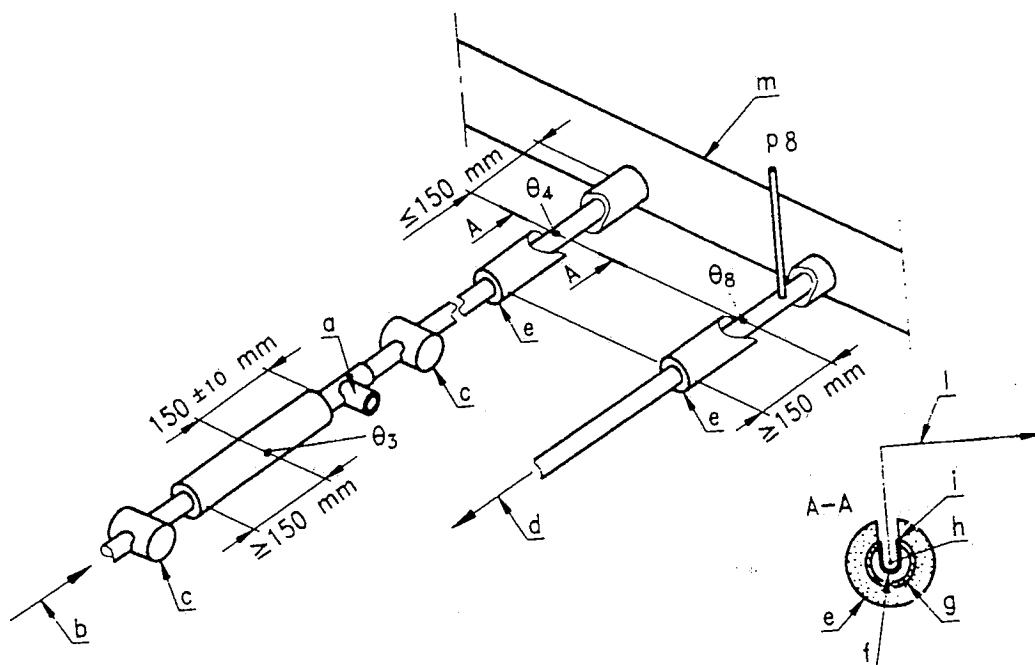
h_8, h_4 is the specific enthalpy in kilojoule per kilogram, where the state at point 8 corresponds to the refrigerant outlet of the cabinet and the state at clause 4 corresponds to the refrigerant inlet of the cabinet;

q_m is the mass flow rate of liquid refrigerant in kilograms per second, if a mass flowmeter is used; or

$q_m = q_{v_3} / v_3$ where q_{v_3} is the volume flow rate in cubic metres per second and v_3 is the specific volume of liquid refrigerant in cubic metres per kilogram, at the flowmeter inlet temperature, θ_3 , if a volumetric flowmeter is used.

NOTE 1: As pressures, temperatures and liquid volume flow rates change in the course of the operating cycle (for instance, pull down after defrost), the values to be taken into consideration are the arithmetic mean values of the values recorded or values of each measurement which are recorded in accordance with a given frequency, during 75% of the operating time, excluding defrost and the time just after defrost.

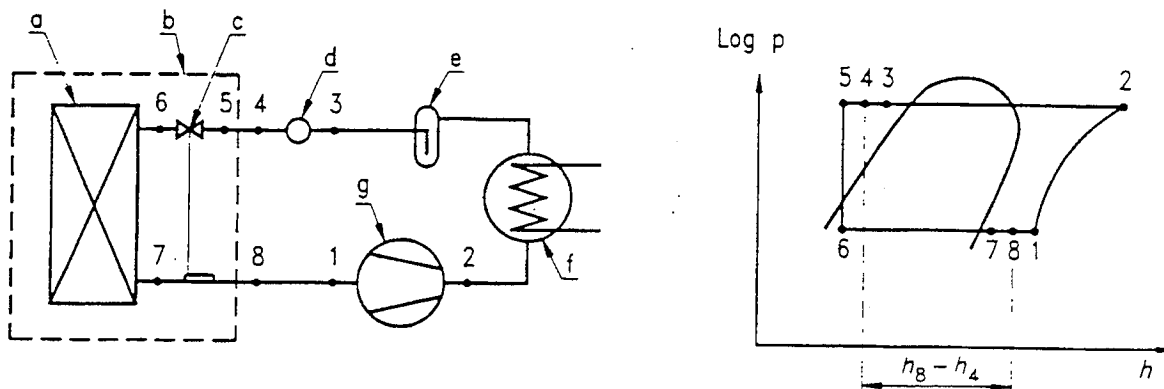
NOTE 2: Where cycling takes place during the test period, the above procedure may be used. However the flow temperatures and pressures will be the arithmetic mean values leading to a mean value of q_m considering both the period of running and the period of stopping of the compressor. Readings should be taken with a frequency of 20 s. The percentage cycling time of the system during the test period and the minimum evaporating temperature should be published in addition to the mean heat extraction rate to enable equipment selection ratings to be calculated.



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Application 1:87-490c-48f9-94ea-
- a) flowmeter
 - b) liquid supply
 - c) sight glass
 - d) vapour return
 - e) insulation (to at least 150 mm from temperature sensor)
 - f) copper thermo-pocket for housing the temperature sensor (shall be filled with glycerin or a similar fluid)
 - g) refrigerant circulation pipe
 - h) temperature sensor
 - i) solder or weld
 - l) to temperature recorder
 - m) pipe connection to cabinet

Figure 1: Connection of the cabinet to a remote compression-type refrigerating system



- a) evaporator
- b) cabinet
- c) expansion device
- d) flowmeter
- e) liquid receiver
- f) condenser
- g) compressor

pressure enthalpy diagram
showing measuring points

Figure 2: Reference point locations for the cabinet connected to a remote compression-type refrigerating system

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