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Testing of refrigerating systems

Essais des machines frigorifiques

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

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This document was prepared by Technical Committee ISO/TC 86, *Refrigeration and air-conditioning*, Subcommittee SC 4, *Testing and rating of refrigerant compressors*.

This first edition of ISO 916 cancels and replaces ISO/R 916:1968, which has been technically revised.

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The main changes compared to ISO/R 916:1968 are as follows:

— clarification in the Scope that this document is applicable to measurements on site;

— complete revision of the structure of the Terms and definitions clause;

— inclusion of transcritical refrigerant systems;

— new wording to the clauses “Tolerance” and “Measuring instruments”;

— deletion of “5.1.2.2, secondary cooling medium (gaseous)”;

— editorial changes;

— structured according to the current version of ISO/IEC Directives Part 2.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Testing of refrigerating systems

1 Scope

This document applies to the performance testing of compressor driven refrigerating systems (hereafter referred to as refrigerating systems) that operate according to the principle of vapour compression and consist of the circuit parts for compression, condensation, and evaporation as well as the connecting pipes and any necessary associated ancillaries required for a complete refrigeration circuit.

This document does not apply to the testing of other refrigeration systems such as absorption or steam jet refrigerating systems.

Testing of the suitability of a refrigerating system for a specific use, such as household refrigerators, refrigerated commercial and display cabinets, air conditioners, is not covered by this document.

This document includes testing outside laboratories or where specific laboratory testing standards for systems do not exist and which is performed according to agreed operating conditions.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5167 (all parts), *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full*

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3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
overall refrigerating capacity
Q_{og}
rate at which heat is extracted from the ambient by the refrigerant

Note 1 to entry: As a rule, for single-stage refrigerating systems, the overall refrigerating capacity corresponds to the product of the mass flow and the difference between the respective enthalpies of the refrigerant at the inlet of the compressor and at the outlet of the condenser or aftercooler, if provided (see also 8.1.1).

3.2
net refrigerating capacity
Q_{on}
rate at which heat is extracted from the cooled medium in the evaporator by the refrigerant

Note 1 to entry: See also 8.1.2.

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3.3
useful refrigerating capacity
Q_{oe}
rate at which heat is usefully extracted by the refrigerant or cooled medium

Note 1 to entry: The useful refrigerating capacity corresponds to the product of the flow of the refrigerant or cooled medium and its difference in enthalpy between the two points specified by agreement between which the cooling effect is made useful (see also 8.1.3).

4 Symbols and units

Parameter	Symbol	Unit
Heat-transfer area	A	m^2
Specific heat capacity	c	J/(kg·K)
Coefficient of performance	COP	—
Specific enthalpy	h	J/kg
Mass flow	m	kg/s
Absolute pressure	p	bar
Power	P	W
Heat flow	Q	W
Refrigerating capacity	Q_o	W
Temperature	t	°C
Absolute temperature	T	K
Overall coefficient of heat transfer	u	$W/(m^2·K)$
Surface coefficient of heat transfer	α	$W/(m^2·K)$
Insulation thickness	δ	m
Isentropic efficiency	η_i	—
Thermal conductivity	λ	W/(m·K)
Kinematic viscosity	ν	m^2/s
Density	ρ	kg/m^3

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Indices:

Index	Parameter
amb	Ambient
cor	Corrected
e	Useful
g	Overall
K	Cooled medium, liquid
L	Heat-transfer medium
m	Mechanical
n	Net
R	Refrigerant
W	Coolant, liquid (cooling water)

Index	Location
Reference point: 1	Measuring point: compressor inlet (suction port)
Reference point: 2	Measuring point: compressor outlet (discharge port)

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Index	Location
Reference point: 3	Measuring point: condenser/gas cooler refrigerant inlet
Reference point: 4	Measuring point: condenser/gas cooler refrigerant outlet or upstream of internal heat exchanger, if installed
Reference point: 5	Measuring point: upstream of the expansion valve for the evaporator
Reference point: 6	Measuring point: evaporator refrigerant inlet
Reference point: 7	Measuring point: evaporator refrigerant outlet
Reference point: 8	Measuring point: aftercooler refrigerant inlet
Reference point: 9	Measuring point: aftercooler refrigerant outlet

5 Performance warranty

5.1 General

5.1.1 Only the characteristics essential to the economic efficiency and the operation of refrigerating systems and verifiable by usual measurement methods shall be the subject of performance warranty. This requires allowances for the variations of operating conditions which are hardly avoidable in practice.

5.1.2 For the data according to 5.2.1 to 5.2.7, it is recommended to indicate several values near the operating conditions according to 5.3, particularly for the temperature values. To avoid interpolation, these values may be presented graphically within the variation limits for each pair of values. Permissible deviations shall be subject to agreement.

5.1.3 The influence of temporary variations on other operating conditions shall be subject to agreement.

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5.2 Subject of technical warranties

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5.2.1 General

Subject of the technical warranties are the refrigerating capacity and the power absorbed at operating conditions which need to be agreed.

5.2.2 Refrigerating capacity

The refrigerating capacity shall be agreed as:

— overall refrigerating capacity (see 3.1);

— net refrigerating capacity (see 3.2); or

— useful refrigerating capacity (see 3.3).

5.2.3 Compressor absorbed power

The following shall be subject to agreement:

a) the power absorbed at the compressor shaft;

b) the power output at the driver shaft;

c) the power absorbed by the motor, e.g. electrical power input at the motor terminals; or

d) the fuel consumption of the engine.

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5.2.4 Absorbed power of ancillaries

The power absorbed by fans, pumps, agitators, heaters, and other associated ancillaries shall be subject to agreement.

5.2.5 Absorbed power of the entire system

The drive power of the entire system shall be subject to agreement.

5.2.6 Cooling water demand

The cooling water demand may be a subject of the technical warranties.

5.2.7 Coefficient of performance

The coefficient of performance, COP, may be subject to agreement instead of the power absorbed according to 5.2.3 to 5.2.5.

5.3 Operating conditions for technical warranties

5.3.1 General

The following shall be subject to agreement:

a) refrigerant designation;

b) condition of the heat-transfer medium when entering, e.g. the condenser, aftercooler, oil cooler (if provided).

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5.3.2 Overall refrigerating capacity

The following shall be subject to agreement:

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a) Pressure and temperature of the refrigerant

   1) at the suction port of the compressor; and

   2) at the outlet of the condenser or of the receiver or aftercooler, respectively.

5.3.3 Net or useful refrigerating capacity

The following shall be subject to agreement:

a) the condition of the cooled medium at the inlet and outlet of the evaporator or at two defined points of the cooled medium circuit; or

b) the condition of the cooled medium at the inlet or outlet of the evaporator or at a defined point of the cooled medium circuit as well as the corresponding mass flow.

The condition of the cooled medium does not only include its temperature but also its physical data.

5.3.4 Conversion to warranty conditions

The conversion to warranty conditions requires the indication of the compressor speed or the power supply frequency (for motor compressors), respectively, the refrigerant pressures in the evaporator and the condenser or the evaporation and condensing temperature, respectively, as well as the intermediate pressures in case of multiple-stage systems.

For this purpose, the permissible deviations of the operating conditions for testing shall be specified.

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