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The methods of performance test for water chilling (heat pump) packages using the vaper compression cycle

蒸气压缩循环冷水(热泵)机组性能试验方法

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1 Scope

GB/T 10870-2014 is the Chinese national standard on the methods of performance test for water chilling (heat pump) packages using the vaper compression cycle, in the field of energy and heat transfer engineering. The /T suffix marks it as a recommended standard: it is not compulsory by itself, but it becomes binding as soon as a contract, a tender or a customer specification calls it up - which in practice is how most foreign buyers meet it. It was issued on 24 June 2014 by the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China; Standardization Administration of China, and has been in force since 31 December 2014. Classification: ICS 27.200, CCS J73. This page is published from the official record of the standard held by the Chinese standards administration: the identification, the dates, the classification and the issuing body are taken from there. The clause text, the tables and the numeric limits are in the document itself, which is delivered complete in English translation.

This standard specifies the terms and definitions, test provisions, test methods, test deviations, gross electric power, evaluation of performance coefficients, etc. of the main performance parameters of chilling water (heat pump) packages driven by electric motors using vapor compression refrigeration cycles. This standard applies to the performance test of chilling water (heat pump) packages (hereinafter referred to as "packages") driven by

electric motors that use vapor compression refrigeration cycles. The cooling tower integrated package, brine package, glycol package, etc. can be implemented with reference to this standard.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) is applicable to this standard.

GB/T 2624.1 Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full - Part 1: General principles and requirements

GB/T 2624.2 Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full - Part 2: Orifice plates

GB/T 2624.3 Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full - Part 3: Nozzles and Venturi nozzles

GB/T 2624.4 Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full - Part 4: Venturi tubes Under the specified heating capacity test conditions, the ratio of the package's heating capacity to the gross electric power of heating, expressed in W/W.

4.1 General rules

4.1.1 Eliminate the non-condensable gas in the refrigeration system of the package and confirm that there is no refrigerant leakage.

4.1.2 There shall be enough refrigerant in the refrigeration (heating) system of the package (according to the requirements of the instruction manual). If the refrigerant is a mixed working fluid, it shall ensure its composition and constitution; it shall maintain the amount of lubricating oil for normal operation in the compressor.

4.1.3 The test system shall be equipped with thermometer casing and pressure gauge outlet joints.

4.1.4 The test equipment and instruments used in the test shall not hinder the normal operation and operation of the package.

4.1.5 The water side of the package which uses side heat exchanger, heat exchanger on the heat source side and oil cooler shall be cleaned.

4.1.6 The water quality used by the package shall meet the requirements of GB 50050.

4.1.7 The test environment of air-cooled and evaporative cooling packages shall be

sufficiently spacious. The air velocity at a distance of

0.5 m from the package shall not be greater than 2 m/s.

4.2 Test requirements

4.2.1 The performance test of the water-cooled package shall include the main test and the verification test, both of which shall be measured at the same time. When the air-cooled and evaporative cooling package are subjected to the main test, two sets of instruments shall be used for simultaneous measurement. During the performance test of the package, a set of measuring instrument interfaces shall be reserved at the corresponding measuring point for third-party testing. The verification test is only applicable to water-cooled packages. The air-cooled and evaporative cooling packages are not subject to verification test. - Liquid refrigerant flow meter method (see 5.3).

4.3.3 The air inlet temperature measurement of air-cooled and evaporative- cooled packages shall be carried out in accordance with Appendix B.

4.4 Test parameters During the test, the test parameters are executed in accordance with the provisions of GB/T 18430.1 or GB/T 18430.2.

4.5 Instrumentation

4.5.1 Test instruments and meters shall be qualified by the statutory metrological inspection department and within the validity period.

4.5.2 The type and accuracy of test instruments and meters shall be in accordance with Appendix C.

4.6 Test data

4.6.1 Generally, the data to be recorded are: - Test date, location and personnel; - Package model and exit-factory number; - Power supply voltage and frequency; - The gross electric power of the package; - Cold (hot) water inlet and outlet temperature at user side; - Cold (hot) water volume flow at user side; - Pressure drop at water inlet and outlet side at user side; - Refrigerant, lubricating oil and its filling volume; - Atmospheric pressure and ambient temperature; - Instructions for heat exchanger insulation at user side.

4.6.2 For water-cooled packages, it shall also record: - Water inlet and outlet temperature on the heat source side; - Water volume flow on the heat source side; - The pressure drop on the inlet and outlet side of the heat source. QI,r - The correction term of heat as released from the refrigerant side of the heat exchanger on the heat source side to the ambient air, in watts (W); QII - The total heat released (absorbed) by auxiliary equipment such as the oil separator and oil cooler from the compressor to the condenser segment to the ambient air, in watts (W); P - The input power of the compressor motor, oil pump motor, electric heater, etc. of the water-cooled package, in watts (W); Qr,r - The correction term of the heat as

introduced from ambient air into the refrigerant side of the heat exchanger on the user side, in watts (W); Kf - The heat transfer coefficient between the outer surface of the above auxiliary equipment and the ambient air, in watts per square meter Celsius [W/(m2·°C)]; Af - The external surface area of the aforementioned auxiliary equipment, in square meters (m2); tr - The average temperature of the outer surface of the above-mentioned auxiliary equipment, in degrees Celsius (°C); ta - The ambient air temperature, in degrees Celsius (°C); Qh,f - The package's heating capacity measured in the verification test (of water-cooled heat pump package), in watts (W); QI,h - The correction item of heat as released by the refrigerant side of heat exchanger on the user side to the ambient air, in watts (W); Qr,h - The correction term of as introduced from the ambient air into the refrigerant side of the heat exchanger on the heat source side, in watts (W); Ke - The heat transfer coefficient between the outer surface of the heat exchanger and the ambient air, in watts per square meter [W/(m2·°C)][can take K = 20 W/(m2·°C)]; Ae - The external surface area of the water side of the heat exchanger on the user side, in square meters (m2); tr,m - The average temperature of the outer surface of the refrigerant side of the heat exchanger on the user side (i.e., the saturation temperature of the refrigerant), in degrees Celsius (°C); Kh - The heat transfer coefficient between the outer surface of the heat exchanger on the heat source side and the ambient air, in watts per square meter Celsius [W/(m2·°C)]; Qn1 - The cooling capacity of the package tested and measured with a set of test instruments (for air-cooled or evaporative-cooled), in watts (W); Qn2 - The cooling capacity of the package tested and measured with another set of test instruments (for air-cooled or evaporative-cooled), in watts (W); Qh1 - The heating capacity of the package tested and measured with a set of test instruments (for air-cooled or evaporative-cooled), in watts (W); Qh2 - The heating capacity of the package tested and measured with another set of test instruments (for air-cooled or evaporative-cooled), in watts (W); Nn - The total electric power of cooling of the package measured in the main test (for water-cooled), in watts (W); Nh - The total electric power of heating of the package measured in the main test (for water-cooled), in watts (W); Nn1 - The total electric power of cooling of the package tested and measured with a set of test instruments (for air-cooled or evaporative-cooled), in watts (W); Nn2 - The total electric power of cooling of the package tested and measured with another set of test instruments (for air-cooled or evaporative-cooled), in watts (W); Nh1 - The total electric power of heating of the package tested and measured with a set of test instruments (for air-cooled or evaporative-cooled), in watts (W); Nh2 - The total electric power of heating of the package tested and measured with another set of test instruments (for air-cooled or evaporative-cooled), in watts (W).

9 Example of performance uncertainty analysis

Refer to Appendix E for an example of uncertainty analysis of heating performance measurement of water-cooled packages. a Applicable to the heating mode of the heat pump, except for the defrosting process and the first 10 minutes after the end of the