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## Integrated water chilling (heat pump) package

一体式冷水（热泵）机组

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# Table of Contents

# Integrated water chilling (heat pump) package

## 1 Scope

This Standard specifies the terms and definitions, types and basic parameters, requirements, test methods, inspection rules, marking, packaging and storage of integrated water chilling (heat pump) package (hereinafter referred to as the package).

This Standard applies to the integrated water chilling (heat pump) package driven by electric motors using a vapor compression cooling cycle.

## 2 Normative references

The following referenced documents are indispensable for the application 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.

GB/T 191, *Packaging and storage marks*

GB/T 3216, *Rotodynamic pumps -- Hydraulic performance acceptance tests -- Grades 1 and 2*

GB 6388, *Transport package shipping mark*

GB/T 10870-2014, *The methods of performance test for water chilling (heat pump) packages using the vaper compression cycle*

GB/T 13306, *Plates*

GB/T 13384, *General specifications for packing of mechanical and electrical product*

GB/T 18430.1-2007, *Water chilling (heat pump) packages using the vapor compression cycle - Part 1: Water chilling (heat pump) packages for industrial and commercial and similar application*

GB 25131, *Safety requirements for water chillers (heat pump) using the vapor compression cycle*

GB/T 29044-2012, *Water quality for heating and air conditioning systems*

GB 50736, *Design code for heating ventilation and air conditioning of civil buildings*

JB/T 4330, *Determination of noise emitted by refrigerating and air conditioning equipment*

JB/T 7249, *Terminology of cooling equipment*

JB/T 9099, *Axial flow fans for cooling tower*

JB/T 10391, *Specification for Y-series (IP44) three-phase asynchronous motor (Frame size 80~355)*

NB/T 47012, *Pressure vessels for refrigerant equipment*

# 3 Terms and definitions

For the purposes of this document, the terms and definitions defined in JB/T 7249 and GB/T 18430.1 as well as the followings apply.

**3.1 integrated water chilling (heat pump) package**

A central air conditioning or process water chilling (heat pump) package that adopts vapor compression cooling cycle, integrates cold (hot) water distribution and treatment system, cold (heat) source system and centralized control system.

**3.2 integrated water chilling (heat pump) package with cooling tower**

An integrated water chilling (heat pump) package that the cooling tower is used as the cold source equipment of the package, and the cold source system includes the cooling tower and the cooling water system.

**3.3 integrated water chilling (heat pump) package with evaporative condenser**

An integrated water chilling (heat pump) package that the evaporative condenser is used as the cold source equipment of the package, and the cold source system includes the evaporative condenser and the spray water system.

**3.4 air-cooled integrated water chilling (heat pump) package**

An integrated water chilling (heat pump) package using air cooling (air heat source).

**3.5 integrated water-source (ground-source) heat pump package**

A water (ground) source heat pump package that adopts a vapor compression cooling cycle, integrating a cold (hot) water distribution and treatment system, a cold (hot) source water distribution and treatment system, and a centralized control system.

**3.6 COP of integrated water chilling (heat pump) package**

**$COP_I$**

Under nominal operating conditions, the ratio of the package's cooling (heating) capacity to the total power consumption of the integrated package.

**3.7 IPLV of integrated water chilling (heat pump) package**

**$IPLV_I$**

The comprehensive part-load performance coefficient is calculated based on the performance coefficient of the integrated package under part-load conditions. The performance coefficient of the part-load condition is the ratio of the package's cooling capacity to the total power consumption of the integrated package.

**3.8 total power consumption of integrated water chilling (heat pump) package**

Under rated conditions, the difference between the total input electrical power of the integrated package and the electrical power of the water pump consumed by the package to provide external head.

**3.9 external pump head**

The static pressure difference at the inlet and outlet of the package after the package water system overcomes its own resistance, measured in meters (m).

**3.10 total pump head**

The sum of the package's water system's own resistance and the external head, in meters (m).

**3.11 water side power output**

The mechanical power transferred to the water by the package is measured in kilowatts (kW).

**3.12 effective water flow rate**

The water flow rate when the package is running at partial load and the temperature difference on the user side is not less than 4 K. If the temperature difference is less than 4 K, the corresponding flow rate is converted according to the cooling capacity (heating capacity) and the 4 K temperature difference.

# 4 Type and basic parameters

## 4.1 Types

**4.1.1** According to the type of cold (heat) source:

- integrated water chilling (heat pump) package with evaporative condenser;

c) Filters or sludge removers shall be installed as needed on the package's inlet main pipe or the inlet pipes of the heat exchanger, circulating water pump, and make-up water pump.

**5.1.3** Water replenishment requirements are as follows:

a) The amount of water to be replenished on the heat source side (or heat release side) of the package shall be calculated and determined based on the sum of the system's evaporation, drift, blowdown, and leakage losses;

b) For packages without water collecting tanks, water shall be added at the chassis. For systems with water collecting tanks, water shall be added at the water collecting tanks;

c) The water replenishment point of the side water system used by the package shall be set at the suction port of the circulating water pump. When a high-level expansion water tank is used to set the pressure, water shall be directly replenished to the system through the expansion water tank. When other constant pressure methods are used, if the water replenishment pressure is lower than the water replenishment point pressure, a water replenishment pump shall be installed. The head of the water replenishment pump shall ensure that the water replenishment pressure is 30 kPa~50 kPa higher than the working pressure of the water replenishment point. The total hourly flow rate of the water replenishment pump shall be 5%~10% of the system water capacity;

d) The design water make-up volume (hourly flow rate) of the package's side water system shall be calculated based on 1% of the system's water capacity.

**5.1.4** The antifreeze requirements for the water system are as follows:

a) In areas where antifreeze is required, the water system shall have antifreeze measures. When not in operation, the equipment and its outdoor pipes shall be able to drain;

b) For evaporative cooling packages and cooling tower packages, antifreeze measures shall be taken on the heat release side during winter cooling operation. Antifreeze shall be added on the heat source side during heating to ensure that the heat source side does not freeze;

c) The packages that add antifreeze shall have appropriate antifreeze regeneration equipment and antifreeze adding devices to ensure that the antifreeze concentration on the heat source side does not decrease.

**5.1.5** Water quality and water treatment requirements are as follows:

a) The circulating water quality on the user side of the package shall comply with the requirements of Table 2 of GB/T 29044-2012. When the hardness of the make-

up water on the user side is high, the make-up water of the package's hot and cold water system shall be softened and meet the requirements of Table 2 of GB/T 29044-2012;

b) The evaporative condenser or cooling tower of the package shall include a water-side dirt collection device and an automatic sewage discharge device;

c) For evaporative cooling packages or cooling tower packages that use antifreeze, the antifreeze used shall not corrode the contact surfaces of the packages and shall meet environmental protection requirements;

d) The water treatment on the water source side of the water source heat pump package shall meet the requirements of GB 50736.

**5.1.6** The requirements for parts are as follows:

a) Evaporative condensers and cooling towers shall use flame-retardant materials and meet fire protection requirements. When installing the filler, the gaps shall be uniform, the top surface shall be flat, there shall be no collapse or overlapping, and the filler sheets shall not be perforated or broken;

b) The fan shall comply with the provisions of JB/T 9099. Its main accessories (such as motors and reducers) shall comply with relevant technical regulations. For fans with belt drive, both the pulley and the fan shall be subjected to static balance tests;

c) The motor shall comply with the provisions of JB/T 10391. Outdoor motors shall be used.

**5.1.7** Monitoring and control requirements are as follows:

a) Monitoring and control contents may include parameter detection, parameter and equipment status display, automatic adjustment and control, automatic conversion of working conditions, equipment interlocking and automatic protection, etc.;

b) The package shall be able to detect the following parameters:

1) Inlet and outlet water temperature and pressure of hot and cold water;

2) Inlet and outlet water temperature and pressure of cold and hot source;

3) When setting up an intermediate heat exchanger, the inlet and outlet temperature and pressure of the primary and secondary sides of the heat exchanger;

4) When setting up the manifold, the temperature and pressure (or pressure difference) of the manifold;

4) When installed or laid in places with freezing hazards.

b) The requirements for anti-corrosion treatment are as follows:

1) The main materials of evaporative condensers, cooling towers and auxiliary structures shall be treated with anti-corrosion or made of anti-corrosion materials, and can pass the 500 h neutral salt spray test (NSS test).

2) The materials of heat exchangers, pipes and their parts and accessories shall be determined according to the nature, concentration and use environment of the contact medium, combined with the corrosion resistance of the material, the importance of the use location and economic factors.

3) In addition to the protective layer of non-ferrous metals, stainless steel pipes, stainless steel plates, galvanized steel pipes, galvanized steel plates and aluminum plates, the outer surface of metal equipment and pipes is generally painted for corrosion protection. The coating type shall be able to withstand the corrosion of the ambient atmosphere. The primer and topcoat of the coating shall be used in combination. Pipes with an external insulation layer shall be primed. The treatment of the outer surface of the pipe before painting shall meet the corresponding requirements of the coating product.

## 5.2 Air tightness, vacuum and leakage requirements

**5.2.1** When using an electronic halogen leak detector or a helium leak detector, the single-point leakage rate of the package's cooling system shall not exceed 14/a. The airtightness of the package shall be fully guaranteed during its application cycle.

**5.2.2** During the vacuum test, there shall be no abnormal deformation in any part of the cooling system. The pressure rise shall not exceed 0.15 Pa.

**5.2.3** When the water system on the user side and heat source side (heat release side) is pressure tested, the system shall be leak-free and the pressure shall not drop.

**5.2.4** The water tanks of the drainage system, condensate system, evaporative condenser and cooling tower shall be leak-free during the water filling test.

**5.2.5** For packages assembled on site and packages charged with refrigerant on site, the cooling system shall be blown clean and subjected to air tightness test, vacuum test and refrigerant charge leak test.

## 5.3 Operation

**5.3.1** The package shall be subjected to an operation test before leaving the factory. If the test conditions are not complete or for packages with a rated voltage of 3 V or above, an operation test may be carried out at the site of use.

**5.3.2** When the water system is in operation, the following requirements shall be met:

a) The water system has no water leakage, water overflow during shutdown, and the water pump has no cavitation;

b) The spray water pump and cooling water pump can self-prime and absorb water. The height difference between the lowest water level of the cooling tower water collection tray or water collection tank and the cooling water pump suction port shall be greater than the resistance of the pipeline, pipe fittings, and equipment;

c) The effective water storage capacity of the chassis or water collection tank of the evaporative condenser and cooling tower is greater than the amount of water required to wet the cooling tower fill. Fill the empty pipe space when the package is shut down, and is greater than the water capacity that flows into the chassis or water collection tank by gravity when the pump is stopped. After the package is shut down, there is no overflow.

**5.3.3** When the whole machine is running, there shall be no abnormal sound, all parts shall operate normally, there shall be no friction or collision between pipelines or between pipelines and parts, and safety protection components shall not be activated to stop operation.

### 5.4 Nominal operating performance

**5.4.1** When the package is operating under nominal conditions of cooling and heat pump heating, its maximum deviation shall not exceed the following provisions:

a) The cooling capacity and heating capacity of the heat pump shall not be less than 95% of the nominal value;

b) The total input power of the package shall not be greater than 110% of the nominal total input power of the package (the total input power of the heat pump heating does not include the power consumption of auxiliary electric heating);

c) The cooling performance coefficient of the package under nominal working conditions shall meet the requirements of Table 5 and shall not be less than 92% of the package's indicated value (when 92% of the package's indicated value is higher than the value specified in Table 5);

d) The flow rate of the package shall not be less than 95% of the package's nominal value;

e) The package's external head shall not be less than 95% of the package's nominal value;

f) The package's water-side output power shall not be less than 92% of the package's nominal value.

When the package operates according to the maximum load conditions in Table 6, the motor, electrical components, connecting wires and other parts shall be able to operate normally.

### 5.6.3 Low temperature conditions

The package shall be able to operate normally when operating under low temperature conditions as shown in Table 6.

### 5.6.4 Heat pump heating conditions

The package shall be able to operate normally when operating under the heating conditions in Table 6. Safety protection components shall not be activated and stop operating.

### 5.6.5 Defrosting conditions

When the package with automatic defrost device is operated according to the defrosting conditions in Table 6, it shall meet the following requirements:

a) The safety protection components shall not be activated and the operation shall stop;

b) Defrosting shall be performed automatically;

c) The melted water during defrosting and the condensed water of the heat exchanger on the heat source side during heating operation can be discharged or processed normally;

d) In the continuous operation after the initial defrosting, the total time required for defrosting shall not exceed 20% of the operation cycle time. For packages with more than two independent cooling cycles, the total defrosting time of each independent cycle shall not exceed 20% of the total operation time of each independent cycle.

### 5.6.6 Variable operating conditions performance

The package's variable operating performance temperature conditions are shown in Table 7.

**Table 7 -- Variable operating performance temperature conditions**

Celsius

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