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# Oil free centrifugal water chilling (heat pump) packages

# 无油悬浮离心式冷水（热泵）机组 （征求意见稿）

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# Foreword

SAC/TC 238 is in charge of this English translation. In case of any doubt about the contents of English translation, the Chinese original shall be considered authoritative.

This document is drafted in accordance with the rules given in of GB/T 1.1—2020 *Directives for standardization — Part 1: Rules for the structure and drafting of standardizing documents*.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. The issuing body of this document shall not be held responsible for identifying the patent rights.

This document was proposed by China Machinery Industry Federation.

This document was prepared by National Technical Committee on Refrigeration and Air-conditioning Equipment of Standardization Administration of China (SAC/TC 238).

# Oil free centrifugal water chilling (heat pump) packages

## 1 Scope

This document specifies the types and basic parameters, technical requirements, test methods, inspection rules, as well as marking, packaging, transportation and storage for oil free centrifugal water chilling (heat pump) packages (hereinafter referred to as "units").

This document is applicable to the centrifugal vapor compression cycle water chilling (heat pump) packages using magnetic bearings, aerostatic bearings and refrigerant lubrication bearings.

## 2 Normative references

The contents in the following documents constitute the essential clauses of this document through normative references in the text. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB 2894—2008 *Safety signs and guideline for the use*

GB/T 4706.32—2024 *Safety of household and similar electrical appliances — Part 32: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers*

GB/T 9237 *Refrigerating systems and heat pumps — Safety and environmental requirements*

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—2024 *Water chilling (heat pump) packages using the vapor compression cycle — Part 1: Water chilling (heat pump) packages for industrial & commercial and similar applications*

GB/T 19409 *Water-source (ground-source) heat pumps*

JB/T 7249 *Refrigeration and air conditioning apparatus — Terminology*

NB/T 47012—2020 *Pressure vessels for refrigerant device*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in JB/T 7249, GB/T 18430.1—2024, GB/T 19409 and the following apply.

3.1

oil free centrifugal water chilling (heat pump) packages

centrifugal vapor compression cycle water chilling (heat pump) packages using magnetic bearings, aerostatic bearings and refrigerant lubrication bearings

Note 1 to entry: Magnetic bearing refers to a bearing that uses attractive or repulsive force of a magnetic field to levitate and dynamically stabilize a rotor.

Note 2 to entry: Aerostatic bearing refers to a sliding bearing that uses air and refrigerant vapors (or possibly other gases) as lubricants. It is divided into two types: static pressure aerostatic bearings and dynamic pressure aerostatic bearings.

Note 3 to entry: Refrigerant lubrication bearing refers to a rolling or sliding bearing that uses refrigerant liquid as a lubricant.

3.2

pressure ratio

the ratio of the absolute pressure at the compressor discharge port to the absolute pressure at the suction port

3.3

quick starting

after the power and control supply of the unit is disconnected, the unit can be started normally without manual intervention after power supply restored within a short period of time

3.4

temperature inversion differential running

the operating state of the unit when the condenser water temperature or ambient temperature is lower than the evaporator water temperature

3.5

surging

an unstable phenomenon during the operation of the compressor or compressor unit, characterized by significant fluctuations in refrigerant vapor flow rate over time, accompanied by strong vibrations and noise

## 4 Types and basic parameters

### 4.1 Types

4.1.1 The classification types specified in GB/T 18430.1—2024 and GB/T 19409 is applicable to this document.

NOTE Clause 4.1.4 of GB/T 18430.1—2024 is not applicable to this document.

4.1.2 The units are classified by the suspension type of the compressor shaft into:

——Magnetic suspension type;

——Aerostatic suspension type:

- Static pressure aerostatic suspension type;
- Dynamic pressure aerostatic suspension type;

——Refrigerant lubrication type:

- Positive pressure liquid suspension type;
- Negative pressure liquid suspension type.

4.1.3 The units are classified by the medium on the heat source side during refrigeration operation into:

——Water-cooled type;

——Air-cooled type;

——Evaporative cooling type;

——Water (ground) source type.

4.2 Model

The model designation method for the unit may be determined by the manufacturer. The cooling capacity of the unit under nominal conditions shall be reflected in the model number.

NOTE The nominal cooling capacity may be an approximate value of the nominal cooling output.

4.3 Basic parameters

4.3.1 Standard conditions for general performance tests

The standard conditions for general performance tests of each type of unit are specified in Table 1～6, respectively.

Table 1 — Standard conditions for general performance tests of water-cooled comfort units

| Condition type | Use side | | Heat source side[a] | |
|---|---|---|---|---|
| | Outlet water temperature ℃ | water flow rate per unit cooling capacity[b] $m^3/(h \cdot kW)$ | Inlet water temperature ℃ | Water flow rate per unit cooling capacity[b] $m^3/(h \cdot kW)$ |
| Nominal cooling[c] | 7 | 0.172 | 30 | 0.215 |
| Maximum load | 15 | | 33 | |
| Minimum load | 5 | | 19 | |
| Minimum pressure ratio operation | 15 | | 19 | |
| Maximum pressure ratio operation | 5 | | 33 | |

| Condition type | Use side | | Heat source side[a] | |
|---|---|---|---|---|
| | Outlet water temperature ℃ | water flow rate per unit cooling capacity[b] $m^3/(h \cdot kW)$ | Inlet water temperature ℃ | Water flow rate per unit cooling capacity[b] $m^3/(h \cdot kW)$ |
| [a] In this document, the heat source side corresponds only to the use side and does not describe the actual heat transfer path.<br>[b] The water flow rate is determined based on the declared value of the unit's nominal cooling capacity.<br>[c] The water temperature shall be corrected according to Appendix B of GB/T 18430.1—2024 (fouling factor of 0.018 $m^2 \cdot ℃/kW$ on the use side and 0.044 $m^2 \cdot ℃/kW$ on the heat source side), and the test conditions are set based on the corrected temperature. | | | | |

Table 2 — Standard conditions for general performance tests of air-cooled comfort units

| Condition type | Use side | | Heat source side | |
|---|---|---|---|---|
| | Outlet water temperature ℃ | Water flow rate per unit cooling capacity[a] $m^3/(h \cdot kW)$ | Dry bulb temperature ℃ | Wet bulb temperature ℃ |
| Nominal cooling | 7 | 0.172 | 35 | — |
| Maximum load | 15 | | 43 | — |
| Minimum load | 5 | | 21 | — |
| Minimum pressure ratio operation | 15 | | 21 | — |
| Maximum pressure ratio operation | 5 | | 43 | — |
| NOTE "—" indicates no requirement. | | | | |
| [a] Water flow rate is determined based on the declared value of the unit's nominal cooling capacity. | | | | |

Table 3 — Standard conditions for general performance tests of evaporative cooling comfort units

| Condition type | Use side | | Heat source side | |
|---|---|---|---|---|
| | Outlet water temperature ℃ | Water flow rate per unit cooling capacity[a] $m^3/(h \cdot kW)$ | Dry bulb temperature ℃ | Outlet water temperature ℃ |
| Nominal cooling[b,c] | 7 | 0.172 | — | 24 |
| Maximum load[b] | 15 | | | 29 |
| Minimum load[b] | 5 | | | 15.5 |
| Minimum pressure ratio operation | 15 | | — | 15.5 |
| Maximum pressure ratio operation | 5 | | — | 29 |

| Condition type | Use side | | Heat source side | |
|---|---|---|---|---|
| | Outlet water temperature ℃ | Water flow rate per unit cooling capacity[a] $m^3/(h \cdot kW)$ | Dry bulb temperature ℃ | Outlet water temperature ℃ |
| NOTE "—" indicates no requirement. | | | | |
| [a] Water flow rate is determined based on the declared value of the unit's nominal cooling capacity.<br>[b] During testing, the temperature of the supplementary water on the heat source side is between 15 ℃ and 30 ℃.<br>[c] The water side (use side) temperature shall be corrected according to Appendix B of GB/T 18430.1—2024 (fouling factor of 0.018 $m^2 \cdot ℃/kW$), and the test conditions are set based on the corrected temperature. | | | | |

Table 4 — Standard conditions for general performance tests of water (ground) source comfort units

| Test condition | | Use side outlet water temperature/ water flow rate per unit cooling (heating) capacity | Heat source side inlet water temperature/ water flow rate per unit cooling (heating) capacity | | | |
|---|---|---|---|---|---|---|
| | | | Water-loop type | Ground-water type | Ground-loop type | Surface-water type |
| Cooling operation | Nominal cooling | 7/0.172 | 30/0.215 | 18/0.103 | 25/0.215 | 25/0.215 |
| | Maximum load | 15/—[a] | 35/—[a] | 25/—[a] | 35/—[a] | 35/—[a] |
| | Minimum load | 5/—[a] | 20/—[a] | 15/—[a] | 15/—[a] | 15/—[a] |
| Heating operation | Nominal heating | 45/—[a,b] | 20/—[a,b] | 15/—[a,b] | 10/—[a,b] | 10/—[a,b] |
| | Maximum load | 50/—[a] | 30/—[a] | 25/—[a] | 25/—[a] | 30/—[a] |
| | Minimum load | 40/—[a] | 15/—[a] | 15/—[a] | 10/—[a] | 10/—[a] |
| NOTE 1 Water flow rate per unit cooling (heating) capacity is in $m^3/(h \cdot kW)$, temperature is in ℃.<br>NOTE 2 Only the cooling operation tests are required for cooling-only units, and only the heating operation tests are required for heating-only units. | | | | | | |
| [a] Water flow rate per unit cooling (heating) capacity is determined under the nominal cooling condition.<br>[b] The water flow rate per unit cooling (heating) capacity of heating-only units is determined based on the design temperature difference (15 ℃/8 ℃). | | | | | | |

Table 5 — Standard conditions for general performance tests of process units

| Condition type | Unit type | Use side | | Heat source side | | |
|---|---|---|---|---|---|---|
| | | | | Water-cooled | Air-cooled | Evaporative cooling |
| | | Inlet liquid temperature | Outlet liquid temperature | Inlet/outlet water temperature | Dry/wet bulb temperature | Dry/wet bulb temperature |
| Nominal cooling | High temperature type | 21 | 16 | 30 / 35 | 35 / — | — / 24 |
| | Standard temperature type | 12 | 7 | | | |
| | Medium temperature type | -5 | -10 | | | |
| | Low temperature type | -20 | -25 | | | |
| | Deep-cooling type | [a] | [a] | | | |
| Nominal heating | All types | [b] | | | | |
| Temperature inversion differential running | High temperature type Standard temperature type | — | 15 | 12 / — | —[c] | —[c] |

If the manufacturer's declared design conditions differ from the standard conditions given in this table, tests may be conducted according to the manufacturer's declared conditions and the performance test methods specified in 6.4.3.

NOTE "—" indicates no requirement.

[a] The nominal cooling test condition for deep-cooling units is according to the manufacturer's specifications.

[b] The nominal heating test conditions for all types of units are according to the manufacturer's specifications.

[c] Conducted at the minimum temperature specified by the manufacturer.

Table 6 — Standard conditions for general performance tests of data center specific units

| Condition type | Use side | Heat source side | | |
|---|---|---|---|---|
| | | Water-cooled | Air-cooled | Evaporative cooling |

| | Water flow rate per unit cooling capacity[a] $m^3/(h \cdot kW)$ | Outlet water temperature ℃ | Inlet water temperature ℃ | Water flow rate per unit cooling capacity[a] $m^3/(h \cdot kW)$ | Dry bulb temperature ℃ | Wet bulb temperature ℃ | Dry bulb temperature ℃ | Wet bulb temperature ℃ |
|---|---|---|---|---|---|---|---|---|
| Nominal cooling[b] | 0.144 | 15 | 30 | 0.172 | 35 | — | — | 24 |
| Maximum cooling load | | 20 | 34 | | 45 | | | 29 |
| Minimum cooling load | | 7 | 12 | | —[c] | | | —[c] |
| Temperature inversion differential running | | 15 | 12 | | —[d] | | | —[d] |
| Low pressure ratio performance | | 15 | 18 | | 15 | | | 15.5 |

NOTE "—" indicates no requirement.

[a] Water flow rate is determined based on the declared value of the unit's nominal cooling capacity.

[b] The water side temperature shall be corrected according to Appendix B of GB/T 18430.1—2024 (use side fouling factor of 0.018 $m^2 \cdot ℃/kW$, heat source side fouling factor of 0.044 $m^2 \cdot ℃/kW$), and the test conditions are set based on the corrected temperature.

[c] Conducted at the minimum temperature specified by the manufacturer.

[d] Conducted at the minimum temperature specified by the manufacturer.

### 4.3.2 Part load performance test conditions

For water-cooled or evaporative cooling comfort units, the standard conditions for part load performance tests [for integrated part load value (*IPLV*)] and use conditions [for non-standard part load value (*NPLV*)] are as specified in Table 7.

Before testing, the water temperature shall be corrected according to the methods in Appendix B of GB/T 18430.1—2024 and the fouling factor given in Table 7, and the test conditions are set based on the corrected temperature.

Table 7 — Part load performance test conditions

| Item | | | Part load performance test condition | |
|---|---|---|---|---|
| Unit component | Name | Unit | *IPLV* | *NPLV* |

| Item | | | Part load performance test condition | |
|---|---|---|---|---|
| Unit component | Name | Unit | *IPLV* | *NPLV* |
| Evaporator | 100% load outlet water temperature | ℃ | 7.0 | Selected outlet water temperature |
| | Part load outlet water temperature | ℃ | | Same as 100% load outlet water temperature |
| | Water flow rate per unit cooling capacity | $m^3/(h \cdot kW)$ | 0.172 | Selected water flow rate |
| | Fouling factor | $m^2 \cdot ℃/kW$ | 0.018 | Specified fouling factor |
| Water-cooled condenser | 100% load inlet water temperature | ℃ | 30.0 | Selected inlet water temperature |
| | 75% load inlet water temperature | ℃ | 26.0 | Obtained by linear interpolation based on inlet water temperature at 100% and 25% load points[a] |
| | 50% load inlet water temperature | ℃ | 23.0 | |
| | 25% load inlet water temperature | ℃ | 19.0 | 19.0[a] |
| | Water flow rate per unit cooling capacity | $m^3/(h \cdot kW)$ | 0.215 | Selected water flow rate |
| | Fouling factor | $m^2 \cdot ℃/kW$ | 0.044 | Specified fouling factor |
| Evaporative condenser | 100% load inlet air wet bulb temperature | ℃ | 24.0 | Selected inlet wet bulb temperature |
| | 75% load inlet air wet bulb temperature | ℃ | 21.9 | Obtained by linear interpolation based on inlet air wet bulb temperature at 100% and 25% load points[a] |
| | 50% load inlet air wet bulb temperature | ℃ | 19.7 | |
| | 25% load inlet air wet bulb temperature | ℃ | 17.6 | 17.6[a] |
| When it is necessary to calculate the coefficient of performance corresponding to the 75%, 50%, or 25% load points by interpolation and attenuation coefficient methods, the inlet water temperature or inlet air wet bulb temperature on the condenser side during the test shall be consistent with the conditions of the corresponding load points. | | | | |
| [a] If the inlet water temperature or inlet air wet bulb temperature on the condenser side recommended by the manufacturer is higher than the temperature specified in the table, the recommended temperature may be used for the test. | | | | |

### 4.3.3 Standard conditions for seasonal performance tests

The cooling seasonal performance test conditions for air-cooled comfort units are as specified in Table 8. The annual integrated cooling performance test conditions for data center specific units are as specified in Table 9.

Table 8 — Standard conditions for cooling seasonal performance test conditions

| Condition type | Load rate[a] | Test point | Use side | | Heat source side | |
|---|---|---|---|---|---|---|
| | | | Outlet water temperature ℃ | Water flow rate per unit cooling capacity $m^3/(h \cdot kW)$ | Inlet air dry bulb temperature ℃ | Inlet air wet bulb temperature ℃ |
| Cooling season | 157%[b] | — | 7 | 0.172[c] | 43 | — |
| | 100% | A | 7 | | 35 | — |
| | 75% | B | 7 | | 31.5 | — |
| | 50% | C | 9 | | 28 | — |
| | 25% | D | 11 | | 24.5 | — |

When it is necessary to calculate the coefficient of performance corresponding to the 75%, 50%, or 25% load points by interpolation and attenuation coefficient methods, the inlet air dry bulb temperature on the condenser side during the test shall be consistent with the conditions of the corresponding load points.

NOTE "—" indicates no requirement.

[a] The permissible deviation of the load rate at the actual operating point of the unit during the test is ±2% of the load rate specified in the table (except for 157% and 100% load points).

[b] Only when it is necessary to calculate the occurrence time of each temperature interval between 35 ℃ and 43 ℃ for cooling in a typical building corresponding to a certain city, the test at this load rate shall be added.

[c] Water flow rate is determined based on the declared value of the unit's nominal cooling capacity.

Table 9 — Standard conditions for annual integrated cooling performance tests

| Condition type | | Use side | | Heat source side | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Chilled water | | Water-cooled | | Air-cooled | | Evaporative cooling | |
| Condition point | Load rate | Outlet water temperature ℃ | Water flow rate per unit cooling capacity[a] $m^3/(h \cdot kW)$ | Inlet water temperature ℃ | Water flow rate per unit cooling capacity[a] $m^3/(h \cdot kW)$ | Dry bulb temperature ℃ | Wet bulb temperature ℃ | Dry bulb temperature ℃ | Wet bulb temperature ℃ |
| A | 100% | 15 | 0.144 | 30 | 0.172 | 35 | — | — | 24 |

| Condition type | | Use side | | Heat source side | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Chilled water | | Water-cooled | | Air-cooled | | Evaporative cooling | |
| Condition point | Load rate | Outlet water temperature ℃ | Water flow rate per unit cooling capacity[a] $m^3/(h \cdot kW)$ | Inlet water temperature ℃ | Water flow rate per unit cooling capacity[a] $m^3/(h \cdot kW)$ | Dry bulb temperature ℃ | Wet bulb temperature ℃ | Dry bulb temperature ℃ | Wet bulb temperature ℃ |
| B | 100% | | | 25 | | 25 | — | — | 19 |
| C | 100% | | | 21 | | 15 | — | — | 13 |
| D | 50% | | | 21 | | 5 | — | — | 7 |
| The test process is detailed in Appendix C of GB/T 18430.1—2024. When it is necessary to calculate the coefficient of performance corresponding to condition point B, C, or D by interpolation and attenuation coefficient methods, the inlet water or inlet air dry/wet bulb temperature on the condenser side during the test shall be consistent with the condition of the corresponding load point.<br>NOTE "—" indicates no requirement. | | | | | | | | | |
| [a] Water flow rate is determined based on the declared value of the unit's nominal cooling capacity. | | | | | | | | | |

4.3.4 Annual performance test conditions

The annual performance test conditions for water (ground) source comfort units are as specified in Table 10.

Table 10 — Standard conditions for annual performance tests

| Condition point | Load rate | Test condition | Outlet water temperature on the use side/water flow rate per unit cooling(heating) capacity | Inlet water temperature/water flow rate per unit cooling (heating) capacity | | | |
|---|---|---|---|---|---|---|---|
| | | | | Water-loop type | Ground-water type | Ground-loop type | Surface-water type |
| A | 100% | Nominal cooling | 7/0.172 | 30/0.215 | 18/0.103 | 25/0.215 | 25/0.215 |
| B | 100% | Nominal heating[b] | 45/—[a] | 20/—[a] | 15/—[a] | 10/—[a] | 10/—[a] |
| NOTE 1 Water flow rate per unit cooling (heating) capacity is in $m^3/(h \cdot kW)$, temperature is in ℃.<br>NOTE 2 Cooling-only or heating-only units are not evaluated for annual coefficient of performance (*ACOP*). | | | | | | | |

| Condition point | Load rate | Test condition | Outlet water temperature on the use side/water flow rate per unit cooling(heating) capacity | Inlet water temperature/water flow rate per unit cooling (heating) capacity | | | |
|---|---|---|---|---|---|---|---|
| | | | | Water-loop type | Ground-water type | Ground-loop type | Surface-water type |
| NOTE 3 Annual coefficient of performance $ACOP = 0.56COP_c + 0.44COP_h$. Where: $COP_c$ is the nominal cooling coefficient of performance, which is the energy efficiency of the unit when operating at full load under the nominal cooling condition; $COP_h$ is the nominal heating coefficient of performance, which is the energy efficiency of the unit when operating at full load under the nominal heating condition. | | | | | | | |
| [a] Water flow rate per unit cooling (heating) capacity is determined under the nominal cooling condition. [b] The water flow rate per unit cooling (heating) capacity of heating-only units is determined based on the design temperature difference (15 ℃/8 ℃). | | | | | | | |

## 5 Technical requirements

### 5.1 General requirements

The units shall be complied with the provisions of 5.1 in GB/T 18430.1—2024.

### 5.2 Sealing and pressure test

The air tightness, vacuum, and pressure requirements of the units shall be complied with the provisions of 5.2 in GB/T 18430.1—2024.

### 5.3 Trial operation

The trial operation requirements of the units shall be complied with the provisions of 5.3 in GB/T 18430.1—2024.

### 5.4 Nominal condition performance

#### 5.4.1 Nominal cooling

5.4.1.1 The measured nominal cooling capacity of the units shall be no less than 95% of the declared value.

5.4.1.2 The measured nominal cooling power consumption of the units shall be no larger than 110% of the declared value.

5.4.1.3 The measured nominal cooling coefficient of performance of the units shall be in accordance with the following requirements:

a) For comfort units: the value shall be no less than the limits specified in Tables 11, 12, 13, or 14, and shall be no less than 95% of the declared value;

b) For process units: the value shall be no less than 95% of the declared value;

c) For data center specific units: the value shall be no less than the limits specified in Table 15, and shall be no less than 95% of the declared value.

NOTE The coefficient of performance of modular units is assessed and evaluated based on an individual module.

Table 11 — Limits of energy efficiency parameters for comfort units (water-cooled type)

| Nominal cooling capacity (CC)<br>kW | Energy efficiency parameters | |
|---|---|---|
| | $COP_c$<br>kW/kW | $IPLV$<br>kW/kW |
| 50＜CC≤300 | 5.10 | 5.60 |
| 300＜CC≤528 | 5.60 | 7.20 |
| 528＜CC≤1163 | 6.00 | 7.50 |
| CC＞1163 | 6.20 | 8.10 |

Table 12 — Limits of energy efficiency parameters for comfort units (air-cooled type)

| Nominal cooling capacity (CC)<br>kW | Energy efficiency parameters | |
|---|---|---|
| | $COP_c$<br>kW/kW | Cooling seasonal performance factor ($CSPF$)<br>(kW•h)/(kW•h) |
| CC＞50 | 3.20 | 3.85 |

Table 13 — Limits of energy efficiency parameters for comfort units (evaporative cooling type)

| Nominal cooling capacity (CC)<br>kW | Energy efficiency parameters | |
|---|---|---|
| | $COP_c$<br>kW/kW | $IPLV$<br>kW/kW |
| 50＜CC≤300 | 4.20 | 5.00 |
| CC＞300 | 4.80 | 5.40 |

Table 14 — Limits of energy efficiency parameters for comfort units [water (ground) source type]

| Type | | Nominal cooling capacity (CC)/Nominal heating capacity (HC)<br>kW | Energy efficiency parameters |
|---|---|---|---|
| | | | $COP_h/ACOP$ [a]<br>kW/kW |
| Heating-only type | Water-loop type | HC≤260 | 5.00 |
| | | HC＞260 | 5.40 |
| | Ground-water type | HC≤260 | 4.50 |
| | | HC＞260 | 4.70 |
| | Ground-loop type<br>Surface-water type | HC≤260 | 4.30 |
| | | HC＞260 | 4.50 |

| Type | | Nominal cooling capacity (CC)/Nominal heating capacity (HC) kW | Energy efficiency parameters $COP_h$/$ACOP$ [a] kW/kW |
|---|---|---|---|
| Heat pump type | Ground-loop type | CC≤260 | 4.70 |
| | | CC＞260 | 5.20 |
| | Ground-water type | CC≤260 | 5.50 |
| | | CC＞260 | 5.80 |
| | Ground-loop type Surface-water type | CC≤260 | 4.70 |
| | | CC＞260 | 5.10 |
| [a] The energy efficiency indicator for heating-only units is $COP_h$, and for heat pump units is $ACOP$. | | | |

Table 15 — Limits of energy efficiency parameters for data center specific units

| Unit type Nominal cooling capacity (CC) kW | | Energy efficiency parameters | |
|---|---|---|---|
| | | $COP_c$ kW/kW | Annual integrated cooling coefficient of performance ($ACCOP$) kW/kW |
| Water-cooled type | CC≤528 | 6.50 | 7.30 |
| | 528＜CC≤1163 | 7.00 | 7.90 |
| | CC＞1163 | 7.50 | 8.50 |
| Air-cooled type | | 3.30 | 5.40 |
| Evaporative cooling type | | 5.60 | 6.30 |

### 5.4.2 Nominal heating

5.4.2.1 The measured nominal heating capacity of the units shall be no less than 95% of the declared value.

5.4.2.2 The measured nominal heating power consumption of the units shall be no larger than 110% of the declared value.

5.4.2.3 The measured nominal heating coefficient of performance of the units shall be no less than 95% of the declared value. For heating-only units, the measured nominal heating coefficient of performance shall be no less than the limits specified in Table 14.

## 5.5 Part load performance

5.5.1 For water-cooled or evaporative cooling comfort units, the measured integrated part load value shall be no less than the limits specified in Table 11 or Table 13, and shall be no less than 92% of the declared value.

5.5.2 For water-cooled or evaporative cooling comfort units, the measured non-standard part load value shall be no less than 92% of the declared value.

5.6 Seasonal performance

5.6.1 For air-cooled comfort units, the measured cooling seasonal performance factor shall be no less than the limits specified in Table 12 and shall be no less than 95% of the declared value.

5.6.2 For data center specific units, the measured annual integrated cooling coefficient of performance shall be no less than the limits specified in Table 15 and shall be no less than 95% of the declared value.

5.7 Annual performance

For water (ground) source comfort units, the measured annual coefficient of performance shall be no lower than the limits specified in Table 14 and shall be no less than 95% of the declared value.

5.8 Water side pressure drop

The requirements of water side pressure drop for the units shall be complied with the provisions of 5.7 in GB/T 18430.1—2024.

5.9 Maximum cooling load

For comfort units and data center specific units, the following requirements shall be met during the maximum cooling load test:

a) the units maintain normal operation;

b) all components of the units remain undamaged, and overload protectors do not activate;

c) the maximum operating current is no larger than the declared maximum operating current of the units.

5.10 Minimum cooling load

For comfort units, the following requirements shall be met during the minimum cooling load test:

a) the units maintain normal operation;

b) all components of the units remain undamaged, and low pressure, anti-freeze, and overload protectors do not activate.

5.11 Minimum pressure ratio operation

For comfort units, the following requirements shall be met during the minimum pressure ratio operation test:

a) the units maintain normal operation;

b) all components of the units remain undamaged, and low pressure, anti-freeze, and overload protectors do not activate.

c) the inverter and motor of the units do not experience high-temperature protection.

### 5.12 Maximum pressure ratio operation

For comfort units, the following requirements shall be met during the maximum pressure ratio operation test:

a) the unit maintain normal operation;

b) all components of the units remain undamaged, and overload protectors do not activate;

c) the maximum operating current is no larger than the declared maximum operating current of the units.

### 5.13 Anti-surging operation

The following requirements shall be met during the anti-surging operation test:

a) all components of the units remain undamaged;

b) the units continue to operate normally after the test.

### 5.14 Temperature inversion differential running

For process units (including data center specific type units), the following requirements shall be met during the temperature inversion differential running test:

a) the units maintain normal operation;

b) all components of the units remain undamaged;

c) low pressure, inverter high-temperature protectors and motor high-temperature protectors do not activate.

### 5.15 Low pressure ratio performance

For data center specific units, the following requirements shall be met during the low pressure ratio performance test:

a) the units maintain normal operation, and inverter high-temperature protectors and motor high-temperature protectors do not activate;

b) the measured coefficient of performance for water-cooled units is larger than 18 kW/kW;

c) the measured coefficient of performance for air-cooled and evaporative cooling units is larger than 10 kW/kW.

### 5.16 Starting current

When the units are tested for starting current according to 6.4.15, the starting current value shall be no larger than the rated current of the units.

### 5.17 Quick starting

For process units (including data center specific units), after the quick starting test according to 6.4.16, the compressors' start-up time shall be no longer than 60 seconds, and the units shall operate normally.

## 5.18 Performance under the application conditions

5.18.1 For comfort units, the testing program shall be reasonably planned by manufacturers through combining with the application scope of the products and referring to the application conditions provided in Table 16, Table 17 or Table 18. These test results shall be used by manufacturers to compile the performance database of the units, including computer-output files, electronic charts, or computer selection software that integrate product owner information, product information, product performance data, version information, etc.

NOTE The scope of actual application conditions is not required to cover the entire range specified in Tables 16, 17, or 18 (and may even exceed it), as this entirely depends on the products' capabilities or their matching application scenarios.

5.18.2 Under any application condition output by the units' performance database, the measured cooling (heating) capacity and coefficient of performance at 100% load shall not be deviated by more than ±5% from the output values of the performance database.

5.18.3 Under any application condition output by the units' performance database, the measured coefficient of performance at part load shall be no less than (100—σ)% of the output values of the performance database, where the limit deviation σ (rounded to the nearest integer) is calculated by the Formula (1).

$$\sigma = 10.5 - (0.07 \times \%\text{load}) + \frac{750}{\Delta T_{FL} \times \%\text{load}} \quad \text{.....(1)}$$

where,

%load – 100 times the load rate, e.g., 75 for load rate of 75%;

$\Delta T_{FL}$ – the temperature difference between the inlet and outlet water at 100% load operation under the same flow rate of the use-side heat exchanger, in degrees Celsius (℃).

Table 16 — Application conditions for air-cooled and evaporative cooling units

Unit: degrees Celsius

| Unit type | Operation mode | Use side | | Heat source side | | | |
|---|---|---|---|---|---|---|---|
| | | Chilled water | | Air-cooled | | Evaporative cooling | |
| | | Temperature difference between inlet and outlet water[a] | Outlet water temperature | Dry bulb temperature | Wet bulb temperature | Dry bulb temperature | Wet bulb temperature |
| Comfort type | Cooling | 3～10 | 5～15 | 21～43 | — | — | 15.5～29 |

| Unit type | Operation mode | Use side | | Heat source side | | | |
|---|---|---|---|---|---|---|---|
| | | Chilled water | | Air-cooled | | Evaporative cooling | |
| | | Temperature difference between inlet and outlet water[a] | Outlet water temperature | Dry bulb temperature | Wet bulb temperature | Dry bulb temperature | Wet bulb temperature |
| Data center specific type | Cooling | 3～10 | 7～20 | 5～45 | — | — | 7～29 |
| NOTE "—" indicates no requirement. | | | | | | | |
| [a] This document only provides a reference range. In fact, after selecting the outlet water temperature, manufacturers decide whether to use a fixed temperature difference or a fixed flow rate for the tests. | | | | | | | |

Table 17 — Application conditions for water-cooled units

Unit: degrees Celsius

| Unit type | Operation mode | Use side | | Heat source side | |
|---|---|---|---|---|---|
| | | Temperature difference between inlet and outlet water[a] | Outlet water temperature | Inlet temperature | Temperature difference between inlet and outlet water[a] |
| Comfort type | Cooling | 3～10 | 5～15 | 19～33 | 3～10 |
| Data center specific type | Cooling | 3～10 | 7～20 | 12～34 | 3～10 |
| [a] This document only provides a reference range. In fact, after selecting the outlet water temperature on the use side and/or inlet water temperature on the heat source side, the specific test conditions may be determined by referring to the *NPLV* method or as specified by manufacturers. | | | | | |

Table 18 — Application conditions for water (ground) source units

Unit: degrees Celsius

| Unit Type | Operation mode | Use side | Heat source side | | | |
|---|---|---|---|---|---|---|
| | | | Water-loop type | Ground-water type | Ground-loop type | Surface-water type |

| e | | Temperature difference between inlet and outlet water[a] | Outlet water temperature | Temperature difference between inlet and outlet water[a] | Outlet water temperature | Temperature difference between inlet and outlet water[a] | Outlet water temperature | Temperature difference between inlet and outlet water[a] | Outlet water temperature | Temperature difference between inlet and outlet water[a] | Outlet water temperature |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Comfort type | Cooling | 3～10 | 5～15 | 3～10 | 20～35 | 3～10 | 15～25 | 3～10 | 15～35 | 3～10 | 15～35 |
| | Heating | 3～10 | 40～50 | 3～10 | 15～30 | 3～10 | 15～25 | 3～10 | 10～25 | 3～10 | 10～30 |
| NOTE Cooling-only type units only require tests under the cooling operation conditions, and heating-only type units only require tests under the heating operation conditions. | | | | | | | | | | | |
| [a] This document only provides a reference range. In fact, after selecting the outlet water temperature on the use side and/or the inlet water temperature on the heat source side, manufacturers decide whether to use a fixed temperature difference or a fixed flow rate for the tests. | | | | | | | | | | | |

## 5.19 Noise

The measured sound pressure level of noise for the units shall be complied with the limits specified in Tables 19, 20, or 21 and shall be no larger than the declared value + 3 dB(A).

NOTE For process units (including data center specific units), no specific noise limits are defined; for water (ground) source comfort units, the noise requirements are consistent with those for water-cooled comfort chillers based on the heat source side classification.

Table 19 — Noise limits for water-cooled units (sound pressure level)

| Nominal cooling capacity<br>kW | Noise<br>dB(A) |
|---|---|
| 50＜CC≤300 | 70 |
| 300＜CC≤528 | 78 |
| 528＜CC≤1163 | 80 |
| CC＞1163 | As required by the supply contract |

Table 20 — Noise limits for air-cooled units (sound pressure level)

| Nominal cooling capacity<br>kW | Noise<br>dB(A) |
|---|---|
| 50＜CC≤300 | 80 |
| CC＞300 | 88 |

Table 21 — Noise limits for evaporative cooling units (sound pressure level)

| Nominal cooling capacity<br>kW | Noise<br>dB(A) |
|---|---|
| 50＜CC≤300 | 80 |
| CC＞300 | 86 |

5.20 Vibration

When tested according to the method as specified in 6.4.19, the measured peak displacement shall be less than 0.03 mm.

5.21 Safety requirements

5.21.1 Insulation resistance

The insulation resistance of the units shall be in accordance with the provisions of 5.13.1 in GB/T 18430.1—2024.

5.21.2 Electrical strength

The electrical strength of the units shall be in accordance with the provisions of 5.13.2 in GB/T 18430.1—2024.

5.21.3 Grounding device

The grounding device of the units shall be in accordance the provisions of 5.13.3 in GB/T 18430.1—2024.

5.21.4 Moisture resistance

The moisture resistance of the units shall be in accordance with the provisions of 5.13.4 in GB/T 18430.1—2024.

5.21.5 Degree of protection

The degree of protection of the units shall be in accordance with the provisions of 5.13.5 in GB/T 18430.1—2024.

5.22 Special requirements for units with heat recovery function

The special requirements for units with heat recovery function shall be in accordance with the provisions of 5.14 in GB/T 18430.1—2024.

5.23 Special requirements for units with cooling storage function

The special requirements for units with cooling storage function shall be in accordance with the provisions of 5.15 in GB/T 18430.1—2024.

# 6 Test methods

## 6.1 Test conditions

The test conditions shall be in accordance with the provisions of 6.1 in GB/T 18430.1—2024.

## 6.2 Installation

The installation shall be in accordance with the provisions of 6.2 in GB/T 18430.1—2024.

## 6.3 Data processing

6.3.1 During the test, the tolerances for each operating condition parameter shall be in accordance with the provisions of Tables 22 and 23.

NOTE 1 Average deviation — the deviation between the measured average value and the specified value of each test condition.

NOTE 2 Maximum deviation — the deviation between the maximum and minimum measured values during the test and the specified value of each test condition.

NOTE 3 When the unit operates stably under each condition and the reading tolerances comply with Tables 22 and 23, the unit is considered to have reached a stable operating state.

6.3.2 Data collection and processing shall be in accordance with the provisions of GB/T 10870.

Table 22 — Reading tolerances for test conditions (average deviation)

| Test condition | Use side | | Heat source side | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Cold/hot water/liquid | | Water-cooled | | Air-cooled | | Evaporative cooling | | Water (ground) source | |
| | Inlet/outlet temperature ℃ | Water flow rate | Inlet/outlet temperature ℃ | Water flow rate | Dry bulb temperature ℃ | Wet bulb temperature ℃ | Dry bulb temperature ℃ | Wet bulb temperature ℃ | Inlet/outlet temperature ℃ | Water flow rate |
| Nominal cooling | ±0.3 | ±5% | ±0.3 | ±5% | ±0.3 | — | — | ±0.5 | ±0.5 | ±5% |
| Maximum cooling load | ±0.5 | | ±0.5 | | ±0.5 | — | — | ±0.5 | ±0.5 | |
| Minimum cooling load | ±0.5 | | ±0.5 | | ±0.5 | — | — | ±0.5 | ±0.5 | |
| Minimum pressure ratio operation | ±0.5 | | ±0.5 | | ±0.5 | — | — | ±0.5 | — | |

| Test condition | Use side | | Heat source side | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Cold/hot water/liquid | | Water-cooled | | Air-cooled | | Evaporative cooling | | Water (ground) source | |
| | Inlet/outlet temperature ℃ | Water flow rate | Inlet/outlet temperature ℃ | Water flow rate | Dry bulb temperature ℃ | Wet bulb temperature ℃ | Dry bulb temperature ℃ | Wet bulb temperature ℃ | Inlet/outlet temperature ℃ | Water flow rate |
| Maximum pressure ratio operation | ±0.5 | | ±0.5 | | ±0.5 | — | — | ±0.5 | — | |
| Low pressure ratio performance | ±0.5 | | ±0.5 | | ±0.5 | — | — | ±0.5 | — | |
| Temperature inversion differential running | ±0.5 | | ±0.5 | | ±0.5 | — | — | ±0.5 | — | |
| Nominal heating | ±0.3 | | ±0.3 | | ±0.3 | — | — | ±0.5 | ±0.3 | |
| Maximum heating load | ±0.5 | | ±0.5 | | ±0.5 | — | — | ±0.5 | ±0.5 | |
| Minimum heating load | ±0.5 | | ±0.5 | | ±0.5 | — | — | ±0.5 | ±0.5 | |
| Part load | ±0.3 | | ±0.3 | | — | — | — | ±0.5 | — | |
| Seasonal performance | ±0.3 | | ±0.3 | | ±0.3 | — | — | ±0.5 | — | |
| Annual performance | ±0.3 | | ±0.3 | | ±0.3 | — | — | ±0.5 | ±0.3 | |
| Nominal heat recovery | ±0.3 | | ±0.3 | | ±0.3 | — | — | ±0.5 | — | |
| Nominal cooling storage | ±0.3 | | ±0.3 | | ±0.3 | — | — | ±0.5 | — | |

NOTE 1 "—" indicates no requirement.

NOTE 2 For units with heat recovery function, the requirements for hot water side of the heat recovery follow the requirements for use side as specified in this table.

Table 23 — Reading tolerances for test conditions (maximum deviation)

| Test condition | Use side | | Heat source side | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Cold/hot water/liquid | | Water-cooled type | | Air-cooled type | | Evaporative cooling type | | Water (ground) source type | |
| | Inlet/outlet temperature ℃ | Water flow rate | Inlet/outlet temperature ℃ | Water flow rate | Dry bulb temperature ℃ | Wet bulb temperature ℃ | Dry bulb temperature ℃ | Wet bulb temperature ℃ | Inlet/outlet temperature ℃ | Water flow rate |
| Nominal cooling | ±0.5 | ±5 % | ±0.5 | ±5 % | ±0.5 | — | — | ±0.5 | ±0.5 | ±5 % |
| Maximum cooling load | ±1.0 | | ±1.0 | | ±1.0 | — | — | ±1.0 | ±1.0 | |
| Minimum cooling load | ±1.0 | | ±1.0 | | ±1.0 | — | — | ±1.0 | ±1.0 | |
| Minimum pressure ratio operation | ±1.0 | | ±1.0 | | ±1.0 | — | — | ±1.0 | — | |
| Maximum pressure ratio operation | ±1.0 | | ±1.0 | | ±1.0 | — | — | ±1.0 | — | |
| Low pressure ratio performance | ±1.0 | | ±1.0 | | ±1.0 | — | — | ±1.0 | — | |
| Temperature inversion differential running | ±1.0 | | ±1.0 | | ±1.0 | — | — | ±1.0 | — | |
| Nominal heating | ±0.5 | | ±0.5 | | ±0.5 | — | — | ±0.5 | ±0.5 | |
| Maximum heating load | ±1.0 | | ±1.0 | | ±1.0 | — | — | ±1.0 | ±1.0 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Minimum heating load | ±1.0 | | ±1.0 | | ±1.0 | — | — | ±1.0 | ±1.0 | |
| Part load | ±0.5 | | ±0.5 | | — | — | — | ±0.5 | — | |
| Seasonal performance | ±0.5 | | ±0.5 | | ±0.5 | — | — | ±0.5 | — | |
| Annual performance | ±0.5 | | ±0.5 | | ±0.5 | — | — | ±0.5 | ±0.5 | |
| Nominal heat recovery | ±0.5 | | ±0.5 | | ±0.5 | — | — | ±0.5 | — | |
| Nominal cooling storage | ±0.5 | | ±0.5 | | ±0.5 | — | — | ±0.5 | — | |
| NOTE 1 "—" indicates no requirement.<br>NOTE 2 For units with heat recovery function, the requirements for hot water side of the heat recovery follow the requirements for use side as specified in this table. | | | | | | | | | | |

6.4 Test procedures

6.4.1 Sealing and pressure tests

6.4.1.1 Sealing test

6.4.1.1.1 Air tightness test

The air tightness test is conducted according to the methods as specified in 7.8.2.1 or 7.8.2.2 of NB/T 47012—2020.

6.4.1.1.2 Vacuum test

The vacuum test is conducted according to the methods as specified in 6.4.1.1.2 of GB/T 18430.1—2024.

6.4.1.2 Pressure test

The pressure test is conducted according to the methods as specified in 6.4.1.2 of GB/T 18430.1—2024.

6.4.2 Trial operation test

The trial operation test is conducted according to the methods as specified in 6.4.2 of GB/T 18430.1—2024.

6.4.3 Nominal condition performance test

6.4.3.1 Nominal cooling test

The unit's energy regulation device is adjusted to a suitable position and the test is conducted under the specified cooling conditions. The measured cooling capacity and cooling power consumption are tested as follows:

a) Water-cooled and water (ground) source units:

The inlet/outlet water temperature and water flow rate on the use side and heat source side are measured as specified in Appendix F of GB/T 18430.1—2024. The cooling capacity is calculated as specified in 6.4.3.3.1 of GB/T 18430.1—2024.The heat exchange on the heat source side is calculated as specified in 6.4.3.3.2 of GB/T 18430.1—2024. To ensure the validity of the test, the primary and secondary side deviation is calculated as specified in 6.4.3.4 of GB/T 18430.1—2024, which shall be no larger than the allowable deviation as specified in 4.2.2 of GB/T 10870—2014.

The input power of the compressor motor, oil pump motor, and control circuit shall be included in the cooling power consumption (excluding the power of the water pump if the unit has its own water system with the water pump).

b) Air-cooled units:

The inlet/outlet water temperature and water flow rate on the use side are measured as specified in Appendix F of GB/T 18430.1—2024. The inlet air dry/wet bulb temperature on the heat source side are measured by using the air sampling device as specified in Appendix B of GB/T 10870—2014. The cooling capacity is calculated as specified in 6.4.3.3.1 of GB/T 18430.1—2024.

The input power of the compressor motor and control circuit, as well as the input power of the cooling fan on the heat source side shall be included in the cooling power consumption (excluding the power of the water pump if the unit has its own water system with the water pump).

c) Evaporative cooling units:

The inlet/outlet water temperature and water flow rate on the use side are measured as specified in Appendix F of GB/T 18430.1—2024. The inlet air dry/wet bulb temperature on the heat source side are measured by using the air sampling device as specified in Appendix B of GB/T 10870—2014 and the water replenishment system of the unit shall be operated automatically during the test. The cooling capacity is calculated as specified in 6.4.3.3.1 of GB/T 18430.1—2024.

The input power of the compressor motor, control circuit, as well as the input power of the water spray pump and cooling fan on the heat source side shall be included in the cooling power consumption (excluding the power of the water pump if the unit has its own water system with the water pump).

6.4.3.2 Nominal heating test

For the water (ground) source unit, the unit's energy regulation device is adjusted to a suitable position and the test is conducted under the specified heating conditions.

The inlet/outlet water temperature and water flow rate on the use side and heat source side are measured as specified in Appendix F of GB/T 18430.1—2024. The heating capacity is calculated as specified in 6.4.3.3.2 of GB/T 18430.1—2024. The heat exchange on the heat source side is calculated as specified in 6.4.3.3.1. To ensure the validity of the test, the primary and secondary side deviation is calculated as specified in 6.4.3.4 of GB/T 18430.1—2024, which shall be no larger than the allowable deviation as specified in 4.2.2 of GB/T 10870—2014.

The input power of the compressor motor and control circuit shall be included in the heating power consumption (excluding the power of the water pump if the unit has its own water system with the water pump).

6.4.3.3 Calculation of performance parameters

6.4.3.3.1 Refrigerant-water heat exchanger (evaporator)

The performance parameters of the unit's evaporator shall be calculated as specified in 6.4.3.3.1 of GB/T 18430.1—2024.

6.4.3.3.2 Refrigerant-water Heat exchanger (condenser)

The performance parameters of the unit's condenser shall be calculated as specified in 6.4.3.3.2 of GB/T 18430.1—2024.

6.4.3.4 Primary and secondary side deviation

The primary and secondary side deviation shall be calculated as specified in 6.4.3.4 of GB/T 18430.1—2024.

6.4.4 Part load performance test

6.4.4.1 The integrated part load value for water-cooled or evaporative cooling comfort units shall be obtained under the conditions as specified in Table 7 and by the test methods as specified in Appendix H of GB/T 18430.1—2024.

6.4.4.2 The non-standard part load value for water-cooled or evaporative cooling comfort units shall be obtained under the conditions as specified in Table 7 and by the test methods as specified in Appendix H of GB/T 18430.1—2024.

6.4.5 Seasonal performance test

6.4.5.1 The cooling seasonal performance factor for air-cooled comfort units shall be obtained by the test methods as specified in Appendix I of GB/T 18430.1—2024.

6.4.5.2 The annual integrated cooling coefficient of performance for data center specific units shall be obtained by the test methods as specified in Appendix C of GB/T 18430.1—2024.

6.4.6 Annual performance test

The unit is tested under the nominal cooling conditions as specified in Table 10 to measure the cooling capacity and total input power at 100% load, and to obtain the cooling coefficient of performance at 100% load. Then the unit is tested under the nominal heating conditions as specified in Table 10 to measure the heating capacity and total input power at 100% load and to obtain the heating coefficient of performance at 100% load. The annual coefficient of performance is obtained by calculating.

6.4.7 Water side pressure drop test

The water side pressure drop test shall be performed by the methods as specified in 6.4.6 of GB/T 18430.1—2024.

6.4.8 Maximum cooling load test

The unit is operated under the maximum cooling load conditions as specified in Tables 1, 2, 3, 4, or 6. After reaching the stable state, the unit is operated for another 2 hours and its components, overload protectors, and operating current are inspected.

6.4.9 Minimum cooling load test

The unit is operated under the minimum cooling load conditions as specified in Tables 1, 2, 3, 4, or 6. After reaching the stable state, the unit is operated for another 2 hours and its components, low pressure, anti-freeze, and overload protectors are inspected.

6.4.10 Minimum pressure ratio operation

The unit is operated under the minimum pressure ratio conditions as specified in Tables 1, 2, or 3. After reaching the stable state, the unit is operated for another 2 hours and its components, low pressure, anti-freeze, and overload protectors, as well as the inverter and motor are inspected.

6.4.11 Maximum pressure ratio operation

The unit is operated under the maximum pressure ratio conditions as specified in Tables 1, 2, or 3. After reaching the stable state, the unit is operated for another 2 hours and its components, overload protectors, and operating current are inspected.

6.4.12 Anti-surging operation

The unit is operated under the anti-surging conditions as specified by the manufacturer. The target temperature of the unit is controlled to reduce the load to the minimum. The minimum load and target temperature are maintained for 2 hours and then the unit's components are inspected.

6.4.13 Temperature inversion differential running

The unit is operated under the temperature inversion differential conditions as specified in Tables 5 or 6. After reaching the stable state, the unit is operated for another 2 hours and its components, low pressure, inverter high-temperature, and motor high-temperature protectors are inspected.

6.4.14 Low pressure ratio performance

The unit is operated under the low pressure ratio conditions as specified in Table 6. After reaching the stable state, the unit is operated for another 2 hours and its inverter high-temperature and motor high-temperature protectors are inspected, and the cooling coefficient of performance is recorded.

6.4.15 Starting current test

the maximum current within 1 minute of compressor start-up is tested under the specified rated voltage and nominal cooling conditions by using a power meter with an accuracy higher than 1%.

6.4.16 Quick starting test

The unit is operated under the nominal conditions for 10 minutes. Then the power and control supply are cut off and the power is restored within 1 minute. The time from power restoration to compressor start-up is measured.

6.4.17 Performance test under the application conditions

The test is performed as follows:

a) Based on the application conditions provided in the unit's performance database, a load rate and a set of application conditions are randomly specified, and the performance data under these conditions are output (including cooling/heating capacity, cooling/heating power consumption and indicated values such as $COP_c$, $COP_h$, *IPLV*, *NPLV*, *CSPF*, *ACCOP*, etc.)

b) The test is performed as specified in 6.4.3, 6.4.4, 6.4.5, 6.4.6, and Appendices C, H, or I of GB/T 18430.1—2024.

c) The output results of the unit's performance database are verified as specified in 5.18.2 and 5.18.3.

6.4.18 Noise test

The noise test shall be performed according to the methods as specified in 6.4.11.1 of GB/T 18430.1—2024.

6.4.19 Vibration test

The vibration test shall be performed according to the methods as specified in 6.4.11.2 of GB/T 18430.1—2024.

6.4.20 Electrical safety test

6.4.20.1 Insulation resistance test

The insulation resistance test shall be performed according to the methods as specified in 6.4.12.1 of GB/T 18430.1—2024.

6.4.20.2 Electrical strength test

The electrical strength test shall be performed according to the methods as specified in 6.4.12.2 of GB/T 18430.1—2024.

6.4.20.3 Grounding device test

The grounding device test shall be performed according to the methods as specified in 6.4.12.3 of GB/T 18430.1—2024.

6.4.20.4 Moisture resistance test

The moisture resistance test shall be performed according to the methods as specified in 6.4.12.4 of GB/T 18430.1—2024.

6.4.20.5 Degree of protection test

The degree of protection test shall be performed according to the methods as specified in 6.4.12.5 of GB/T 18430.1—2024.

6.4.21 Special requirements test for units with heat recovery function

The special requirements test for units with heat recovery function shall be performed according to the methods as specified in 6.4.13 of GB/T 18430.1—2024.

6.4.22 Special requirements test for units with cooling storage function

The special requirements test for units with cooling storage function shall be performed according to the methods as specified in 6.4.13 of GB/T 18430.1—2024.

7 Inspection rules

7.1 Factory inspection, sampling inspection, and type inspection are included in the unit inspections. The inspection items, technical requirements, and test methods are as specified in Table 24.

7.2 Each unit shall be inspected and passed by the manufacturer's quality inspection department before leaving the factory.

7.3 Sampling inspection shall be actively included in the manufacturer's product quality control measures, especially for mass-produced units. However, the specific sampling program, inspection level, and acceptable quality level may be determined by the manufacturer.

7.4 Type inspections shall be conducted at least once every 4 years. The first unit shall be type tested under the following circumstances:

——new product development or significant improvements to existing products;

——use of a completely new production line;

——relocation of the production line or significant improvements to the production line.

Table 24 — Inspection items

| No. | Test item | Inspection type | Technical | Test methods |
|---|---|---|---|---|

| | Name | | Factory inspection | Sampling inspection | Type inspection | requirements | |
|---|---|---|---|---|---|---|---|
| 1 | General Requirements | | — | — | √ | 5.1 | Visual inspection and verification |
| 2 | Sealing and pressure test | Air tightness test | √ | √ | √ | 5.2 | 6.4.1.1.1 |
| 3 | | Vacuum test | √[a] | √ | √ | 5.2 | 6.4.1.1.2 |
| 4 | | Pressure test | — | √ | √ | 5.2 | 6.4.1.2 |
| 5 | Trial operation | | √ | √ | √ | 5.3 | 6.4.2 |
| 6 | Electrical safety | Insulation resistance | √ | √ | √ | 5.21.1 | 6.4.20.1 |
| 7 | | Electrical strength | √ | √ | √ | 5.21.2 | 6.4.20.2 |
| 8 | | Grounding device | √ | √ | √ | 5.21.3 | 6.4.20.3 |
| 9 | | Moisture resistance | — | — | √ | 5.21.4 | 6.4.20.4 |
| 10 | | Degree of protection | — | — | √ | 5.21.5 | 6.4.20.5 |
| 11 | Water side pressure drop | | — | √ | √ | 5.8 | 6.4.7 |
| 12 | Noise | | — | √ | √ | 5.19 | 6.4.18 |
| 13 | Vibration | | — | √ | √ | 5.20 | 6.4.19 |
| 14 | Nominal cooling Capacity | | — | √ | √ | 5.4.1.1 | 6.4.3.1<br>6.4.3.3<br>6.4.3.4 |
| 15 | Nominal cooling power consumption | | — | √ | √ | 5.4.1.2 | |
| 16 | Nominal cooling coefficient of performance | | — | √ | √ | 5.4.1.3 | |
| 17 | Nominal heating capacity | | — | √ | √ | 5.4.2.1 | 6.4.3.2<br>6.4.3.3<br>6.4.3.4 |
| 18 | Nominal heating power consumption | | — | √ | √ | 5.4.2.2 | |
| 19 | Nominal heating coefficient of performance | | — | √ | √ | 5.4.2.3 | |

| No. | Test item | Inspection type | | | Technical requirements | Test methods |
|---|---|---|---|---|---|---|
| | Name | Factory inspection | Sampling inspection | Type inspection | | |
| 20 | Integrated part Load value | — | √ | √ | 5.5.1 | 6.4.4.1 |
| 21 | Non-standard part load value | — | √ | √ | 5.5.2 | 6.4.4.2 |
| 22 | Cooling seasonal performance factor | — | √ | √ | 5.6.1 | 6.4.5.1 |
| 23 | Annual integrated cooling coefficient of performance | — | — | √ | 5.6.2 | 6.4.5.2 |
| 24 | Annual coefficient of performance | — | — | √ | 5.7 | 6.4.6 |
| 25 | Maximum cooling load | — | — | √ | 5.9 | 6.4.8 |
| 26 | Minimum cooling load | — | — | √ | 5.10 | 6.4.9 |
| 27 | Minimum pressure ratio operation | — | — | √ | 5.11 | 6.4.10 |
| 28 | Maximum pressure ratio operation | — | — | √ | 5.12 | 6.4.11 |
| 29 | Anti-surging operation | — | — | √ | 5.13 | 6.4.12 |
| 30 | Temperature inversion differential running | — | — | √ | 5.14 | 6.4.13 |
| 31 | Low pressure ratio performance | — | — | √ | 5.15 | 6.4.14 |
| 32 | Starting current | — | — | √ | 5.16 | 6.4.15 |
| 33 | Quick starting | — | — | √ | 5.17 | 6.4.16 |
| 34 | Performance under the application conditions | — | — | √ | 5.18 | 6.4.17 |
| 35 | Nominal cooling capacity in heat recovery mode | — | √ | √ | D.1.1 of GB/T 18430.1—2024 | D.3,D.4 of GB/T 18430.1—2024 |
| 36 | Nominal heat recovery capacity | — | √ | √ | D.1.1 of GB/T 18430.1—2024 | |
| 37 | Nominal heat recovery power consumption | — | √ | √ | D.1.2 of GB/T 18430.1—2024 | |
| 38 | Part/full heat recovery comprehensive energy efficiency | — | √ | √ | D.1.3 of GB/T 18430.1—2024 | |

| No. | Test item | Inspection type | | | Technical requirements | Test methods |
|---|---|---|---|---|---|---|
| | Name | Factory inspection | Sampling inspection | Type inspection | | |
| 39 | Nominal cooling storage cooling capacity | — | √ | √ | E.1.1 of GB/T 18430.1—2024 | E.3 of GB/T 18430.1—2024 |
| 40 | Nominal cooling storage cooling power consumption | — | √ | √ | E.1.2 of GB/T 18430.1—2024 | |
| 41 | Nominal cooling storage cooling coefficient of performance | — | √ | √ | E.1.3 of GB/T 18430.1—2024 | |
| NOTE "√" indicates items that require inspection; "—" indicates items that do not require inspection. | | | | | | |
| [a] For mass-produced units (e.g., modular units), manufacturers are allowed to use equivalent vacuum processes during the factory inspections to reduce inspection time, provided that the sampling inspection and type inspection conducted according to the methods in this document are passed. | | | | | | |

## 8 Marking, packaging, transportation and storage

### 8.1 Marking

8.1.1 Each unit shall be provided with a permanent nameplate in an obvious place, which shall be in accordance with GB/T 13306 and contain the contents listed in Table 25.

Table 25 — Nameplate contents

| No. | Marking content | | Marking requirements | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Name | Unit | Water-cooled type | Air-cooled type | Evaporative cooling type | Water (ground) source type | | |
| | | | Cooling-only type | Cooling-only type | Cooling-only type | Heat pump type | Cooling-only type | Heating-only type |
| 1 | Product name, model | — | √ | √ | √ | √ | √ | √ |
| 2 | Manufacturer's name, trademark | — | √ | √ | √ | √ | √ | √ |
| 3 | Production date, Product number | — | √ | √ | √ | √ | √ | √ |
| 4 | Rated voltage, number of phases, | V,—,Hz | √ | √ | √ | √ | √ | √ |

| No. | Marking content | | Marking requirements | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Name | Unit | Water-cooled type | Air-cooled type | Evaporative cooling type | Water (ground) source type | | |
| | | | Cooling-only type | Cooling-only type | Cooling-only type | Heat pump type | Cooling-only type | Heating-only type |
| | frequency | | | | | | | |
| 5 | Maximum operating current[a] | A | √ | √ | √ | √ | √ | √ |
| 6 | Refrigerant number, charge amount | —,kg | √ | √ | √ | √ | √ | √ |
| 7 | Water side pressure drop[b] | kPa | √ | √ | √ | √ | √ | √ |
| 8 | Dimensions | mm | √ | √ | √ | √ | √ | √ |
| 9 | Total mass of the unit[c] | kg | √ | √ | √ | √ | √ | √ |
| 10 | Unit type[d] | — | √ | √ | √ | √ | √ | √ |
| 11 | Additional functions[e] | — | √ | √ | √ | √ | √ | √ |
| 12 | Nominal cooling capacity[f] | kW | √ | √ | √ | √ | √ | — |
| 13 | Nominal cooling power consumption | kW | √ | √ | √ | √ | √ | — |
| 14 | Nominal cooling coefficient of performance | kW/kW | √ | √ | √ | √ | √ | — |
| 15 | Nominal heating capacity[f] | kW | — | — | — | √ | — | √ |
| 16 | Nominal heating power consumption | kW | — | — | — | √ | — | √ |
| 17 | Nominal heating coefficient of performance | kW/kW | — | — | — | √ | — | √ |

| No. | Marking content | | Marking requirements | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Name | Unit | Water-cooled type | Air-cooled type | Evaporative cooling type | Water (ground) source type | | |
| | | | Cooling-only type | Cooling-only type | Cooling-only type | Heat pump type | Cooling-only type | Heating-only type |
| 18 | Nominal heat recovery capacity[g] | kW | √ | √ | √ | — | — | — |
| 19 | Nominal cooling capacity in heat recovery mode[g] | kW | √ | √ | √ | — | — | — |
| 20 | Nominal heat recovery power consumption[g] | kW | √ | √ | √ | — | — | — |
| 21 | Part/full heat recovery coefficient of performance[g] | kW/kW | √ | √ | √ | — | — | — |
| 22 | Nominal cooling storage cooling capacity[h] | kW | √ | √ | √ | — | — | — |
| 23 | Nominal cooling storage cooling power consumption[h] | kW | √ | √ | √ | — | — | — |
| 24 | Nominal cooling storage cooling coefficient of performance[h] | kW/kW | √ | √ | √ | — | — | — |
| 25 | Integrated part load value | kW/kW | √ | — | √ | — | — | — |
| 26 | Cooling seasonal performance factor | (kW·h)/(kW·h) | — | √ | — | — | — | — |
| 27 | Annual integrated cooling | kW/kW | √ | √ | √ | √ | — | — |

| No. | Marking content | | Marking requirements | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Name | Unit | Water-cooled type | Air-cooled type | Evaporative cooling type | Water (ground) source type | | |
| | | | Cooling-only type | Cooling-only type | Cooling-only type | Heat pump type | Cooling-only type | Heating-only type |
| | coefficient of performance[i] | | | | | | | |
| 28 | Noise (sound pressure level) | dB(A) | √ | √ | √ | √ | √ | √ |

NOTE 1 "—" indicates no marking required; "√" indicates marking required, but units without corresponding functions do not need to be marked.

Note 2 In addition to the nominal condition parameters specified in this document, the unit may also indicate performance parameters corresponding to specified application conditions.

[a] The maximum operating current allowed under all standard conditions and all application conditions permitted by the manufacturer.

[b] The water side pressure drop for cold/hot water side, cooling water side, and heat recovery side (if applicable) shall be indicated separately, and values under the nominal cooling and heating conditions of cooling water side shall be included .

[c] If necessary, refrigerant (or other charged substances) and lifting accessories shall be include in the total mass of the unit, to guide safe transportation and lifting.

[d] Air-cooled comfort type, water-cooled comfort type, evaporative cooling comfort type, process type, and data center specific type are included in unit types.

[e] Full heat recovery, part heat recovery, and cooling storage are included in the additional functions of the units.

[f] For process type units, the specified conditions of the nominal cooling/heating parameters are to be marked.

[g] Units without heat recovery functions need not to be marked; units with heat recovery functions and the conditions are to be marked.

[h] Units without cooling storage functions need not to be marked; units with cooling storage functions and the conditions are to be marked.

[i] Data center specific units are to be marked; other types of units need not to be marked.

8.1.2 The relevant parts of the unit shall be equipped with signs indicating the operating status (e.g., steering, direction of water flow, indicator gauges, and various control buttons, etc.) and safety signs (e.g., grounding devices, warning signs, etc.)

8.1.3 The unit shall be labeled with the number of this document in the appropriate places (e.g., product manual, nameplate, etc.).

8.1.4 If flammable refrigerants are used in the unit, a permanent warning sign ("Caution: Fire Risk") in accordance with the color and style of No. 2-2 in Table 2 of GB 2894—2008 shall be marked on a prominently position of the unit. The vertical height of the sign shall be no less than 30 mm.

## 8.2 Packaging

8.2.1 Before packaging, the unit shall be cleaned, and all components shall be clean and dry (including internal surfaces in contact with refrigerant and lubricant). Rust-prone parts shall be coated with rust inhibitor.

8.2.2 Before packaging, the unit shall be charged or kept with the specified amount of refrigerant or charged with dry nitrogen at 0.02 MPa to 0.03 MPa (gauge pressure).

8.2.3 Accompanying documents shall be attached to the package, including the product certificate, product manual, and packing list.

The product certificate contains:

——product model and name;

——product factory number;

——manufacturer's name;

——inspection conclusion;

——inspector and signature of inspection supervisor and date.

The product manual shall contain:

——product model and name, working principle, scope of application, the number of this document, and main technical parameters (shall include cold/hot water side pressure drop, circulating water pump head, flow rate, power, and maximum operating current, in addition to the main performance parameters marked on the nameplate);

——structural schematic, system diagram, electrical schematic, and wiring diagram of the product;

——installation instructions and requirements, for the installation of units using flammable refrigerants is in accordance with the requirements given in GB/T 9237;

——instructions for use, maintenance and precautions, for the maintenance and precautions of units using flammable refrigerants are in accordance with the requirements given in Appendix D of GB/T 4706.32—2024, in addition to according to GB/T 9237.

8.2.4 The unit shall be protected against dust (such as wrapped in heat-shrinkable film or winding film, etc.), and the packaging shall be complied with GB/T 13384.

## 8.3 Transportation and storage

8.3.1 During transportation and storage, the unit shall not be bumped, tilted or exposed to rain or snow.

8.3.2 The product shall be stored in a dry and well-ventilated place, with attention to moisture protection of the electrical system.