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**Maximum allowable values of energy efficiency and
energy efficiency grades for data centers**

数据中心能效限定值及能效等级

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Maximum allowable values of energy efficiency and energy efficiency grades for data centers

1 Scope

This document specifies the energy efficiency grades and technical requirements, statistical scope, test and calculation methods for data centers.

This document applies to newly-built, rebuilt and expanded data centers, as well as to individual or modular units of data center buildings that use independent power distribution, air cooling, and electric air-conditioning, for energy consumption measurement, energy efficiency calculation and assessment.

This document does not apply to edge data centers.

Data centers that use other non-electric air-conditioning equipment can refer to this document for implementation.

Note: Newly-built data center refers to the data center that is newly-built by the construction unit in accordance with the prescribed procedures. Rebuilt data center means that the construction unit transforms an existing building into a data center, or rebuilds an existing data center computer room into a new data center. Expanded data center refers to a data center in which the construction unit increases the number of data center cabinets or increases the power consumption of the cabinet in order to expand the business capacity of the data center. Edge data center refers to a data center that is small in scale, deployed at the edge of the network, close to the user side, and realizes the functions of computing, storing and forwarding edge data. The single size does not exceed 100 standard supports.

2 Normative references

The contents of the following documents constitute the indispensable clauses of this document through normative references in the text. For dated references, only the version corresponding to that date is applicable to this document; for undated references, the latest version (including all amendments) is applicable to this document.

GB/T 32910.1, *Data center - Resource utilization - Part 1: Terminology*

5.3 Measuring instruments and meters shall be used to measure the power consumption of information devices, cooling systems, power supply and distribution systems and other auxiliary facilities in the data center during the measurement and calculation period:

a) Information equipment includes but is not limited to:

- Data computing and processing equipment: such as servers, workstations, small hosts, information security equipment;
- Data exchange processing equipment: such as switches, routers, firewalls, network analyzers, load balancing equipment;
- Data storage processing equipment: such as disk storage arrays, optical disc library storage devices, tape storage devices;
- Auxiliary electronic equipment: such as network management system, visual display, control terminal, and other electronic equipment installed in the host room.

b) The cooling system includes but is not limited to:

- Terminal air-conditioning equipment used in the computer room: such as room-level, row-level, cabinet-level, chip-level air-conditioning and computer room temperature and humidity adjustment equipment;
- Outdoor cooling system: such as air-cooling, water-cooling, evaporative cooling air-conditioning equipment and air-conditioning refrigeration conveying equipment;
- Fresh air system: such as fresh air ventilator, supply air, return air blower, air valve.

c) The power supply and distribution system includes but is not limited to:

- Transformers, power distribution cabinets, generators, uninterruptible power supplies (UPS or HVDC), batteries, cabinet power distribution units and other equipment.

d) Other auxiliary facilities include but are not limited to:

- Such as lighting equipment, security equipment, fire extinguishing equipment, waterproof equipment, sensors, management systems for data center buildings.

6 Test and calculation methods

6.1 Test conditions

6.1.1 Test environment

During the test, the temperature, relative humidity and illuminance in the data center shall meet the relevant requirements in GB 50174.

6.1.2 Accuracy of instruments and apparatus

The precision or accuracy of measuring instruments and apparatus shall meet the following requirements:

- Electric energy measuring meter: the accuracy is grade 1;
- Current transformer: grade 0.5;
- Power meter: grade 0.5;
- Voltage transformer: grade 0.5;
- Temperature measuring instrument: the accuracy is $\pm 0.5\text{ }^{\circ}\text{C}$;
- Relative humidity measuring instrument: the accuracy is $\pm 0.5\%$;
- Illuminance measuring instrument: not lower than grade I; the relative indication error is less than or equal to $\pm 4\%$.

6.2 Test location

6.2.1 Location of power consumption measuring points

Measuring instruments and apparatus shall be used to measure power consumption; refer to the location requirements of each measuring point in Figure 1 for the setting of power consumption measuring points in the data center. The location of the installed measuring instruments and apparatus shall be convenient for the collection and management of power consumption data in the data center, and shall be convenient for obtaining the data required by the ratio of electricity consumption of data centers.

The measuring point of the total electricity consumption of data centers shall be taken before the electrical energy is input into the transformer, that is, the sum of the power consumption of measuring point 1 and measuring point 2 in Figure 1.

6.2.2.1 Location of indoor measuring points in the data center

The indoor temperature, relative humidity, and illuminance measuring points of the data center shall be selected in accordance with the relevant requirements in GB 50462.

6.2.2.2 Location of outdoor measuring points in the data center

The location of the outdoor temperature measuring point of the data center shall be located at the center of 1 m from the windward surface of the equipment that affects the cooling performance. If there are multiple outdoor units, the outdoor temperature is the average value of the temperatures measured on the multiple outdoor units; cooling equipment shall be avoided from influencing the temperature measurement.

6.3 Calculation methods

6.3.1 Design value of ratio of electricity consumption of data centers

The design value of ratio of electricity consumption of data centers is calculated according to Formula (1):

$$R_D = \frac{E_D}{E_{DIT}} \quad \dots\dots\dots (1)$$

Where:

R_D – design value of ratio of electricity consumption of data centers;

E_D – the planned design value of the total power consumption, in kilowatt-hours (kWh);

E_{DIT} – the planned design value of the power consumption of information equipment, in kilowatt-hours (kW·h).

6.3.2 Calculated value of ratio of electricity consumption of data centers

6.3.2.1 Test methods

The test method of the numerical value of ratio of electricity consumption of data centers is carried out according to the following regulations:

- a) Under the actual operating load conditions of the data center, select several different time periods within a year, which shall include at least one characteristic operating point of a ~ e specified in Table 2; respectively and continuously measure the total power of the data center and the power of information equipment. Under the refrigeration and information system stable state, continuously measure for not be less than 12 h; the

$$E_c = 8\,760 \times T_a P_a + 8\,760 \times T_b P_b + 8\,760 \times T_c P_c + 8\,760 \times T_d P_d + 8\,760 \times T_e P_e \dots\dots\dots (2)$$

Where:

E_c – the calibration value of the total power consumption, in kilowatt-hours (kWh);

$P_a \sim P_e$ – the total power of the data center measured under the working conditions of a ~ e in Table 2, in kilowatts (kW);

$T_a \sim T_e$ – temperature distribution coefficient, the specific value is taken according to Appendix B;

8 760 – number of hours in a year, in hours (h).

Note: The temperature distribution coefficient $T_a \sim T_e$ represents the time proportion of the temperature interval represented by each characteristic operating point in the temperature distribution of a certain area throughout the year.

6.3.2.3 Calibration value of power consumption of information equipment

The calibration value of power consumption of information equipment is calculated according to Formula (3):

$$E_{cIT} = 8\,760 \times T_a P_{aIT} + 8\,760 \times T_b P_{bIT} + 8\,760 \times T_c P_{cIT} + 8\,760 \times T_d P_{dIT} + 8\,760 \times T_e P_{eIT} \dots\dots\dots (3)$$

Where:

E_{cIT} – the calibration value of power consumption of information equipment, in kilowatt-hours (kWh);

$P_{aIT} \sim P_{eIT}$ – the data center information device power measured under the working conditions of a ~ e in Table 2, in kilowatts (kW);

$T_a \sim T_e$ -- temperature distribution coefficient, the specific value is taken according to Appendix B;

8 760 – number of hours in a year, in hours (h).

Note: The temperature distribution coefficient $T_a \sim T_e$ represents the time proportion of the temperature interval represented by each characteristic operating point in the temperature distribution of a certain area throughout the year.

6.3.2.4 Calculated value of ratio of electricity consumption of data centers

The calculated value of ratio of electricity consumption of data centers is calculated according to Formula (4) and Formula (5):

$$R_{M1} = \frac{E_c}{E_{CIT}} \dots\dots\dots (4)$$

Where:

R_{M1} – the measured valued of characteristic working condition of the ratio of electricity consumption of data centers that is measured according to the method of 5 characteristic working condition points;

E_c – the calibration value of the total power consumption, in kilowatt-hours (kWh);

E_{CIT} – the calibration value of power consumption of information equipment, in kilowatt-hours (kWh).

Where:

R_{M2} – the annual measured value of the ratio of electricity consumption of data centers that is calculated according to the annual power consumption, dimensionless;

E – the measured value of annual power consumption, in kilowatt-hours (kWh);

E_{IT} – the measured value of annual power consumption of information devices, in kilowatt-hours (kW·h).

6.3.3 Determination

The determination of data centers of each grade shall meet the following two conditions at the same time:

- a) The design value of the ratio of electricity consumption of data centers, the calculated value of the characteristic working condition method and the annual calculated value (if any) are in compliance with the requirements for the corresponding grade in Table 1.
- b) The measured value of the characteristic working condition method of the ratio of electricity consumption of data centers and the annual measured value (if any) shall be less than 1.05 times of the design value.

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