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GB 50736-2012

**Design Code for Heating Ventilation and Air
Conditioning of Civil Buildings**

民用建筑供暖通风与空气调节设计规范

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5.3 Radiator Heating

5.3.1 Hot water shall be adopted as heating medium in radiator heating system; central heating system of radiator should be designed according to 75°C/50°C continuous heating, supply water temperature should not be greater than 85°C, and temperature difference between supply and return water should not be less than 20°C.

5.3.2 Indoor heating systems of residential buildings should adopt vertical two-pipe system, household independent two-pipe circulation system sharing the same riser, or vertical single-pipe cross-over system; heating systems of public buildings should adopt two-pipe system or single-pipe cross-over system.

5.3.3 Indoor vertical single-pipe downflow systems in the existing buildings shall be changed to vertical two-pipe system or vertical single-pipe cross-over system and should not be renovated to household independent circulation system.

5.3.4 Vertical single-pipe cross-over system should not exceed 6 stories and horizontal one should not exceed 6 groups of radiators.

5.3.5 In the locations where pipelines might be frozen, heating riser or branch of radiator shall be arranged separately.

5.3.6 Selection of radiators shall meet the following requirements:

- 1 Radiator working pressure shall be determined according to the pressure requirements of heating system and meet the requirements of the current relevant product standards of the nation;

- 2 Corrosion-resistant radiators shall be adopted in the rooms with larger relative humidity;

- 3 Where steel radiators are adopted, the heating system shall be maintained by filling water in the non-heating season, provided that product requirements to the water quality are met;

- 4 Where aluminum-made radiators are adopted, inner anti-corrosion types shall be selected and the requirements of products to water quality shall be met;

- 5 The cast iron radiator with burnt-on sand in water passes should not be adopted in the hot water heating system equipped with heat meter and thermostatic valve;

- 6 Convection radiator should not be adopted separately for tall space heating.

5.3.7 Radiator shall be arranged in accordance with the following requirements:

- 1 Radiator should be installed under the outer wall windowsill, which may also be installed against the inner wall where it is difficult to install or arrange pipelines;

- 2 Radiator shall not be arranged within the foyer between two exterior doors;

- 3 Radiators in the staircase shall be distributed on the bottom layer or on the lower stories in certain proportion.

5.3.8 Assembly pieces of cast iron radiators should meet the following requirements:

- 1 Thick-pillar (including pillar flange) cast iron radiators should not exceed 20 pieces;

- 2 Thin-pillar cast iron radiators should not exceed 25 pieces.

5.3.9 Radiators shall be surface mounted in the buildings other than kindergartens, nursing homes and those with specific functions. Where the radiators must be concealedly mounted, decorative shield shall be provided with reasonable air ducts and adequate area of passage and ensured convenient for maintenance. External surface of radiator shall be painted with

other auxiliary heating equipment shall be arranged, so as to reduce the heating loads undertaken by the floor radiant heating system.

5.4.3 Floor construction of hot water floor radiant heating system shall meet the following requirements:

1 Insulating courses must be arranged where the floor slab directly exposed to the outdoor air and the floor adjacent to non-heating room are used as the heating floor;

2 Insulating course shall be arranged in the bottom layer exposed to the soil; where insulating course is arranged, damp-proof course shall be arranged between insulating course and soil;

3 Isolating course shall be arranged on the filler course or under the surface course in the damp room.

5.4.4 In the case of individual heating by capillary mat radiant system, floor burial mode should be firstly taken into consideration, or wall surface burial mode may be taken into consideration if floor area is insufficient; in the case of capillary mat both serving for winter heating and summer cooling, ceiling installation mode should be firstly taken into consideration, or wall surface or floor burial mode may be taken into consideration if ceiling area is insufficient.

5.4.5 Working pressure of hot water floor radiant heating system should not be greater than 0.8 MPa and that of capillary mat radiant system shall not be greater than 0.6 MPa. Corresponding measures shall be adopted if the above pressure is exceeded.

5.4.6 Material and wall thickness of plastic heating pipe used in hot water floor radiant heating shall be selected according to such conditions as durable life of engineering, pipe material as well as operating water temperature and working pressure of the system.

5.4.7 In the residential buildings, hot water radiant heating systems shall be divided according to the household and equipped with water separators and water collectors; main rooms in each household should be arranged with heating pipes according to different loops.

5.4.8 Laying spacing of heating pipes shall be determined through calculation according to floor heat release, indoor design temperature, mean water temperature, and floor heat transfer resistance, etc.

5.4.9 Water inlet and outlet of heating pipe in each loop shall be connected with water separator and water collector respectively. Inner diameter of water separator and water collector shall not be less than that of total supply and return water pipe, and flow rate of water separator and water collector through the maximum section should not be greater than 0.8 m/s. Each water separator and water collector should be provided no more than 8 branch loops. Supply and return water pipe in each branch loop shall be equipped with shut-off valves.

5.4.10 Bypass pipes with valves should be arranged between total inlet pipe of water separator and total outlet pipe of water collector. Water separator and water collector shall be equipped with manual or automatic air valves.

5.4.11 Hot water suspended ceiling radiant panel heating may be used to the buildings with 3m~30m story height.

5.4.12 Supply water temperature of hot water suspended ceiling radiant panel should be

5.6 Gas-fired Infrared Heating

5.6.1 Such corresponding safety measures as fire preventions and ventilation must be taken in the case of gas-fired infrared heating, which shall meet the requirements of the current codes of the nation related to gas and fire prevention.

5.6.2 Natural gas, manufactured gas, and liquefied petroleum gas etc. may be adopted as gas-fired infrared heating fuel. Gas quality and gas transmission and distribution system shall meet the relevant requirements of the current national standard "Code for Design of City Gas Engineering" (GB 50028).

5.6.3 Installation height of gas-fired infrared radiator should not be less than 3m.

5.6.4 Where gas-fired infrared radiators are used for partial heating at the work site, they shall not be less than two and shall be installed above the personnel in different directions.

5.6.5 When overall radiant heating system is arranged, heat release of the radiators on the surrounding outer wall or at the exterior door should not be less than 60% of total heating load.

5.6.6 The space adopting indoor air supply shall ensure the air amount required by the burner. If the air amount required by the burner exceeds the ventilation rate of this space that is 0.5 cycles/h, outdoor air supply shall be adopted.

5.6.7 Where gas-fired infrared heating system adopted outdoor air supply, air inlet shall meet the following requirements:

- 1 It shall be arranged in the outdoor clean air zone, its distance to the ground shall not be less than 2m;

- 2 Horizontal distance to air outlet shall be greater than 6m; where it is located below air outlet, vertical distance shall not be less than 3m; where it is located above air outlet, vertical distance shall not be less than 6m;

- 3 Filter screen shall be installed.

5.6.8 Tail gas of gas-fired infrared heating system shall be discharged outside the room if there is no special requirement. Air outlet shall meet the following requirements:

- 1 It shall be arranged in the seldom-accessed locations, no less than 2m away from the floor level;

- 2 As for the horizontally-installed exhaust pipe, its air outlet shall protrude the wall surface no less than 0.5m;

- 3 As for the vertically-installed exhaust pipe, its air outlet shall be no less than 1m higher than the highest point of the buildings within the range of its 6m radius;

- 4 Metal sleeves shall be installed where exhaust pipes pass through outer wall or roof.

5.6.9 Gas-fired infrared heating system shall be equipped with control switch that can directly cut off heating system and gas supply system in the position convenient for operation. Where ventilator is used for supplying air, ventilator and heating system shall be arranged with interlocking switch.

5.7 Unitary Gas Furnace Heating & Unitary Air Source Heat Pump Heating

5.7.1 Where residential buildings are heated by gas, unitary gas furnace heating should be

- 2 Warm air heating and warm air curtain systems;
- 3 Domestic hot water supply system;
- 4 Floor radiant heating system;
- 5 Other systems requiring separate heat metering.

5.9.3 Building heating entry with central heating system shall meet the following requirements:

- 1 Supply and return water pipes shall be equipped with shut-off valves, thermometers and pressure gauges respectively;
- 2 Filters and bypass valves shall be arranged;
- 3 Hydraulic balancing device shall be selected according to hydraulic balance requirements and heating system control modes in the buildings;
- 4 Except that several building heating entries share the same heat meter, each building heating entry is equipped with one heat meter that should be installed on the return water pipe.

5.9.4 Heating mains, risers and other pipes (excluding building heating entry of building heating system) shall be equipped with valves in accordance with the following requirements:

- 1 Parallel loops of heating system shall be equipped with closing and regulating devices;
- 2 Where freezing danger exists, distance from the valve on riser or branch to the main shall not be greater than 120mm;
- 3 Valves shall be arranged at the start of supply riser and the end of return riser that shall also be equipped with blowdown and discharging devices;
- 4 As for the unitary independent circulating heating systems sharing the same riser, shut off valves shall be installed on the incoming supply and return water branches connected with the above riser.

5.9.5 Where the heating pipeline fails to meet the requirements by utilizing the natural compensation, compensator shall be arranged.

5.9.6 Horizontal pipe of heating system shall be laid with certain gradient and the slope direction shall facilitate air and water discharging. Supply and return water branch and main gradient should be 0.003 and shall not be less than 0.002; as for the branch connecting riser and radiator, its gradient shall not be less than 0.01; if supply and return water mains (including radiator connecting pipe of horizontal single-pipe series system) fail to maintain the necessary gradient due to restrictions of conditions, the mains may be laid without gradient partially, but the water flow speed in the pipes shall not be less than 0.25m/s; as for the steam pipe containing steam-water countercurrent flow, its gradient shall not be less than 0.005.

5.9.7 Heating pipelines passing through building foundation, expansion joint, settlement joint and seismic joint as well as risers embedded in the building structures shall be provided with measures that can prevent building settlement, resulting in pipe damage.

5.9.8 Where heating pipelines must pass through fire walls, steel sleeves shall be embedded, fixed supports shall be arranged at the wall-through points, and the gaps between pipelines and sleeves shall be plugged with refractory materials.

5.9.9 Heating pipelines shall not be laid in parallel or crosswise in the same pipe trench

meet the following requirements:

1 Heat meters shall be selected according to nominal flow rate and checked for the pressure drop under system design flow rate. Nominal flow rate may be determined according to 80% of the design flow rate;

2 Flow sensor of heat meter shall meet the instrument installation requirements and should be installed on the return water pipe.

5.10.4 Constructed, renovated and expanded radiator indoor heating system shall be equipped with thermostatic radiator valve or other automatic temperature control valve for temperature control. Selection and arrangement of thermostatic radiator valve shall meet the following requirements:

1 Where the indoor heating system is vertical or horizontal two-pipe one, high-resistance thermostatic control valve shall be installed on the supply water branches of each group of radiators; thermostatic control valves with preset resistance control functions should be provided for the vertical two-pipe systems more than 5 layers;

2 Single-pipe cross-over system shall adopt low-resistance two-way or three-way thermostatic control valve;

3 Where the radiator is shielded, external-type thermostatic control valve with bulb shall be adopted;

4 Thermostatic control valves shall be provided with product qualification certificates, instructions for use and performance test reports issued by the quality detection departments, and their regulation performance and other indexes shall meet the relevant requirements of the current professional standard "Thermostatic Radiator Valve" (JG/T 195).

5.10.5 Hypothermal water floor radiant heating system shall be possessed of room temperature control function; room temperature controller should be arranged in the room or area under temperature control; thermoelectric control valve or self-operated thermostatic control valve should be adopted. Loop control and overall control modes may be adopted for arranging automatic control valves and shall meet the following requirements:

1 In the case of loop control, automatic control valve shall be arranged at the water separator or collector for the purpose of controlling the room or area at its own set temperature. Automatic control valve may also be placed in the water collector;

2 In the case of overall control, one automatic control valve shall be arranged on the total water supply pipe of water separator or the return water pipe of water collector for the purpose of controlling the indoor temperature of the whole household or area.

5.10.6 Heat metering heating system shall adapt to the requirements of temperature control; where the indoor heating system is variable flow one, self-operated flow control valve shall not be arranged; arrangement of self-operated differential pressure control valve shall be determined by calculating the differential pressure variation amplitude at the building heating entry.

6 Ventilation

6.1 General Requirement

6.1.1 Ventilation measures should be adopted in priority to eliminate excess heat, excess moisture and harmful substance if they exist in large quantities in the buildings. Effective comprehensive prevention and treatment measures shall be adopted for building ventilation according to such aspects as overall planning, building design and process.

6.1.2 Ventilation and purification measures must be taken before harmful substances or contaminants that cannot be avoided from diffusing are discharged and meet the requirements of the relevant standards of the nation related to atmospheric environment quality and various contaminant discharge.

6.1.3 Natural ventilation shall be adopted firstly to eliminate excess heat and excess moisture in the buildings and indoor contaminant concentration control shall be carried out. Natural ventilation should not be adopted in the areas with serious outdoor air contamination and noise pollution. Where natural ventilation fails to meet the requirements, mechanical ventilation or hybrid ventilation of natural ventilation and mechanical ventilation shall be adopted.

6.1.4 In the rooms with mechanical ventilation, the personnel's fresh air requirement shall meet the requirements of 3.0.6.

6.1.5 Partial air exhaust should be adopted for the equipment diffusing heat, steam or harmful substance installed in the buildings. Where it is impossible to adopt partial air exhaust or partial air exhaust fails to reach the sanitation requirements, partial air exhaust shall be accompanied by or replaced by overall ventilation.

6.1.6 Air exhaust system shall be arranged separately if any one of the following conditions is met:

- 1 Two or more harmful substances mixed together may trigger combustion or explosion;**
- 2 Mixing can generate more poisonous or corrosive mixtures or compounds;**
- 3 Mixing tends to cause steam coagulation and dust accumulation;**
- 4 Room and equipment emitting highly toxic substances;**
- 5 The buildings are arranged with separated rooms for storing combustibles & explosives or those with fire-proof and explosion-proof requirements;**
- 6 Epidemic prevention and sanitation requirements.**

6.1.7 During design of indoor air supply and exhaust, air distribution design shall be optimized according to contaminant characteristics and contaminant source changes; air containing a great deal of heat, steam or harmful substance shall be prevented from flowing into the personnel activity area with little heat, steam or harmful substance, and the normal operation of partial air exhaust system shall not be damaged.

6.1.8 Where mechanical ventilation is adopted, the ventilation systems in important rooms or locations shall be capable of preventing cross infection of the air-borne illness through

compliance with the requirements below:

1 As for the air inlet located in the upper part of a room, unless used for exhaust hydrogen and air mixture, the distance from the upper edge of air inlet to the ceiling plane or roof shall not be larger than 0.4m;

2 If the air inlet is used for exhausting hydrogen and air mixture, the distance from the upper edge of air inlet to the ceiling plane or roof shall not be larger than 0.1m;

3 As for the air outlet located in the lower part of a room, if used for exhausting harmful gases larger than air in density, the distance from its lower edge to floor shall not be larger than 0.3m;

4 As for dead corners where explosive gases are discharged due to building structure, diversion facilities shall be provided.

6.3.3 If an air heater of mechanical air supply system is adopted, the outdoor air calculation parameter shall adopt the outdoor calculation temperature for heating; if it is used for compensating the overall exhaust heat loss, the outdoor calculation temperature for winter ventilation shall be adopted.

6.3.4 The design of residence ventilation system shall meet the following requirements:

1 As for the residence where natural ventilation fails to meet the indoor sanitation requirements, mechanical ventilation system or combined natural-and-mechanical ventilation system shall be arranged. Fresh air from exterior shall first enter the main activity areas for personnel;

2 For kitchen and toilet without external window, mechanical air exhaust system shall be adopted or an opening for mechanical air exhaust system shall be reserved, and necessary inlet air area shall be reserved;

3 The overall ventilation frequency for kitchen and toilet should not be less than 3 cycles/h;

4 Vertical exhaust ducts shall be arranged for kitchen and toilet and shall have functions of fire prevention, backward flow prevention and uniform exhausting and be provided with measures against branch backflow and shaft leakage. A device preventing backward flow of exterior wind shall be arranged on the top.

6.3.5 The ventilation of public kitchen shall meet the following requirements:

1 Kitchen equipment producing a large amount of heat, fume and steam shall be provided with local mechanical exhaust facilities such as exhaust hood emit; for other areas,

2) In case of mechanical air exhaust, the height of emergency air outlet should be determined basing on the refrigerant category. If the air outlets are located in an underground refrigerating machine room and the density of gas leakage is greater than that of air, they shall be arranged separately for the upper and lower parts;

3) For fluorine refrigerating machine room, the air volume and emergency air volume shall be calculated separately. If the data of the heat release of the equipment in machine room are incomplete, the air volume may be taken as (4~6) cycles/h. The emergency air volume shall not be less than 12 cycles/h. The distance from the upper edge of emergency air outlet to the indoor terrace shall not be larger than 1.2 m;

4) Ammonia refrigeration station shall be arranged with mechanical air exhaust and emergency air exhaust systems. The air volume shall not be less than 3 cycles/h, the emergency should be calculated according to $183 \text{ m}^3/(\text{m}^2 \cdot \text{h})$ and the minimum exhaust air volume shall not be less than $34000 \text{ m}^3/\text{h}$. Emergency exhaust fans shall select the explosion proof type and the air outlets shall be located in a high place of side wall or on the roof.

5) An independent air supply/exhaust system should be arranged for direct-fired lithium-bromide refrigerating machine room. The air volume of gas direct-fired lithium-bromide refrigerating machine room shall not be less than 6 cycles/h and the emergency air volume shall not be less than 12 cycles/h. The air volume of oil direct-fired lithium-bromide refrigerating machine room shall not be less than 3 cycles/h and the emergency air volume shall not be less than 6 cycles/h. The air supply volume of the machine room shall be the sum of the exhaust air volume and the air volume required for burning;

3 An independent air supply/exhaust system should be arranged for diesel generator room. The air supply volume shall be the sum of the exhaust air volume and the air volume required for the burning of generator set;

4 An independent air supply/exhaust system should be arranged for substation. For underground substation, the air supply flow should run from the high/low voltage distribution area to the transformer area and then discharged to outside. The air exhaust temperature should not be higher than 40°C . If the ventilation is incapable of guaranteeing the operation of substation equipment, an air conditioning cooling system should be arranged;

5 If mechanical ventilation is adopted for pump house, heating machine room, reclaimed water treatment machine room, elevator machine room, etc., the ventilation rate may be selected according to those specified in Table 6.3.7.

6.5.4 When multiple fans operate in parallel or series, the ventilators with identical characteristic curve should be selected.

6.5.5 If the service duration of the ventilation system is long and the operating conditions (air volume and wind pressure) change greatly, the ventilator should adopt two-speed or variable speed fan.

6.5.6 The fan of the exhaust system shall be located as close to the outdoor as possible.

6.5.7 In one of the following cases, measures, e.g. thermal insulation or frost protection shall be taken for the ventilation equipment and duct:

1 The temperature of air conveyed is higher or lower than the ambient temperature and notable increase or decrease in the temperature of conveyed air is not allowed;

2 Dew formation (freeze) and heat loss of the air heat recovery device are required to be avoided;

3 The exhaust gases, before entering atmosphere, possibly form congelation due to cooling, which blocks up or corrodes the duct.

6.5.8 The ventilation machine room should not be located near or adjoining the rooms of quiet requirement. If it must be located in near or adjoining manner, reliable noise reduction and vibration isolation measures shall be taken.

6.5.9 The ventilation equipment and duct discharging and conveying combustible or explosive mixtures shall all take anti-static earthing measures (including flange bridging) and insulating materials subject to static accumulation shall not be adopted for fabrication.

6.5.10 The air supply/exhaust system in a room with flammable and explosive substances contained in air shall adopt explosion proof ventilation equipment; the supply fan, if located in an independent ventilation machine room and there is a check valve arranged on the air supply main duct, non-explosion proof ventilation equipment may be adopted.

6.6 Duct Design

6.6.1 The ducts for ventilation and air-conditioning systems should adopt round, oblate or rectangular (the ratio of the long to the short side should not be larger than 4) section. The section dimensions of duct should comply with the relevant requirements of the current national standard "Code of Acceptance for Construction Quality of Ventilation and Air Conditioning Works" (GB 50243).

6.6.2 The ventilation and air conditioning systems, e.g. duct material, accessories and flexible joint, shall meet the relevant requirements of the current national standard "Code of Design on Building Fire Protection and Prevention" (GB 50016). If the gas conveyed is

7 Air Conditioning

7.1 General Requirement

7.1.1 In one of the following cases, air conditioning shall be arranged:

1 Heating ventilation cannot meet the human comfort and equipment's requirements of interior environment or it is infeasible or uneconomic;

2 Heating ventilation cannot meet the requirements of process, e.g. interior temperature, humidity and cleanliness;

3 It has an obvious effect on the improving of work efficiency and economic effectiveness;

4 It is favorable to health and can effectively facilitate recovery.

7.1.2 The air-conditioned zone should be arranged collectively. The air-conditioned zones of similar functions, temperature and humidity radices, service requirement, etc. should be arranged in an adjoining manner.

7.1.3 Industrial air conditioning system, under the premise of meeting the environmental requirement of air-conditioned zone, shall minimize the air-conditioned zone, heat and humidity dissipation equipment.

7.1.4 If localized air conditioning can meet the environmental requirement of the air-conditioned zone, full-room air conditioning shall not be adopted. In case of a large and high space, if the lower part is required to be kept at a given temperature and humidity, stratified air conditioning should be adopted.

7.1.5 The air pressure in the air-conditioned zone shall meet the following requirements:

1 In case of comfort air conditioning, if there is an requirements on the differential pressure between the air-conditioned zone and the outdoor or air-conditioned zone, the pressure difference should be valued at 5Pa~10Pa and shall not exceed 30Pa at maximum;

2 Industrial air conditioning system shall be determined according to the environmental requirement of the air-conditioned zone.

7.1.6 The thermal engineering of building in comfort air-conditioned zone shall be designed according to the building properties and the climate region of building in the locality, and shall meet the relevant requirements of current national standards for energy efficiency design.

- 1 A single-duct system should be adopted;
- 2 If a large supply air temperature difference is allowed, a primary return air system shall be adopted;
- 3 If the supply air temperature difference is small and the requirement of relative humidity is not strict, a secondary return air system may be adopted;
- 4 Except the air-conditioned zone with strict requirement of temperature and humidity fluctuation ranges, a heating process shall not coexist with cooling process within the same air handling system.

7.3.6 In one of the following cases, return fans may be arranged for all-air conditioning system. If return fans are arranged, the air pressure of the new return air mixing chamber shall be negative.

- 1 The fresh air volume changes greatly with season and other air exhaust measures cannot meet the requirement of air volume change;
- 2 Return fans are economic and rational since the return air system resistance is large.

7.3.7 If the requirement of allowable temperature and humidity fluctuation ranges or noise criterion in air-conditioned zone is strict, all-air variable volume air conditioning system should not be adopted. If it is permitted technically and economically, an all-air variable volume air conditioning system may be adopted in the following cases:

- 1 If the system serves for a single air-conditioned zone and the operating time of partial load is long, a district variable air volume air conditioning system shall be adopted;
- 2 If the system serves for multiple air-conditioned zones, the loads of those areas vary greatly, the operating time of partial load is long and temperature is required to be under independent control, a variable air volume air conditioning system with terminal device shall be adopted.

7.3.8 The design of all-air variable volume air conditioning system shall meet the following requirements:

- 1 The air-conditioned zone shall be classified by the building module, load change, etc.
- 2 The system type shall be determined through technical and economical comparisons according to the air-conditioned zone served, e.g. classification hours of use and load change;
- 3 The variable air volume terminal devices should select pressure-unrelated type;

4 The maximum air supply volume of the air-conditioned zone and system shall be determined according to the cooling load in summer of the air-conditioned zone and system; the minimum air supply volume of air-conditioned zone shall be determined according to the load change, space air diffusion, etc.;

5 Measures shall be taken to guarantee a minimized fresh air volume;

6 Fans shall adopt variable speed regulation;

7 The air inlet shall meet the requirements of 7.4.2 of this code.

7.3.9 If the air-conditioned zones are in great number, the building storey height is small, and the temperature of those areas is required to be under independent control, fan coil plus fresh air conditioning system should be adopted; if the air quality, temperature and humidity fluctuation ranges of the air-conditioned zones are of strict requirements or there are lots of fume in air, fan coil plus fresh air conditioning system should not be adopted.

7.3.10 The design of fan coil plus fresh air conditioning system shall meet the following requirements:

1 Fresh air should be directly introduced to the personnel activity area;

2 If the air quality criterion is of high requirement, fresh air should bear all the moisture gain of the air-conditioned zone. The design of low temperature fresh air system shall meet the requirements of 7.3.13 of this code;

3 The fan-coil unit whose residual pressure at the outlet is lower should be selected.

7.3.11 In case of an air-conditioned zone in which vibration is large and oily steam is in great amount and places generating electromagnetic wave or high frequency wave, a multi-connected split air conditioning system should not be adopted. The design of multi-connected split air conditioning system shall meet the following requirements:

1 If the load characteristics of air-conditioned zones vary greatly, the multi-connected split air conditioning systems should be respectively arranged; if both cooling and heating are required, heat recovery type multi-connected split air conditioning systems should be arranged;

2 The maximum pipe length and maximum height difference between indoor and outdoor machines, indoor machines shall meet the technical requirements of the products;

3 The equivalent length of the cooling medium pipe of the system shall be such that the full-load performance coefficient under corresponding refrigerated condition is not less than 2.8; if the technical information of the product cannot meet the requirement of check computation, the equivalent length of the cooling medium pipe of the system should not

3 If such cooling method as evaporative cooling and natural cooling source fails to reach the requirements, manual cooling source shall be adopted for cooling.

7.5.2 The quality of water in direct contact with air to be cooled shall meet the hygienic requirements. If natural cooling source is adopted for air cooling, it shall meet the following requirements:

- 1 The water temperature and hardness shall meet the service requirements;
- 2 The backwater of used surface water shall be recycled;

3 The used groundwater shall be recharged to the same aquifer and shall introduce no contamination.

7.5.3 The selection of air cooling device shall meet the following requirements:

1 If evaporative cooling with circulating water or natural cooling source is adopted, direct-evaporation and indirect-evaporation cooling devices and air cooler should be adopted;

2 If manual cooling source is adopted, air cooler should be adopted. If circulating water is required to carry out adiabatic humidifying or water jetting is adopted to increase the saturation after air handling, an air cooler with water injector may be selected.

7.5.4 The selection of air cooler shall meet the following requirements:

- 1 Air and cooling medium shall keep in counter flows;
- 2 The inlet temperature of cooling medium shall be at least 3.5°C lower than the dry-bulb temperature of air outlet. The temperature rise of cooling medium should adopt 5°C~10°C and the flow speed should adopt 0.6m/s~1.5m/s;
- 3 The mass velocity of air on the windward side should adopt 2.5 kg/(m²·s)~3.5kg/(m²·s) and if it is larger than 3.0kg/(m²·s), a watertight shutter shall be arranged after the cooler;
- 4 The air cooler of cold air distribution system shall meet the requirements of 7.3.13 of this code.

7.5.5 The evaporating temperature of refrigerant direct expansion-type air cooler shall be at least 3.5°C lower than the dry-bulb temperature of air outlet. If the normal temperature air-conditioning system operates at full load, the evaporating temperature should not be less than 0°C; if at low load, frost formation on the air cooler surface shall be avoided.

7.5.6 The air-conditioning system shall not adopt direct expansion-type air cooler which adopts ammonia as the refrigerant.

10 Storage system should be used for cold and heat supply in the regions that execute time-of-use (TOU) power price and have great cut-valley price difference, where valley price can act the function "load shifting" and "saving working cost" obviously by the economic and technical comparison;

11 Air-source heat pump soil-source or ground-source heat pump system should be used for cold and heat supply for the medium or small scale building in the regions with hot-summer and cold-winter / aridity and water deficiency;

12 Surface or ground water ground-source heat pump system may be used for cold and heat supply where natural surface water and other resources may be used or shallow ground water available can be used and guarantee 100% recharging;

13 Combined energies may be used for cold and heat supply in the regions with varied energies available.

8.1.2 Except in one of the following conditions, direct electric heating apparatus shall not be used as heating sources for air-conditioning heating or air humidification:

1 Where the building uses cold supply mainly and has small heat load and cannot use heat pump or other mode as heating source; when the electric power supply is sufficient in winter, valley power may be used for heat storage in night-time and the electric boiler is not used in peak and normal period;

2 Where the building has no urban or regional centralized heating but uses gas, coal or oil fuel strictly limited by environmental protection or fire-fighting;

3 Where the building uses regenerative energy for generate power and the electric power output can satisfy the direct electric heating demand;

4 Where the building has no steam source for humidification in winter but high relative indoor humidity requirement in winter.

8.1.3 Public architectural complex in all the following conditions may uses district cooling system upon feasible economic and technical comparison:

1 Where the building that needs be arranged with concentrated air conditioning system has high plot ratio and the buildings in the whole area has larger integrated cooling load density;

2 Where user loads and their characteristic are clear;

3 Where the building requires a longer cooling time and consistent cooling demand all year around; and

4 Where there are conditions for planning and constructing district cooling station and network.

8.1.4 Air conditioners or systems arranged in a distributed manner should be used in one of the following conditions:

1 Where the building needs shorter cooling and heating working times needed all year around and concentrated cooling or heating systems if adopted is uneconomic;

2 Where the building has too scattered room layout requiring air conditioning;

3 Where a little room with different use time and requirement are in the building arranged with concentrated cooling/heating system;

4 Where the existing building need be arranged with air conditioning system additionally and machine room and pipeline are difficult to lay; or

5 Where the building is residential.

3 High-voltage power supply mode may be adopted where the rated input of single motor is greater than 650kW and less than or equal to 900kW.

8.2.5 Where ammonia refrigerant is adopted, monolithic ammonia water-chiller with better safety and sealability shall be adopted.

8.3 Heat Pump

8.3.1 Performance of air-source heat pump unit shall meet the requirements of relevant current national standards as well as the following requirements:

1 The heat pump unit shall have advanced and reliable defrosting control, and the total defrosting time shall not exceed hourly of the operation cycle;

2 The COP in the design operating condition in winter, for cold/hot air unit, shall not be less than 1.80; for cold/hot water unit, not be less than 2.00;

3 Auxiliary heating source shall be arranged in the cold and damp (in winter) regions where the outdoor design temperature is lower than local balance point temperature or an air conditioning system has higher indoor temperature stability requirement;

4 Heat-recovery heat pump unit should be used for building with both cold and heat supply demand in parallel.

Note: the unit COP in design operating condition in winter refers to the ratio of the heating capacity (W) and the input power (W) when the design demand parameters are met at the winter outdoor design temperature condition for air-conditioning.

8.3.2 According to the outdoor design temperature, the effective heating capacity of air-source heat pump unit shall be corrected respectively with temperature correction factor and defrosting correction factor.

8.3.3 Arrangement of air-source heat pump or air-cooled refrigerating unit outdoor unit shall meet the following requirements:

1 Air intake and exhaust shall be kept smooth, and no apparent air flow short-circuit is kept between exhaust air and induced air;

2 It shall be kept from dirty air flow;

3 Noise and removal of heat shall meet the requirements of surrounding environment;

4 Exchanger of an outdoor unit shall be convenient for cleaning.

8.3.4 Design of buried-pipe ground-source heat pump system shall meet the following requirements:

1 The feasibility and economical efficiency of the buried pipe ground heat exchanger system shall be determined by the investigations on construction site condition and shallow geothermal energy resources;

2 Where the used building area is above 5000m², rock / soil heat response test shall be carried out, and the buried pipe ground exchanger shall be designed on the base of the rock / soil thermal response test results;

3 Bury mode, specification and length of buried pipe shall be determined according to such factors as cold (heat) load, area covered, rock / soil layer structure, rock / soil mass thermophysical property and performance of the unit;

4 All-year heating and air-conditioning dynamical load calculation shall be carried out in the design of buried-pipe ground heat exchanger system, and the minimum calculation

period should be one year. The heat release and the total heat absorption capacity of the ground-source heat pump system should be balanced basically within the calculation period;

5 Length of buried-pipe exchanger shall be calculated respectively according to cold and heat supply operating conditions. The maximum heat release and the maximum heat absorption capacity of the buried-pipe ground system have less difference, the length of the buried-pipe exchanger should be the larger one in the calculated lengths; otherwise, the length of the buried-pipe exchanger should be the smaller one in the calculated lengths, auxiliary cold (heat) source shall be added or the system is combined with cooling/heating sources and satisfy the design requirement;

6 Antifreezing measures shall be taken for buried pipes in the regions with possible freeze-up in winter.

8.3.5 Design of groundwater ground-source heat pump system shall meet the following requirements:

1 The continuous water yield of groundwater shall satisfy the maximum heat absorption capacity or the heat release capacity of the ground-source heat pump system; the temperature of groundwater satisfy the operating requirements of the unit, and corresponding water treatment measures shall be taken according to different water quality;

2 Variable flow-rate design should be used for groundwater system, and groundwater usage should be regulated according to dynamic variation of air-conditioning load;

3 When heat pump units are arranged concentrically, water source entering the unit exchanger directly or indirect heat exchange with additional plate exchanger shall be determined according to quality condition of the water source;

4 Reliable recharging measures shall be taken for groundwater to ensure all recharging in same aquifer and prevent ground water resources from pollution.

8.3.6 Design of river/lake water ground-source heat pump system shall meet the following requirements:

1 Surface water resources and water body environment shall be evaluated and the approval from local water authorities shall be obtained. When river/lake is used as navigation channel, the location of intake and discharge outlet shall be approved by the navigation authorities;

2 Waterhead in high-water and low-water seasons of the river shall be considered;

3 The heat exchange mode between heat pump unit and surface water shall be determined according to factors such as unit arrangement, water temperature, water quality, water depth and heat exchange quantity;

4 Intake of open surface water heat-exchange system shall be arranged on position with suitable water level and better water quality, and in the upstream of the discharge outlet and far from the discharge outlet; water treatment measures like filtering, cleaning and algae removal shall be taken before the surface water enters into the heat pump unit, and environmental pollution shall be prevented;

5 When surface-water coil heat exchanger is adopted, form, specification and length of coil shall be determined according to such factors as cold (heat) load, water body area, water body depth, temperature variation rule and performance of the unit;

6 Antifreezing measures shall be taken for closed surface-water heat exchanger system in the regions with possible freeze-up in winter.

system where waste heat or solar energy is used as heating source and the water temperature of the heating source is 60°C~85°C.

8.4.7 As for direct-fired lithium-bromide absorption-type water chiller (warmer), designs in aspects like oil storage, oil supply and fuel gas system shall meet the requirements of the relevant current standards of the nation.

8.5 Hot & Chilled Water System and Condensed Water System

8.5.1 Air conditioning chilled water and hot water parameters shall consider the influence of the factors such as the cooling/heating source devices, terminal equipment, and power of circulating water pump and shall be determined according to the following principles:

1 Where the water chillers are adopted for cooling directly, the supply water temperature of air conditioning chilled water should not be less than 5°C, the temperature difference of supply and return water of chilled water of air conditioning shall not be less than 5°C; If conditions permit, temperature difference of supply and return water should be increased properly.

2 Where the cold storage air conditioning system is adopted, the supply water temperature of air conditioning chilled water and temperature difference of supply and return water shall be determined respectively according to the cold storage medium, cold storage way and cooling way and shall be in accordance with 8.7.6 and 8.7.7 of this code.

3 Where the independent control air conditioning system of temperature and humidity is adopted, the supply water temperature of air conditioner bearing the sensible heat water chiller should not be less than 16°C; where the forced convection terminal equipment is adopted, the temperature difference of supply and return water of chilled water should not be less than 5°C.

4 Where evaporative cooling or natural cooling source is adopted to prepare the air conditioning chilled water, the supply water temperature of air conditioning chilled water shall be determined reasonably according to the local meteorological conditions and work capacity of terminal equipment; where the forced convection terminal equipment is adopted, the temperature difference of supply and return water should not be less than 4°C.

5 Where the radiation cooling terminal equipment is adopted, the supply water temperature shall be determined in the principle of no dew formation on the surface of terminal equipment; the temperature difference of supply and return water shall not be less than 2°C.

6 Where the primary heating source supplied by the municipal heating power or boiler is adopted to pass through the secondary air conditioning hot water heated by heat exchanger, its supply water temperature should be determined according to the system requirements and terminal capacity. As for the non-preheat coil, the supply water temperature should adopt 50°C~60°C, where the preheat coil is used at severe cold zone, the supply water temperature should not be less than 70°C. The temperature difference of supply and return water of air conditioning hot water, in the severe cold and cold zones, should not be less than 15°C, and in the hot summer and cold winter zone should not be less than 10°C.

7 Where the direct-fired water chiller (warm water unit), air source heat pump, ground source heat pump, etc. are adopted as the heating source, the supply and return water temperature and the temperature difference of air conditioning hot water shall be determined according to the equipment requirements and specific conditions, and the equipment shall be

1 The lift of make up water pump shall guarantee that the make up water pressure shall be 30kPa~50Kpa higher than the operating pressure of make up water point;

2 2 sets of make up water pumps should be arranged, the total hours flow of make up water pump should be 5%~10% of system water volume;

3 Where only one set of make up water pump is arranged, standby pump should be arranged for the air conditioning hot water and chilled/hot water party make up water pump in severe cold and cold regions.

8.5.17 Where the make up pump is arranged, make up water regulating tank shall be arranged for the air conditioning water system; the regulating volume of water tank shall be determined according to the factors such as water supply capability of water source, discontinuous operating time of softening equipment, operating conditions of make up water pump, etc.

8.5.18 Constant pressure and expansion design of closed air conditioning water system shall meet the following requirements:

1 The constant pressure point should be arranged at the suction inlet of circulating water pump, the minimal pressure of constant pressure point should be able to make the gauge pressure at any point of pipe system higher than 5kPa;

2 High-order expansion tank constant pressures should be adopted preferentially;

3 Where independent constant pressure facilities are arranged for the water system, valves shall not be arranged on the expansion pipe; where all the systems shall use together the constant pressure facilities and the facilities need overhauling respectively, charged signal service valve shall be arranged on the expansion pipe and each air conditioning water system shall be arranged with safety valve;

4 Expansion water quantity of system shall be recycled.

8.5.19 Water quality of air conditioning cold and hot water shall be in accordance with the requirements of national current relevant standards. Where the feed water hardness is high, water softening treatment should be carried out for the make up water of air conditioning hot water system.

8.5.20 The design of air conditioning hot water pipe shall meet the following requirements:

1 Where the air conditioning hot water pipe fails to meet the requirements by utilizing the natural compensation, compensator shall be arranged;

2 Gradient shall be in accordance with the requirements of 5.9.6 of this code for the hot water heating pipe.

8.5.21 Exhausting and discharging devices shall be arranged for the air conditioning water system.

8.5.22 Filters or strainers shall be arranged as required on the inlet pipes of equipment such as water chillers or heat exchangers, circulating water pumps, make up water pumps, etc.

8.5.23 Arrangement of condensed water pipe shall meet the following requirements:

1 Where the condensed water collector of air conditioning equipment is located in the positive pressure segment of unit, water seal should be arranged at the water outlet of condensate coil, where located in the negative pressure segment of unit, water seal shall be arranged and the water seal height shall be greater than the positive pressure or negative

refrigeration plant, closed cycle system shall be adopted.

8.6.5 The centrally arranged water chiller shall be identical with the cooling water pump, set number and flow; the dispersedly arranged water cooling integral-type air-conditioner or small-size unitary water chiller may share the cooling water system; the lift of cooling water pump shall meet the requirements inlet pressure of cooling tower.

8.6.6 Selection and arrangement of cooling tower shall meet the following requirements:

1 In summer, under the condition of air conditioning outdoor design wet-bulb temperature, the outlet water temperature, inlet and outlet water temperature dropping and circulating water quantity of cooling tower shall meet the requirements of water chiller;

2 The set number of cooling towers with requirements towards the water pressure of inlet shall be identical with that of cooling water pumps;

3 For the region with the heating outdoor design temperature below 0℃, anti-freezing measures shall be taken for the cooling towers operating in winter, the cooling towers not operating in winter and their outdoor pipes shall be emptied;

4 The cooling tower shall be arranged at the well ventilated place, kept away from the high temperature or toxic gas, and kept away from the influence of floating water towards the ambient environment;

5 Noise control of cooling tower shall meet the relevant requirements of Chapter 10 of this code.

6 Cooling tower fabricated with flame retardant materials shall be adopted and meet the fire prevention requirements;

7 As for the duplex refrigerating machine, if the parameters requirement of cooling-water temperatures of unit under two kinds of operating conditions are different, re-computation shall be carried out respectively for the thermal property of cooling tower.

8.6.7 The effective water volume of water collection tray or water collection tank arranged at the lower part of intermittent operating open type cooling tower shall be greater than the required water consumption of components like moistening cooling tower filling and the water volume inflowing the pipe by gravity when the pump is off.

8.6.8 Where the water collection tank of cooling water is arranged and must be arranged indoors, the water collection tank should be arranged at the next layer of cooling tower and the elevation difference design water levels between the water distributor and water collection tank of cooling tower shall not be greater than 8m.

8.6.9 The position and connection between the water chiller, cooling water pump, cooling tower or water collection tank shall meet the following requirements:

1 Cooling water pump shall self-fill the water, the elevation difference of minimum water level between the cooling tower water collection tray or tank and the suction inlet of cooling water pump shall be greater than the resistances of pipe, pipe fittings and equipment.

2 Where the shared collection pipes are used to connect the multiple water chillers and cold water pumps, corresponding motor-driven two-way valve of interlocking switch of water chiller and water pump shall be arranged on each water in or out pipe of water chiller;

3 Where collection pipes are used between the multiple sets of cooling water pumps or water chillers and the cooling towers, corresponding water pump interlocking open/close electric valve should be arranged on the inflow pipe of each cooling tower; for the cooling tower with requirements towards the water pressure of inlet, corresponding water pump

2 The full cool storage or partial cool storage shall be determined and adopted according to the factors such as cooling load curve, power grid peak valley time division and electricity price, space of building able to provide cool storage equipment arrangement, etc. in cool storage-cool release cycle and through comprehensive comparison.

8.7.3 The capacity of ice storage device and refrigerating unit shall guarantee completing the whole scheduled cooling capacity storage in the design cool storage time division and should be determined in accordance with the requirements of Appendix J. The cool storage and cool release characteristic of storage device shall meet the requirements cool storage air-conditioning system.

8.7.4 For the ice cool storage system, where cooling is still needed in the design of cool storage time division and one of the following conditions is met, the basic load unit should be arranged:

1 Where the cooling load of basic load is greater than 20% of cooling capacity under operating condition of refrigerating host single air conditioning;

2 Where the cooling load of basic load is greater than 350kW;

3 Where the total cooling capacity of air conditioning under basic load is greater than 10% of design cool storage quantity (kWh).

8.7.5 The selection and pipe design of ice cool storage system secondary refrigerant shall meet the relevant requirements of the current professional standard "Technical Regulation for Cool Storage Air Conditioning Engineering" (JGJ 158).

8.7.6 Where the ice cool storage system is adopted, the temperature difference of supply and return water of air conditioning chilled water shall be increased properly and shall meet the following requirements:

1 Where the air conditioning chilled water directly enters all air conditioning terminals in the building, if the melting ice in the pipe of ice tray mode is adopted, the temperature difference of supply and return water of air conditioning system chilled water shall not be less than 6°C, and the supply water temperature should not be greater than 6°C; if outside the pipe, the temperature difference of that shall not be less than 8°C and the supply water temperature should not be greater than 5°C;

2 Where the requirement of secondary chilled water exists due to zoned of the air conditioning system of building, if the melting ice in the pipe of ice tray mode is adopted, the temperature difference of supply and return water of air conditioning system primary chilled water shall not be less than 5°C, and the supply water temperature should not be greater than 6°C; if outside the pipe, the temperature difference of that shall not be less than 6°C and the supply water temperature should not be greater than 5°C;

3 Where the air-conditioning system adopts low temperature air supply mode, its chilled water supply and return water temperature shall be determined through economical and technical comparison. The supply water temperature should not be greater than 5°C;

4 Where the district cooling system is adopted, the temperature difference requirements shall be in accordance with the requirements of 8.8.2.

8.7.7 The design for cool (heat) storage system of water shall meet the following requirements:

1 The water temperature of cool storage should not be less than 4°C and the water impoundment depth of cool storage water-basin should not be less than 2m;

1 The clear distance between the unit and wall shall not be less than 1m, and the clear distance between the unit and distribution cabinet shall not be less than 1.5m;

2 The clear distance between the unit and unit or other equipment shall not be less than 1.2m;

3 The maintenance distance not less than the length of evaporator, condenser or cryogenerator should be reserved;

4 The clear distance between unit and its above pipe, flue or cable bridge frame should not be less than 1m;

5 The main passage width of machine room shall not be less than 1.5m.

8.10.3 The design of ammonia chiller plant room shall meet the following requirements:

1 Ammonia chiller plant room shall be arranged separately and kept away from architectural complex;

2 Open fire heating must be strictly forbidden in the machine room;

3 The machine room shall be good ventilated, simultaneously emergency air exhaust device shall be arranged, the ventilation rate per hour shall not be less than 12 times. Explosion proof type of exhaust fan shall be selected;

4 The outdoor pressure relief opening of refrigerant shall be 5m higher than the ridge of the tallest building within the range of 50m, and the devices shall be arranged to avoid the lightning stroke, prevent the rain water or sundries from entering the pressure relief pipe;

5 Emergency ammonia releasing device shall be arranged, in contingency situations, the device can dissolve the ammonia liquor into the water and then drainage the water into the tank or water-basin approved by the departments concerned.

8.10.4 The design of the direct combustion absorbing unit of machine room shall meet the following requirements:

1 The relevant requirements of relevant national current fire protection and code for design of gas shall be met;

2 The machine room should be arranged separately; where the machine room cannot be arranged separately, the machine room shall be arranged near the outer wall of building, and the adjacent position shall be separated by the blast wall with fire endurance greater than 2h and the cast-in-situ floor slab with the fire endurance greater than 1.5h; where door must be arranged at the adjacent position, Grade A fire door shall be arranged;

3 The machine room shall not be arranged at the adjacent position of personnel crowded places and main emergency exit;

4 Where the single-layer area of gas direct combustion type refrigerating unit machine room is greater than 200m², the direct out forward emergency exit shall be arranged in the machine room;

5 Pressure relief opening shall be arranged, and the area of pressure relief opening shall not be less than 10% of floor area of machine room (where the ventilating pipe or air shaft is directly connected to the outdoor, the pressure relief area of the machine room may be included); the pressure relief opening shall be kept clear from the personnel crowded places and main emergency exits;

6 Suspended ceiling shall not be arranged;

7 The flue arrangement shall not influence the combustion efficiency and refrigeration efficiency of unit.

- 2 Power consumption shall be measured;
- 3 Heat output of central heating system shall be measured;
- 4 Water make-up volume shall be measured;

5 Cooling quantity of cooling source of central air conditioning system shall be measured;

- 6 Power consumption of circulating water pump should be measured separately.

9.1.6 Central monitoring management system shall meet the following requirements:

- 1 The system shall be able to indicate all system operation parameters and equipment states in accordance with the time interval and measurement accuracy the same as the on-site measuring instruments. Its: storage medium and database shall be able to guarantee the continuous record of operation parameters above one year;

- 2 The system shall be able to calculate and periodically carry out statistics for the energy consumption of system and the continuous and accumulated operating time of each set of equipment;

- 3 The system shall be able to change the set value of all control unit, and start/stop and adjust directly the equipment arranged under "long-distance" state;

- 4 The system or equipment shall start/stop automatically according to the scheduled time table or in accordance with the energy-saving control procedure;

- 5 Security mechanism such as control of operator's authority, etc. shall be established;

- 6 The system shall be provided with the function of off-limit alarm of parameter, emergency alarm and alarm recording and should be provided with the system or equipment fault diagnosis function;

- 7 Integration joints which may share data with other weak-current system should be arranged.

9.1.7 Monitor and control of smoke control system shall comply with the requirements of relevant national current fire prevention code; the ventilating air conditioning system sharing with smoke control system shall be powered in accordance with the requirements of fire-fighting arrangement, shall be shifted into fire control state in case of fire hazard; the fire proof damper on the duct of ventilating air conditioning should be provided with the position feedback function.

9.1.8 The monitor and control of cold/heating source machine room, ventilating and air-conditioning system with special requirements shall be in accordance with the requirements of relevant specifications.

9.2 Transducer and Actuator

9.2.1 The selection of transducer shall meet the following requirements:

- 1 Where in the purpose of safety protection and equipment state monitoring, the transducers output with the mode of switching value such as temperature switch, pressure switch, air flow switch, water flow switch, differential pressure switch, water level switch, etc. should be selected, the continuous quantity output transducer should not be adopted;

- 2 The measuring range and precision of transducer shall be matched with secondary instrument, and shall be greater than the control and measurement accuracy in the process requirements;

- 3 Flame-proof explosion-proof type transducer shall be adopted for the flammable and explosive environment.

9.2.2 The arrangement of temperature and humidity transducer shall meet the following requirements:

1 The measuring range of temperature and humidity transducer shall be 1.2~1.5 times of temperature range of measuring point, the measuring range and precision of transducer shall be matched with secondary instrument, and shall be greater than the control and measurement accuracy in the process requirements;

2 The two temperature transducers of temperature differences of supply and return water pipes shall be selected in pairs, and the coefficient of temperature deviation shall be positive or negative simultaneously;

3 The wall-mounted air temperature and humidity transducers shall be installed at the position of well-ventilated and capable of reflecting the air state of measured room; the temperature and humidity transducers in the duct shall guarantee the inserted depth, thermal bridge shall not be formed at the detecting head and duct outside; plug-in water pipe temperature transducer shall guarantee that the inserted depth of measuring head is within the mainstream area, and the nearby of installation position shall be free from heating source and water drip;

4 The apparatus dew point transducer shall be installed at the representative position behind watertight shutter and shall be kept away from the influence of radiant heat, vibration, water drip and secondary return air.

9.2.3 The arrangement of pressure (pressure difference) transducer shall meet the following requirements:

1 The working pressure of pressure (pressure difference) transducer shall be greater than 1.5 times the possible maximum pressure (pressure difference) at this point, and the measuring range should be 1.2~1.3 times the normal variation range of pressure (pressure difference) this point;

2 The pressure (pressure difference) transducer installed at the same water system of same building layer should be at a status of the same elevation;

3 The arrangement of pressure testing point and pressure measuring point shall be determined according to the system requirements and medium type, shall be arranged at the place with stable flowing in the pipe and shall be in accordance with the required installation conditions of products.

9.2.4 The arrangement of flow transducer shall meet the following requirements:

1 The measuring range of flow transducer should be 1.2~1.3 times of the maximum working flow;

2 The front and rear of installation position of flow transducer shall be provided with the required straight pipe section length or other installation conditions guaranteeing the products;

3 The flow transducer having transient value output shall be selected;

4 The products with low flow resistance should be selected.

9.2.5 The selection of automatic control valve shall meet the following requirements:

1 For the determination of valve measures and weights, the influence of regulation performance and conveying energy consumption shall be comprehensively considered, 0.3~0.7 should be taken. The valve measures and weights shall be calculated according to the following Formula:

equipment shall be arranged or other noise countermeasure shall be taken. The noise elimination quantity required by the system shall be determined through calculation.

10.2.4 The selection of noise elimination equipment shall be determined according to the required noise elimination quantity, noise source frequency characteristics, acoustic performance of noise elimination equipment, aerodynamic properties, etc. of system and through technical and economical comparison.

10.2.5 The arrangement of noise elimination equipment shall consider the influence of air flow in air duct on the noise elimination capacity. Sound insulation measures shall be taken for the air duct between the noise elimination equipment and partition wall of machine room.

10.2.6 Where the pipe passes through the enclosing structure of machine room, the gap between the pipe and the enclosing structure shall be filled compactly with the elastic materials provided with the fire prevention and sound insulation capacity.

10.3 Vibration Isolation

10.3.1 Where the vibration of equipment such as ventilating, air conditioning, refrigerating unit, water pump, etc. fails to reach the standard relying on the natural attenuation, vibration isolator shall be arranged or other vibration isolating measures shall be taken.

10.3.2 For the equipment without vibration isolating device, where its rotating speed is less than or equal to 1500r/min, spring isolator should be selected; where the rotating speed is greater than 1500r/min, elastic materials like vibration isolation rubber cushion block or rubber isolator may be selected according to the environment requirement and size of equipment vibration.

10.3.3 The selection of spring isolator shall meet the following requirements:

- 1 The ratio of operating frequency of equipment and the natural frequency of spring isolator at vertical direction shall be greater than or equal to 2.5, and should be 4~5;
- 2 The load borne by spring isolator shall not be greater than the allowable operating load;
- 3 Where the resonance amplitude is large, the spring isolator should be used jointly with the materials having large damping;
- 4 The elastic vibration isolation cushion with certain of thickness should be arranged between the spring isolator and foundation.

10.3.4 The selection of rubber isolator shall meet the following requirements:

- 1 The influence of ambient temperature on the compression deformation of vibration isolator shall be included;
- 2 Where the compression deformation is calculated, 1/3~1/2 of ultimate compression amount provided by the manufacturer should be adopted;
- 3 The ratio of operating frequency of equipment and the natural frequency of rubber isolator at vertical direction shall be greater than or equal to 2.5, and should be 4~5;
- 4 The load borne by rubber isolator shall not be greater than the allowable operating load;
- 5 The elastic vibration isolation cushion with certain of thickness should be arranged between the rubber isolator and foundation.

Note: the rubber isolator shall be kept away from direct solar radiation or oils exposure.

10.3.5 Where one of the following requirements is met, the quality and dimension of

11 Heating Insulation and Corrosion Prevention

11.1 Heating Insulation

11.1.1 For the equipment, pipe (including pipe fittings, valves, etc.) equipped with one of the following conditions, thermal insulation shall be carried out:

- 1 The outside surface temperature equipment and pipe is higher than 50℃ (excluding the indoor heating pipe);
- 2 Where the heat medium must guarantee certain of state or parameter;
- 3 Where the equipment and pipes are not thermal-insulating, the thermal losses are large and noneconomic;
- 4 Where the equipment and pipes are installed or laid in the freezing hazardous area;
- 5 Where they are not thermal-insulating, the emanative heat will cause adverse influence or unsafe factors towards the room temperature and humidity parameters.

11.1.2 For the equipment, pipe (including valves, pipe fittings, etc.) equipped with one of the following conditions, cold insulation shall be carried out:

- 1 Where the cold medium is less than normal temperature and it is necessary to decrease the cooling loss of equipment and pipe;
- 2 Where the cold medium is less than normal temperature and it is necessary to avoid the surface condensation of equipment and pipe;
- 3 Where it is necessary to decrease the temperature rise or vaporization of cold medium in production and transport process;
- 4 Where the equipment and pipes are not thermal-insulating, the emanative cooling capacity will cause adverse influence or unsafe factors towards the room temperature and humidity parameters.

11.1.3 The selection of thermal insulation materials for equipment and pipes shall meet the following requirements:

- 1 The main performance of thermal insulation materials and their products shall be in accordance with those specified in the current national standard "Guide for Design of Thermal Insulation of Equipment and Pipes" (GB 8175);
- 2 The burning behavior of thermal insulation materials for equipment and pipe shall meet the requirements of current relevant fire prevention code;
- 3 The allowable use temperature of thermal insulation materials shall be higher than the maximum temperature of medium in normal operation;
- 4 The minimum safe service temperature of cold insulation material shall be less than the minimum temperature of medium in normal operation;
- 5 Materials and products with small thermo-conductivity, small density, low construction cost, being easy of construction shall be selected for the thermal insulation materials;
- 6 The materials with small thermo-conductivity, low hygroscopicity, small water absorption, small density, good low temperature resistance, being easy of construction, low construction cost, high integrated economic benefit shall be selected for the cold insulation material; closed-cell materials and materials with simple and convenient cold insulation towards the special-shaped position shall be preferentially adopted;

7 Where it is proper through integrated economic comparison, composite thermal insulation materials may be selected.

11.1.4 The thickness of the thermal insulation layer of equipment and pipes shall be determined in accordance with the economic thickness method in the current national standard "Guide for Design of Thermal Insulation of Equipment and Pipes" (GB/T 8175), and may also be selected according to Appendix K of this code. If necessary it may also be calculated and determined according to the allowable surface heat loss method or allowable medium temperature drop method.

11.1.5 The thickness of cold insulation layer of equipment and pipes shall be calculated and determined in accordance with the following principles:

1 Where cooling or cooling and heating are carried out at the same time, the thickness shall be calculated in accordance with the economic thickness and thickness of cold insulation layer avoiding surface dew formation method in the current national standard "Guide for Design of Thermal Insulation of Equipment and Pipes" (GB/T 8175) and the thick value shall be taken or shall be selected according to Appendix K of this code;

2 The condensate pipe shall be determined in accordance with the cold insulation thickness avoiding surface dew formation in "Guide for Design of Thermal Insulation of Equipment and Pipes" (GB/T 8175) or be selected according to Appendix K of this code.

11.1.6 Where the compound type air duct is selected, the thermal resistance of thermal insulation materials of air duct shall be in accordance with the relevant requirements in Appendix K.

11.1.7 The design of equipment and pipes shall meet the following requirements:

1 Between the pipes and supports, "thermal bridge" or "cold bridge" prevention measures shall be taken for the pipe through-wall and through-floor slab places;

2 There shall be no condensed water on the outside surface of cold insulation layer;

3 Where the non-closed cell materials are adopted for thermal insulation, protective layer shall be arranged on the outside surface; where the non-closed cell materials are adopted for cold insulation, vapor barrier layer and protective layer shall be arranged on the outside surface.

11.2 Corrosion Prevention

11.2.1 The materials of equipment, pipes and their matched components and auxiliaries shall be determined according to the conditions such as exposed medium property, concentration, environment for use, etc. and the factors such as corrosion resistance behaviors, significance and economical efficiency of parts used, etc.

11.2.2 Except for the non-ferrous metal, stainless steel pipe, stainless steel plate, galvanized steel pipe, galvanized steel plate and aluminum panel, coating should be adopted for the corrosion prevention of outside surface of metal equipment and pipes. The coat category shall be able to withstand the corrosion of ambient atmosphere.

11.2.3 The primer coat of coat shall be used in conjunction with its finish coat. Primer coat shall be coated on the pipe with insulating course outside.

11.2.4 The treatment of outside surface of pipe before painting shall be in accordance with the corresponding requirements of coat products. In case of special requirements, it shall be specified in the design document.

11.2.5 The thermal insulation materials use for exposing to the surface of austenitic

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