

HEATING, VENTILATION AND AIR CONDITIONING FOR PLANT BUILDINGS

DEP 31.76.10.10-Gen.

July 1998
(DEP Circular 43/08 has been incorporated)

DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the indoor climate of **plant buildings** and for the design and engineering of HVAC systems. It takes into account the requirements for both people and electronic equipment. This DEP is intended primarily to apply to new plant buildings; for "revamps" of existing installations it is intended that this DEP should be followed as far as is practical, in consultation with the Principal.

This DEP is a revision of the DEP of the same number dated April 1994.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

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This DEP is intended for use in oil refineries, chemical plants, gas plants and in exploration and production installations.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this document which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this document as closely as possible.

1.3 CROSS-REFERENCES

Where cross-references are made, the number of the section or sub-section referred to is shown in brackets.

All publications referred to in this document are listed in (6).

1.4 DEFINITIONS

For the purpose of this DEP, the following definitions shall hold:

1.4.1 General definitions

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.4.2 Specific definitions

Air handling unit (Re-circulation). HVAC equipment through which air is transported and transformed to the required conditions by filtration, heating, cooling (including

dehumidification by means of condensation) and humidification. Re-circulation air handling units may form part of an HVAC ducting system.

Air handling unit (Self-contained). An air handling unit, located in the space which it serves, which re-circulates the air in that space to the required conditions. A self-contained air handling unit does not normally involve a ducting system.

Chilled water unit (Compressor type). A unit similar to a direct expansion (DX) chiller but including a heat exchanger which utilises the vaporising refrigerant's latent heat to cool a chilled water circuit to the required temperature.

Direct expansion (DX) chiller. A unit consisting of a compressor and a condenser. The refrigerant vapour is compressed to a certain pressure, condensed to liquid refrigerant and then vaporised, thus utilising the vaporising refrigerant's latent heat in a cooling coil (separate from the chiller). The vaporised refrigerant is returned from the coil to the compressor.

(Dry-bulb) Temperature. The temperature of the air indicated by an accurate thermometer.

Electronic/Electrical equipment. Indoor electronic and electrical equipment, including microprocessor based control, safeguarding, telecommunication, computer, power supply and switchgear systems.

Fan coil unit. HVAC equipment through which air is re-circulated from the space in which it is located. The purpose of this re-circulation is to cool or heat this air to the conditions required for the space. This unit is normally connected to the chilled water system.

Fresh air ventilation unit. An air handling unit in which the fresh air is handled to the required conditions and used as ventilation air.

Human comfort. Is defined by the environmental parameters of temperature, radiation, humidity and air movement necessary for thermal comfort and depends on the individual's clothing and activity level. In a control building occupants will typically be sedentary or slightly active and wearing indoor clothing.

Humidity (Relative). The ratio of the weight fraction of water vapour present in the air to the weight fraction of water vapour present in saturated air at the same temperature and barometric pressure.

HVAC system. A heating, ventilation and air-conditioning system which maintains the temperature, relative humidity and air quality in a room or building within defined limits.

Interruptible, maintained electrical supply. A source of electrical power which is backed up by a second (emergency) source of power to provide a supply of electricity that may be interrupted for no more than 15 s.

Plant buildings. Buildings such as control buildings, field auxiliary rooms (FARs), analyser houses, electrical substations and others (e.g. dedicated flow metering buildings). Such buildings may contain different types of rooms. HVAC electrical equipment shall be suitable for the applicable hazardous area. Refer to DEP 32.31.50.13-Gen. for further safety requirements for analyser houses.

Uninterruptible maintained electrical supply. A source of electrical power, which is backed up by a second (emergency) source of power to provide a supply of electricity that may be interrupted for no more than 0.5 ms.

Vital electronic equipment. Electronic equipment which, if failing in operation or when actuated, can cause a process upset, an unsafe condition of the process and/or electrical installation, can jeopardise life, or can cause major damage to the installation.

Vital HVAC system. A HVAC system meant for vital rooms only.

Vital rooms. Rooms containing vital electronic equipment (e.g. instrument auxiliary room, electrical auxiliary room, telecommunications room) and continuously manned rooms (e.g. control room).

1.5 SUMMARY OF CHANGES SINCE LAST REVISION

This revision has been primarily editorial, including updating of references. The only significant non-editorial changes are:

Appendix 3.1, Appendix 3.2:

Clarification of actions to be taken for chillers and chiller pumps during abnormal situations.

2. GENERAL

Plant buildings may require climatic conditioning (i.e. heating, ventilation and/or air conditioning) in order to maintain the temperature, relative humidity and air quality within defined limits. In this way reliable operation of electronic equipment and human working conditions are enhanced.

HVAC systems are generally supplied by specialised Manufacturers as package units or as single components. Standard industrial HVAC equipment should be used.

It shall be ensured that sufficient space in plant buildings is reserved for HVAC equipment and its ducting.

3. DESIGN CONSIDERATIONS

3.1 HUMAN COMFORT

The temperature of rooms continuously occupied by people shall be between 20 and 26 °C, and the relative humidity between 20 and 80%. These requirements, based on ANSI/ASHRAE 55, should enable the majority of occupants to feel comfortable. ISO 7726 and ISO 7730 may also be consulted.

3.2 ELECTRONIC EQUIPMENT

3.2.1 General

Indoor electronic equipment should operate at a room temperature between 18 and 27 °C and a relative humidity between 35 and 75%. Under these conditions reliable and long-term operation of electronic equipment is expected if air contamination is restricted (3.2.2).

The above requirements are mostly congruent with IEC 60654-1, class A1 and IEC 60654-4, class 1.

NOTE: The relative humidity shall never exceed 95%, non-condensing.

3.2.2 Air contamination

Extremely low levels of air contaminants (e.g. a few parts per billion) may cause corrosion and affect the reliability of electronic equipment. Combination of contaminants may cause corrosion rates even higher than those expected from the individual components.

- NOTES:
1. The application of chemical filters is not recommended for reasons of selectivity, maintenance and cost.
 2. Expected air contaminants should be stated to determine any possibility of corrosion. Corrosion tests can be executed locally, based on the reactivity of copper and silver coupons as described in IEC 60654-4, to determine the affect of the expected air contaminants.
 3. Humidity control is the first (and only) line of defence against corrosion due to air contamination.

3.3 INDOOR CLIMATE

3.3.1 Temperature and relative humidity

A general overview of required indoor climatic conditions in plant buildings is given in Appendix 1. Recommended climatic conditions for the various plant rooms are given in Appendix 2.

3.3.2 Air quality

Indoor or outdoor air may contain contaminants. These occur in the form of gases, vapours or dust. Acceptable levels of these contaminants are determined by considering human safety and comfort and/or safety and reliability of electronic equipment (3.2.2). ANSI/ASHRAE 62 will give guidance for an acceptable indoor air quality.

**Amended per
Circular 43/08**

Detectors for flammable and very toxic gas (see DEP 01.00.01.30-Gen.), and their control systems are described in DEP 32.30.20.11-Gen. If the safety level (setting) of such detectors is exceeded, abnormal situations exist and certain actions shall be taken (see Appendices 3.1, 3.2, 3.3 and 3.4).

Ingress and distribution of dust particles in plant buildings shall be avoided by sealing of doors and incorporation of filters in air handling units.

**Amended per
Circular 43/08**

For dusty environments, e.g. desert areas etc., additional measures shall be considered to avoid the entrance of dust into plant buildings. The design implications and deviations resulting from these measures shall be recorded and submitted to the Principal.

3.4 OUTDOOR CLIMATE

For various geographical locations, climatic data such as temperature, humidity, wind, saline content of the atmosphere, chances of sand and dust storms, micro-climatic variations, etc., can be found in handbooks issued by bodies such as the UK Meteorological Office, London Road, Bracknell, Berkshire.

Such information is normally included in the project specification.

In general, the upper inlet air design temperature (dry bulb) for HVAC systems shall be the higher of the following:

- the highest air temperature that is exceeded for 400 hours per year;
- 4 °C lower than the highest air temperature that is exceeded for 40 hours per year.

The lower inlet air design temperature (dry bulb) for HVAC systems shall be determined from available meteorological data.

3.5 HEATING AND COOLING

3.5.1 Heating

Heating may be required to raise the temperature inside a building to the required level. In the heating capacity calculations the dissipated heat from personnel, lighting and electronic equipment shall not be included. Heat losses through walls, floors and roofs shall be taken into account.

The Contractor shall submit the "heating capacity" calculations to the Principal.

3.5.2 Cooling

Cooling may be required to lower the temperature inside a plant building to the required level.

Cooling capacity calculations should be based on heat gain from sources such as personnel, electronic equipment, lighting, fresh air intake, walls, roofs, windows etc.

The heat gain rates and calculations should be based on the data provided in ASHRAE Handbook "Fundamentals".

The heat gain from electronic equipment requires special attention and shall be based on data provided by the Vendors of the electronic equipment.

The Contractor shall submit the "cooling capacity" calculations to the Principal.

NOTE: Under all stated climatic conditions (3.3.1), condensation on air ducting and chilled water piping shall be prevented. Insulation shall be installed where necessary to achieve this.

3.6 FRESH AIR VENTILATION

3.6.1 General

Fresh air ventilation may be required in order to:

- provide a minimum fresh air intake quantity per unit of time;
- maintain an over-pressure in order to prevent the ingress of contaminants;
- compensate for specific exhausts such as those in a designated smoking area, a battery room or laboratory.

Requirements for fresh air ventilation systems are:

- A positive flow from outdoors to indoors and back shall be accomplished.