INTERNATIONAL STANDARD

ISO 15138

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Petroleum and natural gas industries — Offshore production installations — Heating, ventilation and air-conditioning

Industries du pétrole et du gaz naturel — Installations en mer — Chauffage, ventilation et climatisation

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 15138 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum and natural gas industries*, Subcommittee SC 6, *Processing equipment and systems*.

Annexes A through F of this International Standard are for information only.

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Petroleum and natural gas industries — Offshore production installations — Heating, ventilation and air-conditioning

1 Scope

This International Standard specifies requirements and provides guidance for design, testing, installation and commissioning of heating, ventilation, air-conditioning and pressurization systems and equipment on all offshore production installations for the petroleum and natural gas industries which are:

— new and existing;

— normally occupied by personnel and not normally occupied by personnel;

— fixed or floating but registered as an offshore production installation.

NOTE For installations that could be subject to "Class" or "IMO/MODU Codes & Resolutions", the user is referred to HVAC requirements under these rules and resolutions. Should these requirements be of a lesser degree than those being considered for a fixed installation, then this International Standard, i.e. requirements for fixed installation, should be utilized.

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2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 8861, *Shipbuilding — Engine-room ventilation in diesel-engined ships — Design requirements and basis of calculations.*

IEC 60079-10, *Electrical apparatus for explosive gas atmospheres — Part 10: Classification of hazardous areas.*

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

3.1
displacement ventilation
movement of air within a space in piston- or plug-type motion

NOTE No mixing of room air occurs in ideal displacement flow, which is desirable for removing pollutants generated within a space.

3.2
fixed offshore installation
all **facilities** located and installed on **fixed offshore structures**, which are provided to extract oil and gas hydrocarbons from subsea oil and gas reservoirs

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3.3
fixed offshore structure
structure permanently fixed to or located on the sea bed, including moored ships and hulls, which is held in position by anchors or tensioned cables and is provided to (structurally) support topsides facilities

NOTE Vessels and drilling rigs, etc. which are in transit or engaged in exploration and appraisal activities are specifically excluded from this definition.

3.4
fugitive emission
emission which is always present on a molecular scale from all potential leak sources in a plant under normal operating conditions

NOTE As a practical interpretation, a fugitive emission is one which cannot be detected by sight, hearing or touch but may be detected using bubble-test techniques or tests of a similar sensitivity.

3.5
open area
area in an open-air situation where vapours are readily dispersed by wind

NOTE Typical air velocities in such areas should rarely be less than 0,5 m/s and should frequently be above 2 m/s.

3.6
temporary refuge
TR
place where personnel can take refuge for a pre-determined period whilst investigations, emergency response and evacuation pre-planning are undertaken

[ISO 13702:1999, definition 2.1.52]

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4 Abbreviated terms

AC	Alternating Current
AC/h	Air Changes per hour
AHU	Air Handling Unit
AMCA	Air Movement and Control Association Inc.
API	American Petroleum Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BS	British Standard
CCR	Central Control Room
CFD	Computational Fluid Dynamics
CIBSE	Chartered Institution of Building Services
CMS	Control and Monitoring System
CVU	Constant-Volume Terminal Reheat Unit
DC	Direct Current

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DE	Driven End
DX	Direct Expansion
EN	European Standard
ESD	Emergency Shutdown
F&G	Fire and Gas
HAZOP	Hazard and Operability Study
HSE	Health, Safety and Environment
HVAC	Heating, Ventilation and Air Conditioning
HVCA	Heating and Ventilating Contractors' Association
IEC	International Electrotechnical Commission
IMO	International Maritime Organization
IP	Institute of Petroleum
IP	Integrity Protection
LFL	Lower Flammable Limit
LQ	Living Quarters
MODU	Mobile Offshore Drilling Unit
NDE	Non-driven End
NFPA	National Fire Protection Association
NS	Norsk Standard (Norwegian Standard)
QRA	Quantitative Risk Analysis
r.m.s.	Root mean square

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5 Design

5.1 Introduction

Clause 5 together with annex A provide requirements and guidance on all aspects of the design of heating, ventilation and air-conditioning (HVAC) systems for offshore installations for the petroleum and natural gas industries. The HVAC systems form part of the safety services of the installation. The safety goals are to:

— prevent, through pressurization, the ingress of potentially flammable gas-air mixtures into all designated nonhazardous areas;

— prevent the formation of potentially hazardous concentrations of flammable gaseous mixtures in hazardous areas by provision of sufficient ventilation for the dilution, dispersion and removal of such mixtures;

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— maintain ventilation to all equipment and areas/rooms which are required to be operational during an emergency when the main source of power is unavailable;

— provide a controlled environment in which personnel, plant and systems can operate effectively, including smoke control.

These high-level goals are supported by lower-level goals of a functional nature which are stated later in the appropriate sections of this document.

Subclause 5.2 concentrates on functional requirements in the development of a basis of design for either a new project or major modification to an existing installation. The requirements are related to:

a) platform orientation and layout;

b) hazard identification and hazardous area classification;

c) environmental conditions;

d) choice of natural or mechanical ventilation systems;

e) development of the controls philosophy;

f) material selection;

g) design margins and calculations;

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h) design development and validation using wind tunnel testing or Computational Fluid Dynamics (CFD).

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Ventilation may be natural (i.e. the wind) or mechanical or a combination of both. Throughout this International Standard, the use of the term "ventilation" should be taken to include either natural or mechanical ventilation, as appropriate.

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Natural ventilation is preferred over mechanical ventilation where practical, since it is available throughout gas emergencies, does not rely on active equipment and reduces effort required for HVAC maintenance.

For new designs, the development of a design basis may be progressed using the guidance and examples of good engineering practice that are identified in this document, though it should be recognized that it involves a process of iteration as the design matures and does not take place as the sequential series of steps used in this document to facilitate presentation. The processes outlined here are equally applicable to major redevelopments to existing installations, but some compromise may need to be made as a result of historical decisions regarding layout, equipment selection and the prevailing level of knowledge at the time. The challenge of providing cost-effective solutions in redevelopment may be significantly greater than for a new design.

The finalized basis of design may be recorded on data sheets such as those provided in annex E.

The completed design should be subject to hazard assessment review. The Hazard and Operability Study (HAZOP) technique may be used for this.

In 5.2, objectives are identified which establish the goals. Functional requirements are outlined which will enable the objectives to be achieved. The functional requirements are supported by technical guidance given in annex A, which discusses the suitability of different techniques for different applications and identifies examples of good engineering practice or cost-effective solutions that have been used in some parts of the world. The functional requirements may be satisfied by other methods not identified in this document, but it is the responsibility of the user to assess whether the method is technically acceptable and acceptable to the local regulator.

Subclause 5.3 addresses the fundamental choice in system design, i.e. between natural and mechanical methods of ventilation.

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Subclause 5.4 gives functional requirements associated with the design of HVAC systems for different areas of a typical offshore installation which require particular technical considerations due to their location and/or their function.

Figure 1 is intended to illustrate the processes undertaken at various stages of the installation life cycle and to identify reference documents and the appropriate clauses of this International Standard which provide the necessary guidance.

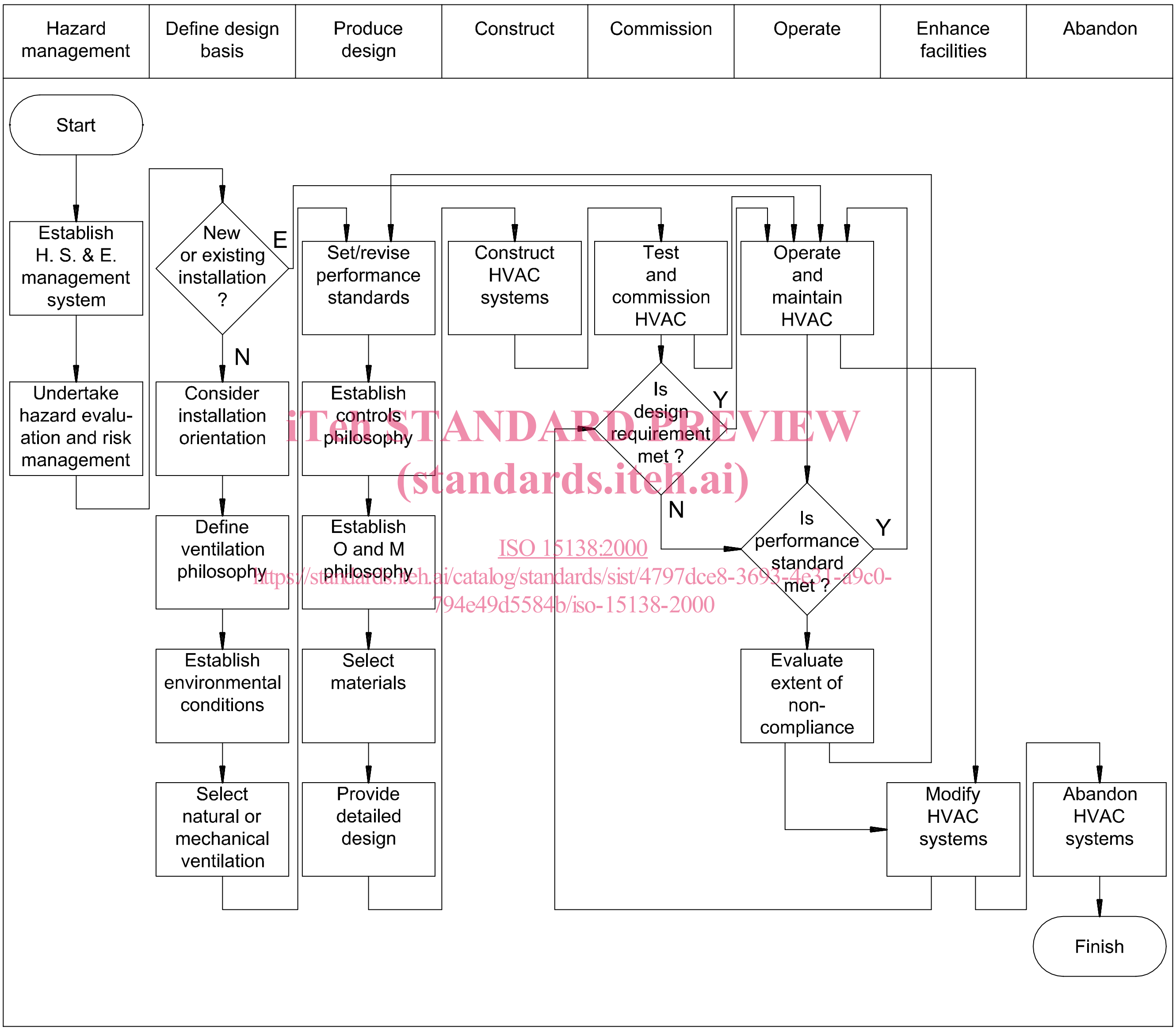

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Figure 1 — Application of this International Standard to a project life cycle

5.2 Development of design basis

5.2.1 Orientation and layout

5.2.1.1 Objective

To provide input into the early stages of design development so that areas and equipment that may have a requirement for HVAC, or be affected by its provision, are sited in an optimum location, so far as is reasonably practicable.

5.2.1.2 Functional requirements

Installation layout requires a great deal of coordination between the engineers involved during design and the operation, maintenance and safety specialists. Attention shall also be paid to the minimization of construction, offshore hook-up and commissioning. It is not the intention of this International Standard to detail a platform-layout philosophy, but to identify areas where considerations of the role of HVAC, and requirements for it, might have an impact in the decision-making surrounding installation orientation and layout.

Each installation should have a temporary refuge (TR). The TR should in almost all cases be the LQ, where they are provided. The survivability of the TR, which is directly related to the air change rate, may introduce consideration of active HVAC systems for pressurization of the Living Quarters (LQ) or enclosed escape and evacuation routes. Active systems require detailed risk assessment exercises to be undertaken as part of the design verification, and passive systems are generally preferred since they do not rely on equipment functioning under conditions of emergency.

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Hazardous areas, particularly those containing pressurized hydrocarbon systems, should be located as far as practicable from the TR so that any gas leaks will be naturally dispersed.

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The layout shall include correct positioning of ventilation inlets and outlets, engine inlets and exhausts, vents and flares to allow for safe operation, particularly of the TR. Hot exhausts shall not interfere with crane, helicopter, production or drilling operations or the LQ, and shall be directed so as not to be drawn into gas turbine air intakes.

Air intakes to hazardous and nonhazardous areas shall be located as far as is reasonably practicable from the perimeter of a hazardous envelope and not less than the minimum distance specified in the prevailing area classification code.

For guidance, reference is made to clause A.1.

5.2.2 Hazardous area classification and the role of HVAC

5.2.2.1 Objective

To adopt in the design and operation processes a consistent philosophy for the separation of hazardous and nonhazardous areas and the performance of ventilation in those areas.

5.2.2.2 Functional requirements

IEC 60079-10 shall be used for classification of a hazardous area. The choice of hazardous area code determines the choice of equipment to be used in particular areas of the installation and also provides input to the performance standards for HVAC systems in those areas.

For guidance, reference is made to clause A.2.

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5.2.3 Environmental conditions

5.2.3.1 Objective

To determine an environmental basis of design that enables HVAC systems to be designed in order to meet the objectives for HVAC.

5.2.3.2 Functional requirements

External and internal environmental bases suitable for the location of the installation shall be established for the design.

For guidance, reference is made to clause A.3.

5.2.4 Natural/mechanical ventilation

5.2.4.1 Objective

To select a means of providing ventilation to any hazardous or nonhazardous area of an installation.

5.2.4.2 Functional requirements

Provide ventilation to any area which may require it, giving consideration to:

a) meteorological conditions, particularly prevailing wind and its strength, external temperature, and precipitation;

b) risk-driven segregation of hazardous areas;

c) heating and cooling design loads;

d) life cycle costs of the purchase and maintenance of mechanical HVAC and associated Emergency Shutdown (ESD) systems;

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e) environmental considerations, such as personnel comfort, particulate control, and noise;

f) weather integrity of instrumentation and controls;

g) need for structural integrity;

h) control and recovery from hydrocarbon loss of containment;

i) process heat conservation.

NOTE Many of these factors are controlled by local legislation, which should be consulted for implications.

For guidance, reference is made to clause A.4.

5.2.5 Selection of controls philosophy

5.2.5.1 Objective

To provide a system for controlling HVAC systems from a frequently manned location that provides the operator with essential information on the status of the plant and is integrated with the installation fire and gas (F&G) and ESD systems, so that actions in an emergency minimize the risk to personnel.

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5.2.5.2 Functional requirements

The control and monitoring system shall:

a) provide the operator with the status of the HVAC plant;

b) provide the minimum necessary controls for the plant consistent with the operation and maintenance philosophies;

c) provide a link to the installed F&G and ESD systems, if required;

d) comply with the installation smoke and gas control philosophy.

For guidance, reference is made to clause A.5.

5.2.6 Operating and maintenance philosophy

5.2.6.1 Objective

To provide an HVAC design which provides as high a degree of operational availability, so far as is reasonably practicable, within the constraints imposed by installed cost, maintenance resources and the consequences of failure.

5.2.6.2 Functional requirements

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The design shall include the necessary standby arrangements, plant operating margins, access provisions and requirements for routine maintenance to enable a specified operational availability to be achieved at minimum cost over the lifetime of the installation.

For guidance, reference is made to clause A.6.

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5.2.7 Materials and corrosion

5.2.7.1 Objective

To specify materials and protective coatings for equipment and components that minimize, as far as is reasonably practicable, life cycle costs for the installation and potential harm to personnel who may be affected by their operation.

5.2.7.2 Functional requirements

The design shall recognize the saliferous atmosphere and relative humidity that will be present throughout the installation life.

Non-combustible, non-toxic materials shall be used throughout; such materials, when heated, shall not emit toxic fumes.

The design shall recognize that operation in conjunction with flammable atmospheres may be required for some components.

For guidance, reference is made to clause A.7.

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5.2.8 Design margins and calculations

5.2.8.1 Objective

To ensure that design integrity is demonstrated in the provision of cost-effective HVAC systems by calculations which take due account of the accuracy of HVAC system data and extremes of design environmental conditions.

5.2.8.2 Functional requirements

The design shall be documented in accordance with suitable industry standards, i.e. those of ASHRAE, CIBSE or similar recognized authorities.

Specification of equipment shall recognize the maturity of the design and the level of information provided by other disciplines in the design process.

For guidance, reference is made to clause A.8.

5.2.9 Wind tunnel and CFD modelling

5.2.9.1 Objective

To undertake a modelling programme that reproduces installation conditions within a reasonable accuracy, so that design options may be consistently evaluated and the chosen option optimized with a high degree of confidence that the design performance will be replicated by actual measurements.

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5.2.9.2 Functional requirements

If required, a modelling programme shall be undertaken to predict

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- natural ventilation rates and frequencies;
- wind pressure distribution around the installation to fix air inlet and outlet positions;
- requirements for secondary ventilation;
- gas build-up inside hazardous modules;
- helideck configurations and operating envelopes;
- hot plume and contaminant (noxious exhaust and hydrocarbon) smoke or gas flows around the installation.

For guidance, reference is made to clause A.9.

5.2.10 Performance standards

5.2.10.1 Objective

To define performance standards for HVAC systems which may be used as a basis for managing risk throughout the life of the installation.

5.2.10.2 Functional requirements

Performance standards are statements which can be expressed in qualitative or quantitative terms of the performance required of the system, item of equipment, person or procedure, and which are used as a basis for the management of risk throughout the installation life. They shall be set commensurate with the magnitude of the risk to be managed and shall clearly define the level of performance required for compliance.

For guidance, reference is made to clause A.10.

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5.3 System design — General

5.3.1 Natural ventilation

5.3.1.1 Objective

Natural ventilation shall, wherever possible, be provided to

— dilute local airborne concentrations of flammable gas due to fugitive emissions;

— reduce the risk of ignition following a leak by quickly removing accumulations of flammable gas.

5.3.1.2 Functional requirements

It is important to note that the distribution of air within an area/module is considered to be at least as important as the quantity of air supplied. As a consequence, compliance with the following basic requirements is necessary if ventilation of an area/module by natural means alone is to be considered sufficient:

— minimum ventilation rate shall be provided throughout the area;

— minimum ventilation rate shall be as stated for mechanical ventilation.

Consideration shall be given to the working environment by the adoption of a natural ventilation philosophy.

For guidance, reference is made to clause A.11.

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5.3.2 Mechanical ventilation

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5.3.2.1 Objective

To provide mechanical ventilation when ventilation by natural means is unable to satisfy requirements.

5.3.2.2 Functional requirements

The HVAC systems shall be designed to prevent contamination between areas and maintain acceptable working and living environments for personnel and non-destructive conditions for equipment.

For practical reasons, systems may be separated for the following areas:

a) nonhazardous areas;

b) hazardous areas;

c) living quarters;

d) areas to be in operation during emergency situations;

e) auxiliary systems for naturally ventilated areas;

f) drilling areas;

g) substructure;

h) areas with contaminated air (separate extract).

The minimum ventilation air volumes shall be documented.

For guidance, reference is made to clause A.12.

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5.3.3 Secondary ventilation systems

5.3.3.1 Objective

To provide a system to supplement natural or mechanical ventilation when the distribution of air is not adequate.

5.3.3.2 Functional requirements

Stagnant areas formed by structural steelwork, decking plates, sumps and equipment, etc. shall be assessed and ventilated accordingly.

Consideration shall be given to the dilution of fugitive hydrocarbon emissions and dissipation of internal heat gains.

A uniform ventilation pattern shall be provided between primary supply and extract points.

For guidance, reference is made to clause A.13.

5.4 Area-specific system design

5.4.1 Process and utility areas

5.4.1.1 Objective

To provide mechanical ventilation when ventilation by natural means is unable to satisfy requirements.

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5.4.1.2 Functional requirements

Systems provided for hazardous areas shall be entirely separate from those serving nonhazardous areas. The system design shall include a fan-powered supply plant which draws 100 % of its outside air from a nonhazardous area and supplies it to the module.

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Airflow in terms of air changes per hour for a nonhazardous area shall be sufficient to meet the pressurization requirements determined by the local regulation or hazardous area code classification adopted, free-cooling and personnel needs. Specific exhaust requirements, e.g. fume cupboards, welding benches/booths, etc., may also require consideration.

At outside maximum and minimum design temperatures, areas shall not exceed the temperature set by local regulation, applicable codes of practice or company standards. Refer to Table A.2 in A.3.4.

Air change rates determined in 5.2.2 shall be applied, but at a rate sufficient to dilute fugitive hydrocarbon emissions. Any free-cooling requirements for the area shall also be met.

For guidance, reference is made to clause A.14.

5.4.2 Living quarters

5.4.2.1 Objective

To provide a controlled environment for personnel.

5.4.2.2 Functional requirements

HVAC systems shall be designed to maintain internal-air conditions defined by local legislation or codes of practice at maximum and minimum outside air conditions, taking into account detectable and latent loads from lighting, personnel and other sources.

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