

DEP SPECIFICATION

**HVAC FOR OFFSHORE INSTALLATIONS
(AMENDMENTS/SUPPLEMENTS TO ISO 15138)**

DEP 37.76.10.10-Gen.

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DESIGN AND ENGINEERING PRACTICE

DEM1



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PART I INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and provides guidance for the design, installation, testing and commissioning of Heating, Ventilation and Air-conditioning (HVAC) systems for offshore installations of the petroleum and natural gas industries.

This DEP is based on ISO 15138:2007. The design of HVAC systems will be particular to each installation; therefore, this DEP is written to provide both requirements and guidance in a similar way to ISO 15138:2007.

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual (DEM) 1 – Application of Technical Standards.

This DEP is not applicable retroactively.

This is a revision of the DEP of the same number dated February 2014; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorization to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to offshore exploration and production facilities. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could 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 with regards to the safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP 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, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that 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 that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. 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 capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

The word **may** indicates a permitted option.

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section or clause number is shown in brackets (). Other documents referenced by this DEP are listed in (Part IV).

1.5 SUMMARY OF MAIN CHANGES

This is a revision of the DEP of the same number dated February 2014. The following are the main changes.

Section/Clause	Change
All	Restructured and clarified requirements, enforced shall/should.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

Shell DEPs Online (Users with access to Shell DEPs Online)	Enter the Shell DEPs Online system at https://www.shelldeps.com Select a DEP and then go to the details screen for that DEP. Click on the "Give feedback" link, fill in the online form and submit.
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DEP Standard Form (other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com .

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

1.8 NON NORMATIVE TEXT (COMMENTARY)

Text shown in italic style in this DEP indicates text that is non-normative and is provided as explanation or background information only.

Non-normative text is normally indented slightly to the right of the relevant DEP clause.

PART II GENERAL

1. Part III of this DEP is written as amendments and supplements to ISO 15138:2007. Wherever reference is made to ISO 15138, it shall be understood to mean ISO 15138:2007 as amended/supplemented by this DEP.
2. For ease of reference, the clause numbering of ISO 15138 has been used throughout (Part III) of this DEP.
3. Clauses and Annexes of ISO 15138, which are not mentioned in this DEP, shall remain valid as written.

PART III AMENDMENTS/SUPPLEMENTS TO ISO 15138:2007

2 Normative references

Add the following:

EN 14986, Design of Fans Working in Potentially Explosive Atmospheres.

Area Classification Code for Installations Handling Flammable Fluids. Part 15 of the IP Model Code of Practice in the Petroleum Industry.

B&ES DW144, Specification for sheet metal ductwork, low, medium & high pressure/velocity air systems.

EN 13779, Ventilation for buildings, performance requirements for ventilation and air-conditioning systems.

EN 288-3: Specification and approval of welding procedures for metallic materials. Welding procedure tests for the arc welding of steels.

EN 378 (parts 1, 2 and 3): Refrigerating Systems and Heat Pumps – Safety and Environmental Requirements.

BS 5422: Method for Specifying Thermal Insulating Materials for Pipes, Tanks, Vessels, Ductwork and Equipment.

BS 5970: Code of Practice for Thermal Insulation of Pipework and Equipment.

ASHRAE 62.1, Ventilation for Acceptable Indoor Air Quality.

ANSI/SMACNA 006: HVAC Duct Construction Standards - Metal and Flexible.

SOLAS, International convention for the Safety of Life at Sea, latest version and amendments.

NMD, Norwegian Maritime Directorate regulations.

4 Abbreviated terms

Add:

AHU Air Handling Unit
CBM Condition-based maintenance.
CFC Chlorofluorocarbon (refrigerant gas).
DX Direct Expansion
F&G Fire and Gas.
GWP Global Warming Potential
HCFC Hydro-chlorofluorocarbon (refrigerant gas).
HFC Hydro-fluorocarbon (refrigerant gas).
HMI Human-machine interface.
HVAC Heating, Cooling and Air Conditioning
HVCA Heating and ventilation Contractors' association.
IPF Instrumented protective function.
LBL Lawrence Berkeley Laboratory
MS Mild steel.
ODP Ozone Depletion Potential
RSA Rolled steel angle.
SMACNA Sheet metal and air conditioning Contractors' national association.
TEWI Total Equivalent Warming Impact.
TR Temporary Refuge.

5 Design

5.2 Development of design basis

5.2.1 Orientation and layout

5.2.1.1 Objective

Add new paragraph:

1. For each plant/installation a HVAC design philosophy shall be established and included as a project document.
2. The philosophy shall include the following:
 - a. process safety requirements;
 - b. safety-critical functions;
 - c. HVAC control philosophy and HVAC controls interfaces with installation control and safety systems.

Add new sub-clause:

5.2.1.4 Interfaces

1. The Contractor shall coordinate the HVAC design, procurement and construction aspects to ensure that all disciplines' requirements are understood and allowed for.
 - a. This shall include all design and operational interfaces and spatial coordination.

5.2.2 Hazardous area classification and the role of HVAC

5.2.2.1 Objective

Add the following new clauses:

1. The segregation of hazardous and non-hazardous areas by means of structure that is specifically designed to be gas-tight and by allowing for hazardous area 'wrap around' as appropriate should be used where possible.

This methodology is preferred because it can relieve the requirement for HVAC systems to provide pressurisation for compliance with the adopted hazardous area classification standard.
2. The structure that provides such segregation shall be considered as safety-critical item.

5.2.2.2 Functional requirements

Replace existing section with new sub-sections:

5.2.2.2.1 Process safety requirements

1. HVAC design SHALL [PS] incorporate the following process safety functions:
 - a. Non-hazardous enclosed facilities to be maintained at a pressure of 50 Pascals (0.2 in wg) above that of an adjacent hazardous area when the non-hazardous area boundary is in contact with the hazardous area and the segregating structure is not gas-tight.
 - b. Provision of ventilation airflow rates for hazardous facilities at a rate meeting the requirements of 'adequate' as defined by the applicable DEP 80.00.10.10-Gen. or DEP 80.00.10.13-Gen.
Alternative approaches could be required for cold climates where it is unfeasible to heat large airflows.
 - c. HVAC equipment located in a hazardous area or potentially handling a flammable mixture of air and gas be designed, constructed and certified in accordance with applicable standards (e.g., ATEX, API or IEC) to prevent it from acting as a point of ignition.
 - d. Gas shut-off dampers be installed at air intakes and outlets for HVAC systems serving all enclosed facilities.
 - e. Mechanically-ventilated enclosed hazardous facilities be negatively pressurised where there is major risk from toxic gas.
 - f. HVAC systems to be shut down (including closure of fire/gas dampers) when required to do so by Fire and Gas or Safety system design requirements.
 - g. Battery rooms be ventilated to prevent accumulation of hydrogen gas.
2. Refer to DEP 32.30.20.11-Gen. for design and operation of fire, gas and smoke detection systems, and DEP 80.80.00.11-Gen. for control and mitigation of fires and explosions on offshore production installations.

5.2.2.2.2 Safety-critical functions

1. The design and function of HVAC systems shall comply with the governing area classification standard.
 - a. Refer also to DEP 80.00.10.10-Gen. or DEP 80.00.10.13-Gen.
2. Safety-critical functions shall be determined in conjunction with Safety discipline and include the following:
 - a. Pressurisation of non-hazardous areas.
 - b. Segregation of hazardous and non-hazardous areas by means of impermeable structure.
 - c. Gas and smoke detection at HVAC air intakes.
 - i. Refer to DEP 32.30.20.11-Gen for Design and operation of fire, gas and smoke detection systems.
 - d. Fire/gas dampers shall close air intakes and outlets of a module and to maintain fire barrier ratings both external and internal.
 - e. Externally located HVAC equipment shall not be capable of acting as a point of ignition to a flammable gas.
 - i. This is achieved by classifying external equipment as suitable for zone 2 (ATEX, API 505 or IEC), or Division 2 (API 500).
 - ii. Any HVAC equipment that has to operate in an emergency shall be suitable for zone 1 (ATEX or IEC) or Division 1 (API 500).
 - f. Leak-tightness of structures containing equipment that will remain live and which could be subjected to a gas cloud following a major release event.
 - g. Ventilation rates of hazardous areas are in relation to area classification requirement.

Hazardous area ventilation is to ensure adequate air distribution and prevention of stagnant areas where gas could accumulate.
 - h. Availability of power in situations when safety-critical functions are required.
 - i. Requirements for a Temporary Refuge.

5.2.2.2.3 Process-critical functions

1. Process-critical functions shall include the following:

- a. Minimum equipment ratings to provide a suitable operating environment during normal operation to ensure reliability of the equipment;

Reliability of equipment is a function of load-bearing capacity and actual required load.

- b. Equipment sparing to allow for reliability and maintenance issues, with automatic changeover to maintain continuity of service;
- c. Availability of electrical power and the sources of power supplies used for HVAC systems;
- d. Equipment tripping philosophy and operation in emergency conditions.

Equipment tripping philosophy includes the load-shedding sequence for HVAC equipment.

5.2.3 Environmental conditions

5.2.3.3 Detailed requirements

5.2.3.3.1 External meteorological conditions

Add to 3rd paragraph ending ‘... extremes are encountered’:

Note that HVAC external design conditions will usually be different (less extreme) from project nominal outside design temperatures, which are based on extreme values for equipment and structures to withstand.

Add new paragraphs at end:

Where HVAC cooling is required, the value of outside relative humidity that is adopted for design has a big effect on resultant cooling capacity and equipment ratings. It is important to make adequate allowance without over-sizing equipment, so the objective is to select an appropriate level of relative humidity coincident with summer design temperature (effectively the enthalpy) that will cover a suitably high percentage of summer conditions.

1. The following approach should be followed:
 - a. Obtain weather data showing the frequency distribution of monthly coincident values of relative humidity and dry-bulb temperature
 - b. Select values of relative humidity coincident with temperature that cover 80% (suggested value) of time-based occurrences
 - c. Express the selected value as relative humidity at summer design dry-bulb temperature
2. The value of 75% RH at summer design dry-bulb temperature may be used as default value.
3. Where the 75% RH at summer design dry-bulb temperature is used as default value, this should be checked for each project.

5.2.3.3.4 Internal environmental conditions

Amend Table 2 for the following:

1. The minimum design temperature for control room, radio room, cabins and offices shall be 21 °C (70 °F).

Add footnotes to table:

1. For calculations of heating requirements allowance may be used for heat gains from equipment where they are continuous day and night during normal operation.
2. For installations operating in hot climates, the maximum design temperatures of unmanned process, utility and plant areas may be increased above 35 °C (95 °F) to allow use of fresh air cooling provided it is assessed in relation any human activities (e.g., maintenance visits) and suitability for equipment operation.

5.2.5 Selection of controls philosophy

5.2.5.3 Detailed requirements

5.2.5.3.1 General

Delete first two paragraphs. Insert new paragraph:

1. For new installations, or major changes to existing installations, the HVAC controls shall be arranged as follows:
 - a. HVAC controls, logic, alarms, status indication and HMI be incorporated into the installation control/monitoring/safety systems (by the main automation Contractor), except for specialist HVAC equipment packages.
 - b. Local HVAC interface panels be included (e.g., in HVAC plant rooms, living quarters, non-hazardous modules).
 - c. Local panel provide as a minimum; local status indication of HVAC plant, fire/gas dampers and to enable local manual switching for maintenance purposes.
 - d. Status indication be provided by means of a serial link.
2. For small installations, or those not normally manned, the HVAC controls shall be arranged as follows:
 - a. Local HVAC control panels with HMI providing logic, alarms and status indication.
 - b. Interfaces between HVAC control panel and installation control/safety systems for transmission of alarms, equipment status and permissive signals.
3. All control system arrangements shall include the following:
 - a. The HMI to provide a mimic diagram of the HVAC system, including fire/gas dampers.
 - b. Controls for specialist packaged equipment such as chillers, direct-expansion cooling systems and humidifiers may use the Manufacturer's standard controls as stand-alone units with interfaces to the HVAC controls for alarms, permissive signals and status indication.
 - c. The fire & gas sub-section of the installation controls to override normal HVAC controls to close fire dampers and shut-down fans and other equipment in accordance with the Cause and Effect logic.
 - d. The status of fire dampers to be monitored at the F&G sub-section with signals handed-off to the local HVAC panel and the main control system.
 - e. Refer to DEP 32.30.20.11-Gen. for F&G system requirements.
4. Motor starters may be included in local HVAC control panels only if they can be isolated and accessed separately from the controls section of the panel.
5. Distributed electric re-heaters shall be controlled by thermostats located within the controlled space, which are to be energised by means of a permissive interlock that is enabled by adequate airflow.

5.2.5.3.3 Control and monitoring – Normal operation

5.2.5.3.3.3 Fire/gas damper controls

Add new text after paragraph 'Where several fire/gas dampers..... the others':

1. The fire/gas damper control system shall include a facility to permit routine function testing of fire dampers.
 - a. As a minimum this shall be done by simulating a 'trip' command (disconnecting power) to damper solenoid valves or electric actuators and temporarily inhibiting alarms and executive actions.
 - i. Further facilities may include logging of test results per damper, testing groups of dampers and automatic resetting.
2. TR fire/gas damper controls shall be arranged to facilitate the testing of TR boundary dampers independently.

5.2.6 Operating and maintenance philosophy

5.2.6.3 Detailed requirements

Add new paragraph at end:

1. Fire dampers shall be located where they can be accessed easily and with permanent access provided in process/utility/machinery spaces.
 - a. Where located above ceilings or behind lining panels (e.g., in living quarters), access panels shall be provided and be prominently labelled to indicate fire damper tag number.

5.2.9 Wind-tunnel and computational fluid dynamics (CFD) modelling

5.2.9.1 Objective

Add new paragraph:

Modelling to be carried out where it will provide beneficial information to determine arrangements and design issues, but it is to be undertaken selectively and not used where issues can be determined reasonably by other means.

5.2.10 Performance standards

5.2.10.3 Detailed requirements

Add new text:

1. Management of HVAC systems during the operations phase shall include testing to demonstrate compliance with Performance Standards and underlying requirements such as area classification codes.
 - a. This shall require proof of airflows/ventilation rates for mechanically-ventilated hazardous process/utility areas and pressure differentials for non-hazardous areas.

Add new sub-clause:

5.2.10.4 Design Information

1. HVAC safety-critical performance requirements shall be clearly identified in final project design documents for incorporation into Performance Standards or other maintained document.

Add new clause:

5.2.11 Modes of operation

5.2.11.1 Objective

To ensure that HVAC systems are designed to suit the operating modes of the installation with regard to power availability, equipment operation and safety systems.

5.2.11.2 Detailed requirements

1. Installation operating modes shall be established at an early stage of design with regard to operating modes and power availability and includes the following:
 - a. normal power generation;
 - b. secondary power generation;
 - c. emergency power generation;
 - d. UPS/battery power.
2. The different levels of power availability at each mode will determine how much HVAC equipment can operate, and the HVAC systems shall be designed to suit what is required.

Telecomms and Instruments panels are likely to be required to operate from UPS power, and they may require cooling which would then require HVAC systems that can also be powered by the UPS.

Temporary refuge emergency cooling systems, if required, may also need to operate from a UPS.
3. For 'black start' situations gas detection systems should be used as a means of determining that an area is safe to energise.
4. Dedicated purging systems shall not be used to determine that an area is safe to energise unless there is a regulatory or overriding functional requirement

5.3 System design – General

5.3.2 Mechanical ventilation

5.3.2.3 Detailed requirements

5.3.2.3.2 Differential pressure

Add to end of 1st paragraph:

1. Design airflow rates shall allow for a differential between gross supply and gross extract.

This is to reflect the anticipated module leakage.

Add to end of 2nd paragraph:

1. When modules are required to be pressurised, the requirement shall be made known to the relevant disciplines to ensure that structure and penetration details are designed to be as leak-tight as possible.
2. Where necessary, modules may be leak tested as described in (Annex F).

Add new paragraphs

1. Non-hazardous modules, including living quarters, shall be pressurised during normal operation to a nominal design value of 50 Pascals (0.2 in wg) relative to outside atmosphere or adjacent hazardous areas.
This is in order to provide protection against major incidents.
 - a. Pressurisation shall be safety-critical if a ventilated non-hazardous area is adjacent to a hazardous area and is not segregated therefrom by gas-tight structure.
2. Stairwells and corridors shall be pressurised to a level slightly above adjacent areas to give additional protection against spread of smoke.
 - a. This shall be done by adjusting the supply/extract balance.
3. The galley shall be negatively pressurised relative to the mess and other adjacent areas.
 - a. This shall be done by design airflow differentials such that the galley extract airflow is greater than supply and the differential airflow is drawn from the mess area which in turn is to have a greater supply airflow than extract.
 - b. If the galley serving hatch has a shutter that can be closed during normal operation, a transfer duct shall be included to allow air to move from the mess area to the galley and maintain the designed airflow/balance.
4. Smoking areas shall be negatively pressurised relative to adjacent areas, to prevent spread of odour and smoke.

5.3.2.3.4 Inlets and outlets

Delete 2nd paragraph 'Gas dampers..... covered'.

Delete 4th paragraph: 'Air from..... hazardous area' and substitute new text:

1. Air outlets from ventilated non-hazardous areas should be exhausted to a non-hazardous area where reasonably feasible to do so.
2. If this would involve disproportionate measures, such as long or difficult duct routes, air outlets may be located in a hazardous area, provided the following shall be met.
 - a. the ventilated non-hazardous area be pressurised to maintain non-hazardous classification and
 - b. reliable means of sealing the exhaust outlet at the module boundary be provided in case pressurisation is lost.

Add new paragraphs at end:

3. Inlet and outlet ducts may require gas or smoke detectors
 - a. Refer to DEP 32.30.20.11-Gen. for Fire and Gas design.
4. The design of inlet ducts that require gas detection shall be coordinated with the design of Fire & Gas detection system such that:
 - a. gas shall not by-pass the detectors, and
 - b. gas shall not enter the module at unacceptable concentrations.
5. Large-volume intake ducts may be used to compensate for the time delay between gas detection and closing of fire dampers.

At inlet ducts with gas detection, the time delay between gas detection and closing of the gas damper can potentially allow gas at low concentration to enter the module served.