

# **Offshore Transformer Platform Technical Standard**

**Energinet.dk**

**HVAC System**

**ETS - 09**

**Rev. 1**

## Revision survey

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## 1. Scope

This Technical Standard covers the design and materials for HVAC systems for fixed offshore transformer platforms.

Compliance is required with all applicable parts of the Codes and Standards specified. The Technical Standard is one of a whole set of Technical Standards. It contains additional Energinet.dk requirements or specifies requirements where the Regulations, Codes and Standards allow alternatives.

## 2. References

### 2.1 Codes and Standards

Danish Energy Authorities	Guidelines For Design Of Fixed Offshore Installations 2008
DS/EN ISO 15138	Petroleum and Natural gas Industries – Offshore production installations – Heating, ventilation and air-conditioning.
DS 447	Code of Practice for mechanical ventilation installations
DS 452	Code of practice for thermal insulation of technical service and supply systems in buildings
DS 474	Code for Indoor Thermal Climate
Eurovent 2/2	Air leakage rate in sheet metal air distribution systems
SBI – 102	Danish Building Research Institute (SBI) – Specification 102. Measurements in ventilating systems.
2006/42/EC	Machinery Directive (DK version = 2006/42/EF)

### 3. Definitions and Abbreviations

#### 3.1 Definitions

Fixed offshore installations	Facilities located and installed on fixed offshore structures which is permanently fixed or located on the sea bed.
Moisture separator – filter coalescer	A single component including weather protection louver / moisture eliminator, a bag or panel coalescer a filter section and if necessary another moisture eliminator or split into separate parts comprising of the above mentioned parts.
Air Handling Unit	Unit split into constituent parts including for example shut off damper, filter section, heater (electrical), cooling coil, empty section for split of air stream into two sections each section including a manually adjustable shut-off damper, fan, and non return damper. The air handling unit can be build up in different ways, see fig. 1 as an example.

#### 3.2 Abbreviations

HVAC	Heating, Ventilation and Air Conditioning
DS	Danish Standard – Code of Practice
EN	European Standard – Code of Practice
IEC	International Electrotechnical Commission
ISO	International Organisation for Standardization
NGTE	National Gas Turbine Establishment

## **4. Technical Requirements**

### **4.1 General**

The design of the HVAC system shall be based on DS/EN ISO 15138, DS 447 and "Guidelines for Design of Fixed Offshore Installations 2006" chapter 9, Danish Energy Authorities

### **4.2 Control Philosophy**

A control philosophy for the HVAC system for the platform in accordance with DS/EN ISO 15138 shall be performed.

The primary goals of the ventilation system shall be identified, some of the goals are:

- Prevent ingress of salt particles and salt- water aerosols, if present, into HVAC covered areas through pressurization and installation of efficient moisture eliminators and filter coalescers.
- Remove generated heat / supply heated air in winter time, and keep a controlled indoor climate in which personnel, plant and systems can operate effectively including smoke control.
- Ventilation shall be maintained to equipment and rooms that need to be operational during an emergency situation when the main source of power is unavailable, if required.

### **4.3 Indoor Climate**

Recommended indoor climate/environmental conditions as given in DS/EN ISO 15138, table A.2 shall be fulfilled as a minimum. Recommendations given in DS447 can be followed.

#### **4.3.1 Pressurization and Air Quality**

Indoor premises/rooms shall be kept under a relative overpressure to reduce the concentration of salt-water aerosols, dust and water particles and keep the indoor air clean.

The air flow shall be determined taking into account the rate of leakage through doors and wall penetrations, the thermal requirements of the rooms and the required airflow to remove polluted air. Rooms should be equipped with pressure control dampers to adjust the pressure in each room to the required level.

Recommendations for airflow and pressure given in "Guidelines for Design of Fixed Offshore Installations 2006" chapter 9, Danish Energy Authorities can be taken as guideline.

If there are workshops on the platform, process ventilation shall be installed. Process ventilation can comprise of welding exhaust arms, fans and filters. Exhaust air shall be led to unclassified areas and well clear of access ways.

#### **4.3.2 Thermal Indoor Climate**

Recommended indoor temperature conditions as given in DS/EN ISO 15138, table A.2 shall be fulfilled as a minimum.

The heat generated in the rooms shall be removed by supplying cooled air. Free cooling utilizing lower outdoor temperatures shall be used to the extent possible, if necessary cooling coils using seawater or cooling medium from condensing units shall be installed. During the heating period heated air shall be supplied to each room.

Duct or unit-mounted heating and cooling coils shall be automatically temperature-controlled by a duct- or room-mounted sensor modulating a heating/cooling-medium proportional controller.

Where both heating and cooling coils are employed, controls shall be interlocked to ensure complementary operation.

#### **4.3.3 Acoustic Indoor Climate**

Recommended maximum indoor noise levels as given in DS/EN ISO 15138, table A.2 shall be fulfilled as a minimum.

#### **4.4 Leakage**

Guidelines for the maximum leakage factor given in DS/EN ISO 15138, Eurovent 2/2 and DS447 shall be followed.

#### **4.5 Ductwork and Components**

##### **4.5.1 Air Intakes and Exhausts**

HVAC air intakes shall be equipped with efficient weather protection louvers / moisture eliminators. The louvers shall be able to remove the majority of the liquid (rain, sea spray, coarse aerosols), the moisture separation efficiency shall typically be 96 % for droplet sizes of 30 µm and larger at a system velocity of 1 m/s.

HVAC air exhausts shall be equipped with efficient weather protection louvers.

A screen or mesh sized to provide protection against birds shall be fitted to the air inlet and exhaust ducts.

Air intakes and exhausts shall be placed far apart from each other. Inflow from generator exhaust, exhaust from combustion engines, fired units or ventilation exhaust shall be avoided.

The air intake shall be located in unclassified area and minimum 3 m away from any classified zone.

#### **4.5.2 Fans and Motors**

Fans and motors shall be selected for optimum efficiency with regard to power consumption, sound level and fan efficiency.

If reliability of the HVAC system is important, i.e. if cooled air is provided by the HVAC system to remove heat generated from equipment, the air handling units shall be provided with two fans, one duty and one stand-by to ensure ventilation if a fan fails. Shut off dampers shall be placed upstream the fans and non-return dampers downstream the fans, in case of repair of a fan, the fan shall be able to be dismantled without air backflow from the fan running, see. Fig.1.

Automatic switch over between duty and standby fan shall be provided. Signal of air flow failure in the ducts, via flow switches in the ducts, or automatic switch over from duty to stand-by fan shall be provided to a normally manned location offshore and/or onshore if the platform is unmanned.

#### **4.5.3 Moisture Separators and Filters**

Efficient moisture separators and filters shall be installed in the HVAC system air intake.

The moisture removal and filtration function can be incorporated into a single component including weather protection louver/moisture eliminator, a bag or panel coalescer, a filter section and possibly another moisture eliminator or split into separate parts comprising of the above mentioned parts.

An efficient moisture separator can be split into 3 stages as described below:

Stage 1 is the 'bulk water' removal stage. In this stage the majority of the liquid (rain, sea spray, coarse aerosols) entering the intake is removed and drained away. Stage 1 is typically a vane separator/weather protection louver.

Stage 2 is the coalescence stage, where fine aerosols that have penetrated the first stage are coalesced to form larger droplets that can be easily removed by the third stage. Stage 2 is often a filtration stage designed to remove dust and other solid particulate.

Stage 3 is typically a vane separator or similar, which stops any concentrated saline solution that has passed through Stages 1 and 2. The entrained liquid is captured and removed from the intake by a manometrically sealed drainage system.

Arrangements can vary dependant on the manufacturer, guidelines to typical air filtration requirements for various rooms can be found in DS/EN ISO 15138 table B.1.

The louver / filter/ coalescer separator should be able to reduce the salt-in-air content at the output to  $0.01 \times 10^{-6}$  by mass against the NGTE (National Gas Turbine Establishment) Standard 30 knot aerosol.

The pressure drop across moisture separators and filters shall be kept at a minimum.

#### **4.5.4 Heating / Cooling Coils**

##### **Electrical heaters**

Electrical heaters shall fulfil guidelines given in DS/EN ISO 15138.

All heaters shall be installed with “high air temperature” or “high element-surface temperature” thermal cut-outs.

##### **Cooling Coils**

Cooling coils can be of direct expansion refrigerant or fluid type. Cooling coils shall be selected to avoid moisture carry-over into the air stream. Cooling coils shall be provided with frost protection and surface temperature shall be measured, i.e. the cooling coil shall be placed downstream the heater, to prevent freezing of the coil in winter conditions.

Seawater cooling coils shall be constructed from seawater resistant material.

Water pipes crossing rooms with electrical equipment should be avoided where possible. If not possible electrical equipment shall be screened against splash and spray in case of a rupture.

#### **4.5.5 Ductwork**

Ducts, equipment and supports placed outside enclosures shall be designed to withstand offshore conditions, wind loads shall be taken into account and ducts shall be made of corrosion resistant material, stainless steel. Ducts and supports placed inside enclosures shall be made of materials with a lifetime equal to the design lifetime of the platform. Guidelines for ductwork and materials as listed in DS/EN 15138 Table B.2 should be followed.

Recommended maximum velocities in duct systems as given in DS/EN ISO 15138 shall be fulfilled. Duct systems shall be designed to fulfil the acoustic requirements and requirements for the maximum air leakage percentage as given in DS447.

Duct systems should be self balancing as far as possible, where this is not the case flow balancing dampers shall be installed.

#### **4.5.6 Dampers**

Dampers should fulfil guidelines given in DS/EN ISO 15138.

##### **Fire dampers**

Fire dampers shall be able to maintain fire-rated barriers when penetrated by HVAC ducts.

Proximity or limit switches to indicate status closed and/or open positions shall be installed on the fire dampers.

The dampers shall be kept in open position by a pneumatic single-action spring-return actuator or a spring-return electric motor depending on if it is supplied with air or electric power. In case of loss of air or electric power the dampers shall close.

A thermal device shall be installed to activate the damper actuator and close the damper in the event of an unacceptable temperature rise in the duct.

**Pressure-relief dampers**

Pressure-relief dampers shall be controlled automatically by tension spring or counterbalance weight, set to restrict blade opening until a preset pressure is exceeded.

**4.5.7 Silencers**

Silencers and sound attenuators shall be selected to reduce duct carried noise from ventilation fans, dampers or other noise sources in the ventilation system.

Recommended HVAC noise limits given in DS/EN ISO 15138 (Table A.2) shall be fulfilled as a minimum.

**4.5.8 Air Handling Units**

Components in air handling units shall fulfil demands as stated in previous sections. Air handling units shall fulfil demands as listed in DS/EN ISO 15138.

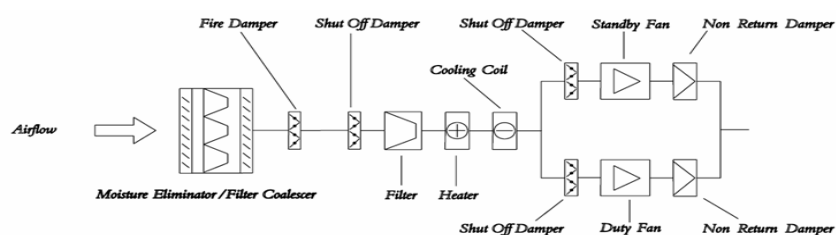


Fig. 1 Air Handling Unit

#### **4.5.9 Control System**

A local control system (such as a programmable RIO) for the HVAC system shall be installed. The local control system shall be linked up to the platforms main control system via a communication bus (modbus or equal) from where the HVAC system is monitored and all control functions can be accessed.

All important information on temperature, air flow failure, equipment failure and status on the system shall be collected and provided to a normally manned location offshore and onshore if the platform is unmanned.

The following controls, indicators and alarms should be present:

##### **Controls**

The following controls should, as minimum, be provided: Start/stop fans, Automatic changeover switch with selector for each duty/standby fan, Open/Close of dampers, and change of temperature set-points.

##### **Indicators**

The following indicators should as minimum be provided: Run/Stop/Tripped fans, Filter dirty, On/tripped heater, lamp test, On/tripped each package equipment item, Open – each fire/gas damper, Close – each fire/gas damper, Loss of pressurization – any area requiring pressurization, temperature readouts.

##### **Alarms**

Alarm should as minimum be given for: Fan trip, heater trip, filter dirty, package equipment trip, loss of pressurization, fire damper operating-mode failure, high/low temperatures.

#### **4.5.10 Insulation**

Ducts placed indoor shall be insulated against condensation, heat loss and fire, see Insulation guidance – table C.1 in DS/EN ISO 15138. Insulating materials shall be fire resistant.

### **4.6 Installation**

#### **4.6.1 General**

Installation guidance as specified in DS/EN ISO 15138 should be followed.

#### **4.6.2 Leakage Test, Air flow measurements and Pressure Test**

Leakage test, air flow measurements and pressure test should be carried out in accordance with relevant codes such as Eurovent 2/2, SBI specification 102 and relevant DS/EN codes of practice

A report with all measured values, method, and place marked up on drawings and instrument type shall be performed and issued.

#### **4.7 Commissioning**

The HVAC system shall be commissioned in accordance with the project requirements. Commissioning should at least include:

- Measurements of design airflows and air temperatures
- Differential pressures
- Sound-pressure levels of spaces

All measurements and settings should be conducted using calibrated instruments, and the results shall be documented in a measurement report.

Acceptance of the HVAC plant should not take place until satisfactory measurements and commissioning has been completed.

### **5. Certificates / Data books**

#### **5.1 General**

Certificates and data for all equipment and parts of the HVAC system shall be collected in Data books. Service procedures and service intervals shall be assembled in a service book.