NORSOK STANDARD

COMMON REQUIREMENTS

# HVAC
# HEATING, VENTILATION AND AIR-CONDITIONING

H-CR-001
Rev. 2, January 1996

**CONTENTS**

# 1 FOREWORD

NORSOK (The competitive standing of the Norwegian offshore sector) is the industry initiative to add value, reduce cost and lead time and remove unnecessary activities in offshore field developments and operations.

The NORSOK standards are developed by the Norwegian petroleum industry as a part of the NORSOK initiative and are jointly issued by OLF (The Norwegian Oil Industry Association) and TBL (The Federation of Norwegian Engineering Industries). NORSOK standards are administered by NTS (Norwegian Technology Standards Institution).

The purpose of this industry standard is to replace the individual oil company specifications for use in existing and future petroleum industry developments, subject to the individual company's review and application.

The NORSOK standards make extensive references to international standards. Where relevant, the contents of this standard will be used to provide input to the international standardisation process. Subject to implementation into international standards, this NORSOK standard will be withdrawn.

Annex A is normative.

Revision 2 includes mainly changes to:
- Fabrication requirements (clause 8).
- Installation requirements (clause 9).
- Commissioning requirements (clause 10).
- Data sheets.

# 2 SCOPE

This standard identifies the basic requirements for the design of heating, ventilation and air conditioning systems.

# 3 NORMATIVE REFERENCES

| | |
|---|---|
| AMCA 201 | Fan application manual. |
| Arbeidstilsynet Best.nr. 391 | Arbeidslokaler og personalrom. |
| Arbeidstilsynet Best.nr. 420 | Luftforurensing ved buesveising. |
| Arbeidstilsynet Best.nr. 444 | Klima og luftkvalitet på arbeidplassen. (Order no. 516, Climate and air quality in the workplace) |
| ASHRAE | Handbook of fundamentals. |
| BS 5422 | Method for specifying Thermal insulating materials on pipes, ductwork and equipment. |
| BS 5970 | Code of practice for Thermal insulation of pipework and equipment. |
| CIBS | Commissioning codes, series A, air distribution. |
| DIN 24154 | Ventilation equipment, flanges, class 1. |
| DIN 24193 | Ducting for ventilation equipment, flanges,series 2, flat and angle flanges. |
| EN288 | Specification and qualification of welding procedures for metallic materials. |

| | |
|---|---|
| Eurovent 2/2 | Air leakage rate in sheet metal air distribution systems. |
| Eurovent 2/3 | Sheet metal air ducts - Standard for dimensions. |
| Eurovent 2/4 | Sheet metal air ducts - Standard for fittings. |
| Eurovent 4/5 | Method of testing air filters used in general ventilation. |
| FEAM 1990 | Forskrifter for elektriske anlegg, maritime installasjoner. |
| HVCA DW/142 | Specification for sheet metal ductwork. |
| IEC 79-13 | Electrical apparatus for explosive gasatmospheres. Part 13: Construction and use of rooms or buildings protected by pressurisation. |
| ISO 7235 | Acoustics measurement procedures for ducted silencers - insertion loss, flow noise and for total pressure loss. |
| NFPA 96 | Standard for ventilation control and fire protection of commercial cooking operations. |
| NS 3421 | Description of technical installations. |
| NS 5575 | Ventilation ducts. Identification colours. |
| SMACNA | Rectangular industrial duct construction standard. |
| SMACNA | Round industrial duct construction standard. |
| UNS S31600 | Austenittic stainless steel (type 316) |
| UNS S31603 | Austenittic stainless steel (type 316L) |
| NORSOK S-DP-002 | Working environment. |

# 4 DEFINITIONS AND ABBREVIATIONS

## 4.1 Definitions

| | |
|---|---|
| Normative references | Shall mean normative in the application of NORSOK standards. |
| Informative references | Shall mean informative in the application of NORSOK standards. |
| Shall | Shall is an absolute requirement which shall be followed strictly in order to conform with the standard. |
| Should | Should is a recommendation. Alternative solutions having the same functionality and quality are acceptable. |
| May | May indicates a course of action that is permissible within the limits of the standard (a permission). |
| Can | Can-requirements are conditional and indicates a possibility open to the user of the standard. |

All terms and phrases within the scope of this standard shall be regarded as defined in the regulations and international codes and standards referred to in this document.

| | |
|---|---|
| Arbeidstilsynet | Directorate of Labour Inspection, Norway |

## 4.2 Abbreviations

| | |
|---|---|
| AMCA | Air Moving and Conditioning Assosiation Inc. |
| ASHRAE | American Society of Heating, Refrigerating and Air-Conditioning Engineers |
| BS | British Standard |
| CCR | Central Control Room |
| CIBS | The Chartered Institution of Building Services |

| | |
|---|---|
| DIN | Deutsches Institut für Normung |
| HVCA | Heating and Ventilating Contractors` Association |
| IEC | International Electrotechnical Commission |
| ISO | International Organisation for Standardisation |
| L.E.L. | Lower Explosion Limit |
| NFPA | National Fire Protection Association |
| NS | Norsk Standard (Norwegian Standard) |
| SMACNA | Sheet Metal and Air Conditioning Contractors National Association, Inc. |
| UNS | Unified Numbering System |
| WPS | Welding Procedure Specification |

# 5 TECHNICAL REQUIREMENTS

## 5.1 General

The design shall take into account both normal and emergency operation requirements.

The ventilation systems shall be designed to:

- Maintain acceptable working and living environment for personnel and non- destructive conditions for equipment.
- Prevent formation of any combustible mixture and maintain an atmosphere where the gas/air mixture is kept below L.E.L. during normal operation.
- Prevent entry of hydrocarbons into closed non-hazardous areas.
- Prevent smoke spreading and keep enclosed escapeways free of smoke in case of fire.
- Comply with the overall Black Start Philosophy.

## 5.2 Design temperatures

For design of the HVAC systems the following ambient temperatures shall be used:

Summer: The temperature that in average is not exceeded more than 50 hours per year.
Winter: The medium of the lowest temperatures for three following days.

For internal room temperatures reference is made to Norsok standard S-DP-002.

## 5.3 Natural ventilation

Minimum requirements for natural ventilation shall be that a local gas leakage rate of 0,05 kg/sec. in hazardous areas shall correspond to less than 20% L.E.L. for the total area volume. The requirement shall be met for 95% of the year.

Ventilation openings shall be optimised with respect to sizes, shapes and positions and give the necessary level of weather protection to improve the working environment.

Potential stagnant zones shall be evaluated

## 5.4 Mechanical ventilation

The HVAC systems shall be designed to prevent contamination between areas.

For practical reasons systems may be separated for the following areas

- Non-hazardous areas.
- Hazardous areas.
- Living Quarters.
- Areas to be in operation during emergency situations.
- Auxiliary systems for naturally ventilated areas.
- Drilling areas.
- Substructure.

Areas with contaminated air (separate extract).

The minimum ventilation air volumes shall be documented.

## 5.5 Fire/smoke ventilation

The HVAC design shall comply with the overall fire and smoke control philosophy.

In a fire situation, the ventilation to an area shall continue until the temperature sensor on the fire damper is activated, or the area is manually shut-down.

The above actions shall close fire dampers in both supply and exhaust ducts to avoid excessive over/under pressure in the room.

Mechanically ventilated enclosed escapeways shall have overpressure against neighboring areas.

When fire extinguishing gases or inert gases are used for fire fighting in a room, the fire dampers shall be controlled by the Fire & Gas system.

## 5.6 Emergency/shut-down operation

All systems shall in normal operation be powered from the main power system. Systems to be in operation during emergency situations shall also be powered from the emergency power system.

HVAC systems serving areas where area classification depends on ventilation or where operational aspects require extensive ventilation availability, should have back-up capacity.

For HVAC systems with back-up fans, these fans shall start automatically on failure of duty fans.

The system shall ensure that all vital equipment in operation during a shut-down will have the necessary cooling.

## 5.7 Heating/cooling

### *5.7.1 Pre-heating/cooling*

All air supplied by the mechanical ventilation systems shall be preheated to maintain a minimum of 5$^{o}$C in non occupied areas. For occupied areas the minimum temperature shall be suitable for the actual areas/rooms (ref. Best. nr. 444 issued by Arbeidstilsynet).

In areas with high cooling or heating loads, the use of local placed recirculation units for heating or cooling should be evaluated instead of increased ventilation air volumes.

Water condensate on cooling coils and droplet eliminators shall be properly drained. Water condensate shall not be transferred into the ductwork. The design shall be based on the extreme ambient conditions regarding temperature and humidity.

#### *5.7.2 Heating*

Heating of ventilation air can be based on the main heating medium system. This can be used directly or via separate low pressure/low temperature water systems.

The type of reheating shall correspond to the ventilation principle chosen.

### 5.8 Room air distribution

Displacement ventilation is recommended and the final design shall comply with normal comfort standard and requirement for early smoke/gas detection for the relevant rooms and applications.

### 5.9 Filtration

If required, the air intake should be provided with prefilters with filter class EU3 (G80) according to EUROVENT 4/5 and equipped for mist and droplet collection.

For dust filtration, reference is made to Bestilling nr. 444 issued by Arbeidstilsynet.

Space for installation of temporary prefilters shall be provided where necessary to reduce intrusion of sand blast grit, diesel exhaust, etc., during hook-up and commissioning phases.

### 5.10 Ventilation fans

Fans should be direct driven.

To secure the availability of stand-by fans, both fans shall have approximately the same running hours.

Fans extracting from contaminated areas should be duct connected on both suction and discharge side.

### 5.11 HVAC control system

#### *5.11.1 Central monitoring and control*

The HVAC system shall as a minimum have the following facilities:

- Auto/manual operation selecting facilities.
- Start/stop of fans.
- Fan and damper status/alarm.
- Alarm for loss of pressurisation/flow.
- Auto/stand-by selecting facilities for fans.

#### *5.11.2 Field instrumentation*

The HVAC system shall as a minimum have the following field instruments:

- Pressure-drop indicator across all filters.
- Temperature indicators in main supply ducts and temperature sensitive areas.

The system logic shall be equipped with manual reset.

#### *5.11.3 Fire dampers*

All fire dampers shall be actuator operated and fail safe.

All fire dampers shall be closed by direct activation of the temperature sensor.

Manual opening and closing shall be implemented.

Limit switch for closed indication shall be provided.

#### *5.11.4 Monitoring of areas*

For monitoring of pressurised areas reference is made to IEC Publication 79-13.

# 6 SYSTEM REQUIREMENTS

## 6.1 Kitchen and laundry

The laundry room shall be provided with separate extracts with local filter sections to prevent the ductwork and equipment to be clogged.

The kitchen shall have a separate extract system including hood. Frying equipment shall have an air curtain from below to improve the working environment for the kitchen personnel.

Vent outlets from steam ovens and washing machines shall have special connections for extract if these are not located below a hood.

The kitchen extract system shall be designed according to NFPA 96.

## 6.2 Drilling area

Spot extract shall be used for extract from mudpits and shale shakers to avoid spreading of dust, fumes, heat etc. and to reduce the amount of general ventilation. Precautions shall be taken to avoid clogging of ducts and contaminated condensate in the exhaust area.

The cooling of the cementing room shall be self-contained during emergency operation. In normal operation the room shall be connected to the general ventilation system.

## 6.3 Utility areas

#### *6.3.1 Emergency generator and firepump rooms*

The cooling of these rooms shall be self-contained during emergency operation. In normal operation the room shall be connected to the general ventilation system.

#### *6.3.2 Battery rooms*

For ventilation of battery rooms reference is made to FEAM-1990.

#### *6.3.3 HVAC rooms*

Structural maintenance to be considered when free suction fans are installed in HVAC Rooms.

In HVAC rooms where the differential pressure to the surroundings is over 150Pa, air lock with air relief hatches in both doors shall be provided.

# 7 LAYOUT AND ARRANGEMENT

## 7.1 General

The main air-handling units should be located in designated HVAC areas.

Ductwork shall be located to enable simple maintenance work.

## 7.2 Clearance and accessibility

All equipment and ducting shall be arranged to provide required headroom and clearances for installations, operation, inspection, maintenance and dismantling with the minimum interference or removal of ducting and equipment. Accessible inspection and maintenance doors shall be installed in ductwork.

## 7.3 Air intakes and outlets

The air intakes shall where possible be located underneath the installation.

Systems for hazardous and non hazardous areas may have common air intake if means are provided to prevent the spreading of gas from hazardous to non hazardous areas. Consideration shall be taken to possible contamination sources such as:

- Ventilation extract outlets.
- Turbine and diesel engine exhaust outlets.
- Mud burning smoke.
- Gas leakage from hazardous areas.

The air intakes shall where possible be upstream of the prevailing wind. The wind influence on the air intake must be studied and documented.

Outlets from hazardous areas should be located at high level.

## 7.4 Air extract

From hazardous areas extract shall be arranged at both high and low level in order to take care of both light and heavy gases.

Spot extract shall be used wherever suitable to avoid spreading of dust, fumes, heat etc. and to reduce the amount of general ventilation.

## 7.5 Ducting

Circular ducts shall be used wherever possible.

Special attention shall be paid to ductwork connections to fan inlets and outlets in order to maximise the fan performance. See AMCA publication 201.

Flexible ducting shall be kept to a minimum and be used only for vibration damping or thermal expansion purposes.

Number of fire dampers shall be kept to a minimum.
Measuring stations shall be installed in all main ducts/ductbranches.

### 7.6 Inspection doors/access

Generally the location of inspection doors shall be based on:

- The manufacturers recommendation.
- General inspection.

Inspection doors shall be 600x600mm. if possible due to ductsize. If the duct is smaller, the door should be as large as possible.

All inspection doors in heavy gauge ductwork shall be hinged.

Access for cleaning of ductwork shall be provided.

The extract ducts from areas exposed for pollution, such as kitchen hood, tumble drier and mud tanks, shall be fitted with inspection doors, suitable for complete clean out of the ducting.

## 8 FABRICATION

### 8.1 General

All duct elements shall be of aerodynamic design. Furthermore it shall be suitable for direct connection to equipment such as fans, air handling units, heaters, coolers, dampers and air terminal units.

The ductwork with fittings shall comply with EUROVENT 2/3 standard for ducts and EUROVENT 2/4 standard for fittings or as documented by ASHREA.

## 8.2 Duct classes

Ductwork is classified with respect to operational conditions.

Table 1 Duct classes

| Duct class | Material | Thickness | Operating Conditions |
|---|---|---|---|
| A | Stainless steel<br>UNS S31603 | 3mm | High strength ductwork<br>Ductwork exposed to weather and saliferious atmosphere<br>Fire rated ductwork |
| B | Stainless steel<br>UNS S31600 | EUROVENT 2/3<br>EUROVENT 2/4 | Internal ductwork |
| C | Stainless steel<br>UNS S31600<br>UNS S31603 | 0.8mm. for Ø80 - Ø200mm<br>1.0mm. for Ø250-Ø315mm<br>1.25mm. for Ø400-Ø630mm<br>1.5mm. for Ø800 - | Internal ductwork |
| D | Carbon steel painted or hot dipped galvanised | 4mm | High strength ductwork<br>Fire rated ductwork |
| E | Pre- galvanised sheet steel | EUROVENT 2/3<br>EUROVENT 2/4 | Internal ductwork |

Alternative duct class or duct material shall be qualified.

## 8.3 Ductwork design

The ductwork shall be true in section and not twisted or distorted.

All ducts shall be designed for actual velocities and max. operating pressures considering possibilities of fans running against closed dampers.

Flanges shall be made according to DIN 24154 Class 1 for circular ducts and DIN 24193 series 2 for rectangular ducts.

Stiffening of light gauge ductwork shall be according to DW142, while stiffening of heavy gauge ductwork shall be according to SMACNA.

All ducts shall be made in suitable lengths, to suit surface protection, installation, maintenance and replacement.

## 8.4 Welding

All welding shall be carried out in accordance with a WPS established in accordance with EN 288 or equivalent.

The throat thickness of the weld shall be defined on WPS, drawing or equivalent. All welds shall be visually examined and show evidence of good workmanship.

# 9 INSTALLATION

## 9.1 Ductwork erection

Different materials shall be isolated to prevent galvanic corrosion.

All relevant details regarding ductwork erection shall be in accordance with DW/142 and NS 3421.

Ductwork with limited access after installation should preferably be welded and/or all connections specially secured.

## 9.2 Joints

The jointing system shall be of a well recommended system with a certified pressure class.

For stainless steel flanges, bolts shall be stainless steel.

## 9.3 Hangers and supports

Ductwork supports shall be arranged to prevent any movement and shall be adequately sized for mechanical loads, wind loads and to accommodate the shipment and tow-out of the platform.

Supports shall not be welded to the ductwork unless specified on the drawings.

Supports which are welded directly to the ductwork and/or equipment shall be attached during the fabrication of the duct/equipment and shall be subject to the same inspection as the duct/equipment.

When being erected, duct runs shall not be forced into place to suit the installed support and thereby introduce undue stresses into the ductwork.

Surfaces of supports which will be inaccessible after erection shall receive the protective coating before assembly.

Where ducts are conveying conditioned air, packing blocks shall be installed between duct and support when externally insulated. The blocks shall be of sufficient insulating value to prevent condensation.

The addition of insulation to ducts should generally not affect the method of support, providing a vapour barrier is not required.

## 9.4 Ductwork insulation

Selection and installation of ductwork insulation shall be in accordance with BS 5422 and BS 5970.

## 9.5 Identification of ductwork

The ductwork shall be marked in accordance with NS 5575.

The identification symbols shall be placed on:

- Ducting in ceiling behind access points.
- Either side of major components (fans etc.).
- All ducting in HVAC plant rooms.
- Ducting in shafts behind access doors and panels.
- Ducting entering and leaving modules.

- Ducting entering or leaving local equipment/control rooms in open modules/areas.
- Both sides of fire walls where the duct penetrates.
- Each leg of a branch duct where the destination is not immediately obvious.

## 9.6 HVAC equipment

Equipment shall be installed in accordance with the supplier`s installation instruction and/or as specified on contract drawings and/or documents.

Grilles, diffusers and louvres shall be installed so as to fit neatly in the ceiling or wall in which they are installed.

Ductwork supports shall be located such that the equipment can be removed from the system without major dismantling of ductwork.

## 9.7 Cleaning and protection

All ductwork, fittings and equipment shall be cleaned before erection.

All protective covers on equipment shall be left in place as long as possible during erection.

Equipment shall be adequately protected against damage during construction.

All duct elements shall be supplied with dustblinds immediately after fabrication. Dustblinds shall remain in place until the duct elements are actually required for installation.

Ductwork terminated for later hook-up shall be equipped with a blind on the open end immediately after installation.

When the ductsystem is finally installed and ready for mechanical completion, the system shall be internally clean along the complete run. For further requirement reference is made to Norsok standard S-DP-002.

Stainless steel ductwork shall be kept externally covered to avoid contamination from other sources.

## 9.8 Pressure testing

### *9.8.1 General requirements*

The ductwork inclusive all equipment shall be pressure tested after installation. Materials such as gaskets, bolting etc., intended as part of the final installation, which are damaged during testing shall be replaced.

### *9.8.2 Preparation for pressure test*

The section of the ductwork to be tested shall be prepared by blanking off equipment, duct outlets etc.

All dampers in the tested ductwork shall be left in open position.

Testing shall be satisfactory completed before insulation or enclosure of the ductwork and before terminal units are fitted.

#### *9.8.3 Test requirements*

The tests shall be carried out in accordance with Eurovent 2/2.

All ductwork shall meet the requirements for Air Tightness Class B

A minimum of 10% of the ductwork shall be tested, and it shall be selected by the company. If this ductwork does not pass the test, then the whole ductwork system shall be tested to the satisfaction of the company.

All test devices shall be removed after the tests have been performed.

# 10 COMMISSIONING

## 10.1 General

CIBS Commissioning codes, series A with appendixes shall generally be applied as a guideline for the commissioning.

Acceptance of the HVAC-plant shall not take place until satisfactory commissioning has been completed.

The commissioning shall take place after mechanical completion of the plant.

## 10.2 Preliminary checks

The purpose of this check is to ensure that the plant is in a satisfactory and safe condition before starting up.

The checks shall be carried out in accordance with CIBS Commissioning codes, series A, section A1.
In addition shall instrumentation and instrument set points be checked.

## 10.3 Setting to work

The setting to work of the plant shall be carried out in accordance with CIBS Commissioning codes, series A, section A2.:

- Precautions against airborne dirt.
- Precaution against frost.
- Initial running of electrically driven fan set.

## 10.4 Air flow adjustments

The balancing of system(s) shall be carried out in accordance with the proportional method as described in CIBS Commissioning codes, series A, section A 2.7.

The balancing shall be carried out with the following tolerances:

- The main air flow, and air flow at each terminal unit shall be within +/-10% of the specified value including errors of measurements.

All measurements and settings shall be documented.

### 10.5 Testing of pressure conditions

A complete adjustment of the specified pressure conditions for the different rooms shall be carried out.

The measurement of pressure difference shall be between closed areas to avoid disturbance from external conditions.

### 10.6 Recording

During the commissioning period records shall be prepared and maintained for all activities and shall include but not limited to the following:

- Air-quantities.
- Temperatures.
- Pressures.
- Sound levels.

## 11 EQUIPMENT

Description and technical requirements of equipment is found in the relevant data sheets and schedules in annex A.

# ANNEX A DATA SHEET

## CONTENTS