Air vent heads
FOREWORD

DNV GL class programmes contain procedural and technical requirements including acceptance criteria for obtaining and retaining certificates for objects and organisations related to classification.

© DNV GL AS March 2016

Any comments may be sent by e-mail to rules@dnvgl.com

This service document has been prepared based on available knowledge, technology and/or information at the time of issuance of this document. The use of this document by others than DNV GL is at the user's sole risk. DNV GL does not accept any liability or responsibility for loss or damages resulting from any use of this document.
CHANGES – CURRENT

This is a new document.
Contents

Changes - current .......................................................................................................................... 3

Section 1 General .......................................................................................................................... 5
  1 Introduction ............................................................................................................................. 5
  2 Documentation ......................................................................................................................... 5

Section 2 Product requirements .................................................................................................... 6
  1 Material requirements .............................................................................................................. 6
  2 Design requirements ............................................................................................................... 6

Section 3 Type testing .................................................................................................................... 8
  1 General ................................................................................................................................ 8
  2 Type tests on non-metallic floats ............................................................................................ 8
  3 Type tests on metallic floats .................................................................................................. 10
  4 Measurement of shape/wall thickness of ball floats .............................................................. 10
  5 Flow characteristics test (pressure drop) ............................................................................... 10
  6 Tightness tests ....................................................................................................................... 13
  7 Discharge/reverse flow test .................................................................................................... 15

Changes - historic ......................................................................................................................... 16
SECTION 1 GENERAL

1 Introduction

1.1 Objective
The objective of this class programme (CP) is to give a description for Type Approval (TA) of air vent heads. For a description of the DNV GL type approval scheme in general and further information on general conditions and procedures for obtaining DNV GL TA certificate, see class programme DNVGL CP 0338, DNV GL Type Approval scheme.

The procedures and requirements described in this CP are applicable for obtaining DNV GL TA certificate based on requirements in:
— DNV GL rules for classification RU SHIP Pt.4 Ch.6
— DNVGL OS D101.

1.2 Scope
This CP gives a description of the procedures and requirements related to documentation, design and type testing applicable for TA of air vent heads.

This CP is not a design standard. TA is based on compliance with design requirements given in the DNV GL rules and/or other regulations and standards. The CP describes the applicable design requirements and how to document compliance with the requirements in order to obtain a TA certificate for the equipment. This includes, where relevant, technical requirements for how the type tests shall be performed.

1.3 Application
TA of equipment in accordance with this CP is not mandatory, but may be used as an alternative to case by case design approvals according to DNV GL rules for classification RU SHIP Pt.4 Ch.6 for equipment to be installed on DNV GL classed vessels. Type testing is mandatory for both type approval and case by case approval.

A TA certificate in accordance with this CP will confirm compliance with the requirements in the DNV GL rules RU SHIP Pt.4 Ch.6 and DNVGL OS D101. The TA certificate will not confirm compliance with requirements in other parts of the rules. In case additional requirements in other parts of the rules shall be covered by the TA certificate, this shall be specified in the application for TA and will be stated in the TA certificate.

2 Documentation
For TA of air vent heads the following documentation shall be submitted:
— Application for TA
— Assembly drawings (for each type/size) with all required dimensional data
— Part list including material specification
— Plots of differential pressure versus volume flow resulting from flow characteristic test report
— Type test reports, see Sec.3.
SECTION 2 PRODUCT REQUIREMENTS

1 Material requirements

1.1
All parts shall be made of material resistant to sea water and tank media as applicable. Where corrosion protection by coatings or other measures are necessary, the appropriate surface preparation and coating procedure shall be specified and submitted. Consideration shall be given to galvanic corrosion issues. The traditional stainless steels, including types 304, 316 or 316L, are not considered suitable for use in seawater systems.
For selection of suitable stainless steel material the pitting resistance equivalent number (PREN) \( W = \%Cr + 3.3\%Mo + 16\%N \), shall not be less than 30.
In case of aluminium, sea water suitable casting alloys, e.g. EN AC-51400 (AlMg5(si)), shall be used.

1.2
Air vent heads made of galvanized steels shall be protected by hot dip galvanizing. The zinc layer shall be 70 to 100 microns.

1.3
For areas of the air vent heads susceptible to erosion (e.g. those parts directly subjected to ballast water impact when the tank is being pressed up, for example the inner chamber area above the air vent head, plus an overlap of 10° or more either side) an additional hard coating shall be applied. This shall be an aluminum containing epoxy, or other equivalent, coating, applied over the zinc layer.

1.4
Closures and seats made of non-metallic materials shall be compatible with the media intended to be carried in the tank and to seawater and suitable for operating at ambient temperatures between -25°C and 85°C.

2 Design requirements

2.1
Air vent heads shall be so designed that they will withstand both ambient and working conditions, and be suitable for use at inclinations up to and including ±40°.

2.2
Air vent heads shall be self-draining.

2.3
The inner and the outer chambers of an air vent head shall be of a minimum thickness of 6 mm. Where side covers are provided and their function is integral to providing functions of the closing device, they shall have a minimum wall thickness of 6 mm.
2.4
The maximum allowable tolerances for wall thickness of floats shall not exceed ± 10% of the wall thickness.

2.5
The design of the air vent head shall provide a flow capacity corresponding to that of the connected stand pipe. Such hydrodynamic behaviour shall be proven through a flow characteristics test (pressure drop).

2.6
Suitable guides for the float shall be provided to ensure undisturbed operation under all working conditions of heel and trim, up to an inclination of 40°. Appropriate design measures shall be taken to prevent damage to the float and inner chamber during operation.

Guidance note:
A float may be ball, disc or other shape.

---end of guidance note---

2.7
Air vent heads shall be constructed to allow inspection of the closure and the inside of the casing as well as changing the seals.
SECTION 3 TYPE TESTING

1 General
Each type and size of air vent head shall be subject to the following tests:

— Tests on floats:
  — Impact test
  — Compression loading test (for non-metallic floats)
  — Shape and wall thickness (for ball floats).
— Tests on fully assembled air vent heads in the following order:
  — Flow characteristic test (also known as pressure drop test)
  — Tightness tests
  — Discharge/reverse test.

Type testing shall be carried out on test specimens representative of the production. Visual inspection and dimensional check shall be performed before the type tests carried out. Test reports shall make reference to the corresponding assembly drawings. The tests shall be carried out in a laboratory recognised by the society or witnessed by a DNV GL surveyor. Relevant test reports shall be issued either by the laboratory or stamped by the surveyor witnessing the tests.

Guidance note:
A recognised laboratory is one accredited in accordance with ISO/IEC 17025 or equivalent.

---end---of---guidance---note---

2 Type tests on non-metallic floats
Impact and compression loading tests shall be carried out on the floats before and after preconditioning in accordance with Table 1:

Table 1 Impact and compression loading tests

<table>
<thead>
<tr>
<th>Test conditions</th>
<th>Test Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-25°C</td>
</tr>
<tr>
<td>Dry</td>
<td>To be done</td>
</tr>
<tr>
<td>After immersing in water</td>
<td>To be done</td>
</tr>
<tr>
<td>After immersing in fuel oil</td>
<td>Not required</td>
</tr>
</tbody>
</table>

Immerging in water and fuel oil shall last for at least 48 hours.
Note: Depending on the float size and material type, the test temperature may be reduced in agreement with DNV GL.

2.1 Impact test
The test shall be conducted on a pendulum type testing machine. The floats shall be subjected to 5 impacts of 2.5 Nm each and shall not suffer permanent deformation, cracking or surface deterioration at this impact loading.

Subsequently the floats shall be subjected to 5 impacts of 25 Nm each. At this impact energy level some localized surface damage at the impact point may occur. No permanent deformation or cracking of the floats shall appear.
2.2 Compression loading test

Compression tests shall be conducted with the floats mounted on a supporting ring of a diameter and bearing area corresponding to those of the float seating with which it is intended that float shall be used. For ball type float, loads shall be applied through a concave cap of the same internal radius as the test float and bearing on an area of the same diameter as the seating. For a disc type float, loads shall be applied through a disc of equal diameter as the float.

A load of 3500 N shall be applied over one minute and maintained for 60 minutes. The deflection shall be measured at intervals of 10 minutes after attachment of the full load. The record of deflection against time is to show no continuing increase in deflection and, after release of the load, there shall be no permanent deflection.
3 Type tests on metallic floats
Tests shall be conducted in accordance with [2.1]. The tests shall be carried out at room temperature and in dry conditions.

4 Measurement of shape/wall thickness of ball floats
The surface and the circularity of the balls shall be inspected. One ball shall be cut in 2 halves, and the maximum and minimum thickness shall be measured. The maximum allowable tolerances for wall thickness of ball floats shall not exceed ±10% of the nominal thickness.

5 Flow characteristics test (pressure drop)

5.1
The flow characteristics of the air vent heads shall be determined. Measuring of the pressure drop versus rate of volume flow shall be carried out using water and with any intended flame or insect screens in place.

Guidance note:
Tests of air vent heads with a wire mesh may be accepted for the same type/size of air vent heads without a mesh installed.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

The test shall be carried out with orifice plates, and for each measuring point the following data shall be recorded
— differential pressure
— flow coefficient (C) of the orifice
— Reynolds number (ReD)
— flow rate and pressure drop at pipe head.

The flow characteristic curves shall be presented graphically in a diagram corresponding to diagram shown in Figure 3. The following conditions shall be satisfied:
— Measuring equipment for mass and volume flow shall comply with recognised standards.
— The orifice plate shall be fitted where the flow is as laminar as possible; this requirement is considered met if the length of the straight pipe upstream and downstream of orifice plate is according to the standard.
— The test medium should be water. If another test medium is used, the specific gravity and the viscosity under the operating conditions shall be documented.
— The volume flow shall be kept constant.
— The pipe shall be completely filled with the test medium.
— The test shall not result any defect on the air vent head, e.g. sealing/seats.
Figure 3 Typical curves for differential pressure (pressure loss) dependent on volume flow for different sizes of air vent heads of same design.

5.2

The test arrangement shall be as shown in Figure 5. If a pump with required capacity is not available, it may be replaced by a container of sufficient volume, which can provide the required static pressure. The volume flow should be calculated as follows:

\[
V = \frac{3}{4} \cdot d^2 \cdot c \cdot \sqrt{\frac{2 \cdot \Delta P}{\rho (\text{H}_2 \text{O})} (3600)} \quad \text{m}^3/\text{h}
\]

Figure 4 Volume flow
Table 2 Symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>inside diameter of piping</td>
<td>(m)</td>
</tr>
<tr>
<td>c</td>
<td>flow coefficient of orifice plate. As an approximation c may be taken to be ( \alpha ).</td>
<td>( - )</td>
</tr>
<tr>
<td>( \alpha )</td>
<td>( \frac{A_m}{A_d} )</td>
<td>( - )</td>
</tr>
<tr>
<td>d</td>
<td>inner diameter of orifice plate</td>
<td>(m)</td>
</tr>
<tr>
<td>A</td>
<td>area of piping cross section</td>
<td>(m²)</td>
</tr>
<tr>
<td>( W )</td>
<td>( \frac{V}{A} )</td>
<td>(m/s)</td>
</tr>
<tr>
<td>g</td>
<td>acceleration of test medium</td>
<td>(m/s²)</td>
</tr>
<tr>
<td>( \rho )</td>
<td>specific gravity</td>
<td>(kg/m³)</td>
</tr>
<tr>
<td>( \Delta p )</td>
<td>differential pressure</td>
<td>(N/m²)</td>
</tr>
<tr>
<td>( V )</td>
<td>volume flow</td>
<td>(m³/hr)</td>
</tr>
<tr>
<td>( h )</td>
<td>differential pressure taken at standard orifice plate measured by U-tube manometer with mercury</td>
<td>(mmHg)</td>
</tr>
<tr>
<td>( \rho_{H_2O} )</td>
<td>Specific gravity of water, shall approximately be taken as 1000</td>
<td>(kg/m³)</td>
</tr>
</tbody>
</table>

Exact value of c for standard orifice plates has been experimentally determined and may be taken from relevant diagrams. However c may conservatively be taken as 0.6.

5.3 Calculation of resistance coefficient for the vent head

The resistance coefficient may be calculated according to the following:
where:

\[ \zeta = \frac{2\Delta P_v}{W^2 \cdot \rho} \]

\[ \Delta P_v \] = pressure losses

\[ W \] = velocity of test medium (m/s)

\[ \rho \] = specific gravity (kg/m³).

The dynamic coefficient for each type and size of vent heads shall be mentioned on the certificate.

6 Tightness tests

An air vent head shall be subjected to a series of tightness tests involving not less than two (2) immersion cycles under each of the following conditions:

— The air vent head shall be submerged slightly below the water surface at a velocity of approximately 4 m/min. and then returned to the original position immediately. The quantity of leakage is to be recorded.

— The air vent head shall be submerged to a point slightly below the water surface. The submerging velocity shall be approximately 8 m/min and the air pipe vent head shall remain submerged for not less than 5 minutes. The quantity of leakage shall be recorded.

Each of the above tightness tests shall be carried out in the normal position as well as at an inclination of 40 degrees under the strictest conditions for the device. In cases where such strictest conditions are not clear, tests shall be carried out at an inclination of 40 degrees with the device opening facing in three different directions: upward, downward, sideways (left or right). See Figure 6 - Figure 9.

The maximum allowable leakage per cycle shall not exceed 2 ml/mm of nominal diameter of inlet pipe during any individual test.

Guidance note:

For example, maximum allowable leakage per cycle for an air vent head with a DN80 inlet pipe will be 160 ml.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---
Figure 7 Inclination 40 degrees opening facing upward

Figure 8 Inclination 40 degrees opening facing downward
7 Discharge/reverse flow test

The air vent head shall allow the passage of air to prevent a vacuum occurring within the tank. A reverse flow test shall be performed to determine the flow at which the float will be sucked into the sealing seat and blocking the inlet of the air vent head. For this purpose a vacuum pump or another suitable device shall be connected to the air vent head. The air flow velocity shall be applied gradually at a constant rate until the float gets sucked into the inlet and blocks the flow. The velocity at the point of blocking shall be recorded. 80% of this value shall be stated in the type approval certificate.
CHANGES – HISTORIC

There are currently no historical changes for this document.
Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our 16 000 professionals are dedicated to helping our customers make the world safer, smarter and greener.