



Guidelines for testing and application of automatic closing
devices preventing progressive flooding in probabilistic
damage stability calculations

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1 Preamble

The function of air pipe closing devices is to allow air to enter and leave the tank freely when necessary, in order to prevent extreme pressures in the tank. At the same time the device shall prevent the ingress of water into the tanks when the air pipe end becomes submerged.

For cargo ships of 80 metres in length and upwards, SOLAS requires a probabilistic damage stability calculation. One of the requirements to be met in damaged conditions that contribute to the final result, is that openings through which progressive flooding may occur may not be submerged in the final stage of flooding. However, openings which are closed while at sea that prevent the ingress of substantial amounts of water, need not to be taken into account in the calculation.

SOLAS does not provide maximum values for acceptable leakage for external openings. However SOLAS accepts minor leakage for internal openings. These guidelines include test values and limits of leakage related to values included in IMO Regulations and assumptions; for instance the acceptable quantity of leakage through closed watertight doors and openings in, or penetrations through, internal watertight bulkheads. The survivability of the ship is not endangered since these limited quantities of ingress can be controlled with the usual ballast pump capacity. Besides the possibility to remove leakage water with the ship's systems, the limited quantities of water that may eventually seep through are way below the accuracy of the damage stability calculations.

These guidelines define the standards the closing devices on air pipes should meet to be accepted as means to prevent progressive flooding within the framework of the probabilistic calculation method, and contains criteria for the good functioning during their life time.

These guidelines are a SOLAS equivalent. These guidelines do not replace the requirements of other Conventions or Regulations such as the Load Line Convention.

Legal relationship to the SOLAS Convention

According to SOLAS Chapter II-1 Regulation 4.2, the Administration may, for a particular ship or group of ships, accept alternative methodologies if it is satisfied that at least the same degree of safety as represented by the Convention is achieved. These guidelines contain such an alternative methodology and should be considered as a SOLAS Chapter I, Regulation 5 equivalent arrangement.



1 General principles

- 1.1 When the probabilistic damage stability calculation allows immersion of the automatic closing devices on deck in the final stage of flooding, and does not consider these devices as down-flooding point, the requirements of paragraph 1.1.1 to 1.1.3 of these guidelines shall apply:
 - 1.1.1 The Automatic closing devices Preventing progressive Flooding (APF) shall be type tested and certified according Annex A of these guidelines.
 - 1.1.2 Throughout the lifetime of the ship control measures for the APF as stipulated in Annex B are applied. The control measures are required to continuously monitor that the design of the device is the fool proof and meets the maintenance free requirements as described in Annex A under all operational circumstances.
 - 1.1.3 Documentation and certificates as stipulated in these guidelines are to be carried on board.
- 1.2 Wherever these guidelines leave room for interpretations the Administration may, upon request of ship designers, ship owners, RO's or other parties, provide guidance and establish unified interpretations.
- 1.3 Where these guidelines prescribe the use of standardized formats, the Administration shall provide such a format and make these available to the users.



2 Application

- 2.1 The application of the principles described in these guidelines for APF as defined in Regulation 3.3 of these guidelines, is limited to cargo ships for which the damage stability is calculated according the SOLAS probabilistic damage stability requirements.
- 2.2 These guidelines shall not be applied to cargo ships that comply with subdivision and damage stability regulations of other instruments developed by the IMO as stipulated in SOLAS Chapter II-1 regulation 4.
- 2.3 These guidelines are only applicable to APF and not to other openings. Other openings such as doors and hatches shall be considered according the applicable SOLAS regulations for these openings.
- 2.4 If during the approval of the damage stability calculation, the competent authority performing the approval has reason to believe that an APF, connected to an intact compartment, is immersed more than 10 meters below the damaged water line, the competent authority shall require further details about this immersion from the designer. In case the device is immersed deeper than 10 meters and connected to an intact compartment, the probability of survival of this damage case s_i shall be taken as zero.
- 2.5 For ships of unusual design and ships with special features where the safe and uninterrupted working of the APF can be doubted, the Administration or the RO on her behalf shall require further proof of the uninterrupted operation of the APF in all envisaged conditions.
- 2.6 APF fitted on board ships that are frequently used in sea areas where icing may occur, shall be fitted with effective devices preventing the accretion of ice in the device or other means to ensure an uninterrupted operation of the device as described in these guidelines. On board ships not fitted with such de-icing devices, special attention shall be paid to the continuous operability of the APF when operating in sea areas where icing may occur. Instructions to that effect shall be incorporated in the ship's ISM manuals.



3 Definitions

- 3.1 Administration: Government of the State whose flag the ship is entitled to fly.
- 3.2 Automatic closing device: Self-acting device that prevents the ingress of water during temporary immersion of de-aeration openings.
- 3.3 APF: Automatic closing device Preventing progressive Flooding. Automatic closing device, compliant with these guidelines, that prevents the ingress of water under any envisaged circumstance and that need not to be considered as downflooding point in the probabilistic damage stability calculation. In general APF's are fitted at pipe ends above the weather deck;
- 3.4 Fool proof design: Device of such a design that it is, under normal circumstances, impossible to mount parts incorrectly or to disable the device by placing parts or appendages incorrectly.
- 3.5 Maintenance free (for a period of x years): Device of such a design and construction that the device remains operable and reliable without the need for maintenance for a period of x years, specified by the manufacturer. This period shall be at least five years. Special attention shall be paid to the construction and fitting of the seal/gasket to warrant the operability of the device.
- 3.6 Manufacturer: Producer of APF.
- 3.7 RO: Organization authorized by the Administration.
- 3.8 SOLAS: International Convention for the Safety of Life at Sea 1974, as amended.
- 3.9 Technical documentation: Complete and comprehensive file, consisting of all drawings, calculations and other documentation, revealing the designs, performance and test reports of the APF.
- 3.10 Type approval: Procedures for evaluating equipment produced, in accordance with the appropriate testing requirements and the issue of the appropriate certificate.
- 3.11 Type test: Test in conformity with the requirements of Annex A of these guidelines demonstrating the functionality of the APF.



4 Documentation and certificates

Each ship designed and built according to the principles stipulated in these guidelines shall have a notice to that effect on the Cargo Ship Safety Certificate or Cargo Ship Safety Construction Certificate. In addition, a copy of the type approval certificate of all types and sizes of APF preventing progressive flooding fitted on board that ship shall be carried on board. Operational requirements as detailed in Annex B are to be recorded in the ship's ISM manuals.

5 Delegation of duties to RO

Where in these guidelines tasks or duties are assigned to 'the Administration or the RO acting on her behalf', an RO may perform these tasks and duties as instructed by the Administration.



Annex A Type testing of Automatic closing devices Preventing progressive Flooding

1 General

APF accepted under these guidelines are subject to type testing. For devices compliant with, and successfully tested according to the requirements of this Annex, the Administration issues a type approval certificate.

2 Requirements for test laboratories

Test laboratories where the operational functionality of APF is demonstrated shall be accredited as testing laboratory by a national accreditation body. In the absence of such an accreditation another equivalent quality system may be accepted by the Administration or the RO acting on her behalf.

In any case, the performed test shall result in a full report displaying all required and measured data throughout the time. The report shall demonstrate the circumstances of the device during the test and the test environment. This report, including the data, may be made available in an electronic format.



3 Obligations of the manufacturer of APF

- 3.1 The manufacturer of the APF shall submit a written request to the Administration for a type approval. A copy of the request shall be sent to the RO of his choice. The request shall, as a minimum, contain:
 - The name and address of the manufacturer;
 - Technical details of the product to be tested, including the product name and/or number;
 - The proposed time and place of the type testing if these are already known.
- 3.2 The manufacturer of the APF shall guarantee that the concerned device is representative for the whole series of products. In case the RO, test laboratory or Administration doubts whether the device subject to the tests is representative for the series, additional devices may be required to be tested or compared.
- 3.3 When a series consists of several sizes or types, each size or type shall be tested individually unless the Administration is convinced that the difference between two or more types does not affect the test results. In that case one test may cover two or more types or sizes. The Administration shall inform the involved RO accordingly about such a decision.
- 3.4 The manufacturer is responsible for the measurement data and shall provide a complete and comprehensive report of all data collected during the tests.
- 3.5 When APF can be fitted with devices preventing the passage of flame into the tank, de-icing devices or other appendages, the RO on behalf of the Administration shall decide whether these appendages may influence the compliance with these guidelines. If deemed necessary additional tests with the appendages fitted shall be carried out. In that case a separate certificate shall be issued for the automatic closing device with and without that appendage. In other cases the type certificate of the device shall mention the appendages that may be fitted.
- 3.6 The test shall be witnessed by a RO on behalf of the Administration. The Administration shall be informed by the manufacturer on time when the test will be carried out, in order to decide to witness the test. The RO shall endorse the report which contains the results of the test.
- 3.7 The uninterrupted functioning of the device during the maintenance free period shall be guaranteed by the manufacturer. Detailed instructions for replacements of parts or other required actions in order to reinstate a new maintenance free period at the end of such a period shall be provided by the manufacturer.
- 3.8 Information as detailed under 3.7 shall made available to the end user.
- 3.9 The manufacturer must take all measures necessary ensuring that all the individual devices of a series produced are identical to the tested device of that series and have the same performance.
- 3.10 The manufacturer must keep a copy of the type approval certificate, the test results and the technical documentation for at least 10 years after the last device in conformity with a valid type certificate has been produced.
- 3.11 The manufacturer shall accept all costs for the type testing and certification.
- 3.12 The manufacturer must inform the Administration immediately of all modifications to the approved product. These modifications are subject to additional approval if required by the Administration. The Administration shall inform the involved RO accordingly about such a decision.



4 Technical requirements for APF

- 4.1 The capability of the APF to prevent the ingress of substantial amounts of water shall be demonstrated by a type testing as stipulated in article 5 and 6 of this Annex.
- 4.2 Design and construction of the APF shall be such that the device is maintenance free for the period specified by the manufacturer. The manufacturer shall demonstrate, to the satisfaction of the RO, that the device will operate without maintenance for the prescribed period. Special attention shall be paid to the construction and fitting of the seal / gasket and appendages, to warrant the operability of the device during the maintenance free period.
- 4.3 The APF shall be of a fool proof design. It shall not be easily rendered inoperable or less performing due to incorrect maintenance or repairs. The RO shall verify whether it is demonstrated that the device will not, under normal circumstances, become inoperable or less performing due to improper use and/or fitting of appendages and/or parts.
- 4.4 The APF and all its parts shall be suitable for use in the environment where it is applied. The housing of the device shall be of non-corroding material or shall be properly protected against corrosion. The moving parts and assembly materials shall be of a material that is corrosion resistant in the marine environment. When parts of different metallic materials are combined, special attention shall be paid to the prevention of galvanic corrosion.
- 4.5 All parts made of non-metallic materials are to be constructed of materials compatible with the media intended to be carried in the tank and to seawater and suitable for operating at ambient air temperatures between -25°C and 85°C. The compatibility and suitability of materials shall be documented in the test reports.
- 4.6 The design of the APF shall be such that it is possible to perform the checks and surveys as prescribed by the manufacturer and in article 2 of Annex B. Visual or other checks shall be possible without removal of any part of the device. This requirement also applies to devices which are fitted with appendages such as devices preventing the passage of flames into the tank, de-icing apparatus or other.
- 4.7 Each APF compliant with these guidelines shall be permanently marked with the year of production and the product name and / or type number in order to allow identification of the device on board of ships and on the type certificate.



5 Test conditions

In order to ensure adequate closure of the APF under all envisaged conditions, the devices shall be tested under water pressures and heeling angles as stipulated in paragraph 5.1 to 5.4 below.

- 5.1 In order to simulate wear and tear during the life time of the device each device used for the tests prescribed under 5.2 and 5.3 shall be subject to a flow test with water of at least 30 minutes before these tests of 5.2 and 5.3 are performed. During the test water shall be pumped through the device with a water pressure of at least 50 kPa. After the flow test, no maintenance or replacement of parts may be performed before the device is subject to the tests of 5.2 and 5.3.
- 5.2 Each APF shall be subject to full scale endurance tests in sea water under two different pressures. The pressure heads shall be measured from the lowest point from which water may enter the device if the closing mechanism would fail. In general this will be the upper edge of the seal.
 - Test 1: A test with a pressure head of 0,10 meters water (1 kPa).
 - Test 2: A test with a pressure head of 10,0 meters water (100 kPa)
- 5.3 The tests prescribed under 5.2 shall be performed in an upright position and under 45° inclination, both in longitudinal and transverse direction. However, when the device is symmetrical, the Administration or RO on her behalf may dispense with one of the heeled tests.
- 5.4 The tests required under 5.2 shall, for each inclination prescribed under 5.3, last for at least 8 hours.

6 Test performance requirements

After completion of the tests prescribed in article 5 of this Annex, the amount of leakage water shall be determined. A device may be regarded as APF for the purpose of these guidelines when the total amount of water after completion of each test cycle of 8 hours is not more than:

- 6.1 20 milliliters of water multiplied by the nominal internal pipe diameter (in millimeters) of the device or,
- 6.2 8 litres of water; whichever is the lesser.



7 Type certificate

- 7.1 Each type of APF compliant with and successfully tested according this Annex will be certified by the Administration. A certificate remains valid for the time specified on the certificate, with a maximum of five years. After expiration of the certificate, the certificate may be renewed by the Administration. A written request thereto shall be submitted by the manufacturer. The producer shall send a copy of the request to the RO involved in the original type testing of that device.
- 7.2 The manufacturer of APF shall inform the Administration of any change the manufacturer intends to make to the product. The Administration shall decide whether such a change renders the type certificate issued invalid and shall inform all authorized RO's accordingly.
- 7.3 Each type certificate shall at least contain the following information:
- Name of the manufacturer;
 - Product name or number as required under article 4.7 of this Annex and a description of the device;
 - Date of type testing and test results;
 - Validity of the certificate;
 - A reference to these guidelines;
 - Date of issue and expiry date;
 - Signature and name of the authorized representative of the Administration; and
 - Reference to appendages such as flame arrestors or de-icing devices if the RO allows so under article 3.5 of this Annex.
- The certificate shall be drawn up according the format attached in Annex C of these guidelines.
- 7.4 In case of an application for a renewal certificate, based on a previously held type test, the manufacturer shall guarantee that the product to be certified is identical to the product tested. This declaration shall be validated by the Administration or the RO on her behalf. The Administration or the RO on her behalf shall decide whether a visit of the production location is necessary for this validation.
- 7.5 In case these guidelines are amended after the date of type testing, the existing test results shall not be used as a base for new certificates, unless the Administration decides that new tests are not necessary.
- 7.6 Notwithstanding paragraph 7.1, the Administration may withdraw a type certificate if the Administration has reason to believe that an already approved type no longer meets the requirements of these guidelines. Grounds for such a withdrawal may be found in reports and records as described in Annex B. The Administration shall inform all authorized RO's accordingly.



Annex B Operational requirements for ships fitted with Automatic closing devices Preventing progressive Flooding

1 General

- 1.1 In order to validate that devices certified under these guidelines are maintenance free for the specified period and of fool proof design, an enhanced monitor and survey programme is applicable to APF.
- 1.2 Close to each APF an identification shall be affixed indicating the position of the device and the compartment to which it is connected. This identification shall be used in the communication required under article 2.4 and 3.4 of this Annex and shall be used on the damage control plan.

2 Ship based performance verification regime

Ship owners shall at least take the following measures, for all ships where APF according these guidelines are fitted:

- 2.1 After the maintenance free period specified by the producer of the device, the ship owner shall replace the complete device or those parts specified by the producer as prescribed in the procedure required under article 3.7 of Annex A of these guidelines. The necessary provisions for these replacements shall be incorporated in the ship's Safety Management System and records of replacements shall be kept available on board for inspection by the RO, flag State and port State control.
- 2.2 Once every month, all APF shall be checked on proper functioning aiming to verify the manufacturers maintenance free period. The necessary provisions for this performance verification shall be incorporated in the ship's Safety Management System and records of performance verifications shall be kept available on board for inspection by the RO, flag State and port State control. During these monthly checks attention shall also be paid to unwanted alterations and the performance of the devices, including but not limited to:
 - damage due to cargo operations,
 - painting on seals, flame screens etc,
 - damage of flame screens,
 - damage and wear of seals,
 - damage and wear of floating devices.
- 2.3 If the device does not fulfill the functional requirements as described in Annex A, immediate repair shall take place. Sufficient spare parts for all types and sizes of automatic closing devices installed shall be carried on board.
- 2.4 In case devices need repair as described under 2.3, the ship owner shall inform the Administration accordingly, specifying the type of repair carried out as well as the make, type, certificate number and age of the affected device. This information shall be provided in a format provided by the Administration. The Administration shall monitor this information and decide whether further measures are necessary.



3 Additional responsibilities of the RO's

- 3.1 All APF shall be subject to an annual and renewal survey for verification of satisfactory operation by the RO, including an inspection of all internal parts of all devices fitted on board. All rejected devices are to be repaired or replaced immediately.
- 3.2 The annual 100% inspection of internal parts as required under 3.1 of this Annex may be dispensed with in the following cases:
 - The automatic closing devices are not more than 10 years old; and
 - The surveyor of the RO finds that all devices are in good condition; and
 - During every annual safety construction survey, internal and external parts of 20% of the devices fitted are inspected by the RO and found without defect; and
 - The selection of 20% of the devices to be inspected shall be such that every device shall be inspected at least once every 5 years; and
 - In the previous year no repairs as detailed under article 2.4 of this Annex have been necessary on board the ship under consideration.
- 3.3 Notwithstanding article 3.2, in any case where during an annual or renewal survey a device is found requiring maintenance or replacement of parts, other than replacements necessary to re-instate a new maintenance free period, an inspection of all internal parts of all devices on board shall be carried out.
- 3.4 In any situation where one or more of the inspected devices need to be repaired or replaced during a survey, other than replacements necessary to re-instate a new maintenance free period, the RO shall inform the Administration without delay using the format as stipulated in article 2.3 of this Annex. The Administration shall decide whether further measures are necessary.



Annex C Form of certificate



The Netherlands

APPROVAL : Automatic closing device Preventing progressive Flooding
Manufacturer : <Name of manufacturer>
Type : <Name and/or number of type>

THE MINISTER OF INFRASTRUCTURE AND THE ENVIRONMENT

Regarding:

- the request of <manufacturer>, at <address>, of <date>;
- the underlying test report dated <date> validated by <classification society>;
- the declaration of <the manufacturer> of <date> stating that the product manufactured are identical to the type as tested;

Considering:

- article 34 of the "Regulation Safety Seagoing Vessels";
- the requirements of the 'Guidelines for testing and application of automatic closing devices preventing progressive downflooding in probabilistic damage stability calculations', notified to the IMO under by Circular letter XXXX;

Declares:

that the automatic closing device(s) preventing progressive flooding <name and/or number>, have (has) been approved for use as automatic closing device preventing progressive flooding in probabilistic damage stability calculations for cargo vessels, to which the Netherlands Shipping Act is applicable;

The following appendages may be fitted on the automatic closing device progressive flooding:

- <appendages such as flame screens if allowed under Annex A, art. 3.5 of the guidelines>
- ..



The Netherlands

Conditions:

1. The automatic closing device preventing progressive flooding shall be installed in accordance with the manufacturer's instructions;
2. The survey and monitor programme for the automatic closing device shall be in accordance with the requirements of Annex B of the 'Guidelines for testing and application of automatic closing devices preventing progressive flooding in probabilistic damage calculations', notified to the IMO under by Circular letter XXXX.

Issued at Rotterdam, <date>, under no. <XXXX>/20XX

The validity of this certificate extends from <date>, under the above-mentioned conditions, until <date>

THE HEAD OF THE NETHERLANDS SHIPPING INSPECTORATE,
on behalf,

<NAME>
Senior Surveyor Netherlands Shipping Inspectorate

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