

# CLASS PROGRAMME

## Type approval

DNVGL-CP-0165

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## Cable and pipe penetrations



## 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.

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## CHANGES – CURRENT

This is a new document.

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## SECTION 1 GENERAL

### 1 Introduction

#### 1.1 Objective

The objective of this class programme (CP) is to give a description of the type approval of cable and pipe penetrations.

For a description of the the Society's type approval scheme in general and further information on general conditions and procedures for obtaining the Society's type approval certificate, see the Society's document DNVGL CP 0338 *Type approval scheme*.

The procedures and requirements described in this CP are applicable for obtaining the Society's type approval (TA) certificate based on requirements in:

- DNV GL rules for classification of ships [RU SHIP Pt.4 Ch.6 Sec.3 \[1.4.6\]](#) (pipe penetrations)
- DNV GL rules for classification of ships [RU SHIP Pt.4 Ch.8 Sec.1 Table 4](#) (cable penetrations)
- SOLAS 74, Issue 2014, Chapter II-2, Regulation 9
- IMO RESOLUTION MSC.307(88) (2010 FTP Code), Annex 1, Part 3 - *Test for "A", "B" and "F" class divisions*.

#### 1.2 Scope

This CP gives a description of the procedures and requirements related to documentation, design and type testing applicable for TA of cable and pipe penetrations with regard to fire safety, including watertightness and gastightness for class "A" penetrations. The conditions outlined in this CP shall be fulfilled before a type approval certificate is issued.

#### 1.3 Application

DNV GL rules for classification of ships [RU SHIP Pt.4 Ch.8 Sec.1 Table 4](#) and [RU SHIP Pt.4 Ch.6 Sec.3 \[1.4.6\]](#) require that cable and pipe penetrations are type approved by the Society, and TA in accordance with this CP is thus mandatory for equipment to be installed on vessels classed with the Society.

A TA certificate in accordance with this CP will confirm compliance with the requirements in the Society's rules as specified in [\[1.1\]](#).

A TA is not required if the pipe penetration is made of steel or equivalent material having a thickness of 3 mm or greater and a length of not less than 900 mm (preferably 450 mm on each side of the division), and no openings. Such penetrations shall be suitably insulated by extension of the insulation at the same level of the division.

Initial TA certificates shall not be issued on the basis of test reports which are more than 5 years old at the date of application for type approval. If the type approval depends on several test reports with different dates, the date of the oldest report governs. However, renewal of existing type approval certificates without retesting may be carried out provided that the test report is not more than 15 years old and that no alteration of components or construction has been made to the product.

## 1.4 Definitions

**Table 1 Definitions**

<i>Term</i>	<i>Definition</i>
<i>penetration</i>	Same meaning as "sealing system". Consist of a metal frame respectively case or conduit sleeve, the sealing material (sealing compounds, packing modules or plugs) the insulation and additional auxiliary means possibly required.
<i>auxiliary means</i>	Auxiliary means are materials used for packing the open ends of the penetration device (cable or pipe-exit openings). They serve the purpose of ensuring the tightness and minimum spacing between the cables/pipes and penetration casing required for filling the sealing compound.
<i>packing and plug systems</i>	Packing and plug systems are modular systems. Packing systems consist of a compression frame, packing modules, anchorage and intermediate plates, and a terminal seal with compression screw. Plug systems normally consist of a conduit sleeve and a sealing plug for sealing of the conduit at both ends.
<i>sealing compounds</i>	Sealing compounds are products which have a good flow capability, consisting of one or more components. When cured, the compound forms the sealing element of the sealing system.
<i>sealing compound systems</i>	Sealing compound systems are sealing systems realised by means of sealing compounds. They generally consist of the conduit sleeve, the auxiliary means for sealing the ends and maintaining the spacing and the sealing compound.
<i>injection mouldings</i>	Injection mouldings are products for sealing of internal voids in the penetrations.
<i>sleeve</i>	Mould, frame, box, coaming etc. in which the cables/pipes runs through.

## 2 Documentation

For TA of Cable and Pipe Penetrations the following documentation shall be submitted:

- application for TA
- drawings and technical specifications of the sealing system components including material specification and service range
- in case of sealing compounds, a manufacturer's declaration concerning the compatibility of the sealing system with the cables as described in [Sec.2 \[2.6\]](#)
- drawings of the test setup and of the sealing system itself including specification of type and cross section of the cables, dimensions and material of the pipes and their supports, the dimensions of the pipes (length, outer diameter and wall thickness), distance between cables/pipes, distance between cable/pipe and the sleeve, the length of sleeve and the insulation design. Furthermore a copy of the approved drawing of the division applicable for the fire tests
- in case that also the approval of the sealing system for water and gas tight bulkheads has been applied for, additional drawings of the test bench set up for the tests specified in [Sec.2 \[4\]](#) shall be submitted
- fire test reports issued by IMO recognised test laboratory including insulation drawings of the cable and/or pipe penetration as tested
- optionally pressure test reports. Pressure tests shall be witnessed and the test reports shall be endorsed respectively stamped by the the Society's representative
- a manufacturer's declaration concerning asbestos-free compliance of all relevant components of the sealing system shall be submitted.

- for TA of new products a sample of the penetration shall, when requested by the Society, be sent for evaluation
- report from initial assessment.

## SECTION 2 TECHNICAL REQUIREMENTS

### 1 Design requirements

The product shall be designed to comply with the following rules and regulations:

- 1) SOLAS Reg. II-2/9.3.1
- 2) IMO 2010 FTP Code Part 3
- 3) IMO MSC/Circ.1120
- 4) IMO MSC.1/Circ.1488
- 5) Asbestos free according to SOLAS Reg. II-1/3-5.
- 6) Applicable parts of this CP.

### 2 Design guidelines

Penetrations shall not inadmissibly impair the strength, tightness and fire resistance of the hull structure. They shall be of sufficient mechanical strength and be protected against corrosion.

Penetrations shall not be made with visible openings (to avoid passage of smoke, etc.). Further, the penetrations shall be made in such a way that ship movement, vibrations, room over-and under pressures, small impacts etc. not will cause stuffing/blocking materials to fall out of the penetration and leave visible openings. In practice, this means that loosely fitted stuffing/blocking materials not will be acceptable. Such materials shall therefore be fixed by adhesion, locking devices, tool mounted restraints, or similar.

With regard to the fire behaviour and water tightness, sealing systems shall meet the requirements given in Sec.2. The mechanical loads and temperatures occurring under operating conditions and temperatures shall not interfere with the tightness capability of the sealing system.

Employed materials for production of sealing compounds, packing modules and sealing plugs shall be suitable for the specified maximal operating temperatures.

Only complete systems including any auxiliary means can be approved. Approval of individual components is not part of this CP.

Penetrations in structural divisions shall not impair the structural strength of the division. The structural make-up of the penetration shall be fully described so that its use and the need for additional stiffening for the division can be fully assessed.

Loose mineral wool/insulation material (around and between cables/pipes) shall be retained by wire mesh or equivalent.

#### 2.1 Compound and injection mouldings

##### 2.1.1 Application and expansion behaviour

Sealing compounds shall remain flowable and workable for a sufficient period, and their expansion behaviour shall be as follows:

- minimum expansion after 24 hrs.  $\geq 0.5\%$
- maximum expansion after 28 days  $\leq 1\%$ .

##### 2.1.2 Curing time

Sealing compounds and or injection mouldings shall set within 24 hrs. and within a period not exceeding 30 days shall be sufficiently cured to ensure that a constant weight is attained.

Sealing compounds and injection mouldings together with the auxiliary means used, shall be so constructed that the curing of the compound within the stated period is ensured.



### 2.1.3 Water absorption

Cured sealing compounds respectively injection mouldings shall not be hygroscopic, and shall not crack, swell or dissolve under the action of water.

## 2.2 Packing and plug systems

Packing and plug systems shall have the following properties:

- packing and plug systems shall be simple to fit
- packing modules and plugs with suitably graded diameters matched to the ship's cable and outer pipe diameters shall be available
- packing modules shall have sufficient elasticity to ensure durable sealing action
- they shall be water-resistant
- plugs shall be marked with manufacturer's trade mark, type of material, type designation and size
- intermediate and anchor plates of non-magnetic materials shall be used when laying single-core AC cables.

## 2.3 Auxiliary means

It shall be ensured by appropriate auxiliary means that a minimum spacing, as specified by the manufacturer and as tested, is maintained between individual cables/pipes, and between the cables/pipes and the casing of the penetration.

Auxiliary means shall be proved in combination with the components used in the sealing system (e.g. sealing compound).

Auxiliary means shall not restrict the space for the sealing compound necessary for ensuring the tight-ness capability.

Auxiliary means shall be part of the penetration during the fire test. Examples of auxiliary means:

- packing material/insulating compounds
- putty
- intermediate layers of all kinds
- expansion elements.

## 2.4 Other sealing systems

Apart from the sealing compound, injection mould and packing systems referred to above, systems using foams or other materials may be employed for cable and pipe penetration systems, provided they comply with the requirements given in [1] and [3].

## 2.5 Additional evaluation and testing for penetrations of non-conventional designs

Reference is made to IMO MSC.1/Circ.1488.

"A"-class pipe penetrations and cable transits that are:

- 1) constructed without structural sleeves of minimum 3 mm thickness and minimum 60 mm length welded or bolted to the division; and/or
- 2) constructed with removable, soft or intumescent filling material;
- 3) are "those types of constructions which do not utilize conventional components of horizontal and vertical divisions" and shall be subject to additional testing and/or design criteria as described below.

Additional testing/design criteria:

Filling materials shall be adequately secured by bonded materials or mechanical means that cannot be removed without the use of tools in order to prevent damage by normal ship vibrations and pressures.

## 2.6 Compatibility of cables

Sealing systems, including the auxiliary means employed, shall be compatible with the cables used, i.e. the cables shall not undergo any inadmissible changes affecting, for example, their swelling behaviour or causing embrittlement, corrosion sheath decomposition or premature ageing.

Parts of sealing systems coming into direct contact with the cables shall be chemically approximately neutral (pH range: 6.5 – 8.5).

Where no special specifications are laid down for the cables, compatibility shall be ensured at least with regard to cables manufactured in accordance with the following standards:

Standards:

IEC 92-350

IEC 92-360

IEC 92-353

IEC 92-376

JIS 3410

DIN 89158, 89159, 89160.

## 3 Fire test requirements

### 3.1 General requirements

Penetrations shall be tested containing either cables or pipes. Penetrations containing both cables and pipes shall be avoided.

Testing for bulkhead is recommended with the insulated side not exposed to the fire, and for deck the insulated side is recommended to be tested exposed to the fire. Testing of "A-0" penetrations is recommended to be performed in uninsulated "A-0" deck/bulkhead.

Testing of "A-0" penetrations in "A-60" bulkheads with the bulkhead insulation on the non-exposed side may be accepted if there is minimum 200 mm uninsulated area around the penetration on both sides of the bulkhead. The test setup shall be submitted to the Society for verification before testing.

Any insulation used on and around the penetration during fire test, shall be kept there also when used in divisions with lower rating than fire tested. As an example: If the penetration is tested as A-60 penetration, any insulation fitted on the penetration itself, including the area 200 mm around it, will be required fitted also for penetrations in "A-0", "A-15" and "A-30" class divisions.

"A-0" cable and pipe penetrations shall not be approved without an "A-0" test although tested and approved as "A-60".

Uninsulated metallic pipes penetrating "A" or "B" class divisions shall be of materials having a melting temperature which exceeds 950 °C for "A-0" and 850 °C for "B-0" class divisions (ref. SOLAS 74/78, Reg.9.3 – 2014 issue).

Bolted penetrations: Bolted penetration shall be tested. Approved bolted penetrations may also be fully welded instead of bolting (tack welding is not accepted).

Cable and pipe penetrations intended for use in aluminium divisions shall be tested in aluminium divisions. A single test in an aluminium deck or bulkhead may be accepted for approval in both deck and bulkhead based on an evaluation by the test laboratory, provided that complete tests have already been performed in steel bulkhead and -deck for the same product.

Performance criteria are including integrity and insulation criteria. The insulation criteria are given at the end of this CP, see extract of the FTP Code 2010. For "A-0" penetrations the integrity criterion is relevant.

### 3.2 Fire test requirements for cable penetrations

The general construction of the test specimen for divisions of type "A" is specified in 2010 FTP Code, Annex 1, Part 3 - Test for "A", "B" and "F" class divisions, Appendix 2, A.IV – Cable Transits.

The penetrations shall be tested in maximum and minimum size in both deck and bulkhead. Both rectangular and circular penetrations, if applicable, shall be tested in both maximum and minimum sizes. The penetrations shall be tested with maximum filling. In addition the largest rectangular penetrations (provided that the surface area of the largest circular penetration is equal or less) shall be tested with minimum filling. We accept a test without any cables for minimum filling.

In cases where insulation is fitted to the cable(s), the distance(s) of  $500 \pm 50$  mm to which the cable shall project shall be taken from the end of the insulation as this is considered an integral part of the penetration(s) being tested and it is necessary that a length of unprotected cable is exposed to the furnace.

If any penetration protrudes less than 25 mm into unexposed side, two thermocouples shall still be fastened to the penetration, either on the sides or at the end (The thermocouples shall as far as possible be fastened to the steel parts of the penetration).

A range of different types of cables (i.e. in terms of number and type of conductor, type of sheathing, type of insulation material, size) shall be used, see [Table 1](#).

#### 3.2.1 Selection of cables

Different cable types and cross sections representative of those normally used on board ships shall be chosen for the tests.

The following aspects shall be observed:

- insulation material (e.g. EPR, XLPE, PVC)
- material of outer sheath (e.g. CR, PVC, SHF1 or SHF2)
- cross section and number of cores of each cable
- braided screen armouring.

Test specimens shall be furnished as listed in [Table 1](#).

Where this is not possible, comparable cabling shall be agreed on with the Society.

In the case of bulkhead penetrations the cables shall be so positioned in the penetration that the large diameters are at the bottom, while the small diameters are at the top.

If approval of a cable bundle is sought, the maximum size of the bundle (in terms of diameter) intended to be used shall be tested.

The ends of the cables introduced shall be sealed on the side not exposed to the fire, so that air or smoke will be prevented from passing through.

Following a conditioning period for sealing compounds of at least 30 days at room temperature, the penetrations to be tested will be subjected to the fire test.

**Table 1 Example of the test occupation for cabling of bulkhead and deck penetrations for the fire test and for verifying water- and gas tightness**

<i>Pos.</i>	<i>Group</i>	<i>Insulation</i>	<i>Sheath</i>	<i>Cable-Type No. of Cores × Cross Section</i>	<i>Ø[mm]</i>	<i>Area [mm<sup>2</sup>]</i>
1	1.2	XLPE	PVC	3 × 120 mm <sup>2</sup>		
2	1.1	XLPE	PVC	3 × 50 mm <sup>2</sup>		
3	1.1	PVC	PVC	3 × 4 mm <sup>2</sup>		
4	1.1	XLPE	PVC	37 × 2 × 0.75 mm <sup>2</sup>		
5	2.2	EPR	CR	1 × 150 mm <sup>2</sup>		

<i>Pos.</i>	<i>Group</i>	<i>Insulation</i>	<i>Sheath</i>	<i>Cable-Type No. of Cores × Cross Section</i>	<i>Ø[mm]</i>	<i>Area [mm<sup>2</sup>]</i>
6	2.1	EPR	CR	3 × 50 mm <sup>2</sup>		
7	2.2	EPR	CR	3 × 25 mm <sup>2</sup>		
8	2.2	EPR	CR	14 × 2 × 0.5 mm <sup>2</sup>		
9	2.1	EPR	CR	27 × 1 mm <sup>2</sup>		
10	3.2	EPR	PVC	3 × 120 mm <sup>2</sup>		
11	3.2	EPR	PVC	3 × 50 mm <sup>2</sup>		
12	3.1	EPR	PVC	14 × 2 × 0.5 mm <sup>2</sup>		
13	4.2	EPR	Elastomere SHF2	3 × 120 mm <sup>2</sup>		
14	4.1	EPR	Elastomere SHF2	14 × 2 × 0.5 mm <sup>2</sup>		
15	4.2	XLPE	Thermoplast SHF1	3 × 50 mm <sup>2</sup>		
16	4.1	XLPE	Thermoplast SHF1	19 × 2.5 mm <sup>2</sup>		
17	4.2	HEPR	Thermoplast SHF1	3 × 16 mm <sup>2</sup>		
18	4.1	HEPR	Thermoplast SHF1	7 × 2 × 2.5 mm <sup>2</sup>		
19	4.2	HEPR	Elastomere SHF2	3 × 50 mm <sup>2</sup>		

<i>Group 1</i>	Cables with thermoplastic core insulation and sheaths					
<i>1.1</i>	Cables with braided or metal screen or armouring					
<i>1.2</i>	Cables without metal screen or armouring					
<i>Group 2</i>	Cables with elastomere core insulation and sheaths					
<i>2.1</i>	Cables with braided or metal screen or armouring					
<i>2.2</i>	Cables without metal screen or armouring					
<i>Group 3</i>	Cables with elastomere core insulation and thermoplastic sheaths					
<i>3.1</i>	Cables with braided or metal screen or armouring					
<i>3.2</i>	Cables without metal screen or armouring					
<i>Group 4</i>	Cables with halogen-free materials					
<i>4.1</i>	Cables with halogen-free elastomerics					
<i>4.2</i>	Cables with halogen-free thermoplastic compounds					

### 3.2.2 Busbars

Each type of busbars will be required to be fire tested in each penetration system for which approval is sought for both bulkhead and deck. In addition, the busbars themselves shall be case-by-case approved for

use on board ships (capacities, electrical characteristics, etc. to be verified and approved by the the Society's responsible electrical section).

When testing busbars, the support and fixing of the busbar(s) shall be by a framework mounted from the restraint frame such that any movement of the bulkhead or deck relative to the busbar(s) will be experienced by the penetration(s) being tested.

### 3.3 Fire test requirements for pipe penetrations

The general construction of the test specimen for divisions of type "A" is specified in the 2010 FTP Code, Annex 1, Part 3 - Test for "A", "B" and "F" class divisions, Appendix 2, A.III – *Pipe and Duct Penetrations*.

#### 3.3.1 Pipe dimensions and pipe materials

At least the maximum and minimum size of the sealing system of each type of pipe penetration as well as the maximum and minimum pipe diameter for which a type approval is applied for shall be tested in horizontal (deck) and vertical (bulkhead) position.

In case of sealing systems for bundle tubes, a bundle tube with the minimum and maximum number of tubes of the range of application shall be used for the tests.

For approval of the sealing system for different pipe materials, every relevant pipe material shall be tested with the sealing system on principle. However, results of fire tests with materials with good thermal conductivity can be transmitted to materials with reduced thermal conductivity, i.e. test results on carbon steel pipes includes stainless steel and test results on copper pipes includes copper alloys and carbon steel.

In case of plastic pipes as well as composite pipes, proof shall be provided by testing for every material type i.e. for PVC, PE, PP, ABS, FRP, etc. Contact the Society in advance of testing.

Multiple pipe penetrations shall be tested with at least two pipes in the same penetration. The maximum number of pipes in one single penetration will be restricted by the maximum tested distances between pipes and between pipes and inner walls of the sleeve. In cases with pipes of higher thermal conductivity (e.g. Cu, CuNiFe, Bronze) the maximum tested number of pipes will be considered for acceptance.

In cases where insulation is fitted to the test pipe(s), the distance(s) of  $500 \pm 50$  mm required in 2010 FTP Code part 3 A.III/2.2.3 to which the pipe shall project shall be taken from the end of the insulation as this is considered an integral part of the penetration(s) being tested and it is necessary that a length of unprotected pipe is exposed to the furnace.

In all cases, the support and fixing of the test pipe(s) shall be by a framework mounted from the restraint frame such that any movement of the bulkhead or deck relative to the pipe(s) will be experienced by the penetration(s) being tested.

If any penetration protrudes less than 25 mm into the unexposed side, two thermocouples shall still be fastened to the penetration, either on the sides or at the end of the penetration detail.

For testing of drain penetrations (scuppers), the internal water lock (drain labyrinth) shall be designed to prevent passage of flames going through the pipes from underneath. The labyrinth shall not be filled with liquid.

## 4 Watertightness and gastightness

### 4.1 Introduction

When the manufacturer requests a statement on the fire safety certificate to include watertightness and gastightness, the requirements given in this chapter shall be fulfilled.

This chapter covers only watertightness/gastightness for the same penetration types and sizes as the ones being fire tested. For other types and sizes, separate certificates shall be issued by the Society's electrical section (cable penetrations) and the Society's piping section (pipe penetrations).

A representative of the Society may require to witness watertightness and gastightness test if the test is not carried out by a recognised test laboratory.

## 4.2 Approval requirements

The approval pressure will be 2/3 of the test pressure. For the penetration of tanks the test sample shall be tested at 2.5 times the approval pressure.

For each type of penetration for which approval is sought the maximum size of the penetration system shall be tested as specified below:

### 4.2.1 Selection of cables

Same selection of cables as has been fire tested is required, ref. [3.2.1]. Maximum and minimum filling rate (as fire tested) shall be tested.

### 4.2.2 Selection of pipes

At least the maximum and minimum pipe size (diameter) shall be tested. The wall thickness of the pipes shall be the minimum for which approval is sought. In case penetrations shall be approved for water and gas tightness also for plastic pipes, the tests shall be carried with pipes from thermoplastics (e.g. PVC pipe) and fibre glass reinforced material (FRP pipe). Approval will be given for all thermoplastic pipes based on testing on one thermoplastic material.

### 4.2.3 Specimen preparation

Before testing the sealing system shall be prepared in accordance with the manufacturer's installation and work instructions. Following a conditioning period for sealing compounds, of at least 30 days and for packing systems of at least 24 hours, the penetration system will be subject to the tightness test.

Test arrangement for both watertightness and gastightness shall be according to [Figure 1](#) and [Figure 2](#).

## 4.3 Watertightness

Sealing systems in "A"-class bulkheads and decks shall be so constructed that they are capable of withstanding a hydraulic test pressure conforming to the conditions specified below:

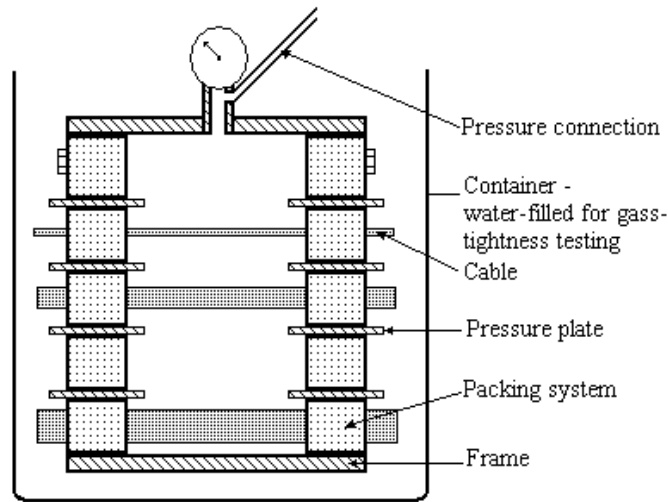
First, the specimen shall be tested for a period of at least 30 minutes under hydraulic pressure equal to the test pressure minimum 1.0 bar. There shall be no leakage during this test.

Second, the specimen shall continue to be tested for a further 30 minutes with the test pressure. The quantity of water leakage shall not exceed a total of 1 litre.

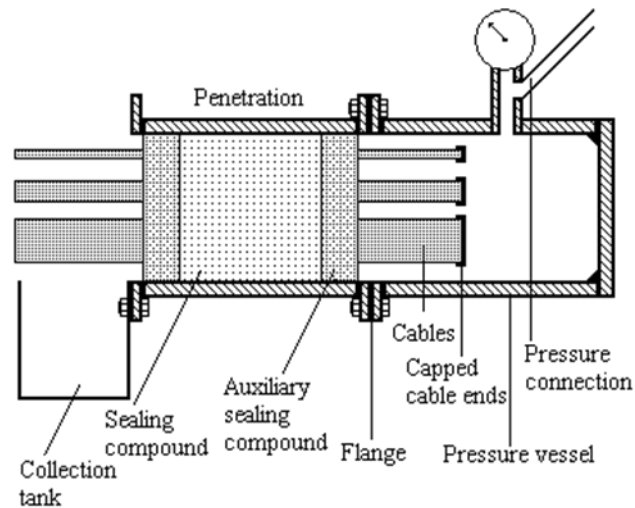
For penetration systems used for the penetration of tanks, no leakage is accepted.

## 4.4 Gastightness

Bulkhead and deck penetrations shall be so constructed that they can withstand a pneumatic pressure of 30 mbar for a test period of 30 minutes. No leak of gas is acceptable. Air as a test medium is acceptable.



**Figure 1 Arrangement for testing the watertightness and gastightness of a packing system**



**Figure 2 Arrangement for testing watertightness and gastightness of a sealing compound system**

## 5 Watertightness and gastightness - special cases

### 5.1 Penetrations with heat-sensitive materials in SPS and passenger ships

When requested to be used in watertight bulkheads on passenger ships and special purpose ships (SPS), the penetration system shall comply with the requirements given in SOLAS Ch. II-1 Reg. 13.2.3 (2014 issue). Penetrations passing through watertight bulkheads are subject for separate examination and approval (water

tightness after a standard fire test). The Society shall be contacted for separate details of performing such additional testing.

It shall however be noted that use of such product on board passenger ships/SPS vessel, even if successfully tested as watertight after a standard fire, is subject to separate case by case approval for each ship for which the product is intended to be used and may not be accepted at all for certain applications and/or flags. Especially for plastic pipes several flags will always require an arrangement with steel pipes and valves to be installed where plastic piping pass through watertight bulkheads.

## 5.2 Penetration of tank boundaries

Penetration systems are generally not to be used for penetrating boundaries of tanks.

When a penetration system is requested for penetrating tanks, an approval may be given on a case by case basis. The penetration system is only to be used at the top of tanks, both vertically and horizontally, and as high up as practical. The penetration system shall be compatible with the liquid medium in the tank. The approval is subject to approval for each individual newbuilding or conversion. Please contact the Society in advance of testing.

## 5.3 Electrical penetration for pressure vessels in diving systems

Specific requirements are given in the the Society's *Rules for Certification of Diving Systems*. Please contact the Society in advance of testing.



## 6 Text in certificate

### 6.1 General text

Certificates for cable penetrations and pipe penetrations shall be issued separately.

The following items shall be specified in the certificate (if applicable):

- maximum and minimum cross sectional size of the penetrations
- geometrical shape of the penetration
- length of sleeve insulation required
- penetration position in deck/bulkhead
- reference to the drawings.

#### 6.1.1 Specific text for cable penetrations

- maximum and minimum cable filling in % of cross sectional area
- if tested with a cable bundle: maximum diameter of bundle
- distance (as tested) between cable and sleeve, and between adjacent cables.

#### 6.1.2 Specific text for cable penetrations

- maximum and minimum cable filling in % of cross sectional area
- if tested with a cable bundle: maximum diameter of bundle
- distance (as tested) between cable and sleeve, and between adjacent cables.

#### 6.1.3 Specific text for cable penetrations

- maximum and minimum cable filling in % of cross sectional area
- if tested with a cable bundle: maximum diameter of bundle
- distance (as tested) between cable and sleeve, and between adjacent cables.

### 6.2 Applications/Limitations: (Example text, where relevant)

- "Approved for use as pipe penetration system in class A-60 steel bulkheads"
  - "Approved for use as pipe penetration system in watertight bulkheads on cargo ships for pipes indicated with entry WT in column X."
  - "The penetration is approved for installation in steel bulkheads. Other applications are subject to case-by-case approval."
  - Example text (when fire tested as A-60, and requested to use for lower ratings): "Class A-0, A-15 and A-30 shall be insulated as class A-60 and in addition the division shall be insulated at least 200 mm around the penetration."
  - "The product or packing shall be marked with the name of the manufacturer, type designation and fire technical rating, as applicable."
  - "Each product shall be supplied with its manual for installation and maintenance."
  - "The penetration system shall not be used for penetrating boundaries of tanks."
  - If not pressure tested: "Watertightness and gastightness is not covered in this certificate."
  - If pressure tested according to [4]: "The pipe penetrations are not approved for use in watertight bulkheads on passenger ships and special purpose ships (SPS)."
- Explanatory note, not to be included in the certificate: This means that we would accept cables and steel pipe penetrations tested for fire and watertightness and gastightness separately (ref. [4]) for use in watertight bulkheads on passenger ships and SPS without the additional testing, ref. [5.1].

## APPENDIX A EXTRACT FROM IMO RESOLUTION MSC.307(88) (2010 FTP CODE), ANNEX 1, PART 3 - TEST FOR "A", "B" AND "F" CLASS DIVISION, APPENDIX 2, A.III – PIPE AND DUCT PENETRATIONS

### A General

- 1) "A" class divisions may have to be provided with apertures to allow them to be penetrated by service pipes and ducts, and it is necessary to reinstate the insulation and/or integrity performance of the division at the position where it has been penetrated.
- 2) Administrations may have different requirements relating to the need to classify pipe and/or duct penetrations, e.g., related to the pipes' diameter and their direct attachment or not to the structural core.
- 3) This section refers from here on to pipe penetrations but may be read as equally applicable to duct penetrations.

### B Nature of the test specimen

#### B1 Dimensions

The maximum and minimum sizes (in terms of both the width and the height, or diameter) of each type of pipe penetration for which approval is sought shall be tested in both vertical and horizontal orientation.

#### B2 Design

A bulkhead which includes the pipe penetration shall be constructed in accordance with paragraph 2.1.1 of Appendix 1 and shall be insulated to class "A-60" on the stiffened face, which shall be the face which is not exposed to the heating conditions of the test. A deck which includes the pipe penetration shall be constructed in accordance with paragraph 2.2.1 of Appendix 1 and shall be insulated to class "A-60" on the stiffened face, which shall be the face which is exposed to the heating conditions of the test.

"A-0" class pipe penetrations are recommended to be performed in an uninsulated ("A-0") bulkhead/deck. If the pipe penetrations are tested as an "A-60" class penetration, any insulation fitted (on the penetration itself and 200 mm around) will be required to be fitted also for class "A-0".

"A-0" penetrations shall not be approved without an "A-0" test although tested and approved as "A-60".

The pipe penetrations shall be positioned only in the top half of a bulkhead but shall not be closer than 200 mm from the edges of a bulkhead or a deck. Where more than one pipe penetration shall be tested simultaneously in a division, the separation between adjacent penetrations shall not be less than 200 mm. Both measurements shall relate to the distance to the nearest part of the penetration system, including any insulation which is part of the system.

Each pipe passing through a penetration shall project  $500 \pm 50$  mm beyond the exposed end of the penetration and  $500 \pm 50$  mm beyond the unexposed end of the penetration. The exposed end of the pipe shall be blanked off, using an appropriate methodology to ensure that any fire penetration into the pipe does not occur via the end of the pipe in advance of it occurring through the exposed perimeter of the pipe.

Each pipe shall be firmly supported and fixed independent of the bulkhead or deck on the unexposed side of the test specimen, e.g., by a framework mounted from the restraint frame. The support and fixing of the pipe shall restrain it from movement during the test.

When the deck penetration is fitted on an exposed side or is fitted symmetrically, general application will be given. When the deck penetration is fitted on an unexposed side, the approval will limit the penetration to the tested orientation.

When the bulkhead penetration is fitted symmetrically, approval would be given for general application. For bulkhead penetrations with an exposed or unexposed fitted frame, one test for each fitting is required in order for obtaining approval for general application.

Sealing of pipe and duct penetrations: there shall be no visible openings before the start of the fire test.

In cases where a test specimen (deck) which includes the prototype penetration(s) is not mounted within a rigid restraint frame but is connected to the furnace roof by side wall coamings, the rigidity of the coamings is to be equivalent to that of a restraint frame and evaluated in accordance with paragraph 5.1 of Appendix 1.

In cases where insulation is fitted to the test pipe(s), the distance(s) of  $500 \pm 50$  mm required in paragraph 2.2.3 to which the pipe should project is to be taken from the end of the insulation as this is considered

an integral part of the penetration(s) being tested and it is necessary that a length of unprotected pipe is exposed to the furnace.

In all cases, the support and fixing of the test pipe(s) is to be by a framework mounted from the restraint frame such that any movement of the bulkhead or deck relative to the pipe(s) will be experienced by the penetration(s) being tested.

### **C Instrumentation**

#### **C1 Positioning of thermocouples on the specimen**

For each pipe penetration, two thermocouples shall be fixed on the unexposed face at each of the following locations:

- .1 on the surface of the pipe at a distance of 25 mm from the centre of the thermocouples to the position where the pipe emerges from the penetration seal;
- .2 on the pipe penetration at a distance of 25 mm from the centre of the thermocouples to the face of the insulation on the unexposed side of the test specimen; and
- .3 on the surface of any insulation or filling material used between the pipe and any coaming or spigot fixed to the division (provided that the gap between the pipe or any such coaming or spigot is greater than 30 mm), or on the surface of any collar or shroud used between the pipe and the division (e.g., vapour barrier).

For pipe penetrations in bulkheads, for each of the positions indicated above, one of the thermocouples shall be fixed directly above the centre of the pipe and the other thermocouple shall be fixed directly below the centre of the pipe.

Additional thermocouples may be required to be fitted, dependent upon the complexity of the pipe penetration.

### **D Performance criteria**

#### **D1 General**

The performance of pipe penetrations may be related to their ability to satisfy both the insulation and the integrity criteria or may be related only to the requirements for integrity, depending on the requirements of the Administration.

Duct penetrations shall meet both integrity and insulation criteria.

#### **D2 Insulation**

Since the pipe penetration is a local weakness in the division it shall be capable of preventing a temperature rise exceeding 180 °C above the initial temperature. The average temperature rise is not relevant.

## APPENDIX B EXTRACT FROM IMO RESOLUTION MSC.307(88) (2010 FTP CODE), ANNEX 1, PART 3 - TEST FOR "A", "B" AND "F" CLASS DIVISIONS, APPENDIX 2, A.IV – CABLE TRANSITS

### A General

"A" class divisions may have to be provided with apertures to allow them to be penetrated by cables, and it is necessary to reinstate the insulation and integrity performance of the division at the position where it has been penetrated. A cable transit consists of a metal frame, box or coaming, a sealant system or material and the cables, and it may be uninsulated, partially insulated or fully insulated.

### B Nature of the test specimen

#### B1 Dimensions

The maximum and minimum sizes (in terms of both the height and the width) of each type of cable transit for which approval is sought shall be tested in both vertical and horizontal orientation.

#### B2 Design

A bulkhead which includes the cable transit shall be constructed in accordance with paragraph 2.1.1 of Appendix 1 and shall be insulated to class "A-60" on the stiffened face, which shall be the face which is not exposed to the heating conditions of the test. A deck which includes the cable transit shall be constructed in accordance with paragraph 2.2.1 of Appendix 1 and shall be insulated to class "A-60" on the stiffened face, which shall be the face which is exposed to the heating conditions of the test.

"A-0" class cable transits are recommended to be performed in an uninsulated ("A-0") bulkhead/deck. If the cable transits are tested as "A-60" penetration, any insulation fitted on an exposed side (on the cable transits itself and 200 mm around) will be required to be fitted also for "A-0".

"A-0" cable transits shall not be approved without an "A-0" test although tested and approved as "A-60".

The cable transits shall be positioned only in the top half of a bulkhead but shall not be closer than 200 mm from the edges of a bulkhead or a deck. Where more than one cable transit is to be tested simultaneously in a division, the separation between adjacent transits shall not be less than 200 mm. Both measurements shall relate to the distance to the nearest part of the transit system, including any insulation which is part of the system.

Notwithstanding the above, the distance between transits shall be sufficient to ensure that the transits do not influence each other during the test, except that this requirement does not apply to multi-transits which are intended to be positioned adjacent to one another.

The cables shall project  $500 \pm 50$  mm beyond the transit on the exposed side of the division and  $500 \pm 50$  mm on the unexposed side.

Each cable shall be firmly supported and fixed independent of the bulkhead or deck on the unexposed side of the test specimen, e.g., by a framework mounted from the restraint frame. The support and fixing of the cables shall restrain them from movement during the test.

Cable transits shall be fitted to the bulkhead or deck in accordance with the manufacturer's specifications. The cables and sealing compounds or blocks shall be incorporated into the transits with the bulkhead and deck panels placed respectively in vertical and horizontal positions. Any insulation shall be applied to the cables and transits with the panels in the same respective positions.

The transit(s) shall be tested incorporating a range of different types of cables (e.g., in terms of number and type of conductor, type of sheathing, type of insulation material, size) and shall provide an assembly which represents a practical situation which may be found on ships. An individual Administration may have its own specification for a "standard" configuration of penetrating cables which it may use as a basis of its approvals.

The test results obtained from a given configuration are generally valid for the tested types of cables of size equal to or smaller than tested.

Tests shall be conducted for the maximum and minimum fill based on the inside cross-sectional area at each transit. The distance between the adjacent cables shall be the minimum specified by the manufacturer, and the cables should be placed close to the centre of the transit.

When the deck cable transit is fitted on an exposed side or is fitted symmetrically, general application will be given. When the deck cable transit is fitted on the unexposed side, the approval will limit the penetration to the tested orientation.

When the bulkhead cable transit is fitted symmetrically, approval would be given for general application. For bulkhead cable transit with exposed or unexposed fitted frame, one test for each fitting is required in order for obtaining approval for general application.

Sealing of cable transits shall have no visible openings before the start of the fire test.

## **C Instrumentation**

### **C1 Positioning of thermocouples on the specimen**

For each uninsulated cable transit, thermocouples shall be fixed on the unexposed face at each of the following locations:

- .1 at two positions on the surface of the frame, box or coaming at a distance of 25 mm from the unexposed surface of the division. When the penetration does not extend a minimum of 25 mm beyond the bulkhead or deck plate on the unexposed side of the assembly, these thermocouples shall be placed at the end of the frame, box or coaming;
- .2 at two positions at the end of the transit, on the face of the sealant system or material at a distance of 25 mm from a cable. If there is insufficient area to affix the thermocouples as described, one or both may be placed within a distance of 25 mm from a cable; and
- .3 on the surface of each type of cable included in the cable transit, at a distance of 25 mm from the face of the sealant system or material. In case of a group or bunch of cables, the group shall be treated as a single cable. In case of horizontal cables, the thermocouples shall be mounted on the uppermost surface of the cables. These thermocouples may be excluded if the diameters of the cables are too small to effectively affix the thermocouples to the cables. This shall be at the discretion of the Administration.

For those thermocouples placed on the outer perimeter of the frame, box or coaming, one thermocouple shall be fixed on each of two opposite faces, which in the case of bulkheads shall be the top and bottom faces.

For each partially insulated or fully insulated cable transit, thermocouples shall be fixed on the unexposed face at equivalent positions to those specified for an uninsulated transit as illustrated in [Figure 1](#).

Additional thermocouples may be required to be fixed, dependent upon the complexity of the cable transit.

When fixing thermocouples to the unexposed surface of the cables, the copper disc and the insulating pad shall be formed over the surface to provide good contact with the surface of the cable. The copper disc and the pad shall be retained in position by some mechanical means, e.g., wiring or spring clips, such that they do not become detached during the test. The mechanical retention shall not provide any significant heat-sink effect to the unexposed face of the thermocouple.

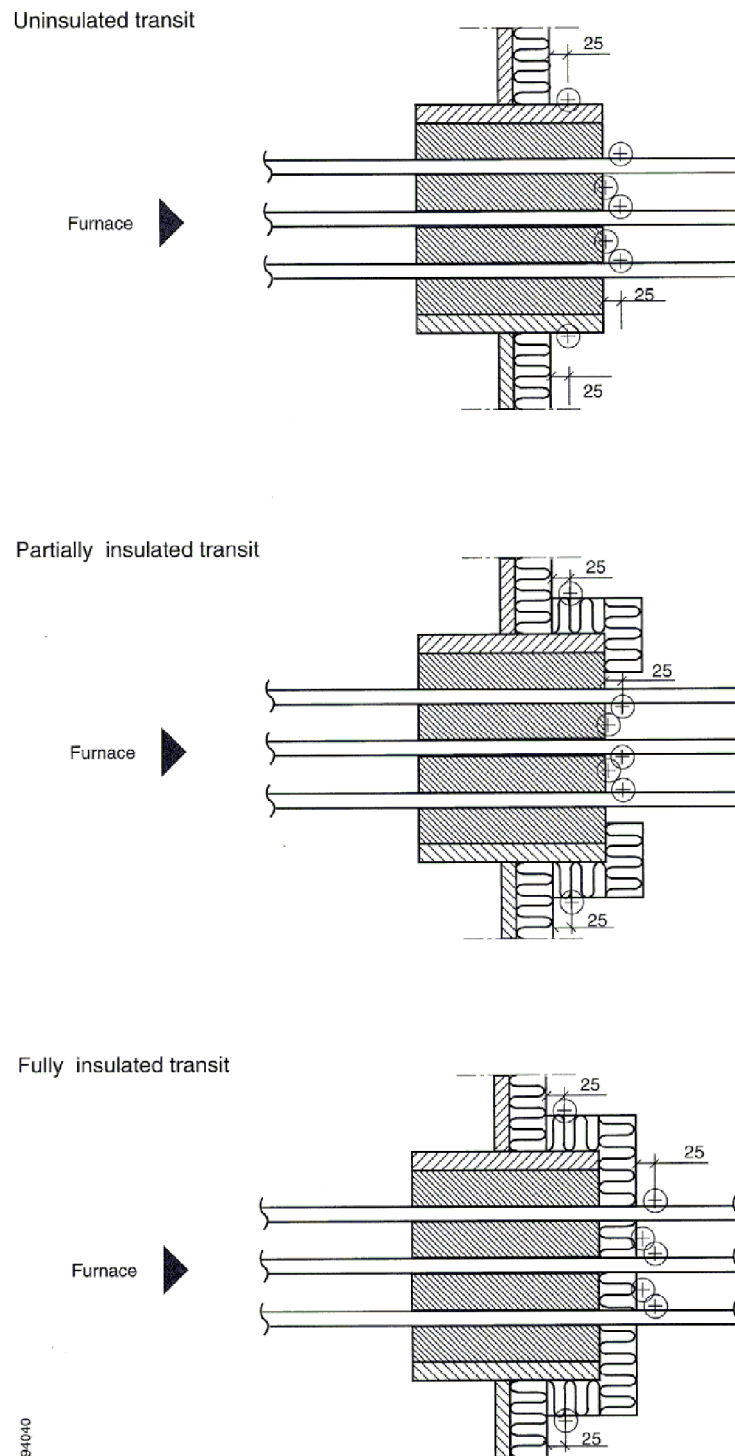
## **D Performance criteria**

### **D1 General**

Cable transits shall meet both integrity and insulation criteria.

### **D2 Insulation**

Since the cable transit is a local weakness in the division, the temperature rise at any point on the surface shall not exceed 180°C above the initial temperature. The average temperature rise shall not be used for this purpose.



**Figure 1 Cable transits: position of unexposed-face thermocouples (shown for bulkhead)**

## CHANGES – HISTORIC

There are currently no historical changes for this document.

## **DNV GL**

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