
**Fire test procedures for divisional
elements that are typically used in oil,
gas and petrochemical industries —**

**Part 2:
Additional procedures for pipe
penetration and cable transit sealing
systems**

*Méthodes d'essais au feu des éléments de séparation habituellement
utilisés dans les industries pétrolières, gazières et pétrochimiques —*

*Partie 2: Modes opératoires supplémentaires pour les systèmes de
calfeutrement de traversées de câbles et de trémies de tuyaux*



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Contents

	Page
Foreword.....	iv
Introduction.....	v
1 Scope.....	1
2 Normative references.....	1
3 Terms and definitions.....	1
4 Principle.....	3
5 Test equipment.....	3
6 Test conditions.....	3
6.1 Preconditioning.....	3
6.2 General.....	3
7 Instrumentation.....	4
7.1 General.....	4
7.2 Roving thermocouple.....	4
7.3 Integrity measurements.....	4
7.4 Infrared camera.....	4
8 Test requirements.....	5
8.1 General.....	5
8.2 Minimum number of test specimens.....	5
8.3 Size and spacing of specimens.....	6
8.4 Pipe and cable restraint.....	6
8.5 Blank penetration seal.....	6
9 Pipe penetration system design and construction aspects.....	6
9.1 General.....	6
9.2 Instrumentation.....	7
10 Cable transit design and construction aspects.....	9
10.1 General.....	9
10.2 Instrumentation.....	9
11 Reporting.....	11
Annex A (informative) Cable types.....	13
Annex B (informative) Guidance on application of test results and classification.....	15
Bibliography.....	18

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 2, *Fire containment*.

A list of all parts in the ISO 20902 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document describes a test procedure to assess the protection afforded by fire protection materials and systems to divisional elements. It gives an indication of how fire protection materials will perform when exposed to a set of specified fire conditions.

The classification of divisional elements (bulkheads and decks) in the marine industry [i.e. ships as defined by the International Maritime Organisation (IMO) and Safety of Life and Sea (SOLAS) convention] is primarily undertaken in accordance with classification society procedures through testing to the fire test procedures (FTP) codes IMO resolution 307(88), formerly IMO A.754(18). Historically, FTP-code-compliant test evidence has been used to support non-marine applications by implementing hydrocarbon time temperature regime profiles. To reduce the burden on industry, this document is compatible with FTP codes IMO resolution MSC 307(88) where relevant, allowing the use of both IMO and ISO test procedures for specific classification ratings.

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Fire test procedures for divisional elements that are typically used in oil, gas and petrochemical industries —

Part 2:

Additional procedures for pipe penetration and cable transit sealing systems

1 Scope

ISO 20902-1 specifies a test methodology for determining the fire resistance of divisional elements with a fire protection system when subjected to cellulosic or hydrocarbon-pool type fire exposure conditions. This document describes additional test procedures for penetration and cable transit sealing systems intended for non-marine applications but suitable for offshore fixed and mobile installations. The test data thus obtained enables subsequent classification on the basis of the duration for which the performance of the divisional element under these conditions satisfies specified criteria.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 834-1, *Fire-resistance tests — Elements of building construction — Part 1: General requirements*

ISO 20902-1:2018, *Fire test procedures for divisional elements that are typically used in oil, gas and petrochemical industries — Part 1: General requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

penetration

aperture within a fire separating element usually present to accommodate the passage of a service through that element

[SOURCE: ISO 10295-1:2007, 3.2]

3.2

penetration seal

single component or system used to maintain the fire resistance of the fire-separating element at the position where services pass through the element

[SOURCE: ISO 10295-1:2007, 3.4]

3.3

penetration sealing system

assembly for test consisting of the penetrating service or services and the penetration seal, materials or devices, together with any service support construction, designed to maintain the integrity and insulation performance of the separating element for the duration of the fire test

[SOURCE: ISO 10295-1:2007, 3.5]

3.4

blank penetration seal

system where an aperture of specified size in the fire separating element is sealed or closed by the specified seal without incorporation of penetrating services

[SOURCE: ISO 10295-1:2007, 3.7]

3.5

test construction

complete assembly, consisting of the separating element and penetration sealing system

[SOURCE: ISO 10295-1:2007, 3.8]

3.6

bulkhead

vertical divisional element typically used in the marine industry

[SOURCE: ISO 20902-1:2018, 3.1]

3.7

deck

horizontal divisional element typically used in the marine industry

[SOURCE: ISO 20902-1:2018, 3.2]

3.8

divisional element

element that is intended for use in maintaining separation between two adjacent areas of facilities within the oil and gas industry, and which may or may not be load bearing

[SOURCE: ISO 20902-1:2018, 3.3]

3.9

hot spot

location on the back of the test specimen, within the permitted measurement area, where the highest temperature is recorded

3.10

structural core

the primary component or components of the divisional element responsible for providing load bearing capability or integrity (as appropriate), excluding additional components provided for insulation purposes

Note 1 to entry: This typically consists of a metallic plate (either flat or corrugated) with stiffeners.

[SOURCE: ISO 20902-1:2018, 3.5]

3.11

cable filling ratio

ratio between a cross-section area of cables and a cross-section area of the transit

3.12**coaming**

raised edge around an opening in a division, which can be an integral part of the division or a frame attached to the division

3.13**symmetrical system**

system that is identical on the fire-exposed and non-fire-exposed sides of the division

3.14**asymmetrical system**

system differing on the fire-exposed and non-fire-exposed sides of the division

3.15**transit system**

system consisting of a frame, box or coaming, a sealant system or materials and cables and/or small bore pipework used to create a gas-, smoke-, water-, fire- and blast-resistant seal around the cables and/or pipes as they pass through openings in walls, floors, bulkheads or decks

Note 1 to entry: The system may be uninsulated, partially insulated or fully insulated.

4 Principle

The method provides supplementary procedures to ISO 20902-1 for the purpose of standardizing testing of divisional elements containing some form of penetration. For the purpose of this document, a penetration is considered as any breach of the integrity of an otherwise continuous divisional element. Examples of penetrations include pipe and duct penetration seals and cable transits. To maintain compatibility with both prescriptive regulations and risk-analysis-derived, performance-based requirements, this document is non-prescriptive in terms of failure criteria and thermal loads. Classification procedures are given to facilitate correct interpretation of tests results derived in accordance with this document.

5 Test equipment

Equipment employed in the conduct of this test consists of a furnace, restraint and support frames and instrumentation as specified in ISO 20902-1.

In addition to the requirements of ISO 20902-1, the internal dimensions of the test furnace shall be such that a distance of at least 200 mm exists between any point of the periphery of any penetration seal and the wall of the furnace.

6 Test conditions**6.1 Preconditioning**

Specimens shall be subject to a conditioning procedure in accordance with ISO 834-1.

6.2 General

All test conditions shall conform to those given in ISO 20902-1, except where directly modified by clauses within this document.

Where a penetration sealing system is intended for use in both horizontal and vertical separating elements, then each orientation shall be tested.

A pressure of (20 ± 2) Pa shall be established at the bottom of the lowest penetration in a vertical assembly.

For horizontal elements, a static pressure of (20 ± 2) Pa in the horizontal plane at (100 ± 10) mm below the underside of the separating element shall exist.

NOTE Backwards compatibility with the pressure control requirements of the FTP codes (2010) is intended. The FTP codes met the pressure criteria above implicitly through control of specimen position and minimum dimensions. The move to explicit control of pressure is intended to provide greater flexibility regarding the number of specimens tested simultaneously.

7 Instrumentation

7.1 General

The control, monitoring and recording equipment necessary to carry out tests in accordance with this document shall be as described in ISO 20902-1, subject to the additional requirements in this clause.

The measurement and control of furnace temperature shall be measured using plate thermometers, in accordance with ISO 834-1, uniformly distributed so as to give a reliable indication of the average gas temperature in the vicinity of the heated face of the test construction. The hot junctions shall be located initially in a plane (100 ± 10) mm from the exposed face of the separating element. In addition, no junction shall be closer than 100 mm to any projecting part of the seal, a penetrating service, or any part of the furnace at the start of the test. At least one plate thermometer shall be provided for every $1,5 \text{ m}^2$ of the heated area of the test construction, subject to a minimum number of four plate thermometers for each test construction.

Unexposed face temperature measurement shall be made using thermocouples in accordance with ISO 834-1. In the case of non-planar surfaces, the disc and pad shall be deformed to follow the surface profile. If there is difficulty in fixing the standard pad, the size of the pad shall be reduced in size subject to a minimum dimension of 12 mm.

7.2 Roving thermocouple

The information obtained on unexposed face surface temperatures shall be supplemented by additional data derived from measurements obtained using a roving thermocouple as specified in ISO 20902-1, applied to identify any local "hot spots" or where temperatures measured by the fixed thermocouples are not reliable.

7.3 Integrity measurements

Where difficulties arise in attempting to use the cotton pad for the assessment of loss of integrity in accordance with ISO 834-1 when the penetration carries a high density of services, the size of the cotton pad shall be reduced to $(20 \times 20 \times 20)$ mm. The wire supporting frame described in ISO 834-1 shall be adapted to the small pad size but still maintain the 30 mm clearance required from adjacent surfaces. Gap gauges should not be used for the determination of integrity loss.

The use of cotton pads may be discontinued when the temperature of the separating element exceeds 300°C within 70 mm of the penetration seal, measured to the edge of the cotton pad.

7.4 Infrared camera

The provisions relating to use of an infrared (IR) camera in ISO 20902-1 shall apply. The use of an IR camera may be omitted for separating elements that are uninsulated on the fire and non-fire side and that are without insulation performance criteria.

NOTE The IR camera is not used for the determination of temperatures but for guiding the placement of the roving thermocouple, as described in ISO 20902-1:2018, 6.10.

8 Test requirements

8.1 General

All penetrations shall be part of a division constructed of materials corresponding to the actual construction.

The division structural core and edge frames shall be constructed in accordance with ISO 20902-1:2018, Clause 5, so far as is practicable.

The penetration, any associated fittings (if applicable), and any associated framework, shall be constructed of a material corresponding to the actual construction and insulated as necessary to achieve the desired standard of insulation.

The method of fixing the penetration or transit frame into the division shall be the same as that used in practice. If the method of fixing the penetration in a test is made by bolts, full welding shall be considered an acceptable alternative method of fixing the penetration or cable transit frame without further tests.

Penetrations shall be fixed or mounted into the structural core such that the side expected to give the inferior performance is exposed to the heating conditions of the test.

Any auxiliary means of maintaining a minimum spacing (as specified by the manufacturer and as tested) between individual cables/pipes and between the cables/pipes and the frame of the penetration, or any auxiliary sealing system necessary to achieve tightness capability, where required, shall be part of the penetration during the fire test. Examples of auxiliary means are:

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

8.2 Minimum number of test specimens

Rectangular and circular penetrations shall be tested separately.

The maximum and minimum dimensions shall be tested.

Penetrations intended for use in divisions with an insulation (I) classification shall be installed in divisions which are insulated to achieve a classification rating equal to the classification rating sought for the penetration specimen. The specimen shall be insulated on the non-exposed face in cases of vertical divisions, and the fire-exposed face in the case of horizontal divisions.

Penetrations intended for use in divisions without an insulation (I) classification shall be installed in divisions which are uninsulated.

Uninsulated divisions without an insulation (I) classification should not be assumed to maintain their insulation and integrity classification following the addition of insulation.

In the case of asymmetrical systems in a vertical separating element, normally two tests shall be carried out: one from each direction of exposure. Where it can be established clearly in an asymmetrical system in a vertical separating element that there is a weaker direction of exposure, it is required to test only the weaker direction. A full justification for the procedure adopted shall be included in the report. Where the penetration sealing system is fully symmetrical, only one specimen is required to be tested with either face exposed to the heating regime.

In the case of horizontal elements, the test specimen shall be exposed to heating from the underside. When a horizontal system is fitted on an exposed side or is fitted symmetrically, the test shall also be

considered applicable for a vertical orientation. When the penetration is fitted on an unexposed side, the approval shall be considered applicable only to the tested orientation.

8.3 Size and spacing of specimens

A penetration and the accompanying penetration seal shall, where practicable, be full size. In order to avoid boundary effects, the distance between the perimeter of the penetration sealing system and the outer perimeter of the heated part of the separating element shall be not less than 200 mm at any point.

In cases where multiple penetrations are included in a single test construction, the minimum distance between adjacent fire seals shall be not less than 200 mm. Each penetration with its associated service(s) and penetration sealing system(s) shall be the subject of a separate evaluation provided that the specified conditions are maintained with respect to the penetration being evaluated.

The maximum and minimum coaming 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 each orientation required.

In cases where multiple penetrations are included in a single test construction, the minimum distance between adjacent fire seals shall be not less than 200 mm, unless as required within the multi-transit system arrangement.

8.4 Pipe and cable restraint

Each pipe shall be firmly supported and fixed independent of the bulkhead of 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.

In cases where a test specimen includes a penetration(s) which is not mounted within a rigid restraint frame but is connected to the furnace roof by side wall coamings, the rigidity of the coamings shall be equivalent to that of a restraint frame and evaluated in accordance with ISO 20902-1:2018, 5.9.

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

8.5 Blank penetration seal

The test results of the blank penetration seals are not applicable to penetrating items. If classification is sought for a blank penetration seal it shall be tested in accordance with this document.

9 Pipe penetration system design and construction aspects

9.1 General

For penetration systems that are uninsulated or partially insulated, the following distances shall be met. The exposed length of the uninsulated surface of the pipe on the fire-exposed face shall be a minimum of 300 mm. The length of the uninsulated surface of the pipe on the unexposed face shall be a minimum of 450 mm. In this context the penetration sealing system shall include any coating, wrapping or other protection to the services.

In the case of pipes, end capping options shall be selected according to [Table 1](#) and the conditions used shall be considered in the corresponding classification of the test result.

Table 1 — Pipe end capping condition

Inside the furnace	Outside the furnace
uncapped	uncapped
capped	uncapped
uncapped	capped
capped	capped

The method of capping shall be welding a cap of the same material, or through other appropriate means, to achieve a hermetic seal.

All pipe penetrations shall be sealed to ensure no visible openings before the start of the fire test.

NOTE Authorities having jurisdiction can potentially have additional or different requirements relating to the classification of pipe penetrations to those given in this document, for example, related to the pipes' diameter and their direct attachment or not to the structural core.

Each pipe passing through a penetration shall project a minimum of 300 mm beyond the exposed end of the penetration and a minimum of 450 mm beyond the unexposed end of the penetration.

In cases where insulation is fitted to the test pipe(s), the minimum distances above which the pipe should 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 for a length of unprotected pipe to be exposed to the furnace.

Penetrations shall be identified as single pipe penetrations or multi-pipe penetrations. Multiple pipe penetrations shall be tested with at least two pipes in the same penetration seal.

In case of sealing systems for pipe bundles (groups of pipes in direct contact with each other), bundles with both the minimum and maximum number of pipes for the intended range of application shall be tested.

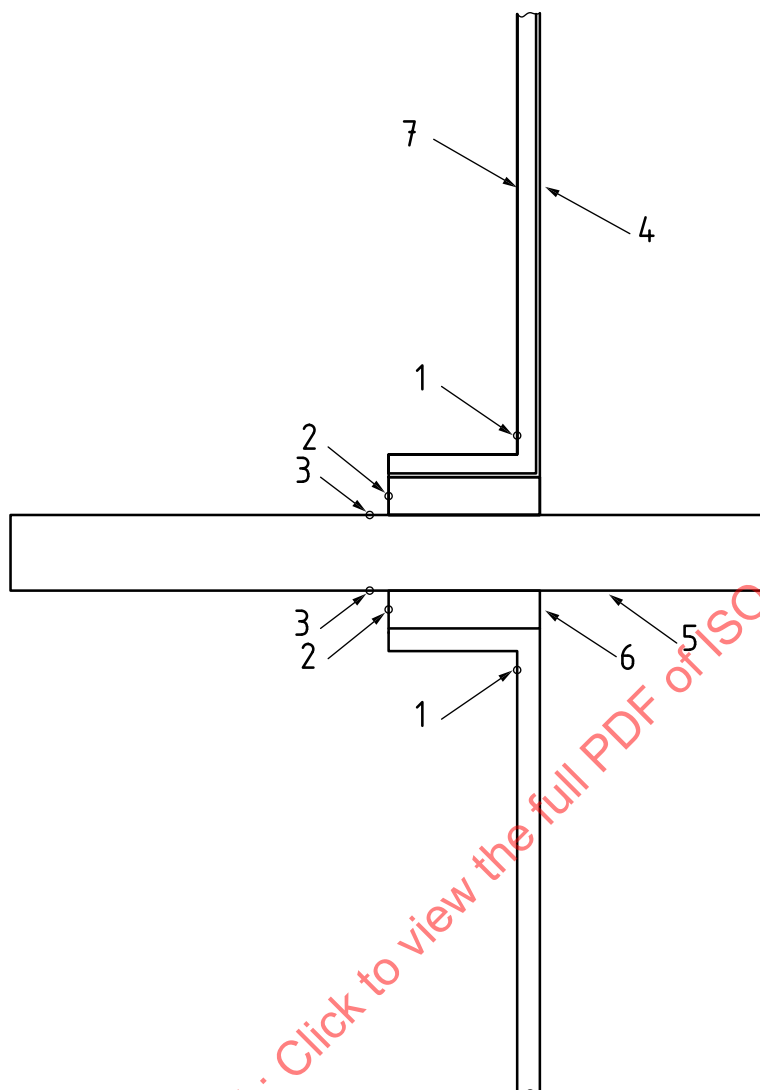
Further guidance on test design and applicability of results is given in [Annex B](#).

9.2 Instrumentation

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

- 1) 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;
- 2) on the surface of any insulation or filling material used between the pipe and any coamings 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);
- 3) 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.

The positions are illustrated in [Figure 1](#).



Key

- 1 TC location 1
- 2 TC location 2
- 3 TC location 3
- 4 fire-exposed face
- 5 pipe
- 6 insulation or filling material between pipe and coaming/spigot
- 7 insulation

Figure 1 — Thermocouple positions for pipe penetration seal

For pipe penetrations in vertical elements, 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 can be required to be fitted, depending upon the complexity of the pipe penetration.

10 Cable transit design and construction aspects

10.1 General

It can be necessary to provide divisions 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 frame, box or coaming, a sealant system or material and the cables, and it may be uninsulated, partially insulated or fully insulated.

The cables shall project a minimum of 450 mm beyond the transit of the exposed side of the division and (500 ± 50) mm on the unexposed side.

Cable transits shall be fitted to the test specimen 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 typical situation in practice. Examples of cable types can be found in [Annex A](#).

NOTE Authorities having jurisdiction can potentially have their own specification for a "standard" configuration of penetrating cables which can be used as a basis for their approvals.

All cable transits shall be sealed to ensure no visible openings before the start of the fire test.

The maximum and minimum dimensions will be tested at the maximum fill ratio. In addition, the largest rectangular penetration (provided that the surface area of the largest circular penetration is equal or less) shall be tested at the minimum fill ratio. A test without any cables is an acceptable alternative to a test at the minimum fill ratio.

In the case of vertical division 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.

Further guidance on test design and applicability of results is given in [Annex B](#).

10.2 Instrumentation

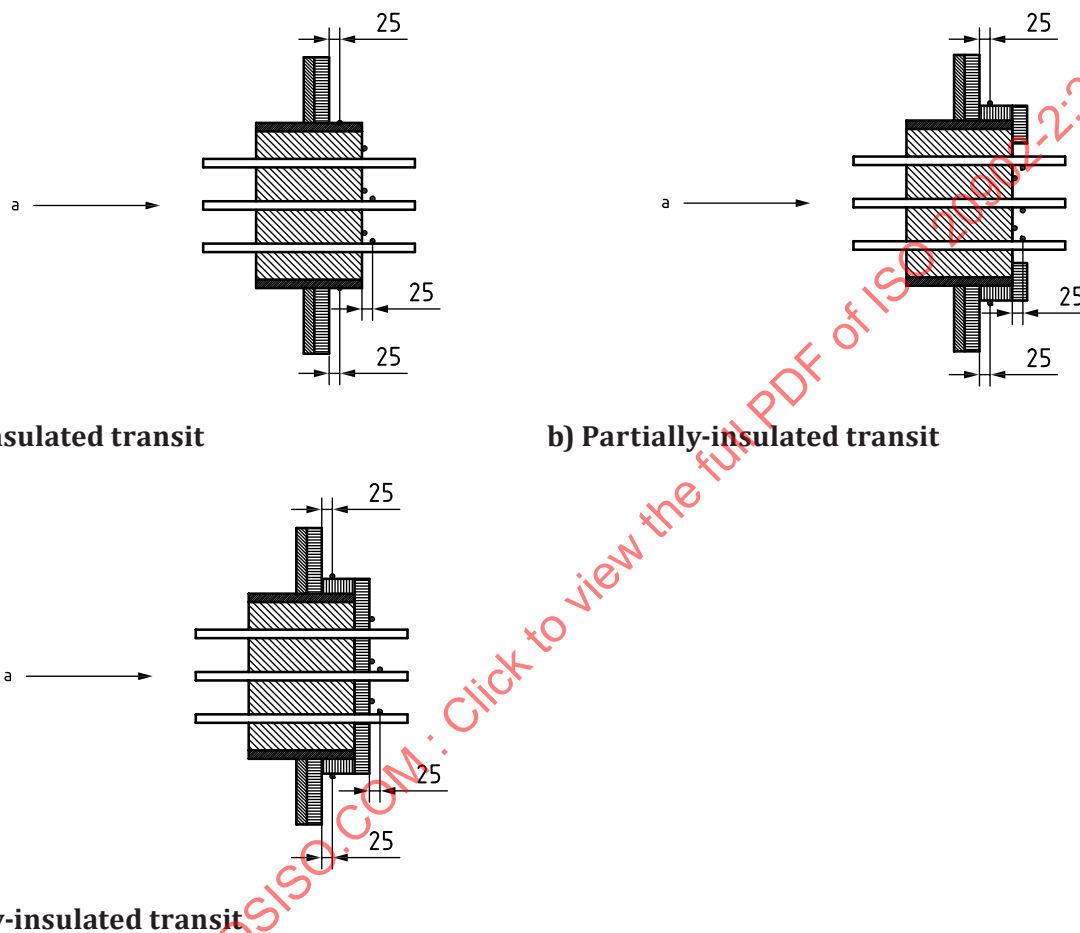
For each uninsulated cable transit, thermocouples shall be fixed on the unexposed face at each of the following locations:

- 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;
- 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 in accordance with the authority having jurisdiction.

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 2](#).



Key

a Furnace.

Figure 2 — Thermocouple positions for cable transit systems

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. The thermocouples shall as far as possible be fastened to the steel parts of the penetration.

It can be necessary to affix additional thermocouples, depending on 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 held in position by mechanical means, for example using 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.

11 Reporting

The test sponsor shall provide full construction details of the test specimen in the form of drawings (including a detailed schedule of components) and method of assembly, such that the laboratory is able to confirm agreement between the actual specimen and the drawings and specifications prior to the test.

The test report shall include the following information:

- a) name of the testing laboratory;
- b) date of the test;
- c) names of the sponsor, the manufacturer and the product;
- d) drawings and technical specifications of the division;
- e) drawings and technical specifications of the penetration, including:
 - 1) the frame construction, and method of connection of the frame to the division, if applicable;
 - 2) the type and density of any insulation materials used, the location of its use, and the dimensions;
 - 3) the method of securing insulation and details of components used for this purpose (e.g., the type and rate of application of any adhesive);
 - 4) any fittings such as hinges, shoot bolts, latches, locks, etc.;
 - 5) any auxiliary means of maintaining pipe/cable spacing or of sealing systems for tightness;
 - 6) the design and length of any conduit sleeve present;
 - 7) the type, density, thickness and length of insulation on the conduit sleeve;
- f) drawings and technical specifications of the pipes or cables, including:
 - 1) type, quantity and cross section of the pipes/cables; identification of multi-transit systems;
 - 2) identification of multi-transit systems (if applicable) with separation distances and relative positions, dimensions and material of the pipes/cables and their supports;
 - 3) the distance between the coaming and the pipe/cable (giving the maximum and minimum distance when a single pipe/cable is off-centre, or when multiple items are present);
 - 4) the maximum and minimum clearance between pipes/cables in multiple-transit systems;
 - 5) distance between cable/pipe and the coaming or sleeve, the length of sleeve and the insulation design;
 - 6) in the case of tests of pipes, a statement of the pipe end situation as per [Table 1](#);
 - 7) maximum dimension of blank penetration seal, if used;
 - 8) in the case of pipe or cable bundles being tested, the maximum diameter of the bundle;
 - 9) in the case of tests of cable transits:
 - i) the cable filling ratio;
 - ii) full details on the cables used, including:
 - the type, quantity and location of cables;
 - the conductor cross-sectional area (maximum, minimum and total);

- the cable outer diameter;
 - the conductor outer diameter;
 - type of sheathing;
 - type of electrical insulation around the conductors;
 - the distance between the conductor and outer cable surface;
- g) sufficient detail of the complete system tested to uniquely define and identify that system and the materials, where appropriate by reference to standards and/or approvals, including classification of fire behaviour;
- h) description of the installation procedures, including the selection of service support system and details of work access (e.g. whether the penetration seal was installed from one or both faces, the pipe end situation, description of fixing);
- i) description of the test procedure and a statement confirming conformance to the procedures of this document (ISO 20902-2) and those of ISO 20902-1, including the publication date of the International Standards used;
- j) records of measurement (e.g. temperatures) and observations (e.g. smoke on the unexposed side of the furnace) obtained during the test;
- k) statement of the performance of the penetration sealing system with respect to integrity and insulation, determined in accordance with the provisions of ISO 20902-1;
- l) any deviations from the procedure and any unusual features observed.

Annex A (informative)

Cable types

A.1 Cable requirements

Different cable types and cross-sections representative of those normally used onboard 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 A.1](#). Where this is not possible, comparable cabling shall be agreed on with the authority having jurisdiction.

Table A.1 — Cable types

Position	Group ^a	Insulation	Sheath	Cable type (# of cores × cross-section)
1	1.1	XLPE	PVC	3 × 50
2	1.2	PVC	PVC	3 × 4
3	1.2	XLPE	PVC	37 × 2 × 0,75
4	1.2	XLPE	PVC	3 × 120
5	2.1	EPR	CR	3 × 50
6	2.1	EPR	CR	27 × 1
7	2.2	EPR	CR	1 × 150
8	2.2	EPR	CR	3 × 25

^a Group definitions are as follows:

- Group 1 — Cables with thermoplastic core insulation and sheaths
 - Group 1.1: Cables without metal screen or armouring
 - Group 1.2: Cables with braided or metal screen or armouring
- Group 2 — Cables with elastomeric core and sheaths
 - Group 2.1: Cables with metal screen or armouring
 - Group 2.2: Cables without metal screen or armouring
- Group 3 — Cables with elastomeric core insulation and thermoplastic sheath
 - Group 3.1: Cables with metal screen or armouring
 - Group 3.2: Cables without metal screen or armouring
- Group 4 — Cables with halogen-free materials
 - Group 4.1: Cables with halogen-free elastomerics
 - Group 4.2: Cables with halogen-free thermoplastic compounds

Table A.1 (continued)

Position	Group ^a	Insulation	Sheath	Cable type (# of cores × cross-section)
9	2.2	EPR	CR	14 × 2 × 0,5
10	3.1	EPR	PVC	14 × 2 × 0,5
11	3.2	EPR	PVC	3 × 120
12	3.2	EPR	PVC	3 × 50
13	4.1	EPR	Elastomere SHF2	14 × 2 × 0,5
14	4.1	XLPE	Thermoplast SHF1	19 × 2,5
15	4.1	HEPR	Thermoplast SHF1	7 × 2 × 2,5
16	4.2	EPR	Elastomere SHF2	3 × 120
17	4.2	XLPE	Thermoplast SHF1	3 × 50
18	4.2	HEPR	Thermoplast SHF1	3 × 16
19	4.2	HEPR	Thermoplast SHF2	3 × 50

^a Group definitions are as follows:

- Group 1 – Cables with thermoplastic core insulation and sheaths
 - Group 1.1: Cables without metal screen or armouring
 - Group 1.2: Cables with braided or metal screen or armouring
- Group 2 – Cables with elastomeric core and sheaths
 - Group 2.1: Cables with metal screen or armouring
 - Group 2.2: Cables without metal screen or armouring
- Group 3 – Cables with elastomeric core insulation and thermoplastic sheath
 - Group 3.1: Cables with metal screen or armouring
 - Group 3.2: Cables without metal screen or armouring
- Group 4 – Cables with halogen-free materials
 - Group 4.1: Cables with halogen-free elastomerics
 - Group 4.2: Cables with halogen-free thermoplastic compounds