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Determination of the resistance to gas explosions of passive fire protection materials —

Part 2: Divisional substrates

Détermination de la résistance aux explosions de gaz des matériaux de protection passive contre l'incendie —

Partie 2: Substrats de séparation

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Foreword

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

A list of all parts in the ISO 23693 series can be found on the ISO website.

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Determination of the resistance to gas explosions of passive fire protection materials —

Part 2:
Divisional substrates

1 Scope

This document describes methods for simulating the mechanical loads that can be imparted to passive fire protection (PFP) materials and systems by explosions resulting from releases of flammable gas, pressurized liquefied gas, flashing liquid fuels, or dust that can precede a fire.

These methods can be used to determine the resistance of passive fire protection materials to such events.

This document considers PFP materials applied to panels, plates, etc. that can be used as divisional elements. The loading on this type of element predominantly results from explosion overpressure applied and drag loadings are typically minimal.

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 23693-1:2021, *Determination of the resistance to gas explosions of passive fire protection materials — 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
ductility ratio
ratio of the maximum dynamic displacement of a panel divided by the displacement at its yield stress

3.2
duration
time for the overpressure in a blast wave to rise to the peak pressure and return to zero

3.3
fixed support
fixation that provides full resistance to force and moments at the edge of the panel

3.4
overpressure
difference between actual pressure and ambient pressure

3.5
rise time
time for the pressure in a blast wave to rise to the peak overpressure

4 Types of pressure loading from explosions

Explosions can give rise to pressure and drag forces. Damage to PFP materials and systems in an explosion can be caused by the direct effects of pressure and drag loadings and by the distortion of the substrate supporting the PFP material.

Types of explosion loading are described in ISO 23693-1. For the panel specimens that are considered in this document, loading is predominantly pressure loading and any drag load will be minimal. Damage to the PFP applied to the panel specimen often results from the distortion of the panel from the explosion loading rather than directly from the pressure loading. Annex C includes a list of damage descriptions.

Test laboratories should be aware of the significant potential hazards involved in gas explosion resistance testing and take appropriate steps to ensure the safety of all concerned.

5 Generation of pressure loading

Methods for generating an explosion load are described in ISO 23693-1.

6 Test specimens

6.1 General

Two types of specimens are considered in this document:

a) PFP test panel: These are panels that are used to assess the performance of PFP systems. Panels shall be designed to provide a certain level of response based on support rotation. PFP test panels are typically used to assess the performance of PFP systems that are directly adhered to their substrates, such as coatings.

b) Representative specimens: These are panels that are representative of those intended to be installed or actually installed in an installation. The test assesses the performance of the complete panel, including its attachments to the surrounding structure, and the PFP materials that are attached to it.

6.2 PFP test panels

If a panel is being used only to assess the ability of a PFP system applied to it to survive a blast loading, then a suitable test panel shall be designed that provides the required level of response based on support rotation; see 11.1. The required response is defined as a support rotation at the panel supports.

A test panel shall:

— have minimum width of 1,0 m and span between supports measuring between 1,0 m and 2,0 m;

— be a flat uniform plate with no added stiffening;

— have fixed supports with uniform cross section over the span;

— be supported along two parallel edges;

— be fabricated from material representative of the material used for the structure onto which it is intended to apply the PFP system in service;

— have a design that is recorded in the test report;

— have a known yield stress that is recorded in the test report;

— have PFP installed upon it that is representative of the PFP material or system used in practice.

When test panels are mounted in a supporting structure placed inside an explosion, that supporting structure shall not move under the blast overpressure. The maximum displacement under test conditions shall not exceed 1 % of the height of the structure. The structure behind the test panel shall be sealed to prevent the overpressure wave from wrapping around the panel.

Alternatively, the PFP test panel may be mounted in front of or into the wall of an explosion chamber. In this case, panels shall be mounted with sufficient clearance behind them so that the displacement of the specimen is not limited by impacting with the explosion chamber structure. The joint between the specimen and the wall shall be sealed to prevent ingress of gas behind the specimen. If there is an enclosed void behind the specimen the void shall be vented to the outside.

The pressure loading shall be measured by a minimum of three pressure transducers. When the test panel is mounted within an explosion chamber, the pressure transducers shall be located within 1,0 m vertically or horizontally of the panel being tested. If the specimen is mounted outside an explosion chamber or an unconfined gas explosion the test panel shall be supported on a suitable structure and the pressure transducers shall be located around the specimen as shown in Figure 1.

6.3 Representative specimens

“Representative specimens” are replicas of walls, floors, ceiling or bulkheads, etc., either acting as part of the structure or separately mounted in a suitable structure.

The test of a representative specimen assesses the mechanical performance of the complete specimen including the PFP materials attached to it. The specimen shall be tested at full scale. If the specimen cannot be tested at full scale, the largest specimen shall be tested. Test specimens shall include all relevant features.

The structure behind the representative specimen shall be sealed to prevent the overpressure wave from wrapping around the specimen and shall be of sufficient volume to ensure that the pressure build–up behind the specimen due to the distortion of the specimen is less than 10 % of the peak test pressure. Annex A describes how to calculate the potential pressure build-up inside the supporting structure. Alternatively, the geometry of the test specimen can be such that the structure behind the sample does not need to be sealed; in this case the pressure behind the specimen shall be measured to ensure that it does not exceed 10 % of the peak test pressure.

If in the real-world installation of a representative specimen it is mounted so that pressure loading can wrap around the specimen or the specimen is porous allowing passage of the pressure wave, then there is no need to seal the structure behind the representative specimen.

The representative specimen may also be mounted in front of, or in the wall of, an explosion chamber, provided the attachments to the surrounding structure are representative of in-service use. In this case specimens shall be mounted with sufficient clearance behind them so that the displacement of the specimen is not limited by impacting with the explosion chamber structure. The joint between the specimen and the wall of the explosion chamber will be sealed to prevent ingress of flammable gas behind the specimen. The void behind the specimen shall have a vent opening to the outside, sized to prevent pressure build-up behind the specimen.

The pressure loading shall be measured by a minimum of three pressure transducers. When the representative specimen is mounted within an explosion chamber the pressure transducers shall be located within 1,0 m of the specimen being tested. If the representative specimen is mounted outside an explosion chamber or an unconfined gas explosion, the specimen shall be supported on a suitable structure and the pressure transducers will be located around the specimen analogously to Figure 1.

The performance of a representative specimen during a test can be monitored using high speed video, strain gauges or measurement of dynamic displacement as required by the test sponsor.

If additional pressure transducers are used, they shall be located within 100 mm of the locations shown in Figure 1.