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Determination of the resistance to jet fires of passive fire protection materials —

Part 1:
General requirements

Détermination de la résistance aux feux propulsés des matériaux de protection passive contre l'incendie — Partie 1: Exigences générales

ICS: 13.220.50

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 22899-1 was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 2, *Fire containment*.

ISO 22899 consists of the following parts, under the general title *Determination of the resistance to jet fires of passive fire protection materials*:

— *Part 1: General requirements*

Further parts of ISO 22899 are planned for future publication.

Introduction

The test described in the procedure described in this part of ISO 22899 is one in which some of the properties of passive fire protection materials can be determined. This test is designed to give an indication of how passive fire protection materials will perform in a jet fire. The dimensions of the test specimen may be smaller than typical items of structure and plant and the release of gas may be substantially less than that which might occur in a credible event. However, individual thermal and mechanical loads imparted to the passive fire protection material, from the jet fire defined in the procedure described in this part of ISO 22899, have been shown to be similar to those by large-scale jet fires resulting from high-pressure releases of natural gas.

NOTE 1 Guidance on the applicability of the test will be covered in a future part of ISO 22899.

Although the method specified has been designed to simulate some of the conditions that occur in an actual jet fire, it cannot reproduce them all exactly and the thermal and mechanical loads do not necessarily coincide. The results of this test do not guarantee safety but may be used as elements of a fire risk assessment for structures or plant. This should also take into account all the other factors that are pertinent to an assessment of the fire hazard for a particular end use. The test is not intended to replace the hydrocarbon fire resistance test (ISO/TR 834-3/EN 1363-2[2]) but is seen as a complementary test.

NOTE 2 Users of this part of ISO 22899 are advised to consider the desirability of third-party certification/inspection/testing of product conformity with this part of ISO 22899.

Determination of the resistance to jet fires of passive fire protection materials —

Part 1: General requirements

CAUTION — the attention of all persons concerned with managing and carrying out this fire resistance test is drawn to the fact that fire testing may be hazardous and that there is a possibility that toxic and/or harmful smoke and gases may be evolved during the test. Mechanical and operational hazards may also arise during the construction of the test elements or structures, their testing and disposal of test residues.

An assessment of all potential hazards and risks to health shall be made and safety precautions shall be identified and provided. Appropriate training shall be given to relevant personnel.

1 Scope

This part of ISO 22899 describes a method of determining the resistance to jet fires of passive fire protection materials and systems. It gives an indication of how passive fire protection materials behave in a jet fire and provides performance data under the specified conditions.

It does not include an assessment of other properties of the passive fire protection material such as weathering, ageing, shock resistance, impact or explosion resistance, or smoke production.

Complete I-beams and columns cannot be tested to this standard due to disruption of the characteristics of the jet.

2 Normative references

ISO 630:1995, *Structural steels — Plates, wide flats, bars, sections and profiles*

ISO/TR 834-3, *Fire-resistance tests — Elements of building construction — Part 3: Commentary on test method and guide to the application of the outputs from the fire-resistance test*

ISO 13702, *Petroleum and natural gas industries — Control and mitigation of fires and explosions on offshore production installations — Requirements and guidelines*

3 Terms and definitions

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

3.1
assembly
unit or structure composed of a combination of materials or products, or both

3.2
cellulosic fire
fire involving combustible material such as wood, paper, furniture, etc.

3.3
critical temperature
maximum temperature that the equipment, assembly or structure to be protected may be allowed to reach

3.4
Delta Tmax
The maximum temperature rise recorded by any of the installed thermocouples

3.5
fire barrier
separating element that resists the passage of flame and/or heat and/or effluents for a period of time under specified conditions

3.6
fire resistance
ability of an item to fulfil, for a stated period of time, the required stability and/or integrity and/or thermal insulation, and/or other expected duty (reaching the critical temperature) specified in a standard fire-resistance test

3.7
fire test
procedure designed to measure or assess the performance of a material, product, structure or system to one or more aspects of fire

3.8
flame re-circulation chamber
mild steel box, open at the front, into which the jet fire is directed giving a re-circulating flame resulting in a fireball

Note 1 to entry: Materials other than mild steel may be used when appropriate.

3.9
integrity
ability of a separating element, when exposed to fire on one side, to prevent the passage of flames and hot gases or occurrence of flames on the unexposed side, for a stated period of time in a standard fire resistance test

3.10
intermediate-scale test
test performed on an item of medium dimensions

Note 1 to entry: A test performed on an item of which the maximum dimension is between 1 m and 3 m is usually called "an intermediate-scale test". This part of ISO 22899 describes an intermediate-scale jet fire test.

3.11
jet fire
ignited discharge of propane vapour under pressure

3.12
jet nozzle
assembly from which the flammable material issues

3.13
outside specimen diameter
specimen diameter measured to the outer surface of the passive fire protection system on a tubular specimen

3.14
passive fire protection
coating or cladding arrangement or free-standing system which, in the event of fire, will provide thermal protection to restrict the rate at which heat is transmitted to the object or area being protected

Note 1 to entry: The term passive is used to distinguish the systems tested, including those systems that react chemically e.g. intumescents, from active systems such as water deluge.

3.15
passive fire protection material
coating or cladding that, in the event of a fire, will provide thermal protection to restrict the rate at which heat is transmitted to the object or area being protected

3.16
passive fire protection system
removable jacket or inspection panel, cable transit system, pipe penetration seal or other such system that, in the event of a fire, will provide thermal protection to restrict the rate at which heat is transmitted to the object or area being protected

3.17
penetration seal
system used to maintain the fire resistance of a separating element at the position where there is provision for services to pass through the separating element

3.18
pool fire
combustion of flammable or combustible hydrocarbon liquid spilled and retained on a surface

3.19
protective chamber
mild steel box, open at the front and back, which is designed to be attached to the rear of the flame re-circulation chamber to shield the rear of the flame re-circulation chamber from environmental influences

Note 1 to entry: A protective chamber is not required for tubular section tests but may be used to provide additional stability to the flame re-circulation chamber.

4 Principle

The method provides an indication of how passive fire protection materials perform in a jet fire that may occur, for example, in petrochemical installations. It aims at simulating the thermal and mechanical loads imparted to passive fire protection material by large-scale jet fires (see Bibliography [3]) resulting from high-pressure releases of flammable gas, pressure liquefied gas or flashing liquid fuels. Jet fires give rise to high convective and radiative heat fluxes as well as high erosive forces. To generate both types of heat flux in sufficient quantity, a 0,3 kg s^{-1} sonic release of gas is aimed into a shallow chamber, producing a fireball with an extended tail. The flame thickness is thereby increased and hence so is the heat radiated to the test specimen. Propane is used as the fuel since it has a greater propensity to form soot than does natural gas and can therefore produce a flame of higher luminosity. High erosive forces are generated by the release of the sonic velocity gas jet 1 m from specimen surface.

5 Test configurations

5.1 General

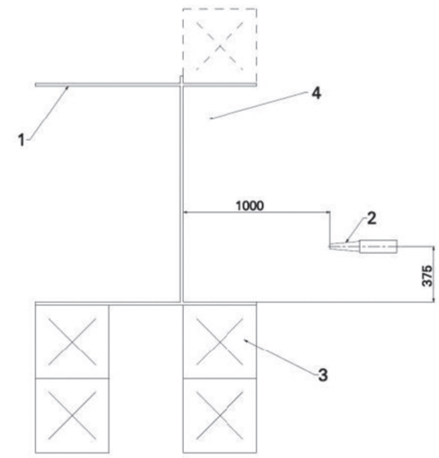
There are two basic configurations under which the test can be operated:

a) an internal configuration where one or more of the inner faces of the box incorporates the test construction;

b) an external configuration where the test construction is installed on supports in front of the box.

These two alternative configurations are shown in Figures 1 and 2.

Dimensions in millimetres



Key

1 protective chamber

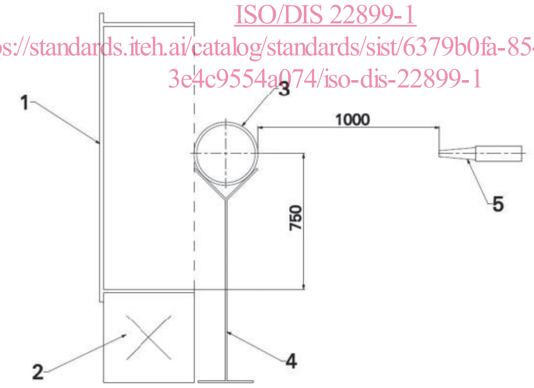
2 jet nozzle

3 supports

4 flame re-circulation chamber either with coated inner surfaces or with the rear face replaced by a panel to form the test construction

Figure 1 — Layout for internal configuration

Dimensions in millimetres



Key

1 flame re-circulation chamber

2 flame re-circulation chamber support

3 test construction

4 test construction support

5 jet nozzle

Figure 2 — Layout for external configuration

5.2 Internal configuration

The internal test configuration is used for determining the jet fire resistance of:

a) protection systems for plane surfaces;

b) protection systems for edge features;

c) bulkheads and other separating elements;

d) penetration systems used in conjunction with bulkheads.

5.3 External configuration

The external test configuration is used for determining the jet fire resistance of protected hollow sections or assemblies mounted on hollow sections.

6 Construction of the test items and substrates

6.1 General

The key items required for the test are the jet release nozzle, the flame re-circulation chamber and a protective chamber. These items are all required for the internal configurations of the test and the test specimen forms all or part of the flame re-circulation chamber. In the external configurations of the test, the flame re-circulation chamber is only used to help produce the fireball and it is not necessary to use the protective chamber.

6.2 Material

The material normally used is 10 mm thick steel plate complying with ISO 630:1995, Grade Fe 430. All welded construction shall be used and all welds shall be 5 mm fillet and continuous unless otherwise stated. All dimensions are in millimetres and, unless otherwise stated, the following tolerances shall be used:

— whole number ± 1,0 mm

— decimal to point ,0 ± 0,4 mm

— decimal to point ,00 ± 0,2 mm

— angles ± 0’ 30”

— radii ± 0,4 mm

6.3 Nozzle

The fuel is released towards the specimen from a nozzle. The tapered, converging nozzle shall be of length 200 ± 1 mm, inlet diameter 52 ± 0,5 mm and outlet diameter 17,8 ± 0,2 mm. Figure 3 shows the details of construction. The nozzle shall be constructed of heat resistant stainless steel. Provisions shall be made for fitting a sighting device.

The side, top and bottom walls of the flame re-circulation chamber shall be constructed from mild steel of 10 mm thickness. The rear wall of the chamber shall either be constructed of 10 mm thick steel welded to the sides of the chamber or of a panel bolted on to form the rear wall. If the substrate material is not steel or the substrate thickness is not 10 mm, the material and thickness used shall be stated in the test report. The details of construction of the flame re-circulation chamber are given in Figure 5.

Dimensions in millimetres

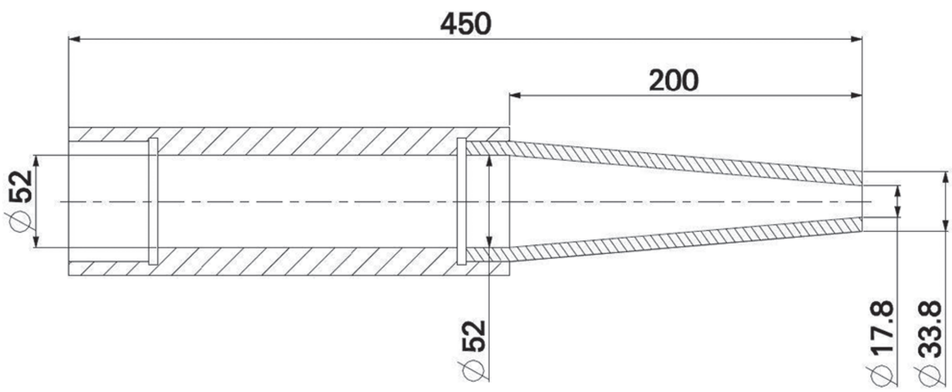
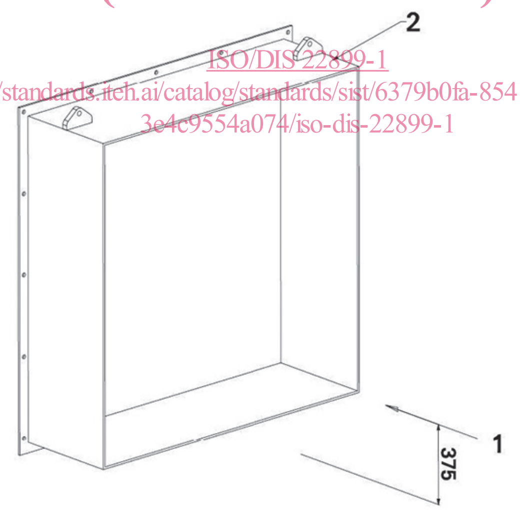


Figure 3 — Nozzle

6.4 Flame re-circulation chamber

The flame re-circulation chamber, having nominal internal dimensions 1 500 mm × 1 500 mm × 500 mm, shall be used for each test. The chamber is flanged at the rear to allow bolting on of a panel when required and attachment, by bolting or clamping, of the protective chamber when required. A general view of the flame re-circulation chamber is shown in Figure 4 and details of construction in Figure 5

Dimensions in millimetres



Key

1 jet position

2 flame re-circulation chamber

Figure 4 — General view of flame re-circulation chamber

Details of the flange construction, apart from the hole spacing, are not given as one of two methods may be used.

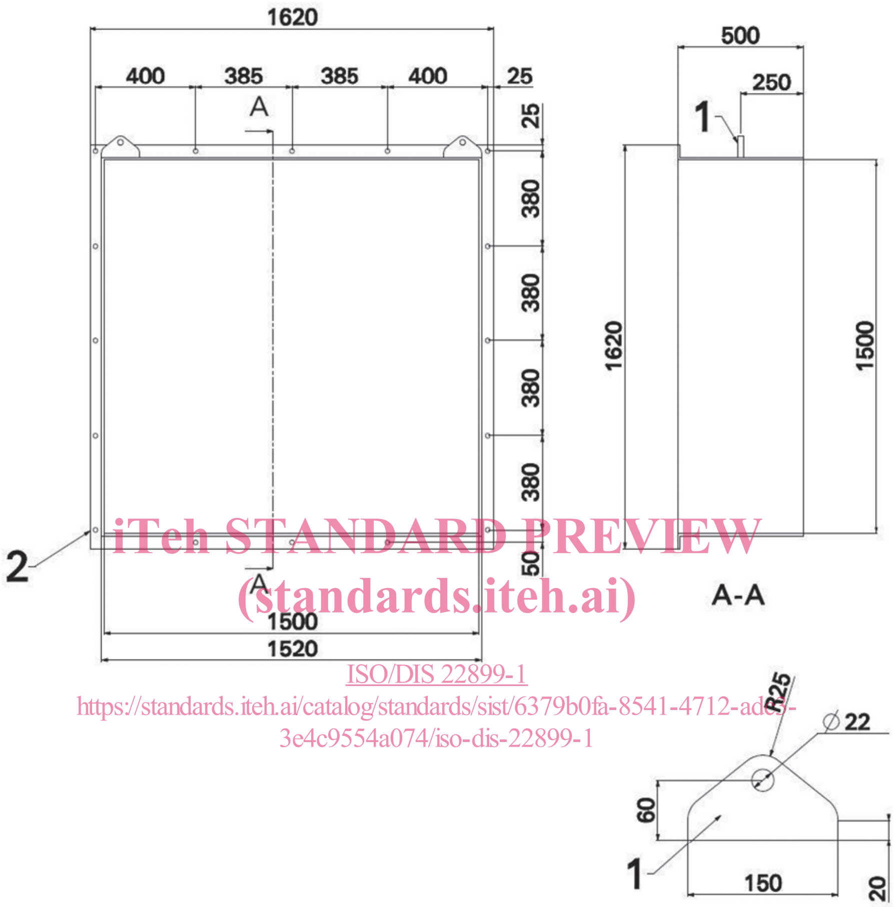
a) The flanges may be constructed by welding L-section steel to the rear of each wall.

b) For structural steelwork specimens, the rear wall may be constructed by continuously welding a 1 620 mm × 1 620 mm plate on to the rear of the flame re-circulation chamber and drilling holes at the appropriate locations in the plate extending beyond the sides of the chamber.

Inner walls that do not form part of the specimen, e.g. the sidewalls in a panel test, shall be protected from distortion by a ceramic board insulation material or other suitable form of passive fire protection material.

NOTE If the substrate is not steel, the material used for construction of the specimen should be at the discretion of the test laboratory and any third-party certifying body.

Dimensions in millimetres



Key

1 lifting lug, 25 mm thick machined steel

2 sixteen holes drilled, Ø 18

Figure 5 — Construction of flame re-circulation chamber

6.5 Protective chamber

The protective chamber (nominal internal dimensions 1 500 mm × 1 500 mm × 1 000 mm) is used to shield the rear of the flame re-circulation chamber from environmental influences in the internal configuration of the test. It shall generally be constructed from mild steel of 10 mm thickness and shall be open at the front and back and flanged at the front to allow fitting to the rear of the flame re-circulation chamber with no visible air gaps.

A general view of the protective chamber is shown in Figure 6 and details of construction in Figure 7.

