FINAL DRAFT

INTERNATIONAL STANDARD

ISO/FDIS 22899-1

ISO/TC **92**/SC **2**

Secretariat: ANSI

Voting begins on:
2021-04-07

Voting terminates on:
2021-06-02

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

Reference number
ISO/FDIS 22899-1:2021(E)

Contents

Page

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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*.

This second edition cancels and replaces the first edition (ISO 22899-1:2007), which has been technically revised. The main changes compared to the previous edition are as follows:

— Corrections to figures;

— Revision of the method of test for penetration seals.

A list of all parts in the ISO 22899 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

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

NOTE Guidance on the applicability of the test is intended to be covered in a future part of the ISO 22899 series.

Although the method specified in this document has been designed to simulate certain 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 plants. 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[3]) but is seen as a complementary test.

Users of this document are advised to consider the desirability of third-party certification/inspection/testing of product conformity with this document.

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

Part 1: General requirements

1 Scope

This document 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 document due to disruption of the characteristics of the jet.

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 834-1:1999, *Fire-resistance tests — Elements of building construction — Part 1: General requirements*

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.

ISO and IEC maintain terminological 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
assembly
unit or structure composed of a combination of materials or products, or both

3.2
critical temperature
maximum temperature that the equipment, *assembly* (3.1) or structure to be protected may be allowed to reach

3.3
Delta Tmax
maximum *temperature rise* (3.18) recorded by any of the installed thermocouples

3.4
fire barrier
separating element that resists the passage of flame and/or heat and/or effluents for a period of time under specified conditions

3.5
fire resistance
ability of an item to fulfil, for a stated period of time, the required stability and/or *integrity* (3.8) and/or thermal insulation and/or other expected duty, reaching the *critical temperature* (3.2) specified in a standard fire-resistance test

3.6
fire test
procedure designed to measure or assess the performance of a material, product, structure or system to one or more aspects of fire

3.7
flame re-circulation chamber
mild steel box, open at the front, into which the *jet fire* (3.10) 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.

3.8
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* (3.5) test

3.9
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 document describes an intermediate-scale jet *fire test* (3.6).

3.10
jet fire
ignited discharge of propane vapour under pressure

3.11
jet nozzle
assembly (3.1) from which the flammable material issues

3.12
outside specimen diameter
specimen diameter measured to the outer surface of the *passive fire protection* (3.13) system on a tubular specimen

3.13
passive fire protection
coating or cladding arrangement or free-standing system that, in the event of fire, provides 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.

3.14
passive fire protection material
coating or cladding that, in the event of a fire, provides thermal protection to restrict the rate at which heat is transmitted to the object or area being protected

3.15
passive fire protection system
removable jacket or inspection panel, cable transit system, pipe *penetration seal* (3.16) or other such system that, in the event of a fire, provides thermal protection to restrict the rate at which heat is transmitted to the object or area being protected

3.16
penetration seal
system used to maintain the *fire resistance* (3.5) of a separating element at the position where there is provision for services to pass through the separating element

3.17
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* (3.7) 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.

3.18
temperature rise
increase in measured temperature above the initial temperature at a given location

4 Principle

The method presented in this document provides an indication of how passive fire protection materials perform in a jet fire that can 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[4] 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

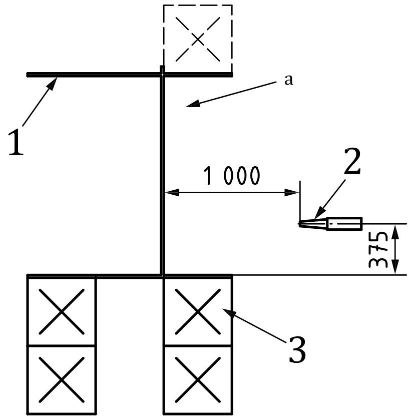
There are two basic configurations under which the test can be operated:

a) an internal configuration where one or more of the inner faces of the flame re-circulation chamber incorporates the test construction;

b) an external configuration where the test construction is installed on supports in front of the flame re-circulation chamber.

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

Dimensions in millimetres



Key

1 protective chamber

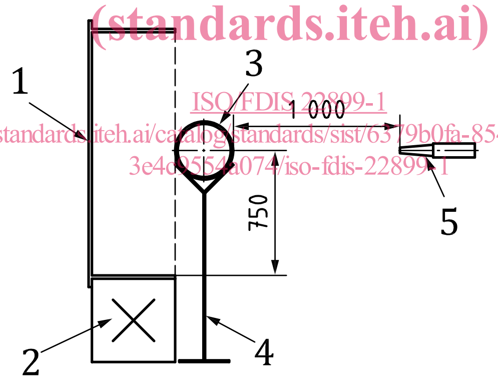
2 jet nozzle

3 supports

[a] 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) fire barriers;

d) penetration systems used in conjunction with fire barriers.

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 conforming to ISO 630-1:2011, Grade Fe 430. All-welded construction shall be used and all welds shall be 5 mm fillet and continuous unless otherwise stated. The use of substrates manufactured from other materials or thicknesses other than 10 mm shall be documented in the report.

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

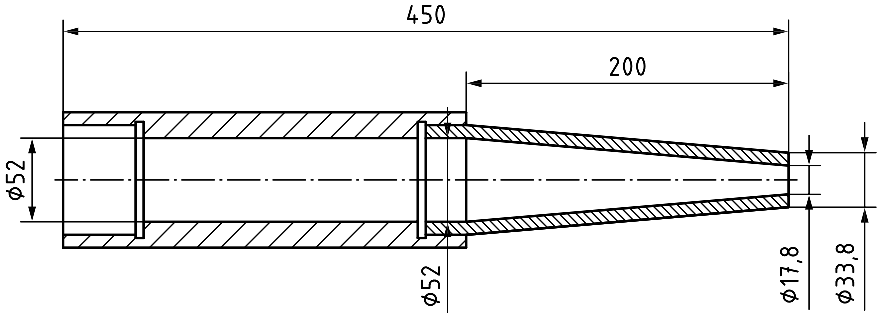
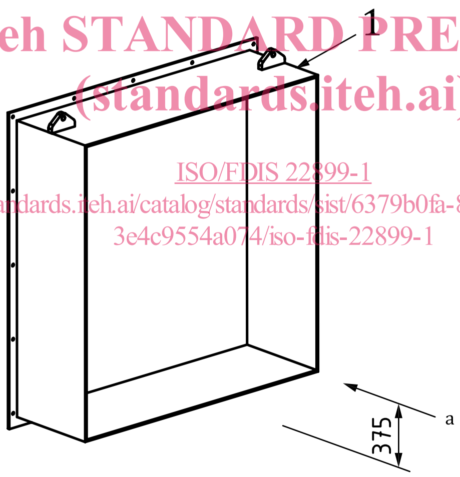


Figure 3 — Nozzle

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 are shown in Figure 5.

Dimensions in millimetres



Key

1 flame re-circulation chamber

a Jet position.

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:

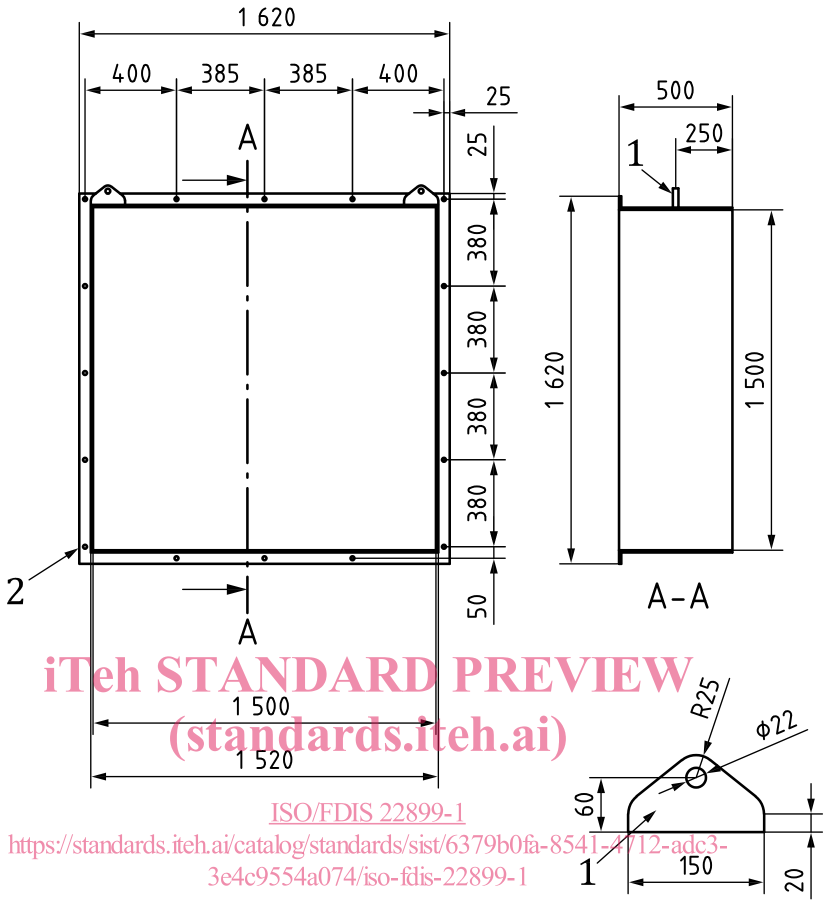
a) The flanges may be constructed by welding L-section steel to the rear of each wall.

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 an alkaline earth silicate board or other suitable form of passive fire protection or insulation material.

When testing in the external configuration, the recirculation chamber shall have a rear wall and the recirculation chamber shall be insulated.

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 are shown in Figure 7.

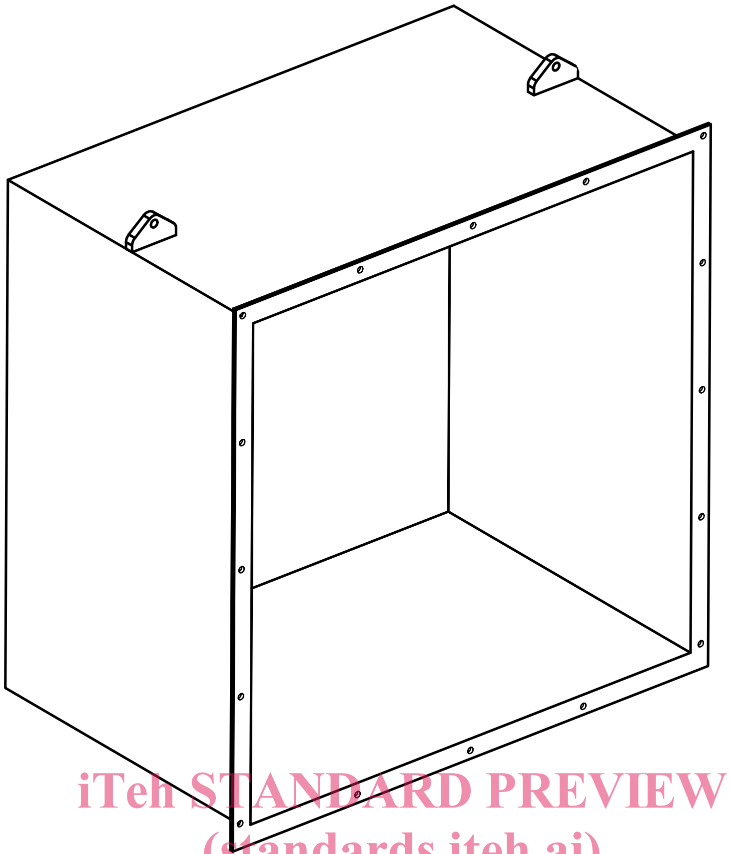
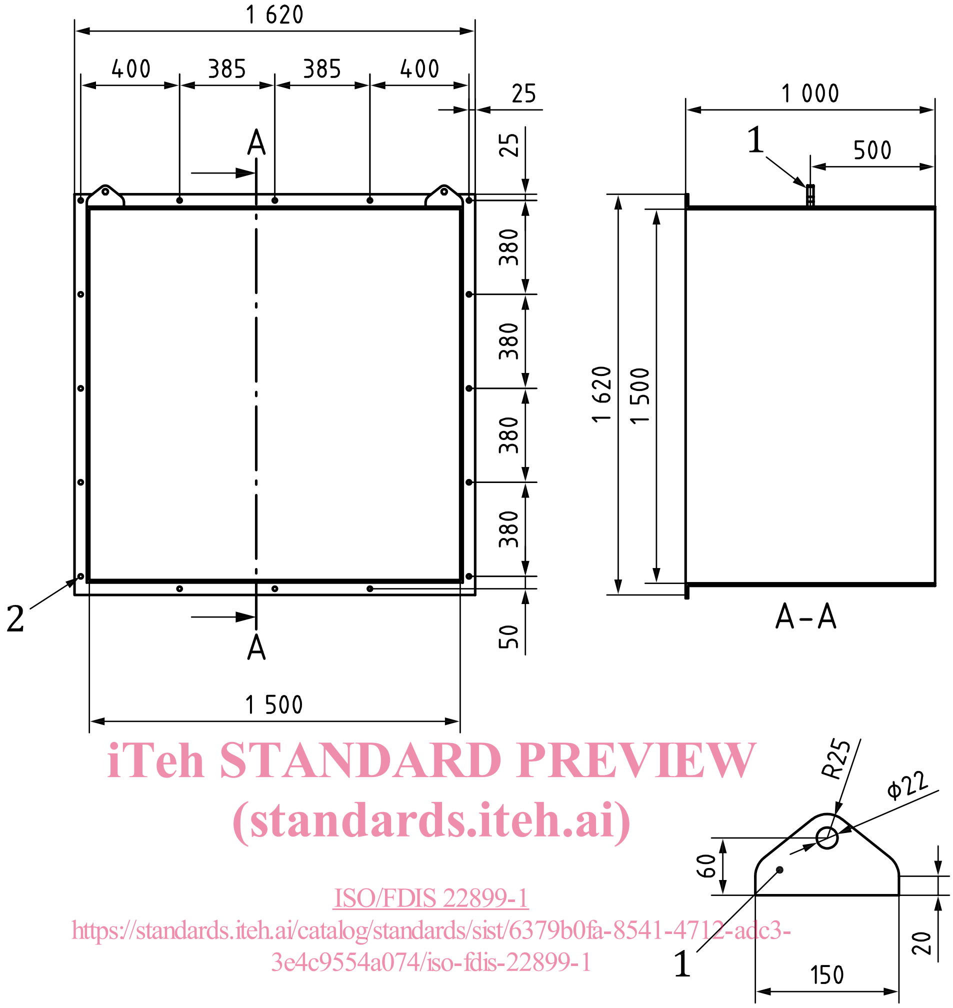


Figure 6 — General view of protective chamber

Dimensions in millimetres



Key

1 lifting lug, 25 mm thick machined steel

2 sixteen holes drilled, Ø 18

Figure 7 — Construction of protective chamber

6.6 Panel test specimens (internal configuration)

The panel test specimen shall consist of a flame re-circulation chamber, with the rear wall replaced by the panel to be tested. The panel is sandwiched between the flame re-circulation chamber and the protective chamber as illustrated in Figure 8. The connection between the panel and the flame re-circulation chamber shall be gas tight. The method of mounting depends on the type of passive fire protection as described in 7.1.