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Interested committees:

Title: Draft BS ISO 3957 Reaction to fire tests - Parallel panel test method for wall systems -Measurement of heat release and smoke production.

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



DRAFT International Standard

ISO/DIS 3957

Reaction to fire tests — Parallel panel test method for wall systems — Measurement of heat release and smoke production

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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).

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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 1, *Fire Initiation and Growth*.

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

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Introduction

This large-scale fire test standard is developed for the purpose of measuring the heat release rates (HRR) and the smoke-production rate (SPR) of exterior and interior wall systems, exposed under severe fire scenarios using a parallel panel setup. Severe fire exposure to an exterior wall system can be either caused by spill plumes from a window, such as in a post-flashover compartment fire, or an exterior fire source such as in a dumpster, vehicle, balcony storage, etc. Some extreme scenarios for an exterior fire include city conflagration (e.g., after an earthquake) or wildland-urban-interface (WUI) fires. Severe interior wall fires can be caused by combustible storage located inside a facility, such as warehouse and manufacturing occupancies, close to the corners of wall system. A common factor of such fire scenarios is the absence or an inadequacy of the traditional active fire protection safeguards (e.g., sprinklers) leading to unmitigated heat exposures to wall systems.

A sufficiently high heat flux is required to simulate such fire exposures — a high heat flux can reveal the flammability of the encapsulated materials used in the wall systems, as well as the vulnerabilities of facers, joints and other components. Literature^[1] shows that severe fire exposure to wall systems is in the order of 100 kW/m². For this purpose, three large-scale fire tests are known to simulate realistically severe fire exposures of about 100 kW/m², and are used to evaluate the performance of both exterior and interior wall systems.^[2-5] These three large-scale fire tests include the 7,6 m (25-ft) high corner fire test, 15 m (50-ft) high corner fire test, and 4,9 m (16-ft) high parallel panel test of the ANSI/FM 4880 standard; the latter is henceforth abbreviated as 16-ft PPT. This International Standard is based on the 16-ft PPT method. The literature background of the method is provided in [Annex A](#).

The 16-ft PPT setup is placed under a large-scale (minimum 3,5 MW) calorimeter in an indoor facility and is therefore not affected by outdoor weather conditions. The HRR measured during the tests provides an objective evaluation to the fire performance of specimens. The test setup is further utilized to evaluate the smoke hazard of the wall systems used in smoke sensitive occupancies from property insurance perspective^[3].

Reaction to fire tests — Parallel panel test method for wall systems — Measurement of heat release and smoke production

WARNING — So that suitable precautions can be taken to safeguard health, the attention of all concerned in fire tests is drawn to the possibility that toxic or harmful gases can be evolved during combustion of test specimens.

Suitable respiratory protection must be worn by those in the test room when the atmosphere in the test room becomes unacceptable.

The test procedure involves high temperatures and combustion processes - from ignition to a fully developed fire. Hazards may exist for burns, ignition of extraneous objects or clothing. Operators should use full turn out firefighting gear including self-contained breathing apparatus.

Specimens with combustible content burning inside metallic facings can be difficult to extinguish. At least one charged water hose should be available for all tests.

Specimen collapse may occur. All personnel within the test area should remain at a sufficient distance from the test specimen to avoid injury should specimen collapse occur.

Combustible or sensitive elements such as wires, pipes and gages close to the setup shall be covered with fire protection blankets.

1 Scope

This International Standard specifies a large-scale fire test method for measuring the heat release rates (HRR) and the smoke-production rates (SPR) of wall systems. The fire scenario covered in this document is representative of severe fires originating in near wall or corner locations of an exterior or interior wall construction. Some examples of severe exterior fire scenarios include dumpster, balcony storage, and vehicle fires originating outside buildings. Fires caused by combustible storage inside un- or inadequately-sprinklered occupancies, such as warehouse and manufacturing occupancies represent a few examples of severe interior fires. All these scenarios can impart a heat flux in the order of 100 kW/m² to the wall systems.

This International Standard measures the HRR and SPR in compliance with ISO 24473 (Fire tests – open calorimetry – measurement of the rate of production of heat and combustion products for fires up to 40 MW). The standard also provides informative guidelines for heat release and smoke production performance limits, developed and used for risk evaluation by the insurance industry.

The test method is not applicable for scenarios where a fire initiates within an air cavity, if present, of an exterior wall system. The test method does not incorporate a window structure and hence cannot cover the hazard from inadequately protected window openings in a post-flashover fire scenario.

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 9705-1, *Fire tests — Full-scale room test for surface products*

ISO 13785-1, *Reaction-to-fire tests for façades — Part 1: Intermediate-scale test*

ISO 13785-2, *Reaction-to-fire tests for façades — Part 2: Large-scale test*

ISO 13943, *Fire safety — Vocabulary*

ISO/TS 14934-1, *Fire tests — Calibration and use of radiometers and heat flux meters — Part 1: General principles*

ISO 14934-2, *Fire tests — Calibration and use of heat flux meters — Part 2: Primary calibration methods*

ISO 14934-3, *Fire tests — Calibration and use of heat flux meters — Part 3: Secondary calibration method*

ISO/TS 14934-4, *Fire tests — Calibration of heat flux meters — Part 4: Guidance on the use of heat flux meters in fire tests*

ISO 24473, *Fire tests — Open calorimetry — Measurement of the rate of production of heat and combustion products for fires of up to 40 MW*

ANSI FM 4880, *American National Standard for Evaluating the Fire Performance of Insulated Building Panel Assemblies and Interior Finish Materials*

ANSI FM 4881, *American National Standard for Evaluating Exterior Wall Systems*

FM 4882, *FM Approvals Standard for Class 1 Interior Wall and Ceiling Materials or Systems for Smoke Sensitive Occupancies*

ANSI FM 4411, *American National Standard for Cavity Wall Systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13943 and the following apply.

3.1 collapse

development of failure mechanisms in an exterior wall system to a degree involving disintegration and falling (parts of) structural members.

[SOURCE: ISO 2394]

3.2 component

a part or element of an exterior wall assembly, including but not limited to, the building panel, foam system, cladding, joint systems, rails, brackets, sealants, insulation, continuous insulation, fire barrier, thermal barrier, water resistive barrier, etc.

3.3 fire propagation

increase in the exposed surface area of the specimen that is actively involved in flaming combustion.

[SOURCE: ISO 12136]

3.4 insulating sandwich panel

multi-layered product consisting of three or more layers bonded together.

Note 1 to entry: One layer is an insulating material, such as mineral or glass wool, cellular plastics, or a natural material, e.g. corkboard protected by facings on both sides. The facing can be selected from a variety of materials and can be either flat or profiled.

Note 2 to entry: The most widely used facing is coated steel. The composite can vary from a simple construction to a complex composite system with specific fixing joints and supports depending on the application and on the performance requirements.

[SOURCE: ISO 13784-1: 2014]

3.5**loadbearing element**

an element that is intended for use in supporting an external load in a building and maintaining this support in the event of a fire.

[SOURCE: ISO 834-1]

3.6**smoke production rate**

rate of smoke produced during the fire test.

3.7**smoke sensitive occupancy**

an occupancy which is susceptible to damage due to smoke infiltration or contamination.

3.8**smoke yield**

ratio of the total mass of smoke released to the total mass of the material vaporized.

[SOURCE: ISO 12136]

3.9**thermal barrier**

a material that both limits the transfer of heat and remains in place when exposed to a standard fire exposure for a specified period of time.

4 Symbols

A_D	Exhaust duct cross-sectional area	m^2
c_p	Mass specific heat capacity of a material	kJ/g-K
$LHV_{C_3H_8}$	Lower heat value of propane	kJ/g
k	Thermal conductivity of a material	kW/m-K
$M_{C_3H_8}$	Molecular weight of propane	g/mol
Δp_{max}	Maximum pressure drop in the exhaust duct	N/m^2
p_s	Standard pressure conditions	Pa
$\dot{Q}$	Target chemical HRR	kW
$\dot{Q}'_{Ch}$	Chemical HRR per unit width of a material	kW/m
$\dot{Q}'_{Ch,Max}$	Maximum chemical HRR per unit width of a material	kW/m
$\dot{Q}'_R$	Radiative HRR per unit width of a material	kW/m
$\dot{q}''$	Net heat flux to the sample ahead of the pyrolysis zone	kW/m^2
$\hat{R}$	Universal gas constant	J/mol-K
R^2	Coefficient of determination	—
ΔT_{ig}	Ignition temperature of the material above ambient	K
TRP	Thermal response parameter of a material	$\text{kW-s}^{1/2}\text{m}^{-2}$

T_s	Standard temperature conditions	K
v	Vertical flame spread rate	m/s
$\dot{V}_{C_3H_8,est}$	Estimated propane flow rate	m ³ /s
$\dot{V}_{D,max}$	Maximum exhaust duct flow rate	m ³ /s
y_f	Flame height	m
y_p	Pyrolysis zone height	m
$y_{p,Max}$	Maximum pyrolysis zone height	m
α	Proportionality constant	—
ρ	Density of a material	g/m ³
ρ_a	Exhaust air density	kg/m ³
τ_{ig}	Ignition time	s
χ_{Ch}	Combustion efficiency of a material	—
χ_R	Radiative fraction	—

5 Principle

This large-scale fire test method evaluates the HRR and SPR performance of wall systems under a scenario representing severe fires.

The test consists of two 4,9 m (16,0 ft) high and 1,1 m (3,5 ft) wide wall assemblies parallelly mounted at 0,53 m (1,75 ft) separation. A propane sand burner of 360 kW exposure provides an approximately 100 kW/m² heat flux to the lower portion of both wall assemblies. The test setup is placed under an ISO 24473^[6] compliant large-scale calorimeter (minimum 3,5 MW HRR capacity), to measure time-resolved HRR and SPR from the wall assemblies during the test. The setup may optionally be installed on a weighing platform to provide mass loss data during the test.

Informative guidance on thresholds for HRR and SPR performance criteria, based on the risk evaluation from the property insurance perspective,^[2,3] is provided in the Annex A.3 of this document.

6 Test facility and instrumentation section

The test setup shall be located in an indoor facility. The test facility height and scale shall be in accordance to ISO 24473^[6].

The calorimeter, or fire products collector (FPC), shall be large enough in terms of capacity to conduct, and accurately measure, up to 3,5 MW HRR during the tests. Although for the safety purposes to avoid plume spillage, an FPC of 5,0 MW is recommended to be used. Annex B provides description of a 5,0 MW calorimeter presently used at a test facility, and an alternative 3,5 MW calorimeter.

The calorimetry instrumentation section shall contain exhaust duct gas velocity probes, gas thermocouples, an absolute pressure transducer, gas sampling probes, a multi-gas analyser system, and a smoke measurement system in compliance with ISO 24473.^[6] An informative description of these systems used at a test facility in the US that houses a 5,0 MW calorimeter is provided in Annex B.

7 Apparatus

7.1 General

The test apparatus consists of two $4\,900\text{ mm} \pm 100\text{ mm}$ (16,0 ft) high and $1\,100\text{ mm} \pm 50\text{ mm}$ (3,5 ft) wide wall assemblies parallelly mounted with the exterior facer of each assembly at $530\text{ mm} \pm 25\text{ mm}$ (1,75 ft) separation, as shown in [Figure 1](#). The wall assemblies shall be mounted on two metal frames. Each metal frame first covered with a $13\text{ mm} \pm 1\text{ mm}$ (0,5 in.) thick plywood and $25\text{ mm} \pm 1\text{ mm}$ (1,0 in.) thick calcium silicate (non-combustible) boards before mounting the wall assembly. Alternative base materials other than plywood are acceptable to back the non-combustible boards. A sand burner of dimensions $1\,100\text{ mm} \pm 50\text{ mm}$ length x $530\text{ mm} \pm 25\text{ mm}$ width x $460\text{ mm} \pm 25\text{ mm}$ height (3,5 ft x 1,75 ft x 1,5 ft) is located at the base, with the long edge of the burner flush with the lower edge of the two wall assemblies.

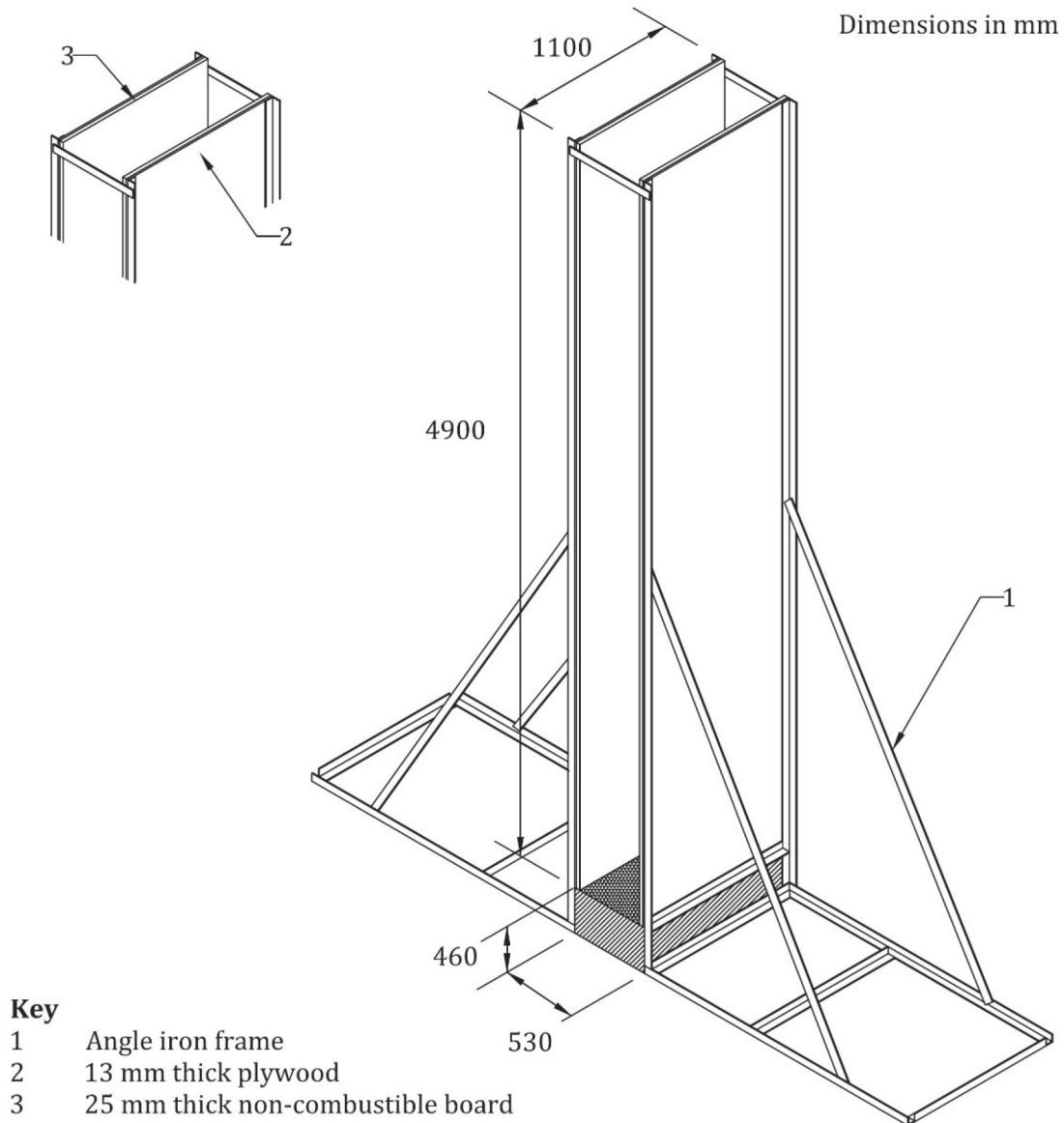


Figure 1 — A schematic of 16-ft PPT apparatus

7.2 Metal frames

All parts of the metal frames shall be constructed from $6,4\text{ mm} \pm 0,3\text{ mm}$ (0,25 in.) thick low carbon (mild) steel or stainless steel. The schematics of the main structure of metal frames are shown in [Figure 2](#). Each structure shall be $5\,300\text{ mm} \pm 100\text{ mm}$ (17,5 ft) high to accommodate $4\,900\text{ mm} \pm 100\text{ mm}$ (16,0 ft) high wall