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Reaction to fire tests — Ignitability of building products subjected to direct impingement of flame —

Part 3: Multi-source test

*Essais de réaction au feu — Allumabilité des produits du bâtiment soumis
à l'incidence directe de la flamme —*

Partie 3: Essai multi-sources

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 11925-3 was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 1, *Reaction to fire*.

ISO 11925 consists of the following parts under the general title *Reaction to fire tests — Ignitability of building products subjected to direct impingement of flame*:

Part 2: Single flame source test

Part 3: Multi-source test

Part 1 is under preparation.

Annexes A to D of this part of ISO 11925 are for information only.

Introduction

Fire is a complex phenomenon: its behaviour and effects depend upon a number of interrelated factors. The behaviour of materials and products depends upon the characteristics of the fire, the method of use of the materials and the environment in which they are exposed. The philosophy of "reaction to fire" tests is explained in ISO/TR 3814.

With the exception of rare cases of spontaneous ignition, for any fire to start, whether smouldering or flaming, it is essential for some form of ignition source to be applied to, or in some way contact, a product in such a way that continuing combustion can take place.

The ignition source can take three forms, something which imposes heat by conduction and/or radiation and/or convection. An example of ignition by conduction is by a hot wire coil or a hot metal bar; by radiation by an electric bar heater; and by convection by a convection heater or paint stripper. Usually, ignition sources of the radiative type include some degree of convection, and a flame includes a contribution from all three.

Recourse to various material fire statistics shows that many fires start from a range of common sources which vary with intensity and severity. Frequent sources of fire have been found to be as follows:

- (i) Cooking appliances
- (ii) Space heating
- (iii) Electrical wiring and installations
- (iv) Other electrical appliances
- (v) Cigarettes and smokers materials (i.e. matches, lighters)
- (vi) Blow lamps, etc.
- (vii) Rubbish burning
- (viii) Candles

A test such as is specified in this part of ISO 11925 deals only with a simple representation of a particular aspect of a potential fire situation typified by a flame playing directly onto a material, composite or assembly. It cannot alone provide any direct guidance on behaviour or safety in fire. A test of this type may, however, be used for comparative purposes or to ensure the existence of a certain quality of performance (in this case ignitability) considered to have a bearing on fire performance generally. It would be wrong to attach any other meaning to performance in this test.

The term "ignitability" is defined in ISO/IEC Guide 52 as the capability of a material of being ignited. It is one of the first fire properties to be manifest and should almost always be taken into account in any assessment of fire hazard. It may not, however, be the main characteristic of the material which affects the subsequent development of fire in a building.

This test does not rely upon the use of asbestos-based materials.

Reaction to fire tests — Ignitability of building products subjected to direct impingement of flame —

Part 3: Multi-source test

CAUTION — So that suitable precautions may be taken to safeguard health, the attention of all concerned in fire tests is drawn to the possibility that toxic or harmful gases may be evolved during exposure of test specimens. The advice on safety given in clause 5 should also be followed.

1 Scope

This part of ISO 11925 specifies a series of ignition sources which can be used for the determination of the ignitability of materials, composites and assemblies when subjected to direct impingement of flames of different size and intensity but without impressed irradiance. The sources may be used in isolation or with the test method specified.

This test method determines the ignitability of a material, composite or assembly and is not designed to assess any other fire parameter (e.g. flame spread). The possibility of the material composite or assembly causing secondary ignition of other materials is also considered by the observation of burning droplets or debris which may be formed.

NOTE — Secondary ignition of material in a growing fire situation can be addressed using ISO 5657 which assesses the ignitability of building products by irradiance.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this part of ISO 11925. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this part of ISO 11925 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/IEC Guide 52:1990, *Glossary of fire terms and definitions*.

3 Definitions

For the purposes of this part of ISO 11925, the definitions given in ISO/IEC Guide 52 and the following apply.

3.1 sustained ignition: After withdrawal of the ignition source, the presence of a flame on the surface of the specimen that persists for at least 4 s.

3.2 transient ignition: After withdrawal of the ignition source, the appearance of flashes, or flames, which are not sustained for a continuous 4 s.

3.3 progressive smouldering: An exothermic oxidation not accompanied by flaming which is self-propagating (i.e. independent of the ignition source) and may be accompanied by incandescence.

3.4 flaming debris: Matter flowing or separating from the specimen during the test procedure and falling below the initial lower edge of the specimen and continuing to flame as it falls.

3.5 afterglow: Persistence of glowing of a specimen, under specified test conditions, after cessation of flaming or, if no flaming occurs, after removal of the ignition source.

3.6 flame application time: The time (in seconds) for which the burner is in its final testing position.

3.7 constant mass: The state of a test specimen when two successive weighing operations, carried out at an interval of 24 h, do not differ by more than 0,1% of the mass of the specimen or 0,1 g, whichever is the greater.

4 Principle

Specimens are exposed to specified flames of different sizes and intensities and their ignition behaviour is observed. Annex C gives guidance on the application of this range of ignition sources to end-use products or specimens which are not essentially flat.

5 Safety requirements

There are hazards encountered when assessing the ignitability of any product using flame sources and it is essential that adequate precautions are taken. Particular attention should be paid to: the handling of flammable gases; the evolution of potentially toxic gases; and the fact that extensive flaming of specimens may occur.

The atmosphere of the testing room (see clause 12) may become hazardous and shall be cleared of smoke and toxic gases by an extractor fan or other means of ventilation.

Adequate means of extinguishing the specimen should be provided, bearing in mind that some specimens may produce severe flaming during the test. A hand and/or fixed water spray which can be directed over the burning area should be available with other means, such as fire extinguishers and fire blankets.

NOTE — In some cases, smouldering may be difficult to extinguish completely and immersion in water may be necessary.

6 Ignition processes

6.1 When building products are exposed to thermal energy, flammable vapours may be generated from their surface. Under suitable conditions (especially in high temperatures), a critical concentration of flammable vapour may form and spontaneous ignition will result. If a flame is present as the sole energy source, or as a supplementary source, the ignition process will be assisted; this mechanism is sometimes known as pilot ignition.

6.2 A specimen of a building product is regarded as ignited when flames appear on its surface. Ignition from the sources detailed in this standard may be transitory or sustained.

6.3 After ignition has occurred, some burning materials create additional fire hazards by forming flaming debris or drips. If this flaming debris falls onto combustible material, secondary ignition may occur and the fire will spread more rapidly.

6.4 The localised application of a heat source to some materials may result in glowing combustion.

7 Characteristics of ignition sources

7.1 The main characteristics of ignition sources and their relation to the test specimen may be defined by the following factors.

- a) The intensity of the ignition source. This is a measure of the heat flux on the specimen resulting from the combined conduction, convection and radiation effects caused by the ignition source.
- b) The area of impingement of the ignition source on the specimen.
- c) The duration of exposure of the specimen and whether it is continuous, intermittent or growing.
- d) The presentation of the ignition source to the specimen and whether or not it impinges.
- e) The orientation of the specimen in relation to the ignition source.
- f) The ventilation conditions in the vicinity of the ignition source and exposed surface of the specimen.

7.2 Flame ignition sources

Two types have been selected.

7.2.1 Diffusion flame source

To form a diffusion flame source, gas (e.g. propane) flows through stainless steel tubes without ingress of air prior to the base of the flame.

NOTE — These flames simulate natural flames well but they often fluctuate and are not convenient to direct if any angular presentation is required toward the specimen.

7.2.2 Premixed flame source

To form a premixed flame source, use a gas burner (e.g. using propane) fitted with air inlet ports or air intake manifold.

NOTE 1 Premixed flame sources are more directional than diffusion flame sources and are more suitable for some laboratory quality assurance tests.

NOTE 2 Premixed flame sources are generally hotter than diffusion flame sources.

8 Gas supply and regulation

A supply of commercial propane connected to the ignition sources by:

- a) a cylindrical regulator with an outlet pressure of 1 bar absolute;
- b) an appropriate length of 5 mm internal diameter high pressure hose;
- c) two flowmeters with integral needle valves and accuracies of $\pm 0,25\%$, with flow ranges covering 25 ml/min to 160 ml/min and 1 L/min to 10 L/min, connected to a common manifold top and bottom to allow measurement with either meter.

Some difficulties have been reported with the supply and measurement of the propane particularly where the propane cylinder has, of necessity, to be stored in an environment cooler than the defined test conditions and/or some distance from the test rig. In these cases, and other situations where difficulties occur, it is important that there is a sufficient length of tubing inside the controlled environment (10°C to 30°C) to ensure that the propane equilibrates to the required temperature before flow measurement. One way to assist this is to pass the propane (before flow measurement) through a metal tube immersed in water maintained at 25°C.

Great care also needs to be exercised with the measurement and setting of the flow rate of the propane. Direct reading flow meters, even those obtained with a direct propane calibration, need to be checked when initially installed, and also at regular intervals during testing, with a method capable of measuring accurately the absolute propane flow at the burner tube. One way of doing this is to connect the burner tube with a short length of tubing (about 7 mm internal diameter) to a soap bubble flowmeter, such that the upward passage of a soap foil meniscus in a glass tube of calibrated volume (e.g. a burette) over a known period of time gives an absolute measurement of the flow. Fine control valves which can be preset to one of the desired propane flow rates, with simple switching means from one to the other, have also proved helpful.

9 Ignition sources

9.1 General

The following ignition sources provide a range of intensities and areas of impingement to be considered for use in fire tests involving building materials. The sources may be used in isolation or may be used with the test method and apparatus described in clause 11. The size of flame and its thermal characteristics for each of these ignition sources are detailed in annex A.

9.2 Ignition source A

This consists of a burner consisting of a stainless steel tube bore of $0,5 \pm 0,1$ mm and with a minimum length of 35 mm.

NOTE 1 A hypodermic syringe, with the tapered end cut off square and cleanly, has been found suitable.

The flowmeter shall be calibrated to supply a propane gas flow rate at 25°C of 25 ± 2 ml/min.

NOTE 2 This source provides a low intensity, low area diffusion flame and is used to simulate the effect of small flames resulting from fault conditions within electrical equipment.

9.3 Ignition source B (Kleinbrenner)

This consists of a burner constructed as shown in figure 1. The burner consists of three parts, a gas jet, a burner tube and a flame stabilizer. The orifice diameter of the gas jet shall be $0,19 \pm 0,02$ mm. The burner tube shall consist of four zones, the air chamber, the gas mixing zone, the diffusion zone and the gas outlet within the air chamber. The burner tube shall have four air holes of 4 mm diameter for air inlets. The forward edge of the air holes shall be approximately level with the tip of the jet. The burner shall have a bore of 1,7 mm and an outlet of 3,0 mm inside diameter.

The flowmeter shall be calibrated to supply a propane gas flow rate at 25°C of 25 ± 1 ml/min.

NOTE — This source provides a low density premixed flame similar in calorific value to source C and its use is advantageous for tests where a small, stable, directable flame is required.

9.4 Ignition source C

This consists of a burner tube consisting of a length of stainless steel tube ($8,0 \pm 0,1$ mm outside diameter, $6,5 \pm 0,1$ mm internal diameter and 200 ± 5 mm in length). The flowmeter shall be calibrated to supply a propane gas flow rate at 25°C of 45 ± 2 ml/min.

NOTE — This diffusion flame has a calorific output approximately that of a burning match.

9.5 Ignition source D

This consists of a burner tube consisting of a length of stainless steel tube ($8,0 \pm 0,1$ mm outside diameter, $6,5 \pm 0,1$ mm internal diameter and 200 ± 5 mm in length). The flowmeter shall be calibrated to supply a propane gas flow rate at 25°C of 160 ± 5 ml/min.

NOTE — This diffusion flame has an intensity and area of impingement simulating that of a cigarette lighter.

9.6 Ignition source E

This consists of a gas burner comprising a 185 mm horizontal stainless steel tube (12,0 mm outside diameter, 9,0 mm inside diameter) closed at each end and fitted with a central gas pipe. The burner tube shall have a row of 14 holes of 1,5 mm diameter at 12,5 mm pitch, arranged so that the gas jets issue at an angle of 45° below the horizontal (see figure 2). The flowmeter shall be calibrated to supply a propane gas flow rate at 25°C of 2 L/min.

NOTE — The heat output and area of impingement of flame simulates that of a burning crumpled newspaper.

9.7 Ignition source F

This consists of a gas burner comprising a 185 mm long horizontal stainless steel tube (12,0 mm outside diameter, 9,0 mm inside diameter) closed at each end and fitted with a central gas supply pipe. The burner tube shall have a row of 14 holes of 1,5 mm diameter at 12,5 mm pitch, arranged so that the gas jets issue at an angle of 45° below the horizontal (see figure 2). The flowmeter shall be calibrated to supply a propane gas flow rate at 25°C of 10 L/min.

NOTE — This source simulates the flame produced by a flaming chip pan, 3 min after ignition of the cooking oil.

9.8 Ignition source G

This consists of a mild steel nickel plated burner (nominally 15,75 mm outside diameter, 13,5 mm internal diameter and 66 mm in length) with four pre-mixing air holes each nominally 20 mm x 3 mm and each nominally 40 mm from the burner end, and spaced equidistant from each other.

NOTE — No flowmeter is required. This premixed source represents a plumbers blow torch. Under these conditions the flame height is approximately 110 mm.