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Furniture — Assessment of ignitability of upholstered furniture —

Part 2:
Ignition source: match-flame equivalent

Ameublement — Évaluation de la facilité d'allumage des meubles rembourrés —

Partie 2: Source d'allumage: flamme simulant une allumette

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Foreword

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Furniture — Assessment of ignitability of upholstered furniture —

Part 2:
Ignition source: match-flame equivalent

0 Introduction

This part of ISO 8191 is one of a series of standards concerned with the ignitability of upholstered furniture using various ignition sources.

The ignition source used in this part of ISO 8191 is a gas flame which is equivalent to a match flame.

The three annexes contained in this part of ISO 8191 do not form integral parts of the Standard.

1 Scope and field of application

This part of ISO 8191 lays down a test method to assess the ignitability of material combinations, such as covers and fillings used in upholstered seating, when subjected to a small flame as an ignition source.

The tests measure only the ignitability of a combination of materials used in upholstered seating and not the ignitability of a particular finished item of furniture incorporating these materials. They give an indication of, but cannot guarantee, the ignition behaviour of the finished item of furniture.

2 Reference

ISO 139, *Textiles — Standard atmospheres for conditioning and testing.*

3 Definitions

For the purposes of this part of ISO 8191, the following definitions apply.

3.1 progressive smouldering: Exothermic oxidation, not accompanied by flaming, that is self-propagating, i.e. independent of the ignition source. It may or may not be accompanied by incandescence.

3.2 flaming: Undergoing combustion in the gaseous phase with the emission of light.

4 Criteria of ignition

4.1 Progressive smouldering ignition

For the purposes of this part of ISO 8191, all the following types of behaviour are considered to be progressive smouldering ignitions:

a) any test assembly that displays escalating combustion behaviour so that it is unsafe to continue the test and active extinction is necessary;

b) any test assembly that smoulders until it is essentially consumed within the test duration;

c) any test assembly that smoulders to the extremities of the specimen, viz upper or lower margins, either side or to its full thickness, within the duration of the test;

d) any test assembly that, on final examination, shows evidence of charring other than discoloration, for more than 100 mm in any direction apart from upwards from the location closest to the position of the source.

Disregard any smouldering which ceases within 120 s after removal of the burner tube.

NOTE — In practice it has been found that there is usually a clear distinction between materials which may char under the influence of the ignition source but which do not propagate further (non-progressive combustion) and those where smouldering develops in extent and spreads (progressive combustion).

4.2 Flaming ignition

For the purposes of this part of ISO 8191, all the following types of behaviour are considered to be flaming ignitions:

a) any test assembly that displays escalating combustion behaviour so that it is unsafe to continue the test and active extinction is necessary;

b) any test assembly that burns until it is essentially consumed within the test duration;

c) any test assembly on which any flame front reaches the lower margin, either side or passes through its full thickness within the duration of the test.

Disregard any flaming which ceases within 120 s after removal of the burner tube.

5 Principle

To subject an assembly of upholstery materials to a match-flame equivalent ignition source. The assembly is arranged to represent in stylized form a junction between a seat and back (or seat and arm) such as might occur in a typical chair. Determination of the ignitability of an assembly by applying smoker's material such as a match-flame equivalent. The test method measures the ignitability of the overall composite of materials, i.e. cover(s), interliner, infill material, etc., as constructed on the test rig. The results shall not be stated as being applicable to the general behaviour of any individual component (see also annex A).

6 Health and safety of operators

6.1 General

The test method specified in this part of ISO 8191 presents a considerable hazard; suitable precautions shall be taken.

6.2 Enclosure

For safety, the tests should be conducted in a non-combustible fume cupboard. If such a cupboard is not available, a test enclosure should be constructed (see 7.2) so that the operator is protected from the fumes.

6.3 Extinguishers

Adequate means of extinguishing the assembly should be provided, bearing in mind that some combinations may produce severe flaming during the test. A hand and/or a fixed water spray which can be directed over the burning area can be useful. Other means such as fire extinguishers (water and halogenated hydrocarbons), fire blankets and a bucket of water will assist.

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

7 Apparatus

7.1 Test rig

A suitable test rig is illustrated in figures 1 and 2. It shall consist of two rectangular frames hinged together and capable of being locked at right angles to each other.

The frames shall be made from nominal 25 mm × 3 mm flat steel bar and shall securely hold mesh steel platforms set 6 ± 1 mm below the top edge of the frames (mesh size should be such that an open mesh area of approximately 15 to 150 mm^2 exists).

The internal width and height of the back frame shall be 450 ± 2 mm × 300 ± 2 mm and the width and depth of the base frame 450 ± 2 mm × 150 ± 2 mm. A standard edging section may be used around the mesh steel platform to give protection and greater rigidity.

The sides of the frames shall extend beyond the back of each frame to provide for the hinge holes and to form the back legs. The hinge rod shall be of nominal 10 mm diameter steel, continuous across the back of the rig and its axis 22,5 ± 0,5 mm beyond the back member of each frame.

The frames shall be lockable at right angles by a bolt or pin through each of the pairs of members forming the back legs. The front legs may be welded across the front corners of the base frame. The height of the legs shall be such as to leave a gap not less than 50 mm high between the lower surface of the base frame and the supporting surface.

For the tests the rig shall be sited within the enclosure (see 6.2) and the testing shall be performed in a basically draught-free environment permitting an adequate supply of air and removal of smoke from the area of the apparatus.

7.2 Test enclosure

The test enclosure shall consist of either a room with a volume greater than 20 m^3 (which contains adequate oxygen for testing) or a smaller enclosure with a through flow of air. Inlet and extraction systems providing air flow rates of 0,02 to 0,2 m/s in the locality of the rig provide adequate oxygen without disturbing the burning behaviour.

7.3 Clock

The clock shall be capable of measuring for a period of at least 1 h with an accuracy to 1 s.

7.4 Ignition source: gas-flame ignition source 1, which is a match-flame equivalent

NOTE — This source has been designed to give a calorific output approximating to that of a burning match. It is envisaged that larger flaming ignition sources will be covered by further parts of ISO 8191.

A burner tube consisting of a length of stainless steel tube (8 ± 0,1 mm outside diameter, 6,5 ± 0,1 mm internal diameter and 200 ± 5 mm in length) is connected by flexible tubing to a cylinder containing propane or butane via a flowmeter, fine control valve, on-off valve (optional) and cylinder regulator providing an outlet pressure of nominal 2,8 kPa [1].

NOTE — Where tubing of these dimensions is not readily available, stainless steel tubing of approximately similar dimensions may be used provided that the 50 mm length at the "flame" end of the tube is machined to the given size.

The flowmeter shall be calibrated to supply a propane or butane gas flow rate at 25 °C of 45 ± 2 ml/min. The flexible tubing connecting the output of the flowmeter to the burner tube shall be 2,5 to 3 m in length with an internal diameter of 7 ± 1 mm.

1) 1 kPa = 10^3 N/m^2 = 10 mbar

7.5 Gas flow control

It is essential that the rate of supply of gas to the burner tube conforms to the flow rate specified. Some difficulties have been reported with the supply and measurement of the gas, particularly where the gas cylinder has, of necessity, to be stored in an environment cooler than the defined test conditions and/or at some distance from the test rig.

In these cases, and other situations where difficulties occur, it is important that there should be a sufficient length of tubing inside the controlled environment (10 to 30 °C) to ensure that the gas equilibrates to the required temperature before flow measurement. One way to assist this is to pass the gas (before flow measurement) through a metal tube immersed in water maintained at 20 °C (which is one of the temperatures specified for a stated flow of gas) so that flow corrections for temperature variations can be avoided.

Great care also needs to be exercised with the measurement and setting of the flow rate of the gas. Direct reading flowmeters, even those obtained with a direct gas calibration, need to be checked when initially installed and also at regular intervals during testing by a method capable of accurately measuring the absolute gas 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 inside diameter) to a soap bubble flowmeter, such that the upward passage of a soap film 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.

8 Atmospheres for conditioning and testing
(see also ISO 139)

8.1 Conditioning

The materials to be tested shall be conditioned for 16 h immediately before the test in one of the following atmospheres:

a) temperature: 20 ± 2 °C
relative humidity: (65 ± 2) %

b) temperature: 23 ± 2 °C
relative humidity: (50 ± 5) % (preferred)

c) temperature: 27 ± 2 °C
relative humidity: (65 ± 5) %

d) any other conditioning atmosphere as agreed by the parties concerned.

8.2 Testing

The test shall be carried out in an atmosphere having a temperature between 10 and 30 °C and a relative humidity between 15 % and 80 %.

9 Test assembly

9.1 General

The test assembly materials shall be representative samples of the cover, filling and other components, such as any interliner, which may be used in a real assembly.

NOTE — The test assemblies may be made up with identical materials in the horizontal and vertical sections.

9.2 Cover material and interliner

9.2.1 Rig cover material

The cover size needed for each test shall be 800 $^{+10}_{0}$ mm × 650 $^{+10}_{0}$ mm.

The long dimension shall be cut parallel to the machine direction. The cover may be constructed from smaller pieces of material provided that the location of the resulting seams does not occur within 100 mm of the area likely to be affected by the test.

The cover shall have cut-outs 325 mm from one end on both sides. The cut-outs shall be positioned so that when assembled on the test rig, the lay of the pile is down the back assembly and from the hinge to the front of the base frame. The size of these cut-outs shall be approximately 50 mm base width × 100 mm height × 25 mm top width.

Where fabric interliner is used, it shall be cut to the same dimensions, and in the same orientation as the cover, for fitting to the test rig under the cover.

9.3 Upholstery filling

Two test assemblies are necessary for each test, with the following dimensions:

a) one piece 450 ± 5 mm × 300 ± 5 mm × 75 ± 2 mm thick;

b) one piece 450 ± 5 mm × 150 ± 5 mm × 75 ± 2 mm thick.

Some cushioning assemblies may consist of several layers that may be typically felt, wadding or various foams. Where the total thickness exceeds 75 mm, reproduce the upper 75 mm of the cushioning assembly except that the upper layer(s) shall not be continued over and round the edges of the assembly.

Where the filling is less than 75 mm thick, the test assembly shall be built up to the required thickness by adding a further layer of the bottom material to the underside.

Some kinds of loose packing materials (e.g. foam crumb, feathers) may be evaluated by this test method. In these cases the loose packing shall be built up beneath the covering materials to reproduce the 75 mm thickness of the assembly at a realistic packing density. Where necessary, a finer grid material or air-porous fabric may be laid over the expanded metal of the test rig to retain the filling.

If used, the loose infill is enclosed in an interlining (or ticking); it is acceptable to make up two bags of the interlining suitably filled and to the overall dimensions given above for use as the upholstery filling beneath the cover(s).

The method is unsuitable and cannot be used with composites where the loose infill material flows out of the assembly during the test and either extinguishes, moves, or adversely affects the burning of the ignition source.

10 Test procedure

10.1 Preparation

10.1.1 Open out the test rig and thread the cover fabric and fabric interliner, if any, behind the hinge bar.

10.1.2 Place the filling samples under the covering fabric, locating them in the frame recesses.

10.1.3 Allow a 20 mm overlap on the inside of the frame, and fasten the fabric over the top, bottom and sides using clips.

NOTE — This action places the cover under some tension and it may be found easier to carry out if the frames are folded together to compress the upholstery partially.

10.1.4 Ensure that the fabric is secure and under even tension. Then lock the frames at right angles by the bolts or pins.

10.2 Ignition source application

10.2.1 Light the gas emerging from the burner tube, adjust the gas flow to the specified rate (see 7.4) and allow the flame to stabilize for at least 2 min.

10.2.2 Position the burner tube axially along the junction between the seat and back so that the flame is not less than 50 mm from the nearest side, edge, or from any marks left by any previous test, and simultaneously start the clock.

10.2.3 Allow the gas to burn for a period of 20 ± 1 s, then terminate the ignition process by carefully removing the burner tube from the test piece.

10.2.4 Observe the progress of combustion, and record any evidence of progressive smouldering or flaming in the interior and/or cover. Disregard any flames, afterglow, smoking or smouldering that cease within 120 s of the removal of the burner tube.

10.2.5 If progressive smouldering (see 3.1) or flaming (see 3.2) of the upholstery components is observed after 120 s from the removal of the burner tube, up to 1 h after the application of the ignition source, extinguish the test assembly and record this. In these circumstances discontinue testing and complete the test report (see clause 11).

If progressive smouldering or flaming is not observed within the 1 h period, repeat the test in a fresh position not less than 50 mm from any previous test damage. If progressive smouldering or flaming is not observed in this retest, record this and carry out the final examination (see 10.3).

NOTE — If preferred this repeat test may be carried out concurrently with the first test.

10.3 Final examination

10.3.1 Measure the extent of the damage in millimetres (maximum length, width and depth) of the test assemblies.

10.3.2 Cases of progressive smouldering undetected from the outside have been reported. Immediately after completion of the test programme on the assembly, dismantle and examine it internally for progressive smouldering. If this is found, extinguish the test assembly, and record a failed result for the relevant test source. For safety reasons ensure that all smouldering has ceased before the rig is left unattended.

11 Test report

The test report, of which the form shown in annex B is an example, shall give the following information:

a) a reference to this part of ISO 8191;

b) whether ignition occurred in each test. If only two tests have been run yielding one ignition and one non-ignition, the overall result is taken as ignition;

c) for each test, the extent of the damage in millimetres (in length, width, depth) for the horizontal and vertical test assemblies;

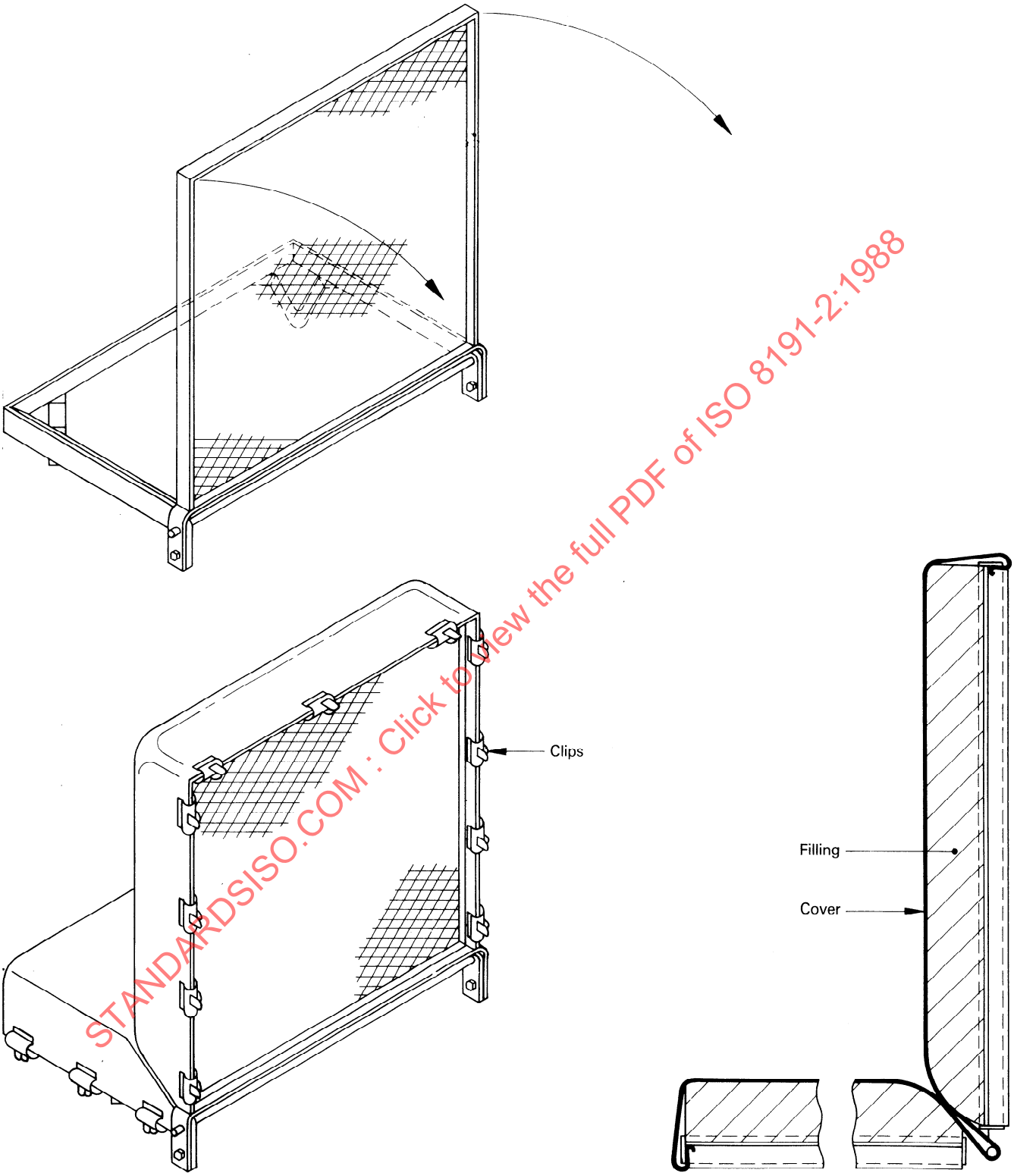
d) for each test, whether the test assembly was extinguished, or whether the test assemblies were found to be smouldering when dismantled.

The report shall contain details of any features of the test assemblies or procedures that may have affected the results. Such features are:

e) conditioning of the test assembly, including the atmosphere (see 8.1);

f) special features of burning, e.g. melting, dripping, charring, development of flames from smouldering;

g) times of major events, e.g. ignition of test assemblies, cover splitting, extinction.

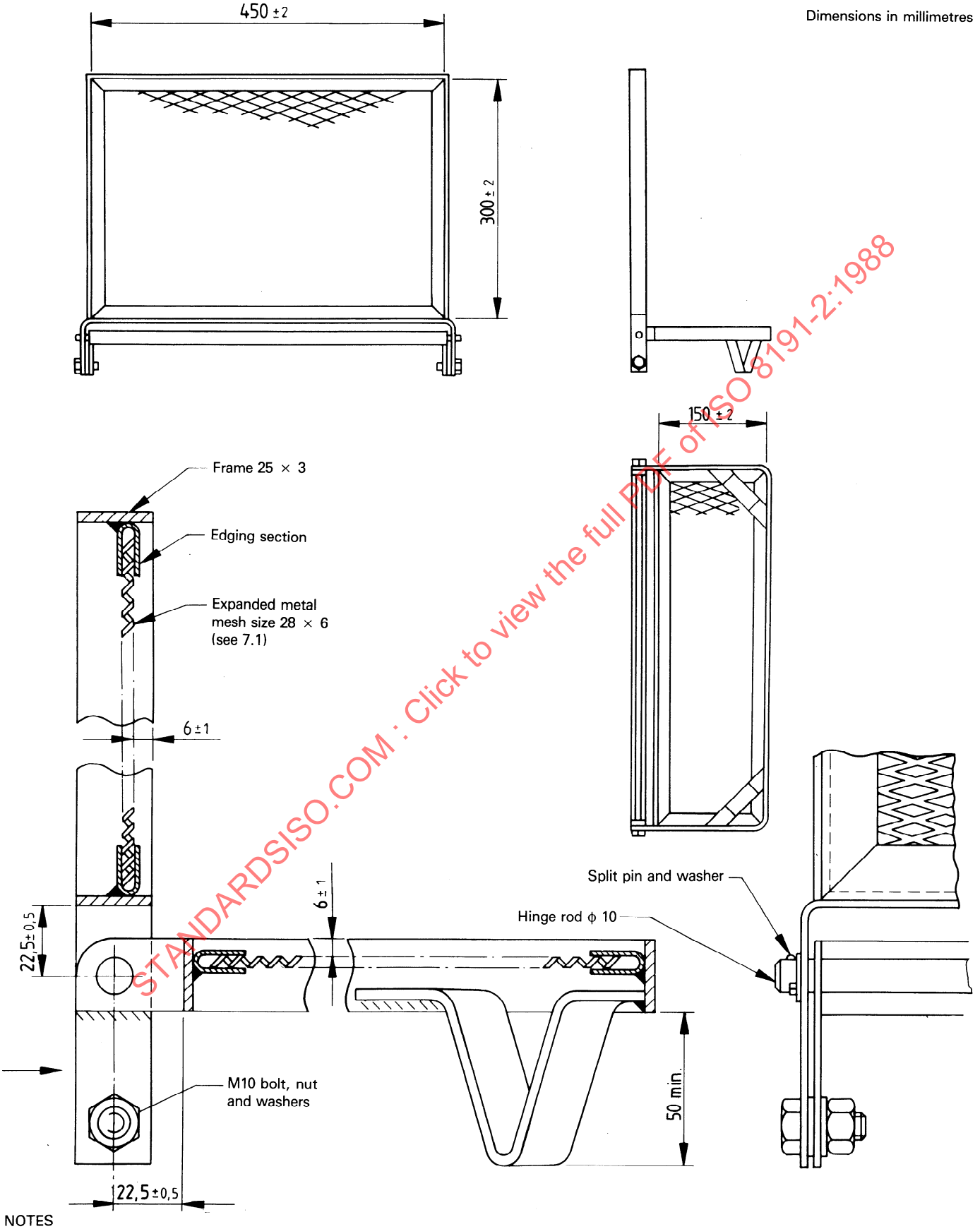


Test rig with cover and fillings

Vertical section

Figure 1 — Test rig assembly

Dimensions in millimetres



NOTES

1 Unless tolerances are indicated, dimensions are nominal.

2 All parts are made of steel.

Figure 2 — Test rig detail

Annex A

Guidance notes for designers and specifiers

(This annex does not form an integral part of the Standard.)

A.1 This part of ISO 8191 lays down methods for examining the ignitability, in defined circumstances, of an assembly of upholstery materials. These materials are combined together in a way intended to be generally representative of their end use in upholstered seating and the ignition sources are selected so that most may be related to everyday sources.

Thus the potential ignitability of a particular cover, filling and interliner in combination can be assessed.

However, there are two important limitations, as follows.

a) The tests are concerned only with ignitability, and any controls of fire hazard have to consider, in addition, other aspects of fire performance such as rate of fire development, heat output, rate and quantity of smoke production and toxic gas evolution. Ideally, any attempts to reduce ignitability ought not to affect these other properties adversely.

b) The limitation detailed in clause 1 occurs because design features of the furniture can greatly affect its fire properties; any ignitability tests of a piece of furniture would therefore need to be carried out on the actual item and not on component materials or mock-ups. However, limited information on ignitability more specifically related to an intended design may be obtained as indicated in clauses A.2 and A.3.

A.2 This part of ISO 8191 lays down laboratory tests for an assembly of materials which will give general guidance on the ignitability of finished furniture, but where more specific information is required, for example tip-up seats or in critical areas of end use, the principles may be applied to complete items or sub-assemblies of furniture or to suitably modified test assemblies, some examples of which are given below. In such cases the source described in 7.4 may be applied at positions which, as a general rule, correspond to those where the hazard of ignition occurs in use.

Example 1

If a chair has a gap between the seat and back cushions, the placing of ignition sources in the angle of the test apparatus is inappropriate. Instead, face ignition, where the source is placed on the horizontal and vertical surfaces, is more meaningful.

Example 2

The test apparatus may be used to model the junction of any vertical and horizontal surfaces so that both arm and back constructions, if different, may be tested separately in conjunction with the seat.

Example 3

The use of different materials in a back and seat of a chair may be reproduced in the test, two different cover fabrics being joined by sewing or with staples behind the hinge bar.

A.3 The ability of a cover material to provide protection against ignition can be indicated by testing it in a combination with a substrate of known flammability. Similarly, the role of a filling can be established by using it in conjunction with covers with different types of behaviour. Such information about the individual materials does not eliminate the need to test the actual combination, but it can help in the short-listing of material combinations and so reduce the overall amount of testing required.