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Furniture — Assessment of the ignitability of upholstered furniture —

Part 1: Ignition source: smouldering cigarette

Ameublement — Évaluation de l'allumabilité des meubles rembourrés —

Partie 1: Source d'allumage: cigarette en combustion

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Foreword

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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 8191-1 was prepared by Technical Committee ISO/TC 136, *Furniture*.

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Furniture — Assessment of the ignitability of upholstered furniture —

Part 1: Ignition source: smouldering cigarette

0 Introduction

This part of ISO 8191 is one of a series of standards concerned with the ignitability of upholstered furniture using different ignition sources. The ignition source used in this part is a smouldering cigarette.

It is the intention to publish further parts utilizing a series of flaming ignition sources of increasing severity. Part 2 will use a gas flame representing a match equivalent flame as the first step in the series and it is anticipated that further parts will extend the range by using larger gas flames and either wooden cribs or filled paper bags.

1 Scope and field of application

This part of ISO 8191 lays down a method of test to assess the ignitability of material combinations, such as covers and fillings used in upholstered seating when subjected to a smouldering cigarette 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 requires active extinction;
- 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 nearest part of the original position of the source.

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 requires active extinction;
- 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.

5 Principle

Subjecting an assembly of upholstery materials to a smouldering cigarette 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 cigarette. 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, an enclosure should be constructed 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 steel flat 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 mm² 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 frame 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 $22,5 \pm 0,5$ 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 base and 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 m³ (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 to at least 1 h with an accuracy of 1 s.

7.4 Ignition source: smouldering cigarette

An unfiltered cylindrical cigarette complying with the following requirements shall be used:

- length : 70 ± 4 mm
- diameter : $8 \pm 0,5$ mm
- mass : $1 \pm 0,1$ g

The smouldering rate shall be $12,0 \pm 3,0$ min/50 mm, when tested as follows.

Mark the cigarette, conditioned as described in 8.1, at 5 mm and 55 mm from the end to be lit. Light it as described in 10.2 and impale it horizontally in air (draught 0,02 to 0,2 m/s) on a horizontal wire spike inserted not more than 13 mm into the unlit end. Record the time taken to smoulder from the 5 mm to the 55 mm mark.

8 Atmospheres for conditioning and testing

(see also ISO 139)

8.1 Conditioning

The materials to be tested and the cigarettes 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 different 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 method of test. 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 a cigarette and draw air through it until the tip glows brightly. Not less than 5 mm and not more than 8 mm of the cigarette shall be consumed in this operation.

10.2.2 Position the smouldering cigarette along the junction between the vertical and horizontal test assemblies so that the cigarette 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 Observe the progress of combustion, and record any evidence of progressive smouldering or flaming in the interior and/or cover.

NOTE — The detection of smouldering may be difficult and is eased by watching for smoke emerging at points at a distance from the cigarette. Smoke is most easily viewed by looking down a rising column by means of a mirror.

10.2.4 If progressive smouldering (see 3.1) or flaming (see 3.2) of the upholstery components is observed at any time within 1 h of placing the cigarette, extinguish the test assembly and record this, together with the time elapsed between placing and extinguishing. 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, or if the cigarette fails to smoulder its complete length, record this and repeat the test with a new cigarette placed 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 or if the cigarette fails to smoulder its complete length, 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 assemblies tested.

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, using the form shown in annex B, 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 assembly;
- d) for each test, the burning time of the cigarette, whether the cigarette failed to smoulder to its full length, and whether the test assembly was extinguished, or if 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, for example melting, dripping, charring, development of flames from smouldering;
- g) times of major events, for example ignition of test assemblies, cover splitting, extinction.

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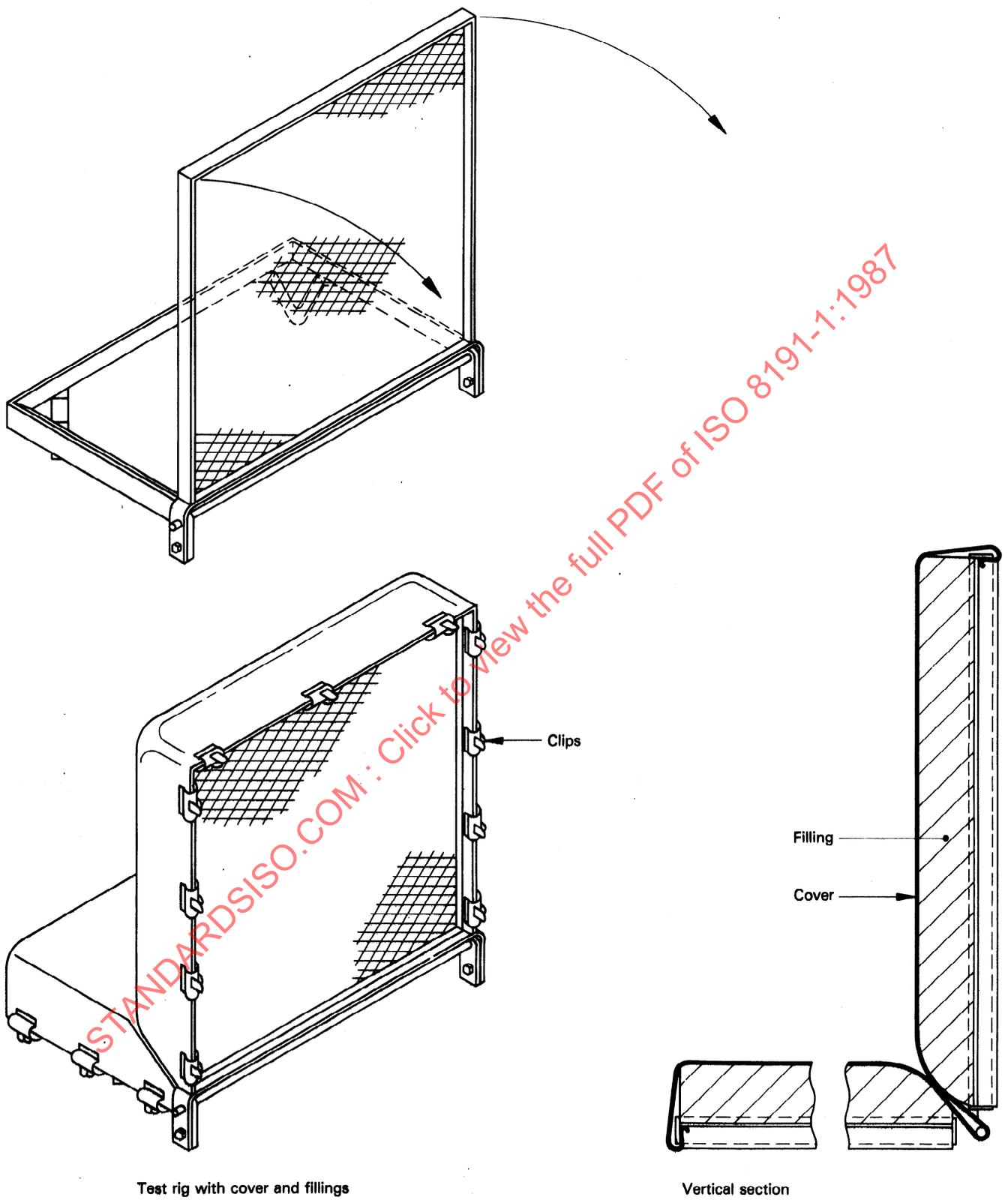
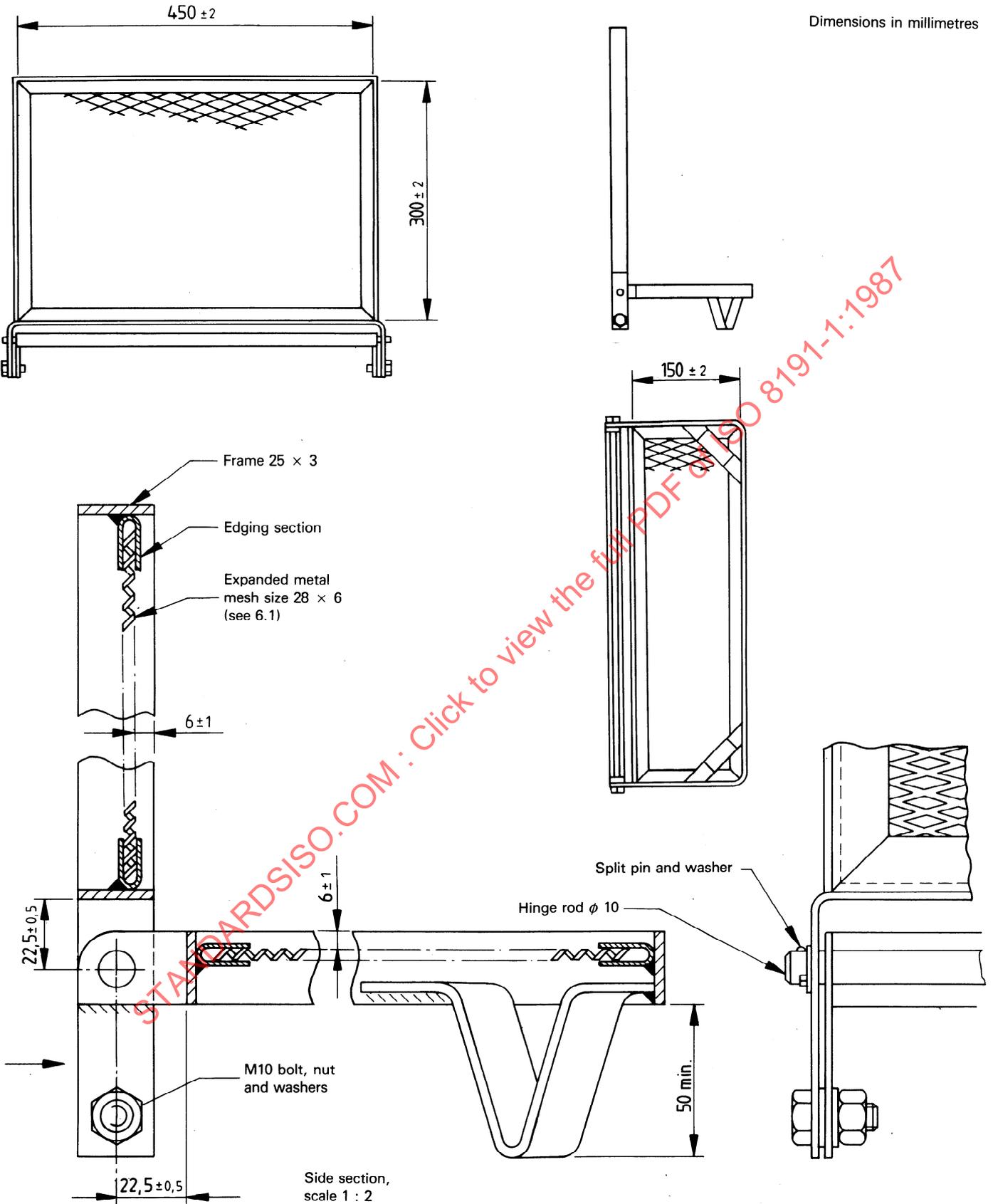


Figure 1 — Test rig assembly



NOTES

- 1 Unless tolerances are indicated, dimensions are nominal.
- 2 All parts are of steel.

Figure 2 — Test rig detail

Annex A

Guidance notes for designers and specifiers

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.