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Meetings of
ISO/TC 92, WG 3,4, and 5

The Hague, 23-27 June 1966

by

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U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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ABSTRACT

A brief account is presented on the discussions during meetings of working groups 3, 4. and 5 of the ISO Committee on Fire Test Methods. These groups are concerned, respectively, with fire test methods for doors, surface flammability test methods, and considerations involving loading and restraint of structures during fire endurance tests.

During discussion, it became apparent that these groups were seriously searching for technical methods for measuring performance of materials and systems. They were interested in American fire test methods, but appeared to be anxious to improve on them where technical deficiencies are apparent.

A summary of apparent deficiencies in ASTM test methods developed on the basis of this meeting is included in text.

Please note that this report is but a portion of a larger report. For simplicity, therefore, the page numbering may appear unusual.

Working Groups of ISO/TC-92

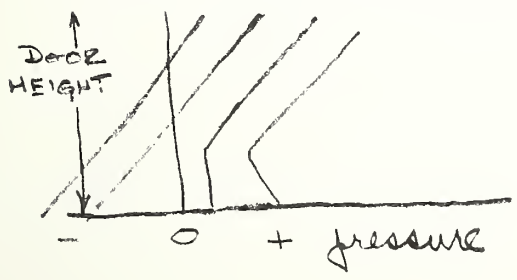
Meetings of three working groups of ISO/TC 92 were attended as a result of an invitation from the Secretariat resulting from concern aroused during the IMCO meetings that American thinking be presented during meetings. I was present, therefore, in observer status, but was encouraged to participate freely in discussion.

The first group No. 3 on "Test Methods for Door Assemblies" met on Monday and Tuesday, 23 and 24 May. Those, in addition to myself, participating included Ashton and Malhotra (UK), Malmstedt(Denmark), Col. Cabret and Bellisson (France)Minne (Belgium),Westhoff (Germany), van Hoogstraten (Netherlands), Shorter (Canada) Sung and van Toutenhoofd (Secretariat ISO).

Mr. Malhotra was selected as future chairman since Mr. Ashton plans to retire in the near future.

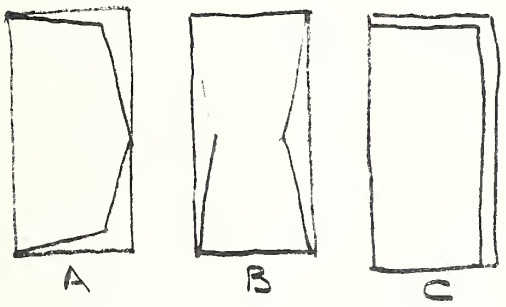
The meeting started off with a general discussion of problems with doors during fires. The working group has been charged to develop a test method for doors which will eventually become a part of the fire endurance test method. It was emphasized that the door frame may be equally important with the door in containment of fire and smoke. England and Canada have similar problems since the door and frame are not supplied by the same manufacturers. In both countries, however, the code requires performance of both door and frame. I described our recent experiments on upgraded doors [7], but emphasized that, although an ASTM test procedure [8] was available several aspects relative to qualification of doors were not clearly defined therein and that in our country most doors used for control of fire spread were tested by Underwriters Laboratories. In France, it was stated that chief concern was for limitation of spread of smoke and gas through or around the door.

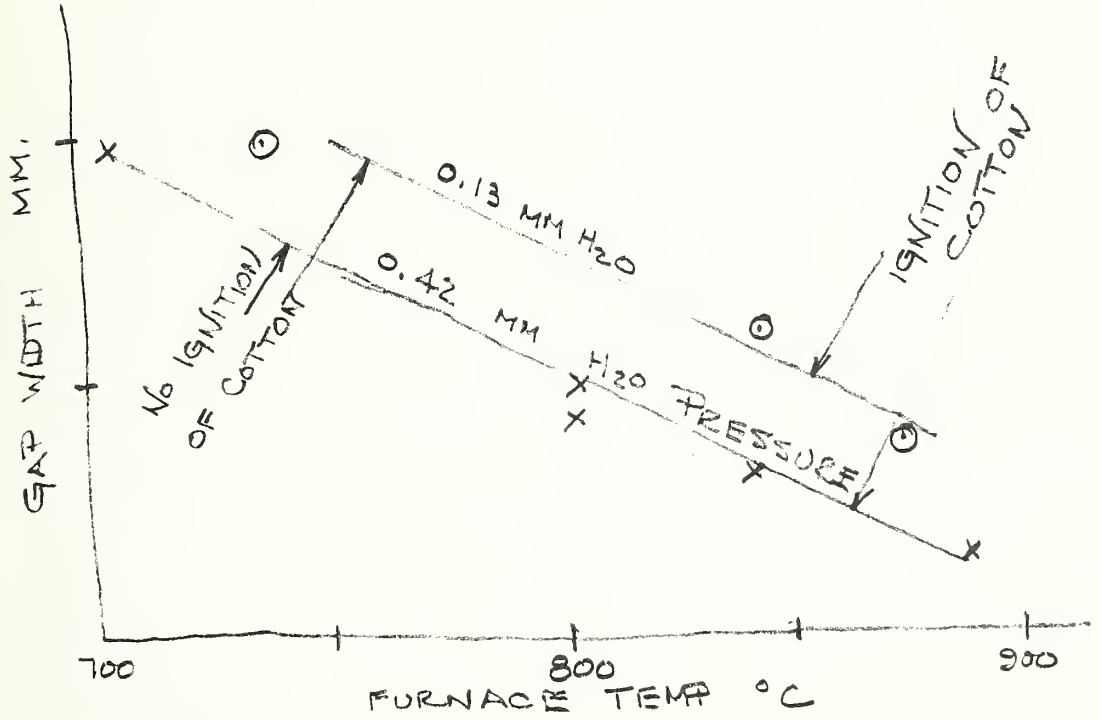
There was considerable discussion of problems relating to control of position of the neutral pressure zone in the furnace. Apparently, Britain and Canada have not been able to position this zone easily. In Denmark, they have perhaps pioneered in control of the location of this zone, but apparently have had difficulty in moving this below the 1/3 height. Malmstedt reported that when he tried to raise the furnace pressure, he got results as shown to the left. He, Malhotra and Shorter indicated they planned further experiments taking more care with the measurement of static pressures in the furnace.



I indicated that our panel furnace was designed for the neutral zone to be below the specimen, but this could be varied by changing draft conditions.

The group had previously initiated studies between laboratories on use of a canopy above the specimen and fitted with radiation and convection measuring units. Three simulated doors were to be used as shown sketch. The "doors" were to be of asbestos wood 3/8 in. thick and of the shapes shown. The shapes were intended to simulate the types of cracks likely to develop with hinged, sliding and folding doors. British and Danish delegates compared their initial measurements with type "A" doors. There seemed to some evidence of agreement of heat flow measurements between laboratories and it was agreed to continue work with some modification of techniques.





The figure summarizes the British studies on ignition of cotton gauze over various crack sizes.

It was agreed that France, Netherlands, Germany Denmark, Belgium and U.K. would participate as planned in the canopy tests for heat transfer measurement through cracks. Belgium would make measurements with small-scale specimens. Other problems such as grills, hardware, paint, etc., were left for future consideration. The meeting was adjourned with a plan to meet again on 7 and 8 March in Copenhagen, with perhaps a prior meeting in October or November of this year, if sufficient progress had been made by that time.

Papers secured at this meeting included:

ISO/TC 92 WG.3 (Secretariat-89) 194
Test Requirements for Door Assemblies
Report of Paris Meeting 27 and 28 April 1965

ISO/TC 92 WG.3 (UK-1) 1
"Program of Tests to Study the Effect of Door Gaps"

ISO/TC 92 WG.3 (UK-2) 2
"Program of Tests to Study the Effect on the Value of Doors as Fire Barriers of Gaps at the Edges" Report No. 1

ISO/TC 92 WG.3 (UK-3) 3
Same as above but Report No. 2

ISO/TC 92 WG.3 (DK-1) 4
Letter from Malmstedt re: Door Test Instrumentation

Working Group 4

The meeting of Working Group No. 4 was held on Wednesday. This group is concerned with the Reaction to Fire Test Methods (flammability). However, it was indicated that they had been charged with the additional problems of collecting information on Smoke and Toxic decomposition products. Those present included Odeen (Sweden), Minne (Belgium), Malmstedt (Denmark), Amy (France), Dorn (Germany), van Hoogstraten and Lie (Netherlands), Malhotra (UK), Shorter (Canada) Sung (ISO Secretariat) and myself.

I agreed to send preprints of our coming paper on smoke as well as try to send the others to be presented next month at the ASTM symposium.

The group had previously participated in round robin flammability tests of 25 materials, in six or eight countries. Since many of the flammability test methods were of different character, it is not surprising that some large differences in material ranking resulted. Mr. Amy had made a statistical study of the results and most of the morning was spent in discussing his findings (France-1) 1. In doing this he observed that each test method classification was based on a number of different experimental observations such as flame arrival time at different stations, stack temperature rise or time at which temperature rise exceeded a certain level. As a result, it occurred to him that perhaps the lack of correlation was based on poor selection of overall index rather than lack of merit of the test itself. He decided to try to check this and selected a number, 2 to 5, of these observations for each test method and then selected pairs of different tests (laboratories) and then proceeded to calculate the correlation coefficient between the two laboratories' results for each of the observations selected. Usually, the coefficient varied significantly and he then selected the two observations showing the highest coefficient. In this way he was able to select one of the observations made by each test method likely to yield the best correlation between all laboratories. The ranking of the various materials on this basis were then listed and it was found that the general overall ranking of materials was quite similar to that originally made. However, by the new ranking method, several of the initial worst offenders were significantly improved. There did not seem to be clear evidence that the ranking of plastics was significantly different, as had been the previous observations.

There was considerable discussion on what these findings meant. In the course of this, the British reported that, as a result of round robin tests in their own country with their box method, they have found that a new manner of calculation of classification permits better correlation. They, therefore, will have to provide Mr. Amy with the new observations for the materials, so he can again review the correlation.

The meeting was closed with an agreement that each laboratory would make a critical review of its own test method with the objective of deciding whether some other weighing of the various observations might not result in a more appropriate overall classification. The participating countries agreed to do this and we were invited to furnish a technical review of the flammability test methods used in our country.

On Wednesday afternoon, Mr. Lie,of Netherlands, and I were asked to review,very briefly, our recent work on smoke. I reviewed our work with the box test method, while Mr. Lie described his photometric measurements in the smoke column above their box flammability test chamber. He has made a correlation of this as a measure of rate of smoke production with the slope of the smoke accumulation curve when the test box is enclosed in a larger container. In general, his thinking is similar to ours, but the concept of a specific optical density as a specimen property had not been developed.

The group agreed to try to meet again in November or December probably at the same time as GS 4 in Copenhagen.

The following papers were distributed during the meeting:

ISO/TC 92 WG.4 (Secretariat-91) 212 July '65
"Report of Meeting Held in Paris 26 and 28 May '65"
Working Group 4.

ISO/TC 92 WG.4 (France-1) 1
"Part III Statistical Analysis of the Results of Spread of Flame Test" (WG.4)

ISO/TC 92 WG.4 (Sweden-1) 2 Octber '64
"Tendency of Surface Finishes to Contribute to Rapid Flame Spread and Heavy Smoke Development" (WG.4)

Working Group 5

The meetings of Working Group 5 were held on Thursday and Friday. This is a newly constituted group formed to study restraint, deformation and loading of fire test specimens during endurance tests. The following delegates participated: Malhotra (UK), Ehm and Pastel representing Professor Hardina who was ill (Germany), Professor Pettersson and Odeen (Sweden), van Santé and van Hoogstraten (Netherlands) Shorter (Canada) and myself as observer.

Prof. Pettersson was elected Chairman. He started the meeting off by asking each delegate to review the requirements in his country with regard to specimen loading restraint and structural failure criteria during fire tests.

Germany DIN 4102

Mr. Ehm reviewed this standard.

1. Floors: Floors are always tested in a freely (support and rollers) supported condition, no restraint in plane of the structure. At Braunsweig, their furnace takes specimens of 4-1/2 meters span while the standard requires a minimum size of 2 x 4 meters. The standard requires that the load applied be sufficient to stress the structural components to the maximum intended in design. Load failure is based on a rate of deflection criterion,

$$\Delta f/\Delta t \geqq \ell^2/9000h$$

where:

$\Delta f/\Delta t$ is rate of deflection at midspan in cm/min.

ℓ is the free span in cm.

h is the structural depth of the specimen cm

2. Walls: Walls are required to be of at least 2 x 2 meter size. No restraint is provided against lateral or vertical expansion of the specimen. Loaded walls are unconfined at sides and loaded from either top or bottom. Both top and bottom are restrained against rotation. Observations are made of bowing deflection of walls during test. Wall must remain structurally stable throughout test. No reload required.

ASTM E-119

Mr. Shorter and I described this test method. We pointed out that several aspects of the method were not completely defined. Thus, the way in which load failure is assessed, degree of restraint applied to specimen, etc., were not clearly defined and could be interpreted differently between laboratories.

BS - 476

Mr. Malhotra described the British Standard.

1. Beams and floors: These members were freely supported unless it could be shown that this situation would never occur in practice. The standard requires that such members be tested under conditions of restraint simulating those intended in the construction. Floors are usually tested with the two edges free and unrestrained or supported. Loading by deadweights for floors, but hydraulic 4-point loading for beams. The standard requires that specimens stand exposure without collapse, but ability to carry test load 48 hours after test is required. To assess this, the load is left on floors for this period while beams are again reloaded after 48 hours.

2. Walls: Load-bearing walls are tested with the two side edges unconfined. Top and bottom of walls are secured against rotation. Non-bearing walls are tested fully restrained. Degree of restraint is not specified. Load failure not detailed, but structural stability requirement as for floors. Reload after 48 hours required for walls.

3. Columns: Columns are tested with both ends fixed against rotation. Both wall and column furnaces can apply a load of 500 tons. Columns, like other load-bearing structures, must be tested to determine ability to carry load 48 hours after test.

NEN 1076D

The test method used in the Netherlands was described by Mr. van Santé. He stated that a general requirement was that structures should be tested under conditions simulating intended practice in use.

1. Floors and Beams: These members are usually tested without lateral or longitudinal restraint, usually without moment restraint at ends. In some cases, floors intended for two-way support are tested with support for all four edges. When proper loading is applied which recognizes the type of support, it is usually found that performance is somewhat poorer than a similar structure loaded and tested in simple bending. Deadweight loading is used and test method requires that specimen not collapse. In the TNO laboratory, they have used the same rate of deflection criteria used by the Germans. The furnace for beams at TNO is capable of testing specimens with a fire-exposed length of 8 meters. Longer specimens have been tested with ends extending over ends of furnace.

2. Walls: Walls are tested with lateral edges free and only low capacity loading equipment is available. Non-bearing walls are free to expand on three edges.

INSTA 28/2

This new Scandinavian test method is still in draft form. Professor Pettersson described its basic requirements. The standard calls for specimens of the following maximum sizes:

Floors	2 x 4 meters
Walls	2-1/2 meters high x 2 meters wide
Columns	2-1/2 meters high
Beams	4 meters span

The test load is to be equal to the design load unless other loading is shown to be more correct for actual practice. Load is to be applied one day prior to test and remain on for one day after specimen has cooled to room temperature. At this time, the structure shall be loaded to failure. Although it was stated that walls are to be tested in a manner similar to that used in Germany and Netherlands, the test specification calls for restraint of specimens in a manner to simulate that actually existing in a structural assembly. It was stated that the standard could be interpreted to require axial restraint of expansion of columns. One interesting feature of this proposed standard is the fact that it suggests ways in which classifications of structures can be based on computation and tests of similar structures.

The meetings of this group were interrupted by a visit on Thursday afternoon to the fire laboratories of TNO at Delft and the Bow Centrum in Rotterdam. On Friday, they resumed review of their task. They agreed to circulate standards of other countries including Australia, Japan, France, etc. They enumerated various topics for consideration under the three main tasks or aspects of their duties: loading, restraint, and deformation, and asked that delegates be prepared to discuss problems in greater detail during the next meeting, probably at Copenhagen in March 1967.

I agreed to furnish copies of papers developed for ASTM symposium. Papers distributed during this meeting included:

ISO/TC 92 WG.5 (Sweden-1)2
"Fire Resistance Test. Determination of Fire Resistance of Parts of Building Construction" INTSTA 28/2

ISO/TC 92 WG.5 (Sweden-2)3
"Comments on above, showing ways in which it differs from ISO Std.

ISO/TC 92 WG.5 (USA-1)4
"Fire Tests of Building Materials and Constructions" ASTM E-119-58.

ISO/TC 92 WG.5 (Germany-1)5
"Brandverhalten von Bonstoffen und Bauteilen" (DIN 4102 Blatt 2) Definitions, Requirements and Tests in German.

ISO/TC 92 WG.5 (Germany-2)6
"Brandverhalten von Baustoffen und Bauteilen" (DIN 4102 Blatt 4) Classifications in German.

ISO/TC 92 WG.% (Holland-1)7
"Fire Tests on Concrete and Brick Floors" Report No. 19/ 1728/1965 TNO.

Summary

The meetings were most interesting. There obviously were different levels of technical interest in the test procedures. However, the overall technical competence of the workers cannot be questioned and future participation in such meeting is recommended.

Comments which seem appropriate with regard to existing test methods include:

1. ASTM: E-152 Fire Tests of Door Assemblies

   a. It was not clear to WG.3 that this standard applies to doors and frames. Door assemblies are not defined.

   b. The location of the neutral pressure zone in the furnace is not defined, see para. 8a.

   c. The test procedure does not require measurement of unexposed surface temperatures nor of heat flow through or around door.

2. Surface Flammability Test Methods.

   a. There was considerable interest in possibility of comparing flammability classifications by the E-84 test method with others used in Europe. We were encouraged to participate in a careful technical appraisal of flammability test methods.

3. ASTM: E-119 Fire Tests of Building Constructions and Materials (Loading & Restraint)

   a. Although it is required that a restraining frame be used to simulate the restraint and type of support furnished floor constructions, the intended degree of restraint furnished non-bearing walls is not well defined.

   b. It was difficult to explain why a wall construction should be required to withstand a reload test after the hose stream, while floor-ceiling constructions are not considered with respect to load carrying ability after test.

   c. Lack of a basis for deciding on point of load failure was critically considered.