NATIONAL BUREAU OF STANDARDS REPORT

9362

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REPORT ON
MEETING OF ISO/92 ON FIRE TESTS

by

J. V. Ryan

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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NBS PROJECT 4215102

July 12, 1966

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ABSTRACT

The author represented the USA (ASA as member-body), in an Observer status, at the meeting of ISO/TC92 in Brussels. A draft recommendation for a fire endurance (or fire resistance) test was completed and three Working Group reports reviewed.

The general organization of the meeting, the various documents, and the effectiveness of the USA Delegate are all discussed. The USA Delegate felt considerable constraint due to the Observer status.

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1. INTRODUCTION

Interest was expressed by the American Society for Testing and Materials, Committee E 5, by the United States Coast Guard, and by Industry, in having an Observer from the United States in attendance at the 1965 meeting of International Standards Organization Technical Committee 92. Therefore, the American Standards Organization was asked to accredit J. V. Ryan, of the National Bureau of Standards, as Observer delegate. NBS was able to fund the necessary travel and per diem.

2. MEETING LOCATION

The "meeting" was held in Brussels, Belgium, from October 25, 1965 through October 29, 1965. The Belgian insurance organization, Assurances Generales, provided the meeting room in the suburbs of Brussels, plus daily transportation from and to their downtown offices. The attendees are listed in the Appendix.

3. MEETING ORGANIZATION

Following the opening welcome, Mr. D. I. Lawson (Director, Joint Fire Research Station, England), was acclaimed as Chairman. The "O" Observers were not entitled to the floor except at the invitation of the Chairman or by request of a "P" Participating member. Mr. R. H. L. Sung (Technical Officer, Building Section, British Standards Institution), representing the Secretariat, felt this was quite strict, but other P members indicated in conversation that they felt it was quite loose. The Chairman agreed with Mr. Sung, apparently. Therefore, the U.S.A. delegate was under a considerable handicap, due to "O" status.

All business was conducted in English and French. After each individual spoke, in either of the two languages, the translator gave the comment in the other language.

4. TECHNICAL MATTERS

The Committee considered comments received with a letter ballot on a draft proposal, plus the reports of three Working Groups (nos. 2, 3, 4).

4.1 Draft Proposal - Fire Resistance Test of Structures

The Third Draft of a proposed ISO Recommendation for Fire Resistance Tests of Structures [ISO/TC 92 (Secretariat-75) April 1964], document 126, had been sent to P members for letter ballot. The results had been:

Agreement, 7;
Agreement subject to proposed amendment, 8;
Disagreement 1 (Canada).

The Chairman stated that the draft was accepted and subject only to editorial revisions. Then the group went through document 126, taking up the amendments proposed by the agreed members, but not the comments by Canada. This went well into the second day, and several of the changes appeared more than editorial. For example: glazing, doors and shutters were removed from the scope, as were all roofs except flat (horizontal?). The application of cotton waste provisions were changed to require a pressure in the furnace, at the crack, between 1 and 2 mm (0.04 - 0.08 in.) water gage in excess of the pressure on the outside of the furnace. After the "Agreement" comments were all resolved, Canada's comments were gone over. Several of their comments were dismissed as being on points already discussed. Others were accepted, such as use of simple support of beams and floors unless the use clearly will require a specific restraint. There was considerable discussion of bare vs encased furnace thermocouples. However, with Canada not present and the U.S.A. in "O" status, neither of the two chief proponents of encased couples was heard from.

The Fourth Draft, based on the above actions, was passed out Thursday, October 28, after the Working Group reports had been heard. Again the group went at this document (228) making numerous changes, although most were editorial. It became apparent there were serious differences in meaning between the English and French texts. The matter was turned over to the Secretariat to prepare two consonant texts, incorporating the changes made that far in document 228, and to mail them out within a month or so. The Chairman asked that the meeting agree that the text so prepared was accepted and was for information rather than for further comment or action.

The document applies to partitions, walls (load-bearing and non-bearing), columns, beams, floors, and flat roofs. Doors, shutters, and glazing are specifically excluded. The time-temperature curve is

$$T - T_o = 345 \log_{10} (8t + 1)$$

where t = time in minutes, T_o = initial temperature in °C, and T = temperature near the specimen in °C. This defines increase above initial furnace temperature, whereas ASTM E119 defines absolute temperature, each for elapsed time. The following tabulation compares the American curve to the ISO, assuming 20°C as initial temperature for the latter.

TIME	TEMPERATURE, °C	
Min.	American	ISO
0	20	20
5	538	576
10	704	679
15	760	738
30	843	841
60	927	945
90	978	1006
120	1010	1049
180	1052	1110
240	1093	1153
360	1177	1213

The document both tabulates and plots these points, stopping at 6 hours. However, it does not say anything about a maximum time beyond which no test should go. It requires symmetrical distribution of furnace thermocouples, in numbers based on area or length of specimens, such that the bare junction is not less than 10 cm (3.9 in.) from the specimen, and kept so throughout the test. Minimum wire size is 0.75 mm (about 22ga W&M).

The document specifies tolerances or deviation of average temperature at any time after 10 min (± 100°C) and on an integrated basis throughout the test.

ISO		E119	
to 10 min.	± 15%	to 1 hour	± 10%
to 30 min.	± 10%	to 2 hours	± 7.5%
beyond 30 min.	± 5%	beyond 2 hours	± 5%

The ISO tolerances are tighter in general.

The document recommends "full size specimens whenever possible," but allows minima significantly smaller than E119. It requires "representative" materials, support, and workmanship, as well as conditioning to "equilibrium with the ambient atmosphere expected in service." Artificial drying may be used with limits.

Unexposed surface temperatures are measured by at least five 0.5 mm (about 25 ga W&M) wire thermocouples, each attached to the center of a 12 mm (0.47 in.) diameter and 0.2 mm (0.008 in.) thick copper disk covered with a 3 cm (1.2 in.) square and 2 mm (0.08 in.) thick oven-dry asbestos pad.

Observations should be made of cracks, holes, deformations, "the moment when the ability to support its load is lost" and of "the moment when collapse takes place." "When there is doubt about the ability of flames and hot gases to pass through openings," the aforementioned pressure differential shall be established.

The document specifies reporting results in hours and minutes, as determined under Stability, Integrity, and Insulation. Stability requires continued ability "to perform the function for which it was constructed (National standards can insert a value for deflection of beams and floors)." Integrity involves openings through which flames or hot gases can pass; cotton waste ignition counts but is not required, apparently. Insulation limits the average unexposed surface temperature rise to 140°C (252°F), the maximum rise to 180°C (325°F), and the absolute maximum to 220 °C (428°F).

If several specimens of an element are tested the result to be taken is that which gives the shortest period of time.

4.2 W. G. 3 - Door Assemblies and Glazing

The Working Group reported progress and Belgium and Norway were added to France, Germany, Scandinavia, and the United Kingdom. The W. G. had discussed points of interest, compared their national procedures, and compared results, but had not prepared a draft proposal.

They recognized three kinds of doors: (a) the fully fire resistant door, complying with all requirements of test prescribed for walls (coupe-feu); (b) the fire check or fire retarding door having no limit on temperature of unexposed surface (pare-flammes); (c) smoke stop doors. They were concerned about edge gaps, total heat transfer (through the door and through gaps), radiation from unexposed surface, and furnace pressure. They are agreed that doors should be tested in a wall of brick or other suitable material, should include all operating devices and hardware, should be exposed to the same furnace temperature curve as walls, etc., that minimum door-to-frame clearances be specified, that fire retardant coatings be prohibited, and no hose stream test be required.

The Working Group will continue its deliberations and studies. Therefore, the foregoing represents the state of their thinking as of that time, and is not fixed.

4.3 W. G. 2 - Combustibility

The Working Group reported on study of two methods, a heated tube furnace test somewhat similar to E136, and a bomb calorimeter test. The latter does not have a feature similar to the muffle furnace exposure incorporated in the Potential Heat method reported at the 1961 ASTM Annual Meeting. The W. G. had been considering that both tests were for combustibility and either TC 92 or the W. G. should decide if they were to choose one or use both.

TC 92 accepted the two U.S.A. concepts: (1) that "noncombustibility" is what is being sought, rather than "combustibility," and (2) the two tests may be used for measuring two ranges of the overall spectrum.

Having considered the above concepts, it was agreed W.G. 2 should prepare a draft proposal on "Noncombustibility" of a furnace type. They should continue the bomb calorimeter and consider work in countries not represented on the W. G., particularly U.S.A. and Norway. Beyond this there was general disagreement over the sequence of future events and the constraints thereon. Some felt the W. G. should draft the furnace test strictly on work done to date, considering U.S.A. and other work only for future revisions. Others objected strenuously to such restraint. Essentially the same difference applied to the status of the bomb calorimeter test.

It was agreed that <u>membership</u> on a Working Group must be limited to "P" members of TC 92 but that any W. G. could correspond, consult with, or otherwise avail itself of the expertise of any competent individual in any country.

The furnace test apparatus involves a single vertical heated tube 75 mm (3 in.) I.D. and 150 mm (6 in.) long surrounded by heating coils and insulation. The tube is open top and bottom. Above the top, a steel draft shield is provided, having 75 mm I.D., and 50 mm height. Below the tube, a steel stabilizer cone is attached, with the joint air tight. The cone is 75 mm I.D. at the top, 9 mm I. D. at the bottom, and 500 mm high. The bottom of the cone is 250 mm (10 in.) above the floor and is within a 550 mm (22 in.) high draft shielf. Air flow through the heated tube is convective.

The test specimen is a prism of 50 x 40 x 40 mm (2 x 1.6 x 1.6 in.) and "must be made out of an initial specimen sufficiently large to be representative of the material, taking into account its possible heterogeneity." It is heated to 60°C (140°F) for 24 hours and cooled in a dessicator before test. A device for rapid and precise insertion of the specimen into the furnace is spelled out in detail.

The furnace is preheated to 750°C (1382°F), stable and uniform to $\pm$10°C over the center 60 mm of height, the specimen inserted, and left for 20 minutes unless failure occurs sooner. Three specimens are tested and the material is non-combustible only if <u>none of the three</u> (a) exhibit an internal temperature rise of 50°C or more above the initial furnace temperature, (b) cause the furnace temperature to increase by 50°C or more, or (c) flames in the furnace for 10 seconds or more.

The bomb calorimeter test is just that, with formulas for computing calorific value, and for corrections for the effects of container, heat loss, ignitor wire, etc., and of a combustion promoter if added.

4.4 W.G. 4 - Flame Spread and Terminology

The Chairman of W.G. 4 asked to be relieved of Terminology, this was agreed.

The approach to flame spread was to interchange 24 specimens among the members of the Working Group, each to subject the 24 to his own (National) test. The results were analyzed, with the analysis "not being very encouraging". In summarizing the properties an ideal test should be able to express, the W.G. members listed the following:

Ease of ignition
Flammability
Spread of flame or fire
Rate of heat released
Flash-over
Smoke or other toxic products of combustion

The W.G. will continue its work on Flame Spread, with no restraints other than those they choose. No decision was made on smoke or toxic products as within or outside their scope.

NOTE: The author was advised by M. Collaret (see attendees list) that CEI Bois is building an 8-ft tunnel, as per FPL.

4.5 New Business

A new Working Group (No. 5) was set up to gather information on loading, restraint, and deformation criteria; as possible basis for draft revisions of the fire resistance test.

A small W.G. (No. 6) was set up for Terminology. There was no general agreement as to the number of terms to be defined. They are to be in English, French, and German. It was pointed out that CEI Bois has a glossary.

It was agreed TC 92 should seek liaison with TC 61-Plastics.

The next meeting was suggested for May 1967 in the Netherlands. This is subject to change.

5. USA DELEGATE EFFECTIVENESS

Through correspondence before the meeting and conversation between sessions, it had been requested that the USA Delegate ("O" status) be invited to comment on two points: encased vs. bare furnace thermocouples

and the philosophy and comparison between unexposed surface thermocouple pads and ISO surface thermocouples. The invitations were not forthcoming The USA Delegate was asked to comment on our procedures in case an unexposed surface thermocouple pad was wetted by water coming from the specimen. The USA Delegate sought (despite "O" status) and gained recognition to make a few technical "Observations". These were in regard to fire resistance requirements for roofs as an avenue for firemen to gain a better position; the desire to find materials exhibiting Noncombustibility rather than those exhibiting Combustibility; the concept of a qualitative scale between the extremes of Noncombustibility and Combustibility.

There were several other times that the USA experiences and practices would have added useful information to the discussion. However, the USA Delegate was not in a position to "push" these matters.

6. RECOMMENDATION

The USA has a large stake in international standardization, particularly as it may affect our position in international trade. We have competence in the field of fire test methods. Therefore, we should take an active role in ISO/TC 92. The only way to do so is as a "P" participating member, and such membership should be sought promptly.

APPENDIX

LIST OF DELEGATES

BELGIUM	Prof. G. A. Herpol (Chef de delegation)	Professeur a l'Universite de Gand, Directeur du Laboratoire pour l'Etude de l'Emploi des Combustibles de cette Universite.
	M. L. Brouwet	Directeur de l'Association nationale pour la protection contre l'incendie.
	M. R. Minne	Ingenieur, Chef de travaux a l'Universite de l'Etat, Gand
	M. J. Van Engelen	Ingenieur a l'Institut Belge de Normalisation.
	M. J.P. Verbestel	Delegue du Centre Technique et scientifique de l'industrie transformatrice du bois et des matieres connexes.
	M. Lecomte	Institut Belge de Normalisation
DENMARK	M. K. Malmstedt (Chef de delegation)	Engineer, M.Sc; Statsproveanstalten (Danish State Testing Institute)
	M. L. Norgard	Civil Engineer, Danish Standards Association.
FRANCE	M. Zeller (Chef de delegation)	Association Francaise de Normalisation.
	M. Amy	Ingenieur en Chef au Laboratoire Municipal de la Ville de Paris

FRANCE (cont'd)		M. Arnault	(C.T.I.C.M.)
		M. Bellisson	Ingenieur du Centre Scientifique et technique du Batiment - Champs-s-Marne.
		M. Jean	Centre Technique du Bois
		M. Sfintesco	Directeur des Recherches - Centre Technique Industriel de la Construction Metallique.
		M. Traverse	Architecte - Ministere de l'Interieur - Service National de la protection civile.
GERMANY	ORR	Dr.-Ing. Westhoff (Chef de delegation)	Staatl. Materialprufungstamt, Dortmund - Aplerbeck.
		Dipl.Ing. Becker	Bundesanstalt fur Materialprufung, Berlin.
		Dr. Rumberg	Staatl. Materialprufungsamt, Dortmund - Aplerbeck.
		Dipl.Ing. von Postel	Institut fur Baustoffkunde und Stahlbetonbau Braunschweig.
NETHERLANDS		Dr. C.W. van Hoogstraten	Director, Brandveiligheidsinstituut, T.N.O. Delft.
NORWAY		M. C. Gartner (Chef de delegation)	Civil Engineer, Director of Felles-Tarifforeningen i Skadeforsikring, Oslo 1.
		M. W. Gundersen	Civil Engineer, Experimental Officer - Norges Brannteknisk[illegible] Laboratorium, Trondheim.
POLAND		M. Strus	Polish Standards Organizat[illegible]

ROUMANIA	M. A. Cordasevschi	Assistant Director of Roumanian Office for Standards.
SOUTH AFRICA	M. A.M. Mehl	Assistant Director of South African Bureau of Standards, Pretoria.
	M. C.S. Grobbelaar	Chief Technical Officer, Civil Engineering Section, South African Bureau of Standards, Pretoria.
SWEDEN	M. A. Kielland	Civil Engineer, Technical Officer, Norges Byggstandardiseringsrad, Dep. of NSF.
UNITED KINGDOM	M. L.A. Ashton, O.B.E.	Chief Experimental Officer, Fire Offices Committee, Joint Fire Research Station.
	M. H. L. Malhotra	Senior Experimental Officer, Fire Offices Committee, Joint Fire Research Station.
	M. C.R. Mullins (rep. Mr. A.S. Minton, Managing Director)	Treharne & Davies Ltd., Analysts & Chemical Consultants.
	M. P. S. Wilson-Dickson, M.B.E. (rep. Mr. H.M. Smith, Home Office)	H.M. Inspector of Fire Services, Home Office. C.B.E.
'O' OBSERVER MEMBERS		
HUNGARY	M. Sandor Fabry	Ingenieur en Chef, Office Hongrois de Normalisatión, Budapest
	M. Lajos Aradi	Expert de securite contre le feu, Budapest
U. S. A.	M. J. V. Ryan	Assistant to the Chief, Building Research Division National Bureau of Standards Washington, D. C.

'O' OBSERVER ASSOCIATIONS

I.M.C.O.	M. Y. Sasamura	Inter-Governmental Martime Consultative Organization
CEUBOIS	M. Gilles	Federations Europeennes des Panneaux de Fibres et de Particules.
	M. J. Collardet	President de Centre Technique de Bois, Paris
CHAIRMAN:	M. D. I. Lawson -	Director, Joint Fire Research Station.
SECRETARIATE:	M. R. H. L. Sung, O.B.E. -	Technical Officer Building Section British Standards Institution

M. Van Droogenbroeck, Directeur General de l'Institut Belge de Normalisation.

INTERPRETER: M. Lacour

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