NBSIR 74-575

Meetings of WG 3, 10 and 11 of ISO/TC 92, March 25-29, 1974

D. Gross

Programmatic Center for Fire Research
Institute for Applied Technology
National Bureau of Standards
Washington, D. C. 20234

September 1974

Progress Report

Prepared for
Subcommittee on International Standards
ASTM Committee E 5.92

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Subcommittee on International Standards
ASTM Committee E 5.92

U. S. DEPARTMENT OF COMMERCE, Frederick B. Dent, Secretary
NATIONAL BUREAU OF STANDARDS, Richard W. Roberts, Director

MEETINGS OF WG 3, 10 AND 11
OF ISO/TC 92
March 25-29, 1974

D. Gross

Meetings of three ISO/TC 92 Working Groups on Door Assemblies, Measuring Instruments and Fire Resistance Tests were held in London and Boreham Wood, England during the week of March 25-29, 1974. The principal agenda items were (a) resolution of comments from the ballots on Draft International Standard ISO/DIS 3008 Fire Resistance Tests on Door and Shutter Assemblies and on Draft International Standard ISO/DIS 3009 Fire Resistance Tests on Glazed Elements, (b) fire test instrumentation and (c) development of a test method for suspended ceilings.

Key words: Door assemblies; fire endurance; fire tests; ISO/TC 92; suspended ceilings; windows.

1. WORKING GROUP 3 -- TEST REQUIREMENTS FOR DOOR ASSEMBLIES

Tenth Meeting, Boreham Wood and London, March 28, 29, 1974

PARTICIPANTS:

H. L. Malhotra, UK, Chairman	P. Arnault, France
W. Morris, UK	G. Bellisson, France
A. Roach, UK	J. C. Laurin, France
Dr. G. Hall, UK	Mrs. Luschevici, France
J. Dekker, Netherlands	J. Keough, Australia
P. Oksanen, Finland	D. Gross, U.S.A.
Westhoff, Germany	R. B. Williamson, U.S.A.
H. Salmark, Denmark	Col. Curtis, UK, Secretariat

The list of appropriate documents is given below.

DOCUMENTS:

(UK-28) 108	First Draft, Test Specification for Smoke Stop Doors
(Belgium-11) 113	Definition of Leakage Factor in Tests for Smoke Control Doors
(Belgium-12) 114	Measurement of the Leakage Factor of Smoke Control Doors - Temperature Conditions
(Sec-26) 115	Comments from Member Bodies on ISO/DIS 3008
(Sec-27) 116	Comments from Member Bodies on ISO/DIS 3009

(Sec-28) 117	Agenda for Tenth Meeting of WG3
(UK-28) 119	Analysis of Comments on ISO/DIS 3008
(UK-29) 120	Analysis of Comments on ISO/DIS 3009
(USA-14) 121	Letter from Dr. Robertson
(Aus-4) 122	Letter from Mr. Keough
(Belg-12) 123	Letter from Mr. Minne

Agenda Item 1. Opening of Meeting

Mr. DiBiase of Italy was added to WG3

Agenda Item 2. Approval of Report of 9th Meeting

Agenda Item 3. Note Draft Report of TC92 Plenary Meeting as Given in Document (Sec-186) 376

Agenda Item 4. Comments and Changes to ISO/DIS 3008 (Door and Shutter Assemblies) Prior to Submission to ISO Council

Out of 24 P-members, there were 17 in favor (71% approval), with 1 abstention and 2 no response. A total of 26 members of ISO voted, with 22 in favor (including USA); 1 abstention (Finland) and 4 against (Belgium, France, Italy and New Zealand).

There was a discussion of how to define glazed doors and whether a fully glazed door belongs in DIS 3008 (Door and Shutter Assemblies) or DIS 3009 (Glazed Elements). Three types were considered:

(a) Glass Door - consisting entirely of glass with no frame.

(b) Fully glazed Door - A framed door containing a maximum extent of glazing.

(c) Door with glazing - A wood or steel door containing a glazed element.

Later during the meeting it was decided to exclude fully glazed doors from the defined scope of DIS 3009.

Para. 4.2 Canopy

After considerable discussion, and in view of several strong objections to the canopy test (France, Belgium) and only minor support, the canopy test was placed in Appendix 2 with this statement: This appendix defines a Canopy test which was initially a part of the Standard, but in view of comments made by members during the balloting, it is now included for obtaining information on performance. It may be suitable for evaluating initial or ultimate integrity... It needs further refinement to increase sensitivity. It is described to enable laboratories to obtain additional experience. (This change moves Paragraphs 4.2, 7.2 and 8.2.3 to the appendix; in the latter paragraph, the maximum and mean temperature limits are replaced by a simple requirement that they be recorded).

Changes, mainly of an editorial nature to clarify the intent of the standard in response to the comments received, were made in the following paragraphs:

5.1 Size; 5.3 Conditioning; 6. Test Procedure; 7.1 Furnace Pressure; 7.3 Unexposed Face Temperature; 7.4 (Footnote) A sentence was added: "Improved instruments are being developed by a working group of ISO/TC92." This comment resulted from discussions in WG10, in which it was pointed out that at relatively low temperatures the sensitivity of a radiometer with a mica window will be limited since a large portion of the long wave-length radiation will not be transmitted through the window. 7.5 Cotton Pad Test (changed from "cotton wool"). Appendix 1. Paragraphs Z.5 Note to Section 6; Z.8 Note to 7.4; Z.12 Note to 8.3.

Agenda Item 5. Comments and Changes to ISO/DIS 3009 Fire Resistance Tests of Glazed Elements

Out of 24 P-members, there were 15 in favor (62% approval), with 4 no response. A total of 27 members of ISO voted, with 22 in favor (including USA) and 5 against (Austria, Belgium, Finland, France and Italy).

The major change was the removal of the canopy test to an appendix as in ISO/DIS 3008. Editorial and clarification changes were made in Paragraphs 1 (Remove fully glazed doors from this standard and place in ISO/DIS 3008); 4.2; 5.1; 5.3; 8.2.2; Appendix Z.2; Z.3; A.9; and figures 1, 2 and 3. Col. Curtis will prepare a revised document DIS 3009 for circulation back to WG3.

Agenda Item 6. Fire Tests for Lift Doors

Document 118, a draft proposal for fire tests of lift doors, was still in preparation and not available for discussion.

Agenda Item 7. Impact Tests for Doors

No report. To be carried over to agenda for next meeting.

Agenda Item 8. Test for Smoke Control Doors

Action deferred; is expected to form a major part of the next session of WG3.

Agenda Item 9. New Business

None.

Agenda Item 10. Next Meeting

WG3 is planning to meet with WG11 in France (week of November 18).

2. WORKING GROUP 10 -- MEASURING INSTRUMENTS[1]

Fourth Meeting, London, March 26, 1974

PARTICIPANTS:

G. Bellisson, France, Chairman	J. Dekker, Netherlands
J. C. Laurin, France	J. Keough, Australia
P. Arnault, France	P. Oksanen, Finland
J-P. Leroy, France	H. Salmark, Denmark
A. Heselden, UK	P. Topf, Germany
S. Thelandersson, Sweden	D. Gross, U.S.A.

DOCUMENTS:

(France-7) 30 + Annex	Construction and Assembly of a Thermopile Heat Flux Meter (in French) by J-P. Leroy, March 1974
(France-9) 31F	Capteurs Dynamometriques de Compression Type RA (in French)
(Germany-2) 32	Calibration of a Small Radiometer by Means of a Black Body
(Canada-1) 33	Remote Measurement of Large Deflections in Fire Tests by Lie and Berndt, April 1972
(Sec-6) 34F	Report of the 3rd Meeting, Paris, March 1973 (in French)
(France-10) 34	Measurement of Temperatures in Furnaces of Fire Resistance Tests, Sept. 1973 (in French)
(UK-11) 35	An Electrical Source of High-Intensity Thermal Radiation by H.G.H. Wraight, August 1973
(Germany-3) 36	Reception Angle and Influence of Cooling Water Temperature on EMF of a Small Radiometer by P. Topf, October 1973
(Sec-6) 37F	Agenda for 4th Meeting, London, March 1974
(USA-4) 38	Infrared Radiation Reference Sources and Standards, Barnes Eng. Co., Bulletin 11-010 (1962)

[1] Certain instruments and equipment are identified in this report since they are mentioned as examples of commercial devices in the meeting discussion. Such identification does not imply a recommendation, or that these instruments are necessarily the best available for the purpose.

(UK-12) 39	Guide to the Measurement of Thermal Radiation by Means of the Thermopile Radiometer BS 4892 (1973)
(UK-13) 40	Measurement of Gas Velocity in Flames and Combustion Products from Fires by G. Cox, Feb. 1974

Agenda Item 1. Opening of Meeting

Agenda Item 2. Approval of Report of 3rd Meeting

Agenda Item 3. Measurement of Temperatures in Furnaces (ISO R 834 Fire Resistance Test, ISO R 1182 Noncombustibility Test)

An extended discussion was held on the relative merits of placing thermocouples into the fire endurance furnace (cf positions 1, 2 and 3 from Document 34). Disadvantage of Position 1 is that specimen deflection changes distance d' (100 mm). Also, length d should be sufficient to prevent excessive conductive cooling. Alternate suggestions included (a) bringing furnace thermocouple along exposed surface of specimen and then bend down 100 mm; (b) provide 2 or more rows of horizontal thermocouples which can be used in succession during test as deflection increases. Mr. Arnault mentioned that a considerable temperature gradient was noted in tests with water cooled columns. See figure 2.

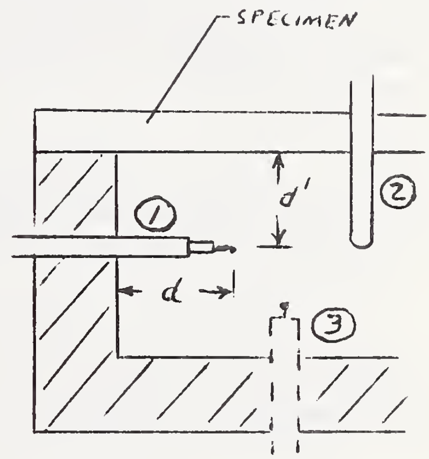


FIG 1

It was concluded that DIS 834 needs an annex with recommendations on how to locate furnace thermocouples for tests or walls, floors, beams and columns. However, it was generally agreed that the principal effort should be in defining the heat balance in furnaces.

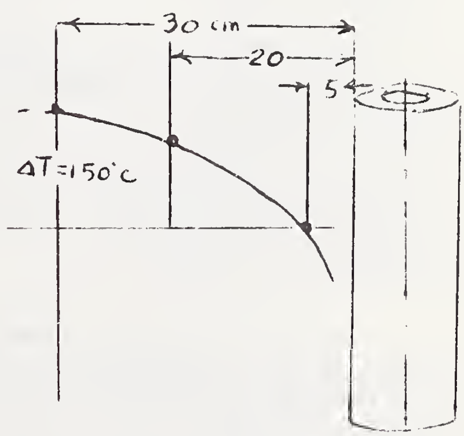


FIG 2

There was some discussion on how to measure the response time (time constant) of furnace thermocouples and reference to Document 17 (USA), Bellisson suggested the use of a small furnace with a Meker Burner No. 4 arranged to follow the standard time-temperature, and the thermocouple mounted in a fixed position. Another suggestion was that the fire resistance furnace itself could serve to measure the time constant.

On the subject of measuring the temperature of steel members, Mr. Keough pointed out the advantages of capacitive welding techniques for securing thermocouples to the steel (based originally on information supplied by Gustaferro). Bellisson also mentioned that precautions are required to ensure the proper location of thermocouples to be embedded in concrete specimens and to prevent water condensation effects.

Agenda Item 4. Measurement of Temperatures on Unexposed Surfaces

Mr. Arnault pointed out the problem resulting from condensation and ponding of water (e.g. 3 mm deep) in the center of a concrete floor slab and the soaking of the asbestos pad. Other comments related to the blistering or intumescence of coatings and the differences in results depending on whether the thermocouple was firmly held (by a spring) to the surface, or allowed to move out with the expanding surface coating. Mr. Dekker remarked that there was a need for a movable temperature sensor, inasmuch as the principal interest should be in the maximum temperature rise.

Agenda Item 5. Measurement of Radiation and Calibration of Instruments

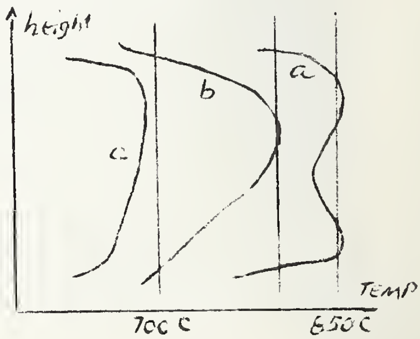
This was a major discussion item, with the following documents described in some detail (28, 39, 35, 36, 38, 30F/30A, 23).

Mr. Wraight's report (Document 35) describes a 4 lamp radiation source operating at a blackbody temperature of over 1000 C and providing a uniformly irradiated area of approximately 5 to 6 cm. It was designed for comparing receiving instruments (radiometers) but may be used also for ignition experiments. Each lamp is rated at 4 KW.

The Fire Research Station (FRS) is working on an absolute heat flux-meter (water-flow calorimeter) for high irradiance levels (approximately 6 months away).

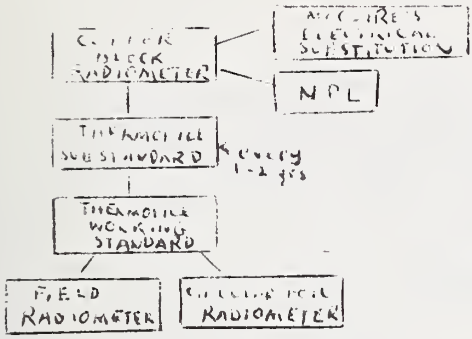
Dr. Topf's report (Document 36) describes the use of a 1250 W halogen lamp to calibrate a radiometer used principally with the ignitability apparatus, but which can also be used with the spread-of-flame test. He investigated the Lambert Cosine Law relation and found that the reception angle can vary between $\pm$ 60° with an accuracy of $\pm$ 4%. He is seeking a commercial source for manufacturing the radiometer which is suitable for 5 W/cm^2 for up to 5 minutes (extended radiation may affect the black coating).

Dr. Topf also discussed Dr. Minne's attempts to measure the temperature in the noncombustibility furnace by (a) radiation pyrometer, (b) thermocouple and (c) narrow angle pyrometer. These measurements were made successively, not simultaneously and several possible explanations for the wide temperature differences were offered.



Mr. Leroy gave a detailed description of the design and construction details of a water-cooled thermopile heat flux meter, suitable for heat flux levels up to 12 W/cm^2. It was suggested for use in the spread of flame test and for the unexposed surface of fire resistance specimens.

Alan Heselden summarized the types of base line calibrations which FRS uses for reference to known standards.



There was a discussion on radiation from and through glazing. Dr. Topf has measured radiation from a single pane of prestressed glass. The glass failed at 10 minutes when the furnace temperature reached 679°C and the glass temperature was about 250 C. The measured radiation, using a 60° radiometer was as follows:

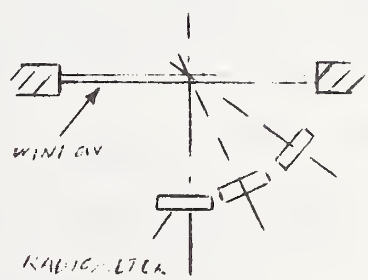
@ 1 meter, 0.6 W/cm^2

@ 1/2 meter, 1.3 W/cm^2

@ 30 cm, 2 W/cm^2

With 2 layers separated by an air space, the assembly lasted 30 minutes.

Mr. Heselden and Dr. Topf stated the desirability of examining whether the glass radiation followed the cosine law, since it would then be possible to use configuration factors to calculate the radiation at different distances and angles. To examine this, it is necessary to rotate the radiometer (not the axis of the radiometer) with respect to the central axis of the window.



Dr. Topf also stated the overall desirable characteristics of a radiometer:

(a) Small size sensor (minimize shadow effect)

(b) High sensitivity

(c) No window or lens

(d) Sufficiently large angle of view

(e) Use aperture of same shape as object (e.g. rectangular for door); can be polished aluminum, but need not be water-cooled.

Agenda Items 6, 7 and 8

Were not discussed because of lack of time.

Agenda Item 9

Document 31F was a descriptive brochure for a strain gage type of load cell (manufactured by BLH in USA) suitable for 600 C. Cost 1000 Francs. However, it was pointed out by Thelandersson that calibration factors are not constant, that they are affected by moisture, and can only be used one time at high (fire) temperatures.

Agenda Item 10. Measurement of Furnace Pressure

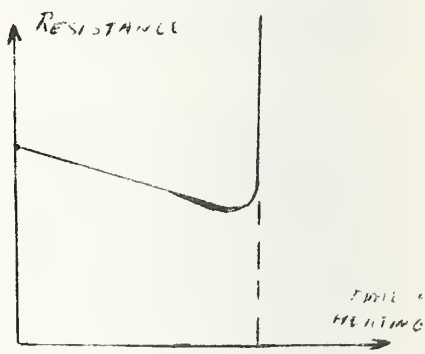
In Ghent, furnace pressure is measured continuously. Australia uses a Decker (USA) instrument with taps at one-third heights. Other commercial sources are Leeds and Northrup, Honeywell and Berri.

Agenda Item 11. Measurement of Oxygen Concentration

Several known commercial sources are Hartmann and Braun (paramagnetic type), Siemens, Serverex and Beckman.

Agenda Item 11.1 Moisture Content Within Specimen

Document No. 56F was received from ISO Committee 125 relating to this. In addition, Thelandersson mentioned an expendable Swedish device consisting of a porous material with a resistance wire which can be installed in concrete. When the heat wave reaches the sensor, the sudden drying causes a very rapid increase in resistance. He will try to supply information to WG3.



Agenda Item 12. Coordination with Other Groups

These items were introduced as resolutions:

A. Dr. Topf's radiometer to be further developed for possible application to measuring radiation from the radiant panel (in the spread-of-flame test) and from doors.

B. The radiometer recommended for use in measuring radiation from doors (DIS 3008) is unsuitable in its present form (because of variation in sensitivity at low source temperatures).

C. The French fluxmeter to be developed further.

D. WG10 will plan to establish a Draft Proposal dealing with a fluxmeter for the Ignitability and Spread of Flame tests, and which will contain limits of use (requirements) without a detailed description of the instrument.

Agenda Item 13. Next Meeting

During the week of October 21-24, 1974 in Germany.

3. WORKING GROUP 11 -- FIRE RESISTANCE TESTS

Fourth Meeting, London, March 25 and 26, 1974

PARTICIPANTS:

K. Kordina, Germany, Chairman
F. Wesche, Germany
P. Oksanen, Finland
J. Dekker, Netherlands
G. Bellisson, France
J. C. Laurin, France
P. Arnault, France
J. Keough, Australia
H. L. Malhotra, UK
G. Hall, UK
F. C. Adams, UK
A. Curtis, UK
H. Salmark, Denmark
S. Thelandersson, Sweden
D. Gross, USA

DOCUMENTS:

(Sec-7) 25	Report of Third Meeting of Working Group II
(Sec-5) 26	Agenda for Fourth Meeting, WG 11
(Germany-5) 27	Letter and Comments on ISO/DIS 834
(Australia-3) 28	Measurement of Temperature of Structural Steel Members - Proposal for Addition to ISO/DIS 834
(Germany-6) 29	Test Methods and Criteria for the Fire Resistance of Suspended Ceilings (Appendix to DIS 834)
(UK-3) 30	(Untitled) Notes/Criteria for Loaded and Unloaded Floor/Beam/Ceiling Assemblies.
(France-1) 31	Tests of Suspended Ceilings (in French)
(Sweden-3) 32	INSTA 28 - Document No. 22, Fire Resistance Test; Determination of Fire Resistance of Parts of Building Construction
(USA-4) 33	Comparison of E119 and ISO/DIS 834
(USA-5) 34	Effect of Furnace Design on Fire Endurance Test Results by L. G. Seigel
(Sweden-4) 35	Connection Between Real Fire Exposure and Standard Fire Resistance for Steel Structures

Agenda Items 1 and 2 (Opening and Approval of Previous Report)

Agenda Item 3

Postponed until 3/26.

Agenda Item 4. Heat Conditions of External Columns

Postponed due to absence of Professor Pettersson.

Agenda Item 5. Action on ISO/DIS 834

Each participant was asked to state his views on the actual and recommended furnace pressures. Germany uses 1 $\pm$ 0.5 mm H_2O (but not suitable for suspended ceilings); UK uses 1.5 mm H_2O for integrity; Sweden uses 2 mm H_2O; France uses cold furnace overpressure (and underpressure) test to look for potential collapse, but leakage around edges makes it difficult to overpressure with suspended ceilings. The fastening method, although not for fire purposes, is important.

As for pressures in actual fires, this can vary from -0.5 mm H_2O at floor level to 1.0 or 1.5 mm H_2O at ceiling. Dr. Hall suggested that 1.5 mm H_2O represented a limit value for the combined effect of fire and wind. It was subsequently decided to recommend lowering the furnace pressure from 1.5 mm H_2O to 1.0 mm H_2O.

Germany (and Belgium) requires 2 identical repeat tests for classification; the average or lower value is used. Professor Kordina mentioned other considerations: the need for an additional shock (impact) test for nonbearing (separating) elements; the use of the ISO cotton wool test may be desirable to limit materials to "nonflammable". Dr. Hall mentioned the Butcher and Fardell paper in which the wind and fire pressures were separately estimated. Professor Kordina is planning some field fire tests in a 4 story building in Braunschweig scheduled for demolition; he will measure ceiling overpressure before and after the addition of a suspended ceiling; he will also add external, unprotected columns; he will use oil burners as well as wood cribs and furniture to examine fire growth and the effectiveness of open and closed doors. Mr. Thelandersson then mentioned Swedish tests of full size single family houses to investigate fire spread as a function of separation distance. Wood cribs and furniture will be used plus large fans to create wind. Professor Kordina summarized briefly the preceding discussions and the status on DIS 834:

1. it is necessary to collect additional information on differences between DIS 834 and national standards;
2. the number of tests is questionable; (in ISO and UK only one; in Germany, duplicate tests);
3. method needed for handling the integrity of a nonloadbearing separating element during fire exposure;
4. suggestions for the appropriate furnace overpressure during tests (including suspended ceilings);
5. additional information desirable on boundary conditions.

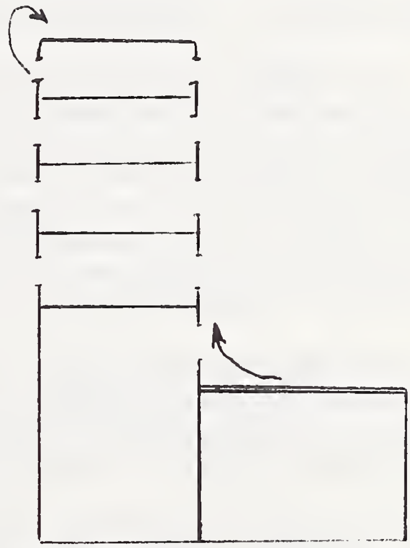
Mr. Keough pointed out the distinctions made in the Australian code between a ceiling/floor construction where the ceiling serves to limit the spread of fire to the floor above, and a ceiling/floor construction where the ceiling serves to limit the fire spread horizontally to other areas on the same floor. A criterion of 325°F temperature limit on combustibles in the ceiling cavity.

Agenda Items 5.2.1 Comparison of Furnaces and 5.2.3 Fuel Feed to Furnaces were postponed pending future reports.

Agenda Item 6. Roofs

Professor Kordina has discussed with Professor Herpol (WG7) the subject of roof testing and WG7 is not concerned with exterior fire exposure, but fire exposure from inside and the effects of snow/wind/fire loads.

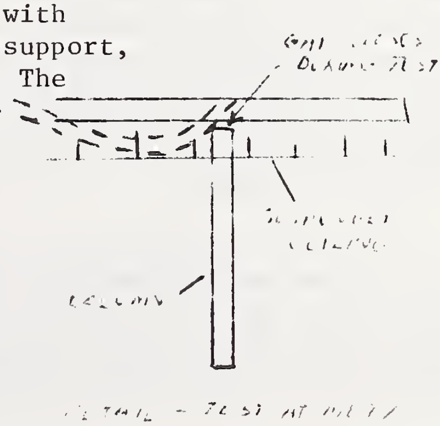
Mr. Dekker stated that the new Dutch standard for exterior fire exposure is similar to the German standard, and deals with exposure to the roof and exposure to a wall from a burning roof. The requirement is that no combustible gases from the roof construction be permitted to enter through the windows of an adjacent building.



Information on fire exposure from inside will be considered for inclusion in DIS 834. Col. Curtis will ask Dr. Thomas (Chairman TC92) whether test for exterior fire exposure to roofs should be referred to WG7 or other working group.

Agenda Item 7. Bearing Assemblies

The furnace at Metz is the only furnace currently suitable for composite (bearing assembly) structures. A series of special tests beginning in June will examine the effects of 3 slabs on 3 columns with different "hats" (arrangements of reinforcing bars). Professor Kordina suggested that information be collected on the displacement and rotation of beams, even if simply supported. Mr. Keough mentioned that Australia is planning a small test program with a flat plate under conditions of a) simple support, b) restraint against horizontal expansion. The load will be varied to produce the same deformation as before.



As an example of the differences between separate and composite test results, Mr. Arnault offered the following:

Separate Ceiling Assembly	CSTB test 4 hr
Separate Gypsum Partition	CSTB test 4 hr (non load bearing)
Separate Door	CSTB test 1 hr
Overall fire endurance	less than 2 hr

(due to expansion of metal door frame, followed by exposure of partition, deflection of ceiling, increased partition load, and subsequent collapse of partition).

Agenda Item 8. New Business/Future Work

Mr. Dekker noted that the O_2 content of the furnace affects ignition of cotton wool; he measured 10% O_2 at ignition at 20 min, and 0 to 6% O_2 at ignition at 30-40 min. There was some discussion on the possibility of finding a material (e.g. fully nitrated cellulose nitrate or polystyrene) whose ignition will not depend on O_2 content of furnace. Alternately, it was suggested that a prescribed O_2 content (10%) could be obtained (and required) by the addition of air. While Mr. Oksanen felt that the furnace O_2 content affected burning rates, Mr. Keough felt it did not.

Mr. Oksanen mentioned the use of a box device to collect gases from all large and small cracks. Professor Kordina requested that members record the temperature at cracks where cotton wool would be used and the temperature at which ignition occurs.

A slight revision was suggested to the proposed addition to ISO/DIS 834 by Keough. This would include the following additional sentence relating to measuring the temperature of structural steel members: "In selecting the sections chosen for temperature measurement, the laboratory should keep in mind the possible location of heat flow paths and the presence of joints."

Agenda Item 9. Suspended Ceilings

Mr. Malhotra joined the group on Tuesday and amplified the statement that furnace overpressure was required only to assess the effect of integrity. It was felt that in the early part of the test (0-10 minutes) it was difficult to control pressure. Based on small-scale tests, the effect of pressure on the FET of suspended ceilings may be $\pm$ 30 to 40%. Whereas U.L. uses a continuous concrete floor to evaluate suspended ceilings, UK uses concrete slabs (in sections) over steel beams with the suspended ceiling.

There was additional discussion on the boundary conditions (e.g. trim strips around furnace), the number of supporting beams, deflection due to application of load, etc., all directed toward estimating or controlling the pressure drop and the passage of hot gases through the floor cavity which could increase the beam temperature more quickly.

Schemes were suggested for sealing the furnace wall edges with asbestos cloth and sand, Kaowool, etc. As a result, Professor Kordina offered to prepare another document which will contain as many of the thoughts and positions presented by the members as possible.

Next meeting, November, 1974 in France.

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15. SUPPLEMENTARY NOTES

16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

Meetings of three ISO/TC 92 Working Groups on Door Assemblies, Measuring Instruments and Fire Resistance Tests were held in London and Boreham Wood, England during the week of March 25-29, 1974. The principal agenda items were (a) resolution of comments from the ballots on Draft International Standard ISO/DIS 3008 Fire Resistance Tests on Door and Shutter Assemblies and on Draft International Standard ISO/DIS 3009 Fire Resistance Tests on Glazed Elements, (b) fire test instrumentation and (c) development of a test method for suspended ceilings.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)* Door assemblies; fire endurance; fire tests; ISO/TC 92; suspended ceilings; windows.

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