NBSIR 73-193 (R)

Meetings of WG 3, 10 and 11 of ISO/TC 92, March 25-30, 1973, on Doors, Instrumentation and Fire Endurance

A. F. Robertson

Institute for Applied Technology
National Bureau of Standards
Washington, D. C. 20234

May 1973

Progress Report

Prepared for
Subcommittee on International Standards
ASTM Committee E 5.92

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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 25-30, 1973

A. F. Robertson

Abstract

Meetings were held of Working Groups on fire tests of Doors, Instrumentation, and Fire Endurance in Paris during the week of March 25-30, 1973. This report enumerates the documents circulated and discussed as well as reporting decisions reached and proposals for future work.

1.0 WG 11 Fire Endurance

PARTICIPANTS:

K. Kordina, Germany, Chairman
F. Wesche, Germany
P. Oksanan, Finland
J. Witteveen, Netherlands
J. Dekker, Netherlands
W. I. Stewart, Australia (observer)
G. Bellisson, France
A. Cabret, France
J. C. Laurin, France, AFNOR
R. Arnoult, France
Grabbe, France
W. Ellis, USA
A. F. Robertson, USA
H. L. Malhotra, UK
Mrs. Bruce, UK, British Standards

On Tuesday the following joined the group:
A. J. J. Hesselden, UK
J. E. Clark, USA

Professor Kordina welcomed the delegates and indicated regret that illness of family members had prevented attendance by Prof. Pettersson of Sweden. The various documents to be considered were enumerated.

Documents: All the following document designations carry the prefix ISO/TC 92/WG 11. In the text reference is made to only the suffix number of the designations listed below:

(Sec-5) 17 and annex 1 - Report of Working Group 11, Meeting held on 16 November 1972 at London.

(Germany-1) 18 and annex 1 - Behavior of Composite Structures in Fire.

(Germany-2) 19 - Differences between D1N 4102 and R 834.

(Sec-6) 20 - Agenda for WG 11 Meeting on 26 and 27 March 1973, Paris.

(UK-4) 21 - Revised Specifications for the Composite Furnace.

(Germany-3) 22 - Test Methods and Criteria for Suspended Ceilings (Appendix to R834)

(Netherlands-1) 23 - Conclusions on Heat Transfer to Specimens in a Furnace

(Germany-4) 24 - Proposals on Heat Conditions of External Columns

DISCUSSION:

The agenda items were considered as presented in Doc. 20.

Agenda Item 2 - Approval of Minutes of London Meeting

Professor Kordina's annex 1 to the minutes was accepted. Several other minor revisions to the minutes were also accepted. These involved changing "roofs" to "suspended ceilings" and modifying the report on the USA discussion of the kiln drying method to assume a more optimistic form.

Agenda Item 3.1 - Proposal on Heat Conditions of External Columns

It was noted that documents had been forwarded from several countries including USA to Professor Pettersson on this subject. Since he was absent and no documents had been forwarded, this item was not discussed further.

Agenda Item 3.2 - Outline for Test of Suspended Ceilings

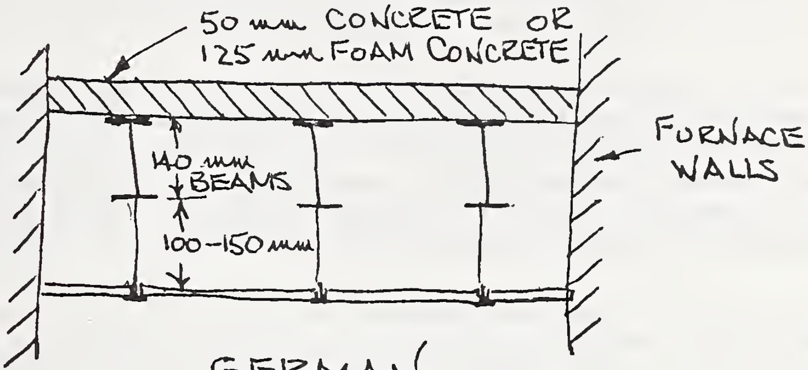
Document 22 prepared for discussion purposes by Kordina was reviewed by Malhotra, who compared it with Part 8 of BS 476 which provides for such tests. He agreed with the requirement of a minimum span of 4 m but suggested that the minimum width might be increased to 2.4 m. He indicated that BS 476 limited maximum rating for tile ceilings to one hour.

Professor Kordina noted several problems which should be recognized in development of the test method:

(a) One cannot be sure all tiles are in place at the time of a fire.
(b) The behavior depends on the performance of the bearing structure by deflections under load.
(c) The behavior will depend on furnace gas pressure. With overpressure endurance is significantly reduced. ISO R834 calls for an overpressure of 1.5 mm water and this is not always used.
(d) There are situations where a suspended ceiling is used without a floor above.

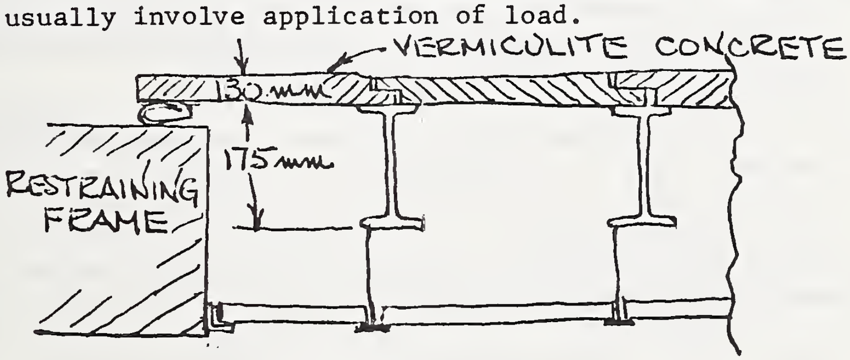
A considerable discussion on various aspects of this type of test followed.

Mr. Laurin asked for a definition of a suspended ceiling. This resulted in descriptions of the test methods used in different countries. Professor Kordina proposed a revision of figure 1 of Doc. 22. This is shown below.



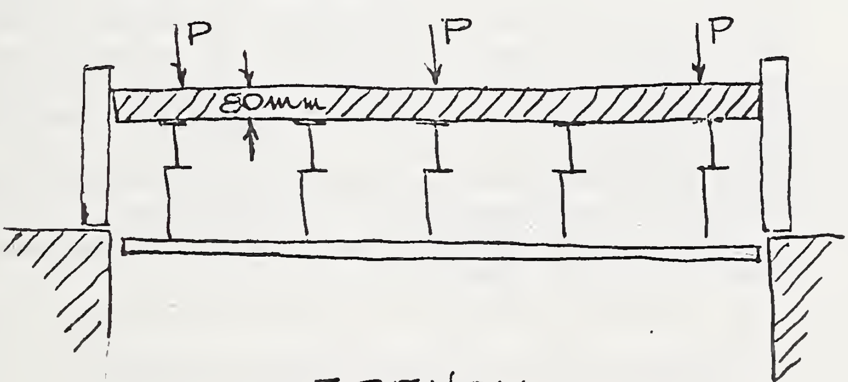
GERMAN

British practice involves building specimen in a test furnace frame. It does not usually involve application of load.



BRITISH

The French procedure involves application of a dead load. Only the ceiling is supported within the furnace. The floor and beams are surrounded by precast concrete slabs.



FRENCH

Mr. Malhotra suggested loading the beams without applying load to floor slabs. Professor Kordina agreed to develop the test method and it was accepted that the exposure of the specimen would be affected by the furnace pressure as well as the thermal properties of the floor slab. Britain has performed tests with different furnace pressures and observed significant variations in performance.

During discussion of criteria of failure it was generally agreed that opening of but one tile was to be considered as specimen failure. A second criteria was proposed to involve resistance to heat transfer. Two bases of thermal failure were suggested. One an average steel temperature of 500°C if specimen is loaded. In absence of load, a temperature of 400°C was proposed.

There was discussion on whether a test of this type would qualify the ceiling for use with different floor constructions. Mr. Malhotra reported that their results suggested a wood floor beam assembly would achieve roughly 1/3 that of a steel beam and insulating concrete assembly. On the otherhand a dense concrete floor beam assembly above a ceiling would yield 1-1/2 to 2 times the endurance of the insulating concrete and steel beam assembly. There was agreement that different floor construction would probably require different ceiling tests.

Dr. Witteveen from Netherlands questioned the need for this test. It was agreed however that it was desirable for comparison of different ceiling constructions.

We agreed to send Professor Kordina information on current USA practice with tests of this type.

Agenda Item 3.3.1 - CIB Comparison of Furnaces

Dr. Witteveen presented a report on the present status of this study, Doc. 23. Only six of the ten countries participating in the study had completed tests. USA (NBS), Belgium, France and South Africa were asked to send results promptly. The final report is planned for completion by 1 June 1973. The following tentative conclusions seem appropriate:

(a) Variations in furnace conditions as well as some damage to heat transducers make it difficult to separate radiative from total heat transfer.
(b) The heat flux at one location in a furnace varies during a given experiment.
(c) There are differences in heat flux in different furnaces and similar positions.
(d) It seems that the differences in (d) above are not greater than (b) and (c) above.

It was suggested that the variations observed may not be larger than those implied by the tolerance on furnace temperature. In general the report seemed to suggest that differences in specimen exposure did not seem as great as was originally expected.

Dr. Witteveen reported that he had made computer studies on 1000 different columns. In this study he had changed furnace exposure conditions, steel/concrete ratio, as well as other design variables. Endurance times varied by ± 20 percent or temperatures at a given time could vary from 400°C to 500°C to 600°C. Professor Kordina reported experimental endurance variations of ± 10 percent on a given specimen under supposedly similar conditions.

We agreed to furnish information on the ASTM method for correction of deviations from the required fire exposure conditions.

Agenda Item 3.3.2 - Alternative for Cotton Wool Test

Since Minne was not present, this discussion was postponed.

Agenda Item 3.4 - Testing Methods and Criteria for Behavior in Fire of Composite Structures

Mr. Oksanan described tests he had conducted in his furnace on two types of composite structures, Doc. 21. These involved short lengths (1-1/2 - 2 meters) of each of the construction assemblies, one at each end of the furnace. One involved a floor wall connection while the other involved wall-wall connections. Photographs were circulated relating to these tests.

Professor Kordina mentioned the problems of structural expansion joints. It was reported that the best way to treat these was to caulk the first 2-3 in with asbestos or other mineral fiber insulation and then apply the caulking material above this.

Mr. Malhotra discussed progress in planning the UK furnace. He mentioned receipt of ours and other comments.

We questioned the propriety of use of the term composite structure. The term was not being used in the structural sense since it was being used to describe assemblies of different building elements such as wall floors and columns rather than the components of a given element. There appeared to be agreement that building element assemblies was a better description of the types being studied.

Professor Kordina made several interesting comments on the British proposal;

(a) He suggested greater height so that columns of at least 4 m could be tested as part of an assembly.

(b) He suggested three jacks be used at the top of columns so that rotation at the end could be forced, restrained and/or the forces measured.
(c) Suggested the provision extra heating so that a furnace temperature of 1200°C could be reached in 15 min.
(d) He suggested increasing recording equipment to monitor at least 200 circuits.
(e) Proposed provision of load capacity in excess of 200 tons for columns.

On being questioned on the need for three jacks for columns Kordina seemed to agree that for tall slender columns this was not so necessary but for short columns it was very desirable to simulate eccentric loading.

Mr. Bellisson and Cabret suggested that the furnace at Metz would meet international needs. It was stated that Mets is an Official Laboratory and is available for international studies. Professor Kordina, who should know because he designed the Metz facility was pessimistic about the use of Metz. He said it would need real modification. Provision had only been made for vertical loads. He suggested more sophisticated tests on smaller scale. He circulated annex 1 to document 18 as an example. He said that this showed a planned modification of his furnace. It had not been implemented. This is incorporated in this report as annex 1.

Professor Kordina emphasized that at present we are only working at prediction of behavior of single elements. In general, walls and columns are subject to unknown lateral forces which tend to reduce the factor of safety in an actual fire situation. On the other hand in many instances continuity of flexual members, beams and floors, tends to increase the strength of these elements over those subjected to fire test without simulation of continuity. In spite of the excellent work of PCA there are many studies to be made. He suggested continued cooperative studies between countries with different facilities providing complimentary data.

Agenda Item 3.3.2 - Alternative for Cotton Wool Test

Mr. Minne reported that his studies of this problem had not been successful. He stated that he had used heat transfer fins on a thermocouple but results were very confusing because of drafts and other air currents. He had also tried thermoplastic filaments but these too were not reliable. He suggests use of cotton pads for only 30 seconds before their replacement.

Professor Kordina suggested that we would keep this recommendation, together with the need for drying the wool, as the basis of a future revision of 834.

Agenda Item 4 - Other Business

Colonel Cabret raised the question of an appropriate procedure for tests of steel sheathed columns. He mentioned that in tests they had run, explosions had been experienced. Several representatives mentioned the need to provide vent holes in the steel sheaths. It was generally agreed that it was desirable to drill holes in the casing of such columns to reduce the danger of explosion in the event of a fire.

Agenda Item 5 - Report to Plenary Meeting

Kordina agreed to draft a report which would be circulated to task group members for prompt comment.

This concluded the meeting of WG 11.

WG 10 Measuring Instruments

Mr. Bellisson opened the meeting at 2:00 p.m. on Tuesday, 27 March.

PARTICIPANTS:

- J. Witteveen, Netherlands
- J. Dekker, Netherlands
- R. Minne, Belgium
- P. Oksanan, Finland
- P. Topf, Germany
- W. I. Stewart, Australia
- H. L. Malhotra, UK
- Mrs. Bruce, UK (BSI)
- W. Ellis, USA
- J. Clark, USA
- A. F. Robertson, USA
- J. Laurin, France (AFNOR)
- G. Bellisson, France
- Mr. Kouper, France
- R. LaCroix, France

DOCUMENTS:

All the following document designation numbers carry the prefix ISO/TC 92/WG 10. In the text references to documents are with respect to the last number in the following designations.

(Sec-4) 24F* - Report of Meeting, 15 November 1972.

(USSR-1) 25 - Methods of Attaching Thermocouples to Specimens.

(Sec-5) 26 - Third Meeting, 27 and 28 March 1973.

(USA-3) 27 and Annex 1 - Proposed Revision of Furnace and Unexposed Surface Temperature Measurement Methods.

(UK-10) 28 - Notes on Instruments for Measuring Irradiance and Heat Flux in Fire Tests.

(France-7) 29F - Measurement of Temperatures by Thermocouples.

(France-8) 30F - A thermal conductivity heat flux meter.

(France-9) 31F - Compression Dynamometers.

(Germany-2) 32 - Calibration of a Small Radiometer by Means of a Black Body.

DISCUSSION:

The report of the last meeting, Doc. 24, was considered and accepted without change.

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*The suffix F indicates that the document is only available in French.

Agenda Item 3 - Measurement of Temperatures in the Furnace

Mr. Bellisson started the discussion by introducing his paper, Doc. 29F. In this paper, he discusses various problems associated with furnace temperature measurement. In the recent past they have used small diameter rapid response sheathed thermocouples. The cost of these, as well as damage caused to them during use, has resulted in reconsideration of their merit. Recent trend has been toward use of bare thermocouples formed from chromel alumel wire by use of a gas flame, the bead varying from 2 to 3 mm dia. The leads are insulated and carried in a series of twin hole procelain insulators of about 6 mm OD (1/2 in) and about 50 mm (2 in) in length. This assembly is supported in the furnace in the position desired with the aid of steel pipes of 20-25 mm dia ($\sim$ 1 in). The junction protrudes from the open end of the pipe by about 25 mm (1 in).

The paper continues with an analysis of the factors influencing the thermal response of thermocouples. The response time or time constant is defined as the time required for the output of the thermocouple to achieve within $1/e^{th}$ of the maximum signal ultimately attained when the couple has been suddenly exposed to a fixed ambient temperature difference.

There was considerable discussion on the relative merit of determining the time constant during a heating or cooling exposure of the thermocouple. Many delegates wanted to be able to make these measurements with a small furnace. It was not clear as to whether a decision had been reached. However, there do seem to be certain advantages to be achieved by making the measurement as a result of cooling from a high temperature. The furnace used can be relatively small and good control over room ambient air movement can be achieved. It seems more likely that such a procedure would yield more uniform results between different laboratories.

Agenda Item 4 - Measurement of Temperatures on the Unexposed Surface of Specimens

We were asked to introduce our paper, Doc. 27 and Annex 1. We reported study of the results supplied by the Russians, Doc. 25. We explained that we had observed very similar condensation problems, below the copper disc, as mentioned by the Russians. We had found that these were significantly reduced by use of a dense 4 mm (1/8 in) thermocouple pad. We also recommended a spring device to hold the pad and thermocouple in place on the specimen surface. Because of difficulties in fabrication of the unit shown in Doc. 27, that shown in Annex 1 was proposed as preferable. This is shown in Annex 2. Some objection was made to the use of screws to fasten the spring in place. It seems possible that a tape involving a thermosetting adhesive might be useful for this purpose.

Almost no opportunity was provided for discussion of this proposal and no further action recommended. We later asked that Doc. 27 with annex be circulated to the various members of the Working Group to secure their reaction as well as samples of insulation used by the various members for unexposed surface thermocouples.

Agenda Item 5 - Radiation Measurements.

This would have been an appropriate time at which to introduce Hesselden's excellent paper, Doc. 28. However, he was not invited to do this. Instead, Topf's paper, Doc. 32, was considered. This describes measurements attempted in calibration of a very small radiometer by means of a specially constructed black body furnace. Errors in calibration by about 10 percent were recognized and during discussion it appeared that at least some of the problems resulted from convection heating of the reference junctions since there was no window on this instrument and it was tightly coupled with the black body aperture.

Unfortunately for the success of the meeting of WG 10, plans were made for a visit to CSTB at Champs sur Marne on the morning of Wednesday. We were interested in the new column and wall furnaces. The latter will accept specimens of 3x3 m dimensions (about 10x10 ft). However, they had run out of money before the loading equipment and specimen frames were completed and as a result the furnace is standing idle. They were in the process of constructing a small corridor type furnace of about 1-1/2 x 1-1/2 x about 5 m length (roughly 5 x 5 x 17 ft). This was to be used for tests of ducts when exposed to conditions simulating the standard temperature-time curve. It seemed likely that they would have trouble with the small burners being installed.

Meetings of the working group were continued at AFNOR after lunch.

Agenda Item 6 - Measurement of Heat Flux.

Mr. Bellisson introduced Doc. 30F and proceeded to wade through all the details of design and construction of a heat flux meter which had not yet been constructed. The device involves a disc of stainless steel cooled by water on one side while the other side is exposed to the thermal flux field. An electrical signal is to be derived from a thermopile measuring the temperature difference between hot and cold disc surfaces.

There was further reference to Doc. 4F describing the spiral copper tube heat flux meter constructed at CSTB. Pairs of these units had been mounted on the surface of a floor-ceiling specimen during repetitive tests with the floor furnace. It was indicated that there was good uniformity over the ceiling surface. The heat flux reported was 100, 140 and 165 x 10^3 kcal/hr m^2 for 1, 2 and 3 hour exposure times. He suggested these were typical for the floor ceiling furnace and similar results had been observed at Metz.

Near the end of the meeting Hesselden was asked to introduce his paper, Doc. 28. This is an excellent and comprehensive discussion of problems associated with heat flux measurements. Each of the various test methods now used are considered and specific suggestions are offered for handling radiant and heat flux measurements. We proposed that the paper be published by ISO as a technical report. It was stated that ISO did not want such documents. We then suggested that Hesselden be thanked for the paper and encouraged to publish it promptly.

Mr. Bellisson agreed to the value of the paper and apologized for its late introduction.

Agenda Items 7-15

These items involving measurements of smoke specimen deformation, specimen restraint, furnace gas pressure, hot gas leaks through specimen cracks, furnace gas oxygen concentration, etc., were hurriedly considered in a time period of about 15 minutes. No decisions were made. The decision on next meeting time and date was postponed until after the plenary meeting.

WG 3 Doors and Shutters

Mr. Malhotra opened the meeting and welcomed the delegates.

PARTICIPANTS:

H. L. Malhotra, UK
P. Oksanan, Finland
G. Bellisson, France
W. I. Stewart, Australia
R. Minne, Belgium
J. Dekker, Netherlands
P. Topf, Germany
J. E. Clark, USA
A. F. Robertson, USA

DOCUMENTS:

All the following document designations carry the prefix ISO/TC 92/WG 3. In the text reference to documents is with respect to the last number in the designation below.

(Sec-23) 103 - Report of WG 3 Meeting on 13 and 14 November 1972.

(Sec-24) 104 - Agenda for Meeting of WG 3 on 29 and 30 March 1973.

(Australia-3) 105 - Air Leakage Through Doors.

(Finland-2) 106 - Results of Air Leakage and Fire Tests of Doors.

(UK-27) 107 - Establishing Criteria for Testing Performance of Smoke Stop Doors.

(UK-28) 108 - First Draft Specification for Smoke Stop Doors.

(USA-11) 109 - Letter to H. L. Malhotra.

(USA-12) 110 - Factors in Controlling Smoke in High Buildings.

(USA-11) 111 - Computer Analysis of Smoke Movement in Tall Buildings.

DISCUSSION:

Consideration was first directed to review of the minutes of the last meeting. These were accepted as prepared.

Prior to organized discussion of papers on the agenda, several items of general interest were mentioned.

It was reported that a group in CEN is working toward a standard for elevator doors. They apparently have modeled it after the proposed standard of ISO/TC 92 for fire tests of doors. AFNOR is serving as secretariat for the group doing this work.

Agenda Item 3(d) - Impact Test.

The USA at numerous previous meetings has requested that provisions be made for an impact test which could be applied to doors and other fire test specimens. It became clear that the members of TC 92 were not receptive to the use of a hose stream for this purpose. So far, we have not made specific recommendations, although we have been invited to.

Accordingly, we reported our lack of action on this item and indicated that we would try to make progress towards specific recommendations before the next meeting. We mentioned that we had received a description of a French test method involving an impact test for railing, and a German test for fire specimens. It seems highly desirable that any test developed be suitable for application during as well as after a fire test.

I asked for an indication of the interest by other countries in this type of test. The results were as follows:

Australia	-	no special interest
Germany	-	test needed
Finland	-	no test used at present
Belgium	-	test needed
France	-	no interest
UK	-	no test used now, but interest in one
USA	-	test desirable

From this convas it seemed to us that there has been a significant change in receptiveness for such a test. We recommend that special consideration be directed towards this problem. Perhaps the projection of a stream of sand or other solid particles would serve the purpose. In any case we have about 9 to 12 months to make progress towards some specific recommendations. Some delegates emphasized that the test must be suitable for application on the fire side of the specimen. We agreed to circulate a description of the test method we use in the USA.

Agenda Item 3(a) - Further Developments in Finland.

Mr. Oksanan introduced his paper, Doc. 106, which reports fire and air permeability tests on six insulated steel doors and two solid core wood doors. Tests were performed with the apparatus described in Doc. 102 presented at the November meeting. This involves use of a box-like attachment to cover the unexposed face of the door and frame. Any gas leakage is caused to flow through a nozzle which is placed in one wall of the box and by means of which the gas flow may be measured.

Tests were run on all doors in the cold condition at 1 and 2 mm H_2O pressure ($\sim$10 and 20 N/m^2). It was found that for the doors tested and pressures applied the flow was independent of the side which was pressurized.

One of the wooden doors was tested at furnace temperatures of 20, 150, 200, and 265°C. The results are reported in the attached Annex 3. For the doors tested under fire exposure the general trend involved a nearly hyperbolic reduction of permeability of the door as a function of time. This was interpreted as resulting from expansion of the door in the frame. It was reported that they had gained considerable experience with this type of test but they were still anxious to secure a better instrument for measuring gas flow.

Agenda Item 3(b) - Techniques for Measuring Air Flow and Tightness

Paper 105 from Australia was introduced by Mr. Stewart. This reports further work by Keough on air flow around doors at room temperature. He also reported that leakage was unaffected by changing the side of the door which was pressurized. Maximum pressure applied was but 5 mm water, about (.2 in water). His previous results suggest that a different conclusion might be reached if pressures closer to 1/2 in water had been used.

Annex 4 to this report shows one of the figures presented in his paper. This has been marked up to designate the portion of crackage which seemed to be influencing gas flow. The correlation of the data for different pressure differentials is evident from this figure.

Discussion of the data was interesting. Dr. Minne questioned the value of special seals for doors since they usually wear out quickly. He suggested testing doors having peripheral gaps of not less than 2 mm. He also suggested that different behavior might be expected between steel and wood doors.

Mr. Bellisson suggested that the test should cover door construction as well as hinges and other fittings which do not melt. The Chairman suggested that where appropriate such items could be discussed in the commentary but we are talking about a test procedure not a specification.

After lunch we were asked to discuss Doc. 109. This is a letter we had sent Malhotra in which we suggested elaboration of the proposal previously made for analysis of door gas leakage data. Specifically we suggested defining an effective leakage area A_ℓ as:

$$A_\ell = \frac{Q}{C\sqrt{2gh}}$$

Where:

Q = volumetric gas flow through door crackage
C = an effective discharge coefficient
g = gravitational acceleration
h = pressure differential across door in height of flaming fluid

Of course consistent units would be required and proper recognition would have to be taken of temperature density and volume relationships of the gas. The assumption of constant pressure conditions seemed appropriate.

It was further proposed that since A_ℓ would be expected to change with h a complete report of door performance might include a plot of A_ℓ as a function of h. If this were to be simplified perhaps two values of A_ℓ might have particular interest.

(a) That corresponding to the maximum value of h which would just permit opening the door.
(b) That at a fixed low pressure differential across the door perhaps h equal to a few milimeters of water.

We pointed out that data of this type would be directly useful in smoke or gas flow calculations past doors.

Dr. Minne proposed measurement of gh in Newtons to be consistent with SI notation. He was asked to prepare his proposal in written form.

The applicability, of A_ℓ, to flow measurements under fire exposure conditions such as Mr. Oksanan has conducted was questioned because of difficulties in defining the effective value of h. In this case, h varies over the height of the specimen.

Apart from this the proposal for reporting door leakage in terms of A_ℓ was generally accepted and will probably form the basis of reports of test application.

Agenda Item 3(c) - Flow of smoke past doors in real and experimental fires.

We introduced Documents 110 and 111 which discuss smoke movement in buildings from the overall point of view. One of these discussed in a general way the factors influencing smoke movement in buildings while the other reports a series of computer solutions on movement of smoke in buildings. We suggested that in spite of the use of doors specifically designed to limit smoke passage it was likely that other building leakage paths would result in extensive smoke flow. These papers were well received but it was evident that there was a desire to have a test for doors intended to reduce smoke movement.

Mr. Malhotra briefly referred to the paper reporting a behavioral study of people when endangered by fire. This document, "The Behavior of People in Fires," will be circulated to the working group later. The report seems to suggest that people will feel confident in trying to escape when they can see things at a distance of 10 meters.

Agenda Item 3(e) - Terminology

During the last meeting we had asked that the term "smoke stop door" be reconsidered with regard to its appropriateness for the test we were proposing to develop. At that time we were asked to come to this meeting prepared to make a decision. After a brief discussion of the matter it was placed to vote and the majority vote was for "smoke control door." There was considerable consternation when the French equivalent turned out to be "par fumé" which sounds very much like perfume! The French seemed happy and it was agreed to circulate a one page note to all members of the working group to inform them of the decision and ask if they have objections.

Agenda Item 4 - Proposed program of tests on smoke stop doors

Mr. Malhotra introduced document 107 which reports tests on smoke movement through doors mounted in a small test building erected in their Experimental Fires Building. Five or six different methods of producing smoke from a wood crib with restricted ventilation and smoke from a well ventilated crib fire seemed to yield satisfactory results. They resulted in development of a neutral axis above the door bottom, temperatures above 200°C in the fire room and pressure differentials across the door of greater than 0.3 mm H_2O. The study is not yet complete but the results to date are interesting. One development has been a definition of the degree of smoke stratification:

$$\text{Stratification} = \frac{OD(2m) - OD(.5m)}{OD(2m)} \times 100$$

The bracketed figures represent the height of the horizontal photometer, in meters, on which the optical density per meter OD is measured.

Agenda Item 5 - Preparation of draft ISO Standard for test of smoke stop doors

Mr. Malhotra discussed his outline, Doc. 108, of the proposed fire test method. This document is reproduced as Annex 5 of this report. Mr. Malhotra indicated that he considered we had made real progress during the meeting and he would attempt to develop the test method further.

This paper stimulated a series of comments from the delegates all the way from "we don't need a smoke" control door test method, to "we need a test of this type very much."

There seemed to be general agreement that a test of this type could serve a useful purpose and that three different levels of fire exposure seemed appropriate. The French wanted to include windows, ducts and flues as well as doors but this was not accepted.

Agenda Item 6 - Report to the Plenary Meeting

It was agreed that the report would be essentially one of progress. Mr. Malhotra would prepare it and circulate it for comment. It would refer to the cooperative attitude which has developed in connection with the work.

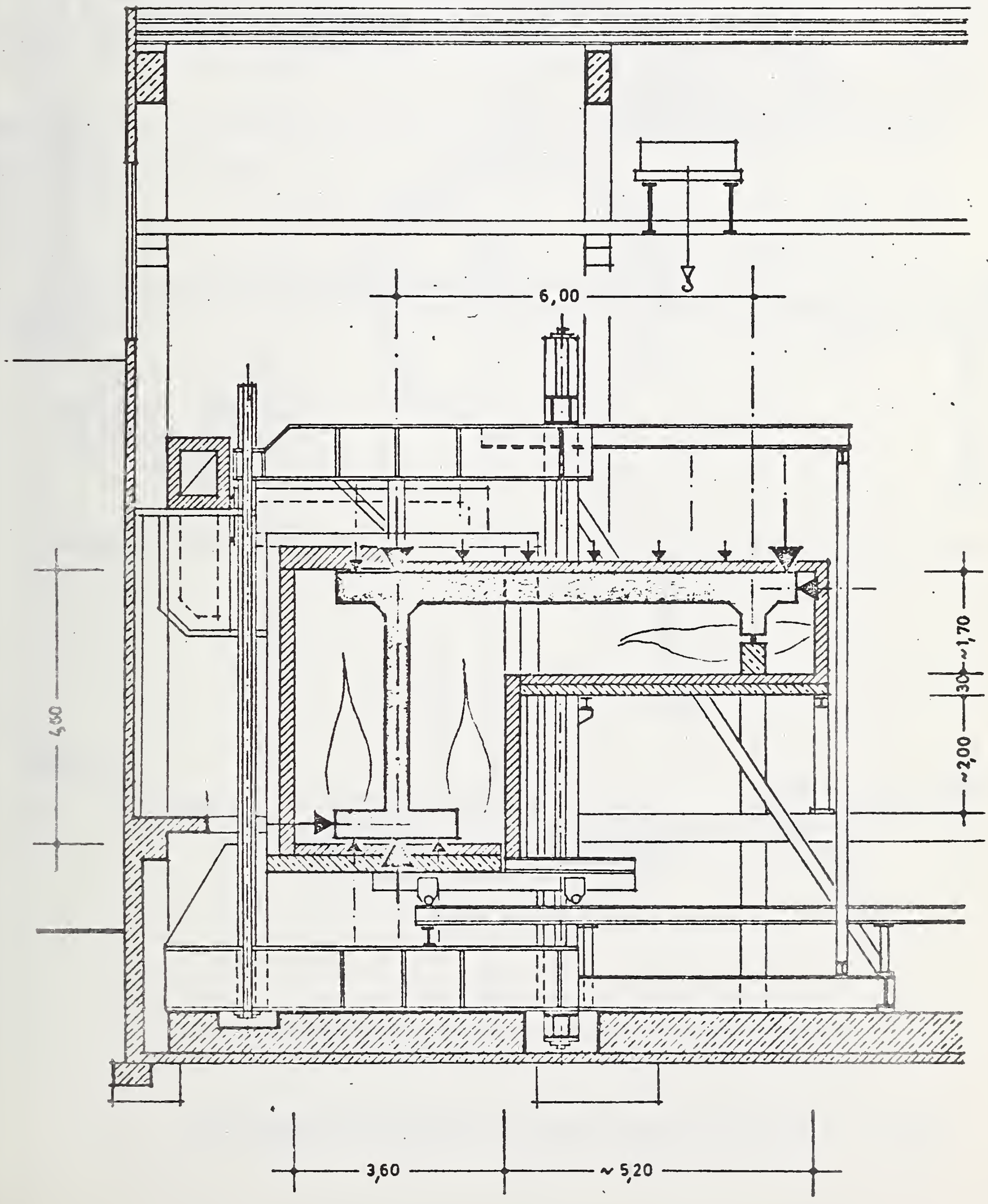
Agenda Item 7 - Other Business

Mrs. Bruce reported that ISO/DIS 3008 was currently being circulated for ballot while 3009 would be coming shortly. The former relates to fire tests of doors while the latter involves tests for glazed elements.

Agenda Item 8 - Date and place of next meeting

No decision was reached. It was suggested that either late in 1973 or early 1974 would be appropriate.

ANNEX 1



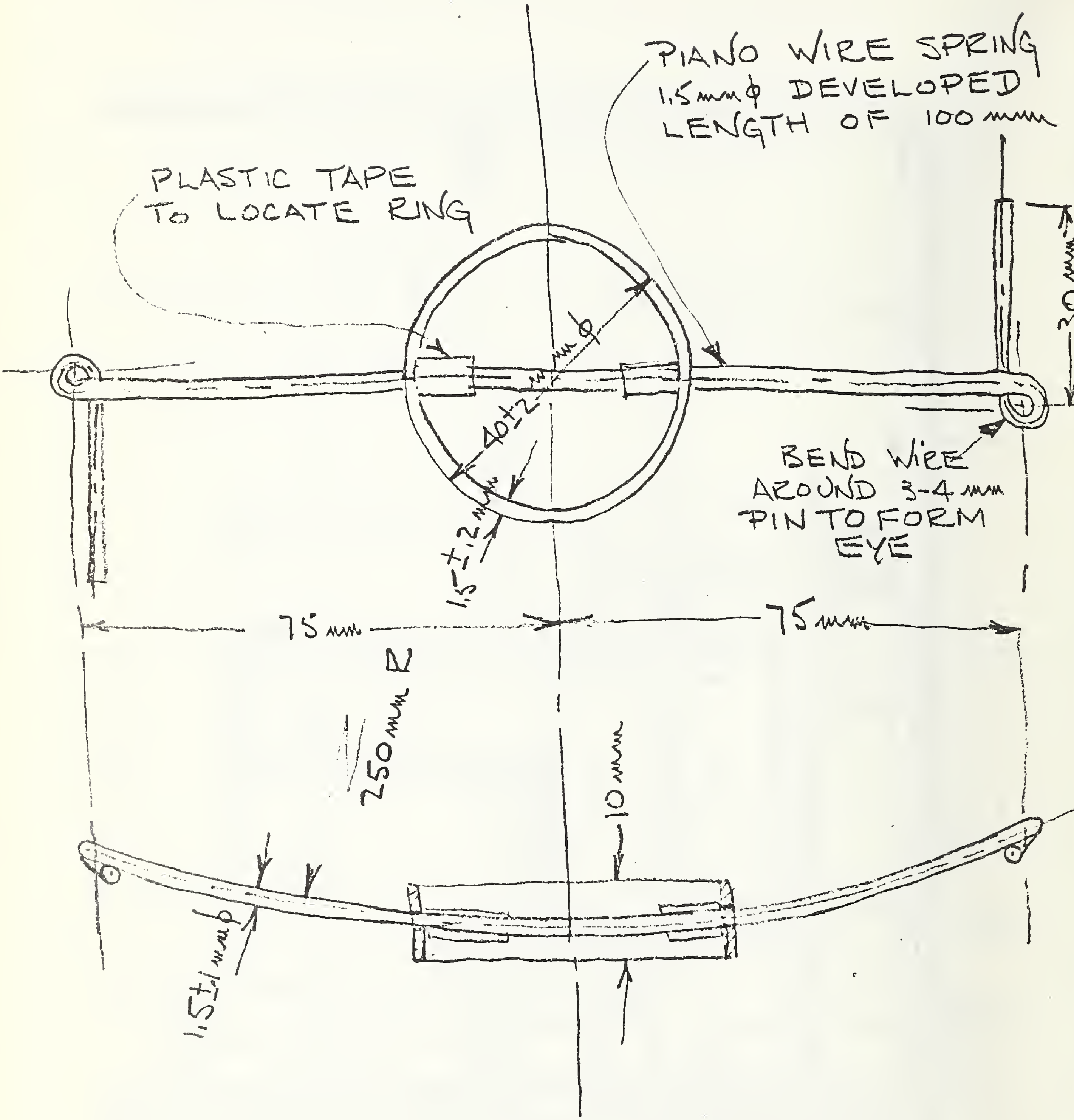


Figure 2 - Alternate Spring Design for Unexposed Thermocouples

Annex 3

Table 2.

Wood Door.	Gap A mm	Gap B mm	Furnace temper-ature °C	Pressure differ-ence N/m² at the sill level	Air leak-age m³/h (Room Temp)	Pressure differ-ence top-sill level N/m²
Door 8 with lap and seal	1,7	3,2		-10	50	
				+10	52	
				+20	82	
				+40	130	
			145	0	30	
				+10	60	
without seal and lap			20	-10	95	
				+10	100	
				+20	150	
				+40	215	
			150	0	55	7,0
				+10	125	
			200	0	60	7,5
				+10	130	
			265	0	60	8,5
				+10	140	

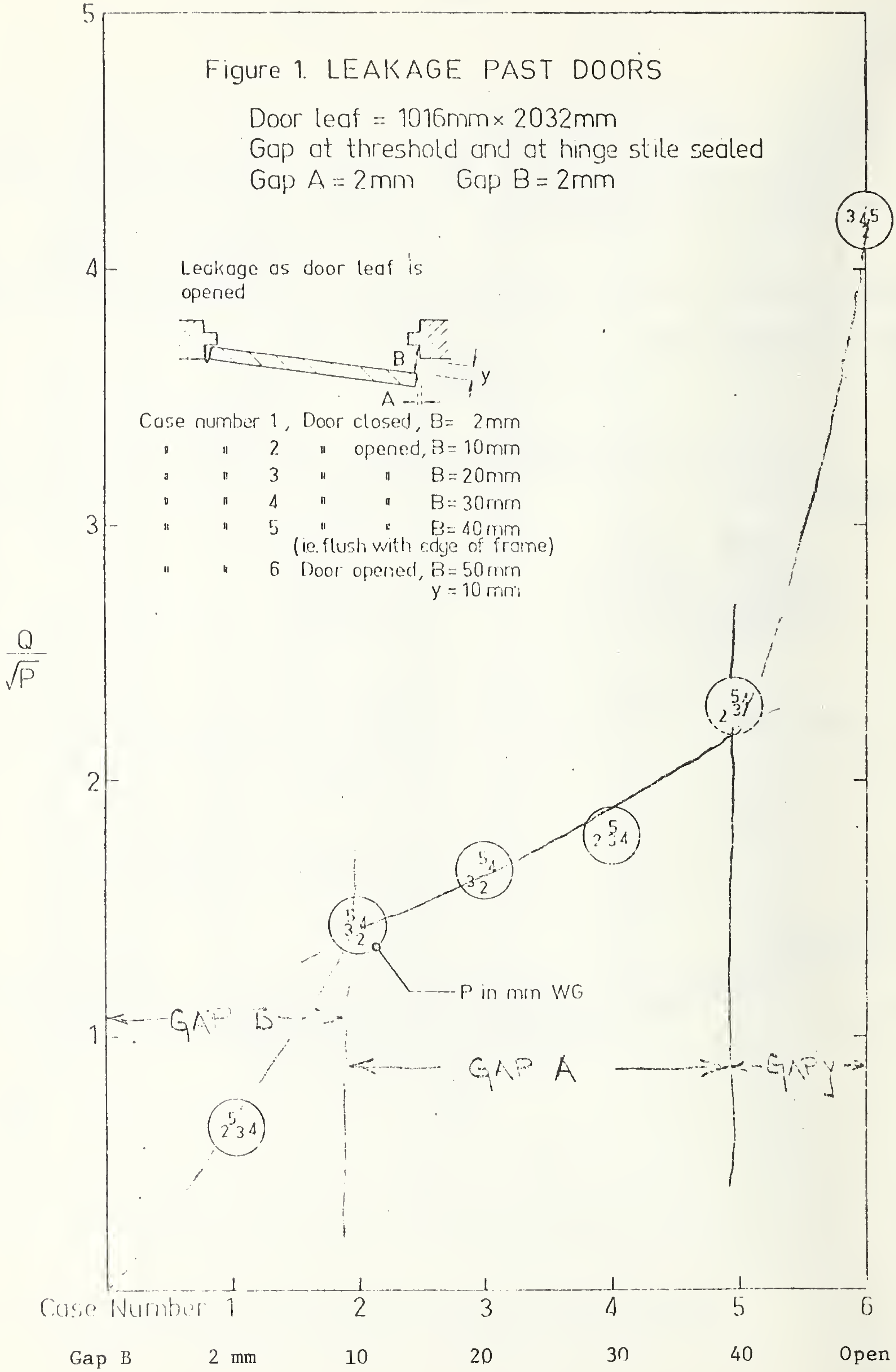


Figure 1. LEAKAGE PAST DOORS
Door leaf = 1016mm × 2032mm
Gap at threshold and at hinge stile sealed
Gap A = 2mm Gap B = 2mm
Leakage as door leaf is opened
B
A
y
Case number 1, Door closed, B= 2mm
" " 2 " opened, B = 10mm
" " 3 " " B = 20mm
" " 4 " " B = 30mm
" " 5 " " B = 40mm
(ie. flush with edge of frame)
" " 6 Door opened, B = 50mm
y = 10 mm
P in mm WG
GAP B
GAP A
GAP y
Q/√P
Case Number 1 2 3 4 5 6
Gap B 2 mm 10 20 30 40 Open

Annex 5

FIRST DRAFT

TEST SPECIFICATION FOR SMOKE STOP DOORS

1. GENERAL

1.1 Purpose

This Standard specifies methods of testing and evaluating the performance of doors intended to resist the passage of smoke in a fire.

1.2 Scope

This Standard is applicable to door assemblies which are provided in buildings to act as a barrier to the passage of smoke and other products of decomposition produced in a fire. The doors may be situated remote from the seat of a fire and therefore not subjected to any appreciable heat or at the other extreme they may be exposed to the full severity of fire. The test specification deals with three situations and provides a testing technique for each. The three situations considered are:

A. No heat exposure and smoke at ambient temperatures

B. Moderate heat exposure and smoke at temperatures around 200°C

C. Severe heat exposure as produced in a fire resistance test

The procedure does not provide a method of classification; the national standard and codes can specify the appropriate criteria for doors intended to be used in different buildings and in different parts of a building.

1.3 Test principle

Smoke and other products of combustion which are evolved in fires can endanger the safe movement of occupants if ~~they can~~ it travels freely from the fire to other parts of a building, particularly those designated as escape routes. Boundary walls of fire compartments are provided with fire resisting doors and the Standard test (ISO/DIS 3008) does not provide any means for assessing their effectiveness as smoke barriers. Other doors are provided to safeguard escape routes and whilst these may not be subject to the severity of fire simulated in a fire resistance test, they are required to provide resistance to the passage of smoke. Some of these doors may be near enough to the seat of a fire to withstand elevated temperatures ($200^{\circ}C$), others may be further away so that smoke is reasonably cool when it reaches them.

All doors have varying degrees of clearances between the door panel and the frame and the presence of slight pressure created by the fire will induce the smoke to be transmitted from one side to the other. High temperatures will result not only in increased pressure but will also cause a pressure gradient to develop over the height of the door. Certain doors can suffer damage and distortion at high temperatures which may increase the size of gaps through which smoke can pass.

The tests described in this Standard reproduce the condition of pressure difference on two sides of a door and measure the flow of gases from the high to the low pressure side with or without the presence of the particular matter which signifies smoke.

Three conditions for which test methods are specified are as follows:

Condition A. Smoke at ambient temperatures

A method for measuring air leakage from one side of the door to the other with a constant pressure difference of [0.5 mm w.g.]

Condition B. Smoke at moderate temperatures

A method for measuring smoke transfer from one side of the door to the other with a pressure gradient over the height of the door and a maximum pressure difference of [0.5 mm w.g.]

Condition C. Smoke at high temperatures

An attachment to be used in the course of fire resistance tests to measure the leakage of hot gases from one side to the other.

2. APPARATUS

Test A - Specification for an air leakage test

Test B - Specification for a smoke transfer test

Test C - Specification for the attachment to be used in the furnace test

3. PREPARATION OF TEST SPECIMENS

4. TEST PROCEDURE

5. MEASUREMENTS AND OBSERVATIONS

6. EVALUATION OF PERFORMANCE

7. TEST REPORT

8. EXPLANATORY NOTES

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15. SUPPLEMENTARY NOTES

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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.)

This document reports on the meetings of three working groups of ISO/TC 92, the committee on fire test methods. It comprises the USA minutes of the meetings which have been developed for the purpose of both informing the membership of ASTM Committee E 5 of the developments and stimulating further participation and exchange of information with this Committee of the Organization for International Standards.

17. KEY WORDS (Alphabetical order, separated by semicolons)

doors; endurance; fire; instrumentation; radiation; smoke; temperature; test methods

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