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industrial processes
building and civil engineering

Testing and classification
of the resistance to fire
of structural building components

Report
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Testing and classification of the resistance to fire of structural building components

Report submitted by:

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PREFACE

In recent years, the harmonization measures undertaken in the building and civil engineering sector have included work on the fire resistance of structural elements.

These activities led to the preparation in September 1977 of a preliminary draft Directive relating to the "classification on the basis of test results of the fire resistance of structural elements" which is well known among the circles concerned as "document 1202".

"Document 1202" is an internal Commission working document based on document ISO D.I.S. 834 and was prepared by joint working parties made up of experts from the relevant national ministries and representatives of the approved testing laboratories and the industry.

Implementation of the provisions of such a document in the form of a directive implies a reciprocal recognition of test results and classifications and raises the problem of the comparability of results obtained when using facilities (test furnaces) which exhibit different structural and operational features. In an effort to find a solution to the problems posed by attempts to establish this comparability, a study of the facilities available in approved Community testing laboratories was initiated.

This investigation was carried out in two stages.

During the first, covering the period from January 1979 to December 1980, an agreement was concluded with the three following experts:

D. VANDEVELDE (RUG)
M. KINGELHÖFFER (MPA)
J. DEKKER (TNO)

for the preparation of a questionnaire to be sent to the approved laboratories.
On the basis of this questionnaire, an enquiry involving laboratory visits was conducted in order to:

- draw up a catalogue of the characteristics of existing installations and of the resources available to them, particularly as regards the measurements performed;
- gain knowledge of the procedure employed in fire-resistance tests, with particular reference to the conditions under which test elements are assembled and to the contents of test reports;
- compare the procedures employed with the provisions laid down in document 1202.

During the second phase of the investigation, covering the period from January 1981 to March 1983, the three specialists were responsible for:

- analyzing the results of the enquiry conducted during the first phase and suggesting changes and areas requiring more detailed study with a view to achieving an optimum degree of harmonization;
- amending and supplementing document 1202 on the basis of the above-mentioned activities with a view to rendering it more relevant from the operational standpoint and to reducing differences of interpretation within its field of application.

The results of these activities are the subject of this report, which is in two parts:

Part I Examination of the equipment used in testing fire resistance in approved Community laboratories.

Part II Method of testing and classifying the fire resistance of structural elements.

At each stage of its progress, the study conducted by the three experts was subjected to critical examination by a Working Party consist-
ing of representatives of the Community laboratories which have been approved for the testing and classification of structural elements. This group, the composition of which is shown in the Annex to this preface met for the last time on 19–21 April 1982 prior to the finalization of this report.

This meeting produced a large measure of agreement among the participants as regards the contents of the report. Some of them even undertook to ensure that full recognition was given to the test reports and, consequently, to the classifications of structural elements based, like the corresponding tests, on the provisions contained in Part II of this report.

At the present juncture, the Commission believes that even though this undertaking to promote voluntary harmonization is not unanimous, it is extremely important and regards it as an encouragement to continuing efforts to bring current harmonization activities to a successful conclusion.

In the field in question, these efforts will relate, in particular, to installations and methods of calculation and extrapolation, but will also involve an expansion of activities to cover other elements and, lastly, the promotion of sustained and continuing cooperation between the approved laboratories.
Annex to the preface

Attendance list for the meeting of representatives of approved laboratories, held in Brussels on 19 - 21 April 1982

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PART I

ANALYSIS OF FIRE TEST EQUIPMENT

IN E.E.C. LABORATORIES
1. **INTRODUCTION**

On request of the "Directorate General III, Internal Market and Industrial Affairs" the three authors undertook the task to visit the officially recognized laboratories of the E.E.C., named by the national delegations in the expert group concerning resistance to fire of building elements. These were the following:

- **Belgium**: R.U.G.  
  Laboratorium voor Aanwending der Brandstoffen en Warmte-ovdrracht  
  Ottergemse steenweg, 711  
  B - 9000 GENT

- **Denmark**: DANTEST  
  Amager Boulevard, 108  
  DK - 2300 COPENHAGEN

- **U.K.**: FIRTO  
  Melrose Avenue  
  Borehamwood, Herts  
  Hertfordshire WD 6 2 BL  
  TRADA  
  Stocking Lane  
  Hughenden Valley  
  High Wiccombe  
  Buckinghamshire HP 14 4ND  
  WARRINGTON RESEARCH CENTRE  
  Holmerfield Road  
  Warrington Cheshire WA1 2DS  
  YARSLEY TECHNICAL CENTRE  
  Trowers Way  
  Redhill  
  Surrey RH1 2JN
France : C.S.T.B.
84, Avenue Jean Jaurès
Champs-sur-Marne
F - 77428 Marne La Vallée Cedex 2

C.T.I.C.M.
Domaine de l'I.R.S.I.D.
F - 57210 Maizières-lez-Metz

Germany : B.A.M.
Unter den Eichen 87
D - 1000 Berlin 45

T.U. Braunschweig
Beethovenstrasse, 52
D - 3300 Braunschweig

M.P.A.
Marsbruchstrasse, 186
D - 4600 Dortmund

F.M.P.A.
Pfaffenwaldring, 4
D - 7000 Stuttgart

H.F. Munchen
Winzererstrasse, 45
D - 8000 Munchen

Italy : Centro Studi ed Esperienzi del Ministro dell'Interno
I - 00100 Roma - Capannelle

The Netherlands : I.B.B.C. - T.N.O.
Postbus, 49
NL - 2600 AA Delft
During the visits the equipment of the laboratories was looked at, and at least one test in each laboratory was observed. Additionally particular questions concerning the test techniques were discussed with the staff of the labs. In order to provide as much information as possible, in preparation of the visits a questionnaire has been prepared by the undersigned. This questionnaire included a request for test reports. The questions were answered by the labs before the visit and the answers discussed and completed during the visits. During the exercise a second questionnaire concerning the calculation of test load was sent around.

As first result of these visits a full report, containing both the answers to the questionnaire and single reports of the visits, with all detailed information, was delivered to the sponsor. The answers to the second questionnaire here included in this report as far as available on the day of delivery of the full report. It was found that this report included a lot of information which seemed to be important for the further harmonization of the resistance to fire test method. Also analysis of the test reports delivered in the laboratories seemed useful.

The authors therefore accepted the task to analyse these voluminous documents in order to prepare conclusions and guidelines for a revision of the existing document 1202.

This report therefore contains:

a) an analysis of the former report including suggestions for modifications and more detailed specifications of the test procedures;

b) a method for testing and classification of the resistance to fire of structural building components.

Because of the increase of detailed specifications a rearrangement of the logical order was felt to be necessary. Chapter 1 contains the general requirements of test procedure and classification, valid for all types of elements; Chapter 2 gives for each type of building component, detailed instruction for the test arrangement; Chapter 3 gives the mandatory contents of the test reports for each type of building component.
2. GENERAL EXPERIENCE WITH DOC. 1202

During the visits the authors made the experience that doc. 1202 was not well known by the laboratories and partially not understood, especially the differences to the national standards were not sufficiently realised and observed. So by most laboratories, even carrying out test following doc. 1202, the tests were done on the basis of the normal way of working, i.e. following the national standard. Only those modifications were made where differences were realised. The results of this were large numbers of differences in test procedure and classification in the different labs.

The reason for this situation was found to be based on:

1°/ A lack of detailed specification in doc. 1202;
2°/ A lack of accessibility to the content of the existing doc. because some information on the same subject is dispersed over the document;
3°/ A lack of knowledge concerning the content of 1202 combined with an underestimation of the influence of smaller details in test procedure on the test results.

For this reason:

- the content of doc. 1202 is rearranged;
- especially in Part II detailed drawings concerning the test arrangements are given;
- tolerances for dimensions, minimum accuracy requirements and maximum intervals for measurements are specified;
- end conditions and other test details are specified closely. This means on the one hand that better harmonization will be obtained, but on the other hand it implicates that some situations are not covered by the test, and are not tested "as in practice";
- it was also felt that there was no reason to exclude protected steel members from the test procedure, as long as the use of test results remains limited to the element tested, and no extrapolation is made;
from these discussions it appeared that extrapolation of test results is not only a problem for protected steel members but also for other building components.

A detailed analysis of the information obtained by the questionnaire and during the visits, is given in the following chapters. Starting from the analysis, amendments and changements to doc. 1202 are proposed. Although much attention was paid during the visits to complete the questionnaires, by making the final analysis it appeared that even in the completed questionnaires some information was not very clear or even missing. Here, either a question mark appears in the tables, or they have been completed by the authors from memory. As the aim of this work was not to judge the quality of the work in the laboratories but to establish a detailed test procedure, single errors which may appear in the tables, but they have no influence on the final outcome of the work.
3. **COMMENTS ON THE FACILITIES IN THE LABORATORIES** (see table 1)

- The answers to the general questions in the questionnaire give an overall idea about the situation in each laboratory.

- Table 1 shows the size of the furnace halls. Their volume vary between about 300 and 15,000 m³.

  It is not expected that this will influence test results unless the specimen is directly in front of a large ventilation air entrance.

  Most of the labs are heated but the temperatures which are likely to be encountered are between 0°C and 30°C.

  In order to avoid influence of ambient conditions on the test results, ambient temperature in the furnace hall has to be kept approximately constant during a test. In this respect harmonization is restricted by the existing furnace halls and their ventilation possibilities.

- In the majority of labs, no special conditioning room for the specimen is available.

  The impression during the visits was that in most laboratories there is not enough space for storing the specimens during the conditioning time (e.g. concrete). In this light the product of the number of tests per year multiplied by the given figures for conditioning time does not fit together with the space available, at least for some laboratories.

- Some labs dispose on a large number of furnaces, others only on one or two which are used for different elements.

  For the multipurpose furnaces in general it will be more complicated to fulfill the requirements for the test, especially where closer specifications are introduced in the revised document.

- Those laboratories who have more than one furnace for a single purpose, probably can provide more information on the influence of furnace construction and other parameters on the test results.

- It is clear that the design of the furnaces influences the test results. In order to get better reproducibility which is necessary for harmonization, it appears desirable to have detailed guidelines for the design of furnaces (preferably working drawings). Such guidelines should be published as recommendation for new furnaces (see also chapt. 7.4).
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Table I - The facilities in the laboratories.
4. **FURNACES**

The furnaces seen in the different labs showed large differences in respect to their dimensions, their design, their heating devices and the furnaces control.

**Design of furnaces**

- Nine of the labs have a wall-furnace of at least 3 m x 3 m, six have only smaller furnaces.
  
  The depth of the furnace differs between 0,36 m and 4,0 m.

- The cross-section of the column furnace differs between 1,4 m diameter and 7,75 m x 5,75 m. The height is between 3,0 and 4,6 m.

  The floor furnaces have a cross-section between 2 m x 4 m and 9,5 m x 4 m : their height between 0,7 and 3,1 m.

  The beam furnaces have a horizontal cross section between 3,0 x 3,7 m and 4 x 11,5 m.

  The height of these furnace dimension on the heat transfer to the specimen is unknown.

- A second factor concerning the heat transfer is given by the klc value of the lining. The information on those values where insufficient, most labs do not know the values for k and c.

  The values for p are situated between 780 and 2 760 kg/m³.

- (The question of heat transfer in furnaces is treated e.g. in the "Van Keulen" report NO TN0 NO BVI 74-17, "Comparison of heat transfer in several wall furnaces", although the special influence of furnace dimensions on heat transfer is not described separately).

- There seems to be no relation between density and durability of the lining.

- Large furnaces have been built in order to test larger components. The existing version of doc. 1202 allows this. Especially in respect of the statical system of the components it is expected that the dimensions of the specimen can have great influences on the measured R/E/I values.

  For harmonization purpose it seems to be necessary to introduce fixed specimen dimensions in the revised doc. 1202.
<table>
<thead>
<tr>
<th>Laboratory</th>
<th>Size x x b (m x m)</th>
<th>Depth (m)</th>
<th>Density of Lining kg/m³</th>
<th>Nr. of Tests until Failure</th>
<th>Type of Burners</th>
<th>Nr. of Burners</th>
<th>Nom. Cap. of all b. flames (MJ/h)</th>
<th>Lenght of Flames (m) x</th>
<th>Is the fuel/air-ratio constant?</th>
<th>Measured</th>
<th>O₂-content av. V. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUG</td>
<td>2 x 3</td>
<td>0,36</td>
<td>780</td>
<td>400</td>
<td>prop.</td>
<td>8</td>
<td>3.200</td>
<td>0,1/0,15</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Dan Test</td>
<td>2,4 x 3,2</td>
<td>1,4</td>
<td>850</td>
<td>750</td>
<td>gas</td>
<td>10</td>
<td>5.220</td>
<td>0,7/1,0</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>FIRTO</td>
<td>3 x 3</td>
<td>0,38</td>
<td>2110/850/2000/80%</td>
<td>150</td>
<td>nat. gas</td>
<td>100</td>
<td>6.360</td>
<td>0,15/0,18</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>TRADA</td>
<td>3 x 3</td>
<td>1,3</td>
<td>900 (20%) 1200 (80%)</td>
<td>35 part.</td>
<td>prop.</td>
<td>10</td>
<td>5.200</td>
<td>0,5/1,2</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Warrington</td>
<td>3,0 x 3,0</td>
<td>0,92</td>
<td>850</td>
<td>400</td>
<td>nat. gas</td>
<td>14</td>
<td>0,4/0,55</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>?</td>
</tr>
<tr>
<td>YARSLEY</td>
<td>3 x 3</td>
<td>0,6</td>
<td>850</td>
<td>?</td>
<td>prop.</td>
<td>10</td>
<td>7.020</td>
<td>0,2/0,3</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>CSTB (xxx)</td>
<td>3 x 3</td>
<td>0,42</td>
<td>2.260</td>
<td>240</td>
<td>oil</td>
<td>12</td>
<td>7.000</td>
<td>no flame in the furnace</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>CTICM (u)</td>
<td>3,1 x 3,1</td>
<td>4,09</td>
<td>2.760</td>
<td>300</td>
<td>nat. gas</td>
<td>12</td>
<td>10.000</td>
<td>0,5/0,55</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>BAM</td>
<td>4,5 x 3,5</td>
<td>1,5</td>
<td>1.800</td>
<td>200</td>
<td>oil</td>
<td>6</td>
<td>?</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>?</td>
</tr>
<tr>
<td>TU Braunschweig</td>
<td>4 x 3,5</td>
<td>1,5</td>
<td>640</td>
<td>150</td>
<td>oil</td>
<td>3</td>
<td>9.030</td>
<td>0,5/0,8</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>MPA NW</td>
<td>2,9 x 2,7</td>
<td>1,84</td>
<td>2.000</td>
<td>200</td>
<td>oil</td>
<td>3</td>
<td>12.000</td>
<td>0,1/1,35</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>FMPA</td>
<td>3 x 2</td>
<td>1,5</td>
<td>?</td>
<td>?</td>
<td>oil</td>
<td>6</td>
<td>10.080</td>
<td>1,2/1,8</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>HFM</td>
<td>2 x 2,5</td>
<td>1,5</td>
<td>740</td>
<td>?</td>
<td>oil</td>
<td>8</td>
<td>5.160</td>
<td>0,75/0,75</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>CSEA Rom</td>
<td>see table 2c</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TNO</td>
<td>2 x 3</td>
<td>0,7</td>
<td>850</td>
<td>?</td>
<td>nat. gas</td>
<td>4</td>
<td>2.400</td>
<td>0,3/0,7</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

x) First value at 50%, second value at 100% of nom. capacity.
xx) At non-combustible materials.
xxx) This furnace is also used for columns, floors and beams.
xxxx) Seems to be an error.
Table 2b - Column furnace.

<table>
<thead>
<tr>
<th>Laboratory</th>
<th>size a x b (m x m)</th>
<th>height (m)</th>
<th>density of lining kg/m³</th>
<th>nr. of tests until relining</th>
<th>type of fuel</th>
<th>nr. of burners</th>
<th>nom.cap. of all b. (mj/h)</th>
<th>length of flames (m)</th>
<th>Is the fuel/air-ratio constant</th>
<th>regulated measured % av.v.</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUG</td>
<td>2.5x2.4</td>
<td>3.5</td>
<td>780</td>
<td>400</td>
<td>prop.</td>
<td>16</td>
<td>14.000</td>
<td>0.2/0.5</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>DanTest</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>FIRTO</td>
<td>1.4 Ø</td>
<td>3</td>
<td>850</td>
<td>50</td>
<td>nat.gas</td>
<td>80</td>
<td>5.088</td>
<td>0.2/0.22</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>TRADA</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Warrington</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>YARSLEY</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CSTB</td>
<td>1.54 Ø</td>
<td>3</td>
<td>2.260</td>
<td>?</td>
<td>oil</td>
<td>10</td>
<td>4.000</td>
<td>0.4/1.0</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>CITCM xxx)</td>
<td>7.75x5.75</td>
<td>3.1</td>
<td>1.000</td>
<td>90</td>
<td>oil</td>
<td>16</td>
<td>6.000</td>
<td>1.3/1.7</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>BAM</td>
<td>2x2</td>
<td>3</td>
<td>1.000</td>
<td>200</td>
<td>oil</td>
<td>4</td>
<td>?</td>
<td>0.75/20</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>TU Braunschweig</td>
<td>3.5x3.6 (x)</td>
<td>3.5</td>
<td>1.500</td>
<td>550</td>
<td>oil</td>
<td>6</td>
<td>1.8060</td>
<td>1.0/1.5</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>MPA NW</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>FMPA</td>
<td>2.3 Ø</td>
<td>3.36</td>
<td>?</td>
<td>?</td>
<td>oil</td>
<td>6</td>
<td>10.080</td>
<td>1.2/1.8</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>HFM</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CSEA Rom</td>
<td>see table 2c</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TNO</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

x) First value at 50%, second value at 100% of nom. capacity
xx) At non-combustible materials.
xxx) This furnace is also used for walls, beams and floors
(x) 3.0/6.0.
### Table 2c - Floor furnace.

<table>
<thead>
<tr>
<th>Laboratory</th>
<th>size a x b (m x m)</th>
<th>height (m)</th>
<th>density of lining kg/m³</th>
<th>nr. of tests until relining</th>
<th>type of fuel</th>
<th>nr. of burners</th>
<th>nom. cap. of all b. (MJ/h)</th>
<th>length of flames x) (m)</th>
<th>Is the fuel/air-ratio constant</th>
<th>regulated</th>
<th>(O_2)-content mea- av.v.</th>
<th>xx) At non-combustible materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUG</td>
<td>2 x 6</td>
<td>2</td>
<td>780</td>
<td>400</td>
<td>prop.</td>
<td>8</td>
<td>14.000</td>
<td>0,2/0,2</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>2-8</td>
</tr>
<tr>
<td>Dan test</td>
<td>5,1 x 2,5</td>
<td>1,3</td>
<td>850</td>
<td>750</td>
<td>gas</td>
<td>18</td>
<td>9.450</td>
<td>0,7/1,0</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>4-10</td>
</tr>
<tr>
<td>FIRTO</td>
<td>7 x 4</td>
<td>1,5</td>
<td>2.100 (650)</td>
<td>70</td>
<td>nat. gas</td>
<td>40</td>
<td>21.200</td>
<td>0,35/0,40</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>?</td>
</tr>
<tr>
<td>TRADA</td>
<td>4 x 3</td>
<td>1,5</td>
<td>900 (50%)</td>
<td>35 part prop.</td>
<td>nat. gas</td>
<td>20</td>
<td>10.300</td>
<td>0,5/1,2</td>
<td>yes</td>
<td>yes</td>
<td>6-8</td>
<td></td>
</tr>
<tr>
<td>Warrington</td>
<td>4,0 x 3,0</td>
<td>0,08</td>
<td>850 (50%)</td>
<td>100</td>
<td>nat. gas</td>
<td>14</td>
<td>6.350</td>
<td>0,4/0,55</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>?</td>
</tr>
<tr>
<td>YARSLEY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSTB</td>
<td>3,0 x 3,7</td>
<td>1,65</td>
<td>2.260</td>
<td>100</td>
<td>oil</td>
<td>2</td>
<td>12.000</td>
<td>1/2,5</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>?</td>
</tr>
<tr>
<td>CITEOM</td>
<td>3,6 x 5,6</td>
<td>3,13</td>
<td>1.000</td>
<td>?</td>
<td>?</td>
<td>8</td>
<td>6.400</td>
<td>0,9/1,1</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>10-12</td>
</tr>
<tr>
<td>BAM</td>
<td>4,0 x 4,1</td>
<td>1,5</td>
<td>1.750</td>
<td>200</td>
<td>oil</td>
<td>4</td>
<td>0,5/0,8</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>?</td>
</tr>
<tr>
<td>TU Braunschweig</td>
<td>9,5 x 4</td>
<td>1,8</td>
<td>2.000 1400</td>
<td>220</td>
<td>oil</td>
<td>14</td>
<td>42.087</td>
<td>1,0/1,5</td>
<td>yes</td>
<td>yes</td>
<td>ro</td>
<td>?</td>
</tr>
<tr>
<td>MPA NW</td>
<td>4,5 x 4</td>
<td>1,8</td>
<td>2.000</td>
<td>200</td>
<td>oil</td>
<td>3</td>
<td>12.900</td>
<td>0,8/1,35</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>5-7</td>
</tr>
<tr>
<td>FMPA</td>
<td>7,9 x 2,3</td>
<td>2,25</td>
<td>?</td>
<td>?</td>
<td>oil</td>
<td>12</td>
<td>20.160</td>
<td>1,2/1,8</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>?</td>
</tr>
<tr>
<td>HFM</td>
<td>-</td>
<td>-</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSEA Rom xxx)</td>
<td>3,0 x 6,0</td>
<td>?</td>
<td>2.000</td>
<td>500</td>
<td>oil</td>
<td>12</td>
<td>41.000</td>
<td>0,75/1,3</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>?</td>
</tr>
<tr>
<td>TNO</td>
<td>2 x 4</td>
<td>0,7</td>
<td>?</td>
<td>?</td>
<td>nat. gas</td>
<td>48</td>
<td>2.880</td>
<td>0,25/0,4</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>2-6</td>
</tr>
</tbody>
</table>

x) First value at 50%, second value at 100% of nom. capacity

xx) At non-combustible materials.

xxx) This furnace is also used for beams, walls (2,4 x 3) and columns.
Table 2d - Beam furnace.

<table>
<thead>
<tr>
<th>Laboratory</th>
<th>size a x b (m x m)</th>
<th>height (m)</th>
<th>density of lining kg/m³</th>
<th>nr. of tests until relining</th>
<th>type of fuel</th>
<th>nr. of burners</th>
<th>nom. cap. of all b. MJ/h</th>
<th>length of flames (m)</th>
<th>Is the fuel/air-ratio constant regulated</th>
<th>O₂-content measured av.v. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUG</td>
<td>2 x 6</td>
<td>2</td>
<td>780</td>
<td>400</td>
<td>prop.</td>
<td>8</td>
<td>14.000</td>
<td>0,2</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Dan test</td>
<td>5,15 x 2,5</td>
<td>8</td>
<td>850</td>
<td>750</td>
<td>gas</td>
<td>18</td>
<td>9.450</td>
<td>0,7/1,0</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>FIRTO</td>
<td>7 x 4</td>
<td>1,5</td>
<td>2.400/65% 850</td>
<td>60</td>
<td>nat. gas</td>
<td>40</td>
<td>21.200</td>
<td>0,7/1,0</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>TRADA</td>
<td>4 x ?</td>
<td>?</td>
<td>900(50%) 1200(50%)</td>
<td>35 part.</td>
<td>prop.</td>
<td>20</td>
<td>10.300</td>
<td>0,5/1,2</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Warrington</td>
<td>4,0 x 3,0</td>
<td>0,98</td>
<td>850(50%) 2050(50%)</td>
<td>100</td>
<td>nat. gas</td>
<td>14</td>
<td>6.350</td>
<td>0,4/0,55</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>YARSLEY</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CSTB</td>
<td>3 x 3,7</td>
<td>1,65</td>
<td>2.260</td>
<td>100</td>
<td>oil</td>
<td>2</td>
<td>12.000</td>
<td>1/2,5</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>CTICM xxx)</td>
<td>3,6 x 3,6</td>
<td>3,13</td>
<td>1.000</td>
<td>?</td>
<td>?</td>
<td>8</td>
<td>6.400</td>
<td>0,9/1,1</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>BAM</td>
<td>2 x 4</td>
<td>1,5</td>
<td>1.750</td>
<td>200</td>
<td>oil</td>
<td>4</td>
<td>?</td>
<td>0,5/0,8</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>TU Braunschweig</td>
<td>9,5 x 4</td>
<td>1,8</td>
<td>1.400</td>
<td>400</td>
<td>oil</td>
<td>14</td>
<td>2.087</td>
<td>1,0/1,5</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>MPA NW xxxxx)</td>
<td>4,2 x 4,0</td>
<td>2,6</td>
<td>2.000</td>
<td>200</td>
<td>oil</td>
<td>8</td>
<td>31.200</td>
<td>0,4/0,6</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>FMPA</td>
<td>7,9 x 2,3</td>
<td>2,25</td>
<td>?</td>
<td>?</td>
<td>oil</td>
<td>12</td>
<td>20.160</td>
<td>1,2/1,8</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>HFM</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CSEA Rome</td>
<td>see table 2c</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TNO</td>
<td>1,4 x 8,0</td>
<td>?</td>
<td>850</td>
<td>?</td>
<td>nat. gas</td>
<td>9</td>
<td>4.050</td>
<td>0,3/0,7</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

x) First value at 50%, second value at 100% of nom. capacity
xx) At non-combustible materials
xxx) This furnace is also used to partitions, columns and floors.
xxxx) Mainly used for floors
5. OPERATING CONDITIONS (see also tables 2a, 2b, 2c, 2d)

5.1 Heating

- As fuel natural gas, propane and oil are used. As in no lab butane is used, it seems to be reasonable to delete it from doc. 1202.
- Concerning the heat transfer with the different fuels, see the "Van Keulen" report.
- The number of burners in the same type of furnace differs very strongly (for wall furnaces between 3 and 100).
  The reason using a large number of burners is to obtain a good uniformity in furnace temperature. This however was also reached in the furnaces with a small number of burners.
- The figures given for the nominal capacity of the furnaces give no indication about the real combustible consumption, which is not measured at most laboratories.
- The expected relation between inner surface of a furnace, $O_2$ content and fuel consumption is not reflected in the figures given for maximum nominal capacity. For some figures it is evident that there are mistakes. For others one can expect that the heating capacity is too low to fulfill at the same time the requirements of $O_2$ excess, and temperature curve for specimens with high heat loss or large thermal capacity.
- In relation with the heat transfer the given values for the length of the flames and the information on the location of the burners, should be looked at. In some furnaces the specimens are heated only by hot gasses, in other furnaces they are subjected to direct radiation from long flames (max. length 2 m). For the moment being one is not in a position to estimate the possible influence of this factor on heat transfer to specimen.
- Although there is the "Van Keulen" report on heat transfer in wall-furnaces which is based on the results of a round-robin exercice, it seems to be useful to study the influence of the detailed factors which are mentioned above.
The aim of these study should be:

a) to show the possible influence of the single factors on test results;

b) to examine the necessity of closer specification of the heating conditions in a future version of doc. 1202.

- Although most furnaces are equipped with automatic temperature control, this equipment is not used and furnaces are manually controlled.

- The question concerning the constancy of fuel air ratio was answered nearly in all cases yes. As it was seen during the visit in most cases the control of fuel and air were linked but as in most laboratories, neither air and fuel consumption nor \( O_2 \)-content are measured, doubts remain within what limits constancy is obtained.

5.2 \( O_2 \)-content

- In most laboratories no equipment for \( O_2 \)-measurement is available. The given figures for \( O_2 \)-content during a test on a non-combustible material in some cases are only rough estimations (Dräger tubes, which do not measure continuously).

- In order to meet the requirement of doc. 1202 it is necessary to provide \( O_2 \)-apparatuses. Experience then will show to what extent the existing furnaces do operate at the prescribed values.

- On the basis of the existing experience it can be stated that the minimum value of 2 % (see doc. 1202) can not be satisfied by specimen of combustible materials, therefore the limits of 2 - 5 % where restricted to elements of non-combustible specimen. Experience will show later if these limits can be brought closer together.

5.3 Pressure conditions

- It is proposed to extend the pressure conditions for separating elements to all building components, taking into account the possible influence of convective heat transfer inside the cladding of protected load bearing elements.

- In some labs there are anomalies in pressure distribution near combustion gas outlets and burners. Therefore calibration tests are proposed.
in order to check the uniformity.

6. **MEASURING DEVICES** (see table 3)

6.1 **Temperature inside the furnace**

- Only in a few cases equipment was seen which allows to keep constant the distance between furnace thermocouples and specimen.

  In order to meet this requirement special arrangements have to be made and for the moment being it is not clear whether there is a significant influence as long as there is no contact between thermocouple and specimen. A change of doc. 1202 therefore was proposed, further measurements have to verify this solution.

6.2 **Pressure**

- The deflector in front of the T-shaped tube is not used in most labs because of practical problems (deformation) and because it had no significant influence.

  For the open tube it was felt that it can give different results from the T-shaped tube, therefore it is proposed that it should not be used without comparing its results with the T-shaped tube.

  Besides this it seems to be necessary to specify more clearly the location of the pressure measuring points.

- The questions concerning the time delay of pressure measurement were answered unsufficiently. The registration records with pressure pick-ups sometimes show very quick pressure changes which are not observed by slower measuring systems.

  With very quick measuring devices the differences between minimum and maximum peaks can be more than 5 Pa.

  In order to guarantee a harmonised way of working it is proposed to base furnace control on a measurement averaged over a 1 minute period.

6.3 **The temperature on non-exposed sides**

- As shown in table 3 some laboratories use only the minimum required number of thermocouples and check the hot spots with a movable thermocouple.

  Others use for this purpose a lot of additional fixed thermocouples. In order to harmonise this a more detailed specification for the different
elements is given in Part 2.

The movable thermocouples used were different in design. A standardized movable thermocouple is defined as the design has great influence on the response.

- It is felt that there is a general lack of calibration of thermocouples.

6.4 Integrity measurement

- Experience during the visits showed that as well the technique of application of the cotton pad, as the evaluation and interpretation of the results were strongly different in the labs.

  In some labs the cotton pad was only applied in front of gaps in others it is also applied in front of hot surfaces (glass) or in front of flames with a duration shorter than 10 seconds. In some laboratories only flaming of the cotton pad is considered as ignition, in others glowing is also considered as ignition (see ISO definition of ignition and combustion)

  A clearly defined specification concerning the cotton wool pad technique is therefore suggested.

- The cotton wool pad technique is not able to judge integrity in the under pressure zone of the partition. Therefore in U.K. and France an additional criterion is used, defined by maximum dimensions of the openings in Germany overpressure in the furnace is increased during short times. In Belgium the overpressure level is higher (20 Pa) and present over the whole height of a vertical specimen.

- The criterion of sustained flaming is interpreted differently in different countries. In some labs any flaming means end of integrity, in others 10 s is the minimum duration limit, in one lab 20 s.

- As this criterion strongly influences the classification of separating elements a new discussion is necessary in order to find a criterion, acceptable for all countries.

  If no agreement is possible on this point, provision has been made in the revised proposal that any flaming on the unexposed faces and its duration is reported so that reclassification in different countries is possible.
<table>
<thead>
<tr>
<th>Laboratories</th>
<th>Surface temperature</th>
<th>Furnace pressure</th>
<th>End of integrity by gases</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUG</td>
<td>10/10 yes -</td>
<td>- 1/1</td>
<td>B/B no yes no</td>
</tr>
<tr>
<td>Dantest</td>
<td>5/5 no -</td>
<td>- 1/2</td>
<td>A/B no yes no</td>
</tr>
<tr>
<td>FIRTO</td>
<td>7/7 no -</td>
<td>- 3/</td>
<td>A spec form No no no</td>
</tr>
<tr>
<td>TRADA</td>
<td>5/5 yes -</td>
<td>- 1/</td>
<td>B/B no yes 150x6 10 no</td>
</tr>
<tr>
<td>Warrington</td>
<td>7/5 yes -</td>
<td>5/3</td>
<td>A/A No no 150x6 10 no</td>
</tr>
<tr>
<td>YARSLEY</td>
<td>6. yes -</td>
<td>- 4/</td>
<td>B-/ no no 150x6 10 no</td>
</tr>
<tr>
<td>CSTB</td>
<td>6/5 no xx) yes 6/1</td>
<td>B/B no no 20-30cm&lt;sup&gt;2&lt;/sup&gt; 20 yes</td>
<td></td>
</tr>
<tr>
<td>CTICM</td>
<td>18/9 yes -</td>
<td>- 1/</td>
<td>A/A no no 60x1,5 10 yes</td>
</tr>
<tr>
<td>BAM</td>
<td>12/6 no yes 1/1</td>
<td>B/B yes yes xxx) &gt; 0 yes</td>
<td></td>
</tr>
<tr>
<td>TU Braunschweig</td>
<td>12/12 no yes 3/1</td>
<td>B/B yes yes xxx) &gt; 0 yes</td>
<td></td>
</tr>
<tr>
<td>MPA NW</td>
<td>14/10 no yes 1/1</td>
<td>A/A yes yes xxx) &gt; 0 yes</td>
<td></td>
</tr>
<tr>
<td>FMPA</td>
<td>13/10 no yes 3/1</td>
<td>B/B yes yes xxx) &gt; 0 yes</td>
<td></td>
</tr>
<tr>
<td>HFM</td>
<td>7/- no yes 3/-</td>
<td>A/- yes yes xxx) &gt; 0 yes</td>
<td></td>
</tr>
<tr>
<td>CSEA Rom</td>
<td>5/5 yes no no no</td>
<td>? ? ? ?</td>
<td></td>
</tr>
<tr>
<td>TNO</td>
<td>10/5 yes no 1/1</td>
<td>B/B no no</td>
<td>10 no</td>
</tr>
</tbody>
</table>

x) First value for walls, second value for floors.

xx) Under development.

xxx) For judging cracks in the underpressure zone, the pressure is increased for a short time to a level that in front of the crack an overpressure of about 10 Pa is realised.
6.5 Stability

From the answers on the questionnaire it appeared that the removal of the stability criterion would not cause problems in the cases of non-loadbearing elements.

In order to avoid the creation of a new classification (EI) it is suggested to combine the criterion R with the criterion E for these elements.
7. **LOADING AND END CONDITIONS**

7.1 **Loadbearing walls**

7.1.1 **Loading system (table 4)**

- In all laboratories a hydraulic system is used for the load application on walls and partitions.

- Mostly a single load distribution beam is applied so that the total load (for partitions) is equally divided over the different load bearing studs. Only some laboratories apply several short distribution beams, each of them transmitting the force of one ram.

  This raises the question of the test load: is the total load determined by the number of studs multiplied by the load per stud or, is it defined by the load per meter multiplied by the width of the partition. Both approaches can conduct to very different load levels besides the differences in national design codes.

  For purposes of harmonization a single load distribution beam over the whole width of the specimen is suggested. This does not cover particular cases where the studs of a partition are unequally loaded.

- The stiffness of the frame has to be considered in direct relation with the load level and therefore a maximum deflection criterion by maximum load, at least for the horizontal members of the frame, has to be established (see C.T.I.C.M.). In the new draft a value of 1/600 for deformation under design load therefore is proposed.

- A similar requirement has to be established concerning a possible partial rotation of the load distribution beam on the vertical members.

- It is observed that very different load capacities (from 8 T to 400 T) are available, linked to very different speeds of the ram: from 0.7 mm/s to 25 mm/s. This can have a minor influence on the stability with a quickly deflecting specimen at the end of the test.

- There is a general and very important uncertainty about the overall accuracy of the load applied to the specimen in most laboratories!

  This is due to one or more of the following facts:
1°/ The measurement, and mostly also the monitoring of the load level during the test is based on a measuring device, the accuracy of which in general is only estimated. A variety of different types of apparatuses are used.

2°/ With exception for load cells, positioned between load distribution beam and specimen, "sensors" are more or less remote from the specimen and subject to faulty measurements caused by friction and/or pressure drop between measuring point and specimen.

3°/ It is astonishing how few information is available in most laboratories about the extent of friction losses in their loading systems.

4°/ A low stiffness of some frame members, together with excentrical loading or specimen deformation can cause jamming of the load distribution beam and hence an uncontrolled increase or decrease of the load.

5°/ Calibration of the loading system in general is insufficient. The use of load cells between specimen and load distribution beam, or at least as close as possible to the specimen, seems necessary. Besides that it is necessary to use frames and loading equipment with minimum friction. This friction should be established with load cells by loading and unloading of the specimen in cold state. It was not possible to propose a generally applicable solution on the basis of the visits, because the loading system is closely linked to the design of the furnace.

- The question of monitoring the load was not understood properly: it is not clear whether all laboratories do keep constant either the load or the position of the load distribution beam. The latter choice provides an increasing load with thermal dilatation of the specimen.

From the answers it appears that some laboratories have automatic control over the load level (by keeping the oil pressure constant), others have manual control. Usually monitoring is done on the basis of the same measuring instrument as used for the initial application of the load.
| 4 Table 4 - Load-bearing Walls: Loading System |
|-----------------|-----------------|-----------------|-----------------|
| **Rams**        | **Load Distribution Beam** | **Stiffness of Frame** | **Position of Floating Beam** |
| Lab.             | Kind of Beam     | Stiffness (%)    | Position of Beam |
|                 |                  |                  |                  |
| R.U.G.           | one beam or one  | High             | Top              |
| DANTEST         | one beam         | Medium           | Top              |
| FIRTO           | two beams        | Very Low         | Bottom           |
| TRADA           | one beam         | Low              | Top              |
| WARR.           | one beam         | Medium           | Bottom           |
| C.S.T.I.C.H.    | one beam         | High             | Bottom           |
| C.T.I.C.H.      | two beams        | Low              | Top              |
| T.U.B.          | two beams        | Medium           | Bottom           |
| M.P.A.          | one beam         | High             | Top              |
| C.S.E.A.        | one beam         | Very High        | Top              |
| T.N.O.          | one beam         | High             | Top              |

<table>
<thead>
<tr>
<th><strong>Load Level</strong></th>
<th><strong>Load Speed Capacity (Ton)</strong></th>
<th><strong>Monitoring the Load Level</strong></th>
<th><strong>Acquisition Type</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000</td>
<td>100</td>
<td>Manual meter</td>
<td>HYDRAULIC</td>
</tr>
<tr>
<td>2,000</td>
<td>200</td>
<td>Manual meter</td>
<td>ELECTRIC</td>
</tr>
<tr>
<td>3,000</td>
<td>300</td>
<td>Manual meter</td>
<td>HYDRAULIC</td>
</tr>
<tr>
<td>4,000</td>
<td>400</td>
<td>Manual meter</td>
<td>ELECTRIC</td>
</tr>
</tbody>
</table>

*Note: Load cells and pressure gauges are used for monitoring the load level.*
7.1.2 Mechanical end conditions (table 5)

- It appears that similar as for non-load-bearing walls and partitions also for load-bearing ones the end conditions with both vertical edges free do not necessarily give the worst results.
  Changement of doc. 1202 in this respect should be discussed.

- Concerning the mechanical end conditions at top and bottom of walls and load-bearing partitions, a distinction must be made between the possibility of rotation and translation for the load distribution beam and for the other horizontal members on the one hand, and for the horizontal edges of the specimen on the other hand.

- The possibility of (partial) rotation and/or (partial) translation of the horizontal members is dependant on the stiffness of the complete frame, on the stiffness of the individual frame members and on the concept of the system.

- The lack of precise answers in the questionnaire show the lack of consciousness in several laboratories concerning this aspect of the mechanical end conditions.
  The influence of this point has already been discussed under § 2.

- The positioning of the walls or partitions against load-distribution beam and against the horizontal members are mostly realised "like in practice" i.e. simply in contact with the frame member for walls and sometimes with top and bottom profile screwed for a partition.

  As the fixing of top and bottom can influence the static system (buckling length), in the new doc. a strict requirement is introduced that this has to be done like in practice.

- It has to be noted that in several laboratories the way of mounting (mechanical and thermal end conditions) for walls (concrete and masonry) is different from the way of mounting for load-bearing partition.

  This is partially due to the different practical problems related with a low level of loading for partitions (up to 20 T) from the high load level for walls (i.e. up to 400 T).

- The figures given in the table have to be considered rather as the interpretation of the authors than as precise answers from the laboratories.
7.1.3 Thermal end conditions (table 5)

- As it can be seen from the table the thermal end conditions in most laboratories are already satisfied. Exposure of all four edges of a load-bearing wall is important. For bottom and top, reduced heat attack can influence E and I. For the vertical edges reduced thermal attack can increase R. Therefore clear specifications are given in Part II.

- The heat loss to the frame at top and bottom of the specimen is influenced by the thermal characteristics of the frame. Therefore a rough specification is introduced in Part II. ($q = 2.0 +/- 0.5 \text{ kg/m}^3$). 

-25-
<table>
<thead>
<tr>
<th>Laboratory</th>
<th>Mechanical-Frame</th>
<th>Mechanical-Specimen</th>
<th>Thermal end conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Upper member</td>
<td>Lower member</td>
<td></td>
</tr>
<tr>
<td></td>
<td>yes part.</td>
<td>no no</td>
<td>Free deflection</td>
</tr>
<tr>
<td>RUG</td>
<td>yes no</td>
<td>no no</td>
<td>yes S.P.</td>
</tr>
<tr>
<td></td>
<td>no no</td>
<td>no no</td>
<td>practice</td>
</tr>
<tr>
<td></td>
<td>no no</td>
<td>yes yes</td>
<td>yes yes (?) yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>yes Fixed/Fixed</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>yes yes</td>
<td></td>
</tr>
<tr>
<td>DANTEST</td>
<td>no no</td>
<td>no no</td>
<td>yes yes yes</td>
</tr>
<tr>
<td>FIRTO</td>
<td>no no</td>
<td>yes practice</td>
<td>? yes yes ?</td>
</tr>
<tr>
<td>TRADA</td>
<td>yes part.</td>
<td>no part.</td>
<td>yes S.P /SP</td>
</tr>
<tr>
<td>WARR.</td>
<td>no no</td>
<td>yes Fixed/Fixed</td>
<td>yes yes yes</td>
</tr>
<tr>
<td>CSTB</td>
<td>no no</td>
<td>no no</td>
<td>no yes yes</td>
</tr>
<tr>
<td>CTICM</td>
<td>yes yes</td>
<td>no no</td>
<td>fixed/(x)</td>
</tr>
<tr>
<td>T.U.B.</td>
<td>part. no</td>
<td>no no</td>
<td>yes yes yes</td>
</tr>
<tr>
<td>M.P.A.</td>
<td>part. part.</td>
<td>yes SP/fixed</td>
<td>no yes yes</td>
</tr>
<tr>
<td>FMPA</td>
<td>part. part.</td>
<td>only 1 side fixed/</td>
<td>yes yes yes</td>
</tr>
<tr>
<td>CSEA</td>
<td>yes part.</td>
<td>part. no</td>
<td>yes/S.P.</td>
</tr>
<tr>
<td>NO</td>
<td>no no</td>
<td>no no</td>
<td>Fixed/yes</td>
</tr>
</tbody>
</table>

(x) Not clear from questionnaire (no or incomplete answer)

S.P. : Simply put.
7.2 **Floors (table 6)**

7.2.1 **Loading system**
- In several labs the loading system used for floors depends on the type of floor and the magnitude of the load.
- As can be seen from the table the loading system in the different laboratories is quite different. This concerns as well the number of loading points as the contact surface. Especially for dead loads the contact surface, which should characterise the thermal influence seems insufficient to characterise it. In C.S.T.B. nearly the total specimen surface is covered although the contact surface is only 0.3%. A solution is presented by limiting the surface of the horizontal projection of the loading points.
- For hydraulic load system A a multipivoted pyramidal load distribution system is necessary in order to guarantee a well defined equal load distribution. In this respect line loads have to be excluded.
  
  This was introduced in the new doc.
- The relation between the size of loading spots and the thickness of the floor seems unreasonable because especially thin floors are weak in relation with high local load concentrations, therefore the corresponding requirement of doc. 1202 was replaced by fixed values of surface area.
- During the visits it appeared that the load distribution did not provide statically equivalent loading (maximum loading moment and maximum shear forces).
  
  The text of the revised doc. has been closer specified.

7.2.2 **End conditions**
- In the discussion it appeared that the end conditions with floors supported at two sides do not give necessarily the worst results.
  
  A changement of doc. 1202 in this respect (3 sides fixed edges in practice) should be discussed.
- In most laboratories free deflection is guaranteed but the thermal elongation in several laboratories is partially prevented by friction. In part II of the revised doc. a rolling support on one side is introduced mandatory.
### Table 6: FLOORS - LOADING SYSTEM AND END CONDITIONS.

<table>
<thead>
<tr>
<th>Laboratory</th>
<th>Load system h=hydraul., d = dead</th>
<th>Loading Nr. of load. points per m²</th>
<th>Contact surface of floor (%)</th>
<th>Max. load capacity (t)</th>
<th>Speed of rams (mm/s)</th>
<th>Distance (cm) between furnace wall and end of specimen</th>
<th>End conditions</th>
<th>Free elongation of specimen</th>
<th>Free deflection of specimen</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUG</td>
<td>h</td>
<td>2 line loads/12</td>
<td></td>
<td>10</td>
<td>30</td>
<td>2,5</td>
<td>0</td>
<td>30</td>
<td>friction</td>
</tr>
<tr>
<td></td>
<td>d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Dantest</td>
<td>h</td>
<td>2 line loads/13</td>
<td></td>
<td>4</td>
<td>20</td>
<td>5</td>
<td>30</td>
<td>40</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>d</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>yes</td>
<td>yes</td>
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<tr>
<td>FIRTO</td>
<td>d</td>
<td></td>
<td></td>
<td>?</td>
<td>10</td>
<td>-</td>
<td>0</td>
<td>25</td>
<td>friction</td>
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<td></td>
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<td></td>
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<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>TRADA</td>
<td>d</td>
<td>variable</td>
<td></td>
<td>-</td>
<td>10</td>
<td>-</td>
<td>0</td>
<td>10</td>
<td>friction</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>yes</td>
<td>?</td>
</tr>
<tr>
<td>Warrington</td>
<td>h</td>
<td>16</td>
<td></td>
<td>1,3</td>
<td>45</td>
<td>10</td>
<td>10</td>
<td>20</td>
<td>friction</td>
</tr>
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<td></td>
<td>d</td>
<td>variable</td>
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<td>-</td>
<td>2,1</td>
<td>-</td>
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<td></td>
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<td>yes</td>
</tr>
<tr>
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<tr>
<td>CSTB</td>
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<td></td>
<td>0,3</td>
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<td>-</td>
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<td>h</td>
<td>2 line loads/12</td>
<td></td>
<td>?</td>
<td>220</td>
<td>?</td>
<td>?</td>
<td>?</td>
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</tr>
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<td>h</td>
<td>8 lines/16</td>
<td></td>
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<td>120</td>
<td>5</td>
<td>35</td>
<td>?</td>
<td>friction</td>
</tr>
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<tr>
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<td>h</td>
<td>4 line loads/16</td>
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<td>6</td>
<td>-</td>
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<td>50</td>
<td>yes</td>
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<td></td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CSEA Rom</td>
<td>h</td>
<td>3 line loads/18</td>
<td></td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>40</td>
<td>50</td>
<td>friction</td>
</tr>
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</tr>
<tr>
<td>TNO</td>
<td>h</td>
<td>1</td>
<td></td>
<td>8</td>
<td>20</td>
<td>15</td>
<td>&lt; 10</td>
<td>&lt; 20</td>
<td>yes</td>
</tr>
</tbody>
</table>

- **Laboratory**: The laboratories involved in the testing.
- **Load system h=hydraul., d = dead**: The type and number of loads applied to the floor.
- **Loading Nr. of load. points per m²**: The number of load points per square meter.
- **Contact surface of floor (%)**: The percentage of the contact surface of the floor.
- **Max. load capacity (t)**: The maximum load capacity in tons.
- **Speed of rams (mm/s)**: The speed of the rams in millimeters per second.
- **Distance (cm) between furnace wall and end of specimen**: The distance between the furnace wall and the end of the specimen in centimeters.
- **End conditions**: Conditions at the end of the specimen, including friction and elongation.
- **Free elongation of specimen**: Whether the specimen has free elongation.
- **Free deflection of specimen**: Whether the specimen has free deflection.
Great differences have been observed concerning the unheated ends of the floors. As this can have great influence maximum values have been introduced.

7.3 **Beams (table 7)**

Most of the remarks made for floors are also applicable for beams, especially the problem of the cold edges.

7.3.1 **Loading system**
- Except in TRADA all Laboratories used hydraulic loading systems.
- In some Laboratories it was noted that in the load distribution system no provision is made to avoid changes in the loading system when the specimen deforms (elongation and deflection). Thus additional horizontal components are created.

The load distribution system must be isostatic by design. A requirement in this direction is introduced in Part II.

- In two labs the topping of the beam was cast in one block and was more or less fixed to the beam with anchors. By this arrangement the topping will overtake at least an undeterminate part of the load bearing function.

In part IIa a detailed description and mandatory requirement for the topping are introduced.

This concerns also the nature of the topping in relation with the heat loss.

Composite floor-beam elements are tested in the same way as floors without additional topping.

- During the visits, no problems with torsional deformation or lateral buckling were observed.

If torsional deformation or a lateral buckling in a test on a single beam are expected provision like in practice can be made in order to avoid this. The load applied during the test shall be adopted accordingly (composite structure).

7.3.2 **Heating conditions**
- Care must be taken that for beams exposed at three sides, the vertical sides are fully exposed over the total height.
<table>
<thead>
<tr>
<th>Laboratory</th>
<th>Nr. of loading points</th>
<th>Loading capacity (t)</th>
<th>Speed of rams (mm/s)</th>
<th>Topping thickness (cm)</th>
<th>Topping nature</th>
<th>can it follow deformation</th>
<th>Distance between furnace wall and support (cm)</th>
<th>End conditions</th>
<th>free elongation of specimen</th>
<th>free deflection of specimen</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUG</td>
<td>2-4</td>
<td>80</td>
<td>2,5</td>
<td>10-80</td>
<td>gas-concrete</td>
<td>yes</td>
<td>15</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Dan test</td>
<td>-</td>
<td>20</td>
<td>5</td>
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<td>FIRTO</td>
<td>4</td>
<td>4,5</td>
<td>?</td>
<td>12,8</td>
<td>concrete</td>
<td>yes (x)</td>
<td>12,5</td>
<td>20</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>TRADA</td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Warrington</td>
<td>4</td>
<td>45</td>
<td>25</td>
<td>13</td>
<td>concrete</td>
<td>yes (x)</td>
<td>30</td>
<td>40</td>
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</tr>
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<td>friction</td>
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</tr>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>?</td>
<td>?</td>
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<tr>
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<td>no detailed informations</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>TU Braunschweig</td>
<td>4</td>
<td>120</td>
<td>6</td>
<td>12,5</td>
<td>gas-concrete</td>
<td>yes</td>
<td>37,5</td>
<td>50</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>MPA NW</td>
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<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>FMPA</td>
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<td>100</td>
<td>?</td>
<td>12,5</td>
<td>gas-concrete</td>
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<td>12,5</td>
<td>21,5</td>
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<td>yes</td>
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<td>-</td>
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</tr>
<tr>
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<td>?</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>40</td>
<td>50</td>
<td>friction</td>
</tr>
<tr>
<td>TNO</td>
<td>4</td>
<td>20</td>
<td>13</td>
<td>&lt; 10</td>
<td>&lt; 20</td>
<td>yes</td>
<td>yes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(x) See comment
7.4 Columns (table B)

- In most laboratories the stiffness of the frame seemed sufficient at least in one direction but there were great differences in the end conditions and the way of mounting the specimen. Especially the possibility of rotation or restrained are not fully defined in most cases.

- Where the possibility of rotation is intended, this was not fully achieved and the same is valid for end restrained.

Concerning clearly defined end conditions a statement is made in doc. 1202. However it is considered that this aim cannot be achieved without important and expensive changements of the equipment. The consequence of the existing differences are judged of great influence on the measured R values, because it influences strongly the buckling length of the specimen, and by this the load bearing capacity.

- An other point of similar importance is the axially, resp. excentricity of the load. By excentric loads, bending moments and torsions are introduced which will cause an earlier failure.

Only in two labs there were special means to guarantee exact excentricity, in one other lab a well defined excentricity was applied in order to meet excentricities which occur in practice and in order to improve the reproductibility during the tests. For harmonization purpose it is absolutely necessary to give clear instructions on this. In the revised doc. therefore it is suggested to check the situation before each test by using straingauges. An alternative solution could be to impose the maximum excentricity allowed for centrically loaded columns and to describe the way how to achieve this.

- It was questioned whether in all cases testing of the two static systems will provide results relevant to practice.

In the revised document it is suggested to check which of the two static systems will give the worst results and not to carry out the other test. An other suggestion was to make a general choice for the static system for the test. T.N.O. offered to prepare a document providing the theoretical background for this choice.
Differences of 0 to 0.6 m were observed between heated length and calculation length, the calculation length being defined as the length between hinges and restrained ends.

It is expected that this causes great differences in R-values. Also this problem can not be solved without important changes to the equipment.

In addition also the heat loss of the column ends to the surrounding (e.g.) concrete blocks, steel plates, unheated column ends was different.

The above-mentioned points show that for columns harmonization is restricted by the differences in the existing equipments.

Comparable results can only be expected by identical furnaces and loading equipments. It is therefore suggested to prepare a design of a furnace which should be followed when new furnaces are built.
<table>
<thead>
<tr>
<th>Laboratory</th>
<th>Max. load capacity (t)</th>
<th>Speed of rams (mm/s)</th>
<th>Heated length minus calculation length (m)</th>
<th>Heated length of frame minus calculation length (m)</th>
<th>Stiffness of frame length H/L</th>
<th>Ends restraint/rotation top</th>
<th>Ends restraint/rotation bottom</th>
<th>Speed of rams (mm/s)</th>
<th>Heated length minus calculation length (m)</th>
<th>Heated length of frame minus calculation length (m)</th>
<th>Stiffness of frame length H/L</th>
<th>Ends restraint/rotation top</th>
<th>Ends restraint/rotation bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUG</td>
<td>400</td>
<td>1.2</td>
<td>3</td>
<td>3.86</td>
<td>H/L</td>
<td>H</td>
<td>H.L</td>
<td>1.2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TU Braunschweig</td>
<td>400</td>
<td>6</td>
<td>-</td>
<td>-</td>
<td>WH</td>
<td>WH</td>
<td>WH</td>
<td>7</td>
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<td>-</td>
</tr>
<tr>
<td>HFP</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
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<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
</tbody>
</table>

TABLE 8: COLUMNS - LOADING SYSTEM AND END CONDITIONS

- VH very high
- H high
- M medium
- L low
- only in one direction
- high in one direction, low in the other
8. TEST LOAD (see table 9)

It is evident that the test load has an important influence on the fire resistance time of a load bearing element.

In most laboratories the test loads are calculated following national design codes. Therefore differences between these codes influence the test load and hence the test result. It is out of the scope of this study to compare the national design codes.

Nevertheless it seemed to be usefull to have some comparative data on the loading calculations.

Therefore the laboratories have been asked to give the calculations of the test load for four load bearing elements.

The elements were:

a) a steel beam - simply supported;
b) steel column - one end hinged, the other end fully restrained;
c) steel column - both ends fully restrained;
d) timber stud wall.

With the exception of Italy answers were received from all the participating countries. The data are summarized in table 9.

For the steel beam the table shows neglectable differences between the test load calculated.

For the steel columns the test loads calculated show differences up to about 200 kN on a test load of app. 1 000 kN.

Extreme great differences are found for the timber stud wall.

It is noted that in some countries the contribution of the lining materials are not taken into account by the calculation of the test load of a timber stud wall. Besides, the situation in Denmark - a great difference between calculated load and test load in practice - is of interest. From this simple investigation on test loads can be learned that full harmonization of fire resistance test requires prior harmonization of design codes within the EEC.

However, according to the statement in § 5.2 of the revised document 1202 the test results are applicable with the limitation to the load applied during the test.

This has to be mentioned expressively in the test report.
Table 9. Summary answers received on questionnaire concerning test load on a beam, column, and partition.

<table>
<thead>
<tr>
<th>Country</th>
<th>Test load in kN</th>
<th>Calculation method</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Steel columns</td>
<td>Wooden partition</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3m HEB 180</td>
<td>3m HEB 180</td>
<td></td>
</tr>
<tr>
<td>Belgium</td>
<td>991 kN</td>
<td>1063 kN</td>
<td>33.4 kN/m²</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>960 kN</td>
<td>1030 kN</td>
<td>37 kN/m²</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>England</td>
<td>970 kN</td>
<td>1019 kN</td>
<td>37.7 kN/m²</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>1140 kN</td>
<td>1198 kN</td>
<td>34 kN/m²</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>969 kN</td>
<td>1136 kN</td>
<td>34.1 kN/m²</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Netherlands</td>
<td>1042 kN</td>
<td>1147 kN</td>
<td>34.1 kN/m²</td>
</tr>
<tr>
<td>Minimum value</td>
<td>960 kN</td>
<td>1019 kN</td>
<td>33.4 kN/m²</td>
</tr>
<tr>
<td>Maximum value</td>
<td>1140 kN</td>
<td>1198 kN</td>
<td>34.1 kN/m²</td>
</tr>
</tbody>
</table>

Construction partition: Studs 60x100mm distance between centres 600mm. Particle board 16 mm on both sides.

No design code available for timber structures. Load on request of sponsor.

Columns and beams DS 412 and 410 in practice 10-40% of design load normally (7-26 kN/m²).


Calc. acc. Fègles de calcul des constructions en acier.

Columns and beam DIN 1050.

Partition DIN 1052 (nail distance 40 mm).


Diameter nails Φ 4 mm.
9. CRITERIA AND APPLICATION OF TEST RESULTS

9.1 Criteria

For load bearing elements which are subjected to bending two different deformation criteria are given for stability.

The one is for simply supported elements, the other for hyperstatic elements. A criterion imposed to avoid a special danger in practice cannot be dependend on the statical system. Therefore it should be considered to apply the same deflection criterion (either deflection rate or a maximum deflection) for both cases.

9.2 Extrapolation

The existing document 1202 does not contain explicitly information on extrapolation and interpolation of test results.

Implicitly extrapolation is allowed by the regulation concerning size of specimen: the requirement to choose a height and width of 3 m for a wall specimen if it is in practice greater, implies an unlimited possibility to extrapolate the dimensions to a greater height.

This requirements excludes as well the possibility of extrapolation to lower dimensions as the possibility of any extrapolation from specimens which have lower dimensions than 3 m x 3 m.

From a technical point of view it seems not acceptable to use this extrapolation rule without limitation.

So one cannot accord the same classification to elements with essential higher dimensions than the tested element.

It is clear that for practical reasons extrapolation of test results is necessary.

These extrapolation rules should cover the field of higher and lower dimensions.

In some countries extrapolation rules exist for some elements and these rules are different from country to country.

For trade, harmonization in this field, is of the same importance as harmonization of the test method.

This work is not covered by this document. It will require an extensive study. In the opinion of the authors it should be started with a detailed questionnaire on the existing extrapolation rules and habits...
in the different countries covering all possibilities of extrapolation
e.g. dimensions, load, massivity factor, etc.

In the light of the above mentioned problems the following points
should be discussed:

- non-load bearing walls and partitions: limitation of the
  extrapolation to a greater height;

- for load bearing elements: the extrapolation limitations should
take into account the static system and the load level;

- extrapolation of steel columns and beams to other profiles the
  massivity factor must be taken into account.
A basic requirement for international acknowledgement of test results is that the test reports contain all necessary information in an understandable and harmonized way. Therefore the actual way of drafting test reports by the different laboratories was compared.

A survey of these reports has been given in table 10. Special attention was given to the following points:

a) description of the test specimen (including drawings and details);
b) information on material properties;
c) description of thermal and mechanical end conditions;
d) test load and its calculation;
e) test procedure;
f) observations during and after the test.

The results of the study have been summarized in the tables 11-15.
<table>
<thead>
<tr>
<th>Country</th>
<th>Name of Laboratory</th>
<th>Beam</th>
<th>Column</th>
<th>Floor or Roof</th>
<th>Non load bearing wall/partition</th>
<th>Load bearing wall/partition</th>
<th>Other Items</th>
</tr>
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<td>X</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>BAM</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>TU-Braunschweig</td>
<td>X</td>
<td>X</td>
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<tr>
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<td>MPA-MM</td>
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<td>H.P.M.</td>
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<td>F.H.P.A.</td>
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<td>CSEA</td>
<td>X</td>
<td>X</td>
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<td>TNO</td>
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### Table 11A. Summary of reports on beams

<table>
<thead>
<tr>
<th>Name of laboratory</th>
<th>Specimen</th>
<th>Construction of specimen</th>
<th>Material properties</th>
<th>End conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Description</td>
<td>drawings</td>
<td>details</td>
</tr>
<tr>
<td></td>
<td></td>
<td>density</td>
<td>relative</td>
<td>thickness</td>
</tr>
<tr>
<td>RUG</td>
<td>Protected steel beam</td>
<td>Missing: way of fixing of the protection cladding (sprayed, by hand etc.) scatter in thickness of the protection.</td>
<td>not given</td>
<td>not given</td>
</tr>
<tr>
<td>TU Braun-</td>
<td>Protected steel beam</td>
<td>sufficient</td>
<td>sufficient</td>
<td>sufficient</td>
</tr>
<tr>
<td>Warrington</td>
<td>unprotected steel beam</td>
<td>sufficient</td>
<td>sufficient</td>
<td>sufficient</td>
</tr>
<tr>
<td>CSTB</td>
<td>Protected steel beam</td>
<td>sufficient</td>
<td>sufficient</td>
<td>sufficient</td>
</tr>
<tr>
<td>CSEA</td>
<td>Special roof beam</td>
<td>poor</td>
<td>dimensions insufficient</td>
<td>given</td>
</tr>
</tbody>
</table>

See also next page for table 11 B.
<table>
<thead>
<tr>
<th>Name of laboratory</th>
<th>Specimen</th>
<th>Testload</th>
<th>Test method</th>
<th>Observations and Measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RUG</td>
<td>Protected steel beam</td>
<td>Calculation of testload</td>
<td>Loadsystem diagram</td>
<td>Time temp. curve or temp.distr. curve within furnace</td>
</tr>
<tr>
<td></td>
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<td></td>
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</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>TU Braunschweig</td>
<td>Protected steel beam</td>
<td>acc. to German standard DIN 1050 Last Fall H = 160 N/mm². Calculation is missing</td>
<td>No detailed description or drawing</td>
<td>No data concerning time temperature curve in report</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warrington</td>
<td>Unprotected steel beam</td>
<td>Complete calc. given in report</td>
<td>No detailed description or drawing</td>
<td>Mean furn. temp. given in diag. not given in the report</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSTB</td>
<td>Protected steel beam</td>
<td>Calc. of test load not given in report</td>
<td>No detailed description or drawing</td>
<td>All thermocouple readings given in a diagram</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>CSEA</td>
<td>Special roof beam</td>
<td>tested unloaded</td>
<td>not applicable</td>
<td>Mean furn. temp. given in report</td>
</tr>
<tr>
<td>Name of lab.</td>
<td>Construction of specimen</td>
<td>Material properties, Measured values on day of test</td>
<td>End conditions</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------</td>
<td>---------------------------------------------------</td>
<td>---------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Drawings</td>
<td>Details</td>
<td>Protecting materials</td>
</tr>
<tr>
<td>RUG</td>
<td>sufficient</td>
<td>suff.</td>
<td>missing joints between rockwool plates</td>
<td>given</td>
</tr>
<tr>
<td>FIRTO</td>
<td>sufficient</td>
<td>suff.</td>
<td>given</td>
<td>given</td>
</tr>
<tr>
<td>BAM</td>
<td>sufficient</td>
<td>suff.</td>
<td>given</td>
<td>given</td>
</tr>
<tr>
<td>FMPA</td>
<td>sufficient</td>
<td>suff.</td>
<td>given</td>
<td>given</td>
</tr>
<tr>
<td>CSEA</td>
<td>sufficient</td>
<td>suff.</td>
<td>missing way in which paint is applied</td>
<td>not applicable</td>
</tr>
<tr>
<td>CSTB</td>
<td>extensive</td>
<td>suff.</td>
<td>not applicable</td>
<td>given</td>
</tr>
<tr>
<td>CTICM</td>
<td>suff.</td>
<td>suff.</td>
<td>given</td>
<td>not given</td>
</tr>
</tbody>
</table>

Table 12A
Summary of test reports on columns

See also next page for table 12 B.
<table>
<thead>
<tr>
<th>Name of lab.</th>
<th>Specimen</th>
<th>Calculation of test load</th>
<th>Test method</th>
<th>Control of furnace temp.</th>
<th>Observation and measurements</th>
<th>Other remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUG</td>
<td>protected steel column</td>
<td>given in rep. acc. to NBN 657.001</td>
<td>not given</td>
<td>200 Pa not given</td>
<td>measured with B thermocoup, results in a diagram</td>
<td>Steel temp. only measured in the middle part of column and not in upper and lower part.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FIRTO</td>
<td>protected steel column</td>
<td>given in rep. acc. to BS 449: part 2: 1969 effective length 0.71 eulor.</td>
<td>only a diagram mean furnace temp, in the report</td>
<td>10 to Pa diagram given in the report</td>
<td>measured with B thermocoup, mean and max. temp, given in the report</td>
<td>Reloading after 24 hours. Persons who witnessed the test are mentioned in the report.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSTB</td>
<td>steel column protected with intumescent paint</td>
<td>only calc. meth. given in the report.</td>
<td>furn. temp. given in a diagram (all readings)</td>
<td>10 to Pa diagram given in the report</td>
<td>measured with B thermocoup, diagram with all readings in the report</td>
<td>given in a diagram</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTIICM</td>
<td>protected steel column only main points of the calc. are given</td>
<td>furnace temp. given in a diagram (all readings)</td>
<td>10 to Pa diagram given in the report</td>
<td>10 to Pa diagram given in the report</td>
<td>measured with B thermocoup, diagram with all readings in the report</td>
<td>given in a diagram</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BAM</td>
<td>rectangular steel column filled with concrete</td>
<td>not given in the report</td>
<td>Furnace temp. given in (mean value and individual readings)</td>
<td>not given</td>
<td>measured with B thermocoup, temp. in a diagram</td>
<td>given in a diagram</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FMPA</td>
<td>protected steel column</td>
<td>the main points of the calc. are given</td>
<td>Furnace temp. given in a diagram (mean value and individual)</td>
<td>10 Pa at 0.75 m from top column</td>
<td>measured with B thermocoup, diagram with all readings in the report</td>
<td>recorded during whole heating</td>
</tr>
<tr>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>CSEA</td>
<td>steel column protected with intumescent paint</td>
<td>not given in the report</td>
<td>Furnace temp. given in a diagram (only mean value)</td>
<td>not given</td>
<td>measured with B thermocoup, results in a diagram</td>
<td>not given</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name of lab.</td>
<td>Specimen</td>
<td>Construction of the specimen</td>
<td>Material properties on day of test</td>
<td>End conditions</td>
<td>Mechanical</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>----------</td>
<td>-------------------------------</td>
<td>----------------------------------</td>
<td>----------------</td>
<td>------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Description</td>
<td>Drawings</td>
<td>Details</td>
<td>Density</td>
<td>Humidity</td>
</tr>
<tr>
<td>RUG</td>
<td>wall of aerated concrete blocks</td>
<td>suff.</td>
<td>suff.</td>
<td>suff.</td>
<td>not given</td>
<td>not given</td>
</tr>
<tr>
<td>Dantest</td>
<td>timber stud wall</td>
<td>suff.</td>
<td>insuff.</td>
<td>Horiz.- vertical joint is not clear.</td>
<td>given</td>
<td>not given</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trade</td>
<td>timber stud wall</td>
<td>suff.</td>
<td>suff.</td>
<td>suff.</td>
<td>not given</td>
<td>only a drying time of 4 weeks is mentioned</td>
</tr>
<tr>
<td>CSTB</td>
<td>Wall of concrete blocks</td>
<td>suff.</td>
<td>suff.</td>
<td>suff.</td>
<td>not given</td>
<td>drying time of 344 days is mentioned</td>
</tr>
<tr>
<td>TNO</td>
<td>timber stud wall</td>
<td>suff.</td>
<td>suff.</td>
<td>suff.</td>
<td>given</td>
<td>-</td>
</tr>
</tbody>
</table>

See also next page for table 13B.
<table>
<thead>
<tr>
<th>Name of lab</th>
<th>Test load</th>
<th>Load system</th>
<th>Test method</th>
<th>Time temperature curve</th>
<th>Integral curve of pressure content</th>
<th>Furnace pressure losses</th>
<th>Furnace temp. control</th>
<th>Observations and measurements</th>
<th>Other remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>Centr. loading: $f = 400 \text{Pa}$</td>
<td>not given</td>
<td>not given</td>
<td>not given</td>
<td>not given</td>
<td>not given</td>
<td>not given</td>
<td>not given</td>
<td>no data concerning furnace temperature.</td>
</tr>
<tr>
<td>Rug</td>
<td>Centr. loading: $f = 400 \text{Pa}$</td>
<td>given in report</td>
<td>not given</td>
<td>not given</td>
<td>not given</td>
<td>given in a diagram</td>
<td>not given</td>
<td>no sufficient</td>
<td>Furnace temperature is not measured in the report.</td>
</tr>
<tr>
<td>Denmark</td>
<td>Centr. loading</td>
<td>not given</td>
<td>not given</td>
<td>not given</td>
<td>not given</td>
<td>not given</td>
<td>not given</td>
<td>not given</td>
<td>no data concerning furnace temperature.</td>
</tr>
<tr>
<td>RUG</td>
<td>Centr. loading</td>
<td>given in report</td>
<td>not given</td>
<td>not given</td>
<td>given in a diagram</td>
<td>not given</td>
<td>not given</td>
<td>no sufficient</td>
<td>Furnace temperature is not measured in the report.</td>
</tr>
<tr>
<td>England</td>
<td>Centr. loading</td>
<td>not given</td>
<td>not given</td>
<td>not given</td>
<td>not given</td>
<td>not given</td>
<td>given in appendix</td>
<td>not given</td>
<td>Furnace temperature is not measured in the report.</td>
</tr>
<tr>
<td>France</td>
<td>Centr. loading</td>
<td>not given</td>
<td>not given</td>
<td>not given</td>
<td>not given</td>
<td>given in a diagram</td>
<td>not given</td>
<td>not given</td>
<td>Furnace temperature is not measured in the report.</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Centr. loading</td>
<td>not given</td>
<td>not given</td>
<td>not given</td>
<td>not given</td>
<td>given in a diagram</td>
<td>not given</td>
<td>not given</td>
<td>Furnace temperature is not measured in the report.</td>
</tr>
<tr>
<td>Specimen</td>
<td>Specimen description</td>
<td>Material properties on day of test</td>
<td>Test conditions</td>
<td>Thermal</td>
<td>Mechanical</td>
<td>Construction of the specimen</td>
<td>Test Specimen</td>
<td>Vertical edges</td>
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<tr>
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<td>------------</td>
<td>-----------------------------</td>
<td>---------------</td>
<td>---------------</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>A symmetrical partition</td>
<td>Not given</td>
<td>-</td>
<td>Not given</td>
<td>Not given</td>
<td>Not given</td>
<td>-</td>
<td>RUG</td>
<td>The 4-sides fixed as in practice to the inner side of a concrete test frame</td>
</tr>
<tr>
<td>2</td>
<td>Non-load bearing wall made of blocks</td>
<td>Not given</td>
<td>-</td>
<td>Not given</td>
<td>Not given</td>
<td>Not given</td>
<td>-</td>
<td>FIRTO</td>
<td>The 4-sides fixed as in practice to the inner side of a concrete test frame</td>
</tr>
<tr>
<td>3</td>
<td>Sandwich panel (concrete and polystyrene core)</td>
<td>Symmetrical partition</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>WARRINGTON</td>
<td>The 4-sides fixed as in practice to the inner side of a concrete test frame</td>
</tr>
<tr>
<td>4</td>
<td>Symmetrical partition</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>VARIOUS</td>
<td>The 4-sides fixed as in practice to the inner side of a concrete test frame</td>
</tr>
<tr>
<td>5</td>
<td>Symmetrical partition</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>CSTB</td>
<td>The 4-sides fixed as in practice to the inner side of a concrete test frame</td>
</tr>
<tr>
<td>6</td>
<td>Symmetrical partition</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>CSB</td>
<td>The 4-sides fixed as in practice to the inner side of a concrete test frame</td>
</tr>
<tr>
<td>7</td>
<td>Symmetrical partition</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>MPA-U</td>
<td>The 4-sides fixed as in practice to the inner side of a concrete test frame</td>
</tr>
<tr>
<td>8</td>
<td>The 4-sides fixed as in practice to the inner side of a concrete test frame</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>MB-SCHWEIG</td>
<td>The 4-sides fixed as in practice to the inner side of a concrete test frame</td>
</tr>
<tr>
<td>9</td>
<td>Symmetrical partition</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>Extensive</td>
<td>CSEA</td>
<td>The 4-sides fixed as in practice to the inner side of a concrete test frame</td>
</tr>
</tbody>
</table>

See also next page for table 14 B.
<table>
<thead>
<tr>
<th>Name of Laboratory</th>
<th>Test method</th>
<th>Time temperature curve</th>
<th>Tolerance temp. distr. within furnace</th>
<th>Integral curve</th>
<th>Furnace pressure</th>
<th>O₃ content of furnace</th>
<th>Observations and measurements</th>
<th>Measurements</th>
<th>Other remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUG</td>
<td>No data concerning furnace temperature given in report</td>
<td>20 ± 5 Pa</td>
<td>Not given</td>
<td>Not given</td>
<td>Unexposed side: extensive</td>
<td>Only average temp. rise unexposed face given in a diagram</td>
<td>Missing: reason why only one test is carried out on an asymmetrical partition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FORTD</td>
<td>Average furnace temp. given in diagram</td>
<td>Not given</td>
<td>Not given</td>
<td>Not given</td>
<td>Extensive</td>
<td>Maximum and mean temp. rise unexposed side given in a diagram</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WARRINGTON</td>
<td>Diagram and table given</td>
<td>Given</td>
<td>Main points given in table</td>
<td>Not given</td>
<td>Not given</td>
<td>Extensive</td>
<td>Maximum and mean temp. rise unexposed side given in a diagram</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PARSLEY</td>
<td>Diagram with readings</td>
<td>Not given</td>
<td>Not given</td>
<td>From 10°C to the end of the test 18 Pa</td>
<td>Not given</td>
<td>Sufficient</td>
<td>All readings of thermo-couples fixed to the unexposed face given in a diagram</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSTB</td>
<td>Diagram with all readings</td>
<td>Not given</td>
<td>Not given</td>
<td>Diagram pressure between 25 Pa and +10°C</td>
<td>Not given</td>
<td>Sufficient</td>
<td>All readings of thermo-couples fixed to the unexposed face given in a diagram</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STICM</td>
<td>Diagram</td>
<td>Not given</td>
<td>Not given</td>
<td>Given in a diagram (25 Pa)</td>
<td>Not given</td>
<td>Sufficient</td>
<td>All readings of thermo-couples fixed to the unexposed face given in a diagram</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZIEGELBRAUNSCHWEIG</td>
<td>Diagram</td>
<td>Not given</td>
<td>Not given</td>
<td>10 Pa</td>
<td>Not given</td>
<td>Extensive</td>
<td>All readings of thermo-couples fixed to the unexposed face given in a diagram</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPA-NW</td>
<td>Table</td>
<td>Not given</td>
<td>Not given</td>
<td>Given in a table (10 Pa)</td>
<td>Not given</td>
<td>Extensive</td>
<td>Thermo-couple readings and deformation measurements given in a table</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIAPA</td>
<td>Diagram with all readings</td>
<td>Not given</td>
<td>Not given</td>
<td>10 ± 2 Pa</td>
<td>10 ± 2 Pa</td>
<td>Short</td>
<td>All readings of thermo-couples fixed to the unexposed face given in a diagram</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEA</td>
<td>Average furnace temp. given in a diagram</td>
<td>Not given</td>
<td>Not given</td>
<td>Not given</td>
<td>Not given</td>
<td>Short</td>
<td>All readings of the 5 thermo-couples fixed to the unexposed face given in a diagram</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tested was only a panel and not a partition (missing vertical joint)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 15a Summary of test reports on floors

<table>
<thead>
<tr>
<th>Name of Laboratory</th>
<th>Specimen</th>
<th>Construction of specimen</th>
<th>Test specimen</th>
<th>Material properties</th>
<th>Test conditions</th>
<th>Thermal properties</th>
<th>End conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUS</td>
<td>Floor consisting of prefabricated floor slabs</td>
<td>Extensive Sufic.</td>
<td>Sufic.</td>
<td>Only composition of concrete is given</td>
<td>Not given</td>
<td>Not given</td>
<td>Not given</td>
</tr>
<tr>
<td>DANTEST</td>
<td>Roof consisting of prefabricated elements</td>
<td>Sufficient Sufic.</td>
<td>Sufic.</td>
<td>Not given Not given</td>
<td>Not given</td>
<td>6050 mm</td>
<td>Each shorter side a strip with a width of 50 - 100 mm</td>
</tr>
<tr>
<td>FIERD</td>
<td>Concrete floor</td>
<td>Sufficient Sufic.</td>
<td>Sufic.</td>
<td>Given in a drawing Measured moist concrete content concrete 28 days compressive strength, with steam, furnace bell properties</td>
<td>4000x3000 mm</td>
<td>Each shorter side a strip with a width of 140 mm</td>
<td>Elongation partly restrained by friction</td>
</tr>
<tr>
<td>TRADA</td>
<td>Timber floor ceiling construction</td>
<td>Sufficient Sufic.</td>
<td>Sufic.</td>
<td>Grade of timber given, Composition of ceiling materials known by the laboratory</td>
<td>Not given</td>
<td>Not given</td>
<td>Not given</td>
</tr>
<tr>
<td>CSTB</td>
<td>Floor (steel beams concrete slab) with ceiling</td>
<td>Sufficient Sufic.</td>
<td>Sufic.</td>
<td>No restrained Not given Not given</td>
<td>Not given</td>
<td>3740x3020</td>
<td>Total area of ceiling directly heated</td>
</tr>
<tr>
<td>WASHINGTION</td>
<td>Concrete PFloor (with corrugated steel plates)</td>
<td>Extensive Sufic.</td>
<td>Sufic.</td>
<td>Given in a drawing way of drying given (natural and forced) mass of drying sample given</td>
<td>2710 x 4200 mm</td>
<td>Each shorter side a strip with a width of 150 mm</td>
<td>Unclear</td>
</tr>
<tr>
<td>ZEICH</td>
<td>Floor with prefabricated prestressed concrete beams</td>
<td>Extensive Sufic.</td>
<td>Sufic.</td>
<td>Given in a drawing Cub strength given concrete content concrete 28 days compressive strength, with steam, furnace bell properties Not given.</td>
<td>4600 x 3140 mm</td>
<td>Each shorter side a strip with a width of 150 mm</td>
<td>Unclear</td>
</tr>
<tr>
<td>NYDBRAIN - SCHNEIS</td>
<td>Timber floor</td>
<td>Extensive Sufic.</td>
<td>Sufic.</td>
<td>Given in a drawing Grade of timber given</td>
<td>4000 x 3060 mm</td>
<td>Total area of ceiling directly heated</td>
<td>Unclear</td>
</tr>
<tr>
<td>WUK-MK</td>
<td>Floor (steel beams + concrete slab) with ceiling</td>
<td>Extensive Sufic.</td>
<td>Sufic.</td>
<td>Given Not given Not given Not given</td>
<td>4000 x 2000 mm</td>
<td>Total area of ceiling directly heated</td>
<td>Steel beams supported on a wall</td>
</tr>
<tr>
<td>CREA</td>
<td>Prefabricated concrete floor</td>
<td>Short Sufic.</td>
<td>Sufic.</td>
<td>Not given Not given Not given</td>
<td>Not given</td>
<td>Not given</td>
<td>Not given</td>
</tr>
<tr>
<td>eng</td>
<td>Timber floor ceiling construction</td>
<td>Sufficient Sufic.</td>
<td>Sufic.</td>
<td>Only mentioned Not given Not given a drying time of 8 weeks</td>
<td>Not given</td>
<td>Not given</td>
<td>Mentioned in report</td>
</tr>
<tr>
<td>Name of Laboratory</td>
<td>Test load</td>
<td>Test method</td>
<td>Observations and Measurements</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------</td>
<td>-------------</td>
<td>------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RUG</td>
<td>Not given (test load according to an equally loaded 0.3kN/m²)</td>
<td>Not given</td>
<td>Sufficient (Diagram: Temp. unexposed face elongation deflection)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DANTEST</td>
<td>Given according to DIN 1051</td>
<td>System given in principle (two line loads)</td>
<td>Sufficient (Diagram: Temp. unexposed face deflection)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FERTO</td>
<td>Not given (load as requested by sponsor)</td>
<td>Dead load (distribution given on a photograph)</td>
<td>Sufficient (Diagram with unexposed steel and concrete temp. deflection)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRABA</td>
<td>Given (Maximum stresses acc. CP 112)</td>
<td>Not given (Average furnace temp. given in a diagram)</td>
<td>Short (Max. temp. unexposed face in a diagram decreased in table)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WARRINGTON</td>
<td>Given in an appendix (photographs)</td>
<td>Diagram and table (Given)</td>
<td>Extensive (Diagram: Temp. unexposed face temp. steel reinforcement temp. concrete deflection)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSTB</td>
<td>Not given, only mentioned amount and distribution of test load</td>
<td>Diagram with all readings</td>
<td>Sufficient (Diagram: Temp. unexposed face temp. steel temp. cavity temp. cement temp. deflection)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTIEC</td>
<td>Not given (two line loads)</td>
<td>Given in a diagram (S-15Pa)</td>
<td>Sufficient (Diagram with unexposed face temp. distribution inside specimen)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TU- BRAUNSCHWEIG</td>
<td>Principles given</td>
<td>Dead load</td>
<td>Extensive (Two tests are carried out)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPA-MW</td>
<td>Calculation not given (Amount of load and bending stresses in steel beams given)</td>
<td>Not given</td>
<td>Extensive (Table with temp. Two tests of unexposed face are carried out with a toppling of several concrete)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSEA</td>
<td>Not given (Only mentioned: a maximum bending moment)</td>
<td>Average furnace temp. given in a diagram</td>
<td>Short (Diagram with unexposed face temp.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TNO</td>
<td>Given (concrete tiles)</td>
<td>Diagram and table</td>
<td>Extensive (Table and diagram unexposed face temp. cavity temp. deflection)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The following points can be listed:

a) In most reports the specimen is described sufficiently, however there is an important lack of information on material properties.
b) Thermal and mechanical end conditions are described insufficiently, especially the supports of loadbearing elements.
c) Test load
   In most of the reports the load is given.
   Four ways of reporting the load appear:
   1. the full calculation;
   2. only the national design code with which the test load is calculated;
   3. the test load as determined by the sponsor;
   4. just the amount of load.
d) Test procedure
   Most reports contain a diagram with the actual furnace temperature (in most cases a copy of the original record paper).
   Only a few reports mention if the prescribed furnace temperature tolerances are satisfied.
   Most reports do not give the measured values but only mention the required overpressure in the furnace.
   No report contains data concerning O₂-content in the furnace.
e) Observations and measurements
   Nearly all reports contain sufficient observations concerning the behaviour of the exposed and unexposed face of the test specimen during heating.
   In most reports the results of the measurement are given in diagrams in some reports in tables. Nearly all reports contain the unexposed surface temperatures, measured by fixed thermocouples. Results of a movable thermocouple are in no reports.
   Most test reports contain diagrams or tables with the following deformation data:
   Column : elongation
   Floors : deflection in the centre
   Load bearing walls : deflection in the centre
The study lead to the conclusion that there is a lack of information in the existing test reports mainly concerning:

- material properties (density, humidity and mechanical properties on day of test);
- thermal and mechanical end conditions;
- calculation of test load;
- results of measurements of furnace conditions: temperatures, overpressure, $O_2$- content;
- results obtained by a movable thermocouple.

By including a chapter 3 with standard test reports in the revised version of document 1202 the above mentioned points were covered.

At the end of each standard test report a chapter 8 "Remarks" was introduced. On this chapter guidelines in relation with the applicability (extrapolation rules, limitation or restrictions, special warnings, etc.) shall be given.
11. **FINAL CONCLUSIONS**

The study carried out has shown a serie of points which have to be harmonized in order to achieve international acknowledgement of test results.

A lot of work remains to be done in respect of harmonization of load calculation and in respect of extrapolation of test results.

The outcome of this work is a revised version of doc. 1202 containing 3 parts:

- **Part I** giving the general outline of the procedure
- **Part II** giving particular rules for testing different elements:
  - non-load bearing walls/partitions
  - load bearing walls/partitions
  - columns
  - floors
  - beams
- **Chapter 3** giving standard test reports for these elements.

The work didn't cover particular types of constructions e.g.:
external walls with particular end conditions, floors with special end conditions.

The scope of doc. 1202 is actually restricted to the above mentioned types of elements.

On the basis of chapter 1 of the revised doc. 1202 the field of application can be extended to other elements (e.g. door assembly) which are especially subject to trade.

It appeared that due to the continuous evolution in building concepts in the daily testing work always new problems arise which have to be solved in a harmonized way. It seems therefore necessary to continue harmonizing by installing regular meetings of the concerned laboratories in the course of which new problems can be solved. A similar way of operating is already established in the U.K. and Germany with good success.

Work remains to be done in respect of harmonization especially concerning extrapolation rules.

Full harmonization for load bearing elements requires also harmonization of the load calculation and the measurements of material properties. This is outside the scope of this study.
PART II

TESTING AND CLASSIFICATION OF THE RESISTANCE TO FIRE OF STRUCTURAL BUILDING COMPONENTS
Chapter 1

SECTION I : SCOPE

1. This document concerns the testing and classification of the fire-resistance of structural building components.

SECTION II : FIELD OF APPLICATION

2. This document is applicable to:

- load-bearing walls or load-bearing partitions*
- non-load-bearing walls or non-load-bearing partitions*
- simply supported floors (with or without ceilings **) with fire attack from the underside only ***
- columns
- simply supported beams.

This document provides no extrapolation rules. The use of the test results may therefore be restricted to the elements tested (see comments on extrapolation). Additional tests and/or requirements may be necessary e.g. in order to check the adhesive quality of claddings, or to meet corrosion problems. The document is not applicable to other building elements than those listed above. The fire-resistance classification by testing of other types of building components requires specific provisions which shall be dealt with in each case by special Documents or annexes to this Document.

Warning:
* This document is intended for walls and partitions with fire from one side only. It does not cover walls and partitions with fire attack from both sides nor the parts containing doors, glazings and installation penetrations (ventilation ducts, pipes, cables). External walls can be included with fire attack from inside as far as the end conditions can be reproduced by the test arrangement following Chapter 2.

** Tests following this document do not determine the contribution
of the suspended ceilings to the fire resistance of a floor construction.

*** In some cases fire attack from the upperside can give a lower fire-resistance.
SECTION III : TEST EQUIPMENT

3.1. Furnace.

The furnace is capable of subjecting a specimen to the standard conditions specified in Chapter 1 Section 5 and Chapter 2. A specification of constructional details of the furnaces is not possible for the moment being (see footnote).

(i) The design of the furnace shall be such that the temperature conditions as given in § 5.1.1. are respected.

(ii) The design must also provide:
   - for horizontal elements, a uniform static pressure in a plane 100 mm below the element;
   - for vertical elements, a linear pressure gradient over the whole height and a uniform pressure over the width.

(iii) One of the following fuels must be used: light heating oil, natural gas, propane, town gas with calorific value about 14.7 Mj/m3.

Footnote:

- The existing furnaces are different in form, size and lining material used. It is recommended to follow the ISO directive (under development) on this subject.

- For the moment being the only advice given in ISO 834/1975 Amendment 2 (1980) is the following: "It is recommended that primarily new furnaces, and existing furnaces when repaired, should mainly be lined with materials having a minimum thickness of 50 mm and a thermal inertia (CVkpc at 773 K not greater than 600 W s$^{1/2}$/mK. Such refractory lining materials are readily available in the form of fibrous bats, solid blocks and castable material".
3.2. Loading equipment.

The test component can be loaded either by applying dead loads or by the use of a hydraulic system or other mechanical system.

The loading equipment must not affect essentially the heat transfer through the test component nor the measurement with the cotton pad or the thermocouples.

Devices must be provided for maintaining the constancy and the distribution of the load throughout the test.

Details of loading equipment are given in Chapter 2.

3.3. Equipment for monitoring furnace operating conditions.
3.3.1. Furnace temperature.
3.3.1.1. Furnace thermocouples.

Specifications:

- Bare wire thermocouples of wire diameter not less than 0.75 mm and not more than 1.5 mm shall be used. The hot junction shall be welded.

- The wires of the thermocouples shall enter in open tubes of heat-resistant material, for example porcelain, approximately 25 mm from the hot junction (Fig. 1).

- Sheathed or other thermocouples may be used provided that they have the same reading and response time as those of (the above mentioned) bare wire thermocouples.

- The overall accuracy of the temperature measurements shall be better than ± 10 °C.

Location:

- At the beginning of the test, the hot junction is at 100 mm from the test specimen.

Even at deformation of the specimen during the test the distance
between specimen and thermocouples shall be between 50 and 150 mm.

**Number:**

- For each type of building component the number of thermocouples required is specified in Chapter 2.
Fig. 1 - Bare wire thermocouple for measuring furnace temperature

Fig. 2 - Pressure sensor
3.3.2. **Furnace overpressure**

3.3.2.1. **Equipment for measuring overpressure in the furnace**

The static pressure in the furnace must be determined by a T-shaped pressure sensor as detailed in Fig. 2. The device shall be constructed of steel tubes. The internal diameter of the tubes must be not less than 5 mm and not more than 10 mm.

A simple stainless steel tube of 5–10 mm diameter or other systems may be used provided that it is checked that the results of this measurement are comparable with those obtained with the T-tube.

The accuracy of the overpressure measurement shall be better than $\pm 1$ Pa. If quick measuring devices are used the furnace control is based on readings averaged over a 1 minute period.

3.3.2.2. **Location of sensor**

The overpressure must be measured and checked at two points:

(a) in the case of horizontal components, both in a plane at 100 mm from the lower surface of the test component;

(b) in the case of vertical components, both located at a height of approximately three-quarters of the height of the test specimen, and for walls and partitions, at a distance of 100 mm from the specimen.

3.3.3. **Oxygen content**

The test equipment must include a device for measuring the oxygen content of the atmosphere in the furnaces.

Measurements may be taken either continuously or at intervals of not more than five minutes, the gases being sampled in the overpressure zone of the furnace. This measurement must be performed with an accuracy of $\pm 0.5$ % oxygen.
Fig. 3

Heat resistant steel holder

Twin-bore porcelain insulator

0.05 mm thick copper disc

Roving thermocouple measuring junction

Insulation pad bonded to surface of specimen. No adhesive between copper disc and specimen surface, nor between copper disc and insulation pad.

Asbestos pad 2 mm thick
Copper disc 12 mm diameter 0.2 mm thick

Electrical insulation of thermocouple

Elevation unexposed surface thermocouple

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3.4. Equipment for measuring the behaviour of the test element.

3.4.1. Temperature of unexposed side.

(a) **Fixed thermocouples**:

Surface temperatures of test specimens shall be measured by means of thermocouples with a wire diameter of not more than 0.7 mm. Each thermocouple junction shall be soldered to the centre of the face of a copper disk 12 mm in diameter and 0.2 mm thick, which is fixed to the surface of the specimen at the required position. The accuracy of the thermocouple reading shall be better than ± 2°C. For the fixed thermocouples the disks shall be covered with overdry square asbestos pads 30 mm x 30 mm and 2 mm thick. The asbestos material shall have a density of 900 kg/m\(^3\) ± 10 % at 100 °C and a thermal conductivity of 0.13 W.m\(^{-1}\).oc\(^{-1}\) at 100°C (Fig. 3). Instead of the asbestos pad a non-combustible asbestos free material with similar characteristics can be used (such as "NEFALITH 16"). The thermocouples are fixed to the specimen before the test and as follows:

- The copper disk shall be held against the specimen surface by the asbestos pad. The pad is glued to the surface with a suitable adhesive, avoiding the presence of any glue between copper disk and specimen and between copper disk and pad.

Instead of gluing the pad, other suitable means like pins, springs, screws, etc... can be used, depending on the nature of the specimen surface. Care shall be taken not to cover the back side of the pad in front of the copper disk.

- In order to get representative measurements, thin decorative surface finishings which tend to loose contact with the specimen during the test have to be removed at the location of the fixed thermocouples (e.g. p.v.c. -folies).

(b) **Movable thermocouples**:

The design of the movable thermocouple is also given in Fig. 3.
Fig. 4 -

Section A-A

handle

100

0.5

1.0

clip opened

cotton pad

100 x 100 mm

weight: 3.4 g
3.4.2. Integrity.

The cotton-wool pad, measuring approx. 100 mm x 100 mm x 20 mm, must consist of new cotton fibres, soft and undyed, without any admixture of artificial fibres.

It shall have a mass between 3 and 4 g. The pad shall be conditioned by drying in an oven at 100 ± 5°C for at least 0.5 h.

It must be attached by metal clips to a 100 mm x 100 mm frame made of steel wire 1 mm in a diameter secured to a suitable handle.

The design of the cotton pad holder is given in Fig. 4.

3.4.3. Deformation measurement.

Information about the location of measuring points and intervals for deformation measurements are given in Chapter 2.

The accuracy of the deformation measurement shall be better than ± 1.0 mm.

The method of measurement must not affect the extent of deformation.
SECTION IV : TEST SPECIMEN

4.1. Construction.

The test shall be made on a test specimen representative of the complete element of construction on which information is required. Each type of element requires a different approach. Detailed specifications are given in Chapter 2 for the different test elements.

The material and standard of workmanship of the test specimen shall be representative of those applying in good practice, as defined by existing national codes and standards.

For load-bearing elements, the constituent materials of the specimen shall have a mechanical strength close to that expected for a similar element in service.

Relevant actual material properties and dimensions must be determined, in accordance with national standards, by the laboratories or on its request, by another laboratory independent of the sponsor. The samples for strength determination must be identical to the test construction and conditioned in the same way to correspond to the material properties of the test construction.

4.2. Number of tests.

The number of tests is depending on the element and the results of the tests. It is specified in Chapter 2.

4.3. Dimensions.

The test specimen should be full-size.
Where this is not possible the specimen shall have the size as specified in Chapter 2.

4.4. Mounting and end conditions.

Mounting and end conditions should be as in practice.
The practical situation however varies from building to building and is usually not known. Some practical situation cannot be realised in the existing furnaces. For these reasons standards conditions are defined in Chapter 2, which cover the different practical situations as far as possible.

Non-load-bearing elements must not be subjected to any static load, except such stresses as produced by the fixing devices, and the thermal elongation of the specimen during the test.
4.5. Conditioning.
The test specimen shall be conditioned in such a way that it corresponds as closely as possible, in temperature, moisture content and mechanical strength, to the expected state of a similar element in service.
The test specimen shall not be tested until its moisture content is in dynamic equilibrium (*) with an ambient atmosphere approximating to that expected in service. This dynamic equilibrium shall be checked either on the test specimen itself or on a representative sample.
The moisture content of the principal materials of the element shall be measured at the time of the test.
The components may be dried either naturally or artificially.
If dried naturally, they must be stored in an atmosphere kept constant at 27°C ± 15°C measured on a dry thermometer, and at a relative humidity of 40 to 65%.
If drying is performed artificially in the laboratory, care must be taken not to reach a temperature that affects the fire-resistant properties of the components. It is recommended that a temperature of 65°C is not exceeded, for gypsum: 42°C.
If the drying time required in order to arrive at a satisfactory moisture content of the test component is too long, the following times should be adopted for natural drying:

- concrete density $\leq 2000$ kg/m$^3$ = 200 days (**)
- concrete density $\geq 2000$ kg/m$^3$ = 100 days
- masonry = 100 days
- claddings applied by moistening = 50 days

Should the product embody synthetic products or resins for which the level of conditioning (e.g., the degree of polymerization) is critical, the applicant or the manufacturer of the component must specify the moment at which stabilization is achieved.

* As normal moisture content inside buildings can be considered: concrete: 3 percent, masonry: 5 percent, timber: 12 percent. Conditioning for other materials shall follow the recommendations of manufacturers.
**Some types of light weight concrete loose their moisture very slowly.
Section V : TEST PROCEDURE

5.1. Furnace conditions.

5.1.1. Temperature

The temperature of the furnace thermocouples shall be measured at intervals not greater than 2 minutes.

By definition the furnace temperature $T$ is the mean of the temperatures recorded by the furnace thermocouples. This temperature must be controlled so that it varies with time, within the limits defined below, according to the following equation:

$$ T - T_0 = 345 \log_{10} (8t + 1) $$

where

$t$ is the time in minutes;

$T$ is the temperature of the furnace at time $t$, expressed in degrees Kelvin;

$T_0$ is the initial temperature of the furnace expressed in degrees kelving.

The above equation gives the values shown in the table below.

Table 1: Rise in the furnace temperature as a function of time.

<table>
<thead>
<tr>
<th>Time $t$ (Mins.)</th>
<th>Rise in furnace temperature $T - T_0$ (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>556</td>
</tr>
<tr>
<td>10</td>
<td>659</td>
</tr>
<tr>
<td>15</td>
<td>718</td>
</tr>
<tr>
<td>30</td>
<td>821</td>
</tr>
<tr>
<td>60</td>
<td>925</td>
</tr>
<tr>
<td>90</td>
<td>986</td>
</tr>
<tr>
<td>120</td>
<td>1 029</td>
</tr>
<tr>
<td>180</td>
<td>1 090</td>
</tr>
<tr>
<td>240</td>
<td>1 133</td>
</tr>
<tr>
<td>360</td>
<td>1 193</td>
</tr>
</tbody>
</table>

The curve representing this function—known as the "temperature/time curve"—is given in Fig. 5.
Fig. 5 - Temperature/time curve
Tolerances.

(a) Deviation of $T - T_0$ from the specified curve.

- This deviation is given as a percentage by the following expression:

$$\frac{A - B}{B} \times 100$$

where:

- $A$ is the integral of the average furnace temperature $T - T_0$, expressed as a function of time, and calculated on the basis of measurement taken with intervals not greater than 2 minutes.
- $B$ is the integral of $T - T_0$ determined by the equation given under 5.1.1. above.

- The deviation must be within the following tolerance limits:
  - $\pm 15\%$ during the first 10 minutes of the test period.
  - $\pm 10\%$ between the 10th and the 30th minute.
  - $\pm 5\%$ after the 30th minute.

(b) Uniformity of furnace temperature.

- At no time after the first 10 minutes of the test period the temperature recorded by any of the thermocouples may deviate from the specified furnace temperature $T$ by more than 100 K.

- In the case of structural components containing combustible materials which flame on the exposed surface, none of the thermocouples may show a deviation of more than 200 K.

5.1.2. Oxygen-content

The oxygen-content of the atmosphere in the furnace during the test, must be measured at intervals not exceeding 5 minutes. The burners must operate at constant fuel/air ratio so that the $O_2$ content with a specimen of non-combustible material is between 2 % and 5 % in volume.

Note: During tests with specimens of combustible material the $O_2$ can fall below 2 %.
5.1.3. **Pressure conditions.**

For all building elements, after the first five minutes, an overpressure of $10 \text{ Pa} \pm 2 \text{ Pa}$, measured as specified in § 3.3.2. at intervals not exceeding 5 minutes, shall exist in the furnace during the whole heating period.

The uniformity of the pressure inside the furnace has to be checked in a calibration test. For horizontal elements in the plane 100 mm below the specimen, for vertical elements along the line as specified in § 3.3.2.2. the pressure variation must be within tolerances of $\pm 2 \text{ Pa}$.

**Warning:** strong local pressure drops can occur near burners, gas outlets, etc.

For vertical elements, overpressure shall exist over at least the upper two thirds of the height of the specimen.

5.2. **Loading.**

The test load shall be determined on the basis of one of the two ways explained in § 5.2.1. and § 5.2.2.

The testing laboratory shall report clearly the basis on which the choice has been made and give full details as required in Chapter 3. Where the test load under 5.2.2. is less than the calculated load under 5.2.1., this shall be clearly stated as restricting the applicability of the test results.

5.2.1. **Calculated test load.**

(a) **Steel- and concrete elements.**

The load is calculated on the basis of the actual (see § 4.1) properties of materials* and the load factors given in rules or standards. If necessary the maximum allowable deflection is also taken into account.
(b) **Timber elements**

In the case of timber elements the test load is calculated on the basis of the permissible stresses and E-modulus belonging to the grade of wood used in the construction.* If necessary the maximum allowable deflection is also taken into account.

5.2.2. **Specified test load**

Specified test load is the load specified by the sponsor on the basis of the use of the element in a building for which loading levels are specified in a code. This specified load shall be adjusted if the actual material properties of the specimen exceed the minimum guaranteed value. This can be neglected for timber elements.

5.2.3. **Application of the test load.**

In a fire resistance test, a uniformly distributed load can be simulated by a number of equal, statistically equivalent spot loads. Details for different types of elements are given in Chapter 2.

- The load must be applied not less than 30 minutes before the thermal attack. Before starting the fire test, stabilization of the deformation of the supports and load equipment must be achieved.

- The level and distribution of the load must be kept constant.

- The overall accuracy of the load level shall be better than +5%. It shall be monitored continuously.

- For details on the application of loading see also Chapter 2.

(*) This grading should follow national codes or standards but a detailed description of the timber in terms of the criteria used for the grading has to be given in the test report.
5.3. Measurements on test specimen.

5.3.1. Temperature.

5.3.1.1. Temperature of the unexposed surface of test components by means of fixed thermocouples.

- The temperatures on the unexposed surface of test components shall be measured at intervals not exceeding 2 minutes by applying thermocouples as specified in chapter 3.4.1. to the surface of the test component.
- Details concerning the location of fixed thermocouples for the different types of elements are given in Chapter 2.
- There it is also specified which of the fixed thermocouples are taken into account for calculation of the mean temperature of the unexposed surface.

5.3.1.2. Temperature of the unexposed surface by means of a movable thermocouple.

The temperature must, furthermore, be measured at any point which seems to attain the highest temperature at any given time during the test. This temperature shall be measured either by means of additional fixed thermocouples and/or the movable thermocouple as defined in § 3.4.1.

A particularly critical area is the periphery of the component; hence the temperature must be measured as close to the edge of the specimen as specified in Chapter 2.

Other critical areas are joints and the bottom of corrugated surfaces: their temperature is measured as specified in Chapter 2, if the dimensions of the movable thermocouples allow it.

5.3.1.3. Temperatures inside the test component.

Temperatures inside the test specimen are measured by means of thermocouples with a wire diameter of not more than 0.7 mm. Each
junction shall be soldered or welded. A suitable way of fixing shall be chosen in function of the application. The wires of the thermocouples for measuring the temperature inside the test specimen should follow the isotherm through the hot junction as closely as possible for a distance of at least 25 mm, starting from the junction.
5.3.2. **Integrity.**

(i) Any flaming on the unexposed face of the specimen and its duration have to be recorded.

(ii) The cotton pad, shall be held for 30 seconds (unless it ignites earlier) at a distance of 20-25 mm from any opening on the unexposed side, and places where flames, even of shorter duration, occur.

The time and position at which the cotton-wool first ignited must be recorded. The pad must not be re-used.

**Note:**

Ignition of the cotton pad includes glowing as well as flaming (both during application and after removal) of the pad (see ISO definition: combustion with emission of visible light).

Charring of the pad without glowing does not mean ignition.

5.3.3. **Deformation and load-bearing capacity.**

Where the rate of deformation is a performance criterion, (beams, floors and columns) the deformation at the points specified in Chapter 2 must be measured and recorded at intervals of 1 minute, for other elements at intervals not exceeding 5 minutes.

For a load-bearing wall or partition, the time at which the specimen collapses (i.e. when it can no longer support the test load) shall be measured.

5.4. **Other observations during the test.**

Throughout the test, observations shall be made of all changes and occurrences which are not criteria of performance but which are relevant for the behaviour in fire, including for example, the emission of smoke or other vapours at the unexposed face of a separating element and the formation of openings and cracks and their size. Nevertheless, combustibility of these gases has not to be checked by a pilot flame. Where possible the following properties and characteristics shall also be noted during the whole test period:
(a) deformation which can facilitate an analysis of the structural
    behaviour of the element and an application of the test results;

(b) other phenomena which are of importance for the load-bearing
    capacity of the element, such as cracking, splitting and structural
    transformation of materials;
(c) the temperature distribution in the interior of the test specimen in
    such a manner that it provides a satisfactory basis for estimating
    the function and the behaviour of the specimen during the test.

5.5. Duration of test.

The test is continued until one or more performance criteria are no
longer satisfied, except other agreement with the sponsor. It shall be
terminated earlier in case of danger.

1. The fire-resistance of a building component shall be expressed as a function of the time during which that component, under the given thermal and mechanical conditions can perform its function.

   This function shall be assessed in accordance with the following performance criteria:
   
   - stability (R)
   - integrity (E)
   - thermal insulation (I).

2. The fire-resistance of a building component shall be expressed in minutes. This shall be the number of minutes rounded down to the whole number closest to the result of the experimental measurement.

3. Performance criteria - Definition:

   (i) **Stability "R"** - only applicable for load-bearing structures. Depending on the type of element and the use for which it is intended, it will be considered to have failed:
   - when it collapses, or
   - when its rate of deformation exceeds the value given in Chapter 2, or

   **Note:**
   For non-load-bearing structures R is deemed to be satisfied as long as E is satisfied.

   (ii) **Integrity "E"** - only applicable to elements with separating function. The test component shall be considered to have failed when the cotton pad referred to in § 5.3.2. ignites, or when sustained flaming (*) of the specimen occurs (see § 5.3.2.).

   (*) Flames of 10 s. duration without interruption are deemed to be sustained.
(iii) Thermal insulation "I" - only applicable for elements with separating function.

The test element shall be considered to have failed when
(a) the average temperature of the non-exposed surface
   exceeds by more than 140 K the initial average temperature;
(b) the maximum temperature of the unexposed surface exceeds by
   more than 180 K the initial average temperature;
(c) the criteria E or R are reached.

6.2. Classification.

If more than one test had to be carried out (see Chapter 2), the classification shall be based on the worst result. The classification shall be expressed in the following form:

R.E.I. -time : Time during which all three criteria stability, integrity and thermal insulation are satisfied.
R.E. -time : Time during which the two criteria stability and integrity are satisfied.
R. -time : Time during which the criterion of stability is satisfied.

The time is expressed in one of the following figures:
15, 30, 45, 60, 90, 120, 180, 240, 360.

The measured time is rounded down to the abovementioned figures. Thus the following classes are defined: REI 15, REI 30, REI 45, ... RE 15, RE 30, ... R 15, R 30 ... .

So a building element with a stability of 155 minutes, an integrity of 80 minutes and a thermal insulation of 42 minutes is classified as follows: REI 30
RE 60
R 120
SECTION VII : TEST REPORT

1. A test report, the detailed contents of which are described in Chapter 3, shall be drawn up in respect of each building element subject to classification.

2. The heading of the report must indicate that the test was carried out in compliance with the provisions of this document, to which reference shall be made.

3. No test report is made if R, E and I < 15 minutes.
furnace wall

frame

specimen

vertical edge 20 mm gap filled with mineral wool ($f = 50 \text{ kg/m}^2$)

fig. 2.1/2

furnace wall

frame

specimen

fig. 2.1/1

joints

min. 0.6 m

at least 2 full panels

3000 mm
(unless in practice smaller)

test n°1

filling panel

3000 mm
(unless in practice smaller)

test n°2

test n°1 and 2

3000 mm
1. Design of specimen and exposure conditions. (fig. 2.1./1.)

1.1. Design of specimen.
- The dimensions of the specimen are 3 m x 3 m unless in practice smaller.
- Partitions must have at least two full panels and at least two vertical joints. If there are horizontal joints in practice at least one is included.
- Partitions provided with compensators (adaptation for the height) are tested with the compensators in mid position.

1.2. Frame
A closed stiff frame has to be used which does not allow elongation of specimens nor rotation of frame members during the test.

For example: reinforced concrete 200 x 200 mm for light partitions.
Care must be taken to avoid deformation of the frame members due to heating during the test (protection if necessary). If the dimensions of the opening have to be reduced this has to be done maintaining the requirements of stiffness for the parts adjacent to the specimen, for example: with masonry or concrete.

The dimensions of the frame must be such that all four edges of the specimen are exposed: $6 \geq 0$ (fig. 2.1./2.).
The material of the frame adjacent to the specimen satisfies $p = 2000 + 500 \text{ kg/m}^3$. Refractory material is advised.

1.3. Exposure conditions. (fig. 2.1./2.)
Two situations have to be simulated.
Test no 1: 4 edges fixed as in practice.
Test no 2: 3 edges fixed as in practice,
1 vertical edge (of full element) without restraint (e.g. the gap between test element and frame filled with mineral wool).
Fig. 2.1/3

a and h > 250 mm

h > 250 mm
or
a > 250 mm

Specimen
2. Furnace thermocouples. (fig. 2.1./3)
At least 1 thermocouple per 1,5 m² specimen surface is used with a minimum of 5 thermocouples (that means at least 6 thermocouples for a 3 x 3 m specimen).

The hot junction of the furnace thermocouples is situated at 100 mm from the majority surface of the specimen, at the start of the test.

Distance shall remain between 50 and 150 mm during the test.
The thermocouples are equally distributed.
Example: see fig. 2.1./3.

3. Measurements on test specimen.

3.1. Surface temperature.
- At least five fixed thermocouples are used for measuring the mean surface temperature. Their location is given in fig. 2.1./4. and would need to be changed if one of these points is at a place with no representative thermal insulation (e.g.: near joints, edges, studs, metal connections or screws).
- For determining the maximum temperatures of the surface, at any place, fixed or movable thermocouples are used where high temperatures are expected. At the location of the joint it has to be avoided to measure gas temperatures by the thermocouples (see fig. 2.1./5a).
- At the fixed edges temperature should be measured by a movable thermocouple, as close as possible to the edge of the specimen (see fig. 2.1./5b).
- In case of grooved surfaces, the temperature of the bottom of the groove is not taken into account provided the groove is more narrow than 12 mm. (fig. 2.1./5c).
- Thermal insulation is not considered at the unfixed edge within a zone of 100 mm width (Test n° 2).

3.2. Integrity measurement.
- In Test n° 2 the cottonwool pad is not applied nearer than 100 mm to the free vertical side of the specimen.
- Location of measuring points for deformation (non mandatory)
- Location of thermocouples for determining the mean surface temperature.

**fig. 2.1/4**

**fig. 2.1/5a**
- At this side flames emerging from the gap between specimen and frame are not taken into account.

3.3. Deformation measurement.
- The location of the (non-mandatory) measuring points for deformation is given in figure 2.1./4.
- The measuring interval is 5 minutes.

4. Number of tests.

The number of tests has to be deduced from fig. 2.1./6.

5. Performance criteria.

No specifications are applied additional to those given in Chapter 1.
fig. 2.1/5b

fig. 2.1/5c
Symmetrical wall or partition

Start with test 1 and test 2

Test 1: 4 sides fixed
Test 2: 3 sides fixed

Is the required REI/RE value higher than 15 min.

if yes

Are the measured REI/RE-values of both tests 10% and at least 10 min. higher than the desired values.

if not

repeat the test with the worst result.

if yes

classification
Assymetrical wall or partition

Is one side of the partition evidently weaker against fire attack or has the element to resist fire in one direction only?

If one of these questions is answered Yes

Go to symmetric partition and test the weaker side real - the side which is exposed to fire in practice.

If both questions are answered NO

Test 1: exposure of side A 4 edges fixed
Test 2: exposure of side A 3 edges fixed
Test 3: exposure of side B 4 edges fixed
Test 4: exposure of side B 3 edges fixed

Was the required REI/RE-value higher than 15 min.

If yes If not

Were the measured REI/RE-values of all tests 10% and at least 10 min. higher than the desired values.

If yes If not

Repeat the test with the worst results

classification
Load distribution beams

fig. 2.2/1

section AA and BB; see fig. 2.2/4

fig. 2.2/2a

fig. 2.2/2b
1. Design of specimen and exposure conditions.

1.1. Design of specimen.
- The dimensions of the specimen are $3 \text{ m} \times 3 \text{ m}$ unless in practice smaller.
- Partitions must have at least two full panels and at least two vertical joints. If there are horizontal joints in practice at least one is included.

1.2. Frame.
- A stiff frame has to be used, able to transmit the forces of the loading system to the specimen with very limited deformation of the beams, so that the load distribution is not influenced by this deformation. For ex. : reinforced concrete $20 \times 20 \text{ cm}$ for light partitions. (see fig. 2.2./1).

The dimensions of the frame must be such that all four edges of the specimen are exposed. ($\varepsilon > 0$)

- Care must be taken to avoid deformation of the frame members due to heating during the test (protection if necessary).
- Load distribution beams:
  (a) In case of walls without studs a stiff load distribution beam should be used with a length equal to the width of the specimen and directly in contact with it. The part of the beam adjacent to the specimen is made of concrete over a height of minimum $0,2 \text{ m}$ (see fig. 2.2./2a).

  The stiffness of these beams is such as to limit the maximum deflection to a value not greater than $1/1000$ at the maximum load.

  (b) In case of walls or partitions with studs the loading system shall be such that by its deformations during the test the constancy of the load on each stud is not influenced (see fig. 2.2./2b).
- Care is taken to avoid friction between the load distribution beam and the studs of the frame.

- The load distribution beam can be either on top or at the bottom of the specimen.

- The horizontal frame members are such that no rotation along their longitudinal axes, nor translation perpendicular to the plane of specimen can occur.
fig. 2.2/3: Example of test frame for load bearing wall
- Vertical movement of the floating beam must be possible with a minimum of friction, guaranteeing the accuracy required for the load (+ 5%). The material of the frame adjacent to the specimen satisfies:
  \[ = 2.0 \pm 0.5 \text{ kg/dm}^3. \]
- An example of a suitable test frame for load-bearing walls is given in fig. 2.2./3.

**Note:** The arrangements of intermediate members at top and bottom in order to adjust the clear space of the frame to the dimension of the specimen can only be used if no additional horizontal movement and rotation are created.

1.3. Exposure conditions. (fig. 2.2./4.)

All 4 edges of the specimen are exposed. The two horizontal edges are fixed as in practice. The two vertical edges are free. The gap between frame and specimen are filled with mineral wool \( \rho \leq 50 \text{ kg/m}^3 \) and have a width of 20 mm.

2. Loading
- For the calculation of the load the specimen considered is centrically loaded.
- In order to avoid unsymmetrical loading the loadplane of the specimen should coincide with the midplane of the frame.
- If the load-bearing capacity of a partition is based on the presence of studs, the test load is determined by the number of studs present, and not by the width of the specimen.
- In case of walls or partitions with studs the loading points are applied like in practice (exactly coinciding with the studs or between them).

3. Furnace thermocouples.

At least 1 thermocouple per 1.5 m² specimen surface is used with a minimum of 5 thermocouples (that means at least 6 thermocouples for a 3 x 3 m specimen).

The hot junction of the furnace thermocouples is situated at 100 mm from the majority surface of the specimen, at the start of the test.
Distance shall remain between 50 and 150 mm during the test. The thermocouples are equally distributed.

Example: see fig. 2.2./5.
vertical edge 20 mm gap filled with mineral wool ($f < 50 \text{ kg/m}^3$)
4. **Measurements on test specimens.**

4.1. **Surface temperatures.** (fig. 2.2./6.)

- At least five fixed thermocouples are used for measuring the mean surface temperature. They are located as shown in fig. 2.2./6. Their location would need to be changed if one of these points is at a place with no representative thermal insulation (e.g.: near joints, edges, studs, metal connections or screws).

- For determining the maximum temperature of the surface, at any place, fixed or movable thermocouples are used where high temperatures are expected. At the location of the joint it has to be avoided to measure gas temperature by the thermocouples (see fig. 2.2./7a). No thermocouple is applied closer than 100 mm to the unfixed vertical edges of a partition.

- At the fixed horizontal edges temperature should be measured by a movable thermocouple, as close as possible to the edge of the specimen (fig. 2.2./7b).

- In case of grooved surfaces, the temperature of the bottom of the groove is not taken into account provided the groove is more narrow than 12 mm. (Fig. 2.2./7c).

- Thermal insulation is not considered at the unfixed edge within a zone of 100 mm width.

4.2. **Integrity measurement.**

- The cottonwool pad is not applied nearer than 100 mm to the vertical sides of the specimen.

- Flames emerging from the gap between specimen and frame are not taken into account.

4.3. **Deformation measurement.**

- The location of the (non-mandatory) measuring points for deformation is given in figure 2.2./6.

- The measuring interval is 5 minutes.

5. **Number of tests.**

The number of tests has to be deduced from fig. 2.2./8.
• Location of measuring points for deformation
× Location of thermocouples for determining the mean surface temperature.

fig. 2.2/6

fig. 2.2/7a
Symmetrical load bearing wall or partition.

Fig. 2.2/8a

First test

Is the required REI/RE/R-value higher than 15 min.

If yes

Are the measured REI/RE/R-values 10% and at least 10 min. higher than the desired values.

If not

If yes

Second test

Classification
Assymetrical load bearing wall or partition

Is one side of the specimen evidently weaker against fire attack or has the element to resist fire in one direction only.

If one of these questions is answered

Yes

Go to symmetric load bearing-wall and test the weaker side resp. the side which is exposed to fire in practice.

If both questions are answered NO.

Test 1: exposure of side A
Test 2: exposure of side B

Was the required REI/RE/R-value higher than 15 min.

If yes

If not

Were the measured REI/RE/R-values of both tests 10% and at least 10 min. higher than the desired values.

If yes

If not

Repeat the test with the worst results.

Classification
6. Performance criteria.

No specifications are applied additional to those given in Chapter 1.

*Note:* These tests do not give information on integrity and insulation failure at sides of the wall, because edges, as they occur in practice, are not included in the tests.
1. Design of specimen and exposure conditions.
   1.1. Design of specimen.
   - The heated length of the specimen is 3 m unless smaller in practice.
     The unheated length of the specimen at top and bottom may not exceed
     0.25 m.
   - If the void between a steel column and a box type cladding is closed
     during the test (no connection to the outside of the furnace), it
     must be closed in practice too, because this point is of a great
     importance on the test result. A warning in this respect has to be
     introduced in the test report.
     In the opposite case the connection tube between the void and the
     outside of the furnace must have a cross-section of about 20 % of
     the cross-section of the void and be situated at the top.
   1.2. Static system.
   - Both of the following static systems have to be tested.
     Test n° 1: Static system A
     Test n° 2: Static system B

If e.g. by calculation it can be checked that one of the two static
systems will give the worst results the test with the other static
system can be deleted.

- As the end conditions can influence very strongly the test result,
  special care has to be taken in order to avoid friction in the hinges
  and to have full restraint at the restrained ends.
- For static system A either bidirectional hinges are used or the
  hinge must allow buckling in the direction of the weakest side.

* FOOTNOTE: Both possibilities are left open because of existing
  furnaces. For reasons of temperature distribution, it
  is preferred to have the hinge at the bottom.
1.3. **Exposure conditions.**

- Free standing columns must be exposed to fire on all sides.
- Columns with one face resting against a wall must be exposed to fire in such a way that the thermal attack is applied to their three free faces.
- Columns partly or wholly built into a wall (with at least one face visible) must be exposed to fire under conditions simulating these situations.
- Columns likely to be stressed by fire on two opposite faces (the other two faces being protected by adjacent walls) must be exposed to thermal attack in simulation of this situation.

2. **Loading.**

The load is applied centrically and calculated accordingly.

Special care has to be taken to avoid excentricity of the loading and lack of parallelism between the restrained ends of the column and the support(s), because of the extreme influence on the test result due to creation of uncontrolled and unknown bending moments. It is advised to check the bending moment in relation to the load before the test, by strain gauges.

3. **Furnace thermocouples.**

At least 3 x 2 thermocouples are used.

These thermocouples are placed at a distance of 100 mm from the outer surface of the specimen at the beginning of the test (see fig. 2.3./1.).
Number of tests

Test 1: Static system A
Test 2: Static system B

Is the required R-value higher than 15 min.

if yes

Are the measured R-values of both tests 10% and 10 min. higher than the desired values.

if not

if yes

Repeat the test with the worst result.

Classification

* Footnote:
If e.g. by calculation it can be checked that one of the two static systems will give the worst results the test with the other static system can be deleted.
4. Measurements on test specimen.

4.1. Specimen thermocouples.
If temperature at the surface or inside the specimen is measured, it should be done in the same horizontal plane of the furnace thermocouples.

4.2. Elongation measurement.
The change in length of the specimen is continuously measured.

5. Number of tests.
The number of tests has to be deduced from fig. 2.3/2.

6. Performance criteria.
- If the test component is formed of materials which disintegrate or rupture under the combined effect of fire and load, as indicated above, the end-of-test criterion shall be collapse or rupture of the component.

- If the test component is formed of materials which deform continuously under the combined effect of fire and load, the end-of-test criterion shall be the rate of deformation of the component, which must not exceed 3 mm/m length. min. (see fig. 2.3/3.). Here deformation is defined as the decrease of the length between both ends of the specimen.
Fig. 2.4/1
Section IV: FLOORS SUBMITTED TO FIRE EXPOSURE AT THE UNDERSIDE

1. Design of specimen and exposure conditions.

1.1. Floors at two sides supported.

1.1.1. Design of specimen. (fig. 2.4.1/1.)
- The specimen has a width of at least 2 m (*) and a heated length of 4 m unless in practice smaller.
- At least two joints in each direction are included in the test specimen if in practice there are joints in this direction.

1.1.2. Mounting of the specimen. (**)
- At the long edges of the specimen a gap with a width of 20 mm between the specimen and the furnace wall is left in order to guarantee free deflection of the specimen. This gap should be filled with mineral wool.
- Each specimen is provided with one rolling and with one hinged support. An example of such support is shown in fig. 2.4.1/1. Extreme care is taken to avoid friction at the rolling support and to allow elongation and deflection.
- The difference between span and heated length may not exceed two times 100 mm.
- The difference between the total length and the span may not exceed two times 50 mm.
- Hollow floors are tested with the voids closed at the ends.

(*) The requirement of having two joints in the direction of the span can involve to test specimen with a greater width.

(**) In cases where the above test arrangement does not cover the fire behaviour of the practical end conditions (e.g. the junction between prefabricated floors and light weight partitions) the practical end conditions have to be included in the test arrangement.
1.2. **Floors at four sides supported.**

The specimen is laid on the furnace walls, the top of which must be smooth and in the same plane in such a way, that all four sides of the specimen are supported by a plane area of 10 cm width. The heated area shall be 3 m x 4 m (if not smaller in practice).

![Diagram of floor support](image)

2. **Loading.**

The loading shall be carried out such as to produce stresses of the same magnitude as could be produced normally with fullsize elements when subjected to the design load i.e. the same maximum bending moment and the same maximum sheer forces.

Instead of a uniformly distributed load a number of equal, statically equivalent spot loads can be applied.

This means at least 1 loading point per m².

In case of floors with load bearing members (e.g. timber joints) the loading points shall be located partially above the load bearing members, (each member being loaded with the same load) partially between them.

The loading points are distributed over the load bearing members and between them in such a way that in the member and also in the floor between them similar stresses occur as those belonging to the theoretical stresses caused by a theoretical uniformly distributed load.

The surface area of the loading spots shall not be smaller than 0,0225 m² in order to avoid high concentration of local stresses. It shall not be greater than 0,0625 m² in order to avoid significant effect on the cooling and surface temperature of the unexposed face. For timber floors the smaller loading points are advised. The overall area of the horizontal projection of the spots where loading is applied shall not exceed 10 % of the area exposed to fire in order to avoid too great influence on the thermal insulation of the specimen. The loading can be done either by dead load or by a hydraulic system. If with hydraulic loading, a load
Fig. 24/2

a < 250 mm
or
h < 250 mm

a and h ≥ 250 mm
distribution system is applied, special care must be taken of the maintenance of the uniformity of the load distribution in all directions at deformation of the specimen. This can be done by choosing a roll-support on one side and a \( \Delta \)-support at the other side of each load distribution profile.

The jacks and the profiles used to introduce loads on the floor shall be fitted to the load distribution system by hinges.

3. Furnace thermocouples.

- At least one thermocouple per 1.5 m² specimen surface is used with a minimum of five thermocouples (that means at least six thermocouples for a 2 x 4 m specimen and at least nine thermocouples for a 3 x 4 specimen).

- The hot junction of the furnace thermocouples is situated at 100 mm from the majority of the lower surface of the specimen at the start of the test. Distance shall remain between 50 and 150 mm during the test. The thermocouples are equally distributed.

Example: see fig. 2.4./2.

4. Measurements on test specimen.

4.1. Surface temperature. (fig. 2.4./3.)

- At least five fixed thermocouples are used for determining the mean surface temperature.

- The location has to be changed if one of these points is at a place which is not representative for thermal insulation (e.g. joints, beams or metal connections). If necessary, additional thermocouples are attached - but not nearer than 100 mm to the long edges of a specimen supported on two sides.

- For determining the maximum temperatures of the surface, fixed or movable thermocouples are used at any place where high
temperatures are expected (mandatory) (except nearer than 100 mm to the long edges of a two sides supported specimen).

4.2. Integrity measurement.

- For floors at two sides supported, the cottonwool pad is not applied nearer than 100 mm to the long sides of the specimen.
- Location of measuring points for deformation

- Location of thermocouples for determining the mean surface temperature.

fig. 2.4/3
Frames emerging from the gap between specimen and frame are not taken into account.

4.3. Deformation measurement.

Point of deformation measurement.
If the floor consists of more than one element, the deformation is measured at the centre of each element.

5. Number of tests.

The number of tests has to be deduced from fig. 2.4.4.

6. Performance criteria.

Besides the criteria described in part one, for isotatically supported floors the stability criterion shall be the rate of deformation of the component, which must not exceed:

\[ \frac{\Delta f}{\Delta t} = \frac{L^2}{9000h} \]

where:
- \( L \) is the span in mm
- \( h \) is calculation height in mm (*)
- \( \Delta f \) is the increase of the deformation in mm during a time interval of one minute
- \( \Delta t \) is the time interval of one minute
- \( \Delta f/\Delta t \) is the rate of deformation in mm/min.

(*) \( h \) is the maximum height used for the calculation of the moment of inertia \( I_w \).
Number of tests

First test

1) Are the measured REI/RE/R - values 10% and 10 min. higher than the required values
2) Are the required REI/RE/R values 15 min.

If both answers are NO
Repeat the test

If one of both answers is YES

Classification
Steel plates for load distribution

mineral wool

4000 mm (unless smaller in practice)

A layer of fibrous material, nominal thickness maximum 25 mm is allowed.

Fig. 2.5/1

Fig. 2.5/2
Section V : BEAMS.

1. Design of specimen and exposure conditions.

Note : Composite floor-beam elements are tested following Section IV.

1.1. Design of specimen. (fig. 2.5./1.)
- The beams are exposed to the fire over a length of 4 m unless smaller in practice.
- If the void between the steel beams and a box type cladding is closed during the test (no connection to the outside of the furnace), it must be closed in practice too, because this point is of a great importance on the test result. A warning of this respect has to be introduced in the test report. In the opposite case the connection tube between the void and the outside of the furnace must have a cross section of about 20% of the cross section of the void and be situated at the top.

1.2. Static system.
The test is performed with both ends of the beam freely supported allowing free elongation and deflection of the beam.

1.3. Mounting of the specimen. (fig. 2.5./1. and 2.5./2.)
- The span is not more than two times 0,1 m longer than the heated length.
- The cold ends of the beam are not longer than two times 0,15 m unless different in practice.
- If the specimen itself is not containing a topping, the topping of the test specimen should be a gas concrete slab having sections not longer than 1 m.
At the loading points the gas concrete topping is replaced by concrete blocks (see fig. 2.5./2.).
Protecting claddings may not be fixed to the topping unless it is done so in practice.
2 thermocouples per meter length

fig. 2.5/3

fig. 2.5/4

A, B, C = D
- The loading system must be articulated so that it can follow the deformation of the test piece.
- The test arrangement must provide lateral stability, e.g. by testing two parallel beams. Such a test arrangement is given in fig. 2.5.3. The clear space between the specimens is ≥ 500 mm, the clear space between specimens and furnace wall ≥ 250 mm.
- In some cases special precautions must be taken in order to prevent torsional deformation along the long axis of the beams, at the ends.

1.4. Exposure conditions
- Beams must have their three faces simultaneously exposed to thermal attack, the fourth face (i.e. the upper face) being protected. The vertical sides are exposed over the full height like in practice.
- Beams with four free faces, all of which can be attacked by fire, must be exposed to thermal attack in simulation of this situation. The distance from the upper side of the beam to the topping of the furnace is at least equal to the width of the beam.

2. Loading
- The loading shall be carried out such as to produce stresses of the same magnitude as could be produced normally with full-size element when subjected to the design load, i.e. the same maximum bending moment and the same maximum shear forces.
  A minimum of two loading points with a minimum distance of 0.5 m between them is required.
- It must be realized that the above conditions do not allow the simulation of beam lengths larger than nearly two times the tested length.
Number of tests

First test

Is the measured R-value 10% and at least 10 min. higher than the required values.
Is the required value 15 min.?

If both answers are NO

Repeat the test

If one of the answers is yes

Classification (no further test necessary)
3. Furnace thermocouples.
At least 2 thermocouples per 1 m length of the specimen are used with a minimum of 6 thermocouples (that means at least 8 thermocouples for a 4 m long specimen).

The hot junction of the furnace thermocouples is situated at 100 mm from the majority surface of the specimen, at the start of the test.
This distance shall remain between 50 and 150 mm during the test. The thermocouples are equally distributed.
Example: see fig. 2.5./4.

4. Measurements on test specimen.
4.1. Specimen thermocouples.
If temperature inside or at the surface of the specimen is measured it should preferably be done in the same vertical plane as the furnace unless an influence of the loading points can be expected there.

4.2. Deformation measurement.
- The deflection of the beam is measured at midspan.
- Zero deflection is the position after applying the load at the beginning of the test.
- The deflection is measured at intervals of 1 minute and hence the rate of deformation is derived.
- Measurement of the elongation and torsion along the longitudinal axis of the beam provides additional non-mandatory information.

5. The number of tests.
The number of tests has to be deduced from fig. 2.5./5.

6. Performance criteria.
- For beams only the 4-criterion is considered.
- For simply supported beams the P-criterion shall be the rate of deformation of the component, which must not exceed:
\( \frac{\Delta f}{\Delta t} = \frac{L^2}{9000h} \)

- **L** = the span in mm
- **h** = calculation height mm
- **\( \Delta f \)** = the increase of the deformation in mm during a time interval \( t \) of one minute
- **\( \Delta t \)** = the time interval of one minute
- **\( \Delta f / \Delta t \)** = the rate of deformation in mm/min.
INTRODUCTION

This chapter contains the form and main content of the test reports. The described data and the order are mandatory. They are considered to be the minimum information. Other points of importance have to be added.

Each report shall give on the first page an indication that the test was fully in line with this document.

When the test procedure or the number of tests are not fully in line with this document no test report referring to this document shall be made.

If special interpretations of this document were necessary because of the nature or application of the building component it shall be explained explicitly in par. 8 of the test report.
Section I: STANDARD REPORT FOR FIRE RESISTANCE TEST ON A NON-LOAD-BEARING WALL OR PARTITION.

1. Identification.
   1.1. Test element.
   1.2. Purpose of test.
   1.3. Reference number and date of the report.
   1.4. Name of testing laboratory.
   1.5. Name of sponsor.
   1.6. Name of manufacturer and the trade name of the test.
       element or of the main components.
   1.7. Date of manufacture/delivery to the laboratory/
       construction in the laboratory.
   1.8. Date of test.

2. Test specimen.
   2.1. The test report should contain a detailed description
       of the test specimen indicating:
       a. the intended function, (e.g. non-load-bearing wall).
       b. the type, composition and characteristics of the
          constituent materials and accessories; if one or
          more constituent materials and accessories are co-
          vered by national or international standards, it
          shall suffice to give an accurate and complete refe-
          rence to these standards.
          In case there has been made use of typical small
          elements, e.g. nails, screws, etc..., these parts
          will be specified and illustrated by drawings in a
          suitable scale if necessary.
       c. The system used to join the various parts together.
       d. the mounting procedure in the laboratory.
       e. a plan or drawings on the most appropriate scale
          illustrating the test specimen by means of vertical
          and horizontal cross-section elevations, contain-
          ing enough details and all dimensions so that it
          will always be possible to confirm subsequently the
          identity of a component with the component that has
          been subjected to the test.
       f. Photos of the specimen or part of it.
2.2. Conditioning procedure.

2.3. Material properties.

2.3.1. Reinforced concrete wall.

Composition of concrete.
Compressive strength and method of determining it (after 28 days and on day of test).
Density and moisture content on day of test.

2.3.2. Walls of bricks, blocks, panels, etc.

a. Composition of the bricks, blocks, panels, etc.
b. Composition of the mortar or glue.
c. Moisture content on day of test.

2.3.3. Lightweight partitions.

a. Grade(*) and kind of the material used for the studs.
b. Composition of the insulating material.
Density and moisture content of the insulating material on day of test.
c. Composition of the lining material. Density and moisture content of the lining material on day of test.

2.3.4. Other non-load-bearing walls and partitions.

Composition of the constituent materials. Density and moisture content of the materials on day of test.

3. Test procedure.

3.1. Mechanical end conditions.

The mechanical end conditions can considerably influence the time of the fire resistance.
For this reason these conditions shall be described in full detail and illustrated by drawings and pictures (see chapter 2).

(*) For timber constructions the grade should follow national codes of standard but a detailed description of the timber in terms of the criteria used for the grading has to be given.
4. Exposure conditions.
The report shall indicate for each test the side on which the wall or partition was directly heated. It should explain in accordance with this document why this side was directly heated.

5. Observations during the test.
5.1 Furnace conditions.
Provide diagrams or tables showing the furnace temperatures recorded (individual readings, mean value and integral, furnace pressure and $O_2$ content at intervals not exceeding five minutes.

5.2. Performance of the test specimen.
Note the appearance of deformation and its speed of development until the test specimen collapses or the test is interrupted.
If the internal temperature of the test specimen is measured, state how it developed with time and give the position of the measuring points.
Note any other information about the performance of the test specimen during the test, e.g. cracking, softening, loosening of parts of the specimen, etc...
Description of the test specimen after the test including photos.

6. Duration.
State on basis of the stability criterion in respect of each test the time in minutes which elapsed from the beginning until the moment when the test was:
- either interrupted intentionally (stating who requested the interruption).
- or interrupted by failure of the test specimen.
The test result should be given in a table as given below:
TABLE I

<table>
<thead>
<tr>
<th>Performance criterion</th>
<th>Duration in minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test 1</td>
</tr>
<tr>
<td>Stability</td>
<td>$r_1 = e_1$</td>
</tr>
<tr>
<td>Integrity</td>
<td>$e_1$</td>
</tr>
<tr>
<td>Thermal insulation</td>
<td>$i_1$</td>
</tr>
</tbody>
</table>

7. Conclusion.

7.1. Duration values to be used for the classification.

Stability $R$ : $r^{1}) = (min)$
Integrity $E$ : $e^{1}) = (min)$
Thermal insulation : $i^{1}) = (min)$.

1) = Lowest value given in Table I.

7.2. Classification

REI ...........
RE ...........
R ...........

8. Remarks concerning the application of the test results.

In this chapter guidelines in relation with the applicability limitations, special warnings etc., (e.g. special mounting and end conditions, warnings concerning the adhesion or corrosion problems with plaster on steel structures) of this test report shall be given.

9. Remarks concerning national special application conditions or instructions etc...... in the country of origin.
1. Identification.
   1.1 Test element.
   1.2 Purpose of test.
   1.3 Reference number and date of the report.
   1.4 Name of testing laboratory.
   1.5 Name of sponsor.
   1.6 Name of manufacturer and the trade name of the test element or the main components.
   1.7 Date of manufacture/delivery to the laboratory, construction in the laboratory of the test specimen.
   1.8 Date of test.

2. Test specimen.
   2.1 Description.
   The test report should contain a detailed description of the test specimen, indicating:
   a. the intended function (e.g. load-bearing wall).
   b. the type, of the constituent materials and accessories; if one or more constituent materials and accessories are covered by national or international standards, it shall suffice to give an accurate and complete reference to these standards.
   In case there has been made use of typical small elements, e.g. nails, screws, etc..., these parts will be specified and illustrated by drawings in a suitable scale if necessary.
   c. the systems used to join the various parts together.
   d. the mounting procedure in the laboratory.
   e. a plan or drawings on the most appropriate scale illustrating the test specimen by means of vertical and horizontal cross-section elevations, containing enough details and all dimensions so that it will
always be possible to confirm subsequently the identity of a component that has been subjected to the test.

f. Photos of the specimen or part of it.

2.2. Conditioning procedure.

2.3. Material properties.

2.3.1. Reinforced concrete walls.
Composition of concrete.
Compressive strength and method of determining it (after 28 days and on day of test).
Density and moisture content on day of test.

2.3.2. Walls of bricks, blocks, panels, etc.
   a. Composition of the bricks, blocks, panels, etc.
      Compressive strength and/or bending strength of the bricks, blocks, panels, etc.
      with reference to the used national or international standard.
   b. Composition of the mortar or glue compressive strength of the mortar with reference to the used national or international standard.
   c. Moisture content on day of test.

2.3.3. Wooden stud partition.
   a. Grade of wood (*) mechanical strength and Emodulus
   b. Density and moisture content of wood on day of test.
   c. Kind of insulating material and density and moisture content on day of test.
   d. Kind and composition of the lining material with density and moisture content on day of test.

(*) For timber constructions the grade should follow national codes of standard but a detailed description of the timber in terms of the criteria used for the grading has to be given.
2.3.4. Other load-bearing partitions.
Composition of the constituent materials.
Density and moisture content on the day of the test.

3. Test procedure.

3.1. Mechanical end conditions.
The mechanical end conditions can considerably influence the time of the fire resistance.
For this reason these conditions shall be described in full detail and illustrated by drawings and pictures (see chapter 2).

3.2. Loading.

3.2.1. Calculation of test load.
The whole calculation and the standards or codes used for the calculation should be given.

3.2.2. Load conditions.
These shall be indicated very clearly, taken into account the following points:

a. Method of applying load: dead or hydraulic load, etc.
b. Information on pre-loading and the moment at which the entire load was applied before thermal attack started.

4. Exposure conditions.
The report shall indicate for each test that the specimen was heated from one side only. It should give the side which was heated and explain in accordance with this document why this side was heated.

5. Observations during the test.

5.1. Furnace conditions.
Provide diagrams or tables showing the furnace temperatures recorded (individual readings, mean value and integral, furnace pressure and O₂ content at intervals not exceeding five minutes.
5.2. Performance of the wall or partition.

Note the appearance of deformation until the test specimen collapses or the test is interrupted.
If the internal temperature of the test specimen is measured, state how it developed with the time and give the position of the measuring points.
Note any other information about the performance of the test specimen during the test, e.g. crackening, loosening of parts of the specimen, opening of joints, etc.
Description of the specimen after the test including photos.

6. Duration.

State on the basis of the stability criterion in respect of each test the time in minutes which elapsed from the beginning until the moment when the test was: either interrupted intentionally - or interrupted by failure of the test specimen.
The test result should be given in a table as given below:

<table>
<thead>
<tr>
<th>Performance criterion</th>
<th>Duration in minutes.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test 1</td>
</tr>
<tr>
<td>Stability</td>
<td>r</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Integrity</td>
<td>e₁</td>
</tr>
<tr>
<td>Thermal insulation</td>
<td>i₁</td>
</tr>
</tbody>
</table>

7. Conclusion.

7.1. Duration values to be used for the classification:

Stability R : r₁ (min)
Integrity E : e₁ (min)
Thermal insulation : i₁ (min)

1) = Lowest value given in table I.
7.2. Classification:

REI  ------
RE   ------
R    ------

8. Remarks concerning the application of the test results.
   In this chapter guidelines in relation with the applica-
   bility (limitations or restrictions, special warnings, etc.
   (e.g. special mounting and end conditions) warnings concerning
   the adhesion or corrosion problems with plaster on steel struc-
   tures of this test report shall be given.

9. Remarks concerning national special application conditions
   or instructions etc. in the country of origin.
Section III: STANDARD REPORT FOR FIRE RESISTANCE TEST ON A COLUMN

1. Identification.
   1.1. Test element.
   1.2. Purpose of test.
   1.3. Reference number and date of the report.
   1.4. Name of testing laboratory.
   1.5. Name of sponsor.
   1.6. Name of manufacturer and the trade-name of the test element or the main components.
   1.7. Date of the manufacture/delivery to the laboratory/construction in the laboratory.
   1.8. Date of test.

2. Test specimen.
   2.1. Description.
   The test report should contain a detailed description of the test specimen indicating:
   a. the intended function, e.g. load bearing.
   b. the type of the constituent materials and accessories, if one more constituent materials and accessories are covered by national or international standards, it shall suffice to give an accurate and complete reference to these standards.
   In case there has been made use of typical small elements, e.g. nails, screws, etc., these parts will be specified and illustrated by drawings in a suitable scale if necessary.
   c. the systems used to join the various parts together.
   d. the mounting procedure in the laboratory.
   e. a plan or drawings on the most appropriate scale illustrating the test specimen by means of vertical and horizontal cross-sections so that it will always be possible to confirm subsequently the identity of a
component that has been subjected to the test.
f. Photos of specimen or part of it.

2.2. Conditioning procedure.

2.3. Material properties.

2.3.1. Reinforced concrete column.

Composition of concrete including sand and cement.
Compressive strength and method of determining it (after 28 days and on day of the test).
Kind of steel (nominal values for yield strength and ultimate strength), form and size. Actual values for yield strength and ultimate tensile strength.

In case of protected concrete columns data should be given concerning the smoothness of the concrete surface especially in relation to the use of oil for removing moulds.

2.3.2. Steel column.

a. Steel profile: dimensions (nominal and actual),
Steel properties: steel grade, yield strength (nominal and actual). Ultimate tensile strength (nominal and actual).

b. Protecting materials.
Composition of the protecting materials.
Thickness of the material.
Density of the material on day of test.
Moisture content on day of test.
The mounting procedure in the laboratory.

c. Surface treatment of the steel before application of the protection.

2.3.3. Timber column.

For the used timber the following data should be given.

a. Grade of wood (*), mechanical strength and E-modulus.

b. Density and moisture content on day of test.

(*) For timber constructions the grade should follow national codes of standard but a detailed description of the timber in terms of the criteria used for the grading has to be given.
3. Test procedure.

3.1. Mechanical end conditions.

The mechanical end conditions can considerably influence the time of fire resistance. For this reason these conditions shall be described in full detail and illustrated by drawings and pictures.

3.2. Loading.

3.2.1. Calculation of test load.

The whole calculation and the standards or codes used for the calculation should be given.

3.2.2. Load conditions.

These shall be indicated very clearly taking into account the following points:

a. Way in which the critical loading is applied.

b. Stress distribution in a cross-section before heating at mid height (if measured).

c. Information on preloading and the moment at which the entire load was applied before thermal attack started.

4. Exposure conditions.

The report shall indicate the sides on which the column was directly heated. It shall also contain explanation why one or more sides were exposed to fire. If only a part of the construction element was directly heated it is necessary to illustrate how the unexposed sides were protected by a drawing. Besides the position and location of the furnace thermocouples should be given in a drawing.

5. Observations during the test.

5.1. Furnace conditions.

Provide diagrams or tables showing the furnace temperatures recorded (individual readings, mean value and integral, furnace pressure and O₂ content at intervals not exceeding five minutes.
5.2. Performance of the test specimen.

Note the appearance of elongation and its speed of development until the test specimen collapses, the elongation criterion is reached or the test is interrupted.

If the internal temperature of the test specimen is measured, state how it developed with time and give the position of the measuring points. Note any other information about the performance of the test specimen during the test, e.g. crackening, softening, loosening of parts of the specimen, etc. .

Description of the test specimen after test including photos.

6. Duration.

State on basis of the stability criterion in respect of each test the time in minutes which elapsed from the beginning until the moment when the test was:
- either interrupted intentionally (stating who requested the interruption);
- or interrupted by failure of the test specimen.

The test result should be given in a table as given below:

<table>
<thead>
<tr>
<th>Performance criterion</th>
<th>Duration in minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test 1 Case A</td>
</tr>
<tr>
<td>Stability R</td>
<td>$r_1$</td>
</tr>
</tbody>
</table>

7. Conclusion.

7.1. Duration values to be used for the classification.

Stability : $R^{2}$) ___________ minutes.

7.2. Classification.

Stability : $R$ ___________
1) see also chapter 2.
2) Lowest value of Table I.

8. Remarks concerning application of test results.
In this chapter guidelines in relation with the applicability, limitation or restrictions, special warnings etc. (e.g. special mounting and end conditions, warnings concerning the adhesion or corrosion problems with plaster on steel structures) of this report shall be given.

9. Remarks concerning national special application conditions or instructions etc.... in the country of origin.
SECTION IV : STANDARD REPORT FOR FIRE RESISTANCE TEST ON A FLOOR WITH AND WITHOUT A CEILING, WITH FIRE ATTACK FROM THE UNDERSIDE ONLY

1. Identification.
  1.1. Test element.
  1.2. Purpose of test.
  1.3. Reference number and date of the report.
  1.4. Name of testing laboratory
  1.5. Name of sponsor.
  1.6. Name of manufacturer and the trade-name of the test element or of the main components.
  1.7. Date of the manufacture/delivery to the laboratory/ construction in the laboratory of the test specimen.
  1.8. Date of the test.

2. Test specimen.
  2.1. Description.
    The test report should contain a detailed description of the complete test assembly indicating:
    a. the type composition and characteristics of the constituent materials and accessories; if one or more constituent materials and accessories are covered by national or international standards, it shall suffice to give an accurate and complete reference to these standards. In case there has been made use of typical small elements, e.g. hangers, nails, screws, etc...., these parts will be specified and illustrated by drawings in a suitable scale if necessary.
    b. the systems used to join the various parts together.
    c. the mounting procedure in the laboratory.
    d. a plan or drawings on the most appropriate scale illustrating the test specimen by means of vertical and horizontal cross-section elevations containing enough details and all dimensions so that it will always be possible to confirm
subsequently the identity of a component with the compo-
nent that has been subjected to the test.

e. Photos of the specimen or part of it.

2.2. Conditioning procedure.

2.3. Material properties.

2.3.1. Concrete floor.
Composition of concrete including sand and cement.
Compressive strength and method of determining if 
(after 28 days and on day of test).
Density and moisture content on day of test.
Kind of steel (nominal values for yield strength and ul-
timate tensile strength) form and size. Actual values for 
yield strength and ultimate tensile strength.
In case of protected concrete floors protected directly 
at the underside with sprayed materials, data should be 
given concerning the smoothness of the concrete surface, 
the use of oil for removing moulds, because these elements 
can strongly influence the adherence of the protection on 
the concrete.

2.3.2. Wooden floor.
For the used timber, the following data should be 
given:

a. Grade of wood(*)

b. Density and moisture content on day of test.

2.3.3. Ceiling.
The following data should be given:

a. Composition of the ceiling materials
b. density and moisture content of the ceiling materials.
c. kind of material and grade if specified of the lay-
ingrid system and hangers if any.

(*) For timber constructions the grade should follow national codes 
of standard but a detailed description of the timber in terms of 
the criteria used for the grading has to be given.
3. Test procedure.

3.1. Mechanical end conditions.

The mechanical end conditions can considerably influence the time of fire resistance.

For this reason these conditions shall be described in full detail and illustrated by drawings and pictures (see Part 2).

3.2. Loading.

3.2.1. Calculation of test load.

The whole calculation and the standards or codes used for the calculation should be given.

3.2.2. Load conditions.

These shall be indicated very clearly taking into account the following points:

a. Type of load: concentrated, uniformly distributed, mixed (concentrated and distributed).

b. Method of applying load: dead load or hydraulic load etc.

c. Information on preloading and the moment at which the entire load was applied before thermal attack started.

4. Exposure conditions.

The report shall indicate the position and location of the furnace thermocouples in a drawing.

Indication that the exposure was only done at the underside.

5. Observations during the test.

5.1. Furnace conditions.

Provide diagrams or tables showing the furnace temperatures recorded (individual readings, mean value and integral) furnace pressure and O₂ content at intervals not exceeding five minutes.

5.2. Performance of the test floor.

Note the appearance of deformation and its speed of development until the test specimen fails or the test is interrupted.

If the internal temperature of the test specimen (e.g. temperature underside floor etc.) is measured, state how it deve-
loped with time and give the position of the measuring points. Note any other information about the performance of the test specimen during the test, e.g. crackening, softening, loosening of parts of the specimen, collapse of the ceiling material etc.....

Description of the specimen after test including photos.

6. Duration.
State on basis of the performance criteria in respect of each test the time in minutes which elapsed from the beginning until the moment when the test was:
- either interrupted intentionally, stating who requested the interruption)
- or interrupted by failure of the test specimen.
The test result should be given in a table as given below.

TABLE I

<table>
<thead>
<tr>
<th>Performance criterion</th>
<th>Duration of test in minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test 1</td>
</tr>
<tr>
<td>Stability R</td>
<td>( r_1 )</td>
</tr>
<tr>
<td>Integrity</td>
<td>( e_1 )</td>
</tr>
<tr>
<td>Thermal insulation</td>
<td>( i_1 )</td>
</tr>
</tbody>
</table>

7. Conclusion.

7.1. Duration values to be used for the classification.
Stability R : \( r^{1)} \) (min)
Integrity E : \( e^{1)} \) (min)
Thermal insulation I : \( i^{1)} \) (min)

1) = Lowest value given in table I

7.2. Classification
REI : ...........
RE : ...........
R : ...........
8. Remarks on the application of the test results. This test gives information for the fire attack from the underside of the tested floor only. In this chapter guidelines in relation with the applicability, limitations or restrictions, special warnings (e.g. special mounting and end conditions, warnings concerning the adhesion or corrosion problems with plaster on steel structures) of this test report shall be given.

9. Remarks concerning national special application conditions or instructions, etc... in the country of origin.
SECTION V : STANDARD REPORT FOR FIRE RESISTANCE TEST ON A BEAM

1. Identification.
   1.1. Test element.
   1.2. Purpose of test.
   1.3. Reference number and date of the report.
   1.4. Name of testing laboratory.
   1.5. Name of sponsor.
   1.6. Name of manufacturer and the trade-name of the test specimen or of the main components.
   1.7. Date of manufacture/delivery to the laboratory/construction in the laboratory.
   1.8. Date of the test.

2. Test specimen.
   2.1. Description.

   The test report should contain a detailed description of the test specimen indicating:
   a. the intended function, e.g. load bearing.
   b. the type of the constituent materials and accessories, if one or more constituent materials and accessories are covered by national or international standards, it shall suffice to give an accurate and complete reference to these standards.
   In case there has been made use of typical small elements, e.g. nails, screws, pinspotters etc., these parts will be illustrated in a suitable scale.
   c. the systems used to join the various parts together.
   d. the mounting procedure in the laboratory.
   e. a plan or drawings on the most appropriate scale illustrating the test specimen by means of vertical and horizontal cross-section elevations containing enough details and all dimensions so that it will always be possible to confirm subsequently the identity of a component with the component that has been subjected to the test.
   f. photos of the specimen or part of it.
2.2. Conditioning procedure.

2.3. Material properties.

2.3.1. Reinforced concrete beam.

Composition of concrete incl. sand and cement.
Compressive strength and method of determining it (after 28 days and on day of test). Density and moisture content on day of test. Kind of steel (nominal values for yield strength and ultimate tensile strength, from and size. Actual values for yield strength and ultimate tensile strength.
In case of protected concrete beams data should be given concerning the smoothness of the concrete surface especial in relation to the use of oil for removing moulds.

2.3.2. Steel beam.

a. Steel profile: dimensions, nominal and actual steel grade, steel properties: steel grade, yield strength (nominal and actual values), ultimate tensile strength (nominal and actual values).

b. Protecting materials.
Compositions of the protecting materials.
Thickness of the material.
Density of the material on day of test.
Moisture content on day of test.

c. Surface treatment of the steel before application of the protection.

2.3.3. Timber beam.

For the used timber the following data should be given:

a. Grade of wood (*)

b. Density and moisture content on day of test.

(*) For timber constructions the grade should follow national codes of standard but a detailed description of the timber in terms of the criteria used for the grading has to be given.
3. Test procedure.

3.1. Mechanical end conditions.

The mechanical end conditions can considerably influence the time of fire resistance. For this reason these conditions shall be described in full detail and illustrated by drawings and pictures.

3.2. Loading.

3.2.1. Calculation of test load.

The whole calculation and the standards or codes used for the calculation should be given.

3.2.2. Load conditions.

These shall be indicated very clearly taking into account the following points:

a. Type of load: concentrated, uniformly distributed, mixed (concentrated and distributed).

b. Method of applying load: dead load or hydraulic load, etc.

c. Information on preloading and the moment at which the entire load was applied before thermal attack started.

4. Exposure conditions.

The report shall indicate the sides on which the beam was directly heated. If the upperside of the beam is not directly heated the composition of the topping materials used to protect the upperside should be given in the report as well as the mounting procedure. Besides the position and location of the furnace thermocouples should be given in a drawing.

5. Observations during the test.

5.1. Furnace conditions.

Provide diagrams or tables showing the furnace temperatures recorded (individual readings, mean value and integral) furnace pressure and \( \text{O}_2 \) content at intervals not exceeding five minutes.

5.2. Performance of the test beam.

Note the appearance of deformation and its speed of development until the test specimen collapses or the test is inter-
rupted or until the deformation criterion is reached. If the internal temperature of the test specimen is measured, state how it developed with time and give the position of the measuring points. Note any other information about the performance of the test specimen during the test, e.g. crackening, softening, loosening of parts of the specimen etc...
Description of the specimen after test including photos.

6. Duration.
State on basis of the stability criterion in respect of each test the time in minutes which elapsed from the beginning until the moment when the test was:
- either interrupted intentionally (stating who requested the interruption)
- or interrupted by failure of the test specimen.
The test result should be given in a table as given below;

<table>
<thead>
<tr>
<th>Performance criterion</th>
<th>Duration in minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test 1</td>
</tr>
<tr>
<td>Stability R</td>
<td>r₁</td>
</tr>
</tbody>
</table>

7. Conclusion.

7.1. Duration values to be used for the classification.
Stability R : r₁ 1) ........... minutes.
1) = Lowest value of table I.

7.2 Classification.
Stability R : ............

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8. Remarks concerning the application of test results. In this chapter guidelines in relation with the applicability, limitations or restrictions, special warnings (e.g. special mounting and end conditions, warnings concerning the adhesion or corrosion problems with plaster on steel structures) of this test report shall be given.

9. Remarks concerning national special applications conditions or instructions, etc.... in the country of design.
Testing and classification of the resistance to fire of structural building components

J. Dekker, M. Klingelhöfer, P. Vandevelde

The report concerning 'Testing and classification of the resistance to fire of structural building components' is divided into two parts.

The first part 'Analysis of fire test equipment in EEC laboratories' concerns:
(i) comments on the facilities in the laboratories;
(ii) furnaces;
(iii) operating conditions;
(iv) measuring devices;
(v) loading and end conditions;
(vi) test load;
(vii) criteria and application of test results;
(viii) remarks on test reports.

This first part regroups a vast quantity of information which up until now had never been covered in the same document.

The second part deals with the application of contents from the first part to the establishment of an operational Community method for the testing and classification of fire resistance of structural building components:
(i) load-bearing walls;
(ii) load-bearing partitions;
(iii) non-load-bearing walls;
(iv) non-load-bearing partitions;
(v) simply supported floors (with or without ceilings) with fire attack from the underside only;
(vi) columns;
(vii) simply supported beams.

This second part provides no extrapolation rules.
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