TNO-rapport / TNO report

2005-CVB-R0160

Determination of the fire resistance of an aluminiu door construction, type FP-67, according to NEN-EN 1634-1: 2001in conjunction with NEN 6069:2001

Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek / Netherlands Organisation for Applied Scientific Research

TNO Built Environment and Geosciences

Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek / Netherlands Organisation for Applied Scientific Research

Centre for Fire Research
Van Mourik Broekmanweg 6
P.O. Box 49
2600 AA Delft

www.tno.nl

T +31 15 276 30 00
F +31 15 276 30 25

TNO report

2005-CVB-R0160

Determination of the fire resistance of an aluminium door construction, type FP-67, according to NEN-EN 1634-1: 2001in conjunction with NEN 6069:2001

Date	June 2005
Author(s)	P.A. Ram Dr. Ir. G. van den Berg
Number of pages	16
Number of appendices	4
Sponsor	Çuhadaroglu Metal San. Ve Paz. A.S. Yakuplu Köyü Yolu 34900 Beylikdüzü Istanbul TURKEY
Project name	Fire resistance door construction
Project number	006.55714/01.01

All rights reserved.
No part of this publication may be reproduced and/or published by print, photoprint, microfilm or any other means without the previous written consent of TNO.

In case this report was drafted on instructions, the rights and obligations of contracting parties are subject to either the Standard Conditions for Research Instructions given to TNO, or the relevant agreement concluded between the contracting parties. Submitting the report for inspection to parties who have a direct interest is permitted.

© 2005 TNO

1 Subject

An aluminium door construction, type FP-67, mounted in a 150 mm thick aerated concrete supporting construction, with the door opening away from the furnace.

2 Investigation

Determination of the fire resistance based on the criteria as mentioned in the Dutch standard NEN 6069: 2001. The investigation was made according the European standard NEN-EN 1634-1: 2001 but the conclusions are drawn according the Dutch standard NEN 6069:2001.

3 Sponsor

Çuhadaroglu Metal San. Ve Paz. A.S.
Yakuplu Köyü Yolu
34900 Beylikdüzü Istanbul
TURKEY

4 Place and date of the investigation

The investigation took place in the laboratory of the Centre for Fire Research of TNO Built Environment and Geosciences in Rijswijk, The Netherlands.

The specimen was mounted in the frame on the 20th April of 2005.
The fire test was performed on the 20th April of 2005.

5 Report identification

June 2005, Report no. 2005-CVB-R0160

6 Investigated construction, type "FP-67"

Investigated was an aluminium door construction mounted in an aerated concrete wall of 150 mm thickness with the following parts:

- One door leaf with two insulating panes;
- Frame construction.

For further details see figure 1 up to 7.

The door construction door was mounted so that it was pivoting away from the fire. Hereunder the different parts of the construction are described.

6.1 Door leave

Measurements of the door leaf:
- height: 2038 mm;
- width: 885 mm;
- thickness: 67 mm.

6.1.1 Construction of the door leaf

The construction of the door leaf was as follows:
- Aluminium profiles;
- In these profiles an isolator type [3][1] was integrated;
- Within these profiles two panes, Pyrostop 60-201 [15] were integrated, dimensions of the panes 712 x 914 mm and 712 x 854 mm (w x h).

6.1.2 Mounting of the glass panes

- fireproof setting blocks [19], thickness 5 mm;
- rubber (EPDM) profiles [9];
- aluminium glazing bead profiles [7], sticked on aluminium profiles;
- additional fixed stainless steel profiles [6] were inside the aluminium door leaf, 2 on every side, for retaining the panes;
- in tumescent tape, Flexpan 200, dimensions 25 x 3 mm, inside the door leaf around the panes.

For further details see figure 1 up to 7.

6.2 Hinges and locks

6.2.1 Hinge

Two aluminium hinges were applied in order to hinge the door leaf to the frame construction.
Position of the hinges: 110 mm and 1795 mm measured from top of door leaf.

[1] The numbers in between the rectangular brackets refer to the item list

6.2.2 Doorhandle

A doorhandle was fixed to the door leaf at the non-exposed side. At the exposed side there was only a cover plate.

6.2.3 Lock

Locking mechanism from stainless steel, type E with 30 mm backset

6.2.4 Automatic door seal

Underneath the door, inside the door frame there was an automatic door seal, type Hafele 950.10.013 Al. br./silicone.

A door-closing device was fixed to the door construction, factory Dorma.
Measured closing force was 38-40 N.

6.3 Specimen frame construction

The specimen frame was constructed from aluminium profiles. The depth of the profiles was 67 mm.
Outside dimensions of the frame:

- 1000 x 2100 mm (w x h).

6.4 Fixing materials

Hilti screw anchor HUS 7,5 x 100:

- Eight were used.
  On the left and right side 3 were used. On the topside 2 were used.

6.5 Insulating materials

- This was used as insulating material in the aluminium profiles. Different sizes were used as shown in figure 1 up to 7.

6.6 Supporting construction

The supporting construction existed of aerated concrete of 150 mm thickness.

7 Production and mounting of the supporting construction and specimen

Production of the supporting construction:
TNO Built Environment and Geosciences, Centre for Fire Research
Rijswijk, The Netherlands.

Production of the door leaf construction:
Çuhadaroglu Metal San. Ve Paz. A.S.
Yakuplu Köyü Yolu
34900 Beylikdüzü Istanbul
TURKEY

8 Course of investigation

TNO was not involved in the selection procedure of the specimen. During mounting the used materials and parts were verified against the supplied data.

8.1 Gap widths measurements

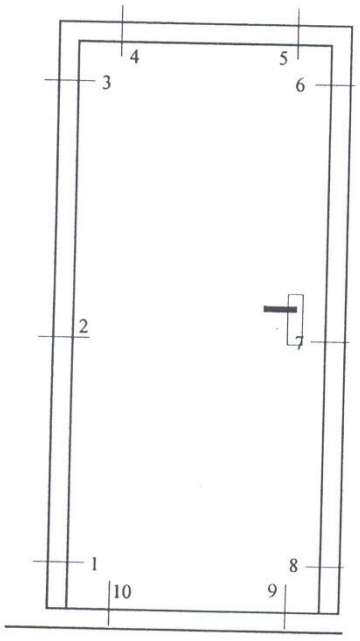


Figure 8.1 –Door joint widths measurement positions

Door gap measured at both side (exposed and non-exposed)
No difference between.

Table 8.1 Gap widths

Measurement position	Door gap (mm)
1	5,8
2	4,3
3	5,1
4	3,7
5	4,4
6	4,0
7	3,2
8	3,8
9	11,1* incl. Door seal
10	11,3* incl. Door seal

8.2 Conditioning

From the moment of installation until the fire test, the specimen was stored in the laboratory of TNO, Centre for Fire Research with the following conditions:

- Ambient temperature: 20 ± 5°C;
- Relative humidity: 50 ± 10 %.

8.3 Density and moisture content

There was no material for determinating the density and moisture content. The door construction was delivered complete including panes, hinges and lock and fire insulation material.

8.4 Fire test

8.4.1 Conditions

The fire test was conducted according to European standard NEN-EN 1634-1: 2001.

The specimen was opening away from the furnace, as requested by the sponsor.
The desired pressure 0.5 m above floor level was 0 Pa.

8.4.2 Measurements

During heating the following was measured and registered:

- The furnace temperatures with 8 plate thermocouples [TPL 1 up to TPL 8];
- The furnace pressure measured at 2.7 m above floor level;
- The surface temperatures of the construction with 35 thermocouples. The positions of the thermocouples on the construction are given in figure C1;
- The radiation measured at one metre distance of the geometrical centre of the construction;
- The displacement of the door leaf.

9 Observations

Thermal insulation was satisfied for 35 minutes. At this, moment the temperature rise measured at thermocouple D2 was 180°C.
At the 62nd minute the 360°C temperature rise was reached at thermocouple K4. At the 96th minute flames were visible longer than 10 seconds: *"end of integrity criterion based on sealing"*.

More details can be found in the Appendix A.

10 Results

The results are given in the appendices B1 up to B4 and C2 up to C8.
During the heating the temperature and air speed in the laboratory complied to the European standard NEN-EN 1634-1: 2001.

10.1 Uncertainty of measurement

Due to the nature of fire resistance testing, in which several non-linear effects are present in both the test configuration and the test specimen, which influence each other, it is at this moment not yet possible to give a stated degree of uncertainty of measurement.

11 Summary

The fire resistance of an aluminium door construction, type FP-67, mounted in the 150 mm thick aerated concrete, with the door leaf pivoting away from the fire, has been determined.

The fire test was conducted according to European standard NEN-EN 1634-1: 2001.
The most important results are given in table 11.1

Table 11.1

Criterion	Time elapsed in minutes, calculated from the start of the test, which the criterion was fulfilled.		
	NEN 6069: 2001	**NEN-EN 1634-1: 2001**	**Remarks**
1. Integrity			
cotton pad	96	96	Not reached
6 mm caliber	96	96	Not reached
25 mm caliber	96	96	Not reached
sustained flaming	96	96	Reached
2. Thermal insulation with relation to the temperature			no criteria in The Netherlands
average rise		81	
maximum rise		96	Not reached
maximum rise (suppl. procedure)		35	Not reached
3. Thermal insulation with relation to the heat radiation	96	96	

12 Conclusion

The fire resistance with regard to the separating function according to the Dutch standard NEN 6069: 2001 of the tested aluminium door construction, type FP-67, mounted in the 150 mm thick aerated concrete, with the door leaf opening away from the furnace: **96 minutes.**

A classification according to European standard NEN-EN 1634-1: 2001 as described in the European standard NEN-EN 13501-2: 2004 can be made in a separate document.

13 Field of direct application of test results

The conclusion given in chapter 12 is only valid for constructions, which are in detail the same, including shutters and applied materials, as the described construction in this report. The following requirement will have to be satisfied:

- The dimensions, w x h, are equal or smaller or the same as investigated;
- Door opening only away from the furnace
- The thickness off the used materials may not be decreased;
- The gap widths should not be greater that the values specified in chapter 8;

- The c.t.c. distances of the fixing materials may not be increased;
- The number of fixing materials may not be decreased;
- The construction should be installed in a supporting construction with a thickness of at least 150 mm and a specific density of at least 625 kg/m^3;
- The number of glazed apertures and each of the dimensions of glass in each pane included within the test specimen may be decreased but shall not be increased beyond the tested pane size;
- The distance between the edge of the glazing and the perimeter of the door leaf, or the distance between glazed apertures shall not be reduced from those incorporated in the test specimen. Other positioning within the door can only be modified if this does not involve the removal or re-positioning of structural members.

14 Extended application

In view of the results of the fire test it is allowed, according NEN-EN 1634-1:2001for a fire resistance of 60 minutes, to increase the dimensions of the door leaf with the following percentage:

- height maximum 15%;
- width maximum 15%;
- total surface maximum 20%.

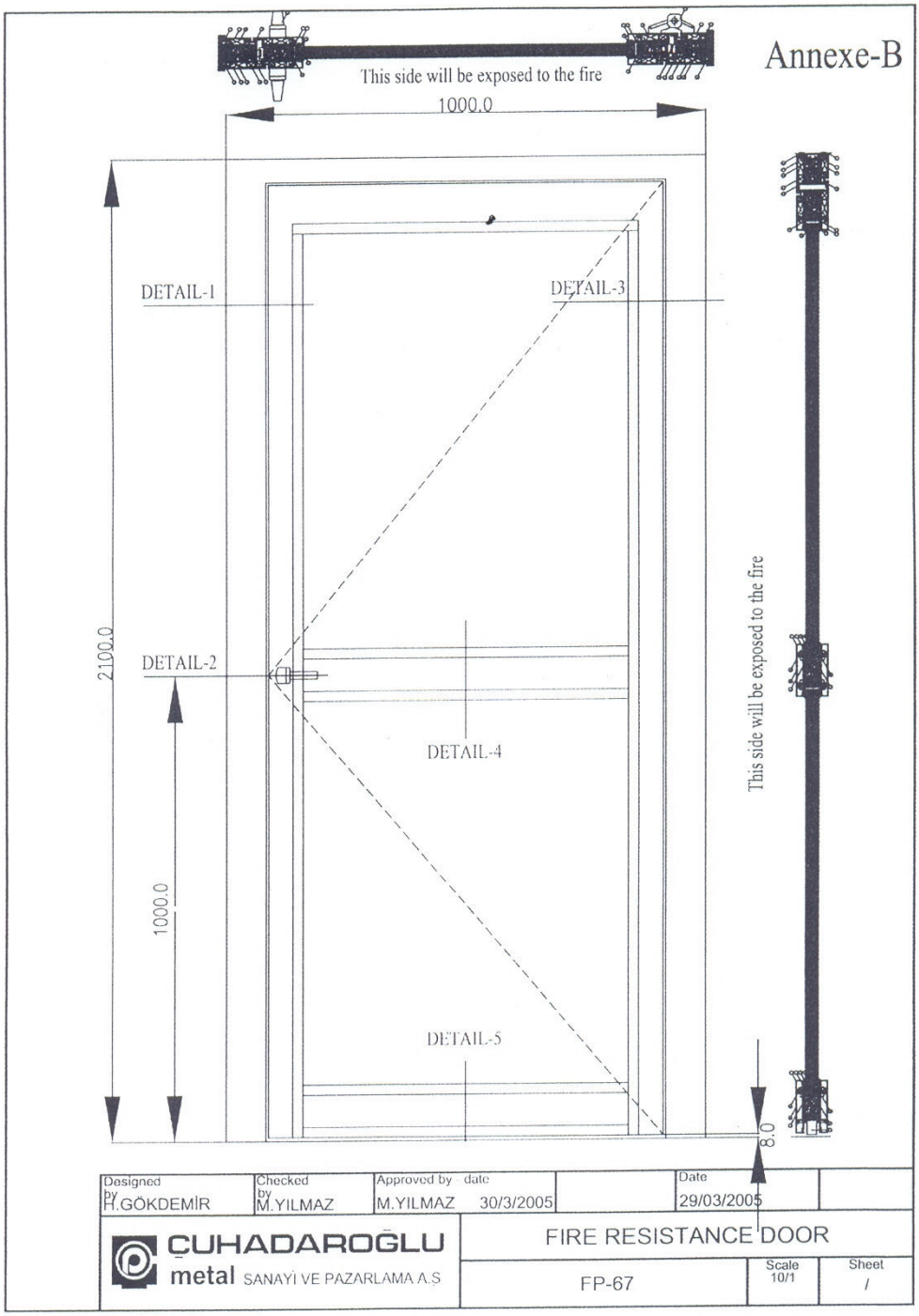
Under the next conditions:

- distance of the fixing height of the top hinge until the top of the door leaf may not increase compared to the investigated construction;
- distance of the fixing height of the lowest hinge until the bottom side of the door leaf may not increase compared to the investigated construction.

P.A. Ram

Dr. Ir. G. van den Berg

Figure 6


Annexe-B
This side will be exposed to the fire
1000.0
DETAIL-1
DETAIL-3
DETAIL-2
DETAIL-4
DETAIL-5
2100.0
1000.0
This side will be exposed to the fire
8.0
Designed by H.GÖKDEMİR
Checked by M.YILMAZ
Approved by - date M.YILMAZ 30/3/2005
Date 29/03/2005
ÇUHADAROĞLU metal SANAYİ VE PAZARLAMA A.Ş
FIRE RESISTANCE DOOR
FP-67
Scale 10/1
Sheet /

A Observations

Time [minutes]	Observation
0	Start of heating
1:10	Cracking of the upper glass on the exposed site.
3:40	Some smoke escape from underneath the door.
4:00	Topmost point of the door on locking side bend a distance of 20 mm from the fire, lowest point 15 mm.
4:30	Upper pane start to turn white.
5:00	Lower pane start to turn white.
6:00	The upper pane at the directly exposed side is falling down into the furnace.
7:00	The lower pane at the directly exposed side is falling down into the furnace.
15:00	Topmost point of the door on locking side bend a distance of 30 mm from the fire, lowest point 20 mm.
21:00	Thermocouple G8 has become unstuck, but still hanging.
23:00	Bending of the door decrease at topmost point to 18 mm, at the lowest to 15 mm.
34:00	Black colour around lock.
41:30	Cap of the upper hinge is falling down.
45:00	Smoke escape over a distance of 300 mm between topmost horizontal glass profile and doorframe.
47:30	Oil is falling down out of the door-closing device.
66:00	Upper pane start to sag.
76:00	Oil leaking out of the door-closing device has been stopped.
90:00	Red glare is visible at the top of the upper pane.
93:00	Flames are visible shorter than 2 sec at the top of the lower pane
96:00	Flames are longer visible than 10 sec at the top of the lower pane. *"End of integrity criterion based on sealing".*
97:00	End of measurements, recordings an heating

C Measurements on specimen

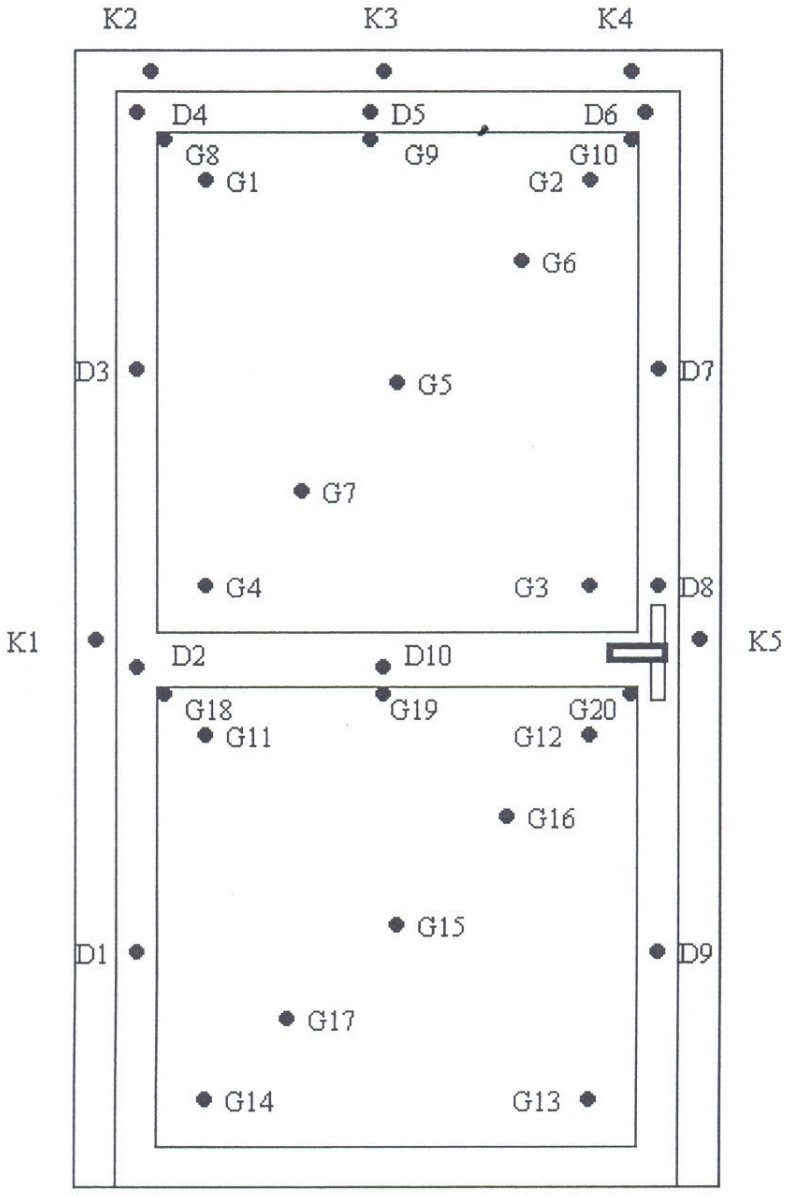
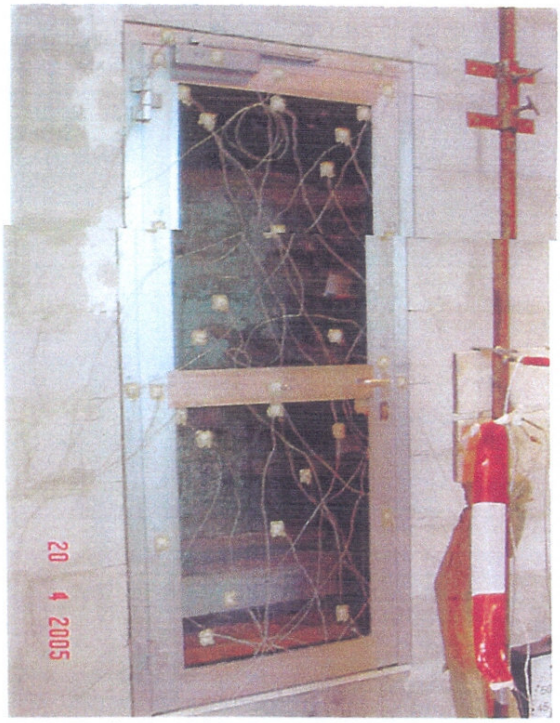


Figure C.1 : Location thermocouples

D Photographs



D1: Specimen before the test

D2: Specimen after 15 minutes

D3: Door-closing device after 50 minutes

D4: Lower pane after 93 minutes

D5: Specimen after 97 minutes