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REPORT

Determination of smoke control according to EN 1634-3:2004 + C1:2007 of metal vertical shutter type " B " manufactured by GORTER GROUP BV

Report no.	2023-Efectis-R000940
Sponsor	Gorter Group BV P.O. Box 265 1740 AG SCHAGEN THE NETHERLANDS
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1. GENERAL

1.1 REPORT

This report details the method of construction, the test conditions and the results obtained when the specific element of construction described herein was tested following the procedure outlined in EN 1363-1:2020, and where appropriate EN 1363-2:1999 + C1:2001. Any significant deviation with respect to size, constructional details, loads, stresses, edge or end conditions other than those allowed under the field of direct application in the relevant test method is not covered by this report.

1.2 SUBJECT

Test of a vertical shutter, opened away from the exposed side, manufactured by Gorter Group BV.

1.3 INVESTIGATION

Determination of smoke resistance according to EN 1634-3:2004/C1:2007: Fire resistance tests for door and shutter assemblies - Part 3: Smoke control doors and shutters

The specimen was tested at ambient and medium temperature as described in EN 1634-3:2004/ C1:2007.

The construction was tested for one side for leakage at ambient **(S_a)** together with medium temperature **(S_m)** with the shutter leaf opening away from the exposed side.

1.4 SPONSOR AND MANUFACTURER

Table 1.1: Sponsor and manufacturer

Sponsor and manufacturer	Gorter Group BV P.O. Box 265 1740 AG SCHAGEN THE NETHERLANDS

1.5 LOCATION AND DATE REGARDING THE EXAMINATION

The research was conducted at the laboratory of Efectis Nederland BV in Bleiswijk, the Netherlands.

Table 1.2: Date of the examination

Notified body number	1234
Assembly-of the test specimen	24th of July 2023
Smoke control test	25th of July 2023

1.6 NORMATIVE REFERENCES

Table 1.3: Normative references

European standard	Part
EN 1363-1:2020	Fire resistance tests – Part 1: General requirements
EN 1634-3:2004 + C1:2007	Fire resistance tests for door and shutter assemblies - Part 3: Smoke control doors and shutters
EN 16034:2014	Pedestrian doorsets, industrial, commercial, garage doors and openable windows – Product standard, performance characteristics – Fire resisting and/or smoke control characteristics
Egolf position paper	006-2019

1.7 REVISION INFORMATION

This is the first issue of the test report.

2. TEST SPECIMEN

2.1 GENERAL

For the dimensions and specifications of the materials and components of the examined construction, also see the figures in chapter 8. Details of the assembly of the construction are given in the paragraphs below.

The tested specimen data were supplied by the Sponsor to the Test Laboratory on his own initiative, in conformity with paragraph 12 of standard EN 1363-1: 2020. The laboratory performed a detailed examination of the test specimen prior to testing and verified the accuracy of the information provided.

2.2 TEST SPECIMEN

The test specimen was a metal vertical shutter of type ' B ' consisting of metal vertical shutter mounted in metal frame. The shutter was surrounded with intumescent strip components manufactured by Gorter Group BV.
The shutter leaf opened away from the exposed side. The shutter was built into an associated supporting construction.

2.2.1 Test Frame

The test frame was constructed of hollow steel profiles with an aperture of 3.4 x 3.4 m (w x h) and an insertion width of 100 mm.

2.2.2 Supporting Construction

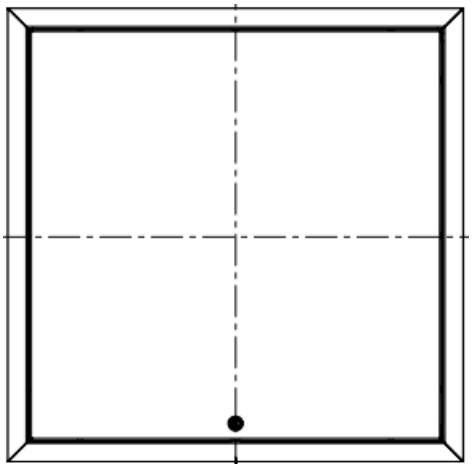
The test specimen was built into an associated supporting construction, being a one layer of gypsum board of 12.5 mm for each side screwed to a metal stud construction and sealed from the edges.

Table 2.1: Specifications supporting construction

Specifications associated supporting construction according to EN 1363-1 table 1	
Overall dimensions	3500 x 3500 x 100 mm (w x h x t)
Aperture	900 x 900 mm (w x h)

Materials	Plasterboard: type “A”,12.5 mm (EN 520) Steel profiles: Rolled steel U- track and C studs profiles.
Manufacturers of components	Plasterboard: Gyproc Steel profiles: Gyproc
Number of layers plasterboard	One layer of 12.5 mm plasterboard on both sides
Fixing	Both layers were fixed with galvanized gypsum board screws at a c.t.c distance of max. 300 mm

2.2.3 Shutter

Specifications shutter	
	
Manufacturer	Gorter Group
Type	Wall shutter type B
Product name	Wall shutter type B, 120 minutes fire resistance.
Material	Steel
Dimensions	Shutter in- in (800 x 800) mm (w x h) Outer out-out (900 x 900) mm (w x h)
Function	Access door.
Fixing	Screwed to the metal stud

2.2.4 Sealant

Specifications sealant	
Manufacturer	Zwaluw
Type	Acryl Exterior+
Product name	Zwaluw Acryl exterieur+
Material	Acrylaatdispersie

Dimensions	310 ml (Koker)
Position	Sealing the gap between the metal stud and wall, And the gap between the vertical shutter and supporting construction.
Function	Sealing the gaps.

2.2.5 Metal profile

Specifications metal profile	
Manufacturer	Gyproc
Type	C75
Product name	Metal profile
Material	steel
Dimensions	75 x 3600 mm
Position	Inside supporting construction.
Function	Assembled to make frame wall

2.2.6 Gypsum board

Specifications gypsum board	
Manufacturer	Gyproc
Type	Plasterboard: type “A”,12,5 mm (EN 520)
Product name	Gypsum board
Material	Gypsum
Dimensions	3600 x 1200 x 12,5 mm
Function	Wall cladding.
Fixing	Screwed to the metal stud

2.2.7 Vapour tight

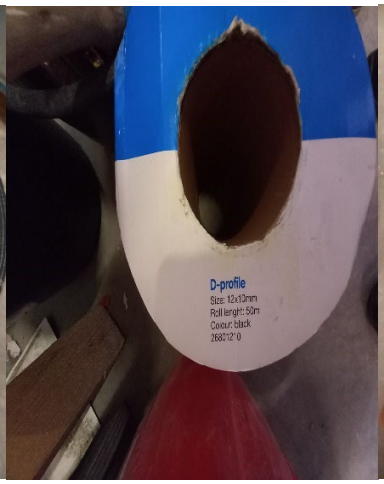
Specifications vapour tight	
Manufacturer	PE Bouwfol
Type	T200
Product name	Bouwfolie
Material	Transparant polyethylene film

Dimensions	(3x 50) m (w x l)
Position	Between metal stud and plasterboard
Function	Vapour tight lay in the wall
Fixing	Duct tape

2.2.8 Screws

Specifications screws	
Manufacturer	A.S.F. Fischer
Type	Fis Fix
Product name	Gypsum screw
Material	Steel
Dimensions	3.5 x 35 mm
Function	Fixing plasterboard to the metal profile

2.2.9 Seal

Specifications seal	
  	
Manufacturer	Kelfort D-profile
Type	Mosrubber D profile
Product name	D profile
Material	Cellular rubber
Dimensions	Kelfort D-profile

Position	Fixed between metal profile and supporting construction
Function	Airtight

2.2.10 Tape

Specifications tape	
Manufacturer	KIP
Type	3824
Product name	Duct tape
Dimensions	50 mm x 50m1
Function	Airtight between supporting construction and frame

2.3 METHOD OF ASSEMBLY

The test specimen was built in the following order:

- Supporting construction was built in the empty frame.
- The vertical shutter was installed in the centre of the supporting construction.

3. ASSEMBLY AND MANUFACTURING OF THE CONSTRUCTION

Table 3.1: Assembly and manufacturing of the construction

Efectis Nederland BV	Test frame
Gorter Group BV	Assembly and manufacturing of support construction and specimen

4. RESEARCH METHOD

4.1 VERIFICATION OF THE SPECIMEN

The materials and components used were inspected during assembly on the basis of the supplied drawings and data. Efectis Nederland BV was not involved in the selection or sampling of the materials.

Efectis Nederland BV received samples of materials used in the construction of the specimen to determine the density and moisture content.

4.2 CONDITIONING OF TEST SPECIMEN

4.2.1 Mechanical conditioning

From the moment of assembly until the smoke resistance test the specimen was stored in the laboratory of Efectis Nederland BV under the following conditions.

Table 4.1: Laboratory conditions during conditioning

Laboratory conditions during conditioning	
Ambient temperature:	20 ± 5°C
Relative humidity:	50 ± 10 %

4.2.2 Density and moisture content

The density and the moisture content of materials and components used during assembly was determined by Efectis Nederland BV.

Efectis Nederland BV received samples of materials used in the construction of the specimen to determine the density and moisture content.

Table 4.2: Density and moisture content

Material	**Density [kg/m^3]** *(information provided by sponsor)*	**Density [kg/m^3]** **(***as determined by Efectis)*	**Moisture content [%]** **(***as determined by Efectis)*
Plasterboard	800	719	0,6

Note: The presented moisture content is calculated based on the dry weight of the product which is in line with international guidelines.

4.3 PRE-TEST EXAMINATION AND PREPARATION

4.3.1 Closing forces

The shutter was not provided with a closing device. Therefore, no closing force was measured.

4.3.2 Open and close cycle

Prior to the smoke leakage test, the shutter was opened and closed 10 times according to EN 1634-3/C1. The shutter was opened to a 30-degree position and then closed again by hand.

4.3.3 Locking

The shutter was locked with its own latch mechanism during the smoke test. Keys were removed from the lock.

4.3.4 Gap measurements

The length of the gap between the shutter leaf and frame was 3200 mm measured from four sides. Prior to the smoke test the gap widths were measured. The measured gap widths are given in chapter 8.

4.4 LEAKAGE TEST

4.4.1 Determination of apparatus leakage rate

In accordance with EN 1634-3/C1 prior to the smoke test the leakage rate of the apparatus was determined:

The leakage rate through the test chamber at ambient temperature (20˚C)
- At ∆10 Pa was 1.1 m^3/h.
- At ∆25 Pa was 2.4 m^3/h.
- At ∆50 Pa was 3.8 m^3/h.

The leakage rate through the test chamber at medium temperature (200˚C):
- At ∆10 Pa was 1.5 m3/h.
- At ∆25 Pa was 0.0 m3/h.
- At ∆50 Pa was 0.0 m3/h.

4.5 SMOKE TEST

4.5.1 Laboratory conditions

During the smoke resistance investigation, the test conditions in the laboratory were as given below.

Table 4.3: Laboratory conditions during smoke test

Laboratory conditions	
Ambient temperature:	10 - 40°C
Relative humidity:	50 ± 10 %

4.5.2 Test conditions

The conditions during the smoke leakage test were according to EN 1363-1.

4.5.3 Procedure of determination of total leakage rate

The average air temperature close to the face of the shutter was raised from ambient temperature to a stabilisation temperature of 200 °C in such a manner that the average air temperature is maintained as described in EN 1634-3. The temperature distribution over the face of the shutter was 200 °C. During the heating up period the pressure in the bottom of the test chamber was maintained below 20 Pa for the first 5 minutes and 10 Pa for the rest of the duration. After 5 minutes, the outlet valve was closed, and the stable conditions are achieved again. The pressure after achieving stable conditions was 20 Pa. See graphs annex B.

- The total leakage rate at ambient temperature (20˚C) for side A was:
  - At Δ 10 Pa → 2.7 m^3/h
  - At Δ 25 Pa → 5.5 m^3/h
  - At Δ 50 Pa → 9.4 m^3/h
  -
- The total leakage rate at medium temperature (200˚C) for side A was:
  - At Δ 10 Pa → 9 m^3/h
  - At Δ 25 Pa → 11.2 m^3/h
  - At Δ 50 Pa → 14.6 m^3/h

4.5.4 Pressure

The total leakage rate was measured at pressure differences of Δ10 Pa, Δ25 Pa and Δ50 Pa pressure was measured at 1182 mm in relation to the sill level.

4.5.5 Measurements

During the smoke test the following data was measured and registered:

Environment (measurements are given in appendix A)

- The temperature in the laboratory outside the smoke chamber.

Smoke chamber conditions (measurements are given in appendix A)

- The air temperature inside the smoke chamber
- The pressure in the smoke chamber.

Air flow (measurements are given in appendix B)

- Air flow rate at ambient temperature;
- Air flow at medium temperature.

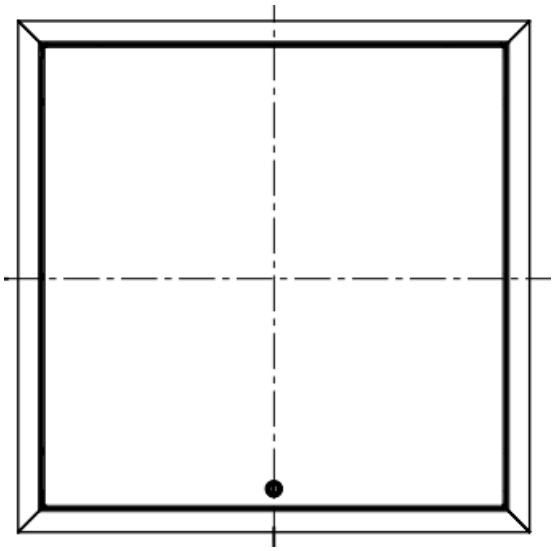
Specimen (measurements are given in appendix B)

The positions of deflection measurements are given in appendix B.

5. RESULTS OF THE SMOKE CONTROLE TEST

5.1 OBSERVATIONS DURING HEATING

Table 5.1: Observations during the smoke test

Observations

The numbers refer to the time and position of the observation

Time [min]	**Observations**
0	Start of test
45	End of test after attainment of the test results

5.2 ABILITY TO OPEN SPECIMEN AFTER MEDIUM TEMPERATURE TEST

After the medium temperature test, it was possible to open the specimen.

5.3 TEST RESULTS

Test results for the specimen(s) are given in Appendix B

5.4 PHOTOGRAPHS

Photographs taken during construction and after the smoke test are shown in appendix C.

5.5 UNCERTAINTY OF MEASUREMENT

Because of the nature of smoke resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of smoke resistance, it is not possible to provide a stated degree of accuracy of the result.

6. SUMMARY OF THE TEST RESULTS

6.1 SUMMARY OF TESTED SPECIMEN

The smoke resistance was determined of a metal vertical shutter of type ' B ' consisting of metal vertical shutter mounted in metal frame. The shutter was surrounded with intumescent strip components manufactured by Gorter Group BV.
The shutter leaf opened away from the exposed side. The shutter was built into a flexible supporting construction.

The smoke test was conducted according to EN 1634-3:2001/C1:2001.

6.2 SUMMARY OF TEST RESULTS

6.2.1 Performances

Table 6.1: Summary of test results ambient together with medium temperature

No of test	Face exposed to pressure	Temperature	*Leakage rate $Q_{spec}^{(20)}$ (m^3/h) at			**Linear leakage rate Q_l ($m^3/h/m$) at		
			10 Δ Pa	25 Δ Pa	50 Δ Pa	10 Δ Pa	25 Δ Pa	50 Δ Pa
1	Side A	Ambient	1.6	3.1	5.6	0.5	0.96	1.75
3	Side A	Medium	7.5	11.2	14.6	n.a.	n.a.	n.a.

* *(minus leakage rate mentioned in 4.4.1)*
** *(divided by gap length mentioned in 4.3.5)*

Table 6.2: Other performances

Performances	*Criteria*	*Pass or fail?*
Smoke leakage	*Maximum leakage rate measured at ambient temperature*	*Pass*
	Maximum leakage rate measured at both ambient temperature and 200 °C	*Pass*

7. FIELD OF DIRECT APPLICATION OF TEST RESULTS

7.1 GENERAL

The field of direct application of test results is restricted to the allowable changes which a sponsor may make to the tested specimen following a successful smoke leakage test. These variations may be introduced automatically without the need for the sponsor to seek additional evaluation, calculation or approval. The results of the leakage test continue to apply to assemblies of a different construction subject to the following:

a) The assembly is of a similar generic construction, e.g. a solid timber leaf in a timber frame or a folded sheet metal leaf in a steel frame.

b) The mode of operation is identical, e.g. single swing, double swing, roller shutter or folding leaf.

c) In the case of assemblies that only require a restriction in the leakage rate from one direction only then the direction does not vary from that tested.

d) The stiffness of the supporting construction and the method of fixing and sealing the frame to the supporting or associated construction shall not be less than that of the tested construction (this may be the specimen frame in some furnaces).

Doors tested in a flexible construction may be installed into rigid constructions but not *vice-versa*. Doors tested in a flexible construction to achieve ambient temperature classification S_a may be installed in alternative flexible constructions. The use of alternative flexible constructions for doors with S_m classification will be the subject of extended application considerations.

7.2 CONSTRUCTION OF ASSEMBLY

7.2.1 General

a) Decorative finishes such as paints may be varied.

b) The clearance gaps between components may be varied but shall not be greater than those in the tested assembly and where gaps are smaller they shall not impair the ability of the leaf/leaves/curtain to close, especially in cases where both leaves of hinged or pivoted door assemblies are opened or closed simultaneously.

c) Threshold gaps protected by active drop seals may be varied within the movement range specified by the seal manufacturer.

7.2.2 Hinged or pivoted leaf assemblies

7.2.2.1 Metal leaves

a) The door leaf shall be constructed in an identical manner and material, i.e. pan and tray, and the method of jointing shall be identical and any stiffening is not reduced, and for ambient temperature (S_a) only applications the stiffening may be increased.

NOTE 1 For medium temperature (S_{200}) smoke leakage rates the stiffening should not be varied as any increase in stiffness may result in higher temperature transfer and/or increased bowing.

b) The door leaf may incorporate additional insulation materials if the assembly is to resist the spread of ambient smoke but extra insulation material shall not be incorporated in door leaves designed to resist medium temperature (S_{200}) smoke.

NOTE 2 Extra insulation material leads to increased thermal differentials which invariably result in increased distortion.

7.3 SIZE AND ASPECT RATIO

7.3.1 Hinged and pivoted leaf assemblies

7.3.1.1

The leaf size shall not be increased but may be reduced providing that the number of any movement restrictors such as locks, latches and hinges is not decreased (but may be increased).

7.3.1.2

The aspect ratio of the leaf may be changed, subject to the restrictions in 13.2.2.1 and/or 13.2.2.2 and subject to the length of the leakage path not being extended.

7.4 HARDWARE AND FITTINGS

Elements of hardware or ironmongery and/or their fixing technique may not be changed without extended application evaluation.

The positioning of elements of hardware or ironmongery may be modified for ambient temperature (S_a) smoke application but shall not be changed for medium temperature (S_{200}) applications.

7.5 SEALS

As the sealing system is a critical part of the test, no modification may be made to the system tested.

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