Report

Metacon B.V.
T.a.v. dhr. M. Asscheman
James Wattstraat 14
2809 PA GOUDA

Our reference	2015-Efectis-R000988/BGG/TNL	Bleiswijk, 21July 2015
Project number	2015600	

Expert judgement on fire resistance
Maximum dimensions of Metacon RGS EW360 ECO Twindoor

Dear Mr. Asscheman,

You have requested Efectis Nederland BV to give expert judgement, using where possible the EXAP standard EN 15269-10:2011, on the fire resistance of a rolling shutter construction developed by your firm. The rolling shutter is of type Metacon RGS EW360 ECO Twindoor.

The construction has been tested for fire resistance. The test results are described in Efectis NL report 2015-Efectis-R000525[Rev.1] dd. June 2015. The tested dimensions of the rolling shutter were 4000 x 3500 mm (width x height). In the direct field of application in the test report a limited extension of the tested dimensions is allowed, see chapter 7.3 of the test report.

Your question is what the maximum dimensions of the rolling shutter can be if the rules from the EXAP standard EN 15269-10:2011 are followed. This will be explained in this letter.

This expert judgement is based on:

− Efectis NL test report 2015-Efectis-R000525[Rev.1] dd. June 2015;

− standards EN 1634-1:2014, EN 15269-10:2011;

− Knowledge and experience of Efectis Nederland BV.

Efectis NL test report 2015-Efectis-R000525[Rev.1]

This report gives the results of a fire test which was performed on a rolling shutter of type Metacon RGS EW360 ECO Twindoor. The rolling shutter construction had overall dimensions 4000 x 3500 mm (width x height).

The rolling shutter construction was a combination of two identical shutters, mounted at both faces of the support construction. One of the rolling shutter was mounted on the fire side and the other rolling shutter was mounted on the non-fire side. The supporting construction consisted of 200 mm thick aerated concrete.

Efectis Nederland
2015-Efectis-R000988/BGG/TNL
21 July 2015
METACON B.V.

Rapport

The fire test was performed on 27 March 2015, according to the European standard EN 1634-1:2014. The results can be summarized as follows:

- Integrity (E)   400 minutes (full test duration)
- Thermal insulation (I_1 and I_2)   30 minutes
- Heat radiation (W)   11.5 kW/m^2 after 400 minutes

See photo 1 for the test specimen, before the fire test.

Photo 1

1. EXPERT JUDGEMENT REGARDING MAXIMUM DIMENSIONS ACC. EN 15269-10:2011

You have asked what the maximum dimensions of the rolling shutter are if the extrapolation rules in the EXAP standard EN 15269-10:2011 are followed.

In the EXAP standard EN 15269-10:2011 rules are given in articles A.1.2 and A.1.4 for the extrapolation of the height and width of tested constructions. These articles give specific requirements for E, EI and EW applications and refer to Annex B for methods of calculation.

These methods of calculation will, as far as possible, be followed in this document.
The calculations will be specific for the Metacon RGS EW360 ECO Twindoor construction. The rolling shutter construction has to remain fulfilling the classifications E and EW for 360 minutes. Officially, according to EN 13501-2, such classifications are not allowed. However, for the present assessment, the calculations are performed as if those classifications exist.

Efectis Nederland
2015-Efectis-R000988/BGG/TNL
21 July 2015
METACON B.V.

Rapport

B.3   Barrel calculations

For the rolling shutter configuration as tested, the following calculation applies.

Barrel outside diameter (D_B) =   133 mm

Lath length (L_L) =   3 600 mm

Height of shutter aperture (h_{AS}) =   2 810 mm

Weight per unit area of lath (ρ_L) =   22.5 kg/m^2

➔   Shutter weight (W_L) =   227 kg

Weight of barrel (W_B) =   43 kg

➔   Barrel assembly weight (W_{BA}) =   2646 N

Barrel wall thickness (t_B) =   3.0 mm

➔   Barrel moment of inertia (I_B) =   2 588 345 mm^4

➔   Barrel section modulus (Z_B) =   38 922 mm^3

Barrel length (L_B) =   3476 mm

➔   Barrel stress (σ_B) =   29.5 N/mm^2

Barrel deformation factor (E_B) =   42 10^3 N/mm^2, taken from EN 1993-1-2
for 1100 ^{o}C (temperature of barrel at not-directly exposed side after 360 minutes)

➔ Free deflection of barrel (d_B) =   13.3 mm

This means a maximum deformation of 13.3 mm in relation to a length of the barrel of 3476 mm. This corresponds to a deformation of 1/260 of the barrel length. This deformation can be accommodated in the labyrinth mounted on the wall and on the last lath. Also the overlap of the mounting frame of the rolling shutter has to be dimensioned for this. In the rest of this document the maximum allowable deformation is set at 1/500 of the barrel length (when ≤ 10 meters) and at 1/800 of the barrel length (when > 10 meters).

If the maximum deformation of the barrel length is exceeded you will use a heavier type of barrel. First you will increase the wall thickness of the barrel within the possible thicknesses of 4.0 - 6.3 mm, eventually combined with an increase in the diameter of the barrel; within the possible diameters of 168.3 - 219.1 - 323.9 mm.

A summary table of acceptable dimensions is given in Table 1.

Efectis Nederland
2015-Efectis-R000988/BGG/TNL
21 July 2015
METACON B.V.

Rapport

Table 1 – Summary of barrel dimensions in relation to the dimensions

clear opening dimensions w x h [mm]	Weight of the rolling shutter [kg]	Barrel diameter [mm]	wall thickness of the barrel [mm]
3 000 x 3 000	203	159.0	3.0
4 000 x 4 000	360	159.0	3.0
5 000 x 5 000	563	168.3	4.0
6 000 x 6 000	810	219.1	4.0
7 000 x 7 000	1 103	323.9	4.0
8 000 x 8 000	1 440	323.9	4.0
10 000 x 8 000	1 800	355.6	4.0
8 000 x 10 000	1 800	323.9	4.0
12 000 x 7 000	1 890	508.0	4.0
7 000 x 12 000	1 890	323.9	4.0
15 000 x 6 000	2 025	610.0	4.0
6 000 x 15 000	2 025	323.9	4.0

For the present calculation the maximum dimensions of the rolling shutter are set to 15 x 6 meters. The EXAP standard EN 15269-10:2011 does not mention maximum dimensions.

B.5 Axle calculations

Axle diameter (DA) = 30 mm

➔ Axle section modulus (ZA) = 2 651 mm^3

Motor weight (W$_{AL}$) = 6 kg

Axle length (L$_A$) = 20 mm (determining till support)

Lath length (L$_L$) = 4000 mm

Height of shutter aperture (h$_{AS}$) = 4000 mm

➔ Barrel assembly weight (W$_{BA}$) = 936 N

➔ Axle bending stress (σ$_{A1}$) = 8 N/mm^2

➔ Axle shear stress (σ$_{A2}$) = 1 N/mm^2

These values are under the allowed stresses because according to EN 1993-1-2 it is specified that 3% of the strength of the steel at room temperature will remain at a temperature of 1100 ^{0}C (this is taken as the temperature of the axle at the not-directly exposed side after 360 minutes of heating). This means 3% of 355 N/mm^2 = 10.1 N/mm^2.

Efectis Nederland
2015-Efectis-R000988/BGG/TNL
21 July 2015
METACON B.V.

Rapport

In case of larger dimensions and weights, the axle diameter will be increased. The diameter will be chosen such that the combined stress will stay below 10.1 N/mm^2. Efectis NL suggest to incorporate some safety margin, and thus advises to stay below 5 N/mm^2. Results are presented in Table 2.

Table 2 – Summary of axle diameters

clear opening dimensions w x h [mm]	Weight of the rolling shutter [kg]	Axle diameter [mm]
3 000 x 3 000	203	30.0
4 000 x 4 000	360	50.0
5 000 x 5 000	563	60.0
6 000 x 6 000	810	70.0
7 000 x 7 000	1 103	70.0
8 000 x 8 000	1 440	90.0
10 000 x 8 000	1 800	120.0
8 000 x 10 000	1 800	90.0
12 000 x 7 000	1 890	120.0
7 000 x 12 000	1 890	90.0
15 000 x 6 000	2 025	120.0
6 000 x 15 000	2 025	90.0

B.6   Endplate calculations

In annex B.6 a method of calculation is given for the dimensioning of the end plates that support the barrel axle on both sides of the barrel.

Endplate height (h_E) =   350 mm

Fixing angle cross-sectional area (A_{FA}) =   350 x 3 = 1050 mm^2

➔   Weight of fixing angle (W_{EEL}) =   288.5 N

Endplate width (w_E) =   350 mm

Endplate thickness (t_E) =   3 mm

Endplate cross-sectional area (A_E) =   1050 mm^2

Area correction factor (ϕ) =   1.0 [-]

Length correction factor (φ) =   16.67 [-]

50% of barrel assembly weight (W_E) =   468 N

Axle end bearing length (L_E) =   10 mm

Load on end plate due to motor (W_M) =   60 N

Effective motor shaft length (L_M) =   300 mm

Efectis Nederland
2015-Efectis-R000988/BGG/TNL
21 July 2015
METACON B.V.

Rapport

➔ Endplate bending stress (σ_{EB}) = 2.4 N/mm^2

Endplate self-weight (W_{ESL}) = 28,3 N

Eccentric loading (W_{EL}) = 528 N

Total endplate load (W_T) = 532 N

Number of bolts = 5

Cross-section of bolt (M10) = 75 mm^2

➔ Shear stress in bolts (τ_{EFB}) = 1.4 N/mm^2

➔ Tensile force on top bolt (F_{EFB}) = 122.5 N

➔ Tensile stress in top bolt (σ_{EFB}) = 1.6 N/mm^2

These values are under the allowed stresses because according to EN 1993-1-2 it is specified that 3% of the strength of the steel at room temperature will remain at a temperature of 1100 ^{0}C (this is taken as the temperature of the endplate at the not-directly exposed side after 360 minutes of heating). This means 3% of 355 N/mm^2 = 10.1 N/mm^2.

In case of larger dimensions and weights, the endplate cross-sections will be increased. The dimensions will be taken in the following steps : width and height 200 – 250 – 300 – 350 – 400 mm etc., and the thickness is chosen as 3 – 4 – 5 mm etc. Efectis NL suggest to incorporate some safety margin, and thus advises to stay below 5 N/mm^2. Results are presented in Table 3.

Table 3 – Summary of endplate dimensions

clear opening dimensions w x h [mm]	Weight of the rolling shutter [kg]	Endplate height x width [mm]	Endplate thickness [mm]
3 000 x 3 000	203	350 x 350	3.0
4 000 x 4 000	360	400 x 400	3.0
5 000 x 5 000	563	450 x 450	3.0
6 000 x 6 000	810	500 x 500	4.0
7 000 x 7 000	1 103	600 x 600	6.0
8 000 x 8 000	1 440	600 x 600	8.0
10 000 x 8 000	1 800	650 x 650	10.0
8 000 x 10 000	1 800	650 x 650	8.0
12 000 x 7 000	1 890	700 x 700	12.0
7 000 x 12 000	1 890	700 x 700	10.0
15 000 x 6 000	2 025	750 x 750	12.0
6 000 x 15 000	2 025	750 x 750	10.0

Efectis Nederland
2015-Efectis-R000988/BGG/TNL
21 July 2015
METACON B.V.

Rapport

B.7   Shutter expansion allowance

If the width of the rolling shutter in practice is larger than in the test, then the depth in through which the laths fall in the side guides will be increased by 5 mm per extra meter of width. If the rolling shutter is less wide then tested then the side guides will be constructed as tested.

B.8   Fire performance of fixings

In test report 2015-Efectis-R000525[Rev.1] it is proven that the tested fixing method (anchoring completely through the wall with anchor plates on the cold side) is a suitable method for a fire resistance of at least 360 minutes if the rolling shutter is mounted on an aerated concrete wall with a thickness of 200 mm. The rolling shutter may also be mounted on heavier supporting constructions such as concrete as long as the fixing method stays the same as tested and the wall is at least 200 mm thick.

For other types of supporting constructions or fixing methods it has to be proven that they fulfil the requirements given in the EXAP standard EN 15269-10 in the articles J.1.1 t/m J.1.6. The rolling shutter may also be mounted on a steel supporting construction if the requirements of article J.2.1 of EN 15269-10:2011 are fulfilled.

1.1   CONCLUSION REGARDING MAXIMUM DIMENSIONS ACC. EN 15269-10:2011

Based on the approach in the EXAP standard EN 15269-10, it is concluded that the rolling shutter construction type Metacon RGS EW360 ECO Twindoor, as tested and described in Efectis NL test report 2015-Efectis-R000525[Rev.1], will have a fire resistance of **360 minutes based on the EW-criteria**.

The construction may be enlarged under the following conditions:

-   Maximum dimensions are 15 x 6 meter (width x height or height x width)

-   Dimensioning of the barrel dimensions according to Table 1 in B.3

-   The axle dimensions at the end plates will be dimensioned on the basis that the remaining steel strength will be at least 5% of the strength at room temperature, see B.5 and B.6

-   Modification of the side guides according to B.7

-   Mounting of the rolling shutter construction following the guide lines from B.8

Efectis Nederland
2015-Efectis-R000988/BGG/TNL
21 July 2015
METACON B.V.

Rapport

2. EXPERT JUDGEMENT REGARDING THE SUPPORT CONSTRUCTION

You have asked whether it is allowed to install the construction in alternative supporting constructions. The test specimen was installed in a support construction of 200 mm thick aerated concrete.

Aerated concrete

A reduction of wall thickness is not allowed in both the direct field of application of the EN 1634-1:2014 as well as the EXAP standard EN 15269-10:2011. The rules in the standards mentioned above are however based on maintaining the same classification as the test result, i.e. 360 minutes based on the EW-criteria.

It is the opinion of Efectis NL that a reduced wall thickness of the support construction can be allowed in case of a reduced fire resistance. For the assessment, the EN 1996-1-2:2011 is used. This is the EUROCODE for masonry. This EN states, in Table N.B.4.2 which is valid for a single blade, load-bearing aerated concrete wall, a fire resistance of REI240 for a thickness of 150 mm. This minimum thickness is considered by Efectis NL to be also valid for installation of the rolling shutter construction type Metacon RGS EW360 ECO Twindoor, as tested and described in Efectis NL test report 2015-Efectis-R000525[Rev.1]. In this case the expected fire resistance is 240 minutes based on the criteria *integrity* and *heat radiation*.

Masonry / concrete walls

Based on a test with aerated concrete, and the assessment above that a thickness of 150 mm aerated concrete will suffice for 240 minutes fire resistance, it is the opinion of Efectis NL that a support construction of masonry or concrete can also be allowed in case of a reduced fire resistance. A thickness of at minimum 170 mm is required for the installation of the Metacon RGS TWIN doors.

Fire resistant steel construction

Based on the experience of Efectis NL, fixation to a steel supporting construction is also allowed. It is required that the steel construction is insulated such that the steel temperature stays below 500 degrees Centigrade during the fire resistance period which is required (i.e. 240 or 360 minutes). The overlap of the flame barrier at the top and the side guides will have to satisfy the conditions defined in the present assessment.

Fixations

In the fire test, the flame barrier at the top of the construction was fixed with M6 steel threaded rods, through the wall. The side guides are fixed with M8 steel threaded rods, also through the wall. These connections will have to remain as tested. This means that the rolling shutter construction at both sides of the wall are to be fixed to each other by means of the steel threaded rods.

Efectis Nederland
2015-Efectis-R000988/BGG/TNL
21 July 2015
METACON B.V.

Rapport
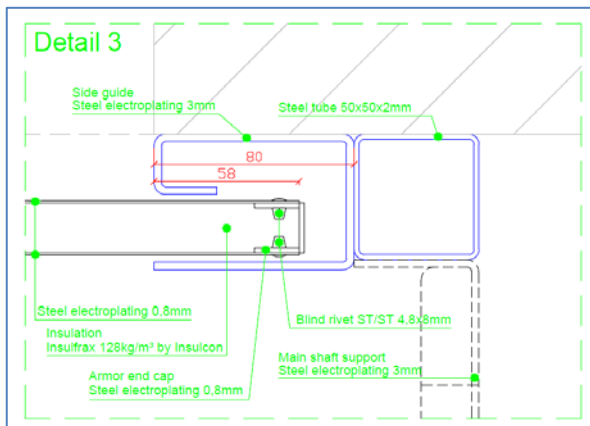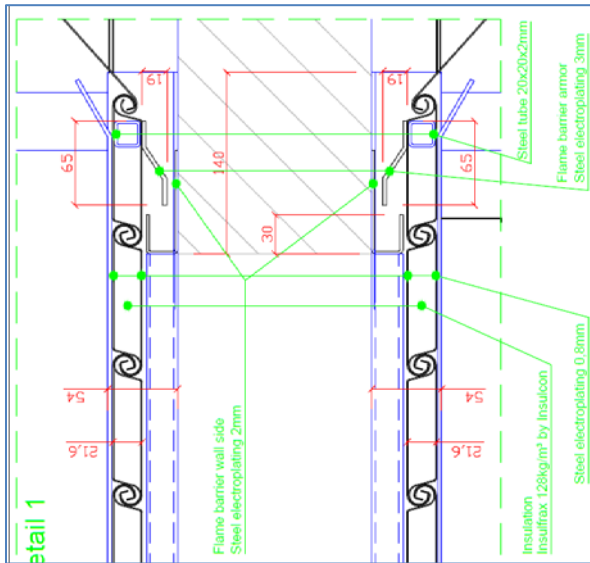
3. VALIDITY

Due to developments in European legislations and the influence this has on the assessment of fire resistance, the present assessment letter is valid until end-December 2018.

Yours sincerely,

Dr. ir. G. van den Berg
Senior consultant fire resistance

P.W.M. Kortekaas
Senior project leader fire resistance

gert.vandenberg@efectis.com
088 3473 746