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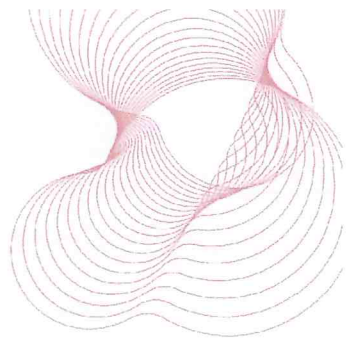
**An assessment of the
fire performance of the
IDE servery rolling
shutter doorset, for
opening sizes up to 3.4m
wide x 2.2m high**

Prepared for:
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30 July 2009

**Assessment report number
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Protecting People, Property and the Planet



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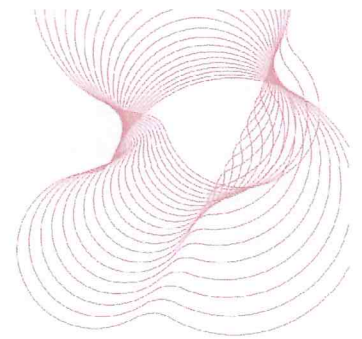
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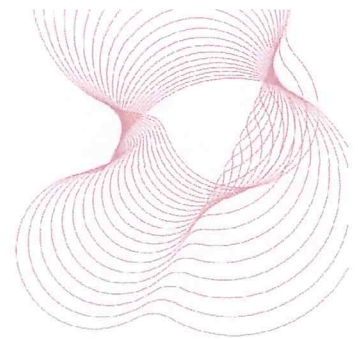
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1 Introduction

The IDE servery rolling shutter doorset, tested at the BRE laboratory, is designed to give up to one hour's fire resistance. This report describes the assessment which has been carried out of the fire performance of the servery rolling shutter doorset, for modifications to the tested design and larger opening sizes up to 3.4m wide x 2.2m high.

2 Scope

This report covers the fire performance of the IDE servery rolling shutter doorset, for a fire rating of 60 minutes in accordance with the integrity criterion of BS 476: Part 22: 1987, for fire exposure from either direction.

3 Supporting Data

This assessment is partly based on supporting test data which is more than five years old. This supporting data has therefore been reviewed against current test procedures.

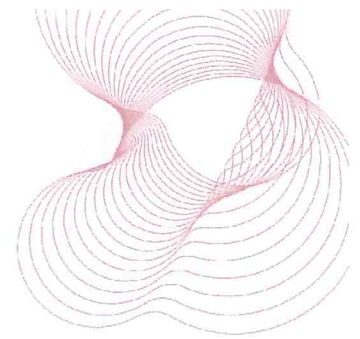
3.1 BRE Test Report No. 208422

An IDE uninsulated steel rolling shutter doorset was subjected to a fire resistance test, for 60 minutes, in accordance with BS 476: Part 22: 1987, on 26 April 2002.

The shutter was installed on the exposed face of a brick wall and had a clear opening of 2200mm wide x 2200mm high. The doorset comprised a curtain of interlocking steel laths, 0.91mm thick (20swg), at 55mm centres, located in steel side guides, 50mm deep, and attached to a horizontal barrel with dimensions 2342mm long x 101mm diameter x 1.63mm thick. The barrel incorporated a Link Controls electric tubular motor (ref. JM60/80) in one end and was supported from 3.25mm-thick steel endplates. The endplates and side guides on each side of the curtain were fixed to the supporting construction via a steel angle, 50mm x 50mm x 3mm. Each steel angle was fixed to the brickwork by M8 x 64mm-long steel expanding anchors at maximum 420mm centres. The barrel assembly was covered by a steel casing, 0.91mm-thick (20swg), supported by the endplates, with the casing top edge attached to the brickwork using one steel cleat, centrally positioned. A T-section bottom rail, 70mm web x 75mm flange, folded from 2mm thick (14swg) steel, was attached to the bottom lath of the curtain.

The servery shutter, when tested, satisfied the integrity criterion of the standard for 34 minutes.

See BRE test report No. 208422 and IDE drawing no. 1474-1A for further details.



3.2 LPC Test Report TE 83228

An IDE uninsulated steel rolling shutter doorset was subjected to a fire resistance test, for 240 minutes, in accordance with BS 476: Part 22: 1987, on 22 February 1993.

The shutter was installed on the exposed face of a brick wall and had a clear opening of 2500mm wide x 2100mm high. The doorset comprised a curtain of interlocking steel laths, 75mm wide x 0.91mm thick (20swg), located in steel side guides, 90mm deep, and attached to a horizontal barrel with dimensions 2342mm long x 102mm diameter x 2.83mm thick. The barrel assembly was covered by a steel casing, 0.91mm-thick (20swg), supported by endplates, with the casing top edge attached to the brickwork using five M8 Rawlbolts at 600mm centres. The bottom lath was clamped between two vertical steel flats, 50mm x 5mm thick, using M8 screws and nuts at 400mm centres.

The shutter, when tested, satisfied the integrity criteria of the standard for 240 minutes.

See LPC test report TE 83228 for further details.

4 Description of Proposed IDE Servery Rolling Shutter Doorset

The proposed servery rolling shutter doorsets are the same as the shutter tested in test No. 208422, but with the following modifications:

- a) An improved bottom bar which has the same design as that tested shutter in TE 83228, i.e. the bottom lath is clamped between two vertical steel flats, 50mm x 5mm thick, using M8 screws and nuts at nominal 400mm centres.
- b) A revised fixing method for attaching the barrel casing to the surrounding structure using three 50mm-long steel angles (50mm x 50mm x 3mm thick). The angles are fastened to the casing by steel rivets and fixed centrally through horizontal slotted holes to the surrounding structure using M8 steel Rawlbolts and fusible washers.

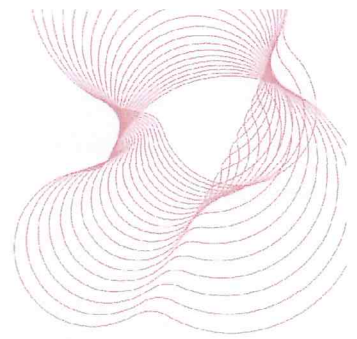
See Industrial Door Engineering drawing no. 1474-3, dated 18/4/02, for further details.

The maximum opening size covered by this assessment is 3.4m wide x 2.2m high.

5 Assessment

5.1 Modifications to Maintain Integrity

The IDE servery rolling shutter doorset tested in BRE test No. 208422 satisfied the integrity criterion of the standard for 34 minutes, at which time a gap exceeding the limits defined in the standard developed



between the bottom rail and the sill. Further problems were detected during the test with gaps developing between the top edge of the barrel casing and the brickwork.

The proposed servery rolling shutter doorset has a modified bottom bar design, which was proven successfully in the four hour fire resistance test (TE 83228). The proposed servery shutter doorset barrel casing has an increased number of fixings attaching it to the supporting structure. The fixings are also through slotted holes with fusible washers to allow the casing to expand without buckling in a fire and so preventing any gaps from developing between the casing and the supporting structure.

5.2 Larger Sizes

The maximum sizes of doorset covered by this assessment are larger than that tested. The suitability of the component sizes have been checked using the calculation method summarised in appendix A. From the equations listed, the barrel deflection, barrel bending and shear stresses, axle bending and shear stresses, endplate bending stress and endplate fixing bolt shear stress are calculated. These have been found to be within acceptable limits for a fire exposure of 60 minutes.

All the calculated stresses and other values, together with the relevant dimensions and parameters, are set out in the data sheet in appendix B.

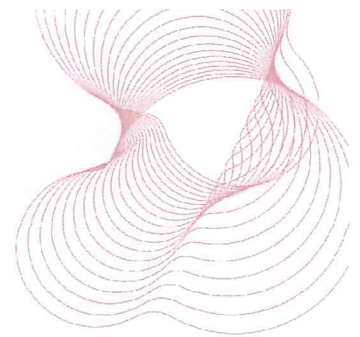
5.3 Surrounding Structure

Where rolling shutters are fixed to masonry supporting elements, the masonry elements must be capable of providing a fire resistance in terms of the criteria of BS 476: Part 21 or 22: 1987 equal to or greater than the fire resistance of the rolling shutter assembly, whilst supporting the shutter assembly for the required fire resistance period, without compromising the fire performance of the doorset. In addition, consideration must be given to the loads imposed by the various doorset components. All concrete/masonry elements must be designed in accordance with BS 5628: Part 3 (Code of practice for use of masonry) and have a density greater than 600kg/m^3 . Lintels spanning the structural opening must comply with BS 8110 (Structural use of concrete): Part 1 (Code of design for design and construction).

Further consideration must be given where rolling shutters are fixed to steel supporting structures to account for the effect of thermal bridging that may occur where cladding systems, protecting loadbearing elements of the supporting structure, have been breached by the various doorset components, i.e. endplates and barrel support brackets. BRE recommends that a critical temperature of 400°C and steel sections with an H_p/A value below 230m^{-1} are used for designing fire resistant steel supporting structures. This temperature, however conservative, will minimise the distortion/deflection experienced by steel members and, in the absence of contradictory test evidence, only steel supporting structures designed to these parameters are considered by BRE to be suitable for supporting rolling shutters.

This report does not cover the following structural support or steel fire protection systems:

- Steel (without the above provisos).
- Aerated concrete (density $< 600\text{kg/m}^3$).
- Drywall partition systems.
- Structural steel protection using an intumescent paint system.



5.4 Electrical Cables and Power Supplies

In cases where the motor is required to close the shutter in the event of a fire, the power should be of a guaranteed supply, and any electrical cable for which Industrial Door Engineering have responsibility should be of an LPCB approved type, or have been fire-tested to BS6387 and have a category of SWX or greater.

Where power is not required to close the shutter, there must be an acceptable and reliable alternative method of automatic closure in the event of fire.

5.5 Opening Variations

This assessment assumes a conventional face-fixed type of installation, however other forms of installation are also considered permissible. These include side-fixed or built-in within a structural opening with the endplates and curtain guides fastened to the inside perimeter of the opening. A variation of this arrangement would cover opening perimeters deeper than the extent of the endplates, i.e. where the endplates are completely contained within the opening. The resulting arrangement would be significantly more fire resistant than the normal arrangement due to the fixture of the endplates on the opening perimeter.

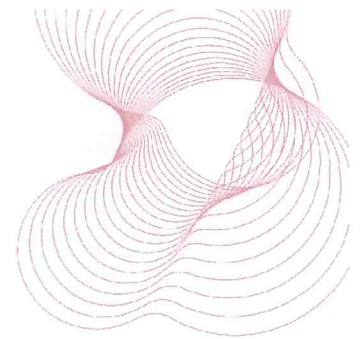
5.6 Hazard Analysis for Uninsulated Doorsets

All cladding systems immediately in front of the fire resisting doorsets, i.e. abutting surfaces, must be constructed from non-combustible materials or materials of limited combustibility which have been shown not to initiate an integrity failure, by causing sustained flaming on the non fire side of the separating element, when exposed to high levels of radiation.

When the rolling shutter doorset is in the fully closed position the elevated temperatures exhibited by the unexposed face is sufficient to cause fire spread by radiant heat transfer. The safe storage distance is influenced by the intensity of the radiation, the area of the radiating surface and the height/width ratio and the susceptibility of the stored material/goods, furniture, etc. to ignition by radiation. The safe distance for storing combustible materials from the face of the assembly is as recommended in section 4 of the LPC Design Guide of the Fire Protection of Buildings.

6 Conclusion

Therefore it is our opinion that the IDE servery rolling shutter doorsets, as described in sections 3 and 4 of this report, are suitable for installations where fire resistance of up to 60 minutes is specified in terms of the integrity criterion of BS 476: Part 22: 1987, for fire exposure from either direction, given the limitations described above.



7 Validity of the Assessment

7.1 Declaration by Applicant

- We the undersigned confirm that we have read and complied with the obligations placed on us by the UK Fire Test Study Group Resolution No. 82 : 2001.
- We confirm that the component or element of structure, which is the subject of this assessment, has not to our knowledge been subjected to a fire test to the Standard against which this assessment is being made.
- We agree to withdraw this assessment from circulation should the component or element of structure be the subject of a fire test to the Standard against which this assessment is being made.
- We are not aware of any information that could adversely affect the conclusions of this assessment.
- If we subsequently become aware of any such information we agree to cease using the assessment and ask BRE Testing to withdraw the assessment.

Signed:

For and on behalf of:

INDUSTRIAL DOOR ENGINEERING LTD.

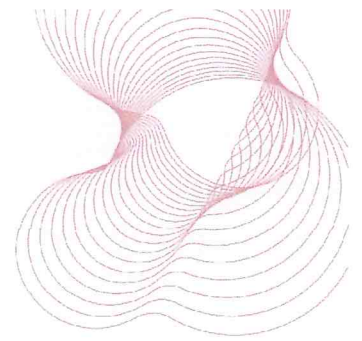
This assessment report is not valid unless it incorporates the declaration duly signed by the applicant.

7.2 BRE Testing Declaration

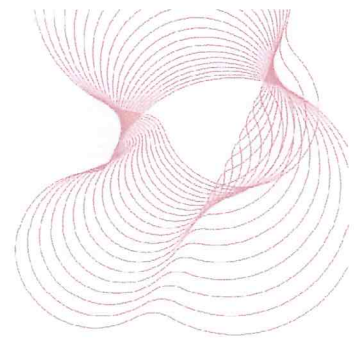
This assessment was reviewed on 30 July 2009. We have received written confirmation from Industrial Door Engineering Limited that there have been no changes in the specification of their servery rolling shutter doorset since the original date of the assessment. There have been no changes in the fire test procedures or methods of assessment, which would adversely affect the fire performance of the doorset. We are therefore satisfied that the validity of this assessment may be extended for a further five years.

This assessment is based on test data, experience and the information supplied. If contradictory evidence becomes available to BRE Testing the assessment will be unconditionally withdrawn and the applicant will be notified in writing. Similarly the assessment is invalidated if the assessed construction is subsequently tested since actual test data is deemed to take precedence over an expressed opinion. The assessment is valid for a period of five years after which it should be returned for review to consider any additional data, which has become available or any changes in the fire test procedures. Any changes in the specification of the product will invalidate this assessment.

This assessment has been carried out in accordance with Fire Test Study Group Resolution No. 82. It relates to the fire performance of the product and does not cover aspects of quality, durability, maintenance nor service requirements. This assessment relates only to the specimen(s) assessed and does not by itself infer that the product is approved under any Loss Prevention Certification Board approval or certification scheme or any other endorsements, approval or certification scheme.



Next review date: 30 July 2014



Appendix A – Structural Analysis Methodology

A.1 General Barrel Support Calculation Principles

The general methodology for checking the proposed specifications is based on accepted engineering first principles but also utilises stress v. deflection data established by BRE. Information published recently in Europe covering the relationship between temperature and load/deflection characteristics was found to be unsuitable in assessing the fire performance of steel rolling shutters.

BRE therefore undertook a series of tests on loaded steel shutter components to determine the maximum stresses and deformation factors, including creep, related to time of exposure. Two different types of barrel exposure were evaluated for fully exposed and partially insulated situations to produce two different tables. This information is now regarded as company-confidential.

A.2 Free Barrel Deflection

Using the following data:

D_B	= Barrel outside diameter
t_B	= Barrel wall thickness
W_B	= Barrel assembly weight
L_B	= Barrel length

- and calculating I_B (Moment of inertia of barrel)

$$I_B = \left[\frac{\pi D_B^4}{64} \right] - \left[\frac{\pi (D_B - 2t_B)^4}{64} \right] \quad (\text{mm}^4)$$

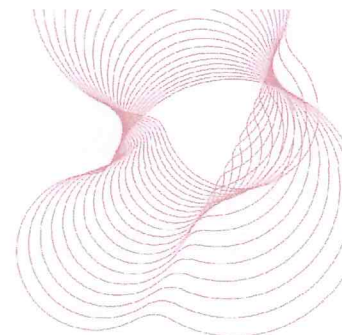
and..... Z_B (Section modulus of barrel)

$$Z_B = \left[\frac{I_B}{D_B/2} \right] \quad (\text{mm}^3)$$

Substituting both the barrel *Moment of Inertia* and the *Section Modulus* along with the barrel length, the Barrel stress (assuming free deflection), σ_B is calculated.

$$\sigma_B = \left[\frac{W_B \times L_B}{8 \times Z_B} \right] \quad (\text{N/mm}^2)$$

From σ_B a value for E_B (Deformation factor, i.e. Young's Modulus) has been calculated using data held by BRE, and from this value of E_B the "free barrel" deflection (d_B) is calculated using the standard engineering formula for deflection.



Free barrel deflection, d_B , is:

$$d_B = \left[\frac{5}{384} \right] \times \left[\frac{W_B \times L_B^3}{E_B \times I_B} \right] \quad (\text{N/mm}^2)$$

A.3 Casing Support Calculations

The casing support system calculation methodology uses the general principle of a balanced system in which:

the "Free deflection of barrel" (d_B),

less: the maximum deflection of the casing supports and the original barrel to casing soffit clearance,

should nominally equal: the effective support "reaction distance".

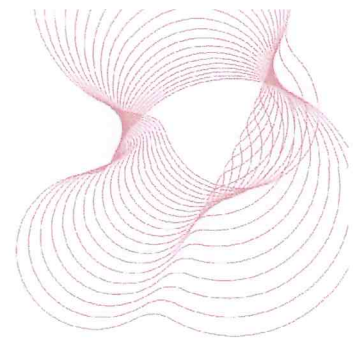
BRE has derived an equation in which the various load and support elements are calculated. This equation also incorporates data from the maximum stress v. deflection coefficient tables referred to above. Referring to the above "balanced system equation", the "reaction distance" incorporates forces produced by the casing and casing supports which are translated into an effective distance employing the standard engineering formula for deflection also referred to in B.2 above.

For a given number of casing supports the value of casing support stress, found by an iterative process, is calculated. Changes are made, to the type of casing support or to the number of casing supports, until acceptable stress limits are obtained. Acceptable stress limits are given in Table B1 below.

Table B1 Stress limits for steel members at elevated temperatures

Fire resistance period	Shear/tensile stress limit (N/mm ²)	Bending stress limit (N/mm ²)
30min	30.0	40.0
60min	15.0	20.0
120min	10.0	14.0
180min	8.0	11.0
240min	6.5	9.0

In this calculation the relevant values of "Moment of Inertia" and "distance of centre-of-gravity to point of maximum stress" of the steel section chosen for the casing supports are used. It should be noted that the latter value is given by the "projecting-leg" length minus the "c-of-g distance" quoted in the steel section tables, as it is considered that the point of maximum fibre stress is at the outer tip of this leg, i.e. away from the casing.



A.4 Axle Stress Calculations

The stresses within each axle are calculated as follows:

From W_A (Load on axle):

$$W_A = \left[\frac{W_B - W_R}{2} + W_{AC} \right] \text{ (N)}$$

where W_R , the reactive load (or potential support provided by barrel support brackets), is obtained from the balanced system equation developed by BRE.

The axle shear stress, σ_{AS} , is calculated from:

$$\sigma_{AS} = \left[\frac{W_A}{A_A} \right] \text{ (N/mm}^2\text{)}$$

The axle bending stress, σ_{AB} , is calculated from:

$$\sigma_{AB} = \left[\frac{W_A \times L_A}{Z_A} \right] \text{ (N/mm}^2\text{)}$$

where	A_A	= Cross-sectional area of axle
	L_A	= Axle exposed length
	W_{AC}	= Ancillary component load on axle
	W_A	= Total imposed load on axle
	Z_A	= Section modulus of axle

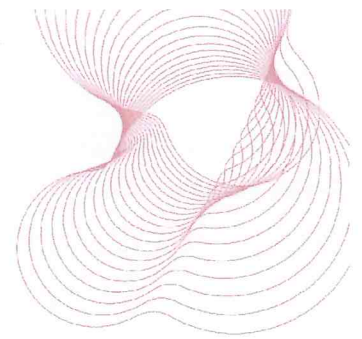
The calculated stresses must not exceed those given in Table B1.

A.5 Endplate Stress Calculations

Only the bending stress in the endplates are considered as a shutter assembly stability failure would occur by a excessive bending of the endplate prior to any shear failure of the endplate. An estimation of bending stresses in each endplate are calculated from the following:

Using the following data:	W_E	= Load on endplates = W_A
	L_E	= Axle bearing length
	W_M	= Load on endplate due to motor
	L_M	= Effective motor shaft length ~ 200mm
	W_E	= Endplate width
	t_E	= Endplate thickness

The Endplate bending stress, σ_{EB} , is calculated from:



$$\sigma_{EB} = \left[\frac{(W_E \times L_E) + (W_M \times L_M)}{\gamma \times w_E \times t_E^2 / 6} \right] \text{ (N/mm}^2\text{)}$$

where (γ) is an empirical factor whose value describes the relationship between the endplate fixing angle and the endplate, and is calculated from the following:

$$\gamma = [1 + \phi + \varphi] \text{ (dimensionless)}$$

with..... $\phi = \left[\frac{A_{FA}}{A_E} \right] \text{ (dimensionless)}$

and..... $\varphi = \left[\frac{L_{FA}}{w_E} \right] \text{ (dimensionless)}$

where.....
 A_E = cross-sectional-area of endplate (along its width)
 w_E = width of endplate
 A_{FA} = cross-sectional-area of fixing angle
 L_{FA} = fixing angle leg length secured to endplate

A.6 Endplate Fixing Bolt Stress Calculations

The calculation of bolt stress is based on the methods of fixture or bracing of the "face-fixing" endplate angle. Assuming load sharing, the stress in the bolts, B_s , whether shear or a composite stress resulting from combined tensile and shear loading, securing the endplate fixing angle is calculated from the addition of all relevant components divided by the total cross-sectional area of all the fixing bolts, to give:

Using the following data:

- W_E = Self-weight of endplate
- W_A = Load on axle
- W_{FA} = Self-weight of endplate fixing angle
- W_M = Load of motor (if applicable)
- A_B = Effective cross sectional area of bolts

The Bolt shear stress, σ_{BS} , is calculated from:

$$\sigma_{BS} = \left[\frac{W_E + W_A + W_{FA} + W_M}{A_B} \right] \text{ (N/mm}^2\text{)}$$

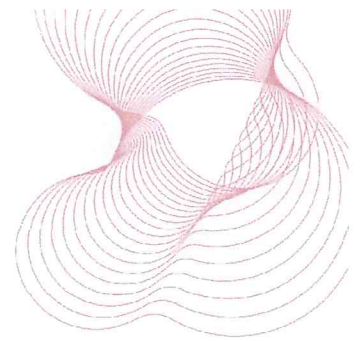
The stresses in the barrel support bracket bolts are calculated adopting a similar calculation methodology.

A.7 Curtain Guide Depth Calculations

Using the following data:

- L_B = Barrel length
- T_m = Exposure temperature
- α = Coefficient of expansion

and calculating..... C_e (Curtain overall expansion allowance)

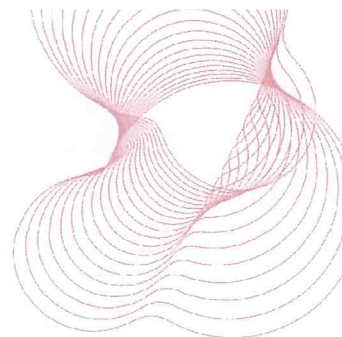


$$C_e = \left[\left(\frac{L_B \times T_m \times \alpha}{1000} \right) + 1 \right] \text{ (mm)}$$

and.....

G_D (Minimum curtain guide depth)

$$G_D = \left[\left(\frac{C_e}{2} \right) + 25 \right] \text{ (mm)}$$



Appendix B – Data Sheet

208825a60
Face-fixed/built-in rolling shutter

Clear Opening Size : 3.4m W x 2.2m H
Using the following data:

Fire resistance	=	60 min
Barrel outside diameter	=	101.0 mm
Barrel wall thickness	=	1.6 mm
Barrel assembly weight	=	307 N
Barrel length (<i>maximum</i>)	=	3530 mm
Support moment of inertia	=	0 N/mm ⁴
Cen. of Grav. to max stress (<i>y</i>)	=	0 mm
Barrel soffit to casing soffit	=	100 mm
Axle line to rear of casing	=	150 mm
Axle diameter	=	17 mm
Axle length (<i>exposed</i>)	=	37 mm
Axle bearing length	=	17 mm
Endplate height	=	300 mm
Endplate width	=	300 mm
Endplate thickness	=	4 mm
Motor endplate overall width	=	300 mm
Motor endplate thickness	=	4 mm

The stress and deflection calculations indicate that barrel support brackets are not required to support the rolling shutter barrel for a fire exposure of 60 minutes.

The following is calculated:

Barrel stress (bending)	=	5.4 N/mm ²	Barrel deflection	=	131 mm
Axle stress (bending)	=	17.0 N/mm ²	Axle stress (shear)	=	1.0 N/mm ²
Curtain overall exp. allowance	=	21 mm	Min. channel guide depth	=	35 mm
Endplate stress (bending)	=	19.5 N/mm ²	Curtain lath thickness	=	0.91 mm
Min. no. of bolts per endplate	=	2 M8	Endplate bolt stress (shear)	=	5.3 N/mm ²

=====REPORT ENDS=====