BS EN 15269-10:2011

BSI Standards Publication

Extended application of test results for fire resistance and/or smoke control for door, shutter and openable window assemblies including their elements of building hardware

Part 10: Fire resistance of steel rolling shutter assemblies

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National foreword

This British Standard is the UK implementation of EN 15269-10:2011.

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A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Extended application of test results for fire resistance and/or smoke control for door, shutter and openable window assemblies including their elements of building hardware - Part 10: Fire resistance of steel rolling shutter assemblies

Application élargie des résultats d'essais en matière de résistance au feu et/ou d'étanchéité à la fumée des blocs-portes, blocs-fermetures et ouvrants de fenêtres, y compris leurs éléments de quincaillerie de bâtiment intégrés - Partie 10: Résistance au feu des rideaux à enroulement en acier

Erweiterter Anwendungsbereich von Prüfergebnissen zur Feuerwiderstandsfähigkeit und/oder Rauchdichtigkeit von Türen, Toren und Fenstern einschließlich ihrer Baubeschläge - Teil 10: Feuerwiderstandsfähigkeit von Rolltoren aus Stahl

This European Standard was approved by CEN on 10 March 2011.

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Contents

Page

Foreword ... 3

Introduction ... 4

1 Scope ... 5

2 Normative references ... 5

3 Terms and definitions ... 6

4 Determination of the field of extended application ... 6
4.1 General ... 6
4.2 Procedure for evaluation ... 6
4.3 Procedure for maximum field of extended application ... 6
4.4 Interpretation of test results ... 7

5 Extended application report ... 7

6 Classification report ... 7

Annex A (normative) **Construction parameter variations for insulated and uninsulated steel rolling shutter assemblies** ... 8

Annex B (normative) **Steel rolling shutter assemblies stress calculation method** ... 38
B.1 Calculation principles ... 38
B.2 Calculation of limiting stress ... 38
B.3 Barrel calculations ... 39
B.4 Barrel support bracket calculations ... 40
B.5 Axle calculations ... 42
B.6 Endplate calculations ... 43
B.7 Curtain expansion allowance ... 46

Annex C (informative) **Figures related to Annex A & Annex B** ... 47

Bibliography ... 67

Foreword

This document (EN 15269-10:2011) has been prepared by Technical Committee CEN/TC 127 “Fire safety in buildings”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2011, and conflicting national standards shall be withdrawn at the latest by October 2011.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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Introduction

This document is one of a series of standards listed below and intended to be used for the purpose of producing an extended application report based on the evaluation of one or more fire resistance and/or smoke control tests. These standards may also be used to identify the best selection of test specimens required to cover a wide range of product variations.

The (pr)EN 15269 series currently consists of:

(pr)EN 15269 Extended application of test results for fire resistance and/or smoke control for door, shutter and openable window assemblies, including their elements of building hardware

Part 1: General requirements

Part 2: Fire resistance of hinged and pivoted steel doorsets

Part 3: Fire resistance of hinged and pivoted timber doorsets and openable timber framed windows

Part 4: Fire resistance of hinged and pivoted glass doorsets

Part 5: Fire resistance of hinged and pivoted metal framed glazed doorsets and openable windows

Part 6: Fire resistance of sliding timber doorsets

Part 7: Fire resistance for steel sliding doorsets

Part 8: Fire resistance of horizontally folding timber doorsets

Part 9: Fire resistance of horizontally folding steel doorsets

Part 10: Fire resistance of steel rolling shutter assemblies

Part 11: Fire resistance of operable fabric curtains

Part 20: Smoke control for hinged and pivoted steel, timber and metal framed glazed doorsets

Before there can be any consideration for extended application the doorset should have been tested in accordance with EN 1634-1 to achieve a test result which could generate a classification in accordance with EN 13501-2 at least equal to the classification subsequently required from extended application considerations.

A review of the doorset construction parameters can indicate that one or more characteristics may be improved by a particular parameter variation. All evaluations should be made on the basis of retaining the fire resistance classifications obtainable from testing to EN 1634-1, including those lower than the test duration. However, this should never lead to an increased classification for any specific fire or smoke performance parameter beyond that achieved during any one test unless specifically identified in the relevant Construction Parameter Variation tables within this series of standards.

The effect on the durability of self closing of the doorsets following an extended application process is not addressed in this series of standards.

1 Scope

This Part of prEN 15269, which should be read in conjunction with EN 15269-1, covers the following types of steel rolling shutter assemblies: un-insulated manually operated rolling shutters, un-insulated powered rolling shutters, insulated manually operated rolling shutters and insulated powered rolling shutters.

This document prescribes the methodology for extending the application of test results obtained from test(s) conducted in accordance with EN 1634-1.

Subject to the completion of the appropriate test or tests selected from those identified in Clause 4 the extended application may cover all or some of the following non-exhaustive list:

- Integrity only (E), radiation (EW) or insulated (EI_1 or EI_2) classifications;
- shutter curtain;
- wall/ceiling fixed elements (frame/suspension system);
- decorative finishes;
- intumescent, smoke, draught or acoustic seals;
- alternative supporting construction(s).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1363-1:1999, *Fire resistance tests — Part 1: General requirements*

EN 1363-2:1999, *Fire resistance tests — Part 2: Alternative and additional procedures*

EN 1634-1:2008, *Fire resistance and smoke control tests for door, shutter and openable window assemblies and elements of building hardware — Part 1: Fire resistance tests for doors, shutters and openable windows*

EN 1993-1-2, *Eurocode 3: Design of steel structures — Part 1-2: General rules — Structural fire design*

EN 13501-2:2007+A1:2009, *Fire classification of construction products and building elements — Part 2: Classification using data from fire resistance tests, excluding ventilation services*

EN 15269-1:2010, *Extended application of test results for fire resistance and/or smoke control for door, shutter and openable window assemblies, including their elements of building hardware — Part 1: General requirements*

EN ISO 13943:2010, *Fire safety — Vocabulary (ISO 13943:2008)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1363-1:1999, EN 1363-2:1999, EN 1634-1:2008, EN 15269-1:2010 and EN ISO 13943:2010 and the following apply.

3.1
full scale test
a test of a full size doorset or rolling shutter in accordance with EN 1634-1

4 Determination of the field of extended application

4.1 General

4.1.1 Before there can be any consideration for extended application the steel rolling shutter assemblies shall have been tested and classified in accordance with EN 1634-1 and EN 13501-2 respectively in order to establish a classification for the doorset.

4.1.2 A review of the construction parameters can indicate that one or more characteristics may be improved by a particular parameter variation. All evaluations shall be made on the basis of retaining the classifications obtainable from testing to EN 1634-1, including those lower than the test duration. However, this shall never lead to an increased classification for any specific parameter beyond that achieved during any one test unless specifically identified in the relevant Construction Parameter Variation tables.

4.1.3 All evaluations shall be made on the basis of retaining the classification obtained from testing to EN 1634-1.

4.1.4 If, by following the ensuing procedure, any part of the classification cannot be achieved by extended application rules that part of classification shall be omitted from the subsequent extended application report and classification report.

4.2 Procedure for evaluation

4.2.1 Identify the variations from the original test specimen(s) which are required to be covered by an extended application report.

4.2.2 Locate the variations in the appropriate parameter variation by reference to columns (1) and (2) of Table A.1.

4.2.3 Review the type of classification to be retained from column (3) of Table A.1 and establish from the contents of column (4) of Table A.1 whether any extended application is available without the need for further testing.

4.2.4 Where this is deemed to be possible this can be recorded in the extended application report together with any appropriate restrictions and the stated rules from column (4) in Table A.1.

4.2.5 Where the variations required can only be achieved from additional testing according to column (5), the additional test can be made on a similar specimen type to the original test against which the extended application is sought. Alternatively, column (5) identifies an option for alternative testing and relevant test parameters.

4.3 Procedure for maximum field of extended application

4.3.1 It is possible to provide a limited field of extended application from the results of a single test. However, where a manufacturer intends to produce a range of steel rolling shutters assemblies

incorporating manual and power drives, insulated and uninsulated version, with alternative elements of construction etc. it is recommended that careful consideration is given to the complete range of designs and options in order to minimise the testing required before testing commences.

4.3.2 Establish all the parameter variations which are required to be part of the product range.

4.3.3 Select specimen(s) for the first test(s) in the series to ensure that the most important parameter variations for the manufactured products are covered.

4.3.4 Complete the first test or a series of tests and prepare a field of direct application and possibly a classification report from the results of the test(s).

4.3.5 Establish which of the original desired parameter variations have not been covered by the direct application and classification report.

4.3.6 Identify these parameter variations in Annex A and establish if any extended application is possible without further testing.

4.3.7 Record this for the extended application report together with any restrictions and rules given in column (5) in Table A.1.

4.3.8 Evaluate which, if any, of the desired parameter variations have not been covered by the field of direct application or the initial field of extended application derived from 4.3.7 above.

4.3.9 Select the required outstanding parameter variations from column (1) and column (2) of Table A.1 and observe from column (5) of Table A.1 which are the most appropriate weakest specimen options for further testing.

4.3.10 If the complete selection of required parameter variations has not been covered by the tests completed in accordance with 4.3.9 above, then an appropriate test or tests may be repeated with the additional product variations incorporated.

4.4 Interpretation of test results

4.4.1 In order to maximise the field of extended application, it is important that the test reports shall record details of any integrity and/or insulation failures throughout the test duration.

4.4.2 Where a series of tests have been conducted, the field of extended application shall be based on the lowest performance achieved from the complete series of tests unless premature failure has been attributed to one or more specific construction parameter variation.

4.4.3 Where it has been possible, to identify specific parameter failures, the extended application for all other construction parameter variations can be based on the performance achieved after isolating the premature failure(s).

5 Extended application report

Prepare an extended application report in accordance with the requirements of EN 15269-1, based on the results of evaluations in accordance with the above.

6 Classification report

The classification report shall be determined from the results of the extended application report and presented in accordance with Annex A of EN 13501-2:2007+A1:2009.

Annex A
(normative)

Construction parameter variations for insulated and uninsulated steel rolling shutter assemblies

Table A.1 is designed to provide rules for the creation of extended application reports by experts in the field of fire resistance testing of the following sliding steel rolling shutter assemblies.

Table A.1 shall only be used to evaluate a field of extended application when at least one positive fire resistance test to EN 1634-1 has resulted in a classification according to EN 13501-2.

The first two columns identify possible variations to the construction details of the specimen tested.

The type of classification achieved from the test can be identified from the 'Performance characteristic' section of Table A.1 column 3 as insulation, radiation control or integrity only.

The effect of the change in each parameter is evaluated for each characteristic in column 3 under E for effects on integrity, I for effects on insulation (whether an I_1 or I_2) and W for the effects on radiation control for EW steel rolling shutter assemblies.

Where symbols are used these relate to the following definitions:

a) < - forecast is a worse performance;

b) > - forecast is a better performance;

c) = - forecast is no significant difference;

d) ≤ - forecast is a worse or equal performance;

e) ≥ - forecast is a better or equal performance;

f) >=< - forecast unknown

These evaluations lead to the judgement of the possibility of the extension of the field of application the results of which are given in column 4. In certain cases, in Column 4, it is a requirement to achieve Category B, the details for which are given in EN 1634-1.

Where additional tests are deemed to be necessary the type of specimen approved for incorporation of the changed parameter is defined in column 5.

Where it is possible to use information from tests performed on one configuration for evidence on a different configuration, this allowance has been made in order to reduce the overall number of tests required for extended application evaluation. The rules given for size increase (width, height, area) of the shutter curtain are applicable for steel rolling shutter assemblies tested in size equal or bigger than the maximum size which can be tested in a standard size furnace (normally 3 m x 3 m). These rules are not applicable to steel rolling shutter assemblies doors tested only with horizontal joints. All size variations based on the results of more than one test with specimens of different sizes can be combined.

In addition to Annex A, where construction parameter variations result in an increase in the weight of the curtain, the requirements given in Annex B shall be satisfied as defined in the relevant parameter of Annex A.

Column 5 defines the side of the steel rolling shutter assembly which has to be tested. Inwards means a test with the loadbearing components such as the runners/hanging mechanism, etc. on the fire side. Outwards means the opposite side. If a special type (e.g. single, double and telescopic) is not specified, the additional test can be carried out with all types of steel rolling shutter assemblies, therefore, if more than one additional test is not specified, only one test is required.

If after consideration of a specific variation, additional changes are required to be made to the specimen, these may be made providing the implications on other variations are also taken into account.

Table A.1 — Construction parameters

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
A General (See Figure C.1 for an example of a General Arrangement of rolling shutter construction)						
A.1 Size variations / construction						
A.1.1 Width between vertical guides (See Figure C.2)	Decrease	≥	≥	≥	Possible providing tightness and expansion clearances are not changed	
A.1.2 Distance between vertical guides (See Figure C.2)	Increase	>=<	>=<	>=<	E,EI,EW Possible providing the static requirements to fixings and load-bearing constructions are fulfilled and the requirements of Annex B are satisfied And for EI Possible, if the guides are insulated from one side with a hardware of at least the same classification as the door + increase depth guides 10 mm/m width increase + increase of width of intumescent sealing material in the same ratio as width increase And for EW Possible providing the radiation criteria 15 kW/m^2 as defined in EN 13501-2 is maintained following calculations in accordance with Annex B of EN 15254-4:2008	
A.1.3 Height from floor level to centre line of barrel (See Figure C.3)	Decrease	≥	≥	≥	Possible providing relation to opening height remains the same	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
A 1.4 Height from floor level to centre line of barrel (See Figure C.3)	Increase	>=<	>=<	>=<	E,EI,EW Possible providing the static requirements to fixings and load-bearing constructions are fulfilled and the requirements of Annex B are satisfied And for EW Possible providing the radiation criteria 15 kW/m^2 as defined in EN 13501-2 is maintained following calculations in accordance with Annex B of EN 15254-4:2008	
A 1.5 Expansion allowances between the end of the lath and guide	Decease	≤	≤	≤	Not possible	
A 1.6 Expansion allowances between the end of the lath and guide	Increase	>=<	>=<	>=<	Possible providing tightness/overlap of laths and guides is increased by the same amount	
A 1.7 Mounting	Face fixed on furnace side to within opening	>=<	≤	≤	E Possible only in accordance with permissible casing/hood details in F.1.8 EI, EW Not possible	
A 1.8 Mounting	Within opening to face fixed on furnace side	>=<	>=<	>=<	Possible only in accordance with permissible casing/hood details in F.1.8	
A.2 Materials and constructions						

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
A.2.1 Insulation material whether intumescent or not	Change	>=<	>=<	>=<	Not possible	
A.2.2 Density of insulation material	Increase	≥	≥	≥	Possible up to 30 % for materials of Euroclass A1 and the requirements of Annex B are satisfied otherwise not possible without an additional test	
A.2.3 Density of insulation material	Decrease	≤	≤	≤	Not possible	
A.2.4 Intumescent material	Change of supplier and/or manufacturer	>=<	>=<	>=<	Possible but only for an identical composition otherwise Not possible without an additional test	Further test to include the required seal supplier/manufacturer's seal
A.2.5 Intumescent material	Alternative material	>=<	>=<	>=<	Not possible	
	Increase	≥	≥	≥	Possible	
A.2.7 Thickness of insulation material other than curtains	Decrease	≤	≤	≤	Not possible without new tests according to EN 1634-1	
B Curtain						
B.1 Laths						
B.1.1 Size (height of lath) (See Figure C.4)	Decrease	=	≤	≤	E: Possible providing interlock remains the same EI,EW: not possible	
B.1.2 Size (height of lath) (See Figure C.5)	Increase	=	≥	≥	Possible by 100 % providing interlock remains the same and providing the barrel is able to accommodate the higher laths	
B.1.3 Thickness of steel	Decrease	≤	≤	≤	Not possible beyond direct application	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
B.1.4 Thickness of steel	Increase	≥	≥	≥	Possible by 50 % providing that the requirements of B.2 are satisfied otherwise not possible without an additional test	
B.1.5 Thickness of insulation material (See Figure C.6)	Decrease	>=<	≤	≤	E Possible assuming that the gap between the skins is full of insulating material and that the thickness of lath creates a corresponding decrease in the width of the guides EI & EW Not possible	
B.1.6 Thickness of insulation material (See Figure C.7)	Increase	>=<	≥	≥	Possible assuming that the gap between the skins is full of insulating material and that the thickness of lath creates a corresponding increase in the width of the guides	
B 1.7 Density of insulation material	Increase	>=<	>=<	>=<	Possible up to 30 % for materials of Euroclass A1 and the requirements of Annex B are satisfied otherwise not possible without an additional test	
B 1.8 Density of insulation material	Decrease	≥	≤	≤	Possible up to 10% (production tolerance)	
B 1.9 Material	Mild steel to stainless steel	>=<	>=<	>=<	Possible for single skin E doors providing that the acceptable 50 % increased expansion value is allowed for in the guide/lath configuration. For other doors not possible without additional test	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
B 1.10 Material	Stainless steel to mild steel	≥	≤	≤	Possible for single skin E doors For other doors not possible without additional test	
B 1.11 Number of laths on barrel when door is in closed position	Decrease	>=<	>=<	>=<	Possible providing half the circumference of the barrel is covered	
B 1.12 Number of laths on barrel when door is in closed position	Increase	>=<	>=<	>=<	Possible providing the cover of the barrel is no more than one circumference more than that tested	
B 1.13 Shape (single skin) (See Figure C.8)	Change	>=<	>=<	>=<	E Possible providing interlock between laths is the same EI,EW Not possible	
B.1.14 Single skin to double skin or double skin to single skin (See Figure C.9)	Change	>=<	>=<	>=<	Not possible	
B.2 Endlocks (see Figure C.10 for example of endlock)						
B.2.1 Size and shape	Decrease	>=<	>=<	>=<	Possible providing requirements in respect of expansion clearances and interlock remain unchanged	
B.2.2 Size and shape	Increase	>=<	>=<	>=<	Possible providing requirements in respect of expansion clearances and interlock remain unchanged	
B.2.3 Thickness (See Figure C.10)	Decrease	≤	≤	≤	Not possible	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
B.2.4 Thickness (See Figure C.10)	Increase	≥	≥	≥	Possible providing requirements in respect of expansion clearances and interlock remain unchanged	
B.2.5 Material	Steel to malleable iron	=	=	=	Possible	
B.2.6 Material	Malleable iron to steel	=	=	=	Possible	
B.2.7 Material	Steel to plastic	≤	≤	≤	Not possible	
B.2.8 Material	Plastic to steel	≥	≥	≥	Possible	
B.2.9 Material	Steel to aluminium	≤	≤	≤	Not possible	
B.2.10 Material	Aluminium to steel	≥	≥	≥	Possible	
B.3. Endlock Fixings						
B.3.1 Size (diameter)	Decrease	≤	≤	≤	Not possible	
B.3.2 Size (diameter)	Increase	≥	≥	≥	Possible	
B.3.3 Type	Change	>=<	>=<	>=<	Not possible with windlock type endlock otherwise possible	
B.3.4 Material	Change	>=<	>=<	>=<	Not possible	
B.3.5 Number	Decrease	≤	≤	≤	Not possible	
B.3.6 Number	Increase	≥	≥	≥	Possible	
B.4 Bottom Rail						

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
B.4.1 Size (See Figure C.11)	Decrease	>=<	>=<	>=<	E Possible by 50 % EI_2, EW possible by 50 % providing thickness of insulation material is not changed EI_1 Not possible	
B.4.2 Size (See Figure C.12)	Increase	>=<	>=<	>=<	E possible by 50 % EI, EW Possible if bottom rail insulation is the same as the shutter insulation. Otherwise not possible.	
B.4.3 Thickness of steel	Decrease	≤	≤	≤	E. Not possible beyond direct application EI, EW not possible	
B.4.4 Thickness of steel	Increase	≥	>=<	>=<	Possible by 50 % providing the requirements of Annex B are met	
B.4.5 Material	Stainless steel to mild steel	≥	≥	≥	Possible	
B.4.6 Material	Mild steel to stainless steel	>=<	>=<	>=<	Possible for E single skin doors providing that the acceptable 50 % increased expansion value is allowed for in the guide/lath configuration. For other doors no possible without additional test	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
B 4.7 Material of safety edge	Change	>=<	>=<	>=<	Not possible without additional test	
B.4.8 Construction (See Figure C.13)	Change from T-section to flat	≥	≥	≥	Possible providing height is the same and thickness of flats is not less than 3 mm EI Not possible	
B 4.9 Construction (See Figure C.14)	Change from flat to T-section	≤	≤	≤	Not possible	
B.4.10 Expansion allowances between the end of the bottom rail and guide	Decrease	≤	≤	≤	Not Possible	
B.4.11 Expansion allowances between the end of the bottom rail and guide	Increase	≥	≥	≥	Possible providing the tightness is maintained	
B.4.12 Construction (See Figure C.15)	Change from T-section to double angles	≤	≤	≤	Possible if the vertical section is the same thickness. Otherwise not possible without additional test	
B 4.13 Construction (See Figure C.16)	Change from double angles to T-section	>=<	>=<	>=<	Possible providing height and width are same or larger	
B 4.14 Construction (See Figure C.17)	Change from insulated to T-section	≤	≤	≤	Not possible	
B 4.15 Construction (See Figure C.18)	Change from T-section to insulated	>=<	>=<	>=<	Not possible	
B.5 Bottom rail fixings						
B.5.1 Size	Decrease	>=<	>=<	>=<	Possible subject to total cross-section of fixings not being reduced	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
B.5.2 Size	Increase	≥	≥	≥	Possible	
B.5.3 Type	Change	>=<	>=<	>=<	Possible subject to total cross-section of fixings not being reduced	
B.5.4 Material	Change	>=<	>=<	>=<	Possible providing the material has an equal or higher melting point	
B 5.5 Number	Decrease	≤	≤	≤	Not possible	
B 5.6 Number	Increase	≥	≥	≥	Possible	
C. Guides **C.1. Section**						
C.1.1 Shape from channel to wind-lock type (See Figure C.19)	Change	≥	≥	≥	Possible	
C.1.2 Shape from wind-lock type to channel (See Figure C.20)	Change	≤	≤	≤	Not possible	
C.1.3 Depth (See Figure C.21)	Decrease	≤	≤	≤	Not possible	
C.1.4 Depth (See Figure C.22)	Increase	>=<	>=<	>=<	Possible providing tightness and expansion clearances are not changed	
C.1.5 Width (See Figure C.23)	Decrease	>=<	>=<	>=<	Not possible	
C.1.6 Width (See Figure C.24)	Increase	>=<	>=<	>=<	Possible in line with direct application	
C.1.7 Material thickness	Decrease	≤	≤	≤	Not possible	
C.1.8 Material thickness	Increase	≥	≥	≥	Possible by up to 100 % or to 5 mm whichever is the greater	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
C.1.9 Material	Stainless steel to mild steel	>=<	>=<	>=<	Possible providing that the different expansion value is allowed for in the attachment configuration	
C.1.10 Material	Mild steel to stainless steel	>=<	>=<	>=<	Possible providing that the different expansion value is allowed for in the attachment configuration	
C.1.11 Expansion allowances	Decrease	≤	≤	≤	Not possible	
C.1.12 Expansion allowances	Increase	≥	≥	≥	Possible	
C.2 Guide fixing section						
C.2.1 Size (See Figure C.25)	Decrease	≤	≤	≤	Not possible	
C.2.2 Size (See Figure C.26)	Increase	≥	≥	≥	Possible	
C.2.3 Thickness	Decrease	≤	≤	≤	Not possible	
C.2.4 Thickness	Increase	≥	≥	≥	Possible	
C.2.5 Material	Stainless steel to mild steel	≥	≥	≥	Possible	
C.2.6 Material	Mild steel to stainless steel	>=<	>=<	>=<	Possible providing that the acceptable 50 % increased expansion value is allowed for and subject to fixing section being able to expand without buckling	
C.2.7 Expansion allowances	Decrease	≤	≤	≤	Not possible	
C.2.8 Expansion allowances	Increase	≥	≥	≥	Possible	
C.2.9 Shape (See Figure C.27)	Change	>=<	>=<	>=<	Possible providing thickness and section modulus is same or greater	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
C 2.10 Continuous section to short sections	Change	≤	≤	≤	Possible providing the distance of the fixings to thee guide and the distance of the fixings to the supporting construction are respected and the continuous section does not influence integrity.	
C.2.11 Short sections to continuous sections	Change				Not possible	
C 2.12 Flag type including endplate (See Figure C.28)	Separate	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied and that the expansion allowances are not changed	
C 2.13 Separate (See Figure C.29)	Flag type	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied and subject to sufficient expansion allowance being made	
C.3 Fixings to supporting construction						
C.3.1 Size	Decrease	>=<	>=<	>=<	Possible subject to more fixings being used so that the total cross-section of the fixings is not decreased	
C.3.2 Size	Increase	≥	≥	≥	Possible	
C.3.3 Spacing	Decrease	≥	≥	≥	Possible	
C.3.4 Spacing	Increase	≤	≤	≤	Not possible	
C.3.5 Number	Decrease	≤	≤	≤	Not possible	
C.3.6 Number	Increase	≥	≥	≥	Possible	
C.3.7 Material or Type	Alternative material and/or type	>=<	>=<	>=<	Possible providing the fixings have been shown by test to have an equal or better pullout strength (in fire conditions), See Annex B, otherwise not possible without an additional test	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
D Barrel						
D.1 Tube						
D.1.1 Outside diameter (See Figure C.30)	Decrease	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
D.1.2 Outside diameter (See Figure C.31)	Increase	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
D.1.3 Wall thickness (See Figure C.32)	Decrease	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
D.1.4 Wall thickness (See Figure C.33)	Increase	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
D.1.5 Material	Alternative material and/or manufacturer	>=<	>=<	>=<	Possible providing the material has an equal or higher melting point and providing requirements in Annex B are satisfied otherwise not possible without an additional test	
D.1.6 Expansion allowances	Decrease	≤	≤	≤	Not possible	
D.1.7 Expansion allowances	Increase	≥	≥	≥	Possible	
D.1.8 Shape (See Figure C.34)	Change	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied and providing that the barrel can accommodate the rolling shutter during winding, that the position of the upper laths with respect to the supporting construction is unchanged.	
D.2 Shaft						
D.2.1 Outside diameter (See Figure C.35)	Decrease	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
D.2.2 Outside diameter (See Figure C.36)	Increase	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
D.2.3 Type (See Figure C.37)	Solid to hollow	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
D.2.4 Type (See Figure C.38)	Hollow to solid	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
D.2.5 Material	Alternative	≥	≥	≥	Possible providing requirements in Annex B are satisfied	
D.2.6 Expansion allowances (lateral)	Decrease	≤	≤	≤	Not possible	
D.2.7 Expansion allowances (lateral)	Increase	≥	≥	≥	Possible	
D.2.8 Shape (See figure C39)	Change	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
D.2.9 Stub shafts (See Figure C40)	Continuous axle	≤	≤	≤	Not possible without additional tests	
D.2.10 Continuous axle (See Figure C.41)	Stub shafts	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
D.2.11 Shaft end retention	Remove	≤	≤	≤	Not possible	
D.2.12 Shaft end retention	Add	>=<	>=<	>=<	Possible providing expansion is permitted	
D.3 Endcaps (Infill at end of tube usually mild steel or casting which sometimes carries a bearing if the shaft is fixed).						
D.3.1 Thickness	Decrease	≤	≤	≤	Not possible	
D.3.2 Thickness	Increase	≥	≥	≥	Possible	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
D.3.3 Material	Alternative material and/or manufacturer	>=<	>=<	>=<	Possible providing the material has an equal or higher melting point, otherwise not possible without an additional test	
D.4 Curtain to barrel fixings						
D.4.1 Size	Decrease	>=<	>=<	>=<	Possible providing the fixings are positioned closer together so that the total cross-section of the fixings is not decreased	
D.4.2 Size	Increase	≥	≥	≥	Possible	
D.4.3 Number	Decrease	≤	≤	≤	Not possible	
D.4.4 Number	Increase	≥	≥	≥	Possible	
D.4.5 Material	Alternative material and/or manufacturer	>=<	>=<	>=<	Possible providing the material has an equal or higher melting point and strength, otherwise not possible without an additional test	
D.4.6 Spacing	Decrease	≥	≥	≥	Possible	
D.4.7 Spacing	Increase	≤	≤	≤	Not possible	
D.5 Springs either inside barrels or externally mounted						
D.5.1	Delete	≥	≥	≥	Possible	
D.5.2	Add	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
D.5.3 Size	Decrease	≥	≥	≥	Possible	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
D.5.4 Size	Increase	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
D.5.5 Number	Decrease	≥	≥	≥	Possible	
D.5.6 Number	Increase	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
D.5.7 Material	Alternative material and/or manufacturer	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
E Barrel/shaft end supports						
E.1 Support brackets/endplates						
E.1.1 Size (See Figure C.42)	Decrease	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
E.1.2 Size (See Figure C.43)	Increase	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
E.1.3 Material thickness	Decrease	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
E.1.4 Material thickness	Increase	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
E.1.5 Material	Alternative material	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied and the material has an equal or higher melting point, otherwise not possible without an additional test	
E.1.6 Shape general	Flat end plate to open bracket assembly	≤	≤	≤	Not possible	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
E.1.7 Shape general	Open bracket assembly to flat end plate	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
E 1.8 Shape	Fabrication detail	>=<	>=<	>=<	Possible providing tested shape is retained and the requirements in Annex B are satisfied	
E.2 Support brackets/endplates Fixings						
E.2.1 Size	Decrease	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied and any fixing manufacturers special requirements under fire conditions must be considered	
E.2.2 Size	Increase	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied and any fixing manufacturers special requirements under fire conditions must be considered	
E.2.3 Material	Alternative material and/or manufacturer	>=<	>=<	>=<	Possible providing the fixings have been shown by test to have an equal or better pullout strength (in fire conditions), otherwise not possible without an additional test	
E.2.4 Number	Decrease	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied and any fixing manufacturers special requirements under fire conditions must be considered	
E.2.5 Number	Increase	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied and any fixing manufacturers special requirements under fire conditions must be considered	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
E.2.6 Spacing	Decrease	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied and any fixing manufacturers special requirements under fire conditions must be considered	
E.2.7 Spacing	Increase	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied and any fixing manufacturers special requirements under fire conditions must be considered	
E.3 Shaft Bearings and / or arrestor						
E.3.1 Size	Decrease	≤	≤	≤	Not possible	
E.3.2 Size	Increase	≥	≥	≥	Possible	
E.3.3 Material	Change	>=<	>=<	>=<	Possible providing the material has an equal or higher melting point and strength, otherwise not possible without an additional test	
E.3.4 Type	Alternative type and/or manufacturer	>=<	>=<	>=<	Possible providing the material has an equal or higher melting point and strength, otherwise not possible without an additional test	
E.4 Shaft Cups						
E.4.1 Size (See Figure C.44)	Decrease	≤	≤	≤	Not possible without additional test	
E.4.2 Size (See Figure C.45)	Increase	≥	≥	≥	Possible	
E.4.3 Material	Alternative material and/or manufacturer	>=<	>=<	>=<	Possible providing the material has an equal or higher melting point and strength, otherwise not possible without an additional test	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
E.4.4 Type (See Figure C.46)	Change	>=<	>=<	>=<	Possible providing the material has an equal or higher melting point and strength, otherwise not possible without an additional test	
E.5 Shaft bearing/cup fixings						
E.5.1 Size	Decrease	≤	≤	≤	Not possible	
E.5.2 Size	Increase	≥	≥	≥	Possible	
E.5.3 Material	Alternative material and/or manufacturer	>=<	>=<	>=<	Possible providing the material has an equal or higher melting point and strength, otherwise not possible without an additional test	
E.5.4 Number	Decrease	>=<	>=<	>=<	Possible providing the fixings are larger so that the total cross-section is not reduced	
E.5.5 Number	Increase	≥	≥	≥	Possible	
E.6 Supports (Additional bracings used with extended motor plates back to structure)						
E.6.1 (See Figure C.47)	Add	≥	≥	≥	Possible	
E.6.2 (See Figure C.48)	Delete	≤	≤	≤	Not possible	
E.6.3 Size (See Figure C.49)	Decrease	≤	≤	≤	Not possible	
E.6.4 Size (See Figure C.50)	Increase	≥	≥	≥	Possible	
E.6.5 Thickness	Decrease	≤	≤	≤	Not possible	
E.6.6 Thickness	Increase	≥	≥	≥	Possible	
E.6.7 Number	Decrease	≤	≤	≤	Not possible	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
E.6.8 Number	Increase	≥	≥	≥	Possible	
E.6.9 Material	Alternative material	>=<	>=<	>=<	Possible providing the material has an equal or higher melting point and strength, otherwise not possible without an additional test	
E.6.10 Cross-section, length or orientation	Alternative	>=<	>=<	>=<	Possible providing resultant stress and strain are retained or improved	
F Casing/Hood						
F.1.1 (See Figure C.51)	Add	>=<	>=<	>=<	Possible providing expansion does not affect the load bearing parts and any power operation is outside the casing	
F.1.2 (See Figure C.52)	Delete	≤	≤	≤	Not possible	
F.1.3 Size (See Figure C.53)	Decrease	>=<	>=<	>=<	Possible providing its dimensions are not less than the endplates	
F.1.4 Size (See Figure C.54)	Increase	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
F.1.5 Material thickness	Decrease	≤	≤	≤	Not possible	
F.1.6 Material thickness	Increase	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
F.1.7 Material (metal)	Alternative material	>=<	>=<	>=<	Possible providing the material has an equal or higher melting point, and thermal expansion is allowed for, otherwise not possible without an additional test	

<table>
<tr><th>Construction parameter</th><th>Variation</th><th colspan="3">Influence of variation on performance characteristic</th><th>Possibility of extension</th><th>Additional evidence required</th></tr>
<tr><td>(1)</td><td>(2)</td><td colspan="3">(3)
E | I | W</td><td>(4)</td><td>(5)</td></tr>
<tr><td>F.1.8 Shape (See Figure C.55)</td><td>Change</td><td>>=<</td><td>>=<</td><td>>=<</td><td>
<table>
<tr><td>detail</td><td>E</td><td>EI,EW</td></tr>
<tr><td>a to b</td><td>P</td><td>P</td></tr>
<tr><td>b to a</td><td>NP</td><td>NP</td></tr>
<tr><td>a to c</td><td>P</td><td>NP</td></tr>
<tr><td>c to a</td><td>NP</td><td>NP</td></tr>
<tr><td>b to c</td><td>P</td><td>NP</td></tr>
<tr><td>c to b</td><td>P</td><td>P</td></tr>
<tr><td>d to a</td><td>NP</td><td>P</td></tr>
<tr><td>d to b</td><td>P</td><td>P</td></tr>
<tr><td>d to c</td><td>P</td><td>NP</td></tr>
<tr><td>a to d</td><td>P</td><td>NP</td></tr>
<tr><td>b to d</td><td>NP</td><td>NP</td></tr>
<tr><td>c to d</td><td>NP</td><td>P</td></tr>
</table>
P = possible
NP = not possible
For E classification test is with barrel on exposed side
For EW and EI classification test is from both sides</td><td></td></tr>
<tr><td colspan="8">F2 Casing/hood fixings</td></tr>
<tr><td>F.2.1 Size</td><td>Decrease</td><td>≤</td><td>≤</td><td>≤</td><td colspan="2">Not possible</td><td></td></tr>
</table>

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
F.2.2 Size	Increase	≥	≥	≥	Possible	
F.2.3 Number	Decrease	≤	≤	≤	Not possible	
F.2.4 Number	Increase	≥	≥	≥	Possible	
F.2.5 Spacing	Decrease	≥	≥	≥	Possible	
F.2.6 Spacing	Increase	≤	≤	≤	Not possible	
F.2.7 Material or type	Alternative material or type	>=<	>=<	>=<	Possible providing the fixings have been shown by test to have an equal or better pullout strength (in fire conditions), otherwise not possible without an additional test	
G Drive systems						
G.1 Drive systems excluding tubular motors						
G.1.1 External drive system (See Figure C.56)	Add	>=<	>=<	>=<	Possible providing all the drive system e.g. gears, chains, sprockets or motors are located outside the casing	
G.1.2 External drive system (See Figure C.57)	Delete	≥	≥	≥	Possible	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
G.1.3 Internal drive systems i.e. where any part e.g. gears, chains, sprockets or motors is located inside the casing (See Figure C.58)	Add	≤	≤	≤	Not possible without additional test if any part of the drive system is inside the casing	
G.1.4 Internal drive systems i.e. where any part e.g. gears, chains, sprockets or motors is located inside the casing (See Figure C.59)	Delete	≥	≥	≥	Possible	
G.1.5 Material	Alternative material	>=<	>=<	>=<	Possible for external drive systems Possible for internal drive systems providing the material has an equal or higher melting point	
G.1.6 Type	Alternative	>=<	>=<	>=<	Possible for external to external Possible for internal to internal providing the alternative is the same type Possible for internal to external Not possible for external to internal	
G.2 Tubular motors						
G.2.1	Add	≤	≤	≤	Not possible	
G.2.2	Delete	≥	≥	≥	Possible	
G.2.3 Type	Alternative	>=<	>=<	>=<	Not possible without test evidence covering the alternative type	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
G.3. Drive system Fixings						
G.3.1 Size	Decrease	≤	≤	≤	Not possible	
G.3.2 Size	Increase	≥	≥	≥	Possible	
G.3.3 Type	Change	>=<	>=<	>=<	Possible providing total cross-section of fixings is the same	
G.3.4 Material	Change	>=<	>=<	>=<	Possible providing the fixings have been shown by test to have an equal or better pullout strength (in fire conditions), otherwise not possible without an additional test	
G.3.5 Number	Decrease	>=<	>=<	>=<	Possible providing total cross-section of fixings is the same	
G.3.6 Number	Increase	≥	≥	≥	Possible	
H Supports for barrel and/or casing						
H.1.1 (See Figure C.60)	Add	>=<	>=<	>=<	Possible for casing supports and possible for barrel supports in accordance with Annex B	
H.1.2 (See Figure C.61)	Delete	≤	≤	≤	Not possible.	
H.1.3 Cross section, size and material thickness	Change	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied .	
H.1.4 Material	Change	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
H.1.5 Number	Decrease	≤	≤	≤	Not possible .	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
H.1.6 Number	Increase	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
H.1.7 Shape/orientation (See Figure C.62)	Change	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied	
H.1.8 Spacing between barrel support bracket locations	change	>=<	>=<	>=<	Possible see B.4	
H.1.9 Location (See Figure C.63)	Inside casing to outside	≥	≤	≤	Not possible for EI,EW doors . Possible for E doors	
H.1.10 Location (See Figure C.64)	Outside casing to inside	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied and for EI,EW doors providing that the insulation is the same.	
H.2 Barrel/Casing Support Fixings						
H.2.1 Size	Decrease	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied and any fixing manufacturers special requirements under fire conditions must be considered	
H.2.2 Size	Increase	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied and any fixing manufacturers special requirements under fire conditions must be considered	
H.2.3 Number	Decrease	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied and any fixing manufacturers special requirements under fire conditions must be considered	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
H.2.4 Number	Increase	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied and any fixing manufacturers special requirements under fire conditions must be considered	
H.2.5 Spacing	Decrease	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied and any fixing manufacturers special requirements under fire conditions must be considered	
H.2.6 Spacing	Increase	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied and any fixing manufacturers special requirements under fire conditions must be considered	
H.2.7 Material	Alternative material and/or manufacturer	>=<	>=<	>=<	Possible providing the fixings have been shown by test to have an equal or better pullout strength (in fire conditions), see Annex B, otherwise not possible without an additional test	
H.2.8 Type of fixings	Alternative material type and/or manufacturer	>=<	>=<	>=<	Possible providing the fixings have been shown by test to have an equal or better pullout strength (in fire conditions), see Annex B, otherwise not possible without an additional test	
J Supporting construction and attachment (technique) of door frame/components						
J.1 General						
J.1.1 Supporting construction (See Figure C.65)	Standard flexible to rigid	≥	≥	≥	Possible providing an appropriate attachment technique is chosen	

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
J.1.2 Supporting construction (See Figure C.66)	Rigid to standard flexible	≤	≤	≤	Not possible without additional test	
J.1.3 Supporting construction (See Figure C.67)	Modified (strengthened) flexible construction to rigid	≥	≥	≥	Possible	
J.1.4 Attachment technique	Alternative tang (built-in fixing) to plug & screw	≤	≤	≤	Not possible without an additional test	
J.1.5 Attachment technique	Alternative plug & screw to tang (built-in fixing)	≥	≥	≥	Possible providing requirements in Annex B are satisfied	
J.1.6 Type of fixings	Alternative material and/or manufacturer	>=<	>=<	>=<	Possible providing requirements in Annex B are satisfied and any fixing manufacturers special requirements for spacing must be considered and providing the fixings have been shown by test to have an equal or better pullout strength (in fire conditions), see Annex B, otherwise not possible without an additional test	
J.1.7 Gap between shutter bottom rail and floor	Increase	≤	≤	≤	Not possible	
J.1.8 Gap between shutter bottom rail and floor	Decrease	≥	≥	≥	Possible	
J.2 Modified supporting construction						

Construction parameter	Variation	Influence of variation on performance characteristic			Possibility of extension	Additional evidence required
(1)	(2)	(3)			(4)	(5)
		E	I	W		
J.2.1 Supporting construction (See Figure C.68)	Change from standard supporting construction to protected structural steel supporting construction	>=<	>=<	>=<	Possible providing the following applies: a) Structural steel section factor, A/V must be less than $230m^{-1}$. Section factor to be calculated assuming section is exposed to fire on all four sides. The section factor shall be calculated as described in EN 13381-4 and EN 13381-8. This rule applies to both the vertical and the horizontal steel sections of the support frame. b) Fire protection system must have been shown by test to EN 13381 to maintain the steel temperature at 400 °C or less to retain strength and minimise the effects of expansion in the steel section. c) The fixings securing the door to the structural steel shall be in accordance with Annex B and must be fabricated from steel and designed not to reduce the fire performance of the steelwork fire protection system in ambient conditions or in fire conditions.	
K Decorative and/or protective finishes						
K.1.1 Paints without contribution to fire resistance	Add	≤	≤	≤	Possible in line with direct application	
K.1.2 Paints without contribution to fire resistance	Alternative	≥	≥	≥	Possible in line with direct application	

Construction parameter	**Variation**	**Influence of variation on performance characteristic**			**Possibility of extension**	**Additional evidence required**
(1)	(2)	(3)			(4)	(5)
		E	I	W		
K.1.3 Thickness of paints with positive contribution to fire resistance	Increase	≥	≥	≥	Possible up to a maximum of 10 % of mean dry film thickness	
K.1.4 Thickness of paints with positive contribution to fire resistance	Decrease	≤	≤	≤	Possible up to 68 % of thickness measurements within ± 20 % of mean value or up to 95 % of thickness measurements within ± 30 % of mean value or all thickness measurements within ± 45 % of mean value	
K.1.5 Type of paints with positive contribution to fire resistance	alternative	≤	≤	≤	Not possible without additional test	

Annex B
(normative)

Steel rolling shutter assemblies stress calculation method

B.1 Calculation principles

The general methodology for checking the proposed specifications is based on accepted engineering first principles which may be modified only in accordance with adjustments given in the following clauses.

The values for material properties such as Young's Modulus shall be taken from EN 1993-1-2 for temperatures measured for the load bearing components at the required classification time. If temperatures of components have not been measured then the furnace temperature according to EN 1363-1 at the required classification time shall be used unless otherwise stated.

NOTE For clarification of terms used in these calculations refer to Figures C.69 and C.70.

B.2 Calculation of limiting stress

The stress in the various loadbearing components including fixings of the tested steel rolling shutter assemblies should be calculated using the methodology outlined in the examples given in B.3, B.4 and B.5 as applicable. The stresses in the tested components shall be used as the limiting stress for those same components in any assessment calculations that are carried out for the same classification period.

For a reduced classification period the following rules apply:

a) If there is no temperature measurement for a relevant load-bearing component then the maximum stress in that tested component shall be used as the limiting stress. Examples of load bearing components are: centre of barrel, barrel support bracket, axle between barrel and bearing support bracket, bearing support bracket/endplate, curtain to barrel fixings, etc.

b) Where the temperature of a load bearing component has been measured during the test the limiting stress for the shorter fire resistance classification periods can be obtained for the relevant component by adjusting the calculated component stresses in the test specimen in relation to the reduction factors for stress-strain relationship given in EN 1993-1-2 for the lower measured temperature using a safety factor of 75 %. For example

— calculated stress for load bearing component in test specimen σ_s;

— tested classification period t_s;

— required reduced classification period t_r;

— permitted stress for same component for reduced period σ_r.

$\sigma_r = \sigma_s$ (reduction factor at temperature at t_r/ reduction factor at temperature at t_s) 0,75

B.3 Barrel calculations

By calculating the moment of inertia (I_B) and section modulus (Z_B) for the barrel, the barrel bending stress (σ_B) can be calculated assuming free deflection.

Curtain weight (W_L) $$= \left[\left(\frac{\pi \ D_B \times L_L}{2} \right) + (L_L \times h_{SA}) \right] \times [\rho_L] \quad \text{(kg)}$$

where

D_B = Barrel outside diameter (m)

L_L = Lath length (m)

h_{SA} = Height of shutter aperture (m)

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

Barrel assembly weight (W_{BA}) (N) $= [(W_B + W_L) \times (9.81)]$

where

W_B = Weight of barrel including springs, axles, tubular motor, etc (kg)

W_L = Full weight of curtain including bottom rail (kg)

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

where

D_B = Barrel outside diameter (mm)

t_B = Barrel wall thickness (mm)

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

where

I_B = Barrel moment of inertia (mm^4)

D_B = Barrel outside diameter (mm)

Barrel stress (σ_B): $$= \left[\frac{W_{BA} \times L_B}{8 \times Z_B} \right] \quad \left(\text{N/mm}^2 \right)$$

where

W_{BA} = ~~B~~arrel assembly weight (N)

L_B = Barrel length (mm)

Z_B = Barrel section modulus (mm^3)

Substituting the deformation factor (E_B) for Young's Modulus then allows a value for theoretical barrel deflection to be calculated. The value for Young's Modulus should be taken from EN 1993-1-2; the temperature used should be that of the barrel, if measured, or furnace at the required time.

Free deflection of barrel (d_B):
$$= \left[\left(\frac{5}{384} \right) \times \left(\frac{W_{BA} \times L_B^{\,3}}{E_B \times I_B} \right) \right] \quad (mm)$$

where

W_{BA} = Barrel assembly weight (N)

L_B = Barrel length (mm)

E_B = Barrel deformation factor (N/mm^2)

I_B = Barrel moment of inertia (mm^4)

B.4 Barrel support bracket calculations

Support brackets may be required to limit effects of barrel deflection during fire conditions for example:

a) For steel rolling shutter assemblies without a casing where the calculated barrel deflection leads to a reduction of the distance between the underside of the barrel and the underside of the lintel being less than that distance observed at the end of the classification period.

b) For steel rolling shutter assemblies with a casing where the calculated barrel deflection exceeds the distance between the underside of the barrel and the bottom of the casing.

The barrel support system calculation methodology uses the general principle of a balanced system in which the theoretical barrel deflection is reduced to an acceptable level by supporting the barrel with one or more barrel support brackets.

When barrel support brackets are used in only one location, the support brackets at that location shall be capable of supporting at least 62,5 % of the barrel assembly weight. Where barrel support brackets are used at two locations, the support brackets at each location shall be capable of supporting at least 31,25 % of the barrel assembly weight.

The following equations calculate the maximum load that can be supported by a given number of brackets. Wr 1 is the maximum theoretical load that can be supported, Wr 2 is the self-load of the bracket, and Wr 3 is the load applied by the casing. The maximum total load that can then be supported is W Total. It should be noted that brackets may be positioned at no more than two locations. Where a single bracket is required it shall be placed at the location of greatest deflection. Where brackets are required at two locations they shall be at a maximum of 20 % of the barrel length apart, and they shall be equally spaced at the location of greatest deflection.

Barrel support stress:

Wr 1 (bracket potential support): $= \left[\frac{I_{SB} \times \sigma_{SB} \times n}{a \times y}\right]$ (N)

where

I_{SB} = Support bracket moment of inertia (mm^4)

σ_{SB} = Support bracket maximum stress (N/mm^2)

n = Number of barrel supports

a = Distance between centreline of axle and rear of barrel support bracket (mm)

y = Distance between barrel support centre of gravity and the point of greatest stress (mm)

Wr 2 (bracket component): $= \left[\frac{b \times A_{SB} \times 7.85 \times g \times n}{10^6}\right]$ (N)

where

b = Barrel support length (mm)

A_{SB} = Support bracket cross-sectional area (mm^2)

n = Number of barrel supports

g = 9,81 (ms^{-2})

Wr 3 (casing hood component): $= \left[\frac{t_{CH} \times L_{CH} \times b \times 7.85 \times g}{10^6}\right]$ (N)

where

t_{CH} = Casing thickness (mm)

L_{CH} = Casing length (mm)

b = Casing soffit length (mm)

g = 9,81 (ms^{-2})

Wr Total = Wr 1 – Wr 2 – Wr 3 (N)

If there are no supports required ‘Wr Total’ equals 0. If supports are required ‘Wr Total’ equals the sum of Wr 1, Wr 2, and Wr 3.

If barrel support brackets are required, the following shall apply:

Wr Total ≥ $(W_{BA} \times 0{,}625)/n$

where

W_{BA} = Barrel assembly weight (N)

n = Number of barrel support brackets

B.5 Axle calculations

The resultant load on each axle is calculated:

Axle section modulus (Z_A): $\left[\frac{{D_A}^3 \times \pi}{32}\right]$ (mm^3)

where

D_A = Axle diameter (mm)

From this the resultant bending and shear stress in the proposed axle can be calculated.

Axle bending stress (σ_{A1}): $= \left[\frac{(W_A + (g \times W_{AL})) \times L_A}{Z_A}\right]$ (N/mm^2)

where

W_A = 50 % of barrel assembly weight (N)

W_{AL} = Motor weight (kg)

L_A = Axle length (mm)

Z_A = Axle section modulus (mm^3)

g = 9,81 (ms^{-2})

Axle shear stress (σ_{A2}): $= \left[\frac{4 \times (W_A + (g \times W_{AL}))}{{D_A}^2 \times \pi}\right]$ (N/mm^2)

where

W_A = 50 % of barrel assembly weight (N)

W_{AL} = Motor weight (kg)

D_A = Axle diameter (mm)

Sufficient allowance shall be made in the axle bearing design for the movement of the end of the axle due to thermal expansion and deflection of the barrel by using the physical properties in EN 1993-1-2.

B.6 Endplate calculations

Only the bending stress in the endplates is considered, as a steel rolling shutter assembly stability failure would occur by excessive bending of the endplate prior to any shear failure occurring. The bending stresses are calculated as follows:

Weight of fixing angle (W_{EEL}): $= \left[\frac{h_E \times A_{FA} \times \rho_{Steel} \times g}{1 \times 10^9} \right]$ (N)

where

h_E = Endplate height (mm)

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

ρ_{steel} = density of steel = 7850 kg/m^3

g = 9,81 (ms^{-2})

Endplate horizontal cross-sectional area (A_E) $= \left[w_E \times t_E \right]$ (mm^2)

where

w_E = Endplate width (mm)

t_E = Endplate thickness (mm)

The area and length correction factors give a value that describes the relationship between the endplate fixing angle and the endplate.

Area correction factor (ϕ): $= \left[\frac{A_{FA}}{A_E} \right]$ (dimensionless)

where

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

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

Length correction factor (φ): $= \left[\frac{L_{FA}}{w_E} \right]$ (dimensionless)

where

L_{FA} = Fixing angle leg length (attached to endplate) (mm)

w_E = Endplate width (mm)

Endplate bending stress (σ_{EB}): $$= \left[\frac{(W_E \times L_E) + (W_M \times L_M)}{\gamma \times w_E \times t_E^2 / 6} \right] \quad \left(N/mm^2 \right)$$

where

W_E = 50 % of barrel assembly weight (N)

L_E = Axle end bearing length (mm)

W_M = Load on endplate due to motor (N)

L_M = Effective motor shaft length (mm)

γ = $[\, 1 + \phi \quad + \varphi \,]$ (dimensionless)

t_E = Endplate thickness (mm)

Endplate self-weight weight (W_{ESL}): $$= \left[\frac{h_E \times w_E \times t_E \times \rho_{Steel} \times g}{1 \times 10^9} \right] \quad (N)$$

where

h_E = Endplate height (mm)

w_E = Endplate width (mm)

t_E = Endplate thickness (mm)

ρ_{steel}= density of steel = 7850 kg/m^3

g = 9,81 (ms^{-2})

Eccentric loading (W_{EL}): $$= \left[W_A + W_{AL} \right] \quad (N)$$

where

W_A = 50 % of barrel assembly weight (N)

W_{AL} = Weight on endplate from motor (N)

Total endplate load (W_T): $$= \left[W_{EL} + W_{ESL} + W_{EEL} \right] \quad (N)$$

where

W_{EL} = Eccentric loading (N)

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

W_{EEL} = Fixing angle weight (N)

Shear stress in all endplate fixing bolts (τ_{EFB}) $= \left[\frac{W_T}{n_B \times a_B} \right]$ (N/mm^2)

where

W_T = Total endplate weight (N)

n_B = Number of bolts

a_B = Area of bolt taken at root diameter (mm^2)

Tensile force in top endplate fixing bolt (F_{EFB})

$$= \left[\frac{\left[(W_{AL} \times y_{AL}) + (W_A \times y_A) + (W_{ESL} \times y_{ESL}) + (W_{EEL} \times y_{EEL}) \right] \times y_{EFBN}}{\left({y_{EFB1}}^2 + {y_{EFB2}}^2 + ... + {y_{EFBN}}^2 \right)} \right] \quad \text{(N)}$$

where

W_{AL} = Motor weight (N)

y_{AL} = Distance from wall to motor centreline (mm)

W_A = 50 % of barrel assembly weight (N)

y_A = Distance from wall to axle centreline (mm)

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

y_{ESL} = Distance from wall to endplate centreline (mm)

W_{EEL} = Fixing angle weight (N)

y_{EEL} = Distance from wall to endplate fixing angle centreline (mm)

$y_{EFB1\ to\ N}$ = Distance from bottom of endplate to each fixing bolt, where N is the total number of bolts counting from bottom to top.(mm)

Tensile stress in top endplate fixing bolt (σ_{EFB}) $= \left[\frac{F_{EFB}}{a_{EFB}} \right]$ (N/mm^2)

where

F_{EFB} = Tensile force in top endplate fixing bolt (N)

a_{EFB} = Area of top endplate fixing bolt (mm^2)

The maximum principle stresses in the bolts resulting from the combined stresses can then be calculated.

Maximum principle tensile stress in top endplate fixing bolt σ_{EFBmax}

$$= \left[\frac{\sigma_{EFB}}{2} + \frac{1}{2} \sqrt{{\sigma_{EFB}}^2 + 4{\tau_{EFB}}^2} \right] \quad \text{(N/mm}^2\text{)}$$

Maximum principle shear stress in top endplate fixing bolt τ_{EFBmax}

$$= \frac{1}{2}\sqrt{{\sigma_{EFB}}^2 + 4{\tau_{EFB}}^2} \quad (N/mm^2)$$

where

τ_{EFB} is the shear stress in all endplate fixing bolts and

σ_{EFB} is the tensile stress in top endplate fixing bolt

B.7 Curtain expansion allowance

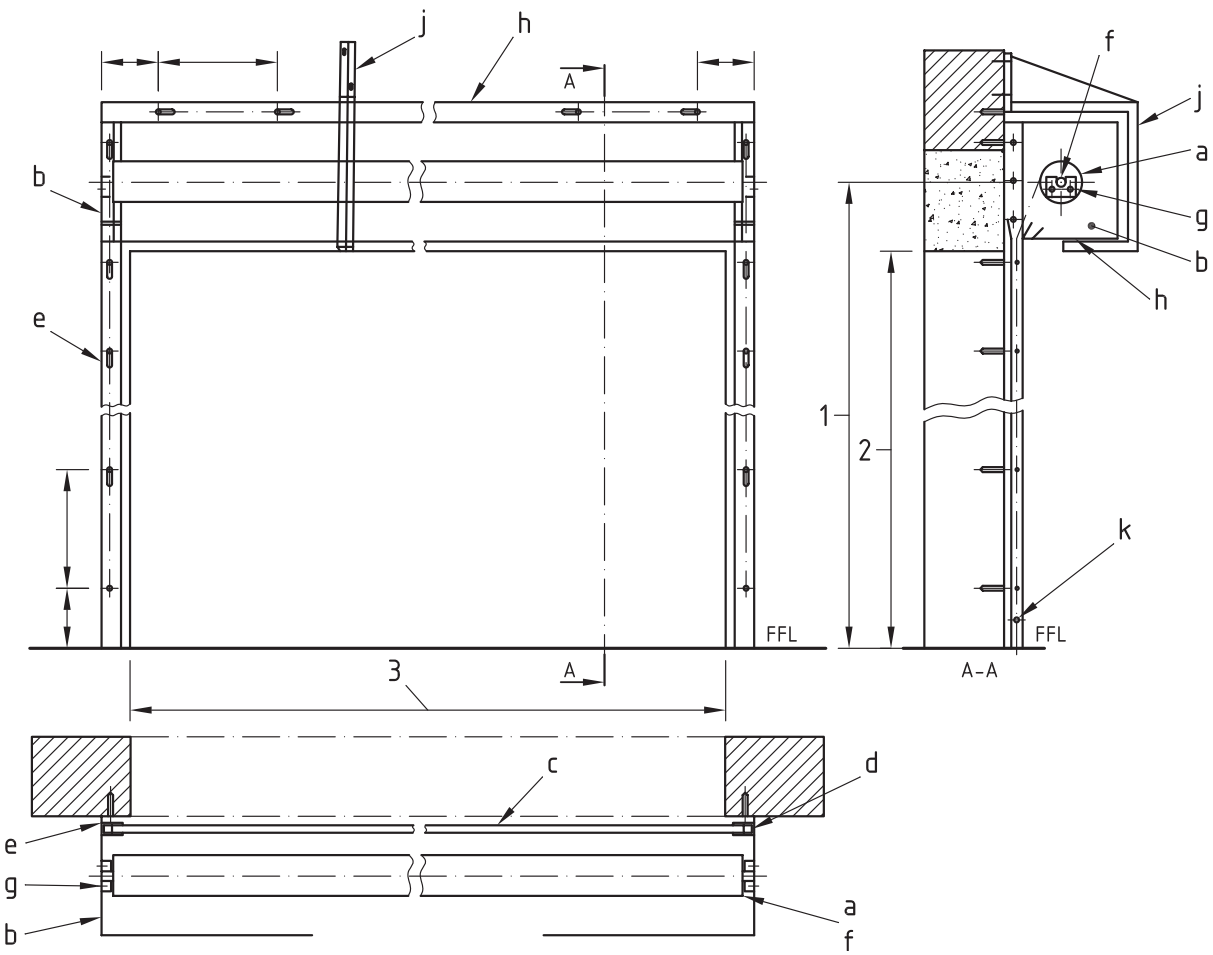
If the width of the curtain is greater than the tested width, the depth of each guide rail shall be increased by 5 mm for every 1 m increase in width and any sealing components (e.g. intumescent material) shall be enlarged in the same ratio. If the width of the curtain is less than the tested width, the depth of each guide rail shall be the same as tested.

B.8 Fire performance of fixings

Throughout this standard, the stated strength of the fixings in fire conditions shall be supported by suitable fire test data. For example, the EOTA Technical Report, TR 020 - Evaluation of Anchorages in Concrete Concerning Resistance to Fire, describes the evaluation for anchorages in normal weight concrete with a strength of at least C 20/25 and at most C 50/60 used for normal structures under fire exposure. Similar evaluations can be carried out on the anchorages in other substrates.

Annex C
(informative)

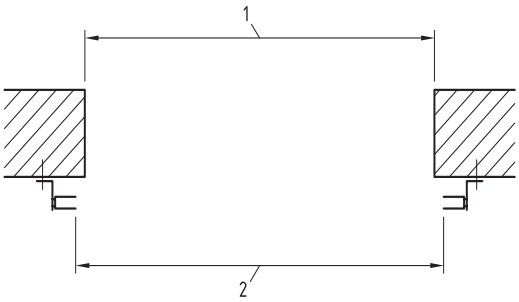
Figures related to Annex A & Annex B



Key

a barrel
b end plate/bracket
c curtain
d guide
e guide fixing angle
f shaft
g shaft cup/support
h coil casing/hood
j barrel/casing support bracket
k bottom rail

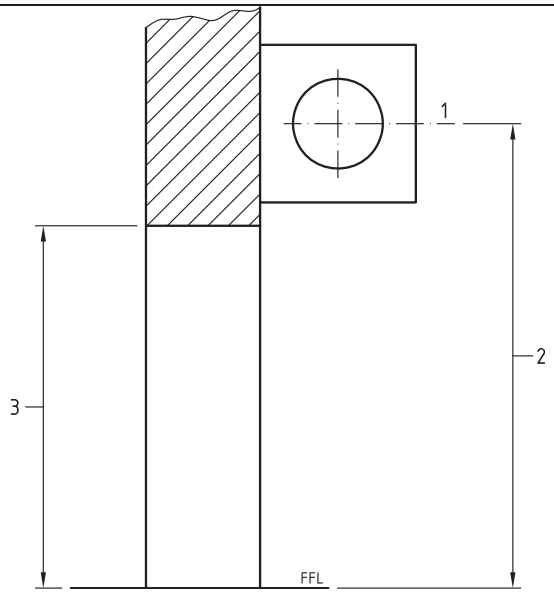
Figure C.1 - Example of a general arrangement of steel rolling shutter assembly



Key

1 opening width
2 width between guides

Figure C.2 - Width between guides



Key

1 centre line of barrel
2 height to centre line of barrel
3 opening height

Figure C.3 - Height to centre-line of barrel

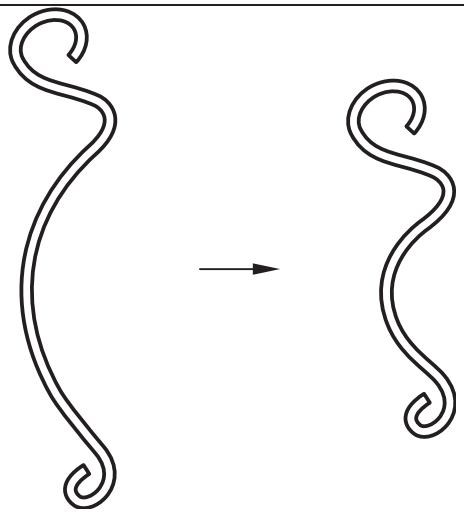


Figure C.4 - Lath – height decrease

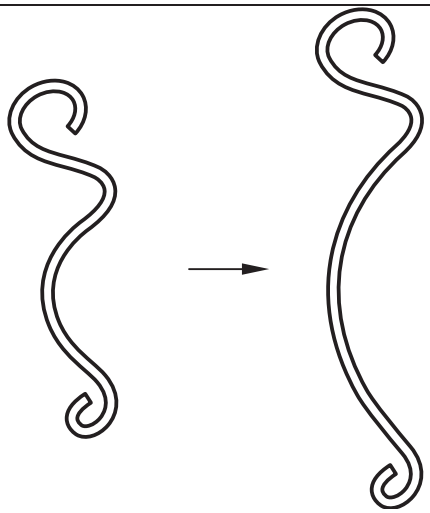


Figure C.5 - Lath – height increase

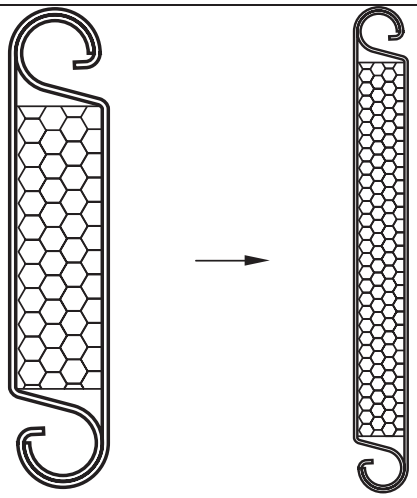


Figure C.6 - Thickness of insulation - decrease

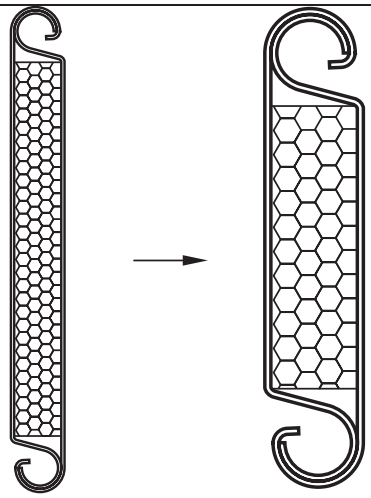


Figure C.7 - Thickness of insulation - increase

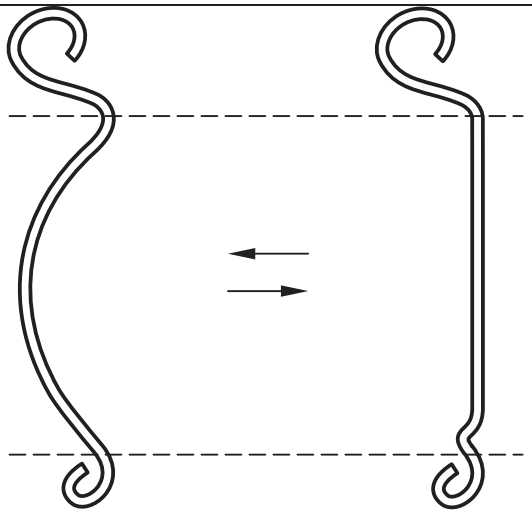


Figure C.8 - Shape of lath

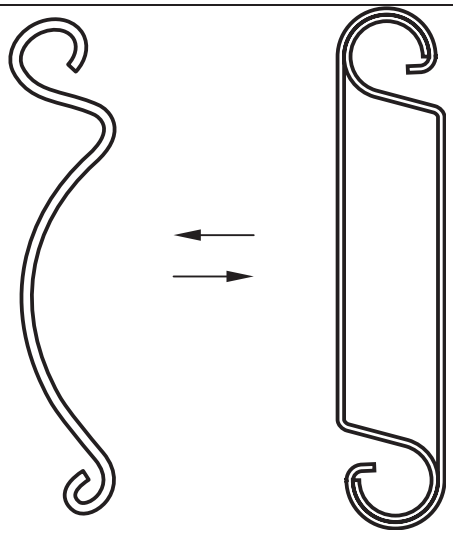


Figure C.9 - Type of lath

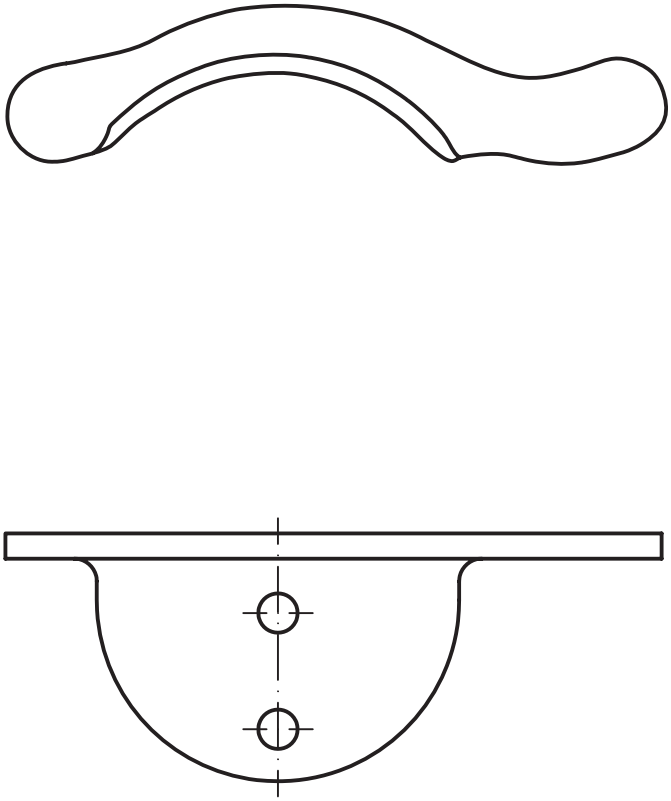


Figure C.10 - Endlocks

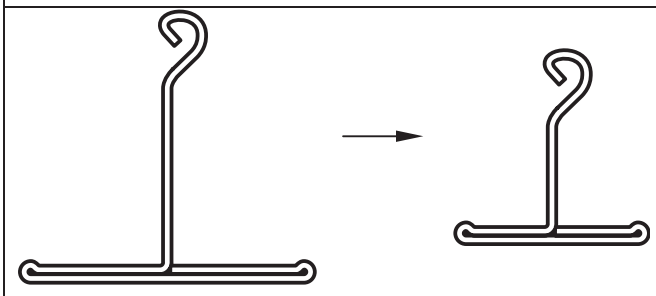


Figure C.11 - Bottom rail - decrease

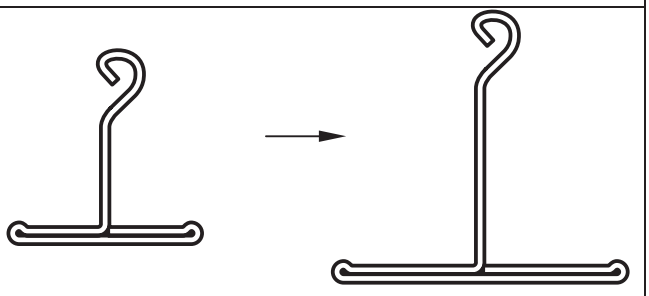


Figure C.12 - Bottom rail - increase

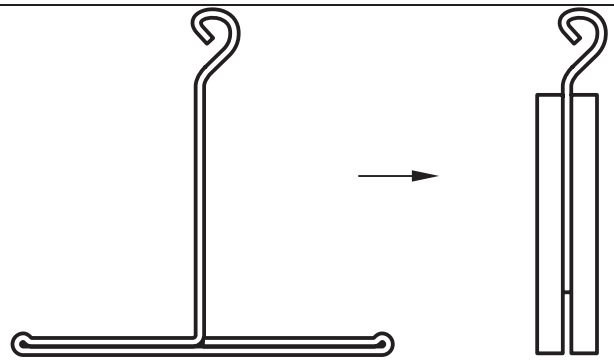


Figure C.13 - Bottom rail – T to flat

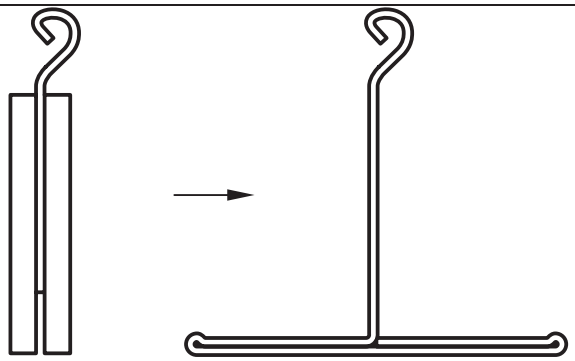


Figure C.14 - Bottom rail – flat to T

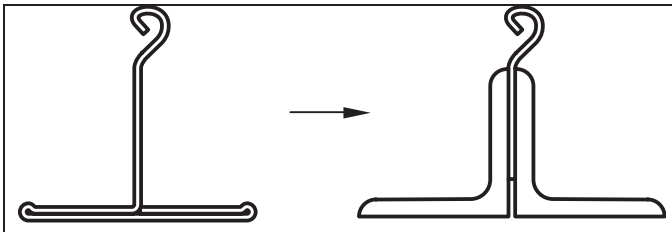


Figure C.15 - Bottom rail – T to double angle

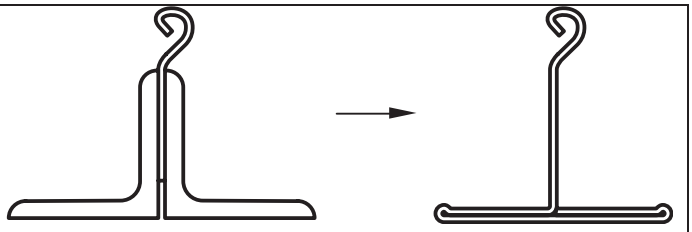


Figure C.16 - Bottom rail – double angle to T

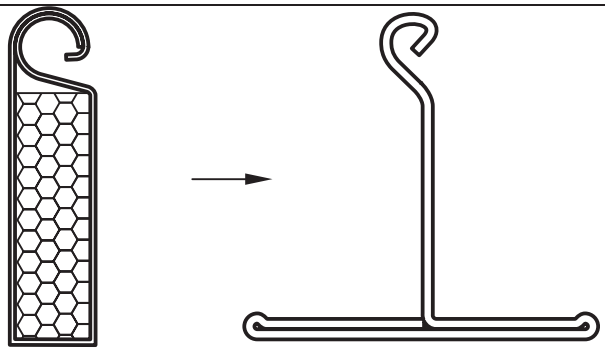


Figure C.17 - Bottom rail – insulated to T

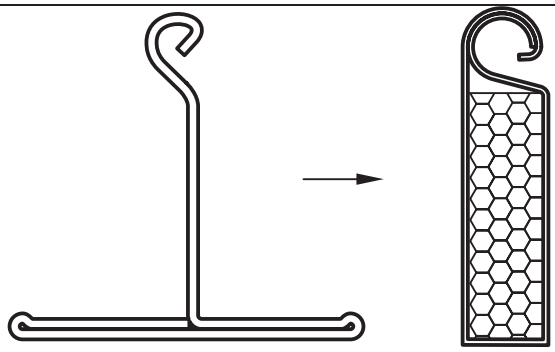


Figure C.18 - Bottom rail – T to insulated

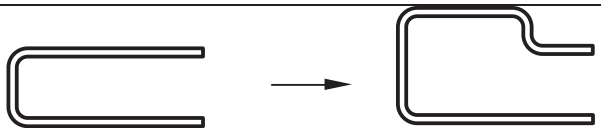


Figure C.19 - Guide – channel to wind-lock

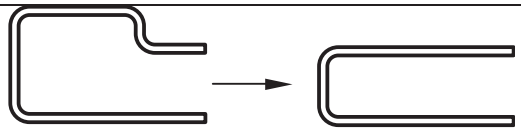


Figure C.20 - Guide – wind-lock to channel

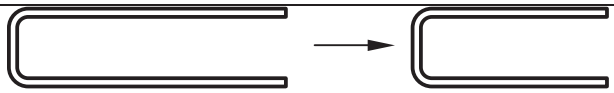


Figure C.21 - Guide – depth decrease

Figure C.22 - Guide – depth increase

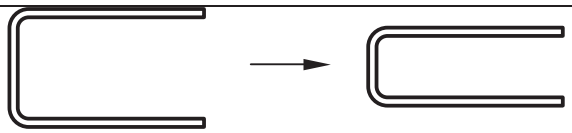


Figure C.23 - Guide – width decrease

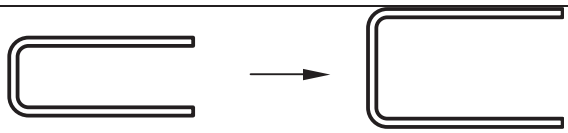


Figure C.24 - Guide – width increase

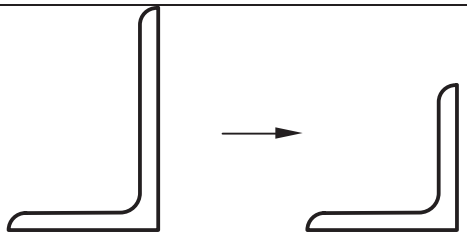


Figure C.25 - Guide fixing – section decrease

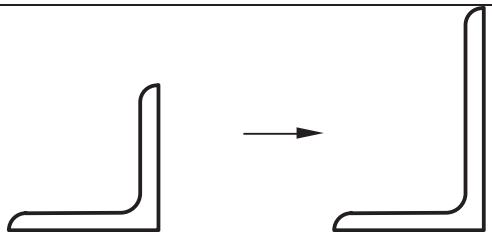


Figure C.26 - Guide fixing – section increase

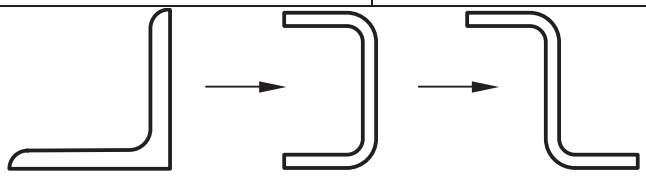
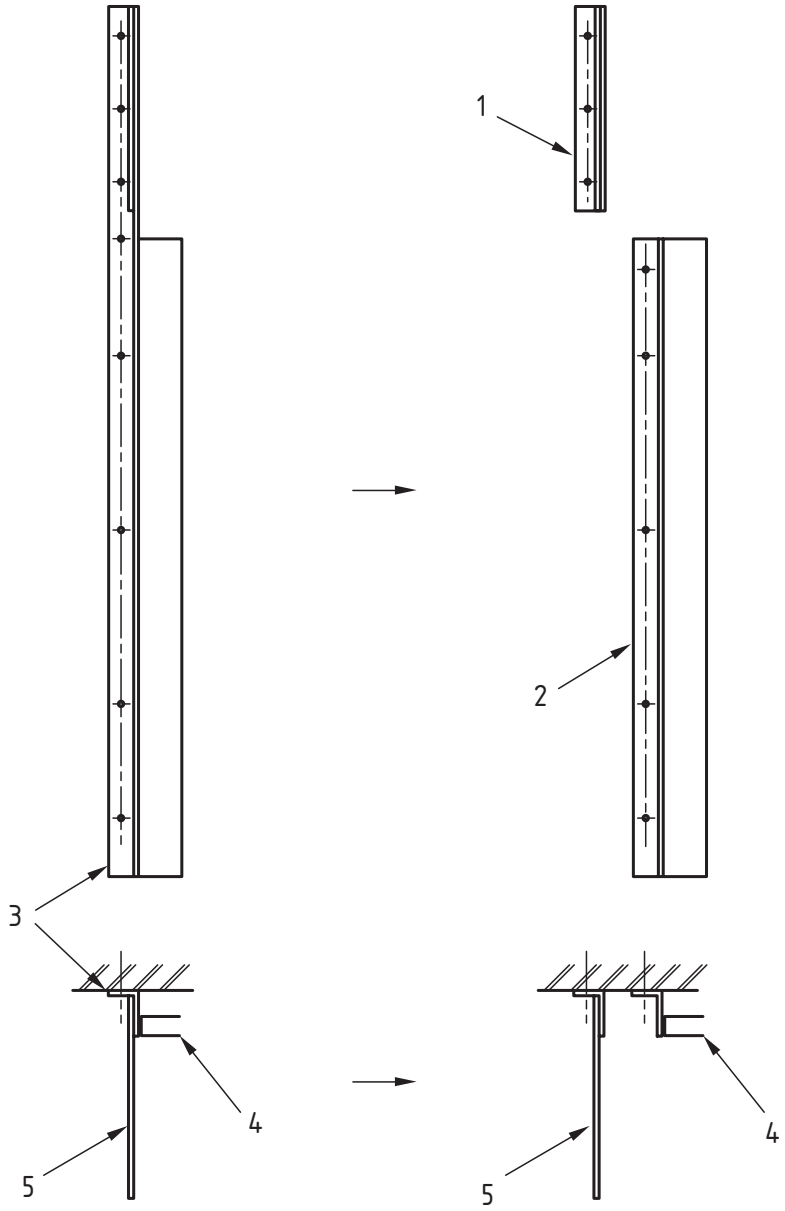


Figure C.27 - Shape of guide fixing – section change



Key

1 endplate support

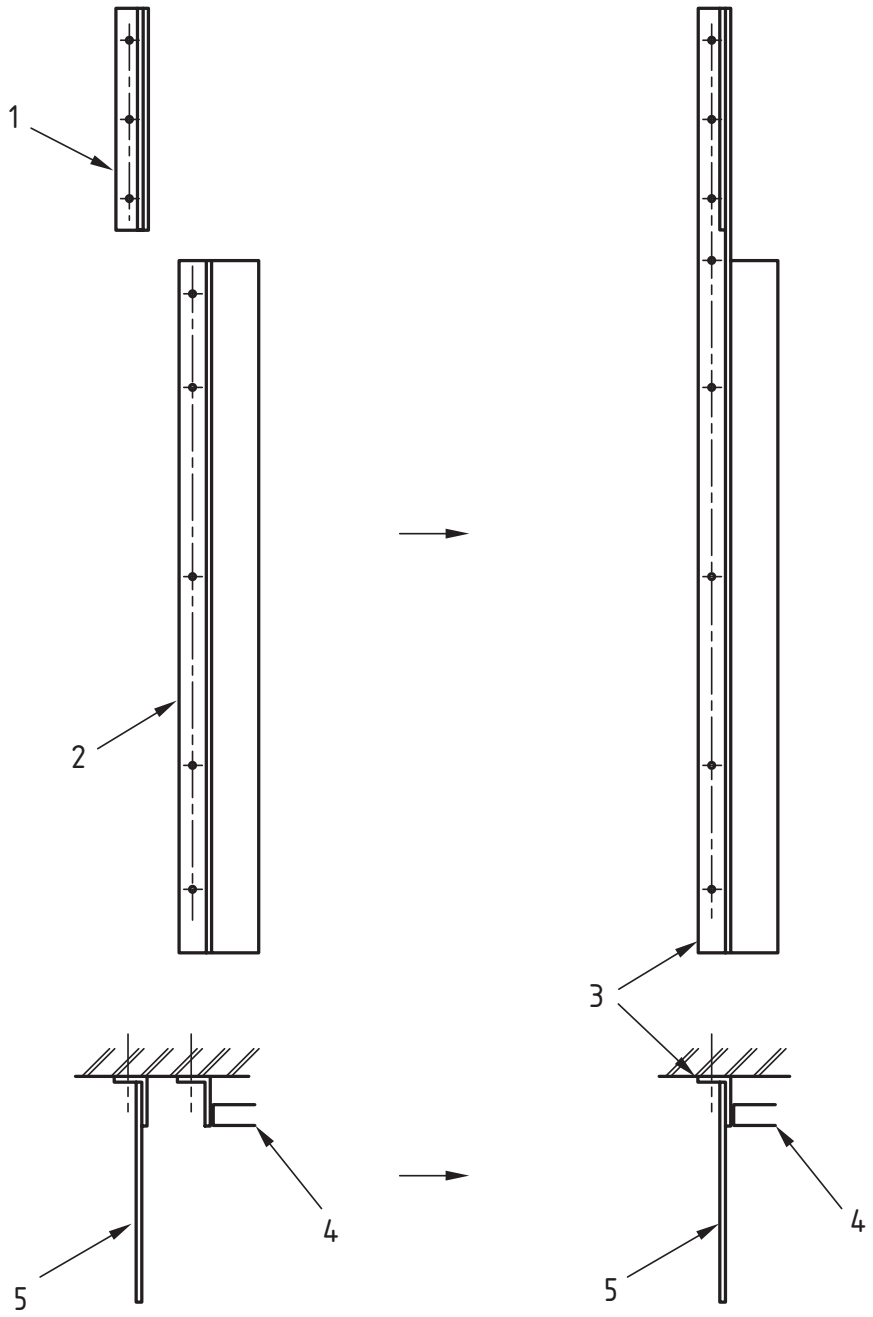
2 guide support

3 full height angle support

4 guide

5 endplate

Figure C.28 – Flag guides to separate type



Key

1 endplate support

2 guide support

3 full height angle support

4 guide

5 endplate

Figure C.29 – Separate guides to flag type

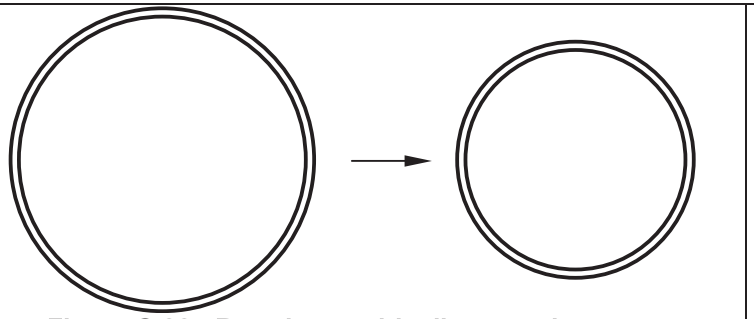


Figure C.30 - Barrel – outside diameter decrease

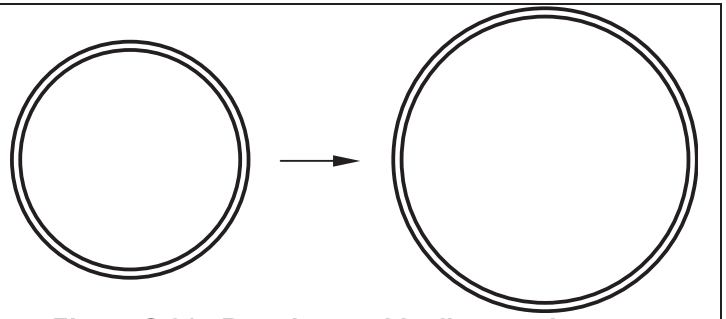


Figure C.31 - Barrel – outside diameter increase

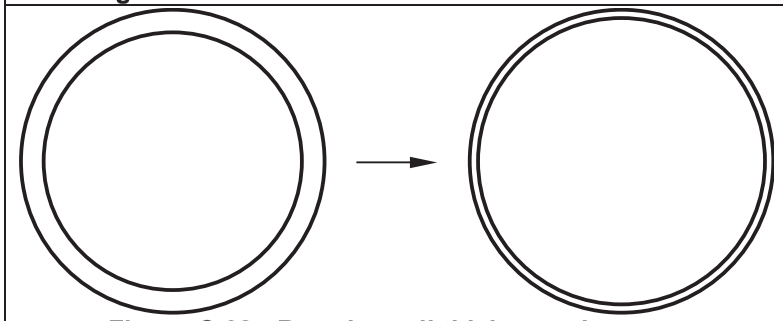


Figure C.32 - Barrel – wall thickness decrease

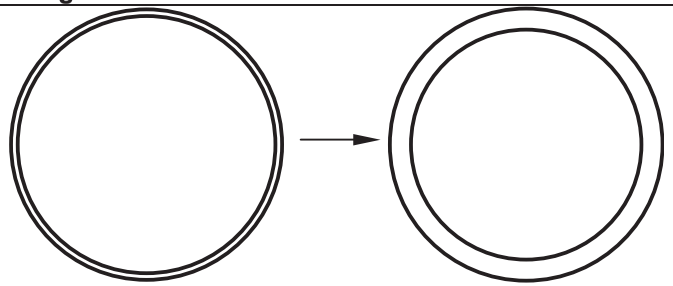


Figure C.33 - Barrel – wall thickness increase

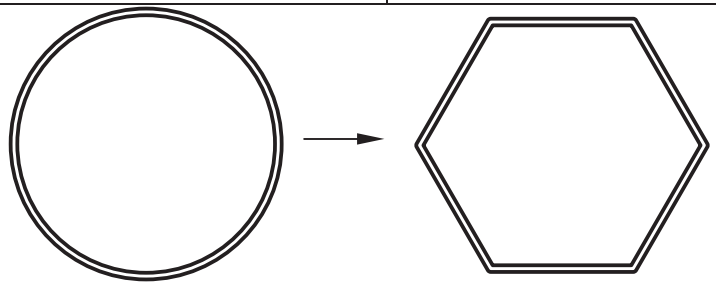


Figure C.34 - Barrel – shape change

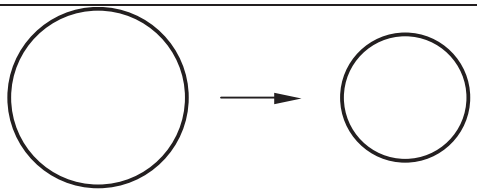


Figure C.35 - Shaft – outside diameter decrease

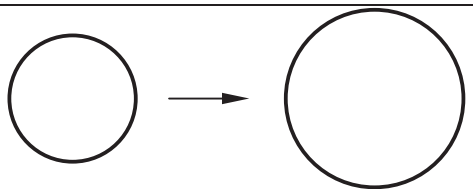


Figure C.36 - Shaft – outside diameter increase

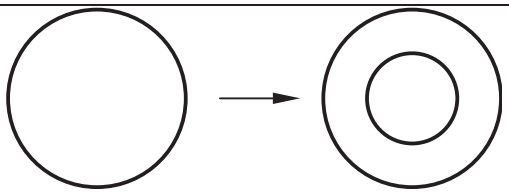


Figure C.37 - Shaft – solid to hollow

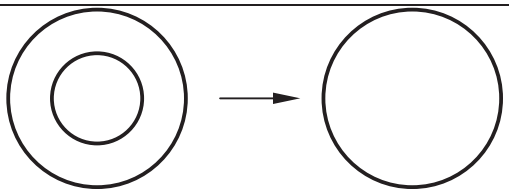


Figure C.38 - Shaft – hollow to solid

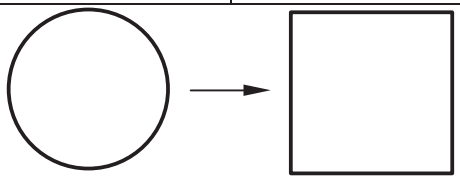


Figure C.39 - Shaft – shape change

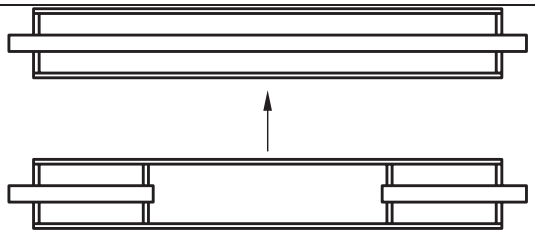


Figure C.40 - Barrel – stub shaft to continuous axle

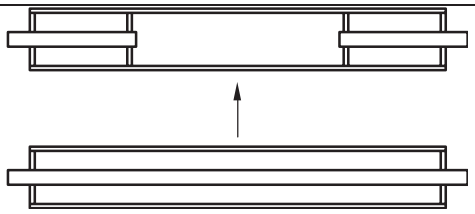


Figure C.41 - Barrel – continuous axle to stub shaft

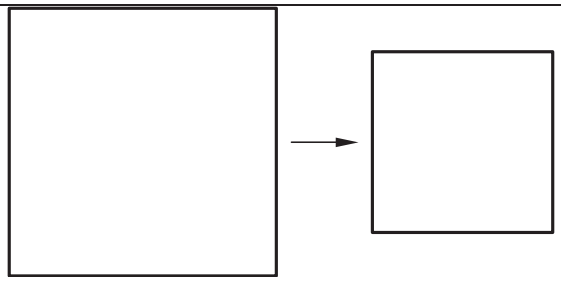


Figure C.42 - Support brackets/endplates - decrease

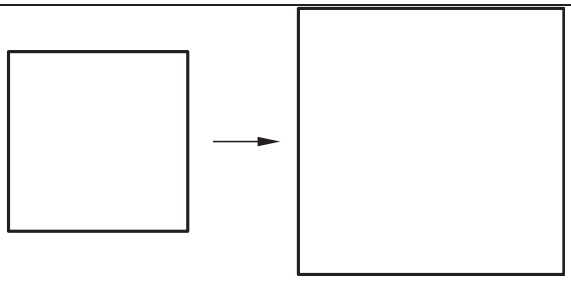


Figure C.43 - Support brackets/endplates - increase

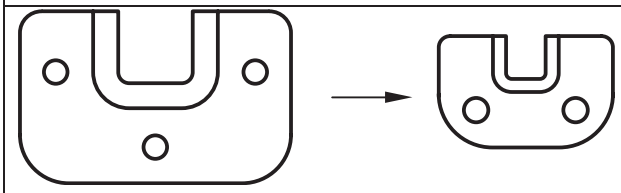


Figure C.44 - Shaft – cup size decrease

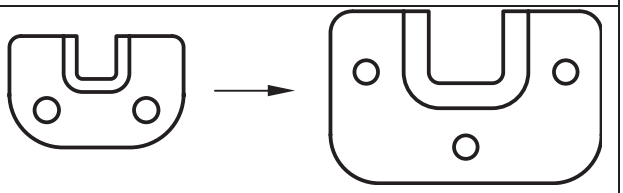


Figure C.45 - Shaft – cup size increase

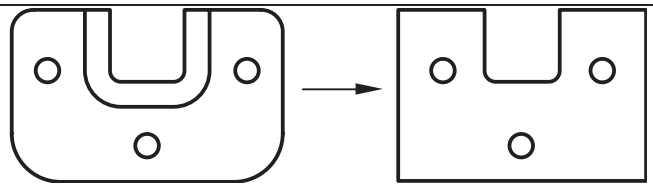


Figure C.46 - Shaft – cup type change

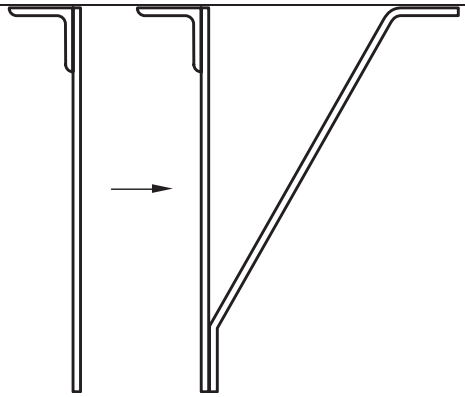


Figure C.47 -

Support bracings - add

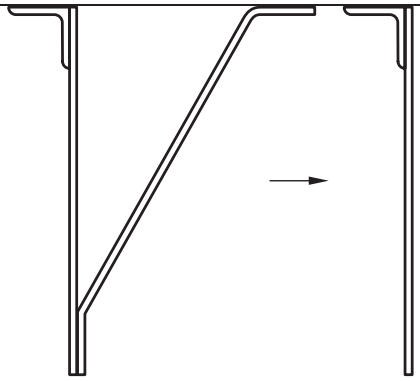


Figure C.48 -

Support bracings - delete

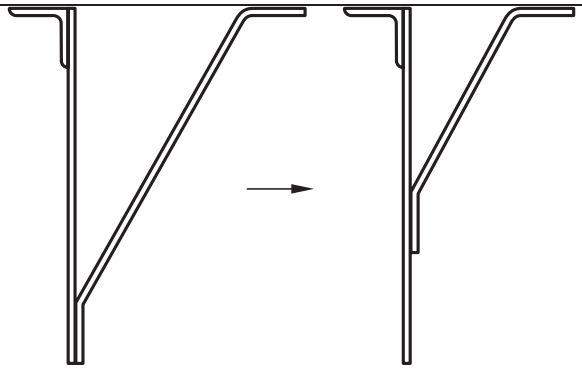


Figure C.49 -

Support bracings – size decrease

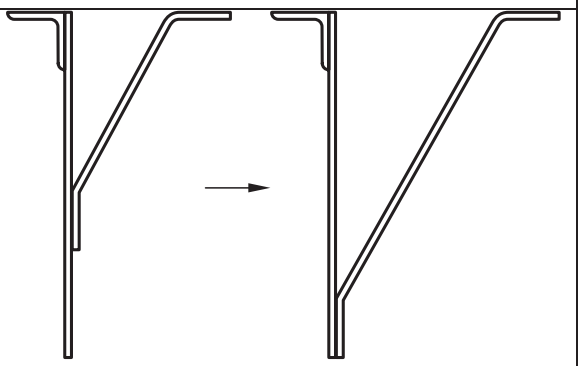


Figure C.50 -

Support bracings – size increase

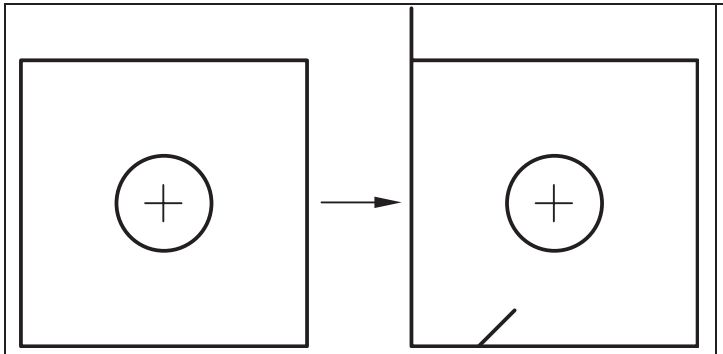


Figure C.51 - Casing/Hood - add

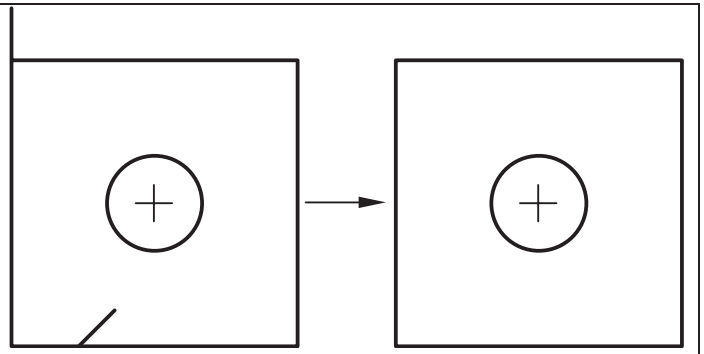


Figure C.52 - Casing/Hood - delete

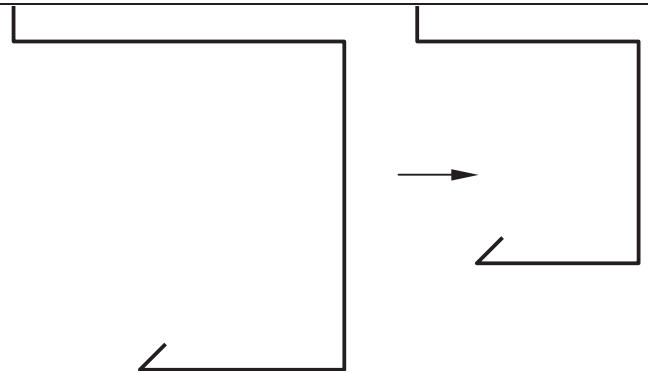


Figure C.53 - Casing/Hood – size decrease

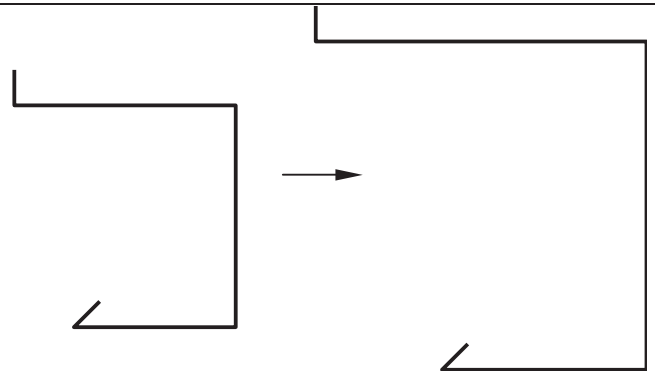
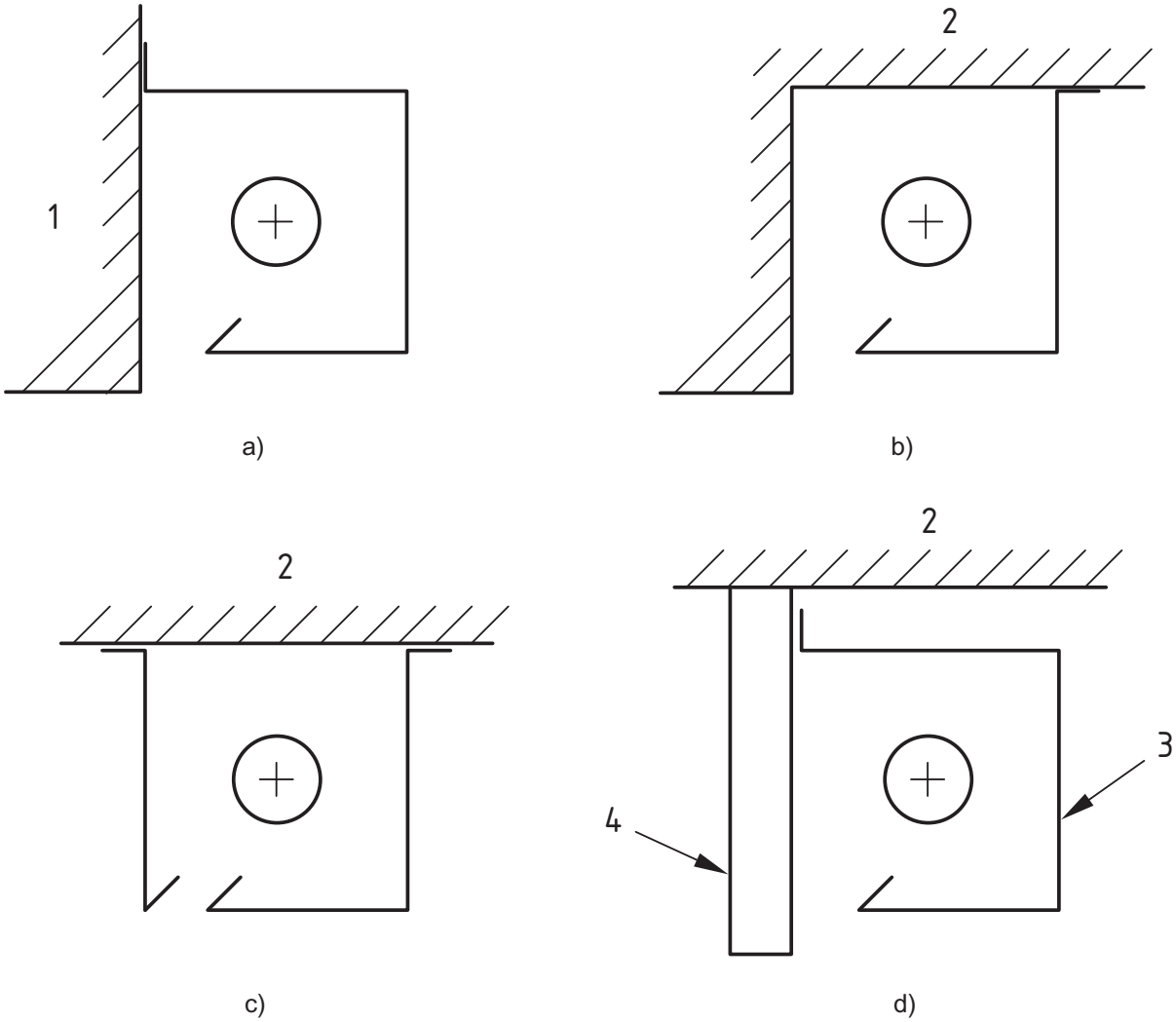


Figure C.54 - Casing/Hood – size increase



Key

a) lintel fixing

b) soffit/lintel fixing

c) soffit fixing

d) soffit/fascia fixing

1 lintel

2 soffit

3 casing

4 insulated fascia

NOTE Insulated fascia is part of specimen and not supporting construction

Figure C.55 – Casing/Hood – shape change

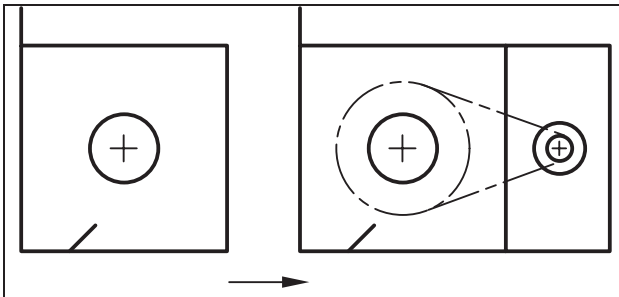


Figure C.56 - External drive system - add

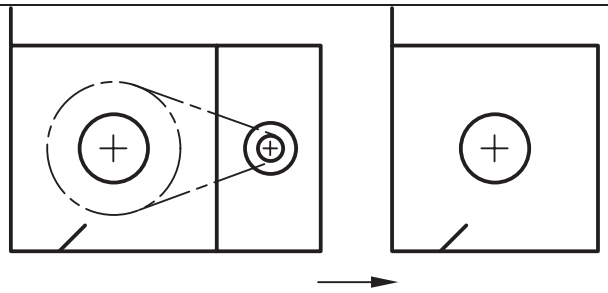


Figure C.57 - External drive system - delete

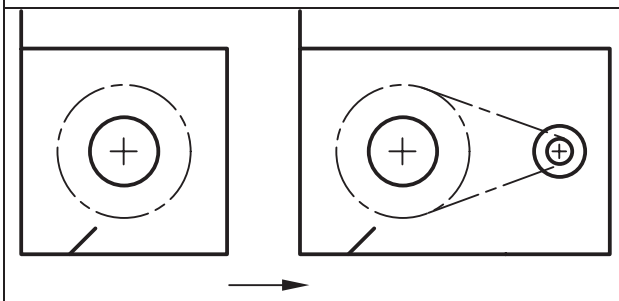


Figure C.58 - Internal drive system - add

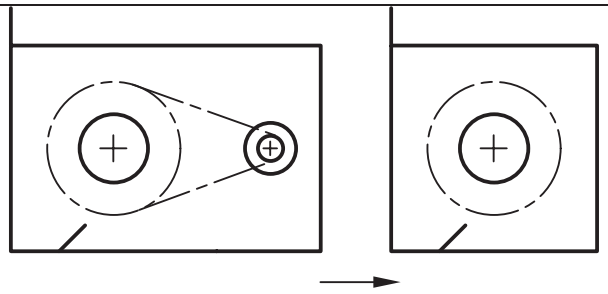


Figure C.59 - Internal drive system - delete

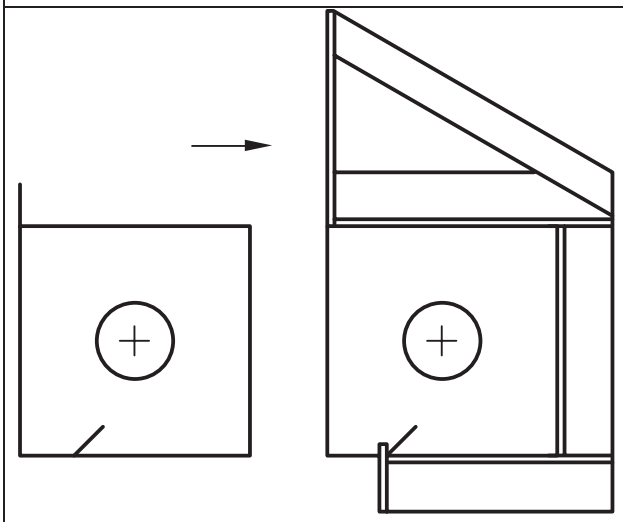


Figure C.60 - Barrel/Casing supports - add

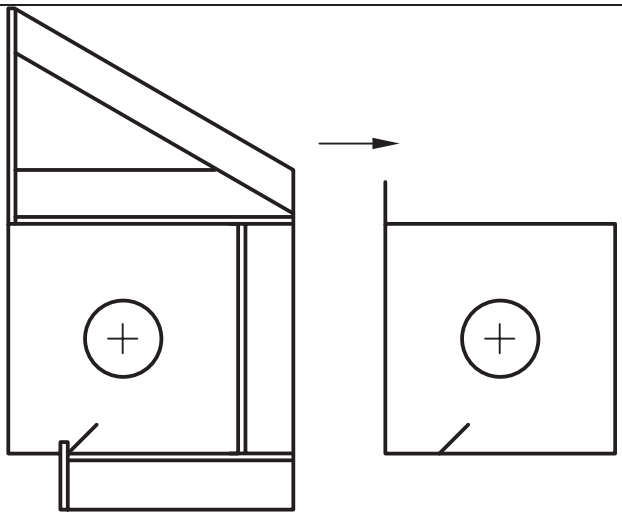


Figure C.61 - Barrel/Casing supports - delete

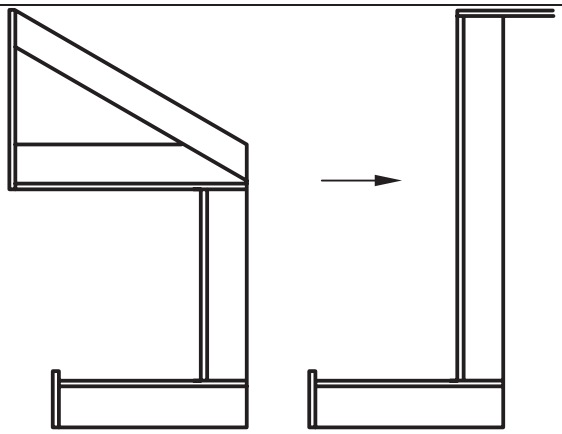


Figure C.62 - Barrel/Casing support shape/orientation - change

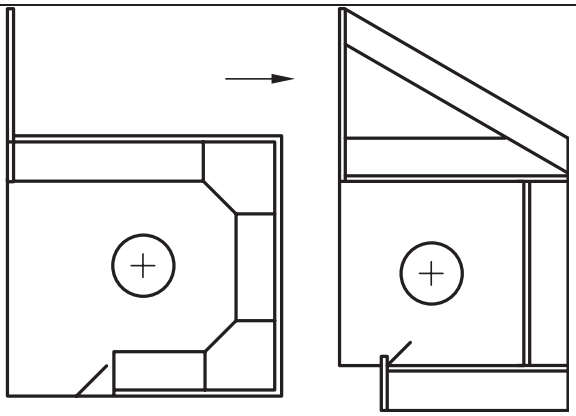


Figure C.63 - Barrel/Casing support – location inside to outside

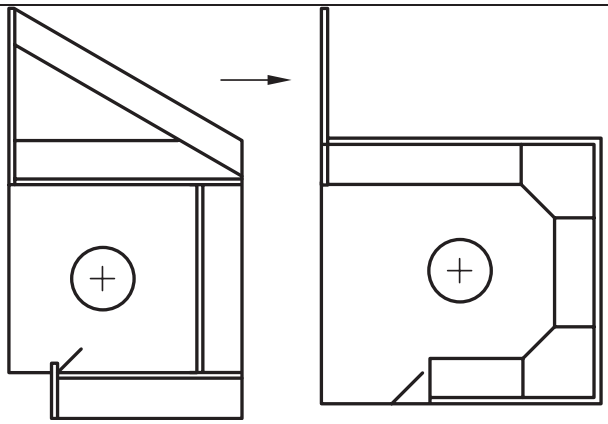


Figure C.64 - Barrel/Casing support – location outside to inside

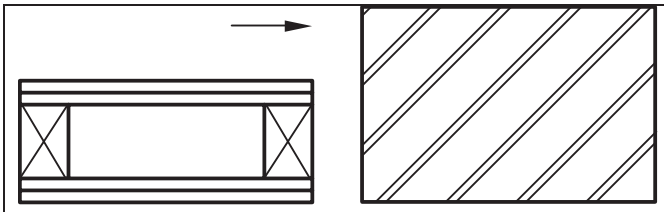


Figure C.65 - Standard flexible supporting construction to rigid

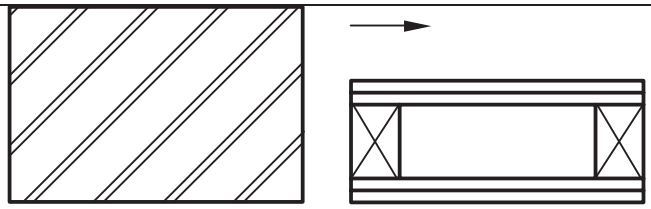


Figure C.66 - Rigid supporting construction to standard flexible

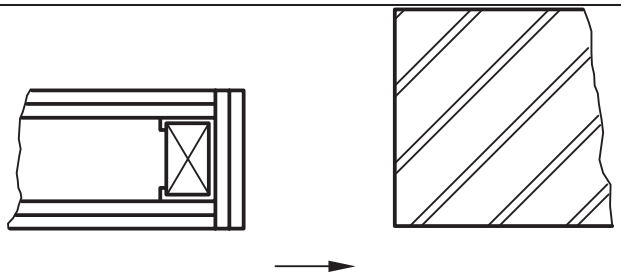


Figure C.67 - Modified (strengthened) flexible supporting to rigid

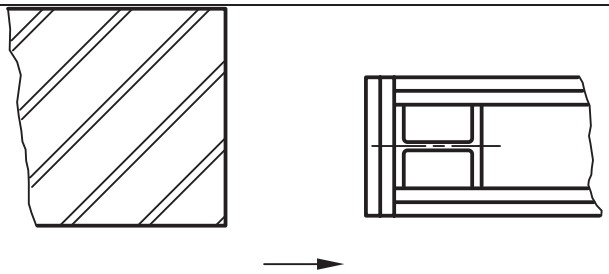
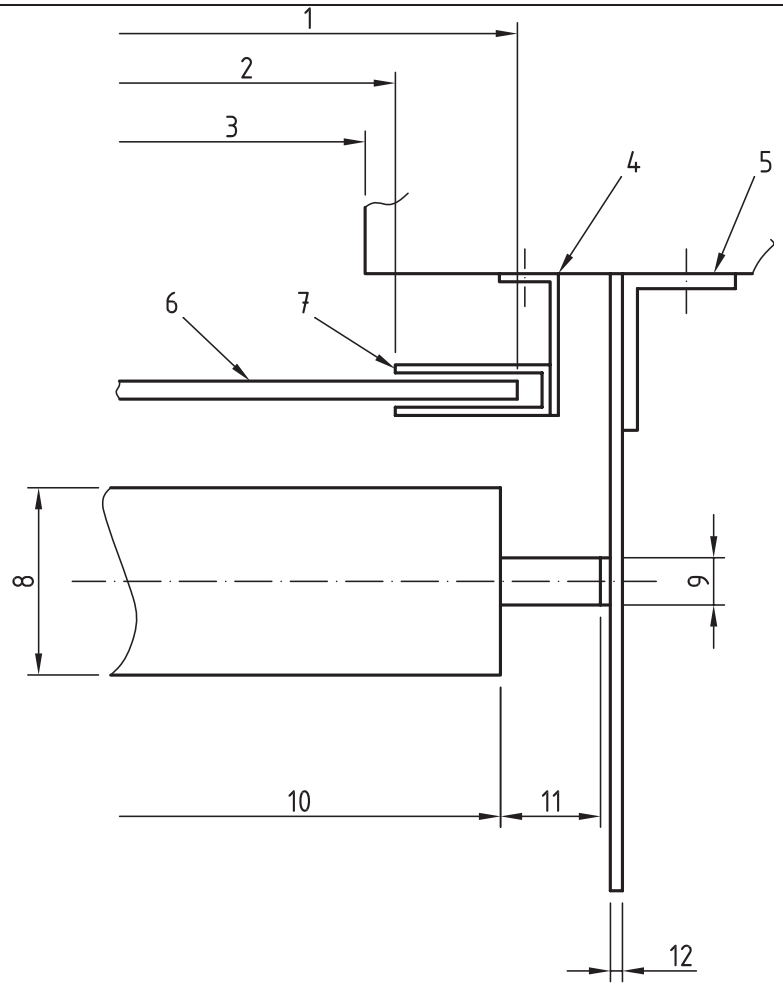


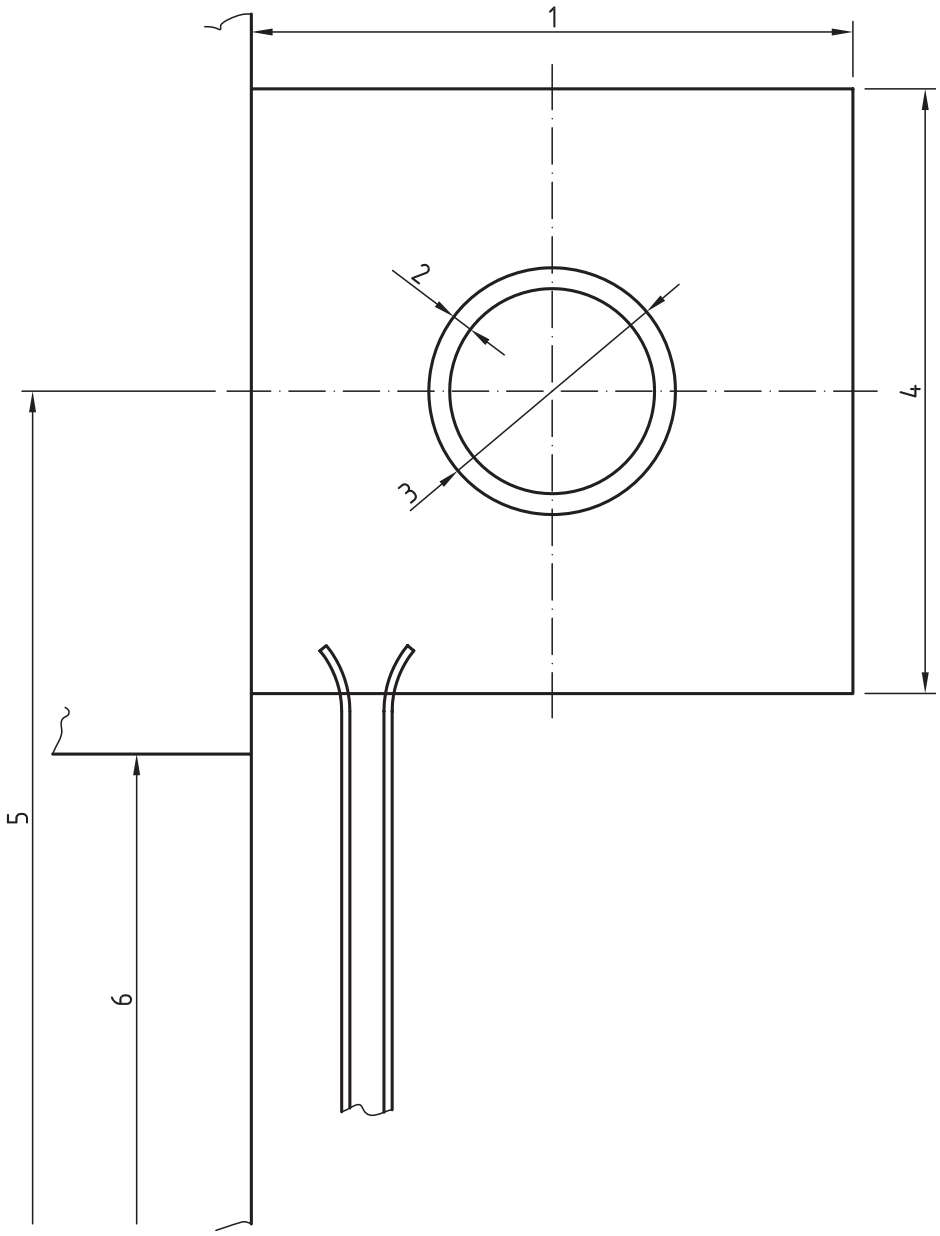
Figure C.68 - Standard supporting construction to structural steel



Key

1 lath length/curtain width
2 width between guides
3 opening width
4 guide fixing angle
5 end plate fixing angle
6 laths
7 guide
8 barrel diameter
9 axle diameter
10 barrel length
11 axel length
12 end plate thickness

Figure C.69 - General terms and components used in steel rolling shutter assembly (partial plan view)



Key

1 end plate width
2 wall thickness
3 barrel diameter
4 end plate height
5 height to centre line of barrel
6 opening height

Figure C.70 - General terms and components used in steel rolling shutter assembly (section view)

Bibliography

[1] EN 1634-2, *Fire resistance and smoke control tests for door, shutter and openable window assemblies and elements of building hardware — Part 2: Fire resistance characterisation test for elements of building hardware*

[2] EN 15254-4:2008, *Extended application of results from fire resistance tests — Non-loadbearing walls — Part 4: Glazed constructions*

[3] EN 13381 (all parts), *Test methods for determining the contribution to the fire resistance of structural members*

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