

FIRE RESISTANCE CLASSIFICATION REPORT No. 22976B

OWNER OF THE CLASSIFICATION REPORT

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INTRODUCTION

This classification report defines the classification assigned to a fire damper (type: CRS-60), in accordance with the procedures given in EN 13501-2:2023: Fire classification of products and building elements – Part 2: Classification using data from fire resistance tests, excluding ventilation services.

This classification report consists of 44 pages and 2 annexes and may only be used or reproduced in its entirety.

1 Details of classified product

1.1 General

The element, type: CRS-60, is defined as an fire damper with fire resistance characteristics.

1.2 Description

The classified product is described below, together with the relevant technical specifications. The description below is a reproduction of the technical files and/or test reports, including the nominal dimensions, provided by the customer. Technical drawings of the dampers are enclosed in annexes 1 till 2.

The exact composition and exposure conditions of the classified products as tested are fully described in the test reports in support of this classification listed in Clause 3.

1.2.1 Fire dampers

1.2.1.1 CRS-60 (100 mm till 315 mm)

1.2.1.1.1 Damper housing

Steel casing	
Material	Galvanised steel
Steel thickness	0.8 mm (NV)
Length	210 mm
Thermal hole pattern	8 rows 3 mm x 40 mm hole pattern covered with Alutape (50 micron)
Inner diameter	312.4 mm (NV)
Outer diameter	314 mm (NV)
Damper blade stop	
Type	Round tube
Material	Steel
Diameter	9 mm
Length	20 mm
Number	2 (1 on each side of the blade)
Fixing	Steel blind rivet nut
Sealing at the Collar side	
Material	EPDM Rubber
Size	U shape 12 mm x 9 mm x 2 mm

Intumescent strip at the Collar side	
Material	Graphite
Size	10 mm x 1.5 mm
Sealing at the Actuator side	
Material	EPDM Rubber
Size	U shape 12 mm x 9 mm x 2 mm
Insulation of the housing at the Actuator side	
Material	Corrugated cardboard
Thickness	2 mm
Width	56 mm
Fixing to the steel casing	With sodium silicate glue and PVC tape (thickness: 0.13 mm)

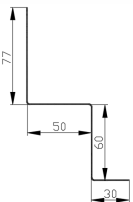
1.2.1.1.2 Damper blade

Damper blade	
Diameter	302 mm
Thickness	14.1 mm (NV)
Fixing of the steel plates to the gypsum boards	With 10 steel bolts (material: steel, length: 20 mm)
Composed of	Two steel plates Silicone sheet One Gypsum board Graphite strips 12 mm axis 16 mm axis
Steel plate	
Material	Steel
Thickness	0.8 mm
Diameter	302 mm
Number	2
Silicone sheet	
Material	Silicone sheet
Diameter	321 mm (NV)
Thickness	0.8 mm
Number	1

Gypsum boards	
Material	Gypsum
Type	Knauf (type F according to EN 520)
Thickness	12.5 mm (NV)
Diameter	297 mm (NV)
Number	1
Graphite strip	
Material	Graphite
Dimensions	12 mm x 2 mm (NV)
Number	2
Fixing	Stapled to the gypsum boards (c/c distance: 30 mm)
12 mm axis	
Material	Steel
Diameter	12 mm (NV)
Fixing	With two bolts (material: steel, length: 20 mm, diameter: 5 mm)
16 mm axis	
Material	Steel
Diameter	16 mm (NV)
Fixing	With two bolts (material: steel, length: 20 mm, diameter: 5 mm)

1.2.1.1.3 Collar

Collar	
Thickness	60 mm
Diameter	415 mm
Fixing to the steel casing	With 2 brackets, 2 steel blind rivets and 4 steel screws
Fixing to the flexible wall	With screws (material: steel, length: 65 mm, diameter: 6 mm) through the brackets
Composed of	Two gypsum rings 2 brackets Steel strip

Gypsum Rings	
Type	Saint Gobain Glassroc F 30mm
Material	Glass fibre reinforced gypsum
Thickness	30 mm
Diameter	414 mm
Number	2
Brackets	
Material	Steel
Thickness	1.25 mm
Dimensions	30 mm x 60 mm x 50 mm x 77 mm 
Width	50 mm
Number	2
Steel strip	
Material	Steel
Thickness	0.6 mm (NV)
Dimensions	Ø415 mm x 30 mm
Slots	40 mm x 3 mm, c/c distance: 10 mm

1.2.1.2 CRS-60 (315 mm till 630 mm)

1.2.1.2.1 Damper housing

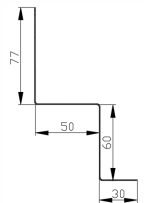
Steel casing	
Material	Galvanised steel
Steel thickness	0.8 mm (NV)
Length	210 mm
Thermal hole pattern	8 rows 3 mm x 40 mm hole pattern covered with Alutape (50 micron)
Inner diameter	627.4 mm (NV)
Outer diameter	629 mm (NV)
Damper blade stop	
Type	Round tube
Material	Steel
Diameter	9 mm
Length	20 mm
Number	6 (3 on each side of the blade)
Fixing	Steel blind rivet nut
Sealing at the Collar side	
Material	EPDM Rubber
Size	U shape 12 mm x 9 mm x 2 mm
Intumescent strip at the Collar side	
Material	Graphite
Size	10 mm x 1.5 mm
Sealing at the Actuator side	
Material	EPDM Rubber
Size	U shape 12 mm x 9 mm x 2 mm
Insulation of the housing at the Actuator side	
Material	Corrugated cardboard
Thickness	2 mm
Width	56 mm
Fixing to the steel casing	With sodium silicate glue and PVC tape (thickness: 0.13 mm)

1.2.1.2.2 Damper blade

Damper blade	
Diameter	617 mm
Thickness	26.6 mm (NV)
Fixing of the steel plates to the gypsum boards	With 24 steel bolts (material: steel, length: 35 mm)
Composed of	Two steel plates Glass fibre textile Two Gypsum board Graphite strips 12 mm axis 16 mm axis
Steel plate	
Material	Steel
Thickness	0.8 mm
Diameter	617 mm
Number	2
Glass fibre textile	
Material	Glass fibre textile
Diameter	636 mm (NV)
Thickness	0.3 mm
Number	1
Gypsum boards	
Material	Gypsum
Type	Knauf (type F according to EN 520)
Thickness	12.5 mm (NV)
Diameter	612 mm (NV) measured parallel with blade axis 607 mm (NV) measured perpendicular to blade axis
Number	2
Graphite strip	
Material	Graphite
Dimensions	12 mm x 2 mm (NV)
Number	2
Fixing	Stapled to the gypsum boards (c/c distance: 30 mm)

12 mm axis	
Material	Steel
Diameter	12 mm (NV)
Fixing	With two bolts (material: steel, length: 35 mm, diameter: 5 mm)
16 mm axis	
Material	Steel
Diameter	16 mm (NV)
Fixing	With two bolts (material: steel, length: 35 mm, diameter: 5 mm)

1.2.1.2.3 Collar

Collar	
Thickness	60 mm
Diameter	730 mm
Fixing to the steel casing	With 4 brackets, 4 steel blind rivets and 8 steel screws
Fixing to the flexible wall	With screws (material: steel, length: 65 mm, diameter: 6 mm)
Composed of	Two gypsum rings 4 brackets Steel strip
Gypsum Rings	
Type	Saint Gobain Glassroc F 30mm
Material	Glass fibre reinforced gypsum
Thickness	30 mm
Diameter	729 mm
Number	2
Brackets	
Material	Steel
Thickness	1.25 mm
Dimensions	30 mm x 60 mm x 50 mm x 77 mm 
Width	50 mm
Number	4

Steel strip	
Material	Steel
Thickness	0.6 mm (NV)
Dimensions	Ø730 mm x 60 mm
Slots	40mm x 3 mm, C/C distance: 10mm

1.2.2 Actuators

1.2.2.1 One

Actuator	
Type	ONE L
Fixing	To the steel casing by means of a steel support and 2 steel bolts (M6)

1.2.2.2 BFN

Actuator	
Type	BFN
Fixing	To the steel casing by means of a steel support and 2 steel bolts (M6)

1.2.2.3 BFL

Actuator	
Type	BFL
Fixing	To the steel casing by means of a steel support and 2 steel bolts (M6)

1.2.3 Penetration seals

1.2.3.1 25 mm stuffed stone wool covered with acryl

Stuffed stone wool	
Type	Rockwool Rocksono Extra
Material	Rockwool
Thickness	25 mm
Position	Between the supporting construction and the duct
Acryl	
Type	Soudal Firecryl FR
Material	Fire rated acrylic sealant
Position	On the rockwool penetration seal

1.2.3.2 5 mm acryl

Acryl	
Type	Soudal Firecryl FR
Material	Fire rated acrylic sealant
Position	Between the supporting construction and the duct

1.2.3.3 Clustered dampers

The largest fire damper was tested with a 5 mm acryl seal with a minimum distance of 10 mm from each other and a minimum distance of 10 mm from the surrounding supporting construction.

1.2.4 Installation methods

1.2.4.1 On the wall/floor

The fire damper was tested installed on the wall/floor, both with the damper inside and outside the furnace.

1.2.4.2 Remote from the wall

The fire damper was tested installed remote from the wall/floor, both with the damper inside and outside the furnace. The duct connecting the fire damper to the wall was insulated with 70 mm Paroc Hvac Fire Mat BlackCoat or 80 mm Rockwool Conlit Fire Mat.

Paroc insulation	
Type	Paroc Hvac Fire Mat BlackCoat ($\lambda_{10} = 0.036 \text{ W/mK}$)
Thickness	70 mm
Density	110.8 kg/m ³ (MV), 90 kg/m ³ (NV)
Rockwool insulation	
Type	Rockwool Conlit Fire Mat ($\lambda_{10} = 0.035 \text{ W/mK}$)
Thickness	80 mm
Density	84 kg/m ³ (MV), 80 kg/m ³ (NV)

1.2.5 Supporting constructions

1.2.5.1 Flexible wall

Flexible wall	
Type	Flexible partition wall
Thickness	≥ 100 mm
Boards	≥ 2 layers of gypsum boards (thickness: ≥ 12.5 mm, density: ≥ 644.4 kg/m ³) on each side
Metal studs	Richter system EN14195 50 mm
Internal insulation	Rockwool Rocksono Extra (thickness: ≥ 40 mm, density: ≥ 56.4 kg/m ³)

1.2.5.2 Shaft wall

Flexible shaft wall	
Type	Flexible shaft wall
Thickness	≥ 80 mm
Boards	≥ 2 layers of gypsum boards (reference: thickness: ≥ 15 mm, density: ≥ 914.4 kg/m ³) on the exposed side No boards on the unexposed side
Metal studs	Richter system EN14195 50 mm
Internal insulation	Rockwool Rocksono Extra (thickness: ≥ 40 mm, density: ≥ 58.1 kg/m ³)

1.2.5.3 Rigid wall

Rigid wall	
Type	Masonry wall
Thickness	≥ 100 mm
Density	≥ 550 kg/m ³ (NV)

1.2.5.4 Rigid floor

Rigid floor	
Type	Aerated concrete
Thickness	≥ 100 mm
Density	≥ 550 kg/m ³ (NV)

2 Test reports/EXAP reports and test results in support of the classification

2.1 Test and EXAP reports

Name of the laboratory	Report ref. no.	Name of the owner	Date of the test	Method
WFRGENT nv	18879A	RF- TECHNOLOGIES NV	28 February 2018	EN 1366-2:2015
WFRGENT nv	21573A	RF- TECHNOLOGIES NV	30 November 2021	EN 1366-2:2015
WFRGENT nv	21574A	RF- TECHNOLOGIES NV	3 December 2021	EN 1366-2:2015
WFRGENT nv	21727A	RF- TECHNOLOGIES NV	1 February 2022	EN 1366-2:2015
WFRGENT nv	21738A	RF- TECHNOLOGIES NV	8 March 2022	EN 1366-2:2015
Efectis Nederland BV	2022- Efectis- R000658	RF- TECHNOLOGIES NV	10 March 2022	EN 1366-2:2015
Efectis Nederland BV	2022- Efectis- R000659	RF- TECHNOLOGIES NV	14 April 2022	EN 1366-2:2015
WFRGENT nv	21929A	RF- TECHNOLOGIES NV	15 April 2022	EN 1366-2:2015
WFRGENT nv	21992A	RF- TECHNOLOGIES NV	4 May 2022	EN 1366-2:2015

WFRGENT nv	21993A	RF- TECHNOLOGIES NV	6 May 2022	EN 1366-2:2015
WFRGENT nv	22157A	RF- TECHNOLOGIES NV	8 June 2022	EN 1366-2:2015
Efectis Nederland BV	2022- Efectis- R000660	RF- TECHNOLOGIES NV	22 June 2022	EN 1366-2:2015
WFRGENT nv	22299A	RF- TECHNOLOGIES NV	9 September 2022	EN 1366-2:2015
WFRGENT nv	22328A	RF- TECHNOLOGIES NV	13 September 2022	EN 1366-2:2015
WFRGENT nv	22328B	RF- TECHNOLOGIES NV	13 September 2022	EN 1366-2:2015
LGAJ Technological Center, S.A.	22/32306738	RF TECHNOLOGIES, S.A.	18 November 2022	EN 1366-2:2015
WFRGENT nv	22045A	RF- TECHNOLOGIES NV	25 April 2022	EN 1366-2:2015
WFRGENT nv	22045B	RF- TECHNOLOGIES NV	25 April 2022	EN 1366-2:2015
WFRGENT nv	22045C	RF- TECHNOLOGIES NV	11 May 2022	EN 15650:2010
WFRGENT nv	22045D	RF- TECHNOLOGIES NV	11 May 2022	EN 15650:2010

WFRGENT nv	22631A	RF- TECHNOLOGIES NV	10 January 2023	EN 15650:2010
WFRGENT nv	22631B	RF- TECHNOLOGIES NV	10 January 2023	EN 15650:2010
WFRGENT nv	22976A	RF- TECHNOLOGIES NV	N/A	EN 15882-2:2022
Efectis France	EFR-23-Zn- 003702	Rf-Technologies NV	27 September 2023	EN 1366-2:2015

Exposure conditions during the fire resistance test (ref. No. 18879A):

Test standard: EN 1366-2:2015 ;
Deviations: none;
Temperature/time curve: standard as in EN 1363-1: 2012*;
Working pressure: -300 Pa;
Position: inside the furnace;
Supporting construction: flexible wall.

* A comparison between versions of the European Standard EN 1363-1:2012 and EN 1363-1:2020 shows that the temperature/time curve is identical.

Exposure conditions during the fire resistance test (ref. Nos. 21573A, 21574A, 21727A, 21738A):

Test standard: EN 1366-2:2015;
Deviations: The thickness of the connecting duct is smaller than allowed by the standard (0.8 mm vs 1.5 mm \pm 0.1 mm). The thermal conductivity of this duct will be higher and therefor more critical;
Temperature/time curve: standard as in EN 1363-1: 2020;
Working pressure: -300 Pa;
Position: inside and outside the furnace;
Supporting construction: flexible wall.

Exposure conditions during the fire resistance test (ref. No. 2022-Efectis-R000658):

Test standard: EN 1366-2:2015 ;
Deviations: none;
Temperature/time curve: standard as in EN 1363-1: 2020;
Working pressure: -300 Pa;
Position: inside and outside the furnace;
Supporting construction: flexible wall.

Exposure conditions during the fire resistance test (ref. No. 2022-Efectis-R000659):

Test standard: EN 1366-2:2015 ;
Deviations: none;
Temperature/time curve: standard as in EN 1363-1: 2020;
Working pressure: -300 Pa;
Position: outside the furnace;
Supporting construction: flexible wall.

Exposure conditions during the fire resistance test (ref. No. 21929A):

Test standard: EN 1366-2:2015 ;
Deviations: The thickness of the connecting duct is smaller than allowed by the standard (0.7 mm vs 1.5 mm \pm 0.1 mm). The thermal conductivity of this duct will be higher and therefor more critical;
Temperature/time curve: standard as in EN 1363-1: 2020;
Working pressure: -300 Pa;
Position: inside the furnace;
Supporting construction: flexible wall.

Exposure conditions during the fire resistance test (ref. Nos. 21992A, 21993A):

Test standard: EN 1366-2:2015 ;
Deviations: The thickness of the connecting duct is smaller than allowed by the standard (0.7 mm vs 1.5 mm \pm 0.1 mm). The thermal conductivity of this duct will be higher and therefor more critical;
Temperature/time curve: standard as in EN 1363-1: 2020;
Working pressure: -300 Pa;
Position: inside and outside the furnace;
Supporting construction: rigid floor.

Exposure conditions during the fire resistance test (ref. No 22157A):

Test standard: EN 1366-2:2015 ;
Deviations: The thickness of the connecting duct is smaller than allowed by the standard (0.7 mm vs 1.5 mm \pm 0.1 mm). The thermal conductivity of this duct will be higher and therefor more critical;
Temperature/time curve: standard as in EN 1363-1: 2020;
Working pressure: -300 Pa;
Position: inside the furnace;
Supporting construction: flexible shaft wall.

Exposure conditions during the fire resistance test (ref. No. 2022-Efectis-R000660, EFR-23-Zn-003702):

Test standard: EN 1366-2:2015 ;
Deviations: none;
Temperature/time curve: standard as in EN 1363-1: 2020;
Working pressure: -300 Pa;
Position: outside the furnace;
Supporting construction: flexible shaft wall.

Exposure conditions during the fire resistance test (ref. No. 22299A):

Test standard: EN 1366-2:2015 ;
Deviations: The thickness of the connecting duct is smaller than allowed by the standard (0.7 mm vs 1.5 mm \pm 0.1 mm). The thermal conductivity of this duct will be higher and therefor more critical;
Temperature/time curve: standard as in EN 1363-1: 2020;
Working pressure: -300 Pa;
Position: outside the furnace;
Supporting construction: rigid floor.

Exposure conditions during the fire resistance test (ref. Nos. 22328A, 22328B):

Test standard: EN 1366-2:2015 ;
Deviations: The thickness of the connecting duct is smaller than allowed by the standard (0.7 mm vs 1.5 mm \pm 0.1 mm). The thermal conductivity of this duct will be higher and therefore more critical;
Temperature/time curve: standard as in EN 1363-1: 2020;
Working pressure: -300 Pa;
Position: outside the furnace;
Supporting construction: flexible wall.

Exposure conditions during the fire resistance test (ref. No. 22/32306738):

Test standard: EN 1366-2:2015 ;
Deviations: The position and spacers of the dampers is more critical than prescribed by the standard.
Temperature/time curve: standard as in EN 1363-1: 2020;
Working pressure: -300 Pa;
Position: outside the furnace;
Supporting construction: flexible wall.

Exposure conditions during the cold leakage test (ref. No. 22045A):

Test standard: §10.3 of EN 1366-2:2015;
Working pressure: -300 Pa and -500 Pa.

Exposure conditions during the cycle test (ref. Nos. 22045C, 22045D, 22631A, 22631B):

Test standard: EN 15640:2010 Annex C;
Deviations: none;

2.2 Test results

2.2.1 Fire tests

2.2.1.1 Test report 18879A

- Orientation: vertical;
- Position: remote from the wall;
- Exposure: inside the furnace;
- Penetration seal: 25 mm stuffed stone wool and 5 mm acryl;
- Fire damper diameter: 630 mm;
- Orientation of blade axis: horizontal;
- Actuator type: fire damper A: Belimo BFN;
fire damper B: Remote One L;
- Duct insulation: None.

Parameter	Limits	Results fire damper A	Results fire damper B
Operating pressure:		-300 Pa	-300 Pa
System leakage:	12 m ³ /h	5.6 m ³ /h	10.2 m ³ /h
Integrity (E^(*) criterion):			
Leakage through the fire dampers ⁽²⁾	360 m ³ /h.m ²	Q _{v max} : 200 m ³ /h.m ²	Q _{v max} : 282.43 m ³ /h.m ²
Ignition of the cotton pad		91 minutes, no failure ⁽¹⁾	91 minutes, no failure ⁽¹⁾
Fail test with the 6 mm and 25 mm gauges		91 minutes, no failure ⁽¹⁾	91 minutes, no failure ⁽¹⁾
Spontaneous, continuous flames		91 minutes, no failure ⁽¹⁾	91 minutes, no failure ⁽¹⁾
Smoke leakage (S^(*) criterion):			
Leakage through the fire damper at an ambient temperature	200 m ³ /h.m ²	not measurable	Q _{v max} : 8.3 m ³ /h.m ²
Leakage through the fire damper during the test ⁽²⁾	200 m ³ /h.m ²	90 minutes	83 minutes
Actuating mechanism:			
Any sign of mechanical damage after the opening and closing test of 50 cycles		No damage	No damage
Time at which the fully-open fire damper closes	2 minutes	22 seconds	35 seconds

(*) Classification according to EN 13501-3.

(1) The test was discontinued after 91 minutes at the test sponsor's request.

(2) These performance criteria apply after 5 minutes from the start of the test.

2.2.1.2 Test report 21573A

- Orientation: vertical;
- Position: on the wall;
- Exposure: fire damper A: outside the furnace;
fire damper B: inside the furnace;
- Penetration seal 5 mm acryl;
- Fire damper diameter: 630 mm;
- Orientation of blade axis: horizontal;
- Actuator type: Remote One L;
- Duct insulation: None.

Parameter	Limits	Results fire damper A	Results fire damper B
Operating pressure:		-300 Pa	-300 Pa
System leakage:	12 m ³ /h	2.4 m ³ /h	5.93 m ³ /h
Thermal insulation – (I^(*) criterion): $\Delta T_m = 140^\circ\text{C}$ $\Delta T_M = 180^\circ\text{C}$		(117% @ 60min) 70 minutes, no failure ⁽¹⁾ (43°C @ 60min) 45 minutes (210°C @ 60min)	(57% @ 60min) 70 minutes, no failure ⁽¹⁾ (43°C @ 60min) 67 minutes (103°C @ 60min)
Integrity (E^(*) criterion): Leakage through the fire dampers ⁽²⁾ Ignition of the cotton pad Fail test with the 6 mm and 25 mm gauges Spontaneous, continuous flames	360 m ³ /h.m ²	70 minutes, no failure ⁽¹⁾ (Q _{v max} : 30.0 m ³ /h.m ²) 70 minutes, no failure ⁽³⁾ 70 minutes, no failure ⁽¹⁾ 70 minutes, no failure ⁽¹⁾	70 minutes, no failure ⁽¹⁾ (Q _{v max} : 6.9 m ³ /h.m ²) 70 minutes, no failure ⁽³⁾ 70 minutes, no failure ⁽¹⁾ 70 minutes, no failure ⁽¹⁾
Smoke leakage (S^(*) criterion): Leakage through the fire damper at an ambient temperature Leakage through the fire damper during the test ⁽²⁾	200 m ³ /h.m ² 200 m ³ /h.m ²	Q _{v max} : 37.8 m ³ /h.m ² 70 minutes, no failure ⁽¹⁾ (Q _{v max} : 30.0 m ³ /h.m ²)	Q _{v max} : 17.9 m ³ /h.m ² 70 minutes, no failure ⁽¹⁾ (Q _{v max} : 6.9 m ³ /h.m ²)
Actuating mechanism: Any sign of mechanical damage after the opening and closing test of 50 cycles Time at which the fully-open fire damper closes	 2 minutes	 No damage 40 seconds	 No damage 40 seconds

^(*) Classification according to EN 13501-3.

⁽¹⁾ The test was discontinued after 70 minutes at the test sponsor's request.

⁽²⁾ These performance criteria apply after 5 minutes from the start of the test.

⁽³⁾ No failure until thermal insulation failure.

2.2.1.3 Test report 21574A

- Orientation: vertical;
- Position: remote from the wall;
- Exposure: fire damper A: inside the furnace;
fire damper B: outside the furnace;
- Penetration seal 5 mm acryl;
- Fire damper diameter: 630 mm;
- Orientation of blade axis: horizontal;
- Actuator type: Remote One L;
- Duct insulation: 80 mm Rockwool Conlit Fire Mat.

Parameter	Limits	Results fire damper A	Results fire damper B
Operating pressure:		-300 Pa	-300 Pa
System leakage:	12 m ³ /h	2.4 m ³ /h	5.93 m ³ /h
Thermal insulation – (I^(*) criterion): $\Delta T_m = 140^\circ\text{C}$ $\Delta T_M = 180^\circ\text{C}$		(77% @ 60min) 68 minutes (95°C @ 60min) 64 minutes (139°C @ 60min)	(94% @ 60min) 69 minutes (131°C @ 60min) 72 minutes, no failure ⁽¹⁾ (158°C @ 60min)
Integrity (E^(*) criterion): Leakage through the fire dampers ⁽²⁾ Ignition of the cotton pad Fail test with the 6 mm and 25 mm gauges Spontaneous, continuous flames	360 m ³ /h.m ²	72 minutes, no failure ⁽¹⁾ (Q _{v max} : 144.2 m ³ /h.m ²) 72 minutes, no failure ⁽³⁾ 72 minutes, no failure ⁽¹⁾ 72 minutes, no failure ⁽¹⁾	72 minutes, no failure ⁽¹⁾ (Q _{v max} : 0.4 m ³ /h.m ²) 72 minutes, no failure ⁽³⁾ 72 minutes, no failure ⁽¹⁾ 72 minutes, no failure ⁽¹⁾
Smoke leakage (S^(*) criterion): Leakage through the fire damper at an ambient temperature Leakage through the fire damper during the test ⁽²⁾	200 m ³ /h.m ² 200 m ³ /h.m ²	Q _{v max} : 38.0 m ³ /h.m ² 72 minutes, no failure ⁽¹⁾ (Q _{v max} : 144.2 m ³ /h.m ²)	Q _{v max} : 23.5 m ³ /h.m ² 72 minutes, no failure ⁽¹⁾ (Q _{v max} : 0.4 m ³ /h.m ²)
Actuating mechanism: Any sign of mechanical damage after the opening and closing test of 50 cycles Time at which the fully-open fire damper closes	 2 minutes	 No damage 40 seconds	 No damage 40 seconds

^(*) Classification according to EN 13501-3.

⁽¹⁾ The test was discontinued after 72 minutes at the test sponsor's request.

⁽²⁾ These performance criteria apply after 5 minutes from the start of the test.

⁽³⁾ No failure until thermal insulation failure.

2.2.1.4 Test report 21727A

- Orientation: vertical;
- Position: on the wall;
- Exposure: fire damper A: outside the furnace;
fire damper B: inside the furnace;
- Penetration seal 5 mm acryl;
- Fire damper diameter: 630 mm;
- Orientation of blade axis: horizontal;
- Actuator type: Remote One L;
- Duct insulation: none.

Parameter	Limits	Results fire damper A	Results fire damper B
Operating pressure:		-300 Pa	-300 Pa
System leakage:	12 m ³ /h	4.11 m ³ /h	8.5 m ³ /h
Thermal insulation – (I^(*) criterion): $\Delta T_m = 140^\circ\text{C}$ $\Delta T_M = 180^\circ\text{C}$		(89% @ 60min) 83 minutes, no failure ⁽¹⁾ (48°C @ 60min) 74 minutes (160°C @ 60min)	(51% @ 60min) 83 minutes, no failure ⁽¹⁾ (32°C @ 60min) 82 minutes (92°C @ 60min)
Integrity (E^(*) criterion): Leakage through the fire dampers ⁽²⁾ Ignition of the cotton pad Fail test with the 6 mm and 25 mm gauges Spontaneous, continuous flames	360 m ³ /h.m ²	83 minutes, no failure ⁽¹⁾ (Q _{v max} : 11.72 m ³ /h.m ²) 83 minutes, no failure ⁽³⁾ 83 minutes, no failure ⁽¹⁾ 83 minutes, no failure ⁽¹⁾	83 minutes, no failure ⁽¹⁾ (Q _{v max} : 76.3 m ³ /h.m ²) 83 minutes, no failure ⁽³⁾ 83 minutes, no failure ⁽¹⁾ 83 minutes, no failure ⁽¹⁾
Smoke leakage (S^(*) criterion): Leakage through the fire damper at an ambient temperature Leakage through the fire damper during the test ⁽²⁾	200 m ³ /h.m ² 200 m ³ /h.m ²	Q _{v max} : 42.5 m ³ /h.m ² 83 minutes, no failure ⁽¹⁾ (Q _{v max} : 11.72 m ³ /h.m ²)	Q _{v max} : 49.77 m ³ /h.m ² 83 minutes, no failure ⁽¹⁾ (Q _{v max} : 76.3 m ³ /h.m ²)
Actuating mechanism: Any sign of mechanical damage after the opening and closing test of 50 cycles Time at which the fully-open fire damper closes	 2 minutes	 No damage 40 seconds	 No damage 40 seconds

^(*) Classification according to EN 13501-3.

⁽¹⁾ The test was discontinued after 83 minutes at the test sponsor's request.

⁽²⁾ These performance criteria apply after 5 minutes from the start of the test.

⁽³⁾ No failure until thermal insulation failure.

2.2.1.5 Test report 21738A

- Orientation: vertical;
- Position: remote from the wall;
- Exposure: fire damper A: inside the furnace;
fire damper B: outside the furnace;
- Penetration seal 25 mm stuffed stone wool and 5 mm acryl;
- Fire damper diameter: 630 mm;
- Orientation of blade axis: horizontal;
- Actuator type: Remote One L;
- Duct insulation: 80 mm Rockwool Conlit Fire Mat.

Parameter	Limits	Results fire damper A	Results fire damper B
Operating pressure:		-300 Pa	-300 Pa
System leakage:	12 m ³ /h	2.68 m ³ /h	8.45 m ³ /h
Thermal insulation – (I^(*) criterion): $\Delta T_m = 140^\circ\text{C}$ $\Delta T_M = 180^\circ\text{C}$ Integrity (E^(*) criterion): Leakage through the fire dampers ⁽²⁾ Ignition of the cotton pad Fail test with the 6 mm and 25 mm gauges Spontaneous, continuous flames		(77% @ 60min) 74 minutes, no failure ⁽¹⁾ (71°C @ 60min) 73 minutes (138°C @ 60min)	64 minutes, no failure ⁽¹⁾ (41°C @ 60min) 54 minutes
	360 m ³ /h.m ²	74 minutes, no failure ⁽¹⁾ (Q _{v max} : 56.83 m ³ /h.m ²)	64 minutes, no failure ⁽¹⁾ (Q _{v max} : 243.55 m ³ /h.m ²)
		74 minutes, no failure ⁽³⁾	64 minutes, no failure ⁽³⁾
		74 minutes, no failure ⁽¹⁾	64 minutes, no failure ⁽¹⁾
		74 minutes, no failure ⁽¹⁾	64 minutes, no failure ⁽¹⁾
Smoke leakage (S^(*) criterion): Leakage through the fire damper at an ambient temperature Leakage through the fire damper during the test ⁽²⁾	200 m ³ /h.m ² 200 m ³ /h.m ²	Q _{v max} : 58.25 m ³ /h.m ² 74 minutes, no failure ⁽¹⁾ (Q _{v max} : 56.83 m ³ /h.m ²)	Q _{v max} : 49.77 m ³ /h.m ² 63 minutes
Actuating mechanism: Any sign of mechanical damage after the opening and closing test of 50 cycles Time at which the fully-open fire damper closes		No damage 40 seconds	No damage 40 seconds

^(*) Classification according to EN 13501-3.

⁽¹⁾ The test was discontinued after 64 minutes at the test sponsor's request.

⁽²⁾ These performance criteria apply after 5 minutes from the start of the test.

⁽³⁾ No failure until thermal insulation failure.

2.2.1.6 Test report 2022-Efectis-R000658

- Orientation: vertical;
- Position: fire damper A: remote from the wall;
fire damper B: on the wall;
- Exposure: fire damper A: inside the furnace;
fire damper B: outside the furnace;
- Penetration seal 5 mm acryl;
- Fire damper diameter: 315 mm;
- Orientation of blade axis: horizontal;
- Actuator type: Remote One L;
- Duct insulation: fire damper A: 80 mm Rockwool Conlit Fire Mat.
fire damper B: none.

Parameter	Limits	Results fire damper A	Results fire damper B
Operating pressure:		-300 Pa	-300 Pa
System leakage:	12 m ³ /h	11.0m ³ /h	12.0 m ³ /h
Thermal insulation – (I⁽¹⁾ criterion): $\Delta T_m = 140^\circ\text{C}$ $\Delta T_M = 180^\circ\text{C}$		(86% @ 60min) 76 minutes, no failure ⁽¹⁾ (120°C @ 60min) 74 minutes (152°C @ 60min)	(95% @ 60min) 76 minutes, no failure ⁽¹⁾ (70°C @ 60min) 67 minutes (172°C @ 60min)
Integrity (E⁽¹⁾ criterion):			
Leakage through the fire dampers ⁽²⁾	360 m ³ /h.m ²	76 minutes, no failure ⁽¹⁾ ($Q_{v \max} < 195 \text{ m}^3/\text{h.m}^2$)	76 minutes, no failure ⁽¹⁾ ($Q_{v \max} < 195 \text{ m}^3/\text{h.m}^2$)
Ignition of the cotton pad		76 minutes, no failure ⁽³⁾	76 minutes, no failure ⁽³⁾
Fail test with the 6 mm and 25 mm gauges		76 minutes, no failure ⁽¹⁾	76 minutes, no failure ⁽¹⁾
Spontaneous, continuous flames		76 minutes, no failure ⁽¹⁾	76 minutes, no failure ⁽¹⁾
Smoke leakage (S⁽¹⁾ criterion):			
Leakage through the fire damper at an ambient temperature	200 m ³ /h.m ²	$Q_{v \max}: 0.0 \text{ m}^3/\text{h.m}^2$	$Q_{v \max}: 0.27 \text{ m}^3/\text{h.m}^2$
Leakage through the fire damper during the test ⁽²⁾	200 m ³ /h.m ²	76 minutes, no failure ⁽¹⁾ ($Q_{v \max} < 195 \text{ m}^3/\text{h.m}^2$)	76 minutes, no failure ⁽¹⁾ ($Q_{v \max} < 195 \text{ m}^3/\text{h.m}^2$)
Actuating mechanism:			
Any sign of mechanical damage after the opening and closing test of 50 cycles		No damage	No damage
Time at which the fully-open fire damper closes	2 minutes	23 seconds	23 seconds

⁽¹⁾ Classification according to EN 13501-3.

⁽¹⁾ The test was discontinued after 76 minutes at the test sponsor's request.

⁽²⁾ These performance criteria apply after 5 minutes from the start of the test.

⁽³⁾ No failure until thermal insulation failure.

2.2.1.7 Test report 2022-Efectis-R000659

- Orientation: vertical;
- Position: on the wall;
- Exposure: outside the furnace;
- Penetration seal
fire damper A: 5 mm acryl;
fire damper B: 25 mm stuffed stone wool and 5 mm acryl;
- Fire damper diameter: 630 mm;
- Orientation of blade axis:
fire damper A: vertical;
fire damper B: horizontal;
- Actuator type: Belimo BFN;
- Duct insulation: none.

Parameter	Limits	Results fire damper A	Results fire damper B
Operating pressure:		-300 Pa	-300 Pa
System leakage:	12 m ³ /h	10.6 m ³ /h	4.3 m ³ /h
Thermal insulation – (I^(*) criterion): ΔT _m = 140°C ΔT _M = 180°C		(93% @ 60min) 71 minutes, no failure ⁽¹⁾ (40°C @ 60min) 69 minutes (167°C @ 60min)	(96% @ 60min) 71 minutes, no failure ⁽¹⁾ (42°C @ 60min) 66 minutes (172°C @ 60min)
Integrity (E^(*) criterion): Leakage through the fire dampers ⁽²⁾ Ignition of the cotton pad Fail test with the 6 mm and 25 mm gauges Spontaneous, continuous flames	360 m ³ /h.m ²	71 minutes, no failure ⁽¹⁾ (Q _{v max} : <11.48 m ³ /h.m ²) 71 minutes, no failure ⁽³⁾ 71 minutes, no failure ⁽¹⁾ 71 minutes, no failure ⁽¹⁾	71 minutes, no failure ⁽¹⁾ (Q _{v max} : <11.48 m ³ /h.m ²) 71 minutes, no failure ⁽³⁾ 71 minutes, no failure ⁽¹⁾ 71 minutes, no failure ⁽¹⁾
Smoke leakage (S^(*) criterion): Leakage through the fire damper at an ambient temperature Leakage through the fire damper during the test ⁽²⁾	200 m ³ /h.m ² 200 m ³ /h.m ²	Q _{v max} : 25.23 m ³ /h.m ² 71 minutes, no failure ⁽¹⁾ (Q _{v max} : <11.48 m ³ /h.m ²)	Q _{v max} : 21.67 m ³ /h.m ² 71 minutes, no failure ⁽¹⁾ (Q _{v max} : 22.48 m ³ /h.m ²)
Actuating mechanism: Any sign of mechanical damage after the opening and closing test of 50 cycles Time at which the fully-open fire damper closes	 2 minutes	 No damage 34 seconds	 No damage 28 seconds

^(*) Classification according to EN 13501-3.

⁽¹⁾ The test was discontinued after 71 minutes at the test sponsor's request.

⁽²⁾ These performance criteria apply after 5 minutes from the start of the test.

⁽³⁾ No failure until thermal insulation failure.

2.2.1.8 Test report 21929A

- Orientation: vertical;
- Position: remote from the wall;
- Exposure: inside the furnace;
- Penetration seal 5 mm acryl;
- Fire damper diameter: 630 mm;
- Orientation of blade axis: horizontal;
- Actuator type: Remote One L;
- Duct insulation: 70 mm Paroc HVAC Fire Mat.

Parameter	Limits	Results
Operating pressure:		-300 Pa
System leakage:	12 m ³ /h	2.44 m ³ /h
Thermal insulation – (I^(*) criterion): $\Delta T_m = 140^\circ\text{C}$ $\Delta T_M = 180^\circ\text{C}$		(66% @ 60min) 76 minutes (80°C @ 60min) 76 minutes (119°C @ 60min)
Integrity (E^(*) criterion): Leakage through the fire dampers ⁽²⁾ Ignition of the cotton pad Fail test with the 6 mm and 25 mm gauges Spontaneous, continuous flames	360 m ³ /h.m ²	77 minutes, no failure ⁽¹⁾ (Q _{v max} : 98.60 m ³ /h.m ²) 77 minutes, no failure ⁽³⁾ 77 minutes, no failure ⁽¹⁾ 77 minutes, no failure ⁽¹⁾
Smoke leakage (S^(*) criterion): Leakage through the fire damper at an ambient temperature Leakage through the fire damper during the test ⁽²⁾	200 m ³ /h.m ² 200 m ³ /h.m ²	Q _{v max} : 47.97 m ³ /h.m ² 77 minutes, no failure ⁽¹⁾ (Q _{v max} : 98.60 m ³ /h.m ²)
Actuating mechanism: Any sign of mechanical damage after the opening and closing test of 50 cycles Time at which the fully-open fire damper closes	2 minutes	No damage 40 seconds

(*) Classification according to EN 13501-3.

(1) The test was discontinued after 77 minutes at the test sponsor's request.

(2) These performance criteria apply after 5 minutes from the start of the test.

(3) No failure until thermal insulation failure.

2.2.1.9 Test report 21992A

- Orientation: horizontal;
- Position: on the floor;
- Exposure: fire damper A: outside the furnace;
fire damper B: inside the furnace;
- Penetration seal 25 mm stuffed stone wool and 5 mm acryl;
- Fire damper diameter: 630 mm;
- Orientation of blade axis: N/A;
- Actuator type: Remote One L;
- Duct insulation: none.

Parameter	Limits	Results fire damper A	Results fire damper B
Operating pressure:		-300 Pa	-300 Pa
System leakage:	12 m ³ /h	4.94 m ³ /h	6.31 m ³ /h
Thermal insulation – (I^(*) criterion): ΔT _m = 140°C ΔT _M = 180°C		(102% @ 60min) 90 minutes, no failure ⁽¹⁾ (45°C @ 60min) 58 minutes (183°C @ 60min)	(45% @ 60min) 74 minutes (40°C @ 60min) 89 minutes (81°C @ 60min)
Integrity (E^(*) criterion): Leakage through the fire dampers ⁽²⁾ Ignition of the cotton pad Fail test with the 6 mm and 25 mm gauges Spontaneous, continuous flames	360 m ³ /h.m ²	90 minutes, no failure ⁽¹⁾ (Q _{v max} : 43.64 m ³ /h.m ²) 90 minutes, no failure ⁽³⁾ 90 minutes, no failure ⁽¹⁾ 90 minutes, no failure ⁽¹⁾	90 minutes, no failure ⁽¹⁾ (Q _{v max} : 80.70 m ³ /h.m ²) 90 minutes, no failure ⁽³⁾ 90 minutes, no failure ⁽¹⁾ 90 minutes, no failure ⁽¹⁾
Smoke leakage (S^(*) criterion): Leakage through the fire damper at an ambient temperature Leakage through the fire damper during the test ⁽²⁾	200 m ³ /h.m ² 200 m ³ /h.m ²	Q _{v max} : 57.33 m ³ /h.m ² 90 minutes, no failure ⁽¹⁾ (Q _{v max} : 43.46 m ³ /h.m ²)	Q _{v max} : 29.76 m ³ /h.m ² 90 minutes, no failure ⁽¹⁾ (Q _{v max} : 80.70 m ³ /h.m ²)
Actuating mechanism: Any sign of mechanical damage after the opening and closing test of 50 cycles Time at which the fully-open fire damper closes	 2 minutes	 No damage 40 seconds	 No damage 40 seconds

^(*) Classification according to EN 13501-3.

⁽¹⁾ The test was discontinued after 90 minutes at the test sponsor's request.

⁽²⁾ These performance criteria apply after 5 minutes from the start of the test.

⁽³⁾ No failure until thermal insulation failure.

2.2.1.10 Test report 21993A

- Orientation: horizontal;
- Position: remote from the floor;
- Exposure: fire damper A: inside the furnace;
fire damper B: outside the furnace;
- Penetration seal 5 mm acryl;
- Fire damper diameter: 630 mm;
- Orientation of blade axis: N/A;
- Actuator type: Remote One L;
- Duct insulation: 80 mm Rockwool Conlit Fire Mat.

Parameter	Limits	Results fire damper A	Results fire damper B
Operating pressure:		-300 Pa	-300 Pa
System leakage:	12 m ³ /h	7.55 m ³ /h	5.22 m ³ /h
Thermal insulation – (I^(*) criterion): $\Delta T_m = 140^\circ\text{C}$ $\Delta T_M = 180^\circ\text{C}$		(51% @ 60min) 71 minutes (71°C @ 60min) 72 minutes (83°C @ 60min)	(82% @ 60min) 85 minutes (114°C @ 60min) 87 minutes, no failure ⁽¹⁾ (132°C @ 60min)
Integrity (E^(*) criterion): Leakage through the fire dampers ⁽²⁾ Ignition of the cotton pad Fail test with the 6 mm and 25 mm gauges Spontaneous, continuous flames	360 m ³ /h.m ²	87 minutes, no failure ⁽¹⁾ (Q _{v max} : 133.14 m ³ /h.m ²) 87 minutes, no failure ⁽³⁾ 87 minutes, no failure ⁽¹⁾ 87 minutes, no failure ⁽¹⁾	87 minutes, no failure ⁽¹⁾ (Q _{v max} : 126.9 m ³ /h.m ²) 87 minutes, no failure ⁽³⁾ 87 minutes, no failure ⁽¹⁾ 87 minutes, no failure ⁽¹⁾
Smoke leakage (S^(*) criterion): Leakage through the fire damper at an ambient temperature Leakage through the fire damper during the test ⁽²⁾	200 m ³ /h.m ² 200 m ³ /h.m ²	Q _{v max} : 27.65 m ³ /h.m ² 87 minutes, no failure ⁽¹⁾ (Q _{v max} : 133.14 m ³ /h.m ²)	Q _{v max} : 116.56 m ³ /h.m ² 87 minutes, no failure ⁽¹⁾ (Q _{v max} : 126.9 m ³ /h.m ²)
Actuating mechanism: Any sign of mechanical damage after the opening and closing test of 50 cycles Time at which the fully-open fire damper closes	2 minutes	No damage 40 seconds	No damage 40 seconds

^(*) Classification according to EN 13501-3.

⁽¹⁾ The test was discontinued after 87 minutes at the test sponsor's request.

⁽²⁾ These performance criteria apply after 5 minutes from the start of the test.

⁽³⁾ No failure until thermal insulation failure.

2.2.1.11 Test report 22157A

- Orientation: vertical;
- Position: fire damper A: remote from the wall;
fire damper B: on the wall
- Exposure: inside the furnace;
- Penetration seal 5 mm acryl;
- Fire damper diameter: 630 mm;
- Orientation of blade axis: vertical;
- Actuator type: Remote One L;
- Duct insulation: fire damper A: 80 mm Rockwool Conlit Fire Mat;
fire damper B: none.

Parameter	Limits	Results fire damper A	Results fire damper B
Operating pressure:		-300 Pa	-300 Pa
System leakage:	12 m ³ /h	4.41 m ³ /h	6.08 m ³ /h
Thermal insulation – (I^(*) criterion): ΔT _m = 140°C ΔT _M = 180°C		(72% @ 60min) 69 minutes (91°C @ 60min) 68 minutes (130°C @ 60min)	(50% @ 60min) 75 minutes, no failure ⁽¹⁾ (43°C @ 60min) 75 minutes, no failure ⁽¹⁾ (89°C @ 60min)
Integrity (E^(*) criterion): Leakage through the fire dampers ⁽²⁾ Ignition of the cotton pad Fail test with the 6 mm and 25 mm gauges Spontaneous, continuous flames	360 m ³ /h.m ²	75 minutes, no failure ⁽¹⁾ (Q _{v max} : 82.68 m ³ /h.m ²) 75 minutes, no failure ⁽³⁾ 75 minutes, no failure ⁽¹⁾ 75 minutes, no failure ⁽¹⁾	75 minutes, no failure ⁽¹⁾ (Q _{v max} : 44.89 m ³ /h.m ²) 75 minutes, no failure ⁽¹⁾ 75 minutes, no failure ⁽¹⁾ 75 minutes, no failure ⁽¹⁾
Smoke leakage (S^(*) criterion): Leakage through the fire damper at an ambient temperature Leakage through the fire damper during the test ⁽²⁾	200 m ³ /h.m ² 200 m ³ /h.m ²	Q _{v max} : 41.59 m ³ /h.m ² 75 minutes, no failure ⁽¹⁾ (Q _{v max} : 82.68 m ³ /h.m ²)	Q _{v max} : 48.76 m ³ /h.m ² 75 minutes, no failure ⁽¹⁾ (Q _{v max} : 44.89 m ³ /h.m ²)
Actuating mechanism: Any sign of mechanical damage after the opening and closing test of 50 cycli Time at which the fully-open fire damper closes	 2 minutes	 No damage 40 seconds	 No damage 40 seconds

^(*) Classification according to EN 13501-3.

⁽¹⁾ The test was discontinued after 75 minutes at the test sponsor's request.

⁽²⁾ These performance criteria apply after 5 minutes from the start of the test.

2.2.1.12 Test report 2022-Efectis-R000660

- Orientation: vertical;
- Position: fire damper A: remote from the wall;
fire damper B: on the wall;
- Exposure: outside the furnace;
- Penetration seal: 5 mm acryl;
- Fire damper diameter: 630 mm;
- Orientation of blade axis: vertical;
- Actuator type: Belimo BFN;
- Duct insulation: fire damper A: 80 mm Rockwool Conlit Fire Mat;
fire damper B: none.

Parameter	Limits	Results fire damper A	Results fire damper B
Operating pressure:		-300 Pa	-300 Pa
System leakage:	12 m ³ /h	7.4 m ³ /h	11.4 m ³ /h
Thermal insulation – (I^(*) criterion): $\Delta T_m = 140^\circ\text{C}$ $\Delta T_M = 180^\circ\text{C}$		(87% @ 60min) 93 minutes, no failure ⁽¹⁾ (106°C @ 60min) 93 minutes, no failure ⁽¹⁾ (156°C @ 60min)	(91% @ 60min) 93 minutes, no failure ⁽¹⁾ (47°C @ 60min) 92 minutes (164°C @ 60min)
Integrity (E^(*) criterion): Leakage through the fire dampers ⁽²⁾ Ignition of the cotton pad Fail test with the 6 mm and 25 mm gauges Spontaneous, continuous flames	360 m ³ /h.m ²	93 minutes, no failure ⁽¹⁾ (Q _{v max} : 19.41 m ³ /h.m ²) 93 minutes, no failure ⁽¹⁾ 93 minutes, no failure ⁽¹⁾ 93 minutes, no failure ⁽¹⁾	93 minutes, no failure ⁽¹⁾ (Q _{v max} : 32.35 m ³ /h.m ²) 93 minutes, no failure ⁽³⁾ 93 minutes, no failure ⁽¹⁾ 93 minutes, no failure ⁽¹⁾
Smoke leakage (S^(*) criterion): Leakage through the fire damper at an ambient temperature Leakage through the fire damper during the test ⁽²⁾	200 m ³ /h.m ² 200 m ³ /h.m ²	Q _{v max} : 43.34 m ³ /h.m ² 93 minutes, no failure ⁽¹⁾ (Q _{v max} : <11.48 m ³ /h.m ²)	Q _{v max} : 58.22 m ³ /h.m ² 93 minutes, no failure ⁽¹⁾ (Q _{v max} : 22.48 m ³ /h.m ²)
Actuating mechanism: Any sign of mechanical damage after the opening and closing test of 50 cycles Time at which the fully-open fire damper closes	2 minutes	No damage 60 seconds	No damage 30 seconds

(*) Classification according to EN 13501-3.

(1) The test was discontinued after 93 minutes at the test sponsor's request.

(2) These performance criteria apply after 5 minutes from the start of the test.

(3) No failure until thermal insulation failure.

2.2.1.13 Test report 22299A

- Orientation: horizontal;
- Position: on the floor;
- Exposure: outside the furnace;
- Penetration seal: 5 mm acryl;
- Fire damper diameter: 630 mm;
- Orientation of blade axis: N/A;
- Actuator type: Remote One L;
- Duct insulation: none.

Parameter	Limits	Results fire damper A	Results fire damper B
Operating pressure:		-300 Pa	-300 Pa
System leakage:	12 m ³ /h	3.57 m ³ /h	3.08 m ³ /h
Thermal insulation – (I^(*) criterion): $\Delta T_m = 140^\circ\text{C}$ $\Delta T_M = 180^\circ\text{C}$		(80% @ 60min) 74 minutes, no failure ⁽¹⁾ (48°C @ 60min) 74 minutes, no failure ⁽¹⁾ (143°C @ 60min)	(99% @ 60min) 74 minutes, no failure ⁽¹⁾ (38°C @ 60min) 61 minutes (177°C @ 60min)
Integrity (E^(*) criterion): Leakage through the fire dampers ⁽²⁾ Ignition of the cotton pad Fail test with the 6 mm and 25 mm gauges Spontaneous, continuous flames	360 m ³ /h.m ²	74 minutes, no failure ⁽¹⁾ (Q _{v max} : 36.14 m ³ /h.m ²) 74 minutes, no failure ⁽¹⁾ 74 minutes, no failure ⁽¹⁾ 74 minutes, no failure ⁽¹⁾	74 minutes, no failure ⁽¹⁾ (Q _{v max} : 51.60 m ³ /h.m ²) 74 minutes, no failure ⁽³⁾ 74 minutes, no failure ⁽¹⁾ 74 minutes, no failure ⁽¹⁾
Smoke leakage (S^(*) criterion): Leakage through the fire damper at an ambient temperature Leakage through the fire damper during the test ⁽²⁾	200 m ³ /h.m ² 200 m ³ /h.m ²	Q _{v max} : 53.51 m ³ /h.m ² 74 minutes, no failure ⁽¹⁾ (Q _{v max} : 36.14 m ³ /h.m ²)	Q _{v max} : 99.87 m ³ /h.m ² 74 minutes, no failure ⁽¹⁾ (Q _{v max} : 51.60 m ³ /h.m ²)
Actuating mechanism: Any sign of mechanical damage after the opening and closing test of 50 cycles Time at which the fully-open fire damper closes		No damage 40 seconds	No damage 40 seconds

^(*) Classification according to EN 13501-3.

⁽¹⁾ The test was discontinued after 74 minutes at the test sponsor's request.

⁽²⁾ These performance criteria apply after 5 minutes from the start of the test.

⁽³⁾ No failure until thermal insulation failure.

2.2.1.14 Test reports 22328A and 22328B

- Orientation: vertical;
- Position: on the wall;
- Exposure: outside the furnace;
- Penetration seal: 25 mm stuffed stone wool and 5 mm acryl;
- Fire damper diameter: test report 22328A: 315 mm;
test report 22328B: 630 mm;
- Orientation of blade axis: vertical;
- Actuator type: Remote One L;
- Duct insulation: none.

Parameter	Limits	Results test report 22328A	Results test report 22328B
Operating pressure:		-300 Pa	-300 Pa
System leakage:	12 m ³ /h	3.44 m ³ /h	5.09 m ³ /h
Thermal insulation – (I^(*) criterion): $\Delta T_m = 140^\circ\text{C}$ $\Delta T_M = 180^\circ\text{C}$		(93% @ 60min) 96 minutes, no failure ⁽¹⁾ (39°C @ 60min) 78 minutes (166°C @ 60min)	(81% @ 60min) 96 minutes, no failure ⁽¹⁾ (29°C @ 60min) 91 minutes (145°C @ 60min)
Integrity (E^(*) criterion): Leakage through the fire dampers ⁽²⁾ Ignition of the cotton pad Fail test with the 6 mm and 25 mm gauges Spontaneous, continuous flames	360 m ³ /h.m ²	96 minutes, no failure ⁽¹⁾ (Q _{v max} : 48.54 m ³ /h.m ²) 96 minutes, no failure ⁽³⁾ 96 minutes, no failure ⁽¹⁾ 96 minutes, no failure ⁽¹⁾	96 minutes, no failure ⁽¹⁾ (Q _{v max} : 42.36 m ³ /h.m ²) 96 minutes, no failure ⁽³⁾ 96 minutes, no failure ⁽¹⁾ 96 minutes, no failure ⁽¹⁾
Smoke leakage (S^(*) criterion): Leakage through the fire damper at an ambient temperature Leakage through the fire damper during the test ⁽²⁾	200 m ³ /h.m ² 200 m ³ /h.m ²	Q _{v max} : 44.89 m ³ /h.m ² 96 minutes, no failure ⁽¹⁾ (Q _{v max} : 48.54 m ³ /h.m ²)	Q _{v max} : 72.93 m ³ /h.m ² 96 minutes, no failure ⁽¹⁾ (Q _{v max} : 42.36 m ³ /h.m ²)
Actuating mechanism: Any sign of mechanical damage after the opening and closing test of 50 cycles Time at which the fully-open fire damper closes	 2 minutes	 No damage 40 seconds	 No damage 40 seconds

^(*) Classification according to EN 13501-3.

⁽¹⁾ The test was discontinued after 96 minutes at the test sponsor's request.

⁽²⁾ These performance criteria apply after 5 minutes from the start of the test.

⁽³⁾ No failure until thermal insulation failure.

2.2.1.15 Test report 22/32306738

- Orientation: vertical;
- Position: on the wall;
- Exposure: outside the furnace;
- Penetration seal 5 mm acryl;
- Fire damper diameter: 630 mm;
- Orientation of blade axis: vertical;
- Actuator type: fire damper A: Belimo BFN;
fire damper B: Remote One L;
- Duct insulation: none.

Parameter	Limits	Results fire damper A	Results fire damper B
Operating pressure:		-300 Pa	-300 Pa
System leakage:	12 m ³ /h	N/A	N/A
Thermal insulation – (I^(*) criterion): ΔT _m = 140°C ΔT _M = 180°C		(66% @ 60min) 85 minutes, no failure ⁽¹⁾ (28°C @ 60min) 85 minutes, no failure ⁽¹⁾ (119°C @ 60min)	(87% @ 60min) 85minutes, no failure ⁽¹⁾ (58°C @ 60min) 75 minutes (156°C @ 60min)
Integrity (E^(*) criterion): Leakage through the fire dampers ⁽²⁾ Ignition of the cotton pad Fail test with the 6 mm and 25 mm gauges Spontaneous, continuous flames	360 m ³ /h.m ²	85 minutes, no failure ⁽¹⁾ (Q _{v max} : <10 m ³ /h.m ²) 85 minutes, no failure ⁽¹⁾ 85 minutes, no failure ⁽¹⁾ 85 minutes, no failure ⁽¹⁾	85 minutes, no failure ⁽¹⁾ (Q _{v max} : <55 m ³ /h.m ²) 85 minutes, no failure ⁽³⁾ 85 minutes, no failure ⁽¹⁾ 85 minutes, no failure ⁽¹⁾
Smoke leakage (S^(*) criterion): Leakage through the fire damper at an ambient temperature Leakage through the fire damper during the test ⁽²⁾	200 m ³ /h.m ² 200 m ³ /h.m ²	Q _{v max} : 39.97 m ³ /h.m ² 85 minutes, no failure ⁽¹⁾ (Q _{v max} : <10 m ³ /h.m ²)	Q _{v max} : 24.17 m ³ /h.m ² 85 minutes, no failure ⁽¹⁾ (Q _{v max} : <55 m ³ /h.m ²)
Actuating mechanism: Any sign of mechanical damage after the opening and closing test of 50 cycles Time at which the fully-open fire damper closes	 2 minutes	 No damage 60 seconds	 No damage 60 seconds

^(*) Classification according to EN 13501-3.

⁽¹⁾ The test was discontinued after 85 minutes at the test sponsor's request.

⁽²⁾ These performance criteria apply after 5 minutes from the start of the test.

⁽³⁾ No failure until thermal insulation failure.

2.2.2 Cold leakage tests

2.2.2.1 Test reports 22045A and 22045B

- Fire damper diameter: test report 22045A: 400 mm;
test report 22328B: 100 mm;
- Actuator type: Remote One L.

Parameter	Results test report 22328A	Results test report 22328B
System leakage	5.46 m ³ /h.m ²	2.65 m ³ /h.m ²
Leakage through the fire damper at an ambient temperature at -300 Pa	Q _{v max} : 39.26 m ³ /h.m ²	Not measurable
Leakage through the fire damper at an ambient temperature at -500 Pa	Q _{v max} : 75.62 m ³ /h.m ²	Q _{v max} : 29.69 m ³ /h.m ²

2.2.3 Cycling tests

2.2.3.1 Test reports 22045C and 22045D

- Fire damper diameter: 630 mm;
- Actuator type: test report 22045C: Belimo BFN;
test report 22045D: Remote One L.

Parameter	Limits	Results test report 22045C	Results test report 22045D
Average cycle time			
Time to open		57 seconds	36.8 seconds
Time to close		17.2 seconds	26.2 seconds
Total cycle time	120 seconds	74.2 seconds	63 seconds
Cycle time of the last cycle			
Time to open		56 seconds	36 seconds
Time to close		16 seconds	25 seconds
Total cycle time	120 seconds	72 seconds	61 seconds

2.2.3.2 Test report 22631A and 22631B

- Fire damper diameter: test report 22631A: 315 mm;
test report 22631B: 630 mm.
- Actuator type: test report 22631A: Belimo BFL;
test report 22631B: Belimo BFN.

Parameter	Limits	Results test report 22631A	Results test report 22631B
Average cycle time			
Time to open		57.9 seconds	56.5 seconds
Time to close		57.8 seconds	56.9 seconds
Total cycle time	120 seconds	115.8 seconds	113.5 seconds
Cycle time of the last cycle			
Time to open		59 seconds	57 seconds
Time to close		58 seconds	57 seconds
Total cycle time	120 seconds	117 seconds	114 seconds
Cycle time during 45° to 60°			
Time to open		8 seconds	7 seconds
Time to close		2 seconds	5 seconds
Total cycle time		10 seconds	9 seconds

2.2.3.3 Test report EFR-23-Zn-003702

- Orientation: vertical;
- Position: in the light partition wall;
- Exposure: inside the furnace;
- Fire damper dimensions: 800 x 600 mm;
- Orientation of blade axis: horizontal;
- Actuator type: fire damper A: Belimo BFL;
fire damper B: RFT ONE.

Parameter	Limits	Results fire damper A	Results fire damper B
Operating pressure:		-300 Pa	-300 Pa
System leakage:	12 m ³ /h	< 5 m ³ /h	< 5 m ³ /h
Thermal insulation – (I^(*) criterion): $\Delta T_m = 140^\circ\text{C}$ $\Delta T_M = 180^\circ\text{C}$		61 minutes 64 minutes, no failure ⁽¹⁾	64 minutes 64 minutes, no failure ⁽¹⁾
Integrity (E^(*) criterion): Leakage through the fire dampers ⁽²⁾ Ignition of the cotton pad Fail test with the 6 mm and 25 mm gauges Spontaneous, continuous flames	360 m ³ /h.m ²	64 minutes, no failure ⁽¹⁾ 64 minutes, no failure ⁽¹⁾ 64 minutes, no failure ⁽¹⁾ 64 minutes, no failure ⁽¹⁾	64 minutes, no failure ⁽¹⁾ 64 minutes, no failure ⁽¹⁾ 64 minutes, no failure ⁽¹⁾ 64 minutes, no failure ⁽¹⁾
Smoke leakage (S^(*) criterion): Leakage through the fire damper at an ambient temperature Leakage through the fire damper during the test ⁽²⁾	200 m ³ /h.m ² 200 m ³ /h.m ²	$Q_{v \max}$: 154.15 m ³ /h.m ² 64 minutes, no failure ⁽¹⁾	$Q_{v \max}$: 54.79 m ³ /h.m ² 64 minutes, no failure ⁽¹⁾
Actuating mechanism: Any sign of mechanical damage after the opening and closing test of 50 cycles Time at which the fully-open fire damper closes	 2 minutes	 No damage 60 seconds	 No damage 60 seconds

(*) Classification according to EN 13501-3.

⁽¹⁾ The test was discontinued after 64 minutes at the test sponsor's request.

⁽²⁾ These performance criteria apply after 5 minutes from the start of the test.

3 Classification and field of application

3.1 Reference of classification

This classification has been carried out in accordance with clause 7 of EN 13501-2:2023.

3.2 Classification

The element, type: CRS-60, is classified according to the following combinations of performance parameters and classes as appropriate. No other classifications are permitted.

The classification is valid for fire dampers (-300 Pa) with the combinations given in the table below.

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Diameter [mm]	Supporting construction	Installation	Exposure	Duct insulation	Penetration seal	Actuator	Separation distance (damper/construction)	
100 mm – 315 mm or 400 mm – 630 mm	rigid floor, rigid wall or flexible wall	on the wall	exposed	N/A	5 mm acryl	BFL*/BFN ONE L	≥ 10 mm / ≥ 10 mm	
					25 mm stuffed stone wool	BFL*/BFN ONE L	≥ 200 mm / ≥ 75 mm	
			unexposed	N/A	5 mm acryl	BFL*/BFN ONE L	≥ 10 mm / ≥ 10 mm	
					25 mm stuffed stone wool	BFL*/BFN ONE L	≥ 200 mm / ≥ 75 mm	
		remote from the wall	exposed	80 mm Rockwool 70 mm Paroc	5 mm acryl	BFL*/BFN ONE L	≥ 10 mm / ≥ 10 mm	
					25 mm stuffed stone wool	BFL*/BFN ONE L	≥ 200 mm / ≥ 75 mm	
			unexposed	80 mm Rockwool 70 mm Paroc	5 mm acryl	BFL*/BFN ONE L	≥ 10 mm / ≥ 10 mm	
					25 mm stuffed stone wool	BFL*/BFN ONE L	≥ 200 mm / ≥ 75 mm	
	flexible shaft wall (studs at the unexposed side)	on the wall		exposed	N/A	5 mm acryl	BFL*/BFN ONE L	≥ 200 mm / ≥ 75 mm
				unexposed	N/A	5 mm acryl	BFL*/BFN ONE L	≥ 200 mm / ≥ 75 mm
		remote from the wall	exposed	80 mm Rockwool 70 mm Paroc	5 mm acryl	BFL*/BFN ONE L	≥ 200 mm / ≥ 75 mm	
					unexposed	80 mm Rockwool 70 mm Paroc	5 mm acryl	BFL*/BFN ONE L

*For dampers with diameter: ≤ 315 mm

3.3 Field of direct application

This classification is valid for the following end use applications according to EN 1366-2:2015.

The results of the fire test are directly applicable to similar constructions where one or more of the changes listed below are made and the construction continues to comply with the appropriate design code for its stiffness and stability:

a) Size of fire damper (when smoke leakage is not required):

The classification is applicable to all dampers of the same type provided that the maximum nominal diameter does not exceed 315 mm for fire dampers CRS-60 (100 mm till 315 mm) or 630 mm for fire dampers CRS-60 (400 mm till 630 mm), and that the components remain in the same orientation as those tested.

b) Size of fire damper (when smoke leakage is required):

The classification is only applicable to the same type of damper provided that the nominal diameter is in the range 100 mm till 315 mm for fire dampers CRS-60 (100 mm till 315 mm) or 400 mm till 630 mm for fire dampers CRS-60 (400 mm till 630 mm), and that the components remain in the same orientation as those tested.

c) Fire dampers installed within structural openings:

The classification for a fire damper installed within a structural opening is only applicable to other fire dampers of the same type installed in the same orientation and position in relation to the supporting construction as that tested.

d) Fire from above:

Fire dampers tested horizontally in floors with fire from below are acceptable in installations where fire might come from above.

e) Separation between fire dampers and between fire dampers and construction elements:

The classification is applicable to a minimum separation in practice of 200 mm between fire dampers in separate ducts and of 75 mm between a fire damper and a constructional element.

f) Supporting constructions:

The following supporting constructions are tested:

- Flexible wall constructions with type F boards;
- Flexible wall constructions with type A boards;
- Flexible shaft wall constructions with type F boards;
- Rigid floor construction with aerated concrete.

A test obtained for a fire damper mounted in or on the face of a standard supporting construction is applicable to a supporting construction of the same type with a fire resistance equal to or greater than that of the standard supporting construction used in the test (thicker, denser, more layers of board, as appropriate).

The test result can also apply to cellular or hollow masonry blocks or slabs that have a fire resistance time equal or greater than the fire resistance required for the fire damper installation.

Test results obtained with dampers installed in flexible vertical supporting constructions may be applied to rigid supporting constructions of a thickness equal to or greater than that of the element used in the tests, provided that the classified fire resistance of the rigid supporting construction is greater than or equal to the one used for the test. The sealants used shall be the same as those tested. Any fasteners used shall be fire rated to suit the supporting construction that is used.

Test results obtained with dampers installed in insulated flexible vertical supporting constructions may be applied to applications where the same flexible vertical supporting construction is uninsulated (less onerous as per EN 1363-1) – aperture framing shall be used using the same materials as used in the test partition construction, using the same number of boards as was tested.

Test results obtained with dampers installed in flexible vertical supporting constructions made with steel studs are not applicable to flexible vertical supporting constructions made using timber studs.

Test results obtained with dampers installed in aerated concrete are applicable to rigid constructions made from hollow blocks, provided that the holes are filled/closed before the addition of the final penetration seal.

g) Blade pivot axis:

Tests with the actuator mounted at the bottom of the fire damper for a test with the blades with a vertical pivot axis shall allow the damper to be installed with the actuator at the top of the unit.

3.4 Field of extended application

a) Damper housing:

The damper housing will have a minimum length of 210 mm. There's no restriction on the maximum length of the damper housing.

b) Connecting duct

The connecting duct can be any material, shape or dimension.

The ductwork connecting a remote installed fire damper to the supporting construction is considered part of the test specimen and cannot be changed.

c) Remote installation

Fire dampers can be installed remote at any distance from the supporting construction. If this distance exceeds the tested distance of 1000 mm, the number of hangers or supports will be increased in accordance with the calculations in EN 1366-1.

d) Annular gap

Stuffed stone wool seal

The gap between the fire damper and the supporting construction can be increased from 25 mm up to a maximum of 37.5 mm.

The gap between the fire damper and the supporting construction can be smaller than 25 mm, on the condition that the reduced gap size does not inhibit the installation of the seal.

Acryl

The gap between the fire damper and the supporting construction can be increased from 5 mm up to a maximum of 7.5 mm.

The gap between the fire damper and the supporting construction can be smaller than 5 mm, on the condition that the reduced gap size does not inhibit the installation of the seal.

e) Blade pivot axis

Fire dampers applied to horizontal or sloped supporting constructions can have their axis oriented in any angle.

f) Orientation of supporting construction

The fire damper can be applied to sloping supporting constructions, on the condition that the damper remains fully in the plane of the slope of the supporting construction.

g) Change in spacing between dampers

The fire dampers were tested with a minimal distance of 10 mm from each other. The classification covers dampers installed from the tested distance upwards.

h) Change in spacing between dampers

The fire dampers were tested with a minimal distance of 10 mm from the damper to the surrounding supporting construction. The classification covers dampers installed from the tested distance upwards.

4 Limitations

This classification document does not represent type approval nor certification of the product.

SIGNED

APPROVED

Signed for and on behalf of Warringtonfire Gent

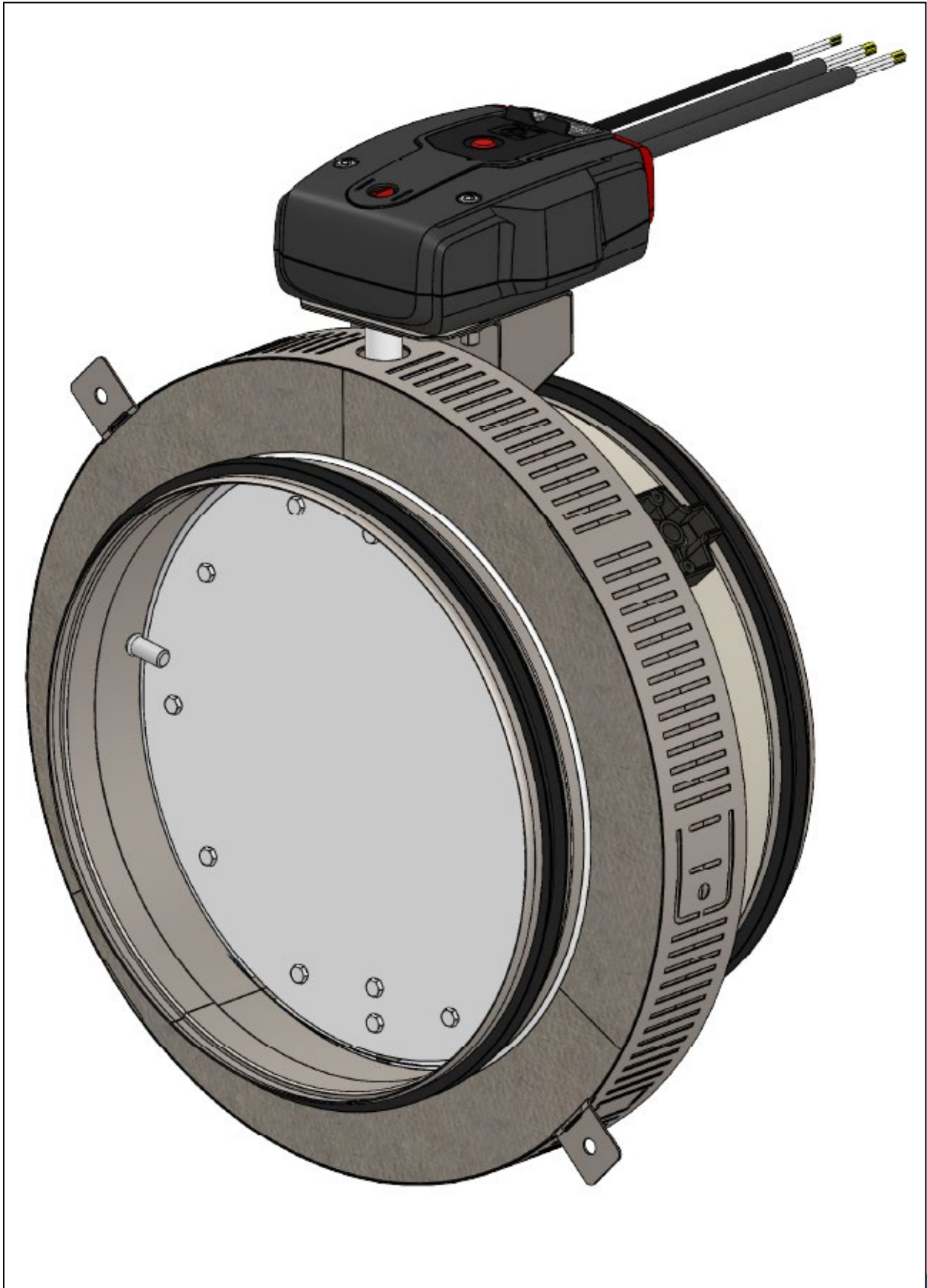
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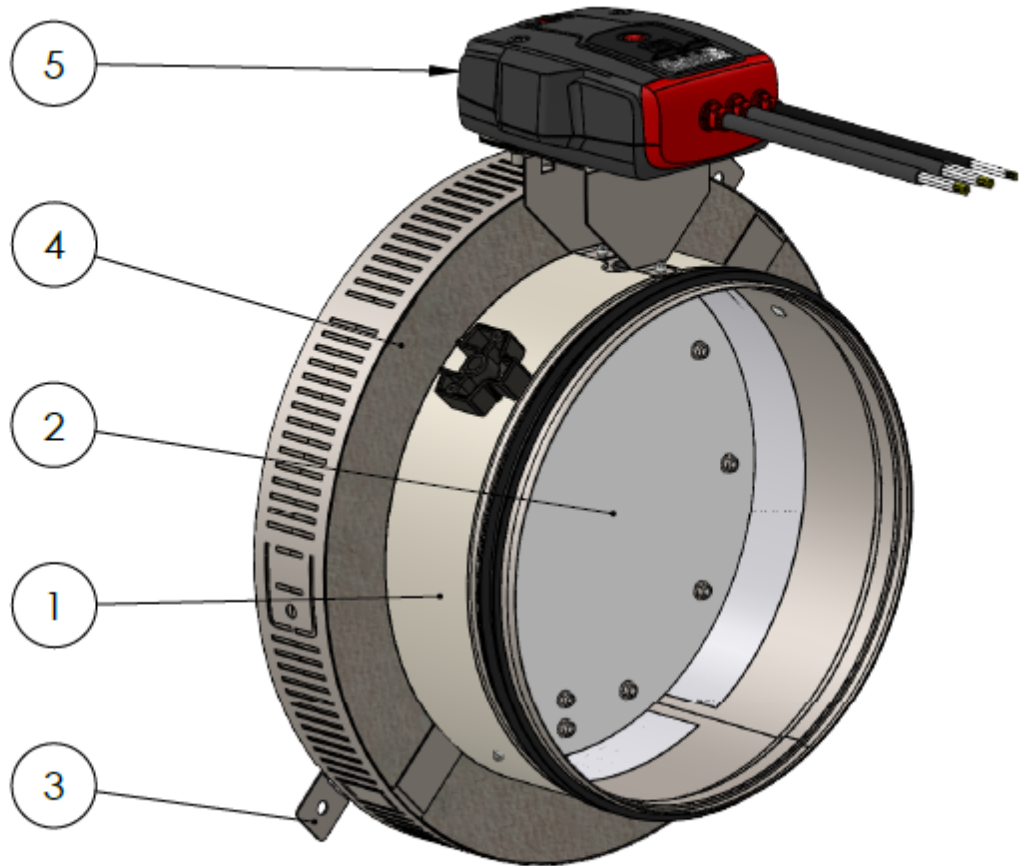
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DRAWINGS





MAIN PARTS

1. Damper tunnel
2. Damper blade
3. Wall limit bracket
4. Refractory ring
5. Actuator