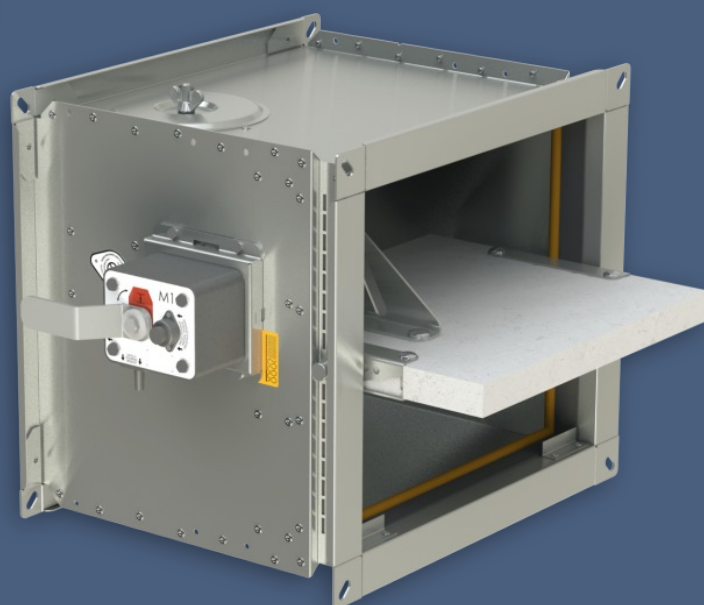
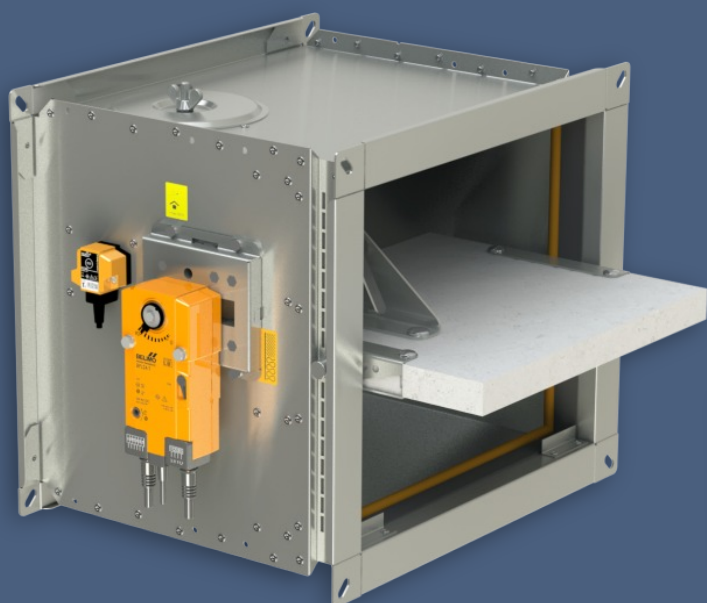


## FDMB

### Fire damper

Technical Documentation

Installation, Commissioning, Operation, Maintenance and Service Manual



These technical specifications state a row of manufactured sizes and models of fire dampers FDMB.  
It is valid for production, designing, ordering, delivery, maintenance and operation.

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# I. GENERAL

## Description

Fire dampers are shutters in ducts of air-conditioning devices that prevent the spread of fire and combustion products from one fire segment to the other one by means of closing the duct in the points of fire separating constructions.

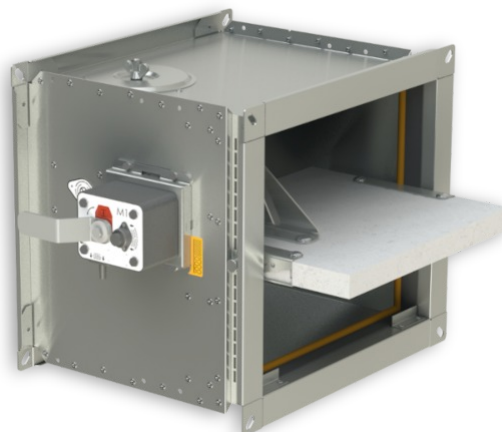
Damper blade automatically closes air duct using a closing spring or a spring return actuator. The closing spring is actuated by pressing a button on the manual control or by melting a thermal fuse.

The return spring of the actuator is actuated when a thermoelectric activation device BAT is activated, when a test button on BAT is pressed or when power supply of the actuator is interrupted.

After closing the blade, the damper is sealed with silicon against smoke penetration. On request by customer, the damper can be supplied silicon-free. In the closed position, the damper is also sealed with material which increases its volume due to increasing temperature and air proofs the air duct.



*FDMB with spring return actuator*



*FDMB with manual control*

### Damper characteristics

- CE certified acc. to BS EN 15650
- Tested in accordance with BS EN 1366-2
- Classified acc. to BS EN 13501-3+A1
- External casing leakage for size: A<160 or B<160 class ATC 4 (old marking "B"), A≥160 a B≥160 class ATC 3 (old marking "C"), Internal leakage class 2 acc. to BS EN 1751
- Cycling test in class C<sub>10000</sub> acc. to BS EN 15650
- Corrosion resistant acc. to BS EN 15650
- Certificate of constancy of performance UKCA No. 2822-UKCA-CPR-XXXX
- Certificate of constancy of performance CE No. 1391-CPR-XXXX/XXXX
- Declaration of Performance UKCA No. PM/FDMB/02/XX/X
- Declaration of Performance CE No. PM/FDMB/01/XX/X
- Hygienic assessment of fire dampers - Report No. 1.6/pos/19/19b

### Working conditions

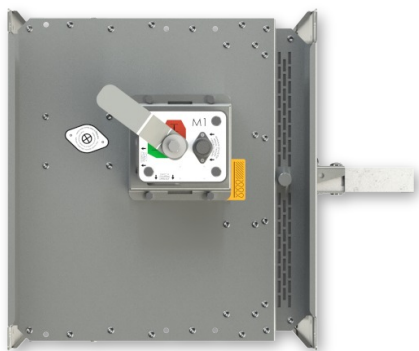
- Exact damper function is provided under the following conditions:
  - maximum air velocity 12 m/s
  - maximum pressure difference 1200 Pa
  - the air circulation in the whole damper section must be secured steady over the entire surface.
- Dampers can be installed in arbitrary position
- Dampers are suitable for systems without abrasive, chemical and adhesive particles.
- Dampers are designed for macroclimatic areas with mild climate according to BS EN IEC 60 721-3-3 ed.2., class 3K22. (Environment 3K22 is typically protected place with regulated temperature)
- Temperature in the place of installation is permitted to range from -30°C to +50°C.

## II. DESIGN

### Design with manual control

#### Design .01

- Design with mechanical control with a thermal protective fuse which actuates the shutting device, after the nominal start temperature 72°C has been reached.
- Automatic initiation of the shutting device is not activated if the temperature does not exceed 70°C.
- In case that other start temperatures are required, thermal fuses with nominal start temperature +104°C or +147°C can be supplied (this requirement must be specified in the order).



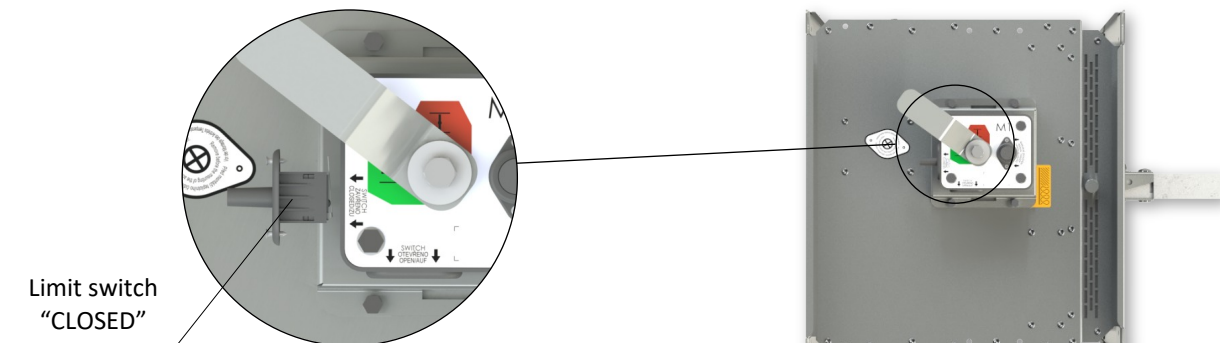
Design .01

#### ATTENTION:

- Mechanisms are produced in three designs M1 to M3, difference is only in size of inner spring, which closes the fire damper.
- For the size of fire dampers is always assigned the size of mechanism → see pages 14 to 19
- It is not recommended to use different size of mechanism, than given by the manufacturer, otherwise, there is a risk of fire damper destruction.

#### Design .11

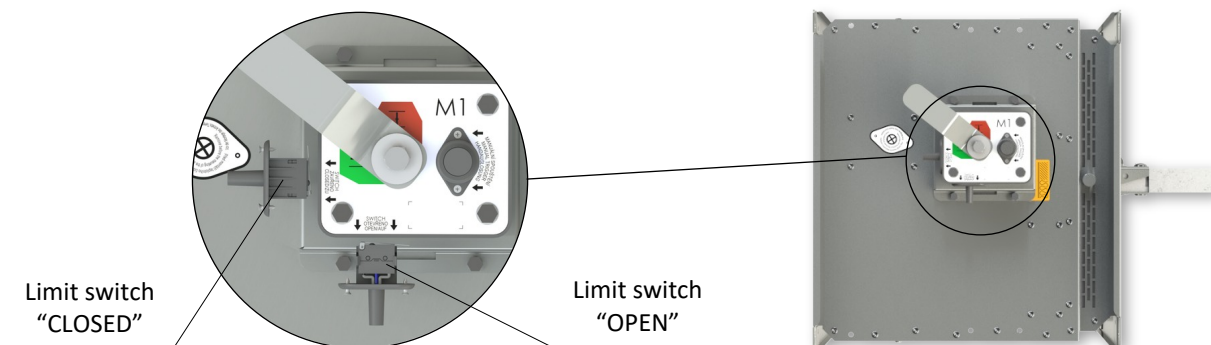
- Design .01 with mechanical control can be complemented with a limit switch signalling of the damper blade position "CLOSED".
- Cable is connected directly to limit switch.
- Limit switch detail → see page 5



Design .11

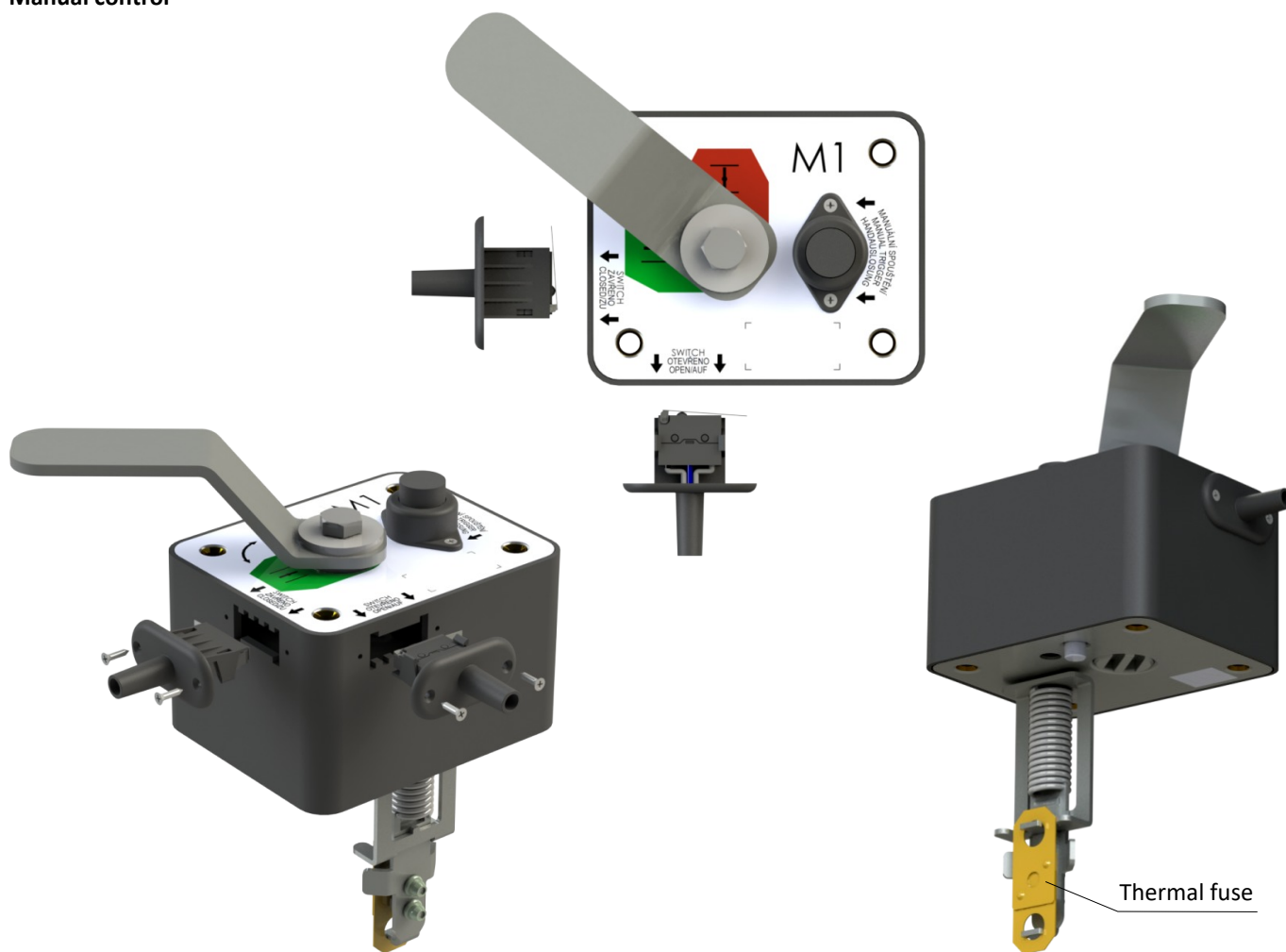
#### Design .80

- Design .01 with mechanical control can be complemented with a terminal switches signaling of the damper blade position "CLOSED" and "OPEN".
- Limit switches are connected via damper casing, cables are connected directly to limit switches.
- Limit switch detail → see page 5

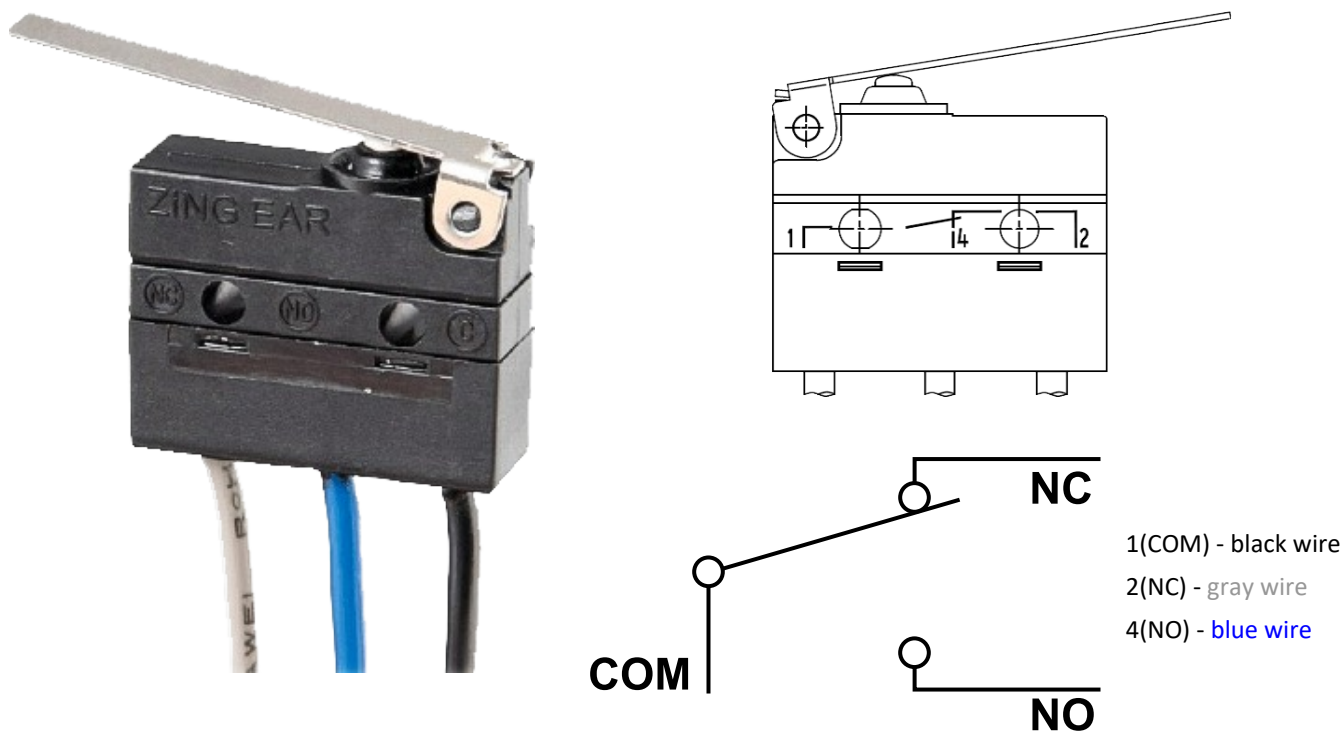


Design .80

Manual control



Limit switch G905-300E03W1



Nominal voltage and maximal current	AC 230V / 5A
Class of protection	IP 67
Working temperature	-25°C ... +120°C

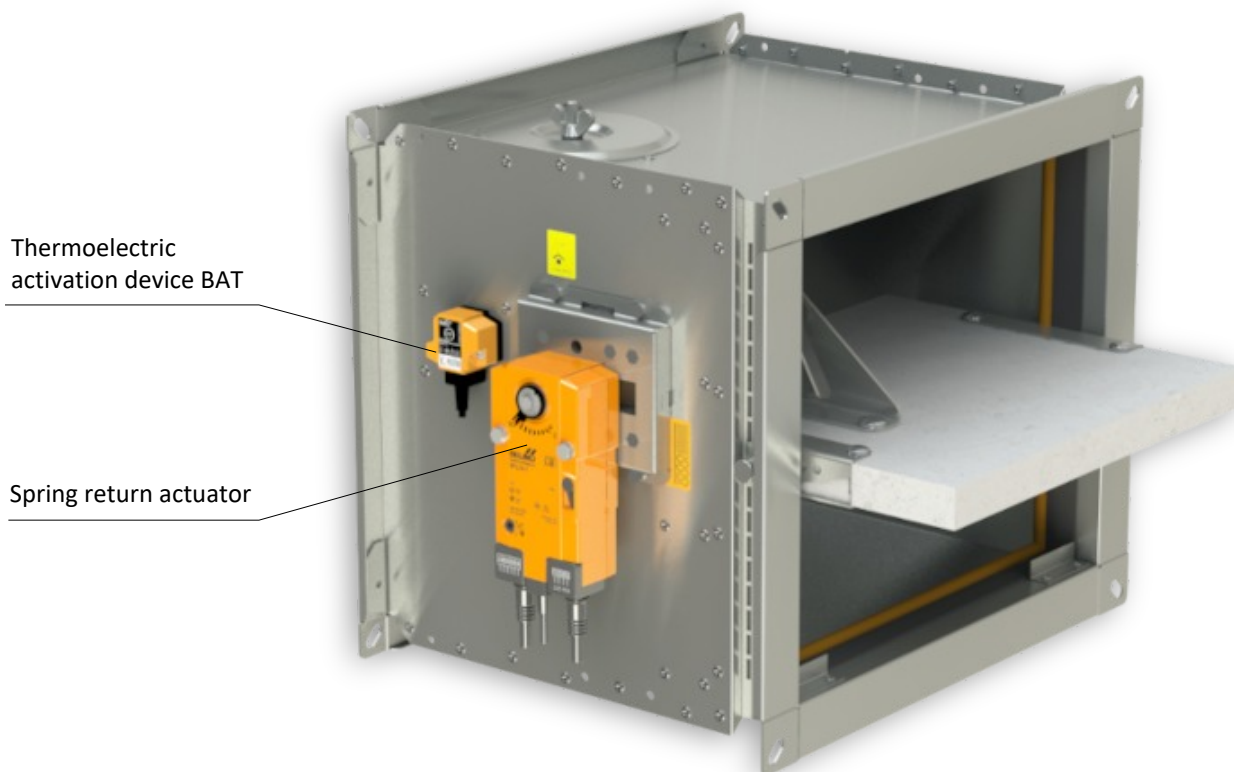
This limit switch is possible to connect in following two versions

- CUT-OFF if the arm is moving ... connect wire 1+2
- SWITCH-ON if the arm is moving ... connect wire 1+4

## Design with spring return actuator

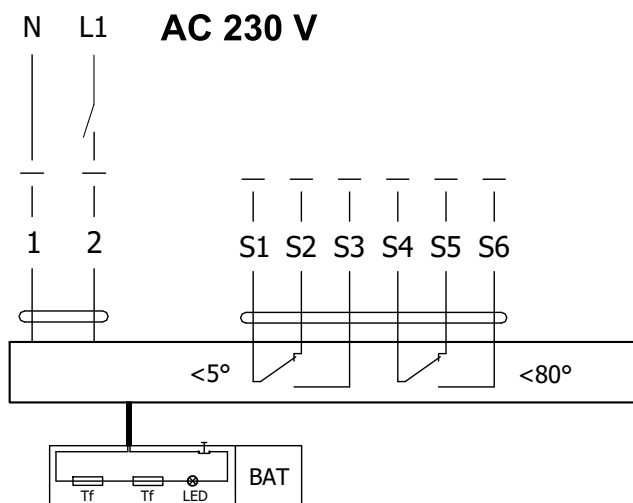
### Design .40 and .50

- The fire dampers are equipped with Belimo spring return actuators with thermoelectric activation device BAT. The spring return actuator types are BFL, BFN or BF depending on the damper size. (Further mentioned as „actuator“).
- After being connected to power supply 230V or AC/DC 24V, the actuator rotates the damper blade to the operating position "OPEN" and at the same time pre-stretches its return spring.
- When the actuator is power supplied, the damper blade is in the position "OPEN" and the return spring is pre-stretched.
- Time needed for full opening of the damper blade from the position "CLOSED" to the position "OPEN" is maximum 120 sec. If the actuator power supply is interrupted (due to loss of supply voltage, or pressing a test button on the thermoelectric activation device BAT), the actuator rotates the damper blade to the breakdown position "CLOSED".
- The time of closing the damper blade from the position "OPEN" to the position "CLOSED" takes maximum 20 sec.
- In case that the power supply is restored again (the blade can be in any position), the actuator starts to rotate the damper blade back to the position "OPEN".
- A thermoelectric activation device BAT, which contains two thermal fuses Tf1 and Tf2, is an integral part of the actuator.
- These fuses are activated when temperature +72°C has been reached (the fuse Tf1 due to temperature outside the duct and the fuse Tf2 due to temperature inside the duct).
- After the thermal fuse Tf1 or Tf2 has been activated, the power supply is permanently and irreversibly interrupted and the actuator, by means of the pre-stretched spring, rotates the damper blade into the breakdown position "CLOSED".
- Signalisation of damper blade position "OPEN" and "CLOSE" is provided by two microswitches.

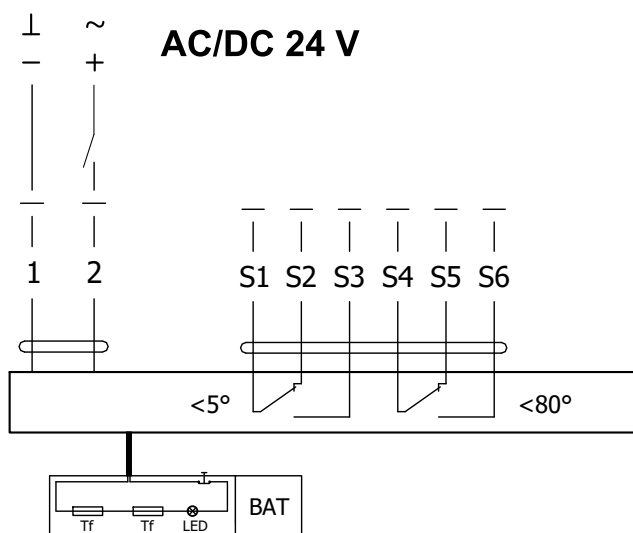


*Design .40 and .50*

**Actuator BELIMO BFL 230-T**



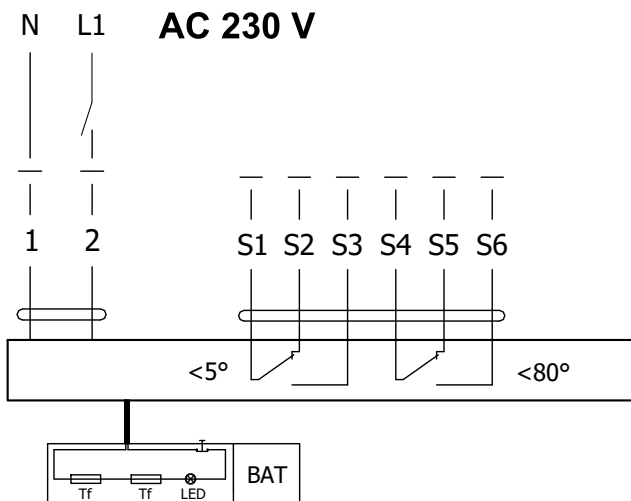
**Actuator BELIMO BFL 24-T(-ST)**



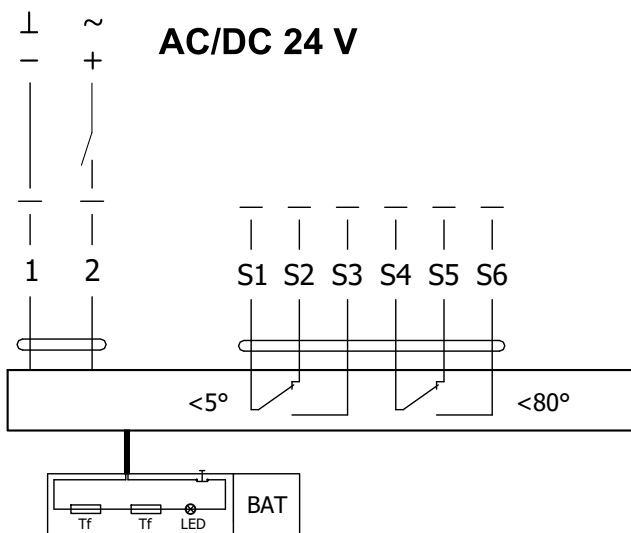
**Actuator BELIMO BFL 230-T(-ST), BFL 24-T(-ST)**

Actuator BELIMO - 4 Nm/ 3 Nm Spring	BFL 230-T(-ST)	BFL 24-T(-ST)
Power voltage	AC 230 V 50/60Hz	AC/DC 24 V 50/60Hz
Power consumption - in operation - in rest position	3,5 W 1,1 W	2,5 W 0,8 W
Dimensioning	6,5 VA (I <sub>max</sub> 4 A @ 5 ms)	4 VA (I <sub>max</sub> 8,3 A @ 5 ms)
Protection class	II	III
Degree of protection	IP 54	
Running time - motor - spring return	< 60 s ~ 20 s	
Ambient temperature - normal duty - safety duty - non-operating temperature	-30°C ... +55°C The safe position will be attained up to max. +75°C -40°C ... +55°C	
Connection - supply/control - auxiliary switch	cable 1 m, 2 x 0,75 mm <sup>2</sup> (BFL 2xx-T-ST) with 3-pin plug-in connectors cable 1 m, 6 x 0,75 mm <sup>2</sup> (BFL 2xx-T-ST) with 6-pin plug-in connectors	
Response temperature thermal fuse	duct outside temperature +72°C duct inside temperature +72°C	

Actuator BELIMO BFN 230-T



Actuator BELIMO BFN 24-T(-ST)

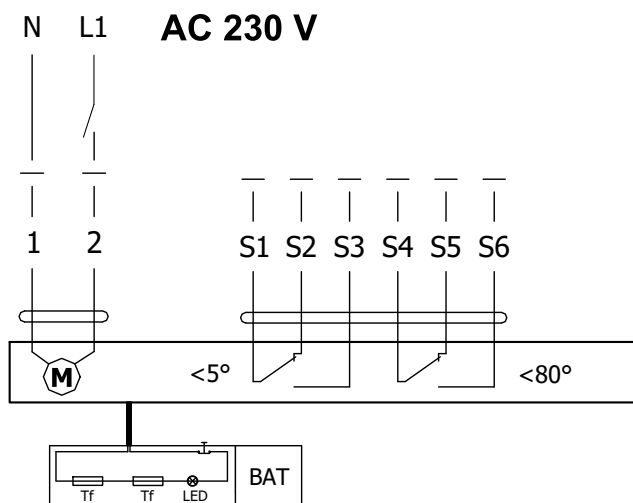


Actuator BELIMO BFN 230-T(-ST), BFN 24-T(-ST)

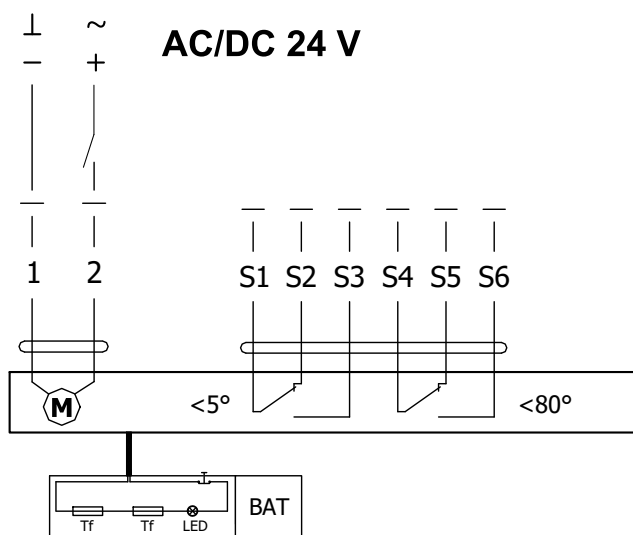
Actuator BELIMO - 9 Nm/ 7 Nm Spring	BFN 230-T(-ST)	BFN 24-T(-ST)
Power voltage	AC 230 V 50/60Hz	AC/DC 24 V 50/60Hz
Power consumption - in operation - in rest position	5 W 2,1 W	4 W 1,4 W
Dimensioning	10 VA (I <sub>max</sub> 4 A @ 5 ms)	6 VA (I <sub>max</sub> 8,3 A @ 5 ms)
Protection class	II	III
Degree of protection	IP 54	
Running time - motor - spring return	< 60 s ~ 20 s	
Ambient temperature - normal duty - safety duty - non-operating temperature	-30°C ... +55°C The safe position will be attained up to max. +75°C -40°C ... +55°C	
Connection - supply/control - auxiliary switch	cable 1 m, 2 x 0,75 mm <sup>2</sup> (BFN 2xx-T-ST) with 3-pin plug-in connectors cable 1 m, 6 x 0,75 mm <sup>2</sup> (BFN 2xx-T-ST) with 6-pin plug-in connectors	
Response temperature thermal fuse	duct outside temperature +72°C duct inside temperature +72°C	



**Actuator BELIMO BF 230-TN**



**Actuator BELIMO BF 24-TN (-ST)**



**Actuator BELIMO BF 230-TN(-ST), BF 24-TN(-ST)**

Actuator BELIMO - 18 Nm/ 12 Nm Spring	BF 230-TN(-ST)	BF 24-TN(-ST)
Power voltage	AC 230 V 50/60Hz	AC/DC 24 V 50/60Hz
Power consumption - in operation - in rest position	8,5 W 3 W	7 W 2 W
Dimensioning	11 VA (I <sub>max</sub> 8,3 A @ 5 ms)	10 VA (I <sub>max</sub> 8,3 A @ 5 ms)
Protection class	II	III
Degree of protection	IP 54	
Running time - motor - spring return	120 s ~ 16 s	
Ambient temperature - normal duty - safety duty - non-operating temperature	-30°C ... +50°C The safe position will be attained up to max. +75°C -40°C ... +50°C	
Connection - supply/control - auxiliary switch	cable 1 m, 2 x 0,75 mm <sup>2</sup> (BF 2xx-TN-ST) with 3-pin plug-in connectors cable 1 m, 6 x 0,75 mm <sup>2</sup> (BF 2xx-TN-ST) with 6-pin plug-in connectors	
Response temperature thermal fuse	duct outside temperature +72°C duct inside temperature +72°C	

**Thermoelectric activation device BAT**

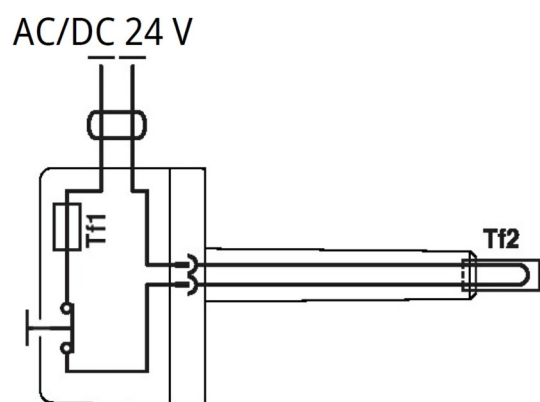
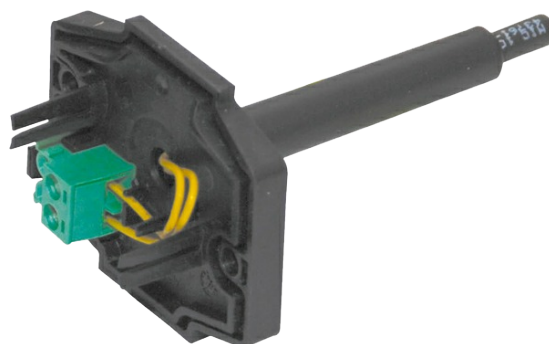
- If the thermal fuse Tf1 breaks (for a temperature close to the fire damper), it is necessary to replace the actuating mechanism. Thermoelectric starting mechanism BAT is integral part of the actuating mechanism.
- If the thermal fuse Tf2 is interrupted (due to temperature inside the duct), only the spare part ZBAT 72.
- When one of the thermal fuses responds, the supply voltage is interrupted permanently and irreversibly.
- The function (interruption of the supply voltage) can be checked by pressing the test button.
- Installation is carried out with the pre-assembled, self-tapping screws.



**Temperature thermal fuse**

Spare parts are only supplied on the basis of an order.

**BELIMO ZBAT 72**  
**Black (BK) = 72°C (standard)**

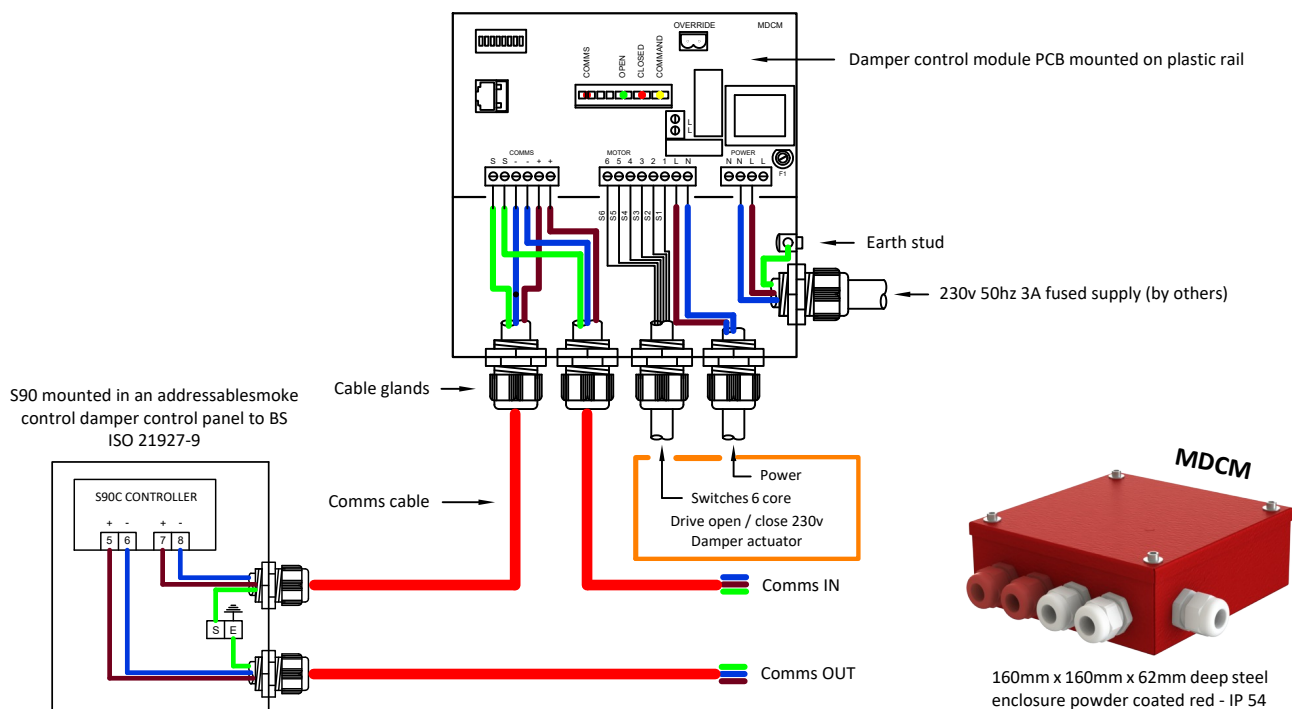


**Thermoelectric activation device BAT 72**

Power voltage	AC/DC 24 V 50/60Hz
Rated current	1 A
AC/DC throughput resistance	<1 Ω
Protection class	III
Degree of protection	IP 54
Probe length	65 mm
Ambient temperature	-30°C ... +50°C
Storage temperature	-40°C ... +50°C
Ambient humidity	Max. 95% RH, non-condensing
Connection supply	Cable 1 m, 2 x 0.5 mm <sup>2</sup> , Betaflam cable heatresistant up to 145°C
Response temperature thermal fuse	Duct inside temperature +72°C Duct outside temperature +72°C

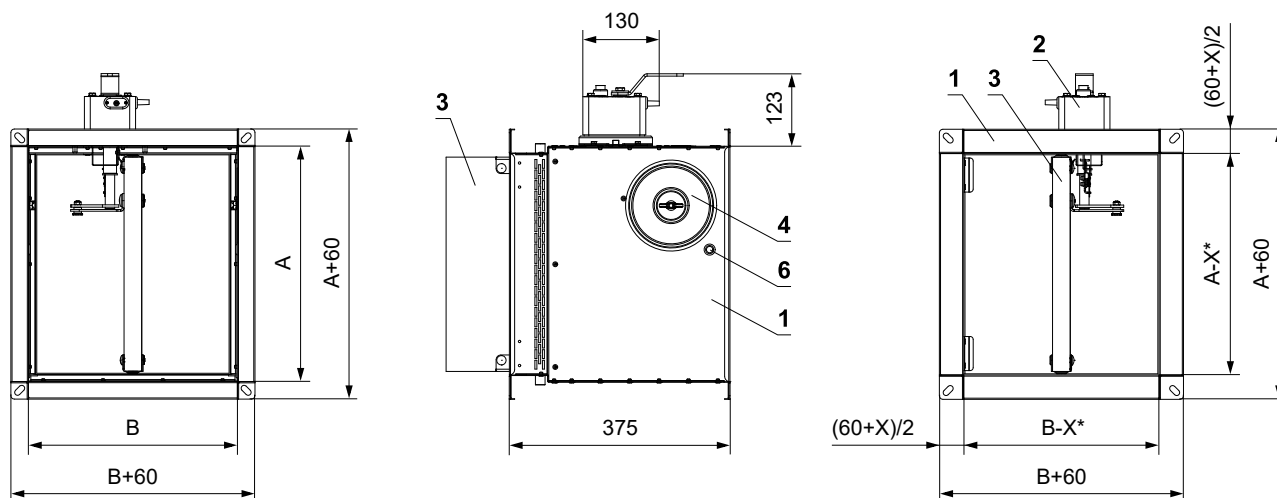
### Communication and control module MDCM

- The MDCM damper control module is connected on a bi directional communication loop back to a control panel, typically located at the FCC.
- Each MDCM has a 230v local spur to power the damper actuator.
- Up to 96x MDCM's can be connected on one loop and multiple loops can be incorporated.
- This accessory is only required with MANDIK control systems.
- Max terminal size in MDCM 2.5mm<sup>2</sup>



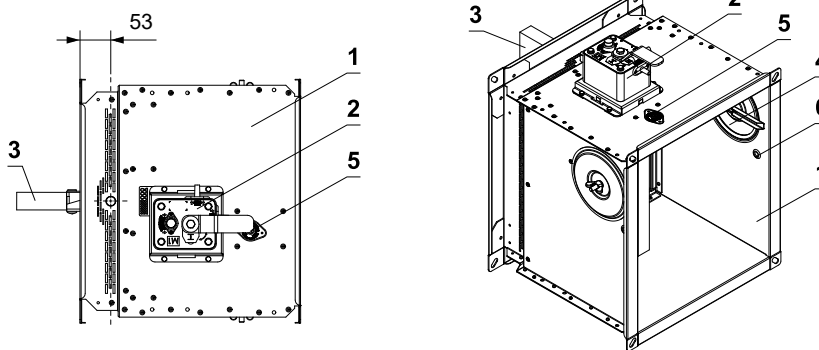
### III. DIMENSIONS

#### FDMB with manual control

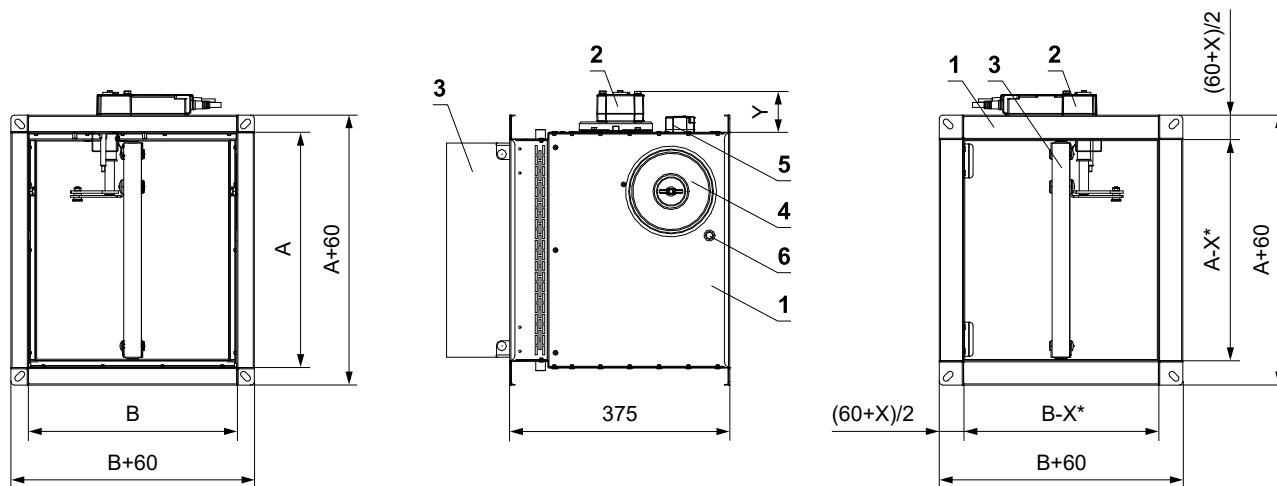


- \* X=14 (A<160 or B<160)
- \* X=23 (AxB≤500x400)
- \* X=36 (AxB>500x400)

- 1 Damper casing
- 2 Manual control
- 3 Damper blade
- 4 Inspection opening cover
- 5 Sensor sticker
- 6 Hole for camera

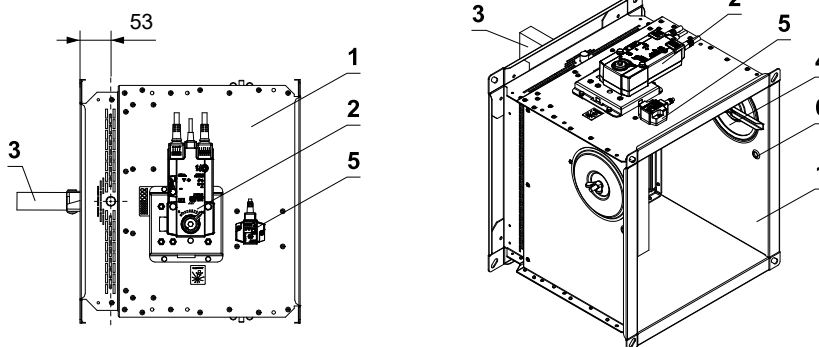


#### FDMB with spring return actuator



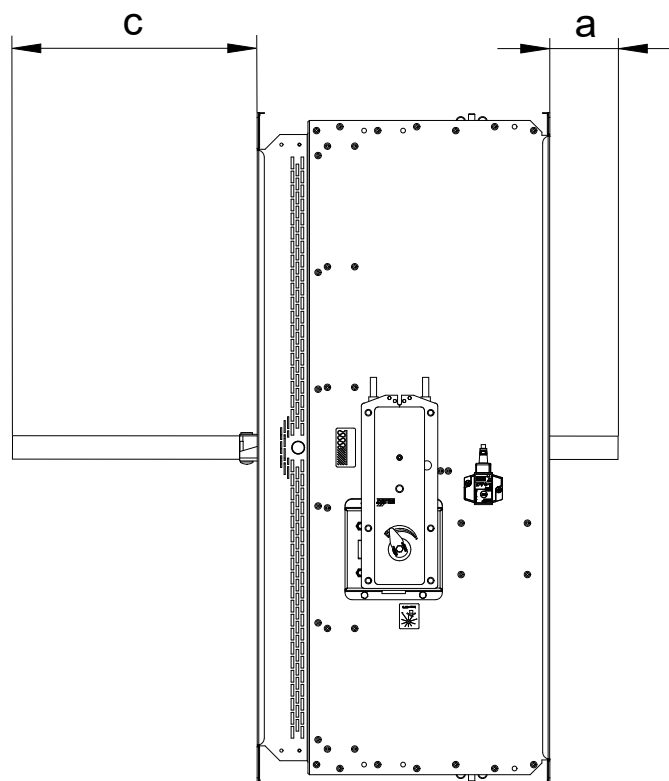
- \* X=14 (A<160 or B<160)      Y=72 mm (BFL)
- \* X=23 (AxB≤500x400)        Y=76 mm (BFN)
- \* X=36 (AxB>500x400)        Y=83 mm (BF)

- 1 Damper casing
- 2 Spring return actuator
- 3 Damper blade
- 4 Inspection opening cover
- 5 Thermoelectric activation device
- 6 Hole for camera



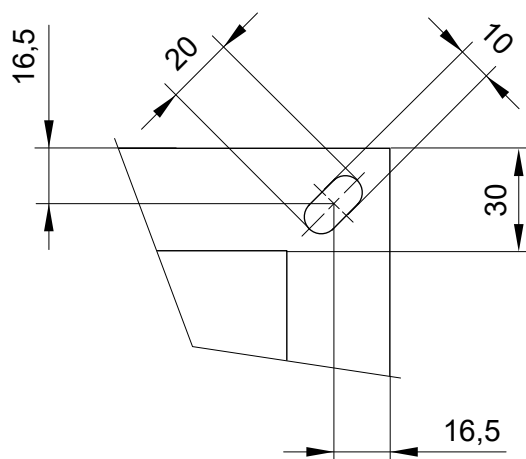
**Damper blade overlaps**

- Open damper blade overlaps the damper casing by the value "a" or "c". These values are specified in chapter Technical parameters → see pages 14 to 19

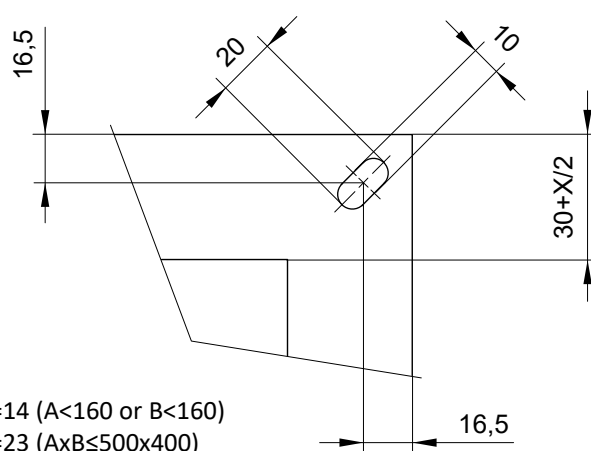


Values "a" and "c" has to be respected when projecting related air-conditioning ducts.

**Flange of a damper - CONTROL SIDE**



**Flange of a damper - INSTALLATION SIDE**



- X=14 (A<160 or B<160)
- X=23 (AxB≤500x400)
- X=36 (AxB>500x400)

*30 mm wide flanges are fitted with oval holes in the corners*

Technical parameters

A x B [mm]	Damper blade overlaps		Weight		Effective area Sef [m²]	Spring return actuator	Manual control	A x B [mm]	Damper blade overlaps		Weight		Effective area Sef [m²]	Spring return actuator	Manual control	
	a [mm]	c [mm]	Man. [kg]	Actu. [kg]					a [mm]	c [mm]	Man. [kg]	Actu. [kg]				
100 x	-	-	4,8	4,9	0,0030	BFL	M1	150 x	250	-	60	6,9	7,0	0,0234	BFL	M1
	-	-	4,9	5,0	0,0037				280	-	75	7,2	7,3	0,0271		
	-	-	5,1	5,2	0,0048				100	-	-	5,6	5,7	0,0055		
	-	5	5,2	5,3	0,0059				110	-	-	5,7	5,8	0,0069		
	-	10	5,3	5,4	0,0066				125	-	-	5,9	6,0	0,0088		
	-	15	5,4	5,5	0,0073				140	-	5	6,0	6,1	0,0108		
	-	25	5,6	5,7	0,0088				150	-	10	6,1	6,2	0,0121		
	-	35	5,8	5,9	0,0102				160	-	15	6,5	6,6	0,0113		
	-	47	6,0	6,1	0,0120				180	-	25	6,7	6,8	0,0137		
	-	60	6,2	6,3	0,0138				200	-	35	7,0	7,1	0,0161		
110 x	-	-	4,9	5,0	0,0034	BFL	M1	160 x	225	-	47	7,2	7,3	0,0191	BFL	M1
	-	-	5,0	5,1	0,0043				250	-	60	7,5	7,6	0,0222		
	-	-	5,2	5,3	0,0055				280	-	75	7,8	7,9	0,0258		
	-	5	5,3	5,4	0,0067				300	-	85	8,3	8,4	0,0282		
	-	10	5,4	5,5	0,0075				315	-	92	8,5	8,6	0,0300		
	-	15	5,5	5,6	0,0084				355	-	112	9,4	9,5	0,0349		
	-	25	5,7	5,8	0,0100				400	-	135	9,9	10,0	0,0403		
	-	35	5,9	6,0	0,0116				450	-	150	10,5	10,6	0,0392		
	-	47	6,1	6,2	0,0137				500	-	175	11,0	11,1	0,0446		
	-	60	6,4	6,5	0,0157				550	-	200	11,4	11,5	0,0500		
125 x	-	-	5,1	5,2	0,0041	BFL	M1	560	-	205	11,5	11,6	0,0511	BFL	M1	
	-	-	5,2	5,3	0,0050			600	-	225	11,9	12,0	0,0554			
	-	-	5,3	5,4	0,0065			630	-	240	12,3	12,4	0,0586			
	-	5	5,5	5,6	0,0080			650	-	250	12,5	12,6	0,0608			
	-	10	5,6	5,7	0,0089			700	5	275	13,1	13,2	0,0662			
	-	15	5,7	5,8	0,0099			710	10	280	13,2	13,3	0,0673			
	-	25	5,9	6,0	0,0118			750	30	300	13,6	14,0	0,0716			
	-	35	6,1	6,2	0,0138			800	55	325	14,2	14,6	0,0770			
	-	47	6,3	6,4	0,0162			900	105	375	15,3	15,7	0,0878			
	-	60	6,6	6,7	0,0186			1000	155	425	16,4	16,8	0,0986			
140 x	-	-	5,2	5,3	0,0047	BFL	M1	100	-	-	5,8	5,9	0,0064	BFL	M1	
	-	-	5,3	5,4	0,0058			110	-	-	5,9	6,0	0,0079			
	-	-	5,5	5,6	0,0075			125	-	-	6,1	6,2	0,0102			
	-	5	5,6	5,7	0,0092			140	-	5	6,2	6,3	0,0125			
	-	10	5,7	5,8	0,0103			150	-	10	6,4	6,5	0,0140			
	-	15	5,8	5,9	0,0114			160	-	15	6,7	6,8	0,0131			
	-	25	6,0	6,1	0,0137			180	-	25	7,0	7,1	0,0159			
	-	35	6,2	6,3	0,0159			200	-	35	7,2	7,3	0,0187			
	-	47	6,5	6,6	0,0187			225	-	47	7,5	7,6	0,0222			
	-	60	6,8	6,9	0,0215			250	-	60	7,7	7,8	0,0258			
150 x	-	-	5,3	5,4	0,0051	BFL	M1	280	-	75	8,1	8,2	0,0300	BFL	M1	
	-	-	5,4	5,5	0,0063			300	-	85	8,6	8,7	0,0328			
	-	-	5,6	5,7	0,0082			315	-	92	8,8	8,9	0,0349			
	-	5	5,7	5,8	0,0100			355	-	112	9,7	9,8	0,0406			
	-	10	5,8	5,9	0,0112			400	-	135	10,2	10,3	0,0469			
	-	15	5,9	6,0	0,0124			450	-	150	10,8	10,9	0,0465			
	-	25	6,2	6,3	0,0149			500	-	175	11,4	11,5	0,0529			
	-	35	6,4	6,5	0,0173			550	-	200	11,8	11,9	0,0593			
	-	47	6,6	6,7	0,0204			560	-	205	11,9	12,0	0,0605			
											600	-	225			12,4
								630	-	240	12,7	12,8	0,0695		M2	
								650	-	250	12,9	13,0	0,0721			
								700	5	275	13,5	13,9	0,0785	BFN		

Sizes listed within the maximum/minimum sizes can be manufactured on request.

A x B [mm]	Damper blade overlaps		Weight		Effective area Sef [m <sup>2</sup> ]	Spring return actuator	Manual control	A x B [mm]	Damper blade overlaps		Weight		Effective area Sef [m <sup>2</sup> ]	Spring return actuator	Manual control	
	a [mm]	c [mm]	Man. [kg]	Actu. [kg]					a [mm]	c [mm]	Man. [kg]	Actu. [kg]				
180 x	710	10	280	13,6	14,0	0,0797	BFN	M2	710	10	280	14,7	15,1	0,1078	BFN	M2
	750	30	300	14,1	14,5	0,0849			750	30	300	15,2	15,6	0,1147		
	800	55	325	14,7	15,1	0,0913			800	55	325	15,8	16,2	0,1233		
	900	105	375	15,9	16,3	0,1041			900	105	375	17,1	17,5	0,1406		
	1000	155	425	17,0	17,4	0,1169			1000	155	425	18,4	20,5	0,1579		
200 x	100	-	-	6,0	6,1	0,0072	BFL	M1	100	-	-	6,4	6,5	0,0093	BFL	M1
	110	-	-	6,1	6,2	0,0089			110	-	-	6,6	6,7	0,0115		
	125	-	-	6,3	6,4	0,0115			125	-	-	6,8	6,9	0,0149		
	140	-	5	6,4	6,5	0,0141			140	-	5	7,0	7,1	0,0182		
	150	-	10	6,6	6,7	0,0158			150	-	10	7,1	7,2	0,0204		
	160	-	15	7,0	7,1	0,0149			160	-	15	7,5	7,6	0,0194		
	180	-	25	7,2	7,3	0,0181			180	-	25	7,7	7,8	0,0236		
	200	-	35	7,4	7,5	0,0213			200	-	35	8,0	8,1	0,0278		
	225	-	47	7,7	7,8	0,0253			225	-	47	8,3	8,4	0,0331		
	250	-	60	8,0	8,1	0,0294			250	-	60	8,6	8,7	0,0384		
	280	-	75	8,3	8,4	0,0342	280	-	75	9,0	9,1	0,0447				
	300	-	85	8,9	9,0	0,0374	300	-	85	9,6	9,7	0,0489				
	315	-	92	9,1	9,2	0,0398	315	-	92	9,8	9,9	0,0521				
	355	-	112	10,0	10,1	0,0463	355	-	112	10,7	10,8	0,0605				
	400	-	135	10,5	10,6	0,0535	400	-	135	11,3	11,4	0,0700				
	450	-	150	11,2	11,3	0,0537	450	-	150	12,0	12,1	0,0719				
	500	-	175	11,8	11,9	0,0611	500	-	175	12,7	12,8	0,0818				
	550	-	200	12,1	12,2	0,0685	550	-	200	13,1	13,2	0,0917				
	560	-	205	12,3	12,4	0,0700	560	-	205	13,2	13,3	0,0937				
	600	-	225	12,8	12,9	0,0759	600	-	225	13,8	14,2	0,1016				
630	-	240	13,1	13,2	0,0804	630	-	240	14,2	14,6	0,1075					
650	-	250	13,4	13,5	0,0833	650	-	250	14,4	14,8	0,1115					
700	5	275	14,0	14,4	0,0907	700	5	275	15,1	15,5	0,1214					
710	10	280	14,1	14,5	0,0922	710	10	280	15,2	15,6	0,1234					
750	30	300	14,6	15,0	0,0981	750	30	300	15,8	16,2	0,1313					
800	55	325	15,2	15,6	0,1055	800	55	325	16,5	16,9	0,1412					
900	105	375	16,4	16,8	0,1203	900	105	375	17,8	18,2	0,1610					
1000	155	425	17,6	18,0	0,1351	1000	155	425	19,1	21,2	0,1808					
225 x	100	-	-	6,2	6,3	0,0083	BFL	M1	100	-	-	6,7	6,8	0,0106	BFL	M1
	110	-	-	6,3	6,4	0,0102			110	-	-	6,8	6,9	0,0131		
	125	-	-	6,5	6,6	0,0132			125	-	-	7,1	7,2	0,0169		
	140	-	5	6,7	6,8	0,0162			140	-	5	7,3	7,4	0,0207		
	150	-	10	6,8	6,9	0,0181			150	-	10	7,4	7,5	0,0232		
	160	-	15	7,2	7,3	0,0171			160	-	15	7,8	7,9	0,0221		
	180	-	25	7,5	7,6	0,0209			180	-	25	8,1	8,2	0,0269		
	200	-	35	7,7	7,8	0,0246			200	-	35	8,3	8,4	0,0317		
	225	-	47	8,0	8,1	0,0292			225	-	47	8,7	8,8	0,0377		
	250	-	60	8,3	8,4	0,0339			250	-	60	9,0	9,1	0,0438		
	280	-	75	8,7	8,8	0,0395	280	-	75	9,1	9,2	0,0510				
	300	-	85	9,2	9,3	0,0432	300	-	85	9,4	9,5	0,0558				
	315	-	92	9,4	9,5	0,0460	315	-	92	10,0	10,1	0,0594				
	355	-	112	10,3	10,4	0,0534	355	-	112	10,2	10,3	0,0691				
	400	-	135	10,9	11,0	0,0618	400	-	135	11,2	11,3	0,0799				
	450	-	150	11,6	11,7	0,0628	450	-	150	11,8	11,9	0,0828				
	500	-	175	12,2	12,3	0,0714	500	-	175	12,5	12,6	0,0942				
	550	-	200	12,6	12,7	0,0801	550	-	200	13,2	13,3	0,1056				
	560	-	205	12,8	12,9	0,0818	560	-	205	13,7	14,1	0,1078				
	600	-	225	13,3	13,4	0,0887	600	-	225	13,8	14,2	0,1170				
630	-	240	13,7	14,1	0,0939	630	-	240	14,4	14,8	0,1238					
650	-	250	13,9	14,3	0,0974	650	-	250	14,8	15,2	0,1284					
700	5	275	14,5	14,9	0,1060	700	5	275	15,1	15,5	0,1398					

Sizes listed within the maximum/minimum sizes can be manufactured on request.

A x B [mm]	Damper blade overlaps		Weight		Effective area Sef [m <sup>2</sup> ]	Spring return actuator	Manual control	A x B [mm]	Damper blade overlaps		Weight		Effective area Sef [m <sup>2</sup> ]	Spring return actuator	Manual control
	a [mm]	c [mm]	Man. [kg]	Actu. [kg]					a [mm]	c [mm]	Man. [kg]	Actu. [kg]			
280 x	710	10	280	15,8	16,2	0,1420		710	10	280	16,7	17,1	0,1638		M2
	750	30	300	15,9	16,3	0,1512	BFN	750	30	300	17,3	17,7	0,1744	BFN	M2
	800	55	325	16,5	16,9	0,1626		800	55	325	18,1	18,5	0,1875		M3
	900	105	375	17,2	19,3	0,1854		900	105	375	19,6	21,7	0,2138		M3
	1000	155	425	18,6	20,7	0,2082	BF	1000	155	425	21,0	23,1	0,2401	BF	M3
300 x	100	-	-	6,9	7,0	0,0114		100	-	-	7,7	7,8	0,0137		
	110	-	-	7,0	7,1	0,0141		110	-	-	7,9	8,0	0,0170		
	125	-	-	7,3	7,4	0,0182		125	-	-	8,1	8,2	0,0219		
	140	-	5	7,5	7,6	0,0223		140	-	5	8,4	8,5	0,0268		
	150	-	10	7,6	7,7	0,0250		150	-	10	8,5	8,6	0,0301		
	160	-	15	8,0	8,1	0,0239		160	-	15	8,6	8,7	0,0288		
	180	-	25	8,3	8,4	0,0291		180	-	25	8,9	9,0	0,0352		
	200	-	35	8,6	8,7	0,0343		200	-	35	9,2	9,3	0,0415		
	225	-	47	8,9	9,0	0,0408	BFL	225	-	47	9,6	9,7	0,0494	BFL	M1
	250	-	60	9,3	9,4	0,0474		250	-	60	10,0	10,1	0,0573		M1
	280	-	75	9,7	9,8	0,0552		280	-	75	10,4	10,5	0,0668		
	300	-	85	10,3	10,4	0,0604		300	-	85	11,0	11,1	0,0731		
	315	-	92	10,5	10,6	0,0643		315	-	92	11,3	11,4	0,0778		
	355	-	112	11,5	11,6	0,0748		355	-	112	12,3	12,4	0,0905		
	400	-	135	12,1	12,2	0,0865		400	-	135	13,0	13,1	0,1047		
	450	-	150	12,9	13,0	0,0900		450	-	150	13,8	13,9	0,1100		
	500	-	175	13,6	13,7	0,1024		500	-	175	14,6	15,0	0,1251		
	550	-	200	14,1	14,5	0,1148		550	-	200	15,1	15,5	0,1403		
	560	-	205	14,2	14,6	0,1173		560	-	205	15,3	15,7	0,1433		
	600	-	225	14,8	15,2	0,1272		600	-	225	15,9	16,3	0,1554		
630	-	240	15,2	15,6	0,1347		630	-	240	16,4	16,8	0,1645	BFN	M2	
650	-	250	15,5	15,9	0,1396	BFN	650	-	250	16,7	17,1	0,1706		M2	
700	5	275	16,2	16,6	0,1520		700	5	275	17,5	17,9	0,1857			
710	10	280	16,4	16,8	0,1545		710	10	280	17,7	18,1	0,1888			
750	30	300	17,0	17,4	0,1644		750	30	300	18,3	18,7	0,2009			
800	55	325	17,7	18,1	0,1768		800	55	325	19,1	21,2	0,2160		M3	
900	105	375	19,2	21,3	0,2016		900	105	375	20,6	22,7	0,2463	BF	M3	
1000	155	425	20,6	22,7	0,2264	BF	1000	155	425	22,2	24,3	0,2766			
315 x	100	-	-	7,0	7,1	0,0121		100	-	-	8,2	8,3	0,0156		
	110	-	-	7,2	7,3	0,0149		110	-	-	8,4	8,5	0,0193		
	125	-	-	7,4	7,5	0,0192		125	-	-	8,6	8,7	0,0249		
	140	-	5	7,6	7,7	0,0235		140	-	5	8,9	9,0	0,0305		
	150	-	10	7,8	7,9	0,0264		150	-	10	9,0	9,1	0,0342		
	160	-	15	8,2	8,3	0,0252		160	-	15	9,1	9,2	0,0329		
	180	-	25	8,5	8,6	0,0308		180	-	25	9,4	9,5	0,0401		
	200	-	35	8,7	8,8	0,0363		200	-	35	9,7	9,8	0,0473		
	225	-	47	9,1	9,2	0,0432	BFL	225	-	47	10,1	10,2	0,0563	BFL	M1
	250	-	60	9,5	9,6	0,0501		250	-	60	10,5	10,6	0,0654		
	280	-	75	9,9	10,0	0,0584		280	-	75	11,0	11,1	0,0762		
	300	-	85	10,5	10,6	0,0639		300	-	85	11,7	11,8	0,0834		
	315	-	92	10,7	10,8	0,0680		315	-	92	11,9	12,0	0,0888		
	355	-	112	11,7	11,8	0,0791		355	-	112	13,0	13,1	0,1033		
	400	-	135	12,3	12,4	0,0915		400	-	135	13,7	13,8	0,1195		
	450	-	150	13,2	13,3	0,0955		450	-	150	14,6	14,7	0,1263		
	500	-	175	13,9	14,0	0,1086		500	-	175	15,4	15,8	0,1437		
	550	-	200	14,4	14,8	0,1218		550	-	200	16,0	16,4	0,1611		
	560	-	205	14,5	14,9	0,1244		560	-	205	16,2	16,6	0,1646		
	600	-	225	15,1	15,5	0,1349	BFN	600	-	225	16,9	17,3	0,1785	BFN	M2
630	-	240	15,6	16,0	0,1428		630	-	240	17,4	17,8	0,1890			
650	-	250	15,9	16,3	0,1481		650	-	250	17,7	18,1	0,1959			
700	5	275	16,6	17,0	0,1612		700	5	275	18,5	18,9	0,2133			

Sizes listed within the maximum/minimum sizes can be manufactured on request.



A x B [mm]	Damper blade overlaps		Weight		Effective area Sef [m <sup>2</sup> ]	Spring return actuator	Manual control	A x B [mm]	Damper blade overlaps		Weight		Effective area Sef [m <sup>2</sup> ]	Spring return actuator	Manual control		
	a [mm]	c [mm]	Man. [kg]	Actu. [kg]					a [mm]	c [mm]	Man. [kg]	Actu. [kg]					
400 x	710	10	280	18,7	19,1	0,2168	BFN	M2	500 x	1000	155	425	26,5	28,6	0,4090	BF	M3
	750	30	300	19,4	21,5	0,2307	BF	M3		125	-	-	10,3	10,4	0,0350	BFL	M1
	800	55	325	20,2	22,3	0,2481				140	-	5	10,5	10,6	0,0428		
	900	105	375	21,9	24,0	0,2829				150	-	10	10,7	10,8	0,0480		
	1000	155	425	23,5	25,6	0,3177				160	-	15	10,8	10,9	0,0364		
450 x	125	-	-	9,2	9,3	0,0283	BFL	M1	180	-	25	11,1	11,2	0,0463			
	140	-	5	9,4	9,5	0,0346			200	-	35	11,5	11,6	0,0563			
	150	-	10	9,6	9,7	0,0388			225	-	47	12,0	12,1	0,0687			
	160	-	15	9,6	9,7	0,0374			250	-	60	12,5	12,6	0,0812			
	180	-	25	10,0	10,1	0,0456			280	-	75	13,1	13,2	0,0961			
	200	-	35	10,3	10,4	0,0538			300	-	85	13,8	13,9	0,1061			
	225	-	47	10,7	10,8	0,0641			315	-	92	14,1	14,2	0,1135			
	250	-	60	11,2	11,3	0,0744			355	-	112	15,3	15,4	0,1335			
	280	-	75	11,7	11,8	0,0867			550 x	400	-	135	16,2	16,6	0,1559		
	300	-	85	12,3	12,4	0,0949				450	-	150	17,2	17,6	0,1808		
	315	-	92	12,6	12,7	0,1011				500	-	175	18,2	18,6	0,2057		
	355	-	112	13,7	13,8	0,1175				550	-	200	18,9	19,3	0,2306		
	400	-	135	14,5	14,6	0,1360				560	-	205	19,1	19,5	0,2356		
	500 x	450	-	150	15,5	15,9			0,1445	BFN	M2	600	-	225	19,9	20,3	0,2555
		500	-	175	16,4	16,8			0,1644			630	-	240	20,5	22,6	0,2704
550		-	200	17,0	17,4	0,1843	650	-	250			20,9	23,0	0,2804			
560		-	205	17,2	17,6	0,1883	700	5	275			21,9	24,0	0,3053			
600		-	225	17,9	18,3	0,2042	710	10	280			22,1	24,2	0,3103			
630		-	240	18,4	18,8	0,2161	750	30	300			23,0	25,1	0,3302			
650		-	250	18,8	19,2	0,2241	800	55	325			24,0	26,1	0,3551			
700		5	275	19,7	21,8	0,2440	900	105	375			26,0	28,1	0,4049			
710		10	280	19,8	21,9	0,2480	560 x	125	-			-	10,4	10,5	0,0356		
750		30	300	20,6	22,7	0,2639		140	-			5	10,7	10,8	0,0436		
800	55	325	21,5	23,6	0,2838	150		-	10	10,8	10,9	0,0489					
900	105	375	23,2	25,3	0,3236	160		-	15	10,9	11,0	0,0371					
1000	155	425	25,0	27,1	0,3634	180		-	25	11,2	11,3	0,0472					
125	-	-	9,7	9,8	0,0316	200		-	35	11,6	11,7	0,0574					
140	-	5	10,0	10,1	0,0387	225		-	47	12,1	12,2	0,0701					
150	-	10	10,2	10,3	0,0434	250		-	60	12,6	12,7	0,0828					
160	-	15	10,1	10,2	0,0419	280		-	75	13,2	13,3	0,0980					
180	-	25	10,5	10,6	0,0511	300		-	85	13,9	14,0	0,1082					
200	-	35	10,9	11,0	0,0603	315	-	92	14,2	14,3	0,1158						
225	-	47	11,3	11,4	0,0718	355	-	112	15,4	15,5	0,1361						
250	-	60	11,8	11,9	0,0834	400	-	135	16,3	16,7	0,1590						
280	-	75	12,3	12,4	0,0972	450	-	150	17,4	17,8	0,1844						
300	-	85	13,0	13,1	0,1064	500	-	175	18,4	18,8	0,2098						
315	-	92	13,3	13,4	0,1133	550	-	200	19,1	19,5	0,2352						
355	-	112	14,5	14,6	0,1318	560	-	205	19,3	19,7	0,2403						
500 x	400	-	135	15,3	15,4	0,1525	BFN	M2	600	-	225	20,1	20,5	0,2606			
	450	-	150	16,3	16,7	0,1626			630	-	240	20,8	22,9	0,2758			
	500	-	175	17,3	17,7	0,1850			650	-	250	21,2	23,3	0,2860			
	550	-	200	18,0	18,4	0,2074			700	5	275	22,2	24,3	0,3114			
	560	-	205	18,1	18,5	0,2119			710	10	280	22,4	24,5	0,3165			
	600	-	225	18,9	19,3	0,2298			750	30	300	23,2	25,3	0,3368			
	630	-	240	19,5	19,9	0,2433			800	55	325	24,2	26,3	0,3622			
	650	-	250	19,9	22,0	0,2522			600 x	140	-	5	11,1	11,2	0,0469		
	700	5	275	20,8	22,9	0,2746				150	-	10	11,3	11,4	0,0526		
	710	10	280	21,0	23,1	0,2791				160	-	15	11,3	11,4	0,0400		
750	30	300	21,8	23,9	0,2970	180	-	25		11,7	11,8	0,0510					
800	55	325	22,7	24,8	0,3194	200	-	35		12,1	12,2	0,0619					
900	105	375	24,6	26,7	0,3642	225	-	47	12,6	12,7	0,0756						

Sizes listed within the maximum/minimum sizes can be manufactured on request.

A x B [mm]	Damper blade overlaps		Weight		Effective area Sef [m <sup>2</sup> ]	Spring return actuator	Manual control	A x B [mm]	Damper blade overlaps		Weight		Effective area Sef [m <sup>2</sup> ]	Spring return actuator	Manual control																																																																																																																																																																																																																																																																																																																																																																																															
	a [mm]	c [mm]	Man. [kg]	Actu. [kg]					a [mm]	c [mm]	Man. [kg]	Actu. [kg]																																																																																																																																																																																																																																																																																																																																																																																																		
600 x	250	-	60	13,1	13,2	0,0893	BFL	M1	630	-	240	22,7	24,8	0,3247	BF	M2																																																																																																																																																																																																																																																																																																																																																																																														
	280	-	75	13,7	13,8	0,1058			300	-	85	14,5	14,6	0,1167			315	-	92	14,8	14,9	0,1249	355	-	112	16,1	16,2	0,1469	400	-	135	17,0	17,4	0,1715	450	-	150	18,0	18,4	0,1989	BFL	M2	500	-	175	19,1	19,5	0,2263	550	-	200	19,9	20,3	0,2537	560	-	205	20,1	20,5	0,2592	600	-	225	21,0	23,1	0,2811	630	-	240	21,6	23,7	0,2976	650	-	250	22,0	24,1	0,3085	BF	M3	700	5	275	23,1	25,2	0,3359	710	10	280	23,3	25,4	0,3414	750	30	300	24,2	26,3	0,3633	800	55	325	25,2	27,3	0,3907	140	-	5	11,5	11,6	0,0494	BFL	M1	150	-	10	11,7	11,8	0,0554	160	-	15	11,6	11,7	0,0422	180	-	25	12,1	12,2	0,0538	200	-	35	12,5	12,6	0,0653	225	-	47	13,0	13,1	0,0798	250	-	60	13,5	13,6	0,0942	280	-	75	14,2	14,3	0,1116	300	-	85	14,9	15,0	0,1231	315	-	92	15,2	15,3	0,1318	355	-	112	16,5	16,6	0,1549	BFL	M1	400	-	135	17,5	17,9	0,1809	450	-	150	18,6	19,0	0,2098	500	-	175	19,7	20,1	0,2387	550	-	200	20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139	650	-	250	22,7	24,8	0,3254	700	5	275	23,8	25,9	0,3543	710	10	280	24,0	26,1	0,3601	750	30	300	24,9	27,0	0,3832	140	-	5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572	160	-	15	11,8	11,9	0,0437	180	-	25	12,3	12,4	0,0556	200	-	35	12,7	12,8	0,0676	225	-	47	13,3	13,4	0,0825	250	-	60	13,8	13,9	0,0975	280	-	75	14,4	14,5	0,1154	BFL	M1	300	-	85	15,2	15,3	0,1274	315	-	92	15,5	15,6	0,1363	355	-	112	16,8	16,9	0,1603	400	-	135	17,8	18,2	0,1872	450	-	150	18,9	19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-	200	20,9	21,3	0,2769	560	-	205	21,1	23,2	0,2829	600	-	225	22,0	24,1	0,3068	630	-	240	22,7	24,8	0,3254	650	-	250	22,7	24,8	0,3254																																				
	300	-	85	14,5	14,6	0,1167			315	-	92	14,8	14,9	0,1249			355	-	112	16,1	16,2	0,1469	400	-	135	17,0	17,4	0,1715	450	-	150	18,0	18,4	0,1989	BFL	M2	500	-	175	19,1			19,5	0,2263	550	-	200	19,9	20,3	0,2537	560	-	205	20,1	20,5	0,2592	600	-	225	21,0	23,1	0,2811	630	-	240	21,6	23,7	0,2976	650	-	250	22,0	24,1	0,3085	BF	M3	700	5			275	23,1	25,2	0,3359	710	10	280	23,3	25,4	0,3414	750	30	300	24,2	26,3	0,3633	800	55	325	25,2	27,3	0,3907	140	-	5	11,5	11,6	0,0494	BFL	M1			150	-	10	11,7	11,8	0,0554	160	-	15	11,6	11,7	0,0422	180	-	25	12,1	12,2	0,0538	200	-	35	12,5	12,6	0,0653	225	-	47	13,0	13,1	0,0798	250	-	60	13,5	13,6	0,0942	280	-	75	14,2	14,3	0,1116	300	-	85	14,9	15,0	0,1231	315	-	92	15,2	15,3	0,1318	355	-	112	16,5	16,6	0,1549			BFL	M1	400	-	135	17,5	17,9	0,1809	450	-	150	18,6	19,0	0,2098	500	-	175	19,7	20,1	0,2387	550	-	200	20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6			23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139	650	-	250	22,7	24,8	0,3254	700	5	275	23,8	25,9	0,3543	710	10	280	24,0	26,1	0,3601	750	30	300	24,9	27,0	0,3832	140	-			5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572	160	-	15	11,8	11,9	0,0437	180	-	25	12,3	12,4	0,0556	200	-	35	12,7	12,8	0,0676	225	-	47	13,3	13,4	0,0825	250	-	60	13,8	13,9	0,0975			280	-	75	14,4	14,5	0,1154	BFL	M1	300	-	85	15,2	15,3	0,1274	315	-	92	15,5	15,6	0,1363	355	-	112	16,8	16,9	0,1603	400	-	135	17,8	18,2	0,1872	450	-	150	18,9			19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-	200	20,9	21,3	0,2769	560	-	205	21,1	23,2	0,2829	600	-	225	22,0	24,1	0,3068	630	-	240	22,7	24,8	0,3254	650	-	250	22,7	24,8	0,3254																										
	315	-	92	14,8	14,9	0,1249			355	-	112	16,1	16,2	0,1469			400	-	135	17,0	17,4	0,1715	450	-	150	18,0	18,4	0,1989	BFL	M2	500	-	175	19,1			19,5	0,2263	550	-			200	19,9	20,3	0,2537	560	-	205	20,1	20,5	0,2592	600	-	225	21,0	23,1	0,2811	630	-	240	21,6	23,7	0,2976	650	-	250	22,0	24,1	0,3085	BF	M3	700	5			275	23,1			25,2	0,3359	710	10	280	23,3	25,4	0,3414	750	30	300	24,2	26,3	0,3633	800	55	325	25,2	27,3	0,3907	140	-	5	11,5	11,6	0,0494	BFL	M1					150	-	10	11,7	11,8	0,0554	160	-	15	11,6	11,7	0,0422	180	-	25	12,1	12,2	0,0538	200	-	35	12,5	12,6	0,0653	225	-	47	13,0	13,1	0,0798	250	-	60	13,5	13,6	0,0942	280	-	75	14,2	14,3	0,1116	300	-	85	14,9	15,0	0,1231	315	-	92	15,2	15,3	0,1318	355	-	112	16,5	16,6	0,1549					BFL	M1	400	-	135	17,5	17,9	0,1809	450	-	150	18,6	19,0	0,2098	500	-	175	19,7	20,1	0,2387	550	-	200	20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734	600	-			225	21,6			23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139	650	-	250	22,7	24,8	0,3254	700	5	275	23,8	25,9	0,3543	710	10	280	24,0	26,1	0,3601	750	30	300	24,9			27,0	0,3832	140	-			5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572	160	-	15	11,8	11,9	0,0437	180	-	25	12,3	12,4	0,0556	200	-	35	12,7	12,8	0,0676	225	-	47	13,3	13,4	0,0825			250	-	60	13,8	13,9	0,0975			280	-	75	14,4	14,5	0,1154	BFL	M1	300	-	85	15,2	15,3	0,1274	315	-	92	15,5	15,6	0,1363	355	-	112	16,8	16,9	0,1603	400	-			135	17,8	18,2	0,1872	450	-	150	18,9			19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-	200	20,9	21,3	0,2769	560	-	205	21,1	23,2	0,2829	600	-	225	22,0	24,1	0,3068	630	-	240	22,7	24,8	0,3254	650	-	250	22,7	24,8	0,3254																
	355	-	112	16,1	16,2	0,1469			400	-	135	17,0	17,4	0,1715			450	-	150	18,0	18,4	0,1989	BFL	M2	500	-	175	19,1			19,5	0,2263	550	-			200	19,9	20,3	0,2537			560	-	205	20,1	20,5	0,2592	600	-	225	21,0	23,1	0,2811	630	-	240	21,6	23,7	0,2976	650	-	250	22,0	24,1	0,3085	BF	M3	700	5			275	23,1			25,2	0,3359			710	10	280	23,3	25,4	0,3414	750	30	300	24,2	26,3	0,3633	800	55	325	25,2	27,3	0,3907	140	-	5	11,5	11,6	0,0494	BFL	M1							150	-	10	11,7	11,8	0,0554	160	-	15	11,6	11,7	0,0422	180	-	25	12,1	12,2	0,0538	200	-	35	12,5	12,6	0,0653	225	-	47	13,0	13,1	0,0798	250	-	60	13,5	13,6	0,0942	280	-	75	14,2	14,3	0,1116	300	-	85	14,9	15,0	0,1231	315	-	92	15,2	15,3	0,1318	355	-	112	16,5	16,6	0,1549							BFL	M1	400	-	135	17,5	17,9	0,1809	450	-	150	18,6	19,0	0,2098	500	-	175	19,7	20,1	0,2387	550	-	200	20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734			600	-			225	21,6			23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139	650	-	250	22,7	24,8	0,3254	700	5	275	23,8	25,9	0,3543	710	10	280	24,0	26,1	0,3601			750	30	300	24,9			27,0	0,3832	140	-			5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572	160	-	15	11,8	11,9	0,0437	180	-	25	12,3	12,4	0,0556	200	-	35	12,7	12,8	0,0676			225	-	47	13,3	13,4	0,0825			250	-	60	13,8	13,9	0,0975			280	-	75	14,4	14,5	0,1154	BFL	M1	300	-	85	15,2	15,3	0,1274	315	-	92	15,5	15,6	0,1363			355	-	112	16,8	16,9	0,1603	400	-			135	17,8	18,2	0,1872	450	-	150	18,9			19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-	200	20,9	21,3	0,2769	560	-	205	21,1	23,2	0,2829	600	-	225	22,0	24,1	0,3068	630	-	240	22,7	24,8	0,3254	650	-	250	22,7	24,8	0,3254						
	400	-	135	17,0	17,4	0,1715			450	-	150	18,0	18,4	0,1989			BFL	M2	500	-	175	19,1			19,5	0,2263	550	-			200	19,9	20,3	0,2537			560	-	205	20,1			20,5	0,2592	600	-	225	21,0	23,1	0,2811	630	-	240	21,6	23,7	0,2976	650	-	250	22,0	24,1	0,3085	BF	M3	700	5			275	23,1			25,2	0,3359			710	10			280	23,3	25,4	0,3414	750	30	300	24,2	26,3	0,3633	800	55	325	25,2	27,3	0,3907	140	-	5	11,5	11,6	0,0494	BFL	M1									150	-	10	11,7	11,8	0,0554	160	-	15	11,6	11,7	0,0422	180	-	25	12,1	12,2	0,0538	200	-	35	12,5	12,6	0,0653	225	-	47	13,0	13,1	0,0798	250	-	60	13,5	13,6	0,0942	280	-	75	14,2	14,3	0,1116	300	-	85	14,9	15,0	0,1231	315	-	92	15,2	15,3	0,1318	355	-	112	16,5	16,6	0,1549									BFL	M1	400	-	135	17,5	17,9	0,1809	450	-	150	18,6	19,0	0,2098	500	-	175	19,7	20,1	0,2387	550	-	200	20,5	20,9	0,2676	560	-	205	20,7			21,1	0,2734			600	-			225	21,6			23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139	650	-	250	22,7	24,8	0,3254	700	5	275	23,8	25,9	0,3543	710	10			280	24,0	26,1	0,3601			750	30	300	24,9			27,0	0,3832	140	-			5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572	160	-	15	11,8	11,9	0,0437	180	-	25	12,3	12,4	0,0556			200	-	35	12,7	12,8	0,0676			225	-	47	13,3	13,4	0,0825			250	-	60	13,8	13,9	0,0975			280	-	75	14,4	14,5	0,1154	BFL	M1	300	-	85	15,2			15,3	0,1274	315	-	92	15,5	15,6	0,1363			355	-	112	16,8	16,9	0,1603	400	-			135	17,8	18,2	0,1872	450	-	150	18,9			19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-	200	20,9	21,3	0,2769	560	-	205	21,1	23,2	0,2829	600	-	225	22,0	24,1	0,3068	630	-	240	22,7	24,8	0,3254	650	-
	450	-	150	18,0	18,4	0,1989	BFL	M2	500	-	175	19,1	19,5	0,2263	550	-			200	19,9	20,3	0,2537			560	-	205	20,1			20,5	0,2592	600	-			225	21,0	23,1	0,2811			630	-	240	21,6	23,7	0,2976	650	-	250	22,0	24,1	0,3085	BF	M3	700	5	275	23,1	25,2	0,3359			710	10			280	23,3			25,4	0,3414			750	30			300	24,2	26,3	0,3633	800	55	325	25,2	27,3	0,3907	140	-	5	11,5	11,6	0,0494	BFL	M1	150	-	10	11,7											11,8	0,0554	160	-	15	11,6	11,7	0,0422	180	-	25	12,1	12,2	0,0538	200	-	35	12,5	12,6	0,0653	225	-	47	13,0	13,1	0,0798	250	-	60	13,5	13,6	0,0942	280	-	75	14,2	14,3	0,1116	300	-	85	14,9	15,0	0,1231	315	-	92	15,2	15,3	0,1318	355	-	112	16,5	16,6	0,1549	BFL	M1	400	-											135	17,5	17,9	0,1809	450	-	150	18,6	19,0	0,2098	500	-	175	19,7	20,1	0,2387	550	-	200	20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734			600	-			225	21,6			23,7	0,2965			BFL	M2			630	-	240	22,3	24,4	0,3139	650	-	250	22,7	24,8	0,3254	700	5	275	23,8	25,9	0,3543	710	10			280	24,0	26,1	0,3601			750	30	300	24,9			27,0	0,3832	140	-			5	11,7	11,8	0,0510			BFL	M1	150	-	10	11,9	12,0	0,0572	160	-	15	11,8	11,9	0,0437	180	-	25	12,3			12,4	0,0556	200	-	35	12,7			12,8	0,0676	225	-	47	13,3			13,4	0,0825	250	-	60	13,8			13,9	0,0975	280	-	75	14,4			14,5	0,1154	BFL	M1			300	-	85	15,2	15,3	0,1274	315	-			92	15,5	15,6	0,1363	355	-	112	16,8			16,9	0,1603	400	-	135	17,8	18,2	0,1872			450	-	150	18,9	19,3	0,2171	500	-			175	20,0	20,4	0,2470	BFL	M2	550	-	200	20,9	21,3	0,2769	560	-	205	21,1	23,2	0,2829	600	-	225	22,0	24,1	0,3068	630	-
	500	-	175	19,1	19,5	0,2263			550	-	200	19,9	20,3	0,2537	560	-			205	20,1	20,5	0,2592			600	-	225	21,0			23,1	0,2811	630	-			240	21,6	23,7	0,2976	650	-	250	22,0	24,1	0,3085	BF	M3	700	5	275	23,1	25,2	0,3359			710	10	280	23,3	25,4	0,3414			750	30			300	24,2			26,3	0,3633			800	55	325	25,2	27,3	0,3907	140	-	5	11,5	11,6	0,0494	BFL	M1	150	-	10	11,7	11,8	0,0554			160	-	15	11,6											11,7	0,0422	180	-	25	12,1	12,2	0,0538	200	-	35	12,5	12,6	0,0653	225	-	47	13,0	13,1	0,0798	250	-	60	13,5	13,6	0,0942	280	-	75	14,2	14,3	0,1116	300	-	85	14,9	15,0	0,1231	315	-	92	15,2	15,3	0,1318	355	-	112	16,5	16,6	0,1549	BFL	M1	400	-	135	17,5			17,9	0,1809	450	-									150	18,6	19,0	0,2098	500	-	175	19,7	20,1	0,2387	550	-	200	20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-			240	22,3			24,4	0,3139							650	-	250	22,7	24,8	0,3254	700	5	275	23,8	25,9	0,3543	710	10	280	24,0	26,1	0,3601	750	30			300	24,9	27,0	0,3832			140	-	5	11,7			11,8	0,0510	BFL	M1			150	-	10	11,9					12,0	0,0572	160	-	15	11,8	11,9	0,0437	180	-	25	12,3	12,4	0,0556	200	-	35	12,7	12,8	0,0676	225	-	47	13,3			13,4	0,0825	250	-	60	13,8			13,9	0,0975	280	-	75	14,4			14,5	0,1154	BFL	M1	300	-			85	15,2			15,3	0,1274	315	-	92	15,5	15,6	0,1363	355	-			112	16,8	16,9	0,1603	400	-	135	17,8			18,2	0,1872	450	-	150	18,9	19,3	0,2171			500	-	175	20,0	20,4	0,2470	BFL	M2			550	-	200	20,9			21,3	0,2769	560	-	205	21,1	23,2	0,2829	600	-	225	22,0	24,1	0,3068	630	-	240	22,7	24,8	0,3254
	550	-	200	19,9	20,3	0,2537			560	-	205	20,1	20,5	0,2592	600	-			225	21,0	23,1	0,2811			630	-	240	21,6			23,7	0,2976	650	-	250	22,0	24,1	0,3085	BF	M3	700	5	275	23,1	25,2	0,3359			710	10	280	23,3	25,4	0,3414			750	30	300	24,2	26,3	0,3633			800	55			325	25,2			27,3	0,3907	140	-	5	11,5	11,6	0,0494	BFL	M1	150	-	10	11,7	11,8	0,0554			160	-	15	11,6	11,7	0,0422			180	-	25	12,1											12,2	0,0538	200	-	35	12,5	12,6	0,0653	225	-	47	13,0	13,1	0,0798	250	-	60	13,5	13,6	0,0942	280	-	75	14,2	14,3	0,1116	300	-	85	14,9	15,0	0,1231	315	-	92	15,2	15,3	0,1318	355	-	112	16,5	16,6	0,1549	BFL	M1	400	-	135	17,5			17,9	0,1809	450	-			150	18,6	19,0	0,2098	500	-							175	19,7	20,1	0,2387	550	-	200	20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3			24,4	0,3139	650	-	250	22,7			24,8	0,3254							700	5	275	23,8	25,9	0,3543	710	10	280	24,0	26,1	0,3601	750	30	300	24,9	27,0	0,3832	140	-			5	11,7	11,8	0,0510			BFL	M1	150	-			10	11,9					12,0	0,0572	160	-					15	11,8	11,9	0,0437	180	-	25	12,3	12,4	0,0556	200	-	35	12,7	12,8	0,0676	225	-	47	13,3	13,4	0,0825	250	-	60	13,8	13,9	0,0975	280	-	75	14,4			14,5	0,1154	BFL	M1	300	-			85	15,2			15,3	0,1274			315	-			92	15,5	15,6	0,1363	355	-	112	16,8	16,9	0,1603	400	-	135	17,8	18,2	0,1872	450	-	150	18,9			19,3	0,2171	500	-	175	20,0	20,4	0,2470			BFL	M2	550	-	200	20,9					21,3	0,2769	560	-			205	21,1	23,2	0,2829	600	-	225	22,0	24,1	0,3068	630	-	240	22,7	24,8	0,3254	650	-	250	22,7
	560	-	205	20,1	20,5	0,2592			600	-	225	21,0	23,1	0,2811	630	-			240	21,6	23,7	0,2976			650	-	250	22,0	24,1	0,3085	BF	M3	700	5	275	23,1	25,2	0,3359			710	10	280	23,3	25,4	0,3414			750	30	300	24,2	26,3	0,3633			800	55	325	25,2	27,3	0,3907			140	-			5	11,5	11,6	0,0494	BFL	M1	150	-	10	11,7	11,8	0,0554			160	-	15	11,6	11,7	0,0422			180	-	25	12,1	12,2	0,0538			200	-	35	12,5											12,6	0,0653	225	-	47	13,0	13,1	0,0798	250	-	60	13,5	13,6	0,0942	280	-	75	14,2	14,3	0,1116	300	-	85	14,9	15,0	0,1231	315	-	92	15,2	15,3	0,1318	355	-	112	16,5	16,6	0,1549	BFL	M1	400	-	135	17,5			17,9	0,1809	450	-			150	18,6	19,0	0,2098			500	-	175	19,7	20,1	0,2387	550	-					200	20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3			24,4	0,3139	650	-			250	22,7	24,8	0,3254	700	5	275	23,8	25,9	0,3543							710	10	280	24,0	26,1	0,3601	750	30	300	24,9	27,0	0,3832	140	-	5	11,7	11,8	0,0510	BFL	M1			150	-	10	11,9					12,0	0,0572			160	-					15	11,8	11,9	0,0437					180	-	25	12,3	12,4	0,0556	200	-	35	12,7	12,8	0,0676	225	-	47	13,3	13,4	0,0825	250	-	60	13,8	13,9	0,0975	280	-	75	14,4	14,5	0,1154	BFL	M1	300	-	85	15,2			15,3	0,1274			315	-			92	15,5			15,6	0,1363			355	-	112	16,8	16,9	0,1603	400	-	135	17,8	18,2	0,1872	450	-	150	18,9	19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-	200	20,9					21,3	0,2769	560	-					205	21,1	23,2	0,2829			600	-	225	22,0	24,1	0,3068	630	-	240	22,7	24,8	0,3254	650	-	250	22,7	24,8	0,3254		
	600	-	225	21,0	23,1	0,2811			630	-	240	21,6	23,7	0,2976	650	-			250	22,0	24,1	0,3085	BF	M3	700	5	275	23,1	25,2	0,3359			710	10	280	23,3	25,4	0,3414			750	30	300	24,2	26,3	0,3633			800	55	325	25,2	27,3	0,3907			140	-	5	11,5	11,6	0,0494			BFL	M1	150	-	10	11,7	11,8	0,0554			160	-	15	11,6	11,7	0,0422			180	-	25	12,1	12,2	0,0538			200	-	35	12,5	12,6	0,0653			225	-	47	13,0											13,1	0,0798	250	-	60	13,5	13,6	0,0942	280	-	75	14,2	14,3	0,1116	300	-	85	14,9	15,0	0,1231	315	-	92	15,2	15,3	0,1318	355	-	112	16,5	16,6	0,1549	BFL	M1	400	-	135	17,5			17,9	0,1809	450	-			150	18,6	19,0	0,2098			500	-	175	19,7			20,1	0,2387	550	-	200	20,5	20,9	0,2676	560	-			205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3			24,4	0,3139	650	-			250	22,7	24,8	0,3254			700	5	275	23,8	25,9	0,3543	710	10	280	24,0	26,1	0,3601					750	30	300	24,9	27,0	0,3832	140	-	5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9					12,0	0,0572	160	-					15	11,8			11,9	0,0437					180	-	25	12,3					12,4	0,0556	200	-	35	12,7	12,8	0,0676	225	-	47	13,3	13,4	0,0825	250	-	60	13,8	13,9	0,0975	280	-	75	14,4	14,5	0,1154	BFL	M1	300	-			85	15,2	15,3	0,1274			315	-	92	15,5	15,6	0,1363			355	-			112	16,8			16,9	0,1603	400	-	135	17,8	18,2	0,1872	450	-	150	18,9	19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-			200	20,9	21,3	0,2769	560	-			205	21,1	23,2	0,2829					600	-	225	22,0			24,1	0,3068	630	-	240	22,7	24,8	0,3254	650	-	250	22,7	24,8	0,3254						
	630	-	240	21,6	23,7	0,2976			650	-	250	22,0	24,1	0,3085	BF	M3	700	5	275	23,1	25,2	0,3359			710	10	280	23,3	25,4	0,3414			750	30	300	24,2	26,3	0,3633			800	55	325	25,2	27,3	0,3907			140	-	5	11,5	11,6	0,0494			BFL	M1	150	-	10	11,7	11,8	0,0554			160	-	15	11,6	11,7	0,0422			180	-	25	12,1	12,2	0,0538			200	-	35	12,5	12,6	0,0653			225	-	47	13,0	13,1	0,0798			250	-	60	13,5											13,6	0,0942	280	-	75	14,2	14,3	0,1116	300	-	85	14,9	15,0	0,1231	315	-	92	15,2	15,3	0,1318	355	-	112	16,5	16,6	0,1549	BFL	M1	400	-	135	17,5			17,9	0,1809	450	-			150	18,6	19,0	0,2098			500	-	175	19,7			20,1	0,2387	550	-			200	20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3			24,4	0,3139	650	-			250	22,7	24,8	0,3254			700	5	275	23,8			25,9	0,3543	710	10	280	24,0	26,1	0,3601	750	30	300	24,9			27,0	0,3832	140	-	5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9			12,0	0,0572	160	-					15	11,8	11,9	0,0437					180	-			25	12,3					12,4	0,0556	200	-					35	12,7	12,8	0,0676	225	-	47	13,3	13,4	0,0825	250	-	60	13,8	13,9	0,0975	280	-	75	14,4	14,5	0,1154	BFL	M1	300	-			85	15,2			15,3	0,1274	315	-			92	15,5	15,6	0,1363	355	-			112	16,8	16,9	0,1603	400	-			135	17,8	18,2	0,1872	450	-	150	18,9	19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-			200	20,9			21,3	0,2769	560	-	205	21,1			23,2	0,2829	600	-			225	22,0	24,1	0,3068	630	-			240	22,7	24,8	0,3254	650	-	250	22,7	24,8	0,3254										
	650	-	250	22,0	24,1	0,3085	BF	M3	700	5	275	23,1	25,2	0,3359			710	10	280	23,3	25,4	0,3414			750	30	300	24,2	26,3	0,3633			800	55	325	25,2	27,3	0,3907			140	-	5	11,5	11,6	0,0494			BFL	M1	150	-	10	11,7	11,8	0,0554			160	-	15	11,6	11,7	0,0422			180	-	25	12,1	12,2	0,0538			200	-	35	12,5	12,6	0,0653			225	-	47	13,0	13,1	0,0798			250	-	60	13,5	13,6	0,0942			280	-	75	14,2											14,3	0,1116	300	-	85	14,9	15,0	0,1231	315	-	92	15,2	15,3	0,1318	355	-	112	16,5	16,6	0,1549	BFL	M1	400	-	135	17,5			17,9	0,1809	450	-			150	18,6	19,0	0,2098			500	-	175	19,7			20,1	0,2387	550	-			200	20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3			24,4	0,3139	650	-			250	22,7	24,8	0,3254			700	5	275	23,8			25,9	0,3543	710	10			280	24,0	26,1	0,3601	750	30	300	24,9	27,0	0,3832	140	-	5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9			12,0	0,0572	160	-			15	11,8	11,9	0,0437					180	-	25	12,3					12,4	0,0556			200	-					35	12,7	12,8	0,0676					225	-	47	13,3	13,4	0,0825	250	-	60	13,8	13,9	0,0975	280	-	75	14,4	14,5	0,1154	BFL	M1	300	-			85	15,2			15,3	0,1274			315	-	92	15,5			15,6	0,1363	355	-	112	16,8			16,9	0,1603	400	-	135	17,8	18,2	0,1872	450	-	150	18,9	19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-			200	20,9			21,3	0,2769			560	-	205	21,1	23,2	0,2829			600	-	225	22,0			24,1	0,3068	630	-	240	22,7	24,8	0,3254	650	-	250	22,7	24,8	0,3254														
	700	5	275	23,1	25,2	0,3359			710	10	280	23,3	25,4	0,3414			750	30	300	24,2	26,3	0,3633			800	55	325	25,2	27,3	0,3907			140	-	5	11,5	11,6	0,0494			BFL	M1	150	-	10	11,7	11,8	0,0554			160	-	15	11,6	11,7	0,0422			180	-	25	12,1	12,2	0,0538			200	-	35	12,5	12,6	0,0653			225	-	47	13,0	13,1	0,0798			250	-	60	13,5	13,6	0,0942			280	-	75	14,2	14,3	0,1116			300	-	85	14,9											15,0	0,1231	315	-	92	15,2	15,3	0,1318	355	-	112	16,5	16,6	0,1549	BFL	M1	400	-	135	17,5			17,9	0,1809	450	-			150	18,6	19,0	0,2098			500	-	175	19,7			20,1	0,2387	550	-			200	20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3			24,4	0,3139	650	-			250	22,7	24,8	0,3254			700	5	275	23,8			25,9	0,3543	710	10			280	24,0	26,1	0,3601	750	30	300	24,9	27,0	0,3832	140	-	5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9			12,0	0,0572	160	-			15	11,8	11,9	0,0437			180	-	25	12,3					12,4	0,0556	200	-					35	12,7			12,8	0,0676					225	-	47	13,3					13,4	0,0825	250	-	60	13,8	13,9	0,0975	280	-	75	14,4	14,5	0,1154	BFL	M1	300	-			85	15,2			15,3	0,1274			315	-			92	15,5	15,6	0,1363			355	-	112	16,8	16,9	0,1603	400	-	135	17,8	18,2	0,1872	450	-	150	18,9	19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-			200	20,9			21,3	0,2769			560	-			205	21,1	23,2	0,2829	600	-			225	22,0	24,1	0,3068	630	-	240	22,7	24,8	0,3254	650	-	250	22,7	24,8	0,3254																		
	710	10	280	23,3	25,4	0,3414			750	30	300	24,2	26,3	0,3633			800	55	325	25,2	27,3	0,3907			140	-	5	11,5	11,6	0,0494			BFL	M1	150	-	10	11,7	11,8	0,0554			160	-	15	11,6	11,7	0,0422			180	-	25	12,1	12,2	0,0538			200	-	35	12,5	12,6	0,0653			225	-	47	13,0	13,1	0,0798			250	-	60	13,5	13,6	0,0942			280	-	75	14,2	14,3	0,1116			300	-	85	14,9	15,0	0,1231			315	-	92	15,2											15,3	0,1318	355	-	112	16,5	16,6	0,1549	BFL	M1	400	-	135	17,5			17,9	0,1809	450	-			150	18,6	19,0	0,2098			500	-	175	19,7			20,1	0,2387	550	-			200	20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3			24,4	0,3139	650	-			250	22,7	24,8	0,3254			700	5	275	23,8			25,9	0,3543	710	10			280	24,0	26,1	0,3601	750	30	300	24,9	27,0	0,3832	140	-	5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9			12,0	0,0572	160	-			15	11,8	11,9	0,0437			180	-	25	12,3			12,4	0,0556	200	-					35	12,7	12,8	0,0676					225	-			47	13,3					13,4	0,0825	250	-					60	13,8	13,9	0,0975	280	-	75	14,4	14,5	0,1154	BFL	M1	300	-			85	15,2			15,3	0,1274			315	-			92	15,5			15,6	0,1363	355	-	112	16,8	16,9	0,1603	400	-	135	17,8	18,2	0,1872	450	-	150	18,9	19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-			200	20,9			21,3	0,2769			560	-			205	21,1			23,2	0,2829	600	-	225	22,0	24,1	0,3068	630	-	240	22,7	24,8	0,3254	650	-	250	22,7	24,8	0,3254																						
	750	30	300	24,2	26,3	0,3633			800	55	325	25,2	27,3	0,3907			140	-	5	11,5	11,6	0,0494			BFL	M1	150	-	10	11,7	11,8	0,0554			160	-	15	11,6	11,7	0,0422			180	-	25	12,1	12,2	0,0538			200	-	35	12,5	12,6	0,0653			225	-	47	13,0	13,1	0,0798			250	-	60	13,5	13,6	0,0942			280	-	75	14,2	14,3	0,1116			300	-	85	14,9	15,0	0,1231			315	-	92	15,2	15,3	0,1318			355	-	112	16,5											16,6	0,1549	BFL	M1	400	-	135	17,5			17,9	0,1809	450	-			150	18,6	19,0	0,2098			500	-	175	19,7			20,1	0,2387	550	-			200	20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3			24,4	0,3139	650	-			250	22,7	24,8	0,3254			700	5	275	23,8			25,9	0,3543	710	10			280	24,0	26,1	0,3601	750	30	300	24,9	27,0	0,3832	140	-	5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9			12,0	0,0572	160	-			15	11,8	11,9	0,0437			180	-	25	12,3			12,4	0,0556	200	-			35	12,7	12,8	0,0676					225	-	47	13,3					13,4	0,0825			250	-					60	13,8	13,9	0,0975					280	-	75	14,4	14,5	0,1154	BFL	M1	300	-			85	15,2			15,3	0,1274			315	-			92	15,5			15,6	0,1363	355	-	112	16,8	16,9	0,1603	400	-	135	17,8	18,2	0,1872	450	-	150	18,9	19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-			200	20,9			21,3	0,2769			560	-			205	21,1			23,2	0,2829	600	-	225	22,0	24,1	0,3068	630	-	240	22,7	24,8	0,3254	650	-	250	22,7	24,8	0,3254																										
800	55	325	25,2	27,3	0,3907	140			-	5	11,5	11,6	0,0494	BFL			M1	150	-	10	11,7	11,8	0,0554	160			-	15	11,6	11,7	0,0422	180			-	25	12,1	12,2	0,0538	200			-	35	12,5	12,6	0,0653	225			-	47	13,0	13,1	0,0798	250			-	60	13,5	13,6	0,0942	280			-	75	14,2	14,3	0,1116	300			-	85	14,9	15,0	0,1231	315			-	92	15,2	15,3	0,1318	355			-	112	16,5	16,6	0,1549	BFL			M1	400	-	135											17,5	17,9			0,1809	450	-	150			18,6	19,0	0,2098	500			-	175	19,7	20,1			0,2387	550	-	200			20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3	24,4			0,3139	650	-	250			22,7	24,8	0,3254	700			5	275	23,8	25,9			0,3543	710	10	280			24,0	26,1	0,3601	750	30	300	24,9	27,0	0,3832	140	-	5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0			0,0572	160	-	15			11,8	11,9	0,0437	180			-	25	12,3	12,4			0,0556	200	-	35			12,7	12,8	0,0676	225			-	47	13,3	13,4					0,0825	250	-	60					13,8	13,9			0,0975	280					-	75	14,4	14,5					0,1154	BFL	M1	300	-	85			15,2	15,3			0,1274	315			-	92			15,5	15,6			0,1363	355	-	112	16,8	16,9	0,1603	400	-	135	17,8	18,2	0,1872	450	-	150	18,9	19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-	200			20,9	21,3			0,2769	560			-	205			21,1	23,2			0,2829	600	-	225	22,0	24,1	0,3068	630	-	240	22,7	24,8	0,3254	650	-	250	22,7	24,8	0,3254																															
140	-	5	11,5	11,6	0,0494	BFL			M1	150	-	10	11,7		11,8	0,0554		160	-	15	11,6	11,7	0,0422	180			-	25	12,1	12,2	0,0538	200			-	35	12,5	12,6	0,0653	225			-	47	13,0	13,1	0,0798	250			-	60	13,5	13,6	0,0942	280			-	75	14,2	14,3	0,1116	300			-	85	14,9	15,0	0,1231	315			-	92	15,2	15,3	0,1318	355			-	112	16,5	16,6	0,1549	BFL			M1	400	-	135	17,5					17,9	0,1809	450									-	150	18,6	19,0			0,2098	500	-	175			19,7	20,1	0,2387	550			-	200	20,5	20,9			0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139			650	-	250	22,7	24,8			0,3254	700	5	275			23,8	25,9	0,3543	710			10	280	24,0	26,1			0,3601	750	30	300	24,9	27,0	0,3832	140	-	5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572			160	-	15	11,8	11,9			0,0437	180	-	25			12,3	12,4	0,0556	200			-	35	12,7	12,8			0,0676	225	-	47			13,3	13,4	0,0825	250			-	60	13,8	13,9			0,0975	280	-	75	14,4	14,5					0,1154	BFL			M1	300					-	85	15,2	15,3					0,1274			315	-	92			15,5	15,6			0,1363	355			-	112			16,8	16,9	0,1603	400	-	135	17,8	18,2	0,1872	450	-	150	18,9	19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-	200	20,9	21,3	0,2769			560	-	205			21,1	23,2			0,2829	600			-	225			22,0	24,1	0,3068	630	-	240	22,7	24,8	0,3254	650	-	250	22,7	24,8	0,3254																																							
150	-	10	11,7	11,8	0,0554		160	-		15	11,6	11,7	0,0422		180	-		25	12,1	12,2	0,0538	200	-	35			12,5	12,6	0,0653	225	-	47			13,0	13,1	0,0798	250	-	60			13,5	13,6	0,0942	280	-	75			14,2	14,3	0,1116	300	-	85			14,9	15,0	0,1231	315	-	92			15,2	15,3	0,1318	355	-	112			16,5	16,6	0,1549	BFL	M1	400			-	135	17,5	17,9	0,1809					450	-	150	18,6					19,0	0,2098	500							-	175	19,7	20,1	0,2387	550			-	200	20,5	20,9			0,2676	560	-	205			20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139	650	-			250	22,7	24,8	0,3254	700	5			275	23,8	25,9	0,3543	710			10	280	24,0	26,1			0,3601	750	30	300			24,9	27,0	0,3832	140	-	5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572	160	-			15	11,8	11,9	0,0437	180	-			25	12,3	12,4	0,0556	200			-	35	12,7	12,8			0,0676	225	-	47			13,3	13,4	0,0825	250			-	60	13,8	13,9			0,0975	280	-	75			14,4	14,5	0,1154	BFL			M1	300	-	85	15,2	15,3	0,1274	315			-					92					15,5	15,6	0,1363	355					-			112	16,8	16,9			0,1603	400			-	135			17,8	18,2	0,1872	450	-	150	18,9	19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-	200	20,9	21,3	0,2769	560	-			205	21,1	23,2	0,2829	600	-			225	22,0	24,1			0,3068	630			-	240			22,7	24,8	0,3254	650	-	250	22,7	24,8	0,3254																																																	
160	-	15	11,6	11,7	0,0422		180	-		25	12,1	12,2	0,0538		200	-		35	12,5	12,6	0,0653	225	-	47			13,0	13,1	0,0798	250	-	60			13,5	13,6	0,0942	280	-	75			14,2	14,3	0,1116	300	-	85			14,9	15,0	0,1231	315	-	92			15,2	15,3	0,1318	355	-	112			16,5	16,6	0,1549	BFL	M1	400			-	135	17,5			17,9			0,1809	450	-	150	18,6					19,0	0,2098	500	-					175	19,7	20,1					0,2387	550	-	200	20,5	20,9	0,2676	560			-	205	20,7	21,1			0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139			650	-	250	22,7	24,8	0,3254	700	5			275	23,8	25,9	0,3543	710	10			280	24,0	26,1	0,3601	750			30	300	24,9	27,0			0,3832	140	-	5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572			160	-	15	11,8	11,9	0,0437	180	-			25	12,3	12,4	0,0556	200	-			35	12,7	12,8	0,0676	225			-	47	13,3	13,4			0,0825	250	-	60			13,8	13,9	0,0975	280			-	75	14,4	14,5			0,1154	BFL	M1	300			-	85	15,2					15,3	0,1274	315	-	92	15,5	15,6			0,1363		355	-		112					16,8	16,9	0,1603	400					-			135	17,8	18,2			0,1872	450			-	150	18,9	19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-	200	20,9	21,3	0,2769			560	-	205	21,1	23,2	0,2829	600	-			225	22,0	24,1	0,3068	630	-			240	22,7	24,8			0,3254	650			-	250	22,7	24,8	0,3254																																																									
180	-	25	12,1	12,2	0,0538		200	-		35	12,5	12,6	0,0653		225	-		47	13,0	13,1	0,0798	250	-	60			13,5	13,6	0,0942	280	-	75			14,2	14,3	0,1116	300	-	85			14,9	15,0	0,1231	315	-	92			15,2	15,3	0,1318	355	-	112			16,5	16,6	0,1549	BFL	M1	400			-	135	17,5			17,9			0,1809	450	-			150			18,6	19,0	0,2098	500	-					175	19,7	20,1	0,2387					550	-	200			20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734	600			-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139			650	-	250	22,7	24,8	0,3254			700	5	275	23,8	25,9	0,3543	710	10			280	24,0	26,1	0,3601	750	30			300	24,9	27,0	0,3832	140			-	5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572			160	-	15	11,8	11,9	0,0437			180	-	25	12,3	12,4	0,0556	200	-			35	12,7	12,8	0,0676	225	-			47	13,3	13,4	0,0825	250			-	60	13,8	13,9			0,0975	280	-	75			14,4	14,5	0,1154	BFL			M1	300	-	85			15,2			15,3			0,1274	315	-					92	15,5	15,6	0,1363	355	-	112			16,8		16,9	0,1603		400			-	135	17,8	18,2	0,1872	450					-			150	18,9	19,3			0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-	200	20,9	21,3	0,2769			560	-	205	21,1	23,2	0,2829			600	-	225	22,0	24,1	0,3068	630	-			240	22,7	24,8	0,3254	650	-			250	22,7	24,8			0,3254																																																																	
200	-	35	12,5	12,6	0,0653		225	-		47	13,0	13,1	0,0798		250	-		60	13,5	13,6	0,0942	280	-	75			14,2	14,3	0,1116	300	-	85			14,9	15,0	0,1231	315	-	92			15,2	15,3	0,1318	355	-	112			16,5	16,6	0,1549	BFL	M1	400			-	135	17,5			17,9			0,1809	450	-			150			18,6	19,0	0,2098			500			-	175	19,7	20,1	0,2387					550	-	200	20,5					20,9	0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139			650	-	250	22,7	24,8	0,3254			700	5	275	23,8	25,9	0,3543			710	10	280	24,0	26,1	0,3601	750	30			300	24,9	27,0	0,3832	140	-			5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572			160	-	15	11,8	11,9	0,0437			180	-	25	12,3	12,4	0,0556			200	-	35	12,7	12,8	0,0676	225	-			47	13,3	13,4	0,0825	250	-			60	13,8	13,9	0,0975	280			-	75	14,4	14,5			0,1154	BFL	M1	300			-	85	15,2					15,3	0,1274	315			-			92			15,5	15,6	0,1363					355	-	112	16,8	16,9	0,1603	400			-		135	17,8		18,2			0,1872	450	-	150	18,9	19,3	0,2171	500			-			175	20,0	20,4	0,2470	BFL	M2	550	-	200	20,9	21,3	0,2769			560	-	205	21,1	23,2	0,2829			600	-	225	22,0	24,1	0,3068			630	-	240	22,7	24,8	0,3254	650	-			250	22,7	24,8	0,3254																																																																											
225	-	47	13,0	13,1	0,0798		250	-		60	13,5	13,6	0,0942		280	-		75	14,2	14,3	0,1116	300	-	85			14,9	15,0	0,1231	315	-	92			15,2	15,3	0,1318	355	-	112			16,5	16,6	0,1549	BFL	M1	400			-	135	17,5			17,9			0,1809	450	-			150			18,6	19,0	0,2098			500			-	175	19,7			20,1			0,2387	550	-	200	20,5					20,9	0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139			650	-	250	22,7	24,8	0,3254			700	5	275	23,8	25,9	0,3543			710	10	280	24,0	26,1	0,3601			750	30	300	24,9	27,0	0,3832	140	-			5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572			160	-	15	11,8	11,9	0,0437			180	-	25	12,3	12,4	0,0556			200	-	35	12,7	12,8	0,0676			225	-	47	13,3	13,4	0,0825	250	-			60	13,8	13,9	0,0975	280	-			75	14,4	14,5	0,1154	BFL			M1	300	-	85			15,2			15,3			0,1274	315	-					92	15,5	15,6			0,1363			355			-	112	16,8					16,9	0,1603	400	-	135	17,8	18,2			0,1872		450	-		150			18,9	19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-	200	20,9	21,3	0,2769			560	-	205	21,1	23,2	0,2829			600	-	225	22,0	24,1	0,3068			630	-	240	22,7	24,8	0,3254			650	-	250	22,7	24,8	0,3254																																																																																			
250	-	60	13,5	13,6	0,0942		280	-		75	14,2	14,3	0,1116		300	-		85	14,9	15,0	0,1231	315	-	92			15,2	15,3	0,1318	355	-	112			16,5	16,6	0,1549	BFL	M1	400			-	135	17,5			17,9			0,1809	450	-			150			18,6	19,0	0,2098			500			-	175	19,7			20,1			0,2387	550	-			200			20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139			650	-	250	22,7	24,8	0,3254			700	5	275	23,8	25,9	0,3543			710	10	280	24,0	26,1	0,3601			750	30	300	24,9	27,0	0,3832			140	-	5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572			160	-	15	11,8	11,9	0,0437			180	-	25	12,3	12,4	0,0556			200	-	35	12,7	12,8	0,0676			225	-	47	13,3	13,4	0,0825			250	-	60	13,8	13,9	0,0975	280	-			75	14,4	14,5	0,1154	BFL	M1			300	-	85	15,2					15,3	0,1274	315			-			92			15,5	15,6	0,1363					355	-	112			16,8			16,9			0,1603	400	-					135	17,8	18,2	0,1872	450	-	150			18,9	19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-	200	20,9	21,3	0,2769			560	-	205	21,1	23,2	0,2829			600	-	225	22,0	24,1	0,3068			630	-	240	22,7	24,8	0,3254			650	-	250	22,7	24,8	0,3254																																																																																											
280	-	75	14,2	14,3	0,1116		300	-		85	14,9	15,0	0,1231		315	-		92	15,2	15,3	0,1318	355	-	112			16,5	16,6	0,1549	BFL	M1	400			-	135	17,5			17,9			0,1809	450	-			150			18,6	19,0	0,2098			500			-	175	19,7			20,1			0,2387	550	-			200			20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139			650	-	250	22,7	24,8	0,3254			700	5	275	23,8	25,9	0,3543			710	10	280	24,0	26,1	0,3601			750	30	300	24,9	27,0	0,3832			140	-	5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572			160	-	15	11,8	11,9	0,0437			180	-	25	12,3	12,4	0,0556			200	-	35	12,7	12,8	0,0676			225	-	47	13,3	13,4	0,0825			250	-	60	13,8	13,9	0,0975			280	-	75	14,4	14,5	0,1154	BFL	M1			300	-	85	15,2					15,3	0,1274	315	-					92	15,5	15,6			0,1363			355			-	112	16,8					16,9	0,1603	400			-			135			17,8	18,2	0,1872	450			-	150	18,9	19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-	200	20,9	21,3	0,2769			560	-	205	21,1	23,2	0,2829			600	-	225	22,0	24,1	0,3068			630	-	240	22,7	24,8	0,3254			650	-	250	22,7	24,8	0,3254																																																																																																			
300	-	85	14,9	15,0	0,1231		315	-		92	15,2	15,3	0,1318		355	-		112	16,5	16,6	0,1549	BFL	M1	400			-	135	17,5			17,9			0,1809	450	-			150			18,6	19,0	0,2098			500			-	175	19,7			20,1			0,2387	550	-			200			20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139			650	-	250	22,7	24,8	0,3254			700	5	275	23,8	25,9	0,3543			710	10	280	24,0	26,1	0,3601			750	30	300	24,9	27,0	0,3832			140	-	5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572			160	-	15	11,8	11,9	0,0437			180	-	25	12,3	12,4	0,0556			200	-	35	12,7	12,8	0,0676			225	-	47	13,3	13,4	0,0825			250	-	60	13,8	13,9	0,0975			280	-	75	14,4	14,5	0,1154			BFL	M1	300	-	85	15,2					15,3	0,1274	315	-					92	15,5	15,6	0,1363					355	-	112			16,8			16,9			0,1603	400	-					135	17,8	18,2			0,1872	450	-	150			18,9	19,3	0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-	200	20,9	21,3	0,2769			560	-	205	21,1	23,2	0,2829			600	-	225	22,0	24,1	0,3068			630	-	240	22,7	24,8	0,3254			650	-	250	22,7	24,8	0,3254																																																																																																											
315	-	92	15,2	15,3	0,1318		355	-		112	16,5	16,6	0,1549		BFL	M1		400	-	135	17,5			17,9			0,1809	450	-			150			18,6	19,0	0,2098			500			-	175	19,7			20,1			0,2387	550	-			200			20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139			650	-	250	22,7	24,8	0,3254			700	5	275	23,8	25,9	0,3543			710	10	280	24,0	26,1	0,3601			750	30	300	24,9	27,0	0,3832			140	-	5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572			160	-	15	11,8	11,9	0,0437			180	-	25	12,3	12,4	0,0556			200	-	35	12,7	12,8	0,0676			225	-	47	13,3	13,4	0,0825			250	-	60	13,8	13,9	0,0975			280	-	75	14,4	14,5	0,1154			BFL	M1	300	-	85	15,2					15,3	0,1274	315	-					92	15,5	15,6	0,1363					355	-	112	16,8					16,9	0,1603	400			-			135			17,8	18,2	0,1872	450			-	150	18,9	19,3			0,2171	500	-	175	20,0	20,4	0,2470	BFL	M2	550	-	200	20,9	21,3	0,2769			560	-	205	21,1	23,2	0,2829			600	-	225	22,0	24,1	0,3068			630	-	240	22,7	24,8	0,3254			650	-	250	22,7	24,8	0,3254																																																																																																																			
355	-	112	16,5	16,6	0,1549		BFL	M1		400	-	135	17,5					17,9	0,1809	450	-			150			18,6	19,0	0,2098			500			-	175	19,7			20,1			0,2387	550	-			200			20,5	20,9	0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139			650	-	250	22,7	24,8	0,3254			700	5	275	23,8	25,9	0,3543			710	10	280	24,0	26,1	0,3601			750	30	300	24,9	27,0	0,3832			140	-	5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572			160	-	15	11,8	11,9	0,0437			180	-	25	12,3	12,4	0,0556			200	-	35	12,7	12,8	0,0676			225	-	47	13,3	13,4	0,0825			250	-	60	13,8	13,9	0,0975			280	-	75	14,4	14,5	0,1154			BFL	M1	300	-	85	15,2					15,3	0,1274	315	-					92	15,5	15,6	0,1363					355	-	112	16,8					16,9	0,1603	400	-					135	17,8	18,2			0,1872	450	-	150			18,9	19,3	0,2171	500			-	175	20,0	20,4	0,2470	BFL	M2	550	-	200	20,9	21,3	0,2769			560	-	205	21,1	23,2	0,2829			600	-	225	22,0	24,1	0,3068			630	-	240	22,7	24,8	0,3254			650	-	250	22,7	24,8	0,3254																																																																																																																											
400	-	135	17,5	17,9	0,1809					450	-	150	18,6					19,0	0,2098	500	-			175			19,7	20,1	0,2387			550			-	200	20,5			20,9			0,2676	560	-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139	650	-			250	22,7	24,8	0,3254	700	5			275	23,8	25,9	0,3543	710	10			280	24,0	26,1	0,3601	750	30			300	24,9	27,0	0,3832	140	-			5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572	160	-			15	11,8	11,9	0,0437	180	-			25	12,3	12,4	0,0556	200	-			35	12,7	12,8	0,0676	225	-			47	13,3	13,4	0,0825	250	-			60	13,8	13,9	0,0975	280	-			75	14,4	14,5	0,1154	BFL	M1			300	-	85	15,2	15,3	0,1274					315	-	92	15,5					15,6	0,1363	355	-					112	16,8	16,9	0,1603					400	-	135	17,8					18,2	0,1872	450	-	150			18,9	19,3	0,2171	500			-	175	20,0	20,4			0,2470	BFL	M2	550	-	200	20,9	21,3	0,2769	560	-			205	21,1	23,2	0,2829	600	-			225	22,0	24,1	0,3068	630	-			240	22,7	24,8	0,3254	650	-			250	22,7	24,8	0,3254																																																																																																																																					
450	-	150	18,6	19,0	0,2098					500	-	175	19,7					20,1	0,2387	550	-			200			20,5	20,9	0,2676			560			-	205	20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139	650	-			250	22,7	24,8	0,3254	700	5	275	23,8			25,9	0,3543	710	10	280	24,0			26,1	0,3601	750	30	300	24,9			27,0	0,3832	140	-	5	11,7			11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572	160	-			15	11,8	11,9	0,0437	180	-	25	12,3			12,4	0,0556	200	-	35	12,7			12,8	0,0676	225	-	47	13,3			13,4	0,0825	250	-	60	13,8			13,9	0,0975	280	-	75	14,4			14,5	0,1154	BFL	M1	300	-			85	15,2	15,3	0,1274					315	-	92	15,5	15,6	0,1363					355	-	112	16,8					16,9	0,1603	400	-					135	17,8	18,2	0,1872					450	-	150	18,9	19,3	0,2171			500	-	175	20,0	20,4			0,2470	BFL	M2	550			-	200	20,9	21,3	0,2769	560	-			205	21,1	23,2	0,2829	600	-	225	22,0			24,1	0,3068	630	-	240	22,7			24,8	0,3254	650	-	250	22,7			24,8	0,3254																																																																																																																																															
500	-	175	19,7	20,1	0,2387					550	-	200	20,5					20,9	0,2676	560	-			205			20,7	21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139	650	-			250	22,7	24,8	0,3254	700	5	275	23,8			25,9	0,3543	710	10	280	24,0	26,1	0,3601			750	30	300	24,9	27,0	0,3832			140	-	5	11,7	11,8	0,0510			BFL	M1	150	-	10	11,9	12,0	0,0572	160	-			15	11,8	11,9	0,0437	180	-	25	12,3			12,4	0,0556	200	-	35	12,7	12,8	0,0676			225	-	47	13,3	13,4	0,0825			250	-	60	13,8	13,9	0,0975			280	-	75	14,4	14,5	0,1154			BFL	M1	300	-	85	15,2			15,3	0,1274			315	-			92	15,5	15,6	0,1363					355	-	112	16,8	16,9	0,1603					400	-	135	17,8					18,2	0,1872	450	-					150	18,9	19,3	0,2171	500	-			175	20,0	20,4	0,2470	BFL	M2			550	-	200	20,9	21,3			0,2769			560	-	205	21,1	23,2	0,2829	600	-	225	22,0			24,1	0,3068	630	-	240	22,7	24,8	0,3254			650	-	250	22,7	24,8	0,3254																																																																																																																																																											
550	-	200	20,5	20,9	0,2676					560	-	205	20,7					21,1	0,2734	600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139	650	-			250	22,7	24,8	0,3254	700	5	275	23,8			25,9	0,3543	710	10	280	24,0	26,1	0,3601			750	30	300	24,9	27,0	0,3832	140	-			5	11,7	11,8	0,0510	BFL	M1			150	-	10	11,9	12,0	0,0572	160	-			15	11,8	11,9	0,0437	180	-	25	12,3			12,4	0,0556	200	-	35	12,7	12,8	0,0676			225	-	47	13,3	13,4	0,0825	250	-			60	13,8	13,9	0,0975	280	-			75	14,4	14,5	0,1154	BFL	M1			300	-	85	15,2	15,3	0,1274					315	-	92	15,5			15,6	0,1363			355	-			112	16,8	16,9	0,1603					400	-	135	17,8	18,2	0,1872					450	-	150	18,9					19,3	0,2171	500	-			175	20,0	20,4	0,2470	BFL	M2	550	-			200	20,9	21,3	0,2769					560	-	205	21,1	23,2	0,2829	600	-			225	22,0	24,1	0,3068	630	-	240	22,7	24,8	0,3254			650	-	250	22,7	24,8	0,3254																																																																																																																																																																					
560	-	205	20,7	21,1	0,2734					600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139	650	-			250	22,7	24,8	0,3254	700	5	275	23,8			25,9	0,3543	710	10	280	24,0	26,1	0,3601			750	30	300	24,9	27,0	0,3832	140	-			5	11,7	11,8	0,0510	BFL	M1	150	-			10	11,9	12,0	0,0572			160	-	15	11,8	11,9	0,0437	180	-	25	12,3			12,4	0,0556	200	-	35	12,7	12,8	0,0676			225	-	47	13,3	13,4	0,0825	250	-			60	13,8	13,9	0,0975	280	-	75	14,4			14,5	0,1154	BFL	M1	300	-			85	15,2	15,3	0,1274					315	-	92	15,5	15,6	0,1363					355	-	112	16,8			16,9	0,1603			400	-			135	17,8	18,2	0,1872					450	-	150	18,9	19,3	0,2171					500	-	175	20,0			20,4	0,2470	BFL	M2	550	-			200	20,9	21,3	0,2769			560	-			205	21,1	23,2	0,2829			600	-	225	22,0	24,1	0,3068	630	-	240	22,7			24,8	0,3254	650	-	250	22,7	24,8	0,3254																																																																																																																																																																															
600	-	225	21,6	23,7	0,2965	BFL	M2	630	-	240	22,3	24,4	0,3139	650	-			250	22,7	24,8	0,3254	700	5	275	23,8			25,9	0,3543	710	10	280	24,0	26,1	0,3601			750	30	300	24,9	27,0	0,3832	140	-			5	11,7	11,8	0,0510	BFL	M1	150	-			10	11,9	12,0	0,0572			160	-	15	11,8	11,9	0,0437	180	-			25	12,3	12,4	0,0556	200	-	35	12,7	12,8	0,0676			225	-	47	13,3	13,4	0,0825	250	-			60	13,8	13,9	0,0975	280	-	75	14,4			14,5	0,1154	BFL	M1	300	-	85	15,2			15,3	0,1274			315	-			92	15,5	15,6	0,1363					355	-	112	16,8	16,9	0,1603					400	-	135	17,8			18,2	0,1872			450	-			150	18,9	19,3	0,2171					500	-	175	20,0	20,4	0,2470			BFL	M2	550	-	200	20,9			21,3	0,2769			560	-			205	21,1	23,2	0,2829			600	-	225	22,0	24,1	0,3068	630	-			240	22,7	24,8	0,3254	650	-	250	22,7	24,8	0,3254																																																																																																																																																																																									
630	-	240	22,3	24,4	0,3139			650	-	250	22,7	24,8	0,3254	700	5			275	23,8	25,9	0,3543	710	10	280	24,0			26,1	0,3601	750	30	300	24,9	27,0	0,3832			140	-	5	11,7	11,8	0,0510	BFL	M1			150	-	10	11,9			12,0	0,0572	160	-	15	11,8	11,9	0,0437			180	-	25	12,3	12,4	0,0556	200	-			35	12,7	12,8	0,0676	225	-	47	13,3	13,4	0,0825			250	-	60	13,8	13,9	0,0975	280	-			75	14,4	14,5	0,1154	BFL	M1	300	-			85	15,2			15,3	0,1274	315	-			92	15,5			15,6	0,1363			355	-	112	16,8					16,9	0,1603	400	-	135	17,8					18,2	0,1872	450	-			150	18,9			19,3	0,2171			500	-	175	20,0	20,4	0,2470			BFL	M2	550	-	200	20,9					21,3	0,2769	560	-			205	21,1			23,2	0,2829	600	-	225	22,0	24,1	0,3068			630	-	240	22,7	24,8	0,3254	650	-			250	22,7	24,8	0,3254																																																																																																																																																																																															
650	-	250	22,7	24,8	0,3254			700	5	275	23,8	25,9	0,3543	710	10			280	24,0	26,1	0,3601	750	30	300	24,9			27,0	0,3832	140	-	5	11,7	11,8	0,0510			BFL	M1	150	-	10	11,9			12,0	0,0572	160	-	15	11,8			11,9	0,0437	180	-	25	12,3	12,4	0,0556			200	-	35	12,7	12,8	0,0676	225	-			47	13,3	13,4	0,0825	250	-	60	13,8	13,9	0,0975			280	-	75	14,4	14,5	0,1154	BFL	M1			300	-	85	15,2			15,3	0,1274			315	-			92	15,5	15,6	0,1363			355	-			112	16,8			16,9	0,1603	400	-					135	17,8	18,2	0,1872	450	-					150	18,9	19,3	0,2171			500	-	175	20,0	20,4	0,2470			BFL	M2	550	-	200	20,9					21,3	0,2769	560	-					205	21,1	23,2	0,2829	600	-	225	22,0			24,1	0,3068	630	-	240	22,7	24,8	0,3254			650	-	250	22,7	24,8	0,3254																																																																																																																																																																																																							
700	5	275	23,8	25,9	0,3543			710	10	280	24,0	26,1	0,3601	750	30			300	24,9	27,0	0,3832	140	-	5	11,7			11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572			160	-	15	11,8			11,9	0,0437	180	-	25	12,3			12,4	0,0556	200	-	35	12,7	12,8	0,0676			225	-	47	13,3	13,4	0,0825	250	-			60	13,8	13,9	0,0975	280	-	75	14,4	14,5	0,1154			BFL	M1	300	-	85	15,2					15,3	0,1274	315	-			92	15,5			15,6	0,1363			355	-	112	16,8			16,9	0,1603			400	-			135	17,8	18,2	0,1872					450	-	150	18,9	19,3	0,2171			500	-	175	20,0	20,4	0,2470			BFL	M2	550	-	200	20,9					21,3	0,2769	560	-					205	21,1	23,2	0,2829	600	-			225	22,0	24,1	0,3068	630	-	240	22,7			24,8	0,3254	650	-	250	22,7	24,8	0,3254																																																																																																																																																																																																															
710	10	280	24,0	26,1	0,3601			750	30	300	24,9	27,0	0,3832	140	-			5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572			160	-	15	11,8	11,9	0,0437			180	-	25	12,3			12,4	0,0556	200	-	35	12,7			12,8	0,0676	225	-	47	13,3	13,4	0,0825			250	-	60	13,8	13,9	0,0975	280	-			75	14,4	14,5	0,1154	BFL	M1	300	-	85	15,2					15,3	0,1274	315	-					92	15,5	15,6	0,1363			355	-			112	16,8			16,9	0,1603	400	-			135	17,8			18,2	0,1872			450	-	150	18,9	19,3	0,2171			500	-	175	20,0	20,4	0,2470			BFL	M2	550	-	200	20,9					21,3	0,2769	560	-					205	21,1	23,2	0,2829	600	-			225	22,0	24,1	0,3068	630	-			240	22,7	24,8	0,3254	650	-	250	22,7			24,8	0,3254																																																																																																																																																																																																																					
750	30	300	24,9	27,0	0,3832			140	-	5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572			160	-	15	11,8	11,9	0,0437			180	-	25	12,3	12,4	0,0556			200	-	35	12,7			12,8	0,0676	225	-	47	13,3			13,4	0,0825	250	-	60	13,8	13,9	0,0975			280	-	75	14,4	14,5	0,1154	BFL	M1			300	-	85	15,2			15,3	0,1274	315	-					92	15,5	15,6	0,1363					355	-	112	16,8			16,9	0,1603			400	-			135	17,8	18,2	0,1872			450	-	150	18,9	19,3	0,2171			500	-	175	20,0	20,4	0,2470			BFL	M2	550	-	200	20,9					21,3	0,2769	560	-					205	21,1	23,2	0,2829	600	-			225	22,0	24,1	0,3068	630	-			240	22,7	24,8	0,3254	650	-			250	22,7	24,8	0,3254																																																																																																																																																																																																																													
140	-	5	11,7	11,8	0,0510	BFL	M1	150	-	10	11,9	12,0	0,0572			160	-	15	11,8	11,9	0,0437			180	-	25	12,3	12,4	0,0556			200	-	35	12,7	12,8	0,0676			225	-	47	13,3			13,4	0,0825	250	-	60	13,8			13,9	0,0975	280	-	75	14,4	14,5	0,1154			BFL	M1	300	-	85	15,2					15,3	0,1274	315	-			92	15,5	15,6	0,1363					355	-	112	16,8					16,9	0,1603	400	-			135	17,8			18,2	0,1872	450	-	150	18,9	19,3	0,2171			500	-	175	20,0	20,4	0,2470			BFL	M2	550	-	200	20,9					21,3	0,2769	560	-					205	21,1	23,2	0,2829	600	-			225	22,0	24,1	0,3068	630	-			240	22,7	24,8	0,3254	650	-			250	22,7	24,8	0,3254																																																																																																																																																																																																																																					
150	-	10	11,9	12,0	0,0572			160	-	15	11,8	11,9	0,0437			180	-	25	12,3	12,4	0,0556			200	-	35	12,7	12,8	0,0676			225	-	47	13,3	13,4	0,0825			250	-	60	13,8			13,9	0,0975	280	-	75	14,4			14,5	0,1154	BFL	M1	300	-	85	15,2					15,3	0,1274	315	-					92	15,5	15,6	0,1363			355	-	112	16,8					16,9	0,1603	400	-					135	17,8	18,2	0,1872	450	-	150	18,9			19,3	0,2171	500	-	175	20,0	20,4	0,2470			BFL	M2	550	-	200	20,9					21,3	0,2769	560	-					205	21,1	23,2	0,2829	600	-			225	22,0	24,1	0,3068	630	-			240	22,7	24,8	0,3254	650	-			250	22,7	24,8	0,3254																																																																																																																																																																																																																																													
160	-	15	11,8	11,9	0,0437			180	-	25	12,3	12,4	0,0556			200	-	35	12,7	12,8	0,0676			225	-	47	13,3	13,4	0,0825			250	-	60	13,8	13,9	0,0975			280	-	75	14,4			14,5	0,1154	BFL	M1	300	-			85	15,2			15,3	0,1274	315	-					92	15,5	15,6	0,1363					355	-	112	16,8			16,9	0,1603	400	-					135	17,8	18,2	0,1872	450	-			150	18,9	19,3	0,2171	500	-	175	20,0			20,4	0,2470	BFL	M2	550	-	200	20,9					21,3	0,2769	560	-					205	21,1	23,2	0,2829	600	-			225	22,0	24,1	0,3068	630	-			240	22,7	24,8	0,3254	650	-			250	22,7	24,8	0,3254																																																																																																																																																																																																																																																					
180	-	25	12,3	12,4	0,0556			200	-	35	12,7	12,8	0,0676			225	-	47	13,3	13,4	0,0825			250	-	60	13,8	13,9	0,0975			280	-	75	14,4	14,5	0,1154			BFL	M1	300	-			85	15,2			15,3	0,1274			315	-			92	15,5	15,6	0,1363					355	-	112	16,8					16,9	0,1603	400	-			135	17,8	18,2	0,1872			450	-	150	18,9	19,3	0,2171	500	-			175	20,0	20,4	0,2470	BFL	M2	550	-			200	20,9			21,3	0,2769	560	-					205	21,1	23,2	0,2829	600	-			225	22,0	24,1	0,3068	630	-			240	22,7	24,8	0,3254	650	-			250	22,7	24,8	0,3254																																																																																																																																																																																																																																																													
200	-	35	12,7	12,8	0,0676			225	-	47	13,3	13,4	0,0825			250	-	60	13,8	13,9	0,0975			280	-	75	14,4	14,5	0,1154			BFL	M1	300	-	85	15,2					15,3	0,1274			315	-			92	15,5			15,6	0,1363			355	-	112	16,8					16,9	0,1603	400	-					135	17,8	18,2	0,1872	450	-	150	18,9	19,3	0,2171			500	-	175	20,0	20,4	0,2470	BFL	M2			550	-	200	20,9			21,3	0,2769			560	-			205	21,1	23,2	0,2829	600	-			225	22,0	24,1	0,3068	630	-			240	22,7	24,8	0,3254	650	-			250	22,7	24,8	0,3254																																																																																																																																																																																																																																																																					
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Sizes listed within the maximum/minimum sizes can be manufactured on request.

A x B [mm]	Damper blade overlaps		Weight		Effective area Sef [m <sup>2</sup> ]	Spring return actuator	Manual control	A x B [mm]	Damper blade overlaps		Weight		Effective area Sef [m <sup>2</sup> ]	Spring return actuator	Manual control
	a [mm]	c [mm]	Man. [kg]	Actu. [kg]					a [mm]	c [mm]	Man. [kg]	Actu. [kg]			
750 x	500	-	175	21,9	22,3	0,2883	BFN	900 x	200	-	35	15,6	15,7	0,0958	M1
	550	-	200	22,8	24,9	0,3232			225	-	47	16,3	16,4	0,1170	
	560	-	205	23,1	25,2	0,3302			250	-	60	17,0	17,1	0,1382	BFL
	600	-	225	24,1	26,2	0,3581	BF		280	-	75	17,8	17,9	0,1637	
	630	-	240	24,8	26,9	0,3790			300	-	85	18,7	18,8	0,1806	
	650	-	250	25,3	27,4	0,3930			315	-	92	19,1	19,5	0,1933	
800 x	150	-	10	13,6	13,7	0,0710		355	-	112	20,6	21,0	0,2273		
	160	-	15	13,4	13,5	0,0546		400	-	135	21,8	22,2	0,2654	BFN	
	180	-	25	13,9	14,0	0,0696		450	-	150	23,2	23,6	0,3078		
	200	-	35	14,4	14,5	0,0845		500	-	175	24,6	26,7	0,3502	BF	
	225	-	47	15,1	15,2	0,1032	BFL	550	-	200	25,7	27,8	0,3926		
	250	-	60	15,7	15,8	0,1219		160	-	15	15,6	15,7	0,0692		
	280	-	75	16,5	16,6	0,1444		180	-	25	16,2	16,3	0,0882	M1	
	300	-	85	17,3	17,4	0,1593		200	-	35	16,8	16,9	0,1071		
	315	-	92	17,7	17,8	0,1705		225	-	47	17,5	17,6	0,1308	BFL	
	355	-	112	19,1	19,5	0,2005		250	-	60	18,2	18,3	0,1545		
900 x	400	-	135	20,2	20,6	0,2341		280	-	75	19,1	19,2	0,1830		
	450	-	150	21,5	21,9	0,2715	BFN	300	-	85	20,0	20,4	0,2019		
	500	-	175	22,8	23,2	0,3089		315	-	92	20,5	20,9	0,2161		
	550	-	200	23,8	25,9	0,3463		355	-	112	22,1	22,5	0,2541	BFN	
	560	-	205	24,1	26,2	0,3538	BF	400	-	135	23,4	23,8	0,2967		
	600	-	225	25,1	27,2	0,3837		450	-	150	24,9	25,3	0,3441		
	160	-	15	14,5	14,6	0,0619		500	-	175	26,4	28,5	0,3915	BF	
	180	-	25	15,1	15,2	0,0789	BFL								
							M1								

Sizes listed within the maximum/minimum sizes can be manufactured on request.

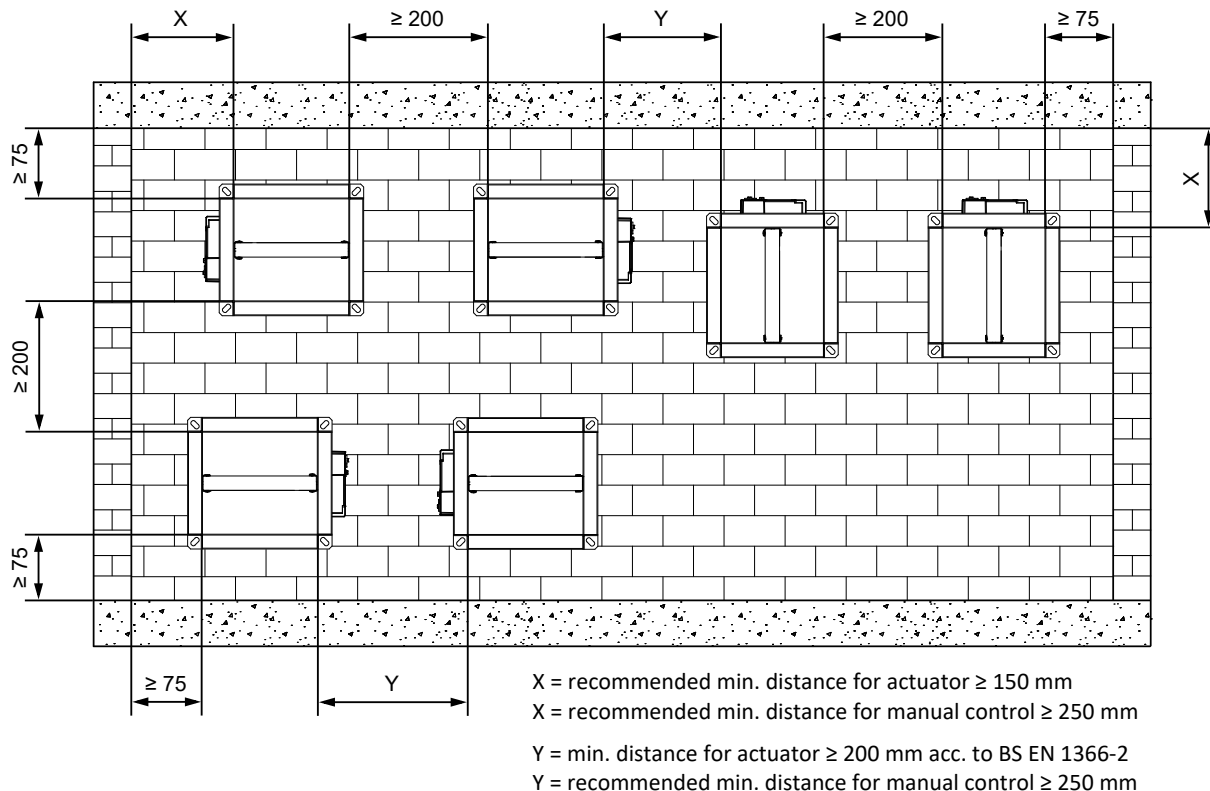
## IV. INSTALLATION

### Placement and installation

- The fire dampers are suitable for installation in arbitrary position in vertical and horizontal passages of fire separating constructions. The damper installation procedures must be done so that all load transfer from the fire separating constructions to the damper is absolutely excluded. Following air-conditioning duct must be suspended or supported so that all load transfer from the following duct to the fire damper is absolutely excluded. The gap between the installed damper and the fire separating construction must be perfectly filled with approved material.
- The damper must be installed so that the damper blade (in closed position) is situated in the fire separating construction - marked by the label BUILT-IN EDGE on the damper casing. If such solution is not possible, the duct between the fire separating construction and the damper blade must be protected according to the certified installation method → see pages 23 to 31
- During the installation and plastering process, the actuating mechanism must be protected (covered) against damage and pollution. The damper casing should not be deformed during bricking in. Once the damper is built in, the damper blade should not grind against the damper casing during opening or closing.
- The distance between the fire damper and the construction (wall, ceiling) must be 75 mm at the minimum, according to BS EN 1366-2. If two or more dampers are to be installed in one fire separating construction, the distance between adjacent dampers must be 200 mm at the minimum, according to BS EN 1366-2.

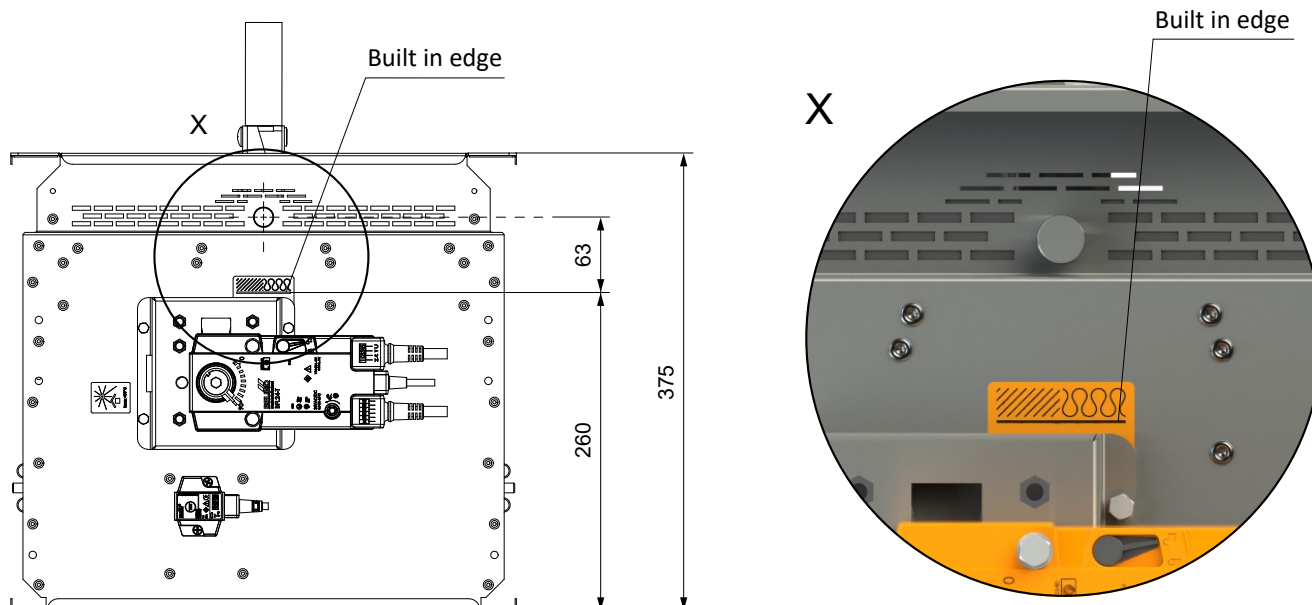
#### Minimum distance between the fire dampers and the construction

- minimum distance 200 mm between dampers, according to BS EN 1366-2
- minimum distance 75 mm between damper and construction (wall/ceiling), according to BS EN 1366-2
- recommended minimum distance 150 mm necessary for access to the actuator
- recommended minimum distance 250 mm necessary for access to the manual control



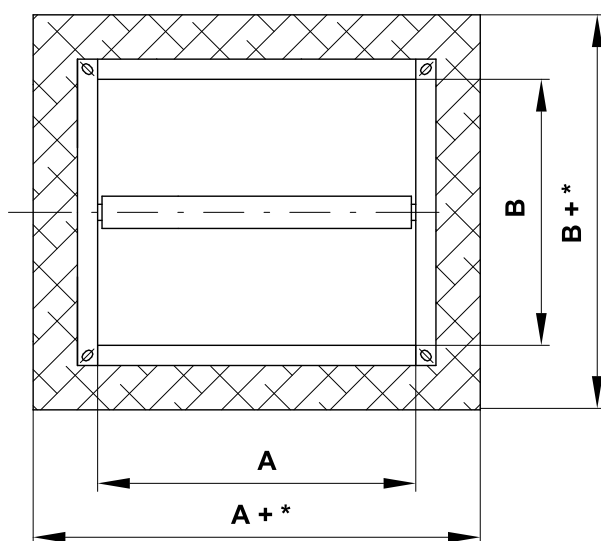
- Always consult the wall manufacturers specific guidelines for deflection heads, penetration size, location to other services, fire stopping and load bearing capacity.
- No other services should pass through the dampers building work opening.
- For lightweight walls always consult the wall manufacturer specific guidelines for penetrations sizes and distances.

**Built in edge**



""BUILT IN EDGE label" indicates the recommended edge of installation of a fire damper in the fire separating construction (wall/ceiling). The damper must be installed so that the entire damper blade (in the closed position) is located in the fire separating construction (wall/ceiling) and at the same time the actuating mechanism and inspection openings are freely accessible.

**Dimensions of an installation opening**



**\* Mortar or gypsum**

- min. A(B)+100
- max. A(B)+300

**Ablative Coated Batt**

- min. A(B)+80
- max. A(B)+260

**Examples of constructions for fire damper installation**

- The fire damper can be installed into:
  - Solid wall construction made e.g. of normal concrete/masonry or porous concrete with min. thickness 100 mm.
  - Gypsum wall construction with min. thickness 100 mm
- Solid ceiling construction made e.g. of normal concrete or porous concrete, with minimum thickness according to BS EN 1366-2.
- Outside the wall/ceiling construction. The duct and damper must be protected by fire insulation.

## Statement of installations

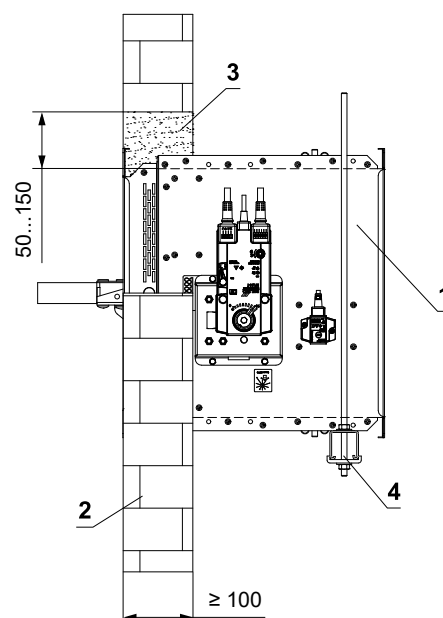
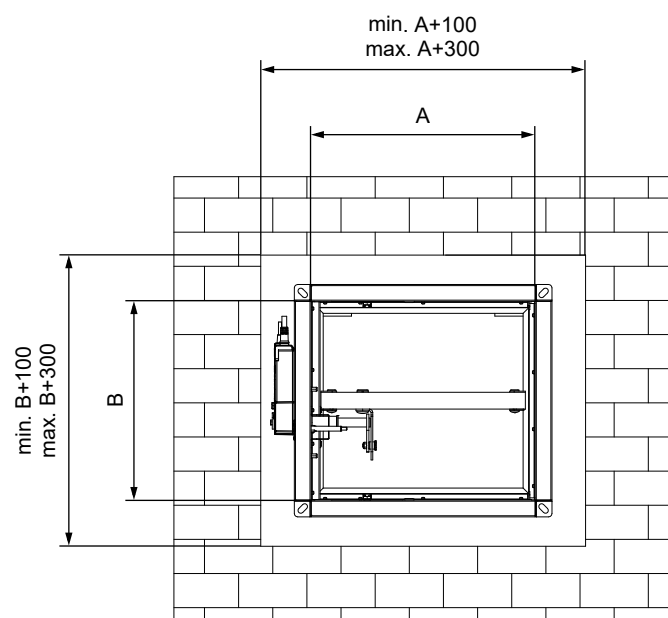
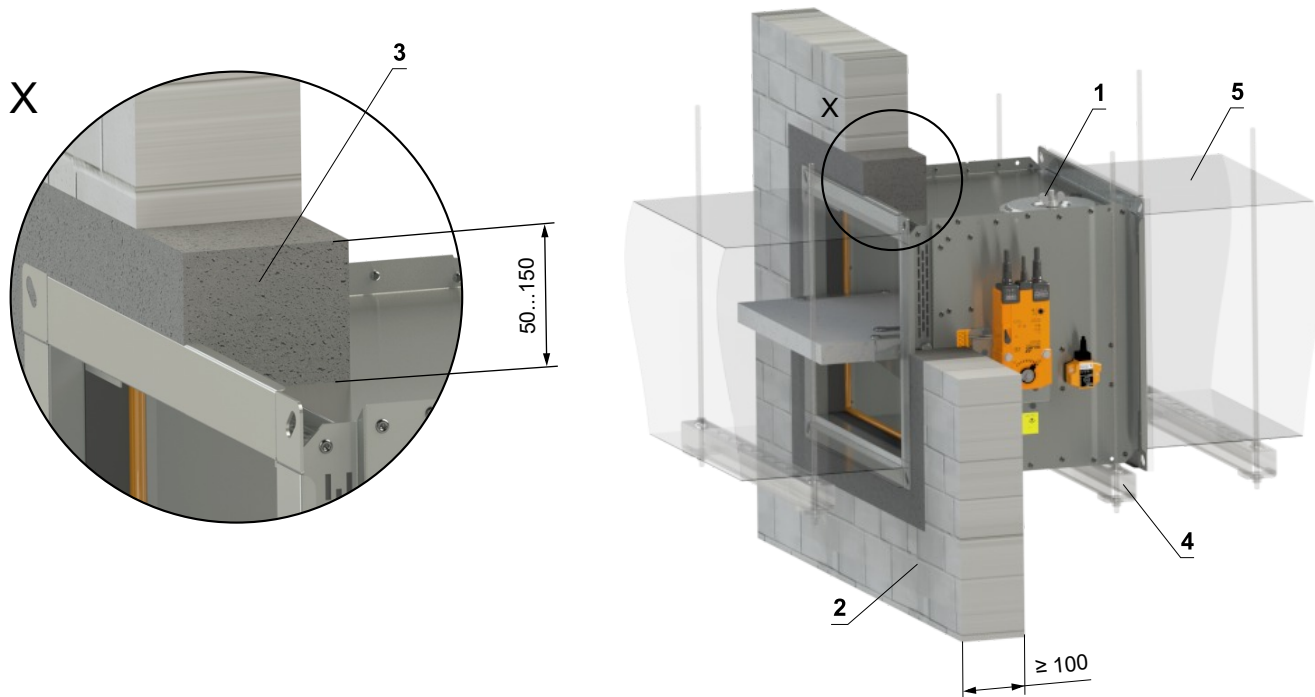
Placement	wall/ceiling min. thickness [mm]	Method of installation	Fire resistance	Page
In solid wall construction	100	Mortar or gypsum	EI 120 (v <sub>e</sub> i↔o) S	23
		Ablative Coated Batt	EI 90 (v <sub>e</sub> i↔o) S	24
Outside solid wall construction	100	ISOVER Ultimate Protect - Ablative Coated Batt	EI 90 (v <sub>e</sub> i↔o) S	25
In gypsum wall construction	100	Mortar or gypsum	EI 120 (v <sub>e</sub> i↔o) S	26
		Ablative Coated Batt 100mm	EI 90 (v <sub>e</sub> i↔o) S EI 60 (v <sub>e</sub> i↔o) S	27
	75	Ablative Coated Batt 50mm	EI 45 (v <sub>e</sub> i↔o) S EI 30 (v <sub>e</sub> i↔o) S	28
Outside gypsum wall construction	100	ISOVER Ultimate Protect - Ablative Coated Batt	EI 90 (v <sub>e</sub> i↔o) S	29
In shaft wall construction	85	Ablative Coated Batt	EI 90 (v <sub>e</sub> i↔o) S EI 60 (v <sub>e</sub> i↔o) S	30
In solid ceiling construction	150	Mortar or gypsum	EI 120 (h <sub>o</sub> i↔o) S	31

## In solid wall construction

### In solid wall construction - mortar or gypsum

EI 120 (v<sub>e</sub> i↔o) S

- For connection following duct → see page 34
- This installation was tested without supports. Supports are optional, if are used, follow the manufacturer's instructions and national standards.

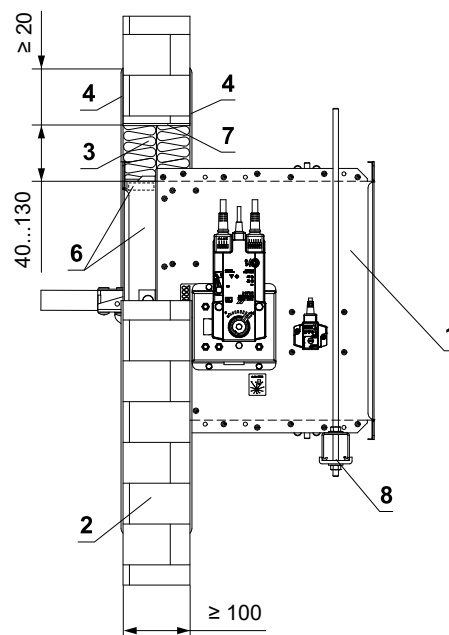
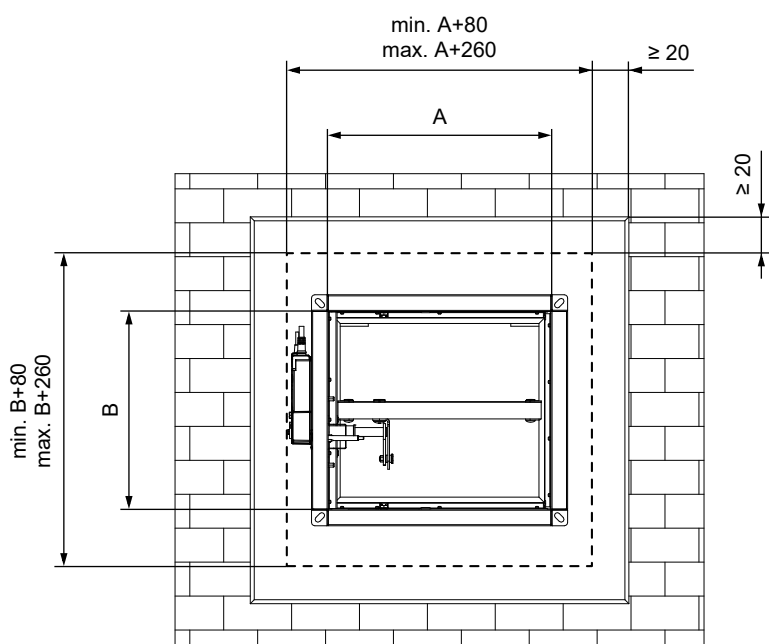
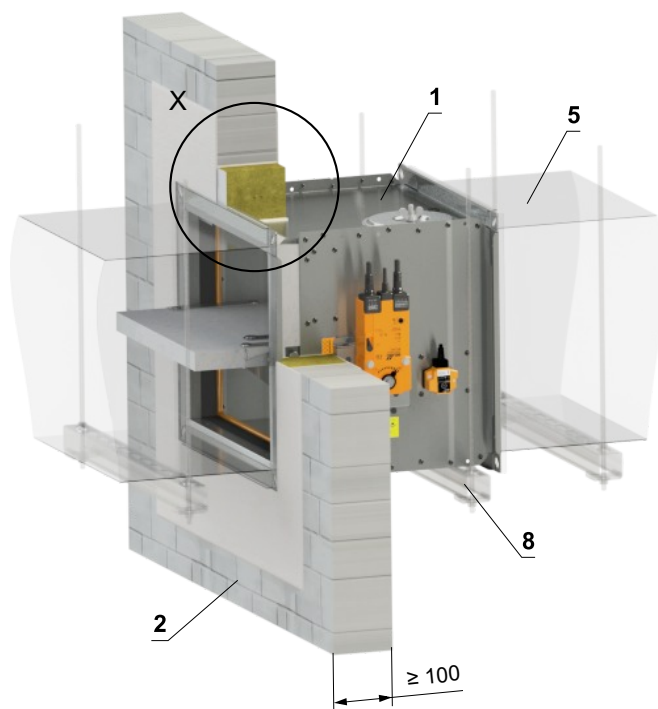
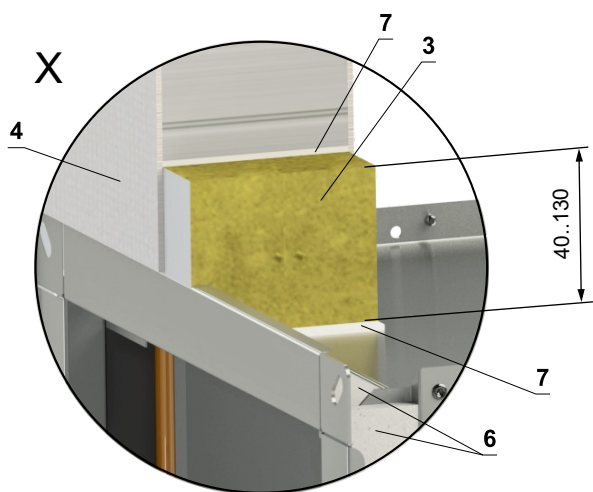


- 1 FDMB
- 2 Solid wall construction
- 3 British gypsum thistle bond 60 (or equivalent can by used) minimum density 670 kg/m<sup>3</sup>
- 4 Fixing profile with threaded rod → see pages 32 to 33
- 5 Duct

In solid wall construction - Ablative Coated Batt

EI 90 (v<sub>e</sub> i↔o) S

■ For connection following duct → see page 34



- 1 FDMB
- 2 Solid wall construction
- 3 Ablative Coated Batt (e.g. Firestop Board HILTI CFS-CT B 1S 140/50 - min. density 140 kg/m<sup>3</sup> + Firestop acrylic sealant HILTI CFS-S ACR or equivalent)
- 4 Fire stop coating thickness 1 mm (e.g. HILTI CFS-CT, PROMASTOP-CC or equivalent)
- 5 Duct
- 6 Protective cladding boards - (not part of the damper) but must be used as part of the penetration filling → see page 43
- 7 Fire resistant mastic - fill the gap on both sides of the fire separation construction and around the perimeter of penetration and damper body. (e.g. HILTI CFS-S ACR)
- 8 Fixing profile with threaded rod → see pages 32 to 33

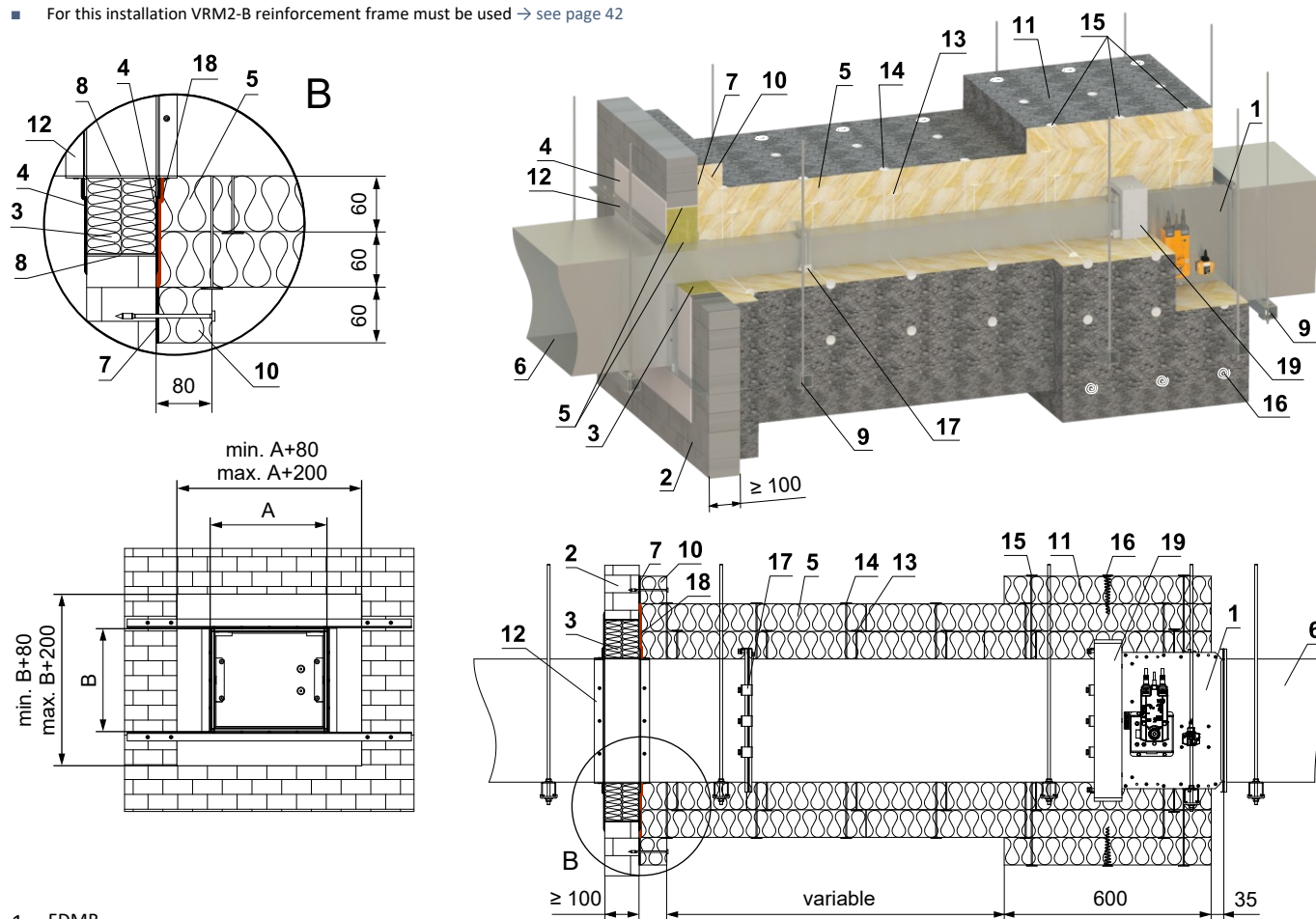


## Installation outside solid wall construction

### Outside solid wall construction - ISOVER Ultimate Protect - Ablative Coated Batt

EI 90 (v<sub>e</sub> i↔o) S

- For connection of following duct → see page 34
- Minimum and maximum distance between the wall and fire damper is unlimited
- When installing the insulation, follow the ISOVER manufacturer's instructions
- The damper and the duct must be suspended separately
- The duct must be suspended on both sides of damper acc. to national rules
- Duct between fire damper and fire separating construction must be suspended by using threaded rods and mounting profiles, or another mounting system acc. to national standards
- Load of the suspension system depends on weight of the fire damper and duct system → see page 32
- Max. distance between two suspension systems is 1500 mm
- Duct at the point of penetration must be fixed to the fire separation structure
- Following air-conditioning duct must be suspended or supported so that all load transfer from the following duct to the fire damper is absolutely excluded. Adjacent duct must be suspended or supported, as required by the duct suppliers
- Damper inspection holes are covered with insulation, therefore it's necessary to make an inspection hole on the connecting duct
- If the threaded rod is located inside the duct insulation, distance between threaded rod and duct is max 30 mm
- If the threaded rod is located outside the duct isolation, distance between threaded rod and isolation is max. 40 mm
- For this installation VRM2-B reinforcement frame must be used → see page 42



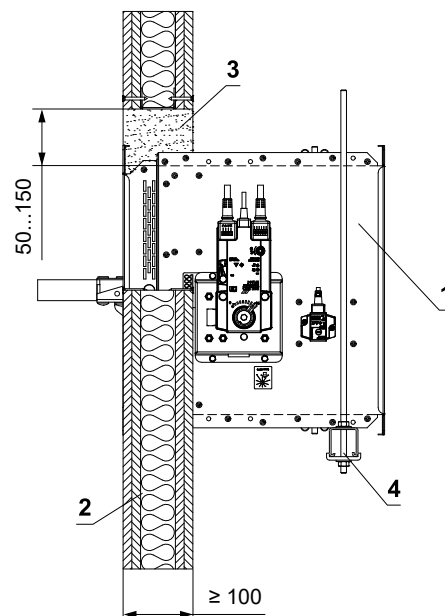
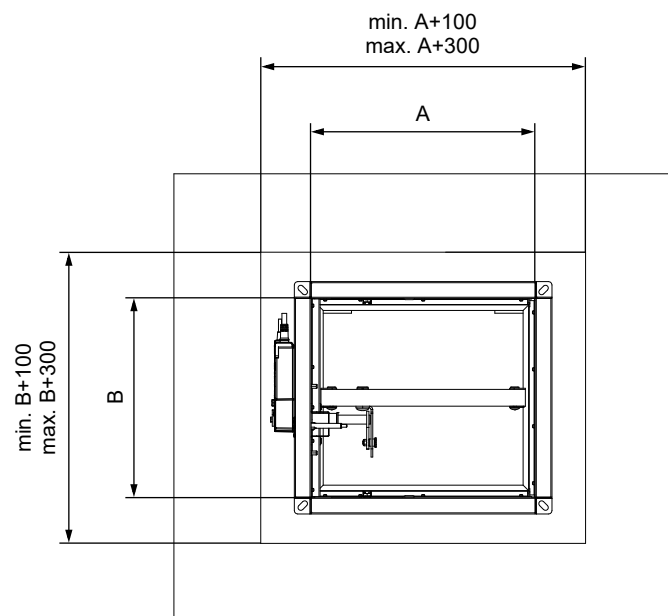
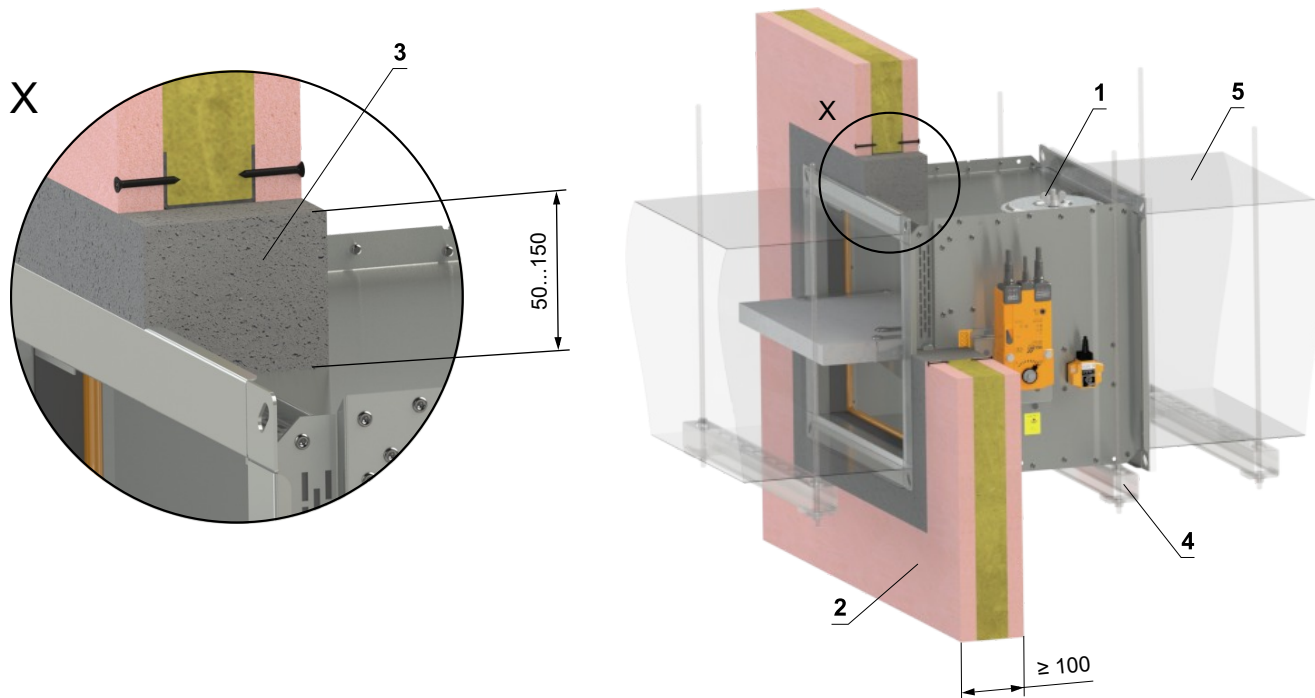
- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1 FDMB</li> <li>2 Solid wall construction</li> <li>3 Ablative Coated Batt (e.g. Firestop Board HILTI CFS-CT B 1S 140/50 - min. density 140 kg/m<sup>3</sup> + Firestop acrylic sealant HILTI CFS-SACR or equivalent)</li> <li>4 Fire stop coating thickness 1 mm (e.g. HILTI CFS-CT, PROMASTOP-CC or equivalent)</li> <li>5 Insulation board made of stone wool, with a surface treatment of aluminum foil, min. density 66 kg/m<sup>3</sup> (ISOVER Ultimate Protect SLAB 4.0 Alu1, th. 60 mm)</li> <li>6 Standard air ducts, made of galvanized sheet thickness 0,8 mm, flanges 30 mm, acc. to BS EN 1507 and DIN 24190</li> <li>7 ISOVER Protect BSK glue - apply on the insulation and stick it to the fire separation construction</li> <li>8 Fire resistant mastic - fill the gap on both sides of the fire separation construction and around the perimeter of penetration and damper body. (e.g. HILTI CFS-SACR)</li> <li>9 Fixing profile with threaded rod → see pages 32 to 33</li> </ol> | <ol style="list-style-type: none"> <li>10 Duct penetration insulation collar - ISOVER Ultimate Protect SLAB 4.0 Alu1, th. 60 mm - glued (pos. 7) and fixed with screws to the wall construction</li> <li>11 Insulating collar of the damper and duct connection - ISOVER Ultimate Protect SLAB 4.0 Alu1, th. 60 mm</li> <li>12 L-profile 30x30x3 mm - dimensions and installation acc. to ISOVER manufacturer</li> <li>13 Stud-welded pins 60 mm - quantity and placing acc. to ISOVER manufa.</li> <li>14 Stud-welded pins 120 mm - quantity and placing acc. to ISOVER manufa.</li> <li>15 Stud-welded pins 180 mm - quantity and placing acc. to ISOVER manufa.</li> <li>16 Fire spiral shaped screws - quantity and placing acc. to ISOVER manufa.</li> <li>17 Steel clamp min. M8 bolts</li> <li>18 ISOVER Protect BSF</li> <li>19 VRM2-B → see page 42</li> </ol> |
|---|---|

**In gypsum wall construction**

**In gypsum wall construction - mortar or gypsum**

**EI 120 (v<sub>e</sub> i↔o) S**

- For connection following duct → see page 34
- This installation was tested without supports. Supports are optional, if are used, follow the manufacturer's instructions and national standards.



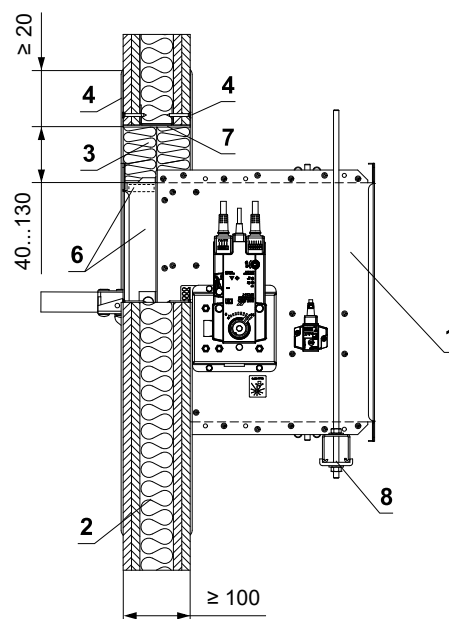
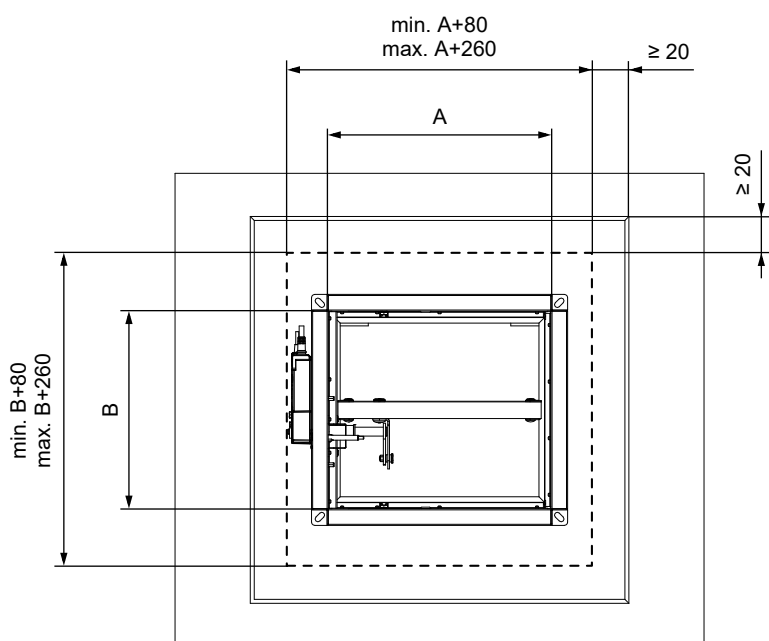
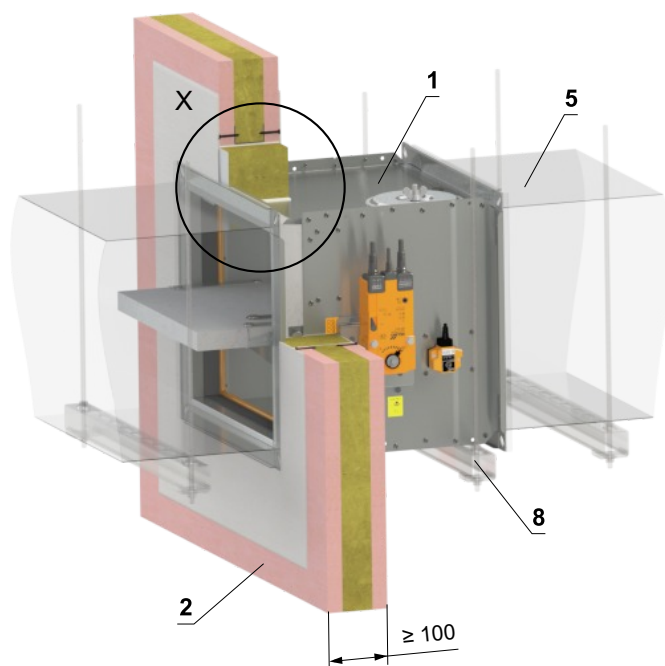
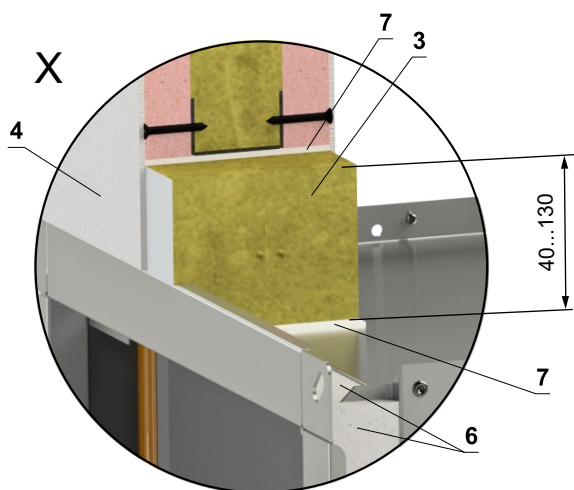
- 1 FDMB
- 2 Gypsum wall construction
- 3 British gypsum thistle bond 60 (or equivalent can by used) minimum density 670 kg/m<sup>3</sup>
- 4 Fixing profile with threaded rod → see pages 32 to 33
- 5 Duct

In gypsum wall construction - Ablative Coated Batt 100mm

■ For connection following duct → see page 34

EI 90 (v<sub>e</sub> i↔o) S with fire resistance wall EI 90

EI 60 (v<sub>e</sub> i↔o) S with fire resistance wall EI 60

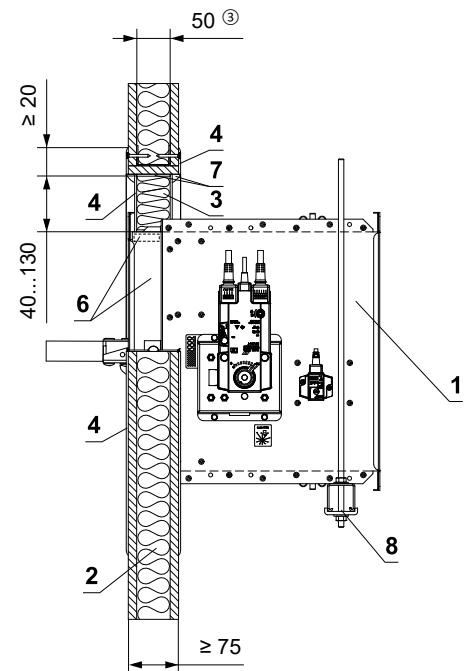
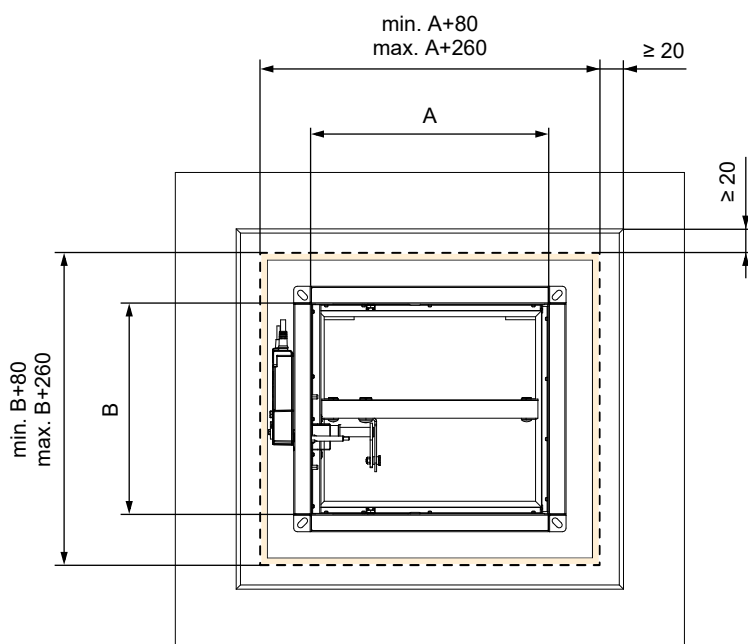
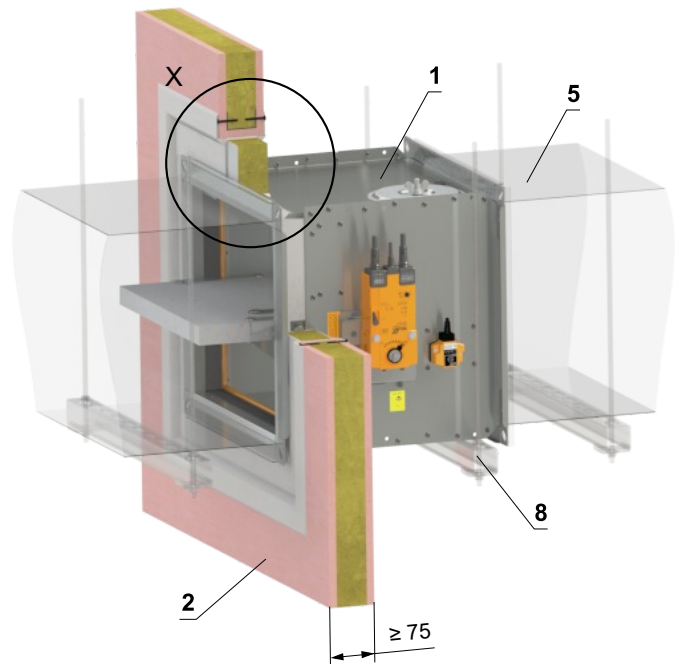
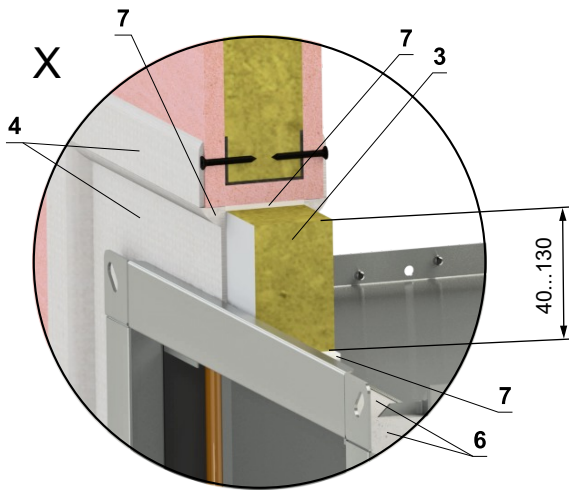


- 1 FDMB
- 2 Gypsum wall construction
- 3 Ablative Coated Batt (e.g. Firestop Board HILTI CFS-CT B 1S 140/50 - min. density 140 kg/m<sup>3</sup> + Firestop acrylic sealant HILTI CFS-S ACR or equivalent)
- 4 Fire stop coating thickness 1 mm (e.g. HILTI CFS-CT, PROMASTOP-CC or equivalent)
- 5 Duct
- 6 Protective cladding boards - (not part of the damper) but must be used as part of the penetration filling → see page 43
- 7 Fire resistant mastic - fill the gap on both sides of the fire separation construction and around the perimeter of penetration and damper body. (e.g. HILTI CFS-S ACR)
- 8 Fixing profile with threaded rod → see pages 32 to 33

In gypsum wall construction - Ablative Coated Batt 50mm

- For connection following duct → see page 34
- In this installation below do not use BUILT IN EDGE sticker. The Damper blade must be installed in the centre line of the wall construction.

EI 45 (v<sub>e</sub> i↔o) S with fire resistance wall EI 45  
EI 30 (v<sub>e</sub> i↔o) S with fire resistance wall EI 30



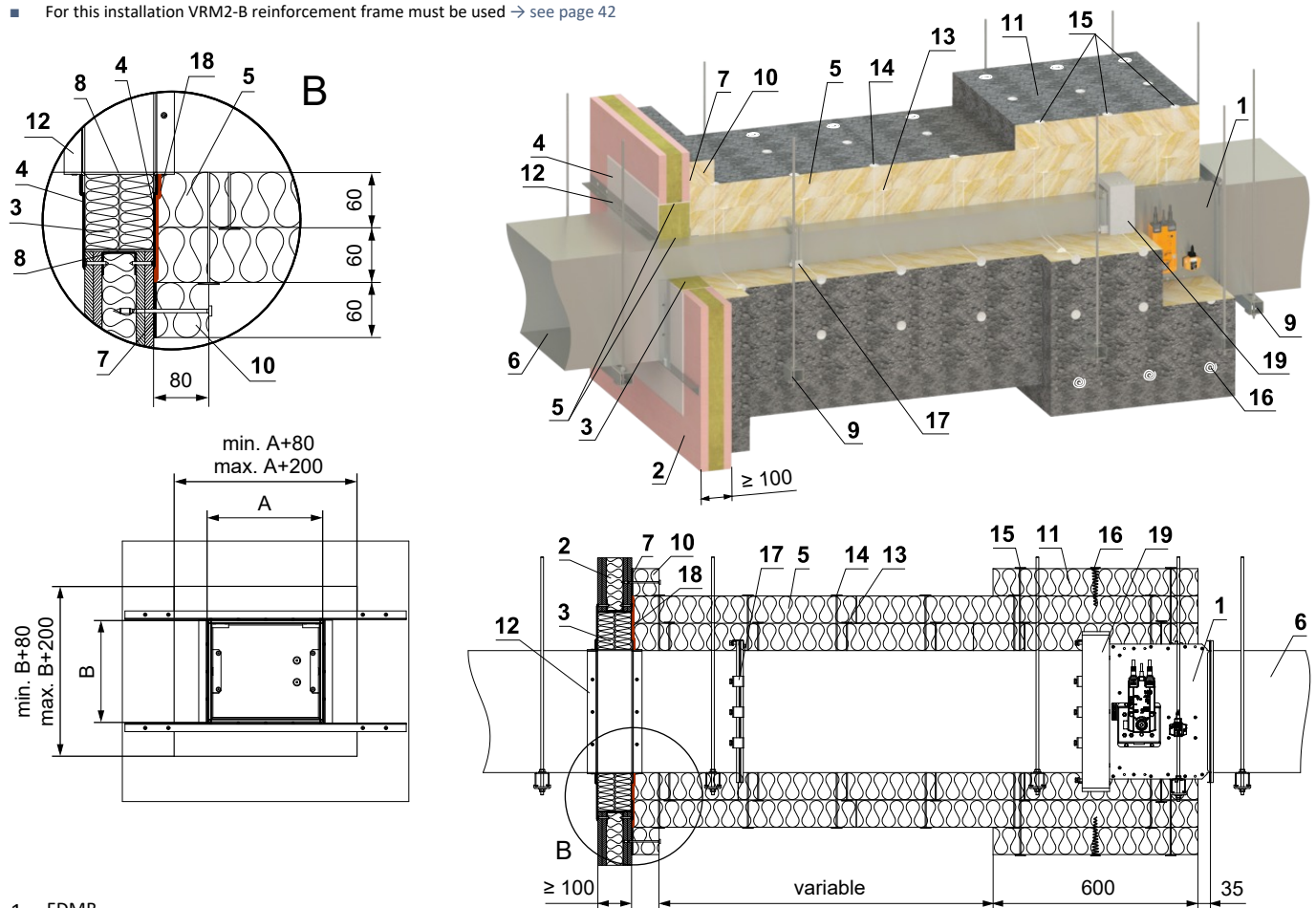
- 1 FDMB
- 2 Gypsum wall construction
- 3 Ablative Coated Batt (e.g. Firestop Board HILTI CFS-CT B 1S 140/50 - min. density 140 kg/m<sup>3</sup> + Firestop acrylic sealant HILTI CFS-S ACR or equivalent)
- 4 Fire stop coating thickness 1 mm (e.g. HILTI CFS-CT, PROMASTOP-CC or equivalent)
- 5 Duct
- 6 Protective cladding boards - (not part of the damper) but must be used as part of the penetration filling → see page 43
- 7 Fire resistant mastic - fill the gap on both sides of the fire separation construction and around the perimeter of penetration and damper body. (e.g. HILTI CFS-S ACR)
- 8 Fixing profile with threaded rod → see pages 32 to 33

## Installation outside gypsum wall construction

### Outside gypsum wall construction - ISOVER Ultimate Protect - Ablative Coated Batt

EI 90 (v<sub>e</sub> i↔o) S

- For connection of following duct → see page 34
- Minimum and maximum distance between the wall and fire damper is unlimited
- When installing the insulation, follow the ISOVER manufacturer's instructions
- The damper and the duct must be suspended separately
- The duct must be suspended on both sides of damper acc. to national rules
- Duct between fire damper and fire separating construction must be suspended by using threaded rods and mounting profiles, or another mounting system acc. to national standards
- Load of the suspension system depends on weight of the fire damper and duct system → see page 32
- Max. distance between two suspension systems is 1500 mm
- Duct at the point of penetration must be fixed to the fire separation structure
- Following air-conditioning duct must be suspended or supported so that all load transfer from the following duct to the fire damper is absolutely excluded. Adjacent duct must be suspended or supported, as required by the duct suppliers
- Damper inspection holes are covered with insulation, therefore it's necessary to make an inspection hole on the connecting duct
- If the threaded rod is located inside the duct insulation, distance between threaded rod and duct is max 30 mm
- If the threaded rod is located outside the duct isolation, distance between threaded rod and isolation is max. 40 mm
- For this installation VRM2-B reinforcement frame must be used → see page 42



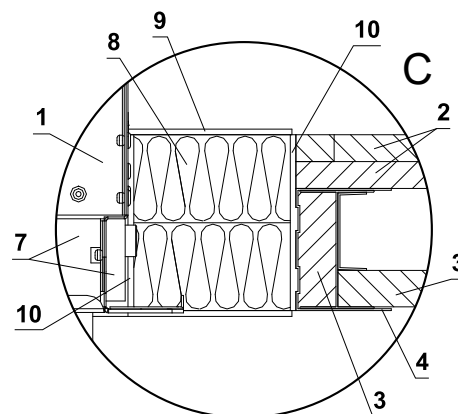
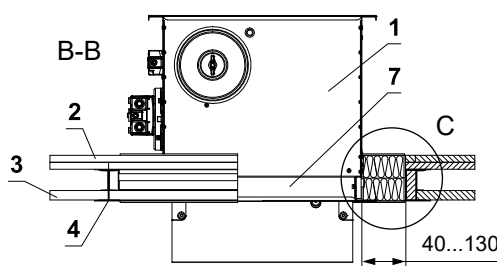
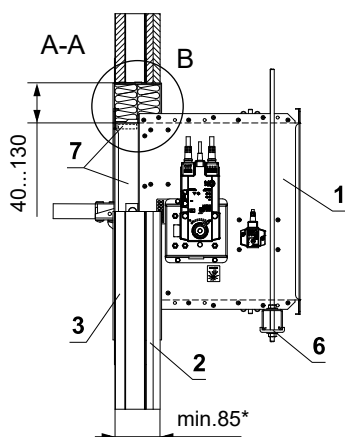
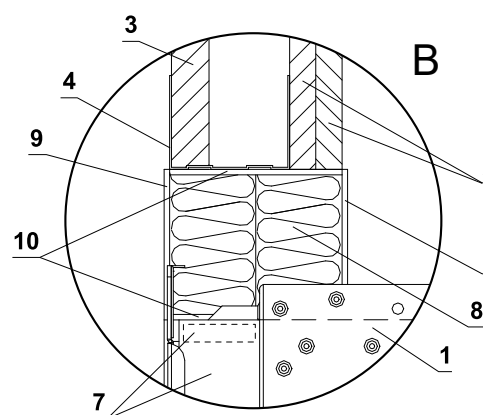
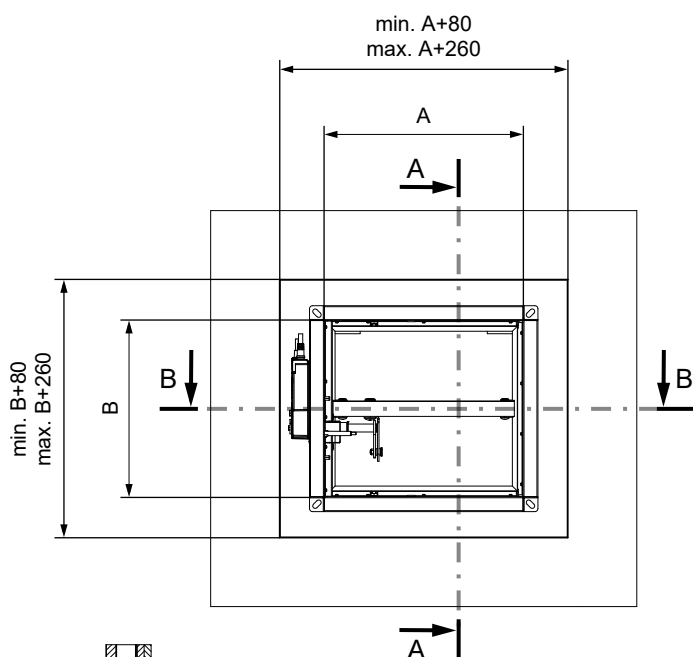
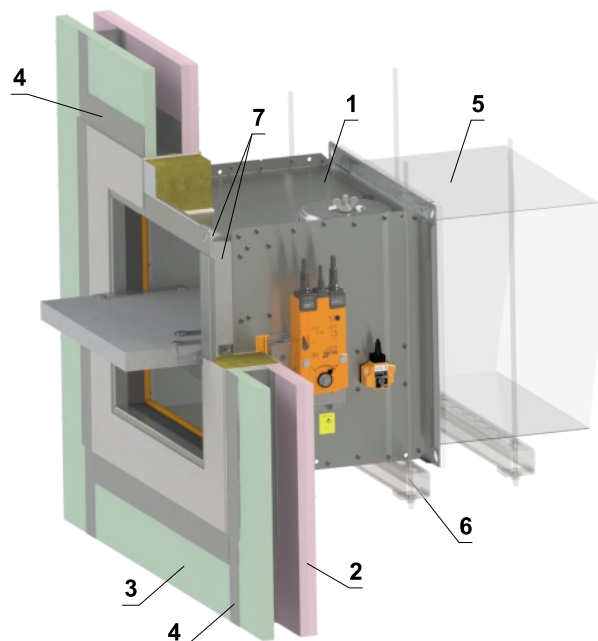
- |  |   |
|--|---|
| <ol style="list-style-type: none"> <li>1 FDMB</li> <li>2 Gypsum wall construction</li> <li>3 Ablative Coated Batt (e.g. Firestop Board HILTI CFS-CT B 1S 140/50 - min. density 140 kg/m<sup>3</sup> + Firestop acrylic sealant HILTI CFS-SACR or equivalent)</li> <li>4 Fire stop coating thickness 1 mm (e.g. HILTI CFS-CT, PROMASTOP-CC or equivalent)</li> <li>5 Insulation board made of stone wool, with a surface treatment of aluminum foil, min. density 66 kg/m<sup>3</sup> (ISOVER Ultimate Protect SLAB 4.0 Alu1, th. 60 mm)</li> <li>6 Standard air ducts, made of galvanized sheet thickness 0,8 mm, flanges 30 mm, acc. to BS EN 1507 and DIN 24190</li> <li>7 ISOVER Protect BSK glue - apply on the insulation and stick it to the fire separation construction</li> <li>8 Fire resistant mastic - fill the gap on both sides of the fire separation construction and around the perimeter of penetration and damper body. (e.g. HILTI CFS-SACR)</li> <li>9 Fixing profile with threaded rod → see pages 32 to 33</li> </ol> | <ol style="list-style-type: none"> <li>10 Duct penetration insulation collar - ISOVER Ultimate Protect SLAB 4.0 Alu1, th. 60 mm - glued (pos. 7) and fixed with screws to the wall construction</li> <li>11 Insulating collar of the damper and duct connection - ISOVER Ultimate Protect SLAB 4.0 Alu1, th. 60 mm</li> <li>12 L-profile 30x30x3 mm - dimensions and installation acc. to ISOVER manufacturer</li> <li>13 Stud-welded pins 60 mm - quantity and placing acc. to ISOVER manufa.</li> <li>14 Stud-welded pins 120 mm - quantity and placing acc. to ISOVER manufa.</li> <li>15 Stud-welded pins 180 mm - quantity and placing acc. to ISOVER manufa.</li> <li>16 Fire spiral shaped screws - quantity and placing acc. to ISOVER manufa.</li> <li>17 Steel clamp min. M8 bolts</li> <li>18 ISOVER Protect BSF</li> <li>19 VRM2-B → see page 42</li> </ol> |
|--|---|

**In shaft wall construction**

**EI 90 (v<sub>e</sub> i↔o) S with fire resistance wall EI 90**  
**EI 60 (v<sub>e</sub> i↔o) S with fire resistance wall EI 60**

**In shaft wall construction - Ablative Coated Batt**

- For connection of following duct → see page 34
- Damper can be installed on either side of the wall
- It is possible to use e.g. wall type A306002 (EIS 60), A306003 (EIS 90)... from [www.british-gypsum.com](http://www.british-gypsum.com)
- It is possible to use walls that have the same or greater thickness and density of boards than the walls listed below (more layers of boards can also be used)
- Follow the instructions of the shaft wall manufacturer.



- 1 FDMB
- 2 Plasterboard BS EN 520 - Type F min. 2x12,5 mm\*
- 3 Plasterboard BS EN 520 - Type F min. 1x19 mm\*
- 4 Plasteboard profile
- 5 Duct
- 6 Fixing profile with threaded rod → see pages 32 to 33
- 7 Protective cladding board - min. th. 10 mm, min. density 870 kg/m<sup>3</sup> (e.g. PROMATECT-H) → see page 43  
Ablative Coated Batt HILTI
- 8 Firestop Board - min. density 140 kg/m<sup>3</sup> (HILTI CFS-CT B 1S 140/50...)
- 9 Fire stop coating - th. 1 mm (HILTI CFS-CT...) - coating is overcoated on the support construction and on the damper casing/duct
- 10 Firestop acrylic sealant - (HILTI CFS-S ACR...) fill the gap from both sides of the fire separation construction and around the perimeter of penetration and damper casing

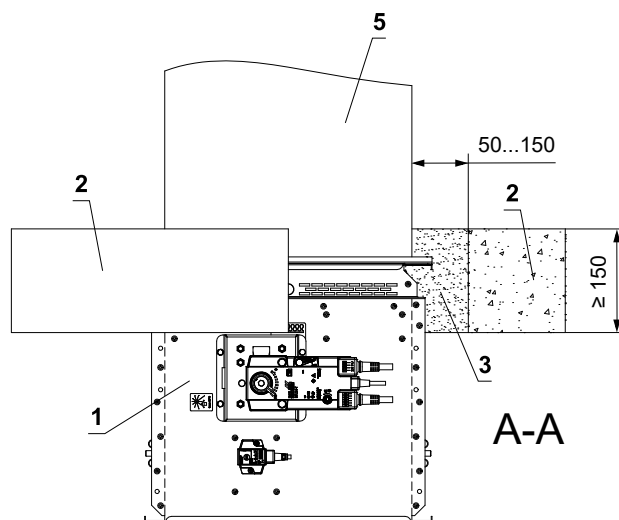
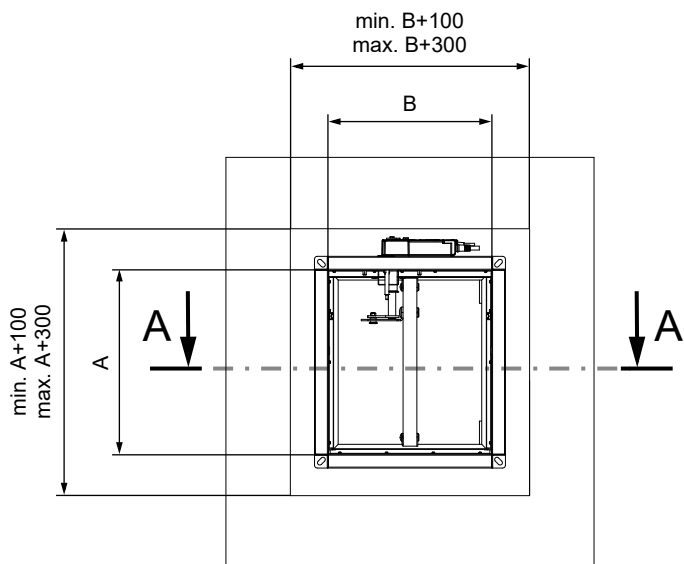
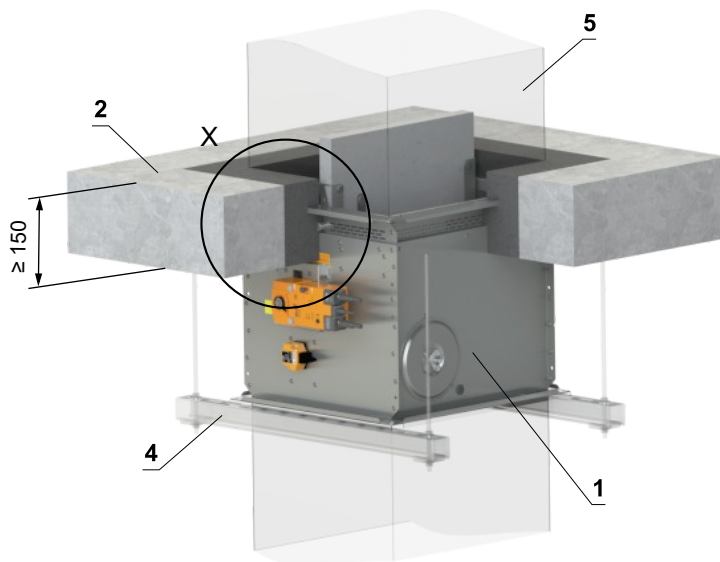
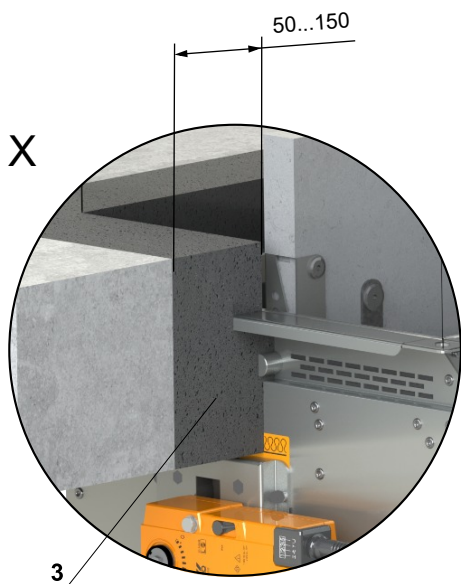
\* For fire resistance of the shaftwall EIS 60

### In solid ceiling construction

#### In solid ceiling construction - mortar or gypsum

EI 120 (h<sub>o</sub> i↔o) S

- For connection following duct → see page 34
- This installation was tested without supports. Supports are optional, if are used, follow the manufacturer's instructions and national standards.



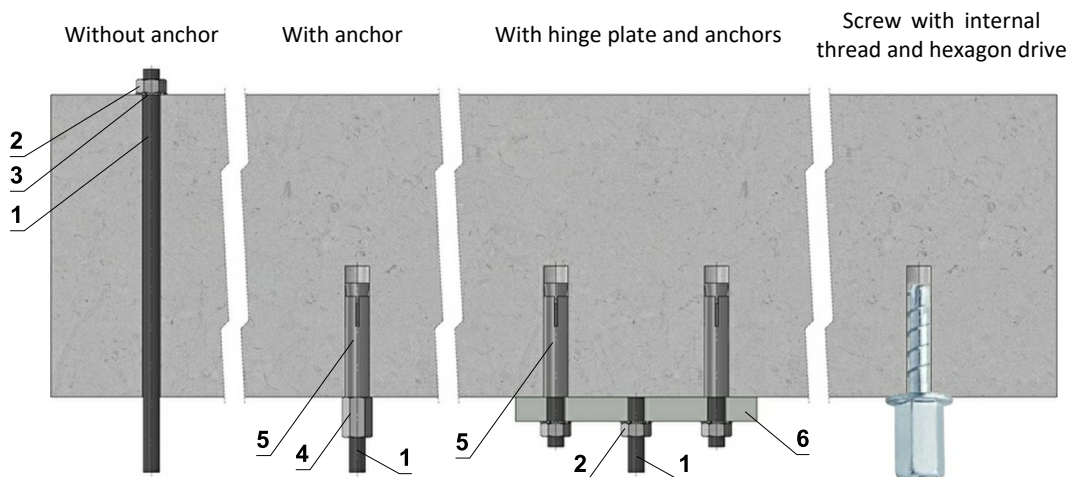
- 1 FDMB
- 2 Solid ceiling construction
- 3 British gypsum thistle bond 60 (or equivalent can by used)  
minimum density 670 kg/m<sup>3</sup>
- 4 Fixing profile with threaded rod → see pages 32 to 33
- 5 Duct

# V. SUSPENSION SYSTEMS

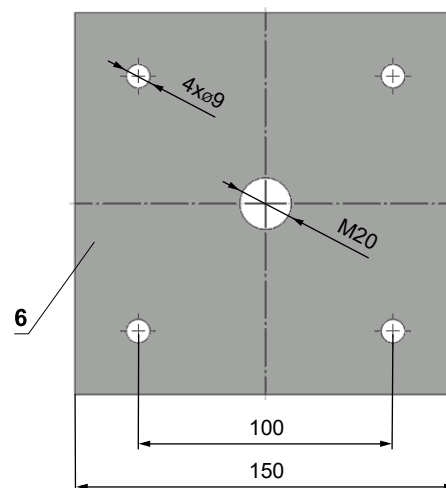
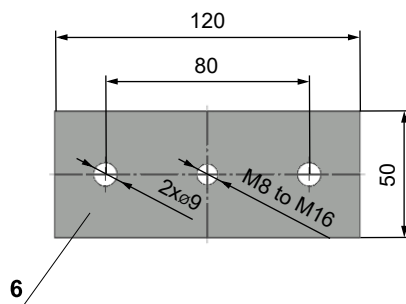
## Mounting to the ceiling wall

- The dampers must be suspended using threaded rods and mounting profiles. Their dimensioning depend on the weight of the damper.
- The dampers and the duct must be suspended separately.
- Following air-conditioning duct must be suspended or supported so that all load transfer from the following duct to the damper flanges is absolutely excluded. Adjacent duct must be suspended or supported, as required by the duct suppliers.
- Threaded rods longer than 1,5 m must be protected by fire insulation.

### Examples of anchoring to the ceiling construction Follow the instructions of fixing specialist or installation company



Hinge plates



- If in doubt, always consult an anchor specialist engineer such as Halfen or Hilti.

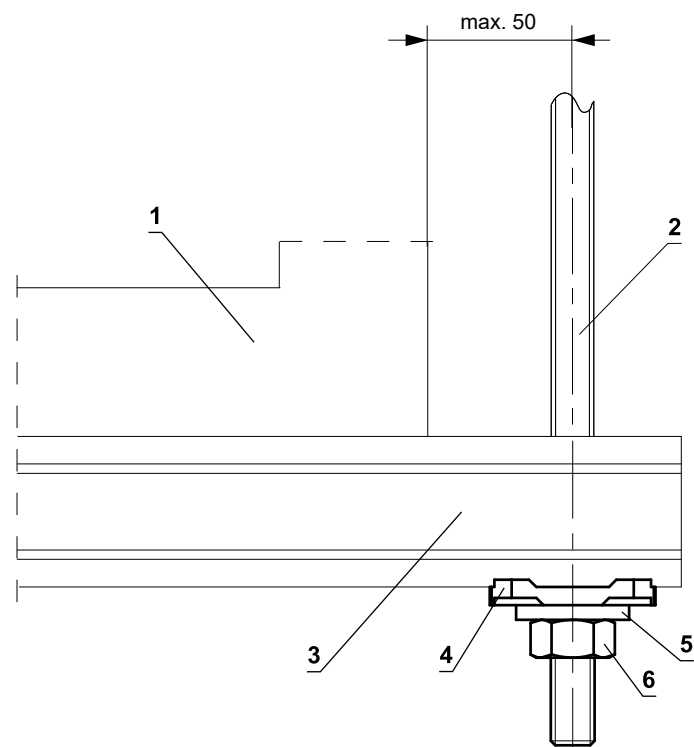
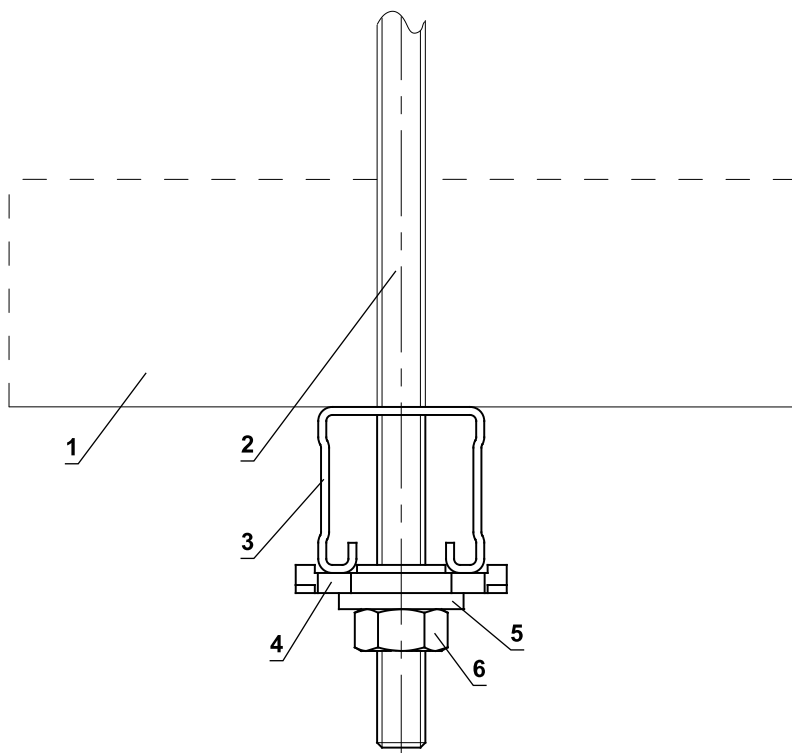
#### Load capacities of threaded rods at the required fire resistance 60 min. <math>t \le 120 \text{ min.}</math>

Size	As [mm <sup>2</sup> ]	Weight [kg]	
		for 1 rod	for 2 rods
M8	36,6	22	44
M10	58	35	70
M12	84,3	52	104
M16	157	96	192
M18	192	117	234
M20	245	150	300

- 1 Threaded rod M8 - M20
- 2 Nut M8 - M20
- 3 Washer for M8 - M20
- 4 Coupling Nut M8 - M20
- 5 Anchor
- 6 Hinge plate - min. thickness 10 mm
- 7 Concrete screw tested for fire resistance R30-R90, max. Tension up to 0.75 KN (length 35 mm)

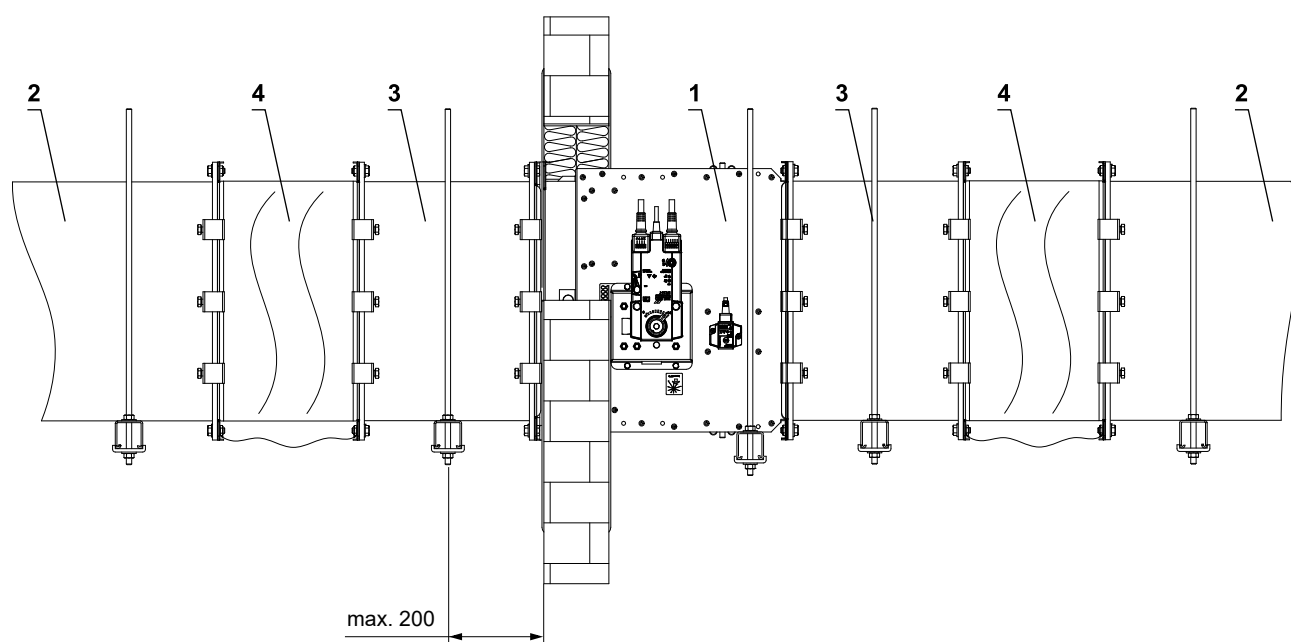


## Example of placing of mounting profiles HILTI



- 1 FDMB
- 2 Threaded rod M8 - M12
- 3 Support HILTI MQ-41 or MQ-41/3
- 4 Bored plate HILTI MQZ-L
- 5 Washer for M8 - M12
- 6 Nut M8 - M12

Example of duct connection



- 1 FDMB
- 2 Connecting air duct
- 3 Extension piece (if required)
- 4 Damping pad or breakaway connection as DW 144

# VI. TECHNICAL DATA

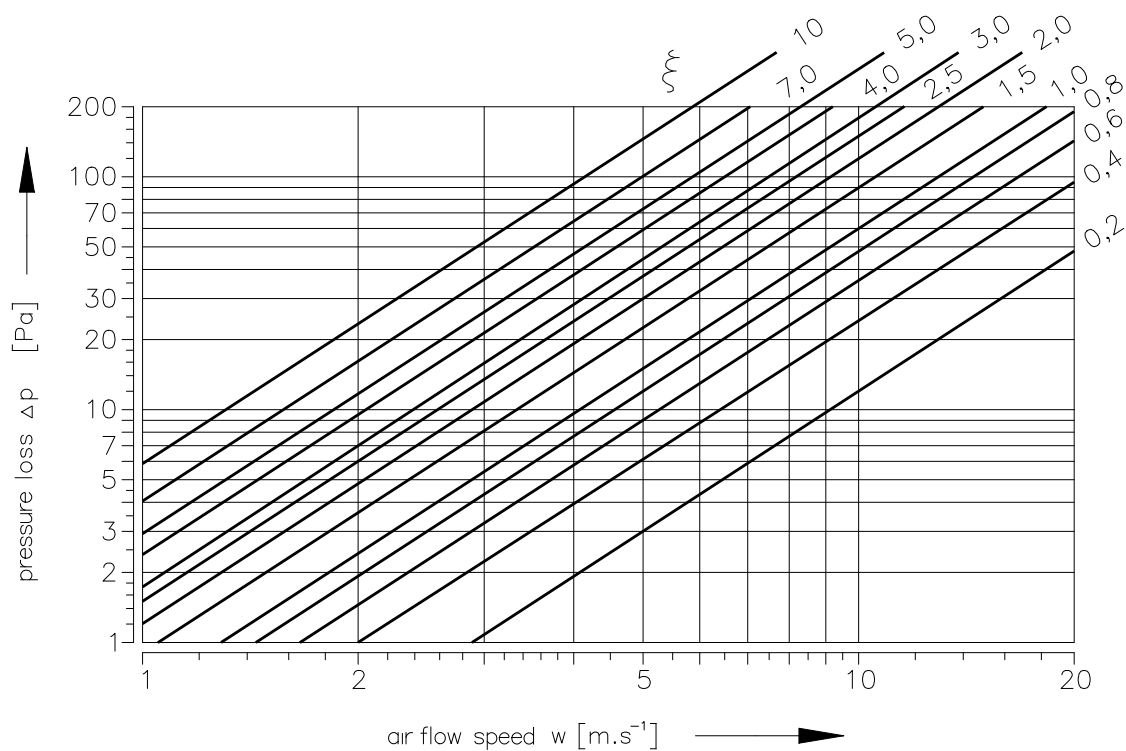
## Pressure loss

### Pressure loss calculation

$$\Delta p = \xi \cdot \rho \cdot \frac{w^2}{2}$$

$\Delta p$	[Pa]	pressure loss
$w$	[m/s]	air flow speed in nominal damper section
$\rho$	[kg/m <sup>3</sup> ]	air density
$\xi$	[-]	coefficient of local pressure loss for the nominal damper section → see page 36

Determination of pressure loss by using diagram  $\rho = 1,2 \text{ kg/m}^3$



Coefficient of local pressure loss

A	B													
	100	110	125	140	150	160	180	200	225	250	280	300	315	355
100	19,025	15,910	11,370	7,983	6,374	5,264	2,959	2,962	2,162	1,548	1,399	-	-	-
110	15,690	12,678	9,499	6,910	5,576	4,528	2,743	2,649	1,978	1,459	1,299	-	-	-
125	11,247	9,984	7,440	5,444	4,529	3,773	2,461	2,208	1,744	1,327	1,163	-	-	-
140	8,673	7,669	5,933	4,489	3,755	3,195	2,204	1,893	1,552	1,217	1,044	-	-	-
150	7,408	6,620	5,144	4,007	3,388	2,899	2,091	1,728	1,443	1,160	0,985	-	-	-
160	6,659	5,813	4,748	3,683	3,129	4,771	3,458	2,717	2,285	1,813	1,538	1,407	1,327	1,165
180	4,528	4,270	3,630	3,000	2,644	4,102	3,251	2,351	2,016	1,676	1,342	1,221	1,136	0,986
200	4,490	4,170	3,466	2,807	2,446	3,701	2,951	2,105	1,867	1,554	1,302	1,113	1,052	0,933
225	4,220	3,969	3,379	2,767	2,431	3,654	2,873	2,056	1,726	1,475	1,226	1,067	1,029	0,917
250	4,120	3,904	3,306	2,744	2,405	3,588	2,793	2,005	1,675	1,386	1,155	1,033	0,987	0,893
280	3,520	3,404	3,005	2,551	2,266	3,411	2,692	1,975	1,599	1,341	1,123	0,986	0,916	0,822
300	3,307	3,225	2,876	2,457	2,189	3,288	2,599	1,903	1,536	1,315	1,101	0,974	0,911	0,787
315	3,219	3,139	2,760	2,338	2,072	3,102	2,454	1,833	1,489	1,289	0,988	0,933	0,833	0,721
355	2,914	2,842	2,550	2,195	1,963	2,955	2,302	1,796	1,412	1,199	0,956	0,902	0,799	0,678
400	3,291	3,125	2,665	2,196	1,926	2,833	2,159	1,703	1,356	1,126	0,931	0,825	0,711	0,635
450	-	-	2,690	2,176	1,884	2,732	2,055	1,623	1,302	1,103	0,852	0,777	0,677	0,599
500	-	-	2,590	2,110	1,836	2,670	1,988	1,587	1,251	1,025	0,796	0,725	0,618	0,529
550	-	-	1,976	1,885	1,731	4,219	2,941	2,237	1,687	1,402	1,156	1,039	0,968	0,827
560	-	-	1,978	1,884	1,727	4,194	2,922	2,222	1,623	1,392	1,147	1,031	0,910	0,820
600	-	-	-	1,841	1,696	4,104	2,857	2,170	1,573	1,357	1,117	1,004	0,935	0,797
630	-	-	-	1,828	1,682	4,046	2,814	2,137	1,553	1,334	1,098	0,986	0,918	0,782
650	-	-	-	1,814	1,670	4,010	2,788	2,116	1,526	1,320	1,086	0,975	0,908	0,773
700	-	-	-	-	1,664	3,975	2,759	2,098	1,515	1,297	1,071	0,965	0,892	0,761
710	-	-	-	-	1,645	3,918	2,720	2,062	1,496	1,284	1,055	0,947	0,881	0,749
750	-	-	-	-	1,630	3,865	2,682	2,032	1,475	1,264	1,037	0,931	0,866	0,736
800	-	-	-	-	1,612	3,808	2,640	1,999	1,445	1,241	1,018	0,913	0,849	0,721
900	-	-	-	-	-	3,715	2,572	1,946	1,414	1,205	0,988	0,885	0,822	0,697
1000	-	-	-	-	-	3,643	2,519	1,904	1,395	1,177	0,964	0,863	0,801	0,679

A	B													
	400	450	500	550	560	600	630	650	700	710	750	800	900	1000
100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
110	-	-	-	-	-	-	-	-	-	-	-	-	-	-
125	-	-	-	-	-	-	-	-	-	-	-	-	-	-
140	-	-	-	-	-	-	-	-	-	-	-	-	-	-
150	-	-	-	-	-	-	-	-	-	-	-	-	-	-
160	1,040	2,025	1,874	1,761	1,741	1,672	1,627	1,601	1,598	1,532	1,493	1,452	1,386	1,336
180	0,922	1,676	1,548	1,451	1,434	1,375	1,337	1,315	1,289	1,256	1,224	1,180	1,133	1,090
200	0,801	1,445	1,332	1,246	1,232	1,179	1,146	1,126	1,106	1,074	1,046	1,015	0,965	0,928
225	0,781	1,239	1,172	1,075	1,035	0,998	0,965	0,938	0,926	0,905	0,873	0,856	0,822	0,803
250	0,736	1,113	1,021	0,952	0,940	0,898	0,871	0,855	0,831	0,813	0,790	0,765	0,725	0,695
280	0,713	0,996	0,912	0,849	0,880	0,800	0,775	0,760	0,742	0,722	0,701	0,678	0,641	0,613
300	0,692	0,937	0,857	0,797	0,786	0,750	0,726	0,712	0,689	0,675	0,655	0,633	0,599	0,572
315	0,634	0,900	0,822	0,764	0,754	0,718	0,695	0,681	0,662	0,646	0,626	0,605	0,572	0,546
355	0,588	0,821	0,749	0,694	0,685	0,651	0,630	0,617	0,603	0,584	0,566	0,546	0,514	0,490
400	0,527	0,757	0,689	0,637	0,628	0,597	0,577	0,565	0,543	0,534	0,516	0,498	0,468	0,445
450	0,507	0,705	0,640	0,591	0,583	0,553	0,534	0,522	0,503	0,493	0,476	0,458	0,430	0,408
500	0,460	0,666	0,603	0,556	0,548	0,520	0,501	0,490	0,482	0,462	0,446	0,429	0,401	0,380
550	0,719	0,635	0,575	0,529	0,521	0,494	0,476	0,465	0,441	0,437	0,422	0,405	0,379	-
560	0,713	0,630	0,570	0,524	0,517	0,489	0,471	0,461	0,448	0,433	0,418	0,401	-	-
600	0,692	0,611	0,552	0,507	0,500	0,473	0,455	0,445	0,426	0,418	0,403	0,387	-	-
630	0,678	0,598	0,540	0,496	0,489	0,462	0,445	0,435	0,418	0,408	0,393	-	-	-
650	0,670	0,590	0,533	0,490	0,482	0,456	0,439	0,428	0,414	0,402	0,387	-	-	-
700	0,656	0,581	0,527	0,483	0,476	0,444	0,431	0,421	0,409	0,398	-	-	-	-
710	0,648	0,571	0,515	0,472	0,465	0,439	0,422	0,412	0,399	-	-	-	-	-
750	0,636	0,560	0,504	0,462	0,455	0,429	0,413	0,403	-	-	-	-	-	-
800	0,623	0,547	0,493	0,451	0,444	0,419	-	-	-	-	-	-	-	-
900	0,602	0,528	0,474	0,434	-	-	-	-	-	-	-	-	-	-
1000	0,585	0,512	0,460	-	-	-	-	-	-	-	-	-	-	-

## Noise data

## Level of acoustic output corrected with filter A

$$L_{WA} = L_{W1} + 10 \log(S) + K_A$$

$L_{WA}$	[dB(A)]	level of acoustic output corrected with filter A
$L_{W1}$	[dB]	level of acoustic output $L_{W1}$ related to the 1 m <sup>2</sup> section
$S$	[m <sup>2</sup> ]	duct cross section
$K_A$	[dB]	correction to the weight filter A

## Level of acoustic output in octave ranges

$$L_{Woct} = L_{W1} + 10 \log(S) + L_{rel}$$

$L_{Woct}$	[dB]	spectrum of acoustic output in octave range
$L_{W1}$	[dB]	level of acoustic output $L_{W1}$ related to the 1 m <sup>2</sup> section
$S$	[m <sup>2</sup> ]	duct cross section
$L_{rel}$	[dB]	relative level expressing the shape of the spectrum

## Tables of acoustics values

Level of acoustic output $L_{W1}$ [dB] related to the 1 m <sup>2</sup> section															
$w$ [m/s]	$\xi$ [-]														
	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1	1,5	2	2,5	3	4	5
2	15,5	18,7	20,9	22,6	24	25,2	26,3	27,2	28	31,2	33,4	35,1	36,5	38,8	40,5
3	26,1	29,2	31,5	33,2	34,6	35,8	36,9	37,8	38,6	41,7	44	45,7	47,1	49,4	51,1
4	33,6	36,7	39	40,7	42,1	43,3	44,3	45,3	46,1	49,2	51,5	53,2	54,6	56,9	58,6
5	39,4	42,5	44,8	46,5	47,9	49,1	50,2	51,1	51,9	55	57,3	59	60,4	62,7	64,4
6	44,1	47,3	49,5	51,3	52,7	53,9	54,9	55,8	56,6	59,8	62	63,8	65,2	67,4	69,2
7	48,2	51,3	53,5	55,3	56,7	57,9	58,9	59,8	60,7	63,8	66,1	67,8	69,2	71,4	73,2
8	51,6	54,8	57	58,8	60,2	61,4	62,4	63,3	64,1	67,3	69,5	71,3	72,7	74,9	76,7
9	54,7	57,9	60,1	61,8	63,2	64,4	65,5	66,4	67,2	70,4	72,6	74,3	75,7	78	79,7
10	57,4	60,6	62,8	64,6	66	67,2	68,2	69,1	70	73,1	75,3	77,1	78,5	80,7	82,5
11	59,9	63,1	65,3	67,1	68,5	69,7	70,7	71,6	72,4	75,6	77,8	79,6	81	83,2	85
12	62,2	65,4	67,6	69,3	70,7	71,9	73	73,9	74,7	77,9	80,1	81,8	83,2	85,5	87,2

Correction to the weight filter A												
$w$ [m/s]	2	3	4	5	6	7	8	9	10	11	12	
$K_A$ [dB]	-15	-11,8	-9,8	-8,4	-7,3	-6,4	-5,7	-5	-4,5	-4	-3,6	

Relative level expressing the shape of the spectrum $L_{rel}$								
$w$ [m/s]	$f$ [Hz]							
	63	125	250	500	1000	2000	4000	8000
2	-4,5	-6,9	-10,9	-16,7	-24,1	-33,2	-43,9	-56,4
3	-3,9	-5,3	-8,4	-13,1	-19,5	-27,6	-37,4	-48,9
4	-3,9	-4,5	-6,9	-10,9	-16,7	-24,1	-33,2	-43,9
5	-4	-4,1	-5,9	-9,4	-14,6	-21,5	-30,0	-40,3
6	-4,2	-3,9	-5,3	-8,4	-13,1	-19,5	-27,6	-37,4
7	-4,5	-3,9	-4,9	-7,5	-11,9	-17,9	-25,7	-35,1
8	-4,9	-3,9	-4,5	-6,9	-10,9	-16,7	-24,1	-33,2
9	-5,2	-3,9	-4,3	-6,4	-10,1	-15,6	-22,7	-31,5
10	-5,5	-4	-4,1	-5,9	-9,4	-14,6	-21,5	-30
11	-5,9	-4,1	-4	-5,6	-8,9	-13,8	-20,4	-28,8
12	-6,2	-4,3	-3,9	-5,3	-8,4	-13,1	-19,5	-27,6

## VII. MATERIAL, FINISHING

- Damper casings are made from galvanized sheet metal without further surface treatment.
- Damper blades are made from fire resistant asbestos free boards made of mineral fibres.
- Manual control have cover made of mechanically resistant and durable plastic and the other parts are galvanized without further surface treatment.
- Thermal fuses are made of sheet brass, thickness 0,5 mm.
- Fasteners and springs are galvanized.
- According to the customer's requirements, dampers can be made of stainless steel material.

### Specifications for stainless-steel design:

- Class A2 – Food-grade stainless steel (AISI 304 – BS EN 1.4301)
- Class A4 – Chemistry-grade stainless steel (AISI 316, 316L – BS EN 1.4401, BS EN 1.4404)

The respective stainless steel is the material for all components that are located or entering the damper inner space; components outside the damper casing are typically from galvanised sheet metal (fasteners for mounting the actuator or manual control, mechanical components except Item 4), frame components.

### The following components, including the fasteners, are made from stainless steel at all times:

- 1) Damper casing and all components permanently attached
- 2) Blade holders including pins, metal parts of blades
- 3) Control components inside the damper (L-profile, pin with lever, rod, fasteners)
- 4) Parts of a manual control entering the inner space of a damper casing (lower sheet of a manual control, lock holder "1", lock lever "2", closing spring, 8 dia. stopper pin, manual control pin)
- 5) Inspection opening cover including the stirrup and fasteners (if they are parts of the cover)
- 6) Bearing for torque transfer from the lever with pin on the blade L-profile (made from AISI 440C)

The damper blade is made from a board of homogeneous material Promatect-MST, thickness 30 mm.

Thermal fuse is identical for all material variants of the dampers. Upon specification by customer, the thermal fuse can be made from A4 from stainless steel sheet metal.

Thermoelectric activation device BAT is modified for stainless-steel variant of the dampers; standard galvanised screws are replaced with stainless-steel M4 screws of corresponding class. Damper casing has stainless-steel riveting M4 nuts.

Plastic, rubber and silicon components, sealants, foaming tapes, glass-ceramic seals, housings, brass bearings of the blade, actuators, and end switches are identical for all material variants of the dampers.

Some fasteners and components are only available in one class of stainless steel; the type will be used in all stainless-steel variants.

The damper blade in the variant for chemical environments (Class A4) is always treated with a coating of chemically resistant Promat SR.

Any other requirements for the design will be considered atypical and will be addressed on an individual basis.

## VIII. TRANSPORTATION AND STORAGE

### Logistic terms

- Dampers are delivered on pallets. As standard, the dampers are wrapped in plastic foil for protection during transport and must not be used for long-term storage. Temperature changes during transport can cause condensation of water inside the packaging and thereby cause corrosion of materials used in the dampers (e.g. white corrosion on zinc-coated items or mould on calcium silicate). Therefore, it is necessary to remove the transport packaging immediately after unloading to allow air to circulate around the product.
- The dampers must be stored in clean, dry, well ventilated and dust-free environment out of direct sunlight. Ensure protection against moisture and extreme temperatures (minimum temperature +5°C). The dampers must be protected against mechanical and accidental damage prior to installation.
- Another required packaging system should be approved and agreed by manufacturer. Packaging material is not returnable in case that another packaging system (material) is required and used and it is not included into final price of damper.
- Dampers are transported by box freight vehicles without direct weather impact, there must not occur any shocks and ambient temperature must not exceed +50°C. Dampers must be protected against impact when transported and manipulated. During transportation, the damper blade must be in the "CLOSED" position.
- Dampers are stored indoor in environment without any aggressive vapours, gases or dust. Indoor temperature must be in the range from -30°C to +50°C and maximum relative humidity 95% (avoid condensation on the damper body). Dampers must be protected against impact when transported and manipulated.

## IX. ASSEMBLY, ATTENDANCE AND MAINTENANCE

- Assembly, maintenance and damper function check can be done only by qualified and trained person, i.e. "AUTHORIZED PERSON" according to the manufacturer documentation. All works done on the fire dampers must be done according international and local norms and laws.
- All effective safety standards and directives must be observed during damper assembly.
- To ensure reliable damper function it is necessary to avoid blocking the actuating mechanism and contact surfaces with collected dust, fibre and sticky materials and solvents.
- Flange and screw joints must be conductively connected to protect against dangerous contact. 2 galvanized lock washers that are placed under the head of one screw and a fastened nut are used for conductive connection.

### Manual operation - actuator control without electric voltage

- A special wrench (part of the actuator) can be used to manually turn the damper blade to any position. When the wrench is turned in the direction of the arrow, the damper blade rotates to its open position. As the blade rotation is stopped, in every position, the actuator will be locked. Unlocking is possible even manually as per instructions on the actuator, or by the activation of the supply voltage.
- If the actuator is manually locked, the damper blade will not close in the event of a fire after the activation of the thermoelectric activation device BAT. To restore correct damper operation, the actuator must be unlocked (manually or by applying power supply).

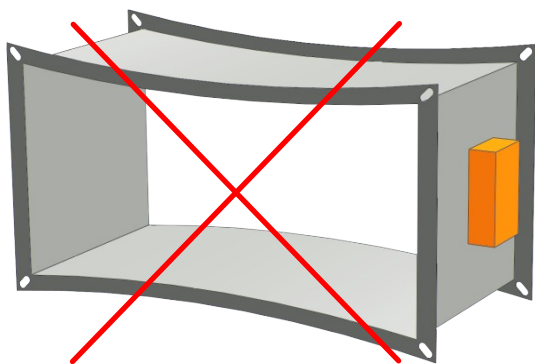
**Limit switches**

- If the damper is equipped with limit switches and these switches are not used during operation (e.g. because of a project change), they can be left on the damper and not connected (they need not be dismantled).
- On the other hand, if the limit switch is to be added to the damper design, the change can be implemented by change kit.
- These facts must be recorded in the respective operation documentation of the damper (record books of the damper, fire logs, etc.) and subsequently, adequate function checks must be carried out.

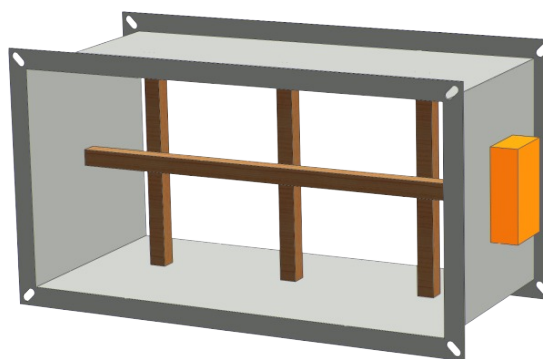
**Installation / fixing the damper**

- The damper casing shall not be deformed in the course of bricking in.
- Once the damper is built in, the damper blade shall not grind on the damper casing during opening or closing.

**Protection of the damper casing against buckling during installation, especially for large sizes!**



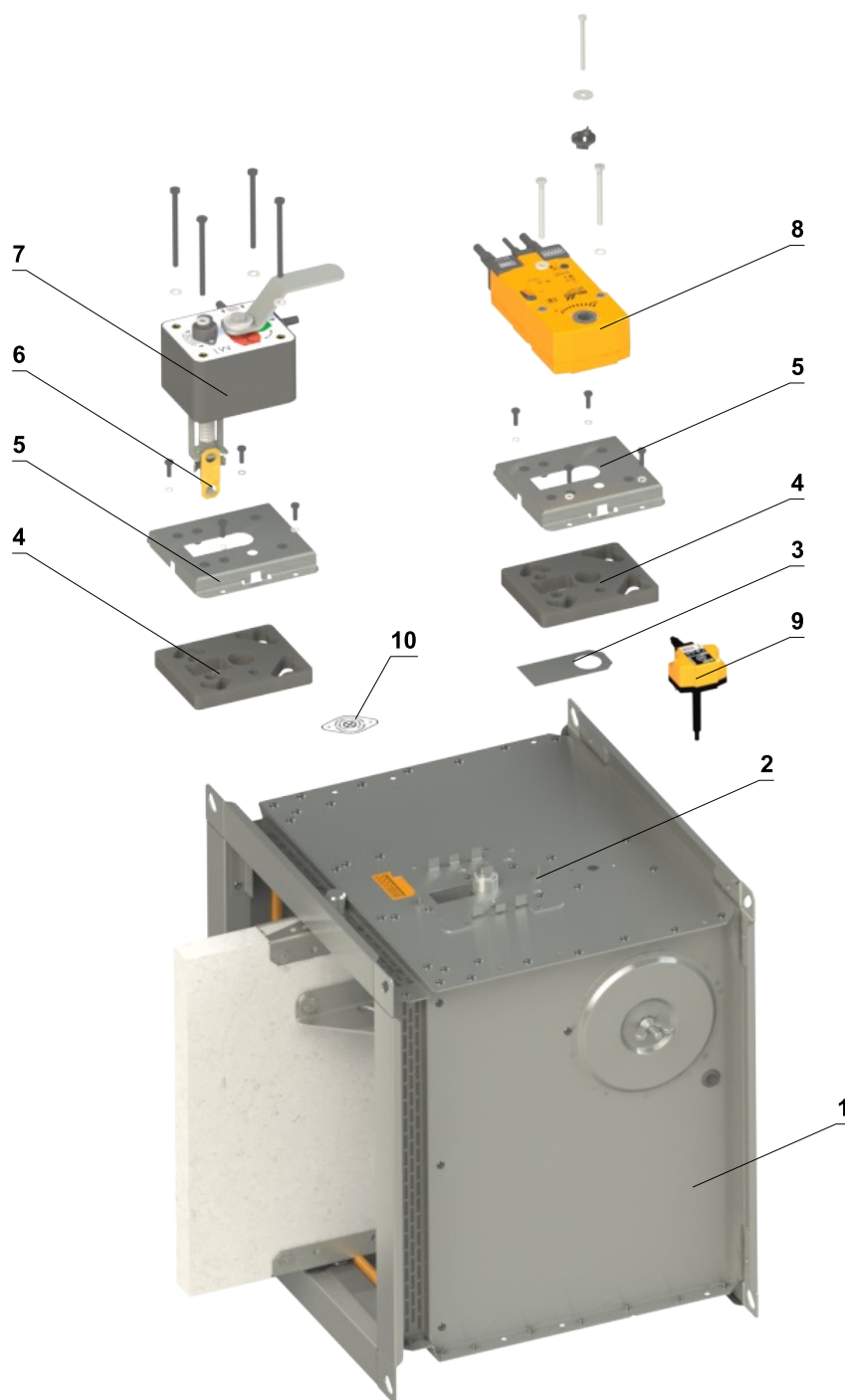
**WRONG!**



**Reinforcement of the casing with wooden beams**



Change of manual control for the actuator or vice versa

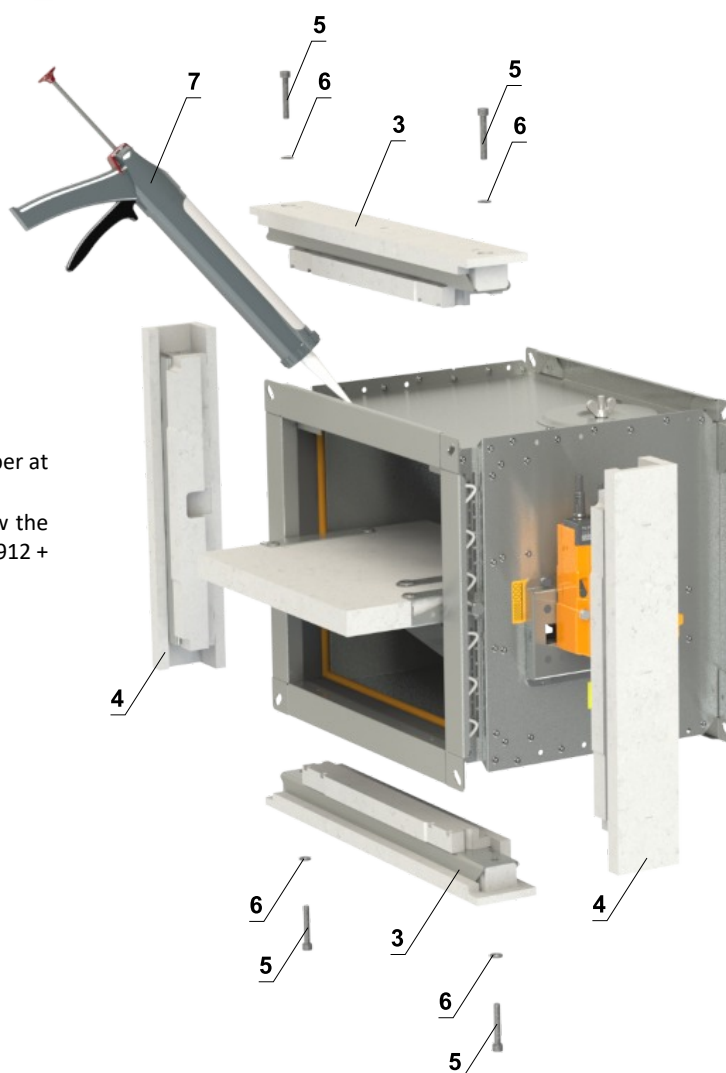
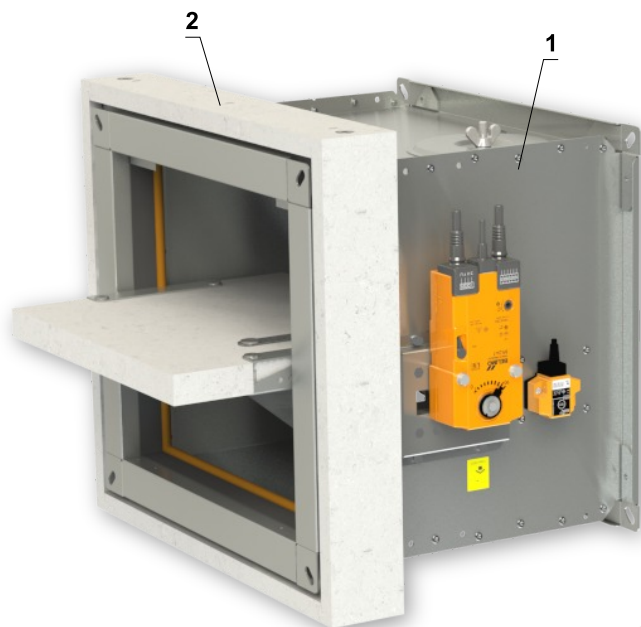


- |   |                             |    |                                      |
|---|-----------------------------|----|--------------------------------------|
| 1 | Damper                      | 6  | Thermal fuse                         |
| 2 | Mounting plate              | 7  | Manual control                       |
| 3 | Sealing cover               | 8  | Spring return actuator               |
| 4 | Sealing of a mounting plate | 9  | Thermoelectric activation device BAT |
| 5 | Cover of a mounting plate   | 10 | Sensor sticker                       |

**Reinforcing frame VRM2-B**

- If the damper is installed outside the fire separation construction with insulation from ISOVER and fire resistance is  $\geq$  EI 90 S, VRM2-B reinforcement frame must be used.
- For lower fire resistance than EI 90 S, VRM2-B reinforcement frame is not necessary!
- Glue K84 is not included in the package

**Fixing of reinforcing frame VRM2-B to the damper casing**



**Installation procedure**

- 1) Apply glue PROMAT K-84 on the entire surface of the damper at the place of perforation on all four sides of the damper
- 2) Attach parts A and B of the VRM2-B to the damper. Screw the parts together using four M8x50 hexagon socket bolts DIN 912 + four M8 washers DIN 7349.

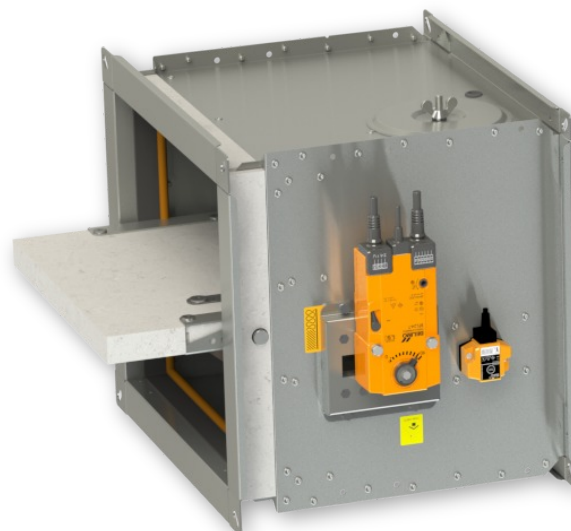
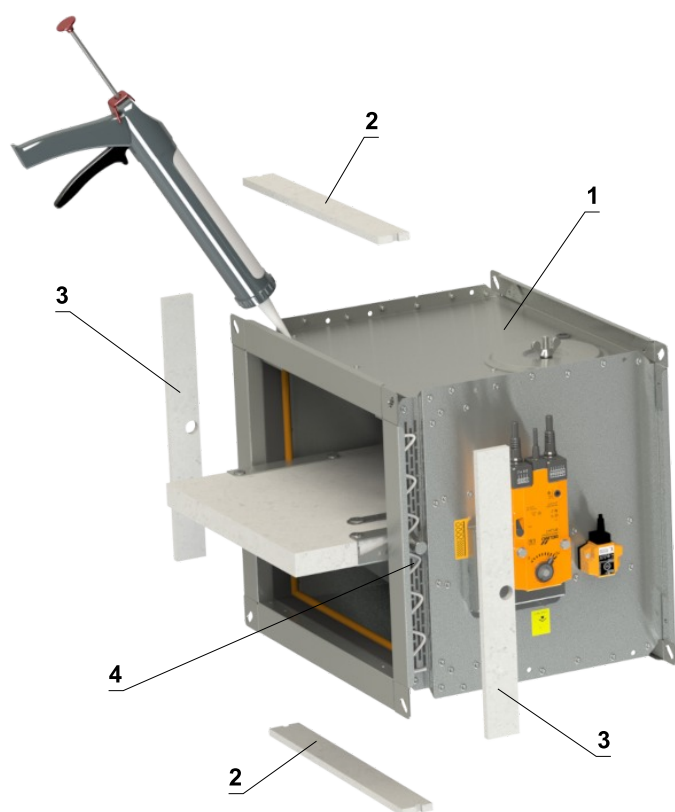
- 1 FDMB
- 2 VRM2-B
- 3 Part A of VRM2-B
- 4 Part B of VRM2-B
- 5 Hexagon socket bolt M8x50 DIN 912
- 6 Washer M8/8,4 DIN 7349
- 7 Glue PROMAT K-84

**Protective cladding boards**

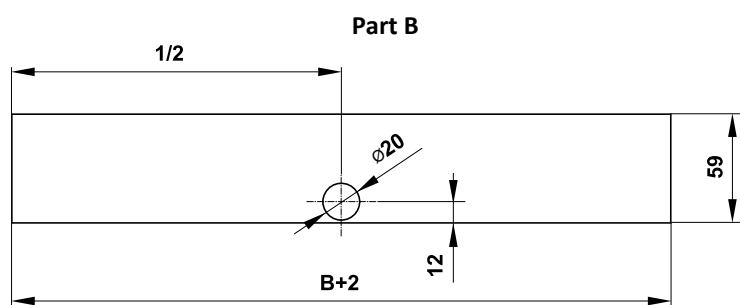
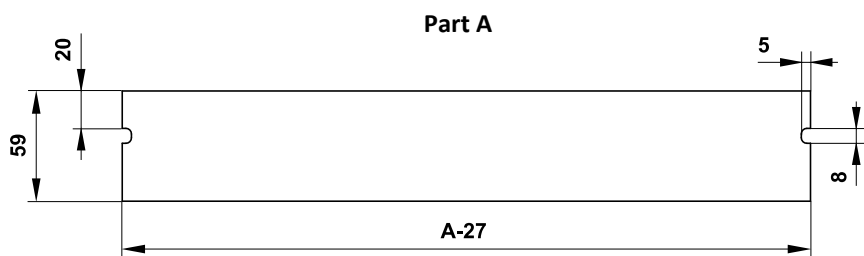
- Protective cladding boards must be used as part of the penetration filling of installation with ablative coated batt
- Can be ordered from MANDIK (installed on the damper or as an accessory) or can be sourced from local supplier
- If protective cladding boards are required, this must be specified in the ordering key
- Boards are made of PROMATECT-H, thickness 10 or 15 mm according to the damper size (SUPALUX, thickness 9 or 15 mm can be used as an alternative)
- Glue K84 is not included in the package

**Installation procedure**

- 1) Apply K84 glue over the entire surface
- 2) Attach protective cladding boards to the damper and glue them to the casing



- 1 FDMB
- 2 Part A
- 3 Part B
- 4 Glue K-84 PROMAT



- Thickness of protective cladding boards according to the damper size:
- for  $A \times B \leq 500 \times 400$ , thickness 10 mm
- for  $A \times B > 500 \times 400$ , thickness 15 mm

## Entry into service and revisions

- Before putting the damper into operation, serviceability checks and functional tests must be carried out including testing of functionality of all electrical elements. After putting into operation these serviceability checks must be carried out at least twice a year. If no defect is found during two subsequent serviceability checks, these checks can be carried out once a year.
- In case that dampers are found unable to serve for their function for any cause, it must be clearly marked. The operator is obliged to ensure that the damper is put into condition in which it is ready for function and meanwhile he is obliged to provide the fire protection by another appropriate way.
- Results of regular checks, imperfections found and all-important facts connected with the damper function must be recorded in the "FIRE BOOK" and immediately reported to the operator.
- Before entering the dampers with actuator into operation after their assembly and by sequential checks. Check of blade rotation into the breakdown position "CLOSED" can be done after disconnecting the actuator supply (e.g. by pressing the test button at the thermoelectric activation device BAT or disconnecting the supply from ELECTRICAL FIRE SIGNALISATION). Check of blade rotation back into the "OPEN" position can be done after restoration of power supply (e.g. by releasing the test button or restoration of supply from ELECTRICAL FIRE SIGNALISATION). Without power supply, the damper can be operated manually and fixed in any required position. Release of the locking mechanism can be achieved manually or automatically by applying the supply voltage. It is recommended to provide periodical checks, maintenance and service actions on fire equipment by authorized persons. The authorized persons can be trained by producer, or by authorized distributor. All effective safety standards and directives must be observed during fire damper assembly.
- Visual inspection of proper damper installation, inner area of a damper, damper blade, contact surfaces and silicon seal.
- For regular or exceptional inspection of interior of fire damper, micro-camera device can be used. On each fire damper is an inspection opening. In the case of inspection by camera, take out the black rubber cap, insert the camera inside the damper, check interior and at the end of inspection, put the rubber cap back tightly to cover the empty hole.

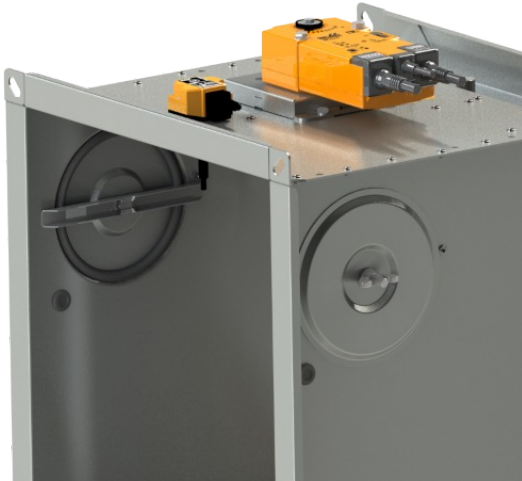
### Following checks must be carried out for dampers with manual control

#### Check of a manual control and thermal fuse

- **To check the function of the manual control proceed as follows:**
- Turn the damper blade to "CLOSED" position as follows:
  - The damper blade is in "OPEN" position.
  - Press the control button of the manual control to turn the damper blade to "CLOSED" position.
  - Check the damper blade rotation to "CLOSED" position.
  - Damper blade closing shall be smooth and fast, the control lever shall be in „CLOSED“ position.
- Turn the damper blade to "OPEN" position as follows:
  - Turn the control lever by 90°.
  - Check the damper blade rotation to "OPEN" position.
  - The lever will automatically lock in "OPEN" position.
- **Check of function and condition of the thermal fuse:**
  - To check the function and the status of the fuse it's possible to remove the manual control from the casing of the fire damper which is attached to the damper casing with four screws M6.
  - Removing the thermal fuse from the fuse holder of a manual control, checks its correct functionality.
  - The manual control is identified as M1 to M3, depending on the closing spring strength.

**Following checks must be carried out for dampers with actuator**

- Check the rotation of the blade to "CLOSED" failure position after disconnection the power supply of the actuator (e.g. by pressing the test button on the thermoelectric activation device BAT or by disconnection the power supply from electrical fire signalization). Check the rotation of the blade back to "OPEN" position by restoring the power supply to the actuator (e.g. by releasing the test button or by restoring the power supply from electrical fire signalization).
- Inspection opening disassembly
  - Release the covering lid by turning the wing nut and while turning the lid right or left release it from the security belt. Then tilt the lid and remove it from its original position.



*Inspection opening detail*

- Ensure each damper is fully checked for operational capability, control should be initiated from the control system or by manual control. Damper blades should open and close correctly and operation should be visually inspected and documented prior to handover.

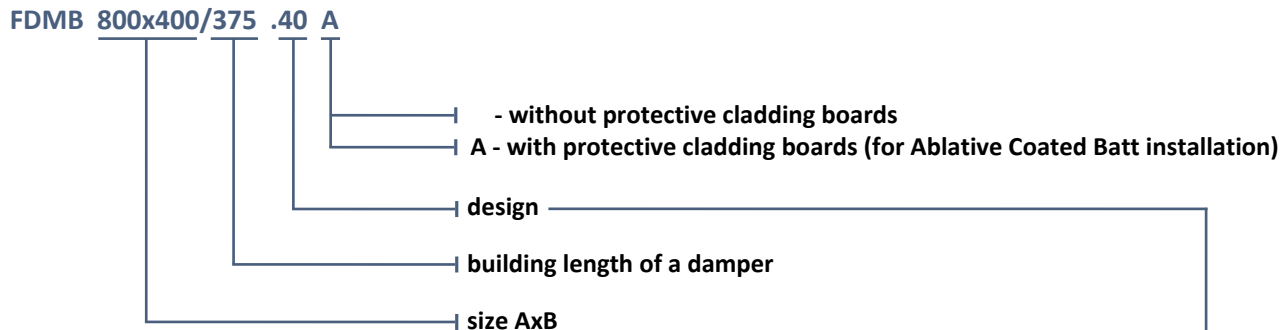
**How to proceed after Tf1 or Tf2 fuses have been activated**

- If the thermal fuse **Tf1** is interrupted (due to temperature outside the duct), it is necessary to replace the spring return actuator. → see page 10
- If the thermal fuse **Tf2** is interrupted (due to temperature inside the duct) , only the spare part ZBAT 72 (95/120/140) needs to be replaced (acc.to the activation temperature). → see page 10

# X. ORDERING INFORMATIONS

## Ordering key

### Fire damper



**EXAMPLE:**

**FDMB 800x400/375 .40 A** - 800x400-damper size, /375-building length of a damper, .40-damper design, A - with protective cladding boards

Dampers design	Additional digit
Manual control and thermal	.01
Manual control and thermal with a terminal switch („CLOSED“)	.11
Manual control and thermal with two terminal switches („OPEN“, „CLOSED“)	.80
With actuator BF 230-TN (BFL, BFN 230-T) - voltage AC 230 V	.40
With actuator BF 24-TN (BFL, BFN 24-T) - voltage AC/DC 24 V	.50

## Accessories

### Reinforcing frame VRM2-B





### Protective cladding boards



## Data label

- Data label is placed on the damper casing (example)

<b>MANDÍK</b> <sup>®</sup>		MANDÍK, a.s. Dobříšská 550, 267 24 Hostomice, Czech Republic		
FIRE DAMPER - XXXX				
DIMENSION:		DESIGN:		
SERIAL.NO.:		WEIGHT (kg):		
CLASSIFICATION:				MANUAL
TPM XXX/XX	Cert. No.: 2822-UKCA-CPR-XXXX, DoP: PM/XXXX/XX/XX/X	EN 15650:2010		UK CA 2822

<b>MANDÍK</b> <sup>®</sup>		MANDÍK, a.s. Dobříšská 550, 267 24 Hostomice, Czech Republic		
FIRE DAMPER - XXXX				
DIMENSION:		DESIGN:		
SERIAL.NO.:		WEIGHT (kg):		
CLASSIFICATION:				MANUAL
TPM XXX/XX	Cert. No.: 1391-CPR-XXXX/XXXX, DoP: PM/XXXX/XX/XX/X	EN 15650:2010		CE 1391

The producer reserves the right for innovations of the product.  
For actual product information see [www.mandik.co.uk](http://www.mandik.co.uk)

**MANDIK**<sup>®</sup>

[www.mandik.co.uk](http://www.mandik.co.uk)

*Manufacturer*

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