



Fireproof installations above fire protection ceilings

Protecting emergency and escape routes

Fight fire. Protect escape and rescue routes.

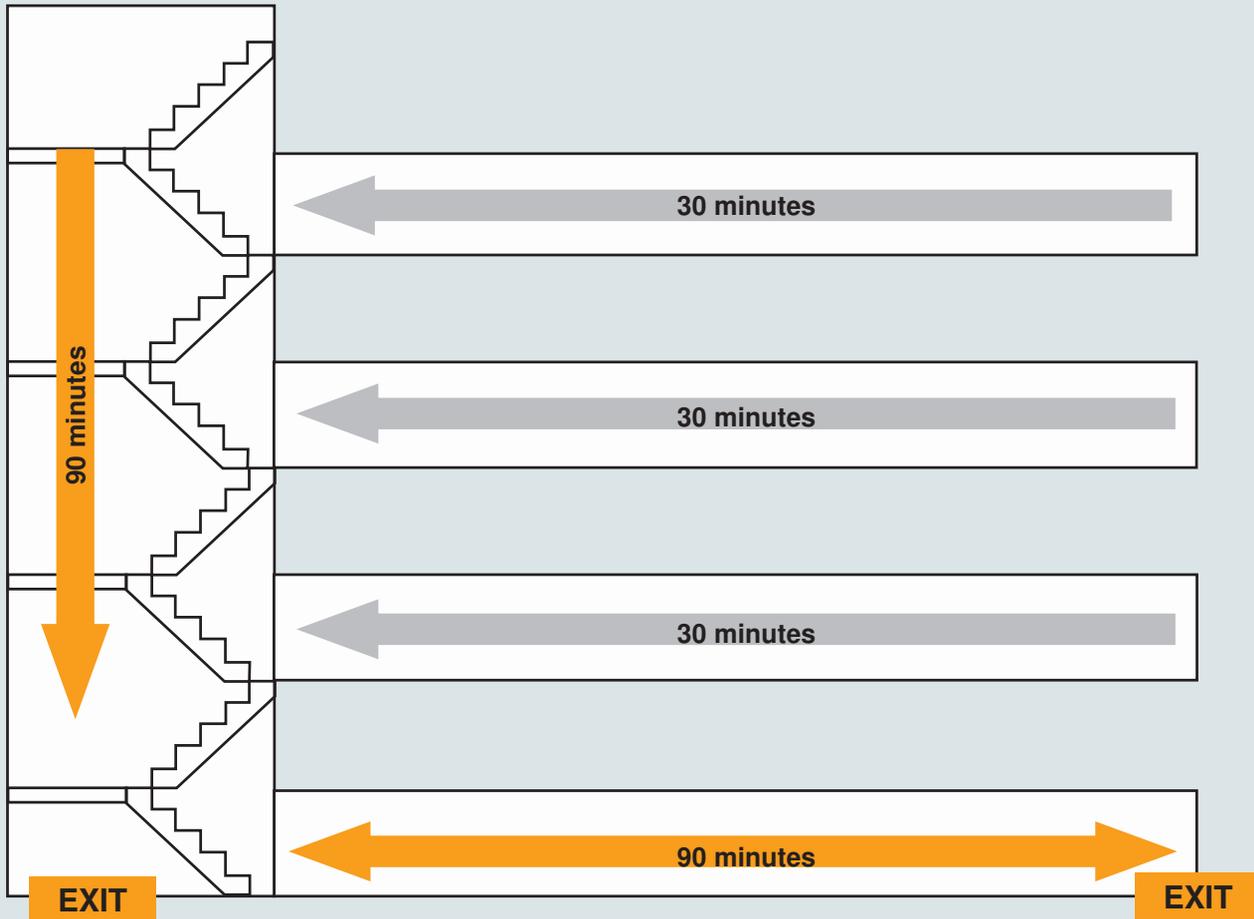


If there is a fire, saving people's lives is the top priority. In particular, heat and smoke developments in corridors and stairwells that lead into the open air in emergencies are a major risk. Smoke poisoning is the cause of death of 95% of all victims of fire. To evacuate people safely from the building in case of fire, escape and rescue routes, as the central lifelines of the building, must always remain free of smoke and fire.

To be able to guarantee this, there must be routes in buildings which are not only normally used for horizontal and vertical access in the building, but also offer the option of evacuation during a fire. At least one structural escape and rescue route, which has been planned and constructed in a fireproof manner, is mandatory in buildings.

Depending on the building type, other structural escape and rescue routes may also be mandatory. These include:

- Necessary stairwells for vertical connection
- Connecting rooms between the necessary stairwells and exits to the outside
- Necessary corridors for horizontal connection



Escape and rescue routes with requirements for 30 or 90 minutes

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Requirements for escape and rescue routes

The escape and rescue routes basically represent areas free from fire loads. This means that any installations here must be made from non-combustible or flame-retardant substances in order to prevent the spread of fire. The fire resistance period of the surrounding components is at least 30 minutes (fire-retardant), as necessary corridors for the horizontal connection of a building must still be free of fire and smoke, and thus usable, 30 minutes after a fire starts. In the case of stairwells and necessary corridors to the exit, this must even be guaranteed 90 minutes after a fire starts.



The problem of fire loads



In the event of a fire, escape and rescue routes are the central life lines and must always remain usable.

The requirements for escape and rescue routes are regulated by the construction regulations, just like other fire protection requirements for cable installations in buildings. In Germany, the decisive directive is the Specimen Guideline on Conduits (MLAR). It was introduced into the valid construction law of the German federal states as the technical construction regulation. According to the MLAR guideline, in the area of emergency and escape routes, a cable installation must not pose an additional fire load.

However, a massive volume of cables, routed openly in a corridor to supply other building areas, is not accepted. These installations increase the risk of fire spreading considerably, as they run like fuse cords along the corridor. Systems tested and approved for fire protection must be installed here.

The basic regulation of the MLAR guideline, that cable installations in escape and rescue routes may not represent any additional fire load, must be fulfilled through appropriate installation types:

- Concealed installation
- Use of non-combustible materials
- Installation in underfloor ducts
- Installation in fire protection ducts
- Installation above suspended fire protection ceilings

The following applies: Fire load through installations in escape and rescue routes = 0 kWh/m²

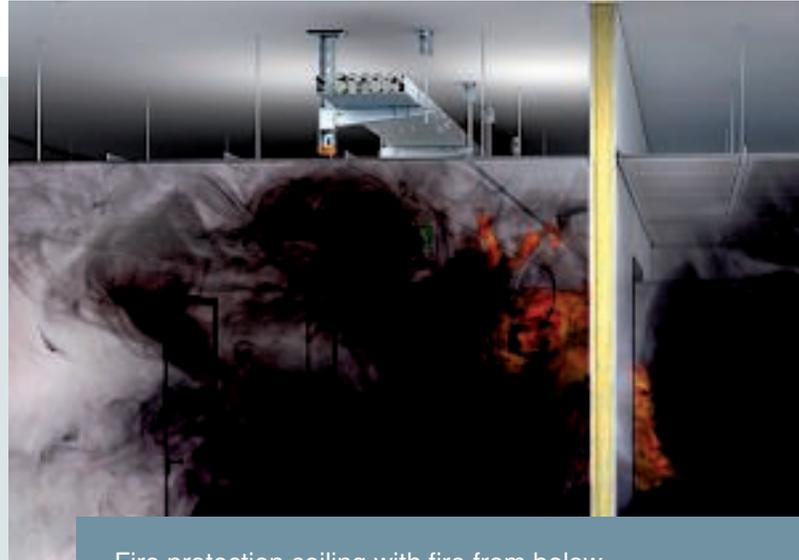
Exceptions:

- Cables only to be used in an escape and rescue route, e.g. to supply the safety lighting
- Individual short branch lines
- Individual fire loads, such as Wi-Fi routers or fire brigade radio

Installation in false ceilings

If corridors are used for the routing of the entire building technology, suspended fire protection ceilings are often used. If there is a fire, the systems, tested at the top and bottom for fire loads, safely shield all the installations in the false ceiling area. If there is a fire in the cables installed there, the escape and rescue route can still be used. However, it must be guaranteed that the suspended ceilings are not subjected to additional mechanical loads through, for example, falling cables or parts of the support system.

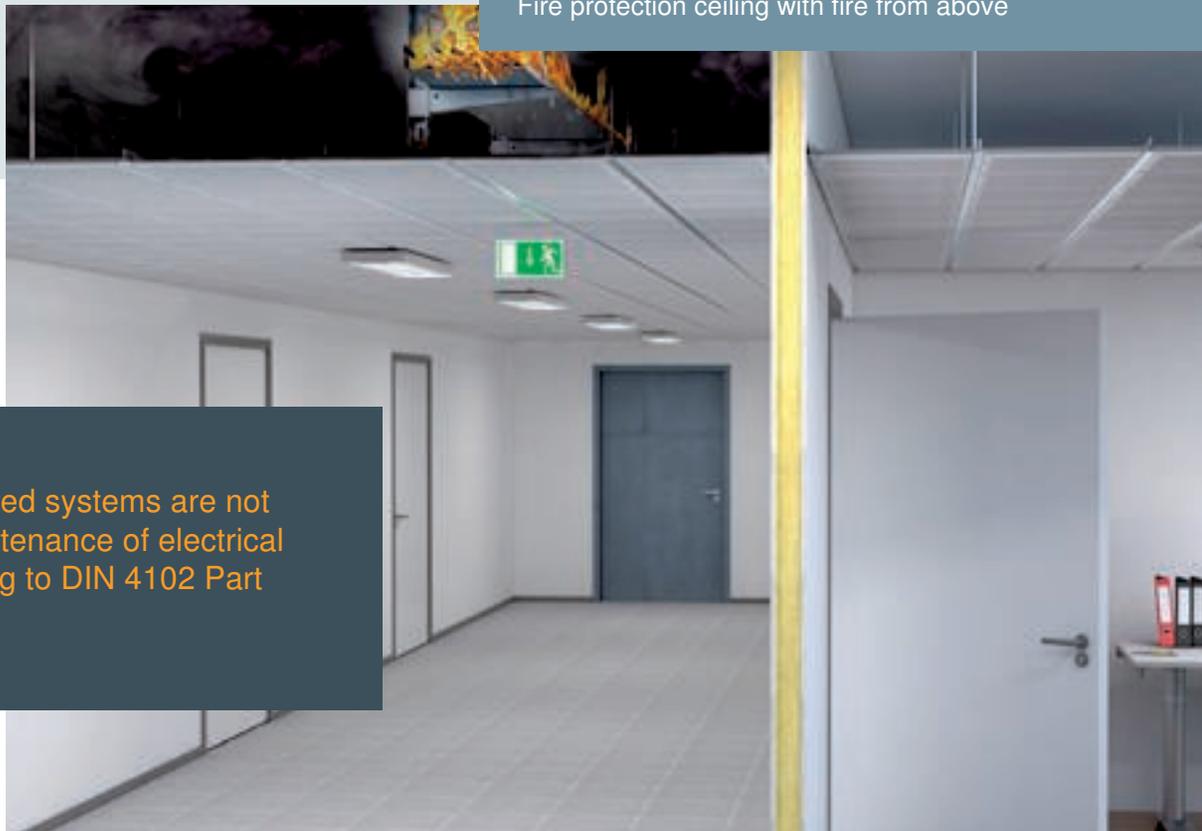
For this reason, special cable support and routing systems are used for electrical installations above suspended fire protection ceilings in the area of escape and rescue routes. For these systems, stability has been proven, even with very high mechanical loads in the event of fire. Despite extreme temperatures, the components remain stable for a specific period without falling.



Fire protection ceiling with fire from below

In addition, the fire protection ceilings can withstand a fire from below, thus preventing the spread of fire via the combustible installations along the corridor.

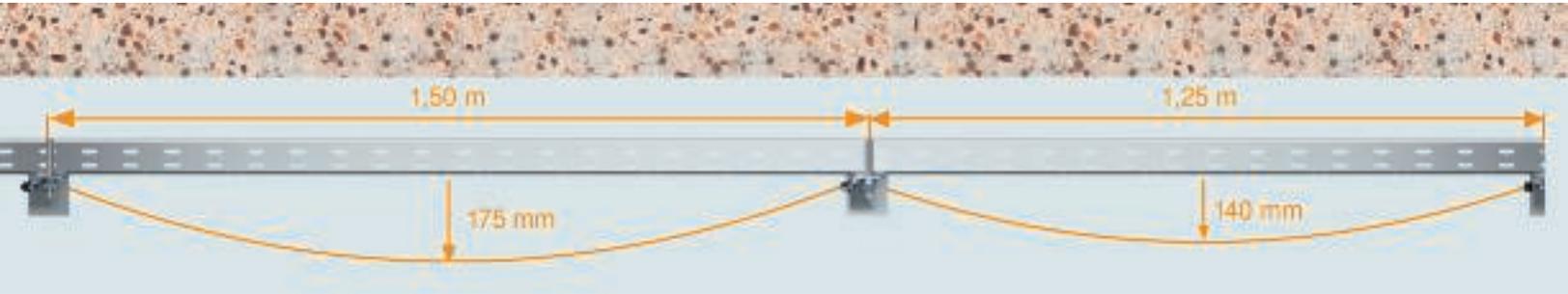
Fire protection ceiling with fire from above



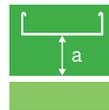
Caution! The tested systems are not qualified for maintenance of electrical function according to DIN 4102 Part 12!

Using the installation space sensibly

Install with space saved, guarantee safety



The cable support and routing systems tested and approved for the false ceiling area still bend when there is a fire. For this reason, there must be sufficient distance to the false ceiling in order to avoid damaging it or subjecting it to a mechanical load. The required minimum distance is calculated from the selected support system, according to different support spacings.



Minimum distance „a“ in mm

Distance between the underside of the cable tray and the upper side of the fire protection ceiling

How can I select a suitable support system?

1. Determine the cable volume
2. Determine the required space
3. Specify the distances to the fire protection ceiling
4. Select the routing system

...with a small amount of cables:

- Grouped supports
- Pressure clips

...with large cable loads

- Cable support systems

The smaller the support distance, the smaller the deformation of the support system and thus the space requirements of the installation will be.

Intervening in an existing system

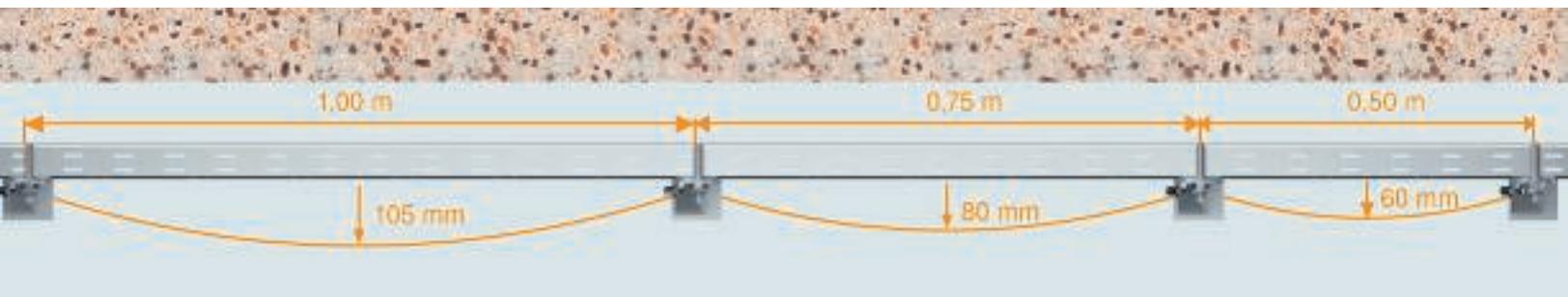
When intervening in an existing system, it is important to check the components of existing support systems for both their structural design and their load capacity. If it becomes apparent that the deformation could become too great if there was a fire, then additional suspensions must be mounted to reduce the support distance. The necessary components can then be derived from the load values calculated.



The right anchors

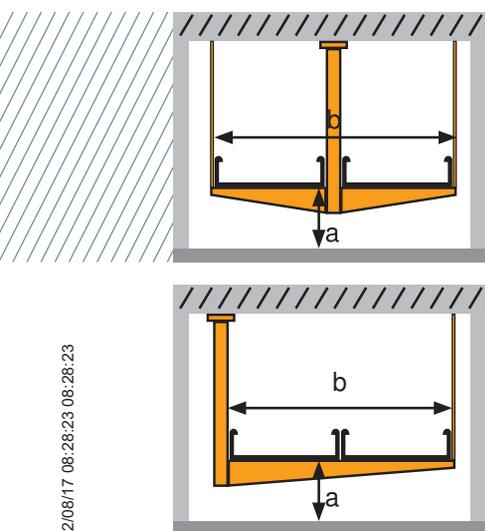
Always ensure that only approved steel anchors are used. Otherwise, a complex dismantling of the system and replacement of the anchors will be necessary.





Practical solutions in limited installation space

Particularly when space is limited, various routing variants can be implemented whilst complying with the cable loads, tray widths and minimum distances to the false ceiling listed in the test report, thus making practical use of installation space.



The maximum deformation of the cable trays in the event of fire must be minimised in order to reduce the height of the installation, whilst taking the minimum distance to the false ceiling into account. This is made possible by:

- Reduction of the support spacing: The smaller the support spacings are between the suspension points of the cable trays, the less the sagging will be if there is a fire. The exact values can be found in the test certificates.
- Distribution of the cable load across two trays with a smaller width: Either symmetrically on both sides or two trays on one bracket

Technical support from OBO Customer Service: Fire protection competence from a single source

Whether for the first consultation, concrete questions or complex problems, via OBO Customer Service, you will reach a direct contact who will rapidly provide you with practical solutions.

Personal service:

- Telephone consultation and e-mail support
- Field service around the world
- Fire protection seminars

Online offer:

- Certificates and approval documents
- Fire protection guide and catalogue
- Mounting instructions and films
- Selection aids



Customer Service
Tel.: +49 23 73 89 - 17 00

OBO system benefits

A wide range of options – economic and flexible

From now on, the tested false ceiling installations can be mounted with the OBO AW15 and AW30 perforated standard brackets. In combination with the matching connection components, product selection becomes simpler and more flexible.

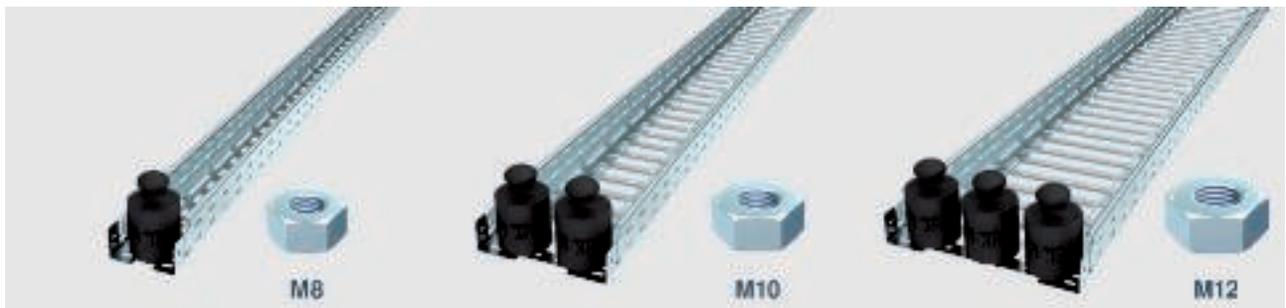
At the same time, adapted system parameters allow the optimum dimensioning of the components according to the mechanical load and cable volume.

- Lighter mounting material (e.g. threaded rods) can be used for lighter installations
- Optimised material use
- More flexible mounting
- System can be economically adapted to individual requirements



The AW15 brackets in the widths 110 to 410 mm and the AW30 brackets in the widths 510 and 610 mm have the appropriate perforations at the bracket tip.

Optimised material use according to cable loads, support spacings, fire load



Be on the safe side: The PLF connection component reliably prevents the mounting rail from opening in the event of fire. In cases where there is a reinstallation in an existing building, the connection component is very easy to mount.

Fire test

of OBO false ceiling systems

No compromises can be made when it comes to fire protection: In an emergency, each product used must function with complete reliability. In addition, strict legal and construction regulations must be complied with. For this reason, the OBO fire protection experts continually check all kinds of installation systems for use in escape and rescue routes. Testing takes place according to DIN 4102 using the following parameters:

- High mechanical loads
- Stability of the routing system
- Deformation of the routing system



During the test, a full-scale fire in the intermediate ceiling area with full cable assignment is simulated. Here, the systems must mechanically withstand temperatures of up to 1,000 °C. In spite of these enormously high temperatures, the system must maintain sufficient mechanical stability, thus ensuring that escape and rescue routes can continue to be used without restriction. The test results serve as the basis for statements on the practical design, for example on the distance to be maintained between the routing system and false ceiling.

The following OBO solutions were successfully tested and are suitable for safe installations in the false ceiling area:

	30	60	90
RKSM cable tray	✓	✓	✓
SKSM cable tray	✓		
Mesh cable tray GRM	✓		
Grip M grouped support	✓	✓	✓
Metal pressure clip	✓		

Overview of the test systems for fire loads of 30, 60 and 90 minutes.

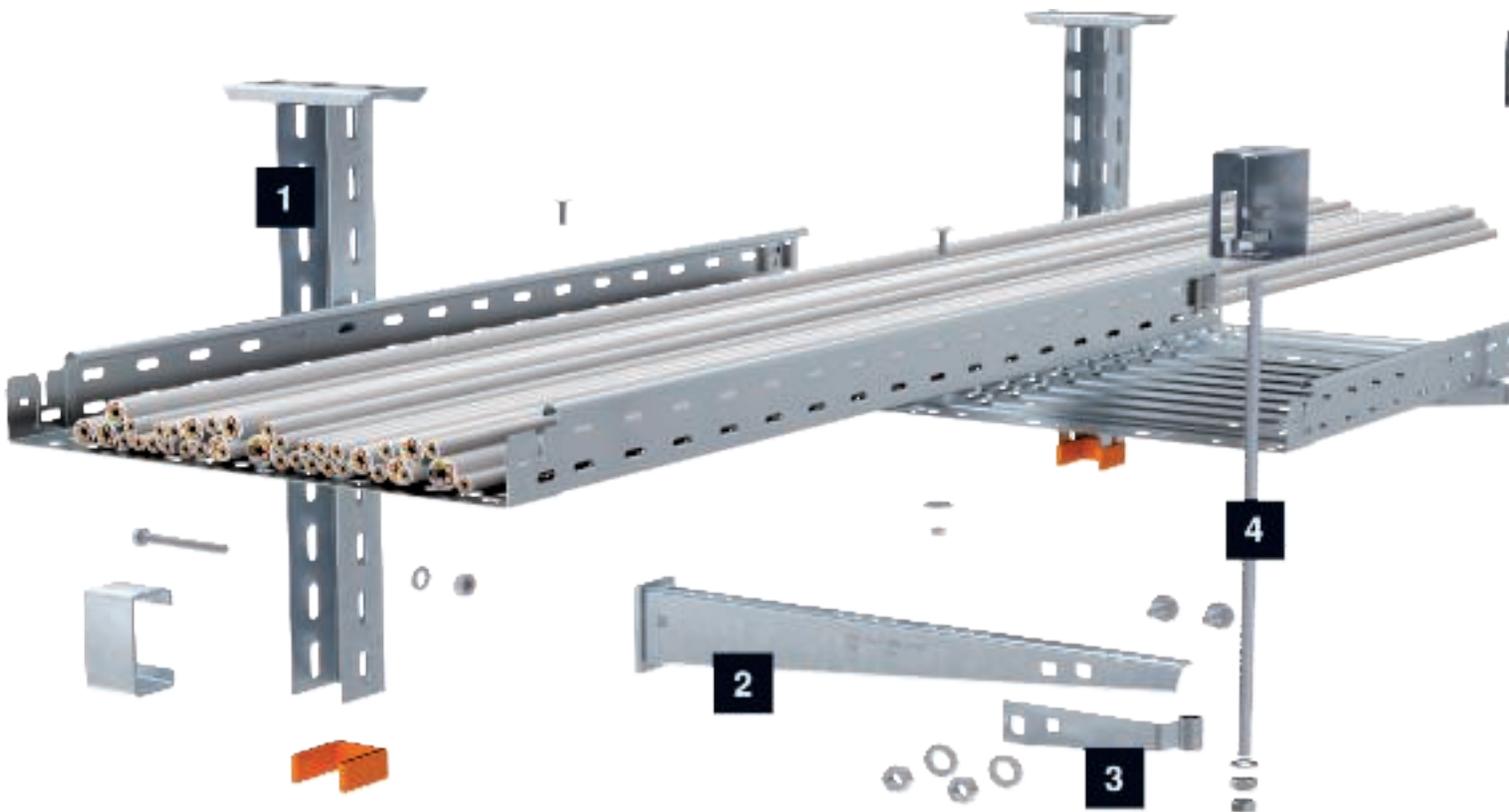
RKS-Magic® cable tray

30

60

90

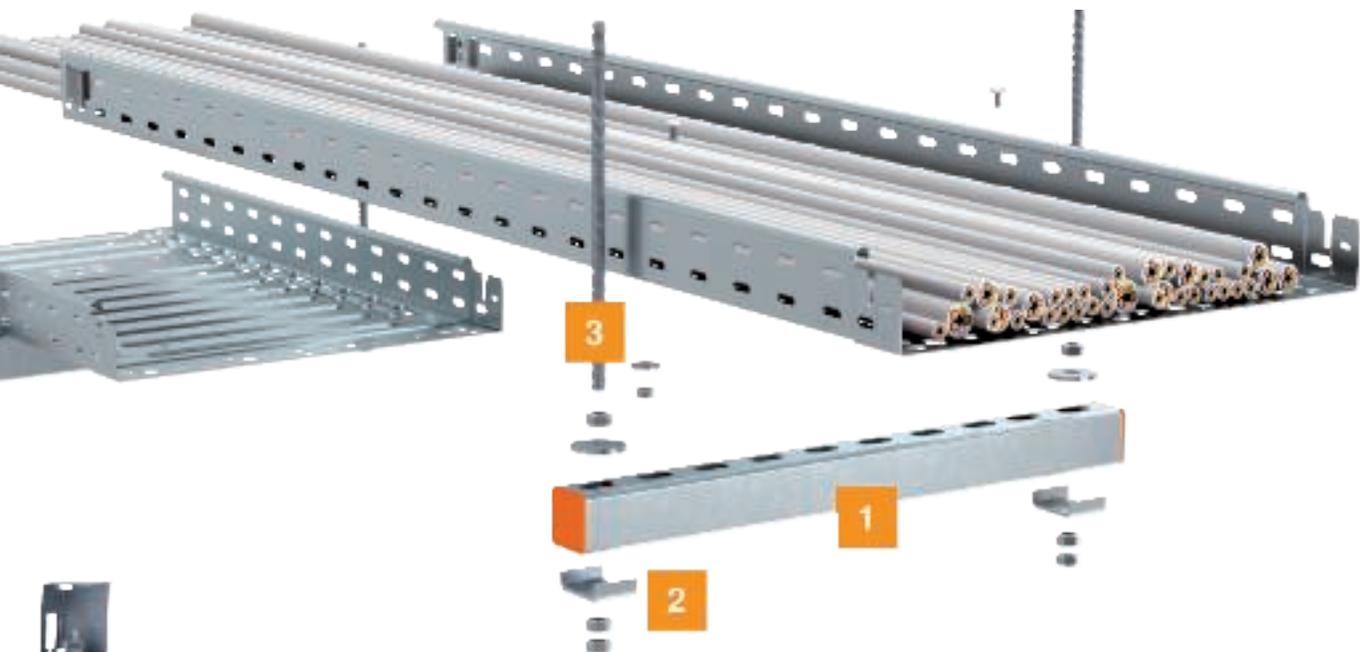
Now also tested and approved for fire loads of 60 and 90 minutes.



Mounting material

- | | |
|---|---------------------------------|
| 1 | US 3 K/US 5 K suspended support |
| 2 | AW15 bracket |
| 3 | AB AW15 connection component |
| 4 | M8/M10/M12 threaded rods |

You can find details on the suitable mounting components in the pages below for the appropriate system.



Mounting material

- 1 MS21/MS41 mounting rail
- 2 PLF connection component
- 3 M8/M10/M12 threaded rods

You can find details on the suitable mounting components in the pages below for the appropriate system.

The tested RKS-Magic® cable tray system is suitable for the installation in the false ceiling area of escape routes. In the event of fire, the system has a proven mechanical stability of 30, 60 and 90 minutes, depending on the system components used. The RKS-Magic® cable tray can be mounted under the ceiling or on the wall with brackets. The brackets are additionally secured on the ceiling with a threaded rod to prevent them from bending in a fire. A

further option for ceiling mounting is the support of the cable tray on profile rails, each mounted under the ceiling with two threaded rods. If the cable loads and tray widths listed in the proof of testing are maintained and the minimum spacings to the false ceiling taken into account, then multi-layer variants can also be implemented.

Fireproof fastening above fire protection ceilings

Fire load	30/60/90 minutes
Proof of testing	OBO Bettermann
Document no. - mounting with mounting rails	BS-05/190-01-01
Document no. - mounting with suspended support/bracket	BS-05/190-01-02
Testing principles	In accordance with DIN 4102

RKS-Magic® cable tray

Maximum support distances for wall and ceiling mounting

Cable tray width [mm]	Fire load [min] Max. cable load [kg/m]									
	30	60/90	Maximum support distance [m]							
100	15	10	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.20
200	30	20								
300	45	30								
400	60	40								

Required minimum distance „a“ for the fire load at different support distances

Maximum support distance [m]	0.50			0.75			1.00			1.25			1.50		
	30	60	90	30	60	90	30	60	90	30	60	90	30	60	90
Cable tray width [mm]	Minimum distance „a“ [mm]														
100	30	30	30	30	35	40	30	70	90	45	130	140	60	145	150
200	30	35	40	50	55	60	70	95	100	115	140	145	160	150	160
300	40	45	50	70	75	85	105	110	120	130	145	150	160	155	160
400	60	60	65	80	80	95	105	120	130	130*	155	160*	160*	160	165*

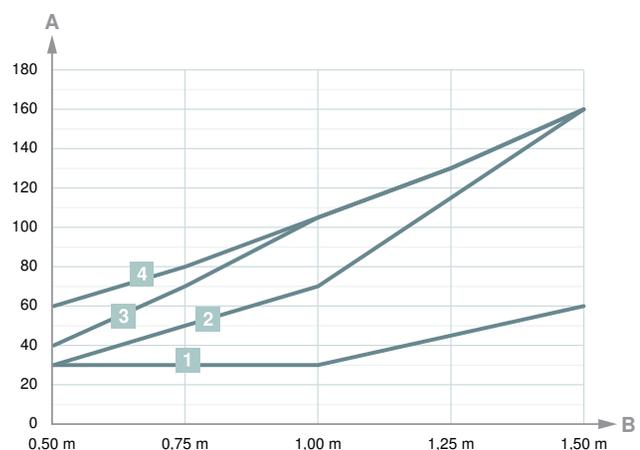
*Observe the maximum support distances according to the table: „Maximum support distances for wall and ceiling mounting“.
The minimum distance „a“ refers to the distance from the underside of the cable tray to the upper side of the fire protection ceiling.

1	RKSM 610
2	RKSM 620
3	RKSM 630
4	RKSM 640

A = Minimum distance "a" in mm to the fire protection ceiling
B = Support distance in m

 The minimum spacing "a" relates to the distance of the under side of the cable tray to the top side of the fire protection ceiling.

Deformation of the RKS-Magic® cable tray in mm for 30-minute fire load



30

60

90

Component assignment

Components to be used for single and double layer mounting at the fire load of 30/60/90 minutes

Components	Suspended support type when mounting		Bracket Type	Mounting rail type				
				Maximum support distance [m]				
Cable tray width [mm]		 		0.50	0.75	1.00	1.25	1.50
100	US 3 K...FT	US 3 K...FT	AW 15 11 FT	MS4121P				
200			AW 15 21 FT					
300		US 5 K...FT	AW 15 31 FT	MS4121P	MSL4141P			MS4141P
400			AW 15 41 FT	MSL4141P			MS4141P*	

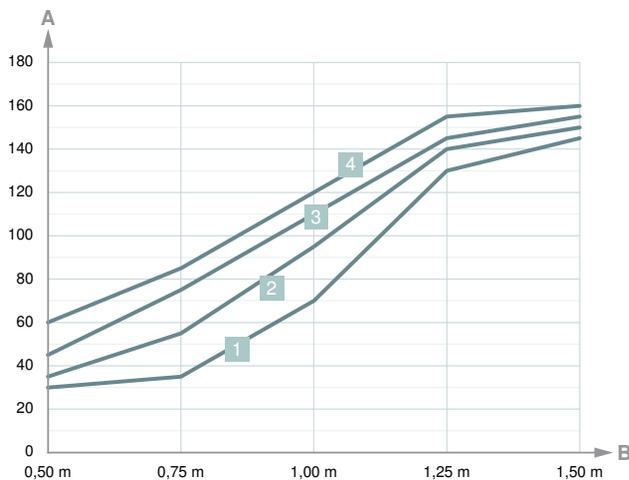
*Observe the maximum support distances according to the table: „Maximum support distances for wall and ceiling mounting“.

Assignment of threaded rods at the fire loads of 30/60/90 minutes

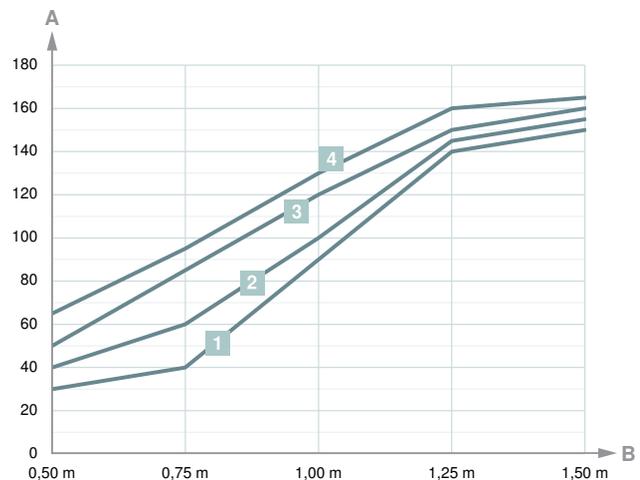
Cable tray width [mm]	Maximum support distance [m]					Maximum support distance [m]				
										
	0.50	0.75	1.00	1.25	1.50	0.50	0.75	1.00	1.25	1.50
100	M8					M8		M10		
200										
300	M8	M10				M10	M12			
400										

*Observe the maximum support distances according to the table: „Maximum support distances for wall and ceiling mounting“.

Deformation of the RKS-Magic® cable tray in mm for 60-minute fire load



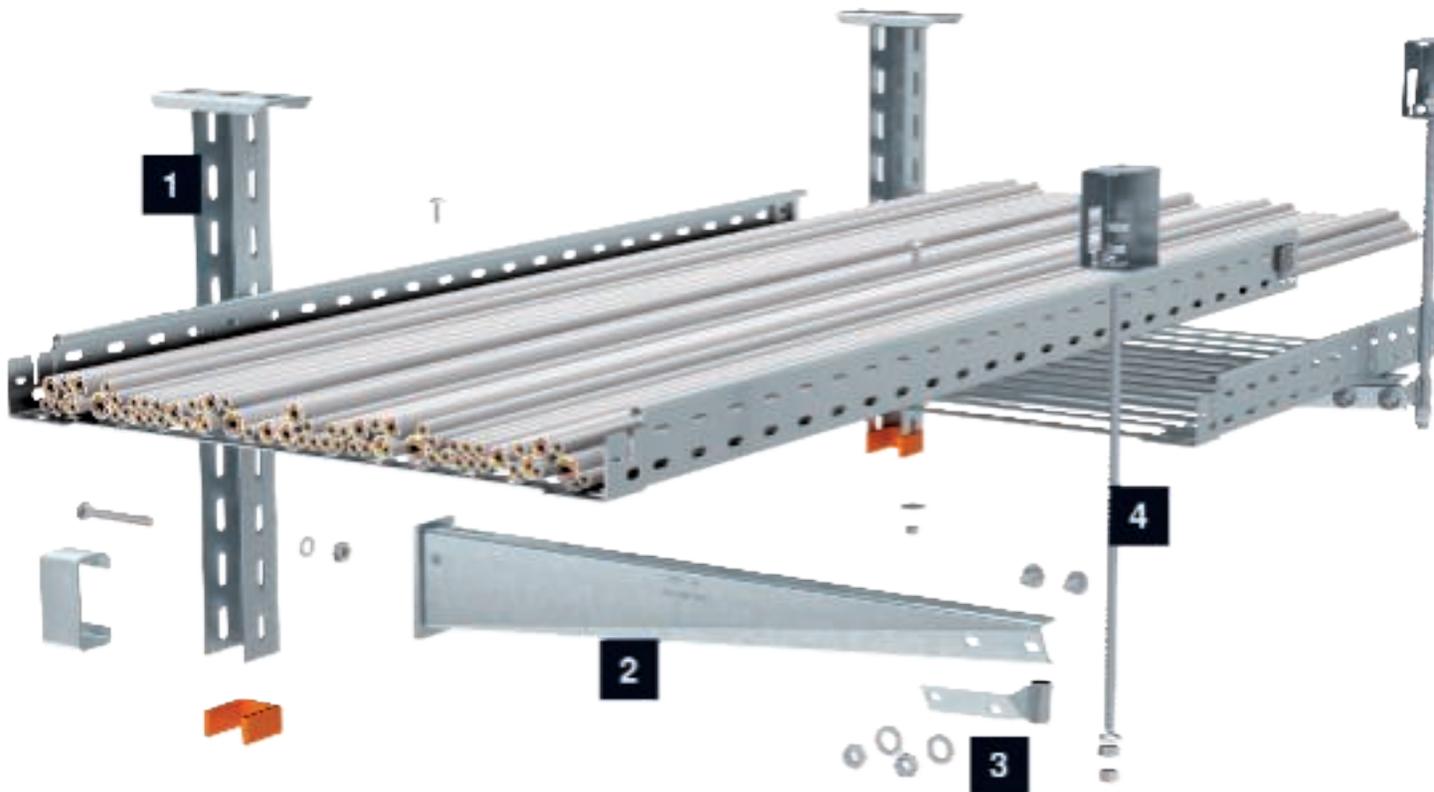
Deformation of the RKS-Magic® cable tray in mm for 90-minute fire load



Cable tray SKS-Magic®

30

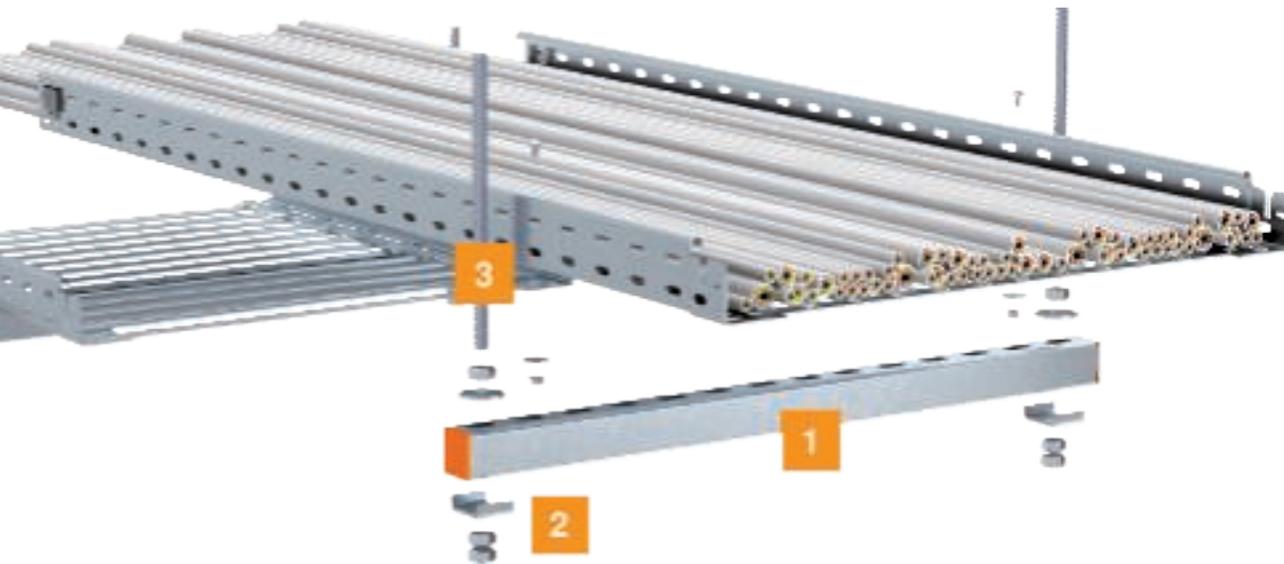
The classic item for large volumes of cables:
Tested and approved for fire loads of 30 minutes.



Mounting material

- | | |
|---|--------------------------------------|
| 1 | US 3 K/US 5 K suspended support |
| 2 | AW15/AW30 bracket |
| 3 | AB AW15/AB AW30 connection component |
| 4 | M8/M10/M12 threaded rods |

You can find details on the suitable mounting components in the pages below for the appropriate system.



Mounting material

- 1 MS21/MS41 mounting rail
- 2 PLF connection component
- 3 M8/M10/M12 threaded rods

You can find details on the suitable mounting components in the pages below for the appropriate system.

The tested SKS-Magic® cable tray system is suitable for installation in the false ceiling area of escape and rescue routes. In the event of fire, the system has a proven mechanical stability of 30 minutes. The SKS-Magic® cable tray can be mounted under the ceiling or on the wall using brackets. The brackets are additionally secured on the ceiling with a threaded rod to prevent them from bending in a fire. If the cable loads and tray widths listed in the proof of testing are maintained and the minimum spac-

ings to the false ceiling taken into account, then multilayer variants can also be implemented. A further option for ceiling mounting is the support of the cable trays on profile rails, each mounted under the ceiling with two threaded rods. A two-layer arrangement of the cable trays is possible, providing that the approved tensile stress in the threaded rods is also maintained in the event of fire.

Fireproof fastening above fire protection ceilings

Fire load	30 minutes
Proof of testing	OBO Bettermann
Document no. - mounting with mounting rails	BS-05/190-02-01
Document no. - mounting with suspended support/bracket	BS-05/190-02-02
Testing principles	In accordance with DIN 4102

Proofs of testing are also available for the SKS cable trays and can be requested.

Cable tray SKS-Magic®

Maximum support distances for wall and ceiling mounting

Cable tray width [mm]	Fire load [min] Max. cable load [kg/m]							
		Maximum support distance [m]						
100	15	1.50	1.50	1.50	1.50	1.50	1.50	
200	30							
300	45							
400	60							
500	75							
600	90							

Required minimum distance „a“ for the fire load at different support distances

Maximum support distance [m]	0.50	0.75	1.00	1.25	1.50
Fire load [min]	30				
Cable tray width [mm]	Minimum distance „a“ [mm]				
100	20	20	20	20	20
200	20	30	30	30	30
300	30	40	55	70	85
400	40	60	85	105*	130*
500	50	70	95*	120*	145*
600	60	80	105*	140*	175*

*Observe the maximum support distances according to the table: „Maximum support distances for wall and ceiling mounting“.
The minimum distance „a“ refers to the distance from the underside of the cable tray to the upper side of the fire protection ceiling.

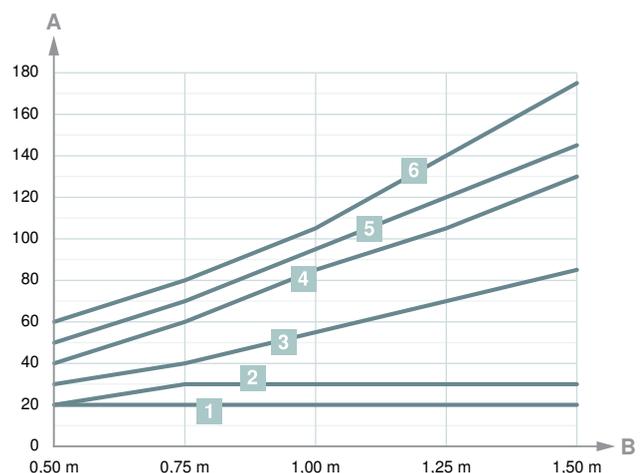
Deformation of the SKS-Magic® cable tray in mm for 30-minute fire load

- 1 SKSM 610
- 2 SKSM 620
- 3 SKSM 630
- 4 SKSM 640
- 5 SKSM 650
- 6 SKSM 660

A = Minimum distance "a" in mm to the fire protection ceiling
B = Support distance in m



The minimum spacing "a" relates to the distance of the under side of the cable tray to the top side of the fire protection ceiling.



Component assignment

Components to be used for single and double layer mounting at a fire load of 30 minutes

Components	Suspended support type when mounting		Bracket Type	Mounting rail type				
				Maximum support distance [m]				
Cable tray width [mm]				0.50	0.75	1.00	1.25	1.50
100	US 3 K...FT	US 3 K...FT	AW 15 11 FT	MS4121P				
200			AW 15 21 FT					
300	US 5 K...FT	US 5 K...FT	AW 15 31 FT	MS4121P	MSL4141P		MS4141P	
400			AW 15 41 FT	MSL4141P		MS4141P*		
500			AW 30 51 FT	MS4141P*				
600			AW 30 61 FT					

*Observe the maximum support distances according to the table: „Maximum support distances for wall and ceiling mounting“.

Assignment of the threaded rods at the fire load of 30 minutes

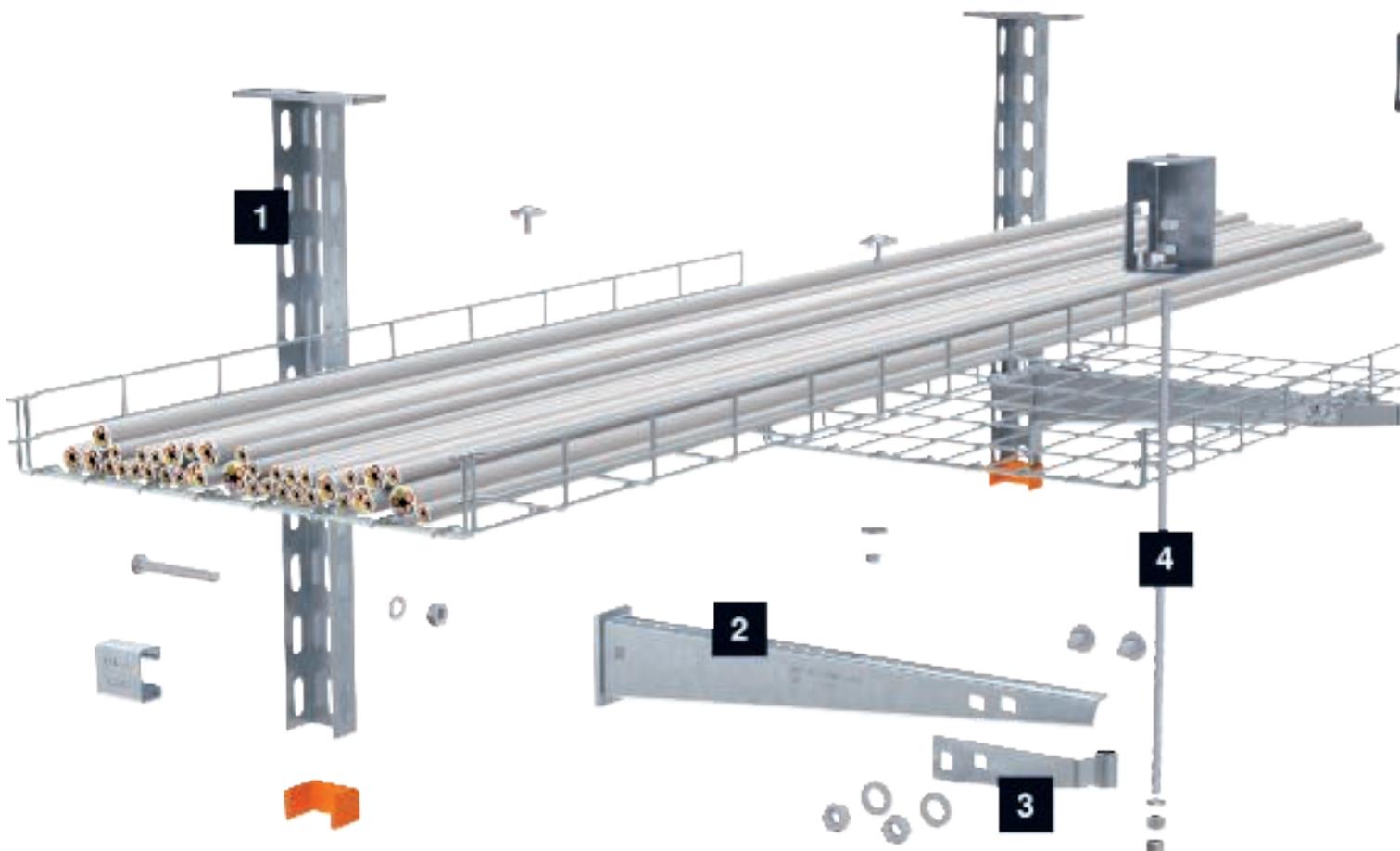
Cable tray width [mm]	Maximum support distance [m]					Maximum support distance [m]				
										
	0.50	0.75	1.00	1.25	1.50	0.50	0.75	1.00	1.25	1.50
100	M8					M8		M10		
200										
300	M8		M10			M10		M12		
400								M12*		-
500	M10			M12		M12		M12*	-	
600								-		

*Observe the maximum support distances according to the table: „Maximum support distances for wall and ceiling mounting“.

GR-Magic® mesh cable tray

30

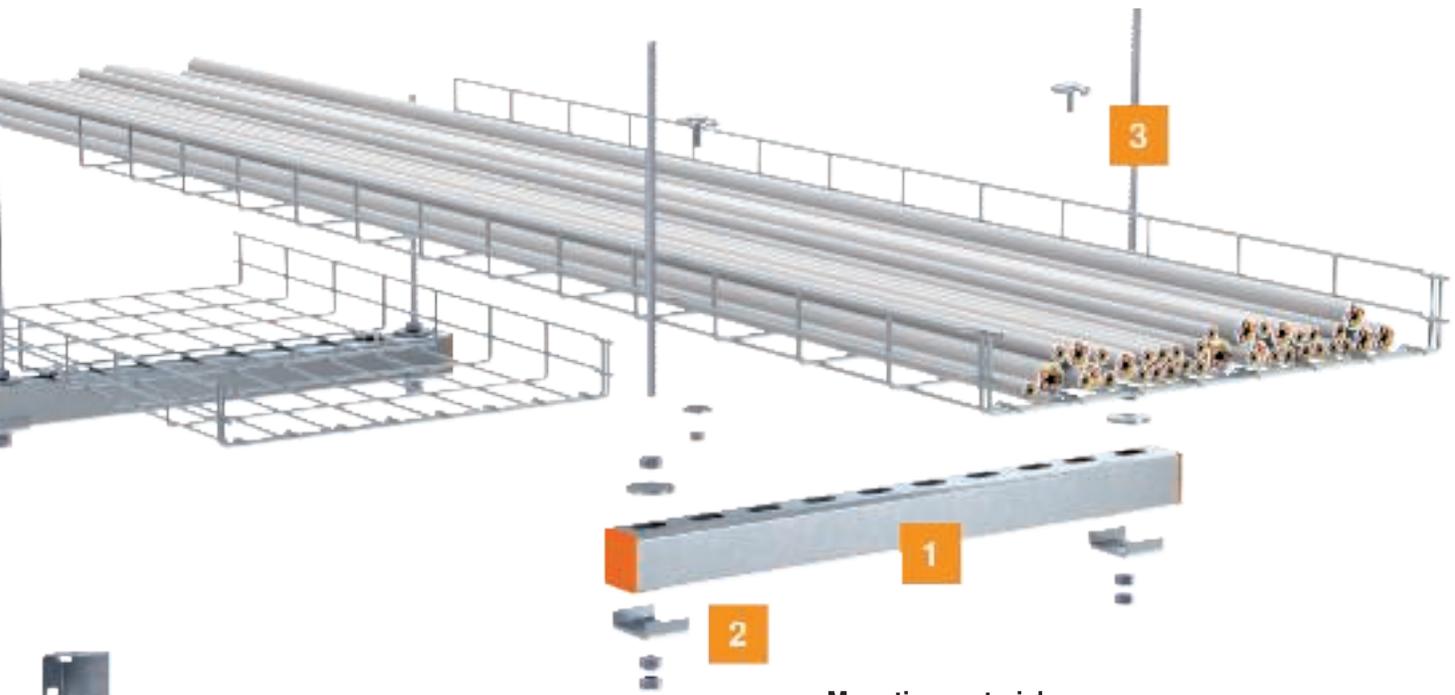
Light-duty routing variant, tested and approved for a fire load of 30 minutes.



Mounting material

- | | |
|---|---------------------------------|
| 1 | US 3 K/US 5 K suspended support |
| 2 | AW15 bracket |
| 3 | AB AW15 connection component |
| 4 | M8/M10/M12 threaded rods |

You can find details on the suitable mounting components in the pages below for the appropriate system.



Mounting material

- | | |
|---|--------------------------|
| 1 | MS21/MS41 mounting rail |
| 2 | PLF connection component |
| 3 | M8/M10/M12 threaded rods |

You can find details on the suitable mounting components in the pages below for the appropriate system.

The tested GR-Magic® mesh cable tray system is suitable for installation in the false ceiling area of escape and rescue routes. In the event of fire, the system has a proven mechanical stability of 30 minutes. The GR-Magic® mesh cable tray can be mounted under the ceiling or on the wall using brackets. The brackets are additionally secured on the ceiling with a threaded rod to prevent them from bending in a fire. If the cable loads and tray widths listed in the proof of testing are maintained and the minimum spacings to the false ceiling taken into account, then mul-

tilayer variants can also be implemented.

A further option for ceiling mounting is the support of the mesh cable tray on profile rails, each mounted under the ceiling with two threaded rods. With this mounting variant, sufficient distances to the false ceiling must be maintained. If the approved tensile strength is maintained in the threaded rods in the event of a fire, then a two-layered arrangement of the mesh cable trays is possible.

Fireproof fastening above fire protection ceilings

Fire load	30 minutes
Proof of testing	OBO Bettermann
Document no. - mounting with mounting rails	BS-05/190-03-01
Document no. - mounting with suspended support/bracket	BS-05/190-03-02
Testing principles	In accordance with DIN 4102

GR-Magic® mesh cable tray

Maximum support distances for wall and ceiling mounting

	Fire load [min] Max. cable load [kg/m]						
Mesh cable tray width [mm]	30	Maximum support distance [m]					
100	10	1.50					
200	20						
300	30						
400	40						

Required minimum distance „a“ for the fire load at different support distances

Maximum support distance [m]	0.50	0.75	1.00	1.25	1.50
Fire load [min]	30				
Mesh cable tray width [mm]	Minimum distance „a“ [mm]				
100	40	60	80	105	150
200	45	65	85	110	155
300	60	80	100	130	160
400	65	85	105	135	165

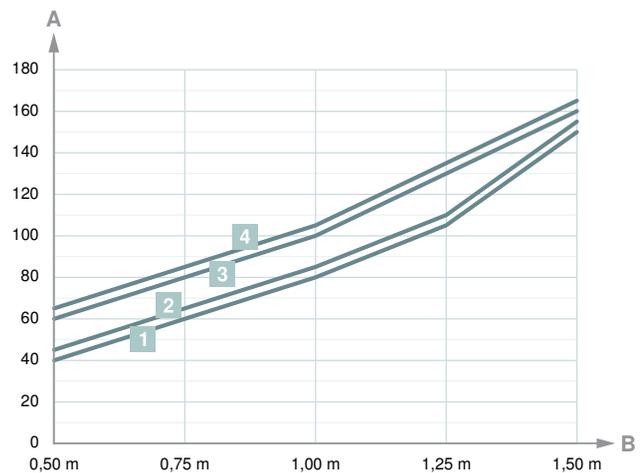
The minimum distance „a“ refers to the distance of the underside of the cable tray to the upper side of the fire protection ceiling.

- 1 GRM 55 100
- 2 GRM 55 200
- 3 GRM 55 300
- 4 GRM 55 400

A = Minimum distance "a" in mm to the fire protection ceiling
B = Support distance in m

 The minimum spacing "a" relates to the distance of the under side of the mesh cable tray to the top side of the fire protection ceiling.

Deformation of the GR-Magic® mesh cable tray in mm for 30-minute fire load



Component assignment

Components to be used for single and double layer mounting at a fire load of 30 minutes

Components	Suspended support type when mounting		Bracket Type	Mounting rail type				
				Maximum support distance [m]				
Mesh cable tray width [mm]				0.50	0.75	1.00	1.25	1.50
100	US 3 K...FT	US 3 K...FT	AW 15 11 FT	MS4121P				
200			AW 15 21 FT					
300		US 5 K...FT	AW 15 31 FT	MS4121P			MS4141P	
400			AW 15 41 FT	MSL4141P	MS4141P			

Assignment of the threaded rods at the fire load of 30 minutes

Mesh cable tray width [mm]	Maximum support distance [m]					Maximum support distance [m]				
	0.50	0.75	1.00	1.25	1.50	0.50	0.75	1.00	1.25	1.50
100	M8					M8				
200										
300						M8		M10		
400								M10	M12	

Grip M grouped support

30

60

90



The tested Grip M grouped supports are suitable for installation in the false ceiling area of escape and rescue routes. In the event of fire, the grouped supports have a proven mechanical stability of 30, 60 and 90 minutes. They can be mounted under the ceiling or on the wall. The grouped supports are made of sheet steel and can be opened and closed easily without the use of tools. To allow simple cable insertion, the supports remain open during cable routing. Then, the grouped supports are closed through simple locking. The construction of the grouped support and weight of the installed cables prevent the lock from opening itself unintentionally.

Proofs

Fireproof fastening above fire protection ceilings

Fire load	30, 60 and 90 minutes
Proof of testing	OBO Bettermann
Document no.	BS-05/190-04-01
Testing principles	In accordance with DIN 4102

Mounting parameters and required minimum distance „a“ [mm] at the fire load of 30 minutes

Type	Fastening distance [m]	Cable assignment [kg/m]		
2031 M15	0.6	3.3	80	100
	0.8	2.5	100	120
2031 M30	0.6	5.8	80	110
	0.8	4.3	100	130
2031 M70	0.6	20.0	80	120
	0.8	15.0	100	140

The minimum distance „a“ refers to the distance of the under side of the grouped support to the upper side of the fire protection ceiling.

Mounting parameters and required minimum distance „a“ [mm] at the fire loads of 60/90 minutes

Type	Fastening distance [m]	Cable assignment [kg/m]		
2031 M15	0.6	3.3	100	120
	0.8	2.5	120	140
2031 M30	0.6	5.8	100	130
	0.8	4.3	120	150
2031 M70	0.6	13.0	100	140
	0.8	10.0	120	160

The minimum distance „a“ refers to the distance from the underside of the grouped support to the upper side of the fire protection ceiling.



The tested pressure clips are suitable for installation in the false ceiling area of escape and rescue routes. In the event of fire, the pressure clips have a proven mechanical stability of 30 minutes. They are mounted under the ceiling. The pressure clips are made of sprung, rustproof

steel. For installation, the hips of the pressure clips are simply bent downwards without tools and the cables pushed in from the side. The edges of the clip slope to exclude the possibility of damage to the cables.

Proofs

Fireproof fastening above fire protection ceilings

Fire load	30 minutes
Proof of testing	OBO Bettermann
Document no.	BS-05/190-05-01
Testing principles	In accordance with DIN 4102

Mounting parameters and required minimum distance „a“ [mm]

Type	Fastening distance [m]	Cable assignment [kg/m]	
2033 M	0.5	2 x 1.84	70
2034 M	0.5	2 x 1.15	50
2035 M	0.5	1 x 1.84	70

The minimum distance „a“ refers to the distance from the underside of the pressure clip to the upper side of the fire protection ceiling.

RKS-Magic® cable tray

St FS

Cable tray RKS-Magic® 60



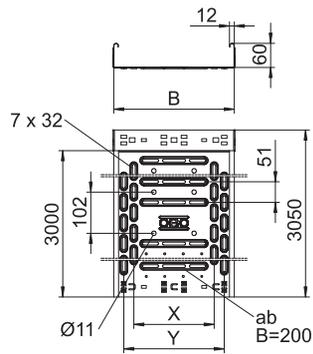
Type	Width mm	Metal thick- ness mm	BS	Pack m	Weight kg/100 m	Item no.
RKSM 610 FS	100	0.75		3	134.334	6047611
RKSM 620 FS	200	0.75		3	181.508	6047638
RKSM 630 FS	300	0.75		3	233.803	6047654
RKSM 640 FS	400	0.90		3	338.459	6047689

Cable tray with integrated quick fastening system. The usable length of the cable tray is 3,000 mm.

The cable tray has continuous side perforations of 7 x 20 mm for the installation of additional connection and mounting components.

The perforation for direct threaded rod suspension has a diameter of 11 mm.

Dimensions



Type	Length mm	Dim. B mm	Usable cross- section cm ²	Dim- en- sion	
				Dim. x mm	Dim. y mm
RKSM 610 FS	3050	100	58	—	50
RKSM 620 FS	3050	200	118	100	150
RKSM 630 FS	3050	300	178	200	250
RKSM 640 FS	3050	400	238	300	350

St FS

Cable tray SKS-Magic® 60

Type	Width mm	Metal thickness mm	BS	Pack m	Weight kg/100 m	Item no.
SKSM 610 FS	100	1.50		3	249.573	6059456
SKSM 620 FS	200	1.50		3	329.180	6059460
SKSM 630 FS	300	1.50		3	385.245	6059462
SKSM 640 FS	400	1.50		3	441.311	6059464
SKSM 650 FS	500	1.50		3	504.852	6059466
SKSM 660 FS	600	1.50		3	553.442	6059468



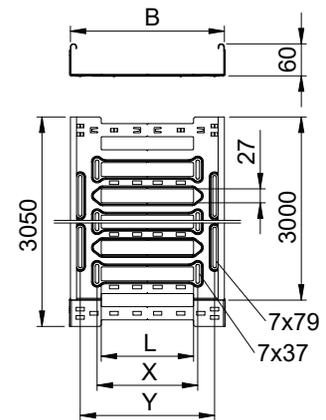
Cable tray with integrated quick fastening system. The usable length of the cable tray is 3,000 mm.

The cable tray has continuous side perforations of 7 x 20 mm for the installation of additional connection and mounting components.

From a cable tray width of 200 mm with 30% hole surface, suitable for use under sprinkler systems according to VdS guideline 2092.

Type	Length mm	Usable Dim. B mm	Usable cross-section cm ²	Dim. L mm	Dim. x mm	Dim. y mm
SKSM 610 FS	3050	100	58	30	-	62
SKSM 620 FS	3050	200	118	80	96	162
SKSM 630 FS	3050	300	178	180	196	262
SKSM 640 FS	3050	400	238	280	296	362
SKSM 650 FS	3050	500	298	380	396	462
SKSM 660 FS	3050	600	358	480	496	562

Dimensions



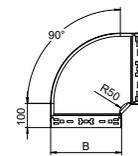
Accessories, cable trays

St FS

90° Magic bend 60

Type	Side height mm	Dim. B mm	Pack Piece	Weight kg/100 pc.	Item no.
RBM 90 610 FS	60	100	1	65.700	6041130
RBM 90 620 FS	60	200	1	121.900	6041134
RBM 90 630 FS	60	300	1	192.200	6041136
RBM 90 640 FS	60	400	1	274.700	6041138
RBM 90 650 FS	60	500	1	376.300	6041140
RBM 90 660 FS	60	600	1	487.000	6041142

90° bend with quick connector system. For all cable tray types of 60 mm side height.

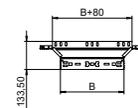


St FS

Add-on tee 60

Type	Side height mm	Dim. B mm	Pack Piece	Weight kg/100 pc.	Item no.
RAAM 610 FS	60	100	1	37.700	6041230
RAAM 620 FS	60	200	1	50.100	6041234
RAAM 630 FS	60	300	1	62.900	6041236
RAAM 640 FS	60	400	1	75.700	6041238
RAAM 650 FS	60	500	1	89.300	6041240
RAAM 660 FS	60	600	1	102.700	6041242

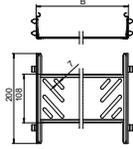
Magic add-on tee with quick connector system. For all cable tray types of 60 mm side height.



Accessories, cable trays

Magic straight connector set 60

St FS



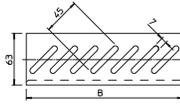
Type	Side height mm	Dim. B mm	Pack Piece	Weight kg/100 pc.	Item no.
KTSMV 610 FS	60	100	1	30.500	6068914
KTSMV 620 FS	60	200	1	37.200	6068918
KTSMV 630 FS	60	300	1	44.000	6068920
KTSMV 640 FS	60	400	1	50.700	6068922
KTSMV 650 FS	60	500	1	57.400	6068924
KTSMV 660 FS	60	600	1	64.200	6068926

Cable tray connector with quick fastening for the screwless connection of perforated cable trays with a side height of 60 mm.

The optimised design means that the connector can be used to create radii and as a length compensation piece for large temperature deviations.

Bottom end plate

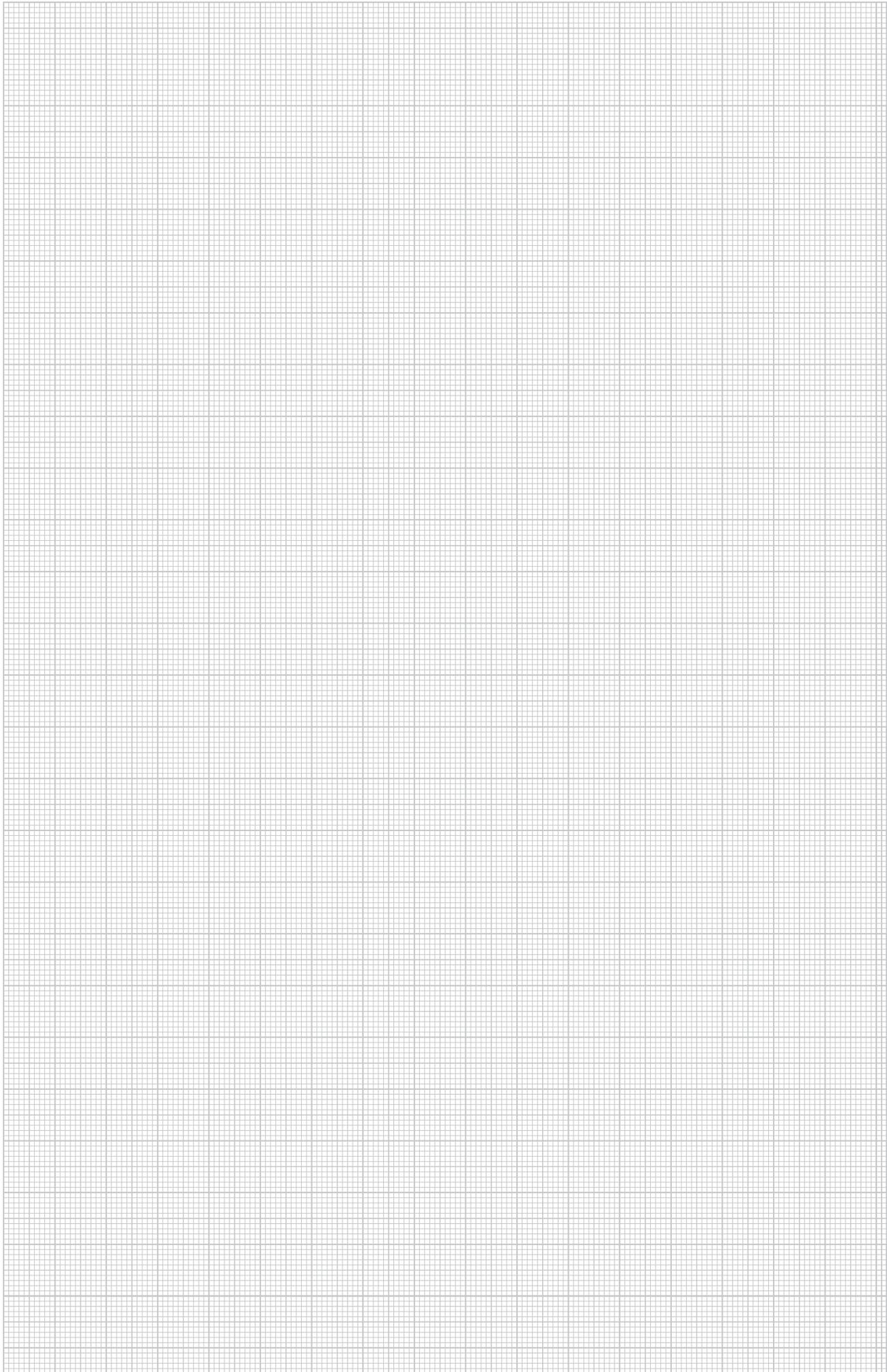
St FS



Type	Dim. B mm	Pack Piece	Weight kg/100 pc.	Item no.
BEB 100 FS	100	1	4.599	7083106
BEB 200 FS	200	1	9.367	7083203
BEB 300 FS	300	1	14.100	7083300
BEB 400 FS	400	1	18.900	7083408
BEB 500 FS	500	1	23.700	7083505
BEB 600 FS	600	1	28.400	7083602

For fastening, please order screws, type FR5B M6x12, separately.

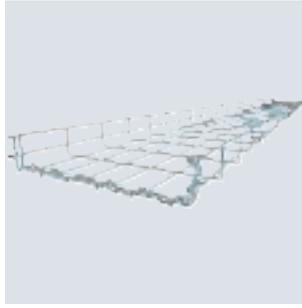
Bottom end plate for floor reinforcement at the ends of the cable tray and as cable protection.



Mesh cable tray system GRM 55

GR-Magic® 55 mesh cable tray

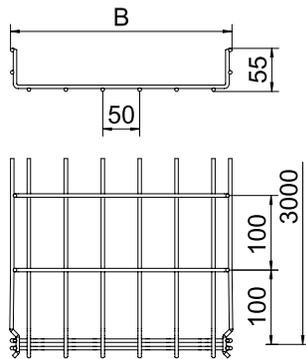
St G



Type	Wire			Pack m	Weight kg/100 m	Item no.
	Width mm	Ø mm	BS			
GRM 55 100 G	100	3.9		3	72.000	6001442
GRM 55 200 G	200	3.9		3	100.667	6001446
GRM 55 300 G	300	4.8		3	192.333	6001448
GRM 55 400 G	400	4.8		3	234.667	6001450

Mesh cable tray with shaped connector of side height 55 mm.

Dimensions

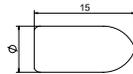


Type	Length mm	Dim. B mm	Usable cross- section cm ²
GRM 55 100 G	3000	100	40
GRM 55 200 G	3000	200	87
GRM 55 300 G	3000	300	129
GRM 55 400 G	3000	400	175

Accessories, cable trays

Protective caps

PVC

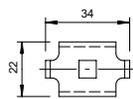


Type	Colour	Pack Piece	Weight kg/100 pc.	Item no.
GR KS 3.9 OR	Pure orange	500	0.045	6003750
GR KS 4.8 OR	Pure orange	500	0.030	6003754

Protective cap to cover cut wire ends of mesh cable trays.

GKS 34 hold-down clamp

St G



Type	Pack Piece	Weight kg/100 pc.	Item no.
GKS 34 G	20	2.188	6016855

Including FRS M6 x 20 bolt with flange nut.

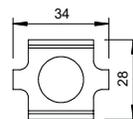
Clamp for fixing mesh cable trays to wall or support brackets.

St G

Joint connector GSV 34

Type	Pack Piece	Weight kg/100 pc.	Item no.
GSV 34 G	20	3.155	6016596

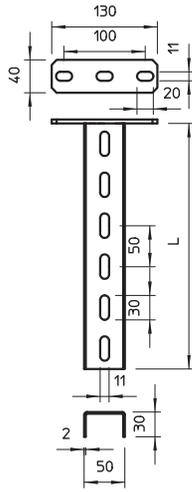
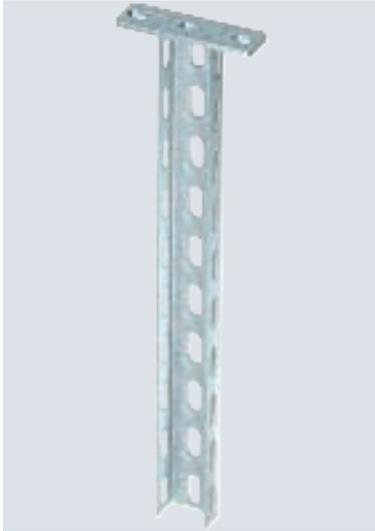
Screwed version of joint connector for mesh cable trays.



Mounting systems

US 3 support

St FT

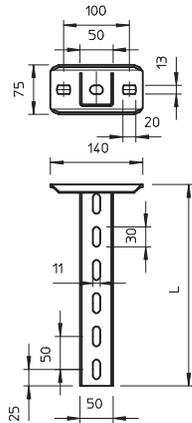


Type	Length mm	Material thickness mm	Tensile load kN	BS	Pack Piece	Weight kg/100 pc.	Item no.
US 3 K 20 FT	200	2	5	BS	1	50.500	6342351
US 3 K 30 FT	300	2	5	BS	1	64.400	6342353
US 3 K 40 FT	400	2	5	BS	1	78.300	6342355
US 3 K 50 FT	500	2	5	BS	1	92.300	6342357
US 3 K 60 FT	600	2	5	BS	1	106.200	6342359
US 3 K 70 FT	700	2	5	BS	1	120.200	6342362
US 3 K 80 FT	800	2	5	BS	1	134.100	6342364
US 3 K 90 FT	900	2	5	BS	1	147.800	6342366
US 3 K 100 FT	1000	2	5	BS	1	162.000	6342368
US 3 K 110 FT	1100	2	5	BS	1	175.900	6342370
US 3 K 120 FT	1200	2	5	BS	1	189.900	6342372

Suspended support (U profile) of dimensions 50 x 30 mm with welded head plate.

US 5 support

St FT

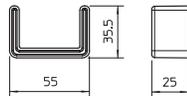


Type	Length mm	Material thickness mm	Dim. L mm	BS	Pack Piece	Weight kg/100 pc.	Item no.
US 5 K 20 FT	200	2.5	200	BS	1	85.000	6341527
US 5 K 30 FT	300	2.5	300	BS	1	110.000	6341535
US 5 K 40 FT	400	2.5	400	BS	1	136.000	6341543
US 5 K 50 FT	500	2.5	500	BS	1	161.000	6341551
US 5 K 60 FT	600	2.5	600	BS	1	185.000	6341578
US 5 K 70 FT	700	2.5	700	BS	1	210.000	6341586
US 5 K 80 FT	800	2.5	800	BS	1	236.000	6341594
US 5 K 90 FT	900	2.5	900	BS	1	261.000	6341608
US 5 K 100 FT	1000	2.5	1000	BS	1	286.000	6341616
US 5 K 110 FT	1100	2.5	1100	BS	1	311.000	6341624
US 5 K 120 FT	1200	2.5	1200	BS	1	337.000	6341632

U support of dimensions 50 x 50 mm with welded head plate.

Protective cap

PE



Type	Colour	Pack Piece	Weight kg/100 pc.	Item no.
US 3 KS OR	Pastel orange	20	1.068	6338458

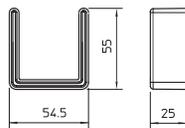
Protective cap to cover the ends of US 3 supports.

PE

Protective cap

Type	Colour	Pack Piece	Weight kg/100 pc.	Item no.
US 5 KS OR	Pastel orange	20	1.300	6338462

Protective cap to cover the ends of US 5 supports.

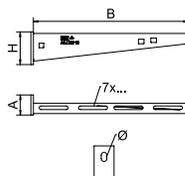


St FT

Wall and support bracket AW 15

Type	Width mm	Dim. H mm	Dim. A mm	Dim. B mm	Hole Ø mm	BS	Pack Piece	Weight kg/100 pc.	Item no.
AW 15 11 FT	110	50	40	110	11		1	13.100	6420656
AW 15 21 FT	210	60	40	210	11		1	24.000	6420680
AW 15 31 FT	310	65	40	310	11		1	38.400	6420710
AW 15 41 FT	410	70	40	410	11		1	54.000	6420745

Light-duty wall and support bracket with welded head plate.

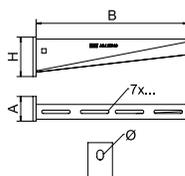


St FT

Wall and support bracket AW 30

Type	Width mm	Dim. H mm	Dim. A mm	Dim. B mm	Hole Ø mm	BS	Pack Piece	Weight kg/100 pc.	Item no.
AW 30 51 FT	510	90	50	510	13		1	129.000	6419798
AW 30 61 FT	610	100	50	610	13		1	157.000	6419828

Medium-duty wall and support bracket with welded head plate.

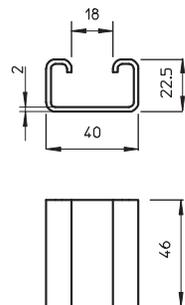


St FT

DSK 25 spacer

Type	Pack Piece	Weight kg/100 pc.	Item no.
DSK 25 FT	20	7.500	6416446

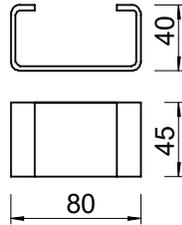
Spacer for use in US 3 supports.



Mounting systems

Spacer DSK 45

St FT

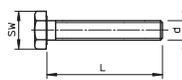


Type	Pack Piece	Weight kg/100 pc.	Item no.
DSK 45 FT	20	18.000	6416500

Spacer for use in US 5 support and in the head plate, type KU 7 VQP.

Hexagonal bolt M10

St F

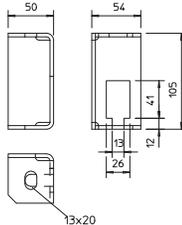


Type	Dimension mm	Dim. L mm	Dim. d mm	Dim. SW mm	Resistance grade	Pack Piece	Weight kg/100 pc.	Item no.
SKS 10x90 F	M 10x90	90	10	17	8.8	20	8.950	6418252

Hexagonal bolt for universal fastening of construction components. With hexagonal nut and 2 washers.

Fire protection clamp

St FT

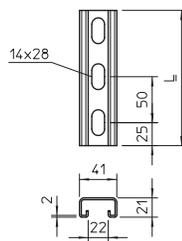


Type	Pack Piece	Weight kg/100 pc.	Item no.
BSB FT	20	42.400	6418198

Fire protection clamp for ceiling fastening of the threaded rod lock for routing types with cable ladders and cable trays for the maintenance of electrical function to DIN 4102 Part 12.

MS4121 mounting rail, slot 22 mm, perforated

St FS



Type	Length mm	Dimension W x H mm	Material thickness mm	Dim. L mm	Dim. BS	Pack Piece	Weight kg/100 pc.	Item no.
MS4121P0200FS	200	41x21	2	200	FS	1	35.000	1122950
MS4121P0300FS	300	41x21	2	300	FS	1	52.500	1122951
MS4121P0400FS	400	41x21	2	400	FS	1	70.000	1122953
MS4121P0500FS	500	41x21	2	500	FS	1	87.500	1122955

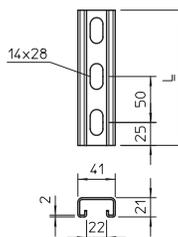
Heavy-duty C profile rail for individual installation of support constructions, e.g. for cable trays or as a panel for switchgear cabinets. Can also be used for cable routing, in conjunction with clamp clips with a U foot.

St FT

MS4121 mounting rail, slot 22 mm, perforated

Type	Length mm	Dimension W x H mm	Material thickness mm	Dim. L mm	BS	Pack Piece	Weight kg/100 pc.	Item no.
MS4121P0200FT	200	41x21	2	200		1	35.100	1122933
MS4121P0300FT	300	41x21	2	300		1	53.000	1122934
MS4121P0400FT	400	41x21	2	400		1	70.000	1122935
MS4121P0500FT	500	41x21	2	500		1	87.000	1122936

Heavy-duty C profile rail for individual installation of support constructions, e.g. for cable trays or as a panel for switchgear cabinets. Can also be used for cable routing, in conjunction with clamp clips with a U foot.

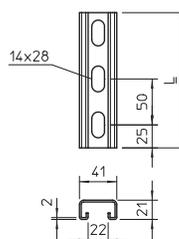


St FS

MS4121 mounting rail, slot 22 mm, perforated

Type	Length mm	Dimension W x H mm	Material thickness mm	Dim. L mm	BS	Pack m	Weight kg/100 m	Item no.
MS4121P2000FS	2000	41x21	2	2000		2	175.000	1122918
MS4121P3000FS	3000	41x21	2	3000		3	141.900	1122920

Heavy-duty C profile rail for individual installation of support constructions, e.g. for cable trays or as a panel for switchgear cabinets. Can also be used for cable routing, in conjunction with clamp clips with a U foot.

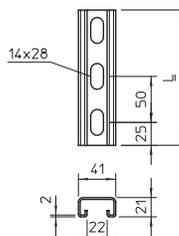


St FT

MS4121 mounting rail, slot 22 mm, perforated

Type	Length mm	Dimension W x H mm	Material thickness mm	Dim. L mm	BS	Pack m	Weight kg/100 m	Item no.
MS4121P2000FT	2000	41x21	2	2000		2	183.000	1122923
MS4121P3000FT	3000	41x21	2	3000		3	151.300	1122924

Heavy-duty C profile rail for individual installation of support constructions, e.g. for cable trays or as a panel for switchgear cabinets. Can also be used for cable routing, in conjunction with clamp clips with a U foot.

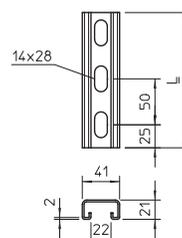


St FS

MSL4141 mounting rail, slot 22 mm, perforated

Type	Length mm	Dimension W x H mm	Material thickness mm	Dim. L mm	BS	Pack Piece	Weight kg/100 pc.	Item no.
MSL4141P0400FS	400	41x41	2	400		1	80.800	1123266
MSL4141P0500FS	500	41x41	2	500		1	101.000	1123268

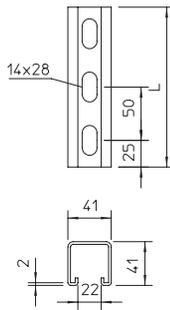
Heavy-duty C profile rail for individual installation of support constructions, e.g. for cable trays or as a panel for switchgear cabinets. Can also be used for cable routing, in conjunction with clamp clips with a U foot.



Mounting systems

MSL4141 mounting rail, slot 22 mm, perforated

St FS

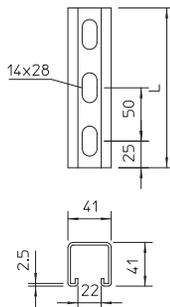


Type	Length mm	Dimension W x H mm	Material thickness mm	Dim.		Pack m	Weight kg/100 m	Item no.
				L mm	BS			
MSL4141P1000FS	1000	41x41	2	1000	FS	1	201.100	1122970
MSL4141P3000FS	3000	41x41	2	3000	FS	3	201.100	1122972

Heavy-duty C profile rail for individual installation of support constructions, e.g. for cable trays or as a panel for switchgear cabinets. Can also be used for cable routing, in conjunction with clamp clips with a U foot.

MSL4141 mounting rail, slot 22 mm, perforated

St FT

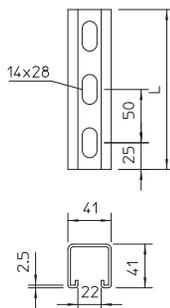


Type	Length mm	Dimension W x H mm	Material thickness mm	Dim.		Pack m	Weight kg/100 m	Item no.
				L mm	BS			
MSL4141P1000FT	1000	41x41	2	1000	FT	1	214.700	1122962
MSL4141P3000FT	3000	41x41	2	3000	FT	3	214.700	1122964

Heavy-duty C profile rail for individual installation of support constructions, e.g. for cable trays or as a panel for switchgear cabinets. Can also be used for cable routing, in conjunction with clamp clips with a U foot.

MS4141 mounting rail, slot 22 mm, perforated

St FT

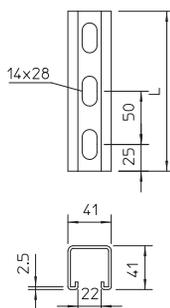


Type	Length mm	Dimension W x H mm	Material thickness mm	Dim.		Pack Piece	Weight kg/100 pc.	Item no.
				L mm	BS			
MS4141P0400FT	400	41x41	2.5	400	FT	1	104.700	1122525
MS4141P0500FT	500	41x41	2.5	500	FT	1	130.800	1122533
MS4141P0600FT	600	41x41	2.5	600	FT	1	156.900	1122541
MS4141P0700FT	700	41x41	2.5	700	FT	1	183.000	1122568

Heavy-duty C profile rail for individual installation of support constructions, e.g. for cable trays or as a panel for switchgear cabinets. Can also be used for cable routing, in conjunction with clamp clips with a U foot.

MS4141 mounting rail, slot 22 mm, perforated

St FS



Type	Length mm	Dimension W x H mm	Material thickness mm	Dim.		Pack m	Weight kg/100 m	Item no.
				L mm	BS			
MS4141P1000FS	1000	41x41	2.5	1000	FS	1	247.500	1122908
MS4141P3000FS	3000	41x41	2.5	3000	FS	3	247.500	1122910

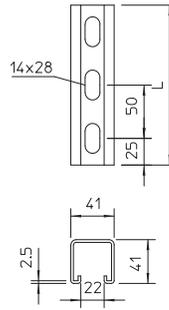
Heavy-duty C profile rail for individual installation of support constructions, e.g. for cable trays or as a panel for switchgear cabinets. Can also be used for cable routing, in conjunction with clamp clips with a U foot.

St FT

MS4141 mounting rail, slot 22 mm, perforated

Type	Length mm	Dimension W x H mm		Material thickness mm	Dim. L mm		Pack m	Weight kg/100 m	Item no.
		W	H		L	BS			
MS4141P1000FT	1000	41	41	2.5	1000	1	1	261.400	1122606
MS4141P3000FT	3000	41	41	2.5	3000	3	3	261.400	1122622

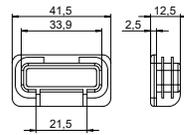
Heavy-duty C profile rail for individual installation of support constructions, e.g. for cable trays or as a panel for switchgear cabinets. Can also be used for cable routing, in conjunction with clamp clips with a U foot.



PE

Type	Colour	Pack Piece	Weight kg/100 pc.	Item no.
MS4121 EK	Pastel orange	50	0.645	1122904

End cap for profile rail, type MS4121.

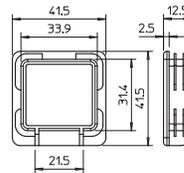


End cap MS4121

PE

Type	Colour	Pack Piece	Weight kg/100 pc.	Item no.
MS4141 EK	Pastel orange	50	0.670	1122906

End cap for profile rail, type MS4141.

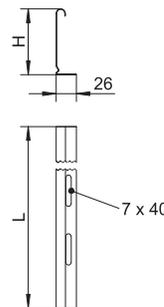


End cap MS4141

St FS

Type	Dim. H mm	Metal thick- ness mm		Dim. L mm	Pack m	Weight kg/100 m	Item no.
		thick- ness	mm				
TSG 45 FS	45	0.75	3000		3	46.700	6062033

Separating retainer for separation of cables of different voltages or functions.

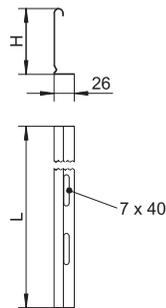


Separating retainer 45

Mounting systems

Separating retainer 60

St FS

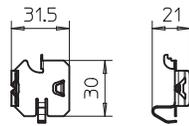


Type	Metal			Pack m	Weight kg/100 m	Item no.
	Dim. H mm	thick- ness mm	Dim. L mm			
TSG 60 FS	60	0.75	3000	3	55.700	6062068

Separating retainer for separation of cables of different voltages or functions.

Hold-down clamp for separating retainer fastening in RKSM

VA 2B

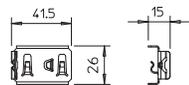


Type	Pack Piece	Weight kg/100 pc.	Item no.

Hold-down clamp for screwless fastening of separating retainers in the cable tray types RKSM, MKS and SKS.

Hold-down clamp for separating retainer fastening in GRM

VA 2B

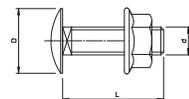
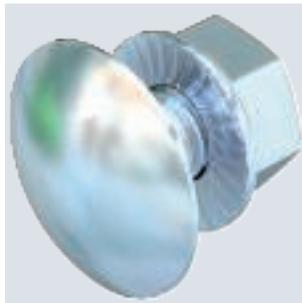


Type	Pack Piece	Weight kg/100 pc.	Item no.

Hold-down clamp for fastening separating retainer in mesh cable trays.

Truss-head bolt with flange nut

St F



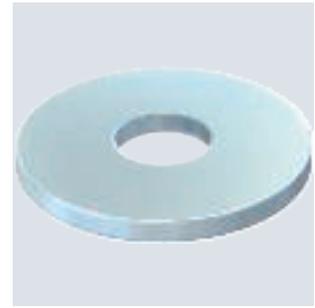
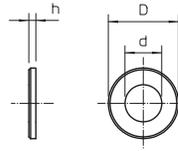
Type	Dimen- sion mm	Dim. L mm	Dim. d mm	Dim. D mm	Resist- ance grade	Pack Piece	Weight kg/100 pc.	Item no.

Truss-head bolt with square neck including flange nut.

St F

Type	Thread	Dim.	Dim.	Pack Piece	Weight kg/100 pc.	Item no.	
		d mm	D mm				Dim. mm
DIN440 7 F	M6	6.6	22	2	100	0.535	6408702

Washer of particularly large outer diameter.



Large washer

St G

Type	Thread	Dim.	Dim.	Break	Pack Piece	Weight kg/100 pc.	Item no.
		d mm	L mm	load kN			
TR M8 1M G	M8	8	1000	14.6	10	30.000	3141128
TR M10 1M G	M10	10	1000	23.2	10	49.000	3141209
TR M12 1M G	M12	12	1000	33.7	10	62.000	3141306

Threaded rod to DIN 976.

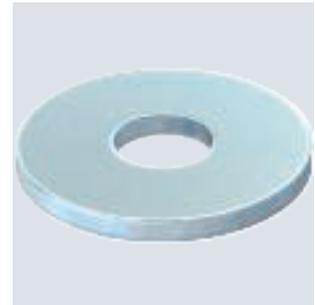
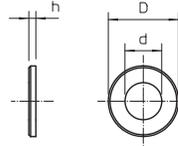


Threaded rod

St G

Type	Thread	Dim.	Dim.	Dim.	Pack Piece	Weight kg/100 pc.	Item no.
		d mm	D mm	mm			
WS M8 G20 G	M8	8.4	20	1.25	100	0.227	3403122

Washer of particularly large outer diameter.

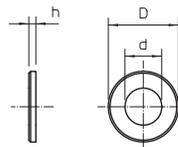


Fender washer

St G

Type	Thread	Dim.	Dim.	Dim.	Pack Piece	Weight kg/100 pc.	Item no.
		d mm	D mm	mm			
WS M10 D20 G	M10	10.5	20	2	100	0.408	3402096
WS M12 D24 G	M12	13	24	2.5	100	0.570	3402126

Washer according to DIN 125, shape A, for universal use.



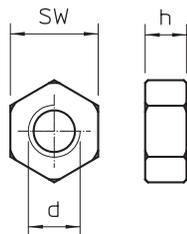
Washer



Mounting systems

Hexagonal nut DIN 934

St G

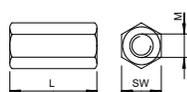


Type	Thread	SW mm	Dim.		Pack Piece	Weight kg/100 pc.	Item no.
			Dim. mm	d mm			
HN M8 G	M8	13	6.8	8	100	0.500	3400085
HN M10 G	M10	17	8.4	10	100	1.014	3400107
HN M12 G	M12	19	10.8	12	100	1.730	3400123

Hexagonal nut to DIN 934 with metric thread.

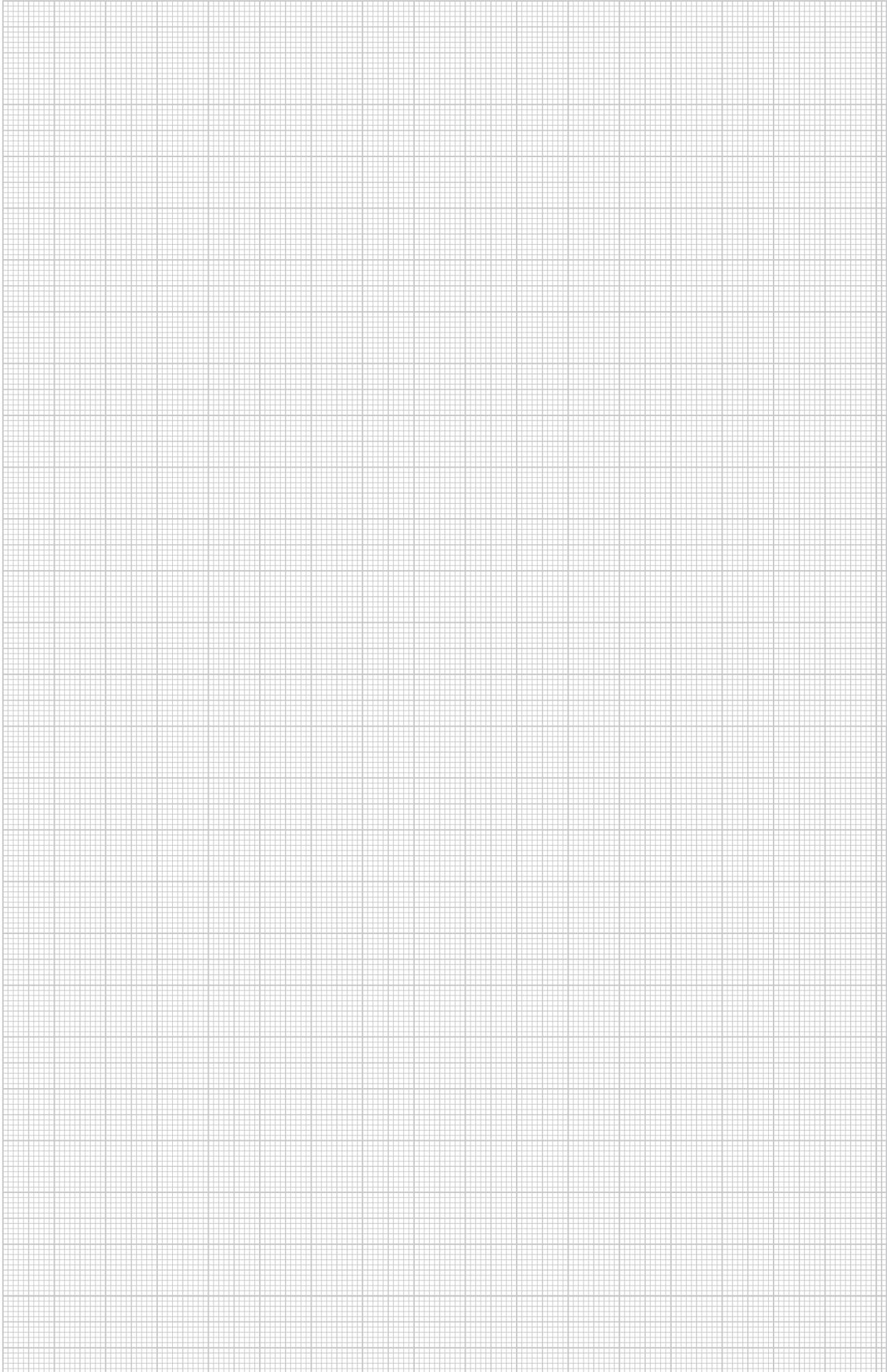
Connection sleeve

St G



Type	Thread	Dim.		Pack Piece	Weight kg/100 pc.	Item no.
		L mm	SW mm			
CSTR M8 G	M8	24	13	50	1.880	6410081
CSTR M10 G	M10	30	17	50	4.150	6410103
CSTR M12 G	M12	40	19	25	7.000	6410111

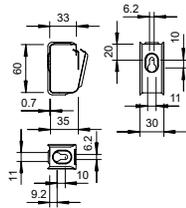
Connection sleeve with continuous internal thread.



Grouped supports, Grip M

Grip collection clamp, metal 15

St FS

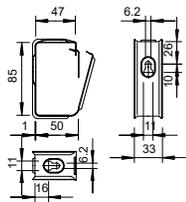


Type	No. of conductors	Shipping box	Pack Piece	Weight kg/100 pc.	Item no.
2031 M 15 FS	15	BS	50	3.700	2207028

Metal grouped support for high mechanical stability, even in case of fire. Suitable for safe mounting above fire protection ceilings. Also approved as a cable-specific variant for the maintenance of electrical function to DIN 4102 part 12. For wall and ceiling mounting. Lock can be opened without tools. Detailed information on the approved routing variants can be found in the appropriate testing documentation.

Grip collection clamp, metal 30

St FS

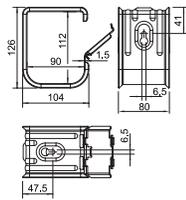


Type	No. of conductors	Shipping box	Pack Piece	Weight kg/100 pc.	Item no.
2031 M 30 FS	30	BS	25	6.200	2207036

Metal grouped support for high mechanical stability, even in case of fire. Suitable for safe mounting above fire protection ceilings. Also approved as a cable-specific variant for the maintenance of electrical function to DIN 4102 part 12. For wall and ceiling mounting. Lock can be opened without tools. Detailed information on the approved routing variants can be found in the appropriate testing documentation.

Grip collection clamp, metal 70

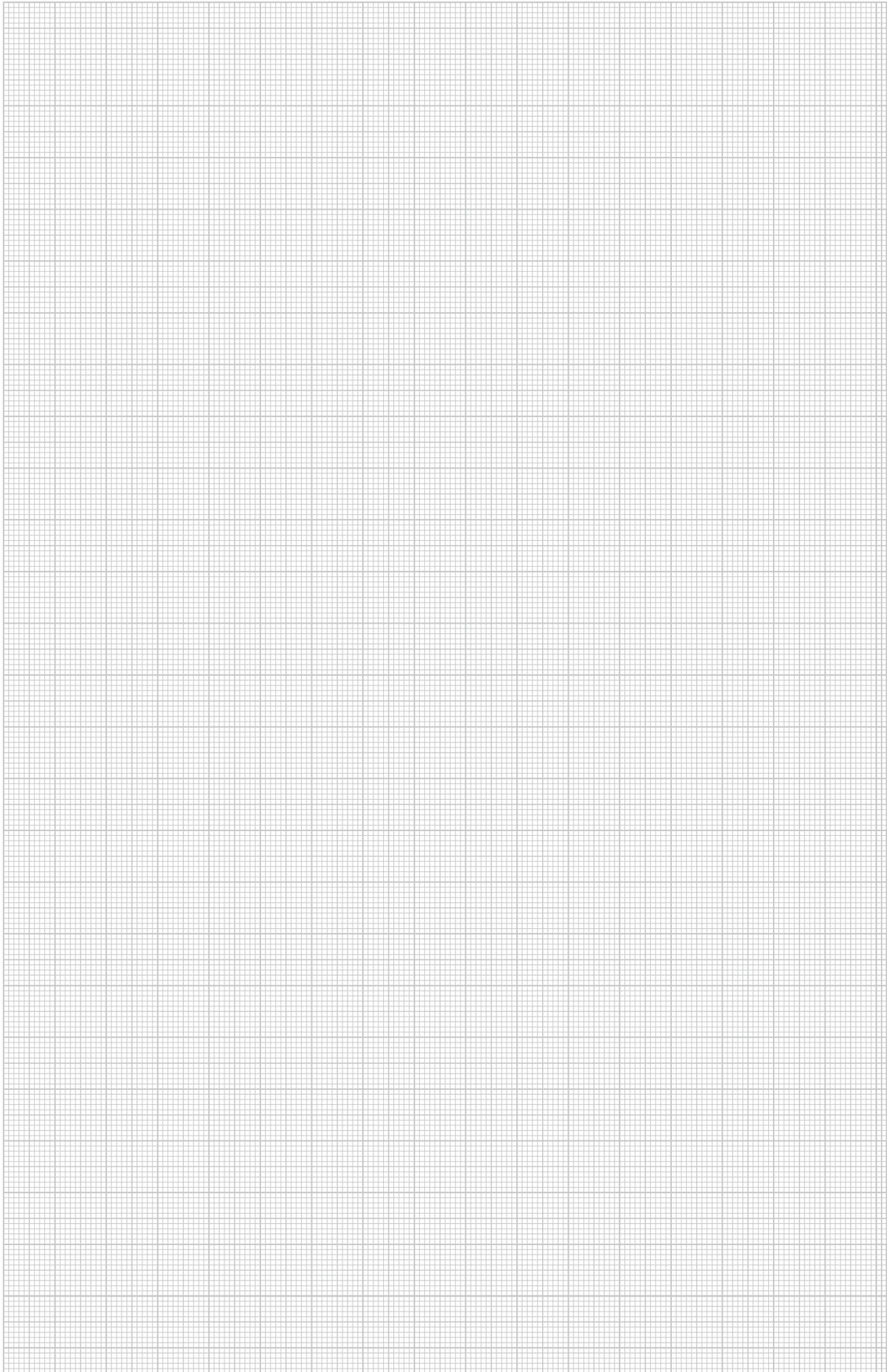
St FS



Type	No. of conductors	Shipping box	Pack Piece	Weight kg/100 pc.	Item no.
2031 M 70 FS	70	BS	10	34.500	2207060

Metal grouped support for high mechanical stability, even in case of fire. Suitable for safe mounting above fire protection ceilings. Also approved as a cable-specific variant for the maintenance of electrical function to DIN 4102 part 12. For wall and ceiling mounting. Lock can be opened without tools. Detailed information on the approved routing variants can be found in the appropriate testing documentation.

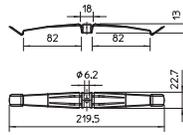




Pressure clips, metal

Pressure clip for 16 cables

VA 2B

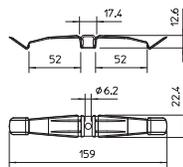


Type	No. of conductors	Pack Piece	Weight kg/100 pc.	Item no.
2033 M A2	16	25	2.310	2204000

The metal pressure clip is halogen and fire load-free, and maintains a good mechanical stability even in fires. The pressure clip is also approved as a cable-specific variant for the maintenance of electrical functionality to DIN 4102 Part 12. The spacer 2033 D 15 x 3 G (must be ordered separately) increases the clamping height of pressure clips from 10 to 13 mm. The pressure clips are suitable for fireproof mounting above suspended fire protection ceilings in accordance with DIN 4102.

Pressure clip for 10 cables

VA 2B

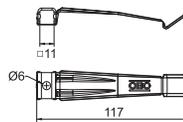


Type	No. of conductors	Pack Piece	Weight kg/100 pc.	Item no.
2034 M A2	10	50	1.860	2204010

The metal pressure clip is halogen and fire load-free, and maintains a good mechanical stability even in fires. The pressure clip is also approved as a cable-specific variant for the maintenance of electrical functionality to DIN 4102 Part 12. The spacer 2033 D 15 x 3 G (must be ordered separately) increases the clamping height of pressure clips from 10 to 13 mm. The pressure clips are suitable for fireproof mounting above suspended fire protection ceilings in accordance with DIN 4102.

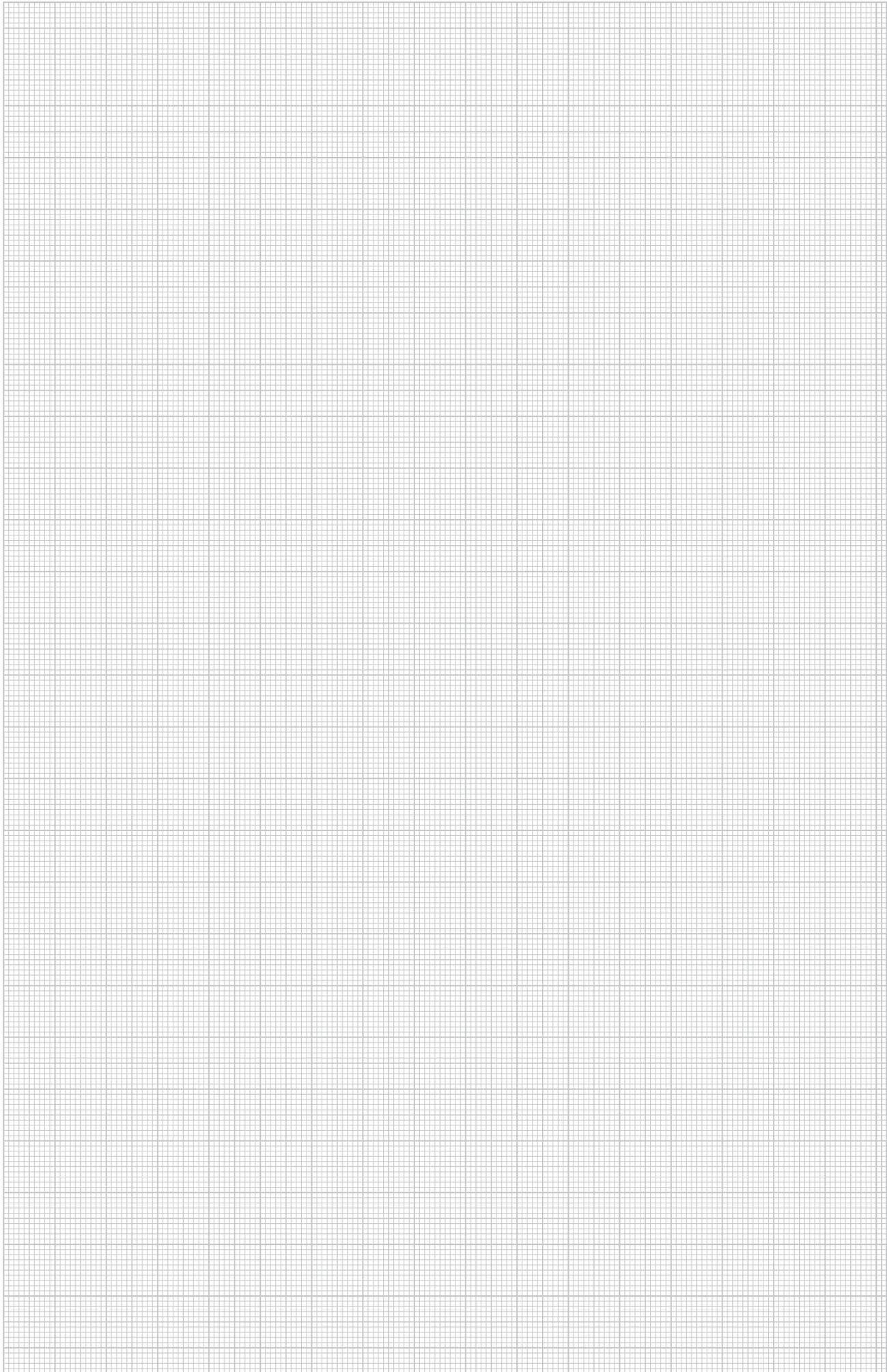
Pressure clip for 8 cables

VA 2B



Type	No. of conductors	Pack Piece	Weight kg/100 pc.	Item no.
2035 M A2	8	20	1.030	2204020

The metal pressure clip is halogen and fire load-free, and maintains a good mechanical stability even in fires. The pressure clip is also approved as a cable-specific variant for the maintenance of electrical functionality to DIN 4102 Part 12. The spacer 2033 D 15 x 3 G (must be ordered separately) increases the clamping height of pressure clips from 10 to 13 mm. The pressure clips are suitable for fireproof mounting above suspended fire protection ceilings in accordance with DIN 4102.



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