Planning aids

Industrial installations
Cable support systems and connection and fastening systems for industry and construction project infrastructure
Because, for us, product features such as installation speed, load capacity, functionality and availability are at the forefront of every innovation, OBO systems are always reliable, safe and of the highest quality. A high production depth and strong process automation also allow us to deal with the requirements of our customers in a targeted manner.

For the new edition of our catalogue, we have once again questioned our own processes. Is OBO a progressive, flexible company? Are our structures effective and our processes efficient? Do we know our markets to a sufficient level? And primarily: Are we actually the best possible partner that you could imagine?

Towards the future

For us to be able to answer these questions with a confident “Yes”, we have optimised our structures once again, sharpened our profile and defined our services more clearly. This will allow us to react more quickly and reliably in future – both nationally and internationally – and also address the requirements of each individual customer even better.

This optimisation is best reflected in the three new installation areas. Thanks to this considerably more streamlined structure, we can emphasise the product benefits even further and make the appropriate areas of application more tangible.

Because it is better:
OBO – simply better
Industrial installations

Cable support systems and connection and fastening systems for industry and construction project infrastructure

- Cable trays
- Mesh cable trays
- Cable ladders
- Industrial ducts and trunking
- Support structures
- Electrical installation pipes
- Wiring ducts and trunking
- Power supply units
- Distributors
- Junction boxes
- Concealed and cavity wall installations
- Terminals
- Cable glands
- Installation and fastening clips
- Anchors and fastening systems

Building installations

Cable routing and underfloor systems for administrative and functional buildings including architectural solutions

- Electrical installation ducts and trunking
- Device installation ducts and trunking
- Skirting ducts and trunking
- Service poles
- Underfloor applications in screed
- Underfloor applications in concrete
- Underfloor applications, on-floor
- Service outlets for underfloor applications
- Floor sockets and floor boxes
- Installation housings and supports
- Tabletop sockets
- Sockets, switches, data and multimedia technology

Safety and protection installations

Lightning, surge and fire protection systems

- Surge protection
- Explosion protection
- Lightning protection
- Earthing
- Equipotential bonding
- Insulation
- Cable bandages – prevention of the spread of fire
- Escape route installations – false ceiling mounting
- Fire protection ducts – protection of escape routes
- Fire protection ducts
- Systems for the maintenance of electrical functionality – cable-specific routing variants
- Systems for the maintenance of electrical functionality – standard support structures and routing systems
- Systems for the maintenance of electrical functionality – FireBox T series junction boxes
- Anchorings
### Planning aids

#### Industrial installations

Cable support, connection and fastening systems for industry and construction project infrastructure

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>General planning aids</td>
<td>7</td>
</tr>
<tr>
<td>Cable trays</td>
<td>59</td>
</tr>
<tr>
<td>Mesh cable trays</td>
<td>85</td>
</tr>
<tr>
<td>Cable ladders</td>
<td>97</td>
</tr>
<tr>
<td>Industrial ducts and trunking</td>
<td>115</td>
</tr>
<tr>
<td>Support structures</td>
<td>133</td>
</tr>
<tr>
<td>Power supply units</td>
<td>161</td>
</tr>
<tr>
<td>Wiring ducts and trunking</td>
<td>175</td>
</tr>
<tr>
<td>Anchors and fastening systems</td>
<td>183</td>
</tr>
</tbody>
</table>
High demands are placed on products that are used in industrial environments. Electrical installations used in industrial settings are exposed to different weather and ambient conditions, need to withstand mechanical demands and loads and must also provide protection in the event of fire.

That is why the properties of the materials used are critical to the selection of installation systems for industrial applications. Depending on where they are used, the corrosion resistance and load-bearing capacity of metals or the chemical and impact resistance of plastics are just some of the key selection criteria. In addition to the structural requirements, other points that can be decisive for the type and design of electrical installation systems in industrial settings include the maintenance of electrical functionality in the event of fire, electromagnetic compatibility or explosion protection.

This catalogue is intended to be both a source of information and a decision-making aid. It provides information on materials, corrosion resistance, surface refinements, testing procedures and protection ratings, among other things. It also explains how cable volumes and loads are calculated and how these can be used to select the appropriate installation system. Maintaining the electrical function of safety-relevant systems in the event of fire is also addressed, as are electromagnetic compatibility and important certificates and test marks.
General planning aids

- Surfaces and corrosion: 8
- Properties of plastics: 18
- Protection ratings: 22
- Nominal values of electrical equipment: 24
- Zone division for explosive areas: 25
- Cable sizes: 26
- Basic values for calculation of the cable volume: 27
- Fastening clips: 28
- Selection of the correct cable support system: 29
- Cable load: 32
- Cable glands and DIN EN 50262: 40
- Information on cable fastening: 41
- Classification of installation pipes (according to DIN EN 61386-1): 42
- Definition of electromagnetic compatibility (EMC): 44
- Guaranteeing EMC: 45
- Magnetic shield insulation of cable support systems: 46
- Transfer impedance of cable support systems: 47
- Maintenance of the electrical supply: 48
- Standards, certifications and test marks: 52
- Every test mark at a glance: 54
- First-hand support and knowledge: 55
- OBO Construct – planning software and product configurators: 56
Metal: Corrosion and corrosion protection

A large number of products used in industrial installations are made of metal. Metals are much tougher than many other materials and are less sensitive to mechanical loading. The OBO metal products are made of aluminium, die-cast zinc, stainless steel or steel.

Steel (St), the most commonly used material, is very strong and has good elasticity and chemical resistance. However, steel is susceptible to corrosion and must therefore be protected accordingly.

Stainless steels consist mainly of alloyed, very hard and rustproof steels. Stainless steels are divided into quality classes according to the percentage of alloys. These are indicated by the material number according to DIN EN 10027.

Aluminium (Al), as a light metal, has comparatively low strength but good electrical conductivity and high corrosion resistance.

Die-cast zinc components (Zn) are very strong and hard. The manufacturing process enables the production of very precise components with good corrosion resistance.

Corrosion protection
“Corrosion protection” means all steps taken to prevent corrosion damage to metallic components. It is impossible to prevent corrosion permanently, so corrosion protection measures generally aim to reduce the speed of corrosion so that the component is not damaged by corrosion for the duration of its service life. The term “passive corrosion protection” refers to all measures designed to shield products from corrosive media. Coatings are one way of achieving passive corrosion protection. At OBO, most steel products are protected from corrosion by a layer of zinc. Zinc coatings can be applied to components using a variety of methods.

Zinc slat covering
Zinc slat coverings are coatings applied in a non-electrolytic manner. They offer a cathodic protection and thus have excellent corrosion protection, while at the same time, there is no risk of hydrogen-induced breakage. Due to these properties, this coating type is used for connection components with a high strength classification or structural parts with high tensile strength. The low layer thickness of the zinc slat covering allows a thin, homogeneous coating, which is particularly important for maintaining the accuracy of screw threads. This coating achieves a resistance of 480 hrs in the salt spray test for the connection elements.
Galvanisation types

Electrogalvanisation – electrolytic galvanisation in accordance with DIN EN 12329
In electrogalvanisation, the component is coated by dipping it not in molten zinc, but in a zinc electrolyte, through which a direct electric current is passed.

Hot-dip galvanisation – hot galvanisation using the dipping method according to DIN EN ISO 1461
Batch galvanisation is mainly used for galvanising prefabricated steel parts, by dipping them in molten zinc at a temperature of around 450 °C.

Strip galvanising – hot galvanised according to the strip-galvanising method in accordance with DIN EN 10346
Strip galvanisation or Sendzimir galvanisation is where a continuous ribbon of steel is galvanised in a continuous line.

Hot-dip coating – zinc-aluminium coating in accordance with DIN EN 10346
In contrast to conventional coating systems, the material being galvanised in the double-dip process passes through two baths in succession: the first contains pure zinc, the second a zinc-aluminium alloy.
Classification of corrosion resistance
All the system components must show sufficient resistance against corrosion in agreement with the standard DIN EN 61537. The minimum zinc layer thicknesses are determined through a measurement. The grouping into the appropriate class is detailed in the table “Classification of corrosion resistance”. The table “Corrosion categories according to DIN EN ISO 12944” shows the area of application and the zinc loss to be expected.
**Classification of corrosion resistance (from the draft of DIN EN 61537)**

<table>
<thead>
<tr>
<th>Class</th>
<th>Reference material and surface treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0*</td>
<td>None</td>
</tr>
<tr>
<td>1</td>
<td>Electroplated to a minimum thickness of 5 µm</td>
</tr>
<tr>
<td>2</td>
<td>Electroplated to a minimum thickness of 12 µm</td>
</tr>
<tr>
<td>3</td>
<td>Pre-galvanised to grade 275 to EN 10327 and EN 10326</td>
</tr>
<tr>
<td>4</td>
<td>Pre-galvanised to grade 350 to EN 10327 and EN 10326</td>
</tr>
<tr>
<td>5</td>
<td>Post-galvanised to a zinc mean coating thickness of (minimum) 45 µm according to ISO 1461</td>
</tr>
<tr>
<td>6</td>
<td>Post-galvanised to a zinc mean coating thickness (minimum) of 55 µm according to ISO 1461</td>
</tr>
<tr>
<td>7</td>
<td>Post-galvanised to a zinc mean coating thickness (minimum) of 70 µm according to ISO 1461</td>
</tr>
<tr>
<td>8</td>
<td>Post-galvanised to a zinc mean coating thickness (minimum) of 85 µm according to ISO 1461 (usually high silicon steel)</td>
</tr>
<tr>
<td>9A</td>
<td>Stainless steel manufactured to ASTM: A 240/A 240M – 95a designation S30400 or EN 10088 grade 1-4301 without a post-treatment *</td>
</tr>
<tr>
<td>9B</td>
<td>Stainless steel manufactured to ASTM: A 240/A 240M – 95a designation S31603 or EN 10088 grade 1-4404 without a post-treatment **</td>
</tr>
<tr>
<td>9C</td>
<td>Stainless steel manufactured to ASTM: A 240/A 240M – 95a designation S30400 or EN 10088 grade 1-4301 with a post-treatment **</td>
</tr>
<tr>
<td>9D</td>
<td>Stainless steel manufactured to ASTM: A 240/A 240M – 95a designation S31603 or EN 10088 grade 1-4404 with a post-treatment **</td>
</tr>
</tbody>
</table>

* For materials which do not have a declared corrosion resistance classification
** The end treatment process is used to improve the protection against crack corrosion and the contamination of other steels

**Corrosivity categories to DIN EN ISO 12944**

<table>
<thead>
<tr>
<th>Corrosion category</th>
<th>Typical environment, inside</th>
<th>Typical environment, outside</th>
<th>Corrosion load</th>
<th>Average zinc removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 1</td>
<td>Heated buildings with neutral atmospheres, e.g. offices, shops, schools, hotels</td>
<td>Atmosphere with low level of impurities. Often rural areas</td>
<td>Insignificant</td>
<td>&lt;0.1 µm/a</td>
</tr>
<tr>
<td>C 2</td>
<td>Unheated buildings in which condensation can occur, e.g. warehouse, sports halls</td>
<td>City and industrial atmosphere, considerable impurities through sulphur dioxide, coastal areas with low salt load</td>
<td>Low</td>
<td>0.1 to 0.7 µm/a</td>
</tr>
<tr>
<td>C 3</td>
<td>Production facilities with a high level of humidity and some air impurities, e.g. plants for food production, laundries, breweries, dairies</td>
<td>Industrial areas and coastal areas with low salt load</td>
<td>Medium</td>
<td>0.7 to 2.1 µm/a</td>
</tr>
<tr>
<td>C 4</td>
<td>Chemical plants, swimming pools, boat sheds over seawater</td>
<td>Industrial areas with high levels of humidity and aggressive atmosphere</td>
<td>Strong</td>
<td>2.1 to 4.2 µm/a</td>
</tr>
<tr>
<td>C 5-I</td>
<td>Buildings or areas with almost constant condensation and with high levels of impurities</td>
<td>Industrial areas with high levels of humidity and aggressive atmosphere</td>
<td>Very strong (industry)</td>
<td>4.2 to 8.4 µm/a</td>
</tr>
<tr>
<td>C 5-M</td>
<td>Buildings or areas with almost continuous condensation and with high levels of impurities</td>
<td>Coastal or offshore areas with salt load</td>
<td>Very strong (sea)</td>
<td>&gt; 4.2 to 8.4 µm/a</td>
</tr>
</tbody>
</table>
Contact corrosion

If two different metals are conductively connected with each other, contact corrosion can occur. This poses a considerable risk to the load capacity and lifespan of the components used.

The level of contact corrosion is primarily determined by the level of the potential difference between the contact partners. Contact corrosion occurs at potential differences of 100 mV or greater and the anodic (electrically negative) partner is at risk of corrosion. Therefore, strongly non-precious metals should never be brought into contact with precious metals.

Additional contact corrosion criteria:
- Level of electrical resistance between the contact partners. The higher the resistance, the lower the contact corrosion. Positive on Al and Ti.
- Occurrence of an electrolyte. An electrolyte, such as perspiration or condensation, attacks the protective layers, increasing conductivity. Dirt increases this effect through released ions.
- Length of the impact of the electrolyte. The longer the electrolyte is active, the greater the corrosion will be.
- The surface ratios of the contact partners influence the current density. The best thing to have is a small surface ratio of the “precious” to the “less precious” contact partner.
- Different environments or atmospheres can increase or influence the risk of contact corrosion to varying degrees.
Installation locations

Whether indoors or outdoors, in aggressive atmospheres or under special hygienic conditions, OBO can offer the perfect surface and materials for your installation, no matter what the requirements may be.

OBO metal products are machined from high-quality sheet steel or steel wire and are available with various surfaces. Different hardening and coating methods ensure tailor-made corrosion protection, specially tailored to the appropriate application:

<table>
<thead>
<tr>
<th>Application</th>
<th>Material</th>
<th>Surface protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indoors</td>
<td>Steel</td>
<td>Painted/powder-coated</td>
</tr>
<tr>
<td></td>
<td>Steel</td>
<td>Strip galvanised (approx. 20 μm)</td>
</tr>
<tr>
<td></td>
<td>Steel</td>
<td>DIN EN 10327</td>
</tr>
<tr>
<td></td>
<td>Steel</td>
<td>Electrogalvanised/electrolytically galvanised (approx. 2.5–10 μm), DIN EN 12329</td>
</tr>
<tr>
<td>Outdoors</td>
<td>Steel</td>
<td>Hot galvanised (approx. 40–60 μm)</td>
</tr>
<tr>
<td></td>
<td>Steel</td>
<td>DIN EN ISO 1461</td>
</tr>
<tr>
<td></td>
<td>Stainless steel A2</td>
<td>Zinc-aluminium coating (approx. 23 μm)</td>
</tr>
<tr>
<td></td>
<td>Stainless steel A4</td>
<td>DIN EN 10346</td>
</tr>
<tr>
<td>Especially corrosive areas</td>
<td>Stainless steel A2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stainless steel A4</td>
<td></td>
</tr>
</tbody>
</table>
Contact corrosion in different environments

### Land climate

<table>
<thead>
<tr>
<th>Component (large)</th>
<th>FF</th>
<th>VA</th>
<th>Al</th>
<th>Cu</th>
<th>CuZn 27</th>
<th>Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel, galvanised</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>!</td>
<td>o</td>
<td>✓</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>✓</td>
<td>✓</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>✓</td>
</tr>
<tr>
<td>Aluminium</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>!</td>
<td>o</td>
<td>✓</td>
</tr>
<tr>
<td>Copper</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>✓</td>
<td>o</td>
<td>!</td>
</tr>
<tr>
<td>Brass</td>
<td>✓</td>
<td>!</td>
<td>o</td>
<td>o</td>
<td>✓</td>
<td>!</td>
</tr>
<tr>
<td>Die-cast zinc</td>
<td>o</td>
<td>o</td>
<td>✓</td>
<td>x</td>
<td>o</td>
<td>✓</td>
</tr>
</tbody>
</table>

- ✓ No risk of contact corrosion
- ○ Low risk of contact corrosion
- ! Risk in case of small area ratio (area of non-precious metal/area of precious metal)
- X High risk of contact corrosion
### Industrial atmosphere

<table>
<thead>
<tr>
<th>Component (large)</th>
<th>FT</th>
<th>VA</th>
<th>Al</th>
<th>Cu</th>
<th>CuZn 27</th>
<th>Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel, galvanised</td>
<td>✓</td>
<td>✓</td>
<td>o</td>
<td>x</td>
<td>!</td>
<td>✓</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>✓</td>
<td>✓</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>✓</td>
</tr>
<tr>
<td>Aluminium</td>
<td>o</td>
<td>o</td>
<td>✓</td>
<td>!</td>
<td>!</td>
<td>✓</td>
</tr>
<tr>
<td>Copper</td>
<td>!</td>
<td>!</td>
<td>x</td>
<td>✓</td>
<td>o</td>
<td>!</td>
</tr>
<tr>
<td>Brass</td>
<td>o</td>
<td>o</td>
<td>x</td>
<td>o</td>
<td>✓</td>
<td>o</td>
</tr>
<tr>
<td>Die-cast zinc</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>x</td>
<td>!</td>
<td>✓</td>
</tr>
</tbody>
</table>

| ✓ | No risk of contact corrosion |
| O | Low risk of contact corrosion |
| ! | Risk in case of small area ratio (area of non-precious metal/area of precious metal) |
| ❌ | High risk of contact corrosion |
### General planning aids

#### Maritime climate

<table>
<thead>
<tr>
<th>Component (large)</th>
<th>SS</th>
<th>SG</th>
<th>FT</th>
<th>G</th>
<th>DD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Steel, galvanised</strong></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stainless steel</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminium</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Brass</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Die-cast zinc</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

**Component (small)**

<table>
<thead>
<tr>
<th>Component (small)</th>
<th>SS</th>
<th>SG</th>
<th>FT</th>
<th>G</th>
<th>DD</th>
<th>Cu/Zn</th>
<th>Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Steel, galvanised</strong></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stainless steel</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminium</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brass</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Die-cast zinc</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

- ✓ No risk of contact corrosion
- ○ Low risk of contact corrosion
- ! Risk in case of small area ratio (area of non-precious metal/area of precious metal)
- ✗ High risk of contact corrosion
Surfaces for special visual requirements or specific environmental conditions

Applications with specific optical requirements or special environmental conditions
Colour-coated products are becoming ever more popular. The coating may be required for optical reasons or for reasons of corrosion protection.

Colour coatings for reasons of corrosion protection
• Products in FT (hot-dip galvanised version)
• All RAL colours available
• Coating of the visible surfaces or the complete system
• Suitable for the colour of the structure when routed openly
• Separation of different voltages/functions (e.g. blue 230/400 V power supply; red weak current such as telephone cables and IT)

Colour-coated systems are not specifically indicated in this Industrial installation product catalogue. You can obtain details of these systems by contacting our telephone hotline on +49 (0)2371 7899-2000.
Plastic: Materials and properties

Essentially plastics be of one of three types: thermoplastics, elastomers and Duroplast.

**Thermoplastics**
Also known as plastomers, these are plastics that can be shaped within a specific temperature range. This process is reversible, in other words, thermoplastics can theoretically be cooled and then melted down again any number of times. Another unique advantage of thermoplastics is that they can be welded.

**Elastomers**
Elastomers have a fixed shape, but can be elastically deformed. They can elastically deform under tensile and compressive stresses, but afterwards will return to their original shape. Elastomers are used for producing seals and membrane entries.

**Duroplastics**
Duroplastics or thermostetting polymers/plastics, are plastics that can no longer be deformed following curing. Duroplasts produce hard, glass-like (brittle) polymeric materials with a high thermo-mechanical strength.

**Properties**
The area of application for which plastic OBO products are suitable depends mainly on the properties of the material being used. The most important material properties are:

- Temperature resistance
- Risk of stress cracks
- Chemical resistance
- Halogen freedom
- UV resistance
- Flame resistance

### Temperature ranges of plastics

<table>
<thead>
<tr>
<th>Material</th>
<th>Max. temperature resistance permanent</th>
<th>Max. temperature resistance short-term</th>
<th>Min. temperature resistance static</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylonitrile butadiene styrene</td>
<td>70°C</td>
<td>85°C</td>
<td>-40°C</td>
</tr>
<tr>
<td>Ethylene vinyl acetate</td>
<td>55°C</td>
<td>70°C</td>
<td>-50°C</td>
</tr>
<tr>
<td>Polyamide</td>
<td>120°C</td>
<td>150°C</td>
<td>-40°C</td>
</tr>
<tr>
<td>Polyamide, fibre-glass reinforced</td>
<td>120°C</td>
<td>160°C</td>
<td>-20°C</td>
</tr>
<tr>
<td>Polybutylene terephthalate</td>
<td>120°C</td>
<td>140°C</td>
<td>-40°C</td>
</tr>
<tr>
<td>Polycarbonate</td>
<td>110°C</td>
<td>125°C</td>
<td>-35°C</td>
</tr>
<tr>
<td>Polyethylene</td>
<td>70°C</td>
<td>90°C</td>
<td>-40°C</td>
</tr>
<tr>
<td>Polypropylene (PP)</td>
<td>90°C</td>
<td>110°C</td>
<td>-30°C</td>
</tr>
<tr>
<td>Polystyrene</td>
<td>70°C</td>
<td>80°C</td>
<td>-10°C</td>
</tr>
<tr>
<td>Polyvinyl chloride</td>
<td>65°C</td>
<td>80°C</td>
<td>-30°C</td>
</tr>
<tr>
<td>Rubber mixture</td>
<td>100°C</td>
<td>110°C</td>
<td>-40°C</td>
</tr>
<tr>
<td>Nitrile rubber</td>
<td>100°C</td>
<td>110°C</td>
<td>-30°C</td>
</tr>
<tr>
<td>Duropoliast, Amino-plast, type 131.5</td>
<td>65°C</td>
<td>90°C</td>
<td>-40°C</td>
</tr>
<tr>
<td>Duropoliast, melamine resin, type 150</td>
<td>80°C</td>
<td>110°C</td>
<td>-40°C</td>
</tr>
</tbody>
</table>
## Risk of stress cracks

<table>
<thead>
<tr>
<th>Medium</th>
<th>ABS/ASA</th>
<th>UF</th>
<th>MF</th>
<th>EVA</th>
<th>NBR</th>
<th>NBR</th>
<th>NBR</th>
<th>PA</th>
<th>PA/UF</th>
<th>PEE</th>
<th>PEE</th>
<th>PE</th>
<th>PE</th>
<th>PP</th>
<th>PP</th>
<th>PS</th>
<th>PVC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk of stress cracks</td>
<td>☒ ☒ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Danger of tension cracks:</td>
<td>✓ Virtually negligible</td>
<td>☐ Low</td>
<td>☐ High</td>
<td>☒ Very high</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Chemical resistance

<table>
<thead>
<tr>
<th>Medium</th>
<th>ABS/ASA</th>
<th>UF</th>
<th>MF</th>
<th>EVA</th>
<th>NBR</th>
<th>NBR</th>
<th>NBR</th>
<th>PA</th>
<th>PA/UF</th>
<th>PEE</th>
<th>PEE</th>
<th>PE</th>
<th>PE</th>
<th>PP</th>
<th>PP</th>
<th>PS</th>
<th>PVC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petroleum</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Fat</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Benzole</td>
<td>☐ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Solvents</td>
<td>☒ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Formic acid</td>
<td>✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Citric acid</td>
<td>✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Lactic acid</td>
<td>✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td>☐ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Sulphanic acid</td>
<td>☐ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Acetone</td>
<td>☐ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Petrol</td>
<td>☐ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Butyric acid</td>
<td>☐ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Chlorine</td>
<td>☐ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Acetic acid</td>
<td>☐ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Nitric acid</td>
<td>☐ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Ether</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Alcohol</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Mild alkalis</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Mild acids</td>
<td>☐ ☐ ✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Ether</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Strong acids</td>
<td>☐ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Strong alkalis</td>
<td>☐ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td></td>
</tr>
<tr>
<td>Hydrofluoric acid</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Paraffin hydrocarbon</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Haloalkanes</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Ketones</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Aldehyde</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Organid acids</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Seawater</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Diesel fuel</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
<tr>
<td>Ammoniac</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>✓ ✓ ✓ ✓</td>
</tr>
</tbody>
</table>

**Resistance:**  ✓ Resistant  ☐ Limited resistance  ☐ Not resistant
Halogen freedom
Estimates suggest that around 95% of fire victims die not due to the immediate effects of the fire, but of poisoning from the smoke. In addition, the corrosive fire gases created during fires cause immense damage to property and can permanently damage the structure of a building. Therefore, halogen-free installation systems should or must always be used in public areas (emergency routes, lifts, etc.). The chemical composition of these halogen-free systems is designed in such a way that, in the case of fire, they produce less hazardous (toxic/corrosive) gases, which could combine with extinguishing agents to form hydrochloric acid. In the sense of the standard DIN VDE 0472, this means that materials are considered halogen-free when “the proportions of the halogens chlorine, bromine and iodine are ≤ 0.2% for chlorine and ≤ 0.1% for fluorine”.

OBO Bettermann offers a wide range of halogen-free products that reduce the risk of harm to people and property to a minimum in case of fire.

UV resistance
Outdoor installations should always be viewed particularly critically with regard to the mounting locations and the selection of the installation materials. UV radiation is damaging to many plastics, causing them to turn yellow and/or brittle or lose their elasticity. However, plastics can be protected against UV damage through the addition of UV stabilisers. Products made from UV-resistant materials are specially marked. In general, besides UV radiation, installations outdoors must also take other environmental influences into account. Factors such as maximum temperatures, regularity of (extreme) temperature changes, humidity and the location of use/mounting (housing, industry, town, region, continent) all have an important role to play here.
Flame-resistance/fire-resistance
Materials are described as flame-resistant if they prevent the spread of fire or are sufficiently fire-resistant. According to DIN EN 60695-2-11 (VDE 0471 Part 2–11), electrical connection materials must be subjected to a glow wire test, in order to evaluate the fire risk of the end product. When the glow wire test is being carried out, a glowing wire (for temperature see table below) is inserted into the component to be tested for a period of 30 seconds and then removed. After 30 seconds at the latest, the object, if it has caught light, must have extinguished again, in order to specify the flame resistance.

<table>
<thead>
<tr>
<th>Types of samples</th>
<th>Surface-mounted</th>
<th>Concealed</th>
<th>Flush-mounted</th>
<th>Cavity wall/furniture</th>
<th>Concrete structure</th>
<th>Installation duct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection sockets</td>
<td>650</td>
<td>650</td>
<td>750</td>
<td>850</td>
<td>650</td>
<td>750</td>
</tr>
<tr>
<td>Accessory sockets and device connection sockets</td>
<td>750</td>
<td>650</td>
<td>-</td>
<td>850</td>
<td>650</td>
<td>750</td>
</tr>
<tr>
<td>Ceiling lights, connection sockets</td>
<td>750</td>
<td>650</td>
<td>-</td>
<td>850</td>
<td>650</td>
<td>750</td>
</tr>
<tr>
<td>Wall light connection sockets</td>
<td>750</td>
<td>650</td>
<td>-</td>
<td>850</td>
<td>650</td>
<td>750</td>
</tr>
<tr>
<td>Device connection sockets</td>
<td>750</td>
<td>650</td>
<td>-</td>
<td>850</td>
<td>650</td>
<td>750</td>
</tr>
<tr>
<td>Connection sleeves</td>
<td>750</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>750</td>
</tr>
<tr>
<td>Insulation sections, which support active parts</td>
<td>960</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Protection ratings

**IP protection rating**

The IP protection rating specifies how far a component is protected against contact and foreign bodies and the ingress of water. The IP protection ratings are controlled by the standard DIN EN 60529 (VDE 0470 Part 1). The IP is always made up of two digits.

The first digit designates the contact and foreign body protection. On the one hand, it specifies how far a housing prevents access to dangerous parts, by preventing or limiting the ingress of body parts or objects held by a person. On the other hand, it specifies how far the housing protects the installed resources against the ingress of solid foreign bodies.

<table>
<thead>
<tr>
<th>First code digit</th>
<th>...against access to the dangerous parts</th>
<th>...against solid foreign bodies</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Protected against access to dangerous parts with the back of the hand</td>
<td>Not protected</td>
</tr>
<tr>
<td>1</td>
<td>Protected against access to dangerous parts with a finger</td>
<td>Protected against solid foreign bodies of 50 mm diameter and larger</td>
</tr>
<tr>
<td>2</td>
<td>Protected against access to dangerous parts with a tool</td>
<td>Protected against solid foreign bodies of 12.5 mm diameter and larger</td>
</tr>
<tr>
<td>3</td>
<td>Protected against access to dangerous parts with a wire</td>
<td>Protected against solid foreign bodies of 2.5 mm diameter and larger</td>
</tr>
<tr>
<td>4</td>
<td>Protected against access to dangerous parts with a wire</td>
<td>Protected against solid foreign bodies of 1.0 mm diameter and larger</td>
</tr>
<tr>
<td>5</td>
<td>Protected against access to dangerous parts with a wire</td>
<td>Dust-protected</td>
</tr>
<tr>
<td>6</td>
<td>Protected against access to dangerous parts with a wire</td>
<td>Dust-proof</td>
</tr>
</tbody>
</table>
The second digit specifies the protection against water. It specifies how far the resource is protected against incoming water and the resulting damage.

### Protection rating against the entry of water with a damaging impact

<table>
<thead>
<tr>
<th>Second code digit</th>
<th>Short description</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Not protected</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>Protected against water droplets</td>
<td>Droplets falling vertically may have no damaging impact.</td>
</tr>
<tr>
<td>2</td>
<td>Protected against water droplets when the housing is tilted to up to 15°</td>
<td>Droplets falling vertically may not have a damaging impact, if the housing is tilted to angle of 15° on either side of the vertical.</td>
</tr>
<tr>
<td>3</td>
<td>Protected against spray water</td>
<td>Water being sprayed at an angle of 60° on both sides of the vertical may not have any damaging impact.</td>
</tr>
<tr>
<td>4</td>
<td>Protected against spray water</td>
<td>Water spraying the housing from any direction may not have any damaging impact.</td>
</tr>
<tr>
<td>5</td>
<td>Protected against water jets</td>
<td>Jets of water pointing at the housing from any direction may not have any damaging impact.</td>
</tr>
<tr>
<td>6</td>
<td>Protected against strong water jets</td>
<td>Strong jets of water pointing at the housing from any direction may not have any damaging impact.</td>
</tr>
<tr>
<td>7</td>
<td>Protected against the effects of being temporarily immersed in water</td>
<td>If the housing is sometimes underwater under standard pressure and time conditions, then water may not enter in such volumes as would have a damaging impact.</td>
</tr>
<tr>
<td>8</td>
<td>Protected against the effects of being continuously immersed in water</td>
<td>If the housing is continuously underwater, then water may not enter in such volumes as would have a damaging impact and this shall be subject to conditions to be agreed between the manufacturer and the user. However, the conditions are more difficult to fulfill than for number 7.</td>
</tr>
</tbody>
</table>

### IK code

The IK code to DIN EN 50102 indicates the protection rating of housings against external mechanical loads. It is made up of the code letters IK and a two-digit number from 00 to 10. Each group of numbers stands for a load energy value in Joules (J). The IK code always applies to the complete housing, which guarantees the protection of resources against the damaging effects of mechanical loads. The housings are tested by knocking them with different testing hammers.
Nominal values of electrical equipment

When using junction boxes, connection sockets and connection terminals, the resources are assigned nominal values. In the designation, a distinction is made between the maximum approved voltage (nominal voltage), the maximum approved current (nominal current) and the maximum approved cross-section (nominal cross-section of the cables to be connected).

**Nominal cross-section**
Largest tested-approved cross-section of the cables to be connected.

**Nominal current**
The nominal current is the highest permissible operating current that can be continuously passed through connections (e.g. terminals) marked with that value.

**Nominal voltage**
Greatest approved voltage at the connection point.

In addition to the nominal values, the number of entries for junction boxes and the number of poles of clamp connectors are also possible labels.

**Number of poles**
Number of connection points of the clamp connector.

**Number of entries**
Number of entries in an electrical connection box or connection socket.
Zones for explosive areas

Products used in potentially explosive areas must comply with the ATEX directives. The ATEX workplace directive 1999/92/EC sets out the minimum requirements for improving the safety and health protection of workers at risk from potentially explosive atmospheres. The directive divides areas with dangerous, potentially explosive atmospheres into zones. Ex-tested products may be used in the respective zones in accordance with their approval.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 0</td>
<td>An area in which it can be expected that, under normal conditions, an explosive atmosphere of gas occurs continuously or for long periods of time.</td>
</tr>
<tr>
<td>Zone 1</td>
<td>An area in which it can be expected that, under normal conditions, an explosive atmosphere of gas occasionally occurs.</td>
</tr>
<tr>
<td>Zone 2</td>
<td>An area in which it can be expected that, under normal conditions, an explosive atmosphere of gas seldom or only briefly occurs.</td>
</tr>
<tr>
<td>Zone 20</td>
<td>An area in which it can be expected that, under normal conditions, an explosive atmosphere of dust/air occurs continuously or for long periods of time.</td>
</tr>
<tr>
<td>Zone 21</td>
<td>An area in which it can be expected that, under normal conditions, an explosive atmosphere of dust/air occasionally occurs.</td>
</tr>
<tr>
<td>Zone 22</td>
<td>An area in which it can be expected that, under normal conditions, an explosive atmosphere of dust/air seldom or only briefly occurs.</td>
</tr>
</tbody>
</table>
The term “cable” means a jacketed electrical cable for the transmission of electrical energy and data. Cables are given according to their nominal cross-section. The external diameter and usable cross-section depend on their nominal cross-section and the number of individual wires contained in the cable. When fastening clips or cable support systems are used, it is important to know the actual space requirements of the individual cables. It is not sufficient to take only the diameter as a basis for the calculation of the cable volume.

To save you work, we have listed the diameter and usable cross-section of the most important cable types below.

**Important:**
These values are average values, which may vary from manufacturer to manufacturer. Please refer to the manufacturer's specifications for the exact values.

---

**Cable sizes**

The circular area of the cable cross-section says little about the actual space required by a cable. Calculate: \((2r)^2\). This value reflects the realistic space requirements, including the compartments.
### Insulated power cables

<table>
<thead>
<tr>
<th>Type</th>
<th>Diameter mm</th>
<th>Usable cross-section cm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x 4</td>
<td>6.5</td>
<td>0.42</td>
</tr>
<tr>
<td>1 x 6</td>
<td>7</td>
<td>0.49</td>
</tr>
<tr>
<td>1 x 10</td>
<td>8</td>
<td>0.64</td>
</tr>
<tr>
<td>1 x 16</td>
<td>9.5</td>
<td>0.9</td>
</tr>
<tr>
<td>1 x 25</td>
<td>12.5</td>
<td>1.56</td>
</tr>
<tr>
<td>3 x 1.5</td>
<td>8.5</td>
<td>0.72</td>
</tr>
<tr>
<td>3 x 2.5</td>
<td>9.5</td>
<td>0.9</td>
</tr>
<tr>
<td>3 x 4</td>
<td>11</td>
<td>1.21</td>
</tr>
<tr>
<td>4 x 1.5</td>
<td>9</td>
<td>0.81</td>
</tr>
<tr>
<td>4 x 2.5</td>
<td>10.5</td>
<td>1.1</td>
</tr>
<tr>
<td>4 x 4</td>
<td>12.5</td>
<td>1.56</td>
</tr>
<tr>
<td>4 x 6</td>
<td>13.5</td>
<td>1.82</td>
</tr>
<tr>
<td>4 x 10</td>
<td>16.5</td>
<td>2.72</td>
</tr>
<tr>
<td>4 x 16</td>
<td>19</td>
<td>3.61</td>
</tr>
<tr>
<td>4 x 25</td>
<td>23.5</td>
<td>5.52</td>
</tr>
<tr>
<td>4 x 35</td>
<td>26</td>
<td>6.76</td>
</tr>
<tr>
<td>5 x 1.5</td>
<td>9.5</td>
<td>0.9</td>
</tr>
<tr>
<td>5 x 2.5</td>
<td>11</td>
<td>1.21</td>
</tr>
<tr>
<td>5 x 4</td>
<td>13.5</td>
<td>1.82</td>
</tr>
<tr>
<td>5 x 6</td>
<td>14.5</td>
<td>2.1</td>
</tr>
<tr>
<td>5 x 10</td>
<td>18</td>
<td>3.24</td>
</tr>
<tr>
<td>5 x 16</td>
<td>21.5</td>
<td>4.62</td>
</tr>
<tr>
<td>5 x 25</td>
<td>26</td>
<td>6.76</td>
</tr>
<tr>
<td>7 x 1.5</td>
<td>10.5</td>
<td>1.1</td>
</tr>
<tr>
<td>7 x 2.5</td>
<td>13</td>
<td>1.69</td>
</tr>
</tbody>
</table>

### Insulated power cables

<table>
<thead>
<tr>
<th>Type</th>
<th>Diameter mm</th>
<th>Usable cross-section cm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x 10</td>
<td>10.5</td>
<td>1.1</td>
</tr>
<tr>
<td>1 x 16</td>
<td>11.5</td>
<td>1.32</td>
</tr>
<tr>
<td>1 x 25</td>
<td>12.5</td>
<td>1.56</td>
</tr>
<tr>
<td>1 x 35</td>
<td>13.5</td>
<td>1.82</td>
</tr>
<tr>
<td>1 x 50</td>
<td>15.5</td>
<td>2.4</td>
</tr>
<tr>
<td>1 x 70</td>
<td>16.5</td>
<td>2.72</td>
</tr>
<tr>
<td>1 x 95</td>
<td>18.5</td>
<td>3.42</td>
</tr>
<tr>
<td>1 x 120</td>
<td>20.5</td>
<td>4.2</td>
</tr>
<tr>
<td>1 x 150</td>
<td>22.5</td>
<td>5.06</td>
</tr>
<tr>
<td>1 x 185</td>
<td>25</td>
<td>6.25</td>
</tr>
<tr>
<td>1 x 240</td>
<td>28</td>
<td>7.84</td>
</tr>
<tr>
<td>1 x 300</td>
<td>30</td>
<td>9</td>
</tr>
<tr>
<td>3 x 1.5</td>
<td>11.5</td>
<td>1.32</td>
</tr>
<tr>
<td>3 x 2.5</td>
<td>12.5</td>
<td>1.56</td>
</tr>
<tr>
<td>3 x 10</td>
<td>17.5</td>
<td>3.06</td>
</tr>
<tr>
<td>3 x 16</td>
<td>19.5</td>
<td>3.8</td>
</tr>
<tr>
<td>3 x 50</td>
<td>26</td>
<td>6.76</td>
</tr>
<tr>
<td>3 x 70</td>
<td>30</td>
<td>9</td>
</tr>
<tr>
<td>3 x 120</td>
<td>36</td>
<td>12.96</td>
</tr>
<tr>
<td>4 x 1.5</td>
<td>12.5</td>
<td>1.56</td>
</tr>
<tr>
<td>4 x 2.5</td>
<td>13.5</td>
<td>1.82</td>
</tr>
<tr>
<td>4 x 4</td>
<td>15</td>
<td>2.72</td>
</tr>
<tr>
<td>4 x 10</td>
<td>18.5</td>
<td>3.42</td>
</tr>
<tr>
<td>4 x 16</td>
<td>21.5</td>
<td>4.62</td>
</tr>
<tr>
<td>4 x 25</td>
<td>25.5</td>
<td>6.5</td>
</tr>
<tr>
<td>4 x 35</td>
<td>28</td>
<td>7.84</td>
</tr>
<tr>
<td>4 x 50</td>
<td>30</td>
<td>9</td>
</tr>
<tr>
<td>4 x 70</td>
<td>34</td>
<td>11.56</td>
</tr>
<tr>
<td>4 x 95</td>
<td>39</td>
<td>15.21</td>
</tr>
<tr>
<td>4 x 120</td>
<td>42</td>
<td>17.64</td>
</tr>
<tr>
<td>4 x 150</td>
<td>47</td>
<td>22</td>
</tr>
<tr>
<td>4 x 185</td>
<td>52</td>
<td>27</td>
</tr>
<tr>
<td>4 x 240</td>
<td>58</td>
<td>33.6</td>
</tr>
<tr>
<td>5 x 1.5</td>
<td>13.5</td>
<td>1.82</td>
</tr>
<tr>
<td>5 x 2.5</td>
<td>14.5</td>
<td>2.1</td>
</tr>
<tr>
<td>5 x 6</td>
<td>18.5</td>
<td>3.42</td>
</tr>
<tr>
<td>5 x 10</td>
<td>20.5</td>
<td>4.2</td>
</tr>
<tr>
<td>5 x 16</td>
<td>22.5</td>
<td>5.06</td>
</tr>
<tr>
<td>5 x 25</td>
<td>27.5</td>
<td>7.56</td>
</tr>
<tr>
<td>5 x 35</td>
<td>34</td>
<td>11.56</td>
</tr>
<tr>
<td>5 x 50</td>
<td>40</td>
<td>16</td>
</tr>
</tbody>
</table>

### Telecommunications cables

<table>
<thead>
<tr>
<th>Type</th>
<th>Diameter mm</th>
<th>Usable cross-section cm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 x 2 x 0.6</td>
<td>5</td>
<td>0.25</td>
</tr>
<tr>
<td>4 x 2 x 0.6</td>
<td>5.5</td>
<td>0.3</td>
</tr>
<tr>
<td>6 x 2 x 0.6</td>
<td>6.5</td>
<td>0.42</td>
</tr>
<tr>
<td>10 x 2 x 0.6</td>
<td>7.5</td>
<td>0.56</td>
</tr>
<tr>
<td>20 x 2 x 0.6</td>
<td>9</td>
<td>0.81</td>
</tr>
<tr>
<td>40 x 2 x 0.6</td>
<td>11</td>
<td>1.12</td>
</tr>
<tr>
<td>60 x 2 x 0.6</td>
<td>13</td>
<td>1.69</td>
</tr>
<tr>
<td>100 x 2 x 0.6</td>
<td>17</td>
<td>2.89</td>
</tr>
<tr>
<td>200 x 2 x 0.6</td>
<td>23</td>
<td>5.29</td>
</tr>
<tr>
<td>2 x 2 x 0.8</td>
<td>6</td>
<td>0.36</td>
</tr>
<tr>
<td>4 x 2 x 0.8</td>
<td>7</td>
<td>0.49</td>
</tr>
<tr>
<td>6 x 2 x 0.8</td>
<td>8.5</td>
<td>0.72</td>
</tr>
<tr>
<td>10 x 2 x 0.8</td>
<td>9.5</td>
<td>0.9</td>
</tr>
<tr>
<td>20 x 2 x 0.8</td>
<td>13</td>
<td>1.69</td>
</tr>
<tr>
<td>40 x 2 x 0.8</td>
<td>16.5</td>
<td>2.72</td>
</tr>
<tr>
<td>60 x 2 x 0.8</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>100 x 2 x 0.8</td>
<td>25.5</td>
<td>6.5</td>
</tr>
<tr>
<td>200 x 2 x 0.8</td>
<td>32</td>
<td>10.24</td>
</tr>
</tbody>
</table>

### IT cables type Cat...

<table>
<thead>
<tr>
<th>Type</th>
<th>Diameter mm</th>
<th>Usable cross-section cm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cat. 5</td>
<td>8</td>
<td>0.64</td>
</tr>
<tr>
<td>Cat. 6</td>
<td>8</td>
<td>0.64</td>
</tr>
</tbody>
</table>

### Coax cable (Standard)

<table>
<thead>
<tr>
<th>Type</th>
<th>Diameter mm</th>
<th>Usable cross-section cm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAT/BK cable</td>
<td>6.8</td>
<td>0.48</td>
</tr>
</tbody>
</table>
Fastening clips are given with their maximum span distance as a nominal size in mm. This makes it easy to determine the appropriate clip for the planned cable volume. If the necessary clamping range is between two nominal sizes, e.g. 16 mm, we recommend using the smaller nominal size.

If cables are not fastened directly in the clip, but routed through an installation pipe for example, the relationship between the external diameter and metric or PG sizes must be observed when selecting the correct fastening clip. You will find more information on this in the table below.

### Overview of external diameters, metric and PG sizes

<table>
<thead>
<tr>
<th>External diameter in mm</th>
<th>Metric size</th>
<th>PG size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 12</td>
<td>M12</td>
<td>PG 7</td>
</tr>
<tr>
<td>Up to 16</td>
<td>M16</td>
<td>PG 9/PG 11</td>
</tr>
<tr>
<td>Up to 20</td>
<td>M20</td>
<td>PG 13.5/PG 16</td>
</tr>
<tr>
<td>Up to 25</td>
<td>M25</td>
<td>PG 21</td>
</tr>
<tr>
<td>Up to 32</td>
<td>M32</td>
<td>PG 21</td>
</tr>
<tr>
<td>Up to 40</td>
<td>M40</td>
<td>PG 36</td>
</tr>
<tr>
<td>Up to 50</td>
<td>M50</td>
<td>PG 42/PG 48</td>
</tr>
<tr>
<td>Up to 63</td>
<td>M63</td>
<td>-</td>
</tr>
</tbody>
</table>
Selection of the correct cable support system

When selecting the right cable support system, the cable volume is not the only decisive factor. The type of cabling, method of laying and cable weight all play an important role. The most important aspects are explained on the following pages.

Cable types
Not all cables are the same. To select the perfect cable support system, you need to know which type of cables are to be laid: Are they sensitive data cables, which must be laid at a certain distance from each other on account of the necessary shielding? Or power cables, for which a not inconsiderable heat build-up must be taken? For all these applications OBO can offer tailor-made system solutions.
System types

Universal cable trays
Areas of application: from low-voltage cabling to power supply.

Mesh cable trays for the installation of light cables
Areas of application: IT cabling, telephone cabling and control cables. Also suitable for use in false ceilings and cavity floors.

Cable ladders for power cables with a large cross-section
Areas of application: (power) cables with large cross-sections. These can be fastened to the rungs using U clamps. The large load capacity and good ventilation ensure perfect cable routing.

Wide span cable trays and ladders for large support distances
Areas of application: for installations in which the support distances are more than three metres, on account of the construction conditions.

Modular system for special tasks
The product range that knows no bounds. The range of individually combinable products is particularly suited to complex installation tasks.

AZ small duct for universal use
Areas of application: from luminaire support systems to low-voltage cabling and power supply.
Finding the appropriate system for the planned cable volume

**Cable height**
The cable height may not exceed the edge height of the cable tray.

**Volume reserve**
When selecting the system, a volume reserve of at least 30% should be planned for possible later installations.

**Branches**
When dimensioning branches, the bending radii of the cables must be taken into account.

**Separation of system levels**
When selecting the volume, pay attention to the different cables. To separate different voltage levels, you must take the required spacings into account.

**Same usable cross-section, different requirements**
There are different requirements for laying data and power cables. Even if the usable cross-section or cable volume is the same, data cables tend to have a narrow, high tray, whereas power cables require a wide, flat version, to avoid heat build-up.

**Examples**
Flat, wide variant:
- E.g. for power cables
- Cable tray width: 300 mm
- Side height: 35 mm
- Usable cross-section: 103 cm² e.g. for data cables
- Cable tray width: 100 mm
- Side height: 110 mm
- Usable cross-section: 108 cm²
Calculating the cable load

Of equal significance for the selection of the most suitable cable support system is the load capacity. This must be matched with the expected cable weight (including the reserve for later installation). There are three variants for determining the cable weight:

**Variant 1: Orientation to experience values**

The average load capacity of a cable tray can be calculated roughly using experience values. For a system with a rail height of 60 mm, a value of 15 kg per 100 mm width is valid for each metre of cable tray or cable ladder. However, more accurate than orientation to experience values is to calculate the cable load using the formula from DIN VDE 0639 Part 1 (Variant 2) or the manufacturer's specifications (Variant 3). The graphics show the load capacities, based on experience values, of cable trays with a rail height of 60 mm, relative to cable tray widths of 100 to 600 mm.

**Variant 2: Calculation formula according to VDE 0639 T1**

DIN VDE 0639 Part 1 (cable support systems) offers a formula for calculating the maximum permitted cable load.

In the example calculation below, the maximum approved cable load for a cable tray is worked out using the dimension 60 mm x 300 mm and a usable cross-section of 178 cm².

**Variant 3: Exact calculation according to manufacturer's specifications**

Most cable manufacturers offer a very accurate method of calculating cable weights, and appropriate lists or tables can be obtained from them. Important: The table below only provides a rough overview. They are average values, which may vary from manufacturer to manufacturer. Please refer to the manufacturer's specifications for the exact values.

<table>
<thead>
<tr>
<th>0.028 N</th>
<th>100 mm = 15 kg/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cable load (F) =</td>
<td>m x mm²</td>
</tr>
<tr>
<td>2. Conversion from Newtons (N) to kilogrammes (kg)</td>
<td>10 N = 1 kg – in our example, this means: 500 N/m = 50 kg/m</td>
</tr>
<tr>
<td>3. Maximum occurring load = 50 kg/m</td>
<td></td>
</tr>
</tbody>
</table>
## Actual cable load of different cable types

### Insulated power cables

<table>
<thead>
<tr>
<th>Type</th>
<th>Cable load kg/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x 4</td>
<td>0.08</td>
</tr>
<tr>
<td>1 x 6</td>
<td>0.105</td>
</tr>
<tr>
<td>1 x 10</td>
<td>0.155</td>
</tr>
<tr>
<td>1 x 16</td>
<td>0.23</td>
</tr>
<tr>
<td>1 x 25</td>
<td>0.33</td>
</tr>
<tr>
<td>3 x 1.5</td>
<td>0.135</td>
</tr>
<tr>
<td>3 x 2.5</td>
<td>0.19</td>
</tr>
<tr>
<td>3 x 4</td>
<td>0.265</td>
</tr>
<tr>
<td>4 x 1.5</td>
<td>0.16</td>
</tr>
<tr>
<td>4 x 2.5</td>
<td>0.23</td>
</tr>
<tr>
<td>4 x 4</td>
<td>0.33</td>
</tr>
<tr>
<td>4 x 6</td>
<td>0.46</td>
</tr>
<tr>
<td>4 x 10</td>
<td>0.69</td>
</tr>
<tr>
<td>4 x 16</td>
<td>1.09</td>
</tr>
<tr>
<td>4 x 25</td>
<td>1.64</td>
</tr>
<tr>
<td>4 x 35</td>
<td>2.09</td>
</tr>
<tr>
<td>5 x 1.5</td>
<td>0.19</td>
</tr>
<tr>
<td>5 x 2.5</td>
<td>0.27</td>
</tr>
<tr>
<td>5 x 4</td>
<td>0.41</td>
</tr>
<tr>
<td>5 x 6</td>
<td>0.54</td>
</tr>
<tr>
<td>5 x 10</td>
<td>0.85</td>
</tr>
<tr>
<td>5 x 16</td>
<td>1.35</td>
</tr>
<tr>
<td>5 x 25</td>
<td>1.99</td>
</tr>
<tr>
<td>7 x 1.5</td>
<td>0.235</td>
</tr>
<tr>
<td>7 x 2.5</td>
<td>0.35</td>
</tr>
</tbody>
</table>

### Insulated power cables

<table>
<thead>
<tr>
<th>Type</th>
<th>Cable load kg/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x 10</td>
<td>0.18</td>
</tr>
<tr>
<td>1 x 16</td>
<td>0.24</td>
</tr>
<tr>
<td>1 x 25</td>
<td>0.35</td>
</tr>
<tr>
<td>1 x 35</td>
<td>0.46</td>
</tr>
<tr>
<td>1 x 50</td>
<td>0.6</td>
</tr>
<tr>
<td>1 x 70</td>
<td>0.8</td>
</tr>
<tr>
<td>1 x 95</td>
<td>1.1</td>
</tr>
<tr>
<td>1 x 120</td>
<td>1.35</td>
</tr>
<tr>
<td>1 x 150</td>
<td>1.65</td>
</tr>
<tr>
<td>1 x 185</td>
<td>2</td>
</tr>
<tr>
<td>1 x 240</td>
<td>2.6</td>
</tr>
<tr>
<td>1 x 300</td>
<td>3.2</td>
</tr>
<tr>
<td>3 x 1.5</td>
<td>0.19</td>
</tr>
<tr>
<td>3 x 2.5</td>
<td>0.24</td>
</tr>
<tr>
<td>3 x 10</td>
<td>0.58</td>
</tr>
<tr>
<td>3 x 16</td>
<td>0.81</td>
</tr>
<tr>
<td>3 x 50</td>
<td>1.8</td>
</tr>
<tr>
<td>3 x 70</td>
<td>2.4</td>
</tr>
<tr>
<td>3 x 120</td>
<td>4</td>
</tr>
<tr>
<td>4 x 1.5</td>
<td>0.22</td>
</tr>
<tr>
<td>4 x 2.5</td>
<td>0.29</td>
</tr>
<tr>
<td>4 x 6</td>
<td>0.4</td>
</tr>
<tr>
<td>4 x 16</td>
<td>1.05</td>
</tr>
<tr>
<td>4 x 25</td>
<td>1.6</td>
</tr>
<tr>
<td>4 x 35</td>
<td>1.75</td>
</tr>
<tr>
<td>4 x 50</td>
<td>2.3</td>
</tr>
<tr>
<td>4 x 70</td>
<td>3.1</td>
</tr>
<tr>
<td>4 x 95</td>
<td>4.2</td>
</tr>
<tr>
<td>4 x 120</td>
<td>5.2</td>
</tr>
<tr>
<td>4 x 150</td>
<td>6.4</td>
</tr>
<tr>
<td>4 x 185</td>
<td>8.05</td>
</tr>
<tr>
<td>4 x 240</td>
<td>11</td>
</tr>
<tr>
<td>5 x 1.5</td>
<td>0.27</td>
</tr>
<tr>
<td>5 x 2.5</td>
<td>0.35</td>
</tr>
<tr>
<td>5 x 6</td>
<td>0.61</td>
</tr>
<tr>
<td>5 x 10</td>
<td>0.88</td>
</tr>
<tr>
<td>5 x 16</td>
<td>1.25</td>
</tr>
<tr>
<td>5 x 25</td>
<td>1.95</td>
</tr>
<tr>
<td>5 x 35</td>
<td>2.4</td>
</tr>
<tr>
<td>5 x 50</td>
<td>3.5</td>
</tr>
</tbody>
</table>

### Telecommunications cables

<table>
<thead>
<tr>
<th>Type</th>
<th>Cable load kg/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 x 2 x 0.6</td>
<td>0.03</td>
</tr>
<tr>
<td>4 x 2 x 0.6</td>
<td>0.035</td>
</tr>
<tr>
<td>6 x 2 x 0.6</td>
<td>0.05</td>
</tr>
<tr>
<td>10 x 2 x 0.6</td>
<td>0.065</td>
</tr>
<tr>
<td>20 x 2 x 0.6</td>
<td>0.11</td>
</tr>
<tr>
<td>40 x 2 x 0.6</td>
<td>0.2</td>
</tr>
<tr>
<td>60 x 2 x 0.6</td>
<td>0.275</td>
</tr>
<tr>
<td>100 x 2 x 0.6</td>
<td>0.445</td>
</tr>
<tr>
<td>200 x 2 x 0.6</td>
<td>0.87</td>
</tr>
<tr>
<td>2 x 2 x 0.8</td>
<td>0.04</td>
</tr>
<tr>
<td>4 x 2 x 0.8</td>
<td>0.055</td>
</tr>
<tr>
<td>6 x 2 x 0.8</td>
<td>0.08</td>
</tr>
<tr>
<td>10 x 2 x 0.8</td>
<td>0.115</td>
</tr>
<tr>
<td>20 x 2 x 0.8</td>
<td>0.205</td>
</tr>
<tr>
<td>40 x 2 x 0.8</td>
<td>0.38</td>
</tr>
<tr>
<td>60 x 2 x 0.8</td>
<td>0.54</td>
</tr>
<tr>
<td>100 x 2 x 0.8</td>
<td>0.875</td>
</tr>
<tr>
<td>200 x 2 x 0.8</td>
<td>1.79</td>
</tr>
</tbody>
</table>

### Coax cable (standard)

<table>
<thead>
<tr>
<th>Type</th>
<th>Cable load kg/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAT/BK cable</td>
<td>0.06</td>
</tr>
</tbody>
</table>

### IT cables type Cat...

<table>
<thead>
<tr>
<th>Type</th>
<th>Cable load kg/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cat. 5</td>
<td>0.06</td>
</tr>
<tr>
<td>Cat. 6</td>
<td>0.06</td>
</tr>
</tbody>
</table>
Finding the appropriate system for the cable load

Explanation of the pictograms: 1 = Load in kN without human weight, 2 = Support width in m, 3 = Strut bend in mm

**Load tests for cable support systems**
All OBO products and systems are subjected to practical load testing. The basic principles for the tests of OBO cable support systems is DIN EN 61537 and DIN VDE 0639. After the load test, the maximum load capacity can be determined for each component, depending on the support distances and specific article parameters, such as component dimensions. This is all shown in a chart, included with each component.

You can find additional information on the load tests for cable trays, brackets and suspended supports on the following pages. The values given do not take resistance against environmental forces such as snow, wind and other outside influences into account.
Finding the appropriate system for the cable load

Load diagram legend
1 = Load in kN/m without human weight
2 = Support width in m
3 = Strut bending in mm
4 = Schematic diagram of the support widths for the testing process
-- = Approved load depending on support width for the different tray widths
-- = Rail bend depending on support width

Information 1: The testing process
The basic principles of the tests of OBO cable support systems is VDE 0639 Part 1 and DIN EN 61537. The purpose of the tests is to determine the maximum load capacities for each component, depending on parameters such as component width, support spacing, etc. and to present this in a diagram to be included with each component. The area highlighted in blue in the above example schematises the experiment set-up with a variable support spacing (L) in the central area and a factor of 0.8 x L at the front and rear ends of the cable tray.

Information 2: Load curves for selected cable tray or cable ladder widths
The load capacity of the cable trays according to the support width can be read off in the diagram using the load curves – this is an example for a cable tray for the tray widths 100 to 600 mm. It may occur that, in the load curves, width differences must be made, allowing multiple curves to be visible simultaneously in the diagram. A key factor for the load capacity of the cable trays is, beside the support spacing and side height, the material thickness, which varies according to type.
General planning aids

Finding the appropriate system for the cable load

Information 3: Possible support spacings
The theoretically possible support spacings for the cable tray can be read off on the axis at the foot of the table. Using the load curves, it is easy to read off to what extent the load capacity of the system falls as the support spacing grows. On all OBO cable support systems (with the exception of the wide span trays), we recommend not exceeding a support spacing of 1.5 m if possible.

Information 4: Ratio: load/span
Which load is possible at which support spacing? With the diagram, you can find the appropriate information at a glance. In our example (with the blue background) a span of 2.25 m for the cable tray produces a maximum load capacity of 0.75 kN for each running metre of cable tray. Please note that, in this example, the volume of the cable tray may exceed the permitted load. Therefore, if at all possible, do not exceed the support spacing of 1.5 m, as recommended by OBO.

Information 5: W = Rail bending
To what extent does the load on a cable tray cause the rail to bend? This information is supplied by the blue curve (w) in millimetres (orientation values on the axis on the right-hand side of the diagram). The course of the blue curve clearly shows how quickly the cable tray will sag as the support spacing increases. In our example, the bend at a support spacing of 2.25 m is shown, here approximately 12 mm.
Key component of the OBO cable support systems are the mounting components, in particular the brackets and suspended supports. They connect the cable trays and ladders to the wall and to the ceiling, and are thus an important construction element of the overall system. When calculating the load capacity of a cable support system, the brackets and suspended supports must not be forgotten. The test diagram is also useful in selecting the right products.

Load diagram legend
1 = Bend in mm at the bracket tip
2 = Load in kN/m without human weight
-- = Load curves for the various bracket lengths
General planning aids

Finding the appropriate bracket for the cable load

Information 1: Recommended maximum load of the brackets
The bracket is the part of the installation system upon which the cable tray or mesh cable tray is located. It is either directly connected to the wall or is connected to the ceiling using supports. The grey bar on the right edge of the diagram provides information on the maximum load capacity of the bracket.

Information 2: Load curves for all bracket widths
The bending of the bracket is dependent on its width, which, in our example, can range from 110 mm to 610 mm. The load curves are assigned to the appropriate bracket type.

Information 3: Bending of the bracket tip at maximum load
The load curve in the diagram provides information on the bending of the boom tip at a specific load. In our example (dotted orange line), a 610 mm-wide bracket with a load of 2 kN bends by approx. 3.1 mm. A basic rule of thumb is: The shorter the bracket, the less the bend will be.

Information 4: Bending of the bracket tip at a specific load
The bending factor of the bracket at maximum load can also be seen in the diagram. In our example (shown in orange), the bend value for a 610 mm-wide bracket at a maximum load of approx. 3.0 kN is approximately 4.5 mm. To minimise the bend, the centre of gravity of the cable load should be as close as possible to the wall or the support fastening.
Finding the appropriate support for the cable load

**Information 1: Various support lengths and bracket widths**
The load capacity of a cable support system is not just dependent on the width of a bracket, but also on the length of a suspended support. The load curves in the diagram provide information on the load capacity of a suspended support of length 600, 1,000, 1,500 or 2,000 mm, taking the bracket width into account.

**Information 2: Calculation of the deflection for the example**
The weight of the total suspended support/bracket/cable tray system causes an excursion of the suspended support from the vertical. The excursion value can be read off from the axis on the left edge of the diagram. In our example (blue background), a 1,500 mm-long suspended support, together with a 400 mm-wide bracket and a weight load of 4 kN at the end of the support will produce a deflection of approximately 14 mm.

**Information 3: Calculation of the excursion at maximum load for the example**
The deflection of the suspended support at a maximum load can also be read off on the diagram. Our blue example shows a deflection of roughly 18 mm at the end of the support for a 1,500 mm-long suspended support in combination with a 400 mm-wide bracket at a maximum cable load of approximately 5 kN.

*Load diagram legend*
1 = Bend in mm at the bracket tip
2 = Load in kN/m without human weight
-- = Load curves for the various bracket lengths
Cable glands and DIN EN 50262

Cable glands are manufactured and tested according to DIN EN 62444. Amongst other things, this standard controls the retaining ability and strain relief of cables. The V-TEC cable glands from OBO Bettermann correspond to version “A”. Table 2A indicates the extraction forces that these cable glands must be able to withstand, according to the standard. The V-TEC cable glands also fulfil the requirements of DIN EN 62444 with regard to the twist protection of cables (see Table 3). To ensure the tested dust and moisture protection of the cable glands, continuous perforations should correspond to the mounting openings specified in the standard DIN EN 62444 according to Table 1. The on-site specialist must ensure that these parameters are complied with in order to hand over a functioning system.

### Table 1

<table>
<thead>
<tr>
<th>Size of the penetration hole</th>
<th>mm</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>16</th>
<th>20</th>
<th>25</th>
<th>32</th>
<th>40</th>
<th>50</th>
<th>63</th>
<th>75</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thread of the cable gland</td>
<td>M</td>
<td>M6</td>
<td>M8</td>
<td>M10</td>
<td>M12</td>
<td>M16</td>
<td>M20</td>
<td>M25</td>
<td>M32</td>
<td>M40</td>
<td>M50</td>
<td>M63</td>
<td>M75</td>
</tr>
<tr>
<td>Diameter of the mounting hole (+0.2/-0.4)</td>
<td>mm</td>
<td>6.5</td>
<td>8.5</td>
<td>10.5</td>
<td>12.5</td>
<td>16.5</td>
<td>20.5</td>
<td>25.5</td>
<td>32.5</td>
<td>40.5</td>
<td>50.5</td>
<td>63.5</td>
<td>75.5</td>
</tr>
</tbody>
</table>

### Table 2 A

<table>
<thead>
<tr>
<th>Cable diameter</th>
<th>Retaining capacity</th>
<th>Strain relief, version A</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>&gt;4 to 8</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>&gt;8 to 11</td>
<td>15</td>
<td>42</td>
</tr>
<tr>
<td>&gt;11 to 16</td>
<td>20</td>
<td>55</td>
</tr>
<tr>
<td>&gt;16 to 23</td>
<td>25</td>
<td>70</td>
</tr>
<tr>
<td>&gt;23 to 31</td>
<td>30</td>
<td>80</td>
</tr>
<tr>
<td>&gt;31 to 43</td>
<td>45</td>
<td>90</td>
</tr>
<tr>
<td>&gt;43 to 55</td>
<td>55</td>
<td>100</td>
</tr>
<tr>
<td>&gt;55</td>
<td>70</td>
<td>115</td>
</tr>
</tbody>
</table>

### Table 3

<table>
<thead>
<tr>
<th>Cable diameter</th>
<th>Torque Version A and B</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>Nm</td>
</tr>
<tr>
<td>&gt;4 to 8</td>
<td>0.10</td>
</tr>
<tr>
<td>&gt;8 to 11</td>
<td>0.15</td>
</tr>
<tr>
<td>&gt;11 to 16</td>
<td>0.35</td>
</tr>
<tr>
<td>&gt;16 to 23</td>
<td>0.60</td>
</tr>
<tr>
<td>&gt;23 to 31</td>
<td>0.80</td>
</tr>
<tr>
<td>&gt;31 to 43</td>
<td>0.90</td>
</tr>
<tr>
<td>&gt;43 to 55</td>
<td>1.00</td>
</tr>
<tr>
<td>&gt;55</td>
<td>1.20</td>
</tr>
</tbody>
</table>
Information on cable fastening

Cable fastening
The standard DIN EN 61914 “Cable holders for electrical installations” specifies that cable holders “must be able to accept cables or cable bundles of the diameter specified by the manufacturer or responsible retailer, without tearing or breaking or shearing off the threads of bolts”. During the installation of cables, the current national and international standards must be taken into account, such as DIN VDE 0100 520. “Suitable tools and methods, which prevent damage or changes to the shape” must be used for fastening.

In addition, with masses of cables, DIN VDE 0298 requires the appropriate “load capacities of cables for fixed laying in and on buildings...” to be taken into account when selecting the fastening systems.

Besides these standardising aspects, the end customer’s or client’s particular laying specifications can/must be taken into account.

The fastening spacing for cables is given in DIN VDE 0100-520, June 2003. For example, cables laid horizontally require a spacing of 20x the cable diameter. However, a spacing of 80 cm should not be exceeded. With vertical laying, the clip spacings may be increased but should not exceed 1.5 m.

The table below shows the maximum fastening spacings for cables according to the cable diameter. The laying spacings given in the “Industrial installations” product catalogue, e.g. for bus holders or Quick clips, are guide values and can only be treated as such.

<table>
<thead>
<tr>
<th>External diameter of the cables (mm)</th>
<th>Maximum spacing for horizontal fastening (mm)</th>
<th>Maximum spacing for vertical fastening (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D ≤ 9</td>
<td>250</td>
<td>400</td>
</tr>
<tr>
<td>9 &lt; D ≤ 15</td>
<td>300</td>
<td>400</td>
</tr>
<tr>
<td>15 &lt; D ≤ 20</td>
<td>350</td>
<td>450</td>
</tr>
<tr>
<td>20 &lt; D ≤ 40</td>
<td>400</td>
<td>550</td>
</tr>
</tbody>
</table>
The OBO Bettermann pipe systems are machined and tested according to DIN EN 61386 (Electrical installation pipe systems for electrical energy and information) and DIN EN 60423 (External diameters of electrical installation pipes and thread for electrical installation pipes and their accessories).

### Numeric code

DIN EN 61386-1 classifies installation pipes using a 12-digit numeric code, which provides information on the pressure resistance, impact resistance or use temperatures. You can find the first five digits in the product descriptions of the pipe systems.

<table>
<thead>
<tr>
<th>First digit</th>
<th>Second digit</th>
<th>Third digit</th>
<th>Fourth digit</th>
<th>Fifth digit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure resistance</td>
<td>Impact resistance</td>
<td>Minimum use temperature</td>
<td>Maximum use temperature</td>
<td>Bending behaviour</td>
</tr>
<tr>
<td>1</td>
<td>Very light (125 N)</td>
<td>Very light (0.5 kg/100 mm)</td>
<td>1</td>
<td>+ 5 °C</td>
</tr>
<tr>
<td>2</td>
<td>Light (320 N)</td>
<td>Light (1.0 kg/100 mm)</td>
<td>2</td>
<td>− 5 °C</td>
</tr>
<tr>
<td>3</td>
<td>Medium (750 N)</td>
<td>Medium (2.0 kg/100 mm)</td>
<td>3</td>
<td>− 15 °C</td>
</tr>
<tr>
<td>4</td>
<td>Heavy (1250 N)</td>
<td>Heavy (2.0 kg/300 mm)</td>
<td>4</td>
<td>− 25 °C</td>
</tr>
<tr>
<td>5</td>
<td>Very heavy (4000 N)</td>
<td>Very heavy (6.8 kg/300 mm)</td>
<td>5</td>
<td>− 45 °C</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>6</td>
<td>+ 250 °C</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>7</td>
<td>+ 400 °C</td>
</tr>
</tbody>
</table>
General planning aids

Classification according to IEC EN 61386-1: Corrosion protection

<table>
<thead>
<tr>
<th>Resistance against corrosion</th>
<th>Suitable surfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Low protection, inside and outside</td>
<td>• Painted black (SW)</td>
</tr>
<tr>
<td></td>
<td>• Electrogalvanised (G)</td>
</tr>
<tr>
<td></td>
<td>• Strip galvanised (FS)</td>
</tr>
<tr>
<td>2 Medium protection, inside and outside</td>
<td></td>
</tr>
<tr>
<td>3 Medium protection inside, high protection outside</td>
<td>• Hot-dip galvanised (FT)</td>
</tr>
<tr>
<td>4 High protection, inside and outside</td>
<td>• Stainless steel (V2A, V4A)</td>
</tr>
</tbody>
</table>

Protection against mechanical loads
OBO metal pipes are particularly suited to use under tough industrial conditions. They provide reliable protection against very heavy mechanical loads during cable routing.

The different material and surface qualities, from galvanised to painted, allow perfect adaptation to the requirements of the appropriate environment.

Maintenance of electrical function E30/E90
Our steel pipes guarantee the maintenance of electrical function to E30/E90. They are thus ideal for the connection of safety-relevant equipment, such as fire alarm systems.
In recent years, the use of electronic circuits has increased continually. Whether in industrial systems, medicine, households, telecommunications systems or electrical building installations – we find powerful electrical equipment and systems everywhere, and these switch ever greater currents, achieve greater radio ranges and transport ever more power in smaller spaces.

However, the use of state-of-the-art technology means that the complexity of applications also increases. The consequence of this is that ever more opposing influences (electromagnetic interferences) can occur from system parts and cables, causing damage and economic losses.

Here, we talk of electromagnetic compatibility.

Electromagnetic compatibility (EMC) is the ability of an electrical unit to function satisfactorily in its electromagnetic environment, without inappropriately influencing this environment, to which other units also belong (VDE 0870-1). In terms of standardisation, electromagnetic compatibility is dealt with by the EMC directive 2004/108/EC. This means that electrical resources emit electromagnetic interferences (emissions), which are picked up by other devices or units (immission) that act as receivers (interference sink). This, in turn, means that the function of an interference sink can be severely reduced, and, in the worst-case scenario, total failure and economic losses. The interferences can then spread along cables or in the form of electromagnetic waves.

Path of faults

<table>
<thead>
<tr>
<th>Fault source (transmitting emissions)</th>
<th>Coupling of interference variables (spreading of interference)</th>
<th>Fault sink (receiving emissions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>For example</td>
<td>- Galvanic</td>
<td>- Process computer</td>
</tr>
<tr>
<td>- Mobile telephones</td>
<td>- Inductive</td>
<td>- Radio receiver systems</td>
</tr>
<tr>
<td>- Switching components</td>
<td>- Capacitive</td>
<td>- Controllers</td>
</tr>
<tr>
<td>- Ignition systems</td>
<td>- Electromagnetic</td>
<td>- Converters</td>
</tr>
<tr>
<td>- Frequency converters</td>
<td></td>
<td>- Measuring units</td>
</tr>
<tr>
<td>- Lighting strike</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Welding devices</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Guaranteeing EMC

A systematic planning process is necessary to guarantee EMC. The interference sources must be identified and quantified. The coupling describes the spread of the interference from the interference source up to the influenced device, the interference sink. The task of EMC planning is to ensure the compatibility at the source, coupling path and sink using suitable measures. During their daily work, planners and installation engineers are confronted with this subject on an increasingly regular basis. This means that EMC is a basic factor to be taken into consideration during the planning of installations and cabling systems. Due to the high complexity of electromagnetic compatibility, the problems of EMC must be analysed and solved using simplifying hypotheses and models as well as experiments and measurements.

Cable support systems and their contribution to EMC
Cable support systems can make an important contribution to the improvement of EMC. They are passive and can thus make a safe, long-lasting contribution to EMC through the fact that cables are run within cable support systems or are shielded by them. Routing cables inside cable support systems greatly reduces the galvanic coupling and coupling due to electrical and magnetic fields in the cables.

Thus cable support systems can make a contribution to the reduction of coupling from the source to the sink. The shielding action of cable support systems can be quantified by the coupling resistance and the shield attenuation. This gives the planner important engineering parameters for cable support systems for the EMC engineering.

Lightning discharge
From the analysis of the effectiveness of EMC in buildings (EN 62305-4), we know that lightning discharge is one of the greatest sources of interference to be expected. This causes a direct current feed into the entire equipotential bonding system in the building and/or to magnetic decoupling of interference currents in electrical cables. With regard to these couplings, cable support systems can offer an effective contribution to the reduction of interference voltages.
Magnetic shield insulation of cable support systems

The magnetic shield insulation of cable support systems is the ratio in decibels (dB) of an induced voltage into an unprotected cable to the induced voltage into the same cable, when this is in a cable support system.

**Experimental structure to determine the magnetic shield insulation of cable support systems:**

An unshielded cable (NYM-J 5x6 mm²) is subjected to an 8/20 magnetic field with a strength of 3 kA/m. Here, the induced voltage \( V_1 \) is measured in the unshielded cable. The same cable is then positioned in the centre of a cable support system (once with a cover, once without) and subjected to the same magnetic field of 3 kA/m. Here, the induced voltage \( V_2 \) is measured in the unshielded cable. The magnetic shield insulation is calculated from the measured values according to the formula:

\[
\alpha_S = 20 \log \left( \frac{V_1}{V_2} \right) \text{ dB}
\]

**Experiment result:**

The magnetic shield effect \( \alpha_S \) of a cable support system could be clearly proved by the experiments and the simulation with an FEM program. The best result of around 50 dB was achieved with cable support systems (cable trays) with covers.

**Note:**

The shield insulation against electrical fields is as it is with a Faraday cage, almost perfect.

| Magnetic shield insulation 8/20 dB |
|-------------------------------|-----------------|-----------------|
| Type, cable tray/cable ladder   | Without cover   | With cover      |
| RKSM 630 FS                    | 20              | 50              |
| MKS 630 FS                     | 20              | 50              |
| MKS 630 FT                     | 20              | 50              |
| MKSU 630 FS                    | 20              | 50              |
| MKSU 630 FT                    | 20              | 50              |
| GRM 55/300 FS                  | 15              | 34              |
| LG 630 NS FT                   | 10              | 15              |
Transfer impedance of cable support systems

Experimental structure for transfer impedance: 1 = length l, 2 = U, 3 = I, 4 = pulse source 8/20

Transfer impedance (coupling resistant) of cable support systems
The transfer impedance of a cable support system is the ratio of the measured voltage $V_{\text{Interference}}$ measured in the lengthwise direction within the cable support system, to the coupled current $I_{\text{Interference}}$. The transfer impedance is determined in the same way as with the measurement of the electrical conductivity properties in Chapter 11.1. (DIN EN 61537). If there is a lightning strike on a building, partial currents will flow through the entire equipotential bonding system. Installed cables are best run within a cable support system. Installed cable support systems are always included in the equipotential bonding system. In so doing, the partial current flows via the cable support system. A very small component can therefore still flow along the cables laid within the cable support system. This component is determined by the transfer impedance of the cable support system.

The following applies for the transfer impedance:

$$Z_T = \frac{U_{\text{Stör}}}{I_{\text{Stör}} \times L} \text{ [mΩ/m]}$$

The values given are based on measurements, in which a pulse current of the wave shape 8/20 was passed through a defined length of a cable support system.

Experiment result:
The effect of the cable support system against galvanic coupling was clearly proved by the experiments. The best result was achieved with cable support systems (cable trays) with covers.

<table>
<thead>
<tr>
<th>Type, cable tray/cable ladder</th>
<th>Without cover</th>
<th>With cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>MKS 630 FS</td>
<td>1.14</td>
<td>0.71</td>
</tr>
<tr>
<td>MKS 630 FT</td>
<td>1.14</td>
<td>0.71</td>
</tr>
<tr>
<td>MKSU 630 FS</td>
<td>0.44</td>
<td>0.09</td>
</tr>
<tr>
<td>MKSU 630 FT</td>
<td>0.44</td>
<td>0.09</td>
</tr>
<tr>
<td>GRM 55/300 FS</td>
<td>6.17</td>
<td>5.5</td>
</tr>
</tbody>
</table>
Safety in case of fire
To ensure that emergency and escape routes and important technical equipment such as emergency lighting, fire alarm systems and smoke exhaust systems remain usable in case of fire, it is absolutely essential to provide special protection for the power supply for these systems. The use of special cables and routing systems means that it is possible to maintain the power supply, even in the case of fire, thus guaranteeing the maintenance of electrical function.
You can find detailed information on the subject of fire protection in the OBO protective installation catalogue.

Maintenance of electrical function is particularly important in buildings regularly frequented by large numbers of people. These include public buildings such as schools, hospitals, meeting places, civic buildings and underground stations, but also industrial plants, high-rise buildings, shopping centres and large car parks.

Fire loads of installation systems
According to rules governing wiring systems in the individual German federal states, no fire loads may be installed in emergency and escape routes. OBO’s fire-tested steel fastenings fulfil these requirements.

Junction boxes with integrated maintenance of electrical function ensure the fireproof connection of the safety cables. The boxes in the FireBox series are tested and approved for 30 to 90 minutes of the maintenance of electrical function in accordance with DIN 4102-12.
30 minutes: maintenance of electrical function for an evacuation. The first 30 minutes after the start of a fire are decisive when clearing the affected building. During this time, the maintenance of the electrical supply must be guaranteed for the following units:

- Safety lighting systems
- Lifts with fire control
- Fire alarm systems
- Alarm systems and systems to issue instructions to visitors and employees
- Smoke extraction systems

90 minutes: Maintenance of electrical function for better fire-fighting. To support firefighting operations, it is imperative that certain technical equipment is supplied with sufficient power even up to 90 minutes after a fire breaks out in a building. This equipment includes:

- Systems to increase the pressure of the water for fighting the fire
- Mechanical smoke extraction and smoke protection pressure systems
- Fire brigade lifts, bed lifts in hospitals
General planning aids

Individual routing systems for the maintenance of electrical function

With the individual laying systems, OBO Bettermann can offer a range of practical, flexible mounting options for electrical installations with the maintenance of electrical function. The systems are suited to vertical and horizontal installation and are approved for the fire protection classes E30 to E90. Standardised supporting constructions as defined in the testing standard, DIN 4102 Part 12, include: The laying of cables with individual clips and the laying of cables with profile rail, clamp clip and a long trough.

**Standard routing type, clamp clip, type 2056**
Standard support construction consisting of clamp clip without long trough for individual laying or bundling cables.

- Wall or ceiling mounting
- Horizontal installation
- Rail mounting: Max. 0.3 m
- Anchor spacing in the rail: Max. 0.25 m
- Individual cable assignment: Diameters of up to 100 mm possible
- Assignment with bunched cables: Max. 3 cables with max. diameter 25 mm

**Collecting clamp**
Cable-specific laying type with cable tidies for individual laying, horizontal/vertical mounting on wall or ceiling.

**Type 2031/M 15**
- Fastening distance: Max. 0.5 m
- Cable assignment: Max. 1.1 kg/m

**Type 2031/M 30**
- Fastening distance: Max. 0.5 m
- Cable assignment: Max. 2.5 kg/m

**Type 2031/M 70**
- Fastening distance: Max. 0.8 m
- Cable assignment: Max. 6.0 kg/m
General planning aids

Standard routing type, single clip, type 732/733
Standard support construction consisting of spacer clips for individual laying or bundling cables.

• Wall or ceiling mounting
• Vertical or horizontal mounting
• Mounting spacing: Max. 0.3 m
• Individual cable assignment: Diameters of up to 50 mm possible
• Assignment with bunched cables: Max. 3 cables with max. diameter 25 mm

Pressure clips
Cable-specific laying type with pressure clips for individual laying, mounting on the ceiling.

Type 2033 M
• Fastening distance: Max. 0.5 m

Type 2034 M
• Fastening distance: Max. 0.5 m
Standards
OBO offers products for professionals, made by professionals: Our products are manufactured and tested according to the respective specifications of the standards. For example, DIN EN 61537 describes all the relevant parameters for cable support systems, such as area of application, test conditions, corrosion resistance and temperature classification. As a competent manufacturer, OBO subjects itself to these requirements on a daily basis. Comprehensive test procedures guarantee that systems which conform to standards function safely.

Specifications
All the OBO products and systems are CE-compliant according to the appropriate EC guidelines. This also applies to standard parts such as bolts, washers and nuts that are components of various product systems. The appropriate EC declaration of conformity certifies agreement with the named directives or standards, but does not guarantee properties. The safety instructions in the product information and the general safety regulations must be complied with during installation and use.

Certifications
For OBO, product quality is closely connected to continuous testing and checking – which is why we manufacture almost all our products ourselves. This enormous depth of production is an expression of our demand for quality. From construction, and the materials used through production, right up to logistics, our employees personally guarantee the quality and availability of OBO products. The multitude of approvals emphasise our high demand for quality and product functionality. Our integrated quality management system forms the solid basis of our ISO 9001 certification, which we have held since 1994. The confirmation of suitability enables defined and workable processes in accordance with KTA 1401 and 10 CFR 50.
Certificates and test marks

VDE
VDE is the Association for Electrical, Electronic and Information Technologies, their study and the technologies and applications based upon them. The VDE mark on electrical equipment is proof that the equipment complies with VDE regulations and/or European or international harmonised standards, and meets the safety requirements of the applicable directives. The VDE mark indicates that a product is safe in relation to electrical, mechanical, thermal, toxic, radiological and other hazards.

CE symbol
Technical resources included in a legal ordinance, i.e. electrical resources, machines and safety components, must have a CE symbol, with which the manufacturer confirms that the safety requirements of the ordinances are fulfilled. In addition, there must also be a declaration of conformity and technical documentation. The CE symbol is not a quality mark, but simply a declaration by the manufacturer that they have complied with the legal requirements and the codes of practice.

UL
Underwriters Laboratories (UL) is an independent organisation that tests and certifies product safety. UL certification is generally required if a product is to be sold on the US market.

UL offers various certification options: the “UL Listed” test mark indicates that UL has tested representative samples of a product and that it conforms to UL’s safety requirements. The “UL Recognized” component test mark entitles a product to be used in a product or system bearing the “UL Listed” test mark.
### Every test mark at a glance

<table>
<thead>
<tr>
<th>Mark</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="ABS" /></td>
<td>American Bureau of Shipping, USA</td>
</tr>
<tr>
<td><img src="image" alt="AENOR" /></td>
<td>AENOR, Producto Certificado, Spain</td>
</tr>
<tr>
<td><img src="image" alt="STOWARZYSZENIE ELEKTRYKÓW POLSKICH" /></td>
<td>STOWARZYSZENIE ELEKTRYKÓW POLSKICH, Poland</td>
</tr>
<tr>
<td><img src="image" alt="Lightning current-tested" /></td>
<td>Lightning current-tested</td>
</tr>
<tr>
<td><img src="image" alt="Lightning current-tested, Class H (100 kA)" /></td>
<td>Lightning current-tested, Class H (100 kA)</td>
</tr>
<tr>
<td><img src="image" alt="CEBEC" /></td>
<td>CEBEC, Belgium</td>
</tr>
<tr>
<td><img src="image" alt="Canadian Standards Association" /></td>
<td>Canadian Standards Association, Canada</td>
</tr>
<tr>
<td><img src="image" alt="DEMKO" /></td>
<td>DEMKO, Danmarks Elektriske Materielkontrol, Denmark</td>
</tr>
<tr>
<td><img src="image" alt="Deutsches Institut für Bautechnik" /></td>
<td>Deutsches Institut für Bautechnik Berlin, Germany</td>
</tr>
<tr>
<td><img src="image" alt="Det Norske Veritas" /></td>
<td>Det Norske Veritas</td>
</tr>
<tr>
<td><img src="image" alt="ENEC Austria" /></td>
<td>ENEC Austria</td>
</tr>
<tr>
<td><img src="image" alt="ATEX certificate for explosive areas" /></td>
<td>ATEX certificate for explosive areas</td>
</tr>
<tr>
<td><img src="image" alt="ELEKTROTECHNICKÝ ZKUŠEBNÍ ÚSTAV" /></td>
<td>ELEKTROTECHNICKÝ ZKUŠEBNÍ ÚSTAV, Czech Republic</td>
</tr>
<tr>
<td><img src="image" alt="FIMKO" /></td>
<td>FIMKO, Finland</td>
</tr>
<tr>
<td><img src="image" alt="Forschungs- und Materialprüfungsanstalt" /></td>
<td>Forschungs- und Materialprüfungsanstalt, Germany</td>
</tr>
<tr>
<td><img src="image" alt="Russia, GOST The State Committee for Standards" /></td>
<td>Russia, GOST The State Committee for Standards</td>
</tr>
<tr>
<td><img src="image" alt="Test marks for technical resources, tested safety" /></td>
<td>Test marks for technical resources, tested safety</td>
</tr>
<tr>
<td><img src="image" alt="Halogen-free; without chloride, fluoride or bromine" /></td>
<td>Halogen-free; without chloride, fluoride or bromine</td>
</tr>
<tr>
<td><img src="image" alt="INMETRO" /></td>
<td>INMETRO, Brazil</td>
</tr>
<tr>
<td><img src="image" alt="KEMA-KEUR" /></td>
<td>KEMA-KEUR, Netherlands</td>
</tr>
<tr>
<td><img src="image" alt="Labelling of metric products" /></td>
<td>Labelling of metric products</td>
</tr>
<tr>
<td><img src="image" alt="MAGYAR ELEKTROTECHNIKAI ELLENŐRZŐ INTEZET" /></td>
<td>MAGYAR ELEKTROTECHNIKAI ELLENŐRZŐ INTEZET Budapest, Hungary</td>
</tr>
<tr>
<td><img src="image" alt="NEMKO" /></td>
<td>NEMKO, Norway</td>
</tr>
<tr>
<td><img src="image" alt="AFNOR Quality symbol of the French standardisation institute" /></td>
<td>AFNOR Quality symbol of the French standardisation institute</td>
</tr>
<tr>
<td><img src="image" alt="Underwriters Laboratories Inc., USA + CSA" /></td>
<td>Underwriters Laboratories Inc., USA + CSA, Canada</td>
</tr>
<tr>
<td><img src="image" alt="Österreichischer Verband für Elektrotechnik" /></td>
<td>Österreichischer Verband für Elektrotechnik, Austria</td>
</tr>
<tr>
<td><img src="image" alt="INSTITUTO ITALIANO DEL MARCO DI QUALITÀ" /></td>
<td>INSTITUTO ITALIANO DEL MARCO DI QUALITÀ, Italy</td>
</tr>
<tr>
<td><img src="image" alt="RINA 1861, Ship Classification, Certification and Services" /></td>
<td>RINA 1861, Ship Classification, Certification and Services</td>
</tr>
<tr>
<td><img src="image" alt="Underwriters Laboratories Inc., USA" /></td>
<td>Underwriters Laboratories Inc., USA</td>
</tr>
<tr>
<td><img src="image" alt="SEMKO An Inchcape Testing Services Company" /></td>
<td>SEMKO An Inchcape Testing Services Company, Sweden</td>
</tr>
<tr>
<td><img src="image" alt="Eidgenössisches Starkstrominspektorat" /></td>
<td>Eidgenössisches Starkstrominspektorat, Switzerland</td>
</tr>
<tr>
<td><img src="image" alt="South African Bureau of Standards" /></td>
<td>South African Bureau of Standards</td>
</tr>
<tr>
<td><img src="image" alt="Shock-tested, Bundesamt für Zivilschutz" /></td>
<td>Shock-tested, Bundesamt für Zivilschutz, Germany</td>
</tr>
<tr>
<td><img src="image" alt="Sähkötarkastuskeskus Elinspektionscentralen Electrical Inspectorate" /></td>
<td>Sähkötarkastuskeskus Elinspektionscentralen Electrical Inspectorate, Finland</td>
</tr>
<tr>
<td><img src="image" alt="Underwriters Laboratories Inc., USA" /></td>
<td>Underwriters Laboratories Inc., USA</td>
</tr>
<tr>
<td><img src="image" alt="Verband der Elektrotechnik, Elektronik, Informationstechnik e.V." /></td>
<td>Verband der Elektrotechnik, Elektronik, Informationstechnik e.V., Germany</td>
</tr>
<tr>
<td><img src="image" alt="German Association of Electricians, tested safety" /></td>
<td>German Association of Electricians, tested safety</td>
</tr>
<tr>
<td><img src="image" alt="5-year warranty" /></td>
<td>5-year warranty</td>
</tr>
</tbody>
</table>
First-hand support and knowledge

OBO KTS seminars: First-hand knowledge
With a comprehensive programme of training courses and seminars, OBO supports its customers with first-hand specialist knowledge. Besides the theoretical principles, practical everyday implementation is also dealt with. Special calculation and application examples round off the comprehensive programme of knowledge transfer.

Invitations to tender, product information and data sheets
We can make life easier for you, with our comprehensive selection of materials designed for practical applications, which provide you with effective support with the planning and calculation of a project. These include:
• Invitations to tender
• Product information
• Information sheets
• Data sheets

Invitations to tender on the Internet at www.ausschreiben.de
More than 10,000 entries can be accessed free of charge. Regular updates and extensions mean that you always have a comprehensive overview of the OBO products. All the current file formats (PDF, DOC, GAEB, HTML, TEXT, XML, ÖNORM) are available.
www.ausschreiben.de
OBO Construct – planning software and product configurators

The OBO Construct electronic planning aids are programs developed to support electrical installation engineers and planners in the design of electrical installation systems.

By systemically querying technically relevant planning parameters, these programs simplify the search for suitable products and related system accessories.

All new OBO Construct apps have responsive design. They can be opened on any device, regardless of operating system.

**Advantages:**
- Work aid independent of time and place
- Transmit planning requirements to complete product systems
- Find suitable products quickly and simply
- Calculate quantities automatically
- Download configuration results as Excel or Word files

**Currently available versions:**
- **Cable support systems**
  - AutoCAD plug-in version 3.0
    (AutoCAD full version from 2013)
- **Underfloor systems**
  - Planning tool version 3.0
    (web app for all devices)
- **Transient and lightning protection systems**
  - Earthing systems version 1.0
    (web app for all devices)
- **Fire protection systems**
  - Insulation selection aid version 3.0
    (web app for all devices)
- **Transient and lightning protection systems**
  - Surge protection version 1.0
    (web app)
- **Cable support systems**
  - Cable assignment version 3.0
    (web app for all devices)

**More information**
www.obo-construct.com
Cable trays

- **Magic® cable tray system**  
  Page 60

- **MKS-Magic®, SKS-Magic® cable tray system**  
  Page 66

- **MKS, SKS, DKS, IKS cable tray system**  
  Page 72

- **Wide span cable tray system**  
  Page 80
The RKS-Magic® cable tray system permits particularly fast straight connections of cable trays. The innovative, screwless straight connector can be mounted in the blink of an eye. Just connect the ends of the cable tray, lock them in place — and you’re done! The long-lasting, static straight connectors can be permanently stabilised by bending the connection flaps. The RKS-Magic® cable tray is available with the side heights 35 and 60 mm. A comprehensive range of fittings with bends (45° and 90°), tees, add-on tees and cross-overs completes the system. 90° bends and adjustable vertical riser (rising/falling) are available for vertical changes of direction. When mounting fittings, always plan additional supports.

Besides the various fittings, the system also includes all types of connectors (straight, angle and adjustable connectors) and additional accessories such as barrier strips, joint plates, mounting plates and lids. You can find detailed mounting aids and article descriptions for this system on the following pages. The RKS-Magic® cable tray is tested for routing with the maintenance of electrical function. You can find comprehensive information on this in our new Safety and protective installations product catalogue.
Installation principle

1. RKSM cable tray
2. 90° Magic bend
3. 45° Magic bend
4. Magic tee
5. Magic horizontal cross-over
6. Magic add-on tee
7. Reducer/stop-end
8. Magic straight connector set
9. Cover with turn buckle
10. Adjustable bend element
11. Unperforated cover and cover clamp
Mounting aid

**Centre suspension application**
Direct centre suspension with threaded rod, type 2078/M10. This mounting variant is possible for RKS cable trays of width 50 to 200 mm.

**Ceiling mounting application, U support with bracket**
Standard mounting of a cable tray with suspended support, type US, and suitable support bracket, type AW.

**Wall mounting application with bracket**
Standard cable tray mounting on the wall with wall and support brackets.

**Quick fastening of cable tray on the bracket**
The quick fastening is pushed upwards and turned through 90°. After locking, the quick fastening is fastened permanently by tightening it.

**Straight cable tray connection, sleeve mounting**
The spring element of the cable tray to be connected is snapped into the spring seat of the preceding cable tray from above.

**Mounting of Magic KTSMV straight connector set**
To strengthen the connection, we recommend screwing on the joint plate for widths of more than 400 mm.

**Floor fastening**
Floor fastening at a distance with stand-off bracket, type DBL.

**Releasing the connection**
The straight connector can be released again at any time. To do this, push a screwdriver under the spring element to release the lock.

**Wall mounting application with bracket**
Standard cable tray mounting on the wall with wall and support brackets.
Magic® cable tray system

Horizontal angle connection of cable trays
Horizontal angle connection of cable trays for brackets created during construction and cut cable tray ends.

Mounting of Magic bend
Mounting of fittings by simple interconnection. For this, the cable tray with the spring side is locked into the fitting connection from above.

Mounting of Magic add-on tee
Mounting of fittings by simple interconnection. For this, the cable tray with the spring side is locked into the fitting connection from above.

Mounting of Magic cross-over
Mounting of fittings by simple interconnection. For this, the cable tray with the spring side is locked into the fitting connection from above.

90° bend (rising/falling)
The 90° vertical bend is pushed over the rail of the cable tray and bolted with truss-head bolts, FRSB M6 x 12 mm. The cover is placed on loosely and fastened using the incoming cable tray covers. The cover clamp DKU can be used for additional fastening.

Mounting of Magic add-on tee (bottom view)
Vertical mounting of the add-on tee as lengthwise funnel. Perforation in the cable tray is created on site. For widths > 400 mm, please order connectors separately.

Mounting of rising adjustable vertical bend
Adjustable vertical bend to bridge height offsets or when changing from horizontal to vertical. The vertical adjustable bend is fastened to the cable tray directly using adjustable connectors.
**Mounting of falling adjustable vertical bend**
Mounting of the vertical adjustable bend, falling, to bridge height differences and changes from the horizontal to the vertical.

**Mounting of floor end plate**
The floor end plate is fastened to the end of the cable tray. It is used to protect outgoing cables.

**Mounting plate with quick fastening**
Fastening of the mounting plate, type MP, on the side rail of the cable tray. The mounting plate can be fastened to the rail with quick connectors, and permanently fastened using truss-head bolts of type FRSB 6x12 mm.

**Universal mounting plate**
The MP UNI mounting plate is attached by screwing it to the side rail of the cable tray.

**Cover mounting with turn buckle**
The cover is fastened to the cable tray using turn buckles; this is done by clamping the turn buckle under the rolled up side rail of the cable tray with a 90° turn.

**Screwless barrier strip mounting**
Screwless mounting of the TSG barrier strip with the KS KR hold-down clamp. The barrier strip can be run over the joint and connected without bolts and without processing using the barrier strip connector TSGV.

**Mounting of fitting cover**
The fitting cover is fastened to the cable tray using turn buckles; this is done by clamping the turn buckle under the rolled up side rail of the cable tray with a 90° turn.

**Screwed barrier strip mounting**
Screwed barrier strip fastening of the barrier strip TSG 60, with truss-head bolts M 6x12. The barrier strip can simply be run over the joint and connected without bolts using the barrier strip connector TSGV.

**Screwless cover mounting**
Screwless cover mounting takes place with unperforated covers and the cover clamps, type DK DRLU. The cover clamp is simply fixed in the rail of the cable tray.
The cable tray is suitable for universal cable routing. From low-voltage cabling to power supplies, from data cables to telecommunications networks. A full product range, with suitable system components, can create perfect solutions for any task. No matter whether used in dry inner areas or in aggressive atmospheres: Different surface versions and materials ensure safe corrosion protection. Side heights of 60, 85 and 110 mm are available. Due to the high hole proportion of 30% and more, the perforated cable trays MKSM and SKSM of widths of 200 mm or greater are ideally suited for use beneath sprinkler systems. The IKSM cable tray also has large openings in the side rail, which can be used for cable entries or exits.

The complete system is supplemented by connectable, screwless fittings with Magic connection. The system also includes all types of connectors and additional accessories such as barrier strips, joint plates, mounting plates and covers.

You can find detailed mounting aids and article descriptions for this system on the following pages.
Installation principle

1. Cable tray MKSM/SKSM
2. 90° Magic bend
3. 45° Magic bend
4. Magic tee
5. Magic horizontal cross-over
6. Magic add-on tee
7. Reducer/stop-end
8. Magic straight connector set
9. Cover with turn buckle
10. Adjustable bend element
Mounting aid

Centre suspension application
Centre suspension of the cable tray systems MKSM, SKSM and IKSM with a centre suspension type MAH and threaded rod 2078/M10.

Wall mounting application with bracket
Standard mounting of a cable tray on the wall with wall and support brackets.

Mounting of Magic KTSMV straight connector set
Simply clamp the two side sections of the connector set in the side rail.

Mounting of Magic KTSMV straight connector set
Insert the corresponding joint plate, push it down and simply lock it in place. To strengthen the connection, we recommend screwing on the joint plate for widths of more than 400 mm.

Change of direction by cutting the cable tray
Cut and bend the cable tray, then fix the cut rail with an angle connector, type RWVL.

Change of direction with separate cable trays
To create a change of direction with 2 separate cable trays, 2 angle connectors are used for fastening.

Change of direction with separate cable trays
Combine the cut trays and fix them from the inside at the joint using angle connectors, type RWVL.
Creating a change of direction with variable Magic bend
The variable Magic bend, type RBMV..., can be used to install infinitely variable direction changes of 0°–90° to the route.

Mounting of Magic add-on tee
Mounting of fittings by simple interconnection. For this, the cable tray with the spring side is locked into the fitting connection from above.

Mounting of Magic tee
Mounting of fittings by simple interconnection. For this, the cable tray with the spring side is locked into the fitting connection from above.

Mounting of Magic cross-over
Mounting of fittings by simple interconnection. For this, the cable tray with the spring side is locked into the fitting connection from above.

90° bend (rising/falling)
90° bend, rising or falling, for the creation of simple vertical changes of direction.

Mounting of adjustable vertical bend element
Mounting of the adjustable vertical bend element for the creation of adjustable bends. The adjustable vertical bend element is connected to the cable tray using adjustable connectors.

Mounting of rising adjustable vertical bend
Rising adjustable vertical bend to bridge height offsets. The adjustable vertical bend is connected to the cable tray using the adjustable connectors.
Screwless cover mounting
Unperforated covers are mounted using cover clamps, type DK DRLU. The cover clamps are first clamped to the cover edge and then snapped on to the cable tray rail with the cover.

Mounting of floor end plate
Fastening of the bottom end plate, type BEB, to protect the cables.

Universal mounting plate
Fastening of the mounting plate, type MP UNI, on the cable tray.

Installation of reducer/stop-end plate
Reducer/stop-end plates are used as closure and to reduce the width of cable trays.

Barrier strip mounting with screw connection
Screwed barrier strip fastening of the barrier strip TSG 60, with truss-head bolts M 6x12. The barrier strip can simply be run over the joint and connected without bolts using the barrier strip connector TSGV.
The cable tray is suitable for universal cable routing. From low-voltage cabling to power supplies, from data cables to telecommunications networks. A full product range, with suitable system components, can create perfect solutions for any task. No matter whether used in dry inner areas or in aggressive atmospheres: Different surface versions and materials ensure safe corrosion protection. Side heights of 35, 60, 85 and 110 mm through to the special cable tray systems DKS and IKS with 30% perforations and large entries and exits are available. When mounting fittings, always plan additional supports. Besides the various fittings, the system also includes all types of connectors and additional accessories such as barrier strips, joint plates, mounting plates and covers. You can find detailed mounting aids and article descriptions for this system on the following pages.
Installation principle

MKS/SKS cable tray system

1. Cable tray MKS/SKS
2. 90° bend
3. 45° bend
4. Horizontal tee
5. Cross-over
6. Add-on tee
7. Reducer/stop-end
8. Straight connector set
9. Cover with turn buckle
10. Adjustable bend element
11. Unperforated cover and cover clamp
Installation principle
DKS cable tray system

1. Cable tray DKS
2. 90° bend
3. 45° bend
4. Horizontal tee
5. Cross-over
6. Add-on tee
7. Reducer/stop-end
8. Straight connectors and joint plate
9. Unperforated cover and cover clamp
10. Adjustable bend element
Installation principle
IKS cable tray system

1 Cable tray IKS
2 90° bend
3 45° bend
4 Horizontal tee
5 Cross-over
6 Add-on tee
7 Reducer/stop-end
8 Straight connectors and joint plate
9 Unperforated cover and cover clamp
10 Adjustable bend element
Mounting aid

Centre suspension application
Centre suspension of the cable tray systems MKS, SKS, DKS and IKS with centre suspension, type MAH, and threaded rod 2078/M10.

Ceiling mounting application
Ceiling mounting of a cable tray with suspended support and wall and support bracket.

Wall mounting application with bracket
Standard mounting of a cable tray on the wall with wall and support brackets.

Installation of RV straight connector set
Straight connection of the cable trays through simply clamping the connector set RV into the side rail.

Screwless RV longitudinal connector set
Press the corresponding joint plate downwards and snap it in place.

Straight connection with joint cover
Cable tray with screwed straight connection and joint plate, type SSLB. The joint plate can also be mounted above the bar of the RV straight connector set.

Horizontal angle connection of cable trays
Horizontal angle connection of cable trays for brackets created during construction and cut cable tray ends.

Vertical adjustable connection of cable trays
Vertical adjustable connection of cable trays for construction-side height jumps of any angle.

Bend creation with corner connector
For 90° bends to be created on-site, the corner connector, type REV, can be used to increase the internal radius.

Direct connection with corner connectors
Corner connector, type REV, to increase the angle when creating tees without fittings. Additional supports should be planned for the area of the branches.

Branch with angle connectors
Installation of built T exit with angle connectors, type WKV. Additional supports should be planned for the area of the branches.

Installation of reducer/stop-end plate
The reducer/stop-end plate component is used as closure and to reduce the width of cable trays.
MKS, SKS, DKS, IKS cable tray system

Screwless barrier strip mounting
Screwless mounting of the TSG ... barrier strip with the KS KR hold-down clamp. The barrier strip can be run over the joint and connected without bolts and without processing using the barrier strip connector TSGV.

Barrier strip mounting with bolt connection
Screwed barrier strip fastening of the barrier strip TSG 60 with truss-head bolts M6x12. The barrier strip can simply be run over the joint and connected without bolts using the barrier strip connector TSGV.

Installation of add-on tee (width 100–300 mm)
To mount the add-on tee, separate the cable tray rail and screw it tight. Additional supports should be planned for the area of the fittings.

Installation of add-on tee (width 400–600 mm)
To mount the add-on tee, separate the cable tray rail and screw it tight. Additional supports should be planned for the area of the fittings.

Installation of vertical add-on tee
Vertical mounting of the add-on tee as length-wise funnel.

Installation of bend (width 400–600 mm)
The bend in widths 400 to 600 mm is connected to the cable tray using connectors and a joint plate. Additional supports should be planned for the area of the fittings.

Mounting of tee
The tee is connected to the cable tray using connectors and a joint plate. Additional supports should be planned for the area of the fittings.

Cross-over mounting
The cross-over is connected to the cable tray using connectors and a joint plate. Additional supports should be planned for the area of the fittings.
MKS, SKS, DKS, IKS cable tray system

90° bend (rising/falling)
90° bend, rising or falling, for the creation of simple vertical changes of direction.

Mounting of adjustable vertical bend element
Mounting of the adjustable vertical bend element for the creation of adjustable bends. The adjustable vertical bend element is connected to the cable tray using adjustable connectors.

Mounting of falling adjustable vertical bend
Falling adjustable vertical bend to bridge height offsets. The adjustable vertical bend is connected to the cable tray using the adjustable connectors.

Mounting of rising adjustable vertical bend
Rising adjustable vertical bend to bridge height offsets. The adjustable vertical bend is connected to the cable tray using the adjustable connectors.

Screwless cover mounting
Unperforated covers are mounted using cover clamps, type DK DRLU. The cover clamps are first clamped to the cover edge and then snapped on to the cable tray rail with the cover.

Mounting of floor end plate
Fastening of the bottom end plate, type BEB, to protect the cables.

Mounting plate with quick fastening
Fastening of the mounting plate, type MP, on the cable tray. The mounting plate can be fastened to the rail with quick connectors, and permanently fastened using truss-head bolts of type FRS B.

Universal mounting plate
Fastening of the mounting plate, type MP UNI, on the cable tray.

Fastening on bracket
The cable tray is fastened to the bracket with truss-head bolts FRS M6 x 12.
Cable tray mounting on steel girders
Cable tray mounting with chuck jaws of type TKS-L-25 and U supports as cantilever beams on steel girders. Use spacers, type DSK, for safe functioning.

Creating a height increase or decrease
After cutting into the side rail, the cable tray is bent manually at an angle of 0°–60° and fixed with the straight connector RLVKV 60 FS. It is not necessary to cut into the bottom plate.
When you need to bridge wide spans and support high cable loads, the OBO wide span cable trays are the perfect solution. The product range comprises cable trays with widths of between 200 and 600 mm and side heights of 110 to 200 mm. Comprehensive system accessories such as fittings and all the fastening materials for concrete and steel mounting round off this product range perfectly. OBO wide span cable trays have proven their worth in many areas of industrial and systems engineering. These systems are becoming ever-more popular in buildings with steel framework. OBO wide span cable trays are the complete product range for all applications and requirements. Their large load capacity combined with large spans allows efficient and optimised power supply.
Installation principle

1. Wide span cable tray
2. 90° bend
3. Add-on tee
4. Straight connector
5. Barrier strip
6. Cover with turn buckle
Mounting aid

**Wall mounting application**
Direct wall mounting of wide span cable trays.

**Wide span straight connection**
Horizontal straight connection of wide span cable trays with straight connector set, type WRVL.

**Mounting of 90° bend**
Bend in combination with wide span cable trays. The bend is connected to the wide span cable tray using external connectors and a joint plate.

**Creation of a tee with an add-on corner**
Removal of the side rails from the wide span cable tray.

**Creation of a tee with an add-on corner**
Mounting of the second add-on corner, type WEAS 110.

**Creation of a tee with an add-on corner**
Removal of the side rail from the ongoing wide span cable tray.

**Creation of a tee with an add-on corner**
Mounting of the finished branch to the ongoing wide span cable tray.

**Mounting of 90° bend**
Add-on tee in combination with wide span cable tray. The side rail is removed for mounting.

**Mounting example**
Double-sided suspended support mounting made of U profiles with transverse traverse. Fastening of a wide span cable tray, type WKSG 110, with truss-head bolts on the transverse profile.
Mesh cable trays

GR-Magic® mesh cable tray system 86

Magic® G mesh cable tray 92

C mesh cable tray 94
OBO Bettermann’s mesh cable tray systems are the ideal basis for quick, safe and economical cable routing in all areas of professional electrical installations. The GR-Magic mesh cable tray system with shaped connector for screwless quick mounting guarantees the shortest possible installation times, even for complex mounting operations. The mesh cable trays are available with side heights of 35, 55 and 105 mm in the electro-galvanised, hot-dip galvanised and stainless steel versions. The comprehensive range of practical accessories, such as mesh cable tray bends, hold-down clamps, quick connectors, barrier strips, suspension profiles, brackets, etc. ensures that the product range is complete down to the smallest detail.
Installation principle

1. Mesh cable tray GR-Magic
2. 90° mesh cable tray bend
3. Mesh cable tray connector, long
4. 90° mounting bracket
5. Stand-off bracket
6. Slotted steel strap, bent
7. Corner connector
8. Joint connector
9. Cover, unperforated
10. Cover clamp, variable
11. Mounting rail, MS 41
12. TP suspended support
13. Central suspension, GMS
14. Barrier strip
15. Mounting plate
16. Fastening element for junction box
17. Wall and ceiling bracket
18. Wall and support bracket TPSAG
19. Cable exit plate
20. Wall and support bracket AWG 15
21. Hold-down clamp for barrier strip fastening
22. Barrier strip connector
23. Ceiling bracket
Mounting aid

Ceiling mounting application
Mounting of mesh cable trays with suspended support, type US 3 K/... and appropriate wall and support bracket AW 15/...

Wall mounting GRM 35 50
Wall mounting for direct wall fastening of mesh cable trays GRM 35 50.

Wall fastening of mesh cable trays
Wall fastening of mesh cable trays with wall bracket, type K 12 1818. Maximum mesh cable tray width 200 mm.

Wall and floor fastener WB GR
Fastening component for direct mounting of mesh cable trays to the wall and floor. Can be screwed or riveted on. Suitable for wire thickness 3.9 mm.

Ceiling mounting with TP wall and ceiling bracket
Ceiling mounting of a mesh cable tray with TP wall and ceiling bracket, type TPDG. The mesh cable tray is fastened to the ceiling clamp without screws.

Straight connection of Magic® mesh cable tray
Creation of a screwless straight connection of the mesh cable tray, type GR-Magic®, by interconnecting two stock lengths.

Screwed straight connection of mesh cable trays
Creation of a screwed straight connection of mesh cable trays with joint connectors, type GSV 34.

Screwless straight connection with quick connectors
Creation of a screwless straight connection of mesh cable trays using a quick connector, type GRV.

Screwless straight connection of mesh cable trays
Creation of a screwless straight connection of mesh cable trays with joint connectors, type GRS.
Screwless barrier strip fastening
Screwless fastening of a barrier strip in mesh cable trays with hold-down clamp, type KS GR. The screwless straight connection of the barrier strip is made using the barrier strip connector TSGV.

Screwed-on barrier strip fastening in mesh cable trays
Fastening a barrier strip in mesh cable trays with hold-down clamp, type GKT 38.

Installation of a mesh cable tray bend
Mounting of a mesh cable tray bend, type GRB 90, with joint connectors, type GSV 34, and corner connector, type GEV 34.

Installation of a mesh cable tray bend
Installation of a complete mesh cable tray bend using joint connectors, type GSV 34, and bent slotted steel strap.

Stand-off of mesh cable trays
Floor stand-off of mesh cable trays with the stand-off bracket, type DBLG 20/... Screwless fastening of the mesh cable tray on the stand-off bracket using clamping lugs.

Mounting adapter for mesh cable trays on stand systems
Mounting system TrayFix for fastening mesh cable trays on FangFix blocks (10 or 16 kg) for cable routing on flat roofs.

Direct floor fastening
Direct floor mounting of mesh cable trays using hold-down clamp, type GKS 50.

Fastening clip on MS profile rail
Screwless, rapid fastening of mesh cable trays on MS profile rails with the help of the fastening clip, type BC SGR 4.8 VA for wire thicknesses of 3.9 and 4.8 mm or BC GR 6.0 VA for wire thickness of 6 mm.

Centre suspension
Suspension of a mesh cable tray using threaded rod, type 2078, and wall and floor fastener, type K12 1818. For use with widths of up to 200 mm.
GR-Magic® mesh cable tray system

Pendulum suspension
Suspension of a mesh cable tray using threaded rod, type 2078, and wall and floor fastener, type K12 1918. For use with widths of 300 mm or more.

Centre suspension with hanger
Centre suspension of a mesh cable tray with hanger, type GMS, and clamp, type GKS 50.

Suspension with side holder
Suspension of a mesh cable tray with side holders, type SH M 10 and threaded rods, type 2078/M10.

Side holder
Mounting of the side holder, type SH KAB, for accepting cable glands.

Mounting plate
Screwless quick fastening of the mounting plate, type MP UNI.

Identification plate
Mounting of the identification plate, type KS-GR, in the side rail of the mesh cable tray.

Cover mounting
Cover with snap-on function for easy locking to the mesh cable tray.

Girder clamping application
Vertical mesh cable tray mounting, fixed with fixing clamp, type BFK, and hold-down clamp, type GKS 50, to steel girder.

Mounting of mesh angle
Fastening of the mesh angle, type GW 40/80, to steel girders using beam clamps, type KL 20 or KL 30.

Creation of a mesh cable tray bend – angular, overlapping
After the mesh cable trays have been cut to size, they can, together with joint connectors, type GSV 34, and a bent slotted steel strap, be installed overlapping to form an angular mesh cable tray bend.

Creation of a mesh cable tray bend – angular
After the mesh cable trays have been cut to size, they can, together with joint connectors, type GSV 34, and a bent slotted steel strap, be installed as a non-overlapping, angular mesh cable tray bend.

Creation of a mesh cable tray bend – round, overlapping
After the mesh cable trays have been cut to size, they can, together with joint connectors, type GSV 34, and a bent slotted steel strap, be installed overlapping to form a round mesh cable tray bend.
GR-Magic® mesh cable tray system

Creation of a mesh cable tray bend – round
Cutting out every second grid of a mesh cable tray allows the creation of mesh cable tray bends with a larger radius. Fixing takes place using corner connectors, type GEV 36.

Rising and falling bends
Rising and falling vertical bends can be created by cutting every second grid in the mesh cable tray edge and bending the mesh cable tray accordingly.

Creation of a mesh cable tray tee
After cutting the side rails and bending the straps, the corner connector, type GEV 36, and the joint connector, type GSV 34, can be used to create tees.

Creation of a mesh cable tray cross-over
After cutting the side rails and bending the straps, the corner connector, type GEV 36, and the joint connector, type GSV 34, can be used to create cross-overs.

Creation of a vertical exit
After cutting the mesh cable tray base, the vertically branching, cut mesh cable tray can be fixed using the joint connector, type GSV 34.

Creation of a reduction
Reductions are possible by single-sided cutting of the different mesh cable tray widths, bending the flaps in the required direction and using the corner connectors, type GEV 36, and the joint connector, type GSV 34.

Mesh cable tray with cable exit plate
Cable exit plate for screwless mounting in mesh cable trays. The cable exit plate allows maintenance of pre-specified bend radii.

Mesh cable tray with cable exit plate
The cable exit plate can be installed in lengthwise and transverse directions.

Earthing terminal/earth connection
Earthing terminal for fastening the equipotential bonding wire to the cable support system.
The Magic G mesh cable tray is the ideal extension of the Magic solutions for the OBO Bettermann mesh cable tray systems. The quick Magic connection means that a screwless and easy-to-mount variant is now also offered for the G mesh cable tray system. Even when mounting in false ceilings, it is an ideal alternative through direct wall or ceiling mounting. The Magic G mesh cable tray is available in four sizes and three surfaces, thus offering ideal solutions for all kinds of tasks.
Mounting aid

**Straight connection of Magic G mesh cable tray**
Creation of a screwless straight connection of the G mesh cable tray, type G-GRM, by interconnecting two stock lengths.

**Direct ceiling mounting**
Direct ceiling mounting of the Magic G mesh cable tray using the hold-down clamp, type K 12 1818.

**Wall fastening of G mesh cable trays**
Wall fastening of G mesh cable trays with wall bracket, type K 12 1818.
The C mesh cable tray system from OBO Bettermann fulfils the highest requirements for load capacities and versatility. The C shape allows support widths of up to three metres. This system, with its 50 mm side height, together with the optimised accessories such as hold-down clamps, Quick connectors, barrier strips, suspension profiles, mounting brackets, etc. is an ideal addition to the overall mesh cable tray system. It is used both in industry and in all other areas of professional electrical installations.
Mounting aid

**Straight connection of C mesh cable tray**
Creation of a straight connection on C mesh cable trays with the joint connector, type GSV 34.

**Horizontal bends**
Implementation of a horizontal bend for C mesh cable trays with corner connector, type GEV 36.

**Vertical bend**
Vertical bend mounting with 90° mounting angle.
Cable ladders

Riveted cable ladder systems  98

Welded cable ladder systems  102

Wide span cable ladder systems  106

Vertical ladder systems  110
The high load capacity and good ventilation of the OBO cable ladder systems can offer tangible benefits, in particular during the installation of power cables. OBO Bettermann’s cable ladder systems can be used universally and, due to the continuous rail and rung perforation, offer countless installation benefits. A factor guaranteeing easy mounting is the option of integrated fastening of cables using OBO clamp clips on the rungs, which are available in various different versions. OBO cable ladder systems are shipped partly folded up, thus saving space during transport and storage. OBO cable ladder systems can be supplied in lengths of 3 m and 6 m, in all standard widths from 200 to 600 mm and with rail heights of 60 and 110 mm. The portfolio is complemented by the wide span cable ladders, which can simultaneously bridge wide gaps and support high cable loads. The wide span cable ladders are available in 6 m lengths, in widths 200 to 600 mm and with rail heights 110 and 160 mm. On the following pages, you can select your preferred mounting variant from the installation diagrams shown.
Installation principle

1. Cable ladders
2. 90° bend, welded
3. Tee, welded
4. Add-on tee, welded
5. Connection piece
6. Straight connector
7. Support plate
8. Inlay plate
9. Corner plate
10. Cover with cover clamp
11. Adjustable bend element
12. Adjustable connector
13. Multifunctional connector
14. Barrier strip
Mounting aid

Suspended support and threaded rod suspension application
Example of mounting cable ladders with suspended supports of U profiles and threaded rod suspension.

Jump application
Implementation of vertical jumps with adjustable connectors, e.g. for ceiling joists.

Centre suspension
Threaded rod suspension of a cable ladder using the centre suspension, type MAHL, and threaded rod, type 2078/M12.

Cable ladder centre suspension with U profile
Mounting of a cable ladder with centre suspension MAHU and a U support.

Suspended support suspension
Suspension of a cable ladder with suspended supports and support brackets.

Straight connection of cable ladders
Straight connection of cable ladders with straight connector, type LVG.

Horizontal angle connection of cable ladders
Horizontal angle connection with straight and angle connectors, type LWVG.

Vertical angle connection of cable ladders
Creation of a vertical angle connection using adjustable connectors, type LGVG.

Mounting of a T exit
Creation of a horizontal T exit of two cable ladders at different heights. The support profile, type LAW, is required to fix two cable ladders.
Riveted cable ladder systems

T exit with support plate
Creation of horizontal tees for cable ladders running at the same height. To increase the cable support and to protect the cables, use support plates, type LALB. Additional supports should be planned for the area of the exits.

Vertical cable exit
The exit plate, type LAB, is used to increase the cable supporting surface for vertically exiting cables and as cable protection.

Screwless barrier strip fastening
Screwless fastening of a barrier strip in cable ladders with hold-down clamp, type KS KL.

Screwed barrier strip fastening
Screwed mounting of the TSG barrier strip through the perforated rung of the cable ladders.

Straight barrier strip connection
Screwless straight connection of barrier strips in cable ladders using the barrier strip TSGV.

Mounting of insertion plate
Mounting of insertion plates, type ELB-L.

Cover mounting
Covers for cable trays and cable ladders can be extended to a locking cover using the cover clamp DK DRLU A2.

Cable ladder hold-down clamp
Cable ladder hold-down clamp KLL for direct mounting of cable ladders on steel girders.

Earthing terminal/earth connection
Earthing terminal for fastening the equipotential bonding wire to the cable support system.
System description

The high load capacity and good ventilation of the OBO cable ladder systems can offer tangible benefits, in particular during the installation of power cables. OBO Bетtermann’s cable ladder systems can be used universally and, due to the continuous rail and rung perforation, offer countless installation benefits. A factor guaranteeing easy mounting is the option of integrated fastening of cables using OBO clamp clips on the rungs, which are available in various different versions. OBO cable ladder systems are shipped partly folded up, thus saving space during transport and storage. OBO cable ladder systems can be supplied in lengths of 3 m and 6 m, in all standard widths from 200 to 600 mm and with rail heights of 45, 60 and 110 mm. On the following pages, you can select your preferred mounting variant from the installation diagrams shown and combine the corresponding articles in the order section.
Installation principle

1. Cable ladders
2. 90° bend
3. Horizontal tee
4. Add-on tee
5. Connection piece
6. Straight connector
7. Support plate
8. Inlay plate
9. Corner plate
10. Cover with cover clamp
11. Adjustable bend element
12. Adjustable connector
13. Multifunctional connector
14. Barrier strip
Welded cable ladder systems

Mounting aid

Adjustable vertical bend
Adjustable vertical bends made from adjustable vertical bend elements, type LGBE, with adjusta-
bile connectors to bridge height offsets.

Add-on tee
Creation of a one-sided branch using an add-on tee, type LAA.

Add-on tee, symmetrical
Mounting two add-on tees, type LAA, on a cable ladder as a symmetrical cross-over.

Mounting of a T piece
Mounting of a T piece, type LT, to create a one-sided branch for cable ladders.

90° bend
Connection of two cable ladders at a horizontal 90° angle with a bend, type LB 90.

Multifunctional connector for cable ladders
Creation of a one-sided branch using a multifunctional connector, type LMFV.

Multifunctional connector for cable ladders
Creation of a reduction, including 45° angle, using a multifunctional connector, type LMFV.
When you need to bridge wide spans and support high cable loads, the OBO wide span systems are the perfect solution. The product range comprises cable trays and cable ladders with widths of between 200 and 600 mm and side heights of 110 to 200 mm. Comprehensive system accessories such as fittings and all the fastening materials for concrete and steel mounting round off this product range perfectly. OBO wide span systems have proven their worth in many areas of industrial and systems engineering. These systems are becoming ever-more popular in buildings with a steel framework. OBO wide span systems are the complete product range for all applications and requirements and, with their large load capacity combined with large spans, provide efficient and optimised power supply.
Installation principle

1. Wide span cable ladders
2. 90° bend
3. Horizontal tee
4. Cross-over
5. Straight connector
6. Cover with turn buckle
7. Barrier strip
Mounting aid

Wide span fitting application
Mounting examples for horizontal and vertical changes of direction for wide span systems.

Wall mounting application
Direct wall mounting of wide span systems.

Girder clamping application
Mounting of a wide span system clamped to steel girders.

Horizontal wide span angle connection
Horizontal angle connection of wide span cable ladders with angle connectors, type WRWWK.

Vertical wide span adjustable connection
Vertical angle connection of wide span cable ladders with adjustable connectors, type WRGV.

Fastening of wide span cable ladders
Fastening of wide span cable ladders to the bracket using clamp, type LKS 60/5.

Mounting of 90° bend
Bend in combination with wide span cable ladder. The bend is connected to the wide span cable ladder using external connectors.

Mounting of tee
Tee in combination with wide span cable ladder. The tee is connected to the wide span cable ladder using external connectors.

Cross-over mounting
Cross-over in combination with wide span cable ladder. The cross-over is connected to the wide span cable ladder using external connectors.

Screwless barrier strip fastening
Screwless fastening of a barrier strip in wide span cable trays and cable ladders with hold-down clamp, type KS KL.

Screwed barrier strip fastening
Barrier strip mounting in wide span cable ladders. Fastening using slide nuts and hexagonal bolts.

Cover mounting
Mounting of covers with turn buckles.
Wide span cable ladder systems

Wall bracket, heavy duty
Mounting of the heavy-duty wall bracket, type AWSS, with clamping angle, type KWS, to steel girder to accept a wide span system. The wall bracket can also be mounted on concrete walls with bolt ties.

45° adapter plate
Mounting of the 45° adapter plate, type KA-E 45, on the steel girder using clamping angles, type KWS. The adapter plate can also be mounted on concrete walls with bolt ties.

Mounting example
Double-sided suspended support mounting of I profiles with transverse traverse. Fastening of a wide span cable ladder, type WKL 200, with hold-down clamp, type LKS 60/5, on the transverse profile.
OBO vertical ladder systems for vertical routing of all kinds of cables. Available as heavy-duty vertical ladders with U profiles and as industrial vertical ladders with I profiles. Both the heavy-duty and industrial vertical ladders can be assembled in variable lengths. The side rails are standard profiles of type US 5 and IS 8, which are connected using the appropriate rungs. The continuous rail perforation of the system and the comprehensive accessories simplify and accelerate installation, which can take place either directly on the wall, clamped to a steel construction or also as a free-standing construction. The system is perfectly complemented with OBO clamp clips.
Installation principle

1 Light-duty vertical ladder
2 Heavy-duty vertical ladder
3 Industrial vertical cable ladder
4 Cover with spacer
5 Rung seat with rung MS4022
Mounting aid

Wall mounting application
Wall mounting of a vertical ladder with mounting angles.

Change of direction application
Implementation of a change of direction with heavy-duty vertical ladder, type SLM.

Free-standing vertical ladder application
Mounting example for free-standing industrial vertical ladders, type SLS, fastened to the ceiling and floor.

Straight connection of vertical ladders
Connection of vertical ladders, types LG and SSL 60, with connectors, type LVG.

Angle connection of cable ladders
Creation of flexible vertical ladder angles with angle connector, type LWVG.

Adjustable connection of cable ladders
Creation of flexible vertical ladder angles with adjustable connector, type LGVG.

Wall mounting, light-duty vertical ladder
Wall mounting of light-duty vertical ladder, type SLL 45, with wall bracket, type WB 30/75.

Direct wall mounting
Direct fastening of the vertical ladders LG and SSL with bolt ties on the wall.

Wall mounting, heavy-duty vertical ladder
Wall mounting of heavy-duty vertical ladder, type SLM 50, with mounting angle, type BW.

Vertical ladder mounting on steel
Mounting of the heavy-duty vertical ladder, type SLM 50, with cantilever beam made of U profile, on a steel construction.

Cable fastening with clamp clip
Fastening of cables to the rung with clamp clips.

Fastening of industrial vertical ladder
Wall mounting of industrial vertical ladder with mounting angle, type BW 80/55.
Vertical ladder systems

- **Fastening of C profile rung**: Fastening of C profile rung, type CK 40, in industrial vertical ladders, type SLS 80.
- **Fastening of angle rung**: Fastening of the angle rung, type WSK 40, in industrial vertical ladders, type SLS 80.
- **Cover mounting, vertical**: Mounting of the cover with spacer on a vertical ladder.
- **Ceiling fastening**: Fastening of a industrial vertical ladder, type SLS 80, to the ceiling using mounting angle, type BW.
- **Illustration of vertical shaft**: Illustration of complete vertical ladder mounting.
- **Rung seat fixed to IS 8 support**: Fastening of the rung seat, type SA, with profile rail, type MS 4022, in I support.
- **Rung seat fixed to steel girder**: Direct fastening (clamping) of the rung seat, type SAA, with profile rail, type MS 4022, on steel girder.
Industrial ducts and trunking
Industrial ducts and trunking

Walkable cable tray system BKRS 116

Metal cable duct LKM 120

AZ small ducts and BKK basic profile 124

Luminaire support systems 128
System description

Optimised for worldwide use in systems construction and in the automotive industry with its automated production lines, the walkable cable tray system from OBO Betermann is ready for any task. The non-slip, impact-resistant covers and the unperforated cable trays, type BKRS, which serve as the base, are ideally suited to the rough and tumble of everyday work. Comprehensive accessories, such as support profiles, Z-shaped barrier strips, end closure plates, dust protection, guard plate and all the fastening materials optimise this system for universal use and ensure a flexible system, which allows low-cost installations.
Installation principle

1. BKRS cable tray
2. Chequer plate cover
3. Dust protection element
4. Cover support
5. Z-shaped barrier strip
6. Reducer/stop-end
7. Support profile
8. Support bracket
9. Z support
10. Protective panel for support bracket
11. Protective panel for Z supports
12. Cover clamp
13. Cover lifter
14. Clamp spring for conductor cable and connection terminal
Mounting aid

Direct floor mounting
Installation of the walkable cable tray system directly on the ground with nail tie or bolt tie.

Stand-off application
Installation and fastening of the walkable cable tray system for floor stand-off using U profiles.

Stand-off with stand-off bracket
Mounting of the walkable cable tray system on stand-off brackets, type DBL.

Stand-off with support profile
Mounting of the walkable cable tray system on Z support STP Z.

Mounting on Z supports, mounting below the walkable cable tray system
When mounting on Z supports, type ZST, other media, such as hydraulic, pneumatic or water, can be mounted under the walkable cable tray system. The protective panel, type SB ZST, is fastened to the Z supports using metal screws, type SPHS.

Mounting on support brackets
Mounting of the walkable cable tray system on special support brackets, type STA BKS.

Mounting below the walkable cable tray system on support brackets
When mounted on support brackets, type STA, other media, such as hydraulic, pneumatic or water, can be laid under the walkable cable tray system. The rails of the support bracket allow the use of U clamps.

Installations when mounted on support brackets
Assignment of the walkable cable tray with different cables, separated by barrier strips. When mounted on support brackets, other media can be laid under the cable tray.

Straight connection
Straight connectors, type RLVL, are used to create a straight connection of the walkable cable tray system.
Releasing the cover
The cover clamps can be released from the cable tray using a cover lifter.

Mounting protective panel
The protection panel type SB is fastened with drilling screws type BS to the support brackets and is designed to protect people, to prevent accidental stepping down from the walkable cable tray system and therefore to avoid accidents.

Mounting of barrier strip
The barrier strip, type TSG, is screwed by means of truss-head bolts in the bottom of the cable tray. Depending on the width of the cable tray system, multiple barrier strips can be used. Here, the barrier strip also serves as a cover support.

Drilling template
The cover lifter can be used as a drilling template to mark the hole for the connector.

Using universal connectors
The universal connector has a wide range of individual applications and can be used for both cross-overs as well as route installation.

Creating changes of direction 90°
The cable trays are cut with appropriate tools so they lie flush against each other. Then they are pushed into each other and connected with angled straight connectors.

Using the cover support for fittings
If fittings are used, the additional cover support, type DST, is used which reliably prevents a sagging of the cover with larger dimensions. The cover support is fixed with screws in the bottom of the cable tray/the fitting.

Cover mounting
The cover is mounted on the cable tray using the cover clamp.
LKM metal cable duct has two areas of application. The stable system for the guidance and protection of cables is used in the field of machines and systems. The completed system allows simple installation at a later date, also with pre-terminated connectors, offering reliable protection against mechanical loads and soiling.

The LKM cable duct of type LKM 20030FS and 60100FS has also been tested as a cable-specific routing type for the maintenance of electrical function according to DIN 4102 Part 12.
Installation principle

1. Duct
2. Duct clamp for the maintenance of electrical function
3. Joint connector
4. Internal corner
5. External corner
6. T piece
7. Flat angle
8. End piece
9. Edge protection ring
10. Partition
11. Cable brackets
12. Duct clamp
Mounting aid

**Machines application area**
In the area of machines, the LKM metal cable routing duct is used to provide additional protection for the cables.

**Wall duct mounting**
Knock-in anchors of type 910/SD can be used to fasten the LKM duct directly on the wall.

**Corridor, stairwell application area**
The stable LKM metal cable routing duct can be used anywhere, in which cables require mechanical protection.

**Internal corner mounting**
As with the LKM duct, the fittings are mounted at the appropriate points.

**Joint connector mounting**
After installing the LKM duct, lock the joint connector into the parts to be connected from inside. This guarantees the equipotential bonding between these two parts.

**Partition mounting**
Insert the partition into the straps located on the floor. This guarantees equipotential bonding without any additional aids.

**Cable bracket mounting**
The cable bracket is mounted using the duct fastening screw. The cables can be held using cable ties, type 555.

**Machine duct mounting**
Screw the LKM metal cable routing duct to the machine, for example, using cylinder head bolts of type 341.

**Installation of duct clamp**
The duct clamp is placed on the loop perforation in the base and then locked into the cover contour. If a partition wall is also installed, the partition wall must be separated into sections.

**Corridor, stairwell application area**
Equipotential bonding
Equipotential bonding is guaranteed between the cover and the base through the special cover contour. The LKM duct is earthed using the connection strap located in the base.

Edge protection ring mounting
Place the edge protection ring on the open ends of the LKM duct. It prevents damage to the cables within.
The modular systems – the product range that knows no bounds. Exiting branches to individual consumers can be implemented with the AZ small duct. The BKK basic profile can be used as a cable link in chemical plants, where large distances and high cable loads must be bridged safely with some fairly large support spacings. Electrical drives, such as motors, etc. are connected using the motor connection column. Thus, the modular system, together with the individually combinable range of accessories, is the universal solution for any task.
Installation principle

1. BKK basic profile
2. AZ small duct
3. Straight and angle connector
4. Motor connection column
5. Cover for motor connection column
6. Device plate
7. Edge protection ring
Mounting aid

**BKK system**
Mounting of the BKK system under the ceiling using IS 8 supports.

**Motor connection column**
Coupling of electric drives to the motor connection column.

**AZ small duct**
Example of mounting the AZ small duct as suspension with threaded rod and the implementation of horizontal-vertical transitions.

**Straight connection of AZ small duct**
Straight connection of AZ small ducts with connectors of type VF AZK.

**90° angle connection**
Angle connection of AZ small ducts with connectors of type VF AZK.

**90° vertical bend, falling**
Mounting of a falling vertical bend with adjustable connectors, type SV.

**90° vertical bend, rising**
Mounting of a rising vertical bend with adjustable connectors, type SV.

**Vertical straight connection**
Vertical angle connection of AZ small ducts with two connectors of type VF AZK.

**Side rail cable protection ring**
Insertion of the cable protection rings, type KSR-DR 910, in the side rail of the AZ small duct.

**Cover fastening**
Mounting of the cover, type AZDMD, on an AZ small duct.

**Mounting of motor connection column with fastening bracket**
Fastening of the motor connection column, type MAS 140/10, to the wall using fastening brackets, type BF 140/10.

**Device plate mounting**
Mounting of the device plate, type GP, to the motor connection column.
AZ small ducts and BKK basic profile

**Joint connection**
Connection of straight joints in the BKK system using the joint connector, type SSV.

**Mounting of base profile**
Mounting of the base profile in the BKK system.

**BKK offset fastening variant**
Possible mounting variant of BKK profiles with offset joint. This mounting variant provides increased joint stability.

**Mounting of base profile**
Mounting of the base profile in the BKK system.

**BKK offset fastening variant**
Possible mounting variant of BKK profiles with offset joint.

**Angle connection**
Simple bend creation with hinge connectors, type SV. For this, the side rails must be cut.
System description

Whether in industry, in purpose-built buildings or in especially attractive buildings, OBO luminaire support systems simplify the installation of light systems in many areas of industry and buildings. They are also be suitable for flexible power and data supplies to machines and workstations. The OBO luminaire support system makes cable laying and the optimum positioning of lighting child’s play for any possible application.
Installation principle

1. Luminaire support tray
2. 90° bend
3. 45° bend
4. Cover with turn buckle
5. Suspension bracket
6. Add-on tee
7. Threaded rod
8. Straight connectors and joint plate
9. Cover
10. Trapezoidal fastening
Mounting aid

**Luminaire support rail application**
Suspension of the luminaire support rail with chain and suspension bracket.

**Luminaire support tray application**
Suspension of a luminaire support tray with centre suspension MAH and threaded rod.

**Straight connection of luminaire support rails**
Horizontal straight connection of the luminaire support rail, type LTS with straight and angle connector, type VF AZK.

**Side rail cable protection ring**
Insertion of the cable protection rings, type KSR 910, in the side rail of the luminaire support rail.

**Horizontal angle connection**
Horizontal angle connection of the luminaire support rail, type LTS with straight and angle connector, type VF AZK.

**Bottom cable protection ring**
Insertion of the cable protection rings, type KSR 915, in the bottom of the luminaire support tray.

**Direct suspension**
Efficient creation of centre suspensions. The luminaire support tray is fastened to the centre suspension without bolts.

**Prewired luminaire supports**
Mounting of a pre-terminated luminaire beneath a luminaire support rail.

**Mounting of luminaire support fitting**
Mounting of luminaire support fittings by simple interconnection of fitting and luminaire support rail.

**Chain suspension**
Implementation of a chain suspension for luminaire support systems with anchor, ceiling hook, type 948/TG6, and suspension chain, type LTK-K.
Support structures
Support structures

Suspended supports and brackets 134

Universal systems 150

Cable support troughs 154

Clamp fastening systems 156
The TP system is a range of light supports and brackets. This product range, which consists of TP suspended supports and brackets, can be used universally as ceiling and wall mounting.
Installation principle
TP supports and brackets

1 TP suspended support
2 TP support/wall and support brackets
3 Spacer
4 End cap
Mounting aid
TP supports and brackets

Ceiling mounting of TP wall and ceiling clamp
Universal mounting of the TPD wall and ceiling clamp on the ceiling (with DS 4 spacer). Maximum tray width 300 mm.

Mounting of TP suspended support with single-sided bracket fastening
Ceiling mounting of a TP suspended support with spacer DS 4 and one-sided bracket mounting. Maximum tray width 300 mm.

Complete mounting of a TP system
Mounting of the TP suspended support with head reinforcement and double-sided bracket mounting and mounting directly on the wall.
System description
U supports and brackets

The perfectly matched U support family consists of US 3 (light-duty system), US 5 (medium-duty system) and US 7 (heavy-duty system). The U support range is particularly noted for its versatility. The U supports can be used as ceiling suspension, floor stand-off or as construction profiles.
**Installation principle**

**U support US 3**

1. US 3 suspended support
2. Spacer
3. Wall and support bracket
4. Head plate
5. US 3 support
6. U support connector
7. End cap
Installation principle
U support US 5

1 US 5 suspended support
2 Spacer
3 Wall and support bracket
4 Head plate
5 US 5 support
6 U support connector
7 End cap
Installation principle
U support US 7

1 US 7 suspended support
2 Spacer
3 Wall and support bracket
4 Heavy-duty head plate
5 US 7 support
6 U support connector
7 End cap
Mounting aid
U supports and brackets

Wall mounting
Direct fastening of wall and support brackets of type AW... on the wall.

Quick fastening of cable tray on bracket
Positioning the cable tray on the bracket.

Quick fastening of cable tray on bracket
Fixing of the cable tray on the bracket using quick fastening.

Wall bracket, variable
Fastening of the variable wall bracket, type AWV, with bolt tie to vaulted or sloping walls/ceilings.

Standard mounting of suspended support with wall bracket, single-sided without spacer
Ceiling fastening of a suspended support with single-sided bracket fastening. A spacer is not always required for widths up to and including 300 mm.

Standard mounting of suspended support with wall and support bracket, single-sided with spacer
Ceiling fastening of a suspended support with single-sided bracket fastening. For widths of over 400 mm, we recommend using a spacer.

Standard mounting of suspended support with wall and support bracket, double-sided
Ceiling fastening of a suspended support with double-sided bracket mounting.

Ceiling mounting

Head plate mounting
Mounting of the standard head plate on support and ceiling. Use with spacer DSK 25 (US 3), DSK 45 (US 5) or DSK 61 (US 7).

Adapter head plate, asymmetrical
Asymmetrical head plate KA-ASY to increase the load capacity for the combination with suspended supports, type US 7 K and IS 8 K.

Adapter head plate, symmetrical
Symmetrical head plate KA-SY to increase the load capacity for the conjunction with suspended supports, types US 7 K and IS 8 K.

Traverse
U support wall mounting
U supports are mounted on walls or girders using bolt ties, directly through the system perforation in the U support.

Variable head plate with US 3 support
Mounting of the variable head plate, type KU 3 V on US 3 support.

Variable head plate
Fastening of the variable head plate KU 5 V to sloping concrete ceilings using bolt ties and spacer DSK 47.

Mounting of spacer
Mounting of the spacer DSK 47 with US 5 supports or DSK 45 with US 7 supports in conjunction with a variable head plate KU 5 V or KU 7 VQP.

45° adapter plate, concrete mounting
Mounting of the 45° adapter plate, type KA-E 45, on a concrete wall. For additional support and implementation of tray routes at angles and room corners.

45° adapter plate, steel clamping
Mounting of the 45° adapter plate, type KA-E 45, on the steel girder using clamping angles or chuck jaws. For additional support of routes in angles and at room corners.

Direct girder clamping
Direct girder clamping of a U suspended support using KWS clamping angle. Route in longitudinal direction of steel girder.

Support structures
Cantilever beam on steel

U supports can be used as cantilever beams on steel girders with chuck jaws of type TKS-L-25. Use DSK spacers for safe functioning.

Steel clamping with C profile, route in longitudinal direction

U suspended support mounting, clamped to steel girder with C profile, type MS 4022, and TKH-L-25 light-duty chuck jaw. Route along steel girder.

Steel clamping with C profile, route in transverse direction

U suspended support mounting, clamped to steel girder with C profile, type MS 4022, and TKH-L-25 light-duty chuck jaw. Route transverse to steel girder.

Head plate mounting

Installation of the head plate using the example KU 7 AOX for direct welding on steel girders.

Cantilever beam on steel

U supports can be used as cantilever beams on steel girders with chuck jaws of type TKS-L-25. Use DSK spacers for safe functioning.

Clamp fastening of heavy-duty brackets

Clamp fastening of a heavy-duty bracket with clamping angles or chuck jaws on a vertical steel girder.
System description
I supports and brackets

The I support system from OBO Bettermann really comes into its own in situations where high loads must be carried, large distances must be bridged and difficult routes must be implemented. The I support system fulfils all the requirements of a heavy-duty mounting system. The high load capacities of all the system components permit the mounting of complex structures. The comprehensive range of head plates allows the implementation of all conceivable solutions. This heavy-duty system is used with large support spacings of wide span systems or for multi-layer set-ups of standard cable trays and cable ladder systems. The combination of I supports and support brackets of type AS 15, AS 30 and AS 55 form a perfectly matched product range, the height of which can be infinitely adjusted.
Installation principle
I supports and brackets

1. I suspended support
2. Carrier lug
3. Support bracket
4. Head plate
5. I support
6. I support connector
7. End cap
8. Mounting angle
Mounting aid
I supports and brackets

Application on the ceiling
Standard mounting of suspended supports to concrete ceilings using bolt ties.

Head plate mounting
Fastening of the standard head plate, KI 8, for I suspended supports to concrete ceilings using bolt ties.

Head plate, variable (rotated through 90°)
Mounting of the variable head plate, type KI 8 VLP, rotated through 90°, to sloping concrete ceilings using bolt ties.

Variable head plate
Mounting of the variable head plate, type KI 8 VQP, to sloping concrete ceilings using bolt ties.

I support connection
Mounting of the I support connector VIS 8 to connect IS 8 supports.

Bracket mounting
Mounting of a three-layer cable support system on the concrete ceiling using support bracket mounting AS 15, AS 30 and AS 55.

Adapter head plate, asymmetrical
Asymmetrical head plate KA-ASY to increase the load capacity for the combination with suspended supports, types US 7 K and IS 8 K.

Adapter head plate, symmetrical
Symmetrical adapter head plate KA-SY to increase the load capacity for the conjunction with suspended supports, types US 7 K and IS 8 K.

Wall fastening, I support
Mounting of an I support on the wall using fastening brackets, type BW 80/55, and bolt ties to accept multiple support brackets, type AS.

Special structure
Example of the mounting of a special structure, consisting of I supports (ceiling/wall mounting) with transverse profile and various support brackets, type AS.

Application on steel girder
Clamp fastening of suspended supports on steel girders using various chuck jaws, lengthwise or transverse to the steel girder.

Direct girder clamping
Direct girder clamping of an I suspended support with heavy-duty chuck jaw, type TKS-S-30. Route in longitudinal direction of steel girder.
Steel clamping with C profile, route in longitudinal direction
I suspended support mounting, clamped to steel girder with C profile and TKH-L-25 chuck jaw. Route along steel girder.

Steel clamping with C profile, route in transverse direction
I suspended support mounting, clamped to steel girder with C profile and TKH-L-25 chuck jaw. Route transverse to steel girder.

Head plate, variable (transverse)
Mounting of the variable, transversely adjustable head plate, type KI 8 VLP, on rising or falling steel structures with profile rail, type MS 5030, and clamping angles, type KWH.
Universal systems for cable support structures are used for small loads. Whether the installation is to be a ceiling fastening, wall fastening or a floor stand-off: In the universal systems, you can find functional fastenings with matching system accessories for any application. These suspension systems, which can be called basic installations, include centrally loaded ceiling clamps or trapezoidal fastenings, which are used with threaded rods and centre suspensions. When using centre suspensions, the load should be even on both sides of the system. If an even load cannot be guaranteed, then other systems should be used.
Installation principle

1 Ceiling bracket
2 Trapezoidal fastening
3 Threaded rod
4 Centre suspension
5 Suspension clamp
6 Stand-off bracket
7 Stand-off bracket
Mounting aid

Mounting of centre suspension
Mounting of the centre suspension MAH 60 on the ceiling using threaded rod 2078/M10 and ceiling bracket 12950. Maximum cable tray width 300 mm.

Universal mounting on the ceiling
The variable ceiling bracket, type DBV, allows threaded rod suspensions on straight and sloping ceilings.

Centre suspension with threaded rod
Direct centre suspension at low loads of a cable tray with threaded rod 2078/M10.

Mounting of centre suspension
Insertion and alignment of the centre suspension MAH in the cable tray.

Threaded rod suspension RKSM > 400 mm
The threaded rod suspension of RKSM cable trays > 400 mm can take place using two threaded rods.

Cable ladder centre suspension with threaded rod
Mounting of a cable ladder with centre suspension MAHU and a threaded rod.

Trapezoidal plate application
Simple, quick fastening of a cable support system to trapezoidal metal roofs.

Mounting of trapezoidal suspension
Mounting of a cable tray on a trapezoidal ceiling using the trapezoidal fastening, type TPB 100 and centre suspension, type MAH 60. Maximum cable tray width 300 mm. The trapezoidal fastening is mounted using the lock, type TPB R.

Threaded rod suspension with suspension clamp
Ceiling mounting of a cable tray with AHB suspension clamp and threaded rod 2078/M10. Maximum cable tray width 400 mm.
Floor fastening at a distance
Mounting of a cable tray at a distance using the DBL stand-off bracket. Maximum cable tray width 600 mm.

Stand-off of mesh cable trays
Floor stand-off of mesh cable trays with the stand-off bracket, type DBLG 20/... Screwless fastening of the mesh cable tray on the stand-off bracket using clamping lugs.
Cable support brackets are used for quick and easy routing of cables in areas where conventional cable support systems cannot be installed due to lack of space. The cable support brackets have a large load-bearing surface and rounded outer edges to protect the cables.
Mounting aid

Factory pre-assembled cable carrier trays help in a fast installation.

Cable carrier trays for single installation to serve a flexible connection of cables.
System description

The beam clamp systems with reduced installation times and work are a clear argument for the use of this system in all areas of professional electrical installations. Beam clamps can be attached without difficult, often unpermitted drilling. The load range runs from light-duty clamping angles to heavy-duty chuck jaws.

The clamping lugs/clamping angles, type KL, KWH and KWS, and the chuck jaws, type TKH and TKS, permit excellent connections without drilling or welding, on account of the perfect matching to additional system articles.
Installation principle

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chuck jaw, heavy duty</td>
</tr>
<tr>
<td>2</td>
<td>Chuck jaw, light duty</td>
</tr>
<tr>
<td>3</td>
<td>Profile rail</td>
</tr>
<tr>
<td>4</td>
<td>Clamping angle</td>
</tr>
<tr>
<td>5</td>
<td>Beam clamp, horizontal</td>
</tr>
<tr>
<td>6</td>
<td>Beam clamp, vertical</td>
</tr>
</tbody>
</table>

[Diagram showing installation principle with numbered components]
Mounting aid

**Application on horizontal steel girder**
Clamp fastenings using clamping angles and chuck jaws on horizontal steel girders.

**Application on sloping steel girder**
Clamp fastenings using clamping angles and chuck jaws on sloping steel girders.

**Direct girder clamping**
Direct girder clamping of an I suspended support using chuck jaw (heavy duty), type TKS-S-30. Route along steel girder.

**Clamp fastening with additional C profile**
Use of an additional C profile rail, type MS, for wider steel girders. Route along steel girder.

**Steel clamping, C profile rail**
Fastening of a C profile, type MS 4022 or MS 5030, to steel girder using clamping angles, type KWS.

**Clamping transverse to steel girder**
Use with two C profile rails for route mounting transverse to the steel girder.

**Cantilever beam on steel**
Mounting of U support as cantilever beam on steel girder. Fastening with clamping angles or chuck jaws depending on load. Fastening with spacers, type DSK.

**Clamp fastening on vertical steel girder**
Mounting of the adapter plate, type KA-AW, on the vertical steel girder using clamping angles or chuck jaws. Wall brackets of type AW are fastened to the adapter plate, using the hexagon head screw, type SKS 12x40 GF.
Clamp fastening systems

45° adapter plate, steel clamping
Mounting of the 45° adapter plate, type KA-E 45, on the steel girder using clamping angles or chuck jaws. For additional support of routes in angles and at room corners.

Vertical clamp fastening
Clamp fastening of a heavy-duty bracket with clamping angles or chuck jaws on a vertical steel girder.

Vertical clamp fastening
Mounting of a mesh cable tray vertically on a steel girder, mounting with a fixing clamp BFK and hold-down clamp GKS 50.

Horizontal clamp fastening
Mounting of AZ small duct using BFK fixing clamp in a longitudinal direction on the steel girder. Maximum cable tray width 100 mm.
Power supply units

Power supply units VH/VHF

Industrial service poles
System description

Suspended energy distributors for workplaces and machines in industry, the trades and in training areas. The power supply units can be positioned freely in the room. The supply comes from the ceiling. They can be equipped flexibly from power, data and media technology through to work media such as compressed air.
Robust and trusted

The housings of the power supply units are made of highly resistant polyamide and offer installation space for 4 to 8 installation devices. This means that power supply units provide connections for work media directly and safely at the workplace.

Cables are inserted in the power supply units via penetration sleeves. Integrated strain relief options in the housing ensure standardised installation. The suspension of the power supply units takes place in a fixed manner with a chain, with a spring or ergonomically with the positioner.

Modul 45® sockets
Up to two Modul 45® sockets can be installed on each connection side of the power supply unit. Different circuits can be installed in the housing. The entire product range of international sockets is available.

Compressed air
The compressed air connection to the power supply unit is designed for compressed air hoses 13 x 3.5 mm. The hose connection is fixed and locked using a hose clip. The power supply unit is equipped with a 2-way distributor ½”.

CEE connection unit
CEE 16 A and CEE 32 A sockets can be installed in the power supply units.

Data technology and multimedia
The entire Modul 45® range of data and multimedia technology is suitable for the network connection of machines and systems and in seminar and training rooms.
Mounting aid

**Installation with knotted chain**
Mounting with a knotted chain is a rigid installation and does not require any additional cable reserves. Shorten the knotted chain to the required length and fasten it using the pre-mounted eyelet on the housing cover.

**Compressed air connection**
The compressed air connection is designed for compressed air hoses 13 x 3.5 mm. The hose connection is fixed and locked using a hose clip.

**VHF device installation – IP44 socket**
The IP44 socket is inserted and locked into the appropriate cover plate. After connecting the cable, place the cover plate on the housing and fix it using screws.

**Installation with tension spring**
With additional installations with a tension spring, always ensure flexible cable routing. The tension spring is usually used with compressed air for VH units and inserted directly in the fastening seat.

**VH device installation – Modul 45®**
The Modul 45® devices are inserted and locked into the appropriate cover plate. After connecting the cable, place the cover plate on the housing and fix it using 2 screws.

**Cable entry**
Cables are inserted using the pre-punched openings in the housing cover. Correct strain relief is achieved using the cable terminals integrated in the housing.

**VH/VHF device installation – extension accessories**
Fasten extension accessories for the 38 x 38 mm fastening system to the appropriate cover plate using the screws supplied. After connecting the cable, place the cover plate on the housing and fix it using fastening screws.

**VH/VHF device installation – CEE**
The connection of cables to a CEE connection unit must be carried out using a pre-mounted cover plate. During device mounting, the cover plate is fastened using 4 fastening screws.

**VH device installation – support ring (EKR)**
After cable connection, accessories with a support ring are screwed directly into the housing. The cover plate is fastened by mounting the central plate.
In the first step, the appropriate support is pre-mounted using a PE terminal strip or N and PE terminal strip in the upper half of the housing. For this, the inner part of the fastening tracks must be completely removed.

In the second step, the support bracket for the power supply unit is mounted in the lower half of the housing. Then the devices are connected and installed.

In the third step, the transparent cover is placed on the cover plate and fastened with 4 screws. After that, mount the cover plate onto the equipped housing side using 4 screws.
**Power supply unit with increased IP protection**

The VHF8 power supply unit is specially designed for use in moist and wet areas. In the unused state, the housing equipment and the devices offer a protection level of IP44 (protected against spray water).

Through the installation of up to 4-pole protection devices, workstations can be protected appropriately and in a decentralised manner.

**Pre-terminated power supply units**

For a quick and easy ordering process, pre-terminated power supply units are available for standard applications, with and without compressed air connections. The sockets are already prewired and tested in the housing. The cable connection is quick and easy and uses prepared screw terminals.
VH and VHF empty housing – freely configurable

Equipment VH4 and VH8
The VH power supply units are available as an empty housing for 4 (type VH4) or 8 (type VH8) connection sides for installation devices. The empty housings are offered with and without compressed air connections.

The standardised cover plates can be used in VH4 and VH8 and allow the installation of Modul 45°, extension sockets with hinged lids, standard installation devices (with 50 mm central plate) and CEE connection units.

Equipment VHF
The VHF power supply units are available as an empty housing for 8 installation devices. The empty housings are offered in versions with and without compressed-air connections.

Special cover plates for increased IP protection are available for the VHF. The special cover plates for VHF allow the installation of extension sockets with hinged lids, CEE connection units and decentral protection devices.
Our industrial service poles combine power, data and compressed air connections in a compact and sturdy manner. This makes changes of location, for example when adjusting production processes, particularly quick and easy. Thanks to the modular set-up, it is easy to equip the service pole according to the new requirements. The ISS basic profile is fully compatible with all known item MB Building Kit Systems.
ISS basic profile

Device installation
ISS industrial poles can be equipped with practically standard systems. The 76.5 mm-wide system opening is ready for the installation of:
- Switching and connection devices
- CEE connection units 16 A/32 A
- Data technology
- Series-mounted devices

Installation
The channel rail enables, using item slot nuts, the attachment of:
- Monitors
- Keyboards
- Reading, transmitting and receiving equipment
- Fixed or flexible pipelines for compressed air or gases

Flexible use
In order to be able to install cables and wires of different voltage levels, it is possible to divide the installation space with a partition.

Compressed air tap
Tap to take off compressed air from the pole profile. The compressed air tap can be mounted onto the pole profile using slot nuts and fastening screws.
Stand and ceiling fastening
A solid stand to be fastened to the floor ensures secure mounting. A solid ceiling fastening at the top can easily be adjusted to different heights.
Mounting in the system opening
The 76.5 mm system opening accommodates accessory mounting sockets of the series 71GD... In addition to standard systems from other manufacturers, the complete OBO product range stands ready for installation of:

- Switching and connection devices
- CEE connection units
- 16 A/32 A
- Data technology from all manufacturers
- Multimedia (audio, video, VGA, XLR, etc.)
- IKR4 and IKR6 series-mounted devices
- Pre-terminated “plug and play” solutions with ready-to-connect connection cables

Mounting in the channel rail
The service pole has one channel rail to every side, aligned to the established item grid dimensions. This means, there are no limitations with regards to adapting all kinds of different expansion elements and integrating the poles into machine and plant constructions. The channel rail provides the option to attach:

- Monitors
- Keyboards
- Reading, transmitting and receiving equipment
- Fixed or flexible pipelines for compressed air or gases
Connection to cable support systems
Using the appropriate brackets, cable ladder and cable tray systems can be attached to the pole easily and securely.

Connection to a walkable cable tray
With our walkable cable tray systems, power and data can be fed into service poles.
System description

An exceptionally large range of products in the usual high quality: Wiring ducts and trunking ensures tidy wiring in a switchgear cabinet. All the duct is made from lead-free material. And, for optimum safety, a selection of halogen-free duct is available from our range.

For professional wiring installation, Wiring ducts and trunking in dimensions between 15 x 15 mm and 100 x 100 mm is available. A soft, burr-free slot and rounded tabs make mounting easier and also prevent injuries. Upon request we can also offer special designs.
Precise measurements and tested quality

The LK4 and LK4/N as well as the LKV and LKV/N duct systems have exactly predetermined points for easy breaking-out of the side retainers. All types have, depending on their size, single or dual-track perforation to their base. Tapering in the side slots of the LK4/N and LKV/N types prevents the cables from falling out.

The Wiring ducts and trunking is VDE-tested and UL-listed (UL File E301798).

**LK4 and LK4/N**

OBO offers the LK4 Wiring ducts and trunking in the measurements from 15 x 15 mm to 80 x 120 mm. Precise processing enables simple attaching and detaching of the cover while, at the same time, ensuring a firm fit.

**LKV and LKV/N**

The special cover contour also guarantees a perfect fit on the LKV Wiring ducts and trunking. In the dimensions from 25 x 25 mm to 100 x 100 mm (DIN EN 50085-2-3), it caters for any size requirement.

**LKV/H**

The LKV/H Wiring ducts and trunking is halogen-free and available in eight different sizes from 50 x 37.5 mm to 75 x 125 mm.

Upon request we can also offer customised solutions:

- Starting dimension of the base perforation can be adjusted variably
- Available without base perforation
- Special lengths
- Special colours

1. Stable duct with high-quality thicknesses
2. Exact predetermined breaking points in the strut and base area
3. Soft, burr-free slot, rounded tabs
4. Absolute dimensional accuracy of the side perforation and base perforation
5. Cut edges rounded and deburred in the closing area
6. Secure positioning of the covers through optimum closing contours
7. Wire retaining nose allows wiring without wire retaining clamp
Wiring ducts and trunking

Mounting aid

Mounting of the Wiring ducts and trunking
The VK Wiring ducts and trunking is fastened to the mounting plate of the switching cabinet using spreading rivets. The spreading rivets are installed using the plastic rivet tool.

Break-out of retainers
The retainers are bent outwards. When a bend angle of approx. 70–80° is exceeded, they break.

Release pliers
The side retainers can be removed down to the base of the duct using the release pliers. When the side retainers have been broken out, there is no loss in volume in the transition area to the next duct piece.

Wire retainers
The wire retainers can be adjusted according to the duct width. To do this, simply break off the wire retainer at the predetermined breaking points. This means that just one wire retainer is necessary for any duct width.

Wire retainer mounting
The wire retainer is inserted into the side slot of the VK Wiring ducts and trunking. This simplifies cable installation and keeps the cables in place in the VK Wiring ducts and trunking. It also guarantees easy attachment of the cover. If installations are required at a later date, then, when the cover is removed, the cables are held in the duct and do not fall out.

Wire holding lugs
In the N versions, there is a holding lug on the side retainer, allowing fixing of the cables in the VK Wiring ducts and trunking.

Cover contour LK4
True to size processing enables easy mounting and removal of the cover, despite a firm cover fit.

Cover contour LKV
The special cover contour also guarantees a perfect fit on the LKV Wiring ducts and trunking.

Mounting of spacers
Through the mounting on spacers, it is possible to install the VK Wiring ducts and trunking at a distance to the mounting plate.
Spacer mounting
The spacers can be connected one on top of the other to allow greater distance to the mounting plate. This allows a certain amount of height variation for any cables to be routed behind the VK Wiring ducts and trunking.

Base perforation
Single and dual-track base perforation to DIN 43659 enable precise work.
Wiring ducts and trunking

Hole patterns and dimensions

<table>
<thead>
<tr>
<th>Item no.</th>
<th>Hole pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>LKV 25025</td>
<td>6178320</td>
</tr>
<tr>
<td>LKV 37025</td>
<td>6178305</td>
</tr>
<tr>
<td>LKV 37037</td>
<td>6178307</td>
</tr>
<tr>
<td>LKV 50025</td>
<td>6178310</td>
</tr>
<tr>
<td>LKV 50037</td>
<td>6178312</td>
</tr>
<tr>
<td>LKV 50050</td>
<td>6178314</td>
</tr>
<tr>
<td>LKV 50075</td>
<td>6178316</td>
</tr>
<tr>
<td>LKV 75025</td>
<td>6178320</td>
</tr>
<tr>
<td>LKV 75037</td>
<td>6178322</td>
</tr>
<tr>
<td>LKV 75050</td>
<td>6178324</td>
</tr>
<tr>
<td>LKV 75075</td>
<td>6178326</td>
</tr>
<tr>
<td>LKV 75100</td>
<td>6178328</td>
</tr>
<tr>
<td>LKV 75125</td>
<td>6178330</td>
</tr>
<tr>
<td>LKV 10037</td>
<td>6178334</td>
</tr>
<tr>
<td>LKV 10050</td>
<td>6178336</td>
</tr>
<tr>
<td>LKV 10075</td>
<td>6178343</td>
</tr>
<tr>
<td>LKV 10075</td>
<td>6178349</td>
</tr>
<tr>
<td>LKV 100100</td>
<td>6178341</td>
</tr>
</tbody>
</table>

VK and VKH Wiring ducts and trunking always starts and finishes – with regards to one delivery length (2,000 mm) – with half a small fastening hole (4.5 x 8 mm).
Dimensions, LK4 Wiring ducts and trunking

<table>
<thead>
<tr>
<th>Item no.</th>
<th>Type</th>
<th>Item no.</th>
<th>Type</th>
<th>Dimension a mm</th>
<th>Dimension A mm</th>
<th>Dimension B mm</th>
<th>Dimension h mm</th>
<th>Dimension H mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>6178001</td>
<td>LK4 15015</td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>17</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>6178003</td>
<td>LK4 30015</td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>17.8</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>6178005</td>
<td>LK4 30025</td>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td>28.6</td>
<td>31</td>
<td>30</td>
</tr>
<tr>
<td>6178010</td>
<td>LK4 40025</td>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td>28.6</td>
<td>31</td>
<td>40</td>
</tr>
<tr>
<td>6178012</td>
<td>LK4 40040</td>
<td></td>
<td></td>
<td></td>
<td>40</td>
<td>43.6</td>
<td>46.2</td>
<td>40</td>
</tr>
<tr>
<td>6178014</td>
<td>LK4 40060</td>
<td></td>
<td></td>
<td></td>
<td>60</td>
<td>64</td>
<td>66.4</td>
<td>40</td>
</tr>
<tr>
<td>6178016</td>
<td>LK4 40080</td>
<td></td>
<td></td>
<td></td>
<td>80</td>
<td>84</td>
<td>87</td>
<td>40</td>
</tr>
<tr>
<td>6178018</td>
<td>LK4 40100</td>
<td></td>
<td></td>
<td>100</td>
<td>104</td>
<td>107.4</td>
<td>40</td>
<td>43.7</td>
</tr>
<tr>
<td>6178026</td>
<td>LK4 60015</td>
<td>6178201</td>
<td>LK4 N 60015</td>
<td></td>
<td>15</td>
<td>18.6</td>
<td>20</td>
<td>60</td>
</tr>
<tr>
<td>6178028</td>
<td>LK4 60025</td>
<td>6178203</td>
<td>LK4 N 60025</td>
<td></td>
<td>25</td>
<td>29</td>
<td>31</td>
<td>60</td>
</tr>
<tr>
<td>6178031</td>
<td>LK4 60040</td>
<td>6178205</td>
<td>LK4 N 60040</td>
<td></td>
<td>40</td>
<td>44</td>
<td>46.2</td>
<td>60</td>
</tr>
<tr>
<td>6178033</td>
<td>LK4 60060</td>
<td>6178207</td>
<td>LK4 N 60060</td>
<td></td>
<td>60</td>
<td>64</td>
<td>66.4</td>
<td>60</td>
</tr>
<tr>
<td>6178035</td>
<td>LK4 60080</td>
<td>6178209</td>
<td>LK4 N 60080</td>
<td></td>
<td>80</td>
<td>84.4</td>
<td>87</td>
<td>60</td>
</tr>
<tr>
<td>6178037</td>
<td>LK4 60100</td>
<td>6178211</td>
<td>LK4 N 60100</td>
<td></td>
<td>100</td>
<td>104.6</td>
<td>107.4</td>
<td>60</td>
</tr>
<tr>
<td>6178039</td>
<td>LK4 60120</td>
<td>6178213</td>
<td>LK4 N 60120</td>
<td></td>
<td>120</td>
<td>124.6</td>
<td>127.8</td>
<td>60</td>
</tr>
<tr>
<td>6178050</td>
<td>LK4 80025</td>
<td>6178225</td>
<td>LK4 N 80025</td>
<td></td>
<td>25</td>
<td>29.4</td>
<td>31</td>
<td>80</td>
</tr>
<tr>
<td>6178052</td>
<td>LK4 80040</td>
<td>6178227</td>
<td>LK4 N 80040</td>
<td></td>
<td>40</td>
<td>44.4</td>
<td>46.2</td>
<td>80</td>
</tr>
<tr>
<td>6178054</td>
<td>LK4 80060</td>
<td>6178229</td>
<td>LK4 N 80060</td>
<td></td>
<td>60</td>
<td>64.4</td>
<td>66.4</td>
<td>80</td>
</tr>
<tr>
<td>6178056</td>
<td>LK4 80080</td>
<td>6178231</td>
<td>LK4 N 80080</td>
<td></td>
<td>80</td>
<td>84.6</td>
<td>87</td>
<td>80</td>
</tr>
<tr>
<td>6178059</td>
<td>LK4 80100</td>
<td>6178233</td>
<td>LK4 N 80100</td>
<td></td>
<td>100</td>
<td>104.8</td>
<td>107.4</td>
<td>80</td>
</tr>
<tr>
<td>6178061</td>
<td>LK4 80120</td>
<td>6178236</td>
<td>LK4 N 80120</td>
<td></td>
<td>120</td>
<td>124.8</td>
<td>127.8</td>
<td>80</td>
</tr>
</tbody>
</table>

Dimensions LK4 Wiring ducts and trunking

Dimensions LK4 Wiring ducts and trunking
**General information**

**Tightening torques**

Different tightening torques apply when mounting a cable support system. Please note that the specified torques are only intended as rough, non-binding guide values (see VDI 2230)!

### Tightening torques of bolts with metric thread made of steel

<table>
<thead>
<tr>
<th>Thread</th>
<th>Grade 5.6</th>
<th>Grade 6.9</th>
<th>Grade 8.8</th>
<th>Grade 10.9</th>
<th>Grade 12.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>M6</td>
<td>3.9 Nm</td>
<td>8.5 Nm</td>
<td>10 Nm</td>
<td>14 Nm</td>
<td>17 Nm</td>
</tr>
<tr>
<td>M8</td>
<td>9.8 Nm</td>
<td>21 Nm</td>
<td>25 Nm</td>
<td>35 Nm</td>
<td>41 Nm</td>
</tr>
<tr>
<td>M10</td>
<td>19.6 Nm</td>
<td>41 Nm</td>
<td>49 Nm</td>
<td>69 Nm</td>
<td>83 Nm</td>
</tr>
<tr>
<td>M12</td>
<td>33.4 Nm</td>
<td>72 Nm</td>
<td>86 Nm</td>
<td>120 Nm</td>
<td>145 Nm</td>
</tr>
<tr>
<td>M14</td>
<td>54 Nm</td>
<td>115 Nm</td>
<td>135 Nm</td>
<td>190 Nm</td>
<td>230 Nm</td>
</tr>
<tr>
<td>M16</td>
<td>82 Nm</td>
<td>180 Nm</td>
<td>219 Nm</td>
<td>295 Nm</td>
<td>355 Nm</td>
</tr>
<tr>
<td>M18</td>
<td>114 Nm</td>
<td>245 Nm</td>
<td>290 Nm</td>
<td>400 Nm</td>
<td>485 Nm</td>
</tr>
<tr>
<td>M20</td>
<td>163 Nm</td>
<td>345 Nm</td>
<td>410 Nm</td>
<td>580 Nm</td>
<td>690 Nm</td>
</tr>
</tbody>
</table>

### Tightening torques of bolts with metric thread made of stainless steel

<table>
<thead>
<tr>
<th>Thread</th>
<th>Resistance grade 50</th>
<th>Resistance grade 70</th>
<th>Resistance grade 80</th>
</tr>
</thead>
<tbody>
<tr>
<td>M6</td>
<td>3.8 Nm</td>
<td>8.2 Nm</td>
<td>10.9 Nm</td>
</tr>
<tr>
<td>M8</td>
<td>9.2 Nm</td>
<td>19.6 Nm</td>
<td>26.2 Nm</td>
</tr>
<tr>
<td>M10</td>
<td>19 Nm</td>
<td>39 Nm</td>
<td>53 Nm</td>
</tr>
<tr>
<td>M12</td>
<td>31 Nm</td>
<td>67 Nm</td>
<td>89 Nm</td>
</tr>
<tr>
<td>M14</td>
<td>50 Nm</td>
<td>106 Nm</td>
<td>142 Nm</td>
</tr>
<tr>
<td>M16</td>
<td>76 Nm</td>
<td>162 Nm</td>
<td>216 Nm</td>
</tr>
<tr>
<td>M18</td>
<td>105 Nm</td>
<td>225 Nm</td>
<td>299 Nm</td>
</tr>
<tr>
<td>M20</td>
<td>148 Nm</td>
<td>316 Nm</td>
<td>422 Nm</td>
</tr>
</tbody>
</table>
The components listed below are now considered to be ineffective screw locks, as the corresponding standards have been withdrawn. They are therefore not permitted as the sole safety devices for strength classes ≥ 8.8.

Withdrawn standards:
- Spring lock washers (DIN 127, DIN 128 and DIN 6905)
- Wave spring washers (DIN 137 and DIN 6904)
- Toothed discs (DIN 6797)
- Serrated washers (DIN 6798)
- Locking plates (DIN 93, DIN 432 and DIN 463)
- Safety cups (DIN 526)
- Locking nuts (DIN 7967)
- Castle nuts with split pin (DIN 937)

All specified standards have now been withdrawn, however these components can often still used as “captive prevention”! Captive protection devices prevent a screw connection from being completely unscrewed, but not from loosening.

At OBO Bettermann, individual products, such as hexagonal bolts with washer and nut, continue to be sold as a complete package, as these are used for electrical contact to surrounding metallic components.

Our systems are generally not exposed to dynamic loads that require screw locking.
Metal spreading anchor

System description

The majority of metal spreading anchors from OBO Betttermann have a European Technical Assessment ETA. Some versions have shock approval from the Federal Office for Civil Protection in Bern, Switzerland. Most metal spreading anchors have also been tested in terms of fire protection for a fire resistance time of up to 120 minutes. You can find detailed information regarding the permitted loads (also in the event of a fire) and the installation conditions that must be observed in the corresponding approvals.

System benefits:
- Wide range of application areas thanks to a variety of versions, load classes and material qualities
- Quick and easy installation
- High tensile loads and shear loads
- Small edge and axis spacings
- Can be used indoors and outdoors (depending on material)
Mounting aid

Drilling an anchor hole
Drilling of the anchor hole according to the anchor approval information for the drill hole diameter and the drill hole depth.

Blowing out of the drill hole
Removing dust from the drill hole by blowing it out several times.

Drilling an anchor hole in the ceiling
Drilling of the anchor hole in the ceiling according to the anchor approval information for the drill hole diameter and the drill hole depth.

Blowing out of the drill hole in the ceiling
Removing dust from the drill hole by blowing it out several times.

Placing the bolt tie BZ-IG
The bolt tie BZ-IG is placed on the setting tool BZ-IGS. It must be ensured that the thread size of the setting tool fits to the corresponding bolt tie.

Knocking in of the bolt tie BZ-IG
Knocking in of the bolt tie BZ-IG with the appropriate setting tool. Then the component to be mounted can be fastened.

Mounting of threaded rod BZ-IG
Mounting of a threaded rod into the bolt tie BZ-IG. The direct mounting of a component with a hexagonal bolt is also possible.

Application of the torque BZ-IG
Fastening of the threaded rod by tightening the hexagonal nut with the torque specified in the approval.
Metal spreading anchor

Nail tie, type N, with threaded connection
Nail tie, type N, with M6 threaded connection, usable in cracked or non-cracked standard concrete C20/25 to C50/60.

Nail tie, type N-K, with drive-in head
Nail tie, type N-K with drive-in head, usable in cracked or non-cracked standard concrete C20/25 to C50/60.

Bolt tie, type BZ
Bolt tie, type BZ, for fastening heavy-duty anchorings in cracked or non-cracked standard concrete C20/25 to C50/60, suitable for push-through mounting, with M8, M10, M12 or M16 thread.

Bolt tie, type BZ-IG
The bolt tie BZ-IG with internal thread is approved for normal drill holes which are not undercut. Within the scope of the European Technical Assessment ETA-99/0010 for cracked and non-cracked concrete, a system comprising nut and washer and a standard threaded rod can be used, as well as hexagonal bolts and countersunk head screws.

Impact tie, type ES
Impact tie, type E, with M6, M8, M10, M12 internal thread. To accept small loads, approved for multiple fixings in cracked and non-cracked concrete of non-load-bearing systems.

Hollow core anchor, type Easy
Hollow core anchor, type Easy, with M6, M8, M10 and M12 internal thread, for use in stressed concrete core slab ceilings.

High-load anchor, type SZ
High-load anchor, type SZ, with M12 thread connection for fastening components with high loads, approved for cracked and non-cracked standard concrete C20/25 to C50/60.
System description

The VMS Plus injection mortar system is particularly suitable for fire-protection fastening in hollow brick, concrete, calcareous limestone, sand-lime brick and masonry. The non-spreading connection is created through the use of the plastic wire sleeve and a threaded anchor rod. The components are tested and approved for a fire resistance period of 90 minutes.

The maximum load capacity depending on the fire resistance period and the fastening substrate is documented accordingly in the available fire protection certificate. Although the load capacity of the injection mortar system is below the load capacity when cold, it is completely sufficient for fireproof fastening of the various components of the different routing types.

System benefits:
- Injection tie tested and approved for fire
- Determined load capacity according to fire resistance period
- Use in calcareous limestone, masonry, hollow brick and sand-lime brick
- Various dimensions for the different routing components and applications
- Proven fastening with plastic wire sieve sleeves
Mounting aid

**Drilling**
Creation of a drill hole with a suitable diameter.

**Cleaning of the drill hole**
Blowing out of the drill hole for cleaning with a hand-held blower or compressed air.

**Cleaning with steel wire brush**
Mechanical cleaning of the drill hole with steel wire brush. The cleaning process with blowing and brushes must be carried out twice.

**Application of the injection mortar**
Pressing of the injection mortar into the drill hole.

**Use in hollow brick**
Drill the hole in the hollow brick according to the selected anchor size and then clean it.

**Mounting preparations**
Insert the fitting plastic sieve sleeve in the drill hole.

**Applying the injection mortar**
Press in the injection mortar from the cartridge from the base of the drill hole to the opening. In so doing, draw the point back slowly.

**Inserting the anchor rod**
Attach the anchor rod in the filled wire sleeve up to the set marking. The mortar pushes through the openings of the wire sleeve, forming a closure.

**Mounted component, hollow brick wall**
Mounting the component with a washer and nut on a hollow brick wall. Comply with the tightening torque in the approval.
System description

Wedge anchors MMS, MMS-ST and HMS-KS from OBO Bettermann offer optimum fastening options in solid masonry types. The various dimensions and head shapes provide installation options for the different routing components. The wedge anchors are screwed directly into the drill hole. There is no need for an additional anchor. No spreading forces develop and mounting near masonry edges is not required. You can find detailed information in the corresponding approvals.

System benefits:
- Quick and easy installation
- High level of safety
- Can be loaded immediately
- Torque control not required
- Mechanical setting is possible without any problems
- Fire protection-tested
Mounting aid

Drilling an anchor hole
Drilling of the anchor hole according to the anchor approval information for the drill hole diameter and the drill hole depth.

Blowing out of the drill hole
Removing dust from the drill hole by blowing it out several times.

Bolt tie, type MMS-plus bolt tie
MMS-plus with pan head for direct mounting without anchors. Suitable for use in concrete and different types of masonry.

Bolt tie, type MMS-plus
Bolt tie MMS-plus with hexagonal head for direct mounting without additional anchors. Suitable for use in concrete and different types of masonry.

Bolt tie, type MMS-ST
Bolt tie MMS-ST with M6 thread and hexagonal head for direct mounting without additional anchors. Suitable for use in concrete and different types of masonry.

Bolt tie, type HMS
Bolt tie HMS with countersunk cone head for direct mounting without additional anchors. Suitable for use in concrete and different types of masonry.