VBS

Planning aids and basic knowledge

Connection and fastening systems

Building Connections

OBO BETTERMANN

Contact
Customer Service
+49 23 73 89 - 17 00

Service times
Monday to Friday 09.00 to 18.00

+49 (0)2371 7899-2500

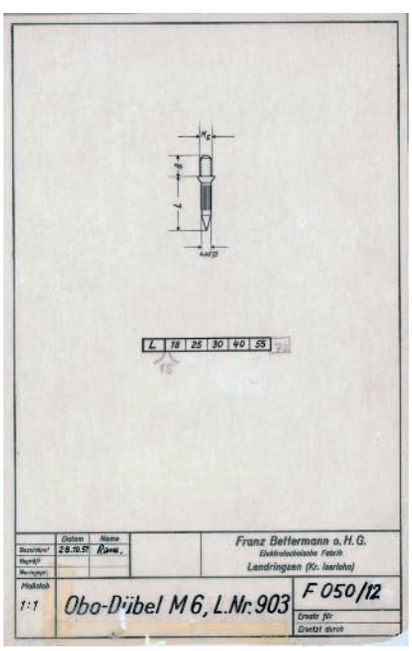
info@obo.de
www.obo.de

OBO BETTERMANN

01_VBS / en / 2019/02/21 09:33:37 09:33:37 (LLExport_02514) / 2019/02/21 09:34:05 09:34:05

VBS – Connection and fastening systems

VBS is one of a total of seven OBO product units, but of those it is one of the longest-standing and most extensive. Indeed, OBO Bettermann takes part of its name from one of the most successful ever products from the VBS product unit – the OBO anchor, a metal anchor invented in 1952 that offers the advantage that it can be fitted "**O**hne **BO**hren", that is, without the need for any drilling.



VBS – Connection and fastening systems

Distribution

- Junction box systems
- Concealed and cavity wall systems
- Terminal systems
- Cable gland systems

Fastening

- Beam clamp systems
- Rail systems
- Clamp clip systems
- Screw-in and knock-in systems

Routing

- Cable and pipe fastening systems
- Pipe systems

01_VBS / en / 2019/02/21 09:33:37 (LLExport_02514) / 2019/02/21 09:34:05 09:34:05

Plastic: materials and properties

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

Thermoplastics
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
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.

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

Temperature ranges of plastics

	Material	Max. temperature resistance Permanent	Max. temperature resistance Short-time	Min. temperature resistance Static
ABS/ ASA	**Acrylonitrile butadiene styrene**	70 °C	85 °C	–40 °C
UF	**Duroplast, Amino-plast, type 131.5**	65 °C	90 °C	–40 °C
MF	**Duroplast, melamine resin, type 150**	80 °C	110 °C	–40 °C
EVA	**Ethylene vinyl acetate**	55 °C	70 °C	–50 °C
NBR SBR	**Rubber mixture**	100 °C	110 °C	–40 °C
NBR	**Nitrile rubber**	100 °C	110 °C	–30 °C
PA	**Polyamide**	120 °C	150 °C	–40 °C
PA/ GF	**Polyamide, fibreglass reinforced**	120 °C	160 °C	–20 °C
PBPT	**Polybutylene tereph-thalate**	120 °C	140 °C	–40 °C
PC	**Polycarbonate**	110 °C	125 °C	–35 °C
PE	**Polyethylene**	70 °C	90 °C	–40 °C
PP	**Polypropylene (PP)**	90 °C	110 °C	–30 °C
PS	**Polystyrene**	70 °C	80 °C	–10 °C
PVC	**Polyvinylchloride**	65 °C	80 °C	–30 °C

Plastic: materials and properties

Risk of stress cracks

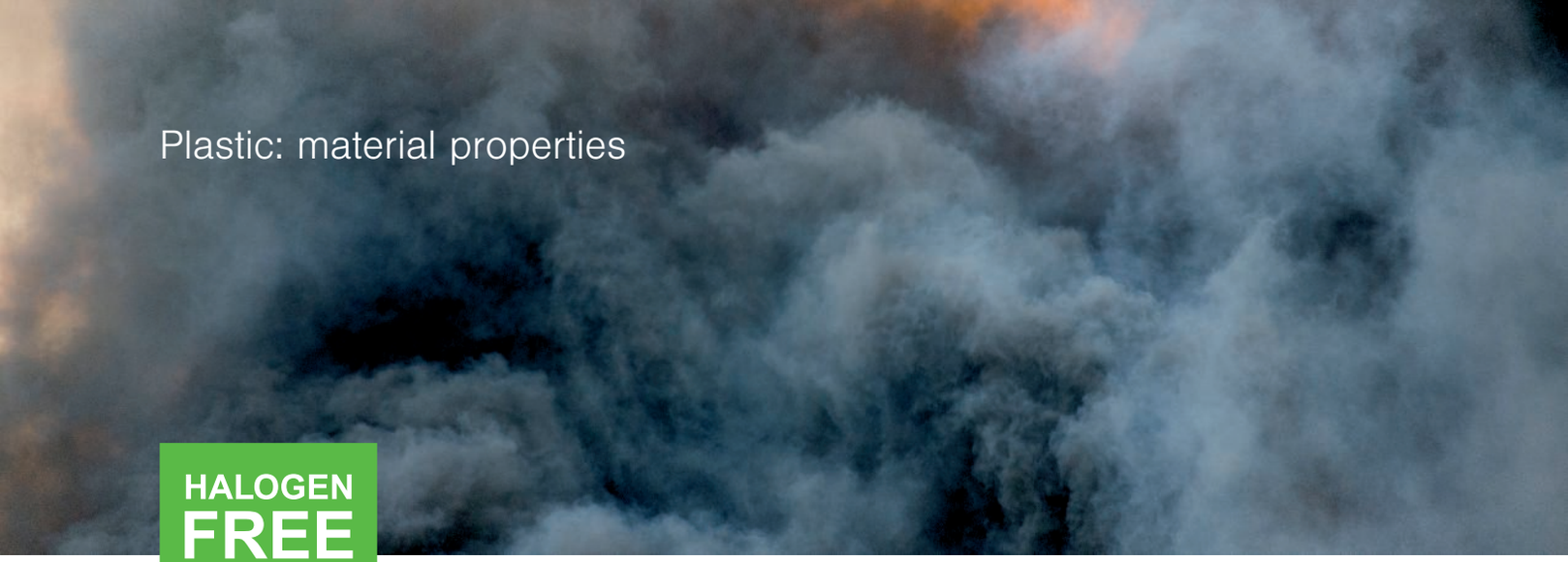
Medium	ABS/ ASA	UF	MF	EVA	NBR SBR	NBR	PA	PA/ GF	PBPT	PC	PE	PP	PS	PVC
Spannungrissgefahr	✗	✓	✓	✓	✓	✓	✓	○	○	✓	!	✓	✗	○

Danger of tension cracks: ✓ Virtually negligible ○ Low ! High ✗ Very high

Chemical resistance

Medium	ABS/ ASA	UF	MF	EVA	NBR SBR	NBR	PA	PA/ GF	PBPT	PC	PE	PP	PS	PVC
Mineralöl	✓	✓	✓	○	✓	○	✓	✓	✓		○	○	○	✓
Fett	✓	✓	✓	✓	✓	○	✓	✓	✓				○	✓
Benzol	!	✓	✓	○	✓	!	✓	✓	○	!	!	○	!	!
Lösungsmittel	!						✓	✓	○				!	!
Ameisensäure	✓	!									!	○		!
Zitronensäure	✓	!		○							!			
Milchsäure	✓	!		○							!	○	!	!
Salzsäure	○	!									✓			!
Schwefelsäure	○	!									✓			!
Aceton	!	✓					✓	✓	○	!	!	○	!	!
Benzin	!	✓	✓	○	○	!	✓	✓	✓	✓	!	○	!	✓
Buttersäure	!	!		○							!	○		!
Chlor	!						!	!	!	!	!	!	!	
Essigsäure	!	!		○							!		!	
Salpetersäure	!	!									✓		!	
Ester		✓	✓	○	!	!								
Alkohol		✓	✓	○			✓						✓	
Schwache Laugen		✓	✓	✓	✓	✓	○	○	!		✓	✓		✓
Schwache Säuren		○	○	✓	✓	✓	!	!	✓	✓	✓			✓
Äther		✓	✓	○									!	
Wasser		✓	✓	✓	✓	✓								
Starke Säuren		!	!	○					!	!	!			!
Starke Laugen		!	!	✓					!		✓	✓		✓
Flußsäure				○							✓			
Parafin- Kohlenwasserstoff				○								○		
Halogene- Alkane				!										
Ketone				!	!								!	
Aldehyde				✓										
Organ. Säuren				○							!	○		
Wasser Seewasser					✓	✓								
Dieselkraftstoff							✓	✓	✓		○	○	!	
Ammoniak									○				!	

Resistance: ✓ Resistant ○ Limited resistance ! Not resistant



HALOGEN FREE

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.

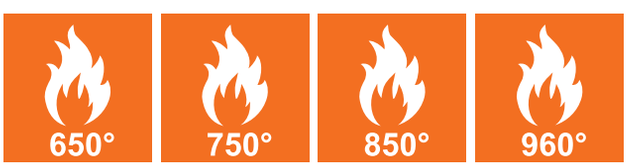
UV Resistant

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 resistances.



Types of installation systems

Types of samples Test temperatures in °C	Surface-mounted	Concealed	Flush-mounted	Cavity wall/ furniture	Concrete structure	Installation duct
Connection sockets	650	650	750	850	650	750
Accessory sockets and device connection sockets	750	650	-	850	650	750
Ceiling lights, connection sockets	750	650	-	850	650	750
Wall light connection sockets	750	650	-	850	650	750
Device connection sockets	750	650	-	850	650	750
Connection sleeves	750	-	-	-	-	750
Insulation sections, which support active parts	960	-	-	-	-	-
Cover for installation sockets	750	-	-	-	-	-
Cover for installation sockets	750	-	-	-	-	-

Metal: corrosion and corrosion protection

A large number of VBS products are made from metal. Metals are much tougher than many other materials, and metal components are less sensitive to mechanical loading.

Corrosion
(from the Latin corrodere, “to eat or gnaw to pieces”)
in a technical context is a reaction between a material (generally a metal) and its surroundings leading to a measurable change in the material and potentially impairing the functionality of a component or system.

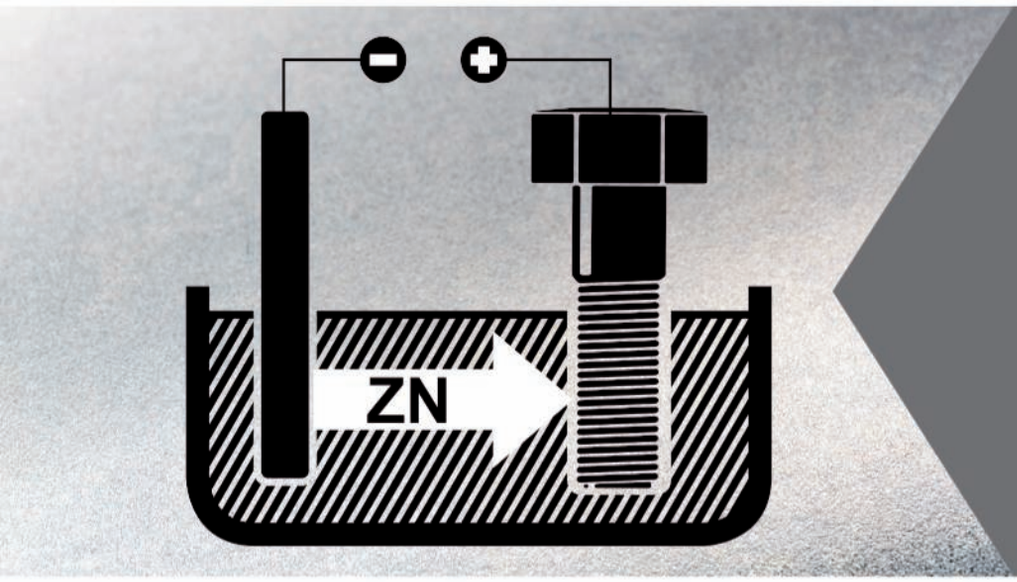
Corrosion protection
Corrosion protection means all steps taken to prevent corrosion damage to metallic components. It is impossible to prevent corrosion permanently, so corrosion protection measures generally aim to reduce the speed of corrosion so that the component is not damaged by corrosion for 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 surface
Zinc slat coverings are coatings applied in a non-electrolytic manner. The cathodic protection means that the zinc slat coverings offer very good corrosion protection. This excludes the risk of a break induced by hydrogen, which is caused through the surface coating process.
The main advantage of this coating is the very high level of corrosion protection, which corresponds to the corrosion protection of a hot galvanised coating. This coating achieves a resistance of 480 hrs in the salt spray test for the connection elements. The low layer thickness of the zinc slat covering allows a thin, homogeneous coating, which is particularly important for maintaining the accuracy of threads.

01_VBS / en / 2019/02/21 09:33:37 09:33:37 (LLExport_02514) / 2019/02/21 09:34:05 09:34:05

Galvanisation types

Electrogalvanisation

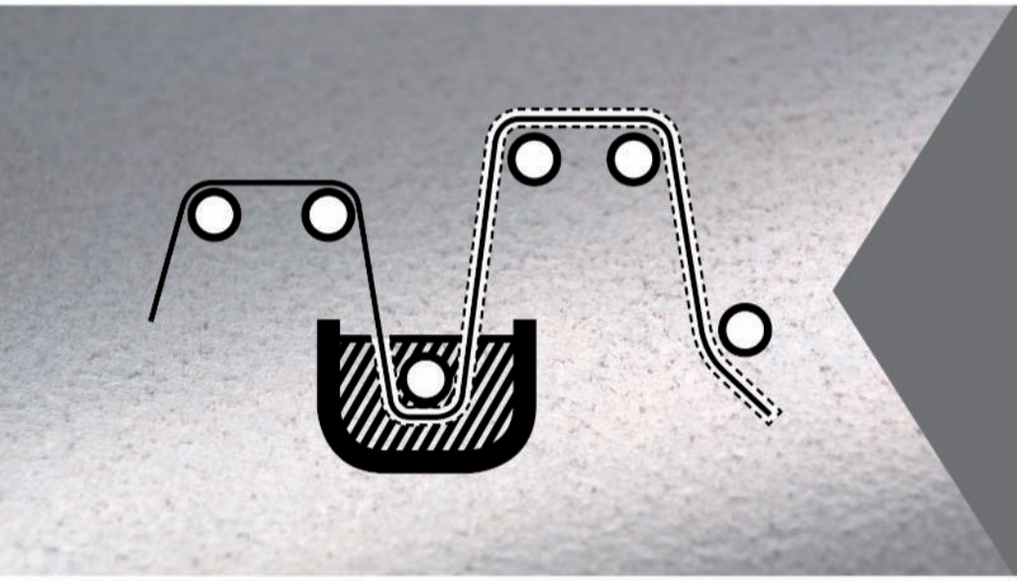


G

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 galvanising

In hot-dip galvanisation, steel is coated by dipping it in molten zinc at a temperature of around 450 °C.



FS

“Continuous galvanising” or “strip galvanising” is where a continuous ribbon of steel is galvanised in a continuous line.

FT

“Batch galvanisation” is mainly used for galvanising prefabricated steel parts.

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 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:

Anwendung	Material	Oberflächenschutz
Innenbereich 	St Stahl	L Lackiert / pulverbeschichtet
	St Stahl	FS Bandverzinkt (ca. 20µm) DIN EN 10346
	St Stahl	G Galvanisch / elektrolytisch verzinkt (ca. 2,5 - 10µm) DIN EN 12329
Außenbereich 	St Stahl	FT Feuerverzinkt (ca. 40-60 µm) DIN EN ISO 1461
	VA Edelstahl A2	
	VA Edelstahl A4	
Besonders korrosive Bereiche 	VA Edelstahl A2	
	VA Edelstahl A4	

Contact corrosion

Contact corrosion between two different metals 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 condensate, 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 at work, 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.

Land climate

Bauteil (groß)	Bauteil (klein) FT	VA	Alu	Cu	CuZn 37	Zn
Stahl, verzinkt (St FS FT G DD)	✓	✓	✓	!	○	✓
Edelstahl (VA V2A V4A V5A)	✓	✓	○	○	○	✓
Aluminium (Alu)	✓	✓	✓	!	○	✓
Kupfer (Cu)	○	○	○	✓	○	!
Messing (CuZn 37)	✓	!	○	○	✓	!
Zinkdruckguss (Zn)	○	○	✓	✗	○	✓

Industrial atmosphere

Bauteil (groß)	Bauteil (klein) FT	VA	Alu	Cu	CuZn 37	Zn
Stahl, verzinkt (St FS FT G DD)	✓	✓	○	✗	!	✓
Edelstahl (VA V2A V4A V5A)	✓	✓	○	○	○	✓
Aluminium (Alu)	○	○	✓	!	!	✓
Kupfer (Cu)	!	!	✗	✓	○	!
Messing (CuZn 37)	○	○	✗	○	✓	○
Zinkdruckguss (Zn)	✓	✓	✓	✗	!	✓

Sea climate

Bauteil (groß)	Bauteil (klein) FT	VA	Alu	Cu	CuZn 37	Zn
Stahl, verzinkt (St FS FT G DD)	✓	○	✗	✗	!	○
Edelstahl (VA V2A V4A V5A)	○	✓	✗	○	○	✓
Aluminium (Alu)	✗	○	✓	!	!	✓
Kupfer (Cu)	!	!	✗	✓	○	!
Messing (CuZn 37)	○	○	✗	○	✓	○
Zinkdruckguss (Zn)	✓	✓	✓	✗	!	✓

✓ No risk of contact corrosion

✗ High 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)

Maintenance of electrical function

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 laying 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 BSS fire protection catalogue.

The 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 which have the capability to maintain electrical function ensure the fireproof connection of the safety cables. The boxes in the FireBox series are tested and approved to maintain electrical function for 30 to 90 minutes in accordance with DIN 4102-12.

E30

30 minutes:
Maintaining 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 electrical function 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

E90

90 minutes:
Maintaining electrical function for better firefighting.

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:

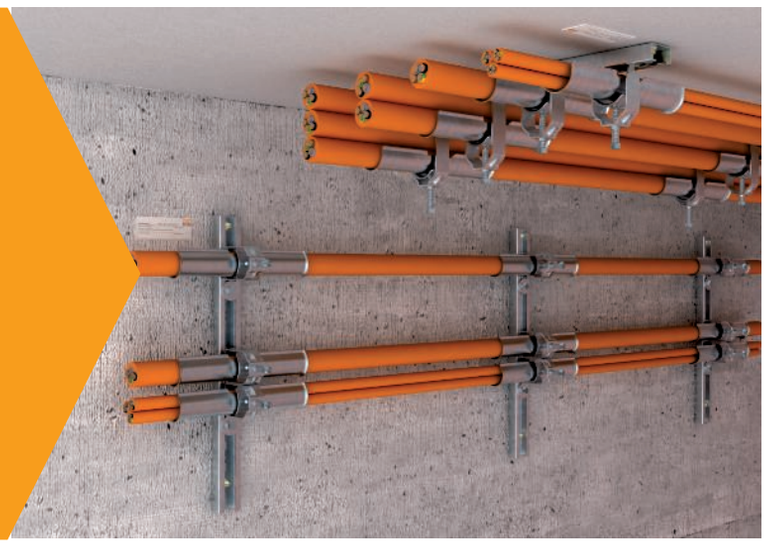
- Systems to increase the pressure of the water for fighting the fire
- Mechanical smoke extraction and smoke protection pressure systems
- Fire brigade lifts, bed lifts in hospitals

Individual routing systems

With the individual laying systems, OBO Bettermann can offer a range of practical, flexible mounting options to maintain function of electrical installations. 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.

Clamp clip

Standard support construction consisting of clamp clip without long trough for individual laying or bundling cables.



Standard routing type, clamp clip
Type 2056

- 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

Cable tidy

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

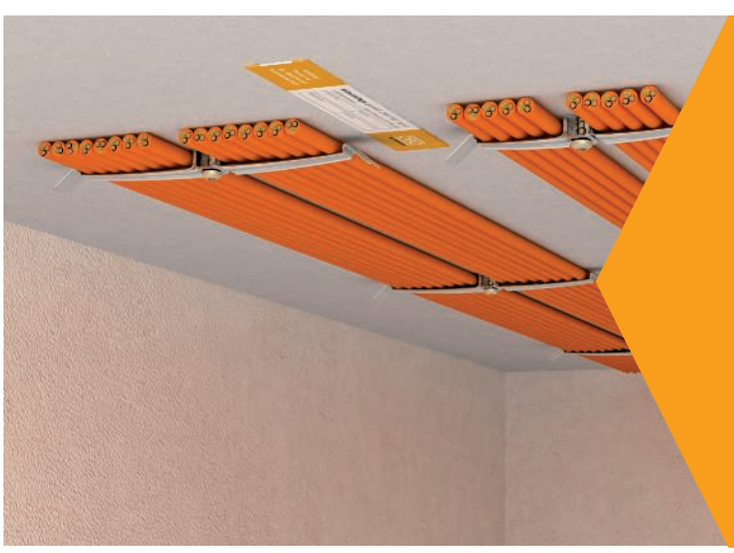
Type 2031/M 70
- Fastening distance: max. 0.8 m
- Cable assignment: max. 6.0 kg/m

Spacer clips

Standard support construction consisting of spacer clips for individual laying or bundling cables.

Standard routing type, single clip
Type 732/733

- 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. three cables with max. diameter 25 mm



Pressure clip

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

01_VBS / en / 2019/02/21 09:33:37 (LLExport_02514) / 2019/02/21 09:34:05 09:34:05

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.

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

Second code digit	Short description	Definition
0	Not protected	-
1	Protected against water droplets	Droplets falling vertically may have no damaging impact.
2	Protected against water droplets when the housing is tilted to up to 15°	Droplets falling vertically may not have a damaging impact, if the housing is tilted to angle of 15° on either side of the vertical.
3	Protected against spray water	Water being sprayed at an angle of 60° on both sides of the vertical may not have any damaging impact.
4	Protected against spray water	Water spraying the housing from any direction may not have any damaging impact.
5	Protected against water jets	Jets of water pointing at the housing from any direction may not have any damaging impact.
6	Protected against strong water jets	Strong jets of water pointing at the housing from any direction may not have any damaging impact.
7	Protected against the effects of being temporarily immersed in water	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.
8	Protected against the effects of being continuously immersed in water	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 fulfil than for number 7.

01_VBS / en / 2019/02/21 09:33:37 09:33:37 (LLExport_02514) / 2019/02/21 09:34:05 09:34:05

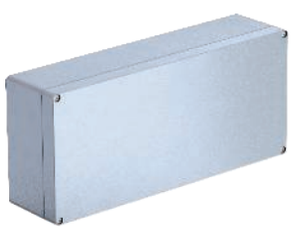
IK code

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 standards 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.

IK code	00	01	02	03	04	05	06	07	08	09	10
Stress energy value [J]	-	0.15	0.20	0.35	0.50	0.70	1	2	5	10	20

Protection classes of electrical resources in accordance with VDE 0140

Protection class	
I	Resources with protective conduction connection (protection measure through protective conductor connection on housing)
II	Resources with protective insulation (protection measure through insulation)
III	Resource with protective low voltage (SELV-PELV, protection through measured voltages max. 25/50 V AC and max. 60/120 V DC)



Empty plastic housings correspond to protection class II, housings made of metal/metal plating must be intended for the connection of a protection conductor and thus meet protection class I.

Electrical designations

When using junction boxes, connection sockets and connection terminals, the resources are assigned nominal values, as defined in VDE 0100 Part 200. 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 cable to be connected.

Nominal current
Largest approved current at the connection point.

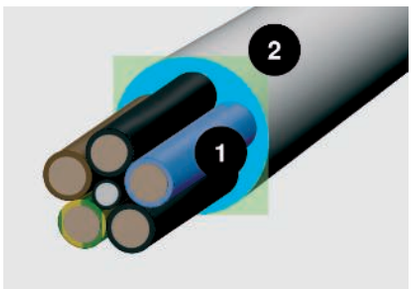
Nominal voltage
Greatest approved voltage at the connection point.

No. of poles
Number of connection points of the clamp connector.

Number of entries
Number of entries in an electrical connection box or connection socket.

Cable sizes

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. Fastening clips are given with their maximum span distance as a nominal size in mm. To determine the correct fastening clip for the component to be fastened, you can find the interplay between the PG sizes and the metric data in the table.



Cable diameter in mm (1) and space required in cm² (2)

Calculation with the formula $(2r)^2$

The diameter says little about the actual space required by a cable. Calculate: **$(2r)^2$**

This value reflects the realistic space requirements, including the compartments.

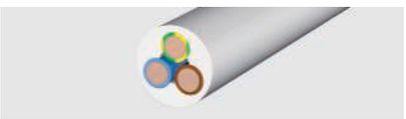
$$(2r)^2$$

Overview of PG and metric sizes

External diameter in mm	PG sizes	External diameter in mm	Metric sizes
12	PG 7	12.5	M 12
13	PG 7	12.5	M 12
15	PG 9	15.2	M 16
16	-	-	M 16
18	PG 11	18.6	M 16/M 20
19	PG 11	18.6	M 16/M 20
20	PG 13.5	20.4	M 20
21	PG 13.5	20.4	M 20/M 25
22	PG 16	22.5	M 20/M 25
23	PG 16	22.5	M 20/M 25
24	-	-	M 20/M 25
25	-	-	M 25
28	PG 21	28.3	M 25/M 32
32	-	-	M 32
37	PG 29	37	M 32/ M 40
40	-	-	M 40
47	PG 36	47	M 40/M 50
50	-	-	M 50
54	PG 42	54	M 50/M 63
59	PG 48	59.3	M 50/M 63
63	-	-	M 63

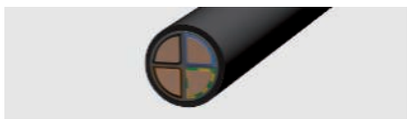
01_VBS / en / 2019/02/21 09:33:37 (LLExport_02514) / 2019/02/21 09:34:05 09:34:05

How can I work out the volume of cables?



Insulated power cables

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



Insulated power cables

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

Telecommunications cables

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

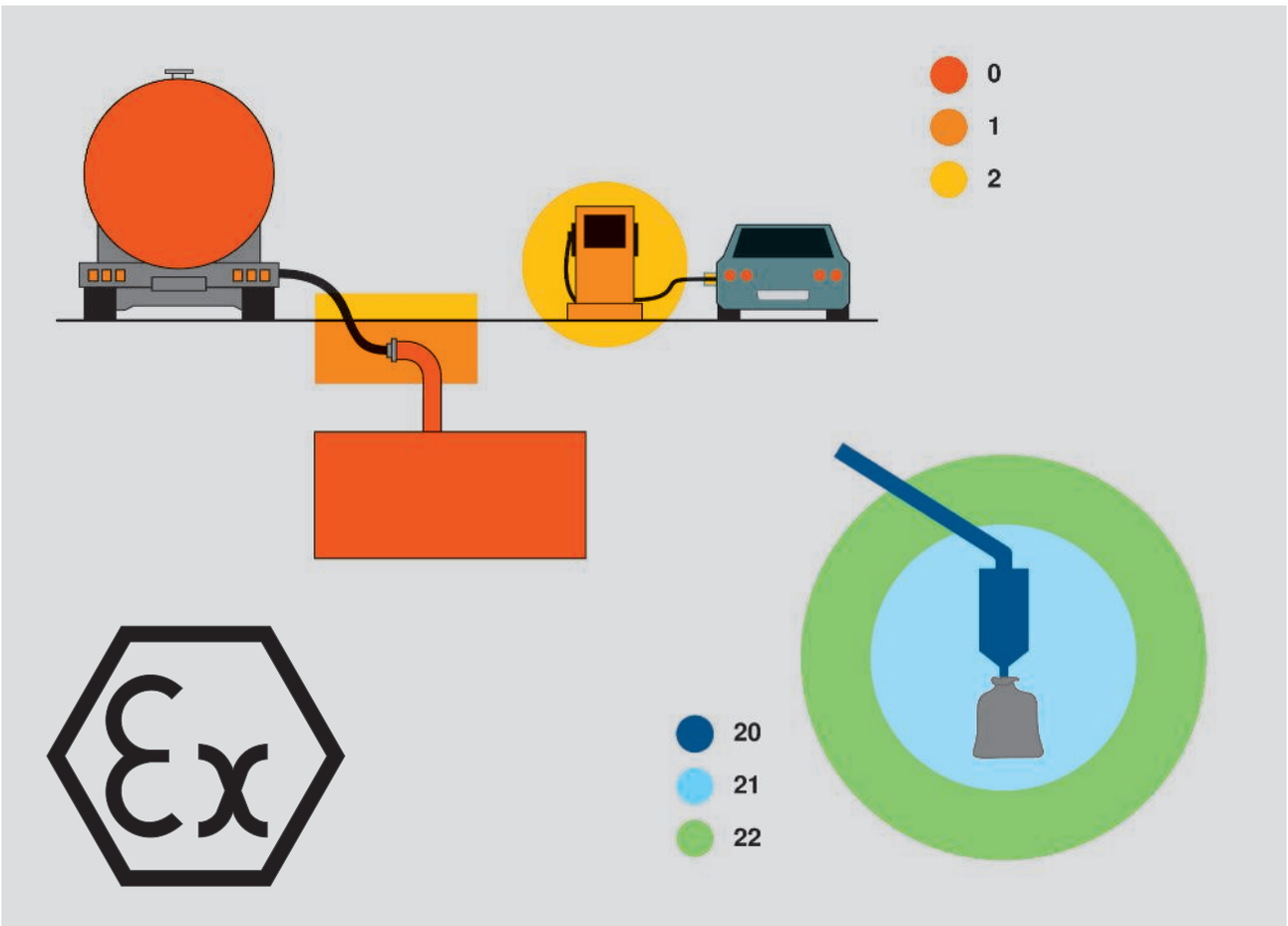
IT cables type Cat...

Type	Diameter mm	Usable cross-section cm²
Cat. 5	8	0.64
Cat. 6	8	0.64

Coax cable (Standard)

Type	Diameter mm	Usable cross-section cm²
SAT/BK cable	6.8	0.48

Zone division for explosive areas



The ATEX workplace directive 1999/92/EC (also known unofficially as “ATEX 137”, a reference to Article 137 of the EC Treaty), sets out the minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres. The directive divides areas with dangerous, potentially explosive atmosphere into zones:

Zone allocation of device group II (applied)

Gas	Dust
Explosive gas atmosphere, zone division to DIN EN 60079-10	**Explosive dust-air mixtures, zone division to DIN EN 61214-10**
Zone 0	Zone 20
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.	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.
Zone 1	Zone 21
An area in which it can be expected that, under normal conditions, an explosive atmosphere of gas occasionally occurs.	An area in which it can be expected that, under normal conditions, an explosive atmosphere of dust/air occasionally occurs.
Zone 2	Zone 22
Area, in which it can be expected that, under normal conditions, an explosive atmosphere of gas seldom or only briefly occurs.	Area, in which it can be expected that, under normal conditions, an explosive atmosphere of dust/air seldom or only briefly occurs.

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.

Test marks

	AENOR, Producto Certificado, Spain
	STOWARZYSZENIE ELEKTRYKÓW POLSKICH, Poland
	CEBEC, Belgium
	DEMKO, Danmarks Elektriske Materielkontrol, Denmark
	Det Norske Veritas
	ENEC Austria
	ATEX certificate for explosive areas
	ELEKTROTECHNICKÝ ZKUŠEBNÌ ÚSTAV, Czech Republic
	FIMKO, Finland
	Russia, GOST The State Committee for Standards
	KEMA-KEUR, Netherlands
	Indication of metric products
	NEMKO, Norway
	AFNOR Quality symbol of the French standardisation institute
	Underwriters Laboratories Inc., USA + CSA, Canada
	Österreichischer Verband für Elektrotechnik, Austria
	INSTITUTO ITALIANO DEL MARCHO DI QUALITÁ, Italy
	Underwriters Laboratories Inc., USA
	SEMKO An Inchcape Testing Services Company, Sweden
	Eidgenössisches Starkstrominspektorat, Switzerland
	Underwriters Laboratories Inc., USA
	Underwriters Laboratories Inc., USA
	Verband der Elektrotechnik, Elektronik, Informationstechnik e.V., Germany

01_VBS / en / 2019/02/21 09:33:37 09:33:37 (LLExport_02514) / 2019/02/21 09:34:05 09:34:05

Pictogram explanation

Surfaces

FS	Strip-galvanised
st	Strip-galvanised/plastic-coated
BK	Bright
F	Hot-dip galvanised
G	Electro-galvanised
El	Electrogalvanised/plastic-coated
GGP	Electrogalvanised, yellow passivated
GTP	Electrogalvanised, transparently passivated
L	Painted
FT	Hot-dip galvanised
Cu	Copper-plated
N	Nickel-plated
ZD	Galvanised, Deltatone 500
ZDM	Galvanised, MAGNI 565
DD	Strip galvanised zinc/aluminium, Double Dip
GA	Zinc-aluminium coated, Galfan
FT SO	Hot-dip galvanised 85 µm

Conformity symbol

CE	Communautés Européennes, EC declaration of conformity according to EC directives
RoHS conform	RoHS-conformant

Quality marks

	Halogen-free; without chlorine, fluorine and bromine
650°	Flame resistant 650 °C
750°	Flame resistant 750 °C
960°	Flame resistant 960 °C
UV RESISTANT	UV-RESISTANT

Nominal cross-section

1,5 mm²	Nominal cross-section 1.5 mm²
1,5–2,5 mm²	Nominal cross-section 1.5–2.5 mm²
2,5 mm²	Nominal cross-section 2.5 mm²
2,5–4 mm²	Nominal cross-section 2.5–4 mm²
4 mm²	Nominal cross-section 4 mm²

Nominal cross-section

4-6 mm²	Nominal cross-section 4–6 mm²
6 mm²	Nominal cross-section 6 mm²
10 mm²	Nominal cross-section 10 mm²
16 mm²	Nominal cross-section 16 mm²

Nominal voltage

400 V	Nominal voltage 400 V
500 V	Nominal voltage 500 V
660 V	Nominal voltage 660 V

Protection rating

IP 20	Protection rating IP 20
IP 30	Protection rating IP 30
IP 31	Protection rating IP 31
IP 44	Protection rating IP 54
IP 54	Protection rating IP 54
IP 55	Protection rating IP 55
IP 65	Protection rating IP 65
IP 66	Protection rating IP 66
IP 67	Protection rating IP 67
IP 68	Protection rating IP 68

Entries

4	4 cable entries
6	6 cable entries
7	7 cable entries
8	8 cable entries
9	9 cable entries
10	10 cable entries
12	12 cable entries
10	10 cable entries ECO
12	12 cable entries ECO
14	14 cable entries ECO
16	16 cable entries
18	18 cable entries ECO
24	24 cable entries

Pictogram explanation

Polarity

3	3-pole
5	5-pole
7	7-pole
8	8-pole
10	10-pole
12	12-pole

Clamp clip base shapes

N	Cable clip for C-profile rail with slot width 11–12 mm
H	Cable clip for C profile rail with slot width 16–17 mm
U	Clamp clip for C profile rail with slot width 18–22 mm

Slot widths

7,5	Slot width 7.5 mm
11	Slot width 11 mm
11-12	Slot width 11–12 mm
12	Slot width 12 mm
15	Slot width 15 mm
16	Slot width 16 mm
16,5	Slot width 16.5 mm
16-17	Slot width 16–17 mm
17	Slot width 17 mm
18	Slot width 18 mm
22	Slot width 22 mm
35	Slot width 35 mm

Diameter

Ø 60	Diameter 60 mm
Ø 68	Diameter 68 mm
Ø 70	Diameter 70 mm
Ø 74	Diameter 74 mm

Gland thread

M	Thread metric
Pg	Thread Pg

Screw heads

	Philips screw
	Torx screw
	Phillips screw
	Pozidrive

Entry size

M20	M20 entry
M25	M25 entry
M32	M32 entry
M40	M40 entry

Materials

	Flat steel
	Angular steel
	U steel
	Round material

Firing devices

	Bolt-firing tool
	Nail device

BSS test marks/material class

E30	Function maintenance class E30
E90	Function maintenance class E90

KTS side heights

	Cable tray, side height 35 mm
	Cable tray, side height 60 mm
	Cable tray, side height 85 mm
	Mesh cable tray, slant height 35 mm
	Mesh cable tray, slant height 55 mm

BSS function maintenance installation

	Escape route ceiling mounting with pressure clip
	OBO Grip, wall routing type
	OBO Grip, ceiling routing type
	Pressure clip, function maintenance, ceiling mounting

01_VBS / en / 2019/02/21 09:33:37 09:33:37 (LLExport_02514) / 2019/02/21 09:34:05 09:34:05

Pictogram explanation

BSS anchor

	Fire protection anchor
	Fire protection bolt tie

Metals

Alu	Aluminium
VA	Stainless steel, grade 304
VA	Stainless steel, 1.4307
VA	Stainless steel, grade 301
VA	Stainless steel, grade 316
VA	Stainless steel, grade 316 L
VA	Stainless steel, grade 354/1
VA	Stainless steel, grade 316 Ti
CuZn 37	Brass
St	Steel
TG	Cast iron
Zn	Die-cast zinc

Plastics

ABS/ ASA	Acrylonitrile butadiene styrene
UF	Duroplast, Aminoplast, type 131.5
MF	Duroplast, melamine resin Type 150
EVA	Ethylene vinyl acetate
FA	Fibre-proof material DIN 28091
NBR SBR	Rubber mixture
NBR	Nitrile rubber
PA	Polyamide
PA/ GF	Polyamide, fibreglass reinforced
PBPT	Polybutylene terephthalate
PC	Polycarbonate
PE	Polyethylene
PP/GF	Polypropylene, Glass-fibre reinforced
PS	Polystyrene
PVC	Polyvinylchloride
ZELL PE	Cellular polyethylene

01_VBS / en / 2019/02/21 09:33:37 (LLExport_02514) / 2019/02/21 09:34:05 09:34:05

Metallic materials

Alu — **Aluminium**

Alu/St — **Aluminium/Steel**

VA (1.4113) — **Stainless steel, grade 434**

VA (1.4301) — **Stainless steel, grade 304**

VA (1.4303) — **Stainless steel, grade 305**

VA (1.4310) — **Stainless steel, grade 301**

VA (1.4401) — **Stainless steel, grade 316**

VA (1.4404) — **Stainless steel, grade 316 L**

VA (1.4435) — **Stainless steel, grade 316 L**

VA (1.4529) — **Stainless steel, grade 354/1**

VA (1.4571) — **Stainless steel, grade 316 Ti**

V2A — **Stainless steel, A2**

V4A — **Stainless steel, A4**

V5A — **Stainless steel, A5**

St — **Steel**

Zn — **Die-cast zinc**

ABS/ASA — Acrylonitrile butadiene styrene
Temperature resistance: permanently up to 70 °C, briefly up to 85 °C and to about minus 40 °C.
Resistant to
Formic acid, citric acid, lactic acid.
Conditionally resistant to
Hydrochloric acid, sulphuric acid.
Unstable with
Acetone, petrol, benzene, solvents for paints and butyric acid, chlorine, acetic acid, nitric acid.
Risk of tension cracking
Relatively high, similar to polystyrene.

UF — Duroplast, Aminoplast, type 131.5
for boxes, glands and clips
Temperature resistance:
permanently up to 65 °C, briefly up to 90 °C and to about minus 40 °C.
Resistant to
Alcohol, ester, ether, benzene, petrol, mineral oils, greases, weak alkalis, water.
Conditionally resistant to
Weak acids.
Unstable with
Strong acids, strong alkalis.
Risk of tension cracking
Low risk of stress cracks.

MF — Duroplast, melamine resin Type 150
For terminal blocks
Temperature resistance:
permanently up to 80 °C, briefly up to 110 °C and to about minus 40 °C.
Resistant to
Alcohol, ester, ether, benzene, petrol, mineral oils, greases, weak alkalis, water.
Conditionally resistant to
Weak acids.
Unstable with
Strong acids, strong alkalis.
Risk of tension cracking
Low risk of stress cracks.

EVA — Ethylene vinyl acetate

FA — Fibre-proof material DIN 28091
To DIN 28091, asbestos-free
Temperature resistance:
up to 300 °C.

NBR/SBR — Rubber mixture

NBR — Nitrile rubber
Temperature resistance:
permanently up to 120 °C, briefly up to 150 °C, and to about minus 30 °C.
Resistant to
Oils and petrol.

PA — Polyamide
Temperature resistance:
permanently up to approx. 90 °C, briefly up to about 130 °C and to about minus 40 °C*.
Chem. resistance generally as for polyethylene.
Resistant to
Petrol, benzene, diesel oil, acetone, solvents for paints and lacquers, oils and greases.
Unstable with
Bleach, most acids, chlorine.
Risk of tension cracking
Low in air-humid conditions; only with some aqueous salt solutions. Highly desiccated parts (high temperature and extremely low air humidity) are highly sensitive to fuels and various solvents.

PA/GF — Polyamide, fibreglass reinforced
Temperature resistance:
permanently up to 100–110 °C, briefly up to 160 °C and to about minus 40 °C*.
Resistant to
Petrol, benzene, diesel oil, acetone, solvents for paints and lacquers, oils and greases.
Slightly susceptible to stress-cracking.
Unstable with
Bleach, most acids, chlorine.
Risk of tension cracking
Low in air-humid conditions; only with some aqueous salt solutions. Highly desiccated parts (high temperature and extremely low air humidity) are highly sensitive to fuels and various solvents.

PBPT — Polybutylene terephthalate
Thermoplastic polyester
Temperature resistance:
permanently up to 120 °C, briefly up to 140 °C and to approx. minus 40 °C.
Resistant to
Petrol, diesel oil, most weak acids, oils and greases.
Conditionally resistant to
Acetone, ammonia, benzene.
Unstable with
Strong acids, chlorine, fluorine, bromine vapour, bleach, trichloroethylene, methylene chloride.
Risk of tension cracking
Low.

PC — Polycarbonate
Temperature resistance:
permanently up to approx. 110 °C (in water 60 °C), briefly up to 125 °C, and to below minus 35 °C.
Resistant to
Petrol, turpentine, most weak acids.
Unstable with
Acetone, benzene, chlorine, methylene chloride, most concentrated acids.
Risk of tension cracking
Relatively low.
Media which can cause tension cracking include benzene, aromatic hydrocarbons, methanol, butanol, acetone, turpentine.

PE — Polyethylene
Temperature resistance:
hard types permanently up to about 90 °C, briefly up to about 105 °C, soft types permanently up to about 80 °C, briefly up to about 100 °C and to about minus 40 °C*.
Resistant to
Alkalis and inorganic acids.
Conditionally resistant to
Acetone, organic acids, petrol, benzene, diesel oil, most oils.
Unstable with
Chlorine, hydrocarbons, oxidising acids.
Risk of tension cracking
Relatively high.
Stress cracks can be caused by, among other things, acetone, various alcohols, formic acid, ethanol, petrol, benzene, butyric acid, acetic acid, formaldehyde, various oils, petroleum, propanol, nitric acid, hydrochloric acid, sulphuric acid, soap solutions, turpentine, trichloroethylene, citric acid.

PP — Polypropylene, Glass-fibre reinforced
Temperature resistance:
permanently up to approx. 90 °C, briefly up to approx. 110 °C and to approx. minus 30 °C*.
Chem. resistance generally as for polyethylene.
Resistant to
Alkalis and inorganic acids.
Conditionally resistant to
Acetone, organic acids, petrol, benzene, diesel oil, most oils.
Unstable with
Chlorine, hydrocarbons, oxidising acids.
Risk of tension cracking
Low, only with some acids such as chromic acid, hydrofluoric acid and hydrochloric acid, as well as nitrogen oxide.

PS — Polystyrene

Temperature resistance:
Because of its relatively high sensitivity to the effects of chemicals, its use is not recommended at temperatures above normal room temperature, about 25 °C.
Resistance to cold: to about minus 40 °C*.

Resistant to

Alkalis, most acids, alcohol.

Conditionally resistant to

Oils and greases.

Unstable with

Butyric acid, concentrated nitric acid, concentrated acetic acid, acetone, ether, petrol and benzene, solvents for paints and lacquers, chlorine, diesel fuel.

Risk of tension cracking

Relatively high.
Stress cracks can be caused by, amongst other things, acetone, ether, petrol, cyclohexane, heptane, methanol, propanol and the softeners used in some PVC cable mixes.

PVC — Polyvinylchloride

Temperature resistance:
permanently up to 65 °C, briefly up to 75 °C and to about minus 30 °C.

Resistant to

Weak acids, alkalis, oils and greases, petrol.

Unstable with

Strong acids, benzene, acetone, iodine, toluene, trichloroethylene.

Risk of tension cracking

Low, only with some solvents such as benzene and acetone.

ZPE — Cellular polyethylene

*The minus values apply only for parts in the quiescent condition with no severe impact stress.
There is no plastic that is resistant to every chemical. The agents listed are only a small selection. Plastic parts are especially at risk in the presence of chemicals and high temperatures. Stress cracks may occur. If in doubt, please consult us and/or ask for a detailed chemical resistance table.
Stress crack formation: stress cracks may occur if plastic parts under tension are exposed to chemicals at the same time. Parts made of polystyrene and polyethylene are particularly susceptible. Stress cracks may even be caused by agents to which the plastic in question is resistant in the absence of stress. Typical examples of parts under constant stress when used as intended: grip clips, intermediate supports of cable glands, ribbon clips.

OBO Bettermann Holding GmbH Co. KG
PO Box 1120
58694 Menden
GERMANY

Customer Service
Tel.: +49 23 73 89 - 17 00
Fax: +49 23 73 89 - 12 38
export@obo.de

www.obo-bettermann.com

Building Connections

OBO
BETTERMANN