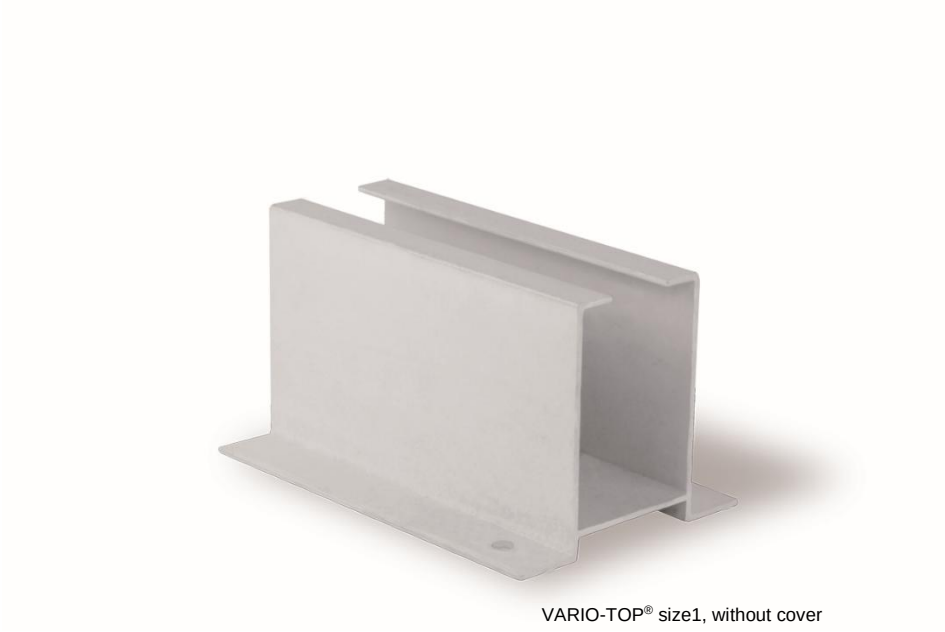
Installation manual

Elevated cable trough system
VARIO-TOP® size1
VARIO-TOP® size2



VARIO-TOP® size1, without cover

VARIO-TOP® size2, without cover

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Content

1. System description

1.1 General description

The elevated cable management system VARIO-TOP® size1 and VARIO-TOP® size2 are cable troughs made of GRP that are used without additional support structures. The system consists of a steel beam IPE 100, two support brackets, a connecting plate and 2 support plates made of steel, the duct profile and the cover profile made of GRP. All steel and fastening parts are hot-dip galvanized and galvanized. The cable troughs are ideal for use in topographically difficult terrain, when crossing streams, on noise barriers and on bridge railings. They can be easily adapted to local conditions, e.g. bypassing masts. With the specially designed support plates, dimensional inaccuracies caused by ramming can be compensated easily.

1.2 Note

The elevated cable routing system VARIO-TOP® may only be installed outside the security room according to EBO (Eisenbahn Bau- und Betriebsordnung – Railway construction and operation decree), respectively legal governmental/by the authorities specifications. The minimum distance of the elevated cable management system VARIO-TOP® to the center of the track is to be determined depending on the line speed according to the currently valid guidelines of the DB AG, respectively legal governmental/by the authorities specifications.

The elevated cable management systems VARIO-TOP® must not be used in tunnels!

It must be taken into account that when installing the elevated cable management systems VARIO-TOP® in cuttings or on slopes, snow slides, snow drifts and the use of a snow plow can be expected, through which a snow load acts on the elevated cable management systems VARIO-TOP® from the side or from above. In such cases, the planner has to check and decide whether the use of the aKFS is possible.

The elevated cable management systems VARIO-TOP® must not be set up in areas at risk of falling rocks. It should also be noted that no loads from rail traffic may affect the elevated cable management systems VARIO-TOP®.

1.2.1 Electrical grounding/earthing

The elevated cable routing system is designed in such a way that no protective earthing measures are required.

1.2.2 Service

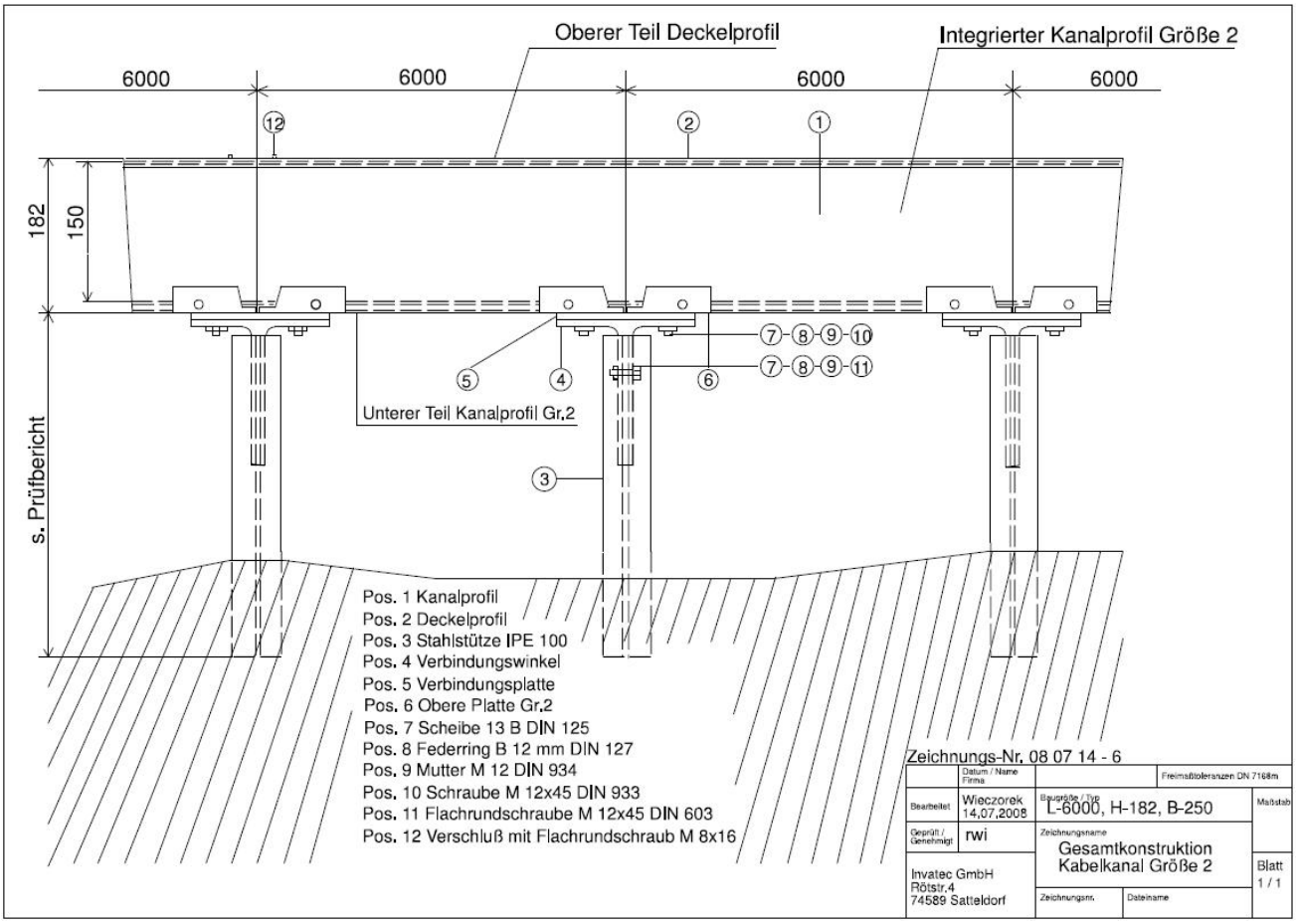
The elevated cable management systems VARIO-TOP® is designed in such a way that no maintenance work is necessary within the service life (see 1.2.3 Service life).

1.2.3 Service life

The elevated cable management systems VARIO-TOP® is designed for a service life of> 20 years.

1.2.4 Span (distance between supports) / Overview

The standard span is 6m. Depending on the altitude, slope of the slope or position within the slope, the span must be shortened to 3m. We advise / support you in the selection of the span, the length of the supports or in arranging a corresponding expert.



2. Technical data

2.1 VARIO-TOP® size1

Characteristic	Value	Dimension unit
Lenght (standard)	6.000	mm
Width	150	mm
Height	170 (174 incl. cover)	mm
Cable room lenght x width x height	ca. 6.000 x 100 x 150	mm
Weight trough	4,3	kg/m
Weight cover	1,0	kg/m
Material	GRP with rovings, matting and surface fleece	
Thermal properties	Thermal dimensionally stable from -30°C to +80°C	
Cable load	0,45 kN/m cable load plus 1 person walking on it (0,75 kN)	

2.2 VARIO-TOP® size2

Characteristic	Value	Dimension unit
Lenght (standard)	6.000	mm
Width	250 (258 incl. cover)	mm
Height	178 (182 incl. cover)	mm
Cable room lenght x width x height	ca. 6.000 x 242 x 150	mm
Weight trough	6,2	kg/m
Weight cover	2,1	kg/m
Material	GRP with rovings, matting and surface fleece	
Thermal properties	Thermal dimensionally stable from -30°C to +80°C	
Cable load	0,90 kN/m cable load plus 1 person walking on it (0,75 kN)	

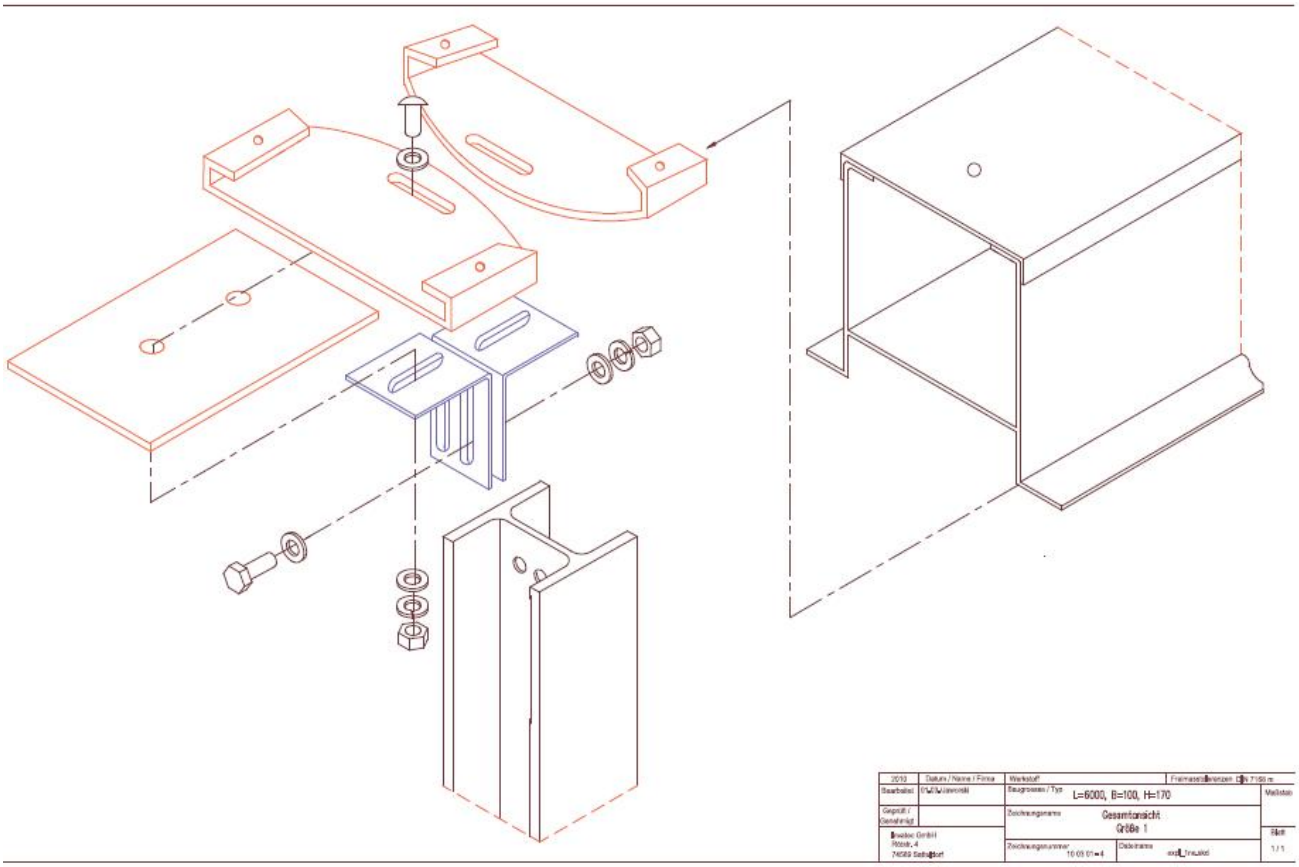
3. Scope of delivery

3.1 Part list VARIO-TOP® size1 (covering a 6 m span)

Article number	Description	Dimensions	Weight	Quantity
D000101	Steel pillar, hot dip galvanized	IPE 100, length 1,5m	12,7 kg	1
D000127	Mounting plate size1		3,7 kg	1
D000409	Mounting kit M12	4 x M12x45 complete	0,08 kg	1
C000305	VARIO-TOP® size1 trough	6000 x 150 x 170 mm		1
C000306	VARIO-TOP® size1 cover	6000 x 118 x 9 mm		1
D000122	Grooved nail ISO 8746	6x15 Geomet 321	2 nails each 6 troughs	

3.2 Part list VARIO-TOP® size1 auxiliary equipment

Article number	Description	Dimensions	Weight	Quantity
	Steel pillar, hot dip galvanized	IPE 100, length 2,5m		
	Steel pillar, hot dip galvanized	IPE 100, length 3m		
D000128	Mounting plate lowering kit			
	Cable outlet flange	Different dimensions available		
	Special fastening console	For bridge and wall mounting		
	Cable coupling kit	To connect cables along the track		
	Excess cable kit	To retain overlength cables		
	Pneumatic ram	With guide bushing for IPE100 pillar		

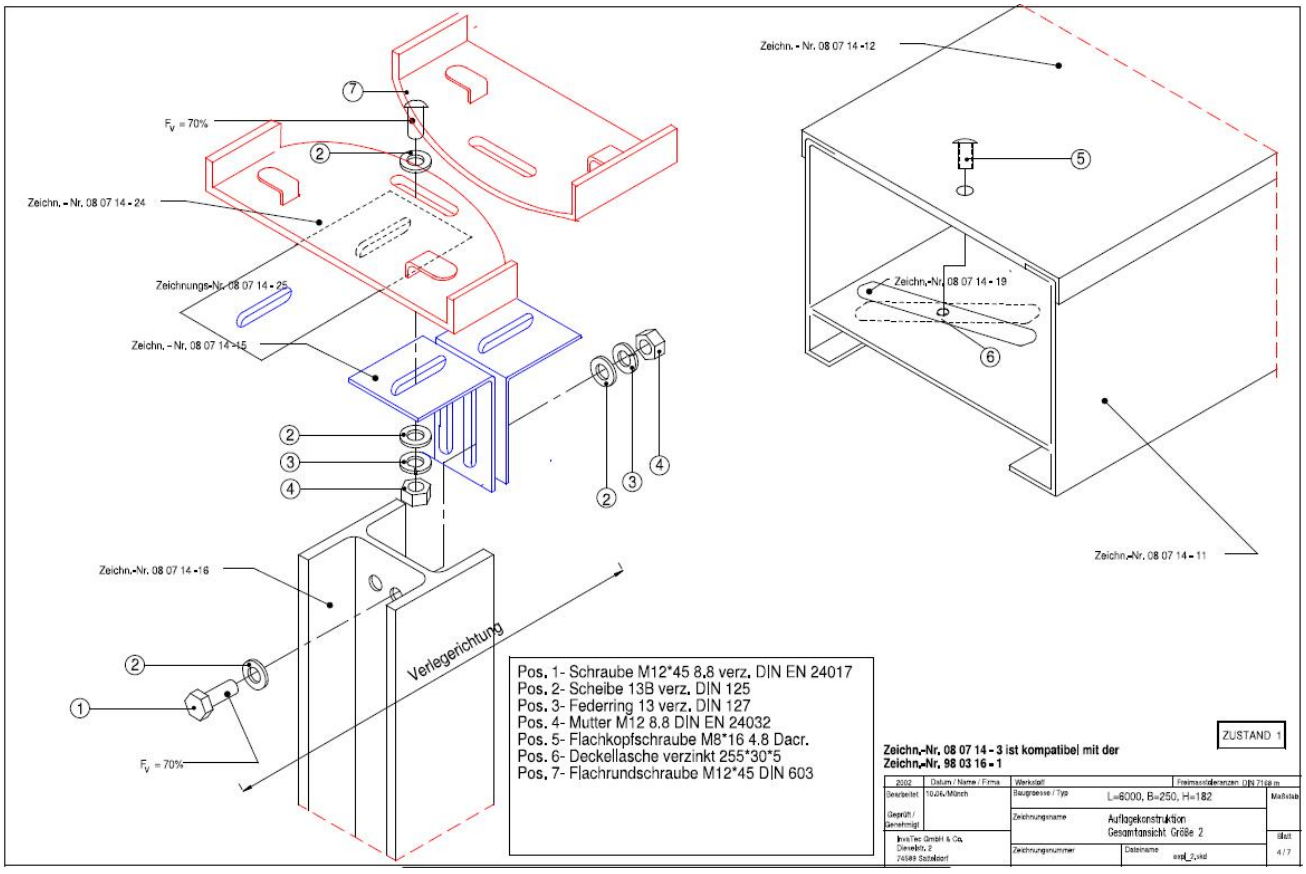


3.3 Part list VARIO-TOP® size2 (covering a 6 m span)

Article number	Description	Dimensions	Weight	Quantity
D000101	Steel pillar, hot dip galvanized	IPE 100, length 1,5m	12,7 kg	1
D000123	Mounting plate size2		4,3 kg	1
D000409	Mounting kit M12	4 x M12x45 complete	0,08 kg	1
C000414	VARIO-TOP® size2 trough	6000 x 250 x 178 mm		1
C000413	VARIO-TOP® size2 cover	6000 x 258 x 9 mm		1
D000122	Grooved nail ISO 8746	6x15 Geomet 321	2 nails each 6 troughs	

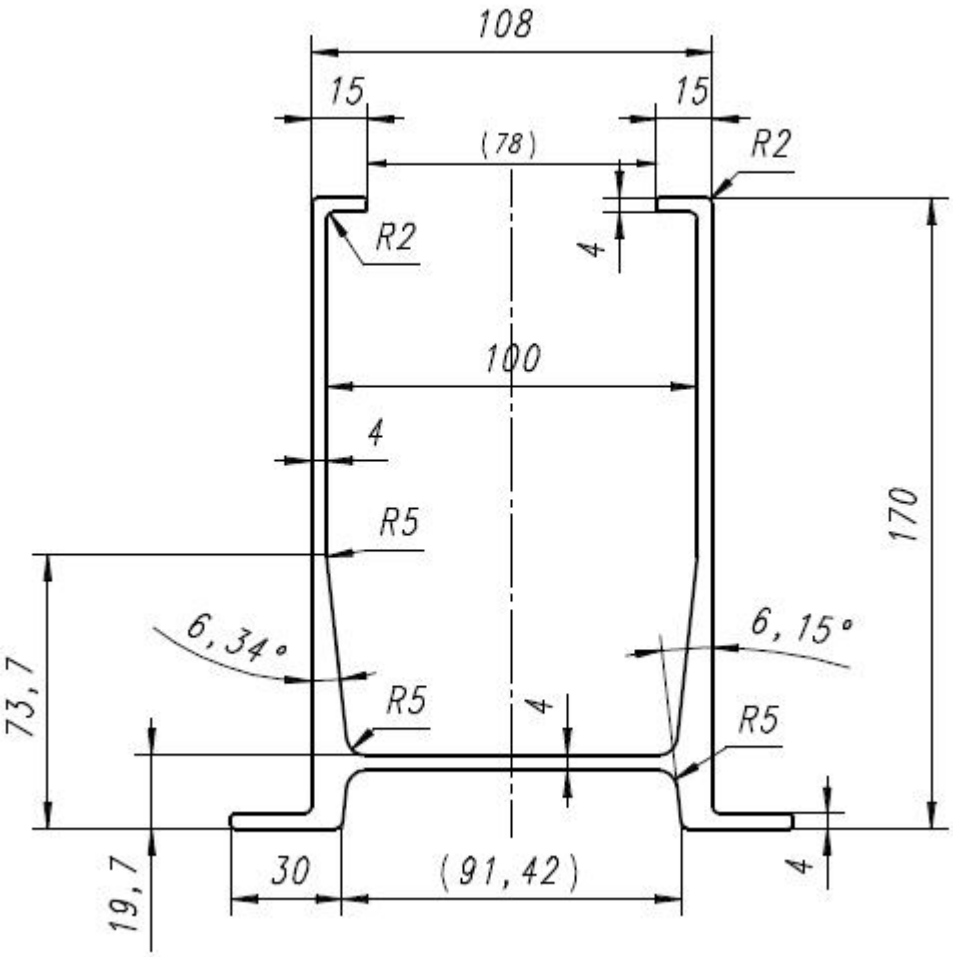
3.4 Part list VARIO-TOP® size2 auxiliary equipment

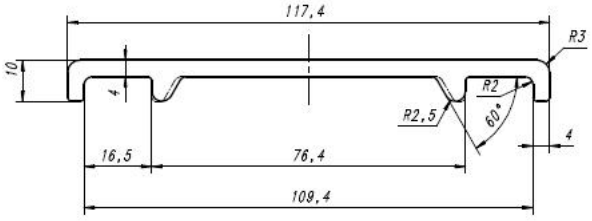
Article number	Description	Dimensions	Weight	Quantity
	Steel pillar, hot dip galvanized	IPE 100, length 2,5m		
	Steel pillar, hot dip galvanized	IPE 100, length 3m		
D000124	Mounting plate lowering kit			
	Cable outlet flange	Different dimensions available		
	Special fastening console	For bridge and wall mounting		
	Cable coupling kit	To connect cables along the track		
	Excess cable kit	To retain overlength cables		
	Pneumatic ram	With guide bushing for IPE100 pillar		



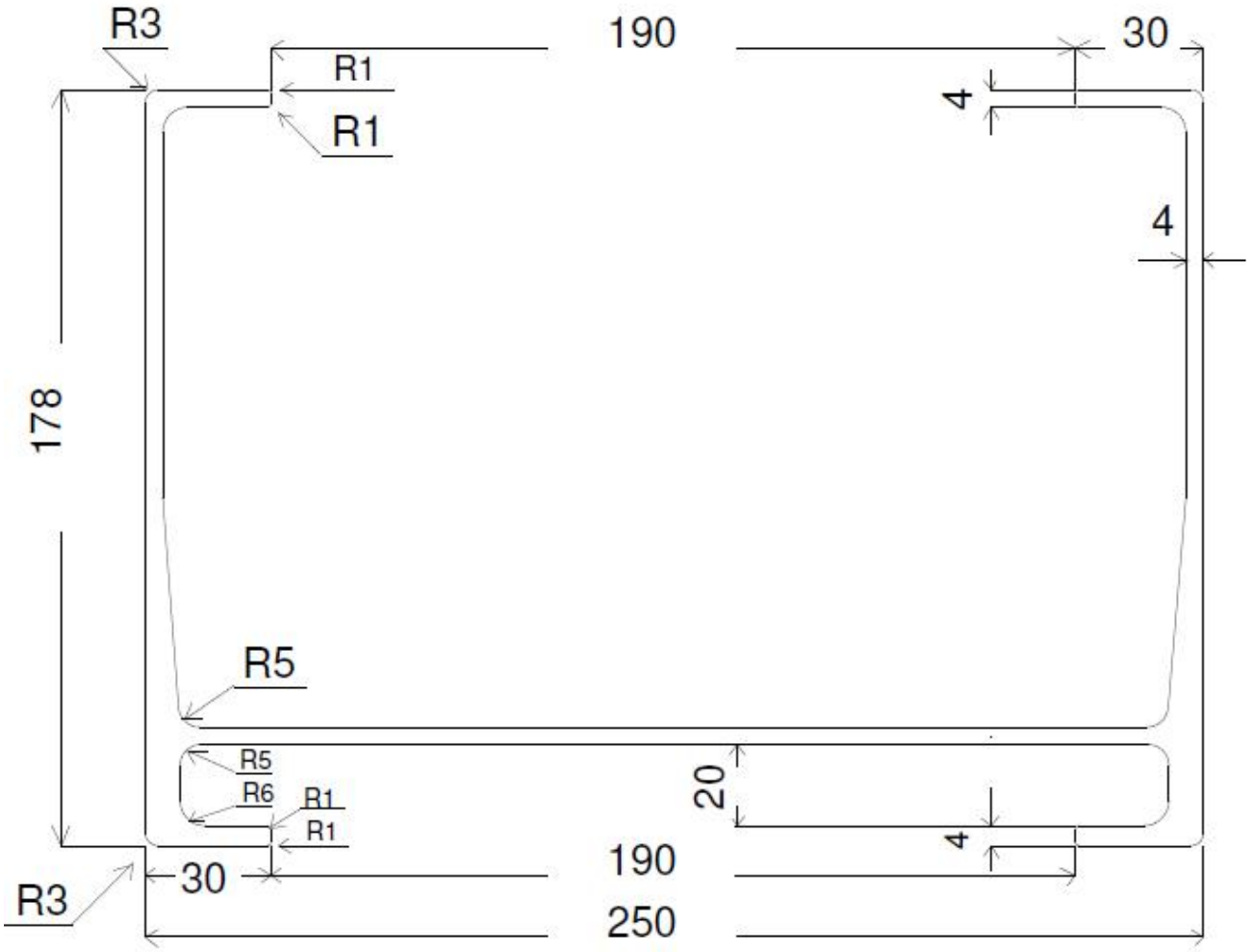
4. Drawings

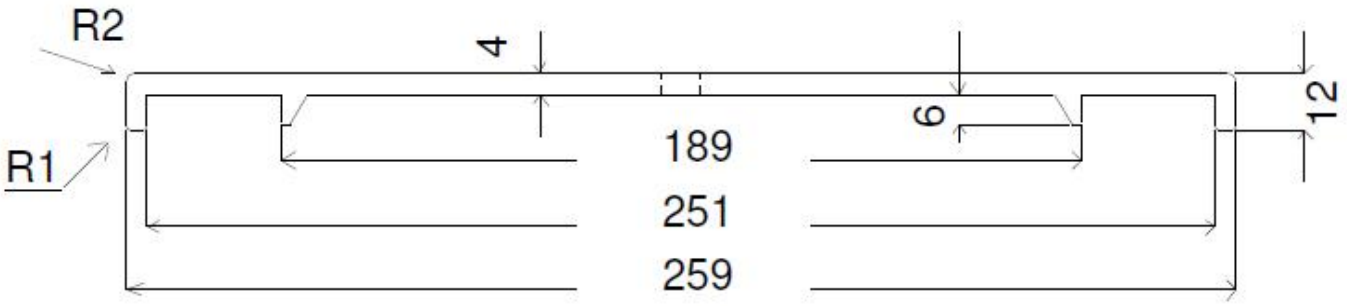
4.1 VARIO-TOP® size1





4.3 VARIO-TOP® size2





5. Installation

5.1 Prepare for assembly

The installation of elevated cable management systems VARIO-TOP® must always be carried out on the basis of the approved planning. The assembly personnel must be instructed. Basically, all components must be checked for damage before installation. Only high quality GRP profiles and steel parts may be used. Changes (e.g. trough profile extension) and repairs to GRP profiles or components lead to an immediate exclusion of warranty. The components are unloaded on the construction site or the storage area only on the supplied pallets with a suitable lifting tool or individually by hand. No liability is accepted for damage or consequential damage caused by improper handling of the individual components.

5.2. Tools

The following tools are required for assembly:
- Piling device with guide sleeve for steel pillars IPE100
- 2pcs. open-end or ring spanner SW19mm
- Drill maschine
- Drill bit 6mm (for the notched nail), optionally 8.5mm (for the cable outlet flange)
- Drill bit D85mm with center drill (option cable outlet flange)
- Torque wrench SW19mm
- Water level
- File
- Angle grinder (shortening or production of changes of direction and subsidence)

5.3 Route preparation

The planned axis of the elevated cable routing system is to be staked out / aligned in terms of its course and height. The minimum distance between the steel supports (cable duct) and the center of the track is to be determined depending on the line speed according to the currently local railway guidelines.

5.4 Foundation / ramming

The IPE100 steel pillars are rammed, buried or concreted in, depending on the local soil conditions. We recommend keeping a cantilever length of 0.2m - 0.3m. The standard clamping depth is 1.2m - 1.3m for standard soil class 3-5. In the event of deviations (e.g. sandy soil conditions), the clamping depth must be adapted to the local conditions.
The steel pillars are adjusted with the help of a gauge (image 1) at a precise distance of 6m and rammed in with a suitable device. It is important to ensure that the supports are flush, level and perpendicular. The steel supports are supplied as standard in a length of 1500mm. Longer supports are marked on the flange (2500mm = 25 or 3000mm = 30). The difference in height from support to support must not exceed 40mm (+/-)! This difference can be compensated for by elongated holes in the support plate. If the support spacing is shortened, the duct profile and possibly the cover profile must be shortened. For driving the supports into the ground, we recommend a GR40 pneumatic pile driver with a guide sleeve for IPE100 (weight approx. 40kg, image 2). When operating the pile driver, the provisions of the accident prevention regulation “Ramming” (VBG 41) and the manufacturer's operating instructions must be observed. The hand ram works in a vertical, horizontal and inclined position. The pressure on the compressor should be between 5 bar and 6 bar. Place the pile driver on the pile to be hammered (image 3), align the pile and slowly open the ball shut-off valve. Hold on to the pile until it is rammed, then continue driving freely. The pile driver must not be held because of the strong vibrations during pile driving.


image 1, spacing template


Image 2, pneumatic ram with IPE100 guiding sleeve


Image 3, ram placed on IPE100

5.5 Mounitng fastening plate

The pre-assembled support structure (consisting of: 2 connecting brackets, 1 connecting plate and 2 supporting plates) is first aligned at the same height with connecting brackets using screws (M12x45 ISO 4017, tightening torque 90Nm) and attached to the steel support. Then the support plates are screwed to the connecting brackets using screws (M12x45 ISO 8677, tightening torque 90 Nm) (image 4). The elongated holes in the support structure enable precise adjustment in the longitudinal and transverse directions as well as in height. In the case of vertical inclination changes, e.g. for ascents and exits or terrain adaptations, a hinge bracket (lowering kit) should be used instead of a standard fastening plate (rigid).

image 4, mounted fastening plate

5.6 Assembly / disassembly of cable duct and cover

5.6.1 Assembly of cable duct and cover

After the fastening plate has been adjusted and screwed to the steel pillar, the cable duct is pushed into the fastening plate (floating assembly). An air gap of 3mm (image 5) must be maintained at the joint of the troughs and the lid. The installed cable ducts must be fixed or secured every 30m with grooved nails (image 6). The hole in the support plate serves as a drilling device for this purpose. A miter cut is not required for horizontal curves on standard rail radius.

Image 5, air gap 3mm

Image 6, use of grooved pin each 30m

The cable troughs must always be installed tension-free! There must be no sharp edges on the cable routing system either inside or outside. The maximum permissible bending radius of the cables to be laid must be observed.

Closing the cover
The enclosed truss-head screws (M8x16 4.8 DACROMET with shoulder) are inserted from above through the hole in the cover and screwed approx. 2 threads into the fastener held against it from below (exploded view). Furthermore, the fastener is turned in the longitudinal direction of the lid (like shown in image 7). If the route is straight, the first cover must be placed in such a way that the center of the cover comes to rest exactly on the joint of the cable ducts (one cover connects two lower parts). Then the truss-head screw is tightened with an offset screwdriver TX40 (tightening torque 30-40 Nm). By turning the truss-head screw, the fastener is also turned and engages the lower part of the trough (image 8). The assembly of the remaining covers is carried out in the same way as the first one. The last cover is cut in two with an angle grinder, equiped with a diamond disc. With the two cover halves, the remaining open lower parts are closed at the beginning and at the end. In the curve area (normal railway radius), the cover may be placed a maximum of 20 mm after the joint of the ducts in order to ensure tension-free assembly.

Image 7, cover/fastener/DACROMET screw and TORX allen key

Image 8, mounted fastener properly closed, inside view

The covers must always be installed tension-free! There must be no sharp edges on the cable routing system either inside or outside. An air gap of 3mm must also be assured during installation of the covers!

5.6.2 Disassembly of the cover / cover opening
The cable trough cover is dismantled in the reverse order to the installation (see 5.6.1 Assembly of cable duct and cover).

5.6.2 Disassembly of the cable trough
The cable trough is dismantled in the reverse order to the installation (see 5.6.1 Assembly of cable duct and cover).

5.7 Creating a bypass
When driving around obstacles such as overhead line or signal masts, etc., the cable troughs and cover profiles must be mitered at the joint according to the required angle using an angle grinder equipped with a diamond disc. Each trough is cut at half an angle at the joint. The standard support plates can be used for this. They can be used at an angle of up to 45 ° (up to 22.5 ° with a straight rammed support, in addition, the support must also be rammed in appropriately rotated).

When creating a bypass, the maximum permissible bending radius of the cables to be laid must be observed!

5.8 Creating a lowering

When connecting to an existing buried cable duct or adapting the terrain, a special support structure called the lowering kit (image 9) can be used. The lowering kit is delivered loosely pre-assembled. The support structure consists of a connecting bracket as well as a hinge bracket and the support plates (upper plates). The brackets are screwed to the steel support using the screws supplied (M12x45 ISO 4017, tightening torque 90Nm). The angle with the hinge is adjusted, fixed and screwed in the direction of the buried cable duct or the terrain offset. The GRP duct is then loosely placed on the plate or pushed in and butted against the buried duct. Then the hinged plate must be placed on the fixed plate with the rigid connection bracket and the miter cut must be drawn vertically on the duct with a pencil. The reference point is the center of the steel column. The marking is carried out on both sides of the cable duct. Then the channels are mitered using a suitable device (each channel at half an angle). The two fastening holes, D = 6mm, are drilled again (on the side of the duct profile), for this purpose the fastening plate is used as a drilling jig. The fastening plate and the cable trough must lie flat when drilling the holes. The GRP trough is then attached to the fastening plate with a hinge bracket on both sides using DIN 1476 - ISO 8746 notched nails. The assembly of the first horizontal GRP duct can then be started.

The gap dimension must also be adhered to with the recesses! In the case of lowering, the maximum permissible bending radii of the cables to be laid must be observed!

Image 9 a/b, lowering kit

5.9 Installation of additional accessories

5.9.1 Cable outlet flange

If the end of the elevated cable route is not connected to the underground cable duct, a cover plate must be fitted at the end of the duct. Pipe sockets are placed on the trough floor from above at the desired location. Use a pencil to mark the four mounting holes and the opening on the trough floor. The opening is drilled with a D85mm hole saw and the mounting holes with a D8.5mm drill. Deburr the opening for the cables with a file or sandpaper. Then the pipe socket is mounted from below on the duct floor with the supplied M8x16 ISO7380 A2 screws (tightening torque 30-40Nm) (image10). The screws are to be inserted from above into the trough base and the base plate of the cable outlet, so that the button head is inside the cable channel.

image 10, cable outlet flange

Use only flexible hose / pipe with the same or higher fire protection class (such as the GRP cable routing system)!

5.9.2 Special console

Special consoles are used to route a cable trough system over an engineering structure (bridge structures, overpasses, viaducts, etc.). These are attached to the railing post using the screws provided (image 11). The shape of the post (round, square or rectangular tube, angle profile, etc.) and dimensions as well as the distance must be determined in advance of assembly.

The use of the elevation system with special brackets on bridge railings and noise barriers etc. must be agreed with the client and approved!

Image 11, special console

If further special solutions are required, please contact the employees of INVATEC directly.

5.9.3 Coupling and excess cable kits

Cable coupling and excess lengths kits in various designs are available as accessories. They are designed to store longer lengths of cable or to create sleeves. Technical data and the scope of delivery can be found on the datasheet „Technical_datasheet_VARIO_TOP_coupling_kit_20210316.pdf"

Coupling kit installation:

The position for the kit is determined according to the specifications of the planner or the building owner next to the cable duct. Then the position of the steel pillars are measured and afterwards driven. The center distance to the adjacent cable trough is 260mm (width of cable trough + spacer plate). The distance between the two steel pillars is 2500m (with a standard socket kit with 3000mm length). The embedment depth of the steel pillars depends on the soil class and the slope design and is at least 1.2m. The fastening plates are then mounted on the steel pillars with the supplied M12x45 screws. The supplied spacer plates are used to connect to the existing, elevated cable trough. These serve as a drilling template at both ends of the socket kit. After drilling, the coupling kit is placed on the fastening plates and aligned horizontally. Now the drill holes can serve as a template for the holes in the existing cable duct. The coupling kit is screwed to the cable trough (truss-head screws M8x40). The passage for the cables is made as follows: Using a jigsaw or hand saw, cut two rectangular recesses at the beginning and end of the sleeve kit through this and the adjacent cable duct. Cleanly deburr the cut edges with a file to avoid damaging the cable. After inserting the sleeve, the cover is put on and closed according to section 5.6.1.

Image 12, coupling kit

5.9.4 Cable trough end cover

If the elevated cable trough is not connected to the underground cable duct, a cover plate must be fitted at the end of the duct.