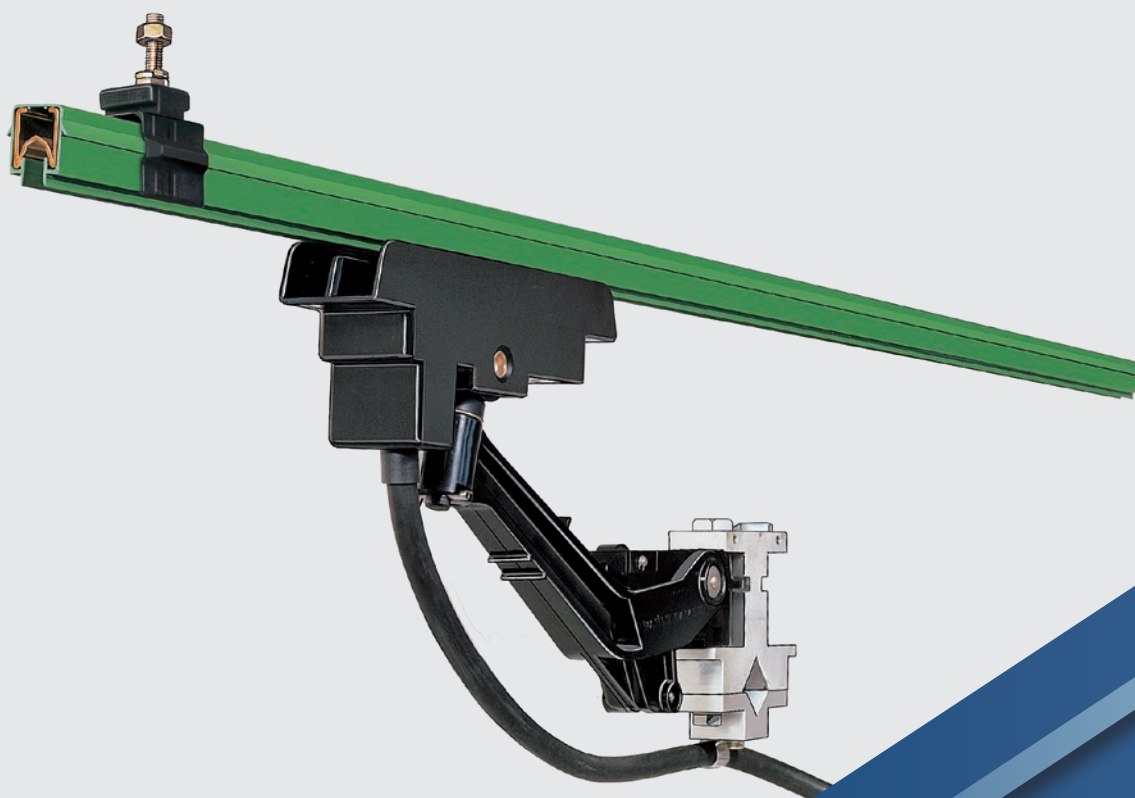


INSTALLATION MANUAL

U15





1. Installation tools

Basic equipment:

Standard tools, drilling template BS 15

Additional equipment:

(in case of large systems with arches and switches)

Bending device BVU 15

Hand punch press HST 15

2. System diagram

2. System diagram

L = standard length of the rails

6 m

L_1 = max. hanger interval
for straight tracks and
in curves (refer to 4.)

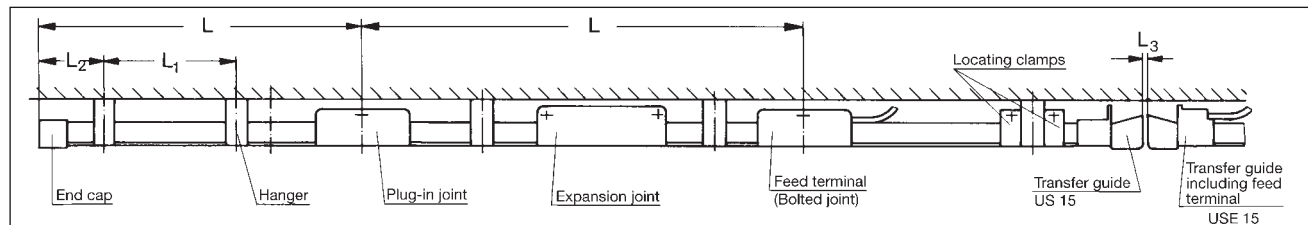
L_2 = max. overhang

150 mm

L_3 = air gap for transfers, e.g. in switches
and lifting stations
for straight transfers, max.

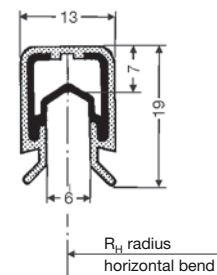
6 mm

10 mm



3. Symbols in installation drawings

— — —	Track	
— — —	Runway	
— — —	Powerail	U 15
— + —	Connector	UV 15
— ● —	Compact hanger, suspension	KA 15/...; UA 15
— ● —	Fixed point	UA 15, KA 15/...; USK 15
— ↓ —	Feed	UE 15 or UEG 15
— — —	End cap	UK 15
— × —	Locating clamp	USK 15
— — —	Expansion section (1 m long)	UDV 15; UDVN 15
— — —	Isolated section	IT/U 15-5, 15, 30, 90
▷ — —	Transfer funnel	EFT U 15
▶ — —	Transition section, straight	US 15 T
▶ — —	Transition section, slanted	US 15 TS
▶ — ↓ —	Transition section, straight with feed	USE 15 T
▶ — ↓ —	Transition section, slanted with feed	USE 15 TS
— — —	Air joint without feed	LT/LT-U 15
— — ↓ —	Air joint with single-sided feed	LTE/LT-U 15
— — ↓ —	Air joint with two-sided feed	LTE/LTE-U 15



5. Insulated hanger and insulators with rail holder

- Attach the insulated hanger (image 1) or the insulators with rail holders or compact hangers to the support brackets.
- Engage the powerails in the rail holders.
- Check to make sure that the powerails can easily be moved in the suspensions. If necessary, align the suspensions to ensure the length expansion of the powerails.

5.1. Compact hanger KA (image 2 and 3)

- Attach by screwing on.
- Drill the attachment holes for screws M 5, (through-hole).
- Screw on the compact hanger.

5.2. Compact hanger KH

- Attachment in Halfen anchoring bracket.
- Weld or screw on the Halfen anchoring bracket at a right angle.
- Slide the compact hanger into the Halfen anchoring bracket and secure it with safety screws.
- Make sure that the compact hanger and Halfen anchoring bracket are correctly aligned.

INSTALLATION PROCEDURE

4. Support bracket

Attach the support bracket and align it in a horizontal position and at a right angle to the runway.

Hanger interval, see table or installation drawing.

Max. hanger interval

	Hanger interval L	
	for straight lengths, inside bends and horizontal bends	for outside bends up to $R_H = 5\text{ m}^*$
single current collector	1000 mm	500 mm
double collector Type KDST	800 mm	400 mm

6. Attachment of the powerails and connectors

The sections of the powerails are joined by connectors. The connecting surfaces must have a bright metal finish for perfect current transfer. Secure the covers against contact with the electricity-conducting parts.

The powerail ends of the sections have already been prepared for attachments to the connector.

Prepare the shorter sections that have to be adjusted during the installation according to 6.2.

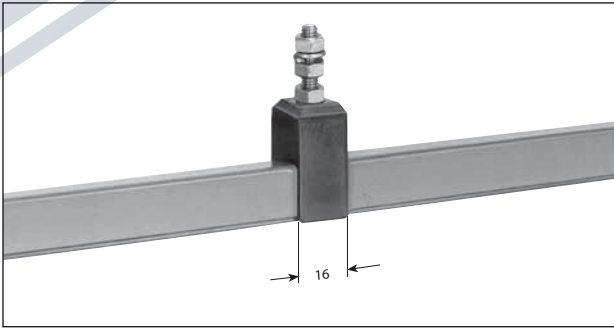


Image 1: Insulated hanger UA 15 on section

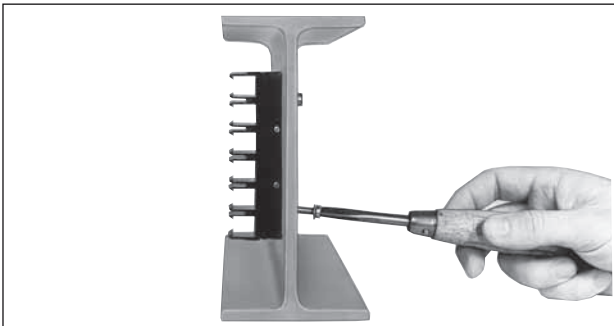


Image 2: Compact hanger KA 15/6

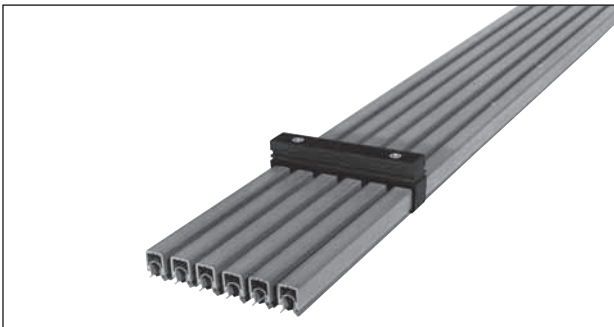


Image 3: Compact hanger KA 15/6

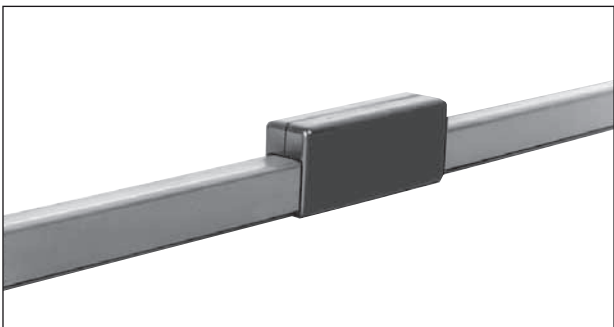


Image 4: Connector UV 15 K4 with cap

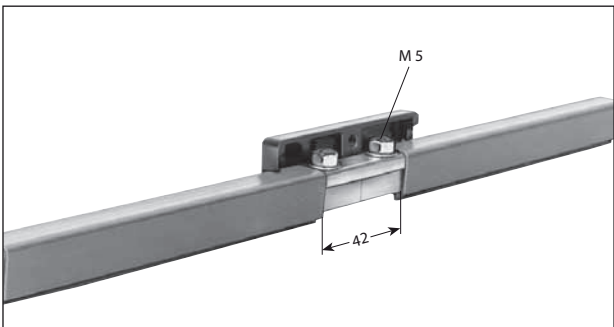


Image 5: Connector UV 15 K 4, open

6.1. Installation of the powerails with the connectors

(Image 4 and 5)

- Slide the connectors half-way into the already installed section of the powerails.
- Press the next section into the rail holders (image 6). The claws have to span the rail profiles (audibly engage).
- Slide the powerail onto the free end of the connector up to the stop.
- Tighten the connector; max. tightening torque 2.5 Nm.
- From the side, position the joint cap halves against the butts of the rails so that the powerail is encompassed tightly. At the same time press the joint cap halves together until their latching lugs engage in the corresponding openings.

6.2. Preparation of the powerails for the connectors

If any shorter sections will have to be adjusted at the construction site, the ends of the powerails have to be prepared as follows for the connectors:

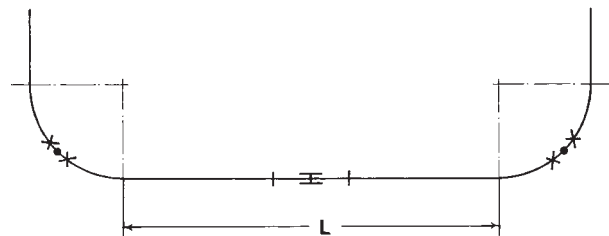
- Mark the track length, saw it off with a hacksaw and deburr it.
- Pull some of the insulation profile off the powerail profile, shorten it by 42 mm and deburr it.
- Slide the insulation profile on the powerail profile back to the point where the conductor profile protrudes by equal lengths on both ends (image 5).

6.3. Expansion sections

The expansion sections have been pre-installed at the factory. Length: 1000 mm.

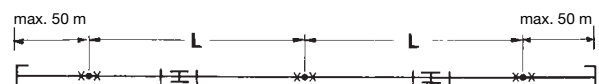
The expansion sections are installed:

- For straight lengths exceeding 100 m.
- If the length of the conductor line between two bends, switches or other fixed points exceeds 20 m (drawing 1).



Drawing 1

The expansion lengths have to be attached with locating clamps in the center between 2 expansion sections or between expansion sections and the end of the system (drawing 2).



Drawing 2

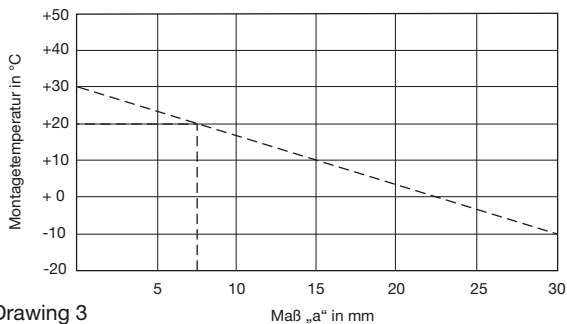
The maximum length L of the expansion track for an expansion section depends on the max. temperature difference (Δt) (see table).

up to Δt	max. L	up to Δt	max L
20 °C	88 m	40 °C	44 m
30 °C	58 m	50 °C	35 m

Maximum expansion path of an expansion section is 30 mm.

Installation according to drawing 3:

- Enter the lowest and highest operating temperature and connect them with a straight line.
- Enter the installation temperature (temp. of the powerails) on this line and read measurement "a".



Drawing 3

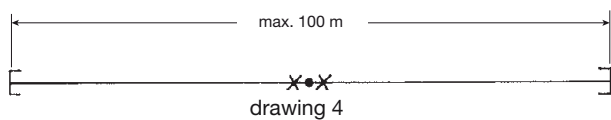
Example: max. operating temperature = 30° C $\Delta t = 40$ °C
 min. operating temperature = - 10° C
 Installation temperature = 20° C
 Measurement "a" = 8 mm

– Install expansion section with measurement "a" (image 7).

7. Locating clamps

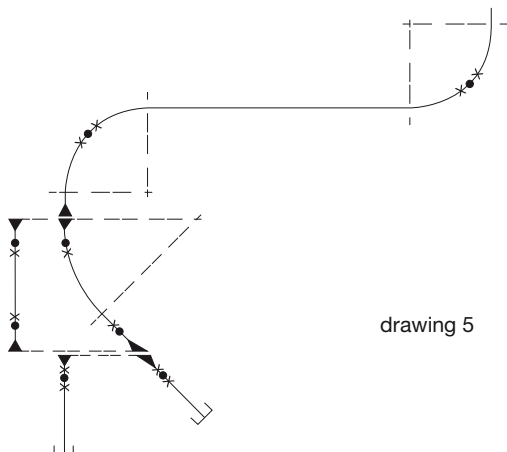
Locating clamps are used to fix powerail sections to prevent the powerail from sliding in a longitudinal direction.

A fixed point is created with two locating clamps that are positioned to the left and right of a rail holder (see image 8).



Arrangement:

- For straight tracks, in the middle of the system (see drawing 4).
- Between two expansion sections (drawing 2) or an expansion section and powerail end.
- In bends (drawing 5).



drawing 5



Image 6: Powerail U 15/25 C, 5-poles, in I-holder

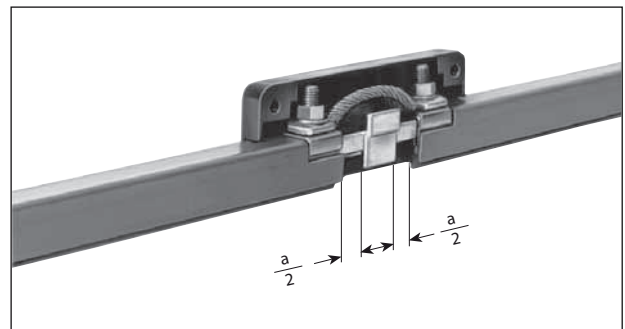


Image 7: Expansion section UDV 15/25 K

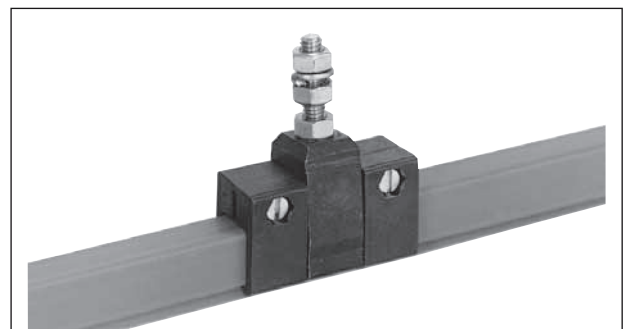


Image 8: Insulated hanger type UA 15 with two locating clamps type USK 15

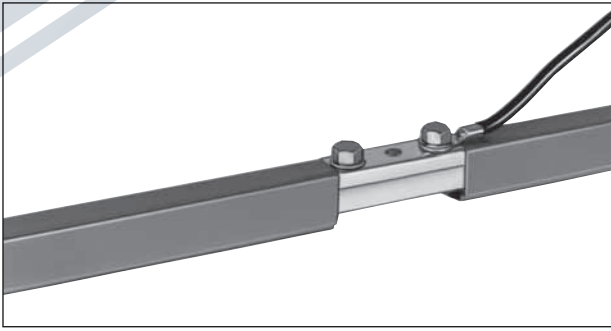


Image 9: Feed UE 15 K 4, open

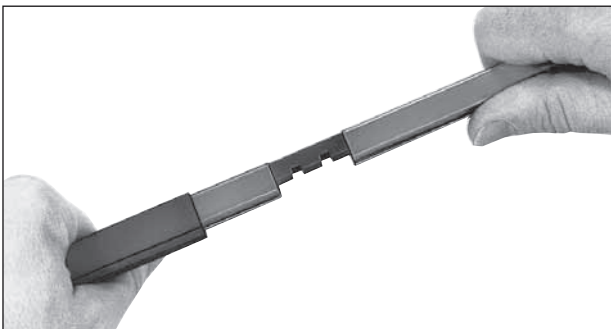


Image 10: Isolated section IT/U 15-30

- If there are interruptions in the track, e.g. caused by switches or lifting stations (drawing 5).

Screw on the locating clamps.

After the installation, the opening of the powerail has to be checked. For straight transfers 6 mm and for slanted transfers 10 mm.

8. Feeds

If possible, feeds should be installed instead of the connectors near the supply cable. Prepare the contact surfaces as in item 6. If the feed is not installed at the butt of the track, the plastic housing has to be modified (8.2).

Feeds in transition sections see 10.

For arrangements where the distance between the rails is 18 mm, the feeds have to be arranged offset for UEG.

The feed cable may not interfere with the clear passage of the current collectors and the powerail's length expansion in case of temperature changes.

8.1 Arrangement instead of the connectors

The installation of the feed is possible in systems with connectors without additional modifications.

8.2 Arrangement on the section

- Mark the position of the feed on the section.
- Pull off the insulation profile, cut it at the marked position and shorten it by 42 mm.
- Slide a copper lug with connecting screws into the powerail profile up to this point.
- Slide the insulation profile back on.

8.3. Installation of the powerails with feeds

- Press the powerails into the holders (avoiding the area of the feed).
- For UE 15 K 4: Attach ring-shaped crimp cable shoes according to DIN 46234 for connection bolts M 5 on connecting cables (image 9). The max. connection diameter for each connections screw is 6 mm².
- For UEG 15 K 4, use the provided special cable shoe for two screw connections. Interior Ø for the cable connection is 8.2 mm.
- Plug the cable with the attached cable shoe on to connection bolts and screw on.
- Remove the cable transfer at the cover in the respective size.
- Place cap on top and press together.
- Also press the powerail into the rail holders in the feed area.
- Attach the strain relief for the feed cable.

9. Joints

The powerail is electrically isolated by means of the joints.

In front of and behind the joints, the powerail also has to be suspended with a max. distance of 200 mm from the center of the joint.

9.1. Isolated sections (image 10)

Installation according to the installation drawing at the factory or during the assembly:

- Mark the position of the joints on the powerail.
- Pull out the copper or stainless steel profile and separate it at the marked area.

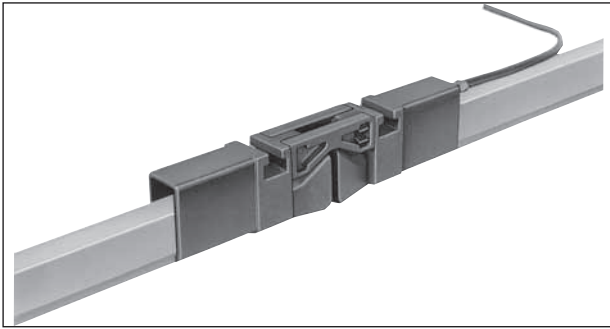


Image 11: Air joint

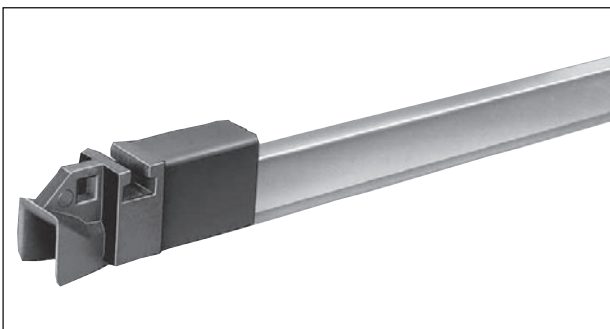


Image 12: Transition section US 15 T

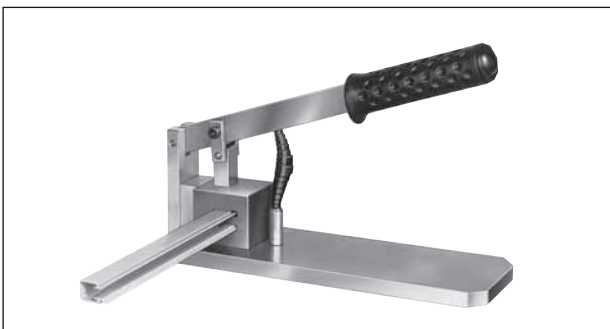


Image 13: Hand punch press

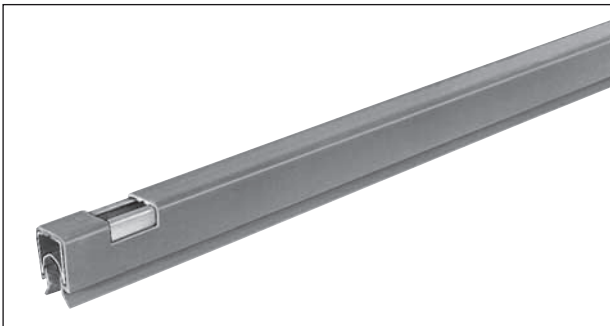


Image 14

- Shorten the copper or stainless steel profile and deburr it (see table).

Name	Length of the joints
IT/U 15- 5	5 mm
IT/U 15-15	15 mm
IT/U 15-30	30 mm
IT/U 15-90	90 mm

- Connect the copper or stainless steel profile with the joint and slide it into the PVC profile (image 10).

9.2. Air joints (image 11)

- Mark the position of the air joints on the conductor profile.
- Separate the powerail in this location and shorten it by a total of 43 mm.
- Process the powerail as described under 10.1.

After they are placed on the powerails, the air joints are connected with the additional lugs by pressing them together sideways (snap button principle).

Combination options:

- |—|— = LT/LT- U 15 without feed
- |—|— = LT/LTE- U 15 with feed, single-sided
- |—|— = LTE/LTE-U 15 with feed, double-sided

10. Transition sections

Usage for switches, lifting stations and removable runway sections.

May also be used as a contact protection for rail ends ("end caps").

There are two types of transition sections:

- a) Transition sections of the types US 15 T
 - US 15 TS
 - USE 15 T
 - USE 15 TS

- Usage: For electric monorail systems with a lateral arrangement (a slanted design is not possible in a suspended arrangement).
- Simultaneous function as a fixed point in connection with BFU; for that reason use expansion sections as frequently as needed.

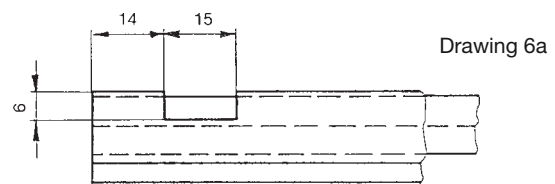
- b) Transition sections of the types US 15
 - USE 15

- Usage: For straight tracks with arrangements that are lateral and suspended (a slanted design is possible after a modification during the installation).
- No simultaneous function as a fixed point.

10.1. Transition sections US 15 T (image 12)

Installation procedure:

- 1) Pull off the insulation profile by about 50 mm from the powerail profile and use the hand punch press HST 15 (image 13) to punch a rectangular recess into the insulation profile (image 14 and drawing 6a).



Drawing 6a

- 2) Position the head of a square screw into the insulation profile recess and slide in the powerail profile until it is flush with the insulation profile again.

- 3) Place the clamping bracket (copper) on top and tighten it with a washer and nut (image 15). Max. tightening torque 2 Nm. (Make sure that the powerail profile and insulation profile are exactly flush at the end.)

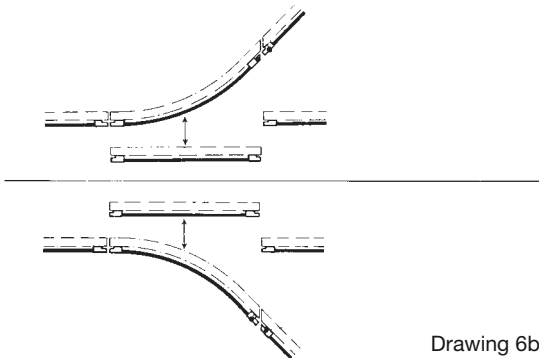
For transition sections with feeds or air joints with feeds, the provided flat connector (6.3 x 0.8 mm) has to be screwed on as well (image 16).

- 4) Slide on the transition section (until it audibly engages).

10.1.1. Arrangement of the transition sections

(lateral arrangement)

The straight transition sections US 15 T and USE 15 T have to be used for straight runway sections; the slanted transition sections US 15 TS and USE 15 TS each have to be used in one part of the slanted section (drawings 6 b, 6 c).



Drawing 6b

10.1.2. Attachment for transition sections BFU

- Mark the through-holes for BFU on the attachment surface (see drawing 6 c).

ATTENTION: The transition sections may not protrude into the rail section under any circumstances..

- Drill the through-holes for M 5 into the attachment surface.
- Slide the transition sections onto the BFU attachment (image 17).
- Screw the BFU onto the attachment surface.
- Knock in the clamping pins to fixate the transition sections.
- In the case of slanted sections, make sure that the head of the fixing screw does not protrude into the cut of a runway profile.

When installing transitions, make sure that facing rail ends are exactly aligned to prevent interferences during the passage of the current collectors.

The max. vertical and lateral offset: ± 2 mm

Max. air joint: in straight transfers: 6 mm
for slanted transfers: 10 mm

EHB runways (switching and lifting stations) have to be aligned before installing the powerails.

10.2. Transition sections US 15, USE 15 (image 18)

- Powerail processing as described under 12.

For transition sections with feeds, connection for flat plugs 6.3 x 0.8 mm.

When installing transitions, make sure that facing rail ends are exactly aligned to prevent interferences during the passage of the current collectors.

The max. vertical and lateral offset: ± 2 mm

Max. Air gap: 6 mm

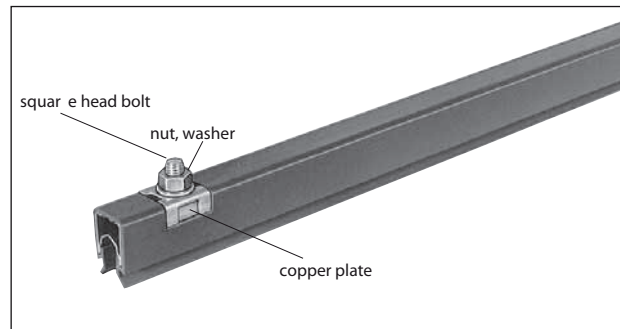


Image 15

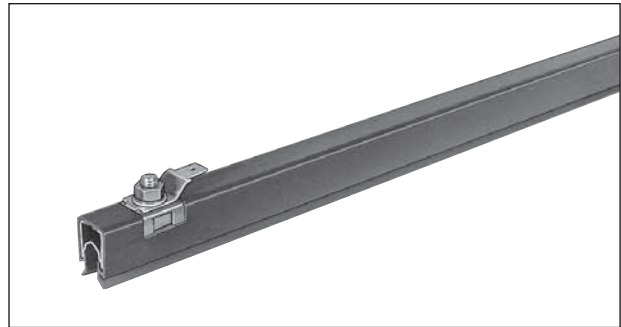


Image 16

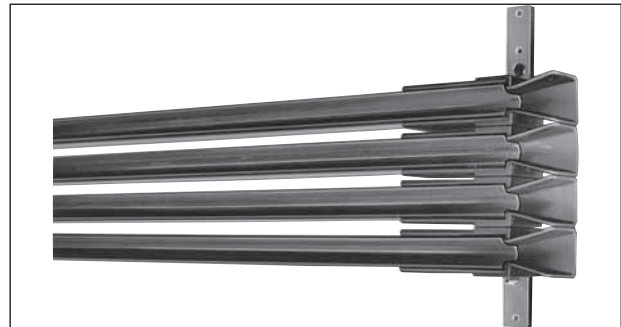
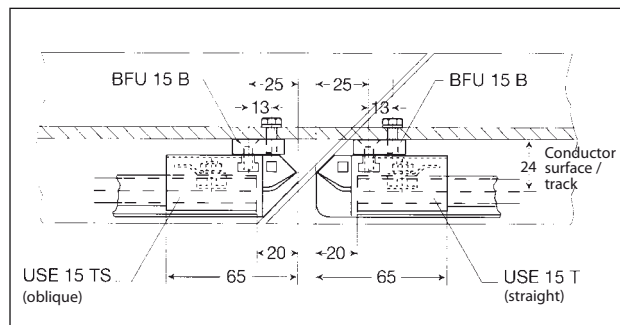


Image 17



Drawing 6c: Slanted rail section with BFU 15 B

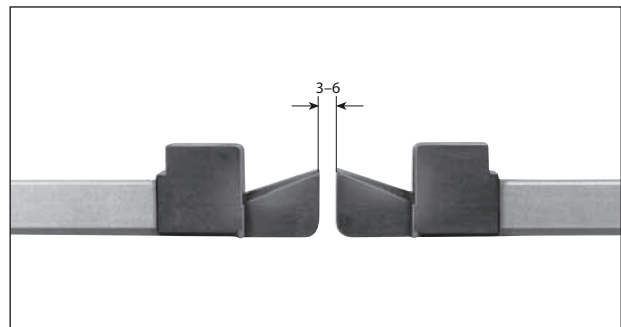


Image 18: Transition sections US 15

11. Transfer funnel

If the powerails are separated in long sections, the current collectors have to be inserted with the aid of a transfer funnel EFTU 15-... .

12. End caps

The end caps form the contact-protected terminals of the powerail and are generally attached on the corresponding powerail sections at the factory.

If the delivery is made in individual sections, proceed as follows:

- Slide drilling template BS 15 (image 19) on the end of the rail and hold it in place.
- Drill Ø 6.5 mm only in the back of the insulation profile (drawing 7). Use hole "B" in the drilling template.
- Drill Ø 3 mm cross-wise through the entire U-Rail (drawing 7). Use hole "D" in the drilling template. Then knock in the provided clamping pin Ø 3 mm according to DIN 1481 (length 12 mm).
- Slide the square of the drilling template head-first into the powerail profile to guide the clamping pin.
- Slide on the end cap until it audibly engages.
- The clamping pin has to be entirely covered by the end cap.

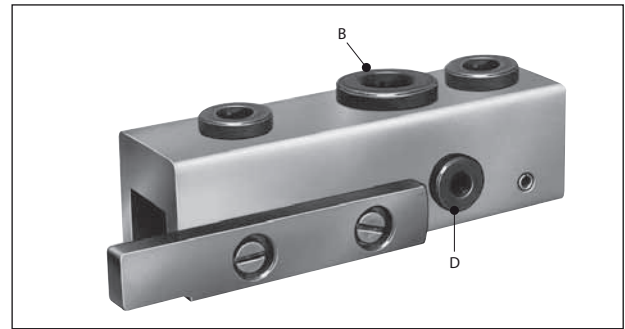
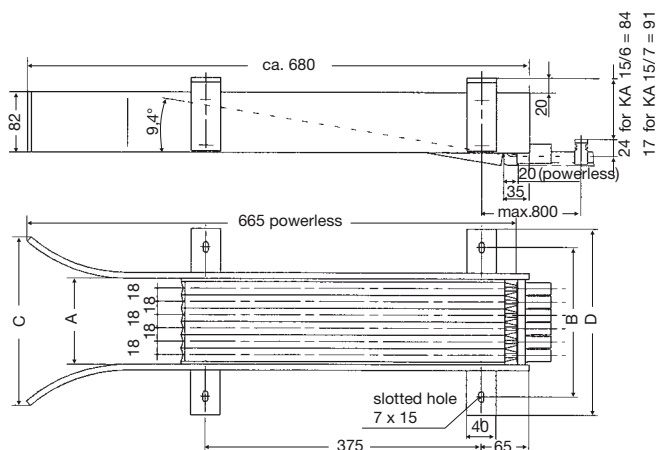
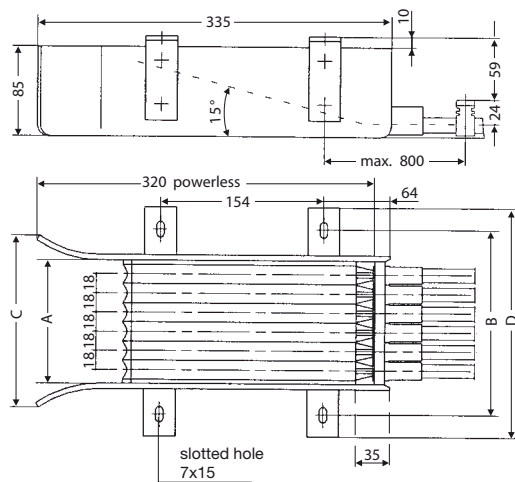
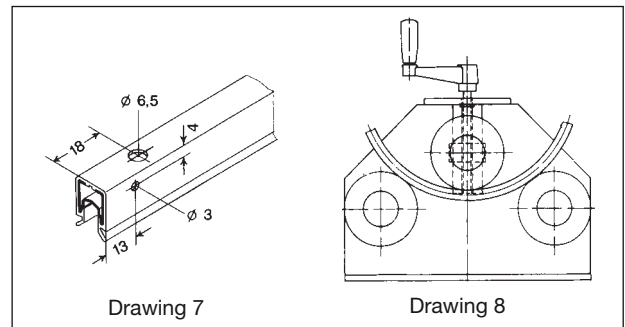


Image 19: Drilling template BS 15



Transfer funnel for KSFU 25

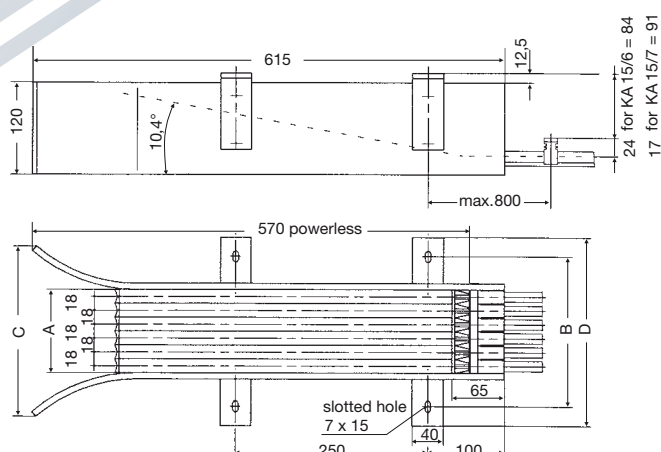
for max. speed $v = 100 \text{ m/min.}$

Type	A mm	B mm	C mm	D mm
EFT U 15-2 - KSFU	44	102	90	144
EFT U 15-3 - KSFU	62	120	108	162
EFT U 15-4 - KSFU	80	138	126	180
EFT U 15-5 - KSFU	98	156	144	198
EFT U 15-6 - KSFU	116	174	162	216
EFT U 15-7 - KSFU	134	192	180	234
EFT U 15-8 - KSFU	152	210	198	252

Transfer funnel for KSTU 30/55

for max. speed $v = 120 \text{ m/min.}$

Type	A mm	B mm	C mm	D mm
EFT U 15-2 - KSTU	44	130	157	180
EFT U 15-3 - KSTU	62	148	175	198
EFT U 15-4 - KSTU	80	166	193	216
EFT U 15-5 - KSTU	98	184	211	234
EFT U 15-6 - KSTU	116	202	229	252
EFT U 15-7 - KSTU	134	220	247	270
EFT U 15-8 - KSTU	152	238	265	288



Transfer funnel for KSTLU / KDSTLU

for max. speed $v = 120$ m/min.

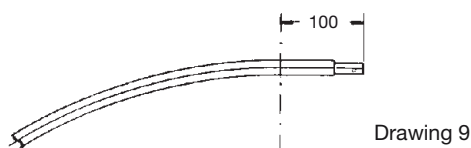
Type	A mm	B mm	C mm	D mm
EFT U 15-2 - KDSTLU	36	122	148	172
EFT U 15-3 - KDSTLU	54	140	166	190
EFT U 15-4 - KDSTLU	72	158	184	208
EFT U 15-5 - KDSTLU	90	176	202	226
EFT U 15-6 - KDSTLU	108	194	220	244
EFT U 15-7 - KDSTLU	126	212	238	262
EFT U 15-8 - KDSTLU	144	230	256	280

13. Bending the powerails

The bends can be manufactured with the bending device BVU 15 (drawing 8). The BVU 15 can be used to bend U15 powerails vertically and horizontally. The cross bars are provided.

Work procedure:

- To prepare the bend, open the desired radius on a flat surface.
- Determine the dimension of the bend (expanded length) of the powerails (possibly from the installation drawing) and mark it on the rail section.
- Saw off the powerail at a length that is about 0.5 m longer than the bend dimension.
- Insert the cross bar into the powerail.
- Twist up the adjustment roll and insert the rail section with the cross bar into the bending device, using a groove that corresponds to the profile.
- Slightly tension the adjustment roll and slide the rail section back and forth.
- To prevent the formation of a fold at the beginning of the radius, move the beginning section for the following bending process a few centimeters towards the inside.
- Repeat the procedure until the radius is bent.
- Remove the cross bar again.
- Saw off the powerail at the length of the bend. To guarantee a problem-free connection, a straight section of about 100 mm has to follow at the ends of the bend for a radius < 700 mm (drawing 9).



14. Current collector

The connecting cables of the current collectors have to be highly flexible and installed in such a way that they do not interfere with the full motion capacity of the current collectors!

14.1. Holders for current collectors in the series KST 20, KST 25, KST 2/40, KSF, KDS and KES

The attachment surface of the current collectors has to be exactly parallel to the crosswise and longitudinal direction of the powerails.

The installation height of the attachment surface for the current collector up to the powerails' conductor surface is determined according to the following table:

14.2. Holders for current collectors in the series KST 15 to KDSTLU 120

- Attach the towing arm exactly at a right angle.
- Installation height according to table.

Current collector Type	Installation height mm	perm. tolerance T for the operation mm
KST 15, KST 40, KST 60	65	± 20
KDST 30, KDST 80 KDST 120	65	± 20
KSTL 15, KSTL 40, KSTL 60	85	± 40
KDSTL 30, KDSTL 80, KDSTL 120	85	± 40
KSTLU 15, KSTLU 40, KSTLU 60	85	± 20/± 40 ⁽¹⁾
KDSTLU 30, KDSTLU 80, KDSTLU 120	85	± 20/± 40 ⁽¹⁾
KST 30, KST 55, KSTU 30, KSTU 55	85	± 20
KSTL 30, KSTL 55, KSTLU 30, KSTLU 55	95	± 30

- Slide the current collector onto the towing arm, align and tighten.

For the ground conductor, the towing arm of the current collector has been milled according to the attachment clamp.

- The installation height refers to the center of the square up to the conducting surface.



Drawing 10

15. Completion of the installation

Once the installation has been completed, check all parts for functionality, perform a test run and make sure that the contact between the carbon brush and powerail is problem-free.

16. Activation

The powerail U 15 and its components are constructed according to VDE 0100 and designed according to VDE 0470 part 1 with shock hazard protection. The shock-hazard-protection may not be impacted after the completed installation (e. g. opening width of the powerails).

Perform a test run after proper installation. Pay attention to the following points:

Conduct first run at low speed.

Current collector must move on the rail without vibration.

No sparks may occur in the area of the carbon.

(Sparking indicates soiled or oxidized grinding surfaces; clean grinding surfaces).

Ensure the perfect intake and exit of the current collectors at the transfer funnels and transition sections in particular.

17. Maintenance

The insulated powerails require low maintenance.

However, the following tasks have to be completed regularly:

1.) Checking the powerails:

Visual inspection every 4 weeks. Also pay attention to the expansion of the powerails and to burn points.

Remove deposited carbon dust especially in the joints and transition sections.

At the transition sections for switches, lifting stations, etc., the max. vertical and lateral offset of 2 mm may not be exceeded.

The max. air gap between the facing transition sections is the following for these types:

US 15 USE 15	image 18	6 mm
US 15 T USE 15 T US 15 TS USE 15 TS	image 12/17	10 mm

To ensure that the current collectors may pass without problems, it is better to keep these values as low as possible.

2.) Control of the current collectors every two months.

a) Mechanical control:

Check the flexibility of the joints, bearings and pivots. Check for mechanical damage.

b) Electrical control:

Check abrasion of the carbon brushes, firm seating of all contact screws and cable fastenings.

Replace the carbon brushes at such an early stage that the sockets of the carbon brushes do not drag on the conductor surface or touch the outer edges of the caps etc.

c) Contact check:

Pull the carbon brushes out of the powerail using a spring scale. The contact strength should be around 3.5 N per carbon brush (series KST 20, KST 25, KST 2/40 and KDS 2/40, KESR).

Approx. 9 N per carbon brush for series KST 15 to KDSTLU 120.

Approx. 5 N for series KST 30 - KSTU 55 and approx. 7 N for the series KESL.



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