AVAHLE

INSTALLATION MANUAL

APOS POSITIONING SYSTEMS FOR U10

Content

1.   General

The Vahle U 10 - APOS system always shows the exact position of the guided transport vehicles and the goods being moved.

Combined horizontally or vertically-constructed transport systems can be monitored and controlled with Vahle U 10 APOS measuring system.

The position of the transport vehicles and the goods being moved are recorded accurately to the last millimetre after a power failure, even if the transport takes place during the non-current phase.

The travel speed and vehicle buffering can be infinitely controlled across the entire transport system

The Vahle U 10 - APOS system consists of the electromagnetic read head, the carrier profile with code rail and the interface converter.

The deployment of Vahle U 10 - APOS systems in rack feeders, crane systems, transfer carriages, carriage body converters and electric suspension rails, forms the basis for monitoring and controlling a fast, maintenance-friendly and efficient unit.

The guided read head and the flexible code strip allow the position to be detected at any location in tridimensional systems.

The code rail to be installed (which corresponds to the outer contour of our isolated conductor rail U10) in our carrier profile follows the c-track system and the current supply is via a conductor line, and as such, it only requires the space of a U 10 unipole power rail.
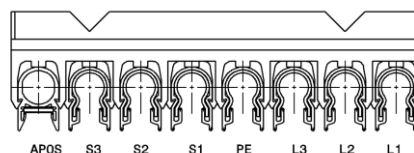
No additional attachments and guides are required.

The APOS read head can be integrated into a multipole compact double current collector KDS 2/40.

An x-bit code is stored in the cross-magnetized code strip, where there is no repeat position, according to a mathematical algorithm.
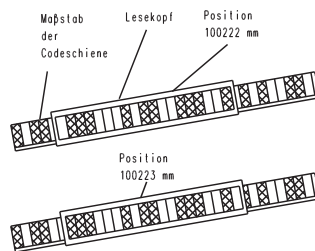
2.   System data Vahle U 10 – APOS System

Resolution	1 mm
Measuring accuracy	+/- 1 mm
Measuring interval	2 ms
Max. travel speed	12 m/s (720 m/min)
code strip length 515 m with 17 bits	
Operating temperature range	-14 °C to + 55 °C
Power supply	8 – 26 VDC
Current consumption	0.15 A
Protective system	IP 54
Code strip length expansion	16 x 10-6 /K
Code strip residual magnetism	min. 90%
Min. horizontal curve radius	750 mm
Min. vertical curve radius	2300 mm
Mounting force on code rail	2 N
max. perm. acceleration	2.5 m/s²

Safety function acc. to EN 954- 1

The APOS read head itself has no safety function acc. to EN 954- 1!
This means that there are two independent measuring systems or redundant faces in the APOS read head.
Therefore the downstream logic unit, such as e.g. a safety PLC of type 3 must always adopt the monitoring of the read head.
The APOS fulfils performance level B acc. to ISO EN 1349. Cat. B, MTTFd = high.

Explosion protection
The APOS read head has no explosion protection conformity in accordance with the EC Product Directive 94/9/EC.

Note:
A greater temperature range is available as an option. Please contact Vahle's main office directly.

3.   Installation of VAHLE U 10 - APOS System

3.1   General

The VAHLE U 10 – APOS - System can be installed as specified in Installation Instructions U10. The following points must be observed particularly during assembly:

1. Proper handling of the materials, particularly with the non-metal parts with regard to mechanical stress, soiling, etc.

2. All adhesive joints must be clean and grease-free.

3. The ends of the code strips and sliding bands must be smooth and burr-free in order to avoid disturbances and high read head wear.

4. All connections must be tightly secured.

5. Damaged materials must not be installed.

6. Observe of all regulations for construction of the system.

7. The location of isolators in the code strip, where reading is not possible (expansion joints, transitions), must be prearranged with the customer.

8. To install it, the sliding strip must be placed on a clean surface in the mounting direction when unwinding it. Any dirt on the code strip must be removed completely before gluing the sliding strip onto it.

9. **The self-adhesive sliding bands must be installed smoothly over the entire code strip! Subsequent attachment is not permissible!**

3.2   Storage of the material

Store crates with components on construction site in dry, dust-free location.

The max. shelf life of the sliding strip is 12 months.

3.3   Application fields

Only for dry inside installations

3.4 Basic information

Carrier profile

- Mounting of the carrier profile is the same as U 10

- fixed points of the carrier profile must be located at a max. of 36 m apart

- If an expansion joint is positioned approx. centrally between two fixed points, a position tolerance of +/- 1 m is permissible.

- The carrier profile is always firmly secured on the left and right to a separately created fix point compact holder.

Code strip

- The code strip is fastened to the fixed points on the power rails. An expansion joint must be included at the centre between two fixed points of the code strip in a carrier profile.

- On systems longer than 515 m, the coding is repeated after the first section. The sections must be identified with the aid of the control for clear recognition.

Transition section US 10 A-D

- When a transition section US 10 A-D is used, installation lengths/part lengths are possible without the use of an expansion joint.
  For this, the codes trip expands away from the fixed point and the change of length is absorbed within the transition section US 10 A-D. For this purpose, the code strip is installed with an overhang to the carrier profile. The transition section US 10 A-D can only be used for straight installation lengths and not in bend sections.

Standard example without expansion joints:
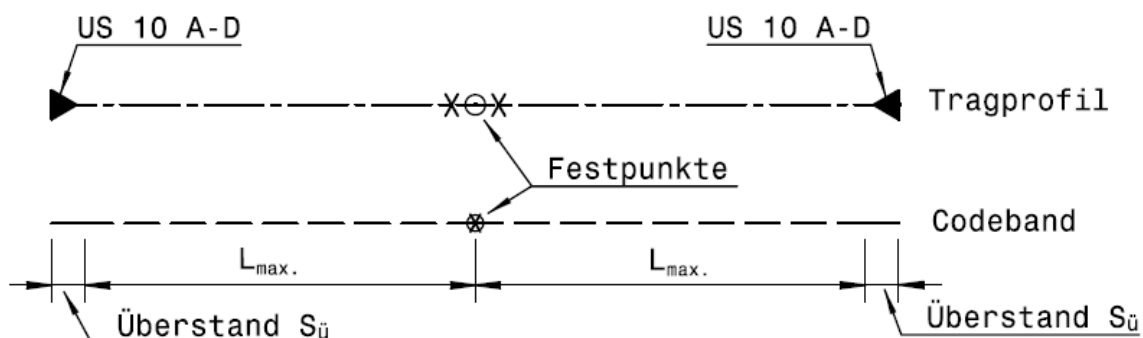
Standard example with expansion joints:
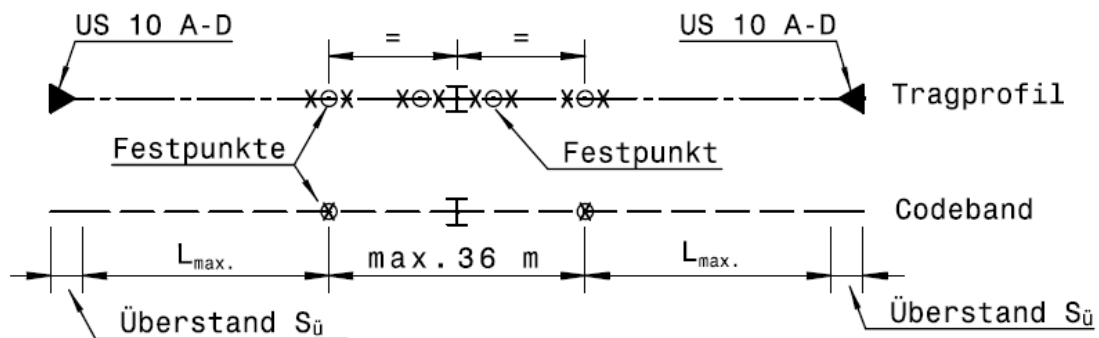
Example hall expansion joint
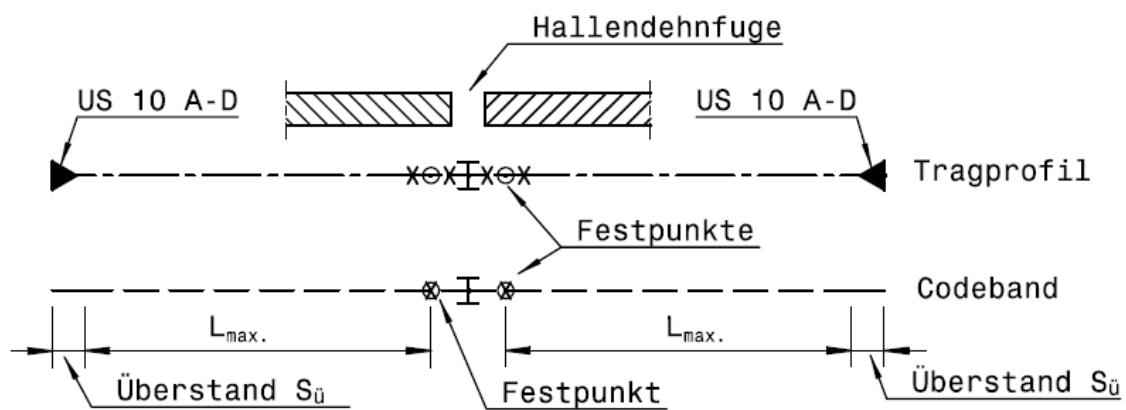
Funnel journeys:

Tunnel journeys, meaning moving the U10 APOS read heads in to/out of the carrier profile are not possible with the APOS U10 system.

Free system ends

- When using the APOS positioning system for crane applications (no EHB installations), it is possible to allow the code strip to hang out freely at the carrier profile ends. As the change in length of the code strip is now not limited by expansion joints or transition sections, a max. system length of 200 m with a central code strip fixed point can be realized.

  The code strip should freely protrude out of the carrier profile by approx. 150 mm.

Bend sections horizontal curve

- For curve radii R > 5000 mm, expansion joints can place in the carrier profile and the code strip

- For curve radii R < 5000 mm, the expansion joint in the carrier profile and the code strip must be moved to the next straight section.

Zeichenerklärung

—·—	Tragprofil APOS
⊙	Kompakthalter
▶	Überleitungsstück
X	Sicherungsklemme
⊥	Dehnverbinder
X⊖X	Festpunkt Tragprofil
⊗	Festpunkt Codeband
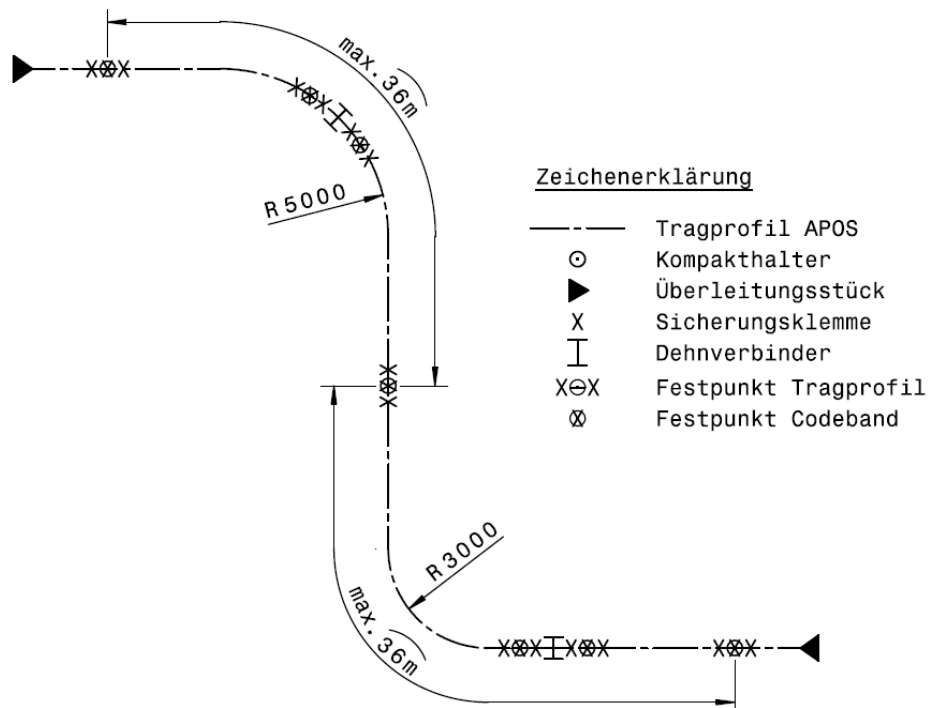
- An additional expansion joint in the carrier profile is assigned to the expansions in the substructure (e.g. building expansions).
  The air gap to be adjusted corresponds to that of the substructure.

Bend section vertical curve

- No expansion joints may be mounted in bend sections for vertical curves.

3.5   Planning Aid

- At the beginning and at the end of each code strip, allow for an overhang of a minimum length of one read head (95mm).

- The code strip does not start with a value of zero.

- Code strips can be cut and used in systems as positioning paths.

- Ensure that only code paths of code strips, for which a duplicate is not present, are used in one data transfer area.

- If a number of code strips are used in one system, they should be assigned to separate data transfer areas and recorded by the software on the system side. The positions in the main direction of motion should be defined in ascending order when laying out the system control.

- Position detection is interrupted in transitions. The shortest non-readable distance in properly installed transitions with US10A transfer sections is 20 mm plus the length of a read head, which is equivalent to 115 mm.

- The actual positions in front of and behind a transition must, however, be read off after installation (e.g. with read head and tester or by moving along the path) and be checked with system-side software and corrected, if required.

- The installation position of the Vahle APOS read head depends on the counting direction of the code strip. When installing the code strip, it is necessary to indicate the counting direction at the beginning and end of the carrier profile with a sticker or colour code. The counting direction is also indicated on the bottom of the read head. Both counting directions must coincide.

- If they do not coincide, the read head can be released from the base by pulling out at an angle and turned 180°. Then press the read head back on to the base and arrest.

- During this operation the coding line remains installed.

- The read head can be inserted by pulling or pushing.

- A laying plan with increasing code direction should be made up for each system and be available during installation. This plan should indicate where the code starts, and where fixed points and transitions are to be installed. The ascending counting direction for the main paths and auxiliary paths should be indicated clearly in the laying plan.

- The positions read off - beginning and end of each position path - are to be entered in this laying plan following installation.

3.6   Carrier profile
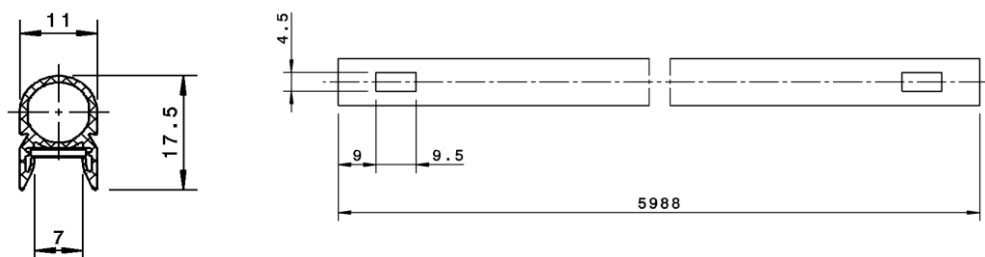
(Illustration of carrier profile with code strip)

Type	Weight kg	Order no.
TPA-U 10-6	0.51	2823258
TPA-U 10-4	0.34	2823468

Technical Information

- The carrier profile is delivered in a standard length of 5988 mm / 3988 mm without code strip and sliding strip.

- Its external configuration matches the isolation profile of the isolated conductor rail   U10, and as such, it can be clipped into the respective compact hangers.

- At the ends of the carrier profile, openings are placed in the back, which allow the joint caps to lock into place.

Project planning

- In connection with the power rail, the carrier profile should be mounted as the upper rail. It is installed in the compact hanger of isolated power rail U10.

Length of carrier profile depending on application

Type of use / Tu - area		Length of carrier profile	Air gap joint (UT = 20 °C (2))
Deep-freeze warehouse	(- 30 °C - 20 °C)	3 m	0 mm
Refrigerated storage	(-8 °C - 20 °C)	5 m	0 mm
Normal	(0 °C - 40 °C)	4 m	5 mm
Normal 1 (1)	(5 °C - 35 °C)	6 m	5 mm
Normal 2 (1)	(10 °C - 30 °C)	6 m	5 mm
Warm	(20 °C - 55 °C)	5 m	10 mm

(1) Application required, as Lmax for transition section US 10 A-D different to normal application.

(2) Air gap for deviating Tu see diagram in section 3.6.

<u>Assembly</u>

- First, install the joints of the transition sections (BFUs) on all the ends of the system / part lengths. Then mount the compact hangers, spacing in straight sections max. 600 mm, in bends max. 300 mm.

- Determine the position of the fixed points and consider them in the mounting sequence.

- The carrier profile is mounted continuously to the fixed point with the transition sections and connectors. Creation of a fixed point, see chapter "Locating clamp for carrier profile"

- Air gap at joint see chapter "Joints for carrier profile/assembly"

- Install carrier profiles up to the end as previously described. The length of the last carrier profile must be shortened at the end.

3.7   Joints for carrier profile
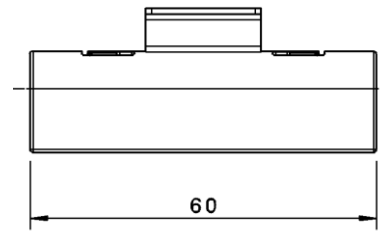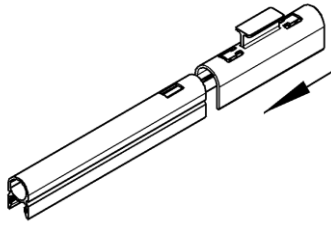
Type	Weight kg	Order no.
UV 10 A	0.004	2823267

Technical Information

● The U 10 - APOS carrier profiles are continuously mounted.
  The carrier profiles are connected using the joint.

Project planning

● The clearance from the next compact hanger should be min. 100 mm, max. 300 mm. In
  the joint, an expansion of plus or minus 5 mm can be supported based on the carrier profile.

Assembly

● Push the joints up against the carrier profile.

● Then insert the other carrier profile into the rail joint that is mounted halfway until it snaps
  into place.

Air gap at joint

①	Tiefkühllager	(-30°C bis 20°C)	--- --- ---
②	Kühllager	(-8°C bis 20°C)	————
③	Normal	(0°C bis 40°C)	---------
④	Normal 1	(5°C bis 35°C)	··················
⑤	Normal 2	(10°C bis 30°C)	-·--·--·-
⑥	Warm	(20°C bis 55°C)	————

Montagetemperatur MT [1°C = 1 mm]

[°C]

```
55
50
40
30
20
10
 0
-10
-20
-30
    0   1   2   3   4   5   6   7   8   9   10  [mm]
```

⑥ ⑤ ③ ④ ② ①

Air gap S_v [1 mm S_v = 10 mm)
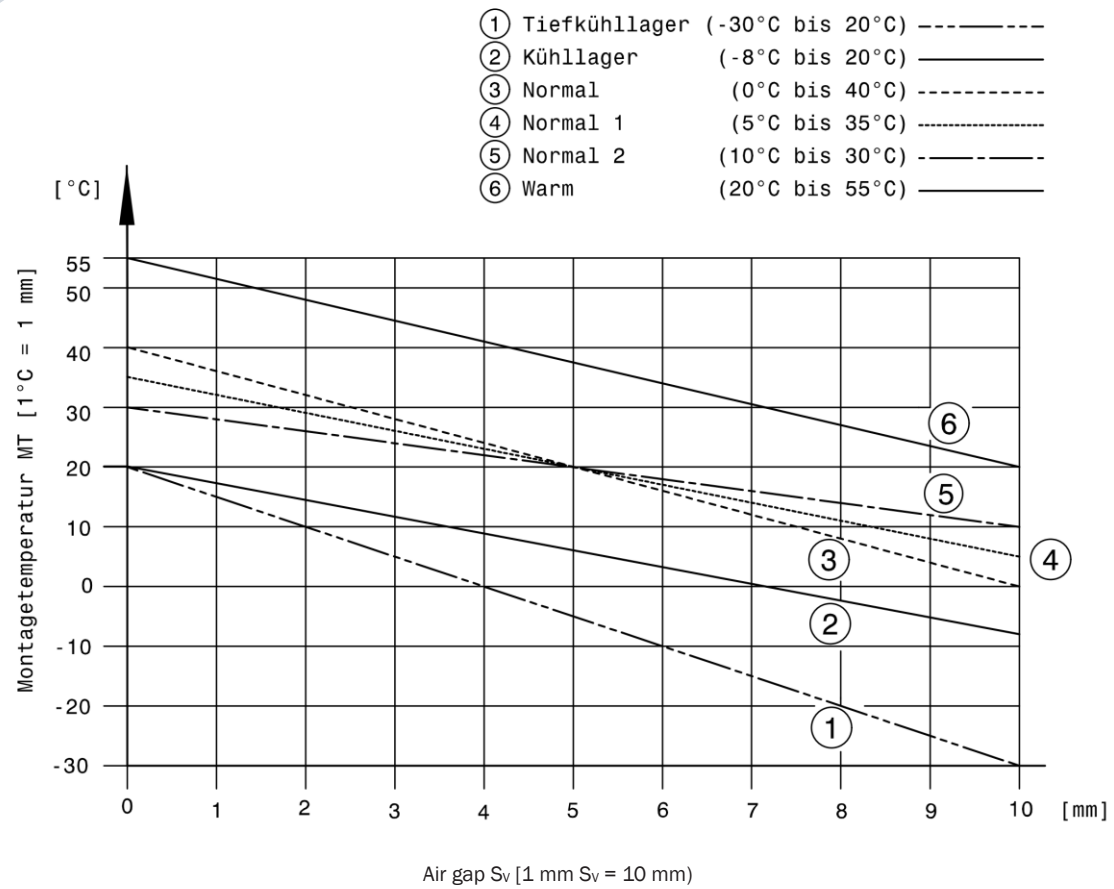
3.8 Locating clamp for carrier profile
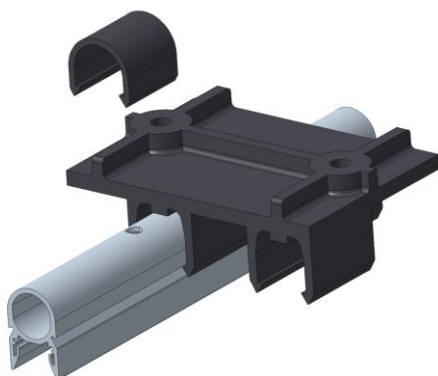
Type	Weight kg	Order no.
USK 10 A	0.002	2823268

Technical Information

- A fixed point consists of one fixed compact holder (not included here) and two locating clamps USK 10A.

- fixed points are assigned to the first and last carrier profile through the transition sections. In addition to that, fixed points are required at every maximum of 36 m in order to establish uniform expansion of the carrier profile.

- The U 10 compact holder is also provided here as a fixed point.

Project planning

- Two locating clamps USK 10A should be provided at every 36 m approximately.

Assembly

- At a set fixed point, in other words, on a fixed point compact holder, drill two holes Ø 3.2 mm into the rear side of the carrier profile using drilling template BS 10A. For hole clearance, see sketch.
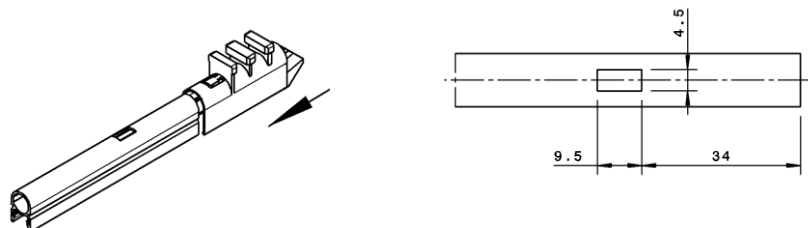
- Insert a locating clamp into each hole and snap the carrier profile into the fixed point compact holder.

3.9 Transition section US 10 A

Type	Weight kg	Order no.
US 10 A	0.005	2823270

Technical Information

● Transition section US 10 A is mounted at bend sections where the code rail is isolated and the curve ends.

● Transition section US 10 A is also mounted at the straight rail end of bend sections in switches

● The transition section is inserted at the beginning and at the end of the carrier profile and serves as fixed point.

Project planning

● In combination with isolated power rail U 10, see catalogue 2a.

● Permissible vertical and lateral offset of max. ± 2 mm (to each other).

● The permissible air gap between the transition sections is max. 6 mm.

Assembly

● Carrier profiles, code strip and sliding strip must have the same length.

● Shorten carrier profile to the appropriate length and insert clip holes with punch pliers LZ 10 A according to sketch.

● Push in transition section until it engages. In combined positioning and power rail systems, the transition sections fit the respective joints for transition sections (BFUs). See catalogue U10 No. 2a.

● Glue enclosed stickers with ascending coding direction clearly onto the carrier profile next to the transition section at counting direction of 80mm.

● Transition section US 10 A must flush with the transition sections of power rails U10.

3.10 Transition section US 10 A-D

Type	Weight kg	Order no.
US 10 A – D	0.008	2823609

Technical Information

- Transition section US 10 A - D is mounted to switches, lifts, sliders and/or straight system ends with transitions. That is where the code rail must be isolated.
- The transition section is inserted at the beginning and at the end of the carrier profile and serves as expansion compensation for the code strip and sliding strip.

- The minimum overhang Ül in the transition section is 10 mm, the max. overhang is 33 mm.

Project planning

- In combination with isolated power rail U 10, see catalogue 2a.

- Permissible vertical and lateral offset of max. ± 2 mm (to each other).

- The permissible air gap between the transition sections is max. 6 mm.

- Due to the construction length, use is only possible with straight power rail ends. Use with curved power rail ends such as e.g. at curved switch sections, is not possible.

Anordnung Überleitungsstücke
Weiche
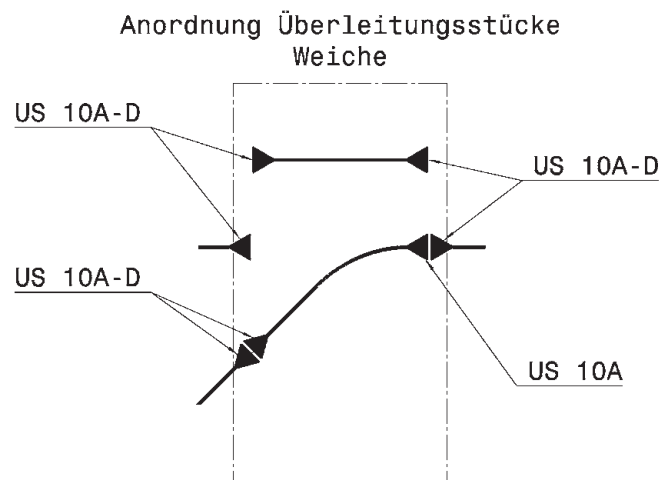
Assembly

- Code strip and sliding strip must be longer than the carrier profile.

- Shorten carrier profile to the appropriate length and insert clip holes with punch pliers LZ 10 A according to sketch.

- First mount the code strip and the sliding strip with the respective fixed point into the carrier profile, adjust overhang Ül and cut off. The fixed point must be central between the transition sections.

- Push in transition section until it engages. In combined positioning and power rail systems, the transition sections fit the respective joints for transition sections (BFUs). See catalogue U 10 No. 2a.

- Glue enclosed stickers with ascending coding direction clearly onto the carrier profile next to the transition section at counting direction of 80 mm.

- Transition section US 10 A-D must flush with the transition sections of power rails U10.

- Overhang Ül to the adjusted in transition section US 10 A – D:

Overhang $Ü_l$ depending on the application

(1) Tiefkühllager (-30°C bis 20°C), L_{max} = 28750 mm ——————
(2) Kühllager   (-8°C bis 20°C), L_{max} = 51340 mm ——————
(3) Normal   (0°C bis 40°C), L_{max} = 35940 mm ----------
(4) Normal 1   (5°C bis 35°C), L_{max} = 47920 mm ··················
(5) Normal 2   (10°C bis 30°C), L_{max} = 71875 mm -——-——-
(6) Warm   (20°C bis 55°C), L_{max} = 41070 mm ——————

Overhang Ü1 [1 mm $Ü_1$ = 10 mm]
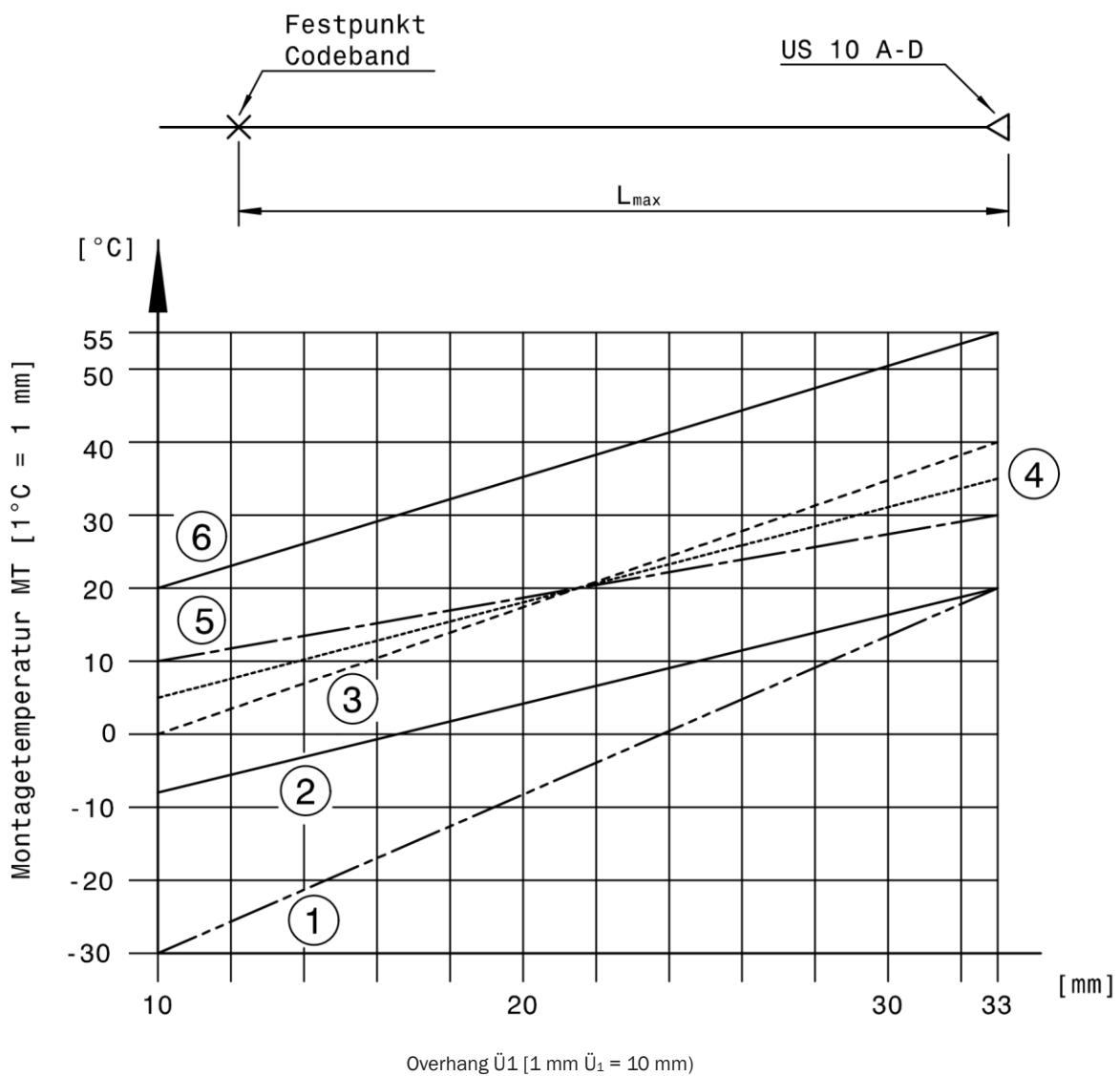
Overhang Ül independent of the application area

③ Normal   (0°C bis 40°C = ± 20K), L_{max} = 36000 mm ----------
④ Normal 1 (5°C bis 35°C = ± 15K), L_{max} = 47000 mm ·················
⑤ Normal 2 (10°C bis 30°C = ± 10K), L_{max} = 72000 mm -——·——-

Overhang Ü1 [1 mm $Ü_1$ = 10 mm)
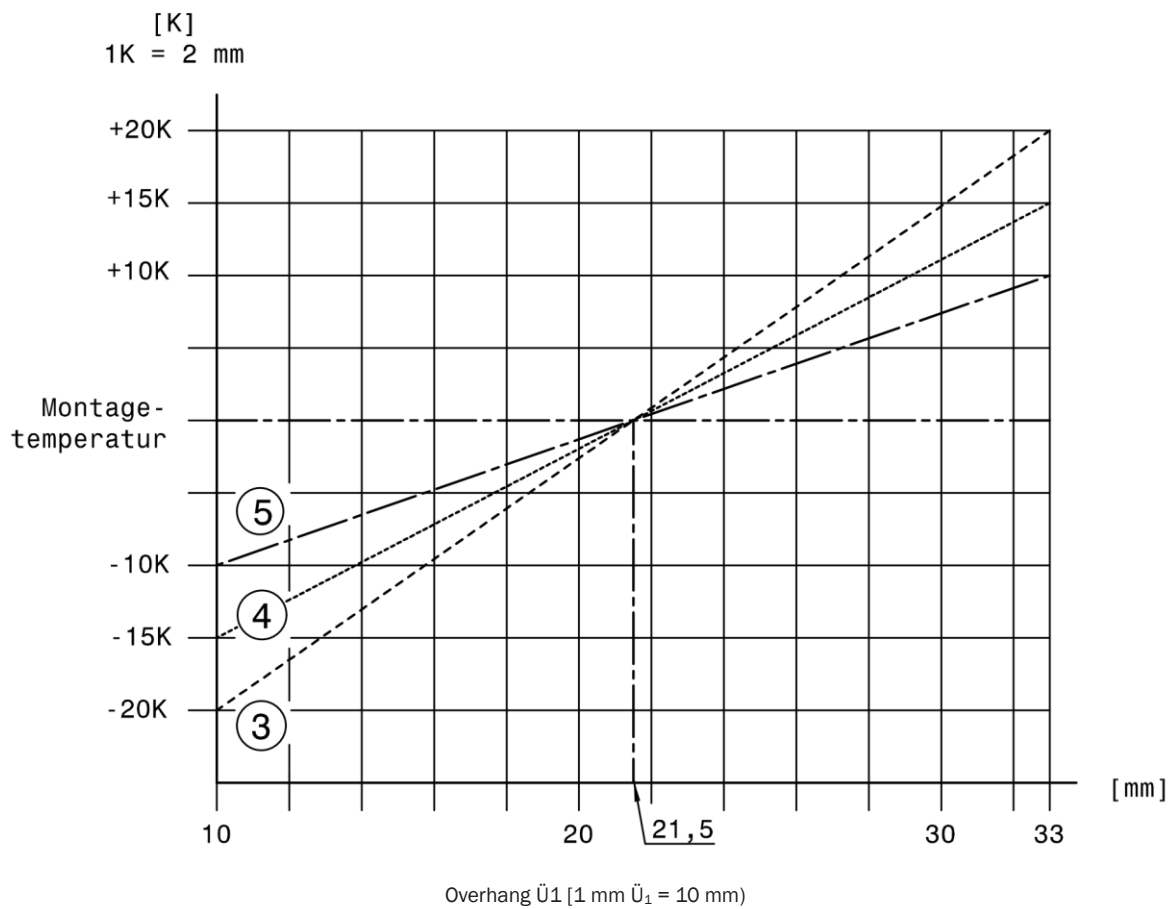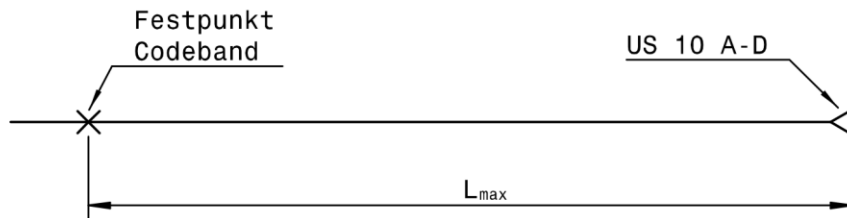
In order to avoid faults during the assembly of the transition section on the BFUs at the oblique section of a switch, the following illustrations are to be observed for clarification purposes.
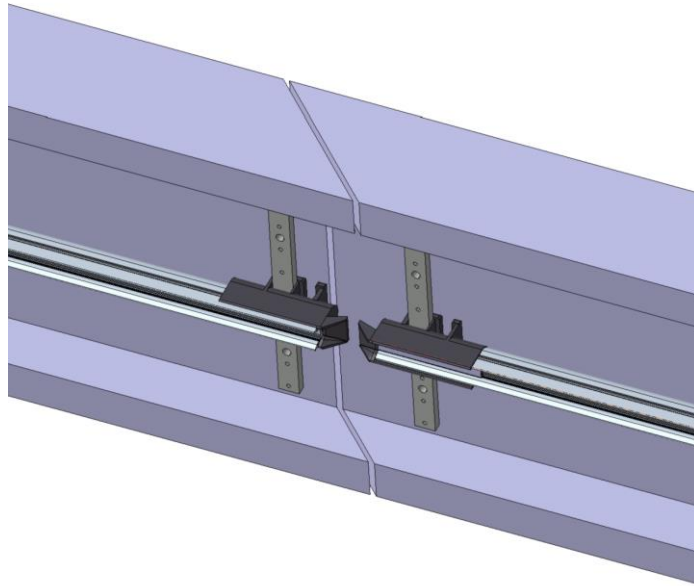
Arrangement of the latching lugs of the transition section at the BFU with power rail right-hand exit, or left-hand entry.
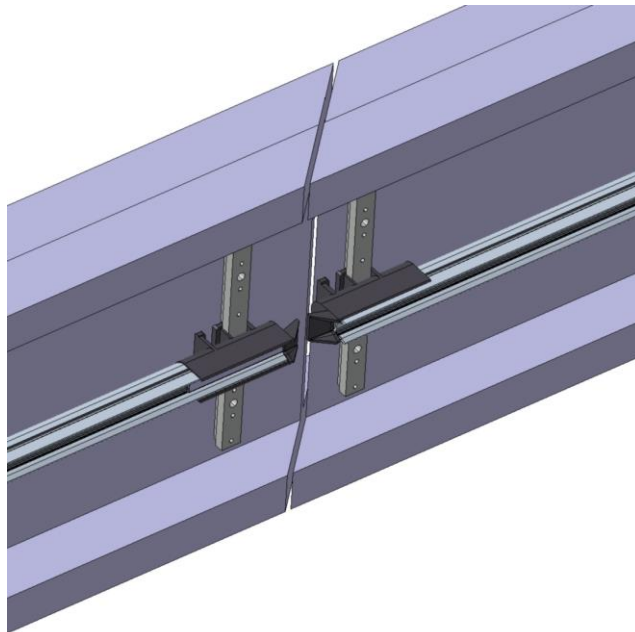
Arrangement of the latching lugs of the transition section at the BFU with power rail left-hand exit, or right-hand entry.

3.11 Expansion joint for code rail

Φ3,2
bei Montage
im Tragprofil

20 ±1   20 ±1

0 - 15   0 - 15

Dehnspalt 15-45

Note:

- Set the expansion gap according to the ambient temperature
- In building expansions, it must be synchronous with the tracks
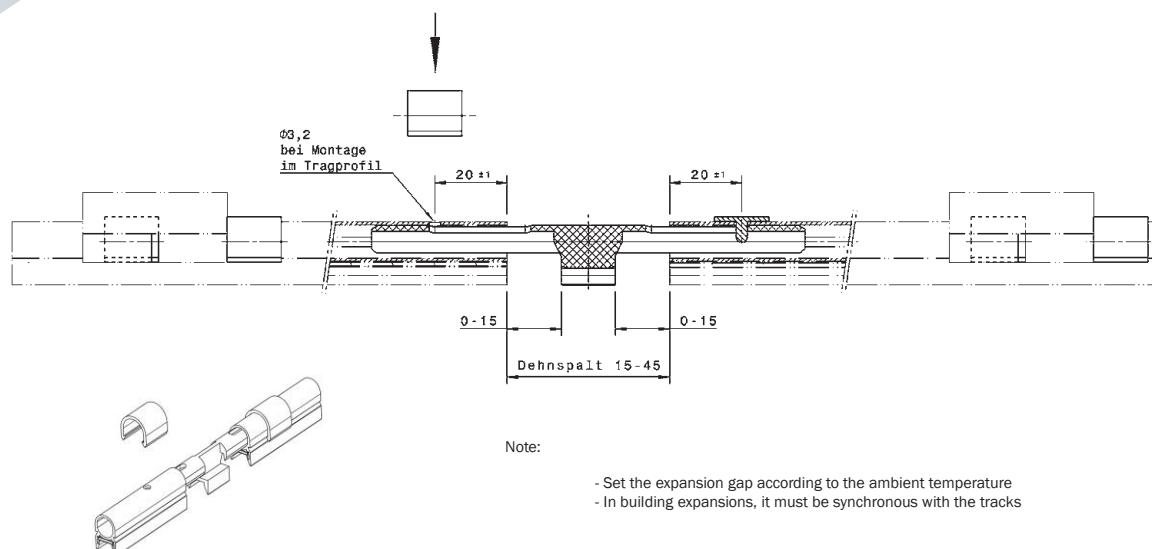
Type	Weight kg	Order no.
UDV 10 A - 30M	0.006	2823269

Technical Information

- The expansion gap serves as expansion range for the code rails.

- The thermal change in length of the carrier profile is supported by the joints.

- Expansion joints should be used for expansions in the conductor profile, code strip or buildings.

- The expansion joint is mounted as centrally as possible between two fixed points with a position tolerance of +/-1mm. Since the position cannot be recorded at this point, it should be discussed with the customer beforehand.

- A fixed point is assigned to the right and left side of a carrier profile.

Project planning

- The expansion joint has an elongation value of max. 30 mm.

- Note the location of the expansion joint when planning; no position is recorded in the expansion joint area.

- An additional compact holder is to be included in the parts list for each expansion joint.

- The delivery contents for an expansion joint includes parts for constructing two fixed points on the carrier profile (9 pieces altogether).

Assembly

- Determine the position of the expansion joint and just the air gap in accordance with the diagram. The clearance to the next compact holder should be approx. 125 mm (centre of expansion joint / centre of compact holder following the adjusted air gap). Then fasten the carrier profile.

- To save assembly time, the expansion joints should be prepare before beginning assembly on the assembly table.

- The distance between a joint, carrier profile and an expansion joint is a minimum of two compact holders.

- Isolate carrier profile.

- Insert holes using drilling template BS 10A according to the sketch. Insert sliding piece and push a locating clamp into each hole.

- Mount a compact holder on either the left or right side of the expansion joint at a maximum clearance of 100 mm. If necessary, mount additional compact holders.

- Fasten each compact holder with a thread rolling screw (included in the delivery).

- Set expansion gap according to ambient temperature or expansion gap in the track.

Expansion gap to be set:

For expansion joints
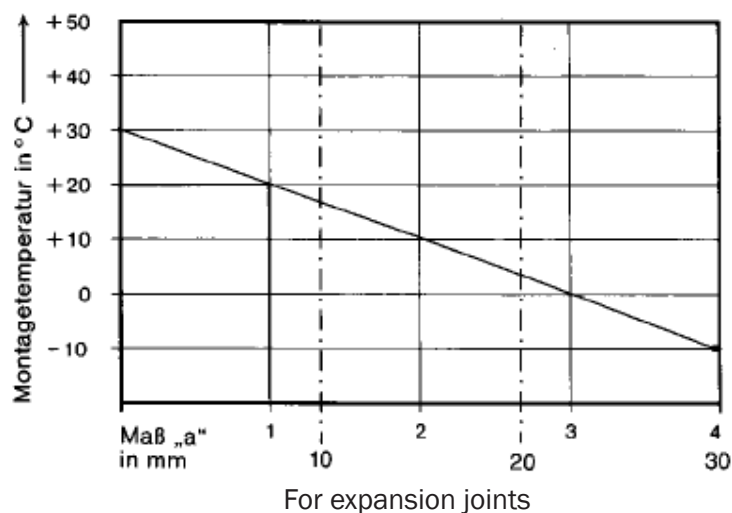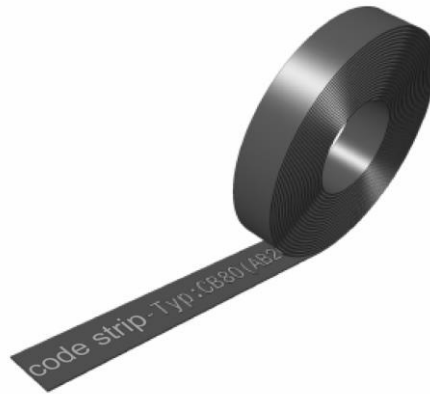
3.12   Code strip

Type	Weight kg/m	Order no.
CB 80	0.046	2823255

Technical Information

- The code strip is a permanent magnet. It is 8 mm wide and 1.5 mm thick, including a metal band placed on its rear side.

- The code strip is delivered on a roll. The coding starts on the outer loop in ascending numeration.

- When making the strip, the metal spine is wound around the exterior.

- The code start is designated

- The maximum length of coding is 515 m.

Project planning

- The maximum roll length is 262 m in roll A, 253 m in roll B, and 9 m in spare roll C.

- To order code strip, use the order number and the required coding for every part length needed.

- The code strip can also be mounted in interrupted measurement paths.

<u>Important note:</u>

No position can be recorded in the expansion joint area (isolation of the code strip).

Ascending counting direction of the code strip is required in vehicles with a single travel direction across the track system (e.g. EHBs).

<u>Assembly</u>

● The code strip is delivered on a roll.
   Coding starts on the outer loop in ascending numeration.

   Note:

   Before beginning assembly, please particularly note that:

   The metal spine of the code strip is wound around the exterior of the roll. The code start at the beginning of the strip is designated.
   The code strip is cut at this point.
   Install code strip from packaging.

● To install it, the code strip roll must be placed on a clean surface in the mounting direction when unwinding it.
   If magnetic particles (iron filings etc.) stick to the code strip, they must be removed completely.
   After cutting it, the code strip is inserted right from the beginning, into the carrier profile using press roll ADR 10A, and installed in sequences. Make sure the code strip does not shift during installation (beginning of the band).
   The counting direction is clearly in ascending order. The metal spine is attached to the carrier profile.

   Caution:

   The packaging serves as an installation aid and must not be cut open.

3.13 Adhesive tape for code strip fixed point

Type	Weight kg	Order no.
Adhesive tape, double-sided, 6 mm wide, 50 m	1.000	2823028

Technical Information

- The fixed point is created using double-sided adhesive tape.

- The adhesive tape can be stored for 2 years.

- After the assembly of the carrier profile and before assembly of the code strip, the adhesive tape is glued over a length of 600 mm to the contact surface of the carrier profile.

- A piece of adhesive tape with a length of 300 mm is sufficient for partial lengths </= 2 m.

- Each code strip length must be fixed. The fixed points are set up every max. 36 m and fix the code strip in the longitudinal direction.

- In case of partial lengths after transition sections, the code strip is fixed with a clearance of <= Lmax. (see chapter 3.9).

- The code rail can expand or contract flexibly in the carrier profiles.

Project planning

- The code strip is to be fixed at a clearance of <= Lmax. following each transition section.

- In the further course of the system the code strip is fixed every max. 36 m.

Assembly

- The double-sided adhesive tape is glued into the carrier profile near the fixed points and directly in front of each transition section.
  The protective film is only pulled off the adhesive tape immediately before assembly of the code strip and the sliding strip (see chapter "Code strip" and chapter "Sliding strip").

- The code strip is fixed centrally in the moving part sections of switches, lifting stations and turntables.

3.14   Sliding strip
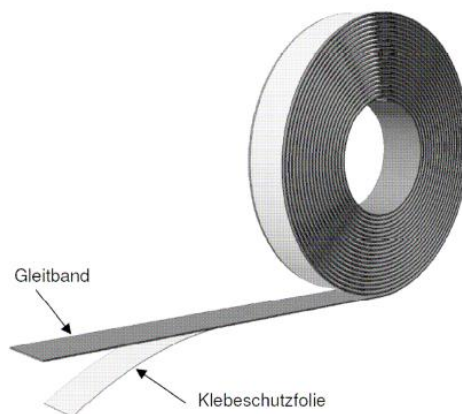
Type	Weight kg/m	Order no.
GB 80	0.132	2823446

Technical Information

- The sliding strip is a flat, self-adhesive stainless-steel strip with the same length as the code strip.

- It serves as the sliding guide of the APOS read head.

- The max. shelf life of the sliding strip is 12 months.

- **The self-adhesive sliding bands must be installed smoothly over the entire code strip! Subsequent attachment is not permissible!**

Project planning

- The required length corresponds to the code strip length.

- The sliding strip must be glued without intervals per segment.

- The roll length is 262 m.

<u>Assembly</u>

- After installing the carrier profile and the code strip, glue the sliding strip uniformly onto the code strip using press roll ADR 10A.

- During the intervals, remove any burrs from the end of the sliding band and must be slightly bent backwards using pliers!

- The sliding strip should be interrupted at expansion joints.

- On system ends (transition sections), deburring takes place before installing the transition sections!

- Also, before installation, bend the code strip backwards together with the glued sliding strip using long-nosed pliers.

- To install it, the sliding strip must be placed in the packaging on a clean surface in the mounting direction. Any dirt on the code strip must be removed completely before gluing the sliding strip onto it.

- In curve sections, the sliding strip is to be glued to the code strip after assembly of the carrier profile.

Important note:

The packaging serves as an installation aid and must not be cut open.

3.15   Inlay strips
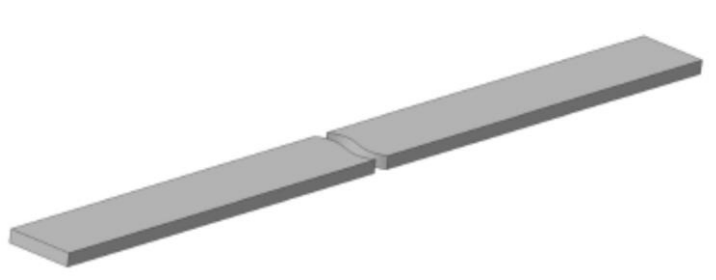
Type	Weight kg	Order no.
8 x 1.5	0.012	2806618

Technical information

- When inlay strips are used, a vertical curve with a minimum of 1000 mm is possible see Chapter 6 "Creating curves ".

- The inlay strip has the same measurements as the code strip.

Project planning

- Note areas with feeder belt, because no position is recorded here by the read head. The length is 2 m.

Assembly

- Installation of the insertion strip analogous to the code tape.

3.16   Wear test segment APOS-U10
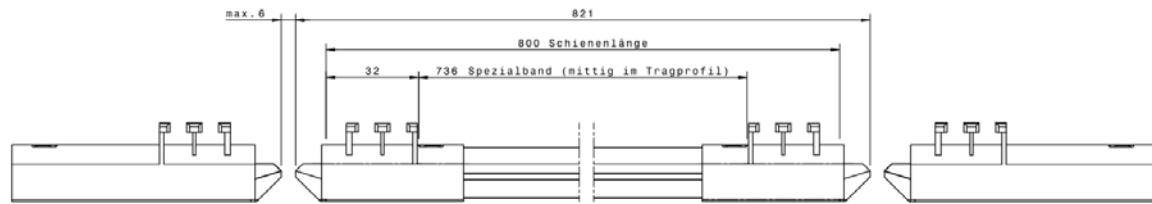
Wear test segment APOS U 10 arrangement

Type	Weight kg	Order no.
Wear test segment APOS U10	1.2	2823438

The APOS system for the VAHLE U10 rails offers a wear recognition feature for the sliding read head.
For recognition it is necessary for the APOS read head to move past a special code segment, which must be provided in the path additionally.
Positioning is not possible within the wear test segment with length of 821 mm.
Subsequent revision /02 the wear test segment can be used bi-directionally.

Technical Information

- The wear test feature is provided only for the APOS read head with Steel2 interface.

- The wear test feature can be initiated by a special code sequence not otherwise present in the path.

- The maximum travel speed in the wear test segment is 1 m/s

- Diagnosis is performed in the wear test segment and the read head does not output any position values

- The wear test will be initialized with a specific position value sequence contained in the wear test segment code tape. This code sequence cannot be changed.
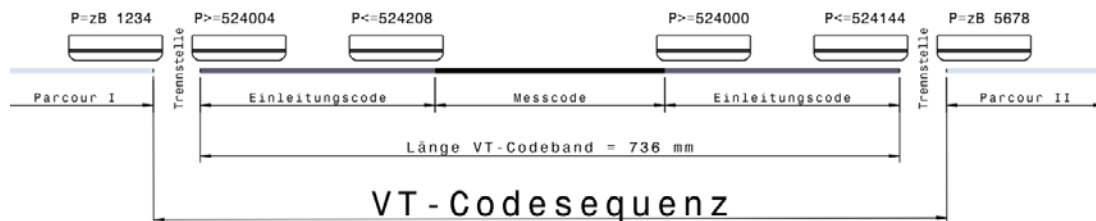
- Up to revision /02 the wear test segment can be used in the indicated direction only. Subsequent revision /02 the wear test segment can be used bi-directionally. However, the reading heads must also be compatible with bi-directional travel.

Description of procedure:

- First run: After start-up or replacement of cap:
  Storage of field strength and setting status message (ERROR bit = 0)

- Subsequent runs: Compare current field strength with value saved => wear continuously decreases the thickness of the read head cap and the field strength increases => after reaching a certain level, the wear reaches a value requiring immediate replacement of the cap.

- When worn a status message is output to the control unit (ERROR bit = 1)

Important note:

It is necessary to report replacement of the housing cap to the read head.
This can be accomplished using the so-called reset key.

Here it is necessary to observe two points:
- The APOS read head must be supplied with power
- The arrows on the reset key and the read head must point in the same direction
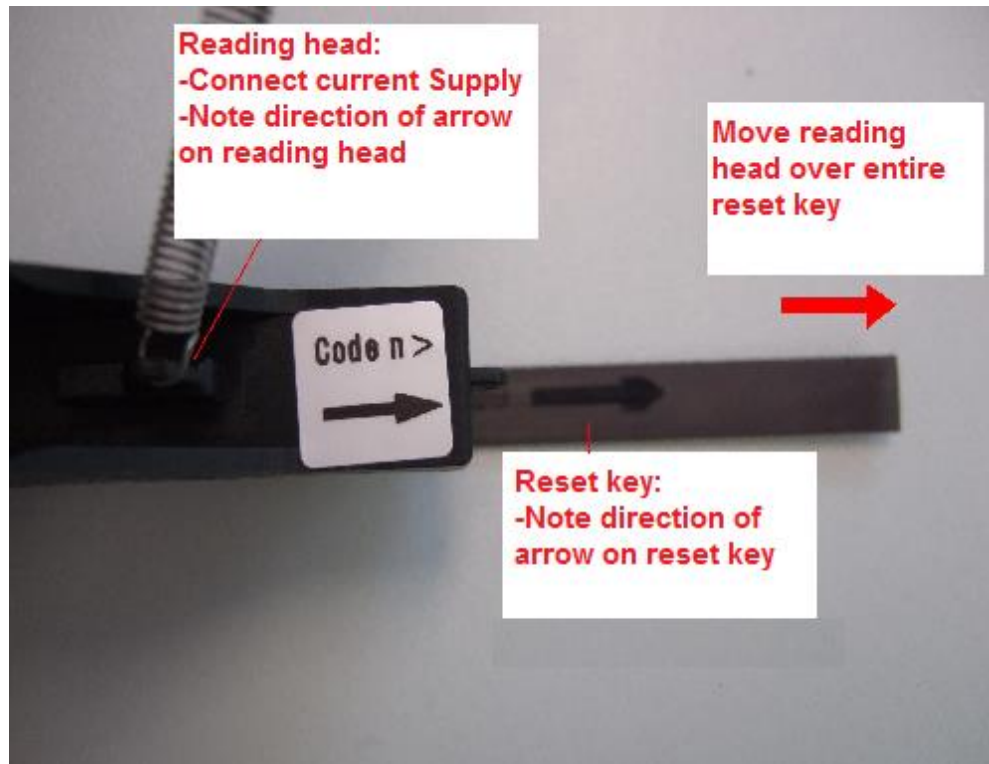
Configuration notes

- The wear test segment can be installed only at straight sections.

- The APOS reading head must move without interruption over the entire VT code sequence.

- Max. travel speed in the wear test segment is 1 m/s.

- Contact interruption, e.g. bouncing or jumping of the reading head on the VT code sequence produces error readings. The reading head must be reset.

- Current supply must be 'on'. Switching to 'on' while traveling of the VT code sequence produces error readings.

- Position detection is not possible within the wear test segment.

- The system's control unit should treat position values > 523836 similar to error messages.

3.17   Read head for APOS

Type	Weight kg	Order no.
LKG- 17, RS 485	0.15	2823626
LKG-A 17 Steel2 compatible / 62,5	0.15	2823666
LKG-A 17-SSI / G	0.15	2823681
LKG-A 17 Leuze BIN 1 compatible	0.15	2823688

Technical Information

- It is mounted sideways or vertically.

- The read head can be deployed by pulling or pushing (reversing operation).

- Smallest curve radius, horizontal min. 750 mm, vertical min. 2300 mm. with readable coding

- When inlay strips are used a vertical curve with min. 1000 mm is possible. Due to the inlay strip, recognition of the coding is not possible here.

- For length of connecting cable, see drawing.

- Extension cables are available.

- The read head is not suitable for entry and exit from the carrier profile.

- The anticipated service life of the APOS-U10 read head housing is approx. 12,500 km on a properly installed system depending on the type of use and environmental conditions.

Project planning

- Lift = ± 15 mm and lateral deviation = ± 15 mm, for attachment to compact current collector KDS 2/40

- Lift = ± 15 mm and lateral deviation = ± 15mm, without attachment to a current collector set

- The read head is integrated into a multipole compact double current collector KDS 2/40.

Assembly

- The counting direction on the underside of the read head must match the counting direction of the code band.

- When laying the connecting cable for the read heads, make sure that the connecting cable does not restrict the mobility of the read head during curved travel and on a straight path. The installation position must not be influenced.

- **Make sure that the stroke and lateral deflection are not exceeded over the entire distance.**

Assembly
Read head LKG-A 17 RS 485

Isometric view
Scale 1:2

Remarks
–Contact pressure approx. 7 N

Read head LKG–A/17
with RS 485 protocol

279-80-171225/2

Pin assignment, connector M12 A-coded

1 = brown	GND (0V)
2 = white	TX-
3 = blue	TX+
4 = black	24 VDC

View X

Connection line
UL listed, unshielded,
4-pole, black, silicone-free,
plug, screwed on, M12x1

Caution!
VE bolts and nuts
included loose

Read direction

Installation height = 77
Stroke = ±15

Deflection ±15

Section A–A
Scale 1:1

Assembly
Read head LKG- 17 with steel 2 protocol and 62.5 kBaud

Isometric view
Scale 1:2
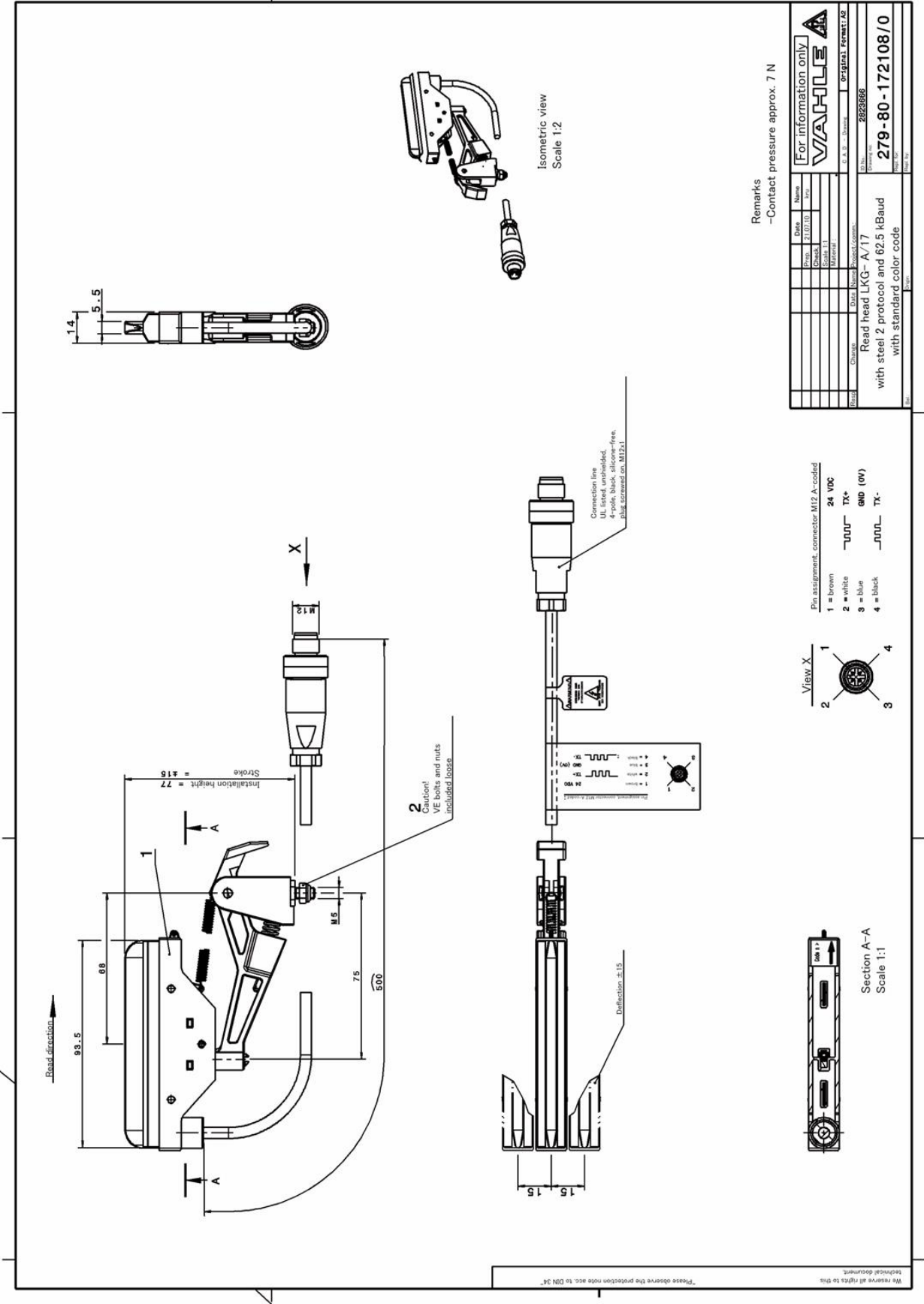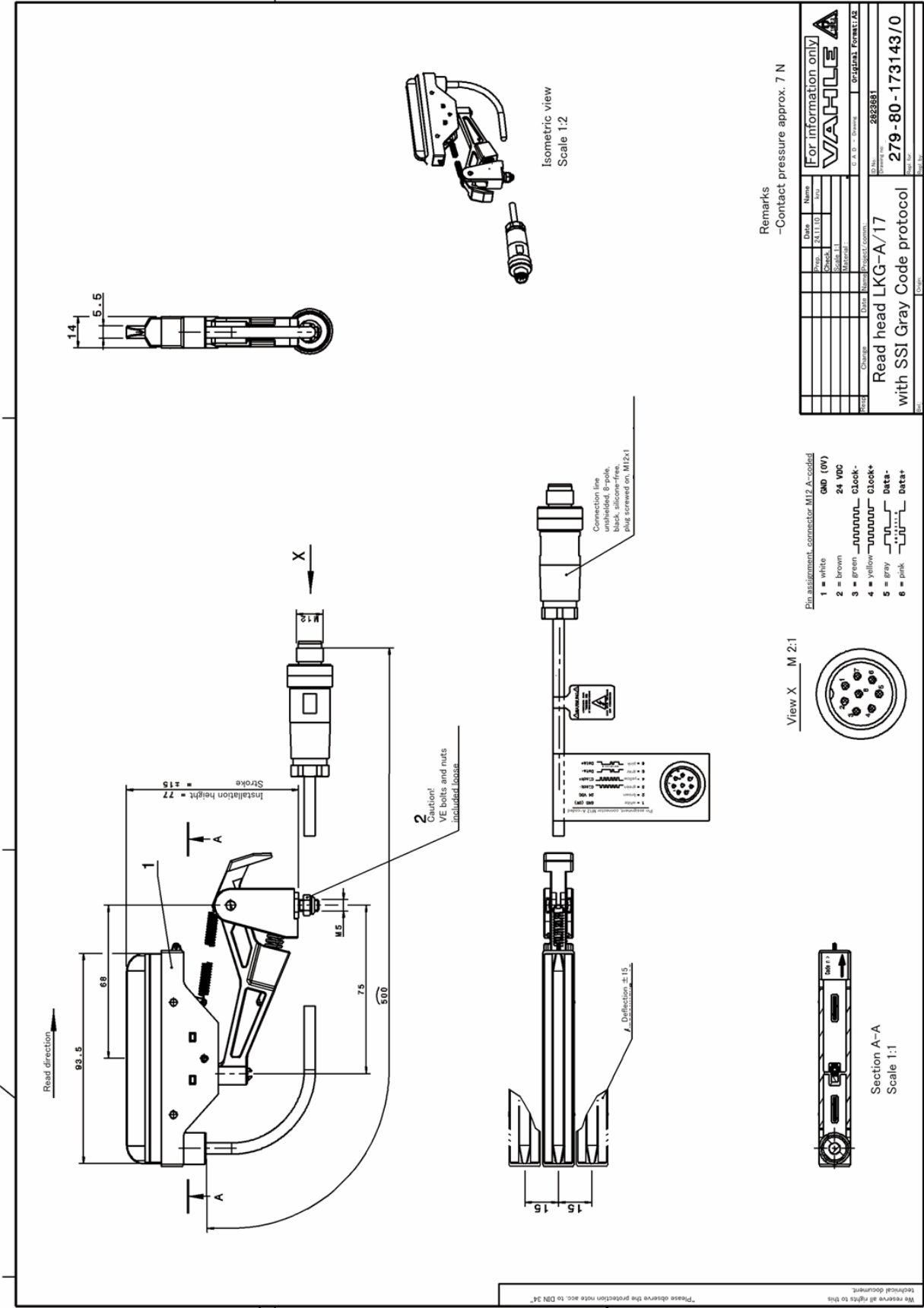
Remarks
~Contact pressure approx. 7 N

For information only

VAHLE

279-80-172108/0

Read head LKG- A/17
with steel 2 protocol and 62.5 kBaud
with standard color code

Pin assignment, connector M12 A-coded
1 = brown   24 VDC
2 = white   TX+
3 = blue   GND (0V)
4 = black   TX-

View X

Section A-A
Scale 1:1

Connection line
UL listed, unshielded,
4-pole, black, silicone-free,
plug screwed on, M12x1

Caution!
VE bolts and nuts
included loose

Read direction

Installation height = 77
Stroke = ±16

Deflection ±15

Assembly
Read head LKG-A 17-SSI / G

Isometric view
Scale 1:2

Remarks
-Contact pressure approx. 7 N

Read head LKG-A/17
with SSI Gray Code protocol

279-80-173143/0

Connection line
unshielded, 8-pole,
black, silicone-free,
plug screwed on, M12x1

Pin assignment, connector M12 A-coded

1 = white   GND (0V)
2 = brown   24 VDC
3 = green   Clock-
4 = yellow   Clock+
5 = gray   Data-
6 = pink   Data+

View X   M 2:1

Read direction

Ø3.5
68
75
500

Stroke = ±15
Installation height = 77

M5

Caution!
VE bolts and nuts
included loose.

Section A-A
Scale 1:1

Deflection ±15

15   15

Assembly
Read head LKG 17 with Leuze binary code type 1

Isometric view
Scale 1:2

Remarks
~Contact pressure approx. 7 N

Read head LKG-A/17
with Leuze binary protocol type 1

279-80-173557/0

Original Format: A3

Connection line
UL listed, unshielded,
4-pole, black, silicone-free,
plug screwed on M12x1

Pin assignment, connector M12 A-coded
1 = brown   24 VDC
2 = white   TX-
3 = blue   GND (0V)
4 = black   TX+

View X

Read direction

Installation height = 77
Stroke = ±15

Caution!
VE bolts and nuts
included loose

Deflection ±15

Section A-A
Scale 1:1

3.18 Changing read head housing for APOS

Disassembly

Read head housing

Snap lock
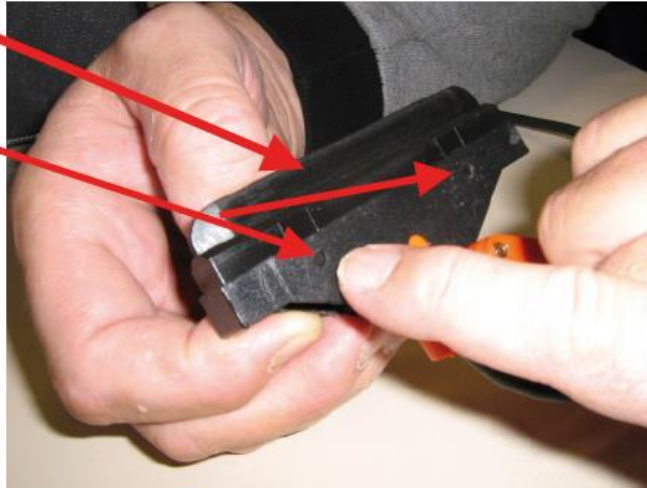
Loosen the snap locks on both sides and lift the housing out of the locking device
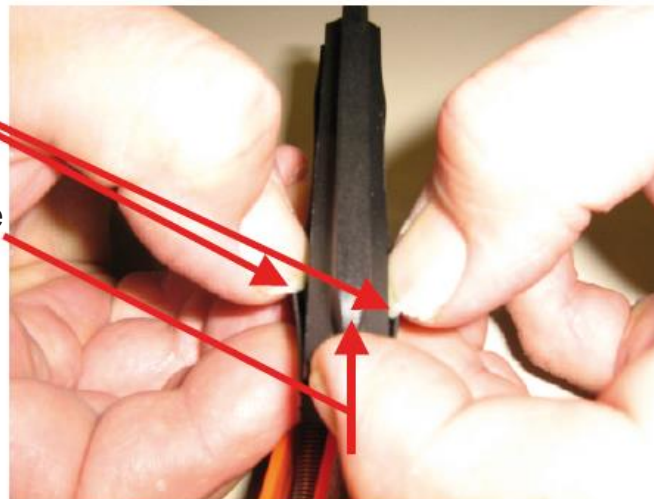
Carefully pull the housing off the read head PCB.

Do not touch the PCB with your fingers!
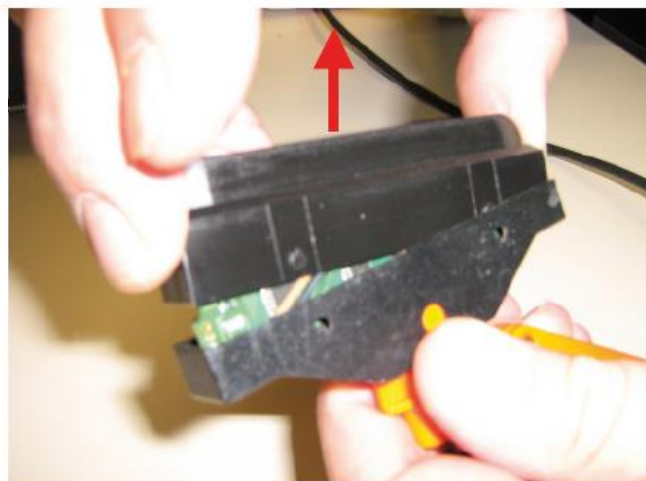
Assembly

Insert the read head
PCB into the guide
grooves of the housing.
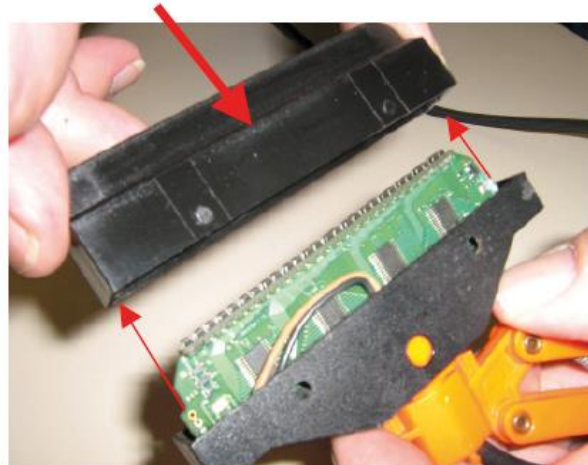
Carefully pull the housing
over the PCB.
In doing so, the position of
the connecting leads
must not be changed.
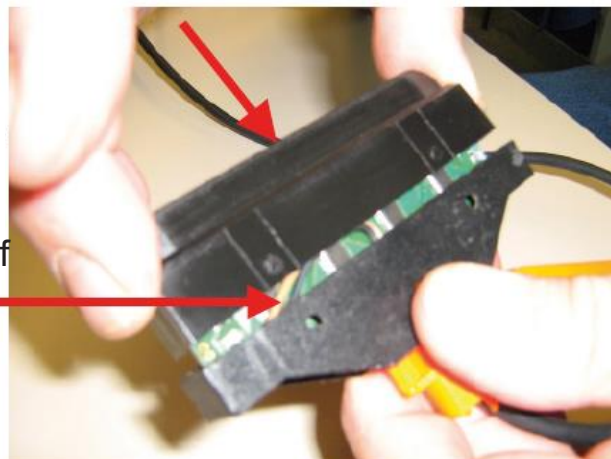
The read head housing is
now pressed into the
bottom section, into the 4
latching lugs.
After locking, the housing
must lie flat on both sides
over the full surface in the
bottom section.
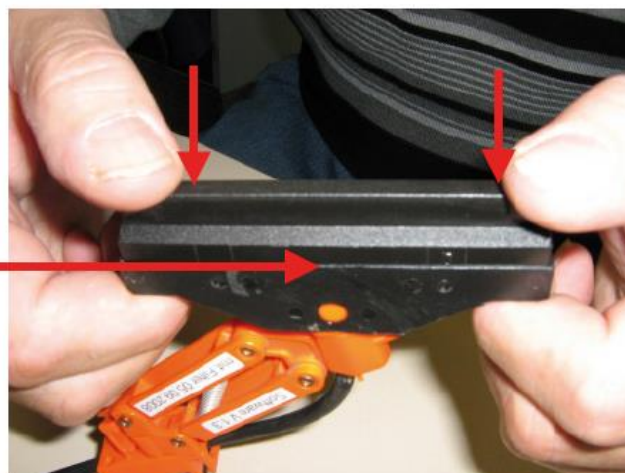
3.19   Interface converter SU for read head

Type	Weight kg	Order no.
SU Profibus for RS485 Steel / 62.5 kBit	0.58	2518699

Technical Information

- The interface converter has supply voltage of 24 VDC.

- The required mounting rails TS 35 can be delivered with end clamps.

- The outlet of the interface converter for controlling is connected through a 9-pole D sub plug-in connector.

Project planning

- If an interface converter is required, read head LKG 17-RS 485 Steel / 62.5 kBit must be used.

- If a bus system is not required, the read head can used installed without interface converter.

- All other read heads do not require an interface converter.

Assembly

- It is installed on a mounting rail TS 35 with end clamps.

- The read head is connected to the interface converter through a 4-pole plug-in connector.

4. Protocol descriptions for read head LKG-A 17

4.1 Standard protocol

The VAHLE APOS standard read head sends its position to the RS485 every 2 ms.

One position transmission consists of 3 bytes, the most significant byte first, the least significant byte last.

The LS bit of the LS byte has a significance of 1mm.

The baud rate is 9600, one start bit, 1 stop bit and no parity bit.

An error code is sent in unreadable areas.

Error code: FFFFFFh
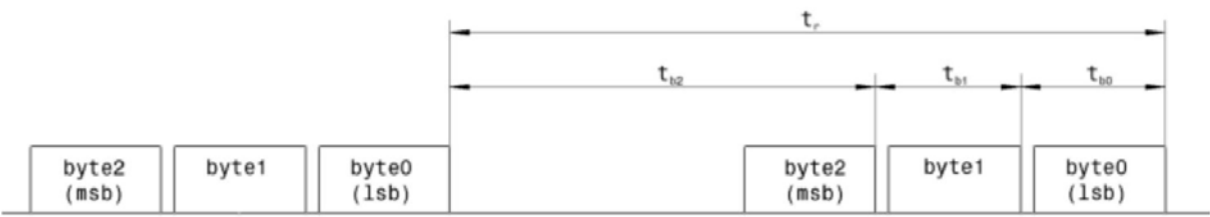
Position (n)   Position (n + 1)

RS 485 time diagram

t_{b2}	(t_{byte2}) = min. 7.0 ms;		max. 7.4 ms
t_{b1}	(t_{byte1}) = min. 1.0 ms;		max. 1.8 ms
t_{b0}	(t_{byte0}) = min. 1.0 ms;		max. 1.8 ms
t_r	(t_{rate}) = min. 9.8 ms;		max. 10.2 ms

4.2 Steel 2 protocol with 62.5 kBd

Interface:	RS 485
Baud rate:	62500 Baud
Data bits:	9
Start bit:	1
Stop bits:	2
Parity:	NONE
Read head response time:	60-120us

Request from the control for a position value of the APOS read head.

Bit	8	7	6	5	4	3	2	1	0
	1	0	1	1	0	0	0	A1	A0

In case of a position request, the APOS read head sends a 4-byte response.

Response of a valid position value from the APOS read head to the control.

Bit	8	7	6	5	4	3	2	1	0
Byte1	0	0	0	A1	A0	0	Pos.18	Pos.17	Pos.16
Byte2	0	Pos.15	Pos.14	Pos.13	Pos.12	Pos.11	Pos.10	Pos.9	Pos.8
Byte3	0	Pos.7	Pos.6	Pos.5	Pos.4	Pos.3	Pos.2	Pos.1	Pos.0
Byte4	0	CS.7	CS.6	CS.5	CS.4	CS.3	CS.2	CS.1	CS.0

Response of an error message from the APOS read head to the control.

Bit	8	7	6	5	4	3	2	1	0
Byte1	0	1	0	A1	A0	0	0	0	0
Byte2	0	0	0	0	0	0	0	0	0
Byte3	0	0	0	0	0	0	0	0	0
Byte4	0	CS.7	CS.6	CS.5	CS.4	CS.3	CS.2	CS.1	CS.0

A0 and A1 correspond with bits 0 and 1 from the request.

Pos.0 to Pos.18 form the required position value.

Pos.0 is the most insignificant bit.

CS.0 to CS.7 are check total bits that are formed as follows:

Byte4 = byte1 x or byte2 x or byte3

4.3   Leuze binary protocol 1, compatible with BPS 8

Interface:	RS485
Baud rate:	57600
Data bits:	8
Start bit:	1
Stop bits:	1
Parity:	NONE
Read head response time:	500us

Position request telegram

	7 Bit	6 Bit	5 Bit	4 Bit	3 Bit	2 Bit	1 Bit	0 Bit
Byte 0	0	0	0	0	1	0	0	0
Byte 1	0	0	0	0	1	0	0	0

Single shot request telegram

	7 Bit	6 Bit	5 Bit	4 Bit	3 Bit	2 Bit	1 Bit	0 Bit
Byte 0	0	0	0	0	1	0	0	0
Byte 1	0	0	0	0	1	0	0	0

Read head position - response telegram

	7 Bit	6 Bit	5 Bit	4 Bit	3 Bit	2 Bit	1 Bit	0 Bit
Status byte	0	0	0	0	0	0	0	0
Data byte1	31 Bit	30 Bit	29 Bit	28 Bit	27 Bit	26 Bit	25 Bit	24 Bit
Data byte2	23 Bit	22 Bit	21 Bit	20 Bit	19 Bit	18 Bit	17 Bit	16 Bit
Data byte3	15 Bit	14 Bit	13 Bit	12 Bit	11 Bit	10 Bit	9 Bit	8 Bit
Data byte4	7 Bit	6 Bit	5 Bit	4 Bit	3 Bit	2 Bit	1 Bit	0 Bit
	x	x	x	x	x	x	x	x

Read head error message in the event of code strip loss or gap

Read head response telegram

	7 Bit	6 Bit	5 Bit	4 Bit	3 Bit	2 Bit	1 Bit	0 Bit
Status byte	0	0	0	0	0	0	1	0
Byte1	0	0	0	0	0	0	0	0
Byte2	0	0	0	0	0	0	0	0
Byte3	0	0	0	0	0	0	0	0
Byte4	0	0	0	0	0	0	0	0
Byte5 XOR	0	0	0	0	0	0	1	0

4.4 SSI standard specification Vahle APOS

A shift register with the current measured value is permanently loaded in the sensor. If a data value is to be read, the control issues a clock pulse cluster on the clock line. The first falling edge controls a monoflop in the sensor an, that switches the shift register from parallel loading to serial output.

A data bit is now issued for each following rising clock edge. The clock pulse is stopped when the lowest significant bit has been received. The monoflop that was always retriggered by the clock pulses falls back to its basic state after expiration of the switching time and enables the adoption of the measured values into the shift register. Until then the data line is kept at low level.

Impulse diagram of data transmission

Tmonoflop_nin =28 µs

Tmonoflop_max =32 µs

Telk >=6.7 µs
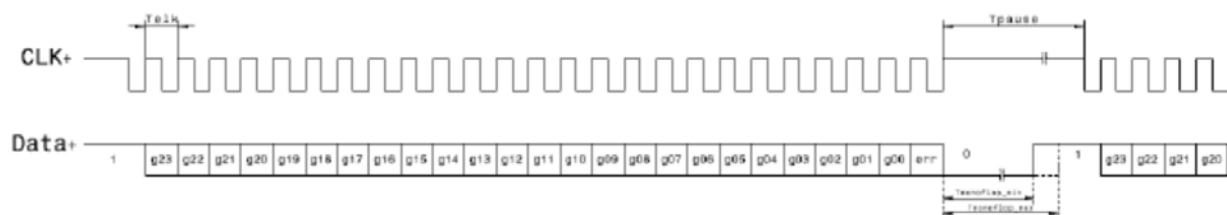
Telk <= Tmonoflop_nin =28 µs

Tpause > Tmonoflop_max =80 µs

fckl =1/Telk <= 150kHz

fckl > 40kHz

GRAY = {g23 ...g00}

Err = 1 "Sensor outside code strip or overruns a gap or expansion point"

Other err = 0

Measuring interval: 2,5 ms

Please note:

The telegram comprises 24 data bits and an error bit (ERROR). The error bit will be placed temporarily at "1" (then back to "0") if a reading error has occurred (reading head has lost contact). Position indicated during this moment is the position value read before error occurred.

5.   Installation tool

5.1   Hole puncher
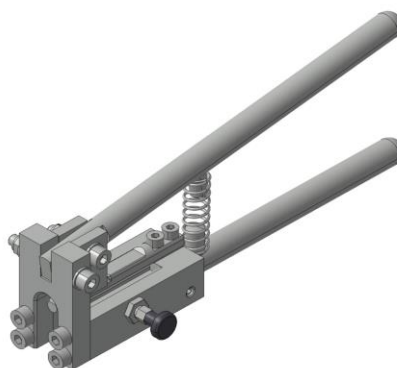
Type	Weight kg	Order no.
LZ 10 A	2.4	2823443

5.2   Drilling template for fixed point carrier
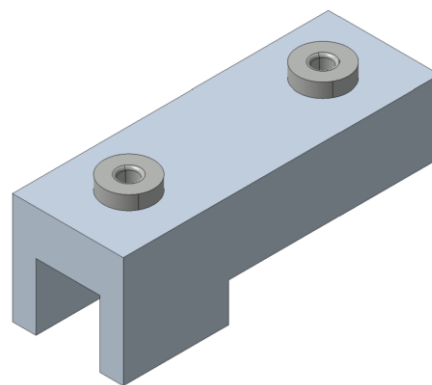
Type	Weight kg	Order no.
BS 10 A	0.15	2823266

5.3   Code strip / sliding strip pressing roller
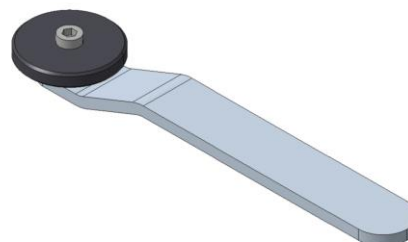
Type	Weight kg	Order no.
ADR 10 A	0.15	2823467

5.4 Unwinding device

Type	Weight kg	Order no.
ASV 10 A-CB 80	2	2823449

5.5 Twist drill

Type	Weight kg	Order no.
Twist drill Ø 3.2 mm	-	1100162

6.   Constructing curves

- Carrier profiles for curves are not pre-bent.

- Horizontal curves, must have a minimum radius of R 750 mm, in other words, if the code strip is bent afterwards across the flat side.

- For better engagement into the joint, each bend must have a straight section of at least 100 mm at the end.

- Joints must be installed in straight sections if possible.

- For curve radii R > 5000 mm, expansion joints in the carrier profile and code strip can be mounted in the curve.

- For curve radii R < 5000 mm, the expansion joint in the carrier profile and the code strip must be moved to the next straight section.

- Vertical curves, must have a minimum radius of R 2300 mm, in other words, if the code strip and sliding band are bent afterwards across the high side. Hence the readability of a coding can be ensured. If an inlay strip 8 x 1.5 with sliding strip CB 80 is used instead of a code strip CB 80, a minimum radius of 1000 mm can be realized. Due to the inlay strip, no recognition of a coding is possible.
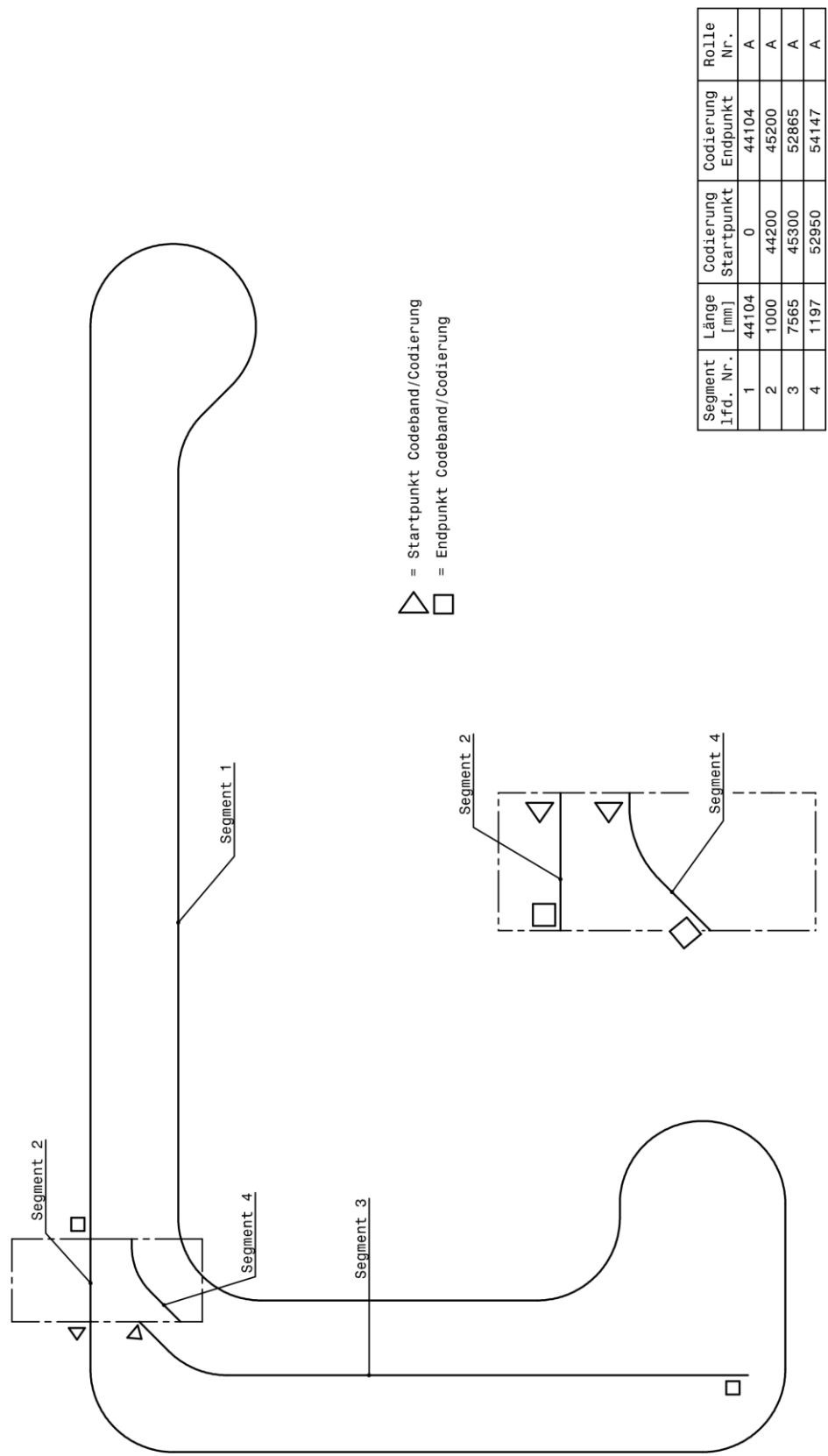
Note:

Note that bends should be placed in the carrier profile through the compact holder. Do not use any bending device for this purpose.

Compact holders are to be additionally positioned in the bend exit, i.e. two additional compact holders per bend are to be enclosed.

7. System layouts

7.1 Example of a system layout

Segment lfd. Nr.	Länge [mm]	Codierung Startpunkt	Codierung Endpunkt	Rolle Nr.
1	44104	0	44104	A
2	1000	44200	45200	A
3	7565	45300	52865	A
4	1197	52950	54147	A

△ = Startpunkt Codeband/Codierung
□ = Endpunkt Codeband/Codierung

7.2   Notes on system layout

- In general, no installation drawings are provided for Vahle U10 – APOS systems.

- The track is outlined systematically like the example on the previous page.

- In this system layout, the unit is divided and named in individual segments.

- Each segment is marked with the starting and end of the coding in ascending counting direction.

- The individual segments with length, coding from starting to endpoint, and the designation of the roll of the code strip, are listed in a table.

- The travel direction of the equipment must be noted separately in the system layout.

- Required, expansion joints, transition sections and fixed points are drawn schematically.

8.   Start-up

Conduct a test run after proper installation according to our installation instructions.

The following points must be observed in doing so:

- Conduct first run at low speed

- Read heads must move on the rail without vibration

- Switches must be moved slowly by hand to check the correct seating of the transition sections (assembly and air gaps).

- A code strip or an inlay strip must be mounted in the entire section in which the read head can be moved.

9. Maintenance regulations

9.1 Working on electrical installations

Before beginning work on an electrical installation, it must be disconnected from the power supply. This condition must be ensured for the entire duration of the work. This requirement is fulfilled when the following safety work is accomplished acc. to DIN EN 50110, Excerpt Para. 9.3:

- Disconnection

  The required separating paths must be completed.

- Secure against switching back on

  For the duration of the work, a prohibition sign must be placed on switch handles or switch drives, on controls, push or swivel buttons, on locking elements and line safety switches used to disconnect a system component or which can liven it. Otherwise, place a clearly designated prohibition sign nearby. In manual switches, use existing mechanical locking devices to prevent reconnection.

- Confirm disconnection

  Disconnection may only be confirmed by a certified electrician. Ensure that all poles are disconnected at the workplace. In addition to that, all poles from the mains if earthing and short-circuiting must be carried out.

- Earthing and short-circuiting

  At the workplace all parts, on which work is to be accomplished must be earthed and then short-circuited. The earthing and short-circuiting must be visible from the workplace. Deviating from this, earthing and short circuiting near the workstation may be performed if the local conditions or safety reasons make it necessary. Devices used for earthing and short-circuiting must always be connected first to the earthing system or to the earth electrode, and then to the parts to be earthed.

- Cover or shield any adjacent live parts/components

  Before starting work check whether it is practical to disconnect adjacent parts.

9.2 U10 – APOS System

The U10 - APOS System requires little maintenance.

However, the following work must be accomplished regularly:

Check the power rail components

Visual inspection every 4 weeks.
At the same time, watch out for the expansion of the carrier profiles and the code strip/sliding band, and for damages as well.

Check the read heads

Every 2 months or as operation requires.

Mechanical inspection

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

● If there is any damage on the read head, check corresponding components for damage or faults (e.g. loose connections).

Contact pressure test

Pull out read head from carrier profile by using a spring scale.
The contact pressure should be approx. 2N for each read head.

10. Final Installation

In order to determine the starting and end points, the segments/measuring distances can be run using a read head and a tester. Alternatively, the coding on the unit can be displayed by the read head.

Make sure that:

1. The ends of the code strips and sliding bands are burr-free.

2. The counting direction on the bottom of the read head matches the counting direction of the code strip.

3. The position of the read head attached is always displayed.

4. No error messages appear in the display.

5. Transition sections must be flush with the transitions of the power ails

Recommendation:

The positions read - the starting and end point of each segment /measuring distance - are to be transferred to the table of the system layout after completing installation.

11. Parts list

2823258
CARRIER PROFILE TPA-U 10-6

2823468
CARRIER PROFILE TPA-U 10-4

2823267
CONNECTOR FOR CARRIER PROFILE UV 10 A

2823268
LOCATING CLAMP USK 10 A

2823270
TRANSITION SECTION US 10 A

2518139
TRANSITION SECTION US 10 A – D

2823269
EXPANSION JOINT UDV 10 A-30 M

2823255
CODE STRIP CB 80

2823028
ADHESIVE TAPE, DOUBLE SIDED, 6 MM WIDE

2823446
SLIDING STRIP GB80

2806618
INLAY STRIP 8 x 1,5

2823438
WEAR TEST SEGMENT

2823626
READ HEAD APOS LKG-A 17-RS 485

2823666
READ HEAD APOS LKG-A 17- Steel2/65,5

2823681
READ HEAD APOS LKG 17-SSI / G

2823688
READ HEAD APOS LKG 17 FOR LEUZE BINARY PROTOCOL TYPE 1

2823654
READ HEAD APOS Base body, compl.

2809533
READ HEAD APOS Insulated housing for read head

2812704
READ HEAD APOS round plug connector 4 pin
TYP RSC 4/7 with screw fitting (plug)

2518699
INTERFACE CONVERTER SU-PROFIBUS

2823443
PUNCH LZ 10 A

2823266
DRILLING TEMPLATE BS 10 A

2823467
INSTALLATION AID ADR 10 A

2823449
FLUSHING DEVICE ASV 10 A-CB 80

1100162
TWIST DRILL   Ø3.2 mm

12. Revision index

Version	Date	Change/Remark
1.0	22.01.2010	Basic version completed
2.0	25.03.2011	Change of reading head base to KESR
2.1	21.06.2011	System data revised
2.2	13.07.2011	SSI system data revised
2.3	15.02.2013	VT system data revised
2.4	15.08.2014	Expansion representation revised
2.5	15.11.2016	Measuring accuracy of ±0.5 in ±1mm
2.6	04.04.2017	Pin assignment of SSI read head changed

VAHLE