Position Encoding System WCS3B-LS221-U* safeWCS/PUS Read Heads

Manual

Your automation, our passion.

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1 Introduction

1.1 Content of this Document

This document contains information required to use the product in the relevant phases of the product life cycle. This may include information on the following:

- Product identification
- Delivery, transport, and storage
- Mounting and installation
- Commissioning and operation
- Maintenance and repair
- Troubleshooting
- Dismounting
- Disposal

Note

For full information on the product, refer to the further documentation on the Internet at www.pepperl-fuchs.com.

Note

For specific device information such as the year of construction, scan the QR code on the device. As an alternative, enter the serial number in the serial number search at www.pepperl-fuchs.com.

The documentation comprises the following parts:

- This document
- Datasheet

In addition, the documentation may comprise the following parts, if applicable:

- EU-type examination certificate
- EU declaration of conformity
- Attestation of conformity
- Certificates
- Control drawings
- Instruction manual
- Functional safety manual
- Other documents

1.2 Target Group, Personnel

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismounting lies with the plant operator.

Only appropriately trained and qualified personnel may carry out mounting, installation, commissioning, operation, maintenance, and dismounting of the product. The personnel must have read and understood the instruction manual and the further documentation.

Prior to using the product make yourself familiar with it. Read the document carefully.

1.3 Symbols Used

This document contains symbols for the identification of warning messages and of informative messages.

Warning Messages

You will find warning messages, whenever dangers may arise from your actions. It is mandatory that you observe these warning messages for your personal safety and in order to avoid property damage.

Depending on the risk level, the warning messages are displayed in descending order as follows:

Danger!

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.

Warning!

This symbol indicates a possible fault or danger.

Non-observance may cause personal injury or serious property damage.

Caution!

This symbol indicates a possible fault.

Non-observance could interrupt the device and any connected systems and plants, or result in their complete failure.

Informative Symbols

Note

This symbol brings important information to your attention.

Action

This symbol indicates a paragraph with instructions. You are prompted to perform an action or a sequence of actions.

2 Safety Notices

Read the information in this documentation carefully and observe this information when working with the device. Failure to observe the safety information and warning messages in this documentation can lead to malfunctions of the safety devices of the machines or plants in which they are fitted.

This can result in serious personal injury or death.

Target Group, Personnel

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismounting lies with the plant operator.

The personnel must be appropriately trained and qualified in order to carry out mounting, installation, commissioning, operation, maintenance, and dismounting of the device. The trained and qualified personnel must have read and understood the instruction manual.

Prior to using the product make yourself familiar with it. Read the instruction manual carefully.

Reference to Further Documentation

Observe directives, standards, and national laws applicable to the intended use and the operating location.

Note

PUS Installation Manual

The PUS installation manual is part of the product and contains important information on integration of the read heads into the PUS system and on their operation and servicing. The programming and parameterization of the devices are described in the programming manual. Precise knowledge and understanding of these is a mandatory prerequisite for a new installation or for adjusting the device function or device parameters.

Make sure that those responsible for planning and integration, system and operations managers, and those working on the assemblies under their own responsibility, have fully read and understood the documentation.

The documentation must be made accessible to such persons in a legible condition.

3 Product Description

3.1 Functional Description

The path coding system essentially consists of the following components:

Read head

The U-shaped read head scans the code rail photoelectronically without touching it. The read head detects a new position value every 0.8 mm.

This results in the following characteristic data:

	Read head
Resolution	± 0.40 mm 1250 pos./m
Movement speed [v_{max}]	12.5 m/s
Y axis (tolerance)	± 15.5 mm
X axis (tolerance)	± 14 mm

After insertion into the code rail, the read head determines a highly accurate position value without reference or delay. The code rail can be scanned at very high speeds. The scanning can be reproduced, is reliable, and is independent of temperature fluctuations.

The position value, movement speed and error codes such as the contamination detection or the "OUT" message can be transmitted directly from the read head to the controller using a communication interface.

Two read heads (hereinafter referred to as safeWCS/PUS) are connected in the opposed mounting position on a safe PUS-F161-B**-WCS evaluation unit (hereinafter referred to as PUS evaluation unit) in the WCS3B-LS221-**U*** series.

The PUS-F161-B**-WCS safe evaluation unit generates a safe position by comparing the two diverse position signals of the read heads.

WCS3B-LS221-U1
The WCS3B-LS221-U1 read head is installed in the direction of travel (position direction counting upward).

WCS3B-LS221-U2
The WCS3B-LS221-U2 read head is installed opposite to the direction of travel (position direction counting downward). The electrical connector plugs of the two read heads point toward each other.

Evaluation unit

The PUS-F161-B**-WCS safe evaluation unit generates a safe position by comparing the two diverse position signals of the read heads.

Code Rail

The code rail carries information for the absolute code. The code rail is routed parallel to the track for the material handling equipment and therefore assigns a unique position to every point on the track. It is possible to route the code rail only at points where positioning is required. The system allows the code rail to be routed along curves and allows branches to be created. The code rail is built to order and delivered in a bundle. Unless otherwise ordered, the code rail always starts with position value 0 and ends with a maximum position according to the ordered length in meters. The length of a code rail segment ranges from 0 to max. 314.573 m total length.

Spacers can also be ordered for repair purposes or specific applications, stating the start or end position of the desired section and the desired length in meters.

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Mounting System

There are three different mounting systems available for mounting the code rail. The bracket system, the WCS3 aluminum profile system, and the WCS2 aluminum profile system with fixture for a guide trolley. The three mounting systems can be screwed directly to the surface or mounted on standard C profile rails.

The bracket system is the easiest to mount as it features mounting brackets for straight section elements and curved sections (vertical, horizontal). The brackets are screwed directly to the code rail and to the surface and C profile rail.

As an alternative to the mounting brackets, the WCS3 aluminum profile system provides better stabilization of the code rail and simplified mounting for long, straight sections. In this case, the code rail is inserted into an extruded aluminum profile developed for the WCS and fixed in place with a fixing cord. The aluminum profile rail is clipped to plastic brackets and attached to the surface with a C profile rail.

3.2 Intended Use

The two connected WCS3B-LS221-U1 and WCS3B-LS221-U2 read heads, which work with stationary code rails, are a high-resolution linear positioning system. The linear positioning system is used for the position detection of moving carriages and conveyor vehicles with millimeter precision along a specified code rail track.

The pair of read heads must only be used in combination with a safety-related evaluation unit (PUS-F161-B**-WCS). The two read heads are connected to the safe evaluation unit (PUS-F161-B**-WCS), which ensures safe positioning by comparing the two diverse position signals of the read heads.

Ensure that the read head pair is only used within the technical specification described in this manual with the approved safe evaluation unit and the code rail system.

The path coding system (hereinafter referred to as WCS) is only approved for correct and intended use. Ignoring these instructions will void any warranty and absolve the manufacturer from any liability.

3.3 Read Head

3.3.1 Introduction

The enclosure of the read head is made from robust plastic and has degree of protection (IP54). The mounting base for securing the read head is included in the scope of delivery. On the inside of the read head there are easily removable, transparent plastic lenses that protect the reading area against dirt and damage. Identification notches can be found on these lenses. The notches are used for adjustment of the zero point for the vertical play of the read head (= Z axis). The reference point is the top edge of the code rail. The read head may move around this reference point within the specified tolerances: If the vertical play on the Z axis is exceeded, the read head signals "OUT" to the controller (read head outside the code rail). The tolerances for the lateral play on the Y axis result from the gap width of the read head. The positions are reliably determined up to a minimum of 500 mm for both an inclined position in the vertical direction and in the horizontal direction, and also in curves. If the position value cannot be determined, for example due to contamination of the optical system, the read head reports a unique error code.

	Read head
Resolution	± 0.40 mm 1250 pos./m
Movement speed [v_{max}]	12.5 m/s

3.3.2 Overview

safeWCS/PUS

safeWCS/PUS read heads have a gap width of 31 mm. This allows greater tolerance when mounting the read head and aligning it with the code rail. safeWCS/PUS systems are suitable for monitoring conveyor belts, automated storage and lifting systems.

Special features of the safeWCS/PUS read head include the status LEDs for the alignment and performance display, an optional "overspeed" output, and an optional 7-segment display for position and diagnostic data.

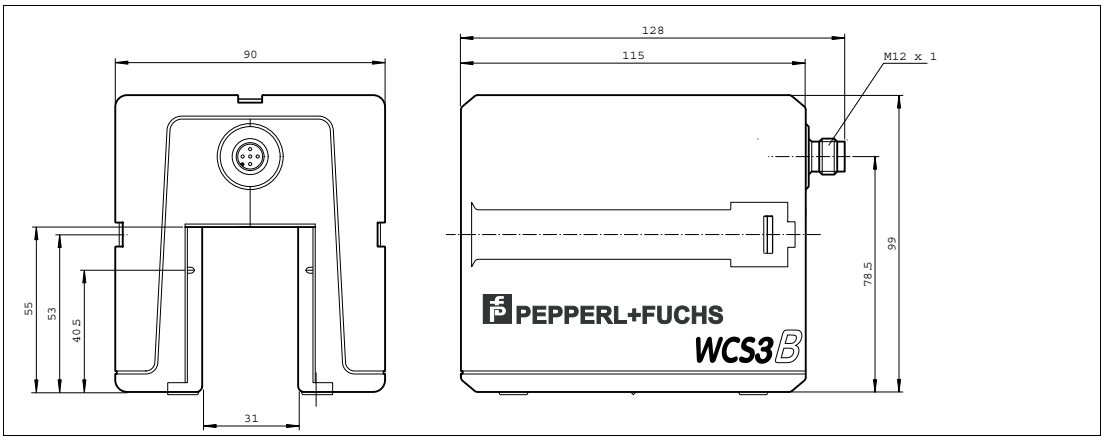

Figure 3.1 Dimension drawing for safeWCS/PUS

safeWCS/PUS-Outdoor

WCS3-Outdoor is a safeWCS/PUS read head in a special outdoor protective enclosure.

Special features of the safeWCS/PUS-Outdoor include an IP69-compliant protective enclosure that, in addition to protecting against dust and humidity, has been specifically designed for resistance to aggressive substances such as saltwater, salty air, acids, and alkalis. It offers increased resistance to impact compared to typical outdoor sources of interference such as falling branches and hailstorms. Integrated heating even allows the WCS3-Outdoor to be operated in snow and temperatures as low as -40 °C. The indicator LEDs and the display are always visible through the translucent enclosure material. The protective enclosure has three cable outlets. Depending on the mounting position, you can route the connector plug through one of the three outlets.

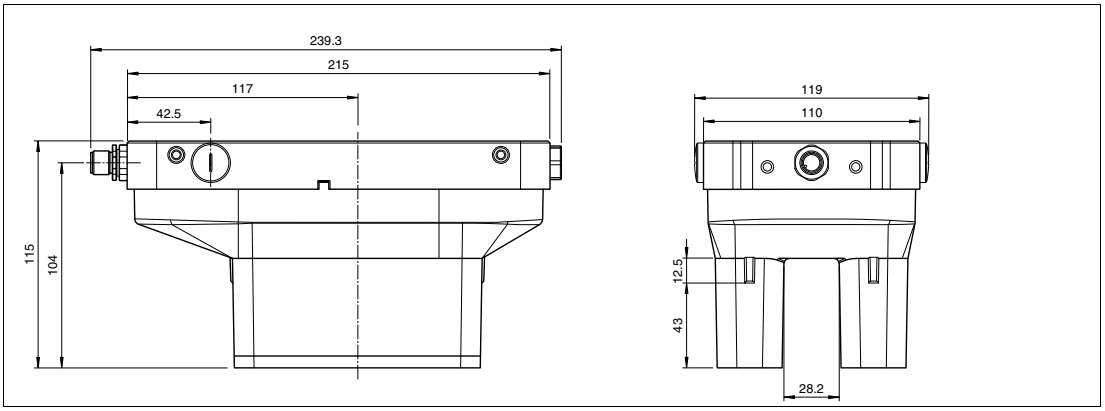

Figure 3.2 Dimension drawing for safeWCS/PUS-Outdoor

3.3.3 Tolerances

Tolerance for Y and Z axis

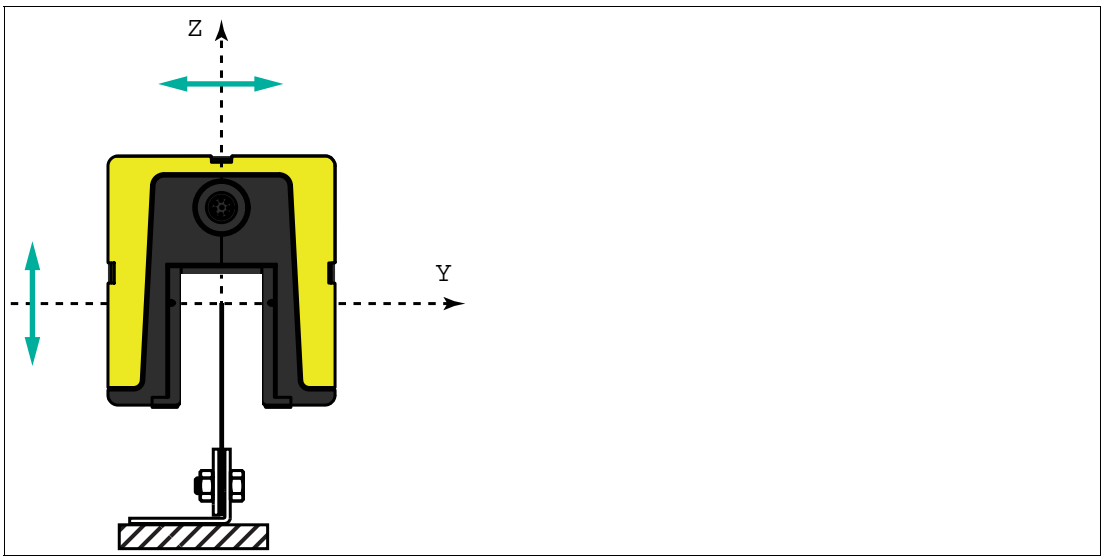

Figure 3.3 Tolerance for Y and Z axis

Read head tolerances	safeWCS/PUS	safeWCS/PUS-Outdoor
Y axis	± 15.5 mm	± 12 mm
Z axis	± 14 mm	± 12 mm

Tolerance for inclined position α

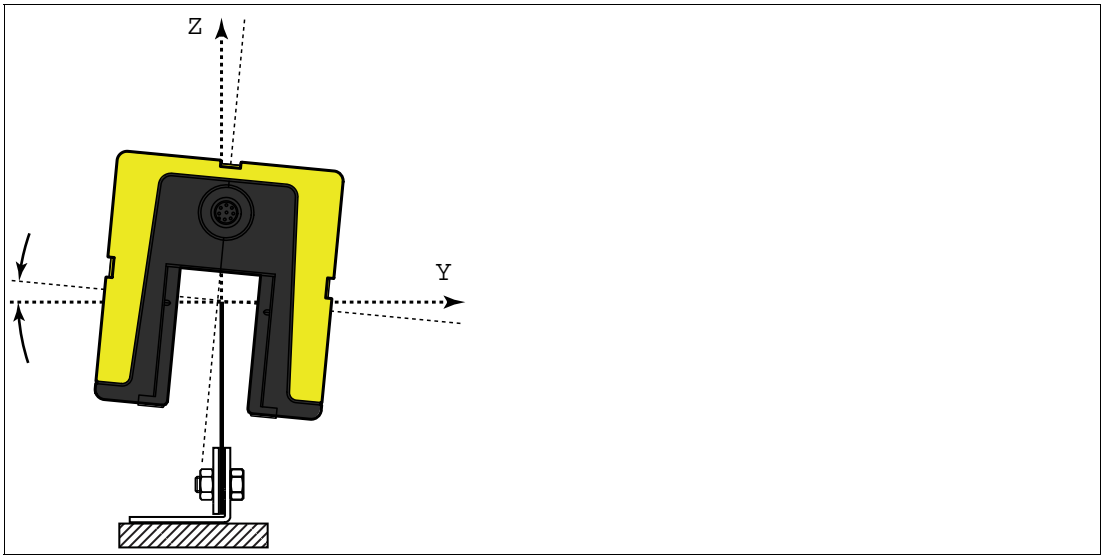

Figure 3.4 Tolerance for inclined position α

Read head tolerances	safeWCS/PUS	safeWCS/PUS-Outdoor
α	±10°	±8°

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Tolerance for inclined position β

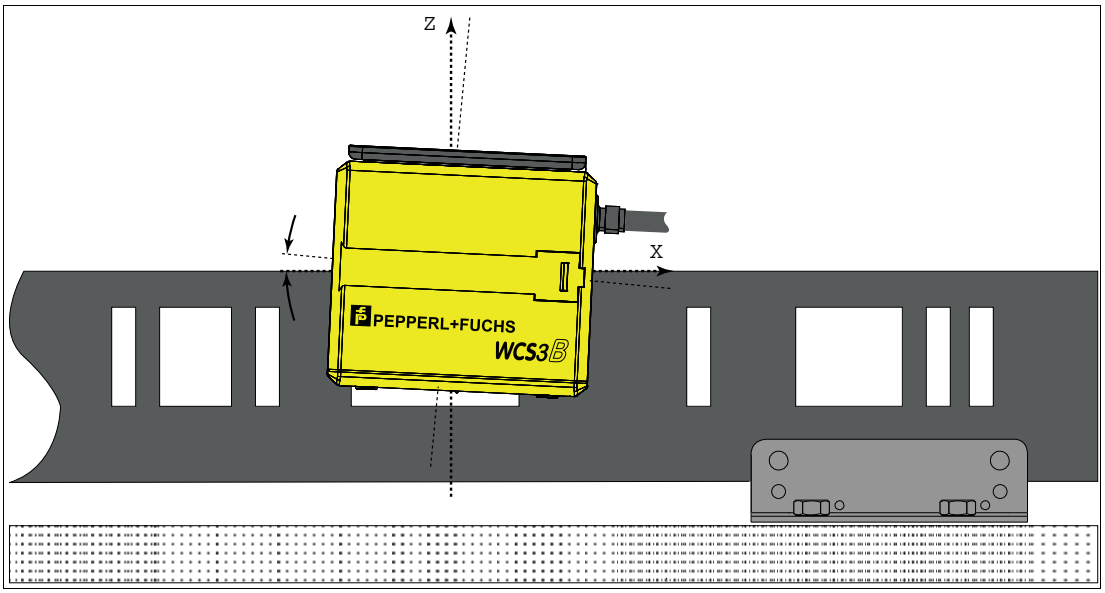

Figure 3.5 Tolerance for inclined position β

Read head tolerances	safeWCS/PUS	safeWCS/PUS-Outdoor
β	±5°	±4°

Tolerance of inclined position β with 2 safeWCS/PUS read heads

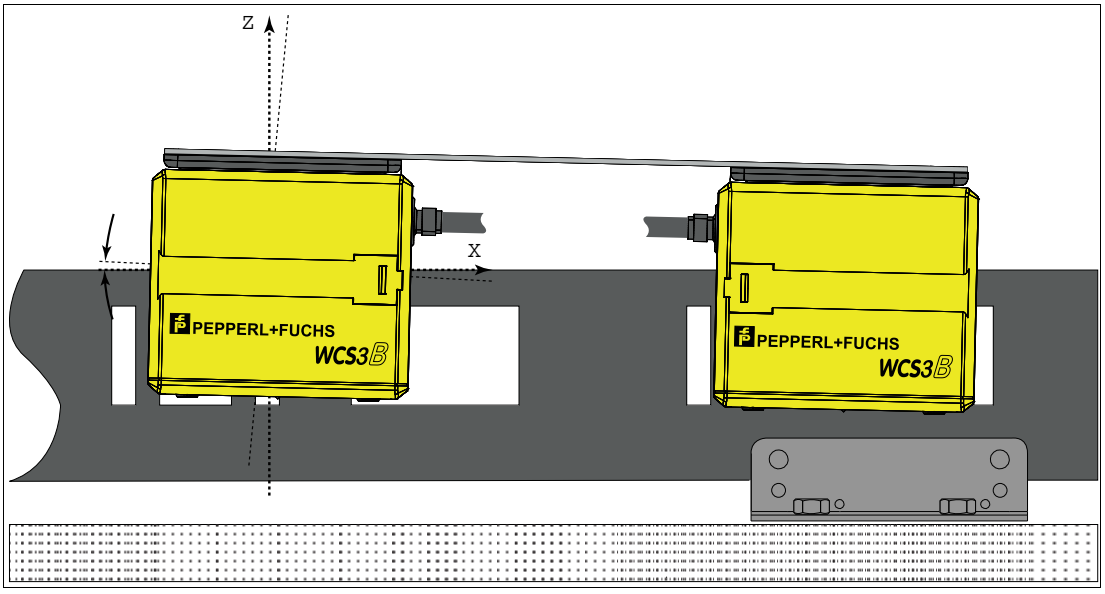

Figure 3.6 Tolerance for inclined position β

Read head tolerances	safeWCS/PUS
β	±1°

3.4 Code Rail

3.4.1 Introduction

The absolute code rail is different for the WCS2 system and the WCS3 system. Therefore, the code rail cannot be swapped between the two systems. For WCS3, the height of the code rail is always 70 mm; for WCS2, the rail can be supplied at a height of 55 mm or 70 mm. Two different materials that have proven successful in practice are available for the code rail: plastic laminate and stainless steel. The code rail is delivered in a coil. Unless otherwise ordered, the code rail always starts with the position value 0.

3.4.2 Overview

Laminate Code Rail

The black laminate code rail is made from a special polyester laminate. It has excellent physical and chemical properties and a low intrinsic weight. The material has a high tensile strength and behaves neutrally to oils, greases, and solvents. Because of its good resistance to acids, alkalis, and aggressive gases, the laminate code rail is suitable for use in electroplating. The laminate code rail is delivered with mounting holes as standard (WCS3-CS70-L1, see also the drawing below). If you use a bracket system to mount the code rail, use of a code rail without mounting holes is recommended (WCS3-CS70-L0).

The laminate code rail can be used in a temperature range from -40 °C ... 60 °C. Temperatures above 70 °C lead to material deformation.

The specific thermal expansion coefficient is approximately 2.8 x 10^{-5} K^{-1}.

Due to its material properties, the laminate code rail must not be mounted at temperatures below 10 °C. In applications with large temperature fluctuations (> 50 K), we recommend the use of the stainless steel code rail.

Warning!
Grinding dust

When mounting the laminate code rail, make sure that grinding dust from current collectors cannot fall directly onto the surface of the code rail. When mounting the laminate code rail on the side, mount it above the sanding lines.

Stainless steel code rail

The stainless steel code rail is made from corrosion-resistant spring steel. It is rust-free and is characterized by high mechanical stability and low thermal expansion.

The stainless steel code rail can be used in the temperature range -40 °C ... 100 °C.

The specific thermal expansion coefficient is 1.6 x 10^{-5} K^{-1}.

WCS3 code rail

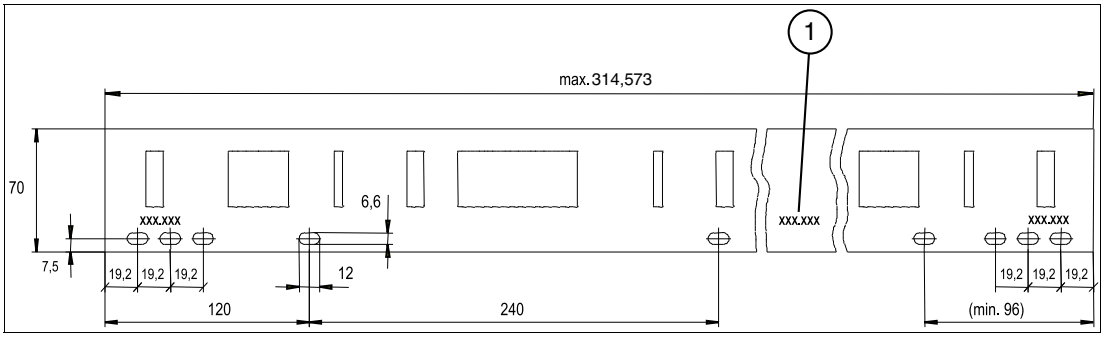

Figure 3.7 WCS3 code rail

1. 6-digit position identifier

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Product name	Description
WCS3-CS70-L1	Laminate, hole 1
WCS3-CS70-M1	Stainless steel, hole 1
WCS3-CS70-L0	Laminate, no hole
WCS3-CS70-L2	Laminate, Vahle VKS hole

4 Transport and Storage

Retain the original packaging. Always store or transport the device in the original packaging to protect it from electrostatic discharge (ESD) and mechanical damage.

5 Mounting the Read Head

5.1 Installing the mounting base and connecting plate

The read heads are supplied with two special mounting bases and a connecting plate. The mounting bases must be attached to the read heads. On three sides of the read head enclosure, dovetail grooves are integrated with a quick release lock. If required, the read heads are pushed onto the guide rail of the mounting base using one of these grooves and engaged with a spring tongue. This quick release lock means that the read head can be bolted to the connecting plate very easily without requiring any adjustment work.

Warning!

Improper mounting

Risk of injury if mounted improperly

- Ensure you have sufficient space before starting work.
- Take care when using sharp-edged components and always wear safety gloves.
- Before mounting, ensure that suspended components cannot fall.

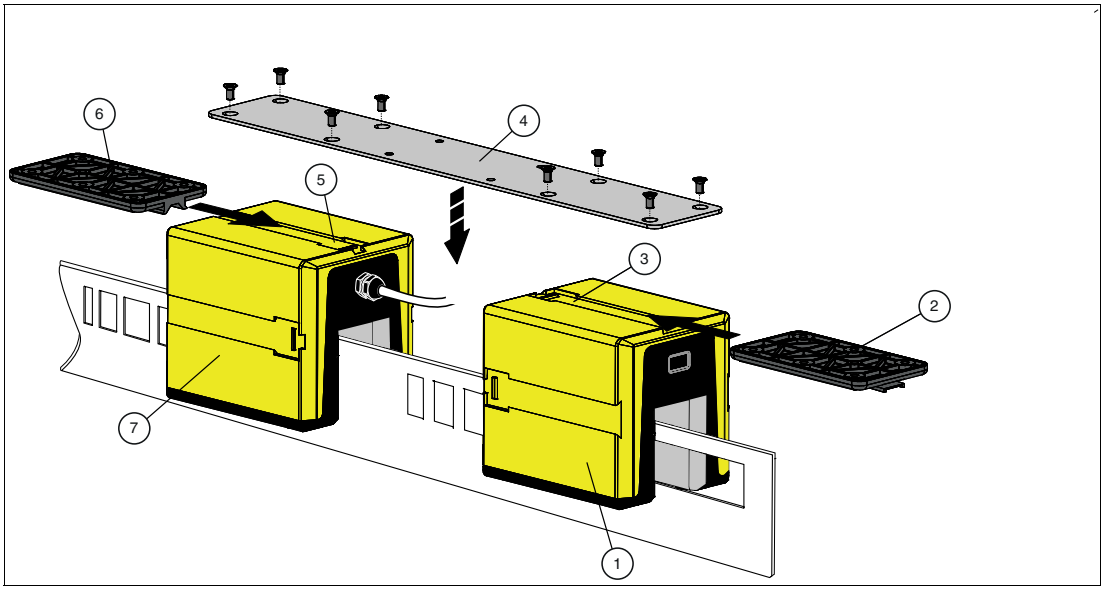

Figure 5.1 Overview

1 Read head (opposite to the direction of travel (position direction counting down))
2 Mounting plate
3 Dovetail grooves with quick release lock
4 Connecting plate
5 Dovetail grooves with quick release lock
6 Mounting plate
7 Read head (in the direction of travel (position direction counting up))

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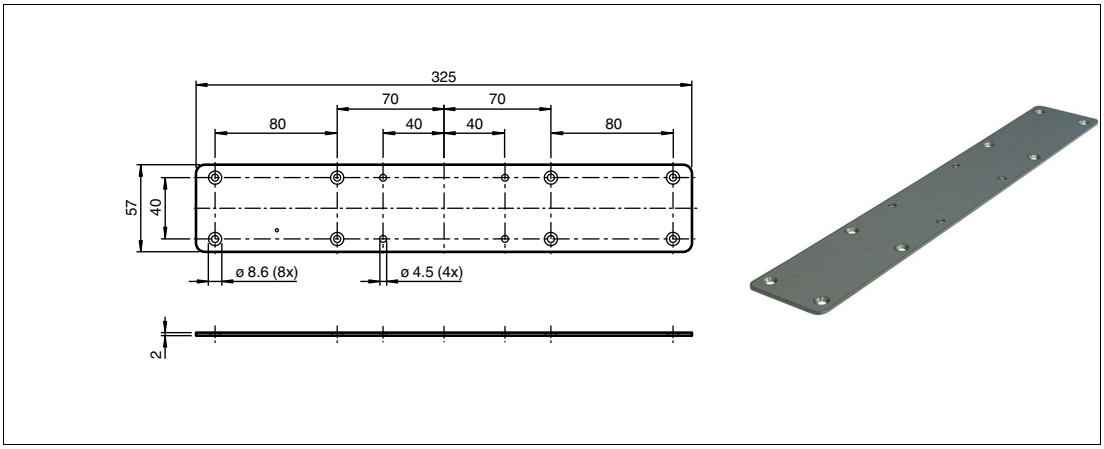
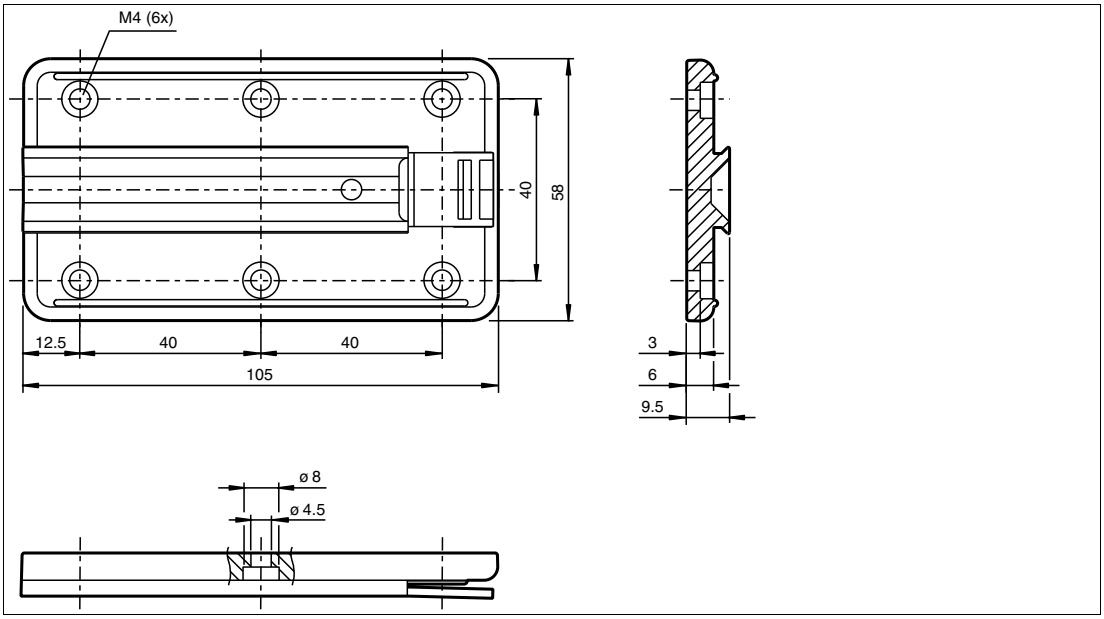
Connecting plate dimensions



Mounting base dimensions

Note

The mounting bases are fitted with press-in nuts so that they can be screwed to the connection plate.



Note

Mounting Position

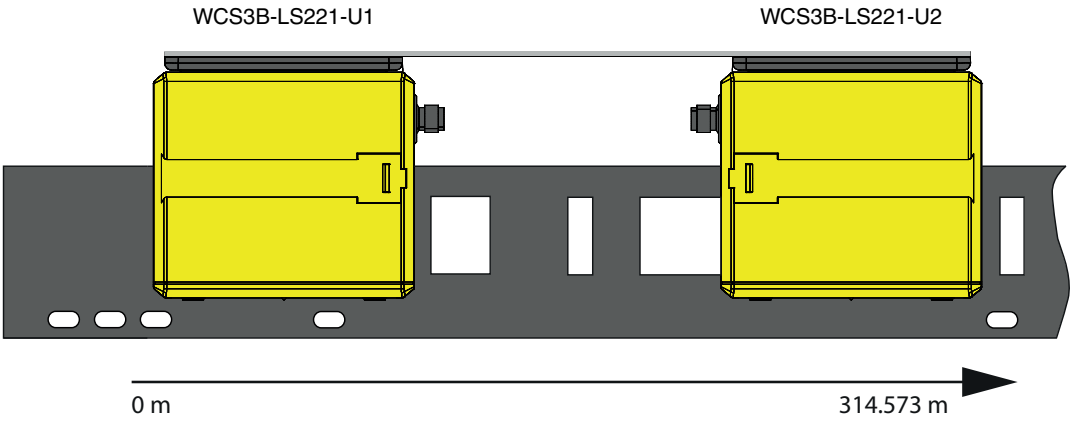


Figure 5.2 Mounting Position

Mount the two read heads so that the read head WCS3B-LS221-U1 points in the direction of travel (counting the position direction upward) and the read head WCS3B-LS221-U2 points in the opposite direction of travel (counting the position direction downward) on the code rail and the electrical connector plugs of the two read heads point to each other.

Tip

Fastening the connecting plate

Plan slots in the design of the fixture on the carriage. These allow you to correct the position of the connecting plate and therefore the read head during mounting.

Note

Reading Heads Sequence

The WCS3B-LS221-U1 and WCS3B-LS221-U2 read heads can also be mounted in a different sequence, LED window side on LED window side, or with a larger or smaller mounting distance to each other. An elongation distance of 10 mm must be maintained between the two read heads as a minimum distance.

The mechanical distance between the read heads is corrected using an offset value on one of the "Encoder offset" read heads in the PUS evaluation unit.

Caution!

Interference from strong sunlight

If strong sunlight shines directly into the read head gap, this can lead to measurement errors.

When planning the plant, avoid a configuration that allows strong sunlight to shine directly into the read head gap.

Caution!

Interference from contamination

If dirt or vapors enter the read head gap, this can lead to malfunctions.

When installing the read head, make sure that the read head gap is protected against dirt and any vapors.

Mount and remove the mounting bases and the connecting plate

1. Slide the dovetail groove on the read head onto the guide rail of the mounting base. In the end position, the spring tongue engages audibly in the quick release lock.
2. Secure the mounting base to the connecting plate with screws.

   ↳ The read heads are mounted.
3. To remove them, undo the screws from the connecting plate.
4. Release the spring tongue with a screwdriver.
5. Push the read head off the guide rail of the mounting base.

5.2 Replacing Plastic Lenses

In the event of damage or contamination, you can replace the plastic lenses on the inside of the read head gap.

Replacing Plastic Lenses

1. Undo two Torx screws (T10) on each lens.
2. Remove the lens.
3. Slide the new lens into the intended position on the inside of the read head gap.
4. Secure the lens with the screws. The maximum torque is 0.8 Nm.

Tip

Always replace lenses in pairs.

The plastic lenses are available in pairs as spare parts. The order designation for 2 lenses with seal is WCS3B-PL2.

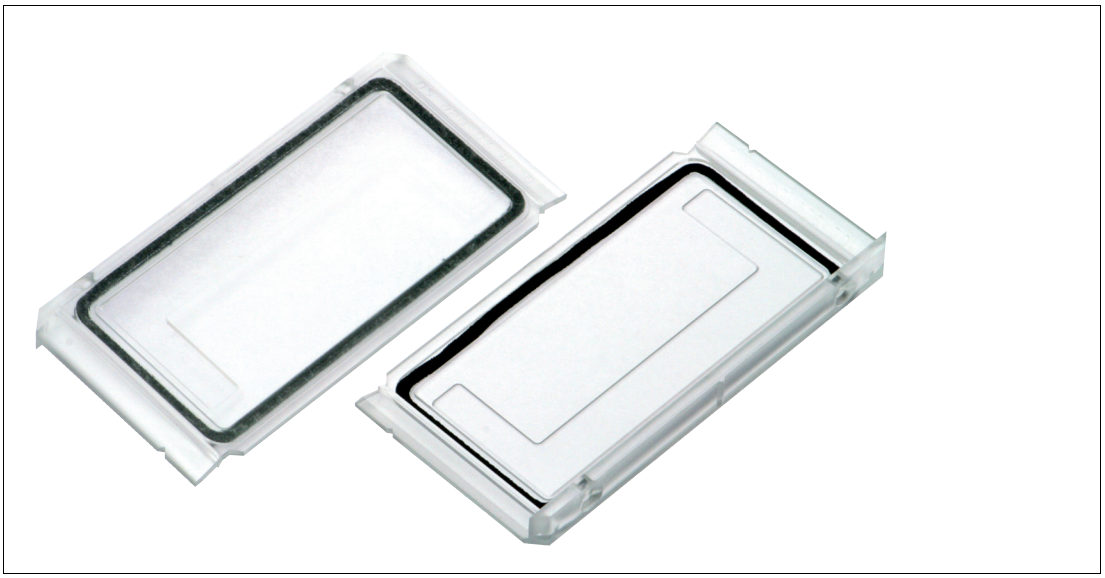


Figure 5.3 Plastic lenses

5.3 Retrofitting the Outdoor Protective Enclosure

The enclosure can be retrofitted to the safeWCS/PUS read heads using RS-485, SSI, and CANopen interfaces. Read heads with EtherNet/IP and PROFINET interface can only be used as pre-assembled devices.

Note

When retrofitting your plant, make sure that you differentiate the mechanical outer dimensions and the fixture for the outdoor protection enclosure from the standard read head.

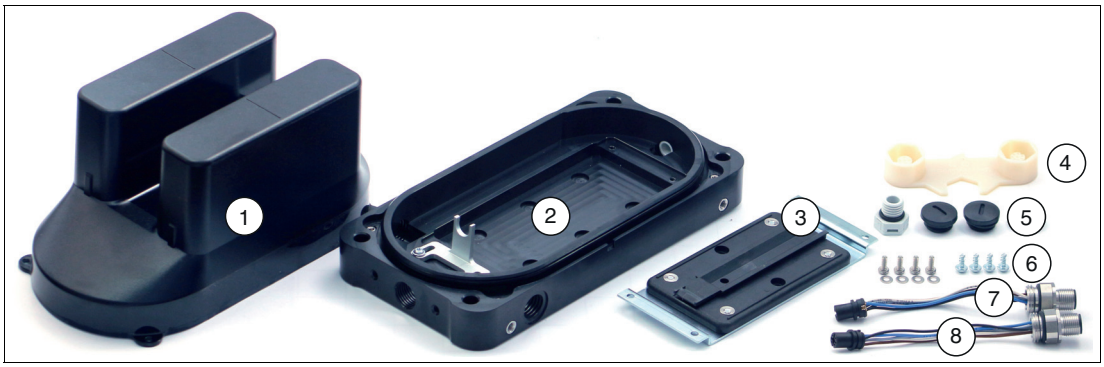


Figure 5.4 Overview of mounting parts

1 Protective cover
2 Protective lid
3 Mounting base
4 Special tool
5 Stopping plugs, pressure relief plugs
6 Fixing screws
7 Five-pin connection cable for RS-485 or CANopen
8 Eight-pin connection cable for SSI

Assembling the Protective Enclosure

1. Undo two Torx screws (T10) on each lens.
2. Remove the lens.
3. Slide the mounting base over the dovetail groove of the read head. In the end position, the spring tongue engages audibly in the quick release lock.

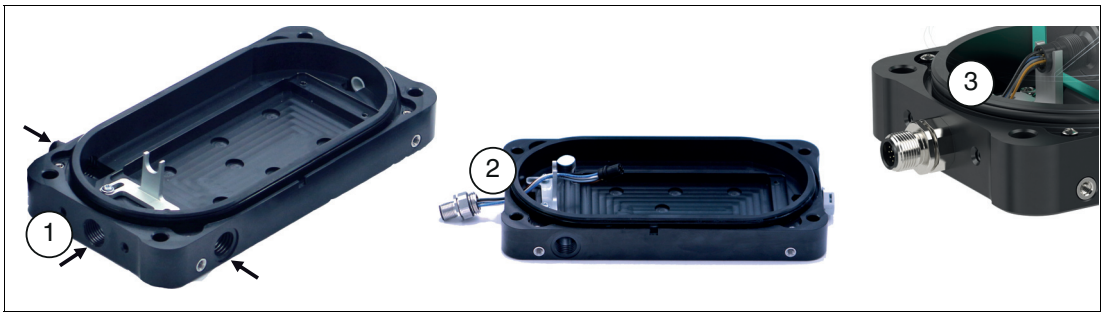


Figure 5.5 Attaching the connection cable

4. Insert the connection cable through one of the three thru-holes in the protective lid and tighten the plug using the special tool. The maximum tightening torque is 1.5 Nm.

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5. Press the socket onto the connector bracket by hand.

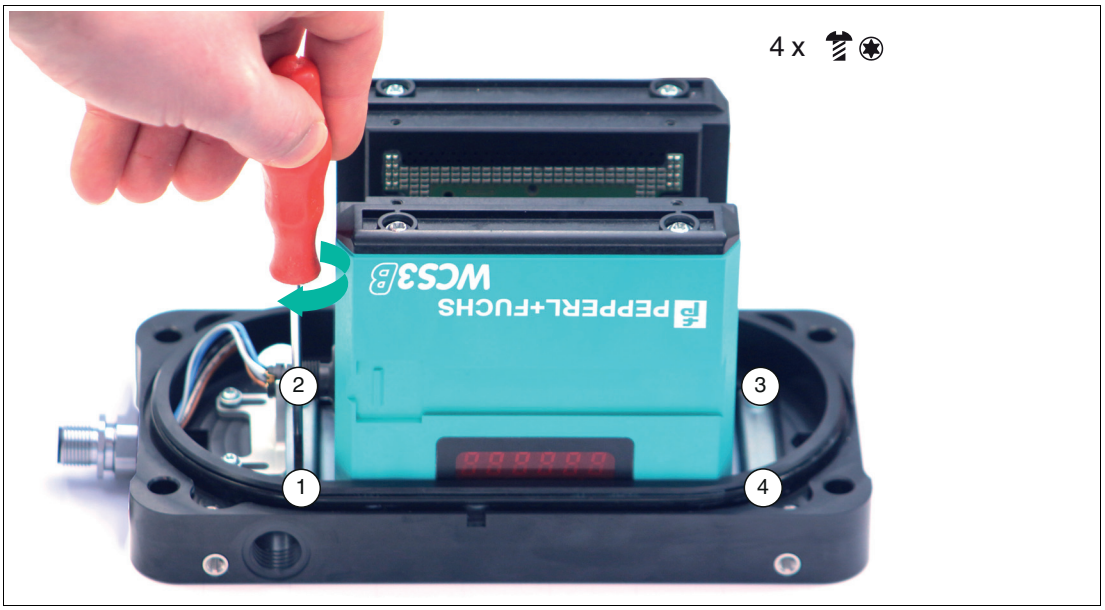


Figure 5.6 Attaching the mounting base

6. Secure the mounting base to the protective lid with four self-tapping screws (galvanized). The maximum tightening torque is 0.7 Nm.
7. Loosen the two fixing screws of the connector bracket by half a revolution each to move the bracket. Move the metal fixture with the socket in the direction of the read head until the socket is connected to the read head. The connector bracket secures the connection between the read head and the socket.
8. Fix the mounting bracket in place with two screws. The maximum tightening torque is 0.7 Nm.

Figure 5.7 Mounting the protective cover

9. Secure the protective cover to the protective lid with four stainless steel screws and four washers. The maximum tightening torque is 1 Nm.
10. Tighten the stopping plugs on the two unused interfaces using the special tool.

11. Tighten the pressure relief plugs in the opposite end of the protective lid using the special tool.

Tip

If you have mounted the protective enclosure completely, you will still be able to see the status LEDs on the front of the enclosure. The green LED lights up if the read head is supplied with power. If the code rail is outside the read range of the read head, the red LED flashes. As soon as the code rail returns to the gap of the read head, the red LED goes out. If the red LED lights up and stays on, there is an internal diagnostic error. The yellow LED lights up when data is being transferred to the device.

If your read head has the seven-segment display, you can read the position status on the side of the enclosure.

Ordering Information

The safeWCS/PUS read head with the options -OM, -OL, and -OR is supplied ready-assembled with the outdoor protective enclosure:

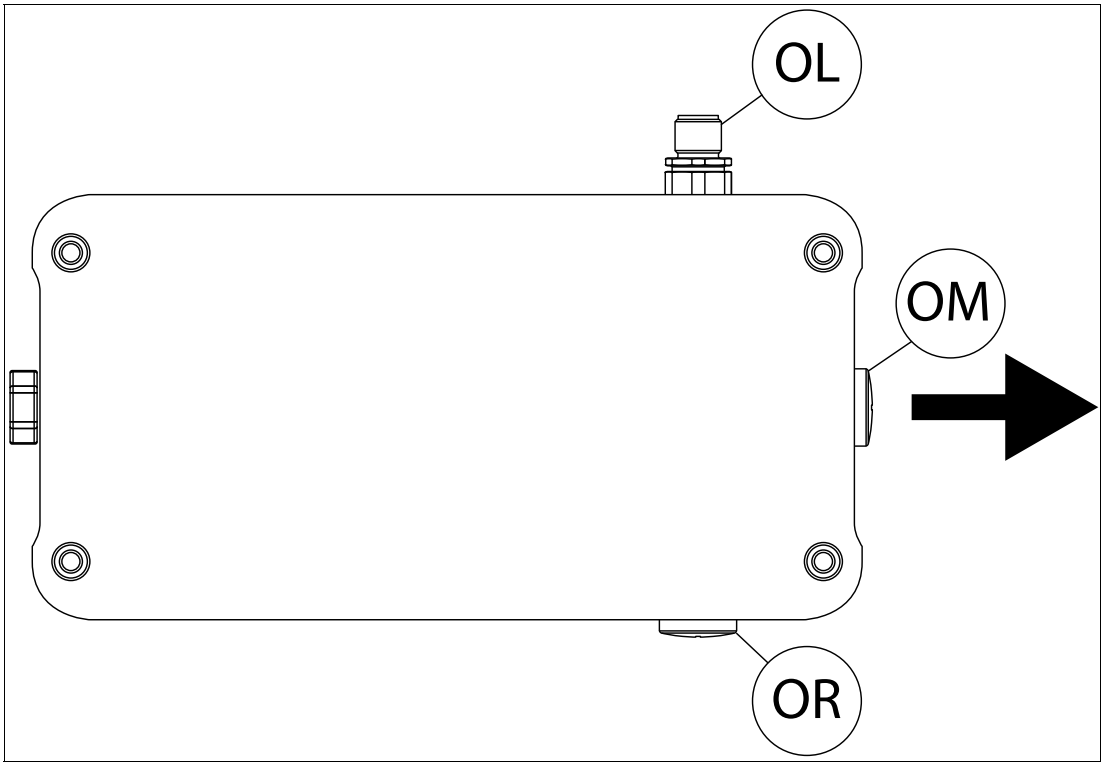


Figure 5.8 safeWCS/PUS-Outdoor protective enclosure cable outlet

The options -OM, -OL, and -OR describe the direction of the plug connection in relation to the nominal direction of travel of the read head. The read head plug always points in the direction of the ascending position of the code rail. The orientation of the plug can also be modified or converted retrospectively. Stopping plugs (WCS3B-OBP) are available for closing unused connections.

5.4 Mounting the Outdoor Protective Enclosure

Warning!

Improper mounting

Risk of injury if mounted improperly

- Ensure you have sufficient space before starting work.
- Take care when using sharp-edged components and always wear safety gloves.
- Before mounting, ensure that suspended components cannot fall.

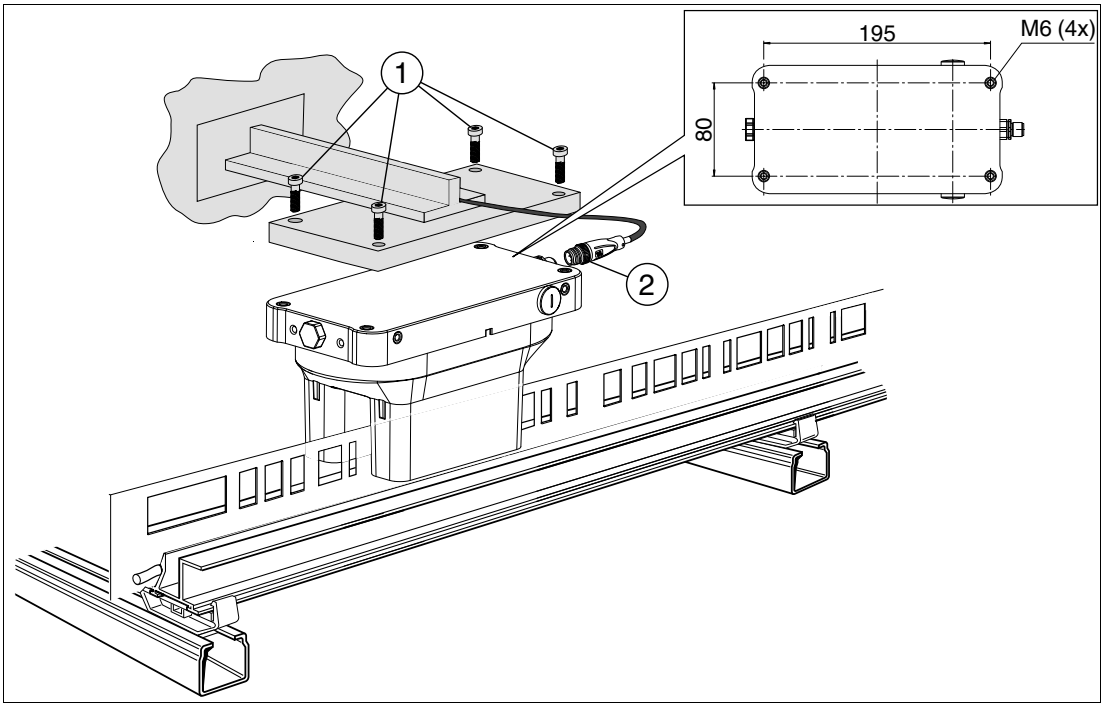


Figure 5.9 Overview

Note

Mounting Direction

Mount the two read heads so that the read head WCS3B-LS221-U1 points in the direction of travel (counting the position direction upward) and the read head WCS3B-LS221-U2 points in the opposite direction of travel (counting the position direction downward) on the code rail and the electrical connector plugs of the two read heads point to each other.

Tip

Mounting

Plan slots in the design of the fixture for your plant (for dimensions, see the figure above).

Mounting and Dismounting the Outdoor Protective Enclosure

1. Attach the outdoor protective enclosure to your plant using M6 screws (1). The maximum torque is 6 Nm.

Note

We recommend using corrosion-resistant stainless steel screws (A2/8.8).

2. Connect the connector plug to the socket of the outdoor protection enclosure.
3. Disconnect the connector plug when dismounting.
4. Loosen the four screws on the outdoor protective enclosure.

6 Mounting the Code Rail

6.1 Introduction

With continuous position measurement for a route, you have to mount the code rail in one piece. Depending on the operational conditions, there are various options for securing the code rail:

- Mounting bracket
- WCS3 aluminum profile rail
- WCS2 aluminum profile rail for mounting WCS guide trolley and WCS3 with outdoor enclosure

Warning!

Improper mounting

Risk of injury if mounted improperly

- Ensure you have sufficient space before starting work.
- Take care when using sharp-edged components and always wear safety gloves.
- Before mounting, ensure that suspended components cannot fall.

Warning!

Insufficient grounding can result in electrical accidents and property damage.

If the code rail is not properly grounded, this can result in potential equalization currents. These currents may injure operating personnel or cause property damage.

When installing a code rail made from laminate or stainless steel, make sure that the code rail is connected with the plant potential every 30 m with low resistance.

6.2 Installation Notes

Mounting Position

The mounting position of the code rail is arbitrary. When mounting the code rail, make sure that all mounting brackets and rail holders of the profile system are at one level. The surface on which the mounting brackets and rail holders are mounted must be level.

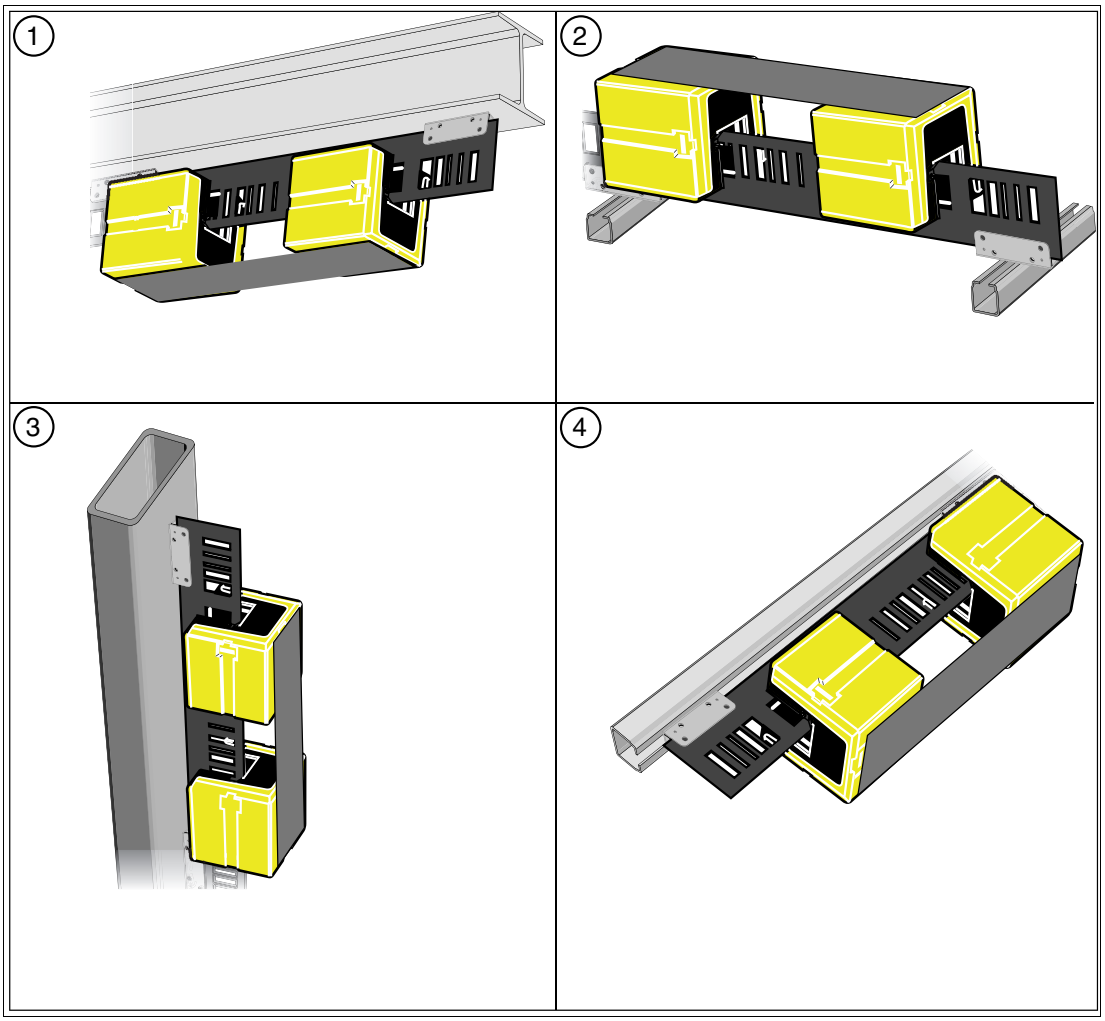


Figure 6.1 Mounting positions with mounting brackets (mounting positions also apply when mounting using the aluminum profile system)

1 Mounting on a ceiling

2 Horizontal mounting

3 Vertical or suspended mounting

4 Lateral mounting on a wall

Note

Outdoor use

If using the WCS system outdoors, we recommend mounting the aluminum profile rails horizontally. This will allow dirt and snow to fall down rather than collecting in the read head gap.

6.2.1 Mounting the Code Rail on a Straight Route

Mounting the Code Rail—Straight Route

1. Mount the mounting brackets at an offset of max. 1.25 m along the route on the substructure.
2. Align the mounting brackets.
3. Slide the code rail up to the stop in each bracket.
4. Tension the code rail by pulling on the free end.
5. Clamp the code rail securely into the bracket by tightening the two M6 x 12 hexagonal screws.

Note

Tightening Torque:
for laminate code rail: max. 8 Nm
for stainless steel code rail: max. 5 Nm

↳ When mounted correctly, the tensioning force on the brackets is so great that the code rail can no longer be pulled out of the bracket.

Tip

In addition to clamping, you can screw the code rail to the bracket. To do so, use the top two free holes (M6) of the bracket. Screwing the rail to the bracket creates a fixed point between the code rail and the substructure.

The screws for the fixed point are not included in the scope of delivery.

The use of C profiles is advantageous for bracket mounting. They are arranged lengthwise or crosswise to the intended route. The brackets for mounting in C profile can be easily secured to them and aligned.

Example

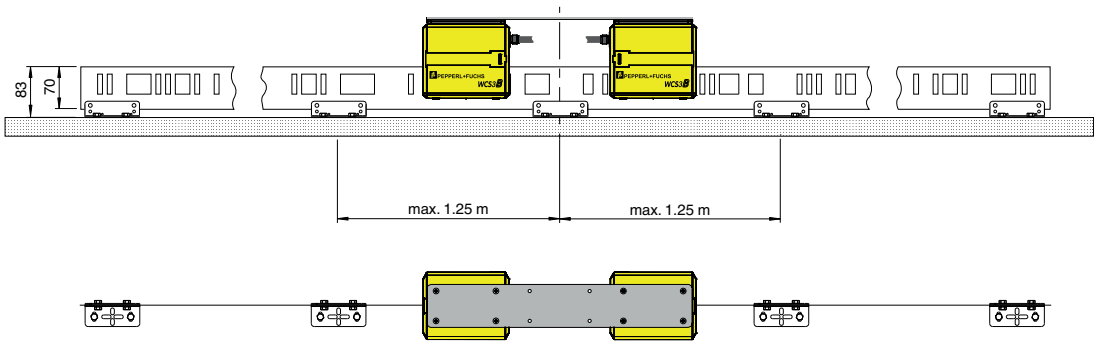


Figure 6.2 Application example: mounting brackets, straight

6.2.2 Mounting in Horizontal Curves

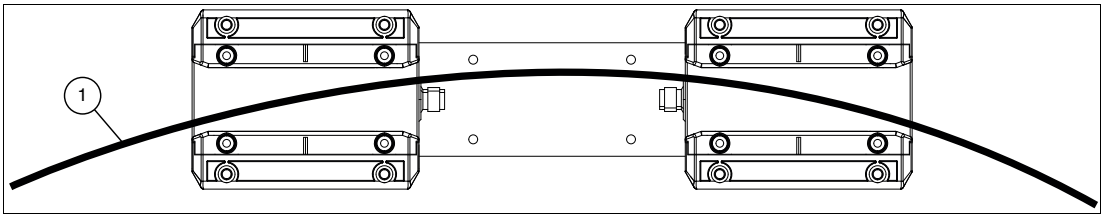
A horizontal curve is a curve to the left/right. The wide read head gap on the safeWCS/PUS read head permits minimum curve radii of 300 mm in conjunction with the mounting bracket system. When using the safeWCS/PUS read head with guide trolleys, the curve radii are limited by the dimensions of the guide trolley.

Curve radius

Read head and mounting system	Horizontal curve radius
safeWCS/PUS	> 300 mm
safeWCS/PUS-Outdoor	> 300 mm
safeWCS/PUS-Outdoor with guide trolley	Not possible
safeWCS/PUS with connecting plate	> 1500 mm

Horizontal curve radius

Maintain the safety margin of 0.5 mm between the code rail and the read head enclosure. This results in a minimum radius of 1500 mm.



1 Code Rail

To create curves, the mounting brackets for curves are used together with a special WCS-SP2 stabilizing profile. The stabilizing profile is delivered in a bundle in the length ordered.

Note

Height and cross offset

The curve brackets are designed so that there is no height or transverse offset of the code rail in the transition from the straight section into the curve.

Mounting the Code Rail—Curve

1. Mount the curve brackets tangentially along the bend of the arc or curve at an offset of max. 0.7 mm.
2. Cut the WCS-SP2 stabilizing profile to the length of the arc or curve.
3. Insert the stabilizing profile into the curve bracket.
4. Press the code rail completely into the groove of the stabilizing profile.
5. Using the M4 hexagon socket head clamping screws, securely clamp the code rail together with the stabilizing profile into the curve brackets.
6. Lock the code rail together with the stabilizing profile using the self-tapping screws supplied.

Application Example

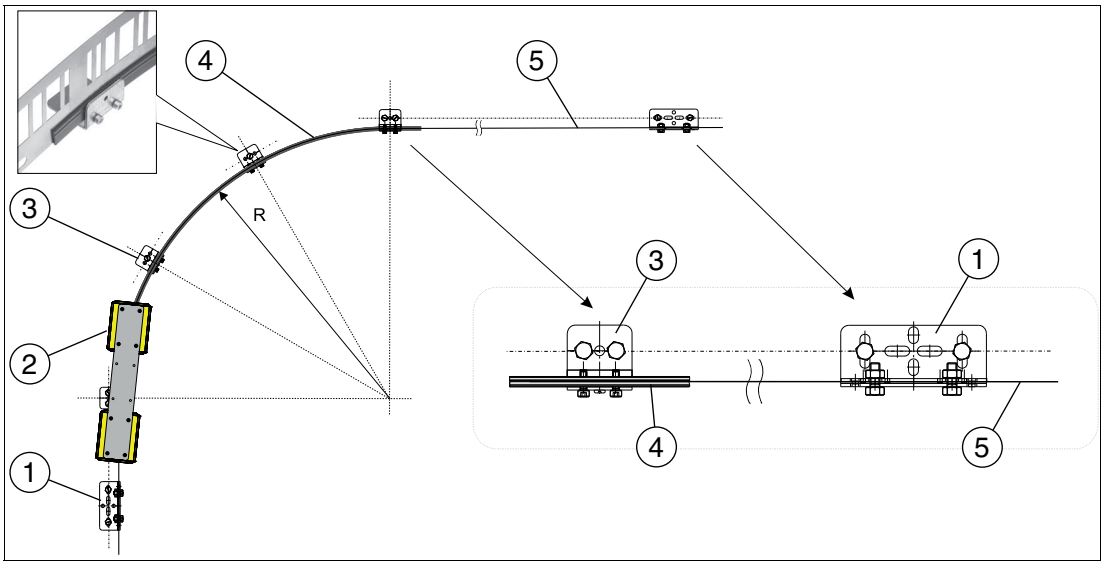


Figure 6.3 Application example: mounting brackets, straight section, and curve

1 Mounting angle
2 Read head
3 Curve bracket
4 Stabilizing profile
5 Code Rail
R Curve radius

Note

Circular Path

Note the following special feature for a closed section (circular path, oval, etc.): Due to how the WCS works, you cannot route the code rail continuously along the entire circumference of the circle.

Maintain an offset of at least 85 mm between the beginning and the end of the code rail. Where the code rail is interrupted, the controller receives the value "OUT"—read head outside the code rail—from the read head. Using two consecutive staggered heads enables continuous route information at all points of the circular path. In this case, when it receives the "OUT" message, the controller switches to the position value of the second read head.

6.2.3 Mounting in Vertical Curves

In addition to horizontal curves, vertical curves are required to create inclines/declines.

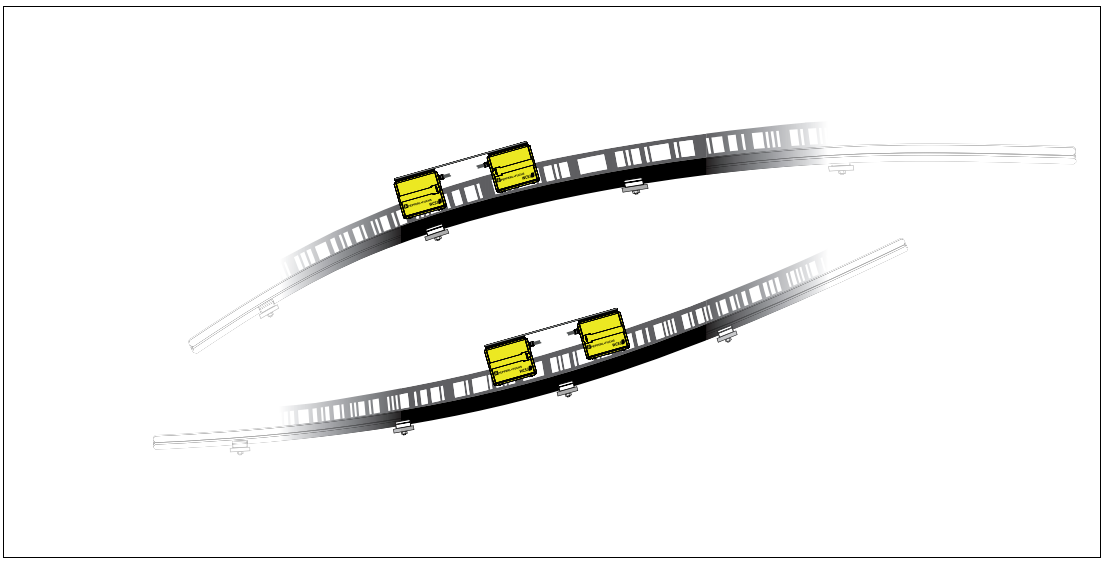


Figure 6.4 Vertical curves

Vertical curves up to a minimum radius of 4 m can be created with the aluminum profile in conjunction with the laminate code rail.

Routing Vertical Curves

1. Mount the required rail holder along the desired route.
2. Carefully bend the required aluminum profiles into the corresponding radius > 4 m.
3. Engage the aluminum profiles in the rail holders.
4. Cut into the required code rail from the beginning to the end of the curve at intervals of approximately 50 mm.

Note

Make sure that you cut into the code rail from below, i.e., from the wider side up into the code window. Cut a small triangle off from each cut to prevent the code rail from overlapping in the aluminum profile.

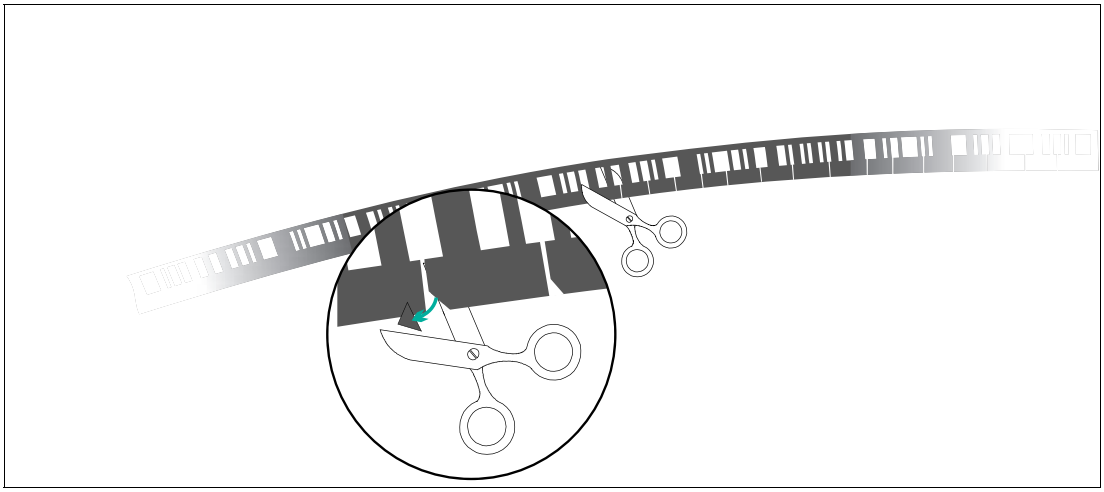


Figure 6.5 Cutting the code rail

5. Insert the code rail into the aluminum profile together with the fixing cord. Secure the code rail with the fixing cord in the aluminum profile rail using the mounting tool (see chapter 6.4.5).

6.2.4 Interruptions in the Profile Rail

In some applications, it is necessary to interrupt the course of the code rail, e.g., for crane crossings, for fire protection gates, or for large expansion joints in buildings.

The principle of the WCS allows for interruptions in the code rail. A **minimum distance A of 85 mm** must be maintained between each pair of code rail segments for the interruption. The read head recognizes when it leaves the code rail and reports "OUT" to the controller.

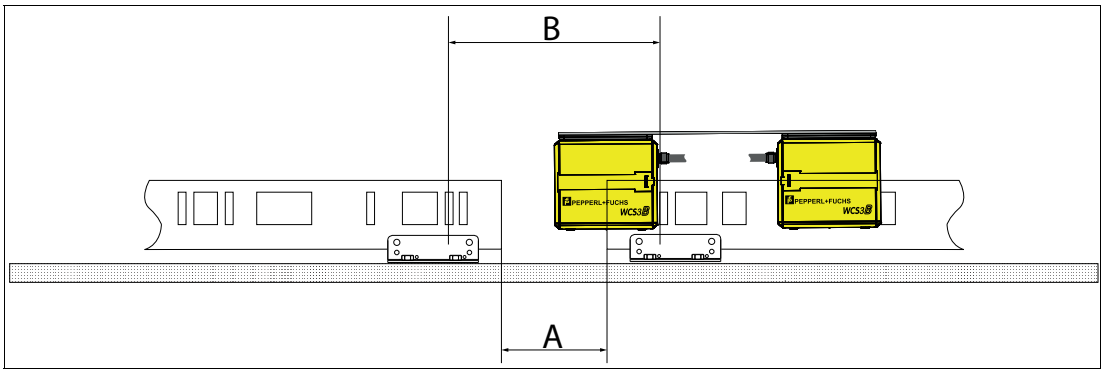


Figure 6.6 An interruption in the code rail

The length of the read head results in a section without valid position values when the code rail is interrupted. This section is calculated as follows: **B = A + 160 mm**

Note

Make sure that interruptions in the code rail are **at least 85 mm** and the two code rail parts are aligned.

The maximum distance from one end of an aluminum profile rail to the next rail holder must not be larger than 50 mm.

Note

An interruption of the code rail results in a safety-related shutdown, encoder errors in the PUS evaluation unit and requires the PUS evaluation unit to be reset by the higher-level controller. For more information on the reset function, refer to the PUS installation instructions, which are located on the product detail page of the PUS evaluation unit under the Product documentation tab.

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Example

In principle, branches of multiple segments or track switches can also be realized with WCS. Make sure that there is a minimum distance of 85 mm between the code rail segments.

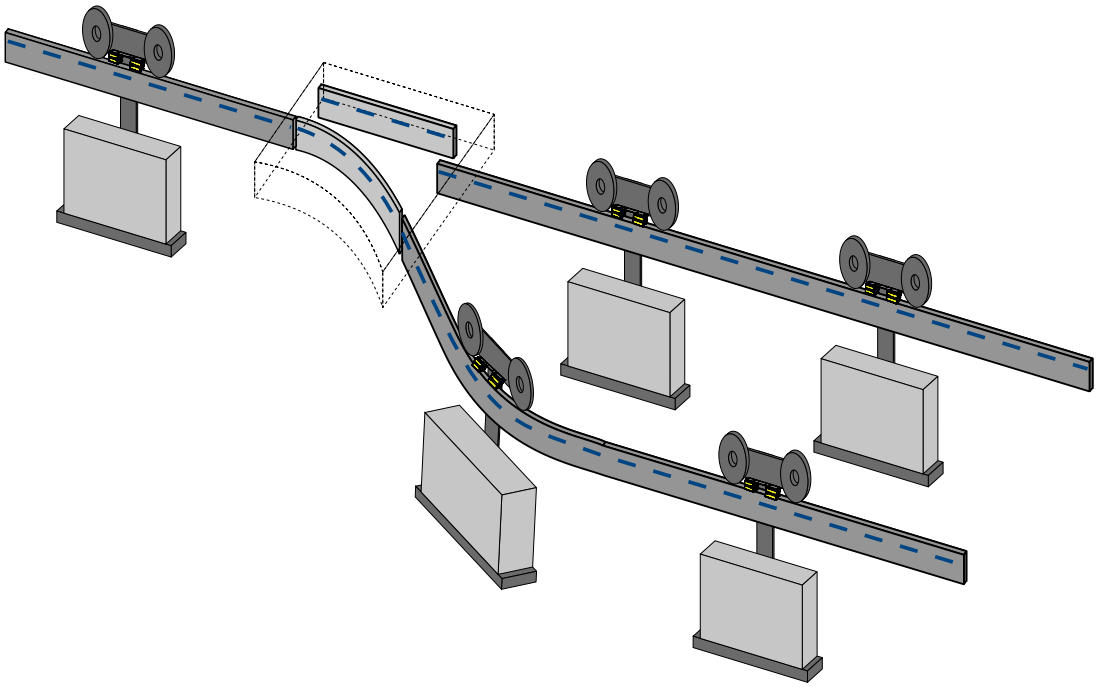


Figure 6.7 Overhead conveyor example

6.3 Mounting the Code Rail with Mounting Brackets

6.3.1 Introduction

The bracket system is an easy way to mount laminate or stainless steel code rails. It consists of brackets for routing the code rail in straight sections, as well as brackets for routing the code rail in curves and circular paths. The brackets are made from galvanized and powder-coated sheet steel and are supplied pre-assembled. The mounting brackets for installation of the code rail can be delivered in three different versions:

- Without fastening screws
- With fastening screws
- With fastening screws for mounting in C profile rails

6.3.2 System overview

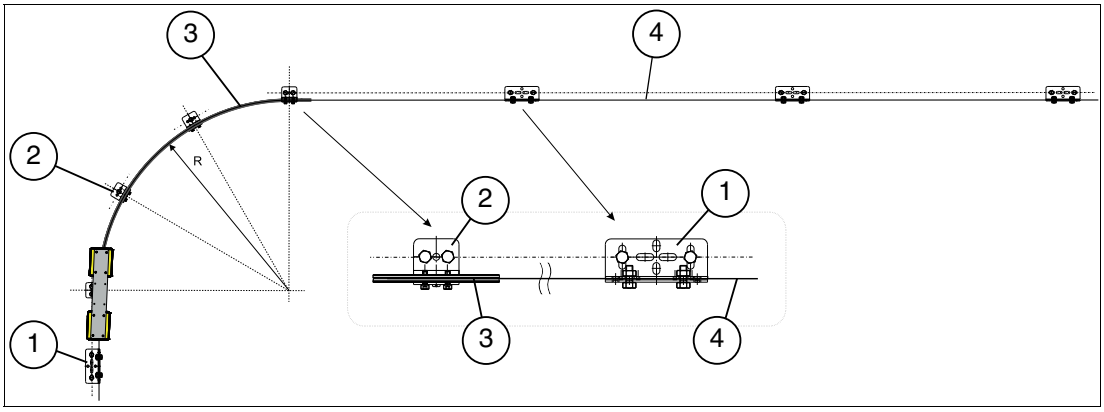
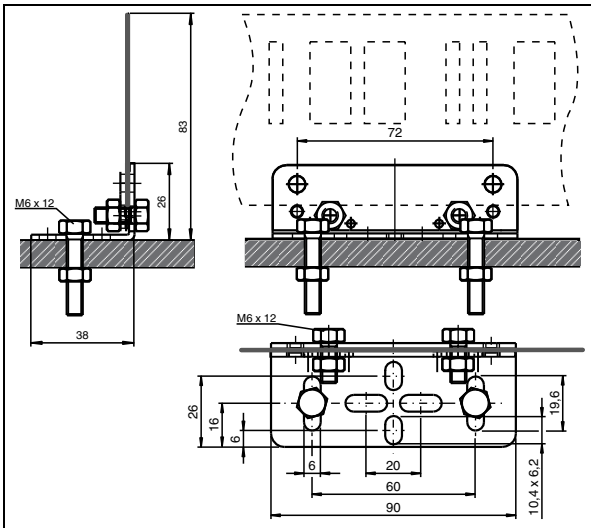


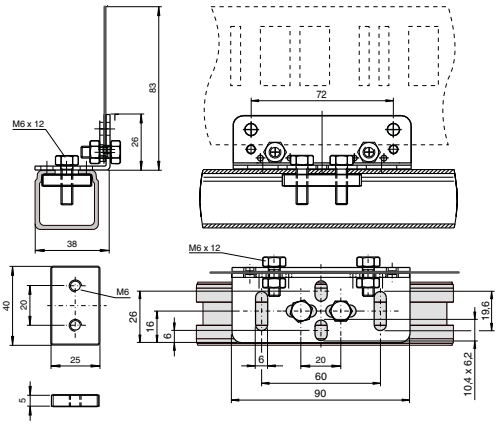
Figure 6.8 Application example: mounting brackets, straight section, and curve

Item	Designation	Product name	Note
1	Mounting angle	WCS-MB*	Support distance, every 1.25 m
2	Curve bracket	WCS-MB*B	Support distance, every 0.5 m
3	Stabilizing profile	WCS-SP2	-
4	Code Rail	WCS3-CS70	Stainless steel, laminated

Mounting Bracket for Straight Routing

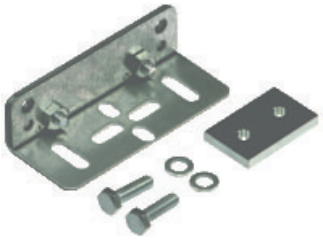


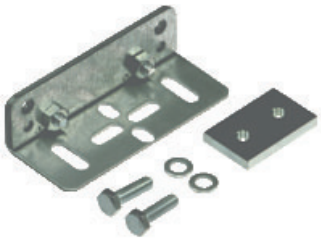
WCS-MB1/WCS-MB1-C
Screw connection with M6 screws



WCS-MB2/WCS-MB2-C
Screw connection with C groove

The brackets are made from galvanized sheet steel and are supplied pre-assembled. Various versions of the mounting brackets for installation of the code rail are available:

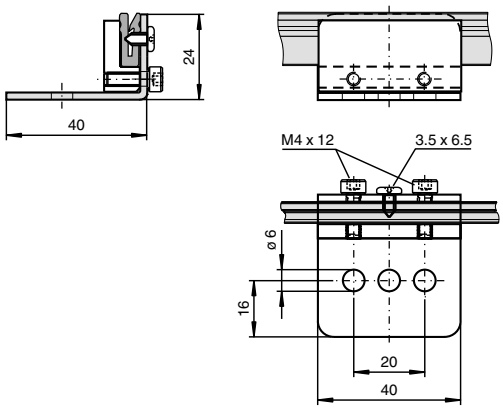
Product name	Description	Product photo
WCS-MB	Bracket for straight sections	
WCS-MB1	Bracket for straight sections With M6 screw connection	
WCS-MB2	Bracket for straight sections With C T-slot nut	

Product name	Description	Product photo
WCS-MB-C	Bracket for straight sections Powder-coated	
WCS-MB2-C	Powder-coated bracket for straight sections With C T-slot nut	

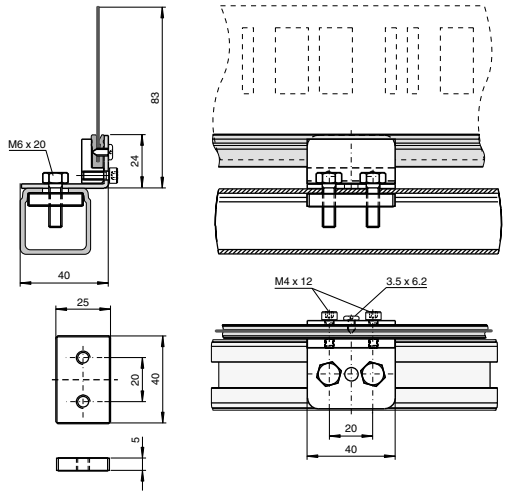
Note

The recommended support distance for straight section elements is at least one bracket every 1.25 m.

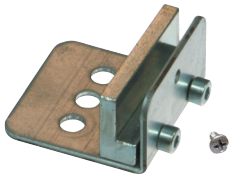
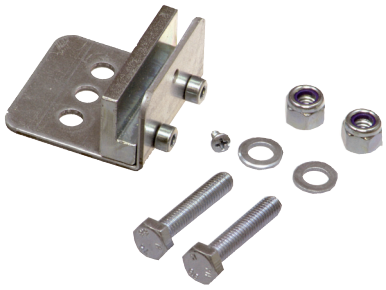
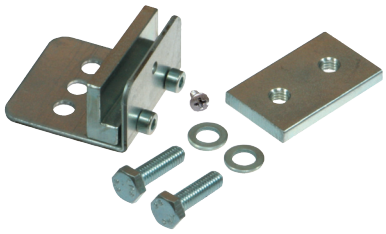
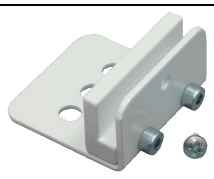
Mounting Bracket for Curves or Circular Paths

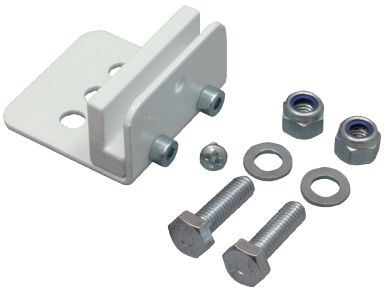
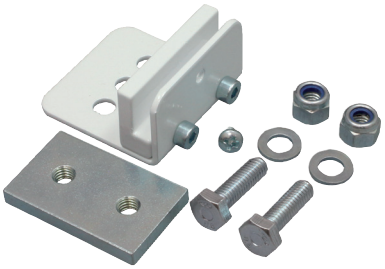
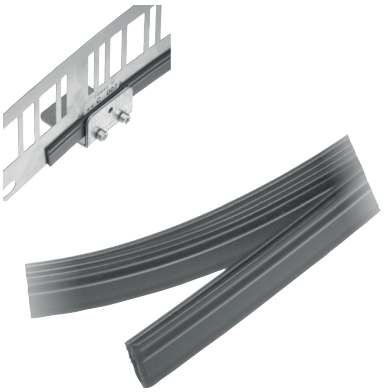


WCS-MB-B
Screw connection with M6 screws available



WCS-MB2-B
Screw connection with C groove

Product name	Description	Product photo
WCS-MB-B	Bracket for curves	
WCS-MB1-B	Bracket for curves With M6 screw connection	
WCS-MB2-B	Bracket for curves With C T-slot nut	
WCS-MB-B-C	Bracket for curves Powder-coated	

Product name	Description	Product photo
WCS-MB1-B-C	Bracket for curves With M6 screw connection and powder coating	
WCS-MB2-B-C	Powder-coated bracket for curves With C T-slot nut	
WCS-SP2	Stabilizing profile For curved sections	

Note

The recommended support distance for curves is at least one bracket every 0.5 m. A WCS-SP2 stabilizing profile must also be used in curves.

6.3.3 Attaching the Tensioning Device

Using the tensioning device prevents the stainless steel code rail from warping due to temperature fluctuations after mounting. It also makes mounting easier.

Note

Pretensioning of the stainless steel code rail is not necessary for system function.
Pretensioning is useful only if large temperature fluctuations can occur within a short time.

The tensioning device can only be used together with the stainless steel code rail.

Three mounting holes are stamped in a row at the beginning and end of the stainless steel rail. They are used for screwing on the tensioning device. There are two options for mounting the tensioning device:

1. The code rail is fastened at one end and tensioned at the other end with the tensioning device.
2. The code rail is fixed in the middle and tensioned with the tensioning device at both ends. This method is advantageous for longer distances (> 50 m).

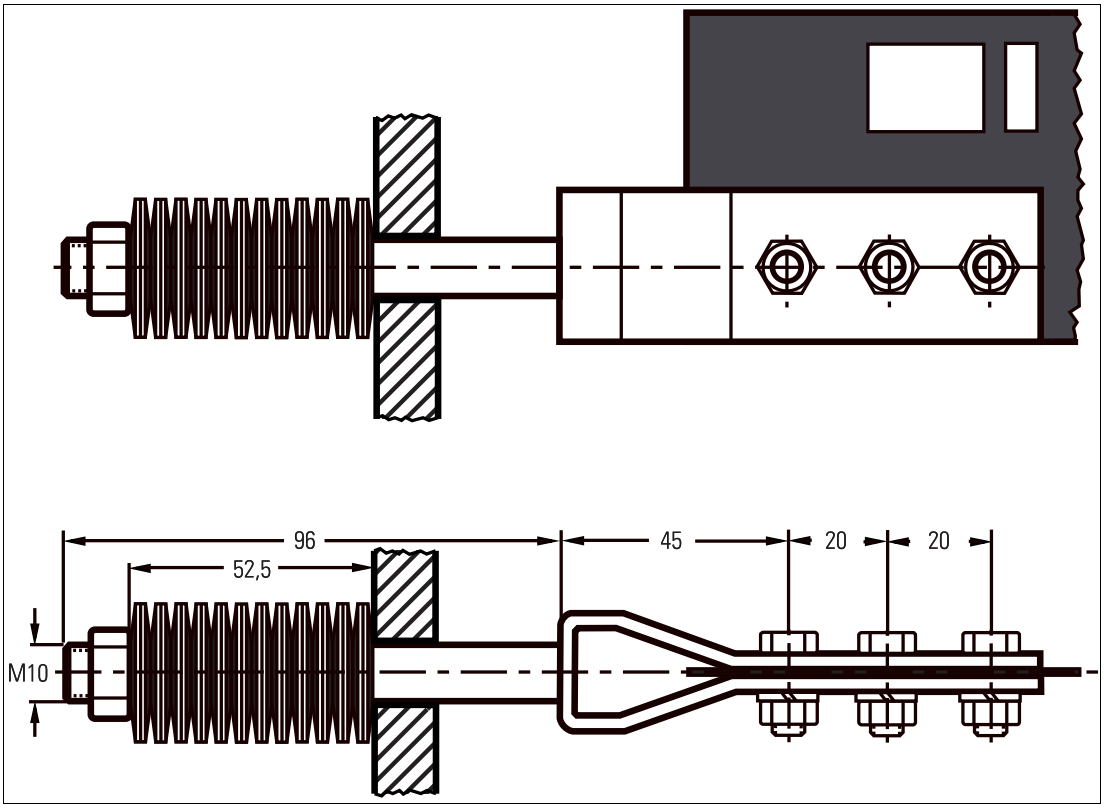


Figure 6.9 WCS-MT1 tensioning device

Stainless steel code rail	Tightening torque
WCS2B, 55 mm	6 Nm
WCS2B, 70 mm	9 Nm
WCS3B, 70 mm	7 Nm

6.4 Assembly of the WCS3 aluminum profile system

6.4.1 Introduction

A special aluminum profile system has been developed for quick mounting of the 70 mm WCS3 code rail made from plastic laminate or stainless steel. The aluminum profile is designed such that it supports the code rail. A plastic fixing cord inserted in the groove of the profile rail ensures the code rail is firmly held in place. The aluminum profile system can be mounted in any location. The profile rails are supplied in 6 m long pieces. The aluminum profile rail is powder-coated and can be supplied in curved segments on request.

Tip

For normal industrial applications, using the laminate code rail has proven successful. Alongside its cost advantages, the low weight of the code rail provides benefits during installation, in particular when installing longer sections.

For extreme operational conditions, we recommend the stainless steel code rail:

- Flying sparks in a welding shop
- Heavy contamination during operation (e.g., waste incineration)

6.4.2 System overview

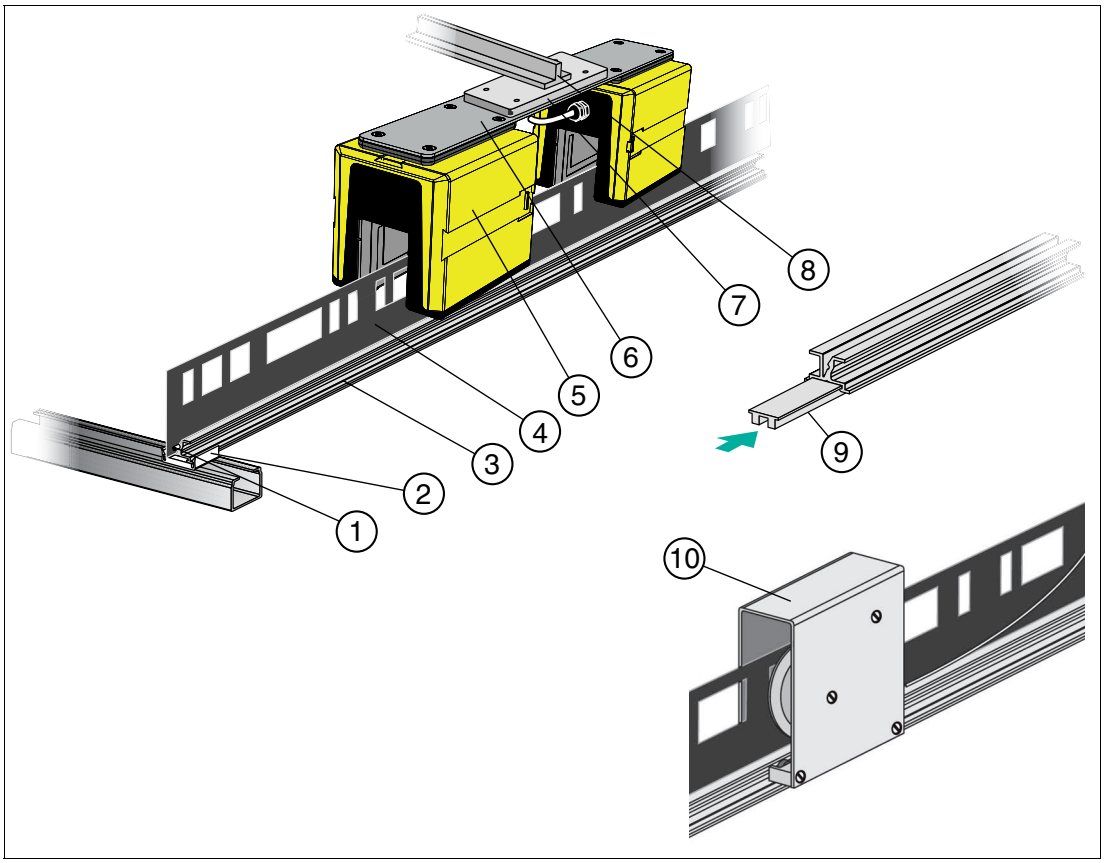


Figure 6.10 Overview

Item	Designation	Product name	Note
1	Fixing cord	WCS-MF1	-
2	Rail holder	WCS3-MH*	Support distance for perpendicular/suspended mounting: < 2.5 m, Lateral mounting: < 2 m

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Item	Designation	Product name	Note
3	Aluminum profile rail	WCS3-PS1*	Length: 2 m/6 m
4	Code Rail	WCS3-CS70-*	Stainless steel, laminated
5	Read head	WCS3B-LS**	-
6	Mounting base	-	-
7 and 8	Vehicle fixture	-	-
9	Butt connector	WCS3-MC1	-
10	Mounting tool for fixing cord	WCS3-FT1	-

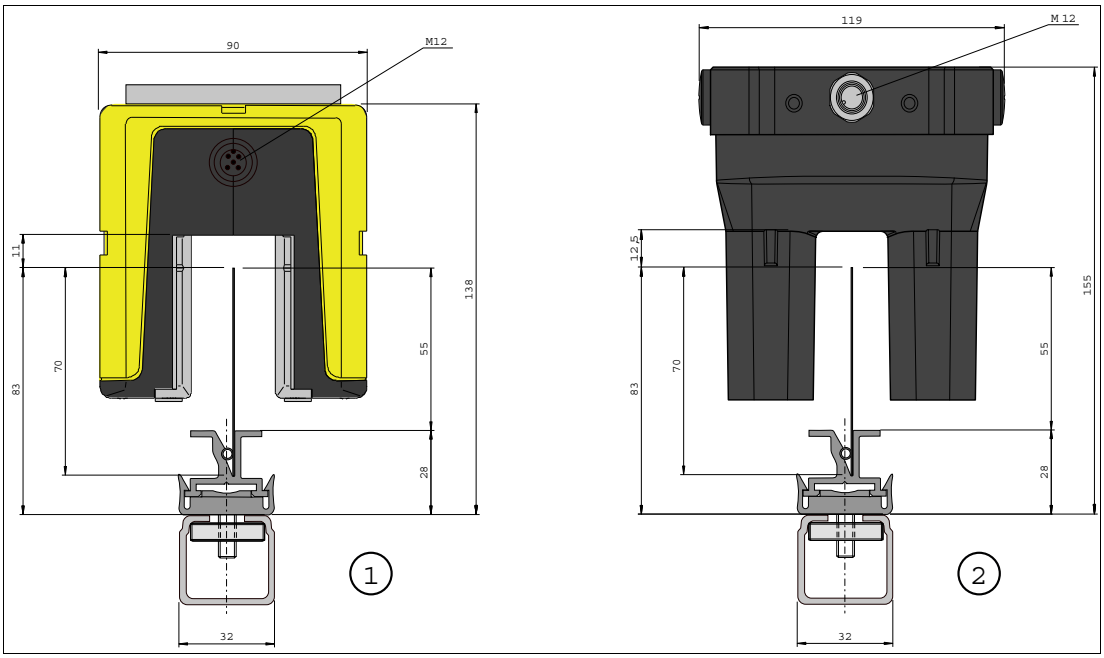
Mounting the Profile Rail

Rail holders are available for mounting the aluminum profile rail quickly. The profile rail is engaged in the rail holders. The rail holders are available in three different versions:

- Without fixing screws
- With fixing screws
- With fastening technology for mounting in C profile rails

The support distance for the profile rail must not exceed 2.5 m for perpendicular and suspended mountings. This corresponds to two to three rail holders for each 6 m rail. If the WCS3 aluminum profile system is mounted laterally, a support distance of 2 m is recommended. This corresponds to three rail holders for each 6 m rail.

Read Head with WCS3 Profile Rail



1. WCS3 profile system with rail holder mounted on C profile rail, with read head
2. WCS3 profile system with rail holder mounted on C profile rail, with outdoor protective enclosure

Rail Holder Overview

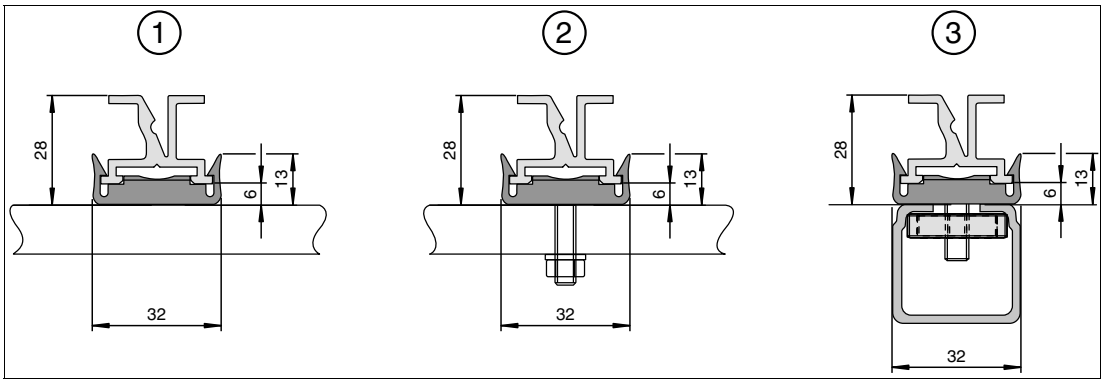


Figure 6.11 Overview

Item	Designation	Product name
1	Rail holder	WCS3-MH
2	Rail holder with screw connection	WCS3-MH1
3	Rail holder with screw connection for C profile rails	WCS3-MH2

Note

Support distance for perpendicular/suspended mounting: < 2.5 m.

Support distance for lateral mounting: < 2 m.

6.4.3 Rail Holder

Mounting the Rail Holders

1. Mount the rail holders at an offset of 2 m along the route on the substructure for a lateral mounting and 2.5 m for a perpendicular or suspended mounting.
2. Align the rail holders along a taut cord.

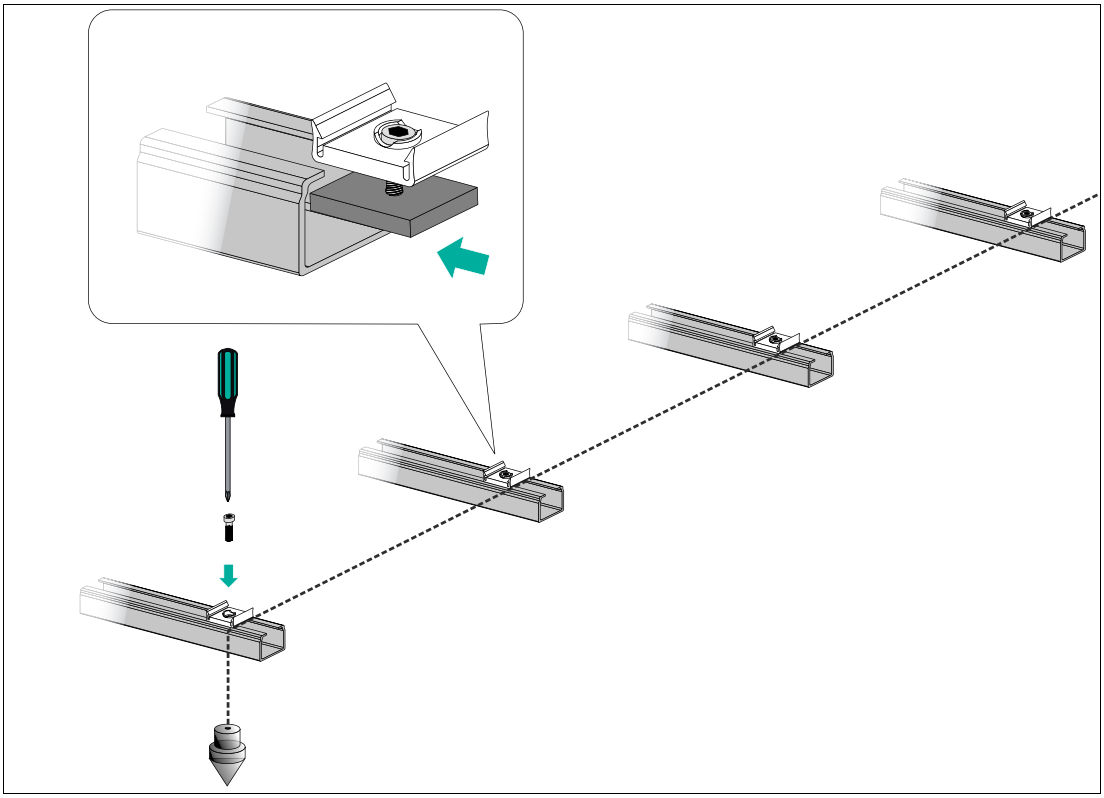


Figure 6.12 Aligning the rail holders (example for WCS3-MH2)

3. Snap the profile rail into the rail holder by pressing lightly.

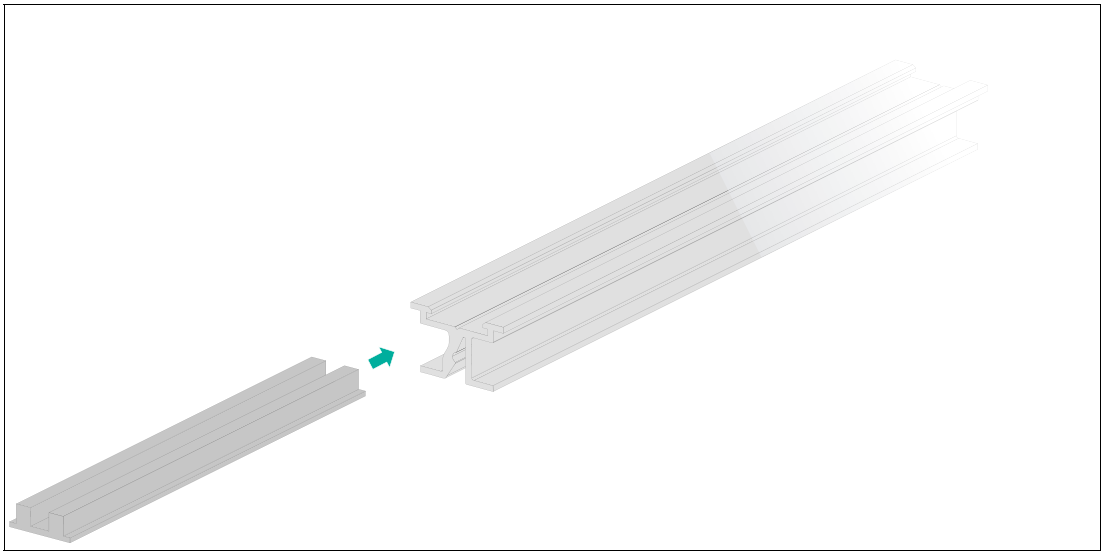
6.4.4 Butt Connectors for Profile Rails

Butt connectors are required for connecting aluminum profile rails. The WCS3-MC1 butt connector consists of a 170 mm long extruded aluminum profile and two self-tapping screws.

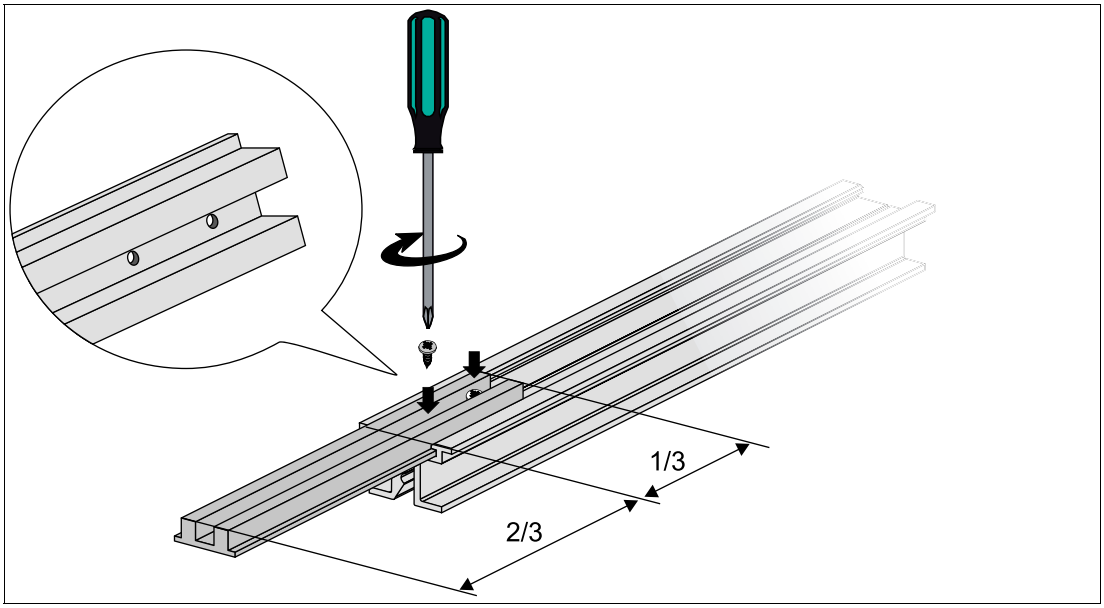
Designation	Part number	Function/use	Material/mounting
WCS3-MC1	184074	Butt connector for aluminum profile rails	Aluminum/steel self-tapping screws M3 x 4.5 mm

Mounting the Butt Connector

1. Slide the butt connector into the bottom grooves of the two profile rails that you want to connect. Push the end of the connector that has the holes in first.



2. Screw the self-tapping screws into the 1.8 mm diameter holes in the flat pieces.



↳ The tips of the screws press into the aluminum profile and fix the butt connector in place

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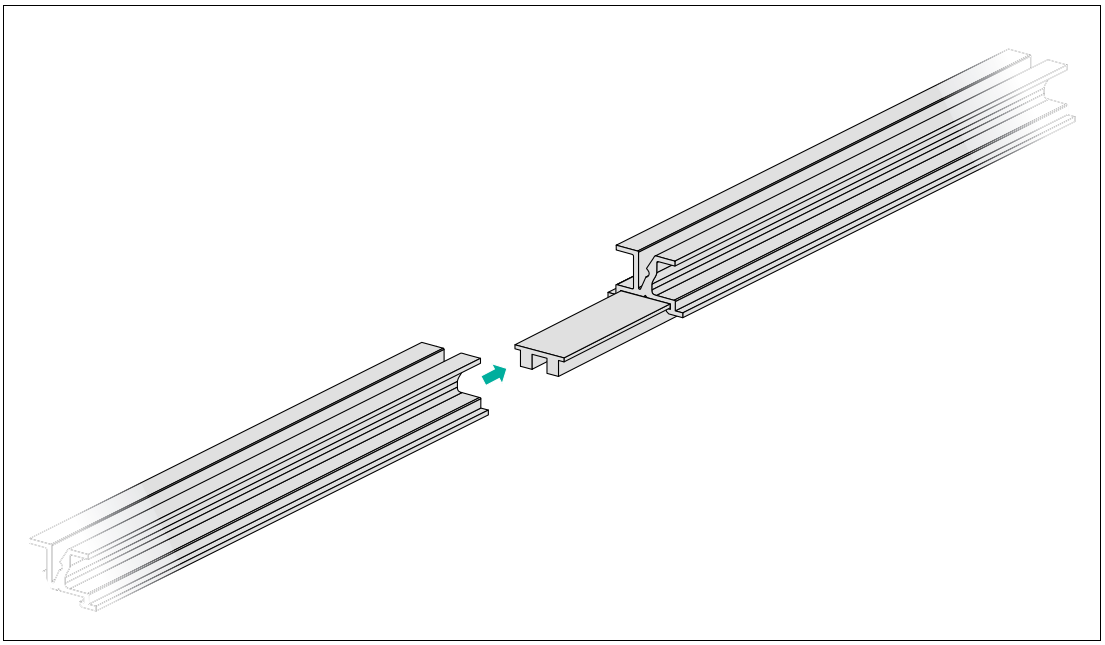
3. Slide the profile rails together with the butt connectors.



Note

When you slide the aluminum profile rails together with the butt connectors, make sure there is a gap to compensate for thermal expansion. A gap is necessary if the maximum possible operating temperature is greater than the temperature during the assembly.

Calculate the necessary gap width as follows:

Gap width in mm = 0.12 * $\Delta\vartheta$

$\Delta\vartheta = \vartheta_{\text{max. operating temp.}} - \vartheta_{\text{assembly temp.}}$

Examples:

$\Delta\vartheta$ = 10 K, gap width = 1.2 mm
$\Delta\vartheta$ = 20 K, gap width = 2.4 mm
$\Delta\vartheta$ = 30 K, gap width = 3.6 mm

6.4.5 Mounting the Code Rail

Mounting the Code Rail in the Profile Rail

1. Insert the code rail into the groove of the profile rail.

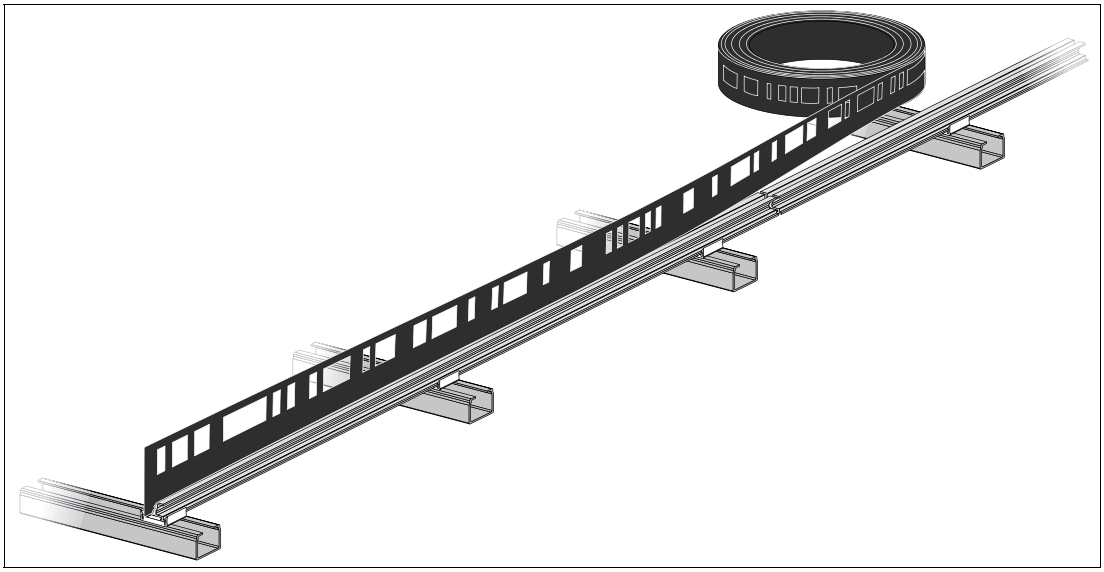


Figure 6.13 Mounting the code rail

2. Fix the code rail in place by pressing the plastic fixing cord into the groove of the profile rail and simultaneously pressing on the code rail.

Warning!

Falling components

A suspended mounting position presents a risk of injury due to falling components.

Make sure that all components are correctly installed.
Do not stand under hanging components during the mounting.

Mounting Tool (WCS3-FT1)

A special mounting tool is available for fixing the code rail in place securely and quickly. The mounting tool is recommended if the aluminum profile system is installed suspended. The tool consists of a housing with casters, similar to the guide trolley.

Mounting the Code Rail with the Mounting Tool

1. Insert the code rail into the groove of the profile rail.
2. Place the plastic fixing cord on the groove of the profile rail.
3. Pull the mounting tool over the profile rail.

   ↳ The code rail is held in position by the guide roller and contact pressure roller. The fixing cord is pressed into the groove of the profile rail by the pressing wheel.
4. Move the mounting tool back and forth on the profile rail.

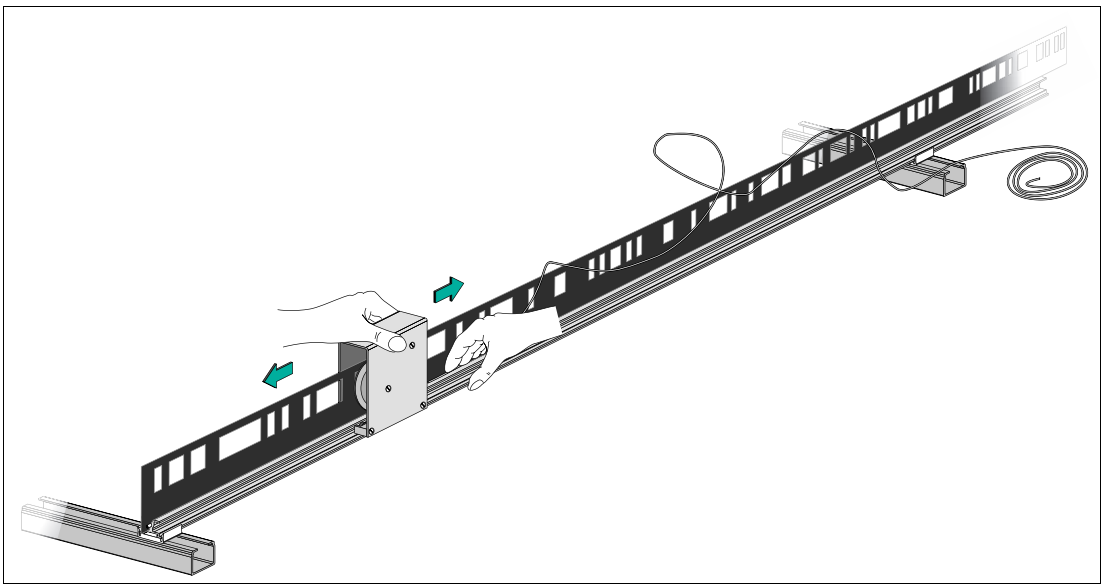


Figure 6.14 Mounting tool

↳ This ensures that the fixing cord sits correctly in the groove. The contact pressure of the fixing cord is so great that the code rail cannot slip out of the profile rail even when it is mounted suspended.

Note

As part of regular plant maintenance, check that the fixing cord and code rail are securely in place, especially if the profile rail is mounted suspended.

6.4.6 Fixed Points

To prevent the aluminum profile rails slipping in the rail holders when mounted horizontally, the profile must be securely connected to the substructure.

Positioning a Fixed Point

1. Position a fixed point in the middle of the section that you want to fix in place.
2. Pierce the rail holder on both sides with a metal drill with 1.8 mm diameter.

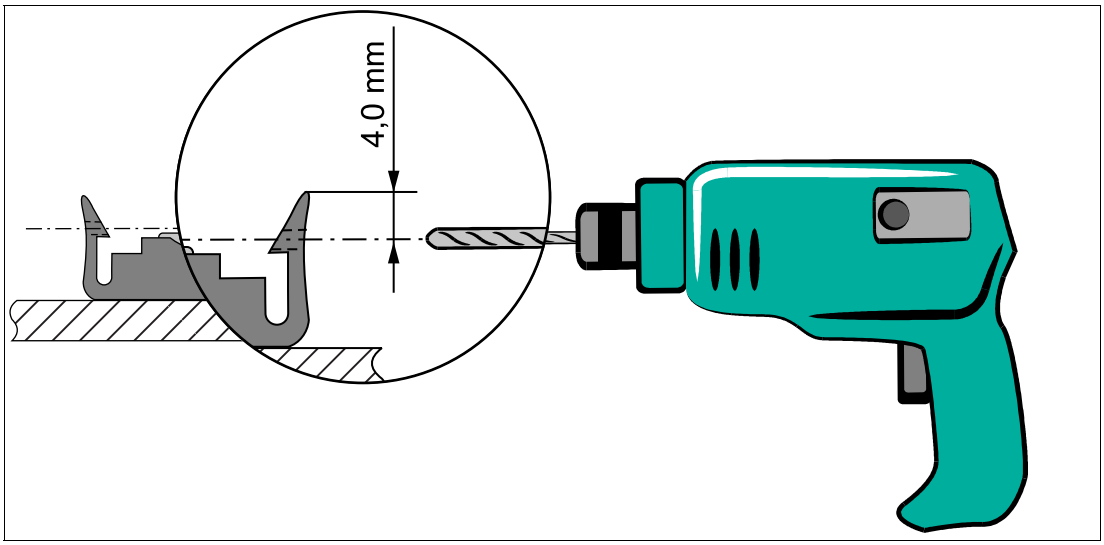


Figure 6.15 Piercing a rail holder

3. Drill two 3 x 6 mm self-tapping screws into the holes.

Note

The self-tapping screws are not included in the scope of delivery.

↳ The screws press into the aluminum profile, establishing a tight-fitting connection between the rail holder and the aluminum profile.

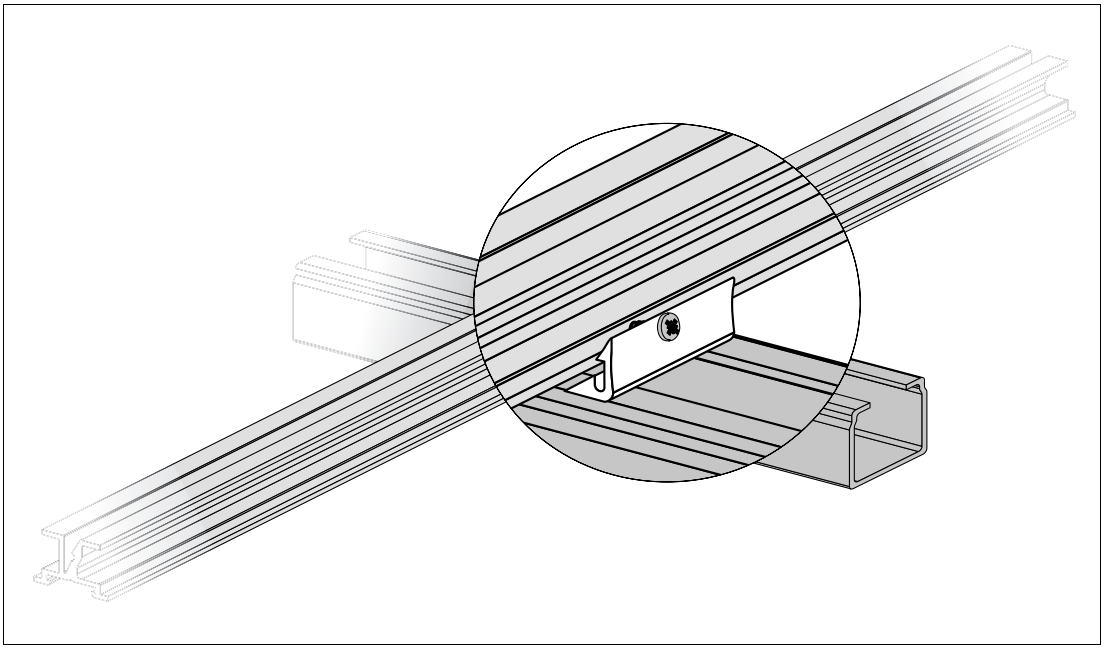


Figure 6.16 Connection between the rail holder and the aluminum profile

Tip

We recommend that you fix the aluminum profile in place at multiple points along a route using the method described. Make sure that there are sufficient expansion gaps between the aluminum profiles (see chapter 6.4.4).

Tip

For vertical mounting, secure the aluminum profile with a suitable support bracket (on site).

6.4.7 Suspended Mounting with Stainless Steel Code Rail

If you want to mount the stainless steel code rail suspended, you have to secure the code rail against falling down. This applies in particular when there are frequent changes in temperature. For lengths up to 25 m, using the tensioning device (see chapter 6.3.3) is sufficient.

For lengths beyond this, we recommend further securing the stainless steel code rail every 12 m with a self-tapping screw or a spring dowel pin in the aluminum profile.

Securing the Code Rail

1. Pierce the aluminum profile and the code rail from the side.

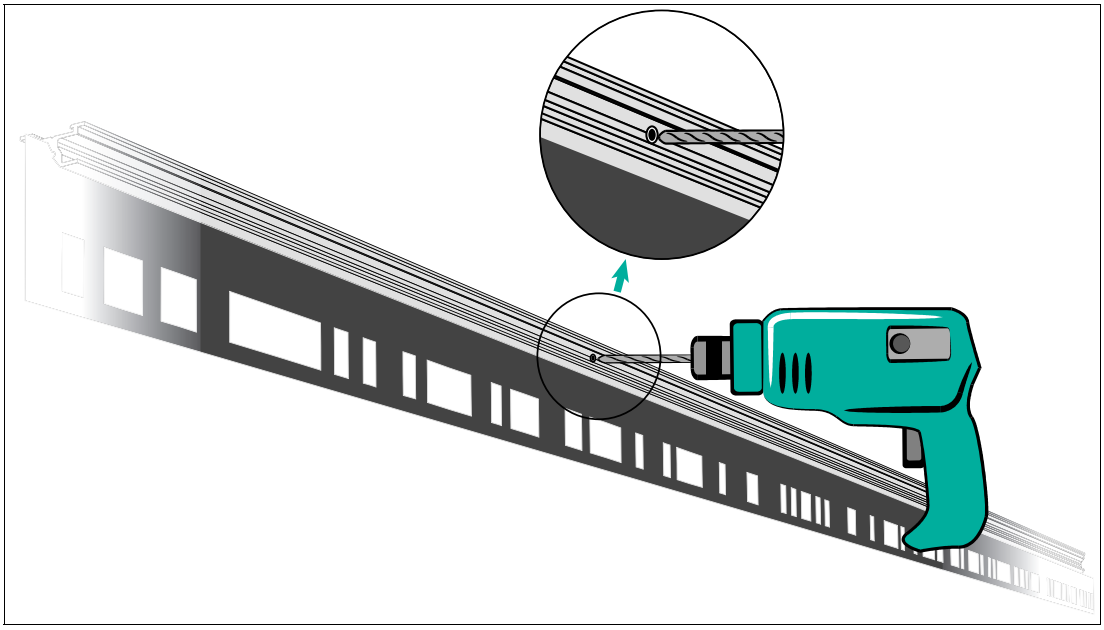


Figure 6.17 Piercing the aluminum profile and the code rail

2. Screw a suitable self-tapping screw into the hole.

Note

Alternatively, you can use a suitable spring dowel pin.
The self-tapping screw or spring dowel pin are not included in the scope of delivery.

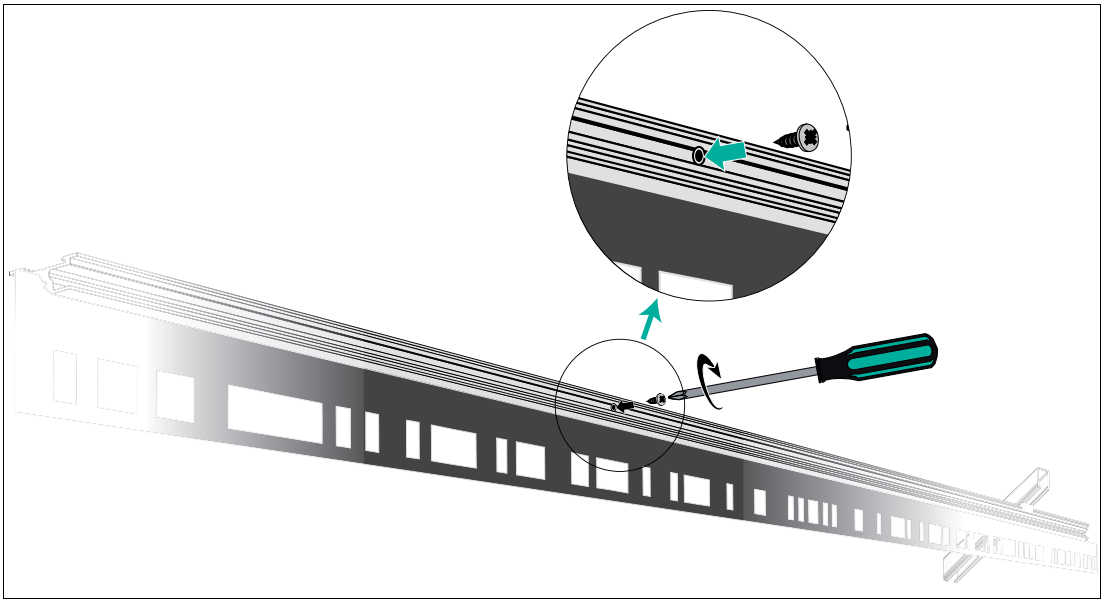


Figure 6.18 Screwing in a self-tapping screw

6.4.8 Grounding the Aluminum Profile System

Connect the aluminum profile with the plant potential at low resistance at least every 30 m.

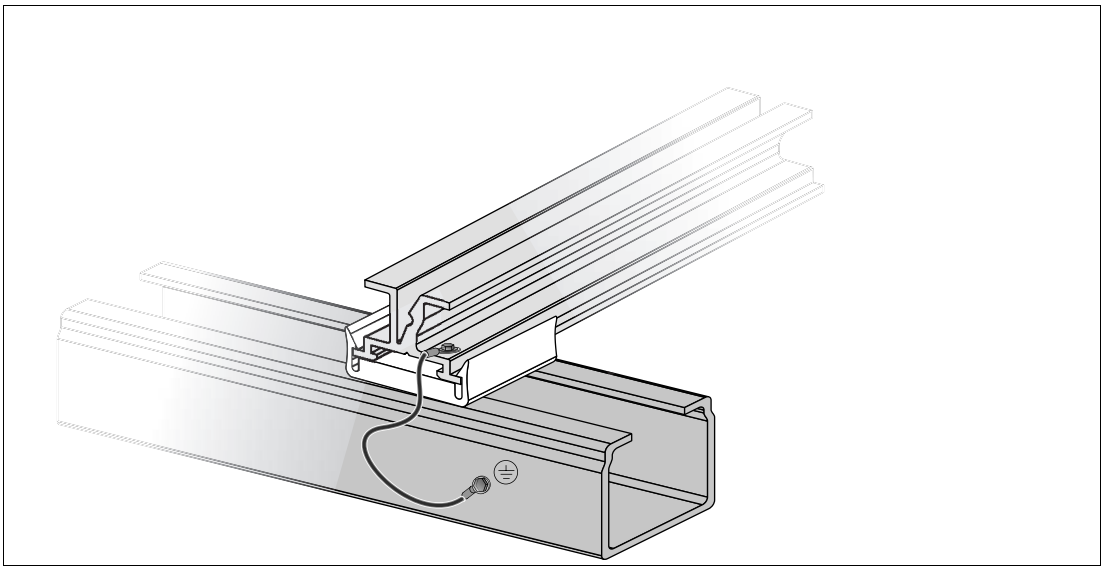


Figure 6.19 Grounding

6.5 Assembly of the WCS2 aluminum profile system

6.5.1 Introduction

A profile rail system with WCS guide trolley has been developed for applications where the moving carriage has high mechanical tolerances. The guide trolley safeguards the optimal position of the read head in relation to the code rail at all times and compensates for running tolerances between the vehicle and the WCS system. At the same time, the read head is decoupled from vehicle vibrations. The aluminum profile system is mounted in a perpendicular and suspended position. The profile rails are supplied in 5 m long pieces and are sawed with a 45° miter at the ends. The aluminum profile rail is also available with a powder-coated finish.

Tip

For normal industrial applications, using the laminate code rail has proven successful. Alongside its cost advantages, the low weight of the code rail provides benefits during installation, in particular when installing longer sections.

For extreme operational conditions, we recommend the stainless steel code rail:

- Flying sparks in a welding shop
- Heavy contamination during operation (e.g., waste incineration)

6.5.2 System Description

safeWCS/PUS Read Head with Outdoor Protective Enclosure and Guide Trolley

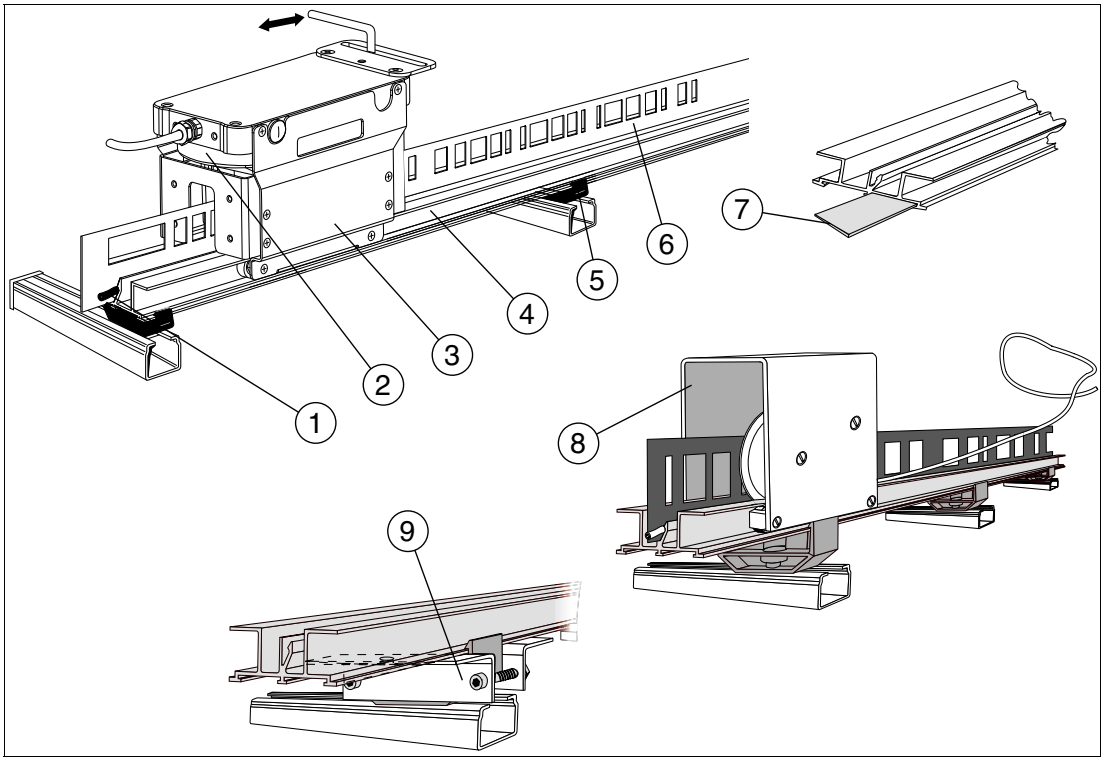


Figure 6.20 Overview

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Item	Designation	Product name	Note
1	Fixing cord	WCS-MF1	-
2	safeWCS/PUS-Outdoor	WCS3B-LS*-O*	Read head with outdoor protective enclosure
3	Guide trolley	WCS3-GT09-P1-O	-
4	Aluminum profile rail	WCS2-PS1(-C)	2.5 m or 5 m long, optional (-C: powder-coated)
5	Rail holder	WCS2-MH*	-
6	Code Rail	WCS3-CS70-*	-
7	Butt connector	WCS2-MC*	-
8	Mounting tool for fixing cord	WCS2-FT1	-
9	Locking bracket	WCS2-LB1*	-

safeWCS/PUS Read Head with Profile Rail

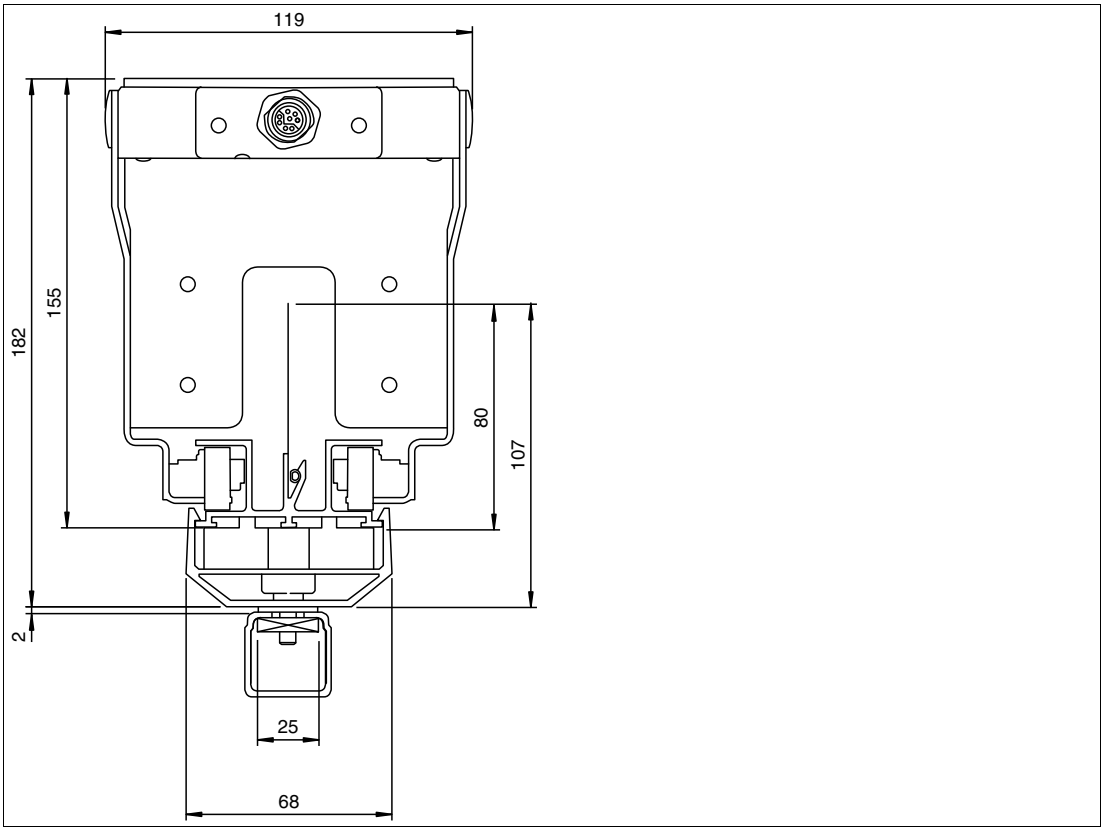


Figure 6.21 WCS2 profile system with rail holder mounted on C profile rail, with safeWCS/PUS-Outdoor read head with guide trolley

Rail Holder Overview

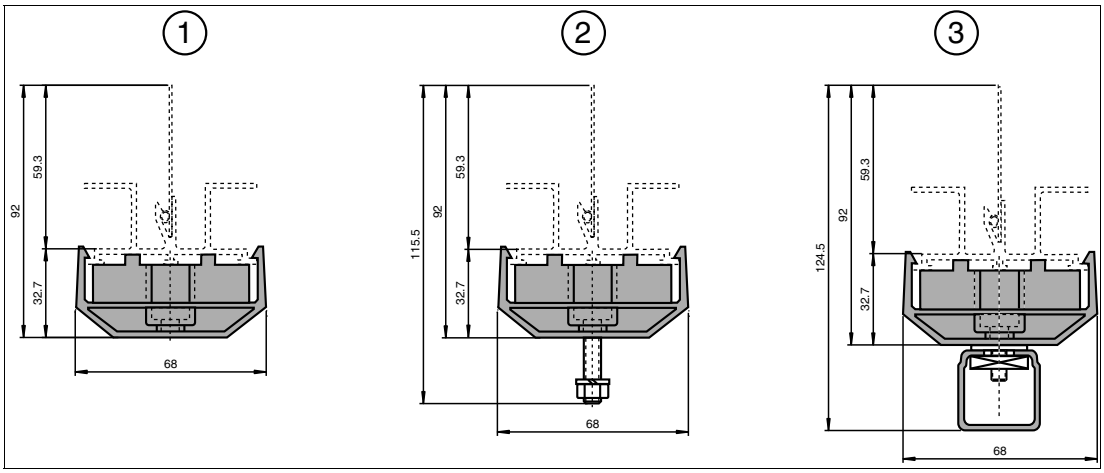


Figure 6.22 Overview

Item	Designation	Product name
1	Rail holder	WCS2-MH
2	Rail holder with screw connection	WCS2-MH1
3	Rail holder with screw connection for C profile rails	WCS2-MH2

6.5.3 Rail Holder

Mounting the Rail Holders

1. Mount the rail holders at intervals of 1.5 m along the route on the substructure for a perpendicular or suspended mounting.

Note

For lateral mounting with a WCS2 guide trolley, the support distance must be reduced to 1.25 m.

2. Align the rail holders along a taut cord.

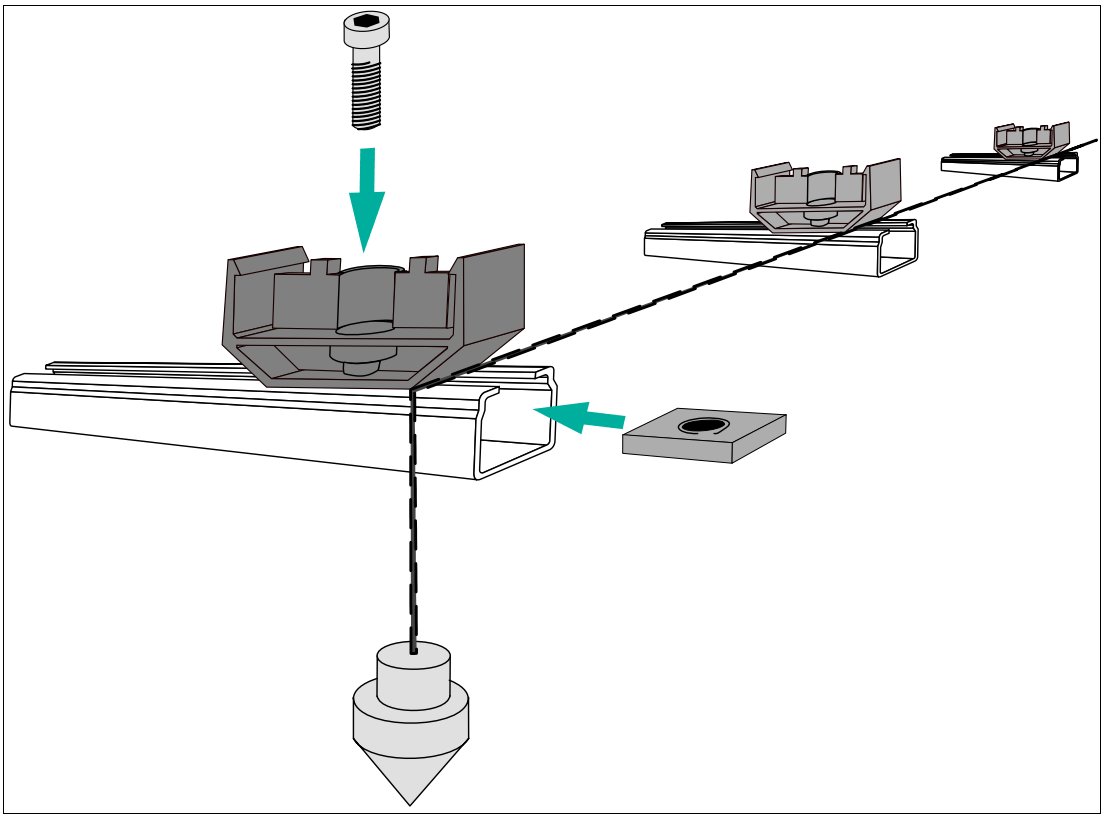


Figure 6.23 Aligning the rail holders (example for WCS2-MH2)

3. Snap the profile rail into the rail holder by pressing lightly.

6.5.4 Butt Connectors for Profile Rails

Butt connectors are required for connecting aluminum profile rails. The WCS2-MC* butt connector consists of two flat pieces and four self-tapping screws.

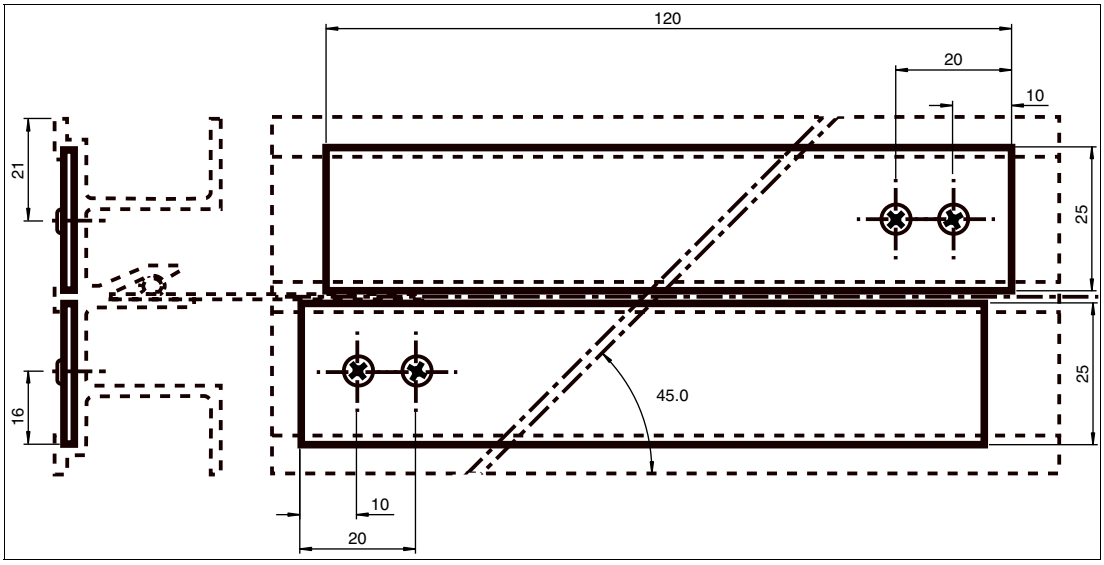
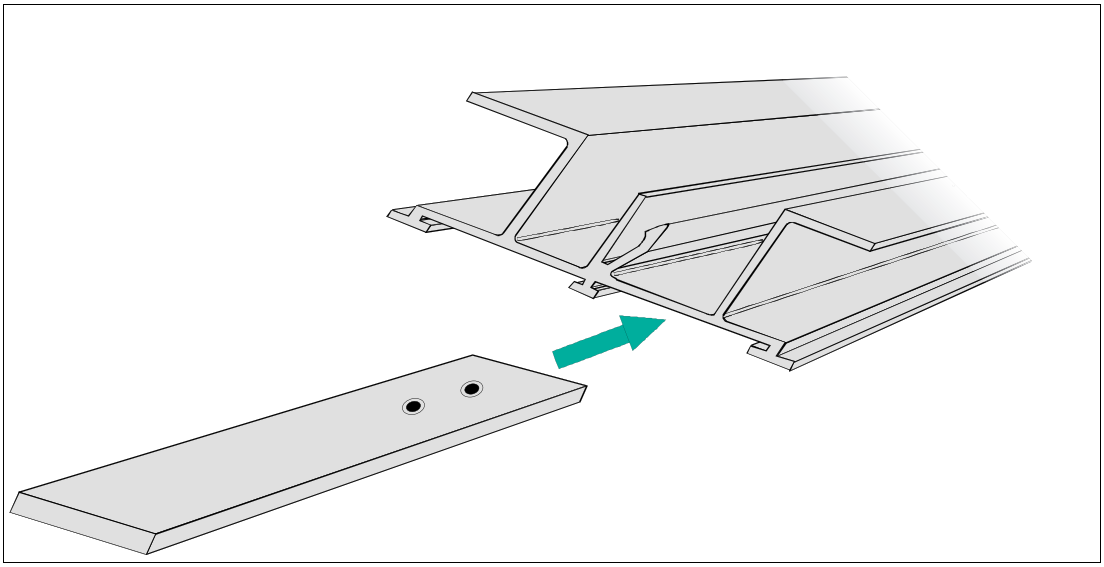


Figure 6.24 WCS2-MC1/WCS2-MC2

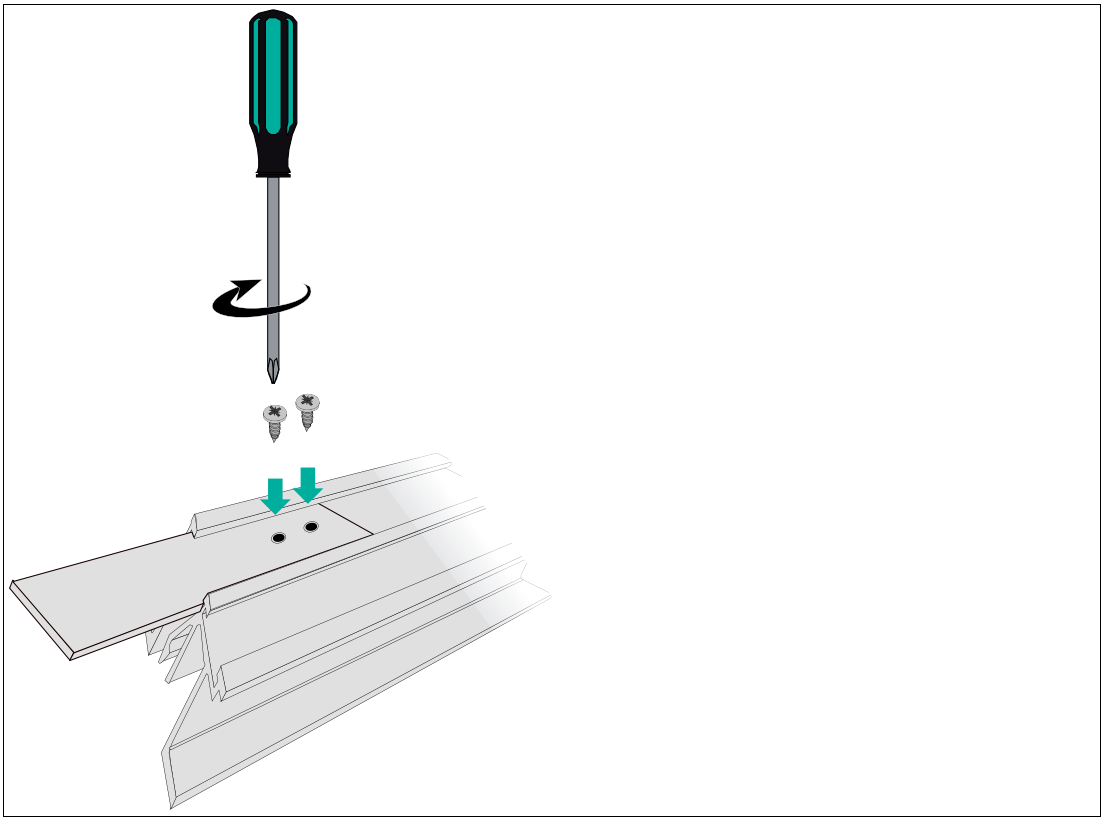
Designation	Part number	Function/use	Material/mounting
WCS2-MC1	184050	Butt connector for aluminum profile rails	Aluminum/steel self-tapping screws M3 x 4.5 mm
WCS2-MC2	184051	Butt connector for powder-coated aluminum profile rails	Stainless steel/stainless steel self-tapping screws M3 x 4.5 mm

Mounting the Butt Connector

1. Slide the two flat pieces into the bottom grooves of the two profile rails that you want to connect. Push the end of the connector that has the holes in first.

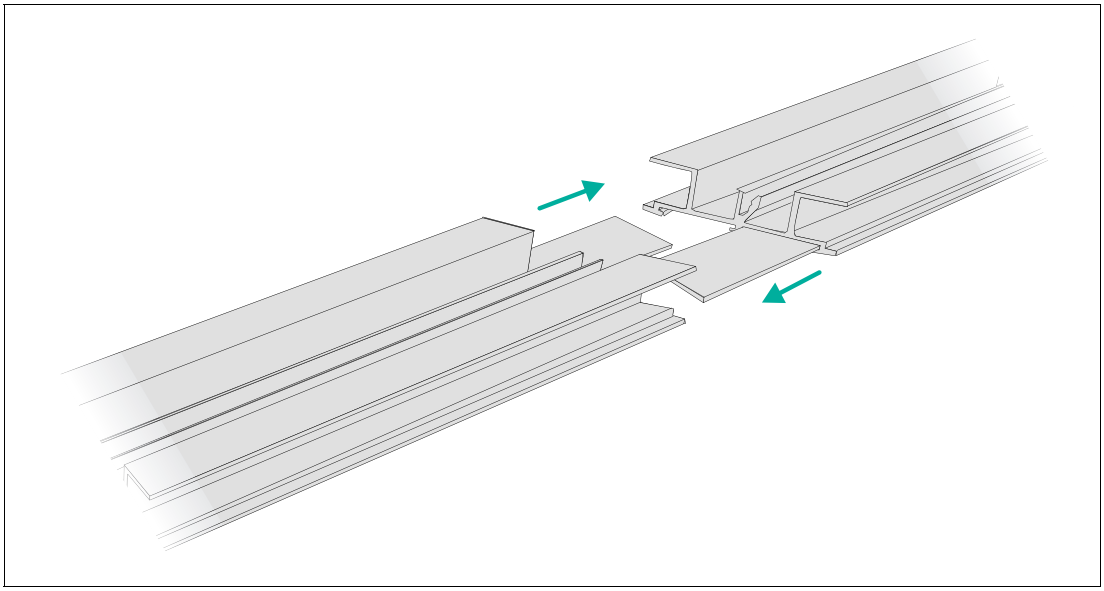


2. Screw the self-tapping screws into the 1.8 mm diameter holes in the flat pieces.



↳ The tips of the screws press into the aluminum profile and fix the butt connector in place.

3. Slide the profile rails together with the butt connectors.



Note

When you slide the aluminum profile rails together with the butt connectors, make sure there is a gap to compensate for thermal expansion. A gap is necessary if the maximum possible operating temperature is greater than the temperature during the assembly.

Calculate the necessary gap width as follows:

Gap width in mm = 0.11 * $\Delta\vartheta$

$\Delta\vartheta = \vartheta_{\text{max. operating temp.}} - \vartheta_{\text{assembly temp.}}$

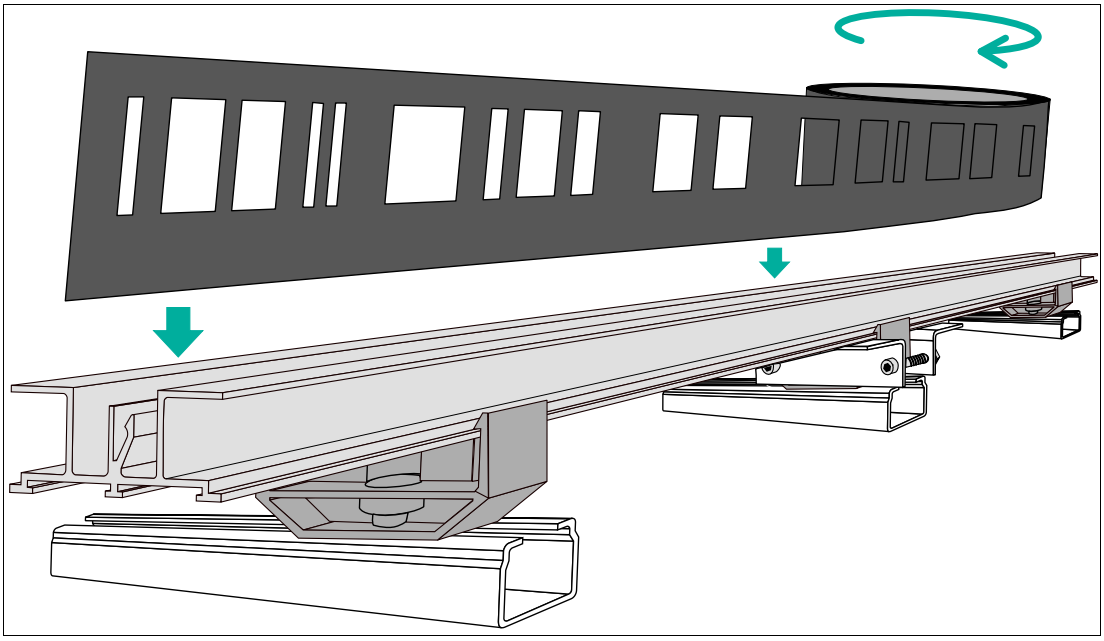
Examples:

$\Delta\vartheta$ = 10 K, gap width = 1.1 mm
$\Delta\vartheta$ = 20 K, gap width = 2.2 mm
$\Delta\vartheta$ = 30 K, gap width = 3.3 mm

6.5.5 Mounting the Code Rail

Mounting the Code Rail in the Profile Rail

1. Insert the code rail into the groove of the profile rail.



2. Fix the code rail in place by pressing the plastic fixing cord into the groove of the profile rail and simultaneously pressing on the code rail.

Warning!

Falling components

A suspended mounting position presents a risk of injury due to falling components.

Make sure that all components are correctly installed.
Do not stand under hanging components during the mounting.

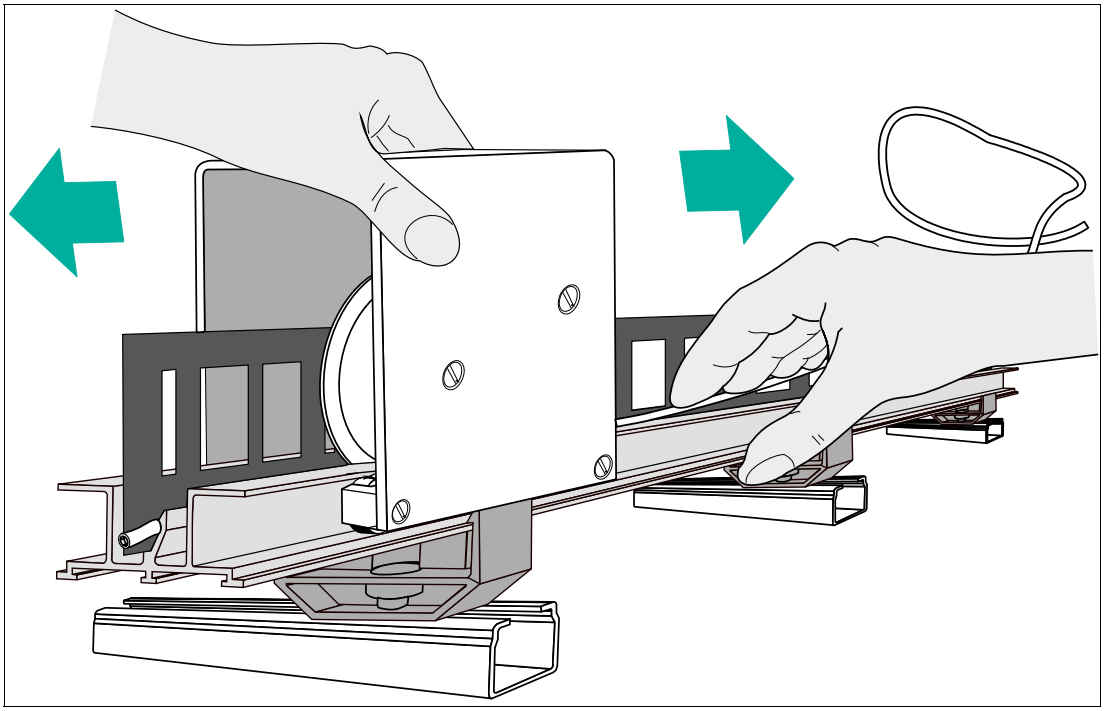
Mounting Tool

A special mounting tool is available for fixing the code rail in place securely and quickly. The mounting tool is recommended if the aluminum profile system is installed suspended. The tool consists of a housing with casters, similar to the guide trolley. Use the mounting tool with order designation WCS2-FT1 for WCS2 aluminum profile systems and the mounting tool with order designation WCS3-FT1 for WCS3 aluminum profile systems.

Mounting the Code Rail with the Mounting Tool

1. Insert the code rail into the groove of the profile rail.
2. Place the plastic fixing cord on the groove of the profile rail.
3. Pull the mounting tool over the profile rail.

   ↳ The code rail is held in position by the guide roller and contact pressure roller.
   The fixing cord is pressed into the groove of the profile rail by the pressing wheel.
4. Move the mounting tool back and forth on the profile rail.



↳ This ensures that the fixing cord sits correctly in the groove.
The contact pressure of the fixing cord is so great that the code rail cannot slip out of the profile rail even when it is mounted suspended.

Note

As part of regular plant maintenance, check that the fixing cord and code rail are securely in place, especially if the profile rail is mounted suspended.

6.5.6 Fixed Points

When the rails are mounted horizontally, a locking bracket is required to prevent the aluminum profile rails slipping in the rail holders.

Designation	Part number	Function/use	Material
WCS2-LB1	184048	Locking bracket for aluminum profile rails	Sheet steel, galvanized
WCS2-LB1-C	184049	Locking bracket for powder-coated aluminum profile rails	Sheet steel, galvanized, powder-coated

Mounting the Locking Bracket

1. Mount the locking bracket around a rail holder in the middle of the section that you want to fix in place.
2. Pierce the profile rail with a metal drill, diameter 7 mm. The drill hole must be aligned with the hole in the locking bracket.
3. Connect the profile rail and the locking bracket with the screw provided.

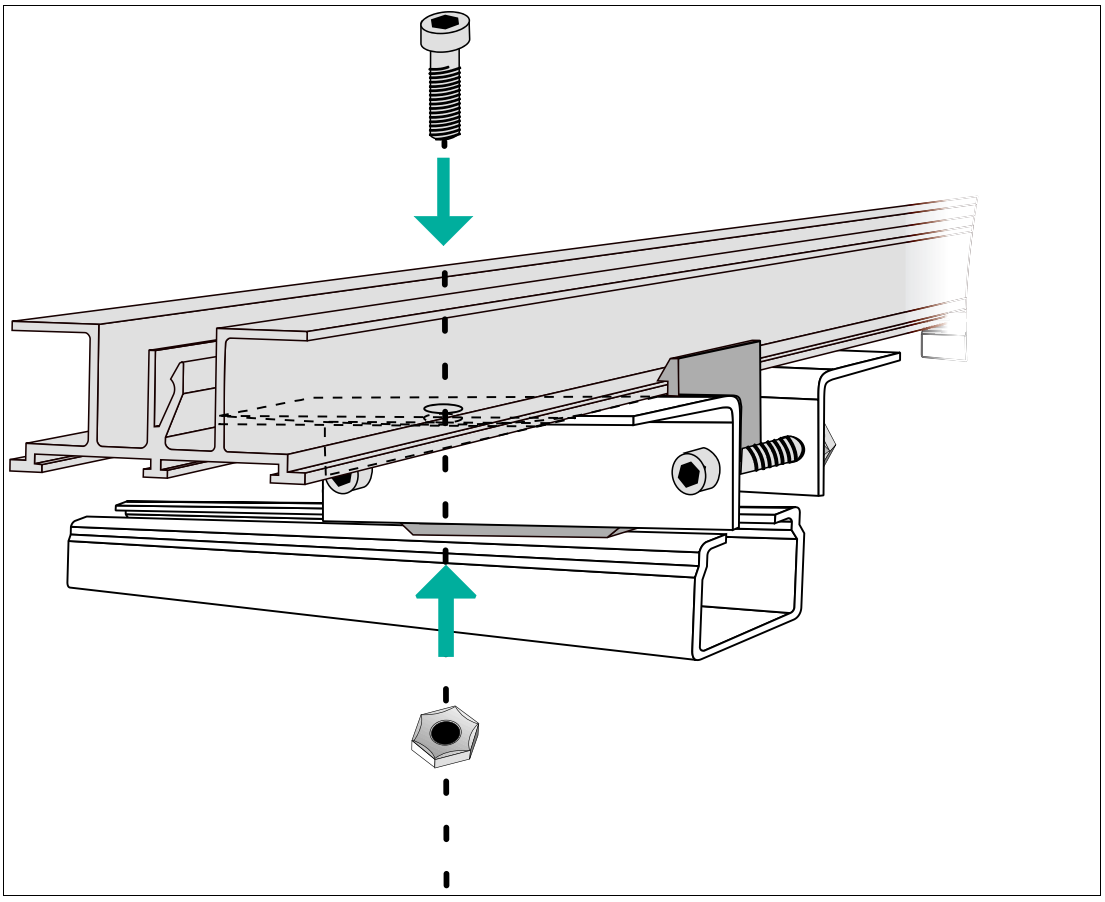


Figure 6.25 Mounting the locking bracket

Tip

For vertical mounting, secure the aluminum profile with a suitable support bracket (on site).

To ensure that the code rail does not slip in the aluminum profile rail, you can fix the code rail in place by using a spring dowel pin or a self-tapping screw in the middle of the section.

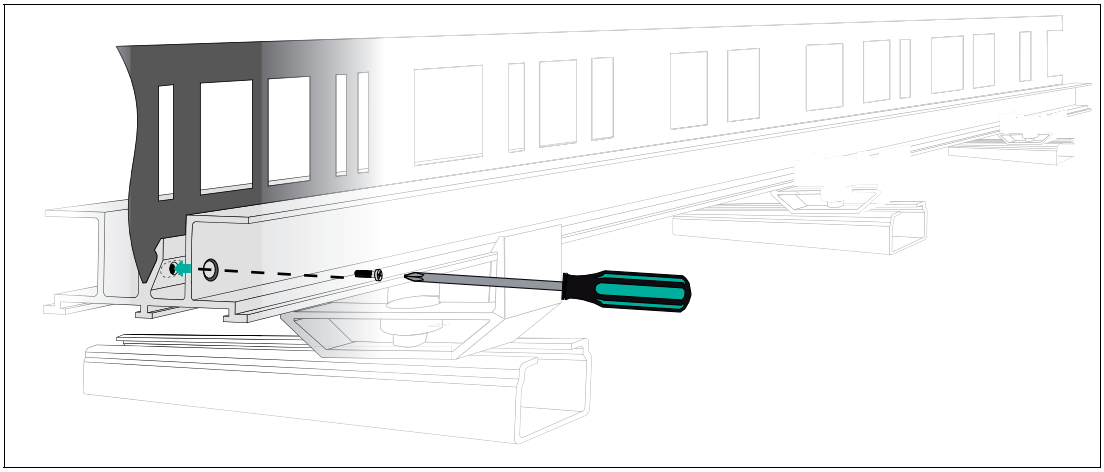


Figure 6.26 Code rail fixed point

6.5.7 Guide Trolley for the safeWCS/PUS-Outdoor Read Head with Protective Enclosure

The protective enclosure with the read head is mounted in the guide trolley (WCS3-GT09-P1-O). The guide trolley is guided over the profile rails to the optimal position between the protective enclosure and code rail.

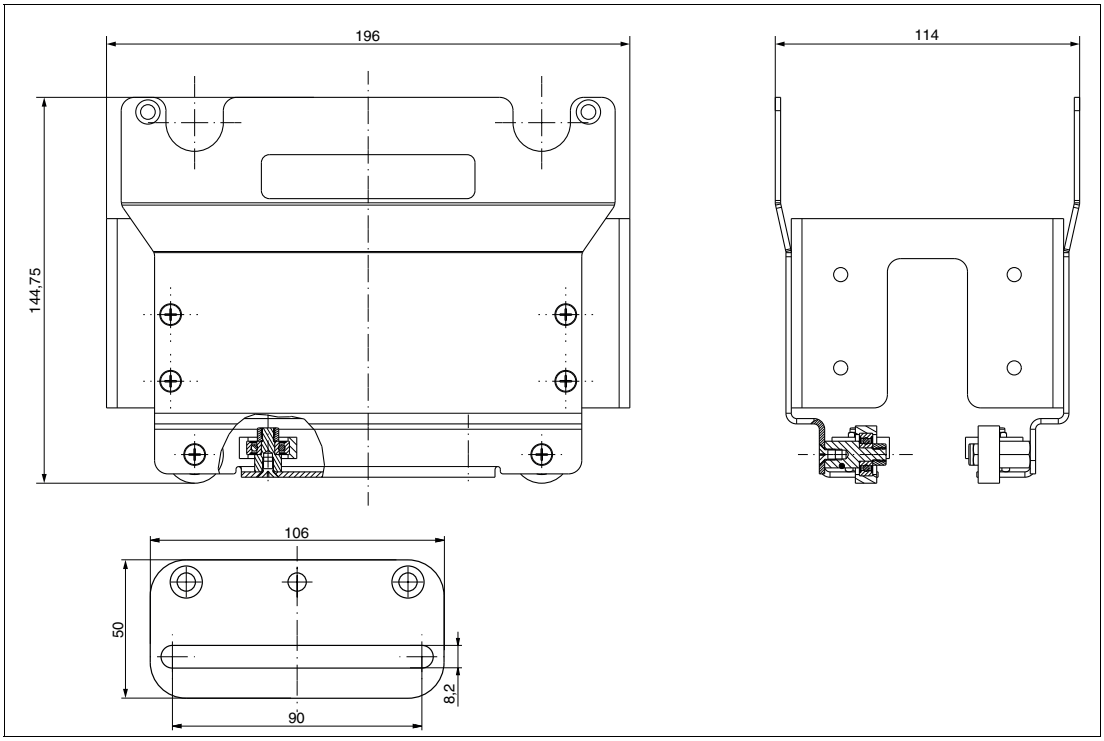


Figure 6.27 Guide trolley and tappet plate dimensions

Mounting the Protective Enclosure with the Read Head in the Guide Trolley

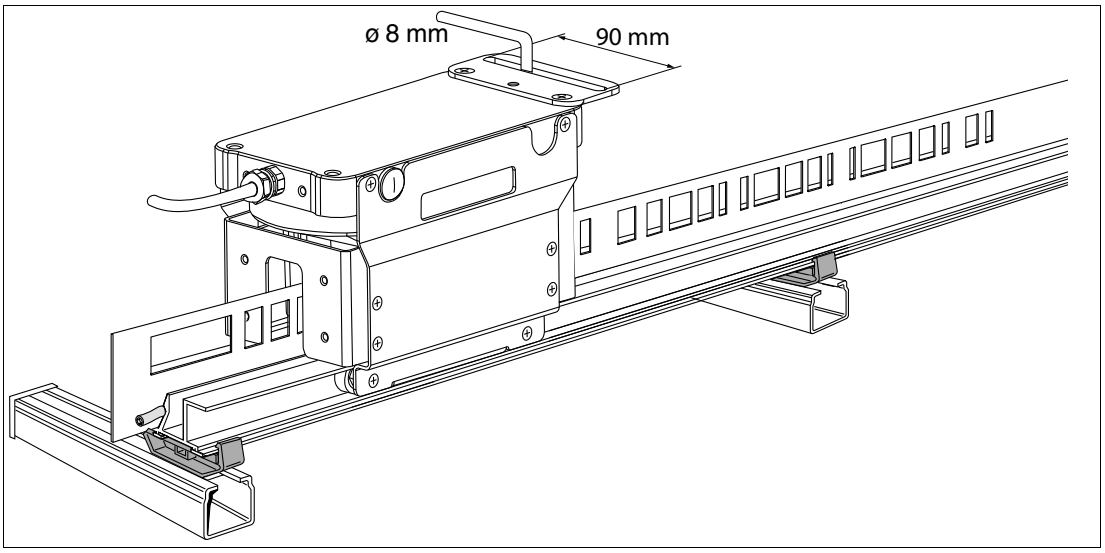


Figure 6.28 Guide trolley with protective enclosure

1. Slide the protective enclosure into the guide trolley from above so that the mounting holes on the guide trolley align correctly with the threaded holes on the protective enclosure.
2. Securely attach the protective enclosure to the guide trolley using the four fixing screws.
3. You can attach the tappet plate to the protective enclosure of the read head using the two fixing screws if required.
4. To dismount, loosen the four fixing screws.
5. Remove the protective enclosure from the guide trolley.

Note

More information and detailed mounting instructions are included with the guide trolley. These mounting instructions are also available at www.pepperl-fuchs.com.

6.5.8 Grounding the Aluminum Profile System

Connect the aluminum profile with the plant potential at low resistance at least every 30 m.

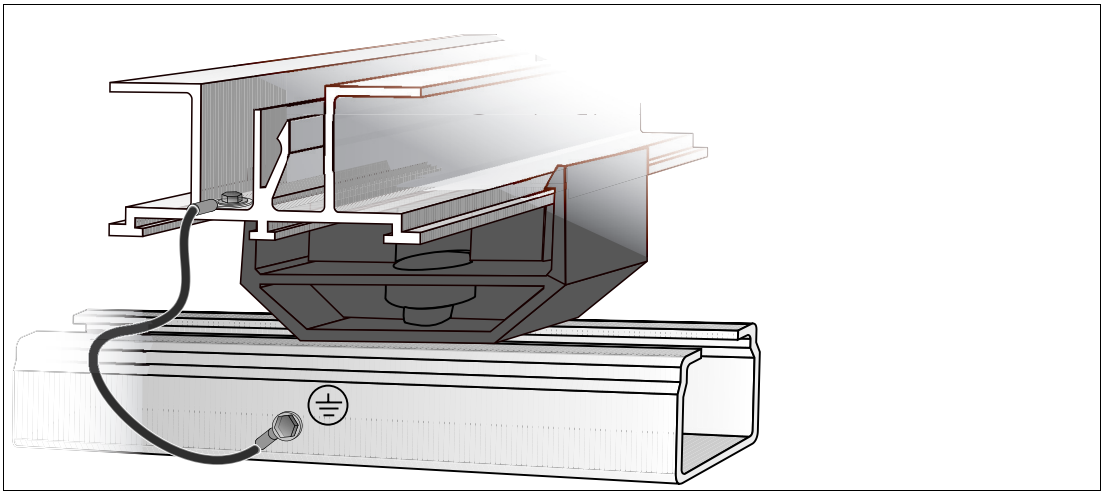


Figure 6.29 Grounding

7 Commissioning

7.1 Electrical Connection

Caution!

Property damage and system malfunctions due to incorrect pinout

Incorrect assignment of the wire pairs to the respective pins can result in property damage and system malfunctions.

- Note the assignment of the wire pairs to the pins as shown in the respective wiring diagrams.

safeWCS/PUS read head connection diagram

The WCS3B read head is connected via a 5-pin M12 plug.

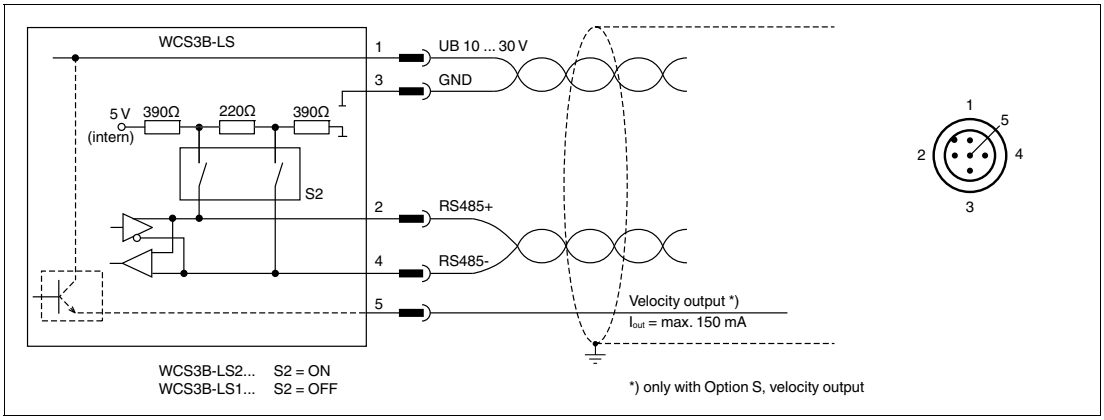


Figure 7.1 WCS3B, RS-485 interface

The counterpart of the plug connections, the 5-pin M12 socket, is not included in the scope of delivery for the read head. You can obtain suitable connectors and cables from Pepperl+Fuchs, .

7.2 Connecting the safeWCS/PUS read heads to the PUS evaluation unit

This chapter describes the setup of the safeWCS/PUS system in simplified form.

Danger!

Danger of death due to defective installation

Incorrect installation can endanger the function and the safety of the device

The PUS installation manual is part of the product and contains important information on integration of the read heads into the PUS system and on their operation and servicing. The programming and parameterization of the devices are described in the programming manual. Precise knowledge and understanding of these is a mandatory prerequisite for a new installation or for adjusting the device function or device parameters.

Note

For more information on the technical data, please refer to the relevant datasheets.

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Connecting the read heads

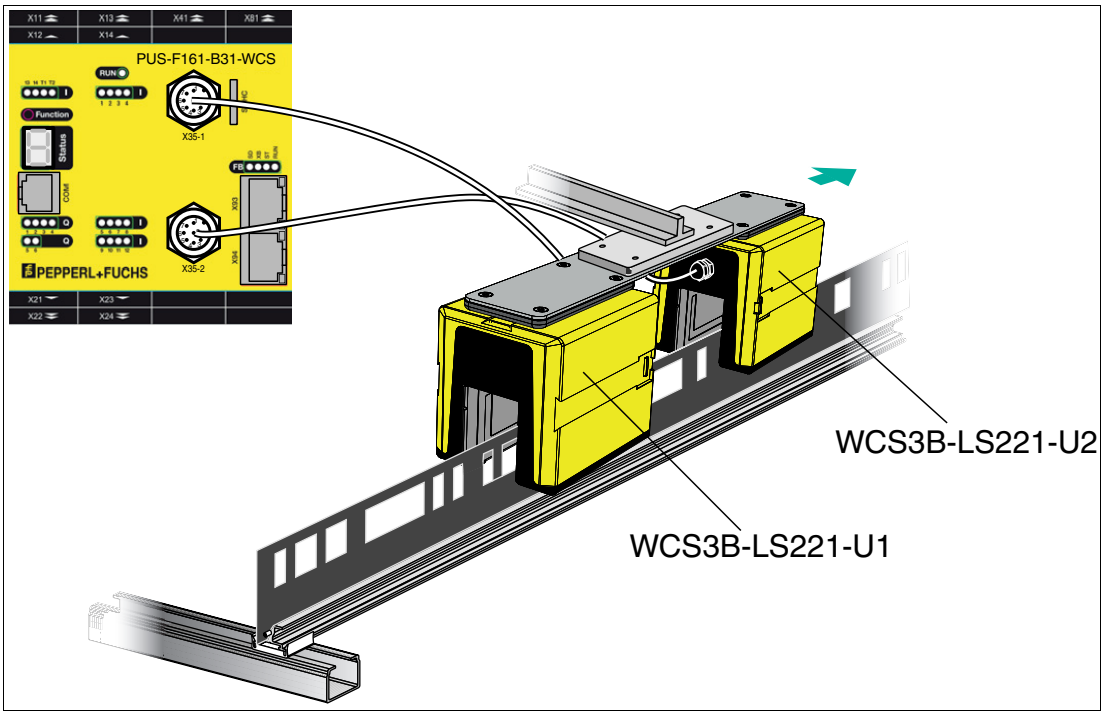

Figure 7.2

1. Connect the WCS3B-LS221-U1 read head (position direction counting upward) to the PUS evaluation unit at plug X35-1.
2. Connect the WCS3B-LS221-U2 read head (position direction counting downward) to the PUS evaluation unit at plug X35-2.

Note

Please note that the counting direction of the two connected read heads must be configured in the later project to match the connection sequence. See the following sections under safeControl Expert Setup.

Please note that the counting direction of the two connected read heads must be configured in the later project to match the connection sequence. For more information, refer to the following section in, .

Connection assignment of safeWCS/PUS read heads to the PUS evaluation unit

The PUS evaluation unit has two separate RS485 interfaces. The two read heads have **a fixed assignment** to the relevant inputs:

Connect the WCS*U1 read head to X35-1 (upper plug)

Connect the WCS*U2 read head to X35-2 (lower plug)

Shielded cables and shielded plugs must be used.

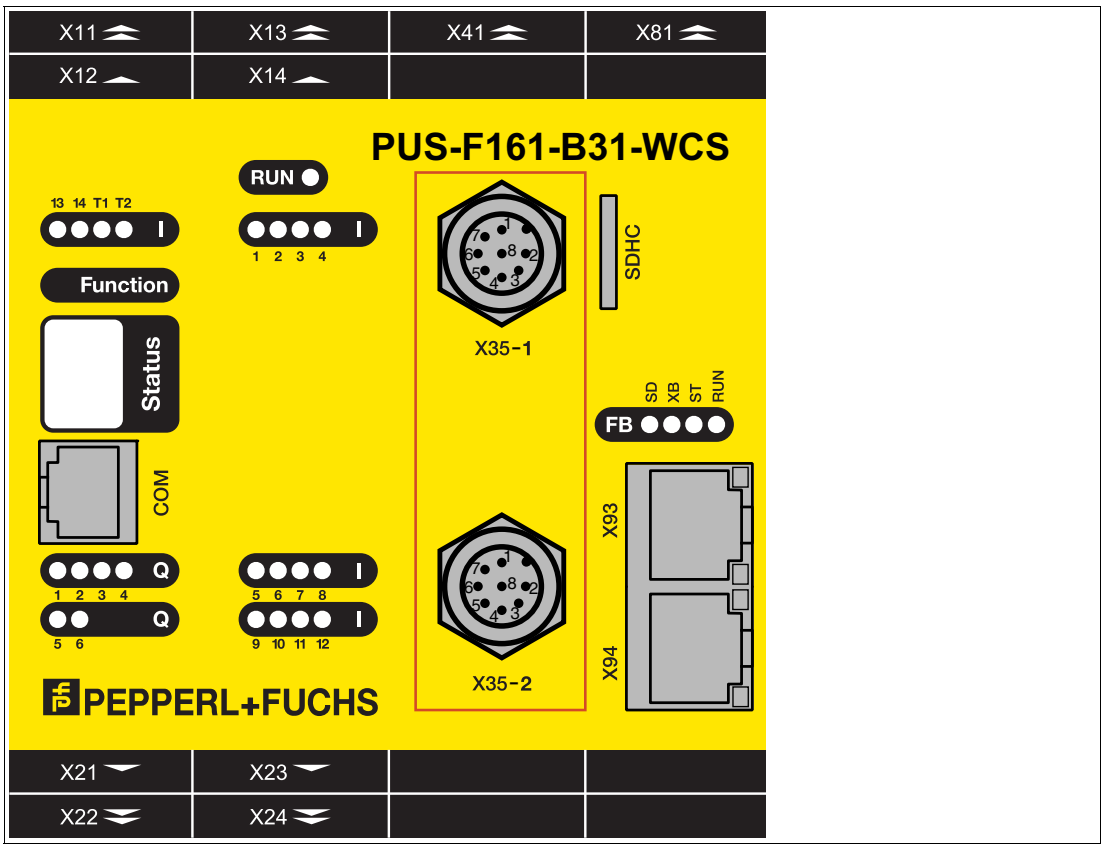

Figure 7.3

Read head interface

RS-485 interface for read head			
Interface	**Pin**	**Designation**	**Description**
X35-1/X35-2 2x M12 socket, 8-pin	1	NC	Not used
	2	UB+	Supply voltage
	3	Data +	Data transfer
	4	Data -	Data reception
	5	NC	Not used
	6	NC	Not used
	7	GND	Ground
	8	NC	Not used

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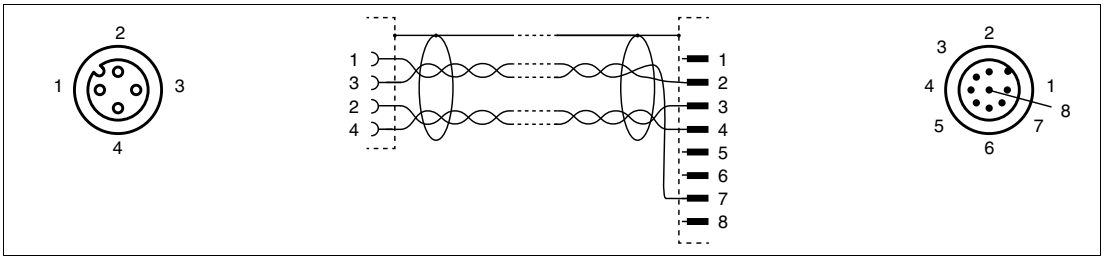

Figure 7.4

PUS evaluation unit M12 plug, 8-pin

safeWCS/PUS read heads 5-pin M12 socket

Note

Shielded twisted-pair cables and plugs with grounding must be used.

Cable	Description
Field-attachable cable	
V1-G-BK5M-PURO2/ CAN-V19-G-Y70	Bus cable DeviceNet/CANopen M12 socket straight A-coded 4-pin to M12 plug straight A-coded 8-pin, PUR cable 4-wire twisted pair black, shielded, UL-approved, suitable for drag chains, outdoor
Cable socket and field-attachable cables supplied by the meter	
V15-G-ABG-PG9-FE	M12 single-ended female cordset, 5-pin, shielded, field-attachable
V19-G-ABG-PG9-FE	M12 cable socket, 8-pin, shielded, field-attachable
WCS-DCS	Available by the meter, 6-pin data cable + shield, 0.14 mm^2 3 x 2 twisted pair wire
WCS-DCF	Available by the meter, 6-pin data cable + shield, 0.25 mm^2 3 x 2 twisted pair wire, suitable for drag chains

7.3 Position direction

The WCS3B-LS221-U1 read head is mounted on the code rail in the direction of travel (counting the position direction upward) and the WCS3B-LS221-U2 read head is mounted on the code rail opposite to the direction of travel (counting the position direction downward).

Position direction of WCS3B-LS221-U1 read head (counting upward)

The front WCS3B-LS221-U1 read head has the same position direction and behavior as a standard WCS3B read head:

Start value: 0 mm/POS = 0 [@Code rail position 0]

End value: 3145632 mm/= 393204 [@Code rail position 393204]

The read head resolution is 0.8 mm per position value or 1250 positions per 1000 mm.

The position values are output in ascending order to the code tape.

Position direction of WCS3B-LS221-U2 read head (counting downward)

The WCS3B-LS221-U2 read head is installed opposite to the direction of travel and with the position direction being counted down:

Start value: 3145632 mm/= 393204 [@Code rail position 0]

End value: 0 mm/POS = 0 [@Code rail position 393204]

The read head resolution is 0.8 mm per position value or 1250 positions per 1000 mm.

The position values are output in descending order to the code tape.

Note

Defining the position directions in the PUS evaluation unit

The position directions in the PUS evaluation unit must be permanently assigned for the evaluation of both read heads. WCS3B-LS221-U1 is defined with upward counting position direction and WCS3B-LS221-U2 with downward counting position direction. For more details on the settings, refer to the safeControl Expert programming manual.

Note

Position difference

The WCS structure is not internally symmetrical with the mechanical center of the read head enclosure. This results in an offset of -3 mm when the LEDs are assigned. This must be taken into account when calculating the difference between the offset value between the two read heads. A mechanical distance of + 100 mm between the two read heads results in a logical position difference of 97 mm.

Note

The WCS code rail is in the ascending position sequence. In this case, the WCS3B-LS221-U2 read head indicates a deviating position.

Calculation of the equivalent position: **POS = 393204 - POS [U2]**

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7.4 Data Protocols

A data protocol is available for the direct connection of the read head to the higher-level controller using a serial communication channel.
A byte has the following format:

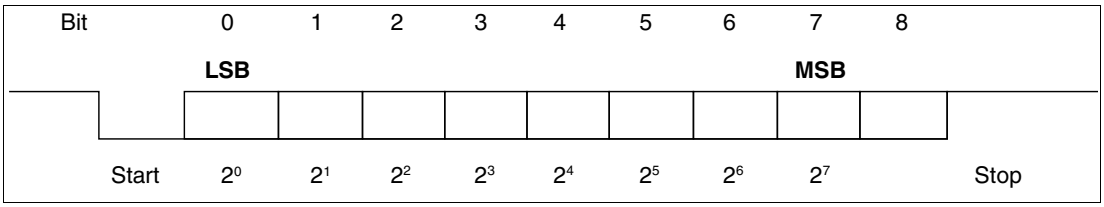

Figure 7.5 Data structure

In the data protocol, the 8th data bit is used to distinguish between request bytes and response bytes.

Response Time
The minimum response time of the read head (to start sending the first data byte from the response telegram) depends on the internal time sequence of the read head and is 10 ... 180 µsec for data protocol 1 and 2.
For data protocol 3, the response time is a byte time + 10 ... 100 µsec. The byte time depends on the baud rate and is calculated from **1/baud rate * 11,000 in** µsec.
For example: **38.4 kBaud**
Byte time = 1/38.4 * 11,000 = **286.5** µsec.

Data protocol 2

Request byte for the read head									
Byte	**Bit 8**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
	1	0	1	1	F0	0	0	A1	A0

Response telegram from the read head									
Byte	**Bit 8**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Byte 1	0	OUT	ERR	A1	A0	DB	P18	P17	P16
Byte 2	0	P15	P14	P13	P12	P11	P10	P09	P08
Byte 3	0	P07	P06	P05	P04	P03	P02	P01	P00
Byte 4	0	Exclusive OR link, byte 1 ... Byte 3							

Data protocol 2 with position and velocity output

Request byte for the read head									
Byte	**Bit 8**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
	1	1	1	1	0	0	0	A1	A0

Response telegram from the read head									
Byte	**Bit 8**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Byte 1	0	OUT	ERR	A1	A0	DB	P18	P17	P16
Byte 2	0	P15	P14	P13	P12	P11	P10	P09	P08
Byte 3	0	P07	P06	P05	P04	P03	P02	P01	P00
Byte 4	0	SST	SP6	SP5	SP4	SP3	SP2	SP1	SP0
Byte 5	0	Exclusive OR link, byte 1 ... Byte 4							

Description of the protocol data

Activation of the read head

F0	A1	A0	Read head address
x	0	0	Read head address 0
x	0	1	Read head address 1
x	1	0	Read head address 2
x	1	1	Read head address 3
0	x	x	Send position value
1	x	x	Send diagnostic result

Data from the read head

Function number for the read head F0=0 (send position value)					
ERR	DB	OUT	SST	Description	State of the read head lens
0	0	0	x	Current position value in P00 ... P18, binary coded	Good
0	0	1	x	Read head outside the code rail, no position value (see OUT message)	Good
0	1	0	x	Current position value in P00 ... P18, binary coded	Poor
0	1	1	x	No position value, read head outside the code rail (see OUT message)	Poor
1	x	x	x	No position value, error message from the read head, error number in P00 ... P04, binary coded	-
x	x	x	1	Current speed unknown, last speed in SP0 ... SP6 *)	-
x	x	x	0	Current speed in SP0 ... SP6 *)	-

*) Speed information

The speed is binary coded in bits SP0 to SP6.

SP0...SP6...	Speed in 0.1 m/s, binary coded	
	0:	Speed less than 0.1 m/s
	126:	Speed more than 12.5 m/s
	127:	Speed unknown
For example:		
SP0...SP6...	1:	Speed 0.1 m/s
	37:	Speed 3.7 m/s
	112:	Speed 11.2 m/s

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Diagnostic function F0=1

The read head can be requested to perform a diagnosis of the photoelectrics via the request byte to the read head. For this purpose, the read head must be located outside the code rail. The level of contamination on the optical unit is detected automatically during operation and the diagnostic bit (DB) is set if the contamination is too high. Therefore the request for diagnosis to the read head via F0 in the request byte is no longer necessary. However, for reasons of downward compatibility, this function is also supported by the new read heads.

Diagnostic bit DB

The diagnostic bit DB displays the result of the integrated diagnostics of the read head.

Function number for the read head F0 = 1 (send diagnosis result)				
ERR	**DB**	**OUT**	**Description**	**State of the read head lens**
0	1	0	Diagnosis invalid, read head not outside the code rail	-
0	1	1	Diagnosis result in P16 ... P18	-
			P16 ... P18 = 0	Good
			P16 ... P18 > 0	Poor
1	x	x	Error message from the read head, error message in P00 ... P04, binary coded	-

Contamination detection

The read heads continually monitor the condition of the lenses. If a drop in light output is detected on the infrared transmitter, e.g., as a result of contamination of the clear lenses, the read head automatically increases the light intensity. If the level of contamination is too high, a warning message is sent to the higher-level controller (diagnostic bit DB=1). The automatic light adjustment in the read head allows you sufficient time to clean the read head as part of the next servicing procedure. The safeWCS/PUS read head emits a visual signal for the "contamination detected" state: the yellow and red LEDs on the front of the read head flash alternately. To clean the lenses, the read head must be removed from the code rail (removed from the mounting plate). After cleaning the transparent lenses, the contamination message is automatically deleted from the read head. If the message is not reset despite careful cleaning or replacement of the plastic lenses, there may be an error. In this case, the read head must be sent for inspection.

OUT message

Function number for the read head F0 = 0 (send position value)					
ERR	**DB**	**OUT**	**SST**	**Description**	**State**
0	x	1	x	P00...P18 = 0 -> the read head is partially outside the code rail	OUT
				P00 = 1, P02...P18 = 0 -> the read head is completely outside the code rail	OUT A

OUT means that the position value cannot be determined because the position of the code rail in the read head gap is incorrect.

OUT A (A=All) means that there is no code rail in the read head gap; all light barriers of the read head report a signal.

The "OUT" message may be desirable and correct, e.g., if the code rail is interrupted and the read head sends this information between the individual rail pieces to the controller. If the "OUT" message must not occur, the following test steps must be performed:

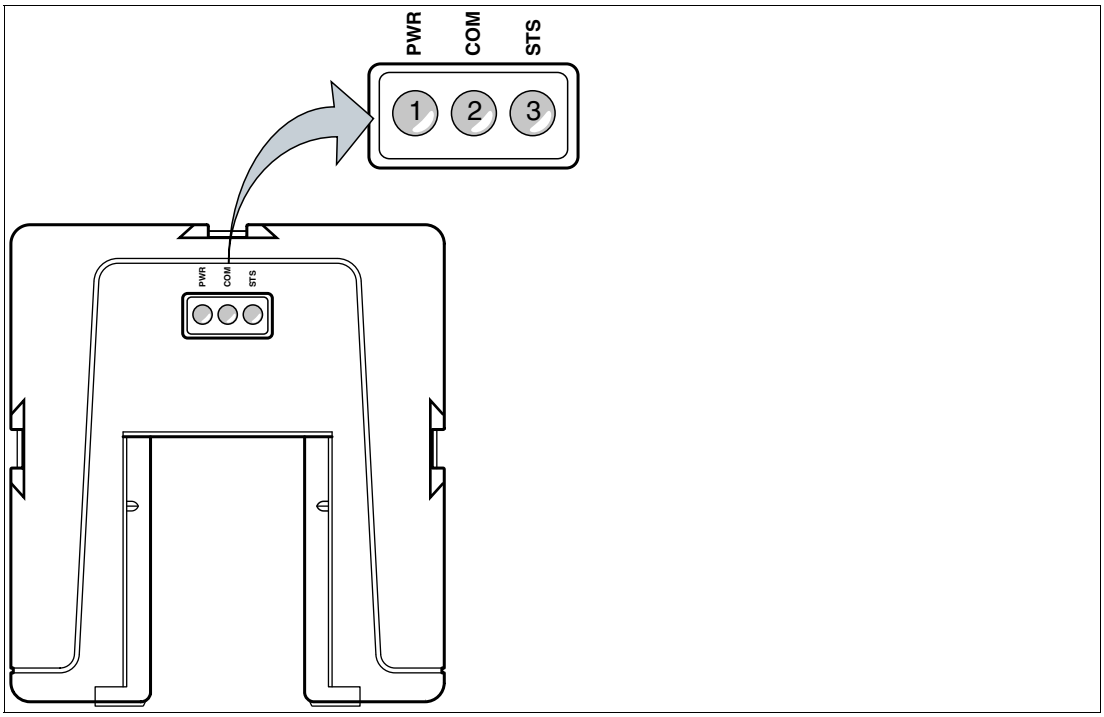
Result of the check	Remedy
The upper edge of the code rail is outside the tolerance range of the read head	• Align the code rail precisely • Aligning the read head • Use the guide system for the read head
The plastic lenses on the optical unit are dirty or scratched	• Clean the optical unit • Ensure the read head is cleaned • Change the lenses
Incidence of ambient light	• Protect the read head against any incidence of ambient light

If these measures do not solve the problem, the read head must be sent for inspection.

7.5 Status and Error Messages

Error number	Cause	Remedy
1 2	WCS read head cannot calculate position value because:	
	Optical unit is dirty	Clean optical unit
	Plastic protective lenses are scratched	Align WCS read head and code rail correctly; replace scratched plastic protective lenses
	Position of the read head in relation to the code rail is incorrect	Check the position of the WCS read head in relation to the code rail; install WCS read head correctly
	Light barriers have failed	Check light barriers; if necessary send for repair
3	RAM error, WCS read head	Send WCS read head for repair
4	EPROM error, WCS read head	Send WCS read head for repair
5	ROM error, WCS read head	Send WCS read head for repair
6	Reserved	
7	No position value available	Message only after switching on the WCS read head and/or after a RESET
8 9 10 11 12	Data transfer error between WCS read head and interface module, data transfer disrupted	Check the cable connection from the WCS read head to the interface module; check the shielding, protective earth, cable routing (EMC)
13	WCS read head cannot be addressed by the interface module	Check the cable connection from the WCS read head to the interface module; check the operating voltage of the read head
14	Read head is located in the initialize or diagnostic routine	Wait for initialization; exit diagnostics (set the selector switch on the interface module to 0 ... 7)
15	Interface module is not set for communication with multiple WCS read heads	Send interface module for correct configuration setting
19	RAM error in interface module	Send interface module for repair
20	EPROM error in interface module	Send interface module for repair

7.6 LED status indicator



Description of the LED Indicators

Item	Display	Designation	Color	Display	Meaning
1	PWR	Operation Indicator	Green	On	Power on
2	COM	Data flow indicator	Yellow	On	Data transfer active
3	STS	Fault Indicator	Red	On	System error
			Red	Flashing	Read head outside the code rail
2 and 3	STS and COM	Contamination indicator	yellow and red	Flash alternately (f=1.5 Hz)	The read head optics are dirty
		Function indicator	yellow and red	for 2 secs	After switching on or a reset

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8 Maintenance

Danger!

Danger to life due to electrical current!

Contact with live parts causes immediate danger to life.

- Allow only qualified electricians to carry out work on the electrical installation.
- Switch off the voltage supply before carrying out servicing, cleaning, and repairs, and prevent the supply from being switched on again.
- Keep the live parts free from moisture.

8.1 Maintenance

The device requires the following maintenance work at regular intervals:

Interval	Maintenance activity	Performed by
Cleaning interval depends on the ambient conditions and the climate	Cleaning the read head and protective enclosure	Specialist
Cleaning interval depends on the ambient conditions and the climate	Code rail	Specialist
Every six months	Checking the screws and connectors	Specialist

8.2 Cleaning

Caution!

Damage to the equipment caused by incorrect cleaning!

Incorrect cleaning may damage the device.

Do not use cleaning agents with aggressive ingredients.
Do not use sharp objects for cleaning.

Cleaning the read head and protective enclosure

1. Clean the read head and protective enclosure using a lint-free cloth and a plastic cleaning agent at regular intervals. The cleaning interval is determined by the ambient conditions.

Cleaning the Code Rail

1. If the code rail is heavily contaminated with oil or grease, clean the code rail with a lint-free cloth.

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8.3 Repairs

Damage to the Read Head

The read head must not be independently repaired, modified, or manipulated. In the event of a failure, always replace the device with an original device.

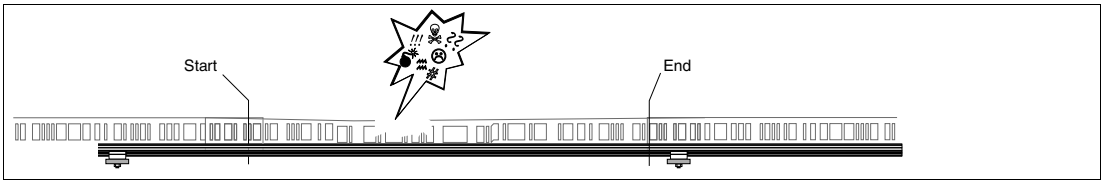
Damage to the Code Rail

For high-quality and lasting results, the use of original Pepperl+Fuchs code rails is recommended. The procedure for replacing damaged code rail sections is described below.

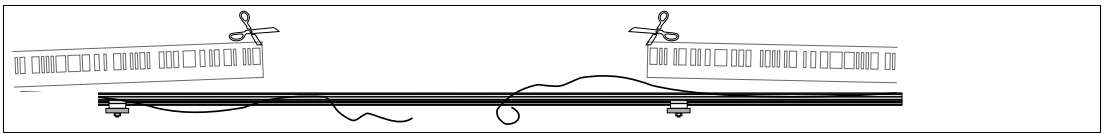
8.3.1 WCS Stainless Steel Code Rail (Aluminum Profile)

Replacing a Damaged Section

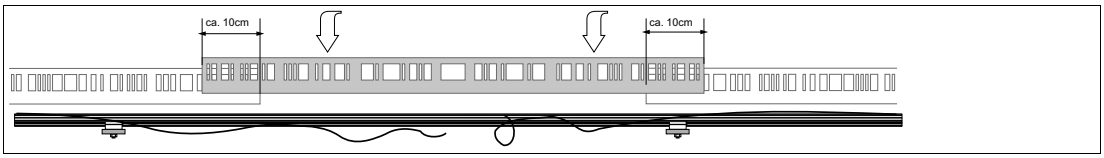
1. When ordering the replacement code rail, specify the beginning and end position, as well the 10 double hollow rivets (WCS-CS-RV) for connecting the replacement code rail with the existing code rail.



2. Determine the position values in front of and behind the damaged area.



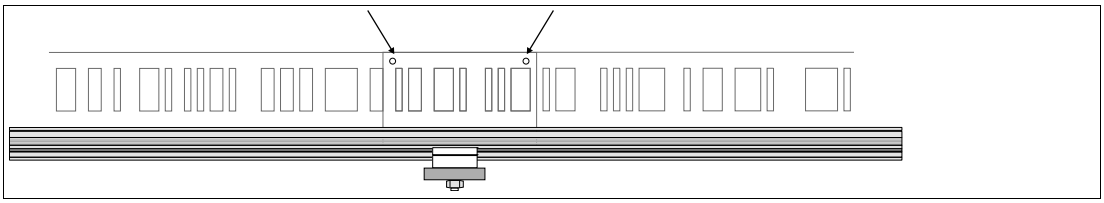
3. Extract and disconnect the fixing cord using a small screwdriver or similar. Lift the code rail out of the aluminum profile by a few meters and cut out the damaged section.



4. Attach the replacement code rail to the existing code rail.

Note

The "old" and "new" (replacement) code rails must each overlap by around 10 cm to ensure that the hole pattern of the two rail sections align correctly. Larger overhangs are cut off.

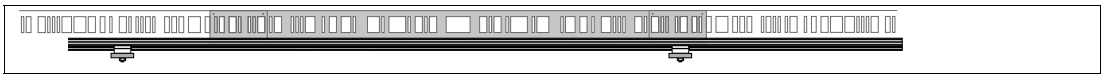


5. To prevent the code rails slipping against each other, securely fasten overlapping sections in place (e.g., using a screw clamp).

6. Weld the two code rails to each other at four points, e.g., using shielding gas welding equipment.

Note

Alternatively, you can connect the code rails using blind rivets. Blind rivets can be used only on the upper edges of the code rails because they do not fit in the V-groove of the aluminum profile. The bore hole diameter depends on the type of blind rivets used. The rivet heads must not protrude into the coding.

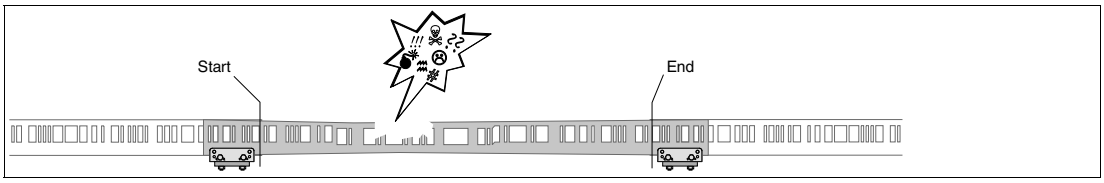


7. Insert the repaired code rail back into the aluminum profile and press the fixing cord in to reinsert it.

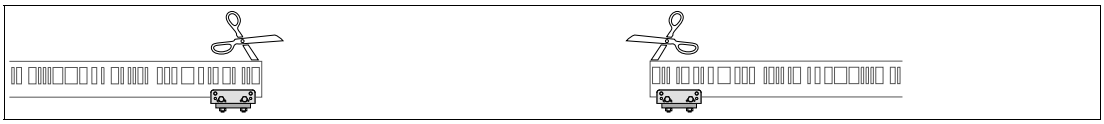
8.3.2 WCS Stainless Steel Code Rail (Mounting Bracket System)

Replacing a Damaged Section

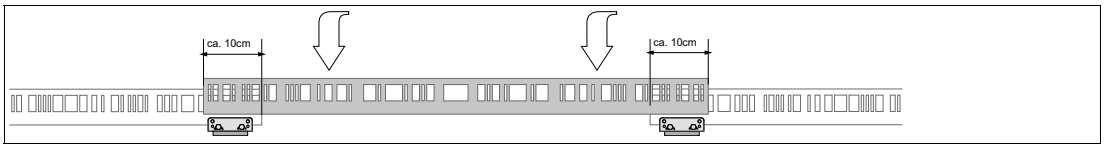
1. When ordering the replacement code rail, specify the beginning and end position, as well the 10 double hollow rivets (WCS-CS-RV) for connecting the replacement code rail with the existing code rail.



2. Determine the position values in front of and behind the damaged area.



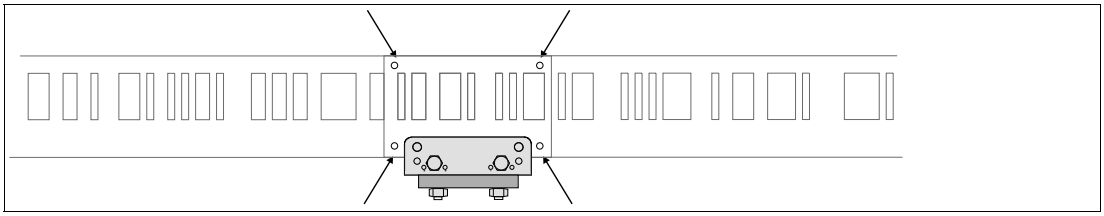
3. Cut out the damaged code rail section using sheet metal shears. Align and deburr the cut edges.



4. Attach the replacement code rail to the existing code rail.

Note

The "old" and "new" (replacement) code rails must each overlap by around 10 cm to ensure that the hole pattern of the two rail sections align correctly. Larger overhangs are cut off.



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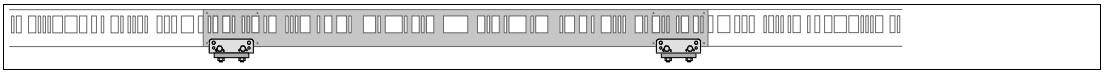
5. To prevent the code rails slipping against each other, securely fasten overlapping sections in place (e.g., using a screw clamp).
6. Weld the two code rails to each other at four points, e.g., using shielding gas welding equipment.

Note

Alternatively, you can drill (or punch) four holes through the code rails and connect the code rails using blind rivets. The bore hole diameter depends on the type of blind rivets used. The rivet heads must not protrude into the coding.

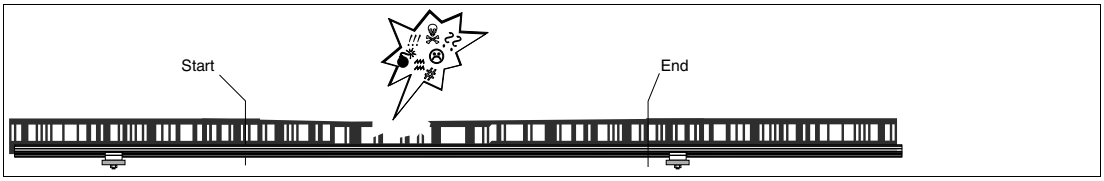


7. Tighten the code rail slightly as needed.

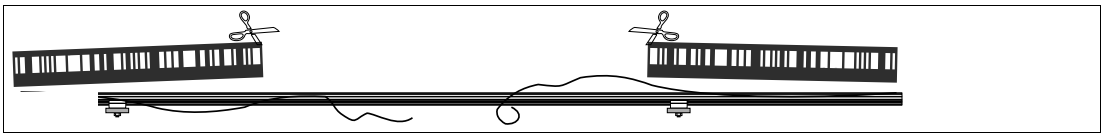
8.3.3 WCS Laminate Code Rail (Aluminum Profile)

Replacing a Damaged Section

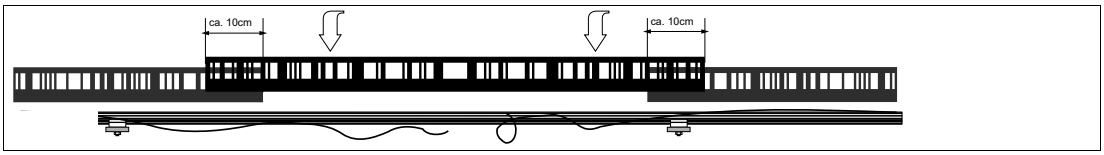
1. When ordering the replacement code rail, specify the beginning and end position, as well the 10 double hollow rivets (WCS-CS-RV) for connecting the replacement code rail with the existing code rail.



2. Determine the position values in front of and behind the damaged area.



3. Extract and disconnect the fixing cord using a small screwdriver or similar. Lift the code rail out of the aluminum profile by a few meters and cut out the damaged section.



4. Attach the replacement code rail to the existing code rail.

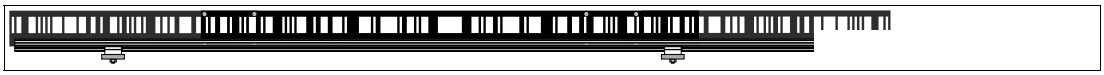
Note

The "old" and "new" (replacement) code rails must each overlap by around 10 cm to ensure that the hole pattern of the two rail sections align correctly. Larger overhangs are cut off.

5. Hold the overlapping code rails firmly to prevent them from shifting. Punch four holes with a diameter of 3 mm through the two code rail sections using a punch as shown in the figure.

6. Insert the hollow rivets from the reparation set in the holes; insert the counterparts and press them together with flat nose pliers or multigrip pliers.

↳ The code rail holds together firmly.

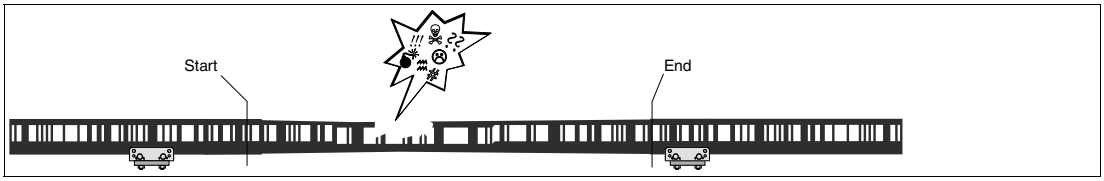


7. Insert the repaired code rail back into the aluminum profile and press the fixing cord in to reinsert it.

8.3.4 WCS Laminate Code Rail (Mounting Bracket System)

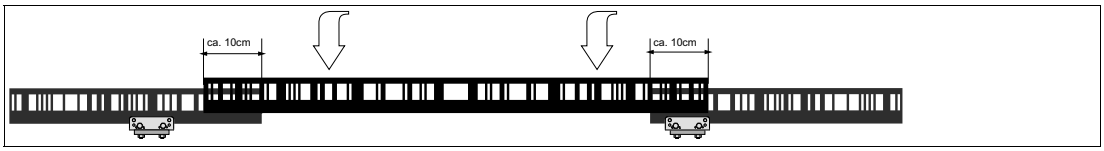
Replacing a Damaged Section

1. When ordering the replacement code rail, specify the beginning and end position, as well the 10 double hollow rivets (WCS-CS-RV) for connecting the replacement code rail with the existing code rail.



2. Determine the position values in front of and behind the damaged area.

3. Cut out the damaged code rail section.



4. Attach the replacement code rail to the existing code rail.

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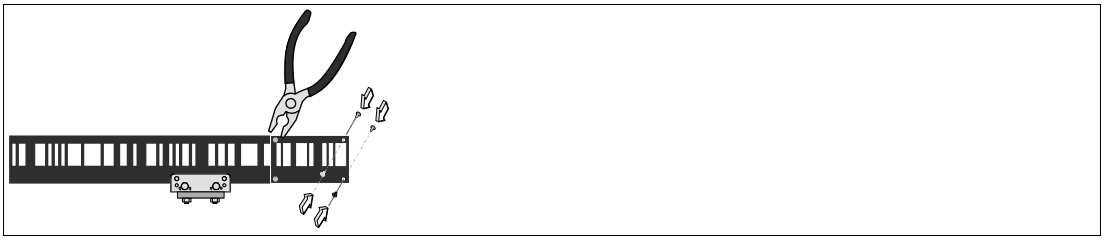
Note

The "old" and "new" (replacement) code rails must each overlap by around 10 cm to ensure that the hole pattern of the two rail sections align correctly. Larger overhangs are cut off.

5. Hold the overlapping code rails firmly to prevent them from shifting. Punch four holes with a diameter of 3 mm through the two code rail sections using a punch as shown in the figure.



6. Insert the hollow rivets from the reparation set in the holes; insert the counterparts and press them together with flat nose pliers or multigrip pliers.

   ↳ The code rail holds together firmly.

7. Tighten the code rail slightly as needed.

9 Disposal

The device, built-in components, packaging, and any batteries contained within must be disposed in compliance with the applicable laws and guidelines of the respective country.

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Your automation, our passion.

Explosion Protection

- Intrinsic Safety Barriers
- Signal Conditioners
- FieldConnex® Fieldbus
- Remote I/O Systems
- Electrical Ex Equipment
- Purge and Pressurization
- Industrial HMI
- Mobile Computing and Communications
- HART Interface Solutions
- Surge Protection
- Wireless Solutions
- Level Measurement

Industrial Sensors

- Proximity Sensors
- Photoelectric Sensors
- Industrial Vision
- Ultrasonic Sensors
- Rotary Encoders
- Positioning Systems
- Inclination and Acceleration Sensors
- Fieldbus Modules
- AS-Interface
- Identification Systems
- Displays and Signal Processing
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