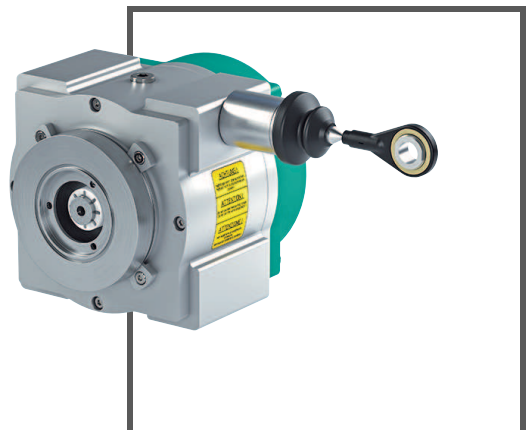


MANUAL

EC*

**Cable Pull and Cable-Pull
Rotary Encoder**





With regard to the supply of products, the current issue of the following document is applicable: The General Terms of Delivery for Products and Services of the Electrical Industry, published by the Central Association of the Electrical Industry (Zentralverband Elektrotechnik und Elektroindustrie (ZVEI) e.V.) in its most recent version as well as the supplementary clause: "Expanded reservation of proprietorship"

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1 Introduction

Please read the operating instructions carefully before installing this device and putting it into operation. The instructions and notes contained in this document will guide you step-by-step through the installation and commissioning procedures to ensure trouble-free use of this product. By doing so, you:

- Guarantee safe operation of the device.
- Can utilize the entire range of device functions.
- Avoid faulty operation and associated errors.
- Reduce costs associated with downtime and incidental repairs.
- Increase the effectiveness and operating efficiency of your plant.

Store these operating instructions somewhere safe to ensure they are available for future work on the device.

After opening the packaging, please ensure that the device is intact and that the package is complete.

Symbols used

The following symbols are used in this manual:



Note!

This symbol draws your attention to important information.



Handling instructions

You will find handling instructions beside this symbol

Contact

If you have any questions about the device, its functions, or accessories, please contact us at:

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Lilienthalstraße 200
68307 Mannheim
Telephone: +49 621 776-4411
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2 Guidelines and Standards

Declaration of Incorporation

Cable Pulls

The **cable pulls** are developed and manufactured as incomplete machinery in accordance with the applicable European Machinery Directive 2006/42/EC. Cable pulls do not bear a CE marking.



Note!

A Declaration of Incorporation may be requested from the manufacturer.

The product manufacturer, Pepperl+Fuchs GmbH, 68307 Mannheim, Germany, has a certified quality assurance system that conforms to ISO 9001.



ISO9001

Cable-Pull Rotary Encoder

The **cable-pull rotary encoders** are developed and manufactured in accordance with the applicable EU Directive 2004/108/EC "Electromagnetic Compatibility" and the harmonized standards referred to therein. Cable-pull rotary encoders bear the CE marking.



Note!

A Declaration of Conformity can be requested from the manufacturer.

The product manufacturer, Pepperl+Fuchs GmbH, 68307 Mannheim, Germany, has a certified quality assurance system that conforms to ISO 9001.



ISO9001

3 Safety

3.1 Symbols relevant to safety



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.

3.2 Intended Use

You may mount, operate, and maintain the cable-pull mechanism only if:

- You have read the mounting instructions carefully
- You are specially trained
- You are authorized to do so by your company.

The cable-pull mechanism may be used only in accordance with the technical data. It is not permitted to make unauthorized structural changes to the cable-pull mechanism. We accept no liability for the resulting damage. In the interests of development, we reserve the right to make technical modifications. The specified product characteristics do not constitute a guarantee.



Note!

Cable pulls and cable-pull rotary encoders must be used only in accordance with their design purpose!



Note!

Cable pulls and cable-pull rotary encoders must be mounted by a specialist with knowledge of precision mechanics! Observe the valid safety and accident prevention regulations specified by the applicable Employer's Liability Insurance Association.



Note!

Never establish or interrupt electrical connections to the device when the power is switched on! To ensure that the connected rotary encoders operate without any problems, the housing must be grounded!



Note!

Do not allow the device to go above or below its operating temperature! Shock and vibration loading must be avoided!



Note!

Do not oil or grease the measurement cable.



Note!

Secure the measurement cable to the measurement object with the cable retracted.

3.3 General notes on safety

Only instructed specialist staff may operate the device in accordance with the operating manual.

User modification and or repair are dangerous and will void the warranty and exclude the manufacturer from any liability. If serious faults occur, stop using the device. Secure the device against inadvertent operation. In the event of repairs, return the device to your local Pepperl+Fuchs representative or sales office.

The connection of the device and maintenance work when live may only be carried out by a qualified electrical specialist.

The operating company bears responsibility for observing locally applicable safety regulations.

Store the not used device in the original packaging. This offers the device optimal protection against impact and moisture.

Ensure that the ambient conditions comply with regulations.



Note!

Disposal

Electronic waste is hazardous waste. When disposing of the equipment, observe the current statutory requirements in the respective country of use, as well as local regulations.

3.4 Specific safety instructions

3.4.1 Possible Hazards

To the best of our knowledge, there are no risks to people during normal operation. A potentially hazardous situation may arise if the cable snaps. However, this can only occur in the event of an operating error or if the operating parameters are not observed.

The possible causes of a snapped or damaged cable include:

- Exceeding the maximum cable extension length.
- Damage to the cable caused by sharp edges and/or objects in the cable extension path. The cable pull path must be unobstructed at all times. It must be protected so that no damage can occur to the measurement cable.
- Measurement cable has been crushed or kinked.

To prevent kinks, pull only on the cable attachment, never on the measurement cable itself!



Danger!

Risk of injury!

Do not exceed the maximum cable extension length! The measurement cable may tear and snap back in an uncontrolled manner or become damaged.

Observe the cable extension length.



Danger!

Risk of injury!

Do not open the cable pull housing! The pretensioned spring poses a significant risk of injury!



Warning!

Risk of short circuit!

Carrying out work while the system is energized may cause injury or result in damage to the device.

Disconnect all devices and equipment affected by the mounting process from the power supply.

The device must be placed on a level mounting surface and attached using the threaded holes located on two sides of the device housing. The size and spacing of the threaded holes can be found in the specific dimensional drawing. During mounting, ensure that the cable outlet is aligned flush with the cable attachment. The cable-pull mechanism must be attached before the cable attachment is attached to the moving object.



Caution!

Risk of injury!

If the measurement cable is released unintentionally, this may damage the device and result in a risk of injury to people!

Hold the measurement cable securely!



Warning!

Risk of injury!

Do not damage the measurement cable! The measurement cable may tear and snap back in an uncontrolled manner.



Caution!

Risk of injury!

Do not kink the measurement cable! The measurement cable may tear and snap back in an uncontrolled manner or become damaged.

Pull the measurement cable by the cable attachment only.



Caution!

Damage to the cable pull!

Do not pull the measurement cable at an angle! This may damage the measurement cable.

Always pull out the measurement cable perpendicular to the cable pull.



Caution!

Damage to the measurement cable!

Do not grind the measurement cable around objects! This may damage the measurement cable.



Danger!

Risk of injury!

Do not wrap the measurement cable around body parts! The measurement cable poses a risk of injury due to the whiplash effect.

3.4.2 Foreseeable Misuse

A potentially hazardous situation may arise if the cable snaps. However, this can only occur in the event of an operating error or if the operating parameters are not observed.

The possible causes of a snapped or damaged cable include:

- Exceeding the maximum cable extension length.
- Damage to the cable caused by sharp edges or objects in the cable extension path.
The cable extension path must be unobstructed and protected at all times so that no damage can occur to the measurement cable.
- Cable has been crushed or kinked.

To prevent kinks, pull only on the cable attachment, never on the measurement cable itself!

4 Product Description

4.1 Areas of Application

Areas of application include:

Construction machinery and special-purpose vehicles

- Detecting the length of telescopic arms
- Detecting the position of support struts
- Detecting the position of traveling trolleys
- Positioning movable tools
- Positioning drilling booms

Mobile elevating work platforms and conveyor systems

- Height detection for work platforms
- Calculating the length of support struts
- Positioning theater stages
- Height detection for transport systems in assembly lines

Drilling platforms and offshore applications

- Positioning pick-and-place robots for drilling rigs
- Boom positioning for cranes
- Detecting the transmission position for ships' propellers

Medical technology

- Lifting and moving equipment for patient examination tables
- Positioning medical equipment
- Length measurement for rehabilitation and sports equipment

Industrial systems

- Level measurement for grain silos
- Level measurement for biogas production
- Position detection for dam shutters and weir wickets
- Length measurement on machine tools

Elevators and lifting equipment

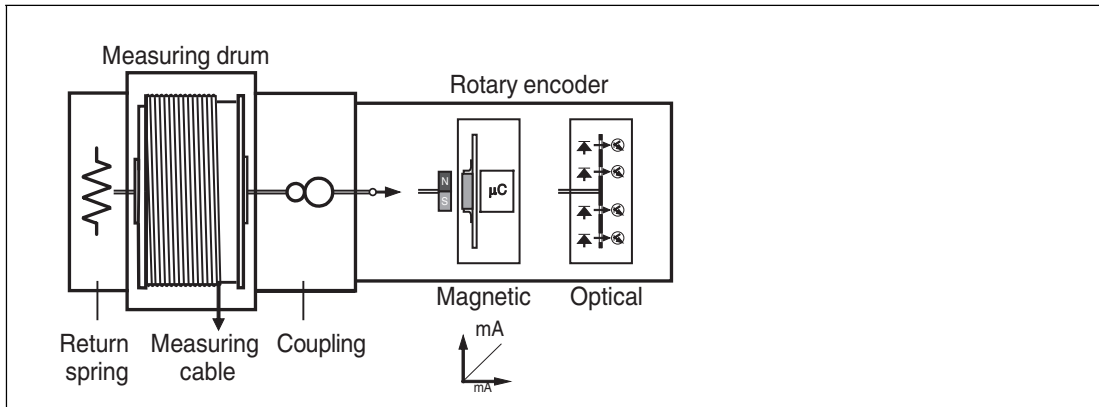
- Height detection for elevators
- Positioning storage robots in high-bay warehouses
- Mobile lifting equipment for container transport systems

These are just a few examples from an almost infinite number of possible applications. It is clear that operation is possible in a wide range of environmental conditions in these different application areas.



4.2 Functional Principle

Cable-pull rotary encoders are a combination of cable-pull mechanisms and absolute or incremental rotary encoders. They are highly dynamic signal converters. A translational movement is converted into a rotary movement by an extension and retraction of a measurement cable that is proportional to the drum revolution. Cable-pull rotary encoders are used for length, position, and speed recording and feedback of linear motion sequences in various applications. Cable-pull rotary encoders are noted for their high degree of measurement accuracy. In general, mechanical tolerances of the application have no negative impact on the measurement result. Cable-pull rotary encoders can be used in hard-to-reach areas, such as when measuring outside the visible measuring range. Assembly and installation are extremely simple.



4.2.1 Absolute Measurement Accuracy

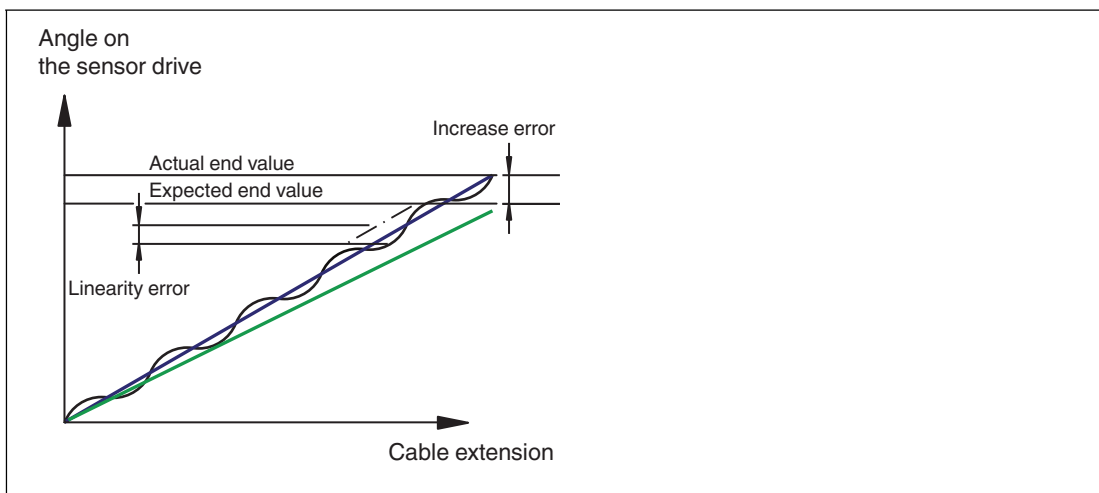
The absolute measurement accuracy of the cable pull system and cable-pull rotary encoder system is influenced by multiple factors.

Linearity Error

The deviation of the measured value from an ideal straight line between the start value and the actual end value. This is caused by diameter fluctuations in the measurement cable, concentricity errors in the measuring drum, and by the sensor connection being offset from the center of the shaft.

Increase Error

The deviation of the end value of the ideal straight line from the expected end value. This is caused by an inaccurate diameter of the measurement cable and measuring drum.

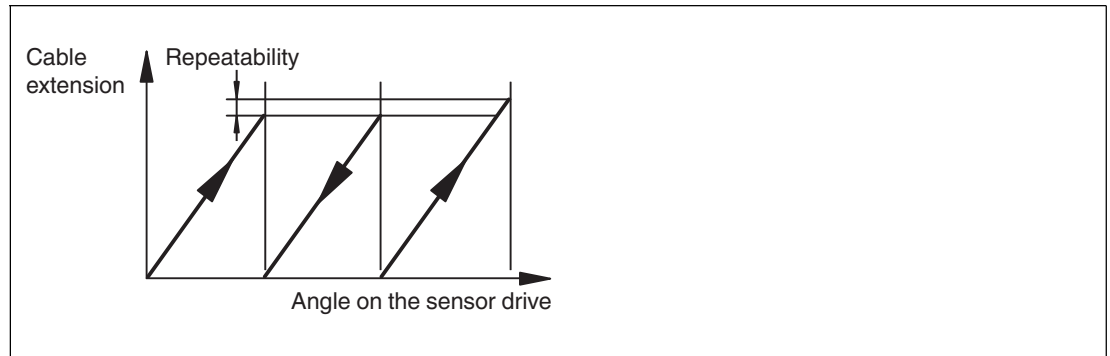


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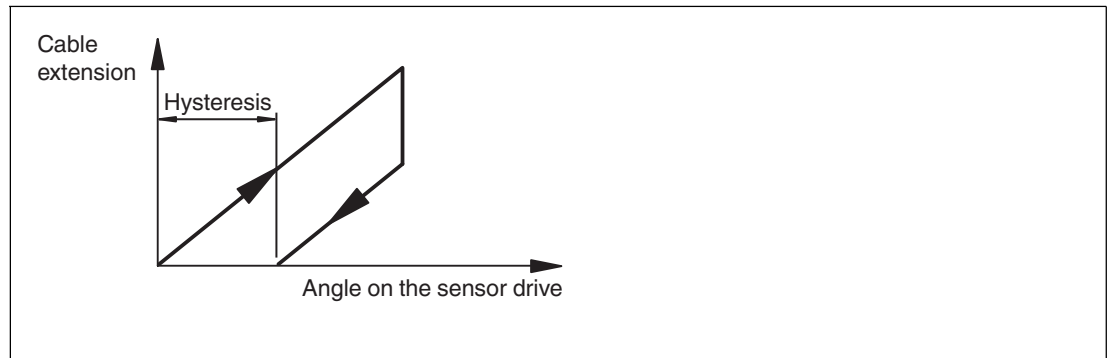
Repeatability

The deviation of the measured value at the same position with multiple approaches from the same direction. This is caused by longitudinal expansion of the measurement cable.



Hysteresis

The deviation of the measured value at the same position with multiple approaches from the opposite direction. This is caused by a change in force between the extension and retraction of the measurement cable and the resulting change in length.



4.2.2 Cable Slack

If the measurement cable is pulled out in a horizontal direction, this results in the measurement cable becoming increasingly slack as the length of the cable increases. This is particularly important if the moved measurement cable may be obstructed by objects during use. The change in length caused by the slack and the resulting measurement error are negligible.

The mass of the slackened measurement cable causes an apparent weight that deflects the measurement cable on a hyperbolic line. The tensioning force in the measurement cable acts against the deflection. This increases through the spring drive as the measurement length increases. With sufficient approximation, the hyperbolic form can be simplified in favor of a simple triangle.

The mass of the measurement cable can be calculated using formula A. The spring rate of the spring drive corresponds to formula B.

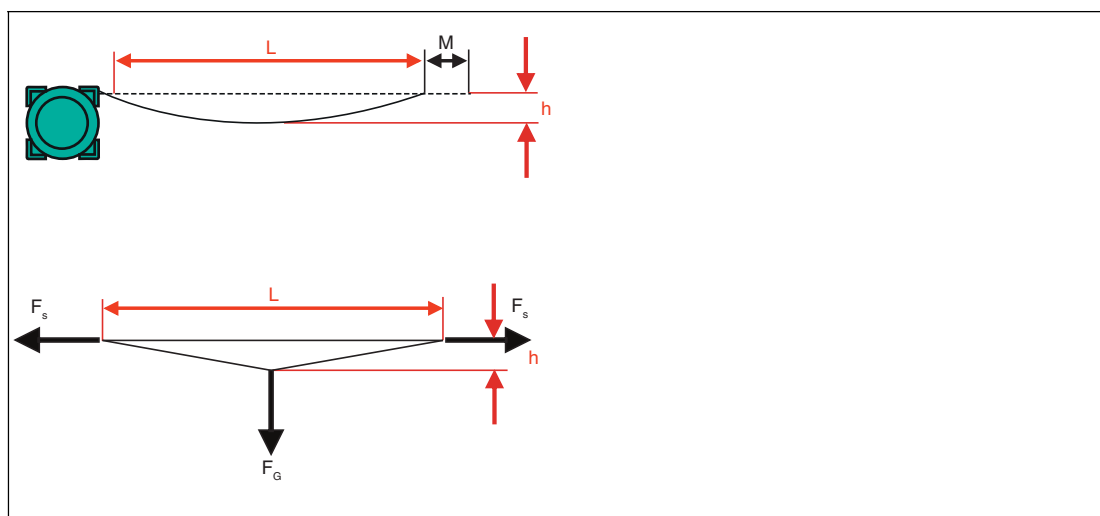
Formula C determines the amount of slack in the measurement cable.

Formula D is used to calculate the measurement error. The practical values differ from the theoretically calculated values to a smaller amount of slack as the measurement cable itself has a certain resistance against the deflection.



Calculation

	Formula	Variables
A	$F_s = 0.5 \times m_L \times g \times L$	F_G = apparent weight of the measurement cable [N]
		m_L = mass per unit length of the measurement cable [kg/m]
		g = gravitational acceleration 9.81 [m/s ²]
		L = free length of the measurement cable [m]
B	$c = \frac{F_{s \max} - F_{s \min}}{L_{\max}}$	c = spring rate of the spring drive [N/m]
		$F_s \max$ = maximum tensile load in the cable [N]
		$F_s \min$ = minimum tensile load in the cable [N]
C	$h = \frac{L^2 \times g \times m_L}{8 \times (c \times L + F_{\min})}$	h = cable slack [mm]
		c = spring rate of the spring drive [N/m]
		$F_s \min$ = minimum tensile load in the measurement cable [N]
		g = gravitational acceleration 9.81 [m/s ²]
		m_L = mass per unit length of the measurement cable [kg/m]
		L = free length of the measurement cable [m]
D	$f = \sqrt{L^2 + 4h^2} - L$	M = measurement error [m]
		h = cable slack [mm]
		L = free length of the measurement cable [m]



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Cable Slack			Measurement error	
Length of measurement cable	Cable diameter		Cable diameter	
Design 80	Ø 1.35 mm		Ø 1.35 mm	Ø 0.81 mm
1 m	-		-	
2 m	5 mm		-	
3 m	10 mm		-	
Design 130	Ø 1.35 mm	Ø 0.81 mm	Ø 1.35 mm	Ø 0.81 mm
5 m	20 mm	10 mm	-	-
10 m	65 mm	25 mm	0.5 mm	-
15 m	130 mm	50 mm	1.5 mm	0.25 mm
20 m	210 mm	80 mm	3.0 mm	0.5 mm
25 m	300 mm	100 mm	5.0 mm	0.75 mm
Design 190	Ø 1.35 mm		Ø 1.35 mm	
30 m	300 mm		9.0 mm	
35 m	400 mm		13.0 mm	
40 m	500 mm		18.0 mm	
50 m	700 mm		28.0 mm	
60 m	1000 mm		42.0 mm	

Steel Wire Strands Made from Stainless Steel 1.4401

Design	Nominal diameter	Minimum breaking force	Weight
1 x 19	0.55 mm	330 N	1.45 g/m
7 x 7	0.81 mm	530 N	2.6 g/m
7 x 19	1.35 mm	1227 N	7.1 g/m

4.2.3 Guide Pulleys and Measurement Cables

If wire cables are guided via guide pulleys, the service life can be increased by selecting the correct guide pulley and the appropriate cable design. The service life of the wire cable depends on:

- The groove geometry
- The ratio between the diameter of the base of the groove and the diameter of the cable
- The surface finish of the groove
- The material of the roller
- The cable design

In particular, the ratio between the diameter of the base of the groove and the diameter of the cable should be selected as follows, based on the cable design:

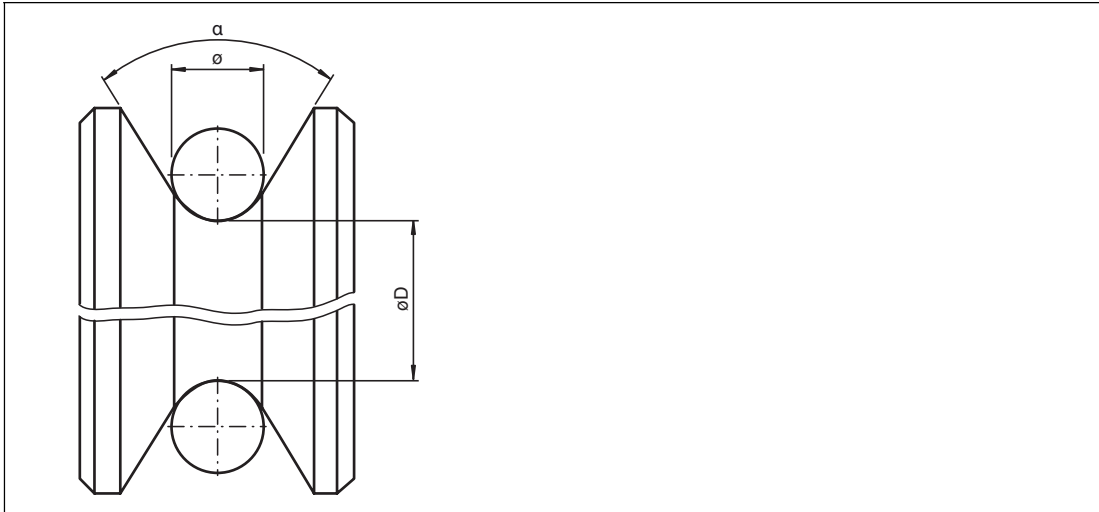


Figure 4.1 D = groove diameter
 ø = cable diameter
 α = groove opening angle = 60°
 r = groove radius = 0.53 x d

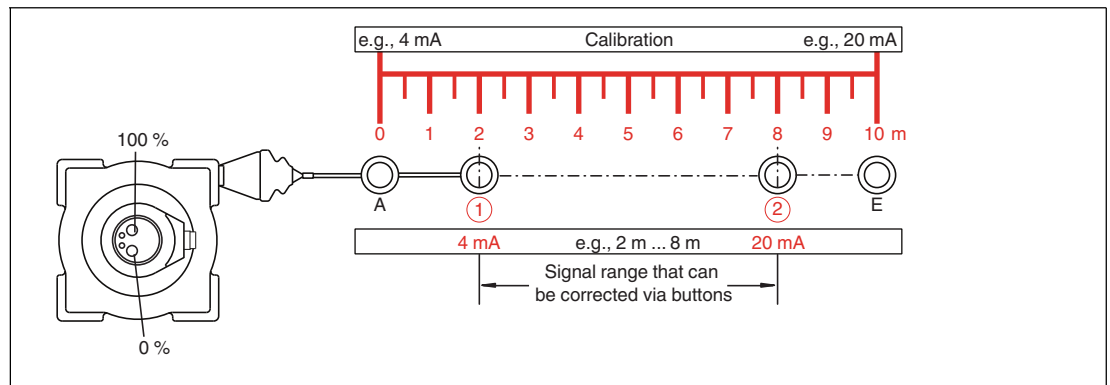
Recommended Minimum Diameter of the Guide Pulleys

Cable design	Figures	Diameter of base of groove in mm
7 x 7		42 x cable diameter (excluding coating)
1 x 19		
7 x 19		25 x cable diameter (excluding coating)

4.2.4 Signal Correction

Scalable Measured Value Output with Buttons

Cable-pull rotary encoders with an analog interface are equipped with Teach-in buttons. The buttons enable electronic scaling of the measuring range, so that the complete output value range can be recorded. The measuring range is scaled by moving the measurement cable to the desired position. The position value is saved by pressing the buttons (Teach-in function). This process automatically scales the measured values between these positions.



4.2.5 Hart Coat

Hart Coat is a coating for finishing aluminum materials and provides protection against wear and corrosion.

Properties

- Outstanding hardness
- High level of insulation
- Optimal bonding between layers
- High level of thermal insulation
- High level of wear resistance
- Excellent corrosion resistance

Technical Data

- Thermal conductivity approximately 1/10 to 1/30 of the thermal conductivity of the base material
- Specific electrical resistance (measured values in a dry atmosphere):
 - At 20 °C: $4 \times 10^{15} \Omega\text{cm}$
 - At 100 °C: $0.8 \times 10^{15} \Omega\text{cm}$
 - At 200 °C: $0.11 \times 10^{15} \Omega\text{cm}$
- Temperature resistance: up to 2200 K short-term
- Dielectric strength is alloy-dependent. The dielectric strength increases as the layer thickness increases, but not proportionally. Example: 30 μm HC on AlMgSi1: 914 V 50 μm HC on AlMgSi1:1213 V¹

1. Arithmetic mean value of ten individual measurements in accordance with DIN EN ISO 2376



4.3 Cable Pull Designs

4.3.1 EC*10TL-*

Lighter and more robust cable-pull rotary encoder with flat housing design.

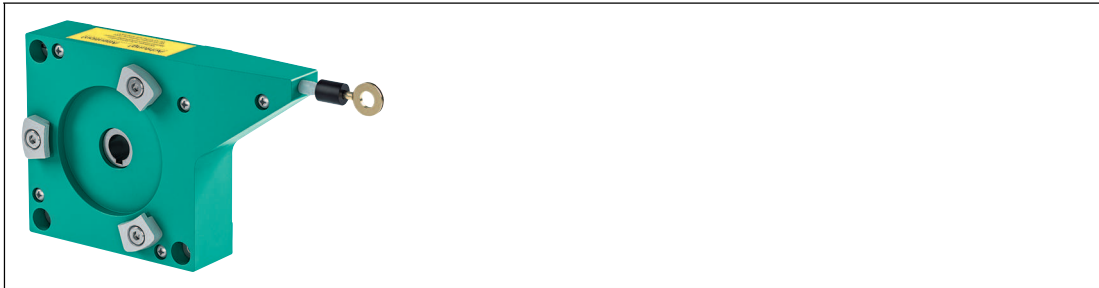
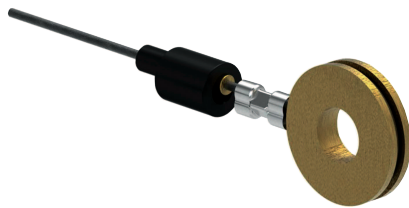


Figure 4.2

- The very lightweight, compact design enables mounting in tight spaces and makes handling easier
- The wide variety of attachment options reduces the mounting work required and increases flexibility
- The coupling-free adaptation of the rotary encoder enables precise information feedback and guarantees reliable processes
- Ring as standard cable attachment

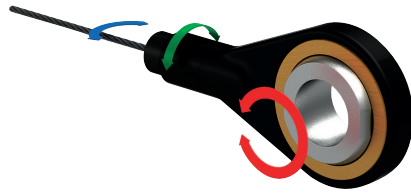


- Ring in the plastic handle as standard cable attachment with measurement cable length of 10 m





- Ball joint as optional cable attachment with measurement cable length of 10 m. Allows the attachment point to move with various degrees of freedom and prevents the measurement cable from kinking.



4.3.2

EC*20IL-*

Cable-pull rotary encoder with a robust design to suit a wide range of requirements.



Figure 4.3

- Robust solution for reliable operation in harsh industrial environments
- Compact design for flexible mounting in tight spaces
- Optional HART-COAT® coating for use in adverse conditions
- Special attachment protects the cable pull, reduces the amount of maintenance required, and increases the service life
- Bellows with steel tip as standard attachment for increased protection against dust and moisture, as well as ice formation on the measurement cable

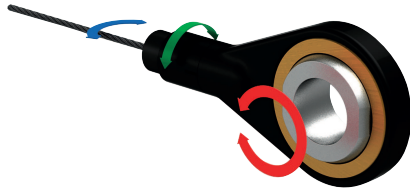


- Ring in the plastic handle as standard cable attachment





- Ball joint as optional cable attachment allows the attachment point to move with various degrees of freedom and prevents the measurement cable from kinking.



- Additional cable attachments available on request.

4.3.3

EC*30PL-*

Flexible cable-pull rotary encoder designed to meet tough requirements in all fields of application.



Figure 4.4

- Robust solution for reliable operation in harsh environmental conditions
- Drum is moved in axial direction via threaded spindle to ensure high level of measurement accuracy and reliable processes
- Optional HART-COAT® coating for use in adverse conditions
- Increased flexibility in the detection of directional changes as well as hard-to-reach measuring areas
- Various cable pull attachments and combinations increase service life
- Bellows with steel tip as standard attachment for increased protection against dust and moisture, as well as ice formation on the measurement cable.



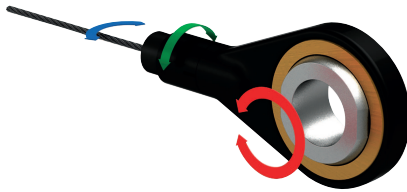


- Ring in the plastic handle as standard cable attachment



- Cable attachment options:

- Ball joint as optional cable attachment allows the attachment point to move with various degrees of freedom and prevents the measurement cable from kinking.

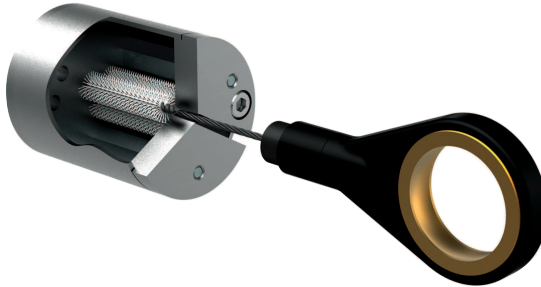


- Additional cable attachments available on request

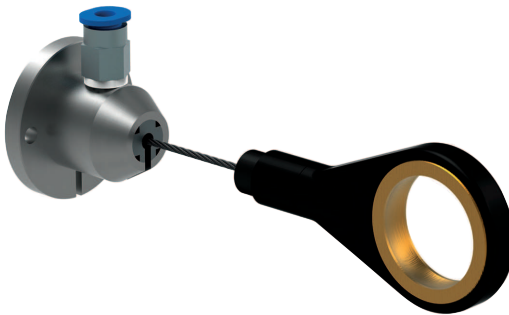


■ Attachment options:

- Brush attachment for environmental conditions with extreme dust or scaling
Spiral brushes constantly wipe the cable to reduce the penetration of particles that accumulate on the cable in extremely dusty conditions.



- Compressed air attachment
A permanent airflow using excess pressure in the cable outlet nozzle prevents penetration of dust and moisture as effectively as possible.

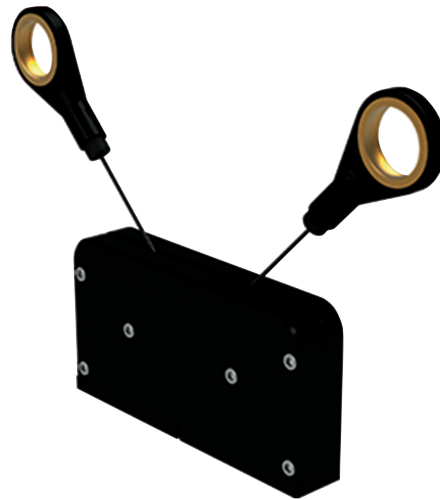


- Guide pulley
Looking in the direction of the cable, the guide pulley allows the cable extension to be moved by 0°...180° and by 360° perpendicular to the cable direction for straight cable extension to the cable attachment.





- Double guide pulley
For measurement objects that require a change in direction of the cable extension.



4.3.4 EC*40HD-*

Cable-pull rotary encoder for use in harsh environmental conditions.

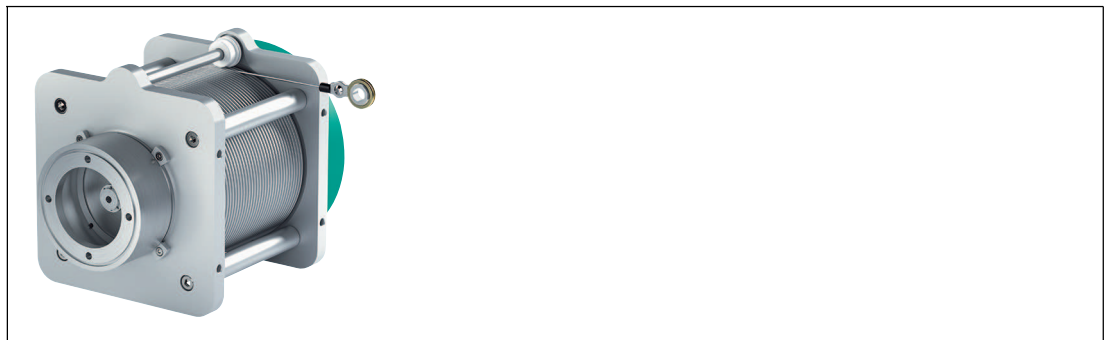
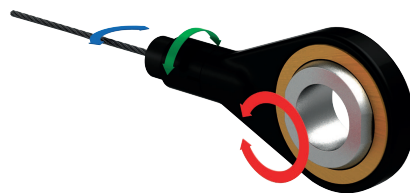


Figure 4.5

- Extremely robust solution for use in exceptionally harsh weather and environmental conditions
- The open cable pull system enables easy cleaning and makes handling much easier
- Measurement cable drum with grooving system for a high level of measurement accuracy and a long service life
- Ball joint as cable attachment increases the flexibility and durability of the measurement cable





5 Installation

5.1 Storage and transport

For storage and transport purposes, package the unit using shockproof packaging material and protect it against moisture. The best method of protection is to package the unit using the original packaging. Furthermore, ensure that the ambient conditions are within allowable range.

5.2 Unpacking

Check the product for damage while unpacking. In the event of damage to the product, inform the post office or parcel service and notify the supplier.

Check the package contents against your purchase order and the shipping documents for:

- Delivery quantity
- Device type and version in accordance with the type label
- Accessories
- Installation instructions

Retain the original packaging in case you have to store or ship the device again at a later point.

Should you have any questions, please contact Pepperl+Fuchs.

5.3 Mounting



Warning!

Risk of short circuit

Carrying out work while the system is energized may cause injury or result in damage to the device.

- Always disconnect the supply voltage before carrying out work on the device.
- Only connect the device to the supply voltage once work has been completed.



Warning!

Damage to the connection line

There is a risk of short circuit or malfunction.

- Use only connection lines that are suitable for the application in terms of their technical specifications.
- When laying the electric cables, make sure they are protected sufficiently against mechanical loads.



Warning!

Electrical interference

There is a risk of short circuits and/or coupling of electrical interfering signals.

Make sure that cables are routed at a sufficient distance from other current-carrying system components. This is the only way to guarantee adequate protection from short circuits and/or coupling of interfering signals.



Mounting a Third-Party Rotary Encoder

The cable pull can be supplied without a mounted rotary encoder. In this case, you can mount your own measuring system on the cable pull. The appropriate coupling and an adapter have been included with the delivery according to your order specifications (e.g., servo flange or clamping flange).

The cable-pull mechanism contains the ordered adapter for mounting the rotary encoder, as well as the coupling elements, screws, seal, and Allen wrench as a mounting set. The screws for mounting the cable-pull mechanism are not included in the delivery as their length is dependent on the type of mounting.



Caution!

Perform mounting as shown (cable outlet of the cable-pull rotary encoder facing upward)! This will prevent the cable from springing off the drum when attaching the rotary encoder. Turning the output shaft of the cable pull or cable-pull rotary encoder is permitted only by pulling on the cable attachment.

Failure to do so may reduce the retraction force of the spring motor and damage the cable-pull mechanism!



Caution!

When executing the instructions below, please note the following:

Axial distortion of the output shaft of the cable-pull mechanism limits functionality!

The shaft adapter must not scrape axially against the sensor housing!

5.3.1 Rotary Encoder and Cable-Pull Mechanism EC*10TL-*



Warning!

Hold the measurement cable securely!

If the cable is released unintentionally, this may damage the device and result in a risk of injury to people!

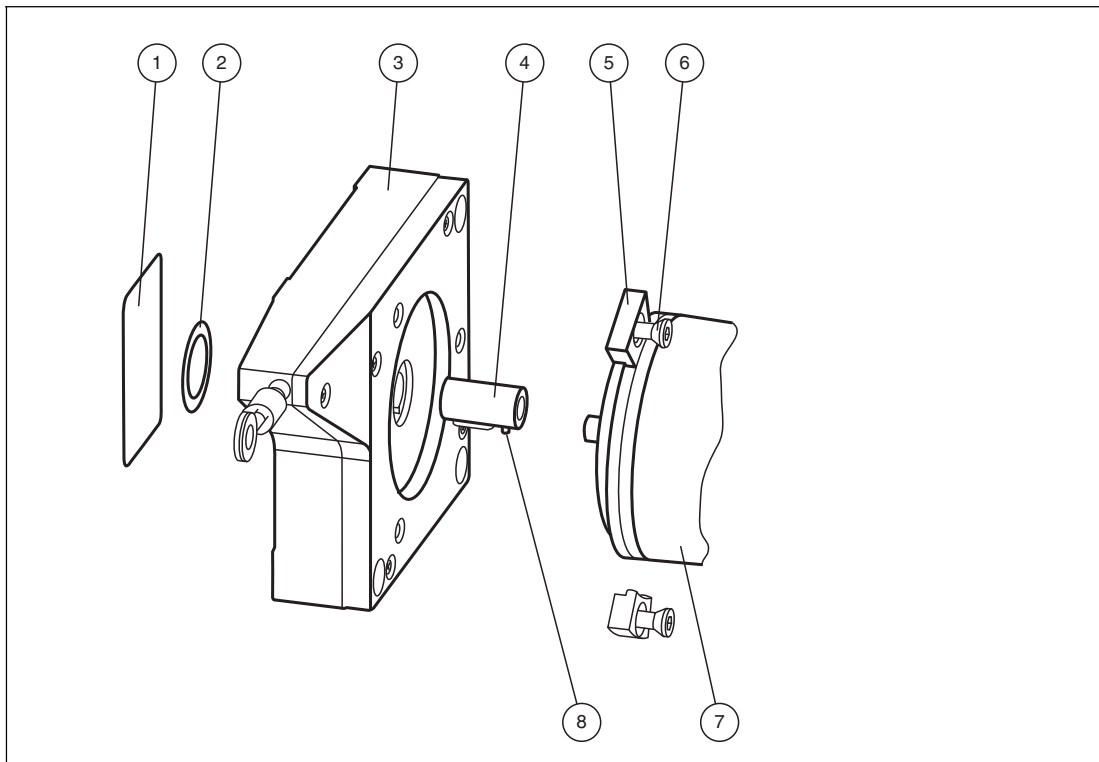
The following installation instructions must be followed.



Caution!

The rotary encoder being mounted must not exceed a maximum starting torque of 1.0 Ncm.

Mounting Sequence for Adapter Flange X1



- 1 Type label
- 2 Cover disk
- 3 Cable pull
- 4 Shaft adapter with feather key
- 5 Mounting clips
- 6 3 screws M 3 x 2
- 7 Rotary encoder
- 8 Set screws



Mounting Sequence for Adapter Flange X1

1. Place the shaft adapter with feather key **(4)** as far as possible onto the drive shaft of the rotary encoder.
2. Secure the shaft adapter with feather key **(4)** using the set screws **(8)**. To do this, use the AF-3 hexagon socket wrench at a tightening torque of 0.4 Nm.
3. Insert the rotary encoder shaft into the cable drum hub of the cable pull **(3)**.
4. Secure the rotary encoder **(7)** to the cable-pull mechanism using mounting clips **(5)** and screws **(6)**. To do this, use the AF-3 hexagon socket wrench at a tightening torque of 0.8 Nm.
5. Check that the mounted system moves freely by carefully pulling on the cable attachment.
6. If you detect any stiffness, release the fastening screws before the measurement cable retracts. Allow the cable to retract only after performing this action.
7. To ensure the cable-pull rotary encoder operates correctly, the cable drum must be moved in an axial direction. With the measurement cable retracted, tighten the fastening screws again. Using an auxiliary tool (e.g., a mandrel), move the cable drum on the rear side slightly toward the sensor system.
8. Check again that the cable pull system moves freely.

- Position the cover disk **(2)** on the back of the cable pull system. Secure the cover disk **(2)** to the type label **(1)**.

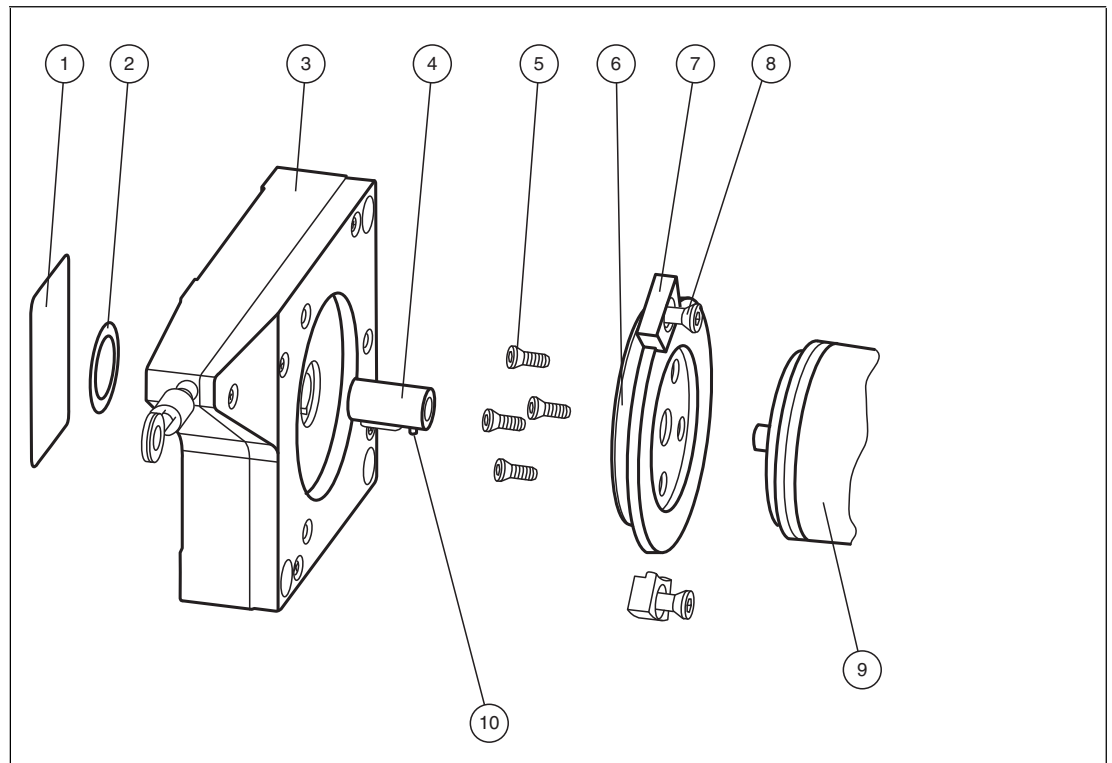


Caution!

If the shaft and hub are fitted tightly, the cable drum may occasionally become distorted in an axial direction in the plastic housing when mounting the sensor.

Axial distortion limits functionality!

Mounting Sequence for Adapter Flange X3



- 1** Type label
- 2** Cover disk
- 3** Cable pull
- 4** Rotary encoder shaft
- 5** Screws
- 6** Adapter flange X3
- 7** Mounting clips
- 8** 3 screws M 3 x 2
- 9** Rotary encoder
- 10** Set screws



Mounting Sequence for Adapter Flange X3

- Insert the rotary encoder **(9)** into the adapter flange X3 **(6)**. Tighten the screws **(5)** using a Phillips head screwdriver to 0.8 Nm.
- Place the shaft adapter with feather key **(4)** as far as possible onto the drive shaft of the rotary encoder.
- Secure the shaft adapter with feather key **(4)** using the set screws **(8)**. To do this, use the AF-3 hexagon socket wrench at a tightening torque of 0.4 Nm.



4. Insert the rotary encoder shaft into the cable drum hub of the cable pull (3).
5. Secure the rotary encoder (7) to the cable-pull mechanism using mounting clips (5) and screws (6). To do this, use the AF-3 hexagon socket wrench at a tightening torque of 0.8 Nm.
6. Check that the mounted system moves freely by carefully pulling on the cable attachment.
7. If you detect any stiffness, release the fastening screws before the measurement cable retracts. Allow the cable to retract only after performing this action.
8. To ensure the cable-pull rotary encoder operates correctly, the cable drum must be moved in an axial direction. With the measurement cable retracted, tighten the fastening screws again. Using an auxiliary tool (e.g., a mandrel), move the cable drum on the rear side slightly toward the sensor system.
9. Check again that the cable pull system moves freely.
10. Position the cover disk (2) on the back of the cable pull system. Secure the cover disk (2) to the type label (1).

5.3.2 Rotary Encoder and Cable-Pull Mechanism EC*20IL-*, EC*30PL-*, and EC*40HD-*

The device must be placed on a level mounting surface and attached using the threaded holes located on two sides of the device housing. The size and spacing of the threaded holes can be found in the specific dimensional drawing. During mounting, ensure that the cable outlet is aligned flush with the cable attachment. The cable-pull mechanism must be attached before the cable attachment is attached to the moving object.

The screws for mounting are not included in the delivery as their length is dependent on the type of connection.



Caution!

Attention! Hold the measurement cable securely!

If the cable is released unintentionally, this may damage the device and result in a risk of injury to people!

The following installation instructions must be followed.

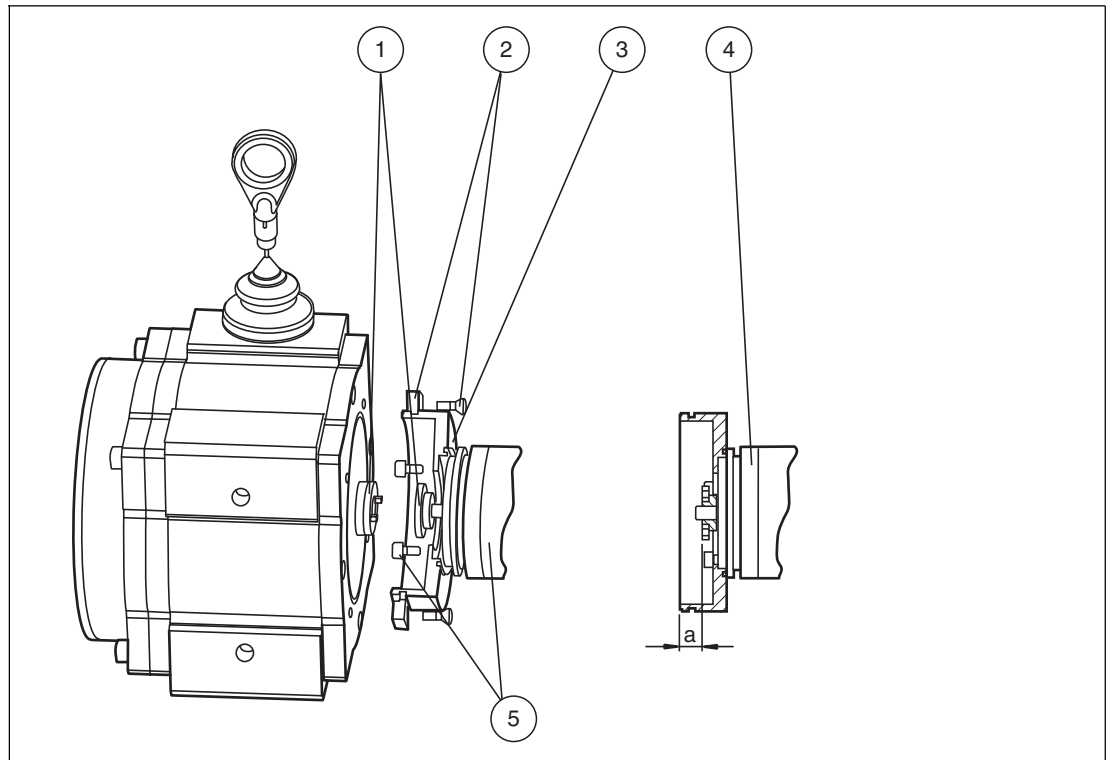


Caution!

Caution—risk of damage!

The rotary encoder being mounted must not exceed a maximum starting torque of 2.0 Ncm. Otherwise, the cable pull may be damaged!

Mounting Sequence for Rotary Encoder with EC*20IL-*, EC*30PL-*, and EC*40HD-*



- 1 Coupling elements
- 2 Mounting clips with screws 3xM4x8
- 3 Adapter flange
- 4 Rotary encoder with screws 4xM3x2
- 5 Rotary encoder with adapter flange



Mounting Sequence for Rotary Encoder with EC*20IL-*, EC*30PL-*, and EC*40HD-*

1. Insert the O-ring into the groove of the adapter flange **(3)**.
2. Insert the rotary encoder into the adapter flange. Secure the adapter flange using the enclosed screws **(4)** and an AF-3 hexagon socket wrench at 0.8 Nm.
3. Place the coupling onto the rotary encoder shaft.
4. Tighten the set screws using an AF-1.3 hexagon socket wrench to 0.4 Nm **(5)**.
5. Attach the coupling element with set screws to the rotary encoder. Make sure that distance *a* from the flange version is correct. Distance *a* between the bottom edge of the adapter and the coupling can be found in the table. Adjust the distance accordingly.
6. If you are using size 55, mount the 1 mm thick shim ring on the drive shaft of the rotary encoder.
7. Connect the other two coupling elements to one another. Attach them to the drive shaft of the cable pull.
8. Engage the two coupling elements.
9. Secure the adapter flange to the cable pull with the mounting clips **(1)** and screws using an AF-3 hexagon socket wrench at 0.8 Nm.

Model Number	Design	Flange	Distance a [mm]
EC*20IL-*	55	X5	8
EC*20IL-*/EC*30PL-*	80	X1	10
EC*20IL-*/EC*30PL-*	130/190	X1	8.2
EC*20IL-*/EC*30PL-*	80	X2	10
EC*20IL-*/EC*30PL-*	130/190	X2	8.2
EC*20IL-*/EC*30PL-*	80	X3	10
EC*20IL-*/EC*30PL-*	130/190	X3	8.2
EC*40HD-*	190	X4	8.2

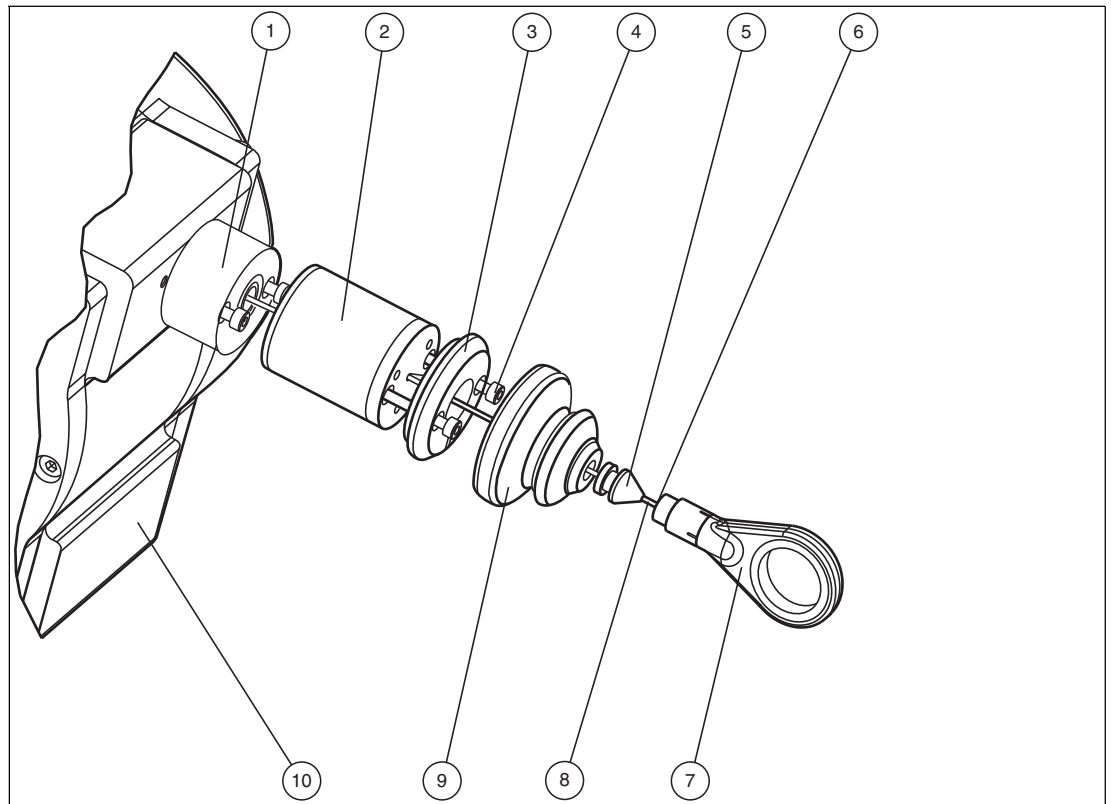
5.4 Accessories for EC*30PL-*

There are various versions of the measurement cable attachments available for the EC*30PL-* cable pull:

- Brush attachment
Mounting instructions see chapter 5.4.1
- Bellows with steel tip
Mounting instructions see chapter 5.4.2
- Compressed air attachment
Mounting instructions see chapter 5.4.3
- Guide pulley
Mounting instructions see chapter 5.4.4
- Double guide pulley
Mounting instructions see chapter 5.4.5
- Brush attachment with bellows
Mounting instructions see chapter 5.4.6
- Brush attachment with compressed air attachment
Mounting instructions see chapter 5.4.7
- Brush attachment with guide pulley
Mounting instructions see chapter 5.4.8

5.4.1 Mounting the Brush Attachment

Design 80



- 1 Aluminum spacer ring
- 2 Brush attachment
- 3 Flange
- 4 2 x screws M 3 x 50
- 5 Cable outlet nozzle
- 6 Rubber buffer on the cable attachment
- 7 Cable attachment
- 8 Measurement cable
- 9 Bellows
- 10 Cable pull

Design 80

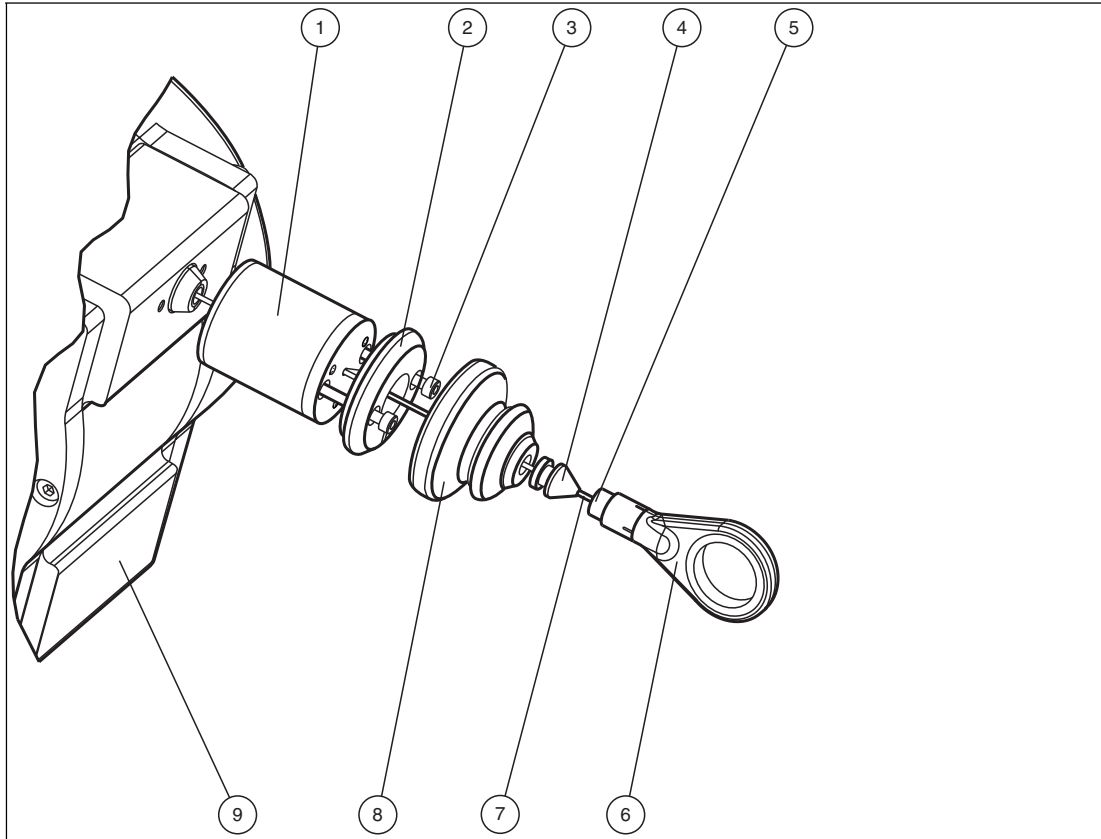
1. Turn the cover of the brush attachment **(2)** to form a continuous slot.
2. Pull the measurement cable **(8)** by the cable attachment **(7)** approx. 10 cm out of the cable pull **(10)**. Attach the measurement cable in a suitable manner.
3. Replace the plastic flange with the aluminum spacer ring **(1)**. Secure the aluminum spacer ring with the screws.
4. Place the brush attachment **(2)** on the measurement cable.
5. Secure the brush attachment **(2)** together with the flange **(3)** to the aluminum spacer ring **(1)** using the screws **(4)**.
6. Allow the measurement cable to retract again in a controlled manner.



7. Turn the cover of the brush attachment **(2)** so that the dirt that has been scraped off can fall out.

↳ The brush attachment is now mounted on the cable pull.

Design 130/190



- 1 Brush attachment
- 2 Flange
- 3 2 x screws M 3 x 50
- 4 Cable outlet nozzle
- 5 Rubber buffer on the cable attachment
- 6 Cable attachment
- 7 Measurement cable
- 8 Bellows
- 9 Cable pull

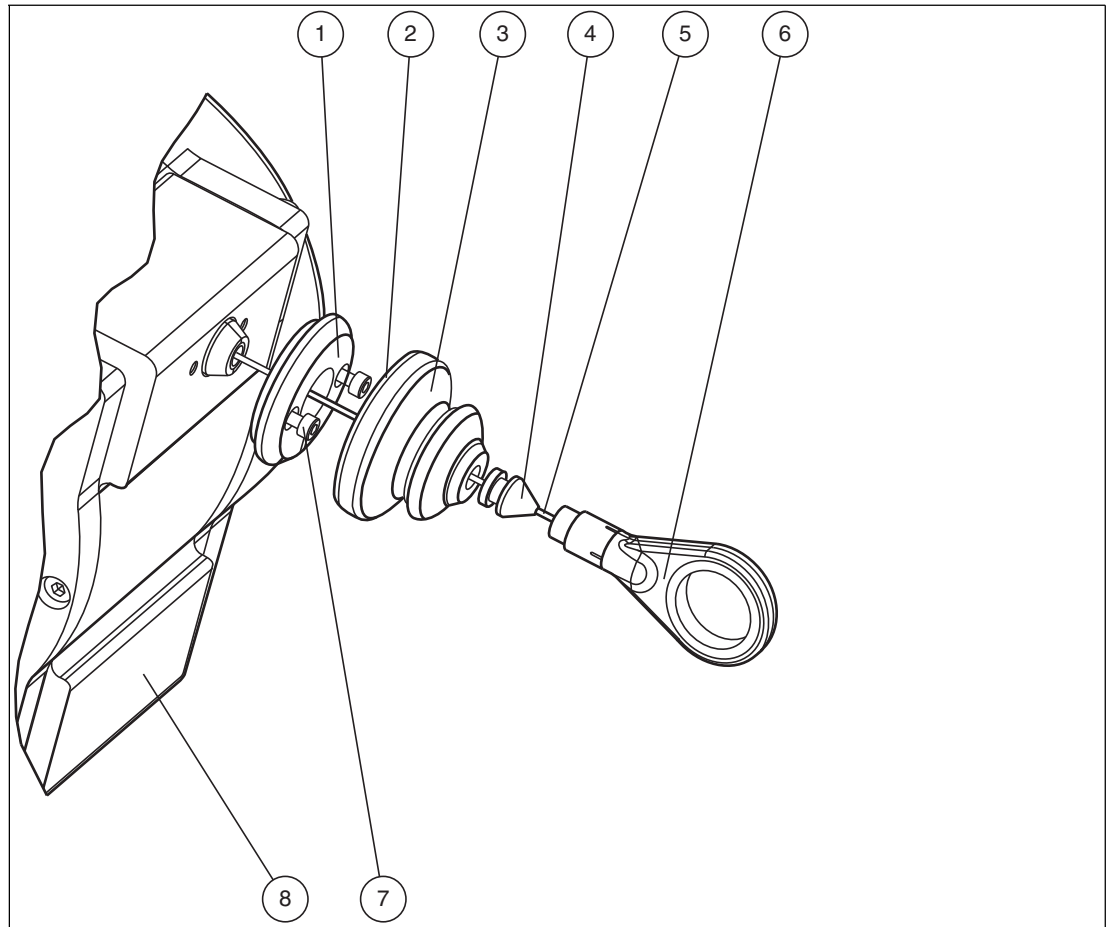


Design 130/190

1. Turn the cover of the brush attachment **(1)** to form a continuous slot.
2. Pull the measurement cable **(7)** by the cable attachment **(6)** approx. 10 cm out of the cable pull **(9)**. Attach the measurement cable in a suitable manner.
3. Place the brush attachment **(1)** on the measurement cable **(7)**.
4. Screw the brush attachment **(1)** to the cable pull housing **(9)** using the screws **(3)**.
5. Allow the measurement cable **(7)** to retract again in a controlled manner.
6. Turn the cover of the brush attachment **(1)** so that the dirt that has been scraped off can fall out.

↳ The brush attachment is now mounted on the cable pull.

5.4.2 Mounting the Bellows with Steel Tip



- 1 Flange
- 2 Rubber pad
- 3 Bellows
- 4 Steel tip
- 5 Measurement cable
- 6 Cable attachment
- 7 Screws M3x50
- 8 Cable pull



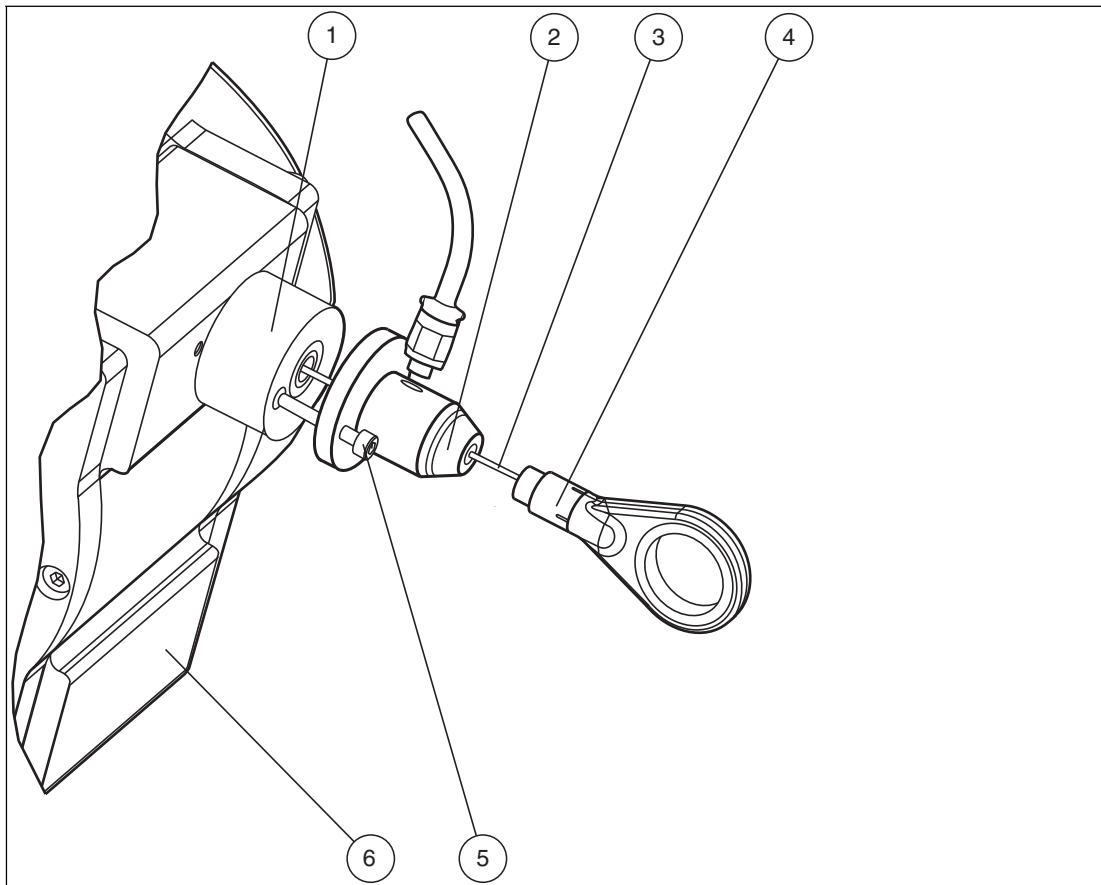
1. Insert the steel tip (4) into the bellows (3).
2. Thread the bellows (3) with steel tip onto the cable (5).
3. Pull out the cable by the cable attachment (6) approx. 10 cm. Hold the cable firmly.
4. Insert the flange (1) for the bellows between the cable pull (8) and bellows (3).
5. Screw the flange (1) to the cable pull housing using the M3x50 screws (7).
6. Allow the cable (5) to retract again in a controlled manner.
7. Pull the rubber pad (2) of the bellows over the flange (1).

↳ The bellows are now mounted.



5.4.3 Mounting the Compressed Air Attachment

Design 80



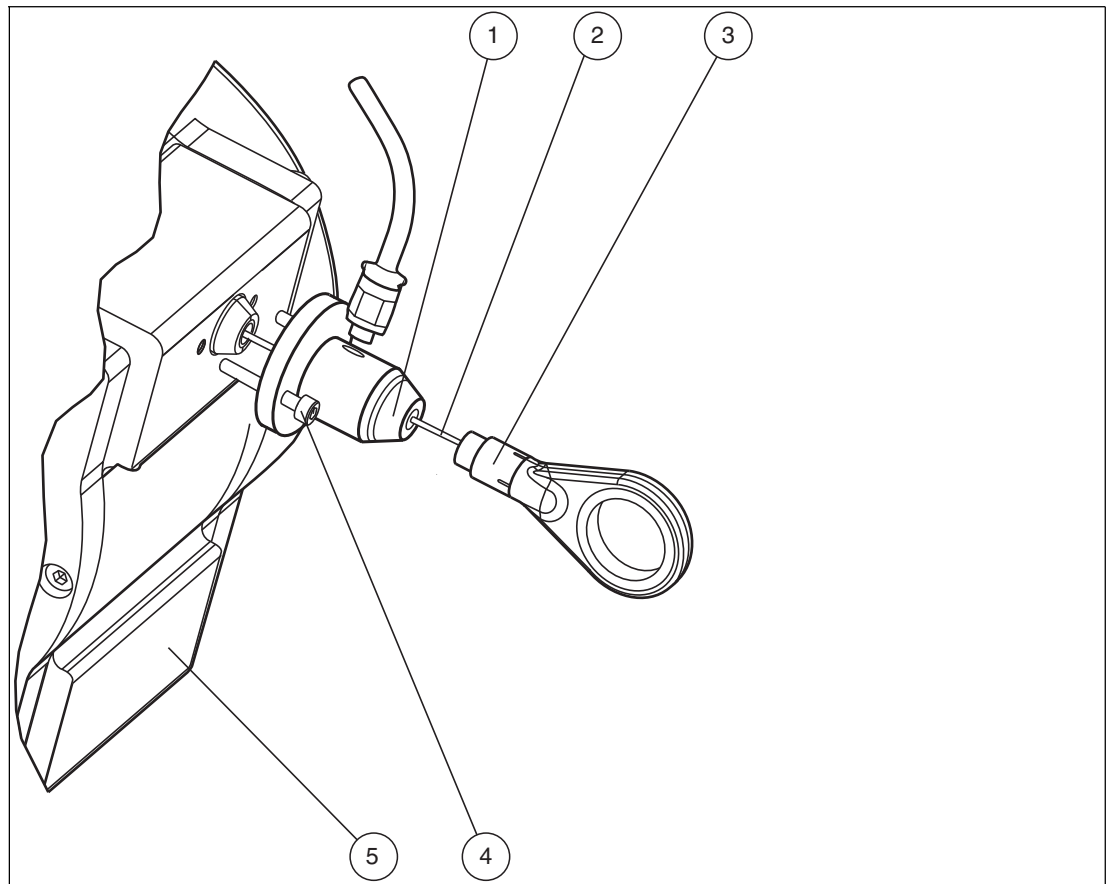
- 1 Flange
- 2 Compressed air attachment
- 3 Measurement cable
- 4 Cable attachment
- 5 M3x50 screws
- 6 Cable pull



Design 80

1. Pull out the measurement cable **(3)**. Attach the measurement cable in a suitable manner.
2. Place the compressed air attachment **(2)** onto the measurement cable **(3)** so that the bores for the screws are positioned perpendicular to the cable pull **(6)**.
3. Insert the intermediate ring between the compressed air attachment **(2)** and cable pull **(6)**.
4. Allow the cable **(3)** to retract again in a controlled manner.
5. Attach the compressed air attachment **(2)** to the cable pull **(6)** using the screws **(5)** and Allen wrench.
6. Connect the compressed air hose to the compressed air connection.
7. Pressurize the attachment with compressed air.
8. Adjust the compressed air supply in accordance with the level of contamination.
↳ The compressed air attachment is now mounted on the cable pull.

Design 130/190



- 1 Compressed air attachment
- 2 Measurement cable
- 3 Cable attachment
- 4 2 x screws M 3 x 50
- 5 Cable pull

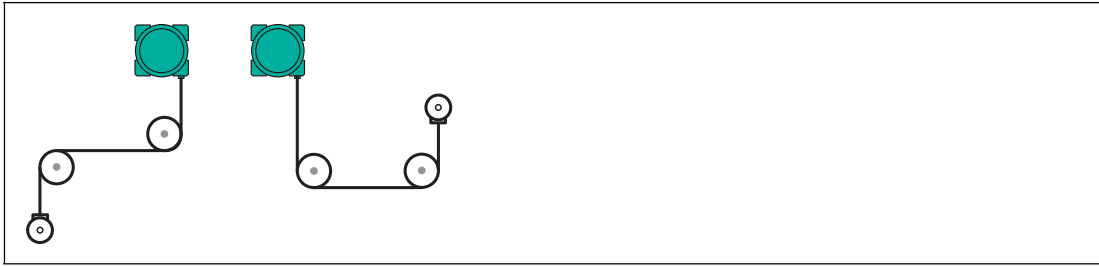


Design 130/190

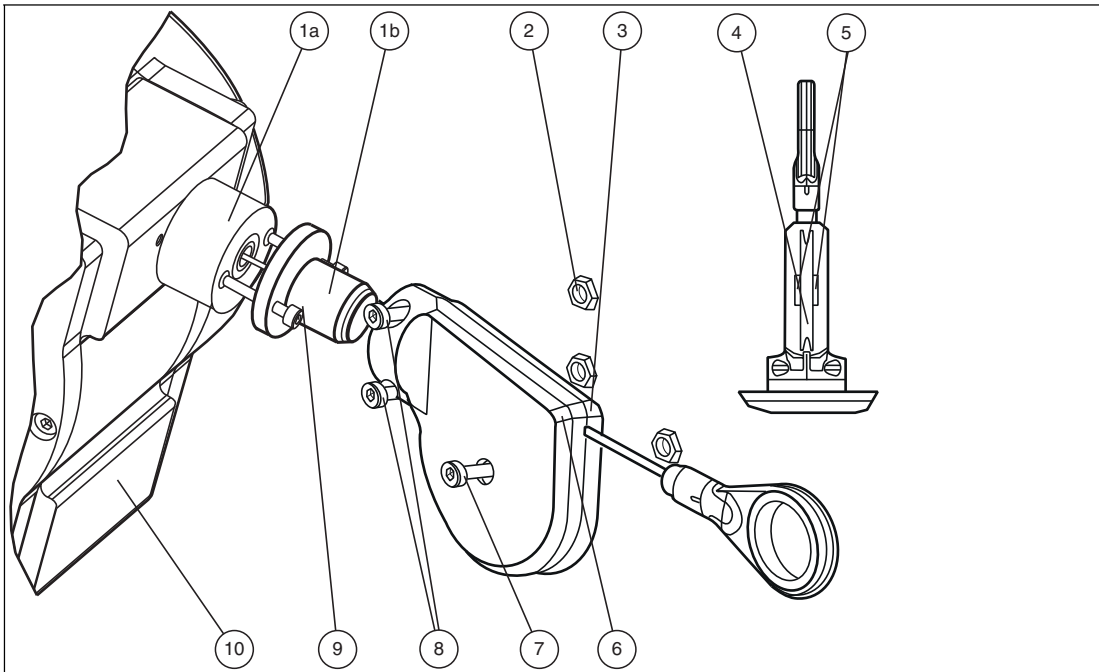
1. Pull out the measurement cable (2). Attach the measurement cable in a suitable manner.
2. Place the compressed air attachment (1) onto the measurement cable (2) so that the bores for the screws are positioned perpendicular to the cable pull (5).
3. Allow the measurement cable (2) to retract again in a controlled manner.
4. Attach the compressed air attachment (1) to the cable pull (5) using the screws (615) and Allen wrench.
5. Connect the compressed air hose to the compressed air connection.
6. Pressurize the attachment with compressed air.
7. Adjust the compressed air supply in accordance with the level of contamination.
 - ↳ The compressed air attachment is now mounted on the cable pull.

5.4.4 Mounting Guide Pulleys

Using guide pulleys enables distances to be measured that are not in a direct line from the cable pull. They open up application areas with limited accessibility, such as an angled position or special environmental conditions.



Design 80



- 1a & 1b** Flange
- 2** Nuts
- 3** Left-hand housing half
- 4** Guide roller
- 5** Washers
- 6** Right-hand housing half
- 7** Central screw
- 8** Screws M3x10
- 9** Screws M3x8
- 10** Cable pull

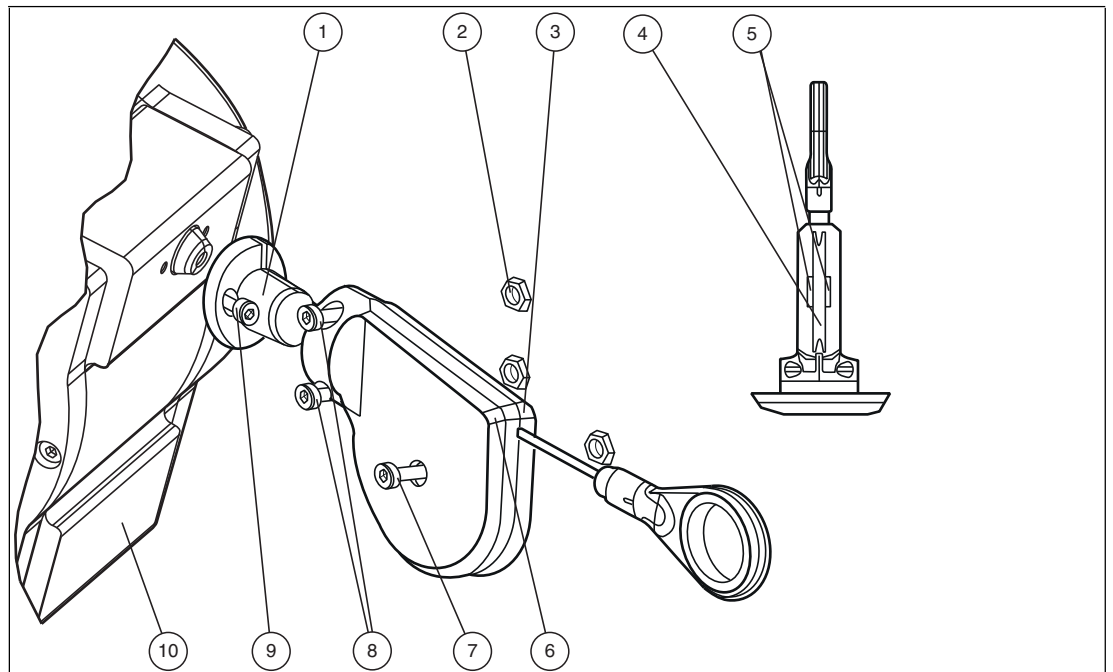
Design 80

1. Pull out the measurement cable. Attach it in a suitable manner.
2. Screw the flanges (**1a & 1b**) to the cable pull (**10**) with the slot facing downward.
3. Loosen the screws (**8**) on the bottom of the guide pulley. Remove the screws. The inserted nuts (**2**) remain in the guide pulley housing (**3 & 6**).
4. Loosen the central screw (**7**) in the center of the guide pulley.
5. Disassemble the housing (**3 & 6**).



6. Place the measurement cable into the base of the groove in the guide pulley.
 7. Place the housing parts (**3 & 6**) around the guide pulley again.
 8. Tighten the central screw (**7**) again.
 9. Secure the housing with the screw (**8**) and nut (**2**) using an AF-2 Allen wrench at 2 Nm.
 10. Insert the guide pulley housing (**3 & 6**) into the flange (**1**). Secure the guide pulley using the screws and an AF-2 Allen wrench at 2 Nm.
 11. Tighten the screws (**9**).
- ↳ The guide pulley is now mounted.

Design 130/190



- | | |
|-----------|-------------------------|
| 1 | Flange |
| 2 | Nuts |
| 3 | Left-hand housing half |
| 4 | Guide roller |
| 5 | Washers |
| 6 | Right-hand housing half |
| 7 | Central screw |
| 8 | Screws M3x10 |
| 9 | Screws M3x8 |
| 10 | Cable pull |

Design 130/190

1. Pull out the measurement cable. Attach it in a suitable manner.
2. Screw the flange (**1**) to the cable pull (**10**) with the slot facing downward.
3. Loosen the screws (**8**) on the bottom of the guide pulley. Remove the screws. The inserted nuts (**2**) remain in the guide pulley housing (**3 & 6**).
4. Loosen the central screw (**7**) in the center of the guide pulley.
5. Disassemble the housing (**3 & 6**).



6. Place the measurement cable into the base of the groove in the guide pulley.
7. Place the housing parts (3 & 6) around the guide pulley again.
8. Tighten the central screw (7) again.
9. Secure the housing with the screw (8) and nut (2) using an AF-2 Allen wrench at 2 Nm.
10. Insert the guide pulley housing (3 & 6) into the flange (1). Secure the guide pulley using the screws and an AF-2 Allen wrench at 2 Nm.
11. Tighten the screws (9).

↳ The guide pulley is now mounted.

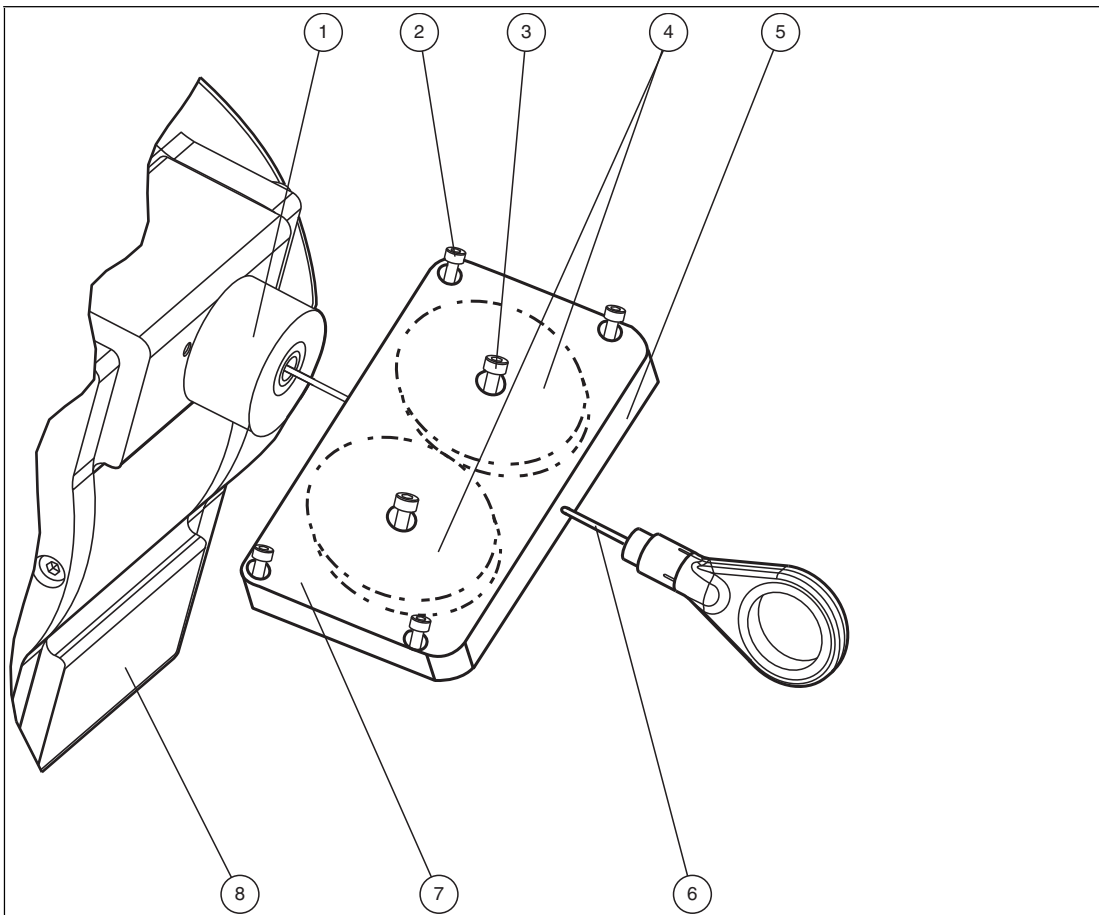
5.4.5 Mounting the Double Guide Pulley



Note!

If the double guide pulley is used, the measurement cable can be pulled max. 45° to the right or left in a horizontal direction only. It is not possible to pull the measurement cable in a vertical direction or more than 90° in a horizontal direction as this may damage the measurement cable.

Design 80



- 1 Flange
- 2 Screws
- 3 Central screws
- 4 Guide pulleys
- 5 Ground plate
- 6 Measurement cable

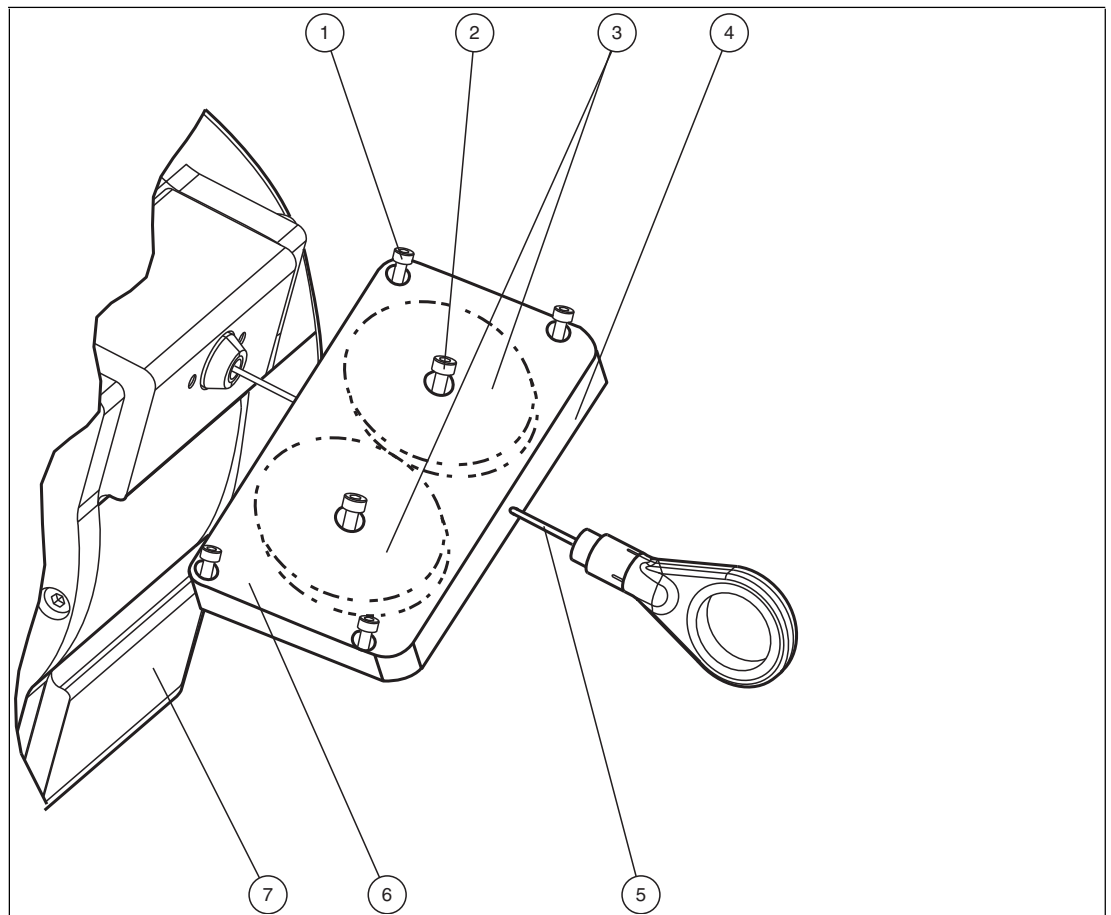
- 7 Cover
- 8 Cable pull



Design 80

1. Pull out the measurement cable. Attach it in a suitable manner.
 2. Screw the flange (1) to the cable pull (8) with the slot facing downward.
 3. Loosen the screws (2 & 3).
 4. Lift the cover (7) off the ground plate (5).
 5. Remove the two guide pulleys (4) along with their washers.
 6. Pull out the measurement cable (6) by the cable pull (8). Thread the cable through the slot on the bottom of the ground plate.
 7. Insert the ground plate (5) into the cable pull housing (8).
 8. Screw the ground plate (5) onto the cable pull housing (8) using the screws and an AF-2 Allen wrench at 1 Nm. Secure the screws with retaining compound.
 9. Place three washers on each of the bearings.
 10. Place one guide pulley (4) onto each of the bearings.
 11. Place three washers on each of the guide pulleys.
 12. Place the cover (6) onto the ground plate (5). Secure the cover using the screws (2 & 3) and an AF-2 Allen wrench at 1 Nm.
- ↳ The double guide pulley is now mounted on the cable pull.

Design 130/190





- 1 Screws
- 2 Central screws
- 3 Guide pulleys
- 4 Ground plate
- 5 Measurement cable
- 6 Cover
- 7 Cable pull



Design 130/190

1. Loosen the screws **(1+2)**.
2. Lift the cover **(6)** off the ground plate **(4)**.
3. Remove the two guide pulleys **(3)** along with their washers.
4. Pull out the measurement cable **(5)** by the cable pull **(7)**. Thread the cable through the slot on the bottom of the ground plate.
5. Insert the ground plate **(4)** into the cable pull housing **(7)**.
6. Screw the ground plate **(4)** onto the cable pull housing **(7)** using the screws and an AF-2 Allen wrench at 1 Nm. Secure the screws with retaining compound.
7. Place three washers on each of the bearings.
8. Place one guide pulley **(3)** onto each of the bearings.
9. Place three washers on each of the guide pulleys.
10. Place the cover **(6)** onto the ground plate **(4)**. Attach the cover using the screws **(1+2)** and an AF-2 Allen wrench at 1 Nm.
 - ↳ The double guide pulley is now mounted on the cable pull.

5.4.6 Mounting the Brush Attachment with Bellows

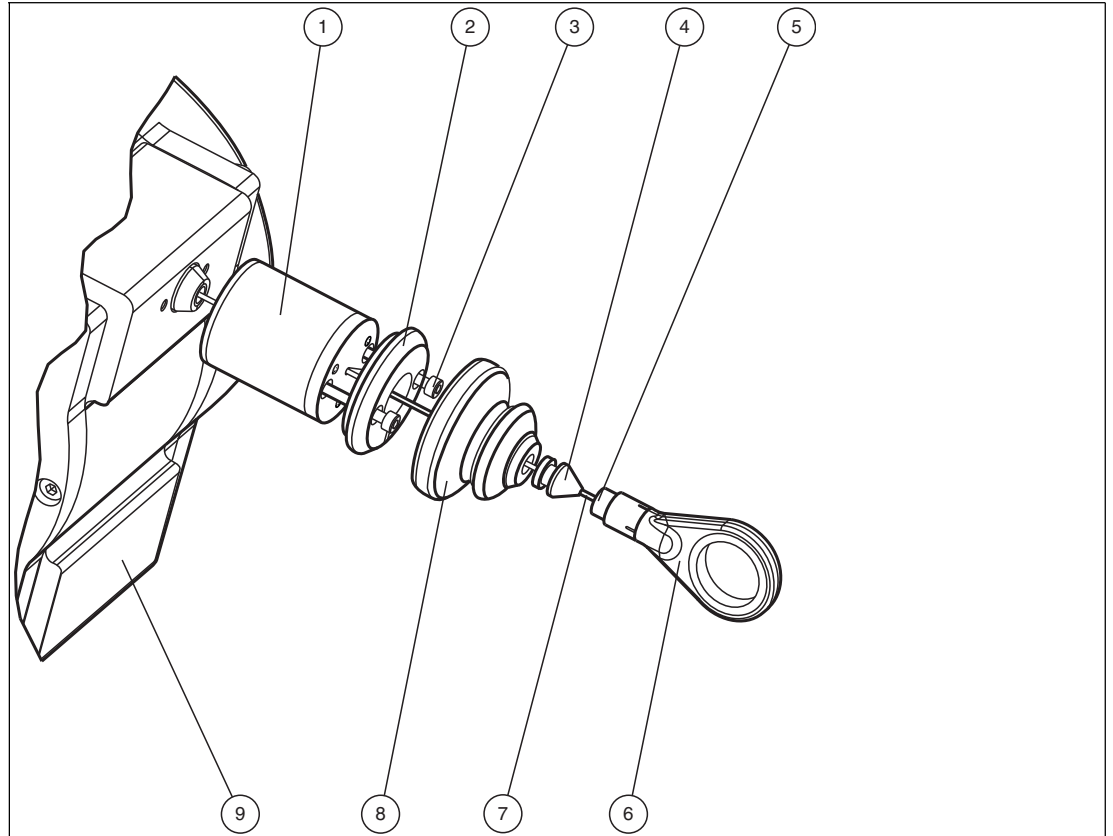


Caution!

Prior to mounting, please note the following:

Mounting reduces the maximum extension length by approximately 15 cm.

Design 80/130/190



- 1 Brush attachment
- 2 Flange
- 3 2 x screws M 3 x 50
- 4 Cable outlet nozzle
- 5 Rubber buffer on the cable attachment
- 6 Cable attachment
- 7 Measurement cable
- 8 Bellows
- 9 Cable pull



Design 80/130/190

1. Turn the cover of the brush attachment (1) to form a continuous slot.
2. Pull the measurement cable (7) by the cable attachment (6) approx. 10 cm out of the cable pull (9). Attach the measurement cable in a suitable manner.
3. Place the brush attachment (1) on the measurement cable (7).
4. Screw the brush attachment (1) to the cable pull housing (9) using the screws (3).
5. Allow the measurement cable (7) to retract again in a controlled manner.



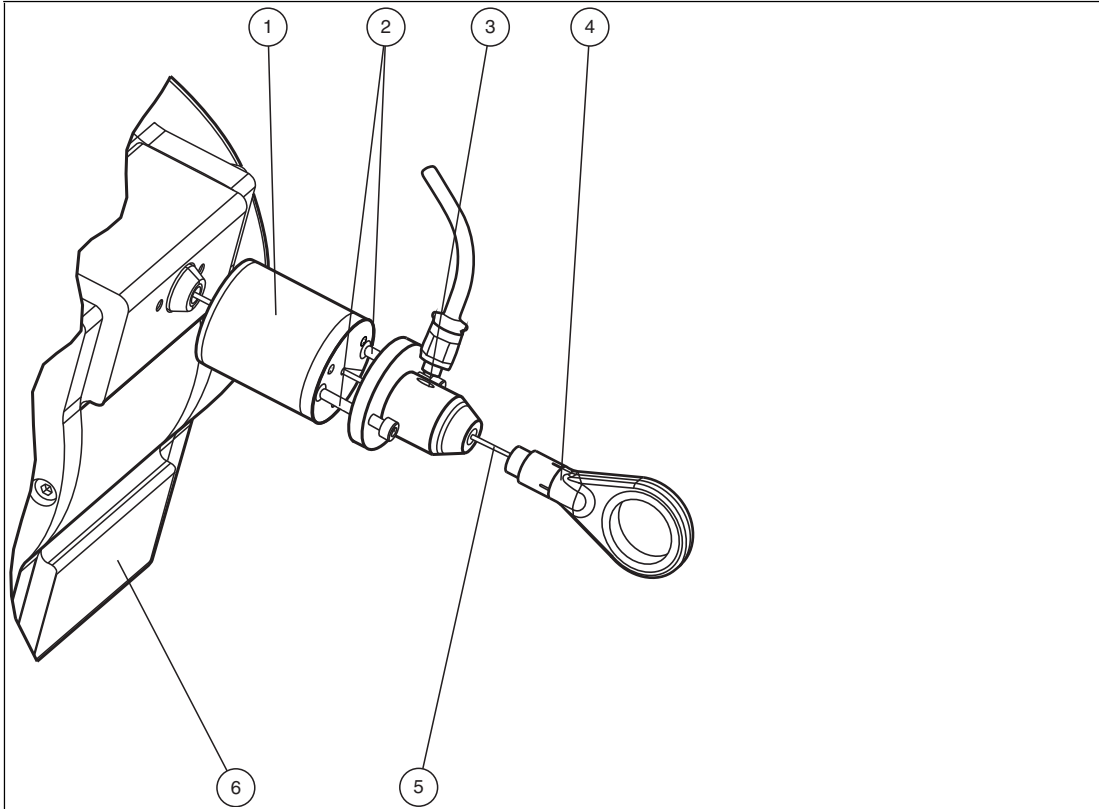
6. Turn the cover of the brush attachment **(1)** so that the dirt that has been scraped off can fall out.

↳ The brush attachment is now mounted on the cable pull.

5.4.7

Mounting the Brush Attachment with Compressed Air Attachment

Design 80/130/190



- 1 Brush attachment
- 2 M3x50 screws
- 3 Compressed air attachment
- 4 Cable attachment
- 5 Measurement cable
- 6 Cable pull



Design 80/130/190

1. Turn the cover of the brush attachment **(1)** to form a continuous slot.
2. Pull the measurement cable **(5)** by the cable attachment **(4)** approx. 10 cm out of the cable pull **(6)**. Attach the measurement cable in a suitable manner.
3. Place the brush attachment **(1)** onto the measurement cable so that the bores for the screws are positioned perpendicular to the cable pull **(6)**.
4. Place the compressed air attachment **(3)** onto the measurement cable **(5)** so that the bores for the screws are positioned perpendicular to the cable pull **(6)**.
5. Insert the intermediate ring between the compressed air attachment **(3)** and brush attachment **(1)**.
6. Allow the measurement cable to retract again in a controlled manner.

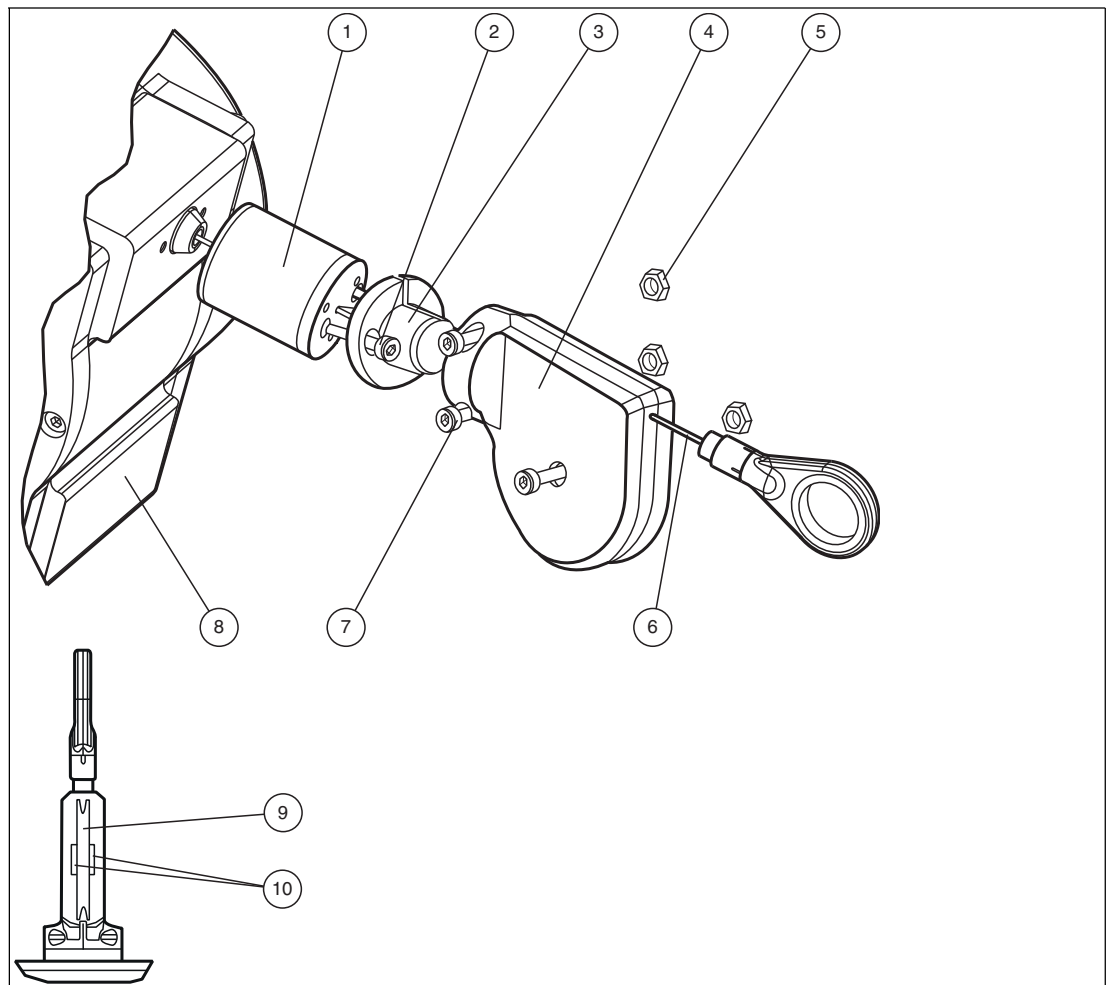


7. Secure the compressed air attachment (3) and the brush attachment (1) to the cable pull (6) using the screws (2) and Allen wrench.
 8. Connect the compressed air hose to the compressed air connection.
 9. Pressurize the attachment with compressed air.
 10. Adjust the compressed air supply in accordance with the level of contamination.
 11. Turn the cover of the brush attachment (2) so that the dirt that has been scraped off can fall out.
- ↳ The compressed air attachment and brush attachment are now mounted on the cable pull.

5.4.8

Mounting the Brush Attachment with Guide Pulley

Design 80/130/190



- 1 Brush attachment
- 2 M3x8 screws
- 3 Flange
- 4 Guide pulley housing
- 5 Nuts
- 6 Measurement cable
- 7 M3x10 screws
- 8 Cable pull



- 9 Guide pulley
- 10 Washers



Design 80/130/190

1. Turn the cover of the brush attachment (1) to form a continuous slot.
2. Pull the measurement cable (6) by the cable attachment approx. 10 cm out of the cable pull (8). Attach the measurement cable in a suitable manner.
3. Place the brush attachment (2) on the measurement cable.
4. Secure the brush attachment (1) together with the flange (2) to the cable pull (8) using the screws (3).
5. Loosen the screws (7) on the bottom of the guide pulley. Remove the screws. The inserted nuts (5) remain in the guide pulley housing (4).
6. Loosen the central screw in the center of the guide pulley.
7. Disassemble the housing (4).
8. Place the measurement cable into the base of the groove in the guide pulley.
9. Place the housing parts (4) around the guide pulley again.
10. Tighten the central screw again.
11. Secure the housing with the screws (7) and nuts (5) using an AF-2 Allen wrench at 2 Nm.
12. Insert the guide pulley housing (4) into the flange (3). Secure the guide pulley using the screws and an AF-2 Allen wrench at 2 Nm.
13. Tighten the screws (2).
14. Allow the measurement cable to retract again in a controlled manner.
15. Turn the cover of the brush attachment (2) so that the dirt that has been scraped off can fall out.

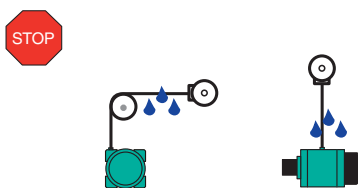
↳ The brush attachment and the guide pulley are now mounted on the cable pull.

5.5

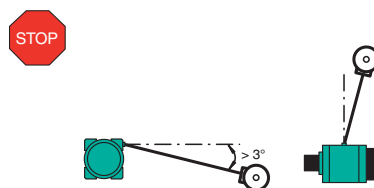
Installation Notes

Usage in damp or dusty environments:

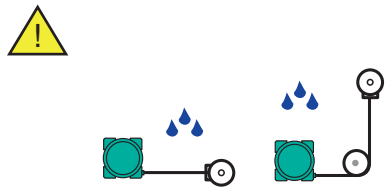
To give the measurement cable a long service life:



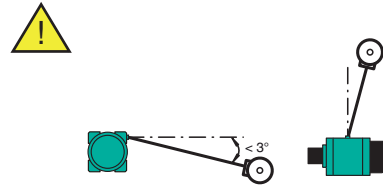
The cable outlet must never be mounted facing upward. Water can run along the measurement cable and enter the cable drum housing. As the measurement cable does not have a smooth surface, it is not completely water-tight.



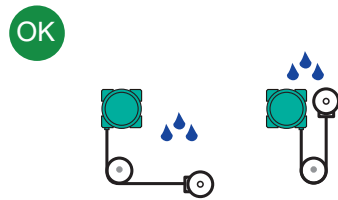
Extending the cable in a straight line is recommended! An extension angle exceeding 3° will cause faults in the cable pull-back mechanism and significant wear on the cable outlet after only a short period of operation.



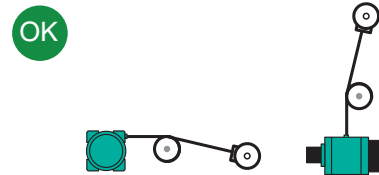
If there is no risk of ice forming on the measurement cable, then the cable outlet can be positioned horizontally. However, the cable outlet should be mounted at the bottom.



An extension angle of up to 3° is possible but not recommended. The service life may be reduced.

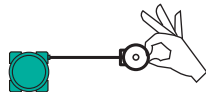


If there is a risk of ice forming on the measurement cable, a guide pulley must be used in order to break up the ice. The cable outlet must always face downward. This arrangement is always preferable wherever moisture or dust may accumulate on the measurement cable.

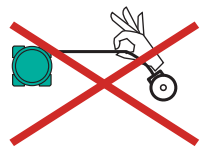


Extending the cable in a straight line is ideal. This can be achieved with a guide pulley if necessary.

To prevent damage to the measurement cable, the following actions must be avoided:



Never allow the measurement cable to retract in an uncontrolled manner. Releasing a tensioned cable will break the device. Risk of injury!



Do not pull on the cable itself as this can cause kinks and prevent the cable from retracting.

Do not pull the measurement cable over edges as the individual wires will be damaged.



5.6 Installation Instructions for the Cable-Pull Rotary Encoder

The device must be placed on a level mounting surface and attached using the threaded holes located on two sides of the device housing. The size and spacing of the threaded holes can be found in the specific dimensional drawing. During mounting, ensure that the cable outlet is aligned flush with the cable attachment. The cable-pull mechanism must be attached before the cable attachment is attached to the moving object.

6 Maintenance and Repair

6.1 Maintenance

When operated in accordance with its intended use, the cable-pull mechanism is maintenance-free. Depending on the type of application, up to one million load cycles are possible. This depends on a number of factors, including whether the entire measuring range is utilized or only parts of it. Other influencing factors are the movement speed, acceleration, and environmental conditions.

Repairs must be performed by the manufacturer only. Opening the device will void any warranty claims.

The measurement cable and the cable drum must not be oiled or greased. The instructions on guiding the cable must be followed during operation. If the cable is guided incorrectly, this can lead to increased wear as well as faults at an early stage.



7 Decommissioning and Disposal



Warning!

Risk of injury

To protect against injury when carrying out any work on the device, observe the safety instructions, see chapter 3.4.1.



Dismounting the Cable-Pull Mechanism of Rotary Encoders

When dismounting the rotary encoder, proceed in the reverse order to that described in section .



Disposal

1. Remove the supply and output cable from the sensor.
2. Loosen the measurement cable from the measurement object. Allow the measurement cable to retract in a controlled manner (do not let it snap back).
3. The sensor is manufactured in accordance with Directive 2006/42/EC. It must be disposed of in accordance with the legal provisions.

8 Appendix

8.1 Terms

Explanation of Terms

Term	Explanation
Operating temperature	Operating temperature range with correct mounting and selection of the device design in non-condensing humidity
Measurement length	Maximum permissible measuring distance in continuous operation
Extension length	Measuring distance up to the stop of the measurement cable. Exceeding the extension length will break the measurement cable.
Drum size	An extension length corresponding to an angle of exactly 360° on the sensor coupling, with specification of the absolute deviation
Linearity	The deviation from an ideal straight line between the start and end value
Repeatability	Repeat accuracy when approaching a measurement point from the same direction
Hysteresis	Repeat accuracy when approaching a measurement point from the opposite direction
Movement speed V_{\max}	Maximum permissible speed of the measurement cable at a reference temperature of 20 °C
Acceleration a_{\max}	Maximum permissible acceleration of the measurement cable at a reference temperature of 20 °C
Tensile load on the measurement cable	Tensile load on the measurement cable at the start and at the end of the measuring range when pulling out the measurement cable. When retracting the measurement cable, the tensile load is 2 N...5 N lower.
Weight	Weight of the measurement system without the sensor system (with sensor system in size 55)

Note on Service Life Information

The service life is dependent on the type of load. The figures are average values. The service life may be reduced if rapid movements are made over longer lengths, or increased if slow movements are made over shorter lengths.

FACTORY AUTOMATION – SENSING YOUR NEEDS



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