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# SENC

Safe HTL Incremental Encoders

## Manual

Doc. No. BA001175
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# Info

## Copyright



## Subject to change

This manual is subject to technical changes for reasons of continued development.

# 1 About this manual

Please read this section carefully before you use this manual and the SENC encoder by Wieland Electric. Here you will find all the information required for commissioning and operation.

## 1.1 Structure of the manual

As a guidance the overall table of contents is available in the manual at the beginning.

## 1.2 Presentation of safety-relevant information

Information that warns of personal injury or property damage is emphasized by safety instructions. Please read this information carefully.

This operating manual uses various safety notices that are assigned according to the severity of a potential hazard:

**Warning!**

Potentially hazardous situation, which, if not avoided, can result in death, serious injury, or equipment damage.


**Attention!**

Recommendation, which, if not followed, may eventually result in death, serious injury, or equipment damage depending on the context.


**NOTE:**

Supplementary information and useful tips, indirectly related to the safety of personnel or property.

NOTE

# 2 Safety

Before using the safety sensor, a risk assessment must be performed according to valid standards (e.g. EN ISO 12100:2010, EN ISO 13849.1:2015, EN 62061:2005+A1:2012). The result of the risk assessment determines the required safety level of the safety sensor (see 5.3).

For mounting, operating and testing, this document as well as all applicable national and international standards, regulations, rules and directives must be observed. Relevant and supplied documents must be observed, printed out and handed to related persons.

**NOTE:** NOTE

Before working with the safety sensor, completely read and study the documents applicable to your task.

In particular, the following national and international legal regulations apply for the commissioning, technical inspections and work with safety sensors:

- Machinery directive 2006/42/EC
- Low voltage directive 2014/35/EU
- EMC directive 2014/30/EU
- Use of work equipment directive 89/655/EEC supplemented by directive 95/63 EC
- OSHA 1910 Subpart O
- Safety regulations
- Accident-prevention regulations and safety rules
- Ordinance on Industrial Safety and Health and employment protection act
- Product Safety Law (ProdSG and 9. ProdSV)

**NOTE:** NOTE

For safety-related information you may also contact local authorities (e.g., industrial inspector- ate, employer's liability insurance association, labor inspectorate, occupational safety and health authority).

## 2.1 Intended use

The product may only be used in compliance with all applicable safety regulations and directives, the specified requirements and the technical data.

Prior to using the product, a risk assessment must be performed in view of the planned application. Based on the results, the appropriate safety measures must be implemented.

Since the product is used as a component in an entire system, the safety of persons must be ensured by means of the design of this entire system (for example, machine design).

Any use other than the use explicitly permitted is prohibited and can result in a safety hazard.

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel.

## 2.2 Qualification of personnel

Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation are authorized to work on and with this product. In addition, these persons must have received safety training to recognize and avoid hazards involved. These persons must have sufficient technical training, knowledge and experience to be able to foresee and detect potential hazards that may be caused by using the product. They must also have sufficient knowledge and experience to understand the operational risks of the mechanical, electrical and electronic equipment of the entire system in which the product is used.

All persons working on and with the product must be fully familiar with all applicable standards, directives, and accident prevention regulations when performing such work.

## 2.3 Responsibility for safety

Manufacturer and operator must ensure that the machine and implemented safety sensor function properly and that all affected persons are adequately informed and trained.

The type and content of all imparted information must not lead to unsafe actions by users.

The manufacturer of the machine is responsible for:

- Safe machine construction
- Safe implementation of the safety sensor, verified by the initial test performed by a competent person (see section 2.2)
- Imparting all relevant information to the operating company
- Adhering to all regulations and directives for the safe commissioning of the machine

The operator of the machine is responsible for:

- Instructing all users
- Maintaining the safe operation of the machine
- Adhering to all regulations and directives for labor protection and safety at work
- Periodic testing by a competent person (see section 2.2)

## 2.4 Exemption of liability

The liability of Wieland Electric GmbH is to be excluded in the following cases:

- Safety sensor is not used as intended.
- Safety notices are not adhered to.
- Reasonably foreseeable misuse is not taken into account.
- Mounting and electrical connection are not properly performed.
- Proper function is not tested.
- Changes (e.g., constructional) are made to the safety sensor.

# 3 Device description

## 3.1 Range presentation

| | | |
|---|---|---|
| Size | 58 mm | 90 mm |
| Shaft | SENC-58S: Solid (10 mm)<br>SENC-58H : Hollow (14 mm) | SENC-90S: Solid (11mm)<br>SENC-90H : Hollow (30 mm) |
| Material | Aluminum (A) | |
| Electronics & signals | HTL: Power supply 11 – 30 V, Output signals digital HTL, AA/, BB/, ZZ/ | |
| Resolutions | Up to 1024 ppr | Up to 1024 ppr |
| Connector | M23-CCW: M23, 12 pins, Counter clockwise wiring | |
| Cable | PUR: PUR cable, 10 wires<br>Available cable lengths : up to 20 m in standard (up to 25 m on request) | |

## 3.2 Mechanical specifications

### 3.2.1 General information

Encoder must be mounted using good mechanical assembly processes and correct tooling in accordance with the details in this manual. Standard IEC/EN 61800-5-2 must also be applied, taking into account amongst others encoder's fastening precautions on driving device listed in the table D.16 of IEC/EN 61800-5-2 (motion and position feedback sensors).

All parts (Shaft, flange) must mate properly with the correct hardware without requiring any excessive external applied load (i.e. hammer, arbor press).

The coupling mounting must be done without deforming the coupling devices or rigid mechanical contact between mating shafts which would invalidate the coupling function.

**Attention!**

In order to avoid the risk of sliding on the mating shaft, use positive locks through a key on both ends for the solid shaft encoder and slots on the hollow shaft encoder.


When mounting a gear, wheel or pulley on the encoder use a key for securing the shaft against angular rotation and design your device in order to limit any axial and radial loads up to the permissible value defined in the encoder data sheet.

**Attention!**

Secure the fasteners (on flange, shaft, clamping rings, couplings…) by using a screw with the appropriate torque and lock the treads with Thread locker Loctite 243 or equivalent.


In case of leakage currents on the driving shaft, a very typical situation with the use of Variable Frequency Drives (VFDs) or industrial DC motors, use the SRS insulated reduction sleeve. Refer to section 3.3.3.

If possible, mount the encoder shaft horizontal or facing downward with the cable-glands or the connector facing downward.

Mounting cautions and mechanical interface configurations are described in detail in the next sections.

### 3.2.2 Mechanical safety features

**Positive Locks**: Form fit for hollow shaft especially designed for safety applications.

**Keyway**: Form fit for solid shaft.

## 3.3 Accessories

### 3.3.1 Stator couplings

Stator couplings are designed to provide a high degree of angular stability while at the same time allowing compensation for the driving shaft runout and dimensional errors as well as any normal axial shaft movement.

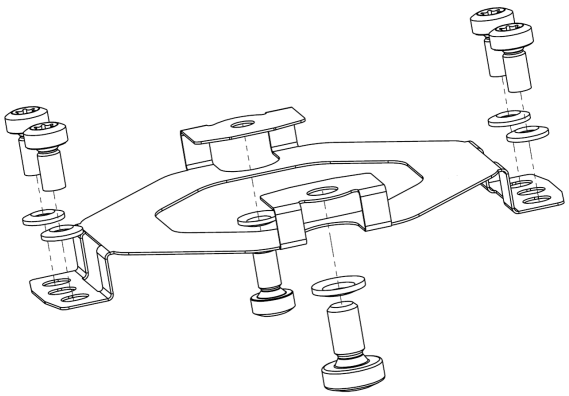
**Attention!**

Exceeding the values listed below drastically reduce the expected life time of the products. Avoid working at or near the load limits and take into account the relation between misalignment and lifetime expectancy.

ATTENTION

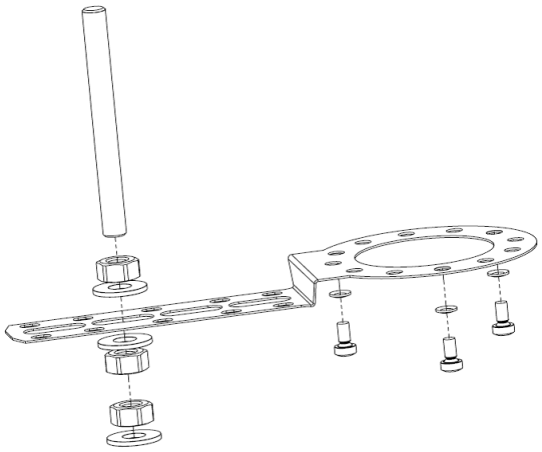
The complete mounting set for stator couplings including all fasteners are available under the following part numbers:

**Stator coupling set for SENC-58 range**
**Order no. COUP-STATOR-58-S**

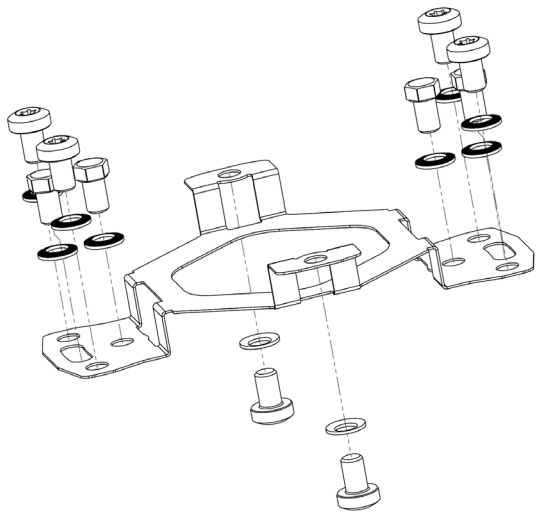
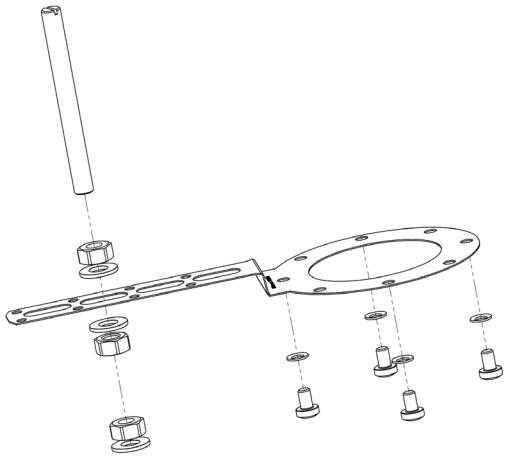


| | | |
|---|---|---|
| Permissible misalignments | Axial | ±1 mm |
| | Radial | ±0.2 mm |
| | Perpendicularity | ±2° |
| | Runout | 0.1 mm |
| Angular rigidity | | >100 Nm/rad |

**Tether arm set for SENC-58 range**
**Order no. COUP-TETHER-58-S**



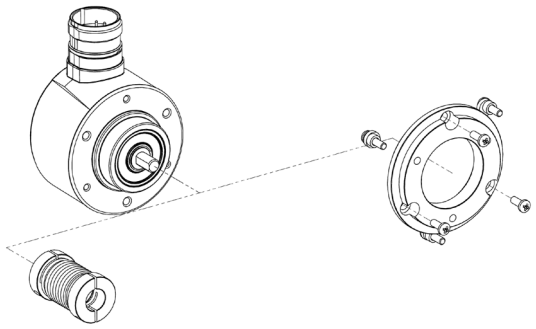
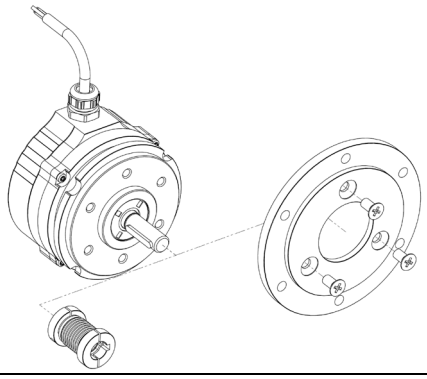
| | | |
|---|---|---|
| Permissible misalignments | Axial | ±1 mm |
| | Radial | ±0.2 mm |
| | Perpendicularity | ±5° |
| | Runout | 0.1 mm |
| Angular rigidity | | >100 Nm/rad |

| Stator coupling for SENC-90 range<br>Order no. COUP-STATOR-90-S | Tether arm for SENC-90 range<br>Order no. COUP-TETHER-90-S |
|---|---|
|  |  |

| | | |
|---|---|---|
| Permissible misalignments | Axial | ±1.5 mm |
| | Radial | ±0.3 mm |
| | Perpendicularity | ±3° |
| | Runout | 0.1 mm |
| Angular rigidity | | >200 Nm/rad |

| | | |
|---|---|---|
| Permissible misalignments | Axial | ±2 mm |
| | Radial | ±0.3 mm |
| | Perpendicularity | ±5° |
| | Runout | 0.1 mm |
| Angular rigidity | | >200 Nm/rad |

### 3.3.2 Flanges

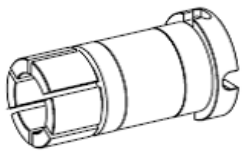
| 58 mm standard flange<br>Order no. FLANGE-58-A | 90 mm standard flange<br>Order no. FLANGE-90-A |
|---|---|
|  |  |

### 3.3.3 Sleeves

The use of Variable Frequency Drives (VFDs) or industrial DC motors often results in leakage currents on the driving shaft. Use the insulated sleeve **SRS** (Safety Reduction Sleeve) to prevent these leakage currents from damaging the encoder bearings and to increase their life time.

Reduction sleeve minimum insulation: 2.5 kV

Material: Plastic

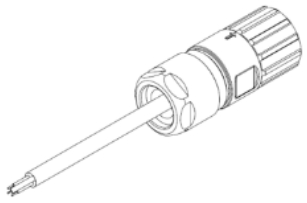
| **Order no.** | **Description** | |
|---|---|---|
| SLEEVE-90H-P-30-20 | Reduction from 30 mm to 20 mm shaft |  |
| SLEEVE-90H-P-30-21 | Reduction from 30 mm to 21 mm shaft | |
| SLEEVE-90H-P-30-22 | Reduction from 30 mm to 22 mm shaft | |
| SLEEVE-90H-P-30-25 | Reduction from 30 mm to 25 mm shaft | |

### 3.3.4 Cable-connector assemblies

For safety applications, we recommend to use Wieland's qualified cable-connector assemblies.

The cable-connector assemblies have M23 connectors on the encoder side, and open ends for the other side.

Ordering key: (ex. CABLE-M23CKW-PUR-015)

| **Connector** | **Wiring** | **Cable type** | **Length** | |
|---|---|---|---|---|
| M23CKW<br>M23 clockwise connector | Counter-clock-wise wiring | PUR<br>PUR cable | From 1.5 m (code: 015)<br>to 20 m (code: 200) |  |
| CABLE-M23 | CKW | PUR | 015 | |

# 4 Electrical interfaces

**Warning!**

**Faulty electrical connection or improper function selection may result in serious injury!**

Only allow qualified persons (see section 2.2) to perform the electrical connection.

Make certain that the safety sensor is protected against overcurrent.

Select the functions so that the safety sensor can be used as intended (see section 2.1).


**SELV/PELV**

NOTE

Acc. to EN 60204-1, the external power supply must demonstrate the ability to bridge short-term mains failures of up to 20 ms. The power supply unit must ensure safe mains separation (SELV/PELV) and a current reserve of at least 2 A.

**Laying cables**

Lay all connection cables and signal lines within the electrical installation space or permanently in cable ducts.

Lay the cables and lines so that they are protected against external damages.

For further information: see EN ISO 13849-2, Table D.4.

**Device connection**

Use shielded cables for device connection.

## 4.1 Power supply

| | **HTL Encoders** |
|---|---|
| **Supply voltage +V** | 11 V to 30 V DC |
| **Ripples** | 250 mV |
| **Consumption without load** | 100 mA max. |
| **Consumption with load** | 220 mA max. |
| **Output current** | 40 mA max by pair. |
| **Min max load:** | at 30 V: 750 ohms – 3 kohms<br>at 24 V: 600 ohms – 3 kohms<br>at 11 V: 275 ohms – 3 kohms |
| **Supply type** | Power supply according to SELV/PELV with a maximum 60 V DC fault. |

## 4.2 Electrical protections

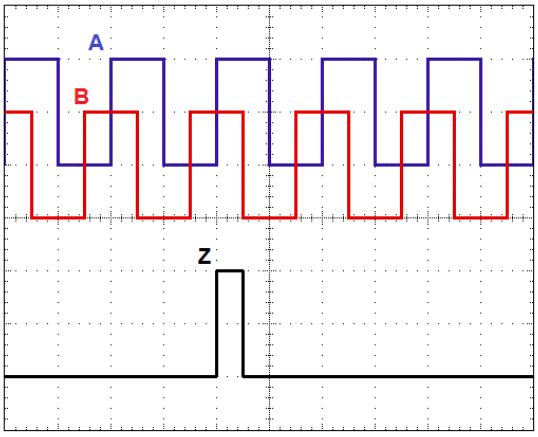
| | |
|---|---|
| **Polarity inversions** | Yes |
| **Short circuits** | 0 V = yes<br>+V = no<br>To other signals = yes |
| **Overvoltage** | Exceeding the nominal supply voltage range may definitely damage the encoder (stay in safe mode up to 60 V in both cases) |
| **Surges/transients** | Yes |

For further details on electrical immunity, refer to section 13.3.4.

## 4.3 Output signals

**The safety encoder's digital signal:**

- A first safety channel named "channel 1" composed of a signal A and a signal inverted A/,
- A second safety channel named "channel 2" composed of a signal B and a signal inverted B/,
- A third channel not for safety named "channel 0" composed of a signal index Z and a signal inverted Z/.




**Response time:** 4 µs typical

**Initialization time:** Refer to section 5.1 .

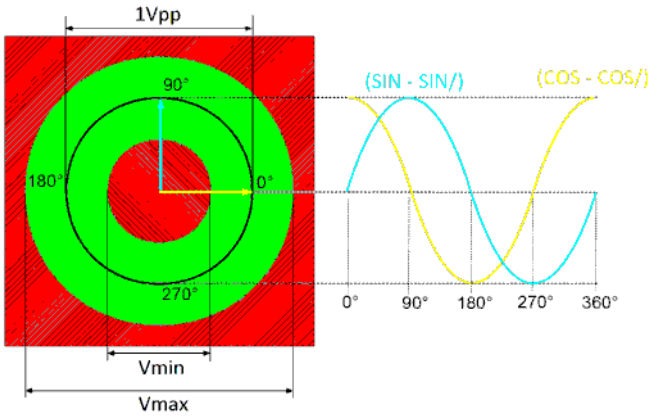
Output signal specifications (typical data, not relevant for safety purpose):

| | |
|---|---|
| **Phasing tolerance** | 90° ±10° |
| **Output Signal Frequency** | 300 kHz max. depending on cable length. Refer to section 7 for further details. |
| **Duty Cycle** | 50% ±5% |
| **Jitter** | <2% |

**Safety monitoring tolerance**

Digital signals are computed from sine/cosine signals (1 Vpp) which are internally monitored in Lissajous diagram by a permissible area defined between two circles of amplitude:

Vmin=0.5 V  Vmax=1.3 V




## 4.4 Recommended safety system

Refer to section 5.2 on the present manual for the external monitoring needed.

Refer to section 4.1 on the present manual for the power supply requirements.

# 5 Functional safety

## 5.1 Safety Encoder function / Safe state

### Safety function

The safety function ensured by the device is to convert a mechanical rotation into safe electrical information readable by electronics.

If a fault is detected, the internal monitoring of the encoder switches all the outputs to the safe state.

Due to the monitoring tolerances in the diagnosis of the sine/cosine wave signals, there is an uncertainty angle in the safety function. This uncertainty angle is less than one quarter of the period of the encoder resolution.

### Safe state

One or more of the outputs in high-impedance, with or without power supply.

High-impedance output leakage current: ±10 µA.

In case of error, the internal monitoring is able to switch off the outputs in less than 200 ms.

### Initialization time

After a power-up, the initialization time for outputs signal activation is around 30 ms, and around 250 ms (560 ms maximum) for internal monitoring activation.

**Warning!**

During the initialization time, the output signals are not under internal monitoring. The external monitoring needs to be deactivated during that unsafe initialization time, which does not exceed 560 ms.


**Reset**

When a fault is detected, the following procedure must be followed:

- Analyze the reason of the fault.
- If a parameter did not exceed its absolute maximum rating, fault may be reset by switching off and switching on the device again.

**Warning!**

In case an environmental parameter exceeds its absolute maximum rating, or if the fault recurs without concrete and clearly identified reason, the use of the unit may result in a potentially hazardous situation. Replace encoder immediately.

## 5.2 Prerequisites for safe system loop

In **speed monitoring applications not using the direction feature**, the channels 1 and 2 can be considered as redundant, which may result in a different category according to EN ISO 13849.

In **position monitoring applications** or in **speed applications using the direction feature**, the requirements for diagnostic are increased because the channels 1 and 2 cannot be considered as redundant.

According to these statements and depending on the intended level of the safety loop, there are prerequisites to external safety loop, e.g. safety controller

| External safety loop prerequisites | | | | | |
|---|---|---|---|---|---|
| Electronics & signals | Positive lock | Cable break detection | Speed comparison | Inverse signal monitoring | Exclusive bit check |
| HTL | + | + | ++ | ++ | +++ |

+: Prerequisite for all safety levels.

++: Additional prerequisite for SIL3/PLe.

+++ Needed for SIL3/PLe in case of speed with direction, direction or position. (Not needed in case of speed without direction.)

### Detailed external safety loop prerequisites description

**Positive lock:**

The positive lock (or fault exclusion for mechanic connections) means that the encoder shaft must be safely and firmly coupled with the driving shaft, to avoid any uncontrolled sliding.

The mechanical precautions and mounting procedure must be followed to prevent accidental encoder rotation/dismantle caused by a stator coupling, tether arm or flange adapter (synchro flange) failure.

**Cable break detection:**

Cable break detection is essential because all internally detected faults within the encoder as well as any loss of connection to the encoder have to be detected on the external safety loop (e.g. safety controller) by this method.

High impedance in one or more of the inputs from encoder to the safety PLC means a dangerous fault.

**Speed comparison**

Speed comparison means that channel 1 (A or A/) and channel 2 (B or B/) are considered as to be redundant and shall have the same frequency within a tolerance.

**Inverse signal monitoring**

In each safety digital channel, the non-inverted (A and B) and inverted (A/ and B/) signals must at all times, have an opposite signal level.

During the transition state, a very short period of a few microseconds showing the same signal level is allowed.

**Exclusive bit check**

The code formed by the safety digital signal A (from channel 1) and B (from channel 2) is comparable to a 2 bits Gray code: at any time, there is only one bit changing.

In case of a simultaneous bit changing, it must be considered as a dangerous fault. The same is true for the 2 bits code formed by the inverted ones A/ and B/.

This diagnostic method is required for **positioning applications** and for **speed applications with direction**.

## Additional precautions for safe system loop

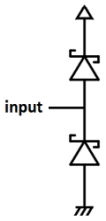
### Output voltage levels

Insure that the PLC is compatible with the Low Level and High Level of the output encoder signal mentioned in the table below:

| Vmax | Low Level signal (20 mA) | | | High Level signal (20 mA) | | |
|---|---|---|---|---|---|---|
| **(power supply)** | Min. | **Typ.** | Max. | Min. | **Typ.** | Max. |
| **11 V to 30 V** | 0 V | **0.5 V** | 2.5 V | Vmax – 3 V | **Vmax – 0.5 V** | Vmax |

### User inputs protection

A dual power Schottky diodes combination is recommended at each user inputs in order to clamp the signal to 0 V – 11/30 V range.




**Attention!**

The shaft direction can be deduced by the 90° phase between channel 1 and channel 2.

The use of this feature adds requirements. See "External safety loop prerequisites" table above.

ATTENTION

**Attention!**

The encoder may deliver an index signal, one time per revolution.

The index channel (Z, Z/) does not provide a safety signal.

ATTENTION

## 5.3 Safety related figures

| Safety incremental encoders | PFDavg | PFH | MTTFd | DCavg | Mission Time | SIL | PL |
|---|---|---|---|---|---|---|---|
| Speed sensing applications (partly redundant) at 40°C | 7.63E-05 | 8.72E-10 | 1180 | 97.02% | 20 years | SIL3 | PLe |
| Speed sensing applications (partly redundant) at 80°C | 3.46E-04 | 3.95E-09 | 258 | 96.88% | | | |
| Positioning applications (single-channel) at 40°C | 9.52E-05 | 1.09E-09 | 1050 | 99.00% | | | |
| Positioning applications (single-channel) at 80°C | 4.38E-04 | 5.00E-09 | 228 | 99.00% | | | |

## 5.4 Examples of safety functions

In order to achieve one or more safety functions in a system, a safe drive or PLC needs a Safe Encoder as a safe speed sensor and/or as a safe relative position sensor and/or as a safe direction sensor.

The combination of a safe encoder from Wieland Electric with an appropriate safety controller, drive or PLC permit to achieve the following functions amongst others (up to SIL3 / PLe / Cat. 4):

| **Safety function** | **Description (purpose of the encoder in the particular safety function)** |
|---|---|
| **SLS (Safely-Limited Speed)** | Speed monitoring with upper limit |
| **SSM (Safe Speed Monitor)** | Speed monitoring with lower limit |
| **SSR (Safe Speed Range)** | Speed monitoring with upper and lower limit (range) |
| **SLA (Safely-Limited Acceleration)** | Acceleration monitoring with upper limit |
| **SAR (Safe Acceleration Range)** | Acceleration monitoring with upper and lower limit (range) |
| **SDI (Safe Direction)** | The phase between channels 1 and 2 is monitored for direction monitoring. |
| **SS1 (Safe Stop 1)** | Monitoring/controlling of the brake ramp by speed monitoring. Drive has no power (torque) after stop. |
| **SS2 (Safe Stop 2)** | Monitoring/controlling of the brake ramp by speed monitoring. Drive has still power (torque) after stop. |
| **SOS (Safe Operating Stop)** | Standstill monitoring after brake ramp and stop |
| **SLP (Safely-Limited Position)** | Position monitoring with a limit value |
| **SEL (Safe Emergency Limit)** | Position limit value is monitored. |
| **SLI (Safely-Limited Increment)** | Position increment monitoring with a limit value |
| **SCA (Safe Cam)** | Position monitoring with one or more value ranges |

**Attention!**

**Safe stop applications**

With a digital encoder version, there is a small angle rotation which does not generate change on A A/ or B B/. The amplitude of this angle is equal to a quarter period of safety signal.

The user has to check that the requirements for the safety stop are still fulfilled with this small angle uncertainty.

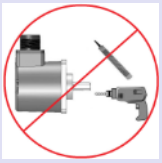
# 6 Mechanical mounting

**Warning!**

**Risk of injuries, personal damage and damage of the encoder!**

WARNING

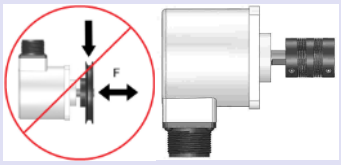
No shocks nor important stresses.



Do not use tools.

Avoid installing with shaft upright, liquid may pool and eventually cause internal leaking.

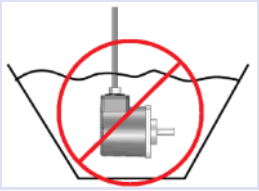
Do not drop.




Do not hard couple encoder to driving shaft. Instead use flexible couplings to minimize stress on encoder bearings.

Do not dismantle nor repair.

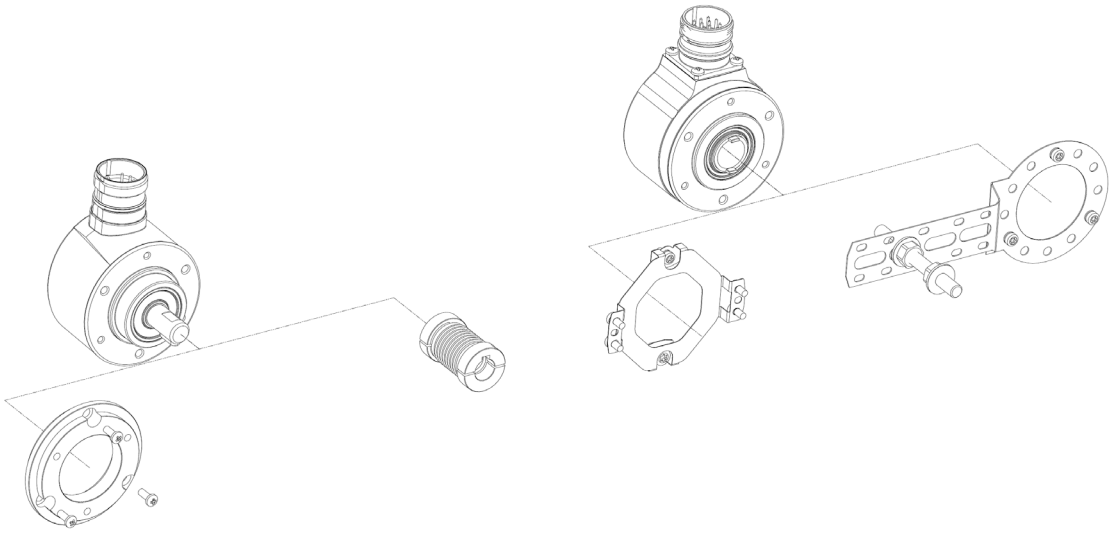
Do not carry the encoder by the cable.



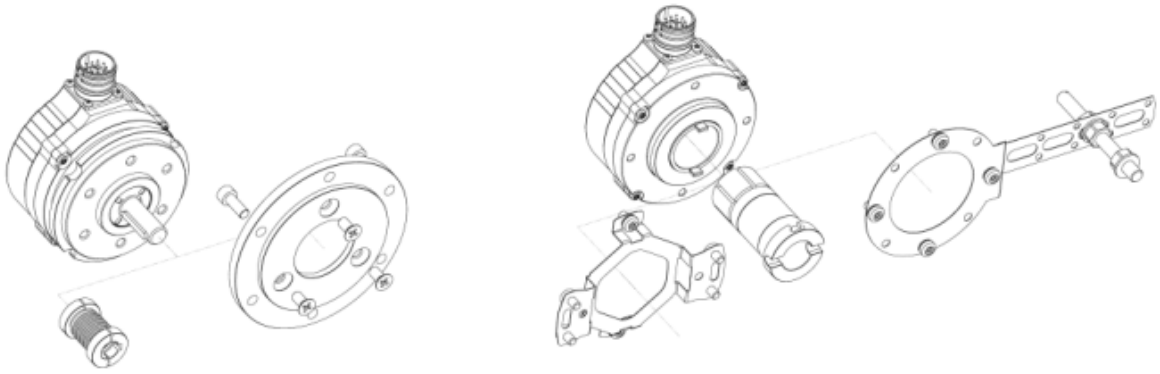
Do not dip encoder into water, check encoder's IP code.

## 6.1 Mounting options

### Size 58 mm



### Size 90 mm

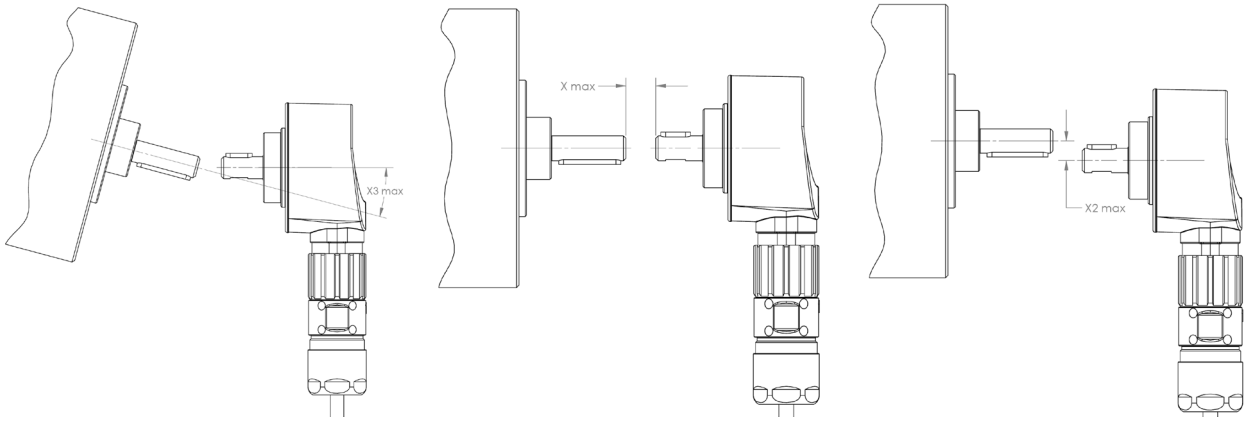


## 6.2 Mechanical mounting procedure

### 6.2.1 Mounting SENC-58S and SENC-90S with solid shaft

**1. Coupling**

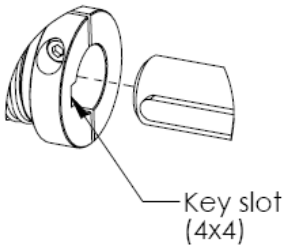
Before mounting, check the shaft runout and alignment. These parameters must be in accordance with coupling's specifications.




Lateral misalignment has a negative effect on the service life of the couplings. Exact alignment of the coupling considerably increases the service life of the encoder. By reducing or eliminating lateral misalignment, the radial load on the adjacent bearing is reduced while increasing service life and reducing heat generation (see section 13.2). It is important to remain within the coupling technical specifications to operate within the permissible values for the three types of misalignment limits. This ensures long life and proper operation of the coupling.

Encoder shafts are machined with a key slot. Use a keyed coupling to secure the rotation transmission.

Coupling dimensions and tolerances must comply with the shaft dimensions and tolerances given in the encoder's datasheet. It is recommended to use diameter XXmm H7 and Ra 0.4-1.6.




**2. Instructions for connectors:**

**Attention!**

Do not mount deformed or damaged connectors.

Check if the O-ring is in place into the connector housing. If a deformation of the connector is detected, do not try to plug it in.

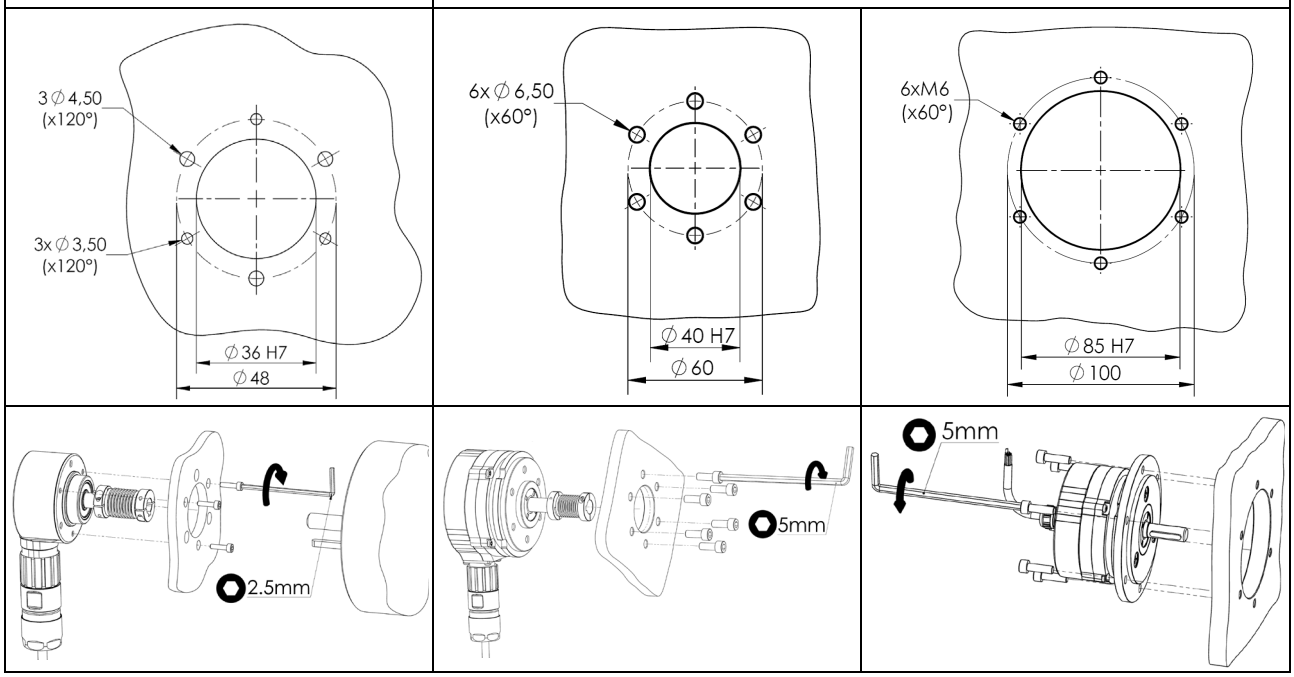
In this case, the IP rating is no longer insured and the electrical connection can be affected.

ATTENTION

Screw entirely the mating connector to ensure good electrical and mechanical contact and avoid loosening of the connection over time.

**3. Mount encoder on a mechanical frame (bell, bracket etc.).**

| SENC-58S – hole pattern | SENC-90S-12mm with hole pattern | SENC-90S-11mm with tachoflange – hole pattern |
|---|---|---|
| Use at least three M3 or three M4 screws for a safe assembly. Minimal screwing depth 5 mm for M3 and 6 mm for M4 | Use at least three M6 screws for a safe assembly. Minimal screw depth is 10 mm. | |




For a safe mounting secure the screws with appropriate washers and Threadlocker Loctite 243 or equivalent.

If possible, prefer orienting the cable or connector downwards.

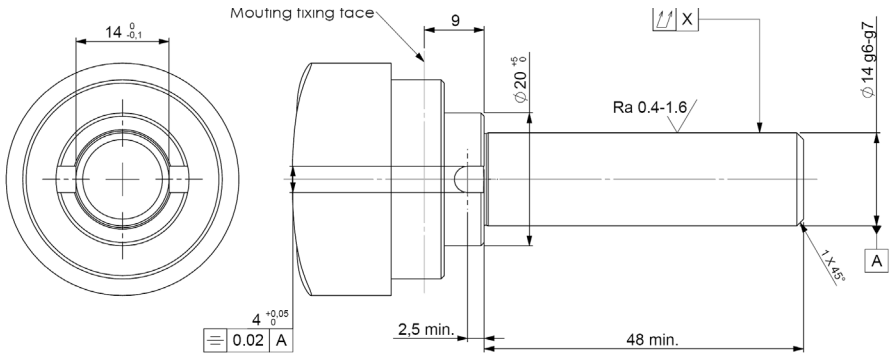
**Caution:** For mounting a gear, wheel or pulley refer to section 3.2.1.

## 6.2.2 Mounting SENC-58H and SENC-90H with hollow shaft

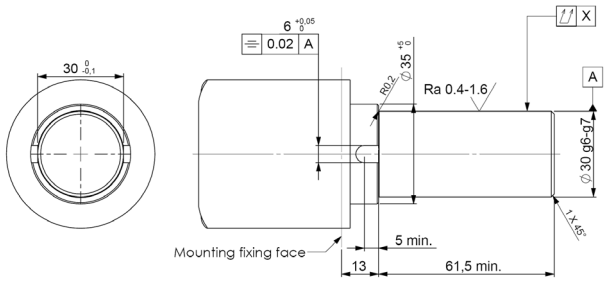
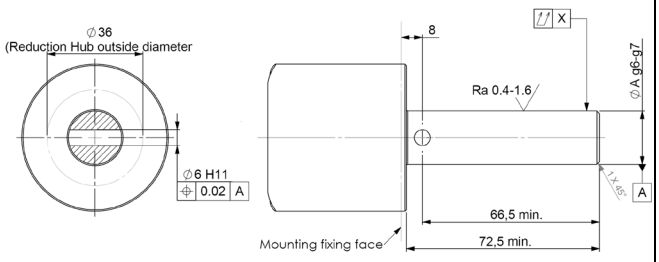
**1. Coupling**

Check the driving shaft runout and tolerance: diameter X H7.

**Shaft dimensions – SENC-58H**

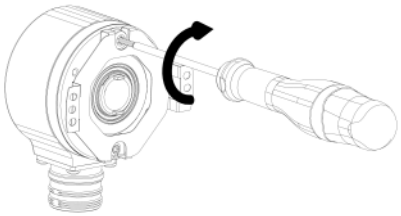
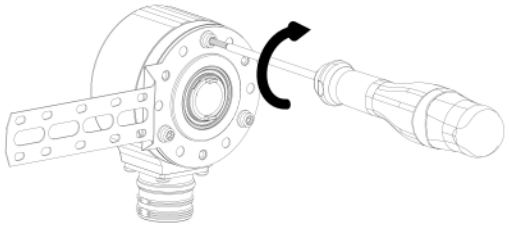
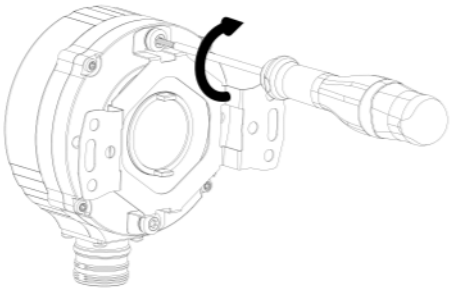
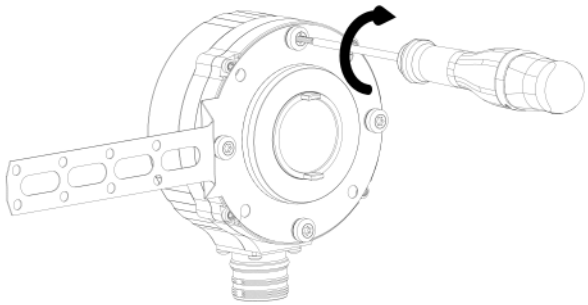



| Speed (RPM) | Permissible Runout (X) |
|---|---|
| < 100 | 0.2 |
| < 1500 | 0.05 |
| < 4000 | 0.02 |

| Shaft dimensions without SRS sleeve – SENC-90H | Shaft dimensions with SRS sleeve – SENC-90H |
|---|---|
|  |  <br>Shaft diameter: A = 20 mm, 25 mm |

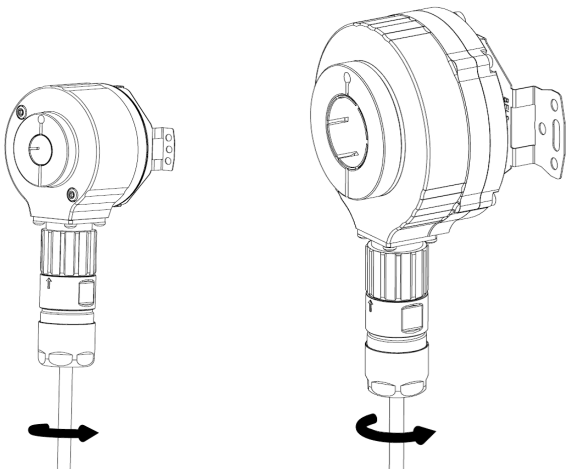
### 2. Mount the coupling on the encoder

Secure the screws with the ribbed lock washers and Threadlocker Loctite 243 or equivalent

| | With stator coupling | With tether arm |
|---|---|---|
| SENC-58H |  |  |
| SENC-90H |  |  |

| Recommended tightening torques: | M3 | M4 | M5 |
|---|---|---|---|
| | 2 Nm | 2.5 Nm | 4.5 Nm |

### 3. Instructions for connectors



**Attention!**

Do not mount deformed or damaged connectors.

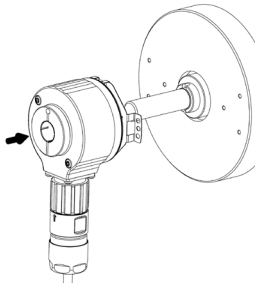
Check if the O-ring is in place into the connector housing. If a deformation of the connector is detected, do not try to plug it in.

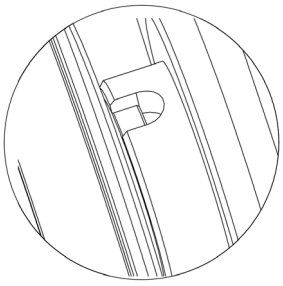
In this case, the IP rating is no longer insured and the electrical connection can be affected.

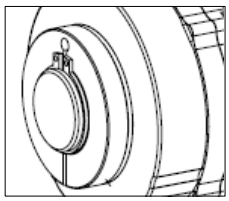
ATTENTION

Screw entirely the mating connector to ensure good electrical and mechanical contact and avoid loosening of the connection over time.

**4. Slide the encoder on the shaft.**





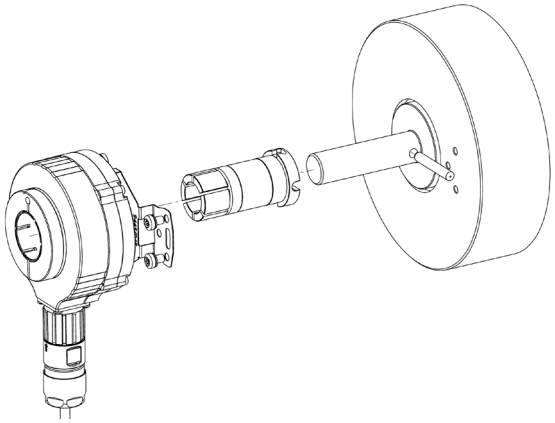


Check that the positive locks are in the correct position for proper engagement.

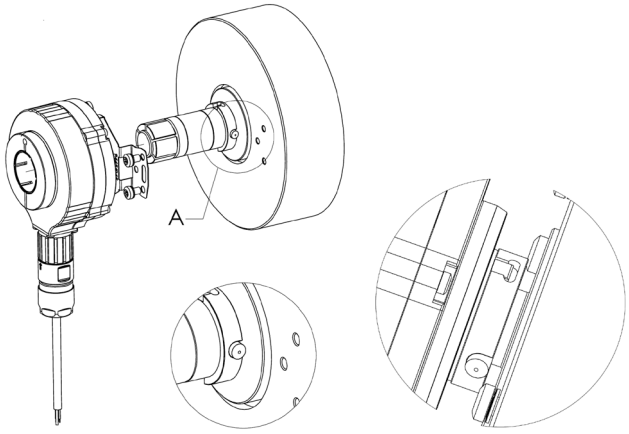
Secure the encoder in axial translation by an appropriate mechanical stop (retaining ring, nut, pins…) on the driving shaft.

**5. Mount reduction sleeves (optional):**

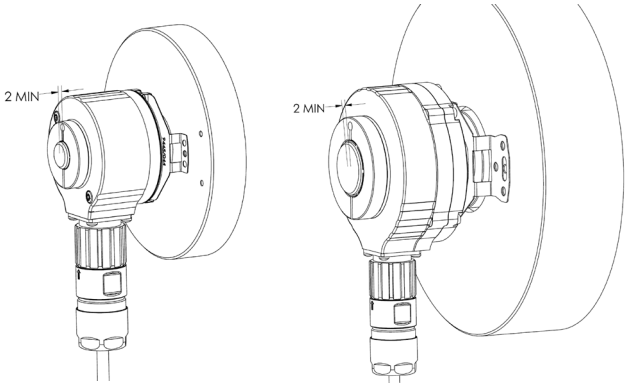
1. To secure the connection between the driving shaft and the encoder, mount a 6 mm pin centered in the shaft (length: 30 mm min. and 40 mm max.). Pin must be secured by press fit mounting or glue.



2. Put the reduction sleeve on the shaft. Be sure that the pin fits in the reduction sleeve slot.

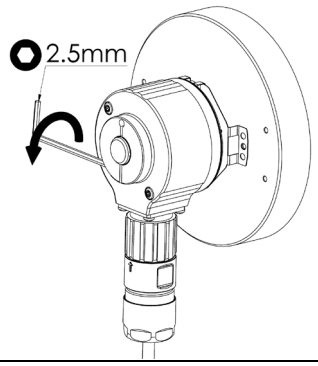
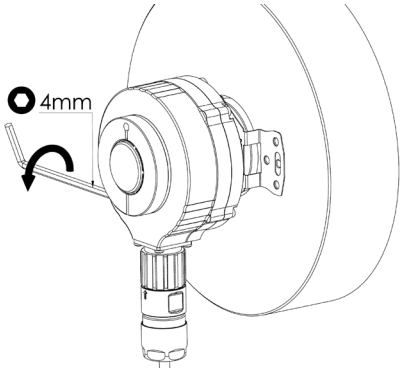



**6. Clamp the encoder.**



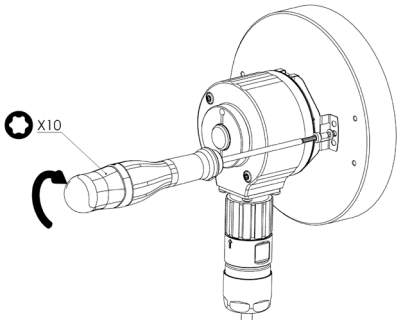
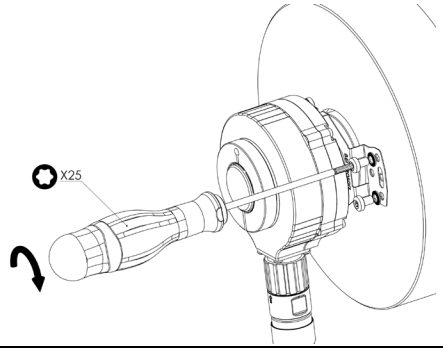
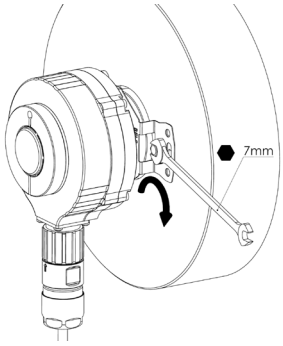

For safe clamping verify the driving shaft extends at least 2 mm out of the encoder. Check the position of the stator coupling. Avoid compressing or extending it to insure a minimal load on the bearing block.

**7. Tighten the clamping ring to the recommended torque.**

| SENC-58H: 2 Nm ±10% | SENC-90H: 4.5 Nm ±10% |
|---|---|
|  |  |

**8. Fasten the encoder on the frame.**

**Option 1: Stator coupling**

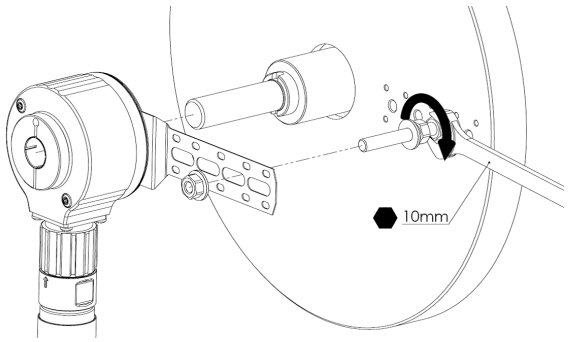
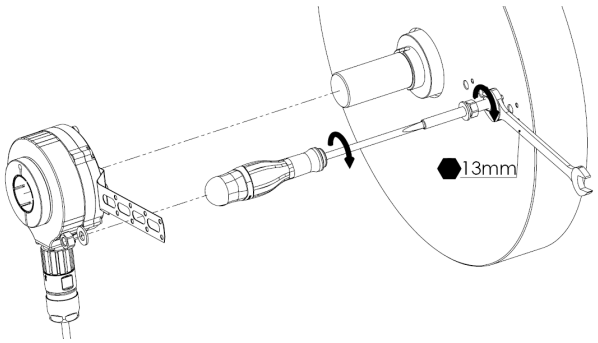
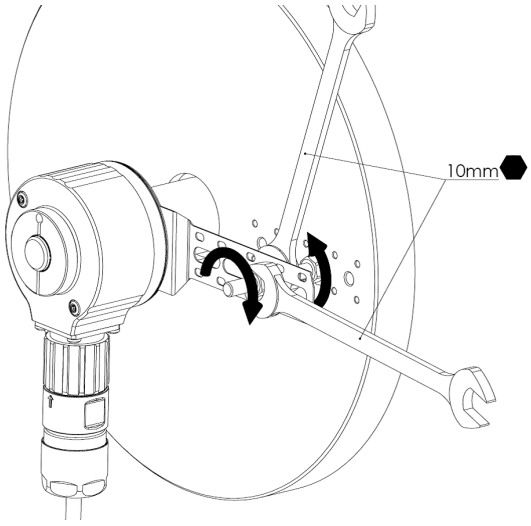
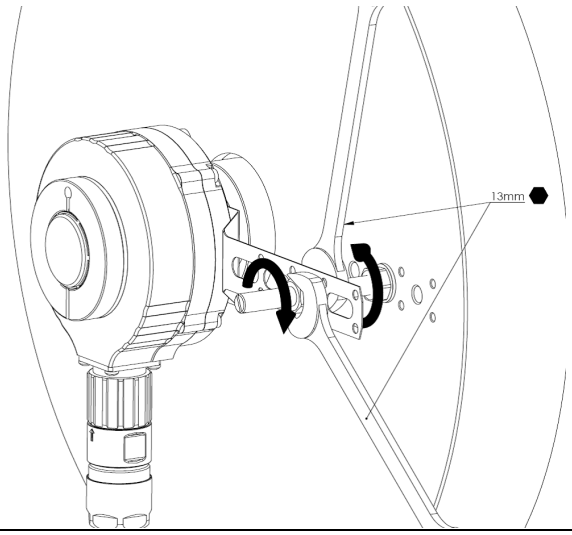
| SENC-58H | SENC-90H | |
|---|---|---|
| Tighten the M3 screws at 2 Nm with the ribbed lock washers. | Tighten the M5 screws at 4.5 Nm with the ribbed lock washers. | |
| Mounted by 2 or 4 screws on diameter 64 mm | Mounted by 4 screws on diameter 100 mm | Mounted by 2 Hexagonal screws on diameter 78 mm |
|  |  |  |

(All fasteners are available in the set.)

**Option 2: Tether arm**

Tighten the threaded rod into the frame.

Screw the nuts with the washers on the tether arm. The mounting must be done without deforming the coupling devices.

| SENC-58H | SENC-90H |
| --- | --- |
|  |  |
|  |  |

If possible, prefer orienting the cable or connector downwards.

If the encoder's shaft is orientated vertically, it is recommended to use a protective cap to avoid liquid retention in seals areas.

# 7 Electrical installation

## General information

General parameters given in the datasheet or in this manual (electrical and environmental) may never be exceeded.

Respect the standard recommendations governing the use of cables and other connection devices in industrial applications, including all the recommendations listed in this table.

## Mechanical precautions

Bending radius

| **Cable type** (refer to 3.1 for range presentation) | **Jacket material** | **Smallest bending radius (static use)** | **Smallest bending radius (dynamic use)** |
|---|---|---|---|
| PUR | Polyurethane | 30 mm | 90 mm |

Protect the cables to avoid a cut or damage during operation, otherwise protection degree could be compromised.

Do not pull cable during mounting and operation.

Avoid loads generated on the encoder by eventual cable tension. Always oversize a little the cable length between encoder and the first cable clamp.

## Electrical precautions

**Warning!**

Never connect the encoder to mains (115 V, 220 V…)!

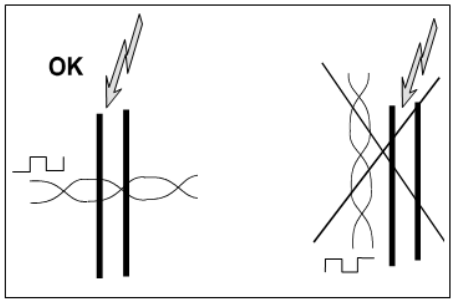

Never operate with a cable which is totally or partially rolled. It could lead to EMC disturbances or irreversible electrical damage on the installation.

Never connect outputs together.

Never connect outputs to a potential.

Never use the same cable for driving power and encoder signals: separate output data signal cables (low voltage) and potentially interfering signal cables (higher voltage, such as power supply, frequency inverter, servo drive, etc.) with a grounded metal screen.

Do not let power and signal cables run parallel – Cross them perpendicularly.



**Power supply wires cross section**

A small conductor cross-section can cause power supply voltage drop on the cable, on 0 V and +V wires.

Original Wieland cable-connectors assemblies are recommended. If using another cable type, contact customer service for more information.

Ensure that cable impedance is compatible with the encoder:

**Max. impedance:** 100 ohms/km

**Signal wires cross section**

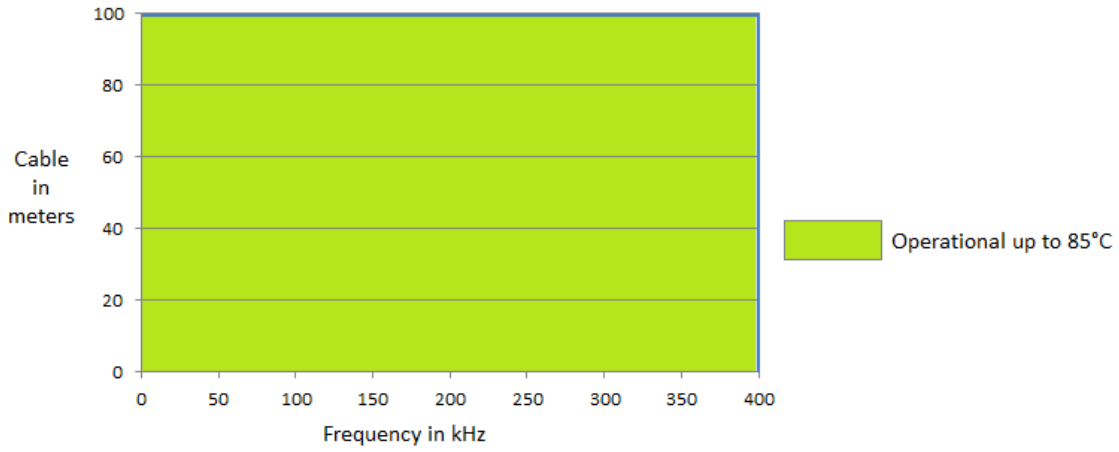
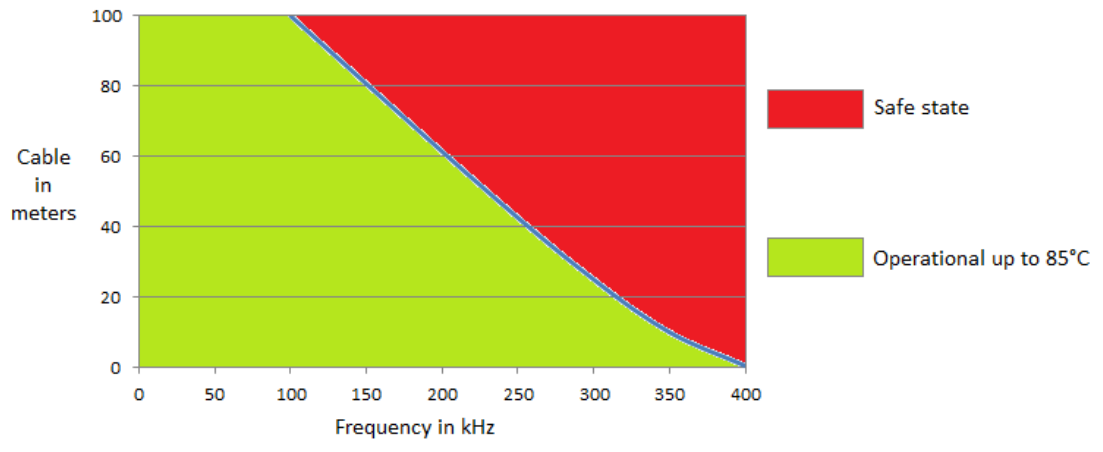
A section of 0.14 mm² up to 0.22 mm² is recommended in order to avoid heavy capacitance between signals causing coupling.

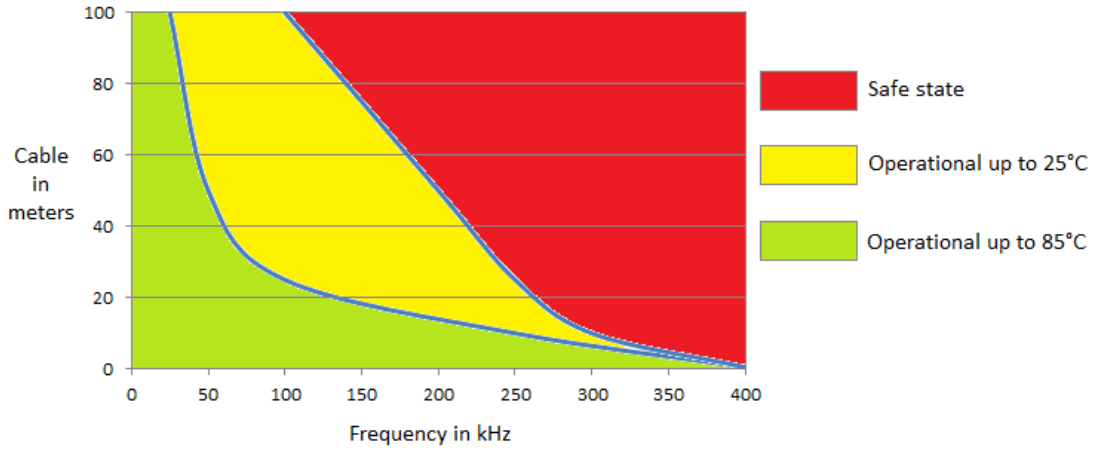
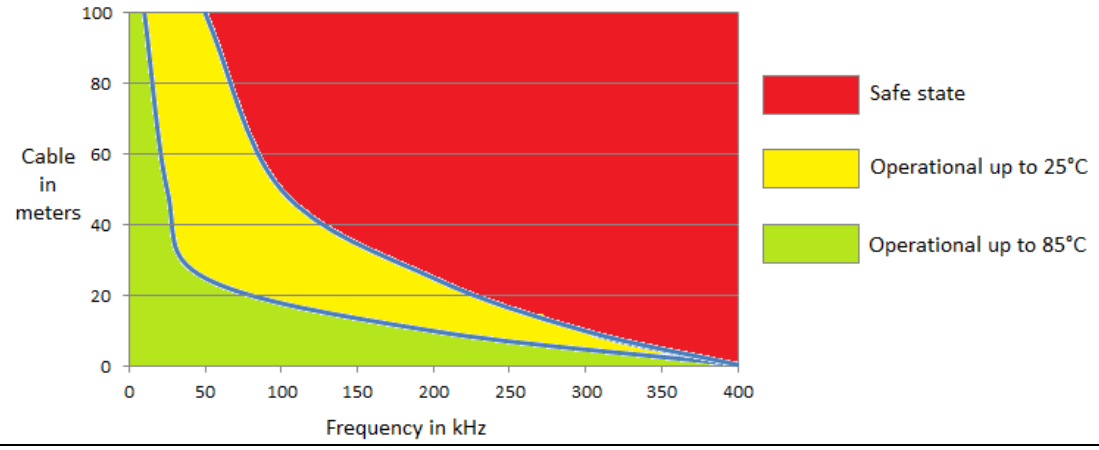
| | |
|---|---|
| **Max. impedance** | 150 ohms/km |
| **Max. capacitance between wires** | 100 pF/m |
| **Max. capacitance wires to shield** | 150 pF/m |

Check that the electrical input interface of evaluation electronics is compliant with the external loads required in section 4.

Check that the required external monitoring is available on the evaluation electronics (Safety Controller, PLC or drive).

Check that cable length is adapted to your application in terms of max. frequency and electrical interface:

| **Elec-tronics** | **Electrical operating area** (for Wieland cables) |
|---|---|
| |  |
| **11 V (HTL)** |  |

| Elec-tronics | **Electrical operating area** (for Wieland cables) |
|---|---|
| **24 V (HTL)** |  |
| **30 V (HTL)** |  |

## Wiring and installation precautions

**Warning!**

The safety encoder function requires that the four safety signals (AA/ and BB/) are connected to the safe PLC. Never leave one of these signals unused! They must always be connected and used in the safety loop.

WARNING

**Attention!**

The index channel 0 (Z and Z/) is not a part of the safety function! However, they can be used as standard signals.

In case Z and Z/ are not used in the application, connect each of them to pull down 3 kohms resistors connected to 0 V.

ATTENTION

### Pin and color assignment

Pin assignment and color codes for the cable-connector assembly can be seen in the table below.

NC = "Not connected". Pins/wires are not used or connected.

| **PIN** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Color code** | PK | BU | RD | BK | BN | GN | NC | GY | NC | WH | WHGN | GNBN |
| **Color** | Pink | Blue | Red | Black | Brown | Green | NC | Gray | NC | White | White-Green | Green-Brown |
| **Signal** | A/ | +V | Z (0) | Z/ (0/) | B | B/ | NC | A | NC | 0 V | 0 V | +V |

**Shield connection**

Ensure that encoder's housing and cable shield extremity are both connected to the same potential grounds.

Do not cut nor leave the ground wire unconnected.

In the cabinet, connect the encoder cable shielding screen to the ground if available, otherwise to the 0 V (signal common).

To avoid destructive electrostatic discharging shaft phenomena, always ground the encoder housing.

If a metallic connector is assembled by the user on the encoder cable, ensure a 360° contact on that connector.

When using a shielded pair cable, always connect signals of the same channel to the same twisted pair: A with A/, B with B/ and Z with Z/.

# 8 Packaging, storage and transport

## 8.1 Box content

Each encoder is delivered in an individual package. Identification of the box is ensured by a label. Each box contains:

- 1 Encoder
- 1 Quick Installation Manual

Accessories should be ordered and therefore may be delivered in a separate package. Datasheet can be downloaded online from the Wieland eShop on www.wieland-electric.com.

## 8.2 Storage conditions

Take into account ambient conditions which are listed in the encoder's datasheets.

Storage in original package is recommended. Prevent device from dust, humidity and dirty environments.

The connectors are protected by a cap. Remove the cap just before connecting the mating connector in order to avoid any dust or liquid in contact with the connection pins. The IP protection of the encoder is only applicable when it is correctly connected.

## 8.3 General cautions for transport

Encoders must always be transported in their original packaging. The package content must be maintained in its original position in the box. Do not remove shaft, coupling or connector protections during transport.

Prevent package from shocks and falls.

**Attention!**

If an external damage is detected on the box when it is received, inspect encoder attentively 'before mounting (connector, shaft, stator coupling…). Damage due to transport may lead to dangerous fault. In case of doubt, the unit must be replaced.

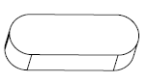
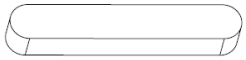

# 9 Maintenance and spare parts

## 9.1 Maintenance

No specific maintenance is required during the encoder's life time. In case of any unexpected product behavior, contact Wieland Electric for analysis.

## 9.2 Spare parts

Available spare parts are mainly listed in section 3.3. In addition, the following products can be ordered:

| Picture | Accessory | Order no. |
|---|---|---|
|  | Key for SENC-58S models | KEY-SHAFT-58S-S-04-10 |
|  | Key for SENC-90S models | KEY-SHAFT-90S-S-04-25 |

# 10 Disposal

Devices are constituted of various materials which can be recycled. Discard products according to local recommendations and regulations.

# 11 Service and support

Service hotline:

+49 (0) 951 9324-999

E-mail: safety@wieland-electric.com

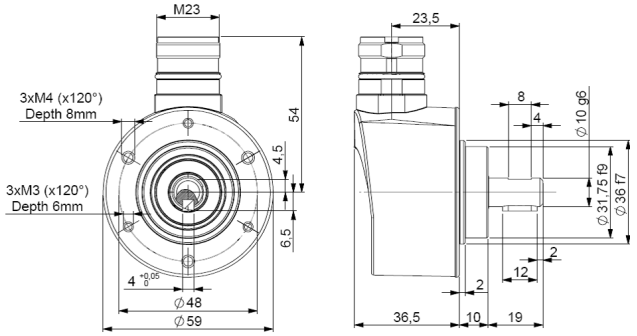
Wieland Electric GmbH
Brennerstraße 10–14
D-96052 Bamberg
Tel. +49 (0) 951 / 9324-0
Fax +49 (0) 951 / 9324-128

E-mail info@wieland-electric.com
http://eshop.wieland-electric.com
http://www.wieland-electric.com

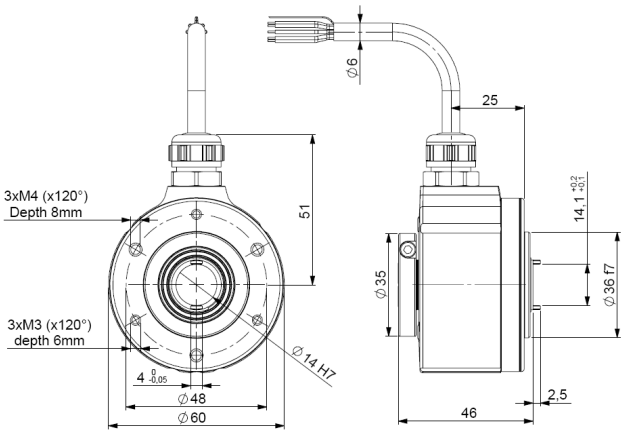
# 12 Technical data

## 12.1 Dimensions

### Size: 58 mm

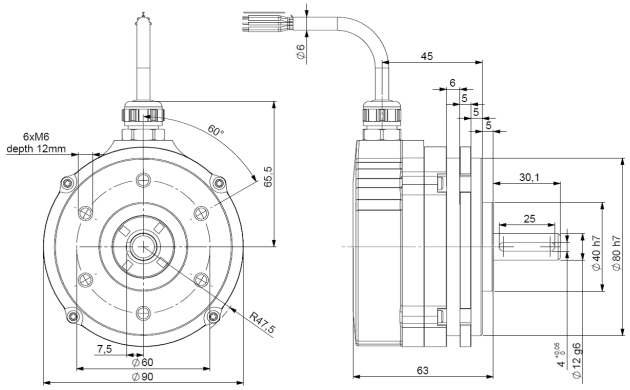



Solid shaft (SENC-58S)

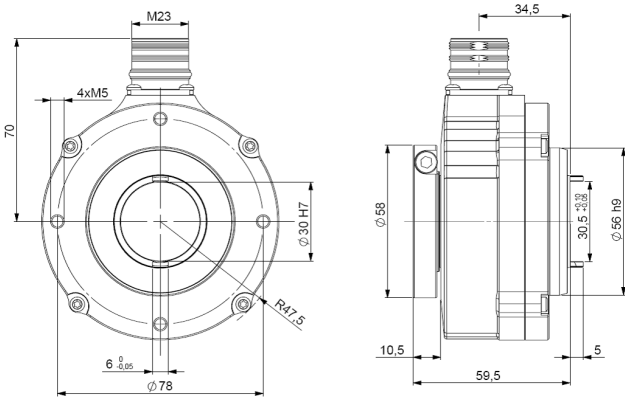



Hollow shaft (SENC-58H)

### Size: 90 mm



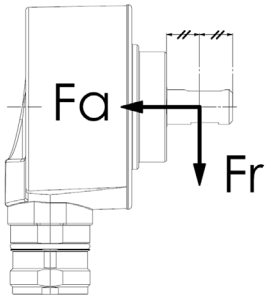
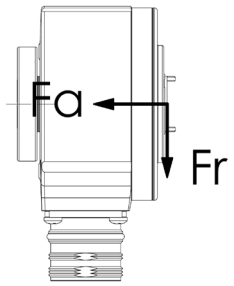
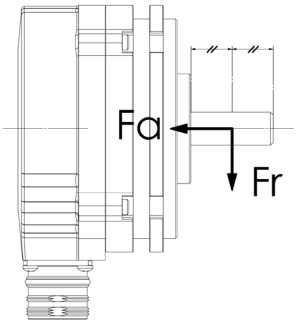
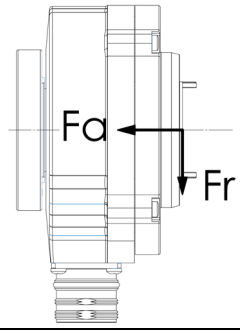

Solid shaft (SENC-90S)




Hollow shaft (SENC-90H)

Mechanical detailed outline drawings are available in Wieland eShop on www.wieland-electric.com.

## 12.2 Bearing lifetimes

| Model | Axial/radial load (N) (Fa/Fr) | Continuous speed (rpm) | Lifetime, L10h* (hours) | Scheme |
|---|---|---|---|---|
| SENC-58S | 40 / 80<br>20 / 40 | 6 000 | 36 392<br>82 365 |  |
| SENC-58H | 20 / 40<br>10 / 20 | 4 000 | >100 000<br>>100 000 |  |
| SENC-90S | 100 / 200<br>50 / 100 | 6 000 | 9 104<br>20 147 |  |
| SENC-90H | 25 / 50<br>12.5 / 25 | 3 000 | > 100 000<br>> 100 000 |  |

* According to ISO 281: 1990, L10

Values are calculated based on the complete temperature range of the encoders.

## 12.3 Environmental specifications

### 12.3.1 Ingress protection (IP)

Refer to the Datasheets for the IP rating for each product in the Wieland eShop on www.wieland-electric.com.

### 12.3.2 Operating temperatures

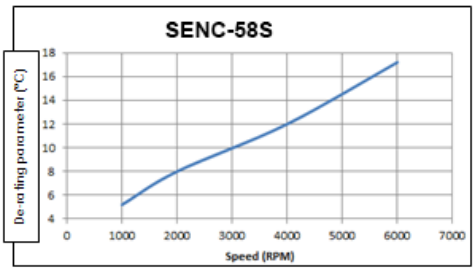
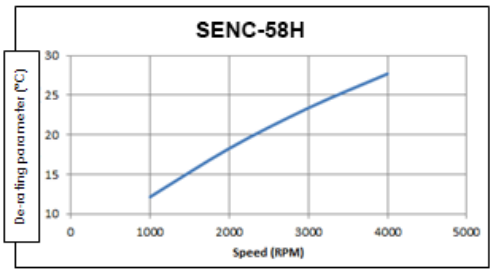
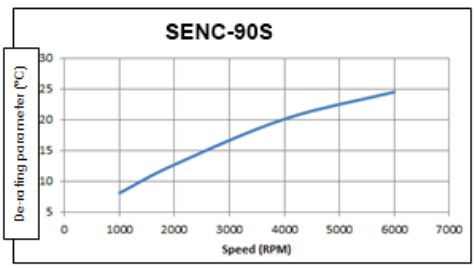
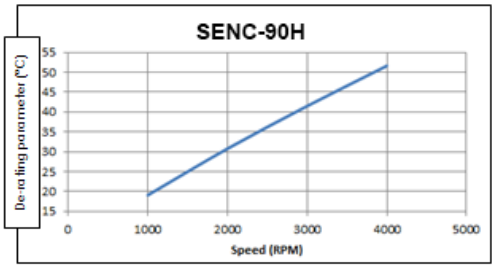
Working temperature range for all encoders is from **-20 °C to +85 °C**. This temperature range corresponds to the housing surface temperature. The de-rating parameters listed below must be taken into account when estimating the maximum permissible ambient temperature range in the application.

**Attention!**

Operating admissible ambient temperature is dependent on the parameters listed in the table below.


**Attention!**

Overheating of the encoder could cause irreversible mechanical damage leading to a potential loss of seal. Any encoder which has been subjected to temperatures outside its rated specifications loses its safety rating.


| De-rating parameters | Value |
|---|---|
| **Power supply*** | Typically, the more the power supply is, the more the power dissipation of the input stage will be. |
| **Electrical loads*** | The lower the output load is, the more the warming will be. However, never exceed the highest value of output load given in the documentation. |
| **Mechanical loads*** | Mechanical heating is influenced by the load on the bearing block. |
| **Application power dissipation*** | The encoder's surface temperature is dependent on the configuration of the area around the device: heat transmission with other parts (frame, shaft, radiator…), to the air (air flow)/liquid/dust. |
| **Encoder speed** | The temperature given on the following charts is to add to the ambient temperature. It must never exceed the maximum T °C given in the datasheet.         These temperature elevations are typical values which should be considered as indications only. |

* For further information on de-rating parameters, please contact the technical support (see section 11).

### 12.3.3 Chemical protection

All housings have been submitted to salt spray test – EN 60068-2-11 / Part 2, Test type Ka – according to their respective data sheet.

Aluminum covers are protected by an epoxy powder coating.

All shafts are AISI 303 stainless steel.

Connectors are in nickel-plated brass or stainless steel.

Rotary seals and O-rings are in Nitrile. Detailed specifications are available on request.

Jacket material is available as PUR. Environmental specifications are available on request.

### 12.3.4 EMC

The complete encoder range is compliant with the EMC:

#### Emissions

According to general standard **EN 61000-6-4**

| **Phenomenon** | **Basic standard** | **Level** |
|---|---|---|
| Radiated emission | EN 5016-2-3 | Test from 30 MHz to 1 GHz,<br>3 m distant antenna |

#### Immunity

According to general standard **EN 61000-6-2**

The increased levels are in accordance with the IEC 62061 (2005).

| **Port** | **Phenomenon** | **Basic standard** | **Increased value for additional tests for SRECS performance** |
|---|---|---|---|
| Enclosure | Electrostatic discharge (ESD) | IEC 61000-4-2 | 6 kV/ 8 kV contact/air discharge |
| | Electromagnetic (EM) field | IEC 61000-4-3 | 20 V/m (80 MHz – 1 GHz)<br>6 V/m (1.4 GHz – 2 GHz)<br>3 V/m (2 GHz – 2.7 GHz) |
| | Rated power frequency magnetic field | IEC 61000-4-8 | 30 A/m |
| VDC Power | Burst | IEC 61000-4-4 | 4 kV |
| | Surge | IEC 61000-4-5 | 1 kV line-to-line<br>4 kV line-to-ground |
| | Conducted RF | IEC 61000-4-6 | 10 V at frequencies given |
| I/O signals / Control lines | Burst | IEC 61000-4-4 | 2 kV for lines >3 m |
| | Surge | IEC 61000-4-5 | 2 kV line-to-ground |
| | Conducted RF | IEC 61000-4-6 | 10 V at frequencies given |
| Functional earth | Burst | IEC 61000-4-4 | 2 kV |

To fully comply with the EMC performance test done, the encoder housing and the cable shield have to be grounded.

# 13 EC Declaration of Conformity

wieland

QU-QP-APP-02/16e_05-268-00

CE

**EC-Declaration of Conformity**

Product name: Safe HTL Encoder
Type designation: SENC-58S
SENC-58H
SENC-90S
SENC-90H

Applicant: Wieland Electric GmbH
Brennerstraße 10-14
96052 Bamberg

*declares under its sole responsibility that the above indicated products are manufactured and tested in compliance to the attached listed directives and standards.*

| Directive | Standard | Edition |
|---|---|---|
| 2006/42/EU (MAS) | EN ISO 13849-1<br>Performance Level „e" (PLe) | 2015 |
| | IEC 62061<br>SIL3 | 2015 |
| | IEC 61800-5-2 | 2017 |
| 2014/30/EU (EMC) | | |
| 2011/65/EU (RoHS) | | |
| | IEC 61508 parts 1-7 | 2010 |

Note: These modules are components that operates with the final equipment. Due to possible influences the installer must re-qualify the final product regarding the EMC directive again.

Authorized documentation representative
Wieland Electric GmbH, Brennerstr. 10-14, 96052 Bamberg

has been certified by: TÜV Rheinland Industrie Service GmbH
Notified body/ address: Bereich Automation Funktionale Sicherheit
Am Grauen Stein, 51105 Köln
reg. nr.: 0035
Certification no: 01/205/5694.00/18

Bamberg, den 16.01.2019

i.V.

Klaus Stadelmaier
Manager R&D, Electronics

Wieland Electric GmbH

i.V.

Klaus Jungstädt
Manager Approvals, Standards

Additional requirements may apply to the installation of components in equipments.

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Geschäftsführer:
Dr. Oliver Eitrich
Dr. Ulrich Schaarschmidt

Vorsitzender des Beirats:
Johann Weber

Registergericht
Bamberg HRB 105

# 14 TÜV certificate

## EC Type-Examination Certificate

TÜVRheinland CERTIFIED
Product Safety
Functional Safety
www.tuv.com
ID 0600000000

**Reg.-Nr./No.: 01/205/5694.00/19**

| | | | |
|---|---|---|---|
| **Prüfgegenstand**<br>**Product tested** | Inkrementalgeber für Sicherheitsanwendungen<br>Incremental Encoders for Safety Applications | **Zertifikats-inhaber**<br>**Certificate holder** | Wieland Electric GmbH<br>Brennerstr. 10 - 14<br>96052 Bamberg<br>Germany |
| **Typbezeichnung**<br>**Type designation** | SENC-58S, SENC-58H, SENC-90S, SENC-90H | | |
| **Prüfgrundlagen**<br>**Codes and standards** | EN 61800-5-2:2017<br>IEC 62061:2015 | | EN ISO 13849-1:2015<br>IEC 61508 Parts 1-7:2010 |
| **Bestimmungsgemäße Verwendung**<br>**Intended application** | Sicherheitsgerichtete Geschwindigkeits und Positionsmessung für rotierende Maschinen. Die Geber erfüllen die Anforderungen der Prüfgrundlagen (Kat. 4 / PL e nach EN ISO 13849-1, SIL CL 3 nach EN61000-5-2 / EN 62061 / IEC 61508) und können in Anwendungen bis PL e nach EN ISO 13849-1 und SIL 3 nach EN 62061 / IEC 61508 eingesetzt werden.<br>Safety-related speed and position measurement at rotary machines. The encoders comply with the requirements of the relevant standards (Cat. 4 / PL e acc. to EN ISO 13849-1, SIL CL 3 acc. to EN 61800-5-2 / IEC 62061 / IEC 61508) and can be used in applications up to Cat. 4 / PL e acc. to EN ISO 13849-1 and SIL 3 acc. to IEC 62061 / IEC 61508. | | |
| **Besondere Bedingungen**<br>**Specific requirements** | Die Hinweise in der zugehörigen Installations- und Betriebsanleitung sowie des Sicherheitshandbuchs sind zu beachten.<br>The instructions of the associated Installation, Operating and Safety Manual shall be considered. | | |

Es wird bestätigt, dass der Prüfgegenstand mit den Anforderungen nach Anhang I der Richtlinie 2006/42/EG über Maschinen übereinstimmt.
It is confirmed, that the product tested complies with the requirements for machines defined in Annex I of the EC Directive 2006/42/EC.

Gültig bis / Valid until 2023-10-18

Der Ausstellung dieses Zertifikates liegt eine Prüfung zugrunde, deren Ergebnisse im Bericht Nr. 968/FSP 1777.00/19 vom 08.01.2019 dokumentiert sind.
Dieses Zertifikat ist nur gültig für Erzeugnisse, die mit dem Prüfgegenstand übereinstimmen.
The issue of this certificate is based upon an examination, whose results are documented in Report No. 968/FSP 1777.00/19 dated 2019-01-08.
This certificate is valid only for products which are identical with the product tested.

TÜVRheinland 0035 Notified Body

Köln, 2019-01-08

Notified Body for Machinery, NB 0035

Dipl.-Ing. Eberhard Frejno



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# 15 Definitions of terms

## C

**CC**: Continuous Current

**CCW**: Counter ClockWise direction, view from flange side.

**Channel**: A channel is constituted of two complementary outputs. Standard incremental encoders provide three channels: channel 1 (A & A/), channel 2 (B & B/), channel 0 (Z & Z/).

**CKW**: ClockWise direction, view from flange side.

## D

**DC** (definition 1): Duty Cycle.

**DC** (definition 2): Diagnostic Coverage. Refer definition in EN 13849-1.

## E

**EMC**: Electromagnetic Compatibility.

## F

**Form fit**: Mechanical interlocking between driving and driven shafts.

## G

**Ground**: Ground or Earth potential  is different from common (0 V)  . Both potentials are not connected together inside the encoder. Common (0 V) is corresponding to zero volt relative to power supply +V.

## H

**Hazard**: Potential source of injury or damage to health.

## I

**Initialization time**: Time between effective power-on and fully operational state of the encoder (output signals availability and control by monitoring)

**IP**: Ingress Protection. Level of sealing of encoder's enclosure. IP level is tested according to standard IEC 60529.

## K

**Keyway**: Form fit for solid shaft. A keyway must be used with the suitable key.

## M

**MTTFd**: Mean Time To dangerous Failure.

## P

**PFD**: Probability of Failure on Demand.

**PFH**: Probability of Failure per Hour.

**PLC**: Programmable Logic Controller.

**PL**: Performance Level according to EN 13849.

**Positive Locks**: Refer form fit.

**Ppr**: Pulses Per Revolution. Encoder's resolution.

## R

**Reset**: Action of switching off and switching on of the encoder's power supply. Each reset action generates an initialization time.

**Response time**: Time between instantaneous physical position or speed and corresponding effect on electrical output signals.

**Rpm**: Encoder's shaft angular speed in Revolution Per Minute.

## S

**Safe state**: State which is clearly determined and interpretable by an external monitoring. Encoder's safe state is described in section 5.1.

**SFF**: Safe Failure Fraction is similar to diagnostic coverage (DC) but also takes account of any inherent tendency to fail towards a safe state. SFF is defined in standard IEC 61508.

**SIL**: Safety Integrity Level according to IEC 61508.

**SRECS**: Safety-Related Electrical Control System.

**SRS**: Safety Reduction Sleeve. Sleeve permitting to insulate and reduce the diameter of hollow shaft encoders. This sleeve includes positive locks.

**Stator coupling**: Anti-rotating accessory which maintains encoder's housing in an angular position and compensates mechanical misalignments.

## T

**Tether arm**: Anti-rotating accessory which maintains encoder's housing in an angular position and compensates mechanical misalignments.

## V

**Vmax**: Power supply voltage provided by the system and applied to the encoder relatively to 0 V.

**V DC**: Voltage – Direct Current.

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