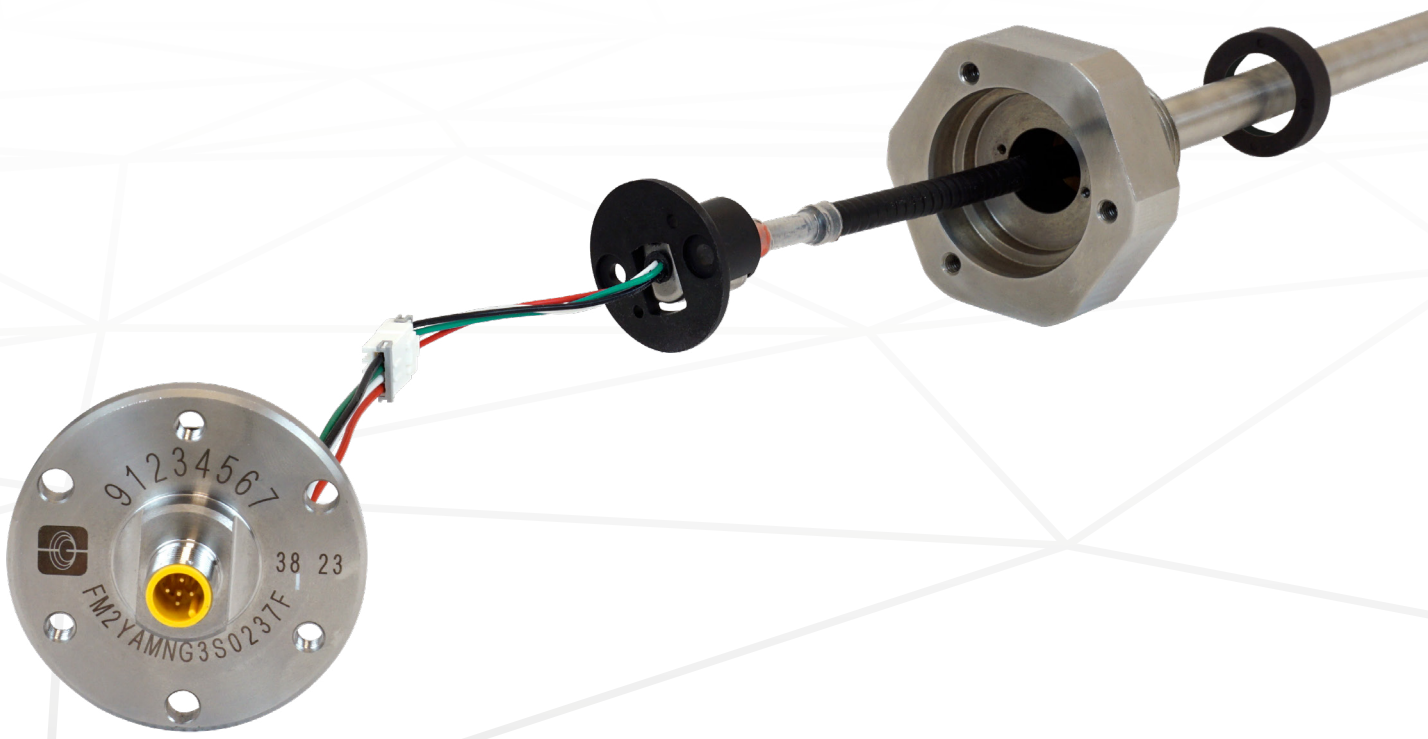
Temposonics
AN AMPHENOL COMPANY

Installation Manual

MH-Series FLEX Safety

Magnetostrictive Linear Position Sensors



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1. Introduction

1.1 Purpose and use of this manual

Before starting the operation of Temposonics® position sensors, read this documentation thoroughly and follow the safety information. Keep the manual for future reference!

The content of this technical documentation and of its annex is intended to provide information on mounting, installation and commissioning by qualified automation personnel [1] or instructed service technicians who are familiar with the project planning and dealing with Temposonics® sensors.

1.2 Used symbols and warnings

Warnings are intended for your personal safety and for avoidance of damage to the described product or connected devices. In this documentation, safety information and warnings to avoid danger that might affect the life and health of operating or service personnel or cause material damage are highlighted by the preceding pictogram which is defined below.

Symbol	Meaning
NOTICE	This symbol is used to point to situations that may lead to material damage, but not to personal injury.

2. Safety instructions

2.1 Intended use

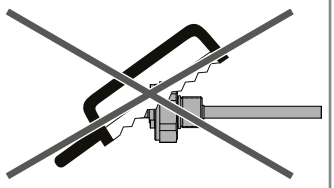
This product may be used only for the applications defined under item 1 and only in conjunction with the third-party devices and components recommended or approved by Temposonics. As a prerequsite of proper and safe operation: the product requires correct transport, storage, mounting and commissioning and must be operated with utmost care.

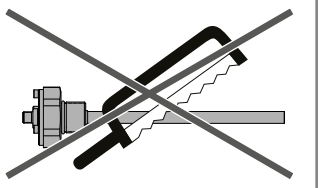
1. The MH-Series sensor systems are intended exclusively for measurement tasks on mobile hydraulic equipment. The sensors are considered as system accessories and must be connected to suitable evaluation electronics, e.g. a PLC, IPC, indicator or other electronic control unit.

2.2 Forseeable misuse

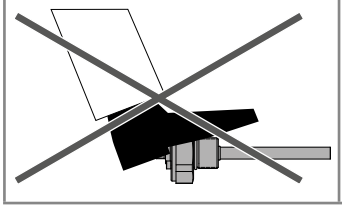
Foreseeable misuse	Consequence
Wrong sensor connection	The sensor will not work properly or can be damaged
Operate the sensor out of the operating temperature range	No signal output – the sensor can be damaged
Power supply is out of the defined range	Signal output is wrong/ no signal output/ the sensor will be damaged
Position measurement is influenced by an external magnetic field	Signal output is wrong
Cables are damaged	Short circuit – the sensor can be damaged/sensor does not respond
Wrong connection of ground/shield	Signal output is disturbed – the electronics can be damaged
Use of a magnet that is not specified by Temposonics	Error in position measurement

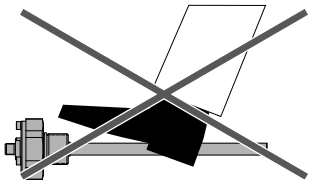
Do not reprocess the sensor afterwards.
➔ The sensor might be damaged.





Do not step on the sensor.
➔ The sensor might be damaged.





1/ The term qualified technical personnel characterizes persons who:
- are familiar with the safety concepts of automation technology applicable to the particular project,
- are competent in the field of electromagnetic compatibility (EMC),
- have received adequate training for commissioning and service operations
- are familiar with the operation of the device and know the information required for correct operation provided in the product documentation.

2.3 Installation, commissioning and operation

The position sensors must be used only in technically safe condition. To maintain this condition and to ensure safe operation, installation, connection and service, work may be performed only by qualified technical personnel.
If danger of injury to persons or of damage to operating equipment is caused by sensor failure or malfunction, additional safety measures such as plausibility checks, limit switches, EMERGENCY STOP systems, protective devices etc. are required. In the event of trouble, shut down the sensor and protect it against accidental operation.

Safety instructions for commissioning
To maintain the sensor operability, it is mandatory to follow the instructions given below.

1. Protect the sensor against mechanical damage during installation and operation.
2. Connect the sensor very carefully and pay attention to the polarity of connections and power supply.
3. Use only approved power supplies.
4. Ensure that the specified permissible limit values of the sensor for operating voltage, environmental conditions, etc. are met.
5. Check the function of the sensor regularly and provide documentation of the checks.
6. Before applying power, ensure that nobody's safety is jeopardized by starting machines.

2.4 Safety instructions for use in explosion-hazardous areas

The sensor is not suitable for operation in explosion-hazardous areas.

2.5 Warranty

Temposonics grants a warranty period for the Temposonics® position sensors and supplied accessories relating to material defects and faults that occur despite correct use in accordance with the intended application [2]. The Temposonics obligation is limited to repair or replacement of any defective part of the unit. No warranty can be provided for defects that are due to improper use or above average stress of the product, as well as for wear parts. Under no circumstances will Temposonics accept liability in the event of offense against the warranty rules, no matter if these have been assured or expected, even in case of fault or negligence of the company. Temposonics explicitly excludes any further warranties. Neither the company's representatives, agents, dealers nor employees are authorized to increase or change the scope of warranty.

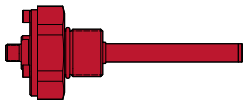
2.6 Return

For diagnostic purposes, the sensor can be returned to Temposonics. Any shipment cost is the responsibility of the sender [2].
For a corresponding form, see chapter "5. Appendix - Safety declaration" on page 22.

2/ See also applicable Temposonics sales and delivery on www.temposonics.com

3. Identification

3.1 Order code of FLEX Safety – Full Assembly



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
F	M	2							M										
a			b	c						d		e	f			g	h		i

a	Form factor
F M 2	Full assembly

b	Pipe
A	Rod Ø 12.7 mm, flat end plug
B	Rod Ø 12.7 mm, end plug with M4×0.7 female thread

c	Stroke length
X X X X X M	00250…5000 mm (in 5 mm steps)

d	Electrical wiring
M12 connector (VDC – GND – HI – LO) incl. flange	
N F	Connector wiring: F: 2-3-4-5

e	Sensor element wire length
A	80 mm

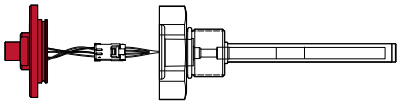
f	Output
S 0 2	CANopen Safety
J 9 1	SAE J1939-76 Safety

g	Baud rate
CANopen Safety (S02)	
0	1000 kbit/s
1	800 kbit/s
2	500 kbit/s (default)
3	250 kbit/s
4	125 kbit/s
6	50 kbit/s
7	20 kbit/s
8	10 kbit/s
SAE J1939-76 Safety (J91)	
2	500 kbit/s (default)
3	250 kbit/s

h	Node ID (CANopen) / Source address (SAE J1939)
CANopen Safety (S02)	
	Hex 01…7F (default: 7F)
SAE J1939-76 Safety (J91)	
	Hex 01…FD (default: FD)

i	Cycle Time
A	01 msec
B	05 msec
C	10 msec
D	20 msec (default SAE J1939-76 Safety)
E	25 msec (default CANopen Safety)
F	30 msec
G	40 msec
H	50 msec

3.2 Order code of FLEX Safety – Lid electronics assembly



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F	M	2	L	N	F							
a			b	c		d			e	f		g

a	Form factor
F M 2	Lid electronics assembly

b	Lid electronics assembly
L	Lid electronics assembly

c	Connection type
N F	Connector wiring: F: 2-3-4-5

d	Output
S 0 2	CANopen Safety
J 9 1	SAE J1939-76 Safety

e	Baud rate
CANopen Safety (S02)	
0	1000 kbit/s
1	800 kbit/s
2	500 kbit/s (default)
3	250 kbit/s
4	125 kbit/s
6	50 kbit/s
7	20 kbit/s
8	10 kbit/s
SAE J1939-76 Safety (J91)	
2	500 kbit/s (default)
3	250 kbit/s

f	Node ID (CANopen) / Source address (SAE J1939)
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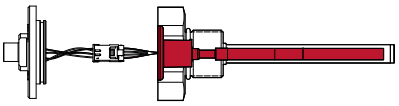
	Hex 01…FD (default: FD)

g	Cycle Time
A	01 msec
B	05 msec
C	10 msec
D	20 msec (default SAE J1939-76 Safety)
E	25 msec (default CANopen Safety)
F	30 msec
G	40 msec
H	50 msec

3.3 Order code of FLEX Safety – Smart sensor element



1	2	3	4	5	6	7	8	9	10	11
F	M	2	E						M	
a			b	c						d

a	Form factor
F M 2	Smart sensor element

b	Smart sensor element
E	Smart sensor element

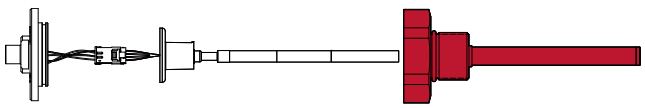
c	Stroke length
X X X X X M	00250…10,500 mm (in 5 mm steps)

d	Sensor element wire length
A	80 mm
B	130 mm
C	210 mm

NOTICE

Smart sensor element available up to 10.5 m for use in applications with customer supplied enclosures.

3.4 Order code of FLEX Safety – Pressure pipe



1	2	3	4	5	6	7	8	9	10
F	M	2							M
a			b	c					

a	Form factor
F M 2	Pressure pipe

b	Pipe
C	Rod Ø 12.7 mm, flat end plug
D	Rod Ø 12.7 mm, end plug with M4×0.7 female thread

c	Stroke length
X X X X X M	00250…05000 mm (in 5 mm steps)

NOTICE

Pressure pipe available up to 5 m.

3.5 Nameplate

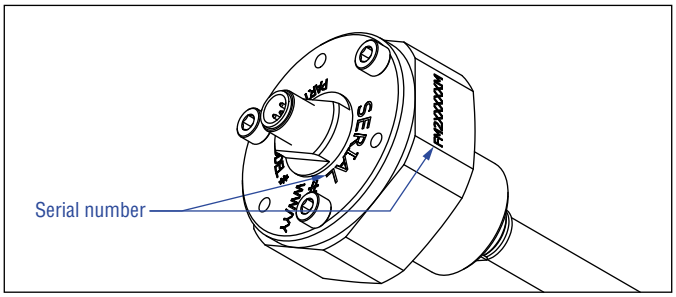


Fig. 1: Example of nameplate

3.6 Scope of delivery

FLEX Safety (full assembly):
- Pressure pipe
- Lid electronics assembly
- Smart sensor element
- O-ring

FLEX Safety (lid electronics assembly):
- Lid electronics assembly

FLEX Safety (smart sensor element):
- Smart sensor element

FLEX Safety (pressure pipe):
- Pressure pipe
- O-ring

4. Product description and commissioning

4.1 Functionality and system design

Product designation
- Position sensor Temposonics® MH-Series

Sensor model
- Temposonics® FLEX Safety

Stroke length
- 500…5,000 mm (with optional pipe)
- 250…10,500 mm Smart SE

Output signal
- J1939-76
- CANopen Safety

Principle of operation and system construction
The absolute, linear position sensors provided by Temposonics rely on the company's proprietary Temposonics® magnetostrictive technology, which can determine position with a high level of precision and robustness. Each Temposonics® position sensor consists of a ferromagnetic waveguide, a position magnet, a strain pulse converter and supporting electronics. The magnet, connected to the object in motion in the application, generates a magnetic field at its location on the waveguide. A short current pulse is applied to the waveguide. This creates a momentary radial magnetic field and torsional strain on the waveguide. The momentary interaction of the magnetic fields releases a torsional strain pulse that propagates the length of the waveguide. When the ultrasonic wave reaches the end of the waveguide it is converted into an electrical signal. Since the speed of the ultrasonic wave in the waveguide is precisely known, the time required to receive the return signal can be converted into a linear position measurement with both high accuracy and repeatability.

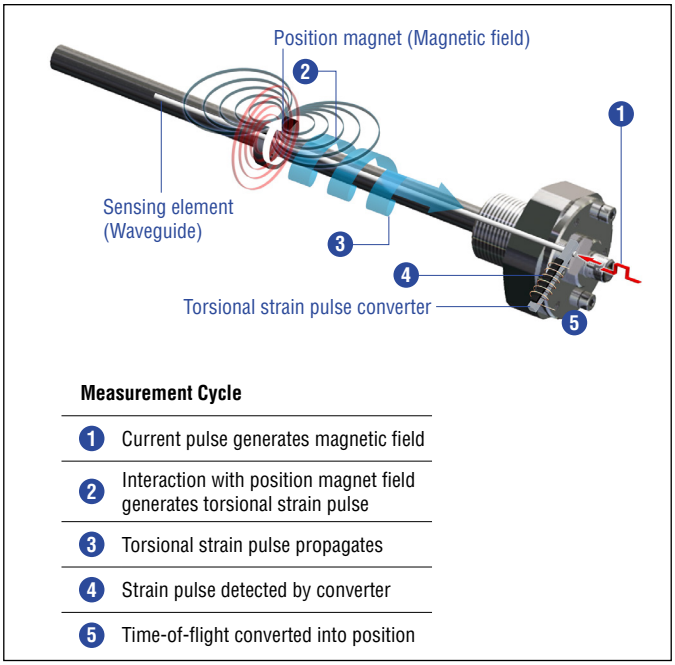
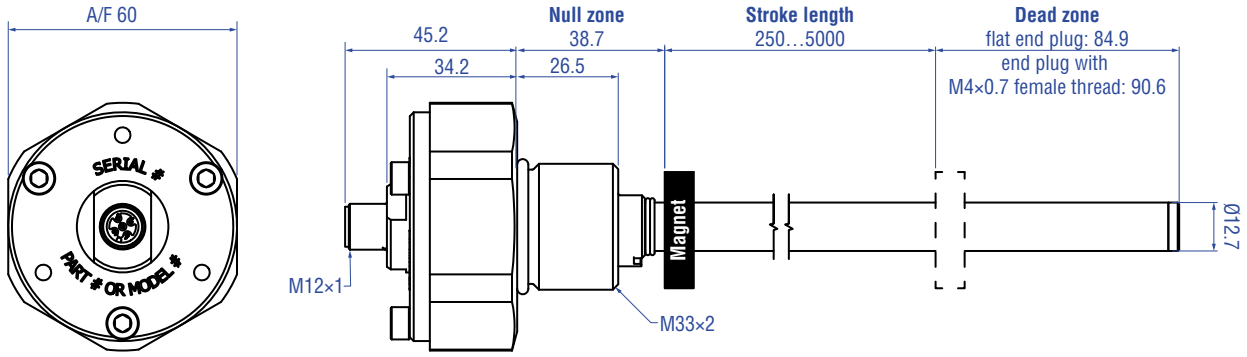


Fig. 2: Principle of operation: Time-based magnetostrictive position sensing principle

Modular mechanical and electronic construction
- The sensor rod protects the inner sensor element.
- The sensor electronics housing, a rugged stainless steel construction, contains the electronic interface with active signal conditioning.
- The external position magnet is a permanent magnet. It travels along the sensor rod and triggers the measurement through the sensor rod wall.
- The sensor can be connected directly to a control system. Its electronics generates a strictly position-proportional signal output between zero and end position.

4.2 Styles and installation of MH-Series FLEX

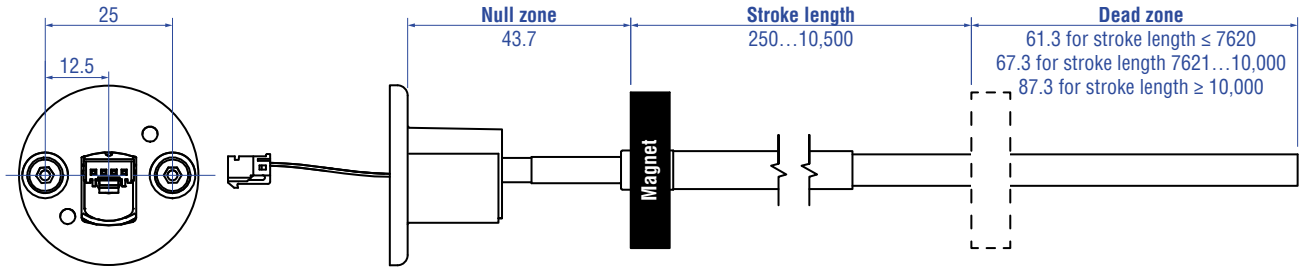
FLEX – Full Assembly



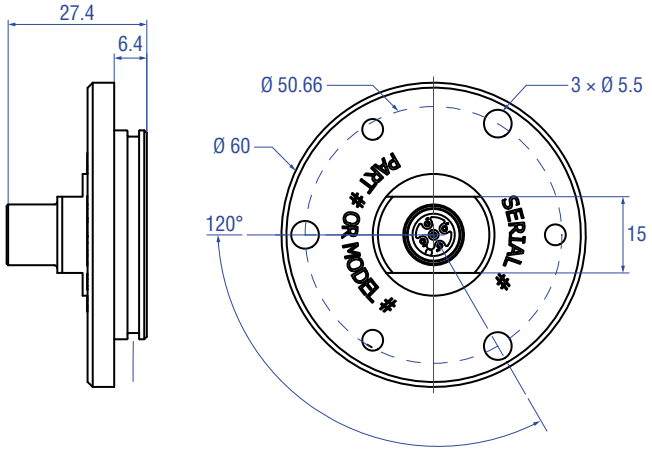
Controlling design dimensions are in millimeters

Fig. 3: Temposonics® MH-Series FLEX – Full Assembly

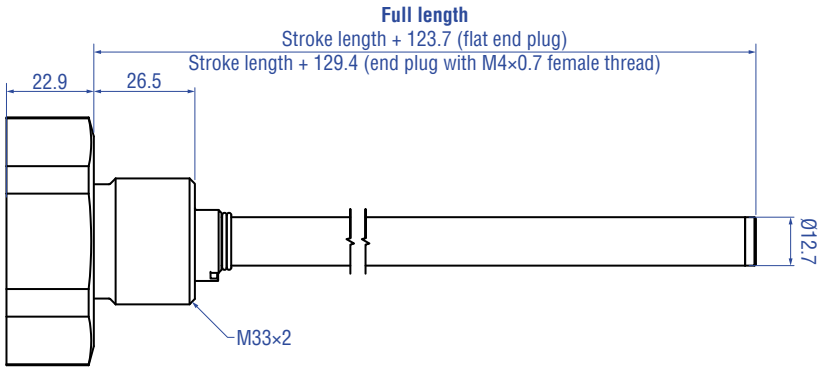
FLEX – Smart sensor element



FLEX – Lid electronics assembly



FLEX – Pressure pipe



Controlling design dimensions are in millimeters

Fig. 4: Temposonics® MH-Series FLEX Safety parts

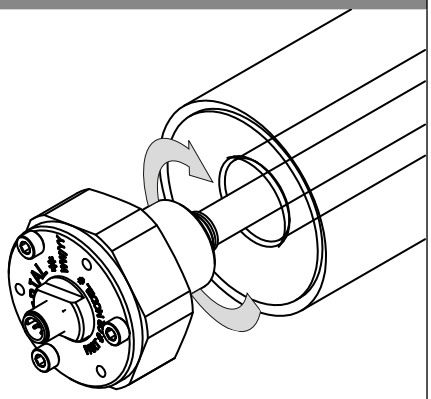
4.3 MH FLEX Safety – Full Assembly Installation

Installation of a rod-style sensor in a fluid cylinder

The rod-style version has been developed for direct stroke measurement in a fluid cylinder. Mount the sensor via threaded flange. Use non-magnetic material for mounting support.

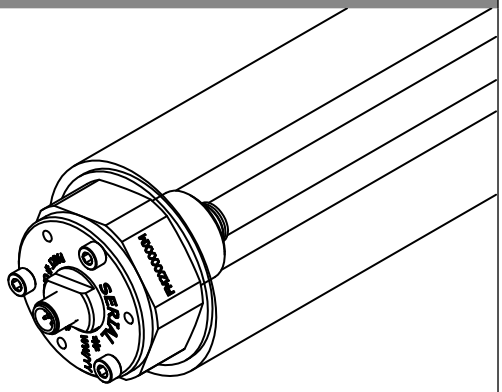
- Mounted on the face of the piston, the position magnet travels over the rod without touching it and indicates the exact position through the rod wall – independent of the hydraulic fluid.
- The pressure resistant sensor rod is installed into a bore in the piston rod.

Step 1



1. Install the sensor to "hand" tightness (< 10 Nm)
2. Insert sensor into cylinder. Be careful not to drop or cause impact to the sensor.
3. Screw the sensor into the cylinder by hand
4. Stop rotation when sensor is flush with the cylinder (do not use much force in Step 2. It should screw in smoothly)

Step 2



1. Finish installation with appropriate torque value
2. Set torque to 310 Nm
3. Tighten sensor to a torque of 310 Nm

Fig. 5: Sensor in fluid cylinder

Cavity Dimensions

Notice for metric threaded flanges

Thread (d_1×P)	d_2	d_3	d_4 +0.1 0	L_1 +0.4 0	L_2	L_3	L_4	Z° ±1°
M33×2	72	33	35.4	3.1	30	2.5	27	15°

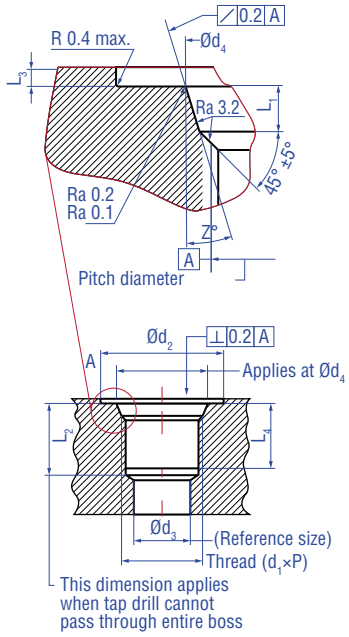
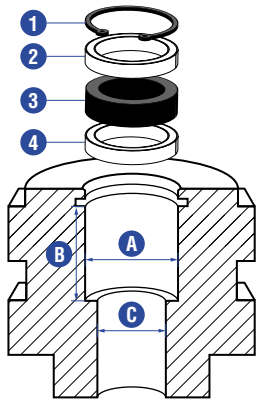


Fig. 6: Dimensions of the cylinder cavity for the pressure pipe

Magnet installation



1	Circlip	
2	Non-magnetic spacer (≥ 5 mm)	
3	Position magnet	
4	Non-magnetic spacer (≥ 5 mm)	
	Position magnet (Part no. 402 316)	
A	30.5 mm +0.1	
B	≥ 18 mm	
C	**Sensor rod**	**Piston rod drilling**
	Ø 12.7 mm	Ø 16 mm

Fig. 7: Magnet installation

4.4 Installing Smart SE

The FLEX Safety Smart SE and Lid Electronics Assembly may be mounted into the FLEX Safety Pressure Pipe (available up to 5 m), or a user designed enclosure which conforms to the same dimensions. The following information may be used to mount the Smart SE and Lid Electronics Assembly in a custom enclosure.

Please keep in mind

- The Electronics Lid Assembly is designed to seal the Smart SE into an enclosure. The Smart SE is expected to be enclosed and protected against ingress (ie. Water and Hydraulic Fluid) and pressure (ie. Mounted in a hydraulic cylinder).
- Enclosure surrounding the Smart SE must consist of non-ferrous material to allow proper detection of the magnet by the sensing element.

NOTICE

Contact Temposonics for guidance and assistance with design for your application and use case.

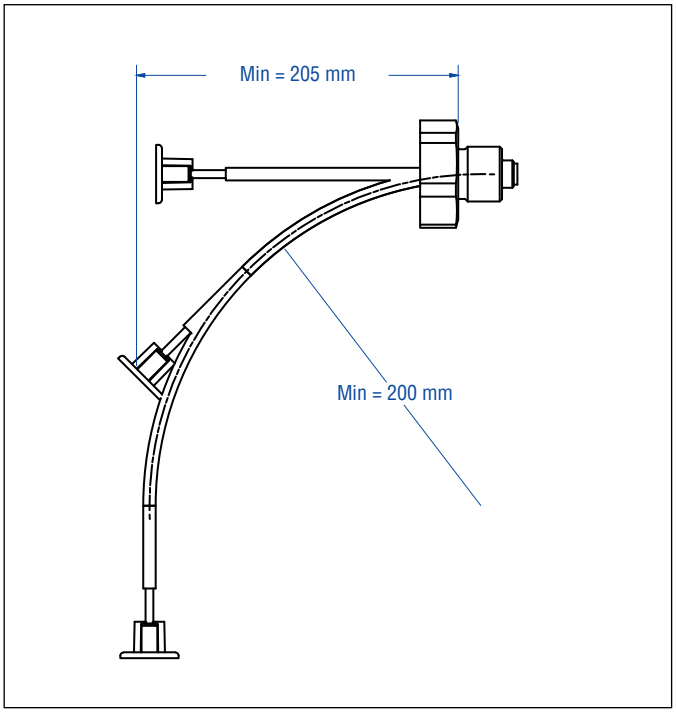


Fig. 8: Bending radius

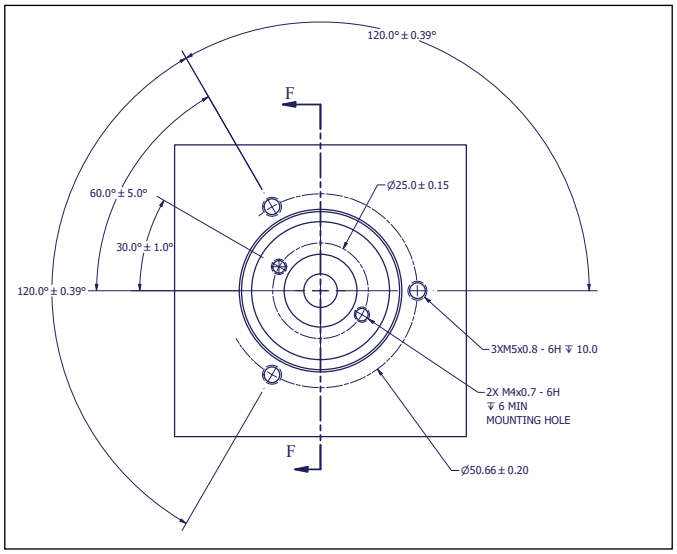


Fig. 9: Dimensions of the cavity for the SE, part 1

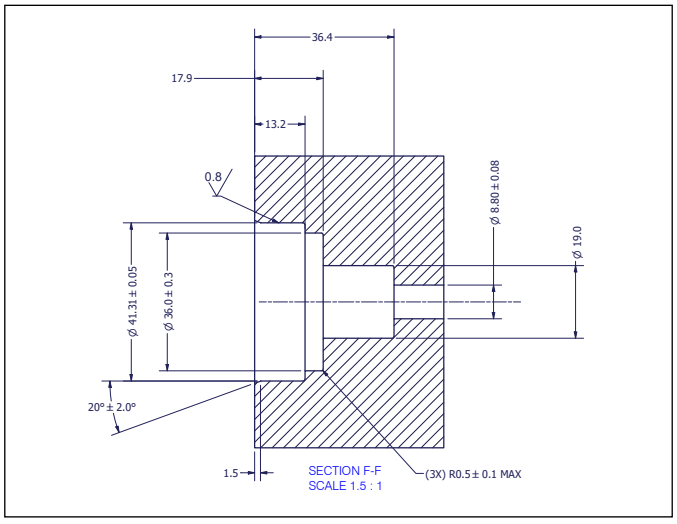
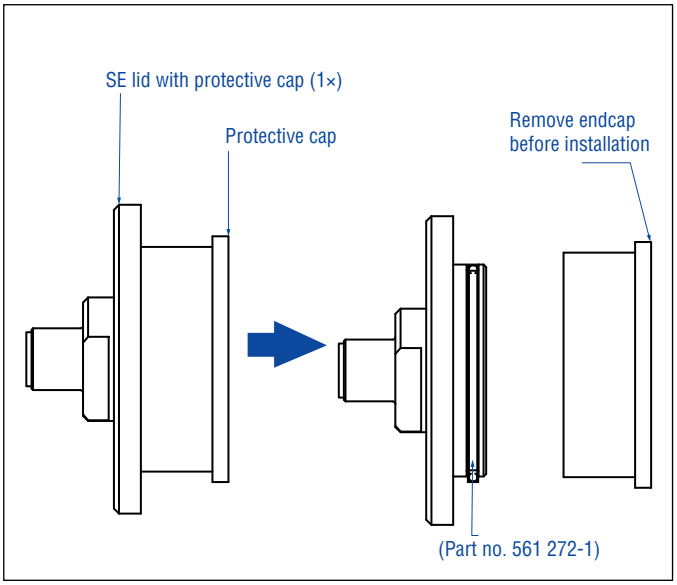
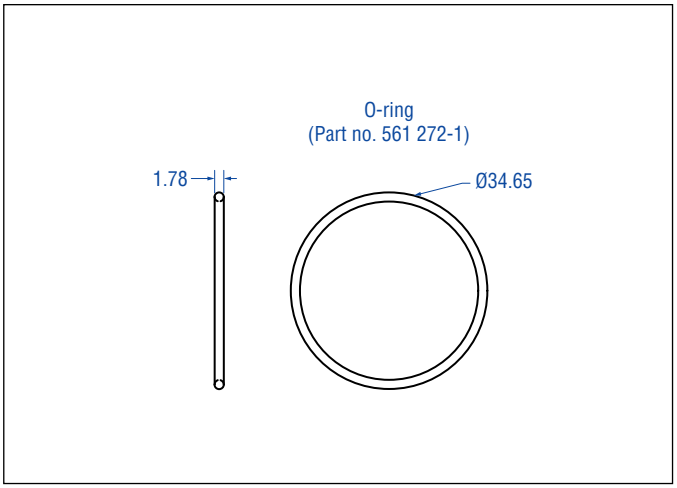
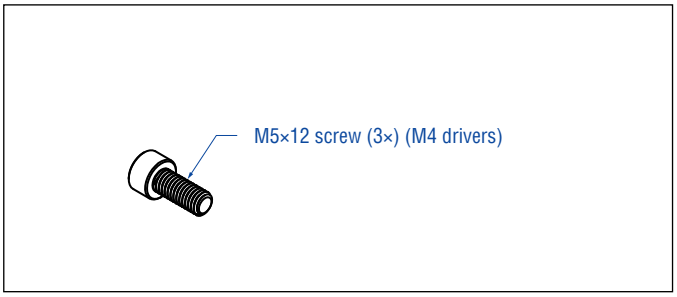


Fig. 10: Dimensions of the cavity for the SE, part 2

4.5 MH FLEX Safety – Lid electronics assembly replacement procedure

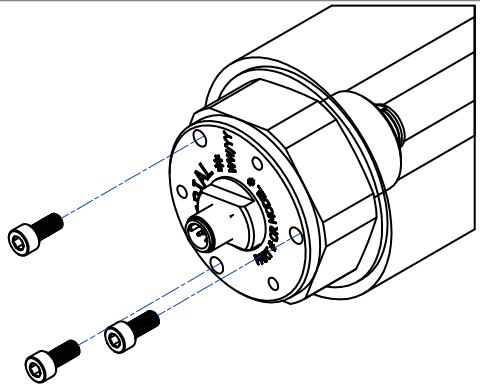






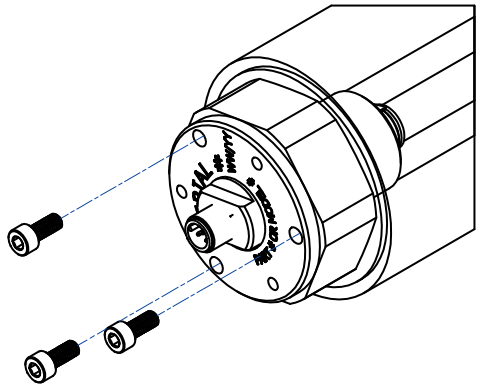
4.5.1 Remove lid electronics assembly

Step 1A



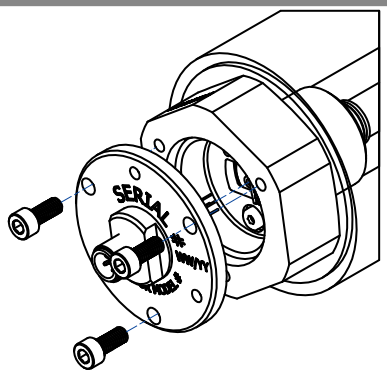
- Remove 3 screws (M5×12 mm)

Step 1B



- Insert screws into threaded holes in lid to aid lid removal

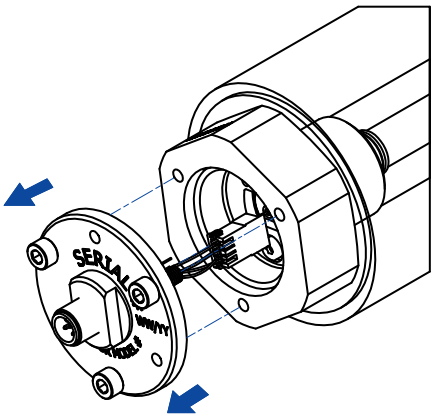
Step 1C



- Spin screw 1 in (clockwise) with 2 rotations
- Spin screw 2 (any other screw) in (clockwise) with 2 rotations
- Spin screw 3 (last, remaining screw) in (clockwise) with 2 rotations
- Repeat the above steps until all 3 screws are fully inserted

Fig. 13: Remove lid electronics assembly, part 1

Step 1D

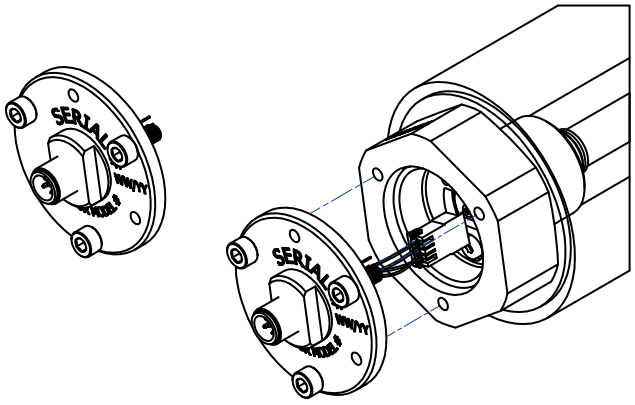


- Pull lid out from behind flange

Fig. 14: Remove lid electronics assembly, part 2

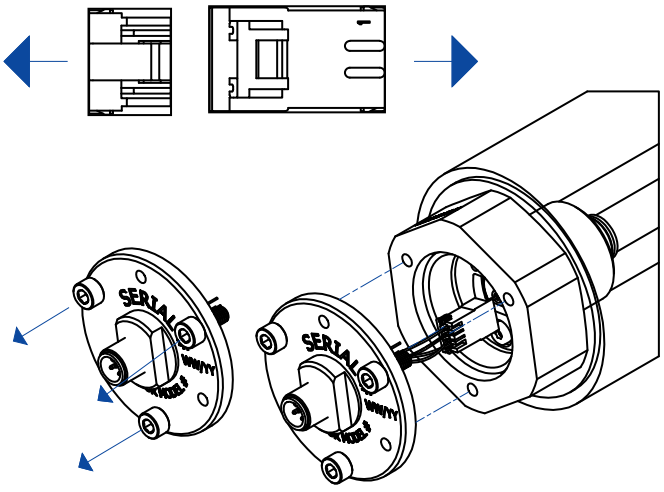
4.5.2 Unplug lid electronics assembly

Step 2A



- Slowly remove lid entirely
- Be careful not to damage PCB or wires

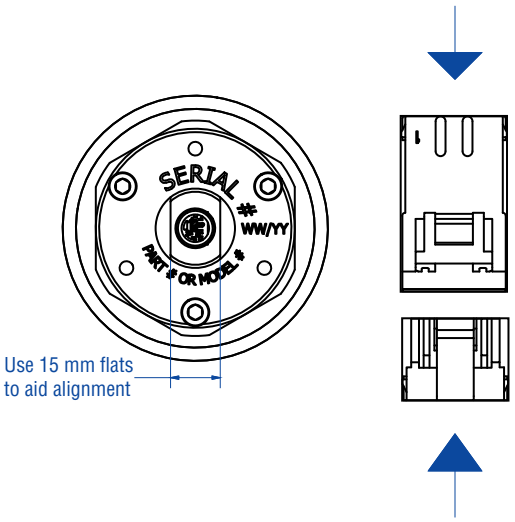
Step 2B



- Unplug SE and lid cables
- Pull straight out
- Grip the connector. Do not pull on wires
- Unscrew all 3 M5×12 screws from lid. Save screws for step 2D

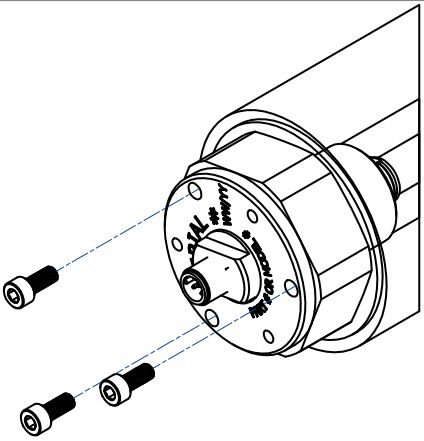
Fig. 15: Unplug lid electronics assembly, part 1

Step 2C



- Spin screw 1 in (clockwise) with 2 rotations
- Spin screw 2 (any other screw) in (clockwise) with 2 rotations
- Spin screw 3 (last, remaining screw) in (clockwise) with 2 rotations
- Repeat the above steps until all 3 screws are fully inserted

Step 2D



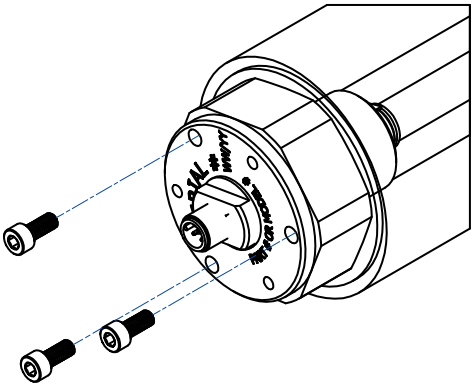
- Apply Loctite 242 to each screw
- Insert M5×12 screws into lid's unthreaded holes
- Screw all 3 screws to housing's threads
- Torque M5 screws to 5.9 Nm (±0.3 Nm)

Fig. 16: Unplug lid electronics assembly, part 2

4.6 MH FLEX Safety – SE Replacement

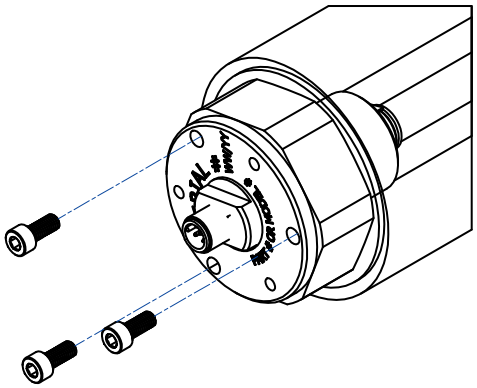
4.6.1 Remove lid electronics assembly

Step 1A



- Remove 3 screws (M5×12)

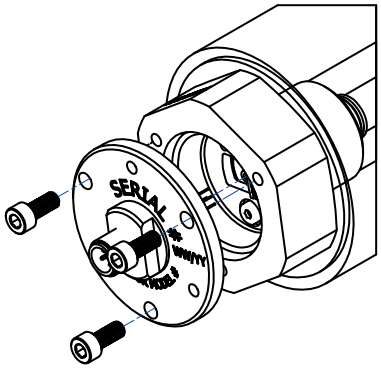
Step 1B



- Insert screws into threaded holes in lid to aid lid removal

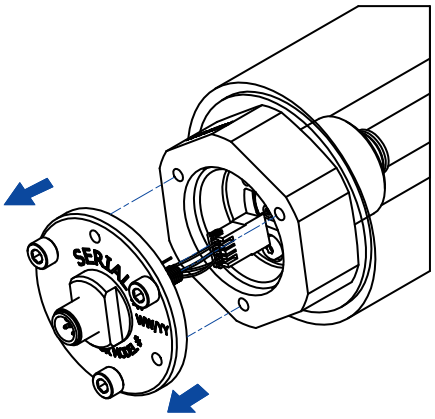
Fig. 17: Remove lid electronics assembly, part 1

Step 1C



- Spin screw 1 in (clockwise) with 2 rotations
- Spin screw 2 (any other screw) in (clockwise) with 2 rotations
- Spin screw 3 (last, remaining screw) in (clockwise) with 2 rotations
- Repeat the above steps until all 3 screws are fully inserted

Step 1D

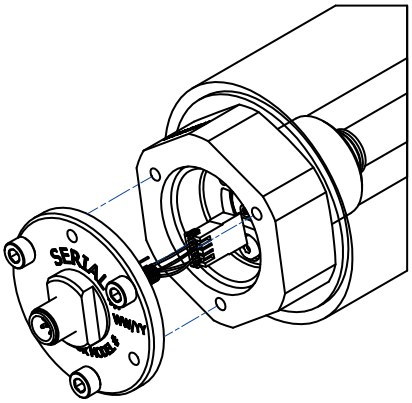


- Spin screw 1 in (clockwise) with 2 rotations
- Spin screw 2 (any other screw) in (clockwise) with 2 rotations
- Spin screw 3 (last, remaining screw) in (clockwise) with 2 rotations
- Repeat the above steps until all 3 screws are fully inserted

Fig. 18: Remove lid electronics assembly, part 2

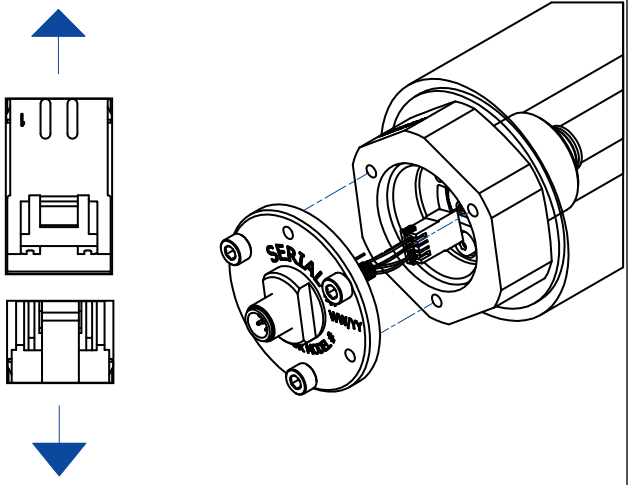
4.6.2 Remove SE

Step 1E



- Slowly remove lid entirely
- Be careful not to damage PCB or wires

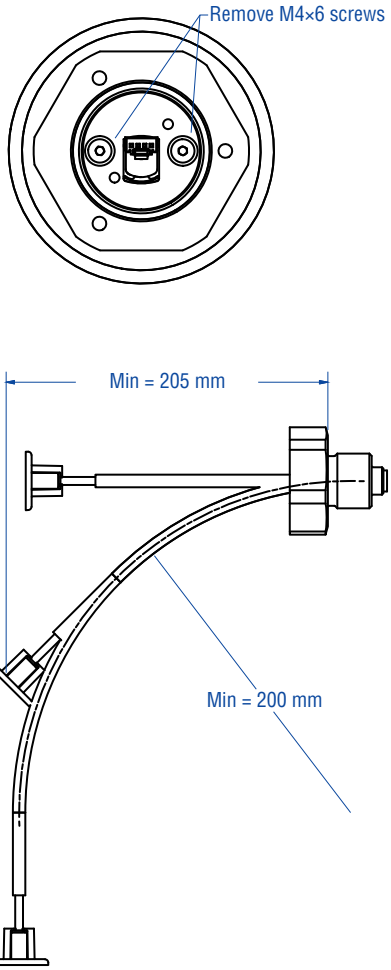
Step 1F



- Unplug SE from PCB in lid
- Pull straight out
- Grip the connector. Do not pull on wires.

Fig. 19: Remove SE, part 1

Step 1G

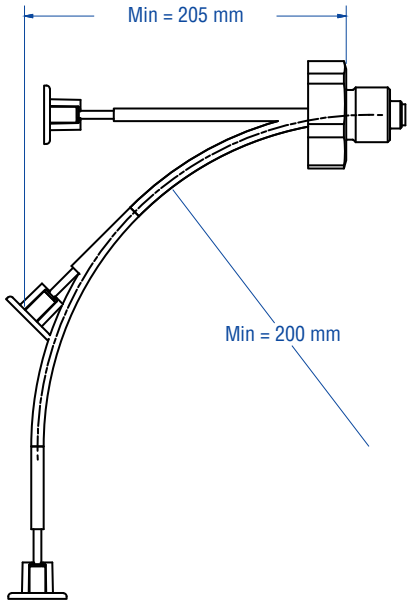


- Remove the M4×6 screws
- Remove SE
- Take care not to bend SE < 200 mm

Fig. 20: Remove SE, part 2

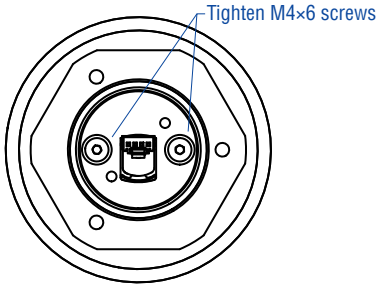
4.6.3 Install new SE

Step 1A



- Insert new SE into sensor cavity
- Be careful not to bend the SE more than 200 mm radius

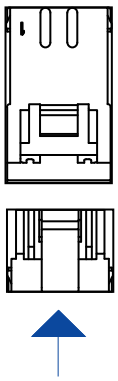
Step 1B



- Apply one drop of Loctite 242 to each screw thread
- Tighten SE screws (M2.5×10 screws) to 0.27 Nm, (±0.06 Nm)

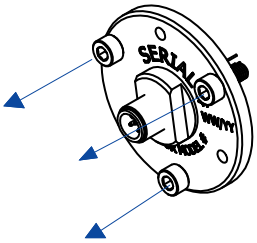
Fig. 21: Install new SE, part 1

Step 1C



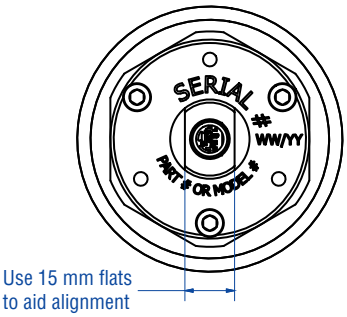
- Plug connectors together

Step 1D



- Unscrew all 3 M5×12 screws from lid. Save screws for step 4B

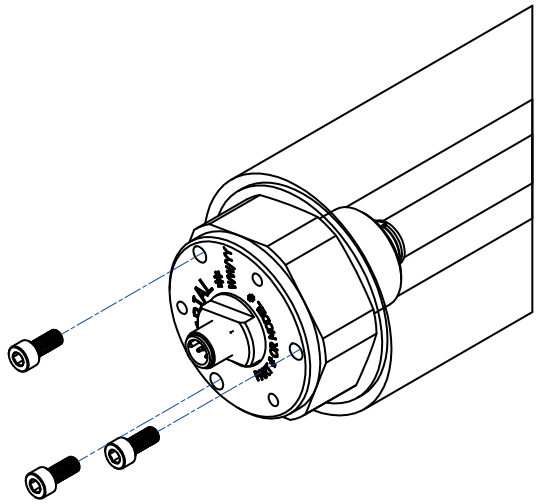
Step 1E



- Insert lid into sensor cavity
- Align the lid through holes with the sensor cavity threaded holes
- Take care to not pinch the wire while installating the new lid

Fig. 22: Install new SE, part 2

Step 1F



- Apply loctite 242 to each screw
- Insert M5×12 screws into lid unthreaded holes
- Screw all 3 screws to housing's threads torque M5 screws to 5.9 Nm (±0.3 Nm)

Fig. 23: Install new SE, part 3

4.7 Electrical connections

Placement of installation and cabling have decisive influence on the sensor's electromagnetic compatibility (EMC). Hence correct installation of this active electronic system and the EMC of the entire system must be ensured by using suitable metal connectors, shielded cables and grounding. Overvoltages or faulty connections can damage its electronics despite protection against wrong polarity.

NOTICE

1. Do not mount the sensors in the area of strong magnetic or electric noise fields.
2. Never connect / disconnect the sensor when voltage is applied.

Instructions for connection

- Use low-resistant twisted pair and shielded cables. Connect the shield to ground externally via the controller equipment.
- Keep control and signal leads separate from power cables and sufficiently far away from motor cables, frequency inverters, valve lines, relays, etc..
- Use only connectors with metal housing and connect the shielding to the connector housing.
- Keep the connection surface at both shielding ends as large as possible. Connect the cable clamps to function as a ground.
- Keep all non-shielded leads as short as possible.
- Keep the earth connection as short as possible with a large cross section. Avoid ground loops.
- With potential differences between machine and electronics earth connections, no compensating currents are allowed to flow across the cable shielding.
  Recommendation:
  Install potential compensating leads with large cross section, or use cables with separate double shielding, and connect only one end of the shield.
- Use only stabilized power supplies in compliance with the specified connecting values.

M12 connector (NF)

- Attached A-coded M12 connector
- Toolless assembly
- Sealing IP67, up to IP69K with plugged mating connector

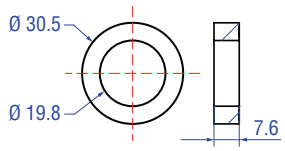
Connector wiring		F	
	Pin	Wire	Function
	1	–	–
	2	BN	VDC
	3	WH	GND
	4	YE	CAN_H
	5	GN	CAN_L

View on connector

Fig. 24: Connector wiring

4.8 Frequently ordered accessories

Position magnet



Ring magnet
Part no. 402 316

Material: PA ferrite coated
Weight: ca. 13 g
Operating temperature: –40…+100 °C
Surface pressure: 20 N/mm²

Controlling design dimensions are in millimeters

Temposonics
AN AMPHENOL COMPANY

5. Appendix - Safety declaration

Dear Customer,
If you return one or several sensors for checking or repair, we need you to sign a safety declaration. The purpose of this declaration is to ensure that the returned items do not contain residues of harmful substances and/or that people handling these items will not be in danger.

Temposonics order code: _____ Sensor model(s): _____

Serial number(s): _____ Stroke length(s): _____

The sensor has been in contact with the following materials:

Do not specify chemical formulas.
Please include safety data sheets of the substances, if applicable.

In the event of suspected penetration of substances into the sensor, consult Temposonics to determine measures to be taken before shipment.

Short description of malfunction:

Corporate information

Company: _____

Address: _____

_____

Contact partner

Phone: _____

Fax: _____

Email: _____

We hereby certify that the measuring equipment has been cleaned and neutralized.
Equipment handling is safe. Personnel exposure to health risks during transport and repair is excluded.

Stamp

Signature _____

Date _____

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