

SC-01 Installation procedure

Introduction

This document aims to describe the installation procedures for the deployment of the SC-01 strain sensor on a surface of a monitored object. SC-01 can be as well embedded into the concrete – after being correctly mounted it is possible to grout or spray the sensor with the concrete.

Installation of the sensor brackets depends on the installation possibilities and surface material type. For achieving the most stable and long-term bond between the monitored structure and the SC-01 sensor brackets, we recommend selecting the installation methods in order as Welding → Screwing → Gluing.

Installation requirements

Instruments & Tools

- SC-01 mounting brackets (MBS-01)
- Two spanner keys, size 19
- FBG interrogator with suitable bandwidth
- Standard welding equipment and accessories
- Personal Protective Equipment
- Optional: High Strength Thread-Locking Adhesive Loctite 2701
- Optional: Additional adhesives for combined installation (mechanical-chemical)

note: other standard tools, accessories, and equipment may be required for the installation but there not the subject of this guide.

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Installation time

Typical installation time for SC-01 sensor: **between 5-10min** (surface preparation not considered).

Installation sequence

Time indicates the estimated time efforts of the installation (in detail in the next chapters).

- (1) Anchoring distance [<1 minute]
- (2) Surface preparation [5 minutes] ¹
- (3) Mounting of brackets [2 minutes]
 - I. Welding
 - II. Mechanical (Screwing)
 - III. Chemical (Gluing)
- (4) Mounting of SC-01 into brackets [2 minutes]
- (5) Setting up pre-strain [2 minutes] ²

¹ Time for completing highly depends on the surface of the monitored object.

² Requires sensor to be connected to the interrogator.

(1) Anchoring distance and gauge length

The SC-01 is a long gauge strain sensor that can be manufactured with various gauge lengths. The gauge length is defined before the sensor production and the gauge length, in most cases, is near or equal to the anchoring distance. The position of the sensors' mounting brackets is defined by the anchoring distance.

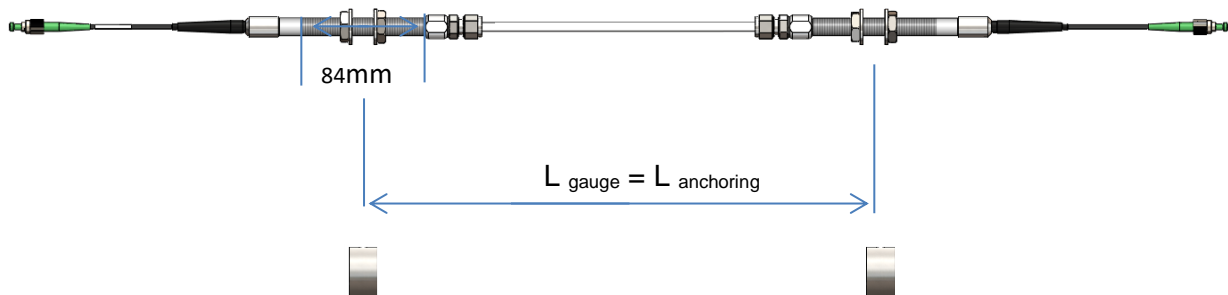


Figure 1: Schematic representation of the SC-01 gauge and anchoring length.

(2) Surface preparation

Regardless of the installation method, it is recommended to properly treat the surface to which the brackets should be installed. This process includes mechanical cleaning of the surface using abrasive materials and removal of any protective paint, rust, debris, or similar imperfection from the surface. It's only necessary to clean areas where the mounting brackets will be installed.

Chemical treatment of the surface is recommended to happen no longer than 20min before the installation to avoid the creation of oxide layers on the treated surface.

Recommended cleaning solvents (not included inside the packaging):

- ▲ Loctite 7061
- ▲ Loctite 7063

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(3) Installation of the mounting brackets

The SC-01 brackets (optional item, MBS-01) are made from stainless steel 316 and therefore they are possible to be welded down to a steel surface, mechanically mounted (screwed), or even bonded to a surface using an appropriate adhesive. Welding is recommended for long-term deployment.

No matter what method is chosen, several critical conditions have to be fulfilled to have the mounting brackets reliable installed on the surface:

- (1) The anchoring distance represents the distance from center to center of a pair of MBS-01 mounting brackets used for the installation of one SC-01 sensor (see Figure 1).
- (2) Mounting brackets have to be installed in one axis with each other and perpendicular to the measured surface.
- (3) Both brackets have to be in the same height level, otherwise, possible geometrical errors can occur during the measurement.

Direct welding

Direct welding³ of the mounting brackets is recommended for long-term applications since it creates a stable bond between the brackets and the monitored surface. The anchoring distance has to be respected during welding to allow pre-strain adjustment. The sequential installation steps are shown in Figure 3.



Figure 3: Installation of the mounting brackets using direct welding.

³ Welding using MIG technology or electrode technology is applicable for this method.

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Mechanical installation (screwing)

Mechanical installation is based on using two standard M8 metric screws (one at each side). These screws are supplied with brackets⁴. This method is possibly be applied to concrete, walls, or even metal structures when welding is prohibited.



Figure 4: Mechanical installation of the mounting brackets.

Chemical installation (glue bonding)

Chemical installation is based on using an adhesive that bonds the bracket with the measured surface. The glue is not supplied with the sensor.

The selection of suitable adhesives highly depends on the material of the surface⁵ and environmental conditions. Special curing procedures such as elevated temperature, or air humidity can be mandatory for a successful curing process.



Figure 5: Chemical installation of the mounting brackets.

⁴ Suitable thread adhesive (Loctite 2701) or secure washers can always improve the stability of this installation method. The dowels are not supplied with the bolts.

⁵ As an example, for steel surface a so-called liquid metal can be used, Loctite 3450. For concrete surfaces, EPO-TEK® 730 is possible to be used.

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(4) Mounting of SC-01 into brackets

Before placing the SC-01 into the installed brackets (Figure 6), slide the washers and nuts to the sides. There has to be one nut and a washer on each side of a bracket.

Tip: Place the sensor into the brackets in a way that one bracket is close to the end of the threaded part, around 1cm from the edge (Figure 6, second step). This will make the pre-straining process more convenient. Secure this position by using two spanner keys size 19.

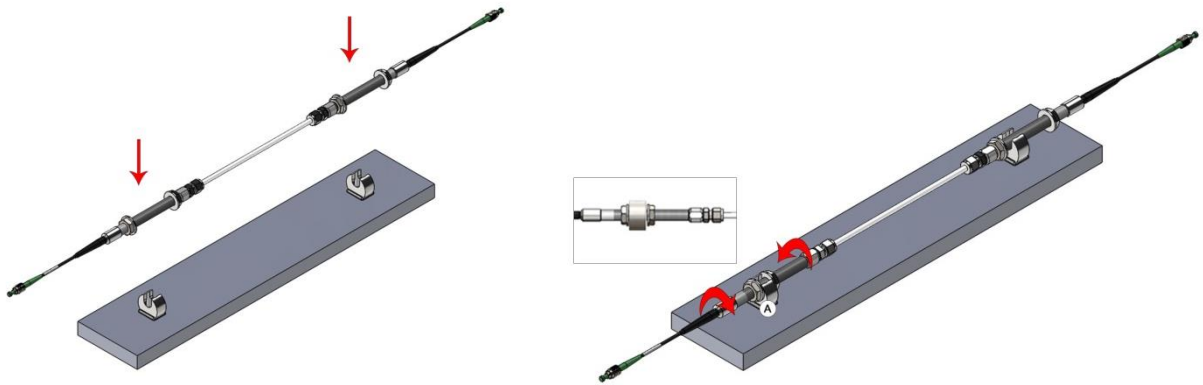


Figure 6: Mounting of SC-01 into brackets.

Table 1 shows the sensor absolute length change as a relationship with applied pre-strain (example based on 5000 $\mu\epsilon$ pre-strain). Please note, the values indicated in Table 1 are representing only an approximation to the real value.

Gauge Length (m)	Anchoring distance (m)	Wavelength shift after $\pm 5000\mu\epsilon$ pre-strain setup (nm)	Absolute elongation after pre-strain setup (mm)
0,35	0,35	6000	1,75
0,5	0,5	6000	2,5
1	1	6000	5
2	2	6000	10
5	5	6000	25

Table 1: Conversion table between relative and absolute length change units.

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(5) Setting up pre-strain

The SC-01 doesn't have an in-built pre-strain and therefore it is necessary to pre-strain this sensor during installation to detect compression. This is performed already with the sensor positioned inside the mounting brackets and therefore, it's mandatory to have the mounting brackets in place before the pre-strain process.

For example, if the desired measuring range of the SC-01 should be $\pm 2000\mu\epsilon$, it is required to pre-strain the sensor for no less than 4800 μm (4,8nm). The necessary wavelength shift can be calculated using equation (1).

$${}^6\lambda_{shift} = \epsilon_{max} \times 1,2 \quad (1)$$

where, λ_{shift} is the calculated wavelength and ϵ_{max} is the maximum assumed strain.

After securing one side of the SC-01, the pre-straining of the sensor can be done as shown in Figure 7. Use a spanner key size 19 and rotate the inner nut in a clockwise direction to adjust the pre-strain to the required value. Afterward, secure the sensor in place by using two spanner keys size 19, as shown in Figure 7.

It is recommended to use a thread locking adhesive like Loctite 2701.

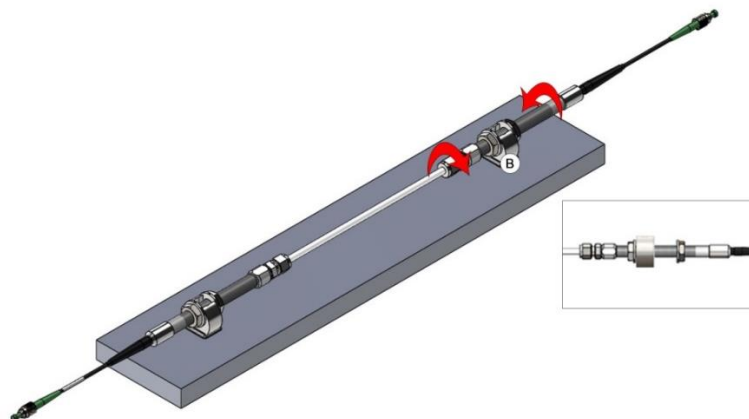


Figure 7: Pre-straining the sensor.

For more information contact our sales team at sales@sylex.sk

* Specifications are subject to change without notice

⁶ The conversion constant between wavelength shift and strain change can slightly differ due to sensors gauge length. Please, refer to the datasheet for a more accurate value.