OPERATING INSTRUCTIONS
SMART SILO SENSOR
FOR LEVEL MEASUREMENT

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RAD-SEN-XX-04AX-XX

RAD-SEN-XX-05AX-XX

Document Information

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1. About this document

1.1 Function

This document provides all information required for installing the sensor. Please read this document before installation of the product and keep this manual accessible in the immediate vicinity of the product.

1.2 Silo measurement

Please be aware that if this sensor is not used for replacement of an existing sensor, the dimensions of the silo also need to be measured according to the instructions in chapter 5.

1.3 Target group

This installation instruction is directed to trained and qualified personnel.

1.4 Symbols used

Caution

If this section is ignored, faults, malfunctions or injury and damage to persons, equipment and the instrument can result.

2. Safety

2.1 Authorized personnel

All operations described in this documentation must be carried out only by trained, qualified personnel authorized by the plant operator. During work on and with the device, the required personal protective equipment must always be worn.

2.2 Intended use

The product is a sensor for level measurement. You can find more information about the area of application in chapter "Product description". Operational reliability is ensured only if the instrument is properly used according to the specifications in the operating instructions manual as well as possible supplementary instructions.

2.3 Warning about incorrect use

Inappropriate or incorrect use and/or installation of this product can give rise to application-specific hazards, e.g. silo overfill through incorrect mounting or adjustment. Damage to property and persons or environmental contamination can result. Also, the protective characteristics of the instrument can be impaired.

2.4 General safety instructions

The operator is responsible for the trouble-free operation of the instrument. When measuring aggressive or corrosive media that can cause a dangerous situation if the instrument malfunctions, the operator has to implement suitable measures to make sure the instrument is functioning properly.

During the entire duration of use, the user is obliged to determine the compliance of the necessary occupational safety measures with the current valid rules and regulations and also take note of new regulations.

The safety instructions in this operating instruction, the national installation standards as well as the valid safety regulations and accident prevention rules must be observed by the user.

For safety and warranty reasons, any invasive work on the device beyond that described in the operating instruction may be carried out only by personnel authorized by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden. For safety reasons, only the accessory specified by the manufacturer must be used.

To avoid any danger, the safety approval markings and safety tips on the device must also be observed and their meaning read in this operating instruction.

2.5 Contact information

In case of questions or technical assistance is needed please contact:

Abel Sensors
Noordeinde 30
2611KH Delft
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e-mail:info@abelsensors.com
phone number : +31 15 202 30 39

3. Regulations and conformity

3.1 EU directives

The device fulfils the legal requirements of the applicable EU directives. By affixing the CE marking, we confirm the conformity of the instrument with these directives.

3.2 FCC and ISED Declarations

3.2.1 Compliance statement (part 15.19)

This device complies with part 15 of the FCC Rules and to RSS of Industry Canada.
Operation is subject to the following two conditions:
(1) this device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

3.2.2 Warning (part 15.21)

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

3.2.3 Information to the User (Part 15.105 (b))

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
--Reorient or relocate the receiving antenna.
--Increase the separation between the equipment and receiver.
--Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
--Consult the dealer or an experienced radio/TV technician for help.

This Class B digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de Classe B est conforme à la norme Canadienne ICES-003.

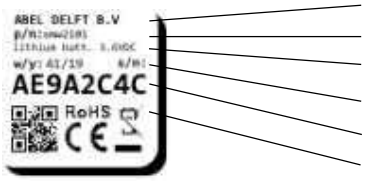
To comply with FCC and Industry Canada RF radiation exposure limits for general population, the antenna(s) used for this transmitter must be installed such that a minimum separation distance of 20 cm is maintained between the radiator (antenna) and all persons at all times and must not be co-located or operating in conjunction with any other antenna or transmitter.

This device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's license-exempt RSS(s). Operation is subject to the following two conditions:
(1) This device may not cause interference;
(2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:
1. L'appareil ne doit pas produire de brouillage;
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

4. Product description

4.1 Product info



1. Company name
2. Product number
3. Power
4. Production week/year
5. (unique) serial number
6. QR serial number

Serial number

The serial number is unique.

4.2 Description

The product is a sensor for level measurement of bulk solids and liquids. The product is suitable to be used in smaller silo applications.

4.3 Working principle

The product contains a 77gHz radar sensor to measure the relative distance between sensor and its target.

5. Installation

5.1 General instructions

This product must be mounted on a silo in order to measure the distance to the content surface.

5.2 Prerequisites (only for NB-IoT variants)

The sensor communicates over cellular 4G/5G communication. In order for the sensor to function properly there should be local NB-IoT coverage with reasonable quality. Quality is sufficient under the following conditions:

- RSRQ > -15dBm
- RSRP > -113dBm
- SNR > -3dB
- The following exceptions are allowed (only one exception allowed at a time!):
    - RSRQ may be up to -122dBm if no other values are below the thresholds above.
    - RSRP may be up to -18dBm if no other values are below the thresholds above.

These conditions can be tested with a network tester.

5.3 Tools and equipment

Aerial work platform

⚠ An appropriate work platform is required for installation. The roof of the silo has to be reached in a safe manner in order to install the sensor. Examples of suitable and unsuitable work platform are given below. Always work in a safe environment in accordance with the instructions given for the operation of the equipment.

suitable for correct installation	not suitable for correct installation
• Able to reach height of silo + 1 meter • Open platform • Support beam mounted to the side of the platform Example:	• No open tray • Support beam mounted at the bottom of the platform Example:

Safety equipment

⚠ Always use all the required safety equipment. Always work in a safe environment in accordance with the instructions given for the safety equipment.

Tools

The following tools are required:

Item	Checklist
Caulking Gun	
Wire brush	
Surface cleaner (degreaser)	
Cleaning wipes / cloth	
Laser measurement tool	
Tape measure, long enough for silo circumference	
Digital level (needs to support digital reading for measurement of silos with asymmetric cones)	
Waterproof marker	
Measurement forms with pen/pencil	

Item (Silos where screen is needed)	Checklist
Cordless drill	
Holesaw 111mm	
Socket spanner 7mm suitable for cordless drill	

Item (Silos where angled adapter screen is needed)	Checklist
Cordless drill	
Jigsaw	
Socket spanner 7mm suitable for cordless drill	

Item (For dismounting removeable hatch)	Checklist
Socket set	
Wrenches	
Screwdrivers	

The product

The sensor product and mounting accessories:

Item	Checklist
Silo Sensor	
Glue (TEC7 Mount&Seal)	

Items (Silos where screen is needed)	Checklist
Polycarbonate flat screen	
4x Screws	
4x Washers	

Items (Silos where angled adapter screen is needed)	Checklist
Polycarbonate angled adapter screen	
4x Screws	
4x Washers	

5.4 Location of the sensor

The location of the sensor must be carefully chosen in order for the product to work properly. The following image represents the silo top view with green coloured locations suitable for installation. The orange coloured sections are not suitable locations for mounting the sensor.

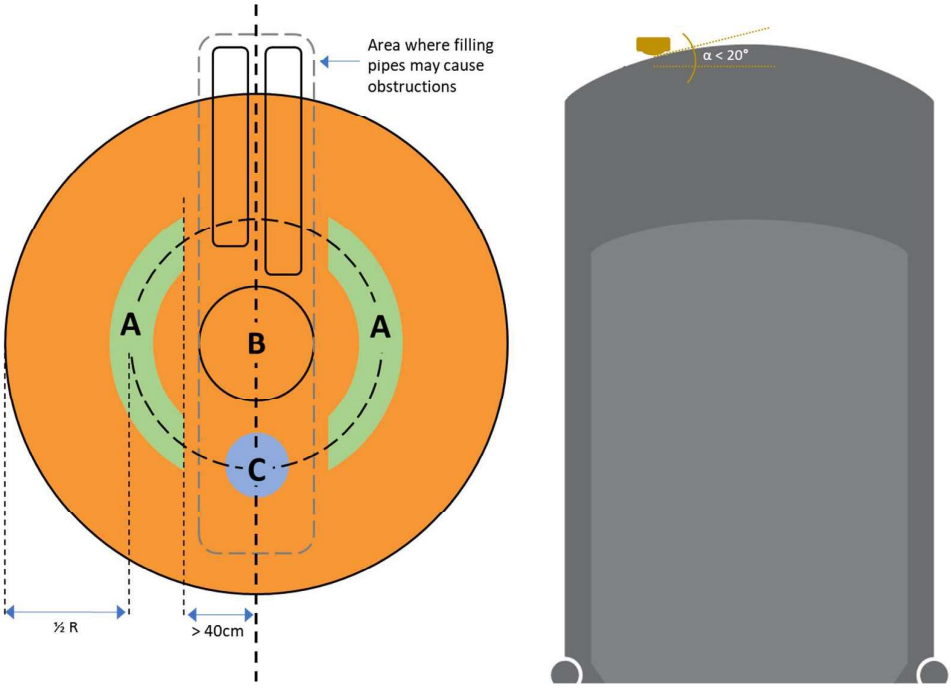


Figure 1: Sensor location on cylindrical silos

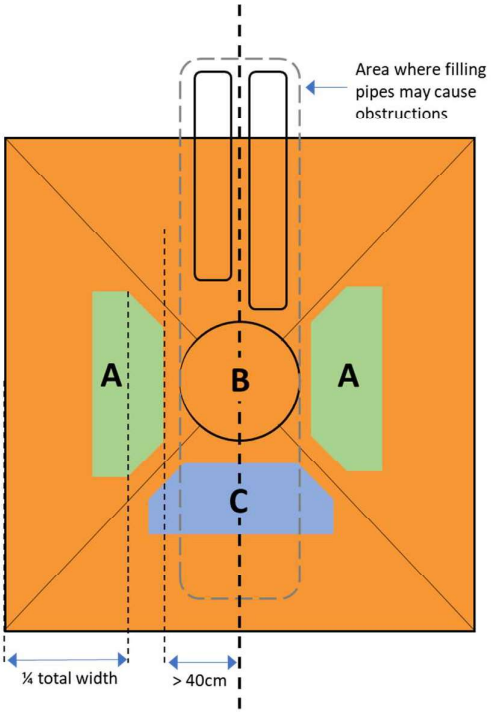


Figure 2: Sensor location on rectangular silos

Please follow the numbered mounting recommendations below carefully:

1. Preferred mounting area

Mounting area A is the preferred mounting area for the sensor, see Figure 1 for cylindrical silos and Figure 2 for rectangular silos.

If mounting area A is not available then it is also possible to mount in the centre of the silo (area B), but only under the following conditions:

- Area B consists of a removable hatch, which can be opened. Or there is a hatch nearby.
- An inspection is performed to verify that there are no obstacles underneath or near Area B.

Area C marked in the figures is only to be used in case of asymmetric silos, and only in case where the bottom exit is underneath area C. Please see paragraph 5.4.1 for additional instructions for mounting on asymmetric silos.

2. Offset from silo wall

Optimal placement of the sensor is at a distance of ½ the silo radius from the side of the silo in case of cylindrical silos and 1/4th of the silo width in case of rectangular silos, see Figure 1 and Figure 2. The sensor should never be placed closer than 50cm to the side of the silo.

3. Offset from fill pipes and other (metal) objects.

Fill pipes entering the silo might protrude into the silo and occupy the area marked in Figure 1 and Figure 2. In order to avoid unwanted reflections from pipes, the sensor must be mounted with sufficient distance from this area. Rule of thumb is to keep at least 40cm distance from any visible tubes, hatches

4. Silo roof angle

The device should preferably be mounted on level surface to avoid the signal deflection. In case the device is mounted on an angled surface the roof angle should be less than 20 degrees. If the rotation of the mounting bracket is not sufficient to get the sensor leveled, the silo is unsuitable for installation with the regular mounting bracket and an angled adapter plate should be used (see installation option in 5.5).

5.4.1 Additional instructions for silos with an asymmetric cone (offset)

In some cases, the cone of a silo has an offset, so the shape is not symmetrical. In this case additional requirements for the positioning of the sensor must be met.

Figure 3: Example of silo with an asymmetric cone

In case of an asymmetric cone the following two requirements must be met:

- The sensor should be positioned above the bottom exit, preferably at a distance of ½ the silo radius from the side of the silo (1/4th the silo width in case of rectangular silos) and also keeping in mind the other general restrictions described in 0.
- The sensor should be located above line A for as much as possible (see Figure 4), while keeping in mind the restrictions regarding potential presence of fill pipes as described in 0. A slight offset from line A is allowed as long a placement is still within the green area in Figure 4.

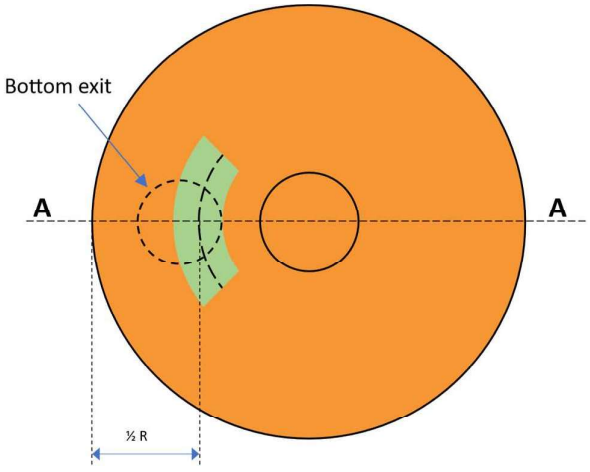
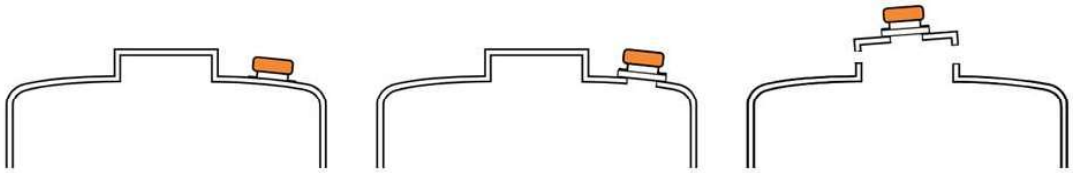


Figure 4: Sensor positioning on silo with asymmetric cone

5.5 Selection of installation method

Use the silo application fact sheet to determine the best installation method. This depends on the silo material and thickness, silo geometry and feed type.



Method **M1** Method **M2** Method **M3**

M1: Non intrusive installation, on GRP silo

Glued on top of silo. No need for modifications of the silo or an opening in the silo wall. The sensor measures through the silo wall. See **appendix A** for installation instruction of method M1.

M2. Installing the sensor on top of the silo with a flat or angled plastic screen (adapter).

Pay Attention! Make sure the silo does not contain dust!

Note, this method can cause pollution to the silo during drilling/installation. It is required to clean the silo to remove residues from installation.

M2A: Installation on GRP silo with radar screen or adapter

A hole will be drilled in the top of this silo. The hole will be permanently covered and closed with a screen that enables the radar signal to penetrate through the silo. The sensor is then installed on the screen.

M2B: Installation on metal silo with radar screen

Same as M2, but on metal silo.

See **appendix B** for installation instruction of method M2.

M3. Using radar screen, "on removable part".

In this case the same radar screen will be used as mentioned above. However, the screen and sensor will be placed on a removable part of the silo (e.g. hatch) that will be disassembled for installation.

First the removable part (e.g. hatch) will be disassembled and the silo will be covered to protect against ingress. Secondly a hole will be drilled in the disassembled hatch. The hole will be permanently covered and closed with a screen that enables the radar signal to penetrate through the silo. The sensor is then installed on the adapter plate and the hatch is reinstalled on top of the silo.

See **appendix B** for installation instruction of method M3.

5.6 Photographing the device and installation

Take the following photos of the device and installation after the installation is complete:

Take a photo of the device

1. Take a photo of the device where the serial number is clearly visible (photo 1 in the installation app).
2. Take a photo of the device with a leveler placed on the device, such that the level of the device can be checked (photo 2 in the installation app).
3. Take a photo such that the location of the device relative to the silo roof is clearly visible (photo 3 in the installation app).

Taking photographs of the silo

4. Take a photo where the entire silo is in frame and the silo number (if present) is clearly readable (photo 4 in the installation app).
5. Take a photo where the installed silo can be seen with surroundings. Relevant surroundings can be, other installed silo's or the location on the premises (photo 5 in the installation app).

5.7 Measuring the silo

The dimensions of the silo should be filled in on the corresponding measurement form for the correct shape of silo. Instructions for taking the measurements can be found in appendix C, examples of the measurement forms can be found in appendix D Also write down the product UID and silo details on the form.

6. Register the product and silo dimensions

Submitting with the app

1. Go to: https://apps.dutchsense.net/apps/silo/link-devices
2. Fill in group name. Example: Abel Sensors Group

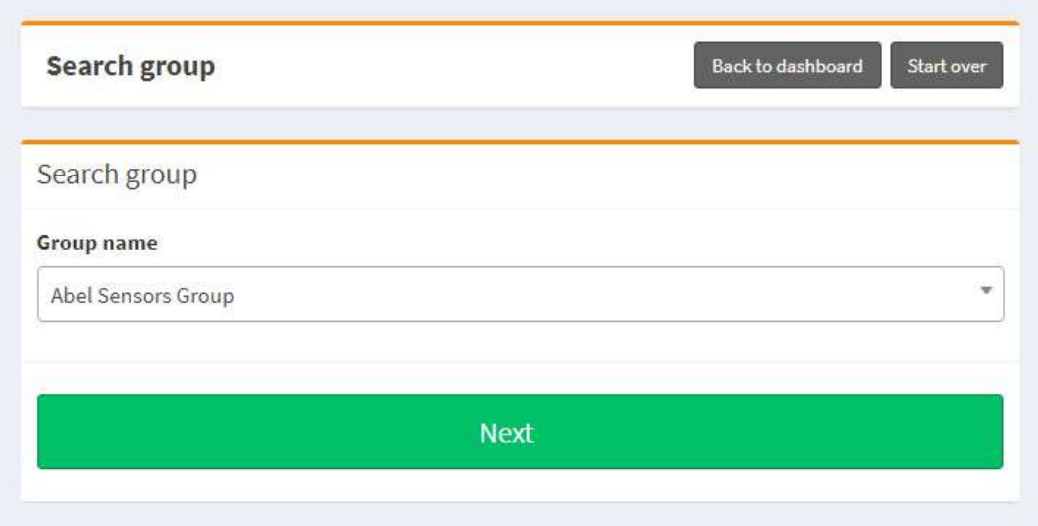
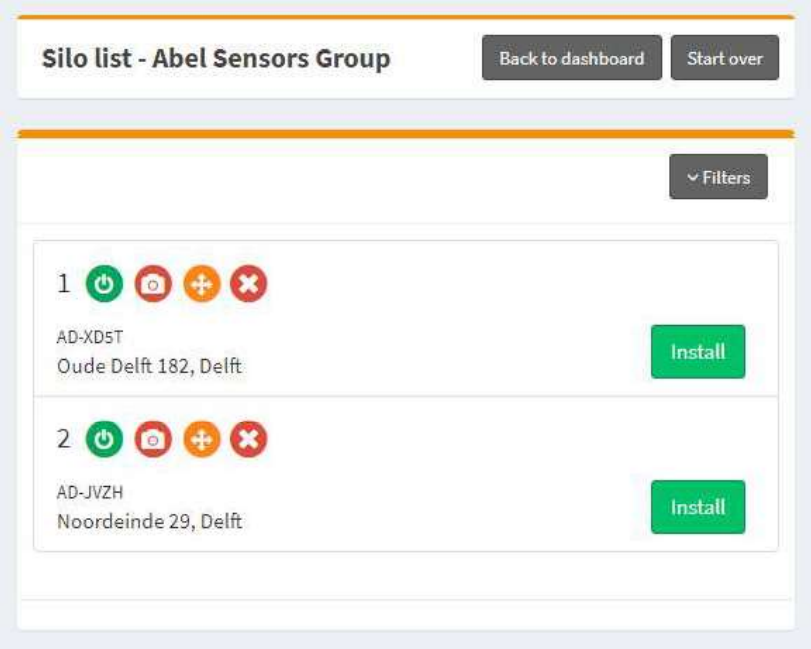
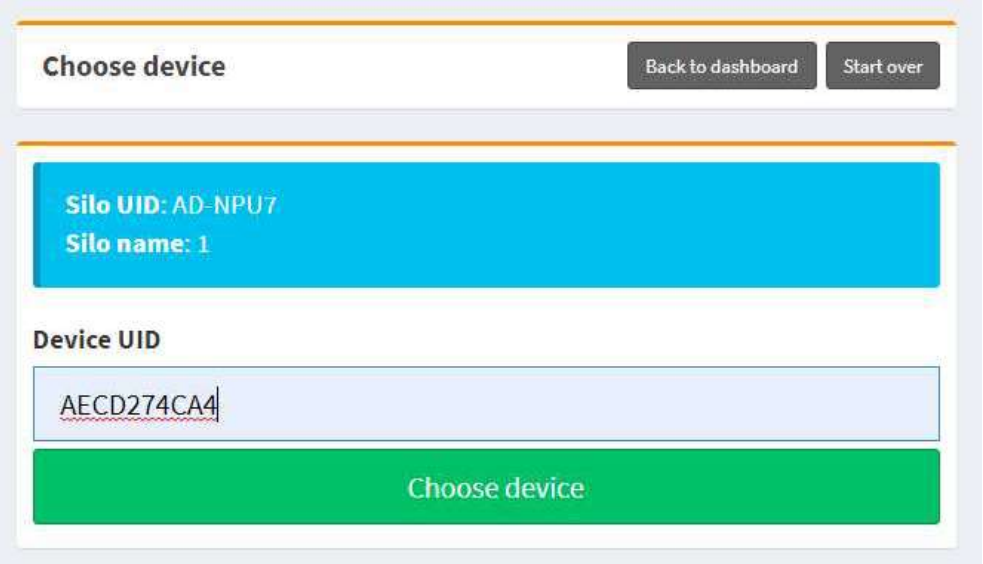


Figure 5: Selecting group

3. Choose silo and select **Install**

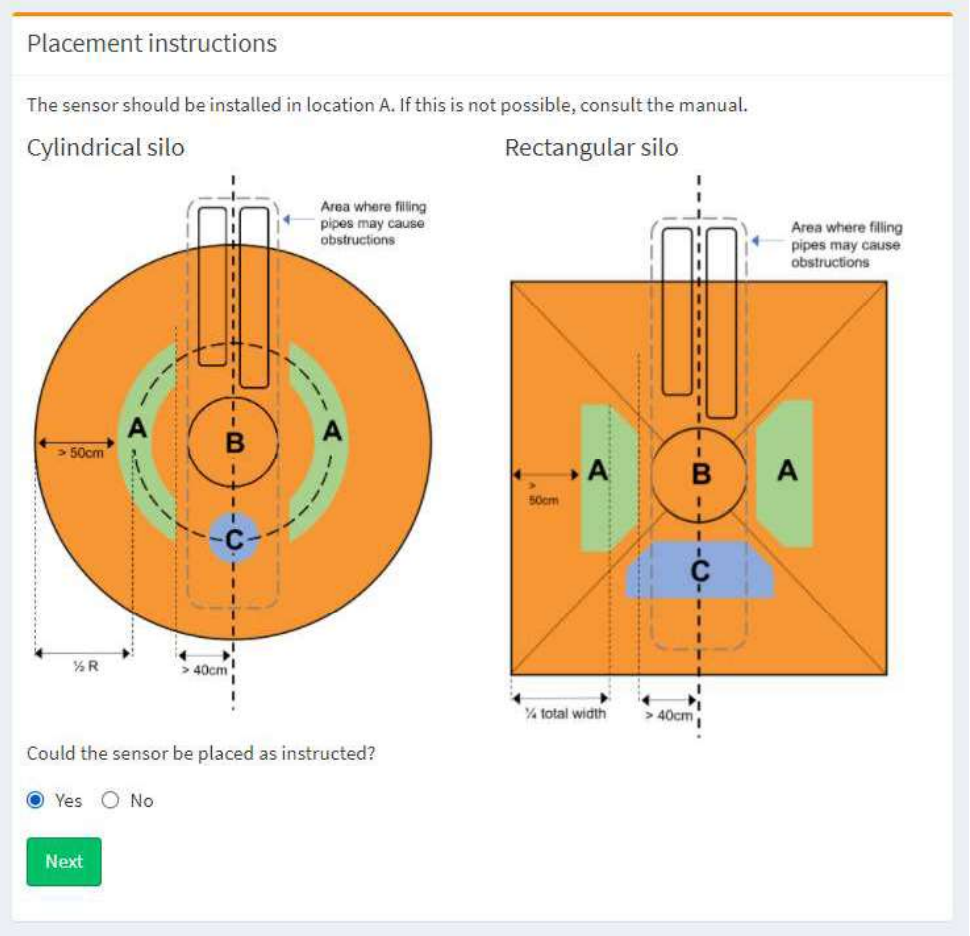


4. Enter UID of the device and select **Choose Device**

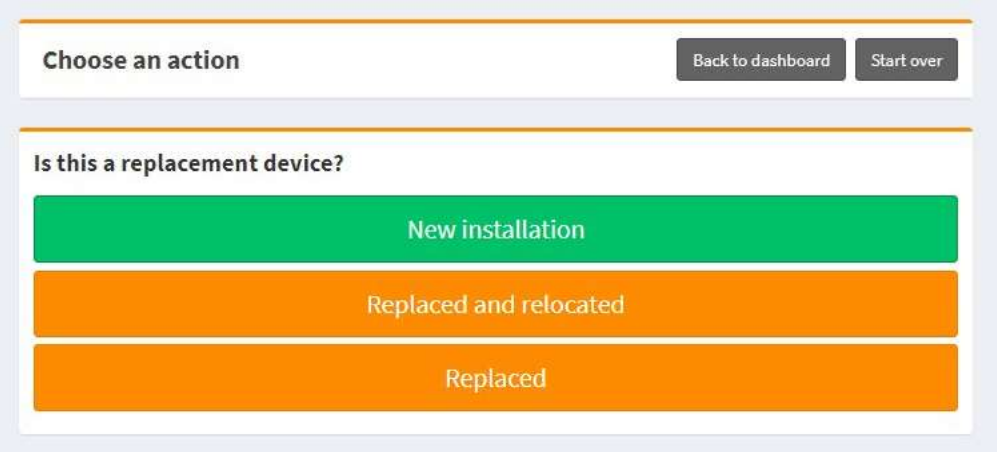


The app performs a check on the state of the sensor. Contact the Abel supportdesk when faults appear.

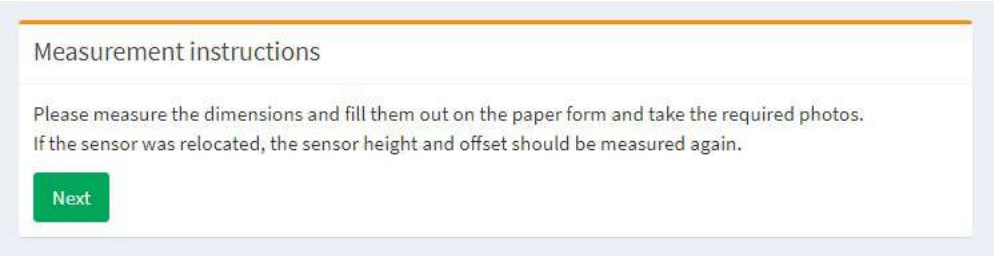
5. Confirm that installation is performed according to the installation procedure by selecting **Yes**.



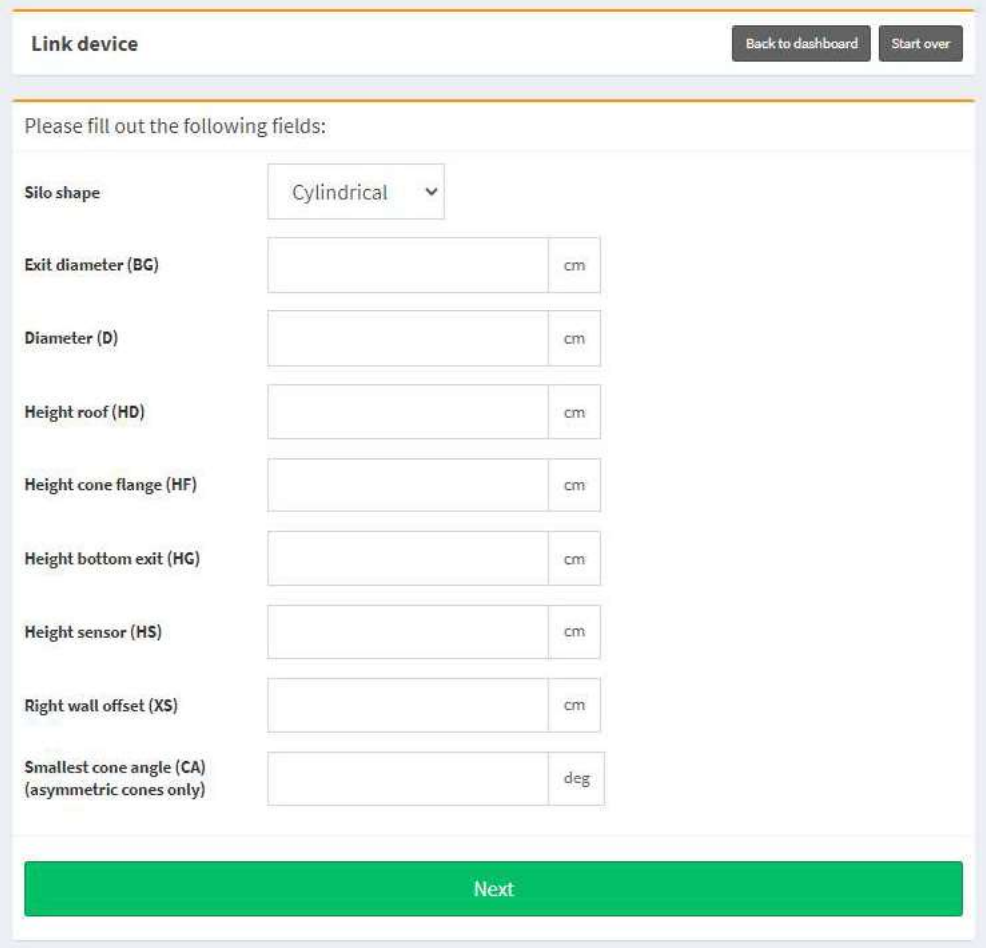
6. Select **New installation**.

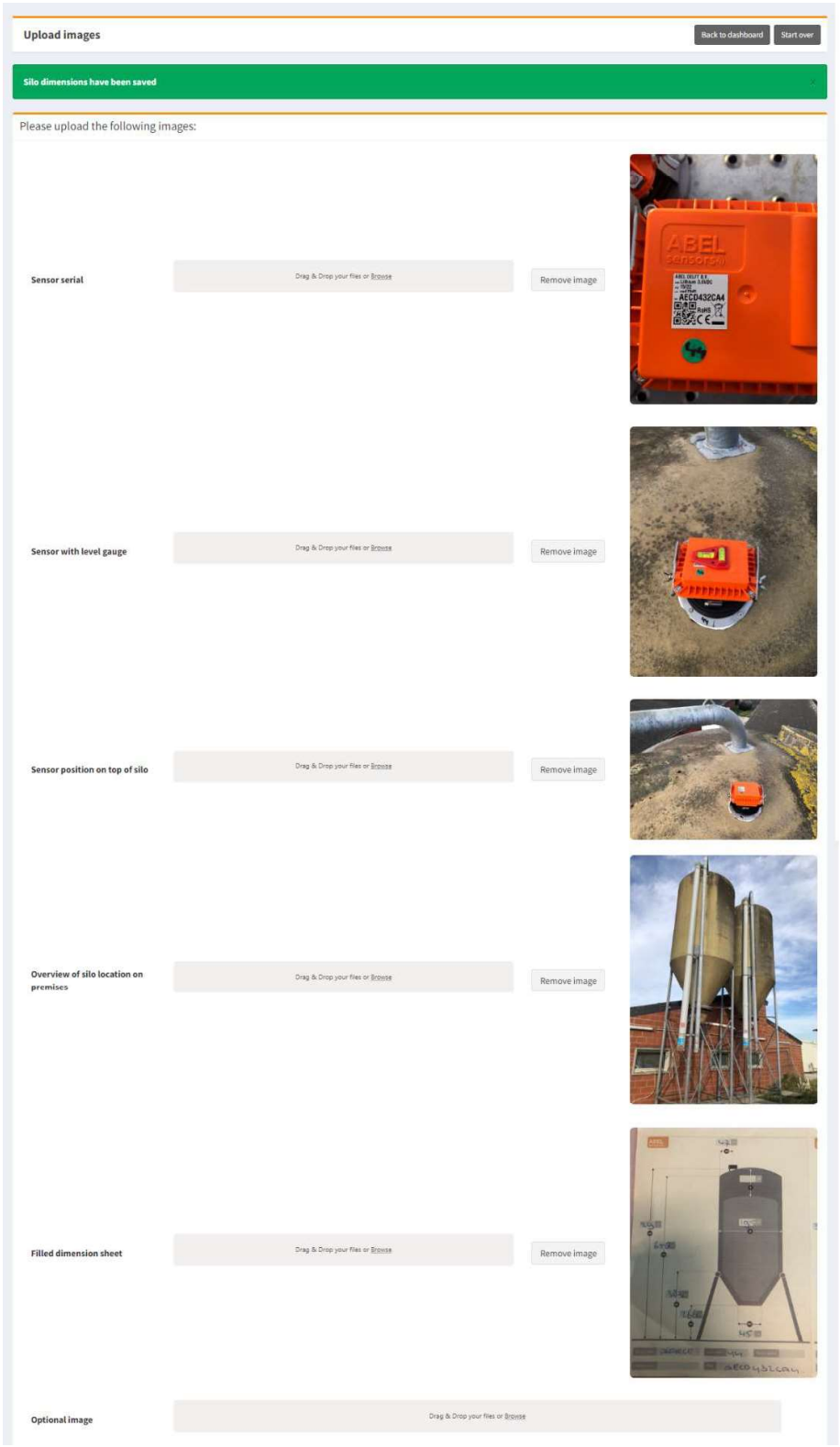


7. Read instruction and select **Next**



8. Enter Silo dimensions and select **Next**



Abel Sensors will supply a silo dimension sheet with each sensor. This sheet can be found in appendix A.1. During installation this sheet should be filled in. The filled in silo dimension sheet should be kept as backup for administration and troubleshooting purposes.

9. Submit photographs and select **Next.** Five pictures must be uploaded, the last is optional. This can be used for particularities or uploading a silo type plate.