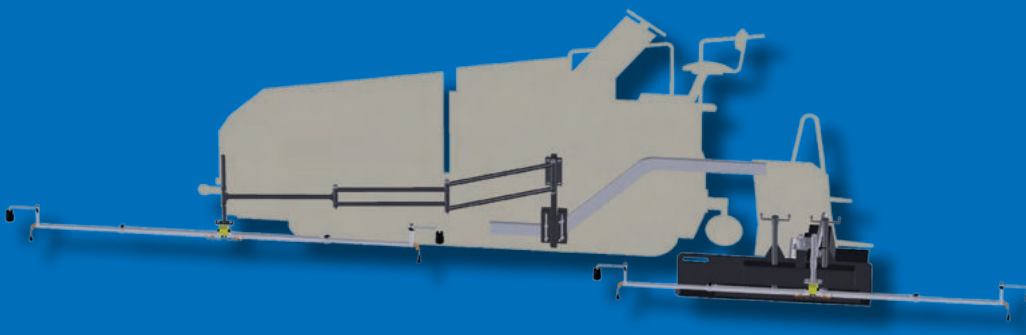
TECHNOLOGIES
PAVING INNOVATION

Mini-Line®
Averaging Beam
Installation guide



Mini-Line®
Averaging Beam

Installation Manual

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PAVING INNOVATION

Kratbjerg 214 - DK 3480 Fredensborg - Denmark - Phone: +45 48 48 26 33 - Email: sales@tf-technologies.com
www.tf-technologies.com

Mini-Line® Averaging Beam installation guide

Content and structure

This installation guide has been developed for operators to provide the necessary information to install the Mini-Line® Averaging Beam, so that it can be used together with the Mini-Line® Grade and Slope Control System. The Danish version of this manual constitutes the original installation guide for the Averaging Beam, and can therefore be used as a reference in case of doubt regarding use or misuse of the system.

The installation guide is a practical guide for the installation of the Averaging Beam, but is also full of good advice regarding the choice of sensors and their location.

Safe use

Before starting to use the Averaging Beam, the operator should ensure that it is installed as described in the guide. The manual for the selected Mini-Line® controller should also be read through completely to ensure correct and safe operation of the Mini-Line® Grade and Slope Control System together with the Averaging Beam. Dangerous situations that can arise when using the Averaging Beam are presented in the guide when relevant, and are summarised in the Safety Guide section on p. 71.

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Contact information

TF-Technologies A/S
Kratbjerg 214
3480 Fredensborg
Denmark
Tel.: +45 4848 2633
E-mail: sales@tf-technologies.com

Information about the installation guide

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Symbol overview

This user manual uses a range of symbols and warning notifications throughout the manual to make the operator aware of important safety measures or information regarding operation. The following symbols are used in this manual:

Warning!

Indicates important information the operator must be aware of to avoid dangerous situations which can result in death or serious personal injury

Caution!

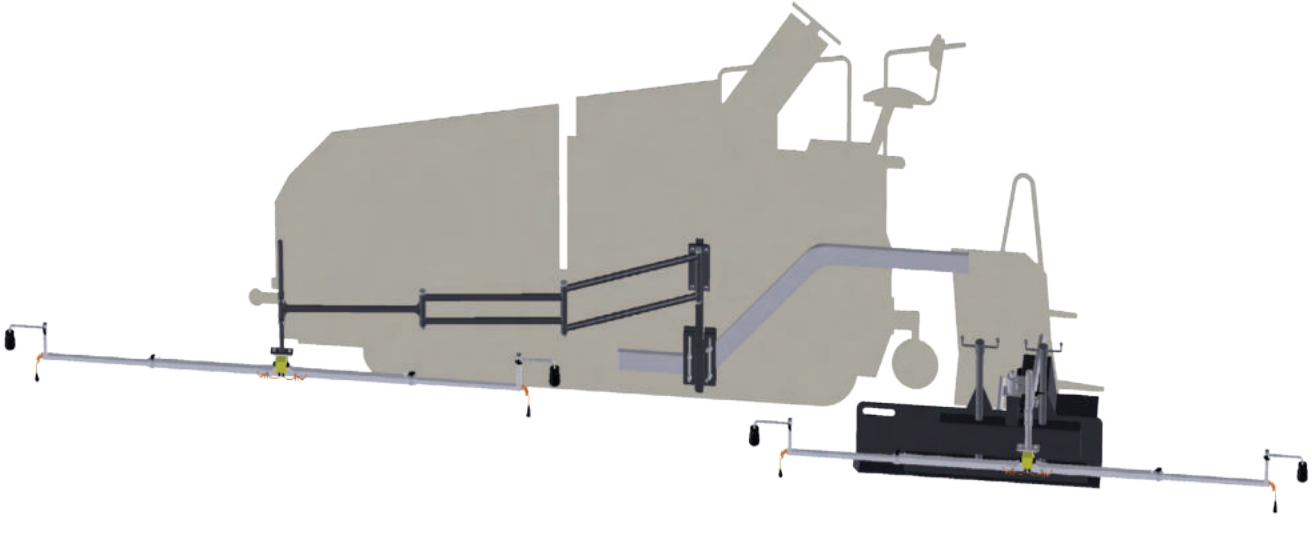
Indicates important information the operator must be aware of to avoid dangerous situations which can result in material damages

Tip

Indicates information regarding efficient and failure-free operation of the Mini-Line® Grade and Slope Control System

Step-by-step instructions

Indicates a step-by-step instruction, where a particular order of actions is required or recommended



Introduction

Using the Averaging Beam

The screed is attached to the tractor of the asphalt paver via two tow points located on either side of the paver, and which are regulated independently of each other according to grade or slope.

The Averaging Beam is used instead of a single grade sensor. If both sides of the paver are to be regulated according to grade with the Averaging Beam, two complete Averaging Beams each with four sensors must be used.

Why use an Averaging Beam?

A single grade sensor is perfect for following a reference, but when several grade sensors are combined on an Averaging Beam, local irregularities in the reference are evened out by taking an average of all the sensor measurements.

This evening out effect is what makes the Averaging Beam highly desirable and particularly useful if you do not have a good reference.

It is always recommended to use an Averaging Beam on at least one side to achieve an optimum paving result if a perfect reference is not available, such as a stringline. The other side can be controlled by a slope sensor, if a defined slope is required.

When ground sensing is used, however, this always has an influence on the final result, and even with the use of the Averaging Beam, larger irregularities can be transferred to the final road. This is due to the design of the asphalt paver itself, which means that it takes a certain amount of time for the screed to work its way up through the material when the tow point is altered. As a result, the asphalt paver is not able to completely even out large rises or fluctuations, and such large irregularities in the road should therefore be removed by improving the base before new asphalt is applied.

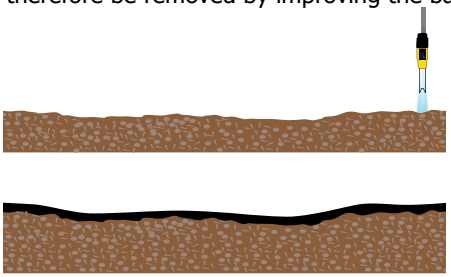


Figure 1: Regulation with a single grade sensor can together with the screed even out minor irregularities

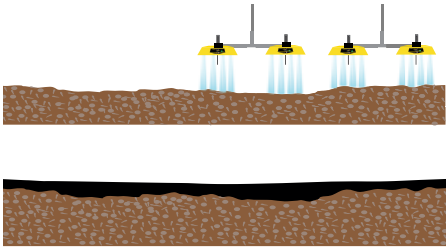


Figure 2: Regulation with an Averaging Beam can also even out larger irregularities and smoothen the surface of the road

Good advice regarding when the Averaging Beam can be used

If the ground is used as reference and it has been milled with just one sensor on either side, the milling machine will largely have copied the irregularities of the pre-existing road. Without the use of an Averaging Beam, these irregularities will be transferred to the new road when paving

If the base layer has already been paved based on ground sensing, the paver may have left small bumps or depressions in the paved mat caused by starting and stopping during paving. These small changes will be significantly minimised or evened out completely across the length of the Averaging Beam

The higher the intended driving speed on the road once completed, the greater the need to use an Averaging Beam

The more layers are paved with an Averaging Beam, the more the irregularities in the base are evened out

Introduction to Mini-Line® Averaging Beam

The Averaging Beam in the Mini-Line® series is designed to ensure optimum results for every paving job. The Averaging Beam must be used with a Mini-Line® Grade and Slope Control System with four Mini-Line® grade sensors, each supplying measurement results to a Mini-Line® controller. The Mini-Line® controller produces an average of the four measurements, so that a smoothening effect is achieved.

The design of the Averaging Beam for the use of four sensors produces reliable evening out in both large and small paving jobs, as opposed to beams with fewer sensors, where the distance between the sensors is often too great when the beam is used to its full extent on larger pavers.

The Averaging Beam is a robust construction, yet at the same time light and compact, as well as easy to install.

The two-part design of the Averaging Beam makes it unique and particularly easy to use. The two Sensor Beams can be folded up, the telescopic arms can be pushed in and the mountings can be disassembled, so that the complete Averaging Beam can easily be packed up in the luggage compartment of a normal car. This makes it easy to transport the beam from one paving job to the next, and the beam can easily be stored on site in case of larger jobs so that it is always accessible.

At the same time, the two-part design makes it easy to access the paver while asphalt is being applied, without having to step over the Averaging Beam, thereby reducing the risks associated with such dangerous situations. The two-part design also ensures the user-friendliness of the beam on both small and large pavers.

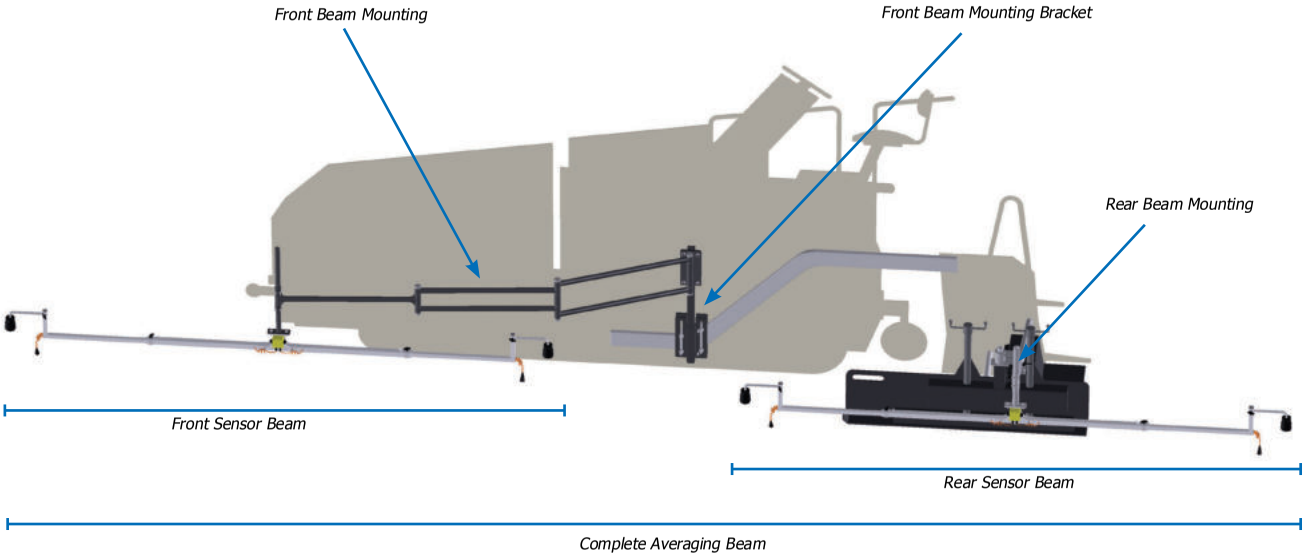
The Averaging Beam has internal wiring and Snap Connectors for the sensors, reducing the set-up time for sensors and controller to a minimum, as well as protecting the cabling during paving.

Finally, the Averaging Beam provides the operator with total flexibility during the paving job, as the beam can either be used as a complete beam with four sensors or be used with fewer sensors as required by connecting and disconnecting sensors during the paving process. Connected sensors are averaged automatically when connected.

Structure of the Averaging Beam

A complete Averaging Beam for four sensors comprises two Sensor Beams, each of which can hold two sensors. Both Sensor Beams are installed on the same side and are identical.

One Sensor Beam is installed on the screed with the aid of a Rear Beam Mounting, and one Sensor Beam is installed on the tow arm with the aid of a Front Beam Mounting. The Front Beam Mounting can be installed with a Front Beam Mounting Bracket or a mounting plate.



Complete Mini-Line® Averaging Beam installed on an asphalt paver with a Front Beam Mounting Bracket
S-50316

Parts

Components of the Averaging Beam

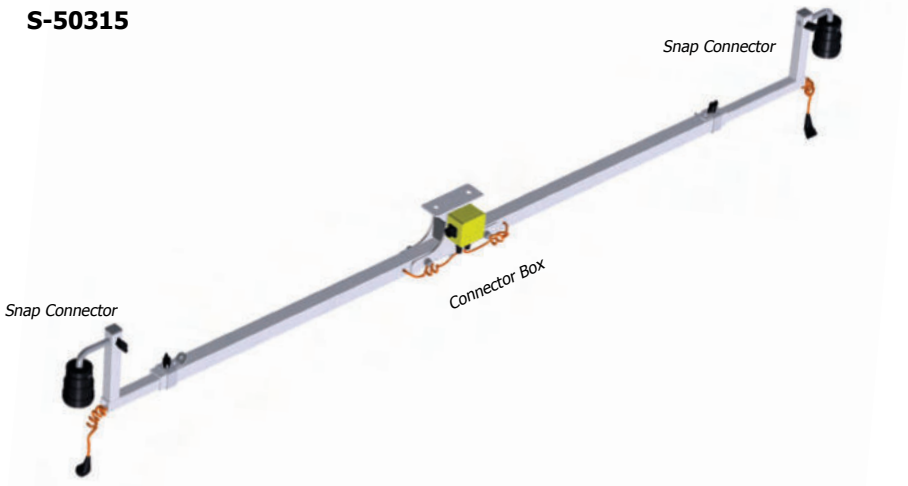
Rear part of the Averaging Beam

The rear part of the Averaging Beam is installed on the screed and always comprises a Sensor Beam and a Rear Beam Mounting.

Sensor Beam

The Sensor Beam is fully assembled with internal cabling and Connector box and is supplied with Snap Connectors.

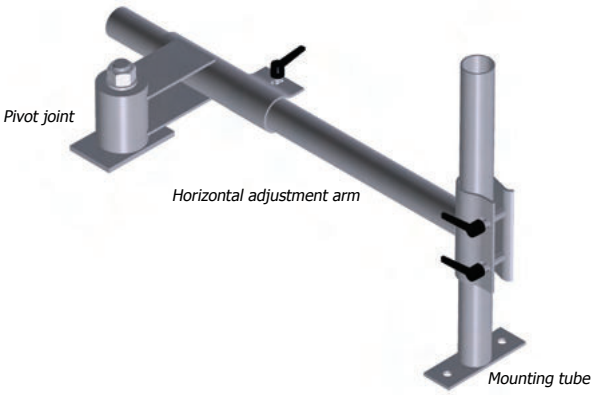
S-50315



Rear Beam Mounting

The Rear Beam Mounting comprises a pivot joint, a horizontal adjustment arm and a mounting tube.

S-50313



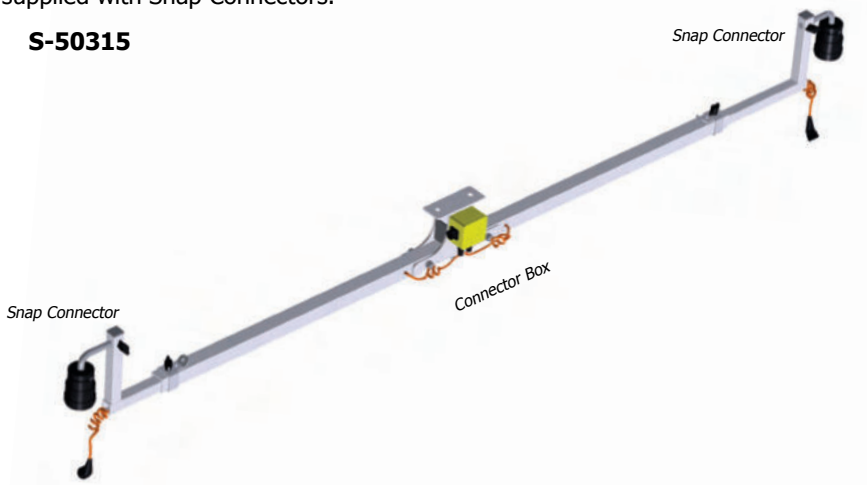
Front part of the Averaging Beam

The front part of the Averaging Beam is installed on the tow arm and always comprises a Sensor Beam and a Front Beam Mounting, as well as possibly a Front Beam Mounting Bracket.

Sensor Beam

The Sensor Beam is fully assembled with internal cabling and Connector box and is supplied with Snap Connectors.

S-50315



Front Beam Mounting

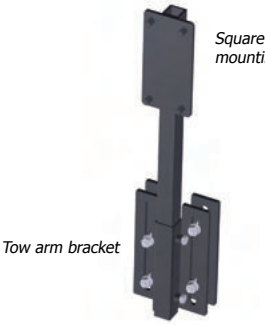
The Front Beam Mounting comprises a scissor arm that can have two or three folds, as well as a mounting tube. A mounting plate is also supplied. The mounting plate is only used if the Front Beam Mounting Bracket is not used.

S-50304 (three-fold) / S-50303 (two-fold)

Front Beam Mounting Bracket

A Front Beam Mounting Bracket is often used for installing the Front Beam Mounting, depending on the type of asphalt paver on which the Averaging Beam is to be installed. The Front Beam Mounting Bracket comprises a tow arm bracket and a square beam with a mounting plate. If the Front Beam Mounting Bracket is not being used, a mounting plate that is supplied with the Front Beam Mounting is used instead.

S-50308



Tools for installation

The following tools must be used when installing the Averaging Beam. The tools are not included. If the mounting plate is used, it may also be necessary to have welding equipment if it is to be welded in place.

The following tools must be used

19 mm 24 mm 27 mm 36 mm 4 mm

or

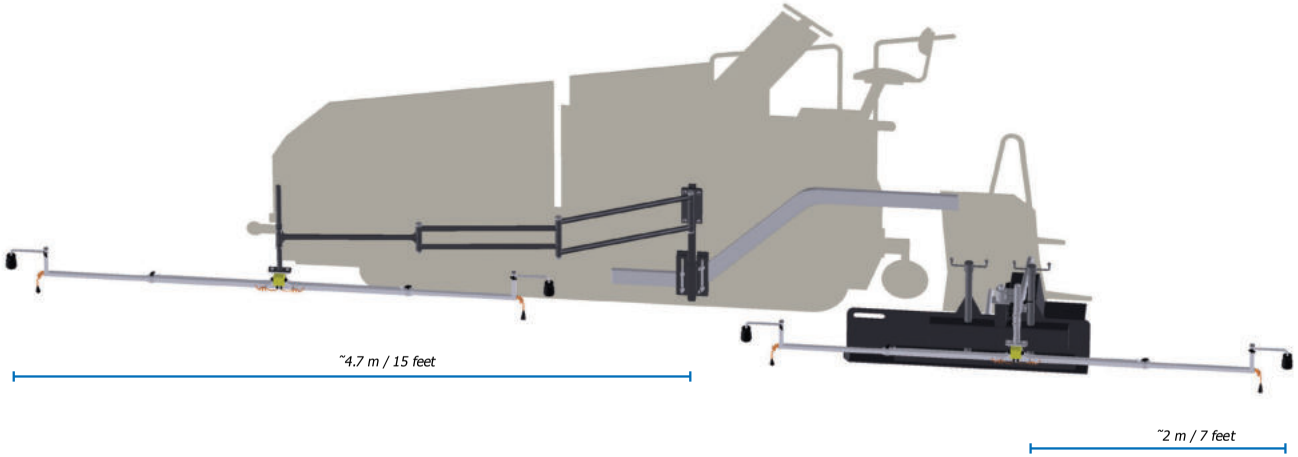
0.7-1.5” 3/8-16 UNC

Not included

Location

Length of the Averaging Beam

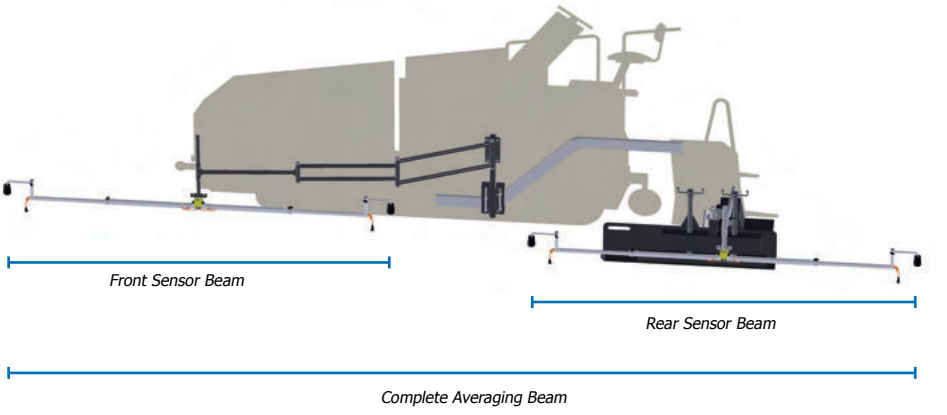
The Mini-Line® Averaging Beam is in two parts, and the combined length is therefore dependent on how the two Sensor Beams are installed. The front sensor can be positioned up to approx. 4.7 m / 15 feet from the mounting point on the tow arm, and the rear sensor can be positioned up to approx. 2.0 m / 7 feet from the mounting point on the screed.



Location of Sensor Beams

The two Sensor Beams that jointly make up a complete Averaging Beam are installed with four sensors that all measure the surface. When the Averaging Beam is connected to a controller, an average is produced of the four sensors' measurements. The Averaging Beam thereby works in the same manner as one single, very large sensor.

The combined Averaging Beam will have a balance point that is dependent on the location of the sensors, and is significant for the regulation. It is important that the balance point is located correctly to ensure a good result.



Balance point of the Averaging Beam

The balance point is important for the regulation and corresponds to the influence the location of one sensor has on the regulation when a single sensor is used (instead of the Averaging Beam with four sensors).

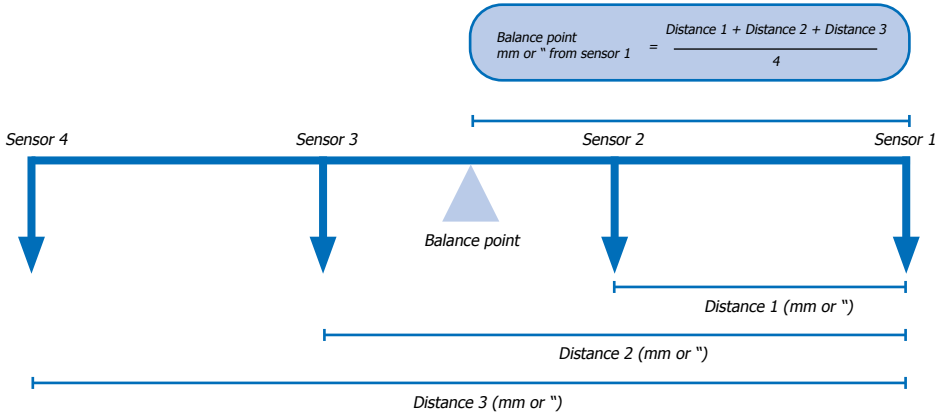


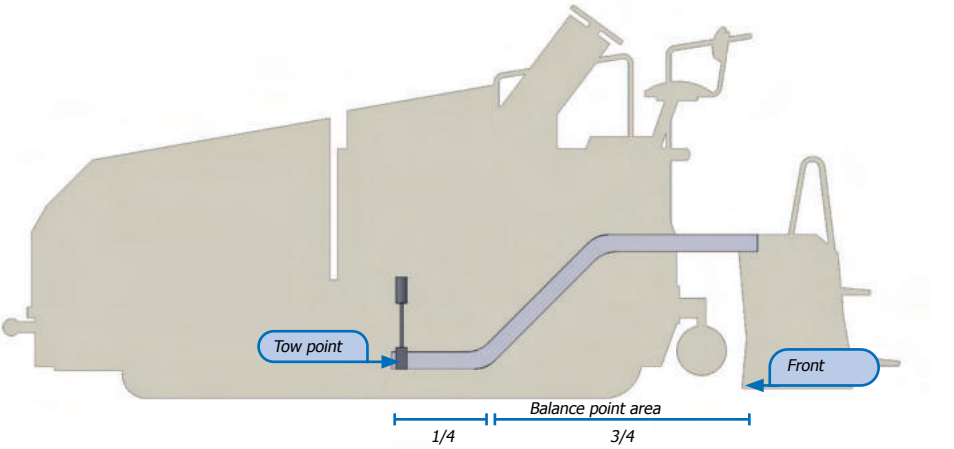
Figure 3: When the sensors are evenly distributed, the balance point is in the middle.

When the sensors are evenly distributed across the length of the Averaging Beam, the balance point will be in the middle of the Averaging Beam. If, for practical reasons, the sensors must be located at varying distances from each other, the balance point can be calculated so that is its correctly positioned in relation to the regulation.

Figure 4: In the event of an uneven distribution of the sensors, the balance point is not in the middle of the beam.

Location of the balance point

The balance point must always be located between the tow point and the front edge of the screed in order to follow the movements of the screed. In order to achieve a rapid regulation that leaves a smooth surface, it is recommended to position the balance point inside the rear ¾ of the distance between the tow point and the front edge.



If you are in doubt about the location of sensors and calculation of the balance point, you are recommended to position the four sensors evenly spaced, so that the balance point will always be in the middle of the Averaging Beam. The middle of the Averaging Beam (= the balance point) should then be positioned between the tow point and the front edge of the screed

The balance point must always be positioned between the tow point and the front edge of the screed

If the balance point is positioned too close to the tow point, regulation speed is reduced, which is otherwise one of the advantages of using the Mini-Line® Grade and Slope Control System rather than manual regulation. You are therefore not recommended to place the sensor inside the last ¼ of the distance between the tow point and the front edge of the screed, as this location results in overly slow regulation.

On the other hand, if the location of the sensors entails that the balance point is positioned very close to the front edge, the regulation becomes very aggressive. In such cases, the operator should be careful to adjust the control parameter Sensitivity of the controller and to adapt the speed of the paver, in order to prevent this resulting in over-compensation and an uneven road.[1]

The greater the distance between the four sensors, the greater the effect of the Averaging Beam

[1] *The location of the sensors must always fit with the controller, and the control parameter "Sensitivity" should be adjusted if necessary when the balance point is moved. See the controller's manual.*

Free line-of-sight to the reference and distance to reflecting surfaces

The sensors must have free line-of-sight to the reference being used. For this reason, ultrasonic sensors must maintain a distance to reflecting surfaces of at least 25 cm; for example, the sensors must be placed at least 25 cm / 10” from the side plate.

Distance to heat sources

The sensors must not be placed too close to major heat sources, such as the exhaust of the paver or an installed joint heater. Even though the grade sensors have built-in heat compensation, a position less than 50 cm / 20” from a major heat source can disrupt sensor measurements, as the temperature can easily change by ±50°C every time the wind changes direction.

The location of sensors must always take into consideration heat sources, reflecting surfaces and the influence of the sensors on each other

- There must be at least 50 cm / 20” between two sensors, so that they do not disrupt each other
- There must be at least 50 cm / 20” between a sensor and any heat sources, such as exhaust or a joint heater
- There must be at least 25 cm / 10” between sensor and reflecting surfaces

The installation of the Sensor Beams must never prevent the free movement of the screed

Installation

Setting up paver for installation

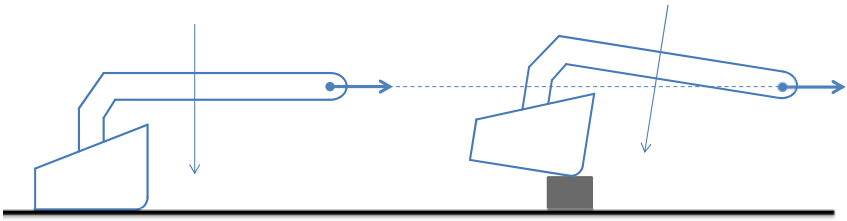


Figure 5: A change to the height of the screed changes the height and incline of installed equipment, such as an Averaging Beam

To ensure that the Averaging Beam has the correct height and incline in use, the screed must be set up as when paving prior to installation of the Averaging beam:

- Position the tow point as when paving
- Lift the screed to a typical paving height, so that the angle of attack is the same as when paving

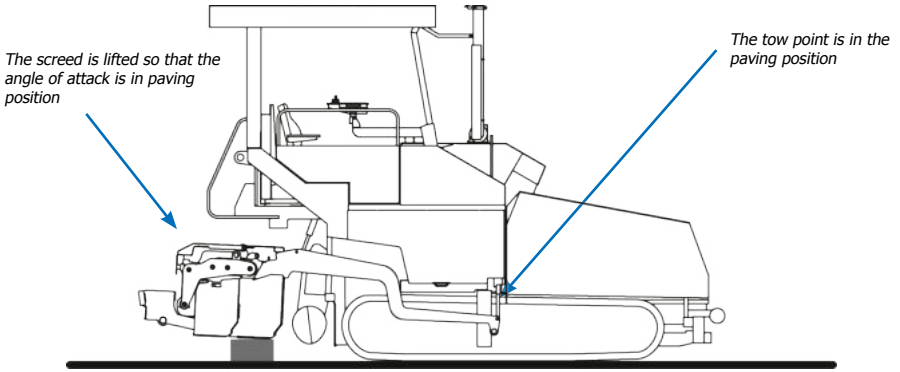


Figure 6: In order to ensure the correct installation of the Averaging Beam, place the screed paving position prior to installation, e.g. by placing start shims under the front edge of the screed

The position of the Averaging Beam can subsequently be fine-tuned to take into consideration various mat thicknesses and slopes.

In order to set up the screed in the same position as during paving, the following is recommended:

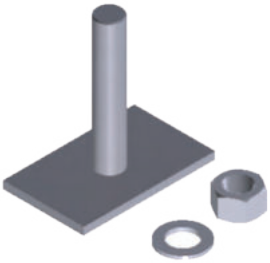
1. Build up an area of asphalt or place a start shim under the front edge of the screed, corresponding roughly to the mat thickness used
2. Lower the screed and check that the built up area is horizontal within ± 2°

Installation of rear Sensor Beam

Mountings for rear Sensor Beam

Rear Beam Mounting

S-50313



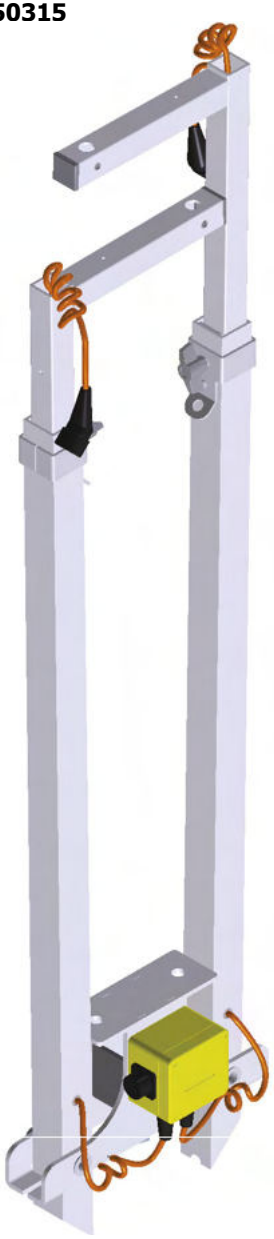
1 x Mounting plate for Rear Beam Mounting

1 x Pivot joint

1 x Mounting tube for rear Sensor Beam

1 x Horizontal adjustment arm

Rear Sensor Beam
S-50315



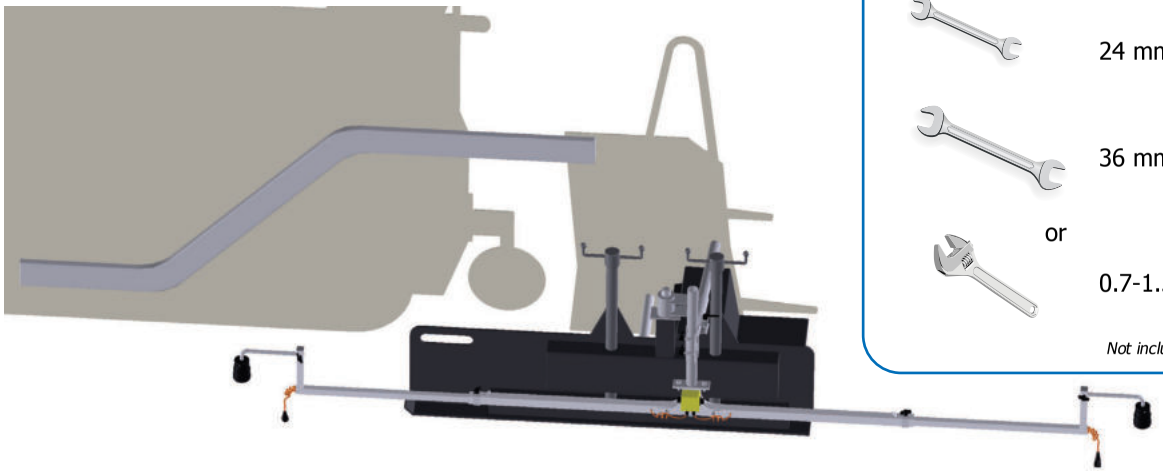
2 x Snap Connector (incl. screws)

1 x Sensor Beam with Connector box and internal cabling

2 x Sensor support bar

2 x Thumb screw

Example of assembled Sensor Beam installed on Rear Beam Mounting on the screed



The following tools must be used

19 mm

24 mm

36 mm

or

0.7-1.5”

Not included

Installation of Rear Beam Mounting

1 Find a suitable horizontal surface on the side plate of the screed to place the mounting plate of the Rear Beam Mounting on.

- The surface must have a height of approx. 800 mm / 30”, when the screed is in the paving position[2] (see page 21).
- The surface only needs to be roughly horizontal, as the incline of the Sensor Beam can be adjusted subsequently.
- There should be a maximum of 1.5 m / 5 feet from the mounting plate to the front or rear edge of the screed, so that the sensors on the Sensor Beam reach out over the screed.

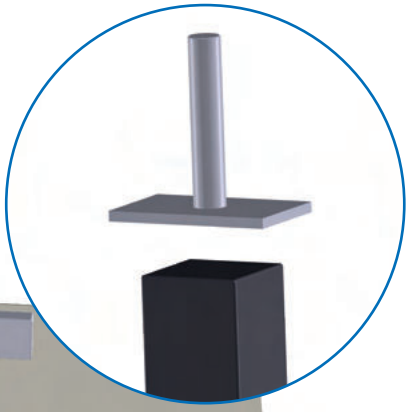


Figure 7: The mounting plate must be secured to a good even surface

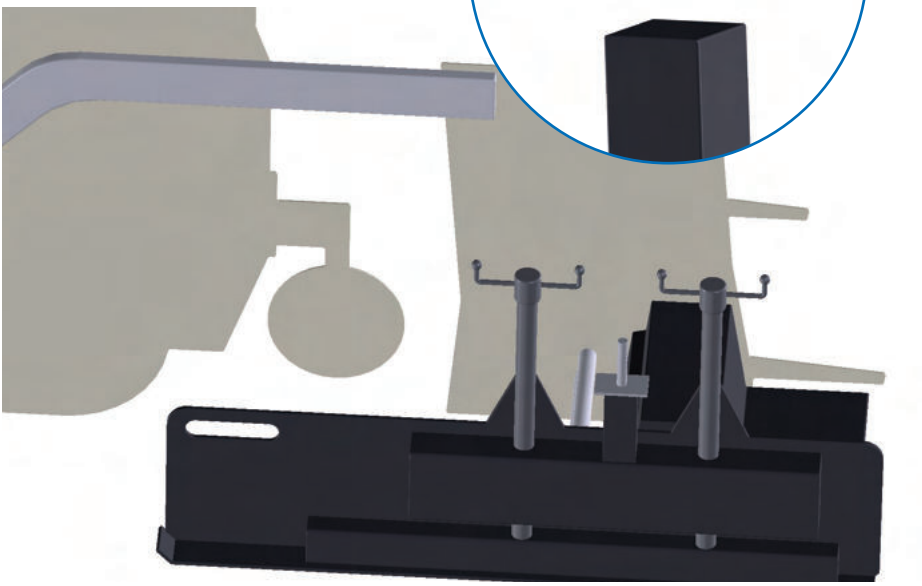


Figure 8: Example of location of the mounting plate

2 The distances from the bottom of the mounting plate (top of the block) to the surface can be found by adding up the known partial distances: The distance from the block to the bottom of the sensors (approx. 220 mm / 8”) + the height of the sensors (approx. 120 mm / 5”) + the recommended sensor height (approx. 400 mm / 16”) + the thickness of the asphalt. This produces a figure of approx. 800 mm / 30” from the top of the block to the surface.

2 Secure the mounting plate on the side plate The mounting plate can be installed with bolts or by welding it in position. However, there must be room for the pivot joint to move freely.

If there is no suitable surface for the mounting plate, it is recommended to weld a block onto the side plate, ensuring a suitable position as well as height and incline

During welding, both electrical equipment and the battery must be removed

3 Install the pivot joint on the mounting plate. The pivot joint should be tightened almost fully on the mounting plate, while still being able to turn. The pivot joint is only tightened fully when the Sensor Beam is installed.

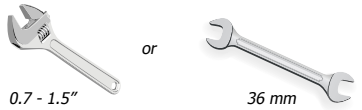


Figure 9: The pivot joint is positioned over the thread of the mounting plate

Figure 10: Installation of the pivot joint of the Rear Beam Mounting

4 Insert the mounting tube into the clamp of the adjustment arm.

Figure 11: Vertical adjustment arm and mounting tube

5 Find a suitable point on the mounting tube and secure it with the thumb screws of the adjustment arm. If the mounting tube is mounted on its center, it will fit with the recommended height of the mounting plate.

Figure 12: Example of recommended assembly, where the mounting tube is secured on its center

6 Decide whether the Sensor Beam is to be installed so that it measures inside or outside the side plate of the screed. Not all screeds offer the potential for installation inside the screed, where the Sensor Beam goes over the screed.

- Some screeds are too high, so that the sensors end up positioned too high.
- Some screeds have a design whereby it is not appropriate to have the Sensor Beam over the screed.

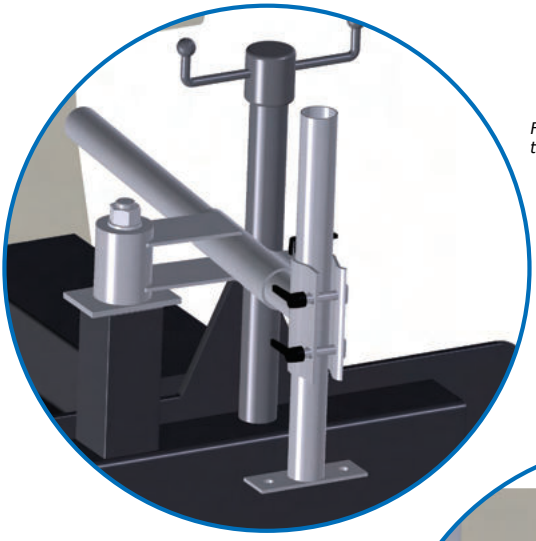


Figure 13: Example of a positioning of the mounting tube on the outer side the side plate of the screed

Figure 14: Example of a positioning the mounting tube on the inside of the side plate, where the Sensor Beam goes over the screed

The smoothening effect is achieved with the complete Averaging Beam, regardless of whether the rear Sensor Beam is installed inside or outside the side plate. Some operators prefer one installation over the other, although the installation is often determined by what reference is to be used. For example:

- At joints, where the sensors have to measure the grade of the adjoining lane, the Sensor Beam is installed outside the side plate
- When the ground inside the side plate is more reliable than the surface outside the side plate, the Sensor Beam is installed inside the side plate

If the Sensor Beam is installed inside the side plate, the operator must take care not to move the side plate too far in, where the Sensor Beam can be trapped or where the sensors are positioned too close to reflecting surfaces

The installation of the Sensor Beams must never prevent the free movement of the screed

7 Position the pivot joint so that when mounting sensors on the Sensor Beam later, they will not be located too close to any reflecting surfaces, such as the side plate or the screed. The field of view of the sensors can be read from their data sheets, but as a rule of thumb there should be at least 25 cm / 10” from the side plate to the mounting tube.

8 Secure the pivot joint in the required position, so that it can no longer be turned.

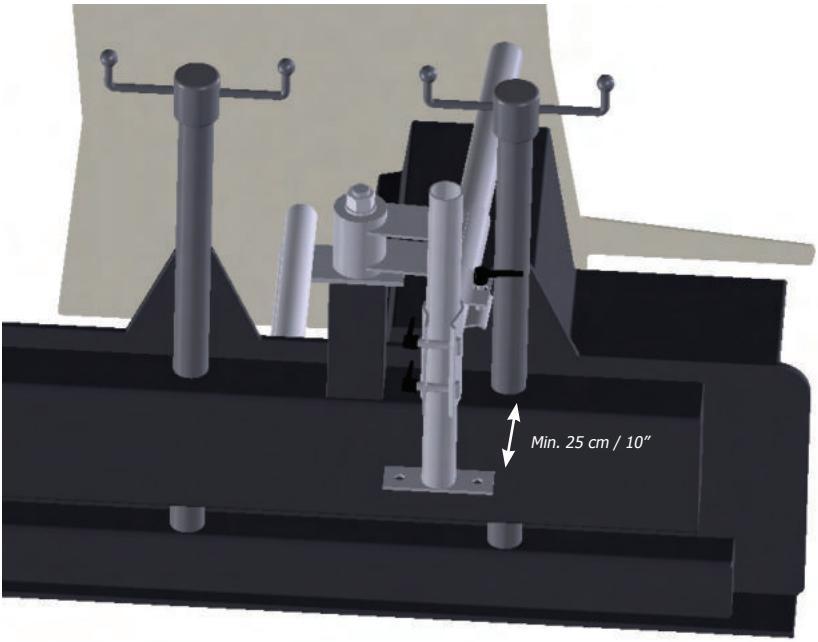


Figure 15: Example of location of the mounting tube

9 Secure the horizontal adjustment arm in the pivot joint, so that the mounting tube is vertical and its flange is at the correct height.

- As a starting point, the flange must be 600 mm / 25” above the ground, when the screed is in paving position (see page 21).
- The surface at the bottom of the mounting tube must be horizontal within ± 5°, when the screed is in paving position (see page 21).

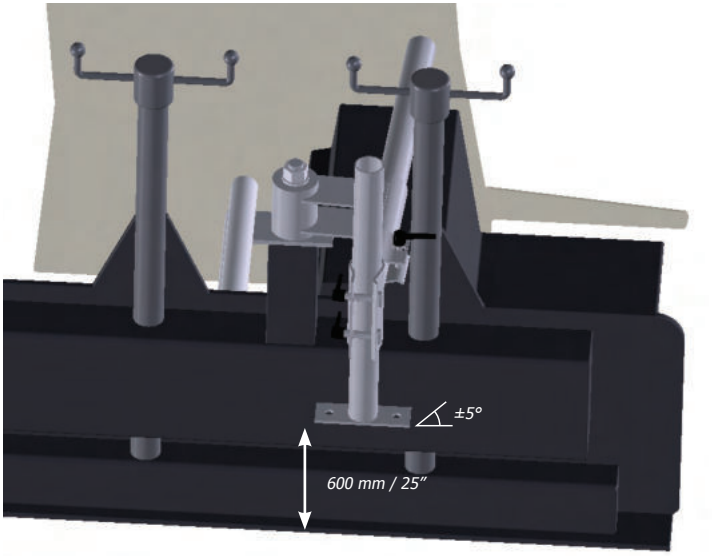


Figure 16: Example of location of the mounting tube

[3] *The distances from the flange to the surface can be found by adding up the known partial distances: The distance from the top of the Sensor Beam to the bottom of the sensors (approx. 45 mm / 4”) + the height of the sensors (approx. 120 mm / 5”) + the recommended sensor height (approx. 400 mm / 16”) + the thickness of the asphalt. This produces a figure of approx. 600 mm from the flange to the surface.*

Installation of Sensor Beam on Rear Beam Mounting

1 Secure the bracket on the top of the Sensor Beam hinge to the mounting tube. This must be done while the Sensor Beam is still folded.

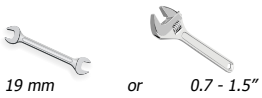


Figure 17: The Sensor Beam is mounted with two bolts

Figure 18: Installation of Sensor Beam on Rear Beam Mounting

When the screed is lifted, the Sensor Beams must always be folded, so that the sensors do not make contact with the ground. This applies in particular to the front Sensor Beam. Bear in mind that the screed is frequently lifted, for example when positioning the paver, under transport and when starting and stopping.

2 Unscrew the retaining nut in the bottom of the Sensor Beam. The Sensor Beam can then be unfolded.

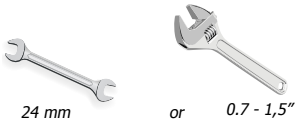


Figure 19: Before unfolding the Sensor Beam, first remove the retaining nut in the bottom

Figure 20: Folded Sensor Beam

3 Unfold the Sensor Beam by pulling the telescopic arms. Tighten the retaining nut so that the Sensor Beam is held in the extended position.

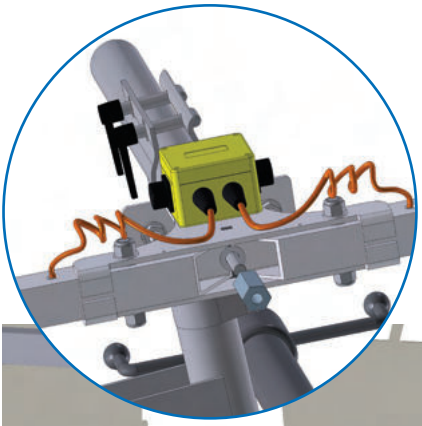


Figure 21: When the Sensor Beam is unfolded, the arms are held in place by the retaining nut

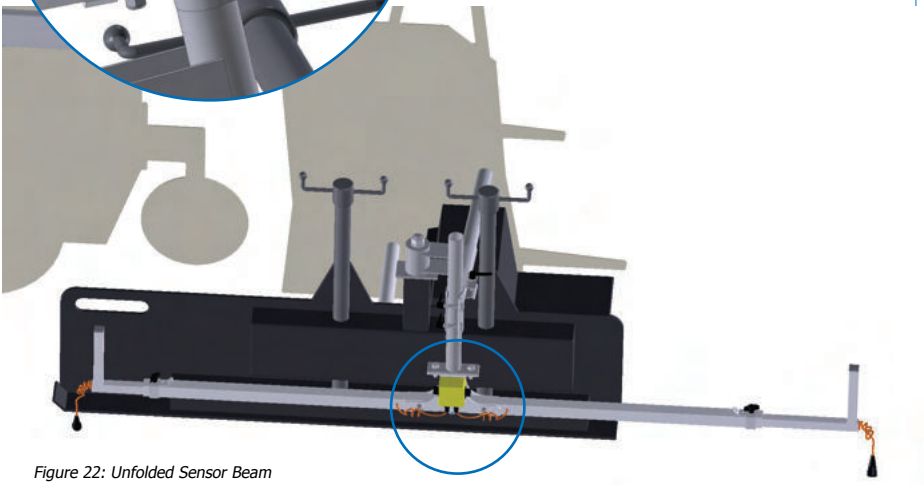


Figure 22: Unfolded Sensor Beam

4 Adjust the length of the two telescopic arms of the Sensor Beam. The two arms should normally be extended to full length, but their length should also take into consideration the field of view of the sensors and the combined balance point.[4]

- There must always be at least 0.5 m / 20" between two sensors, so that they do not disrupt each other.
- The sensors must be at least 0.25 m / 10" from machine components, so that the ultrasound is not reflected.

Figure 23: The length of the telescopic arms is adjusted by loosening the thumb screw and pulling the extension out to the desired length

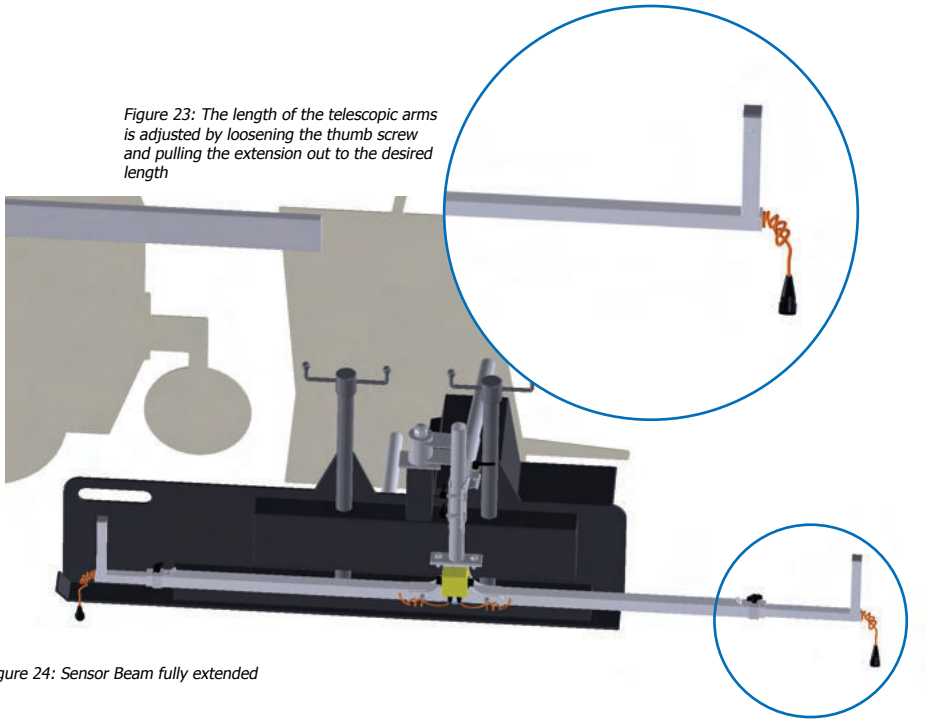


Figure 24: Sensor Beam fully extended

[4] *See section Location of Sensor Beams, p. 16.*

The greater the distance between the four sensors on a complete Averaging Beam, the greater the effect of the Averaging Beam

The length of the arms can be adjusted to ensure that the four sensors have the required distance between them. Pay attention to the fact that the two central sensors may be positioned too close to each other

The measurements taken by the grade sensors can be affected by sudden changes in temperature. For this reason, e.g. exhaust fumes or hot ventilation air can cause a sensor to measure incorrectly when the sensor is alternately exposed to cold wind and hot air from the paver or joint heater. The grade sensors should therefore be positioned 0.5 m / 20” from all heat sources

Installation of front Sensor Beam

Mountings for front Sensor Beam

Front Beam Mounting

S-50304

1 x 3-fold scissor arm

1 x Mounting tube for front Sensor Beam

1 x Mounting plate for scissor arm
Only used if the Front Beam Mounting Bracket is not used

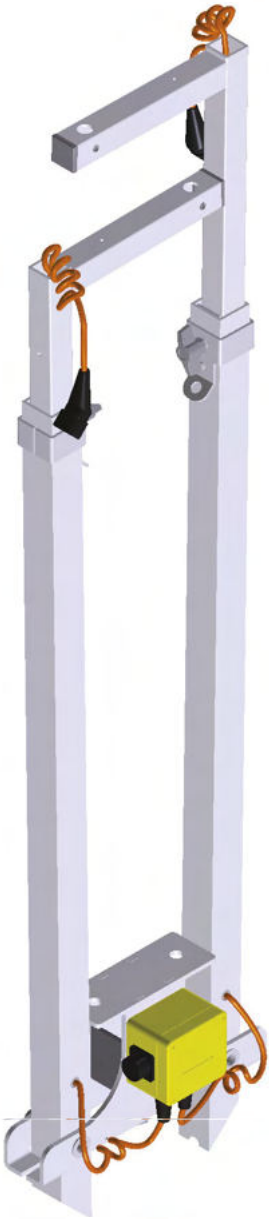
Front Beam Mounting Bracket
S-50308

1 x Square beam with mounting plate

4 x Bolt

1 x Tow arm bracket

Front Sensor Beam
S-50315



2 x Snap Connector (incl. screws)

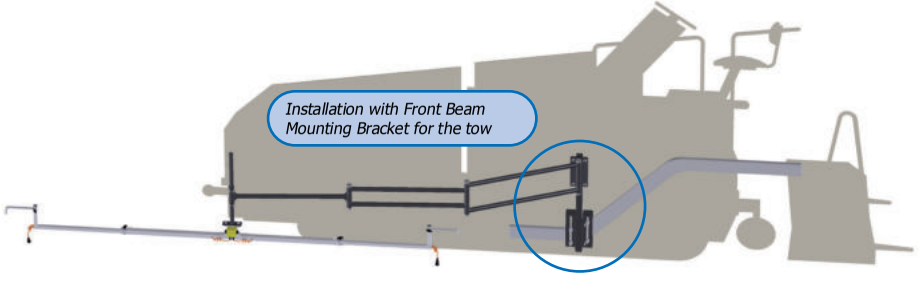
1 x Sensor Beam with Connector box and internal cabling

2 x Sensor support bar

2 x Thumb screw

Example of assembled Sensor Beam on Front Beam Mounting, installed with Front Beam Mounting Bracket on the tow arm

The front Sensor Beam is installed on the tow arm, which can take place either with a Front Beam Mounting Bracket that is secured to the tow arm or with the supplied mounting plate that is welded or bolted directly onto the tow arm. Installation with Front Beam Mounting Bracket is shown here.



The following tools must be used


19 mm


24 mm


36 mm

or


0.7-1.5”

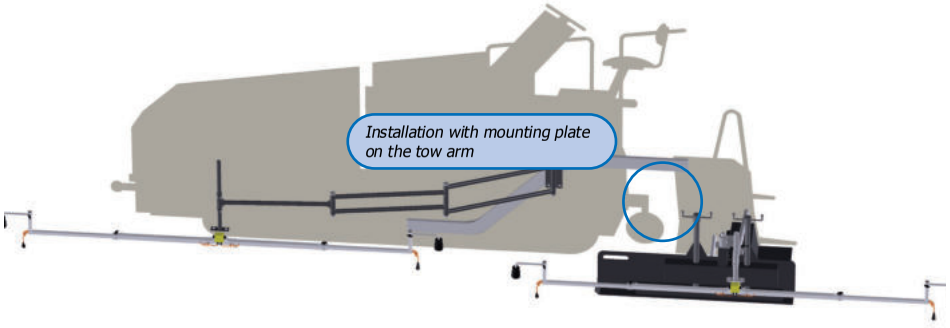
Not included

- With the Front Beam Mounting Bracket, installation is more flexible, as both height and incline can be adjusted
- The Front Sensor Beam can easily be moved to another tow arm
- Installation can take place towards the front of the paver, where the tow arm is low

- The Front Beam Mounting Bracket cannot be installed on all pavers, either because there is not enough space behind the tow arm for installation or because the bracket can come into contact with machine components

Example of assembled Sensor Beam on Front Beam Mounting, installed with mounting plate on the tow arm

The front Sensor Beam is installed on the tow arm, which can take place either with a Front Beam Mounting Bracket that is secured to the tow arm or with the supplied mounting plate that is welded or bolted directly onto the tow arm. Installation with mounting plate is shown here.



The following tools must be used


19 mm


24 mm


36 mm

or


0.7-1.5”

Not included

- When the Front Beam Mounting Bracket cannot be installed on a paver, the mounting plate can often be used

- However, it is not always possible to install the supplied mounting plate at a sufficient height, due to the design of the screed. In such situations, the Front Beam Mounting Bracket should be used
- The incline of the Sensor Beam cannot be adjusted after installation

Installation of Front Beam Mounting with Front Beam Mounting Bracket

1. Find a suitable location on the tow arm. As a starting point, this should be as far forward on the tow arm as possible, although still bearing in mind the balance point.[5]
2. Secure the tow arm bracket so that the square beam will be vertical within ± 5°, when the screed is in paving position (see page 21).

Figure 25: The tow arm bracket is bolted in place on the tow arm

Figure 26: Example of location of the tow arm bracket

[5] See section Location of Sensor Beam, p. 16.

3 Place the square beam with the mounting plate in the tow arm bracket at the desired height, and secure the beam with the two bolts on the side of the tow arm bracket. As a rule of thumb, the upper side of the mounting plate should be approx. 1 m /3 feet above the ground, where possible.[6] Often, the design of the tow arm restricts the installation options, though.

Figure 27: The square beam with the mounting plate secured with two bolts on the side of the tow arm bracket.

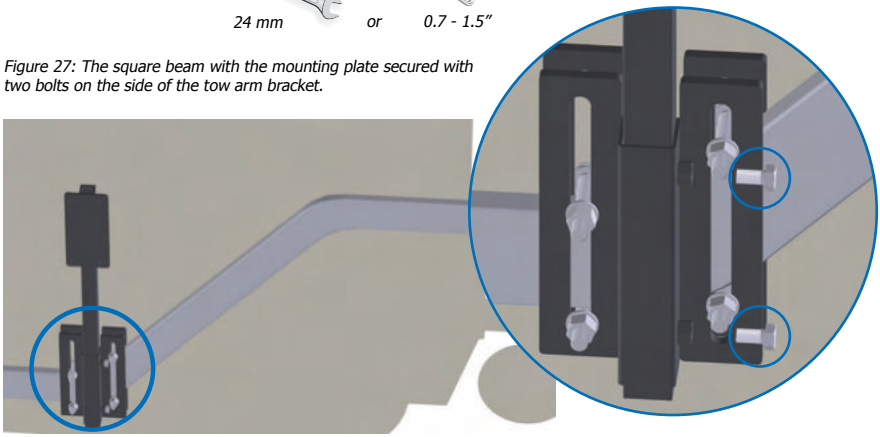


Figure 28: Example of height of the mounting plate.

The Front Beam Mounting Bracket for the scissor arm must not be in the way of the paver

- The mounting plate on the square beam must not come into contact with machine components when raising or lowering the screed. If an additional distance to the machine is required, it is possible to insert a plate between the tow arm and the tow arm bracket
- The square beam must not protrude down so far that it can scrape against the ground when the screed is fully lowered

[6] *The distances from the mounting plate to the surface can be found by adding up the known partial distances: The distance from the top of the mounting plate to the Sensor Beam (400 mm / 16") + from the Sensor Beam to the bottom of the sensors (approx. 45 mm / 4") + the height of the sensors (approx. 120 mm /5") + the recommended sensor height (approx. 400 mm / 16") + the thickness of the asphalt. This produces a figure of approx. 1 m / 3 feet from the top of the mounting plate to the surface.*

Installation of Front Beam Mounting with the supplied mounting plate (instead of Front Beam Mounting Bracket)

1 Find a suitable location on the tow arm. In general, the mounting plate must be positioned as far forward as possible on the tow arm, although the mounting plate must also be situated at a suitable height.

- The upper side of the mounting plate should ideally be located 1 m / 3 feet above the ground during paving, as this ensures maximum height adjustment of the sensors subsequently.[6]
- The maximum height is 1.3 m / 4 feet and the minimum height is 0.8 m / 2,5 feet.

2 Secure the mounting plate on the tow arm so that the upper side is horizontal within ± 2°, when the screed is in paving position (see page 21). The mounting plate can be secured by welding or bolting it in place. As it is difficult to adjust the mounting plate subsequently, it is important for it to be installed correctly and for the screed to be in the paving position.

Figure 29: The mounting plate can be welded or bolted onto the tow arm

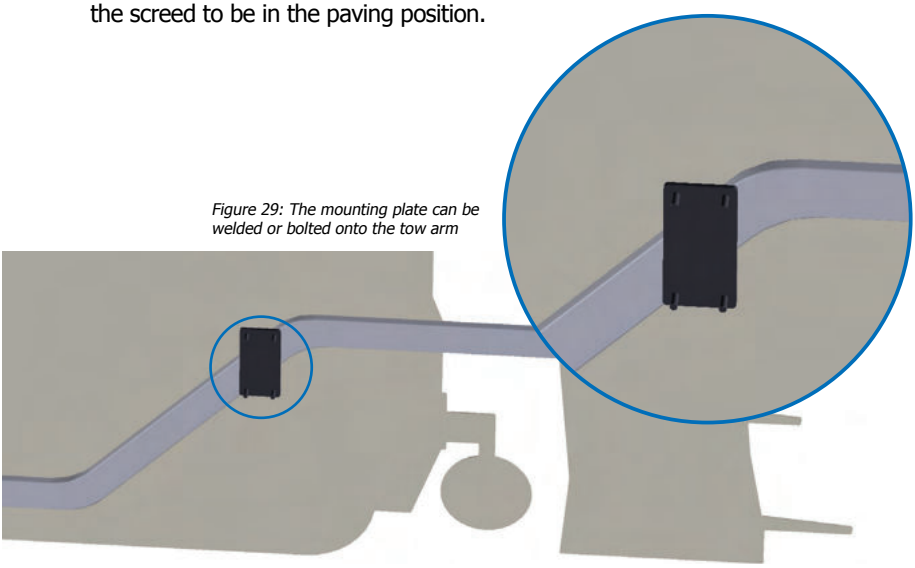


Figure 30: Example of location of the mounting plate for the Front Beam Mounting

It is not always possible to find a suitable location for the Mounting plate.
In such cases, the vertical Front Beam Mounting Bracket should be used

During welding, both electrical equipment and the battery must be removed

Assembly of the Front Beam Mounting

1 Insert the mounting tube into the scissor arm clamp before installing the scissor arm.

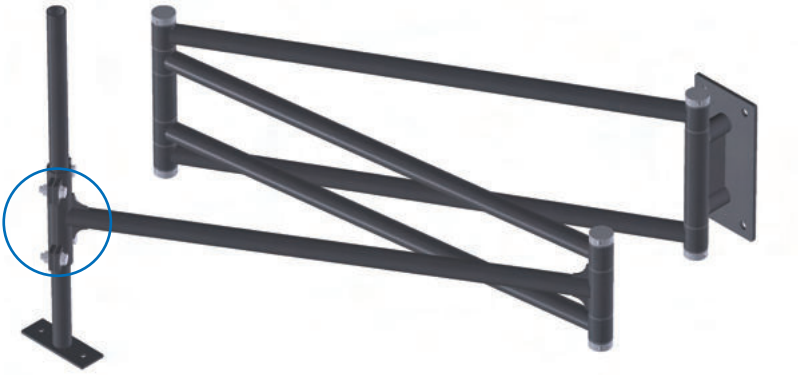
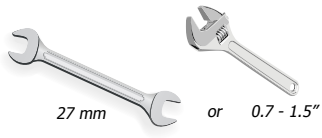


Figure 31: The Front Beam Mounting comprises a scissor arm with a mounting tube for the rear Sensor Beam



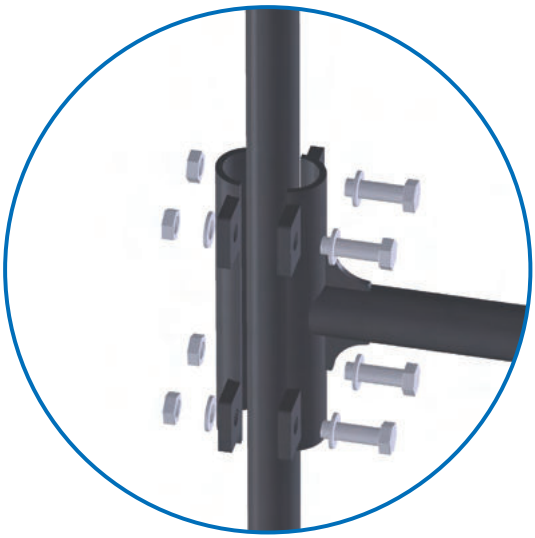


Figure 32: The mounting tube is imounted with four bolts

Installation of Front Beam Mounting with Front Beam Mounting Bracket

1 Secure the Front Beam Mounting to the Front Beam Mounting Bracket.

Figure 33: The Front Beam Mounting is mounted with four retaining nuts

Figure 34: Example of installation of Front Beam Mounting with Front Beam Mounting Bracket

2 Adjust the height of the mounting tube for the front Sensor Beam.

- The underside of the bracket, where the Sensor Beam is attached, must as a rule of thumb be situated at a height of 600 mm / 2 feet. [7]
- The height of the square beam with the mounting plate can also be adjusted, if there is a need for more adjustment than that allowed by the mounting tube.

[7] *The distances from the flange to the surface can be found by adding up the known partial distances: The distance from the top of the Sensor Beam's hinge to the bottom of the sensors (approx. 45 mm / 3") + the height of the sensors (approx. 120 mm / 5") + the recommended sensor height (approx. 400 mm / 16") + the thickness of the asphalt. This produces a figure of approx. 600 mm / 2 feet from the flange to the surface.*

Installation of Front Beam Mounting with mounting plate

1 Secure the Front Beam Mounting to the secured mounting plate.

Figure 35: The Front Beam Mounting is installed with four retaining nuts.

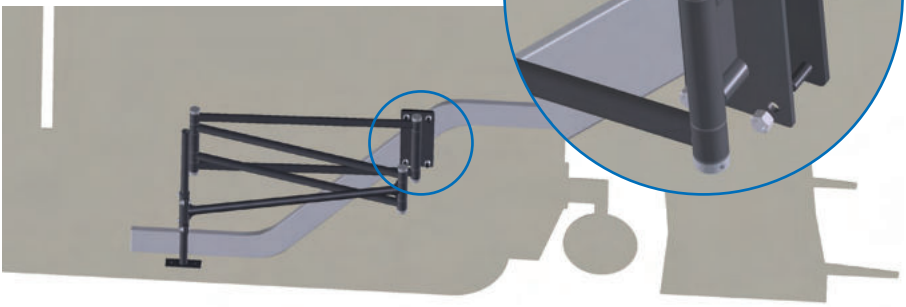


Figure 36: Front Beam Mounting installed with mounting plate

2 Adjust the height of the mounting tube for the front Sensor Beam. The underside of the bracket, where the Sensor Beam is attached, must as a rule of thumb be situated at a height of 600 mm / 2 feet.[7]

The height of each sensor must always be checked before paving, so that they are not working at the outer limit of their working range. The sensor height changes as the asphalt thickness is adjusted. The sensor height is also affected if the installation is not horizontal

- The mounting bracket of the Front Beam Mounting should be horizontal within ± 5° at the start of paving, while the screed produces the correct asphalt thickness
- Positioning the sensors too near or too far from the ground, may result in error codes

Installation of Sensor Beam on Front Beam Mounting

1 Secure the bracket on the top of the Sensor Beam hinge to the flange of the mounting tube. This must be done while the Sensor Beam is still folded.

Figure 37: The Sensor Beam is installed with two bolts

Figure 38: Example of installation of Front Sensor Beam on the Front Beam Mounting

When the screed is lifted, the Sensor Beam must always be folded, so that the sensors do not make contact with the ground. Bear in mind that the screed is frequently lifted, for example when positioning the paver, and when starting and stopping and during transport

2 Extend the scissor arm so that the Sensor Beam is positioned as far forward as possible.

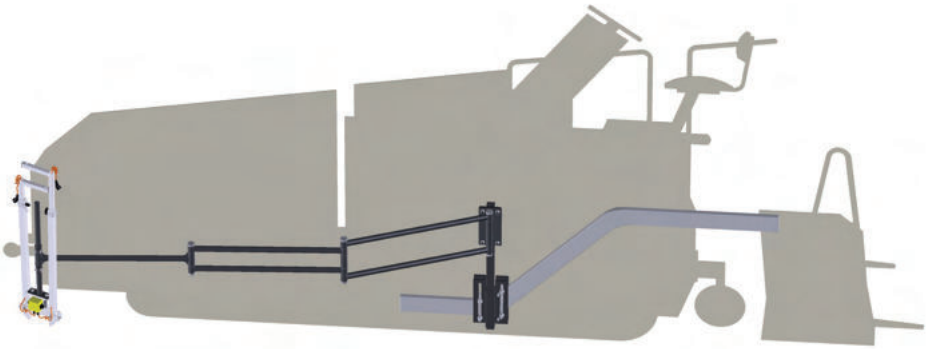


Figure 39: Pulled out Front Grade Support Arm

3 Unscrew the retaining nut in the bottom of the Sensor Beam. The Sensor Beam can then be unfolded.

Figure 40: Before unfolding the Sensor Beam, first remove the retaining nut in the bottom

Figure 41: Fully extended scissor arm with folded Sensor Beam

4 Unfold the Sensor Beam by pulling the telescopic arms. Tighten the retaining nut so that the Sensor Beam is held in the extended position.

Figure 42: When the Sensor Beam is unfolded, the arms are held in place by the retaining nut

Figure 43: Fully extended Front Beam Mounting with unfolded Sensor Beam

5 Adjust the telescopic arms so that they are parallel with the paver.

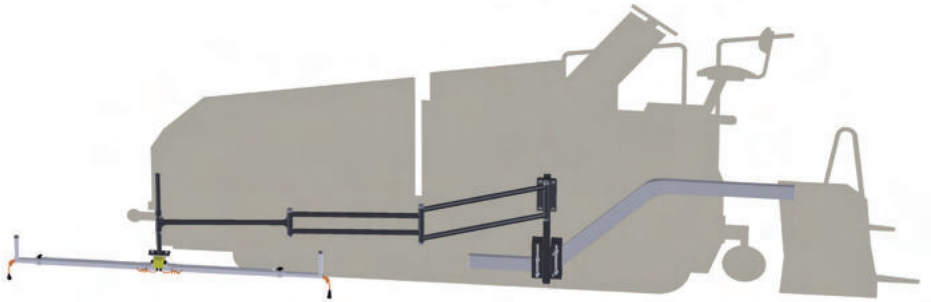


Figure 44: Fully extended scissor arm, where the unfolded Sensor Beam is parallel with the paver

6 Adjust the length of the two telescopic arms of the Sensor Beam. The two arms are normally extended to full length, although their length must also take into consideration the field of view of the sensors and the balance point.[8]

- There must always be at least 0.5 m / 20" between two sensors, so that they do not disrupt each other.
- The sensors must be at least 0.25 m / 10" from machine components, so that the ultrasound is not reflected.

Figure 45: The length of the telescopic arms is adjusted by undoing the thumb screw and pulling out the extension to the desired length

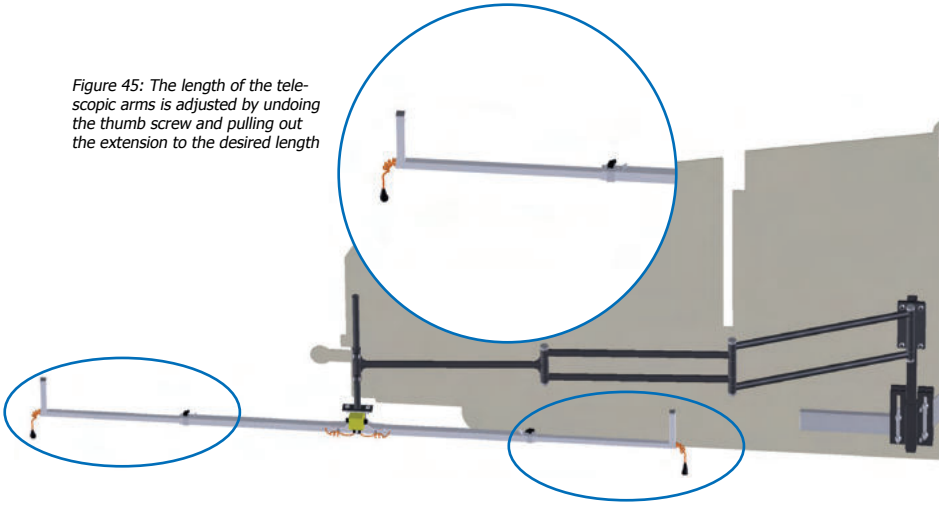


Figure 46: Sensor Beam with arms at full length

[8] *See section Location of Sensor*

The greater the distance between the four sensors on a complete Averaging Beam, the greater the effect of the Averaging Beam

The length of the arms can be adjusted to ensure that the four sensors have the required distance between them. Pay attention to the fact that the two central sensors may be positioned too close to each other

The measurements taken by the grade sensors can be affected by sudden changes in temperature. For this reason, e.g. exhaust fumes or hot ventilation air can cause a sensor to measure incorrectly when the sensor is alternately exposed to cold wind and hot air from the paver or joint heater. The grade sensors should therefore be positioned 0.5 m / 20” from all heat sources

Equipment for sensor installation

Installation of sensor support bar

1 Insert a sensor support bar in the large hole on the vertical part of the telescopic arm, so that one of the threads of the support bar is alighed with the small hole in the vertical section.

- The inner thread is for a single sensor, e.g. G221.
- The outer thread is for a multi-sensor, e.g. G224.

2 Catch the relevant thread in the sensor support bar with the thumb screw, and tighten the screw.

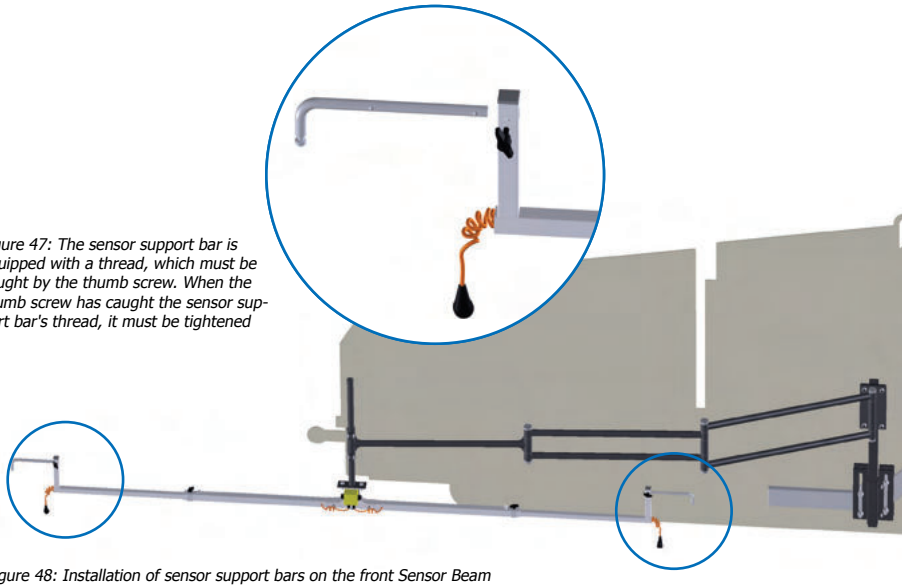


Figure 47: The sensor support bar is equipped with a thread, which must be caught by the thumb screw. When the thumb screw has caught the sensor support bar's thread, it must be tightened

Figure 48: Installation of sensor support bars on the front Sensor Beam

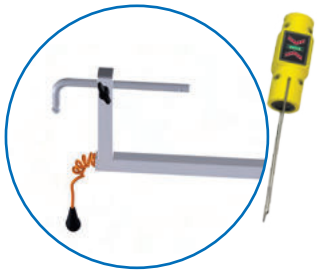


Figure 49: Innermost position for a single sensor, e.g. G221

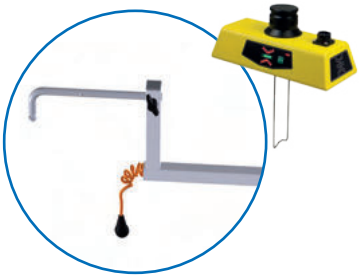


Figure 50: Outermost position for a multi-sensor, e.g. G224

Installation of Snap Connector

1 Find the screw included, which is kept in one of the two threads, located on the side of the Snap Connector. The Snap Connector has both a mm thread (M8) and an inch thread (3/8 UNC), although securing with a single screw is sufficient.

2 Insert the sensor support bar in the Snap Connector, so that the groove at the end of the sensor support bar is alighed with the thread of the Snap Connector.

3 Tighten the screw, when the groove is alighed with the thread in the Snap Connector.

4 mm or 3/8-16 UNC

Figure 51: The sensor support bar is equipped with a groove that the screw has to catch. When the screw is fully tightened, the Snap Connector is securely fastened to the Sensor Beam

Figure 52: Installation of Snap Connector shown on the front Sensor Beam

When the Snap Connector is dismantled, the screw should remain in the Snap Connector so that it does not get lost

Choice of sensors and controller

The Averaging Beam can be used in combination with various Mini-Line® controllers and Mini-Line® sensors. However, there are differences between what the various controllers and sensors can do.

Choice of controller

The Mini-Line® series has two controllers for asphalt pavers to choose between. The two tow points of the screed are regulated independently of each other, and together they determine the grade and slope of the mat. The operator can choose to have an HS301 handset on either side of the paver, or choose the PL2005 controller, which connects the two sides and acts as an operating panel on either side of the paver.

HS301

HS301 – Simple, mobile asphalt paving

In the case of paving jobs where it is easy for the operator to access both sides of the paver, the HS301 controller provides simple manual operation, which offers mobility around the paver.

PL2005

PL2005 – Paving with full control on both sides

With the PL2005 system, the operator has full control of all sensors and settings on both sides of the paver from a single unit.

Choice of sensor

TF-Technologies has developed three ultrasonic sensors in the Mini-Line® series, all of which can be used with the Averaging Beam. The sensors are all contract-free, consequently eliminating the problems that are typical with mechanical sensors, which easily come into contact with obstacles and are soiled with asphalt or bitumen. They all deliver high levels of accuracy and can indicate to the operator whether they are connected and functioning optimally.

G220

G220 – Basic grade sensor for most jobs

Just like the other grade sensors, the G220 is perfect for ground sensing. It easily follows the reference, achieving an optimum grade. A flashing diode indicates whether the G220 is correctly connected and located within its working range.

G221

G221 – Extra durable grade sensor

The G221 is an upgraded version of the G220, and has been improved with an extended working range and a large display that gives the operator a visual indication of whether or not the sensor has achieved the desired grade. The reference bail, which compensates for changes in temperature, has also been improved with a click-on feature. Finally, the G221 has an upgraded, encapsulated transducer, making this sensor particularly resistant to environmental effects and easy to clean.

G224

G224 – Flexible grade sensor for both ground sensing and stringline sensing

In addition to ground sensing, the G224 is suitable for stringline sensing and can follow curved surfaces, such as kerbs with a rounded top. The G224 is a multi-sonic grade sensor with four integral ultrasonic sensors, which can conduct local averaging and smooth out small, local irregularities.

S298/ S299

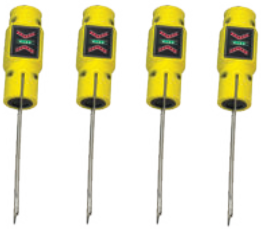
S298/S299 - High-precision slope sensor

In addition to the grade sensors, TF-Technologies has developed a range of slope sensors that are adapted to the various controllers. They work well in combination with the Averaging Beam, when a certain slope is desired.

Mini-Line® Grade and Slope Control System for Averaging Beam

When a Mini-Line® Grade and Slope Control System is used with the Averaging Beam, four Mini-Line® sensors, one Mini-Line® controller and cables are always used. For information and help when selecting controllers and sensors, and for configuring these in a Mini-Line® Grade and Slope Control System, contact your local sales representative. Please also refer to the user manuals of the controllers.

Example of a Mini-Line® Grade and Slope Control System for an Averaging Beam



4 x Mini-Line® G221 sensors (with different labels)

1 x Mini-Line® HS301 Controller

1 x V-cable

1 x I-cable

Installation of Mini-Line® Grade and Slope Control System

For a complete guide regarding the installation of the Mini-Line® Grade and Slope Control System, including installation of the relevant controller, please refer to the user manual of the controller. However, special conditions relating to the installation of grade sensors on the Averaging Beam are covered below.

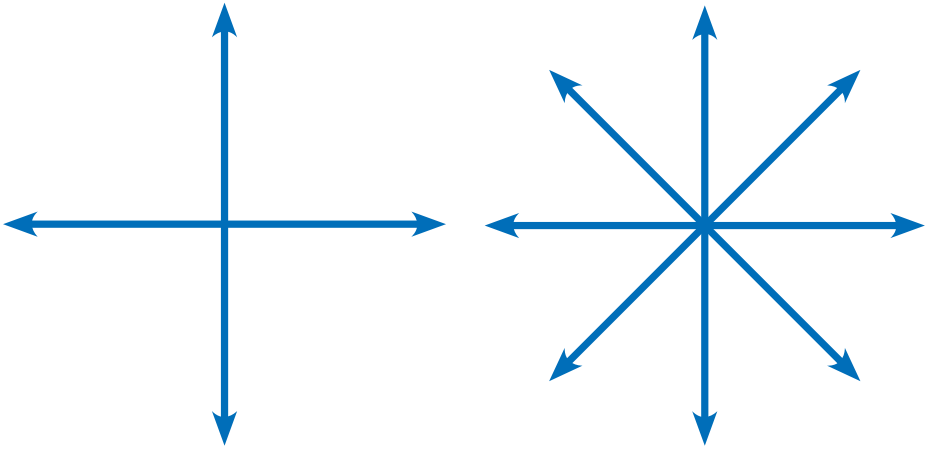
Installation of grade sensors

All Mini-Line® grade sensors have a display or indicator that indicates the condition of the sensor, and it is therefore important for that the sensor displays/indicators are visible to the operator. The G221 and G224 also give an indication of the current regulation on their display, so that the operator is able to monitor when the height of the tow point is adjusted.

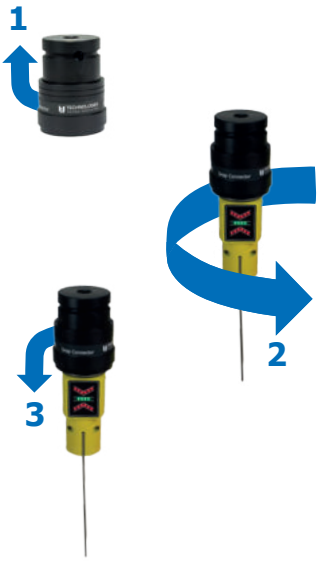
With the Averaging Beam, the operator has four sensors to look at, and it can therefore be an advantage to install the grade sensors so that some displays point forward while others point backward. This enables the operator to obtain information about the regulation as he walks around the paver.

The Snap Connector easily makes such installation possible. The Snap Connector has a locking mechanism that ensures a rapid installation and provides a firm grip on the grade sensor locking it at a fixed angle, This can be used to ensure that the sensor displays are visible from several angles.

The G220 and G221 can be secured in four positions, while G224 can be secured in eight positions. There is always a locked position aligned with the screw holes in the Snap Connector, and the operator can therefore allow the screw to point in the same direction that the sensor display should subsequently be pointing.

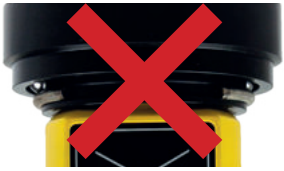


Step-by-step instructions for installation of grade sensor in Snap Connector



1. Retract the outer cover of the Snap Connector and insert the sensor, while still holding on to the sensor so that it does not fall out
2. Turn the sensor to one of the locked positions
3. Release the outer cover and lock the position. It is important that the Snap Connector has locked correctly before letting go of the sensor

When a grade sensor is mounted in the Snap Connector, the outer cover should conceal the ¾ spring clip



Visible ¾ spring clip
- not locked correctly

Concealed ¾ spring clip
- locked correctly

Examples of installation of sensors - G224

The G224 has four sensor heads and two displays, which means that it can be used for both stringline sensing and ground sensing with local averaging. When the G224 is mounted on an Averaging Beam, it is always used for ground sensing, which places certain demands on the installation:

- The sensor support bar must be installed in the outer thread
- The sensor must be mounted in the direction of travel (not transverse)
- The display for the end of the sensor must be used

Figure 53: G224 with the display facing forward

Figure 54: G224 with the display facing backward

Examples of installation of sensors - G221

The G221 is always used for ground sensing, and for this reason it can be easier to point the sensor display towards the operator:

- The sensor support bar can be installed in either the inner or outer thread
- The display can easily be pointed in the required direction
- When installing the Snap Connector, the screw must point in the same direction that the sensor display is to point

Figure 55: G221 with sensor support bar installed in the inner thread, with the display facing outwards

Figure 56: G221 with sensor support bar installed in the outer thread, with the display facing outwards

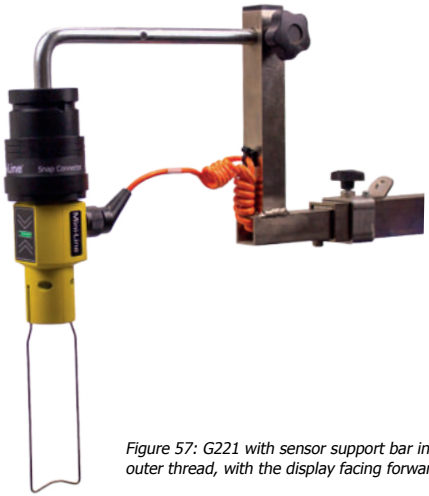


Figure 57: G221 with sensor support bar installed in the outer thread, with the display facing forwards

Connection of Mini-Line® Grade and Slope Control System

For a complete guide regarding the connection of the Mini-Line® Grade and Slope Control System, including safety instructions, please refer to the user manual of the controller. However, special conditions relating to the connection of grade sensors on the Averaging Beam are covered below.

Colour of the grade sensor labels

In order for the Mini-Line® controller to recognise the difference between the grade sensors on the Averaging Beam, the four sensors must have different addresses, which can be seen from the colour of the labels on the sensors. The four grade sensors that are used on an Averaging Beam must therefore always have different label colours.

The four standard colours in an averaging kit are: white (address 8), red (address 9), yellow (address 10), and blue (address 11).

Grade sensors with different label colours

Two grade sensors with the same colour must never be connected on the same side of the paver, as this will result in incorrect regulation

There is also a green label colour (address 4), which can be used as a reserve sensor. The advantage of having a fifth colour for the reserve sensor is that if a sensor is damaged during a paving job, the green sensor can replace all the standard colours without problems.

The colour codes on the sensor labels are the same for all the grade sensors, so that two identical colours on the G220, G221 and G224 may also not be connected to the same controller. The three different types of grade sensors can be mixed and connected to the same handset, as long as the sensors each have a different colour.

However, a slope sensor may be combined with a grade sensor, even if they are the same colour, as the label colour of the slope sensor has no implication on the grade sensors.

Connecting additional sensors

It is possible continually to connect fewer or more sensors, if required. It is possible to connect between one and four sensors on an Averaging Beam to the same Mini-Line® controller, and when several grade sensors are connected, they are automatically averaged. However, the connection of sensors must take place in manual mode, for the new sensors to be registered. After connection, the new configuration must be allocated a new reference point before the controller can be set in auto mode.

Paving with the Averaging Beam

Throughout the paving process, it is important for all the grade sensors to be able to see the reference. As the reference is not always parallel with the paver, it is recommended to keep an eye on the grade sensors, and to disconnect those that temporarily lose their target, or shift for a short while to manual mode where the level is maintained even if the sensors lose the target, until all the grade sensors can see the reference again.

Connecting the Mini-Line® Grade and Slope Control System to the Averaging Beam

Each Sensor Beam has integrated cables which connect the sensors to a Connector box on the Sensor Beam. The two Sensor Beams therefore only need to be connected with one cable, and the Mini-Line® controller is then easily connected to both Sensor Beams via a cable to the Connector box on the Rear Sensor Beam.

Step-by-step instructions for connecting the Mini-Line® Grade and Slope Control System to the Averaging Beam

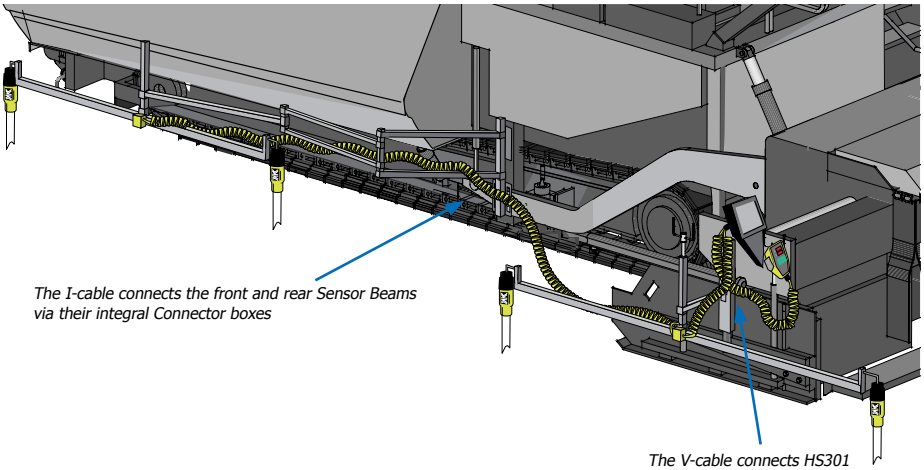
1.
2.
3.

1 The four Mini-Line® sensors are mounted in the four Snap Connectors, and connected to the cables at the end of each telescopic arm on the Sensor Beams

2 The two Sensor Beams are connected with an I-cable via their Connector Boxes

3 The Mini-Line® controller is connected to the Connector box on the rear Sensor Beam

- The HS301 controller is connected with a V-cable
- The PL2005 controller is connected with an I-cable



The I-cable connects the front and rear Sensor Beams via their integral Connector boxes

The V-cable connects HS301 and the rear Sensor Beam

Connection of Averaging Beam with V-cable

Checking installation of the Averaging Beam

Hazardous situations that should be checked after every installation

The installation of the Sensor Beams must never prevent the free movement of the screed

The Front Beam Mounting Bracket must not be in the way of the paver.

- The square beam with the mounting plate must not come into contact with machine components when raising or lowering the screed
- The square beam must not protrude down so far that it can scrape against the ground when the screed is fully lowered

If an additional distance to the machine is required, it is possible to insert a plate between the tow arm and the tow arm bracket

Undesirable situations that can affect the sensors and produce errors

The sensor height of each sensor must always be checked before paving, so that the sensor is not operating at the outer limits of its working range, if the distance to the surface is altered as the tow point is regulated. The sensor height is affected more if the installation is not horizontal.

- The mounting bracket of the Front Beam Mounting should be horizontal within ± 5° at the start of paving, while the screed produces the correct level of asphalt

If the mounting bracket of the Front Beam Mounting is not horizontal within ± 5° at the correct level of asphalt, the mounting plate should be adjusted. If the Front Beam Mounting Bracket is used, this can take place by adjusting the tow arm bracket

If the sensors are positioned outside of their working rage, they will produce an error code

The measurements taken by the grade sensors can be affected by sudden changes in temperature. For this reason, e.g. exhaust fumes or hot ventilation air can cause a sensor to measure incorrectly when the sensor is alternately exposed to cold wind and hot air from the paver or joint heater. The grade sensors should therefore be positioned 0.5 m / 20” from all heat sources

The balance point must always lie between the tow point and the front edge of the screed.

- Regulation speed is reduced if the balance point is too close to the tow point. For this reason, the balance point should always maintain a distance of approx. 0.5 m / 20” from the tow point
- At the same time, there must always be at least 0.5 m / 20” between two sensors, so that they do not disrupt each other

If the balance point is too far forwards:

1. Do not extend the front telescopic arm on the rear Sensor Beam
2. Still too far forwards: Do not extend the front telescopic arm on the front Sensor Beam

If the balance point is too far back:

1. Do not extend the front telescopic arm on the front Sensor Beam
2. Still too far back: Do not extend the rear telescopic arm on the rear Sensor Beam

The greater the distance between the four sensors on a complete Averaging Beam, the greater the effect of the Averaging Beam

Hazardous situations when installing inside the side plate

If the rear Sensor Beam is installed inside the side plate, the operator must take care not to move the side plate too far in:

- The Sensor Beam can be trapped
- The sensors can be positioned too close to reflecting surfaces

Safety Instruction

Safety guide

The Mini-Line® Averaging Beam has been developed to work together with the Mini-Line® Grade and Slope Control System on an asphalt paver. Safe use of the Averaging Beam first and foremost required that it is used for this purpose. The manual of the Mini-Line® controller also contains safety instructions for the safe use of the Grade and Slope Control System, which must also be followed. The Mini-Line® system should only be operated by a trained operator, in order to avoid personal injury and damage to equipment.

The operator must:

- Read and understand the manual for the controller used
- Go through "Checking installation of the Averaging Beam" on p. 66
- Be aware of hazardous or undesirable situations that can arise when using the Averaging Beam

Hazardous or undesirable situations that are checked during paving

The installation of the Sensor Beams must never prevent the free movement of the screed

If the rear Sensor Beam is installed inside the side plate, the operator must take care not to move the side plate too far in:

- The Sensor Beam can be trapped
- The sensors can be positioned too close to reflecting surfaces

When the screed is lifted, the Sensor Beams must always be folded, so that the sensors do not make contact with the ground. Bear in mind that the screed is frequently lifted, for example when positioning the paver, under transport and when starting and stopping

[1]TF-Technologies reserves the right to make changes in specifications without further notice. Refer to www.TF-Technologies.com/paving-academy for latest versions of data sheets.

Hazardous or undesirable situations when installing

When welding on the paver, Averaging Beam or mountings, electrical equipment can be damaged as large currents pass through the structure. For this reason, the following precautions should be taken before welding:

- Remove all electrical equipment where possible
- Disconnect the negative terminal in the paver battery, or install voltage protection over the battery terminals
- Place the negative electrode close to the welding point
- Remove paint before welding

The Front Beam Mounting Bracket must not be in the way of the paver

- The square beam with the mounting plate must not come into contact with machine components when lifting or lowering the screed. If an additional distance to the machine is required, it is possible to insert a plate between the tow arm and the tow arm bracket
- The square beam must not protrude down so far that it can scrape against the ground when the screed is fully lowered

Hazardous or undesirable situations when cleaning

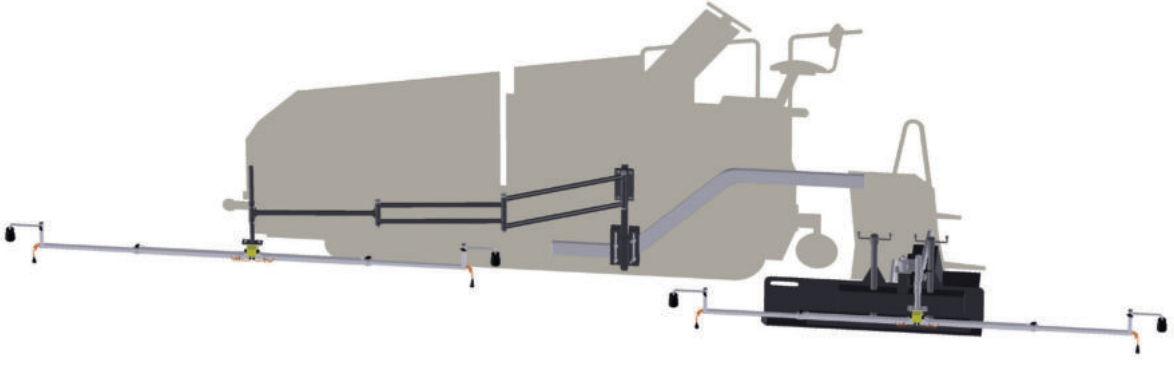
Equipment can be damaged when cleaning the paver, for example when using a high-pressure washer. For this reason, all equipment, including the Sensor Beams, should be removed before cleaning the paver

Appendix

Examples of installation options

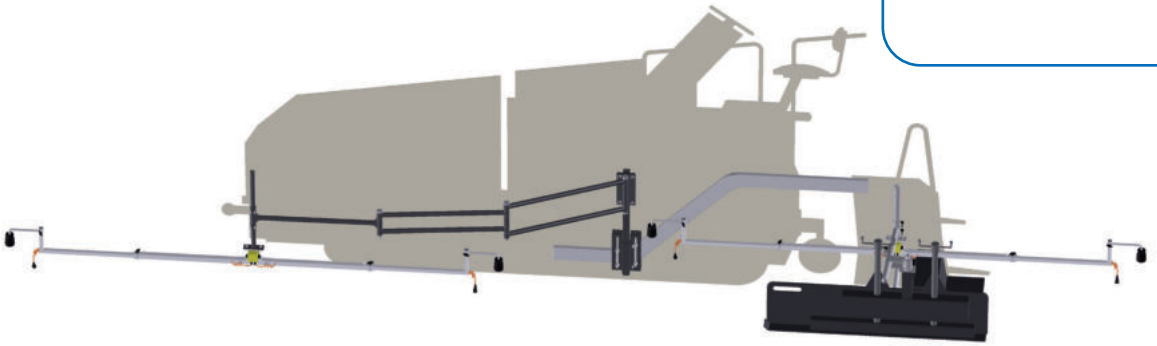
Example of front Sensor Beam on Front Beam Mounting Bracket with rear Sensor Beam outside of the screed

When the rear Sensor Beam is located outside of the screed, the sensors can follow an adjoining mat (joint matching) or the surface under the screed

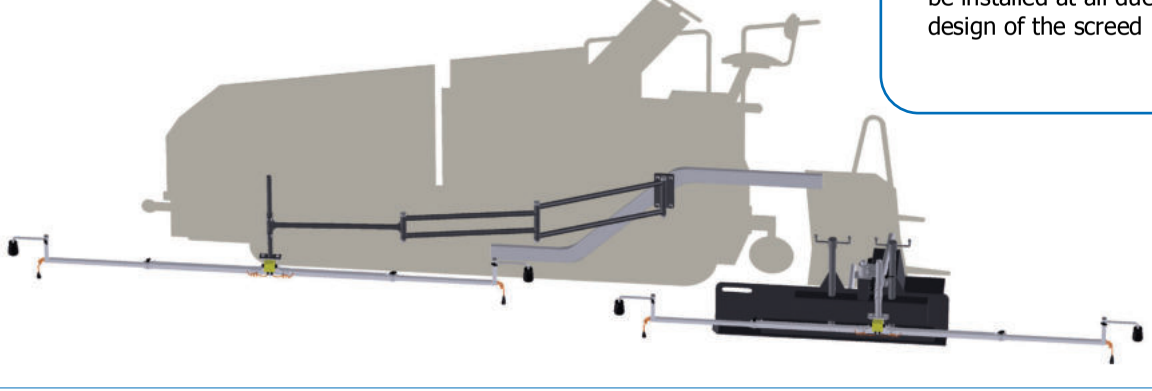


Example of front Sensor Beam on Front Beam Mounting Bracket with rear Sensor Beam inside the screed

When the rear Sensor Beam is located inside the screed, three sensors can perform ground sensing while the final sensor measures the paved asphalt. This can be an advantage if the surface outside of the side plate is not reliable

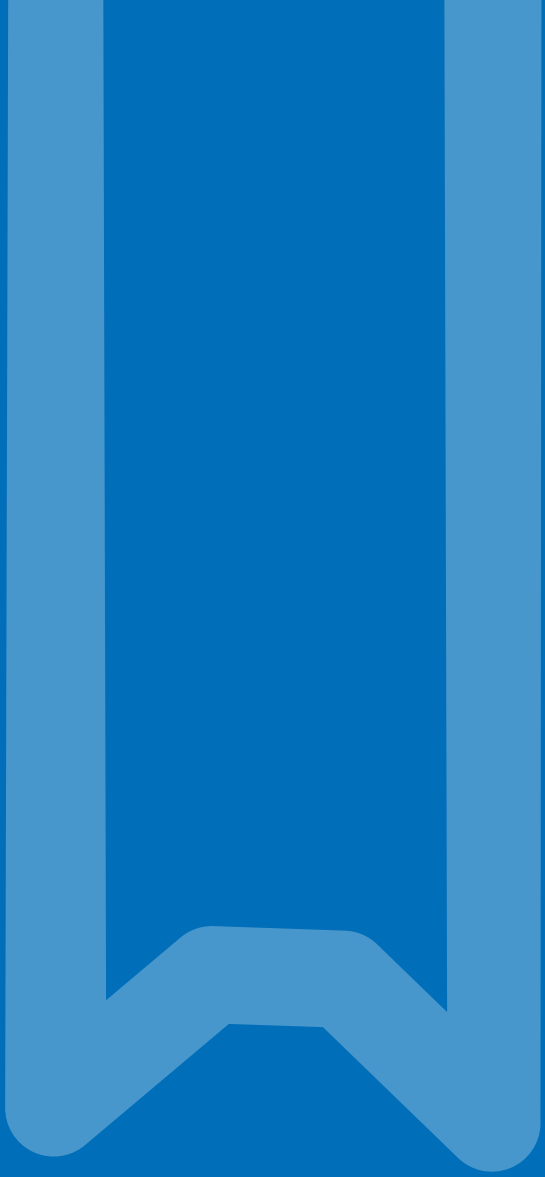


Example of front Sensor Beam installed with mounting plate



Simpler installation is achieved when the front Sensor Beam is installed with the mounting plate, although the front Sensor Beam cannot be positioned nearly as far forward on the paver.

On some occasions it cannot be installed at all due to the design of the screed



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PAVING INNOVATION

Kratbjerg 214 - DK 3480 Fredensborg - Denmark - Phone: +45 48 48 26 33 - Email: sales@tf-technologies.com
www.tf-technologies.com