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Safety for Rail

Installation instructions

Wheel sensor 2N59-1R-250-xx

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Wheel sensor 2N59-1R-250-xx
Installation instructions

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1.3 Overview of revisions

Status	Editor	Date	Auditor	Date	Reason for change
00	C. Schmücker	23.01.2018	S. Dünnwald	18.04.2018	New creation
01	D. Frede	15.06.2018	S. Dünnwald R. Wiengarten	04.07.2018 06.07.2018	Adaptation for translation into English, title page changed, wrong pictures replaced, GAG method removed, BVR17 removed. New version due to extensive testing
02	S. Dünnwald	11.01.2019	G. Ulke / D. Weiler		Chapter 8 changed extensively, rail profile list updated
03	C. Schmücker	29.10.2020 23.11.2020 24.11.2020			Mounting material adapted, layout Adaptation after review Adaptation after review
04	C. Schmücker	10.03.2021 21.04.2021 28.04.2021 to 30.04.2021 26.05.2021			Adaptations Adaptations chapters 7 and 8.5 Adjustment chapter 7.1 Revision after verification
04	J. Ludwichowski	27.05.2021			Verification SV as of 27.05.2021 Chapter 4.2.2: illustration reference corrected. Chapter 8.1: description of decimal points corrected and added to info.
04	C. Schmücker	31.05.2021- 02.06.2021 23.06.2021 24.06.2021 01.07.2021 07.07.2021 22.07.2021			Revision after validation Chapter 3 last point adapted and info box added Chapter 8.1 third sub-point deleted Chapter 8.4 three information boxes added Chapter 7 and chapter 10 tubular rivet added. Chapter 4 two note boxes added Chapter 5 note box added Chapter 11 table adapted Chapter 7.1 info box added Revision after verification Chapter 7.1 info box adapted Chapter 8.4 note box, info box adapted Chapter 8.5 info box adapted Chapter 11 table adapted Pictures in chapters 10 and 7 adapted and figure 2 adapted Chapter 11 adapted Chapter 11 adapted Chapters 11, 8, 3 and KSABs adapted

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		26.07.2021 28.07.2021 29.07.2021			Chapter 8, chapter 5.1, chapter 1.4 and chapter 11 adapted Chap. 7, Fig. 21 caption added and NLX12 deleted
05	C. Schmücker	30.07.2021 02.08.2021 12.08.2021 13.08.2021			Chapters 12, 7 and 1.6 adapted Table in chapter 12 formally adapted Table in chapter 12 adapted Adaptation of table 9, chapter 8.2 last warning box added, and danger box added in chapter 2
06	C. Schmücker A. Schmücker C. Schmücker C. Schmücker	18.08.2021 31.08.2021 14.09.2021 21.09.2021			Adaptation chapters 7 and 8 Adaptation chapters 5.2, 6, 8.2, 8.3, 8.4 Adaptation chapter 8.3 Adaptation chapters 8.3, 8.4 and chapter 9 moved to 8
07	C. Schmücker	01.10.2021			Adaptation chapter 3 illustration 2
08	C. Schmücker	14.10.2021 15.10.2021			Adaptation chapters 11 and 6 Adaptation chapter 12
09	J. Ludwichowski	19.10.2021 20.10.2021 21.10.2021 05.11.2021			Adaptation chapter 6 KSAB06 added. Illustration 21 description corrected Mail address corrected Verification SV added KSAB adjusted Chapter 6 tubular rivets corrected
10	J. Ludwichowski	17.01.2022			KSAB06, KSAB19 adjusted, KSAB29 added
11	J. Ludwichowski	11.02.2022 17.02.2022 21.02.2022 22.02.2022			Chapter 9.4 added. Chapter 9.4 limit values adjusted. Chapter 9 45 KS -15°C added, minor formal corrections. References corrected

Table 1: Overview of revisions

1.4 List of abbreviations

Abbreviation	Comments
ABG	Evaluation module (interface module / isolation amplifier (G94))
BVR	Drilling device
DSS	Double rail switch = wheel sensor
EW	Adjustment tool
GAG	Railway siding housing
KSAB	Customer safety-related conditions of use
PPE	Personal protective equipment (PPE)
SA	Switching distance
SAHL	Gauge for checking height wear of the rail
SBKL	Gauge for checking track borehole

Abbreviation	Comments
SO	Distance between top of the track and top of the wheel sensor
SSPV	Rail switch test device
SW	Wrench Size

Table 2: List of abbreviations

1.5 Safety instructions

The safety instructions used in this document are listed below. Please note that it is essential to follow these instructions in order to avoid possible damage to property or injury to persons.

Symbol	Signal word	Comments
	Tipp	Useful recommendations are given in this section
	Note	This section draws attention to potential problems
	Caution	Hazards that can lead to minor injury or serious damage to property.
	Warning	Hazards that could result in serious injury or death
	Danger	Immediate hazards that are certain to result in serious injury or death

Table 3: Safety instructions

1.6 Bibliography

Referenz	Name	Erläuterung	Ausgabe
[EBO]	EBO	Railway construction and operating regulations (Eisenbahn-Bau- und Betriebsordnung)	05.04.2019
[ERTMS]	ERA/ERTMS/033281	ERA/ERTMS/033281 - Interfaces between control-command and signalling trackside and other subsystems	20.09.2018
[Fo336]	Fo-336	QM-Form Fo-336	-07
[MontAnlSSK8]	2-EL-83183-00	Installation Instructions SSK8	-05
[SAB]	EL-83089-00	List of safety-relatet conditions of use	-0D

Table 4: Referenced documents

2 Usage

In case the wheel sensor 2N59-1R-250-45 is operated on PINTSCH interface modules and no old technology is involved (4AB10/1105 and 4AB10/1105/1), the wheel sensor must be set to constant current.

If third-party switching amplifiers are used which do not supply constant current, or if the modules 4AB10/1105 or 4AB10/1105/1 are used, the wheel sensor must be set to NAMUR.

2.1 General mode of operation

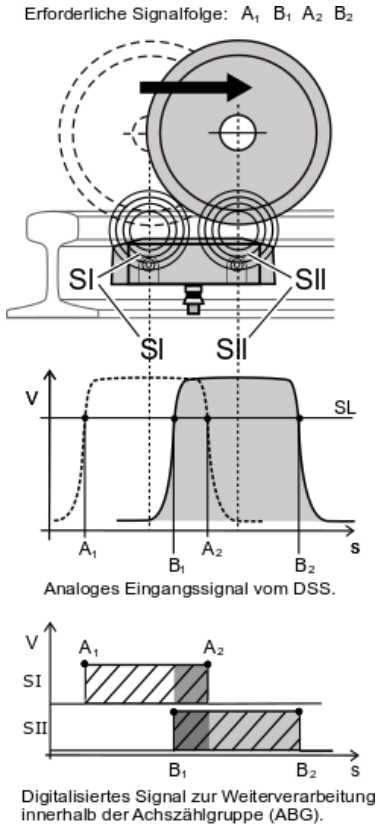


Illustration 1: Switch principle of the wheel sensor

The purpose of a wheel sensor is the direction-dependent detection of the wheel flanges of track wheels.
The metal of the wheel flange of a railway wheel rolling across the wheel sensor causes damping of the two individual systems.

This leads to a change in the internal resistance of the sensor systems and is evaluated in a subsequent interface module (ABG).

The arrangement of the two sensor systems is selected in such a way that the pulses generated by the damping overlap and can thus be used for direction-dependent axle counting and / or for direction-dependent switching commands (see illustration 1).

3 Installation site

In the function for using the wheel sensor on vignole rails, the switch can be mounted on the rail by means of rail web boreholes and screws or with the help of a rail switch claw (see chapter 8).

The installation place chosen for operational and safety reasons is indicated in the site plan. The following aspects must be considered:

- Determine rail type (embossing in the rail pocket or on the rail web).
- If possible, place the wheel sensor on an isolated track
- The wheel sensor is mounted on the inside of the track (in relation to the centre of the track)
- If possible, in track curves, choose the inner rail for mounting.
  (Example in viewing direction: in track curves to the left, this is the left rail and vice versa)
- Mark the centre of the wheel sensor on the rail head at the installation site.
- Before drilling, remove any scrap marks, incrustations, rust or dirt.
- If there is a weld seam nearby, a distance of 1000mm must be observed.

If the site plan with the dimensions below (illustration 2) cannot be adhered to, the next adjacent sleeper bay must be chosen. Please discuss this with an authorised person beforehand.

The dimensions in illustration 2.1 to illustration 2.5 apply to a vignole rail assembly and must not be undershot!

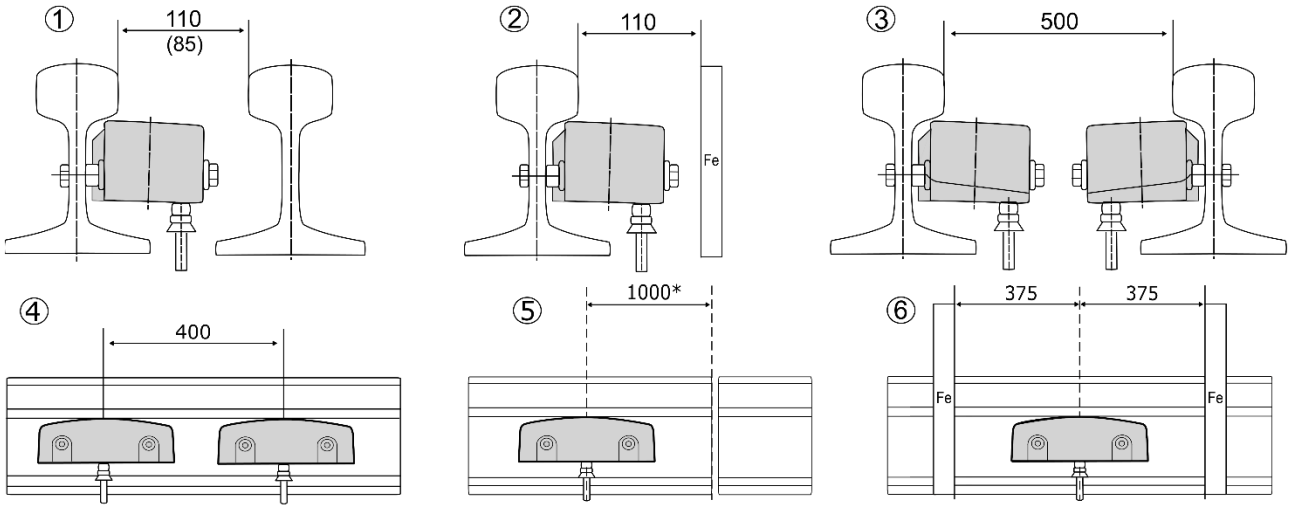


Illustration 2: Wheel sensor mounting clearance dimensions

- Illustration 2.1: In the movable section of the switch blade, the dimension of 110 mm can be reduced to 85 mm. The wheel sensor is not run over in this case.
- Illustration 2.2: Distance between rail and iron parts
- Illustration 2.3: Distance rail to rail, for directly opposite wheel sensors
- Illustration 2.4: Distance wheel sensor centre to wheel sensor centre
- Illustration 2.5: Distance wheel sensor centre to a weld seam
- Illustration 2.6 Distance wheel sensor centre to iron parts

4 Drilling

4.1 Drilling with drilling jig type BVR 17

The manufacturer recommends drilling rail web holes using the LD-1P (Cembre) drilling jig.

Separate installation instructions for drilling rails with the BVR17 can be found in document 2-EL-09588-00-XX.

4.2 Drilling with drilling jig LD-1P (Cembre)

These drilling instructions only apply to the Cembre rail drilling jig named LD-1P-ECO. If other Cembre models are used, the applicable operating instructions for these must be used.

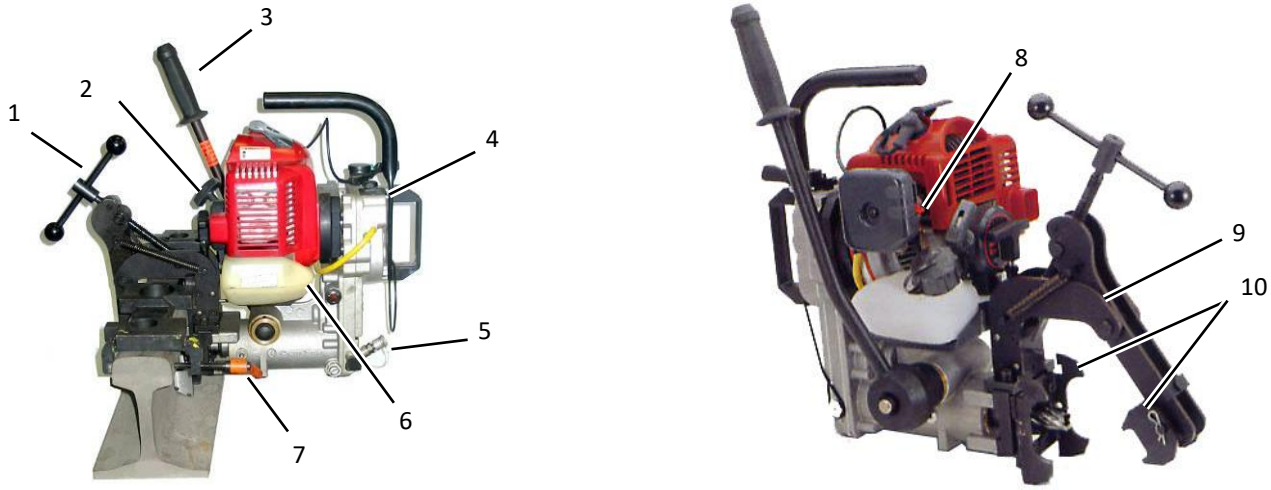


Illustration 3: Overview drilling jig LD-1P with mounting arm

Nr.	Description	Nr.	Description
1	Clamping handle	6	Fuel tank
2	Pull starter	7	Clamping lever
3	Manual lever	8	Choke
4	Switch ON	9	Mounting arm
5	Coolant inlet	10	Jaw profiles (depending on rail type!)

Table 5: Legend of the drilling jig components

4.2.1 Preparation of operating resources

Illustration 4: LD1-P coolant tank SR 5000

Before operation, overpressure must be generated in the tank by pumping several times using the retractable arm, so that sufficient coolant is available during drilling.

Fill tank with fuel mixture for two-stroke engines (oil / petrol with min. 88 octane, mixing ratio 1:50).

4.2.2 Selecting jaw profiles to match rail profile

To adapt the LD-1P drilling jig to the different rail profiles, jaw profiles matching the rail profile and the corresponding base plates must be selected for the drilling jig. Base plate SR SKI for large rail profiles such as for S54 or UIC60 and SR SKI-C for smaller rail profiles such as for S49.

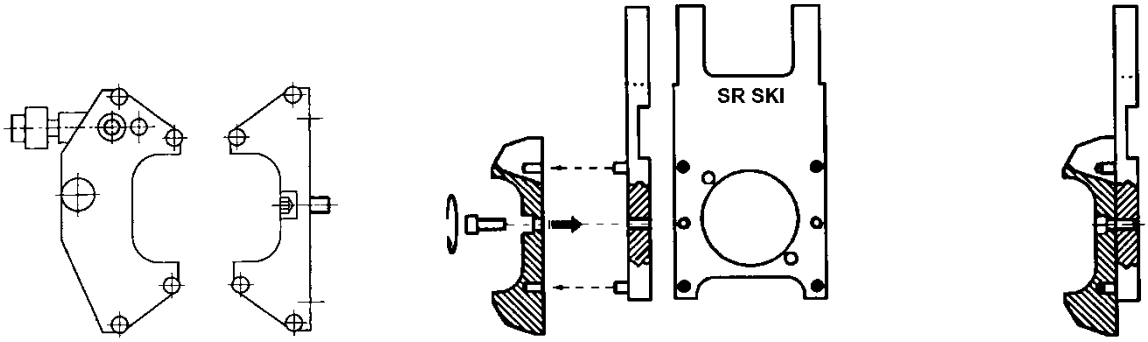


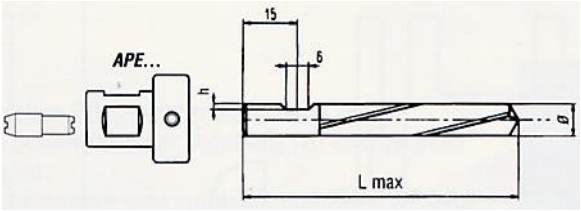
Illustration 5: Select jaw profiles and base plates for LD-1P

The LD-1P is already supplied by Cembre with jaw profiles for rail profiles S49, S54 and UIC60. These Cembre jaw profiles must not be used for mounting the PINTSCH wheel sensor due to excessive tolerances! For safety reasons, only the jaw profiles approved and supplied by PINTSCH may be used!

Jaw profiles for other rail profiles must be ordered separately.

Select and prepare mounting materials as follows:

- Select jaw profiles matching the rail profile for mounting the wheel sensor.
- Push suitable drill bit into adapter and fasten with grub screw.
- Insert the adapter into the spindle and fix it with 2 grub screws.



Spiralbohrer Typ	Ø mm	L max. mm	h mm	Adapter Typ
PE 80	8	76	1,4	APE 80
PE 130	13		1,6	APE 130

Illustration 6: Drilling adapter

Push the adapter in as far as it will go to ensure the flow of cooling water. Resistance caused by the ball seat of the cooling water valve must be overcome. Fully retract the drill with the hand lever so that on clamping the drill jig the jaw profiles first rest on the 4 pins (see illustration 7, point 1)!

Illustration 7: Mounted jaw profiles and drills on the base plate

After mounting on the machine, the adapter with the drill must not protrude over the jaw profiles, otherwise the drill will be pressed against the rail first when mounting the drilling jig on the rail – and thus be destroyed.

- Mount the SR SKI (or SR SKI-C) base plate to the drilling jig with two M6x25 mm screws.
- Mount the jaw profile on the base plate with one M6x16 mm screw each.
- Mount the jaw profile on the opposite side of the mounting arm DBG-F (cannot be mixed up).

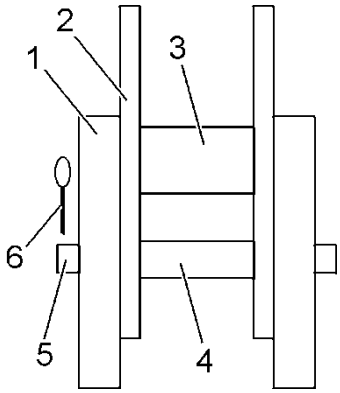


Illustration 8: Mounting the jaw profiles on the double arm bracket

Secure movable jaw profiles against compression and displacement as follows:

- Insert cotter pin (5) through jaw profiles (1), double arm bracket (2), anti-twist device (3) and middle spacer sleeve (4).
- Insert cotter pin locks (6) into cotter pins (5).

4.2.3 Aligning the MRF SR-SFA distance gauge to the rail

To maintain the spacing of the drill holes when drilling, a spacing gauge must be mounted on the rail.

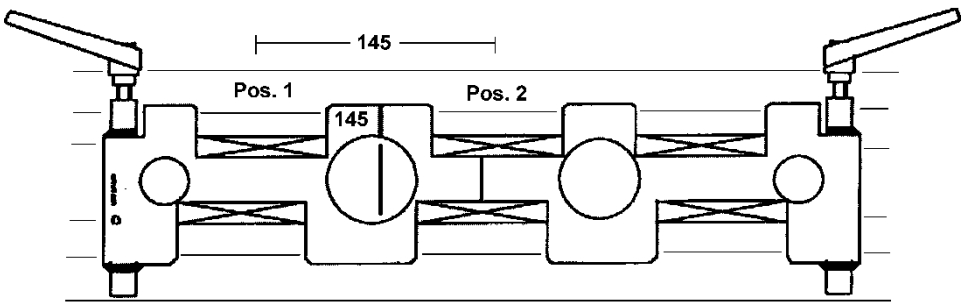


Illustration 9: Distance gauge MRF SR-SFA for drilling jig LD-1P

When drilling, the hand lever of the drilling machine is pressed against the handle of the distance gauge. In order to achieve more room for movement for the hand lever, the position of the handle can be changed afterwards by pressing it slightly or, if necessary, the handle in question can be exchanged for a normal screw (see illustration 10) (e.g. M6 x 60).

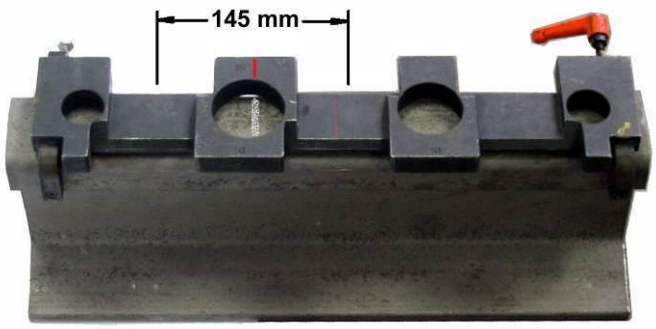


Illustration 10: Moving MRF SR-SFA distance gauge into position

Attach the distance gauge as follows:

- If possible, place it on the rail with the fastening handles facing towards the centre of the track.
- Move the distance gauge so that the marking on the gauge (145 mm) matches the marking on the rail visible through the hole
- Tighten the fastening handles

To avoid excessive drilling tolerance deviations, the holes must be drilled from the side where the wheel sensor is to be mounted later. In addition, the notes regarding the installation site in chapter 3 must be observed!

4.2.4 Attaching the LD-1P with the DBG-F mounting arm to the distance gauge

To drill the two holes at a distance of 145 mm, clamp the drilling jig from the marking line into the right (illustration 9, item 1) and into the left (item 2) recess with the fastening arm in the distance gauge.

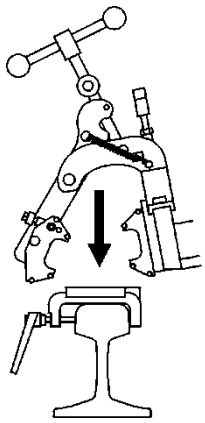


Illustration 11: Place the Cembre

- Insert the fastening arm DBG-F into the socket for the first hole (see illustration 11).
- Then adjust the jaw profile with the LD-1P
- Then press on the arm with the opposite jaw profile (see illustration 12)

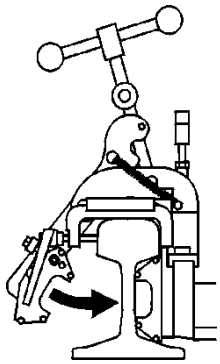


Illustration 12: Push Cembre arm

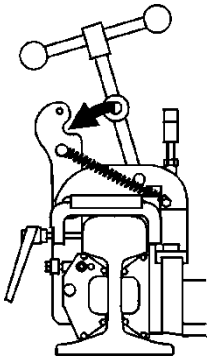


Illustration 13: Engaging the Cembre clamping handle

- Pull the clamping handle towards the arm until the clamp is in the recess (see illustration 13).
- Turn the toggle handle anticlockwise and tighten the arm until the drill jig is firmly against the rail (see illustration 14)
- Gently wiggle the jaw profiles to position them correctly in the rail web.

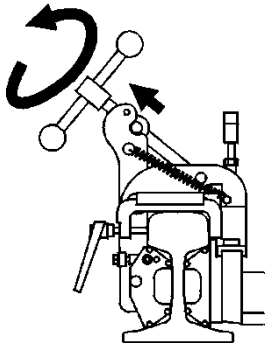
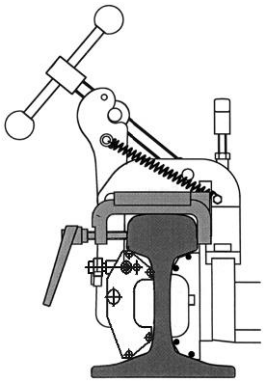


Illustration 14: Turn Cembre toggle handle



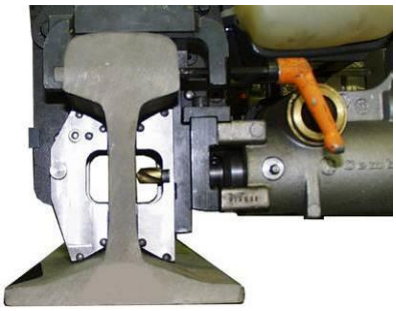


Illustration 15: Attach fastening arm DBG-F to the distance gauge

4.2.5 Starting the Cembre drilling jig LD-1P and drilling

The Cembre drilling device has a two-stroke motor as drive for the drilling spindle. The feed movement of the drill is carried out by hand via a hand lever (see illustration 3, no. 3).

For easier drilling, the hand lever on the LD-1P can be adjusted as follows:

- Press the button in the lever axle and retract the hand lever as far as possible.
- Put the hand lever back as far as possible to be able to drill the hole in one operation.

The drill speed can be completely reduced by setting the carburettor to "minimum".

- Lock the hand lever (see illustration 3, no. 3) in the foremost push position.
- Press the ON switch (see illustration 3, no. 4).

After a longer standstill of the engine, pump some fuel with the hand pump (a small rubber bladder between the choke and the tank). Two gentle squeezes on the pump are usually enough.

- Pull the cable starter (see illustration 3, no. 2).
- If necessary, change the choke lever position (see illustration 3, no. 8), push the throttle a little and pull the starter cable again (see illustration 3, no. 2).
- When the engine starts, adjust the speed of the drill by turning the throttle lever up to maximum.
- Adjust the coolant supply through the valve (see illustration 3, no. 5) or spray it directly onto the drill.
- To drill, press the hand lever (see illustration 3, no. 3)

- After drilling, reduce the speed of the drill as much as possible so that the drill does not run at full speed when it is switched on again at a later time.

4.2.6 Shifting the LD-1P drilling device in the drilling template

- Turn the rotary arm lever (see illustration 3, no. 1) slightly until the fastening arm DBG-F (see illustration 3, no. 9) detaches from the drilling jig.
- Place the LD-1P with the fastening arm DBG-F in the drilling jig for the second drill hole and screw it tight
- Then repeat chapter 4.2.5.

4.2.7 Switching off the LD-1P drilling device

- Press OFF to switch off the drilling device.

After completion of the drilling process, it is mandatory to remove the burrs on both sides of the borehole using a larger drill bit or a deburrer (see also *General Technical Note TM 2010-110 I.NVT 4* of Deutsche Bahn).

5 Checking the dimensions of rails and bore holes

5.1 Checking the rail web holes

This check must always be done, in case of self-drilled holes or already existing holes.

Check the hole distance of 145 mm (± 0.5 mm) of the two mounting holes with a vernier caliper.

Please observe the different tolerances for the two drilling jigs:
BVR17: ± 0.5 mm; Cembre: ± 1.0 mm.

Check the distance of the holes to the underside of the rail head with the SBKL 1 (carry out the following points carefully in order to achieve reproducible results):

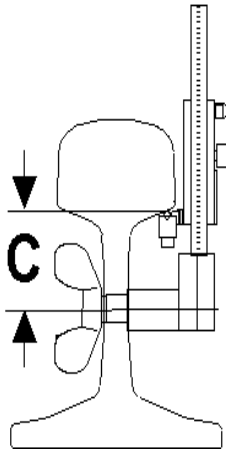


Illustration 16: SBKL 1

- Unscrew the knurled screw on the movable carriage.
- Press the movable leg firmly against the underside of the rail head from below with your index and middle fingers, building up pressure from the top of the rail head with your thumb.
- Now screw the SBKL 1 into the web hole with the wing nut. Vary the pressure on the movable leg and increase the pressure shortly before the web screw is finally tightened.
- Now tighten the knurled screw of the leg with the second hand.
- Carefully remove SBKL 1 from the rail so that the movable leg is not displaced.
- Read off the measured dimension and compare it with the rail profile list in chapter 12.

5.2 Height wear of the rail (drive-off dimension)

This chapter must not be used to check the rail web holes!

5.2.1 Measuring the height wear of the rail with gauge SAHL 1

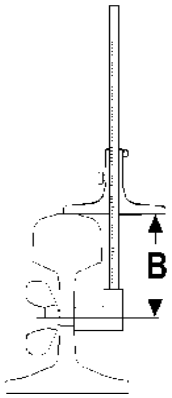


Illustration 17: SAHL 1

- Insert the gauge into a wheel sensor mounting hole and fasten it with the wing nut.
- Loosen the knurled screw, press the movable gauge leg onto the rail head and tighten the knurled screw again.
- Loosen the wing nut to remove the SAHL 1 from the rail without displacing the measuring leg.
- Read off the measured dimension B
- The drive-off dimension X is calculated as follows:
- 86.5mm – the measured value (dimension B)
- On tracks with inner web mounting, the wheel sensor must be lowered by 9mm at X = 6mm at the earliest, but no later than at X = 7mm (cf. chapter 7.1)

Dimension B is 86.5 mm plus the tolerance from the drilling jig, related to a new rail!

Illustration 18: Checking the drilling distances with SBKL (right) or SAHL 1 (left)

5.2.2 Measuring the height wear of the rail with a depth gauge or with the gauge SAHL 2

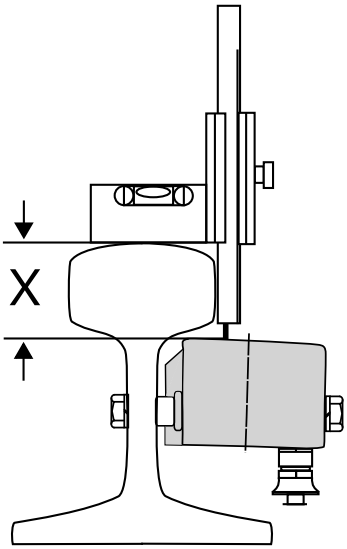


Illustration 19: SAHL 2

- The height wear is measured perpendicular to the rail web from the highest point of the rail head (due to the rail inclination, the highest passing point is also useful!) to the highest point of the wheel sensor (dimension X).
- On tracks with inner web mounting, the wheel sensor must be lowered by 9mm at X = 39mm at the earliest, but no later than at X = 38mm (cf. chapter 7.1).

6 Mounting material

KSAB22: The wheel sensor may only be considered as safe if it has been mounted according to the installation instructions and with the mounting material provided. In case of deviations, the operator must ensure safe functioning.

KSAB05: Sabotage, vandalism or damage due to improper use can impair the safe function of the sensor. The operator is responsible for preventing such damage.

The following mounting materials are available for web mounting.

- 10* mounting rings (1, 2, 4, 8 mm)
- 2* screws M12*130
- 4* Nord-Lock wedge lock washers
- 2* nuts M12
- 6* Tubular rivets (2* AK13*0.4*11, 2* AK13*0.4*14, 2* AK13*0.4*16)

Before mounting the switch, the mounting rings must be used according to the rail type and the height wear in order to obtain the required pre-attenuation and the correct switching distance.

There are four different mounting rings with thicknesses of 1 mm, 2 mm, 4 mm and 8 mm.

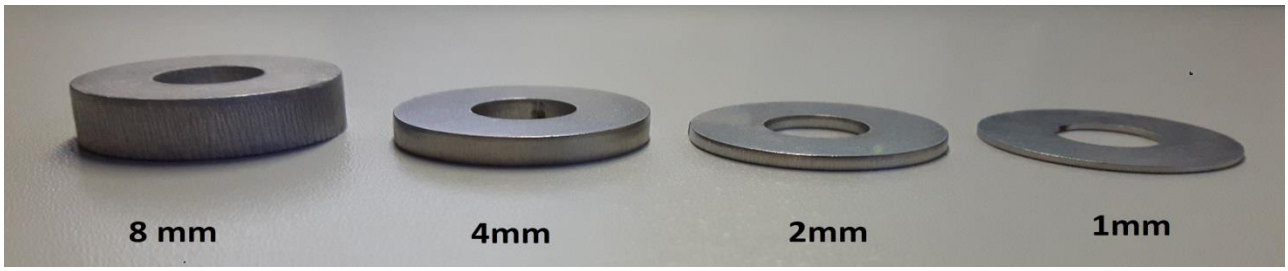


Illustration 20: Mounting rings

Type	Article no.	a (± 0.1-0.2 mm) (see table 12 in chapter **Fehler! V erweisquelle konnte nicht gefunden werden.**)
Large	2-091971	8 mm
Medium	2-091981	4 mm
Small	2-091980	2 mm
Extra small	2-091979	1 mm

Table 6: Mounting rings

7 Mounting the wheel sensor on the rail web

KSAB03: Installation, maintenance and servicing of the wheel sensor may only be carried out by trained personnel.

KSAB27: When installing or servicing the wheel sensor, the results must be recorded in the test report [Fo336].

KSAB15: To reduce the risk of injury when working on the track during installation and maintenance, or caused by the wheel sensor directly, personnel must be equipped with adequate PPE.

KSAB08: The wheel sensor is designed for use in areas with compliance to [EBO] and [ERTMS]. Outside this framework, safe operation must be coordinated with the manufacturer.

KSAB29: Outer side installation of the wheel sensor is not permitted without the required proof of functional safety.

Each time changes are made to the mounting of the wheel sensor, or if the switching distance is outside the permissible tolerances after a check, the switching distance must be readjusted (cf. chapter 9.2).

The following illustrations show the successive operations to mount the wheel sensor on the rail web:

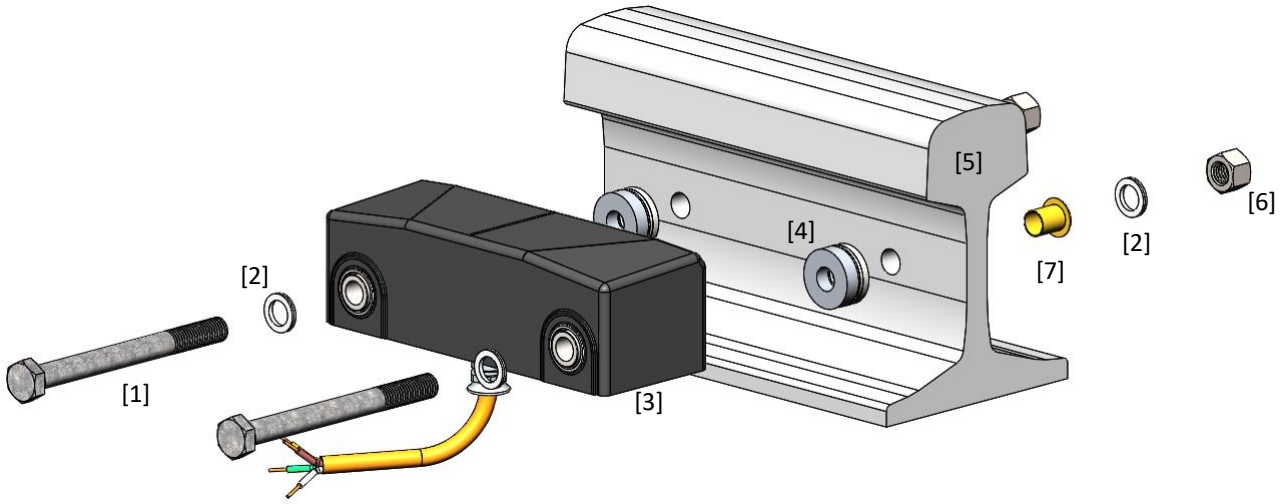


Illustration 21: Exploded view of wheel sensor

[1] Hexagon bolts M12 x 130; ISO 4014; 8.8, galvanised
[2] Nord-Lock washer NL12; Stahl, zinc flake coated
[3] DSS250
[4] Spacer washers (2x 8 mm + 2x 4 mm + 4x 2 mm +2x 1 mm)
[5] Rail (clamping device)
[6] Hexagon nut M12; ISO4034; 8 galvanised
[7] Tubular rivets

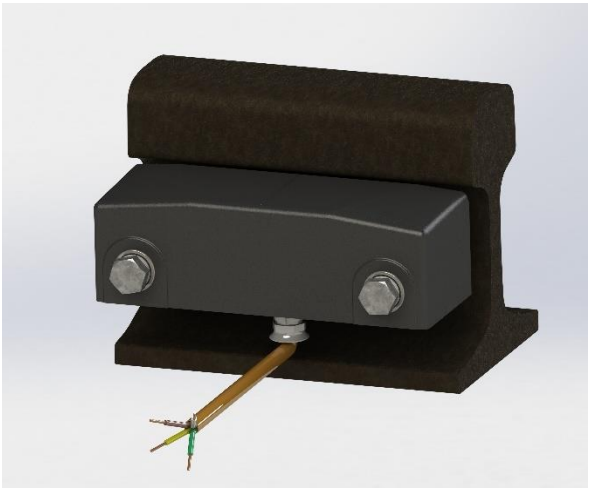


Illustration 22: DSS-250

Use the mounting material (article number 2-092119).

Insert the two tubular rivets into the 13 mm hole in the rail web. Push the tubular rivet through from the side where no wheel sensor is mounted. The bumper edge must not be on the side of the mounting rings.

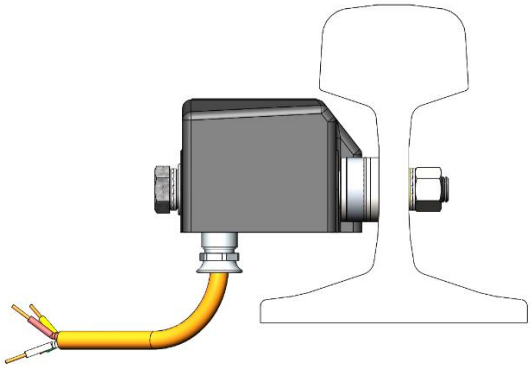


Illustration 23: Mounting DSS-250

There are 3 different lengths of tubular rivets.
Please refer to table 12 in chapter 12 to see which tubular rivets must be used for which rail type.

Insert the screws with the Nord-Lock washers through the sockets of the wheel sensors.

The screws can also be mounted the other way round; to do this, first insert the screws through the rail.

Illustration 24: Mounting rings

Fit the mounting rings.

Please refer to table 12 in chapter 12 to see which rings must be used for which rail types.

Illustration 25: Wheel sensor mounting

Mount the wheel sensor on the rail with a Nord-Lock washer and a nut (SW19).

Counter the bolt head with a wrench and tighten the nut clockwise with a torque of 50 N ± 5 Nm.

7.1 Lowering for worn rails

The purpose of lowering is to prevent the wheel sensor from being damaged by the different wheel flanges.

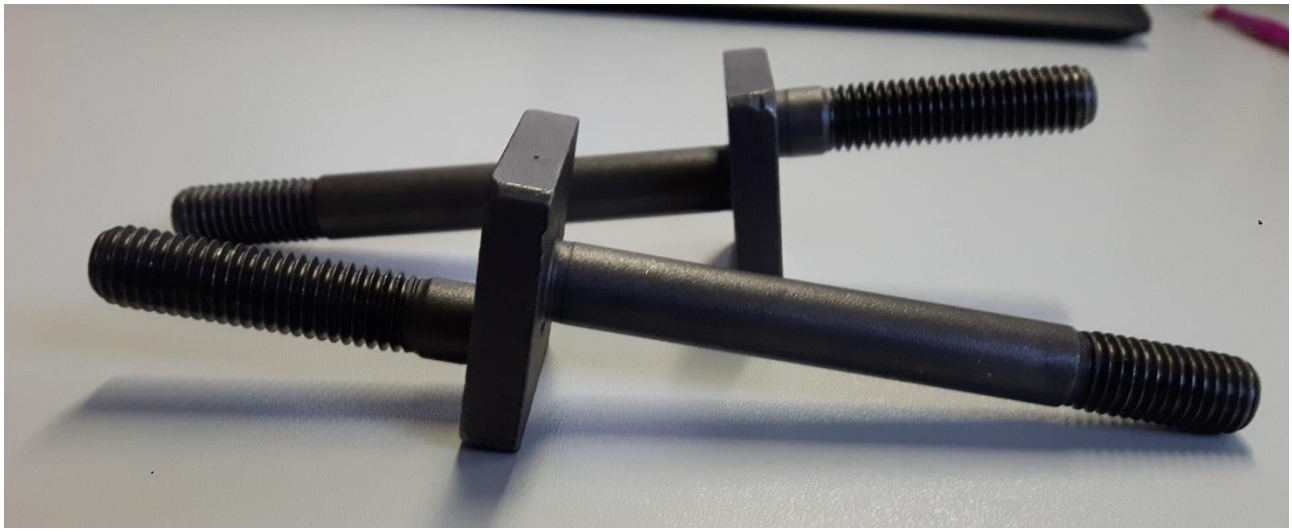


Illustration 26: Eccentric screw (height adapter)

KSAB19: The wheel sensor must be lowered at the latest when the distance between the upper edge of the rail and the upper edge of the wheel sensor housing is 38mm. Should it no longer be possible to lower the wheel sensor, damage to the wheel sensor cannot be ruled out. In this case, the operator must take suitable measures to prevent damage to the wheel sensor or the wheel sensor must be taken out of service immediately.

When mounting the wheel sensor on the inner web, the wheel sensor must be lowered by 9mm at the earliest at 6mm, but no later than at 7mm rail head wear, using an eccentric screw (2-091978). The mounting material 2-092121 is to be used.

In the case of measuring sections with several wheel sensors, please note that these must be lowered altogether.

If the wheel sensor is used in areas with activated magnetic rail brake, the switching distance must be set to X - 2mm if possible. In the event that the minimum switching distance is reached and this setting is no longer possible, miscounting may occur from a switching distance of X - 0.5mm.

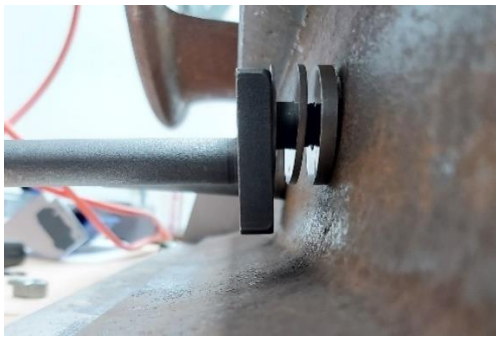


Illustration 27: Mounting rings on eccentric screw

- Mount the mounting rings on the short side of the eccentric screw.
- Use the appropriate mounting rings for the different rail profiles according to table 12 in chapter 12.

Illustration 28: Mounted eccentric screw

- Mount the eccentric screw on the rail and fix it with the Nord-Lock washer and a nut.
- Make sure that the eccentric screws are both flat against the rail web and perpendicular.
- Do not tighten the nuts yet.

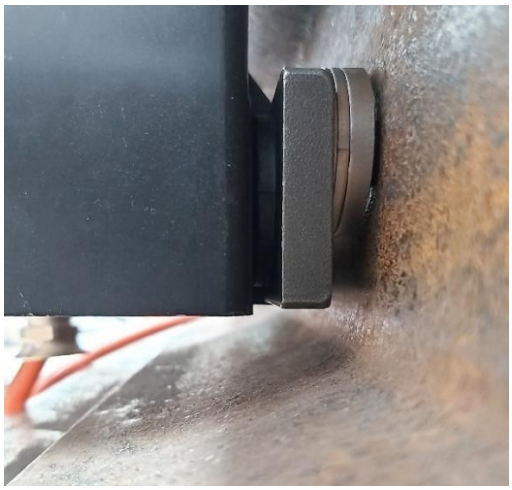


Illustration 29: Wheel sensor on eccentric screw

- Mount the wheel sensor.
- Make sure that the square is in direct contact with the socket and that the mounting rings are in contact with the rail.
- Then tighten the nuts to 50 Nm (± 5 Nm).

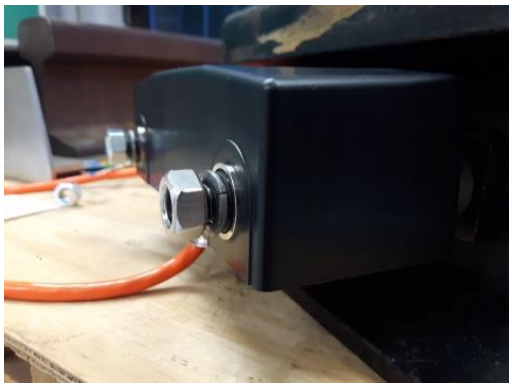


Illustration 30: Eccentric screw with mounted wheel sensor

Fix the wheel sensor with the eccentric screws. Mount the Nord-Lock washers and the nuts to the rail web at 50 Nm (± 5 Nm).

8 Mounting the wheel sensor on an SSK8

The mounting of the wheel sensor on a rail switch claw (SSK8) is described in a separate document, see document [MontAnlSSK8].

9 Function test and adjustment of the switching distance

Each time changes are made to the mounting of the wheel sensor, or if the switching distance is outside the permissible tolerances after a check, the switching distance must be readjusted (cf. chapter 9.2).

It is strongly recommended to carry out the switching distance test as soon as possible after setting the switching distance.

9.1 Testing device type R58/135

Illustration 31: Testing device R58/135

The test device contains two evaluation electronics for the wheel sensor with LEDs as function display. The power supply is provided by a built-in accumulator.

- The accumulator has its maximum voltage at max. 4.2 V_{DC}
- From a voltage of 3.4 V_{DC} and lower, the ON/OFF LED is switched on permanently in red.
- Below 3.2 V_{DC} the testing device switches off and requires charging.

1 = **On/OFF-LED** (Charge)

- Lights up yellow when the R58/135 is switched on
- Flashes yellow slowly when charging the battery
- Lights up red whenever the battery voltage is low
- Flashes red in the event of a USB charging error

2 = **Function displays SI and SII**

- A correct switching distance lights up "Too Low" and "Too High" at the same time
- If the switching distance is too low, "Too Low" lights up
- If the switching distance is too high, "Too High" lights up

2 = **„SHORT / OFF RAIL“**

- This LED lights up in case of a short-circuit on the corresponding system

2 = **„OPEN“**

- Indicates that no lines are connected to the corresponding system or that a wire break has occurred.

3 = **„Display“**

- 7-segment display

4 = **Button "On" or "OFF"**

- Press to switch the unit on.

The software version number is briefly shown in the display! (e.g. 2.03)

- Press until OFF appears on the display and release the button to switch off the unit.

After 15 minutes the unit switches off by itself.

5 = **Button „A/L“**

- This button can be used to change the value shown on the display:

- Initial status → Display switched off
- Press 1x → Display voltage of system 1
- Press 2x → Display voltage of system 2
- Press 3x → Decimal potentiometer value of system 1
- Press 4x → Decimal potentiometer value of system 2
- Press 5x → Display battery voltage
- Press 6x → Display switched off

The decimal points show which display mode is currently active:

- The decimal point at the last digit of the display provides information about the selected system. An illuminated decimal point indicates system 2, a non-illuminated decimal point indicates system 1.
- If one of the first two decimal points is displayed, a system voltage is indicated.
- If neither of the first two decimal points is displayed, a potentiometer value is displayed.
- If all three decimal points are displayed, the battery voltage is displayed.

6 = **Button „START1“**

- By pressing this button, the switching distance for system 1 can be set automatically (further explanation in the following chapter).

7 = **Button „START2“**

- By pressing this button, the switching distance for system 2 can be set automatically (further explanation in the following chapter).

8 = **Signal input connection**

- Cable 2-092097 for connection to the wheel sensor, SI and SII.
- Cable 2-092098 for connection to a USB charging port

9.2 Adjusting the switching distance

The wheel sensor 2N59-1R-250-45 can be adjusted at any temperature between -30 °C and +80 °C. The wheel sensor 2N59-1R-250-40 can be adjusted at any temperature between -40 °C and +70 °C.
Mechanical tolerances due to mounting must be balanced by the wheel sensor settings and adjustment.

The R58/135 must not be connected to the wheel sensor together with the external evaluation module. Adjustment of the switching distance is only possible with a disconnected external evaluation module.

Using the wrong mode (table 7) on the R58/135 to adjust the wheel sensor may result in miscounts.

To adjust the switching distance, please proceed as follows:

1. Determine the drive-off dimension X of the rail (see chapter 5.2.2)
2. Adjust the SSPV9 to the desired switching distance
   - 2N59-1R-250-40: X - 2mm (± 0.1mm)
   - 2N59-1R-250-45: X + 3mm (± 0.1mm)

When adjusting a wheel sensor type 2N59-1R-250-45 in constant current mode at temperatures ≤ -15°C, the switching distance must be set to X + 9mm.

In case the wheel sensor is used in areas with activated magnetic rail brake, the switching distance must be set to X - 2mm if possible. If this setting is no longer possible as the minimum switching distance has been reached, miscounting may occur from a switching distance of X - 0.5mm.

KSAB07: Miscounts are possible with an activated eddy current brake. Using it for safe axle counting is not permitted on lines equipped with eddy current brakes.

3. Place the SSPV9 in the centre of the wheel sensor.
   - The SSPV9 must be placed in the centre of the wheel sensor (follow the marking on the wheel sensor) and be in contact with the rail head.
4. Connect the R58/135 to the connection wires of the wheel sensor.
   - For this purpose, connect the wires of the R58/135 connection cable and the wheel sensor connection cable in matching colours.

Never connect the R58/135 to a mounted wheel sensor during a thunderstorm or more generally when the rail is in danger of being struck by lightning.

5. Adjust the desired wheel sensor type on the R58/135.
   - To set the desired wheel sensor type, please proceed as follows:
   - Press the **START1** (6) and **START2** (7) buttons simultaneously for about 3 seconds. After releasing both buttons, the currently set wheel sensor type is displayed on the 7-segment display (3).
   - Press the **START1** button (6) repeatedly until the correct wheel sensor type is displayed. The wheel sensor types that can be set are:

Name	Type
DSS250-40	2N59-1R-250-40
DSS250-45 CU	2N59-1R-250-45 (NAMUR)
DSS250-45 CI	2N59-1R-250-45 (constant current)
DSS500-40	Must not be selected

Table 7: wheel sensor types R58/135

- Press the **START2** button (7) until **"STO"** appears on the 7-segment display (3). After releasing the button, the new wheel sensor type is set.

The adjusted wheel sensor type is stored in the R58/135 even after it is switched off. Thus, in case you always calibrate the same wheel sensor type, it is only necessary to set the wheel sensor type once.

The wheel sensor type setting cannot be accessed during manual adjustment or while automatic adjustment is in progress.

- To adjust another wheel sensor type, repeat steps a to c to set the desired type.

6. Adjusting the wheel sensor system I:
   - With the R58/135 switched on, briefly press the **START1** button (6).
   - If the check does not reveal any problems, the display will show "i. O." for OK.
   - If "n. i. O." or "ERR CAL" is displayed, the automatic adjustment process was not successful. Verify that the correct wheel sensor type is set and readjust the desired switching distance if necessary.
   - If "ERR COM " is displayed, no connection to the wheel sensor could be established. Verify that the wheel sensor is correctly connected to the R58/135.
7. Adjusting the wheel sensor system II:
   - Briefly press the **START2** button (7) with the R58/135 switched on.
   - The outputs on the display (3) correspond to those of step 6.

If no " i. O." can be achieved at step 6 or 7, even after several attempts at automatic adjustment, the DSS must be returned to the manufacturer for inspection.

KSAB06: After disconnecting the setting device and reconnecting it to the track connection housing (in short "GAG") – e.g. for switching distance settings during installation or maintenance – the switching distance must be checked either at the higher-level unit or directly at the sensor using a voltmeter at the system terminals in the GAG. Here, the switching distance must be within the tolerance range of the corresponding wheel sensor. If this is not the case, please check the cable path, the wheel sensor and the calibration of the adjustment tool.

After adjusting with the R58/135, the switching distance must be checked as described in chapter 9.4 or chapter 9.6.

9.3 Measuring the switching distance using R58/135

This procedure is purely informative and can in no way replace the measurement at the evaluation module or with the multimeter (see chapter 9.4, 9.5 or 9.6).

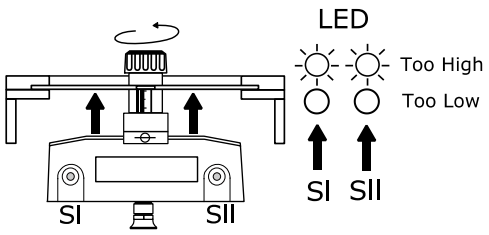


Illustration 32: Wheel sensor undamped

Step 1:
The SSPV 9 must be placed in the centre of the wheel sensor (follow the marking on the wheel sensor) and be in contact with the rail head. Wind the SSPV 9 far upwards. The function indicator "Too High" should light up for both systems (sensor systems are undamped).

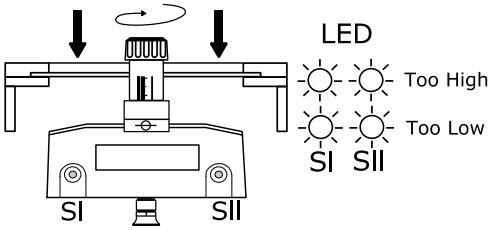


Illustration 33: Wheel sensor damped

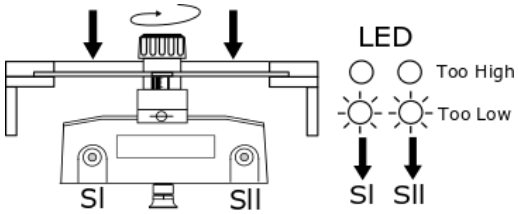


Illustration 34: SA too low

Step 2:
Sensitively lower the test plate in the direction of the wheel sensor until the function indicators "Too High" and "Too Low" light up at the same time.
If the test plate has been turned down too far, the "Too Low" LED lights up. In this case, the test plate must be brought up and then carefully lowered again until both LEDs ("Too High" and "Too Low") light up.

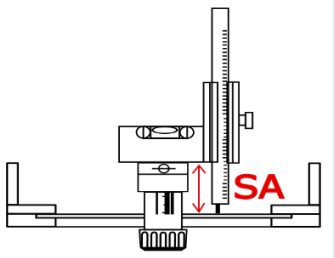


Illustration 35: SA with SAHL 2 at SSPV 9

Step 3:
Read off the switching distance on the SAHL 2 for the relevant system.
The switching distance must be at

- 2N59-1R-250-40: X - 2mm (± 0.5mm)
- 2N59-1R-250-45 NAMUR: X + 3mm (± 1mm)
- 2N59-1R-250-45 constant current: X + 3mm (± 1mm)
  or X + 9mm (± 1mm) at temperatures ≤ -15°C

For ambient temperatures deviating from 20°C (<0°C & >35°C), it is recommended to check the switch within the next six months.

Table 8: Measuring SA with R58/135

9.4 Checking the switching distance using a multimeter

KSAB10: The tool used must be calibrated regularly as part of its maintenance interval.

Before connecting the cable in the track connection housing, the work steps and instructions from chapter 9.7 must be followed.

When testing the switching distance using a multimeter, this must be done as a voltage measurement of the corresponding system at the GAG.

The multimeter must have an internal resistance ≥10MΩ when measuring voltage.

The switching distance of the DSS 2N59-1R-250-45 must be at least 2mm above the top of the rail in constant current operation.

At temperatures ≤ -15°C, this test method is not suitable for wheel sensors of type 2N59-1R-250-45 in constant current operation. In this case, check the adjusted switching distance according to chapter 9.5 or 9.6.

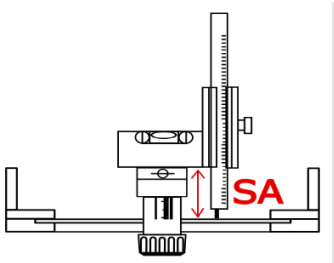


Illustration 36: SA with SAHL 2 at SSPV 9

Step 1:
Using the SAHL 2, set the switching distance of the SSPV 9 to

- 2N59-1R-250-40: X - 2mm (± 0.1mm)
- 2N59-1R-250-45: X + 3mm (± 0.1mm)

and place the SSPV 9 in the centre of the wheel sensor and against the rail head (follow the marking on the wheel sensor).

Step 2:
For each system, connect the multimeter in parallel in the GAG and read off the voltage value.
The voltage value must be at

- 2N59-1R-250-40: 6.45V ± 0.4V
- 2N59-1R-250-45 (NAMUR): 6.70V ± 0.2V
- 2N59-1R-250-45 (constant current): 6.45V ± 0.5V

	Step 3: • If both voltage values are within the tolerances specified in step 2, the set switching distance is considered correct. • If at least one of the two voltage values is not within the tolerances specified in step 2, the test must be repeated according to chapter 9.5 or 9.6.

Table 9: Check SA with multimeter

If the switching distance of the sensor systems is not within the desired tolerance range, the switching distance must be readjusted by resetting the SSPV9 and using the R58/135 (see chapter 9.2).

9.5 Measuring the switching distance

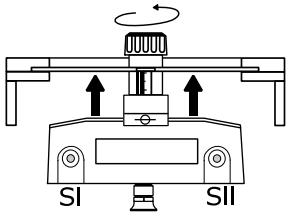
KSAB10: The tool used must be calibrated regularly as part of its maintenance interval.

Before connecting the cable in the track connection housing, the work steps and instructions from chapter 9.7 must be followed.

When testing the switching distance using a multimeter, this must be done as a voltage measurement of the corresponding system at the GAG.

The multimeter must have an internal resistance ≥10MΩ when measuring voltage.

The switching distance of the DSS 2N59-1R-250-45 must be at least 2mm above the top of the rail in constant current operation.

 **Illustration 37: Wheel sensor undamped**	**Step 1:** The SSPV 9 must be placed centrally on the wheel sensor (follow the marking on the wheel sensor) and be in contact with the rail head. Wind the SSPV 9 far upwards. Connect the multimeter to the corresponding system in parallel in the GAG and read off the voltage value. The corresponding system of the wheel sensor has a voltage of ≤ 6V (sensor system is undamped).

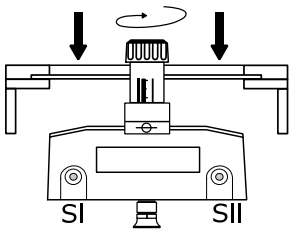
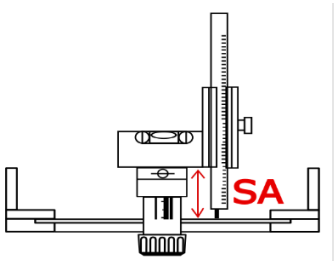
 **Illustration 38: Wheel sensor damped**	**Step 2:** Sensitively lower the test plate in the direction of the wheel sensor until a voltage of • 2N59-1R-250-40: 6.45V ± 0.10V • 2N59-1R-250-45 (NAMUR): 6.70V ± 0.10V • 2N59-1R-250-45 (constant current): 6.45V ± 0.10V is displayed on the multimeter.
 **Illustration 39: SA with SAHL 2 at SSPV 9**	**Step 3:** Read off the switching distance on the SAHL 2 for the corresponding system. The switching distance must be at • 2N59-1R-250-40: X - 2mm (± 0.5mm) • 2N59-1R-250-45 NAMUR: X + 3mm (± 1mm) • 2N59-1R-250-45 constant current: X + 3mm (± 1mm) or X + 9mm (± 1mm) at temperatures ≤ -15°C

Table 10: Measuring SA

In case a wheel sensor type 2N59-1R-250-45 is adjusted in constant current mode at temperatures ≤ -15°C, the switching distance must be set to X + 9mm.

If the switching distance of the sensor systems is not within the desired tolerance range, the switching distance must be readjusted by re-setting the SSPV9 and using the R58/135 (see chapter 9.2).

9.6 Checking the switching distance by means of an external evaluation module

KSAB10: The tool used must be calibrated regularly as part of its maintenance interval.

Before connecting the cable in the track connection housing, the work steps and instructions from chapter 9.7 must be followed.

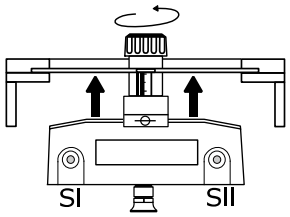
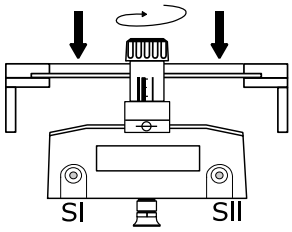
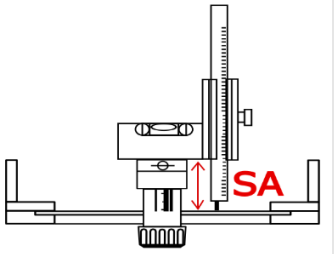
 **Illustration 40: Wheel sensor undamped**	**Step 1:** The SSPV 9 must be placed centrally on the wheel sensor (follow the marking on the wheel sensor) and be in contact with the rail head. Wind the SSPV 9 far upwards. The LED of the corresponding wheel sensor system on the evaluation board does not light up (sensor system is undamped).
 **Illustration 41: Wheel sensor damped**	**Step 2:** Rotate the test plate in a quarter turn downwards in the direction of the wheel sensor until the evaluation module indicates occupancy (LED of the wheel sensor system on the evaluation module lights up).
 **Illustration 42: SA with SAHL 2 at SSPV 9**	**Step 4:** Read off the switching distance with the SAHL 2 for the SI and SII systems and compare it with the required dimension for the new rail: • 2N59-1R-250-40: X - 2mm (± 0.5mm) • 2N59-1R-250-45 NAMUR: X + 3mm (± 1mm) • 2N59-1R-250-45 constant current: X + 3mm (± 1mm) or X + 9mm (± 1mm) at temperatures ≤ -15°C

Table 11: SA check with ABG

If the switching distance of the sensor systems is not within the desired tolerance range, the switching distance must be readjusted by re-setting the SSPV9 and using the R58/135 (see chapter 9.2).

9.7 Electrical connection of the wheel sensor

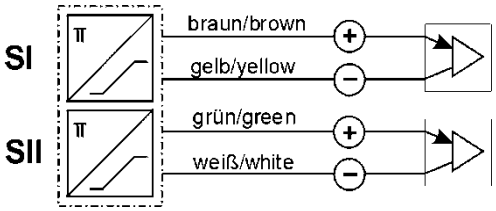


Illustration 43: Wheel sensor connection diagram

After the mounting has been completed, the connection cable of the wheel sensor must be laid in the cable distributor in accordance with the electrical specifications.

If the application in which the wheel sensor is to be used requires signalling safety, the connection cable must be laid with sufficient protection, e.g. in a 28/20 mm neoprene protective hose.

KSAB09: Before operation, an assignment check of the sensor systems of the wheel sensor must be carried out (e.g. by simulation of a crossing).

KSAB18: Though the wheel sensor and leads are designed to be very robust, the customer is responsible for protecting the wheel sensor against biological damage. Thus, the use of a rodent-proof protective tube is recommended in case of rodent problems along with treating the corpus with animal-repellent materials if it may be attacked by animals.

With a wire cross-section of 0.75mm², the total length of the cable between the wheel sensor and the evaluation module must not exceed 3500m.

The total line resistance (outward and return line) of 200Ω between the wheel sensor and the evaluation module must not be exceeded.

In case of a deviation of the wire cross-section (≠ 0.75mm²), the maximum cable length must be recalculated according to the maximum cable resistance.

KSAB21: Safe operation of the wheel sensor can only be guaranteed if a minimum distance of 6cm is maintained between the four-star stranded cable from the interface module to the wheel sensor and any adjacent parallel power cables. If this cannot be guaranteed, as is the case with other cable types or smaller distances, suitable shielding measures must be coordinated with the manufacturer.

KSAB11: When work has been carried out at the sensor, the track must be checked for possible problems for train traffic. All potentially hazardous tools must be removed from the track.

There is a risk of tripping if the cable is poorly laid.

10 Assembly drawing

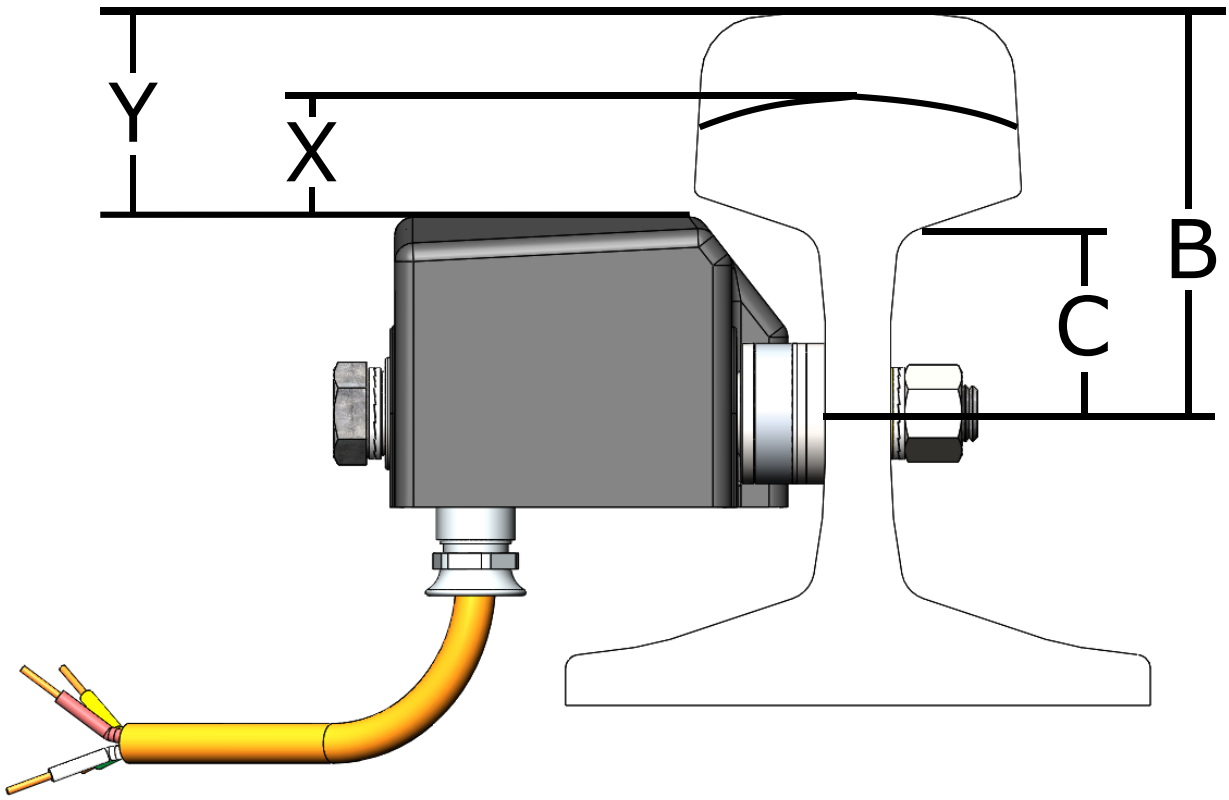


Illustration 44: Assembly drawing wheel sensor

Legend:

B: Drilling dimension for new rails 86.5 mm (±1.0 mm)

C: SBKL dimension (see rail profile list in chapter 12)

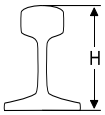
X: Drive-off dimension of the rail (see rail profile list in chapter 12), for new rails X = Y

Y: Wheel sensor to top edge of rail with new rail 45 mm (±1mm)
(± rail manufacturer's tolerance)

11 SAB list

SAB no.	Description
KSAB03	Installation, maintenance and servicing of the wheel sensor may only be carried out by trained personnel.
KSAB05	Sabotage, vandalism or damage due to improper use can impair the safe function of the sensor. The operator is responsible for preventing such damage.
KSAB06	After disconnecting the setting device and reconnecting it to the track connection housing (in short "GAG") – e.g. for switching distance settings during installation or maintenance – the switching distance must be checked either at the higher-level unit or directly at the sensor using a voltmeter at the system terminals in the GAG. Here, the switching distance must be within the tolerance range of the corresponding wheel sensor. If this is not the case, please check the cable path, the wheel sensor and the calibration of the adjustment tool.
KSAB07	Miscounts are possible with an activated eddy current brake. Using it for safe axle counting is not permitted on lines equipped with eddy current brakes.
KSAB08	The wheel sensor is designed for use in areas with compliance to [EBO] and [ERTMS]. Outside this framework, safe operation must be coordinated with the manufacturer.
KSAB09	Before operation, an assignment check of the sensor systems of the wheel sensor must be carried out (e.g. by simulation of a crossing).
KSAB10	The tool used must be calibrated regularly as part of its maintenance interval.
KSAB11	When work has been carried out at the sensor, the track must be checked for possible problems for train traffic. All potentially hazardous tools must be removed from the track.
KSAB15	To reduce the risk of injury when working on the track during installation and maintenance, or caused by the wheel sensor directly, personnel must be equipped with adequate PPE.
KSAB18	Though the wheel sensor and leads are designed to be very robust, the customer is responsible for protecting the wheel sensor against biological damage. Thus, the use of a rodent-proof protective tube is recommended in case of rodent problems along with treating the corpus with animal-repellent materials if it may be attacked by animals.
KSAB19	The wheel sensor must be lowered at the latest when the distance between the upper edge of the rail and the upper edge of the wheel sensor housing is 38mm. Should it no longer be possible to lower the wheel sensor, damage to the wheel sensor cannot be ruled out. In this case, the operator must take suitable measures to prevent damage to the wheel sensor or the wheel sensor must be taken out of service immediately.
KSAB21	Safe operation of the wheel sensor can only be guaranteed if a minimum distance of 6cm is maintained between the four-star stranded cable from the interface module to the wheel sensor and any adjacent parallel power cables. If this cannot be guaranteed, as is the case with other cable types or smaller distances, suitable shielding measures must be coordinated with the manufacturer.
KSAB22	The wheel sensor may only be considered as safe if it has been mounted according to the installation instructions and with the mounting material provided. In case of deviations, the operator must ensure safe functioning.
KSAB27	When installing or servicing the wheel sensor, the results must be recorded in the test report [Fo336].
KSAB29	Outer side installation of the wheel sensor is not permitted without the required proof of functional safety.

12 Rail profile list

Identify rail profile				TO-BE height new rail		Check bore holes / mounting		Distance DSS front edge to rail web	Mounting position	Web mounting plates (spacer plates)	Sockets Web mounting
					CEMBRE LD-1P 	SBKL1 	SAHL2 			Spacer washers 8 mm 4 mm 2 mm 1 mm 	tubular rivet 10.8mm 13.8mm 15.8mm
New rail				H	Base plate + jaw profiles	C	X	S		a	
Field of operation	Weight	Name									
		Norm	specific	[mm]		[mm]	[mm]	[mm]		[mm]	[mm]
Germany	33 kg/m	33E1	S 33	134.00		53.75	> 38	87 (±0.5)	Normal	8 + 2 = 10	10.8
							> 38	n. possible	Down	n. possible	
Germany Sweden	41 kg/m	40E1	S 41 (R14)	138.00	EL-318873-13-xx	52.00	> 38	91 (±0.5)	Normal	8 + 4 + 2 = 14	10.8
							> 38	87 (±0.5)	Down	2	
Germany Austria	49 kg/m	49E1	S 49	149.00	SR-SKI (6-085423) EL-418891-00-01	43.83	> 38	92 (±0.5)	Normal	8 + 4 + 2 + 1 = 15	13.8
							> 38	89 (±0.5)	Down	4	
USA Canada	50 kg/m	AREA 100	100 RE	152.40		51.09	> 38	91 (±0.5)	Normal	8 + 4 + 2 = 14	13.8
							> 38	88 (±0.5)	Down	2 + 1 = 3	
Switzerland Austria Germany	54 kg/m	54E2	SBBIV UIC54E Form C	161.00	EL-318873-15-xx	45.10	> 38	91 (±0.5)	Normal	8 + 4 + 2 = 14	15.8
							> 38	89 (±0.5)	Down	4	
Switzerland Germany Finland	55 kg/m	54E1	SBBIII UIC54 K54	159.00	SR-SKI (6-085423) EL-318873-14-xx	47.10	> 38	91 (±0.5)	Normal	8 + 4 + 2 = 14	15.8
							> 38	89 (±0.5)	Down	4	
Germany	55 kg/m	54E4	S 54	154.00	SR-SKI (6-085423) EL-318873-01-xx	40.67	> 38	93 (±0.5)	Normal	8 + 4 + 2 + 2 = 16	13.8
							> 38	92 (±0.5)	Down	4 + 2 + 1 = 7	
USA Canada	57 kg/m	AREA 115	115 RE	168.28	SR-SKI (6-085423) EL-318873-07-xx	50.50	> 38	90 (± 0.5)	Normal	8 + 4 + 1 = 13	13.8
							> 38	88 (± 0.5)	Down	2 + 1 = 3	
Germany Belgium Switzerland Austria	60 kg/m	60E1, 60E2	UIC 60, E2 SBB VI Form VII	172.00	SR-SKI (6-085423) EL-318873-02-xx	45.59	> 38	92 (± 0.5)	Normal	8 + 4 + 2 + 1 = 15	15.8
							> 38	89 (± 0.5)	Down	4	
USA Canada	66 kg/m	AREA 132	132 RE	180.98	SR-SKI (6-085423) EL-318873-09-xx	49.01	> 38	92 (± 0.5)	Normal	8 + 4 + 2 + 1 = 15	15.8

							> 38	89 (± 0.5)	Down	4	
USA Canada	**66 kg/m**	**AREA 133**	133 RE	179.39	EL-318873-17-xx	46.70	> 38	93 (± 0.5)	Normal	8 + 4 + 2 + 2 = 16	
							> 38	89 (± 0.5)	Down	4	
USA Canada	**68 kg/m**	**AREA 136**	136 RE	185.74	SR-SKI (6-085423) EL-318873-10-xx	44.34	> 38	93 (± 0.5)	Normal	8 + 4 + 2 + 2 = 16	15.8
							> 38	90 (± 0.5)	Down	4 + 1 = 5	
USA Canada	**70 kg/m**	**AREA 140**	140 RE	185.74	EL-318873-16-xx	43.80	> 38	93 (± 0.5)	Normal	8 + 4 + 2 + 2 = 16	15.8
							> 38	90 (± 0.5)	Down	4 + 1 = 5	
USA Canada	**70 kg/m**	**AREA 141**	141 RE	188.91	SR-SKI (6-085423) EL-318873-11-xx	41.15	> 38	93 (± 0.5)	Normal	8 + 4 + 2 + 2 = 16	15.8
							> 38	91 (± 0.5)	Down	4 + 2 = 6	

Table 12: Rail profile list

The corresponding parameters of other rail types can be requested from the manufacturer.