proceq

Zehntner ZRM 6010
Retroreflectometer R_L
Firmware as from 2.1.0

Instruction Manual

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1	Description of device

The Zehntner ZRM 6010 is a portable handheld top class Retroreflectometer for determination of night visibility (R_L) for all types of road markings.

In particular, this instrument has the following features

- 5.7" high resolution colour touchscreen with excellent visibility under all light conditions
- Telescopic handle for easy field and laboratory operation
- Ultrafast retroreflection measurement (R_L) in about 1 second
- Innovative options such as integrated 5-megapixel camera, compass and level-meter, GPS-unit, as well as various printer versions
- Intuitive, easy-to-use menu navigation in several languages
- Automatic stray light supervision and compensation, particularly important for measuring profiled markings
- Measuring of profiled markings with heights up to 15mm and long profile gaps
- Measuring of road markings of all colours without recalibrating the retroreflectometer due to V(λ) conformity
- Simple calibration at the push of a button
- Multiple retroreflection measurements with continuously updated average; additionally each single measurement is stored
- Wet timer (for countdown) and interval timer (for periodic measurements)
- Integrated measurement of environmental temperature and relative humidity
- Easy management of the measuring data in the instrument´s archive
- Data transfer to USB-printers or storage devices within seconds
- Easy evaluation and export to Microsoft Excel through the included mapping and data analysis software "MappingTools"
- Compact dimensions and low weight
- In accordance with CE, FCC and RoHS regulations
- In accordance with EN 1436 (R_L dry, wet and rain), ASTM E1710 (R_L), ASTM E2177 (R_L wet) and ASTM E2832 (continuous wetting) standards
- Factory calibration traceable to the independent Swiss Federal Institute of Metrology METAS
- Approved by the accredited association StrAus-Zert, Germany (test No. 0913-2018-02)

Features of options:

- The integrated 5-megapixel camera takes pictures of the road marking for additional visual evaluation
- The data of the compass and level-meter deliver additional information to the retroreflection measuring values
- With the GNSS GPS-unit is possible to display the measurement in the included mapping and data analysis software "MappingTools"
- Optional built-in thermal printer or portable USB-printer for easy printouts directly on site for simple reporting of the retroreflectivity of road markings

2 Safety information

2.1 Symbols used

🛈 This note comprises instructions needed to follow directions, specifications, proper working procedure and to avoid data loss, damage or destruction of the instrument.

⚠ This note signifies a warning about dangers to life and limb if the apparatus is handled improperly. Observe these notes and be particularly careful in these cases. Also inform other users on all safety notes. Besides the notes in this instruction manual the generally applicable safety instructions and regulations for prevention of accidents must be observed.

2.2 Safety notes and hints

⚠ The Zehntner ZRM 6010 is a high quality, state of the art instrument and is safe to operate. Nevertheless there is always risk when the instrument is handled inappropriately.

⚠ Every person working with the Zehntner ZRM 6010 or maintaining the Zehntner ZRM 6010 must read and understand the manual completely, in particular the safety precautions and warnings.

⚠ Avoid any mode of operation that could affect the safe working with the Zehntner ZRM 6010. Especially the determination of the night and visibility of road markings must take place as described in this instruction manual.

⚠ Operate the device only on blocked street sections.

⚠ Do not use the battery charger in wet conditions.

⚠ In case of a damaged power cable of the battery charger, the cable may not be used any longer.

⚠ A damaged battery charger has to be replaced.

⚠ During operation, surfaces in the surrounding area of the print head may heat up. Therefore, direct contact with the print head must be avoided to prevent burning acccidents.
Do not put heat-sensitive objects close to this heat source.

⚠ On principle the printer hat to be kept dust-free. Never use sharp objects for cleaning, this might cause damage to the print head.

⚠ Do not touch the print head, this might cause damage by electrostatic discharge.

⚠ It is no longer possible to safely operate the device, if:
- the housing has been damaged
- moisture reached the inside of the device
- smoke is coming from the inside of the device

❗ It is strictly forbidden to open the housing of the Zehntner ZRM 6010. Otherwise all the guarantee and liability claims to Proceq SA will be void.

❗ Keep the device dry! **Danger of short circuit!**

❗ The Zehntner ZRM 6010 is exclusively intended for the determination of night visibility (R_L) for all types of road markings. Any other use is considered as not being in accordance with the intentions of the manufacturer. The manufacturer is not liable for damage resulting from inappropriate application. The user bears the full responsibility.

❗ **Proceq SA** refuses all warranty and liability claims for damages caused by usage of the Zehntner ZRM 6010 in combination with **non-original accessories**, or accessories from 3rd party suppliers.

❗ Unauthorized modifications and changes of the Zehntner ZRM 6010 are not allowed.

❗ Reproduction is not allowed.

⚠ Before any maintenance make sure that the Zehntner ZRM 6010 is unplugged from power supply and turned off.

❗ All maintenance and repair work which is not explicitly allowed and described in this manual (see chapter 15.1 "Maintenance carried out by the user" on page 58) shall only be carried out by **Proceq SA** or your authorized Proceq agent, failure to comply voids warranty.

❗ For the operation of the Zehntner ZRM 6010 apply all local safety regulations.

3   Delivery of device

3.1 Damages during carriage
On the receipt of the goods, check for any visible damages on the packaging. If it is undamaged you may sign the receipt of the goods. If you do suspect by your visual inspection that damage has occurred, make a note of the visible damage on the delivery receipt and request the courier to countersign it. Moreover, the courier service must be held responsible for the damage in writing.

If a hidden damage is discovered while unpacking, you have to inform and hold the courier liable immediately in the following way: **"When opening the parcel we had to notice that … etc."** This superficial checking of the goods has to be done within the time limit set by the carrier, which is normally 7 days. However, the period could vary depending on the carrier. Hence, it is recommended to check the exact time limit when receiving the goods.

If there are any damages also inform your authorized Proceq agent or **Proceq SA** immediately.

3.2 Shipment
Should the device be transported again, it must be packaged properly. Preferably use the original packaging for later shipments. Additionally use filling material in the package to protect the device from any shock during carriage.

3.3 Standard delivery

Following parts are included in the delivery:

1	battery operated retroreflectometer with 5.7" colour touchscreen, telescopic handle	
1	battery charger (100 - 240 V, 50 - 60 Hz)	
1	mapping and data analysis software "MappingTools"	
1	USB cable	
1	product certificate	
1	certificate of calibration	
1	calibration standard	
1	positioning support	
1	Carrying case with wheels	

3.4 Carrying case

The Zehntner ZRM 6010 is delivered in a transportation case. Whenever you want to transport the instrument, use the case. Nevertheless, please take care that for shipments the case has to be put into a cardboard box and protected with filling material. The transportation case is an optimal storage case for the equipment. When not in use, the Zehntner ZRM 6010 should be locked into the calibration standard and safely stowed in the carrying case.

3.5 Configurations

3.5.1 Zehntner ZRM 6010 Retroreflectometer R_L Basic

This version is without built-in options.

3.5.2 Zehntner ZRM 6010 Retroreflectometer R_L Pro

This version is equipped with the integrated option:
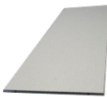
• GNSS GPS-unit	

3.5.3 Zehntner ZRM 6010 Retroreflectometer R_L Advanced

This version is equipped with all available integrated options:

• GNSS GPS-unit	
• integrated camera with 5 Megapixel	
• built-in thermal printer	
• compass and level-meter	

3.6 Separate options

• 41020903 portable printer	
• 41020905 2nd calibration standard (pavement marking tape) measured by Zehntner incl. certificate of calibration	
• 41020902 voltage converter 150 W to be plugged into the car cigarette lighter	

 Proceq refuses all warranty and liability claims for damages caused by usage of the Zehntner ZRM 6010 in combination with non-original accessories, or accessories from 3rd party suppliers.

4	Device overview
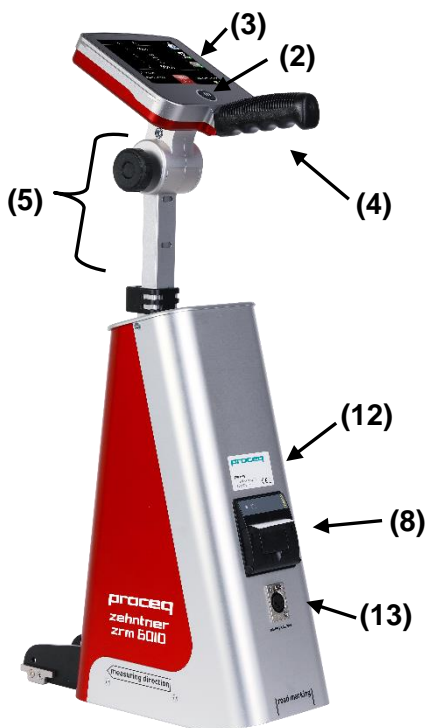
(1) On/Off button
(2) Measuring button
(3) Touchscreen
(4) Handle
(5) Telescopic handle
(6) Release turning knob
(7) Height shifting knob
(8) Optional built-in thermal printer
(9) Host USB-interface (type A)
(10) Mini USB-interface (type B)
(11) Measuring area
(12) Label with serial number
(13) Port for battery charger
(14) Height lock
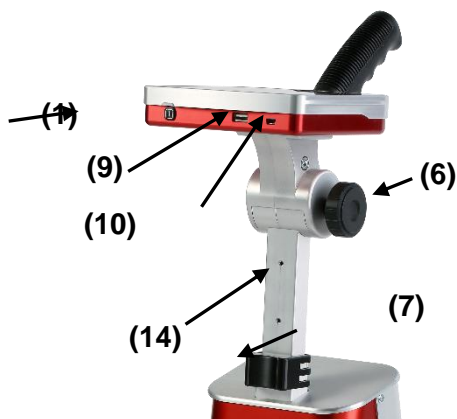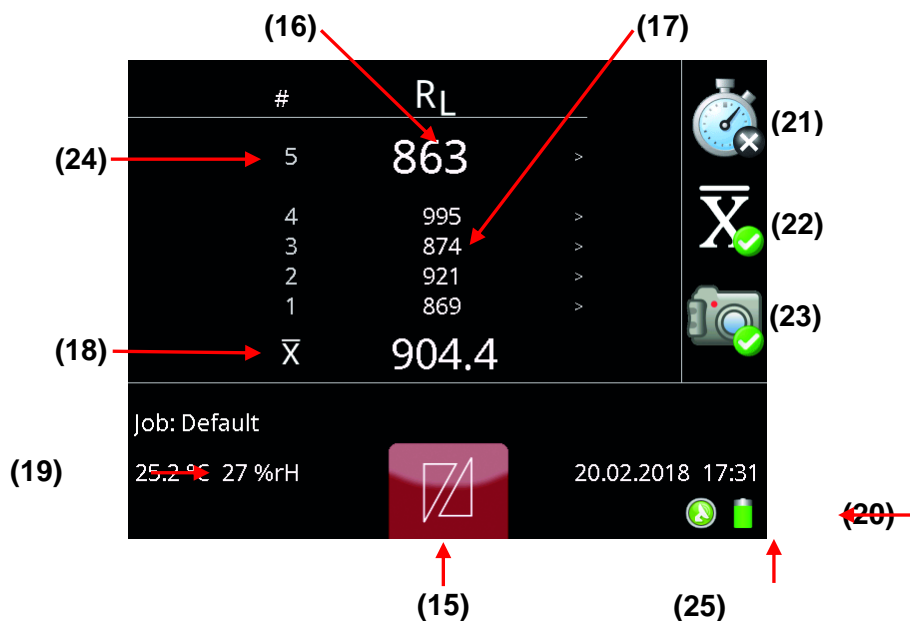
(15) **Quick start menu button**
(16) **Current measuring value**
(17) **Single values**
(18) **Average value**
(19) **Ambient temperature & relative humidity**
(20) **Battery status**
(21) **Wet timer**
(22) **Multiple measurement with average**
(23) **Optional camera**
(24) **Number of measurements in average mode**
(25) **GPS status**

5	Setting up

By pressing the On/Off button ⬛, you switch on/off the instrument.

During startup, the Zehntner-logo will be displayed.

Press and hold the measuring button 🔘 during startup to directly access display for language selection.

6	Navigation

6.1 Activation/deactivation

By pressing icons on the display certain functions are activated or deactivated.

This is either shown with a white tick on green background ✅ for

activated functions, a green thick ✔ for selected menu options, with a

yellow marking e.g. 🔳 for active controls or a grey marking ⬛ 338 for selected measurements.

6.2 Scrolling

Scroll through lists by pressing the 🔽 and 🔽 buttons or by swiping up or down on the list.

6.3 Exit

Return to measuring mode from any function by pressing the measuring button 🔘

The only exception are functions with a cancel button `Cancel` which need to be explicitly closed by pressing cancel or accept. Some functions allow going up a

level by pressing the backwards arrow ◀.

7	Calibrate

7.1 Calibration standard

The calibration standard has been measured and the calibration value of R_L has been inscribed.

Always protect the calibration standard from dust, moisture and other environmental influences and safley store it in the carrying case of the Zehntner ZRM 6010.

Calibration standard

Label
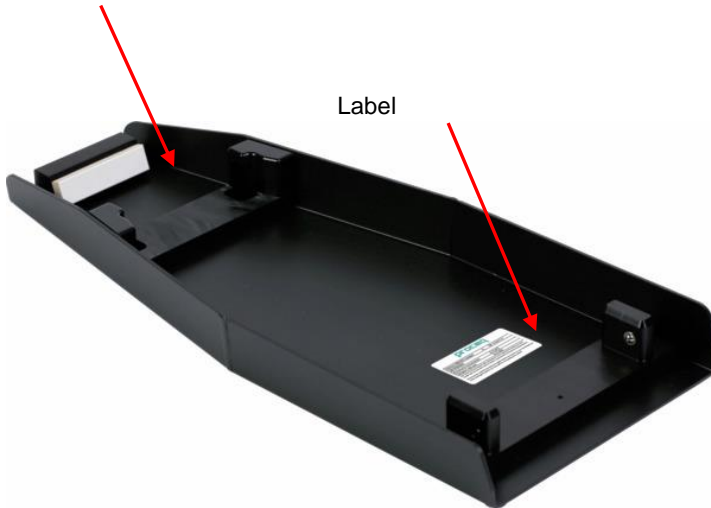
ⓘ After the expiry date of the calibration standard a factory calibration of the ZRM 6014 and its corresponding calibration standard is required. Contact either Proceqr or your authorized Proceq agent. The factory calibration is valid for 2 years.

ⓘ The calibration standard delivered with the Zehntner ZRM 6010 is not changeable and is valid only for the delivered instrument.

7.2 Cleaning of the calibration standard

If the calibration standard is soiled or covered by dust, it can be cleaned carefully using window cleaner and a soft tissue.

ⓘ A damaged or a polluted calibration standard may cause incorrect calibration and therefore incorrect measuring results.

7.3 Calibration on calibration standard

When the instrument indicates that the calibration is outdated, or if it is required by the applicable regulations, the instrument should be calibrated.

Remove the instrument and the calibration standard from its carrying case.
Tilt the instrument slightly forward facing and insert it into the frontal prong support. Tilt the device back into horizontal position, it should click into place.
The device will indicate incorrect placement with an error message.
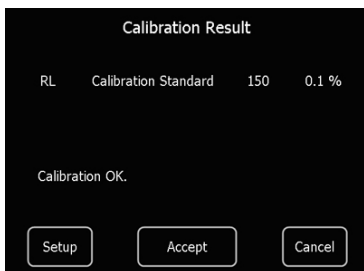
Press the symbols [symbol] and [symbol] to open the calibration function. By default night visibility (R_L) is calibrated. Trigger the calibration by pressing [Calibrate]. The "Calibration Result" displays the measured value as well as the deviation from the expected value in percent. Successful calibration is indicated by "Calibration OK". Confirm the calibration by pressing [Accept] and to return to the measuring mode.
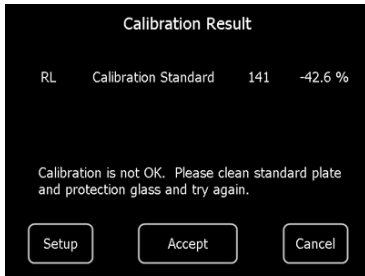
Calibration results with deviations greater than 15 % are indicated by "Calibration is not OK". This can be caused by a soiled or damaged standard or a soiled optic window. It is suggested to reject such a calibration result by pressing [Cancel] before determining the reason for the deviation. Clean the standard as described in chapter 7.2 "Cleaning of the calibration standard" on page 18 and recalibrate again.

🛈 By experiencing repeatedly a deviation greater than 15%, a calibration by the manufacturer is required.

The data of the calibration settings of R_L can be viewed by pressing [⊘], [⏲ Calibrate] and [Setup] then selecting the geometry. The desired geometry can be activated/deactivated by clicking on the line "Calibrate" and choosing "On" or "Off".

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8 Measure

8.1 Preparation

The Zehntner ZRM 6010 has a telescopic handle which grants triggering measurements comfortable at the street and in the laboratory.

After removing the Zehntner ZRM 6010 from the carrying case, the length of the telescopic handle can be adjusted to the right length and the handle can be turned into the right angle. To change the length, the height shifting knob must be pressed, to change the angle of the handle and the display, the release turning knob must be turned. The telescopic handle must click in its final position.

🛈 Before the device is put back into the carrying case, the telescopic handle has to be retracted and the brought into horizontal position.

8.1.1 Adjusting the length of the telescopic handle

8.1.2 Adjusting the angle of handle and display

8.1.3 Mounting the positioning support
Mounting the positioning support is quick and easy. Lay the positioning support to the floor, tilt the instrument slightly to the front and slide it in this position into the frontal prong support. Tilt the device back into horizontal position, it should click into place.
Ensure proper fixation by raising the instrument shortly.

8.2 Measuring area and illumination field
The dimension of the measuring area of the ZRM 6010 is 52 mm x 489 mm and of the illumination field is 50 mm x 100 mm.

The actual measuring takes place in the area which is concurrently covered by measuring area and illumination field.
The positions of measuring area and illumination field shift depending on the measuring height (e.g. profiled markers).

h = -1 mm
h = 0 mm
h = 1 mm
h = 2 mm
h = 3 mm
h = 4 mm
h = 5 mm
h = 6 mm
h = 7 mm
h = 8 mm
h = 9 mm
h = 10 mm
h = 11 mm
h = 12 mm
h = 13 mm
h = 14 mm
h = 15 mm
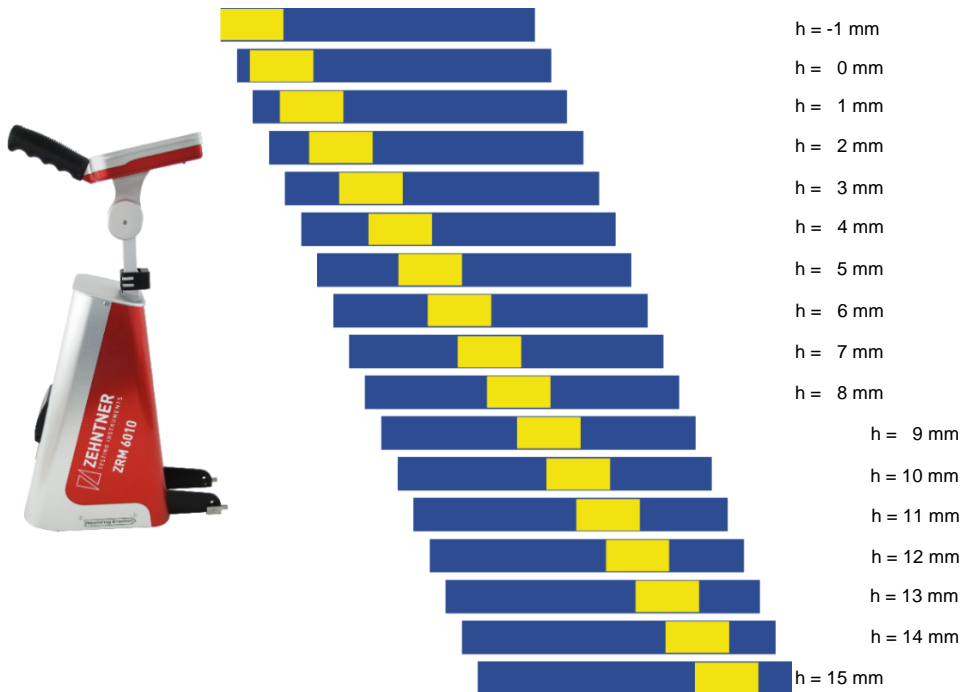
There is the following relation for the position of the illumination field:
At a height of -1 mm the illumination field directly starts at the end of the black device prong.
It will shift 46 mm by increasing the measuring height by each 1 mm.
(Derivation: 30m/0.65m = 46.15)

8.3 Measure mode

🛈 For instructions on the correct positioning of the device on the road marking please refer to chapter 8.4 and 8.5 as from page 26

🛈 For editing or deleting measurements please refer to chapter 8.3.5 on page 25

🛈 For changing the settings of the measure mode, please refer to chapter 13.3 on page 46

8.3.1 Single measurements

To trigger a measurement press the measuring button 🔵. Active measurement period is indicated by "-" on the top line and the symbol 🔵 in the top left corner.

After a successful reading the current measurement values will be shown on the top. Previous measurements are shown on the following lines, with the most recent one at the top.

8.3.2 Average measurements

Activate average reading by tapping the symbol 🔵. To trigger a measurement press the measuring button 🔵.
Single measurements are displayed with a chronological sequence number.
The current average is displayed at the bottom line.

8.3.3 Wet measurements

The Zehntner ZRM 6010 is perfectly suitable for measuring night visibility on wet road markings according EN 1436 and ASTM E2177 ("bucket" method) or for measuring night visibility under contiouous wetting using a rain simulator according ASTM E2832 or EN 1436.

The in integrated wet timer countdown eases the procedure of wet measurement corresponding to the "bucket" method.

To activate the wet timer press the symbol on the touchscreen.

Press the measuring button (m) and the wet timer countdown which will measure automatically after completion.
The wet timer can also be combined with averaging function and picture recording .

⚠ Do not expose the device to direct rain. Never pour water on the instrument or dip it into water.

8.3.4 Measurements with picture

If the instrument is equipped with the optional camera pictures to a measurement can be taken. The usage of this option is described more deeply in chapter 10.1.1 "Taking measurements with picture" on page 33.

8.3.5 Edit, delete and store measurements

To add location, manufacturer and other info to a measuring value, tap the measurement you want to edit. An editing menu will be opened beside the list. Edit additional information for the measurement by tapping "Comment".
Delete a measurement by tapping "Remove". Deleting multiple measurements at once is possible in the archive (see chapter 11 "Archive" as from page 38, at "delete jobs" see chapter 13.5 "
Jobs" on page 52 or using the "MappingTools" software, see separate instruction manual.
The "Edit" menu allows to add additional information using the touchscreen. This information is applied to all future measurements until changed again. Additional information can also be added later using the archive. For this refer to chapter 11 "Archive" as from page 38.

To add special characters, press and hold the button until the respective special character is shown. Alternatively tap the

button 12? to open the numeric keyboard or

the button @# to open the special characters keyboard.
For faster editing it is possible to connect a keyboard on the USB-interface.

8.4 Information for a proper measuring procedure

For most accurate measurements the device should be placed as planarly as possible. If there is significant unevenness in the road marking use the positioning support.

8.5 Measuring profiled markings

The Zehntner ZRM 6010 is capable of measuring profiled road markings with profiles of heights between -1mm up to +15 mm.

The measuring geometry is according to the standards EN 1436 and ASTM E1710 within this range. Profiles with heights out of this range can evoke wrong measuring results. This fact depends also on the gap between the single profiles (refer to Chapter 8.5.3 „Comments to the measurement of profiled road marks" page 30). It is recommended to use the enclosed positioning support to obtain most accurate measurement results.

8.5.1 Preparation

Mounting the positioning support is quick and easy. Lay the positioning support to the floor, tilt the instrument slightly to the front and slide it in this position into the frontal prong support. Tilt the device back into horizontal position, it should click into place.

Ensure proper fixation by raising the instrument shortly.

Profiled road markings are not homogenous considering their retroreflection (normally the front side has a higher retroreflection value than the upper side). Cause of that measuring of a profiled road marking means that an average value from several measurements has to be calculated which respects all areas on and between the profiles evenly.

The result corresponds then to the overall impression out of a driving car.

Locate the marker labelled with „illumination field" on the upper side of the positioning support. The illumination field is at this place, when the instrument is measuring from a height of 0 mm. It will shift 46 mm by increasing the measuring height by each 1 mm.
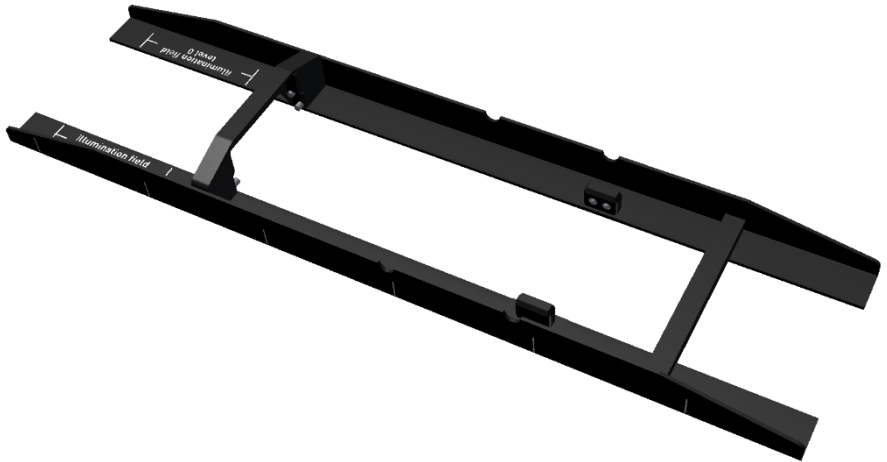
There are markers on the side of the positioning support in a distance of 10cm (length of the illumination field) which help to shift the instrument in steady steps over a profiled marking. The first two markers show also the illumination area at height of 0 mm („level 0").

8.5.2 Procedure of measurement

Activate the averaging mode by touching the symbol $\overline{X}_x$. This is acknowledged by showing the checking mark.

Place the instrument on the profiled road mark in a way that the first mark on the positioning support lays on the front edge of a specific profile.
Execute the first measurement for the average here.

Shift the instrument 10 cm to the 2nd mark on the positioning support and execute the 2nd measurement in average mode.

Shift the instrument another 10 cm to the next mark on the positioning support and execute the next measurement in average mode.

Repeat the last step n times until you measured a sufficient number of profile sections and the first mark on the positioning support is on the front edge of a profile again.
Do not execute a measurement on the last postion! You measured this kind of position with the first measurement already.

Complete the average measurement by touching the symbol .

8.5.3 Comments to the measurement of profiled road marks

Most oft he profiled road marks have a higher retroreflection value on the front side than on the upper side.

By measuring several places of a profile an average value over the whole profile is calculated, which respects front and upper side evenly and therefore integrates the overall impression of the road mark.

Measuring concept R_L: The measuring instruments contain the geometry as represented below in a smaller scale (refer to chapter 17 „Graphical illustration of the measuring principles" page 61).
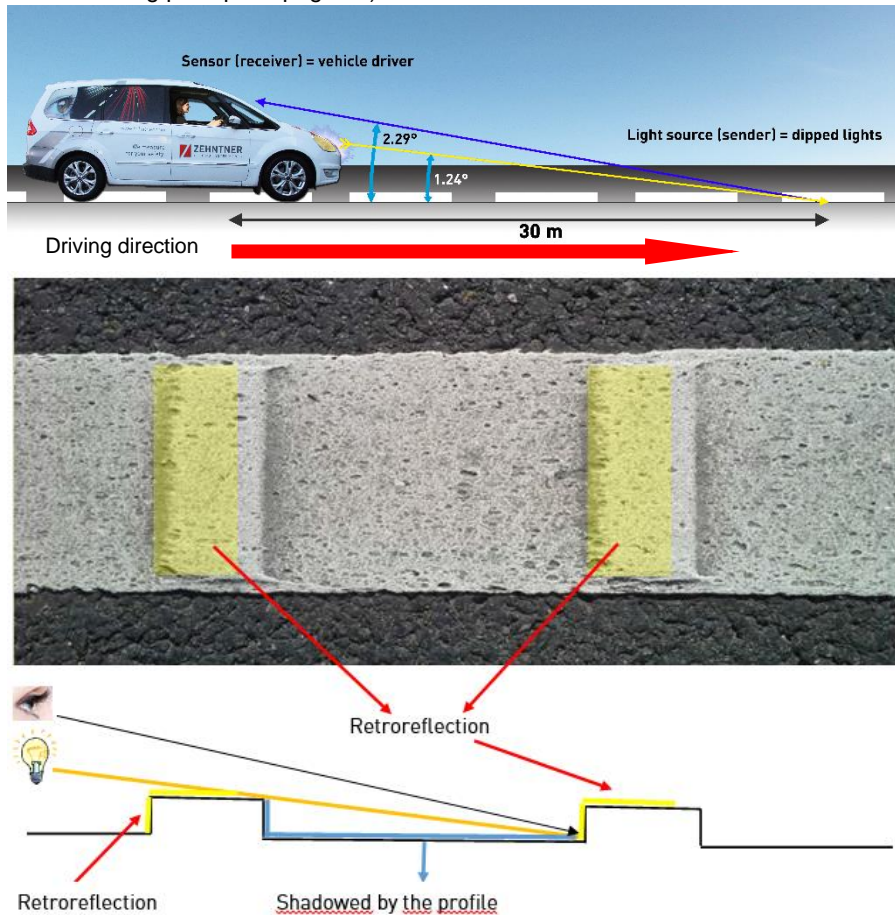
By the predetermined geometry there is a constant relation between the height of profiles and the lenght of the shadowing effects: length = 46 * height
(i.e. for a height of a profile of 1 mm there is shadowing of 46 mm)

8.6 Local regulations
Please observe that some countries have regulations regarding the measuring procedure. E.g. it could be regulated how many measurements must be taken. Please inform about your local regulations.

8.7 Obtain exact measuring values
Ensure that the marking to be measured is as flat as possible along the whole measuring range of the device, otherwise the measuring angles would change. Crooked or bent samples provoke incorrect measuring results. You can measure only from heights up to 15 mm correctly.
For measurements in the laboratory you have to be aware that your samples must be absolutely plane.

Use samples of sufficent size, absolutely plane, distortion-free and insensitive to moisture (e.g. metal plates).

9   Quickstart menu

Quickstart menu opens by touching the symbol [symbol]. Various functions can be accessed by pressing the respective icons, described below.
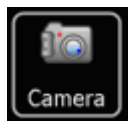
The camera is an option at extra cost and this icon is only shown if purchased. Press the icon to see a preview of the picture you would get at a measurement. Pictures can be taken with or without zoom. For further information refer to chapter 10.1 on page 33.

In the menu different settings can be made. For more information on this please refer to chapter 13 "Menu" as from page 45.
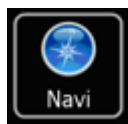
The button Navi is shown if at least one of the options at extra costs compass and level meter or GNSS GPS-unit had been aquiered. Press the icon to get some information about the current positioning of Zehntner ZRM 6010. For further information refer to chapter 10.2 on page 35 or to chapter 11.3 on page 39.

All stored measurements are located in the archive (memory). Here you can edit, delete, export to USB flash drive as well as to print out measurement results. For further information refer to chapter 11 "Archive" on page 38.

Here you can print the last measurement or a specific measurement marked earlier in the measuring mode display using the optional built-in thermal printer or an USB printer such as our optional portable printer. If no measurement is selected, the latest one will be printed. The settings of the informations to be printed on the measuring report can be configured, as described in chapter 13.6.11 "Options" on page 55.

Here you can calibrate the night visibility (R_L) and change the calibration settings. For further information refer to chapter 7 "Calibrate" as from page 18.

10	Options

10.1 Built-in camera for pictures

With the optional camera the Zehntner ZRM 6010 features the possibility to take pictures of the road markings in a resolution of up to 5MP (2592 x 1944). This is very helpful for the interpretation of the measuring data. The pictures are intended for the evaluation of road markings in regard of colour, type (type-I or type-II), embedding and allocation of glass beads, and if there is heavy soiling.

10.1.1 Taking measurements with picture

Pictures can be taken while measuring when the symbol is activated. It is possible to make single or average measurements with pictures. Choose between pictures with or without zoom.

Picture without zoom
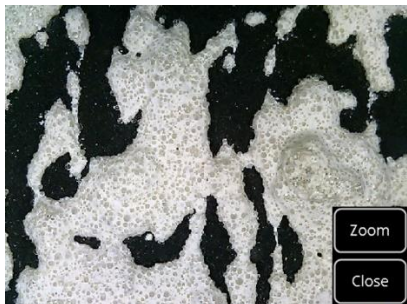
Picture with zoom

For instructions on the correct positioning of the unit on the road marking please refer to chapter 8.2 and 8.5 as from page 26.

Taking single measurements with picture
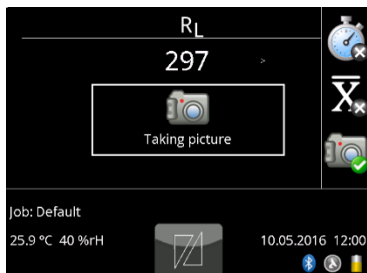
Only the symbol is activated. To trigger a measurement press the measuring button . The picture will be shown for about 5 seconds after the measurement.
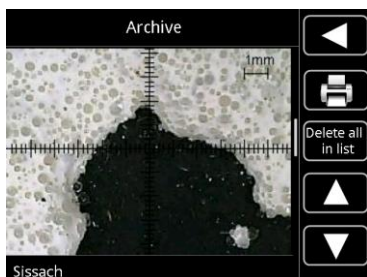
After this period, pictures can be viewed in the archive, as described in chapter 11 "Archive" as from page 38.

This is an example of a picture taken with zoom, as shown in the archive.

Taking average measurements with picture

For this both symbols and have to be activated. By default at average readings only one picture at the first reading will be taken. To change this setting please refer to chapter 13.6.7 "Camera" on page 54. The measuring procedure is the same as for single measurements with picture. The measuring procedure is the same as for single measurements with picture.

10.2 Compass and level-meter

With this feature the Zehntner ZRM 6010 allows to store the orientation of the device at the time a measurement is taken. So you can always reproduce in what driving direction the measurements had been taken. This is particularly interesting for center lines.

It is also possible to store the gradient of the road to a measurement. The gradient is an important factor in assessing wet measurements.

Further information is available in chapter 9 "Quickstart menu" on page 32.

10.3 GNSS GPS-unit

With this feature the Zehntner ZRM 6010 features the possibility to store the exact geographical position for every measurement taken. As the module is not only GPS-unit but a GNSS module particularly, it can also use data from other navigation satellites like Galileo, Glonass and Beidou.

If the module is built in, the Zehntner ZRM 6010 indicate left of the battery status the status of the GPS receiption.

|		
	No GPS signal	The GPS-unit is not able to receive a positioning signal. The coordinates cannot be displayed.
	Weak GPS Signal	The GPS-unit is receiving the positioning signal. The quality of the GPS signal is poor.
	Normal GPS signal	The GPS-unit is receiving the positioning signal. The quality of the GPS signal is fine.
	Intense GPS signal	The GPS-unit is receiving the positioning signal. The quality of the GPS signal is very good.

DOP Value	Rating	Description
1	Ideal	This is the highest possible confidence level to be used for applications demanding the highest possible precision at all times.
1-2	Excellent	At this confidence level, positional measurements are considered accurate enough to meet all but the most sensitive applications.
2-5	Good	Represents a level that marks the minimum appropriate for making business decisions. Positional measurements could be used to make reliable in-route navigation suggestions to the user.
5-10	Moderate	Positional measurements could be used for calculations, but the fix quality could still be improved. A more open view of the sky is recommended.
10-20	Fair	Represents a low confidence level. Positional measurements should be discarded or used only to indicate a very rough estimate of the current location.
>20	Poor	At this level, measurements are inaccurate by as much as 300 meters with a 6 meter accurate device (50 DOP × 6 meters) and should be discarded.
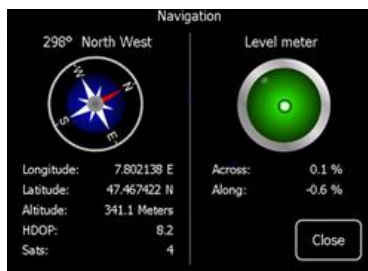
By pressing [icon] and [icon] GPS coordinates and device orientation can be viewed. Coordinates will be stored for each measurement. A "No signal" indicator means that the GNSS GPS module is not able to receive a positioning signal and no GPS coordinates will be stored.

After switching the Zehntner ZRM 6010 on, it takes up to 15 minutes until the unit is receiving coordinates. The performance of the GPS module can be affected by narrow streets with high buildings that prevent clear view to the sky. Indoors it is normally not possible to receive coordinates.

Technical Data:
Accuracy: min. ±15 meters, < ±3 meters under good conditions
Earth Datum Index: WGS84

10.4 Built-in thermal printer

The Zehntner ZRM 6010 features the possibility to print out a measuring report using the optional built-in thermal printer.

Replacing the thermal paper roll

For replacing the thermal paper roll, you have to carry out the following steps:
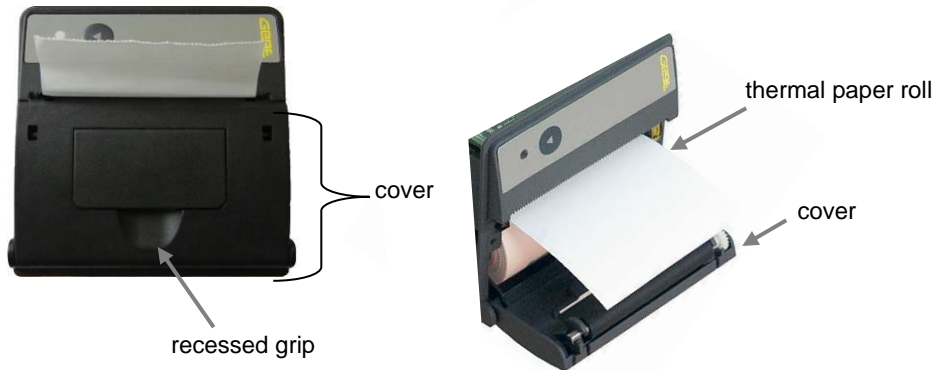
- Position your finger under the recessed grip and open it with a slight pull.
- Put the paper roll into the thermal paper roll feeder so that the end of the paper roll is on the top.
- Close the cover, so that a slip of paper will be on the outside.
- Now the thermal printer is ready to use.

11   Archive

All stored files are located in the archive. The archive can be accessed by pressing

and selecting .

In case the measurements are not stored automatically, the settings have been changed. This is described in chapter 13.3 "Measure mode" on page 46.

11.1 Sorting of the measurements

Measurements can be sorted by different criteria. "Readings with pics" are grouped by date. "All measurements" are sorted by date and time in descending order. If the last measurement was a single measurement, it is listed under "Last measurement". Tap the corresponding line to display the sorted list.
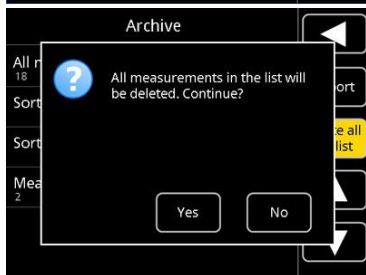
Emptying the archive cannot be undone. All data is lost irrevocably. Only delete an archive if the data is no longer needed.

It is recommended carrying out a back-up copy on your computer or on a USB-flash drive. If you really wish to delete the complete archive, you need to confirm this message.

11.2 Overview measurements (sorted)

This is an example sorted by job. All measurement files under a certain job are listed. R_L and Qd values are shown, in addition to date, time and job listed in the third column. For average measurements, the total count of measurements is also displayed in the last column. Please note:

⚠️ "Delete all in list" will delete all single measurements sorted in this job.

Tap a single measurement to get additional options. "Delete" will delete the measurement from memory. "More" opens a window where additional info such as location, manufacturer etc. can be viewed and adjusted.

11.3 Detailed entry information

The detailed info view displays measuring values, the date/time and on which standard the instrument has been calibrated for this measurement.

Additional information such as temperature, humidity and – depending on equipment - picture, GPS-coordinates, compass indication etc. is also displayed.
"On Standard: True" indicates that the measurement has been made on the calibration standard. Such a measurement must not be used for the evaluation of a road marking.

11.4 Input of additional information
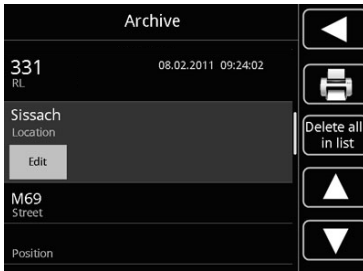
Below the measurement data, additional information such as Location, Street etc. can be added or changed.
To edit a value, tap the entry and press "Edit", then enter the new value and confirm.

11.5 Printing of a measuring report
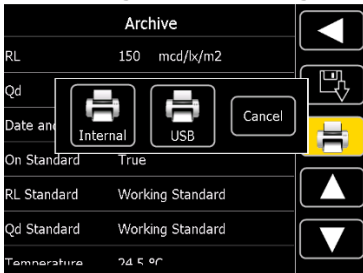
Select a printer by pressing the symbol 🖶
The optional built-in thermal printer or an external printer connected to the USB-interface can be used. The measuring report can be printed out by selecting the desired printer the measuring report will be printed out. To choose the information to be printed on the measuring report, please refer to chapter 13.6.8 "Printer" on page 54.

11.6 Storing the measuring data on a USB mass storage device

Connect a USB drive to the USB interface (host). By pressing the button Export all measuring entries will be stored on the USB drive. The exported measurements can be opened on a PC using the software "MappingTools". For further information, refer to the separate "MappingTools" instruction manual.

---

12 Data export and "MappingTools" software

12.1 Interfaces

The Zehntner ZRM 6010 is equipped with the following interfaces for data export:

• Host USB interface (type A) for external units such as USB drive or keyboard

• Client USB interface (type B mini) for connecting to a PC

12.2 PC Mode
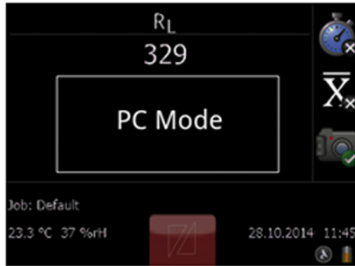
The Zehntner ZRM 6010 can be connected to a computer using a Mini-USB cable connected to the client interface on the Zehntner ZRM 6010. The message „PC Mode" on the touchscreen of the Zehntner ZRM 6010 indicates a successful connection.
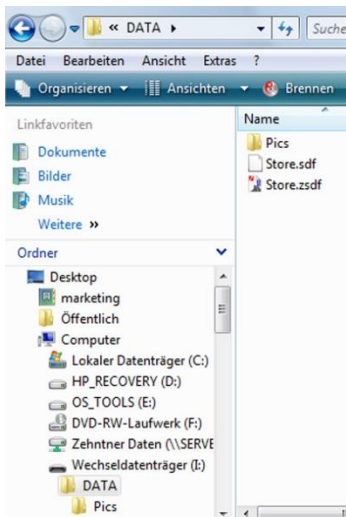
After the device has been recognised, it will be displayed in Windows as a removable device. To create a back-up of the data, copy (the files Store.sdf, Store.zsdf and the folder Pics) to your desired backup volume.

The measuring archive on the Zehntner ZRM 6010 can be viewed using our free mapping software „MappingTools".

12.3 Evaluation and mapping software "MappingTools"

For evaluation of measurements start the free software „MappingTools". For information on installation and working with the mapping software, please refer to the separate instruction manual.

After opening tick the archive in order to display it in the „MappingTools". If the measurements have been taken without the optional GPS module, the mapping browser will show you a random map. The mapping browser can be deactivated as described in the separate instruction manual „MappingTools".
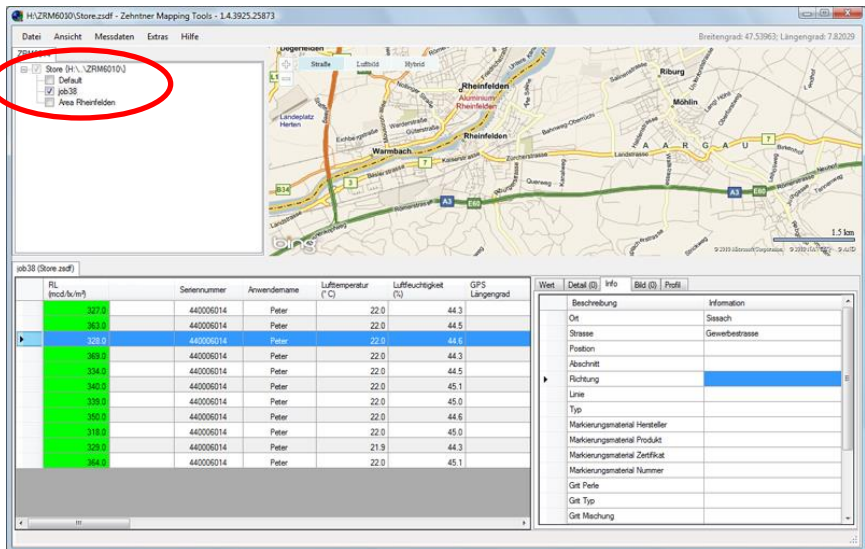
If the Zehntner ZRM 6010 is equipped with the optional GNSS GPS-unit and there was signal when the measurements have been taken, then the measurements will be displayed in the mapping browser.
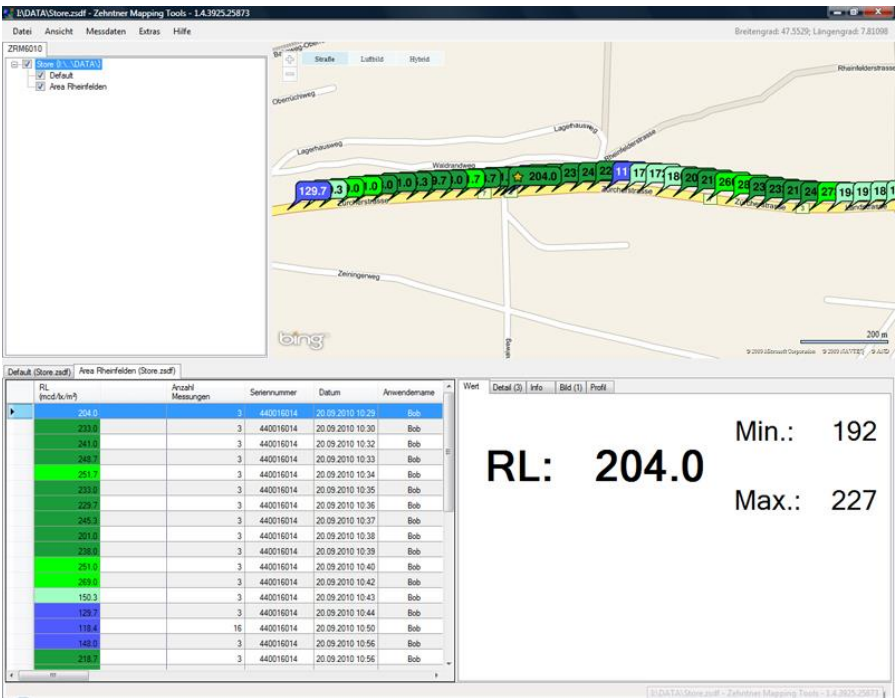
12.4 Data export to Microsoft Excel

After opening the measuring data using the „MappingTools" you are able to export them to Microsoft Excel, as described in the instruction manual „MappingTools". An Excel-Measuring report may look as follows:

Job Name: Default
Device Name: ZRM 6010
Serial Number: 440006010

Date	Number of Measurements	RL (mcd/lx/m²)	Location	Serial Number
08.11.2010 10:17	1	92	Sissach	440006014
08.11.2010 10:17	1	93	Sissach	440006014
08.11.2010 10:17	1	95	Sissach	440006014
08.11.2010 10:17	1	97	Sissach	440006014
08.11.2010 10:17	1	99	Sissach	440006014
08.11.2010 10:18	1	101	Sissach	440006014
08.11.2010 10:18	1	103	Sissach	440006014
08.11.2010 10:18	1	105	Sissach	440006014

13 Menu

13.1 Menu structure

Measure Mode
- Geometries: R_L
- Auto save measurements
- Average: On/Off

Timers
- Wet timer: On/Off
- Internal timer: On/Off

Jobs
- New job
- Edit job
- Load job
- Delete job

Setup
- User
  - Select user
  - User role
  - New user
  - Edit user
  - Delete user
- Language
- Date and time
  - Year / Month / Day
  - Hour / Minute
  - Time format
  - Date format
- Power
  - Auto off time
- Sound
  - Enable sound: On/Off
  - Sound volume: (0-5)
- Database
  - New database
  - Rename database
  - Current database
  - Delete database
  - Export to text file
- Camera
  - Show pic after measurement
  - Time to show pic after measurement
  - Only one pic in average mode
  - Camera resolution
- Printer
  - USB printer list
  - Thermal printer list
- Calibration
  - Calibration interval
  - Show deviation 2nd std
- Units
  - Temperature: °C/°F
  - Unit of length: meters/miles
- Options
  - Enable GPS: On/Off
  - Enable camera: On/Off
  - Enable level-meter: On/Off
  - Enable compass: On/Off
  - Enable Temp. Humid: On/Off
- Reset settings to factory default

Diagnostics
- Info
  - Device name / Company name
  - Device serial number
  - Software version
  - Measurement counter
  - Disk space
  - Last calibration: R_L / Qd
  - New factory calibration
  - Cal code / Device version

13.2 Navigation in the menu

Press [icon] and [icon] to open the menu. The top bar shows the name of the currently selected option. Most device options can be configured and switched on/off from the menu. Refer to chapter 6"Navigation" on page 17 for instructions on how to navigate in the menu.

13.3 Measure mode

Selecting "Measure mode" from the menu opens the measurement settings.

Measure mode	◀
Geometries	RL
Auto save measurements	On
Average	On
Automatically new average group	Off

By default, R_L geometry is activated. If required, this could be changed to R_{L15}. "Auto save measurements" defines, whether all settings are saved to the archive automatically or need to be saved individually. If deactivated, measurements have to be stored manually. By default, "Auto save measurements" is activated.

"Average" activates average measurement mode. Average measurement mode can also be activated by pressing [icon] directly on the touchscreen when in measurement mode. "Automatically new average group" creates a new group automatically when the desired number of measurements has been reached.

13.4 Timers
13.4.1 Wet timer

The Zehntner ZRM 6010 is equipped with a countdown timer to take measurements exactly at the right time after the road marking has been moistened.

Wet timer	◀
On	✓
Off	

Select "Timers" and "Wet timer" from the menu to activate the wet timer. Alternatively, press [icon] symbol in measurement mode on the touchscreen to activate the wet timer.

Timers	◀
Wet timer	On
Wet timer time	60 seconds
Wet timer mode	Single
Interval timer	Off

If the wet timer is activated, the "Timers" menu shows the current settings for the wet timer. "Wet timer time" allows to set the countdown between 2 and 1000 seconds. "Wet timer mode" allows to select between "Single" and "Continuous" mode. "Single activates the timer for one measurement, "Continuous" keeps it active for each measurement.

13.4.2 Interval timer

The interval timer can be used to define the performance of the retroreflection of a marking in dependence on the drained water at wet measurements.

Interval timer	◀
On	✓
Off	

Select "Timers" and "Interval timer" from the menu to activate the internal timer.

Timers		◀
Wet timer	Off	
Interval timer	On	
Interval time	1000 seconds	
Interval counts	3 measurements	

The interval timer takes multiple measurements at the defined interval up to the selected count. "Interval time" sets the time between measurements and can be set from 5 to 1000 seconds. "Interval counts" sets how many measurements will be taken.It can be set to a value from 2 to 500. If both timers are activated, all current timer settings are shown.

Practical example of interval timer

At the interval timer the first measurement starts right after pressing the measuring

button **m**.

It is recommended to combine the interval timer with the wet timer if the first measurement should start after a certain period after the measuring button has been pressed. Please also refer to "Practical sample combination of wet timer and interval timer".

Here, the performance of the R_L-value of a moistened type-II road marking tape is measured during 60 seconds at an interval of 5 seconds. As the measurements should start right after moistening the road marking tape, it does not make sense using the wet timer. This example requires the following settings:

- Activate the internal timer.
- Set the interval time to 5 seconds.
- Set the interval counts to 12.

After carrying out the measurements, the measuring data can be exported to Microsoft Excel using the software „MappingTools".For this you need either to store the measuring data on a USB flash drive as described in chapter 11.6" Storing the measuring data on a USB mass storage device" on page 40 or open the measuring data directly on the Zehntner ZRM 6010 as described in chapter 12 "Data export and "MappingTools" software" as from page 40.

Example Excel-report exported using "MappingTools":

Job Name: Default
Device Name: ZRM 6010
Serial Number: 440006010

Date	Number of Measurements	RL (mcd/lx/m²)	Location	Serial Number
08.11.2010 10:17	1	56	Sissach	440006014
08.11.2010 10:17	1	73	Sissach	440006014
08.11.2010 10:17	1	83	Sissach	440006014
08.11.2010 10:17	1	86	Sissach	440006014
08.11.2010 10:17	1	89	Sissach	440006014
08.11.2010 10:17	1	92	Sissach	440006014
08.11.2010 10:17	1	93	Sissach	440006014
08.11.2010 10:17	1	95	Sissach	440006014
08.11.2010 10:17	1	97	Sissach	440006014
08.11.2010 10:17	1	99	Sissach	440006014
08.11.2010 10:18	1	101	Sissach	440006014
08.11.2010 10:18	1	103	Sissach	440006014
08.11.2010 10:18	1	105	Sissach	440006014

Using this table, you are able to create a diagram to show the R_L performance.

Interval timer measuerements

(Chart: R_L value in mcd\lx\m² versus Seconds after start)
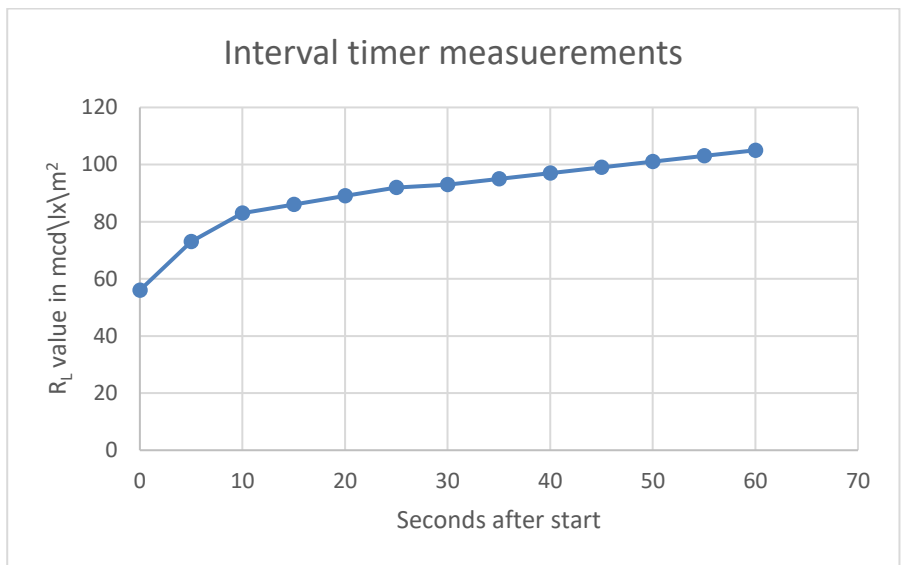
For the interpretation of the measuring data, we give you the following explanation:

Date	Seconds after start	Measurement No.	RL (mcd/lx/m²)
Moistening of the road marking and start interval timer by pressing the measuring button at: 08.11.2010 10:17	0	1	56
08.11.2010 10:17	5	2	73
08.11.2010 10:17	10	3	83
08.11.2010 10:17	15	4	86
08.11.2010 10:17	20	5	89
08.11.2010 10:17	25	6	92
08.11.2010 10:17	30	7	93
08.11.2010 10:17	35	8	95
08.11.2010 10:17	40	9	97
08.11.2010 10:17	45	10	99
08.11.2010 10:18	50	11	101
08.11.2010 10:18	55	12	103
08.11.2010 10:18	60	13	105

At the beginning the R_L-values surge until there is only a slight increase. This is expected from a type-II road marking sample.

Practical example combination of wet timer and interval timer

A combination of the wet timer and interval timer makes sense if the interval measurements should not start immediately after moistening of the road marking.

- Activate the wet timer.
- Set the wet timer time to 45 seconds.
- Activate the internal timer.
- Set the interval time to 5 seconds.
- Set the interval counts to 3.

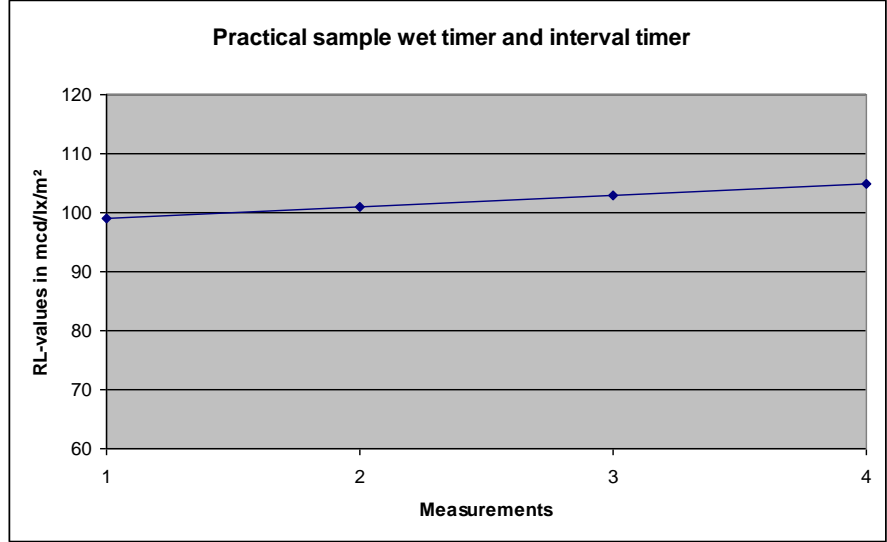After pressing the measuring button the following procedure starts:

Start wet timer		Measurement	Measurement	Measurement	Measurement
HH:mm:ss 14:00:00		HH:mm:ss 14:00:45	HH:mm:ss 14:01:50	HH:mm:ss 14:01:55	HH:mm:ss 14:02:00
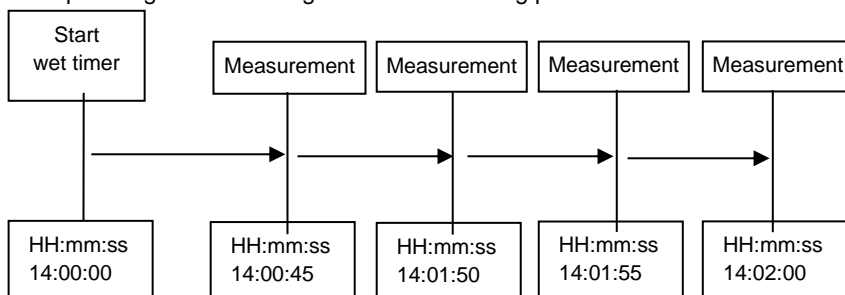
The first measurement will be carried out by the wet timer. Afterwards the set number of interval counts will be carried out. So in this sample there will be a total of 4 measurements.

The measurements can be shown on your computer using the „MappingTools". For this you need either to store the measuring data on a USB flash drive as described in chapter 11.6 "Storing the measuring data on a USB mass storage device" on page 40 or open the measuring data directly on the Zehntner ZRM 6010 as described in chapter 12 "Data export and "MappingTools" software" as from page 40.

Job Name: Default
Device Name: ZRM 6010
Serial Number: 440006010

Date	Number of Measurements	RL (mcd/lx/m²)	Location	Serial Number
08.11.2010 10:17	1	99	Sissach	440006014
08.11.2010 10:18	1	101	Sissach	440006014
08.11.2010 10:18	1	103	Sissach	440006014
08.11.2010 10:18	1	105	Sissach	440006014

This can be used to show the developing graphically:

Practical sample wet timer and interval timer

For the interpretation of the above measuring data, we give you the following explanation:

Date	Seconds after start	Measurement No.	RL (mcd/lx/m²)
Moistening of road marking and start wet timer by pressing the measuring button	0		
08.11.2010 10:17	45	1	99
08.11.2010 10:18	50	2	101
08.11.2010 10:18	55	3	103
08.11.2010 10:18	60	4	105

In the time range between 45 seconds and 60 seconds there is only a slight increase of the R_L-values.

13.5 Jobs

The Zehntner ZRM 6010 features the possibility to relate measurements to a specific job. Depending on the type of your company (contractor, road laboratory, manufacturer of road marking materials) a job could be a specific client, the development of a specific product and so on.

Jobs	◀
New Job	
Edit Job	
Load Job	TestJob
Delete Job	

Selecting "Jobs" from the menu opens the job options. Here is possible to add a new job or edit, load and delete an existing one.
If nothing has been changed in this menu, the job "default" will be indicated in the measure mode.

13.6 Setup
13.6.1 User

User	◀
Select user	Peter
User role	User
New user	
Edit user	
Delete user	

Select "Setup" and "User" from the menu. Adding a user enables relating measurements to a specific operator and to store user specific settings. If no user has been added, the user „Peter" will be used for each measurement. The operator is shown at the bottom of the measuring report.
If a user is selected, all other settings will be stored for that user. Switching to another user sets all other settings accordingly.

13.6.2 Language

Language	◀
Deutsch	
English	✔
Français	
Limba româna	
Svenska	

Select "Setup" and "Language" from the menu and choose the desired language. The current language is marked with ✔.

If a wrong language has been chosen and you don´t find the language menu back, switch off the unit. Press and hold the

measuring button (m) during startup to directly access display for language selection.
If you want to contribute and translate a new language or if you have some comments on an existing one, please feel free to contact Zehntner.

13.6.3 Date and time
Select "Setup" and "Date and time" from the menu. The current date and time as well as the date and time format can be changed in this menu.

Top list:

Date and time	◀
Year	2013
Month	10
Day	28
Hour	23
Minute	48

▼

Bottom list

Date and time	◀
Day	28
Hour	23
Minute	48
Time format	24 hrs
Date format	DD.MM.YYYY

▲

13.6.4 Power

Power	◀
Auto off time	60 minutes

Select "Setup" and "Power" from the menu to set the auto off time. The instrument will automatically shut off after the selected time. The timer can be set from 10 to 60 minutes.

13.6.5 Sound

Sound	◀
Enable sound	Off
Sound volume	0

Select "Setup" and "Sound" from the menu. "Enable sound" activates or deactivates the sound played after a measurement. "Sound volume" sets the volume between 1 and 5.

13.6.6 Database

Database	◀
New database	
Rename database	
Current database	Database.zsdf
Delete database	
Export to text file	

Select "Setup" and "Database" from the menu. Here is possible to create a new database or select, rename and delete an existing one. You can export a database to a semicolon separated text file, which can be edited e.g. in Excel.

ⓘ Before deleting a database, make sure you have selected the correct one and made a backup of it before if necessary.

13.6.7 Camera

Camera	
Show pic after measurement	On
Time to show pic after measurement	5 seconds
Only one pic in average mode	Off
Camera Resolution	800 x 600 px
Camera Zoom	Off

Select "Setup" and "Camera" from the menu. "Show pic after measurement" will show the picture after each measurement. It is activated by default. .
"Time to show pic after measurement" sets how long the picture will be displayed. If the function "Only one pic in average mode" is activated, a picture will only be taken for the first measurement of an average mode. "Camera resolution" sets the resolution for the pictures taken. "Camera Zoom" defines whether the camera will be zoomed in by default.

13.6.8 Printer

Printer	
USB printer list	
Thermal printer list	

Select "Setup" and "Printer" from the menu. Select an available printer from the USB or Thermal printer list to set which information should be included on reports with the selected printer.

13.6.9 Calibrate

Calibrate	
Calibration interval	2 days
Show deviation 2nd std.	Off

Select "Setup" and "Calibration" from the menu to change calibration settings. "Calibration interval" sets the time after which the device will require calibration in the standard.
"Show deviation 2nd std" sets whether the deviation should be shown when calibrating with the second standard.
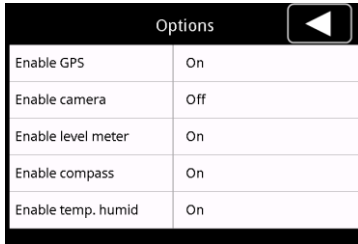
13.6.10 Units

Units	
Temperature	Celsius °C
Unit of length	Meters

Select "Setup" and "Units" from the menu to choose the preferred measurement units.

13.6.11 Options

Options	
Enable GPS	On
Enable camera	Off
Enable level meter	On
Enable compass	On
Enable temp. humid	On

Select "Setup" and "Options" from the menu. Installed options can be activated and deactivated for each user profile. Only installed options are shown.

13.6.12 Reset settings to factory default

Select "Setup" from the menu. "Reset settings to factory default" will reset all settings of the Zehntner ZRM 6010 to factory defaults. This cannot be undone. If you are sure to carry out the reset to the factory default you need to confirm this message.

Are you sure to reset the settings to the factory default?

Yes   No

13.7 Diagnostics

Select "Setup" and "Diagnostics" from the menu to display diagnostic information. The following information will be displayed:

- Device name
- Company name
- Device serial number
- Software version
- Measurement counter
- Disk space
- Last calibration R_L
- Next factory calibration
- Cal Code
- Device version

14   Built-in battery and charging

14.1 Battery

The LI-Ion-Mn battery used has a very high capacity. The capacity is continuously being observed. When the voltage becomes too weak the battery sign is shown on the display and the battery has to be charged.
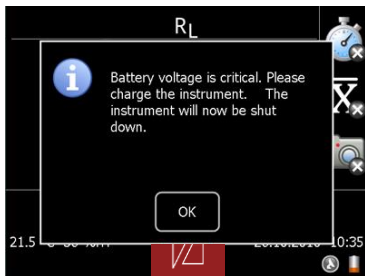
In order to prevent a damage of the battery, the instrument switches off automatically before the battery is completely empty. The Zehntner ZRM 6010 announces this by displaying the symbol of an empty battery 🔋 and an error message. In order to save power you can set a shorter "Auto off time". For this please refer to chapter 13.6.4 "Power" on page 53.

14.1.1 Battery status indication on the display

🔋 Battery is empty. The instrument switches off automatically.

🔋 Battery is critically low. The instrument should be charged.

🔋 approx. 50 %

🔋 approx. 80 %

🔋 100 % - battery is full

⚡ The instrument is connected to the battery charger. The charging status is shown on the battery charger.

Indicator on charger

Indicator light of the on the charger shows the actual charging cycle of the battery:

- **Red:** Fast charging is active. The charging current is on maximum.
- **Orange:** The battery is in the "final charge". This is achieved with about 80% of the battery capacity. The battery charger holds the voltage constant and decreases the current.
- **Green:** The battery is fully charged and charge retention is active.

14.2 Charging

To charge the battery, connect the charger to the Zehntner ZRM 6010 and a wall socket (100 - 240 V, 50 - 60 Hz).
The special plug on the battery cable has a reverse polarity protection. The Zehntner ZRM 6010 can be switched on or off while charging.
For disconnecting the charger press the "push button" on the port for the battery charger.

🛈 Always charge the battery completely and only with the supplied charger.

🛈 The battery may only be replaced by Zehntner or by an authorized Zehntner-agent!

🛈 If you have not used your instrument during several months, the battery should be charged before using.

15	Maintenance

15.1 Maintenance carried out by the user

You may only carry out the following maintenance and repair yourself:

- Charging as described in chapter 14.2 on page 57.
- Cleaning as described in chapter 15.2 on page 58.
- Replacing the thermal paper roll as described in chapter 10.4 "Built-in thermal printer" on page 37.

🛈 All other maintenance and repair work may only be carried out by Proceq or your authorized Proceq agent, otherwise all warranty voids.

⚠ Make sure that the Zehntner ZRM 6010 is unplugged from power supply and turned off before any maintenance, except for charging.

🛈 The instrument consists of delicate optic and electronic precision parts. Protect it from shocks, moisture and dust. Please store the instrument in the transportation case.

15.2 Cleaning

We recommend that the instrument is checked and certified by Proceq or authorized Proceq Service partner every two years. Otherwise clean the instrument periodically using water- and oil-free compressed air (max. 1.5 to 2 bar), or wipe the exit window on the bottom of the optics housing with a soft brush.

The exit window is coated with a special antireflection coating that should not be damaged. If the soft brush is not sufficient for cleaning the window, you may use a soft paper tissue and window cleaning liquid.

🛈 The optics housing may not be opened under any circumstances since the measuring geometry would be misaligned. The measuring geometry can only be adjusted by means of special testing equipment in our factory.

16.1 Status message – "Battery voltage is critical"
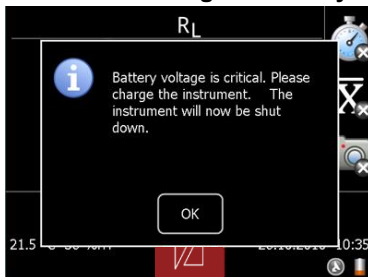
In order to prevent a damage of the battery, the instrument switches off automatically before the battery is completely empty. The Zehntner ZRM 6010 announces this by displaying the symbol 🔋 and a status message.

Charge the battery as described in chapter 14.2 "Charging" on page 57.

16.2 Status message – "Please calibrate R$_L$"

Press the warning triangle to get a more detailed explanation.
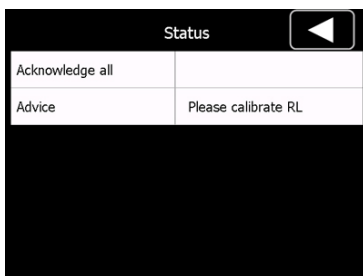
To solve this, carry out the calibration as described in chapter **0** "
Calibrate" as from page 18. If you are sure that is not necessary to carry out a calibration, you can press "Acknowledge all" and the message will disappear.
To change the calibration interval refer to chapter 13.6.9 "Calibrate" on page 54.

16.3 Error message – "Calibration is not OK"
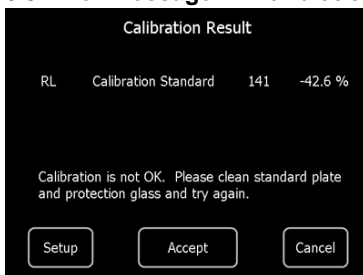
Calibration results with deviations greater than 15 % are indicated by "Calibration is not OK". This can be caused by a soiled or damaged standard or a soiled optic window. It is suggested to reject such a calibration result by pressing `Cancel` before determining the reason for the deviation. Clean the standard and recalibrate again as described in chapter 0 on page 18 and. By experiencing repeatedly a deviation greater than 15%, a calibration by the manufacturer might be required.

16.4 Error message – "Factory calibration has expired"

Press the warning triangle and afterwards the advice "Factory calibration has expired" to get a more detailed explanation.

Status	
Error type	Advice
Message	Factory calibration has expired
Help	Please get the instrument factory calibrated
Date	28.10.2013 17:43:46
Native error	RL factory calibration exp

The instrument has been calibrated in the factory 2 years ago. It should be sent back to the manufacturer for checking, calibration and certification. Contact Proceq or your authorized Proceq agent for returning the unit.

16.5 Error message – "Camera failed, please retry"
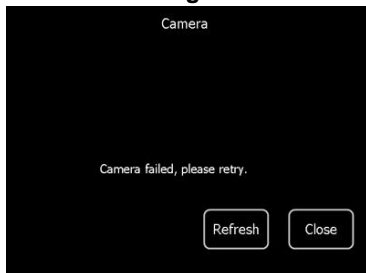
- Press the button Refresh.
- If the camera still failed, restart the instrument as described in chapter 5 "Setting up" on page 17.

16.6 Reset of the Zehntner ZRM 6010

If the firmware of the Zehntner ZRM 6010 has a hang-up, you can reset the instrument by shutting of the instrument completely as described in chapter 5 "Setting up" on page 17.

17.1 Night visibility R_L

R_L is the coefficient of retroreflected luminance (night visibility) of road markings.
The observation angle of 2.29° corresponds to the viewing distance of a vehicle
driver of 32 m from height of 1.20 m.
The illumination angle of 1.24° corresponds to the illumination distance of a head
lamp of 30 m from height of 0.65 m.
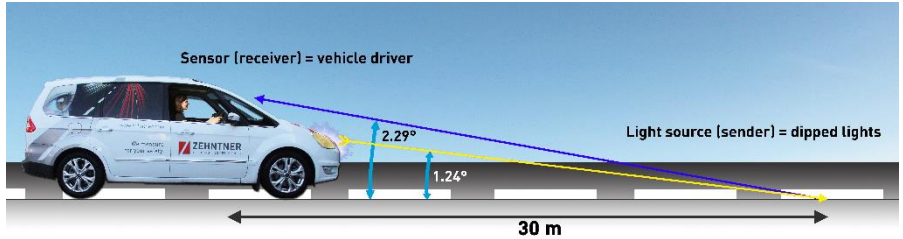
Above mentioned angle definitions are related to EN 1436.
ASTM E1710 uses the same geometry just with different description of the angles.
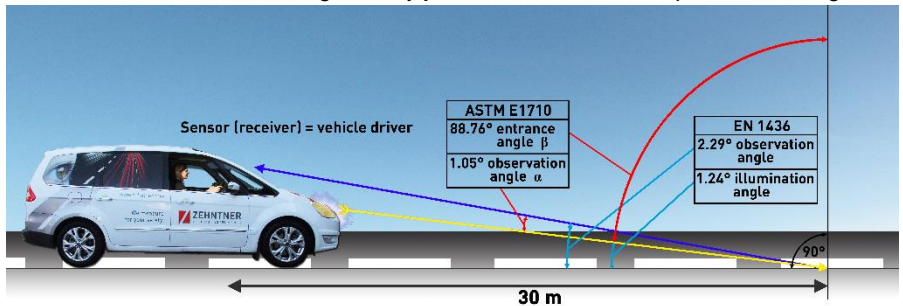
18 Technical specification

Observation distance:	30 m, according to CEN geometry
Observation angle (R_L):	EN 1436: 2.29°
	ASTM E1710: 1.05°
Illumination angle (R_L):	EN 1436: 1.24°
	ASTM E1710: 88.76°
Measuring area:	52 mm x 489 mm
Illumination field:	50 mm x 100 mm
Measuring sensor adaption:	$V(\lambda)$
Measuring range (R_L):	0 - 4'000 mcd·m^{-2}·lx^{-1}
	profiled markings -1 mm to +15 mm,
Measuring period:	ca. 1 second (without picture)
Memory:	1 GB (ca. 1'000'000 measurements without pictures. 1'000-10'000 with pictures (depending on resolution)
Display:	VGA 5.7" colour touchscreen
Pictures:	resolution: 5MP (2592 x 1944), file format: jpg
Battery Charger:	100 - 240 V, 50 - 60 Hz, 50 VA, universal
Battery:	Li-Ion 96.5 Wh (14.4 V, 6.7 Ah)
Charging time:	ca. 3 hours
Life cycle LED:	> 100'000'000 measurements
Operating temperature:	+ 0° C to + 50° C, non condensing
	+ 0° C to + 40° C, during charging of battery
Storage temperature:	- 20° C to + 60° C, non condensing
Dimensions (LxWxH):	
Device:	340 mm x 152 mm x 575 mm
Carrying case:	700 mm x 350 mm x 530 mm
Weight:	
Device:	6.4 kg
incl. carrying case:	17.9 kg
Standards:	EN 1436 (R_L dry, wet and continous wetting)
	ASTM E1710 (R_L)
	ASTM E2177 (R_L, wet)
	ASTM E2832 (R_L, continous wetting)

W