

Instruction manual

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ZRM 1021 Zehntner-Reflectometer 45/0°



Index

Exclusion of liability	2
1. Safety precautions and warnings notes	3
1.1 Dangers	3
1.2 Safety notes	3
2. Delivery of device	4
2.1 Transport damages	4
2.2 Extent of delivery	4
3. Outline of the instrument, operating elements	5
4. Putting into operation and calibration	6
5. Calibration standards	6
6. Measuring procedure	7
7. Hiding power	7
8. Luminance factor β	8
9. Contrast ratio of road markings	9
10. Accumulator	9
11. Maintenance and storage	10
12. Errors	10
13. Technical specification	12
13.1 Dimensions:	12
13.2 Weights:	12
13.3 Reflectometer:	12
13.4 battery charger:	12

Enclosures:

- Certificate of Manufacturer
- Certificate of Calibration

Exclusion of liability

Illustrations, descriptions as well as the technical specifications accord with the instruction manual in hand for the time of printing. Subject to change resulting from technical improvement, modified construction or similar changes.

This instruction manual has been written with the utmost care. Nevertheless, errors can not entirely be eliminated. The manufacturer shall not be liable for errors contained herein or for incidental or consequential damages resulting from possible errors.

We would therefore welcome any suggestions and references to errors.

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1. Safety precautions and warnings notes

1.1 Dangers






Attention!

This note is included in this instruction manual wherever it is warned about dangers which will arise to life and limb of persons 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 these instruction manual the generally applicable safety instructions and regulations for prevention of accidents have to be taken into account.

Note

This symbol marks instructions you should take notice of in order to follow directions, specifications and the correct working process as well as to avoid data loss, damage or destruction of the instrument.

1.2 Safety notes

-  It is strictly forbidden to open the housing of the ZRM 1021! If not observed, all the guarantee and liability claims to **Zehntner GmbH Testing Instruments** will expire.
-  The ZRM 1021 Reflectometer is exclusively intended for the determination for the measurement of lightness, hiding power of emulsion paints, density, brightness values and luminance factor β of road markings. Any other use is considered as being not in accordance with the intentions of the manufacturer. For damages resulting thereof the manufacturer is not liable; the risk for this is taken by the user alone.
-  Reconstruction without permission and modifications of the ZRM 1021 are not permitted. For damages resulting thereof the manufacturer is not liable; the risk for this is taken by the user alone.
-  All maintenance and repair work which is not explicitly permitted and described in the present instruction manual (see clause 10 "Maintenance and storage" on page 10) shall only be carried out by Zehntner GmbH Testing Instruments or your authorized ZEHNTNER dealer, otherwise all the guarantee and liability claims will expire.
-  All maintenance and cleaning work of the ZRM 1021 which are described in the present instruction manual shall be carried out only if the ZRM 1021 is switched off. Never immerse the device in water or other liquids: Danger of short circuit!

2. Delivery of device

2.1 Transport damages

During carriage the ZRM 1021 is to be handled with the usual care. To ensure carriage without damages the device is to be transported in the original packaging and under normal freight conditions. Pushes during carriage are to be avoided.

At the receipt of the goods, you have to check if there are any visible damages at the outer packaging. If the packing is alright, you can sign the receipt documents. If you even suspect by your visual impression that damage has occurred, make a note of the suspected damage on the delivery receipt or freight papers and get the carrier to sign it. Moreover, the forwarding agent/courier service must be held responsible for the damage in writing.

If a hidden damage is discovered while unpacking, you have to inform and must held the forwarding agent / courier service immediately in the following way: "When opening the parcel we had to notice that etc. etc." This superficial checking of the goods has to be done before the time limit of the forwarding agent / courier service expires which is normally within 7 days. However, the period could be less. Hence, it is recommended to check the exact time limit when receiving the goods.

If there are any damages inform also immediately your authorized ZEHNTNER dealer or Zehntner GmbH Testing Instruments directly.

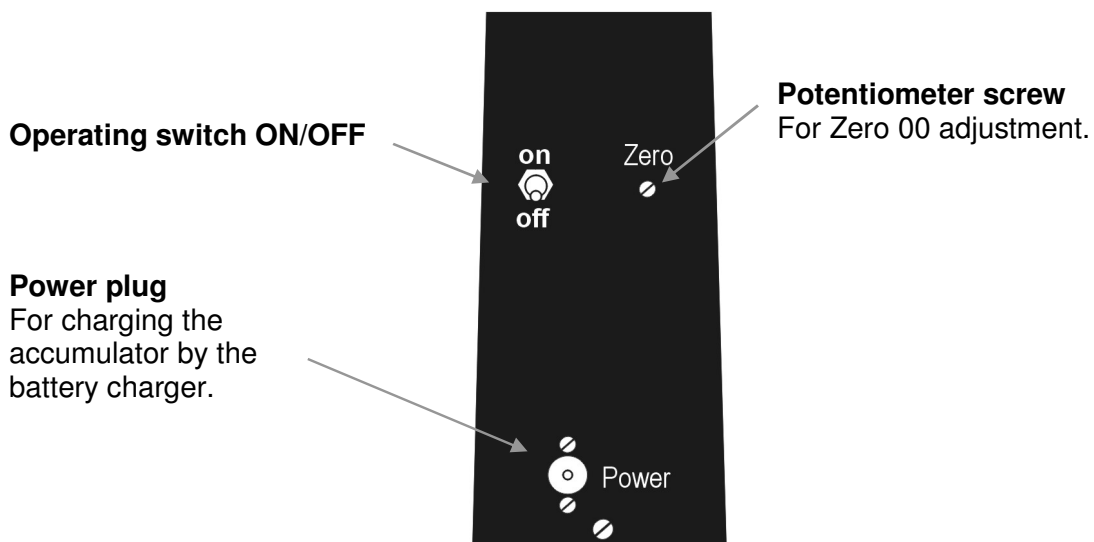
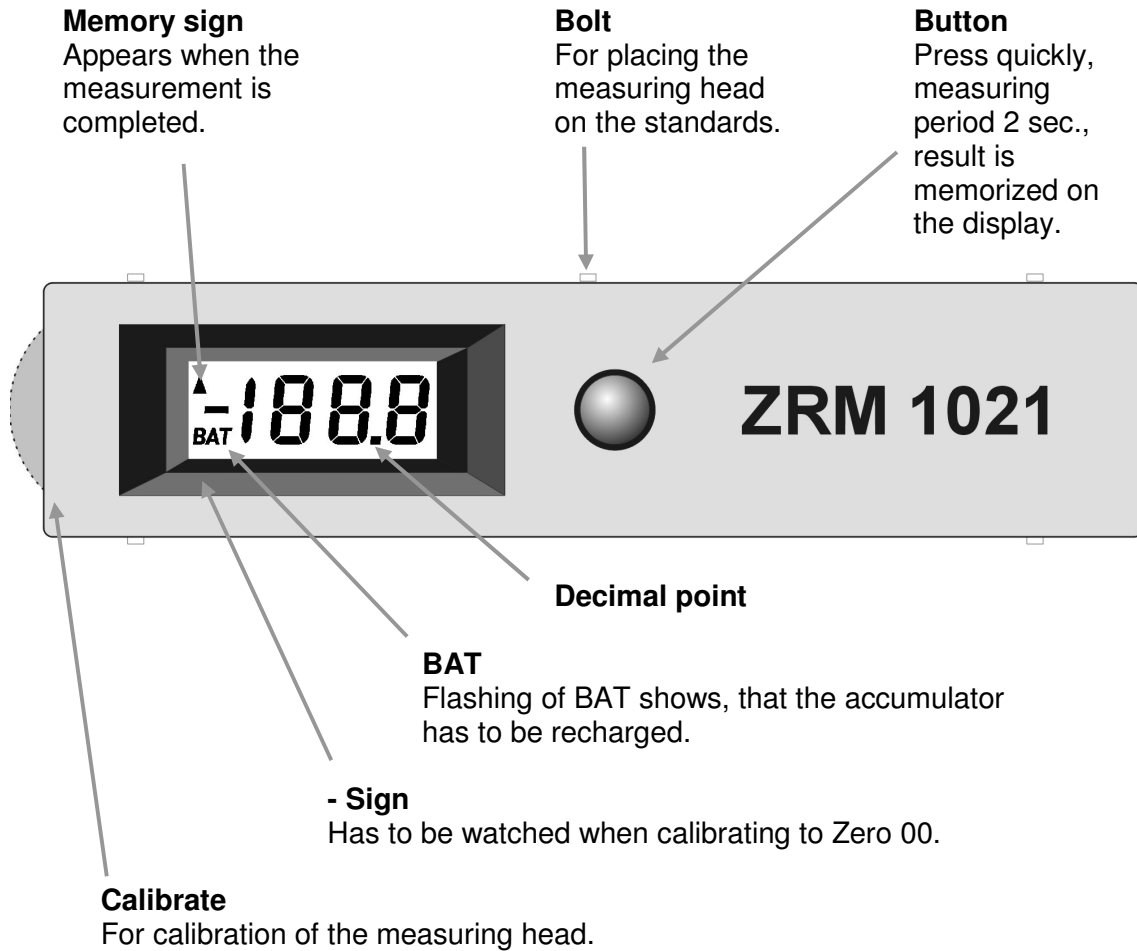
2.2 Extent of delivery

The following parts are included in the delivery:

- 1 Reflectometer
- 1 working standard
- 1 zero standard
- 1 battery charger incl. cable
- 1 spare lamp with allen key
- 1 screw driver
- 1 certificate of manufacturer
- 1 certificate of calibration
- 1 carrying case

! **Zehntner GmbH Testing Instruments** refuses all warranty and liability claims for damages caused by usage of the ZRM 1021 in combination with **non-original accessories**, or accessories from 3rd party suppliers.

3. Outline of the instrument, operating elements



4. Putting into operation and calibration

Because of the built-in accumulator the ZRM 1021 is ready for work immediately after switching the instrument on.

Calibration

Two standards are available for the calibration of the measuring head.

- a) Zero 00 (black glass)
- b) White calibration standard

Proceedings

- **Zero 00 adjustment**

Place the instrument on the Zero 00 standard, operate the button and adjust to 00,0 by means of the screw on the right side-wall of the instrument.

- **Calibrate**

Place the instrument on the white calibration standard which must be clean. Adjust the value that is mentioned on the standard by means of the potentiometer „Calibrate“.

The measuring head is placed on the individual standards always in the same direction. This is guaranteed by a bolt on the back of the measuring head.

5. Calibration standards

- Handle the reference standards with care.
- It is important to preserve them from dust and scratches.
- To make sure an exact calibration, only use original ZEHNTNER standards which have been defined by an official controlled primary standard.
- We recommend to have the standards checked or replaced regularly (every two years) by the producer, since the values of the standards may alter during the time because of environmental factors despite of handling them with care.

Cleaning of the standards

- **Zero 00 (black glass)**
It is cleaned by means of a new and soft tissue and window detergent.
- **White calibration standard**
The surface of the calibration standard is very delicate.
Only use a new and soft tissue and window detergent for cleaning it.

Exact calibrations can only be done by means of perfect and impeccable standards!

Hiding power determination according to ISO 2814 involves measuring whiteness of a known test material. Our working standard was defined by barium sulphate for white-standard DIN 5033 and will be used as reference.

6. Measuring procedure

- Switch the instrument on and place it on the test sample.
- Press the button quickly. The display shows the measuring result (in percent) immediately. The measuring period takes at least 2 sec. or more, if the button is pressed longer.
- The memory sign appears when the measurement is completed. The measuring result is memorized on the display for approx. 1,5 min.; then, the instrument will switch off to preserve the accumulator.

7. Hiding power

For measuring the opacity, a uniform film of coating has to be applied on a black and white test chart. After drying, the application can be measured by our ZRM 1021 Zehntner-Reflectometer 45/0°. Make one measurement on the black side and one on the white side of the test chart. The obtained measuring results are in percent. With these two measuring results you can calculate opacity as follows:

$$\text{Formula: } \frac{Y_{\text{black}}}{Y_{\text{white}}} \times 100 (\%) = \text{Opacity } (\%)$$

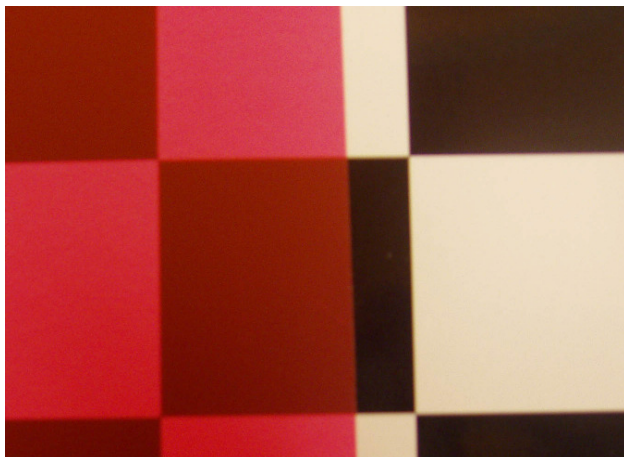
Example:

If you receive a measuring result on the black side of 50% and on the white side a measuring result of 80% then in this example the opacity amounts to 62.5%.

$$\text{Our example: } \frac{50}{80} \times 100 (\%) = 62.5\%$$

Whereby 100% opacity means 100% hiding, there will be no difference between the application on the black and white part of the test chart.

Below find a sample of insufficient hiding power:



8. Luminance factor β

The luminance factor β is the ratio of the luminance of the field of the road marking in the given direction to that of a perfect reflecting diffuser identically illuminated.

For some structured road markings, the measured value of the luminance factor β is not reliable. To assess the visibility in daylight or under road lighting for such road markings, the measurement of Q_d may be a more suitable method of test. For further details, please have a look at the standard EN 1436.



The β value is calculated by dividing the value of the instrument by 100: If you receive with our instrument for example the value 78.0, the β value is 0.78. So when the instrument measures 57.9 the β value is 0.579, when it measures 60.0 the β value is 0.6.

In most countries the luminance factor β is only used for laboratory measurements. The Q_d value is more common as the luminance factor β does not reflect what a vehicle driver sees. This is shown in the graphic below:

Light source (sender)
lamp



9. Contrast ratio of road markings

The contrast ratio can be calculated by measuring the luminance factor of the bright (road marking) β_2 and the dark (pavement) area β_1 . The contrast can be calculated by using a formula. There are different ways to calculate the contrast. In Germany, the DIN gives following formula:

$$\text{Contrast ratio: } \frac{\beta_1 \text{ (dark)}}{\beta_2 \text{ (bright)}} \quad \text{or} \quad \text{Contrast ratio: } \frac{\beta_1}{(\beta_1 + \beta_2)}$$

You need to check which formula you have to use (e.g. standard specifications etc.). The contrast value is always positive and is between 0-1 or between 0% - 100%.

For measurement you can either use the **ZRM 1021 Reflectometer 45/0°** (luminance factor β) **or the ZRM 6013 / 6014 Retroreflectometer RL/Qd using only the Qd values.**

Kindly be informed that there is no standard available yet which describes how the contrast ratio should be measured. In Germany, however, they made a research project and found out that contrast value is more realistic when calculated by the Qd values (e.g. measured by a ZRM 6013 or ZRM 6014 Retroreflectometer).

10. Accumulator

General features

- The accumulator consists of a package of 6 cells of 1,2 V - 1,5 Ah each and is situated inside the glossmeter.
- Only use ZEHNTNER-accumulators!
- Should the accumulator not operate in the correct way, please contact an authorized ZEHNTNER-representative; do not change the accumulator on yourself.

Charging the accumulator

- A built-in electronic accu monitor shows by blinking „Batt“ (on the display) that the accumulator has to be recharged by the battery charger.
- Charge the accumulator by means of the battery charger.
- Connect the battery charger to the measuring head.
- Connect the battery charger to a 220 V plug.
- It takes 14 hours to charge the accumulator completely.
- While charging the accumulator, the instrument can be used normally.
The measuring result will be memorized as long as the battery charger is connected and in operation.

11. Maintenance and storage

Measuring device




- The instrument consists of delicate optical and electronic precision parts. Do not drop it and preserve it from shock, moisture and dust.
- It is best to store the instrument incl. its accessories in the carrying case.
- We recommend having the instrument checked and certified by ZEHNTNER every two years.

Standards of calibration

- For the maintenance of the standards please refer to chapter 5 „Calibration standards” on page 6.

Accumulator

If it is handled with care, it has a long life and needs no special maintenance.

-  **Never** let the accumulator come into contact with metallic objects which might cause a short circuit.
-  **Never** throw an accumulator into a fire; it might explode.
-  **Never** undo the accumulator.

12. Errors

- Error:** Accumulator blinks or there is no indication on the display, Accumulator cannot be charged.
- Cause 1:** battery charger or cable are defective
- Realization:**
- If the battery charger is switched on and the mains switch lightened, then the battery charger is o.k.
 - If the cable is connected to the measuring head and the ZRM 1021 is working, the battery charger and the cable are o.k.
- Cause 2:** Accumulator is defective
- Realization:** The ZRM 1021 only works if the battery charger is switched on. Charging the accumulator is not possible.
- Remedy:** Exchange the accumulator; only use an accumulator by **ZEHNTNER!**

Error: The ZRM 1021 cannot be calibrated.

Cause: The lamp is defective.

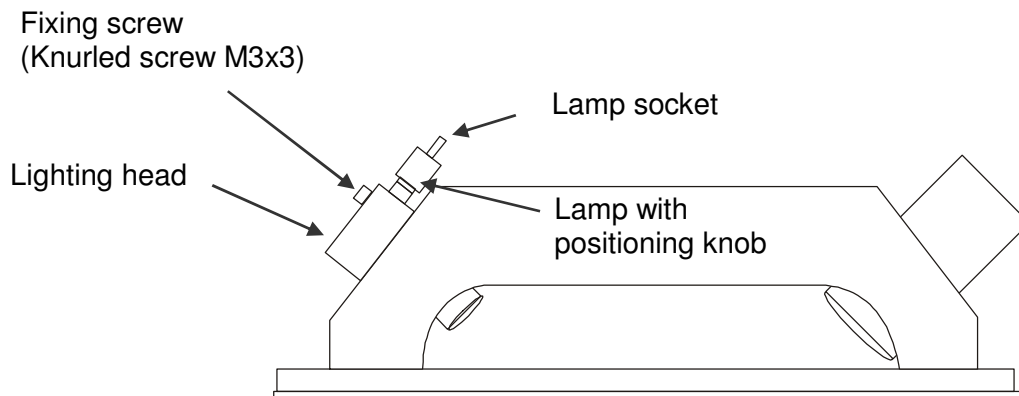
Realization: Press the button while looking through the measuring port. Check if the lamp is working.

Remedy 1: If the lamp is working, contact the service representative of the ZEHNTNER instruments.

Remedy 2: If the lamp does not work, replace it as follows:

- Switch the ZEHNTNER gloss measuring head off ("off") and unplug the connecting cable. Unscrew the four housing screws and take the housing off.
- Release the defective lamp by means of the allen key and remove it from its socket.
- Replace the lamp.
- Clean the lamp with alcohol before inserting it in the lighting head (while doing so, only held the lamp by its socket to avoid finger-prints, etc.) Make sure that the positioning knob of the lamp is inserted exactly into the positioning slit on the lighting head.
- Lightly tighten the lamp with the supplied allen key.

! Caution: Only the shown knurled screw may be unscrewed when changing the lamp! (see figure below) Unscrewing of other screws on the optics may cause a change of the light path of the lamp.



! When changing lamp always make sure the positioning knob is at the right place in the lighting head.

13. Technical specification

13.1 Dimensions:

Measuring head:	192 mm x	53 mm x	110 mm
battery charger:	95 mm x	50 mm x	135 mm
accumulator:	14.5 mm x	28 mm x	155 mm
Carrying case:	380 mm x	290 mm x	70 mm

13.2 Weights:

ZRM 1021:	1,100 kg
Accumulator:	0.130 kg
Complete set (measuring device incl. carrying case and accessories)	3,080 kg

13.3 Reflectometer:

Geometry:	45/0°
Measuring port: (for all angles)	40 mm x 15 mm
Measuring area:	7 mm x 10 mm
Measuring accuracy:	≤ 1 unit
Lamp:	Tungsten filament lamp 2,5V
Standard illuminant:	C adapted
Detector:	Silicium-photoelement
Spectral evaluation:	V (λ) approximate
Accumulator	7,2V nickel-cadmium accumulator, (rechargeable)

13.4 battery charger:

Voltage: 230V 50Hz + 10% - 15% 5VA Output voltage: stabilized Fuse: 80mA	<i>or</i>	Voltage: 115V 60Hz + 10% - 15% 5VA Output voltage: stabilized Fuse: 125mA
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