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Instruction manual

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ZRW 5070
Retroreflectometer R'
for Warning clothes

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1. General Description

1.1 Care and Maintenance

The ZRW 5070 Retroreflectometer R' is a high precision retroreflection measuring device. Its compact design and straightforward operation make it ideal for quick measurements of retroreflecting material on working clothes. In order to obtain reliable results and to avoid damage a few basic rules must be followed.

Maintenance

No parts of the ZRW 5070 Retroreflectometer R' shall be repaired or replaced by the user.

Perfect functioning and maximum durability are guaranteed by regular service by the manufacturer. Please refer to your supplier in case of any fault or for carrying out any service.

Bulb Change

Changing the measuring bulb has to be accompanied by subsequent adjustment and calibration of the measuring device.

Therefore please leave any lamp change to be carried out **only by the manufacturer** or by **authorised dealers**. The device could otherwise suffer damage or produce a false measurement result.

1.2 Storage and Transport

Always store and transport the ZRW 5070 Retroreflectometer R' and its accessories in the specially designed carrying case. This provides optimal protection against vibration, superficial damage and - to a certain extent - inclement weather conditions (rain, fog, snow). Nevertheless, avoid exposing the case and equipment to excessive vibration or extreme precipitation.

The ZRW 5070 Retroreflectometer R' including the charging equipment and the reference sample should only be stored indoors in a dry place and only at temperatures from 0 ..+ 35°C (32 … 95 F)!

Longer storage outside this temperature range can lead to a change in the characteristics of the reference sample so that its reflective value no longer corresponds to the one imprinted.

The sample should only be stored in its protective cover and only cleaned carefully with a damp cloth. Never touch the reference sample with bare hands. Avoid scratching or scoring or similar occurrences at all costs!

If possible do not leave the ZRW 5070 near heaters or in direct sunlight for extended periods. In particular storage in a parked vehicle left in full sunlight is to be avoided.

1.3 Operation

Basically, the same hints given for transport and storage apply to operation, too: excessive vibration and extreme humidity as well as use of the ZRW 5070 Retroreflectometer R' in heavy rain should be avoided.

If the ZRW 5070 Retroreflectometer R' is taken into indoor warmth after longer usage or storage in low temperatures this could result in internal moisture condensation with adverse effects on operational functioning. In such case wait for a period of time (approx. two hours) until the ZRW 5070 Retroreflectometer R' has warmed up enough and the precipitation e.g. from the glass cover on the front of the instrument has disappeared.

Please note that the available battery power decreases in low temperatures.

1.4 Cleaning

Slight dirt on the ZRW 5070 Retroreflectometer R' casing or handle can be removed with a damp cloth, detergent or glass cleaner.

Do not use gasoline or organic solvents like acetone!

Only paper cloths suitable for optic lenses should be used to clean the ZRW 5070 Retroreflectometer R's glass cover front.

Damage to the glass through scratching or breaking is to be avoided at all costs as the measurement accuracy can be affected.

While cleaning make sure that no moisture enters into the instrument.

The reference sample may only be wiped with a damp cloth and if necessary, a mild detergent. Make sure that the surface is not damaged by scratching etc. as the sample will otherwise lose its stated reflective value.

1.5 Power Supply

The ZRW 5070 Retroreflectometer R' is powered by an integrated high grade battery. On being fully charged, this allows approx. 600 readings and approx. 400 readings when using a Barcode Reader.

When the battery is low, a complete recharging is necessary before the next measuring operation. A complete charge of the battery takes about 1.5 hours.

The integral battery loses capacity also when unused over an extended period of time, approx. 1% per day of the original charge at room temperature.

The ZRW 5070 Retroreflectometer R's integral power cells contain heavy metals (nickel cadmium cells or nickel hydride cells) and must not be disposed together with normal household rubbish. Following the end of their life expectancy they should be handed in to an authorized disposal site.

Replacement of the battery should only be carried out by an authorised dealer or by the manufacturer.

2. Device Specifications

2.1 Area of Operation

The portable ZRW 5070 Retroreflectometer R' measures the coefficient of retroreflection of **retroreflective materials according to DIN standard EN 471**.

The measured material index is the coefficient of retroreflection R' [cd • lx^{-1} • m^{-2}]

being calculated and directly displayed after the measuring process without any conversion by the user.

2.2 Preparation

All parts necessary for measuring such as sample lighting, sensors and electronic analysis components are integrated into the ZRW 5070 Retroreflectometer R' and perfectly syntonized.

Due to its broad scale of measurement from 0,1 cd • lx^{-1} • m^{-2} (highest resolution) up to 1999 cd • lx^{-1} • m^{-2} the ZRW 5070 Retroreflectometer R' allows the assessment of virtually all retroreflecting materials.

The ZRW 5070 Retroreflectometer R' is ready-to-operate immediately after being switched on and requires no additional calibration or warming up period.

2.3 Method of Measurement

To carry out a measurement, a circular, evenly lit area is produced on the material under survey by means of a halogen light bulb. The light reflected by the sample and the light emission by the bulb are measured and used to calculate the coefficient of retroreflection R'. The ZRW 5070 Retroreflectometer R's angle sizes comply with the values constituted in DIN standard EN 471.

2.4 Measurement Trigger

For measuring put the cloth under survey on a planar surface and place the ZRW 5070 Retroreflectometer R' on the garment so that the measuring port is seated solidly on the retroreflecting material. The measurement trigger then automatically initiates the measuring process.

3. Operation

3.1 Control Panel

The following figures illustrate the control and display panels.

1: LC Display
2: Mode Selector Switch
3: Barcode Scanner Button
4: Menu Button (Clock setting, Display of number of measuring samples)
5: Operation Indicator
6: Barcode Scanner Display

3.2 Switching on

To carry out measurements switch on the ZRW 5070 Retroreflectometer R' with Mode Selector (2). After turning on the display shows for about 3 seconds the report "ZRW 5070". Now you can choose between the two measurement modes: single measurement or multiple measurements. The Operation Indicator **ON** (5) above the display should be green.

After switching on, until the first reading, the display shows

3.3 Measurement

Single measurement:

For a single measurement turn the Mode Selector Switch (2) from the OFF position one step to the right (position). With the Menu Button (4) you can switch the display between measured value and number of measurements.

Multiple measurements (Averages)

In order to obtain an average value out of multiple measurements turn the Mode Selector Switch (2) from the OFF position two steps to the right (position). After switching on the display shows:

The first 0 shows the number of measurements since turning on the ZRW 5070 Retroreflectometer R'. "s" (single) tells that the value shown is an individual measurement and "0.0" is the measured coefficient of retroreflection (from individual measurement).

After measurements are carried out the display changes as shown by the following examples:

When you now choose the average mode by pressing the Menu Button (4) the calculated average out of these 3 individual measurements will be displayed:

3a 116,7 („a“ for average)

If another value is measured in this setting it will be automatically added to the average (up to 99 measurements).

The individual measured value will be displayed when pressing the Menu Button (4).

The measurement series can be ended by turning off the ZRW 5070 Retroreflectometer R’ or by turning the Mode Selector Switch (2) to another position.

Carrying out a measurement:

To start the measurement process press the ZRW 5070 Retroreflectometer R’ orthogonally on the clothing under survey so that the trigger is initiated and wait for measurement completion.

The measurement process’ start and end is indicated by a short beep. During the measurement process the display shows the word “Measurement”.

3.4 Reading the measured value

After the final beep the result is shown on the display and remains there until the next measurement or until the ZRW 5070 is switched off manually or automatically (after approx. 4 minutes).

3.5 Changing the measuring band

To attain the highest possible measurement accuracy it is useful to choose the measuring band according to the expected value.

The changing of the measuring band according to the measured value is carried out automatically within levels.

Sample	Band	Resolution
Sample below 200	0 – 199.9	0.1
Sample 200 – 2000	200 – 2000	1

All values in: $cd \cdot lx^{-1} \cdot m^{-2}$

3.6 Switching Off

After having completed your measurement series you should switch off the ZRW 5070 to avoid spending battery power unnecessarily.

To do so the Mode Selector Switch (2) is turned to position **OFF**.

3.7 Stand-By Mode

If you forget to switch off the ZRW 5070 changes automatically to stand-by mode about four minutes after the last measurement. At the same time, the display is switched off, too.

Therefore make sure that you note down the reading within this time.

To reactivate the ZRW 5070, it only has to be positioned on a sample. The measurement is triggered automatically.

As the ZRW 5070 however requires a small amount of residual energy on stand-by mode, the Mode Selector Switch (2) should always be turned to **OFF** during periods of storage or transport.

3.8 Alerts

All error messages are shown on the display (1) and are indicated acoustically by a triple beep.

A further measurement is prevented. The ZRW 5070 has to be switched off first before a new measurement can be started.

Possible sources of malfunction can be a low battery, a defective bulb or interruption of the measurement before the end signal.

Please note:

To protect against stray light intrusion and to prevent mechanical damage the measuring front is equipped with a rubber covering which also protects the sample's surface during the measuring process.

This Rubber Covering must not be damaged; otherwise stray light can penetrate the measuring slot and lead to wrong measuring results.

3.9 Battery level

Before starting a series of measurements or after lengthy storage it is advisable to check the charging level of the battery. To do so the Mode Selector Switch (2) is turned to the symbol. The display (1) shows alternately the battery level, date and time.

To obtain a correct measurement the battery should still have more than 10% of its nominal capacity.

For example a display

1 0 0

shows a **fully charged** battery.

e.g. a value of

1 0

is an indication of an **almost empty** battery.

3.10 Charging

To charge the battery, switch the ZRW 5070 to **OFF** and connect it to the power supply systems with the accompanying ZRW 5070-L mains adapter device.

To ensure maximum battery capacity and an extended lifetime, you should charge the battery only at room temperature and when it is extensively discharged. In case of a fully run-down battery a charging time of **approx. 1,5 hours** is required.

3.11 Charge Indicator

During the charge operation the red lamp on the battery charger is on.

The red lamp is blinking when the charge operation is finished. (The charger supplies a trickle charge to maintain the charging level). A manual override of the charge mode is not possible.

Never open up the mains adapter - mains supply circuit parts could become accessible, with consequent risk to life!

3.12 Power Point

To charge the internal battery with the delivered charger ZRW 5070-L please use the power connection on the back of the ZRW 5070.

3.13 Barcode reader

The ZRW 5070 can be equipped with a Barcode read. Therefore a module has been developed that is installed underneath the housing in front of the handle.

Barcode reader dismantled

Barcode reading:

- Push Barcode Reading Button (3)
- Barcode Reader Indicator (6) flashes (yellow)
- Read the Barcode with the laser beam (in front, in direction of measurement) The laser beam has to be wider than the Barcode.
- The reading is confirmed with a short beep, the Barcode Reader Indicator (6) flashes and the laser beam is switched off.
- If no Barcode is registered within 30 seconds the Barcode Reader turns off automatically. The malfunction is signalised by a triple beep and the Barcode Reader Indicator (6) is switched off.
- The Barcode is saved for all following measurements until a new Barcode is read or the ZRW 5070 is switched off.

Important note:

When the Barcode Reader is dismantled the interface plug in front of the handle has to be covered with a protective cap.

The red glass that covers the Barcode reader front is an optical filter. Take care that it does not get scratched or broken. If it is soiled it should be cleaned with paper cloths suitable for optical lenses. Do not use strong detergents in any case.

3.14 Memory

The ZRW 5070 has an internal memory for 1000 measurements. Stored are number of measurement, date, time, coefficient of retroreflection, and Barcode. All data can be read out with the program DataExport.

3.15 Show Number of Data Sets

To see the number of data sets in the ZRW 5070's internal memory, press the Menu Button (4) twice in quick succession.

3.16 Delete Memory

To delete the ZRW 5070's internal memory press the Barcode Reader Button (3), the Menu Button (4) and the measurement trigger simultaneously.

3.17 Date / Time

The ZRW 5070 has an integrated clock. The time of each measurement is stored.

Setting date / time:

- Turn Mode Selector Switch (2) to position clock / storage battery. Battery level, date and time are displayed alternately.
- Press Barcode Button (3). The date is shown and decade position flashes on the LC Display (1).
- The value can be changed by pressing the Menu Button (4).
- Press Barcode Reader Button (3) again. Next position flashes.
- Change value by pressing the Menu Button (4).
- After changing all date positions time appears on the LC Display (1) automatically.
- The time can be set in the same way as the date.
- When the last position (minutes) has been set the current settings are stored automatically by pressing the Menu Button (4).
- On the LC Display (1) the battery level, date and time are shown alternately again.

3.18 Interface

On the back of the ZRW 5070 is a serial RS 232 interface (SubD 9-pin) to read out and reset the internal memory with the help of the program DataExport.

3.19 Error Messages

Error Message	Description
OV	exceeded measuring band (> 2000) or defective bulb
MAX	too many measured values in multiple measurements (> 99)
LOW BAT	battery voltage too low
ERROR	interruption of the measurement by untimely release of the start button
E CLOCK	lack of data date / time please set date / time

4. Calibration procedure

4.1 General introduction

In this document the handling of the re-calibration features of ZRW 5070 software version 1.1 is described.

The re-calibration functions enable the calibration of the ZRW 5070 without any connection to a PC.

It is only possible to calibrate a single colour (CAL ONE).

4.2 Abbreviations

CAL ONE – Single colour calibration

4.3 Calibration mode selection

Before switching on the ZRW 5070 press and hold menu button.

M (Menu) button (right) => for CAL ONE

Then switch ZRW 5070 on.

Press button for one second until the device name (for example “ZRW 5070”) is shown on the LC display.

Release button.

After switching on the selected mode is indicated. Additionally a message regarding RS232 is shown.

Mode	Button	LCD message	RS232 message
Single colour calibration	Menu (right)	CAL ONE	Calib Mod = CAL ONE

4.4 Calibration measuring

Initiate measuring and assess calibration sample.

During the calibration the message “CALIBRAT” is displayed. When the measuring is finished the actual value of the sample is indicated.

4.5 Target value setting

The indicated actual value of the sample can be modified with help of the buttons Barcode / Menu.

```
Barcode button (left) => Value is reduced
Menu button (right)  => Value is increased
```

According to how long you press the buttons, the modified digit and thus the modification speed is varied. Short pressing will modify the last digit, pushing the buttons for two seconds or five seconds changes the preceding digits respectively.

	Indicated value	Short press	After 2 seconds	After 5 seconds
Digit modified on LCD		**123.4**	**123.4**	**123.4**
Digit modified on LCD	200 - 2000	**1567**	**1567**	**1567**

By pressing the barcode button the values can be changed as follows:

	Indicated value	Short press	After 2 seconds	After 5 seconds
Digit modified on LCD		**123.4**	**123.4**	**123.4**
Digit modified on LCD		**123.3**	**122.4**	**113.4**
Digit modified on LCD		**123.2**	**121.4**	**103.4**

By pressing the menu button the values can be changed as follows:

	Indicated value	Short press	After 2 seconds	After 5 seconds
Digit modified on LCD		**123.4**	**123.4**	**123.4**
Digit modified on LCD		**123.5**	**124.4**	**133.4**
Digit modified on LCD		**123.6**	**125.4**	**143.4**

4.6 Calibration finishing

The re-calibration phase is finished by pressing the measuring trigger once more after having set the target value on the display (see section 5).

The message „CAL END“ is indicated and the calibration factor is re-calculated. The display is set to “0.0”.

The message is reported via the RS232 interface.

Example: „Col 1 CFOld = 58862 CFNew = 62311“ .

5. Maintenance / Repairs

The ZRW 5070 contains no parts intended to be serviced by the user. Therefore never try to open the casing or carry out other such measures yourself, otherwise this could result in irreparable damage.

On opening the casing, the manufacturer's warranty expires.

5.1 Bulb

The life expectancy of the ZRW 5070's halogen bulb is generally 10,000 measurements. Therefore under normal conditions of use no change of the bulb should be necessary between service intervals. During every reading the functionality of the bulb is electronically checked. If a malfunction is detected, an error-message is shown on the LC Display (1).

5.2 Battery

The battery of the ZRW 5070 has a capacity of about 600 readings per loading cycle or 400 readings when using Barcode Reader. This might vary due to charging level and duration of storage.

It can be recharged at least 1,000 times given normal ambient temperatures and working conditions. Accordingly a typical battery lifecycle allows about 600,000 measurements or 400,000 measurements when using Barcode Reader.

A replacement therefore is not necessary. A repair-exchange can be done ONLY by the manufacturer or authorised dealer.

ATTENTION: The battery contains heavy metals. Do not dispose of the battery in domestic waste!

5.3 Malfunctions

In the event of a persisting or constantly recurring malfunction, please note down the exact accompanying circumstances, e.g. measured sample, temperature range, adjustment of measuring scale.

These data provide an important diagnostic aid and help to keep the service periods of the ZRW 5070 as short as possible.

5.4 Reference Sample

By means of the accompanying reference sample you can check the proper function and calibration of the ZRW 5070 yourself. Trigger a measurement by placing the sample on the front (see Fig. 9).

The ZRW 5070 must have a clear and unscratched glass face.

Please do not touch the reference sample with bare hands and store it in the accompanying protective cover.

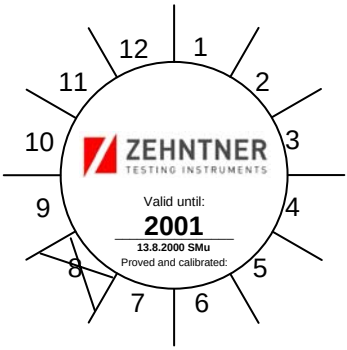
Correct Measurement alignment

The value shown on the Display (1) must be within the tolerance area indicated on the reference sample. If it is not, a service is advisable. To ensure measuring results are correct you should carry out this check regularly at best before every series of readings.

5.5 Regular Service

The manufacturer recommends an annual service of the ZRW 5070 to ensure proper function, to check all equipment functions and if necessary to repair damaged parts. The next service date is indicated on the service sticker on the rear of the device.

For individual services or a service contract please contact your supplier or the manufacturer.



Sticker displaying next year and month of service

6. Technical Data

Measuring geometry:	Measuring geometry complies with DIN EN 471, Part 1, downsized with scale 1:20
Observation angle:	α = 0,2°
Illumination angle:	β = 5°
Light source:	halogen bulb 6V / 10W
Receiver:	Si-photo diode
Illumination:	approx. 30 lx on sample surface
Spectral specification:	based on standard light source type A (Tf = 2856K) and visual sensitivity V(λ)
Measuring range:	• highest resolution: R'min = 0.1 cd • lx^{-1} • m^{-2} • max. measured value: R'max = 2000 cd • lx^{-1} • m^{-2} manual measuring band selection
Maximal measuring error:	±7% from measured value ±2 Digit
Battery:	Nickel-cadmium or nickel-metal-hydride batteries, in total 9,6V • Replaceable at maintenance service • Sufficient for approx. 600 measurements per load or 400 measurements when using Barcode Reader

Power supply:	13,5 ... 16V DC, type. 0.8 A, protected against reversal of polarity during charging process
Operational temperature:	+5 to +35°C (41° to 95°F)
Storage temperature:	0 to +35°C (32° to 95°F)
Dimensions (LxWxH):	approx. 280 mm x 85 mm x 220 mm incl. handle
Weight:	• ZRW 5070: 1'800 g • Barcode reader: 100 g
Measuring speed:	• Approx. 3 seconds for one reading • Approx. 2 seconds interval between two successive readings • Automatic switch-off after approx. 4 minutes