TEQTO

Crack depth meter ET-28

Operation manual

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Preface

This operation manual, combined with a product passport, contains information on the purpose, operating principle, technical specifications, design, operation, and rules for the use, transportation, and storage of the ET-28 electro-potential crack depth meter, (hereinafter referred to as the crack depth meter).

1. DESCRIPTION

1.1 INTENDED USE

The ET-28 electro-potential crack depth meters are designed for measuring the depth of surface-breaking defects, such as cracks, in metal components. The device measures the depth of cracks that are visible on the surface of products and have been previously detected using another method.

1.2 FUNCTIONS AND TECHNICAL CHARACTERISTICS

- Calibration of the main scales to correct additional errors that may occur after prolonged use.
- Creation of additional configurations (calibrations) for inspection purposes.
- Setting control thresholds and providing colour-coded alerts when measurement results exceed these thresholds.
- Organising a data archive in the form of named blocks of measurement results and transferring data to a computer.
- Monitoring the battery charge level and alerting the user when the battery is low.
- Configuring the automatic shutdown time during idle periods to conserve battery life.
- Adjusting the display backlight settings to further save battery power.
- Selecting the interface language (customisable upon user request).

Basic technical characteristics of the crack depth meter are listed in Table 1.

Table 1

Parameter	Value
Crack depth measurement range • probe 1x4 • probe 2x2 • probe 3+1	 0.5 - 30 mm 0.5 - 20 mm 0.5 - 30 mm
Crack depth indication range • probe 1x4 • probe 2x2 • probe 3+1	 30 - 100 mm 20 - 100 mm 30 - 100 mm
Measurement accuracy	±(0.1h + 0.2 mm), where “h” is the crack depth
Maximum crack opening	Up to 3.5 mm depending on probe design
Minimum crack length	5 times the crack depth, but no less than 3 mm
Radius of curvature of tested surfaces (convex and concave)	At least 4 mm
Power supply	Rechargeable battery, 3.6 V, with a capacity of at least 1.1 Ah
Display backlight	Present
Automatic shutdown of the device	Present
Overall dimensions	150 × 80 × 30 mm
Device weight	500 g
Operating temperature range	-5°C to +40°C
Service life	5 years

1.3 DELIVERY SET

Crack depth meter delivery set is given below in Table 2.

Table 2

Designation	Quantity (pcs)	Notes
Electronic unit	1	
Probe «**1x4**»		Agreed upon when ordering
Probe «**3+1**»		Agreed upon when ordering
Probe «**2x2**»		Agreed upon when ordering
Battery (integrated into the electronic unit)	1	
Charger	1	
Protective cover and strap for securing the device to the operator's arm		
Operation manual	1	
Cable for PC connection	1	
Bag or case for transportation and storage		Agreed upon when ordering

Control sample KO-281-1 with crack simulations No. _____

Nominal defect depthvalues (mm)	1	2	3
Actual defect depth values (mm)			

Additional accessories		
Additional control sample KO-281-1 with crack simulations		
Reference sample KO-281		
Cordless grinder for preparing the inspection area on the surface of the product		

1.4 DESIGN AND PRINCIPLE OF OPERATION

1.4.1 Principle of operation

The operating principle of the crack depth meter is based on the electro-potential method.
Using current electrodes, a constant current with a frequency of 1.0 kHz is passed near the monitored crack. Using receiving electrodes and the electronic unit, the voltage generated by the current passing through the crack walls is measured. This voltage is proportional to the depth of the crack.

The electronic circuitry converts the signal from the probe into a form that is easily perceivable by the operator.

Measurements can be performed using various probes.
The most versatile probe, "**1×4**," allows for measuring crack depths in the range of 0.5–30 mm and estimating depths in the range of 30–100 mm.

The “**2x2**” probe is designed for use in hard-to-reach areas of components (such as thin shafts and fillet transitions) within a range of 0.5–20 mm for measurement and 20–100 mm for estimation. It is also suitable for surfaces with closely spaced cracks.

The “**3+1**” probe is intended exclusively for use with magnetic materials (steel, cast iron) and allows for measuring crack depths in the range of 0.5–30 mm and estimating depths in the range of 30–100 mm. The “**3+1**” probe is the most suitable option for estimating crack depths in the 30–100 mm range.

1.4.2 Crack depth meter design

The crack depth meter consists of a probe and an electronic unit for receiving and processing signals from the probe. The general appearance of the electronic unit is shown in Figure 1, and the general appearance of the probes is shown in Figure 2.

Electrical signals from the probe are converted into a digital code within the probe’s unit and sent to the controller’s microprocessor. The device’s front panel features a display and a keyboard. A connector for the probe and a USB port for connection to a PC are located on the side panel. The USB port also serves as a charging point for the battery.

Figure 1

The rear panel features a nameplate indicating the serial number of the crack depth meter.
Operation of the crack depth meter is controlled via the keyboard. All information is displayed on a screen with adjustable backlighting.

The electronic unit of the crack depth meter is made in the form of the portable type device.
On the front panel there are:

- A graphical display (hereafter referred to as the display),
- A keyboard with the following buttons « ▲ », « ▼ », « ◀ », « ▶ »,
- «⚙» for accessing the menu,
- «↵» for entering information,
- «⏻» for turning the crack depth meter on/off,
- «>0<» for zero adjustment,
- «⇄» for selecting the measurement scale.

A schematic representation of the probes for the crack depth meter is shown in Figure 2.

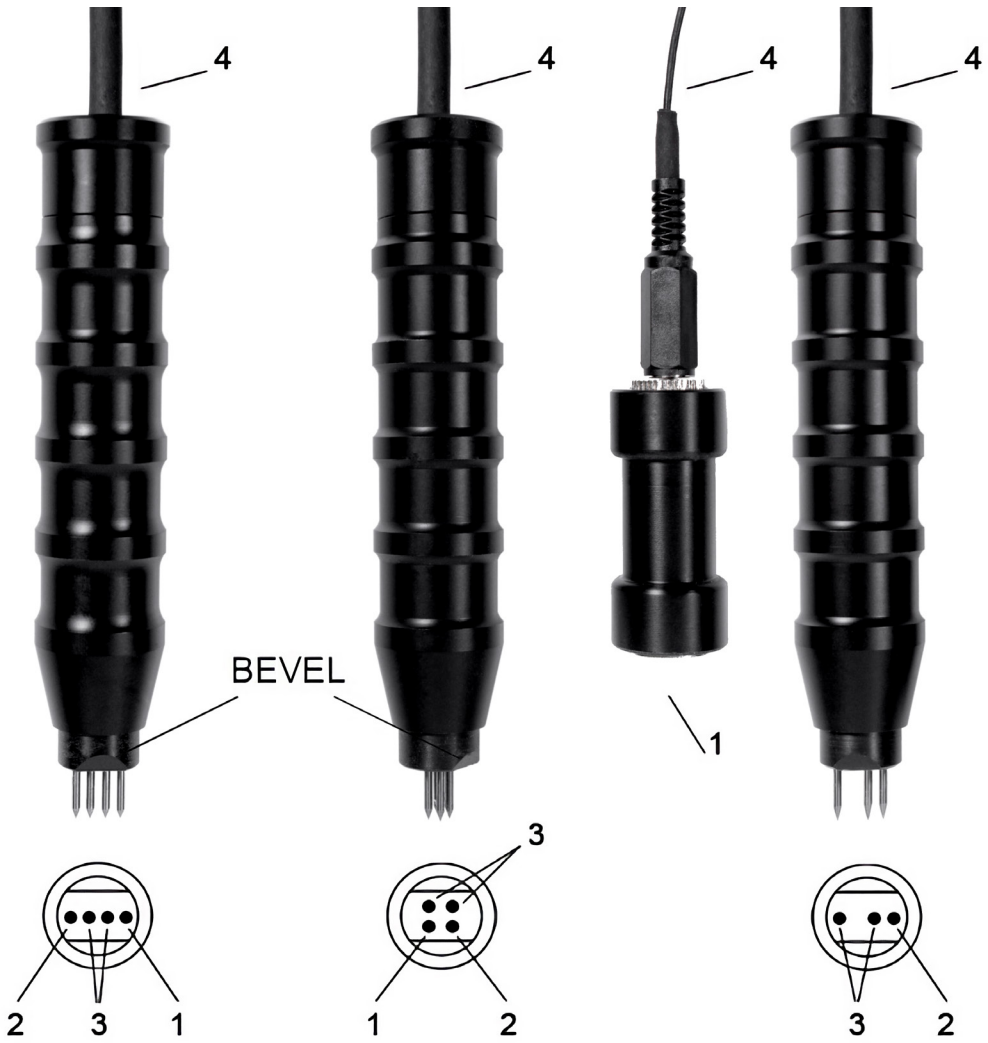


Figure 2

Probe 1x4 **Probe 2x2** **Probe 3+1**

1 - the first current electrode
2 - the second current electrode
3 - receiving electrodes
4 - connecting cable

1.4.3 Crack depth meter menu

All settings for the crack depth meter (except for selecting working scales) are configured through the device's graphical menu.
The menu is multi-level. For ease of use, logically related settings are grouped into categories, which can be accessed through nested submenus under the corresponding menu item.
To access the menu, press the «⚙» button. The general appearance of the menu is shown in Figure 3. Navigation between menu items is performed using the « ▲ », « ▼ » buttons. To select an item (enter the parameter settings or navigate to a submenu), press the « ↵ » button. The display will show either a parameter input window (see further details below) or a submenu.

To exit the menu (or submenu) and return to the measurement mode or a higher menu level, press the «⚙» button or select the on-screen "OK" button and press « ↵ ».

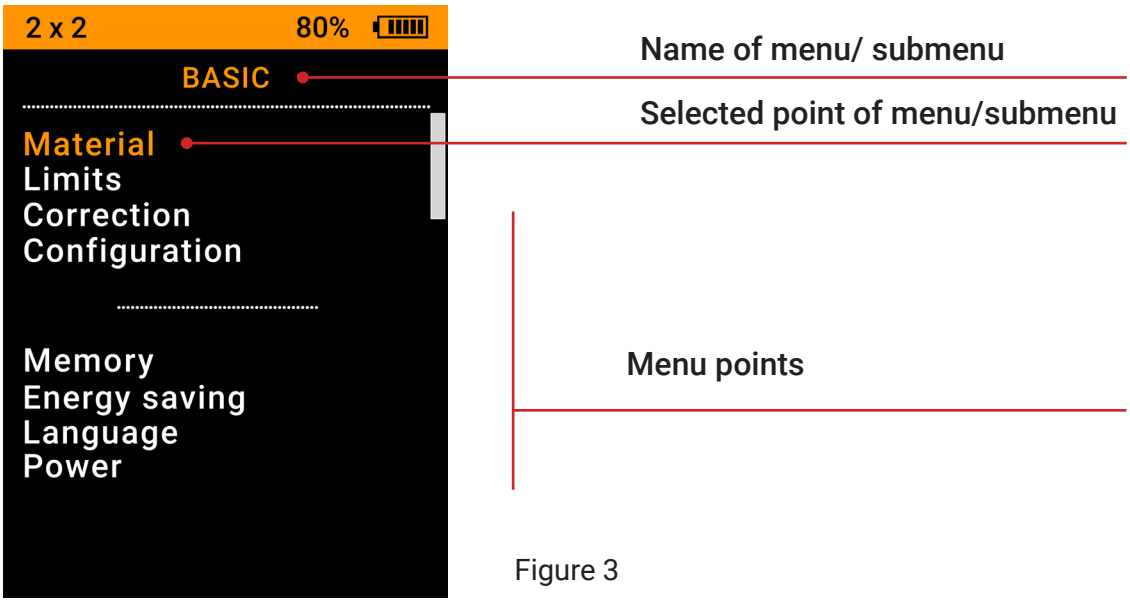


Figure 3

1.5 MARKING AND SEALING

1.5.1. On the rear side of the electronic unit, there is a nameplate indicating:
- name of the manufacturing company,
- name of the crack depth meter,
- serial number of the crack depth meter.

1.5.2 The inscriptions, symbols, and images on the nameplate are applied in a manner that ensures their durability during storage and use of the device.

1.6 PACKAGING

For storage and transportation, the electronic unit of the crack depth meter, sensors, and accessories are placed in a special bag or case (depending on the order configuration), which is included in the delivery set.

2. OPERATION

2.1 MEASUREMENT SEQUENCE

2.1.1 The measurement or estimation of crack depth using the device is performed in two stages.
2.1.2 In the first stage, the current flowing through an intact section of the material, located away from the crack, is measured. This operation is also referred to as zeroing.

For "**1x4**" and "**2x2**" probes, the measurement is conducted on an undamaged section of the material, at least 10 mm away from the nearest electrode, by pressing the «0» button.

The probe is held on the defect-free area until the zeroing scale is completed.

For the “**3+1**” probe, the first (external) current electrode must be at least 60 mm from the crack, and the nearest receiving electrode must be positioned 10–15 mm from the crack.

The result of this stage is the device’s automatic calibration to account for the current flowing through the crack.

2.1.3 The second stage involves the actual measurement of the crack depth.

The receiving electrodes of the «**1x4**» and “**2x2**” probes are placed on both sides of the crack edges.

For the «**3x1**» probe, the receiving electrodes are also placed on both sides of the crack edges, but the position of the first (external) current electrode remains unchanged from the first stage.

The measurement result, indicating the crack depth in millimetres, will appear on the device’s screen.

Schematic diagrams of the electrode arrangements during measurement are shown in Figure 4 - probe «**1x4**», Figure 5 - probe «**2x2**», Figure 6 - probe «**3x1**».

Probe «1x4»

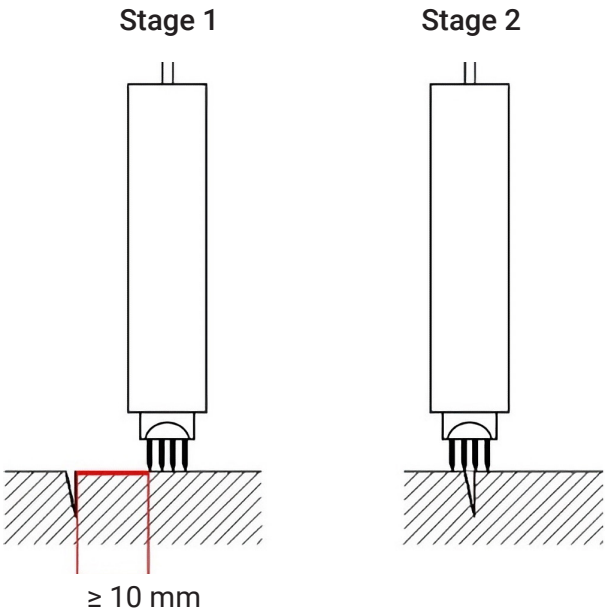


Figure 4

Probe «2x2»

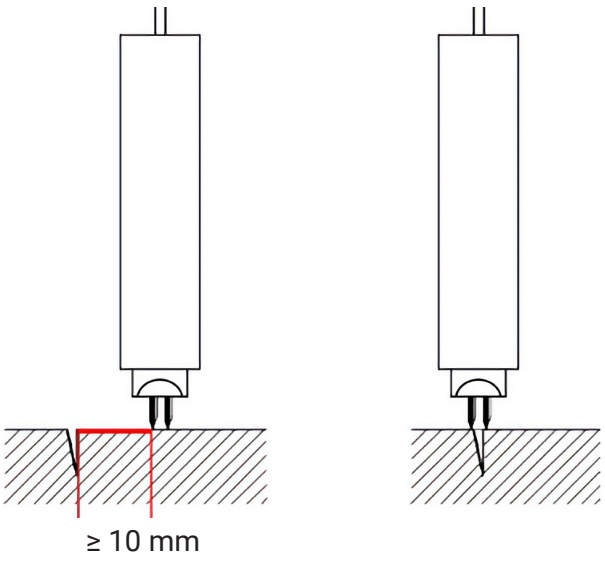
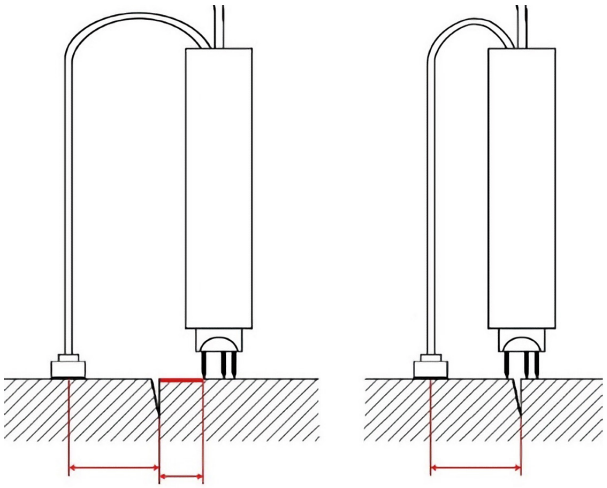


Figure 5

Stage 1 Stage 2



Probe «3x1»

Figure 6

≥ 60 mm 10-15 mm ≥ 60 mm

2.1.4 Before starting measurements, it is necessary to verify the functionality of the device using a control sample.

If measurements are to be conducted on materials with electromagnetic properties significantly different from those of the samples used during the device's calibration, an additional control sample must be prepared. This sample should include a crack corresponding to the upper limit of the expected crack depth. The device should then be adjusted or a custom configuration created accordingly.

2.2 PREPARING THE DEVICE FOR OPERATION

2.2.1. Verification using a control sample.

Before each use of the device, its functionality must be verified using the included control sample or the KO-281sample (sold separately). The nominal and actual crack depth values for KO-281-1 are provided in Section 1.3.

To ensure proper electrical contact, it is necessary to clean the defect-free area (for zeroing) and the crack area on the control sample.

Connect the probe to the device.
Turn on the device by briefly pressing the «⏻» button. The display screen will appear as shown in Figure 7. The first line of the screen displays the type of material being inspected.

Use the material (scale) selection buttons « ▲ », « ▼ » to choose the required material type for inspection. The middle section of the screen shows the measurement result.

The top line displays the type of connected probe. The battery status is also shown here.

Press the «>O<» button. The screen will display the message "ZERO" and a scale indicating the zeroing progress.

Position the probe according to Section 2.1.2.
The screen will show the potential value of the defect-free area, and the zeroing scale will begin to fill. Once the zeroing process is complete, remove the probe from the sample.

The display screen will appear as shown in Figure 7.

Position the probe according to Section 2.1.3 and measure the crack depth.

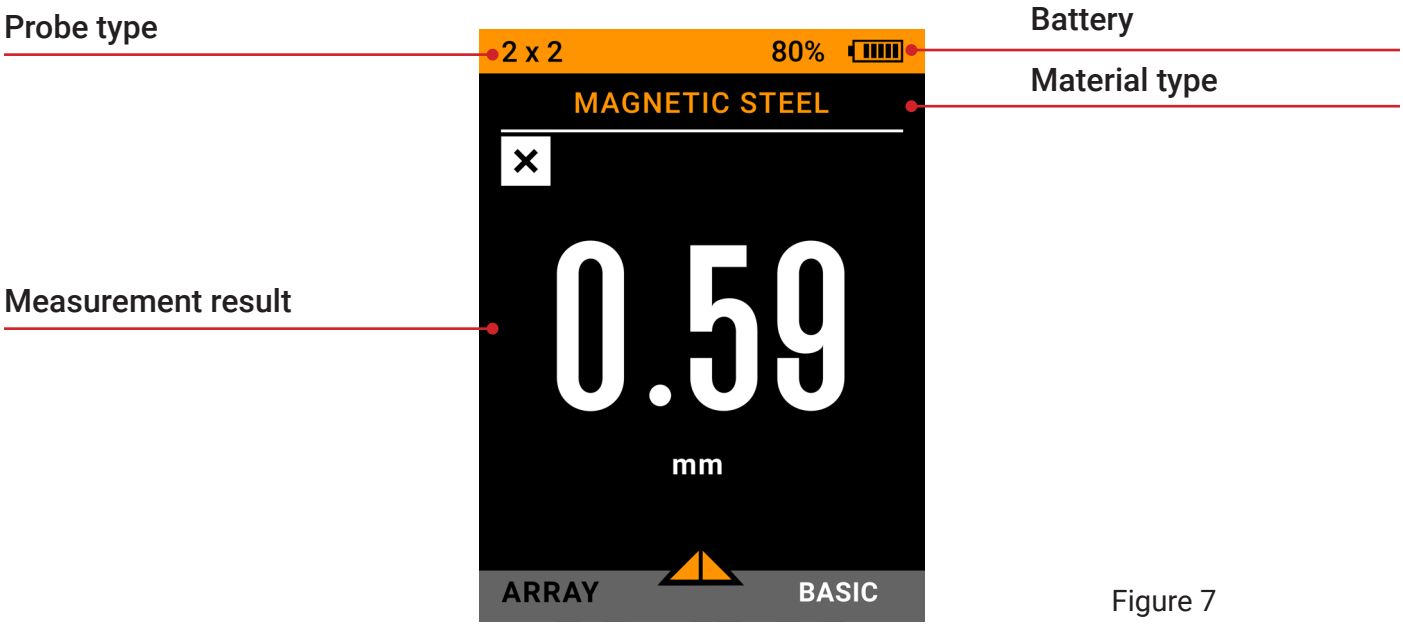


Figure 7

If the measurement results using the device with the selected base configuration and the KO-281-1 scale corresponding to the material do not exceed the allowable margin of error, the device is suitable for further operation.

2.2.2 Material selection

By default, the crack depth meter is equipped with three main scales designed for measurements on magnetic and non-magnetic steels, as well as aluminium, each with corresponding labels.

To switch between scales in measurement mode (see Figure 3), use the «⇄» button.

Alternatively, scale selection can be performed through the “Material selection” menu. Use the « ▲ », « ▼ » and «↵» buttons to choose the required scale (material).

2.3 THRESHOLD SETTING

Setting thresholds for the automatic defect signalling system is done through the “Thresholds” menu option.

Use the « ◀ » and « ▶ » buttons to select the signalling mode (“None,” “Less,” “Greater,” or “Range”).

If any of the available modes is selected, the required threshold or range value must be set using the « ▲ », « ▼ » and « ◀ », « ▶ » buttons. This can be done by pressing the «↵» button when the value is highlighted, or by using the « ◀ » and « ▶ » buttons to set the desired value in increments of 0.1. Then, press the «↵» and «⚙» buttons to confirm the selected mode.

Now, measurement results that exceed the set thresholds will be displayed in red.

2.4 CORRECTION OF THE CRACK DEPTH METER SCALES

2.4.1 General information

The correction process for the crack depth meter scales (or additional configurations) involves aligning the device’s **averaged** readings on defect model gauges or control samples with known crack depths to their passport (nominal) values.

The essence of the correction process lies in making adjustments to the initial factory settings.

Correction of the crack depth meter scales allows for restoring measurement accuracy in the event of additional errors caused by natural wear and tear of the probe's mechanical parts.

Correction must be performed using defect model gauges or their equivalents, which have valid verification certificates or are properly certified.
Correction is applied to the selected scale/additional calibration/additional scale in the menu and does not affect other scales or calibrations.

IMPORTANT!
Correction of the main scales and additional configurations apply only to the probe connected at the time of correction. This means that correction performed for the «**1×4**» probe will not affect the operation of the device with the «**2×2**» or «**3+1**» sensors. Replacing a corrected probe with a new one, or repairing the existing probe, will require repeating the correction procedure.

IMPORTANT!
If a new correction is required, the previous correction must first be deleted.
Correction can be performed using a single cut (crack simulation) or up to 8 cuts. Correction using a single gauge (sample) is allowed if this ensures the permissible error across the required measurement range.

IMPORTANT!
Correction of the main scales must **ONLY** be performed if the device exhibits unacceptable error on these scales. The presence of such error is determined by measurements on defect model gauges (cut type) with valid metrological verification or their properly certified equivalents.

Before performing correction, it is **recommended** to ensure that the unacceptable error is not the result of a failed previous correction. In such cases, the crack depth meter should be restored to factory settings by deleting the correction. After this, its functionality should be verified according to Section 2.2, "Preparing the device for operation."

2.4.2 Correction of the main scale

To perform correction, prepare the appropriate defect model gauges (cut type) with valid metrological verification or properly certified equivalents.

To enter correction mode, select the desired crack depth meter scale (material), then access the menu and choose the options <**CORRECTION**> — <**CORRECTION**>.

The device screen will appear as shown in Figure 8.

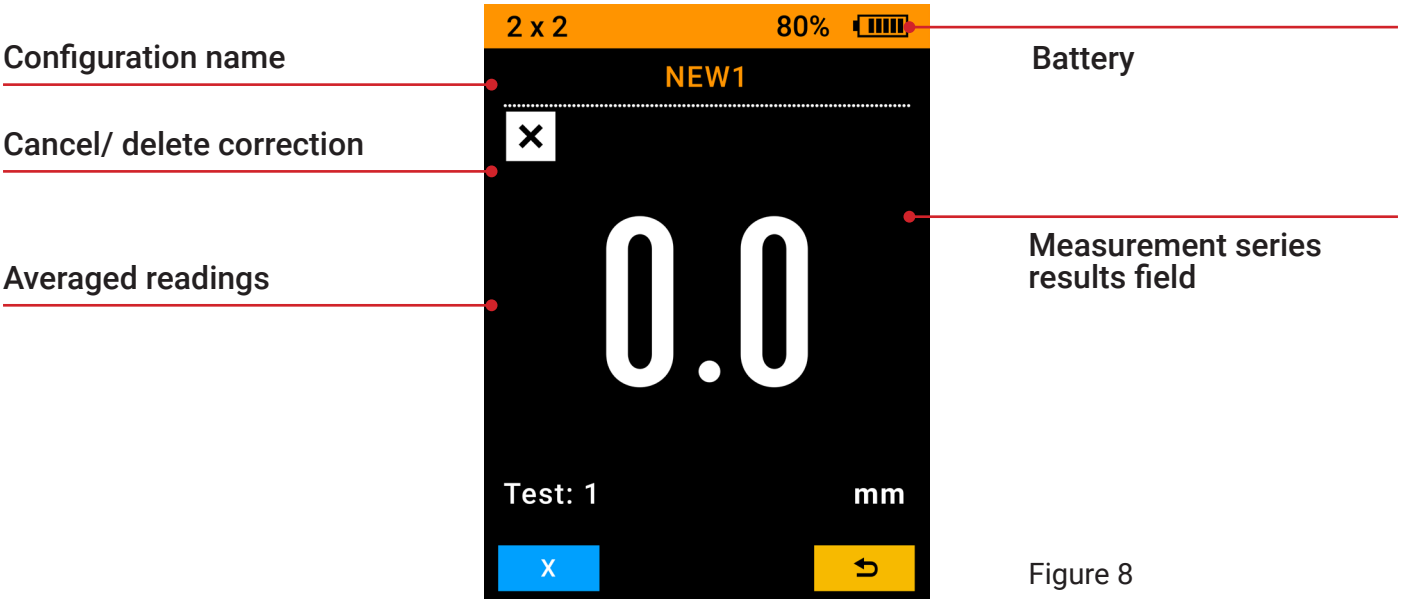


Figure 8

First, zeroing must be performed according to Section 2.1.2. Conduct at least two measurements on the control crack (cut) to ensure that the device has been properly prepared for operation. Use the up and down buttons « ▲ », « ▼ » to set the actual depth value of the crack (cut). Then, select the appropriate button « ⮌ ».

If the correction is being performed using multiple cracks (cuts), repeat the procedure the required number of times. The device can be corrected for up to 8 cracks at most.

Upon completing the correction procedure, select the « Ok » button. The correction will be saved to the selected scale.

2.4.3 Deleting a correction adjustment.

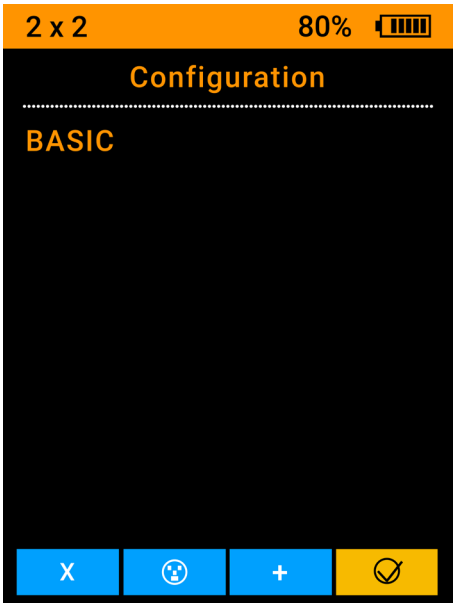
To delete a correction adjustment, enter the “Correction” mode. Without performing zeroing or taking measurements, use the « ◀ » and « ▶ » buttons to select the « X » option displayed on the screen. After pressing the « ↵ » button, confirm the restoration of the device’s default settings.

2.4.4 Crack depth meter configuration

Creating configurations for the crack depth meter allows you to duplicate the factory scales (materials) of the device for subsequent calibration (reconfiguration) to enable measurements on materials with electromagnetic properties that significantly differ from those used in the device’s factory settings.

Please note that for accurate calibration of a custom scale for non-standard material, an additional control sample must be prepared with at least one crack corresponding to the upper limit of the expected crack depth. The calibration should then be performed in the new configuration following Section 2.4.2 of the manual.

To create a new configuration, select the “Configuration” menu option. The device screen will appear as shown in Figure 9.



X – Delete the selected configuration

– Rename the configuration

\+ – Create a new configuration

– Confirm the selection

Figure 9

Basic configuration - is the factory default setting of the device, which is activated by default upon powering on until another configuration is selected. The basic configuration is protected from being deleted from the device’s memory.

When creating a new configuration, it must be selected using the« ▲ », « ▼ » buttons and confirmed by pressing the « ↵ » button.

While operating in the new configuration, the device copies the basic scales (settings for various materials) from its memory.
To create a custom scale for a specific material, select the scale that matches the parameters of your material and perform calibration in accordance with section 2.1.2.

2.5 WORKING WITH MEMORY

2.5.1 General Information

The device allows for the flexible organisation of a data archive containing measurement results, their analysis, and transfer to a computer.

The archive is organised in the form of named memory blocks. Each memory block contains measurement results recorded on a single scale.
Memory blocks are defined by the user (e.g., a block containing measurement results of a crack on a specific part).

Recording to a block is performed by holding down the «↵» button for an extended period (the device will emit a sound indicating that the data has been recorded).

2.5.2 Creating a block

To create a new data block, select the menu item <**MEMORY**>. The screen will display an interface similar to Figure 11.

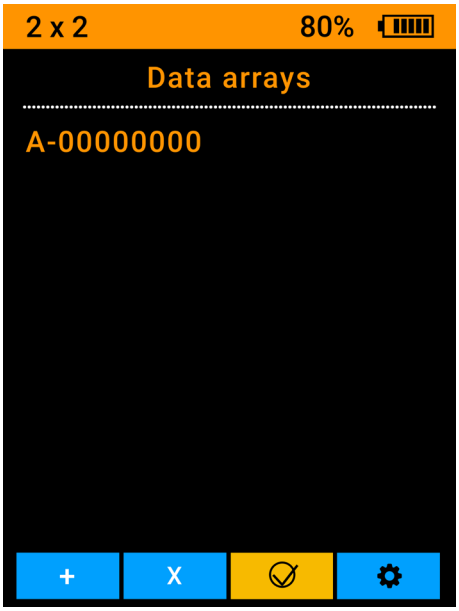


Figure 10

To create a memory block, use the « ◀ » and « ▶ » buttons to select the « + » option in the bottom menu, then press the «↵» button. In the menu that appears, enter a name for the new memory block using the « ◀ », « ▶ », « ▲ », « ▼ » and «↵» buttons. To finish, press the «⚙» button.

To delete a memory block, select the « X » option in the bottom menu and confirm the deletion.

To select an active (recording) memory block, choose the « ✓ » option in the bottom menu.

By selecting the « ⚙ » option, you can view the measurement results saved in the memory block, clear the entire memory block, rename it, or set it as active.

2.5.3 Transferring data to a computer

To obtain the software required for working with the data on a PC, please contact the manufacturer via email or download it from the manufacturer's official website.
To transfer data to a computer, connect the crack depth meter to the computer using the supplied cable. On the computer, install and launch the software provided with the device.

Then proceed as follows:

- Turn on the device if it is powered off,
- Connect the data transfer cable to the port located on the side of the electronic unit. Plug the other end of the cable into one of the computer's USB ports. A message will appear on the device display indicating that it is connected to the computer,
- Launch the software on the computer.

2.5.4 Power Saving Settings

To adjust the automatic shutdown time or the screen backlight duration of the device, access the “Power saving” menu. Use the « ◀ » and « ▶ »buttons to modify the corresponding operation times as indicated on the screen.

2.6 OPERATING THE CRACK DEPTH METER ON MATERIALS

2.6.1 When performing measurements on a product, it is **ESSENTIAL** to ensure electrical contact by cleaning the following areas:

- The area of the defect-free section (for “zero” reading),
- The inspected crack area,
- The location for the magnet (first current electrode) for the «**3+1**» probe. Note that the first current electrode must be positioned at least 60 mm away from the crack.

2.6.2 Connect the probe to the device.

Turn on the device by briefly pressing the «⏻» button. The display screen will appear as shown in Figure 6.

Use the «⇄» button to select the material type required for inspection. Press the «>0<» button. The screen will display “ZERO.” Position the probe as described in Section 2.1.2.

The screen will show the potential value on the defect-free section. Once the zeroing process is complete, lift the probe off the sample. The display will then appear as shown in Figure 7.

Position the probe as described in Section 2.1.3 and proceed with measuring the crack depth.

2.7 POWER SUPPLY CONTROL, CHARGING AND TURNING OFF THE DEVICE

2.7.1 The device includes a battery discharge monitoring mode. If the battery is low, its icon on the screen will start to “blink,” and the crack depth meter will then power off automatically.
The battery is charged using the charger included in the delivery set. The charging time is determined automatically and takes up to 5 hours when fully discharged.

2.7.2 The device can be turned off using any of the following three methods:

2.7.3 Press and hold the «⏻» button for at least 3 seconds. Release the «⏻» button, and the device will shut down.

2.7.4 From the main menu of the device’s operating modes, navigate to the “Power off” mode and press the «↵» button. The device will shut down.

2.7.5 If the “Auto shutdown” mode is enabled, the device will automatically turn off after the programmed idle time following the end of operation.

ATTENTION!
Do not leave the device unattended during charging.

3. MAINTENANCE

3.1 A technical condition check of the crack depth meter should be carried out at least once a year to ensure its functionality throughout its service life. The inspection should follow this sequence:

- Perform an external visual inspection of the device.
- Verify the completeness of the device according to section 1.3.
- Visually check the functionality of the control elements, connection cables, and the condition of painted and coated surfaces.

3.2 The most common malfunctions of the crack depth meter and their solutions are listed in Table 3.

Table 3

Type of malfunction	Probable reason	Solution method
Does not measure the crack depth	There is no probe contact with the device	Check the integrity of the connecting cable and the correct condition of the connector
Unstable readings	Pollution and corrosion of controlled surface	Clean the controlled surface
Unstable readings	Incorrect user calibration of the device	Delete the user calibration

4. TRANSPORTATION AND STORAGE

The crack depth meter is stored in the case in the closed heated room with air temperature (25±10)°C, relative humidity from 45 to 80%, atmospheric pressure from 630 to 800 mm Hg.

5. DISPOSAL

At the end of its service life, the crack depth meter poses no danger to human life, health, or the environment and does not require special disposal methods.
The device's power supply components should be disposed of in accordance with the applicable regulations for such items.

6. WARRANTY

6.1 The manufacturer guarantees that the electro-potential crack depth meter ET-28 complies with the requirements outlined in this Operation Manual, which is combined with the device's passport, throughout the warranty period.
The warranty period for the crack depth meter is 12 months from the date of sale, but no more than 15 months from the date of manufacture, provided the requirements for operation, maintenance, transportation, and storage specified in this manual are followed.

6.2 If defects are detected in the crack depth meter during the warranty period, the user must draft a report outlining the need for repairs. The device and one copy of the report should be sent to the manufacturer or its authorised representative (supplier).

6.3 Warranty repairs do not cover crack depth meters that have been damaged due to violations of operational requirements, precautions during use, maintenance procedures, transportation, or storage conditions.

6.4 Warranty repairs do not apply to crack depth meters with mechanical damage (except for signs of normal wear and tear), evidence of liquid ingress, or other impacts that cause the device to malfunction.

6.5 Warranty repairs do not apply to crack depth meters that show signs of unauthorised opening and/or attempted self-repair.

6.6 The manufacturer's warranty does not cover batteries or third-party accessories (chargers, grinding machines, etc.) included in the delivery set with the crack depth meter.

6.7 Warranty and post-warranty repairs of the device are carried out at the manufacturer's facility upon presentation of this Operation Manual, combined with the device's passport.

7. ACCEPTANCE CERTIFICATE

Electro-potential ET-28 Crack depth meter serial number _____ corresponds to the ET-28 operating manual OM and is recognized as suitable for operation.

Release date

“_____” _____ 20

Signatures of persons, responsible for acceptance:

_____

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