ZORN
INSTRUMENTS

Instruction Manual
Light Weight Deflectometer

- ZFG 3.0
- ZFG 3.1
- ZFG 3000

According to German Technical Test Specification for Soil and Rock in Road Construction TP BF-StB Part B 8.3

(for further regulations see preliminary remarks)

Subject to change without prior notice.
Status: 01/2021

CE

Preliminary Remarks

These operating instructions refer to the factory settings of the **ZFG 3.0**, **ZFG 3.1** and **ZFG 3000** units.

If you make changes to the settings yourself, the properties described here may differ. Crossreferences are inserted in the relevant sections, which will take you to the information.

Light Weight Deflectometers **ZFG 3.0**, **ZFG 3.1** and **ZFG 3000** are the current generation of precision deflectometers introduced by ZORN INSTRUMENTS in the early 1990s.

German Technical Test Specification for Soil and Rock in Road Construction TP BF-StB Part B 8.3 (2012) has been revised several times since its initial publication. Since latest revision, regulations on calibration have been part of a separate specification, TP BF-StB Part B 8.4 (2016).

Outside Germany, TP BF-StB Part B 8.3 (2012) serves as a guide for the application of the Light Weight Deflectometer. However, a growing number of countries have now also published their own national standards. The following specifications are examples of this:

Austria: RVS 08.04.04 (March 2008)
Switzerland: VSS 70 313 (July 2019)
Belgium: SB 250 versie 4.1, 4.16.2 (April 2019)
Spain: UNE 103807-2:2008 (July 2008)

USA: ASTM E2835 - 11 (2020)
China: TB 10001-2016 (Design Guidelines Railroad Substructure)
Russia: N° 52068-12 (State Register of Approved Measuring Instruments)

Table of Contents

1. Intended Use

The **ZFG 3.0**, **ZFG 3.1** and **ZFG 3000** Light Weight Deflectometers (LWD) are used to determine the dynamic deformation modulus E_{vd} [MN/m²] by means of dynamic plate load tests. This provides conclusions on the bearing capacity and compaction quality of soils.

The main field of application for LWD equipment is earthworks and road construction. Further applications are landscaping and soil exploration.

According to test specification TP BF-StB Part B8.3 (2012), the Light Weight Deflectometer is particularly suitable for the testing of:

- Coarse and mixed-grained soils with a maximum grain size of up to 63 mm
- Fine-grained soils or comparable building materials with a stiff to firm consistency
- Soils after soil improvement measures

The Light Weight Deflectometer may be used for self-monitoring and for acceptance test in accordance with this regulation.

For the **ZFG 3.0**, **ZFG 3.1** and **ZFG 3000** Light Weight Deflectometers, the standard version with 10 kg loading device and 300 mm load plate has an upper measuring limit of E = 70 MN/m² (MPa). This corresponds to a settlement of about 0.3 mm.

Measurements on more highly compacted soils should be carried out with the 15 kg loading device with 1.5 times the impact load. This extends the measuring range to 105 MN/m².

The Light Weight Deflectometer can be used as a supplement or alternative to the static plate load tester according to DIN 18134 and has the following advantages:

- No loading support (truck) or tripod necessary
- Testing is possible under confined conditions (e.g. track construction, trench backfilling, backfilling, boreholes, other places difficult to access)
- Low space requirement and low mass of the testing device
- Low time requirement for the test (approx. 2-3 min. per measuring point)

Information on other equipment configurations, on special applications of the Light Weight Deflectometer and on the so-called Medium Weight Tester M-FG can be found at our website www.zorn-instruments.com.

2. Safety Instructions

2.1 General Safety Instructions

⚠ **CAUTION**

Indicates a possible imminent danger.

If it is not avoided, slight or minor injuries and damage to property may result.

⚠ **HINT**

Designates general hints, useful tips and recommendations. These, however, have no influence on the safety and health of the personnel.

2.2 Safety instructions ZFG

⚠ **CAUTION**

To prevent accidents and damage to the device, secure the LWD when transporting with the transport lock!

Only plug in the measuring cable when the Light Weight Deflectometer is on the ground and the electronic measuring device is switched off.

Do not handle under the Light Weight Deflectometer when it is latched on top!

Wearing protective work shoes is recommended. To avoid injuries, only grip the Light Weight device by the triangular catch handle!

⚠ **HINT**

Check your Light Weight Deflectometer for damage before each use and only use it if it is not damaged.

During the measuring process, make sure that the transport lock is removed. If the Light Weight Deflectometer is not in use, the drop weight must be at the lower end of the guide rod.

Use only recommended batteries or original rechargeable batteries for the electronic measuring device.

Protect the printer at all times from external influences such as moisture and soiling, e.g. sand and dust.

Only use the supplied charger to recharge the **ZFG 3000** or the printer for the **ZFG 3.0** or **ZFG 3.1**.

3. Scope of Delivery

3.1 Technical Equipment

The technical equipment of the **ZFG 3.0**, **ZFG 3.1** and **ZFG 3000** Light Weight Deflectometer is described below.

The loading device with drop weight, guide rod, spring assembly and release lever is identical for all models. The same applies to the bearing plate and the MEMS acceleration sensor used.

Differences exist in the design of the measuring electronics.

▶ The **ZFG 3.0** model has measuring electronics as a hand-held device, which in the basic equipment allows the comfortable execution of the dynamic bearing plate compression test. The user is guided by the device through the measuring process. The device automatically calculates the settlement values of the bearing plate and the deformation module E_{vd}. In addition, it stores the measurement data (optionally internally or on SD card).

This basic equipment of the **ZFG 3.0** can be extended by additional technical features. Available features include an integrated GPS receiver for localizing measurements, a WiFi transmitter for transferring measurement data to a Windows PC or to tablets and smartphones (iOS and Android). In addition, a thermal printer is available for instant printing of test reports (optionally in a robust aluminum case).

▶ The measuring electronics of the **ZFG 3.1** model are technically the same as those of the **ZFG 3.0**, but already include a WiFi transmitter in the basic equipment for transmitting the measured data to a PC or mobile device. As with the **ZFG 3.0**, the electronics can be expanded to include additional features.

Both models can be easily distinguished by a different coloured casing.

▶ The **ZFG 3000** also has an electronic measuring system with automatic calculation of the bearing plate settlement values and the deformation module E_{vd}. It stores measurement data either internally or on an SD card.

The electronics of this model are located in a robust case. Already EX Works, the **ZFG 3000** is fully equipped with a GPS receiver, thermal printer and a license for the use of the ZORN FG software for the convenient creation of professional test reports on MS-Windows PC. A transparent cover protects the electronics with LCD display and control buttons as well as the printer from dust and splash water. If required, the **ZFG 3000** can be operated with the lid closed by means of specially secured, external buttons.

Scope of Delivery

	ZFG 3.0	ZFG 3.1	ZFG 3000
Components			
Loading device 10 kg	✓	✓	✓
Loading device 15 kg	○	○	○
Bearing plate with accelerometer	✓	✓	✓
Measuring electronics handheld	✓	✓	
Measuring electronics compact casing with integrated printer			✓
Measuring cable	✓	✓	✓
SD card	✓	✓	✓
Batteries (4x AA)	✓	✓	
Rechargeable NiMH battery			✓
USB card reader	✓	✓	✓
Paper roll (1x in printer, 2 spare)			✓
Leather case for handheld	✓	✓	
Optional equipment			
External printer	✓	✓	
Case for handheld and printer	✓	✓	
Additional modules electronics			
GPS (internal)	○	○	✓
WiFi (internal)	○	✓	○
Documents			
User manual long	online	online	online
User manual short	✓	✓	✓
Flyer free download	✓	✓	✓

○ = optional

GPS integrated

ZFG 3000 is equipped with a GPS module as standard.

ZFG 3.0, **ZFG 3.1** are optionally available with a GPS module. If you have chosen a device without GPS, you can have this module retrofitted at any time.

WIFI integrated

ZFG 3.1 is equipped with a WiFi module as standard.

ZFG 3.0, ZFG 3000 are optionally available with a WiFi module. If you have chosen a device without WiFi, you can have this module retrofitted at any time.

WiFi
SSID: ZORNZFG
KEY: ZORN1870

3.2 Light Weight Deflectometer | Details

Level

Handle

Head Limit Stop with Release Mechanism

Catch Handle

Drop Weight

Lever for Transport Safety Lock

Guide Rod

Catch for Transport Safety Lock

Spring Element in Bellows

Tilt Protection

Centering Cone

Carrying Handle

Sensor Connector

Bearing Plate

Mounting Pin with Sensor
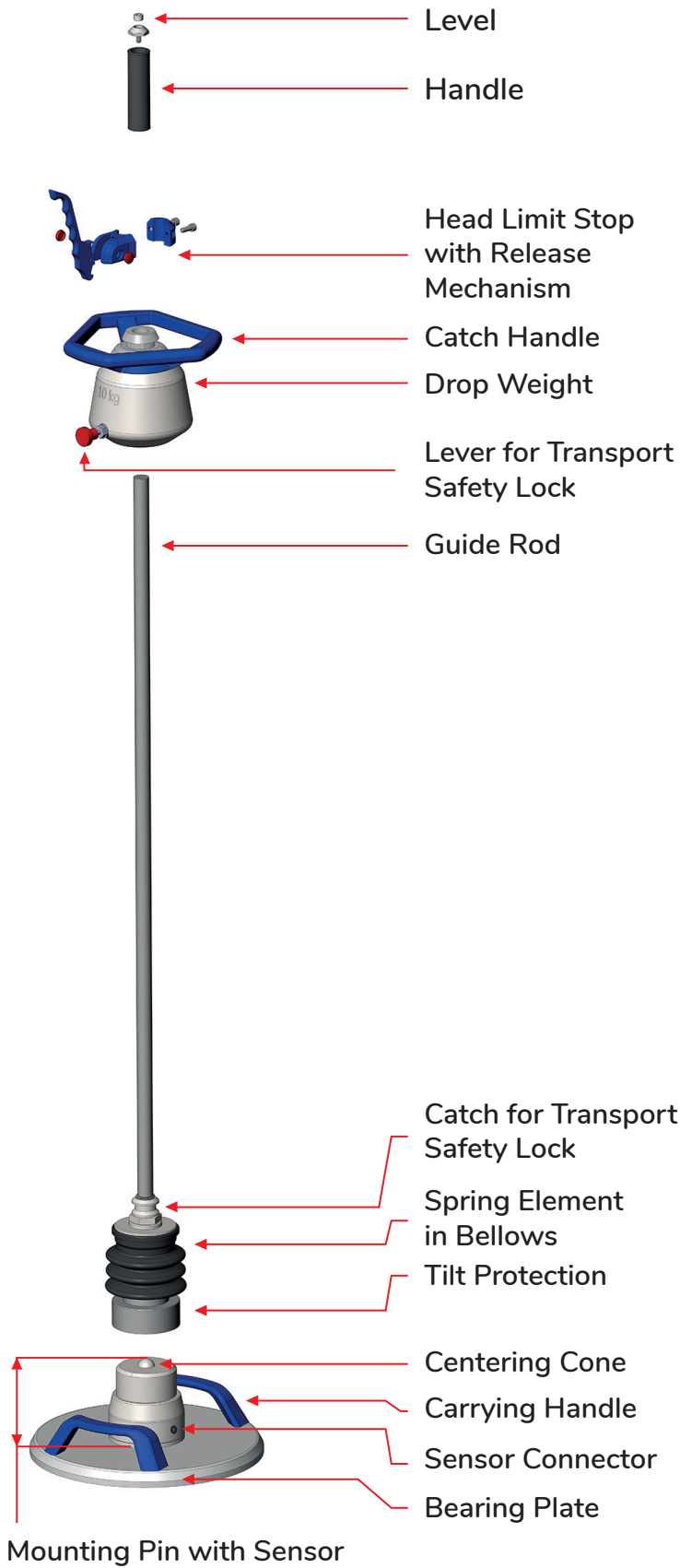
ZFG 3.0

ZFG 3.1

Measuring electronics handheld | example view

Carrying bag

with case, printer

ZFG 3000

3.3 Accessories

3.3.1 ZFG 3.0 and ZFG 3.1 Printer

A thermal printer is available as an accessory for the **ZFG 3.0** and **ZFG 3.1** models. This allows test reports to be printed out immediately after the measurement. Changes to the basic settings should only be made by trained personnel.
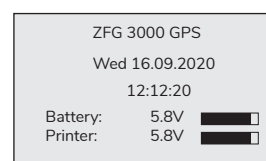
A | Using the Printer

Connect the printer to the electronic meter using the supplied printer cable (mini-USB - 3.5 mm jack) to the electronic measuring device. To do this, plug the jack into the socket of the electronic measuring device and the mini-USB plug into the socket provided for this purpose on the printer.

Switch on the printer by pressing the <FEED/ENTER> key.

The printer enables the printout of test reports immediately after the measurement. Initiate printing by pressing the <Print> key on the electronic measuring device when measurement results are displayed on the screen.

The printer information on the start screen appears or is updated when:

- • The printer is connected to the device
- • The <Print> key on the home screen is pressed
- • Or a printout is made.

```
ZFG 3000 GPS
Wed 16.09.2020
12:12:20
Battery:       5.8V
Printer:       5.8V
```

B | Charging the Printer Battery

Only charge the printer battery with the supplied power supply unit!

If you have connected the printer to the **ZFG 3.0** or **ZFG 3.1** and the printer has been recognized by the device, the start screen of the measuring device will display information about the charging status of the printer. This is indicated by a voltage value and a battery symbol. If the battery symbol is empty, you will only be able to make very few or no printouts at all. Before printing, an additional message appears: "Printer battery empty".

When using a new battery pack, at least three complete charging and discharging cycles must be performed for it to reach its full capacity.

Avoid deep discharging the batteries, as this is damaging. If a battery is deeply discharged, the charging process may stop after 30 minutes. In this case, you must restart the charging process by disconnecting and reconnecting the power supply unit.

The charging time for fully discharged batteries is approx. four hours.

Replace a defective or used battery only with an original battery!

For further accessories get in touch with us: +49 3931 25273-116 or sales@zorn-instruments.de.   **!**

C | Quick Test of the Printer

To check the printer separately, you can perform a self-test. To do this, disconnect the printer from the electronic measuring device and switch off the printer (it also switches itself off after one minute without use).

Press the <FEED/ENTER> key for at least three seconds. A test printout is now created, on which the firmware version and the character set are printed. If no printout or an incorrect printout is made, follow the instructions under > *E | Problems When Using the Printer* (see below).

D | Changing the Paper Roll

To change the thermal paper roll, the cover of the printer compart-ment must be opened. To do this, pull the cover upwards. The war-ning light flashes red when the cover is opened.

Remove the sleeve of the empty paper roll and replace it with a full thermal paper roll. Insert the new thermal paper roll so that the paper unrolls downwards. Place the beginning of the roll over the tear-off edge of the printer.
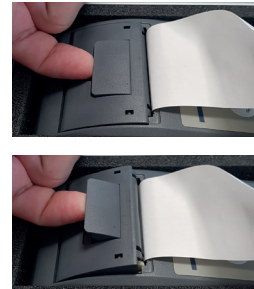
E | Problems Using the Printer

If the electronic measuring device does not recogni-ze the printer after pressing the <Print> key, the message shown in the picture on the right will appear in the device.

Connect printer and
switch on!

<OFF> Escape

Disconnect the printer and the electronic measuring device and plug in the printer cable again.

If still no printouts can be made with the printer, check whether the power supply of the printer is secure. Switch off the electronic measuring device and press the <FEED/EN-TER> key on the printer. If the LED light flashes green, the power supply is secure. If the LED does not light up or goes out in less than one minute, you must charge the battery.

Check if the paper roll is used up. In this case, a red signal flashes on the printer. Then insert a new thermal paper roll following the steps as described in *point D*.

If the thermal printer does not print after changing the thermal paper roll, either it has been inserted the wrong way round or it is not a thermal paper roll.

3.3.2 ZFG 3000 Printer

The measuring electronics of the **ZFG 3000** includes an integrated thermal printer. This allows test reports to be printed out immediately after the measurement. Changes in the basic settings should only be made by trained personnel.

A | Using the Printer

The printer allows printing of test reports immediately after the measurement. Initiate printing by pressing the <Print> key of the electronic measuring device when measurement results are displayed on the screen.

B | Power Supply of the Printer

The NiMH rechargeable battery built into the **ZFG 3000** supplies both the measuring electronics and the thermal printer. The battery should be recharged from time to time. For this purpose, only use the supplied power supply unit. After switching on the device, the charge status can be seen from the charging bar in the display after the device is switched on.

C | Change Paper Roll

To change the thermal paper roll, the cover of the printer compartment must be opened. To do this, pull the cover upwards. Remove the core of the empty paper roll and replace it with a full thermal paper roll. Insert the new thermal paper roll so that the paper unrolls downwards. Place the roll beginning over the tear-off edge of the printer.
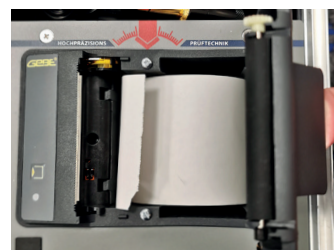
For suitable thermal paper and other products get in touch with us: +49 3931 25273-116 or sales@zorn-instruments.de. **!**

3.3.3 Aluminum Case

The aluminum case is a transportation case for the protection and safe storage of the electronic measuring device models **ZFG 3.0** and **ZFG 3.1** and the thermal printer. The screwdriver contained is used to open the battery compartment.

3.3.4 Further Accessories

You can optionally purchase further accessories from us:
- Transport case ZORN-ACC4 for splash-proof transport and storage of the Light Weight Deflectometer
- Transport trolley for practical and energy-saving transport on the construction site
- Magnetic stand for safe storage of the loading device during alignment of the bearing plate
- ZORN FG software for processing and evaluation of measurement data
- ZFG VIEWER APP for displaying the measured values on a tablet or smartphone
- ZORN D PLUS Bluetooth control for the Light Weight Deflectometer for tablet or smartphone

4. Performance of the Measurement

While the Light Weight Deflectometers of the models **ZFG 3.0**, **ZFG 3.1** and **ZFG 3000** differ in the design of the measuring electronics, there is no difference in the application of the devices.

4.1 Memory Concept

All measurements are automatically saved on the supplied SD card as long as it is in the SD slot of the electronic measuring device during the measurement. The electronic measuring device works with the "ZFG" subfolder of the SD card set up Ex Works. There are three different file types in it: *.zxz files, *.nrz files and *.zxc files.

Each measurement is saved in its own *.zxz file. The file name corresponds to the test number. Example: If ten measurements were saved on the SD card, there are 10 *.zxz files in the directory (0001.zxz to 0010.zxz).

The number of *zxz files in the directory is stored under the file ZFG.nrz. The file ZFG.zxc contains the card number. The measuring device accesses all files.

i   If you make manual changes to the directory (e.g. renaming or deleting files), the measuring device may not recognize all files correctly.

In addition to the SD card, the device can also save data in the internal memory (flash). These data can subsequently be copied from the internal memory to the SD memory card.

To avoid problems, it is recommended that you do not make any manual changes to the "ZFG" directory.

You back up your files by backing up the entire "ZFG" directory.

If you no longer need files, you must delete the entire directory.

If GPS data are to be displayed and saved as well, this setting must be selected in advance under "Settings" *(see point 5.5.7)*.

4.2 Preparation

4.2.1 Saving the Measurement Data

If you want to save the measurement data on the supplied SD card, you must insert it into the electronic measuring device as follows:

- In the case of a **ZFG 3.0**, **ZFG 3.1** and **ZFG 3000**, hold the SD card so that the contacts point downwards and towards you.
- Insert the SD card into the SD slot of the electronic measuring device until a click is heard. If the card is inserted correctly, it will protrude approx. 3 mm above the face of the measuring device.
- To remove the SD card, press on the protruding end of the SD card. A click will be heard and the card is pushed out of the device slightly.
- Now you can remove the card.

4.2.2 Placing the Bearing Plate

The surface to be tested must be level and as horizontal as possible. If necessary, fill cavities with dry medium sand (see also test specification TP BF-StB Part B 8.3).
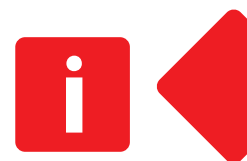
- Place the bearing plate completely and horizontally on the prepared test surface by pushing and turning it.
- Both the electronic measuring device and the bearing plate each have a sensor connector. Plug one end of the measuring cable into the connector of the electronic measuring device and the other end into the connector of the mounting pin of the bearing plate. The electronic measuring device must be switched off.
- Now place the loading device on the bearing plate.
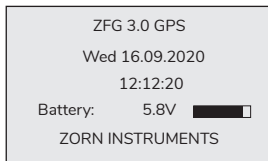
4.2.3 Preloading

Unlock the transport safety lock. Before a measurement can be performed, you must preload the test surface by applying three impacts.
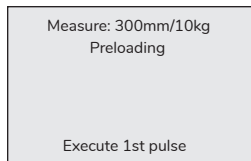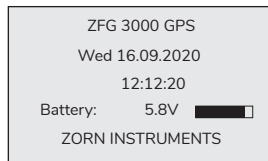
> By default, the preloaded impacts are recorded by the electronic measuring device. You can deactivate this function under > *5.5 Settings > Preloading*.
>
> If the preloading impacts are not to be recorded by the electronic measuring device, you can also carry out the preloading with the electronic measuring device switched off. Deactivate the "Pre-loading" function for this purpose as well.

Switch on the electronic measuring device by pressing the <ON/OFF> key. The start screen will appear (left **ZFG 3.0**, **ZFG 3.1**; right **ZFG 3000**):

ZFG 3.0 GPS
Wed 16.09.2020
12:12:20
Battery: 5.8V
ZORN INSTRUMENTS

ZFG 3000 GPS
Wed 16.09.2020
12:12:20
Battery: 5.8V
ZORN INSTRUMENTS

Measure: 300mm/10kg
Preloading
Execute 1st pulse

Images if printer is not connected

Display indicator during preloading

The current date, time and battery voltage with charge level are displayed. If the data is to be saved on the SD card, the SD card must be inserted at this point at the latest. If the SD card is not inserted, the message "No SD card!" appears above the date.

Press the <OK> key on the electronic measuring device. The preloading measurement process will start.

> If "Textinput" has been activated in advance, the possibility to enter text appears first. After entering, saving and pressing <OK> again, the preloading starts (see section *5.5.5 Text input*).

Hold the loading device by the handle with one hand and lift the drop weight by the catch handle to the limit stop with the other hand. Pull the release mechanism to the handle and hook the drop weight in the notch provided (see Fig. 1).

Align the guide rod of the loading device vertically.

Use the level (depending on the model at the top of the handle or directly on the notching device) as orientation. Release the drop weight by pulling the release mechanism and allow it to bounce on the spring element (see Fig. 2). After the first recoil, latch it on the catch handle and hook it back into the release mechanism (see Fig. 3). Perform this step a total of three times (observe display indicator).

Re-engage the drop weight in the release mechanism. The preloading is now complete.

4.3 Measurement Procedure

4.3.1 Performing the Measurement

After preloading is completed, the device switches to the measuring mode automatically.

> If you did not record the preloading impacts using the electronic meter, you must now turn on your instrument by pressing the <ON/OFF> button. Press the <OK> key.

The measurement settings (e.g. bearing plate size/mass of the drop weight) will now be displayed. If necessary, you must switch this to the intended test mode. In the second line, there will be a request to perform the first impact. A single beep signals readiness.

```
Measure: 300mm/10kg




Execude 1st pulse
```
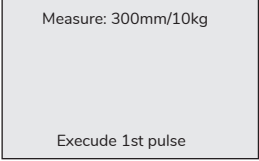
After the first impact, the settlement value s1 will appear in the display. You will now be prompted to perform the second impact by a subsequent beep. This will be repeated until the third impact.

```
Measure: 300mm/10kg
s₁: 0,431 mm



Execude 2nd pulse
```
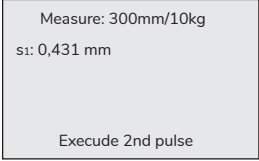
After the third impact, you will hear a double beep indicating that your measurement is complete and all three settlement values will be displayed. Put the drop weight down safely.

```
Measure: 300mm/10kg
s₁: 0,431 mm
s₂: 0,428 mm
s₁: 0,427 mm
```
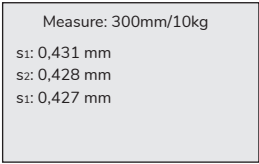
The measurement results will be automatically saved to the SD card at the end of the measurement. The prompt "Press <OK>" will be displayed in the second line. After following this prompt, the results will be visible to you (if GPS is switched on, there is a short waiting time "Wait for GPS"). The measurement process is now finished.

```
Result
N₀: 20    16.09.20      12:12
Sₘ: 0.429 mm
s/v: 1.981        300mm/10kg
Eᵥd: 52.45 MN/m²
```
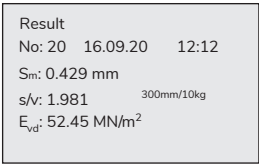
4.3.2 Measuring without SD Card

You can also perform your measurements without an SD card. However, the measurements will then be saved only in the internal memory. For further processing, the data must be saved on an SD card. When starting the measurements, the message will appear that the measurements cannot be saved.

```
Measure
No card inserted!
Use built-in memory
Press <OK>
```

> After the measurement, **check** whether the measurement data has been saved on the SD card: Press <Mode> key > "Read card" (*see also point 5.2*).

If the "Repeat pulse" prompt appears in the display after a measurement impact has been performed, a measuring error has occurred. This can be caused, for example, by latching the drop weight too hard.

If the same error message occurs during impact repetition, there can be several causes:
- The ground is too soft (v > 4.000 mm/s or s > 20 mm).
- The ground is too hard (s < 0.1 mm).
- There is a contact problem with the jack.
- The sensor connection cable is broken (cable break).
- The acceleration sensor may be defective.

> In these cases, the measurement with the device can no longer be performed. Check the sensor connection cable and the cable connection. If necessary, perform a self-test with the device (*see section 5.8.1*).

4.4 Displaying the Measurement Results and Settlement Curves

In the results overview, you have in front of you the screen on the right. The lines have the following meaning:

(1) Display mode and text entry, if necessary.
(2) Sequential number (only if SD card is inserted), date and time of the measurement.
(3) s_m = mean settlement in mm
(4) s/v = degree of compactability
(5) E_{vd} = dynamic deformation modulus in MN/m² (MPa)
(6) Geographical coordinates (only for GPS module)

Result
No: 20   16.09.20   12:12
S_m: 0.512 mm
s/v: 1.981   300mm/10kg
E_{vd}: 43.95 MN/m²

To display settlement curves and the individual settlement values, press the <Mode> key.

4.5 Printing the Measurement Results

You can print the log if you connect the electronic measuring device to the printer and press the <Print> key.

The printout contains the data listed under *point 4.4*, additionally the individual settlements and velocities as well as free fields for handwritten notes.

4.6 After the Measurement

When your measurements are finished, you can switch off the instrument by pressing the <ON/OFF> key. If you still want to take further measurements, no further setting is required and you can continue with the next measurement by pressing the <OK> key.

After each measuring process, remove any debris from the drop weight such as soil, sand, clay or dust and secure the drop weight (transport safety lock, see also *point 6*).

5. Electronic Measuring Device

The following information applies equally to all models, **ZFG 3.0**, **ZFG 3.1** or **ZFG 3000**. You can call up the device menu with additional functions by pressing the <Mode> key. Using this key, you can scroll through the individual sub-menus. Pressing the <OK> key selects the highlighted menu.

Changed settings are saved by pressing the <ON/OFF> key. This key is also used to exit the menu.

5.1 Measuring

This menu item starts the measuring process. You only need to select this menu item if you have previously made changes to the settings.

5.2 Reading the Card

Here you can read the data that are already stored on the SD card.

Press the <Mode> button to enter the menu. Scroll to the "read card" menu sub-item using the <Mode> key. Open the sub-menu by pressing the <OK> key.
- The first thing you will see in the display is the last saved data record, which shows the sequential number of the individual measurement called up, the total number of measurements saved, date and time of the stored single measurement, and the mean settlement, s/v value and E_{vd} value.
- Using the <+> and <-> keys, scroll through the stored individual measurements.
- Pressing the <Mode> key will take you to the second results page, which contains the settlement curves and the three individual settlements. Geographical coordinates are displayed here, if provided by the system.
- Press the <Print> key to print out the respective log (see also *Section 4.4*).

5.3 Deleting the Measurement

This function allows you to delete the last saved measurement.

Press the <Mode> key to call up the menu. Scroll to the "Delete measurement" sub-menu using the <Mode> key. Open the sub-menu by pressing the <OK> key. The following screen will appear.

In the example, the last measurement has the test number 23. By pressing the <OK> key, you can delete permanently the measurement.

```
Delete Flash
0023.ZXZ

Are you sure?
<OK> Delete
<OFF> Escape
```
Display ZFG 3.0 without SD card,
Flash = Internal Memory

```
Delete SD
0023.ZXZ

Are you sure?
<OK> Delete
<OFF> Escape
```
Display ZFG 3000 with SD card

5.4 Deleting the Card

This function allows you to delete all data sets contained on the SD card in the "ZFG" folder in one step. The number of measurements that will be deleted is displayed for information.

Press the <Mode> key to call up the menu. Scroll to the "Delete map" sub-menu using the <Mode> key. Open the sub-menu by pressing the <OK> key.

5.5 Settings

In the "Settings" area, you can adjust the device to your preferred settings.

To do this, first press the <Mode> key to call up the menu. Scroll to the "Settings" sub-menu using the <Mode> key. Open this by pressing the <OK> key.

5.5.1 Language

The "Language" menu appears as the first selection option in the "Settings". Select with the <+> and <-> key to select the desired language. The following languages are available:

· German	· Polish	· Portuguese	· Russian
· English	· Italian	· Slovenian/Croatian	· Chinese
· French	· Spanish	· Serbian	

Save your selection with the <ON/OFF> key.

5.5.2 LCD Contrast

Here you can change the pixel brightness of the display.

In the "Settings" menu, scroll with the <Mode> key to the sub-menu "LCD Contrast". Adjust the brightness with the <+> and <-> key and save your settings with the <ON/OFF> key.

5.5.3 Type

Here you can change the selected measurement type if the device is designed for several measurement types (e.g. 300 mm/10 kg, 300 mm/15 kg, 150 mm/10 kg, 150 mm/5 kg, CBR, etc).

> When changing the loading device (10, 15 kg) or the bearing plate (150, 300 mm), the settlement measuring device must be manually switched to the changed measuring type!

In the "Settings" menu, scroll with the <Mode> key to the sub-menu "Type". Select the desired type with the <+> and <-> key and save your selection with the <ON/OFF> key.

5.5.4 Unit

You can display the unit of the E_{vd}-value in MN/m² or in MPa. In the "Settings" menu, scroll to the "Unit" sub-menu with the <Mode> key. Select the desired unit with the <+> and <-> keys and save your selection with the <ON/OFF> key.

5.5.5 Text Input

With the help of the text input, you can add text to the measurement. You will find this on the printout and in the saved file on the SD card. When you read the file into the software for further processing on the computer, you will find the added text under the "Remarks" field.

In the "Settings" menu, scroll to the "Textinput" sub-menu using the <Mode> key. Open the sub-menu by pressing the <OK> key.

By default, text input is disabled (shown as "Off" in the settings). If you want to use it, you must activate the text input first before the measurement (shown as "On" in the settings).

Use the <+> and <-> keys to select the characters you want for the text (<PRINT> selects, <MODE> deletes) and save your selection with the <ON/OFF> key.

Textinput
0123456789ABCDEF
GHIJKLMNOPQRSTUV
WXYZ/-+._,#

When starting the measurement, the screen for entering text appears before the prompt to perform the preloading (see image on the right).

You will be shown an alphabet with a sequence of numbers and special characters. An underscore marks your current position with the cursor. You can change the position by pressing the <+> and <-> key.

Using the <Print> button, you can add the selected character to the text. Your text can consist of a maximum of 16 characters. You will find your text in the bottom line on the display.

By pressing the <Mode> key you can delete the last character. The entered text will be carried over for the next measurement unless you cancel the text entry or the measurement by pressing the <ON/OFF> key.

> **i** If the text contains a digit as the last character, the instrument automatically counts up from this digit for the next measurements in ascending order from this digit (automatic numbering). This function is well suited for counting measurements within a test lot.

5.5.6 Preloading

With this sub-menu, you can activate or deactivate the recording of the preloading impacts, which take place before the actual measurement.

> Preloading impacts are performed in the same way as measurement impacts. By default, the preloading impacts are activated. The results of the preloading impacts are not included in the measurement result and are not saved.

In the "Settings" menu, scroll with the <Mode> key to the sub-menu "Preloading". Use the <OK> key to switch preloading "On" or "Off". The results of the preloading impacts are not included in the measurement result and are not saved.

5.5.7 GPS

This function is only available on devices with a GPS module and can be switched on or off in the "Settings" menu.

A GPS (Global Position System) is used to determine the location. The installed GPS module receives navigation satellite signals to determine the position in open terrain. Under cover and indoors, reception is only possible to a limited extent.

Depending on the strength of the satellite signals, the device needs between 30 and 120 seconds to display the location coordinates. Instead of "Zorn Instruments", the location coordinates now appear on the display.

In the "Settings" menu, scroll with the <Mode> key to the sub-menu "GPS." Use the <+> and <-> keys to select the desired setting and save your selection with the <ON/OFF> button.

> When the GPS module is on, the power consumption increases. With one set of batteries, you can perform approx. 150 measurements with GPS display.

5.5.8 Coordinates

This function is only available for devices with GPS module.

Depending on the setting, the coordinates are displayed as latitude and longitude (Lat/Lon) or according to the UTM system (Universal Transverse Mercator).

In the "Settings" menu, scroll with the <Mode> key to the sub-menu "Coordinates". Use the <+> and <-> keys to select the desired setting and save your selection with the <ON/OFF> key.

5.6 Setting the Clock

In this sub-menu, you can set the time and date of the device.

Press the <Mode> key to enter the menu. Scroll with the <Mode> key to the sub-menu "clock settings".

Open the sub-menu by pressing the <OK> key. The current value is marked with an underscore. You can change the value by pressing the <+> and <-> keys to set it. You can move to the next value by pressing the <Mode> key.

Press the <ON/OFF> key to save the settings and exit the "Clock Settings" menu.

> When opening the menu, the "ppm" value can also be changed. This is responsible for the accuracy of the clock. Change the value only if the clock is too fast or too slow.

5.7 Info

Here you can display the instrument data (version, instrument number, calibration factor, calibration date and language).

Press the <Mode> key to call up the menu. Scroll to the "Info" sub-menu using the <Mode> key. Open the sub-menu by pressing the <OK> key.

You can print out the device data by pressing the <Print> key (if a printer is connected). On the printout, you will also find the information about the hardware version.

Press the <ON/OFF> key to exit the "Info" menu.

5.8 Calibration

With this menu item you can check the functionality of the sensor.

Press the <Mode> key to call up the menu. Scroll to the "Calibration" sub-menu using the <Mode> key. Open the menu sub-item by pressing the <OK> key. If the measuring cable connection between the bearing plate and the electronic measuring device is correct, **a** value of around 0.0 is displayed.

The value changes by approximately two whole numeric values when the bearing plate is turned upside down (centering cone down).

From the **Type** display, you can obtain information on the current measurement type settings.

5.8.1 Sensor Self-Test

If **a** deviating value is displayed, which does not change even when turned upside down, then there is a fault in the cable, the socket or the sensor. In this case, contact the manufacturer to narrow down the error more precisely.
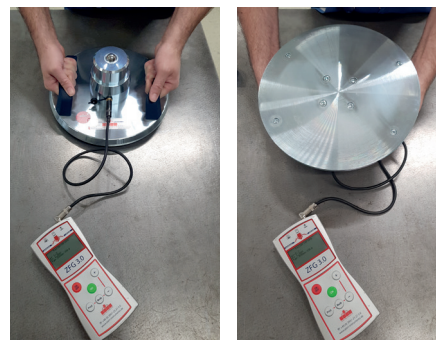
> **i** The calibration factor **F** is set by the manufacturer when calibrating the device.

Calibration

a=0.5
F=0.937
Typ=300mm/10kg

5.9 Showing Map Directory

This function is only available for devices with GPS module. You can use this menu item to display all stored directories. You can also see from the display how much memory is available on the SD card.

In the "Settings" menu, scroll to the "Show card directory" sub-menu using the <Mode> key. Open the sub-menu by pressing the <OK> key.

5.10 Copying Data

With this menu item, you can move internally stored data to the SD card.

In the "Settings" menu, scroll with the <Mode> key to the sub-menu "Copy files". Open the sub-menu by pressing the <OK> key. The number of available data will be displayed. Confirm the copying process with the <OK> key. Exit the menu by pressing the <ON/OFF> key.

> To protect any data already on the SD card, the measurements of the internal memory are copied to a separate directory on the SD card. This is only visible when using the FG software on the PC.

6. Care and Maintenance

Your **ZFG 3.0**, **ZFG 3.1** or **ZFG 3000** is an electro-mechanical precision instrument. To ensure reliability and a long service life, please observe the following instructions:

- After each measurement process, remove any debris, such as soil, sand, clay or dust from the bearing plate with the mounting pin and the loading device with the drop weight using a dry cloth.
- Make sure that the bellows tightly enclose the springs to prevent dust and dirt from entering.
- Remove stubborn dirt with methylated spirits or kerosene. Do not use oils or grease!
- Transport and store the drop weight device protected from shock or impact, dry and with the transport safety lock engaged.
- Remove damp objects (e.g. cleaning rags) from the device and from the transport case.
- Avoid prolonged exposure of the electronic settlement measuring device to sunlight.
- Occasionally check the drop height specified on the calibration record and the calibration plate.

6.1 Changing the Battery (ZFG 3.0, ZFG 3.1)

- Open the battery compartment on the rear of the device by removing both screws (to do this, carefully slide the protective seal downwards).
- Remove the old batteries and replace them with new ones. Instead of the original disposable batteries, rechargeable batteries (4x1.2 V) can also be used. In this case, a slightly lower charge battery status will be displayed.
- When inserting the new batteries, make sure that the polarity is correct. This is marked on the bottom of the battery compartment.
- Close the battery compartment using the screws. Pay attention to the protective seal.

Change the batteries of the electronic meter when:
- the electronic meter displays the "Low Battery" warning,
- the battery symbol indicates an empty battery,
- or when the instrument can no longer be switched on.
- It is recommended to replace the batteries when the charge level is below 50 percent or, in the case of rechargeable batteries, to charge them.

6.2 Rechargeable Battery Packs (ZFG 3000)

In the ZFG **3000**, a 4.8V, 4500mAh battery pack (4x NiMH) supplies the measuring electronics and the printer with power. Good care of the rechargeable battery ensures that the Light Weight Deflecto-meter is always ready for use.

The built-in NiMH battery should only be recharged from time to time with the supplied power supply unit. The charge status can be seen on the charge bar in the display. Depending on the discharge state of the batteries, the charging process is completed after approx. four hours. After a longer period of non-use, the battery must always be recharged to avoid having to interrupt measurements on site due to an empty battery.

6.3 Protection against Deep Discharge (ZFG 3000)

The measuring device is equipped with a deep discharge protection for the battery pack, i.e. in case of deep discharge the battery is switched off. The settlement measuring device can then no longer be switched on. Connecting the charger will recharge the device and it will be ready for use again after approx. four hours.

6.4 Calibration

In accordance with test specification TP BF-StB Part B 8.3, the Light Weight Deflectometer must be calibrated annually (outside Germany, different regulations may apply). Please contact your local ZORN partner for this.

After the calibration period has been exceeded, a corresponding message appears when the device is switched on.

6.5 Calibration Sites

ZORN INSTRUMENTS GmbH & Co. KG
Benzstr. 1 | 39576 Stendal | Germany

Phone: +49 3931 / 25 27 3-0
Fax: +49 3931 / 25 27 3-10

eMail: info@zorn-instruments.com
Web: www.zorn-instruments.com

Further calibration bodies can be found on the website of the Federal Highway Research Institute (BASt): www.bast.de.