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User's manual of the LB -798 hygrometer

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from the firmware version **2R0**
LB79x program version 1.05



¹ *Continuous development of our products sometimes causes need to make changes that are not described in this manual*

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1. 1 Description of the hygrometer

LB -798 materials hygrometer is designed to measure a moisture of bulk materials, especially construction aggregate, for example sand, grain and other materials with a grain diameter up to several millimeters. You can save to the memory the characteristics of the materials of any user (up to 50 characteristics) using the LB79x. Calibration of the meter for the new material may be performed by an User or the LAB- EL lab after delivery of material samples.

The operating principle of hygrometer is based on the measurement of constant of dielectric material by a capacitive method. The measured material should be poured to the container (350 ml capacity), which belongs to the meter equipment. The dielectric constant of a dry material such as sand is about 4, while the dielectric constant of water is 80. Wet sand has intermediate dielectric constant values - on this basis the moisture is calculated. In addition, it is possible to estimate the conductivity of the material and to measure its temperature (using the internal sensor is connected to the lower part of the container).

The hygrometer is not a stand-alone device and the panel LB- 796P (or LB- 796A) is required to read the results of measurements.

The main characteristics set hygrometer LB- 796P + LB -798 are as follows:

- easy to read LCD display, energy-efficient measuring microprocessor
- meter can be calibrated for any material supplied by the user to the lab – the calibration parameters are stored in non-volatile memory of the meter (it is possible to store up to 50 types of materials), you can get the meter calibration certificate for the type of material,
- temperature measurement with a sensor built in the meter for the range of -20...70 °C, it is also possible to measure temperature using the optional external sensor TL-2/796/DB9 which may be connected to the panel LB- 796,
- battery powered,
- measurement of the dielectric constant of the material
- ability to measure the conductivity of the material,
- sound signaling of humidity level after crossing preset humidity threshold
- the hygrometer automatic switch off after 3 minutes of inactivity,
- signaling of the measuring range exceed,
- remembering of the last selected material,
- short circuit signaling of the meter electrodes - this way we obtain an unambiguous measurement of humidity,
- Battery low voltage indication
- auto-zero function when you turn on the meter, it is also possible to reset on request.

1.1 Elements of the hygrometer

Location of elements on the LB- 796P panel, which are accessible for the user, is presented one the Figure 1.

- A - 3.5 digit LCD display,
- B – keyboard,
- C - multifunction socket for connecting:
 - LB-798 hygrometer,
 - external thermometer TL-2/796/DB9,

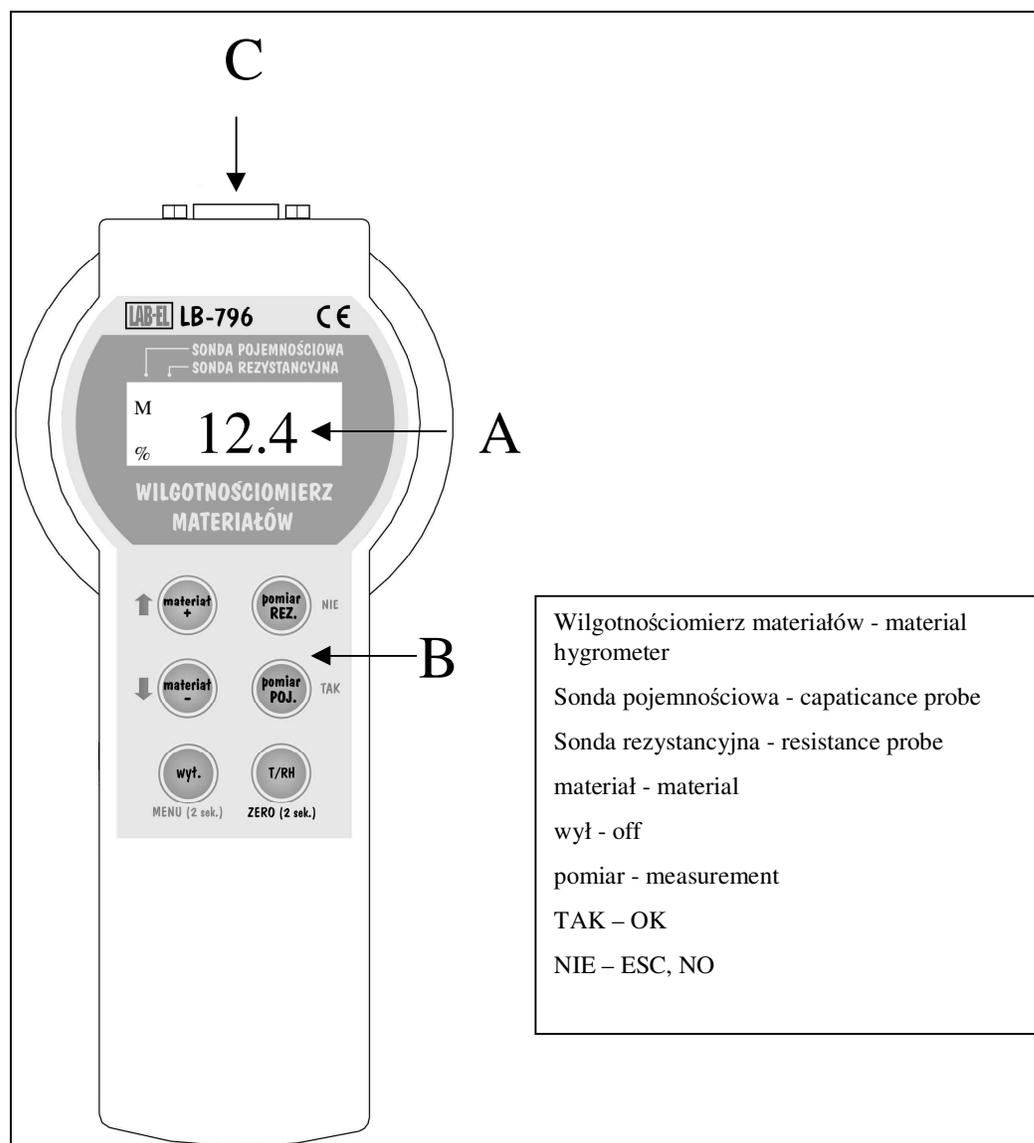


Figure 1 Panel LB-796P – view from the keyboard

From the bottom there is an access to the battery.

The hygrometer set includes:

- LB -798 hygrometer + LB- 796P reading panel (or LB- 796A)
- communication cable LB- 79xRS with power supply - optional with the LB79x calibration software,
- the converter LB-376c – optionally together with a calibration program LB79x.

1.2 Performance of the measurement – short description

This chapter presents a short description of the material moisture measurement, the conductivity of the material and the temperature of the material. More details regarding operation of the meter is presented in the Chapter 2, you should be aware of them.

To measure the moisture content one should perform the following activities:

- connect hygrometer LB-798 and LB- reading panel 796 (to the socket labeled C in Figure 1), attached to the socket with the screws included in the plug probe,
- pour the material into a container **to full** (see chapter "*Method for filling a container with material*"),
- wait for the stabilization of temperature, if the material has a different temperature than the hygrometer,
- press any button to turn the meter on except the "wyl" (off) button. – wait for the appearance of the "798" inscription and press the "Pomiar POJ" (moisture measurement) button,
- the display will show the "CAL" inscription, which indicates auto-zeroing of the meter and then the symbol of recently selected material, the symbol  shown on the screen will inform, that the moisture measurement mode is on.
- choose the right material by pressing the "material+ or material-" (material), you will see its three-character code, a list of materials stored in the meter and the corresponding codes can be found in an **additional annex** to the manual,
- Press the "Pomiar POJ" button again – the character % with the measurement of humidity will be displayed on the screen,
- If the measurement result is blinking, it means exceeding the measuring range,
- when you press the "Pomiar REZ." (resistance measurement) button, the conductivity of the material will be displayed in mS / m (miliSimens / meter) - about the resistance measurement activity will inform you the symbol  on the screen,
- after pressing the T/RH the temperature of the material will be displayed, the activity mode is indicated by temperature symbol °C.

2. Operation of the hygrometer

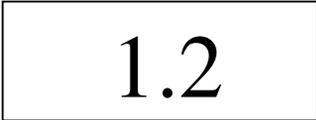
2.1 Switching on and off

Before switching on, the device must be connected to reading panel LB- 796 and LB -798 probe (socket labeled as C in Figure 1).

Turning the panel on may be done with any button other than the "wyl" (off) button, which is for the switching off. After you turn the display moisture meter on, for a moment internal firmware version of panel LB- 796 will display with a single letter version of the meter, for example:

2.2P

and then the firmware version of the connected probe will be shown, for example:

1.2

and after a moment the symbol of connected probe:

798

During displaying of these inscriptions, there is carried out initial testing of the instrument. The meter is equipped with **auto off function** – it activates after 3 minutes after the last pressing of any key on the keyboard, and when the result of the humidity measurement has not changed in that time by more than 10% of the measuring range (auto off will switch off after 10 minutes regardless of this condition). If the hygrometer does not react for attempt to switch off with the keyboard, remove the batteries and re-insert them back.

2.2 Description of the keyboard

The reading panel LB-796 is equipped with a 6- button keypad. There are two modes of operation:

- measurement mode - button functions are described in black,
- menu mode - button functions are described in blue (see *Menu Mode*).

In the measurement mode buttons have the following meanings:

- Pomiar POJ. - Starts measuring humidity
- Pomiar REZ. - Starts measuring the conductivity,
- T/RH - starts measuring temperature,
- materiał+ - material selection (scroll forward by one material)
- materiał- - material selection (scroll back by one material)
- wł. (off) - turns off the device.

2.3 Menu mode

From version 2.0 software, the meter is equipped with a 6 press button keyboard with the menu mode. Button functions in the menu mode are marked **in blue**:

- MENU (2 sec.) - to start the menu mode, you may press it and hold for 2 seconds until the menu mode starts, release of the button earlier than 2 seconds will turn off the meter (the function of this button is shared with a button, which turns off the meter).
- ↑ up arrow is used to select menu options or to set various parameters in the menu (increasing parameter)
- ↓ down arrow is used to select menu options, or to set various parameters in the menu (decreasing parameter)
- TAK (YES) - enter the selected menu item or approval of an adjustable parameter in menu,
- NIE (NO) - exit from the menu (or go up one level in the menu).

2.3.1 Menu options

- **bu** - threshold activation for audible signals

- **Pro** - calibration mode, selecting this mode will input in calibration mode (you cannot exit this mode by pressing the "NIE" (NO) button - you have to turn off the meter).
- **nr** - (no) displays serial number of probe LB -798.

2.4 Measurement of humidity and conductivity of the material

2.4.1 Measurement of material moisture

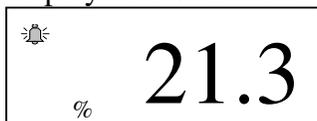
Material moisture measurement should be carried out as follows:

- connect hygrometer LB -798 and LB- reading panel 796 (to the socket labeled C in Figure 1), attached to the socket with the screws included in the plug probe,
- pour the material into a container **to full** (see chapter "*Method for filling a container with material*"),
- wait for the stabilization of temperature, if the material has a different temperature than the hygrometer,
- after turning the hygrometer display, when the 798 inscription shows, press "Pomiar POJ" button - the display will read after a moment:

A rectangular display box with a black border. Inside, the word "CAL" is written in a large, bold, black serif font, centered horizontally and vertically.

indicating the auto-zeroing of capacitance probe (**at the time do not touch the probe electrode**) and the symbol for the last selected material will show. The displayed symbol , informs that an activity of humidity measurement mode is on.

- by pressing the "material+" button or "material+" button - select the material code, which moisture has to be measured. This code will show up on the display. The list of available materials and corresponding codes may be found in **an additional annex** to the manual,
- Press the "Pomiar POJ" button again - the character % will show on the display with some humidity measurement result (lower measurement range),

A rectangular display box with a black border. In the top left corner, there is a small bell icon. Below it, the character "%" is displayed. To the right of the bell icon, the number "21.3" is shown in a large, bold, black serif font.

- If the measurement result is blinking, it means exceeding the measuring range,
- when the display shows alternately with the measurement of humidity message like this:

A rectangular display box with a black border. In the top left corner, there is a small bell icon. Below it, the character "%" is displayed. To the right of the bell icon, the text "ErL" is shown in a large, bold, black serif font.

this means that the probe electrodes short circuit (too high a conductivity of the material caused by salinity). The measurement result may be incorrect.

- during the measurement of the moisture flashes °C, this means that the active temperature compensation for material moisture is on.

- it is possible to set the moisture threshold, from which the system beeps (see chapter *Sound signal of the moisture level*).

2.4.2 Conductivity measurement of the material

Conductivity measurement of the material should be carried out as follows:

- connect hygrometer LB -798 and LB- reading panel 796 (to the socket labeled C in Figure 1), attached to the socket with the screws included in the plug probe,
- pour the material into a container **to full** (see chapter *"Method for filling a container with material"*),
- wait for the stabilization of temperature, if the material has a different temperature than the hygrometer,
- after turning the hygrometer on, when the display will show **798** inscription press Pomiar REZ button. - the display will read for a moment:

A rectangular display box with a white background and a black border. The word "CAL" is centered in a large, bold, black serif font.

indicating the auto-zeroing capacitance probe (**do not touch at the time the probe electrode**) and then some conductivity measurement result in mS / m (miliSimens / meter) will display,

A rectangular display box with a white background and a black border. In the top left corner, there is a small square icon containing the letter "M". To the right of this icon, the number "6.2" is displayed in a large, bold, black serif font.

- when the display shows alternately with the measurement of conductivity message like this:

A rectangular display box with a white background and a black border. In the top left corner, there is a small bell icon. Below it, the text "ErL" is displayed in a large, bold, black serif font. At the bottom left corner, there is a small percentage symbol "%".

this means that the probe electrodes short circuit (too high a conductivity of the material caused by salinity).

- conductivity of the material should not be confused with the conductivity of water in the material.

2.4.3 A method for filling a container with material

The method of electrodes placing in the material has a **decisive influence** on the accuracy of the measurement of humidity and conductivity of the material. First of all, **the container must be filled to full**, to obtain the correct measurement result. There are two ways to pour material to the container:

- with manual compaction of the material,
- without compaction.

It is important that the material does not create air bubbles that cause a downward deviation of the measurement result. For construction aggregates measurement, it is necessary to feed the container with a tablespoon, by layers at about 2cm, compacting aggregate at every layer (with a spoon). For other materials, the material should be filled with gradual manual compacting, unless the material is in the form of defined

pellets and does not form air bubbles - in this situation the material may be poured without compacting (for example for grains). Material compacting should be applied for the following materials: **sand, construction aggregates, sand, slag, soil, coal dust, fine coal, copper sulphate.**

Additional information during the measurement:

- the humidity measurement (conductivity) to select the sample of the material for the measurement to be hygro representative of the entire sample, or need to do some measurements and average (mix the measured material)
- after the measurement, clean and wash the container
- metal elements contained in the material increase the result.

2.5 Measurement of the material temperature

A thermistor temperature sensor is placed in the bottom of the container.

Measurement of the material temperature should be carried out as follows:

- connect hygrometer LB -798 and reading panel LB- 796 (to the socket labeled C in Figure 1), attached to the socket with the screws included in the plug probe,
- pour the material into a container,
- if the material has a different temperature than the hygrometer, wait for stabilization of temperature,
- After turning the display shows 798. Press T/TH - display will briefly read:

A rectangular display box with a black border containing the text "CAL" in a large, bold, serif font.

indicating the auto-zeroing capacitance probe (do not touch at the time the probe electrode) and then displays the symbol °C and temperature measurement results such as:

A rectangular display box with a black border. On the left side, there is a small "°C" symbol. To its right, the number "23.4" is displayed in a large, bold, serif font.

- If the measurement result is blinking, it means exceeding the measuring range.

2.6 Audible signal level of humidity

The meter can be set for the humidity threshold alarm sounds. The default threshold is 50 %, if you need a different threshold, it can be set in the range 0..199.5 % in increments of 0.5 % in the following way:

- start the menu mode and select the **bu** menu option,
- confirm the setting with "TAK" (YES) button, the display shows the currently set threshold humidity, by which the sound signal is activated,
- Now you can change the threshold value by using the arrow keys ↑ ↓,
- after setting the appropriate threshold it should be confirmed by pressing YES button, the approval will be signaled acoustically and you exit to the one level above,
- you exit the menu mode by using the **NIE** (NO) button,

- You can check by hand approach to the probe electrode whether a beep is generated when the threshold is exceeded.

2.7 Calibration of the meter for new materials

In the case of measurement of humidity of materials, which are not contained in the list of materials in an additional annex, the interpretation of the result depends on the user. The relations between the measurements are preserved, i.e. if one sample of the material indicated reading is less than the result shown on the second sample (of the same type of material), the first sample is more dry than the other.

To properly calibrate the moisture meter to indicate the result of such a mass % moisture you should provide material samples to the laboratory LAB-EL (or information on how to prepare the material) in order to calibrate the meter for the new material. Guidelines for the preparation of specimens are as follows:

- sample of the material should have a maximum expected moisture (if you can not soak the material and the water content in the material due to manufacturing processes), and should be enclosed in a sealed package,
- in the case of materials that can be soaked in, a sample should be absolutely dry state, also should be sealed,
- the amount of material approximately 1.5dm³

Calibration of the meter for the new material can also be performed by the User. You need for this the **LB79x** calibration program and appropriate instrumentation (scales, drier) or have another standard meter to measure the moisture content of the material.

The following part describes how to calibrate the probe LB-798 in order to adapt it to measure the humidity of new materials and the procedure for writing to the memory the characteristics of the materials by means of the LB79x. Prior to calibration, refer to the operating instructions describing the measurement of moisture in order to properly perform calibration measurements.

2.7.1 Entering the calibration mode

Entering the calibration is done by selecting the appropriate menu option (see Menu Mode). Therefore it is necessary:

- run mode menu and select the menu option **Pro**
- press the "TAK" (YES) button to confirm the selection, you will go to the calibration mode,
- calibration mode is indicated by the sign  blinking,
- when the meter is in calibration mode press T/RH to start temperature measurement,
- exit the calibration mode is performed **only** by pressing the "wył" (off) hygrometer button.

In the calibration mode, the display shows the value of the parameter that will be measured during the calibration measurements. This parameter should be interpreted as a square root of the dielectric constant of material (referred to as **sqrteps**), *the measurement should be made in compliance with the all guidelines, which are*

submitted for the moisture measurement (especially filling a container with material).

2.7.2 Performance of calibration measurements

Meter calibration for the new material is based on performance of the parameter measurement with the LB-798 meter (in the calibration mode) and the measurement of moisture material with the other device, which is considered by the User as a model device (for example by the drying-weighing method according to the *PN-EN ISO 12570 standard* – for construction materials and products, PN-ISO 11465 or PN-ISO 11461 for soil, or with any other standard meter) for at least two different moisture material measurements, which would create a measurement range. Ideally, the humidity measured values are separated, i.e. once the material, which is considered to be almost dry, is measured, then we measure the material, which is considered as a wet one. The calibration results consists of a table with moisture material values and material parameter values, as it is presented in the Table 1.

Humidity [%]	SqrtEps
0	2.32
10.8	3.42
18.1	4.03
25.3	4.84
33.6	5.45

Table 1 Sample calibration table for the new material

The greater the number of measurement points, the better the later accuracy. The calibration should be performed for the material temperature as close as possible to 20 degrees because of the correctness of automatic temperature compensation.

The measurement of parameter with averaging is recommended, i.e. for a specific material moisture the several measurements should be performed and the average calculated.

If measurements are made using **drying-weighing method**, the best way would be to dry material completely (0 % humidity) to measure the value of the parameter sqtreps for dry material (the first calibration point) and then gradually add water while stirring the material - this way new calibration points will be created up to full saturation of the material with water.

2.7.3 Processing of measurement results

After the calibration measurements there should be drawn characteristics of the material i.e. the function of humidity (parameter), for example in Excel. This function should be increasing. In general, the large part of it should be a straight line, with the curvature on the endings for the measuring ranges (for small and large humidities) may be higher. The shape should be visually assessed and, for example, the measures, which indicate their error during measurement, rejected (or if the data points are more than 15). You may calculate the approximating function by, for example, polynomials and with its help generate points evenly to write to the device. An extrapolation of characteristics is acceptable when at the end of the range there is a clear saturation

(fold of the line) but during the extrapolation, it should be taken into account that the range of the parameter is approximately:

- **sqrteps - 1.0...10.0** - when parameter increases, the humidity increases too. In general extrapolation (extending beyond the measured characteristics of humidity) should be made so that the end of the measuring range for the characteristic values would be equal to the characteristic values, for example, for 100 % humidity.

2.7.4 Entering the characteristics of the material to the meter memory – operation of the LB79x software

Using the LB79x calibration software enter the characteristics of the material to the memory of the meter. To do this, perform the following steps while **maintaining the specified order**:

- install the LB79x software (if it was not already installed)
 - run the software installer located on the CD, which is supplied with the device a and sequentially perform the installer instructions,
 - if the installation program started automatically, turn it off.
- LB -798 connection to the computer (the LB79x software should be off):
 - when the **LB- 79xRS communication cable** is included to the set - connect the cable to the LB-798 probe, on the other side of the computer (COM port), turn on the power supply to the grid,
 - when the **LB- 376c converter** is included to the set – connect the converter to the meter LB-798 on the other side of the computer (USB port) using the USB cable that is supplied with the converter set,
 - after connection of the LB-376c to the computer, the operating system should detect and automatically install the appropriate drivers for the converter – the correct operation of the LB-376c converter will be indicated by a **red LED (PWR) on**,
 - if for some reason the system does not recognize the correct converter LB-376c, the proper driver should be installed manually. The driver is located in the USB directory of LB79x software (typically this is C:\ Program Files \ LB79x \ USB). To do this, use the Windows Device Manager to find improperly installed the USB device and update the driver by indicating the position previously described.
 - the above described configuration of LB-376c converter should be done only once on the first use - every the next connection of the converter (to the same USB port) should be automatically detected by the operating system without any messages from of the operating system.
- start the LB79x software and select:
 - COM port number (menu *Settings- serial port*), to which the meter will be connected to,
 - for the LB- 376c converter the port will be named (*USB Serial Port*)

- the LB79x program stores the original settings of the port and if the device is connected to the same port as before, you may skip this step.
- in the window of the LB79x program the temperature display should show up - it proves the correctness of communication processes. When working with LB79x do not disconnect the LB-798 probe from the computer - it may lead to the loss of materials characteristics, which are recorded in the meter. The meter can be disconnected from the computer after turning off the LB79x program .

From the Panel menu, select the submenu "*Charakterystyki Materiałów*"(Characteristics of Materials), all the characteristics of the material will be read, you should select a free characteristics record by a double clicking and fill the following fields of the characteristics record:

- activate the characteristics record (mark an appropriate box),
- select **the appropriate method of measurement** - capacitance,
- activate (or not) **temperature compensation** - it is recommended to activate the compensation, especially when the water volume is more than 10 % of the sample material,
- enter a three characters **material code**, the shown digits are 0...9, letters: **A, B, C, D, E, F, G, H, I, L, N, O, P, R, T, U, U, Y, V, J, a space**, when other letter is used the minus sign will be displayed; **unacceptable codes: Er0...Er9 bat OFF, ERL, CAL**. The code will be **displayed** on the meter. If possible, the code should be associated with the type of material such as sand (in Polish - piasek) - PIA etc..
- ten characters of **material name** – enter the name of the material such as sand, etc.
- **number of active points** – enter how many points are active in the characteristics (2...15)
- **characteristic points** - enter calibration points, the maximum number of points pairs is 15, the first and last point mark the end of the measuring range - it will be indicated by flashing a result of the measurement, using the "*wykres*" (chart) button you can see how the characteristics looks visually and whether the points are entered correctly,
- **calibration certificate number** - does not apply, you can type any indication,
- **date of the characteristic creation** - date when the characteristic has been created,
- **the date of characteristic entering** - the date when the characteristic was written to the device,
- **temperature compensation coefficients** - if temperature compensation is activated, you should enter the coefficients values: $d = 1, a = b = c = 0$,
- **description of the material** - 40 characters, you can briefly describe the material.

After entering the characteristics to the meter, you should record characteristics on the disk with the "*eksportuj*" (export) command, this way you can easily restore the recorded characteristic in case of system failure by (using the "*importuj*" (import) command).

2.7.4.1 Authorization keys.

For each copy of LB -798 there is assigned an authorization key provided by the manufacturer, together with the LB79x program (on request). The key is related to the type of device and its serial number. The keys are stored in the directory: KEYS of the LB79x program (for example C:\Program Files\LB79x\KEYS). If the user does not have an authorization key for his/her LB79x meter, the program only will operate in a demo mode (you cannot make setting characteristics, etc.). File with the appropriate key should be copied to the KEYS directory (to read the key you should turn off and turn on the LB79x program). When selecting in the window of LB79x program select "*Ustawienia→Klucze Autoryzacyjne*" (Settings → Key Certificate Authority), you can read the current key.

2.7.5 Checking the meter readings for the new material

After entering the characteristics to the memory of the meter it is recommended to perform test measurements. The measurements should be performed in the measurement mode, after you press "material+" or "material-" (material) to select an appropriate material code that has been assigned to the new material. The measurement conditions should be identical as in the calibration process, for example a similar manner filling container with material. The effect of test display is the humidity table, which is calculated by reference or humidity method measured with the LB -798 meter.

Standard Humidity [%]	Humidity LB-798[%]
6,3	6,2
11,8	12,0
18,9	19,2
29,9	29,4
42,8	42,3

Table 2 Example table of the values obtained from the validation of the LB -798 meter indications after calibration

2.8 Measurement of the dielectric constant of the material

To measure the dielectric constant of the material you have to enter the calibration mode (Chapter *Calibration meter for new materials*) and perform measurement as if the moisture in the material is measured. In the calibration mode, the meter shows the square root of the dielectric constant of the material, to obtain the dielectric constant you square increase the measured parameter, or press and **hold** the "Pomiar POJ." button - then the display shows the dielectric constant of the material.

Another way to measure the dielectric constant of the material is to save to the device characteristics of the material type 1:1 (two pairs of points are sufficient humidity - parameter (0,0), (10,10), **do not activate the temperature compensation !**). After creating the characteristic measurement parameter *sqrtsteps* (square root of the dielectric constant of the material) we select the appropriate code by pressing *material+* or *material-* button for the assigned to *sqrtsteps*. This way you will not need to enter the calibration mode to measure the dielectric constant of the material.

2.9 Displaying an additional information

This section describes additional messages, which are displayed on the meter.

2.9.1 Battery low voltage indication

The indication of the battery low voltage is consists of two threshold:

- flashing sign  - poor battery but it is possible to make the measurements, it is a signal to buy a new battery,
- continuous illumination of the sign  and the inscription shown on the display:



indicates that the battery should be replaced.

2.9.2 Signaling excess of the measuring range

Exceeding the measuring range (bottom and top), for both humidity and temperature, is indicated by the **flashing** of the measurement result. In special cases, the flashing of the measurement result may indicate damage to the meter. In the case of measuring conductivity there is not signaling the range - it is only a short electrodes signal - ERL.

2.9.3 Signaling an electrodes short circuit

If during the measurement of humidity or conductivity on the display alternately with the result of humidity shows the message:



this means that the probe electrodes are shorted (too high a conductivity of the material caused by salinity). Then the measurement of humidity is significantly erroneous and its interpretation should be performed with caution. **Note:** This message may mean an erroneous reset of the meter (especially when it is displayed and the container is empty), so you should try to reset to zero the meter as instructed. (see the Chapter *The sonde zeroing*)

2.9.4 Displaying the serial number

Entering displaying the serial number is done by selecting the appropriate menu option (see *Menu Mode*). The menu item is named "nr" (number) may be used to

display the serial number. Please confirm the menu selection with the "TAK" (yes) button, then the serial number will be displayed. The menu is left by using the "NIE" (NO) button.

2.9.5 Signaling the automatic temperature compensation

Automatic temperature compensation is indicated by a flashing sign ° C.

2.9.6 Signaling the operation mode of LB- 796 as a reading panel

When LB- 796 works as a reading panel there is **flashing colon ":"** on the display. **Then all measurements, which are displayed are related to the probe, not to the LB- 796 panel, which also has its own measuring functions. Their starting is similar to the LB -798.**

2.9.7 Other messages

- When you turn off the meter the following message displays briefly:

OFF

which means that after a while the meter will switch off. If it does not switch off you have to turn the device off by pressing the "wył" (off) button.

- After switching the capacitive method on, the message appears after several

CAL

seconds:

which means the automatic zeroing of the probe (you should not touch the electrode probe at that moment).

- If after you turn on the meter or during its operation the meter displays the message:

Er_x

where $x = 0, 1, 2, 3$ or 7 , it means, that this is the time to deliver the meter for the service. When $x = 2$ - you can try to hold the "material+" button for about 10 seconds till the sign '---' shows up and wait a few seconds after that. If you still see the Er₂ message you should be deliver the meter to the service. When the message OFF shows up, you should turn off and turn on the meter.

- message:

 **Er₄**

indicates that there is not stored in the meter any material characteristic.

- message:



means that there is not stored in the meter any characteristics of the material in the resistive method - the message is related to the LB- 796 panel.

- message:



indicates a communication error between the LB- 796 and LB -798 probe. Generally, this error occurs if you disconnect the probe and the panel LB- 796 during measurements.

- message:



means that the reset has not been properly carried out. You should turn off the meter and try to reset again.

2.10 Validation hygrometer readings

- Validation of meter readings should be made in calibration mode, so you should enter this mode (see the *Chapter Meter calibration for new materials*). The hygrometer, if the container are dry and clean, should indicate the parameter value 1.00 ± 0.2 , otherwise you should reset the probe. After filled with water (if possible use distilled water) the hygrometer should indicate the sqrsteps parameter value equal to 9.0 ± 0.3 for water at 20 °C..

2.10.1 Resetting the probe to zero

To reset the probe to zero:

- complete empty and dry the container
- activate the temperature measurement mode with the T/TH button (above the button there is the inscription **ZERO (2sek.)**). Then hold the button for about two seconds, and after a few seconds a sign will show up on the display:



and the meter returns to the temperature measurement, this means the end of reset to zero. During the zeroing **you may not touch the container internal electrode**. Resetting to zero should be carried out every few weeks after validation of the readings.

2.11 Notes on use

1. In the case of longer periods of the device inactivity, it is recommended to remove the battery from the LB- 796 panel in order to avoid pouring out of the electrolyte.
2. It is recommended to use good quality batteries (alkaline, lithium).

3. You should not unplug the LB- 796 panel during device operation. Before the battery removal the keyboard should be switched off.
4. Do not allow water to splash on the LB- 796 panel or dew to condensate on it.
5. Protect your hygrometer against exposure to strong sunlight, which can lead to overheating of the device.
6. The hygrometer does not require maintenance.

3. Measurement Specifications

This chapter presents the measurement specifications of the instrument for measuring temperature, humidity and conductivity. Measuring range of materials available in the meter is shown on the additional annex to this manual.

The hygrometer tends to show a mass humidity, which is defined as follows:

$$w[\%] = \frac{\text{water mass contained in the material}}{\text{mass of the absolutely dry material}} \cdot 100$$

If humidity is defined otherwise, it is indicated in the additional annex to the manual (kg / kg - mass moisture, m³/m³ - volume moisture). It is possible to scale the meter to indicate the humidity defined in other method.

PERFORMANCE DATA FOR MATERIAL MOISTURE	
Measuring range	depending on the type of material (shown in the table with a list of materials)
Resolution of measurement	0.1%
Uncertainty of measurement	3% of measured value
PERFORMANCE DATA FOR MATERIAL CONDUCTIVITY	
Measuring range	0...100mS/m
Resolution of measurement	0.1 mS / m
Uncertainty of measurement	10 % of measured value
PERFORMANCE DATA FOR TEMPERATURE	
Measuring range	-20..70 °C
Resolution of measurement	0.1 °C
Uncertainty of measurement	± 0.2 °C
POWER SUPPLY	
Battery	1 battery 9V type 6F22
Other	When communicating with a computer, the meter is powered by the computer
Power consumption	5 mA - temperature measurement
	13...18 mA mA - measurement of humidity and conductivity
OPERATING TEMPERATURE RANGE	
Device	Range

LB-798	0..+50°C
LB-376C	-20..+50°C
OTHER PARAMETERS	
LB-798 dimensions	125x80x140mm
LB-376C dimensions	56x31x24mm
density of LB -798 housing	IP67 - not applicable for probe plug
density of housing LB- 376c	IP30
Container material	stainless steel
Standard cable length	1 meter
Container capacity	350ml