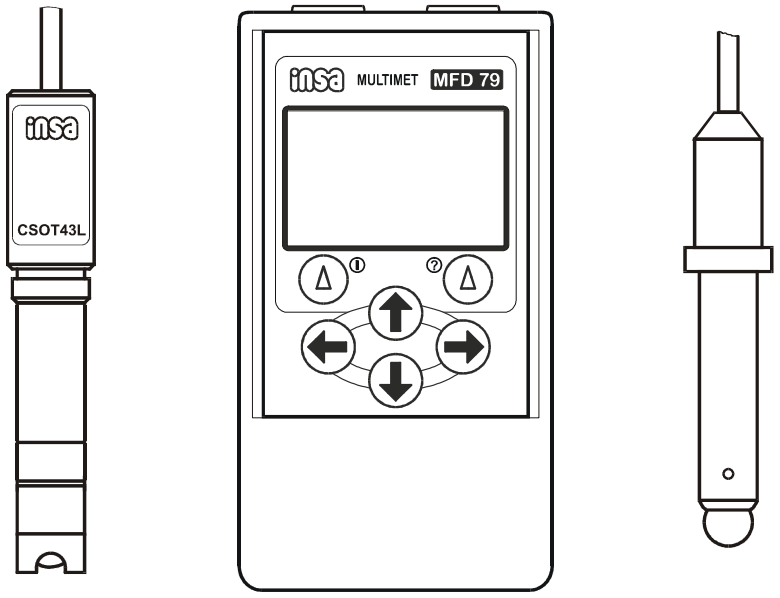
MULTI-PARAMETER METER

MFD 79



Operating and maintenance instruction manual

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▪ EXPLANATORY NOTES

In this manual, following signs are used:

Ignoring of this warning can lead to a damage of instrument or to a wrong measuring (control).

Ignoring of this warning can lead to an irreversible damage of instrument, of technological equipment or to a health jeopardy.

Information, how to dispose of waste

1. RANGE OF APPLICATION

The Multiparameter meter MFD 79 enables measuring of pH-value, ORP value, oxygen concentration and temperature in the laboratory, in technological plants as well as in the field.

For the measuring of pH SEOJ 11PV/G-S or SEOJ 19 PV/G-S (pH electrode with temperature sensor) electrodes can be used, for ORP measurement PtEJ 12PV/G-S sensor. For the measuring of oxygen concentration, the sensors CSOT 43LZS must be used. The part of the oxygen sensor CSOT 43LZS is also a temperature sensor (-4,0 to 50,0°C). As long as we measure the oxygen concentration and the temperature, only, no other sensor is necessary. The temperature, measured by the thermistor of the oxygen sensor, can also be used for the correction of the temperature dependence of the pH electrode.

The instrument is equipped with a memory block for storing of approximately 770 measured values.

For display of measured values and for communication with the operator, graphic display LCD is installed.

The instrument is powered either from two AA batteries or rechargeable batteries.

▪ 2. DELIVERY SIZE

The delivery consists of the meter MFD 79 with oxygen sensor with spare membrane head and electrolyte (except of version E).

Parts of the delivery are further:

- Operation and maintenance manual (CD) 1 pc
- Short form of operation and maintenance manual 1 pc
- AA batteries 2 pc
- Membrane head MH 11 O2L 1 pc
- Electrolyte ES 43 O2, 20 ml 1 pc

Optional accessories:

- Transport case TB 04

Sensors:

- Oxygen and temperature measuring sensor CSOT 43LZS - sensor with thread, convenient for field measuring
- pH electrode SEOJ 11PV/G-S
- pH electrode SEOJ 19PV/G-S (pH electrode with temperature sensor)
- ORP sensor PtEJ 12PV/G-S

Spare parts

- Membrane Head MH 11 O2L
- Electrolyte ES 43 O2
- pH/ORP electrode transport case
- pH/ORP electrode protective case
- Sealing Φ8x2

▪ 3. SAFETY PRECAUTIONS

The MFD 79 meter was fabricated and tested according to ČSN EN 610 10.

For a safe operation of the instrument, use only the recommended sensors and observe following instructions:

Use only the original net adapter delivered with your meter. Otherwise, you may risk a damage of the instrument or electrical accident to persons. Keep the connecting cable of the net adapter clean and undamaged. Avoid its damage by aggressive agents, high temperature or mechanical effects.

The instrument contains batteries. Exhausted batteries remove from instrument and liquidate by prescribed way.

The instrument must not be used for other reasons then those, it was manufactured for.

The instrument must not be voluntarily modified.

Any repairs of the instrument only a workplace, authorized by the manufacturer, may perform.

The instrument must not be operated in environments, which do not guarantee a safe operation, e.g. in a hazardous area containing vapours of inflammable liquids or a flammable dust.

The instrument must not be exposed to a temperature higher than 50°C. At higher temperatures, the damage of batteries and consequently even an irreversible damage of the whole instrument is imminent!

If the user wouldn't respect some of the above mentioned warnings and if in a casual connection with this a damage would occur, the manufacturers liability is excluded.

- **Certification**

The company imsa s.r.o. confirms, that this instrument was thoroughly fully tested and was in accordance with all specifications, mentioned in this manual, when dispatched from the factory.
The meter **MFD 79** was tested according to following standards:
ČSN EN 61010, ČSN EN 25814, ČSN EN 61187, ČSN EN 61010-1, EN 50082-1, light industry category, ČSN 55011-1, light industry category

▪ 4. INSTRUCTIONS FOR PUTTING INTO OPERATION

4.1 INSTALLATION OF BATTERY

The instrument is powered from two AA batteries or rechargeable batteries. Batteries are fitted in the lower rare part of the casing. We insert batteries by taking off the lid of the battery space (secured by a screw), and putting batteries in proper polarity in. Be sure that lid is fixed correct and tight.

Lifetime of batteries is approx. 1 000 hours (without backlight). Lifetime of rechargeable batteries is shorter. **Backlight on reduces lifetime considerably.**

4.2. ARRANGEMENT OF CONTROL ELEMENTS

For communication with the operator, the instrument is equipped with six keys. Their arrangement shows fig. 1.

Functions of the keys are as follows:

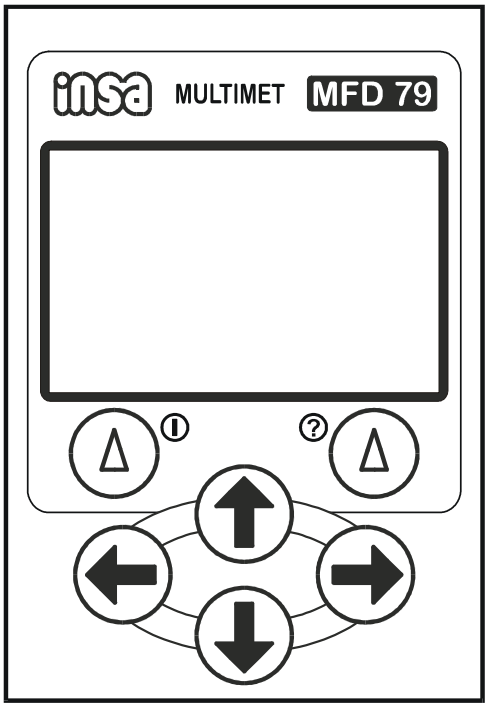

Fig. 1. Control elements of the MFD 79 meter

By pressing the key ① we execute the function marked on the display above this key - - MENU, BACK, CANCEL, etc. With long pressing (through a few seconds) we turn instrument on and off. We **turn the instrument off always from the mode measuring** (display shows measured values).
By pressing the key ② we execute again the function marked on the display above this key - CALIBRATE, OK, SAVE, LIGHT ON etc. With long pressing of this key in - any mode - we raise function help to this mode.

Function of the keys ⮌, ⮍, ⮏ and ⮊ in main mode is shown on the instrument display – using these keys we choose basic modes of the instrument. In other modes by means of the keys ⮌ a ⮊ we shift selections to the left and right (with the keys ⮍, ⮏ up and down) and/or we make constants (numbers) greater, smaller.

In the mode **Measuring** we can go by pressing ⮌ key directly to the mode calibration and with ⮊ key to recording mode.

If the instrument is not in the mode measuring for time longer than 10 minutes and no key was activated, then it goes automatically to mode measuring. As long as of any reason it is not desirable, pressing of any key is necessary before elapsing of waiting time.

4.3. CONFIGURATION – SENSOR SELECTION, DISPLAY OF MEASURED VARIABLES

During the configuration, we determine, which variable is to be measured and on which line of the display to be shown. We have six lines at disposal and on every line can choose any variable or we can leave certain line empty. During the measurement we can roll, by the help of ⮍ and ⮏ keys, among single lines – measured variables. If we choose ------ in certain line, this line remains empty and will not be displayed.
With long pressing (through a few seconds) of left upper key we turn instrument on.

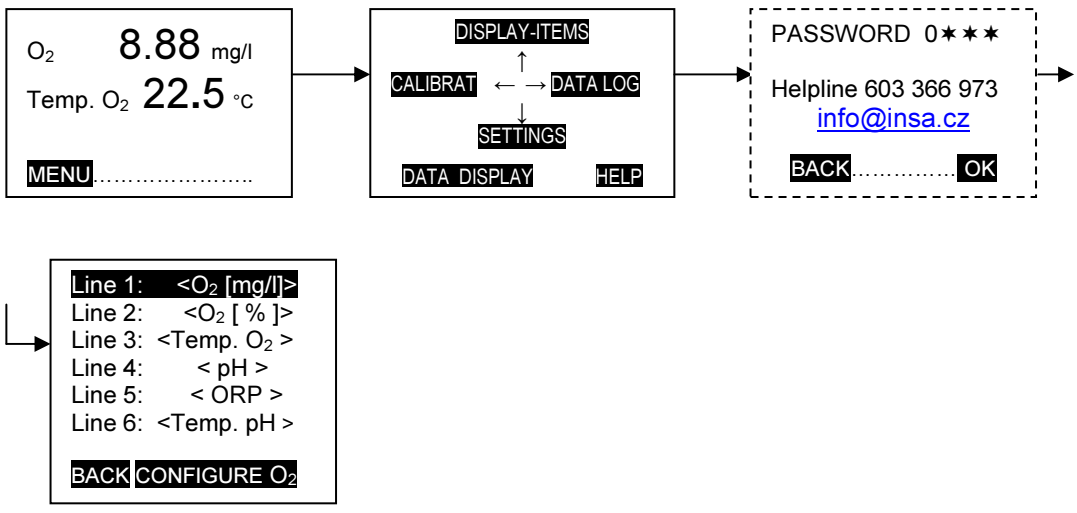

Fig. 2. Configuration – sensor selection

After implementation of the entry diagnostics, the instrument changes to the measuring mode. We push the key ⓐ again, this time shortly, and the main menu appears on the display. With ↑ key we go to **DISPLAY - ITEMS** mode (Fig. 2) and on the following display we have an overview of factory adjusted measured variables. With ↑ and ↓ keys we choose single lines (selected line is displayed in inverse mode) and with ← and → keys select required variable that will be displayed on this line.

We can choose from following variables – oxygen concentration in mg/l **<O_2 [mg/l >**, oxygen saturation in % **<O_2 [%] >**, pH, ORP, temperature measured with oxygen sensor **<Temp. O_2>** and temperature measured with pH sensor **<Temp. pH >**. If we select **------**, the relevant line remains empty. Selection of measured and displayed variables is unrestricted. We can select, e.g, one variable only. We will have on the upper line measured variable and lower one remains empty. If we choose three and more lines, we can during measurement, by the help of ↑ and ↓ keys, move lines up and down. It is useful place empty lines to bottom positions – these lines will not be displayed and will not disturb display.

If we measure oxygen, we may select the measuring either in mg/l or % or both of them simultaneously. There is possible to correct measured value of oxygen according current value of barometric pressure after opening **CONFIGURE O_2**.

After selection of pH, the menu of buffer solutions follows, which the instrument will offer at each calibration and also temperature compensation mode. If we open **CONFIGURE pH** we may store the values of our own solutions – the instrument will offer us a certain solution, the value of which we may change, arbitrarily, by pushing the ←, → keys. If we leave pH buffers values unchanged**,** the instrument will offer us the buffers acc. IEC PUB. 746.2 – 4.01, 6.87 and 9.18 (25°C), at every calibration.

After opening **Compensation** mode we can (by the help of ←, → keys) either switch off temperature compensation (**<Off>)** or compensation switch on and select temperature sensor from which the compensation will be deduced (**<T – O_2>** – oxygen sensor, **<T – pH >** temperature sensor of pH electrode), and this sensor must be connected to the instrument, of course

Configuration - pH measurement

Compensation	**<Off>**
Solution“4“	**<4,01>**
Solution“7“	**<6,87>**
Solution“9“	**<9,18>**
BACK	

Fig. 3. Configuration – pH measurement

4.4. CONNECTING OF SENSORS

The sensors are to be connected to the instrument as shown in the fig. 4.

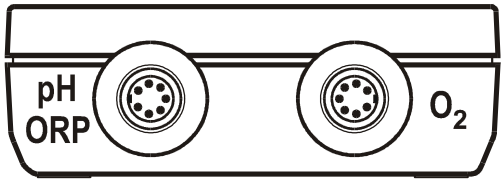

Fig. 4. Connection of sensors to the meter MFD 79

We prepare the pH and ORP sensors for measuring so, that we immerse them into a potable water or a buffer 6,87 (7,00), for one to two hours when delivered dry. Electrodes delivered in transport case with solution of KCl, c = 3 mol/l, are prepared for immediate measurement.

4.4.1 Oxygen sensor preparation – membrane head exchange

When putting the sensor into operation or replacing the worn off membrane, observe following procedure:

1. Screw off the membrane head.
Due to the risk of damage, be sure that the membrane head does not catch on the spiral of the reference electrode.

2. Drip into the new membrane head aprox.15 drops of electrolyte. Drip the electrolyte upon the membrane, at first.

3. Screw the membrane head **slowly (to enable the surplus electrolyte drain and to avoid a plastic deformation of the membrane)** and gently on the electrode body. During the screwing, the sensor is in a vertical position. After the screwing was completed approximately to the half of the thread, knock slightly upon the membrane head to release the air bubbles, which stick to the walls. Tighten the membrane head with delicacy **but firm**. The head must fit perfectly tightly on the silicone O-ring **inside of the sensor**.

4. Flush and wipe the sensor with a cotton wool.

Before filled up, the sensor must not be dipped in water. There is danger of irreversible damage of the sensor.

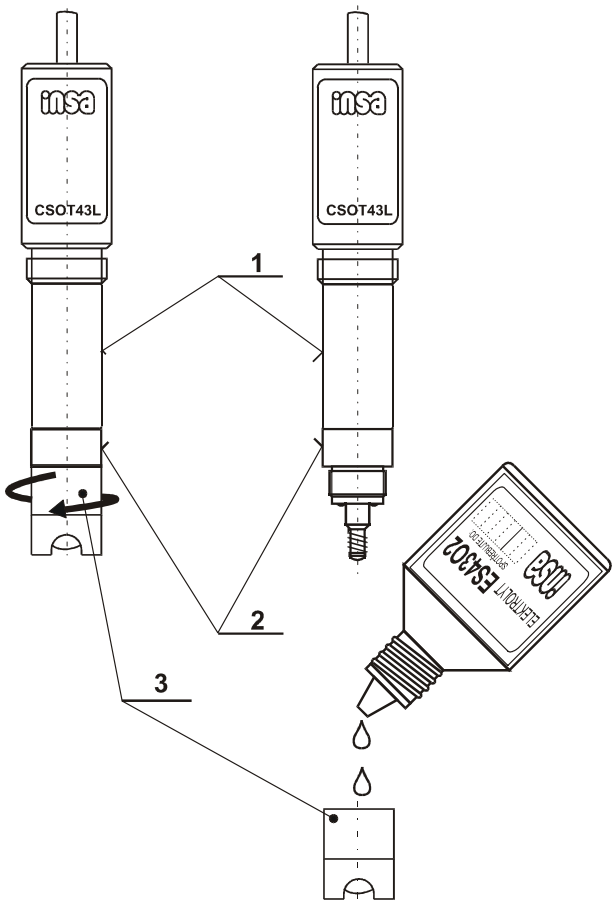

Fig. 5. Sensor CSOT 43LZS – membrane head exchange

The oxygen sensor will polarize, immediately after connection to the meter, regardless if the instrument is on or off – the sensor is then prepared for an immediate measuring. This function is advantageous mainly when measuring in a plant or in field. It is enough to switch on the instrument prior to the measuring and to leave it on, during the measuring time only. The polarization takes approximately 20 minutes and runs after every connection of the sensor to the instrument. It is therefore advantageous to disconnect the sensor, if we don't use the instrument for a longer time – more than 3 months, only. The oxygen sensor will stop to polarize also in the case, when a complete discharging of batteries occurs and the instrument will switch off, automatically.

- **NOTE**

In case, that the instrument was exposed to rapid temperature changes before put into operation, which could lead to a condensation of water vapours on the high-ohmic parts, it is necessary to operate the instrument before the calibration such a long time, until the date on display is stable.

▪ 5. CALIBRATION

The instrument enables three methods of calibration.

- **One point calibration** (quick calibration) is an operative calibration in **one point** of those values, where a more frequent calibration is presumed, i.e. pH, ORP, oxygen. We activate this mode by pushing the key ↻ in the mode **measuring** or choosing **CALIBRATION** in main menu.
- **Two points calibration** is a pH calibration in two points, We activate this mode in the same way as one point calibration.

For common routine measurement is it sufficient to execute one point calibration one time within one month. Two points calibration by exchange of the electrode or suspicion on malfunction of the electrode only.

- **Service calibration** is the basic calibration, made in the factory.

The calibration mode can be conditioned by entering a password.

5.1. CALIBRATION - pH

Slope of the glass electrode (change of voltage of electrode cell with change of pH), and the zero point of the electrode (ISO pH, asymmetric potential) is different for each electrode and alters with course of time.

Those changes can be eliminated through calibration. During the calibration, the instrument sets the calibration constants so, that the output data (pH value on display) correspond exactly with the actual measured value.

▪ **The frequency of calibration depends only on the quality of electrodes, on the medium, the electrodes are working in, and on the required measuring accuracy. For each new application or a new type of electrode, it is necessary to check the frequency of calibration by a more frequent revision of measuring quality with buffer solutions. The interval for calibration can be from 1x within a few days to 1x within a few months.**

▪ 5.1.1. pH calibration – buffer solutions

The setting of correction constants of the instrument according to the properties of the used electrodes is made by means of standard solutions (buffers) with a defined pH.

It is recommendable to use buffers in accordance with the recommendation IEC PUB. 746.2., for the calibration. Such buffers, the manufacturer of the instrument delivers. For an orientation operational setting, other buffers can be used, as well.

It is necessary to realize, that the quality of the buffers affects the accuracy of the measuring in a crucial extent. Soiled or contaminated buffers must be rejected, immediately. The best way is to make a calibration with new buffers, always. High quality buffers must be replaced by fresh ones once in a year, at least.

▪ 5.1.2. pH calibration - procedure

We execute the setting of correction constants by means of one or two buffer solutions with a defined pH. One solution should have pH in the area, in which we will carry out the measuring (usually pH 4,01 or pH 9,18). The other one (by two points calibration) should have pH near to the zero point of the electrode - pH 7.

For the calibration we need: standard solutions, cotton wool and distilled water or potable water.

▪ 5.1.2.1. Two points calibration

We activate this mode by pushing the key ↻ in the mode **measuring** or choosing **CALIBRATION** in main menu.

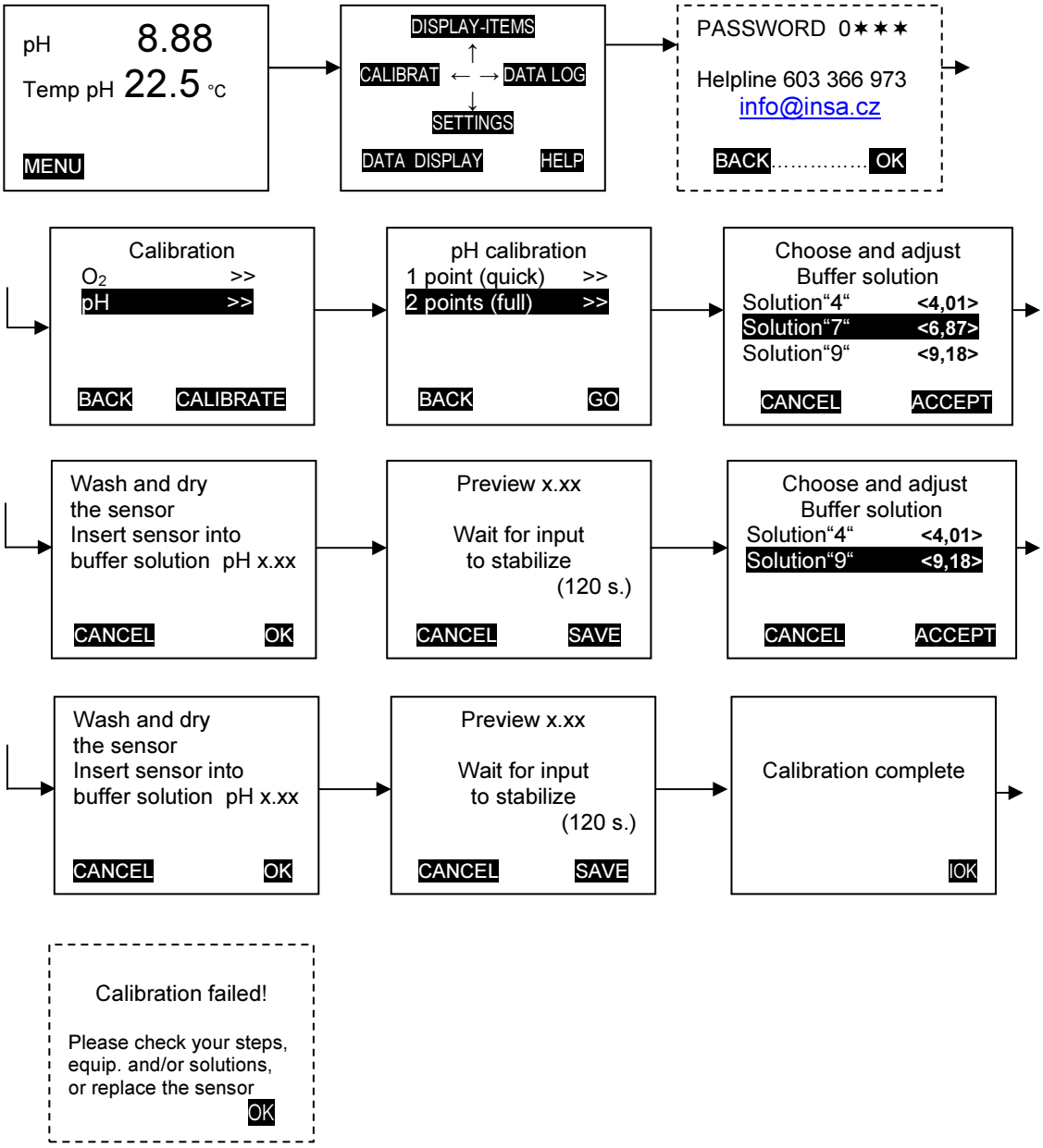

Fig. 6. Two points pH calibration

After entering the password (if switched on), the instrument will offer us all measured variable, for calibration. By pressing ↑, ↓ keys, we choose pH and press key ⓐ - **CALIBRATE** afterwards. Following information we have on the display now (**Fig. 6**) – **1.point (quick) >>** / **2. points (full) >>.** We select **2. points**, confirm with **GO** and on the next display (**Choose and adjust buffer solution:**) we choose the buffer, we want calibrate in. With the help of ↶ and ↷ keys we can value of the selected buffer make more precise still, if necessary. After pressing key **ACCEPT** we have **Wash and dry the sensor** and **Insert sensor into buffer solution pH x.xx** on the following display. Now we wash electrode, if necessary, and immerse it to the selected buffer and press key ⓐ - **OK** again.

On the top of the following display the pH value of the used buffer, calculated according to the constants acquired during the foregoing calibration, will appear. From this value, we can see how the sensor approaches the stabilized value and how this value is close to the value of used buffer. We can also observe whether the measured value becomes stable quickly enough. On this display we have further instruction **Wait for the input to stabilize** as well as a time stamp, which informs about the time in which the instrument will read the value of the buffer. When the waiting time is over, the instrument will pick-up the measured value automatically and will shift the mode of calibration to the next step. If the electrode stabilizes more quickly, it is possible to shorten the waiting time by pushing the key ⓐ - **SAVE** . Calibrations procedure goes further with calibration in second buffer. **Choose and adjust buffer solution:** is on the display and we select the second buffer and press key ⓐ - **ACCEPT**. **Wash and dry the sensor** and **Insert sensor into buffer solution pH x.xx** we have on the next display. Sensor – electrode is to be washed with water, wiped with cotton wool and immersed to the second buffer. Procedure than go ahead in the same way as the calibration in the first buffer.

When the calibration is ready – and if everything is OK – the information **Calibration completed** will appear on display, for several seconds, and the instrument will pass over into the measuring mode. On the contrary, when something is wrong - **Calibration failed is on the display** and **Please check your steps, equipment and/or solutions, or replace the sensor**. This information we must confirm with ⓐ - **OK** key.

- **5.1.2.2. One point calibration**

We activate this mode by pushing the key ↶ in the mode **measuring** or choosing **CALIBRATION** in main menu.

After entering the password (if switched on), the instrument will offer us all measured variable, for calibration. By pressing keys ↑, ↓ , we choose pH and press key ⓐ - **CALIBRATE** afterwards. Following information we have on the display now (**Fig. 7**) – **1.point (quick) >>** / **2. points (full) >>.** We select **1. point**, confirm with **GO**. The further procedure is identical with the one for a complete calibration in the first buffer.

- **5.1.3. pH calibration- evaluation**

The instrument automatically evaluates constants of the pH sensor obtained by every calibration. When everything is OK (slope between 80 to 105%, ISO potential less than ± 40 mV) – the information **Calibration completed** will appear on display,

for several seconds, and the instrument will pass over into the measuring mode. On the contrary, when something is wrong **Calibration failed is on the display** and **Please check your steps, equipment and/or solutions, or replace the sensor**. This information we must confirm with ⓐ - **OK** key.

Possible reasons of the unsuccessful calibration are:

We used, by mistake, other buffer than selected on the display during calibration or using, during 2. points calibration one buffer twice.

Wrong buffers.

Defective pH sensor (or temperature sensor).

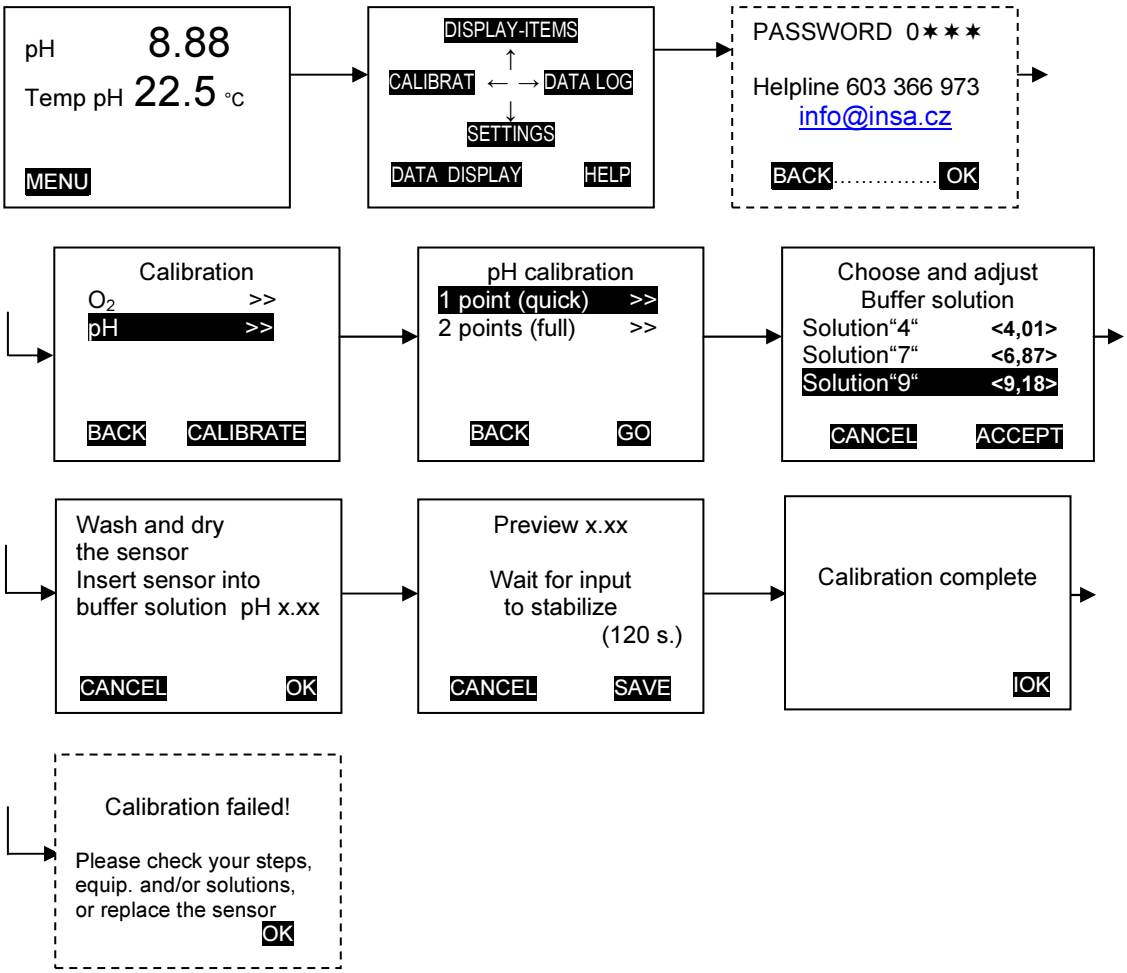

Fig. 7. One point pH calibration

5.2. CALIBRATION- ORP

The ORP value is measured by means of a cell, consisting of a metallic main

electrode and a reference (mostly argentochlorid) electrode. Due to the contamination of surfaces of both electrodes and to the ageing of the inner solutions, the properties of the cell are changing, during the operation. These changes which will appear by a shift of the zero point of the electrode can be eliminated by a calibration. During the calibration, the instrument will set the calibration constant so that ORP value on corresponds exactly with the really measured value.

The frequency of calibration depends on the quality of the electrode, on the environment in which the electrode works and on the required measuring accuracy. For each new application, it is necessary to verify the calibration frequency by a more often checking of the measuring quality, using the standard solution, and to find the optimal calibration period, which can be 1x in a week up to 1x in a few months.

▪ 5.2.1. ORP calibration – reference solution

For a correct calibration, it is advisable to use the reference solution SS ORP 11, delivered by the manufacturer of the instrument.

It is necessary to become conscious, that the quality of the reference solution influences the measuring accuracy in a crucial extent. Soiled or contaminated solution must be rejected, immediately. The reference solution SS ORP 11 must be replaced by a fresh one at least once in 24 months, approx.

▪ 5.2.2. ORP calibration - procedure

We adjust the correction constant by means of a reference solution with a defined ORP. The solution is to be poured into a clean vessel. For the calibration, we need: reference solution, cotton wool and distilled or potable water.

We activate mode **Calibration** by pushing the key ⮌ in the mode **measuring** or choosing **CALIBRATION** in main menu.

After entering the password (if switched on), the instrument will offer us all measured variable, for calibration. By pressing ⮍, ⮏ keys, we choose ORP and press key ⓐ - **CALIBRATE** afterwards. Following information we have on the display now - **Insert ORP sensor into reference solution** and **Adjust value +225 mV**. By means ⮌ and ⮎ keys we can value +225 mV adjust to correct value of reference solution used. After pressing key ⓐ - **OK**, there is instruction **Wait for the input to stabilize** as well as a time stamp, which informs about the time in which the instrument will read the values of the reference solution. When the waiting time is over (and everything is OK), the instrument will pick-up the measured value and the information **Calibration complete** will appear on display. If the sensor stabilizes more quickly, it is possible to shorten the waiting time by pushing the key ⓐ - **SAVE**. After a few seconds, the instrument will pass into the measuring mode, automatically.

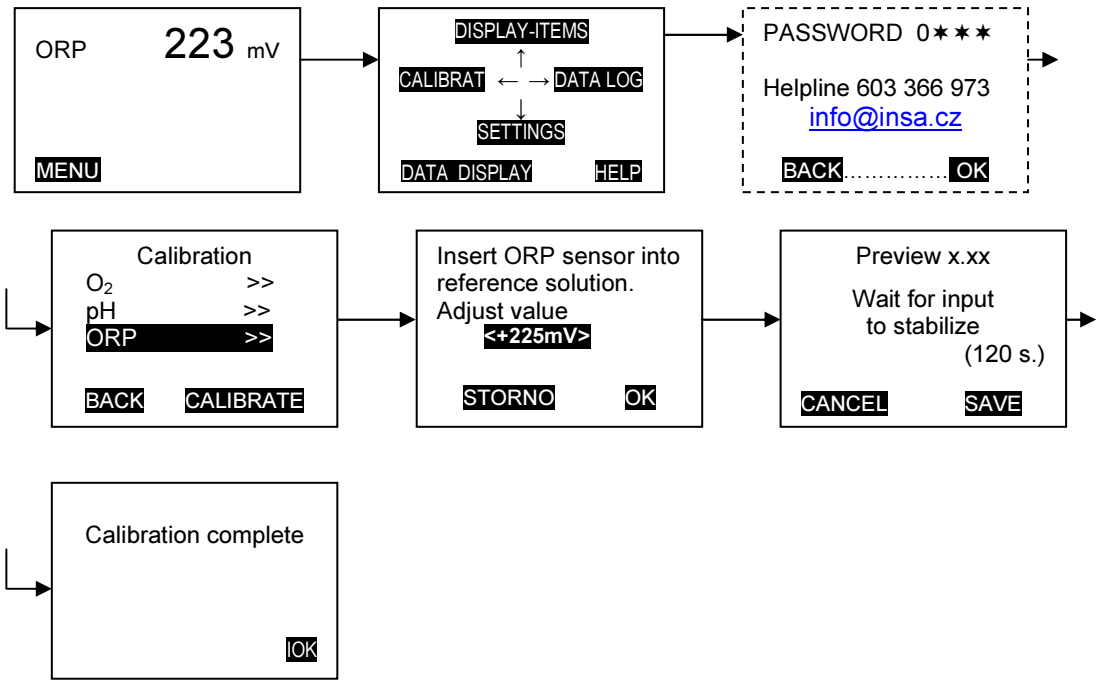

Fig. 8. ORP calibration

5.3 CALIBRATION - OXYGEN

When the oxygen sensor has been connected to the instrument, it polarizes. During the polarization time, the current of the sensor quickly decreases and the value on display (if the instrument is switched on) falls rapidly (the speed of decrease becomes lower, with the time). The time for which the sensor polarizes is about 15 minutes (depending on accuracy, which we need to measure with). For a sensor, having a new membrane or having been out of operation for a longer time, the polarization time is longer.

The sensor begins to polarize after the connection to the instrument, regardless if the instrument is switched on or off. **The polarization will stop when the sensor gets disconnected from the instrument or when the batteries are fully discharged.**

After the sensor was started up, we can calibrate the instrument.

The function **CALIBRATION** enables an easy and error-free calibration. We go to this mode by pushing the key ↵ in the mode **measuring** or choosing **CALIBRATION** in main menu.

In the next display (password is off) we confirm **CALIBRATE** by pressing key ⓘ and on following display we have instruction "**Cleanse and dry the sensor**" and "**Insert sensor into cover (approx. 30 min)**". We put the sensor into protective sensor case (provided it was not there before) and leave it for approx. 30 minute

to stabilize temperature of the sensor. The thing is that temperature of the plastic membrane and the one of the thermometer block of the sensor - Fig.5, pos.2 – should be the same during calibration. Protective sensor case serves as a calibration block.

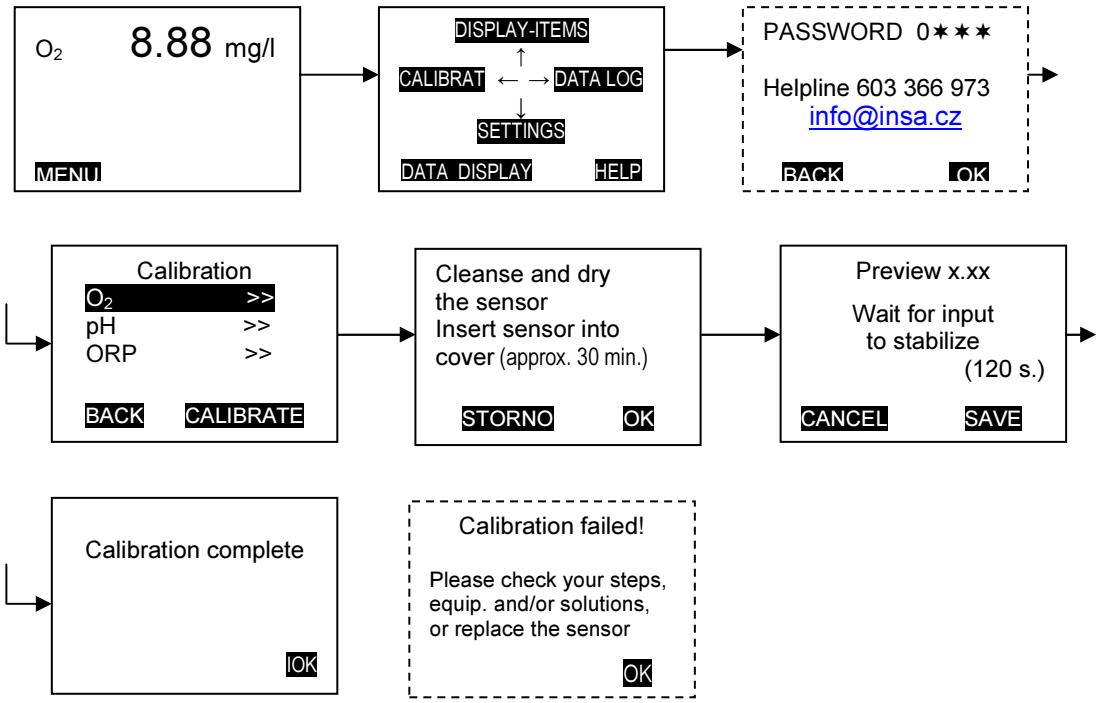

Fig. 9. Oxygen calibration

The sensor membrane must be dry, during the calibration – the sensor must measure the oxygen concentration in the air. If the sensor was in the water, prior to the calibration, wipe top of it slightly. On the central part of the membrane, which the detection system is leaning against, not a single drop of water must be (the sensor would measure the oxygen concentration in the drop and not in the air). The water drops on the other sensor parts make no problem.

Afterwards we press key and the value of oxygen concentration will show up, on the upper line of the display, calculated due to the constants acquired during the last calibration, and on the lower part, the instruction "**Wait for input to stabilize**" will appear, as well as the time, for which the calibration will run, still. When the necessary time expired, the instrument accomplish calibration process automatically, on the display appears for a few seconds "**Calibration complete**" and will pass into the measuring mode.

Note 1. The frequency of calibration depends on the way, how the sensor is used, and on the accuracy, we want to measure with. At the beginning of the work with the instrument, choose a more frequent calibration. In accordance with gained experiences, the frequency of calibration can be adjusted.

After installation of a new membrane, a slow forming of the membrane as well as other changes of the sensor will occur, the consequence of which are slow changes of the properties of sensor signal. The forming takes approximately 48

hours. After expiration of this time, the sensor signal is relatively stable. In most cases, when the sensor properties are stabilized, it is sufficient to repeat the calibration once per month, roughly.

Note 2. When working with the sensor, after some time (several months) the membrane begins to lose its mechanical properties. This process appears by an unstable sensor signal and by increasing of the idle current – if the sensor is in the oxygen-free solution (e.g. in a sulphite solution), instrument wouldn't show value 0.0, but a higher one. If the value on the instrument with sensor is higher than 0.20, it is advisable to replace the membrane.
Preparing the sulphite solution is in following way: *Add approx. 3 g (roughly a full teaspoon – a bigger amount doesn't make a problem) of natrium sulphite - $Na_2SO_3 7\ H_2O$ - to 100 ml of water (potable water is good enough). Prepare the solution at least 6 hours before the test. On this way prepared solution can be used for about 3 months.*
If no damage of the plastic membrane occurs, its life-span is 12 months, at least.
If it is a problem for the user to prepare the sulphite, it's recommended a preventive replacement of the membrane head after approx. 12 months.

• 6. INSTRUCTIONS FOR MEASURING

6.1 DAMPING SETTING

The instrument enables to set the magnitude of damping of signals from the sensors to the optimal value. If the damping is too small, the statement (measured value) on the display will get stable quickly, but after the stabilization fluctutes. If the damping is too big, the stabilization of the measured value on the display is slow.

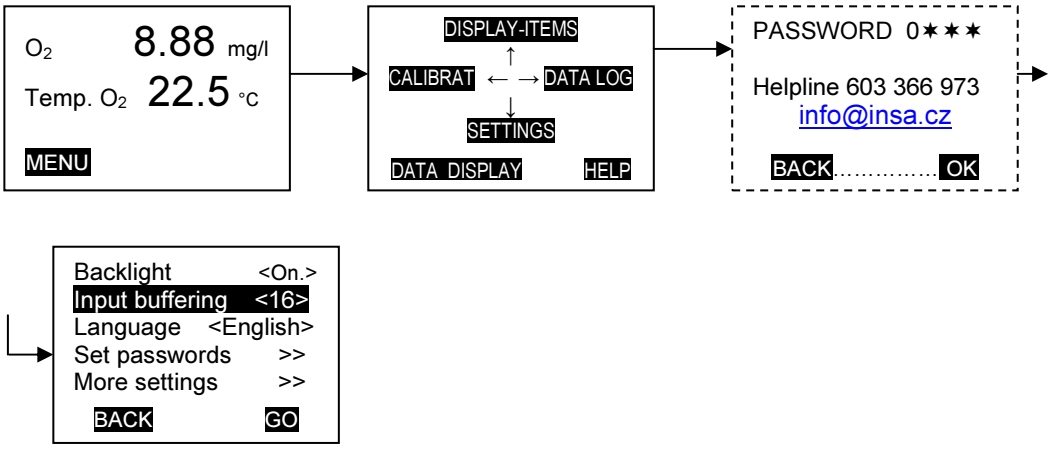

Fig. 10. Display of function damping

From the production, the damping is set on the value 16. If this value is inconvenient, it is possible to change it in the mode **SETTINGS** → **Input buffering**. By means of the ↶ and ↷ keys (Fig. 10) we set the required damping. The bigger is the damping – the slower the stabilization of the measured value and the more stable the statement on the display will be.

6.2 BACKLIGHT SETTING

Instruments display is provided with backlight, that makes us possible to read measured values and also other information on display in dark light conditions comfortably. As backlight **reduces lifetime of batteries** it is possible the backlight switch on and off. As far as the backlight is on than after each pressing of any key backlight switches on for a few seconds. Backlight is possible to turn off and on according Fig.10 - SETTINGS→ **Backlight** by means ↶ and ↷ keys.

6.3. MEASURING pH AND ORP

The quality of measuring is given by the quality and condition of the sensors, first of all, and by the quality of standard solutions – see also instructions for calibration. A soiled sensor will influence the measured value, significantly. In order to secure a correct measuring, it is necessary to avoid a contamination of the sensor surfaces, mainly by non-conducting and impermeable coatings

Glass electrodes must not be used in acidic solutions of fluorides.

The samples con-tainting a substance, which can clog the ceramic frit of the reference system (e.g. ions, which create little soluble salts with the solution of the reference electrode, like silver, mercury, tetraborate etc.), reduce considerably the lifespan of the electrode.

If we need to clean the electrodes, we proceed according to the recommendations of the manufacturer. Basically, we use a short time (up to 5 minutes) exposition in a diluted HCl (concentration 1M), for the removal of deposits with calcium, potassium or metal hydroxides. For removal of fatty substances, spirit, aceton, organic solvents or, preferably, the cleaning solutions delivered by the manufacturers of the electrodes can be used. We wet a cotton wool in them and clean the sensor. After the cleaning, we wash carefully the sensor with distilled or potable water. After the exposition in HCl, the properties of the sensor stabilize, for approx. 30 minutes.

If we don't measure, it is appropriate to keep pH and ORP electrodes in a solution of KCl, c = 3,0 mol/l.

6.4 OXYGEN MEASURING

For the oxygen measuring, we must use the sensors CSOT 43LZS, manufactured and delivered by the company imsa s.r.o.. Those sensors have a very small consumption of oxygen, during the measuring, and it is possible to measure with them relatively precisely, even in those cases, when the water motion is very small. This advantage is redeemed by lower dynamics of the sensors.

It is necessary to be aware, that quality of measuring results can be obtained with a clean sensor, only. The function of sensor is disturbed mainly by oil or fat layers, deposited on the sensor membrane. Also biological deposits on the membrane can considerably influence the function. We clean the sensor membrane so, that we wipe it slightly with cotton wool, wetted with clean potable water or in alcohol.

The oxygen sensor will polarize, immediately after connection to the instrument, **regardless if the instrument is on or off** – the sensor is then prepared for an immediate measuring. This function is advantageous mainly when measuring in a plant or in field. It is enough to switch on the instrument immediately prior to the measuring and to leave it on, during the measuring time only. The polarization takes

approximately 15 minutes and runs after every connection of the sensor to the instrument. It is therefore advantageous to disconnect the sensor, if we don't use the instrument for a longer time – more than 3 months, only. The oxygen sensor will stop to polarize also in the case, when a complete discharging of batteries occurs and the instrument will switch off, automatically.

During the measuring, the sensor must be immersed in the measured water 10 mm above the metallic block (Fig. 5, pos. 2), at least, in which the temperature sensors are placed. The sensor may be immersed in the measured water completely, **nevertheless sensor is not designed for standing immersing in water**.

The sensors CSOT 43LZS generate a relatively small signal, it is advisable to limit the movements of the sensor cable to the minimum, thus.

If taking measurement in nitrification basin of WWTP be aware that fluctuation of oxygen concentration due to aeration cause always an unstable measurement.

After finishing measurement we clean oxygen sensor, if necessary, flick rest of water off (in similar way as we do it with a thermometer) and screw protective sensor case on. We do not wipe small droplets of water off to avoid desiccation of the electrolyte.

The separation membrane of the oxygen sensor is ageing. Therefore, it is necessary to replace it as soon as the signal in sulphite is bigger than 3% of the signal, corresponding with the saturated state at the given temperature (as long as we measure in percents, it is 3% of the measured value in the air), or the value of the measured parameter on display is unstable. If no damage of the sensor membrane during manipulation and no sensor exposition outside of the range of temperature occurred, the lifespan of the membrane is 12 months, at least.

If it is a problem for the user to prepare the sulphite, it's recommended a preventive replacement of the membrane head after 12 months approx..

As a matter of principle, we replace the whole membrane head.

The description of the membrane head replacement can be seen in the chapter 4.4.1 page 10.

We keep the sensors, which are out of measuring, in a sensor transport case.

If we don't work with the oxygen sensor for a longer time than 3 months, it is advisable to take off the membrane head. Afterwards rinse the membrane head as well as the detection system carefully with drinking water, dry a little and screw it on the membrane head slightly (don't tighten).

The oxygen sensor must not be exposed to temperatures higher than 50,0°C.

6.5. TEMPERATURE MEASURING

When measuring temperature, we take care that the sensor is immersed by 30 mm, at least.

▪ 7. RECORDING OF MEASURED VALUES - GRAPH

The instrument can store approx. 770 measured values. Each measured value is completed by a time stamp. There are two modes of recording possible. First one is "**Advanced**" mode. In this mode we can choose any of measured variables for recording in any combination. It is possible to record either at regular intervals or at the moment when the determined levels are exceeded. To simplify the orientation during the evaluation of recorded values the instrument stores the measured values into the individual files. We ourselves determine the boarders of files by help of the START LOGGING / STOP LOGGING key.

When recording in this mode, mark **M** appears, during measurement, to the right side of measured value recorded, and information START LOGGING / STOP LOGGING is in the bottom right side of the display. In this mode we can choose, also, whether the oldest recorded values should be overwritten, when data-logger full or recording should be stopped. **Recorded values remain in the instrument memory even after the instrument is switched of. During replacing of batteries remain recorded values in the memory for approx 24 hours when instrument is completely without power supply.**

Second recording mode is called "**Back-trace xxx hrs.**". **All measured** variables are recorded in this mode in three possible firm determined time intervals of 1 minute, 10 minutes and 1 hour. **The oldest recorded values are overwritten, when data-logger full, in this mode**. The total recording time depends upon number of measured variables and time interval chosen. **All recorded values ere deleted after instrument goes off.** After the instrument is switched on, recording starts automatically. There is no information on the display during measurement in this mode.

7.1. TIME AND MODE SETTING.

Instrument is not provided with real time clock. All time data are relative therefore.

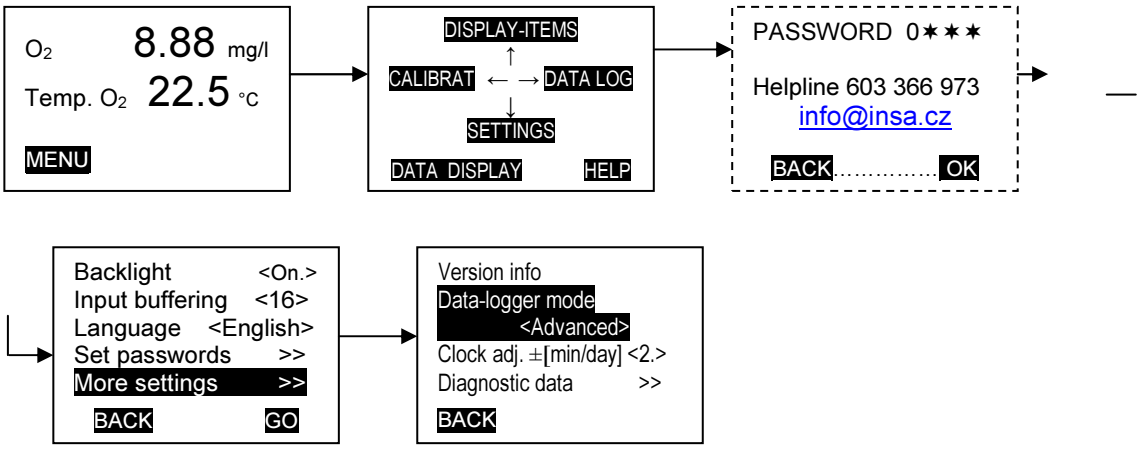

Fig. 11. Time and mode setting

In the mode **Advanced** they are related to the start time of the respective file. In the mode **Back-trace** to the time the file is opened for viewing – numbers on the time axis are negative.

As the instrument is not provided with full-value clock, time data are rather inaccurate. We can make it more precisely in **Settings** → **More settings** → **Clock adj.[min/day] <0>**.
At the same display we select mode of registration – **Data-logger mode** → (**<Advanced> / <Back-trace xxx hrs>**)

7.2. SELECTION OF MEASURED VARIABLES FOR RECORDING, SETTING OF INTERVAL

We activate mode **Data-logger** by pushing the ➲ key in the mode **measuring** or choosing DATA LOGGER in main menu. We have on the display either information **(No data)** or data already recorded and in bottom right side OPTIONS. After pressing ⓐ - OPTIONS key we select **Data logger setup**. On the following display we select variables we want to store and time interval. After opening **Trigger** we set recording

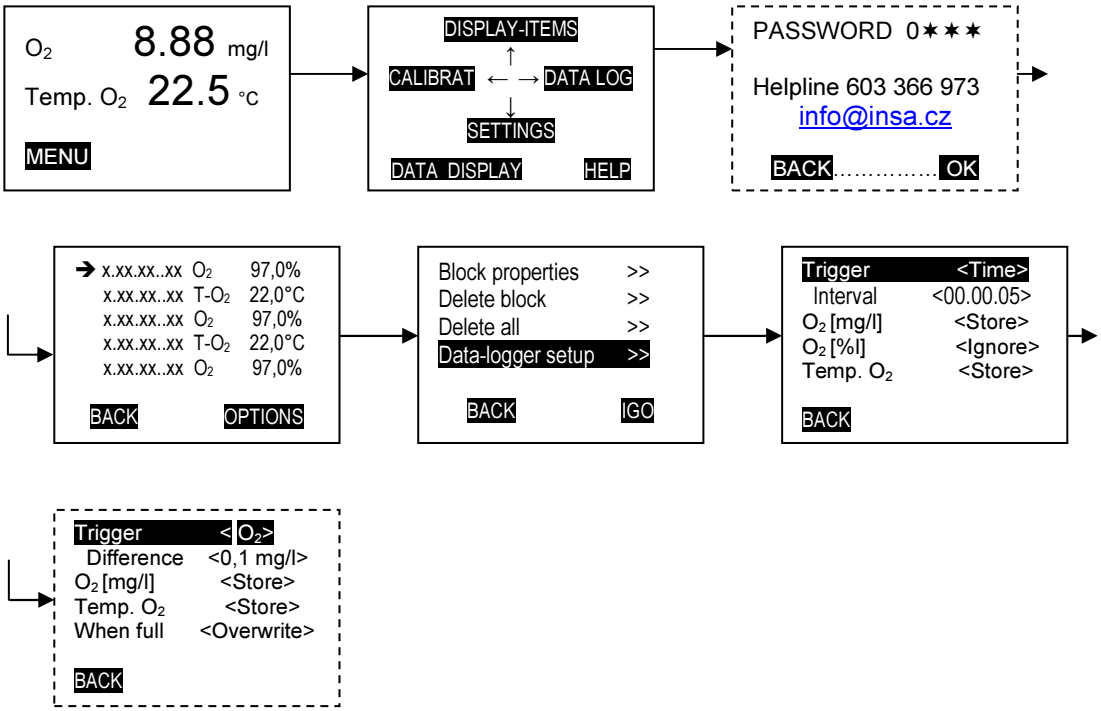

Fig. 12. Interval setting, selection of variables

mode and time interval. If we select **Time** (by means of ➲ and ➲ key) than instrument will record measured variables (all variables, which were selected for recording), in regular time intervals, irrespective changes of the measured values. If we select some measured variable, instrument will offer **Difference** by exceeding of which instrument will carry out a recording of **all** values, we have chosen for recording. We enter **ORP** and the difference 10 mV, e.g. (0,1 pH unit etc.). That means, that the instrument will record the measured values always, when the level 10 mV (pH 0,1) will be exceeded, from above or from below. If, e.g., the measured value alternates between 105 to 165 mV (pH 6,95 to 7,55), the values 110, 120,

130, 140 a 150 mV (pH 7,00, 7,10, 7,20, 7,30, 7,40, 7,50) and **the actual values of all variables selected for recording** are recorded, simultaneously**.**

On the following lines we select variables for registration – **Store** means the variable will be recorded.

7.3. START UP AND TERMINATION OF RECORDING

If **Advanced** mode is selected, than in the course of measuring, we can start up the recording or stop it anytime, by pressing the key ⍰Δ (START LOGGING / STOP LOGGING). After every new start data are stored into new file.

7.4. VIEWING THE RECORD, DELETING THE RECORD

Back-trace mode.

In measuring mode, after **short** pressing of the ➲ key appears graph of the variable **placed on the upper** line of the display in measuring mode. When graph of the other variable is wanted, we shift this variable - by the help of ↑, ↓ keys – on the first line of the display and press short ➲ key again.

Scale of the display is adjusted automatically. There are all recorded values of the recorded variable on display. If the display is not optimal, we can by **long** pressing of the ➲ and ➲ keys **enlarge** and/or **reduce** scale on the horizontal axis and by ↑, ↓ keys on the vertical axis.

By the help of **short** pressing of the ⍰Δ key, we can remove signs from the axis.

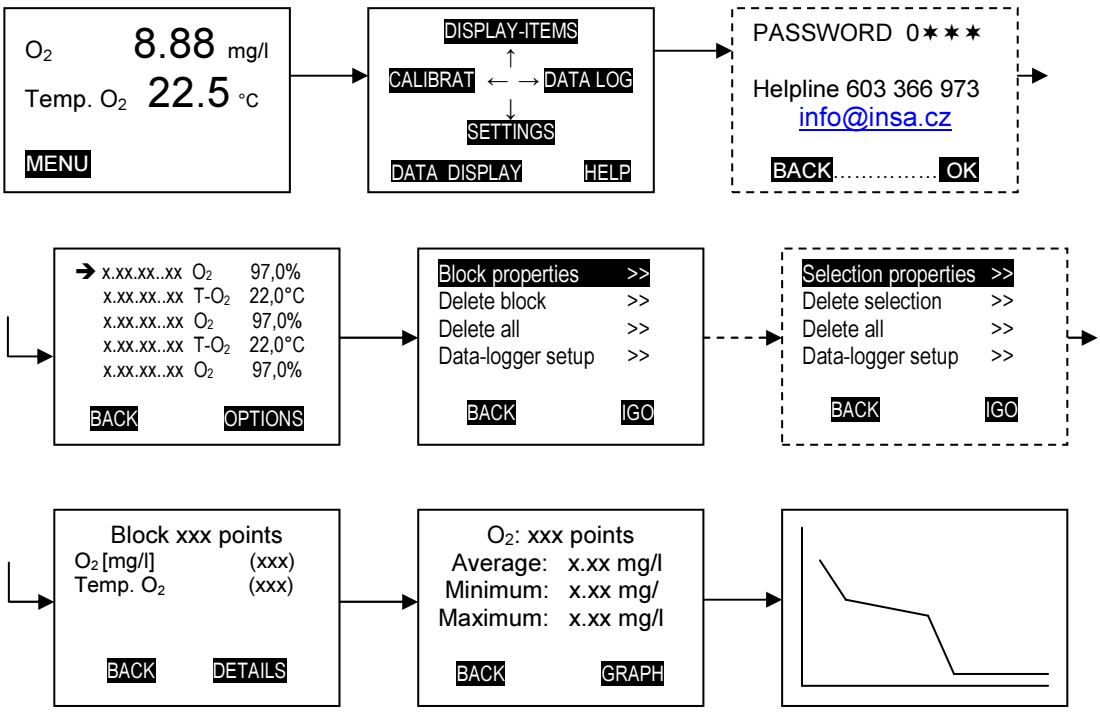

Fig. 13. Viewing the record

Advanced mode.

On the display we have measured values with sign **M** on the right side of the line(s) of the recorded variable(s). After **short** pressing of the ➲ key appear recorded variables divided into single blocks on the display with cursor ➔ at the start of the first block, or on the place we abandoned record by the last viewing. By the help of ➲, ➲ keys we move in the block up and down. By every shift of the cursor appears – briefly – number of the appropriate block on the beginning of the line.

By pressing Ⓐ **OPTIONS** key we open display with offer **Block properties** etc. If we select “block properties” we can subsequently choose variable we are interested in and open - by pressing **DETAILS** key – next display where we have detailed information of selected block. After pressing **GRAPH** key there is graph of the chosen variable on the display. With the graph we work in the same way as we in the „back trace mode“ do.

Displays “block properties”, “graph” are created for the file – block in front of which the cursors occurs in the moment.

We leave graph by the help of the Ⓐ key.

When in the mode “measuring”, we can display graph by **long** pressing of the ➲ key. Graph of the variable **placed on the upper** line of the display appears. In graph there are displayed **all** values recorded in **all** blocks of appropriate variable**. If there is no recorded variable on the upper line of the display (line is empty), the graph will not appear**.

On the display with recorded values we can create a new block – **selection** of values by means of ➲ and ➲ keys. Information on **Block properties** etc displays refer to this selection than.

•8. PASSWORDS SETTING

The access to some instrument functions can be conditioned by the password to avoid setting from unwanted changes (either by mistake or unauthorized person) or to hide unused functions. By passwords we can lock **Calibration, Display configuration** (is not possible to switch of/on measured variables, to change order of measured variables on the display), **Settings** (is not possible to change settings) and **Main menu** (access to main menu is locked, is possible to read display only).

• ENTER PASSWORD INTO THE SYSTEM

By pushing ⓐ key we pass from the mode **Measuring** to **Main menu,** select the function SETTINGS and **Set passwords** by pressing ↑, ↓ keys and GO. On the actual display we select mode, we want to lock by password (by means of ↺ and ↻ keys we choose **Yes** for appropriate mode). Password consist of four signs 0 to 9 and ✶. Symbol ✶ is identical with number 0. We set password acc. Fig. 14 - by means of ↑, ↓ and ↺, ↻ keys we select our number combination and confirm it by ⓐ.

After opening the display **Set passwords** we can see all modes protected by passwords. At the and off every line is either **(free)** – mode is not protected by password or **(locked)** – mode is protected by password.

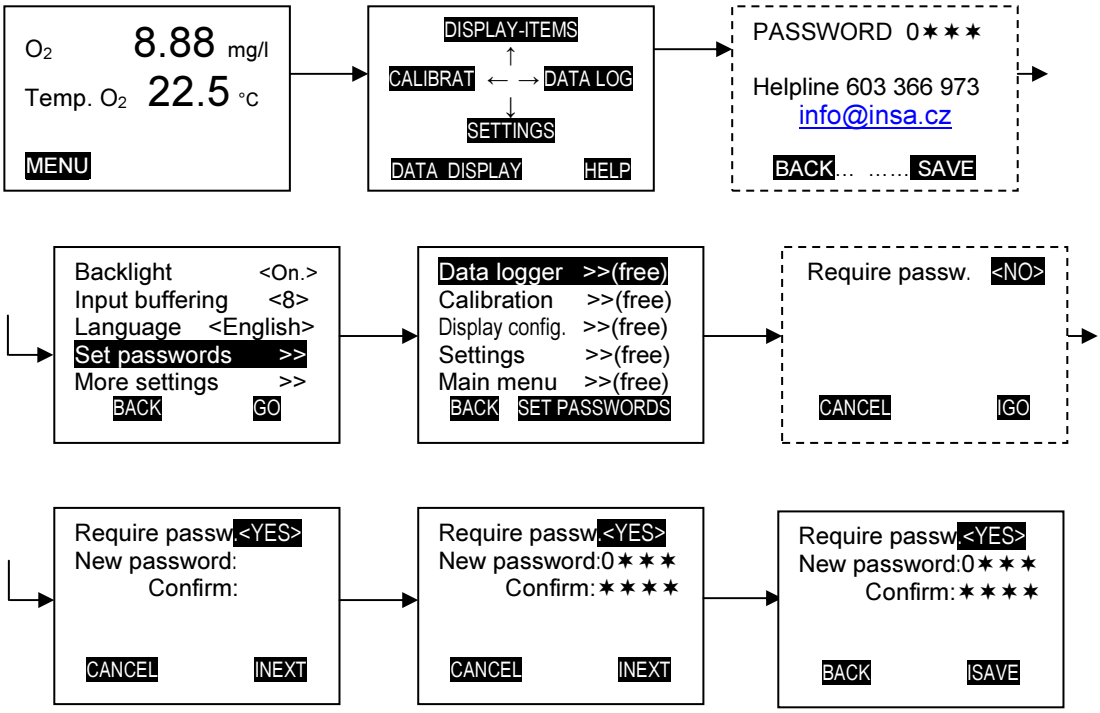

Fig.14. Display of function passwords

▪ 9. METHOD OF OPERATION

The electric signals from the sensors are processed in the analogue circuits of the instrument, transferred to the numerical state by an analogue-digital converter and processed in the computer, which secures the setting of constant during the calibration, displaying of the measured values on a numerical display as well as other functions.

• 10. MECHANICAL CONSTRUCTION OF THE INSTRUMENT

The circuits of the instrument MFD 79 are placed in a plastic box.

We protect the box from the impact of aggressive substances. For the cleaning of the box, we use water or alcohol. We take care, that we don't scratch the front shield of the instrument, under which the display is placed.

▪ 11. INSTRUCTIONS FOR MAINTENANCE AND REPAIRS OF THE INSTRUMENT

The electronic circuits of the transducer don´t require any maintenance.

The reliability of the electronic circuits of the instrument is very high. Any problems during the measuring are caused by the sensors, almost in all cases.

▪ 12. TECHNICAL DATA

Measuring Range - oxygen	0,1 to 30,0 mg/l, 0,1 to 200,0%
- pH	0,00 to 14,00
- temperature	-5,0 to 50,0°C
- ORP	±1000 mV
Displaying of the Measured Value	graphic display with backlight
Sensor pH, ORP	connector SUBM
Maximal Resistance of Sensor	$1.10^9\ \Omega$
Temperature Compensation of pH sensor	aut. in the range -5 to 50°C
Input Resistance (input pH, ORP)	$1.10^{12}\ \Omega$
Input Current (input pH, ORP)	3.10^{-12} A
Basic Error - pH	±0,5% of the range
Basic Error - ORP	±0,5 mV
Additional Error at Change of Ambient Temperature	±1% of the range at a change by ±10°C (ORP, pH)
Sensor for Oxygen Measuring	CSOT 43LZS (temperature range -4 to 50°C, min. speed of medium 2 mm/s)
Temperature Compensation	automatic in range 0 to 50°C
Basic Error of Oxygen Measuring	±1% of range
Additional Errors at Change of Temperature of Measured Medium (oxygen)	±3% of range at temperature t_{ref}= 20°C ±15°C
Additional Error at Change of Ambient Temperature	±1% of range at change by ±10°C (oxygen)
Basic Error of Measuring Temperature	±0,2°C
Additional Error at Change of Ambient Temperature	±0,3°C at change by ±10°C
Cover	IP 54 (with plugged sensors)
Dimensions	120x65x22 mm (wxhxd)
Weight	approx. 200 g

- **Ambient conditions**

Ambient Temperature	-15 to+40°C
Relative Humidity	10 to 90%
Air Pressure	600 to 1060 hPa
Supply Voltage	two AA batteries
Resistance to Vibrations and Shocks	specified in ČSN EN 61010-1
Resistance to Electromagnetic Emission	acc. to ČSN EN 50082-1, category – light industry
Electromagnetic Emission	acc. to ČSN EN 55011-1, category – light industry

The instrument must not be operated in hazardous environment.

Reference Conditions

Ambient Temperature	25±1°C
Relative Humidity	40 to 50% (temperature 25 ±1°C)
Air Pressure	980 to 1020 hPa
Supply Voltage	12 V % ±1%

Electromagnetic Disturbance	negligible
Vibrations, Shocks	negligible

②IP 00 for instrument with firm connected oxygen sensor

▪ 13. STORAGE

The instrument must be stored in a covered and dry store, in a protective cover, at a temperature between 0 to 40°C and a relative humidity up to 80%. During the storage, the instrument must be protected against mechanical damage, meteorological effects and chemical fumes.

Sensors for measuring pH a ORP are to be stored in solution of KCl, c = 3 mol/l.

Sensors for oxygen measuring are to be stored unfilled, with the membrane head slightly screwed on the body of the electrode.

▪ 14. PROTECTION OF THE ENVIRONMENT

This product complies with EU directive 2002/96/EC. The product at the end of its life must be disposed of separately from domestic waste by taking it to separate waste disposal site for electric and electronic appliances.

From the instrument we dismount the batteries and dispose of on the specified way.

The instrument box is made of a recycled plastic.