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# SET-2000 Oil/Sludge

## Alarm Device for Oil Separators



### Installation and Operating Instructions



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## SYMBOLS



Warning / Attention



Pay attention to installations at potentially explosive atmospheres



Device is protected by double or reinforced insulation

**1 GENERAL**

SET-2000 Oil/Sludge is an alarm device for monitoring the thickness of the oil layer accumulating in the oil separator and the accumulation of sludge or sand layer on the bottom of separator. Depending on the order, the delivery consists of SET-2000 Oil/Sludge control unit, SET DM/3 probe, SET/S2 probe, junction box and installation supplies.

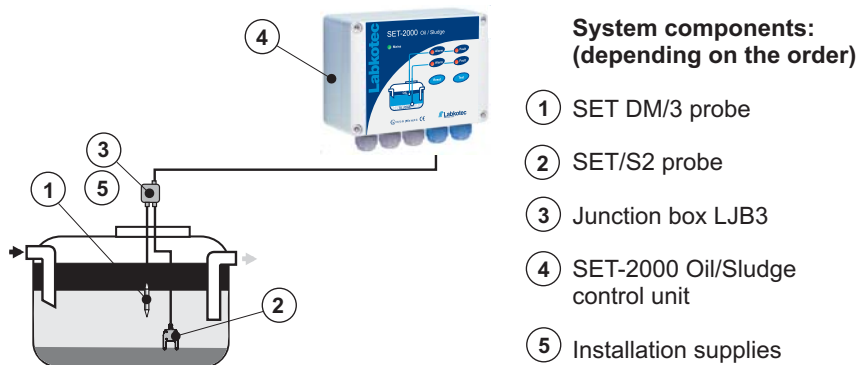


Figure 1. Oil separator alarm system with SET-2000 Oil/Sludge

The SET DM/3 probe is installed into the light liquid storage chamber and gives an alarm when the chamber is filled to a pre-determined degree. The function is based on the measurement of the electrical conductivity of the surrounding liquid – water conducts electricity much better than oil. The probe is normally immersed in water.

SET/S2 probe is installed in the separator or tank and it gives an alarm when the sludge reaches the probe. The principle of measurement is ultrasonic. When sludge, sand or other solid particles accumulate between the two probe heads, the signal strength weakens, causing an alarm. The probe is normally immersed in water.

Oil separator is regarded as a potentially explosive (Ex) area. The probes can be installed in zone 0, 1 or 2 potentially explosive atmosphere but the control unit must be mounted in a safe area.

The LED indicators, push buttons and interfaces of the device are described in figure 2.

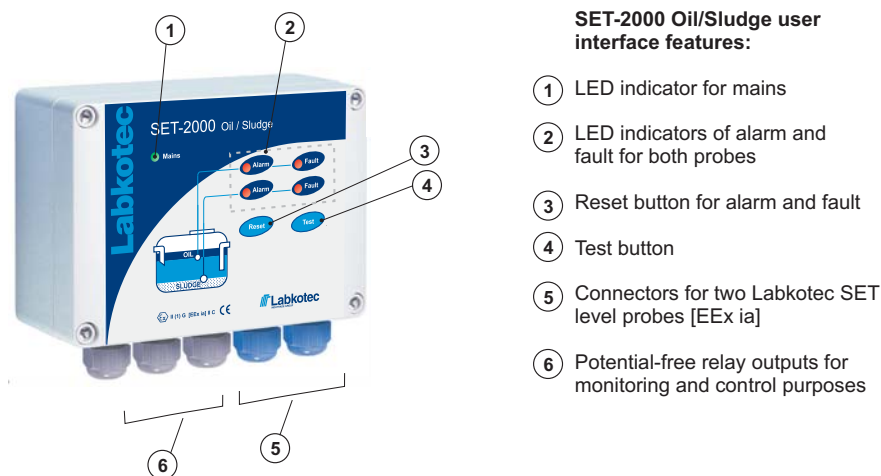


Figure 2. SET-2000 Oil/Sludge – features

## 2 INSTALLATION

### 2.1 SET-2000 Oil/Sludge Control Unit

The SET-2000 Oil/Sludge control unit can be wall-mounted. The mounting holes are located in the base plate of the enclosure, beneath the mounting holes of the front cover.

The connectors of the external conductors are isolated by separating plates. The plates must not be removed. The plate covering the connectors must be installed back after executing cable connections.

The cover of the enclosure must be tightened so, that the edges touch the base frame. Only then do the push buttons function properly and the enclosure is tight.

Before installation, please read the safety instructions in chapter 6!

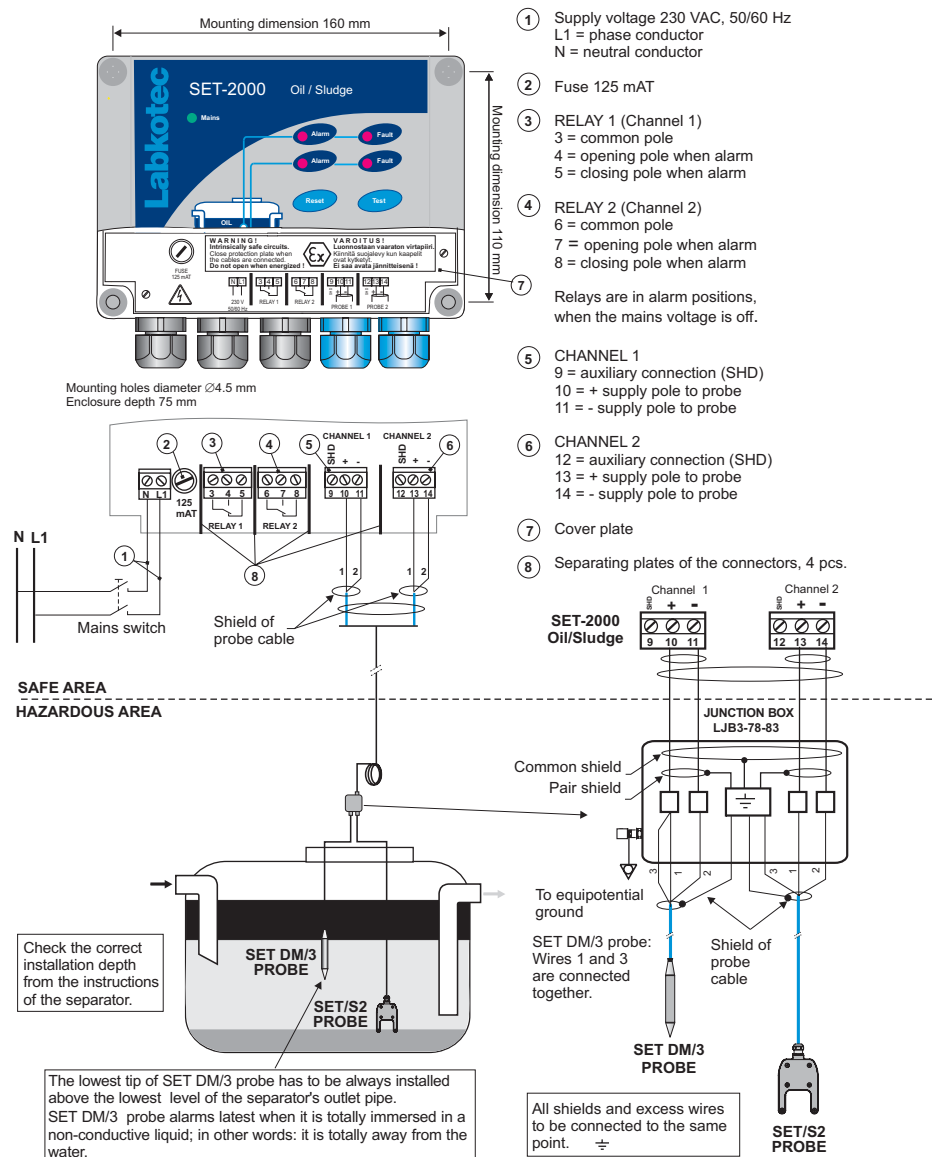


Figure 3. Installation of SET-2000 Oil/Sludge alarm device.

## 2.2 Probe installation

The probe installation should be done as described in figure 3.

SET DM/3 probe gives an alarm earliest when the upper electrode is in oil and latest when the probe is totally immersed in a non-conductive liquid – in other words, it is totally away from the water.

SET/S2 probe gives an alarm when there is enough sand or sludge accumulated between the two heads of the probe. When the sludge layer on the bottom of the separator or settling tank is pretty solid, the correct installation depth can be adjusted based on the current level. In case the level is not that clear, a tryout period of couple of days may be useful.

Both probes can be mounted suspended from the ceiling of the separator by their cable.

Please check the correct installation depth also from the instructions of the oil separator.

## 2.3 Junction box

If the probe cable must be extended or there is need for equipotential grounding, it can be done with the cable junction box. The cabling between the SET-2000 control unit and the junction box should be done with a shielded twisted pair instrument cable.

The cabling in figure 3 can be done with a two-pair shielded twisted pair cable, whereupon both pairs are equipped with their own shields. **Make sure that the signal wires of the cables can never be connected to each other.**

LJB3 junction box enables cable extension in potentially explosive atmospheres.

In figure 3 the shields and excess wires have been connected to the same point in galvanic contact with metallic frame of the junction box. This point can be connected to equipotential ground thru the ground terminal. Other components of the system that need to be grounded can also be connected to the same ground terminal.

The wire used for equipotential grounding must be min. 2.5 mm<sup>2</sup> mechanically protected or, when not mechanically protected, the minimum cross section is 4 mm<sup>2</sup>.

Please make sure, that the probe and the cable between SET-2000 control unit and the probe do not exceed the maximum allowed electrical parameters – see chapter 7 Technical data.

Detailed cabling instructions can also be found in the installation instructions of SET DM/3 and SET/S2 probes.



Junction box of type LJB3 includes light alloy parts. When installing in explosive atmosphere, make sure, that the junction box is located so, that it can not be mechanically damaged or it will not be exposed to external impacts, friction etc. causing ignition of sparks.

Make sure, that the junction is closed properly.

### 3 OPERATION AND SETTINGS

SET-2000 Oil/Sludge is initialized at the factory. The operation of the device should always be checked after the installation. The operation should also be checked always when emptying the separator or at least once every six months.

*Functionality test* **Oil alarm (SET DM/3 probe)**

1. Immerse the probe into water. The device should be in normal mode (see chapter 3.1).
2. Lift the probe up in the air or oil. Oil alarm should occur. (see chapter 3.1).
3. Immerse the probe back into water. Alarm should go off after 5 sec delay.

*Functionality test* **Sludge alarm (SET/S2 probe)**

1. Immerse the probe into water. The device should be in normal mode.
2. Lift the probe up in air or sink it into sludge. An alarm should be generated after 30...40 seconds (see chapter 3.1).
3. Immerse the probe back into water. The alarm should go off after a delay of 30...40 seconds.

Clean up the probes before placing them back into the separator.

A more detailed description of the operation is provided in chapter 3.1. If the operation is not as described here, check the factory settings (chapter 3.2) or contact a representative of the manufacturer.

#### 3.1 Operation

The operation of a factory-initialized SET-2000Oil/Sludge is described in this chapter.

*Normal mode – no alarms*

*SET DM/3 probe is totally in water and the two heads of the SET/S2 probe are totally immersed in water.  
Mains LED indicator is on.  
Other LED indicators are off.  
Relays 1 and 2 are energized.*

*Oil alarm*

*SET DM/3 probe is in oil. The probe gives an alarm earliest when the upper electrode is in oil and latest when the probe is totally immersed in a non-conductive liquid, in other words, totally away from water.  
(Note! The same alarm takes place when SET DM/3 probe is in the air)  
Mains LED indicator is on.  
Oil Alarm LED indicator is on.  
Buzzer on after 5 sec delay.  
Relay 2 remains energized.  
Relay 1 de-energizes after 5 sec delay.*

*After removal of an Oil alarm, the alarm LED indicator and buzzer will be off and relay 1 will be energized after 5 sec delay.*

*Sludge alarm*

*The two heads of the SET/S2 probe are immersed in sludge or sand.  
Mains LED indicator is on.  
Alarm LED indicator is on after approx. 5 sec. delay. (Delay of the probe.)  
Buzzer is on after 30...40 sec delay. (30 sec delay of the control unit incl.)  
Relay 1 remains energized.  
Relay 2 de-energize after 30...40 sec delay.  
(Note. The same alarm takes place when SET/S2 probe is in the air.)*

*The operational delay of SET/S2 (30...40 sec) prevents false alarms from occurring when garbage or other obstacles, which weaken the measurement signal momentarily, pass across the probes heads.*

*Note! When testing SET/S2 probe operation in a separate vessel, the water put into the vessel should stand for about 30 minutes before testing. This prevents false alarms caused by the attachment of air bubbles on the probe heads.*

*After removal of Sludge alarm (the two heads of the probe are in water), the Alarm LED indicator will be off and relay 2 will be energized and buzzer will be off after a delay of 30...40 sec.*

*Fault alarm* A broken probe, probe cable break or short circuit, i.e. too low or too high probe signal current.  
Mains LED indicator is on.  
Probe circuit Fault LED indicator is on after 5 sec delay.  
The relay of the respective channel de-energizes after 5 sec delay.  
Buzzer is on after 5 sec delay.

*Reset of an alarm* When pressing the Reset push button.  
Buzzer will go off.  
Relays will not change their status before the actual alarm or fault is off.

#### TEST FUNCTION

Test function provides an artificial alarm, which can be used to test the function of the SET-2000 Oil/Sludge and the function of other equipment, which is connected to SET-2000 via its relays.



Attention ! Before pressing Test button, make sure that the change of relay status does not cause hazards elsewhere !

*Normal situation* When pressing the Test push button:  
Alarm and Fault LED indicators are immediately on.  
Buzzer is immediately on.  
Relays de-energize after 2 sec of continuous pressing.  
When the Test push button is released:  
LED indicators and buzzer go immediately off.  
Relays energize immediately.

*Sludge or Oil alarm on* When pressing the Test push button:  
Fault LED indicators are immediately on.  
The Alarm LED indicator of the alarming channel remains on and the respective relay remains de-energised.  
Alarm LED indicator of the other channel is on and the relay de-energizes.  
Buzzer remains on. If it has been reset earlier, it will return to be on.  
When the Test push button is released:  
The device returns without delay to the preceding status.

*Fault alarm on* When pressing Test push button:  
The device does not react with regards to the faulty channel.  
The device reacts as described above with regards to the functional channel.

### 3.2 Factory settings

If the operation of SET-2000 Oil/Sludge is not as described in the previous chapter, check that the device settings are as in figure 4. Change the settings according to the following instructions if needed.



The following tasks must only be executed by a person with proper education and knowledge of Exi devices.

We recommend, that when altering the settings the mains voltage is off or the device is initialized before the installation is executed.

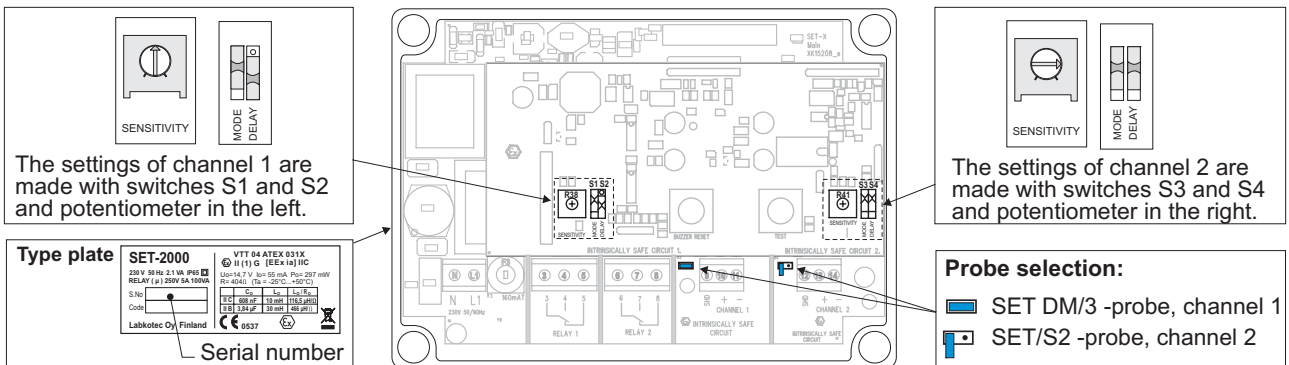
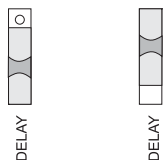


Figure 4. Factory settings of SET-2000 Oil/Sludge

The settings are made with switches (MODE and DELAY) and potentiometers (SENSITIVITY) located in the upper printed circuit board (figure 4) and with the jumpers located in the lower board. Switches in figure 4 are as set in the factory.

#### OPERATIONAL DELAY SETTING (DELAY)



Delay 5 sec.      Delay 30 sec.

Switches S2 and S4 are used to set the operational delay of the device.

When the switch is in low position relays de-energize and buzzer is on after 5 seconds after the probe current has reached the trigger level, and if the level still remains on the same side of the trigger level.

When the switch is in high position, the delay is 30 seconds.

Delays are operational in both directions (energizing, de-energizing). Alarm LEDs follow the probe current value and trigger level without delay. Fault alarm takes place after a fixed delay of 5 sec.



## 4 TROUBLE-SHOOTING

**Problem:** MAINS LED indicator is off

**Possible reason:** Supply voltage is too low or the fuse is blown. Transformer or MAINS LED indicator faulty.

- To do:**
1. Check if the two pole mains switch is off.
  2. Check the fuse.
  3. Measure the voltage between poles N and L1. It should be 230 VAC  $\pm$  10 %.

**Problem:** No alarm when SET DM/3 probe in oil or air, or the alarm will not go off

**Possible reason:** The SENSITIVITY setting is wrong in the control unit (see figure 4), or probe dirty.

- To do:**
1. Clean-up the probe and lift it up in the air or immerse it into oil.
  2. Turn the SENSITIVITY potentiometer slowly anticlockwise until the probe gives an alarm.
  3. Immerse the probe into water and wait until the alarm goes off. If the alarm does not go off, turn the potentiometer slowly clockwise until the alarm goes off.
  4. Lift the probe up in the air or oil. The probe should give an alarm again.

**Problem:** No alarm when SET/S2 probe in sludge or air, or the alarm will not go off

**Possible reason:** The SENSITIVITY setting is wrong in the control unit (see figure 4).

- To do:**
1. Lift the probe up in the air or immerse it into sludge and wait 10 seconds.
  2. Turn the SENSITIVITY potentiometer slowly anticlockwise until the probe gives an alarm.
  3. Immerse the probe into water and wait until the alarm goes off. If the alarm does not go off, turn the potentiometer slowly clockwise until the alarm goes off.
  4. Lift the probe up in the air or sink into sludge. The probe should give an alarm again.

**Problem:** FAULT LED indicator is on

**Possible reason:** Current in probe circuit too low (cable break) or too high (cable in short circuit). The probe might also be broken.

- To do:**
1. Make sure, that the probe cable has been connected correctly to the SET-2000 control unit. See probe specific instructions.
  2. Measure the voltage separately between the poles 10 and 11 as well as 13 and 14. The voltages should be between 10,3...11,8 V.
  3. If the voltages are correct, measure the probe current **one channel at a time**. Do as follows:
    - 3.1 Disconnect probe's [+] wire from probe connector (poles 11 and 13).
    - 3.2 Measure short circuit current between [+] and [-] poles.
    - 3.3 Connect mA-meter as in figure 5.  
Make a comparison to the values in Table 1.
    - 3.4. Connect the wire/wires back to respective connector(s).

If the problems can not be solved with the above instructions, please contact Labkotec Oy's local distributor or Labkotec Oy's service.



Attention ! If the probe is located in an explosive atmosphere, the multimeter must be Exi-approved !

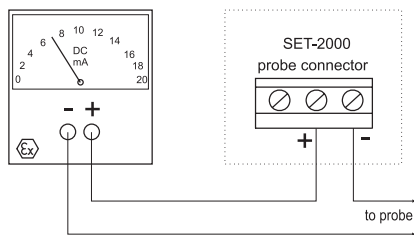


Figure 5. Probe current measurement

	SET DM/3, Channel 1 Poles 10 [+] and 11 [-]	SET/S2, Channel 2 Poles 13 [+] and 14 [-]
<b>Shortcircuit</b>	20 mA - 24 mA	20 mA - 24 mA
<b>Probe in the air</b>	9 - 10 mA	13 - 14 mA
<b>Probe in the oil</b>	9 - 10 mA	---
<b>Probe in the sludge or sand</b>	---	12 - 14 mA
<b>Probe in the water</b>	2 - 3 mA	5 - 7 mA
<b>Factory setting for alarm point</b>	approx. 6.5 mA	approx. 11 mA

Table 1. Probe currents

## 5 REPAIR AND SERVICE


The probes should be cleaned and the operation of the alarm device should be tested when emptying the oil storage chamber or at least once every six months. The easiest way to check the operation is to lift the probes up in the air and put them back to the separator. The operation is described in chapter 3.

For cleaning, a mild detergent (e.g. washing-up liquid) and a scrubbing brush can be used.


The mains fuse (marked 125 mA) can be changed to another glass tube fuse 5 x 20 mm / 125 mA complying EN 60127-2/3 . Any other repair and service works on the device may be carried out only by a person who has received training in Exi devices and is authorized by the manufacturer.


In case of queries, please contact Labkotec Oy's service: [labkotec.service@labkotec.fi](mailto:labkotec.service@labkotec.fi).


## 6 SAFETY INSTRUCTIONS

 SET-2000 Oil/Sludge must not be installed in potentially explosive atmosphere. Probes connected to it may be installed in zone 0, 1 or 2 potentially explosive atmosphere.



In case of installations in explosive atmospheres the national requirements and relevant standards as *EN 50039 and/or EN 60079-14* must be taken into account.

 If electrostatic discharges can cause hazards in the operating environment, the device must be connected into equipotential ground according to requirements with regards to explosive atmospheres. Equipotential grounding is made by connecting all conductive parts into same potential e.g. at the cable junction box. Equipotential ground must be earthed.

 The device does not include a mains switch. A two pole mains switch (250 VAC 1 A), which isolates both lines (L1, N) must be installed in the main power supply lines in the vicinity of the unit. This switch facilitates maintenance and service operations and it has to be marked to identify the unit.

 When executing service, inspection and repair in explosive atmosphere, the rules in standards EN 60079-1 and EN 60079-19 about instructions of Ex-devices must be obeyed.

## 7 TECHNICAL DATA



SET-2000 Oil/Sludge	
Dimensions	175 mm x 125 mm x 75 mm (L x H x D)
Enclosure	IP 65, material polycarbonate
Ambient temperature	-25 °C...+50 °C
Supply voltage	230 VAC ± 10 %, 50/60 Hz Fuse 5 x 20 mm 125 mA (EN 60127-2/3) The device is not equipped with a mains switch
Power consumption	4 VA
Probes	Labkotec SET/S2 and SET DM/3
Max. impedance of the current loop between the control unit and a probe	75 Ω.
Relay outputs	Two potential-free relay outputs 250 V, 5 A, 100 VA Operational delay 5 sec or 30 sec. Relays de-energize at trigger point. Operation mode selectable for increasing or decreasing level.
Electrical safety	EN 61010-1, Class II  , CAT II / III
Insulation level Probe / Mains supply voltage	375V (EN 50020)
EMC Emission Immunity	EN 61000-6-3 EN 61000-6-2
Ex-classification Special conditions (X)	 II (1) G [EEx ia] IIC VTT 04 ATEX 031X (Ta = -25 °C...+50 °C)
Electrical parameters	$U_o = 14,7 \text{ V}$ $I_o = 55 \text{ mA}$ $P_o = 297 \text{ mW}$ $R = 404 \text{ } \Omega$
Characteristic curve of the output voltage is trapezoidal	
See table 2.	

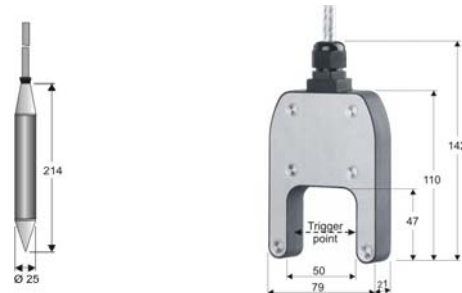
Due to non-linear characteristics of the probe voltage, the interaction of both, capacitance and inductance, must be taken into account. The table below indicates the connecting values in explosion groups IIC and IIB. In explosion group IIA the values of the group IIB can be applied.

	Max. permissible value		Combined Co and Lo	
	Co	Lo	Co	Lo
II C	608nF	10 mH	568nF	0,15 mH
			458 nF	0,5 mH
			388 nF	1,0 mH
			328 nF	2,0 mH
			258 nF	5,0 mH
II B	3,84µF	30 mH	3,5 µF	0,15 mH
			3,1 µF	0,5 mH
			2,4 µF	1,0 mH
			1,9 µF	2,0 mH
			1,6 µF	5,0 mH

$$L_o/R_o = 116,5 \text{ } \mu\text{H}/\Omega \text{ (IIC)} \text{ and } 466 \text{ } \mu\text{H}/\Omega \text{ (IIB)}$$

Table 2. SET-2000 Oil/Sludge electrical parameters

SET DM/3 probe (Oil alarm)	
Principle of operation	Measurement of conductivity
Enclosure	IP68, materials: AISI 316 and PVC
Ambient temperature	-20 °C...+70 °C
Supply voltage	Approx. 12 VDC from SET control unit
Cable	Fixed oil resistant PVC cable 3 x 0,5 mm <sup>2</sup> , standard length 5 m.
EMC Emission Immunity	EN 50081-1 EN 50082-1
Ex-classification	 II 1 G EEx ia IIA T4 VTT 02 ATEX 012X
Electrical parameters	$U_i = 16,5 \text{ V}$ $I_i = 80 \text{ mA}$ $P_i = 330 \text{ mW}$ $C_i = 700 \text{ pF}$ $L_i = 10 \text{ } \mu\text{H}$
Special conditions concerning Ex-classification (X):	
<ul style="list-style-type: none"> <li>- Ambient temperature -20 °C...+70 °C</li> <li>- Shielded probe cable shall be connected to equipotential ground</li> <li>- If probe cable have to be extended, please use LJB3-78-83 junction box. The junction box shall also be connected to equipotential ground.</li> </ul>	
SET/S2 probe	
Principle of operation	Ultrasonic
Enclosure	IP68 Materials:PP, AISI304, AISI 316, PVC and NBR rubber
Ambient temperature	0 °C...+60 °C
Supply voltage	Approx. 12 VDC from SET control unit
Cable	Fixed oil resistant PVC cable 3 x 0,5 mm <sup>2</sup> , standard length 5 m.
Weight	Approx. 450 g
EMC Emission Immunity	EN 61000-6-3 EN 61000-6-2
Ex-classification	 II 1 G Ex ia IIB T5 VTT 07 ATEX 051X
Electrical parameters	$U_i = 16 \text{ V}$ $I_i = 80 \text{ mA}$ $P_i = 320 \text{ mW}$ $C_i = 3 \text{ nF}$ $L_i = 80 \text{ } \mu\text{H}$
Special conditions concerning Ex-classification (X):	
<ul style="list-style-type: none"> <li>- Ambient temperature -25 °C...+60 °C</li> <li>- Shielded probe cable and extra wires shall be connected to equipotential ground</li> <li>- If probe cable have to be extended, please use Labko LJB3-78-83 junction box. The junction box shall also be connected to equipotential ground.</li> </ul>	



- Figure 6. Dimensional drawings of SET DM/3 (left) and SET/S2 (right)