

Manual DK002111, rev.15. June 2015

DR. E. HORN GmbH / Schoenaich, Germany

Water in Oil Identification System for standalone installation:

- **Sensor FRG00032....**
- **Connection box GHG02088-4**
- **3x relay outputs**
- **optional: Analog output for water content and oil Temperature**
- **optional: Indicator box with analog indicator(s), operating devices and acoustic alarm**

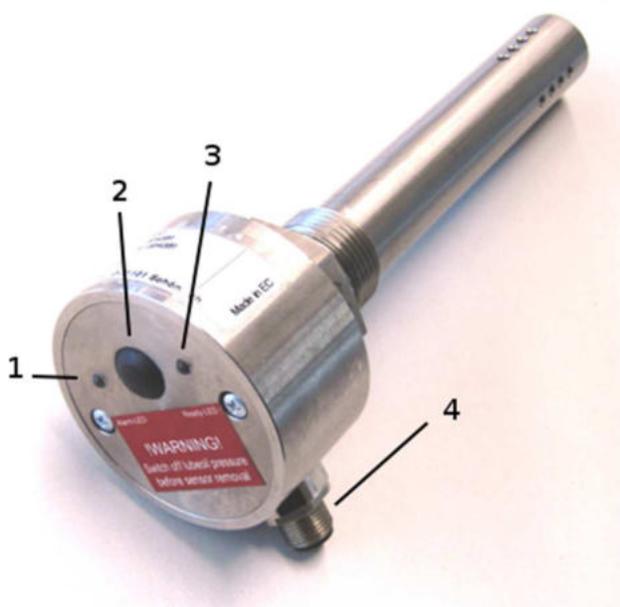
1. Water in Oil (WiO) system

The basic stand-alone version of the water in oil sensor consists of:

- Sensor type FRG00032-... (drawing no.1)
- Connection cable KSG03244-1 with standard length of 15m
- Connection box type GHG02088-4 (drawing no.2)

The sensor type FRG00032-... can be ordered in the following configurations:

FRG00032-2_AW	Sensor unit with 3x relay output
FRG00032-10_AW-1	Sensor unit with 3x relay + analog output for water content (Aout1)
FRG00032-10_AW-2	Sensor unit with 3x relay + analog output for water content and oil temperature (Aout1 + Aout2)



1	Alarm LED
2	Function test button
3	Ready LED
4	M12 connector (A-coded)

Sensor FRG00032-...

Optional accessory:

1. Analog Indicators for displaying of measuring result for local installation options, Aout1 and Aout2

Devices EA 96x96.2slw DW, can be connected to pin 21...24 for visual inspection of the measured data.



2. Indicator Box with analog Indicator(s), function buttons and acoustic alarms. (Stand-alone or optionally connected to AMS)

A yellow signal lamp will be illuminated once pre-alarm occur, a further red signal lamp as well as an acoustic alarm will come up once main alarm occur.



2. Working principle and installation requirements

The working principle is a capacitive measurement operating on absorption of water in oil. The physical measured value is the so called "Water activity" value „AW”.

New oil has the ability to hold a certain amount of dissolved water. The maximum water amount oil can hold is called "saturation point".

Above the "saturation point" free water will fall out which can cause corrosion inside of the engine.

The "saturation point" is influenced by temperature and other different factors like the composition of oil mineral or synthetic, formulation of additives and will change during the lifetime of the oil.

The Water in Oil Sensor (WiO) is not measuring free water or emulsion, which is detectable by regular Water in Oil test kits, it measures the absolute water content in oil.

The context between humidity and „AW" is: $x.x \text{ AW} \times 100 = 100\% \text{ humidity}$

The PAV (Pre Alarm Value) of 0.5AW means 50% of humidity.

The MAV (Main Alarm Value) of 0.9AW means 90% of humidity.

More than 100% (or 1.0AW) means free water, from this point regular Water in Oil test kits begin to measure.

Normally, at site, the water in oil content is measured by a Water in Oil test kit.

The results are mostly <0.02% (or 100.02% humidity), this value means free water content.

→ If the WiO shows alarm, the value is higher than 90%.

Please note:

1. No cleaning of the sensor is needed.
2. Attention: Opening of a sensor immediately expire warranty.
3. It is possible that after a longer time of still stand of the engine, alarm is given. It needs some time of running the engine and oil separators, before a limit of less than 0.5 AW is reached.
4. If the AMS (Alarm Monitoring System) allows a connection of 4...20mA or 0...5V (as ordered by the customer) for the water content and oil temperature, an analog output is available, too. The limit values for the alarm levels, by using the analog outputs, have to be set by the customer.

3. Function

The sensor starts its measurement after power on, based on the calibration in new oil SAE30 TBN5-10 with a temperature of 45°C ex factory, and compares this with the existing lube oil in the system.

4. LED Indication

After power up an internal auto-check starts. The green LED of the connection box indicates by flashing mode that no sensor failure exists. The red alarm LED is **OFF**.

4.1 Indication if water content is >PAV (Pre Alarm Value)

If water content >PAV, the RED Alarm LED in the sensor cover turns in to flashing mode.

4.2 Indication if water content is >MAV (Main Alarm Value)

If the detected water content >PAV is still rising and the value runs >MAV, the RED Alarm LED at the sensor cover changes from flashing to continuous **ON**.

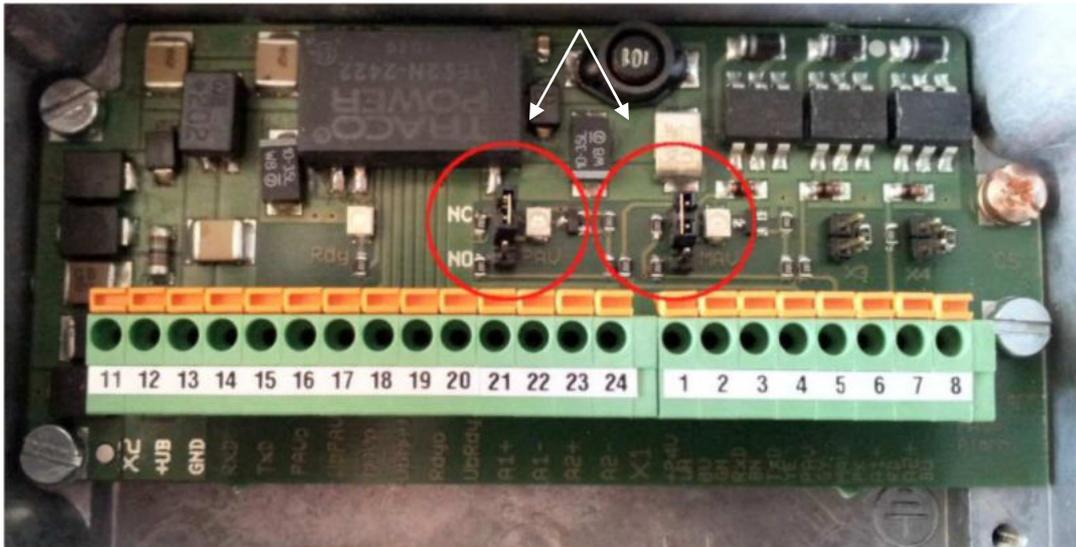
4.3 Sensor - LED indication table

Green LED	Red LED	Indication
flashing	off	Normal operation phase / water content <PAV
flashing	flashing	Water content >PAV → High alarm
flashing	on	Water content >MAV → High / High alarm
off	off	Fault, sensor not connected
on	on	Sensor fault

4.4 Terminal box - LED indication table

Ready LED	Pre Alarm LED	Main Alarm LED	Indication
on	off	off	Normal operation phase
on	on	off	Water content >PAV → High alarm
on	off	on	Water content >MAV → High / High alarm
off	on / off	on / off	Fault

Attention: Inside the terminal box the signal mode of the Alarm LEDs can be changed by jumpers from normally open (N.O. = default settings) to normally closed (N.C.) - if necessary.



Jumpers to change LED signal mode from N.O. to N.C. if necessary

4.5 Indicator Box – LED indication table / acoustic alarm table



- Normal operation phase: The analog indicators are permanently showing the measuring result of “AW” or “C”.
- Water content PAV: the yellow signal lamp is flashing.
- Water content MAV: the red signal lamp is flashing and the acoustic alarm is coming up. By pressing the red signal lamp the acoustic alarm is reset, only for the current alarm.
- System fault: Please check LED status of WiO sensor and LED status of the terminal box.

5. Relay operation table of GHG02088-4 box

Ready relay Position	Status
Open	Sensor defect
Closed	Sensor OK
Water content relay >PAV Position	Status
Closed	water content <PAV
Open	water content >PAV → High alarm
Water content relay >MAV Position	Status
Closed	water content <MAV
Open	water content >MAV → High / High alarm

6. Alarm function test

The sensor has a black rubber button between the two LEDs. Pressing the rubber button for 10sec. the unit will initiate a PAV alarm for 60sec., followed by a MAV alarm for 60sec. The optional analog outputs will also change the value to 50% and later to 90% of the output range. The LEDs will light up and the relay contact will be activated and alarm is coming up at the Alarm Monitoring System (AMS). After the test, the sensor turns back to normal operation mode.

7. Operation and action

PAV → wait

- If the engine crankcase doors had been opened or the lube oil pump had been switched OFF, and sensor at its place of installation might be at that high air humidity in the engine room, the sensor gives alarm. This alarm must go off after lube oil pump starts.
- Attention: It may take up to 24hrs with running lube oil purifier to separate the water from the oil and to set back the Pre-Alarm Value (PAV) to normal.
- Before removing the sensor because of alarm. Please wait for this time to allow the drain-off of the water from the lube oil.

MAV → immediate action = OFF

- If the engine crankcase doors had not been opened, but after engine start gets a water alarm, most probably an inrush of water into the lube oil system causing this alarm. Check water level inside compensation tank and check oil with the on board oil analyzing kit.

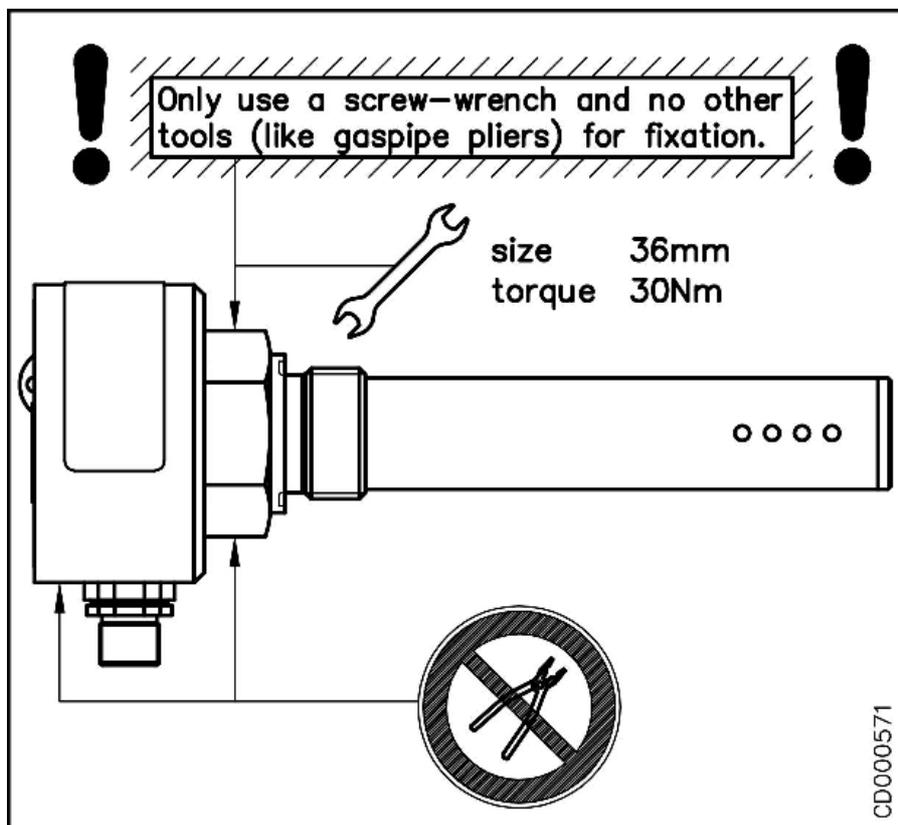
8. Installation and Replacement

8.1 Sensor FRG00032-...

The sensor part must be inserted in the inlet pressure line close to the main engine in accordance and within the limits of drawing no.5+6.

Note:

1. Use a new O-ring for replacing the sensor.
2. For sensor installation in the inlet pressure line a $\frac{3}{4}$ " thread nozzle is needed.
Note: Max. torque moment for tighten the sensor part is **30Nm**.
Please use Loctite® no.545 for mounting on the thread.
3. Please do not use rude pliers for the installation of the sensor – see drawing below. Only use the hexagon part above the $\frac{3}{4}$ " thread with a 36mm wrench for installation. Turning of sensor head will damage and destroy the sensor !



8.2 Terminal box GHG02088-4

The terminal box GHG02088-4 must be placed within the distance of 15m, which is the length of the connection cable.

Attention:

**Remove the paint under the connection point of the PE screw !
Please connect the PE wire of the terminal box correctly to the mounting plate and ensure that the mounting plate is also connected to GND.**

The terminal box GHG02088-4 must be mounted in a position which allows a free view to the LEDs.

8.3 Connection to the sensor part type FRG00032-...

For connection between the sensor and the terminal box GHG02088-4, please use the connection cable type KSG03244-1.

The cable plug nut has to be connected with the socket of the sensor head.

Please pay attention to the internal plug nose of the cable plug and insert the plug carefully into the thread socket of the sensor head.

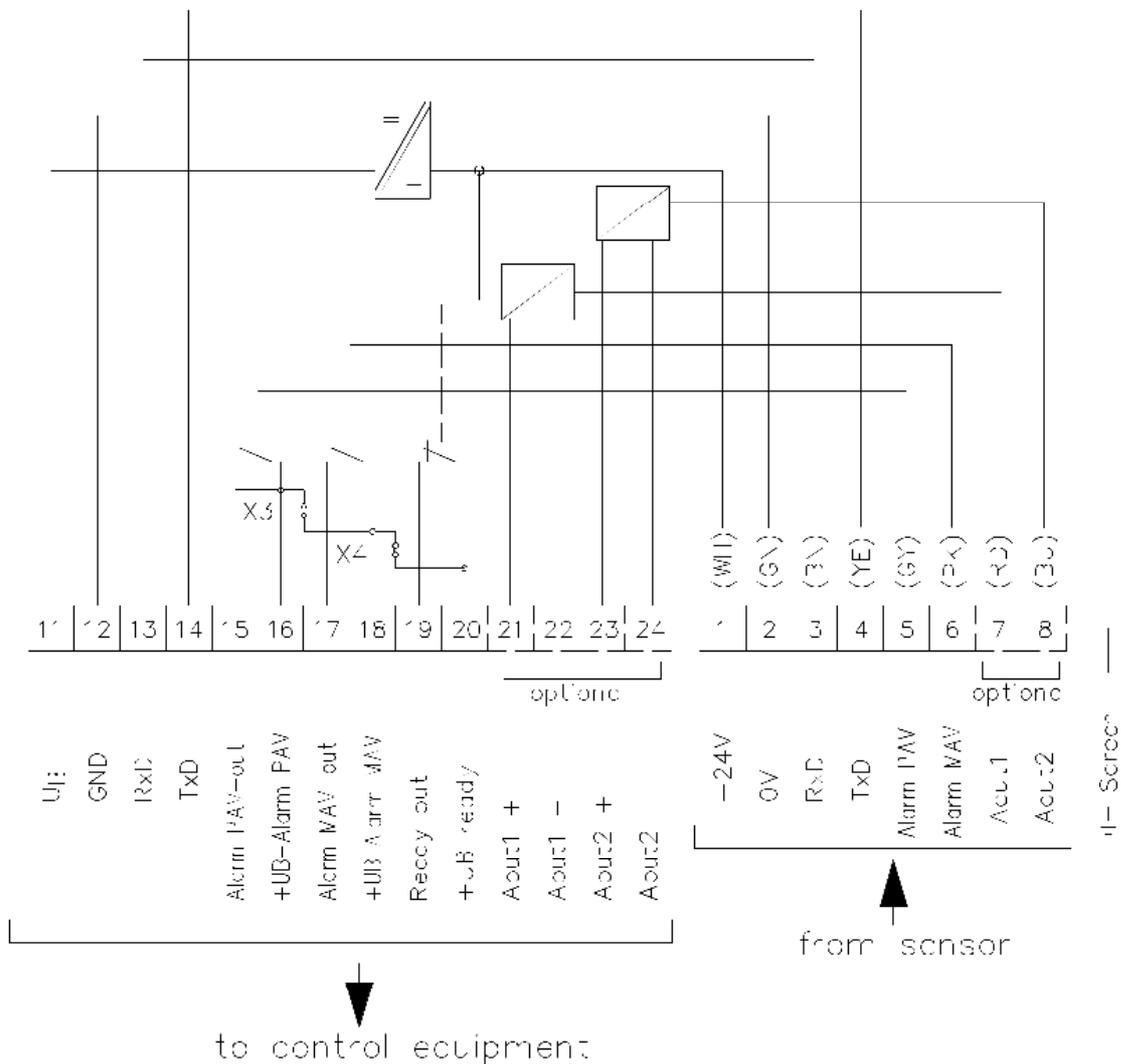
8.4 Connection to the terminal box type GHG02088-4

After removal of the cover of the terminal box type GHG02088-4, the other side of the connection cable can be inserted into the connection terminals 1...8.

Note: The internal wiring in the connection box is already made ex factory.

Technical data:

Power supply	18...32VDC
Current consumption	<60mA
Wrong polarity protection	yes
Photo-MOS outputs	<60VDC
+UB Alarm PAV, +UB ready	
+UB Alarm MAV	
Output current	<300mA
Operating temperature	-25...+85°C
Protection degree	IP67
Spring - cage terminals	
max. cross section	1mm ²
Rload of Aout	<1kΩ



The 24VDC power supply must be made to the connection terminals 11 (+U_B) and 12 (0V/GND).

The alarm relay connection for PAV water in oil is to be made at 15 (-) and 16 (+)

The alarm relay connection for MAV water in oil is to be made at 17 (-) and 18 (+)

The ready relay connection must be made at 19 (-) and 20 (+)

Optional outputs:

The analog water content connection must be made at 21 (+) and 22 (-)

The analog oil temperature connection must be made at 23 (+) and 24 (-)

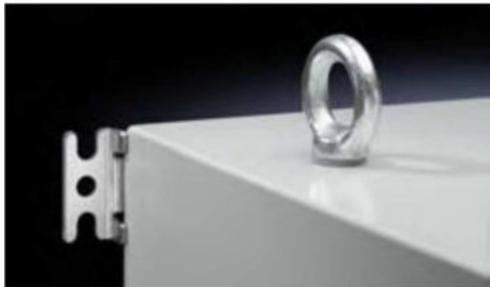
Usually the relay outputs are connected to the Alarm Monitoring System (AMS).

Otherwise analog signal can be used for the water content indication at the Engine Control Room.

Note: Operator / The yard is responsible for the alarm settings of the AMS.

8.5 Installation of optional Indicator Box

The indicator box should be placed in the Engine Control Room (ECR). Please take note of the location in reference to the length of 50 Meter of the connection cable, which is part of the system. **Please ensure that the indicator box is also connected to GND.**



The indicator box is prepared for wall mounting. Depending on the location, compact accessories are optional available.



Easily accessible GND/PE earthing bolt on the back plate.

Door earthing via perforated door strip.

Earth straps in various cross-sections and lengths are available as optional accessories.



A gland plate for easy installation is supplied loose.

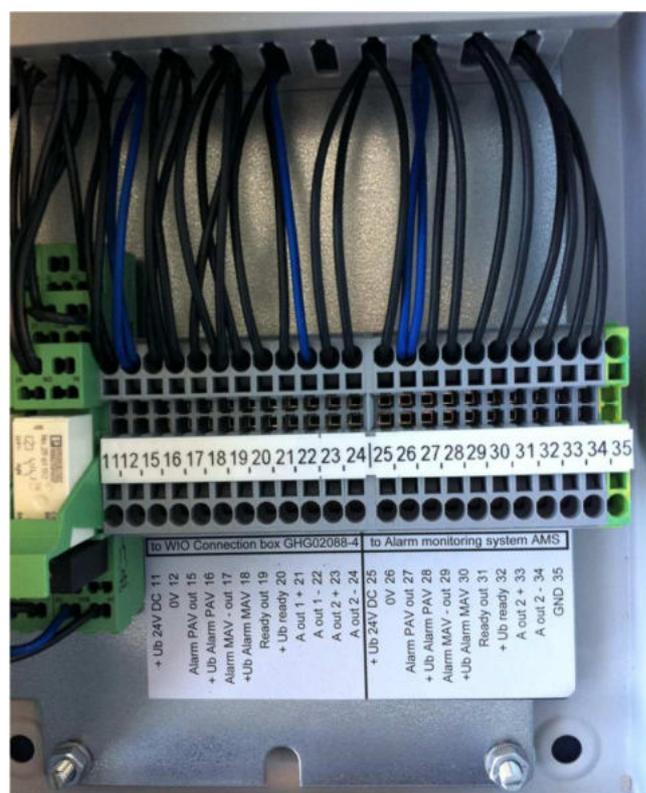


For fast, time saving installation of the indicator box, use wall mounting brackets. Simply insert the expandable dowel into the hole on the backside of the box from the outside and screw-fasten the wall bracket from the outside. In this way the wall bracket securely can be tightened without opening the box door.

8.5.1 Electrical wiring of Indicator Box (see page 19 “Cable connection diagram of Indicator Box”)



Terminal Box



Indicator Box

The terminals of the indicator box have to be connected with the terminals of the terminal box. The lines 11 up to 24 of the terminals have to be connected in parallel. The line 13 and line 14 of the terminal box staying free, because the indicator box doesn't have line 13 and line 14.

For connection of the Alarm Monitoring System (AMS) of the Ship Network to the Indicator Box see also Chapter 8.4. Equivalent to the terminal lines 15 up to 24 of the terminal box, the terminal lines 27 up to 34 have to be used in case to WiO stand-alone system should be connected with the AMS. The lines 25 and 26 should be connected to power supply. Line 35 is connected to GND.

8.6. Sensor replacement

Before the sensor can be removed, please carry out the following operations:

- Stop lube oil pump; drain lube oil pipe; ensure that lube oil pipe is drained
- Disconnect the sensor cable type KSG03244-1; unscrew / disconnect sensor

Use a new O-ring when installing the sensor part again and use Loctite® no.545 to seal the thread. Note the max. torque moment of **30Nm**. (see 8.1)

9. Technical data

9.1 Sensor FRG00032

Power supply	18...32 VDC
Current consumption	<30mA
Wrong polarity protection	yes
Output status	PNP / Ri=10k
Output current max.	200mA (Short Circuit Protected)
Operating temperature	-25...+85°C
Protection degree	IP67
Pressure resistance against medium	10bar
Rload of Aout1 + Aout2	<1k

9.2 Terminal box GHG02088-4

Power supply	18...32 VDC
Current consumption	60mA
Polarity protection	yes
Photo-MOS outputs	<60VDC
Alarm relays: PAV, MAV, Ready	
Output current	<300mA (Short Circuit Protected)
Operating temperature	-25...+85°C
Protection degree	IP67
Spring cage terminals	
max. cross section	1mm ²
Analog output: Water in oil (Aout1)	4...20 mA (equiv. 0...1AW)
Analog output: Temperature (Aout2)	4...20 mA (equiv. 0...100°C)

9.3 Indicator Box GHG02088-50

Power supply	18...32 VDC
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10. Drawings

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HA = High Alarm or Pre Alarm Value (PAV)
HHA = High High Alarm or Main Alarm Value (MAV)

Technical data:
 Power supply 18...32 VDC
 Current consumption <30 mA
 Wrong polarity protection YES
 Output status PNP/R_i=10K
 Output current max. 200mA
 Operating temperature -25...+85 °C
 protection class IP65
 electronic part red/black
 warning label 10 bar
 Pressure resistance against medium stainless steel
 Housing material Rload Aout1 & Aout2 <1k

Wiring Diagram:

```

    +24V --- 1 WH
    0V --- 3 GN
    RxD --- 2 BN
    TxD --- 4 YE
    Alarm PAV --- 5 GY
    Alarm MAV --- 6 PK
    Aout1 optional --- 7 RD
    Aout2 optional --- 8 BU
    
```

< HA	OFF	Flashing	Low	Low
HA < HHA	Flashing	Low	High	Low
> HHA	ON	Low	Low	Low

Operating mode:
 active
 Flashing
 adjusting
 ON

Water Activity:
 < HA
 HA < HHA
 > HHA

Alarm LED:
 Alarm HA output
 Alarm HHA output

Ready LED

Z.-Nr. FRG00032-...
 Benennung: **Wasser in Oil Sensor**
Water in oil sensor
 Maßstab: **1:1.25**

Tag	Name
31.03.10	Schmid
31.03.10	Vollmer

Norm

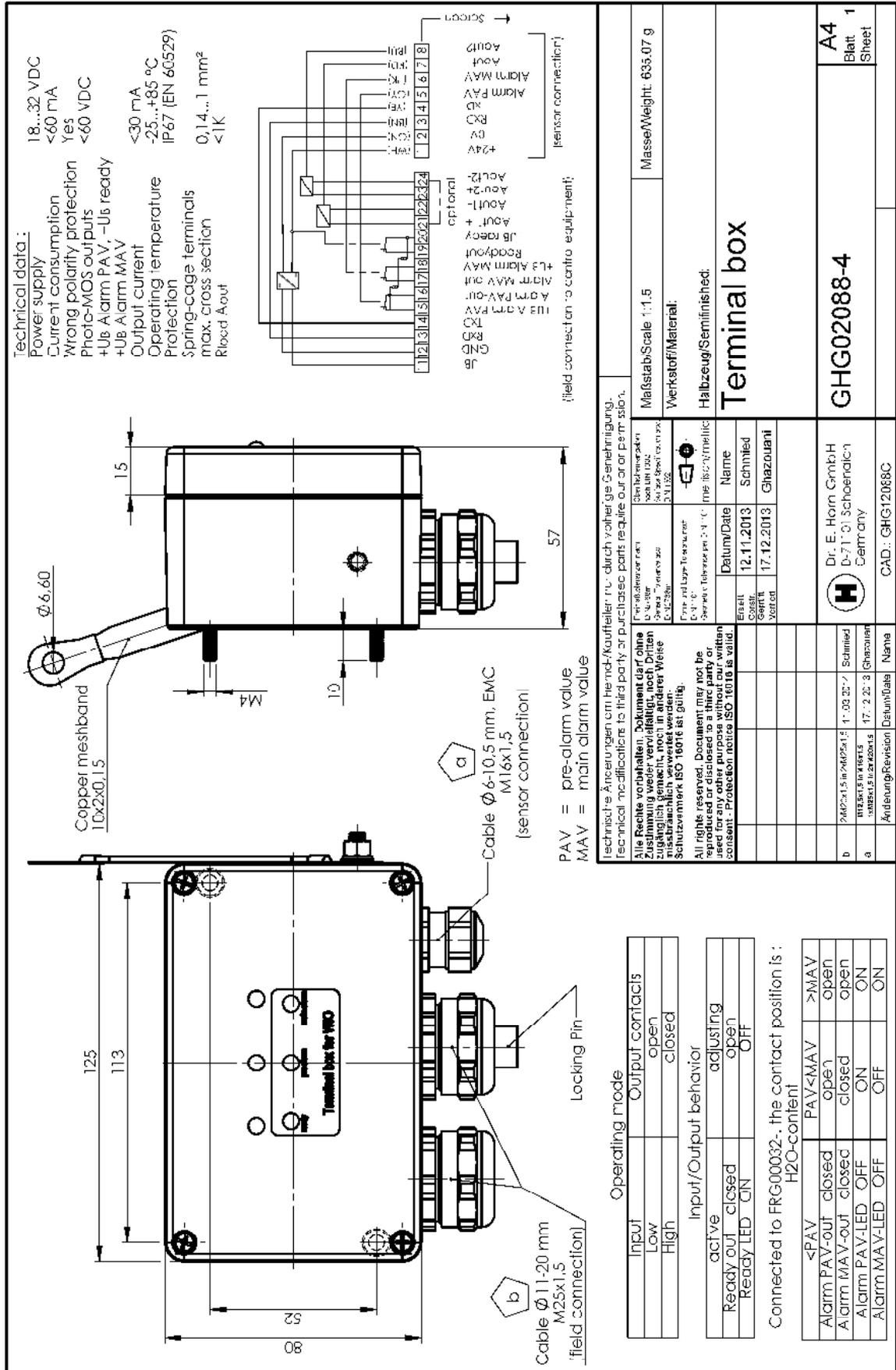
Dr. E. Horn GmbH
 D-71101 Schönaich

a	Connection restyled	16.11.10	Schmid
b	new Connection diagr.	04.06.12	Fischer

CAD Nr. FRG0003K

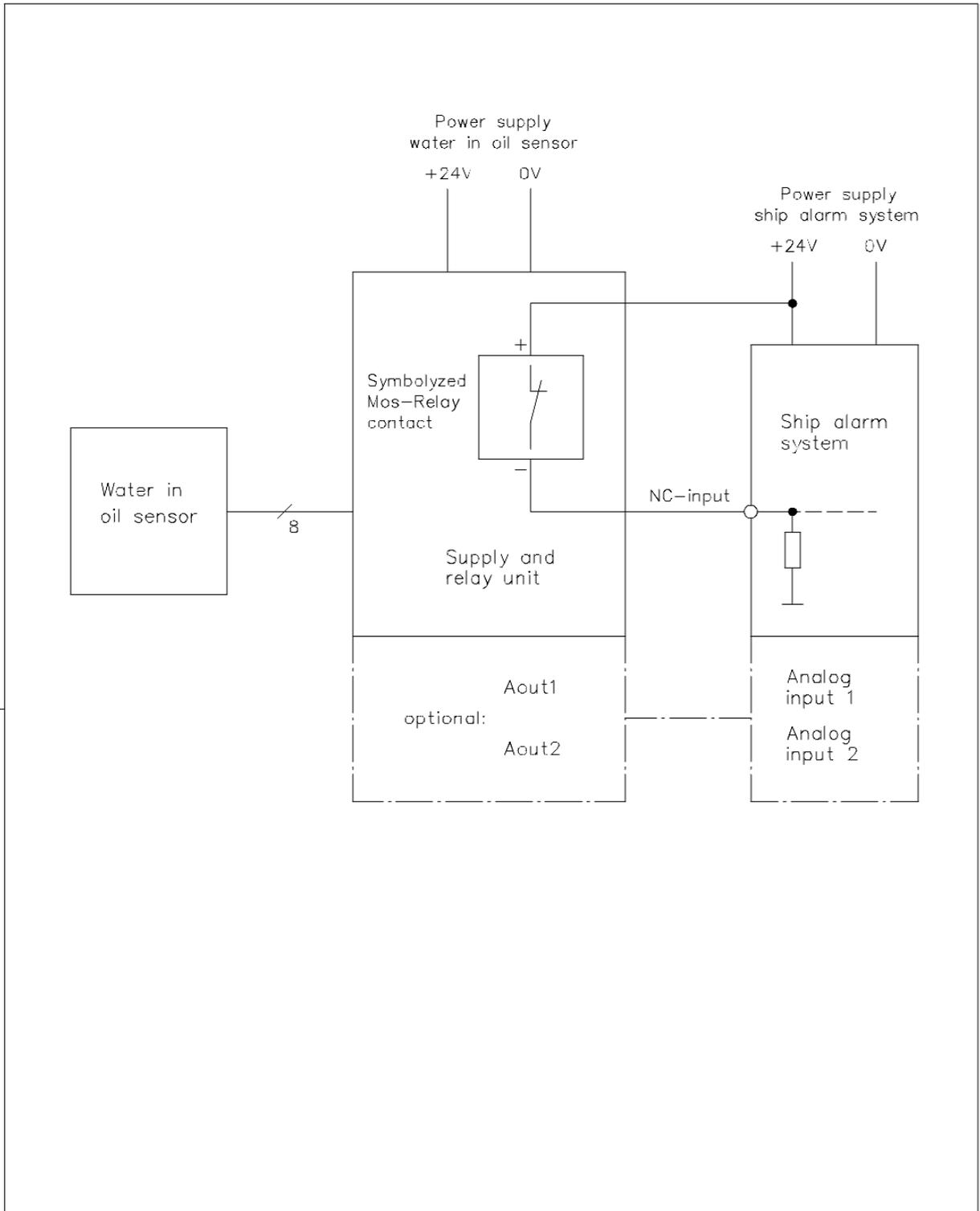
Drawing no. 1

Water in Oil sensor type FRG00032-...



Drawing no. 2 Connection box type GHG02088-4

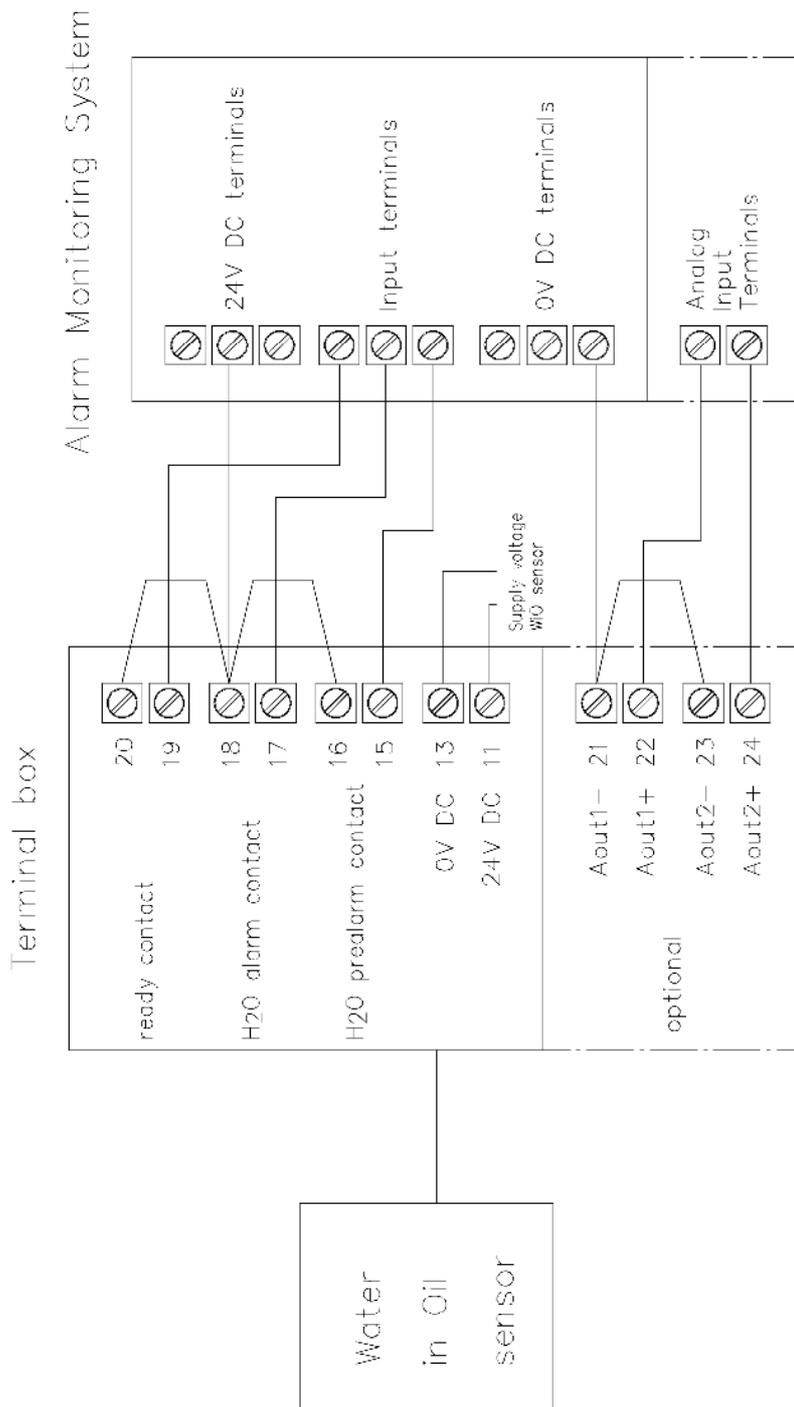
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CAD Nr. EY100089				Tag	Name	Z.-Nr.	Maßstab	
				Gez.	10.06.10	Schmied	EY100089	
				Gepr.	10.06.10	Vollmer		
				Norm				
Benennung						Connection princip		
e				 Dr. E. Horn GmbH D-71101 Schönaich		Ersatz für		
d						Ersetzt durch		X Y
c								
b								
a	Changed the title block Änderung	10.06.10 Tag	Stengelin Name					

Drawing no. 3 Connection principle

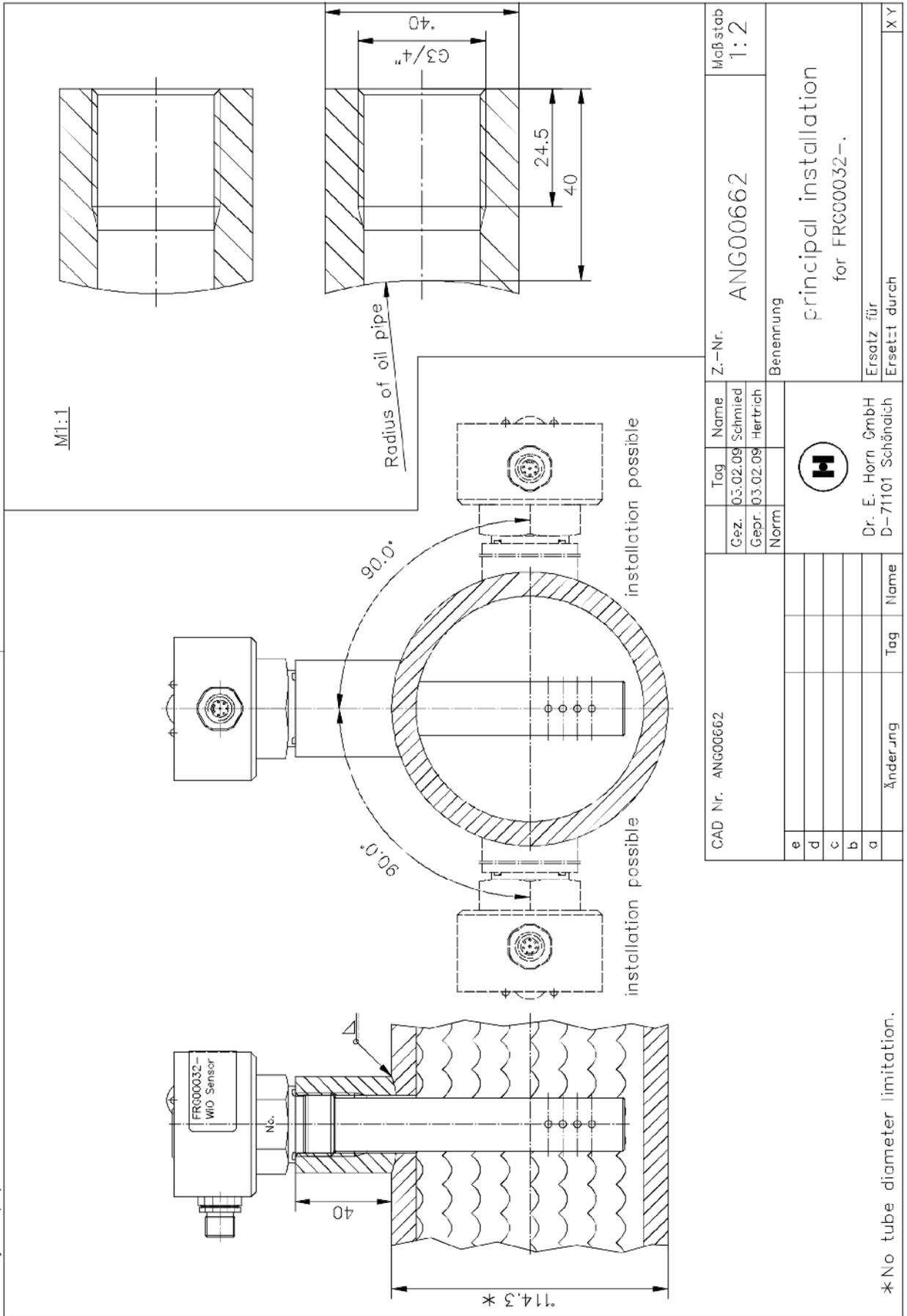
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CAD Nr. EY500251			Tag	Name	Z.-Nr.	Maßstab
			Gez. 10.06.10	Schmied	EY500251	
			Gepr. 10.06.10	Vollmer		Benennung
			Norm		Wiring Diagram	
e						Ersatz für
d						
c						
b						
a	Changed the title block	29.04.13				
	Änderung	Tag	Name	D-71101 Schönaich		

Drawing no. 4 Connection principle to ship's Alarm Monitoring System (AMS)

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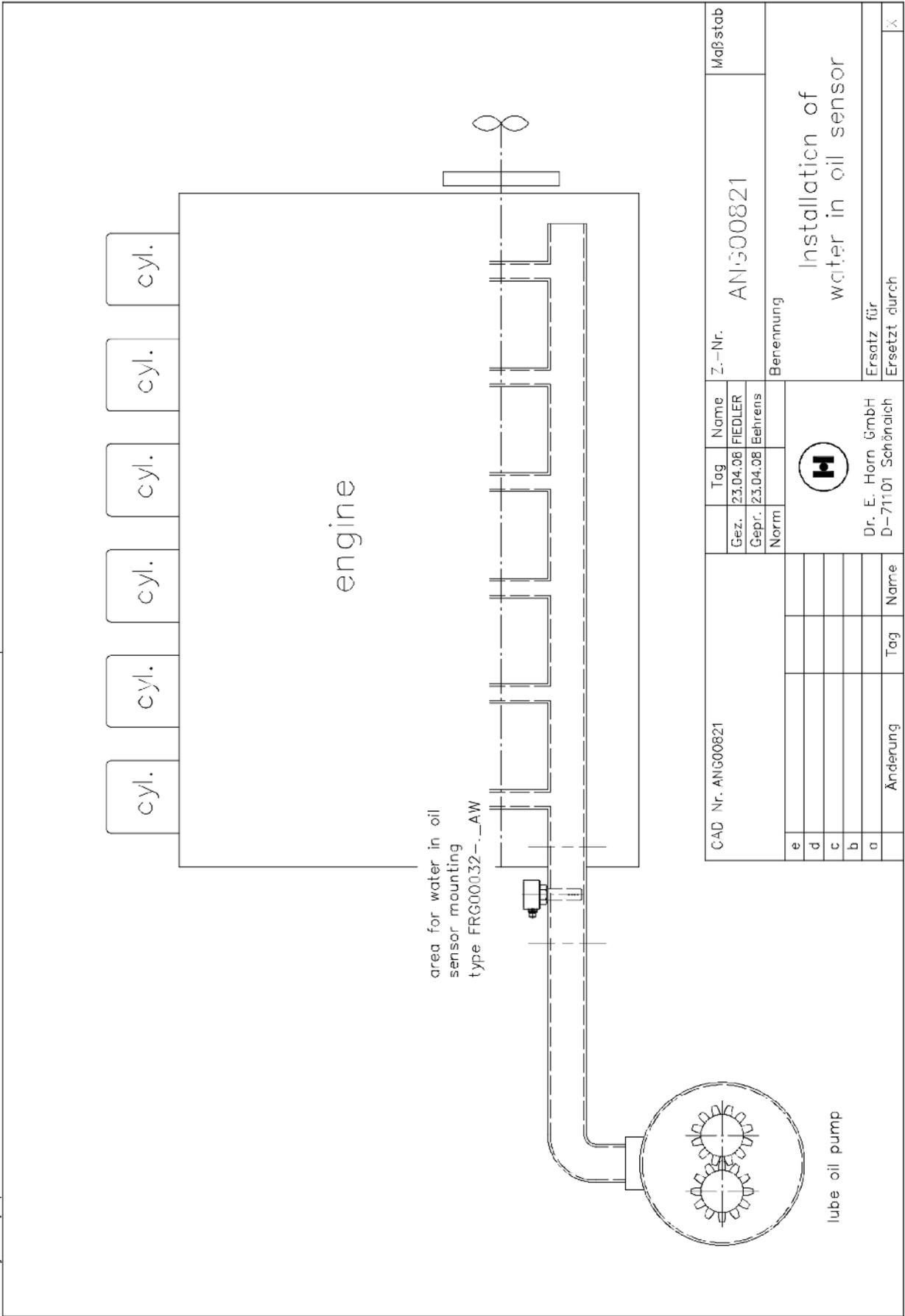
Drawing no. 5

Possible position of Water in Oil sensor in oil tube

CAD Nr. ANG00662		Z.-Nr. ANG00662		Maßstab 1:2	
Gez. 03.02.09	Tag 03.02.09	Name Schmied	Benennung		
Gepr. 03.02.09	Gepr. 03.02.09	Name Hertrich	principal installation for FRG00032-.		
Norm				Ersatz für	
		Dr. E. Horn GmbH		Ersetzt durch	
		D-71101 Schönaich		XY	
e		Änderung	Tag	Name	
d					
c					
b					
a					

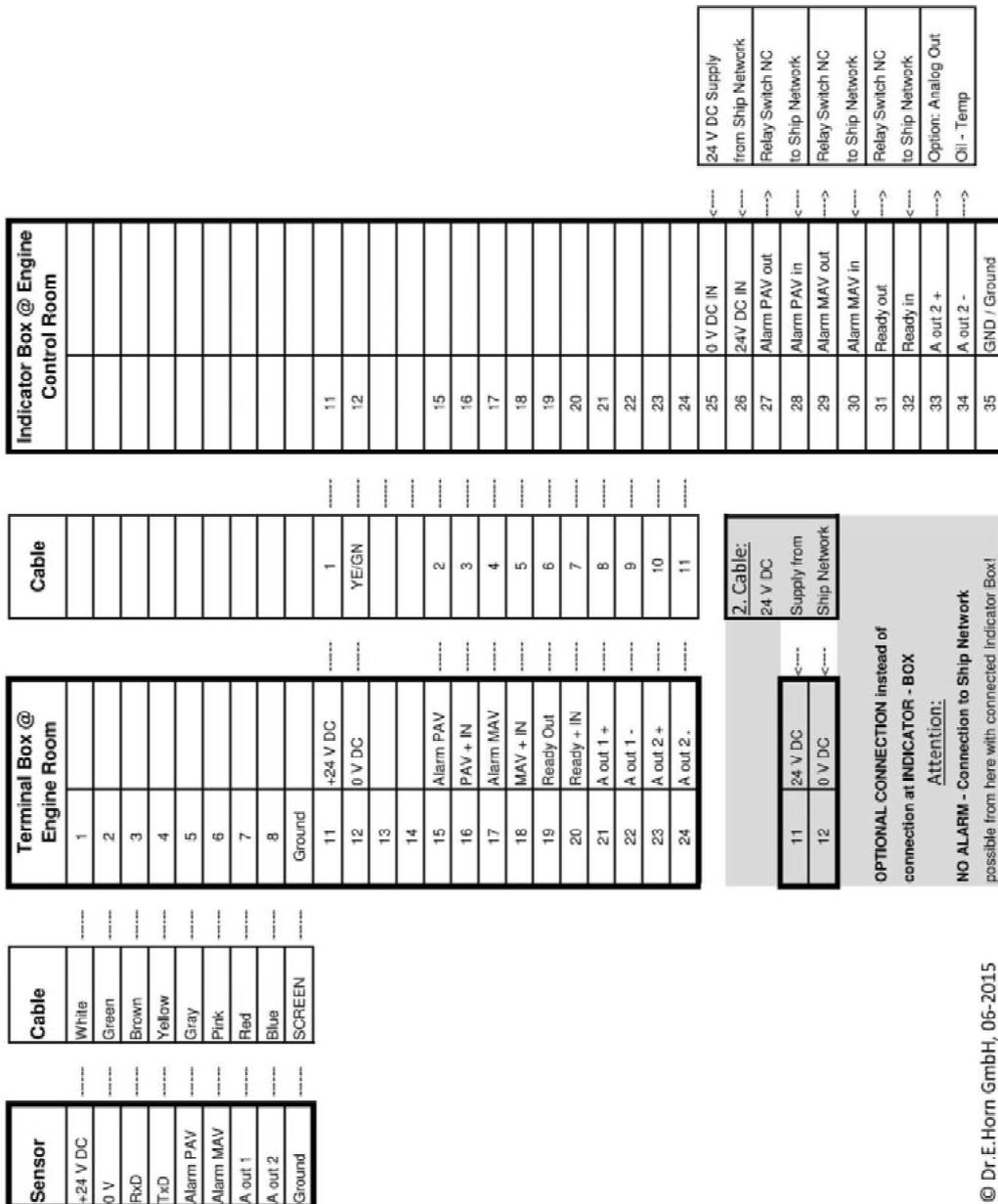
*No tube diameter limitation.

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Drawing no. 6 Possible location of Water in Oil sensor

Cable connection diagram of Water in Oil Monitoring System and Indicator Box



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Fixing and mounting sizes [mm] of Indicator Box

