

OIL MANAGEMENT SWITCHES

Instruction manual HBOC and HBOR both mk1 and mk2 versions.

Introduction

The sensors are designed for control of oil levels in gas **HBOC** and in Liquid ammonia **HBOR**. **HBOR** will also be useable for measuring water in oil. Both sensors can control a level based on a single switch. These sensors replace the common mechanical float and the two-switch solution where a minimum and maximum level switch is used for controlling the level.



The difference between mk1 and mk2 is the output on the cable.

- HBOC/C and HBOR/C has 24 **VDC** max 24 W output on the cable
- HBOC/C mk2 and HBOR/C mk2 has 24 V **AC/DC** max 24 W output on the cable

Mk2 version are labeled mk2. Mk1 versions are not labeled mk1

The sensors share the same tool and technology, and they can be setup for these 4 modes:

Compressor

For compressors and similar solutions where oil is constantly consumed or removed, the switch can open a valve which fills up the oil reservoir. The **HBOC** is used.

Separator

For oil separators and similar solutions where oil is constantly added, the switch can open a valve which drains up the oil reservoir. The **HBOC** is used.

Switch

As a normal oil switch which can be configured to any oil type and temperature by changing the calibration

Oil return

For control of oil pots and suction accumulators where oil, liquid ammonia and ammonia gas can be present. This application is like oil separator, but this switch can handle the liquid ammonia. The **HBOR** is used. The switch is also capable of detecting water in oil - if the water separates.




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Safety Instructions

CAUTION! Always read the instruction manual before commencing work! Heed all warnings to the letter! Installation of HBOC/HBOR requires technical knowledge of both refrigeration and electronics. Only qualified personnel should work with the product. The technician must be aware of the consequences of an improperly installed sensor and must be committed to adhering to the applicable local legislation.

If changes are made to type-approved products, this type approval becomes void. The product's input and output as well as its accessories may only be connected as shown in this guide. HB Products assumes no responsibility for damages resulting from not adhering to the above.

Explanation of the symbol for safety instructions. In this guide, the symbol below is used to point out important safety instructions for the user. It will always be found in places in the chapters where the information is relevant the safety instructions, and particularly the warnings, must always be read and adhered to.

	<p>CAUTION! Refers to a possible limitation of functionality or risk of use.</p> <p>NOTE! Contains important information about the product and provides further tips.</p> <p>The person responsible for operation must commit to adhering to all the legislative requirements, preventing accidents, and doing everything to avoid damage to people and materials.</p>
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Intended use, conditions of use. HBOC/HBOR level controller is made for continuous measurement and control of oil levels in compressors and separators. If HBOC/HBOR is to be used in a different way or with another purpose, and if the operation of the product in this function is determined to be problematic, prior approval must be obtained from HB Products

Prevention of collateral damage Make sure that qualified personnel assess any faults and take necessary precautions before attempting to make replacements or reparations, to avoid collateral damage.

Environmentally correct behavior, disposal instruction: HBOC/HBOR is built so that the modules can easily be removed and sorted for disposal.



NOTE! All terminals are protected against incorrect termination with a supply voltage of up to 40V. If the supply voltage is greater than 40 V, the electronics will be damaged.

Design

The sensor consists of a mechanical part and an electronic part. These are easily separated by loosening 2 set screws, or by loosening the large threaded union. The electronic part is designed in accordance with IP54 for the solutions with set screws and IP66 for the products with threaded union. The mechanical part is produced in AISI304/PTFE and tested to withstand high pressure and all common refrigerants.

Software

The sensor is supplied with the latest firmware. The sensor is configured with a configuration tool, "HB Tool", using a PC. It can determine on its own the current version which was delivered. The latest version of the tool is backwards compatible. It is not possible to update the firmware in a sensor which has already been delivered.

Working principles

Compressor mode

For installations in a compressor or similar applications, where the oil level is reduced over time.

The switch will be passive if it detects oil.

The switch will detect oil if the level is above the trigger point and keep detecting until the level is below the hysteresis. The hysteresis is a lag built into the switch to make the detection more stable.

When the measured is below hysteresis point, the switch starts to operate.

The operation starts with a delay called sensor dwell.

Then the oil cycle period starts, and the switch measures the level. If it is below the hysteresis level it will open the inlet valve for a period.

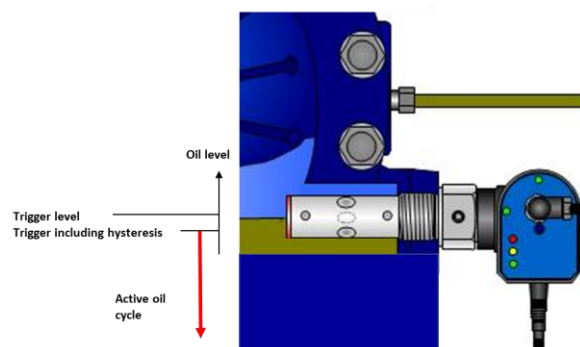
After the first oil cycle has ended a new period will start and this will continue as long as the oil level is below the trigger point. If the number of cycles, where oil does not pass the trigger level, pass the alarm limit an alarm will be set and the systems should be stopped.

The following numbers can be set as parameters:

The trigger point is typically 50% and related to the calibration of the switch. It means that the switch has a trigger point when it is half covered with oil.

The switching hysteresis can be changed, and it means that the level measurement in the switch need to be lowered by a certain percentage to stop detection of oil. The initial value is 11% and this secures a good operation.

Dwell delay is as standard set to 10 seconds.



Oil cycle period is as default set to 60 seconds and the length can be changed if a frequent oil feed is needed.

Oil valve opening time. This valve must be specified so that the oil feed capacity is larger than the consumption, but not too large. The standard value is 10 seconds, but the value must reflect the size of valve and oil consumption which means the value must be set based on calculations or experience. The opening time should be adjusted so it secures the sump is filled in between 1 and 5 cycles.

The Alarm counter is used to detect failures in the system like lack of oil, high consumption etc. and it detect when an abnormal high number of oil cycles have not been able to fill the oil sump to the required level. The standard number is 30 cycles, but the value depends on the other settings.

Filter time calculate an average over time and makes the output more stable. 5-10 seconds is a good starting point.

The complete controlling system can either operate all the time or the system can be put on standby when the system is stopped or paused. This is done via the run-in signal. If set to off the switch will operate constantly. If put to on the controller will only work when 10-24 V is applied to pin 5.

Separator mode

For installations in a suction accumulator, oil separator or similar applications, where the oil level is increased over time.

In the picture an application for oil return in liquid ammonia with a HBOR is shown in combination with an ejector for oil control. In an oil pot where oil and gas is present the HBOR will be used as it measures oil in gas.

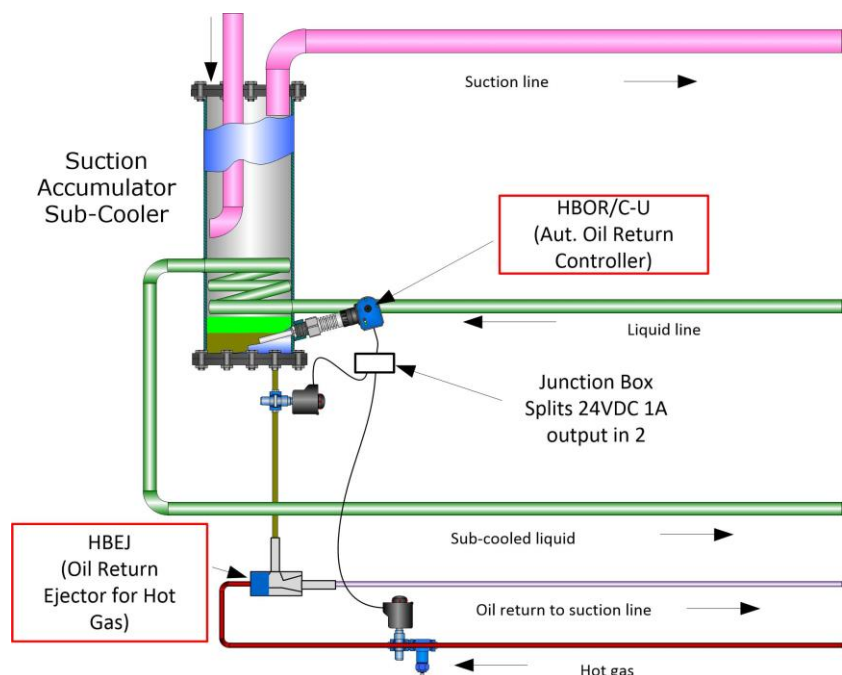
The switch will be passive if it does not detect oil.

The switch will detect oil if the level is above the trigger point and keep detecting until the level is below the hysteresis. The hysteresis is a lag built into the switch to make the detection more stable.

When the measured level is above the hysteresis point, the switch starts to operate.

The operation starts with a delay called sensor dwell.

Then the oil cycle period starts, and the switch measures the level. If it is above hysteresis level it will open the inlet valve for a period.





After the first oil cycle has ended a new period will start and this will continue as long as the oil level is above the hysteresis point. If the number of cycles, where oil does not pass the hysteresis point is higher than the alarm limit, an alarm will be set, and the systems should be stopped.

The following numbers can be set as parameters:

The trigger point is typically 50% and related to the calibration of the switch. It means that the switch has a trigger point when it is half covered with oil.

The switching hysteresis can be changed, and it means that the level measurement in the switch need to be lowered by a certain percentage to stop detection of oil. The initial value is 11% and this secures a good operation.

Dwell delay is as standard set to 10 seconds.

Oil cycle period is as default set to 60 seconds and the length can be changed if a frequent oil drain is needed.

Oil valve opening time. This valve must be specified so that the oil drain capacity is larger than the consumption, but not too large. The standard value is 10 seconds, but the value must reflect the size of valve and oil consumption which means the value must be set based on calculations or experience. The opening time should be adjusted so it secures the sump is drained in between 1 and 5 cycles.

The Alarm counter is used to detect failures in the system like too much oil, high filling rate etc. and it detect when an abnormal high number of oil cycles have not been able to drain the oil to the required level. The standard number is 30 cycles, but the value depends on the other settings.

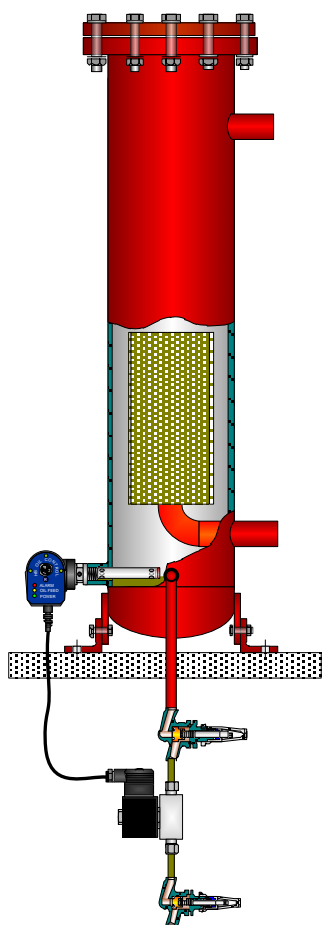
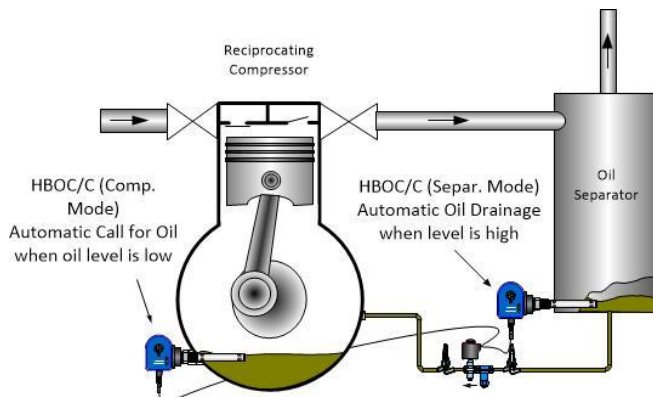
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Applications

HBOC is typically used for oil level control in compressors and oil separators. In both applications oil level is measured in gas and the sensor can provide direct control of a magnetic valve

Control of oil level in compressors: The sensor detects if there is oil where it has been installed. When the level falls below the target level, oil is added from an oil reservoir or a separator, according to the specified parameters. Especially in high pressure systems, it is crucial to avoid oil flooding in the crankshaft housing, and therefore the oil return valve must be precisely controlled.



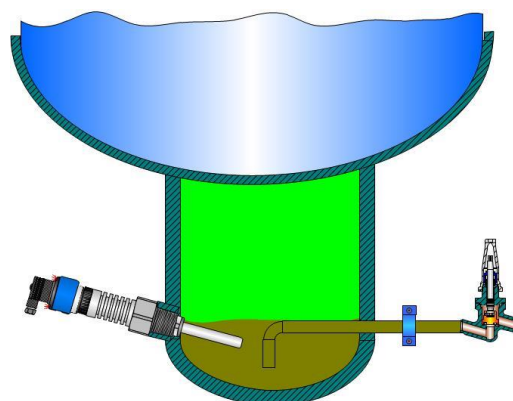
Control of oil level in separators: The sensor detects if there is oil in the container. If there is too much oil, the valve opens to allow drainage to the compressor crankshaft housing or to an oil reservoir. The sensor is also able to raise an alarm if, during a given period, the amount of oil separated does not conform to expectations. All parameters for the use of **HBOC** in this function are easily set up in the configuration tool.

Liquid separators contain oil, liquid ammonia, and gas. For this application the **HBOR** is used, and it detects the oil below the ammonia.

Both the simple **HBOR**, connected to a PLC, and the more advanced **HBOR/C** can be used to control the oil level. The **HBOR/C** is able to control a solenoid valve directly and this can reduce the cabling work.

The controlling is described under working principles

The sensor will also detect gas if no or only a little liquid ammonia is present.



HBOR-U
(Oil Return Switch)

Installation Guide

For both applications, the following applies:

- 1) The sensor must be installed in a horizontal position.
- 2) During installation, check the sensor's length as well as its placement with the refrigeration compressor manufacturer or the oil separator producer. Oil pockets may not form around the sensor, and there must be a gap of at least 2mm between the sensor and the other mechanical parts.



CAUTION! In case of welding work on the unit, please make sure that proper earthing is carried out to avoid damaging the electronics.

Accessories:

The sensor can be supplied with the following accessories:

- 1) USB cable for configuration - HBxC-USB
- 2) Supply cable with M12 plug (5 at 10m length) – HBxC-M12/5 / HBxC-M12/10
- 3) HBS/ADAP/FLANGE: Flange adapter that replaces sight glass for the installation of the HBOC on refrigeration compressors. There are several different flange types, which are ordered independent of the type of compressor (see the attachment with an overview of compressors and ordering codes).



Mounting Guide

HBOC is mounted either on a compressor or an oil separator. On a compressor, an adapter flange can be provided as an accessory. The sensor is sealed with Teflon tape or liquid gasket before installation. Dependent upon the thread type, the gasket consists of:

- NPT thread = Teflon tape or liquid gasket
- BSPP & UNEF = Aluminum washer/gasket



Required for installation is: 2.5mm Allen key, a shifting spanner, as well as gasket material depending on the thread type.



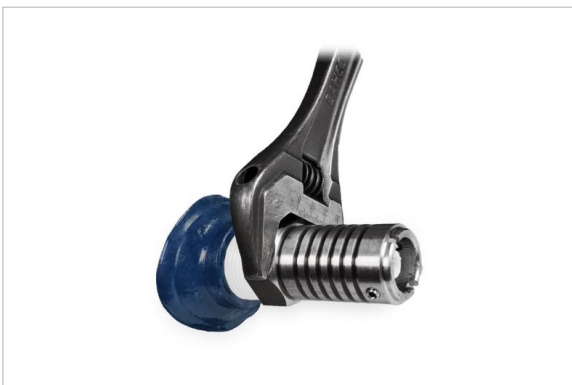
Loosen two set screws, or loosen the threaded union



Separate the electronic part from the mechanical part.

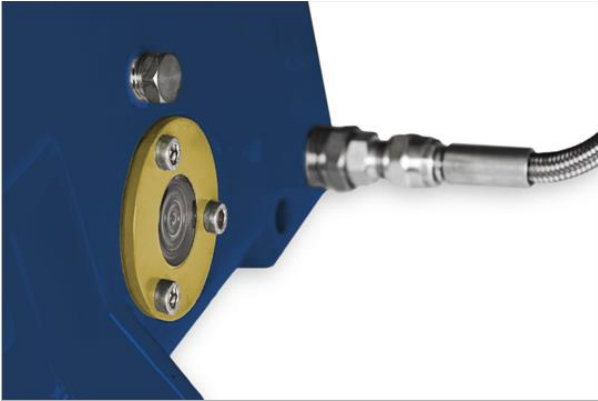


Teflon or liquid gasket is applied to the conical thread. Cylindrical thread is installed with gasket.



Fasten the mechanical part with a suitable spanner (tightening torque 80-150 Nm, depending on thread type).

Installation on Flange



HBOC can be installed on the compressor housing directly where the sight glass is installed.



Remove sight glass and clean surface.



Install flange on the compressor housing. Use O-ring Ø32x2.5 for sealing



Teflon or liquid gasket is applied to the mechanical part of the sensor, and it is secured to the interior thread of the flange.

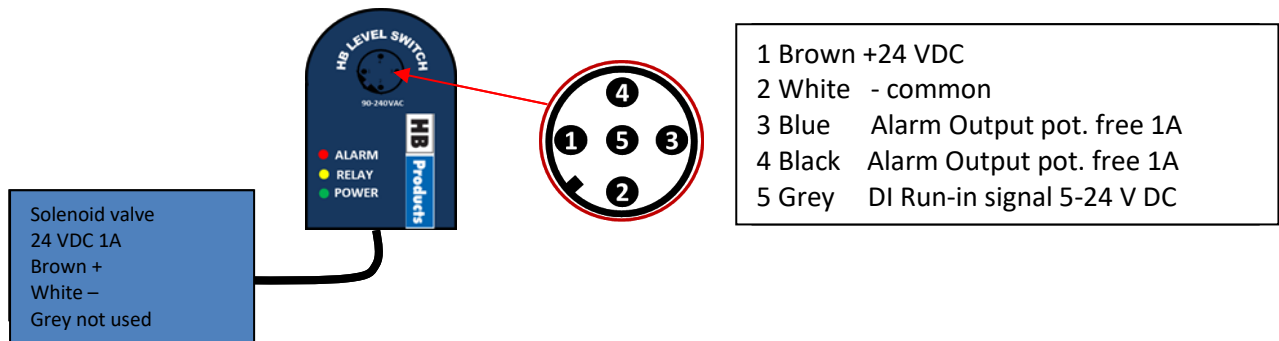


The sensor housing is re-installed, either via a threaded union or the 2 set screws

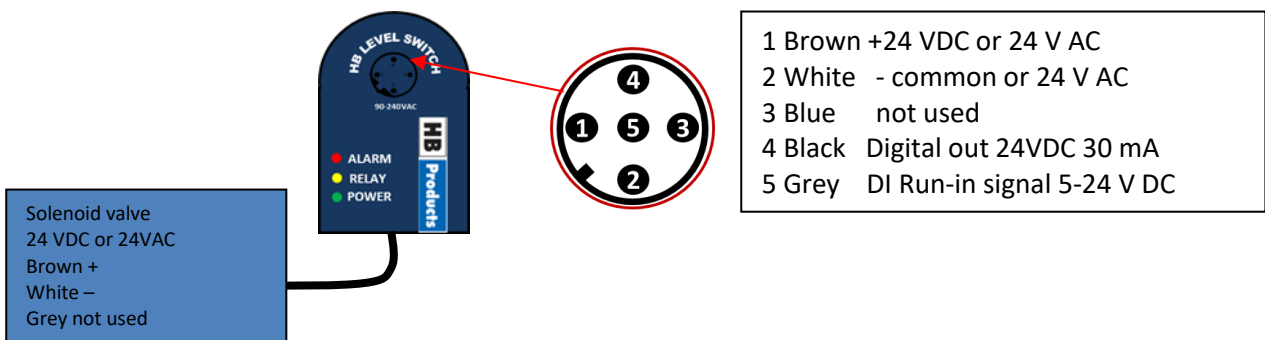
Electrical connections

HBOC/C and HBOR/C can be supplied with direct control of the magnetic valve, or it can be connected to the central control via the sensor's control/alarm output. See the diagrams below for the two variants

HBOC/C and HBOR/C - mk1 (DC version – DC supply and DC output on cable)



HBOC/C and HBOR/C – mk2 (AC version – AC/DC supply and AC/DC output on cable)



The sensor controls the valve independent of other parts of the system. The function starts to work when the supply is connected. The control function can be activated/deactivated via an external run signal with "Run in" (pin 5) or work continuously

LED Indication & Calibration

LED indication:

- 1) 3 x green LEDs indicate oil level
- 2) Green Power LED constant light indicate sensor is standby – not controlling
Green Power LED flashes when the sensor is in control operation.
- 3) Yellow LED indicates supply is open to magnetic valve
- 4) Red LED indicates ALARM

LED signal	ON/OFF/Frequency	Functionality
Green (3x)	ON	Oil detected
	Flash	Turbulence in the compressor housing
	OFF	Oil is not detected
Green POWER	ON	Standby power connected
	Flash	In operation or when the sensor is connected to HB Tool. (Red and yellow LED also flashes)
	OFF	No supply
Yellow	ON	Activation/supply to the magnetic valve
	OFF	Magnetic valve is not being supplied
Red	ON	Alarm. Activated automatically according to a calculated time span if oil has not been detected (oil cycle x alarm counter = Time before alarm goes off). Output relay (pin 3 & 4) is activated.
	OFF	Oil level reached in accordance with the calculated time span / number of oil cycles.
	Flash	Sensor is faulty

Calibration:

HBOC is pre-calibrated upon delivery and ready for use in refrigeration systems systems using conventional mineral and PAO oils. If the **HBOC** is used in other oil types a calibration might be needed. This calibration is done by using the HB tool connected via an USB cable.

Calibration instructions:

Both a calibration in gas an oil must be done:

A zero calibration is performed when the switch is in gas. The calibration is done by clicking on the zero-calibration button in the tool.

A span/max calibration is done when the switch is covered with oil. The calibration is done by clicking on the span-calibration button in the tool.

HBOR is pre-calibrated upon delivery and ready for use in ammonia systems only. If the sensor is used in other systems/applications, please contact HB products

PC Configuration

The sensor is supplied with the following configuration options and factory settings:

Compressor mode	Configuration options	Factory settings
Alarm delay	0...3600 s	5 s
Oil separator mode		
Alarm delay (separator mode)	10...10.000 min	60 min
General settings		
Oil cycle periods/time	1...300 s	60 s
Oil valve open time	1...300 s	10 s
Alarm counter (no of oil cycles)	1...100	30
Filter func/time cons. in sec	1...30 s	5 s
Switching hysteresis in %	1...50%	11 %
Oil sensor dwell delay in sec	1...30 s	10 s
Calibration function	ON / OFF	OFF
Set trigger set point in %	0...100%	50%
Oil cycle function	ON / OFF	ON
Alarm output signal	NO / NC	NC
Run in signal	ON / OFF	OFF

Fault Detection

General:



NOTE! Fault detection on the electronics and/or replacement of the electronics can be carried out without releasing pressure on the system or removing the mechanical part of the sensor

Fault Detection

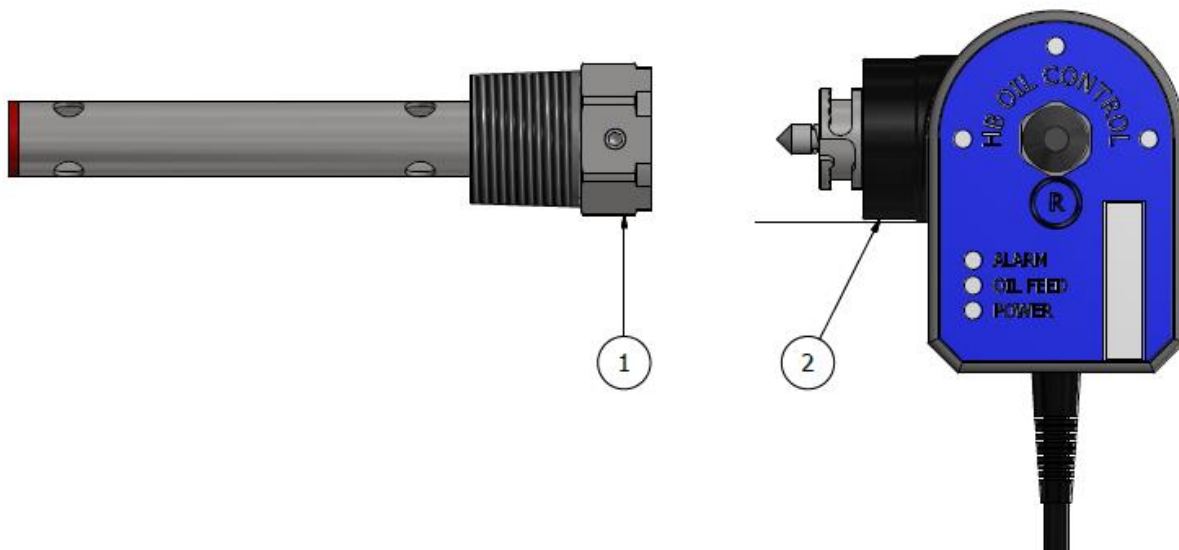
Fault	Reason	Correction of fault
No LED is on.	No supply to the sensor or defective cable/plug	Check and find faults in the power supply. Change the supply cable.
Sensor does not trigger even though there is oil.	Quality/type of oil is different from that used during factory calibration.	Recalibrate the sensor.
Red alarm	Oil level has not been attained during the specified number of oil cycles.	Check system oil return. Check oil filter and magnetic valve if necessary.
3 x green flash	There is oil turbulence in the compressor housing.	Change "filter func/time cons" to a higher value.
No output (3 x green LED are on, but the output signal is not active)	Check the setup of the parameters/which contact function has been selected, NC or NO (Normally closed/Normally open)	Change the setup using the tool.
Delay in sensor activation	May be caused by gas and foam bubbles in the system.	Check if the sensor is placed optimally.
No detection	Fault in the electronics	Send the sensor to be repaired.
Red LED flash	Sensor is faulty	Contact supplier

Sensor Repair

The sensor electronics are completely embedded and can therefore not be repaired.
In case of faults with the sensor, it will typically only be necessary to replace the electronics.

Complaint cases are handled by the HB Products dealers/distributors.
Their complain procedures must be followed before returning the sensor.

Spare parts



Position	Type	Specification	Part number
1	Mechanical part	1/2" NPT	HBSO1-MEK-1
		3/4" NPT	HBSO1-MEK-2
		1 1/8 UNEF	HBSO1-MEK-7
2	Electronic part	PC-programmable	HBOC/C-EL

Further Information

For further information, please visit our website, www.hbproducts.dk, or send an email to: support@hbproducts.dk.

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