Instruction manual

HBSO – Oil Level Switch
For detecting oil in refrigeration systems
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Safety Instructions

CAUTION! Read the instruction manual before commencing work! Heed all warnings to the letter! Installation of the oil switch 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.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>!</td>
<td>CAUTION! Refers to a possible limitation of functionality or risk of use.</td>
</tr>
<tr>
<td></td>
<td>NOTE! Contains important information about the product and provides further tips.</td>
</tr>
<tr>
<td></td>
<td>The person responsible for operation must commit to adhering to all the legislative requirements, preventing accidents, and doing everything so as to avoid damage to people and materials.</td>
</tr>
</tbody>
</table>

Intended use, conditions of use The HBSO1 switch is made to detect oil type PAO, PEO & mineral used in refrigeration systems. The HBSO2 switch is made to detect oil type PAG. If HBSO1/HBSO2 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, so as to avoid collateral damage.

Disposal instructions: The oil switch is built so that the modules can easily be removed and sorted for disposal.
Introduction

HBSO1/HBSO2 is a level switch for detecting common lubricating oils in refrigeration systems.

Typically it is installed in/on the compressor and the oil separator, but it is also suited for installation in other locations in the oil system.

The sensor’s measurement principle makes it unique for these purposes, since the properties of the measurement principle allows it, among other things, to detect oil without detecting refrigerant.

It is calibrated so that it is unaffected by oil spray and only allows a small amount of foam.

The sensor is also constructed so as to resist high pressure and temperatures. The sensor HBSO2 is suited for use on transcritical CO₂ refrigeration systems.

Measurement principle

The sensor is a capacitive sensor. The capacitive measurement principle is based on the electrical properties in the proximity of a capacitor. A capacitor is an electrical component that is capable of building and sustaining an electrical charge.

Principally, a capacitor consists of two plates. When a charge is applied to a plate, the other plate will be charged with the opposite polarity and retain the charge until it has been grounded. The magnitude of the charge (the capacitance) that can be generated depends, among other things, on what is found between the plates.

The substance between the plates is referred to as a dielectric.

Rather than two plates, the sensor for level measurement is shaped as a cylindrical rod. When liquid covers the sensor, the measured capacity is changes.

HB Products sensors are calibrated so that they differentiate between conductive and non-conductive liquids. In refrigeration systems, the oil, HFC’s and liquid CO₂ are not regarded as conductive fluids, whereas refrigerants such as ammonia and brine are regarded as conductive.

Design

The sensor consists of a mechanical part and an electronic part. These are easily separated by loosening 2 grub screws, or for mechanisms with mounting tabs, by pressing the electronic part in towards the mechanical part and turning the housing counter-clockwise until a wave washer pushes it from the mounted position. The electronic part is designed in accordance with IP65 waterproof rating and so as to withstand vibrations. The mechanical part is produced in AISI304/PTFE and tested to withstand high pressure.
Technical data

Connection:
- Supply: 24 V AC/DC ±10%
- Frequency: 50/60Hz
- Current draw: Max 50 mA
- Current consumption: < 10 mA
- Plug: DIN 43 650
- Required cable size: 3 x 0.34 mm²
- Required cable glands: PG7 / M8

Output:
- Transistor output: PNP or NPN
- Output function: NC or NO

Installation conditions:
- Ambient temperature: -20…+50°C
- Oil temperature: 0…+80°C
- Max. operational pressure: 150 bar
- Waterproof rating: IP65
- Vibrations: IEC 68-2-6 (4g)

Authorisations:
- EMC Emission: EN61000-3-2
- EMC Immunity: EN61000-4-2
- GOST R: No 0903044

Oil type:
- HBSO1: PAO, PEO & Mineral
- HBSO2: PAG

Mechanical specifications:
- Thread connection: ½”, ¾” & 1 ½”
- Materials, mechanical: AISI304/PTFE
- Materials, electronics: Nylon 6 (PA)
- Weight: 500 g

Indication:
- LED indication: 4 x LED (red)

Accessories:
- Plug with power supply: HBPA
  (110-240 V AC / 24 V DC)

Please note! All terminals are protected against improper termination with a supply voltage up to 40 V. If the supply voltage is greater than 40 V the electronics will be damaged.

Please note! Supply Voltage may differ from the data given in the manuals. Applicable will always be the sensor label.
Function

HBSO is a level switch for detecting PAO, PAG & PEO lubricating oils in refrigeration systems. Typically, it is installed in/on the compressor and the oil separator, but it is also suited for installation in other locations in the oil system.

The sensor differentiates between oil and refrigerant gas, so that the electrical signal from the sensor changes when the oil level drops below/ rises above the level it was installed at.

The sensor is calibrated to switch in the centre of the sensor’s cylindrical part, with a hysteresis of about 1 mm. When the oil is on the same level or above this point, 4 LEDs light up (irrespective of the output relay NO/NC).

Examples of usage

HBSO is intended for use in refrigeration systems, including

Screw and piston compressors, as
  1. level alarm for low oil levels for protecting against damage
  2. ensuring that there is oil during start-up and operation

Oil separators
  3. to indicate min/max level so as to be able to regulate accordingly

Oil pipe system
  4. as an indication of oil flow
Installation instructions

The following applies during installation:

1) In case the sensor is installed in a threaded sleeve/pipe stub, this should be welded at a 5-10° upwards angle relative to the horizontal, so as to prevent the formation of liquid pockets.

2) The sensor should not be installed vertically, since there can be a risk that gas pockets displace the oil from the sensor.

3) Installation on the compressor can take place using an adaptor or flange, given that the following is taken into account:

![Diagram showing sensor installation angle]

**NOTE!** So as to avoid touching parts of the compressor or container and risking damage or operational problems, the sensor’s installation length must be taken into account. There must be at least 2mm between the sensor’s mechanical part and other fixed or moving parts.

**CAUTION!** In case of welding work on the unit, the electronic part must be removed. Welding work can damage the electronics. The mechanical part of the sensor must not be installed in the pipe socket during welding.

Accessories

Using a power supply (HBPA), the switch can be connected to 110/240VAC

![Image of HBPA power supply]

HBPA is installed instead of the plug which was provided. The power supply is universal and can be connected to 110/240 V AC.
Power connection

HBSO can be delivered with a PNP or NPN output.
The connection depends on the selected sensor type as well as the type of controller/PLC used.

**Source / PNP**

- + 24 V DC
- Digital ON/OFF
- PNP current flow
- Ext. relai, coil max 50mA
- 0V common

**Sink / NPN**

- + 24 V DC
- Digital ON/OFF
- NPN current flow
- Ext. relai, coil max 50mA
- 0V common

**Sensor relay specifications:**
A) Voltage: 24 V,
B) Max coil resistant: 475 ohm
C) Coil effect: 1,2 W

Example on relay types:
- SCHRACK type MT221024
- OMRON type G22A-432A

**NOTE!** Supply Voltage may differ from the data given in the manuals. Applicable will always be the sensor label.

**NOTE!** In addition to the connections shown in this graphic the electrical connection requires further deciding whether to use the "contact mode" as NO (normally open) or NC (normally closed). NO / NC refer to the state that the switch occupies when it is "Dry", ie not influenced by the liquid.
It should also be borne in mind that NONE of these combinations in itself is "Fail Safe". It is expected that the design of the control system in which these switches integrate, understand the requirements of a fail-safe structure. Especially when this is carried out with the "solid-state" switching technology as here.
Damage incurred external equipment not supplied by HB Products, can generally not be covered by "HB Products" product warranty or 3ed party insurance. Should such HB Product 3ed party insurance coverage is desired, it requires at least our pre-approval of the "Fail Safe" design. This emphasizes that one can NOT currently buy a Fail Safe HB Products switch.

Electrical connection - with HBPA - 110/ 240 VAC power supply

HBSO can be fitted with 110/240 VAC power supply / relay output. The power supply is designed so that it can be used on both PNP and NPN sensors.
Installation guide

HBSO is installed on either a threaded sleeve or with a flange that corresponds to the sensor’s external thread. The sensor is sealed with Teflon tape or liquid gasket or solid gasket depending on the thread type.

<table>
<thead>
<tr>
<th>Thread type</th>
<th>Sealing type</th>
</tr>
</thead>
<tbody>
<tr>
<td>½” BSPP</td>
<td>Bonded seals - ø21,65/26,70 x 1,25</td>
</tr>
<tr>
<td>¾” BSPP</td>
<td>Bonded seals - ø27,30/32,50 x 1,25</td>
</tr>
<tr>
<td>1 1/8” UNF</td>
<td>Bonded seals - ø29,33/36,58 x 2,34</td>
</tr>
</tbody>
</table>

For the installation of HBSO with conical thread, one requires Teflon tape/liquid gasket, a shifting spanner or single-end wrench NW 27, 32, or 36mm (depending on the thread type), as well as 2.5 mm Allen key.

Loosen the two set screws so that the electronic part can be removed. For variants without set screws, the electronic part is pushed down towards the mechanical part and the housing is turned counterclockwise until the wave washer pushes it from its mounted position.

For other thread types, solid gasket is used.
**Separate the two parts.**

**Apply Teflon or liquid gasket on the sensor with the conical thread. For other thread types, solid gasket is used.**

**Install the mechanical sensor part in an oil separator or the connection thread on the container/compressor.**

**Pressure test the assembled product if needed.**

**Install the electronic part again with set screws or twist the electronic part into place. Put a small amount of pressure to overcome the force from spring wash installed in mechanical part.**
Installation on Flange

HBSO 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 as gasket (not included with flange).

Tighten screws (depending on the quality of the screws).
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 mounting tab or it is secured with 2 set screws.

**LED indication**

LED indication: 4 x red LEDs indicate oil level

Irrespective of the output function NO/NC, LEDs are activated by means of the oil level.

Sensor to the right shown with power supply HBPA.

**Fault detection**

NOTE! Fault detection on the electronic function can be carried out without releasing pressure from the system or disassembling the mechanical part from the sensor.

IMPORTANT! In case of removing the mechanical part, make sure the system is de-pressurized
The easiest way to carry out fault detection is to have an extra mechanical part available.

The electronic part to be tested is installed on the extra mechanical part. The electronics can easily be tested using a container with oil (see illustration). If the electronics switch the way they are supposed to during the test, one can exclude the possibility of an fault on the senor.

In case of fault, it is enough to only replace the electronic part.

<table>
<thead>
<tr>
<th>Fault</th>
<th>Possible Reason</th>
<th>Correction of fault</th>
</tr>
</thead>
<tbody>
<tr>
<td>No LED is on when the sensor is in the medium.</td>
<td>No supply to the sensor or defective cable/plug.</td>
<td>Check the power supply or replace the power supply cable.</td>
</tr>
<tr>
<td>No output (4 x red LED are on but the output signal is not active)</td>
<td>Check if the sensor’s output matches the control’s input; if it is a PNP/NPN and NO or NC respectively. See the output charge instructions below.</td>
<td>Create alignment between the sensor and control so that the two are identical.</td>
</tr>
<tr>
<td>No contact activation (4 x red LED are not on, even though liquid should activate the sensor)</td>
<td>There may be dirt between the electronic housing and the mechanical housing.</td>
<td>Separate the two parts and clean the spring tip.</td>
</tr>
<tr>
<td>Delay in sensor activation</td>
<td>1) Can be caused by a gas pocket that displaces the liquid.</td>
<td>1) Install the sensor so that the gas pockets cannot displace the liquid</td>
</tr>
<tr>
<td>Output and 4xLED are activated constantly, even though liquid is not in contact with the sensor.</td>
<td>Threaded sleeves are installed with negative slope so that liquid can collect in the threaded sleeves which activate the sensor.</td>
<td>Place the threaded sleeves according to the instructions. See installation.</td>
</tr>
</tbody>
</table>

Function of charge output on pin 3 & 4:
- **NC**: There should be no signal when it is in oil.
- **NO**: There should be a signal when it is in oil.
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

<table>
<thead>
<tr>
<th>Position</th>
<th>Specification</th>
<th>Type</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Electronic part – HBSO1</td>
<td>PNP/NO</td>
<td>HBSO1-EL/PNP/NO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PNP/NC</td>
<td>HBSO1-EL/PNP/NC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NPN/NO</td>
<td>HBSO1-EL/NPN/NO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NPN/NC</td>
<td>HBSO1-EL/NPN/NC</td>
</tr>
<tr>
<td>1</td>
<td>Electronic part – HBSO2</td>
<td>PNP/NO</td>
<td>HBSO2-EL/PNP/NO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PNP/NC</td>
<td>HBSO2-EL/PNP/NC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NPN/NO</td>
<td>HBSO2-EL/NPN/NO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NPN/NC</td>
<td>HBSO2-EL/NPN/NC</td>
</tr>
<tr>
<td>2</td>
<td>Mechanical part</td>
<td>½” NPT</td>
<td>HBSO1-MEK-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>¾” NPT</td>
<td>HBSO1-MEK-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>½” BSPT</td>
<td>HBSO1-MEK-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>¾” BSPT</td>
<td>HBSO1-MEK-4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>½” BSPP</td>
<td>HBSO1-MEK-5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>¾” BSPP</td>
<td>HBSO1-MEK-6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 1/8 UNEF</td>
<td>HBSO1-MEK-7</td>
</tr>
</tbody>
</table>

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