STAUFF®

Local Solutions For Individual Customers Worldwide

Oil Condition Sensor OCS-I
and Accessories

Manual

CONTENT

1. Explanation of Symbols and Notes

The following designations and symbols for dangers are used in this manual:

This symbol denotes safety precautions, the non-observance of which can endanger persons.

This symbol marks an important note for the proper use of the off-line unit. The non observance of these notes can lead to damage to the off-line unit.

This symbol is followed by user tips and other useful information. They help you to obtain optimum function from all sections of your system.

2. Introduction

The STAUFF Oil Quality Sensor (OCS), allows real time reporting of the condition of the oil in virtually any piece of equipment which uses oil. The sensor utilizes sophisticated electronics to indicate the current condition of oil relative to the initial condition of new oil.

Based on the sensor output, the oil drain-down intervals may be extended on large industrial equipment where the cost of replacing and monitoring the oil is expensive. The sensor triggers an investigation into the quality of the oil, preventing the need for expensive routine maintenance.

STAUFF OCS sensor can reduce the overall operating cost of machinery through the removal of routine inspections, waste oil disposal and subsequent renewal.

The STAUFF OCS sensor is designed to be easy to use in a variety of configurations depending on the monitoring equipment to which you would like to interface. It uses a simple four wire connection to connect to its power supply and output the oil condition and temperature on individual 4-20mA current sink outputs, with an additional two wires if you would like to use an RS485, CANBus or Modbus interface to connect to an external device.

IMPORTANT SAFETY NOTES

Please pay attention to following safety notes:

- Sensor is not IECEx certified
- Never reassemble, repair or tamper with the sensor.
- Ensure that the supply voltage is within the specified range.
- Ensure the load currents do not exceed the rated value.
- Check all the wiring for correct connection before powering the unit.
- Ensure the sensor case is earthed.

3. Measuring Oil Quality

3.1. Introduction

There are a number of ways to describe oil wear and oil condition:

- Tan Delta Number (TDN)
- Loss Factor Percentage
- Oil Quality Index

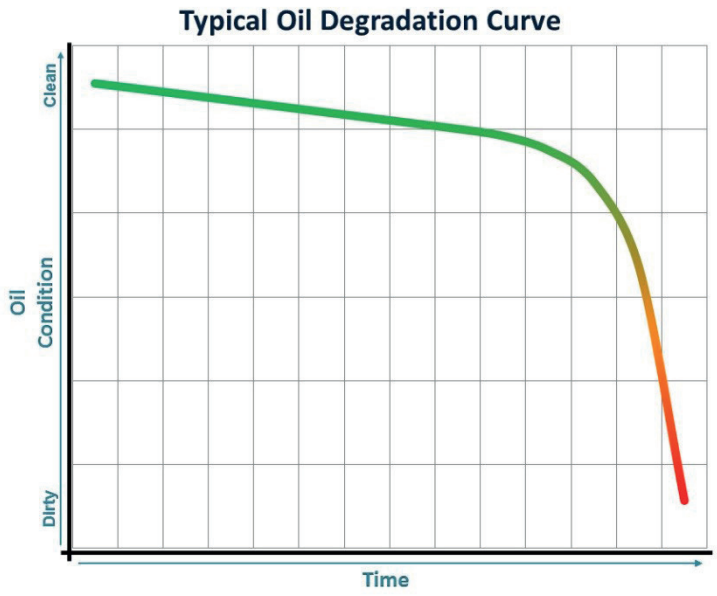
3.2. Tan Delta Number

To make it easier to monitor and trend the overall oil condition, regardless of your current method, we have introduced the "Tan Delta Number" (TDN). The TDN has been designed to be easy to understand, to give a very good level of accuracy and to create a common language for describing overall oil wear and oil condition, which can also be combined with other methods such as ISO cleanliness levels and laboratory test results.

The full scale goes from 1200 to 0, with the value decreasing as oil quality degrades. For most applications, the useable range is from 1050 to 300.

3.3. Oil Degradation

It is important to understand that oil degradation is exponential and your use of STAUFF products should reflect this. Once the TDN begins to fall at an increasing rate you know the oil is nearing the end of its life and you need to be vigilant. To help with this, our display units have warning/alarm and 'rate of change' functions to alert you to any potential issues.



3.4. TDN Value vs Loss Factor Percentage

The underlying value which the sensor is recording for the oil condition is the Loss Factor Percentage which is then converted into a TDN value (see page 18).

3.5. Traffic Lights

First and foremost, the TDN scale offers a 'traffic light' view of oil condition, so there is a Green section, an Amber section and a Red section to illustrate OK, Warning and Alarm conditions respectively. The thresholds for these sections can be user-defined for any application. Factors such as likelihood/nature of contamination, how critical the machinery is and manufacturers' guidelines should all be considered when setting the thresholds. Please contact your distributor or sales@stauff.com for further guidance on setting your warning/alarm levels.

3.6. Numbering/Levels

The TDN scale extends from 1200 down to 0. For most applications, the 'green' section includes all values from 1050 to 420. 'Amber' (warning) will go from 400 to 300: this is the point at which you need to monitor the quality closely and prepare to filter or change the oil. The 'red' (alarm) section applies to values of 300 and below. At this point, the oil needs to be changed as it is no longer providing sufficient lubrication.

3.7. Clean Point (Start Point)

The starting point for a new oil is called the Clean Point. For most oils, this will generally be between 950 and 850 on the TDN scale. The actual value will depend on a number of factors but most importantly how pure the base stock is and what additive packages have been included.

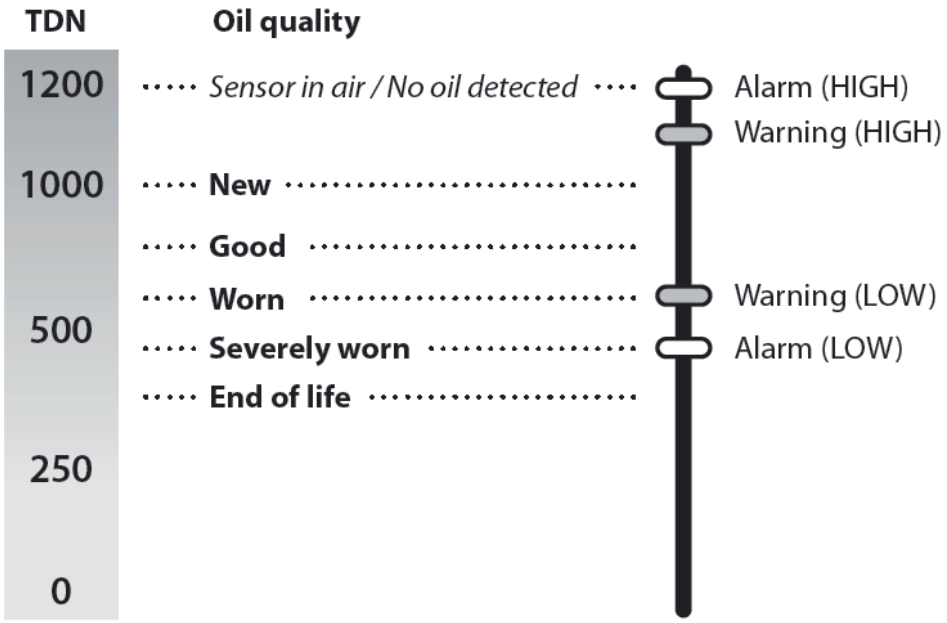


Fig. 1

As the oil begins to deteriorate the value will decrease.

NOTE: TDN does not start at 1000 for a new, clean oil, as some oils can be improved by using sophisticated on-line or off-line filtration. Oil can also improve on the TDN scale, as well as deteriorate.

3.8. Loss Factor

A clean oil has a Loss Factor Percentage of approximately 0% and then as the oil changes and degrades this Loss Factor Percentage increases. For most applications, oil would be considered to be degraded at a Loss Factor Percentage of 25% and at the "end of life" at a Loss Factor Percentage of 30% or above.

3.9. Oil Quality Index

The OQI measurement scale (-2 to +21) offers a 'traffic light' view of oil condition. There is a green section (1-13), an amber section (14-17) and a red section (18-20) to mark OK, Warning and Alarm thresholds respectively. The OQI scale is linear within the safe, green level but the amount of change reduces by half for the warning, amber level and alarm, red level. Unlike the TDN scale, the green, amber and red sections cannot be adjusted.

OIL QUALITY		LOSS FACTOR	
INDEX	DESCRIPTION	MIN	MAX
21	Maximum		≥ 33.75
20	Severe	32.50	33.74
19		31.25	32.49
18		30.00	31.24
17	Significant	28.75	29.99
16		27.50	28.74
15		26.25	27.49
14		25.00	26.24
13	Moderate	22.50	24.99
12		20.00	22.49
11		17.50	19.99
10		15.00	17.49
9	Mild	12.50	14.99
8		10.00	12.49
7		7.50	9.99
6		5.00	7.49
5	Good	2.50	4.99
4		0.00	2.49
3		-2.50	-0.01
2		-5.00	-2.51
1		-7.50	-5.01
0	Low	-10.00	-7.51
-1	Error/In Air	-12.50	-10.01
		-15.00	-12.51
		-17.50	-15.01
		-20.00	**-17.51**
-2	Fault	≤ 20.01	

4. What's in the Box?

When unpacking your OCS unit, please ensure that all the following items are present. If any of the items are missing, please contact your distributor.

- OCS Oil Quality Sensor
- Quick start guide
- Test Certificate

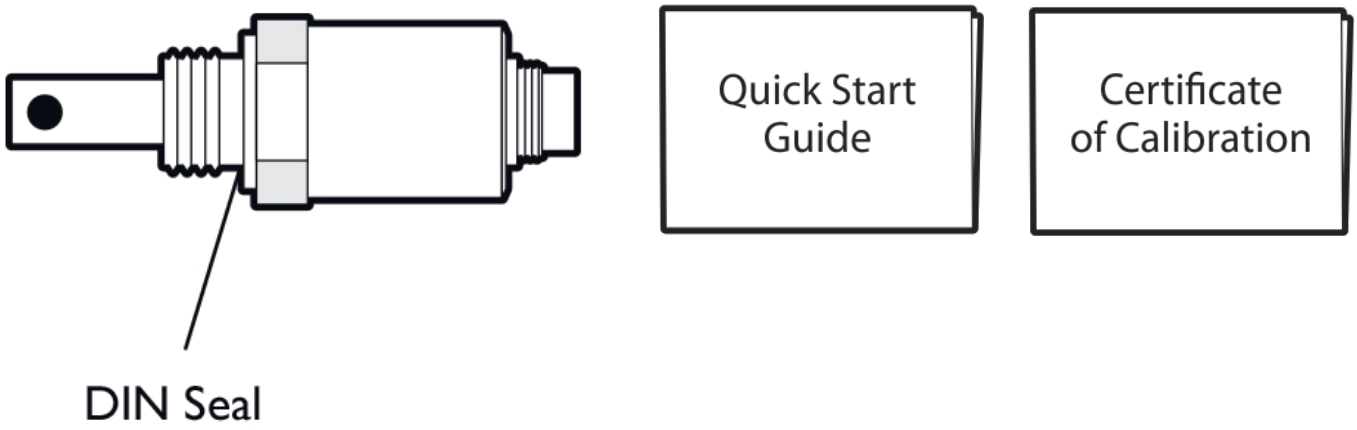


Fig. 2

5. Configuration

Before installation, configure the OCS to your specifications using the STAUFF OCS Software.

5.1. Set Up

To install the software:

1. Connect the PC or laptop to the OCS oil sensor using the configuration cable.
2. Connect the memory stick to a USB port on your PC or laptop. Allow the PC/laptop to automatically update drivers, if needed.
3. When prompted, select Open folder to view files.
4. Launch the setup.exe file and follow the instructions in the setup wizard.
5. When prompted, click on Install.
6. When installation is complete, OCS Software is displayed (see Figure 4).

It may take up to a minute for the software to identify the OCS.

Allow configuration cable to update Drivers
Select correct oil type and communication protocol

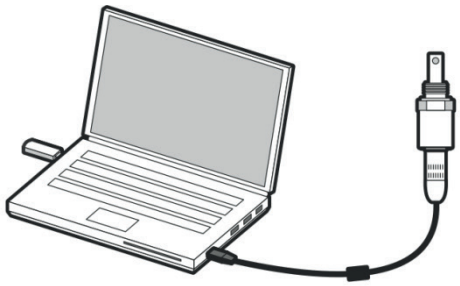
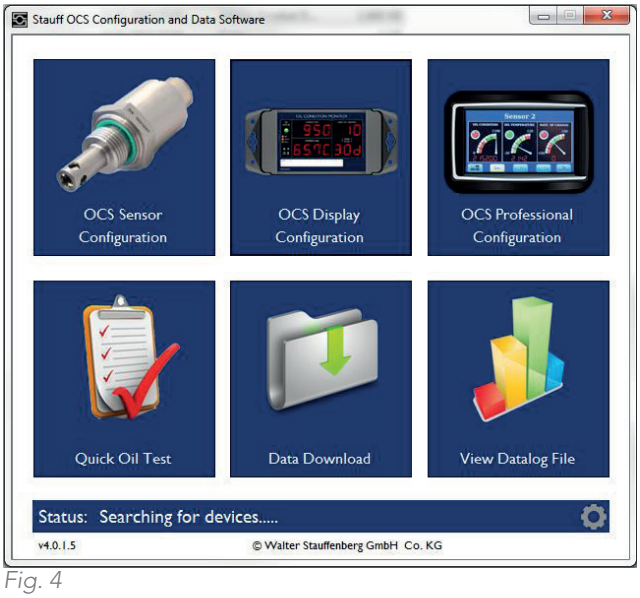


Fig. 3

5.2. Using OCS Software

When the Welcome screen is displayed on your laptop, select OCS Sensor Configuration.



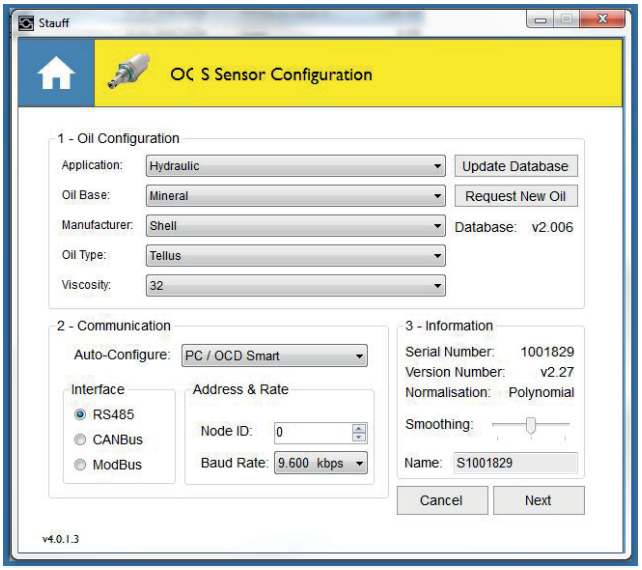
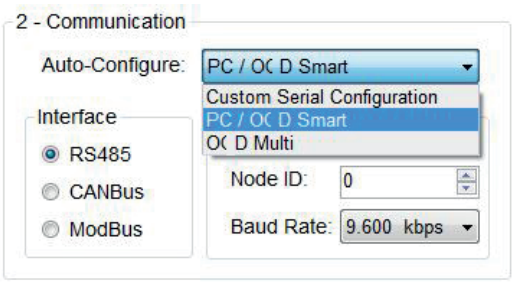


Fig. 4

The OCS configuration options are divided into three sections:

1. Oil Configuration
2. Communication
3. Information



5.2.1. Oil Configuration

Choose the required oil profile, select from:

- Application
- Oil Base
- Manufacturer
- Oil Type
- Viscosity

5.2.2. Communication

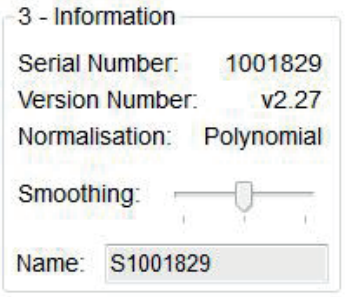
Set the communication interface.

If you are using the sensor with the STAUFF Oil Quality Display Multi (OCS I-Display) or Oil Quality Display Smart (OCS I-Displays), select the appropriate option from the Auto-Configure drop down list. Otherwise, select a protocol from the RS485, CANbus or ModBus options.

NOTE: If you are using the sensor with the OCS I-Display you must set the Node ID, numbered 1-4.

5.2.3. Information

Naming the sensor is optional. The name is used as an identifier for the OCS I-Display.



5.2.4. Smoothing

This function uses hysteresis to reduce the noise caused by changes in the oil such as temperature. In order for the algorithms to settle the sensor must go through at least one 'thermal cycle' of the application, this just means running the machine from standby until it reaches its highest normal operating temperature.

Available settings are Off, Low and High so you can define what level of smoothing you want. We recommend you start at Low and run the sensor in-situ for a few weeks (definitely over a few thermal cycles of the application). If the data is relatively smooth leave the smoothing at Low, if not, set to High. If data is completely static, you can turn the smoothing filter off.

5.2.5. Confirming Configuration

1. When you have finished editing the sensor settings, click on the Next button. A summary of the configuration is shown (see below).
2. Check all settings are correct and then click on the Write button.
3. A progress bar is displayed while settings are being sent to the sensors. 'Write Successful' appears in the bottom left corner when this is finished.
4. Click on Home to return to the OCS Software welcome page

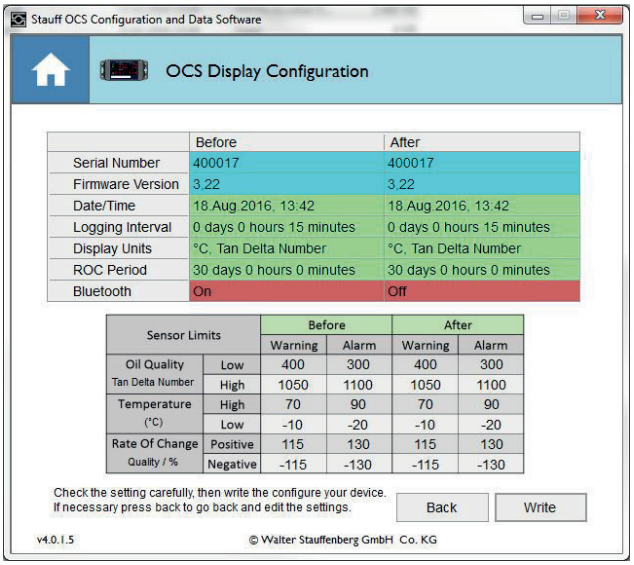


Fig. 5

6. Installation

6.1. Precautions

Please read these instructions before installing the oil quality sensor. The sensor has been designed to be robust, however it is liable to be damaged by mistreatment. The following must be noted:

- Install the sensor into the equipment before attempting electrical/wiring connections.
- To avoid thread damage, do not use with taper fittings.
- Tighten with a correctly adjusted size spanner (M32) and do not over tighten.
- Do not attempt to screw or tighten the sensor using the body. Always use the "Hex" head with the correct size spanner (M32).
- Do not twist the cable relative to the sensor head.
- Keep away from sharp edges which may cut into the cable.
- Do not bend the cable, minimum bend radius = 50 mm (2 inches).
- Where possible, keep the cable away from sources of heat, (such as an engine block), and electrical interfaces.

6.2. Choosing the Sensor Mounting Location

The performance of the sensor will be enhanced through careful consideration of the mounting location. The following guidelines should be followed:

- The sensor should not be mounted in the bottom of a sump since the sensor head may become restricted preventing correct operation.
- Dynamic oil flow is necessary; do not mount in places where the oil is likely to stagnate or be static, since the oil in the sensor needs to be representative of the whole system.
- When the oil condition sensor is mounted in a pipeline, please ensure that the sensor will not restrict flow.
- When mounting the oil condition sensor in a lubrication system, for maximum performance, please ensure the sensor is located prior to the oil filters, oil coolers etc. to ensure oil is representative of the whole system.

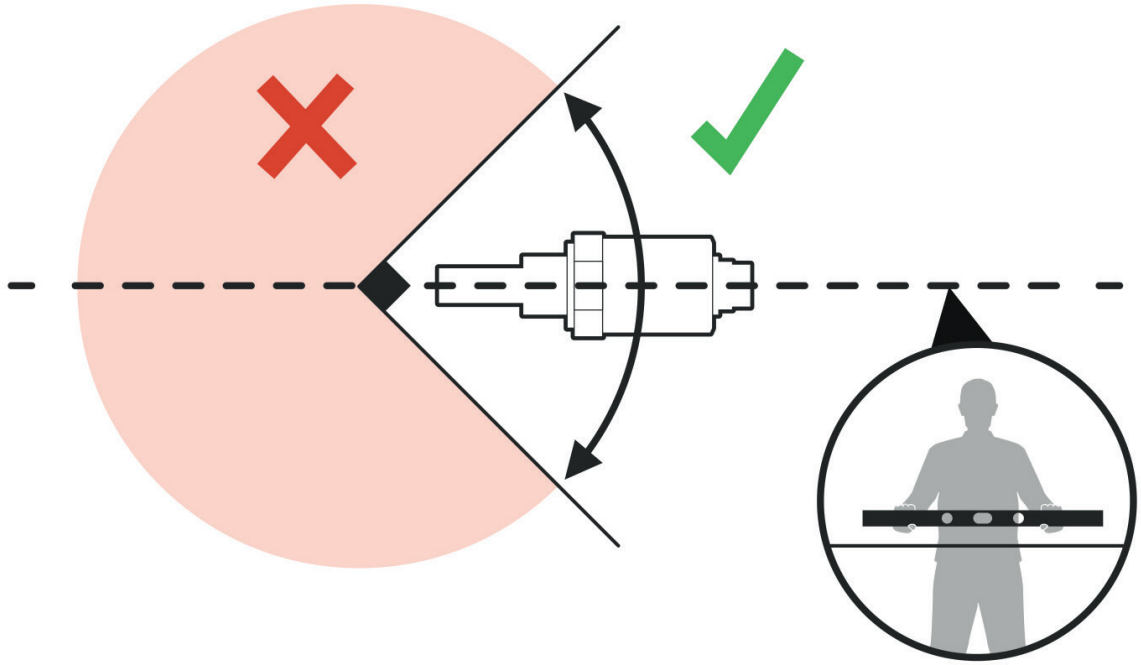
6.3. Fitting Method

- The standard thread is ½ inch BSP requiring an M32 spanner for installation.

- Decide on an appropriate location for sensor head installation.
- Drain the lubricant sufficiently to allow the sensor to be fitted.
- Install the sensor head into the selected location/position, being careful not to over tighten.
- Route the cable, fixing (cable ties) at appropriate intervals.
- Avoid sharp edges and hot surfaces.
- Connect the sensor to the chosen interface (see page 15).

6.4. Orientation

Ideally horizontal, no more than +45° or less than -45°.



6.5. Immersion

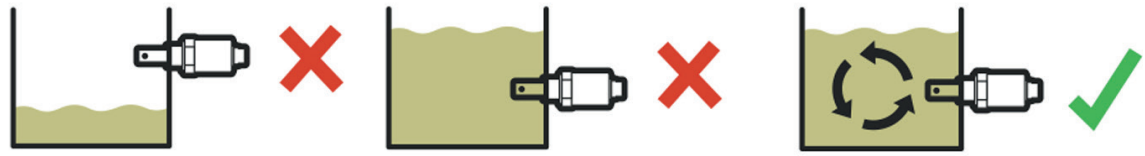


Fig. 6

6.6. Electrical Connection

6.6.1. Power Supply

Connect a suitable power supply (9-30Vdc, at least 100mA) to pins 3&4 on the right-hand connector (see Figure 7).

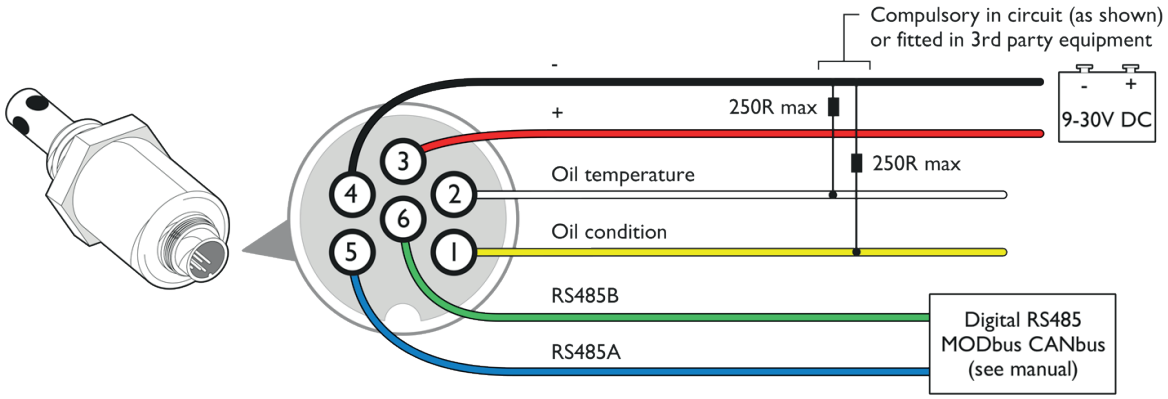


Fig. 7

6.6.2. Connecting to a STAUFF OCS I-Displays

Connect the Oil Quality Sensor (OCS) to the left-hand connector. We recommend using a STAUFF Female to Male cable. Align and slot in the 6-pin connector and then tighten the connector screw-cap. Please refer to the OCS I-Displays manual for further information about OCS I-Displays setup and configuration.

6.6.3. Data output

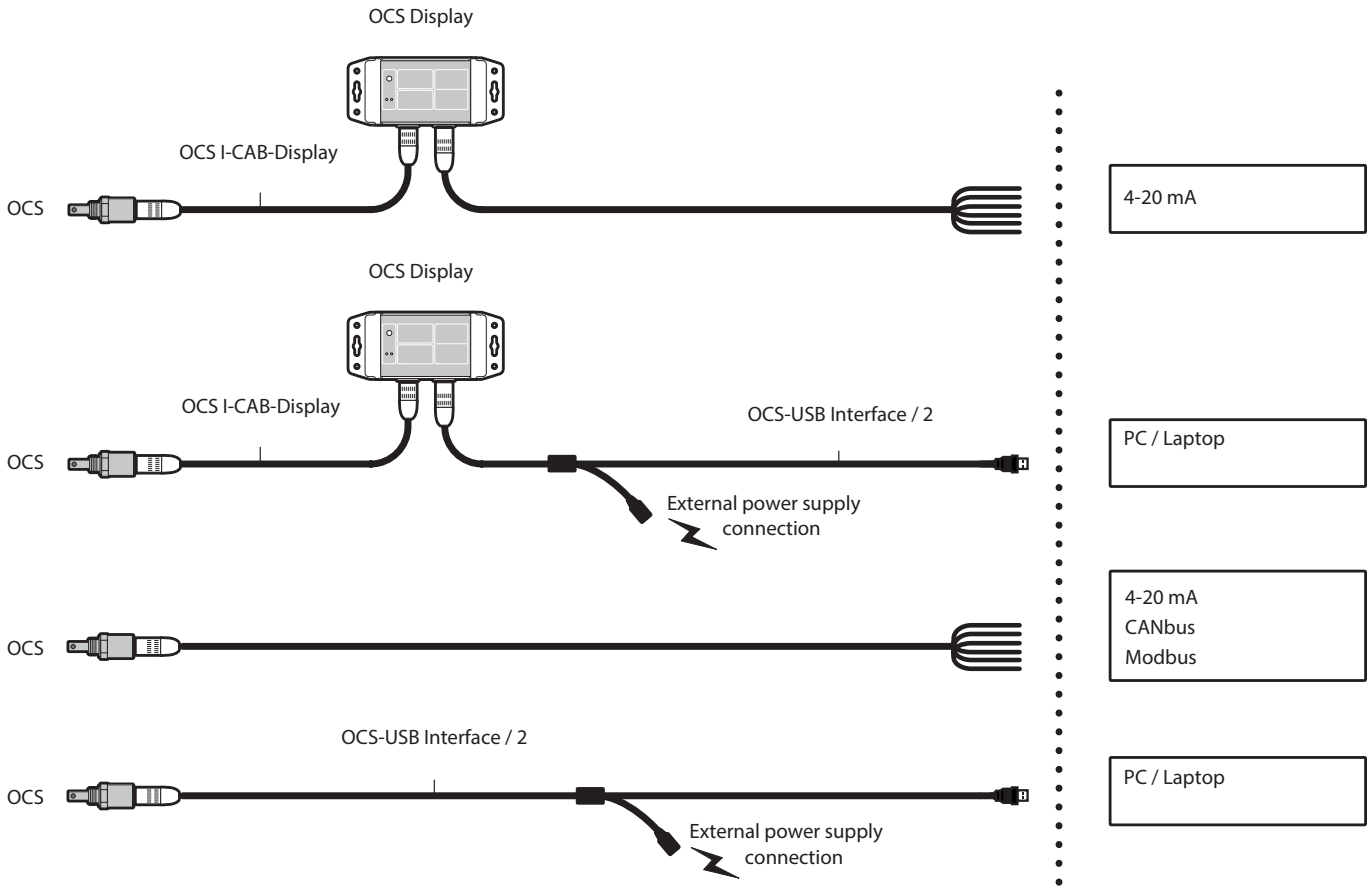
You can use the output from Pins 5&6 to provide analog indication of the oil temperature and condition on other, third party, data acquisition and control systems.

6.6.4. Using the Oil Quality analog output

Oil quality is output on Pin 1 as a Loss Factor Percentage and is linearly scaled from -20% (4 mA) to 60% (20 mA). Loss Factor Percentage can easily be converted to the OQI scale using the table on page 18. A clean oil should provide an output of about 8 mA. For most applications, we recommend setting a warning alert for a value of 13 mA and an alarm notification for values over 14 mA. Any value below 4 mA indicates a fault.

6.6.5. Using the Oil Temperature output

The analog output on pin 2 provides a linearly scaled measure of Oil Temperature in °C between -30° C (4 mA) and +130° C (20 mA) – see page 19.



7. Cleaning & Maintenance

Please follow this procedure to clean the sensor:

► Clean any excess oil from the end of the sensor by spraying Loctite 7063 cleaner (or any other low residue cleaner which will dissolve oil):

- ► Into each of the four holes at the end of the sensor.
- ► Into the end of the sensor.

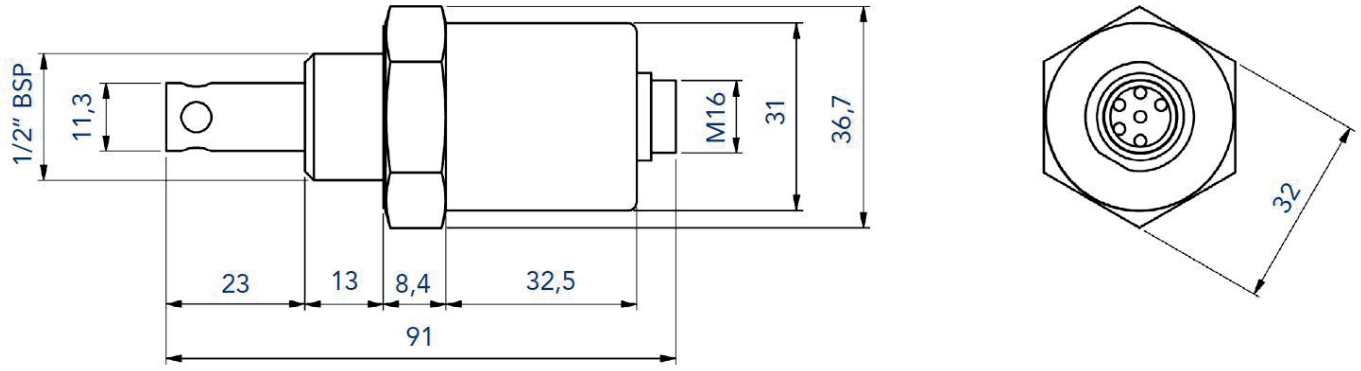
► Remove any excess cleaner, ideally with an airline or with a quick shake of the sensor.

► Rinse the end of the sensor in distilled water.

► Blow-dry the end of the sensor using a hot-air gun (set to a low temperature (~60 to 80°C) for one minute to ensure no solvent or moisture remains.

NOTE: The sensor does not require cleaning once it has been installed.

8. Physical Dimensions



9. Product specification

ENVIRONMENTAL SPECIFICATIONS	
Protection Rating	IP67 When connected
Sensor Temperature	-20C to +120C
Fluid Temperature	-20C to +120C
External Pressure	0 bar to 20 bar
Fluid Pressure	Up to 20 bar

PHYSICAL CHARACTERISTICS	
Material	Stainless Steel AISI304
Dimensions	90mm x 37mm
Weight	160g
Thread	½" BSPP Thread/M32 Hex Thread
Seal	DIN 3869 Viton Seal (Alternative threads and seals available upon request)

CONNECTIVITY	
General	6 pin Lumberg male (IEC 61076-2-106) (Alternatives are available upon request)

ELECTRICAL	
Power Supply	9-30V DC
Power Consumption	Average 0.4w continuous 30mA

DATA OUTPUT/INPUT	
Analogue Output	2 x 4-20mA (current syncing, passive input)
Digital Output	1 x RS485:9600 baud half duplex
	Modbus protocol supported on RS485
	CANbus: CANopen protocol supported on RS485

RANGE AND ACCURACY*	
Sensor oil quality normal operating range	-10% to +30% loss factor
Sensor oil quality accuracy/repeatability	+/- 3% loss factor
Sensor temperature normalisation accuracy	Pre V2.4 +/- 3% loss factor
	Post V2.4 +/- 1.5% loss factor
Sensor oil temperature normal operating range	-20C to +120C
Sensor oil temperature accuracy	+/-3% of full range (+/-4.2°C)
Sensor internal temperature operating range	-20C to +120°C
Sensor internal temperature accuracy	+/-3% of full range (+/-4.2°C)
Sensor 4-20mA accuracy	+/- 1% of full range (+/- 0.2mA)

**The accuracy testing was done according to the calibration fluid (Mineral 15W40 Shell Helix HX5). The accuracy values may vary on other fluids.*

STANDARDS AND APPROVALS

CE marked:

- IEC 60529:1989/AMD2:2013 IP67 Dust and Water Ingress.
- IEC 60068-2-30:2005 Cyclic Humidity.
- IEC 60068-2-6:2007 Sine Vibration.
- IEC 60068-2-27:2008 Mechanical Shock.
- EN 61000-6-4:2007 Generic Emissions Standard for Industrial Environments.
- EN 61000-6-2:2007 Generic Immunity Standard for Industrial Environments.

10. Appendix

10.1. Oil Condition Conversion Chart

Oil condition is output as a Loss Factor Percentage and the output is linearly scaled between -20% (4mA) and +60% (20mA). The Loss Factor Percentage can easily be converted to the TDN scale using the following table.

4-20MA	LOSS FACTOR	TDN	ALARM SETTING
<4			
4 mA	-20.0 %	1200 TDN	
	-19.0 %	1200 TDN	
	-18.0 %	1200 TDN	
	-17.0 %	1200 TDN	
	-16.0 %	1200 TDN	
5 mA	-15.0 %	1200 TDN	
	-14.0 %	1180 TDN	
	-13.0 %	1160 TDN	
	-12.0 %	1140 TDN	High Alarm
	-11.0 %	1120 TDN	
6 mA	-10.0 %	1100 TDN	
	-09.0 %	1080 TDN	
	-08.0 %	1060 TDN	High Warning
	-07.0 %	1040 TDN	
	-06.0 %	1020 TDN	
7 mA	-05.0 %	1000 TDN	
	-04.0 %	0980 TDN	
	-03.0 %	0960 TDN	
	-02.0 %	0940 TDN	
	-01.0 %	0920 TDN	
8 mA	000.0 %	0900 TDN	
	001.0 %	0880 TDN	
	002.0 %	0860 TDN	
	003.0 %	0840 TDN	
	004.0 %	0820 TDN	
9 mA	005.0 %	0800 TDN	
	006.0 %	0780 TDN	
	007.0 %	0760 TDN	
	008.0 %	0740 TDN	
	009.0 %	0720 TDN	
10 mA	010.0 %	0700 TDN	
	011.0 %	0680 TDN	
	012.0 %	0660 TDN	
	013.0 %	0640 TDN	
	014.0 %	0620 TDN	
11 mA	015.0 %	0600 TDN	
	016.0 %	0580 TDN	
	017.0 %	0560 TDN	
	018.0 %	0540 TDN	
	019.0 %	0520 TDN	

4-20MA	LOSS FACTOR	TDN	ALARM SETTING
12 mA	020.0 %	0500 TDN	
	021.0 %	0480 TDN	
	022.0 %	0460 TDN	
	023.0 %	0440 TDN	
	024.0 %	0420 TDN	Low Warning
13 mA	025.0 %	0400 TDN	
	026.0 %	0380 TDN	
	027.0 %	0360 TDN	
	028.0 %	0340 TDN	
	029.0 %	0320 TDN	Low Alarm
14 mA	030.0 %	0300 TDN	
	031.0 %	0280 TDN	
	032.0 %	0260 TDN	
	033.0 %	0240 TDN	
	034.0 %	0220 TDN	
15 mA	035.0 %	0200 TDN	
	036.0 %	0180 TDN	
	037.0 %	0160 TDN	
	038.0 %	0140 TDN	
	039.0 %	0120 TDN	
16 mA	040.0 %	0100 TDN	
	041.0 %	0080 TDN	
	042.0 %	0060 TDN	
	043.0 %	0040 TDN	
	044.0 %	0020 TDN	
17 mA	045.0 %	0000 TDN	
	046.0 %	0000 TDN	
	047.0 %	0000 TDN	
	048.0 %	0000 TDN	
	049.0 %	0000 TDN	
18 mA	050.0 %	0000 TDN	
	051.0 %	0000 TDN	
	052.0 %	0000 TDN	
	053.0 %	0000 TDN	
	054.0 %	0000 TDN	
19 mA	055.0 %	0000 TDN	
	056.0 %	0000 TDN	
	057.0 %	0000 TDN	
	058.0 %	0000 TDN	
	059.0 %	0000 TDN	
20 mA	060.0 %	0000 TDN	

NUMBER FORMAT

Loss Factor = Always 4 characters (including -) to 1

TDN = Always 4 digits

CONVERSION

4-20mA to Loss Factor = (mA - 4) * 5 - 20

4-20mA to TDN = (mA -17) * -100

10.2. Oil Temperature Analog Output

The table below shows how the oil temperature output (4-20mA) converts to temperature.

OCS OUTPUT 4.20MA VALUE		TEMPERATURE CONVERSION °C		°F	
MIN	MAX	MIN	MAX	MIN	MAX
20		130		266	
19.5	19.99	125	129	257	264.2
19	19.49	120	124	248	255.2
18.5	18.99	115	119	239	246.2
18	18.49	110	114	230	237.2
17.5	17.99	105	109	221	228.2
17	17.49	100	104	212	219.2
16.5	16.99	95	99	203	210.2
16	16.49	90	94	194	201.2
15.5	15.99	85	89	185	192.2
15	15.49	80	84	176	183.2
14.5	14.99	75	79	167	174.2
14	14.49	70	74	158	165.2
13.5	13.99	65	69	149	156.2
13	13.49	60	64	140	147.2
12.5	12.99	55	59	131	138.2
12	12.49	50	54	122	129.2
11.5	11.99	45	49	113	120.2
11	11.49	40	44	104	111.2
10.5	10.99	35	39	95	102.2
10	10.49	30	34	86	93.2
9.5	9.99	25	29	77	84.2
9	9.49	20	24	68	75.2
8.5	8.99	15	19	59	66.2
8	8.49	10	14	50	57.2
7.5	7.99	5	9	41	48.2
7	7.49	0	4	32	39.2
6.5	6.99	-5	-1	23	30.2
6	6.49	-10	-6	14	21.2
5.5	5.99	-15	-11	5	12.2
5	5.49	-20	-16	-4	3.2
4.5	4.99	-25	-21	-13	-5.8
4	4.49	-30	-26	-22	-14.8
<4		Fault			

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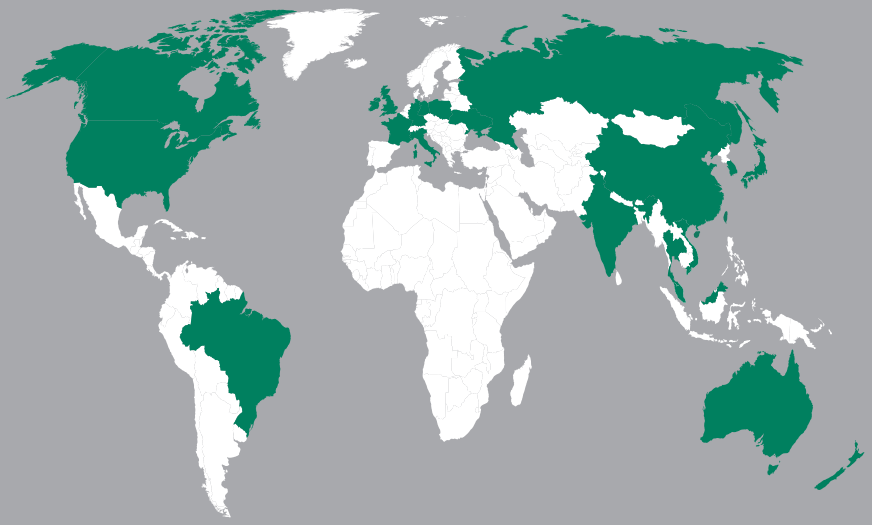

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