

# User Guide

## SENSE-3 Kit



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## DEFINITIONS



WARNING: Risk of injury or death.



CAUTION: Risk of damage to objects



IMPORTANT: Important information

## TABLE OF ACRONYMS

|                               |                                    |                                      |
|-------------------------------|------------------------------------|--------------------------------------|
| MOT - Mobile Oil Tester Kit   | TBN - Total Base Number            | LHS - Left Hand Side                 |
| FSH - Full Spectrum Holistics | UKCA - UK Conformity Assessed      | PDO - Process Data Object            |
| OQS - Oil Quality Sensor      | FAQ's - Frequently Asked Questions | ENC - Electronic Navigational Charts |
| TDN - Tan Delta Number        | BS - British Standard              | Ts&Cs - Terms and Conditions         |
| TAN - Total Acid Number       | RHS - Right Hand Side              |                                      |

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## DISCLAIMER

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain. Always ensure the correct configuration, installation, and connection of the sensor in accordance with these instructions prior to any use.

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AMENDMENT RECORD SHEET

| Version Number | Amendment(s) | Amended by | Date             |
|----------------|--------------|------------|------------------|
| 1              | New document | S Rickards | 29 November 2024 |
|                |              |            |                  |
|                |              |            |                  |
|                |              |            |                  |

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## 1 SENSE-3 KIT - INTRODUCTION

### 1.1 Product overview

SENSE-3 is a scalable data monitoring & analysis solution giving you access to both live and historic data using Tan Delta's **Cumolicity** application.

The standard kit allows up to three OQSx-G2 sensors to be connected out of the box. However, you can expand the system to include up to 16 Sensors by connecting multiple Gateway Hubs to the SENSE-3 standard kit (additional sensors and hubs are sold separately)

Therefore, you can monitor large multi-asset systems where timing of maintenance intervals is crucial. SENSE-3 enables data transmission using a variety of methods depending upon location and network availability. These include Cellular, WiFi and Ethernet.

### 1.2 Kit Contents

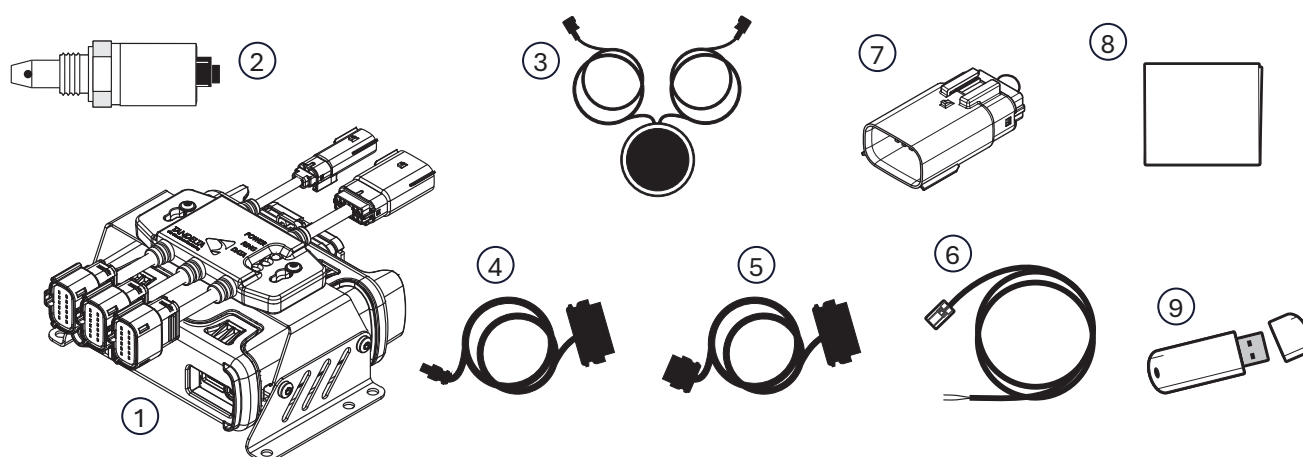


Fig. 1-1 SENSE-3 Kit Contents

Check that your kit contains the following items:

#### What's in the box? Product Code: SENSE-3-BS1

| Item | Description  |
|------|--|
| 1    | SENSE-3 Unit - Gateway pre-assembled with Gateway Hub and Mounting Kit                       |
| 2    | OQSx-G2 Sensor   |
| 3    | Gateway 4 G Antenna  |
| 4    | Sensor to Hub Cable 5 m (Cable SH)   |
| 5    | Gateway Hub to Gateway Cable 0.2 m (Cable GH)  |
| 6    | Gateway Hub Power Cable 10 m (Cable HP)  |
| 7    | 2 x Gateway Hub Continuity Plug (HCP-1)  |
| 8    | Quick Start Guide  |
| 9    | USB Stick containing: Gateway Configurator, Software, CADS and Gateway component User Guides |

### 1.3 About this User Guide

This User Guide provides details on how to configure, install, operate, and maintain the components of the SENSE-3 Kit.

## 2 PRODUCT INFORMATION - TAN DELTA OIL QUALITY GATEWAY (OQTg)

### 2.1 Introduction

The Tan Delta Oil Quality Gateway (OQTg) is a comprehensive networking device.

The OQTg - coupled with Cumulocity or TD Online - provides remote visibility for all connected assets.



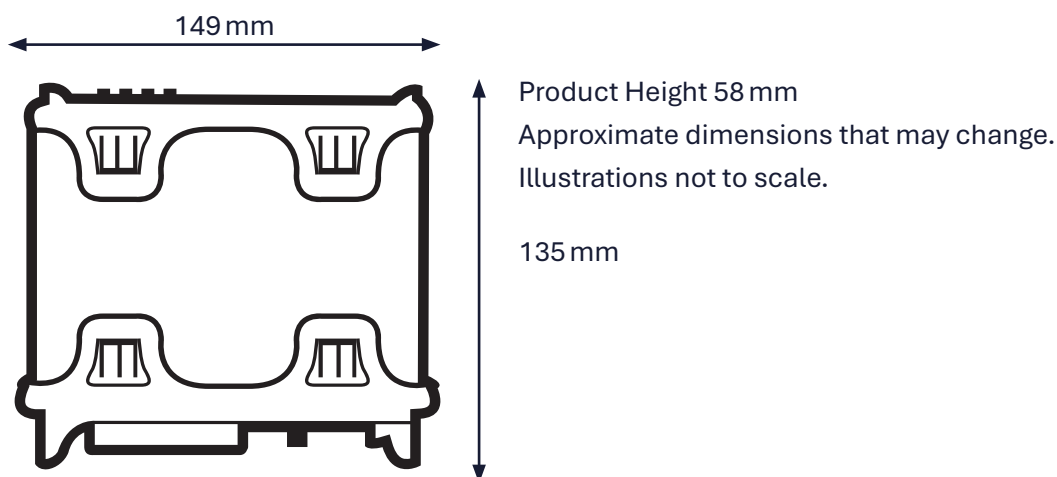
Fig. 2-1 Tan Delta Oil Quality Gateway (OQTg)

### 2.2 Important Safety Information

Pay attention to the following safety notes:

- The Gateway is not IECEx certified.
- Never disassemble, repair or tamper with the Gateway.
- Make sure that the supply voltage is within the specified range.
- Make sure that the load currents do not exceed the rated value.
- Check all the wiring for correct connection before powering the unit.

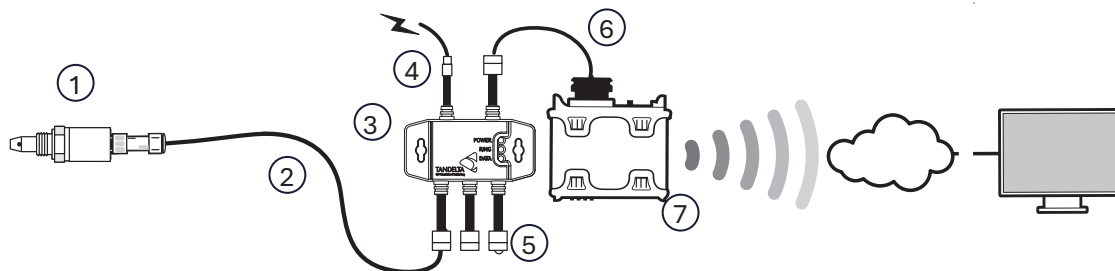
### 2.3 Dimensions





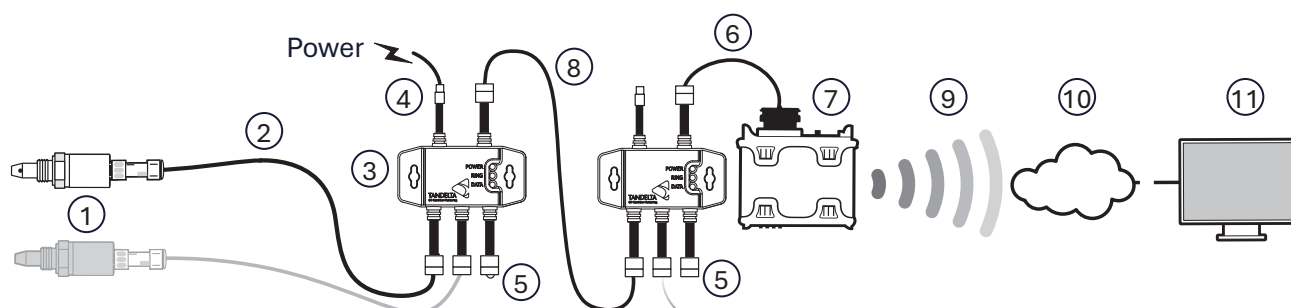
## 2.4 Connections

### 2.4.1 SENSE-3 Kit - Standard kit, as supplied



| Item | Description  |
|------|--|
| 1    | OQSxG2 Sensor  |
| 2    | OQSxG2 Sensor to OQTh Gateway Hub Cable - Cable SH               |
| 3    | Gateway Hub  |
| 4    | Gateway Hub Power Cable - Cable HP                               |
| 5    | OQTh Gateway Hub Continuity Plug (1 per unpopulated sensor slot) |
| 6    | OQTh Gateway Hub to OQTg Gateway Cable                           |
| 7    | OQTg Gateway   |

### 2.4.2 Multi-Sensor and Hub System - Typical example



| Item | Description   |
|------|---|
| 1    | OQSxG2 Sensor   |
| 2    | OQSxG2 Sensor to OQTh Gateway Hub Cable - Cable SH    |
| 3    | Gateway Hub   |
| 4    | Gateway Hub Power Cable - Cable HP                    |
| 5    | OQTh Gateway Hub Continuity Plug                      |
| 6    | OQTh Gateway Hub to OQTg Gateway Cable                |
| 7    | OQTg Gateway  |
| 8    | OQTh Gateway Hub to OQTg Gateway Hub Cable - Cable HH |
| 9    | 4G / Wi-Fi / Ethernet                                 |
| 10   | Internet  |
| 11   | Cumulocity Software Application                       |

#### Gateway Hubs and Sensors

| Nº of Gateway Hubs | Nº of Sensors Supported |
|--------------------|-------------------------|
| 1                  | 3                       |
| 2                  | 5                       |
| 3                  | 7                       |
| n                  | 2n+1                    |

### 3 OQSx-G2 SENSOR CONFIGURATION



#### IMPORTANT:

You must configure the sensor to your specifications using the Tan Delta **Configuration and Data Management Software (CADS)**.

Install **CADS** by going to our website and clicking the link to download:

[www.tandeltasystems.com/support/](http://www.tandeltasystems.com/support/)



#### NOTE:

The CADS application **must** be installed on a windows PC or laptop.

CADS **does not** operate on Mac devices or Chromebook devices.



#### 3.1 Set Up



#### NOTE:

You will Administrator privileges on your computer to Install the CADS application.

Also, when CADS has installed, we recommend that you connect the Configuration cable to the PC whilst Administrator privileges are still granted, so it will recognise the cable and install any drivers that are needed.

#### 3.1.1 Install the CADS application onto a PC / Laptop

- 1) Install CADS by accessing [www.tandeltasystems.com/support/](http://www.tandeltasystems.com/support/)
- 2) Follow the link and download.
- 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**.  
When installation is complete, **CADS** is displayed.  
It may take up to a minute for the software to identify the OQSx-G2.
- 6) Allow the PC/laptop to automatically update drivers, if needed.

#### 3.1.2 Start the software

Start the CADS application and wait for the home screen to load.

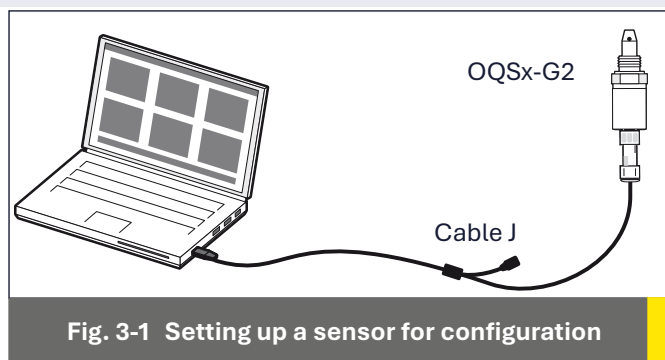


#### NOTE:

If sensors are configured to Modbus/CANbus, you **must** open the software first, and then connect the Sensor.

#### 3.1.3 Connect the OQSx-G2

- 1) Once the home screen has loaded, select **Configure Oil Quality Sensor** from the options on the home screen.
- 2) Connect the OQSx-G2 to your computer using the configuration cable (**Cable J**) as shown in Fig. 3-1.



(Standard sensor shown)



### 3.1.4 Select your Sensor

CADS will display a list of all connected devices, identified by serial number, as shown in Fig. 3-2.

- 1) Select the required device.
- 2) Click the arrow in the top right corner to proceed



Fig. 3-2 CADS Sensor selection screen

### 3.1.5 Communication Settings

The CADS application lists the options for the device to which you are connecting the sensor, as shown in Fig. 3-3. SENSE-3 Gateway Devices are supplied configured for Modbus, and therefore require Custom Communications Settings.

Earlier versions of the Gateway were not configured for Modbus. If you have a query, contact Tan Delta Support [www.tandeltasystems.com/support/](http://www.tandeltasystems.com/support/)

- **Custom Communications Settings** – Allows you to select custom **Node ID** and **Bit Rate** for RS485, CANbus, J1939, Modbus RTU.



Fig. 3-3 Communication options

### 3.1.6 Oil Configuration

This page allows you to select any oil from our database.

The boxes at the top of each column allow you to either search or filter the database with the drop-down menu or type directly into the box.

If the oil you require is not in the database, please contact [support@tandeltasystems.com](mailto:support@tandeltasystems.com) for help.

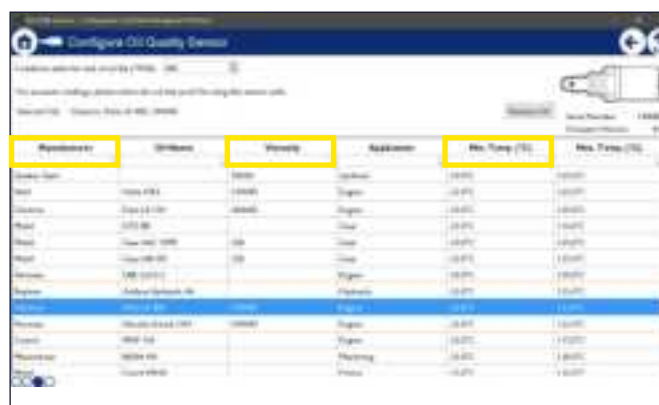


Fig. 3-5 Oil Selection

## 4 TAN DELTA OIL QUALITY GATEWAY - CONFIGURATION & INSTALLATION



### NOTE:

You **MUST** configure the QGSxG2 Sensor for use with the Oil Quality Gateway (OQTg) **before** configuring the OQTg.

This is done in CADs. See the Sensor Configuration section of this User Guide for more information.

The Gateway configurator software is provided on the USB stick within the Sense 3 kit.



### 4.1 Writing your Configuration settings to a USB

Before you can use the OQTg, it must be configured to work on the particular network that you have chosen to use.

This is done by writing the configuration settings to a USB stick and uploading them to the device.

#### 4.1.1 Run the Software

- 1) Run the Gateway Configuration Tool from the product USB
- 2) To start the application, double-click on the file **OQGatewayConfigurator.exe**



Fig. 4-1 OQGatewayConfigurator.exe

#### 4.1.2 Selecting and setting up your interface settings

The Configurator has three interface options.

- LAN (Ethernet)
- WLAN (Wi-Fi)
- GPRS (Mobile Data)

Select the one that applies to your chosen network type.

#### 4.1.3 LAN (Ethernet) configuration

- 1) Select either **Dynamic (DHCP)** or **Static** – Consult with your network administrator to make sure that you select the correct option.

Make sure through your IT provider that the device will be granted access to the Internet through any applicable firewalls or other security protocols.

- 2) If **Static** is selected, enter the **IP Address**, **Subnet Mask** and **Gateway**.
- 3) When you have chosen the required settings, click **Save Configuration to File**.

Refer to Section 4.1.6.

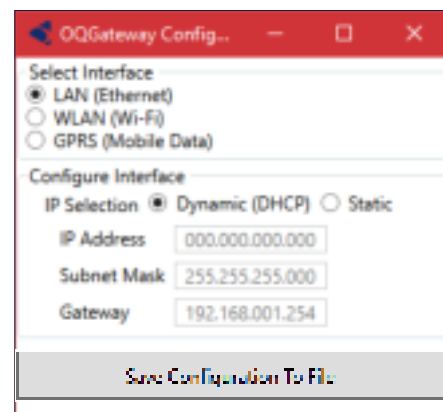


Fig. 4-2 LAN (Ethernet)



### 4.1.6 Save the Configuration Settings

- 1) When you have entered the required configuration details click **Save Configuration To File**.  
This file will be saved automatically to the USB stick.
- 2) Close the OQTG Configurator and remove the USB stick safely from your computer.



Fig. 4-6 List of available GPRS Networks

## 4.2 Uploading your settings to the OQTg

- 1) Turn on power to the OQTg Gateway.
- 2) Remove the translucent clip-on cover on the front of the OQTg.



### NOTE:

The Gateway device will take a few minutes to start up. A green LED will show once device is operational.

- 3) Make sure you are using the memory stick containing the required network configuration, as set up in Section 4.1.
- 4) Refer to Fig. 4-7. Insert the memory stick into the USB port of the OQTg.
- 5) Wait for the Red LED to turn on and off again before removing USB memory stick.

Once your network configuration has been loaded, the OQTg will reboot.

- 6) Wait for Green LED to turn on – this may take several minutes.

The OQTg is now loaded with your network configuration.

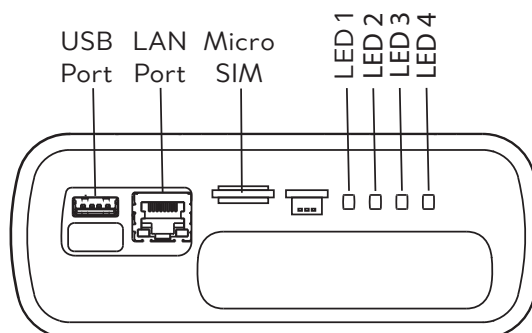


Fig. 4-7 OQTg Interface ports and LEDs

## 4.3 Mounting the OQTg

The OQTg has mounting brackets that allow it to be mounted to any suitable surface.

Refer to the environmental and approvals specifications this User Guide and make sure that the mounting location meets these requirements.

## 5 OQSx-G2 SENSOR INSTALLATION

### 5.1 Precautions

**Read these instructions before installing the oil quality sensor.**

The sensor is robust, however it can be damaged by mistreatment.

The following must be noted:

- Install the sensor into the equipment **before** making electrical/wiring connections.
- Make sure that the fittings being used correspond with the sensor thread size
- Tighten to no more than 20 Nm with a 32 mm spanner.  
**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 (32 mm).
- Refer to Fig. 5-1. To prevent vibration having any adverse effects to the cable/sensor connectors, the cable must either be mounted on the same plane as the sensor, or have a loop fitted to absorb vibration.
- 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 excessively, 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.
- Oil pressure must not exceed 70 bar.

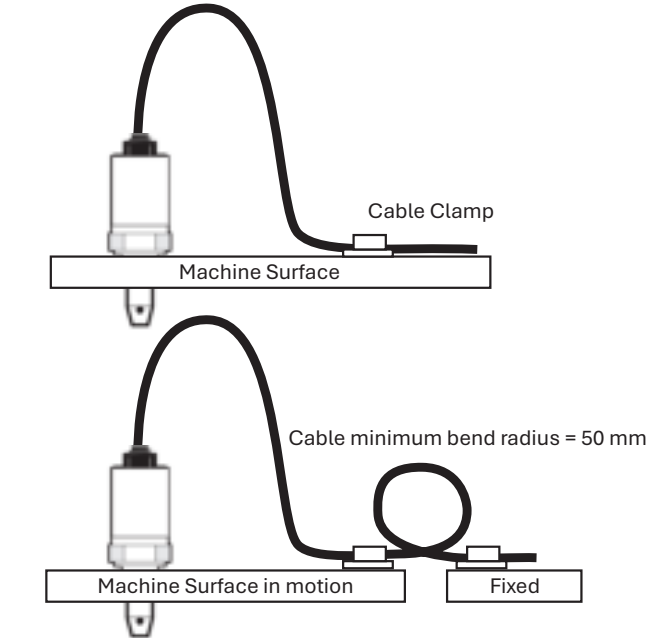


Fig. 5-1 Cable Fitting

### 5.2 Choosing the Sensor Mounting Location

The performance of the sensor will be enhanced through careful consideration of the mounting location.

Refer to Fig. 5-2.

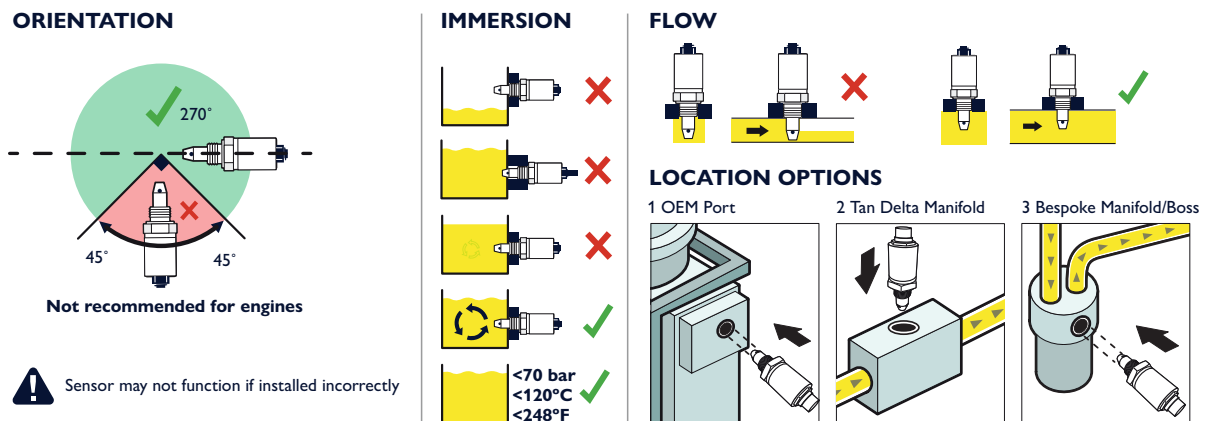


Fig. 5-2 Choosing a mounting location for the Sensor

The following guidelines must be followed.

- The Sensor must, if possible, be mounted in a horizontal position.
- Whenever possible, the sensor **should not** be mounted in the bottom of a sump, as the sensor head may become restricted which will prevent correct operation.
- Dynamic oil flow is necessary: do not mount in places where the oil is likely to stagnate or be static; The oil in the sensor needs to be representative of the whole system.
- The sensor nose must remain immersed in the oil at all times.
- When the oil quality sensor is mounted in a pipeline, make sure that the sensor will not restrict flow.
- For maximum performance when mounting the oil quality sensor in a lubrication system, make sure that the sensor is located prior to the oil filters, oil coolers etc. This ensures that the oil is representative of the whole system.



### 5.3 Fitting Method

- Use a 32 mm Torque-adjustable spanner for installation.
- Decide on an appropriate location for the sensor head installation.
- Drain the lubricant sufficiently to allow the sensor to be fitted.
- Install the sensor head into the selected location/position. Torque to 20 Nm, being careful not to over-tighten.
- Route the cable, fixing it with cable ties at appropriate intervals.
- Avoid sharp edges and hot surfaces.
- Connect the sensor to the chosen interface.

## 6 OQTg GATEWAY - UNDERSTANDING DATA

### 6.1 Dynamic Maintenance Optimisation (DMO)

Dynamic Maintenance Optimisation (DMO) is the method by which the data can be used to optimise the maintenance intervals for the lubricating oil in the application.

Changing the oil at an interval determined by Tan Delta software means you are only changing the oil when you need to, not at a predetermined schedule when the oil may still be in a useable condition.

### 6.2 Cumolocity

**Cumolocity** is a cloud-based Internet of Things (IoT) solution that uses a Gateway device connected to the Internet to send data from either one or a multiple sensors to a cloud-based viewing platform.

**Cumolocity** allows live reading of oil condition and oil temperature.



Fig. 6-1 Cumolocity Live Readings display

The **Cumolocity** platform allows you to simply view the data live, or alternatively set alerts and alarms for oil condition from a remote online portal.

Alerts and alarms can be configured to show in the online dashboard or to email relevant personnel to take action.



Fig. 6-2 Cumolocity Online Alerts and Alarms Dashboard



Historic data collected from the sensor and presented on **Cumolocity** can also be viewed through the Data Explorer menu, including viewing pre-set date ranges or setting a custom period to review.



Fig. 6-3 Cumolocity Data Explorer Menu

### 6.3 Example good sensor output readings

The graph in Fig. 1-4 shows a classic “sawtooth” representation of an engine in operation, illustrating when oil changes have taken place at checkpoints F, L and R.

The green lettered checkpoints are where oil samples would normally be sent for analysis to ensure oil condition is acceptable.

With the OQSxG2 installed, oil sampling is not required prior to checkpoints F, L and R.



Fig. 6-4 Example sensor output readings



## 6.4 Implementing DMO in Cumulocity

**Cumulocity** presents oil condition data as the Tan Delta Number (TDN)

Legacy versions of the application presented oil condition as percentage loss factor (%LF) values.

DMO can be reported as an alert on **Cumulocity** and also via email.

The Cockpit, displayed on logging in, shows the alerts across all assets to which you have access.



Fig. 6-5 Cumulocity Alerts

### 6.4.1 Adding a Smart Rule

- 1) Refer to Fig. 6-6. Click on the **Smart rules** tab.



Fig. 6-6 Adding a Smart rule

The **Smart rules** screen displays a list of the smart rules that have been set up for your asset.

- 3) Click on **Add smart rule**.

The **Add local smart rule** pop-up window is displayed, as shown in Fig. 6-7.

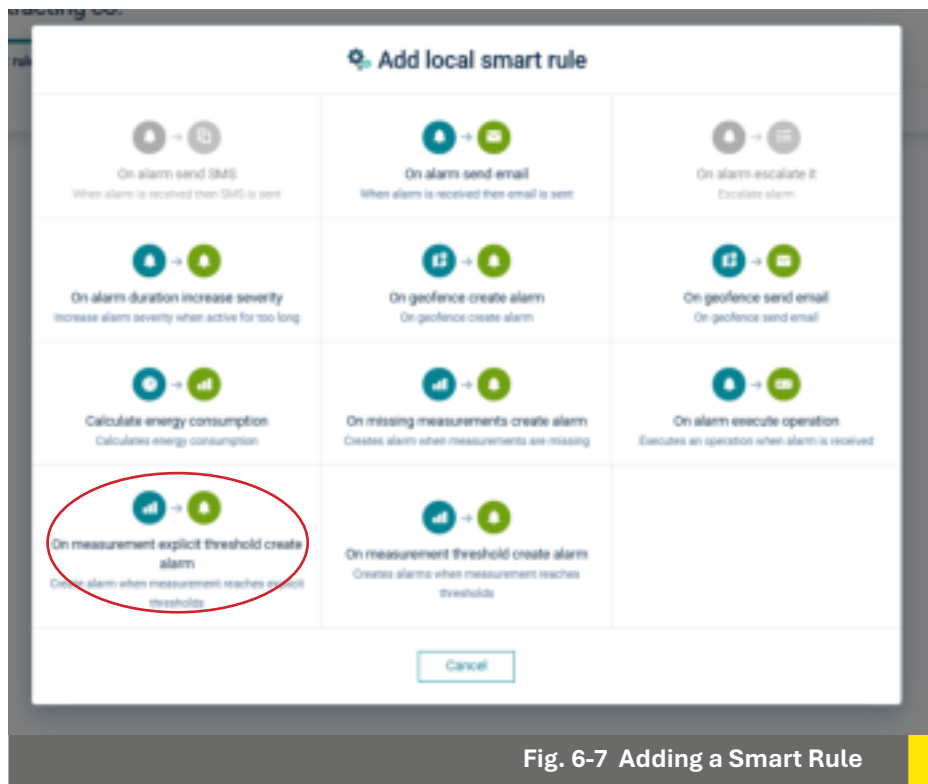


Fig. 6-7 Adding a Smart Rule

- 4) Select **On measurement explicit threshold create alarm**.
- 5) Click on the **Select data point to prefill inputs below** drop-down list. See Fig. 6-8.

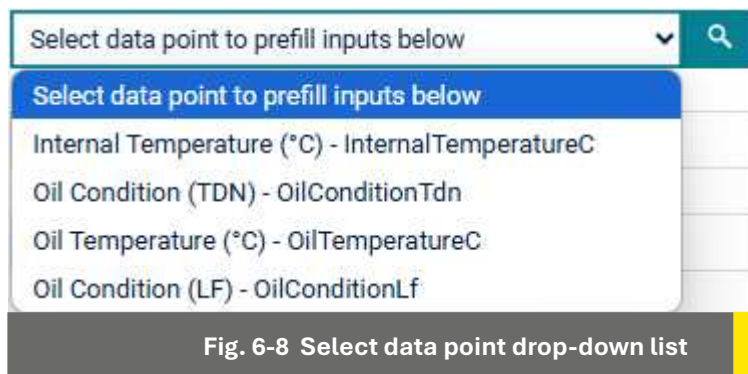


Fig. 6-8 Select data point drop-down list

Select the required data point from **Internal Temperature (°C)**, **Oil Condition (TDN)**, **Oil Temperature (°C)** or **Oil Condition (LF)**.

Continued...

Fig. 6-9 shows the data point alarms settings options for Oil Condition (TDN).

- 6) Enter the values that you want to trigger the alarm.
- 7) Click on **Create**.



**2 On threshold:**

Oil Condition (TDN) - OilConditionTdn

OilReading

OilConditionTdn

0  
Default: 90

300  
Default: 100

Cancel Create

Fig. 6-9 Data point alarm threshold settings

The new smart rule will be displayed in the **Smart rules** tab of the Cumulocity Cockpit, as shown in Fig. 6-10.

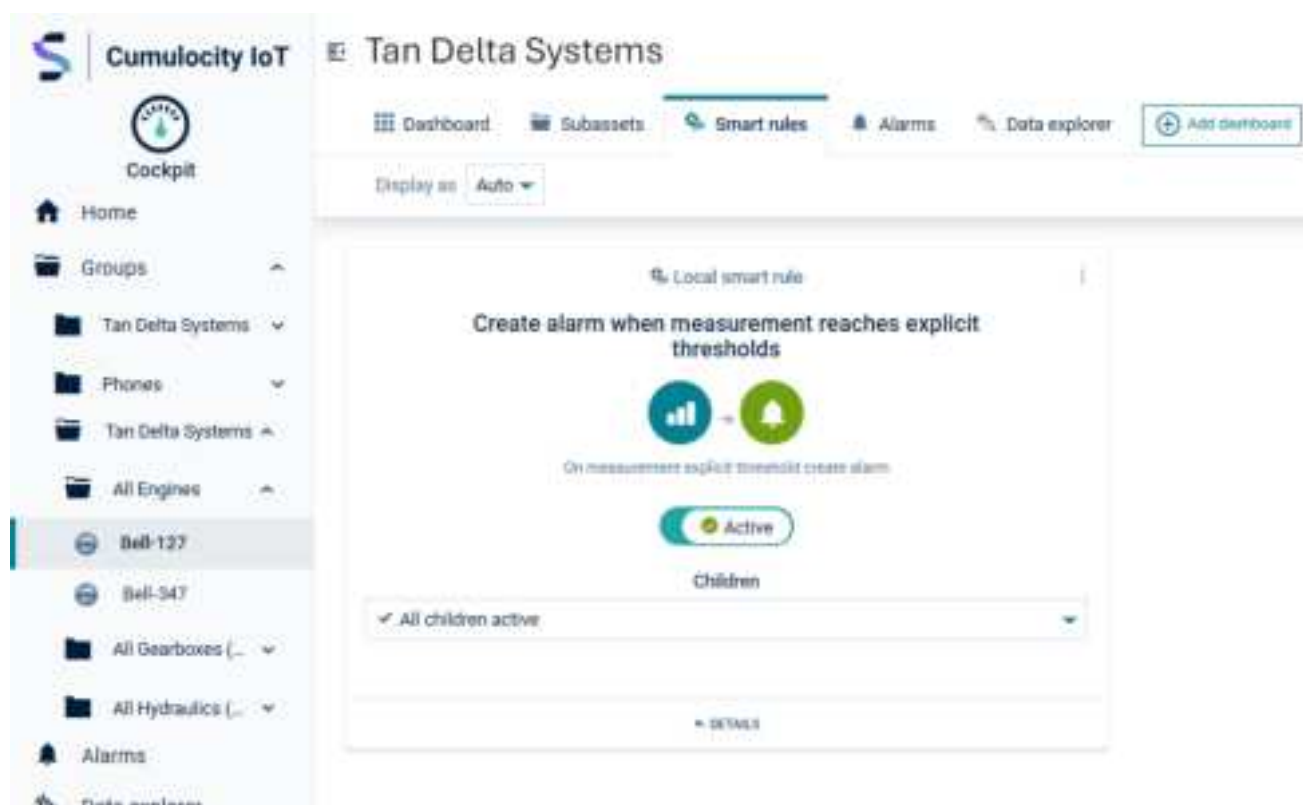


Fig. 6-10 Smart rule displayed in Cockpit view

### 6.4.2 Setting up an email alert

- 1) To set up an email alert, you will need to know the **Type** details of the alarm.

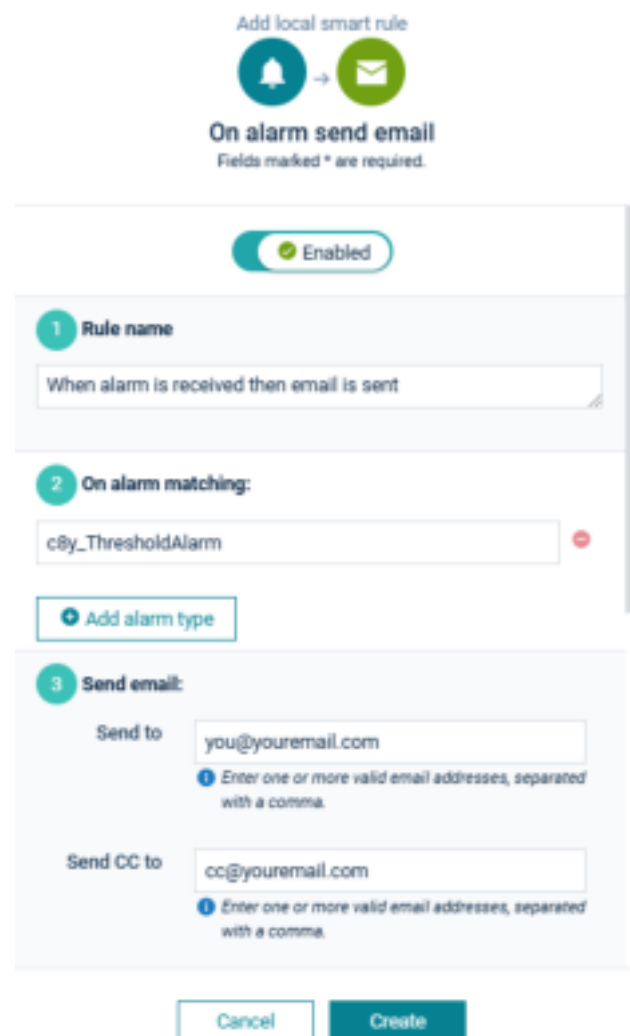
This is shown on the alarm details on the Alarms screen e.g. 

- 2) Click the **Add smart rule** link in the **Smart rules** screen, and select the **On alarm send email** option.

The **On alarm send email** window is displayed, similar to Fig. 6-11.

- 3) Enter a **Rule name** for your rule.
- 4) In the **On alarm matching field**, enter the **Type** of the alarm e.g. **c8y\_ThresholdAlarm**
- 5) In the **Send email** details, enter the email address for each recipient in the **Send to** field. For multiple email addresses, separate each address with a comma.
- 6) If required, enter the **Send CC to** email address for recipients of a copy of the email.
- 7) When you have entered the required details, click on **Create**.

The new smart rule will be displayed in the **Smart rules** tab of the Cumulocity Cockpit, as shown in Fig. 7-12.



The screenshot shows the 'Add local smart rule' window for the 'On alarm send email' action. At the top, there's a header with a bell icon and an envelope icon, and the text 'On alarm send email' and 'Fields marked \* are required.' Below this is a toggle switch labeled 'Enabled'. The main form has three sections: 1. 'Rule name' with a text input field containing 'When alarm is received then email is sent'. 2. 'On alarm matching:' with a text input field containing 'c8y\_ThresholdAlarm' and a red error icon. 3. 'Send email:' with two text input fields: 'Send to' containing 'you@youremail.com' and 'Send CC to' containing 'cc@youremail.com'. Both email fields have a red error icon and a hint: 'Enter one or more valid email addresses, separated with a comma.' At the bottom, there are 'Cancel' and 'Create' buttons.

Fig. 6-11 Setting an email alert



The screenshot shows the 'Local smart rule' window for the 'On alarm send email' action. At the top, there's a header with a bell icon and an envelope icon, and the text 'On alarm send email'. Below this is a toggle switch labeled 'Active'. The main form has a section: 'Children' with a text input field containing 'Add children active'. At the bottom, there is a 'DETAILS' link.

Fig. 6-12 Setting an email alert



## 6.5 Advanced Fault Detection (AFD) & Event Identification and Validation (EIV)

**Advanced Fault Detection (AFD)** is the identification of potential issues in a piece of machinery that through analysis of the holistic oil condition.

Similarly, **Event Identification and Validation (EIV)** uses the same methodology to track maintenance and other interactions which affect the oil.

Through our in-house analytics, it is possible to identify different faults and events, including degradation of the oil, water ingress, wear metals, TBN decrease and soot increase.

The below list shows the range of alerts which will be triggered in Cumulocity, and what the implications are for the asset:

### 7.5.1 Oil Condition Alerts

#### Sensor in Air

- This can indicate a loss of oil from the asset, a blockage, or incorrect sensor installation.

#### Oil Approaching End of Life

- Warning to monitor the asset as the oil is approaching its end of life.

#### Oil At End of Life

- Indicating that the oil is now worn sufficiently to require changing.

### 7.5.2 Oil Behaviour Alerts

#### Accelerated Oil Wear

- The oil is showing wear at a faster rate than expected, indicating an issue with the oil or the asset itself.

#### Water / Coolant Contamination

- Detection of water ingress or coolant leakage into the oil system.

#### Particulate Contamination

- Detection of particulate contamination (e.g. soot or wear metal) giving early indication of an asset maintenance issue.

#### Fuel Dilution

- Leakage of fuel into the oil system, indicating an asset problem requiring immediate attention.

### 7.5.3 Event Detection Alerts

#### Oil Change

- Detection that an oil change has occurred, to confirm with the maintenance team.

#### Top Up / Sweeting

- Detection that an oil top-up has occurred, to confirm with the maintenance team.

#### Incorrect Oil Filled

- Flagging that the incorrect oil has been installed in the system, which doesn't fit the configured oil profile.

## 7 OQTg GATEWAY - SUPPORT

| Issue                                | Possible cause                                     | Checks   | What to do if the check fails...  |
|--------------------------------------|--|--|---|
| Cannot see any data in Cumulocity    | Power Issue?                                       | Check the Green LED on the Hub                         | Make sure that the power supply to hub is 9-30V DC                          |
|                                      |  |  | Make sure that a secure connection is made from cable HP to hub device      |
|                                      |  |  | Replace Hub   |
|                                      |  | Check the Green LED on the Gateway                     | Allow the Gateway to boot up (5-10 minutes)                                 |
|                                      |  |  | Check the Hub to Gateway Cable  |
|                                      | Internet Issue?                                    | Check the Amber LED on Gateway                         | If SIM: Is SIM inserted correctly?  |
|                                      |  |  | Is 4G antenna connected?  |
|                                      |  |  | Is there 4G signal in the area on that network?                             |
|                                      |  |  | Check SIM configuration   |
|                                      |  |  | Check SIM APN details with network provider                                 |
|                                      |  |  | If WiFi: Check WiFi configuration   |
|                                      |  |  | Check WiFi network with IT provider (Signal, firewall etc...)               |
|                                      |  |  | If LAN: Check the LAN cable to the Gateway                                  |
|                                      |  |  | Check LED activity on the Gateway LAN port                                  |
|                                      |  |  | Check the LAN cable to the switch   |
|                                      |  |  | Check the LED activity on the network switch LAN port                       |
|                                      |  |  | Check the LAN with your IT provider (Internet connection, firewall etc...)  |
|                                      | Sensor Communication Issue?                        | Check "Ring" LED                                       | Make sure that all connections are made correctly                           |
|                                      |  |  | Make sure that continuity plugs are installed into all unused hub locations |
|                                      |  | Check "Data" LED for a flash once per sensor connected | Check the sensor configuration using CADS                                   |
|                                      | If all the above are OK, contact Tan Delta Support |  |   |
| Cannot see the asset in Cumulocity   | Access rights issue                                | Check tenancy access with system administrator         | Contact Tan Delta Support   |
| Cannot see dashboard in Cumulocity   | Dashboard not present                              | System administrator can add a new dashboard           | Contact Tan Delta Support   |
| Cannot log into Cumulocity           | Incorrect password                                 | Enter email into forgotten password link               | Contact Tan Delta Support   |
|                                      | Unauthenticated user                               | System administrator can add new users                 | Contact Tan Delta Support   |
| Not receiving alerts from Cumulocity | Alerts not setup for user                          | System administrator can edit alerts in cumulocity     | Contact Tan Delta Support   |

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Oil Condition Monitoring

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