DUSTCANARY TREND 420
PERSONAL DUST MONITOR

Operating Guide

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www.DustCanary.com

CONTENTS

1. Overview 3

2. Getting Started 4

Initial Battery Recharge 4

Mounting the Device 4

Recharging the Battery 4

3. Operating the Device 5

Switching Dust Detection On 5

Switching to Standby Mode 5

High Dust & Warning Alarms 6

Respirable Dust Measurement 6

Datalogging 6

Qualitative Dust Measurements 7

4. Menu Structure 8

Bluetooth 8

Alarm Settings 8

Battery 8

Alarm Status 8

Dust Level 8

5. Service Requirements 9

Regular Maintenance 9

Optional Prefilter 9

Device Sensor Checks 9

6. Annual Sensor Replacement 10

7. DustCanary Browser Application 11

Application Overview (Version 4XX) 11

Live View 12

Alarm Settings 13

Other Settings 14

App Settings 16

Transferring Recorded Session Data 17

1. OVERVIEW

The DustCanary Trend 420 is a personal dust monitor designed to be worn within the breathing zone. Equipped with an internal battery, sensor, and secure clothing clip, the DustCanary is compact, unintrusive and does not require any additional tubing that can hinder the wearer's movement.

The unit uses an optical particle counter to take qualitative measurements of respirable dust in real-time (mass concentration of particles less than 4µm in diameter), activating alarms based on these readings. Real-time qualitative respirable dust levels are displayed on the unit and may be transferred to a PC via Bluetooth.

Key features of the DustCanary:

- Respirable dust levels monitored and displayed in real-time
- Audible and visual warning and high dust alarms
- OLED display and menu
- Bluetooth coms for configuration and data transfer to PC via DustCanary browser application software

The monitor uses a rechargeable 5V Li-ion battery that provides power for 12 to 16 hours of operation. The battery takes approximately 4 hours to recharge.

The **DustCanary browser software** can be used to configure the device as well as download and export respirable dust levels records (see DustCanary Browser Application section).

2. GETTING STARTED

INITIAL BATTERY RECHARGE

To comply with freight regulations, the battery in a new unit will not be fully charged. To charge the battery:

- Connect a USB-C cable to a laptop or power outlet and plug into the base of the device.
- Charging is indicated by the left-hand LED flashing blue and will take 4 hours from a low charge at 1A. Once fully charged, the LED will stop flashing and remain blue. A fully charged battery will give a minimum of 12 hours operation even after 200 recharge cycles.

MOUNTING THE DEVICE

For personal monitoring, the DustCanary should be clipped to the outermost layer of clothing with the inlet facing forward. The location should be within the breathing zone, up to 300mm from the nose. This will ensure that the inlet experiences similar exposure to the individual and that the data is representative of the dust they are breathing.

For applications where the DustCanary is used to monitor dust levels at a particular location over time, the unit can be permanently connected to a power source via USB-C. The unit should be mounted on a tripod or orientated so that the inlet is horizontal.

RECHARGING THE BATTERY

The battery should be recharged overnight between uses with a USB-C cable. A full battery has sufficient capacity for over 12 hours of operation. If used in a fixed location, the device may be permanently powered by a USB-C cable.

The battery charge level is shown on the display. The LED will start to flash green and intermittently sound an alarm when the battery has less than 1 hour remaining.

3. OPERATING THE DEVICE

The instrument is controlled by two buttons on the left side of the front case:

- The upper **black button** which is used to scroll through the displayed screens.
- The lower **yellow button** which is used to toggle dust detection and enter commands such as exit, mute and toggling Bluetooth on or off.

To conserve battery life, the display remains illuminated for 30 seconds before dimming, and can be reactivated by pressing either button.

When dust detection has been switched on, alarms and data recording will become active, indicated by the green LED illuminating. After collecting data in field, records can be uploaded to a PC at the end of the day.

SWITCHING DUST DETECTION ON

Dust detection may be switched on and off by pressing the yellow on/off button on the front of the device and holding for 2 seconds. When the unit is switched on, the display becomes active (initialising and displaying the firmware version), and the green LED is constantly lit. A faint noise may also be heard from the fan drawing samples into the sensor.

If the unit does not switch on when the yellow on/off button is first pressed, this means that the unit is exiting standby mode. Repeat the 2 second press on the yellow on/off button until there is an audible beep.

To confirm that dust detection is on, check that the green LED is lit. The green LED will remain illuminated during dust detection, and only flash when there is less than one hour of battery remaining, indicating that the unit requires charging.

SWITCHING TO STANDBY MODE

To switch dust detection off and put the DustCanary into standby mode, press and hold the yellow button for 2 seconds. The display will show the words “shutting down”, the LED lights will all switch off, and the fan will stop.

In standby mode, the menu can still scroll between Bluetooth and battery level menus. The green LED will not be lit in standby mode and no dust detection or recording occurs.

HIGH DUST & WARNING ALARMS

If alarms are enabled (via user settings in the DustCanary application software), they will be active whenever the instrument is in dust detection mode and the green LED is illuminated.

Upon entering the alarm state, the DustCanary:

- Produces an audible alarm (which can be muted by selecting the yellow button)
- Changes to the alarm state on the display.
- Illuminates a red LED for high dust alarm or a yellow LED for warning alarm.

Alarm levels should be set while considering normal dust levels experienced by an individual when dust controls are working correctly. They may in certain circumstances be set at higher levels for Short Term Exposure Limits (STELs) since this increased dust exposure contribution to the 15-minute average is only for the period where preventative action is not taken (which is generally seconds).

RESPIRABLE DUST MEASUREMENT

The DustCanary uses an advanced optical particle counter (OPC) sensor module to collect real-time measurements for respirable dust. A replaceable respirable foam filter may be fitted to the inlet of the device to filter out larger particles than 4µm before they enter the OPC module, helping to extend its life.

The valid measurement range of the device is 0.001 to 10mg/m^3, however the device monitors respirable dust levels up to 15mg/m^3.

The sensor module should be replaced annually. This will vary depending on the application and how the device is used. Each sensor will be supported with a manufacturer's reference calibration report. Consult your local Air-Met Scientific for specific recommendations to ensure your sensor stays healthy.

DATALOGGING

Data is automatically stored in the device whenever the instrument is in dust detection mode (indicated by the green LED). Different recording sessions are created each time dust detection is toggled on, and these sessions may be downloaded and viewed as excel graphs using the DustCanary application software (see DustCanary Browser Application section).

The default recording rate is once every 5 seconds, however this can be configured within the range of 1 - 60 seconds using the DustCanary application software.

The 15-minute rolling average of dust levels is also calculated by the DustCanary application software and may be graphed in addition to the recorded data. This data may be used to complement periodic compliance sampling and helps ensure exposure is being controlled between compliance samples.

QUALITATIVE DUST MEASUREMENTS

Real-time qualitative measurements from the DustCanary grant valuable insights into your safety program in several ways including:

- Complementing gravimetric samples taken for compliance with additional insights.
- Understanding the fluctuations in dust levels throughout the day.
- Monitoring personal exposure to respirable dust over short periods, particularly durations that gravimetric sampling cannot be used for.

4. MENU STRUCTURE

When activating dust detection mode, the device goes through a 20 second intialising process and displays the version of the firmware being run. Once the unit is running, pressing the black button will allow the user to cycle through the device's menus in the following order.

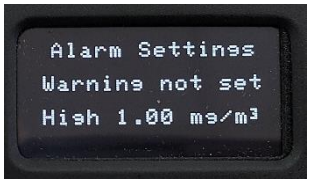
Bluetooth > Alarm Settings > Battery > Alarm Status > Dust Level

In standby mode (green LED off), the black button will only cycle between the Bluetooth and battery menus.

BLUETOOTH

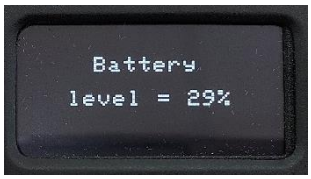
The Bluetooth state is shown at the top of the screen. Use the yellow button to toggle Bluetooth on or off. While Bluetooth is activated, this screen will also display the Bluetooth identifier which is the same as the device's serial number. Bluetooth must be switched on to communicate with the DustCanary PC software.

ALARM SETTINGS



Here, current settings for warning and high dust alarms will be displayed in mg/m^3 if they have been set. To change alarm settings, connect to the DustCanary browser software while Bluetooth is on. Here, you can set thresholds, the holdoff period and enable alarms (refer to DustCanary Browser Application section).

BATTERY



Here, the unit's current battery level will be displayed as a percentage. If the unit is connected to power, the charging status will also be displayed. It is recommended that the unit be recharged when battery reaches 20% or less. When there is less than 10% remaining, it will shut down.

ALARM STATUS

This screen displays the current alarm state ranging from the following:

- No dust alarm
- Warning alarm
- High dust alarm
- Dust protection mode (if activated)
- Sensor error

DUST LEVEL

The dust level is displayed in mg/m^3 and is updated once every second. The maximum value that can be recorded and displayed is 15 mg/m^3. To view the trend of dust levels from recorded sessions, switch Bluetooth on and connect to the DustCanary application software (see DustCanary Browser Application section).

5. SERVICE REQUIREMENTS

REGULAR MAINTENANCE

The DustCanary should be kept clean with excess dust deposits removed by a soft brush, cloth or vacuum. Excess dust on the inlet to the device should never be blown into the device, as this may contaminate the optical sensor.

OPTIONAL PREFILTER

The device has an aerosol filter to remove larger particles and protect the optical sensor from contamination. These particles are greater than 10µm, meaning that they are not included in respirable dust measurements.

In cases where the dust level is regularly greater than 1mg/m^3, the aerosol filter will not be able to cope in the long term. Instead, an optional prefilter can be installed on the inlet. This will remove particles greater than 4µm in size and will hence not affect the measurement. This filter should be replaced either after 40 hours of operation above 1mg/m^3, or once per month, whichever is first.

DEVICE SENSOR CHECKS

The device continuously monitors the condition of its sensor to ensure accurate measurements. Should a sensor failure occur, the device will automatically shut down. The reason for sensor failure is recorded in the alarm log and can be reviewed by downloading the session. After exporting the session file, select the *Dust Log* tab. The alarm state is displayed in the last column.

Please note that if the alarm state reads “OPC degraded”, this is not a failure and should not be a cause for concern unless it is happening more than 25% of the time.

A	B	C	D	E	F
DEVICE	DATE + TIME	TIME	QUALITATIVE DUST LEVEL	QUALITATIVE 15M AVERAGE	ALARM STATE
DCCCCCCD	2023/06/02 08:08:36	8:08:36	0.36250	0.36250	OPC_DEGRADED, OPC_FAN_ERROR
DCCCCCCD	2023/06/02 08:08:41	8:08:41	0.45870	0.41060	SENSOR_OK
DCCCCCCD	2023/06/02 08:08:46	8:08:46	0.34080	0.38733	SENSOR_OK
DCCCCCCD	2023/06/02 08:08:51	8:08:51	0.12400	0.32150	SENSOR_OK
DCCCCCCD	2023/06/02 08:08:56	8:08:56	0.37210	0.33162	SENSOR_OK

Potential failure states include:

- Laser error
- Memory error
- T/ RH error
- Fan error

Sensor replacement is normally required to solve a persistent sensor failure condition. Please contact your local Air-Met Scientific to arrange servicing and repairs where required.

6. ANNUAL SENSOR REPLACEMENT

DustCanary instruments should be returned to Air-Met Scientific for sensor replacement annually to maintain reading accuracy. The unit is programmed to display a reminder whenever a sensor calibration is due, however Air-Met Scientific will instead provide a replacement sensor directly from the factory to ensure optimal performance. The instrument will continue to operate after the reminder is displayed, however further measurements may not be reliable, and a sensor replacement should be organised immediately.

7. DUSTCANARY BROWSER APPLICATION

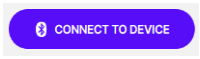
APPLICATION OVERVIEW (VERSION 4XX)

The DustCanary application software allows users to:

- Configure device settings (alarms, recorded sessions, logging intervals etc.).
- Download recorded sessions from the DustCanary, graph and export data into XLXS and CSV formats and NIOSH's EVADE software.
- View live data for fixed location installations and demonstrations.

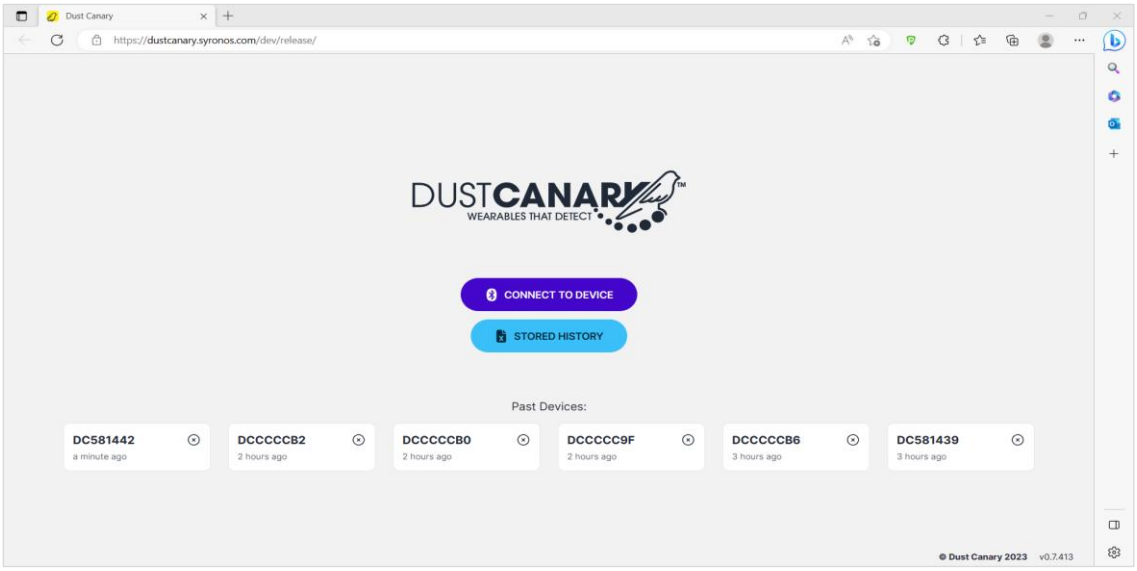
The PC must be connected to the internet when first running the application, however further connection is not required to run the application with a unit (unless accessing browser application updates).

To run the application:

- Ensure Bluetooth is on for the DustCanary by scrolling through the menu until Bluetooth is displayed, and using the yellow button to toggle Bluetooth on.
- Navigate to https://app.dustcanary.com on your browser.
- Select 

- Select DC XXXX where XXXX is the device's serial number, then pair the device. The serial number can be found in two locations; on the back of the instrument and on the Bluetooth menu while Bluetooth is connected.
- The display will show *connecting* and then *preparing* before moving to the *device recording* tab on the left menu.

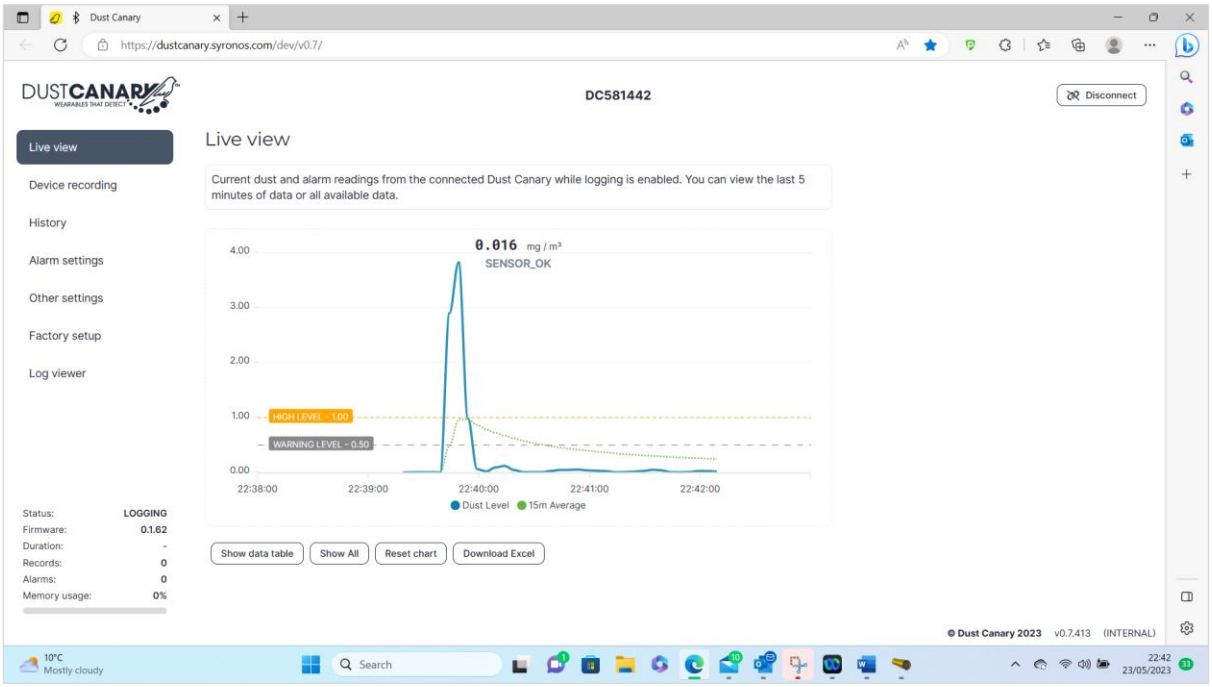
Should there be any problems in connecting, exit the application and switch Bluetooth off for the unit before repeating the above steps.



LIVE VIEW

The *Live View* tab is used to show current results from the device. It is helpful for viewing operating parameters and demonstrating functionality.

Select the *Live View* tab on the top left of the screen to graph the current dust level against time. The alarm thresholds for alarms that are enabled will also be displayed on the same graph as a dotted line. Operating parameters of the device can be viewed on the bottom left of the screen.



Dust levels shown on *Live View* may be downloaded as an Excel file via the Download Excel button. Note that the recorded data sessions in the device cannot be accessed with *Live View* and should instead be downloaded from the *Device Recording* and *History* tabs.

ALARM SETTINGS

To configure the dust alarm settings for your device, select *Alarm Settings* from the left menu.

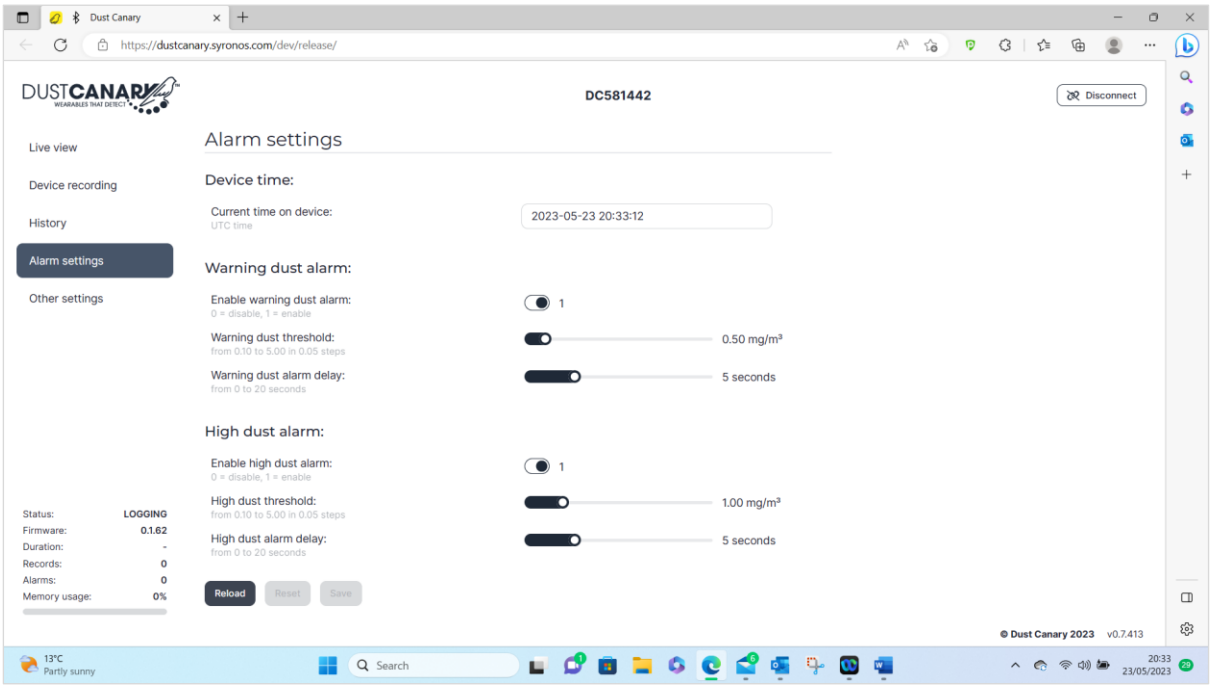
Warning and high dust alarms can be set independently. When the DustCanary Trend 420 is used for making surveys, these alarms can be switched off. When worn as a safety device to warn the wearer of elevated dust levels, both warning and high dust alarms should be enabled. This will trigger both audible and visual alarms when the alarm conditions are met.

Standard dust conditions on site and intended effect of controls should be considered when setting alarm dust levels. Alarm settings are configured by sliding the indicator bars to the required values before selecting the save button.

Configurable alarm options include:

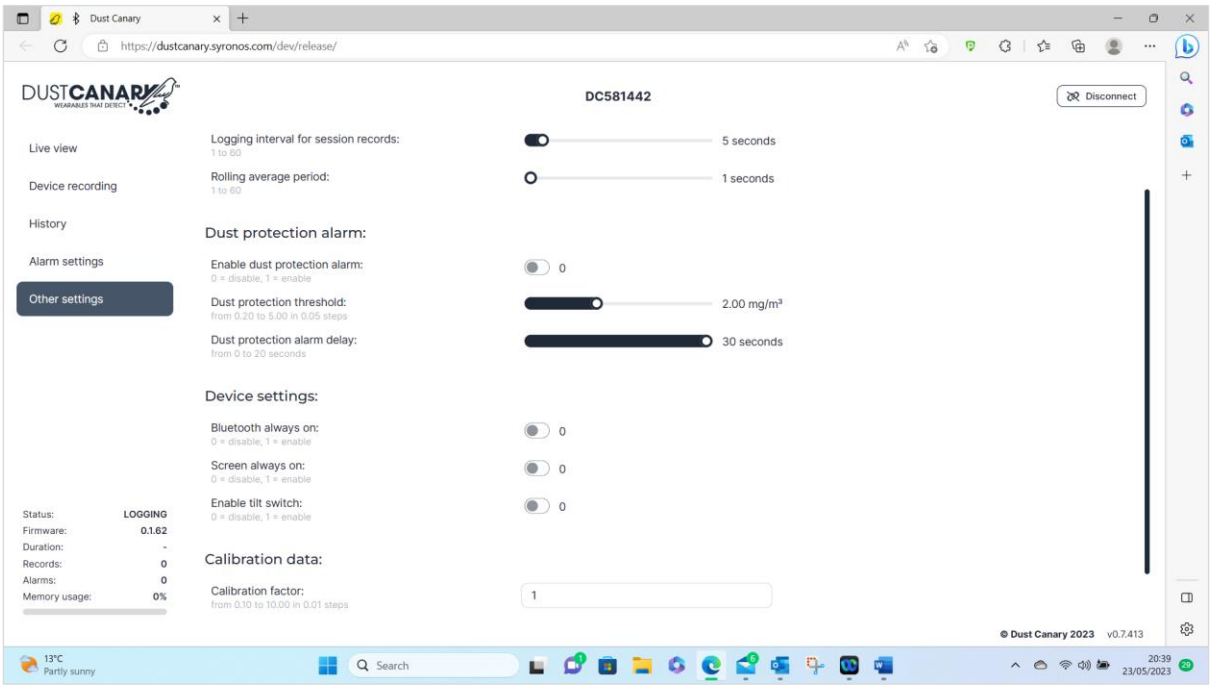
- Warning dust alarm - 0 is Off, 1 is On
- Warning dust threshold – Increments of 0.05 from 0 to 5mg/m^3
- Warning dust alarm delay – Can be used to avoid triggering alarms from momentary increased exposure.
- High dust alarm - 0 is Off, 1 is On
- High dust threshold – Increments of 0.05 from 0 to 5mg/m^3
- High dust alarm delay – Can be used to avoid triggering alarms from momentary increased exposure.

Once changed, settings must be saved to transfer settings to the device. If the current time on the device is not set correctly, a menu which gives the option to synchronise to the PC's time will appear when first connecting to the device.



OTHER SETTINGS

To change recording settings and advanced settings, select *Other Settings.*



This screen is used to configure the following settings. Ensure you select save after making any changes.

- Logging interval – This is the period between each dust level recording, which will also affect the refresh rate for plotted data in the *Live View* tab. The logging interval should typically be set to 5 seconds. It may be reduced to 1 second if high resolution dust profiles are required, however this will slow down the transfer of recorded data.
- Rolling average – The averaging period applied to the raw dust measurement. This is increased if the dust signal is too noisy to interpret.
- Dust protection alarm levels – This high alarm is used to protect the sensor from avoidable contamination at high dust levels
    - When this alarm activates, the sensor is put into sleep mode and the sampling fan switches off until either the alarm is overidden by the wearer or normal dust levels resume.
    - Dust protection mode is typically set at a 3mg/m^3 threshold and 30 second alarm delay to allow the sensor to detect short periods of elevated dust levels without suffering from contamination if persisting for more than 30 seconds.

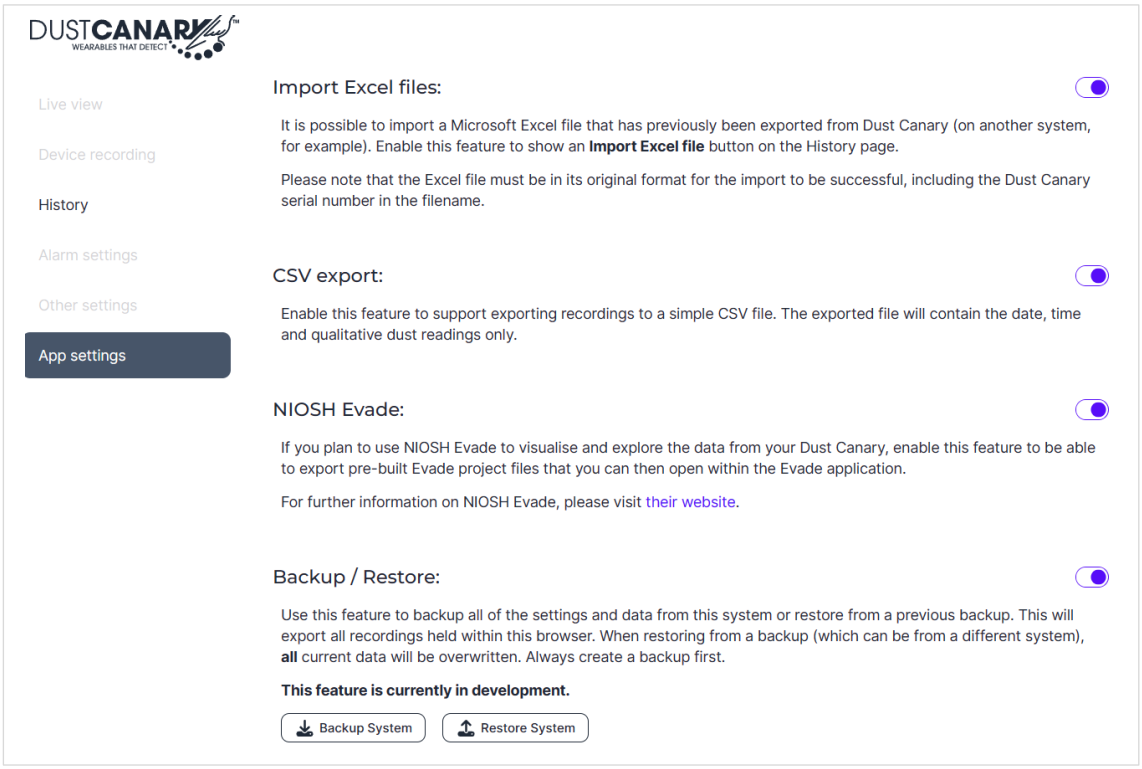
- Device settings - In order to conserve battery life, both the bluetooth connection and device display will automatically switch off after 30 seconds of not being used.
    - Bluetooth always on - Can be enabled to allow live data to be continuously streamed.
    - Screen always on – Can be enabled to keep the screen permanently active. This will allow it to constantly display dust levels without needing to press a button to wake up the screen.
    - Enable tilt switch - The tilt switch function inverts the display when the device is upside down to keep the display upright. This option allows you to disable the tilt switch. **Please note the tilt switch feature is not available on products shipped before July 2023.**
- Calibration factor (please consult Air-Met Scientific before changing this setting)
    - This is a calibration scaling factor which can be applied to the qualitative output of the device to improve data quality when comparing to reference gravimetric samples.
    - The calibration factor is calculated as the ratio of the average dust result from a gravimetric sample to the averaged signal from the DustCanary. The device should be located close to the gravimetric sampler inlet and operated for the same period of time as the sampler.
    - Care should be taken in adjusting the calibration factor at dust concentrations less than 0.5mg/m^3 where the uncertainty of the gravimetric sampler may be significant.
    - The calibration factor should not normally be changed without prior consultation with Air-Met Scientific.

APP SETTINGS

The *App Settings* tab allows the user to toggle which features of the software are shown or hidden including:

- Bluetooth addresses of devices previously connected to the browser app in the connection screen.
- Option to import Excel files
- CSV file export
- NIOSH EVADE project file export (to link data with video footage)

In addition, the *Backup / Restore* feature is available from this page. This allows the user to save a backup of all settings and files into a single file, either for safekeeping or to be transferred. The backup file can be restored on a different device, providing a convenient method of sharing and transferring data.



TRANSFERRING RECORDED SESSION DATA

Sessions

The device records data in separate sessions each time dust detection is switched on and off. The session is made up of dust level records over a period and includes a session header which summarises how the device was configured.

The device has sufficient capacity for a standard working week of data recording, however it is recommended to transfer the data at the end of each day of use to reduce download times.

Session data can be exported from the browser application into a variety of formats for analysis in external programs such as Excel and EVADE.

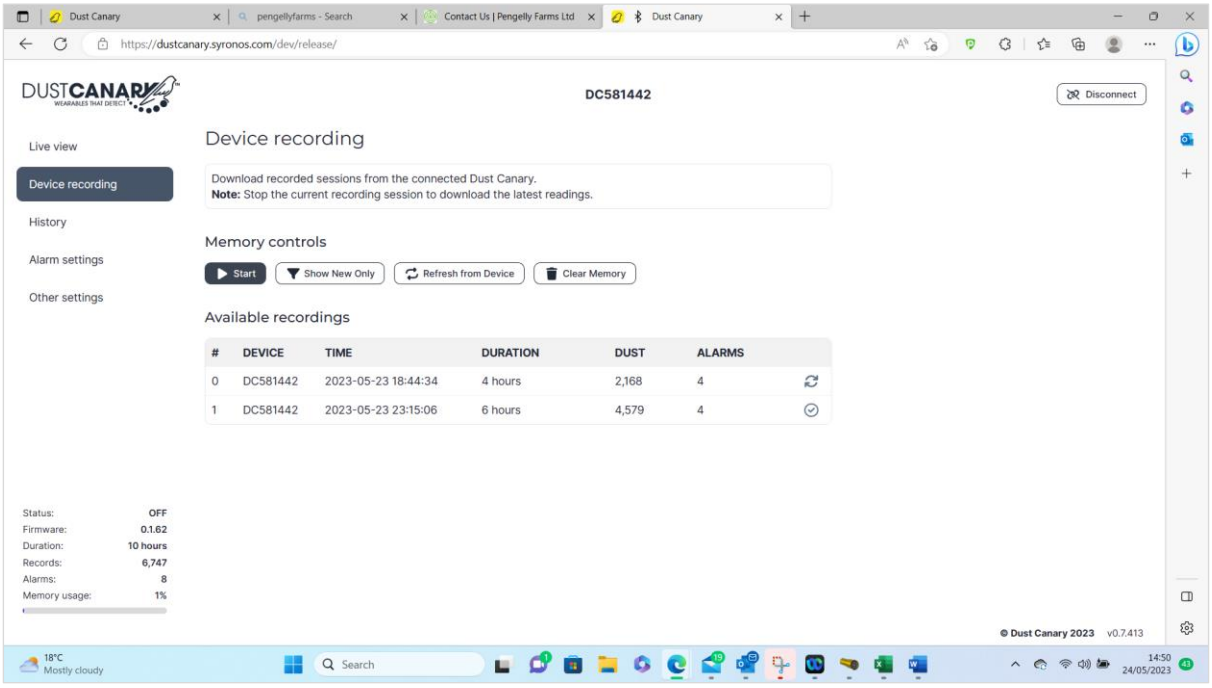
1. Downloading sessions from the device.

Select the *Device Recording* tab to view the recorded sessions of data in the device.

a) To download a session, select the symbol.

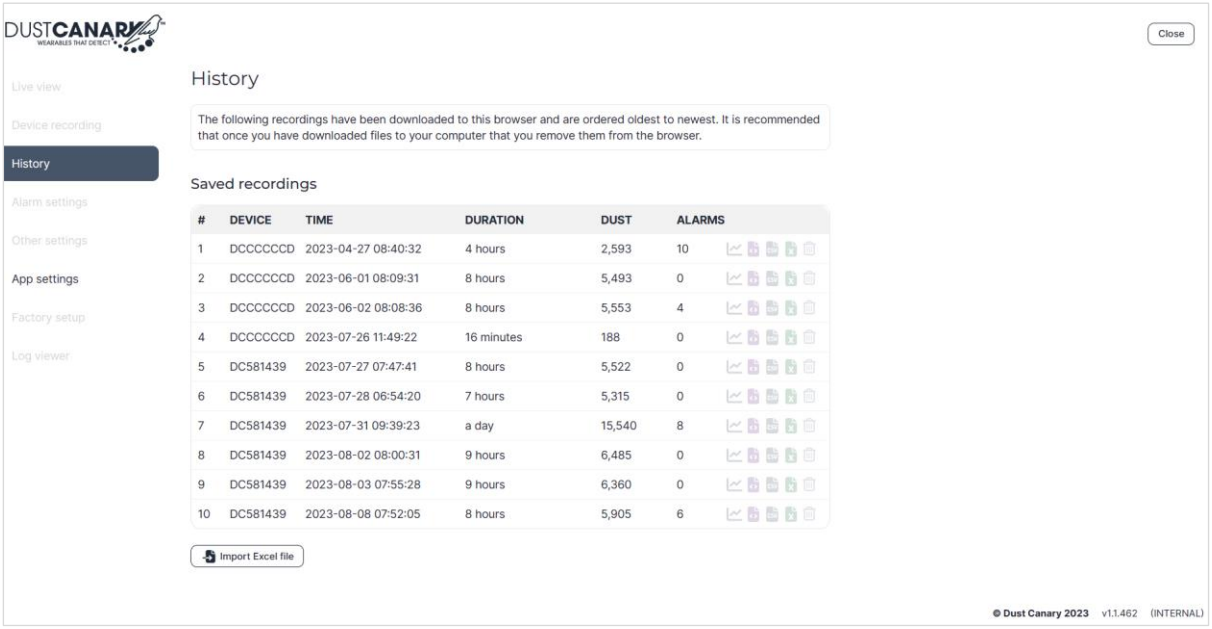
b) To view sessions which have not been downloaded yet, use the *Show New Only* filter. Recorded sessions that have not been downloaded will have the symbol on the right.

c) Once you have confirmed that all required sessions have been downloaded, the device's memory can be cleared by selecting Clear Memory.



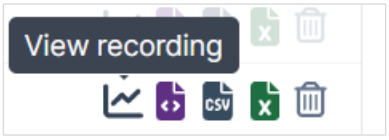
2. Selecting downloaded sessions from *History.*

Select the *History* tab to view the sessions which have been downloaded. Sessions which have been previously downloaded can be accessed without needing to connect a device.

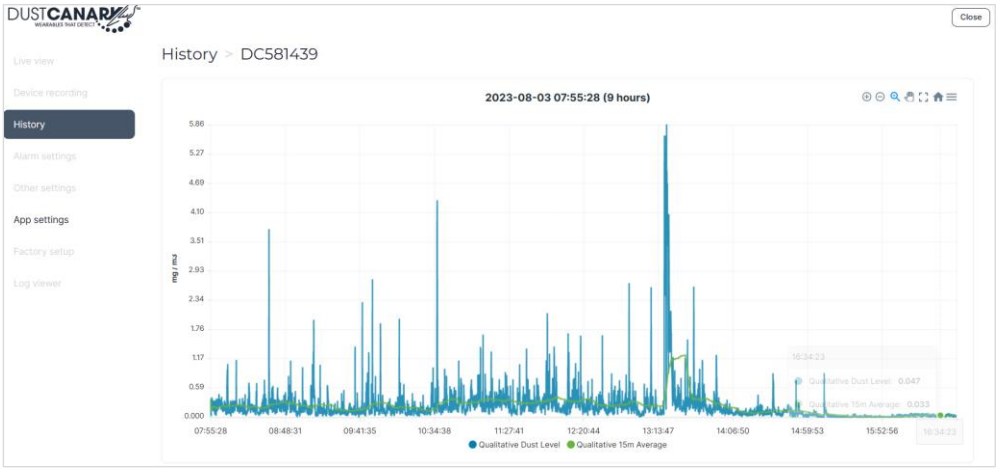


3. Viewing a graph for recorded dust levels.

a) Hover the cursor over the icons on the right of each row to view their labels.



b) Select *View Recording* to bring up a graph for the recorded dust levels.



c) To exit the graph and return to the previous screen, simply click *History* again.

d) To zoom in on a particular section of the graph, click and drag the cursor over the section of interest.

e) The toolbar on the top right can be used to:

- Zoom in and zoom out
- Zoom in on a selected part of the graph
- Drag the view
- Reload the complete graph
- Superimpose alarm threshold levels on the graph
- Download the image in svg, png and csv formats

4. Exporting and reviewing with Excel.

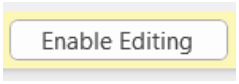
Downloaded sessions can be exported through the *History* tab, allowing for analysis with external software.

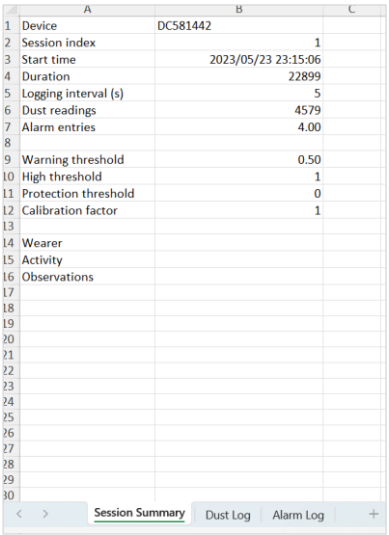
Excel can be used to analyse the recorded data in detail and can also be used to graph the recorded data to see peaks and variability in dust levels.

Where a separate video has been taken simultaneously (e.g. with a Helmet camera) NIOSH's **EVADE software** can be used to synchronise the recorded dust levels and video, allowing the user to understand what activities the wearer was performing and where the device was located while particular readings were recorded. This may be useful for identifying tasks that caused the readings to peak to help optimise your safety program.

To export the data to Excel:

a) Select the symbol on the session of interest and an Excel file will be downloaded with the filename, "*DCXXXXXX YYYY-MM-DD HH-mm NNNNNN.xlsx*", where "NNNNNN" is the number of the record.

b) Open the Excel file and select  located directly below the toolbar.



	A	B	C
1	Device	DC581442	
2	Session index	1	
3	Start time	2023/05/23 23:15:06	
4	Duration	22899	
5	Logging interval (s)	5	
6	Dust readings	4579	
7	Alarm entries	4.00	
8			
9	Warning threshold	0.50	
10	High threshold	1	
11	Protection threshold	0	
12	Calibration factor	1	
13			
14	Wearer		
15	Activity		
16	Observations		
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			

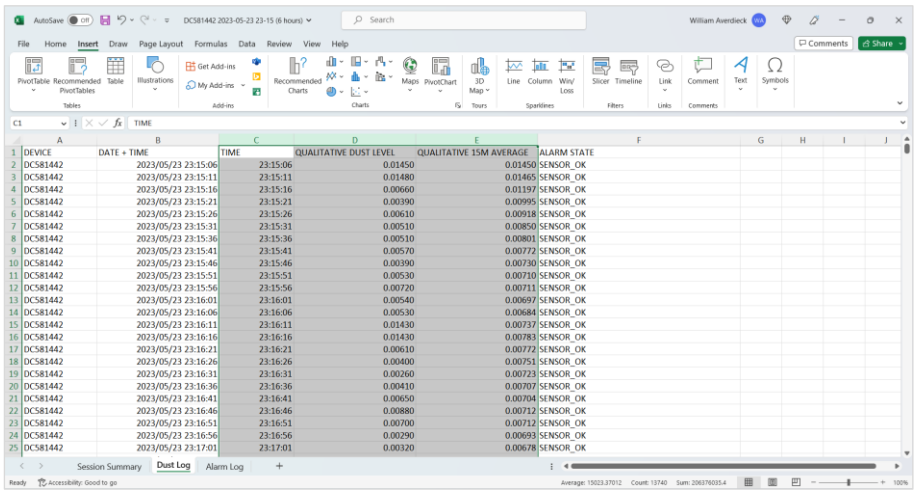
Session Summary | Dust Log | Alarm Log

c) View the *Session Summary* tab. The following details are recommended to be added to the sheet to help when referring back to the record in the future.

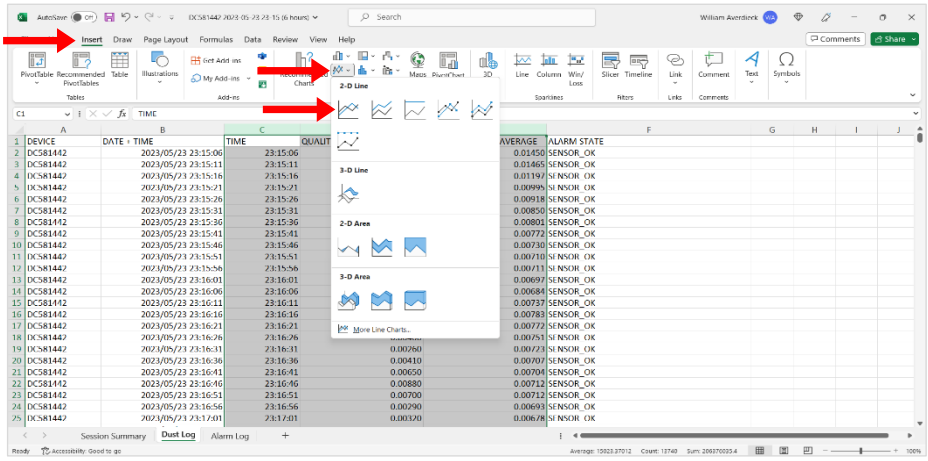
- Wearer
- Activity
- Observations

d) To create a dust level graph, select the *Dust Log* tab at the bottom of the spreadsheet.

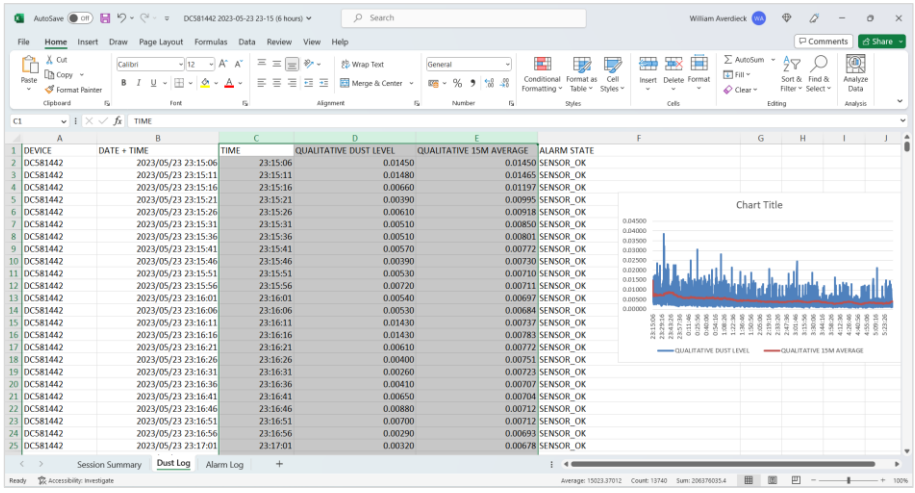
e) Select the data in column C, D and E for graphing by holding down the Ctrl key on your keyboard while selecting each of these three columns.



f) Select the *Insert* tab from the toolbar, then click the *Insert Line or Area Chart* button as shown below. Choose the first option, the 2D line graph.

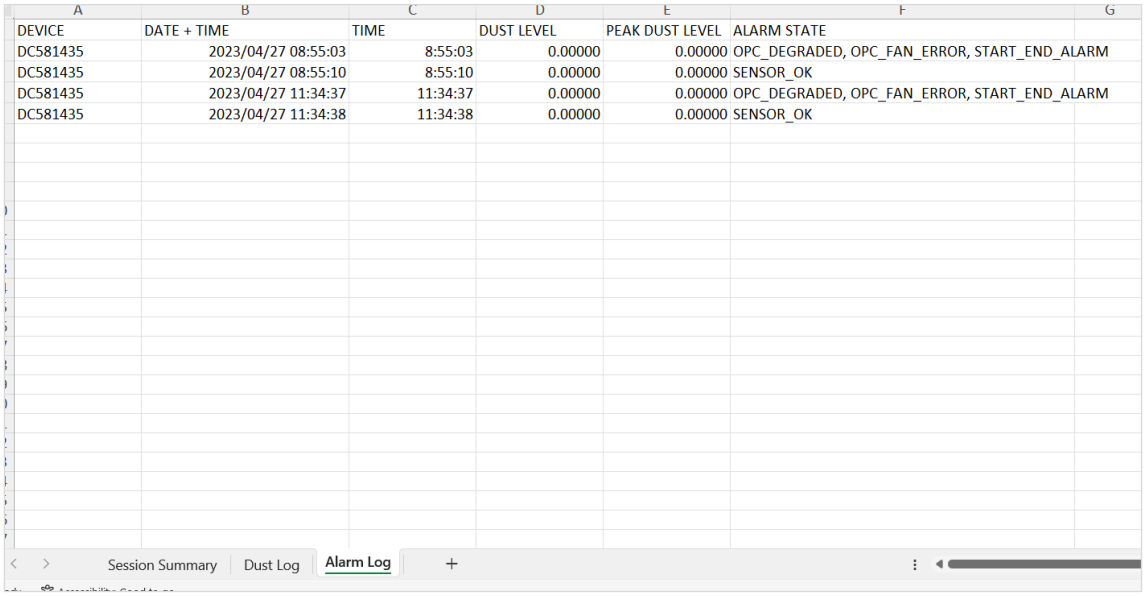


This will create a graph like below showing dust levels and the 15-minute average for the session's duration. The 15-minute average may be useful for linking trends in dust levels to work patterns.



g) Select *Alarm Log* to view a history of alarms during the session.

Note that *OPC degraded, OPC fan error* is related to sampling fan transition at sensor start up and shut down and is not a cause for concern. Remember to save the spreadsheet in an appropriate location for a permanent record and to capture notes added in session header and any graphs created.



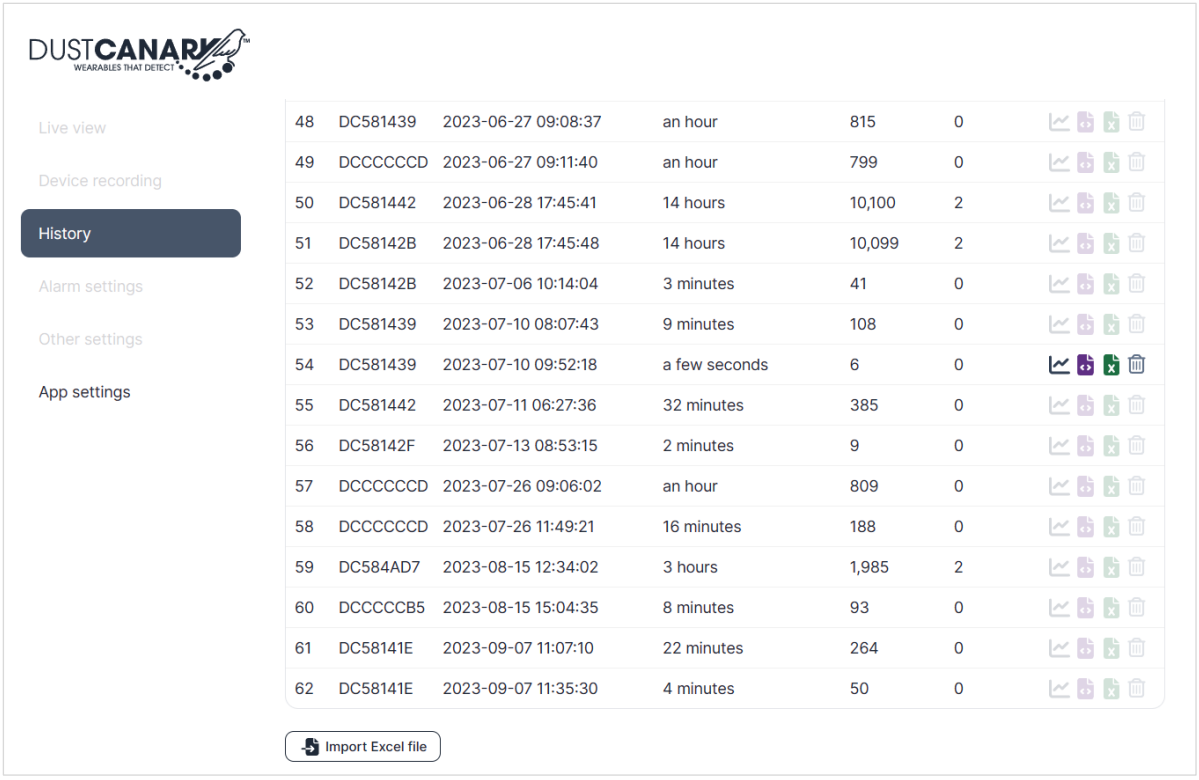
	A	B	C	D	E	F	G
1	DEVICE	DATE + TIME	TIME	DUST LEVEL	PEAK DUST LEVEL	ALARM STATE	
2	DC581435	2023/04/27 08:55:03	8:55:03	0.00000	0.00000	OPC_DEGRADED, OPC_FAN_ERROR, START_END_ALARM	
3	DC581435	2023/04/27 08:55:10	8:55:10	0.00000	0.00000	SENSOR_OK	
4	DC581435	2023/04/27 11:34:37	11:34:37	0.00000	0.00000	OPC_DEGRADED, OPC_FAN_ERROR, START_END_ALARM	
5	DC581435	2023/04/27 11:34:38	11:34:38	0.00000	0.00000	SENSOR_OK	

Session Summary | Dust Log | Alarm Log

5. Importing an Excel file to the browser application.

Files previously exported from the browser application to Excel can be reimported. This also allows files to be shared between users. If this feature is required, it should be enabled in the *App Settings* tab.

a) Select the Import Excel file button at the bottom of the list of sessions from the *History* tab of the browser application. Select the file you wish to import. Note that the file name, contents and structure must be in the same format as it was originally exported in, as originally generated by the application.

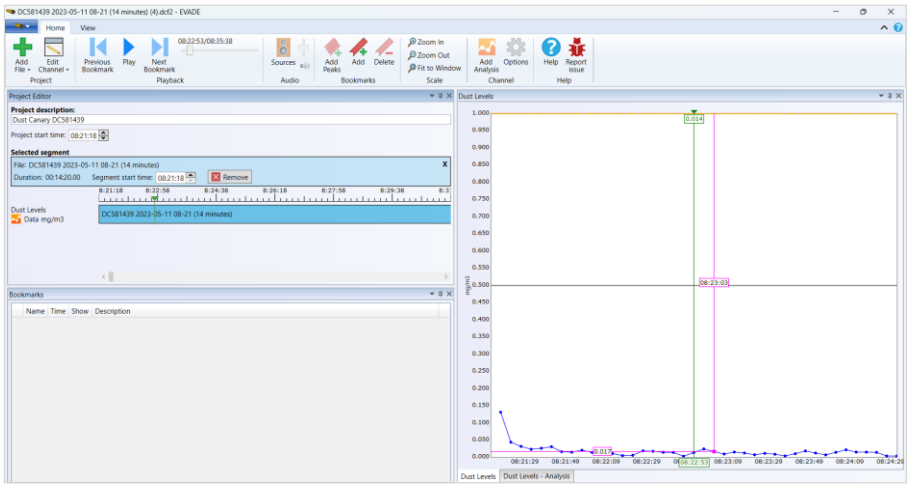


6. Exporting a file to NIOSH's EVADE software.

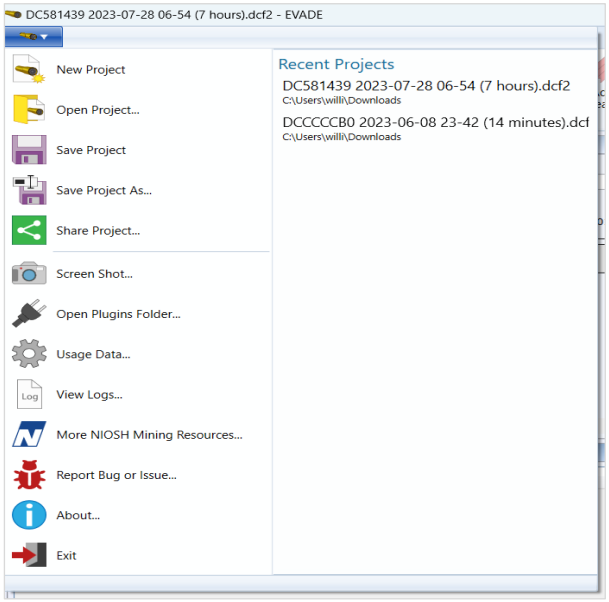
Records can be exported to NIOSH's EVADE software to be synchronised with any videos taken. If this feature is required, it should be enabled in the *App Settings* tab. There are two ways to export the data into EVADE. The first is by exporting the CSV file by selecting from the *History* tab before importing the data into EVADE. The second and recommended method is outlined below.

a) From the *History* tab, export the dcf file by selecting the icon.

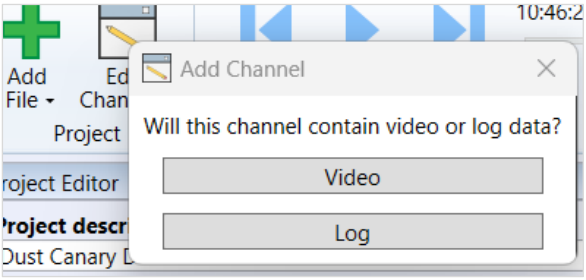
b) Once the file has downloaded, open it to either run the EVADE program or download and run the program if it has not been used before. This process may take a while.



c) To select the file containing the relevant data, click on the arrow on the top left of the screen, select *Open Project* and navigate to your downloaded file.



d) To add a video, select the *Add File* button and simply select the video you wish to add.



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