

# plumespector 4.0

## User manual

Online monitoring  
of thermal spray  
processes for the  
shop floor

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our sensors, your productivity.

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## MANUAL PART

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The material contained in this document is provided “as is” and is subject to change without notice in future editions.

## OVERVIEW:

- Table of contents at the beginning of the document
- Table of figures at the beginning of the document

This manual contains the following sections:

- Safety
- Product description
- Installation
- Maintenance
- Operation
- Software

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## 1 SYSTEM DESCRIPTION

### 1.1 INTRODUCTION

The present document gives a complete description and principle of operation of the Plumespector 4.0 sensor as well as a description of its components.

#### 1.1.1 OVERVIEW

The main purpose of the Plumespector 4.0 is to ensure consistent, high-quality coatings by monitoring the in-flight particles and plume properties before each spray run. This ensures that the spray properties are within predetermined acceptance ranges for ideal coating and performance.

To help detect potential issues such as electrode wear, partial clogging of the nozzle or in the powder injection system, and instability of the powder feeder before the coating process, the Plumespector monitors:

- Plume profile and intensity;
- Plume position;
- Plume width;
- Plume angle;
- Process stability.

The Plumespector 4.0 can also be used to:

- Develop and optimize spray parameters;
- Transfer parameters from one booth to another (anywhere in the world);
- Transfer parameters from one spray gun to another;
- Extend the useful lifespan of hardware;
- Significantly reduce the number of test coupons;
- Troubleshoot day-to-day issues;

With its long working distance, the Plumespector is especially well suited for long range, difficult to access, applications such as VPS and LPPS.



**1.2 GENERAL PRECAUTIONS**

The following precautions should be observed at all times while operating the Plumespector 4.0. Tecnar Automation Ltd. assumes no liability whatsoever for a user’s failure to comply with these precautions or the warnings throughout this manual.

To protect your Plumespector 4.0 from damage, you must:

- Connect it to an unloaded, properly grounded power line (50–60 Hz. 100-240VAC, 50-60Hz, 1.5 A).
- We also recommend using an additional power line filter to filter out any power surges or bursts;
- Use it at an ambient temperature between 4 and 45 °C;
- Supply 30 LPM (2CFM) of cooling/cleaning air at 1.7–2.7 bar (25–40 psi) to the sensor head AT ALL TIMES while the unit is powered on.;
- Use only original spare parts.

All Plumespector 4.0 users should read this user manual, take the web-based introduction and training session, and contact Tecnar with any further questions. We also recommend that a copy of the user manual should always be kept near the equipment.

## 2 DESCRIPTION

The Plumespector 4.0 system includes the following elements:

- 1) A sensor head;
- 2) A controller;
- 3) Air hoses and filter;
- 4) Controller power cable;
- 5) Sensor head power and communication cable;
- 6) Controller's WiFi antennas

Each element is described in details on the following pages.

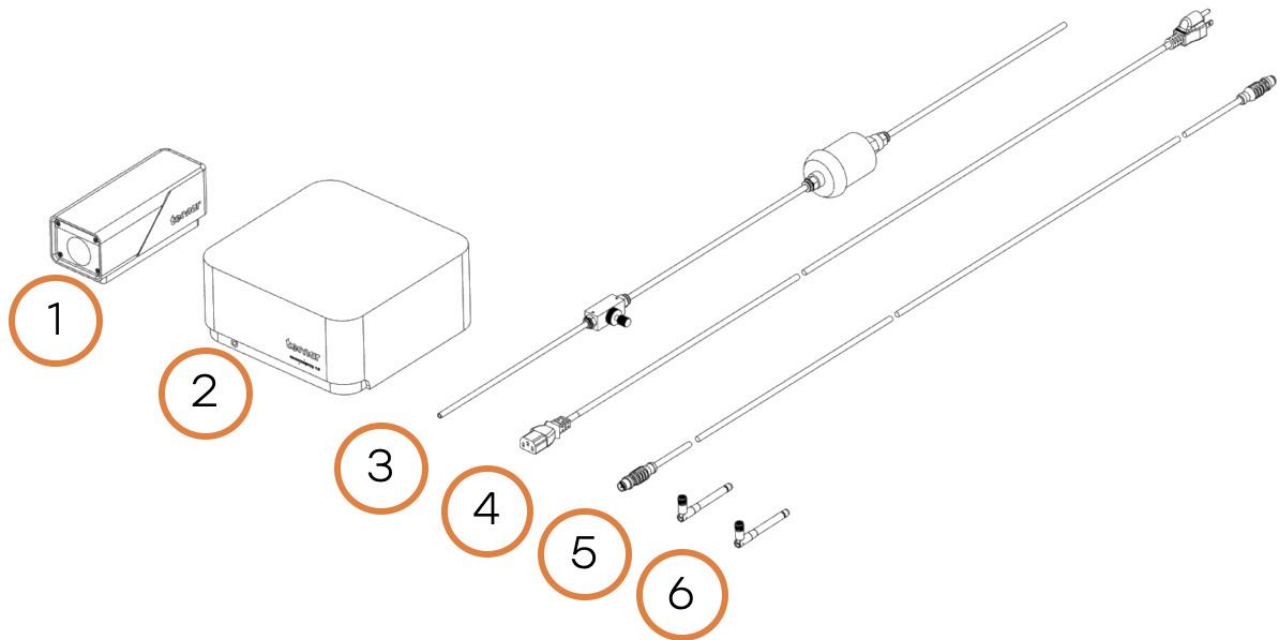


FIGURE 1 SCHEMATICAL DESCRIPTION OF THE SYSTEM

## 2.1 CONTROLLER

The controller must be kept in a ventilated area to reduce the risk of overheating.

The controller receives readings from the sensor head. It processes the data and broadcasts the results to the user interface(s).



FIGURE 2 CONTROLLER (FRONT)

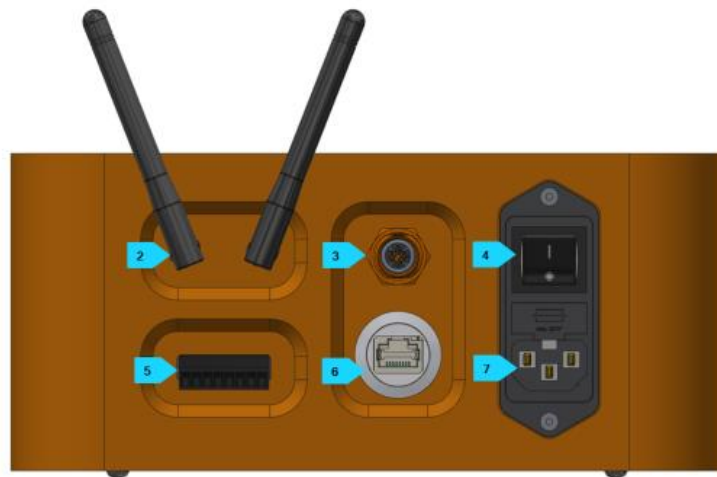
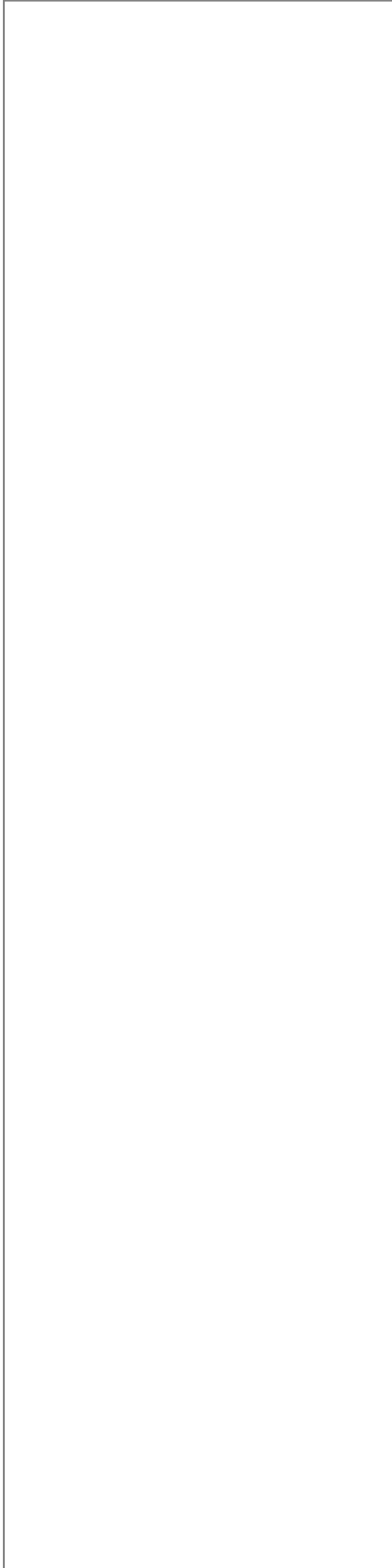


FIGURE 3 CONTROLLER (BACK)





Component	Description
1. LED	<p>LED</p> <p>Off: Power supply is OFF;                      Green: The system is working properly;                      Yellow: Sensor head is not connected;                      Red: Unit power up but an error is detected.</p>
2. Wi-Fi antenna	<p>Used to access the Plumespector user interface through a wireless network connection. The Wi-Fi connection acts as a Hotspot. It can be disabled but not reconfigured.</p>
3. Sensor head port	<p>Used to power and communicate with the sensor head.</p>
4. Power switch	<p>Used to active the unit.</p>
5. User interface port	<p>Used to interface the Plumespector to the user's spray controller via digital I/Os.</p>
6. Ethernet	<p>Used to access the Plumespector user interface through a wired network connection.</p>
7. Power inlet	<p>Provides power to the Plumespector.</p> <p><i>Connect it to an unloaded, properly grounded power line (100-240VAC, 50-60Hz, 1.5 A).</i></p>

## 2.2 SENSOR HEAD

The sensor head measures the following particles and spray plume properties:

- Plume profile and intensity;
- Plume position;
- Plume width;

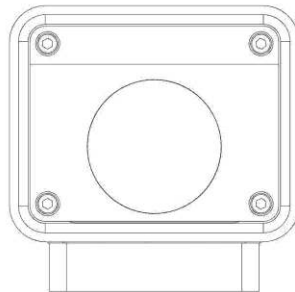


FIGURE 4 SENSOR HEAD (FRONT)

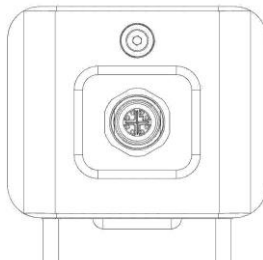


FIGURE 5 SENSOR HEAD (BACK)

Component	Description
1. Air knife	The air knife is used to keep the Plumespector windows clean and free of dust.
2. Camera viewport	Viewport of the camera used to characterize the plume geometry.
3. Air supply port	Compressed air is used both as active cooling for the head's internal components and, as it is exhausted from the head, to generate an air knife that keeps the viewport windows clean.
4. Communication port	Used to power the sensor head and communicate with the controller.

**2.3 CABLES, HOSES AND ANTENNAS**

The Plumespector 4.0 is delivered with several cables, hoses and antennas, which are described in the following table.

Cables/Hoses/Antennas	Description
IEC power cable	Used to connect the Plumespector to a power outlet.
Communication cable	Communication between the controller and the measurement head.
Antennas	Used for Wi-Fi communication.
Compressed air hoses	Provide compressed air to the measurement head for cooling and purging purposes. <ul style="list-style-type: none"> <li>• One hose connects the compressed air supply to the air filter;</li> <li>• One hose connects the air filter to the pressure regulator;</li> <li>• One hose connects the regulator to the measurement head;</li> </ul>

### 3 OPERATION SOFTWARE

#### 3.1 USER INTERFACE

The user interface can be accessed with most internet browsers. It connects to the controller via an Ethernet cable or Wi-Fi network.

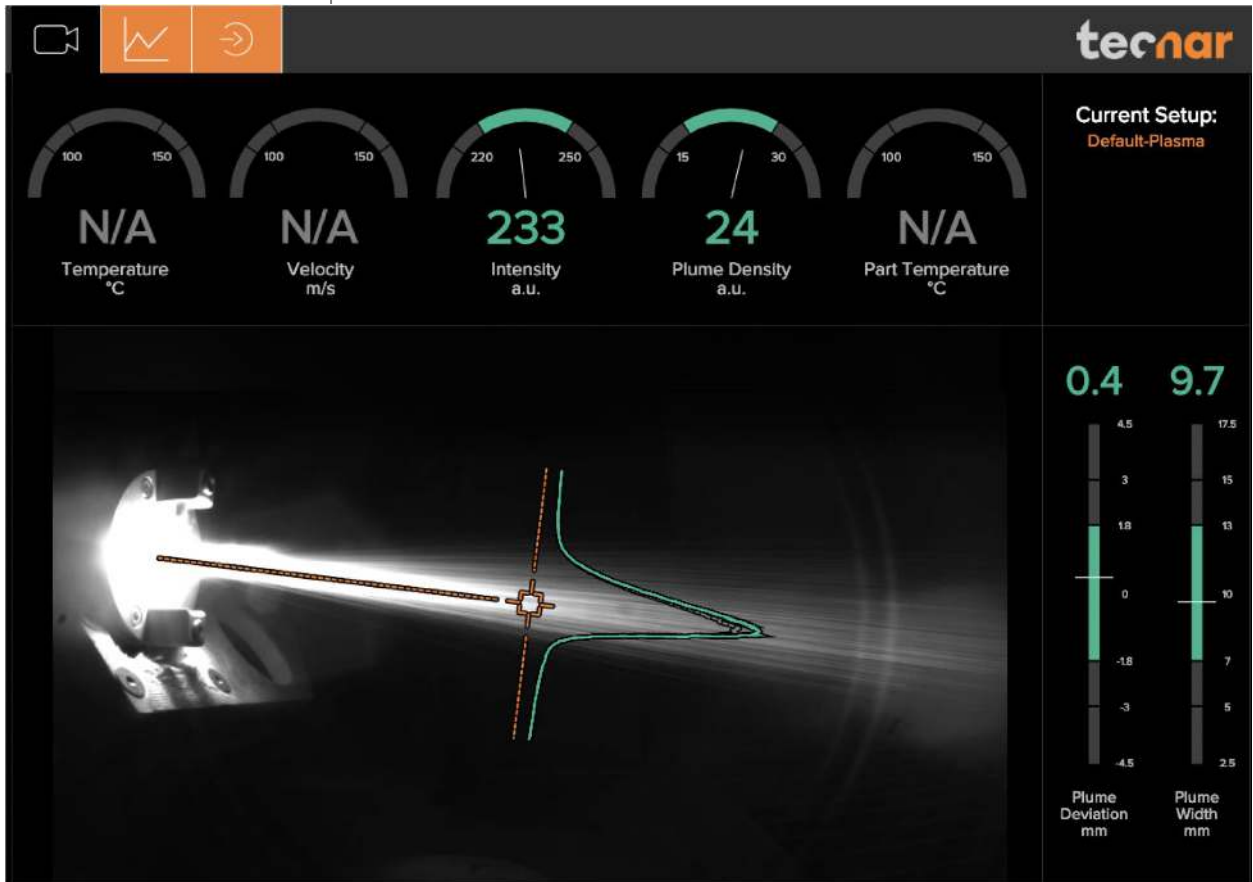

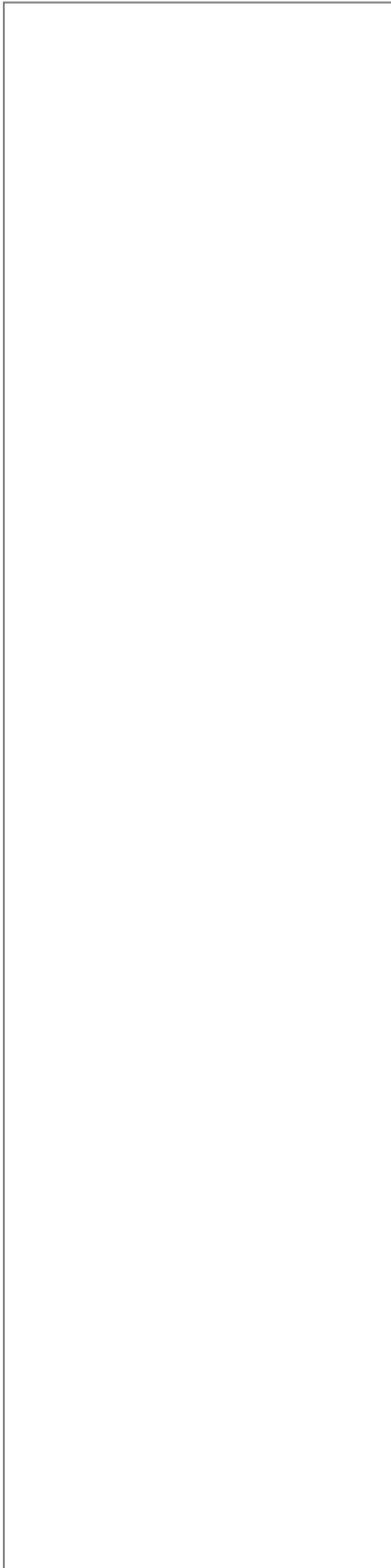


FIGURE 6 PLUMESPECTOR 4.0 USER INTERFACE

#### 3.2 NAVIGATION ICONS

Different icons are displayed at the top of the Plumespector user interface in order to navigate between the different screens. The following table describes those icons.

Icons	Description
	Access the main measurement screen.



Access the charts screen.



Access the setup screen (Only when logged in as Operator or Administrator)



Access the menu to change user's passwords.



Take control and access the configuration screen (Operators and Administrators only)



Log in.



Log out.

### 3.2.1 CAMERA SCREEN

The camera screen displays, in real time, all measurements taken by the Plumespector.

The measurements are displayed at the top and to the right of the screen.

Color codes indicate whether or not the measurements are within the acceptance range as defined in the setup by the process engineer. A measurement fully within the acceptance range is shown in green, a measurement just barely within the acceptance range is shown in yellow, and a measurement outside the acceptance range is shown in red. Corrective actions should be taken to ensure that all measurements are within the acceptance range and displayed in green.

In the middle of the screen, in the camera view, an orange bullseye represents the position where the measurements are taken. The distance between the bullseye and the tip of the spray gun, called the standoff distance, is represented by the dotted horizontal orange line. The green curve shows the plume intensity profile as measured by the sensor along the vertical line.

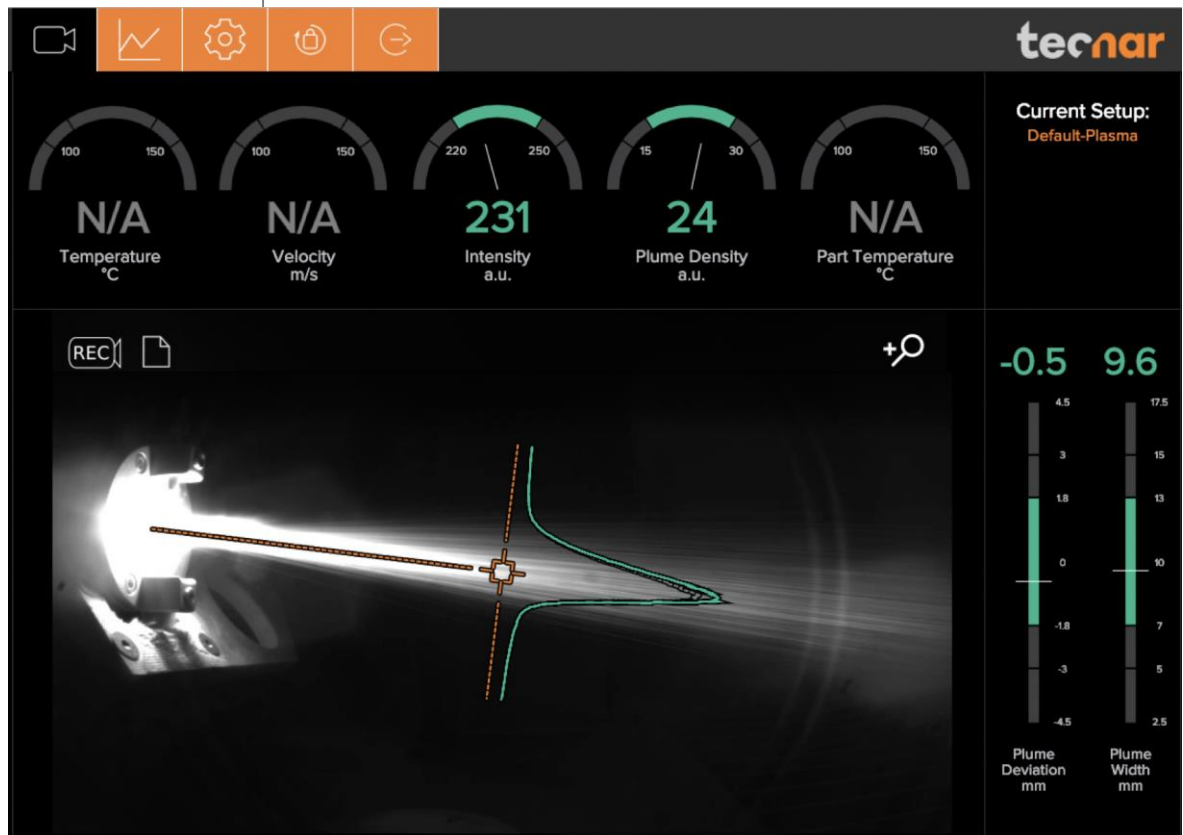


FIGURE 7 CAMERA SCREEN

The different measurements provided by the Plumespector are described in details in the table below.

Parameters	Description
Intensity	Intensity of the spray plume. This measurement is very sensitive to minute changes in the spray conditions. The parameters that have the strongest effect on the plume intensity are: <ul style="list-style-type: none"> <li>• Particles temperature;</li> <li>• Average particles diameter;</li> <li>• Feedstock emissivity;</li> <li>• Feed rate.</li> </ul>
Plume density	Provides an indication of the particles flow rate. It is the overall intensity of the plume divided by its width.
Plume deviation	Deviation of the plume position from the center of the image (as defined by the bullseye).
Plume width	Width of the spray plume taken at 70% from its maximum intensity point.

### 3.2.1.1 Zoom in / out

It is possible to zoom in on the center of the image where the bullseye is located.

To do so, click on the magnifying glass icon. This will enlarge the image so that the sampling line, the dotted vertical line overlaid on the camera image, takes 50% of the screen. To return to the full screen click on the magnifying glass again.

This feature is especially useful for HVAF/HVOF where the plume is quite narrow and can be difficult to see when viewing the full camera frame.

### 3.2.1.2 Recording a video sequence

Sequences can be recorded and recalled using the icons on the top left corner of the video. The camera icon is used to launch a recording.

Once the Plumespector is recording, the letters in the camera will turn red to indicate that the Plumespector is recording.

To stop recording, click on the square icon next to the camera. This will automatically download the sequence to your computer in your web browser default download directory.

Recorded video sequences are not stored on the Plumespector Controller.

### 3.2.1.3 Playing back a video sequence

To open a saved sequence, click on the folder icon, select the sequence that you want to replay.

As mentioned previously, the video sequences are not stored on the Plumespector controller. You will find them on your computer in your default download directory or wherever you have stored them.

When replaying a sequence an X icon will appear. It is used to exit replay mode and return back to live mode.

It is possible to pause a sequence using the Pause icon and resume playback using the Play icon.

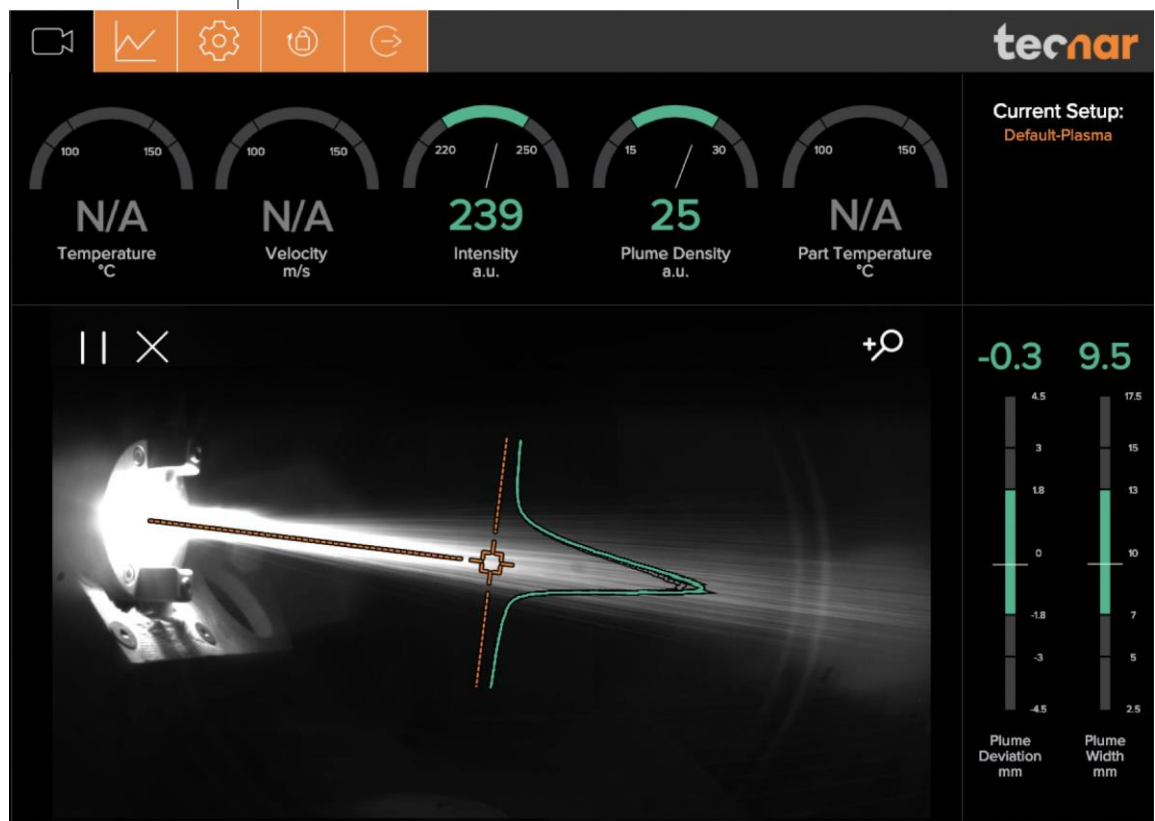


FIGURE 8 EXPERIMENT PLAYBACK



### 3.2.2 STRIPCHART SCREEN

The stripchart screen displays the evolution over time of measurements available on the camera screen. For the measurement descriptions, see the [camera screen](#) section.

In the middle of the screen are two graphs, each displaying one measurement. It's possible to select which measurement to display from the table located to the right of the graphs.

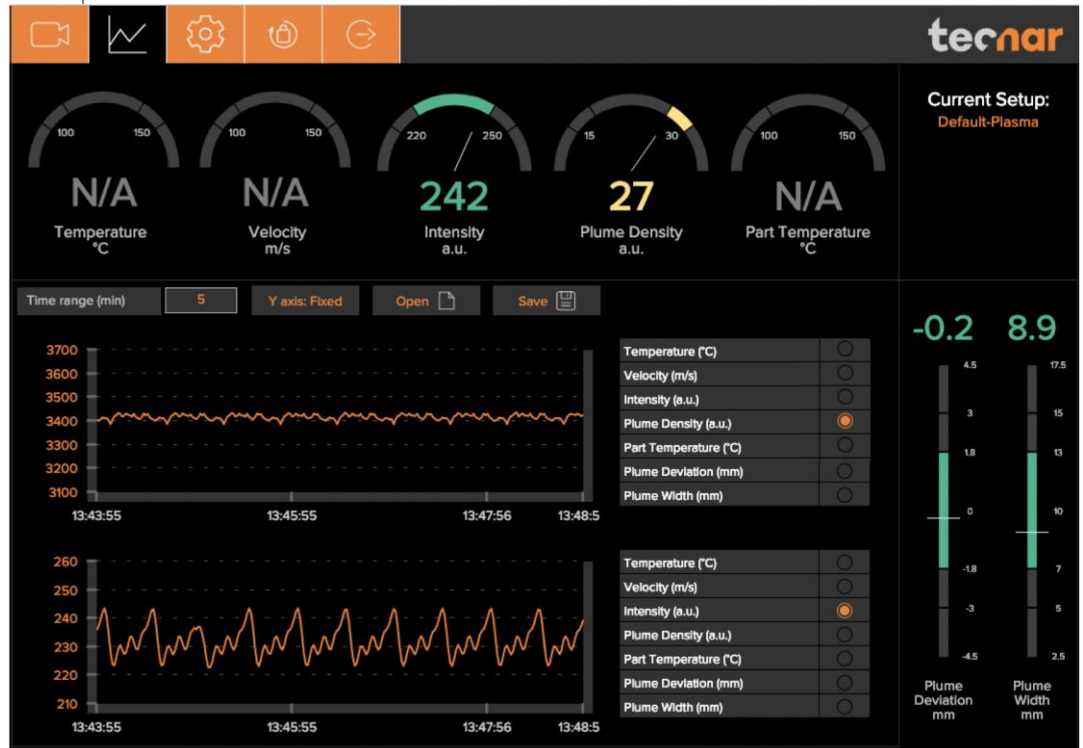


FIGURE 9 STRIPCHART SCREEN

#### 3.2.2.1 Adjusting the time display

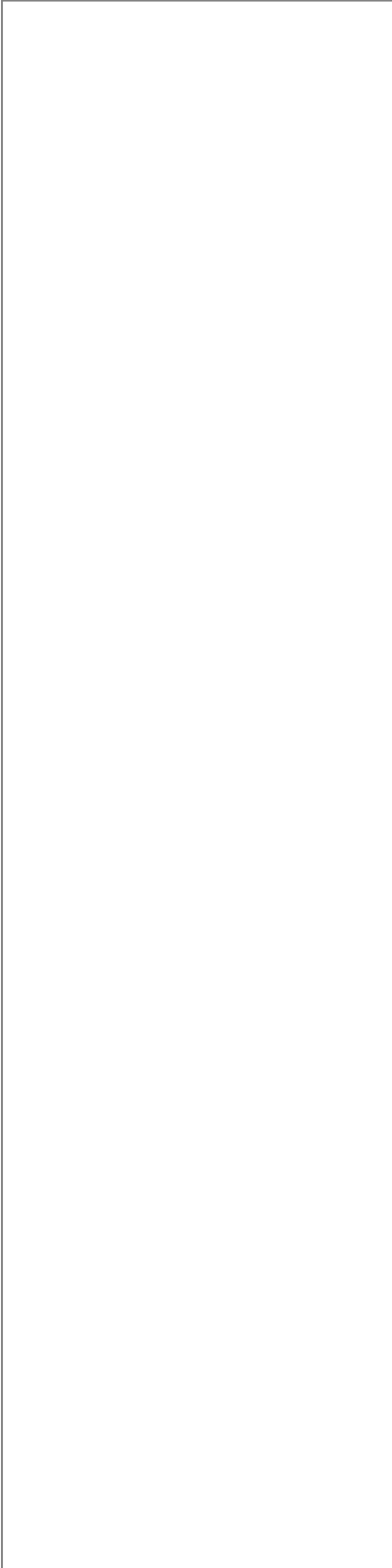
The time duration displayed on the strip charts can be adjusted using the text box at the top of the page. The charts can display up to 60 minutes of measurements.

The last 60 minutes are stored in the database and can be recalled at any time.

#### 3.2.2.2 Adjusting the Y-axis display

The range of the strip charts Y axis can be adjusted in two ways:

- Fixed - Sets the Y-axis limits (min and max values) according to the Acceptance Ranges as defined by the setup.
- Auto – Sets the Y-axis limits (min and max values) according to the full scale of the values captured by the sensor.



**3.2.2.3 Production Reports**

Production reports can be generated from the Strip Chart screen. When users select “Save” the data contained in the strip charts and a screenshot of the camera screen will be copied into a .pdf and .csv files.

The production reports are stored on the Plumespector controller’s hard drive. The directory where the files are stored is accessible by clicking on the “Open” icon. It also contains all the strip charts. The duration of the strip charts in the production report is the same as what was displayed in the User interface at the time when the production report was generated.

If desired, you can take the strip charts .csv file and generate your own graphs to manipulate the data.

### 3.2.3 LOGGING IN

The power of this interface is the ability to have multiple, simultaneous, users (up to 5) of the software. For instance:


- One user or “the operator” can actually be using the system for measurement (will need to “take control” as covered in subsequent slides)
- Another user can be “watching” the “operator” from the engineering office via the network or wireless
- Another user can view saved files from previous runs in the QC department

When accessing the Plumespector interface, users are in viewer mode and can only visualize the sensor’s readings like the engineer or QC person discussed earlier.

To actually use the sensor and record sequences it is necessary to log in by clicking the designated icon. Users can Log in either as Operators or Administrators.

- Operators (user name: operator) can change the setup used by the sensor and record measurement sequences. The default password for operators is: `accura.operator`
- Administrators (user name: admin) have the same rights as the Operators and can created, modify and delete setups. The default password for administrator is: `accura.admin`



To log in click  to display the login window and enter your credentials

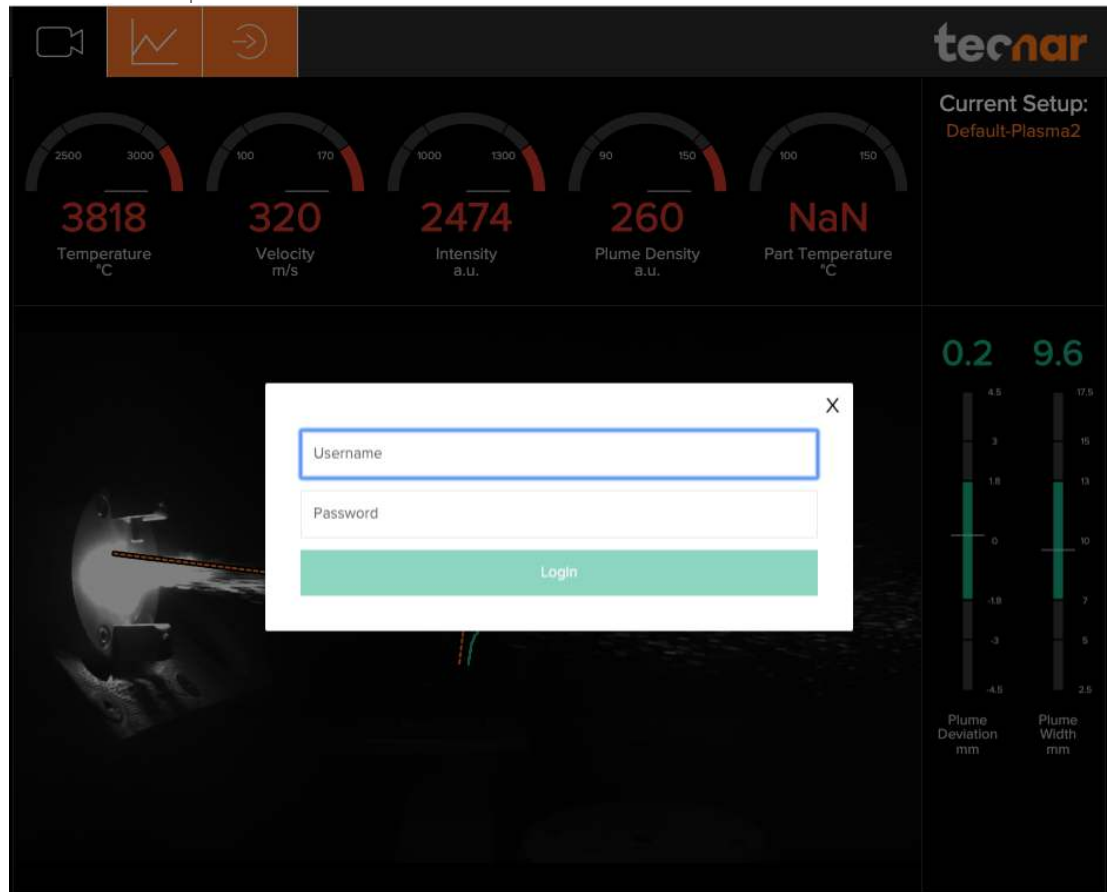


FIGURE 10 LOGIN WINDOW

### 3.2.4 MODIFYING USER'S PASSWORD

To modify user's password, click on the lock icon at the top of the screen. Once on the Password page enter a new password and click 'Change Password' to apply it.

Note that you will have to login either as Operator or Administrator to access this screen.

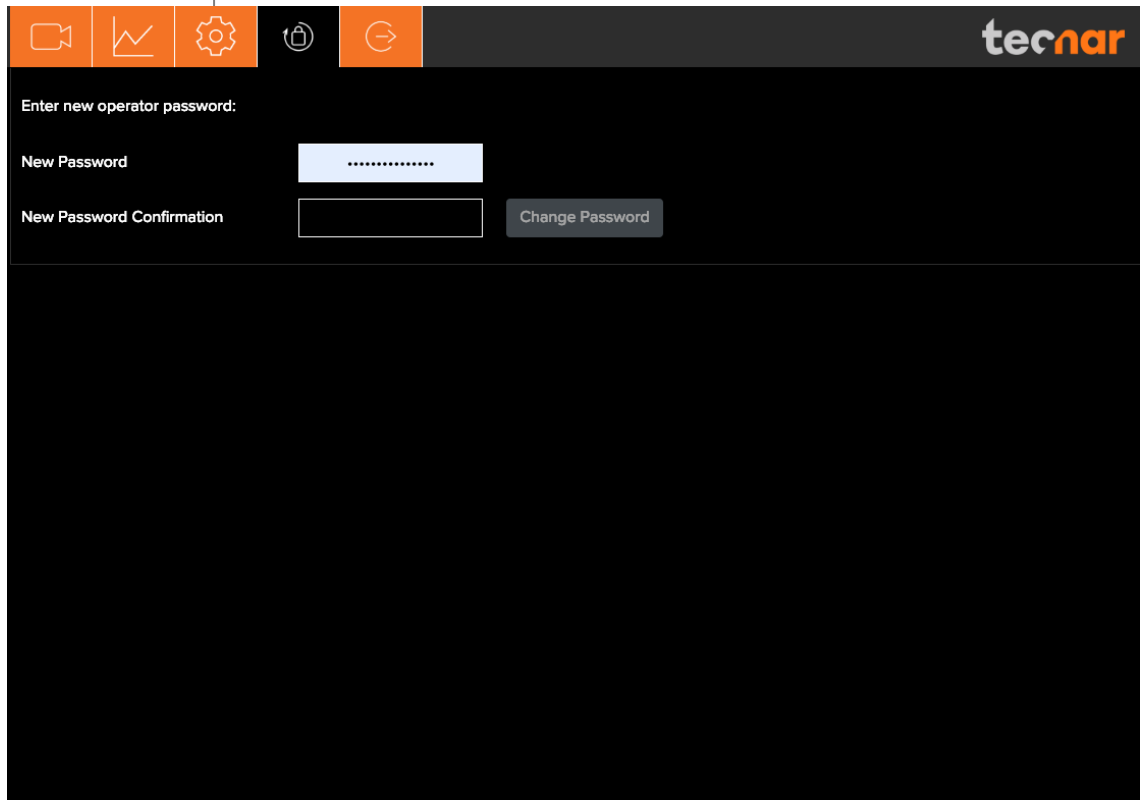


FIGURE 11 PASSWORD SCREEN

### 3.2.5 SETUP SCREEN (OPERATOR AND ADMINISTRATOR ONLY)

The left side of the setup screen shows the data acquisition parameters for the current process.

The right side of the configuration screen shows the acceptance ranges. The min and max values represent the values past which the process is considered off (red zone). The range between those values contains the green and yellow zones. The green value represents 60% of the full range between the min and max while the yellow regions warns the operators that the measurement is approaching the red zone. The yellow zones are located 20% from the min and max values of the process.

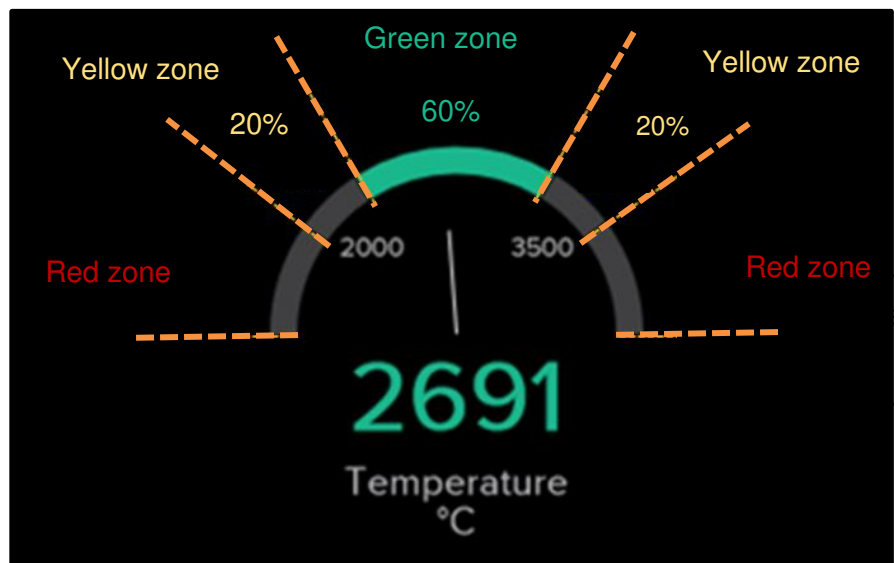


FIGURE 12 DIALS PROCESS CONTROL ZONES

### 3.4 MANAGING SETUPS

The Setup screen is where the different parameters of the sensor head are



managed. Click to access the configuration screen.



FIGURE 13 MANAGING SETUPS

### 3.5 LOADING A SETUP



On the Setup screen, click . This displays the list of setups.

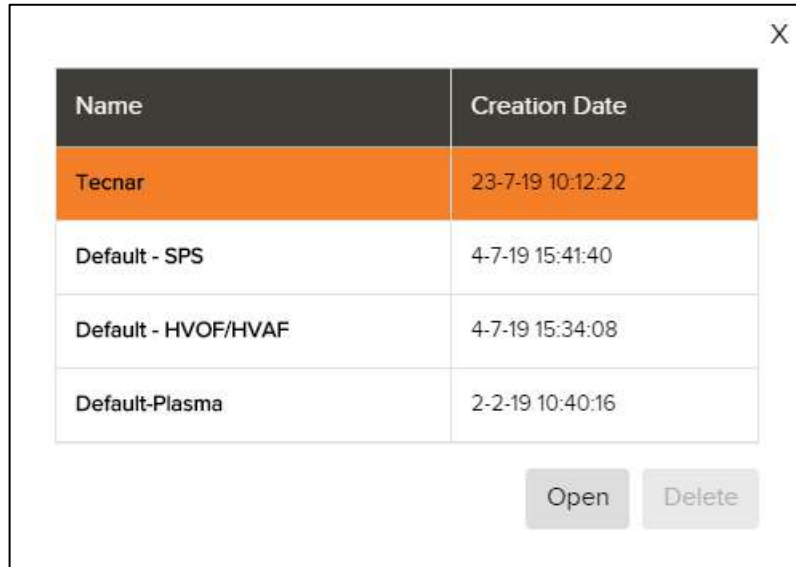


FIGURE 14 SETUP SELECTION WINDOW

Select the setup and click Open. The new setup is automatically applied.

#### 3.5.1 SAVING A SETUP

Once you have modified any parameter on the configuration screen, you can save them as a new setup or overwrite the existing setup.



On the configuration screen, click . This displays the following window.



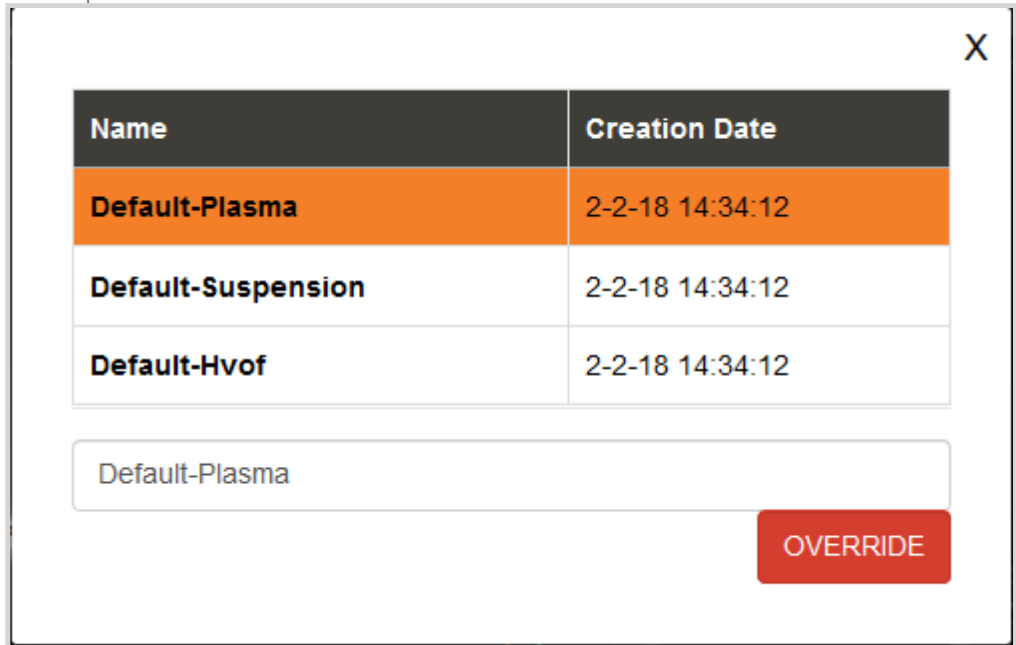


FIGURE 15 SETUP OVERRIDE WINDOW

To overwrite a setup, select a setup and click Override. The new parameters are automatically saved.

To add a new setup, enter a new setup name and Save.

### 3.5.2 SETUPS IMPORT AND EXPORT

Setups can be exported from one Plumespector units and imported to another. When clicking on the “Export” button a setup file will be downloaded on your computer.

To import a setup, simply click on the “Import” button and select the setup file that you wish to import from your computer.

This enables you to ensure that multiples sensors are using the same setting. That is especially useful to compare two booths that are identically set-up using two different Plumespector units.

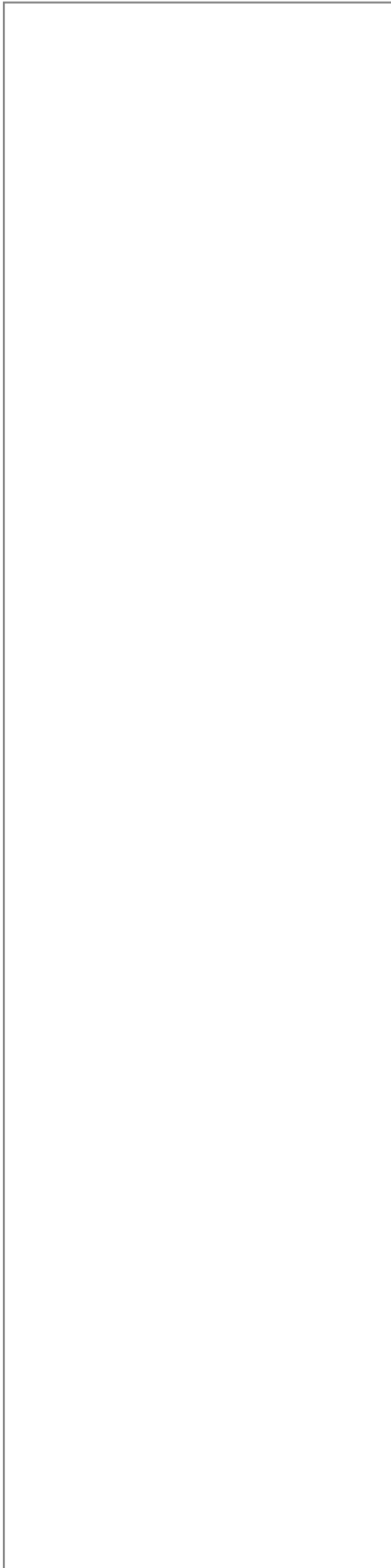


FIGURE 16 EXPORT / IMPORT SETUP

### 3.5.3 SETUP PARAMETERS

The table below explain the Data acquisition parameters – Used to configure the Plumespector according to the spray process you'll be monitoring.

Parameters	Description
Spray direction	Particles travel direction (left to right or right to left) in the Plumespector field of view.
Standoff distance	Distance between the Plumespector measurement point (bullseye) and the spray gun output. Typically, it is the process spray distance.
Plume angle	This value tilts the sampling line so that it lays perpendicular to the general direction of the particle flow (typically -5° for top injected plasma spraying and 0° for HVOF spraying).
Sampling line length	This value determines the length, in the plane of the plume, of the path along which the intensity profile is measured. It is normally set to about four times the regular plume width.
Process type	This value indicates to the sensor if the process brightness is high or low. Typically, SPS, Arc spray and SSPS are considered high brightness processes while HVOF and HVAF are considered low brightness.
Reaction Time	Length of the rolling average used by the sensor to display measurements. This parameter is used to smooth out natural variations in the process that would make the sensor's reading unstable and unusable for process control.  Typical reaction time for APS and Wire arc is 5 to 15 seconds. For HVOF/HVAF 1 to 5 seconds is usually sufficient.
Signal amplification	This parameter is not used in the Plumepsector
Exposure time	This value needs to be increased until signal level reaches roughly 50% (the % value next to the amplification level is the level of saturation).  Normally, the autoset will take care of this adjustment for you.
Save Reference curve	By clicking this button, the user captures the current plume profile and sets it as the reference for future measurement.



Execute Autoset This feature automatically adjusts the camera "exposure time.

This setting can be modified manually but it is easier via the AUTO SET.

However, before this can be accomplished, the spray plume has to be centered on the bullseyes and the following data acquisition parameters must be entered:

- Spray direction;
- Standoff distance;
- Sampling line length;

### 3.6 TECHNICAL SPECIFICATIONS

#### 3.6.1 SENSOR HEAD

Parameters	Description
Width	110 mm (4.33 in.)
Height	62 mm (2.44 in.)
Length	790 mm (31.10 in.)
Weight	1.85 kg (4.1 lb.)
Working distance from spray gun axis	200 mm (7.87 in.)
Plume relative intensity measurement	2% precision
Plume geometry measurement	0.1 mm (0.004 in.) accuracy
Camera field of view	400 mm (15.75 in.)
Particle's measurement volume	3.2 mm x 10 mm x 25 mm (0.13 in. x 0.39 in. x 0.98 in.)

#### 3.6.2 CONTROLLER

Parameters	Description
Width (a)	230 mm (9.06 in.)
Height (b)	100 mm (3.94 in.)
Length (c)	230 mm (9.06 in.)
Weight	4.40 kg (9.7 lb.)
Power requirement	100–240 VAC, 50–60 Hz, 1.5 A, auto-switch

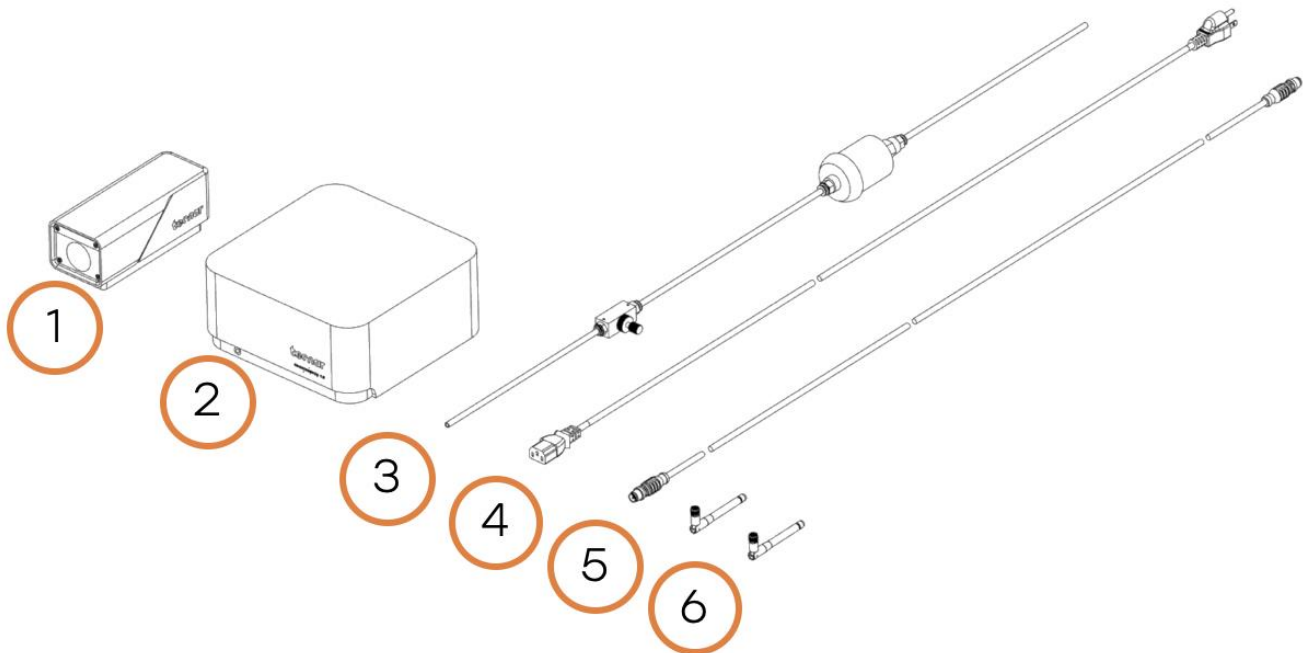
## 4 INSTALLATION

### 4.1 INSTALLING THE SENSOR HEAD

#### 4.1.1 UNPACKING THE PARTS

Carefully open the box, remove the content, and set it on a work surface. The box should contain the following items:

1. Sensor head;
2. Controller;
3. Air filter and hoses;
4. Controller power cable;
5. Communication cable between the head and controller;
6. Controller's Wifi antennas



### 4.1.2 INSTALLING THE SENSOR HEAD

#### 4.1.2.1 Where to install

Install the sensor head in the spray booth at a location easily reachable by the robot (spray gun). Also, ensure that the sensor head does not interfere with normal spraying operations.

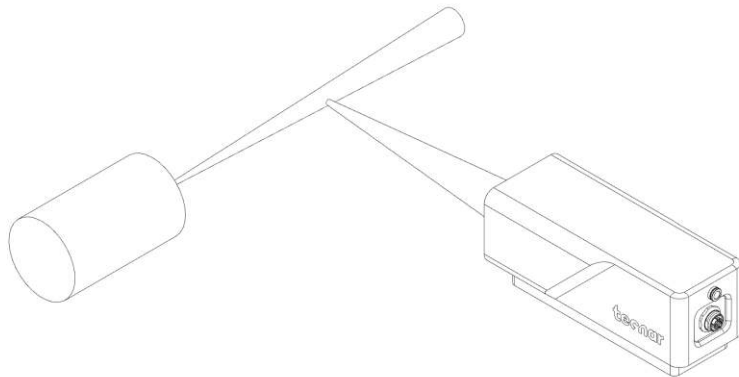


FIGURE 17 POSITION OF THE SENSOR HEAD

Install the sensor head on a sturdy mounting that does not vibrate or move during spraying. Refer to the following schematic of the Plumespector mounting plate.

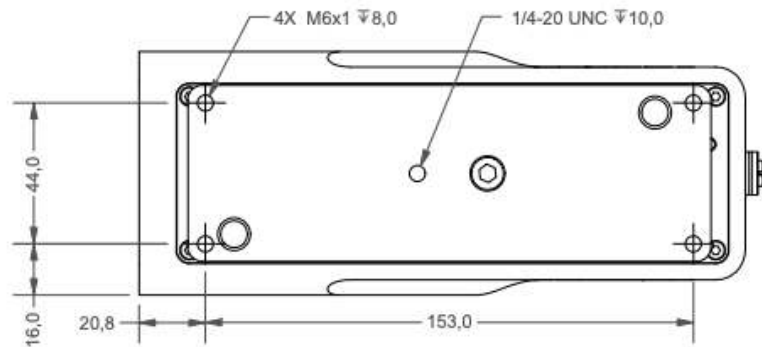


FIGURE 18 SENSOR HEAD MONTING PLATE DIMENSIONS

### 4.1.2.2 Installation procedure

Attach the sensor head mounting plate to your support bracket using the 4 mounting holes.

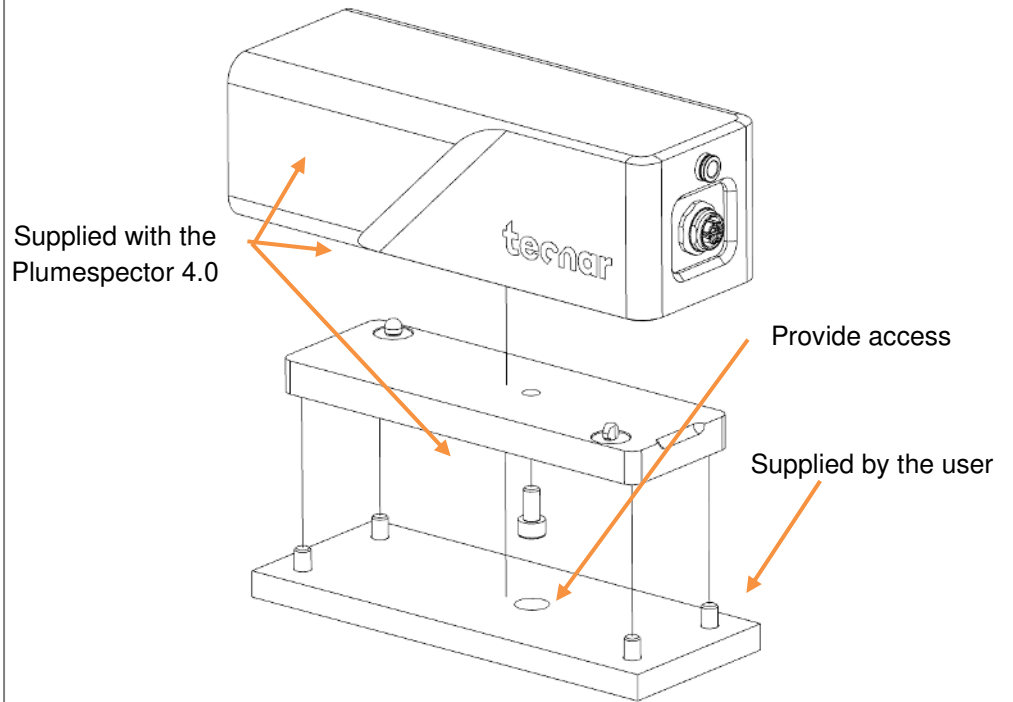


FIGURE 19 MOUNTING THE SENSOR HEAD

Connect compressed air supply and communication cable to the sensor head. Pull the other end of the communication cable out of the spray booth. Connect the air hoses to the booth air supply.

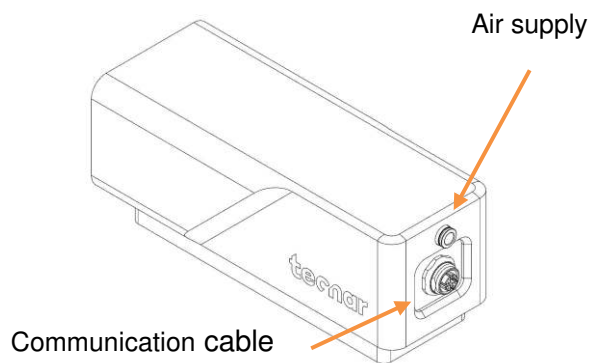


FIGURE 20 SENSOR HEAD INTERFACE

**4.1.3 INSTALLING THE CONTROLLER**

**4.1.3.1 Where to install**

Install the controller outside the spray booth, ideally, close to the booth control equipment.

**4.1.3.2 Installation procedure**

Connect the sensor head communication cable.

Connect the power cable to the controller and into a power socket.

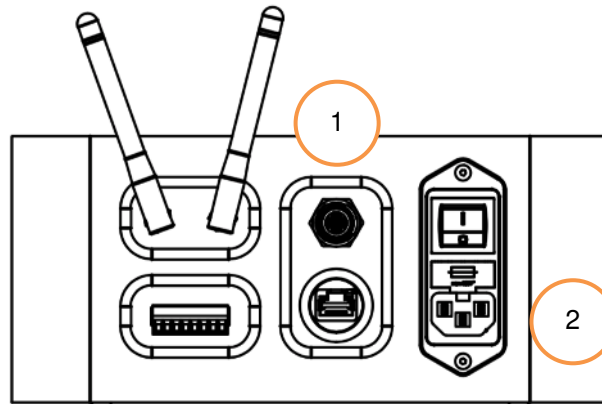


FIGURE 21 CONTROLLER INTERFACE

Flip the Plumespector controller power switch to ON. Wait until the LED turns green.

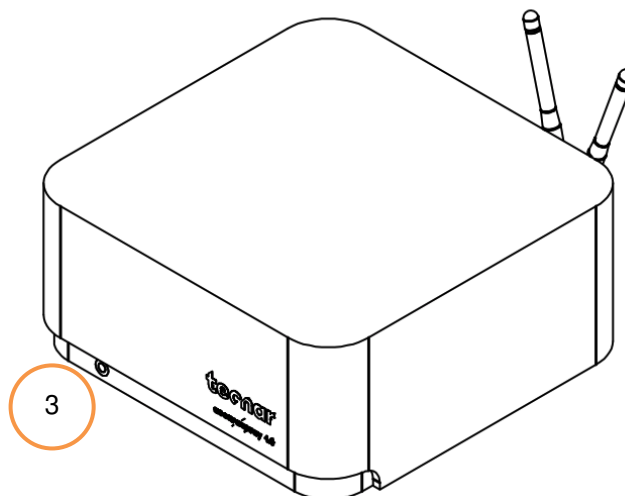


FIGURE 22 CONTROLLER STATUS LED



**4.1.4 ADJUSTING THE SPRAY GUN POSITION**

Bring the spray gun near the sensor head as shown on the schematic below.

The sensor measurement point is normally set to your standard process spray distance.

The distance between the front of the sensor head and the spray torch axis should be adjusted to 200mm.

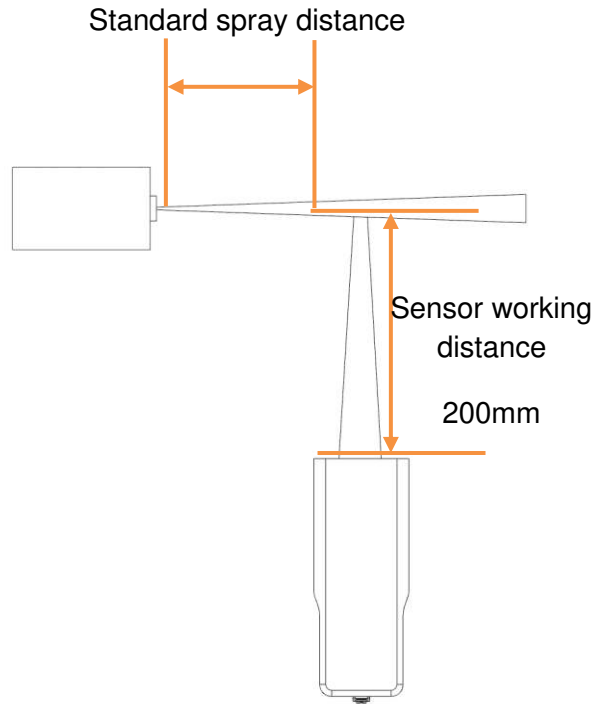
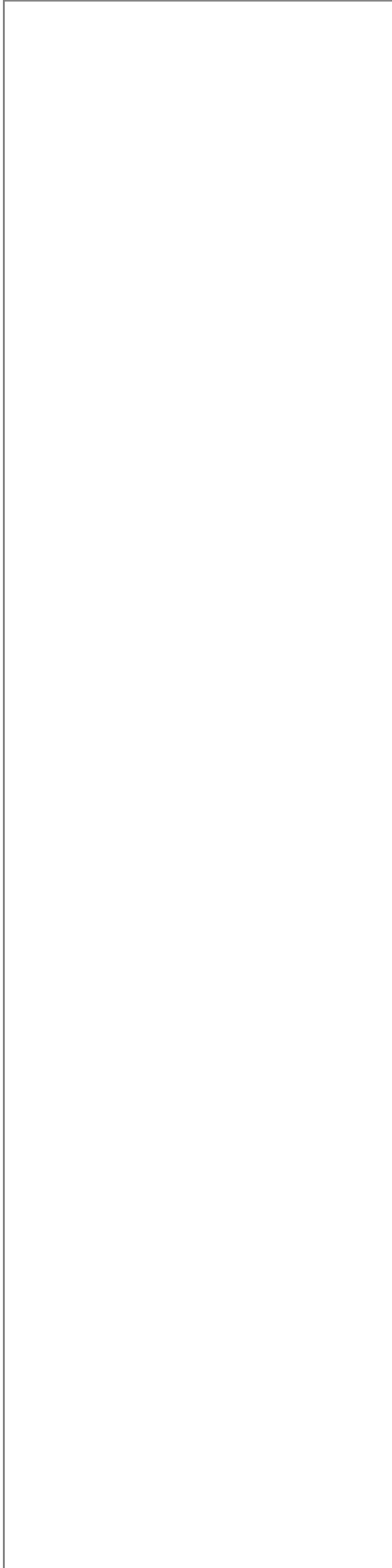


FIGURE 23 SENSOR HEAD WORKING DISTANCE

Save the new position as Sensor Home on the spray gun.



#### 4.2 ACCESSING THE USER INTERFACE

The Plumespector 4.0 user interface is accessible through a web browser but it is not actually hosted on the internet. It is streamed from the Plumespector controller. We recommend to use Google Chrome for optimal performance.

Go to the normal WiFi menu on your computer or tablet and look for “Accura 4.0 – serial number”. The password to access the WiFi is “accura.wifi”.

Open your browser and enter the URL: <http://accurag4-00000000/> to connect to the Plumespector user interface. Replace the zeros by the serial number of the unit you are trying to reach. The serial number is composed of 8 digits which can be found in the WiFi network name or under the controller.

**4.3 SETTING UP THE PLUMESPECTOR ON A NETWORK (OPTIONAL)**

To connect the Plumespector to your local network you must connect the controller to the network with an Ethernet cable, wi-fi connection is not possible.

**4.4 CONNECTING THE I/Os (OPTIONAL)**

You may remotely control the Plumespector using the I/Os connections.

To use the I/Os connections, please refer to the following schematic and descriptions.

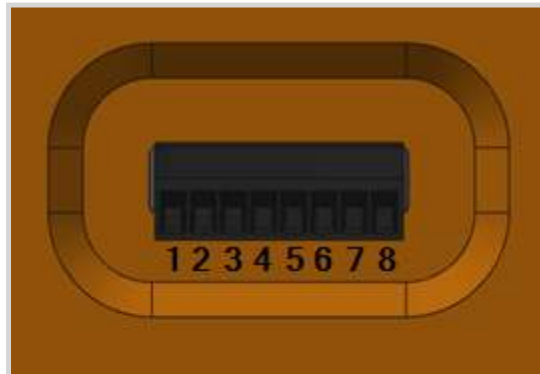


FIGURE 24 I/O PORT

**4.5 USING THE INPUT TO GENERATE REPORTS**

The Input can be used to automatically generate reports and .csv files. It must be held 'high' for at least 1 second to be detected by the controller. If you set the input 'high' for more than 1 second but less than the reaction time, the auto-generated report length will be set to 1 second. Therefore, the system will record 1 second of data after the reaction time.

On the other hand, if you set the input 'high' for more than the reaction time, the auto-generated report length will be set to ('input high time' – 'reaction time'). For example, if you set the reaction time to 5 seconds and leave the input 'high' for 10 seconds, the auto-generated report will contain 5 seconds of data, starting after the 5 seconds reaction time.

Pin	Name	Description	Logic
1	IN 24 VDC	Input/Output reference Voltage + Supplied by user	
2	IN 0 VDC	Input/Output reference Voltage – Supplied by user	
3	IN 1	Start measurement sequence (the data acquired by the Plumespector will be saved) when logic is 1 and stop when logic is 0	Logic 1 : 11-24V above 0VDC IN Logic 0 : 0-5V above 0VDC IN
4	OUT 1	Wait for data acquisition. This output indicates that the sensor is acquiring its initial data buffer. Once the buffer is filled, this output will fall.	Logic rising edge: Acquiring initial buffer Logic falling edge: Initial buffer acquired
5	OUT 2	Measurement valid. Following the acquisition of the first buffer this output 1 will be raised when measurements are valid.  If the measurements are invalid, <a href="#">error messages</a> will be displayed in the user interface and measurements results should be ignored.	Logic 1 : 24 VDC IN Logic 0 : 0 VDC IN
6	OUT 3	All measurements are within the <a href="#">green zone</a> .	Logic 1 : 24 VDC IN Logic 0 : 0 VDC IN
7	OUT 4	At least one measurement is within the <a href="#">yellow zone</a> .	Logic 1 : 24 VDC IN Logic 0 : 0 VDC IN
8	OUT 5	At least one measurement is within the <a href="#">red zone</a> .	Logic 1 : 24 VDC IN Logic 0 : 0 VDC IN

## 5 MAINTENANCE

### 5.1 MAINTENANCE SCHEDULE

Components	Actions	Frequency
Sensor head	<a href="#">Cleaning the sensor head windows</a>	Daily
	<a href="#">Replacing the sensor head windows assembly</a>	When damaged
	<a href="#">Sensor head calibration</a>	Annually
Compressed air filter cartridge	<a href="#">Replacing the filter cartridge</a>	Periodically (see visual indicator on the cartridge assembly)

**5.2 MAINTENANCE PROCEDURES**

**5.2.1 CLEANING THE SENSOR HEAD WINDOWS**

To ensure accurate measurements, the sensor head windows must be free of dust, oil and scratches. The sensor head windows must be cleaned after each measurement procedure.

Tools and materials required:

- Compressed air;
- Lens paper;
- Isopropanol (rubbing alcohol);

Instructions

- Blow clean & dry compressed air on the windows;
- If any marks remain, clean the windows with lens paper. Wipe the paper across the window in a single motion instead of rubbing back and forth;
- If any marks remain, clean the windows with lens paper and a small amount of isopropanol. Wipe the paper across the window in a single motion instead of rubbing back and forth;
- If any marks remain, replace the sensor head window assembly (see next section).

**5.2.2 REPLACING THE SENSOR HEAD WINDOW ASSEMBLY**

We recommend you use latex or nitrile gloves when replacing the sensor head window plate. To avoid damaging the lens, do not use your fingers or sharp objects.

Tools and materials required:

- Latex or nitrile gloves;
- 2.5 mm Allen key;
- Sensor head window plate (20303-00930-00);

Instructions

- Remove the four M3 screws and carefully remove the window assembly.
- Put the new assembly on the sensor with the air knife at the top (facing downward). Insert the four M3 screws to secure the plate.

**5.2.3 CALIBRATING THE SENSOR HEAD**

All sensor heads are calibrated at Tecnar before being shipped to the end-users. To ensure accurate measurements, sensor calibration should be verified every year so that their calibration is NIST-traceable.

You must send the sensor heads to Tecnar Automation Ltd every year for calibration, contact [service@tecnar.com](mailto:service@tecnar.com). There is no need to send the cables and controller.

**5.3 RECOMMENDED SPARE PARTS**

Components	Part number
Compressed air filter cartridge	10201-00599-00
Sensor head windows assembly	30201-00820-00

## 6 TROUBLESHOOTING

On power-up of the controller, once the sensor is initialized properly, the back-plate LED will start blinking quickly (3 quick blinks every 5 seconds), it behaves the same way as a beacon light. This initial blinking indicates that the electronics components inside the sensor are up and running, and that the sensor is waiting for the software to connect. Note that the back-plate LED button is not available during this initialization sequence. Once the software is connected to the sensor, the LED will stop blinking immediately, and the back-plate button becomes enabled. Thus, it can now be used for alignment purposes. The start-up time of the controller is usually as fast as the initialization of the sensor head. Depending on the start-up time duration, the blinking might be hard to notice if the controller connects to the sensor as soon as it is initialized.

In the event that the initialization sequence is not successful, the LED will not stop blinking. Instead, it will start blinking more slowly, indicating that the sensor is now in error state (the LED will be held ON for approximately 1.5 seconds instead of 166 milliseconds, maintaining a 5 second interval in between the blinks). The back-plate button will remain disabled. Refer to the troubleshooting section for more information on the LED error codes.

### 6.1 SECTION TROUBLESHOOTING (LED ERROR CODES)

As mentioned in the operation section, in the case of hardware failure, the back-plate LED is used as a troubleshooting tool to provide more information on the system error state. Here is a list of all the possible codes, descriptions, and troubleshooting actions to be taken.

Error code	Description	Actions
2 blinks	The controller did not connect to the sensor within 2 minutes after the initialization	Reboot the controller
3 blinks	Internal micro-switch error	Contact Tecnar service team
4 blinks	Microcontroller error	Contact Tecnar service team



## 6.2 ERROR REPORTING IN THE USER INTERFACE

Error code	Corrective measures
Invalid plume width, plume deviation, plume intensity & density measurements (Signal level too low)	<ul style="list-style-type: none"> <li>• The proper setup has been selected.</li> <li>• The sensor head windows are clean.</li> <li>• EXPOSURE TIME is set adequately for your process.</li> </ul>
Invalid measurements (Saturated signal)	<ul style="list-style-type: none"> <li>• The proper setup has been selected.</li> <li>• EXPOSURE TIME is set adequately for your process.</li> </ul>

### 6.3 SERVICE & SUPPORT

Should you have any questions concerning our equipment please contact us at:

TECNAR Automation

1021, Marie-Victorin Street

St-Bruno, Qc, Canada, J3V 0M7

Phone: 450-461-1221

Fax: 450-461-0808

Email: [service@spraysensors.tecnar.com](mailto:service@spraysensors.tecnar.com)

**ANNEX 1 – HTTP REQUESTS**

The following document describes the communication protocol used by the Plumespector 4.0 to stream measurement data and load setups (system configurations) remotely.