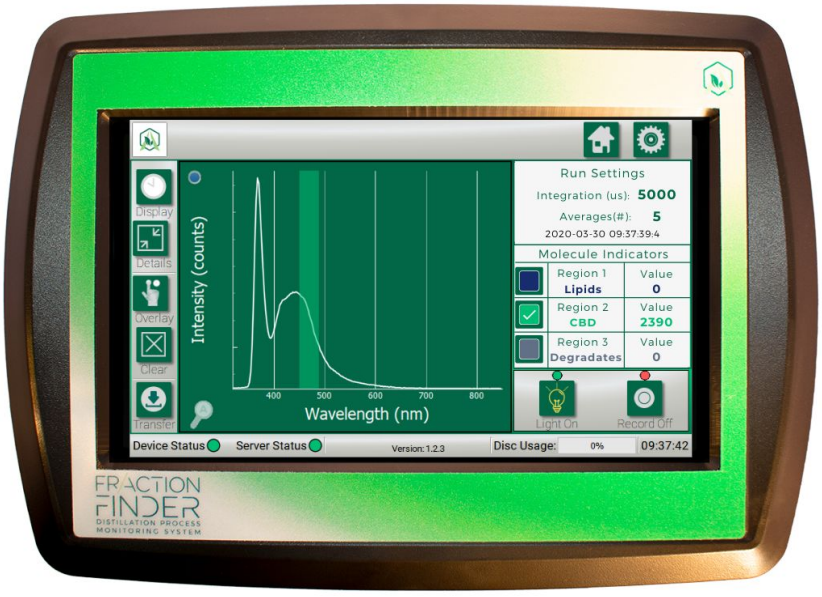
AROMETRIX

FRACTION FINDER

APPLICATION GUIDE FOR
WIPED/THIN FILM EVAPORATION



YOU MUST READ THIS MANUAL BEFORE USE

WARNING: NEVER LOOK DIRECTLY INTO THE LIGHT SOURCE

TABLE OF CONTENTS

Section 1: Description and Principles of Operation	**3**
Section 2: Screenshots - Desirables	**4**
Section 3: Screenshots - Undesirables	**5**
Section 4: Terpene Stripping Pass - What to Expect	**6**
Section 5: Cannabis Refining Pass - What to Expect	**7**
Section 6: Unpacking and Inspecting	**8**
Section 7: Installation for Wiped Film Evaporation	**9**
Section 8: Resources	**10**
Section 9: Specifications	**10**

FRACTION FINDER
DISTILLATION PROCESS MONITORING SYSTEM

Section 1: Description and Principles of Operation

The Fraction Finder detects the presence of distillation molecules via induced fluorescence. While many molecules can show fluorescence simultaneously, looking at the wavelength of the fluorescence peaks helps inform the distillation operator what molecule is being detected.

Purpose of using the Fraction Finder for wiped film evaporation (WFE):

- **Parameter Feedback -** WFE parameters and setpoints are not adjusted often; however, they might be adjusted when first setting up the WFE, when changing source material, when the seasons change, or when changing pre-processing methods. The Fraction Finder's readings can provide parameter feedback for temperature and wiper speed.
- **In-Line Quality Assurance -** The Fraction Finder's readings can provide quality assurance and indicate oddities. Users can recognize in real-time if there are "undesirables" in their line. This is especially useful if there is no in-house HPLC.
- **High Efficiency -** The Fraction Finder's readings can indicate if cannabinoids are being rejected in the residue stream; this information can be used to adjust parameters in order to minimize rejected cannabinoids, therefore, optimizing efficiency. *See "Installation" section for more details on this.*

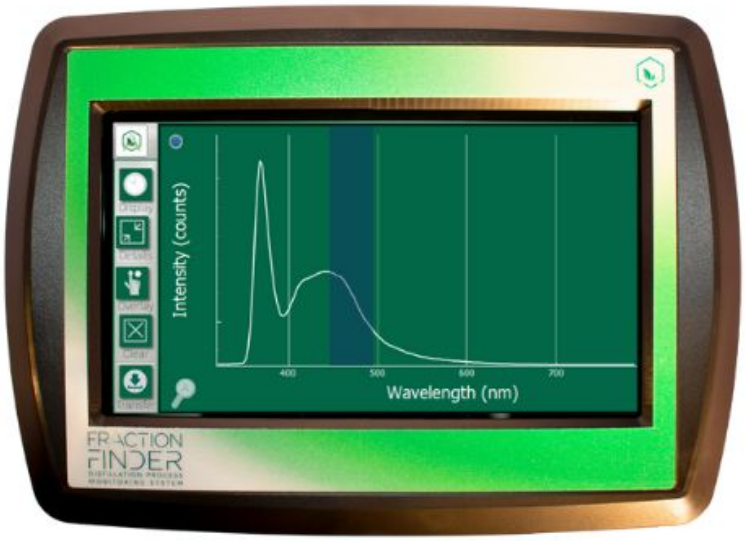
The relevant molecules that the Fraction Finder can detect during WFE, and their respective wavelength regions are:

- **Reference Peak @** 360-370 nm
    - The Reference/Excitation peak is from the sensor device and is not indicative of any distillation fractions or molecules.
- **Δ^9-THC** @ 440-500 nm
- **CBD Indicator** @ 450-490 nm
    - CBD and THC fluoresce at similar wavelengths, but have different waveforms. Note: The FRACTION FINDER does not distinguish between CBD and THC simultaneously.
- **Degradates (degraded THC/Cannabinoids)** @ 510-550 nm, centered at 490 nm
- **Chlorophyll**; may show 1 or 2 peaks @ 680 nm and 710 nm
- **Lipids** @ 550-620 nm
    - Lipids aren't one chemical, but a class of chemicals. For the purpose of this document, a lipid that exhibits fluorescence at 535 nm is shown.
- **"Fool's Gold"** @ 405-435 nm
    - "Fool's Gold" is a colloquial term for a chemical component commonly seen during distillation which is golden in color and looks like a desirable cannabinoid. The molecular species that is "Fool's Gold" is currently unknown.

***NOTE**: See our "Chemical Cheat Sheet" for an updated list of chemicals that the unit can detect.*

Section 2: Screenshots - *Desirables*

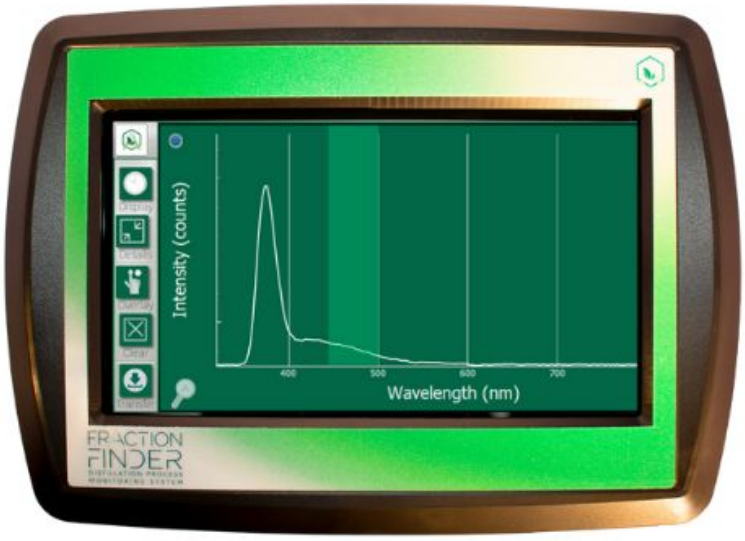
CBD Indicator | Wavelength: 450-490 nm



TIP: WFE of hemp oil with the goal of producing CBD-dominant distillate is becoming increasingly popular. The Fraction Finder can provide an indication of when CBD is passing through.

The CBD Indicator appears as a *sharp* peak.

Delta-9 THC | Wavelength: 440-500 nm



TIP: Similarly to CBD, Delta-9 THC is considered a "desirable" during WFE of THC. In these processes, the Fraction Finder can assist operators in collecting the most amount of this molecule as possible by indicating when it is passing through.

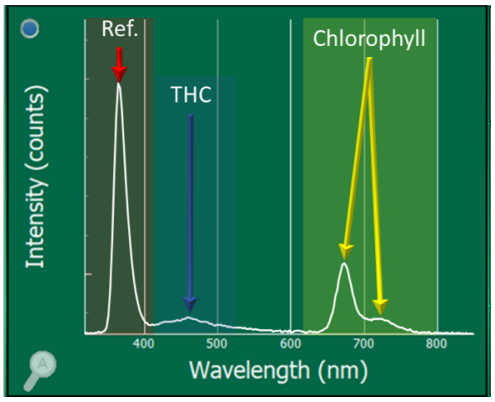
The THC Indicator appears as a *short, broad* peak.

***Note**: The FRACTION FINDER does not distinguish between CBD and THC **simultaneously**; while they have different waveforms, they fluoresce at the same wavelength location. However, if one fraction comes out before the other, such as during Chromatography, it is possible to determine the change.*

Section 3: Screenshots - *Undesirables*

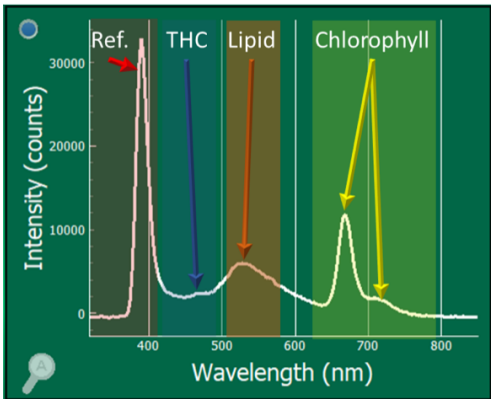
As you will learn in this section, other molecules can fluoresce at the same time that the main cannabinoid fluoresces. This is when parameter feedback is most relevant. For these examples, we use THC as the desired cannabinoid.

THC and Chlorophyll



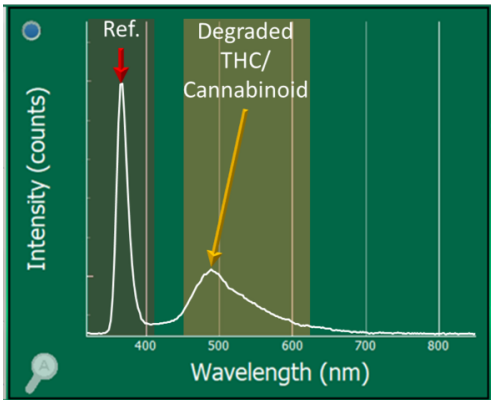
TIP: If a WFE operator sees the Chlorophyll signal, s/he should perform a carbon scrub (or other chlorophyll remediation) before starting distillation or on the distilled product. If Chlorophyll is detected on the distillate line of the cannabis refining pass, wiper speed should likely be increased or WFE internal chamber temperature decreased.

THC, Chlorophyll, and Lipid



TIP: If a WFE operator sees the signal for Lipid (a peak that is centered between 530-620 nm), this indicates that their lipids removal is not removing all the fats.

Degraded Cannabinoids



TIP: Degraded THC/cannabinoids are typically considered “undesirables” and should not be collected.

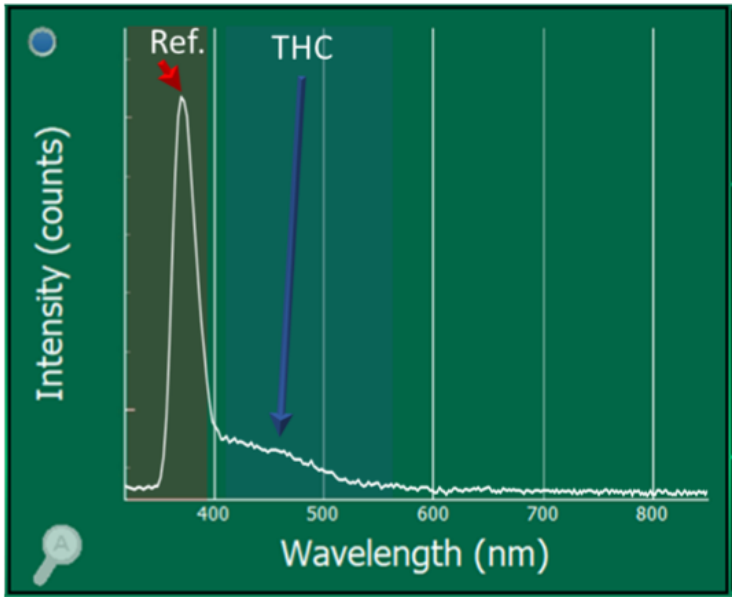
Section 4: Terpene Stripping Pass - What to Expect

The relatively low-temperature terpene-stripping pass is typically performed before trying to distill the desired cannabinoid. During this pass of a WFE, the temperature is intentionally set slightly lower than the boiling point of the desired cannabinoid, so that only terpenes, degraded terpenes, residual solvents, and other undesirables boil off. In this example, it is assumed this is a Δ^9-THC distillation.

Residue Side (Crude without Terpenes)

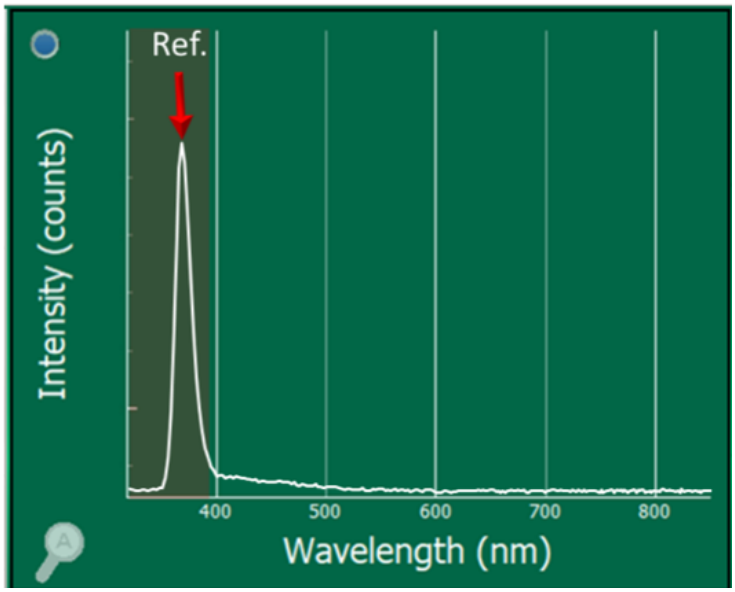
This side should not have terpenes, degraded terpenes, etc. What is left is all the molecular species from the crude, and as such, the majority of the spectra will be cannabinoids, degraded cannabinoids, and chlorophyll/lipids if they were present in the crude material. The THC signal should be very low in intensity. A labeled example of what to expect from the Fraction Finder is given.

***WARNING** – if the fluid coming out the residue side is either very low flow or very dark the chemical analyzer/sensor may not be able to detect the chemicals flowing through the sensor.*



Distillate Side (Terpene Enriched Effluent)

This side should have only terpenes, degraded terpenes, etc... This line may also contain some “Fool’s Gold” at 410 nm if it is present in the crude; it should be ejected with the terpenes as it is typically not wanted in the final product. As the Fraction Finder is insensitive to the majority of solvents and terpenes, only the reference peak will likely be observed. A labeled example of what to expect from the Fraction Finder is given.



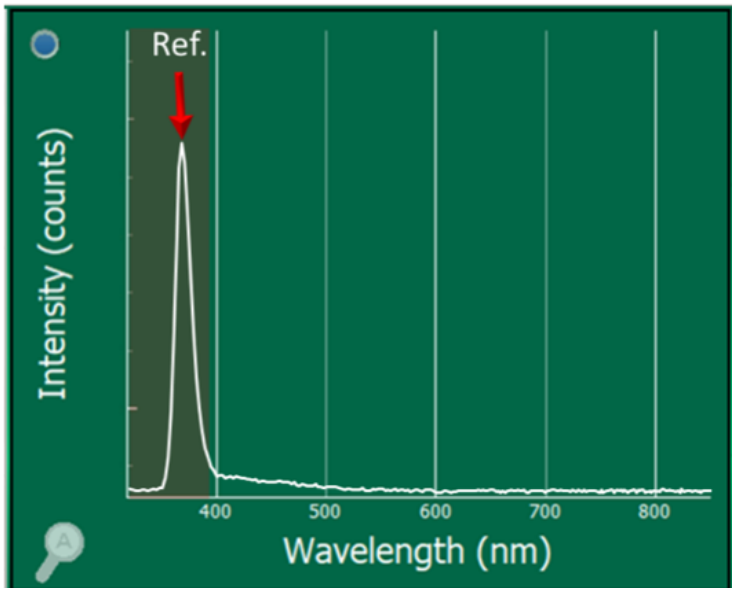
Section 5: Cannabis Refining Pass - What to Expect

The relatively high-temperature cannabinoid refining pass is typically performed after a terpene stripping pass. Only the desired cannabinoids are distilled while all other molecular components get rejected to the residue side of the WFE. In this example, it is assumed this is a Δ^9-THC distillation.

Residue Side (Waste Effluent)

This side should have everything but the desired cannabinoid. While during SPD, this would typically include a lot of degraded cannabinoids, the heating time for the crude in WFE is low enough that it is atypical to see a significant presence of degraded cannabinoids. A labeled example of what to expect from the Fraction Finder is given.

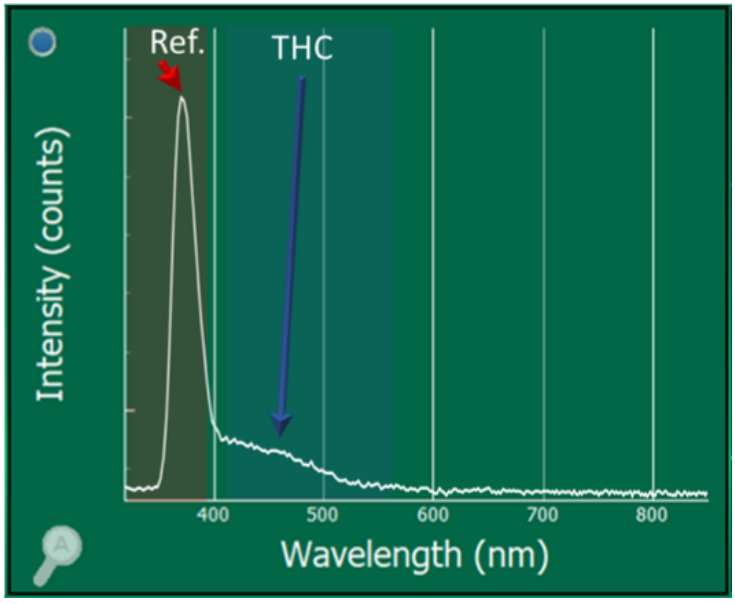
***NOTE** – If there is a (small) bump at 490-510 nm, that is OK – it is the chemical signature associated with degraded cannabinoids.*



Distillate Side (Desired Product Effluent)

This side should have just the desired cannabinoid. A labeled example of what to expect from the Fraction Finder is given. If Chlorophyll is detected on the distillate line of the cannabis refining pass, wiper speed should likely be increased or WFE internal chamber temperature decreased.

***NOTE** – The spectra used here is representative and used here for learning purposes. This THC intensity should not be analyzed, as intensities will vary. On the distillate side of the cannabis refining pass, the THC signal will be intense (more intense than it was during the terp strip).*

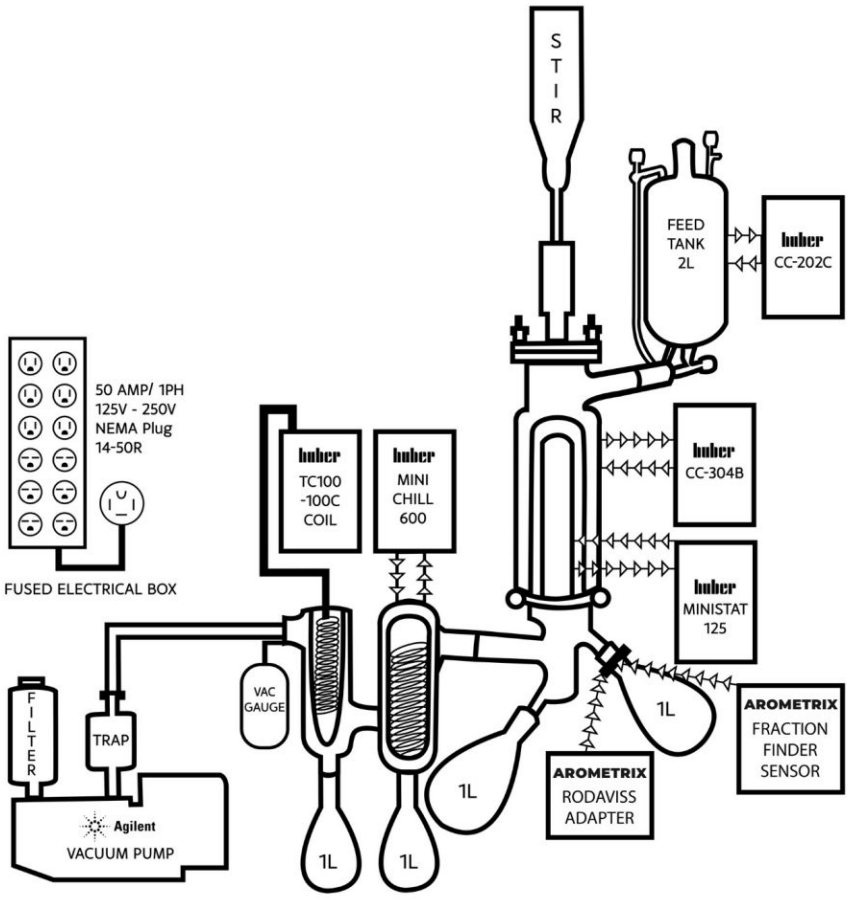


Section 6: Unpacking and Inspecting

After the instrument is received, it should be carefully unpacked and inspected for damage during shipment and to confirm that all components are present.

Each FRACTION FINDER comes with:

- Fraction Finder Sensor *(Size 29 or 34)*
- Display *(with pole mounting bracket)*
- Sensor Cable, USB, 2 feet
- Light-Blocking Tape
- International Power Supply
- Warranty Card
- Glass Adapter (optional)
    - *If Root Sciences/VTA, Prescott, Pope, or WFE with gear pump* → Collection Jar Bundle
    - *If PurePath100* → PUREPATH Rodaviss Adapter OR PUREPATH Rodaviss Neck Flask
    - *If Deutsche or WFE with metal connections* → 1.5” or 2” Sanitary Flange Sight Glass
    - *If Lab Society HVE Thin Film* → KF25 to 35/25 Ball Joint Adapter



Featured: Cascade Sciences PUREPATH100 with Fraction Finder & Rodaviss Adapter

Section 7: Installation for Wiped Film Evaporation

Users can select if they would like to operate with ***1 or 2*** Fraction Finder systems.

Installation with *1* Fraction Finder	**Installation with *2* Fraction Finders**
If operating with *1* Fraction Finder, Arometrix recommends that users: ● Install the sensor → on the **residue** line during **terpene stripping pass** ● Swap the sensor → to the **distillate** line during **cannabis refining pass**	If operating with *2* Fraction Finders, Arometrix recommends that users: ● Install the sensor → on the **residue** line during **both passes** ● Install the sensor → on the **distillate** line during **both passes**
Note: If you select to operate with ONE Fraction Finder, please disregard the "Terpene Stripping Pass - Distillate Side" and "Cannabis Refining Pass - Residue Side" sections; they will not be relevant.	*Note: The added value of operating with TWO Fraction Finders is the "High Efficiency" bullet point mentioned in the "Overview", as users can additionally monitor for cannabinoid rejection.*

General Installation Instructions

1. Apply the light-blocking tape to the glassware apparatus. This is ***especially*** important in labs with a lot of ambient light, as it will block the light from saturating your sensor's readings.

2. Install the optical sensor with the thicker part of the sensor down. The sensor should be installed on, or directly above, the collection vessel. *(See image of Fraction Finder and Collection Jar Bundle installed on the VTA.)*

3. Plug the sensor cable into the sensor and the display. Give the sensor ~2-5 minutes to boot up.

4. Mount the display to a lab pole using the mounting bracket screw.

5. Use the supplied AC adapter to power your display. Allow it to boot.

6. Ensure: (1) That the Device Status and Server Status indicator; (2) that the "Light On/Light Off" toggle button is turned on

7. In Settings: (1) Set Scans to Average to 5; (2) Turn AutoIntegration (AID) on by tapping the checkbox

Section 8: Resources

If you haven't already, we encourage you to:

- Read the full FRACTION FINDER user manual to learn more about the interface, software updates, troubleshooting issues, and more
    - All sections in the user manual ARE relevant and useful to wiped film evaporation processes, except perhaps, the "Installation for Short Path Distillation" section
- Visit arometrix.com/resources for a full list of resources for each FRACTION FINDER application
- For further assistance, please contact our Technical Support team:
    - brains@arometrix.com
    - (240) 492-6556 (call or text)

Section 9: Specifications

SYSTEM	
Creator	Arometrix, Inc.
Application(s)	Distillation (short path; wiped film; thin film)
State of Materials	Distillates
Expected Life Span	10+ years
Shipping Weight	5 lbs
Shipping Dimensions	10″ x10″ x8″
Technology Validation Reference	"In Situ Fluorescence Spectroscopy for InLine Distillation Process Monitoring", published by Cannabis Science & Technology
SENSOR	
Type	Standard
Technology	In-situ fluorescence spectroscopy sensor (contains an optical light pulse and UV fluorescence detector)
UV Domain	Near UV
Size(s)	Size 29; Size 34
Interface Requirements	Size 29 Glass (28-30mm outer diameter) Size 34 Glass (31-34mm outer diameter) *Do not use with double-jacketed glass
Cable Length	2'-30'
Max Temp	100 C
Min Temp	5C
Optical Detection Range	300 – 1000 nanometers

Lower Detection Limit	1 mg/mL (at a volume of 1 cubic centimeter of oil)
Accuracy	Spectral resolution: 15 nm max
Margin for Error	*Not applicable to qualitative measurements*
Reading Speed	> 1 second
Flow Rate Limits	No flow rate limit
Min Fill Level	1/8 volume
Calibration	No
DISPLAY	
Type	7 inch LCD TFT display (contains a compute module with advanced software)
Power	100-240VAC 50/60 Hz CE Rated (12 Volt 1 Amp into Display)
Power Supply	Yes
Mount	Mounts to a laboratory stand bracket (pole up to ½" thick)
Units	Wavelength Nanometers (nanometers); Wavelength Intensity Values (arbitrary units)
Plots	Spectrogram; Wavelength Intensity graph
Metric Type	Qualitative
Telemetry Options	USB
PLC Communication Type	Serial UART (BAUD: 115200, DATABITS: 8, STOPBITS: 1, PARITY: NONE)

AROMETRIX