ASTON IMPACT
OPERATOR MANUAL

June 2022
Software Version: 1.0
Document Version: 1.0

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Aston Impact Product Manual v. 1.0. 5/20/2022, Software version 1.0

Revision History

Revision	ECO	Change Log	Author
A	ECO-001XX	No content change in this guide	Vinay Kulkarni

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CHAPTER 1 – GETTING STARTED

1.1 General Safety Information

WARNING!

All work described in this document must be conducted by persons who have suitable technical training and the necessary experience, or who are working under the supervision of the end-user of the product. Only qualified Atonarp representatives must install and service the equipment.

The warranty period starts on the date the installation is complete. All warranty claims expire if any unauthorized changes are made to the Aston system. During the warranty period, any components with material or design-related defects will be replaced or repaired by the manufacturer.

This warranty excludes the following:

- Accidental or willful damage.
- Parts and accessories are expendable in the normal operation of the Aston system.
- Improper or inadequate operation, maintenance, adjustment, or calibration by the user.
- Packaging and transport damage.

If the device malfunctions, contact Atonarp for support.

The packaging of the Aston system provides the best possible protection against transport damage. We recommend retaining the shipping package of the Aston, should it be returned to Atonarp or shipped elsewhere. However, immediately inspect each delivery for signs of transport damage. If the shipment is incomplete or damaged, inform the manufacturer within three working days. Also, inform the freight carrier about any transport damage.

1.2 Introduction

1.2.1 Purpose of Aston Impact

Aston Impact is a mass spectrometer-based instrument that performs residual and process gas analysis for process control in high-volume manufacturing environments, including semiconductor chip manufacturing, flat panel displays, solar panels, etc.

1.2.2 Aston Impact Description

Aston Impact is a self-contained enclosure that includes two sample inlets, the vacuum chamber, a dual inlet turbomolecular pump, the mass spectrometer sensor, associated Control Box (CB) electronics, a pressure gauge, a programmable drive board, and an optional diaphragm pump. The sample inlet and vacuum chamber are heated. The front panel features are electrical, pneumatic, and communications connections.

1.3 Using The Operator Manual

This manual helps the user to establish the required connectivity, set up and navigate through the user interface to initialize the instrument, turn ON the ionizer, configure scan parameters, collect data, manage data files, set up Workflows, and setup up in Standby mode.

1.4 Contacting Customer Support

For technical support, repair service, or any queries regarding the Aston products, it is recommended to raise a support request at the Atonarp customer portal available at https://support.atonarp.com/. This ensures a formal record of the request. For further follow-up and allows Atonarp to provide the fastest response.

Contact Atonarp for login details needed to access the Atonarp support website. A user ID can be suggested for the account. Once access is granted, a notification email is sent to the email ID with the log details.

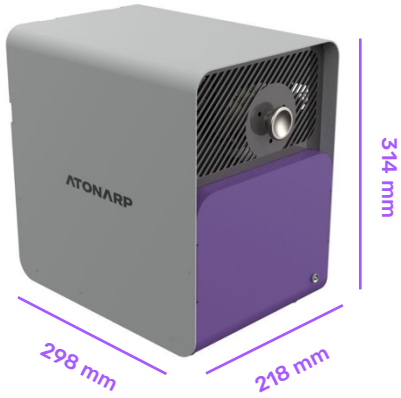
1.5 Aston Impact Performance Specifications

PARAMETER	CONDITION	MIN	TYPICAL	MAX	UNITS
Mass Range		2		350	u
Mass Resolution	Full Width at 10% Valley for N_2	0.6	0.8	1	u
Mass Number Stability		0.1	0.1	0.3	u
Sensitivity (FC/SEM)	Nitrogen-equivalent		$5x10^{-6}/5x10^{-4}$		A/Torr
Minimum Detectable Partial Pressure (FC/SEM)	Nitrogen-equivalent		$10^{-9}/10^{-11}$		Torr
Limit of Detection	Nitrogen-equivalent		10		ppb
Maximum Operating Pressure			10^{-3}		Torr
Dwell Time per u		1	40	200	ms
Scan Update Rate per u			37		ms
Sampling Pressure Range		$1x10^{-5}$		$1x10^{-3}$	Torr
Operating Temperature	80% relative humidity non-condensing	5		35	°C
Emission Current		0.1	0.4	1	mA
Emission Current Accuracy		0.03	0.05	0.1	%
Start-up Time			5		mins
Ion Current Stability	Over 24 hrs at constant ambient & pressure		< +/-1		%
Concentration Accuracy			< 1		%
Concentration Stability		±0.5	±0.5	±1	%

1.6 Physical Requirements

1.6.1 Physical Dimensions

L x W x H (mm): 298 x 218 x 314 (front-end sampling accessories not included)



1.6.2 Weight

The weight of Aston Impact, not including cables, is 13 kg

1.6.3 Ventilation Requirements

If Aston is to be deployed inside an enclosure, e.g., NEMA, adequate ventilation using a fan, for instance, and maintaining at least 25.4 mm clearance around Aston must be provided.

1.7 Electrical Power Requirements

1.7.1 Universal AC power: 90-240 VAC

1.7.2 Required Frequency: 50-60 Hz

1.7.3 Power Rating: 250 W

1.7.4 Electrical Connections:

110 VAC; 3 pronged; grounded plug or, 230 VAC; European style; 2 prong plug with ground contact.

1.8 Nitrogen Purge Gas

In the case of corrosive applications (e.g., CVD and Etch) and to protect its bearings, a ten sccm flow of dry Nitrogen N_2 (or Argon Ar) is required for the TMP. The N_2 purge can be produced using an external regulator to be connected to the purge port of Aston, as shown in Chapter 2. The N_2/Ar source can be a regulator below 69 kPa (10 PSIG).

1.9 Pump Exhaust

A ¼" Swagelok fitting, mounted on the onboard dry roughing pump, is available on the front panel to connect the facility's house exhaust. In the case of corrosive applications, exhausting the TMP can be done directly, bypassing the roughing pump.

1.10 Air Pressure Requirements and Connections

Dry compressed air or N2 is required to operate the two electro-pneumatic valves available on Aston. The acceptable air pressure range is 0.4-0.8 mPa (58-116 PSIG). The compressed air supply is connected to the solenoid inside Aston via a 1/4" polymer hose inserted into a connector mounted on the front panel. Also mounted are two 1/8" valve connectors to which 1/8" polymer hoses can be inserted.

1.11 Environmental Requirements

1.11.1 Operating Temperature Range: 15-35 ℃ (59-95 °F)

** 1 ℃ temperature regulation recommended when performing stable measurements to within ±1%.*

1.11.2 Maximum Humidity: 80% RH (non-condensing)

1.12 Computer System Requirements

Atonarp can supply a laptop PC fully configured and hosting AtonLab for data acquisition and control of Aston Impact. The minimum resource requirements of a laptop or desktop include:

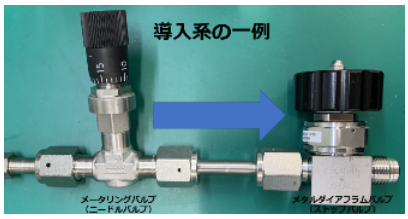
- CPU Intel Core i5 – minimum 8th generation recommended 9th generation.
- Storage – 512 GB SSD – minimum, 1TB SSD Recommended.
- 16GB Memory (Dual Channel memory) – Recommended.
- 1x RJ45 – Network port.
- x USB minimum (Debug USB and Recovery USB to be directly connected without hubs).
- 1x USB to RJ45 – (laptop is to be configured in DHCP or P2P modes, this can then be used for Team Viewer connection for remote support and debugging)/ WIFI can be used as backup (QOS could be a concern)
- OS – Windows 10 Updated to - 10.0.19043 or later
- Screen resolution of 1920 X 1080 (Minimum).

CHAPTER 2 - INSTALLING ASTON

Aston Impact features two sample inlets; both use ¼" female VCR fittings. The sampling configuration depends on the process pressure, and gas flow of the user application:

- The bottom inlet corresponds to the intermediate port of the turbomolecular pump (TMP) and could be used as a sample bypass for enhanced response times. If not used, it should be capped off using a ¼" male VCR fitting.
- The top inlet is the main sample inlet.

A Typical & Simple Installation



1 Attach a needle valve (manual or computer-controlled) or a combination of a metering valve and shut-off valve to the main sample inlet.

2 The valve should be closed prior to injecting the gas sample into Aston.

3 Connect the purge gas regulator set to the TMP purge gas inlet (1/8"/ 6 mm polymer hose port) if the application involves corrosive gases (see next page for installation using an external regulator).

4 When using pneumatic valves, connect the compressed gas supply to the gas inlet using ¼" (6 mm) polymer hose, and two 1/8" (4 mm) polymer hoses to each valve (see requirements under 1.10 and example of the installation below).

5 Connect the LAN cable to ETHERNET.

6 Connect the ASTON power cable to the power source.

7 Connect the power cable on the PC and set up the PC.

8 Turn on the POWER SWITCH on ASTON.

9 Double-click on the AtonLab application on the PC desktop.

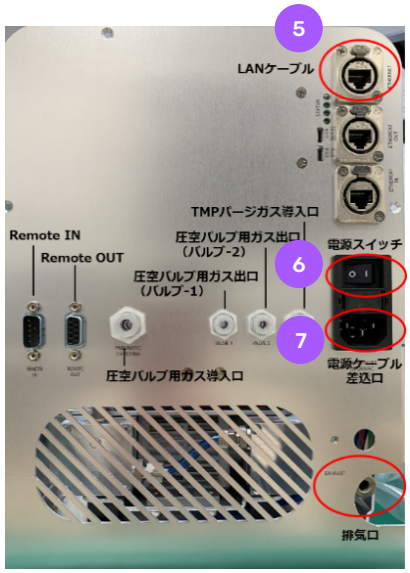
10 The window on the right is open.

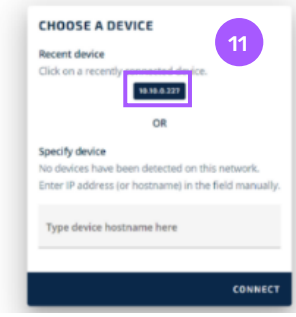
11 Click on the IP address.

Please refer to the Login credentials for the URL (in the Aston Package).

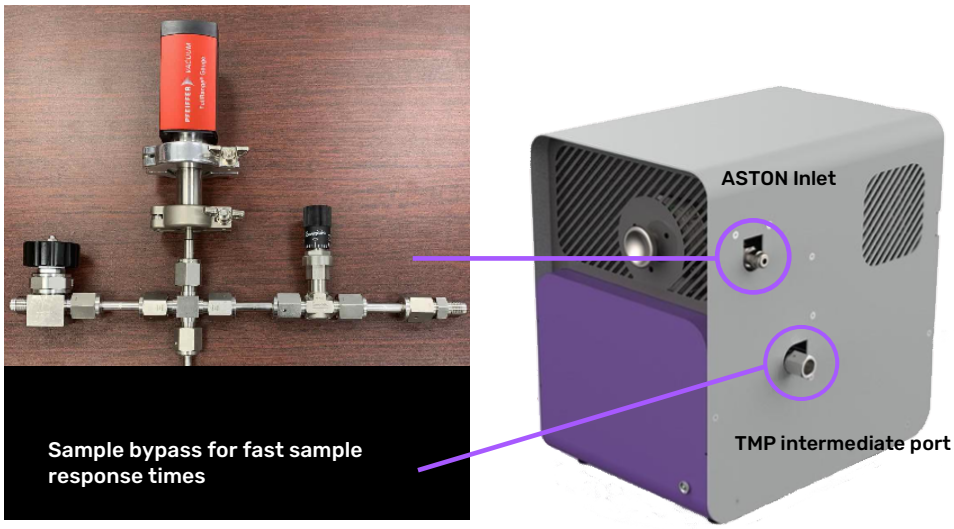
12 Wait for AtonLab to start up.

AtonLab starts 2-3 minutes after power up.

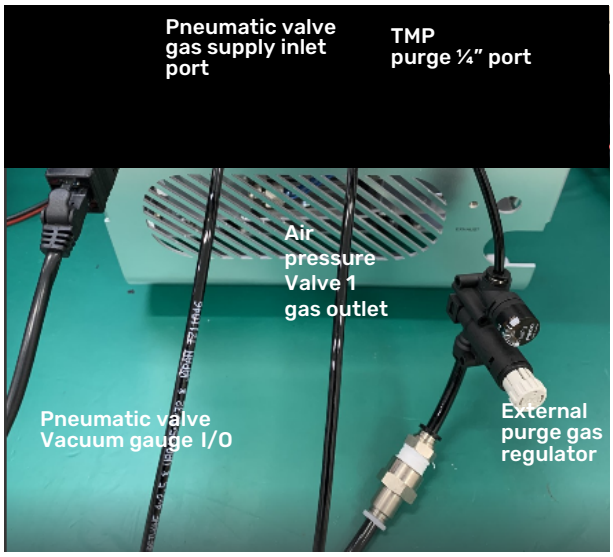




An example of a sample gas introduction system is shown below:

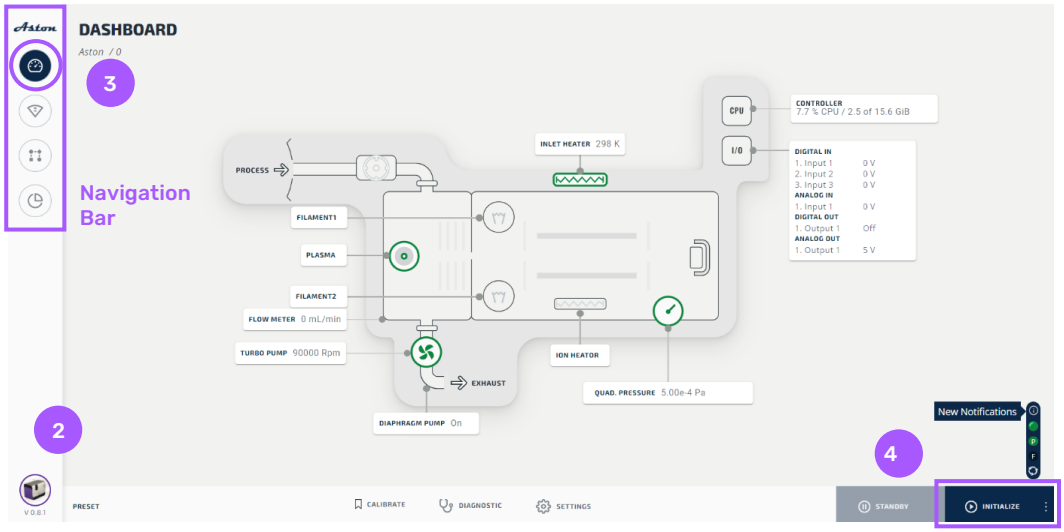


Example of TMP purge gas connection via an external regulator/pneumatic valves gas connection:



CHAPTER 3 – OPERATING ASTON

Aston's data acquisition and control are performed via the AtonLab application. Aton Lab's DASHBOARD below shows a block diagram of the various modules of the instrument, their status, and the ability to turn them ON/OFF and change their settings. The various modules include the sample inlet, the dual (plasma/EI) ionizer, the Hyper Quad sensor, the detector, the TMP, the diaphragm pump, the purge gas flow meter, the pressure transducer, the heaters, DAIOs, and CPU resources.



OPERATION PROCEDURE

1. Ensure that the ASTON inlet (sample introduction system, valve, etc.) is closed.
2. Click twice on the  AtonLab icon to start the user interface (UI) application.

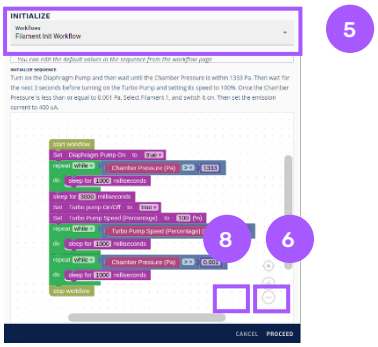
** When the AtonLab software starts, the DASHBOARD screen above is open.*

** If the UI startup protocol is not executed properly, the **INITIALIZE** and **STANDBY** buttons at the bottom right of the screen will be grayed out. Check the connection of the LAN cable and turn it back on.*

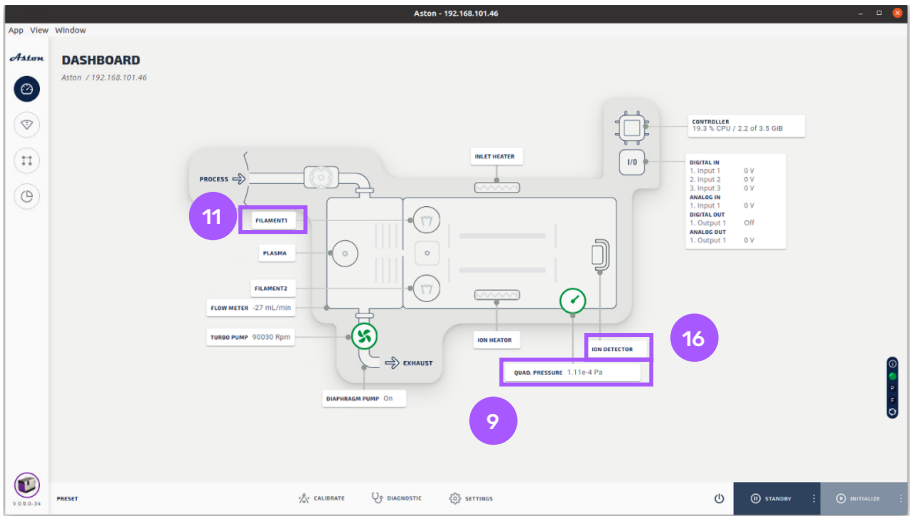
** The Navigation bar on the left side of the screen shows four (4) icons:*

DASHBOARD	To set up the device.
SCAN	To perform measurements.
WORKFLOW	To set up recipes.
REPORTS	To analyze, manage, and export data.

3. Make sure the  Navigation Icon Dashboard is open.
4. Click on INITIALIZE at the bottom right of the screen to get the system ready to scan.



5. Select Filament Init Workflow from the pull-down menu under INITIALIZE.
6. Click on PROCEED at the bottom right of the INITIALIZE screen.
7. The initialization starts based on the Workflow selected. The Filament Init Workflow selected here performs the following:
    - Starts the diaphragm pump
    - When pressure is less than or equal to 1333Pa (10 Torr), the TMP starts ramping up to 90000 RPM
8. By clicking CANCEL, the INITIALIZE Workflow screen is minimized but continues its execution.



9. Ensure that the vacuum chamber pressure is below $1x10^{-3}$ Pa ($7x10^{-6}$ Torr) as read by QUAD PRESSURE.
10. Adjust the operating pressure using the inlet valve to be within the recommended range 10^{-4} - 10^{-3} Pa ($7x10^{-7}$ - $7x10^{-6}$ Torr).

    ** A protection and interlock system turns off the filament and SEM if the ambient pressure exceeds $5x10^{-3}$ Pa ($3.5x10^{-5}$ Torr).*

    ** Provided sufficient sensitivity, operating at lower pressures is highly recommended to extend the lifetime of both filament and SEM.*

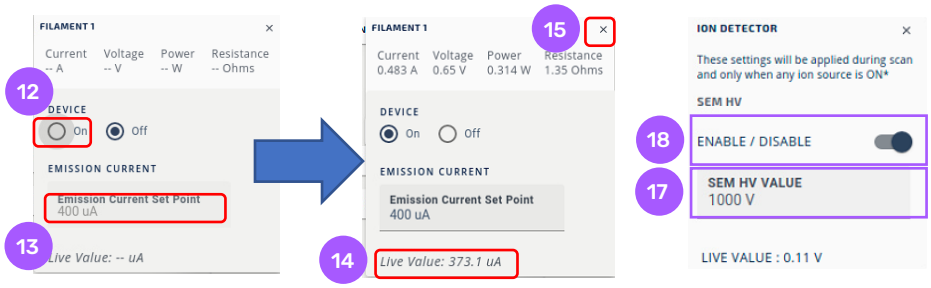
11. Click FILAMENT1 or FILAMENT2 to turn ON electron emission.
12. Turn the DEVICE ON.

    ** When FILAMENT is turned on, the "In Progress" message is displayed on the screen.*

13. When the "In Progress" message disappears, change the Emission Current Set Point to 100 µA.
14. Ensure that the Emission Current successfully converged at approximately 100 µA.

    ** When the Emission Current reaches the set point, the "In Progress" message disappears, and the actual value is displayed under Live Value.*

15. Close the screen with an X in the upper right corner of the screen



16. Click on ION DETECTOR.
17. Ensure that the SEM HV VALUE is set to 1000 V setpoint.
18. Verify that the ENABLE/DISABLE is set to ENABLE.

    ** When set to ENABLE, the SEM voltage is raised to the setpoint automatically when the scan is initiated*

    ** When set to DISABLE, the SEM remains OFF.*

19. Aston is now ready to scan and collect data.

The list below shows optimum operating parameters and their respective range

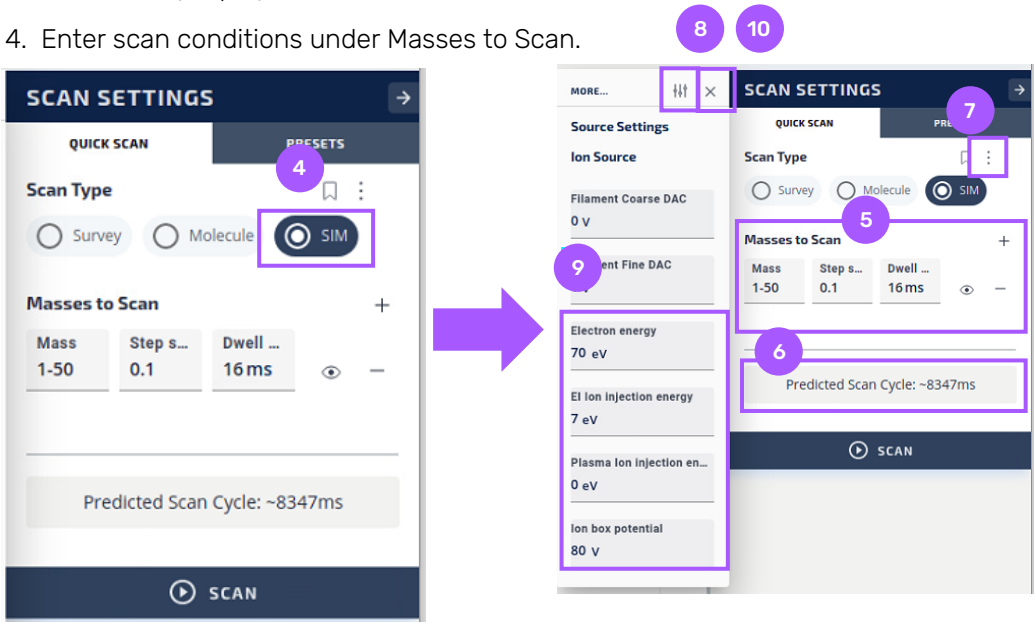
	Optimum Settings	**Range**
TMP Speed	90000 ±2% rpm	**0 – 90000 RPM**
TMP Power	25 W	**5 - 70 W**
Sample Inlet Temperature	80.0 ± 5 ℃	**0 - 80** ℃
Quad. Chamber Temperature	200.0 ± 5 ℃	**0 - 250** ℃
Electron Emission Current	100 µA	**10 - 400 µA**
SEM High Voltage	1000 V	**0 - 1500 V**
Quad. Chamber PRESSURE	$1x10^{-5}$ - $1x10^{-3}$Pa	**$1x10^{-6}$ - $1x10^{-5}$ Pa**
TMP Intermediate Port Pressure	10 - 50 Pa	**0 - 80 Pa**

CHAPTER 4 – COLLECTING DATA

Data collection is performed through the screen below using the following steps below:

1. Select the SCAN icon from the navigation bar to open the screen below.
2. Select scan parameters under SCAN SETTINGS (follow steps 3 through 9).

3. Select SIM (step 4).
4. Enter scan conditions under Masses to Scan.



Scan parameters are application dependent. A typical set is shown below:

Mass (Scan Range)	Step (Scan Resolution)	Dwell time (measurement time per data point)
10-200	0.1	32 s

5. The predicted scan cycle time is shown below the Masses to Scan box
6. Click on the ⋮ upper right corner of the screen to display Source Settings
7. Click in the upper right corner of the screen to display source parameters

8. The default parameters are show below

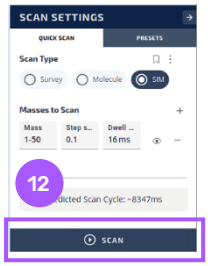
Electron energy	EI Ion injection energy	Ion box potential
70 V	7 eV	80

9. Click X in the upper right corner of the Source Settings screen to accept and close the screen.

10. The FILAMENT electron EMISSION value, QUAD PRESSURE value, etc. are shown in the DEVICE PARAMETERS box at the bottom right

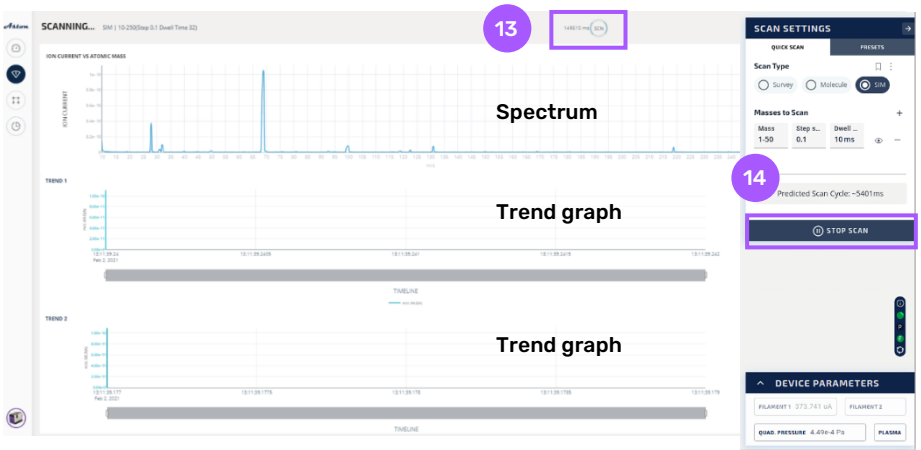
** Clicking FILAMENT1 (or FILAMENT2) in DEVICE PARAMETERS, show the actual filament electrical values, the emission setpoint, and actual value, and the ON/OFF control*

11. Click on the SCAN button to start collecting data



12. During the scan cycle, displayed under SCN is the actual measurement time for each scan

13. At the end of the scan, a spectrum (ion current vs m/z) is displayed at the top. Below the spectrum are trend graphs monitoring specific default masses (m/z values) over time. The m/z values can be changed by the user.

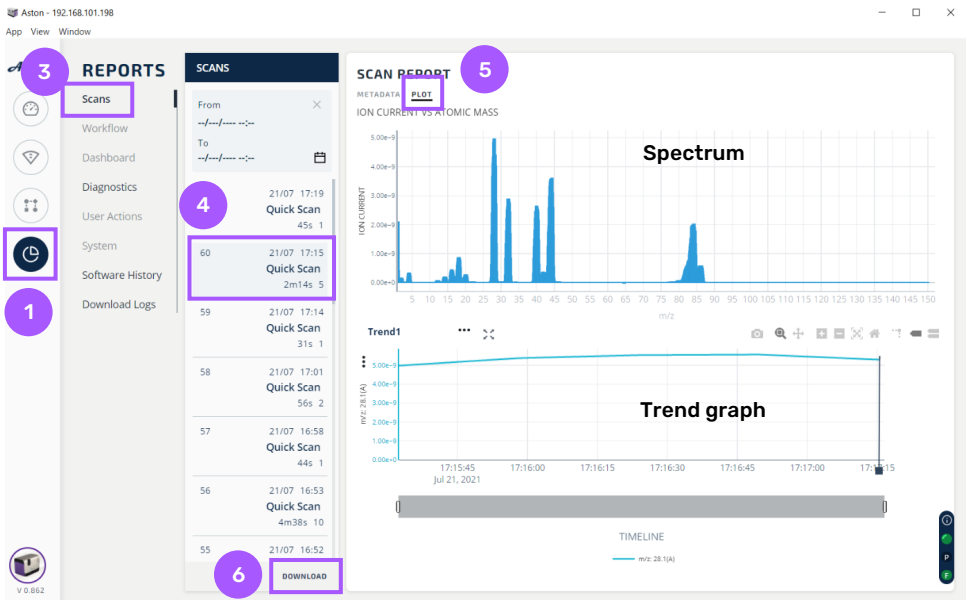


14. Click STOP SCAN to stop the measurements and data collection.

CHAPTER 5 - MANAGING DATA

This section helps the user view, plot, download data files using the following steps:

1. Select the **REPORTS** icon from the navigation bar.
2. The **REPORTS** screen opens.
3. Select **SCANS**.
4. Select the desired data under **SCANS**.
5. Under **SCAN REPORT** two buttons are available: **METADATA** and **PLOT** (see details below).
6. Click on **DOWNLOAD** to export the data file.



** When downloading, the report file will be saved in the following folder.*

C:\Users\Account Name\aston-reports\CB name.atoms.app

- Account Name is the name of the account when logging in to Windows.
- CB name is the name of the Controller Box in ASTON.
  Example of folder name: C:\Users\atonarp\aston-reports\fox-P03.atoms.app

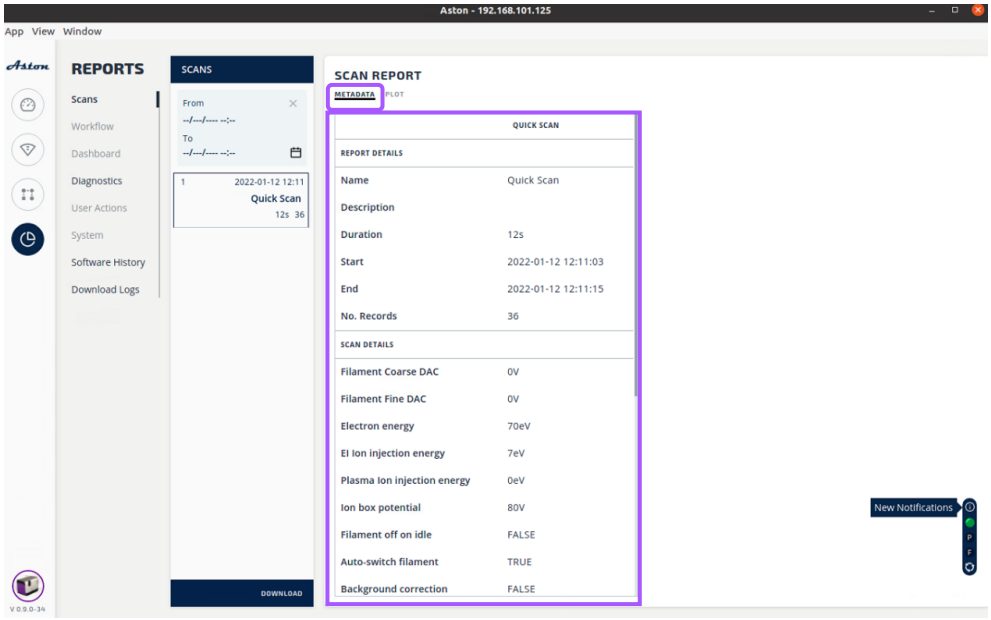
** Simple report files are also automatically saved in the following folders.*

C:\Users\Account Name\aston-live-dump\CB name.atoms.app

- Account Name is the name of the account when logging in to Windows.
- CB name is the name of the Controller Box in ASTON.
  Example: C:\Users\atonarp\aston-live-dump\fox-P03.atoms.app

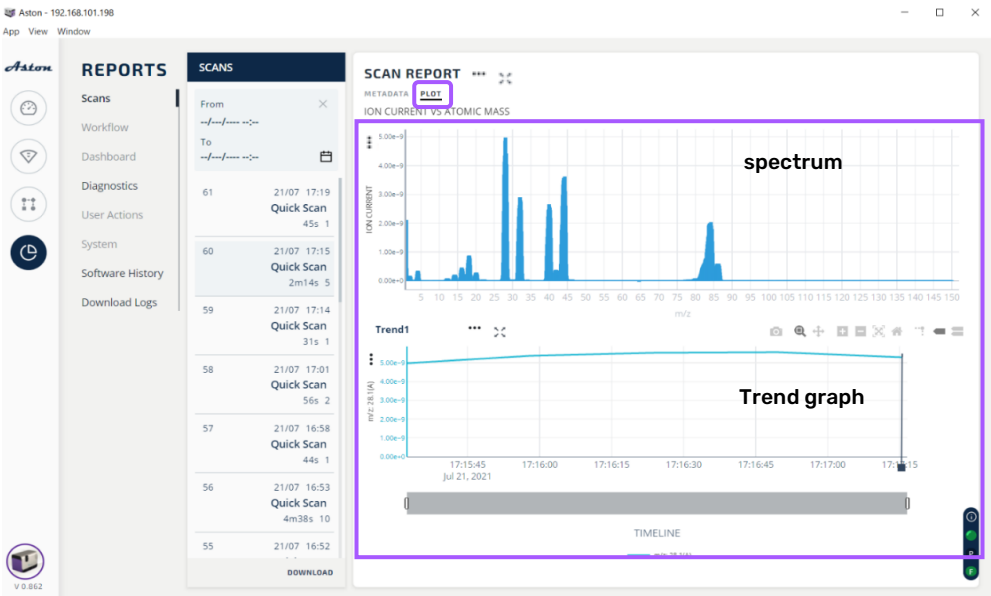
A. METADATA

Under METADATA, the user can access the metadata of the file selected. These include such information as start/end time and scan parameters.



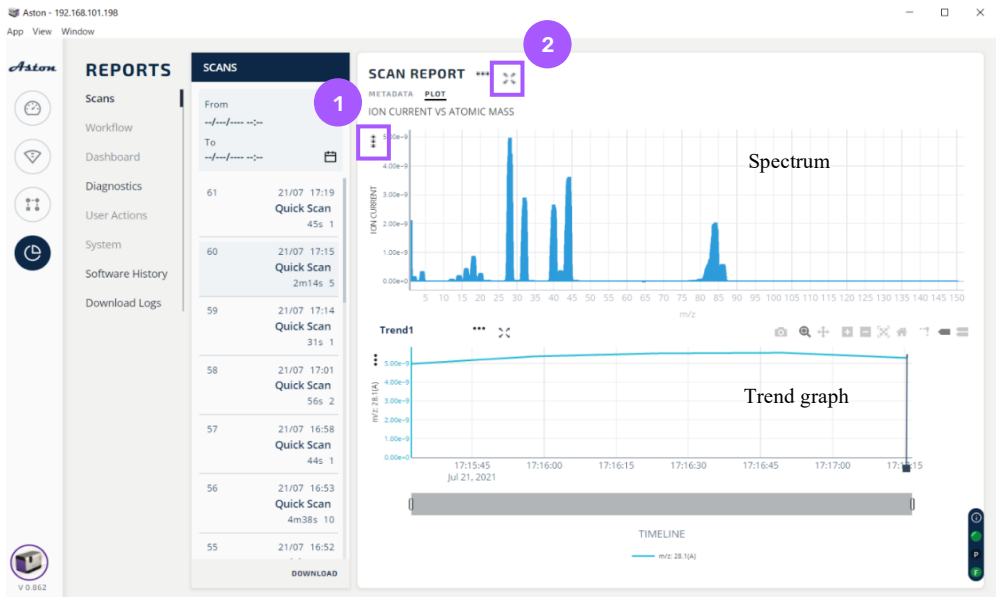
B. PLOT

Under PLOT, the user can view mass spectra as well as trend graph. The same display functions as those in the SCAN screen are available under PLOT.



B1 - Spectral analysis

Changes to the display can be made by clicking on various icons as shown below.



1 Click on to make ⋮ available the various plot display options.

Chart Types

1. Scatter with smooth lines
2. Scatter with straight lines and markers
3. Bar graph
4. Scatter

Y-axis Scale

5. Relative value: Vertical (Y-axis) Linear display
6. Absolute value: Vertical (Y-axis) Log display

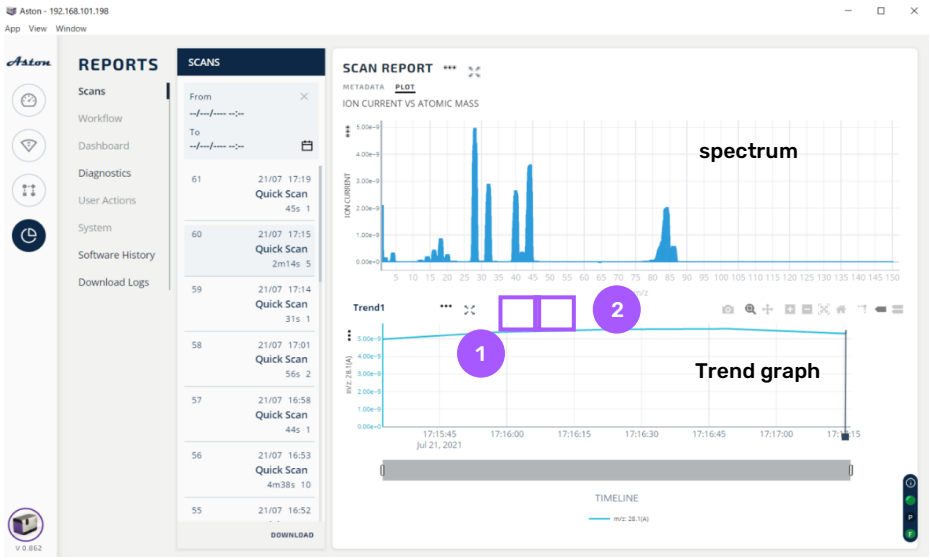
Y-axis Units

7. Relative Scale: Vertical axis (Y axis) Normalized (100%) display to the most abundant peak.
8. Logarithmic Scale: Vertical (Y-axis) absolute strength

2 Click on to ⤧ zoom in on the spectrum.

B2 – Trend analysis

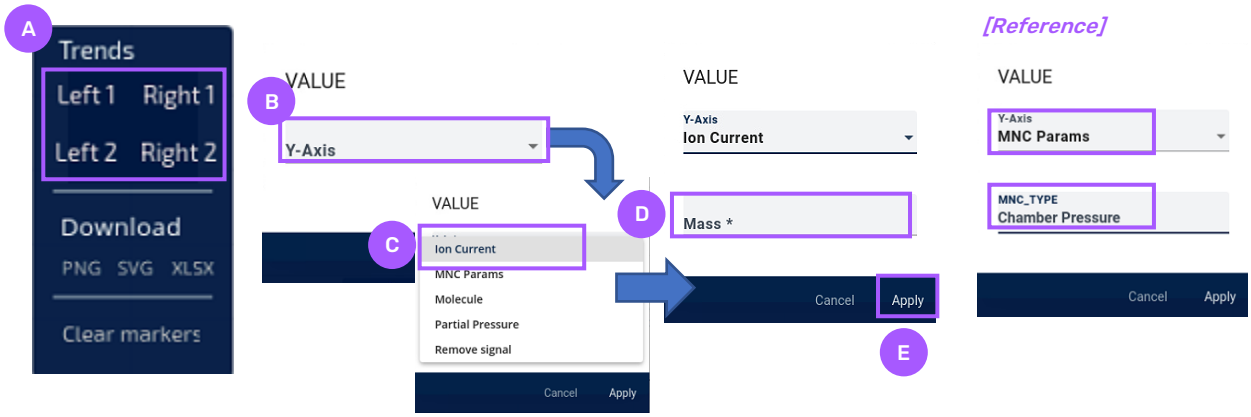
Changes to the display can be made by clicking on various icons.



By clicking on icon, *** changes to the time scale of the trend graph display can be made.

** Up to four (4) vertical axes can be selected (2 on the right and 2 on the left)*

** Given that four (4) trend graphs are available, up to sixteen (16) trends can be monitored.*



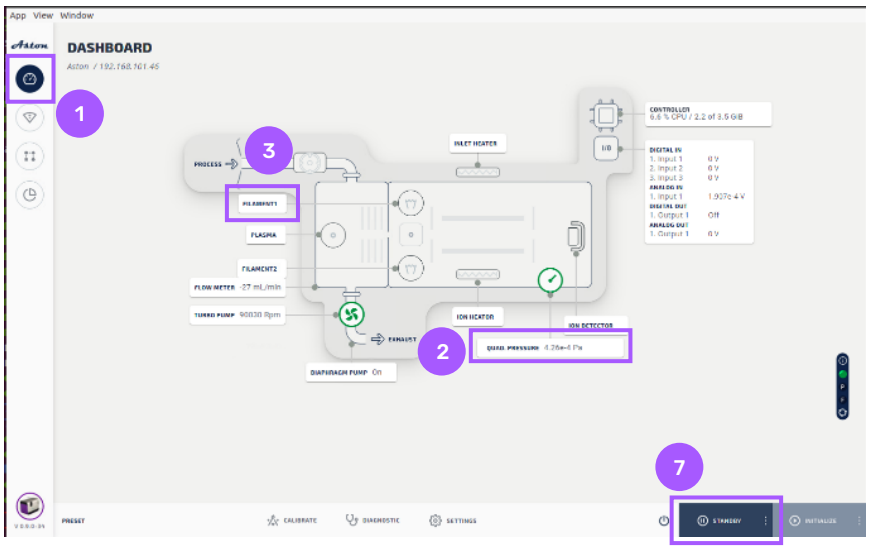
a. Select and click 1,2 on the right and 1,2 on the left (Left1,2, Right1,2).
b. A pull-down menu with choices of Y-axis variables opens.
c. Select Ion Current.
d. Fill in the desired m/z under Mass*.
e. Click Apply.
f. The trend trace of the selected ion with the specific m/z value is displayed.

** Other variables can be selected from the MMC Params pull down menu. Under Reference shown above, the Chamber Pressure from MNC_ TYPE is selected.*

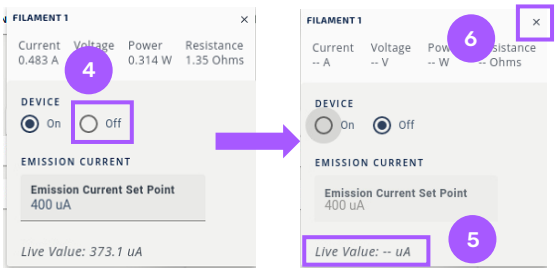
CHAPTER 6 - ASTON IN STANDBY

To set Aston on standby:

1. Select the DASHBOARD icon
2. Close the inlet valve of the sampling system and monitor the internal pressure via QUAD PRESSURE.



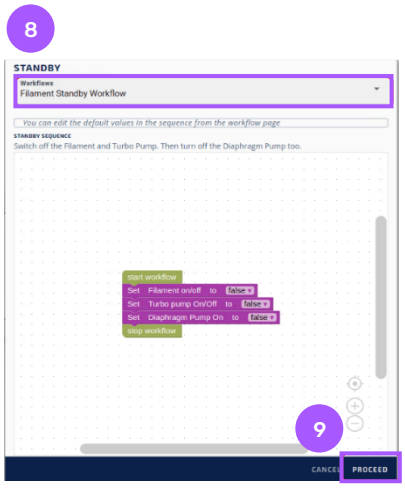
3. Click on the FILAMENT emission value.
4. Turn FILAMENT OFF.
5. When the filament is OFF, the actual emission value is close to 0 µA.
6. Close the screen with X in the upper right corner of the screen.

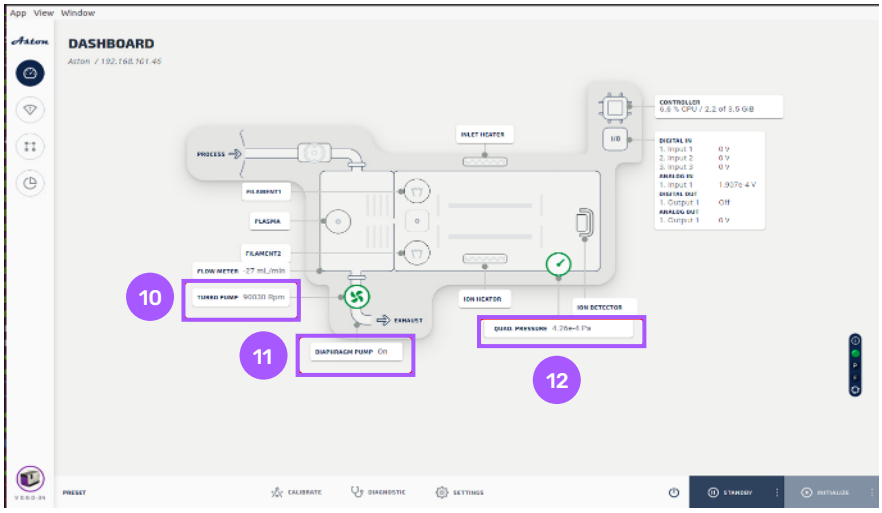


7. Click on STANDBY at the bottom right of the screen.
8. From the Workflows pull-down menu, select Filament Standby Workflow.
9. Click on PROCEED.

** The typical Standby Workflow shown here turns off filaments, turbomolecular pumps, and diaphragm pumps.*

** Filament Standby Workflow recipe is user settable and can be changed by the user to satisfy the intended application.*



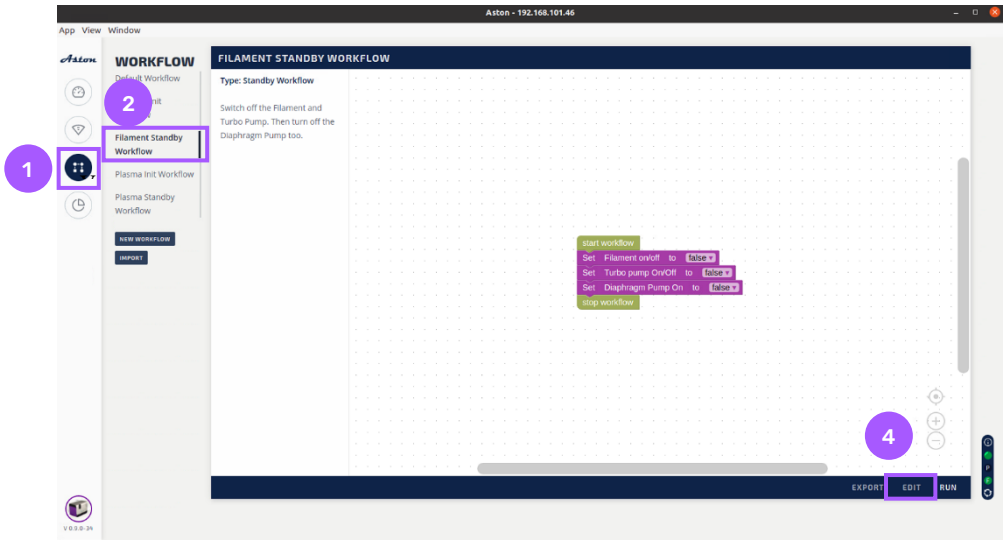


10. Verify that the TURBO SPEED decreases to 0 RPM.
11. The DIAPHRAGM PUMP status should be OFF.
12. The QUAD PRESSURE should be increasing.
13. Click X in the top right corner of the screen to close the AtonLab user interface.
14. Turn off the POWER SWITCH on ASTON.
15. Turn off the power of the PC.
16. If necessary, remove electrical, communication cables and pneumatic connections.

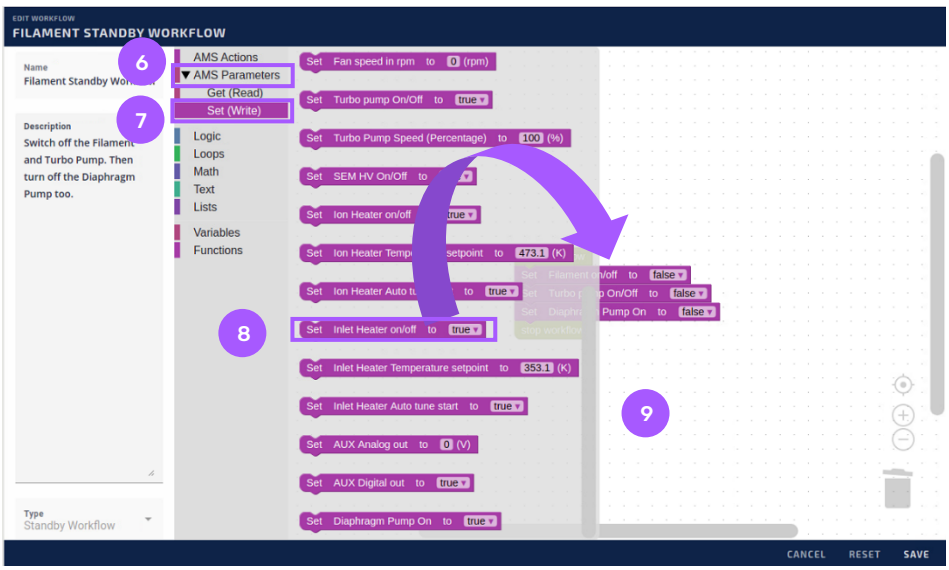
CHAPTER 7 – SETTING UP WORKFLOWS

Aston Workflows represent a series of actions assembled in the form of recipes. Such recipes can be built by creating already available steps in the Workflow editor. The operation resembles completing a puzzle. For example, a typical Filament Standby Workflow (which can be modified by the customer depending on the application) can be accessed by performing the following steps:

1. Select the WORKFLOW icon
2. Click on Filament Standby Workflow.
3. The contents of the Filament Standby Workflow are displayed.

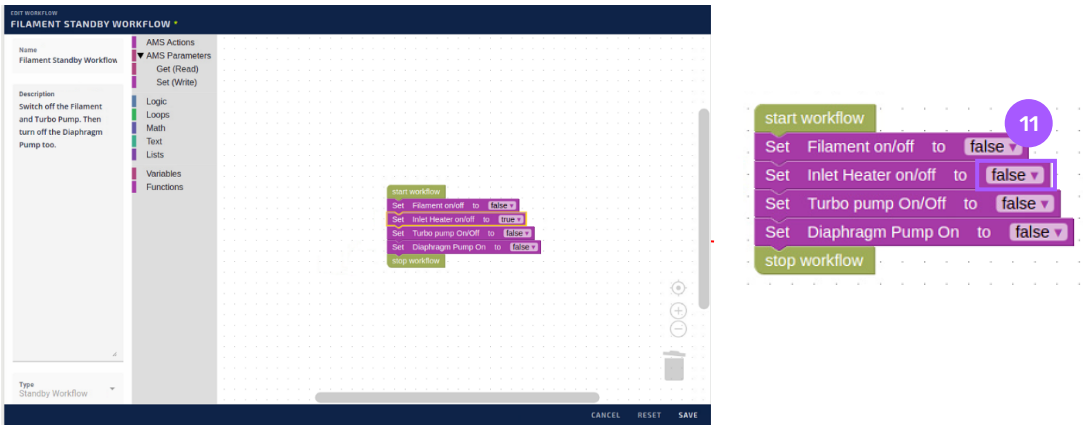


4. Select Edit.
5. The Workflow edit screen opens.
6. Click AMS Parameters.
7. Click Set (Write).



8. Lower the scrollbar on the right to display the INLET HEATER ON/OFF items.

9. Drag the INLET HEATER ON/OFF to the workflow as shown below.



10. INLET HEATER ON/OFF to be false.

true: ON.
false: OFF

11. The same steps (7 through 11) could be followed using the ION HEATER ON/OFF if required by the user.

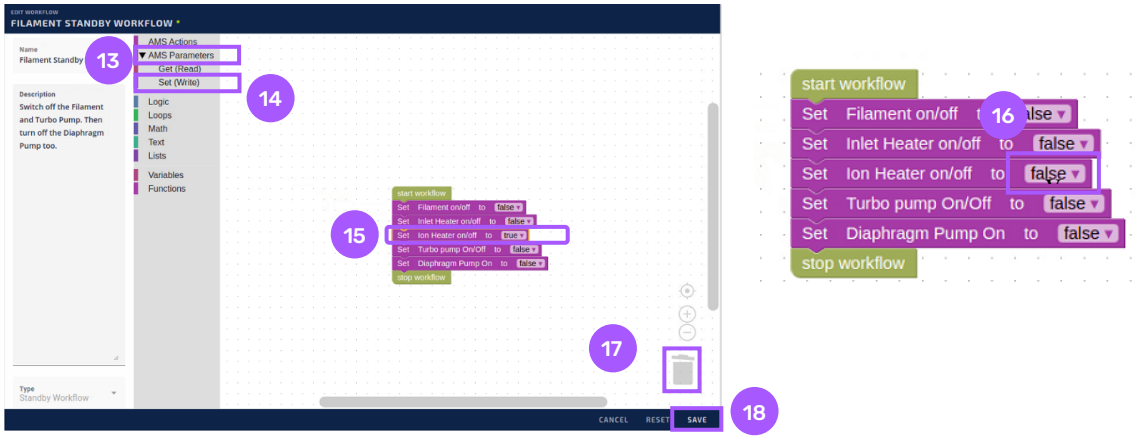
12. Click Set (Write).

13. Lower the scrollbar on the right to display the ION HEATER ON/OFF item.

14. Drag ION HEATER ON/OFF to insert it behind the INLET HEATER ON/OFF item.

15. ION HEATER ON/OFF to be false.

true: ON
false: OFF



16. Workflow items can be removed by selecting and pressing Delete on the keyboard, or by dragging it into the Recycle Bin at the bottom right.

17. Click Save to save the Workflow.

18. Editing and modifying the Filament Standby Workflow is now complete.

** Creating new Workflow and editing/modifying existing ones can be accomplished using steps that are like the one shown in the example above.*

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