EVG 510 Wafer Bonder User Manual

Version of 2024-10-02.

1. Introduction

This manual explains how to operate the EVG 510 equipment to bond a stack of two wafers together, using standard bonding methods such as anodic, direct, or adhesive bonding.

The EVG 510 bonding system capabilities are:

- Max. tool force 10kN.
- Max. temperature 550 °C.
- Chamber vacuum < 1E-04 mbar.
- Max. voltage (anodic bonding) 1000V.

2. Login on CAE

Login with your “CMi” username and password on the Zone 06 CAE accounting computer.

Select the “EVG 510 Wafer bonder”.

3. Check the configuration

Several parts in the bonding chamber, such as the bond chuck and pressure insert, are designed differently (and have different part number) depending on the bonding method and the wafer diameter.

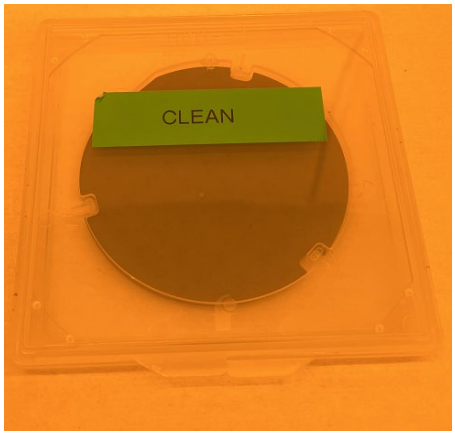
The parts will be exchanged by the CMi staff based on the user’s configuration request in the equipment booking system.

This will guarantee an optimal process stability and reduce cross-contamination between different processes.

The three configurations are:

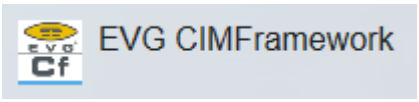
CLEAN	Direct or thermo-compression bonding
ANODIC	Anodic bonding
DIRTY	Adhesive, eutectic, glass frit bonding

Before starting, the operator should check that the configuration has been correctly changed by looking at the label on the plastic box on the EVG 510 desk.



4. Bonding recipe edition

Note: The EVG bonding tools (bonder, plasma activation equipment and cleaner) are using a unified GUI program platform called EVG CIMFramework.



The tool operation will be very similar on all tools.

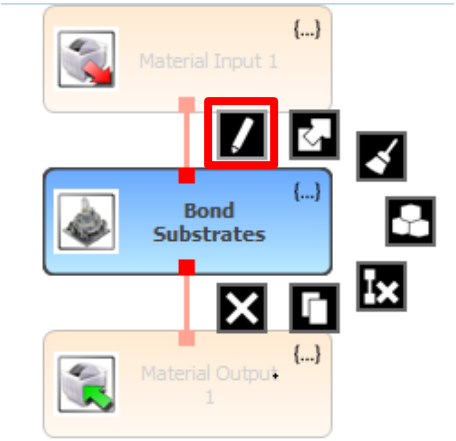
At the bottom of the user interface, different tabs are available, but only “Jobs”, “Modules” and “Recipes” will be useful to operators.

The operator can access the recipe management interface by clicking on **“Recipes”.**

Recipes are stored in laboratory/group-specific folders. They can be edited, exported, moved, renamed, deleted…

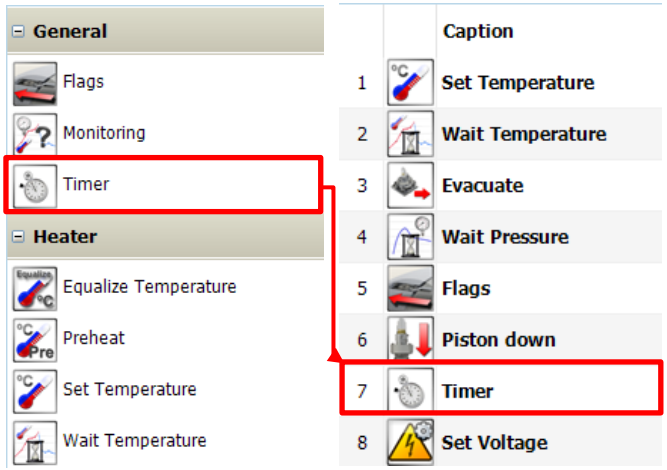
To edit a specific recipe, double-click on it. The recipe will first appear in a sequence-like structure, with three steps: 1) Material Input, **2) Bond Substrates,** 3) Material Output. The input and

output options are only used on EVG systems with an automatic robot loading/unloading interface and it can be ignored in our system.



Right-click on “Bond Substrates” and then on

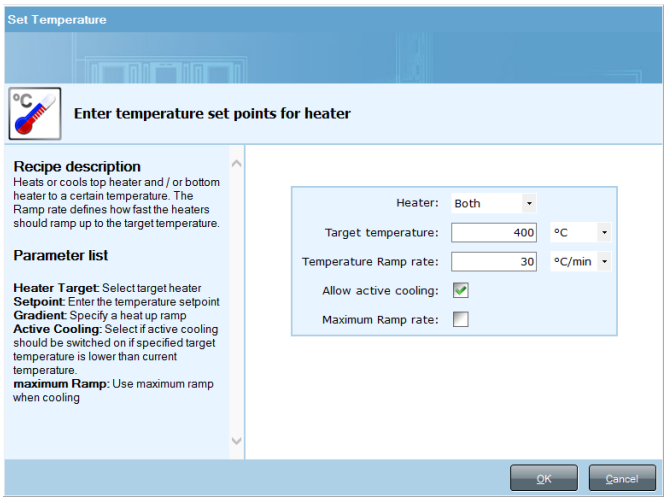
The recipe will be shown as a series of steps with different actions, each action having a certain number of parameters. New actions, from the list on the left side of the UI, can be inserted in the sequence by a simple drag-and-drop procedure.



Actions are organized in the following categories:

- General: action to remove the spacers (flags) and insert timers into the sequence
- Heater: heating and cooling down functions for both pressure plates
- Piston: functions to apply the tool force on the stack of wafers
- Vacuumsystem: pumping, purge, vent functions
- Voltage: Used to apply a voltage bias between the two pressure plates (for anodic bonding)

The step parameters are modified by double-clicking on each step:



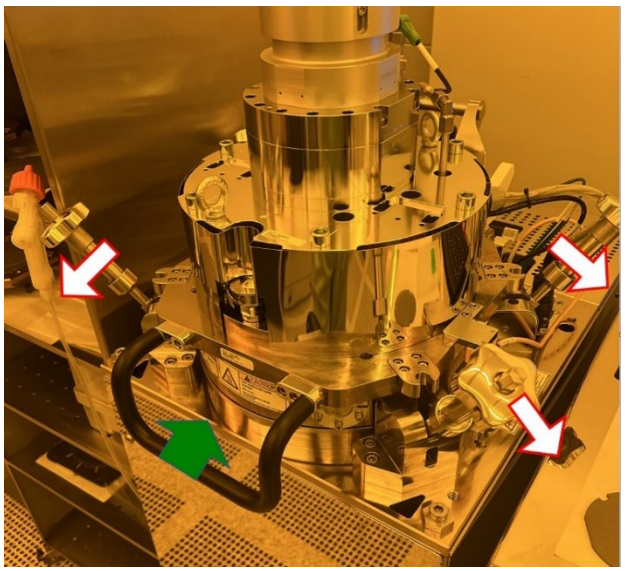
Operators of the EVG 510 are free to edit and save their own recipes (temperature, ramps, tool force, etc…) but it is generally recommended to discuss any changes with the staff.

After edition, it is possible to test the validity of the process with the following button:

An example of sequence (anodic bonding) is shown at the end of this guide.

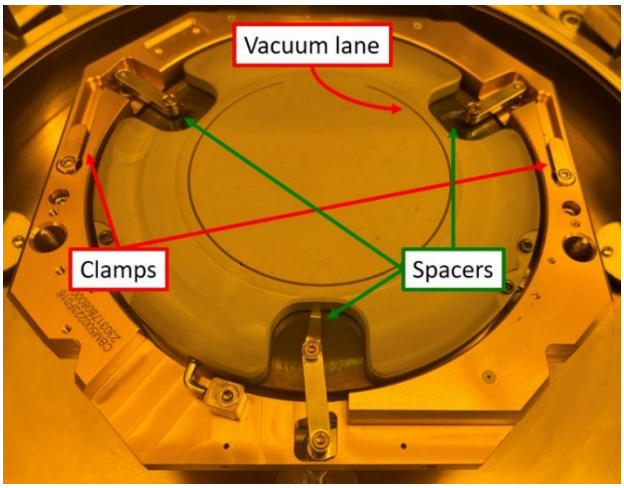
5. Preparing the bond fixture, step by step.

The operator should find the bond chamber closed when arriving to the tool. Unscrew and pull down the side clamps and lift the chamber cover with the handle.



The bond fixture should sit at the bottom side of the chamber.

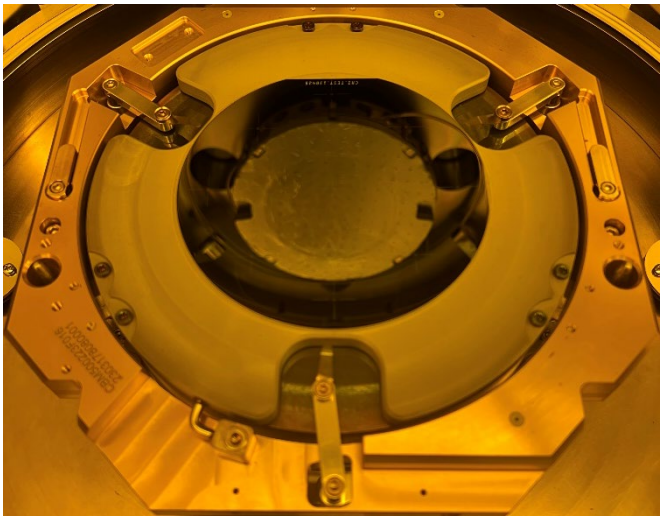
Note: The equipment is compatible with both 4inch and 6inch wafers but the following description & images are using the 4inch toolings.



There are two different scenarios for mounting the wafer stack on the fixture:

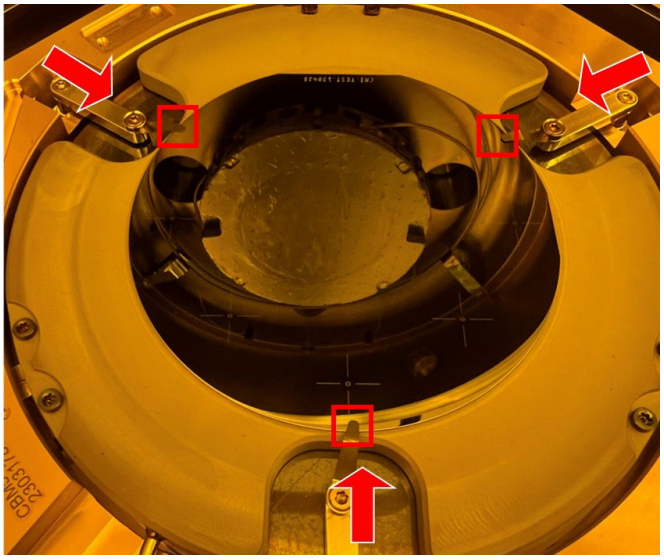
1. Fine alignment (down to < 2um accuracy) is needed between the two wafers: the fixture is transferred to the EVG 610 bond aligner. Check the EVG 610 user manual for details on the alignment operation.
2. Wafers do not need precise alignment, just flat to flat positioning. In that case, the two wafers are either already pre-bonded in the EVG 301 cleaner IR station or they are still separated from each other. Then follow the next steps:

If the wafers are not pre-bonded, they will be loaded one after the other, with the possibility to insert spacers.



Step 1: Load wafer 1 with bond-side facing UP. The flat is positioned to the north direction (vacuum lane gap), as shown in the image above.

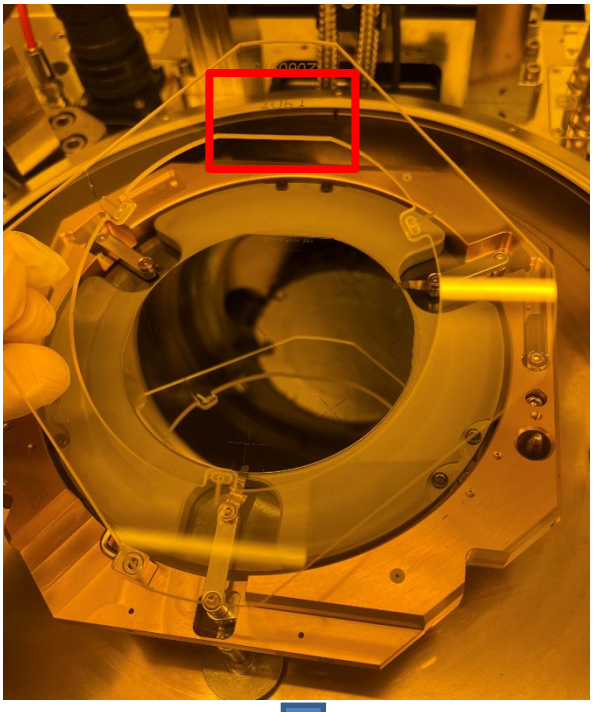
Step 2 (optional): Push all three spacers in, on top of the wafer surface.

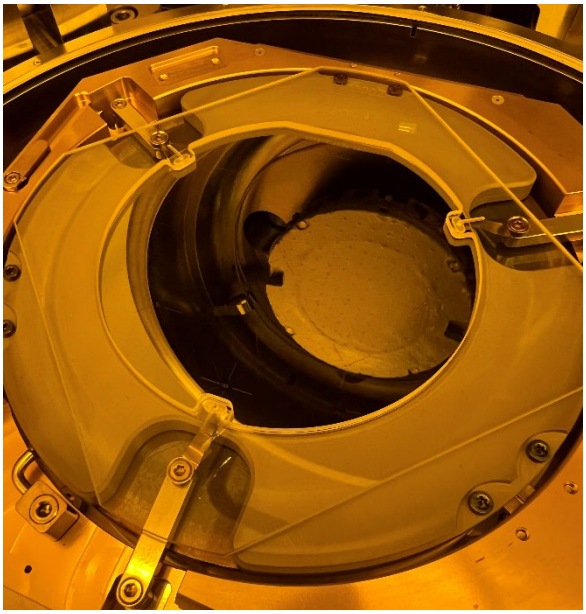


Step 3: Load wafer 2 with bond-side facing DOWN. Align the wafers flat-to-flat as best as possible.

Step 4: Load the quartz plate (used for clamping) on top of both wafers. Align the quartz plate flat to the stack of wafers.

Warning: The "TOP" text near the flat of the quartz plate should be inverted and not be readable (TOP should be on the glass bottom-side)

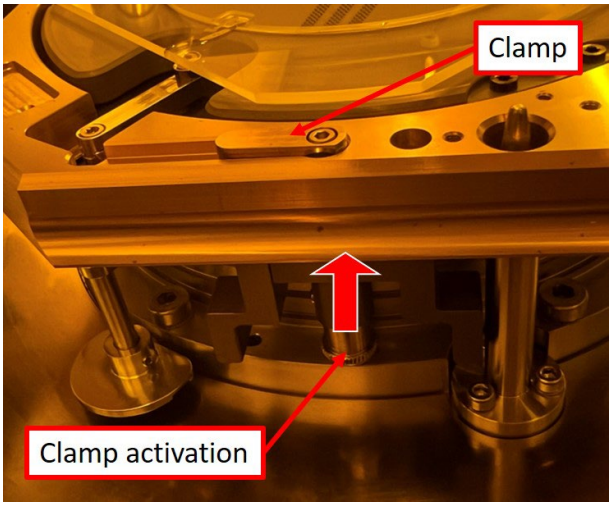




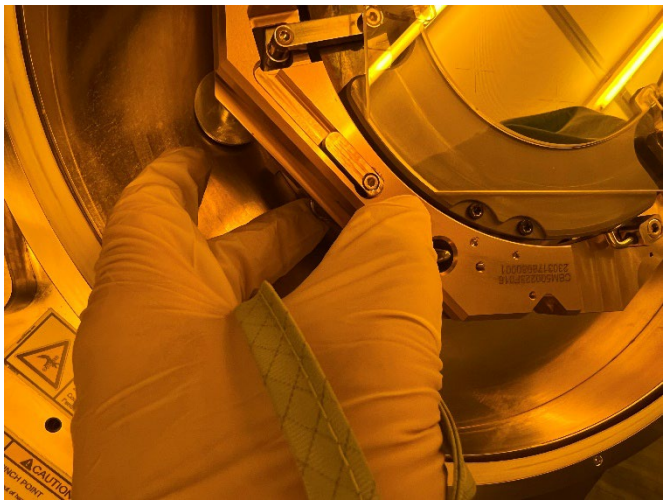
Step 5: Insert the clamps.

!This step is the most difficult one since the clamps need to be inserted in and down on both sides, at the same time, without moving the stack of wafers + quartz plate!

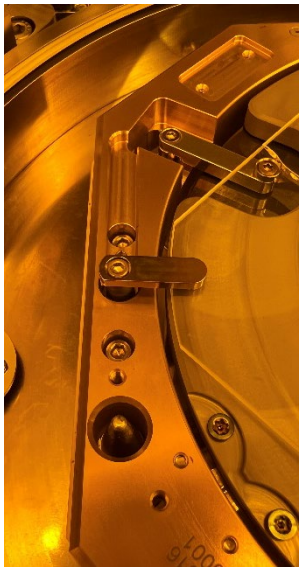
Here is the view of the clamp activation mechanism from the side:

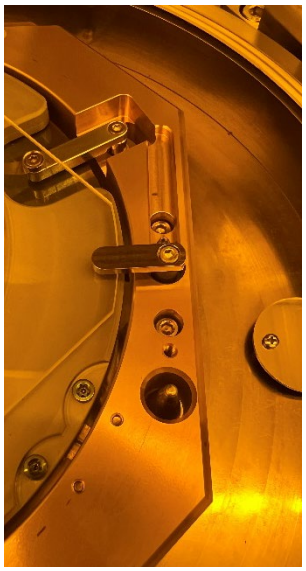


Here is a recommendation on how to place your hand and to maintain the fixture with the thumb in order to keep the whole stack stable, while rotating the clamp:



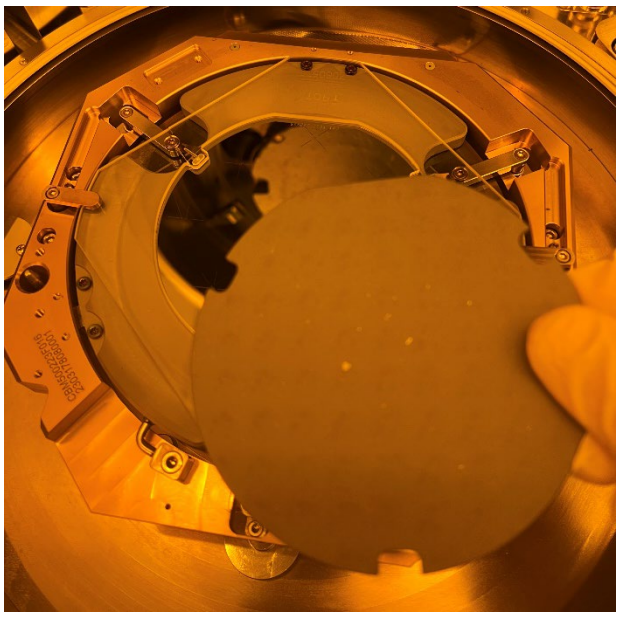
Here is the view (left and right) with clamps in, on top of the quartz plate:



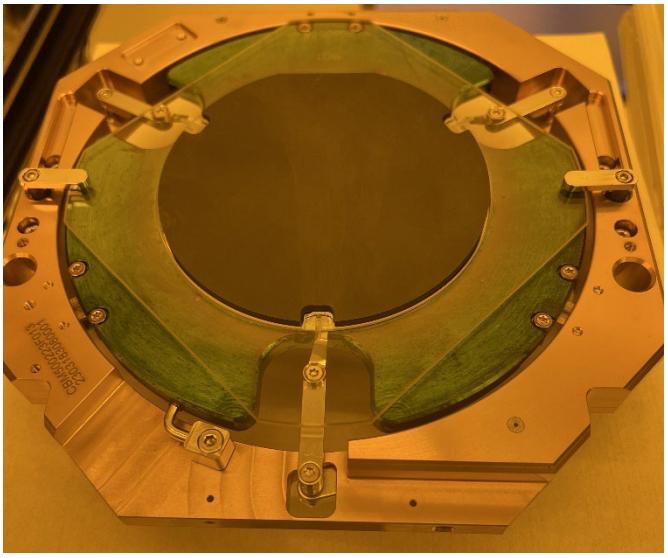


Step 6: Insert the top pressure disk.

The pressure disk fits perfectly into the quartz plate opening.

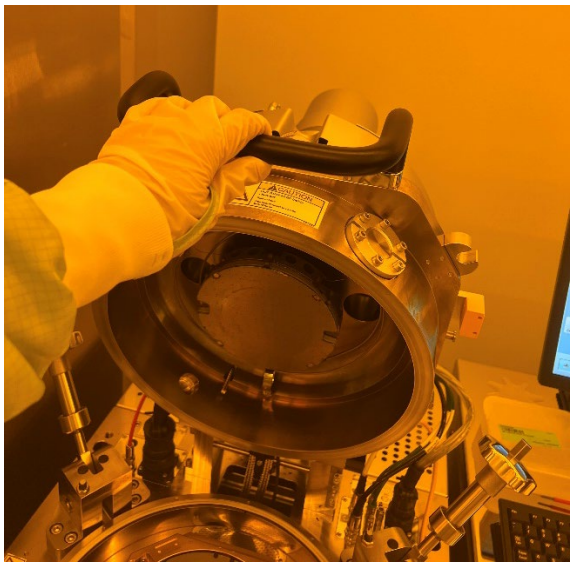


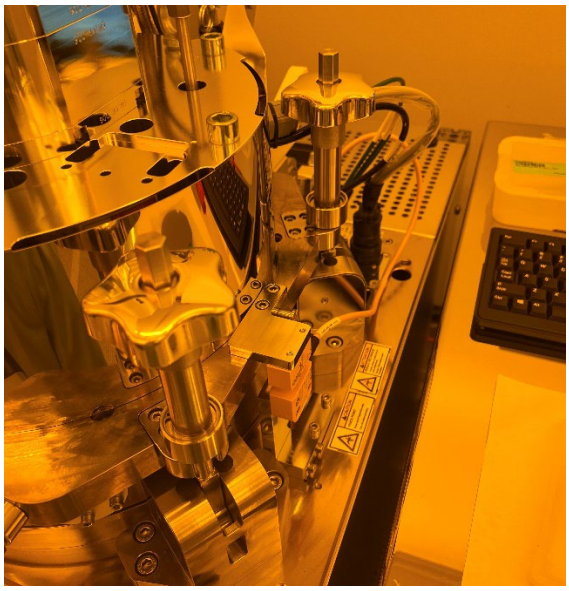
Finally, the stack is ready for bonding:



Step 7: Close and lock the bond chamber.

Use the handle to close the chamber and lock the four side clamping screws.

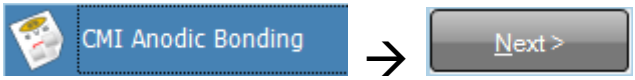




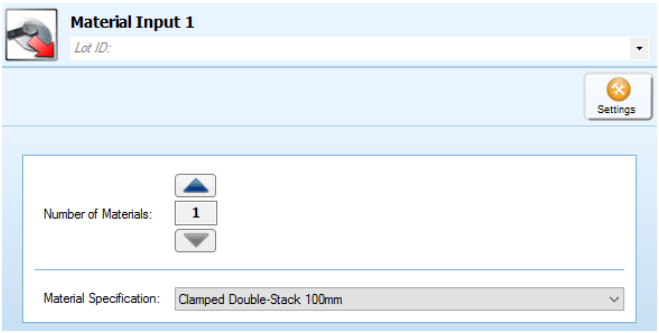
6. Starting and monitoring the job.

The bonding process is started from the “Jobs” tab by clicking on:

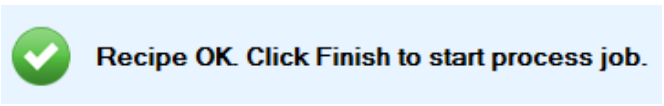
Find your recipe in your unit’s folder, select it and press “Next”



Then, select the number of materials and wafer stack, which means the number of times the bonding sequence will be ran (usually one time with one double-stack of 100mm wafers).

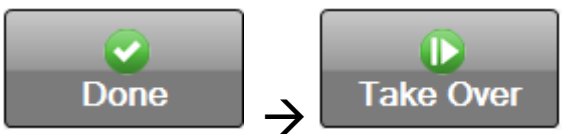


Proceed to the summary page by clicking on “Next”, and then “Finish” to start the job:



The UI will then ask you to “Insert Material” (load the fixture), which you may have already done by following the previous section of this manual.

Proceed with:



Monitoring the progress of the process through the steps can be done from the “Modules” tab. However, the EVG 510 uses a second software, called ***EVG Analytics*** to monitor the process in real time, as well as check log files from previous runs.

Hover your mouse to the EVG explorer icon and start EVG Analytics:

Once loaded, click on:

A list of jobs, organized by date, will be presented. The top one is the running live process.

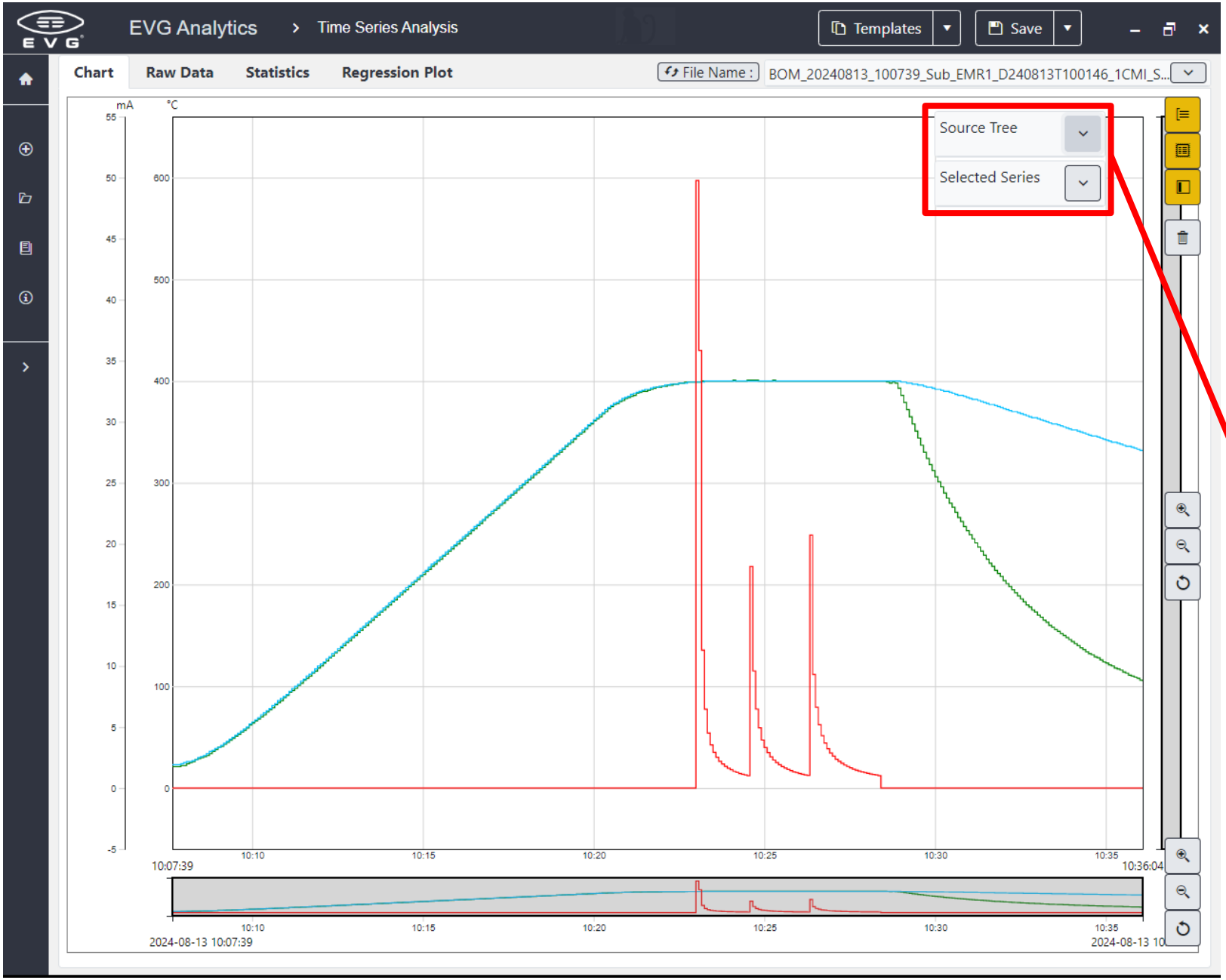
Select the job you want to display and click on:

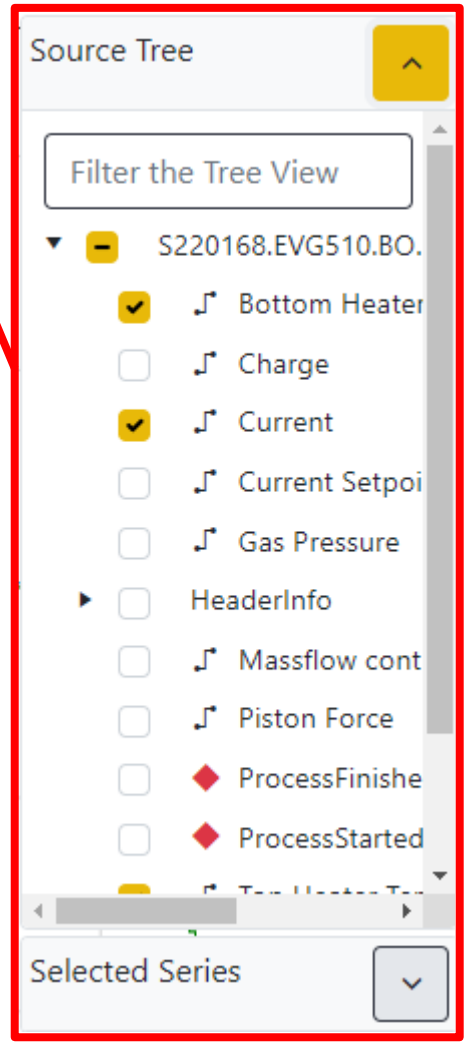
Two viewing options will be available:

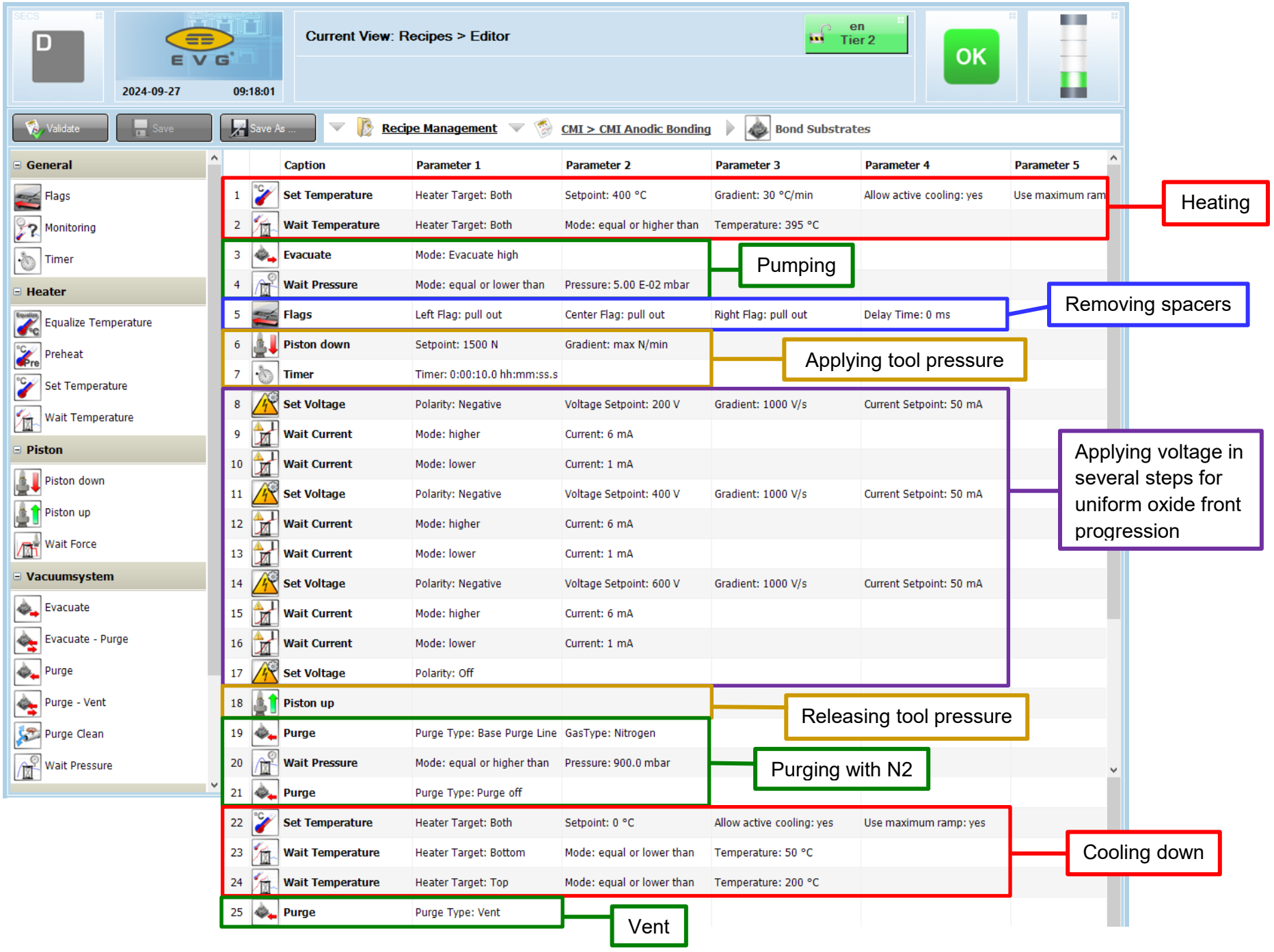
- Time Series Analysis: show a single recorder data set with multiple y-axes
- Time Series Comparison: show & compare a single parameter one multiple recorder data sets

The “Time Series Analysis” will be used most of the time, as it will allow to monitor multiple parameters on the same graph (temperature, current, tool pressure, etc…)

See next page for an image of the monitoring interface.


EVG Analytics
Time Series Analysis
Templates
Save
Chart
Raw Data
Statistics
Regression Plot
File Name :
BOM_20240813_100739_Sub_EMR1_D240813T100146_1CMI_S...
mA
°C
Source Tree
Selected Series
10:07:39
10:36:04
2024-08-13 10:07:39


Source Tree
Filter the Tree View
S220168.EVG510.BO.
Bottom Heater
Charge
Current
Current Setpoi
Gas Pressure
HeaderInfo
Massflow cont
Piston Force
ProcessFinishe
ProcessStarted
Selected Series


Current View: Recipes > Editor
en Tier 2
OK
2024-09-27 09:18:01
Validate
Save
Save As ...
Recipe Management
CMI > CMI Anodic Bonding
Bond Substrates
General
Flags
Monitoring
Timer
Heater
Equalize Temperature
Preheat
Set Temperature
Wait Temperature
Piston
Piston down
Piston up
Wait Force
Vacuumsystem
Evacuate
Evacuate - Purge
Purge
Purge - Vent
Purge Clean
Wait Pressure
Caption | Parameter 1 | Parameter 2 | Parameter 3 | Parameter 4 | Parameter 5
1 Set Temperature | Heater Target: Both | Setpoint: 400 °C | Gradient: 30 °C/min | Allow active cooling: yes | Use maximum ram
2 Wait Temperature | Heater Target: Both | Mode: equal or higher than | Temperature: 395 °C
3 Evacuate | Mode: Evacuate high
4 Wait Pressure | Mode: equal or lower than | Pressure: 5.00 E-02 mbar
5 Flags | Left Flag: pull out | Center Flag: pull out | Right Flag: pull out | Delay Time: 0 ms
6 Piston down | Setpoint: 1500 N | Gradient: max N/min
7 Timer | Timer: 0:00:10.0 hh:mm:ss.s
8 Set Voltage | Polarity: Negative | Voltage Setpoint: 200 V | Gradient: 1000 V/s | Current Setpoint: 50 mA
9 Wait Current | Mode: higher | Current: 6 mA
10 Wait Current | Mode: lower | Current: 1 mA
11 Set Voltage | Polarity: Negative | Voltage Setpoint: 400 V | Gradient: 1000 V/s | Current Setpoint: 50 mA
12 Wait Current | Mode: higher | Current: 6 mA
13 Wait Current | Mode: lower | Current: 1 mA
14 Set Voltage | Polarity: Negative | Voltage Setpoint: 600 V | Gradient: 1000 V/s | Current Setpoint: 50 mA
15 Wait Current | Mode: higher | Current: 6 mA
16 Wait Current | Mode: lower | Current: 1 mA
17 Set Voltage | Polarity: Off
18 Piston up
19 Purge | Purge Type: Base Purge Line | GasType: Nitrogen
20 Wait Pressure | Mode: equal or higher than | Pressure: 900.0 mbar
21 Purge | Purge Type: Purge off
22 Set Temperature | Heater Target: Both | Setpoint: 0 °C | Allow active cooling: yes | Use maximum ramp: yes
23 Wait Temperature | Heater Target: Bottom | Mode: equal or lower than | Temperature: 50 °C
24 Wait Temperature | Heater Target: Top | Mode: equal or lower than | Temperature: 200 °C
25 Purge | Purge Type: Vent
Heating
Pumping
Removing spacers
Applying tool pressure
Applying voltage in several steps for uniform oxide front progression
Releasing tool pressure
Purging with N2
Cooling down
Vent