Operator Manuals

Interlock List

Start Up

Recipe Programming

Process Description

Recorder Software

PM-Manual

Interlock List

Customer Support Documentation
EVG520IS / EVG520HE

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1 Interlock List

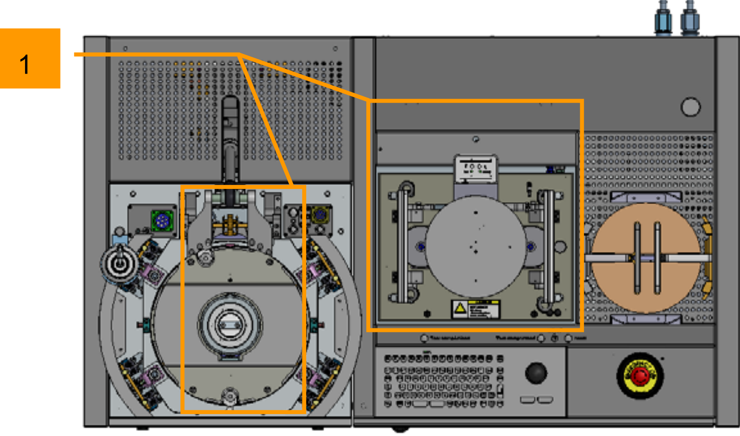

Figure 1 - Top View

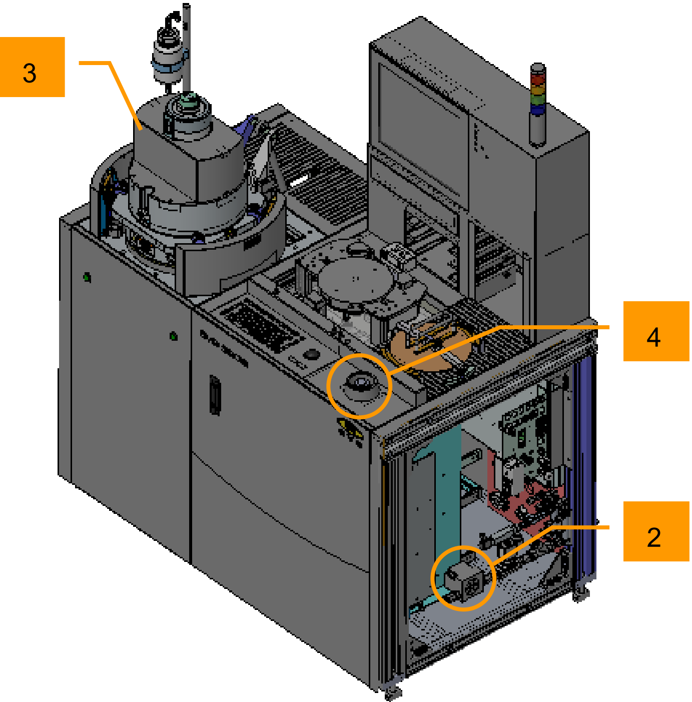

Figure 2 - Isometric View

1	Leak Sensor
2	Water Flow Sensor
3	Over temperature Sensors
4	EMO Button

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1.1 Leak Sensor

Below the cooling station and the bond chamber there is a tray with a liquid sensor. If liquid reaches the sensor the system shuts down.

Sensor:

Liquid level switch SK1-8-M12-P-nb-Ö-PTFE

Figure 3 - Leak Sensor

Function:

If liquid reaches the sensor the machine shuts down.

Recovery Procedure:

1) It is necessary to fix the leak.
2) Restart the whole system.
3) Perform an automatic clean up (if available).
4) Start a new process.

Location:

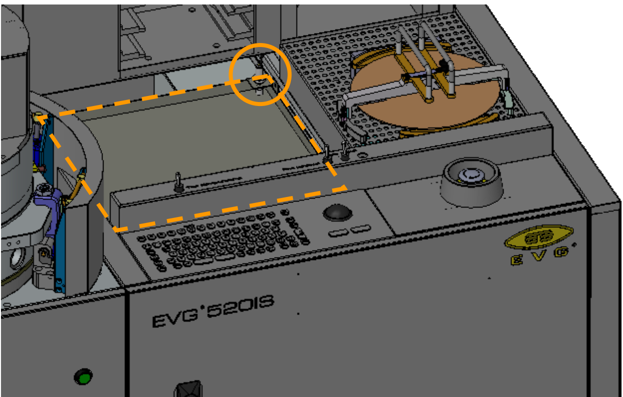

Figure 4 - Leak Sensor

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1.2 Water Flow Sensor

The water flow sensor checks the general water flow.

Sensor:

Flow Meter 150C 24VDC

Figure 5 - Flow Meter 100CT 24VDC

Function:

If the water flow is to low the top and bottom heaters shut down after 120 sec.

Recovery Procedure:

1) Check the water flow.
2) Start a new process.

Location:

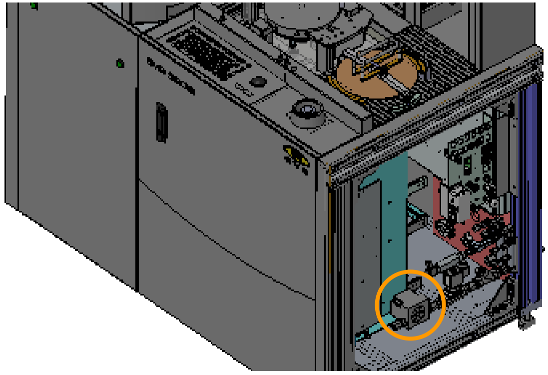

Figure 6 - Water Flow Sensor

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1.3 Over Temperature Sensor

The over temperature sensor checks the temperature of the heaters.

1.3.1 Over Temperature Sensor in the Electronic Rack (3a)

Sensor:
Temperature Limiter TB45

Function:
If the temperature is higher than 650°C the chamber will be disabled.

Recovery Procedure:

1) Reset the temperature limiter TB45.
2) Enable the chamber.
3) Check the heating and start a new process.

This failure occurs only when there is a problem with the hardware. In this case call EV Group!

1.3.2 Over Temperature Sensor at the Bond Cover (3b)

Sensor:
Temperature Limiter R22A214 (marked with “a” in picture below)

Function:
If the temperature is higher than 63°C the station will be disabled.

Recovery Procedure
Permit a cool down and check the cover cooling (cooling chuck marked with “b” in picture above). Enable the station and start a new process.

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Location:

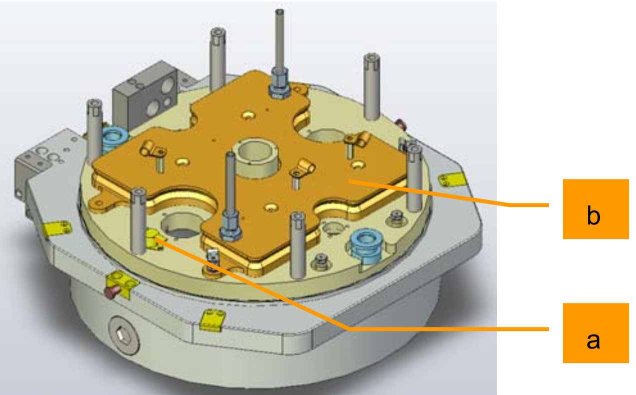

Figure 7 –Bond cover

There is another over-temperature sensor (“Temperature switch E21 125°C nc”; marked with “c” in the picture below) on the bottom side of the bond cover.

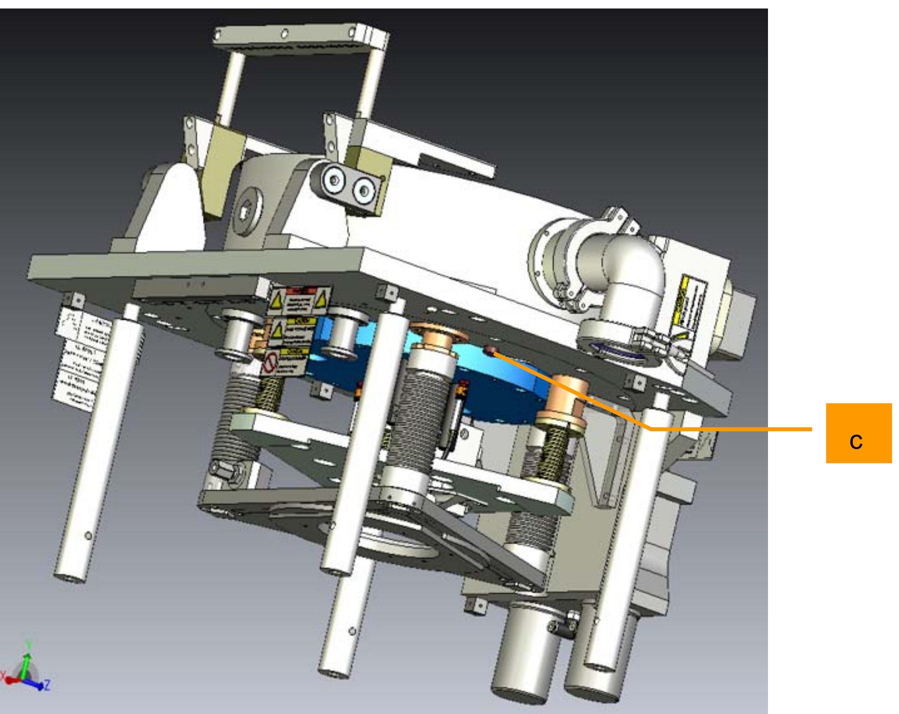

Figure 8 - Bottom side of the bond cover

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1.4 EMO Button

The Emergency OFF Button (EMO Button) shuts down the system immediately.

Switch:

Emergency off switch

Figure 9 - EMO Button

Function:

In an emergency situation press the nearest EMO Button on the system. Emergency situations are situations where injury of personnel or serious damages of the system impends immediately.

Recovery Procedure:

In order to operate the system again it has to be restarted:

1) Release the EMO button (turn clockwise).
2) Start up the system.
3) Perform an automatic clean up (if available).
4) Start a new process.

Location:

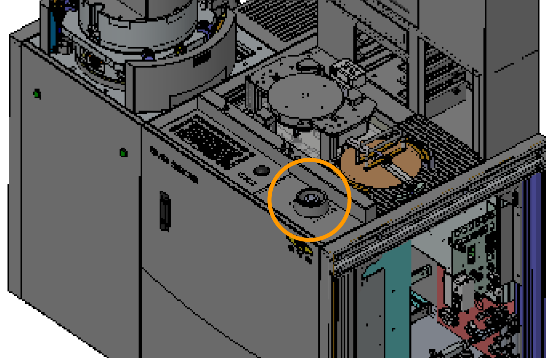

Figure 10 - EMO Button

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2 Circuit Diagrams

The following figure shows an example electronic drawing of an interlock connection:

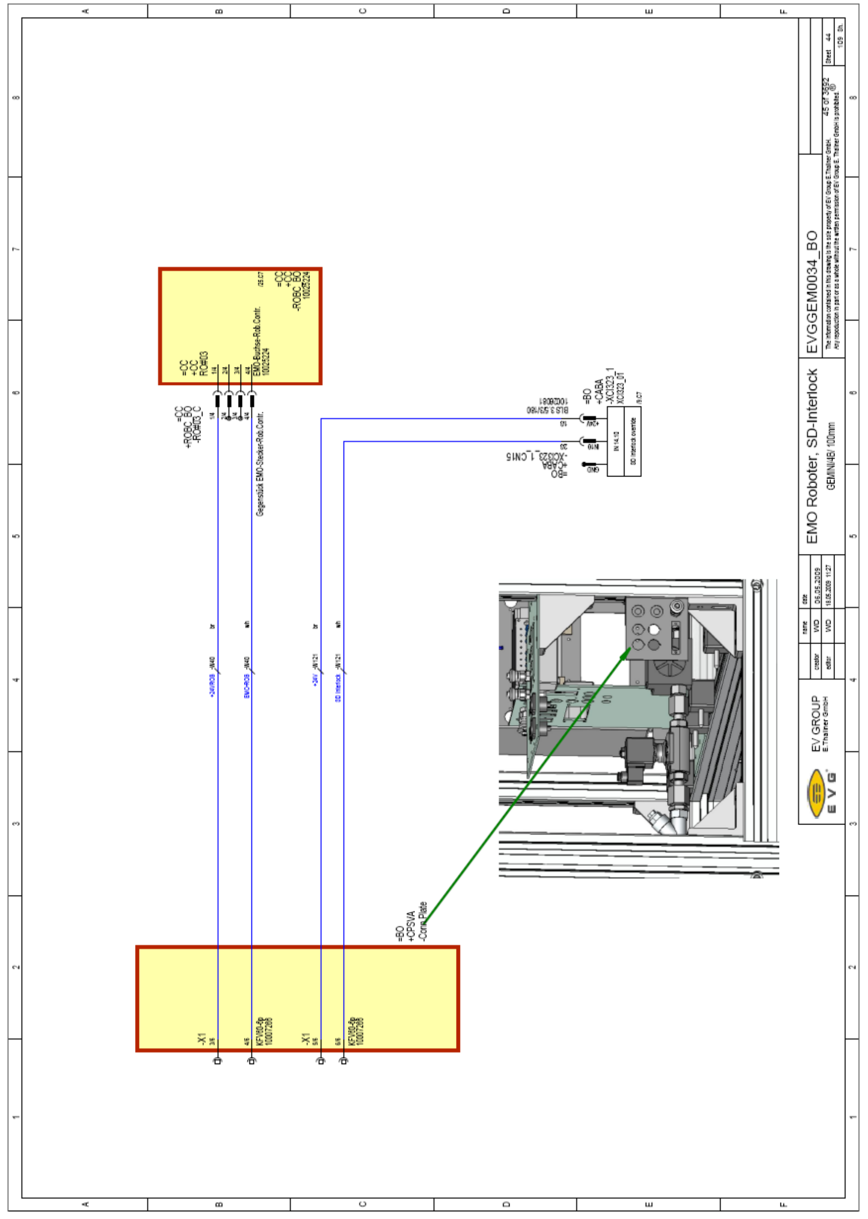

Figure 11 - Electronic Drawing (EMO Robot, Safety Door Interlock)

Note: This is an example circuit diagram. Refer to “Technical Documentation” / “Electronic Drawings” to find all circuit diagrams of the system.

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History

Date	Modification	by
2007-10-02	First written with GCA	HMA
2010-04-06	Formatted and updated	WAA

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Start Up and GUI

Customer Support Documentation
EVG520 & EVG520IS

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1 Note to the User

Installation, adjustment, programming and maintenance (except periodical maintenance described in the manual) may only be done by qualified EVG service engineers.

For further deliveries please check immediately after unpacking that the consignment confirms to the information given on the packing list.

Read and understand the operating instructions before you operate the unit and follow them in all respects.

The equipment may only be operated by personal trained from EVG service engineers.

No liability will be accepted for personal injury nor material damages in the event that damage or breakdowns occur as a result of failure to comply with these operating instructions; neither will any guarantees relating to repairs to or replacements of our products apply.

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2 Safety

- The equipment represents state-of-the-art technology and optimum operationally reliable. The user may however be exposed to hazards if it is used improperly or for other than its intended purpose!
- If the equipment is used for any other than its intended purpose, all liability and warranty claims will lapse!
- All unauthorized modifications and alterations affecting the safety are prohibited!
- The use of self-made tools is not allowed in any case.
- Any use by unauthorized personnel or careless handling may increase the potential danger.
- If the media support specified from EVG is not fulfilled, the operational function of the equipment is not guaranteed.
- Always wear gloves during operating with the system.

- Avoid any contact with any liquid used in the system
- Wear Safetyglasses.

!! ATTENTION !!

Do not remove or change any safety facilities from the system.

3 System Description

Before working with the EVG System read and understand the General Safety Instructions.

Following Manual is written for Operator Login Level.

3.1 Short Description

“Chip-To-Wafer” (C2W) or “Wafer Level” (W2W) -bonding are key enabling process steps for the manufacturing of advanced chip scale devices. The inherent flexibility of these bonding and alignment techniques has allowed technology to advance to multilayer bonding schemes in which the bonding is part of the assembly as well as the packaging.

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3.2 System Layout

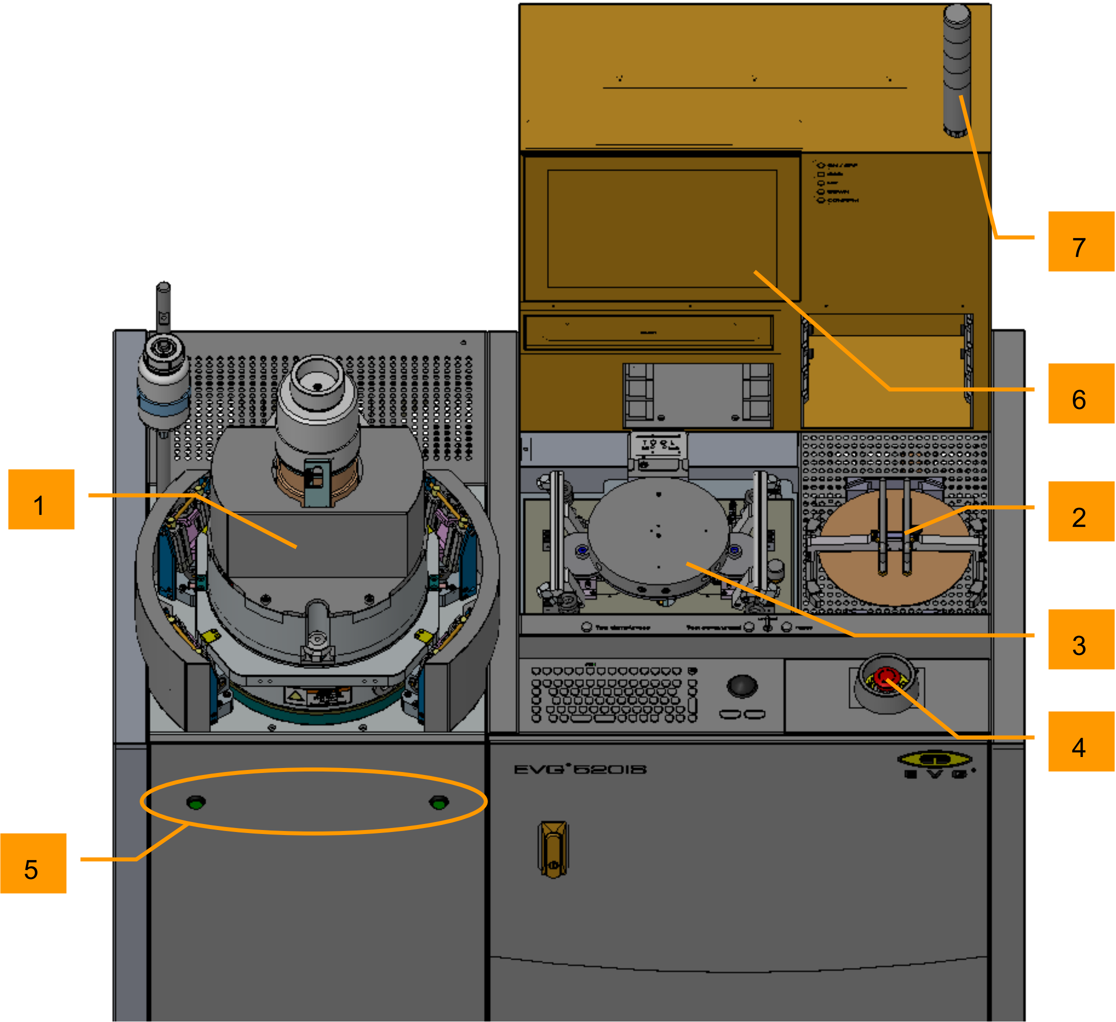

Figure 1 - System Layout

1	Bond module
2	Buffer/Loading station (if equipped)
3	Cooling station (if equipped)
4	EMO button
5	Cover open/close button (if equipped)
6	PC Monitor
7	Signal lights

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3.3 Safety

3.3.1 Safety Interlocks

Refer to “Interlock List” for a detailed description about the location and functionality of all safety interlocks on the system.

3.3.2 Emergency OFF Button (EMO Button)

The Emergency OFF Button (EMO button) shuts down the system immediately. To operate the tool again it has to be restarted (see chapter “System Startup”).

Only use the EMO in emergency situations. Emergency situations are situations where injury of personnel or serious damages of the system impends immediately.

Location:

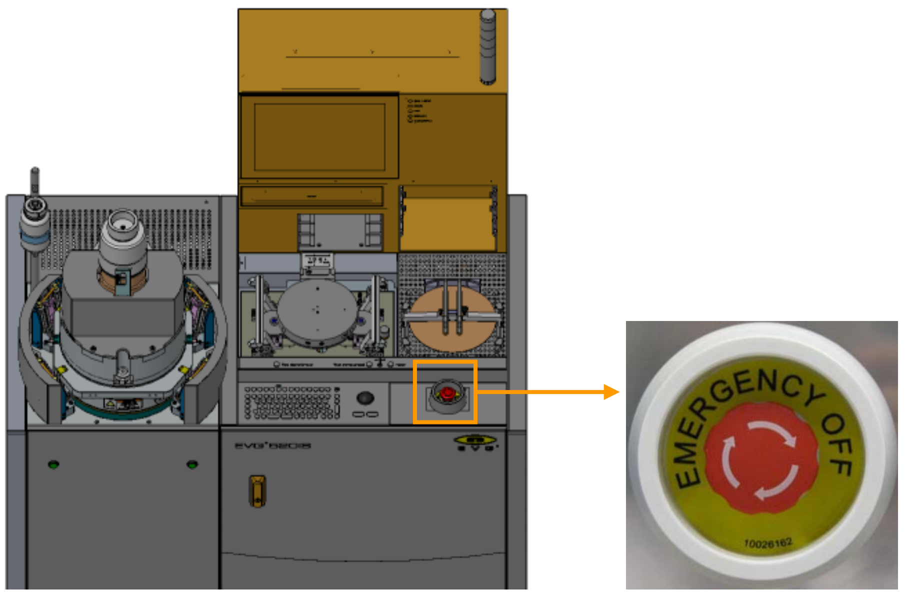

Figure 2 - EMO Button

3.3.3 Start Heating – Heating not Possible

When the temperature of the heating cartridge ground plate reaches more than 80°C an error message occurs (“Heating not possible”) and the heaters shut off immediately.

Recovery Procedure:

Permit a cool down and restart the process.

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3.3.4 Safety Switches in the Clamps of the Cover (if equipped)

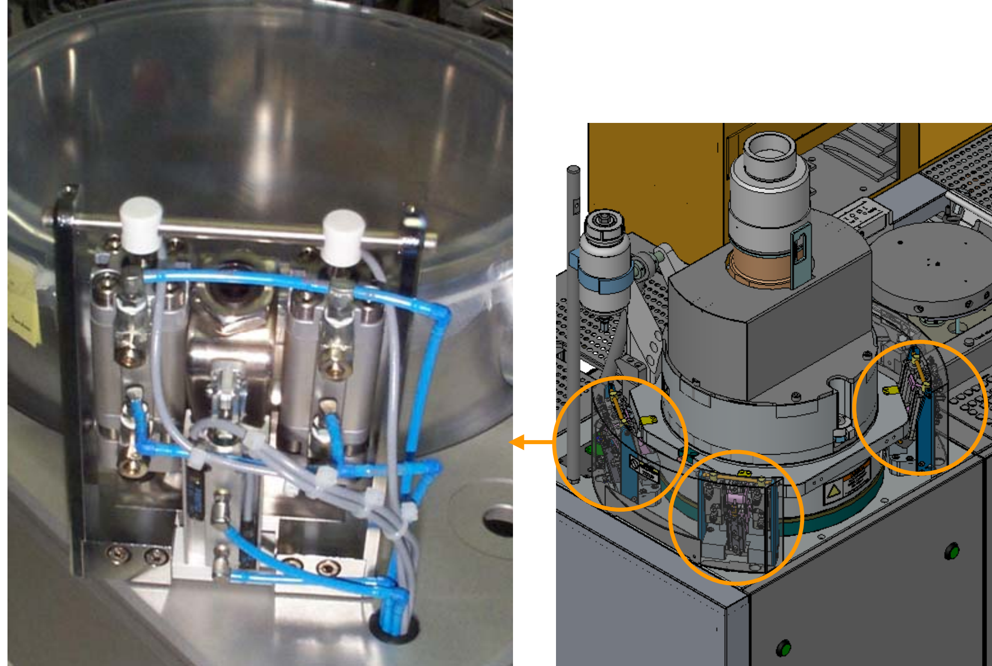

Figure 3 - Cover Clamp

If the four cover clamps are not closed properly when trying to start a process, an error message will occur (“Cover not locked. Not possible to start process!”). Open the cover again and check the stack height (16mm). Close the cover and try to restart the process.

3.3.5 Open/Close Chamber ("Cover Service")

3.3.5.1 Request Cover Service

In process view click on the bond chamber, go to "Cover Service" and click on "Request Cover Service":

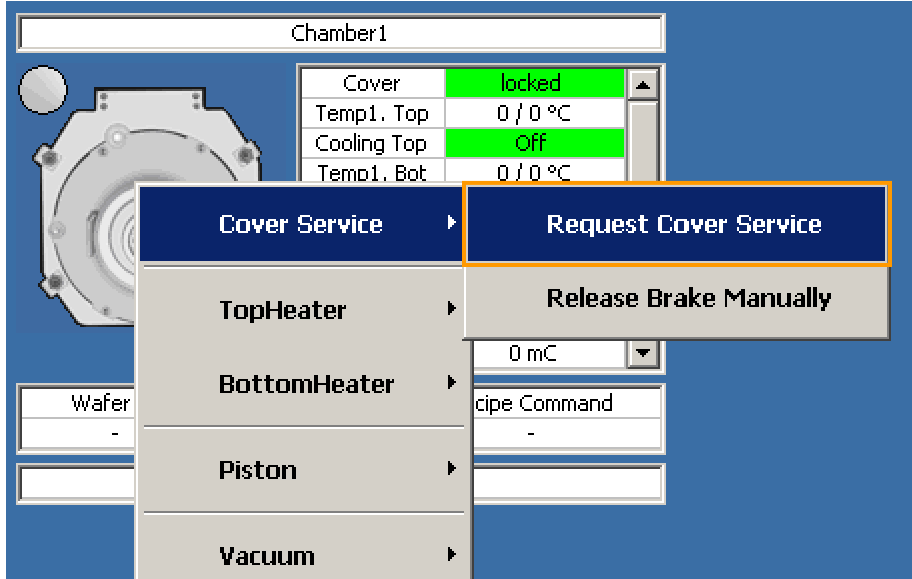

Figure 4 - Request Cover Service

Confirm the following message box by clicking on "OK":

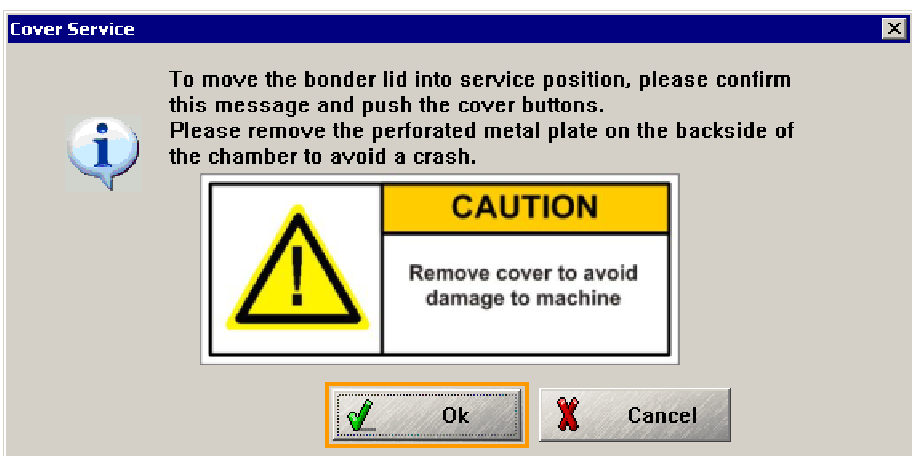

Figure 5 - Request Cover Service

Caution: Remove cover to avoid damage to machine!

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Press both “Cover Open / Close” buttons at same time.

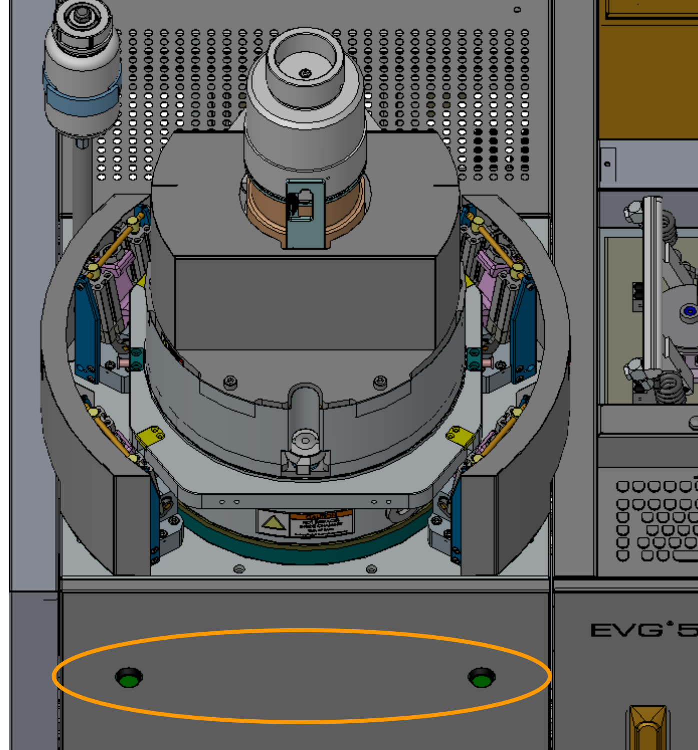

Figure 6 - “Cover Open / Close” buttons

The state of the entry “Cover” in the Process View changes from “Open” to “Service”:

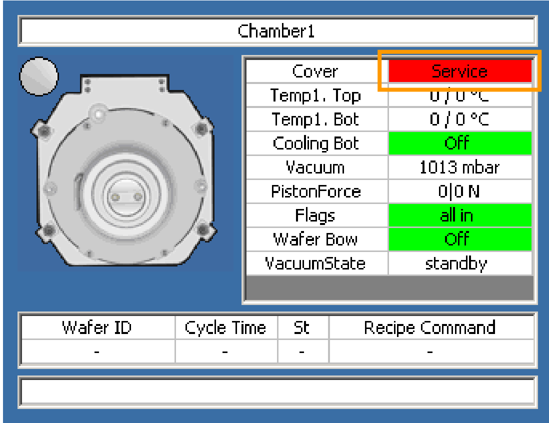

Figure 7 - Process View

3.3.5.2 Release Brake Manually

To close the Cover press button "Release Brake Manually" in Process View / Chamber menu.

Confirm the following message box by clicking on "Yes":

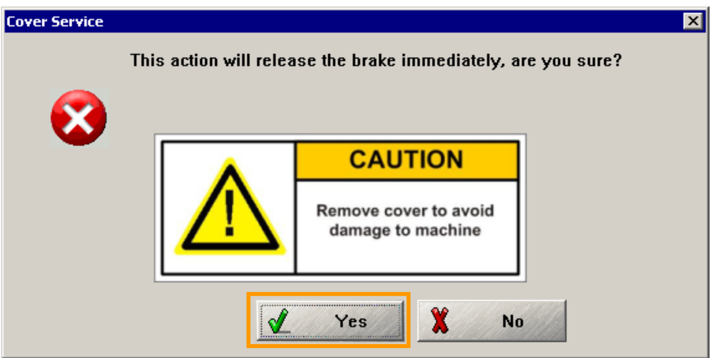

Figure 8 - Release Brake Manually

Caution: Remove cover to avoid damage to machine!

3.3.6 Cooling Station Tool Clamp/Unload (if equipped)

Press both clamping buttons at the same time:

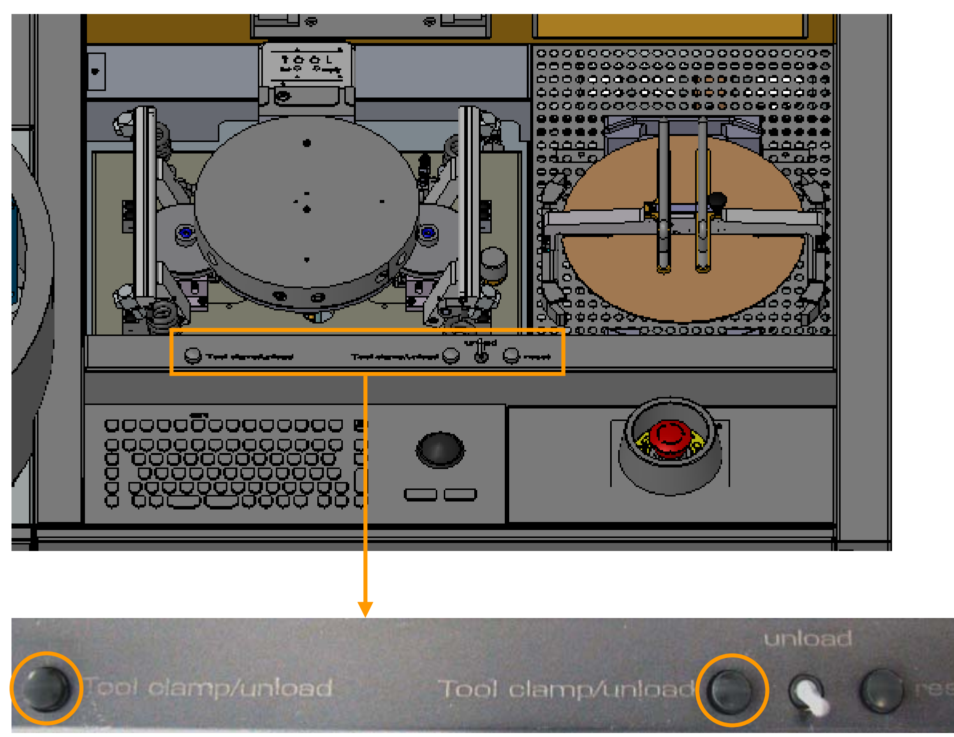

Figure 9 - Clamping Buttons

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3.3.7 Facility Problems

3.3.7.1 Missing Water Flow

If the water flow is missing a timer will be started (standard: 2 minutes) and a message box will appear on the screen. Click on “OK” to confirm the message box.

In the meantime the chamber will continue processing but the handling will be paused.

Water flow resumes in time:	Water flow does not resume in time:
If the water flow resumes within the time set, the message box has to be confirmed by the user.	If the water flow does not resume within the time set, all heaters will be shut down and the process will be aborted.

Note: The message box has to be confirmed even if the water flow resumes in time! Otherwise the process could be paused at some point until the message box is confirmed.

3.3.7.2 Missing CDA

If the CDA pressure is missing a timer will be started (default: 2 minutes, maximum: 5 minutes) and a message box will appear on the screen. Click on “OK” to confirm the message box.

In the meantime the chamber will continue processing but the handling will be paused.

CDA pressure resumes in time:	CDA pressure does not resume in time:
If the CDA pressure resumes within the time set, the message box has to be confirmed by the user. The handling will resume.	If the CDA pressure does not resume within the time set, the process will be aborted.

Note: The message box has to be confirmed even if the CDA pressure resumes in time! Otherwise the process could be paused at some point until the message box is confirmed.

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4 System Startup

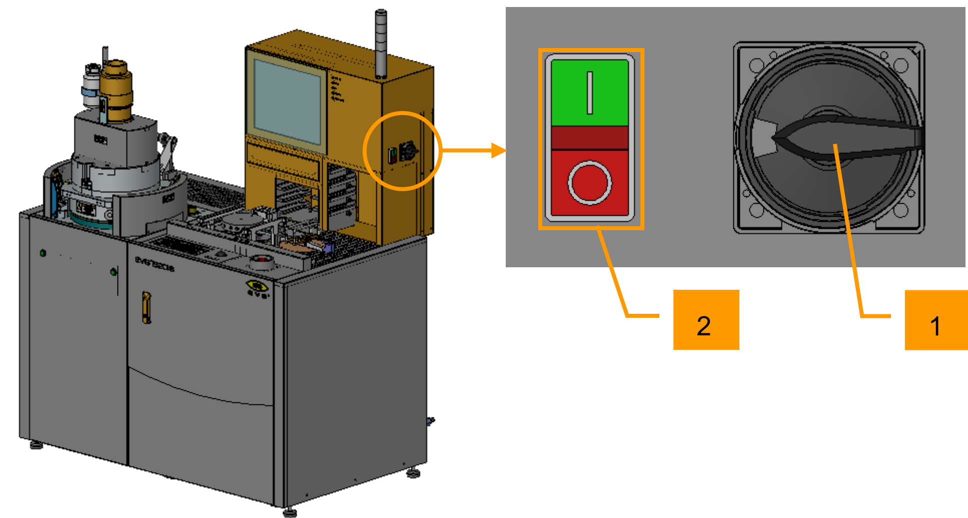

Figure 10 - Main Switch

1) Turn the main switch on the monitor (1) fully clockwise. If the three lamps above the switch are on the system is supplied with main voltage.
2) To the left of the main switch there is an emergency off button (2). The red button stands for OFF and the green button stands for ON. Press the green button.
3) Check if all circuit breakers are on.
4) In the center of the rack there is a key switch (Mini Environment). Turn mini environment key switches to “ON” (if equipped).

It is not necessary to switch on the PC separately. After the PC has booted the EVG5xx software will be started automatically.

As soon as the EVG Explorer appears the boot sequence is finished. Follow the instructions in the following chapters to continue.

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5 EVG Explorer

Figure 11 - EVG Explorer

Move the trackball (see “1” below) to the EVG system software icon and double click the left trackball button (see “2” below) to start the software.

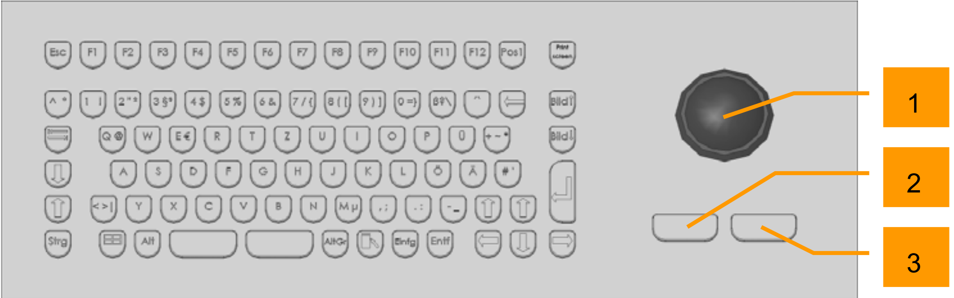

Figure 12 - Keyboard Layout with Trackball

1	Trackball
2	Left Trackball button
3	Right Trackball button

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6 EVG Software

6.1 Login

After starting the EVG5xx software the following screen will show up:

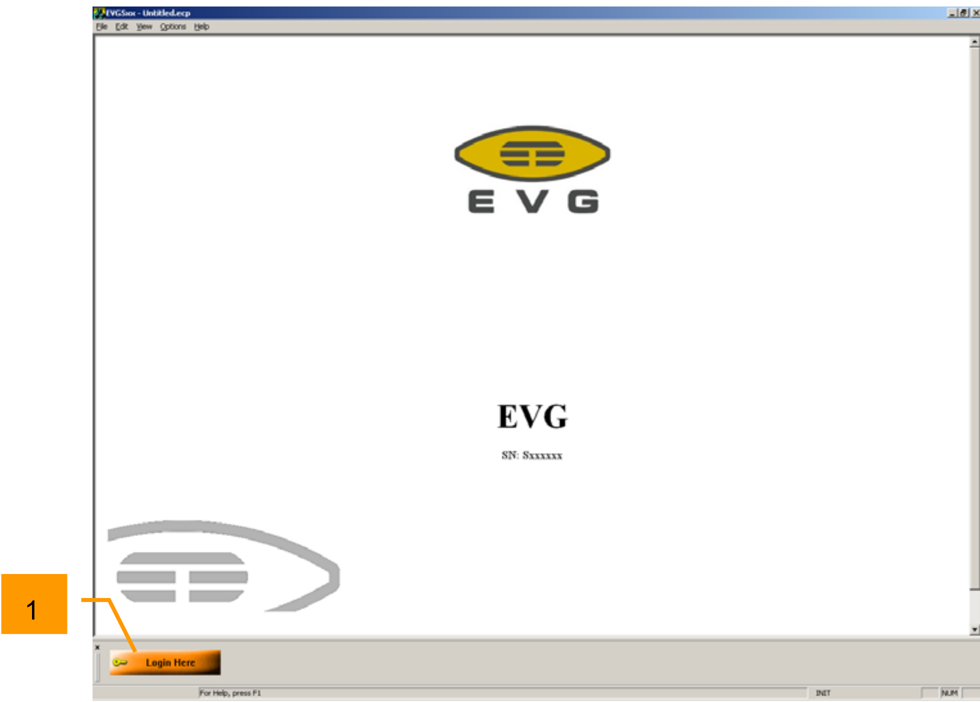

Figure 13 - EVG Software

Click on the button “Login Here” (1) to open the login window.

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The “Login”-window will appear. Enter the user ID (username) and the password and then click on the button “Login” to continue:

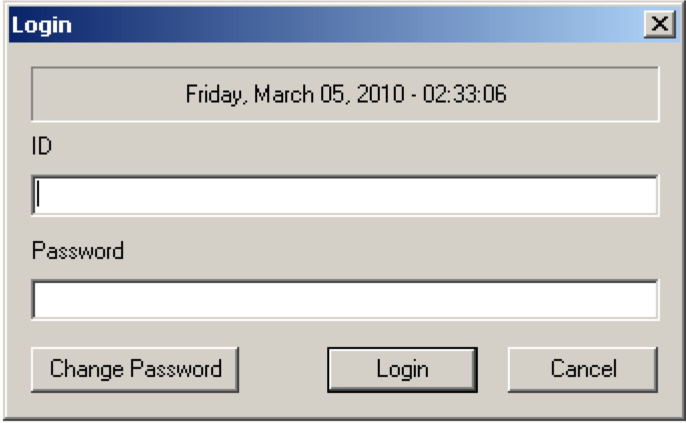

Figure 14 - Login window

If the user ID or the password is incorrect the following error message will appear:

Figure 15 - Login Error

Click “OK” and repeat the login procedure from the first step.

If the login was successful the user can work with the EVG system.

6.2 Jobs

Click on the following icon to open the jobs screen:

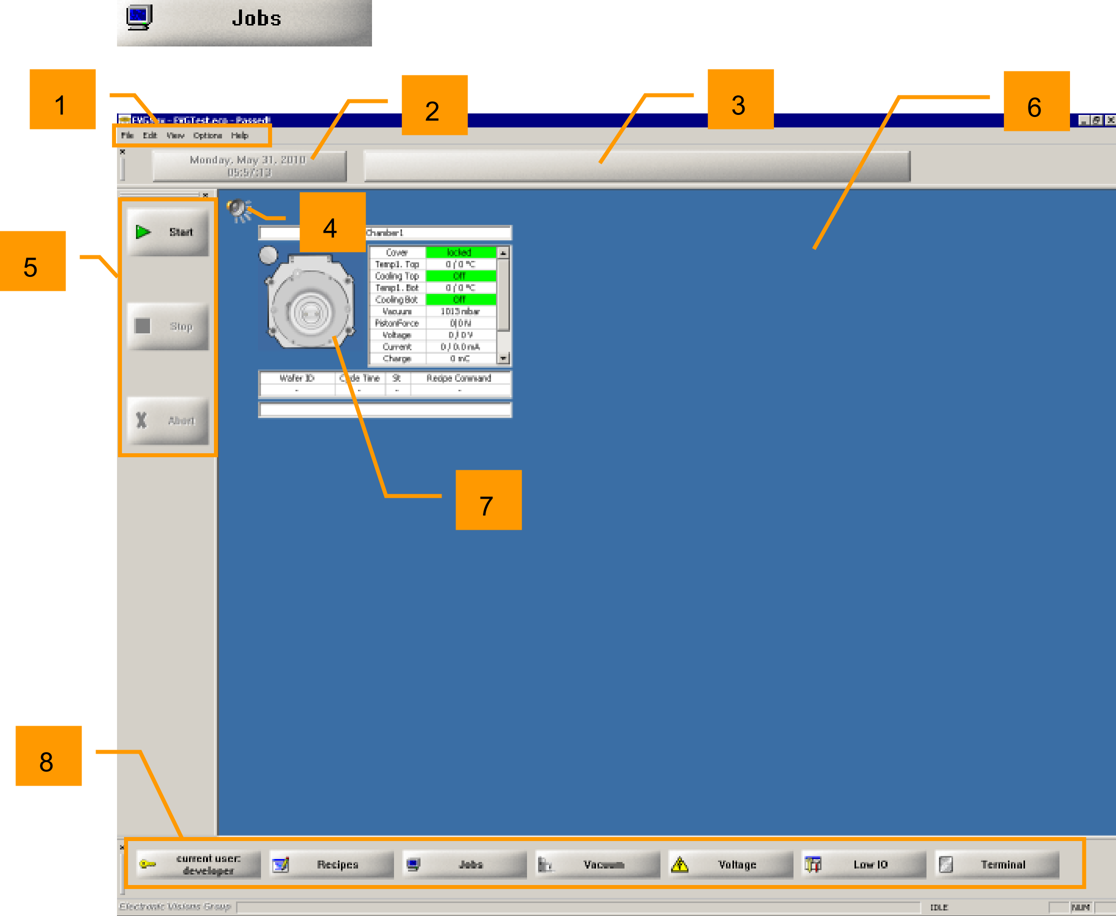

Figure 16 - "Jobs" window

1	Menu bar
2	Information box
3	Message box
4	Warning & Safety icons
5	Process control
6	Main window
7	Bond module
8	Navigation bar

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6.3 Menu Bar

Figure 17 - Menu Bar

6.3.1 File

Figure 18 - File Menu

6.3.2 Edit

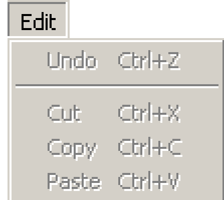

Figure 19 - Edit Menu

6.3.3 View

Figure 20 - View Menu

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6.3.4 Options

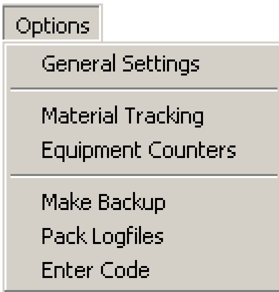

Figure 21 - Options Menu

6.3.4.1 General Settings

Logfile record levels

Record Levels (number of log messages) can be set here:

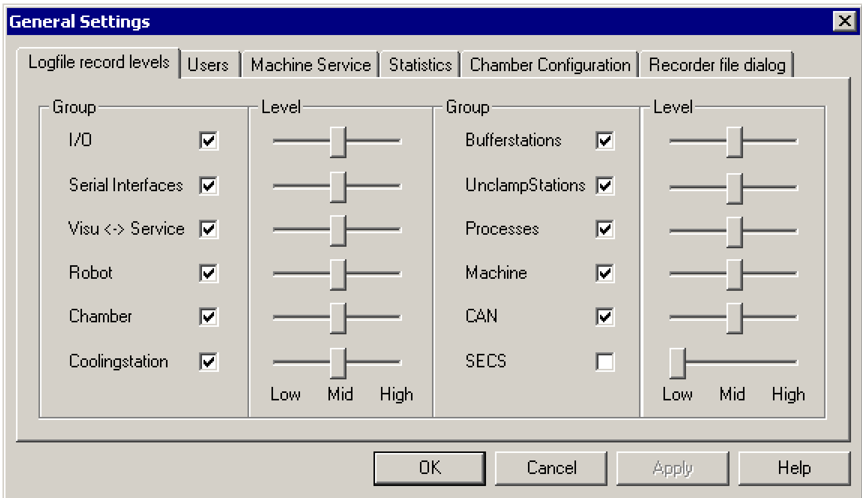

Figure 22 - Logfile record levels

Users (Administrator only)

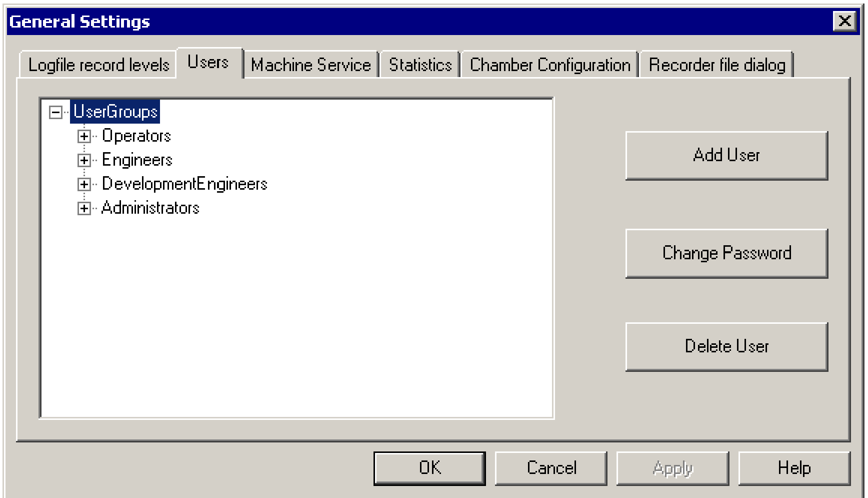

Figure 23 - Users

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Add User

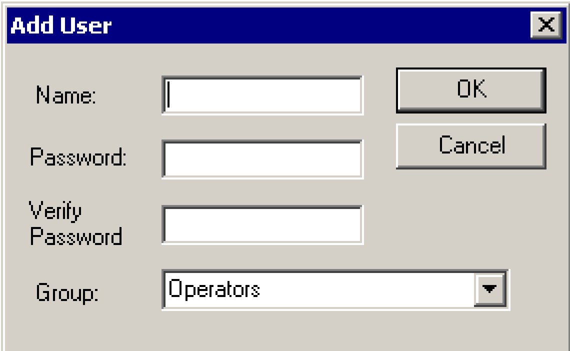

Figure 24 - Add User

1) Click on “Add User”
2) Enter Name
3) Enter Password
4) Enter Verify Password
5) Select Group
6) Click on “OK” to confirm and create the new user

Change Password

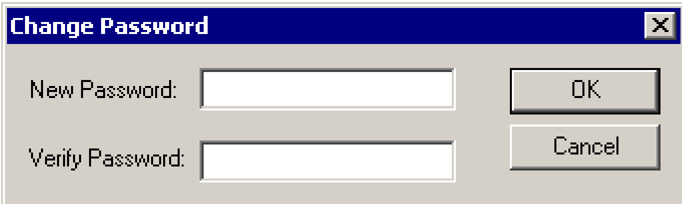

Figure 25 - Change Password

1) Enter “New Password”
2) Enter “Verify Password”
3) Click on “OK” to confirm and change the password

Machine Service

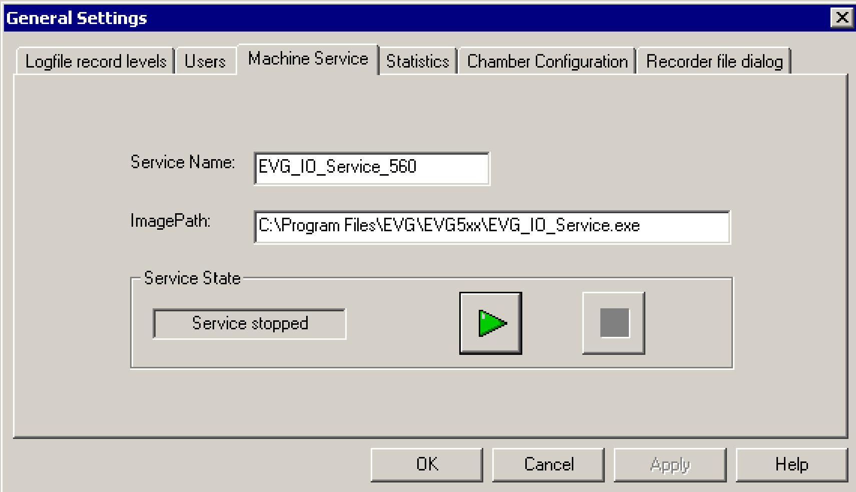

Figure 26 - Machine Service

Statistics

This window displays information about system uptime & downtime:

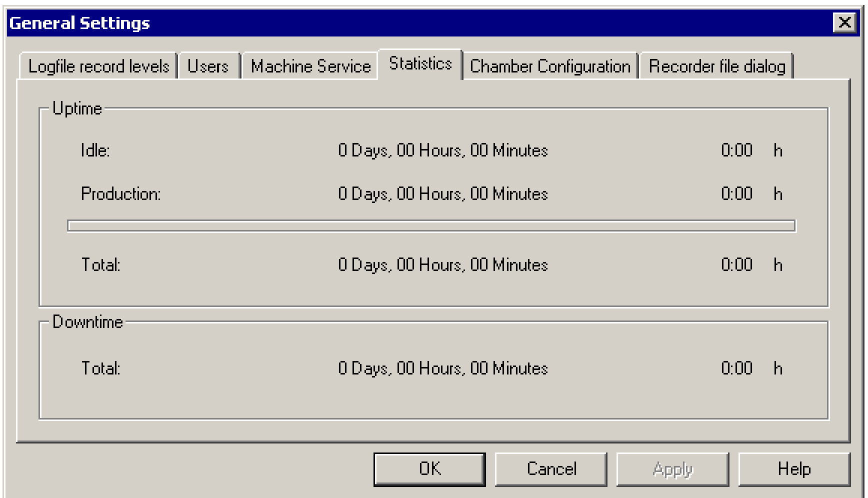

Figure 27 - Statistics

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Chamber Configuration

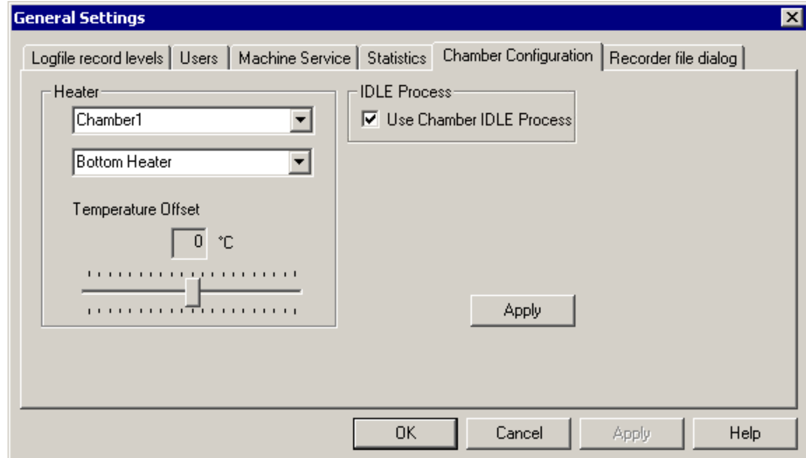


Figure 28 - Chamber Configuration

Short Description

Temperature offset:

The thermocouple sensors used on EVG bonding systems are very accurate, but still have a small measurement tolerance. That is why the same temperature reading on different EVG bonding machines may lead to a small temperature difference from bonder to bonder.

In order to compensate this difference and to run one production bonding recipe on different machine with the same result, a temperature offset setting is possible which can be adjusted individually from bondchamber to bondchamber.

This setting adds an individually adjustable offset in the range of +5 to -5°C to the set point in the recipe. The status window on the screen shows the temperature including the offset.

e.g.: If a 380°C heating set point is adjusted in the recipe and the offset is defined with +3°C, the heaters reach a temperature of 383°C according to the thermocouple in the bonder and will show 383°C in the status window and in the recorder file.

How to adjust the temperature offset

In the window above a temperature offset of +/- 5° C for every heater can be set.

Afterwards the apply button has to be clicked for saving the new adjustment. This will not work if a process is running. In this case there will be a message that the IO service has to be restarted to apply the adjustment.

These adjustments can only be done by administrators.

IDLE Process

Use Chamber IDLE Process:

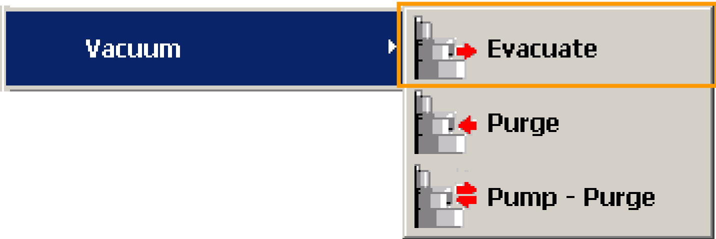
If this box is checked an “IDLE Process” will be performed after the next process is finished.

The IDLE Process will be started on every bond chamber that is set to “Enabled”.

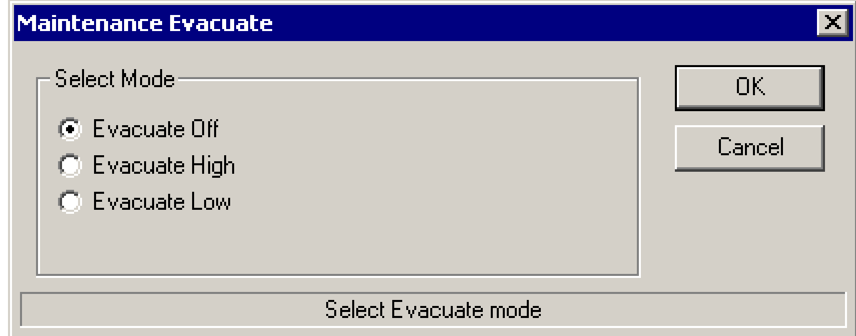
Manually starting or stopping an IDLE Process

1) Click on a bond chamber

2) Go to “Vacuum” and click on “Evacuate”:



3) Use the “Evacuate Off” or “Evacuate High” command to stop or start an IDLE Process and confirm by clicking “OK”.



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Recorder file dialog

The recorder files will be stored in the following folder:

C:\Program Files\EVG\EVG5xx

The subfolder and file format can be changed in the "Recorder file dialog":

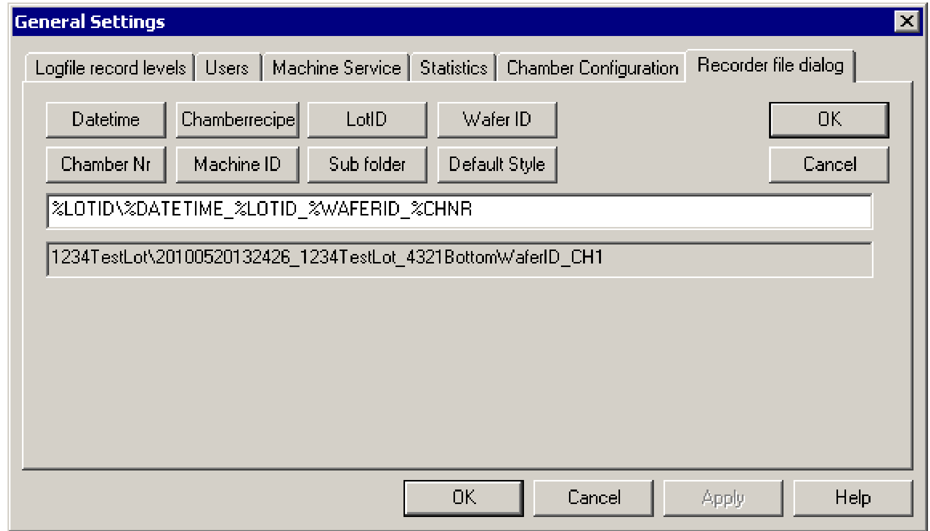
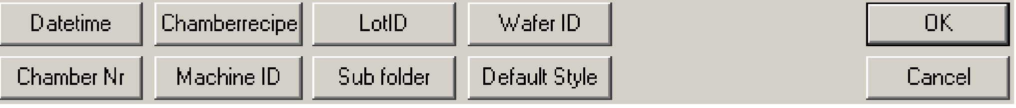
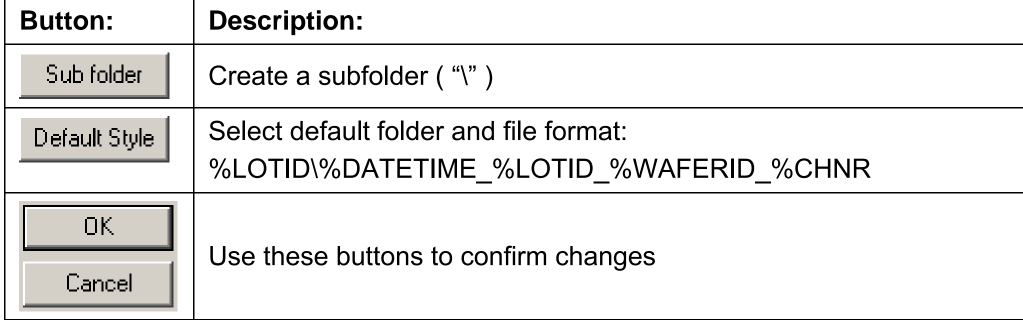


Figure 29 - Recorder file dialog

Settings

Use the following buttons to set up a folder and file format:





Button:	Description:
Sub folder	Create a subfolder ("\")
Default Style	Select default folder and file format: %LOTID\%DATETIME_%LOTID_%WAFERID_%CHNR
OK Cancel	Use these buttons to confirm changes

The first line contains the folder and file format of the recorder file:

%LOTID\%DATETIME_%LOTID_%WAFERID_%CHNR

The second line displays an example of the current folder and file format:

1234TestLot\20100520132426_1234TestLot_4321BottomWaferID_CH1

Lot files

In the folder that is set up in the recorder file dialog a .lot-file will be created.

The .lot-file contains a list of .rec-files with the following information:

1	Destination Slot (Receive Cassette)
2	Bondchuck ID
3	Wafer ID (Top wafer)
4	Cassette of origin (SVA side)
5	Slot of origin
6	Wafer ID (Bottom wafer)
7	Cassette of origin (SVA side)
8	Slot of origin
9	Processed OK/Aborted/Error
10	Chamber ID
11	Recipe Name
12	Process Time
13	Recorder file path

<u>Example .lot-file:</u>

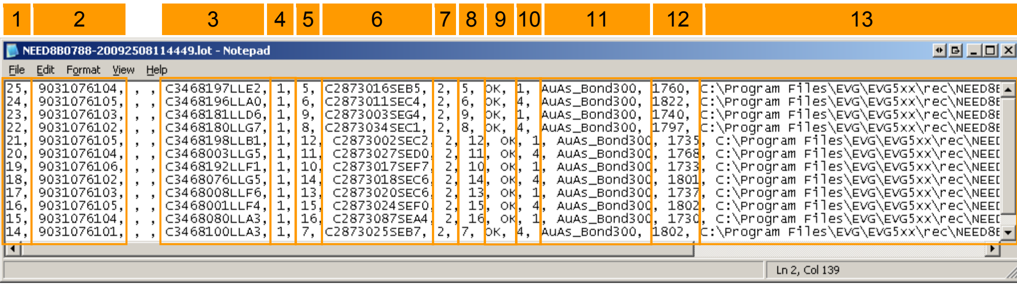


Figure 30 - .lot-file

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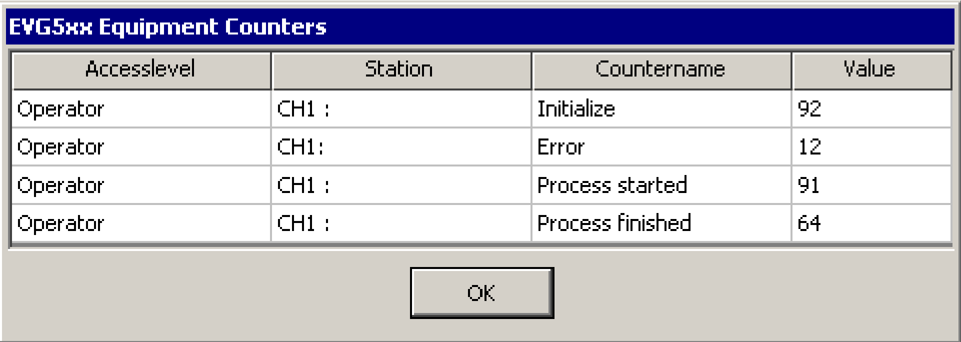
6.3.4.2 Equipment Counters

The window "Equipment Counters" will display a list of all events on all modules of the system (e.g. bond chamber, robot module, barcode reader,…).

Example:

Some events on bond chamber 1 (CH1):


EVG5xx Equipment Counters

Accesslevel	Station	Countername	Value
Operator	CH1 :	Initialize	92
Operator	CH1:	Error	12
Operator	CH1 :	Process started	91
Operator	CH1 :	Process finished	64

OK

Figure 31 - Equipment Counters

Resetting a Counter

Right-click on a line and click on "Reset Counter" to reset the counter of a specific event on a module (e.g. "Process started"-counter of bond chamber 1):

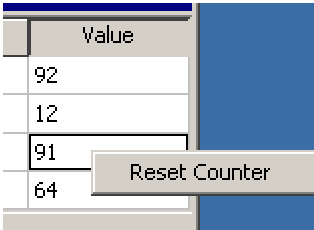
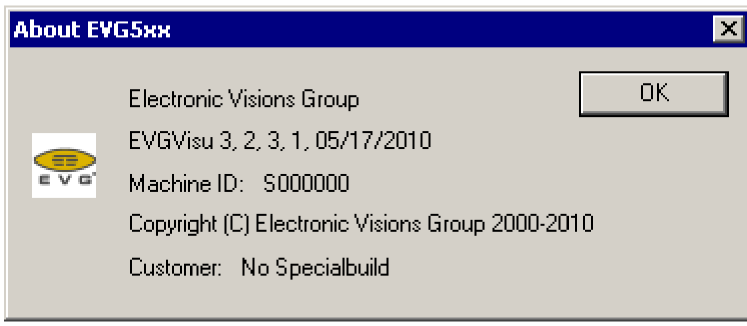


Figure 32 - Reset Counter

6.3.5 Help

Figure 33 - Help Menu

6.3.5.1 About EVG5xx



6.4 Toolbar

By selecting the menu „View“ and clicking „Toolbar“ the toolbar (see below) will be activated or deactivated.

Figure 34 - Toolbar

The buttons in the toolbar offer shortcuts to functions like “Open” in the “File”-menu.

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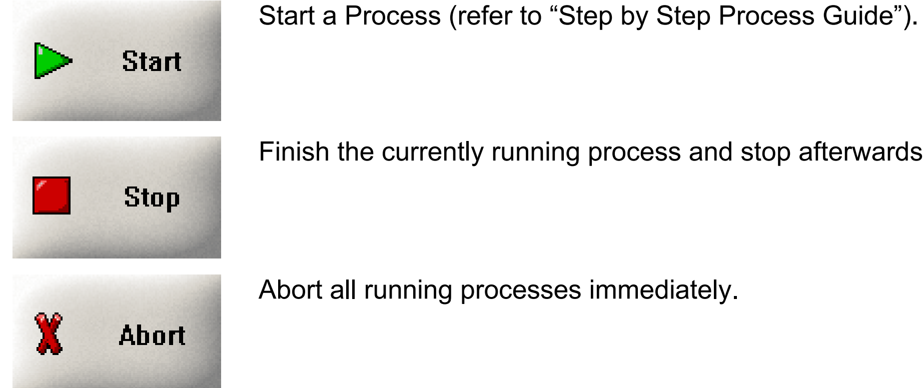
6.5 Process Control



Start a Process (refer to “Step by Step Process Guide”).

Finish the currently running process and stop afterwards.

Abort all running processes immediately.

If a process is completed successfully the following message box will appear:

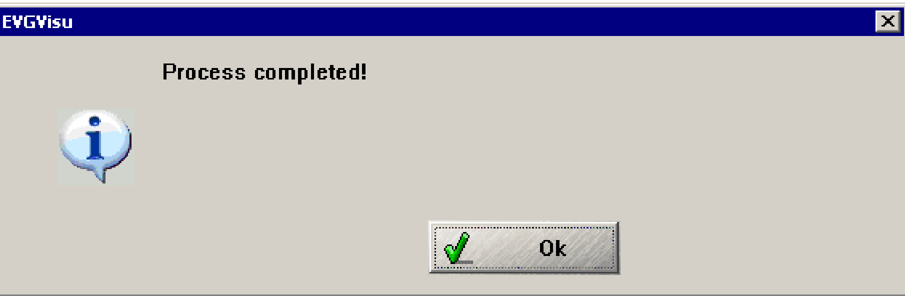


Figure 35 - Process Completed

6.5.1 Stop Process

Stopping a process will finish the currently running process step and stop processing afterwards.

Stopping the process has to be confirmed by clicking “Yes” in the following message box:

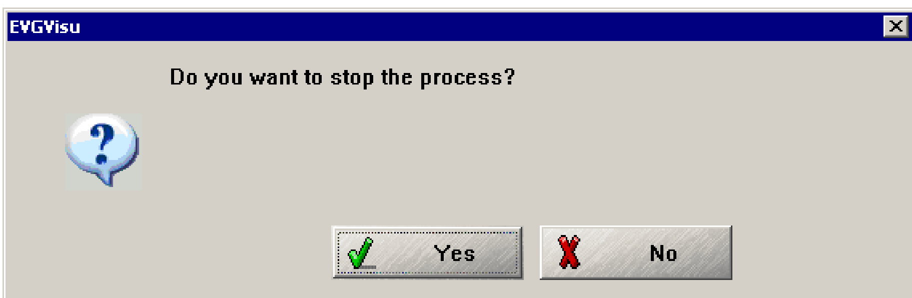


Figure 36 - Stop the process?

As soon as processing ends the following message box will appear:

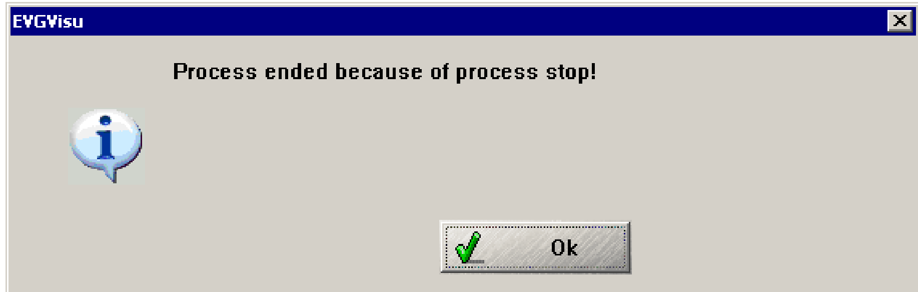


Figure 37 - Process stopped

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6.5.2 Abort Process

Clicking the button “Abort” will stop processing immediately.

Aborting the process has to be confirmed by clicking “Yes” in the following message box:

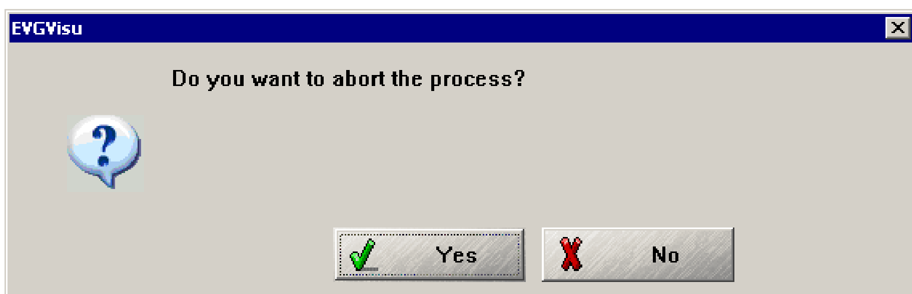

Figure 38 - Abort the process?

As soon as processing ends the following message box will appear:

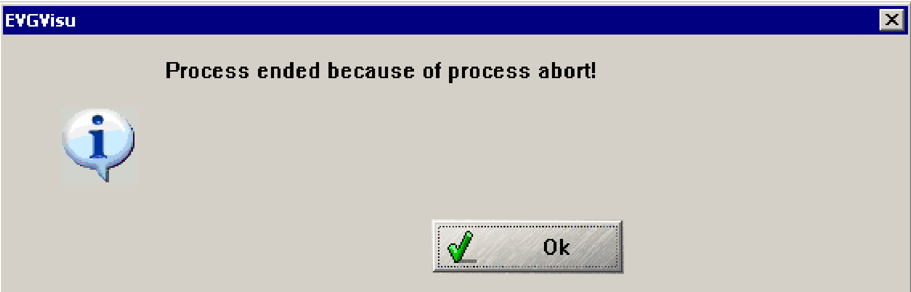

Figure 39 - Process aborted

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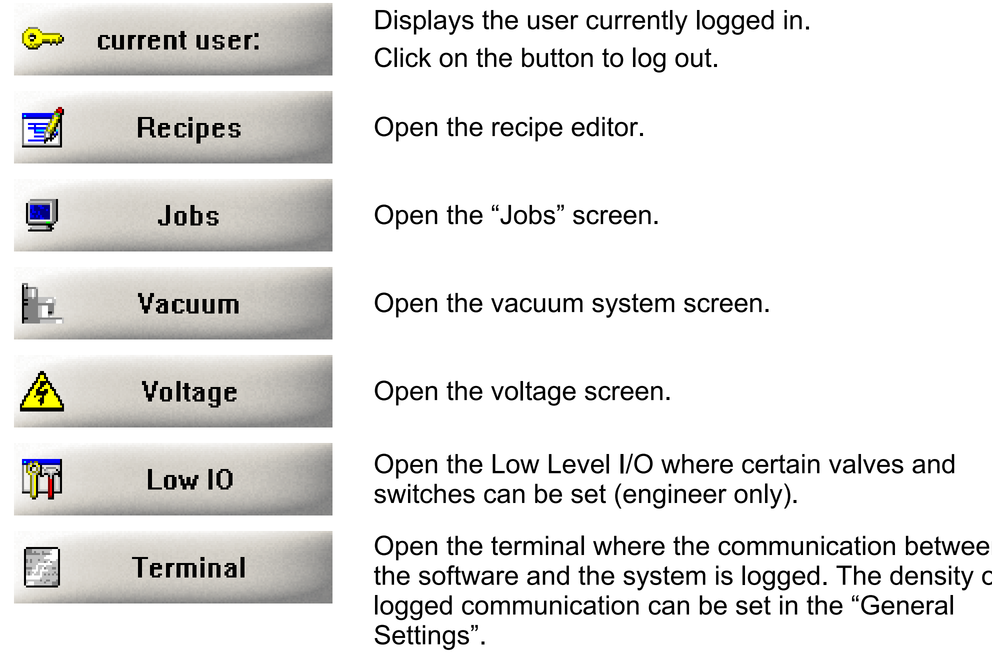
6.6 Navigation Bar

At the bottom of the screen there is the navigation bar containing the following items (depending on system configuration):



Button	Description
current user:	Displays the user currently logged in. Click on the button to log out.
Recipes	Open the recipe editor.
Jobs	Open the “Jobs” screen.
Vacuum	Open the vacuum system screen.
Voltage	Open the voltage screen.
Low IO	Open the Low Level I/O where certain valves and switches can be set (engineer only).
Terminal	Open the terminal where the communication between the software and the system is logged. The density of logged communication can be set in the “General Settings”.

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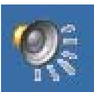
7 Alert Status



Icon activates / deactivates the alert.

8 Recipes

Click on Recipes to open the recipe window:

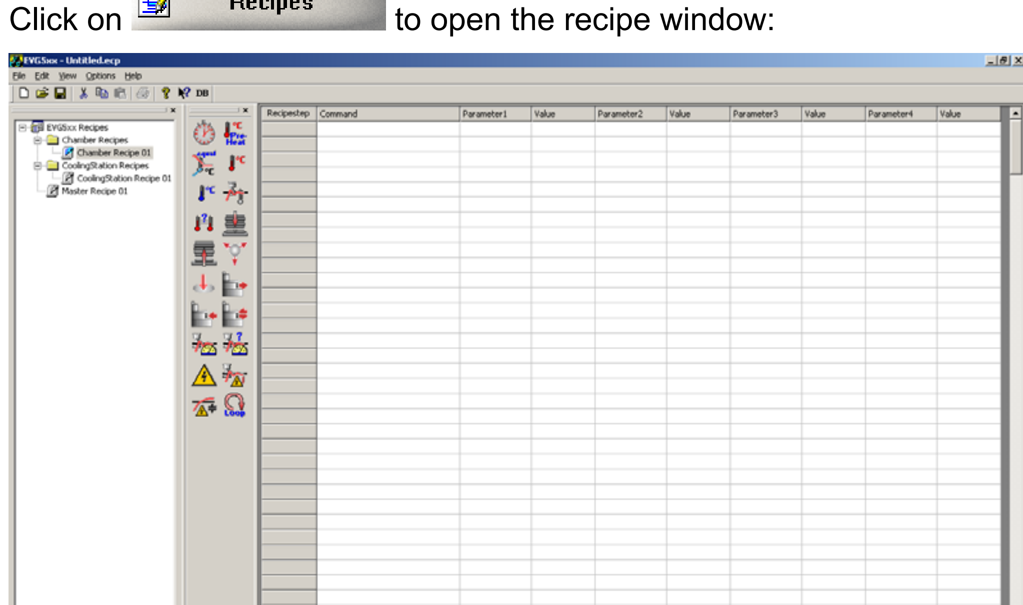


Figure 40 - Recipe Window

8.1 Create Recipe

Recipe programming only for Engineers (refer to Recipe programming manual).

8.2 Save Recipe

Recipe programming only for Engineers (refer to Recipe programming manual).

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8.3 Load Recipe

1) In the “Jobs” window, click on Start.
2) Choose a saved recipe that corresponds with the product being run.
3) Insert Lot ID “customized”.
4) Click on “OK”.

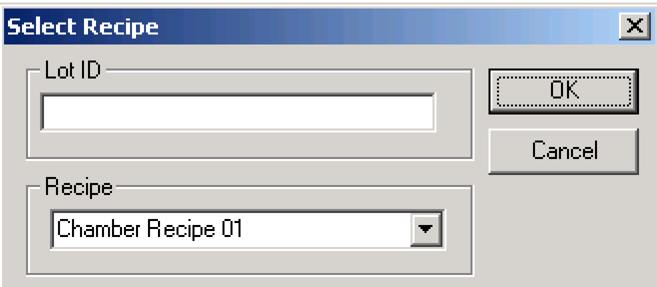


Figure 41 - Select Recipe

9 Bond Module

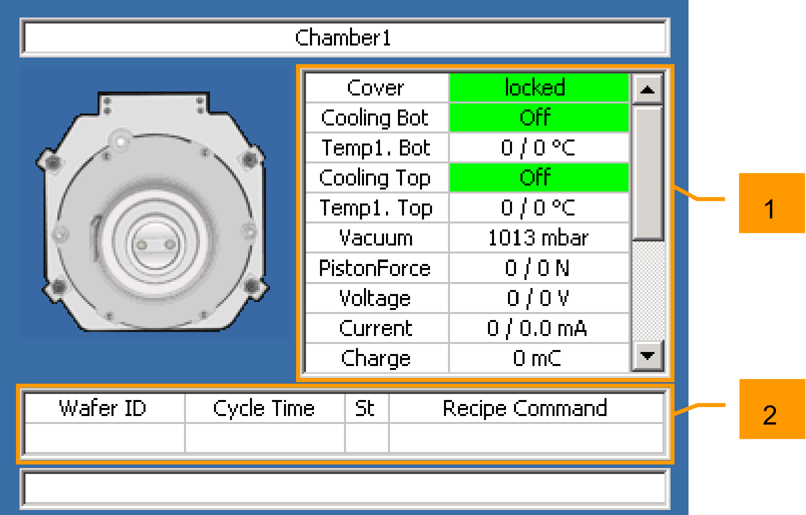


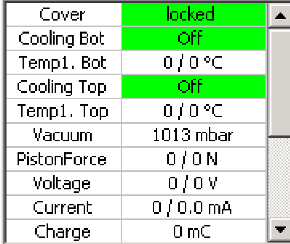
Figure 42 - Bond Module

1	Status Information
2	Process Information

Status Information:

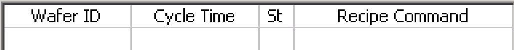
Displays the current status of the system (Temperature, Force…).

e.g.: “Cover” “locked” / “open”, “Cooling Bottom” “On” / “Off,” “Temp Bottom”: Temperature Sensor on bottom side, Vacuum level,…



Process Information:

Process information Window displays current status information (only active when process is running)



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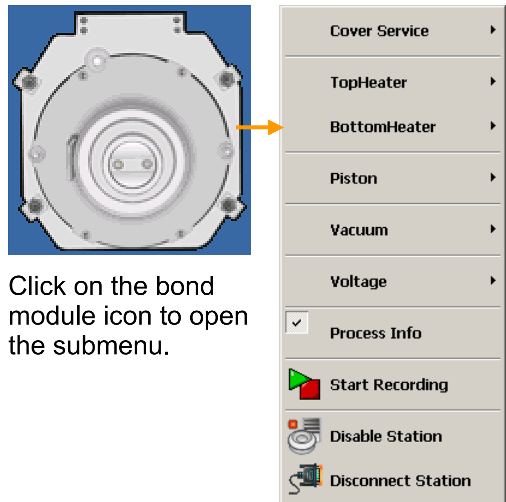
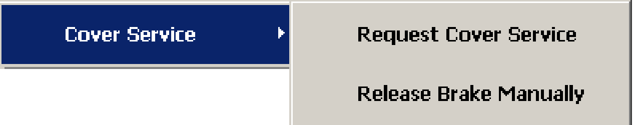
9.1 Submenu Bond Module



Click on the bond module icon to open the submenu.

Note: Available submenu items depend on system configuration!

9.1.1 Cover Service



Refer to chapter “Open / Close Chamber (“Cover Service”)” for a detailed description.

Request Cover Service:

Confirm the following message box by clicking on “OK”:

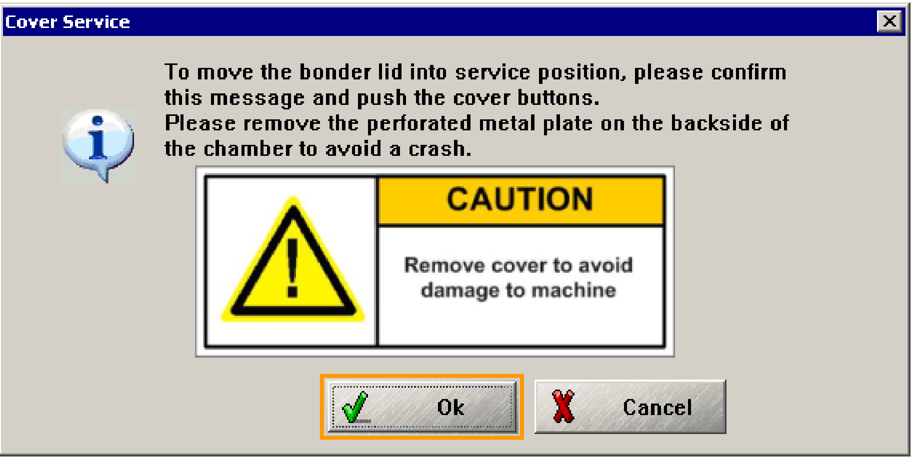


Figure 43 – Request Cover Service

Release Brake Manually:

Confirm the following message box by clicking on “Yes”:

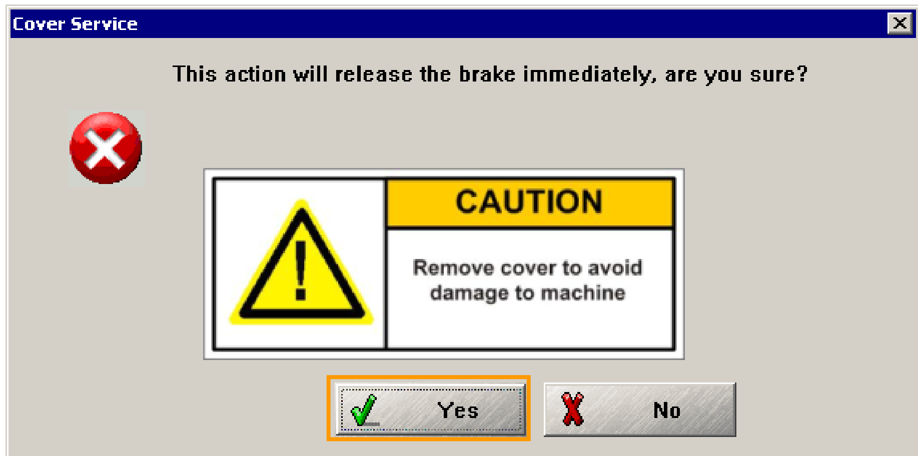
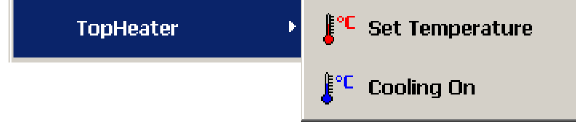


Figure 44 - Release Brake Manually

Caution: Remove cover to avoid damage to machine!

9.1.2 TopHeater



Set Temperature:

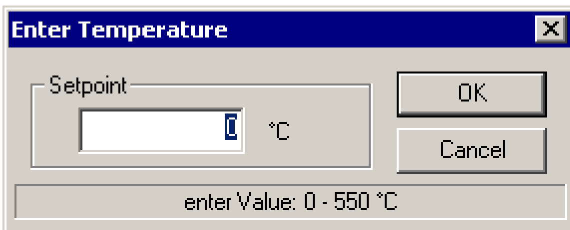
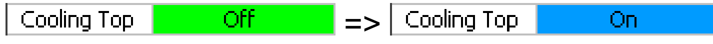


Figure 45 - Set Temperature

Cooling On / Off:



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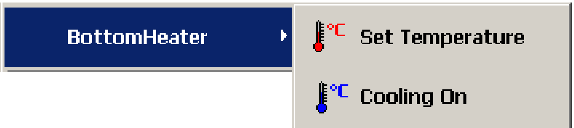
9.1.3 BottomHeater



Set Temperature:

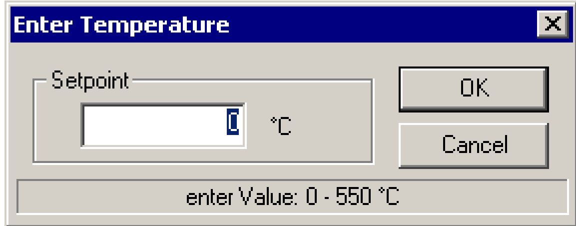
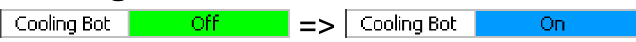


Figure 46 - Set Temperature

Cooling On / Off:



9.1.4 Piston

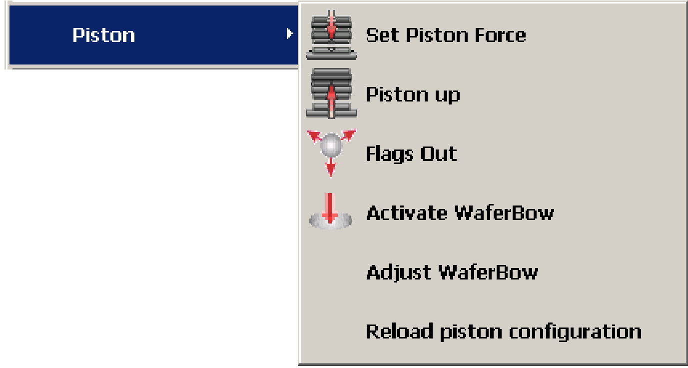
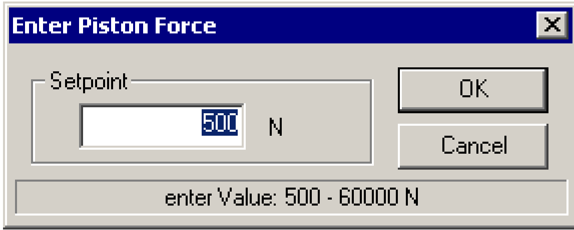


Figure 47 - Piston Menu

Set Piston Force:

Enter a value in the “Setpoint”-field (in N) and click on “OK” to confirm.



Piston up / down:

Move the piston up or down.

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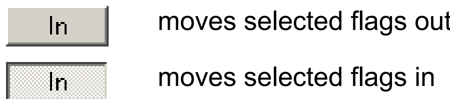
Flags Out:

By default this command will move the selected flags out. Activate the button “In” to invert the command (will move the selected flags in):



moves selected flags out

moves selected flags in

Select the flags that should be moved in or out and confirm by clicking on “OK”:

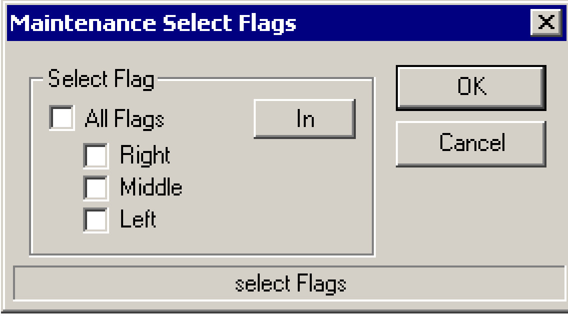


Figure 48 - Flags Out

Activate WaferBow (hydraulic system only):

This command will activate the wafer bow function (the ceramic pin that will contact the wafers first when the piston moves down).

Adjust WaferBow (hydraulic system only):

Adjust the wafer bow screw on the bond cover and click on “Ok” to confirm:

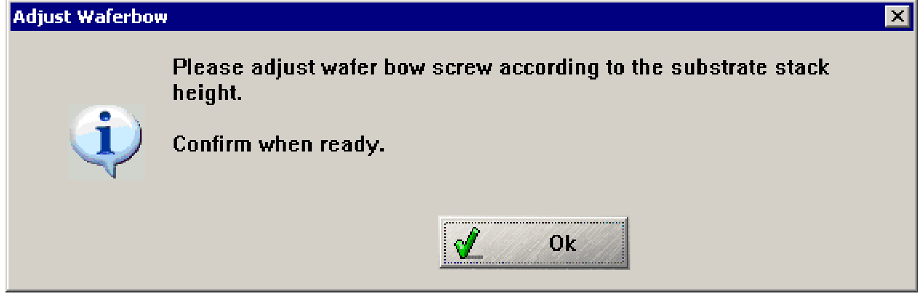


Figure 49 - Adjust WaferBow

Reload piston configuration:

It is necessary to reload piston configuration if one of the following values of the piston is changed in the RegistrySettings:

- Settings for pressure regulation
- Settings for reading the pressure

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9.1.5 Vacuum

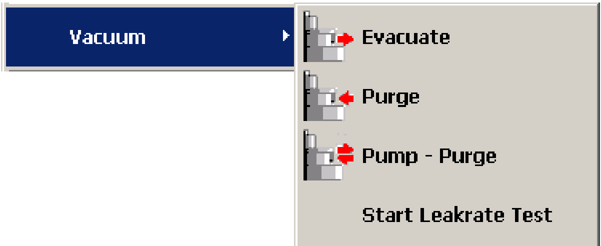

Figure 50 - Vacuum Menu

Evacuate:

Starts ("Evacuate High" or "Evacuate Controlled") and stops ("Evacuate Off") the evacuation of the bond chamber:

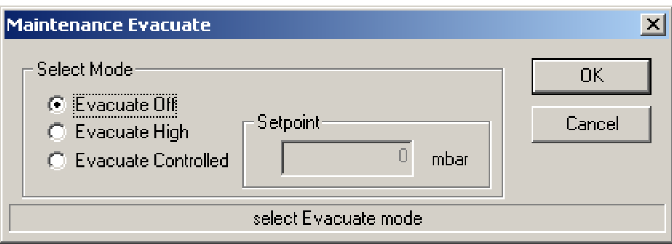

Figure 51 - Evacuate

Purge:

Fills the chamber with different types of gases after evacuation:

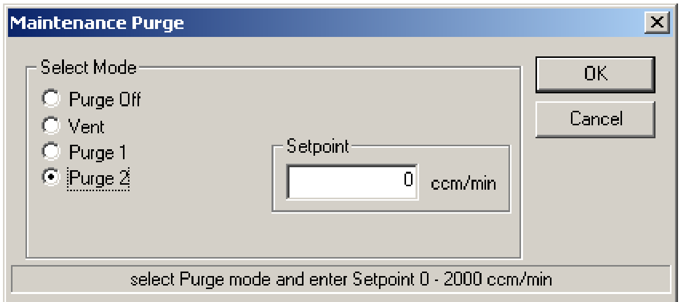

Figure 52 - Purge

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Pump – Purge:

This command allows a controlled amount of gas flowing through the chamber:

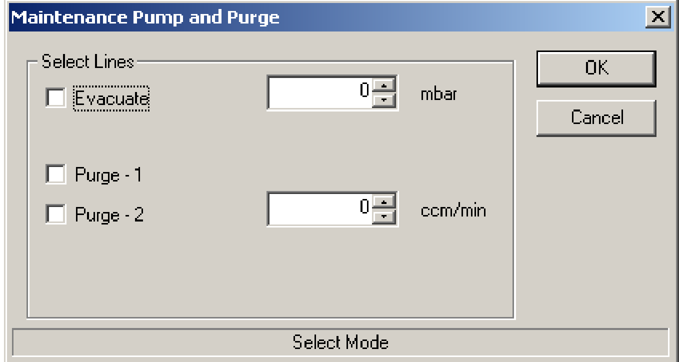
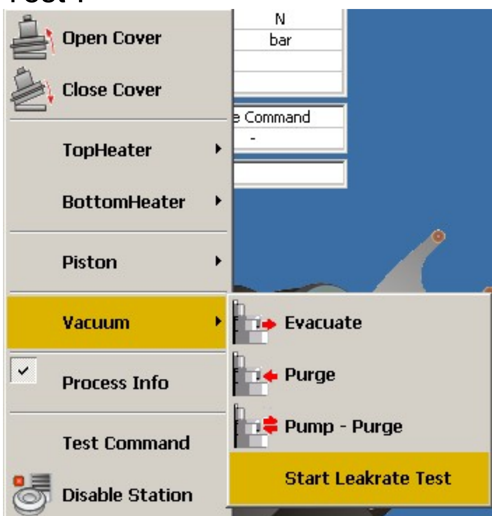


Figure 53 - Pump - Purge

Start Leakrate Test:

In order to test a bond chamber for leaks the following steps have to be performed:

1) Click on the chamber, go to “Vacuum” and click on “Start Leakrate Test”:



2) Enter the “Vacuum Setpoint” (1) in mbar (less than 1 mbar), the “Wait Time” in hours, minutes and seconds (2) and then click “OK” to start the Leakrate Test:

The chamber will be evacuated until the vacuum is reached and then all valves will be closed for the “Wait Time” set in the Leakrate Dialog.

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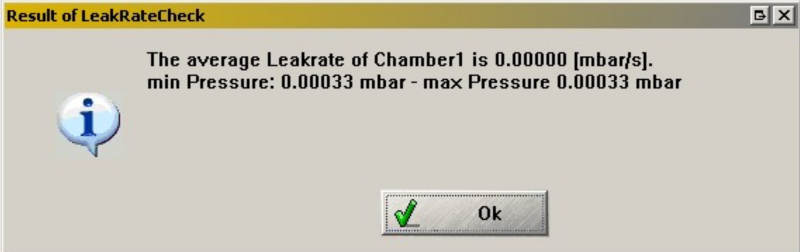
3) A new window with the results of the Leakrate Test will be opened showing the average leakrate of the chamber in mbar per seconds, the minimum and the maximum pressure in mbar:



Stop Leakrate Test:

While the Leakrate Test is in progress the user can abort it at any time by clicking on the chamber, going to "Vacuum" and clicking on "Stop Leakrate Test":

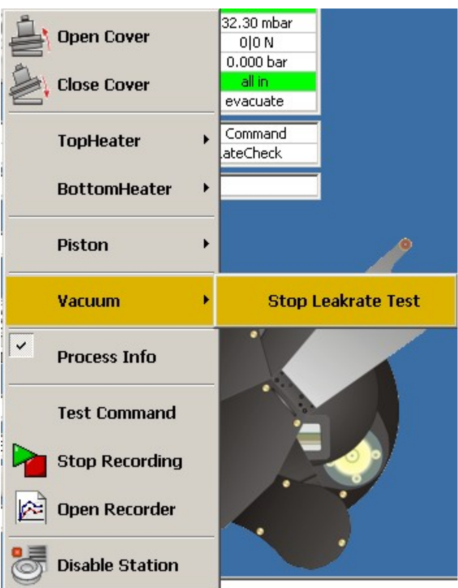


Figure 54 - Stop Leakrate Test

Note: If the test is aborted before it is finished the window showing the results of the Leakrate Test will not be displayed.

9.1.6 Voltage

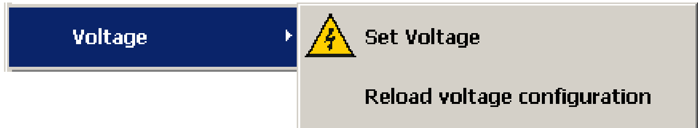


Figure 55 - Voltage Menu

Set Voltage (anodic bonding only):

This command is used to apply a voltage for anodic bond processes. It is also needed for switching the voltage off after the anodic bond is finished:

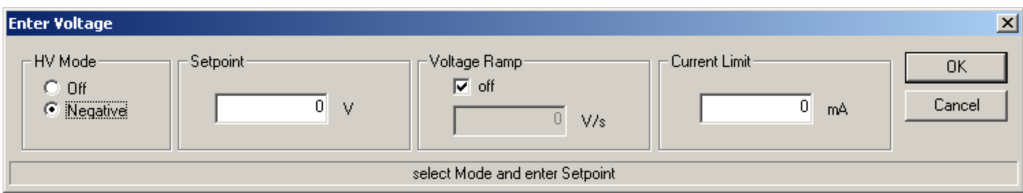


Figure 56 - Set Voltage

Reload voltage configuration:

It is necessary to reload voltage configuration if one of the following values of the high voltage system is changed in the RegistrySettings:

- Settings to limit voltage
- Current values (min and max values)

9.1.7 Process Info

Figure 57 - Process Info

Click here to enable or disable the display showing process information:

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9.1.8 Start Recording

Click here to start recording:

Figure 58 - Start Recording

Click on the following button to open the recorder software:

Figure 59 - Open Recorder

9.1.9 Disable Station

Click here to enable or disable the station:

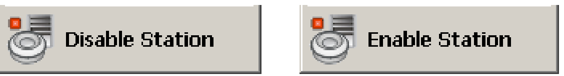

Figure 60 – Disable/Enable Station

9.1.10 Disconnect Station

Disconnect or connect station (only applies to systems with two bond chambers):

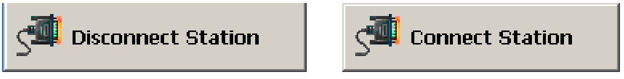

Figure 61 – Disconnect/Connect Station

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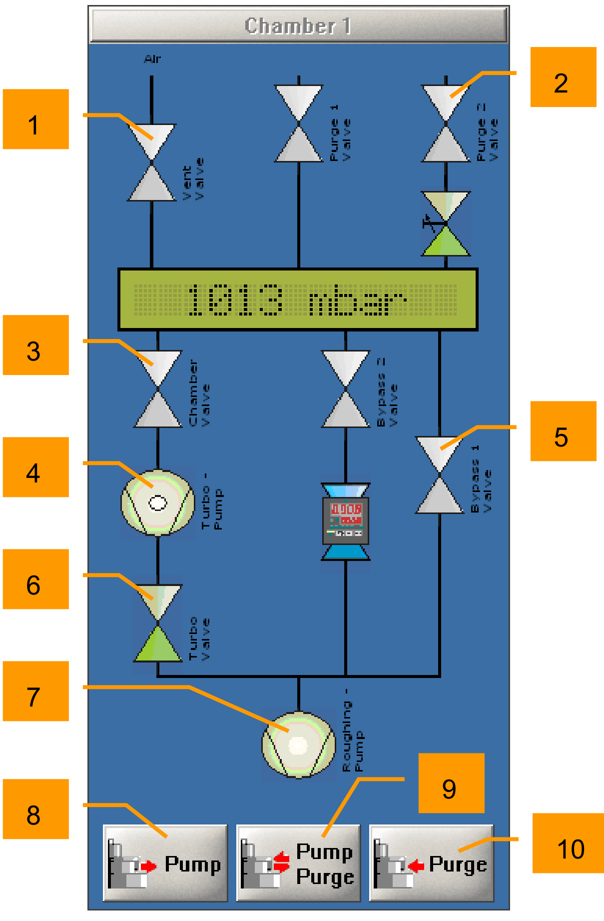
10 Vacuum System

Refer to “Technical Documentation” => “Vacuum Equipment” for details about the vacuum system.

Click on Vacuum to open the vacuum system (may vary depending on system configuration):



1	Vent Valve	2	Purge 1 Valve
3	Chamber Valve	4	Turbo Pump
5	Bypass Valve	6	Turbo Valve
7	Roughing Pump	8	Pump (refer to recipe)
9	Pump & Purge (refer to recipe)	10	Purge (refer to recipe)

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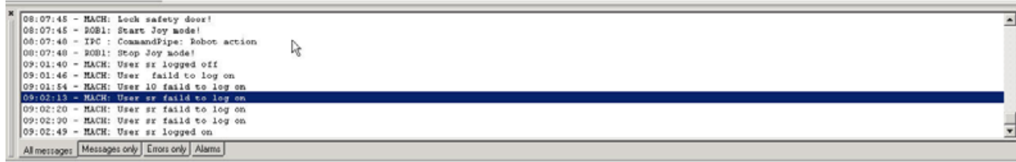
11 Low IO

Click on the button Low IO (only for engineers).

12 Terminal

Click on the button Terminal to open or close the terminal.

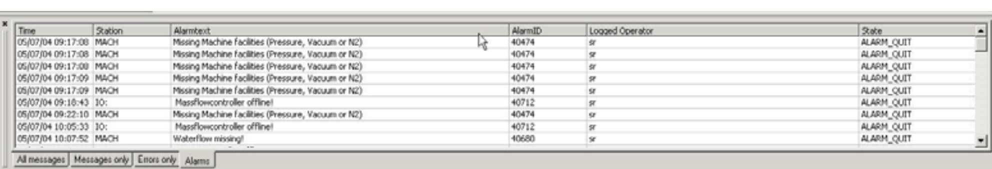
12.1 All Messages



12.2 Messages Only

12.3 Errors Only

12.4 Alarms



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13 Recovery from Errors

Most errors that will occur require going into an engineering or maintenance level screen to execute certain functions to recover the tools and the system.

Things that the operator can do in case of an error:

1) Press the Emergency Stop button only if the probability of damage or Injury may occur.
2) Call a trained maintenance person to perform what is needed to recover.

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14 Handling Tool for Emergency Situations & Unloading after Bonding

If for any reason any bond tools have to be handled after a recovery please use the bond tool-handling device, heat resistant gloves and protective eye wear to avoid any potential injury from a hot bond tool.

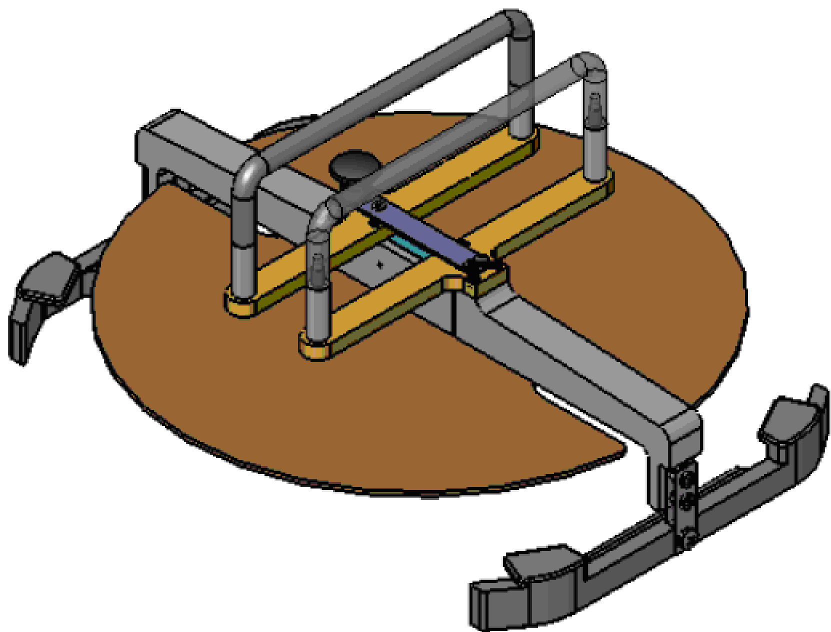

Figure 62 - Handling Tool

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15 Step by Step Process Guide

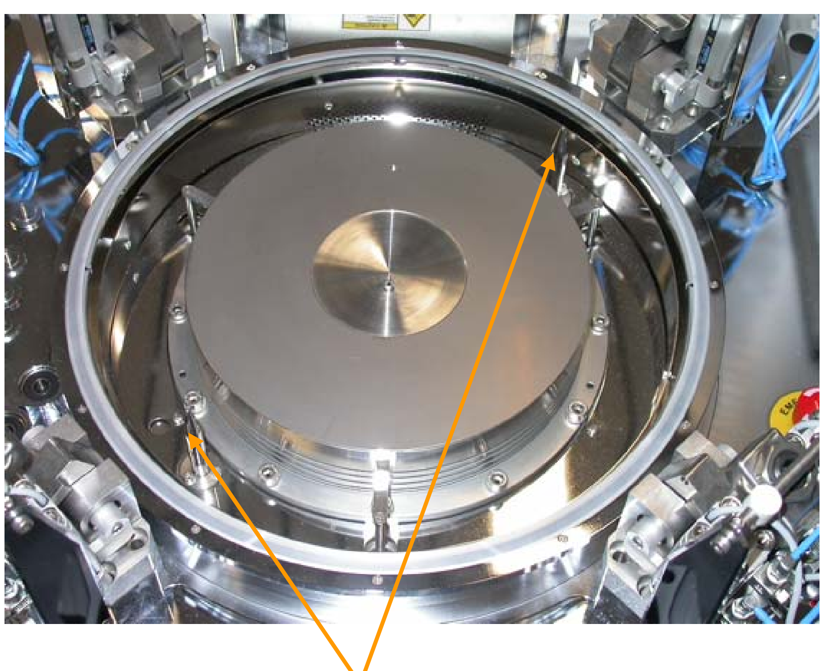
1) Load the wafers on the bond tool.

2) Open the cover of the bond chamber by pressing the cover **open**/close buttons at the same time.

3) Put the bond tool in the chamber.

Take the bond chuck top, where the already aligned wafer stack is clamped, with the handling tool and bring it in. The 2 positioning pins must fit into the holes of the bond chuck top. Only when you put the bond chuck top into the right position the TOOL thermocouple fits exactly into the hole on the steel insert (depending on the design). See the figures below.

For 6" and 8" Bondchucks:



Use the two position pins to load the bond chuck correct into the EVG520.

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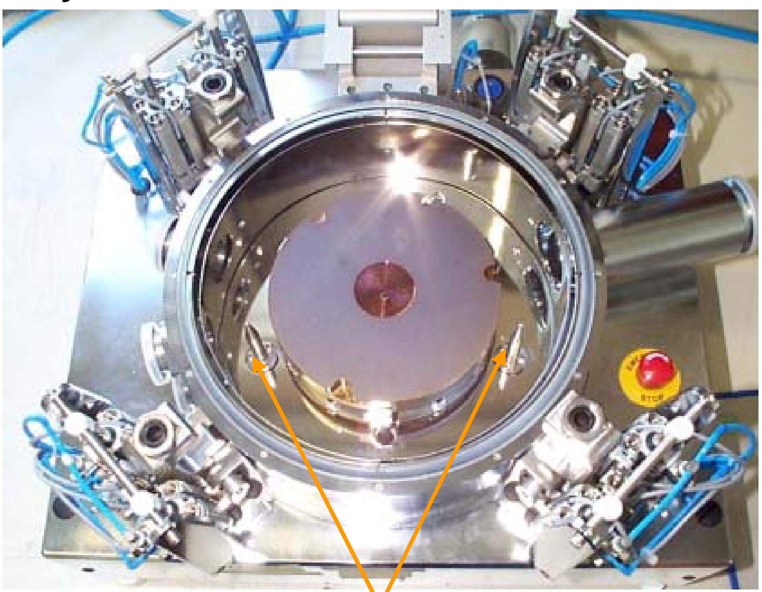
Only for 6” Bondchucks:

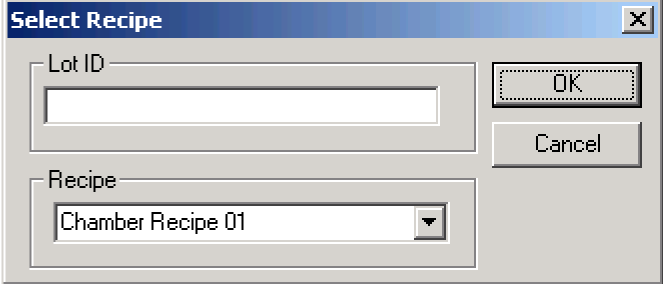


Use the two position pins to load the bond chuck correct into the EVG520.

4) Put the field electrode on the clamped wafers and close the cover of the bond chamber by pressing the cover open/close buttons at the same time.

5) Click on Start

6) Choose saved recipe that corresponds with the product being run and insert LOT ID “customized”:



7) Click on “OK”:
The initializing window will start right now. After all stations are initialized, the process will start.

8) Now the defined bond process will be started.

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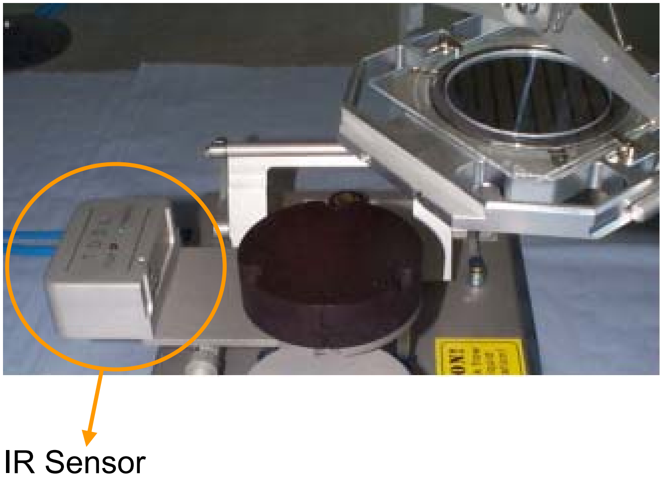
9) After the defined bond process is finished, the chamber can be opened by pressing the cover open/close buttons again and taking the bond tool with the handling tool onto the cooling station.

Warning: Do not touch the bondtool with your fingers. It might be hot!!



Warning: The cooling station is water-cooled and has a temperature from about 18°C. If your wafers are very temperature shock sensitive, cool them down to a temperature where nothing can happen. We recommend cooling the bond chuck top down to 350°C before putting it onto the cooling station.

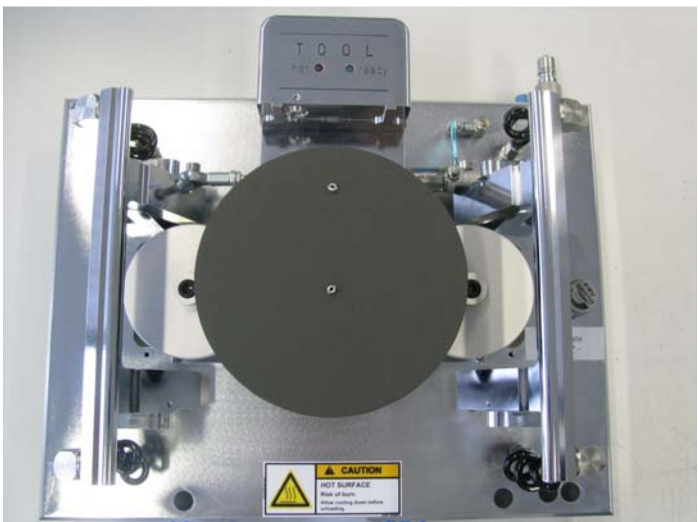
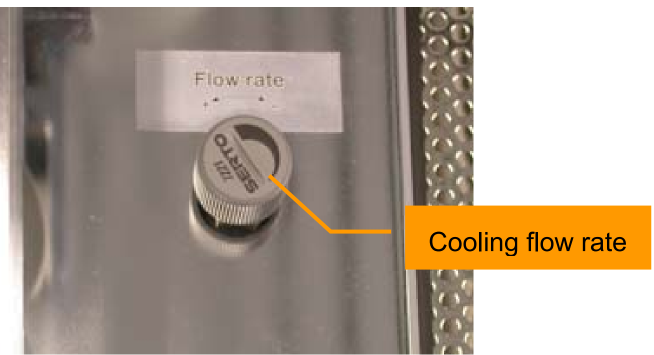


Figure 63 - Cooling Station

10) Clamp function:
When the bondchuck top is on the cooling station switch the clamp switch into the clamp position.

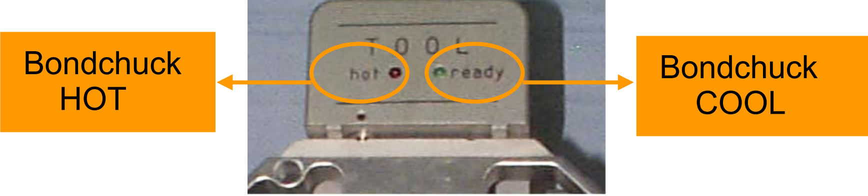


Then press both clamping buttons at the same time:

After this the bondchuck top will be clamped.

11) Indicator LED's:

The indicator LED's on the cooling station show if the bondchuck top is still hot or already cool.



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12) Unclamping the wafer stack:

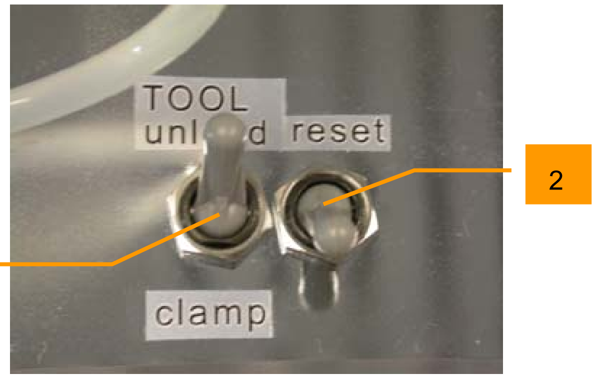
As soon as the green LED is on the switch can be turned to the tool unload position:

Then both clamp buttons have to be pressed again and the wheels of the cooling station will lift up. Then the wheels can be rotated and the bondchuck top can be unloaded:

Turn the wheels to move the clamping feet out of the wafer stack.

Now it is save to take the clamping glass and the bonded wafer stack off the bond chuck top.

After this the tool can be unclamped with the reset switch:



1	Clamp switch
2	Reset switch (OFF position)

After cooling process it is important that the clamp switch is switched back to the clamp position and the reset switch is switched to the off position.

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16 System Shutdown

1) Click on “File” and “Exit” to exit the EVG5xx software:

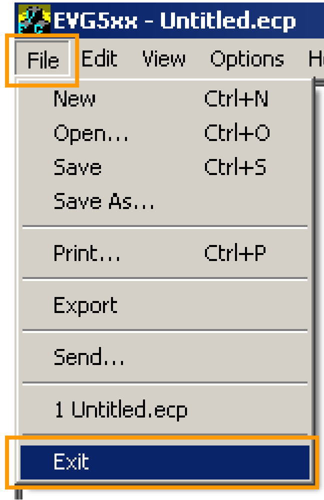

Figure 64 - File - Exit

After closing the EVG5xx software the EVG Explorer will be displayed:

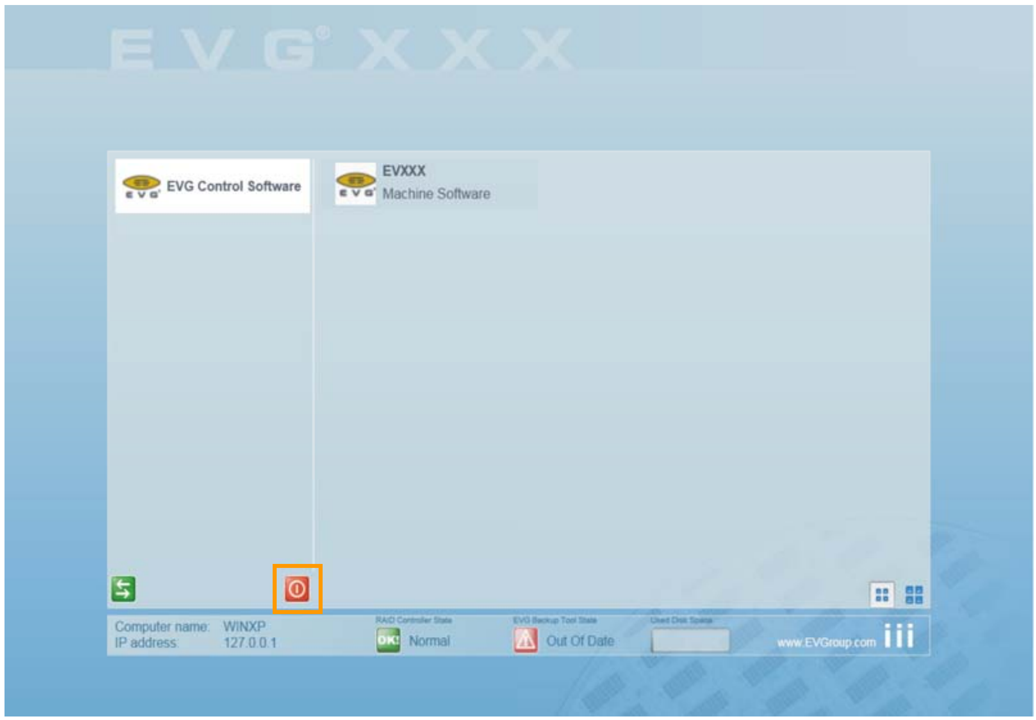

Figure 65 - Shut down button in EVG Explorer

2) Click on [icon] to open the “Shut down” window. In the shut down window select “Shut down” (default) and click on “OK” to shut down the operating system:

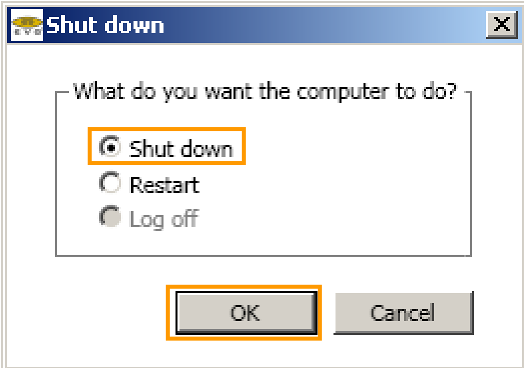

Figure 66 - “Shut down”-window

3) Wait until the screen “It is now safe to turn off your computer” shows up. Turn the main switch (1) fully counter clockwise.

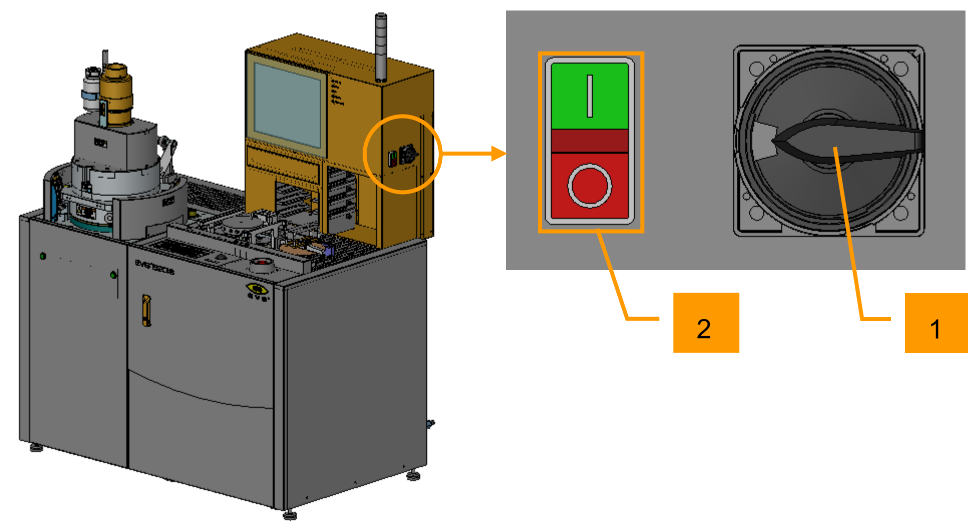

Figure 67 - Main Switch

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History

Date	Modification	by
2006-06-23	Updated and formatted	KAR
2007-10-10	Updated (with GCA)	HMA
2008-02-20	Added and updated “Open/Close Chamber (“Cover Service”)”	HMA
2009-03-05	Added “Adjust heater offset” with SOJ and HP, updated and formatted	SEB
2010-03-29	Added “Leakrate Test” and reworked with ZH	WAA
2010-05-20	Added “IDLE Process” with SÖJ	WAA
2010-06-25	Reworked (e.g.: new monitor design)	WAA

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State:	Released		Author:	WAA
File:	EVG520_CAN_StartUp_GN_eng_10.doc			
Created on:	2010-03-01		Printed on:	2010-06-25
Version:	10.0		Last revision	2010-06-25
Purpose:	Operation		Language:	EN

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Recipe Programming

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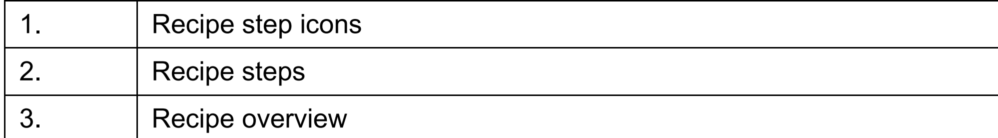
1 General

1.1 Recipe Window

A recipe defines the process.



1.	Recipe step icons
2.	Recipe steps
3.	Recipe overview

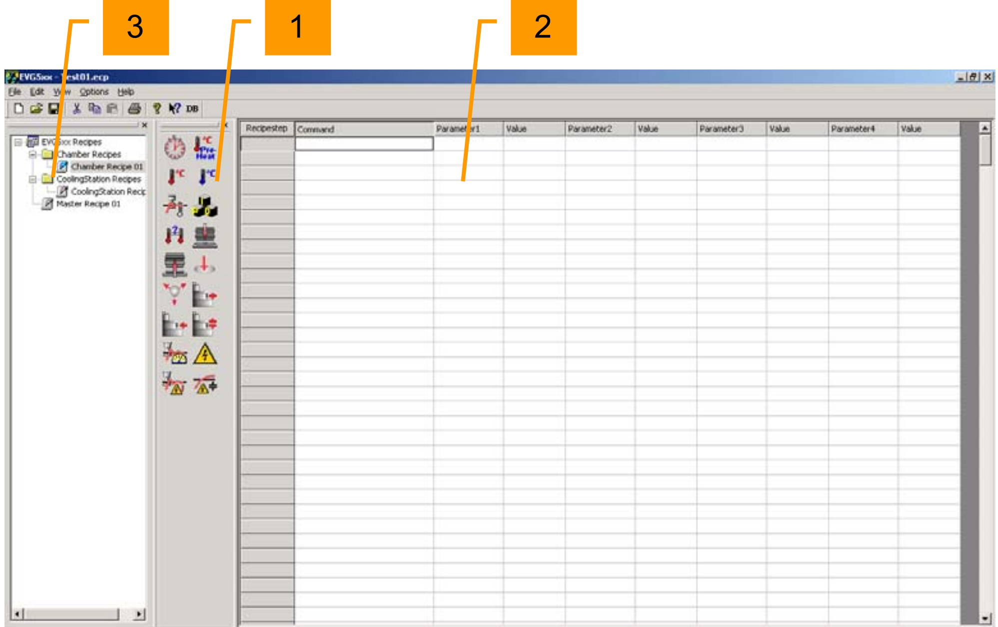


Figure 1 - Recipe Window

1.2 How to create a recipe:

Click on an icon and move it to the first free line (drag and drop). When you drop the recipe step a window appears where you can enter the parameters. To delete a step do a right-click on it. The parameter value(s) can be changed by double-clicking on the step. You can also paste a step between two existing steps. Just drop it over the second step.

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1.2.1 Create Recipe (Master Recipe)

Press “File” → “New” → “Save As” enter Recipe Name.

File format of saved recipe (*.ecp).

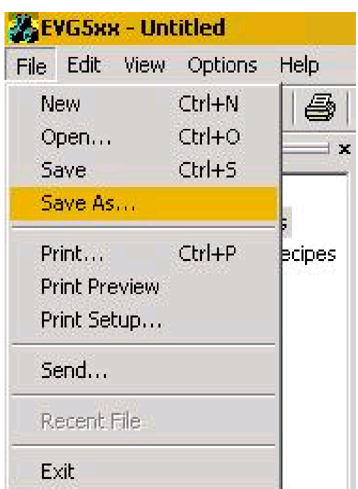

Figure 2 - Menu

Press on Chamber Recipe and select “New Chamber Recipe”.

Additional sub recipes can be created in the Master Recipe.

Chamber Recipes can be: Deleted, Renamed, Cut, Copied, Pasted.

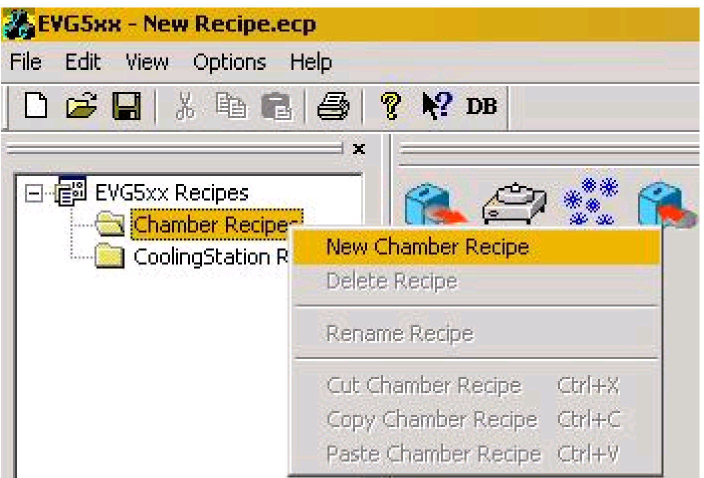

Figure 3 - New Recipe

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Icon bar will be displayed and recipe programming can be started.

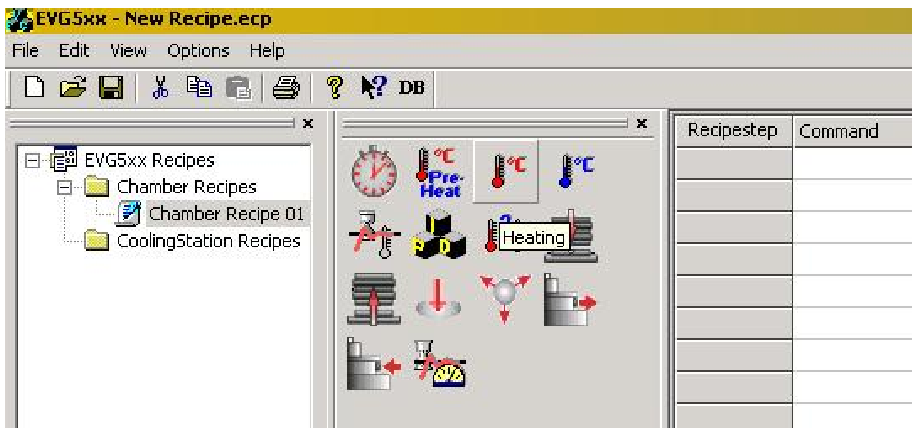

Figure 4 - Start Recipe Programming

Put the icon via "Drag&Drop" into Recipe Process List. After that the parameter window (if available for chosen recipe step) will open.

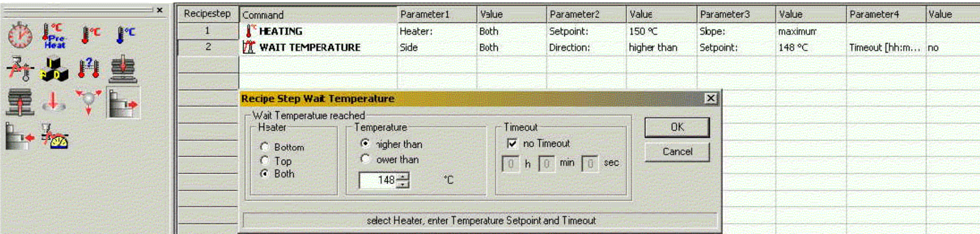

Figure 5 - Parameter Windows

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1.3 Overview - Icon Description/Commands

Icon	Recipe Command	EVG 520	EVG 520HE	EVG540 C2W	EVG 540	EVG560 Gemini	EVG560 Gem + LT
	Timer	●	●	●	●	●	●
	Pre-Heating	●	●	●	●	●	●
	Equalize Temperature	●	●	●	●	●	●
	Heating	●	●	●	●	●	●
	Cooling	●	●	●	●	●	●
	Wait Temperature	●	●	●	●	●	●
	SET PID Parameter	●	●	●	●	●	●
	Check Temperature	●	●	●	●	●	●
	Piston Up	●	●	●	●	●	●
	Evacuate	●	●	●	●	●	●
	Purge	●	●	●	●	●	●
	Pump and Purge	●	●	●	●	●	●
	Wait Pressure	●	●	●	●	●	●
	Piston Down	●	●	●	●	●	●
	Set Piston Pressure	--	--	●	--	--	--
	Attach Vacuum	--	●*	●*	--	--	--
	Wafer Bow	●	●	--	●	--	●
	Flags	●	●	--	●	--	●
	Set voltage	●*	●	--	●	--	●
	Wait Current	●*	●	--	●	--	●

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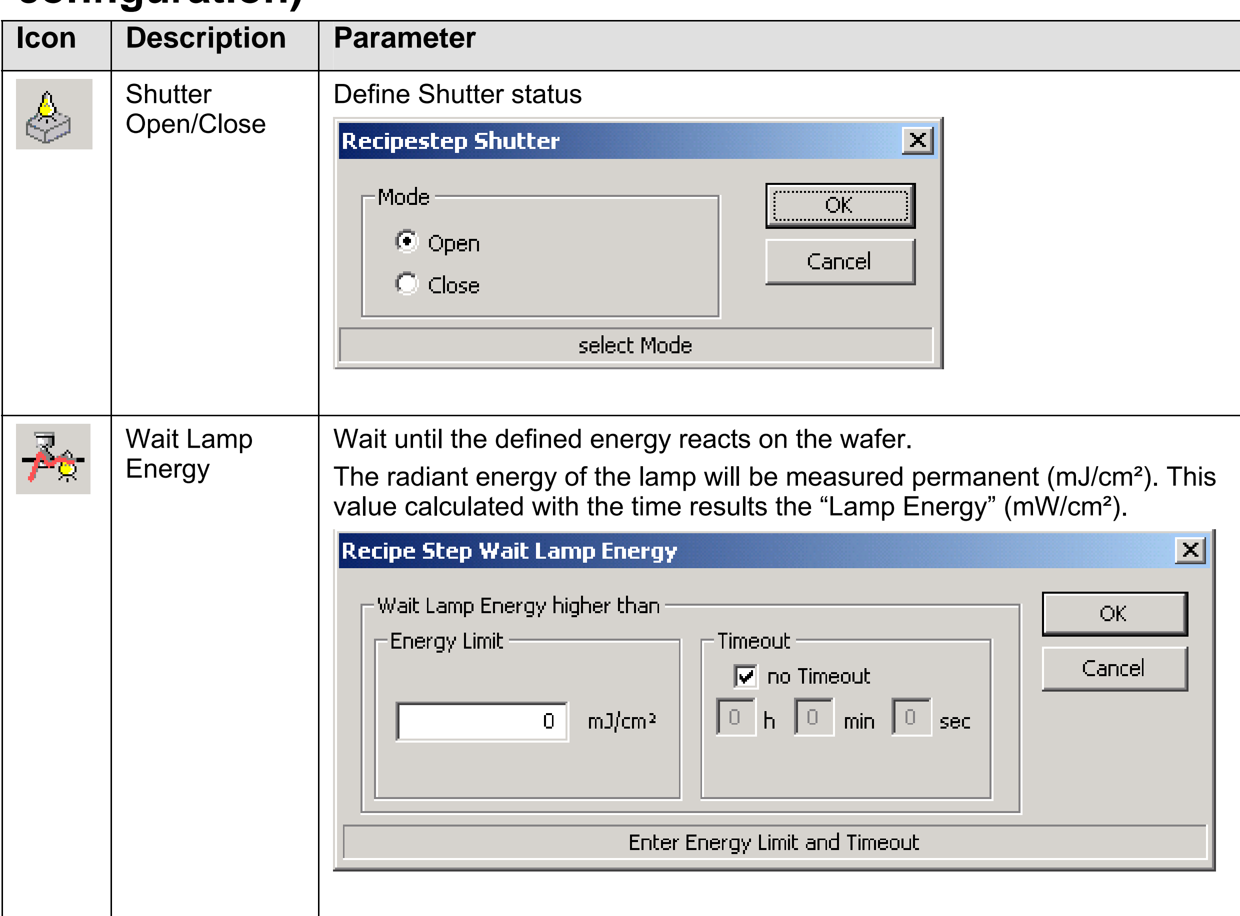
	Wait Charge	●*	●	--	●	--	●
	DeEmbossing Pins	--	●	--	--	--	--
	Wafer Unclamp	--	●	--	--	--	--

●… Equipped
-- … Not Equipped
* … Functions depending of the System

1.3.1 Exposure Function (depending of system configuration)



Icon	Description	Parameter
	Shutter Open/Close	Define Shutter status Recipestep Shutter Mode: Open / Close OK / Cancel select Mode
	Wait Lamp Energy	Wait until the defined energy reacts on the wafer. The radiant energy of the lamp will be measured permanent (mJ/cm²). This value calculated with the time results the “Lamp Energy” (mW/cm²). Recipe Step Wait Lamp Energy Wait Lamp Energy higher than Energy Limit: 0 mJ/cm² Timeout: no Timeout; 0 h 0 min 0 sec OK / Cancel Enter Energy Limit and Timeout

1.3.2 General Icons

Icon	Description	Parameter
	Timer	The system keeps the adjusted conditions until the time defined in this command is elapsed. The Timer has to be specified in hours, minutes and seconds. Max. allowed wait time: 9hours 59min 59sec For a longer wait time, multiple Timer can be inserted in the recipe. Recipe Step Timer Timersettings 0 hours 0 min 0 sec OK Cancel enter time to wait
	Pre-Heating	The defined temperature for the bottom- and topside heater (**Setpoint**) is valid when no process is running. In other words, as soon as a process has ended, the temperature on the top and the bottom side heater will go back to the values defined in this command. The actual value of the temperature can vary in the range defined in the field **Tolerance.** If the temperature is above or below the defined range, no further process will start, and no chuck can be loaded to the chamber (for EVG540, EVG560 and GEMINI systems) until the temperatures of the heaters have reached the specified range. Recipe Step Set Preheat Temperature Top Heater Setpoint 0 °C Tolerance 0 °C Bottom Heater Setpoint 0 °C Tolerance 0 °C OK Cancel enter Preheat Temperatures and Tolerances
	Equalize Temperatures	To equalize Top and Bottom Temperature before heating. Recipestep Equalize Temperatures Equalize Temperatures Equalize to warmest warmest average coldest Tolerance 0 °C Timeout no Timeout 0 h 0 min 0 sec OK Cancel select Mode, enter Tolerance Setpoint and Timeout
	Heating	Heats the top- or the bottom side heater or both together to a specified level.

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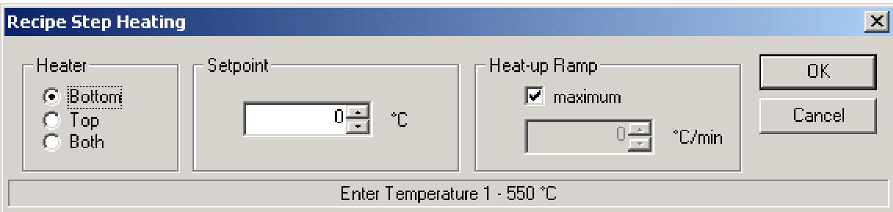
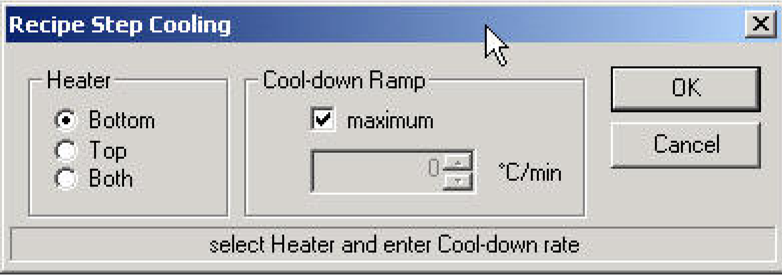
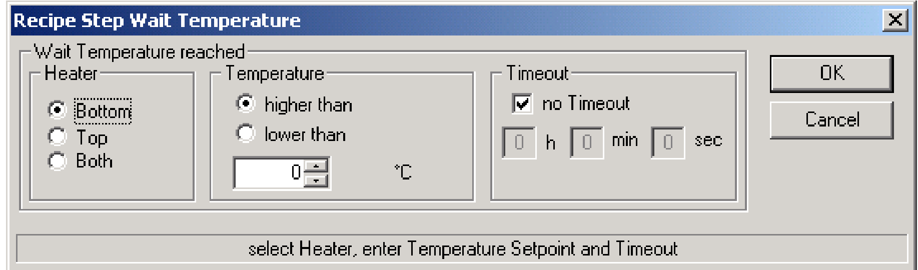
		The **Heat-up Ramp** defines the speed how fast the heaters should ramp up to the temperature. If the check box for maximum is activated, the system heats up as fast as possible until the specified temperature is reached. For defining different heat up procedures for the two heaters, the **Heating** command has to be inserted 2 times to adjust top- and bottom temperature independently. 
	Cooling	Cools the top- or the bottomside heater or both together to a specified level. The **Cool-down Ramp** defines the speed how fast the heaters should cool down. If the check box for maximum is activated, the system cools down as fast as possible until the specified temperature is reached. For defining different cool down procedures for the two heaters, the **Cooling** command has to be inserted 2 times to adjust the top- and bottom temperature independently. 
	Wait Temperature	The system waits until the specified temperature is reached on one or on both heaters. According to the process command before, the system will heat or cool and therefore the temperature will pass the defined temperature upwards (**higher than**) or downwards (**lower than**). The **Timeout** defines the maximum allowed wait time until the system stops the process and comes up with a timeout error message. It is recommended to use the **Timeout** feature only in well known and often used processes. The command is not useful for R&D processes as long as parameters are changed often. The risk that the system stops the process because of a wrong **Timeout** is high. 

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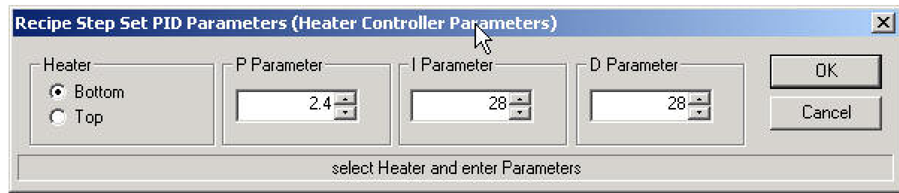
	Set PID Parameter	This command allows reconfiguring the PID parameters for the bottomside and/or the topside heater. Changed PID parameters are only valid for the recipe in which they are defined. The controller will automatically step back to the default values if the PID parameters are not specially defined. It is recommended to change the PID parameters in the first lines of the recipe to make them valid for the rest of the process. EVG adjusts the PID parameters to the best-known values. For standard processes and setups it is not needed and not recommended to change them. The values which are shown in the window are the best-known values adjusted by EVG. 
	Check Temperature	This command allows compares temperature sensors to other temperature sensors. Basically it would be possible to check every box and compare all the sensors against each other. The **Tolerance** defines the maximal allowed difference between the sensors. If more sensors are chosen and the temperature difference between two of them is above the tolerance the process will be stopped. The command allows furthermore to compare the actual temperature of one sensor to the **Last Setpoint** set prior to this command. **Operator Request:** Choose a timeout for how long the system has to wait for any operator command. Select mode “**Operator Request**”. If “**No Timeout**” is chosen the machine will wait for operator command endlessly. If “**Standard Timeout**” is chosen, the system will wait for 180 seconds for an operator command. After this 180 seconds the system will go on. If “**User Input**” is chosen enter a time in hours, minutes and seconds till the machine will go on without a operator command. Press “**Continue**” to operate the next recipe step. If “**Abort**” is chosen the system will abort the process. **Automatic Mode:** The automatic mode works the same way the standard timeout does.

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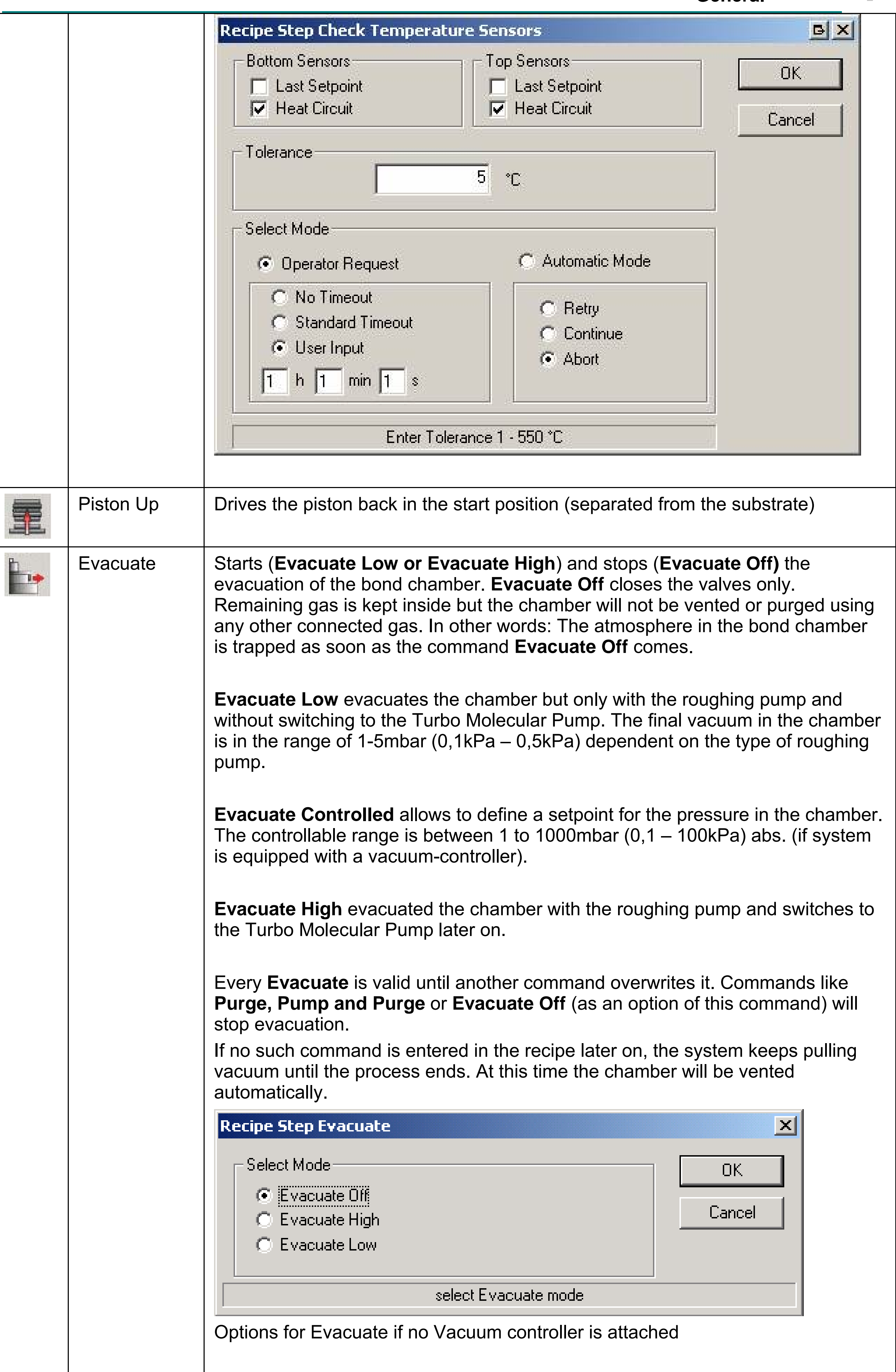
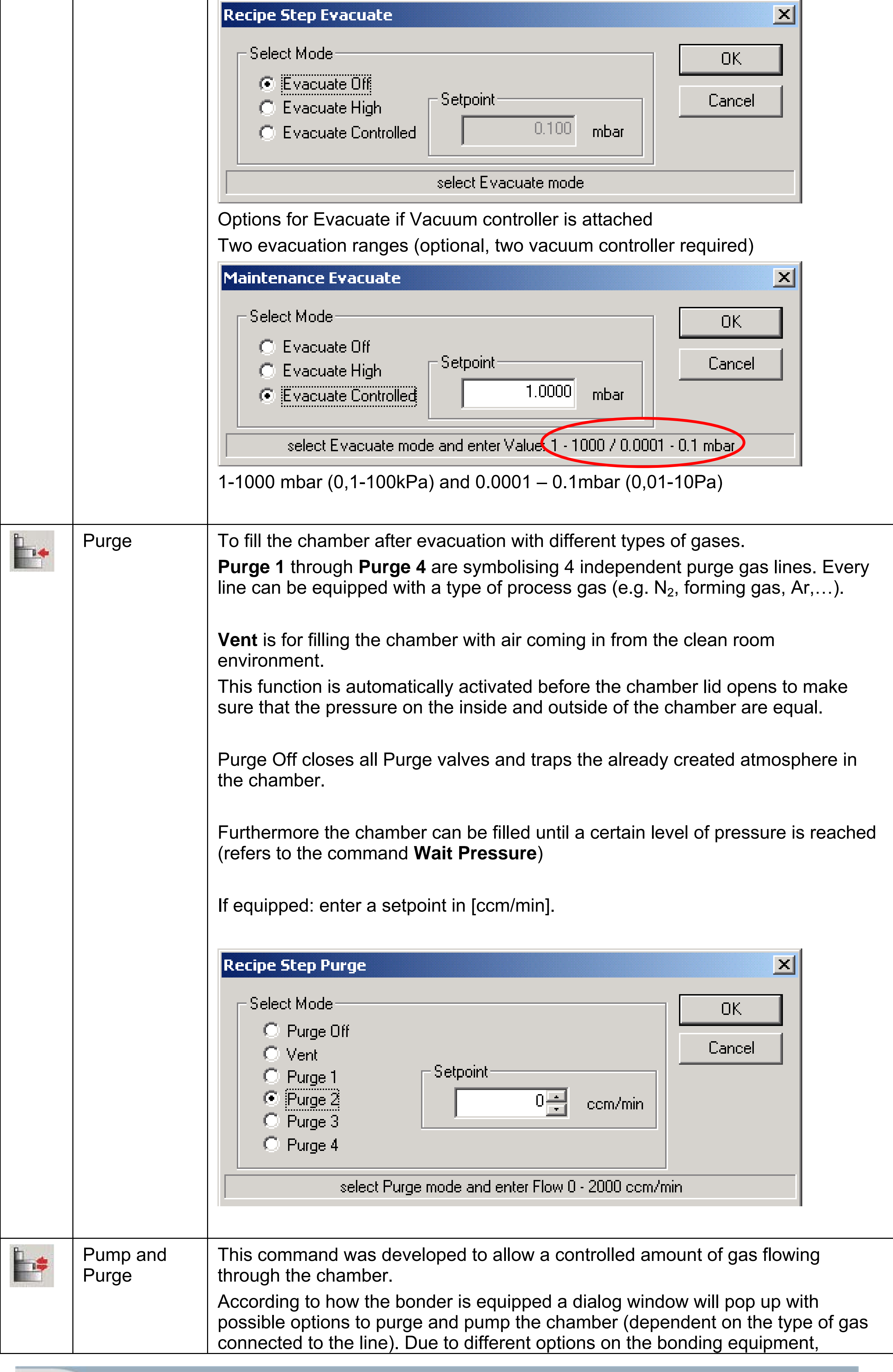


		Recipe Step Check Temperature Sensors Bottom Sensors: Last Setpoint, Heat Circuit Top Sensors: Last Setpoint, Heat Circuit OK / Cancel Tolerance: 5 °C Select Mode: Operator Request (No Timeout, Standard Timeout, User Input: 1 h 1 min 1 s); Automatic Mode (Retry, Continue, Abort) Enter Tolerance 1 - 550 °C
	Piston Up	Drives the piston back in the start position (separated from the substrate)
	Evacuate	Starts (**Evacuate Low or Evacuate High**) and stops (**Evacuate Off)** the evacuation of the bond chamber. **Evacuate Off** closes the valves only. Remaining gas is kept inside but the chamber will not be vented or purged using any other connected gas. In other words: The atmosphere in the bond chamber is trapped as soon as the command **Evacuate Off** comes. **Evacuate Low** evacuates the chamber but only with the roughing pump and without switching to the Turbo Molecular Pump. The final vacuum in the chamber is in the range of 1-5mbar (0,1kPa – 0,5kPa) dependent on the type of roughing pump. **Evacuate Controlled** allows to define a setpoint for the pressure in the chamber. The controllable range is between 1 to 1000mbar (0,1 – 100kPa) abs. (if system is equipped with a vacuum-controller). **Evacuate High** evacuated the chamber with the roughing pump and switches to the Turbo Molecular Pump later on. Every **Evacuate** is valid until another command overwrites it. Commands like **Purge, Pump and Purge** or **Evacuate Off** (as an option of this command) will stop evacuation. If no such command is entered in the recipe later on, the system keeps pulling vacuum until the process ends. At this time the chamber will be vented automatically. **Recipe Step Evacuate** Select Mode: Evacuate Off, Evacuate High, Evacuate Low OK / Cancel select Evacuate mode Options for Evacuate if no Vacuum controller is attached



		Options for Evacuate if Vacuum controller is attached Two evacuation ranges (optional, two vacuum controller required) 1-1000 mbar (0,1-100kPa) and 0.0001 – 0.1mbar (0,01-10Pa)
	Purge	To fill the chamber after evacuation with different types of gases. **Purge 1** through **Purge 4** are symbolising 4 independent purge gas lines. Every line can be equipped with a type of process gas (e.g. N_2, forming gas, Ar,…). **Vent** is for filling the chamber with air coming in from the clean room environment. This function is automatically activated before the chamber lid opens to make sure that the pressure on the inside and outside of the chamber are equal. Purge Off closes all Purge valves and traps the already created atmosphere in the chamber. Furthermore the chamber can be filled until a certain level of pressure is reached (refers to the command **Wait Pressure**) If equipped: enter a setpoint in [ccm/min].
	Pump and Purge	This command was developed to allow a controlled amount of gas flowing through the chamber. According to how the bonder is equipped a dialog window will pop up with possible options to purge and pump the chamber (dependent on the type of gas connected to the line). Due to different options on the bonding equipment,

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<table>
<tr>
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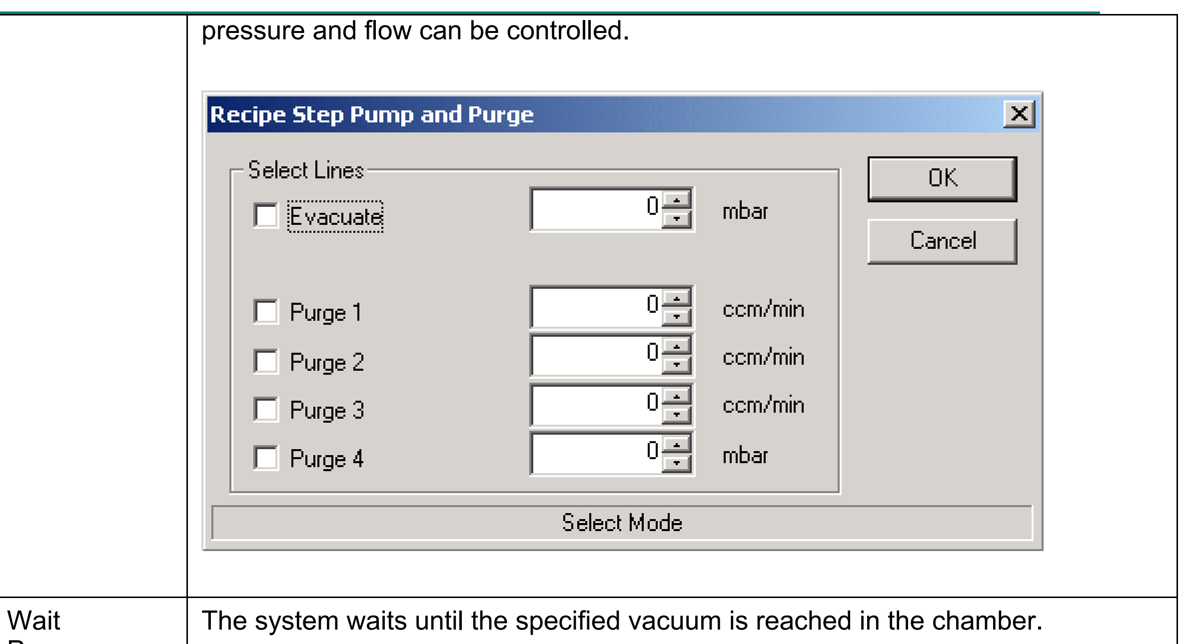
<td>
pressure and flow can be controlled.

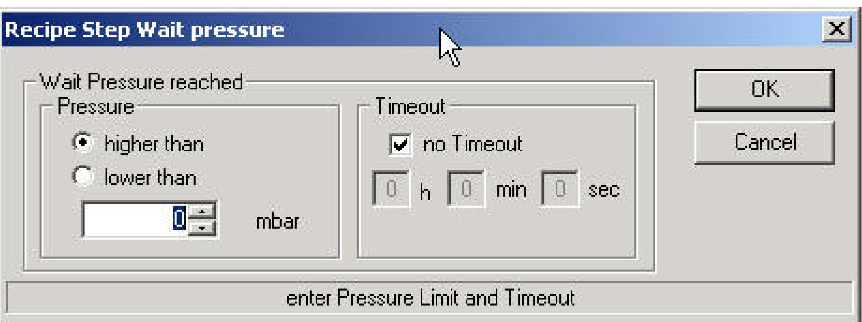


</td>
</tr>
<tr>
<td> </td>
<td>Wait Pressure</td>
<td>
The system waits until the specified vacuum is reached in the chamber.

According to the process command before, the system will check evacuation (**lower than**) or purging (**higher than**).

The **Timeout** defines the maximum allowed wait time until the system stops the process and comes up with a timeout error message.

It is recommended to use the **Timeout** feature only in well known and often used processes. The command is not useable for R&D processes as long as parameters are changed often. The risk that the system stops the process because of a wrong **Timeout** is high otherwise.



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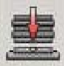
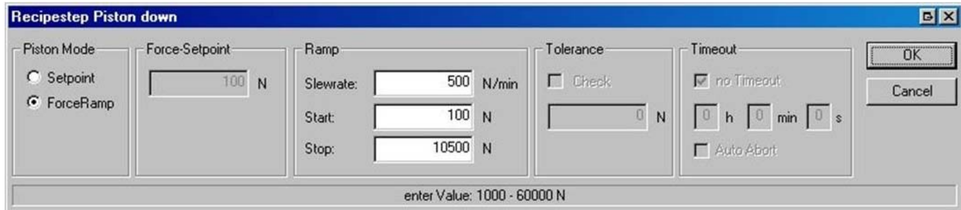
</tr>
<tr>
<td></td>
<td>Piston Down (EVG520HE =EVG540= EVG560)</td>
<td>
Moves the piston of the bonder. The topside heater comes in contact with the substrate. The force, which is used to press the topside heater down, has to be defined in this command.



Warning: Piston Down: The value for the Newton indication is limited:

Pneumatic Bonders: minimal force: 100N

Hydraulic Bonders: minimal force: 500N.

Functions:

If **“Setpoint”** in “Piston Mode” is chosen:

Enter a Force-Setpoint – the Piston goes down with the entered force.
</td>
</tr>
</table>

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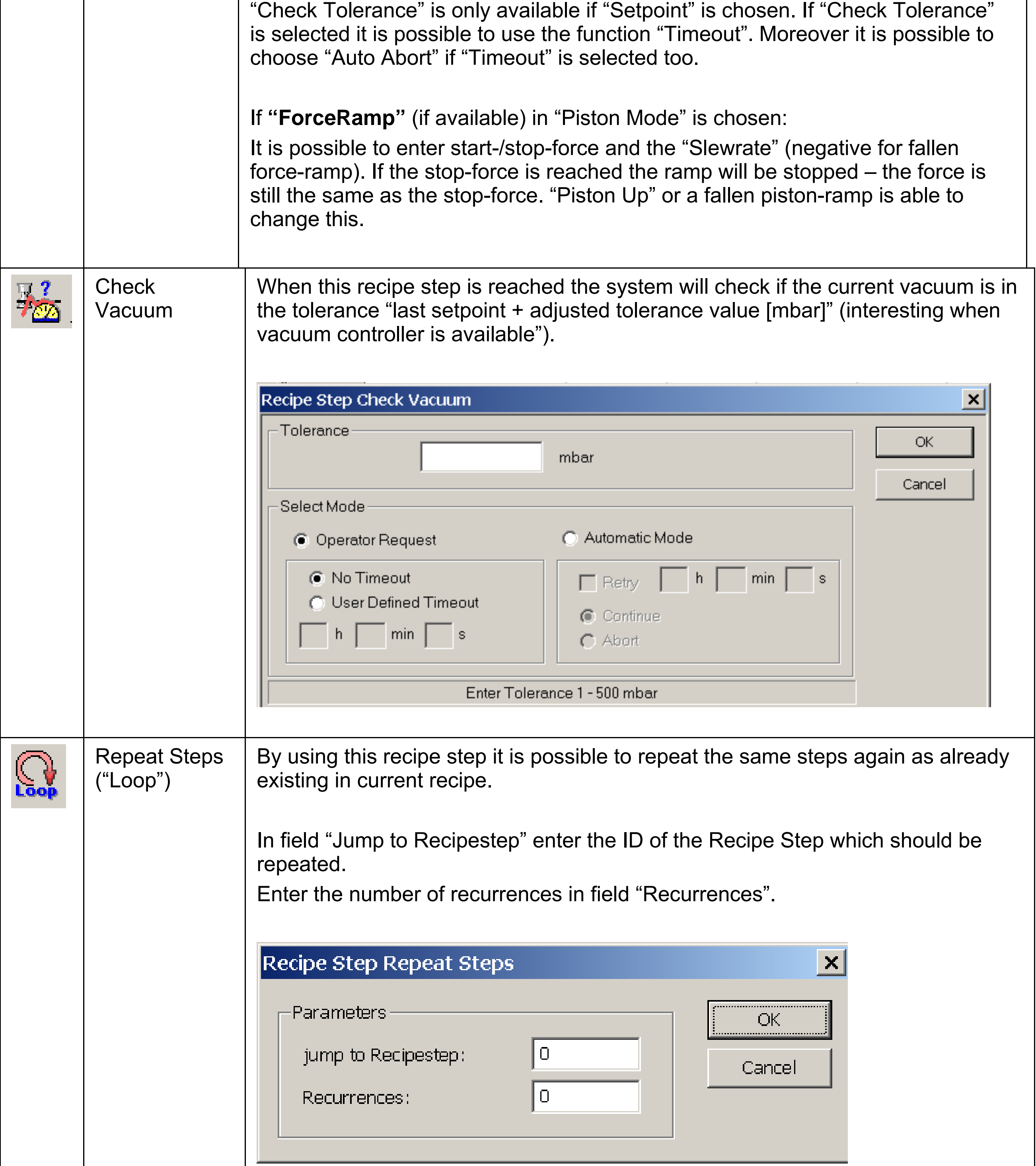

		"Check Tolerance" is only available if "Setpoint" is chosen. If "Check Tolerance" is selected it is possible to use the function "Timeout". Moreover it is possible to choose "Auto Abort" if "Timeout" is selected too. If **"ForceRamp"** (if available) in "Piston Mode" is chosen: It is possible to enter start-/stop-force and the "Slewrate" (negative for fallen force-ramp). If the stop-force is reached the ramp will be stopped – the force is still the same as the stop-force. "Piston Up" or a fallen piston-ramp is able to change this.
	Check Vacuum	When this recipe step is reached the system will check if the current vacuum is in the tolerance "last setpoint + adjusted tolerance value [mbar]" (interesting when vacuum controller is available").
	Repeat Steps ("Loop")	By using this recipe step it is possible to repeat the same steps again as already existing in current recipe. In field "Jump to Recipestep" enter the ID of the Recipe Step which should be repeated. Enter the number of recurrences in field "Recurrences".

1.4 Max. Piston Force specified according to the type of pressure disc

This table should provide benchmark numbers for orientation what is possible with different pressure disc materials.

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**Warning: Bondchucks and pressure discs have to match to each other. EVG recommends using appropriated pressure discs and bondchucks.
Bonding of substrates which do not fit to the specified size of pressure disc and bondchuck results in lower max piston force, bending or breaking the pressure disc or substrate.**

Note: Bondchucks and pressure discs have to be flat. Warpaged parts can cause breaking or warping.

The colored field shows the piston force in steady state condition (without any temperature change).

The uncolored field shows the force applicable during the heating or cooling sequence. The values are based on standard Si-substrates according to SEMI standards. If more force is applied either substrate or pressure disc breakage (Quartz, Ceramic) may occur.

Bonder Size	**150mm**											
Pressure Disc for	**200mm**		**150mm**		**125mm**		**100mm**		**3in**		**2in**	
Stainl. St. /Ti			60kN	8kN	50/40kN*	5kN	30kN	4kN	15kN	1,5kN	6kN	1kN
Quartz*			10kN	5kN	8kN	4kN	5kN	2kN	3kN	1kN	2kN	0,5kN
Ceramic			10kN	5kN	8kN	4kN	5kN	2kN	3kN	1kN	2kN	0,5kN

*) Quartz material is extremely sensitive to particles on the substrate surface. Take care that all surfaces which are in contact with the quartz during bonding are very clean.

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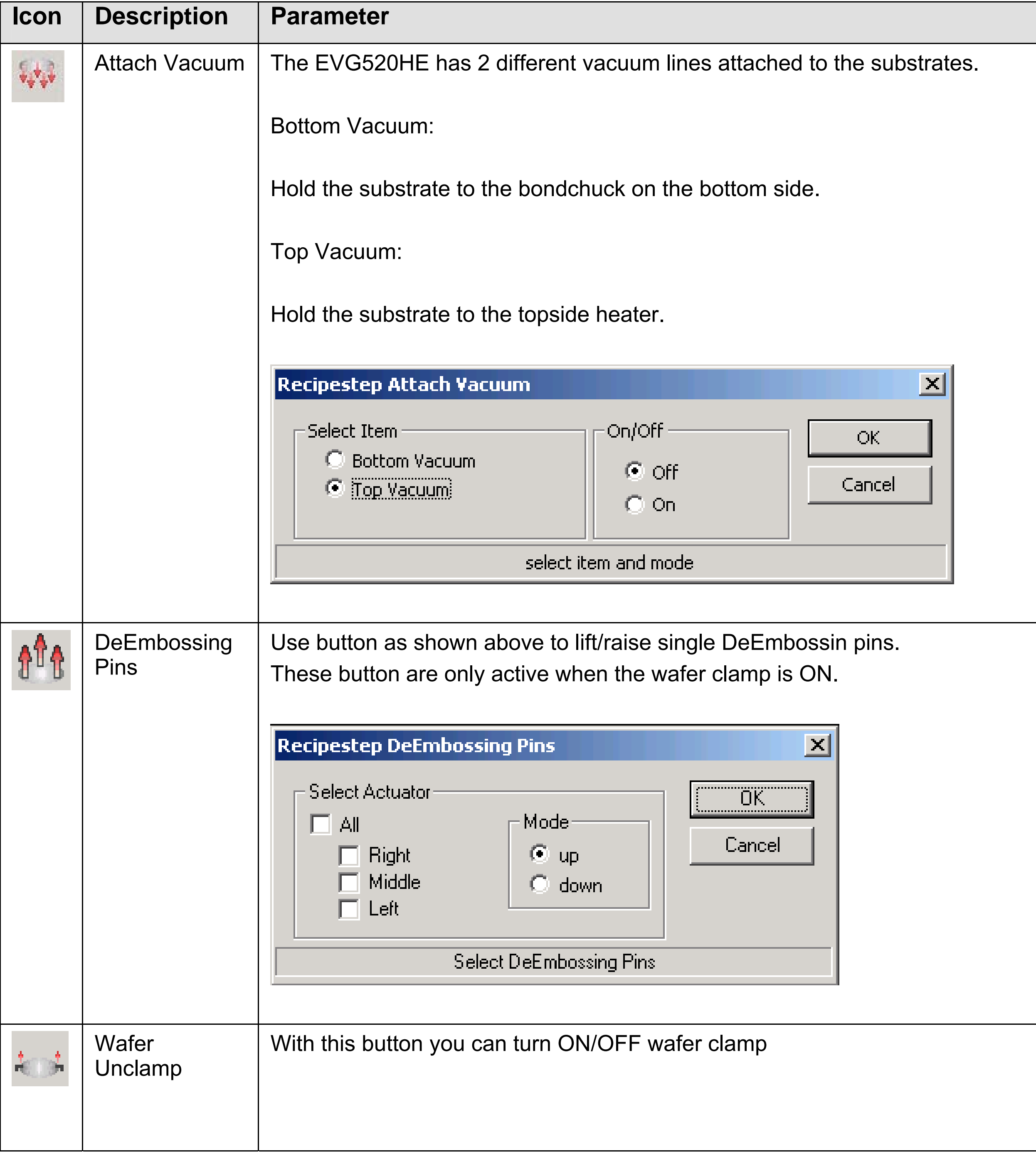
1.4.1 EVG520HE Recipe Icons



Icon	Description	Parameter
	Attach Vacuum	The EVG520HE has 2 different vacuum lines attached to the substrates. Bottom Vacuum: Hold the substrate to the bondchuck on the bottom side. Top Vacuum: Hold the substrate to the topside heater.
	DeEmbossing Pins	Use button as shown above to lift/raise single DeEmbossin pins. These button are only active when the wafer clamp is ON.
	Wafer Unclamp	With this button you can turn ON/OFF wafer clamp

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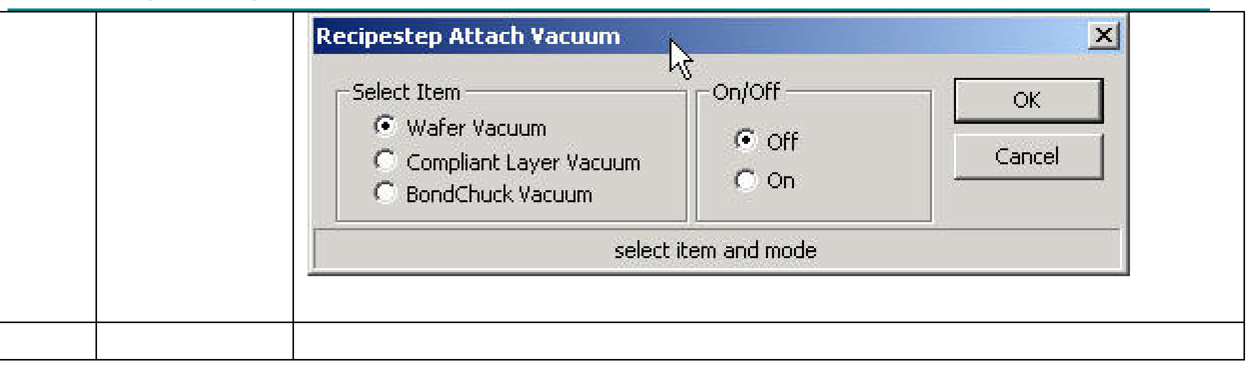
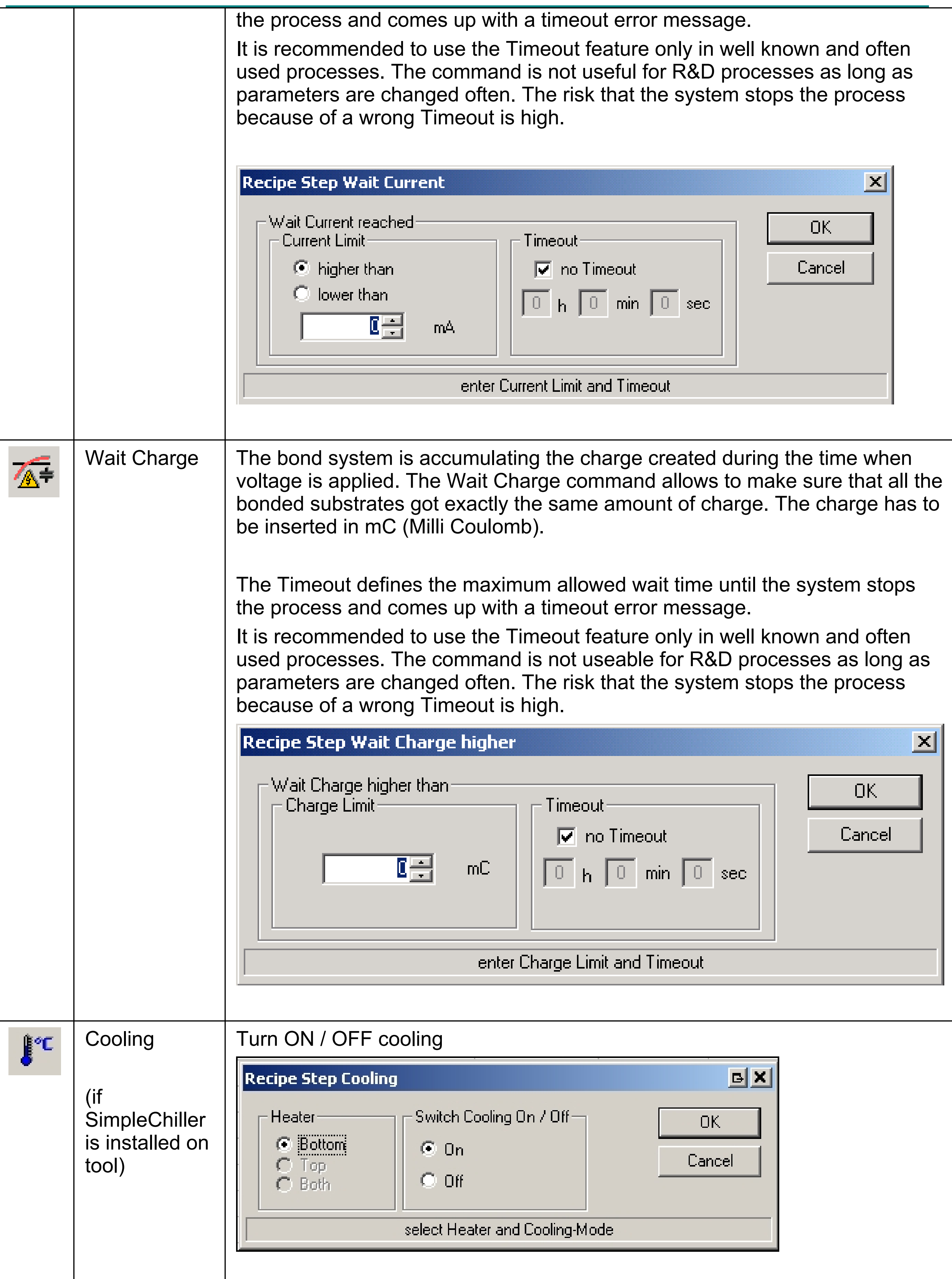
1.4.2 EVG540 C2W Recipe Icons

Icon	Description	Parameter
	Piston Down EVG540 C2W	Moves the piston of the bonder. The topside heater comes in contact with the substrate.
	Set Piston Pressure EVG540 C2W	The field PISTON PRESSURE defines the pressure, which is applied to the total amount of area defined in the parameter file. The system automatically calculates the center of area and adjusts the force in a way that all the chips get the same amount of bond force. Mode: automatic – search for parameter File According to the barcode of the substrate the system is looking for a data file containing the information of the center of area. The subdirectory where this file is stored can be adjusted in the software. If no file can be found with the necessary data the system will automatically jump to the manual mode and is asking for inserting the parameters manually. (Refer to EVG540 Start Up Description → Parameter File Directory) manual – enter parameters manually The parameters for calculating the centre of area has to be adjusted manually in the software. The data have to be inserted when the start button for the process is pressed.
	Attach Vacuum	The EVG540 C2W has 3 different vacuum lines attached to the substrates. Wafer Vacuum: Hold the substrate to the bondchuck on the bottom side. Compliant Layer Vacuum: Hold the compliant layer to the topside heater. This vacuum is the only vacuum which is switched on by default. Bond Chuck Vacuum: This vacuum holds the bondchuck down in order to avoid lifting it during the piston up procedure.


Recipestep Attach Vacuum
Select Item
Wafer Vacuum
Compliant Layer Vacuum
BondChuck Vacuum
On/Off
Off
On
OK
Cancel
select item and mode

1.4.3 EVG520, 540 and EVG560 Recipe Icons

Icon	Description	Parameter
	Wafer Bow	Activates the wafer bow function The ceramic pin that makes contact with the wafers first when the piston comes down in the bonder. (More details refer to manual – wafer bow pin function. Pay attention to the Wafer Stack Height!)
	Flags	Pulls the wafer separation flags. The command allows defining either to pull out all 3 spacers at once or to pull the spacer one by one. For pulling the spacer individually the proper check box has to be activated and the command has to be inserted 3 times in the recipe. Each time with a different check box activated. Recipestep Flags out Select Flag All Flags Right Middle Left OK Cancel select Flags
	Set Voltage	In this command all the parameters for applying the voltage have to be defined. The HV Mode defines which polarity the part attached to the high voltage connection on the topside of the bonder should have. The command is furthermore necessary to switch the voltage off after the anodic bond is performed. The Setpoint defines the Voltage applied to the substrate. The Voltage Ramp defines how fast the Voltage should ramp up. The checkbox Off under Voltage Ramp leads to applying the voltage as fast as possible. The default value for the Current Limit is the max. achievable current and limited at 50mA. The limit can be set according to the process requirements. Recipestep Set Voltage HV Mode: Off, Negative, Positive Setpoint 0 V Voltage Ramp off 0 V/s Current Limit 50 mA OK Cancel select Mode and enter Setpoint
	Wait Current	According to the defined value in the field Current Limit, the system will check for the current passing the limit downwards (lower than) or upwards (higher than). The Timeout defines the maximum allowed wait time until the system stops



		the process and comes up with a timeout error message. It is recommended to use the Timeout feature only in well known and often used processes. The command is not useful for R&D processes as long as parameters are changed often. The risk that the system stops the process because of a wrong Timeout is high.
	Wait Charge	The bond system is accumulating the charge created during the time when voltage is applied. The Wait Charge command allows to make sure that all the bonded substrates got exactly the same amount of charge. The charge has to be inserted in mC (Milli Coulomb). The Timeout defines the maximum allowed wait time until the system stops the process and comes up with a timeout error message. It is recommended to use the Timeout feature only in well known and often used processes. The command is not useable for R&D processes as long as parameters are changed often. The risk that the system stops the process because of a wrong Timeout is high.
	Cooling (if SimpleChiller is installed on tool)	Turn ON / OFF cooling

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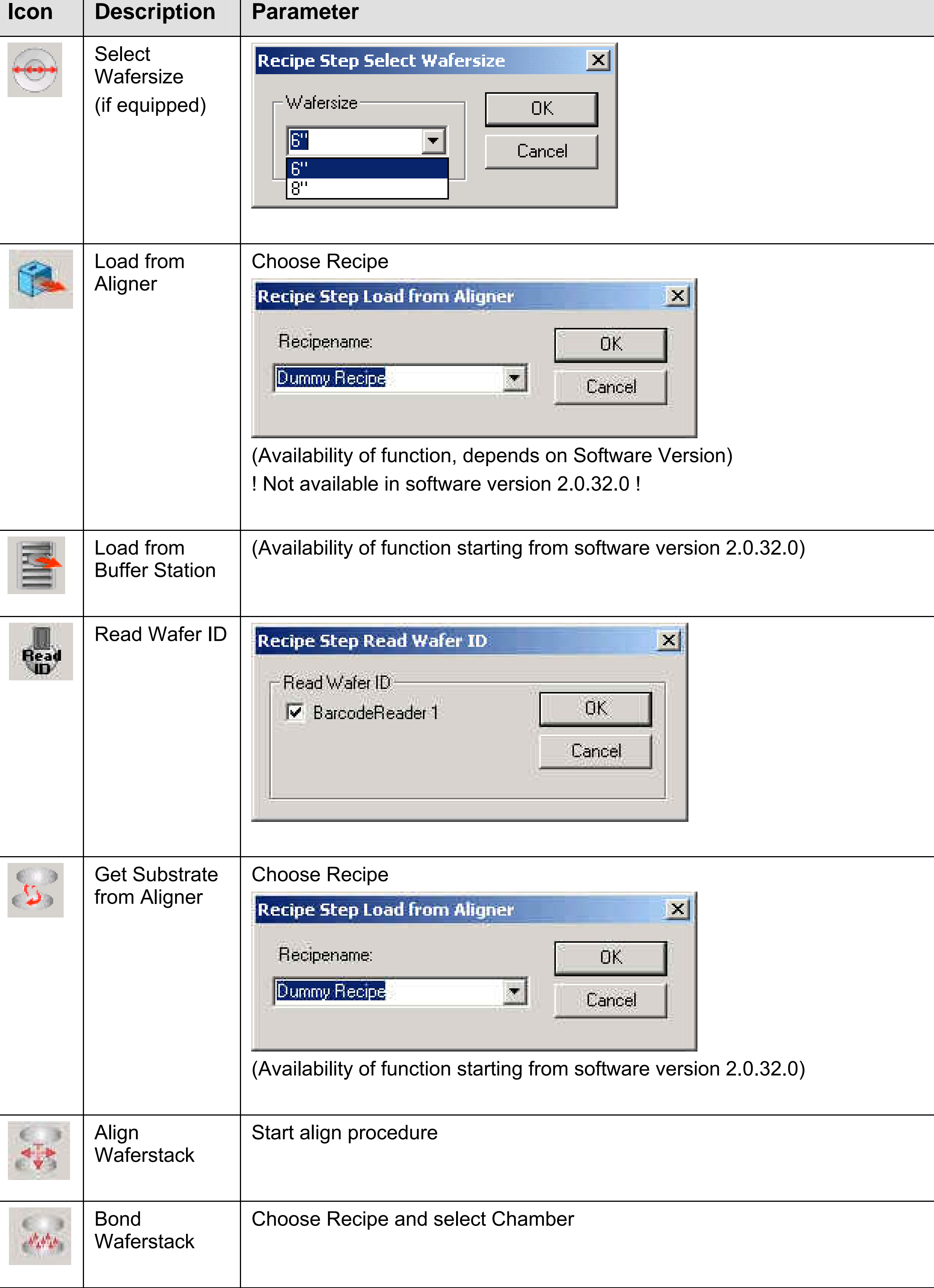
1.4.4 EVG560 Gemini Master Recipe Icons



Icon	Description	Parameter
	Select Wafersize (if equipped)	Recipe Step Select Wafersize Wafersize: 6" / 8" OK / Cancel
	Load from Aligner	Choose Recipe Recipe Step Load from Aligner Recipename: Dummy Recipe OK / Cancel (Availability of function, depends on Software Version) ! Not available in software version 2.0.32.0 !
	Load from Buffer Station	(Availability of function starting from software version 2.0.32.0)
	Read Wafer ID	Recipe Step Read Wafer ID Read Wafer ID BarcodeReader 1 OK / Cancel
	Get Substrate from Aligner	Choose Recipe Recipe Step Load from Aligner Recipename: Dummy Recipe OK / Cancel (Availability of function starting from software version 2.0.32.0)
	Align Waferstack	Start align procedure
	Bond Waferstack	Choose Recipe and select Chamber

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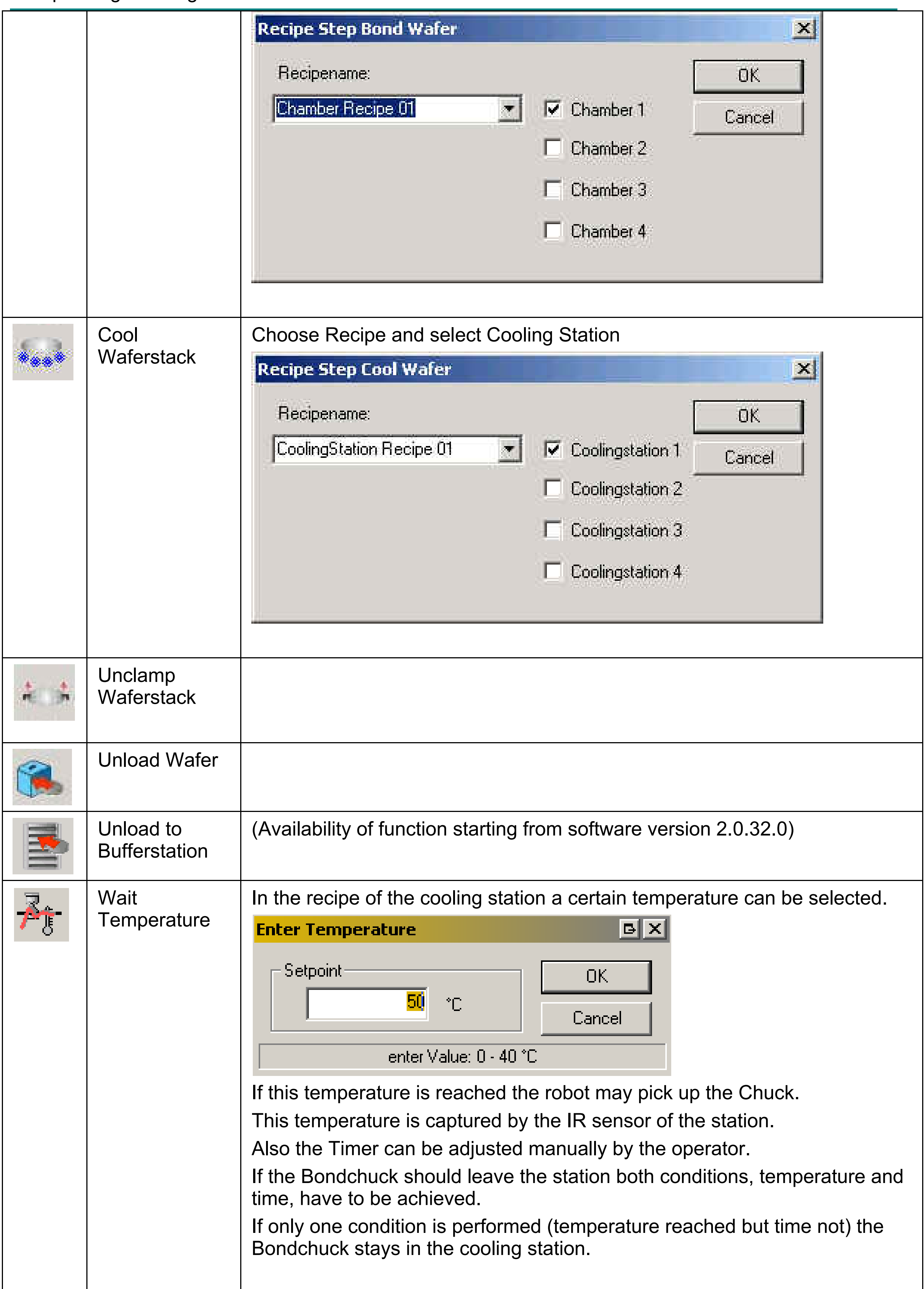

	Cool Waferstack	Choose Recipe and select Cooling Station
	Unclamp Waferstack	
	Unload Wafer	
	Unload to Bufferstation	(Availability of function starting from software version 2.0.32.0)
	Wait Temperature	In the recipe of the cooling station a certain temperature can be selected. If this temperature is reached the robot may pick up the Chuck. This temperature is captured by the IR sensor of the station. Also the Timer can be adjusted manually by the operator. If the Bondchuck should leave the station both conditions, temperature and time, have to be achieved. If only one condition is performed (temperature reached but time not) the Bondchuck stays in the cooling station.

Example:

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Recipestep	Command	Parameter1	Value	Parameter2	Value
1	SELECT WAFERSIZE	Size	8"		
2	LOAD FROM BUFFERSTATION				
3	READ BONDCHUCK ID	Stations	1		
4	GET SUBSTRATE FROM ALIGN...	Recipename:	Aligner Recipe 1		
5	BOND WAFER	Recipename:	Timer	Chambers:	1,3
6	BOND WAFER	Recipename:	test	Chambers:	2,4
7	COOL WAFER	Recipename:	CoolingStation Rec...	Coolingsta...	1,2,3,4
8	UNCLAMP WAFER				
9	UNLOAD WAFER				
10	UNLOAD TO BUFFERSTATION				

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2 Save recipe

Click „File“ in the menu bar and then on „save“ or “save as”. Enter the recipe name and click on “save”.

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3 Terminal

In the Log Terminal window all commands can be watched.

You will get the Terminal when you click


```
12:50:19 - COT2: ChuckMotor: Stop rotation.
12:50:17 - COT2: Loadingpins up!
12:50:18 - COT2: Loadingpins down!
12:50:20 - COT2: Switch on chuckvacuum!
12:50:21 - COT2: Open Cover!
12:51:51 - COT2: Open Cover!
12:51:52 - COT2: Loadingpins up!
12:51:53 - COT2: Loadingpins down!
12:51:53 - COT2: Close Cover!
12:51:53 - COT2: Open Cover!
12:51:54 - COT2: Loadingpins up!
```

All messages | Messages only | Errors only | Alarms

Choose between “All messages”, “Messages Only”, “Error Only” or “Alarms”. To switch between the states click the folders on the bottom of the terminal window.

4 Initialization

The Initialization for Maintenance runs over the windows™ registry.

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5 Set-up Procedures

The following section contains information about any set-up procedure that is necessary to run a process on a selected product.

5.1 Adjustment of the wafer stack-thickness for Wafer Bow

When activating wafer bow the bow cylinder lowers the piston including absorber plate with pressure disk down. It moves down so that there is 2mm clearance between pressure disk and wafer stack and the spring-loaded center pin makes contact to the wafer stack and retracts 0.5mm (offset).

The spring coefficient of that spring is 5N/mm and it is preloaded with 5N.

The total bow-force applied to the wafer stack will be:

5N + 0.5mm * 5N/mm=7.5N

The stroke can be adjusted on the dial indicator mounted on top of the pressure head and must be appropriate to the stack height. Otherwise pressure disk moves down too far and flags won't pull out or even the wafer stack can be damaged.

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5.2 Before Adjusting the Wafer Bow (Hydraulic System only)

Note: The following steps only have to be done on hydraulic systems before adjusting the wafer bow.

1) Click on the chamber where the wafer bow has to be adjusted (1).
2) Go to "Piston" (2) and click on "Adjust Waferbow" (3).

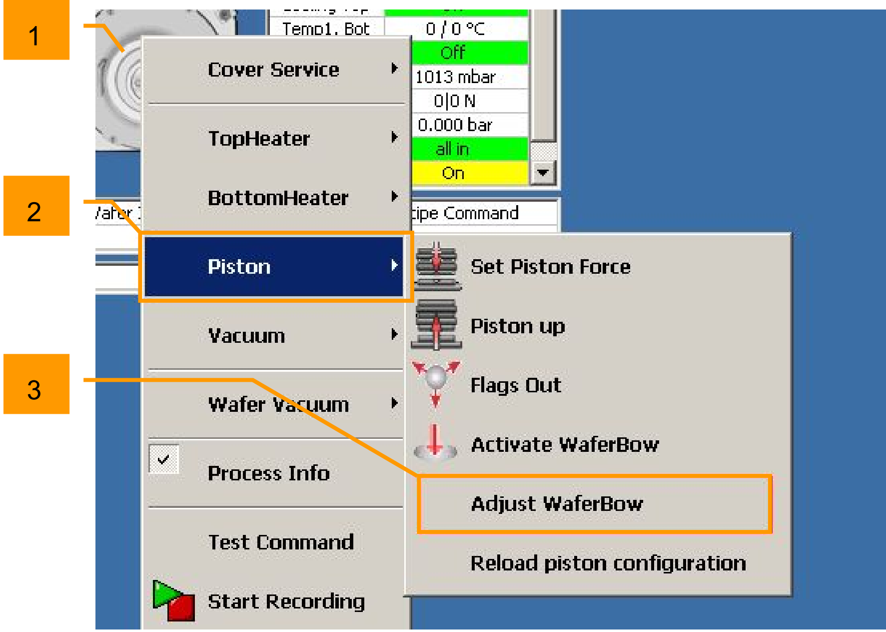

Figure 6 - Adjust Wafer Bow

The following message box will appear:

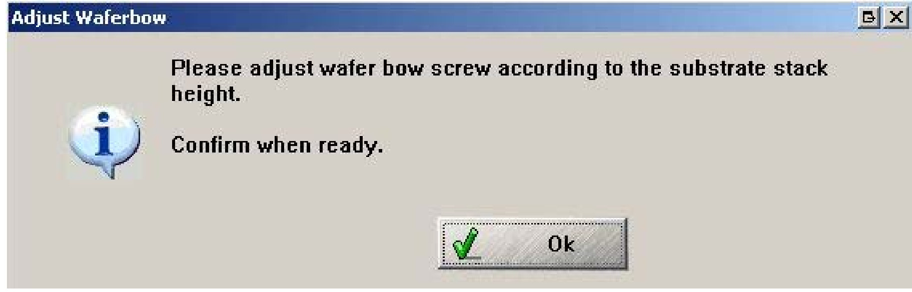

Figure 7 - Adjust Waferbow Message Box

3) Follow the instructions in the message box and click on "OK" when finished.

Note: Do not click on "OK" if the wafer bow screw is not adjusted correctly yet!

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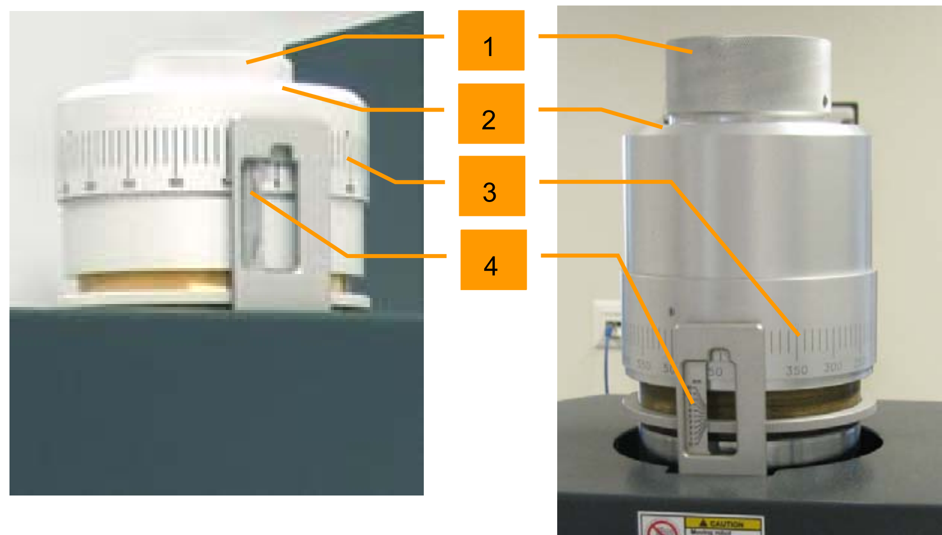
5.3 Location and Description of Dial Indicator

The dial indicator is used to set the stack height:

Figure 8 – Location on the EVG5xx



1	Locking Hub
2	Adjustment wheel
3	Scale for fine adjustment
4	Scale for coarse adjustment

By setting the stack thickness the stroke of the bow piston is limited according the stack thickness. The stack thickness must be set with the adjustment wheel (see “2” above).

Warning: You must not adjust the stack-thickness below zero! An adjustment below zero will cause damage to the bonder!

One turn of the wheel means a change of the stroke by 1 mm which is indicated on the scale for coarse adjustment beside the wheel.

Using the scale for fine adjustment on the wheel itself allows us to adjust for micrometers.

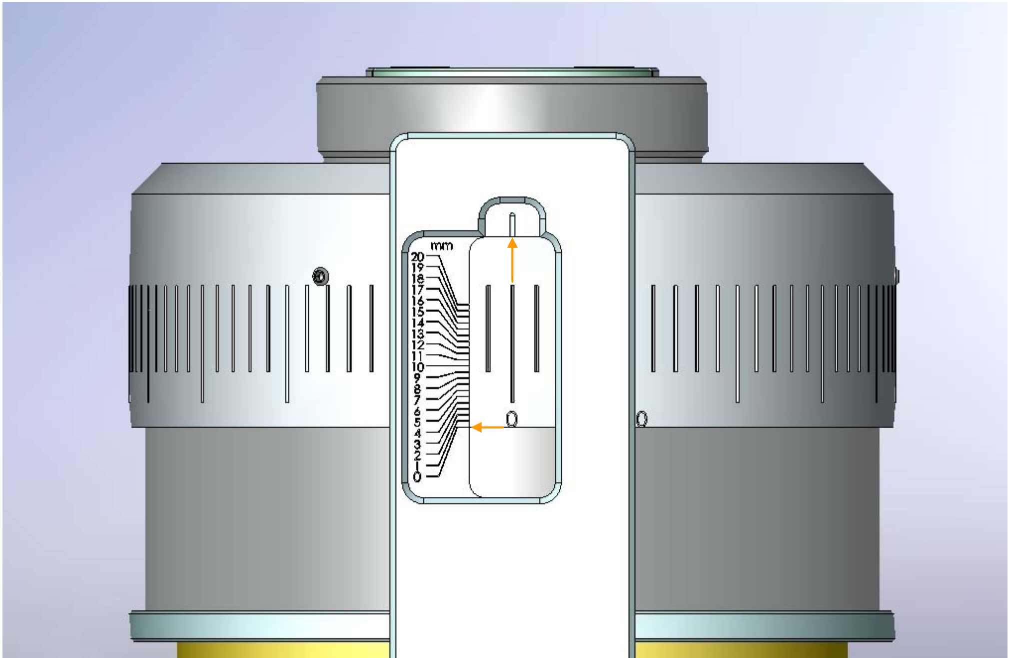


Figure 9 - Scale for fine adjustment set to zero

Attention: The wafer stack thickness must be the same on all bond-tools for the chosen process program. If its not, you may not be able to pull the wafer separation flags and this could damage your wafer stack!!!!!

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5.4 Example for wafer stack thickness

Use the following example for the adjustment of your stack:

Thickness of first wafer	480µ
Thickness of flags	50µ
Thickness of second wafer	480µ
Thickness of electrode (movable center disc)	1000µ
Total Stack Thickness:	**2010µ**

5.5 Sequence during process

When wafer bow is applied the pressure disk lowers until 3mm clearance to wafer stack and center pin retracts 0.5mm. The force applied to the center of the wafer stack will be 7.5N (5N pre-load + 0.5mm * 5N/mm).

Wafer flags are pulled out. Piston down is performed and pressure disk lowers, the Wafer Bow pin moves 2mm to the inside and the force of the center pin will increase by 10N (2mm * 5N/mm) to 17.5N on the wafer. This is not a bow-force anymore because the flags at this point are pulled and not separating the wafers any more and the entire pressure disk will make contact to the wafer stack.

5.6 Spring ratings

In 8” systems the standard springs for wafer bow are rated at 5N per mm.

There may be processes where other springs are necessary (thin wafer, thick wafer, deep etched wafer, thick flags, etc.).

Please contact EV Group for your specific needs.

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History

Date	Modification	by
2006-01-01	Page 7: Wait Lamp Energy; formatted file	HMA
2006-06-01	Add Softwarechanges for Piston Down (Page 15)	HMA
2006-07-04	Add item "1.4 Max. Piston Force specified according to the type of pressure disc"	HMA
2006-10-24	Updated "Recipe Step Check Temperature Sensors"	HMA
2007-08-22	Updated table in "1.4 Max. Piston Force specified according to the type of pressure disc"	HMA
2007-10-10	Updated with GCA (added recipe steps "Check Vacuum" and "Repeat Steps"; added information for "Purge")	HMA
2007-10-18	Added values in Pascal (bar – Pascal)	HMA
2008-06-04	Modified warning "Bondchucks and Pressure Discs"	HMA
2008-07-31	Added recipe icon "Wait Temperature" (EVG560)	PRW
2008-09-01	Added Simple Chiller recipe command "Cooling"	HMA
2010-04-28	Updated Set-up Procedures with PC	WAA

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Development Engineer - Process Description

Customer Support Documentation
EVG5xx

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1 Wafer Bonding Processes

1.1 Direct Wafer Bonding

This is a wafer bonding method in which the adhesion between two surfaces occurs as a result of chemical bonds established between molecules from the two surfaces. Typically the adhesion is weak at room temperature (mediated by Van der Waals forces) and maximum bond strength is reached by transforming the weak bonds into covalent bonds through a high temperature thermal annealing (process flow shown in fig. 1).

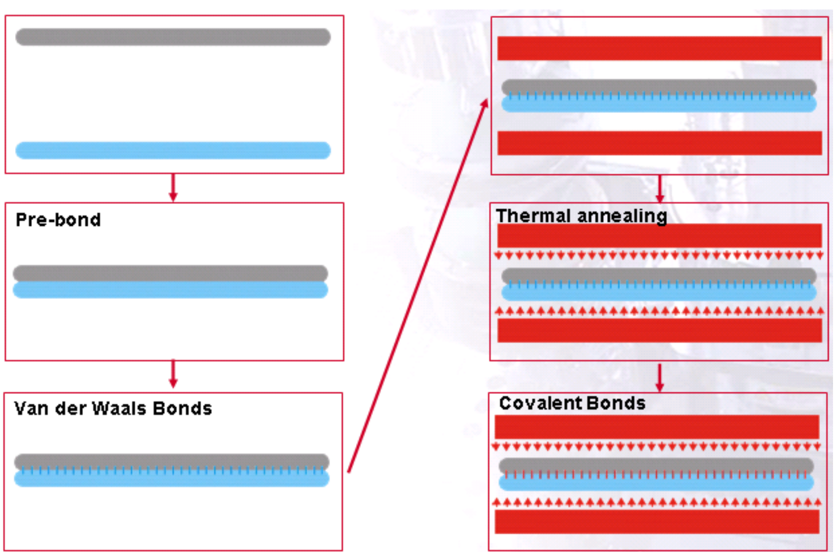

Figure 1 - Direct wafer bonding process flow

For Si-Si direct bonding the annealing temperature is >600°C for hydrophobic bonding (SiO_2 removed from Si prior bonding by 1-2% HF) or >900°C for hydrophilic bonding (with native, thermally grown or deposited oxides). After correct thermal annealing the bond strength reaches same range as Si bulk fracture strength.

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Surface activated wafer bonding is also a direct bonding method which uses a special surface preparation process (surface activation) in order to change and control the bonding mechanism by controlling the surface chemistry. After surface activation, higher energy bonds are formed at room temperature (even covalent) compared to the non-activated surfaces and thus the energy required to reach the maximum bond strength by forming covalent bonds across the entire bonded interface is lower. As a result, the annealing temperature and annealing time in this case are much lower than in a standard direct bonding process. The annealing temperature for this type of process ranges from room temperature to 400°C, depending on materials to be bonded.

The typical surface activation used for this process is a plasma activation using an EVG®800 series plasma chamber for accurate process control.

Typical materials used for direct wafer bonding under various process conditions are:

- Si, silica, quartz, quartz glass (), other glasses (e.g. borofloat, BK7, special properties glasses)

- Compound semiconductors (GaAs, InP, GaP, etc.)

- Oxide materials (LiNbO3, LiTaO3, etc.)

The general requirement of direct bonding is that surfaces have a microroughness <0.5 nm (in some situations even higher values may be acceptable, depending on process conditions boundaries). Microroughness is typically defined as surface Rms measured by Atomic Force Microscope (AFM) on 2 x 2 µm² areas across the substrate.

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1.2 Anodic Wafer Bonding

Initially reported for joining a metal surface to a glass surface, the term “anodic bonding” is used today mainly to identify the bonding of silicon wafers to glass wafers with high content of alkali oxides (fig. 2). The glass materials mostly used for anodic bonding are Borofloat® from Schott Glass - Germany, and Pyrex®7740 from Corning Inc., USA.

The bond occurs when the two wafers are heated after being brought in contact and an electric field is applied. At a certain temperature (depending on the glass composition) oxides dissociate and the mobile alkali ions are driven by the electric field into the glass, creating an oxygen rich layer at the silicon-glass interface. Oxygen ions are driven by the electric field to the silicon surface and produce oxidation of Si. The resulting bond strength is very high and the process is irreversible.

In terms of equipment, it is important for the bond chamber to provide good temperature uniformity and ensure good electrical contacts.

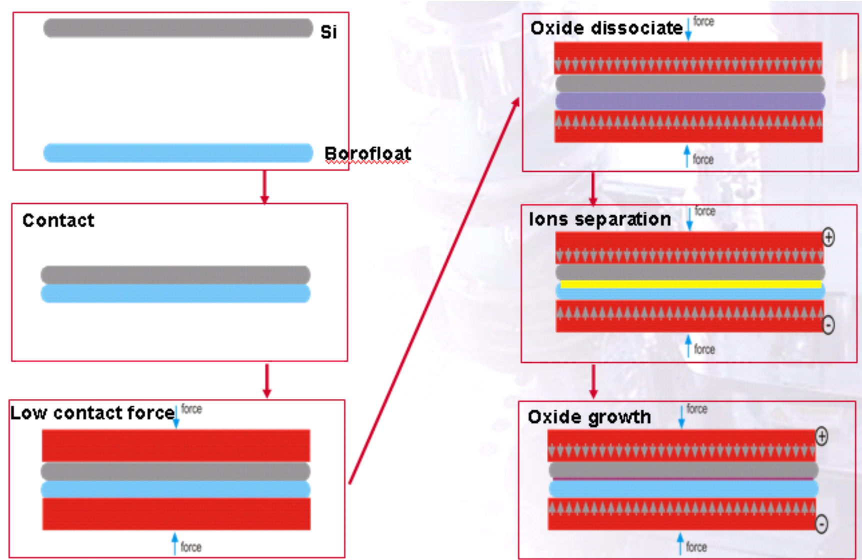

Figure 2a - Anodic wafer bonding process flow

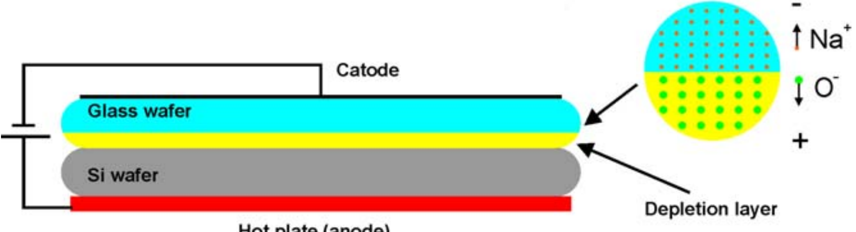

Figure 2b - Bonding mechanism

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1.3 Adhesive Wafer Bonding

Adhesive wafer bonding is a technique using an intermediate layer for bonding. Polymers, spin-on glasses, resists and polyimides are some of the materials suitable for use as intermediate layers for bonding. The choice of the material for intermediate layer is always made considering the substrate materials and topography.

The main advantages of using this approach are: low temperature processing (maximum temperatures below 400°C), surface planarization and tolerance to particles (the intermediate layer can incorporate particles with the diameter in the layer thickness range).

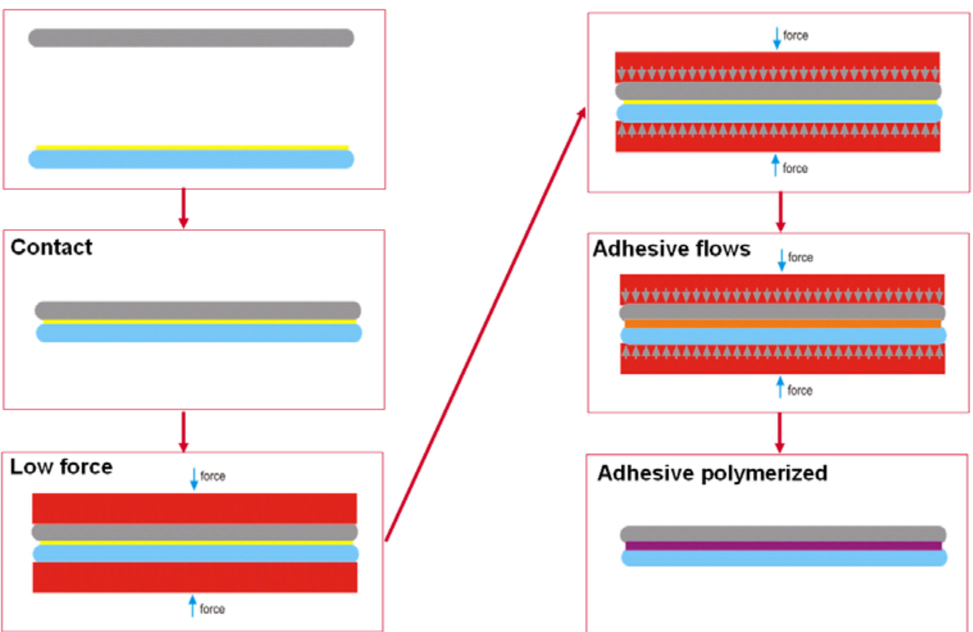

Figure 3 - Adhesive wafer bonding general process flow

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1.4 Glass Frit Wafer Bonding

This type of bond is using as intermediate layer for bonding a low melting point glass. The bond occurs by heating the substrates with applied contact force (fig. 4).

Glass frit bonding has a high tolerance to surface roughness and can incorporate high topography of the substrates. Glass frit material can be deposited by screen printing or used as glass preformed sheets. This process is very reliable and is used in high volume production by major MEMS devices manufacturers for applications where low vacuum encapsulation is required.

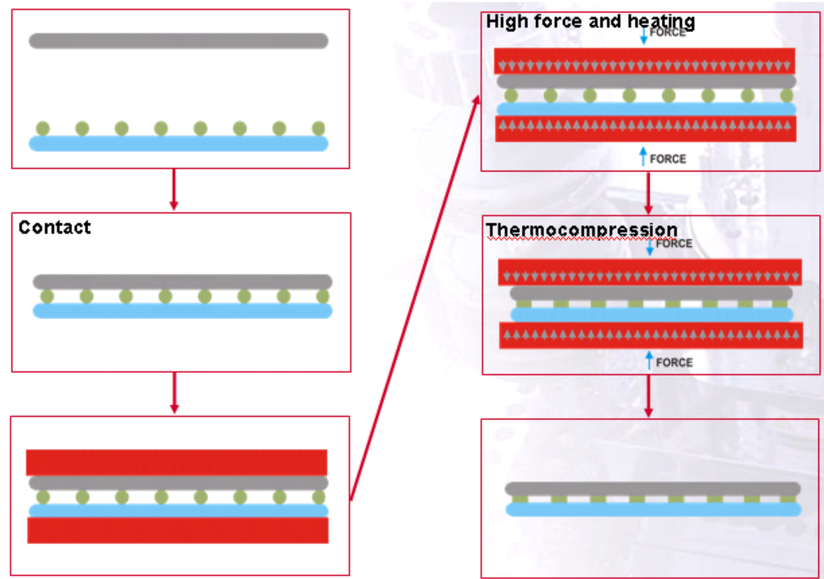

Figure 4 - Glass frit wafer bonding general principle

1.5 Eutectic Wafer Bonding

This is a wafer bonding process which uses as bonding layer an eutectic alloy formed during bond process. Eutectic alloy is formed at the bonding interface in a process which goes through a liquid phase: for this reason, eutectic bonding is less sensitive to surface flatness irregularities, scratches, as well as to particles compared to the direct wafer bonding methods (metal layer can incorporate particles with diameter lower than the eutectic layer thickness).

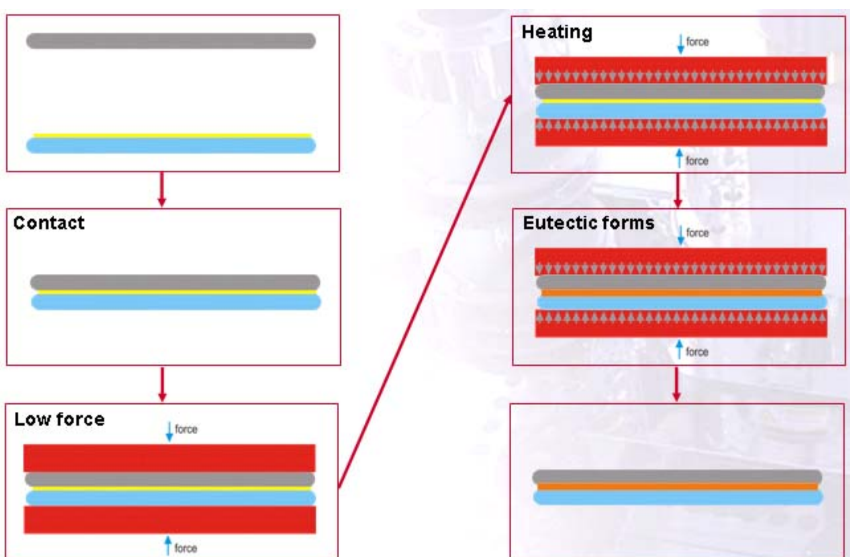

Figure 5 - Eutectic wafer bonding process flow

Some of the main eutectic alloys used for wafer bonding applications are listed in table 1.

Eutectic System	Eutectic Temperature	Bonding Temperature (recommended)
Au:Sn (80:20)	Au:Sn- 300°C	290°C
Au:Si	363°C	375°C
Au:Ge	380°C	390°C
Al:Ge	423°C	435°C
Au:In	510°C	520°C

Table 1 - Main eutectic combinations used for wafer bonding

For a successful eutectic bonding process it is very important that bonder assures a good temperature uniformity across the entire wafer surface and also to control very well the temperature value (avoid overshooting the set point) in order to have a reliable process.

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Experimental results showed that good quality interfaces are obtained when temperature is raised to a value lower than the eutectic temperature (heating simultaneously from top/bottom), maintained constant for short time to reach uniform heating of both wafers, than increased again by heating both heaters to a temperature exceeding the eutectic point with 10-20°C (depending on specific process conditions and on substrates restrictions) followed by cooling down to a temperature below the eutectic temperature.

A typical thermal profile of a eutectic wafer bonding process is shown in fig. 6.

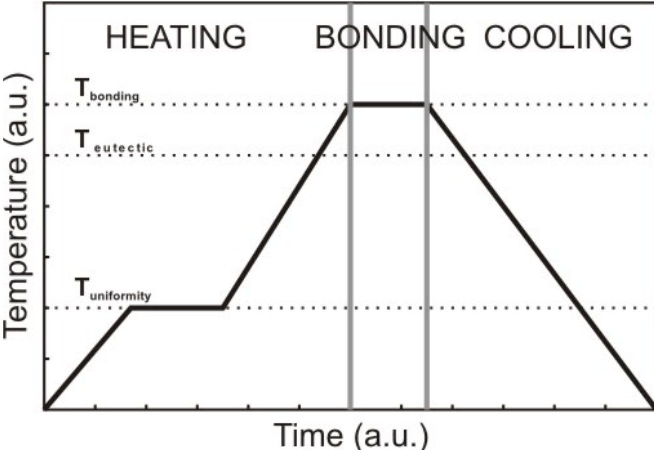

Figure 6 - Schematic thermal profile of a eutectic wafer bonding process

Eutectic wafer bonding does not require application of high contact force. Due to the liquid phase formed during the process, high contact force results always in metal squeezing out of the interface, resulting in poor interface layer uniformity as well as contamination of the bond tools and bond chamber. The role of the light contact force required is just to ensure good contact of the two wafers and good contact of the two heaters of the bonder with wafers' back sides.

Eutectic wafer bonding is a good candidate to high-vacuum applications as this process has a very low specific outgasing due to the use of only high purity components. The liquid melt formed during process can only enhance the high vacuum compatibility by allowing high quality sealing even on non-perfect surfaces.

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1.6 Transient Liquid Phase (TLP) Wafer Bonding

For some applications the process temperatures must be lower than the bonding temperatures of the most usual eutectic alloys (300°C - 400°C). In such situations an alternative process can be used, which results in an inter-metallic compound bonding layer. In literature this process is known under different names among which can be mentioned “diffusion soldering” or Transient Liquid Phase (TLP) bonding.

This bonding process is an advanced type of solder bond that can form high-quality hermetic seals at lower temperatures than other bonding technologies. This technique uses one thin layer of metal (typically 1-10µm thick) which during a thermal process diffuses into its bonding partner forming an inter-metallic compound layer with re-melting temperature higher than the bonding temperature (table 2). The process flow and recommended thermal profile are same as for eutectic wafer bonding (fig. 6).

Component 1 (thick)	Component 2 (thickness)	Bonding temperature	Diffusion time	Remelting temperature
Cu	Sn (1µm) Sn (5µm)	280°C 300°C	4 min. 20 min.	>415°C >676°C
Au	In (2µm) In (5µm) In (2µm)	260°C 200°C 160°C - 240°C	15 min. 30 sec. 10 min.	>278°C >495°C >495°C
Ag	Sn (2µm) Sn (5µm)	250°C - 350°C 250°C	10 min. 60 min.	>600°C >600°C

Table 2 - Examples of metals which can be used for Transient Liquid Phase (TLP)

* Table adapted from [G. Humpston, and D. Jacobson, in Principles of Soldering, ASM International 2004, p. 231]. Times correspond to full diffusion of the specified thickness of Component 2.

Same as eutectic wafer bonding, diffusion soldering bonding is attractive for MEMS vacuum packaging as the process is completed at low temperatures (150°C - 300°C) and can withstand much higher temperatures after bonding (see Table 2), bonding layers are made out of metals (low permeability), and they can planarize over surface defects or particles resulting from prior processes.

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1.7 Metal Thermo-compression Wafer bonding

Quite often people are wrongly considering that thermo-compression and eutectic bonding are one single process. In thermo-compression bonding process the two surfaces adhere to each other due to a metal bond established between two metal surfaces pressed together under heating. The bonding mechanism is enhanced by the deformation of the two surfaces in contact in order to disrupt any intervening surface films and enable metal-to-metal contact (fig. 7). By heating the two metal surfaces the contact force applied for the bond process can be minimized. High force uniformity across the bonding area results in high yield.

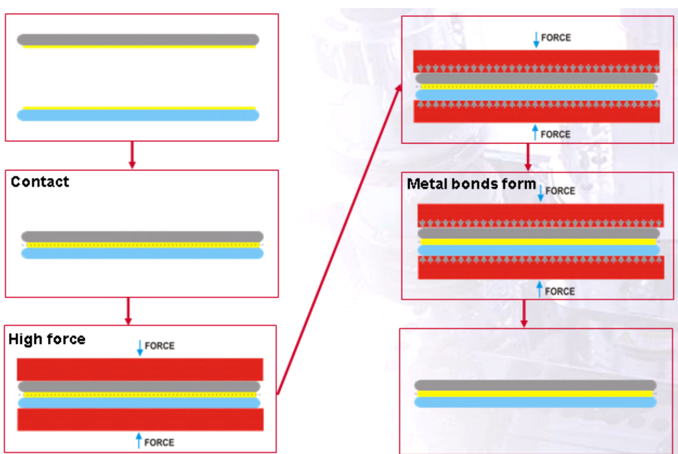

Figure 7 - Metal thermo-compression wafer bonding process flow

There are several metals used for metal thermo-compression bonding, as Au, Cu or Al. These are considered interesting for wafer bonded MEMS applications mainly due to their availability in main microelectronics applications. Their use for one or another type of applications is conditioned by the type of substrates used (e.g. no Au-containing substrates can be further processed in CMOS lines).

Typically the metals used for this process are evaporated, sputtered or electroplated on the surface. In such process it is extremely important to assure a proper diffusion barrier or adhesion layer between the metal bonding layer and its substrate.

The surface microroughness of the metal bonding layers ranges from <1nm and up to few tens of nm, depending on the metal used, on deposition technique and on the wafer bonding process conditions.

Important:
The aim of this section of the operator manual is to offer a short overview of the available wafer bonding processes which can be performed in EVG permanent bonding equipment.
For detailed discussion regarding substrates or bonding layers specifications, general process conditions or specific applications-related topics EVG customers are advised to contact a qualified EVG process engineer.

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History

Date	Modification	by
2010-07-12	First written with DV	WAA

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State:	Released		Author:	WAA
File:	EVG500-GEM_CAN_ProcessDescription_DO_eng_04.doc			
Created on:	2005-07-18		Printed on:	2010-07-12
Version:	4.0		Last revision	2010-07-12
Purpose:	Process Description		Language:	EN

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Recorder Software

Customer Support Documentation
EVG5xx

EV Group
E. Thallner GmbH
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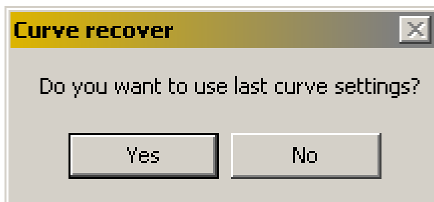
1 General

This software allows to record all process parameters and save this parameters.

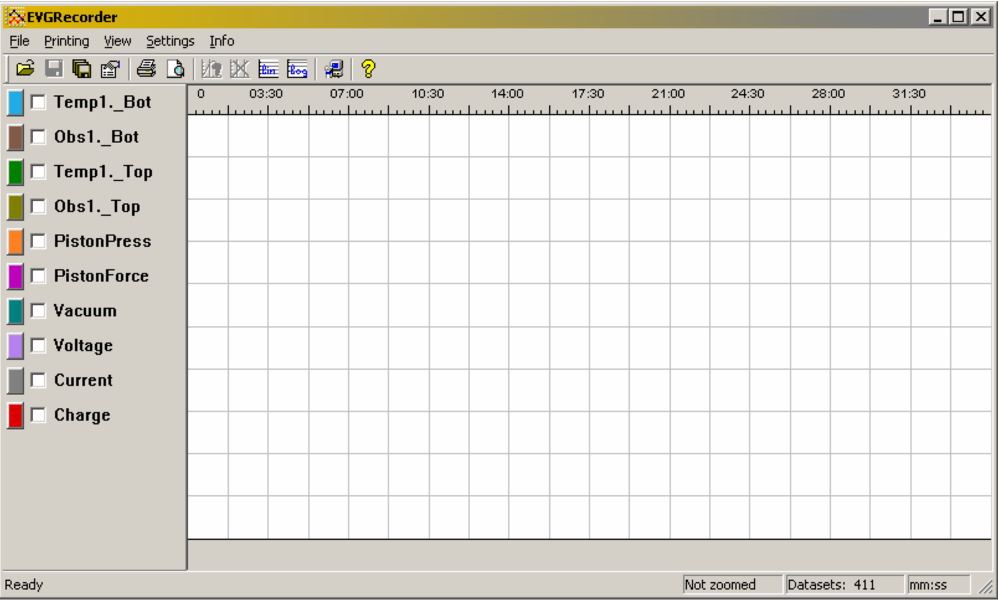
After opening the Recorder- Program following window appears:



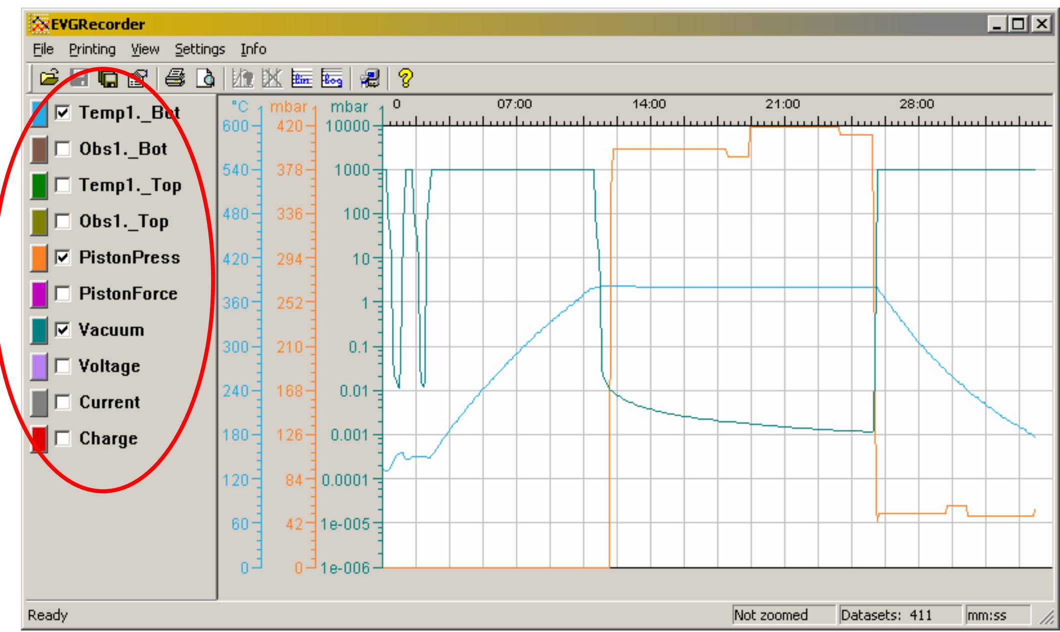
Press “Yes” to show the view as last used.

Press “No” to adjust the settings new.

The Recorder looks like this:

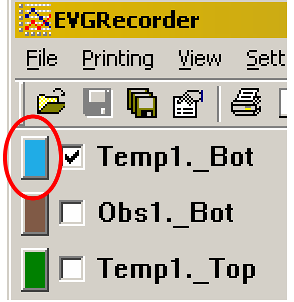


2 Choose parameters



Choose the parameters which should be shown in the left scale. For each chosen parameter a seperate scale is shown (in the same colour as the parameter line).

2.1 Settings for graphs and scales



Press the **right** mouse button on the colour field to adjust the colour for the graphs and the scale of the chosen value. Choose a colour and press “OK” to confirm the new colour or press “Cancel” to cancel the colour adjustment.

Press the **left** mouse button on the colour field for more “Graph Settigs” of the chosen value. Following window will be shown:

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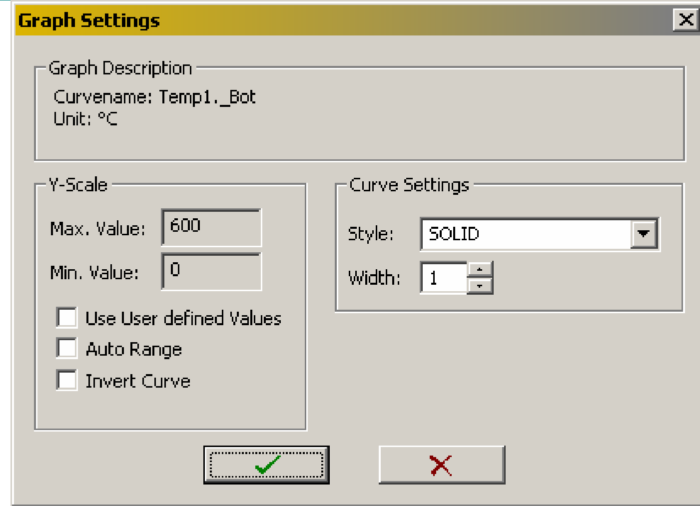


Find general information of the chosen graph in the field **"Graph Description"**.

Field **"Y-Scale"**:

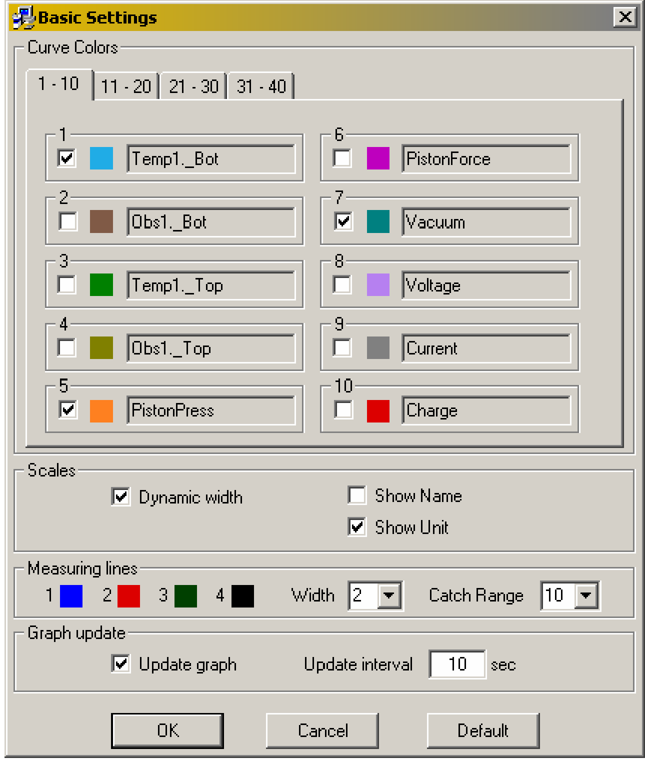
"Auto Range": the software searches automatically the best view by using the available values for the chosen graph.

Use "User defined Values" and enter values for "Max. Value" and "Min Value" in the defined fields.

Choose "Invert Curve" to invert the chosen graph.

In the field **"Curve Settings"** it is possible to choose the style and the width of the chosen graph.

Use "Settings" – "Basic Settings" or press "Ctrl" + "S" on the keyboard to adjust the basic settings for graphs, scales, measuring lines and graph update.



Measuring Lines: Adjust the colors and the width of the lines (find more in item “Measure Bars”) as they should be shown. Catch Range: the mouse pointer catches the measuring line x Pixel early as the line is shown. Enter a value (for x) in the field “Catch Range”.

Graph Update: this is an automatic update of the measuring point of the curves. Update Interval: a value for the time in seconds for interval of updating the graph.

Note: This has no importance to updating the measuring points!

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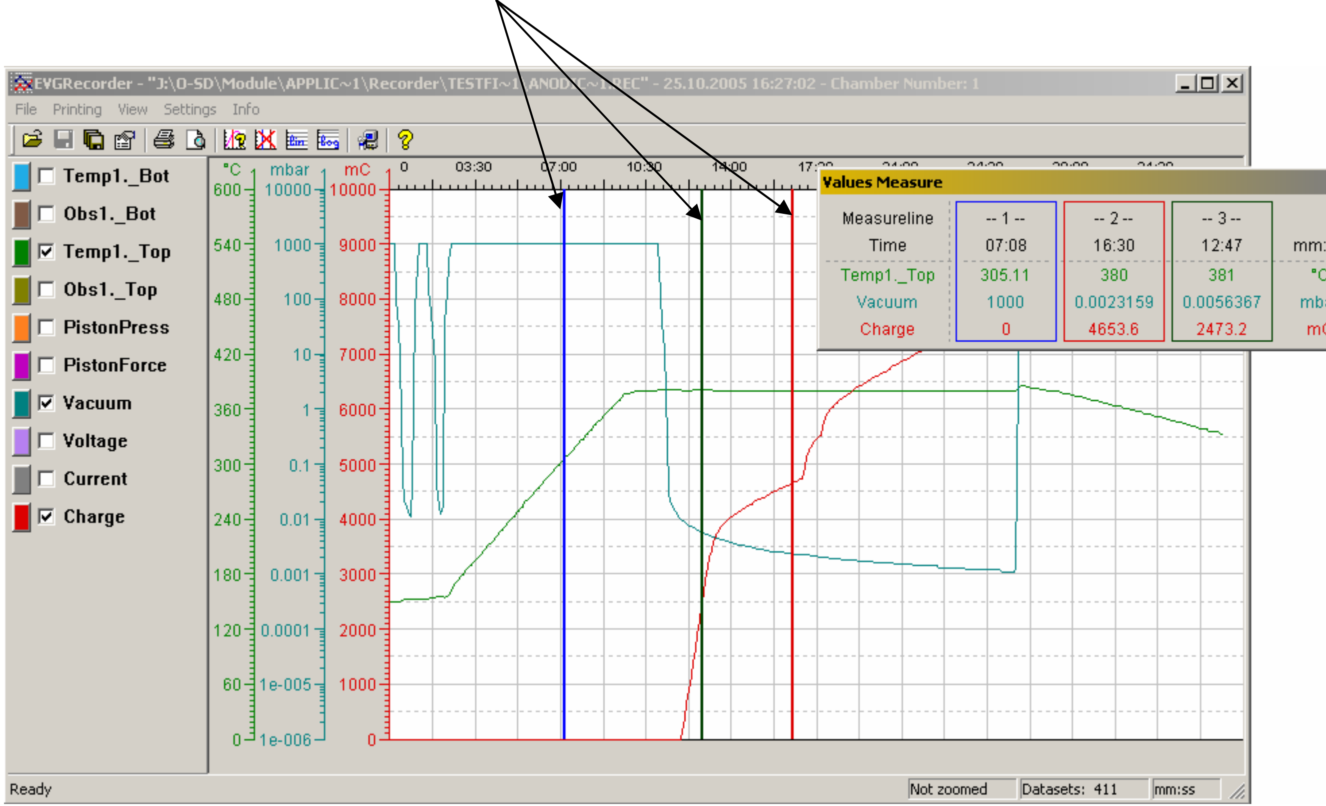
3 Measure Bars

With the measure bar it is possible to find exact values of the visible graphs.

3.1 Show Measure Bar

Press „Strg“ + left mouse button or „Shift“ + left mouse button to show a measure bar. (Place the mouse pointer before pressing the left mouse button where the measure bar should appear.)

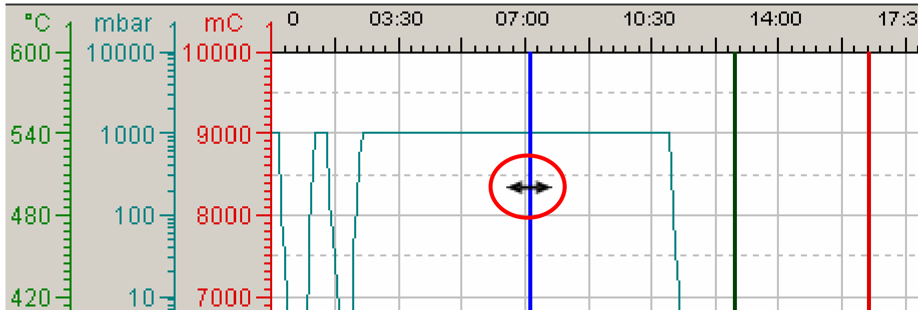
Up to four measure bars can be shown.



Find the specific values for all measure lines in the window “Values Measure”. If this window does not appear use the button “Toggle Measure Window” in the toolbar to open it.

3.2 Move Measure Bar

Move the mouse over a measure bar. The mouse button will change into double arrow (as shown).



Use the left mouse button to move the measure bar.

3.3 Delete Measure Bar

Delete one measure bar:

Press “Strg” or “Shift” on the keyboard and point with the mouse on the measure bar which should be deleted and press the right mouse button.

Delete all measure bars:

Use the button “Delete Measure Bars” in the toolbar.

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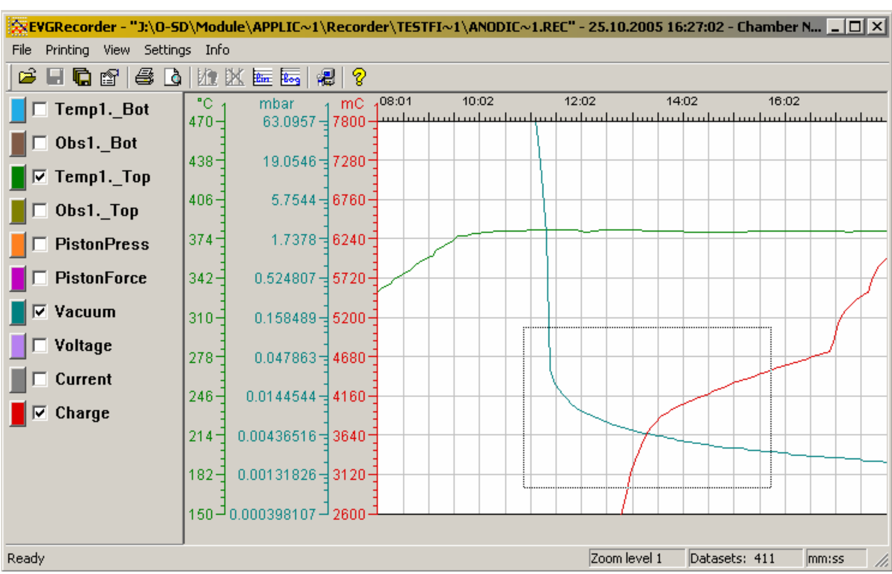
4 Zoom

Draw a rectangle over the part which should be zoomed with the mouse pointer:



There are four zoom- steps available.

Press the right mouse button to go back one zoom- step.

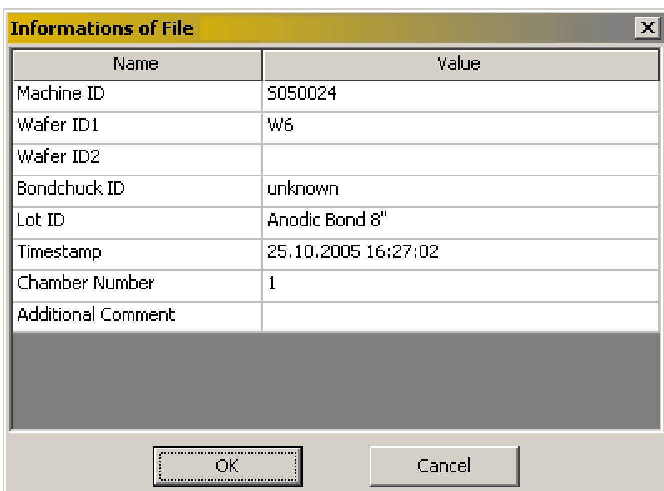
5 More functions of the recorder Software

5.1 Grids

Choose the view of the grids. Choose “Linear Grid” or “Logarithmic Grid” according to the shown graphs.

5.2 File Info

Press “File” / “File Info” or use button to open the window “File Info”.



Find all corresponding information of the current file in this window.

Add an additional comment if necessary. This comment will only be saved if save button will be pressed afterwards.

5.3 “Printing”

Find the buttons “Print”, “Print Preview” and “Print Setup” at menu “Printing” in the menu bar.

“Print Setup”: activate / deactivate printing the legend, the filename and the scales. Choose print orientation “Portrait” or “Landscape”.

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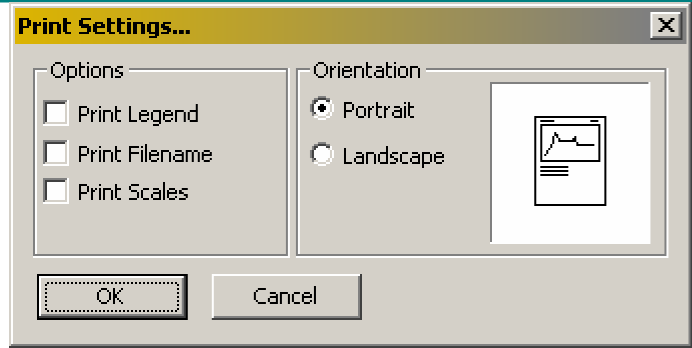

"Print Preview": Take a look at the print preview before printing the document.

"Print": Print document.

5.4 "About Recorder"

Find information about the software- version and the registration (limited or unlimited) in the window "About EVGRecorder" (press "Info" / "About EVGRecorder" in the menu bar).

5.5 Save / Open

5.5.1 Open

Open an existing file via „File" / "Open" or the button

5.5.2 Save

Save the current file via „File" / "Save" or the button .

Save the current document with a new name via "File" / "Save As" or the button .

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6 Activate the recorder software

The recorder software has to be activated by an EVG Engineer.

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History

Date	Modification	by
January 30th, 2007	Manual for new Recorder- Software; first written	HMA

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Created on:	2007-01-30		Printed on:	2007-11-02
Version:	1.0		Last revision	
Purpose:			Language:	EN

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Preventive Maintenance Manual

Customer Support Documentation
EVG520

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1 Note to the user

General:

Installation, adjustment, programming and maintenance (except periodical maintenance described in the manual) may only be done by qualified EVG service engineers.

For further deliveries please check immediately after unpacking that the consignment confirms to the information given on the packing list.

Read and understand the operating instructions before you operate the unit and follow them in all respects.

The equipment may only be operated by personal trained from EVG service engineers.

No liability will be accepted for personal injury no material damages in the event that damage or breakdowns occur as a result of failure to comply with these operating instructions; neither will any guarantees relating to repairs to or replacements of our products apply.

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1.1 Safety instructions

- The equipment represents state-of-the-art technology and optimum operationally reliable. The user may however be exposed to hazards if it is used improperly or for other than its intended purpose!

- If the equipment is used for any other than its intended purpose, all liability and warranty claims will lapse!

- All unauthorized modifications and alterations affecting the safety are prohibited!

- The use of self-made tools is not allowed in any case.

- Any use by unauthorized personnel or careless handling may increase the potential danger.

- If the media support specified from EVG is not fulfilled, the operational function of the equipment is not guaranteed.

- Always wear gloves during operating with the system.

- Avoid any contact with any liquid used in the system

- Wear Safety glasses.

!! ATTENTION !!

Do not remove or change any safety facilities from the system.

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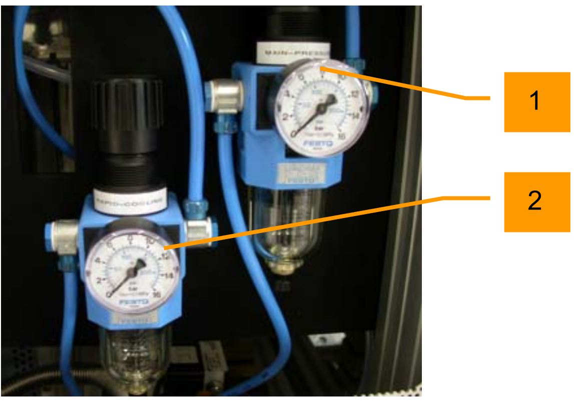
2 Daily Maintenance

2.1 Main Pressure

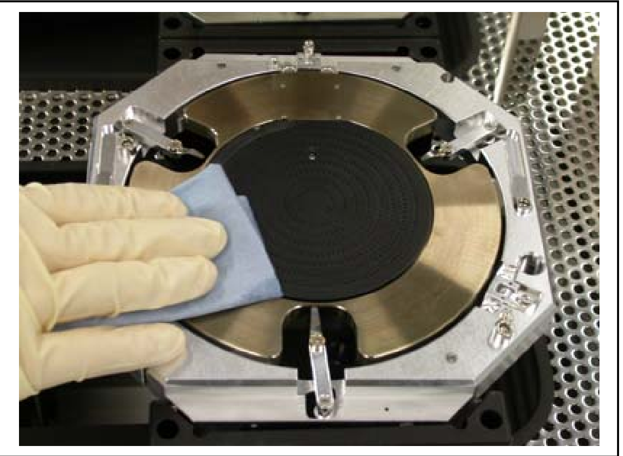
Inspect the main pressure regulator on the rear wall. The normal pressure would be around 6,5 bar (650 kPa), when you activate cooling the pressure shouldn't drop below 6bar (600 kPa).

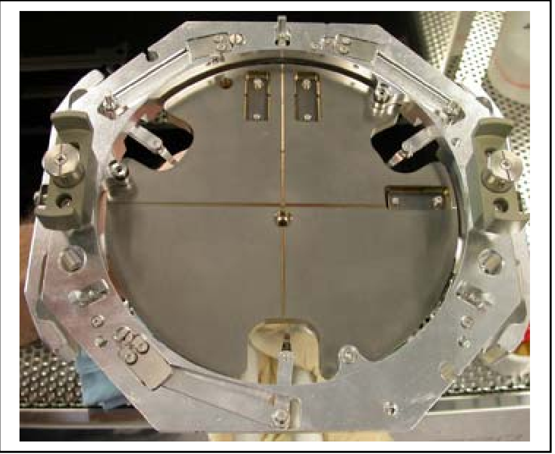


1	Main Pressure
2	Rapid Cooling

2.2 Bondtools

Visually inspect the bondtool surface. There should be no deposits or scratches visible. Clean the bond tools with alcohol. Particularly the top and bottom surface of the bond chuck insert.





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1 ... Top surface of the bond tool

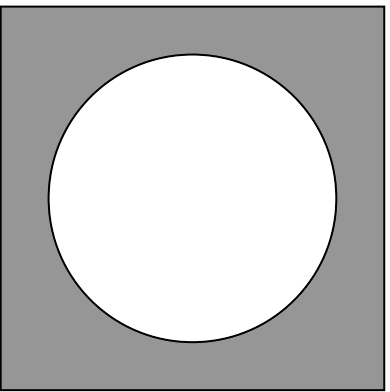
2 ... Bottom surface of the bond tool

2.3 Flags

Make a visual inspection of the flags on the bondtools. Insure that the flags are not bent, and that the screws which hold them in place are secure. The flag height must be higher than the bottom wafer.

2.4 Clamping glasses

Make a visual inspection of the clamping glasses. Insure that there are no scratches or cracks.



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3 Weekly Maintenance

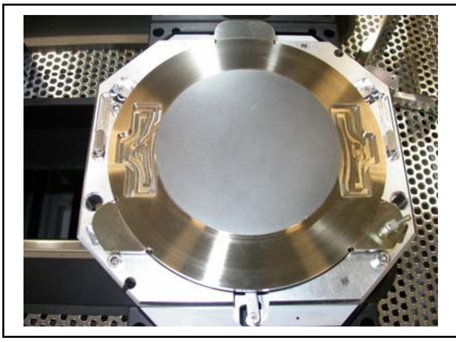
Check the following points in addition to the daily maintenance

3.1 Error Tracking: Memory Leak

We recommend restarting the machine computer and the Microsoft Windows operating system in a regular interval, like during the weekly pre-maintenance, to avoid problems and to provide a stable production environment.

3.2 Flatness of the bondtools

Check the bondtool inserts with a straight edge. Make sure that the surface is absolutely even and no spots are visible.



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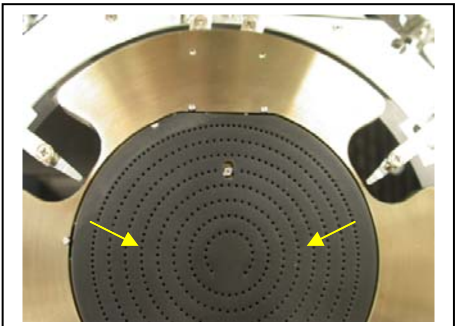
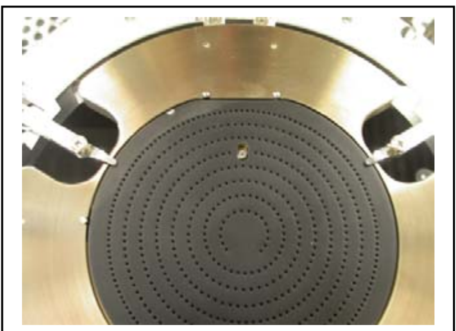
3.3 Flag pulling mechanism

Manually activate the flag pulling mechanism. Insure that the flag pulling mechanism is working smoothly, and that there is no debris that might cause a flag to fail. There shouldn’t be any cracked waferpieces in the bellow of the pulling mechanism.





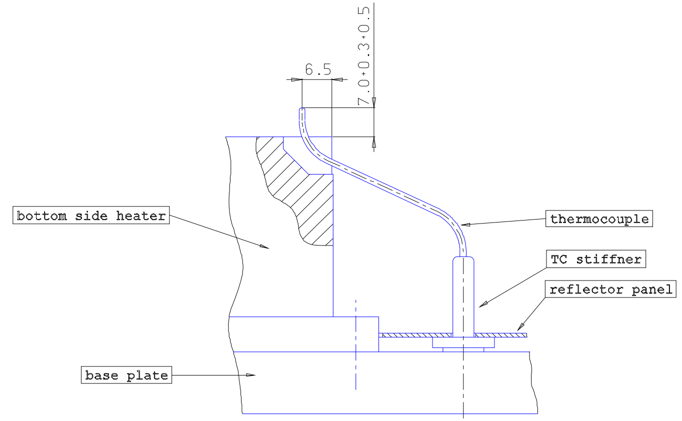
3.4 Top side pressure glass

Make a visual check of the top side pressure glass. There should be no crack or spot detectable.

3.5 Tool Temp TC (Only for 6”)

Check the position of the bondchuck top TC. Refer to the figure below for the exact position.

thermocouple measurements
for AB1-PV(EV501);EV500(EV520)



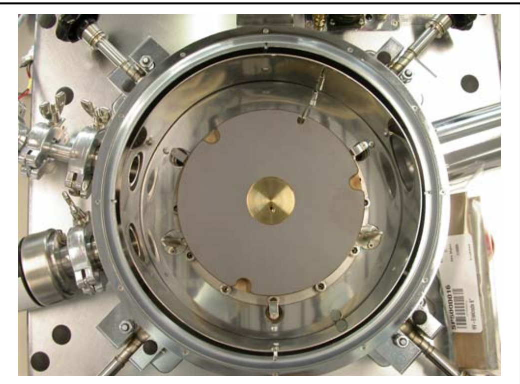
3.6 Cleaning

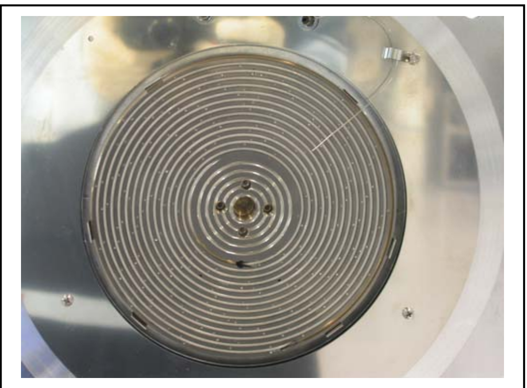
For all cleaning processes the entire EVG520 system must be switched off, and the heater temperature has to be below 50°C. Alcohol and a wipe suitable for clean rooms can be used for all cleaning actions.

Clean all bottom heating chucks of bond chamber with alcohol.

Clean the pressure disk of the top heater of pressure lids.

(Example 6”)





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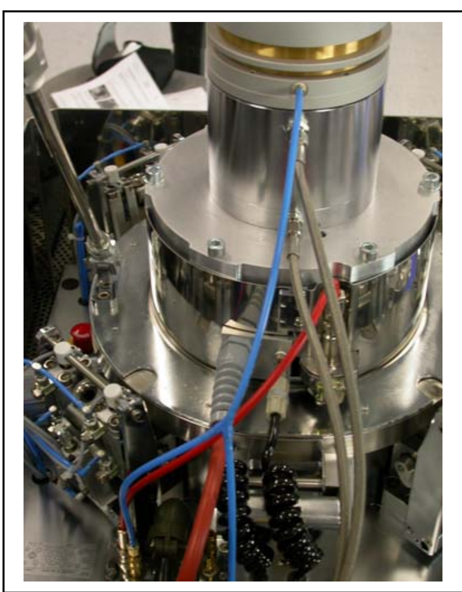
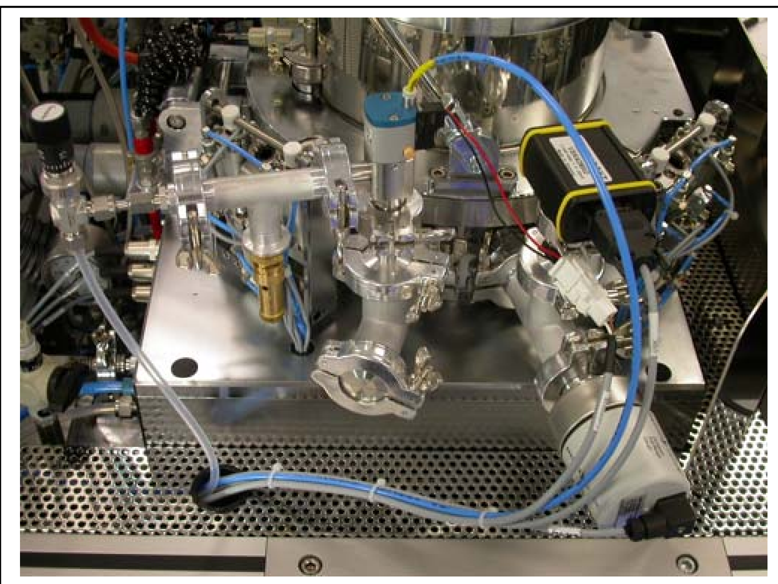
4 Monthly Maintenance

4.1 Cover connection lines

Check all the lines (pneumatic, electric and water-cooling) for cracks.

Make sure that the water and pneumatic lines are not crimped.





4.2 Piston Motion

The motion of the piston has to be smooth and it must fully retract

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4.3 Main Pressure Regulator Unit

Check the main pressure regulator and the filter for the presence of oil or water.

4.4 Emergency Stop

Check if the emergency stop is functioning correctly.

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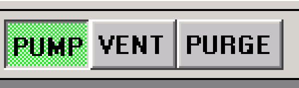
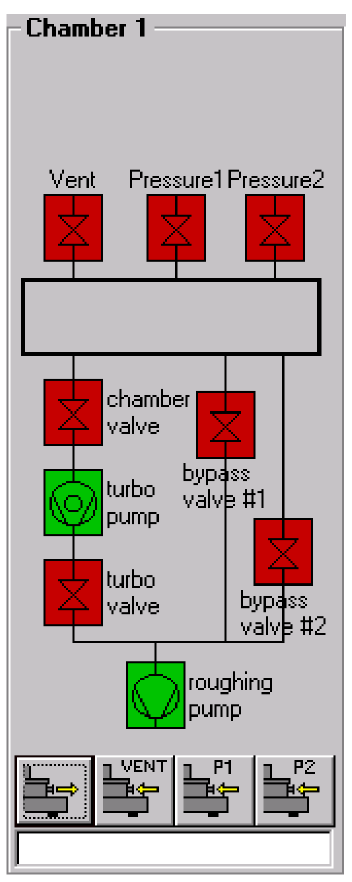
4.5 Vacuum System

Check the functionality of the vacuum system. (Software Bonder diagnostic)

6-inch systems: 8-inch systems:





4.6 Roughing pump

Oil sealed pump:

Check the color of the oil in the Roughing pump. Refer to the color table in the technical manual of the pump.

Dry pump:

Check the end vacuum of the pump by connecting a vacuum gauge at the end of the tube.

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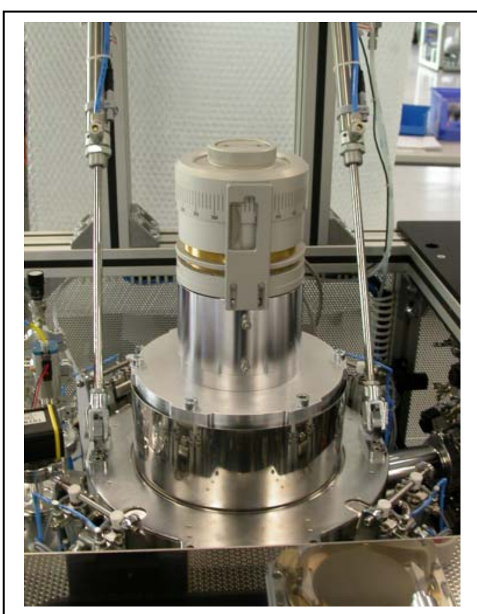
4.7 Cover Open/Close

Take care that the cover open and close smoothly.

Open cover. Check display window if the status of Cover open and Cover close will change.

Close cover. Check display window if the status of Cover open and Cover close will be changed.



4.8 Check of Sensors

Check all sensors with the PC program EVG520. Select function "BONDER DIAGNOSTIC".

Test the following functions:

Type in a bond pressure in the field "Pressure" and check if the pressure that is displayed in the control window is about the same you’ve typed in.

Please control also if the piston moves down. Don’t forget to adjust the stack thickness.

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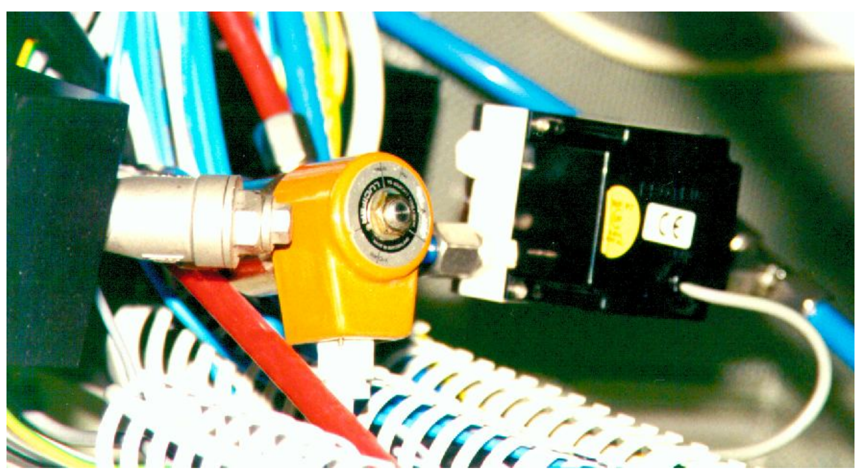
4.9 Water filter

Open the water filter and clean it. If there are any deposits in the sieve check your cooling water quality. To find the location of the water filter refer to the picture below.



4.10 Water Cooling/Glycol Mix

Check the Glycol / Water Mix in the Chiller. Be sure that it is a 50% mix.

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5 Quarterly Maintenance

5.1 Checking Bond module and chuck

Make a visual check of the Bond tool and the chuck. There should be no crack or spot detectable. The surface must be flat.

5.2 Adjust heater offset

5.2.1 Short Description

5.2.1.1 Temperature offset:

The thermocouple sensors used on EVG bonding systems are very accurate, but still have a small measurement tolerance. That is why the same temperature reading on different EVG bonding machines may lead to a small temperature difference from bonder to bonder.

In order to compensate this difference and to run one production bonding recipe on different machine with the same result, a temperature offset setting is possible which can be adjusted individually from bondchamber to bondchamber.

This setting adds an individually adjustable offset in the range of +5 to -5°C to the set point in the recipe. The status window on the screen shows the temperature including the offset.

e.g.: If a 380°C heating set point is adjusted in the recipe and the offset is defined with +3°C, the heaters reach a temperature of 383°C according to the thermocouple in the bonder and will show 383°C in the status window and in the recorder file.

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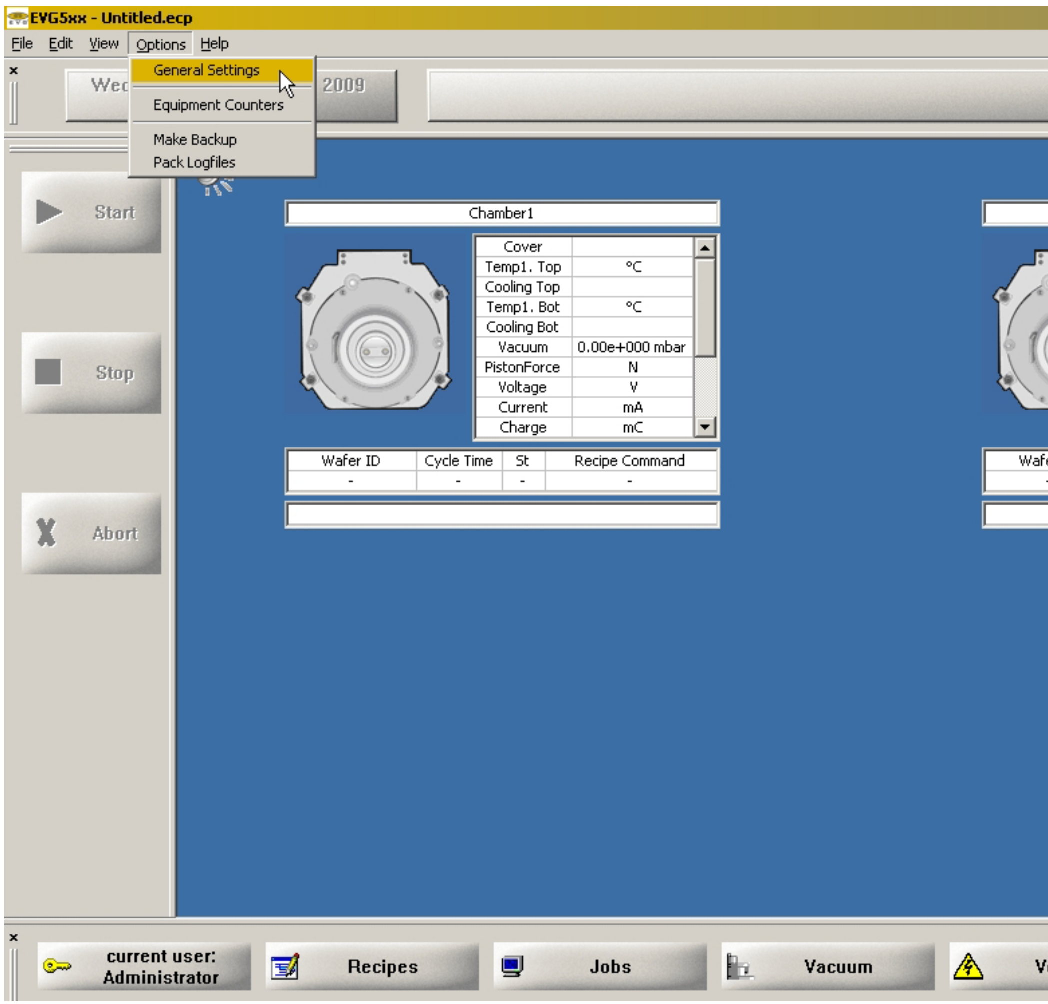
5.2.2 How to adjust the temperature offset

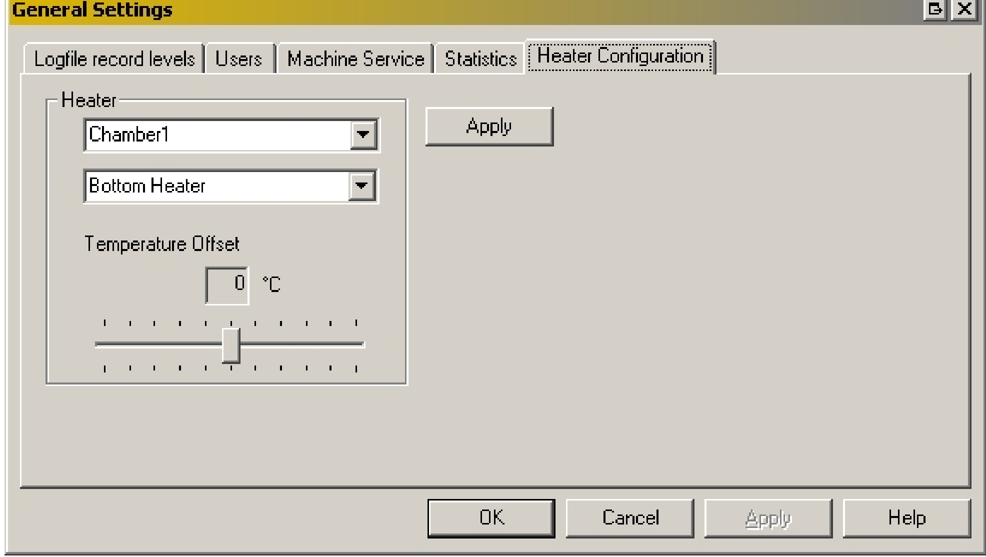
To adjust the heater offset click on:

Options\General Settings\Heater Configuration

(as shown in the window below):



Here a temperature offset of +/- 5° C for every heater can be set.



Afterwards the apply button has to be clicked for saving the new adjustment. This will not work if a process is running. In this case there will be a message that the IO service has to be restarted to apply the adjustment.

These adjustments can only be done by administrators.

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6 Annual Inspection

Check the following points in addition to the monthly maintenance

Tools needed for any PM.

Metric Allen wrench set

US Allen wrench set

Metric open-end box end wrenches

Philips head screwdriver (small and medium size)

Flat head screwdriver (small and medium size)

Volt meter

Spare Latex gloves

6.1 Cooling Fluid

Using a hydrometer, check that the fluid contains the proper percentage of Glycol. Also insure that the flow and pressure meet the specifications. Also check the PH value of the fluid.

6.2 Cooling Lines

Check the lines for deposits, corrosion, and leaks.

6.3 Cleaning Procedure

Clean all chambers with IP alcohol; to do this you must remove the inner reflector shield. After you have cleaned the whole chamber (including the heating chuck) wipe all surfaces of the bonder with IP alcohol. After you have cleaned everything, heat the chamber up to 300°C and evacuate it overnight.

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6.4 Vacuum Pump

Exchange the tip seal of the vacuum pump annually.

6.5 Vacuum Gauges

Remove the vacuum gauges and ship them to the manufacturer for cleaning and recalibration.

6.6 Heater Cooling

Check the flow rate for the top and bottom side heater. Compare the rates with the recommended ones.

6.7 Waterlines

Clean all waterlines chemically and mechanically. If there are visible deposits in the lines check your water quality and the water filter!

6.8 Turbo pump

It is strongly recommended to exchange the oil lubricant reservoir in the pump annually.

Further instructions how to precede please find in the Pfeiffer Operation Manual in the Technical Section of this manual.

6.9 Waferbow Contact of the Piston

Check if the waferbow contacts the bondtool when you press waferbow button in the bonder diagnostic. The adjustment has to be done by an authorized EVG service engineer.

A yearly maintenance done by an EVG Service Engineer is strongly recommended.

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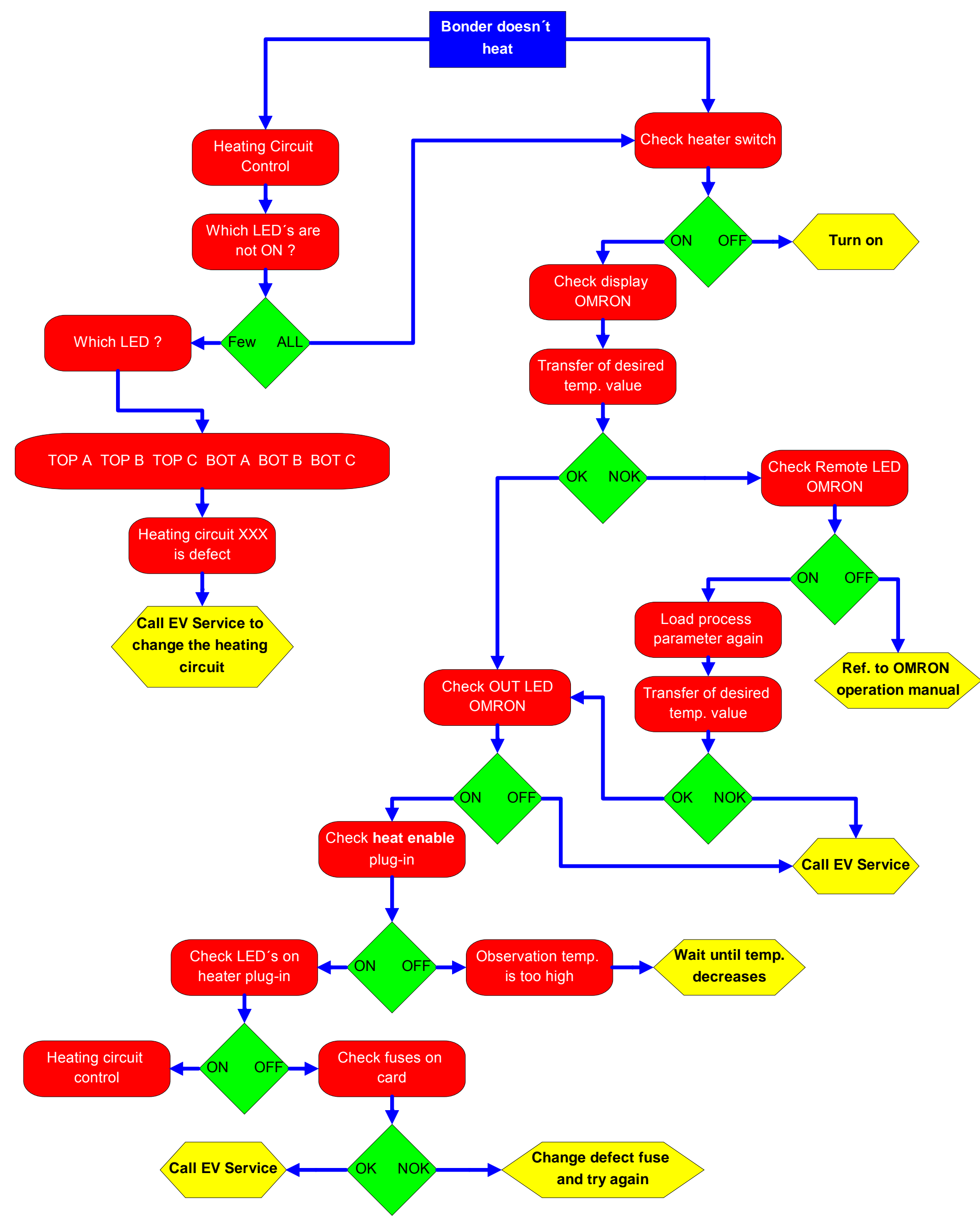
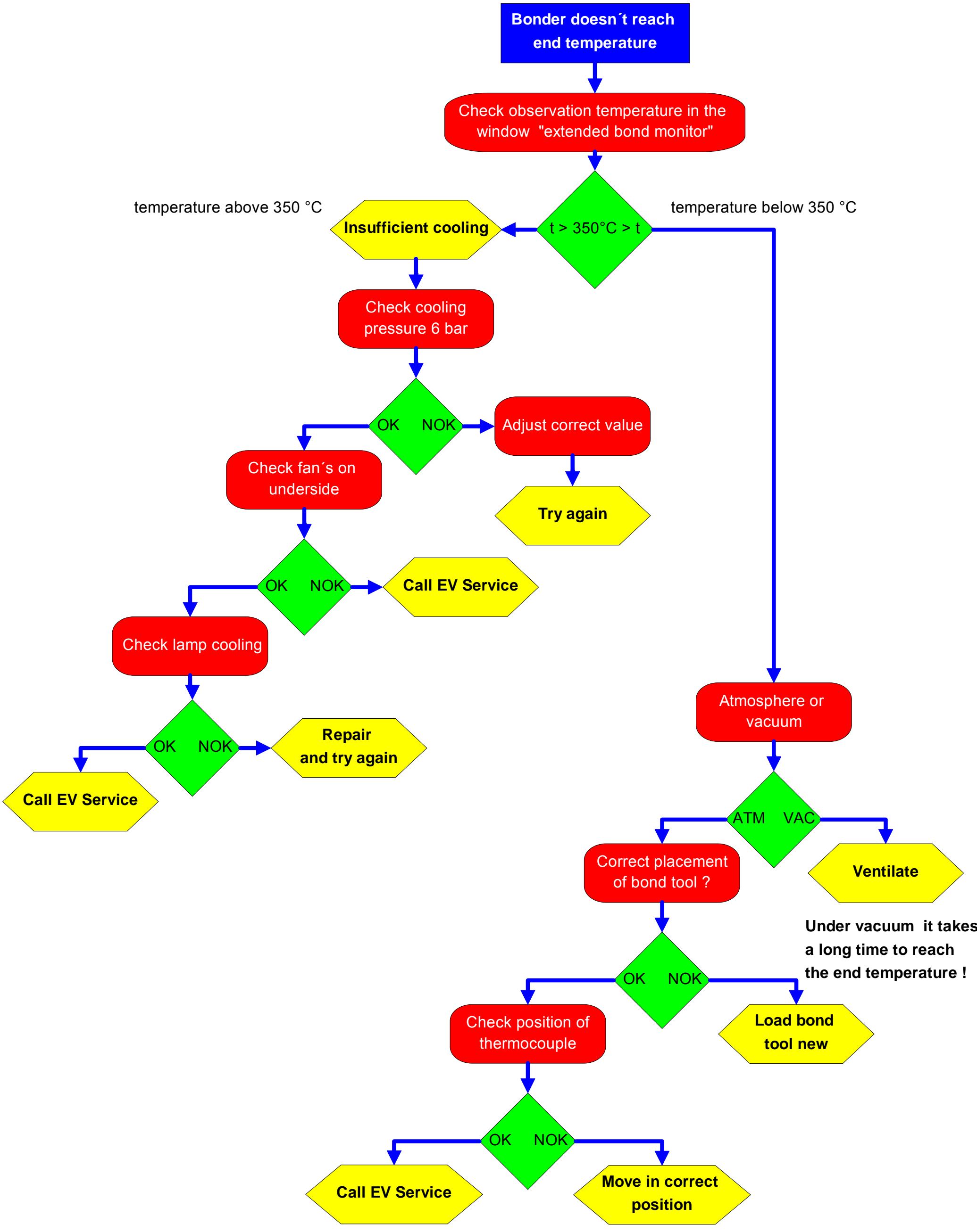
7 Troubleshooting

7.1 Bonder doesn’t heat

Bonder doesn’t heat



7.2 Bonder doesn’t reach end temperature



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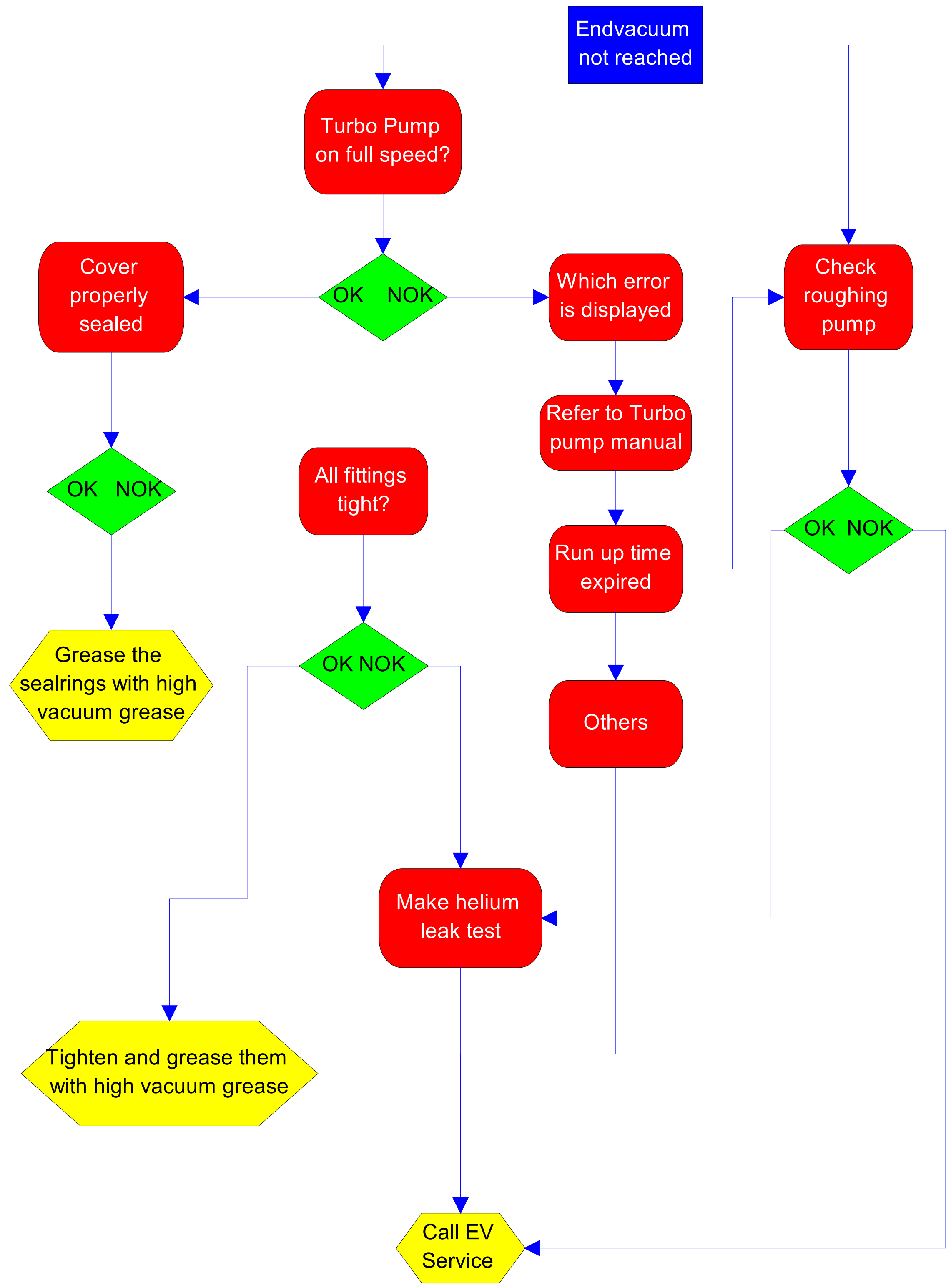
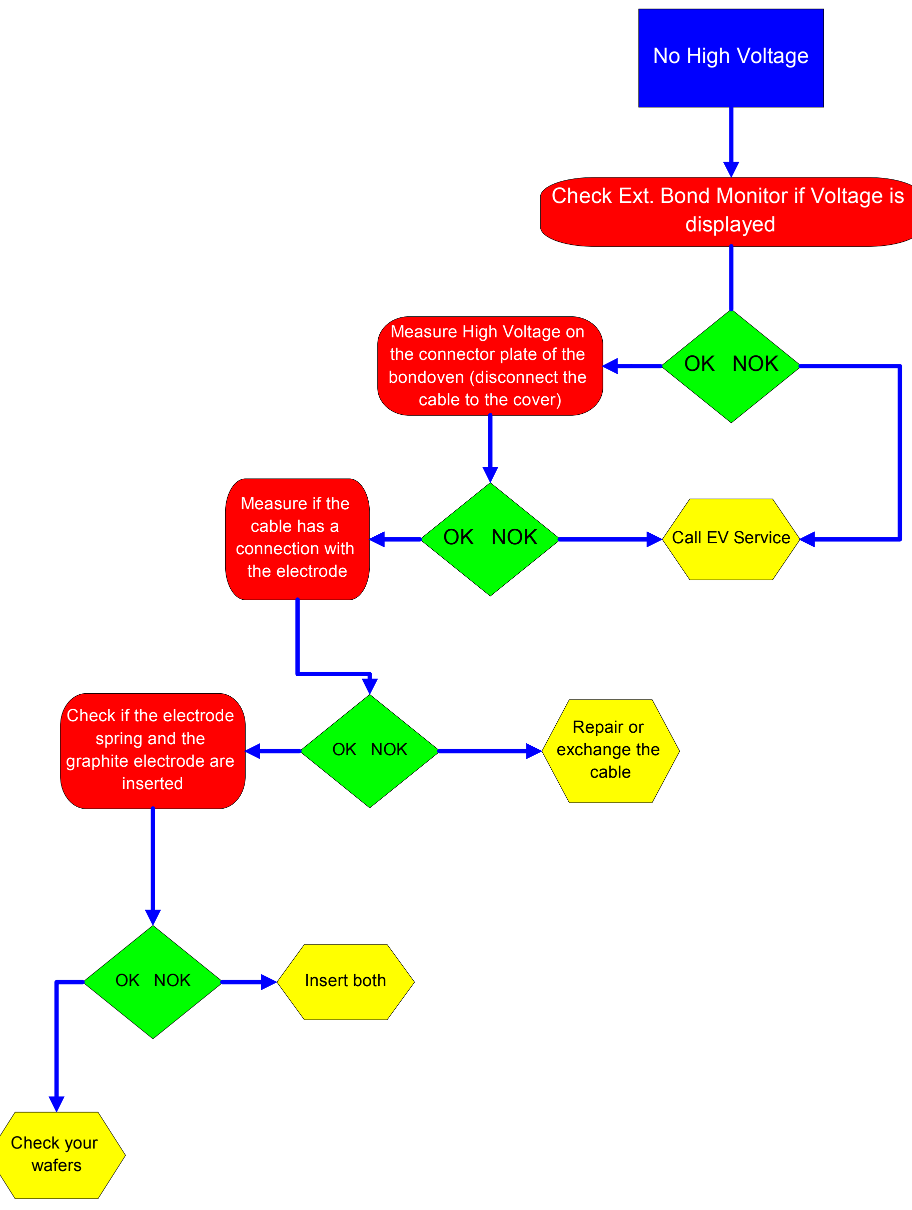
7.3 Endvacuum not reached



7.4 No High Voltage



Attention High Voltage: Take care when you measure on the high voltage connectors. Measure only with specified tools and take care about the safety requirements.

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8 Personal Protective Equipment (PPE)

1. **Chemical resistant latex gloves**

   This PPE is required when working with Isopropyl alcohol or NH_4OH contaminated units (cleaning chambers, brushes, etc…).

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9 Lockout/Tagout

1. **Mainswitch OFF and LOCK:**

   Start und shutdown procedure

   ### Power OFF

   The sequence for powering down the system is:

1. Follow the guidelines for shutting down Windows

2. At the screen “It is now OK to turn off your computer”, Turn the main switch counter clockwise 90* to the OFF position

   ### Power ON

   The sequence for powering up the system is:

1. Turn the “Main Switch” clockwise 90* to the ON position

   Switch on the computer which is located behind the left door.

   The main EVG520 program should be located on the Windows desktop in a folder called EVG520, open this folder and double click on the EVG520 icon

2. Turn on the heater power circuit breaker clockwise 90* to the ON position.

   NOTE:

   Main switch has to be on when switching on the heater-power circ. Breaker.

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History

Date	Modification	by
12.12.2008	Formatted	AAW
06.03.2009	Added “Adjust heater offset”	SEB

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