

Standard Operating Procedure for the Struers Grinding and Polishing Tools

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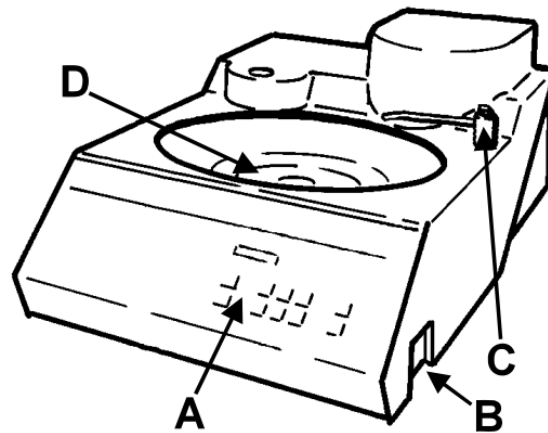
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About the Struers Grinding and Polishing System

The Struers Grinding and Polishing System consists of four tools: the RotoPol-31, Rotoforce-4, Mutidoser, and Rotocom. These tools can be used together or separately to produce a sample with a plane, smooth surface.

RotoPol-31

The RotoPol is the base of the grinding and polishing system. It can be used on its own or as part of the system. It can run at 150 or 300 rpm and has a water tap built in. CCMR's Rotopol is equipped with the MD System so all grinding papers and polishing clothes can be attached to the system magnetically for clean, easy removal.



RotoPol (RotoPol-31)

- A Front panel controls
- B Main switch
- C Water tap with sprinkler tube
- D Turntable

Figure 1: Rotopol-31

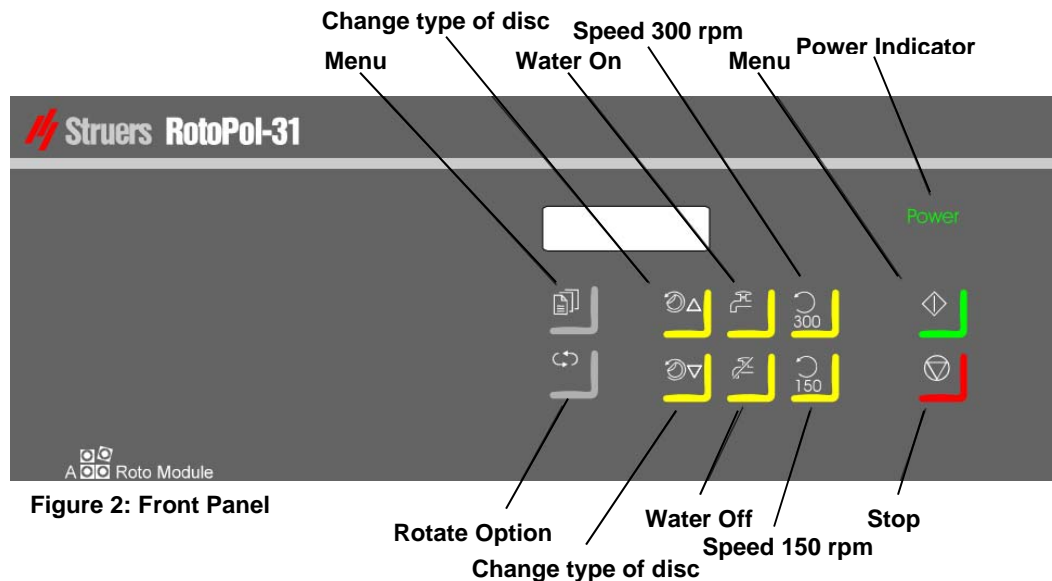
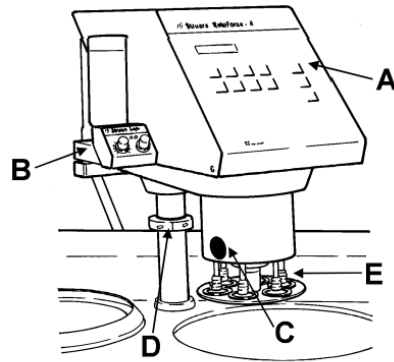


Figure 2: Front Panel

RotoForce-4

The RotoForce is the specimen mover and attaches to the RotoPol. It can be set to rotate in the same direction or opposite the RotoPol. It applies force on the sample which can be adjusted from 5-400N. The RotoForce is also where the length of the run is set. The time of the run can vary from 5 seconds to 99 minutes 30 seconds. The RotoForce is equipped with a Lupo drip lubricator, but CCMR has a Multidoser for such purposes. It is also equipped with a function that will sync the RotoForce with the RotoPol so that they start and end the run together.



RotoForce-4

- A Control keys and display
- B Lupo drip lubricator
- C Release knob
- D Supporting column and stop ring
- E Pressure feet for single samples

Figure 3: RotoForce- 4

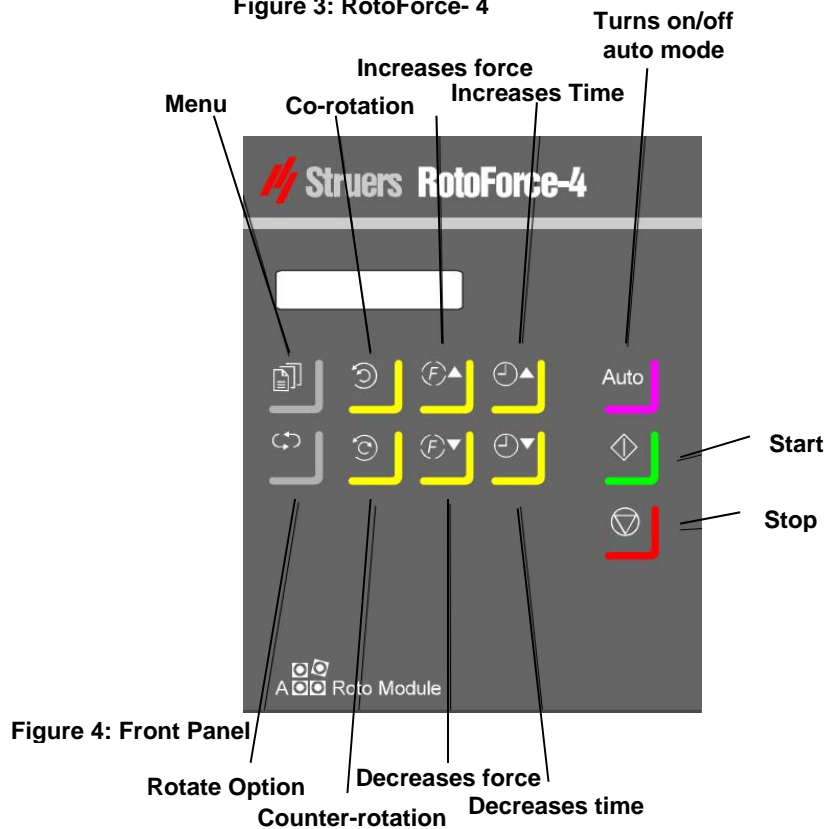


Figure 4: Front Panel

Multidoser

The Multidoser controls the amount and type of lubricant or suspension added to the disc. The tubes through which the suspensions flow are attached to the RotoForce so that the fluids can be applied to the plate throughout the run. There are six bottles for dispensing suspensions and lubricants. These bottles can hold DP-, diamond polishing, suspensions, DP-Lubricants, or OP-, oxide polishing, suspensions. Bottles 1-4 can hold DP-Suspensions or DP-Lubricants. Bottle 5 can hold a DP-suspension. Bottle 6 can hold an OPSuspension. The Multidoser can be set to dispense suspensions or lubricants at different time intervals. It can dispense from multiple bottles at the same time.



Figure 5: Multidoser

Multidoser

- 1) Front Panel with display
- 2) Bottles for lubricants and suspensions
- 3) Rotocom

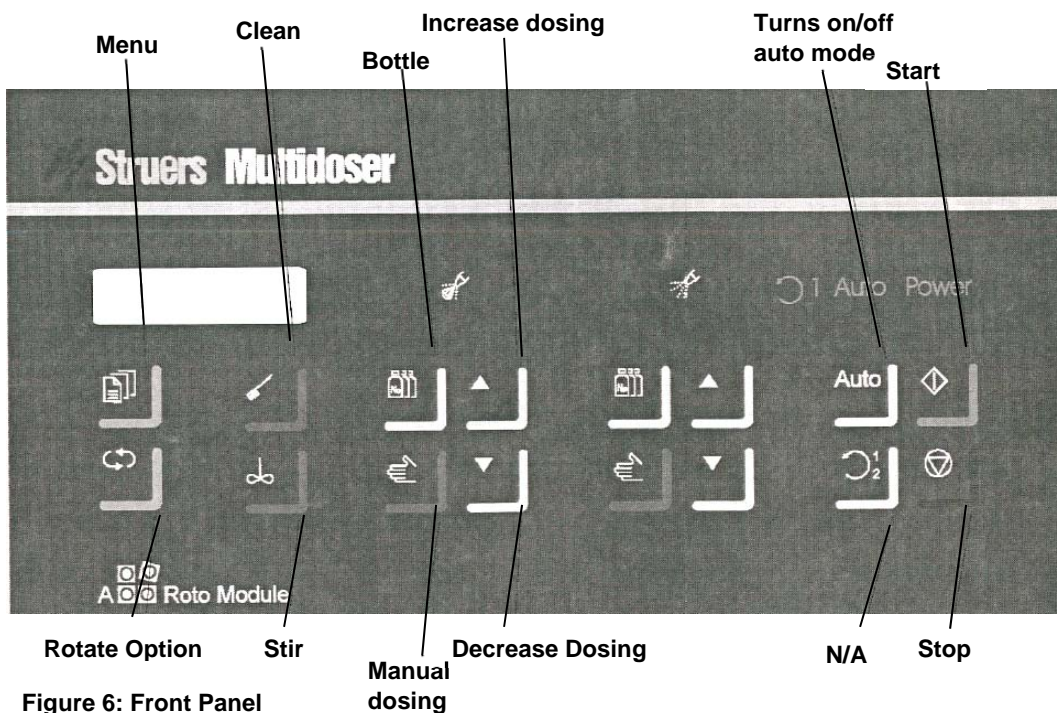
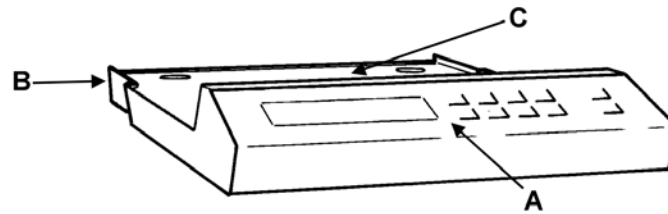


Figure 6: Front Panel

RotoCom

The RotoCom is a memory and control unit for the Struers grinding and polishing system. When all other devices are attached and set to communicate with the RotoCom, the method used for each step in the grinding and polishing process can be stored in the RotoCom. It can be programmed with different methods for different materials, which allows for easy repetition. When running a programmed method with the Struers system in auto mode, the RotoCom will adjust the settings on all of the other devices in preparation for the run. It comes preloaded with some of Struer’s metalog methods which were created for samples with properties as given in Struers’ Metalog Guide. It can also be programmed with new methods.



- A** Display and front panel controls.
- B** Electrical connections on the back of RotoCom.
- C** Base plate for mounting of Multidoser.

Figure 7: RotoCom

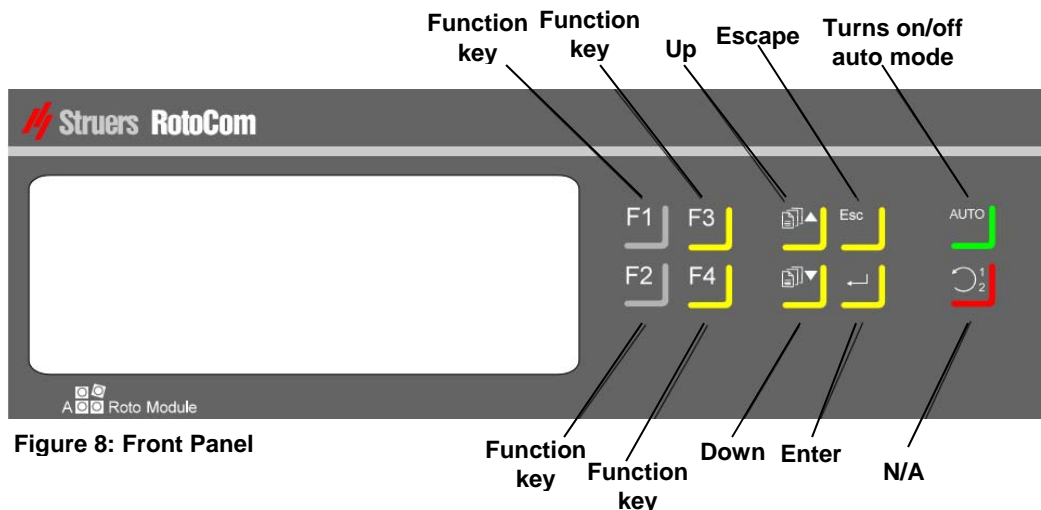


Figure 8: Front Panel

Safety

Equipment

Safety glasses should be worn while the machine is in use

Gloves should be worn when using polishing powders and when mounting

Proper disposal of chemicals

Silicon Carbide and alumina oxide powders may be disposed of in the trash

Dichloromethane must be used in the hood and disposed of as a chemical waste

Acetone should be disposed of as a chemical waste

Koldmount should be disposed of as a chemical waste

How to Mount a Sample

Samples that must be mounted can be mounted using cold or hot mounting techniques. To cold mount a sample there is Koldmount, a cold mounting epoxy, available. For hot mounting there are two options. There is a hot mounting press which will embed the sample in a phenolic or bakelite puck. There are also metal mounts of various sizes along with two different types of wax which will allow the sample to be mounted on top of the mount rather than in it.

Cold Mounting

Place sample in the appropriate sized mold

Combine 2 parts powder to one part liquid by volume

Mix for no less than 30 seconds

Pour into the mold and allow to stand for 30 minutes

Hot mounting

Place mount on hot plate

Heat to flow point of wax (Crystal Bond 77°C, Black Wax 80-90°C)

Apply a uniform layer of wax to mount

Place sample on wax and try to fill in center/edges until wax is level

Remove mount from heat and place lubricated weight on the sample to cool

How to Load a Sample

Samples can be loaded as "single samples" with a sample mover plate or in a sample holder.

"Single samples" does not mean only one sample can be run, it simply means a sample holder will not be used. Single samples can be mounted, but if they are large enough they do not have to be. With "single samples" the samples are placed directly on the surface in a sample mover plate and feet lower out of the RotoForce to apply the specified pressure. When using "single samples", the RotoForce has a force range of 5N-100N.

A sample holder will hold the samples firmly in place throughout the run and applies the force to the samples by applying a force to the sample holder. A sample holder is made to hold mounted samples. When using a sample holder, the RotoForce has a force range of 30N-100N.

There are three sample holders available: a 7 sample holder for 1 ½" diameter mounts, a 9 sample holder for 1" diameter mounts, and a 1 sample holder for ½" diameter mounts. The sample mover available holds 5 samples that are less than 1 ¼" in diameter and has 1 mover for a square sample of less than 1 1/8" length or a circular sample of less than 1 ¼" diameter.



Figure 9: Sample mover plate





Figure 10: Sample holder


Single Sample

Single samples have force applied by pressure feet which lower as the run begins. They are rotated by a sample mover plate in which they are placed. A sample mover must be used when running single samples.

Make sure the RotoForce is set to single samples:

Press Menu once 

If holder type is set to sample holder press rotate option 

When holder type is set to single samples press stop to exit to main screen 

To load the sample mover place it under on the coupling on the RotoForce

Press and hold the release button on the side of the RotoForce and guide the three pins into the corresponding holes on the sample mover plate


Release the button when in place


To run a sample in a mover plate the plate must be lowered before the sample is placed in one of the holes in the plate


Sample Holder

A sample holder holds multiple mounts, or samples of similar size and shape to a mount. A sample holder is more stable than a sample mover because the mounts are tightly held in during the run. Because of this it is more inconvenient to clean samples in between runs. The samples mount also has a higher range of forces than the single sample because it was made for running multiple samples.

Make sure the RotoForce is set to sample holder:

Press Menu once 

If holder type is set to single samples press rotate option 

When holder type is set to sample holder press stop to exit to main screen 

Slide the mounted sample into the hole on the sample holder. Be sure the sample holder is weighted evenly by using counter weights which do not need to touch the

grinding or polishing surface. Also, be sure the sample is below the surface of the sample holder and below any counter weights.

Tighten the holder using the Allen key

To load the sample holder place it under on the coupling on the RotoForce

Press and hold the release button on the side of the RotoForce and guide the three pins into the corresponding holes on the sample holder

Release the button when in place

Using the RotoPol-31

Once the sample has been mounted and loaded the grinding paper or polishing cloth must be attached to the RotoPol. The RotoPol has a magnetic disc system so the discs can be changed with ease. Grinding papers and polishing cloths are fixed to ferrous plates that mount to the magnetic disc system on the Rotopol. Be sure to attach the polishing cloth or grinding disc to the appropriate metal plate as marked on the back. Be sure there are no air bubbles on the disc or it can ruin your grinding/polishing step. Grinding papers and polishing cloths can be reused as long as they are washed in between. Replace the paper and cloths as they wear down or rip. Please wash the cloths and papers after use and spin or stand to dry.


To turn on the RotoPol, Multidoser, and RotoCom turn the knob on the right side of the RotoPol


Menu 

The menu can adjust three things: disc cooling, language, and communication.


Disc cooling should be set to “when water off.” When disc cooling is set to when water off water will cool the disc from underneath so the sample will not get wet and the disc will stay cool. If it is not


Press menu 


Press rotate option until disc cooling is set to when water off 

Press stop to exit to the main screen 


Language can be adjusted in a similar way


Press menu twice until language screen comes up 


Press rotate option until language is set 



Press stop to exit to the main screen 

Communication should be set to RotoCom when it is in use and standard when it is not.

Press menu three times until communication screen comes up 



Press rotate option until set appropriately 

Press stop to exit to the main screen 

Water should be on for most grinding methods and off for most polishing methods. To turn the water off press the water off button.  To turn the water on press water on button.  To adjust the flow of water, turn the knob on top of the water spout.

The RotoPol-31 rotates counterclockwise at two different speeds, 150 rpm and 300 rpm.

To change the speed press the appropriate button: 300 rpm , 150 rpm .

Once the appropriate settings are chosen and everything is mounted and ready press the start button to begin.  In order to stop the run, if only the RotoPol is being used, or to pause the run when other tools are being used with it, press the stop button. 

Using the RotoForce-4

To turn on the RotoForce turn the knob on the back right of the head.

Make sure the sample is loaded as described above.


Menu 


The menu can adjust four things: holder type, language, communication, and force reduction.

Holder type can rotate between single samples and sample holder by the method explained in “How to Load a Sample”.

Language can be adjusted as for the RotoPol


Press menu twice until language screen comes up


Press rotate option until language is set 

Press stop to exit to the main screen 

Communication should be set to RotoCom when it is in use and standard when it is not.


Press menu three times until communication screen comes up


Press rotate option once 



Press stop to exit to the main screen 



Force reduction will cause the force to be reduced to 5N during the last 30 seconds. Force reduction can be turned on and off through the menu.



Press menu four times until force reduction screen comes up

Press rotate option until the force reduction is set 

Press stop to exit to the main screen 

The RotoForce will rotate in the same or opposite direction as the RotoPol. To adjust this press co-rotation,  or counter-rotation. 

The force settings on the RotoForce vary depending on the sample holder used. If a single sample mover is used the force varies from 5-100N. If a sample holder is used the force varies from 30-400N. To adjust the force press increase force  to increase it and decrease force  to decrease it. If there is a long beep while trying to adjust the force it means the force cannot be adjusted any higher or lower.

Adjusting the time will change how long this run will last. Increase time  Decrease  time

The auto setting allows for easy communication between devices. When the RotoForce is set to auto mode it will start the run with the RotoPol. The RotoPol will also turn off with the RotoForce after the amount of time set. If communication is set to standard, toggle the auto setting by pressing Auto on the RotoForce. If the communication is set to RotoCom, toggle the auto setting by pressing Auto on the RotoCom.

The start button on the RotoForce will only start the RotoForce when it is not in auto mode. The stop button will stop the entire run. If in auto mode, press the stop button on the RotoPol to pause the run.

There is a handle on the right side which will raise, lower, and lock the RotoForce. When the handle is angled back, the RotoForce head is raised. This is the appropriate setting for loading samples. When the handle is vertical, the RotoForce head is lowered to working position. In this setting it can still be moved horizontally. When the handle is horizontal, it is locked in position. The RotoForce should be in the locked position for the entirety of the run.

Using the Multidoser

When connected with the RotoPol, the Multidoser should turn on with the RotoPol.


Menu

There are two menus on the RotoPol, bottles setup and basic setup

Bottles setup is how the Multidoser knows what is in each bottle. Bottles should always be setup in the order that they will be used, coarsest grain size first.

Press menu to bring up bottles setup

Press menu again until you reach the bottle you would like to set.

First the type will come up. For bottles 1-4, the type can be set as DP-suspension, lubricant, or no bottle. Bottle 5 can only be set as DP-suspension or no bottle and bottle 6 can only be set as OP-suspension or no bottle. These settings can be adjusted by pressing rotate option. 

When the correct bottle type has been chosen press menu to get to bottle text. This will adjust what type of lubricant or grit of suspension is in the bottle. Lubricant options are blue, red, green, brown, and yellow, when in communication with the RotoCom. When not in communication with the RotoCom, lubricant options are Lub., blue, red, green, lub. 1, and lub. 2,. For DP-suspensions the options are 15 μm , 9 μm , 6 μm , 3 μm , 1 μm , and 0.25 μm , when in communication with the RotoCom. There are 3 additional options, sup., sup. 1, and sup. 2, when not in communication with the RotoCom. For OP-Suspensions the options are OP-A, OP-S, and OP-U, when in communication with the RotoCom. There are 3 additional options, OP, OP 1, and OP2, when not in communication with the RotoCom. These are also adjusted using the rotate option. A description of what these names correspond to is given in the table below.

Struers	General
Lubricant	
Blue	Alcohol based, high cooling, low smearing, high material removal
Red	High smearing, lower cooling, polishing soft and ductile metals
Green	Water based, high cooling, low smearing, high material removal
Brown	Alcohol based, fine grinding and diamond polishing
Yellow	alcohol based, final polishing soft, water sensitive materials
OP-Suspensions	
OP-A	Aluminum oxide and water polishing suspension, good for all, use with non-ferrous metals or composites
OP-S	Silica and water polishing suspension for use with reagents that increase chemical reaction, use with very ductile materials
OP-U	Silica and water polishing suspension good for use with non-ferrous materials or composites

The basic setup will set all of the more general machine settings. It can adjust language, communication, 2 disc system, OP flush time, pre-dosing, end-dosing.


To get to the basic setup


Press menu to get to the bottles setup

Press rotate option once until basic setup comes up 

Language can be adjusted as for the RotoPol


Once in the basic setup press menu once until language screen comes up


Press rotate option until language is set 

Press stop to exit to the main screen 

Communication should be set to RotoCom when the RotoCom is in use. If the RotoCom is not in use communication should be set to standard.


Press menu twice from basic menu until communication screen comes up

Press rotate option until set to RotoCom 

Press stop to exit to the main screen 

This Multidoser is attached to a 1 disc RotoPol, so 2 disc system should be set to no. If it is not


Press menu three times from basic menu until it says 2 disc system

Press rotate option once 

Press stop to exit to the main screen

The OP flush time can also be adjusted. This time is how long after the preset preparation time the Multidoser will flush the sample with water. This is done when working with OP-suspensions. This can be varied from 10-30 seconds.


Press menu four times from basic menu until it says OP flush time

Press rotate option until desired flush time has been selected 

Press stop to exit to the main screen

Pre-dosing is useful when using new dry polishing cloths. It adds an extra amount of lubricant at the beginning of each preparation step to prep the polishing cloth. There are four different pre-dosing options: no (no pre-dosing), low (0.7 seconds), medium (1.5 seconds), high (3.0 seconds).

Press menu five times from basic menu until it says pre-dosing

Press rotate option until pre-dosing is set appropriately 



Press stop to exit to the main screen


End-dosing is appropriate when the sample is large and is prepared on a very smooth disc. It prevents adhesion between the disc and the sample. It can be set to yes (1 second) or no (off).



Press menu from basic setup until it says end-dosing


Press rotate option  until end-dosing is set


Press stop to exit to the main screen


The Multidoser has two identical sets of four buttons on it. The left ones control the suspensions  and the right ones control the lubricant. 

To select which suspension or lubricant to use press  until you reach the desired suspension or lubricant.

To adjust the amount of suspension or lubricant used press  to increase the dosing and  to decrease the dosing.

To manually add suspension or lubricant press and hold 

The Multidoser has a self-cleaning mechanism. Press  to clean. There is an option to clean all tubes or just the OP-suspension. To adjust this press the rotate option and the clean button. Follow the instructions on the screen. When each instruction is complete press the clean button. The tubes should be cleaned after each use.





The Multidoser will also stir the suspensions and lubricants. To stir press the stir button  twice. Make sure the lids are on the bottles. When using a suspension that has been sitting, it should always be stirred either using the stir option on the Multidoser, or manually.

To connect the Multidoser to the RotoPol and RotoForce when not in communication with the RotoCom, press Auto on the Multidoser. To put the Multidoser in Auto mode when in communication with the RotoCom press Auto on the Multidoser. When in auto mode, the Multidoser will begin and end its run with the RotoPol and RotoForce. When not in auto mode, press the start button on the Multidoser to begin dosing. When in auto mode, press start on the RotoPol to begin the run. Pressing stop on the Multidoser when in auto mode will pause the run.

Using the RotoCom

When connected with the RotoPol, the RotoCom should turn on with the RotoPol.

Menu




The menu on the RotoCom is called Configuration or Config. To get to the menu press F1  from the main screen. The menu has three options: consumables, options, and LCD contrast. To select an option press the up  and down  arrows until the option is highlighted then press enter. 




Consumables


The consumables menu allows you to adjust the surfaces, suspensions, or lubricants available in the menus. They can be added, edited, or deleted by selecting the appropriate function button (F1, F2, F3, or F4)

Options




Options allows you to adjust the language, number of discs in the system, and the write protect.

To adjust the language, use the up  and down  arrows until the language is highlighted and press enter  until the appropriate language is selected.

The number of discs in this system is 1 so 2-Disc system should be set to no. If it is not use the up  and down  arrows until the 2-Disc system is highlighted and press enter. 

When write-protect is turned on, methods cannot be copied, edited, or deleted. To turn the write-protect on and off highlight and write protect option and press enter. 

LCD contrast

The LCD contrast on this screen can be problematic. If the menus on the screen are visible the LCD contrast can be adjusted by going to the LCD menu and pressing up  and down  until the screen contrast is adjusted and then pressing enter.  If the screen is difficult to see, use the following procedure from the main menu.

Press F1

Press down  twice



Press enter 

Press up  and down  until the screen can be read




The RotoCom stores methods so that they can be accurately reproduced in the future. All of the information can be stored including: time, force, cloth and suspension type. Methods can be programmed in two ways: they can be programmed from scratch, or they can be copied and adjusted from preprogrammed methods

Programming from scratch

When programming from scratch each tool must be set up for the run individually. To do this all of the machines must be set in communication with the RotoCom, but cannot be set in auto mode.

The RotoPol controls the speed of the plate, whether the water is on or off, and the type of surface used. These can all be adjusted in the same way they would be if it was not in communication with the RotoCom. The type of surface can be adjusted by pressing up  or down  on the RotoPol until the correct surface is showing. The selection of surfaces is set by the consumables list on the RotoCom.

The RotoForce controls the time of the run, the force applied, the direction of rotation, and whether it is a single sample or sample holder. These are all adjusted as they would be if the RotoForce was not in communication with the RotoCom.

The Multidoser controls the suspension and/or lubricant that is used and how often it is applied. Once the bottles are set up in the main menu the appropriate bottles must be selected by pressing bottle  until the appropriate one is chosen. The amount of lubricant or suspension used must be selected by pressing up  or down  to increase or decrease the dosing. The Multidoser can apply a maximum of one lubricant and one suspension per step.

When all three tools are set with the correct settings chose the appropriate group, method, and step number on the RotoCom and press F4 twice to save this data on the RotoCom.

Copying a preprogrammed method

Any of the methods that are preprogrammed can be copied into a different group. It is useful to copy a method when a similar method is to be used. The settings of a method can be updated. To copy a method:

Go to the group with the method you would like to copy

Highlight desired method

Press F1, copy, twice

Go to the group where you would like to place the copied method

Choose the method number where you would like to insert it

Press F2, insert, twice

This method can now be updated to adjust the necessary parameters

Updating an existing method

Choose the appropriate group, method and step

Press auto on the RotoCom to set the machines according to the step chosen

Press auto again to allow the machines to be adjusted

Set the machines to the appropriate settings as described previously

Press F4, update, twice

All methods can be updated except for the Metalog methods unless write-protect is turned on

Inserting a preparation step

Select the appropriate group and method

Highlight where you would like the preparation step inserted

Press F2, insert, twice

Deleting a preparation step

Select the appropriate group and method

Highlight the step you would like to delete

Press F3, delete, twice

Renaming a group or method


Highlight the appropriate group or method


Press F4, edit name


F2 inserts character at location of cursor

F3 deletes character at location of cursor




F4 saves the name

 moves left

 moves right

 brings up the keyboard

Keyboard

When using the keyboard on the RotoCom it was created for many languages, so it has a wide variety of characters. To adjust between keyboards use the F1 and F3 buttons to scroll through the different selections. These buttons are also used to move left and right in choosing the letter on the appropriate keyboard. In the keyboard  moves up,  moves down, and  will accept the letter highlighted

Running a method

Once the method has been setup in the RotoCom it will be stored for future runs. To run one of the stored methods:

Choose the appropriate group

Choose the appropriate method

Choose the step you would like to run

Press auto on the RotoCom, be sure the auto lights on the other machines are illuminated, if not turn auto off and adjust their communication settings

When the sample is loaded press start on the RotoPol

When the step has completed running all the tools will stop automatically and the RotoCom will set the tools up in preparation for the next step

When ready to run the next step, press start on the RotoPol