Lucidity

miniGC Operation Manual

LUCIDITY

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1.0 Installation Overview

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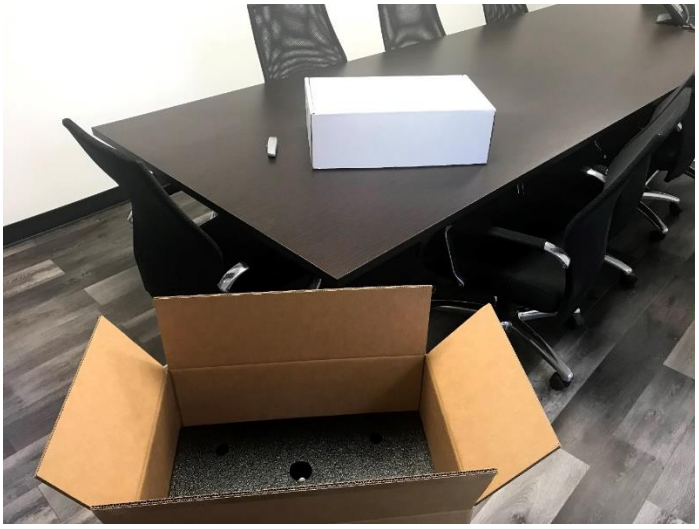
1.2 Connection of gas lines and gas requirements
1.3 Connecting the system and turning everything on
1.4 Setting up the autosampler
1.5 Installing the Starter Column
1.6 Checking for errors and interface overview
1.7 Running the system for the first time

1.1 Unpacking & what's in the box

Your miniGC will arrive in a box like this

Upon opening the box you will see the accessories box in the top



The miniGC will be in the box below the Accessory Kit

In the big accessories box you'll find 1) the Accessory Kit (if ordered), 2) the System Accessories, and the Starter Column (if ordered).

Inside the Accessory Kit you will see the laptop that is used to operate the miniGC that is preloaded with the miniGC software, the MXT-5 (30m x 0.25mm x 0.25um) column that comes standard with the miniGC, and 2 other boxes filled with accessories.

The miniGC (NP-1397 or NP-1408) comes with:

- miniGC system
- power cord
- laptop preloaded with software and installation and training videos
- ethernet cable to connect miniGC to laptop
- mouse and mousepad

The miniGC Accessory Kit (NP-1402) must be ordered separately and includes:

- Pack of 50 Septum (Restek PN: 23864)

- Pack of 5 Inlet Liners (Restek PN: 23309)
- Inlet Liner Removal Tool (Restek PN: 20181)
- Septum Puller (Restek PN: 20117)
- Syringe for Manual Injections (Restek PN: 24932)
- 5 Liner O-rings (Restek PN: 29528)
- 5 Liner Nut O-rings (Restek PN: 29259)
- Tool for Liner Nut & Septum Nut (Restek PN: 29260)
- Air Line Wrench (Restek PN: 20387)
- GC-FID Test Mix (Restek PN: 35108)

The miniGC Starter Column (Lucidity PN: NP-1403, Restek PN: 70223-LUC25) must also be ordered separately and includes

- Restek MXT-5 column (30m x 0.25mm x 0.25um) preinstalled onto a column holder

The miniGC, miniGC Accessory Kit, and miniGC Starter Column will all come in the same box (the box shown) if ordered.

For more information see the Lucidity website (https://luciditysystems.com/product/minigc/).

Below the accessories is the miniGC between 2 pieces of foam. When sending a miniGC back to Lucidity make sure to use these 2 pieces of foam to pack the miniGC. If you don't have them, you can get additional foam from Lucidity. Do not attempt to pack the miniGC any other way. Also, make sure to put the big accessories box back in the shipping box even if it is empty since it acts as a spacer to keep the miniGC from moving around during shipment.

Once you remove the top piece of foam you will see the miniGC

Inside the accessories boxes you will find the power cord and communication cable that connects the miniGC to the laptop controller

Once unpacked the miniGC will look like this. It requires a standard wall outlet and gas line connections.

One of the features of the miniGC is that it comes with training and installation videos that allows it to be self-installed in less than 30 minutes. You can find these videos on the Lucidity website here () and on the laptop that comes with the miniGC.

One of the first things you should do when unpacking and setting up your miniGC is to plug the laptop in and turn it on so you can access the training videos.

These videos should be viewing sequentially while setting up the system to ensure proper setup. These topics are also detailed in this section.

1. Connecting Gas Lines to the miniGC
2. Connecting the laptop to the miniGC
3. Installing Septum, Liner, and o-rings
4. Establishing a connection between the software and the miniGC
5. Installing your column
6. Starting a run and injecting the GC-FID Test Mix
7. During a run
8. Cooldown & viewing results
9. Connecting the miniGC Autosampler
10. Installing a syringe in & calibrating your autosampler
11. Starting a run with your autosampler

1.2 Connection of Gas Lines & Gas Requirements

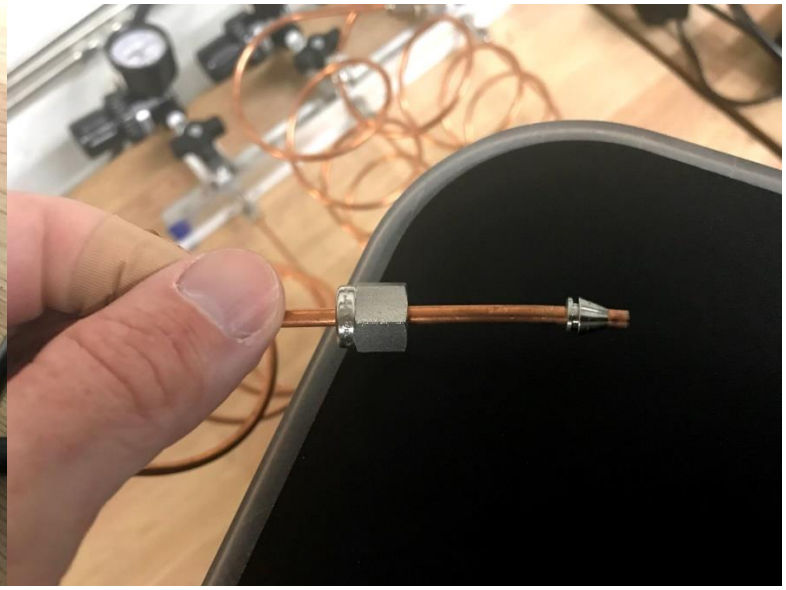
On the back of the miniGC you'll see the gas hookup connections. Three gases are required: Carrier gas (Hydrogen, Helium, or Nitrogen can be used), Hydrogen (for the FID), and Compressed Air (for the FID). All 3 gasses should have inlet pressures between 45 psi and 100 psi and the flow requirements are as follows:

Carrier Gas: Up to 300mL/min

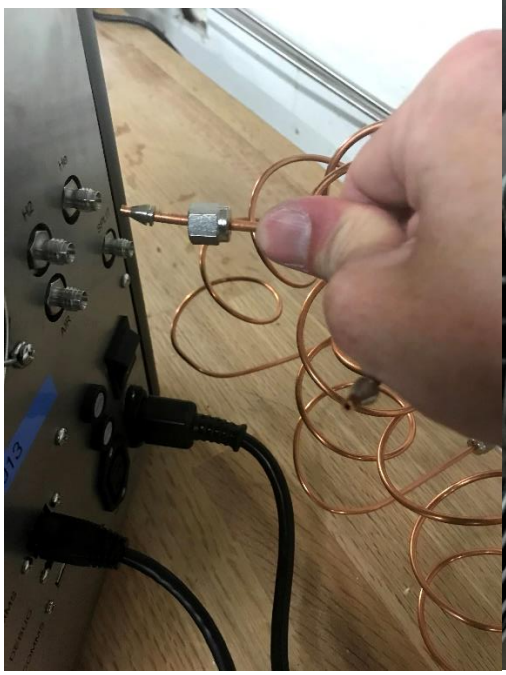
Hydrogen: Up to 30mL/min

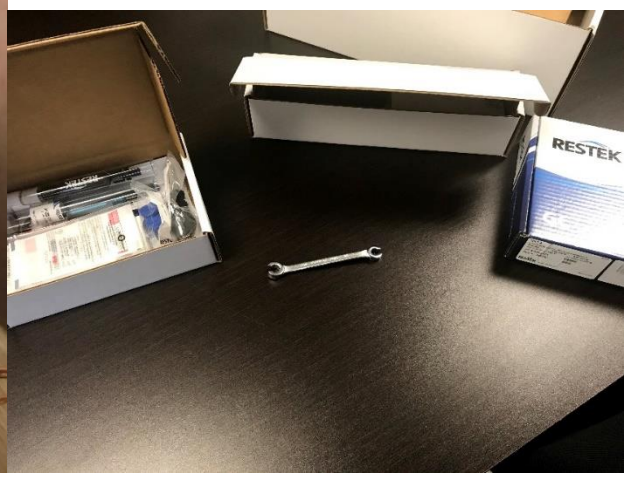
High Purity Zero Air: Up to 300mL/min

The system will provide a warning if the gas flow from any of the gasses is not enough.

The system comes with standard 1/8” metal compression fittings on the back of the unit. These nuts and ferrules should be removed from the back of the system and then installed onto 1/8” gas lines from the gas sources then the lines should be swaged onto the fittings on the back of the miniGC.



A wrench is included in the Accessory Kit that will fit the nuts on the back of the unit and allow you to tighten the fittings once the lines are installed.

The nuts should be tightened until the lines cannot be pulled out through the ferrules.

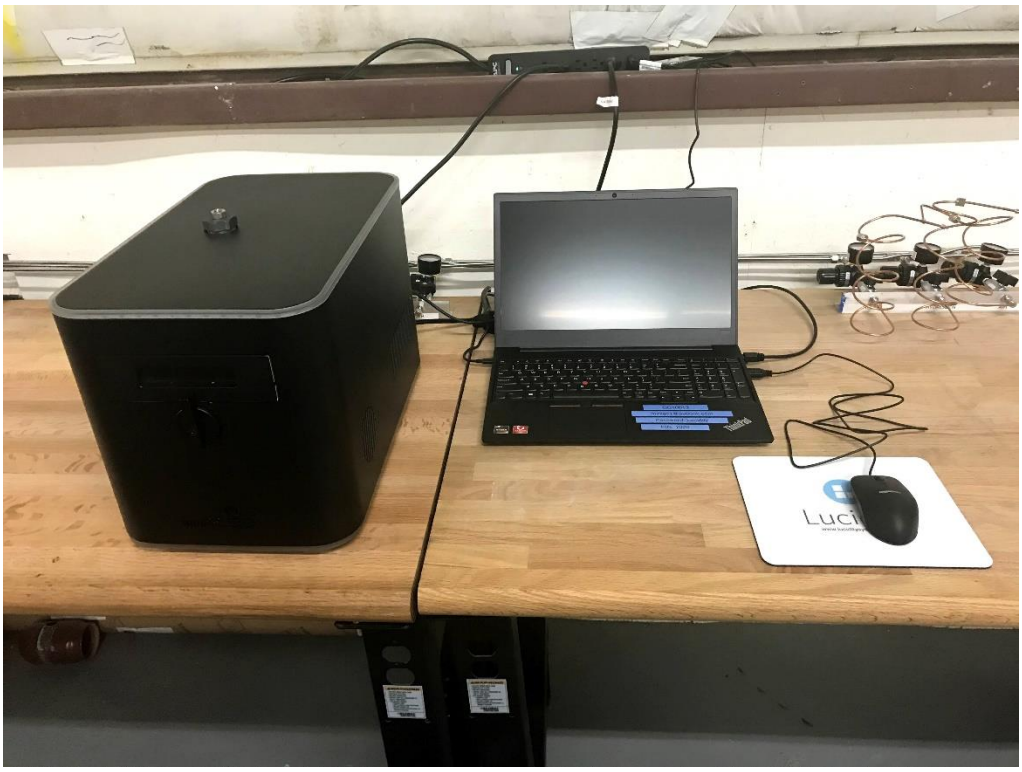
1.3 Connecting the system and turning everything on

Once the gas lines have been connected plug the power cord and network cable into the back of the miniGC. The power cord goes into a standard power outlet (120V / 60Hz or 240V / 50Hz depending upon the version of the miniGC). Ensure that you have ordered the correct version of miniGC before plugging it in. The serial tag on the back of the system will tell you what version you have. The part number for a 120V / 60Hz system is NP-1397 and the part number for a 240V / 50 Hz system is NP-1408.

[Show a pic of the serial tag.]

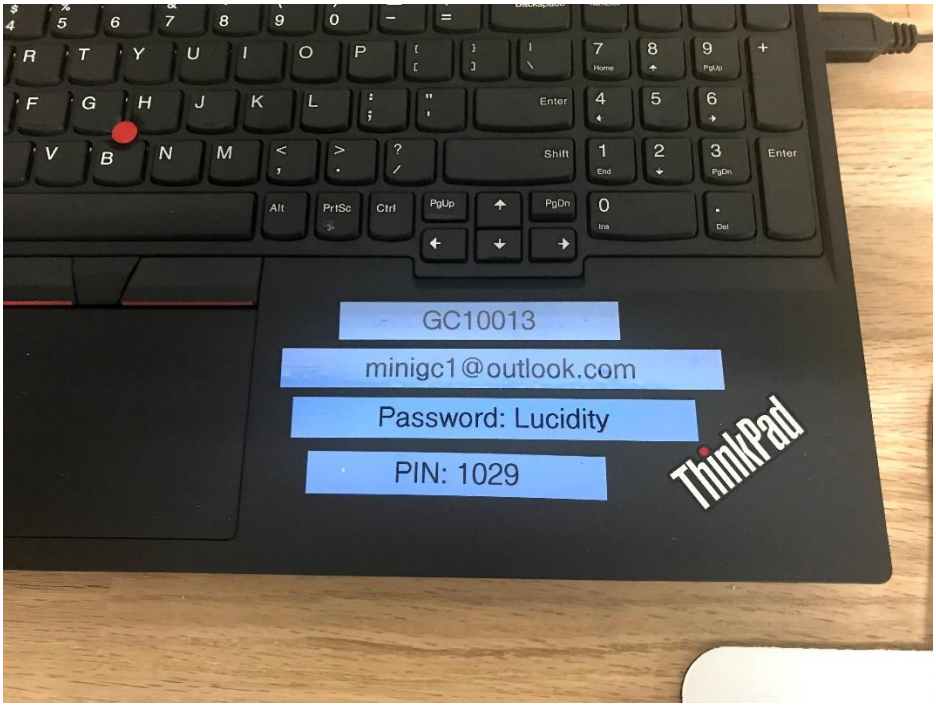
The other end of the network cable goes into the laptop. The laptop also has a power cable included that should be plugged into the laptop and the wall.

Also, plug the included USB mouse into the laptop, which is easier to use than the laptop mouse and gives you full functionality for the zooming features in the software. A mouse pad is also included with the system.



Once installed the system should look something like this.

The miniGC is just under 11 inches wide and the laptop is just under 15 inches wide so you may need 27 inches or so of bench width depending upon how you position the laptop.



All miniGCs and laptops are set up in checkout at Lucidity so that they should establish connection as soon as they are connected and powered up whether you are setting up a new system or whether you are setting up a replacement miniGC with your existing laptop. The laptop contains all of your method and results data, so if you are setting up a replacement system you do not need to worry about transferring any data from the miniGC.

If for some reason you have an issue with connecting the laptop and miniGC, check the IP addresses.

Laptop: Fixed IP, 172.16.0.10

miniGC: 172.16.0.90

The software is preloaded on the laptop and shows up as an icon on the desktop.

Before turning the system on, it's a good idea to install the septum, liner, and 0-rings in the injection port while the injection port is still room temperature. Once you turn the system on, the injection port will automatically begin to heat to 200C. If you turn the system on, make sure to turn to turn it back off and check the temperature of the injection port before attempting to work with it.

Warning: Always check the temperature of the injection port before grasping any part of it. The injection port should always be assumed to be hot. If the miniGC is on the injection port will be hot,

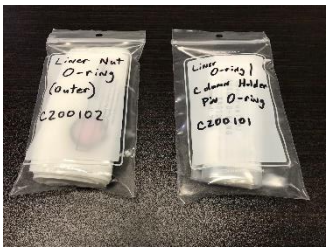
even if the system is in sleep mode. Even once the system is turned off, it will take some time for the injection port to cool down.

Tools & Parts Used

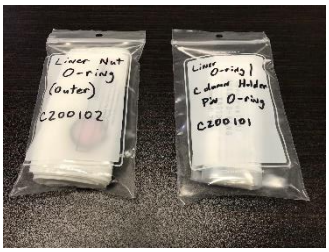
Liner Nut & Septum Nut Tool
Lucidity PN: C100200 (https://luciditysystems.com/product/minigc-accessories-kit/)
Restek PN: TBD

Septum Puller
Lucidity PN: R20117 (https://luciditysystems.com/product/minigc-accessories-kit/)
Restek PN: 20117
(https://www.restek.com/catalog/view/86/20117)

Liner Removal Tool
Lucidity PN: R20181 (https://luciditysystems.com/product/minigc-accessories-kit/)
Restek PN: 20181
(https://www.restek.com/catalog/view/3148/20181)



Liner O-Ring
Lucidity PN: C200101 (https://luciditysystems.com/product/minigc-accessories-kit/)
Restek PN: TBD



Liner Nut O-Ring
Lucidity PN: C200102 (https://luciditysystems.com/product/minigc-accessories-kit/)
Restek PN: TBD

Septa, pk of 50
Lucidity PN: R23864 (https://luciditysystems.com/product/minigc-accessories-kit/)
Restek PN: 23864
(https://www.restek.com/catalog/view/9550/23864)

Liners, pk of 5
Lucidity PN: R23309 (https://luciditysystems.com/product/minigc-accessories-kit/)
Restek PN: 23309
(https://www.restek.com/catalog/view/49232/23309)

All of these parts are in the miniGC Accessory Kit that comes with the miniGC. Part numbers and links are included for reordering. We encourage you to reorder all of your parts through Restek, but parts can also be reordered through Lucidity if needed.

Installing or Changing a Liner

We recommend for use in the miniGC the Topaz 4.0mm ID Low Pressure Drop Precision Inlet Liner with Wool (Restek PN: 23309). This liner is used to perform the 3 GC-FID Test Mix runs during checkout at Lucidity, and it is the recommended liner any time you are performing the Test Mix test on the miniGC. A pack of 5 of these liners is included in the miniGC Accessory Kit that comes with the miniGC. The miniGC is shipped without a liner in the system so one must be installed during setup of the system.

Other liners may be used in the miniGC and have been used successfully, but the results may vary depending upon which liner is used as is the case with any GC.

The first step in installing or changing either the Liner or the Septum is to turn the miniGC off (power switch is on the back of the unit) and wait for 20-30 minutes for the injection port to cool down.

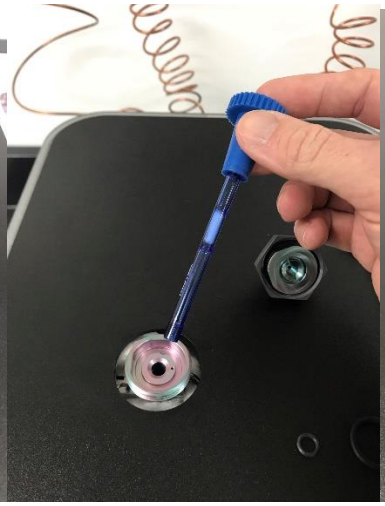
Caution: The injection port may be extremely hot! The injection port will be at an elevated temperature while the miniGC is on even when it is in Sleep Mode (which is indicated by the system being purple). To

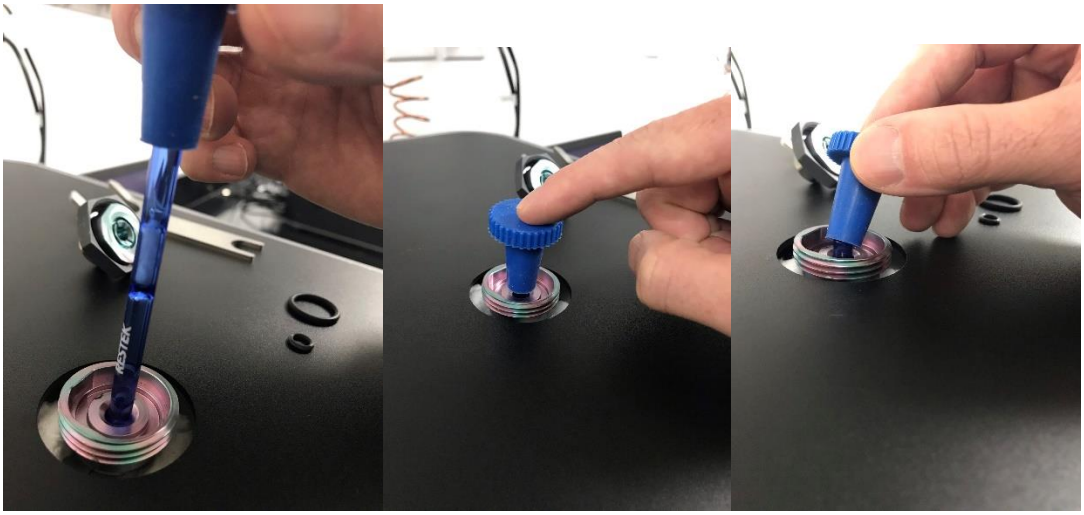
cool the injection port, turn the system off and wait 20-30 minutes for the injection port to cool down. Even after this period test the temperature of the injection port carefully before manipulating it.

To remove or install a liner, first use the larger side of the Liner Nut & Septum Nut Tool to loosen the Liner Nut then remove the nut using your hand.

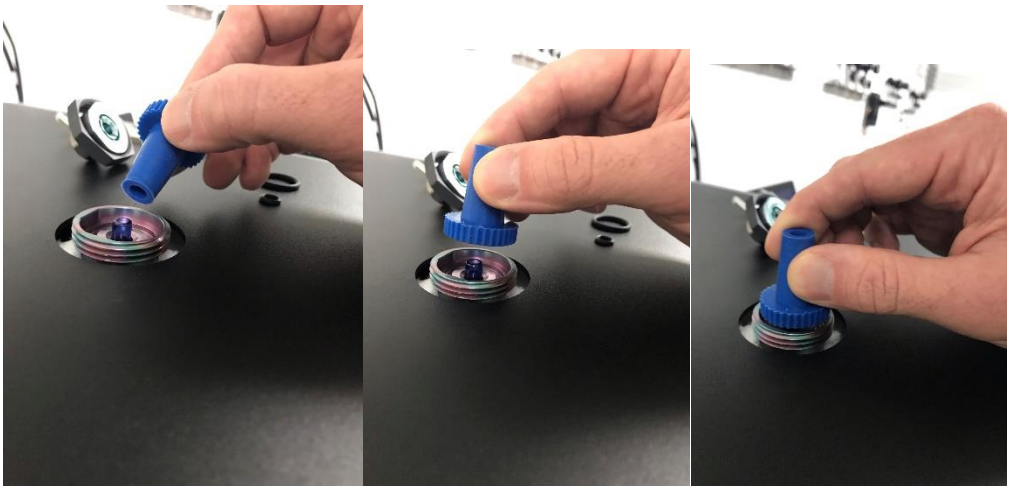


Once the liner nut has been removed use the Liner Removal Tool to grasp the top of the liner. Use the pictures to ensure that the liner is inserted in the correct orientation.

Once the liner is inserted fully into the injection port use the flat end of the Liner Removal Tool to ensure that the liner is fully inserted into the injection port. Use only a gentle push.

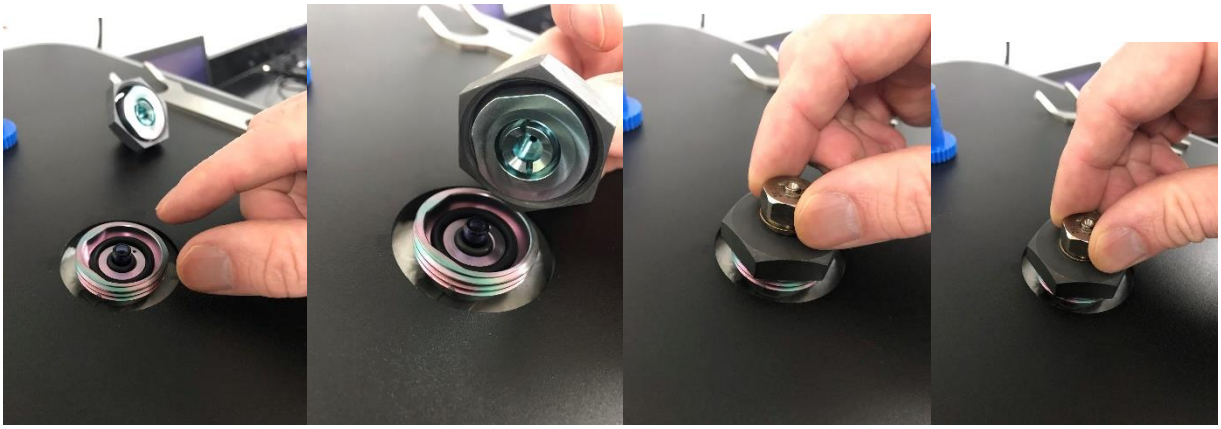


Once the liner is fully inserted, put the Liner O-Ring on the outside of the liner and push it down to the point it makes contact with the injection port. You can also put the Liner O-Ring on the outside of the

liner before you insert the liner into the injection port. Just make sure that both the liner and the o-ring are fully inserted into the injection port.

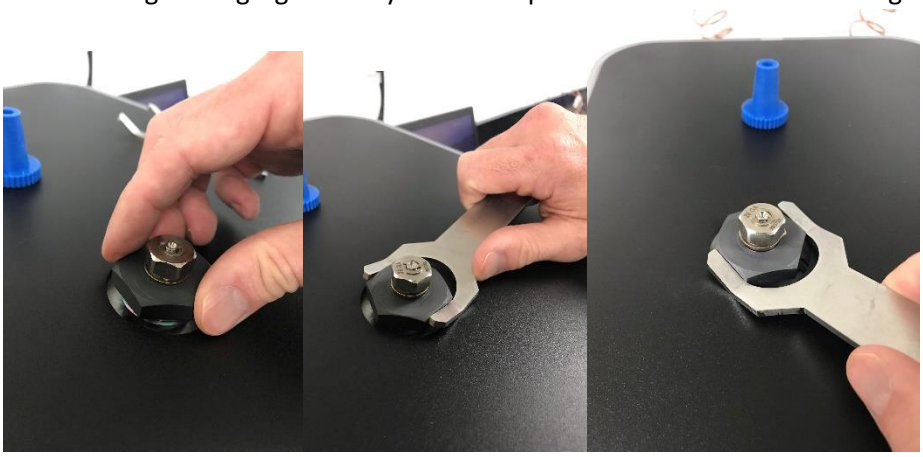
Caution: If you are using a liner other than the one we recommend, make sure that it is the same length, otherwise it will not fit properly into the injection port and may even break if you attempt to force it in.

After the liner and liner o-ring have been inserted fully into the injection port, place the Liner Nut O-Ring (the larger o-ring) in place. It sits in a groove as shown. Next put the Liner Nut back in place. Note that the Liner Nut is keyed into the injection port with two flats, so it must be oriented correctly before the liner nut can be tightened.



Once in place the liner nut should be finger tightened before using the Septum & Liner Nut Tool to tighten it further. The Liner Nut does not need to be tightened much more than finger tight to make a

seal. Overtightening significantly can cause problems with the threads longer term.



If the Liner Nut is not fully tightened the system will show a Split Flow error and low pressure meaning the carrier gas is leaking from the liner nut. Another cause for the same leak and error is an overly worn or missing Liner Nut O-Ring (the outer o-ring). This Liner Nut O-Ring and Liner Nut together seal the top of the injection port along with the Septum and Septum Nut to ensure that the carrier gas does not escape from the top of the injection port but rather proceeds into the column and split flow pathway.

The Liner O-Ring (the smaller o-ring) and Liner do not prevent the carrier gas from escaping the injection port, so a Split Flow error or low pressure do not indicate an issue with these components. Rather the Liner and the Liner O-Ring ensure that the carrier gas is split properly between the gas that goes into the column and the gas that exits the injection port through the split flow exit. So, an overly worn or missing Liner O-Ring or missing Liner will result in a lower than expected split, which will not produce any errors in the system since none of the carrier gas is leaking from the injection port. What you will see is bigger peaks than expected after an injection since more of the sample than expected is being injected onto the column. A great way to test for this is to inject the GC-FID Test Mix and compare against the saved cgrams of these runs. If the peaks are larger than they should be then you most likely need to replace your Liner O-Ring.

Both the Liner O-Ring and the Liner Nut O-Ring are made of high quality Kalrez, which makes them able to handle elevated temperature very well, meaning they are suited for long term use and don’t need to

be replaced weekly or monthly as may be the case with other GC o-rings. If you notice obvious deformation then they should be replaced.

Installing or Changing the Septum

We recommend for use in the miniGC the 11mm Thermolite Plus Septa (Restek PN: 23864). These septa are used to perform the 3 GC-FID Test Mix runs during checkout at Lucidity, and they are the recommended septa any time you are performing the Test Mix test on the miniGC. A pack of 50 of these septa is included in the miniGC Accessory Kit that comes with the miniGC. The miniGC is shipped without a septum in the system so one must be installed during setup of the system.

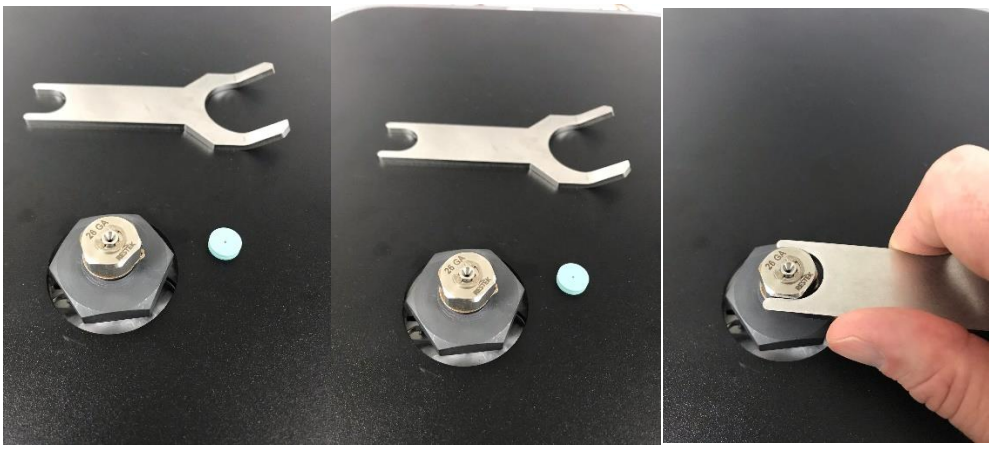
Other septa may be used in the miniGC and have been used successfully, but the results may vary depending upon which septum is used as is the case with any GC.

The first step in installing or changing either the Liner or the Septum is to turn the miniGC off (power switch is on the back of the unit) and wait for 20-30 minutes for the injection port to cool down.

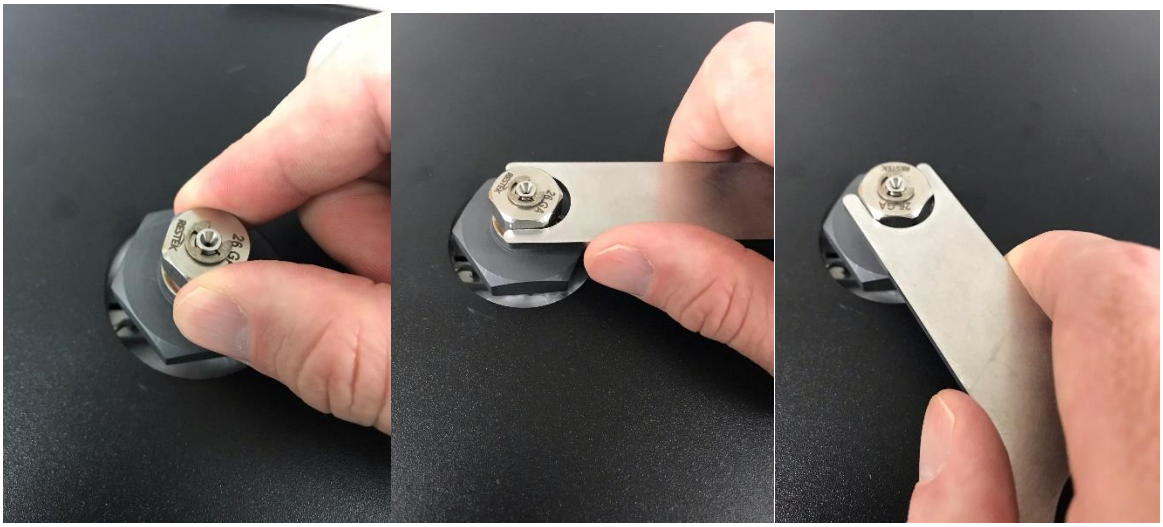
Caution: The injection port may be extremely hot! The injection port will be at an elevated temperature while the miniGC is on even when it is in Sleep Mode (which is indicated by the system being purple). To

cool the injection port, turn the system off and wait 20-30 minutes for the injection port to cool down. Even after this period test the temperature of the injection port carefully before manipulating it.

To remove or install a septum, first use the smaller side of the Liner Nut & Septum Nut Tool to loosen the Septum Nut then remove the nut using your hand.



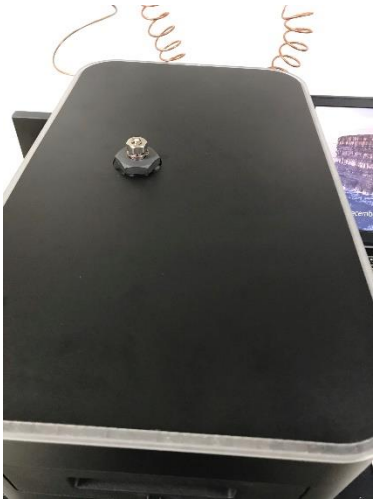
Next place the septum with the CenterGuide (a hole partially through the septa) facing up as shown. Then place the Septum Nut back in place and tighten manually.



After tightening manually, use the Septum Nut and Liner Nut Tool to snug the Septum Nut. You don't need to tighten the Septum Nut much more than finger tight to get a good seal. Overtightening can cause issues with the threads longer term.

If the Septum Nut is not tightened enough, you will see a Split Flow Leak error when the system is turned on and a lower than expected pressure. This means that the carrier gas is leaking from the septum / septum nut. Tightening the Septum Nut slightly will correct this. A septum that has been overly punctured will begin to create a permanent hole in the septum which will also begin to show up

as slightly lower than expected pressures and eventually a Split Flow Leak error. A missing septum will also result in this error. It is recommended to replace the septum after around 50 injections.



At this point the system should be turned on. Once your system is powered up and connected it will look something like this.

Goal #1: Make sure software is communicating with miniGC

Once the laptop is turned on you can click on the icon for the miniGC software on the desktop to open the software. Once opened you will be asked to select a user profile and log in. During installation log in through the Administrator profile using the password “Administrator”. The password for any of the preloaded profiles is simply the name of the user. Once you are logged in as the Administrator you can edit profiles and passwords and create your own.

Once you are logged in you will see the home screen. From here you can see the dashboard with the flows and temperatures, and you can go to the Run section, Methods, Results, or Settings. Backing out of any of these areas will take you back to the home screen.

Dashboard

Settings

Methods

Results

Run Screen,
Setup a run

It’s best to keep the miniGC on while unpacking the miniGC Autosampler to allow it to warm up, which will make the column installation easier.

1.4 Setting up the autosampler

Once the miniGC has been set up and connected to the laptop, you should unpack the autosampler and connect it to the miniGC. Shown here is the box that the autosampler arrives in. This box will include the miniGC Autosampler (NP-1398), which must be ordered separately from the miniGC, and the miniGC Autosampler Accessory Kit (NP-1404), which must be ordered separately from the miniGC Autosampler.

The miniGC Autosampler (NP-1398) includes the following parts:

- miniGC Autosampler
- integrated power cable that plugs into the miniGC
- communications cable that connects the miniGC and miniGC Autosampler

The miniGC Autosampler Accessory Kit (NP-1404) includes the following parts:

- Autosampler Syringe (Restek PN: 23924)
- Replacement Plungers for Autosampler Syringe (Restek PN: 21284)
- 2 Replacement Needles for Autosampler Syringe (Restek PN: 23946)
- Pack of 100 Sample Vials, Caps, & Septa (Restek PN: 26596)
- Pack of five 5mL Solvent / Waste Vials (Restek PNs: 23084 & 23092)

For more information see the Lucidity website (https://luciditysystems.com/product/minigc-autosampler/).


mini GC
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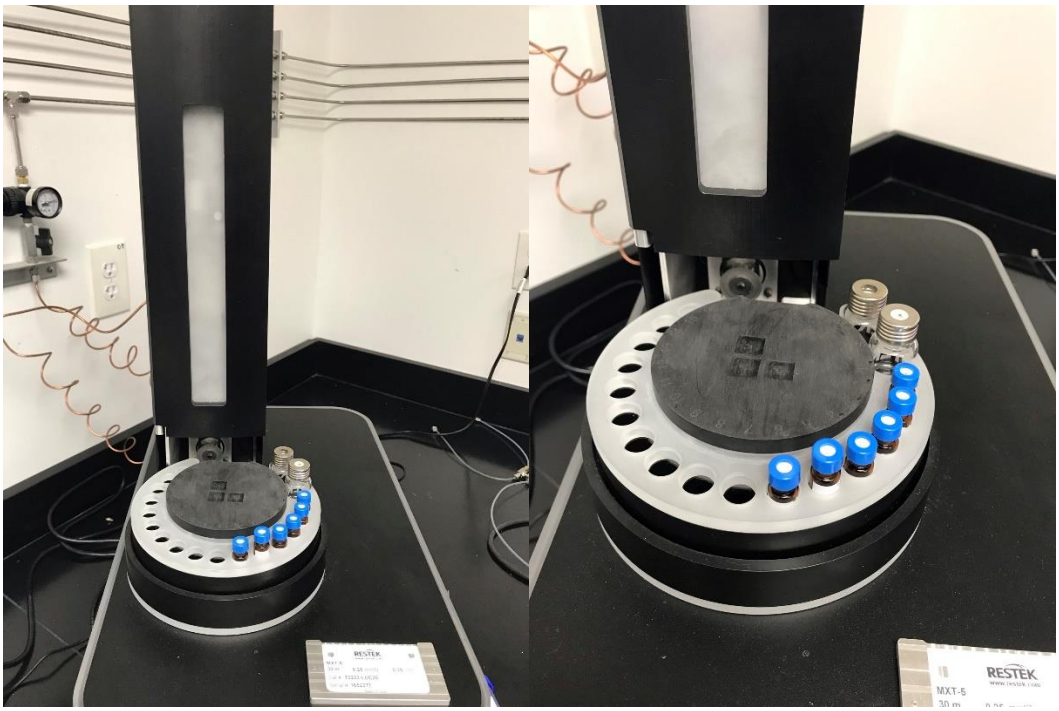
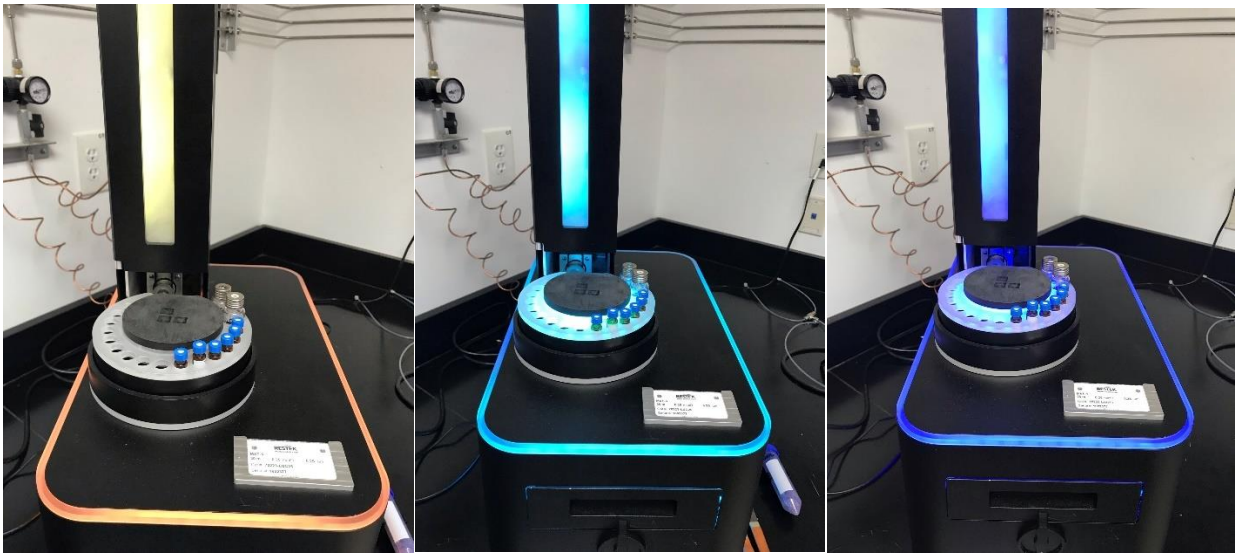
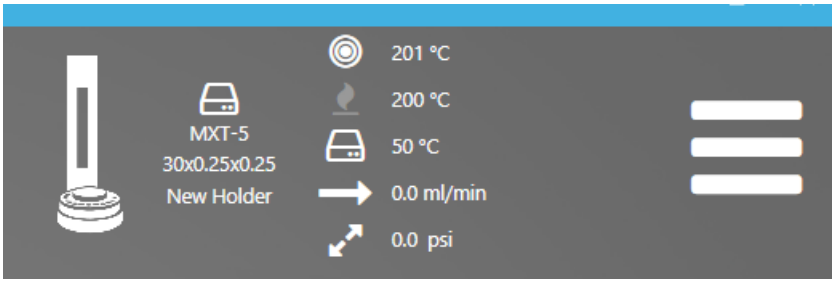


With the miniGC turned off, place the miniGC autosampler on top of the miniGC as shown and connect the power cable from the miniGC autosampler into the back of the miniGC then connect the communications cable as shown from the miniGC Autosampler to the miniGC. At this point the autosampler does not have to be in a perfectly aligned position. Once the autosampler is on top of the miniGC and the power and communication cables are connected, turn the miniGC back on. Both the miniGC and the miniGC Autosampler should light up.



You should see the autosampler indicator light up on the laptop software in the dashboard. If the autosampler indicator does not light up, go into Settings as shown and turn the autosampler to the on position. After this, the indicator light should light up.



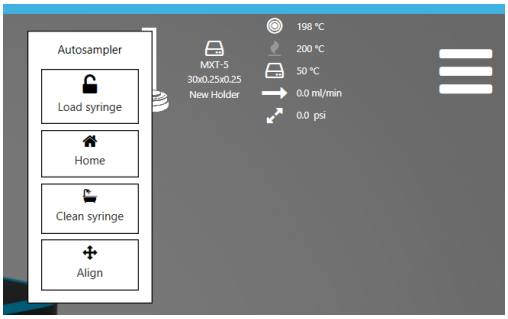
If it does not, power off the miniGC and exit the laptop software, then turn the miniGC back on and open the laptop software back up.

The miniGC Autosampler is now connected and communicating with the miniGC and the software and it is ready for alignment and installation of the syringe. If you wish to remove the miniGC Autosampler from the miniGC at any point simply disconnect the power and communication cables and tip the miniGC Autosampler sideways breaking the magnetic force and allowing you to easily remove the autosampler.

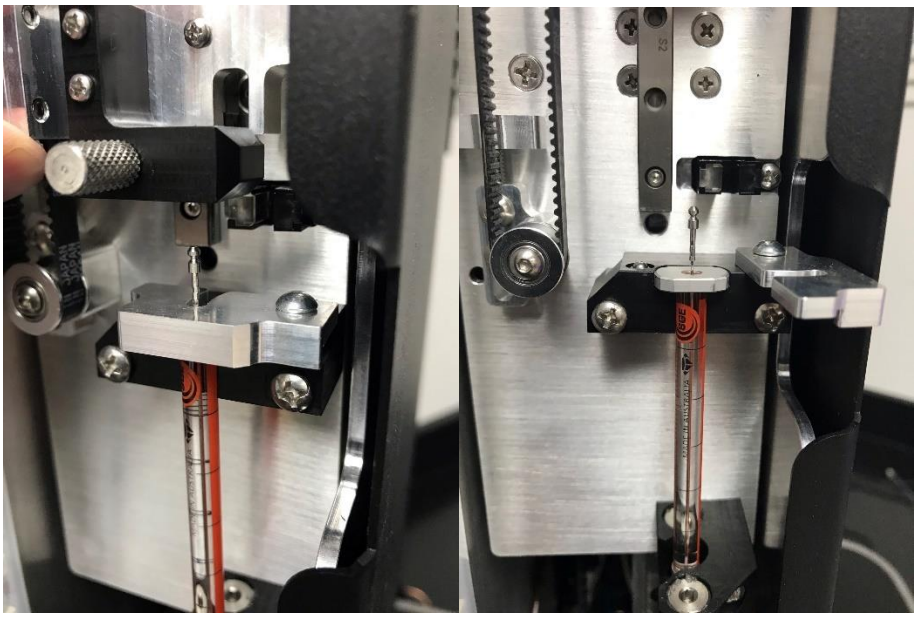
Installing the syringe

The syringe for the autosampler comes in the miniGC Autosampler Accessory Kit along with 2 replacement plungers and 2 replacement needles. First remove the plunger that comes with the syringe and insert one of the replacement plungers into the syringe which allow it to be installed into the autosampler as shown.

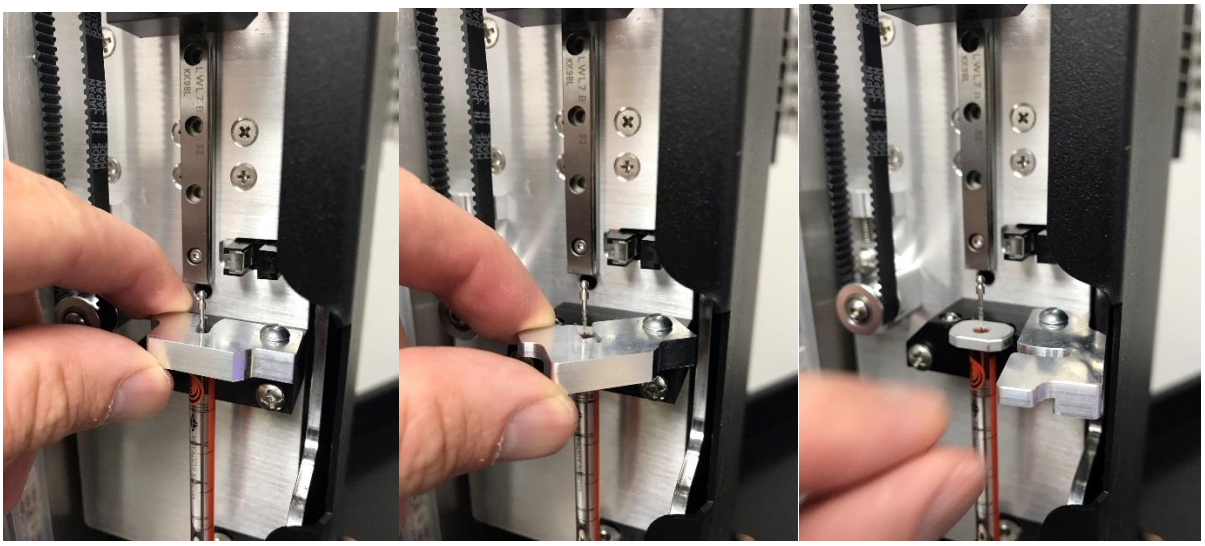
Next click on the autosampler icon on the software and click the load syringe button.

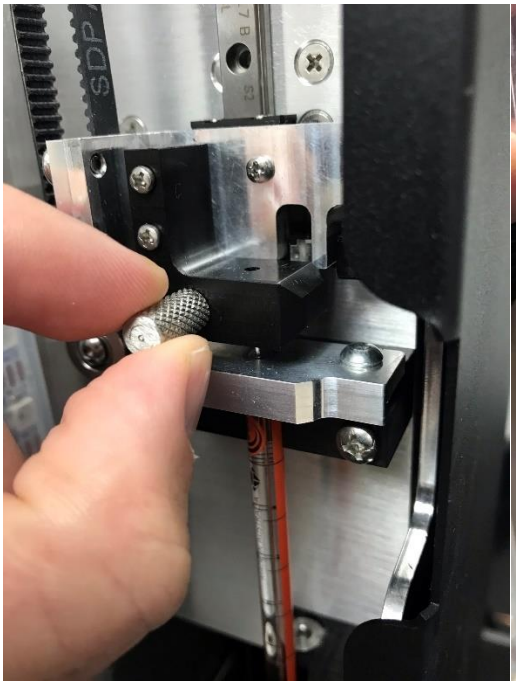
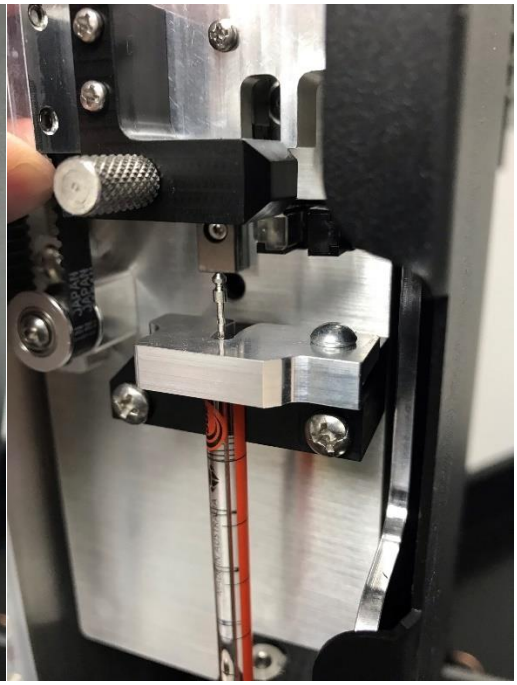


This positions the plunger holder so that the syringe can be installed.



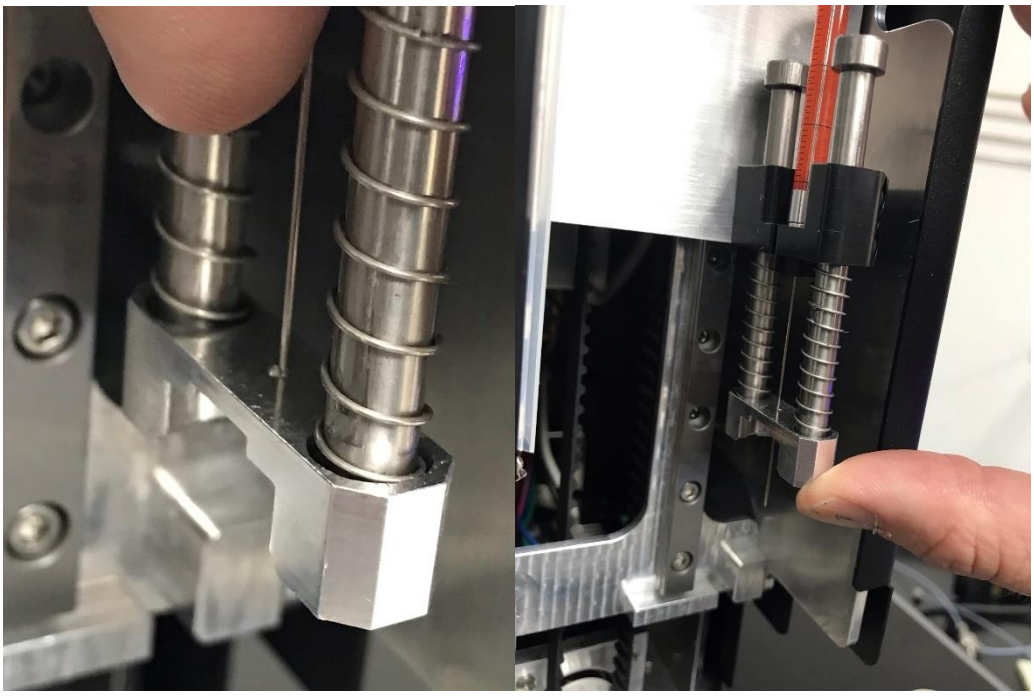
Swing the syringe barrel holder back as shown and insert the syringe as shown making sure the needle goes through the hole in the syringe holder foot then swing the syringe barrel holder closed so that it holds the syringe as shown.



Next turn the syringe plunger knob counter clockwise ½ to 1 rotation which will allow the tip of the plunger to go up into this mechanism and be grasped. Once you have done this, press the Syringe Home button on the software screen to bring the plunger holder down over the tip of the plunger. Once the plunger holder is over the tip of the plunger, turn the knob clockwise until you feel a slight bit of resistance. Do not overtighten. Once tight, press the Syringe Load button in the software again. You should see the plunger holder mechanism go up and take the plunger with it (the plunger should now be grasped in the plunger holder). If the plunger is secured in the plunger holder, press the Home Syringe button again to leave the syringe in the home position.

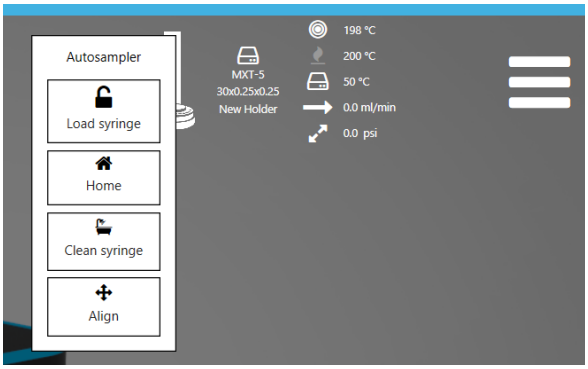
One other thing to make sure of is that the needle of the syringe is positioned to go through the foot of the syringe holder as shown below. If it is not positioned through this hole, then the needle will bend when the syringe goes into the down position.



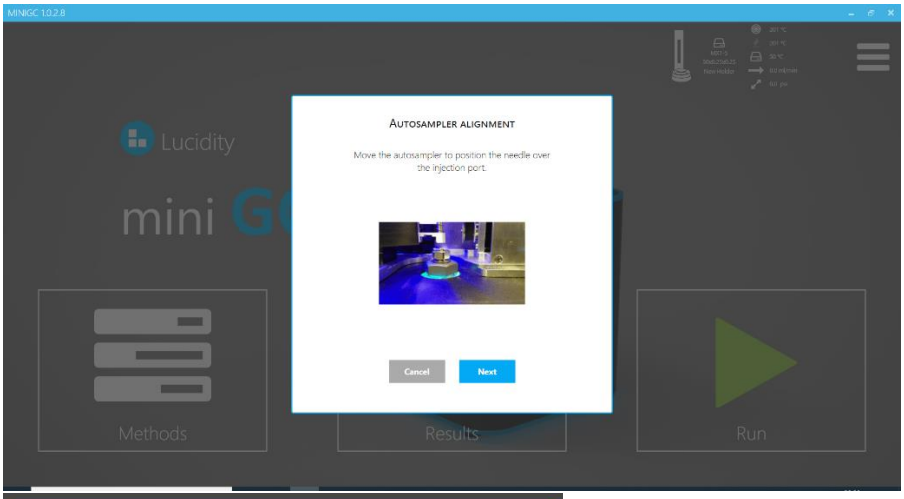
The syringe is now installed.

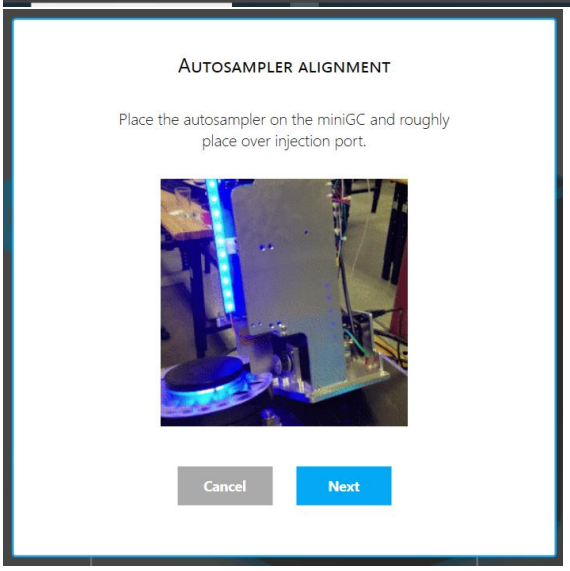
Aligning the miniGC Autosampler to the miniGC

The next step is to align the miniGC Autosampler to the miniGC so that the needle of the syringe goes into the injection port during an injection. To begin this process, press the Align Autosampler button on the software and follow the prompts as shown.

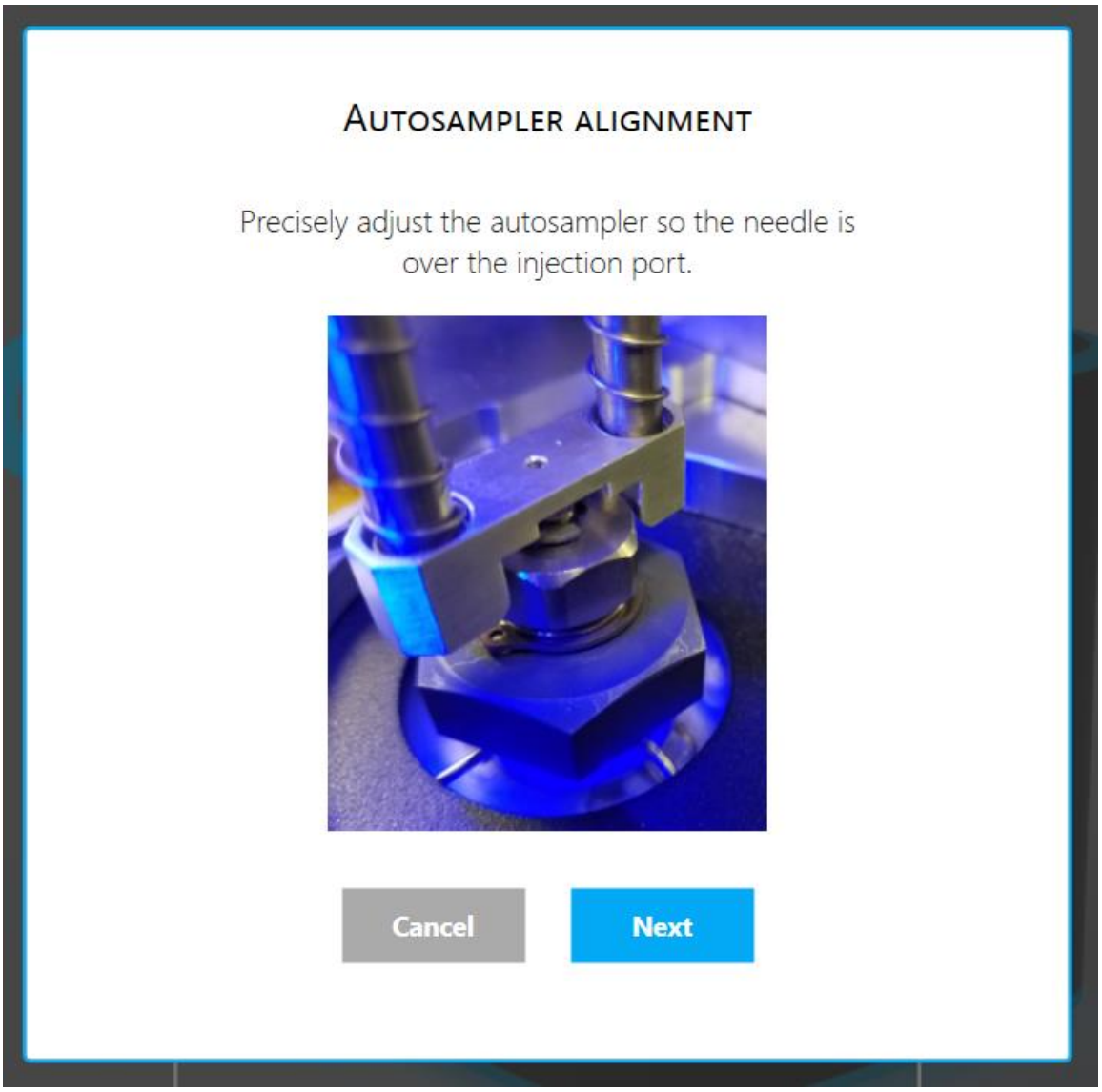


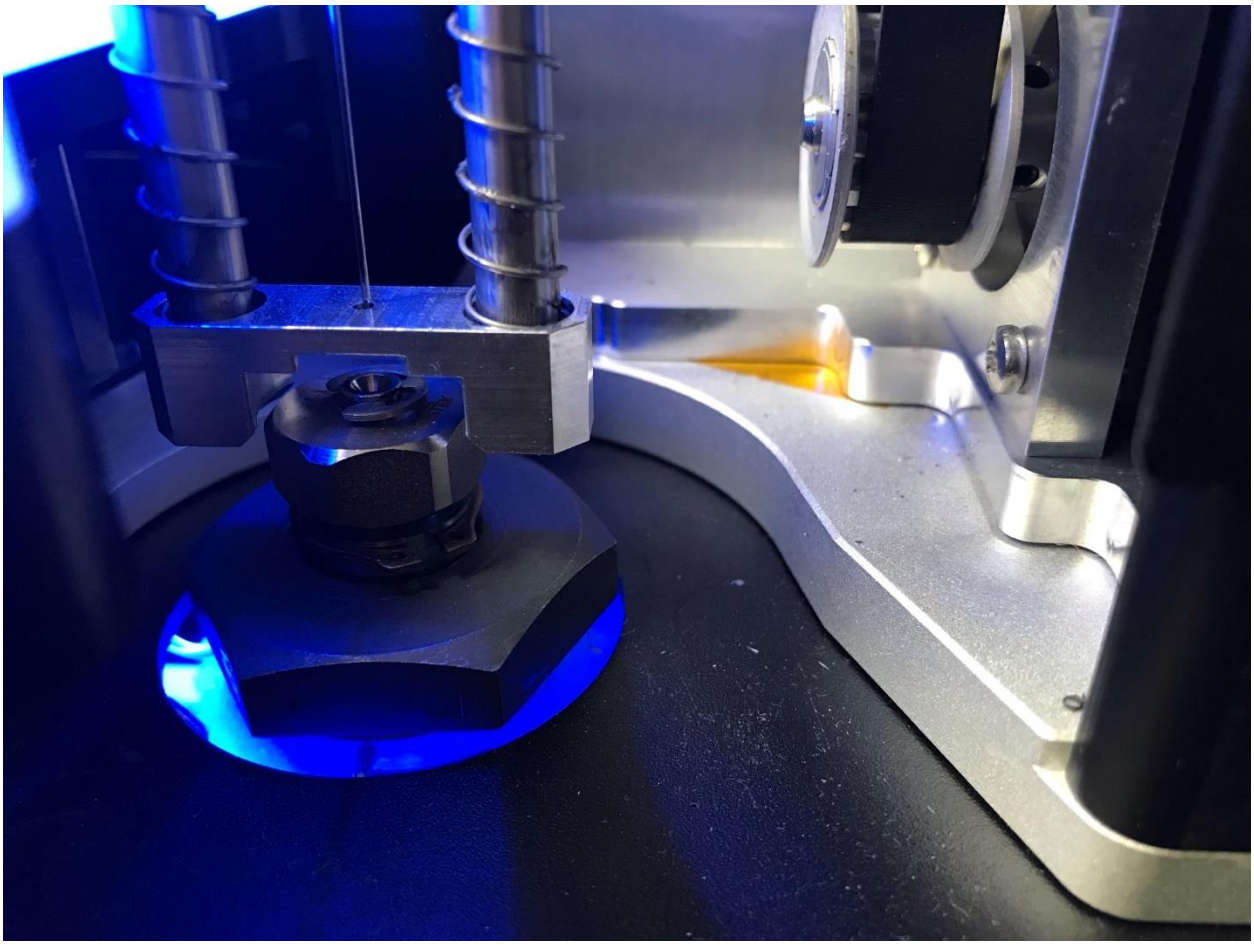
The software will first ask you to press a button the lower the syringe assembly partially towards the injection port giving you a better idea of how close the system is to being aligned. Then the software will ask you to manually move the autosampler around on the top of the miniGC to visually align the syringe assembly to the injection port. You can do this by bumping the base of the autosampler slightly to get it to move slightly in the desired direction.





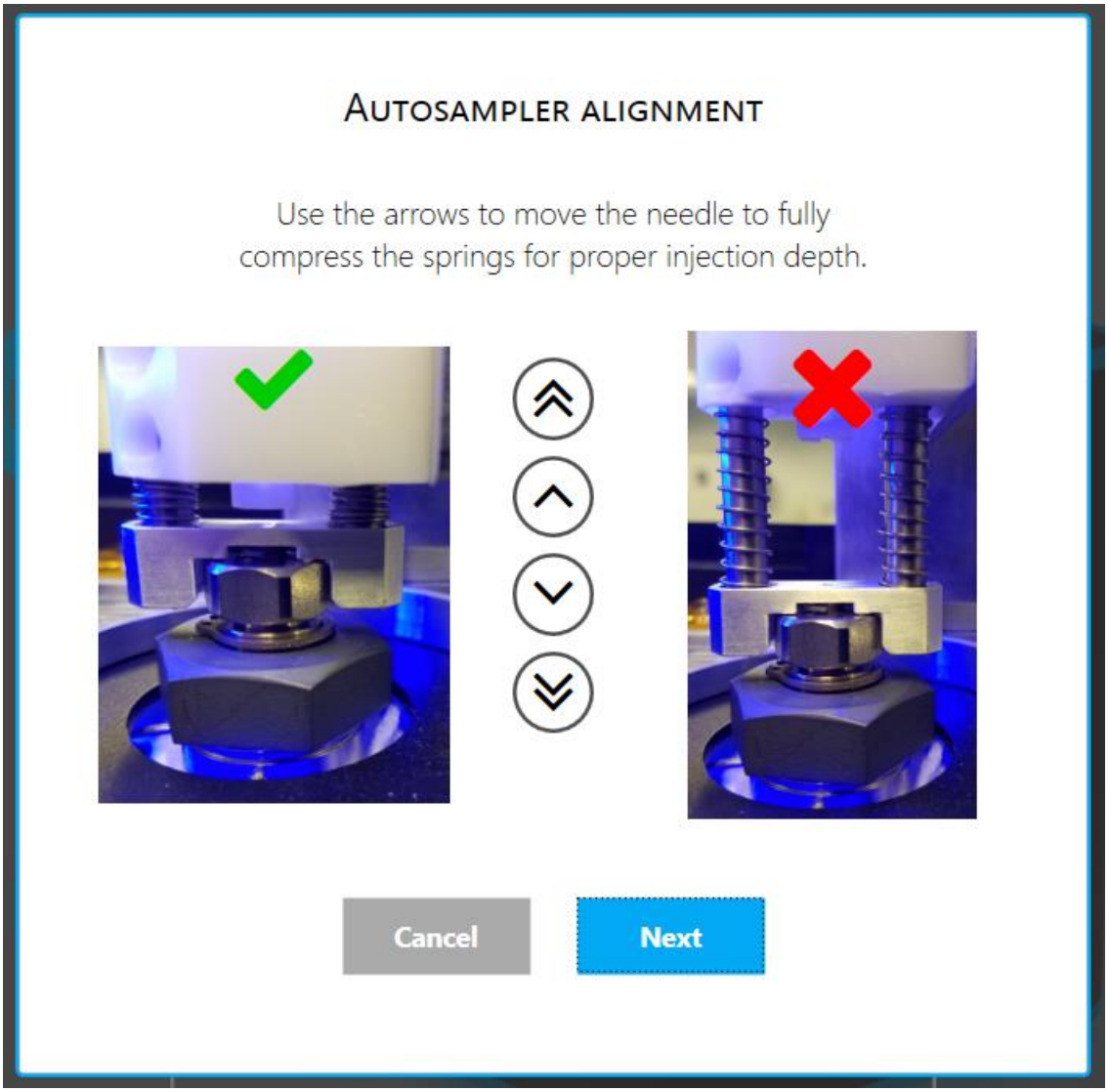
Once you have an approximate alignment, you can lower the foot of the syringe assembly even further to get a better alignment. The software will show you pictures of what correct alignment should look like. The foot of the syringe assembly and the injection port should be aligned as shown in the following picture.

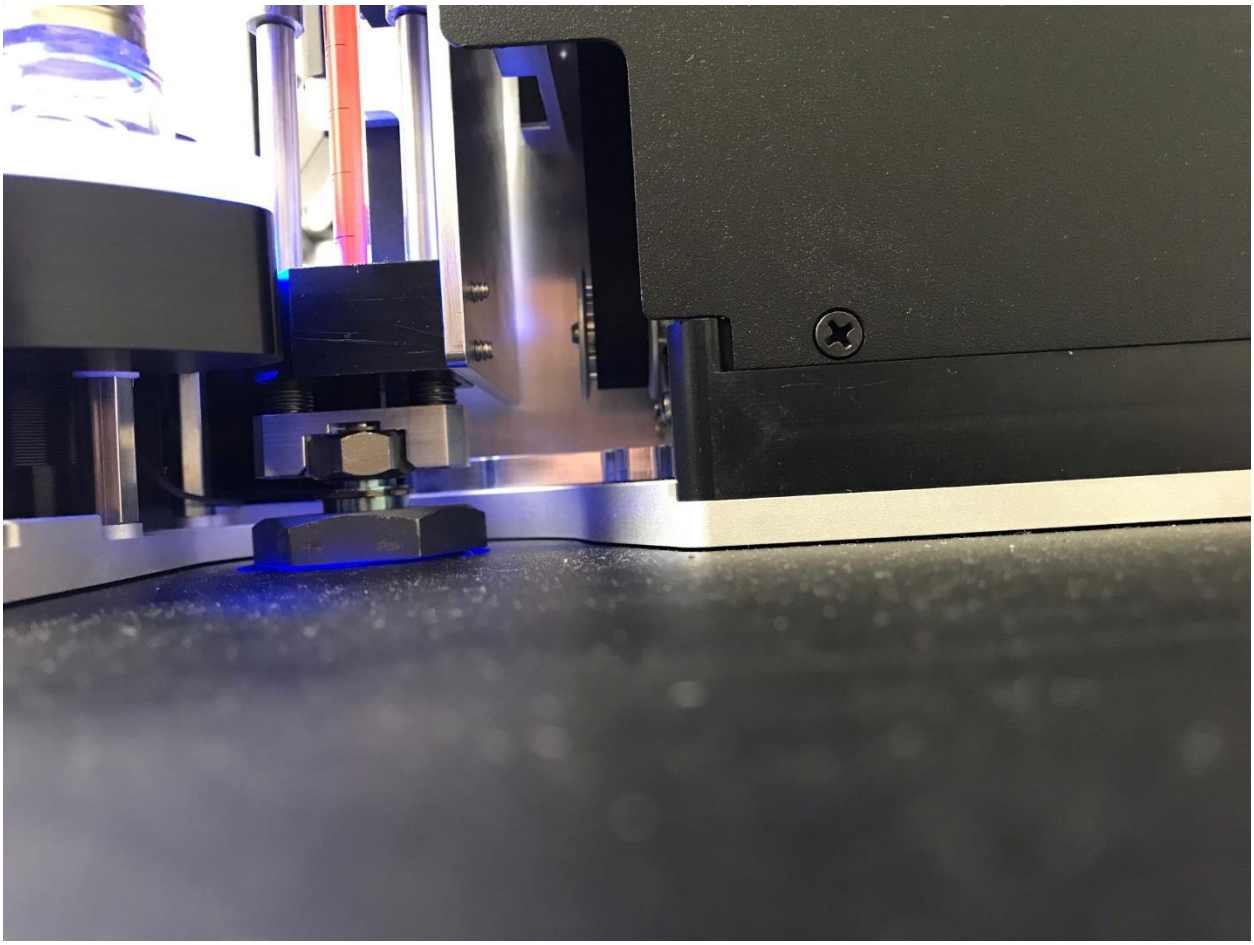

AUTOSAMPLER ALIGNMENT
Precisely adjust the autosampler so the needle is over the injection port.
Cancel
Next



Once the foot of the syringe assembly is aligned to the injection port, the needle depth must be set.

The software will give you up and down arrows to move the syringe up and down to set the proper injection depth. Two arrows up indicate a bigger move up and one arrow up indicates a smaller move up. The same is true for the down arrows. The proper injection depth is shown below. The software will also show you the proper injection depth as you are aligning it.


AUTOSAMPLER ALIGNMENT
Use the arrows to move the needle to fully
compress the springs for proper injection depth.
Cancel
Next



A trick for calibrating the injection depth correctly is to lower the syringe until it bottoms out (where the springs on the two bolts are completely compressed) and then raise it with two presses of the double arrow button, which will take some compression off of the springs and look like the following.

Once the injection depth is correct, click confirm and the system will save this injection depth.

Now the autosampler is completely aligned. Press the Home Autosampler button to home the autosampler, and the autosampler is now ready to run.

1.5 Installing the Starter Column

In order to have the column install into the system smoothly, you want to allow the system to warm up, which should take less than 5 minutes. Any time you turn the miniGC on, it will warm up to its default or sleep parameters, which warm the injection port and detector to 200C. This is plenty warm enough for the column to insert smoothly. If the system has been on while you've been aligning the autosampler, the system should be warm enough to smoothly install the column.

Pics of column being installed, and nomenclature of different column parts.

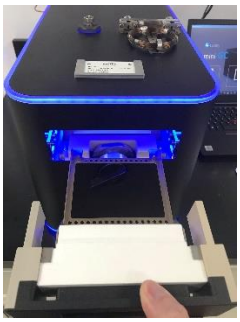
Shown here is the miniGC Starter Column (NP-1403), which is a Restek MXT-5 (30m x 0.25mm 0.25um) column presintalled into a Lucidity column holder. The miniGC Starter Column can be order either from Lucidity or Restek and can be ordered either preinstalled on a column holder or by itself, in which case you have to install the column on the column holder itself and will need to order a column holder separately.

Additional columns can be ordered from Restek and can be ordered either uninstalled on the column holder or preinstalled on the column holder. For more information on ordering columns, see the ordering columns section at the end of this manual or visit our website at (https://luciditysystems.com/products/minigc/minigc-columns/).

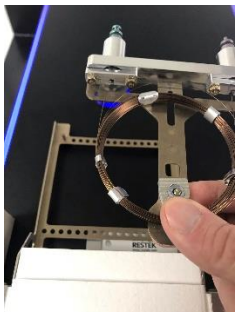
Inside the Starter Column box you will find the column preinstalled on the column holder and the column tag, which identifies what type of column it is and the serial number. Remove the column tag from the box and put it in the Tag Puck, which comes with the miniGC. The Tag Puck can then magnetically attach to the top of the miniGC which allows you to identify what column is in the system at any point in time. If you put a different column in the miniGC, switch out the column tag so you can keep track of what column is in the system.

To install a column in the miniGC, turn the knob on the front of the system clockwise which will eject the Column Caddy. Remove the Column Caddy from the system and place the Column Holder into the Column Caddy using the two alignment pins on the front of the Column Caddy. Once the Column Holder is in the Column Caddy you just insert the Column Caddy back into the miniGC and turn the knob counterclockwise to engage the column completely in the system. The knob should be pointing straight up when the column is fully installed. As mentioned before it is important that the injection port and detector manifolds be somewhat warm for a smooth engagement. If you attempt to install a column when the injection port and detector manifolds are cold, the column will not engage smoothly. After the miniGC has been powered on for a couple of minutes, the manifolds should be warm enough for smooth engagement.

1. Preinstalled column: column in Column Holder

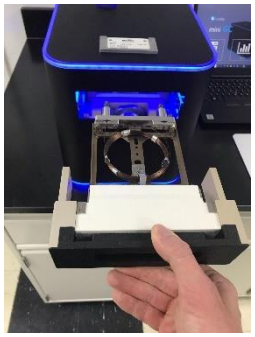


2. Column Caddy being removed from miniGC with Column Holder not in place



3. Column Holder being placed on Column Caddy

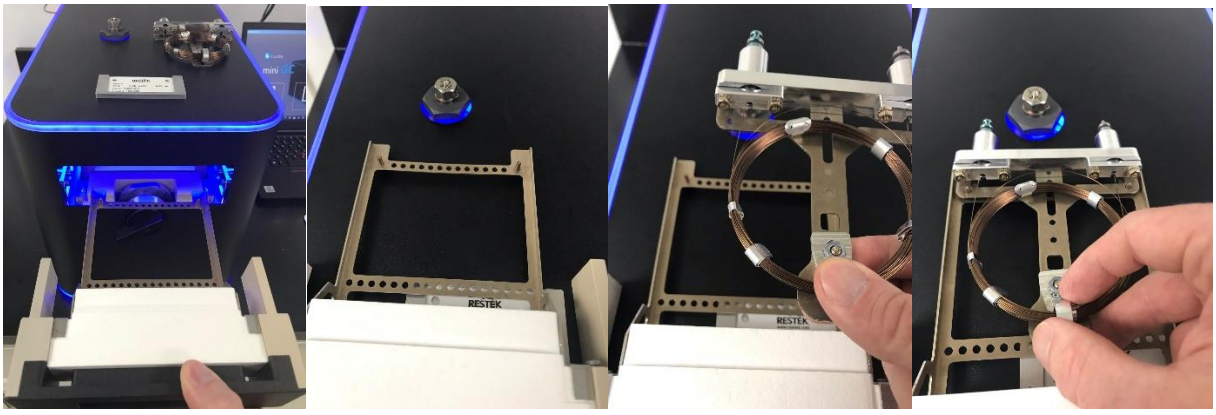
4. Column Holder being placed on Column Caddy via 2 alignment pins



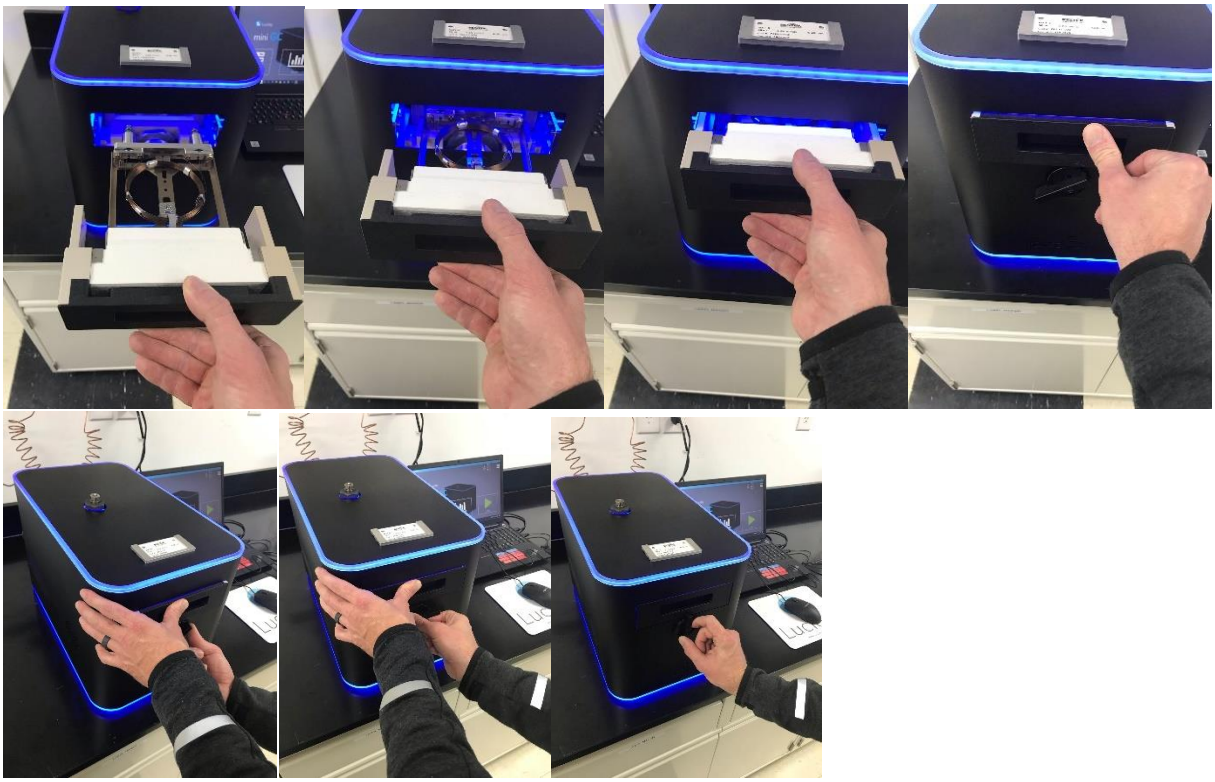
5. Column Caddy being inserted into miniGC with Column Holder in place

Unpacking the column and column tag

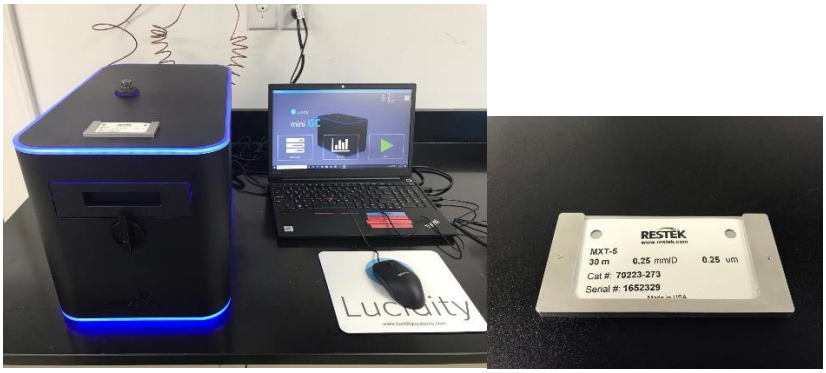
Taking the Column Caddy out of the miniGC



Putting the Column Holder with column in the Column Caddy



Putting the Column Caddy with Column Holder and column into the miniGC

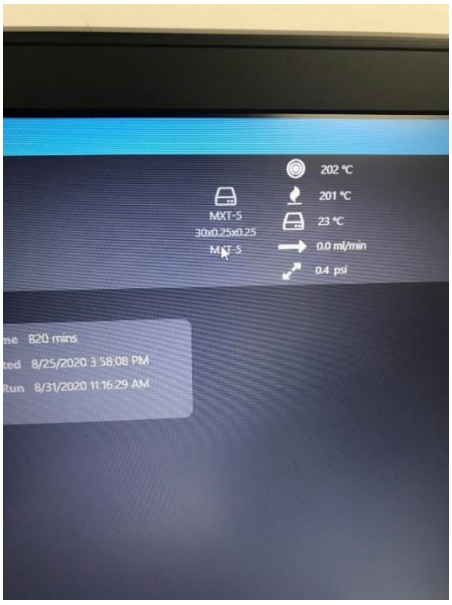


Selecting or Creating a Column in the Software

An important thing to remember when putting a column into the miniGC is to make sure the software knows what column is in the system. Having an incorrect column identified in the software will not affect the performance of the system at all, but you won't be able to accurately track the runs and run history on each column. Accurately identifying in the software which column is in the system will allow you to track all the runs that have been made on that system. You will also get warnings if you attempt

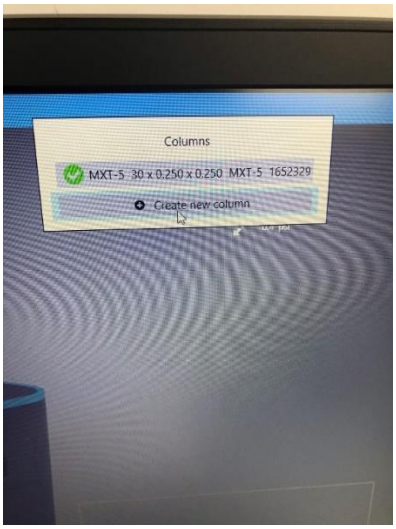
to run a method that is designed for a different type of column or if you attempt to run a method that goes above the recommended operating temperature of a column.

Your system will come with one column preloaded. This is the column that was used in the factory to run the 3 injections of the Test Mix that are stored in the results section. If you ordered a Starter Column with the system, this is also the column that shipped with your system.

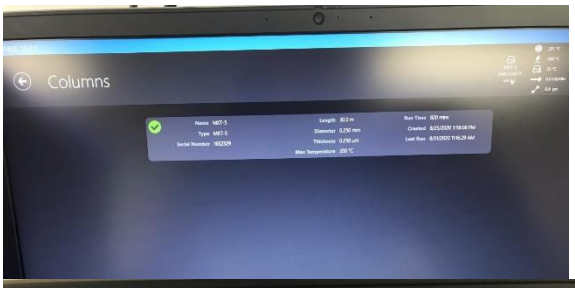


Check the icon shown here to see what column the miniGC thinks is installed in the system. If this is the column that is installed then you are good to proceed. If not, then you need to change the column selection. Click on this icon or go the Columns section in Settings to change the column selection.

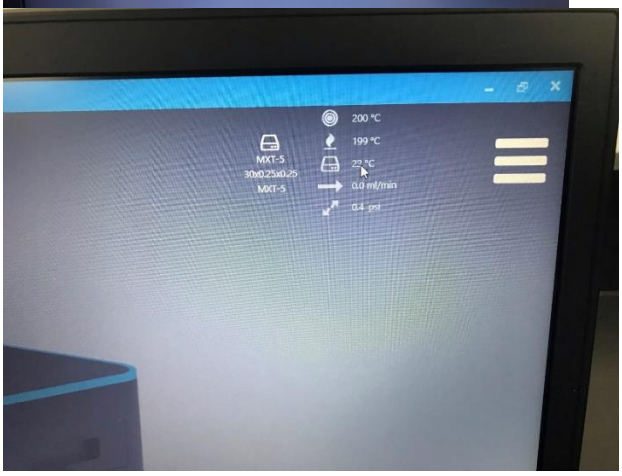
Once there you can either create a new column or select an alternative column that has already been created.



In order to create a new column click on the create new column button.



Enter in the required information and choose a name for the column and then it will appear in the columns section. The column with the green check mark is the currently selected column. This can be changed by clicking on a different column.



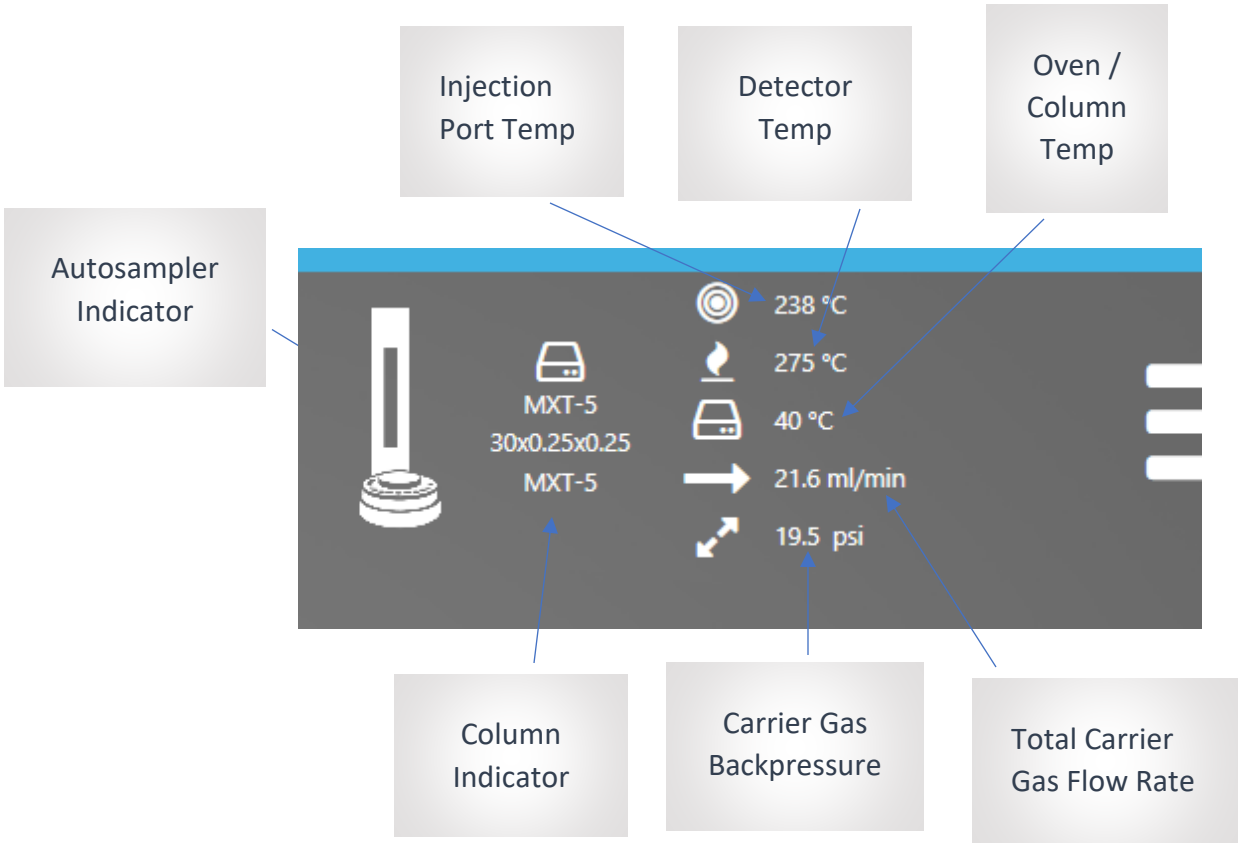
Upon exiting the columns menu, the new active column will show up in the column icon.

1.6 Checking for Errors and Interface Overview

Once the column is installed and the miniGC, autosampler, and applications software are all communicating, the next goal is to make sure there are no errors in the system. In order to do this, it's important to understand a little more about the dashboard, which contains critical information about the different temperatures, flows, and pressures in the system, as well as warnings that give information on issues.

In the miniGC software, the dashboard stays with you no matter where in the software you are. From the dashboard you can see the temperature of the injection manifold, the temperature of the detector manifold, the temperature of the column / oven, the flow rate through the column, the back pressure experienced by the carrier gas, the information for the column currently selected, the presence of

absence of the autosampler, whether or not the software is connected to the miniGC, any warnings, and what mode the system is in (Sleep, Cooling, etc.)



Autosampler Indicator: If this is icon is not present then you have not selected "Autosampler" in the Settings menu. If this icon is present but greyed out, then "Autosampler" is selected in the Settings menu, but the miniGC does not see an autosampler. If this icon is present and not greyed out (as shown here), then "Autosampler" is selected in the Settings menu, and the miniGC sees and is successfully connected to an autosampler.

Column Indicator: This icon indicates the user defined name and information on the GC column that is currently installed in the system. You can click on this icon to access the column page where you can add new columns or select the active column.

Injection Port Temp: The injection port temperature is the temperature of the bottom section of the injection port. The injection port actually has 2 independently controlled temperature zones, the top and the bottom. The bottom portion of the injection port is the temperature that is displayed here and the one that is set in the Methods. The temperature of the top portion of the injection port is displayed and set in the Settings Menu. It is set globally and never changes unless the user changes it in Settings.

It is highly recommended that you do not change this setting. It is set at 200C as a default. It is set at this temperature to reduce off-gassing from the o-rings in the top of the injection port. The length of the needle of the standard syringes included with the miniGC (2.00" needle for manual injections and 2.25" needle for autosampler injections) ensure that the sample is injected low enough into the injection port that a temperature of 200C for the top portion of the injection port does not create issues even when injecting extremely non-volatile compounds.

Detector Temp: The detector temp is the temperature of the detector manifold where the flame ionization detector (FID) is housed.

Oven / Column Temp: This is the temperature of the oven and column as measured by the air temperature in the oven near the column.

Total Carrier Gas Flow Rate: This is the flow rate of the carrier gas into the injection port. How much of this flow goes into the GC column depends upon the split. A split of 0:1 means that there is no carrier gas exiting through the split flow exit and that all of the carrier flow is going into the column and out through the detector, which is splitless flow. A split flow of 100:1 indicates that 100 parts of the carrier gas are exiting through the split flow (entering the injection port but not entering the column) and 1 part is exiting through the column / detector. For a column flow (what is shown and edited in the method) of 2mL/min and a split of 10:1, the total carrier flow would be around 22mL/min with 2mL/min going into the column and 20mL/min exiting through the split exit port in the injection manifold.

Carrier Gas Backpressure: This is the backpressure the carrier gas experiences as it enters the injection port. This backpressure is created by the long, narrow column which the gas must push against as it flows through the column. You can see the calculated value for this parameter in a method, which can be used to ensure proper functioning of the system. This value is calculated in each method based on the carrier gas and flow and column dimensions. When you load a method as the flows and temperatures stabilize at their setpoints the carrier gas flow should stabilize and be close to the predicted value from the method. If the carrier gas backpressure is very low (less than 2 psi) then most likely there is a leak in the system.

The values displayed in the dashboard represent the actual values of these parameters. Upon start up of the miniGC these values will go the following set points:

Injection Manifold: 200C

Detector Manifold: 200C

Oven Temp: 50C

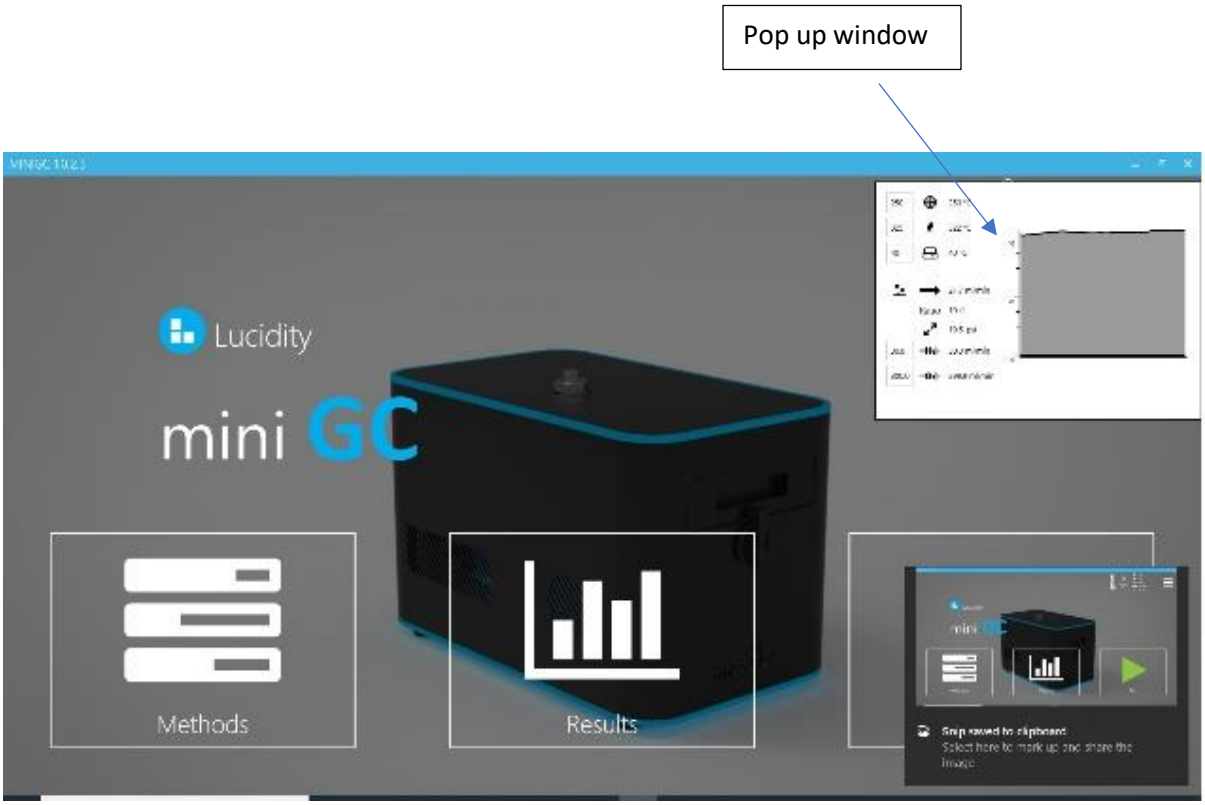
Carrier flow (through the column): 2.0mL/min

These are the same values that are set when the systems enters sleep mode. The system enters sleep mode automatically after a certain period of time. This time can be set in Settings.

If a method is loaded through the run screen (it does not have to actually be run) then the method parameters will be loaded as the system set points. As soon as you load a method in the Run screen, you will notice the system parameters begin to change and begin to approach the set points of the method.

A second way to change these setpoint is to click on the dashboard and you will be allowed to change these set points as you want.

Clicking on the dashboard brings up this pop up window which shows all of your temperatures and flows and their setpoints as well as detector signal.



On the pop up screen you will see the same flows and temperatures that you see on the dashboard but you will also be able to see the setpoints of these different values and be able to change the setpoints. Along with the values on the dashboard you will also see a place to change the split flow of the system. The flow rate you are setting is the flow through the column (after the split), so if you set a flow rate of 2mL/min and a split flow of 100:1 then your total flow rate will be around 202mL/min (2mL/min through the column and 200mL/min that exits through the split flow exit).

Again, the setpoints are either set to the default values mentioned above when you first power up the miniGC or it goes into sleep mode, or they are based on the setpoints from a method. When a method is loaded through the Run Screen (it does not have to be run), this method's setpoints will become the setpoints for these temperatures and flows. And these will remain the setpoints until a different

method is loaded, the system enters sleep mode, or until they are changed manually through this pop up window.

In order to change one of these values, enter the new desired value and click on the refresh icon which will update the setpoint. After clicking on the refresh button you should notice the setpoint for that parameter change and the actual value of that parameter begin to change as it begins to move to the new setpoint.

The flow rate shown on the dashboard is the flow rate of the carrier gas into the injection manifold, so it takes into account the flow rate through the column as well as the split flow. For example, if you set a flow rate in a method or on the dashboard of 2.0 mL/min and a split flow of 100:1 then the overall flow rate will be 202 mL/min, because the carrier gas will be entering the injection port at 202mL/min and 1/100 of this flow (or 2 mL/min) will be flowing on to the column and the rest will flow out through the split flow outlet in the back of the system.

The pressure shown shows the amount of back pressure experienced by the carrier gas as it enters the injection port manifold. If no column is installed then you will notice this back pressure is around 0 psi since the carrier gas will enter the injection port then come out of the injection port where it seals the column pin in the back of the oven without experiencing much backpressure.

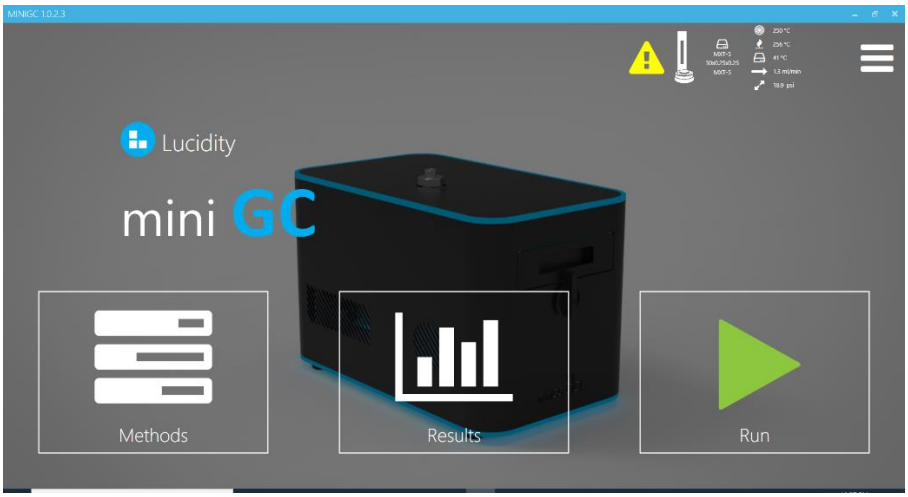
A pressure of 0 psi can also indicate a leak in the injection port from a missing septum, a missing liner, a missing or leaking liner nut o-ring, a liner nut or septum nut that is not tightened enough, or a column pin that is not sealing well into the injection port. A missing or leaking liner o-ring will not result in a low back pressure – it will result in an improper split which will show up as larger peaks in a run (because more sample is getting on to the column that is supposed too).

You can use the pressure as a check on the system to make sure there are no leaks by loading a known method and column and observing this value. When you load the GC-FID method and the standard MXT-5 column that comes with the miniGC (30m x 0.25mm 0.25um) you should see about 19.4 psi of pressure. Each method (or set of parameters) and column will have a different expected back pressure. You can use this pressure to ensure that everything in the system is sealed properly.

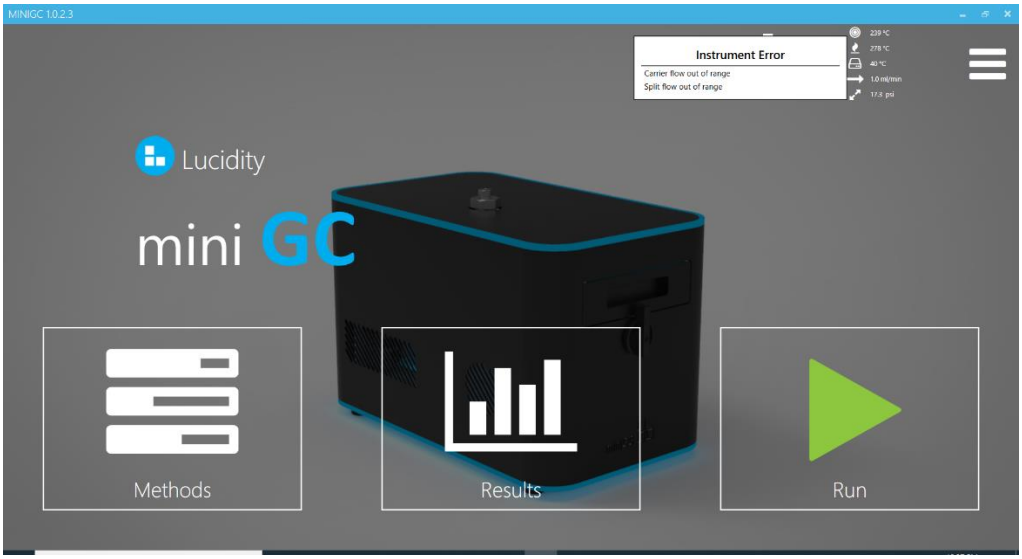
Note: when you first turn on the system, you may have to let the system warm up for a couple of minutes before the column pins seal properly to the injection port and detector.

Low pressure will also be accompanied by a warning sign that will indicate “low split flow”. This warning means there is a leak in one of the above-mentioned areas.

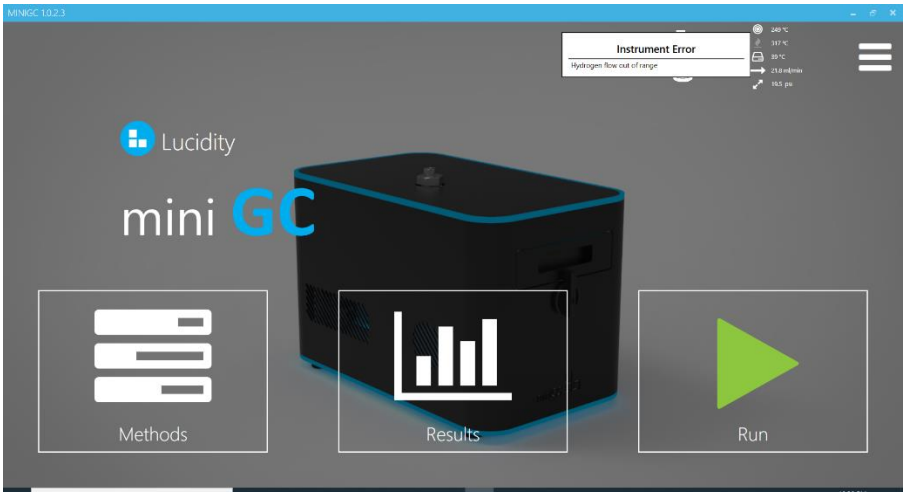
If you notice a yellow triangle with an exclamation point in the dashboard like is shown below, you have a warning. Click on this icon to see what warning(s) you have.



A lack of carrier gas flow (at least 250mL/min capability) or pressure (at least 45 psi) or not having a carrier gas connected will produce the following warning:



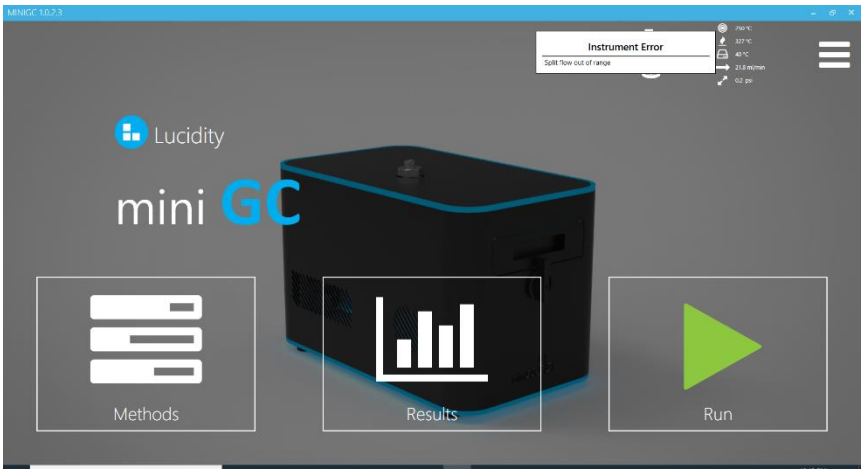
A lack of Hydrogen flow (at least 30mL/min capability) or pressure (at least 45 psi) or not having Hydrogen hooked up will produce the following warning:



A lack of High Purity Compressed Air flow (at least 300mL/min capability) or pressure (at least 45 psi) or not having High Purity Compressed Air hooked up will produce the following warning:

Having all of your gasses hooked up correctly but having a leak somewhere in the system possibly from one of the following results in the following warning:

- Column not inserted
- System still heating up (if a column holder is inserted into a system when cold it may not seal correctly until the system warms up)
- Missing septum
- Septum nut not tightened
- Liner nut not tightened
- Missing or damaged liner nut 0-ring

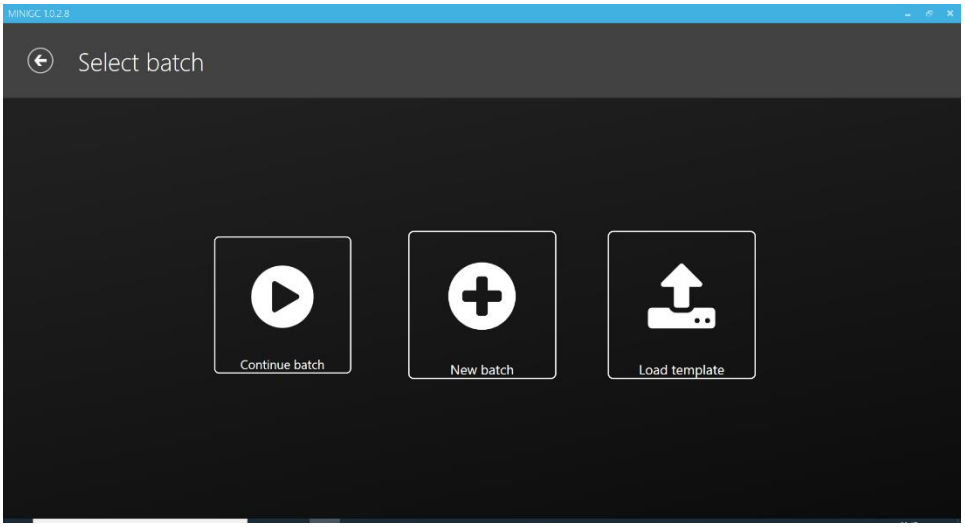


Errors other than these should be reported to Lucidity.

Once the system is on and everything is connected and the gasses are all connected and there aren't any errors, the system is ready to run.

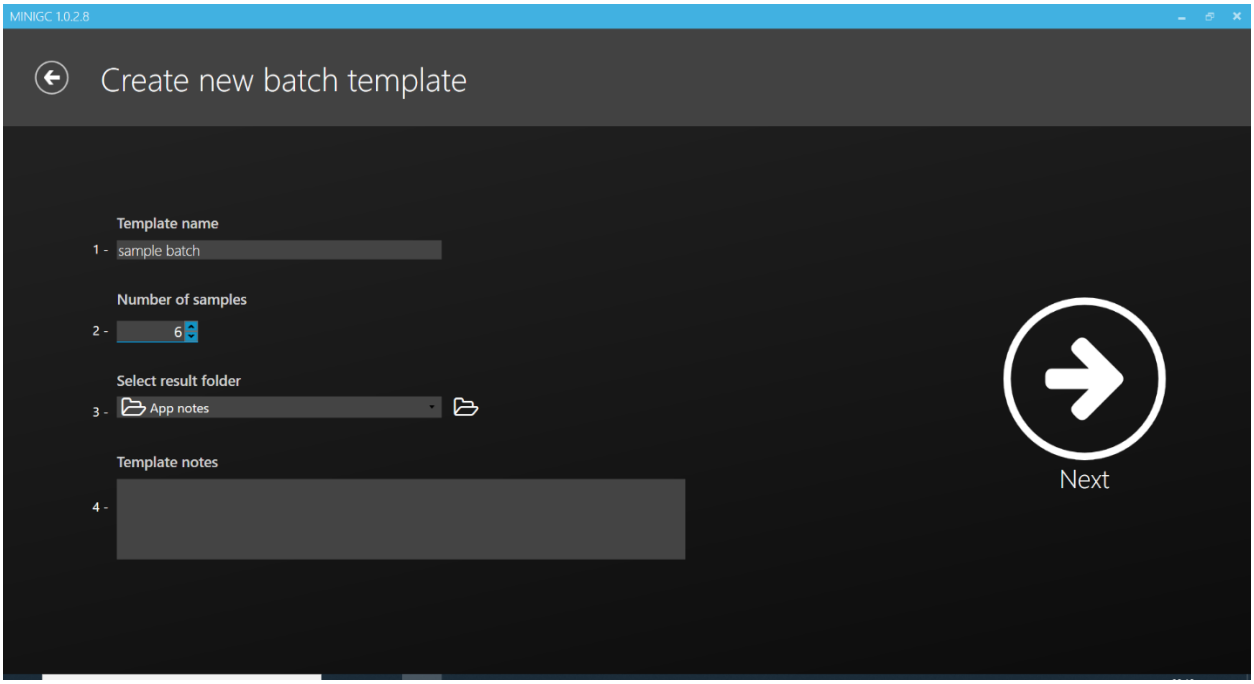
1.7 Running the system for the first time

Now that we have ensured that the system is functioning properly, it's time to run the GC-FID Test Mix. To do this, go to the Run section. There you will be given 3 options: Continue batch, New batch, and Load template.

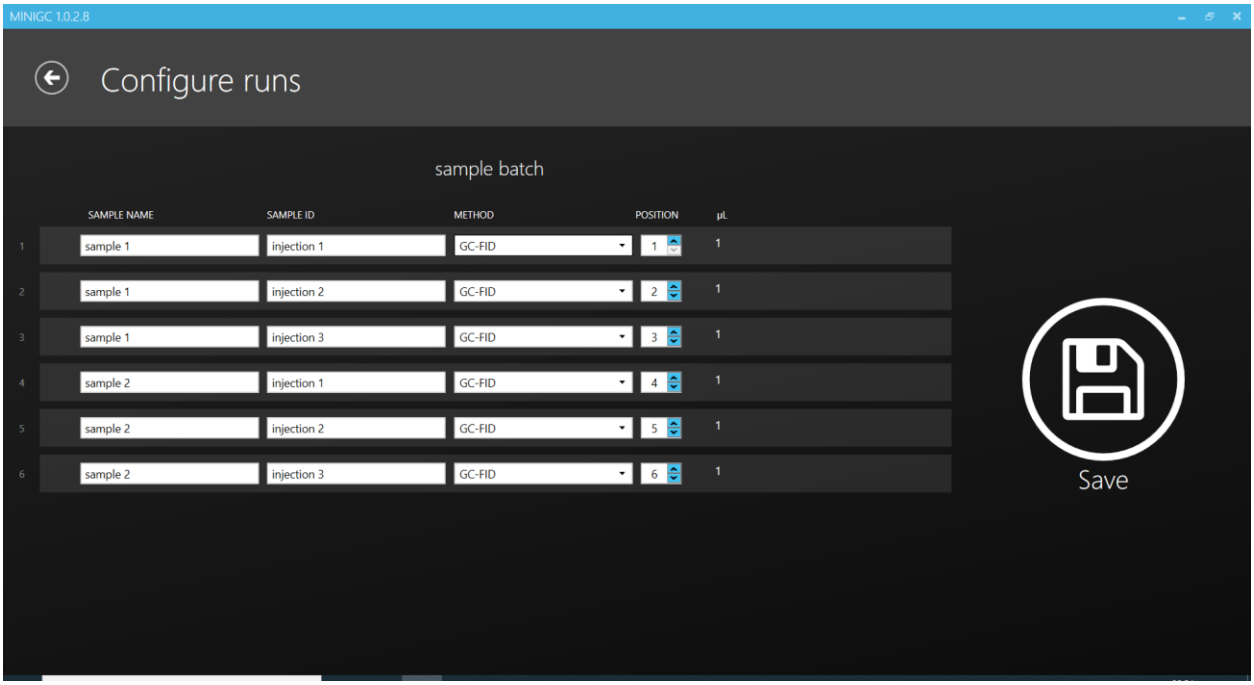


Continue batch allows you to access a currently running or previously run batch. New batch allows you to create a new batch of runs, and Load template allows you to load a previously created batch for a new set of runs.

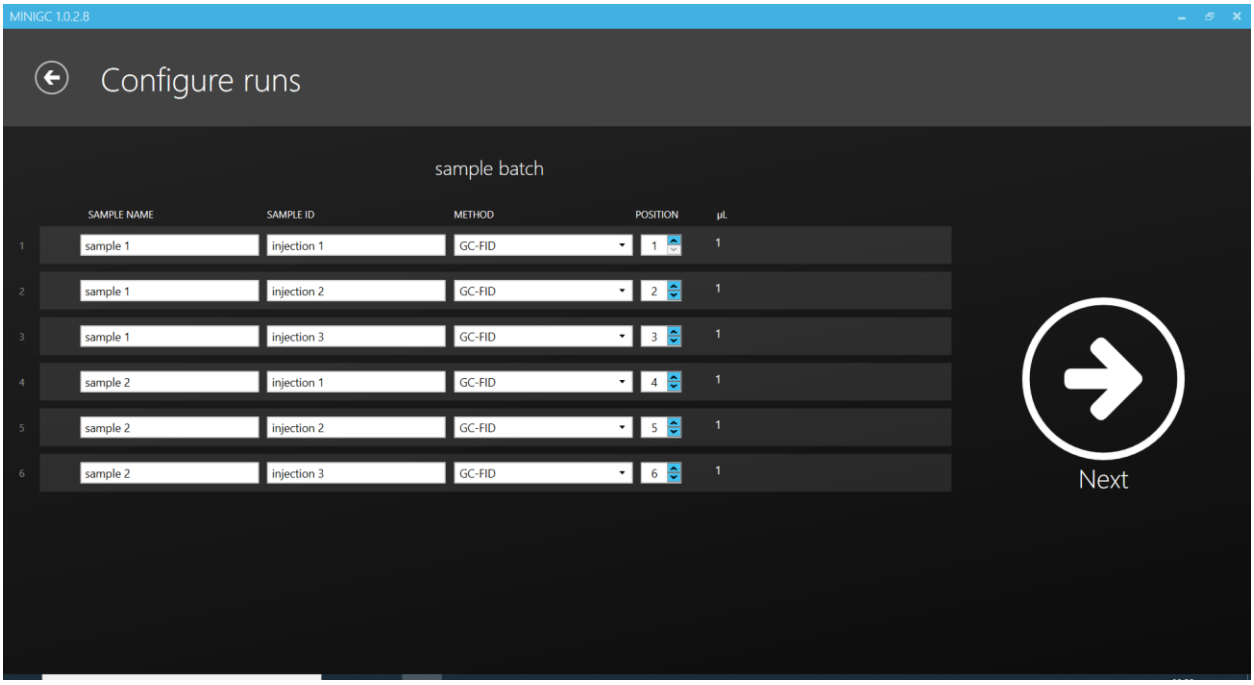
To run the Test Mix, choose New batch.



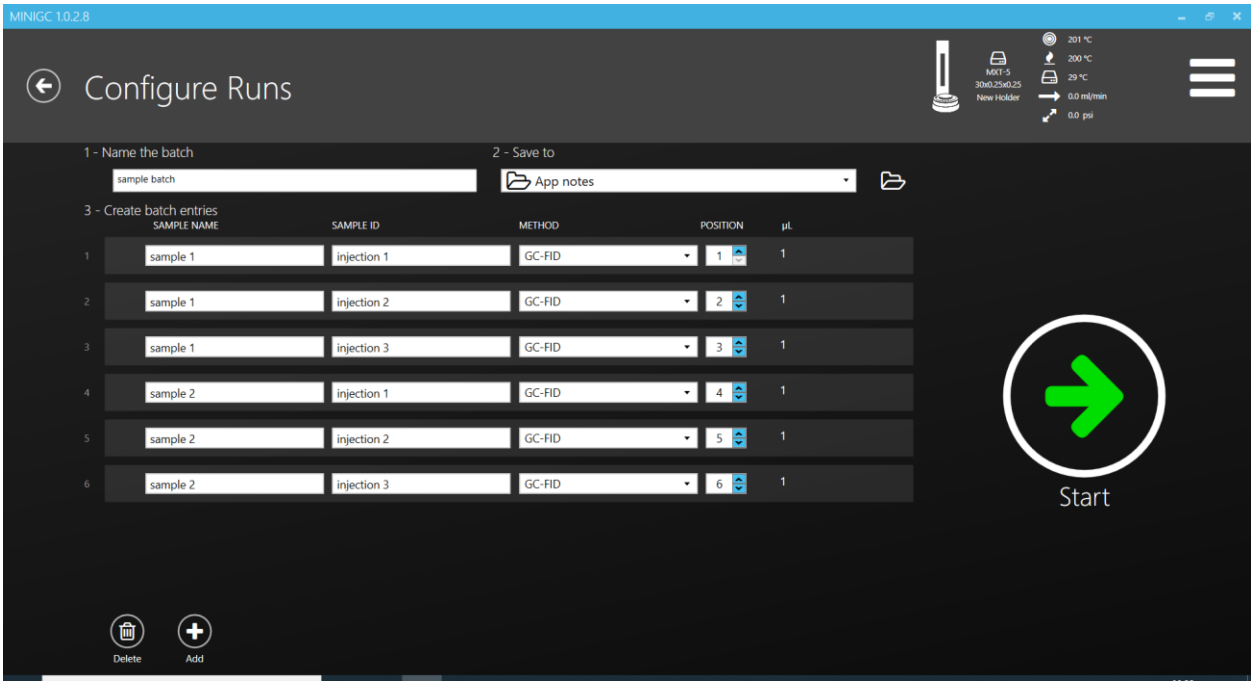
Then enter in the batch name, number of samples to run, where to save the results, and any notes. For the first run, just choose 1 sample.



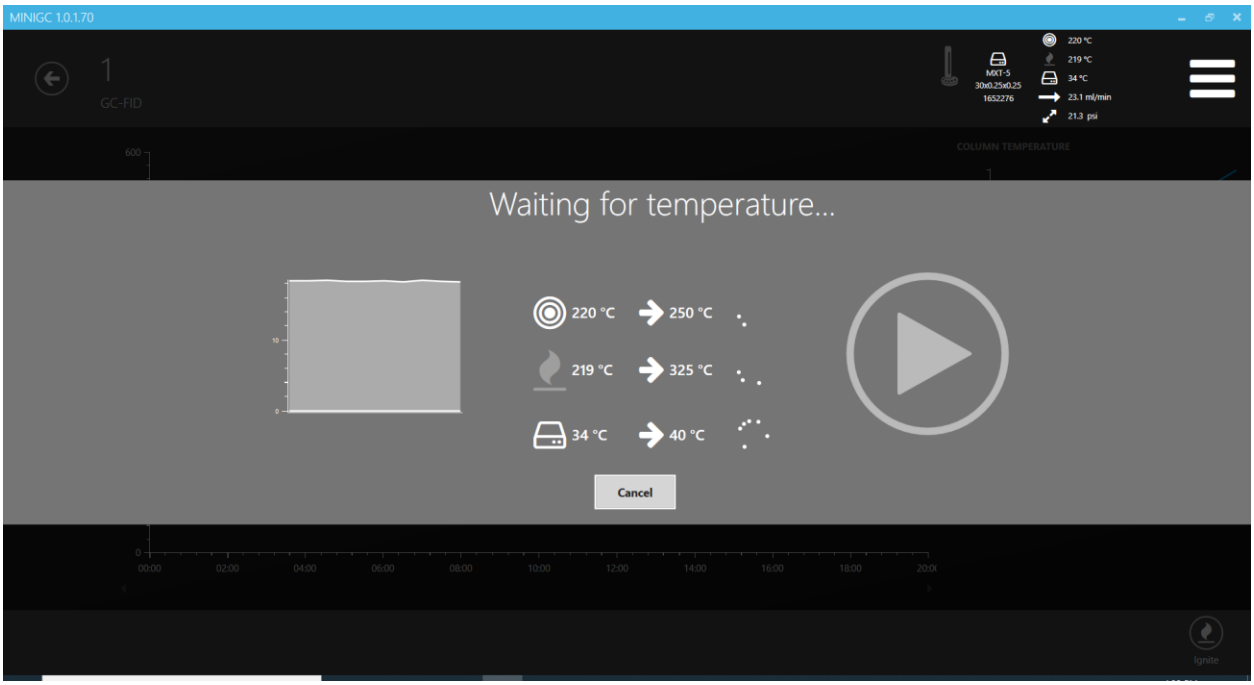
Enter in sample name, sample ID, the method and the position of the Test Mix vial. Choose the method "GC-FID" which comes preloaded in the system, choose a position for the vial, and then put the Test Mix vial into that position. A 1uL injection should be chosen. This is set in the method, so if the run displays a different injection volume, change it in the method. Press Save.



Then press Next.



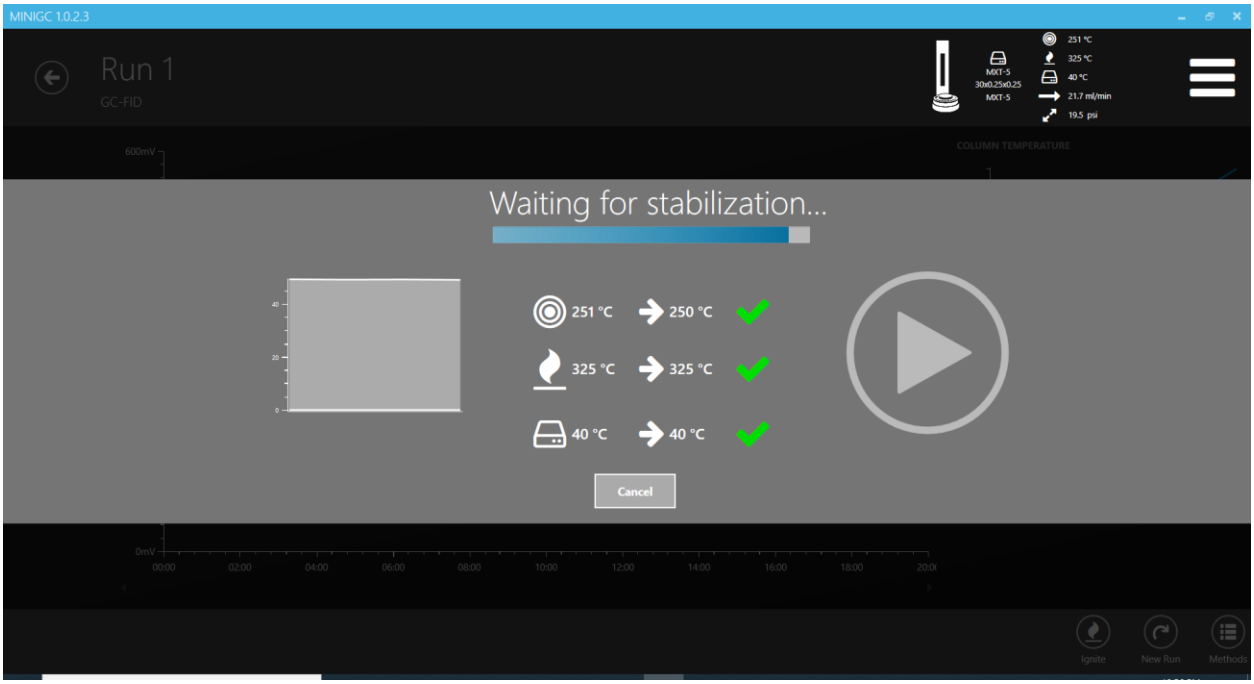
Then press Start.



Once you press Start you will see the above screen appear and the system parameters will begin to approach the setpoints of those parameters in first method in the batch mode or the only method in single mode. The column flow rate and split will change to the values defined in the first method, and the injection port temperature (bottom zone), the detector temperature, and the oven temperature will approach the setpoints defined in the first method. You can see the actual temperatures and the

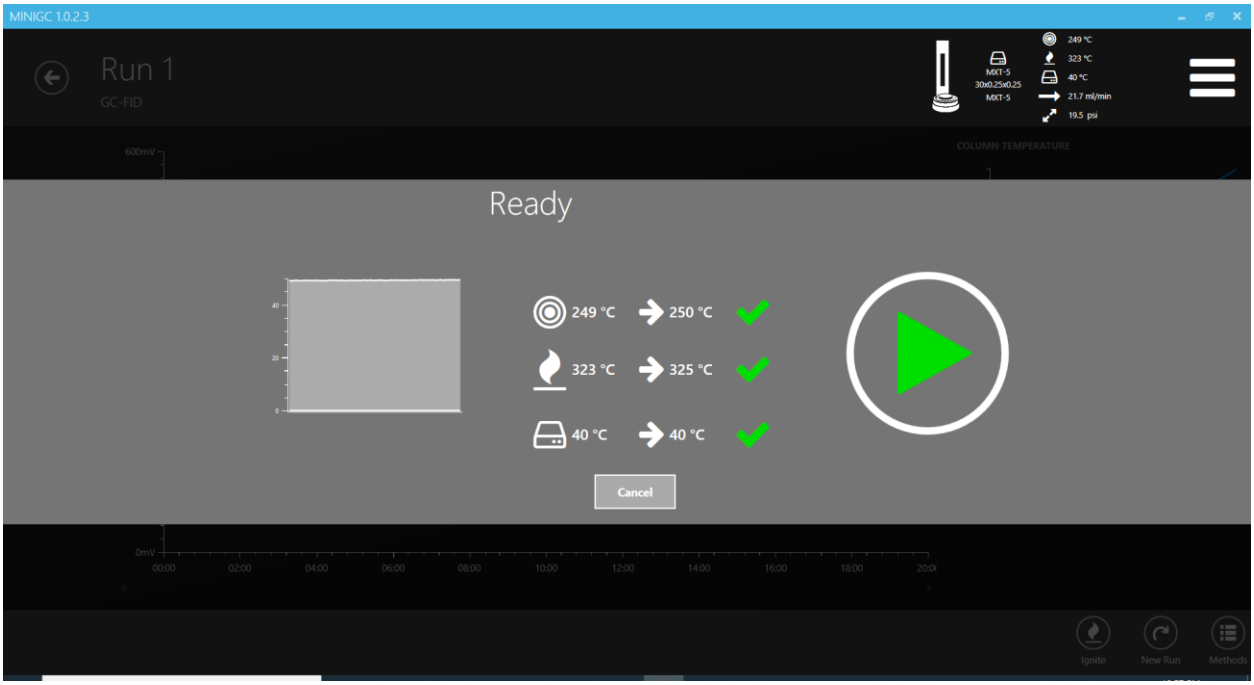
setpoints they are approaching in this screen. On the left you can also see the detector signal, so you can monitor the stability of the detector as the system equilibrates in preparation for the run.

**This feature can and should be used to quickly change setpoints of the system by creating a dummy run name, selecting a method, and clicking start then clicking “Cancel” on the following screen. Even after clicking cancel the parameters from the method selected will still remain the setpoints for the system parameters, all of which will be reflected in the dashboard.



If you intend to run the run, you will remain on the following screen and watch as the system parameters approach the setpoints of the method. The first parameter is the injection port temperature, the second is the detector manifold temperature, and the third is the starting oven temperature. On the left you can see a real time output of the detector signal to watch for detector stability before starting a run.

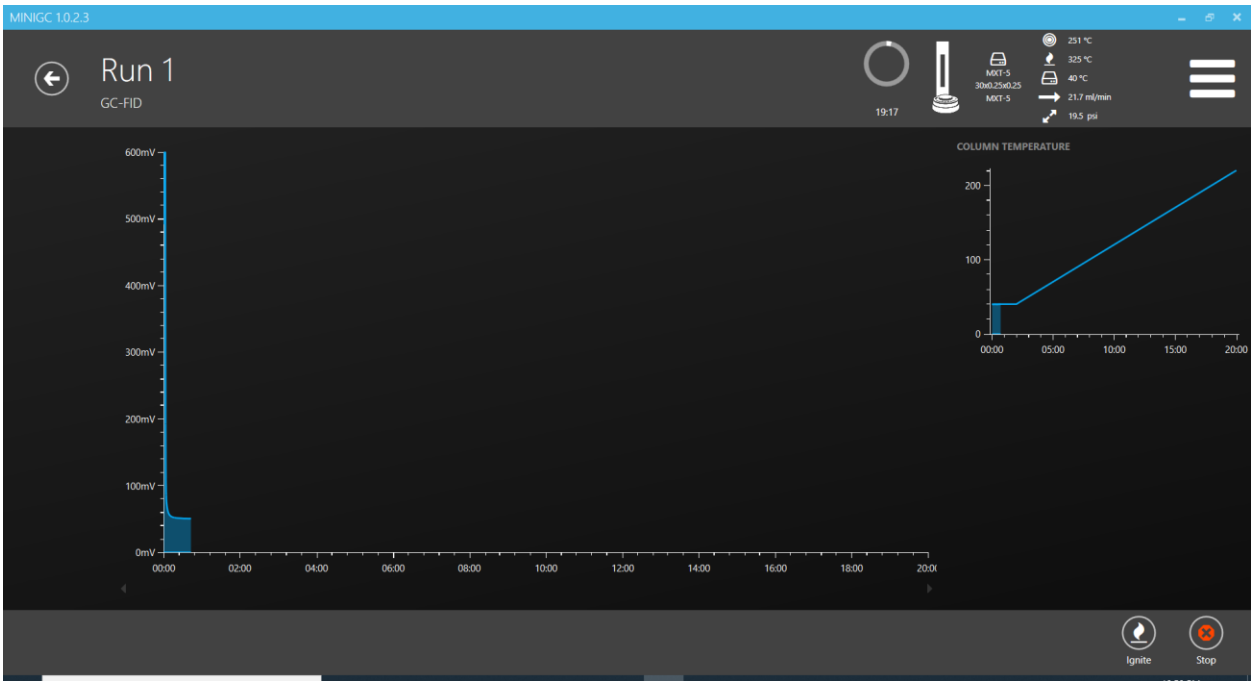
Once a system parameter reaches its setpoint, you will see a green checkmark appear next to that parameter. Once all three parameters have reached their setpoints, you will see the stabilization progress bar appear at the top of this window. You can change to stabilization time in Settings. Once the stabilization time has expired one of two things will happen. If you are in Single mode, the Run arrow on the right will turn green and be active. If you press this button the run will begin. If the system is in Batch mode once the stabilization time has expired, the autosampler will automatically begin to process samples starting with run 1. If you wish to stop the system before this happens you can press the Cancel button at the bottom of the window and you will exit the run screen and stop the runs, but your system parameters will remain at the same setpoints until another run is loaded, they are changed manually in the dashboard, or the system enters sleep mode by sitting idle for the amount of time set in Settings.



Once the setpoints have been reached and the stabilization time expires in Batch mode, the autosampler will begin to clean the needle, pull sample from the defined location for run 1, and inject the sample into the miniGC. You will see icons reflecting this and detailing the stage of the procedure on the screen until the sample is injection and then you will see the run screen.

For a manual injection (Single mode) once you press the Run button you will see a countdown on the screen. Before you press the run button you should have your sample ready to inject in your manual syringe. Then you want to time your injection to coincide with the appearance of a large syringe icon that will appear on the screen at the end of the countdown. Once this syringe icon appears indicating

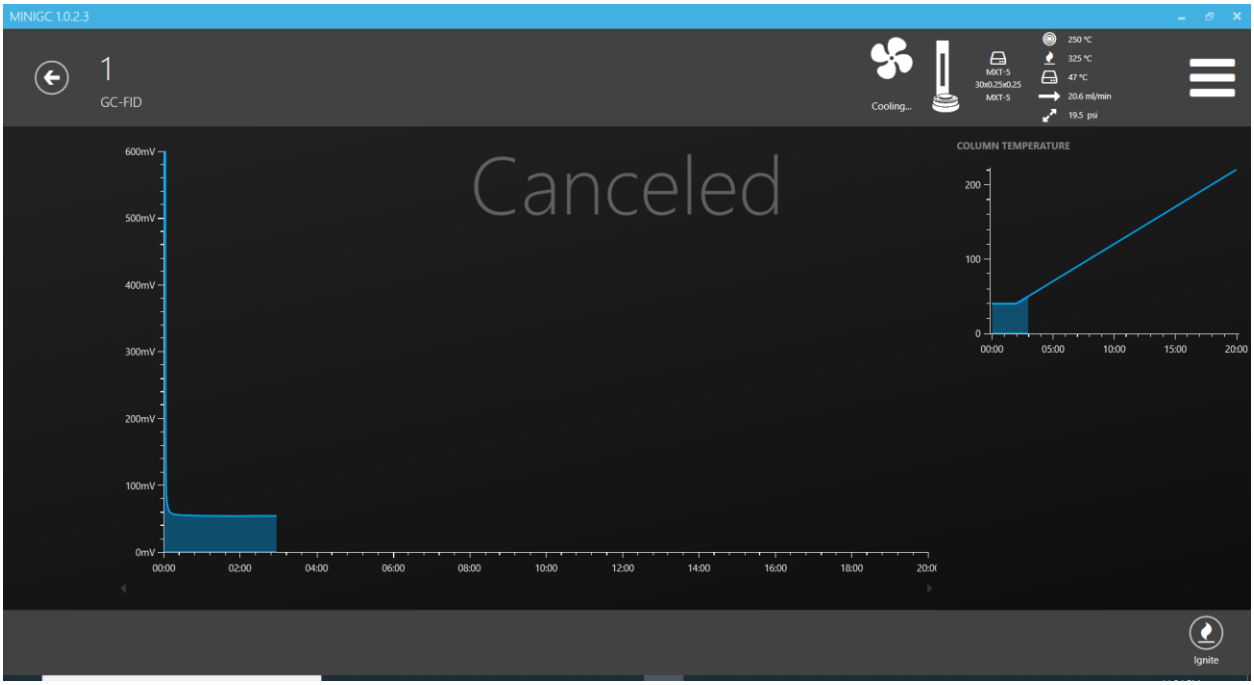
when the injection should take place, the system will assume you have injected the sample and enter the run screen shown below.



Once the run begins, you will be taken to the run screen, shown here. This screen will display your chromatogram and temperature profile as the run progresses. You can back out of this screen at any time by clicking the back button in the top left-hand corner of the screen, which will take you back to the home screen. The settings menu will be disabled during a run, but you can go into the method and result sections to create and modify methods and to analyze results while runs are ongoing. To get back to the run screen you simply go back to the home screen and click on the run button. Instead of going to the run setup screen you go straight to the run screen where you will see the live chromatogram.

If you are running a batch you will see the subsequent runs displayed in the bottom right of the run screen. An active run can be stopped at any point by pressing the stop button, which will cause the system to immediately enter cooldown mode as shown below.

When a run is stopped or a run has ended, the system will immediately enter cooldown mode, which is indicated by the appearance of the cooling fan icon in the dashboard. You will also hear the oven cooling fan come on. Whether you stay on the run screen or exit the run screen cooling will continue until the system has reached the starting point parameters of either the next method in the batch or the starting parameters of the method just run depending on whether there are more runs in the batch or whether this was the last run in the batch or the only run in single mode. If there are more runs in the batch, as soon as the setpoints of the next method in the batch are reached the next run will begin and the autosampler will begin its procedure for injecting the next sample.



During the run, in addition to the Stop button at the bottom of the screen you will also notice the Ignite button at the bottom of the screen. You shouldn't ever have to use this button. It is there just in case. The FID should always be lit when the system is on and not in Sleep mode. And as redundancy the system will relight the flame in the FID at the beginning of the equilibration period and again at the beginning of the run, which is why you will usually see the very end of a peak at the very beginning of every run, just like you see above.

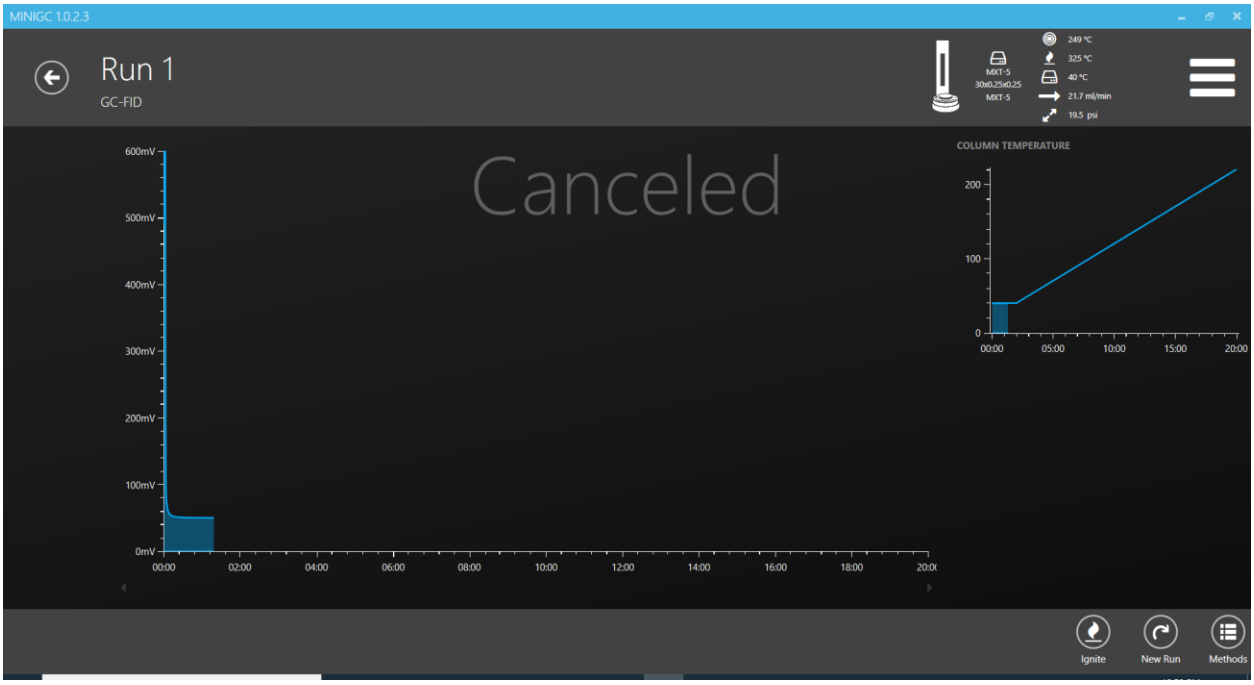
As the run progresses you should see a peak maybe 10-60 seconds in width in the first 3 minutes of the run, which is your solvent peak. It should essentially max out the detector for most of this time and then come back down to the baseline. After that you should begin to see your peaks of interest come out. If you set a solvent delay time in your method that is later than when the end of your solvent peak comes out, then your chromatogram should rescale to the next peaks it sees after this time so that you can see your peaks more clearly. If it does not, then your peaks may appear very small or you may not be able to see them at all at full scale, and you will need to zoom in to see them.

To zoom in, hold down the wheel on the mouse and draw a rectangle on the area you want to zoom into or hover over they y axis and move the mouse wheel up or down to increase or decrease the y values of the viewable graph. The maximum value of the FID on the chromatogram is 5,000mV, but you can see peaks that are only 0.5mV above the baseline. So you will most likely need to zoom in to see your peaks of interest if you don't set your solvent delay correctly to ignore your solvent peak in the scaling.

**Note: The solvent delay time in the method does not affect when you begin collecting or saving data. It only affects when the autoscaling begins on the chromatogram. Its purpose is to allow you to more easily see your peaks of interest during a run.

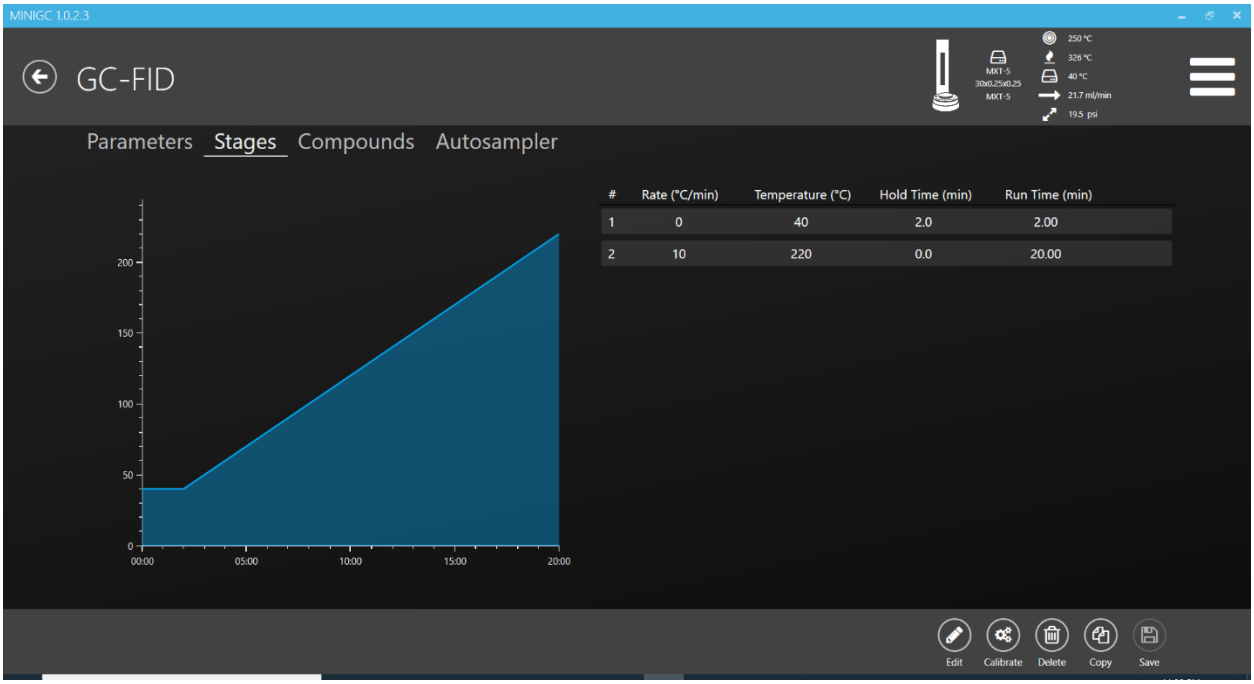
At any point during the run if you want to return to the original scale double click the mouse wheel.

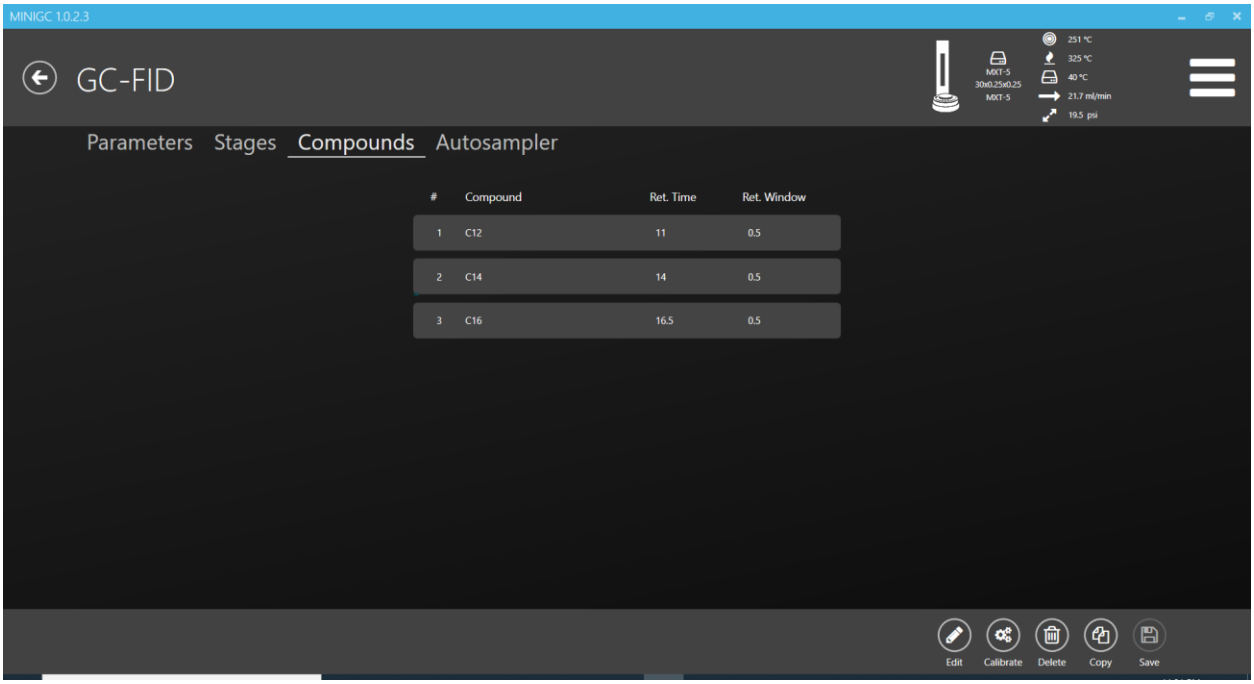
During a run at any point you can press the Back button on the top left hand corner of the screen to exit the run screen and go into the method or results sections to modify methods or view runs. This will not end your run or batch. Navigating back to the run screen you will see the run in progress.

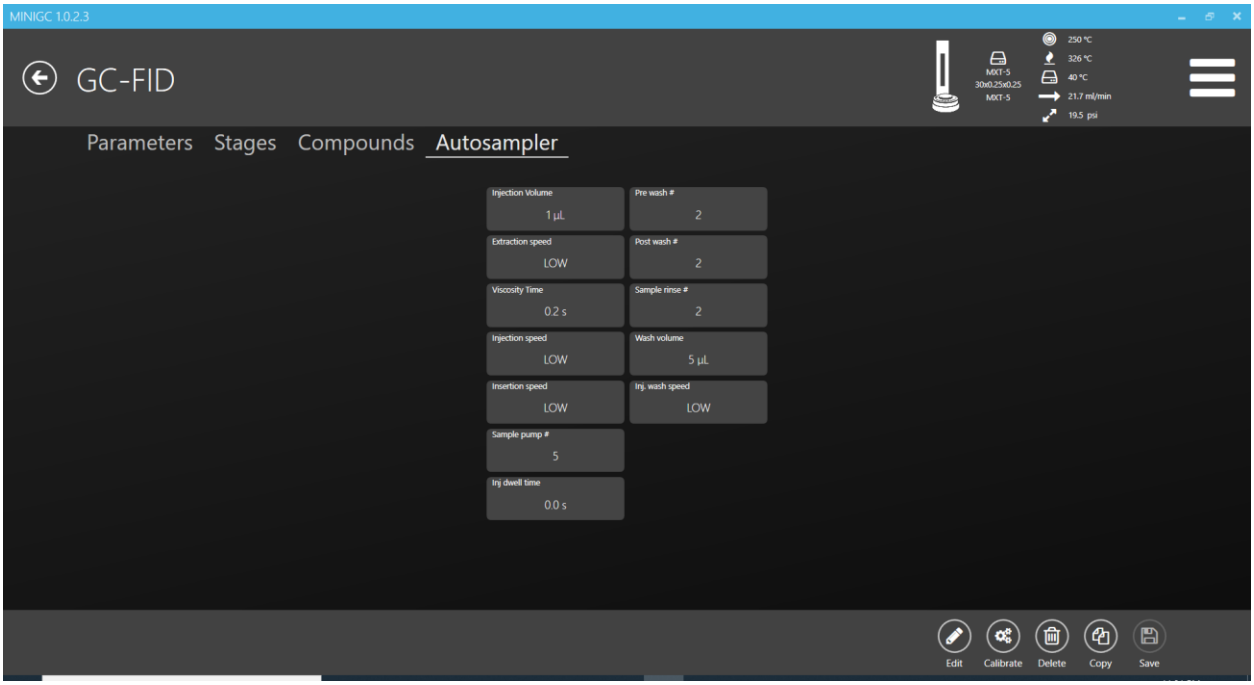


Once the cooling has ended for the last run, you will see a screen similar to this one where you can either create a New Run or new batch if you are in batch mode. If you press the back button at this point you will be taken back to the Home Screen the same as you would during a run, but pressing the Run button on the home screen will take you back to the screen where you set up a run or batch.

This is the method you run the first time around







Section 2, which follows discusses in detail what the chromatogram should look like for an injection of the Test Mix. You should examine the cgram as the run is in progress, which will let you know whether the system is performing correctly or not. The criteria listed in the next section will determine whether the system is performing correctly or not. You should also overlay the result obtained in this first run with the 3 results stored in the system for the Test Mix that were generated during factory checkout of your miniGC.

Once you're done with this first injection and the results pass the outlined criteria, installation is complete and you are ready to run samples!

You can leave your miniGC on all the time in which case it will enter Sleep mode and turn purple after a set amount of time (default time is 1 hour). Loading a method or changing a parameter on the dashboard will cause the system to exit sleep mode and approach the new set parameters. It usually only takes the system a few minutes to reach the setpoints of any method.

Alternatively, you can turn off the power button on the back of the miniGC if you anticipate the miniGC not being used for a longer period of time. To restart the miniGC simply turn the power switch on the back of the miniGC back on and the system will begin to warm up and approach the sleep mode setpoints. This should only take a few minutes. You can also load a method as soon as the system is turned on and the system will go immediately the method setpoint parameters. This should only take a few minutes as well.

2.0 Running the Check Standard

2.1 What is the GC-FID Test Mix
2.2 How we run the Test Mix during check out
2.3 What are the passing criteria
2.4 Troubleshooting the chromatogram

2.1 What is the GC-FID Test Mix

This is the GC-FID Test Mix. It is a standard part from Restek (PN:35108, https://www.restek.com/catalog/view/33563) that can be purchased from their website. It is also included in the Accessory Kit that comes with the miniGC. It is used to QC every miniGC during checkout at Lucidity before it leaves our facility. And it is the primary means for troubleshooting your miniGC.

The Test Mix contains 3 hydrocarbons (C12, C14, and C16) at a concentration of 20ug/mL each in a solution of hexane.

2.2 How we run the Test Mix during checkout

After production, every miniGC goes into checkout before boxing and shipment. During checkout, we run 3 runs of the Test Mix in the miniGC and these runs are capturing in the results for the system so that they can be viewed by the user when the system arrives at their facility. Each run is made using the GC-FID Method loaded in the system during checkout that remains in the system when it arrives at the user's facility.



The method can also be found on our website (https://luciditysystems.com/products/minigc/instructional-troubleshooting-documents/). A 1uL injection is made using the GC-FID method. The method details are as follows:

Name: GC-FID
Carrier Gas: Helium
Control Type: Constant Pressure
Flow: 2.00mL/min
Split Ratio: 10:1
Inj Temp: 250C
Det Temp: 325C
Temp Stages:

1. *Hold at 40C for 2.0 min*
2. *Ramp at 10C/min to 220C*
3. *Hold at 220C for 0.0 min*

Column: MXT-5 (30m x 0.25mm x 0.25um)

At a 10:1 split rate, 1 uL injections, and injected concentrations of 20ug/mL, the on column amount of each compound is around 2ng, or roughly 2ppm.

2.3 What are the passing criteria?

The passing criteria of a GC-FID Test Mix run is as follows:

- Peak height for each of the 3 component peaks (C12, C14, and C16) should be between 25-45 mV (this is measured from the top of the peak to the baseline)
- Peak area run-to-run consistency for the 3 runs should be <5% RSD
- Retention times should be as follows:
    - C12 11.75 min +/- 0.50 min (between 11:15 and 12:15)
    - C14 14.50 min +/- 0.50 min (between 14:00 and 15:00)
    - C16 17.00 min +/- 0.50 min (between 16:50 and 17:50)
- Retention time run-to-run consistency for the 3 runs should be <5% RSD
- Solvent peak should begin between 1.50 min and 1.75 min (between 1:30 and 1:45)
- Solvent peak width should be 0.75 min +/- 0.15 min (between 0:39 and 0:51)
- Baseline should be between 30 mV and 75 mV

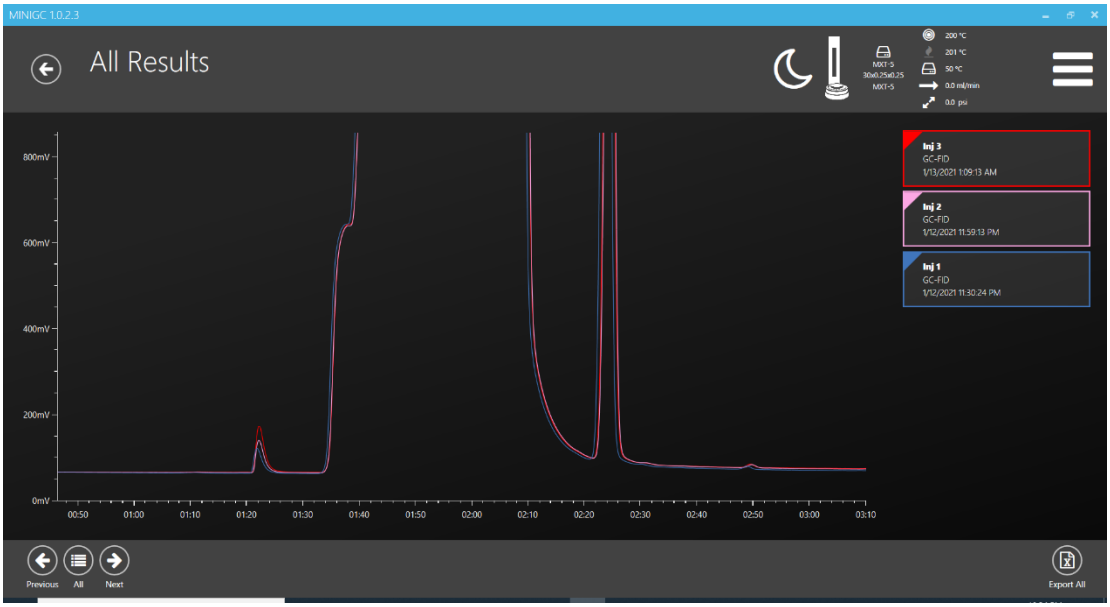
You can expect some contamination peaks on the first run, but you should still be able to see the 3 component peaks clearly. If there are excessive other peaks these should go away after a couple of runs. If they do not, then it is recommended to run the Bakeout method that is loaded into every system.

These are some examples of how the Test Mix Chromatogram should look:

2.4 Troubleshooting the chromatogram

Solvent Peak:

The first thing to observe is the solvent peak. Here is an example of what it should look like:



If you don't see a solvent peak (or any other peak), this could mean that the flame in your FID is out. Proceed to the "How To Check if the Ignitor is Working in the miniGC" document to see if this is the issue and if so how to correct it.

If you have a solvent peak, make sure it is the correct width.

If it is too narrow this can indicate a bad injection or a leak. If it is a leak in the system you should see a yellow warning triangle on the top of the interface indicating a low split flow error. This leak could be coming from:

- The injection port – check or replace the liner nut o-ring (the outer o-ring in the top of the injection port), make sure the liner nut is tight (needs only to be slightly tighter than finger tight, use the supplied tool), check or replace the septum, and make sure the septum nut is tight (needs only to be slightly tighter that finger tight).
- The column sealing correctly with the system – remove the column caddie, make sure the column holder is situated correctly on the column caddie, and reinsert the column caddie in the system. If you encounter much resistance when inserting the column caddie, it may be a sign that the unit is cold and needs to warm up before the column will fully seal with the system. Load a method or manually increase the injection port and detector temps to at least 200C and try inserting the column again after a few minutes.

If the solvent peak is too wide this can indicate a leak around the liner o-ring (the inner o-ring in the top of the injection port) or a missing liner. If the liner is missing, or the liner o-ring is not installed properly, the split flow will not operate properly and you will be injecting a much more concentrated sample on to your column, so the peaks will all appear bigger. Check or replace the liner o-ring, make sure the liner is in place, and make sure the liner nut is tight (needs only to be slightly tighter than finger tight, use the supplied tool).

Baseline:

If the baseline is below 30 mV this can indicate that the FID is not lit. Proceed to “How to Check if the Ignitor is Working in the miniGC”.

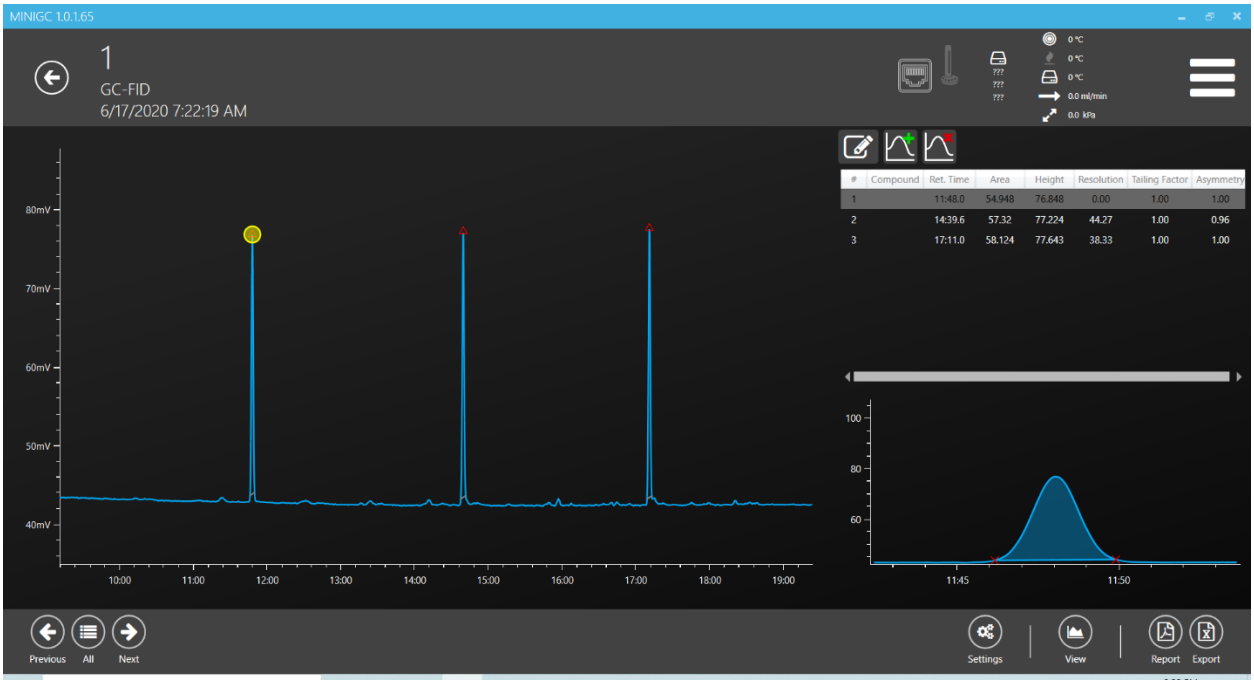
If the baseline is above 75 counts mV, it's possible it is due to excessive contamination. If there is enough contamination on the column, then instead of a lot of extra or unexpected peaks, you will see what appears to be a high baseline as these components come off of the column and into the detector. Run the Bakeout method one or more times (make sure that the bakeout method is compatible with column you are using and does not go to higher temps than are recommended for the column you are running). The standard Bakeout method that comes preloaded in the system is for MXT-5 columns, which have a fairly high max allowable temp. If you are running a column with a lower max allowable temp, then you will need to create a new bakeout method with a lower max temp, otherwise you can destroy your column, and you will in turn see a higher baseline. If the baseline does not begin to come down to the desired level after multiple bakeouts, then there may be another issue.

Retention Times:

Peak Heights:

The next thing to observe is the peak heights of the 3 components (C12, C14, and C16). The peak height of each component should be at least 25 mV and not more than 45 mV.

Here are some examples of what the peaks should look like:



If the peaks are too low in height, this may indicate a bad injection (or possibly a leak). If it is a leak, you should also notice a solvent peak that is too narrow. If the solvent peak is the appropriate width, but the component peaks heights are too low, it is mostly due to a bad injection. Whether you are doing a manual injection or an autosampler injection, check the syringe once you pull up the standard and make sure you have 1uL of liquid in the syringe. If the autosampler is not pulling up 1uL of liquid, make sure

the injection volume is set to 1uL in the method, and make sure that the syringe position in the vial is not too low – if it is it will bottom the needle out on the bottom of the vial and not be able to pull the full injection volume into the syringe. This can be resolved by resetting the “vial” depth position of the autosampler in settings.

If the peaks are too high and the solvent peak is too wide, this would indicate a leaking liner o-ring or missing liner, which means that the split is not accurate and you’re getting more sample than expected on the column and into the detector.

If the peaks are too high and the solvent peak is the proper width, this could indicate that the GC-FID Test Mix needs to be replaced. If the Test Mix is left opened too long or with a septum that has been puncturing a lot, it will evaporate and the 3 hydrocarbon components will be more concentrated in the solution since they evaporate at a slower rate than the solvent.

Repeatability of Retention Times and Peak Areas:

If the peaks do not meet the above criteria for retention time repeatability but all else is fine, there may be an issue with the oven temperature or oven cooling fan. Contact us.

If the peaks do not meet the above criteria for area repeatability but all else is fine it may be a case of intermittently bad injections or a leaky liner o-ring. Replace the liner o-ring and monitor the syringe on the injections to make sure the syringe is filled with liquid up to the 1uL mark for every injection you are comparing.

Here is how to calculate the %RSD for the peak retention times and peak areas:

1) Convert retention times into minutes from minutes:seconds. For example 12:15 is 12.25 minutes.
2) Calculate the average retention time and area for each of the 3 peaks for 3 different runs
3) Calculate the standard deviation of the retention time and area of each of the 3 peaks for these runs
4) %RSD = 100 * (Standard Deviation / Average)

For the 3 runs shown in these examples the %RSD values would be:

Ret Time

	C12	C14	C16
Inj 1	11.73	14.62	17.14
Inj 2	11.73	14.62	17.14
Inj 3	11.74	14.62	17.15
AVG	**11.73**	**14.62**	**17.14**
STDEV	**0.01**	**0.00**	**0.01**
%RSD	**0.0%**	**0.0%**	**0.0%**

Area

	C12	C14	C16
Inj 1	42.4	46.4	47.2
Inj 2	42.1	45.8	46.2
Inj 3	42.5	45.3	50.1
AVG	**42.3**	**45.8**	**47.8**
STDEV	**0.21**	**0.55**	**2.03**
%RSD	**0.5%**	**1.2%**	**4.2%**

These 3 injections were done manually (rather than with the autosampler); therefore, this system would pass the performance test since the %RSD values are all less than 5%. To do some further analysis on these 3 runs, the C16 peak in the 3rd injection is the only one that keeps all the peak areas from being within 2%, and if you observe this peak, you will notice that it appears there is a slight amount of contamination in the run that appears just on the back end of this peak, possibly slightly affecting its peak area. Keep in mind these compounds (C12, C14, and C16) are only 2 ng on column (around 2 ppm), so even very small amounts of contamination can affect these peaks.

3.0 Interface Overview

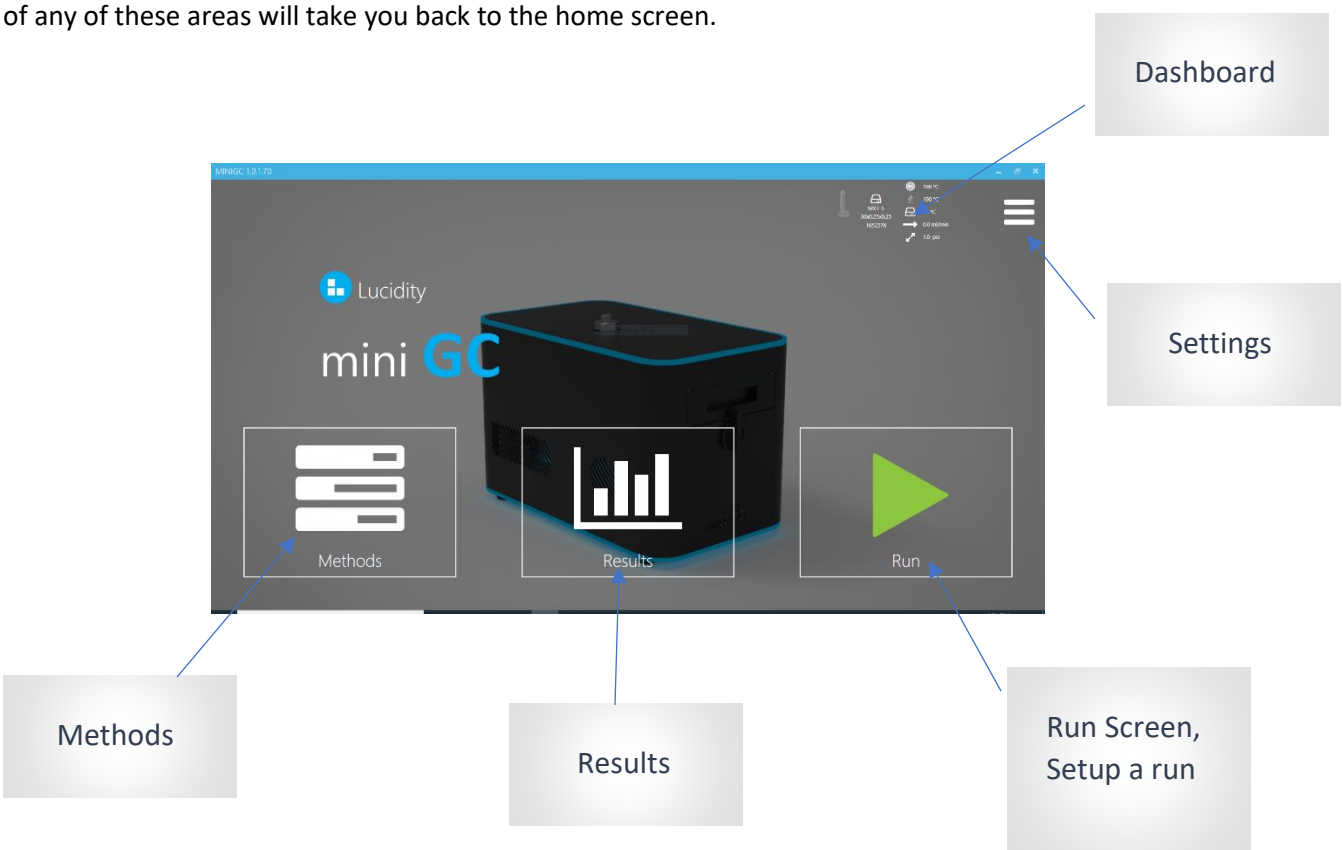
3.1 Login and users

Every miniGC comes with a laptop preloaded with miniGC laptop software (as opposed to the internal software that's inside the miniGC). In order for the software to communicate with your miniGC, the IP address for the ethernet port on the laptop needs to be 172.16.0.10 and the IP address for the miniGC (which is set in the laptop software) needs to be 172.16.0.90. Every laptop and miniGC that are shipped from Lucidity are preset to these IP addresses so they should connect successfully with each other as soon as they are connected and powered on.

Once the laptop is turned on you can click on the icon for the miniGC software on the desktop to open the software. Once opened you will be asked to select a user profile and log in. During installation log in through the Administrator profile using the password "Administrator". The password for any of the preloaded profiles is simply the name of the user. Once you are logged in as the Administrator you can edit profiles and passwords to create your own.

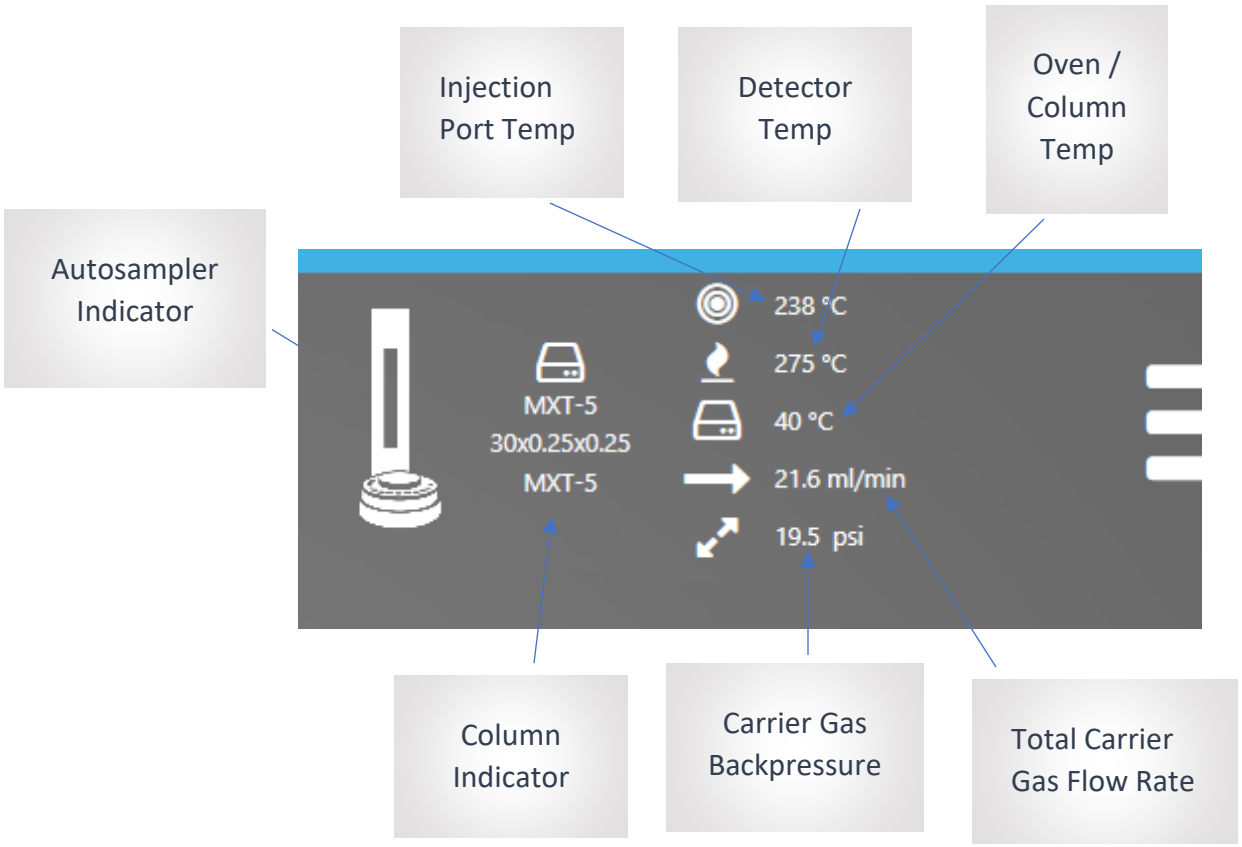
3.2 Home screen

Once you are logged in you will see the home screen. From here you can see the dashboard with the flows and temperatures, and you can go to the Run section, Methods, Results, or Settings. Backing out of any of these areas will take you back to the home screen.



3.3 Dashboard

The dashboard stays with you no matter where in the software you are. From the dashboard you can see the temperature of the injection manifold, the temperature of the detector manifold, the temperature of the column / oven, the flow rate through the column, the back pressure experienced by the carrier gas, the information for the column currently selected, the presence of absence of the autosampler, whether or not the software is connected to the miniGC, any warnings, and what mode the system is in (Sleep, Cooling, etc.)



Autosampler Indicator: If this is icon is not present then you have not selected "Autosampler" in the Settings menu. If this icon is present but greyed out, then "Autosampler" is selected in the Settings menu, but the miniGC does not see an autosampler. If this icon is present and not greyed out (as shown here), then "Autosampler" is selected in the Settings menu, and the miniGC sees and is successfully connected to an autosampler.

Column Indicator: This icon indicates the user defined name and information on the GC column that is currently installed in the system. You can click on this icon to access the column page where you can add new columns or select the active column.

Injection Port Temp: The injection port temperature is the temperature of the bottom section of the injection port. The injection port actually has 2 independently controlled temperature zones, the top and the bottom. The bottom portion of the injection port is the temperature that is displayed here and the one that is set in the Methods. The temperature of the top portion of the injection port is displayed and set in the Settings Menu. It is set globally and never changes unless the user changes it in Settings. It is highly recommended that you do not change this setting. It is set at 200C as a default. It is set at this temperature to reduce off-gassing from the o-rings in the top of the injection port. The length of the needle of the standard syringes included with the miniGC (2.00" needle for manual injections and 2.25" needle for autosampler injections) ensure that the sample is injected low enough into the injection port that a temperature of 200C for the top portion of the injection port does not create issues even when injecting extremely non-volatile compounds.

Detector Temp: The detector temp is the temperature of the detector manifold where the flame ionization detector (FID) is housed.

Oven / Column Temp: This is the temperature of the oven and column as measured by the air temperature in the oven near the column.

Total Carrier Gas Flow Rate: This is the flow rate of the carrier gas into the injection port. How much of this flow goes into the GC column depends upon the split. A split of 0:1 means that there is no carrier gas exiting through the split flow exit and that all of the carrier flow is going into the column and out through the detector, which is splitless flow. A split flow of 100:1 indicates that 100 parts of the carrier gas are exiting through the split flow (entering the injection port but not entering the column) and 1 part is exiting through the column / detector. For a column flow (what is shown and edited in the method) of 2mL/min and a split of 10:1, the total carrier flow would be around 22mL/min with 2mL/min going into the column and 20mL/min exiting through the split exit port in the injection manifold.

Carrier Gas Backpressure: This is the backpressure the carrier gas experiences as it enters the injection port. This backpressure is created by the long, narrow column which the gas must push against as it flows through the column. You can see the calculated value for this parameter in a method, which can be used to ensure proper functioning of the system. This value is calculated in each method based on the carrier gas and flow and column dimensions. When you load a method as the flows and temperatures stabilize at their setpoints the carrier gas flow should stabilize and be close to the predicted value from the method. If the carrier gas backpressure is very low (less than 2 psi) then most likely there is a leak in the system.

The values displayed in the dashboard represent the actual values of these parameters. Upon start up of the miniGC these values will go the following set points:

Injection Manifold: 200C

Detector Manifold: 200C

Oven Temp: 50C

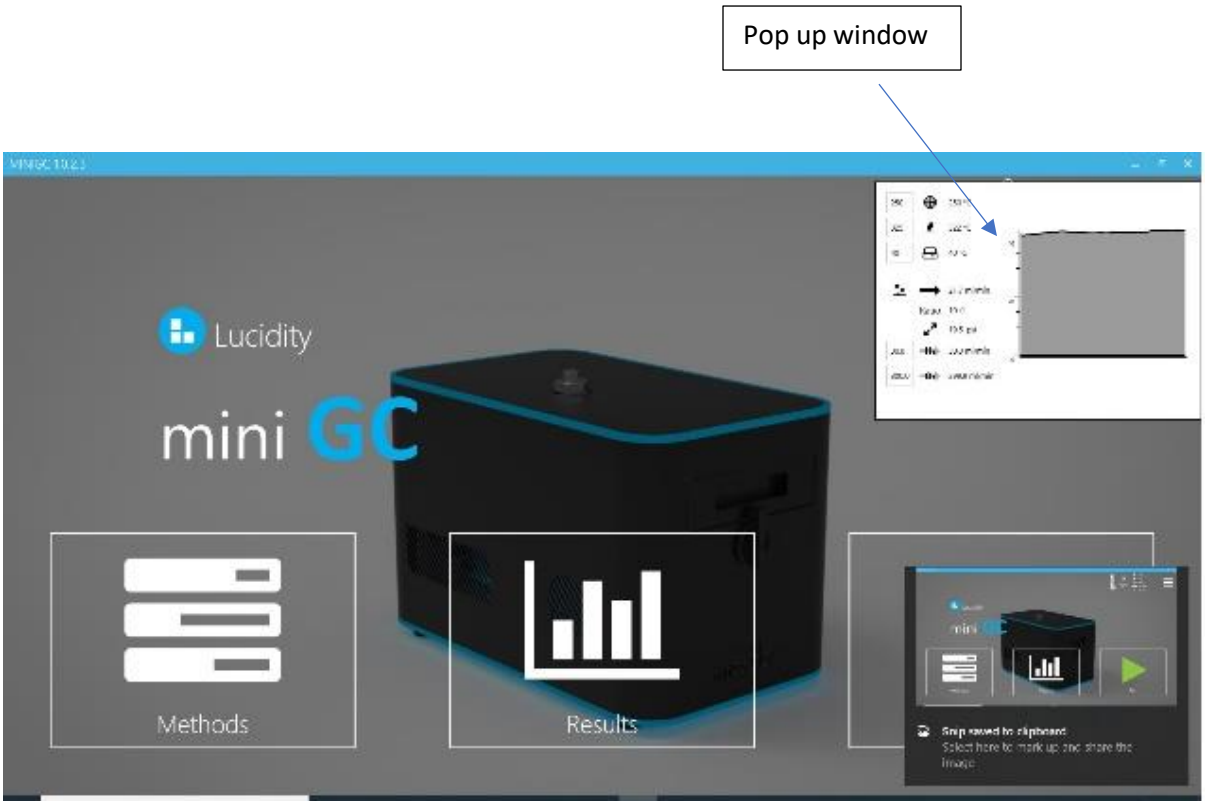
Carrier flow (through the column): 2.0mL/min

These are the same values that are set when the systems enters sleep mode. The system enters sleep mode automatically after a certain period of time. This time can be set in Settings.

If a method is loaded through the run screen (it does not have to actually be run) then the method parameters will be loaded as the system set points. As soon as you load a method in the Run screen, you will notice the system parameters begin to change and begin to approach the set points of the method.

A second way to change these setpoint is to click on the dashboard and you will be allowed to change these set points as you want.

Clicking on the dashboard brings up this pop up window which shows all of your temperatures and flows and their setpoints as well as detector signal.



On the pop up screen you will see the same flows and temperatures that you see on the dashboard but you will also be able to see the setpoints of these different values and be able to change the setpoints. Along with the values on the dashboard you will also see a place to change the split flow of the system. The flow rate you are setting is the flow through the column (after the split), so if you set a flow rate of

2mL/min and a split flow of 100:1 then your total flow rate will be around 202mL/min (2mL/min through the column and 200mL/min that exits through the split flow exit).

Again, the setpoints are either set to the default values mentioned above when you first power up the miniGC or it goes into sleep mode, or they are based on the setpoints from a method. When a method is loaded through the Run Screen (it does not have to be run), this method's setpoints will become the setpoints for these temperatures and flows. And these will remain the setpoints until a different method is loaded, the system enters sleep mode, or until they are changed manually through this pop up window.

In order to change one of these values, enter the new desired value and click on the refresh icon which will update the setpoint. After clicking on the refresh button you should notice the setpoint for that parameter change and the actual value of that parameter begin to change as it begins to move to the new setpoint.

The flow rate shown on the dashboard is the flow rate of the carrier gas into the injection manifold, so it takes into account the flow rate through the column as well as the split flow. For example, if you set a flow rate in a method or on the dashboard of 2.0 mL/min and a split flow of 100:1 then the overall flow rate will be 202 mL/min, because the carrier gas will be entering the injection port at 202mL/min and 1/100 of this flow (or 2 mL/min) will be flowing on to the column and the rest will flow out through the split flow outlet in the back of the system.

The pressure shown shows the amount of back pressure experienced by the carrier gas as it enters the injection port manifold. If no column is installed then you will notice this back pressure is around 0 psi since the carrier gas will enter the injection port then come out of the injection port where it seals the column pin in the back of the oven without experiencing much backpressure.

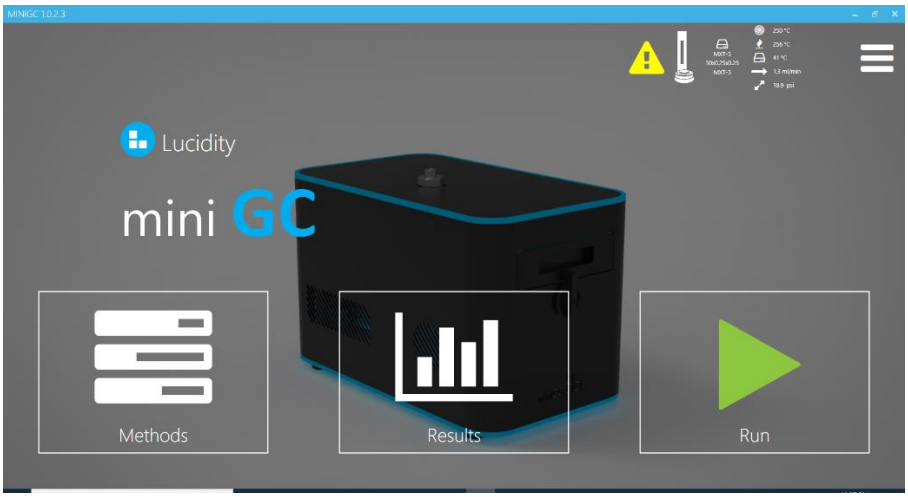
A pressure of 0 psi can also indicate a leak in the injection port from a missing septum, a missing liner, a missing or leaking liner nut o-ring, a liner nut or septum nut that is not tightened enough, or a column pin that is not sealing well into the injection port. A missing or leaking liner o-ring will not result in a low back pressure – it will result in an improper split which will show up as larger peaks in a run (because more sample is getting on to the column that is supposed too).

You can use the pressure as a check on the system to make sure there are no leaks by loading a known method and column and observing this value. When you load the GC-FID method and the standard MXT-5 column that comes with the miniGC (30m x 0.25mm 0.25um) you should see about 19.4 psi of pressure. Each method (or set of parameters) and column will have a different expected back pressure. You can use this pressure to ensure that everything in the system is sealed properly.

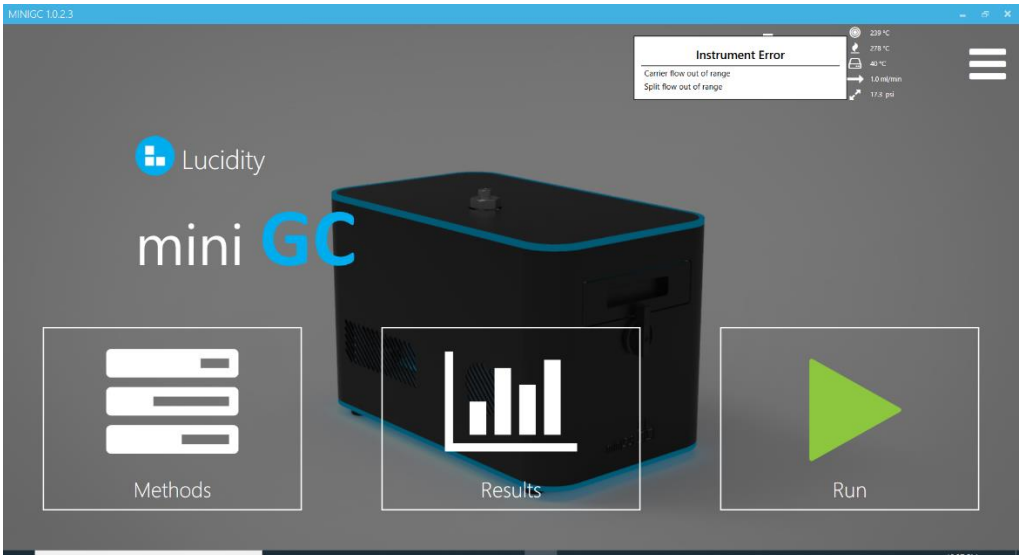
Note: when you first turn on the system, you may have to let the system warm up for a couple of minutes before the column pins seal properly to the injection port and detector.

Low pressure will also be accompanied by a warning sign that will indicate "low split flow". This warning means there is a leak in one of the above-mentioned areas.

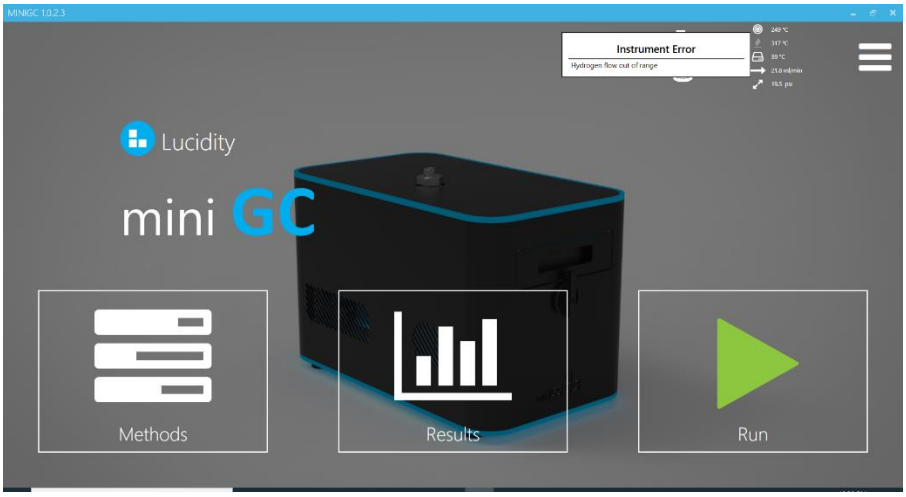
If you notice a yellow triangle with an exclamation point in the dashboard like is shown below, you have a warning. Click on this icon to see what warning(s) you have.



A lack of carrier gas flow (at least 250mL/min capability) or pressure (at least 45 psi) or not having a carrier gas connected will produce the following warning:



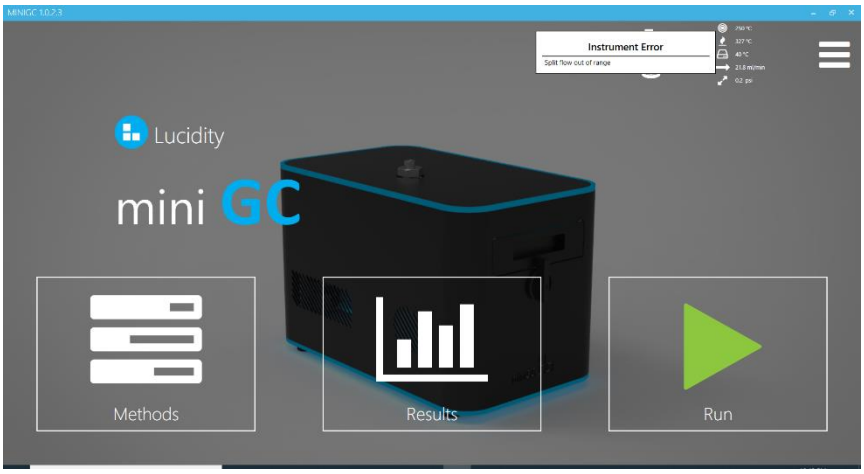
A lack of Hydrogen flow (at least 30mL/min capability) or pressure (at least 45 psi) or not having Hydrogen hooked up will produce the following warning:



A lack of High Purity Compressed Air flow (at least 300mL/min capability) or pressure (at least 45 psi) or not having High Purity Compressed Air hooked up will produce the following warning:

Having all of your gasses hooked up correctly but having a leak somewhere in the system possibly from one of the following results in the following warning:

- Column not inserted
- System still heating up (if a column holder is inserted into a system when cold it may not seal correctly until the system warms up)
- Missing septum
- Septum nut not tightened
- Liner nut not tightened
- Missing or damaged liner nut 0-ring



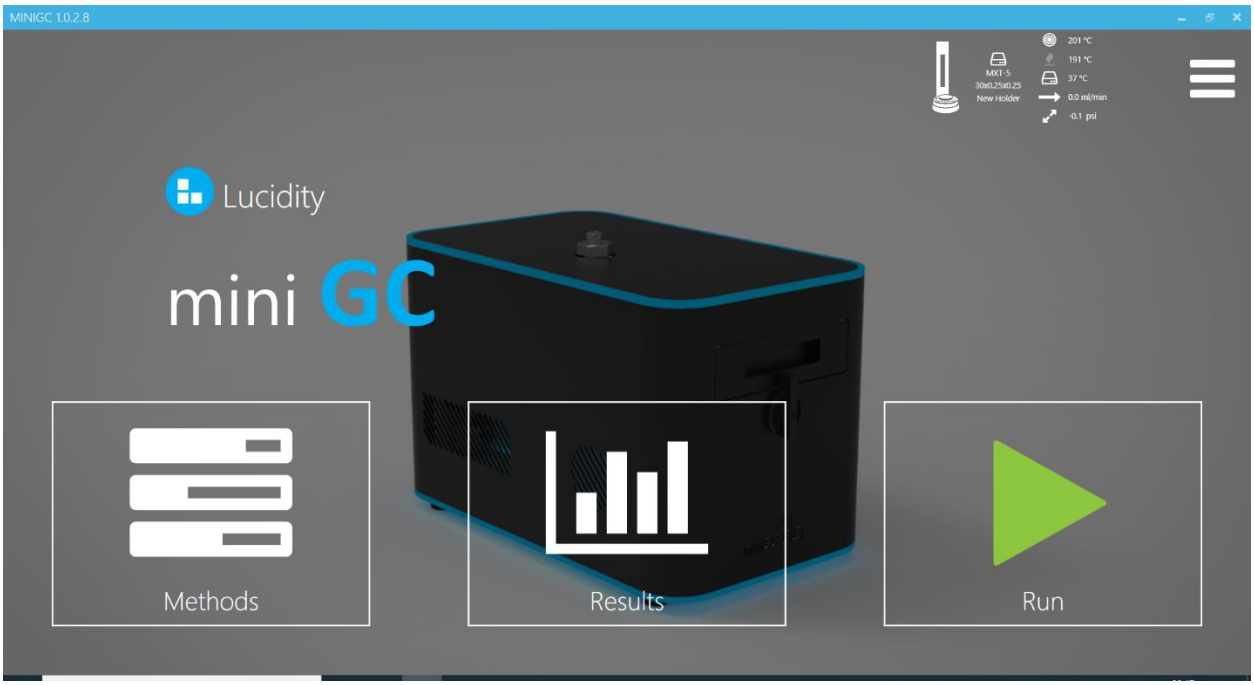
Errors other than these should be reported to Lucidity.

3.4 Column selector

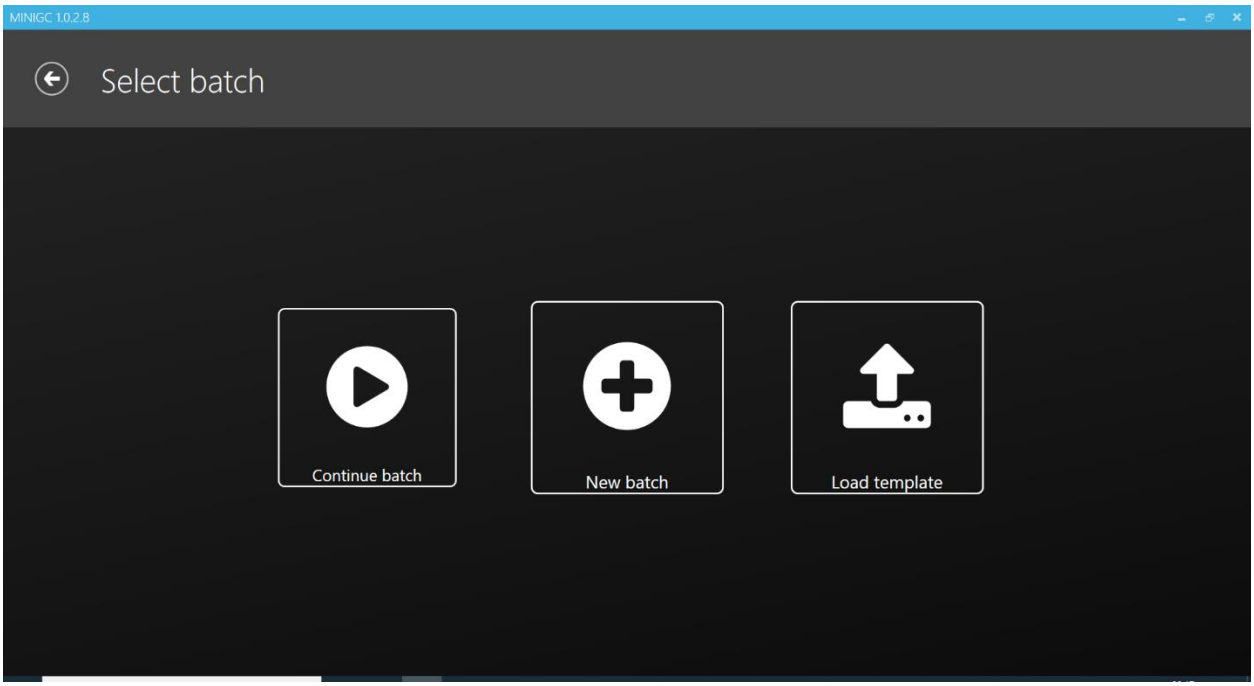
Included in the dashboard is an icon that looks like a column holder along with information on the column that is currently installed (or thought to be installed) in the system.

Clicking on this icon allows you to see more information on this column, and the columns that have been entered into the system. From this screen you can also select a different active column if you wish to put a different column in the system. Doing this properly will keep track of how many runs and what runs have been run on each column as well as provide warning when users attempt to run a method that was not designed for the column currently in the system.

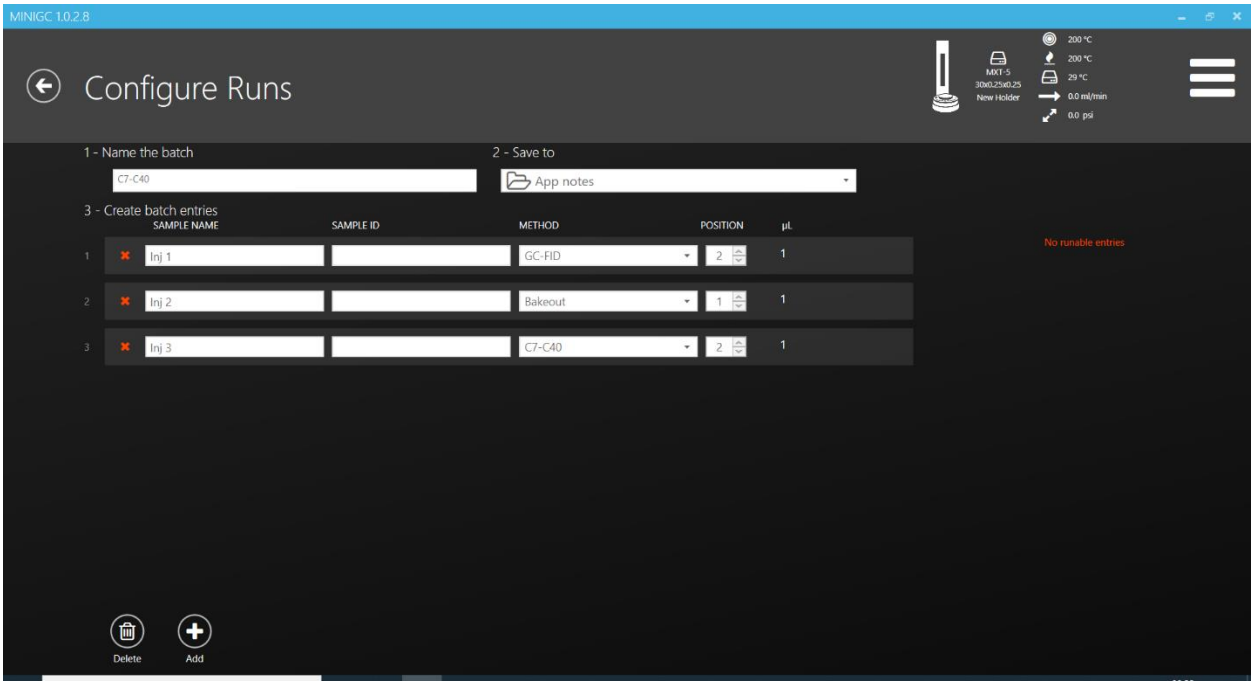
3.5 Run Screen



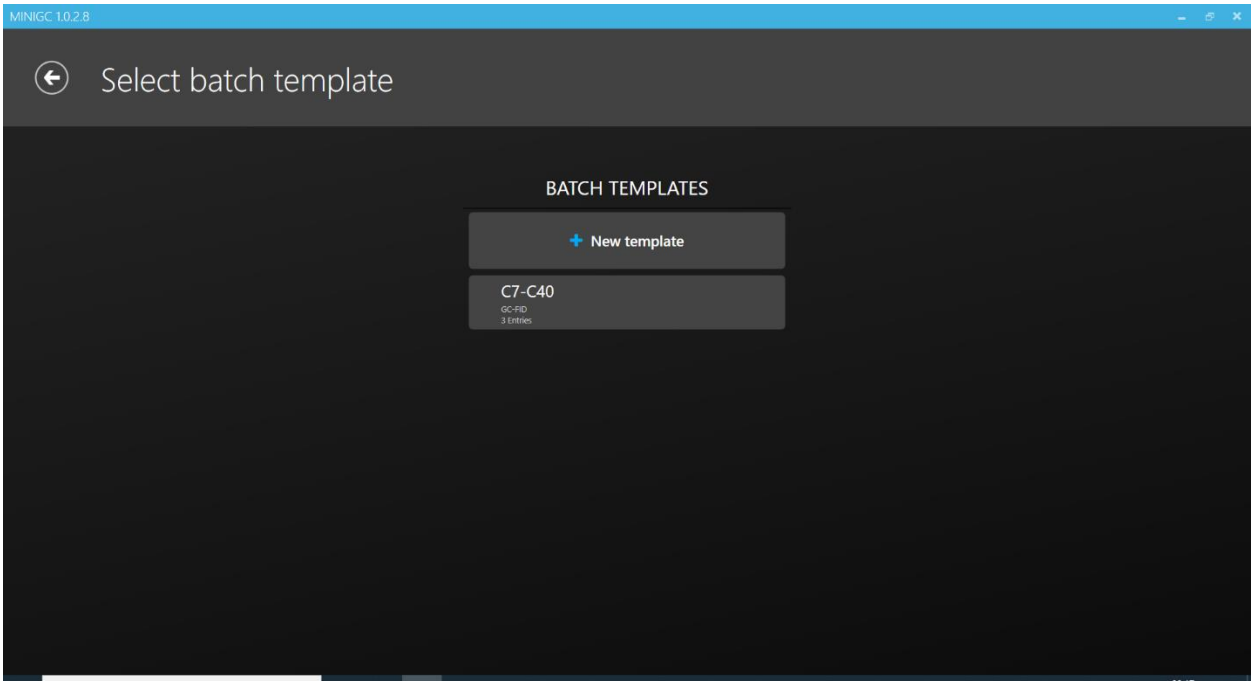
From the home screen you can go into the run screen to view runs in progress or set up new runs. If there is a run in progress pressing run will take you directly into the run screen for that run. If there is not a run in progress then pressing run will take you to the following screen.



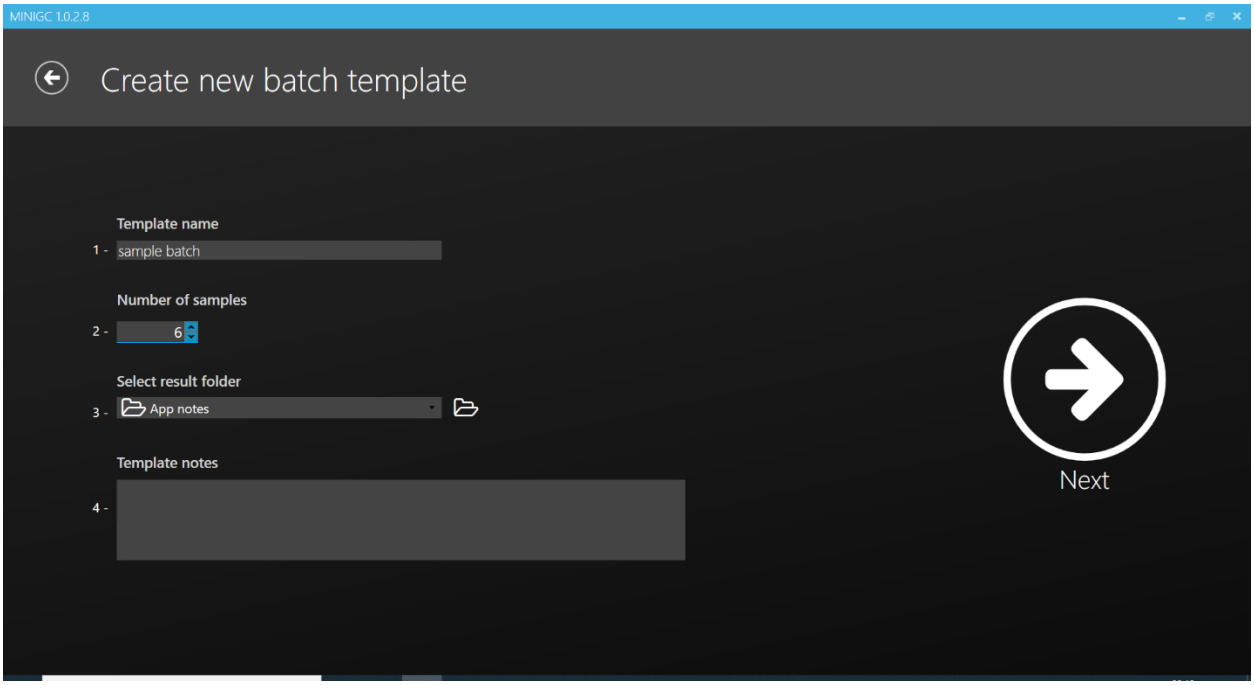
From here you have 2 or 3 options. If a batch has been paused or stopped before it completed you will see the Continue batch option along with the New batch and Load template options.



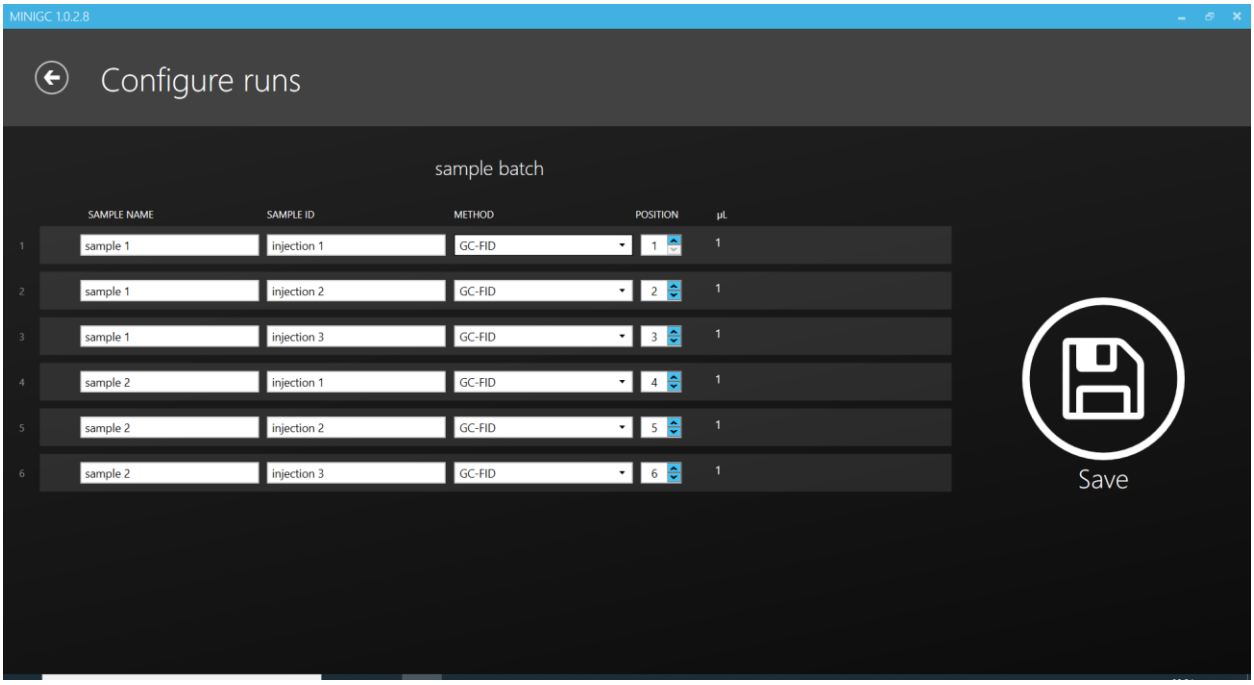
Pressing Continue batch will take you to a screen like this showing you the previous batch and whether or not there are runs in that batch that are still runable.



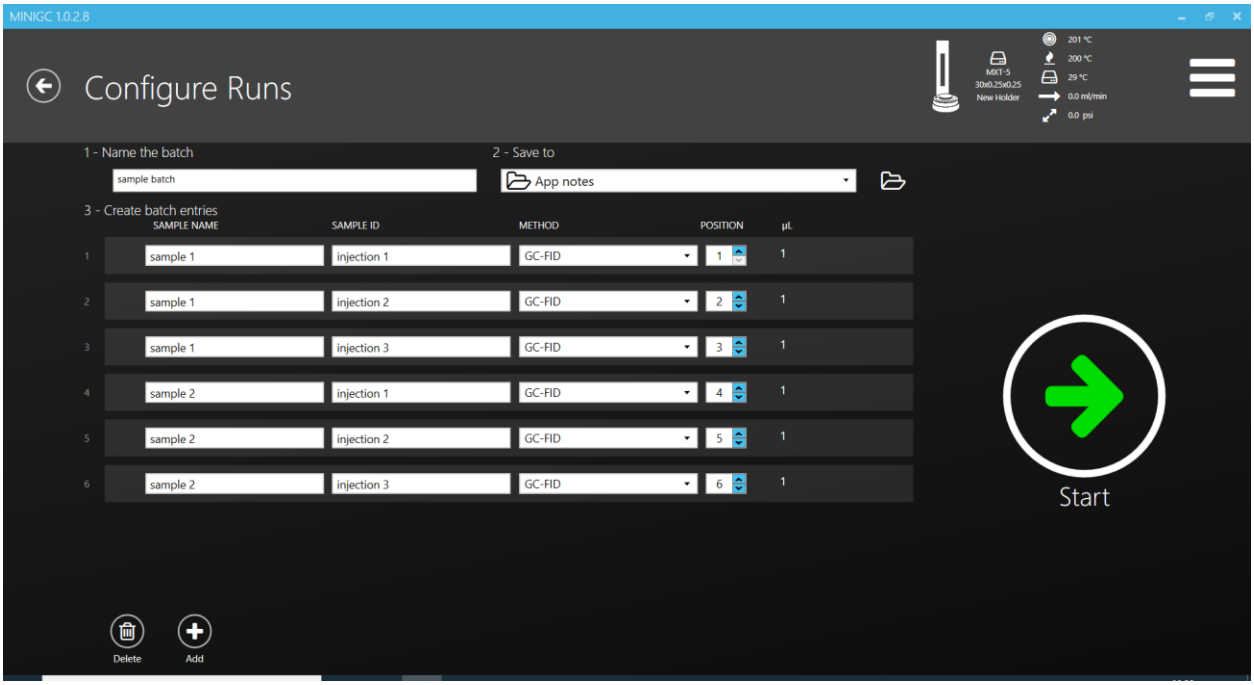
Load template will take you to a screen like this that will allow you to load batch templates that you have previously created.



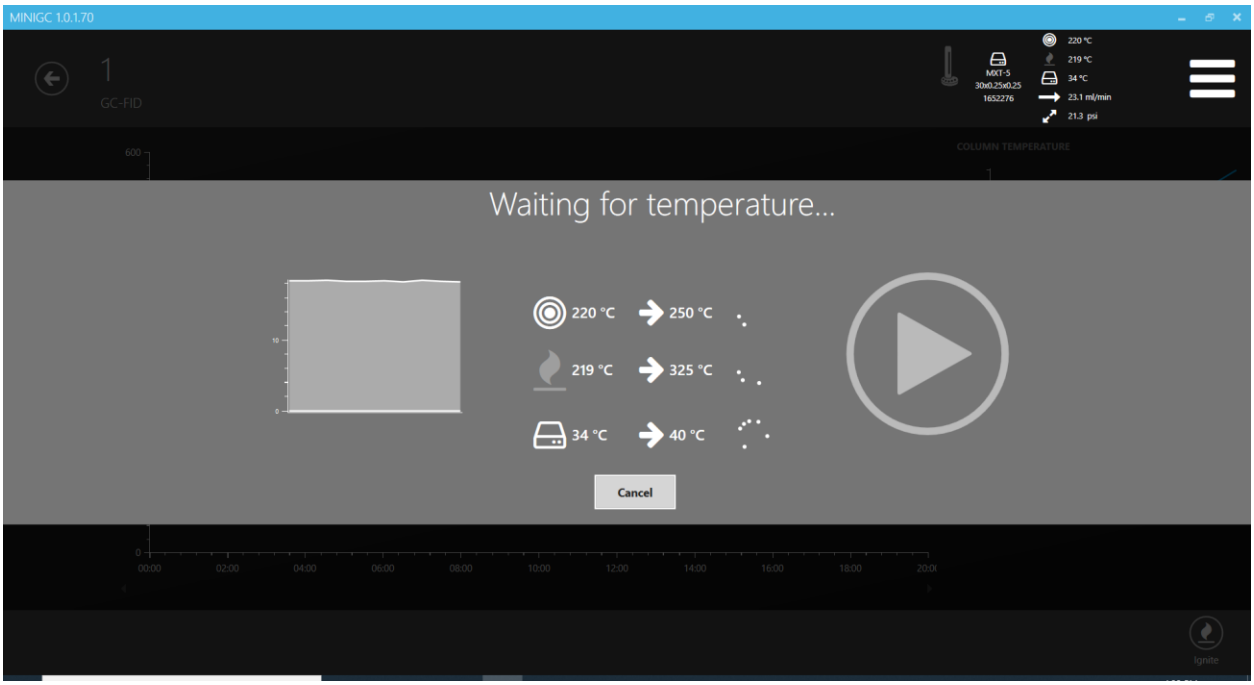
Selecting New batch will allow to create a new batch on a screen like this. In addition to giving this batch a name and choosing how many runs will be in this batch, you can also select a results folder for the results to be stored in. Once created, a new batch will appear in the batch templates and can be selected for future runs.



The batch creator allows you to create run names and sample IDs for each run along with selecting the method for each run and the position the sample occupies on the turntable. The injection volume for each run is displayed but not editable. This value can only be edited in the method.



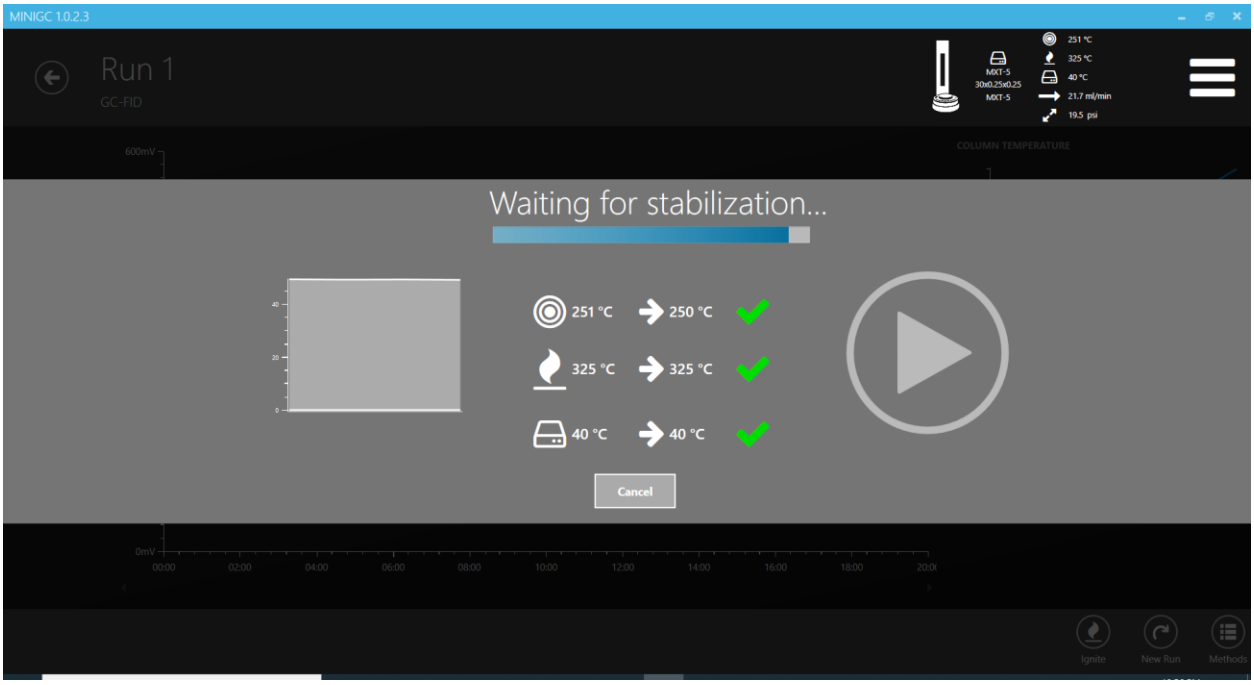
Once saved, the batch can be loaded by pressing Start.



Once you press Start you will see the above screen appear and the system parameters will begin to approach the setpoints of those parameters in first method in the batch mode or the only method in single mode. The column flow rate and split will change to the values defined in the first method, and the injection port temperature (bottom zone), the detector temperature, and the oven temperature will approach the setpoints defined in the first method. You can see the actual temperatures and the

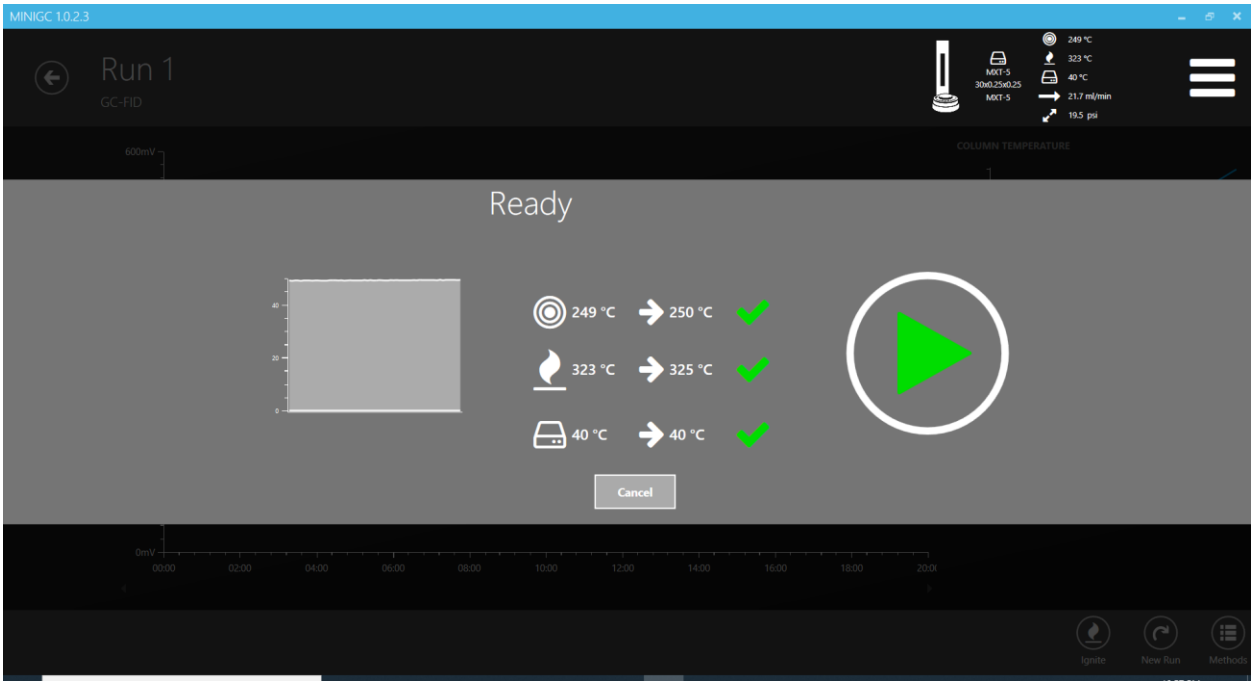
setpoints they are approaching in this screen. On the left you can also see the detector signal, so you can monitor the stability of the detector as the system equilibrates in preparation for the run.

**This feature can and should be used to quickly change setpoints of the system by creating a dummy run name, selecting a method, and clicking start then clicking “Cancel” on the following screen. Even after clicking cancel the parameters from the method selected will still remain the setpoints for the system parameters, all of which will be reflected in the dashboard.



If you intend to run the run, you will remain on the following screen and watch as the system parameters approach the setpoints of the method. The first parameter is the injection port temperature, the second is the detector manifold temperature, and the third is the starting oven temperature. On the left you can see a real time output of the detector signal to watch for detector stability before starting a run.

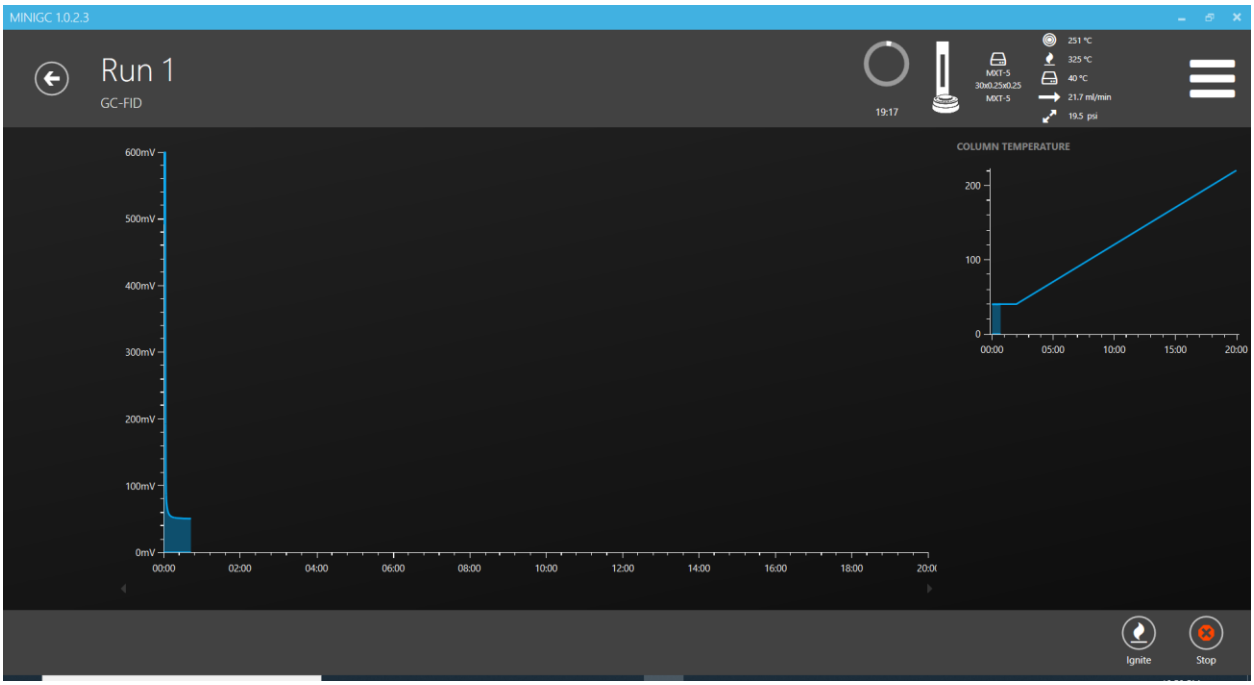
Once a system parameter reaches its setpoint, you will see a green checkmark appear next to that parameter. Once all three parameters have reached their setpoints, you will see the stabilization progress bar appear at the top of this window. You can change to stabilization time in Settings. Once the stabilization time has expired one of two things will happen. If you are in Single mode, the Run arrow on the right will turn green and be active. If you press this button the run will begin. If the system is in Batch mode once the stabilization time has expired, the autosampler will automatically begin to process samples starting with run 1. If you wish to stop the system before this happens you can press the Cancel button at the bottom of the window and you will exit the run screen and stop the runs, but your system parameters will remain at the same setpoints until another run is loaded, they are changed manually in the dashboard, or the system enters sleep mode by sitting idle for the amount of time set in Settings.



Once the setpoints have been reached and the stabilization time expires in Batch mode, the autosampler will begin to clean the needle, pull sample from the defined location for run 1, and inject the sample into the miniGC. You will see icons reflecting this and detailing the stage of the procedure on the screen until the sample is injection and then you will see the run screen.

For a manual injection (Single mode) once you press the Run button you will see a countdown on the screen. Before you press the run button you should have your sample ready to inject in your manual syringe. Then you want to time your injection to coincide with the appearance of a large syringe icon that will appear on the screen at the end of the countdown. Once this syringe icon appears indicating

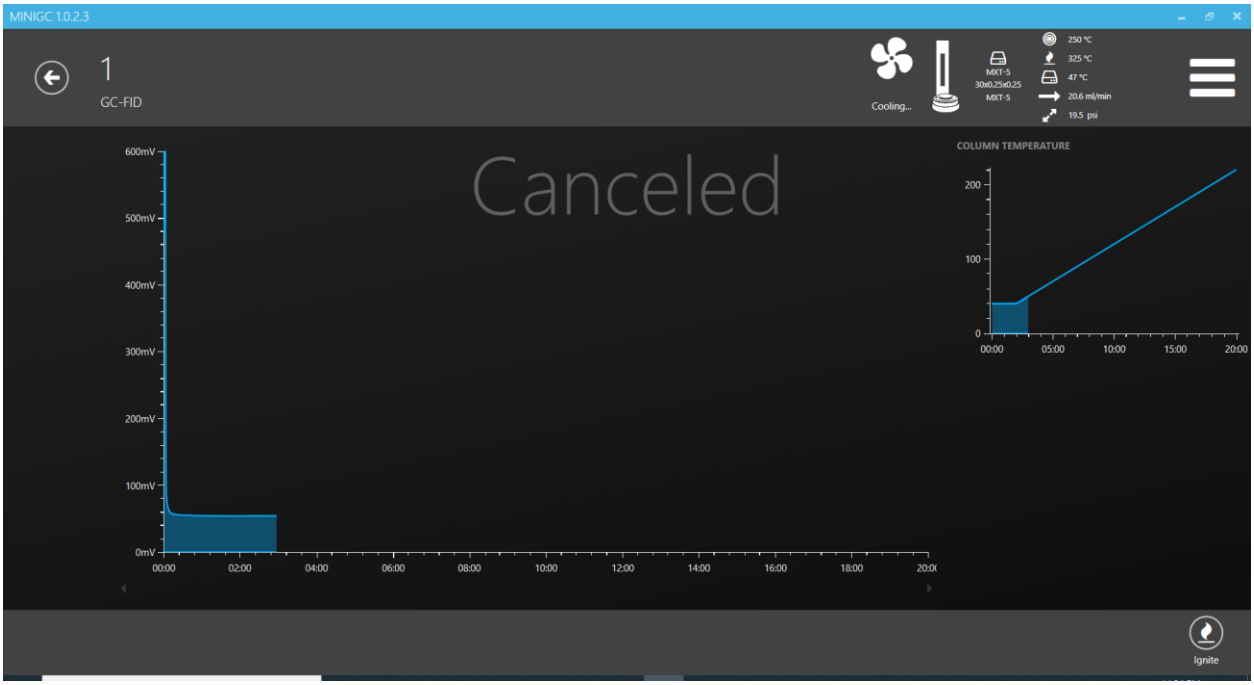
when the injection should take place, the system will assume you have injected the sample and enter the run screen shown below.



Once the run begins, you will be taken to the run screen, shown here. This screen will display your chromatogram and temperature profile as the run progresses. You can back out of this screen at any time by clicking the back button in the top left-hand corner of the screen, which will take you back to the home screen. The settings menu will be disabled during a run, but you can go into the method and result sections to create and modify methods and to analyze results while runs are ongoing. To get back to the run screen you simply go back to the home screen and click on the run button. Instead of going to the run setup screen you go straight to the run screen where you will see the live chromatogram.

If you are running a batch you will see the subsequent runs displayed in the bottom right of the run screen. An active run can be stopped at any point by pressing the stop button, which will cause the system to immediately enter cooldown mode as shown below.

When a run is stopped or a run has ended, the system will immediately enter cooldown mode, which is indicated by the appearance of the cooling fan icon in the dashboard. You will also hear the oven cooling fan come on. Whether you stay on the run screen or exit the run screen cooling will continue until the system has reached the starting point parameters of either the next method in the batch or the starting parameters of the method just run depending on whether there are more runs in the batch or whether this was the last run in the batch or the only run in single mode. If there are more runs in the batch, as soon as the setpoints of the next method in the batch are reached the next run will begin and the autosampler will begin its procedure for injecting the next sample.



During the run, in addition to the Stop button at the bottom of the screen you will also notice the Ignite button at the bottom of the screen. You shouldn't ever have to use this button. It is there just in case. The FID should always be lit when the system is on and not in Sleep mode. And as redundancy the system will relight the flame in the FID at the beginning of the equilibration period and again at the beginning of the run, which is why you will usually see the very end of a peak at the very beginning of every run, just like you see above.

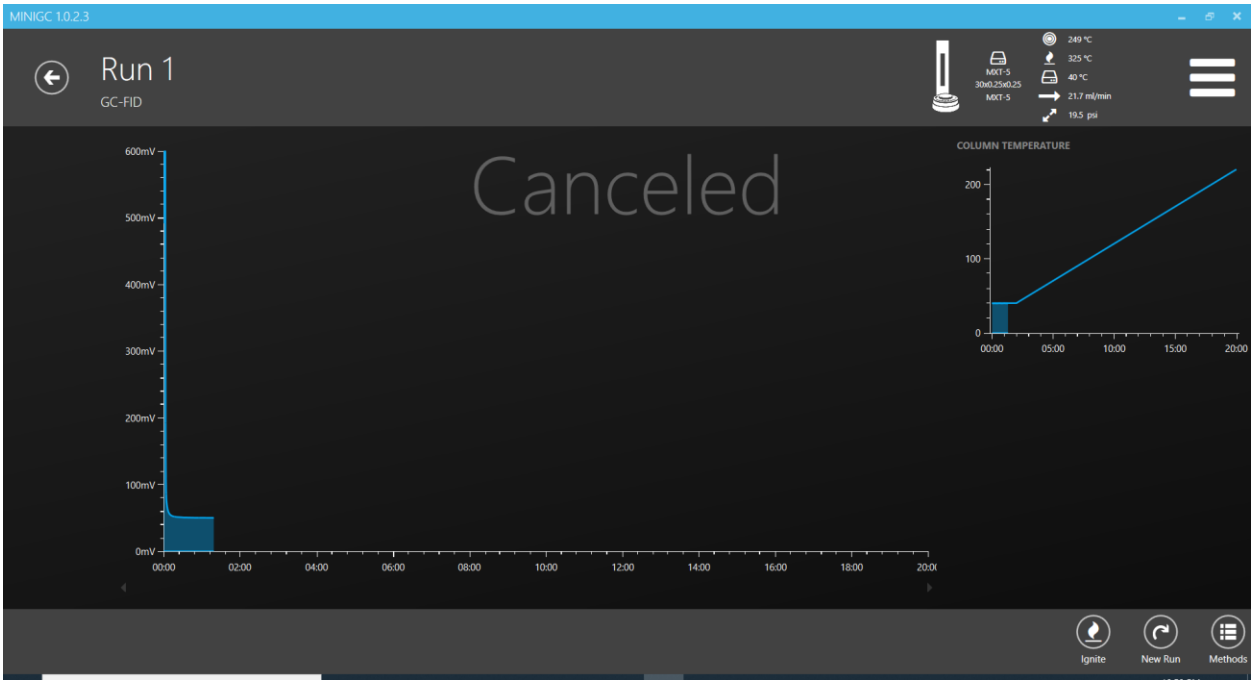
As the run progresses you should see a peak maybe 10-60 seconds in width in the first 3 minutes of the run, which is your solvent peak. It should essentially max out the detector for most of this time and then come back down to the baseline. After that you should begin to see your peaks of interest come out. If you set a solvent delay time in your method that is later than when the end of your solvent peak comes out, then your chromatogram should rescale to the next peaks it sees after this time so that you can see your peaks more clearly. If it does not, then your peaks may appear very small or you may not be able to see them at all at full scale, and you will need to zoom in to see them.

To zoom in, hold down the wheel on the mouse and draw a rectangle on the area you want to zoom into or hover over they y axis and move the mouse wheel up or down to increase or decrease the y values of the viewable graph. The maximum value of the FID on the chromatogram is 5,000mV, but you can see peaks that are only 0.5mV above the baseline. So you will most likely need to zoom in to see your peaks of interest if you don't set your solvent delay correctly to ignore your solvent peak in the scaling.

**Note: The solvent delay time in the method does not affect when you begin collecting or saving data. It only affects when the autoscaling begins on the chromatogram. Its purpose is to allow you to more easily see your peaks of interest during a run.

At any point during the run if you want to return to the original scale double click the mouse wheel.

During a run at any point you can press the Back button on the top left hand corner of the screen to exit the run screen and go into the method or results sections to modify methods or view runs. This will not end your run or batch. Navigating back to the run screen you will see the run in progress.



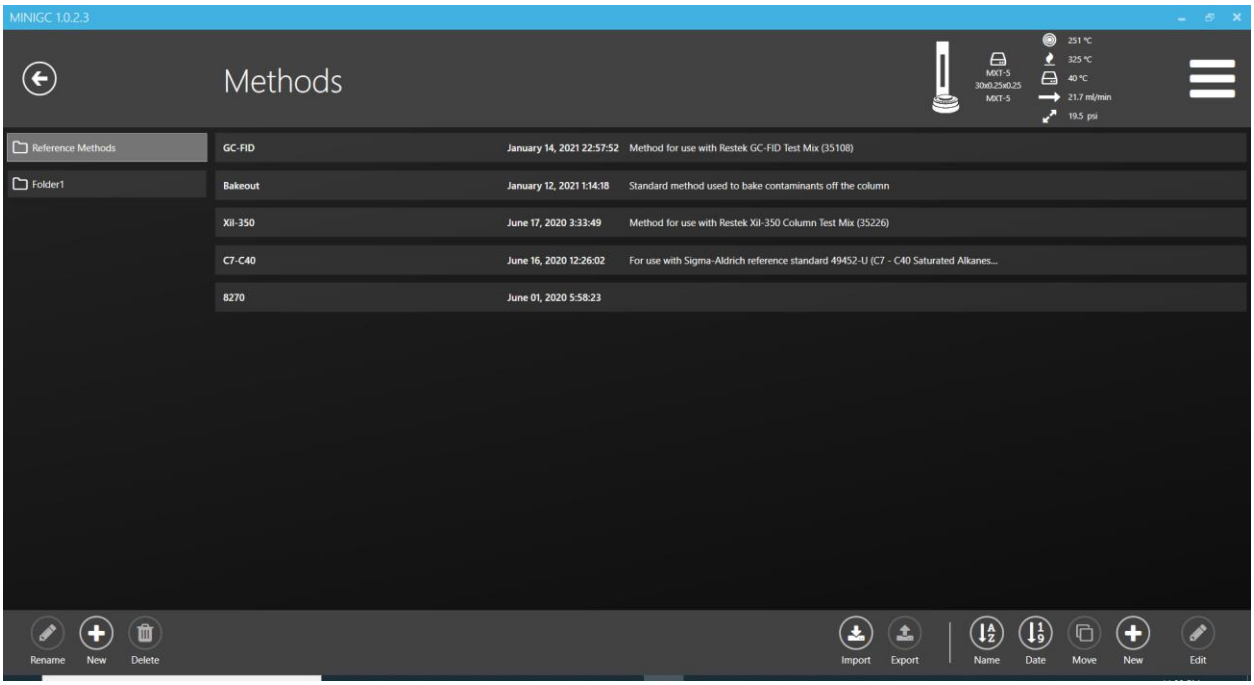
Once the cooling has ended for the last run, you will see a screen similar to this one where you can either create a New Run or new batch if you are in batch mode. If you press the back button at this point you will be taken back to the Home Screen the same as you would during a run, but pressing the Run button on the home screen will take you back to the screen where you set up a run or batch.

3.6 Methods

By clicking on methods from the home screen you will be taken to the main methods screen, where you can see all of your methods. Your methods are saved in a database on the laptop so updating your software will not affect the methods you have. The miniGC software initially comes with 5 methods:

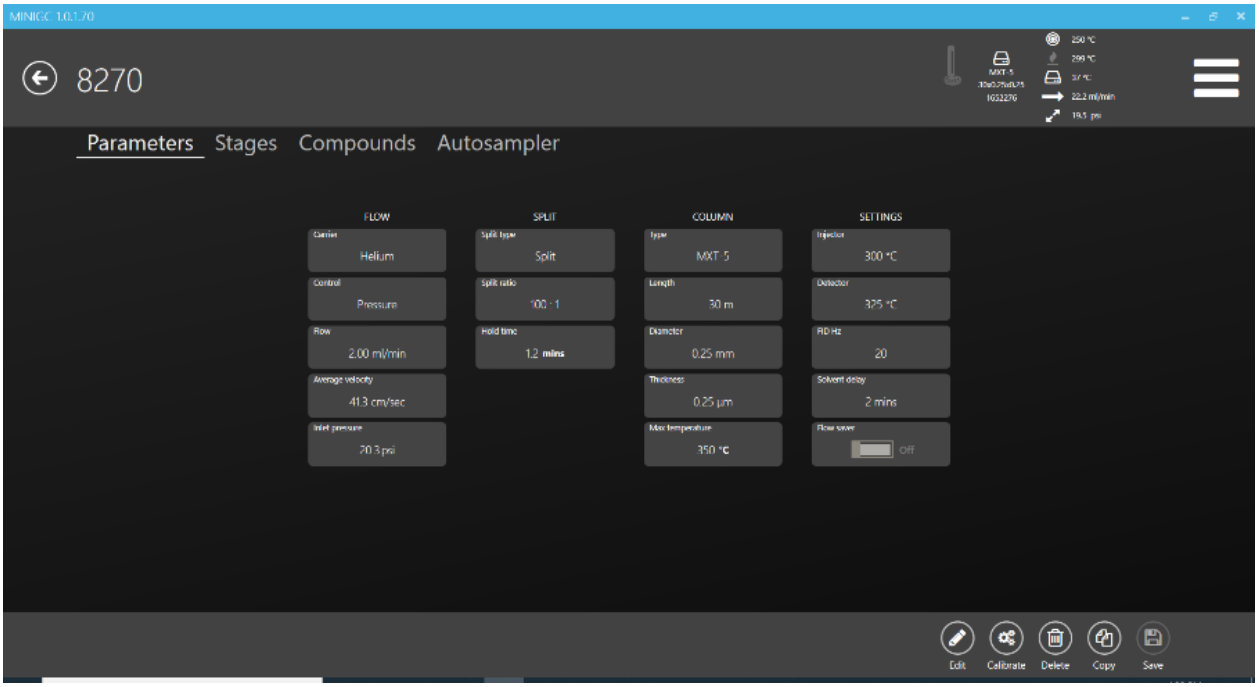
1) GC-FID
2) Bakeout
3) Xil-350
4) C7-C40
5) 8270

From the main methods screen you can create methods, delete them (if you are an administrator), edit them, copy them, import them from a memory stick, or export them to a memory stick. You can select multiple methods on which to perform an operation by Ctrl clicking or Shift clicking.



You can also create and delete folders for your methods, using the buttons in the bottom left hand corner of the screen, and move your different methods in and out of different folders to organize them. Initially you will see 2 method folders, “Reference Methods” and “Folder1”. The 5 methods that come preloaded in the system will appear in the folder “Reference Methods”.

By either double-clicking on a method or selecting the method and pressing the Edit button, you will be taken into that method and initially see the screen below.



A method has 4 different tabs to organize the method parameters. These tabs are “Parameters”, “Stages”, “Compounds”, and “Autosampler”. The Parameters screen shown above contains the following parameters:

FLOW

Carrier: The type of carrier gas that is hooked up. The options are Helium, Hydrogen, or Nitrogen. Changing this will change the values of the calculated parameters Average Velocity and Inlet Pressure.

Constant: This is a standard setting for GCs. You can choose whether you want to run the method using constant pressure or constant velocity.

Constant Pressure - changes the flow rate of the carrier gas through the column to ensure a constant backpressure. The flow rate and average velocity of carrier gas will decrease over time during the run as the oven and column temperature increase since gasses increase in viscosity with an increase in temperature. This is typically preferred since the amount of pressure required to maintain a constant flow rate can exceed the maximum capabilities of the system as the temperature of the column increases.

Constant Velocity – changes the head pressure applied to the carrier gas to maintain a constant flow rate through the column.

Flow: This is the desired flow rate in mL/min of carrier gas through the column. This is a standard GC value. You can increase or decrease this value to attempt to find the optimal average velocity or to speed up the analysis.

Average Velocity: This is a calculated value based on the carrier gas, flow rate, and column dimensions. There is an optimal value for this parameter that ensures optimal separation. Too fast of an average velocity does not give the compounds flowing through column in the carrier gas enough time to interact

fully with the stationary phase on the walls of the column and too slow of an average velocity allows too much band broadening to occur via linear diffusion. You will see this number reported a lot in methods.

Inlet Pressure: The inlet pressure is another parameter that is calculated from the flow rate, carrier gas, and column dimensions. This value is the backpressure generated in the injection port from pushing the carrier gas through the column at the desired flow rate. For constant pressure flow this is the pressure that will be maintained throughout the run as the flow rate decreases from the increased viscosity of the carrier gas at elevated temperatures. The inlet pressure is also a great trouble shooting tool. The pressure you see displayed in the dashboard should match this pressure once you have loaded the method and have the correct column in the system.

SPLIT

Split Type: The split types are Split or Splitless. Splitless means that all of your carrier gas is going into and through your column and out through your detector, so the split exit from the injection port is closed. Split mode means that this split port is open to some degree allowing some of your carrier gas that enters the injection port to exit through the split port and not go into the column. The ratio of these two flow rates is determined by the Split Ratio. This is a common GC setting. Split flow is most commonly used. Splitless is sometimes used for very low concentration samples so that all of the sample is injected onto the column. But this will also create a very large (wide) solvent peak that can obscure compounds that elute nearby.

Split Ratio: The split ratio is the ratio of carrier gas flow that exits through the split flow to the ratio of carrier gas that goes into and through the column. A split of 100:1 means that 100 parts of the carrier gas are going out of the split flow exit and only 1 part of the carrier gas (and therefore sample) are going onto the column. A split of 1:1 means that half of the injected samples is going onto the column, and a splitless injection is essentially a split of 0:1 with all of the injected sample going onto the column.

Hold Time: Hold time is a parameter that is calculated based on flow rate and column dimensions. It is the amount of time that a compound that is completely unretained on the column takes to move through the system and into the detector. It is a troubleshooting parameter that allows you to understand the earliest possible time in the run that something could have migrated through the entire system.

COLUMN

The column parameters are in the method because each method should be associated with a particular column. You can run methods with columns other than the ones associated with the method, but you may get different retention times for your analytes. Also, the method takes into account the maximum recommended operating temperatures of the column associated with the method. In addition, the column dimensions are used to calculate parameters like the average linear velocity and inlet pressure. Using a different column will affect these values. If a column other than the one associated with a particular method is installed in the system when attempting a run with that method, you will get a warning letting you know that the column in the system does not match the one in the method and

asking you if you wish to continue. This also prevents some frustrating situations where you may have forgotten to change over to the proper column before a certain run.

Type: The type of stationary phase in the column, for example MXT-5

Length: The length of the column

Diameter: The inner diameter of the column

Thickness: The film thickness of the stationary phase in the column

Max Temperature: The max recommended operating temperature of the column. If you attempt to run a method with a column installed where the method calls for the oven to go to higher temperatures than is recommended for the column, then you will get a warning before you start the run. This is to attempt to lessen situations where you accidentally run your column too hot and decrease its lifetime or kill the column.

SETTINGS

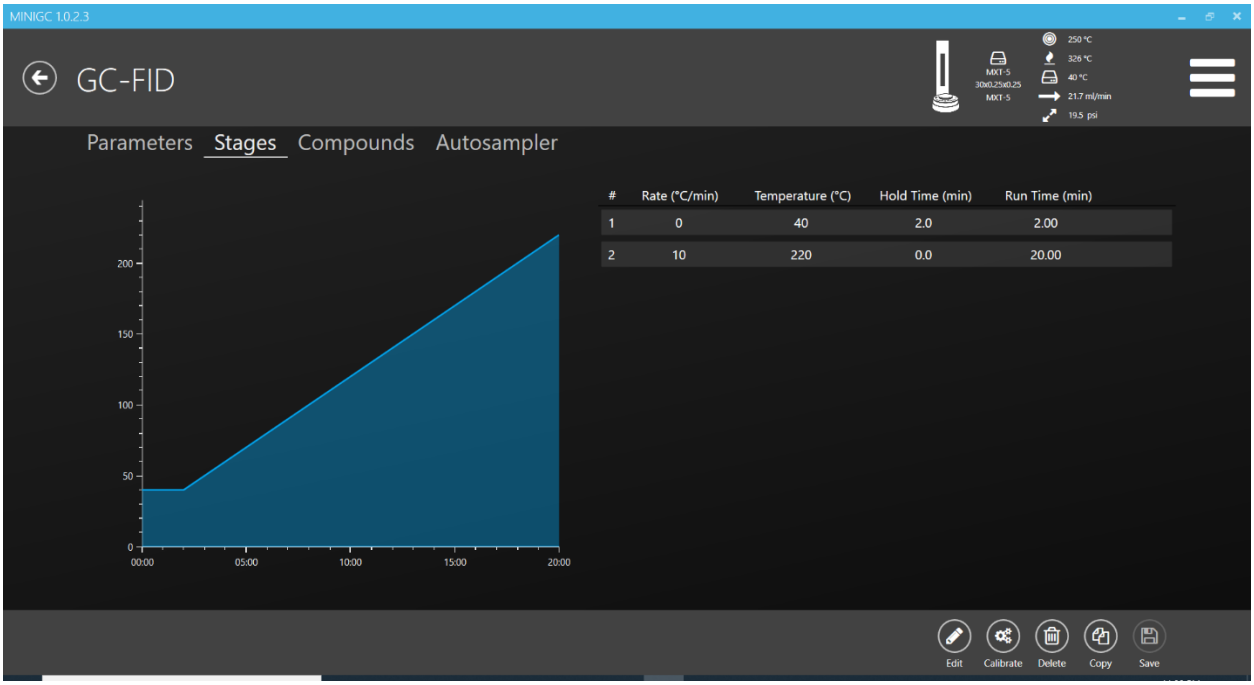
Injector: The injection port temperature for the run (this only affects the bottom part of the injection port where the tip of the syringe is positioned and where the column pin engages into the injection port). This is a standard setting in GC.

Detector: This is the temperature of the FID manifold where the column pin (detector side) engages into the detector manifold and where the sample is introduced into the detector. This is a standard GC setting.

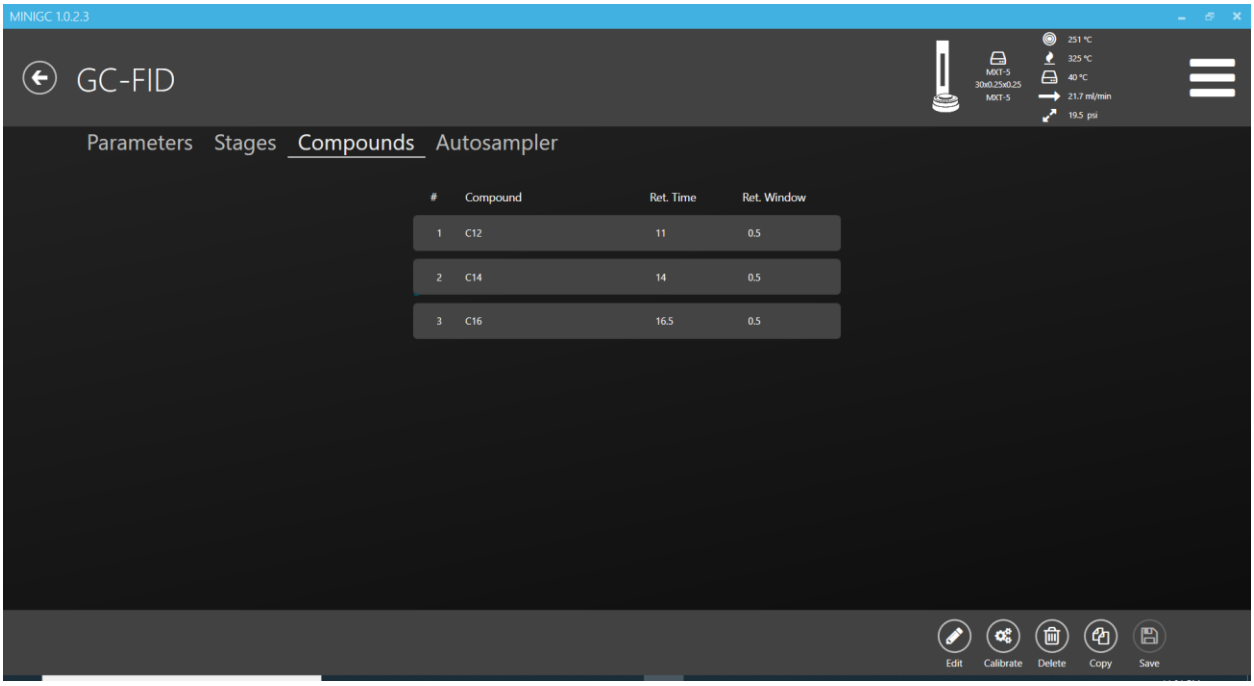
FID Hz: This is the frequency of the detector sampling. It is defaulted to 20Hz. There is usually no need to change this.

Solvent Delay: This is only for autoscaling the graph during a run and when you open up a result. The chromatogram captures every run from injection until the end of the temperature profile. But entering a solvent delay time allows the run viewer and results viewer to ignore the peaks in the chromatogram that come out before this time when autoscaling the chromatogram. For example if your solvent peak begins at 2:15 and ends at 2:45 then you should set a solvent delay time of 3:00 (3 minutes 00 seconds). Doing this means that you will see your chromatogram on the run screen at full scale (y axis maximum is 5,000mV) until 3:00. After 3:00 the chromatogram will autoscale the y axis to fit the peaks that appear after 3:00. The peaks of interest may only by 150mV with a baseline of 60-80mV, so being able to autoscale after the solvent peak gives you a much better view of the chromatogram. This same autoscale will be applied in the results screen when you view the chromatogram. You can always change the scale and zoom in or zoom out in both the run screen and the result screen so you never "lose" any part of the chromatogram.

Flow Saver: Turning this feature on turns off the split flow after the initial injection in order to reduce carrier gas consumption.

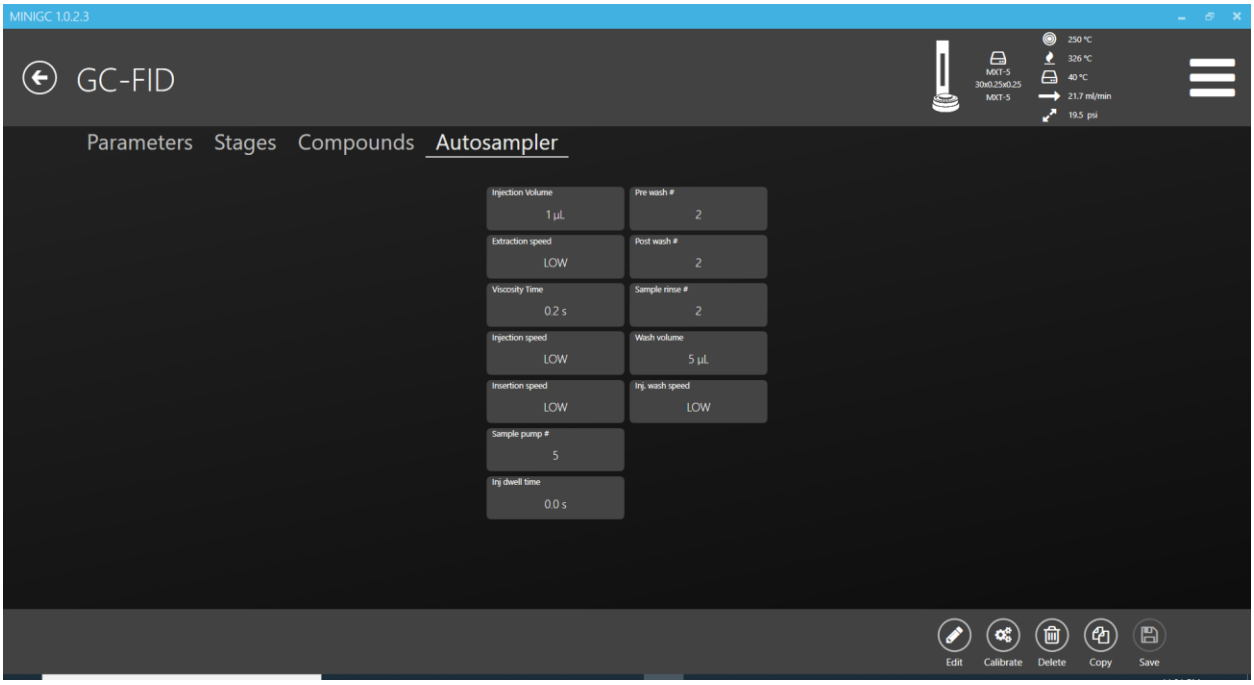


The Stages tab allows you to create the oven / column temperature profile of the method. The max allowable oven temperature is 400C and the max allowable ramp rate is 60C/min.



The Compounds tab allows you to enter compounds into a method that you expect to appear in the chromatogram, each with respective retention times. Once a run is complete and the result is opened for analysis, the software will attempt to match these compounds to peaks in the resultant

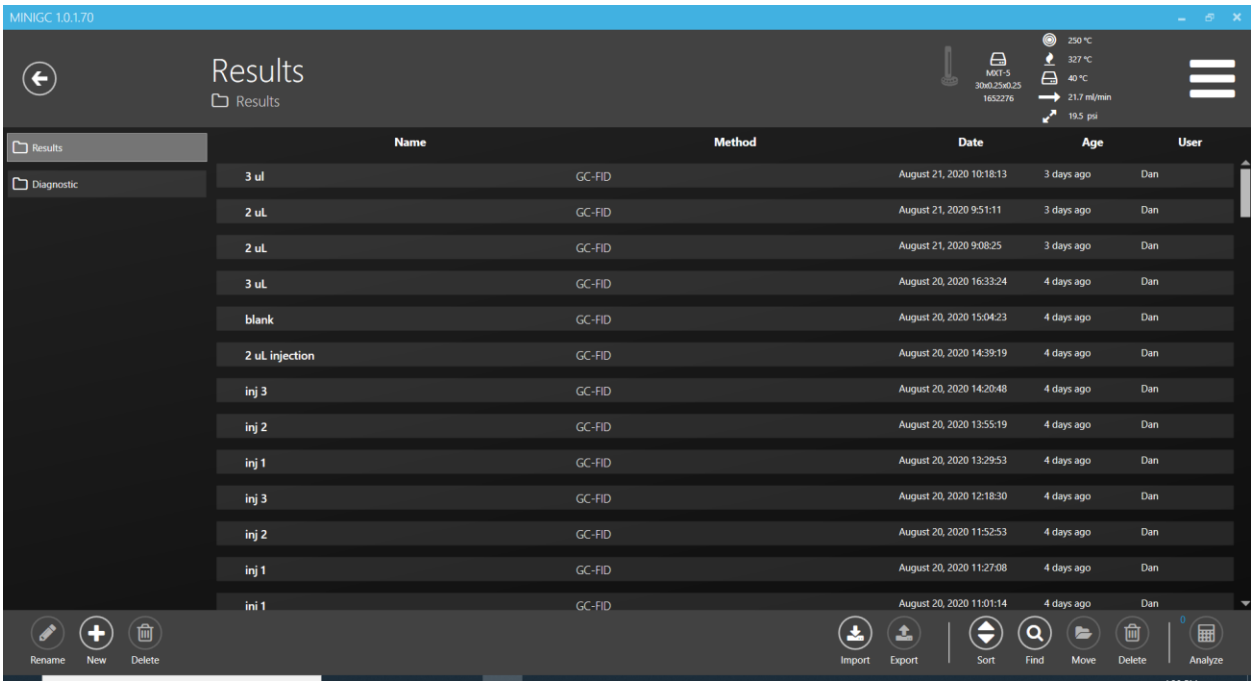
chromatogram and show the names of these compounds in the peak list and report. For example, in the GC-FID method, we have entered 3 compounds, C12, C14, and C16.



The Autosampler tab contains parameters that are related the autosampler such as injection volume and wash parameters.

All parameters are defaulted to reasonable starting values, and all parameters are parameters you would typically find values for in a published GC method, so that GC methods found in publications, online, or elsewhere, can easily be input into the miniGC software. Methods for importing can also be found on the Lucidity website (https://luciditysystems.com/products/minigc/minigc-methods/).

3.7 Results

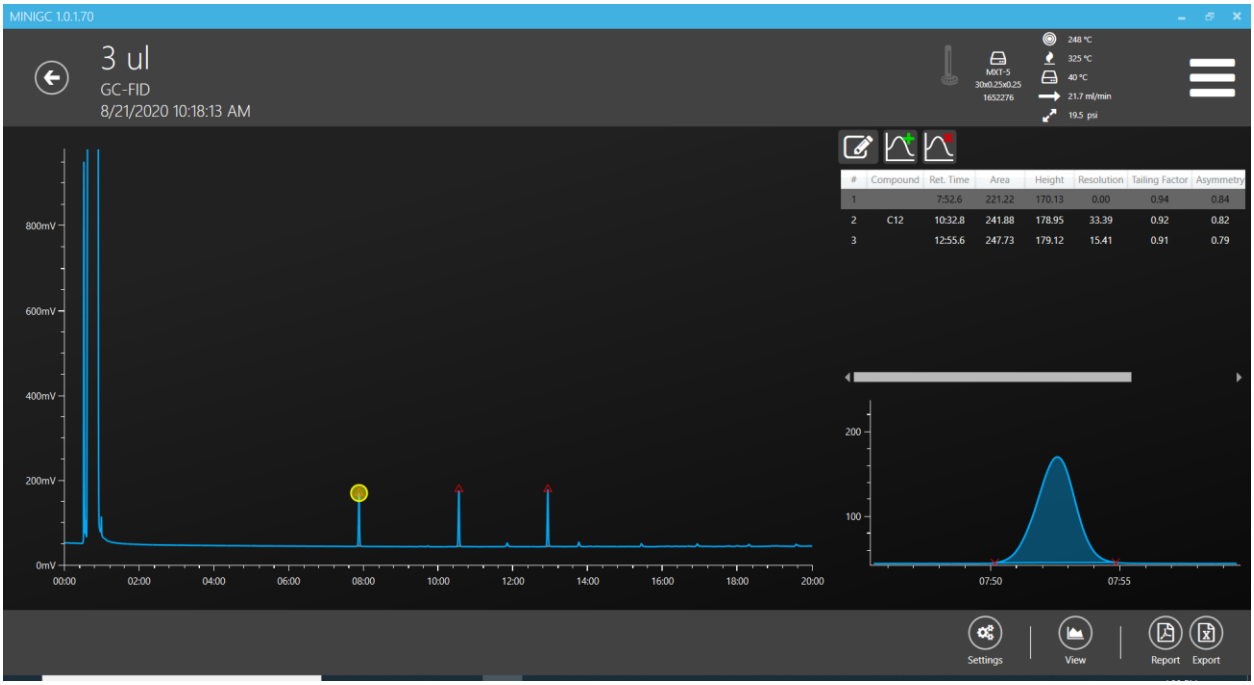


Clicking on the results button from the home screen will take you into the results section where you can view results, overlay multiple results, delete results (if you are an administrator), import results from a memory stick, export results to a memory stick, create folders for your results, and organize your results into different folders. Once inside the results you can adjust the integration parameters, zoom into different areas of the chromatogram, get area, height retention time values and more, modify peak lists, and create and export reports.

A result appears automatically as soon as a run completes and the run enters cooldown. While the run is still in cooldown you can back out of the run screen and go into the results screen and you will see that result. The software will initially have 3 runs in the results section from the 3 runs of the GC-FID Test Mix that were performed during checkout at Lucidity.

You can see a result by double clicking on that result or by selecting it and pressing the Analyze button at the bottom of the screen. You can select multiple runs to view simultaneously in an overlay by Ctrl clicking or Shift clicking the runs and pressing the Analyze button at the bottom. The Analyze button will always have a small blue number just above and to the left of it that show you how many results are currently selected and will viewed in the overlay if you press the Analyze button.

If you select one run, then the result screen will look like this.

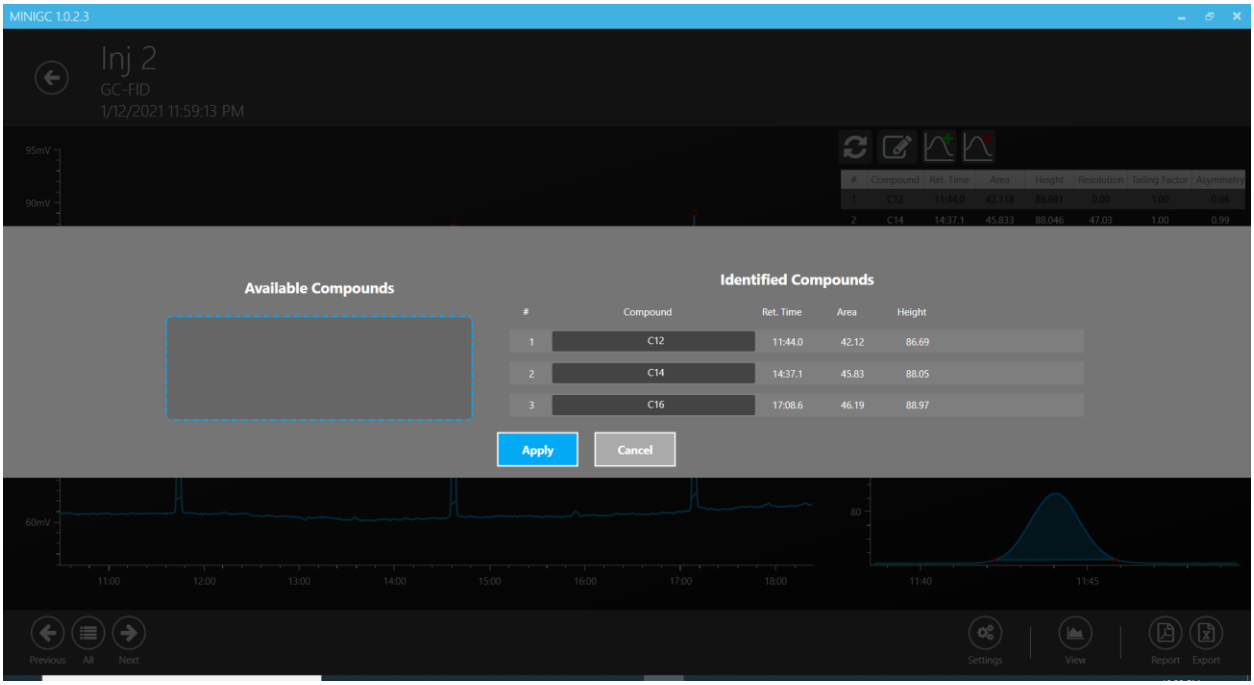


The chromatogram that was produced during the run will appear in the largest part of the window, and a peak list will appear in the top right hand part of the screen. The peak list is based on parameters set in the software that it uses to identify peaks. If it does not find a peak of interest to you, you can manually add this peak by clicking on the button just above the peak list with the green plus and following the prompts. If the software puts a peak in the peak list that you are not interested in, you can remove this peak from the peak list by selecting it and pressing the button just above the peak list with the red X.

If you highlight a peak in the peak list you will also see a closeup of this peak in the bottom right hand corner of the screen. If you wish to adjust how the software has integrated this peak, you can drag and drop the red x's in the closeup graph to redraw and recalculate the area of the peak. The software considers the shaded blue area the area under the peak.

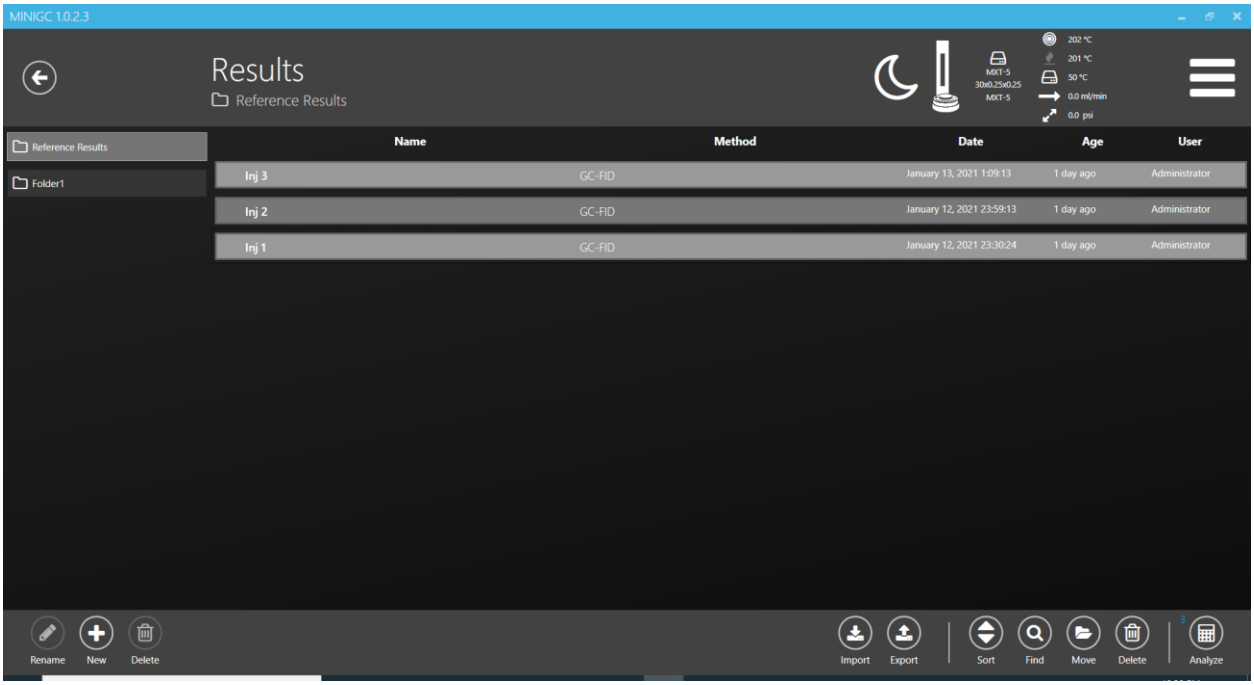
The software will use the compounds entered into the method (if there are any) to attempt to match compounds to the peaks based on the retention times and windows given in the method. If it is able to match these compounds to a peak, the name of the compound will appear in the peak list. You can modify which compounds are associated with which peaks and create new compound names to associate with peaks by clicking on the button above the peak list with the pencil.

You can create a .pdf report that includes the chromatogram and peak list by clicking on the Report button. You can export the .csv file of the chromatogram for analysis in other software by clicking the Export button. The data will export as a list of x-y points with the x point being the time in minutes and the y point being the signal from the detector in mV.



You can zoom in on the cgram by holding down the middle wheel on the mouse and moving the mouse over the location on which you want to zoom in. Double clicking the mouse wheel will zoom out to the original scale.

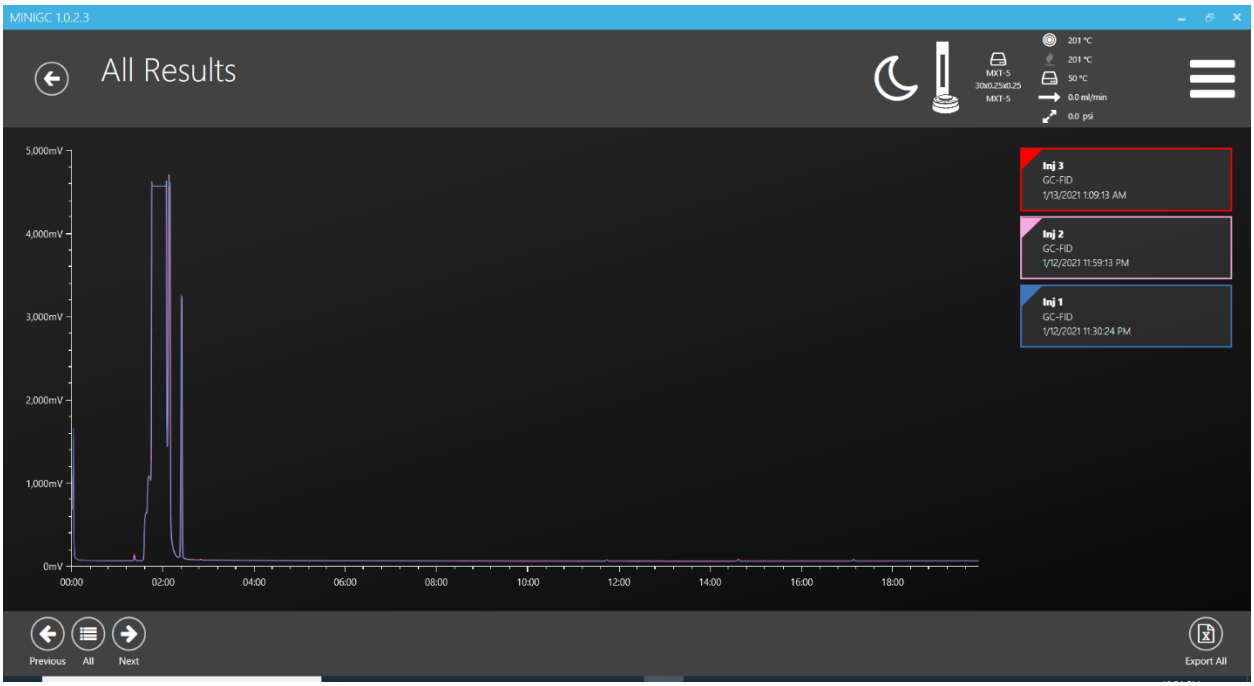
To view multiple results, select the results you wish to view by Shift-clicking or Ctrl-clicking multiple runs then pressing the Analyze button at the bottom of the screen in the Results screen.



If you choose view multiple runs, there will be multiple screens to the result viewer. The first screen is an overlay of all the runs on top of each other. On this screen you can select or deselect individual runs but clicking on the buttons on the right that correlate to each individual run. Each button has the run name and time date stamp as well as an identifying color. This color is the color in which the chromatogram is drawn to the left.

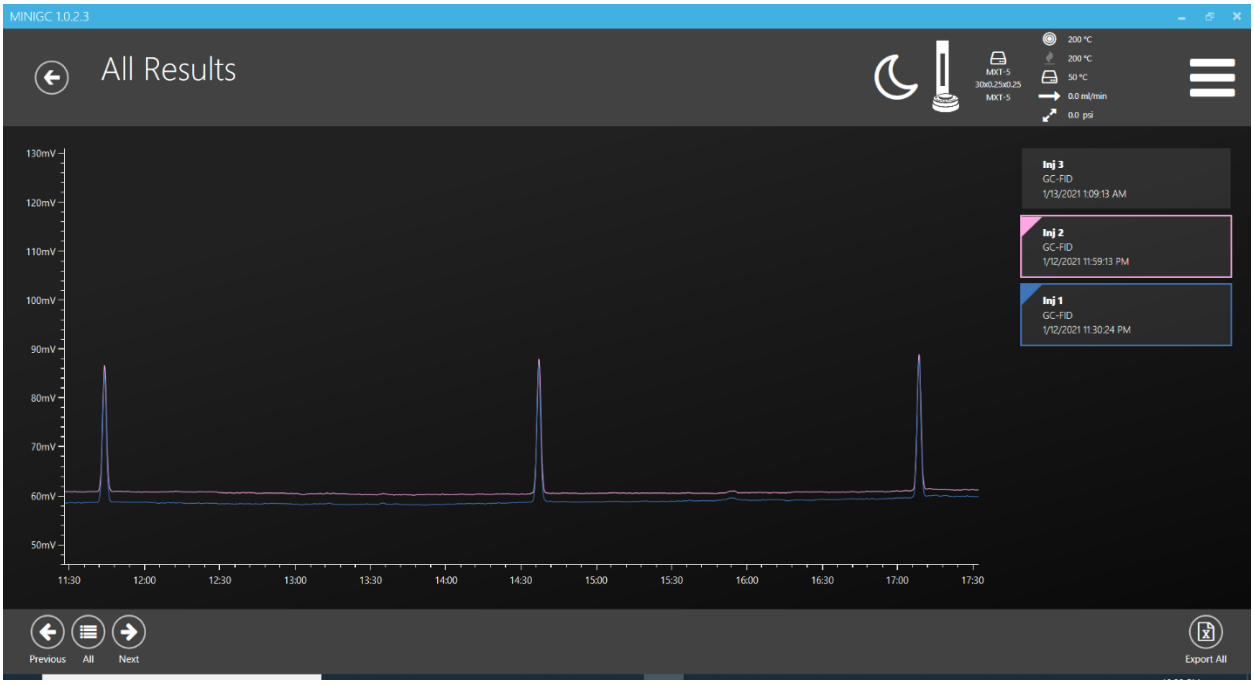
At the bottom of the screen you can use the right and left arrows to see each of the individual runs and the button in between the arrows to see all the runs overlaid on top of each other.

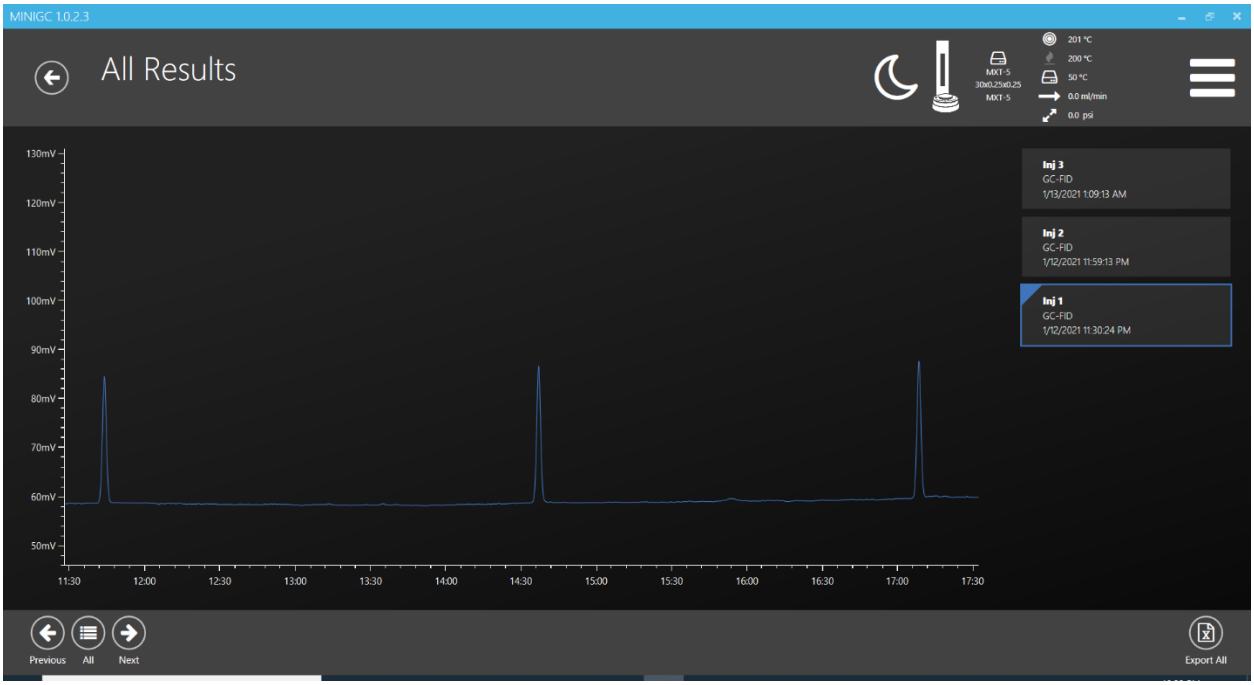
In any of these screens you can zoom in and out using the same techniques mentioned above to view different parts of the cgram.

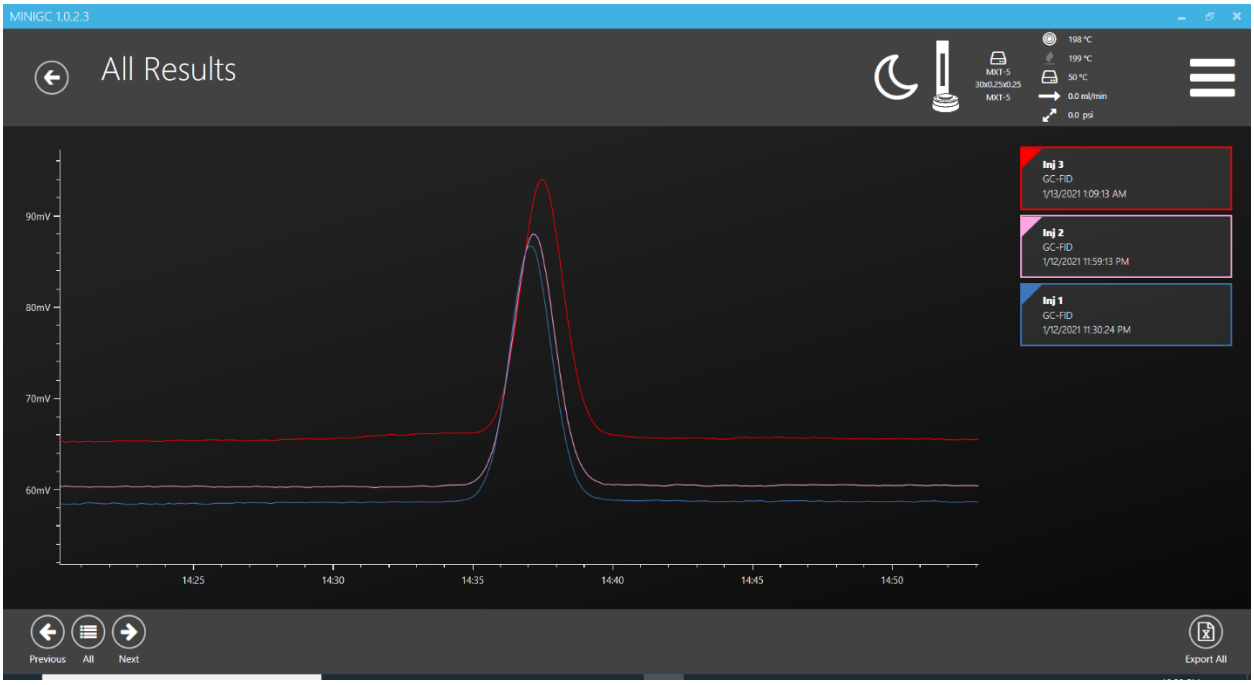


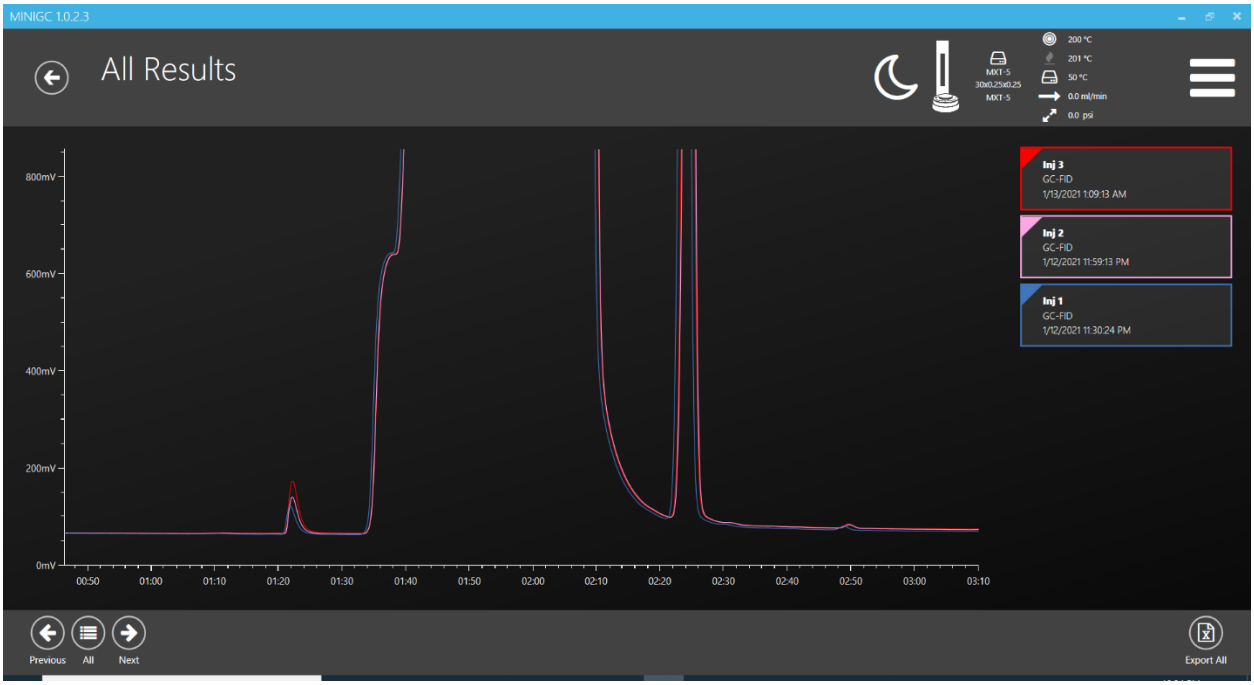
One things to notice in these examples, which are examples of the GC-FID Test Mix runs, are that you appear to have no peaks after the solvent peak at the beginning of the run when you view the cgram in full scale. It isn't until you zoom in on the baseline that you can see the peaks for the 3 compounds in the Test Mix. This is especially true for the Test Mix since the compounds are only on column in about a 2ppm concentration. But once you zoom in you can see very sizable peaks.


MINIGC 1.0.2.3
All Results
201 °C
200 °C
50 °C
0.0 ml/min
0.0 psi
MXT-5
30x0.25x0.25
MXT-5
130mV
120mV
110mV
100mV
90mV
80mV
70mV
60mV
50mV
11:30
12:00
12:30
13:00
13:30
14:00
14:30
15:00
15:30
16:00
16:30
17:00
17:30
Inj 3
GC-FID
1/13/2021 1:09:13 AM
Inj 2
GC-FID
1/12/2021 11:59:13 PM
Inj 1
GC-FID
1/12/2021 11:30:24 PM
Previous
All
Next
Export All


MINIGC 1.0.2.3
All Results
200 °C
200 °C
50 °C
0.0 ml/min
0.0 psi
MXT-5
30x0.25x0.25
MXT-5
130mV
120mV
110mV
100mV
90mV
80mV
70mV
60mV
50mV
11:30
12:00
12:30
13:00
13:30
14:00
14:30
15:00
15:30
16:00
16:30
17:00
17:30
Inj 3
GC-FID
1/13/2021 1:09:13 AM
Inj 2
GC-FID
1/12/2021 11:59:13 PM
Inj 1
GC-FID
1/12/2021 11:30:24 PM
Previous
All
Next
Export All


MINIGC 1.0.2.3
All Results
201 °C
200 °C
50 °C
0.0 ml/min
0.0 psi
MXT-5
30x0.25x0.25
MXT-5
130mV
120mV
110mV
100mV
90mV
80mV
70mV
60mV
50mV
11:30
12:00
12:30
13:00
13:30
14:00
14:30
15:00
15:30
16:00
16:30
17:00
17:30
Inj 3
GC-FID
1/13/2021 1:09:13 AM
Inj 2
GC-FID
1/12/2021 11:59:13 PM
Inj 1
GC-FID
1/12/2021 11:30:24 PM
Previous
All
Next
Export All


MINIGC 1.0.2.3
All Results
198 °C
199 °C
50 °C
0.0 ml/min
0.0 psi
MXT-5
30x0.25x0.25
MXT-5
90mV
80mV
70mV
60mV
14:25
14:30
14:35
14:40
14:45
14:50
Inj 3
GC-FID
1/13/2021 1:09:13 AM
Inj 2
GC-FID
1/12/2021 11:59:13 PM
Inj 1
GC-FID
1/12/2021 11:30:24 PM
Previous
All
Next
Export All

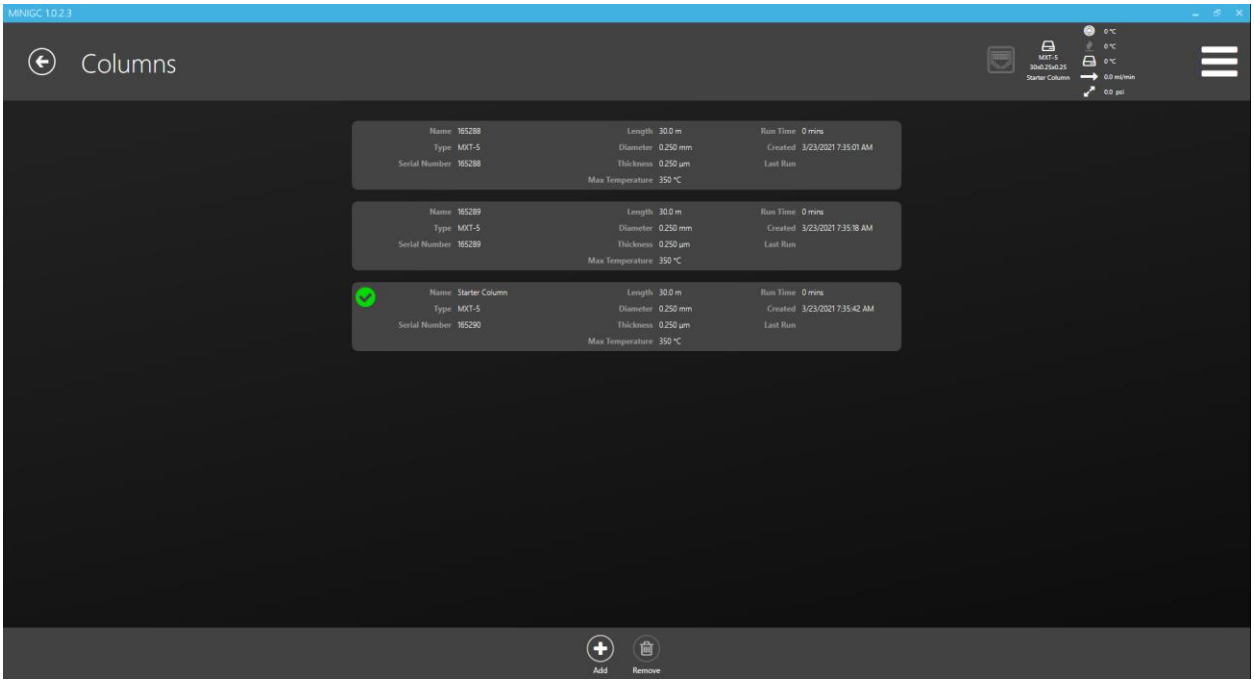

MINIGC 1.0.2.3
All Results
MXT-5
30x0.25x0.25
MXT-5
200 °C
201 °C
50 °C
0.0 ml/min
0.0 psi
800mV
600mV
400mV
200mV
0mV
00:50
01:00
01:10
01:20
01:30
01:40
01:50
02:00
02:10
02:20
02:30
02:40
02:50
03:00
03:10
Inj 3
GC-FID
1/13/2021 1:09:13 AM
Inj 2
GC-FID
1/12/2021 11:59:13 PM
Inj 1
GC-FID
1/12/2021 11:30:24 PM
Previous
All
Next
Export All


MINIGC 1.0.2.3
All Results
MXT-5
30x0.25x0.25
MXT-5
201 °C
201 °C
50 °C
0.0 ml/min
0.0 psi
80mV
75mV
70mV
65mV
60mV
55mV
50mV
05:30
06:00
06:30
07:00
07:30
08:00
08:30
09:00
09:30
Inj 3
GC-FID
1/13/2021 1:09:13 AM
Inj 2
GC-FID
1/12/2021 11:59:13 PM
Inj 1
GC-FID
1/12/2021 11:30:24 PM
Previous
All
Next
Export All

3.8 Settings

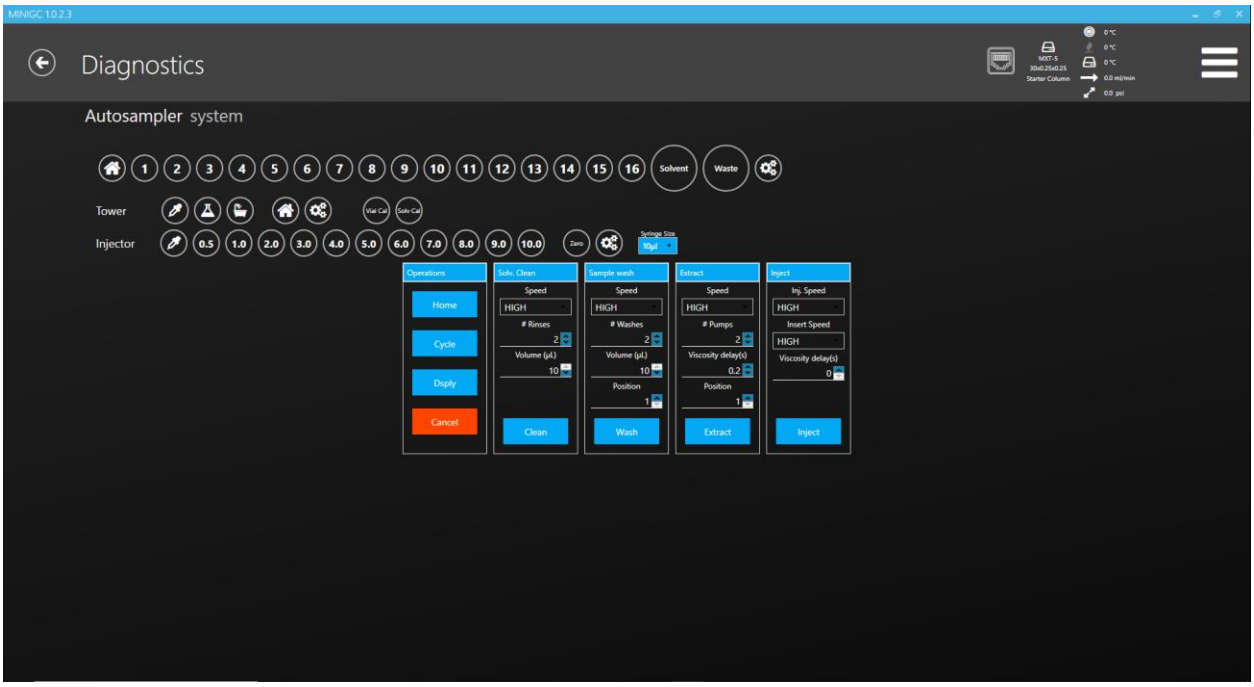
The 3 bars in the top right-hand corner of the screen represent the Settings screen. Pressing this icon will take you to the following menu. (You can't access this menu from the run screen, and you can't access it while a run is taking place.)

Under Settings you will see Columns, Autosampler, Settings, and Users.



Columns:

Columns takes you to the same place as clicking on the Column icon in the dashboard. In this section you can add new columns, edit and view column information, and select the active column (the column that is currently in the miniGC). Once a new column is made active the information in the dashboard will be updated.



Autosampler:

The Autosampler allows you to manually move the autosampler to different locations and recalibrate different locations. The autosampler icon in the dashboard allows you to access the calibration walkthrough which is the recommended method for autosampler alignment, but the Autosampler section in Settings gives you more control if desired.

The top row of buttons move the autosampler turntable to the desired location. For example, pressing the “4” button moves the autosampler turntable to sample position 4. You can check all or any of these positions by pressing these buttons. If a position does not appear to be correct, you can press the gear button on the far right of the top row to reset one of the positions.

** You should not ever have to reset any of these positions since they come calibrated from the factory to the correct position, so make sure you are sure you want to recalibrate a position before you do so.

The second row of buttons move the tower of the autosampler. This is the carriage that holds the syringe and moves up and down. The first 3 icons in this row from left to right are Injection position, Bottom of Sample Vial position, and Bottom of Wash or Solvent Vial position. The Injection position is the position in which the needle of the syringe is fully inserted into the injection port of the miniGC and the springs on the injector are almost fully compressed. The Bottom of the Sample Vial position is where the needle is almost (but not quite) at the bottom of one of the sample vials that occupy positions 1 through 16. The Bottom of Wash or Solvent Vial position is where the needle is at almost (but not quite) at the bottom of the Wash or Solvent Vial.

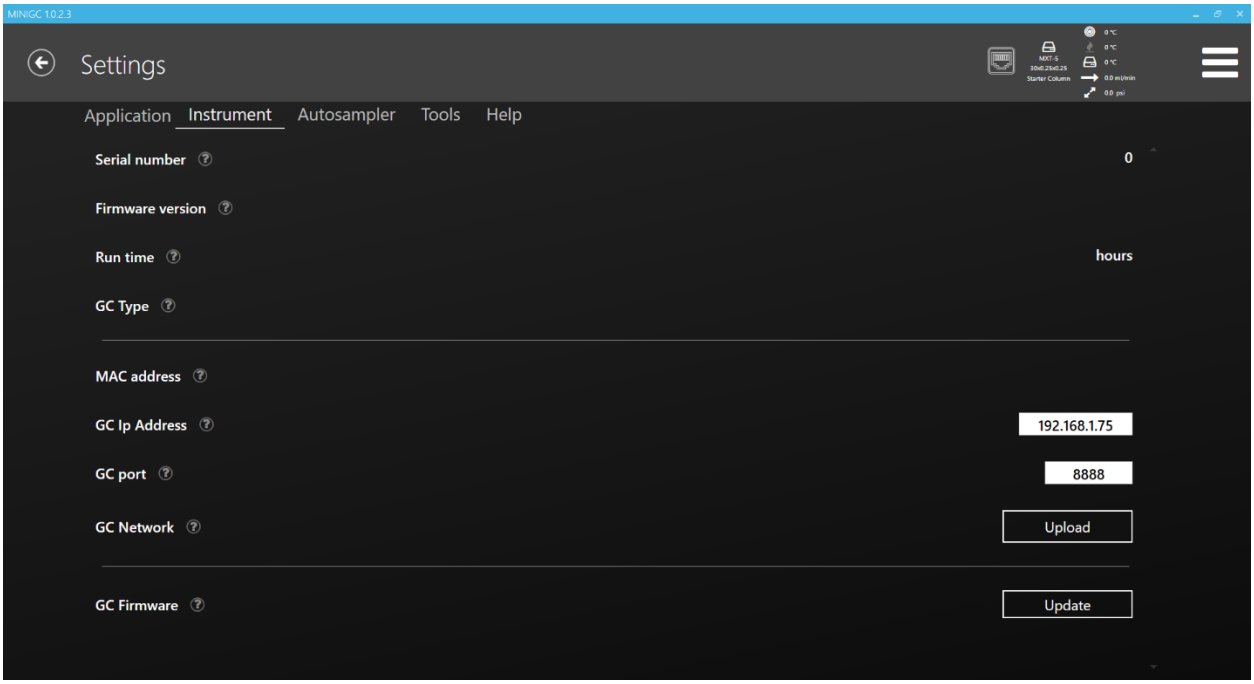
The Home button to the right of these 3 buttons in the second row is used to home the Tower (which is the top position), and the Settings icon can be used to recalibrate the positions of the Tower. The “Vial Cal” and “Solv Cal” buttons alternate the position to be calibrated between the Sample Vial and Solvent Vial positions.

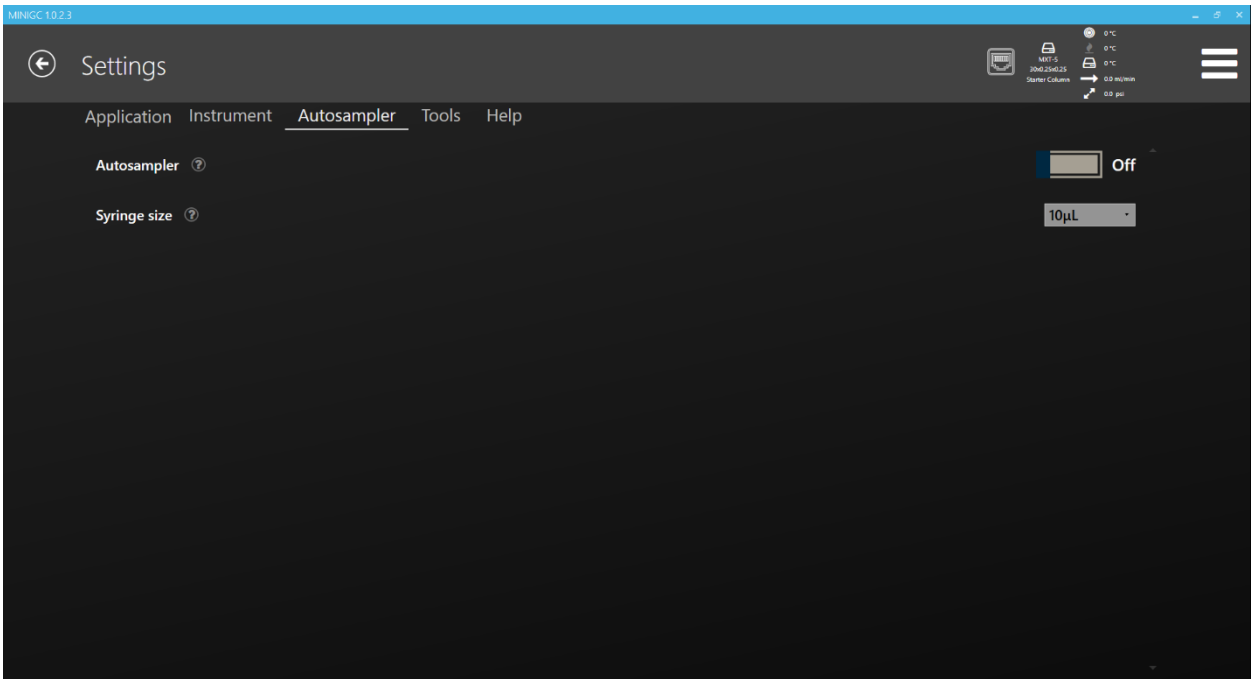
** These positions may need to be calibrated but should first be calibrated using the calibration walkthrough accessed through the autosampler icon in the dashboard which will shows detailed pictures of the desired positions of the tower.

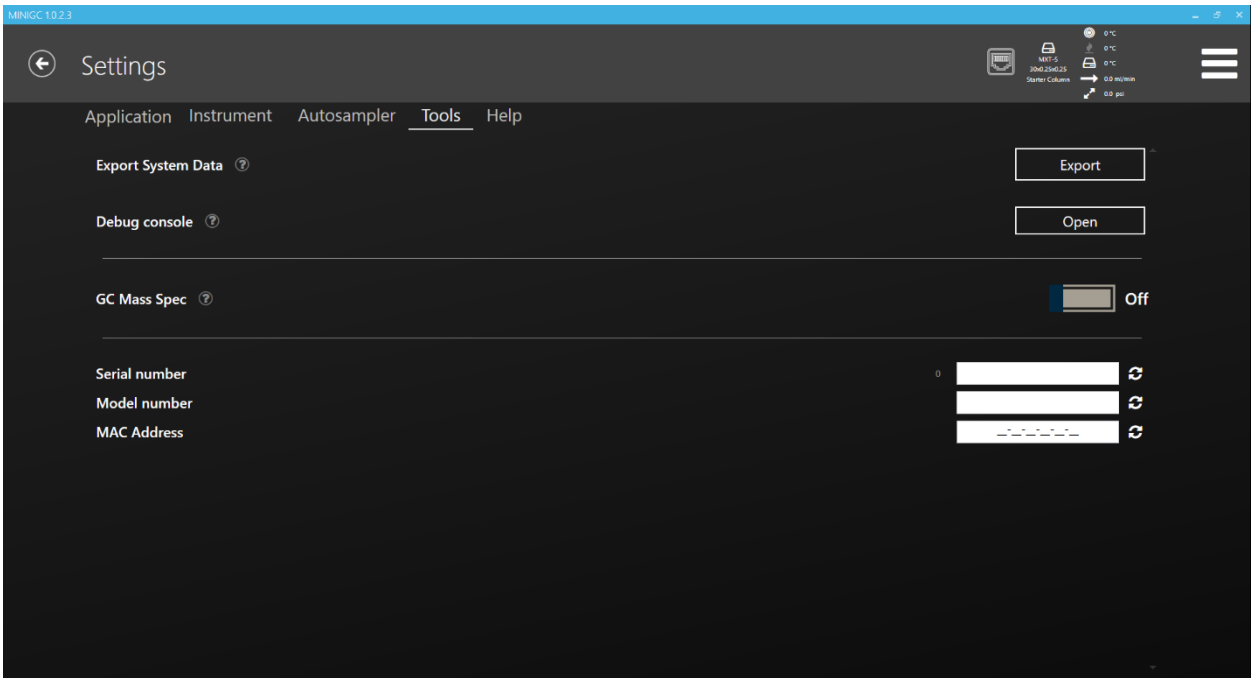
The third row of icons move the syringe plunger. The first three buttons on this row allow the user to move the plunger to the Inject position (0uL), the 0.5uL position, and the 1.0uL position. The home button homes the syringe plunger to the 0uL position, and the Settings button allows the user to change the positions of the plunger.

**These positions should not need to be recalibrated.

The other buttons on this screen allow you to perform different functions with the autosampler such as extracting a sampler, cleaning the syringe, or performing an injection, so that you can monitor or check one or more of these functions in isolation to ensure that the system is performing properly.







Under the Settings section of the Settings menu you'll see the following options:

Autosampler: Tells the system whether or not to look for an autosampler. Switch this to the On position if an autosampler is attached and to the Off position if one is not. Once in the On position you will see the autosampler icon appear in the dashboard. If the system is able to connect to the autosampler the icon will appear white, if the system is not able to connect to the autosampler the icon will appear grayed out.

LIMS Output – Allow output to a LIMS system. Currently inactive.

Stabilization Delay: This is the time in seconds after which a run can begin once the setpoint parameters have been reached.

Injection Countdown: This is the time in seconds that the system will countdown from in manual injection mode when prompting the user to inject.

Injection Upper Temperature: This temperature was mentioned in the Dashboard section above. This temperature and setpoint are for the top portion of the injection port. This section of the injection port is above where the tip of the needle is when it is fully inserted. This section is held at a lower temperature (200C) that the lower section of the injection port in order to maximize the lifetime of the injection port o-rings and septum as well as to reduce off-gassing from these components. The miniGC is unique from other GCs in having 2 independently controlled temperature zones in the injection port, so when you see Injection Port temperatures from other systems, this is comparable to our lower injection port temperature which is set in a method and varies method to method. This top zone should never be changed and always remain at 200C, which will allow even very nonvolatile compounds to still make it onto the column. This setting is in the system more as a diagnostic feature.

GC Sleep Mode Delay: Amount of time sitting idle before the GC will enter sleep mode. When the unit enters sleep mode it will display a moon icon in the dashboard and the system will turn purple. The injection port (bottom) temperature and detector temperature will go to 200C and the column flow rate will go to 2mL/min with no split. The oven temp will go to 40C. Loading a method will exit the system from Sleep mode. Methods and Results can still be manipulated in Sleep mode.

GC IP Address: This number comes defaulted to 172.16.0.10 for every miniGC. It should never be changed from this number.

GC Firmware: You can use this Update button to update the internal software in the miniGC.

Users: This section allows you to Create, Delete, and Edit users as well as change the rights given to each user.

Ignite Button: Allows you to Ignite the Flame Ionization Detector (FID) if you are unsure if it’s currently lit or not. This is for diagnostic purposes only. You should never have to use this.

4.0 Hardware

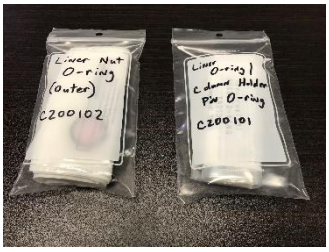
4.1 How to change liners, septa, and o-rings

4.1.1 Tools & Parts Used

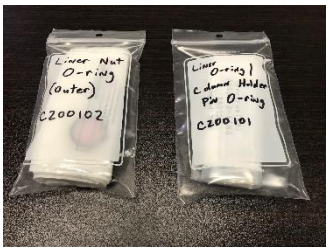
Liner Nut & Septum Nut Tool
Lucidity PN: C100200 (https://luciditysystems.com/product/minigc-accessories-kit/)
Restek PN: TBD

Septum Puller
Lucidity PN: R20117 (https://luciditysystems.com/product/minigc-accessories-kit/)
Restek PN: 20117
(https://www.restek.com/catalog/view/86/20117)

Liner Removal Tool
Lucidity PN: R20181 (https://luciditysystems.com/product/minigc-accessories-kit/)
Restek PN: 20181
(https://www.restek.com/catalog/view/3148/20181)



Liner O-Ring
Lucidity PN: C200101 (https://luciditysystems.com/product/minigc-accessories-kit/)
Restek PN: TBD



Liner Nut O-Ring
Lucidity PN: C200102 (https://luciditysystems.com/product/minigc-accessories-kit/)
Restek PN: TBD

Septa, pk of 50
Lucidity PN: R23864 (https://luciditysystems.com/product/minigc-accessories-kit/)
Restek PN: 23864
(https://www.restek.com/catalog/view/9550/23864)

Liners, pk of 5
Lucidity PN: R23309 (https://luciditysystems.com/product/minigc-accessories-kit/)
Restek PN: 23309
(https://www.restek.com/catalog/view/49232/23309)

All of these parts are in the miniGC Accessory Kit that comes with the miniGC. Part numbers and links are included for reordering. We encourage you to reorder all of your parts through Restek, but parts can also be reordered through Lucidity if needed.

4.1.2 Installing or Changing a Liner

We recommend for use in the miniGC the Topaz 4.0mm ID Low Pressure Drop Precision Inlet Liner with Wool (Restek PN: 23309). This liner is used to perform the 3 GC-FID Test Mix runs during checkout at Lucidity, and it is the recommended liner any time you are performing the Test Mix test on the miniGC. A pack of 5 of these liners is included in the miniGC Accessory Kit that comes with the miniGC. The miniGC is shipped without a liner in the system so one must be installed during setup of the system.

Other liners may be used in the miniGC and have been used successfully, but the results may vary depending upon which liner is used as is the case with any GC.

The first step in installing or changing either the Liner or the Septum is to turn the miniGC off (power switch is on the back of the unit) and wait for 20-30 minutes for the injection port to cool down.

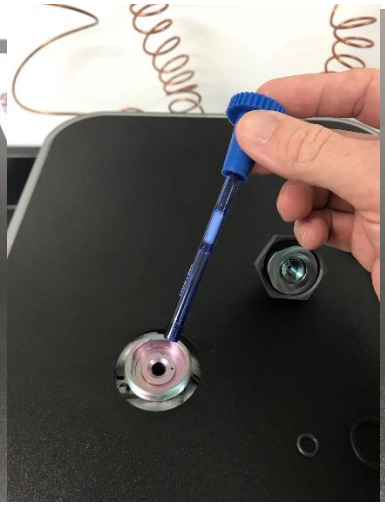
Caution: The injection port may be extremely hot! The injection port will be at an elevated temperature while the miniGC is on even when it is in Sleep Mode (which is indicated by the system being purple). To

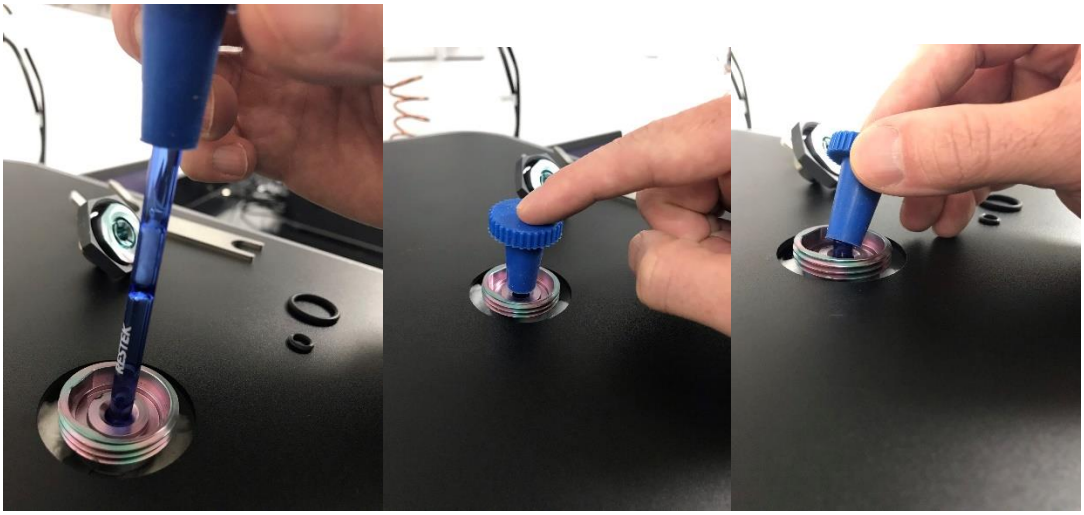
cool the injection port, turn the system off and wait 20-30 minutes for the injection port to cool down. Even after this period test the temperature of the injection port carefully before manipulating it.

To remove or install a liner, first use the larger side of the Liner Nut & Septum Nut Tool to loosen the Liner Nut then remove the nut using your hand.

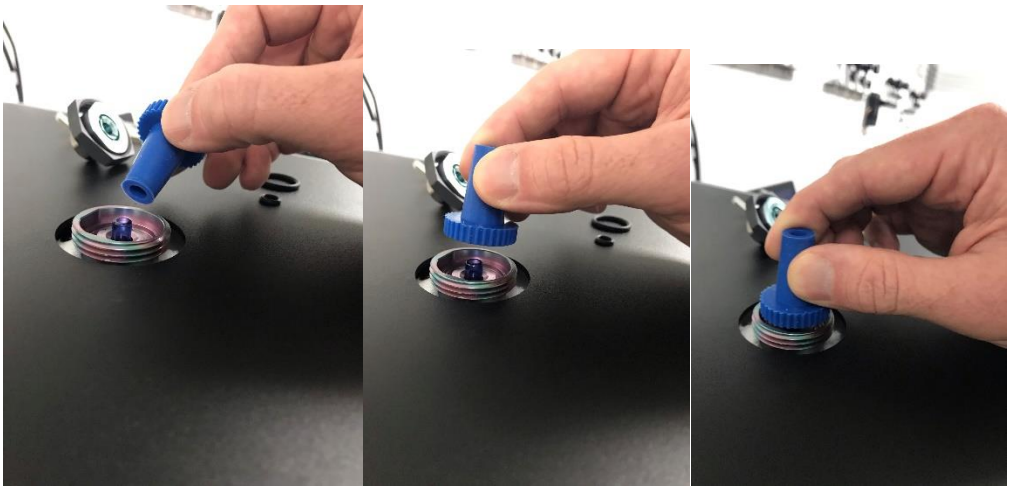


Once the liner nut has been removed use the Liner Removal Tool to grasp the top of the liner. Use the pictures to ensure that the liner is inserted in the correct orientation.

Once the liner is inserted fully into the injection port use the flat end of the Liner Removal Tool to ensure that the liner is fully inserted into the injection port. Use only a gentle push.

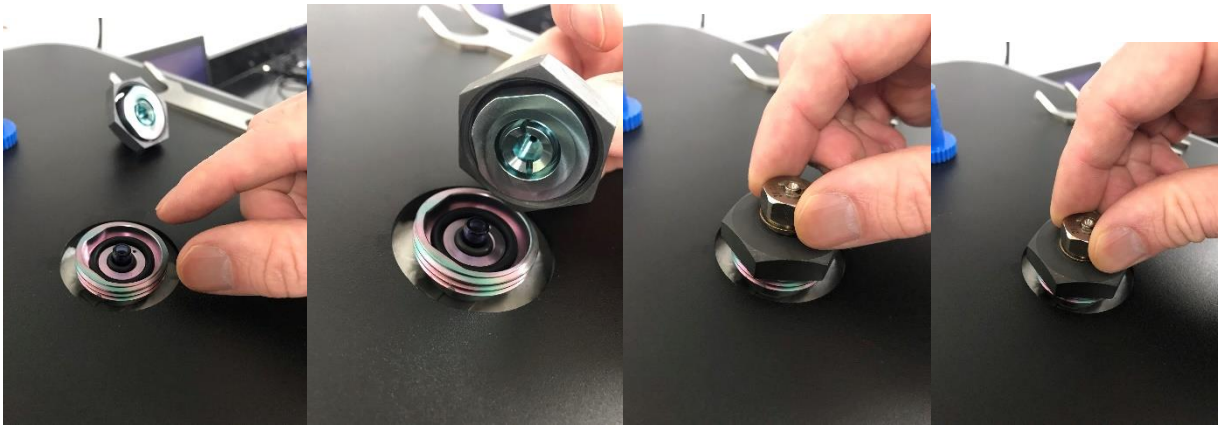


Once the liner is fully inserted, put the Liner O-Ring on the outside of the liner and push it down to the point it makes contact with the injection port. You can also put the Liner O-Ring on the outside of the

liner before you insert the liner into the injection port. Just make sure that both the liner and the o-ring are fully inserted into the injection port.

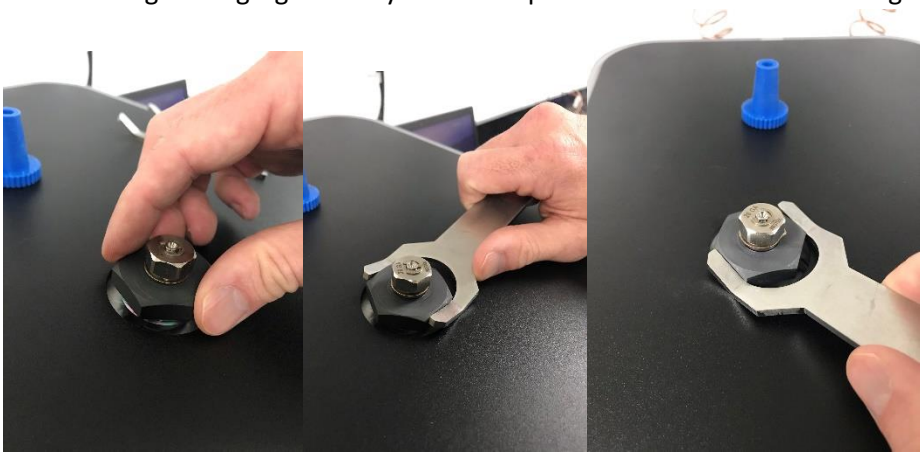
Caution: If you are using a liner other than the one we recommend, make sure that it is the same length, otherwise it will not fit properly into the injection port and may even break if you attempt to force it in.

After the liner and liner o-ring have been inserted fully into the injection port, place the Liner Nut O-Ring (the larger o-ring) in place. It sits in a groove as shown. Next put the Liner Nut back in place. Note that the Liner Nut is keyed into the injection port with two flats, so it must be oriented correctly before the liner nut can be tightened.



Once in place the liner nut should be finger tightened before using the Septum & Liner Nut Tool to tighten it further. The Liner Nut does not need to be tightened much more than finger tight to make a

seal. Overtightening significantly can cause problems with the threads longer term.



If the Liner Nut is not fully tightened the system will show a Split Flow error and low pressure meaning the carrier gas is leaking from the liner nut. Another cause for the same leak and error is an overly worn or missing Liner Nut O-Ring (the outer o-ring). This Liner Nut O-Ring and Liner Nut together seal the top of the injection port along with the Septum and Septum Nut to ensure that the carrier gas does not escape from the top of the injection port but rather proceeds into the column and split flow pathway.

The Liner O-Ring (the smaller o-ring) and Liner do not prevent the carrier gas from escaping the injection port, so a Split Flow error or low pressure do not indicate an issue with these components. Rather the Liner and the Liner O-Ring ensure that the carrier gas is split properly between the gas that goes into the column and the gas that exits the injection port through the split flow exit. So, an overly worn or missing Liner O-Ring or missing Liner will result in a lower than expected split, which will not produce any errors in the system since none of the carrier gas is leaking from the injection port. What you will see is bigger peaks than expected after an injection since more of the sample than expected is being injected onto the column. A great way to test for this is to inject the GC-FID Test Mix and compare against the saved cgrams of these runs. If the peaks are larger than they should be then you most likely need to replace your Liner O-Ring.

Both the Liner O-Ring and the Liner Nut O-Ring are made of high quality Kalrez, which makes them able to handle elevated temperature very well, meaning they are suited for long term use and don’t need to

be replaced weekly or monthly as may be the case with other GC o-rings. If you notice obvious deformation then they should be replaced.

4.1.3 Installing or Changing the Septum

We recommend for use in the miniGC the 11mm Thermolite Plus Septa (Restek PN: 23864). These septa are used to perform the 3 GC-FID Test Mix runs during checkout at Lucidity, and they are the recommended septa any time you are performing the Test Mix test on the miniGC. A pack of 50 of these septa is included in the miniGC Accessory Kit that comes with the miniGC. The miniGC is shipped without a septum in the system so one must be installed during setup of the system.

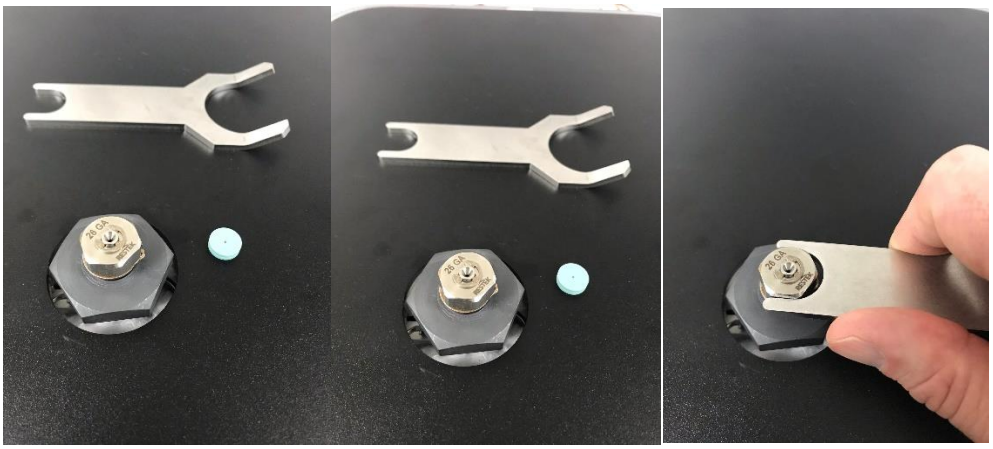
Other septa may be used in the miniGC and have been used successfully, but the results may vary depending upon which septum is used as is the case with any GC.

The first step in installing or changing either the Liner or the Septum is to turn the miniGC off (power switch is on the back of the unit) and wait for 20-30 minutes for the injection port to cool down.

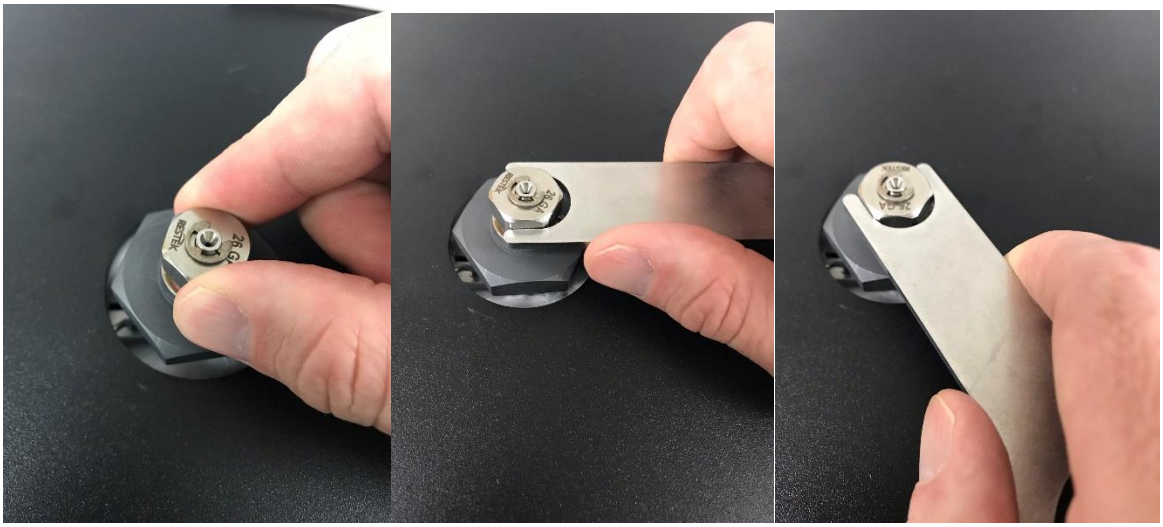
Caution: The injection port may be extremely hot! The injection port will be at an elevated temperature while the miniGC is on even when it is in Sleep Mode (which is indicated by the system being purple). To

cool the injection port, turn the system off and wait 20-30 minutes for the injection port to cool down. Even after this period test the temperature of the injection port carefully before manipulating it.

To remove or install a septum, first use the smaller side of the Liner Nut & Septum Nut Tool to loosen the Septum Nut then remove the nut using your hand.



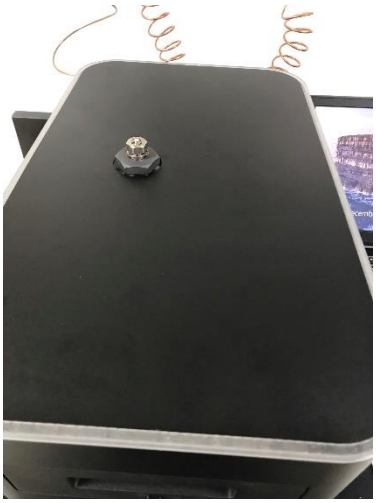
Next place the septum with the CenterGuide (a hole partially through the septa) facing up as shown. Then place the Septum Nut back in place and tighten manually.



After tightening manually, use the Septum Nut and Liner Nut Tool to snug the Septum Nut. You don't need to tighten the Septum Nut much more than finger tight to get a good seal. Overtightening can cause issues with the threads longer term.

If the Septum Nut is not tightened enough, you will see a Split Flow Leak error when the system is turned on and a lower than expected pressure. This means that the carrier gas is leaking from the septum / septum nut. Tightening the Septum Nut slightly will correct this. A septum that has been overly punctured will begin to create a permanent hole in the septum which will also begin to show up

as slightly lower than expected pressures and eventually a Split Flow Leak error. A missing septum will also result in this error. It is recommended to replace the septum after around 50 injections.



4.1.4 Maintenance Schedule

Every 100 Injections:

Replace the Septum

Every 3 Months:

Run the GC-FID Test Mix

Every 6 Months:

Replace the Liner O-Ring and Liner Nut O-Ring

Every 12 Months:

Replace the Column Pin O-Rings