Agilent

Trusted Answers

GC Intelligence: User-Guided Troubleshooting

Introduction

The recent GC hardware revisions of (the Agilent Intuvo 9000 GC and Agilent 8890 GC) have provided an opportunity to enhance the user's day-to-day experience in many ways. Much of these enhancements have allowed a variety of Smart GC features to be added to the instrument, with the addition of a touch screen and a browser interface. These two new interfaces have allowed an array of new features to be added to the instrument. Some of these new features include integrated diagnostic and maintenance procedures, onboard instrument help content, and GC intelligence[1] (such as Peak Evaluation, Troubleshooting, and Diagnostic/Chromatographic Trend Plots). This white paper focuses on the various aspects and features that are found within the GC intelligence features of troubleshooting.

What is troubleshooting?

Troubleshooting is a GC intelligence feature that helps the user through the troubleshooting process to determine and help fix chromatographic issues with the instrument. This troubleshooting is similar to generic GC troubleshooting guides that are typically provided to users from instrument manufactures (e.g., the Agilent GC Troubleshooting poster), but this troubleshooter is now integrated into the instrument through the GC's firmware. This will allow for a much better user experience because the user will be provided with specific troubleshooting steps for the specific instrument/configuration they are having an issue with. This provides the user with a more relevant troubleshooting approach and a better overall experience.

The Troubleshooting integrated into the instrument is focused on chromatographic issues the user may be experiencing on the instrument (such as analyte retention time shift or area loss), compared to possible hardware issues that may be present (such as a major inlet leak). Other Smart GC features (such as integrated instrument diagnostics) focus on potential hardware related issues that may be present on the instrument. The following nine chromatographic symptoms/issues can be used with Troubleshooting:

– No peaks

– Low response

– High response

– Retention time shift

– Area repeatability

– Peak tailing

– Peak fronting

– Resolution loss

– Contamination/carryover

Within each chromatographic issue, troubleshooting is broken down into the four major areas of the GC:

– ALS

– Inlet

– Column/oven

– Detectors (currently MSD is not supported in the GC firmware version 2.5)

Each of these four GC areas will provide a decision tree to assist the user with determining the chromatographic issue they are having with the GC.

How to initiate troubleshooting on the instrument

Troubleshooting can be initiated through either the touch screen or through the browser interface (currently not available through the data system). If the user notices a chromatographic issue, troubleshooting can be initiated through either interface. Users can initiate troubleshooting on the browser interface by clicking the **Diagnostics** tab at the top of the screen (Figure 1). Then, users can click **Troubleshooting** on the left side of the screen (Figure 2).
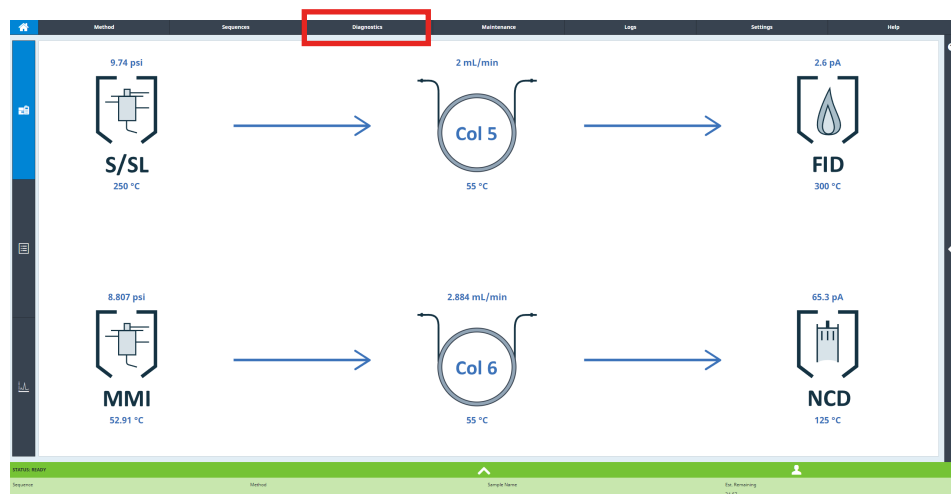

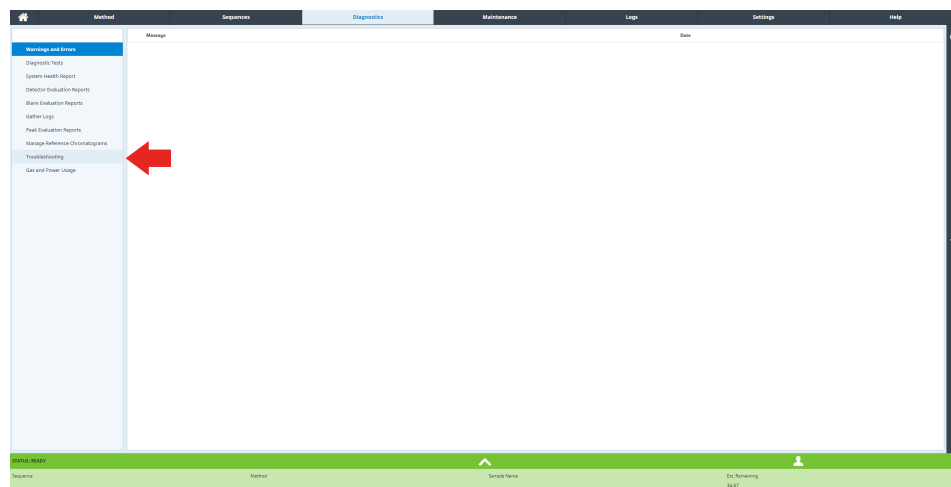**Figure 1.** Click the Diagnostics tab on the browser interface.

Figure 2. Select the Troubleshooting tab from the left menu of the Diagnostics tab.

Then, users will be taken to the Troubleshooting window where they can generate troubleshooting reports from previous instances of troubleshooting that were run on the instrument. In the upper right-hand corner, users can then click **Start Troubleshooting** to start a troubleshooting session (Figure 3). Users can then start troubleshooting on the instrument by selecting the chromatographic issue they are having (Figure 4). Example images of the chromatographic issues are provided to assist the user in selecting the appropriate chromatographic issue.

Figure 3. Click **Start Troubleshooting** from the upper-right of the Troubleshooting window.

Figure 4. Initial Troubleshooting screen on the browser interface

Users can also initiate Troubleshooting from the touch screen interface. Figures 5 to 8 show the steps for initiating Troubleshooting on the touch screen.
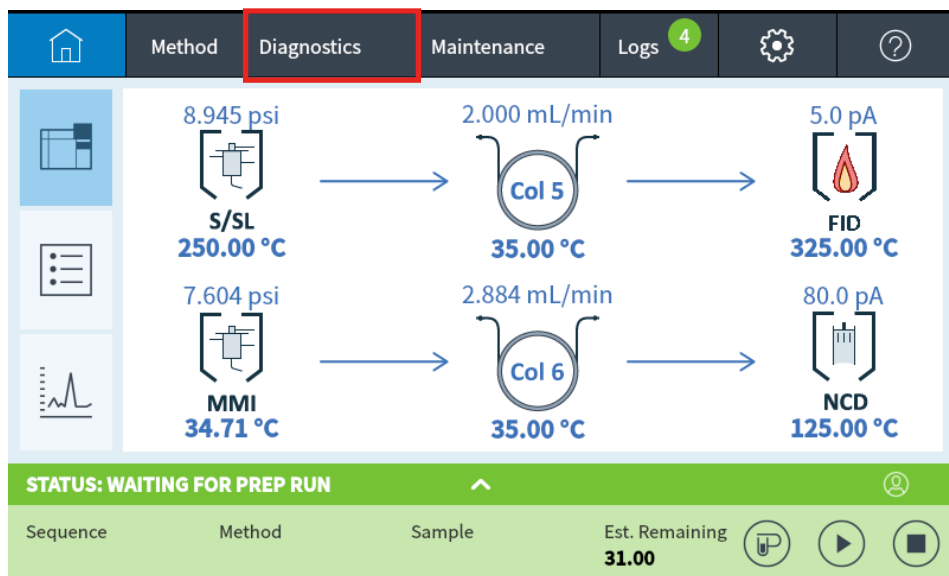
Figure 5. Initiate troubleshooting by tapping the Diagnostics tab at the top of the touch screen.
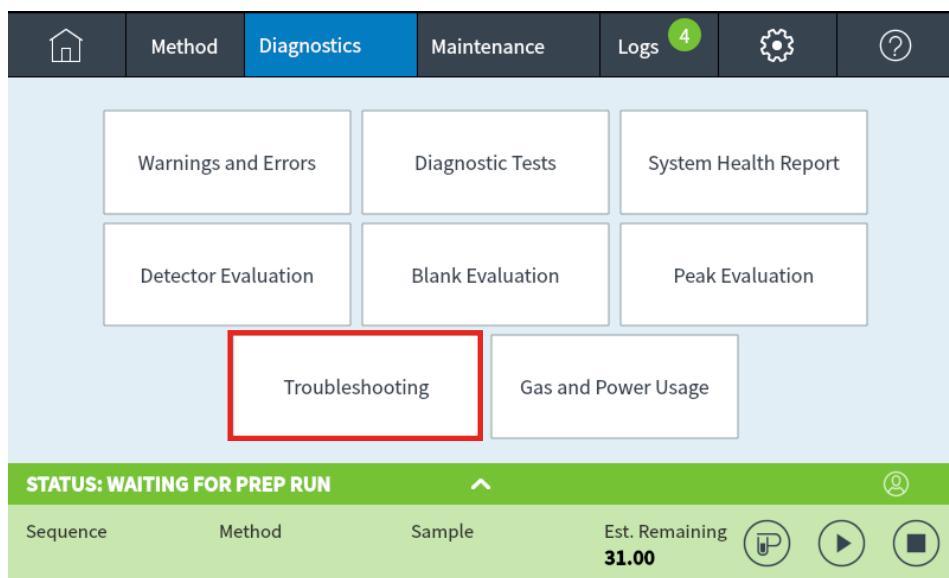
Figure 6. Tap **Troubleshooting** in the Diagnostics tab window.

Another way to initiate troubleshooting is through a failed Peak, Blank, or Detector Evaluation (Figure 9). If the user has setup the GC intelligence feature of Peak, Blank, or Detector Evaluation, the instrument can determine if an issue is present after each injection by constantly monitoring the different parameters. The instrument will then attempt to determine which area to start the troubleshooting process. Depending on which parameter(s) failed (area, retention time, etc.), the instrument will use the failed Evaluation results to determine and recommend what area to start troubleshooting. If the instrument is not sure which area of troubleshooting to start in, the user will be asked to choose the chromatographic issue (the same way if the user-initiated Troubleshooting). The user can also pick a different troubleshooting area to start in if desired (the instrument will only recommend an area to start troubleshooting; the user can always change this and initiate troubleshooting in a different area if desired).

Figure 7. Tap **Start Troubleshooting** to initiate troubleshooting on the instrument.

Figure 8. After initiating troubleshooting, users can select what chromatographic issue to start troubleshooting.

Figure 9. Initiating troubleshooting through a failed Peak Evaluation.

Highlights/features of troubleshooting

Troubleshooting has a variety of features to help assist the user in determining the cause and fix the chromatographic issue they are having. The first feature is the decision tree that is used to guide the user through a variety of troubleshooting steps.

After the user starts troubleshooting (either from a failed Peak Evaluation or the Diagnostic tab), the instrument will begin to guide the user through a decision tree to help determine the chromatographic issue they are currently having. This guided decision tree asks the user a series of questions to help determine the cause of the chromatographic issue. Throughout the decision tree, users will be asked to perform a variety of tasks or to check certain area of the instrument to help diagnose the chromatographic issue. Figure 10 shows an example of the guided decision tree for a retention time shift in the column/oven area of the instrument.

The first step in the decision tree will be to have the user verify the active method setpoints on the instrument. Troubleshooting can only use the active method that is found on the instrument. Usually this will be the last method that was downloaded to the instrument from either the browser or the data system. Troubleshooting will then walk through different method setpoints/configurations and allow the user to verify these parameters. The example in Figure 10 shows the types of questions a user might be asked during a typical troubleshooting session. Throughout troubleshooting, the user will have opportunities to modify some of the method setpoints as needed. Changing method setpoints will again only modify the active method that is currently being used on the instrument (this is typically the method that is present on the browser and touch screen). If a method setpoint is modified during troubleshooting (such as the oven temperature), the user will need to upload this new method to any connected data system and resave the method in the data system. Users will be prompted to do this at the end of troubleshooting.
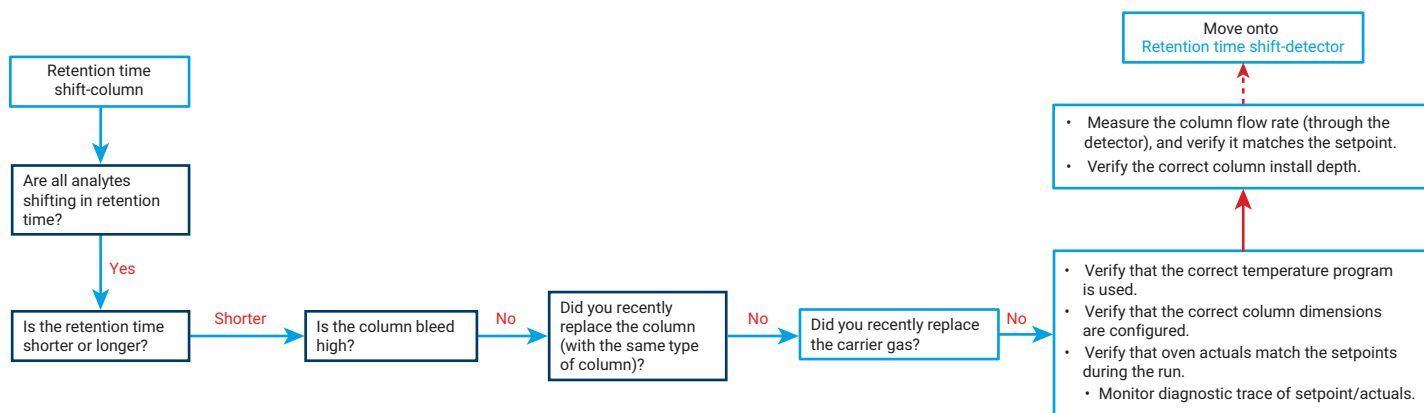

Figure 10. Troubleshooting decision tree example for a chromatographic issue of retention time shift in the column/oven area of the instrument. The user's responses to the troubleshooting questions are in red.

As the user continues down the decision tree, they might be provided with suggestions to run one of the integrated diagnostic tests (such as the automated inlet leak and restriction test (Figure 11). These user-initiated diagnostic tests are built into the instrument's firmware and can be run with little-to-no user interaction. If the diagnostic test fails, the user will be provided with additional assistance to help resolve the failed test (such as changing the inlet septum for a leak in the inlet). If the test passes, the user will continue down the decision tree to complete the troubleshooting process.

Troubleshooting may also suggest the user perform a maintenance task and ask the user if they would like to use one of the integrated maintenance procedures. As with the integrated diagnostic tests, these integrated maintenance procedures are built into the instrument's firmware and can prepare the instrument to perform a maintenance task (such as cooling down the inlet to change the inlet septum). If an integrated maintenance procedure is not available, Troubleshooting can be minimized (or paused) to allow the user to perform the required task (Figure 12). Once the user has completed the requested task, Troubleshooting will resume in the same place in the decision tree and continue with the troubleshooting process. Troubleshooting can be resumed from either the browser or the touch screen interface (troubleshooting steps are in sync with both interfaces). This will allow the user to pause Troubleshooting without having to repeat previously completed steps.

Figure 11. Example of integrated diagnostics tests.
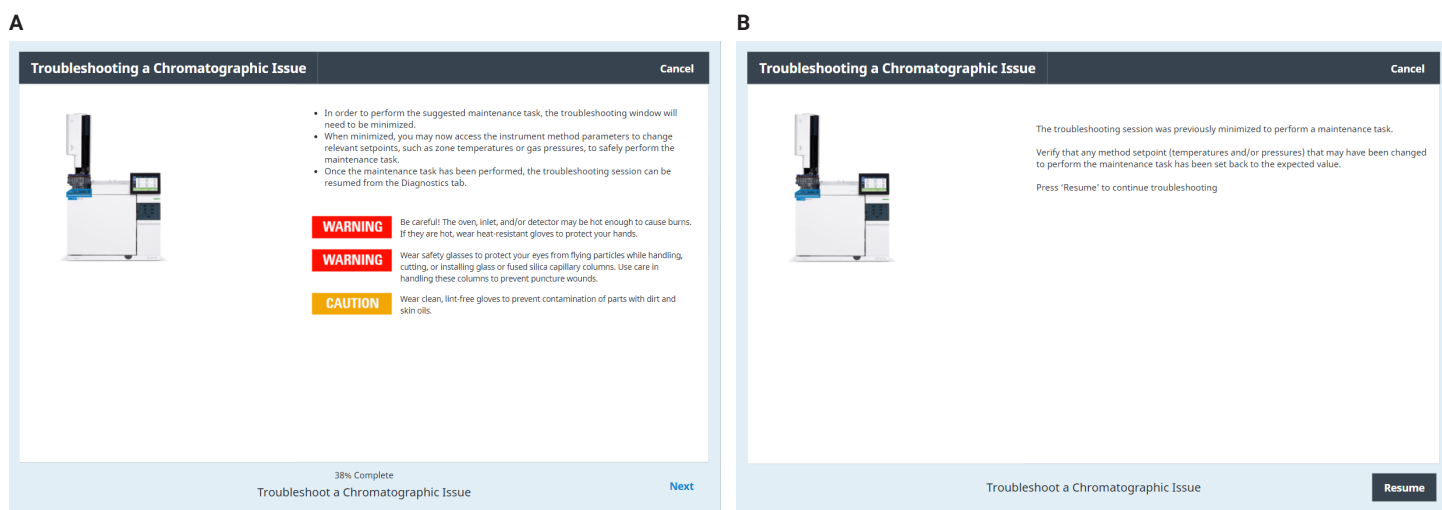
Figure 12. (A) Minimizing/pausing Troubleshooting. (B) Resuming Troubleshooting.

Once the user has completed the troubleshooting process, a verification run will be made on the instrument (Figure 13). This verification run will allow the user to make an injection to determine if Troubleshooting has solved the chromatographic issue. The verification run will make a single injection using the active method currently on the instrument (including any modifications made during the troubleshooting process). During the verification run, a real-time plot of the detector output will be displayed on the browser and touch screen so a user can monitor the chromatogram to verify if changes made during troubleshooting have resolved the chromatographic issue. See Figure 14 for an example of the real-time plot during the verification run. If Peak Evaluation was originally enabled in the method, it will again be run as part of the verification run. This will provide the user with an automated check to determine if the chromatographic issue was resolved during troubleshooting. After the verification run, the user will have the option to either continue with troubleshooting (if the issue is not resolved) or stop troubleshooting (if the issue was resolved (Figure 15).
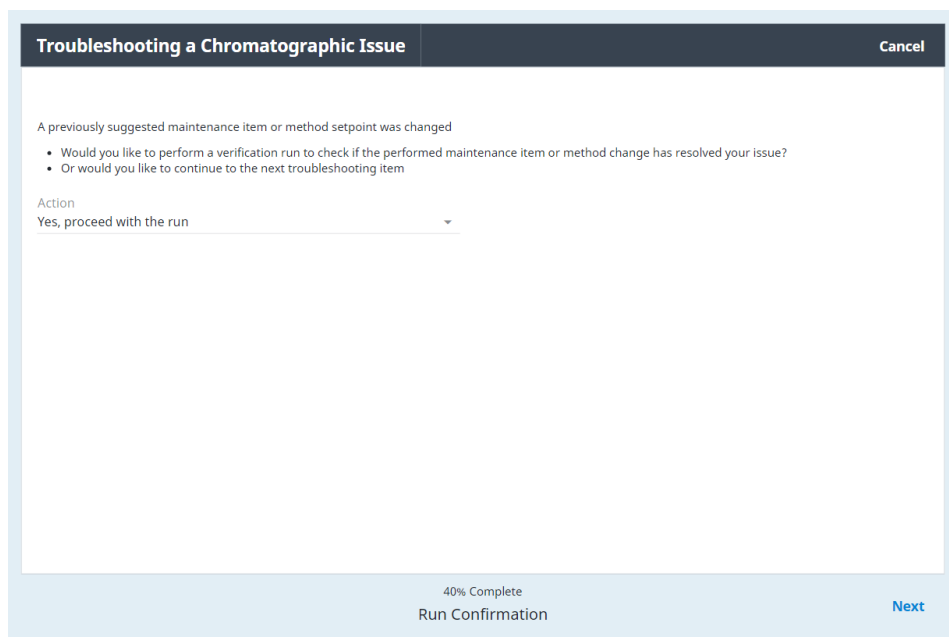
Figure 13. Troubleshooting verification run.
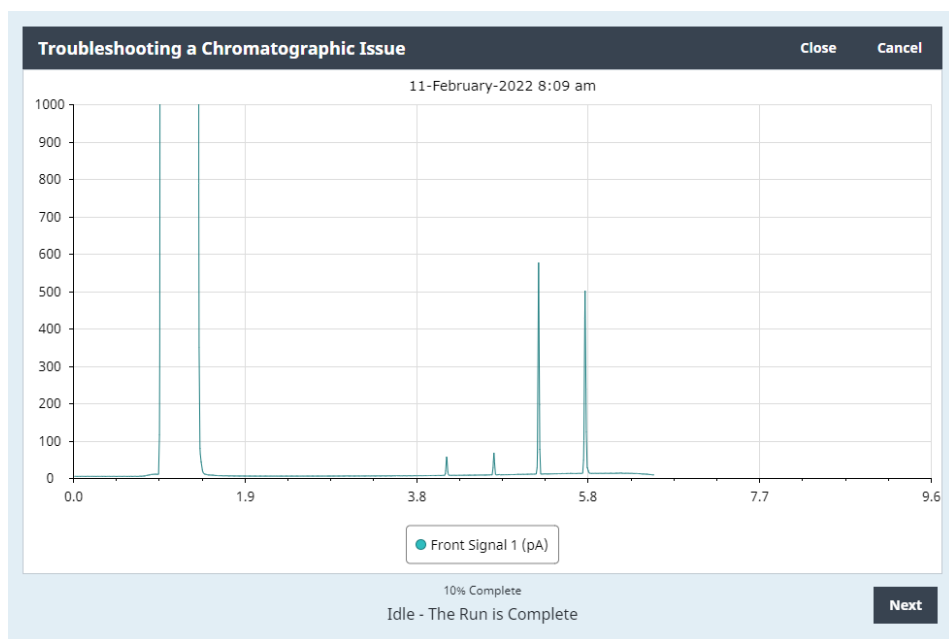
Figure 14. Example of troubleshooting verification run.
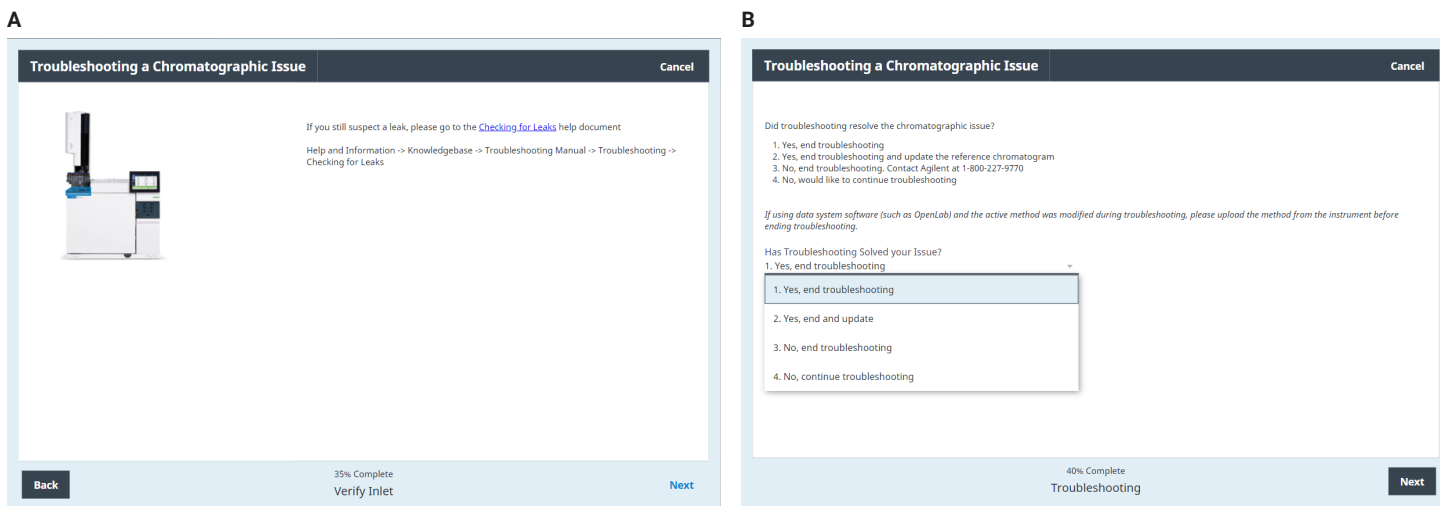
Figure 15. (A) Additional Troubleshooting help content. (B) End of Troubleshooting and the Agilent Support number.

At the end of Troubleshooting, if the chromatographic issue was not resolved, the user will be provided with additional help topics that can be found with the instrument's onboard help content and/or be provided the Agilent support number (Figure 15). Users will also have the ability to view reports of previous Troubleshooting sessions that have occurred on the instrument from both the browser and touch screen interfaces (Figure 16). Both summary (Figure 17) and detailed (Figure 18) Troubleshooting reports are available to the user. The detailed report will contain the individual Troubleshooting steps with answers provided by the user, and any verification run chromatograms that were collected. These reports can be printed or saved for future reference (such as when contacting Agilent support).

Figure 16. Previous Troubleshooting reports available on both the browser and touch screen interfaces.

Figure 17. Example of summary troubleshooting report.

Figure 18. Example of detailed troubleshooting report.

User-example application

Below is an example of the troubleshooting steps a user will be guided through if they have the chromatographic issue of low response and the troubleshooting resolution was that the column needed to be trimmed. The questions below are the troubleshooting questions that would be asked to the user and the responses the user provided (user response options to be selected are in bold).

Troubleshooting is initiated through a failed Peak Evaluation

The user performs a configuration/method check to verify that the correct setpoints are being applied. **All setpoints are correct.**
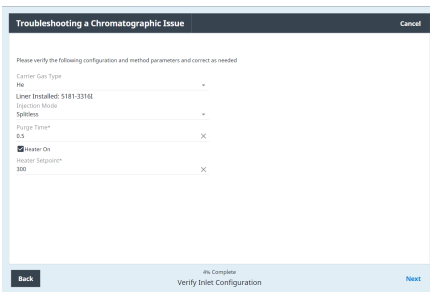
Low response: ALS

– Could the sample have degraded (some samples change with heat or ultraviolet light)? **No**
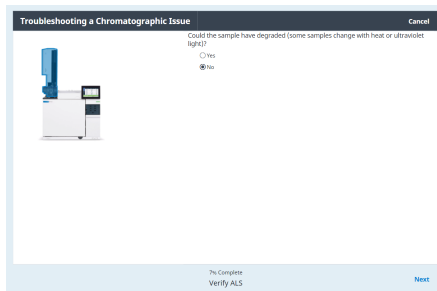
– Is the correct syringe size configured (10 µL)? **Yes**

– Is the correct syringe volume injected (1.0 µL)? **Yes**
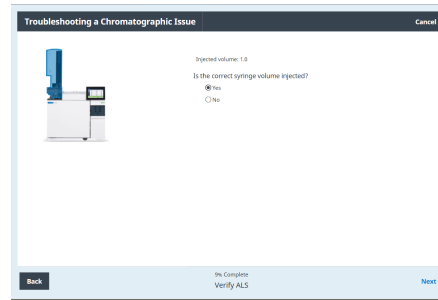
Low response: inlet

– Do you suspect a leak in the system? **Not Sure**
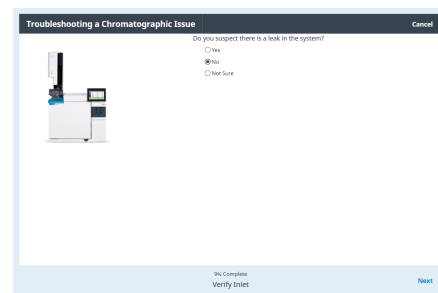
– Would you like to run the automated Leak and Restriction Test? **Yes**
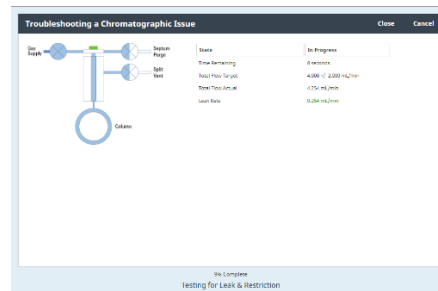
– Integrated Leak and Restriction Test is run on the instrument. **Test passed**

– Would you like to run the automated Pressure Decay Test? **No**

  – If you still suspect a leak, please go to the "Checking for Leaks" help document (located within the instrument's help). **Next**

  – Would you like to minimize Troubleshooting? **No**

– Do you suspect contamination in the system? **No**

– Is the inlet linear type appropriate for the sample? **Yes**

Low response: column/oven

– Was the column cut/installed correctly during the last installation? **Yes**
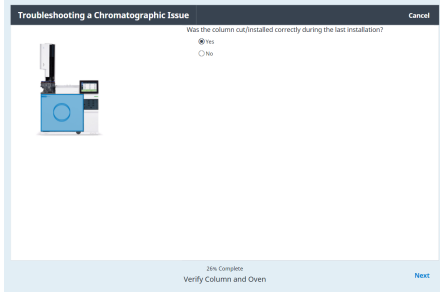
– Is the correct column type used for the analyte? **Yes**

– Does the column need maintenance? **Not Sure**

– Would you like to bake out the column? **Yes**

– Do you want to run the bake out procedure? **Yes**

  – User inputs the maximum column temperature and a bakeout time of 30 minutes.

– Would you like to proceed to the verification run? **Yes**

– Issue still present (low response). **Continue with Troubleshooting**

– Would you like to perform the trim column maintenance procedure? **Yes**

– Do you want to run the column trim maintenance procedure? **Proceed with Column Trim**
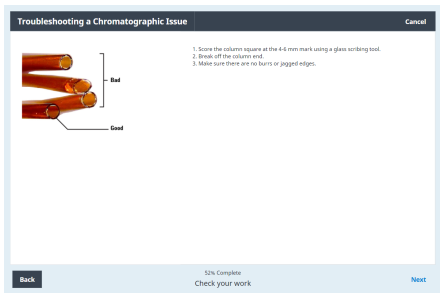
  – Integrated column trim maintenance procedure starts on the instrument.

  – User enters a new column length (completed within the column trim maintenance procedure).

  – Column trim maintenance procedure completes with the user trimming 0.2 m off the column.

– Would you like to proceed to the verification run? **Yes**
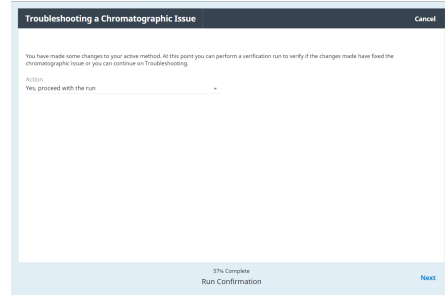
– Issue resolved: chromatogram looks normal and passes Peak Evaluation.
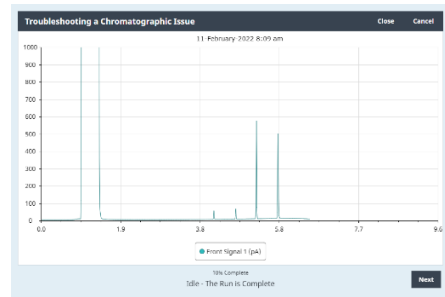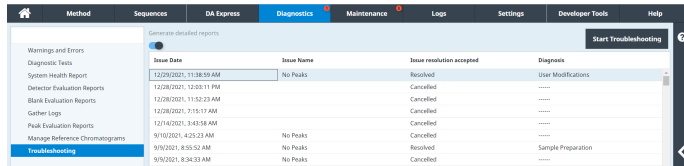
– User ends troubleshooting and the instrument logs are updated.
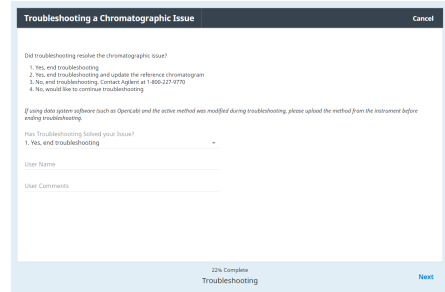
Reporting

To view the reports of previous troubleshooting that occurred on the instrument, click the Diagnostics tab on the browser interface and then click **Troubleshooting** on the left side of the screen (reports are also available from the touch screen interface).

Both summary and detailed reports are available.

Summary report

Detailed report

References

1. GC intelligence | Agilent

www.agilent.com

Agilent
Trusted Answers