User’s Manual
FLIR QL320

Quantitative Optical Gas Imaging

Product Versions: V1.4.2

November 29, 2023

Legal Disclaimer

For warranty terms, please refer to https://www.flir.com/warranty.

U.S. Government Regulations

This product may be subject to U.S. Export Regulations. Please send any inquiries to exportquestions@flir.com.

Copyright

Patents

This product is protected by patents, design patents, patents pending, or design patents pending.

Important Note on This Manual

The packing list is subject to specific customer configuration and may contain more or fewer items described in this manual.

FLIR reserves the right to discontinue models, parts, and accessories, or change specifications at any time without prior notice.

In some cases, the manual may describe features that are not available in your particular configuration.

Technical Support

https://flir.custhelp.com

Table of Contents

1. Introduction

Optical Gas Imaging (OGI) is a technology that utilizes a specially designed Infrared (IR) imager (also commonly referred to as “gas detecting IR camera” or simply “OGI camera”) to image a gas plume that is otherwise invisible to the naked eye. The FLIR GF320 is an example of an OGI camera which provides a visual and effective method to detect gas leaks from industrial process equipment.

Quantitative Optical Gas Imaging (QOGI) extends OGI to provide a quantitative result (i.e., leak rate). While OGI can qualitatively detect the presence of a gas leak, QOGI will quantify the gas leak and provide a measurement of leak rate.

Model FLIR QL320 is a device to be used for QOGI applications. It is a data acquisition and analysis module designed to work seamlessly with the FLIR GF320, FLIR GFx320 or FLIR GF620 OGI cameras manufactured by FLIR Systems, Inc. The FLIR QL320 does not require any modifications or alterations to the OGI camera, firmware or lens but the OGI camera should be calibrated prior to use with a FLIR QL320

For the FLIR QL320 to perform a rate measurement, the operator needs to enter certain parameters such as the ambient temperature and the distance from the camera to the leak. These parameters are referred to as “meta data” in this manual.

This User’s Manual provides specific instructions on how to use the FLIR QL320. In Appendix A, some frequently asked questions (FAQ’s) are answered, and useful tips are provided to achieve accurate leak rate measurement.

Nomenclature: In this User’s Manual, the words “user”, “operator”, and “you” are used interchangeably. The phrase OGI camera refers to specific FLIR GF Series camera models: FLIR GF320, FLIR GFx320 and FLIR GF620.

2. Parts List

The FLIR QL320 package includes the following items:

Quantity	Description
1	FLIR QL320 rugged tablet.
1	Battery (3950 MAH).
1	AC adapter (65W) and power cord.
1	USB cable.
1	Micro SD card with adapter.
1	Screen cleaning cloth.

3. Before First Use

Before taking the FLIR QL320 into the field, review each of the following sections to ensure accurate QOGI results.

3.1. Getting to know the FLIR QL320 Tablet

The FLIR QL320 quantitative method is installed on a rugged tablet suitable for field use. **Figure 3-1** shows various views of the tablet depicting key features.

Figure 3-1 FLIR QL320 Rugged Tablet.

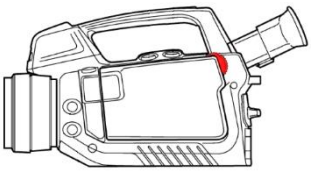
The following legend annotates each feature of the tablet.

1. Power On/Off Button
2. Brightness Adjust Up/Down
3. Programmable Button (disabled by default)
4. Windows “Start” Button
5. Docking Connector (for Office/Vehicle dock)
6. Charging Port
7. Camera Launch Button (disabled by default)
8. LTE SIM Card Slot
9. USB 3.0 SS Port (2 Ports)
10. MicroSD Card Slot
11. 3.5mm Headphone Jack
12. Battery Lock/Release Latch

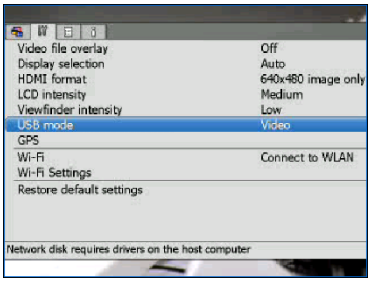
3.2. Configuring the camera

Prior to connecting your FLIR GF320 camera to your FLIR QL320 unit, you will need to ensure that your OGI camera is configured to transmit video over USB.

Using the *Mode Wheel* on the camera, go to Setup ( ).



Using the joystick, navigate to the *Camera* screen
Make sure *USB Mode* is set to *Video.*



3.3. Connecting the camera to the FLIR QL320

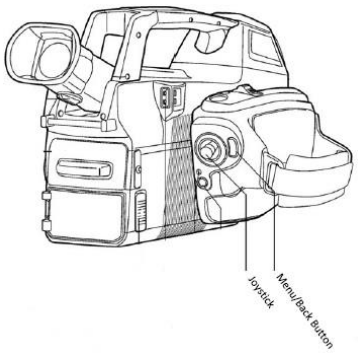
Plug the supplied USB cable into the computer and the tablet.

The larger “Type A” plug connects to the tablet.

The smaller “Mini-B” plug connects to the camera.

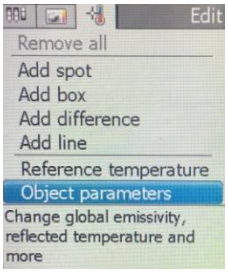
3.4. Setting object parameters

Using the Mode Wheel on the camera, go to Video.



Use Menu button and Joystick to edit the Object parameters:

- Set Emissivity to 1
- Set Distance to 0.1



3.5. Camera calibration

Although the FLIR QL320 does not require calibration, it is recommended that you calibrate your OGI camera prior to use for QOGI measurements. The FLIR QL320 method uses the radiometrically calibrated data from your OGI camera, so the accuracy of the FLIR QL320 results depends, in part, on the accuracy of the OGI camera calibration. FLIR recommends annual calibrations for your OGI camera when used for QOGI applications.

3.6. Field equipment

Performing a QOGI measurement with the FLIR QL320 requires certain field equipment (in addition to the OGI camera). One important accessory is a tripod for the camera. The plume extraction algorithm in the FLIR QL320 is change based, therefore it requires a steady image to separate the plume from the background. This requires the operator to place the OGI camera on a tripod to perform any QOGI measurement.

In addition to the tripod, a thermometer and a tape measurer (or infrared range finder) are recommended as the operator will need to provide the ambient temperature and distance from the OGI camera to the leak. An anemometer is also recommended, though not absolutely required. The operator will provide an estimate of the wind conditions (IE calm, normal or high), not an exact wind speed measurement.

FLIR offers the FLIR QL320 accessory kit which is includes:

- Tripod with clamps
- Laser Rangefinder
- Thermo-Anemometer
- Tablet Pouch

Contact your FLIR representative for more info.

3.7. Q-Mode

Q-Mode is a feature on some OGI cameras which allows the operator to enter user data (such as temperature and distance) directly into the camera and record videos onto the SD card which are in the proper format for quantitative processing on the FLIR QL320. If your OGI camera does not have the Q-Mode option, contact your FLIR representative about a firmware update. See Section 5.1 for more information on performing a measurement using Q-Mode.

3.8. Training

As with any quantitative method, training is recommended to ensure accurate results. QOGI training is offered by the Infrared Training Center (ITC). Contact ITC at 1-866-TRAINIR or visit the ITC website at https://www.infraredtraining.com/index.html for more information.

4. Overview of the FLIR QL320 User Interface

4.1. Launching the FLIR QL320 application

On power up, the FLIR QL320 tablet will boot directly to the desktop. Double tap the FLIR logo on the desktop to launch the FLIR QL320 user interface. The FLIR QL320 will auto-connect to the OGI camera if it is connected and properly configured, resulting in a live streaming image in the user interface.

4.2. User Interface

Figure 4.1 below shows the User Interface (UI) of the FLIR QL320. In the center of the UI is the streaming image from the OGI camera. This will be a live streaming image if the FLIR QL320 is connected to an OGI camera.

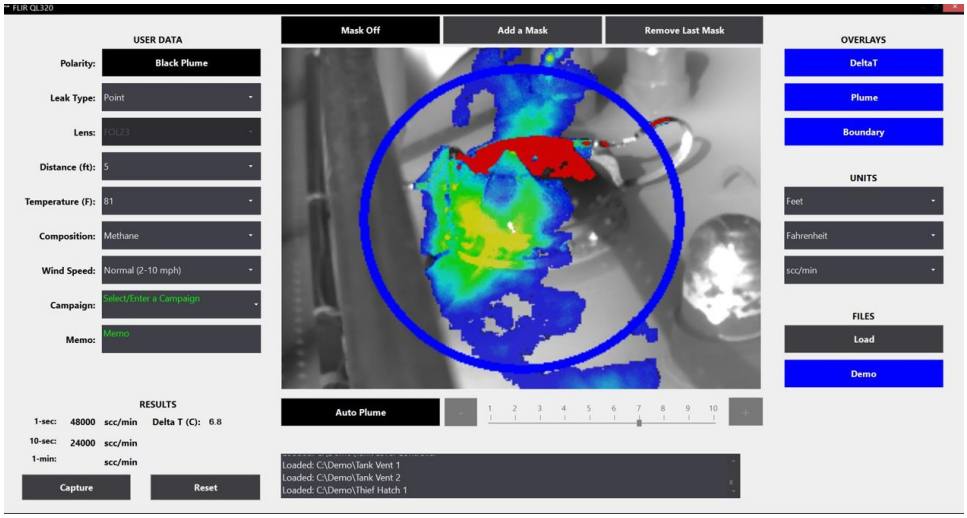


Figure 4.1 FLIR QL320 User Interface

On the left side of the image is a series of user data drop down selections described in Section 4.3. On the right side of the central image is a series of configuration settings described in Section 4.4. Above the central image are three buttons related to the masking feature described in Section 4.5. Below the central image are controls which allow the user to adjust the plume extraction threshold manually as described in Section 4.6.

4.3. User Data

User data, also known as meta data, describes a set of user-entered parameters which are required to obtain a quantitative result. Many of the user data fields are drop down fields, meaning the user can access a drop-down list of values by touching the control with either a finger or a stylus. Touching the control will reveal the selectable values. Note that the previous values for the user data will be loaded when the application starts but these values should be updated for each measurement. When a measurement is captured, all the user data fields are captured and stored along with the measurement result and the 10 second frame buffer. See Section 4.8 for more information on data capture. Each user data field is described below:

1. **Polarity** refers to the polarity of the plume being measured. Considering white to be hot, a Black plume will appear colder (or darker) than the background. It is typical to have a Black plume when the apparent temperature of the background is warmer than the ambient temperature. A White plume appears warmer (or brighter) than the background. It is typical to have a White plume when the apparent temperature of the background is colder than ambient temperature. This user input is a toggle button, meaning a touch with your finger or a stylus will change the value between White and Black.
2. **Leak Type** refers to the geometry of the leak. This is a drop-down control, so a touch on the control reveals two options: Point and Diffuse. A Point leak is one whose source is less than 2 inches in diameter. An example of a Point leak is a fitting on ¼" tubing. A Diffuse leak is one whose source is greater than 2 inches in diameter. An example of a diffuse leak is a thief hatch on a storage tank.
3. **Lens** refers to the lens attached to the camera. There are three lenses available: 23mm (24° FOV); 38mm (14° FOV); and 92mm (6° FOV).
4. **Distance** refers to the distance from the camera to the leak. The distance can be entered in feet or meters, depending on the user setting. See section 4.4 for more info on changing units. This is a drop-down control, meaning the valid distances will be displayed when you touch the control. Note that the available distances will be different for each lens as these are method limits for the QOGI measurement.
5. **Temperature** refers to the temperature of the gas. It is common to use ambient temperature to represent the gas temperature. The assumption being made is that the gas will quickly equilibrate to ambient temperature, even if there is a pressure drop at the leak source. The temperature can be entered in Fahrenheit or Celsius, depending on the units selected. See section 4.4 for more info on changing units. Temperature is a drop-down control, meaning the valid temperatures will be displayed when you touch the control.
6. **Composition** refers to the gas composition being measured. This is a drop-down control, meaning that several pure gases are displayed when you touch the control. It is possible to measure pure gases or even blended gases which are not displayed in this drop-down control by using a response factor (RF). See Section 5.1 for more on response factors.
7. **Wind Speed** refers to the current wind conditions. This is a drop-down field with three options: Calm (0-1 mph); Normal (2-10 mph) and High (> 10 mph). These general wind conditions are meant to describe the dispersion qualities of the plume being measured. It is not necessary to make an exact wind speed measurement for each FLIR QL320 measurement, rather the user just needs to describe the general conditions.

8. **Campaign** is a text field which allows the user to enter the name of the measurement campaign. Touching the control will make the control active and allow the user to type a campaign name using the keypad. This Campaign field is optional. See Section 6.1 for more on file management and Campaign mode. The Campaign field is often used to describe the location of the leak being measured (IE Tank Farm or East Pump House).
9. **Memo** is a text field which can be used to describe the leak being measured. Touching the memo field allows the user to type a message using the keypad. The message will be captured along with the other user data and displayed in the report. The Memo field is often used to describe the identifier for the leak being measured (i.e., "LDAR 2345A" or "Tank A Thief Hatch"). The Memo field is Optional.
10. **Undo Changes** is a button which appears only when changes have been made to the User Data in an archived .dat FLIR QL320 file. When this button appears, pressing it will revert any user data back to the original settings when the file was captured. This feature only applies to data files captured on the FLIR QL320, it does not apply to .seq files captured in Q-Mode.

4.4. Configuration Settings

There are three types of Configuration Settings: Overlays, Units and Files.

Overlays refer to colorized enhancements overlaid onto the infrared image. The Overlay buttons are toggle controls which will change between enabled and disabled when you touch them with a finger or stylus. They will turn blue when enabled and grey when disabled. There are three types of Overlays:

1. **Delta T**: When the Delta T overlay is enabled, the image will be colorized red in regions where the delta temperature is not large enough to provide a quantitative result. The QOGI method in the FLIR QL320 requires a minimum of 2 degrees (Celsius) difference between the gas temperature (IE ambient temperature) and the apparent temperature of the background. See Section 5.5 for more on the importance of delta temperature.
2. **Plume**: When the Plume overlay is enabled, the extracted plume signal will be colorized. The color palate for the plume overlay ranges from blue to yellow, with yellow representing the highest concentrations within the plume. Enabling the plume overlay allows for better visualization of the plume behavior and source of the leak.
3. **Boundary**: When the Boundary overlay is enabled, the blue measurement ring is shown on the infrared image. The measurement ring represents a flux boundary. For volumetric and mass emission measurements, the result represents the amount of plume crossing this boundary. The plume extraction threshold in Auto mode is also determined by the changes observed on the boundary. Masking portions of the boundary may be necessary at times to improve the plume extraction (See Section 4.5).

Units refers to user configurable units for the FLIR QL320. The unit selections are drop down controls which will display the selectable values when you touch them with a finger or stylus. There are three configurable units:

1. **Distance**: The User can select which units of distance to use. Valid options are feet and meters.
2. **Temperature**: The User can select which temperature units to use. Valid options are Celsius and Fahrenheit.
3. **Measurement**: The User can select which units of measurement are used. Valid options are:
    a. scc/min (standard cubic centimeters per minute)
    b. sl/m (standard liters per minute)
    c. g/hr (grams per hour)
    d. scf/hr (standard cubic feet per hour)
    e. lb/hr (pounds per hour)
    f. mt/yr (metric tons per year)
    g. PPM-M (parts per million - meter)
    h. PPM (parts per million)

Files refers to a set of user controls to load and display files. The **Load** button allows the user to load archived data. Two different file types can be loaded: .dat files which are captured on the FLIR QL320 and .seq files which are captured on the camera in Q-Mode. By default, files captured on the FLIR QL320 are stored in the C:\Archive folder. See Section 6.1 for more on file formats.

The **Demo** button is a toggle button which enables a demo mode. The button will turn blue when Demo mode is enabled and grey when it is disabled. When Demo mode is enabled, a set of pre-recorded demo files is displayed on the FLIR QL320. This is intended for training purposes as the user can experiment with FLIR QL320 features as if taking a measurement in real time. The Demo mode will load any files stored in the C:\Demo folder. The User can add or delete files from this folder to build a training library. The **Demo** feature is a great way to get to know your FLIR QL320 before taking it into the field.

4.5. Masking Feature

There are three buttons above the central image which relate to the Masking feature. The Masking feature allows the user to delete sections of the measurement boundary (IE blue ring). In general, any areas of the image which are changing but are not related to the plume (IE interferences) should be removed from the measurement boundary. These interferences can affect the plume extraction threshold (in Auto Plume Mode, see Section 4.6) and/or it can bias the result high by adding noise to the plume pixels. Examples of common interferences are an LDAR tag moving in the wind, glint from a reflective surface or rotating equipment. Figure 4.2 below shows the User Interface of a FLIR QL320 with the masking feature enabled.

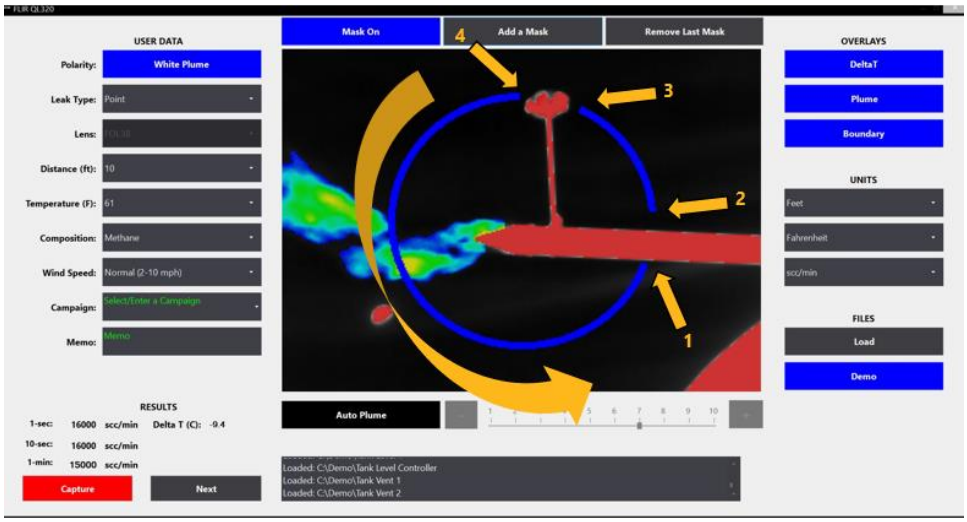


Figure 4.2 FLIR QL320 User Interface with Masking Feature enabled.

Note that the first button is blue when the Masking Feature is enabled and the text reads “Mask On”, as shown in Figure 4.2. When the Masking Feature is disabled, this button will be grey, and the text will read “Mask Off”. This is a toggle button. You can enable or disable this button by touching it with a finger or stylus. When the Mask Feature is enabled, the user can add masks by touching the blue ring. Traversing the ring in a counterclockwise direction, the user will touch the ring where the mask should begin and again touch the ring where the mask should end. In Figure 4.2, the first touch is labeled 1 and initiates the first mask. Touch 2 completes the first mask by deleting the measurement boundary between the two touches. If the user touches the measurement boundary again, the previous mask will be replaced, and a new mask will be applied upon the second touch. In Figure 4.2 a second mask is added. To add a second mask, touch the Add a Mask button to save the current mask and begin a new mask. Touch 3 then initiates the second mask and touch 4 completes it. To remove the last Mask added, simply hit the Remove a Mask button. In this way the user can select the active regions of the measurement boundary, avoiding any areas of interference. The example in Figure 4.2 shows a boundary with two masks applied.

4.6. Plume Threshold Feature

The controls below the central image relate to the Plume Threshold feature. There are two ways to define the threshold applied to separate plume pixels from background pixels: Auto Mode and Manual Mode. In Auto Mode, the FLIIR QL320 algorithm will determine the suitable threshold to sperate plume pixels from background pixels. If the user touches the Auto Mode button, the control will turn blue, and the text will change to manual mode. In addition, the slider bar to the right of the control will be enabled. Now the user can adjust the plume extraction by adjusting the threshold with the slider bar. A recommended practice is to use Auto Mode whenever possible. If Auto Mode is not extracting the entire plume, the most likely cause is some interference touching the measurement boundary (IE blue ring). Use the Masking Feature described in Section 4.5 to remove the interference and the plume extraction will likely improve. In the event that a manual threshold for the plume extraction is required, enable the feature by touching the Auto Mode button. The control will turn blue, the text will change to Manual Mode and the slider bar to the right will be enabled. Use the slider bar to increase the sensitivity (IE higher number) until you see background noise begin to appear in the image. Background noise represents changes in the image which are not caused by the plume or by any specific interference. Background noise tends to affect all pixels. Once the level of Background noise is found, reduce the sensitivity by 1 to achieve optimal plume extraction.

4.7. Results

When the FLIR QL320 is connected to an OGI Camera, the measurement results will be shown in real time on the bottom left corner of the User Interface. There are three measurement results provided: 1 second rolling average, 10 second rolling average and 1 minute rolling average. These results will be reset when certain user controls are changed, such as Temperature or Distance.

4.8. Capture and Reset Controls

When the FLIR QL320 is connected to an OGI Camera, there are two controls on the bottom left of the User Interface named **Capture** and **Reset**. The **Reset** button will reset the background, plume extraction and results. You should hit the Reset button any time you move or reposition the camera, and any time a significant interference enters the field of view (such as a person walking between the camera and the plume.) Following a Reset, the Capture button will be disabled as shown in Figure 4.1. It will remain disabled until 10 seconds of results have been averaged. Once 10 seconds of results are averaged, the Capture button will be enabled and it will change color to red, as shown in Figure 4.2. The red color is an indicator that the 10-second average and the 1-minute average are more than 10% apart. After about 45 seconds the 1-minute average will begin reporting results. If the 10 second result is within 10% of the 1-minute result the Capture button will turn green as shown in Figure 4.3 below.

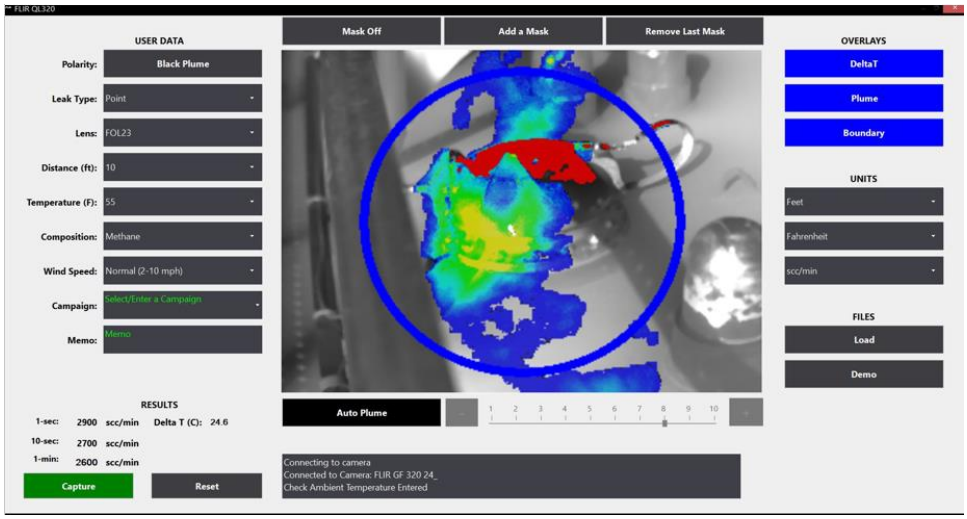


Figure 4.3 FLIR QL320 User Interface with green Capture button.

The Capture button will switch between green and red as an indicator to the user when the 10 second result is within 10% of the 1-minute result. When the Capture button is pressed, the last 10 seconds of video images, along with the 10 second average result, are stored on the FLIR QL320 in the C:\Archive folder. The background will periodically reset itself, clearing the results and disabling the Capture button.

4.9. Dialog Box

At the bottom of the User Interface is a Dialog Box which provides messages to the user. When measurements are recorded, the results and the file path will be displayed in the Dialog Box. Any error messages will also be shown here.

5. Performing a measurement

In a typical field use, the OGI camera will be used as a hand-held camera to first identify a gas leak. To measure the leak, the user will select a measurement position, place the camera on a tripod and enter the user data described in Section 4.3. There are two ways to use the FLIR QL320 quantitative method. The FLIR QL320 device can be tethered to the camera for real time measurements in the field, or the user can record Q-Mode files to the SD card on the camera for post processing. When using a tethered FLIR QL320, the quantitative result will be displayed in real time. When using Q-Mode, the user will need to post process the file using the FLIR QL320. Both options are discussed in Section 5.1.

5.1. Measurement with tethered FLIR QL320 verses measurement with Q-Mode

The basic steps to perform a measurement with a tethered FLIR QL320 are as follows:

1. Select a measurement position and place the OGI camera on a tripod.
2. Aim the OGI camera so that the leak is in the center of the FOV.
3. Connect the FLIR QL320 to the OGI camera using the USB cable provided.
4. Enter user data into the FLIR QL320.
5. Hit the Reset button to begin the quantification process.
6. 1-second, 10-second and 1-minute averages are displayed in real time.
7. Hit the Capture to record the measurement.

The basic steps to perform a measurement with Q-Mode are as follows:

1. Select a measurement position and place the OGI camera on a tripod.
2. Ensure that an SD card is inserted into the OGI camera.
3. Place the OGI camera into Q-Mode.
4. Enter user data into the OGI camera.
5. Aim the OGI camera so that the leak is in the center of the measurement boundary (ring).
6. Enable temperature screening overlay to ensure minimum 2°C delta temperature (see OGI camera manual for details).
7. Record a .seq video file to SD card.
8. Transfer .seq file to the FLIR QL320 for a quantitative result.
9. Process Q-Mode file using the Load button.

The following sections provide additional information on performing measurements with the FLIR QL320.

5.2. Selecting measurement position

Once a leak is identified, the operator will observe the leak from several positions to find a viewing angle that gives the FLIR QL320 module the best measurement position to quantify the leak. Factors to consider when determining the optimal viewing angle:

1. Ideally, you will want an unobstructed view of the leak location. If this is not possible, you will want an unobstructed view of the gas plume.

2. Selecting a suitable background is important as quantification requires sufficient thermal contrast. In general, the gas plume will be the same temperature as the ambient air temperature because the small amount of gas escaping from the equipment and entering the atmosphere will quickly equilibrate with ambient temperature. The background should be at least 2°C warmer (or colder) than ambient temperature to provide

sufficient contrast to quantify the plume. This is critical for an accurate measurement.

Most materials are not perfect blackbodies (i.e., their emissivity is less than one) and they reflect the IR rays from the sun or other thermal energy sources, making their apparent temperature higher. For thermography applications, it is important to segregate the reflected energy from the emitted energy to determine absolute temperature. For QOGI applications, apparent temperature is more important. This is the reason why we set the Emissivity in the camera to 1 (see Section 3.4). A clear sky can also provide a suitable background because the apparent temperature in the sky is typically low.

3. Select a location suitable for the OGI camera. You will need to mount the OGI camera on a tripod so look for a relatively flat surface within a reasonable distance of the leak.
    a. While the FLIR QL320 is agnostic to distance (within method limits), it is best to place the camera at a distance somewhere between 5 to 15 feet for small leaks and from 20 to 40 feet for large leaks.

Set up the tripod at the viewing location you have chosen. Choose the height and location of the tripod to optimize the background as described above. Position the OGI camera so the previously identified leak location is centered in the camera's Field of View (FOV). Once you have found a suitable camera viewpoint for performing the QOGI measurement, you have two options to capture measurement data. You can connect your FLIR QL320 to the OGI camera (see Section 3.3) or you can place the camera in Q-Mode and record images to the SD card in the camera (see Section 3.7). In either case, you will need to enter the user data to provide an accurate quantitative result.

5.3. Measuring distance

Distance from the OGI camera to the gas leak is another parameter you will need to enter into the FLIR QL320 module. While the FLIR QL320 is agnostic to range (i.e., the FLIR QL320 will operate at any distance within the method limits), you must provide this distance for accurate quantification.

The range for the FLIR QL320 module is a function of the lens attached to the OGI camera. For the 23mm lens (24° FOV) the range is from 5 feet to 54 feet (1.5 to 16 meters). For the 38mm lens (14° FOV) the range is from 8 feet to 90 feet (2 to 27 meters) For the 92mm lens (6° FOV) the range is from 20 feet to 210 feet (6 to 64 meters). In general, small leaks should be measured near the bottom of the range and large leaks should be measured near the top of the range.

5.4. Measuring Ambient Temperature

The ambient air temperature is one of the parameters you will need to provide to the FLIR QL320. The measurement of this air temperature should be taken within the same general area as the gas leak, although it is not necessary to get into the midst of the gas leak. A measurement taken at the location of the camera/FLIR QL320 module is generally acceptable unless there is a significant temperature gradient between the leak location and the location of the camera/FLIR QL320 module. A measurement read off an instrument like a smart phone that gives the general temperature of the city is NOT recommended as local temperature can vary considerably (especially in close proximity to process equipment).

A few words of caution when obtaining the air temperature:

1. Do not place the thermometer in direct sunlight as the solar heating tends to bias the reading high.
2. Do not place the thermometer on the ground as this may not be representative of true ambient air temperature.
3. Ideally the thermometer should be placed in a position where it is exposed to the same free-flow ambient air conditions as the gas plume and free from potential interferences such as direct sunlight or other radiating heat sources.

It is strongly recommended that the ambient temperature be measured each and every time a quantification is performed. The ambient temperature entered by user will be captured by the FLIR QL320 (or by Q-Mode) along with the video images.

5.5. Assessing delta temperature

Use the Delta T overlay (right hand side of the user interface) to show areas of the field of view where there is insufficient delta temperature for quantification. Those areas will be highlighted red when the delta temperature overlay is enabled, as shown in Figure 5.1 below.

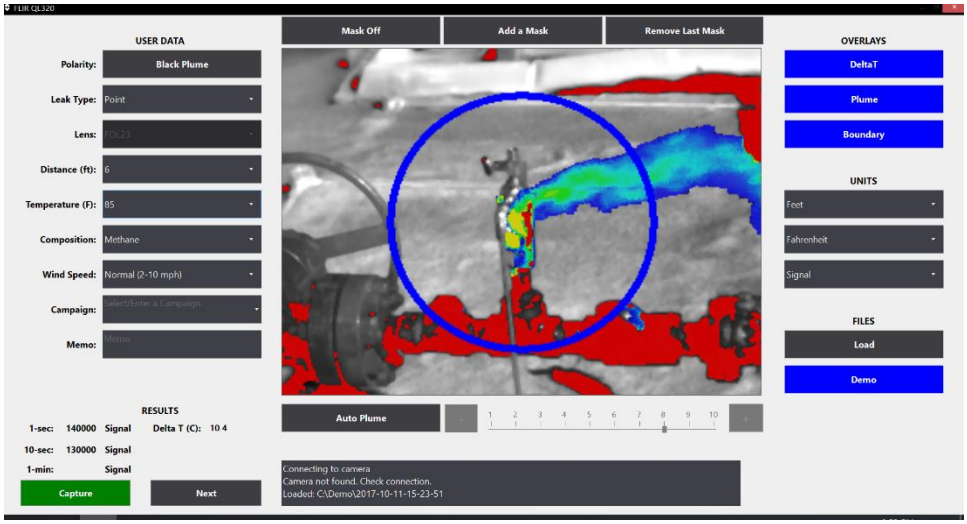


Figure 5.1 shows delta temperature screening.

If parts of the scene are below the minimum delta temperature, it may still be possible to perform a measurement. If you can position the camera so that the measurement ring is placed in a region of good delta temperature, then you can proceed with the measurement. If that is not possible, try changing the viewing angle. Recall that for quantitative optical gas imaging, both reflected energy and emitted energy contribute to the apparent temperature. It is often possible to

change the apparent temperature just by changing the viewing angle to the background, thereby changing the amount of energy reflected to the camera. If you can find no angle or camera position that provides sufficient delta temperature, then you may not be able to perform a measurement. Returning to the site at a different time of day will often yield a different delta temperature.

5.6. Adjusting temperature range of camera

For each background, you should check to see that the camera is operating in the proper temperature range. The OGI camera will provide the upper and lower temperatures for each range and a visual indicator to show the distribution of the pixels in the image. If a majority of the pixels are near the top or the bottom of the temperature range, the operator should adjust the temperature range to obtain accurate QOGI results. A common scenario where this becomes necessary occurs when the sky is used as a background. The sky typically has very little radiance in the mid-wave infrared. As a result, the apparent temperature of the sky can be quite low. It is often necessary to lower the temperature range of the camera when switching to a sky background. See the camera user manual for instructions on selecting and changing the temperature range.

5.7. Adjusting the field of view and focus

A critical component of the FLIR QL320 leak rate measurement process is adjusting the field of view (FOV) for the OGI camera. The camera should be positioned so that the leak location is in the center of the FOV. Whether you are using a tethered FLIR QL320 or Q-Mode, the display will have a measurement boundary drawn on it to aid in aiming the camera. You should verify that the gas leak is in the center of the measurement boundary (IE blue ring) and that the gas plume is flowing across the measurement boundary. In general, the best FLIR QL320 results will be obtained if the leak originates in the center of the FOV with a clear field of view as the plume passes across the measurement boundary roughly perpendicular to the camera FOV.

In some cases, it is easy and obvious to determine the location of the leak. These leaks are emanating from a single location and the plume emanates from that single location. In other cases, the leak may emanate from a component such as a flange or valve without a clearly defined source. In these cases, centering the component in the FOV is sufficient.

The focus of the OGI camera can potentially affect the measurement. The user should take care to ensure that both the leak site (leaking component or plume) as well as the background are in focus. This may or may not be feasible depending on the camera lens used (which determines the depth of field, or DOF), the distance between the leak site and the background objects, and the distance to the OGI camera. When it is not feasible to bring both the plume and the background into focus, priority should be given to the plume.

5.8. Recording User Data

The quantitative method in the FLIR QL320 requires the user to input certain parameters (User Data). In the case of a tethered FLIR QL320, the User Data is entered directly into the user interface as described in Section 4.3. In the case of a Q-Mode capture, the User Data is entered into the camera. In both cases, the User Data is recorded with the raw images. This allows the user to re-run archived files without the need to maintain separate field notes. It is important that these parameters are checked for each measurement as they can have a profound impact on the result.

5.9. Recording leak rate

As mentioned previously, there are two ways to record a leak rate with the FLIR QL320. Tethering the FLIR QL320 to the OGI camera as described in Section 3.3 is the recommended method. Although this requires bringing the FLIR QL320 out into the field with the camera, the advantage is that the user will have immediate results. This allows an assessment of the delta temperature, background quality, plume behavior and other factors which affect the accuracy of the measurement. To capture a result with the FLIR QL320 tethered, the user simply needs to hit the Capture button. The FLIR QL320 will store a 10-second image buffer (.dat file) along with the quantitative result in the C:\Archive folder. It is recommended to wait until the Capture button turns green as this indicates that the 10-second average is within 10% of the 1-minute average.

The other option is to place the camera in Q-Mode and record .seq files to the SD card. These files can then be transferred to a FLIR QL320 and loaded through the application to obtain a quantitative result. Although this method is easier to deploy in the field, it does not allow for immediate feedback. Care must be taken to ensure that the images collected will be of a high enough quality for quantification. Often this requires some experience with the FLIR QL320 method, so a new user may want to favor the tethered option.

5.10. Method limits

The quantitative method in the FLIR QL320 has certain limits. For example, the method requires a minimum delta temperature of 2°C for accurate results. The method limits for distance are a function of the lens:

1. 23mm lens (24° FOV): 5 feet to 54 feet (1.5 to 16 meters).
2. 38mm lens (14.5° FOV): 8 feet to 90 feet (2 to 27 meters)
3. 92mm lens (6° FOV): 20 feet to 210 feet (6 to 64 meters)

In terms of release geometry, the current method works for point releases (2" diameter or less) and diffuse releases up to 12" in diameter. With respect to leak rate, the current method has been calibration from 0.2 sl/m up to 300 sl/m (methane). With respect to wind speed the calibration extends to 10 mph. Future versions of the FLIR QL320 quantitative method may extend these method limits to enable measurement of higher leak rates, farther distances and additional measurement geometries.

5.11. Response factors

The FLIR QL320 requires the user to select from a list of pre-defined pure gases, but often the plume is not a pure gas or is a pure gas that is not listed on the FLIR QL320. For these situations, the user can use a response factor (RF) to correct the result. A response factor provides the user with the relative response of one gas to another. Response factors for 400 different compounds can be found in Providence's online RF calculator:

http://www.flir.com/response-factors/

Two examples are provided to illustrate the use of response factors.

Example 1: Measuring a pure gas that is not listed in the FLIR QL320

If the gas to be measured is not listed in the FLIR QL320, measure the leak as you normally would by selecting Propane as the composition. Then look up the RF for the gas being measured using the online calculator. Divide the Propane result by the RF to get a corrected result.

Example 2: Measuring blended gases

If the gas to be measured is a blend of different gases, perform the measurement as you normally would by selecting Propane as the gas composition. Then look

up the RF of each gas in the composition and calculate a volume weighted RF for the blended gas. Divide your Propane result by the volume weighted RF to get a corrected result. If needed, the corrected result can then be used to derive a speciated leak rate for each compound. This can be useful if you need to determine the methane and non-methane portions of a leak.

5.12. Measuring leak rate verses concentration

The FLIR QL320 allows you to measure both leak rate and concentration.

When measuring leak rate (i.e., volumetric or mass emission rate), the Boundary overlay displays a blue ring on the image. The ring performs two important functions:

- The plume extraction threshold (in Auto Plume mode) is determined by examining the plume interaction with the ring.
- The flux across this boundary is used to determine the emission rate.

The ring is always centered in the middle of the field of view and the ring size generally cannot be changed. You will notice that the ring size does change as you change the distance or lens. This is because the ring is used to scale the image to the calibration conditions built into the FLIR QL320.

If you choose PPM or PPM-M as your units, you are now measuring concentration rather than an emission rate. PPM-M is the maximum path-averaged sum concentration in the plume, while PPM represents the max concentration in the plume. When you select PPM or PPM-M, you will see that the ring boundary overlay is turned off and replaced with a box, as shown in Figure 5.2 below.

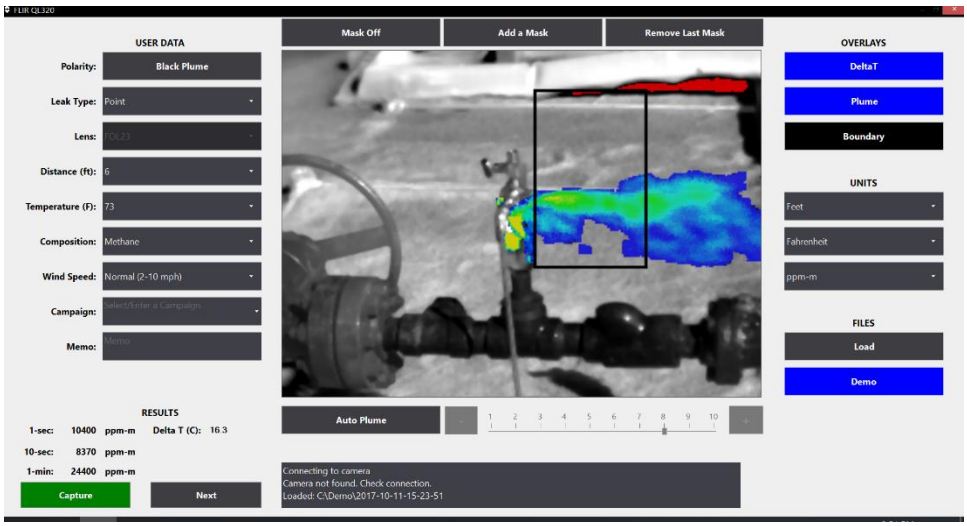


Figure 5.2 Measuring concentration in PPM-M

The FLIR QL320 will report the maximum PPM or PPM-M concentration within the box. The box can be redrawn anywhere on the image by dragging your finger (or a stylus) to define the diagonal of a new box. Note that the blue measurement ring has no bearing on the PPM-M measurement, but it does still define the plume extraction threshold in Auto Plume mode. If you are measuring PPM or PPM-M and have some difficulty with plume extraction, turn the Boundary overlay back on and look for noise on the ring. Use the Mask feature to remove any noise and improve plume extraction.

6. File Operations

6.1. File Management

All data captured by the FLIR QL320 is archived to the folder C:\Archive within a folder that is date/time stamped. A typical folder name is D:\Archive\2019-06-15-04-29-36 which is in date/time format YYYY-MM-DD-hh-mm-ss. If a Campaign was specified on the User Interface, there will be a subfolder in the C:\Archive folder with the campaign name and any data captured will be in the subfolder. For each measurement, there are four files generated: data file (.dat), video image (.avi), video image with user selected overlays (.avi) and a results file (.pdf). The .dat file holds all of the raw images along with the user data. The files can be moved to other folders or other storage devices.

Q-Mode files will be in .seq format. They can be captured on a micro-SD card on a camera equipped with Q-Mode. The files can then be transferred to the FLIR QL320 and loaded using the Load File button (see Section 4.4). When a .seq file is loaded, the QOGI method will be applied generating .avi files and the results pdf file. The folders for files can be renamed to be more descriptive if needed, it will not affect the quality of the data or the ability to reuse the data.

6.2. Loading archived files

Selecting the Load File button will allow you to load a .dat or .seq file from archived data. Once the Load File button is selected it will prompt you to browse to a folder containing the data you wish to process. Once you select a valid file, it will read the camera information and user supplied parameters from the .dat or .seq file and determine the resulting leak rate or concentration. After the result is determined, you are free to change the user supplied inputs and rerun using the Rerun button. Note that any changes you make to user data will be saved in the case of .dat files but will not be saved in the case of .seq files.

7. Troubleshooting

Common questions and troubleshooting tips for the FLIR QL320:

1. The OGI camera does not connect to the FLIR QL320 module.

Check to ensure that the OGI camera's video mode is set to USB Video. Refer to the OGI camera user manual for the procedure to set the camera's video mode. If the video mode is correct, check that the USB cable is properly connected to both the FLIR QL320 and the OGI camera. Reseat both ends of the USB cable and restart the FLIR QL320 application. If this does not fix the problem, try a power-cycle of the OGI Camera.

2. I tried recording a video clip on my FLIR GF320 while the FLIR QL320 was connected, and the camera froze.

For some models of the OGI camera, recording to an SD card while streaming to the FLIR QL320 can cause this issue. If this occurs, please restart the camera. Recommended practice is to disconnect the FLIR QL320 if you are recording to an SD card.

3. Can FLIR QL320 be used as a standalone measurement device, or do I have to have an OGI camera?

The Optical Gas Imaging (OGI) camera is the sensor and the FLIR QL320 is the data acquisition and analysis module. The combination of the two modules makes a complete QOGI measurement device. The FLIR QL320 can only be used in conjunction with a FLIR GF320, FLIR GFx320 or FLIR GF620 camera.

4. Does the FLIR QL320 need to be calibrated?

No. The FLIR QL320 is factory calibrated for intended uses. The user does not need to calibrate the FLIR QL320, but it is recommended that the user maintains annual temperature measurement calibrations for the OGI camera used in conjunction with the FLIR QL320.

5. Can I use the FLIR QL320 without a tripod?

No. In general, the FLIR QL320 requires the OGI camera to be steady during the data capturing phase of the measurement. If the OGI camera is moved or shaken during data capture, the plume extraction may be compromised which can lead to an inaccurate result.

6. Will the OGI camera's focus affect the measurement?

Yes, the OGI camera focus can potentially affect the measurement. There are two factors to be considered when focusing the camera. One is the leak site (the leaking component) to be measured and the other is the background scene. The best scenario is that both the leak site and the background scene can be brought into focus. This may or may not be feasible depending on the camera lens used (which determines the depth of field, or DOF), the distance between the leak site and the background objects, and the distance to the OGI camera. When it is not feasible to bring both the leak site and the background into focus, priority should be given to the plume.

7. The gas I am measuring is not listed on the FLIR QL320.

You can measure the leak as Propane and use a response factor to correct the result. See Section 5.11 for more information on response factors.

If the compound you are imaging is not found in the drop-down list or the plume contains several compounds, select Propane as the default. It is possible to adjust this result manually by applying a Response Factor to the Propane result. Contact Providence technical support for more information.

8. How do I extend the battery life?

In general, screen brightness is the factor which has the largest influence on battery life. Reduce the screen brightness to extend the battery life. Spare batteries can also be purchased, and are field-swappable. Contact FLIR for more information.

9. What camera settings will affect the result?

The only OGI camera setting which will affect the result is the temperature range. The user must place the OGI camera into a suitable temperature range for the scene, ensuring that the background pixels are not saturated or underfilled. Any other camera settings, such as high sensitivity mode, will change the way the video appears in the OGI camera but will not influence the result.

10. Can I measure any type of leak with the FLIR QL320?

No. The gas being measured must have some absorbance within the spectral response of the OGI camera (IE 3.3 – 3.4 um). There should be at least 2°C difference between ambient temperature and the apparent temperature of the background. Your measurement should also resemble calibration conditions and fall within the method limits. This means that the leak geometry should be 12” or less and the leak rate should be between 0.2 sl/m and 600 sl/m. Large area leaks cannot be measured with the current FLIR QL320 method.

11. Why is the FLIR QL320 not highlighting the plume even though I can see it with the OGI camera?

First, check to ensure that you have the Plume overlay turned on. If you do, check for noise that is unrelated to the plume which is touching the blue measurement boundary. If there is some significant noise it may be affecting the plume extraction threshold. Try masking those regions using the Masking feature. If that does not improve the plume extraction, try using the manual plume threshold feature and increase the sensitivity until you have a good plume extraction. If you still can’t separate the plume from the background the leak rate may be below the method limit.

12. Can I process mp4 videos saved to the SD card on the OGI camera?

No - mp4 videos cannot be processed by the FLIR QL320. Only Q-Mode videos (.seq) can be processed.

13. When I change the temperature range in the OGI camera the image on the FLIR QL320 goes all white (or all black).

Restarting the FLIR QL320 application after changing the temperature range in the OGI camera will correct the issue.

14. When I use the 92mm lens my image on the FLIR QL320 is rotated 180 degrees.

Restarting the FLIR QL320 application after changing the lens in the OGI camera will correct the issue.

15. Should I use Q-Mode or use the FLIR QL320 in tethered mode?

Each approach has some advantages and limitations. Using Q-Mode is generally more convenient as it does not require bringing an additional device into the field. It also allows you to maintain the electrical classification if you are using the GFx320, enabling measurements in Class 1 Div 2 areas. The disadvantage of using Q-Mode is that there is no immediate feedback to the operator. Special care must be taken to ensure that you have sufficient delta temperature and that the video recorded will yield a quantitative result. It is also important to ensure that the camera is stable during the data capture as a shaking image can interfere with the plume extraction. In general, it is recommended to use the FLIR QL320 tethered for new users as they gain experience with the quantitative method. Experienced users will find it easier to use Q-Mode.

16. What is the maximum distance from the leak to the OGI camera?

The range for the FLIR QL320 module is a function of the lens attached to the OGI camera. For the 23mm lens (24° FOV) the range is from 5 feet to 54 feet. For the 38mm lens (14° FOV) the range is from 8 feet to 90 feet. For the 92mm lens (6° FOV) the range is from 20 feet to 210 feet. In general, small leaks should be measured near the bottom of the range and large leaks should be measured near the top of the range.

17. What is the best data quality indicator (DQI) for the FLIR QL320 result?

Delta Temperature is provided for each measurement and is an effective data quality indicator. At a minimum, delta temperature should be greater than 2°C (or less than -2°C for white plumes). A delta temperature greater than 5°C is ideal.

18. Why does the screen on my FLIR QL320 sometimes go black?

The default behavior of the P programmable button (Item 3 in Figure 3-1) is to launch the FLIR QL320 application, but in some instances this button can be reconfigured to turn the display of the FLIR QL320 on/off. If the P programmable button has been configured to turn the display off, it is likely that an inadvertent touch of the button is the culprit.

Website
http://www.flir.com

Customer support
http://support.flir.com

Disclaimer
Specifications subject to change without further notice. Models and accessories are subject to regional market considerations. License procedures may apply. Products described herein may be subject to US Export Regulations. Please refer to exportquestions@flir.com with any questions.

Publ. No.: T810544
Release: 1.4.2
Date: Nov 30, 2023