# GLSI Hg253

Portable Mercury Vapor Analyzer

# OPERATION MANUAL

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Version 1.08

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# Introduction

The GLSI Hg253 Portable Mercury Vapor Analyzer is a field-portable elemental mercury vapor detection instrument. This unit accurately detects ultra-trace amounts of vapor-phase elemental mercury, digitally recording up to 99 sample results. Results can be browsed in the field or even uploaded to an office personal computer. And the large, colorful touch-screen interface ensures quick and easy operation for trained and untrained operators alike.


**Features**

- Portable.
- Real-time data reported in continuous and single-sample modes.
- Simple, intuitive 256-color LCD touch-screen interface with adjustable contrast control.
- Dual-beam optical system allows real-time background correction for lamp intensity and temperature drift as well as immunity to virtually all background interferences.
- High-intensity mercury source lamp has built-in digital lamp monitoring and control circuitry for increased lamp stability.
- Ultra-small, low-power 1 LPM (liter per minute) vacuum pump provides rapid sample flush times while minimizing battery drain.
- Built-in NIST-traceable digital temperature sensor reports the current temperature of each sample.
- Two RS-232 communication ports for field data upload to a PC or for use with future accessories.
- Internal 2MB non-volatile flash memory allows sample data logging of up to 99 samples.
- MerSORB™ mercury filtering cartridges provide an ultra-clean baseline measurement increasing the sensitivity of the unit in noisy environments.
- A 0.25-micron particulate filter is incorporated within the hand-held sample probe to minimize dust and particulate interferences.
- Plumbing incorporates 100% borosilicate glass, quartz, Viton™ and Teflon™ (PTFE) components in the analytical sample stream to eliminate mercury concentration carryover due to adhesion.
- Matched, precision-ground, 10cm quartz analytical sample cells yield significantly increased sample sensitivity.
- A rugged, field-portable carrying case allows easy travel and safe long-term storage.

## Technical Specifications

| | |
|---|---|
| **Target Analyte:** | Elemental gas-phase mercury. |
| **Sample Flow Rate:** | Approximately 1.0 L/min continuous. |
| **Measuring Range:** | 0.001 mg/$m^3$ to 10.000 mg/$m^3$. |
| **Reporting:** | Real-time measurements are displayed on screen.<br>Peak and/or average reading is displayed at the sample conclusion as well as a graph of the sample measurements over the entire sample interval. |
| **Baseline Correction:** | Automatic baseline correction with internal scrubber. |
| **Alarm Range:** | 0.001 mg/$m^3$ to 10.000 mg/$m^3$, user-settable in 0.001 mg/$m^3$ intervals. Alarm can be disabled. |
| **Power Source:** | Single button-press, replaceable, rechargeable 12V 2300mAh lead-acid battery. Battery voltage is monitored in-system and displayed on-screen. Instrument can be powered by battery or by a 2A 12V DC power wall cube. |
| **Internal Plumbing:** | All internal surfaces (tubing, fittings, connections, etc.) are borosilicate glass, quartz, PTFE Teflon or Viton. *The only exception is the diaphragm pump, which uses EPDM plastic for its valves and diaphragm. The pump, however, is downstream of all analytical components and will not contaminate the analytical flow.* |
| **Physical Dimensions:** | 10.5”W x 6.5”D x 6.25”H (267mm W x 165mm D x 159mm H) |
| **Weight (with battery):** | 7.5lb (3.4kg) |

# Theory of Operation

**Spectroscopy Theory**

The Hg253 Portable Mercury Analyzer operates using the principles of atomic absorption spectroscopy (AAS). AAS is a widely used and accepted analytical technique capable of determining trace amounts of elements or metals in a wide variety of samples. The AAS technique involves subjecting ground-state elemental atoms to light of a very specific wavelength. As long as the wavelength used is among the characteristic absorption wavelengths of the analyte element, the ground-state atoms will absorb this light and a transition to a higher energy level will occur. The intensity of this transition can be mathematically related to the original concentration of the ground state atoms in the analytical sample cell. According to the mathematical relationship,

$$T = P / P_o$$

where $T$ is the transmittance of light through the sample cell, $P$ is the power of the light source passing through the sample cell, and $P_o$ is the power of the light source before it passes through the sample cell. The transmittance represents the percentage of original light that passes through a sample. In practice, the transmittance is typically converted into an absorbance number. Absorbance is used in AAS techniques to quantify the percent reduction in power due to elemental absorption. The absorbance, $A$, is related logarithmically to the transmittance as follows:

$$A = - \log T = - \log P / P_o = \log P_o / P$$

The *Beer-Lambert* law further relates sample absorbance to the concentration of the element within the analytical cell, in this case: mercury (Hg). According to this law,

$$A = abc$$

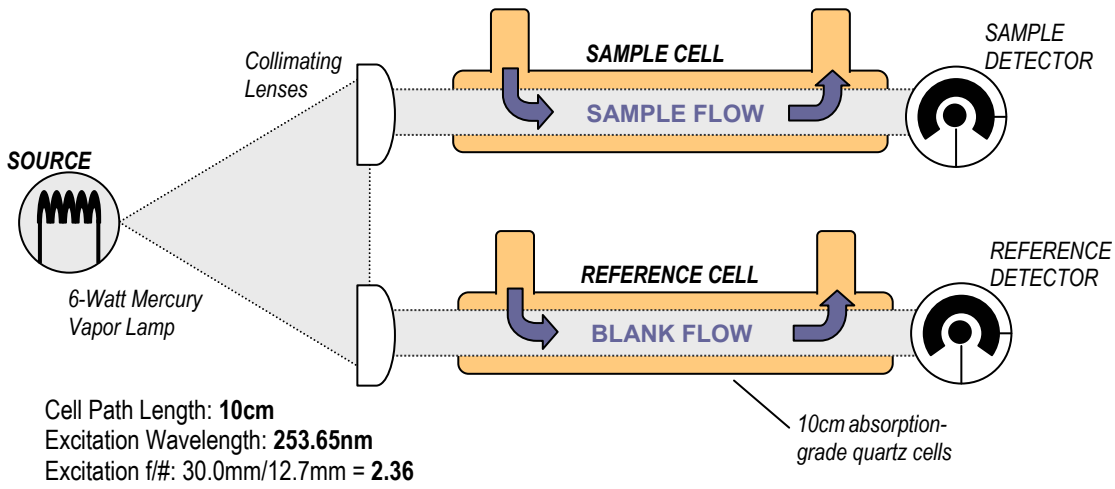
where $A$ is the sample absorbance, $a$ is the absorptivity in g/L-cm, $b$ is the cell length in cm, and $c$ is the concentration of the analyte within the sample in g/L (this is easily converted to $mg/m^3$). Since the absorptivity and the sample cell length remain relatively constant, the concentration of mercury within a sample can be linearly related to the absorbance of that sample. This is the fundamental theory of operation behind our instrument.

**Dual-Beam System**

The Hg253 Portable Mercury Vapor Analyzer uses a dual-beam optical detection system. The dual-beam system incorporates two separate quartz analytical cells instead of the typical single analytical cell. The first cell is used as a *reference detection cell*. The sample gas that flows through this cell first passes through a mercury scrubber to clean the air completely free of mercury (and mercury

alone). The second cell is the *sample detection cell*. Sample air flowing through this cell is not scrubbed clean of mercury. Sample air arrives in the detection cell unaltered. A single UV mercury vapor lamp (excitation wavelength of 253.65nm) is used in the system to excite ground-state mercury atoms. This lamp acts as the excitation source for both analytical cells. The instrument uses two individual UV sensors: one to monitor the radiated power received through each analytical cell. When no mercury contamination is present in the air sample, both sensors will detect identical amounts of radiated power. This is known as a *blank* reading. The instrument will report a *blank* for any reading below the minimum instrument detection limit (IDL), i.e. less than 0.001 mg/m$^3$. When mercury contamination is present in the sample air, the *sample detector* will detect a noticeable decrease in radiated power. As described in the previous section, this change in radiated power can then be directly correlated to a specific concentration of mercury vapor within the sample.

**Hg253 *Optical Path***

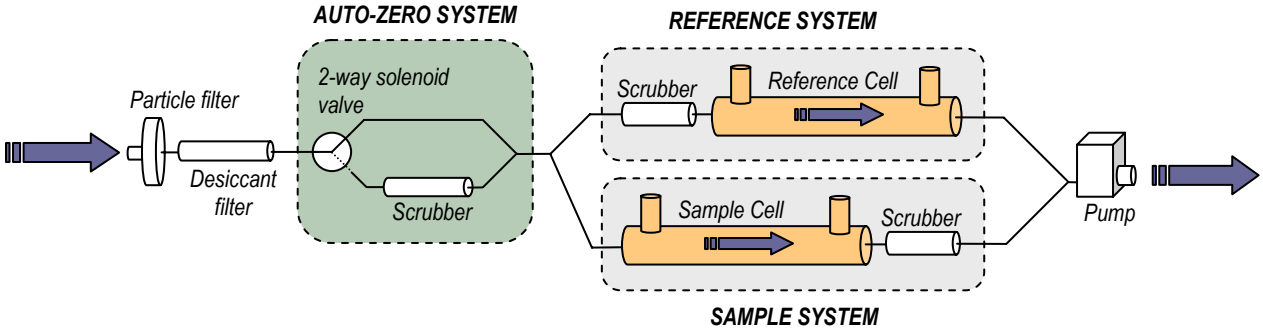



The dual-beam system also provides supreme interference immunity to background contamination such as $H_2S$, light organics, and water vapor. If there is a background contaminant present, both the *sample detector* and the *reference detector* will detect a change in radiated power. Since the change will be present at both detectors, the ratio-metric decrease in radiated power will remain constant and the interference will be rejected. Because of this, false mercury concentration readings due to background contaminants are virtually eliminated. The dual-beam system also eliminates false readings due to lamp drift, a common problem in analytical instrumentation. Since the *reference detector* monitors the total radiated power of the source continuously, a drop in lamp intensity can be immediately corrected before it creates a false absorbance reading.

**Flow System**

The gas flow system for the Hg253 Portable Mercury Vapor Analyzer is straightforward and simple. The input sample gas is first cleaned of particles and moisture by the *particle filter* and the *desiccant filter*. A *two-way solenoid valve* is then used to automatically (and/or manually) switch in a *mercury-scrubbing filter* upstream of the detection system. This allows the unit to perform an in-line automatic-zero correction of the sample gas. Users can also manually switch on the auto-zero solenoid at any time during continuous screening mode to verify proper instrument operation. After passing through the auto-zero system, the sample gas stream is split into two paths: a sample path and a reference path. The reference path contains an in-line *mercury scrubber* before the *reference detection cell*. This scrubber removes all mercury from the gas stream, leaving a reference (*blank*) gas stream at sample temperature, humidity and pressure. Since the reference path only scrubs mercury, any other common interference contaminants will remain in the reference path, decreasing the reference baseline accordingly. The sample path measures the radiated power decrease in the non-filtered sample gas stream. The *sample detection cell* measurement and the reference baseline are used in conjunction to calculate the final mercury concentration in the sample, adjusted for ambient temperature and free from contaminant interferences. Finally, the flow system also incorporates a mercury-scrubbing filter downstream of the *sample detection cell* to capture any mercury contaminants before the sample gas is released back into the environment. This ensures that the instrument does not re-emit hazardous levels of mercury into the area.

**Hg253 *Sample Flow Path***



# Operation

### Introduction

The Hg253 Portable Mercury Vapor Analyzer uses a 256-color LCD display for reporting results and an overlaid touch-screen panel for user input. This interface provides a simple, colorful and intuitive interface for operating the unit. Large color buttons are used for input and measurement results are reported real-time in color. The interface is designed so that common functions like sampling and browsing results are only one button-press away. The less common features are typically a few button-presses away to avoid complicating the basic interface simplicity. The touch-screen interface is not just more intuitive to use, but also allows greater design flexibility. As application demands change in the future, we can quickly and easily update the interface software to incorporate new features, adding new buttons, removing unused buttons, or even changing the entire interface layout!

### Touch-Screen Operation

To operate the touch-screen, simply press the touch-screen where a visual interface button appears on the LCD screen. Very little pressure is required to actuate the touch-screen input. Also, only a single contact point will register at a time. If the touch-screen is pressed in more than one location at the same time, the resulting input will be unpredictable. The use of sharp objects when operating the touch-screen will scratch or possibly damage the touch-screen surface. Use only the soft pad of your finger for touch-screen input!

To clean the screen, use a dry lint-free cloth to wipe away fingerprints, dust and other grime. If the screen is extremely dirty, apply a small amount of water to the cloth and gently clean the screen.

### Basic Interface

There are a few basic principles that remain consistent throughout the software interface:

- Any screen that prompts for user input will always display a red **CANCEL** button in the top-right corner and a green **OK** button in the bottom-right corner. Pressing **CANCEL** will abort the current screen without saving data and return to the previous screen. Pressing **OK** will store the current data or user-input data and return to the previous screen.

**CANCEL**

**OK**

- Any screen that does not require user input can be exited by pressing the green **CLOSE** button. This button is always located in the top-right corner. Whenever a **CLOSE** button is present on-screen, there is no data to be stored. Pressing **CLOSE** will return to the previous screen.

**CLOSE**

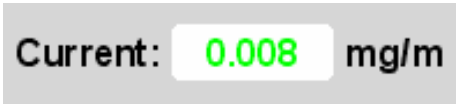
- All other interface buttons are displayed in blue. Pressing an **INTERFACE** button will generally proceed to a new screen according to the function of the pressed button. Some navigation buttons, however, like the **UP ARROW** or the **PLUS** will not proceed to a new screen, but perform a simple navigation action within the current screen. Below are some typical examples of **INTERFACE** and **NAVIGATION** buttons.

**SAMPLE** **UP ARROW** **PLUS**

- Disabled buttons are crosshatched with gray. **DISABLED** buttons are typically disabled as a result of current instrument settings. A button may also be permanently disabled within a specific software version until a later update. **DISABLED** buttons can be pressed, but are not functional.

**ENABLED** **DISABLED**

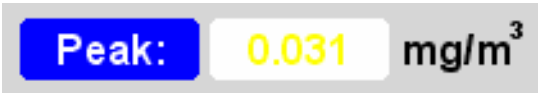
- Numeric/text indicators are typically displayed as text on a white background. Often a label and/or unit designator accompanies these indicators. This type of indicator is commonly used to present status information or instrument readings to the user. Below is an example of a typical numeric/text indicator:




**NUMERIC/TEXT INDICATOR**

- Numeric/text toggle indicators are very similar to the standard numeric/text indicator. The current setting is still displayed as text on a white background. The accompanying label, however, is displayed on

a blue button background. Pressing the label/button will toggle available settings for the numeric/text toggle indicator. For example, the **PEAK** measurement indicator in the Sample screen can be toggled to an **AVERAGE** measurement indicator by pressing the indicator's label/button. Pressing the label again would return to **PEAK** measurement mode. Below is an example of a typical numeric/text toggle indicator:



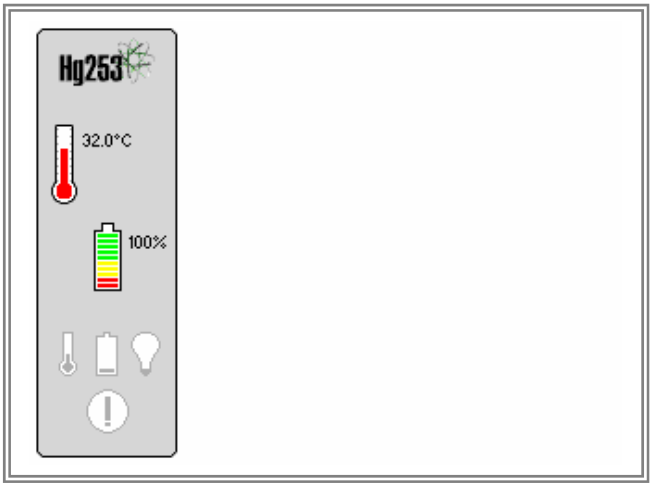

**NUMERIC/TEXT TOGGLE INDICATOR**

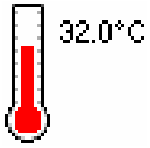
**Splash Screen**

When the unit is first powered on, the Splash screen shown below will appear for 4 seconds. Some very important information is located in the bottom-right corner of this screen. The first line of text in the bottom-right corner displays the unit factory serial number, e.g. **253-01-004**. Each unit has a unique serial number so that we can track its hardware and software revision history as well as its warranty and repair service history. The second line of text displays the unit's current software version number, e.g. **Version 1.08**. Updated software versions will be released periodically in the future to offer new features, repair known software issues and/or to provide support for custom field requirements. The last line of text displays the official release date of the unit's current software version, e.g. **August 28, 2001**. If this date is 6 months to a year in the past, there is likely a new software update available. We will generally update all customers when new software and/or hardware updates are available. However, feel free to contact a GLSI service representative at any time to get current software and/or hardware version information. All software version updates are free.

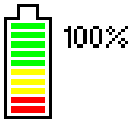
**Status Bar**

The Status Bar is always visible on the left side of the display screen. The Status Bar is shown below. This region continually reports on the status of the unit. The status bar consists of two (2) real-time gauges and four (4) status indicators as further detailed below.




*Temperature Gauge.* The temperature gauge reports the current real-time temperature in degrees Celsius. This gauge is NIST-traceable to within 1°C. **NOTE**: When operating over long periods of time, the internal temperature sensor may become susceptible to self-heating effects from the mercury vapor lamp and/or the LCD inverter. Under these conditions, artificially inflated readings may occur.




*Battery Gauge*. The battery gauge reports the current battery charge remaining on the replaceable battery as a percentage. If the battery charge drops below 20% the unit will not allow analytical sampling. Change the battery to run more samples.

*Temperature Indicator*. When this indicator is flashing red, the current temperature is too hot (**> 50 °C**) for accurate sampling. When this indicator is flashing light blue, the current temperature is too cold (**< –10 °C**) for accurate sampling. In either case, the unit will not perform a sample measurement until the temperature returns to within the acceptable range ( **–10 °C** to **50 °C**). If the indicator is light gray and white, the temperature is within range and sampling may occur.

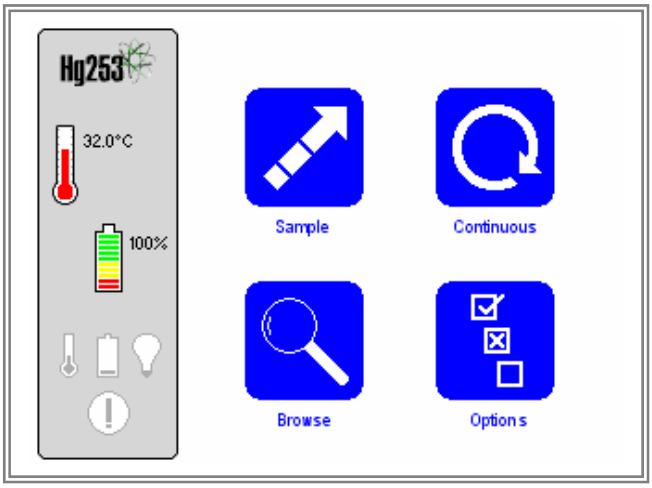
*Battery Indicator*. When this indicator is flashing yellow, the current battery charge is getting low. This is just a warning. The low battery warning will flash every minute as a reminder. Sampling may still occur during a low battery condition. When this indicator is flashing red, the current battery charge is critically low. The indicator will flash continuously (about once per second). When the battery is critically low, any further sampling is disabled. If the instrument is currently taking a measurement, the reading will be immediately terminated and the user returned to the Main screen. Remove the discharged battery and insert a charged battery to continue sampling. If this indicator is light gray an white, the battery charge is good.


*Lamp Indicator*. When this indicator is flashing yellow, the lamp is warming up. If the lamp was previously off, it may take as long as 2 minutes to warm the lamp to the appropriate operational temperature for analytical sampling. If this indicator is flashing orange, the lamp control circuitry is currently regulating the lamp intensity to within acceptable limits. The lamp may occasionally drift in intensity during operation. This is very common and is quickly corrected by the built-in regulation circuitry. If the lamp intensity drifts too far during a sample, the lamp will be forced into regulation mode, flashing this indicator orange and restarting the current sample. The sample will begin again as soon as the lamp intensity is stabilized (usually within a few seconds). When this indicator is solid yellow, the lamp intensity is stable and sampling is under way. When this indicator is light gray and white, the lamp is off.


*Service Indicator*. When this indicator is solid red, the unit requires immediate servicing. Typical causes of this warning are a broken lamp or detector, a unit out of calibration, or damaged internal electronics. Contact GLSI or a qualified Hg253 service technician for a service appointment. All analytical sampling is disabled if this service indicator is red. When this indicator is light gray and white, the unit is performing within parameters and does not require servicing.

**Main Screen**

The Main screen appears below. Following the initial Splash screen, this is the first screen the user will see at power-on. This screen is comprised of the Status Bar on the left and four (4) blue application buttons that access the main functionality of the unit.




*Sample.* Pressing the **SAMPLE** button will cause the instrument to enter Sample Mode. In Sample Mode, the unit will perform a single sample reading, storing the results upon completion. A sample will typically take about 3 minutes to perform. Sample Mode is described in greater detail later.

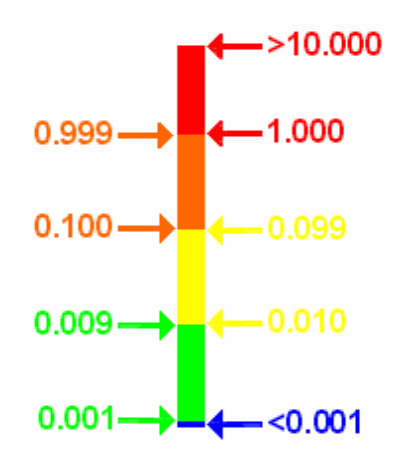
*Continuous.* Pressing the **CONTINUOUS** button will cause the instrument to enter Continuous Sample Mode. In Continuous Sample Mode, the unit will continuously take mercury concentration readings, displaying the real-time results. The unit will remain in Continuous Sample Mode until cancelled by the user. Results in this mode may be stored upon user request. Continuous Sample Mode is described in greater detail later.

*Browse.* Pressing the **BROWSE** button will bring up a list of all currently stored sample readings. The user may browse forward and backward through the recorded samples.

*Options.* Pressing the **OPTIONS** button will bring up a list of the instrument optional settings. From the Options screen, the user can change options like the LCD contrast and the audible alarm setting.

**Sample Display Format**

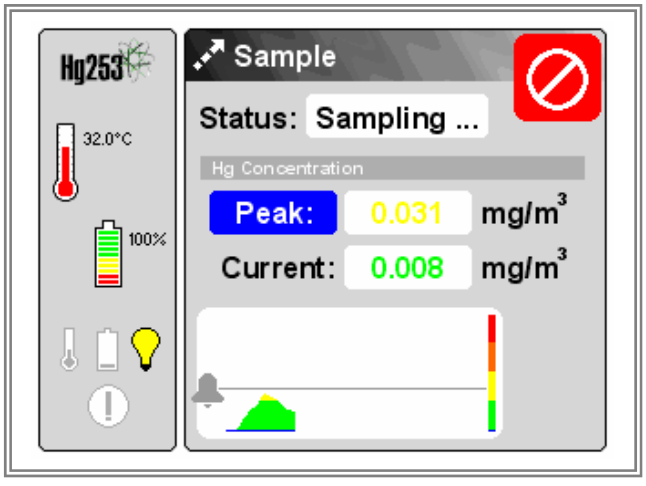
All mercury sample concentration measurements on this device are stored and displayed using units of milligrams per cubic meter, i.e. **mg/m$^3$**. So, if a numeric concentration is reported alone as **0.009**, this is **0.009 mg/m$^3$**. Also, note that concentration measurements are always reported in color. Anytime that an instrument sample is displayed and/or plotted on screen, a specific color scheme is used to help quickly identify the relative magnitude of the sample reading. The logarithmic color scheme is as follows:




- Extremely high levels (**1.000** to **>10.000 mg/m$^3$**) are plotted in red.
- High levels (**0.100** to **0.999 mg/m$^3$**) are plotted in orange.
- Intermediate levels (**0.010** to **0.500 mg/m$^3$**) are plotted in yellow.
- Low levels (**0.001** to **0.009 mg/m$^3$**) are plotted in green.
- Blank levels (**<0.001 mg/m$^3$**) are plotted in blue.

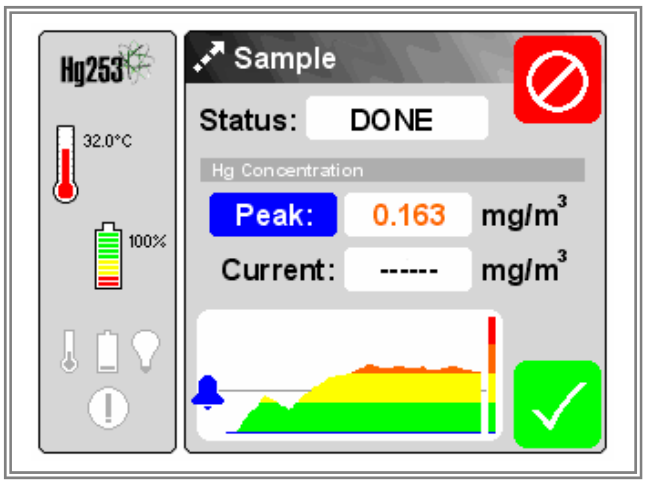
**Sample Mode**

The Sample Mode screen appears below. In Sample Mode, the instrument will perform a single mercury concentration reading. A typical sample will take approximately 3 minutes to complete, but may take as long as 5 minutes if the lamp intensity becomes unstable. After the initial lamp warm-up period of 2 to 3 minutes, the actual analytical sample is performed in less than 30 seconds. During the sample period, the instrument status is updated on the screen. Also the current, average and peak concentrations are recorded on-screen. The peak and average reading share a numeric/text toggle indicator control, so pressing



the blue label will toggle the control between peak and average display modes. The sample is also plotted in real-time at the bottom of the screen. This graph is a logarithmic plot of instantaneous mercury concentrations over the sample duration. If the audible concentration alarm is currently enabled, a gray alarm icon will appear on the graph along with a line indicating the audible alarm level. If, at any time during the sample, the instantaneous concentration exceeds the alarm level, the audible alarm will sound and the alarm icon will turn blue. If any instantaneous concentration reading exceeds the alarm icon, then the alarm icon will be blue at the conclusion of the sample.

Pressing the **CANCEL** button will abort the sample and return the user to the Main screen. No data is stored if the **CANCEL** button is pressed. When a sample completes, the status reports: **DONE**. At this time, the current real-time reading is cleared and only the **PEAK** and **AVERGE** readings over the sample interval are reported. Instantaneous concentrations over the entire sample duration are plotted on the graph at the bottom of the screen. Also, as soon as a sample completes, a green **OK** button will appear in the lower-right corner. Pressing the **OK** button will accept the sample result, store the result in memory and return the user to the Main screen. Only the **PEAK** and **AVERAGE** readings over the interval are stored in memory for a sample. Real-time readings are discarded. Pressing the red **CANCEL** button will discard the sample results, not storing results in memory, and return the user to the Main screen.

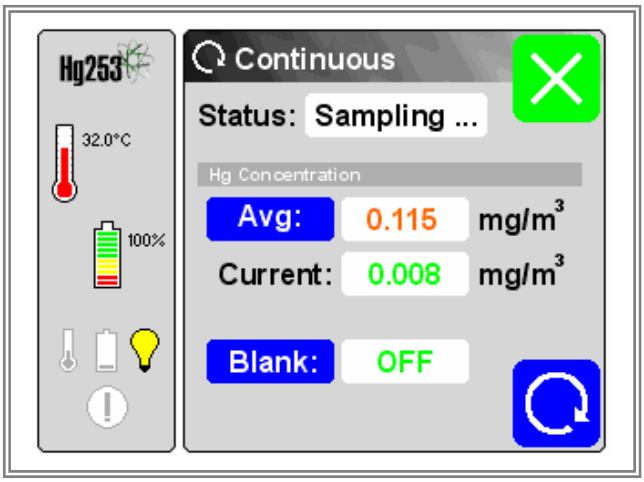



**Continuous Sample Mode**

The Continuous Sample screen appears below. In Continuous Sample Mode, the instrument will continuously perform mercury concentration measurement of the sample gas. In most respects, this sample mode is very similar to the standard Single Sample mode. However, in Continuous Sample Mode, the instrument constantly samples the air for mercury. It will not stop after a single sample is complete. Instead, current, peak and average concentration measurements are

calculated and displayed continuously. Due to size restrictions, the graph and alarm icons available in Single Sample mode are unavailable in this mode (though the audible alarm will still sound). A manual **BLANK** feature is available in this mode. When manual blank is **ON**, the auto-zero system is manually engaged. This has the effect of blanking out the sample air. When the manual blank is **OFF**, the unit will perform normally. Use the manual blank mode to verify the presence of mercury in the air or to check for massive interferences in the environment.

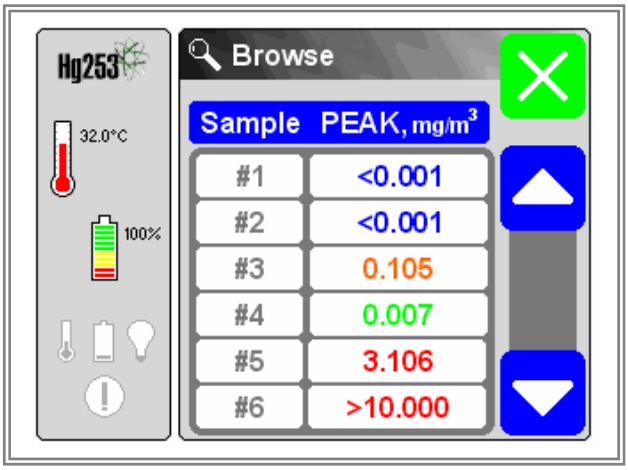
The Continuous Sample Mode is intended for rapid screening of large areas and longer term testing. Samples may still be stored in this mode using the blue **CONTINUOUS SAMPLE** button in the lower-right corner. This button will store the current reading in memory and continue sampling. If a valid reading is currently unavailable (possibly due to re-zeroing or lamp intensity drift), this button will be temporarily disabled. Pressing the **CLOSE** button will exit Continuous Sample Mode and return to the Main screen.




**Browse Samples Screen**

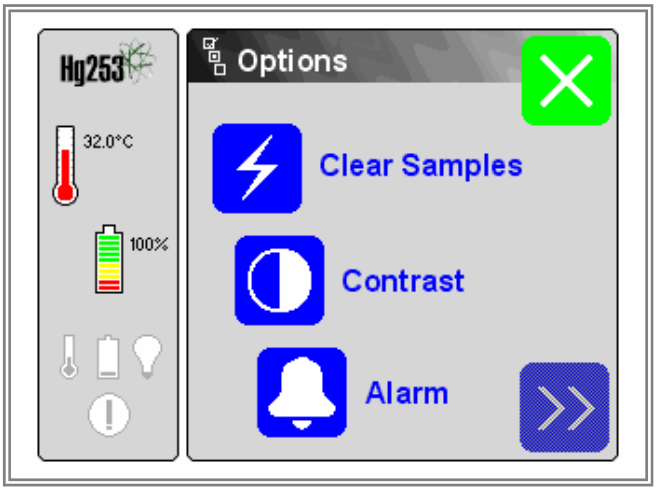
The Browse Samples screen appears below. In this screen, the user can browse through all previously recorded samples. Samples are numbered incrementally from **#1** up to **#99**. Sample **PEAK** and **AVERAGE** concentrations are stored in **mg/m$^3$** from **0.001** to **10.000**. Pressing the blue header bar at the top of the browse list toggles display of **PEAK** or **AVERAGE** concentration values for all samples. When entering the Browse Samples screen, the last recorded sample reading is always displayed. If a blank or under-limit reading is recorded, it will be displayed in blue text as **<0.001**. If an over-limit reading is recorded, it will be displayed in red text as **>10.000**. In-range readings are recorded as follows: green text for readings between **0.001** and **0.009**, yellow text for readings between **0.010** and **0.099**, orange text from **0.100** to **0.999** and red text for readings over **1.000**. Press

the **UP** and **DOWN** arrow keys to browse additional pages. If an arrow key is disabled, there are no more samples stored in that direction. Press the **CLOSE** button to close this screen and return to the Main screen. Use the **CLEAR SAMPLES** button in the Options screen to clear the sample list.



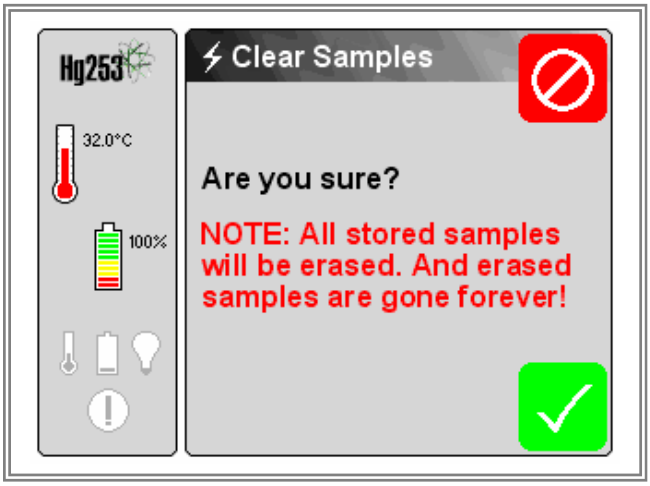

**Options Screen**

The Options screen appears below. In this screen, the user can reach optional settings for the LCD contrast level and the audible alarm level. There is also an option to clear ALL currently saved samples from memory. The **ADVANCED OPTIONS** button in the lower-right corner is currently disabled awaiting future software update. Advanced features like Manager lockout control and data logging will be supported through an Advanced Options menu. Pressing the **CLOSE** button will close this screen and return to the Main Screen.



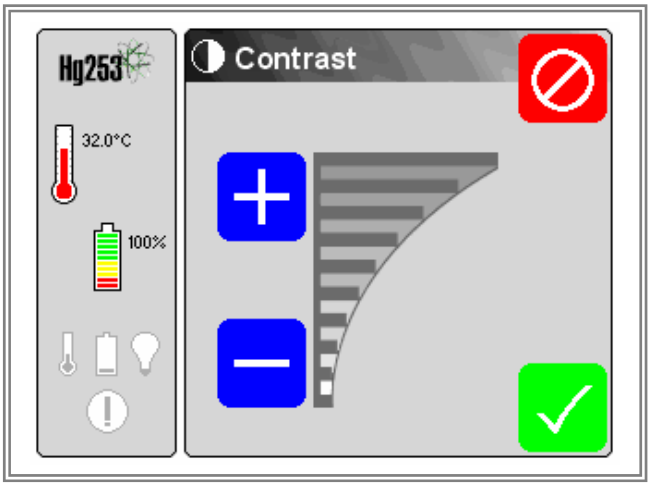
**Clear Samples Screen**

The Clear Samples screen appears below. When a user presses the **CLEAR SAMPLES** button in the Options screen, this screen will appear. Clearing sample memory is final and irrevocable. For this reason, confirmation of the **CLEAR SAMPLES** button is required. Press **OK** to clear all samples and return to the Options screen. Press the **CANCEL** button to safely exit the erase operation and return to the Options screen.




**Contrast Screen**

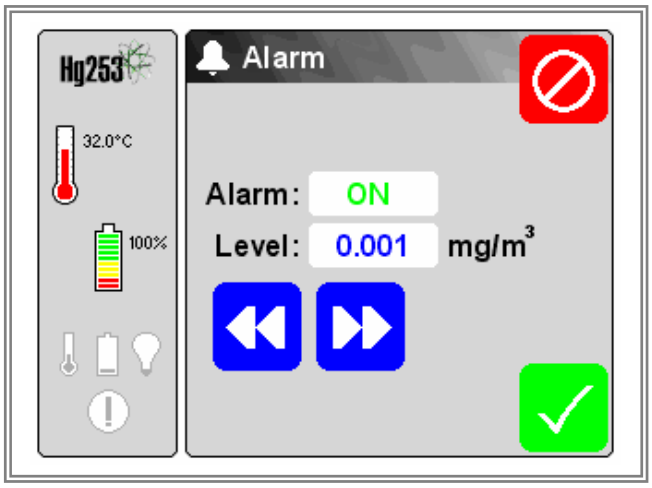
The Contrast screen appears below. In this screen the user can adjust the LCD contrast level up or down accordingly. The setting is stored in memory and will be retained even after power-off. Press the **PLUS** button to increase the contrast. Press the **MINUS** button to decrease the contrast. Pressing the **OK** button in the lower-right corner will store the current setting and return to the Options screen. Pressing the **CANCEL** button at any time will close the Contrast screen and return to the Main screen without saving any changes.



**Audible Alarm Screen**

The Audible Alarm screen appears below. In this screen, the user can set the mercury concentration level at which an audible alarm will sound. During sampling, any concentration measurement greater than or equal to the set level will cause the alarm to sound. The alarm is real-time only. Time-averaged alarm features, however, will be available in future software updates. The alarm can also be disabled. The **NEXT** and **PREVIOUS** buttons will cycle forward and backward through the available alarm levels (including **OFF**). The current available alarm level settings are (in **mg/m$^3$**): **OFF**, **0.001**, **0.010**, **0.012**, **0.050**, **0.100**, **0.500**, and **1.000**. Other alarm level settings will be added in future updates. The next software version will also support a manager function that sets the alarm levels available in this screen. In this way, managers can add custom alarm levels and limit the available levels to only their own in-house standards.

Pressing the **OK** button in the lower-right corner will store the current setting and return to the Options screen. Pressing the **CANCEL** button at any time will close the Audible Alarm screen and return to the Main screen without saving any changes to the alarm settings.



# Maintenance

**Maintenance Summary**
The GLSI Hg253 Portable Mercury Vapor Analyzer is a low maintenance instrument. There are a handful of replaceable/serviceable filters, including a particulate filter, a dehydrating (desiccant) filter, and mercury scrubbing filters. There are also other possible replaceable/consumable parts, including a mercury vapor lamp, sample probe, additional batteries, and battery components. Under normal operation, only the external particle filter need be replaced. All other replaceable components are replaced annually during factory calibration. The rechargeable batteries must be recharged daily or as used. Use the included wall chargers to recharge the batteries. Detailed maintenance cycles for each replaceable part are listed below.

*External filter.* The external 0.25µm Teflon™ particulate filter attached to the sample probe must be replaced weekly. Replace it more frequently if the instrument is operated in areas of high particle concentration (dust, pollen, etc.) 25mm-diameter Teflon syringe filters with pore sizes of 0.50µm to 0.2µm are an acceptable replacement part. Smaller 13mm Teflon syringe filters are too small, and drastically restrict airflow through the instrument. 25mm Teflon syringe filters can be purchased from several scientific product distributors such as Cole-Parmer®, VWR Scientific®, and Fisher Scientific®.

*Internal filters.* The internal dehydrating filter and mercury scrubbing filters will typically last over a year. These filters are routinely replaced during annual factory recalibration and are rarely a problem. If, however, the unit is operated within areas of extremely high mercury concentrations (greater than 1.000 $mg/m^3$) for extended periods of time, the mercury scrubbers may require early replacement. Also, if the unit is operated in areas of high humidity, the dehydrating filter may require early replacement. In these rare cases, the instrument must be serviced at the GLSI facilities or on-site by a qualified Hg253 service technician. Removal of the internal filters requires recalibration and should not be attempted by the user at any time.

*Mercury lamp.* The internal mercury vapor lamp may also require replacement in the event of lamp failure. It is possible that a severe impact or extreme heat may cause damage to the lamp filament or cause a loss in vacuum pressure. Either problem would cause a lamp malfunction and necessitate immediate replacement. As with the internal filters, in this case the instrument must be serviced at the GLSI facilities or on-site by a qualified Hg253 service technician. Replacement of the mercury vapor lamp requires detector recalibration and should not be attempted by the user at any time.

Instruments sent back to GLSI facilities for service are typically repaired and returned within five working days after arrival on-site.

**Maintenance Schedule**

The daily and weekly maintenance issues for the Hg253 Portable Mercury Vapor Analyzer are very minimal. The largest daily maintenance issue involves the rotation and charging of the quick-swap battery packs. Although these battery packs allow much longer operating periods they must be changed and recharged frequently. A 12-hour sampling period requires approximately 6 to 8 batteries. There is no danger of running the batteries too low, but the batteries will take roughly 8 hours to recharge using the supplied wall chargers. We recommend recharging all batteries at the end of each workday. Also if the lead-acid batteries sit on a shelf too long (over a month), they may require an additional recharge before they will function properly.

The particulate filter should be replaced weekly, or more frequently in very 'dirty' areas. The unit should never be operated without a particulate filter; erratic results may occur, as small particles will randomly interfere with lamp intensity.

Annual maintenance issues are typically addressed during our provided factory calibration service. If, however, you choose not to use our calibration service, these maintenance issues must be addressed.

***Typical Maintenance Schedule***

**Daily**

- Replace batteries as needed during the day.
- Recharge batteries at the end of the day using included wall chargers.

**Weekly**

- Replace external particulate filter.

**Monthly**

- Recharge any batteries that have been sitting for over a month.

**Annually**

- Replace external sample probe.
- Replace internal dehydrating (desiccant) filter.
- Replace two internal mercury scrubber filters.
- Replace internal mercury vapor lamp.
- Replace two internal analytical quartz cells.
- Replace internal glassware and tubing.
- Replace internal diaphragm pump.

**Basic Maintenance Procedures**
The common daily, weekly and monthly maintenance is very minimal. We do offer some recommended procedures for the removal and replacement of three of the commonly handled items: the sample probe, the particulate filter, and the batteries.

*Sample probe removal/attachment.* To attach the vapor sample probe, hold the cylindrical, black plastic fitting located at the base of the probe. Twist the entire sample probe clockwise while applying minimal forward force to help thread the probe Luer™ fitting onto the case fitting. Twist the sample probe until the cylindrical, black plastic fitting is nearly flush with the instrument case. To remove the sample probe, simply reverse the process.

*Particulate filter replacement.* First remove the current exhausted filter by twisting the filter counter-clockwise. Discard the old filter appropriately. After removal of the current filter, attach a new replacement filter. Remove new filter from packaging and twist the filter clockwise while applying minimal forward force to help thread the filter into place. The filter should require just under a full turn to remove or attach.

*Rechargeable battery replacement/recharging*. First, turn off the power switch on the instrument and remove the DC power cord, if necessary. Press the manual battery release button located just above the battery to eject the current battery. Remove the battery and replace with a new battery. The new battery will click and lock in place when it is pressed in fully. Charge the depleted battery using the supplied wall chargers.

# Factory Calibration Service

**Service Summary**
In addition to the regular maintenance of the instrument, we strongly recommend an annual GLSI factory calibration. This service is intended to re-certify the instrument for continued operation. The instrument will require recalibration annually to ensure it is operating properly. Typically this service will take less than a single week to perform after we receive a unit on-site. All instrument software will be upgraded to the latest version and a new operation manual will be included, if necessary. All internal and external replaceable components will be replaced with new components at the factory and will be thoroughly tested. The NIST-traceable temperature sensor will also be recalibrated and re-certified. And, of course, the instrument will be chemically recalibrated to in-house mercury concentration standards.

**Service Details**
During the factory calibration service, the following maintenance, calibration and update procedures are performed:

**MAINTENANCE PROCEDURES**

- External sample probe replacement (1).
- Internal desiccant filter replacement (1).
- Internal mercury scrubber filter replacement (3).
- Internal mercury vapor lamp replacement (1).
- Internal analytical quartz cell replacement (2).
- All internal glassware and tubing replacement (variable).
- Internal diaphragm pump (1).

**CALIBRATION PROCEDURES**

- Flow calibration.
- Mercury vapor lamp calibration.
- NIST-traceable temperature sensor certification.
- Mercury concentration calibration.

**UPDATE PROCEDURES**

- Software update.
- Operation manual update.
- Design refits may be completed during this service as well. Refits will be announced as available.

Please contact a GLSI representative to determine current pricing and scheduling for our factory calibration service.

# Warranty

**Comprehensive Warranty**
The GLSI Hg253 Portable Mercury Vapor Analyzer is covered by a 1-year comprehensive warranty from the date of delivery. This instrument is warranteed for a period of one year to be free from defects in material and workmanship and will conform to published GLSI technical specifications. Any defective or non-conforming product will be repaired at our expense during the warrantee period. The warranty will cover normal replacement/repair of: electrical board failure, internal wiring, battery mounting hardware failure, and external switch/port damage. Defects in the strap, handle, packaging and carrying case are also fully covered. Minor cosmetic packaging defects, such as scratches and dents are not covered under warranty. This comprehensive 1-year warranty covers the entire instrument with the exception of the touch-screen and the common consumable/replaceable components specifically listed below.

**Consumable Parts Warranty**
These items are NOT specifically covered by the 1-year comprehensive instrument warranty above. These consumable/replaceable components will have individual warranty periods as specifically identified.

| | |
|---|---|
| Sample Probe | 90-day part warranty |
| Internal desiccant filter | 90-day part warranty |
| Internal mercury scrubber filter | 90-day part warranty |
| Internal analytical quartz cell | 90-day part warranty |
| Internal glassware and tubing | 90-day part warranty |
| Internal mercury vapor lamp | 90-day part warranty |
| Lead-acid batteries | 90-day part warranty |
| Lithium-ion batteries | 90-day part warranty |
| Particulate filter | NO warranty |

**Touch-Screen Warranty**
The color touch-screen is covered by its own 1-year warranty. Internal electrical component failure of the touch-screen and damage under normal operation will be fully covered under warranty with the following exceptions. Use of sharp and/or metallic objects with the touch-screen will void the warranty. These objects will scratch the touch-screen surface and may cause internal damage. To avoid unnecessary scratching, use only the pad of your finger with the touch-screen. Surface scratches will not be repaired under warranty. Large concussive forces may also damage the internal backlight. Avoid dropping the unit or hitting the touch-screen surface with significant force. Damage to the touch-screen due to large concussive forces will not be repaired under warranty.

**Operating Environment**
The GLSI Hg253 Mercury Vapor Analyzer is intended for vapor use only. Do NOT allow the sample probe or the instrument's intake port to come into direct contact with liquids or other foreign material. Irreparable damage may result. Hazardous, extreme environments may also cause damage to the unit and operation under these conditions will void any warranty coverage. If the instrument is damaged as a result of extreme environmental conditions, we will not repair the instrument under warranty.

This instrument contains fragile internal glass components and is, therefore, susceptible to damage from highly concussive forces, including dropping the instrument. Lamp, touch-screen and internal glassware damage due to severe impacts will not be covered under warranty.

THIS INSTRUMENT IS NOT EXPLOSION-PROOF. This instrument is not designed to operate in hazardous environments where device malfunction could result in personal injury. Use of this product in hazardous environments is done at the risk of the user.

Obvious cases of excessive user abuse will not be covered under warranty; and GLSI is the sole determiner of what constitutes excessive user abuse.