CAL1250
Sound Level Calibrator

Reference Manual

LARSON DAVIS
A PCB DIVISION

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Warranty

For warranty information, go to the Larson Davis Product Warranty page.

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Chapter 1 Introduction to the CAL1250

The Larson Davis CAL1250 sound level calibrator is a battery-operated, precision instrument used for calibrating sound level meters and other sound measurement equipment at multiple frequencies and levels.

It has been designed for both field and laboratory use. The accuracy has been calibrated to a reference traceable to the National Institute of Standards and Technology (NIST).

1.1 Features

The Larson Davis CAL1250 Sound Level Calibrator has the following features:

- Meets CLASS 1 Acoustic Calibrator specifications
- OLED display
- Internal temperature, humidity, and static pressure sensors
- Dual output levels: 94.0 dB and 114.0 dB (user selectable)
- Dual output frequency: 250 Hz and 1 kHz (user selectable)
- Internal rechargeable lithium-ion battery (user-replaceable)
- USB-C charge port
- Swappable microphone adapter

1.2 Included “In-The-Box”

The original packaging for the CAL1250 Calibrator will include the following:

- CAL1250 Sound Level Calibrator
- Protective Carrying Case (CCS064)
- Adapter for use with 1” microphones (ADP117)
- Adapter for use with 1/2” microphones (pre-installed on calibrator) (ADP118)
- Adapter for use with 1/4” microphones (ADP119)
- USB-C to USB-C cable and USB-A to USB-C adapter (CBL242-03)
- Calibration Certificate (CER-CAL1250)

1.2.1 Optional Accessories

The following accessories are available separately from Larson Davis:

- Adapter for use with 1/8” microphones (ADP120)
- Adapter for use with 3/8” microphones (ADP121)

1.3 Getting Started

The following sections provide the information needed to prepare the CAL1250 for use. Referring to these sections before using the calibrator will provide the best results.

1.3.1 Charging the Battery

The CAL1250 is shipped from Larson Davis with the internal lithium-ion battery charged to about 50%. It is recommended to charge the unit to full before first-time use. Using the provided USB-C cable (and USB adapter if necessary), connect one end of the USB-C cable into the USB-C port on the side of the CAL1250, and the other end to an appropriate power supply (5 V, > 500 mA). The calibrator will power on when connected to power over USB but will not produce a tone unless un-muted by pressing the “dB” button.

While charging, the calibrator will show a battery-charging animation in the top-right corner of the display. When fully charged, the battery animation will be replaced with a lightning bolt icon. If the unit powers off while charging, the display will briefly show a large battery icon with a lightning bolt in the center to indicate the unit is still charging. A full charge takes approximately 3.5 hours.

NOTE The battery will slowly discharge over time, even while unit is off. If the unit is left unused for an extended period of time (several months), it may be necessary to recharge the battery.

1.3.2 Calibrator Display and Button Overview

The CAL1250 has four buttons: Power, Hz, dB, and Info.

To power on the calibrator, briefly push the power button. Repeat to turn off the calibrator.

When powered on, the calibrator will automatically begin emitting a tone. The level can be toggled between 114.0 dB and 94.0 dB by briefly pushing the “dB” button. The frequency can be toggled between 1000 Hz and 250 Hz by briefly pushing the “Hz” button. The active level/frequency combination when the calibrator is powered off will remain the active combination when powered on again.

Holding the “dB” button for several seconds will switch the calibrator from “Normal Mode”, to “Infinite Mode”. In Normal Mode, the calibrator will power on for 120 seconds before shutting down. This countdown is shown in the upper left corner of the display. Any button press during this countdown resets it to 120 seconds. In Infinite Mode, the calibrator will emit a tone until the user turns the unit off or the battery dies, and the countdown timer will be replaced by the “infinity” symbol (∞).

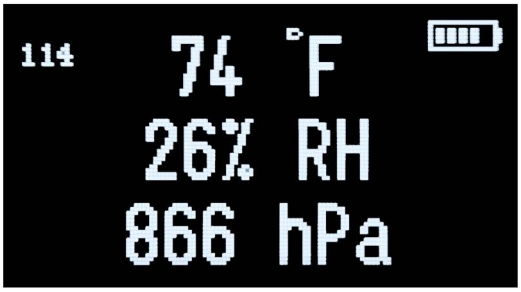
NOTE When the calibrator is connected to power over USB, the calibrator will power on with the tone muted. It can be un-muted by briefly pressing the “dB” button.

The CAL1250 can display three unique pages. The default page shows the calibrator frequency, level, and microphone coupling status. When the circular icon below the battery status icon is filled, the microphone is coupled. When the circle is empty, the microphone is decoupled.

FIGURE 1-1 Overview Screen

To see the Sensor page, with information about temperature, humidity, and static pressure, press and release the “Info” button (“i” with a circle around it). To change between Celsius and Fahrenheit, press and hold the “Info” button.

FIGURE 1-2 Sensor Screen



To see the About page, with shows the device serial number, firmware version, manufacture date, and hardware revision, press and hold the “Hz” button.

Tapping “Hz”, “dB”, or “Info” on the Sensor page or About page will return the calibrator to the default page.

1.3.3 Installing Microphone Adapters

The CAL1250 requires a microphone adapter. This can be easily changed to match the required microphone size.

- For 1” microphones, use the ADP117.
- For 1/2” microphones, use the ADP118.
- For 1/4” microphones, use the ADP119.

To remove the installed adapter, grip the outer ring of the adapter and turn it a quarter turn counter-clockwise (looking into the calibrator chamber), then pull the adapter out of the chamber.

To install an adapter, first ensure that the calibrator chamber and adapter are free from debris and dirt. Insert the adapter into the calibrator chamber, lining up until it seats properly. Then rotate a quarter turn clockwise to secure the adapter in the chamber.

Chapter 2 Using the Calibrator

In this chapter:

2.1 Performing a Calibration

The CAL1250 provides a nominal tone of 1 kHz, which requires no weighting corrections when used with sound level meters utilizing A, B, C or Z (Flat) frequency weighting. The CAL1250 also can output 250 Hz, but will require correction if using A frequency weighting.

A few things to consider before starting a calibration:

- Allow the calibrator sufficient time to adjust to environmental conditions, especially temperature. This allows for more accurate calibrations.
- Ensure that the ambient noise level is sufficiently low for an accurate calibration. Calibration levels will be influenced by less than 0.015 dB for external noise levels lower than 89 dB for the 114.0 dB level and 69 dB for the 94.0 dB level.
- Ensure the microphone grid cap is installed securely before inserting the microphone into the calibrator chamber to avoid microphone damage.
- Ensure the proper microphone adapter is installed on the calibrator.
- When the CAL1250 battery is too low for a calibration, a “Low Battery” symbol will flash on the display a few times and the unit will not power on.
- It is good practice to perform a calibration check and any necessary adjustments of the instrument before beginning of a sequence of measurements. At the end of the measurement sequence, the calibration should be checked again. The inaccuracy of the measurements will be at least as large as the difference between the level measured for the initial calibration (or calibration check) and the level measured for the final calibration check.

2.1.1 Performing the Calibration

Step 1. Power on the calibrator and select the appropriate level and frequency.

Step 2. Insert the microphone into the calibrator chamber, as shown in **FIGURE 2-1** below. Ensure they fit together securely. If the wrong adapter is installed, see **1.3.3 Installing Microphone Adapters** for instructions.

WARNING! Ensure the microphone's grid cap is installed before inserting the microphone into the calibrator. Failure to do so may result in microphone damage.

Step 3. Allow time for the calibrator to stabilize, typically less than 10 seconds. The calibrator is stable when the "dB" indicator on the display stops flashing.

Step 4. Fix the arrangement vertically. If this is not possible, laying the arrangement on a flat surface is preferred to holding the arrangement by hand. Initiate the calibration on the instrument and wait for it to complete.

The preferred method for calibrating with the CAL1250 is to mount the preamplifier in a fixed, vertical position.

When calibrating a meter that has an auto-calibration feature, ensure the calibrator has stabilized before accepting the results of the calibration on the meter.

FIGURE 2-1 Vertical Positioning

Step 5. To verify the calibration was successful, take a measurement while the calibrator is still active. If the reading is not within tolerance, try recalibrating, or refer to the instrument's manual for instructions on how to adjust the instrument.

2.2 Calibrator Level Corrections

Sound Field Influence depends on the type and model of a microphone used for calibration. The level measured by a microphone in an acoustic calibrator will also be affected by variations in the construction of the microphone. For pressure microphones, the influence is less than it is for free-field microphones. The frequency response of most microphones is flat at 251.2 Hz, so the "correction" at that frequency is always 0.00 dB. Correction is only necessary

when calibrating at higher frequencies. **Table 2.1** below provides typical correction values for microphones manufactured by PCB Piezotronics and Larson Davis.

Table 2.1 Typical Correction Values for PCB/Larson Davis Microphones

Model	Correction (dB @ 251.2 Hz)	Correction (db @1000 Hz)
377A06	0.00	-0.06
377A07	0.00	-0.16
377A12	0.00	-0.03
377A14	0.00	0.00
377A15	0.00	0.00
377A21	0.00	-0.01
377B02	0.00	-0.12
377B11	0.00	0.00
377C01	0.00	-0.07
377C10	0.00	0.00
377C13	0.00	-0.03
377C41	0.00	-0.07
2520	0.00	-0.07
2530	0.00	0.00
2540	0.00	-0.04
2559	0.00	0.00
2560	0.00	0.00
2570	0.00	-0.23
2575	0.00	0.00
Other	See **2.2.1**	See **2.2.1**

To calculate the corrected calibrator level as found on your calibrator certificate, take the certified level from your calibrator and add the correction above for your microphone model.

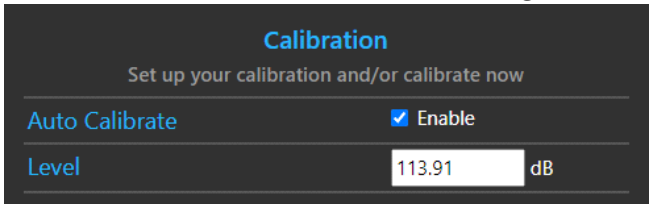
Level Seen By Meter = Certified Calibrator Level + Correction Value

Example: A user wants to calibrate their sound level meter at 114 dB and 1000 Hz. The user's calibrator is certified to 114.03 dB at 1000 Hz. They are using a 377B02 Free-Field Microphone on their meter. At 1000 Hz, the correction from the table for the 377B02 is -0.12 dB.

114.03 dB + (-0.12 dB) = 113.91 dB.

So, the user would set the calibration level in their sound level meter to 113.91 dB, instead of 114.0 dB, as shown in **FIGURE 2-2**.

FIGURE 2-2 SLM Calibration Settings



If the user were calibrating at a different frequency or level, they would need to look at the calibrator's certification for that combination. The following table provides an example for each frequency and level available.

Table 2.2 Example Meter Calibration Setting with 377B02

Desired Frequency and Level	Example Calibrator Certification	Typical 377B02 Correction	Meter Calibration Setting
1000 Hz @ 114 dB	114.03 dB	-0.12 dB	113.91 dB
1000 Hz @ 94 dB	93.99 dB	-0.12 dB	93.87 dB
250 Hz @ 114 dB	113.98 dB	No Correction	113.98 dB
250 Hz @ 94 dB	94.02 dB	No Correction	94.02 dB

2.2.1 Finding 1kHz Free-Field to Pressure Correction from Microphone Certificate

The certificate included with a microphone typically has correction values for 251.2 Hz and 1000 Hz. These values can be used to calculate the free-field to pressure correction for the microphone. The correction is equal to the difference between the 1000 Hz value and the 251.2 Hz value.

Correction Value = (1000 Hz Certification in dB) - (251.2 Hz Certification in dB)

Example: The certificate below is for a specific 377B02 microphone. **Table 2.1** suggests the typical 1000 Hz correction for a 377B02 is -0.12 dB. The correction value can be calculated by subtracting the 251.2 Hz level from the 1000 Hz level.

FIGURE 2-3 Example 377B02 Microphone Certificate

Frequency [Hz]	Actuator [dB]	Free Field [dB]	Lower limit [dB]	Upper limit [dB]	Result
251.19	0.00	0.00	-0.50	0.50	Pass ‡
316.23	0.00	0.01	-0.50	0.50	Pass ‡
398.11	-0.01	-0.01	-0.50	0.50	Pass ‡
501.19	-0.02	0.02	-0.50	0.50	Pass ‡
630.96	-0.03	0.01	-0.50	0.50	Pass ‡
794.33	-0.04	0.05	-0.50	0.50	Pass ‡
1,000.00	-0.06	0.06	-0.50	0.50	Pass ‡
1,059.25	-0.07	0.06	-0.50	0.50	Pass ‡
1,122.02	-0.07	0.07	-0.50	0.50	Pass ‡
1,188.50	-0.08	0.07	-0.50	0.50	Pass ‡

Subtract

Correction Value = (-0.06 dB @ 1000 Hz) - (0.00 dB @ 251.2 Hz) = -0.06 dB

The following table provides an example for each frequency and level available.

Table 2.3 Example Meter Calibration Setting Using Microphone Certification

Desired Frequency and Level	Example Calibrator Certification	Correction Calculation using Microphone Certification	Meter Calibration Setting
1000 Hz @ 114 dB	114.03 dB	-0.06 - 0.00 = -0.06 dB	113.97 dB
1000 Hz @ 94 dB	93.99 dB	-0.06 - 0.00 = -0.06 dB	93.93 dB
250 Hz @ 114 dB	113.98 dB	No Correction	113.98 dB
250 Hz @ 94 dB	94.02 dB	No Correction	94.02 dB

2.3 Calibration History

Larson Davis strongly recommends that a history of each calibration adjustment be kept for each piece of equipment. Normally, most modern equipment requires little or no adjustment once the initial calibration is performed. Systematic drifts are possible, and these should be recorded for corrective action.

Most Larson Davis sound level meters keep a history of each calibration change that can be retrieved. Please refer to the individual instrument manuals for details.

2.4 Environmental Precautions

While the CAL1250 will perform normally under a wide variety of gradually changing environmental conditions, some precautions should be taken when sudden changes occur:

- The temperature of the CAL1250 should be stable. If the temperature changes suddenly, such as moving between indoor and outdoor environments, allow at least 15 minutes, or more optimally, 45 minutes for the calibrator to adjust. This will ensure that the temperature compensation sensors are at the same temperature as the rest of the unit.
- While the CAL1250 is not adversely impacted by humidity, avoid environments that promote condensation. Avoid settings where the relative humidity exceeds 90%, as condensation is likely to occur.
- The CAL1250 is effectively immune to electric or magnetic fields. However, the instrument being calibrated may not be. Therefore, calibration should not be done near motors, dynamos, high voltage wires, or other sources of electromagnetic fields.

2.5 Calibrating the Calibrator

The American National Standards Institute states, “An acoustical calibrator should be recalibrated at least annually by the instrument manufacturer or an acoustical test laboratory qualified to perform calibration.” (American National Standards Institute. Specifications for Acoustical Calibrators. ANSI S1.40, 2006, par. 5.2)

If the CAL1250 is being used to calibrate several instruments, then the history of calibration adjustments can usually pinpoint which instrument is drifting. If all the measurement instruments are drifting in the same direction by an amount considered significant, the CAL1250 should be re-certified. If several instruments and several calibrators are in use, then the history of calibration adjustments would precisely pinpoint any problem pieces of equipment. Furthermore, it is probably satisfactory to recalibrate only one of the calibrators each year.

Chapter 3 Troubleshooting and Care

3.1 Troubleshooting

If the calibrator is behaving erratically, a hardware power-off may resolve the issue. This can be done by holding the power button for about 20 seconds.

The calibrator may also display an Error Code.

While the error code is displayed, pressing any button will return the device to normal operation. Rebooting the device is often the best way to see the error code again.

Refer to **Table 3.1 "Error Codes"** for details about the error code.

Table 3.1 Error Codes

Code	Error Name	Error Description
2	Sensor Failure	One or more of the sensors (Pressure, Temperature, Humidity) has failed. This means the device cannot correct for environmental conditions which could result in bad calibrations.
3	Audio Failure	Either the internal reference microphone is not working or the speaker is not producing a calibration tone. If you can hear the speakers cal tone, then this means the internal reference microphone is damaged or disconnected. This will likely mean the calibrator will never show it is stable.

3.2 Using G4 LD Utility with the CAL1250

The CAL1250 can be connected to G4 LD Utility in order to read and update the firmware version. Using a USB-C cable, connect the calibrator to a computer and open G4 LD Utility. Click on the calibrator (listed as CAL1250 XXXXX) under the “Meters” panel on the left side of the window to see a range of information about the calibrator including the firmware version. To update the firmware, click on the three dots (“...”), then click on “Upgrade Firmware”. A dialog box will open, and the newest firmware version should be selected automatically. Click “Upgrade Firmware” and wait for the process to complete.

3.3 Replacing the Battery

The CAL1250 comes with a rechargeable lithium-ion battery. We recommend that you use only an lithium ion battery approved by Larson Davis. The CAL1250 will run for up to 10 hours on one full charge, or approximately 2 months if run for 10 min/day. The battery should be replaced after 500 charge cycles or 3 years, whichever comes first.

NOTE If the CAL1250 battery is deeply discharged, pressing the power button may have no effect. In this situation, the unit may need to be charged via USB for 15-30 minutes before it will turn on. After plugging into USB, the CAL1250 should flash a battery symbol on the screen before turning the screen off while a battery charge recovery occurs.

To replace the battery:

Step 1. Remove the screw in the battery door (see **FIGURE 3-1** below).

FIGURE 3-1 Battery Door Screw Location

Step 2. Slide the battery door up away from the rest of the calibrator to remove it.

Step 3. Gently pull the existing battery from the battery terminals.

Step 4. Insert replacement battery into terminals, ensuring proper polarity.

NOTE If the battery is inserted backwards, the calibrator will not power on unless connected to power over USB. When connected to USB, the calibrator will assume the battery is dead and attempt to charge it, but a reversed battery cannot be charged. A reversed battery will not cause damage to the calibrator.

Step 5. Slide the battery door back into place, and re-attach the screw to secure it in place.

3.4 Cleaning the Calibrator

In most circumstances, wiping down the CAL1250 with a damp microfiber cloth is sufficient for cleaning. If desired, isopropanol can be used instead of water. DO NOT submerge the calibrator in liquids. If the chamber of the calibrator needs to be cleaned, take care not to allow any liquids through the vent holes onto the speaker.

Appendix A CAL1250 Specifications

The specifications contained in this appendix are subject to change without notice. Please refer to calibration and measurement results for data on a specific unit.

In this Appendix:

A.1 Standards Met

The CAL1250 sound level calibrator complies with the following international standards:

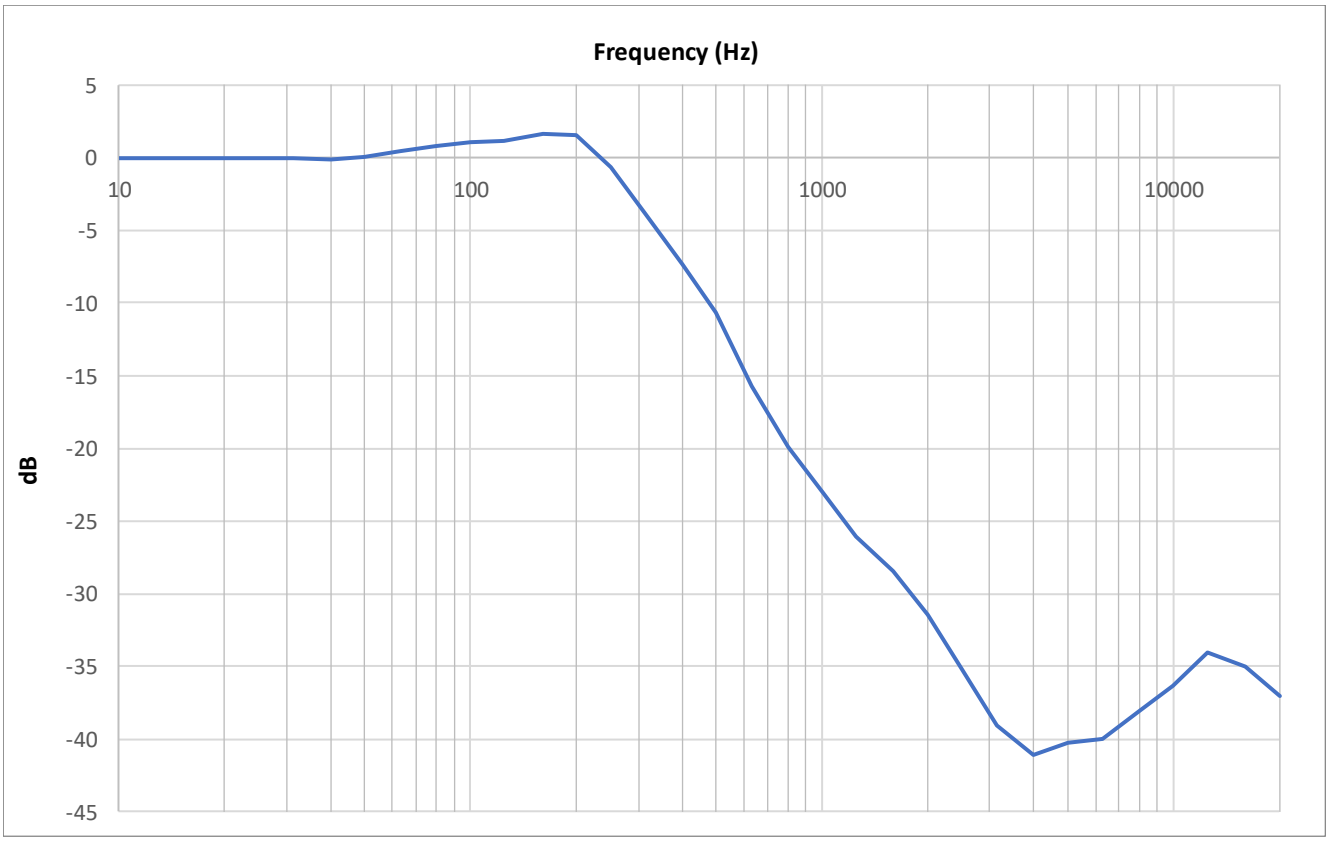
Specifications and Verification Procedures for Sound Calibrators, Class 1	**ANSI S1.40-2006**
Sound Calibrators Class 1	**EN 60942:2018**
Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use	**IEC 61010-1:2010**
EMC Standards	**EMC Low Voltage Directives** **EMC Immunity:** EN 61000-6-2:2005 per EN 60942:2018, EN 61000-3-2:2005+A1:2008+A2:2009, EN 61000-3-3:2008 (Device is immune to radio-frequency fields in all orientations. Minimum immunity occurs while charging over USB.) **EMC Emission:** EN 61000-6-3:2007+A1:2011 per EN 60942:2018 (Maximum emissions occur while charging over USB; frequency and level have no effect.)
	CE — CE-mark indicates compliance with the EMC, Low Voltage, and RoHs Directives WEEE mark indicates compliance with the EU WEEE Directive UKCA mark indicates conformity with the applicable requirements for products sold within Great Britain

A.2 Technical Specifications

Calibration sound pressure level	94.0 dB and 114.0 dB ± 0.2 dB re: 20µPa @ 101.3 kPa, 23 °C and 50% RH (114.0 dB is the principal sound pressure level)
Equivalent free-field level	93.88 dB and 113.88 dB for 1/2" free-field microphones, including 377B02 and other WS2F-compliant free-field microphones See **2.2.1**.
Specified frequencies	1000.0 Hz ± 1 Hz 251.2 Hz ± 1 Hz (1000 Hz is the principal frequency)
Total harmonic distortion	< 2%
Stabilization time	< 10 seconds (@94dB ambient noise < 69 dB, @114dB ambient noise < 89 dB) Allow >45 minutes when moving calibrator between environments with different temperatures and humidity (i.e. indoors to outdoors).
Static pressure range	65 kPa to 108 kPa, SPL variation < ± 0.2 dB
Temperature range	-10 °C to 50 °C, SPL variation < ± 0.2 dB, Frequency variation < ± 2 Hz
Humidity range	10% to 90% relative humidity (non-condensing), SPL variation < ± 0.2 dB, Frequency variation < ± 2 Hz
Displayed environmental values	The following accuracies are based on stabilization time given above. Temperature: ± 2 °C Relative Humidity: ± 5% Barometric Pressure: ± 0.4 kPa
Storage temperature	-40 °C to 60 °C
Storage humidity	0% to 90% relative humidity (non-condensing)
Load volume sensitivity	250 Hz : < 0.05 dB for effective load volume < 400 mm^3 1000 Hz : < 0.10 dB for effective load volume < 400 mm^3
Dimensions	Length 106.1 mm (4.18 in.) Width 63.4 mm (2.5 in.) Thickness 25.9 mm (1.02 in.)
Weight	156 grams (5.5 oz.)
User-replaceable lithium-ion battery (BAT027)	Run time: 10 hours (typical) Charge time: 3.5 hours (typical)
Battery specifications	3.7 V nominal, 1100 mAh
USB power	4.5 to 5.5 V, ≥500 mA
Traceability	Utilize a 1/2" IEC 61094-4 (WS2P) microphone in conjunction with other traceable measuring instruments to establish traceability of the output level and frequency of the Model CAL1250
Display	Monochrome OLED White 128x64 pixels 1.54" diagonal

Microphone compatibility	According to IEC 61094-4:1995: 1” WS1P, WS1F and WS1D microphones with ADP117 adapter. 1/2” WS2P, WS2F and WS2D microphones with ADP118 adapter. 1/4” WS3P, WS3F and WS3D microphones with ADP119 adapter. According to IEC 61094-1:2000: 1” LS1P with ADP117 adapter 1/2” LS2P with ADP118 adapter

FIGURE A-1 Typical Acoustic Isolation in Chamber



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