

Sound Lab by Gold Line

Noise Level Analysis

About NLA

The NLA module of Sound Lab is used to analyze noise over a specified period of time. NLA can be set to run for as short as one minute or as long as 24 hours. Traditionally this measurement is used to document compliance with local noise ordinances or OSHA noise requirements in the work place. NLA is also useful when designing and installing sound systems in places like gymnasiums, where noise is often the primary inhibitor to intelligibility.

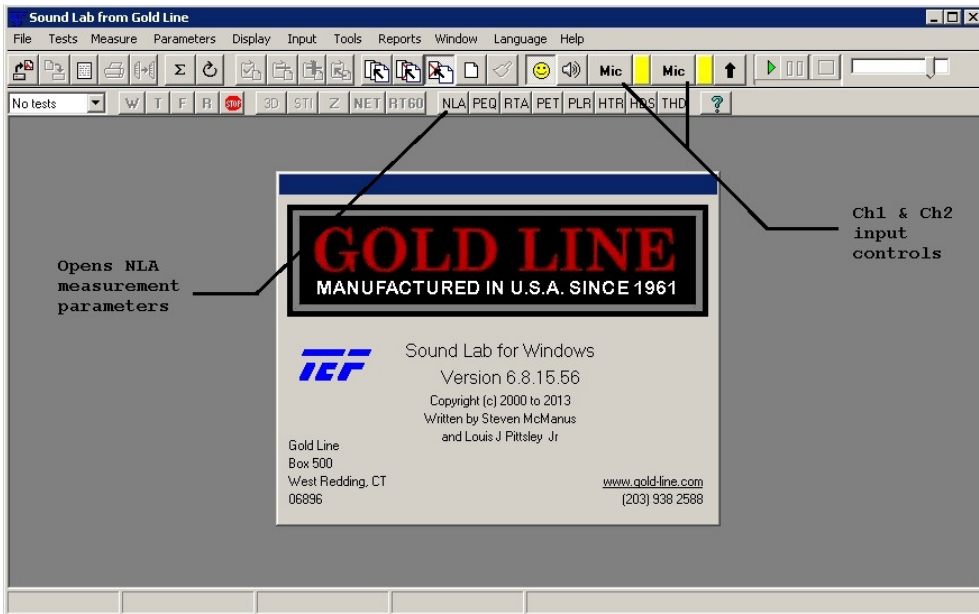
The original NLA was written for a product that only had one input channel. This has been expanded with the TEF25 to two channels in the new NLA release, version 6.8.14 or greater. Also, a new ability has been added to merge several consecutive NLA files into a summary file that contains all of the information of the individual files. This is useful when you need detailed information by the hour but you also need to do an 8-hour workday analysis or a 24 hour noise profile.

An enhanced version of NLA is available with WAV extensions. Several features have been added to increase the power of this measurement tool. The first added feature is post process Edit, The Edit function gives you the ability to edit an NLA measurement after it has been made by selecting points where extraneous noise has occurred and muting those points so that they do not interfere with the measurement. The muted data remains but it is skipped when calculating any statistical information about the measurement.

The NLA enhancement package also offers you new features associated with WAV files: Import, Output and audio playback. The Import feature allows you to load a WAV file into Sound Lab and convert it to an NLA measurement. The Output feature allows NLA to save a recording of the actual audio that the microphone was hearing at the time of the measurement, which is synced to the NLA measurement. The audio streaming function allows you to select a time span on an finished NLA measurement and play back the audio associated with that selected time span through the computer speakers. The Listen function extends this capability to allow you to hear the audio from the microphone during a live NLA measurement session. These features will be covered in more detail later in this document.

The Sound Lab application

The most important settings in Sound Lab are the input control settings. Channel 1 and Channel 2 must both be selected for a two channel measurement. They can be changed by clicking



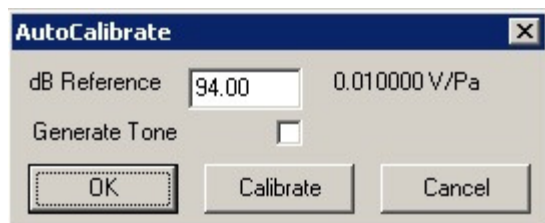
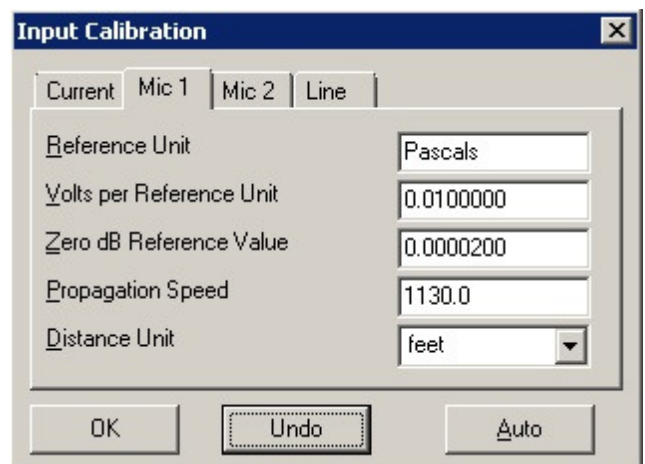
on the channel control, which will cycle to the next possible selection, or by opening the {Input, Settings} selection on the menu bar. The control will change to “Mic” (or “Line”), “Int” or “Off”. The microphone indication will change between “Mic” and “Line” based on the detection of an XLR plug in the Input jack of the appropriate channel. It is a good idea to

switch the unused channel to “Off” when you intend to make a one channel measurement.

Phantom power must be supplied to the microphone in most cases. The TEF25 can supply this voltage. An indicator on the TEF25 shows when phantom power is present. A gray box to the right of the input control will change to yellow when the phantom power has been enabled. This setting can also be controlled by opening the {Input, Settings} control on the menu bar.

Calibration

The most important aspect of an NLA measurement is the accuracy of the measurement. This is accomplished by use of the microphone calibration form. This setting can be accessed by opening the {Input, Settings} control on the menu bar. The standard microphone supplied by Gold Line has a Volts per Reference Unit value of 0.01 (10 mV/Pa).



The Zero dB

Reference is typically set to 0.00002 (20 uV). It is recommended that the user should use a Class 1 acoustical calibrator prior to testing to validate the microphone calibration before running any tests, especially where the

measurement is being used for a government or legal issue. The Auto calibrate function will accurately determine the calibration level based on the output of an acoustical calibrator.

Accessing the NLA parameters

Click on Parameters on the Menu Bar and select Noise Level Analysis, or click on the NLA shortcut on the module function bar. This will open the control for the NLA test parameters.

NLA measurement parameters

Start Time: A new measurement will begin when the system clock matches the start time, based on a 24 hour clock. A double click will set this value to the current time.

Stop Time: The measurement will stop when the system clock matches the end time, based on a 24 hour clock. Changing this value will modify the duration.

Auto Start: The Auto Start option will cause an NLA measurement to start when the system clock matches the Start Time.

Time per Point: Every NLA measurement consists of 703 data points. The incoming audio data is averaged according to the Integration setting. The Time per Point setting is affected by the Duration.

Integration

Selection of the Integration time controls how the NLA data is displayed. This can be changed at any time before, during or after the measurement has completed.

Leq is the Equivalent continuous sound level. The steady continuous level that would yield the same total sound energy over a given period of time as the varying measured levels. It is useful for studying long-term trends in environmental noise. A single number can be used to define an entire day's noise history.

Lden is a 24-hour Leq, except 5 dB is added to all levels measured between 7:00 PM and 10:00 PM and 10 dB is added to all levels measured between 10:00 PM and 7:00 AM to account for the need for more quiet during sleep hours.

Ldn is a 24-hour Leq, except 10 dB is added to all levels measured between 10:00 PM and 7:00 AM to account for the need for more quiet during sleep hours.

Dose is a rating of the time weighted acoustic exposure level that a person receives over a period of time, usually 8 hours. It is commonly used to determine if a person has been subjected to an environment that could cause hearing injury or permanent loss.

Linear / Time displays data in time versus mPascals instead of time versus decibels.

Register is a chart of SPL levels encountered during a measurement versus the percentage of time that that SPL was seen.

Histogram is a count of the number of times a SPL level was seen during a measurement.

The screenshot shows the 'NLA Parameters' dialog box with the following settings:

- Start: 19:47
- Stop: 20:47
- Auto Start:
- Time per point: 5.1 s
- Duration: 01:00
- Auto Repeat: 1
- Auto Save:
- Integration: Ldn
- Weighting: A
- Gain Adjust: 0.0 dB
- Second Channel: (dropdown menu)
- WAV Capture: WAV Import

Buttons at the bottom: Do Test, Undo, Close.

Weighting

A weighting curve is used to change the information in the incoming audio to make it appropriate for the type of measurement that you are making.

Flat is the original unmodified signal.

A weighting is a curve that models the susceptibility of human hearing to be injured by loud noises, which has been adopted by most places worldwide as the standard for sound measurements. Most regulatory standards for noise are written as an A weighted specification.

C weighting is a curve that models the response curve of human hearing. It is useful for determining the perceived sound.

User allows a custom curve to be loaded. A level compensation can be applied when a user curve is loaded to compensate for filters that were designed for different applications.

Second Channel

The second channel display traditionally would show the data from the first input channel in a different way, since it was developed for a one channel analyzer. The new NLA release, version 6.8.14 or greater, adds the capability to show the second input channel as the second display trace.

Blank will have no second channel display.

Peak will display the peak responding data from the same input as the first display trace. The normal display is RMS (root mean square) since we are normally interested in the power of the measured signal. The standard readouts show the maximum and minimum peak values, but the peak plot shows all the other points.

Unweighted shows the unmodified or raw data from the same input as the first display trace. Normal measurements are made with A weighting curve in order to comply with several community standards. This results in the same curve as Flat weighting.

Channel 2 uses the second signal input as the audio source for the second display trace. It will use the same weighting and integration as the first display trace. All of the controls, readouts and cursors that are displayed for channel 1 are duplicated for channel 2. This allows NLA to be used as a two channel measurement device. This feature was introduced in version 6.8.14 of NLA and later.

WAV Capture and WAV Import

An exciting new set of optional features have been added to NLA. This set of features is part of the NLA WAV extensions. This allows NLA to create or load standard WAV files in conjunction with an NLA measurement. These features were introduced in version 6.8.16 of NLA enhanced and later.

WAV Capture causes NLA to save a WAV file at the same time as it saves the NLA data. The user can also Listen to the signal that NLA is reading at the microphone. The raw audio signal is saved in a file with the same name as the NLA file. Both files are loaded when the NLA file is opened.

WAV Import opens a tool that allows you to convert an existing WAV file into an NLA file.

WAV Import parameters

The WAV import function was introduced in version 6.8.16 of NLA enhanced and later. It allows you to convert a mono or stereo 16bit 48 kHz sampled WAV file into an NLA file. The only other requirement is that the length of the WAV file is the length of the measurement (Duration, NLA Parameters).

The WAV Import process requires only four steps to convert a WAV file (or group of files) into NLA measurement files.

The first step: Select an Import WAV file or files. The

Date, Time, Length, Output NLA File and Media Properties are all set by this action. The field labeled Number of Files to Import is also set by this action. The Date and Time values can be edited to reflect the actual time the recording took place. Multiple files have to share the same Media Properties, Length and base file name. The base file name in this example is MZ and the file number is 000003. The file with the lowest file number is picked as the starting file. This action also sets the Start, Stop, Duration and Time per Point values in NLA parameters. The Output NLA File is also set by this command. The default value is the base file name with “_Import_” followed by the file number. This value can be overridden. The default value for this example would be MZ_Import_000003.

The second step: Modify the Date and Time to match the measurement time of the first file. Some operating systems change the file date and time during conversion or copying.

The third step: Set the output directory. The default output is set to the Sound Lab data directory.

The fourth step: Load a calibration WAV file or set the V / Ref values by hand. The WAV Import function can convert the levels in the WAV data to calibrated levels by determining the gain structure that was used during the recording. It is common practice to record a calibration file on the WAV recorder before running the test to validate the microphone levels are good.

You could press the Process button at this time. Processing typically takes about 3 minutes for a one hour file. However, there are a few other considerations. A stereo WAV Import file will normally generate a two channel NLA measurement. The pan control with (L) left, (R) right and (2 ch) stereo settings can be used to make a one channel measurement out of a two channel file. The first calibration file would be used for a one channel measurement with a two channel import file.

The screenshot shows the 'WAV Import' dialog box with the following fields and controls:

- Import WAV File:** C:\USERS\LOUIS PITTSLEY\DESKTOP\DOCUMENTS\GOLD LINE\IMPORT_WAV\MZ000003.WAV
- Calibration WAV Files:** C:\Users\Louis Pittsley\Desktop\Documents\Gold Line\Import_wav\MZ000001_cal_left.wav
- Calibration Level:** 94.0
- Output Directory:** C:\Users\Louis Pittsley\Desktop\Documents\Gold Line\Data
- Output NLA File:** MZ_Import_000003.NLA
- Number of Files to Import:** 1
- Process:** Button
- Cancel:** Button
- V / Ref:** 0.2454254 (Left), 0.1731884 (Right)
- Zero Ref:** 0.00002
- Media properties:** Mono (selected), Stereo, 16, 24, 32, 44.1, 48, WAV (checked), RIFF (checked), PCM (checked), Std. (checked)
- Date:** 10/29/2013
- Time:** 02:41:31
- Length:** 00:01:00

The NLA display form

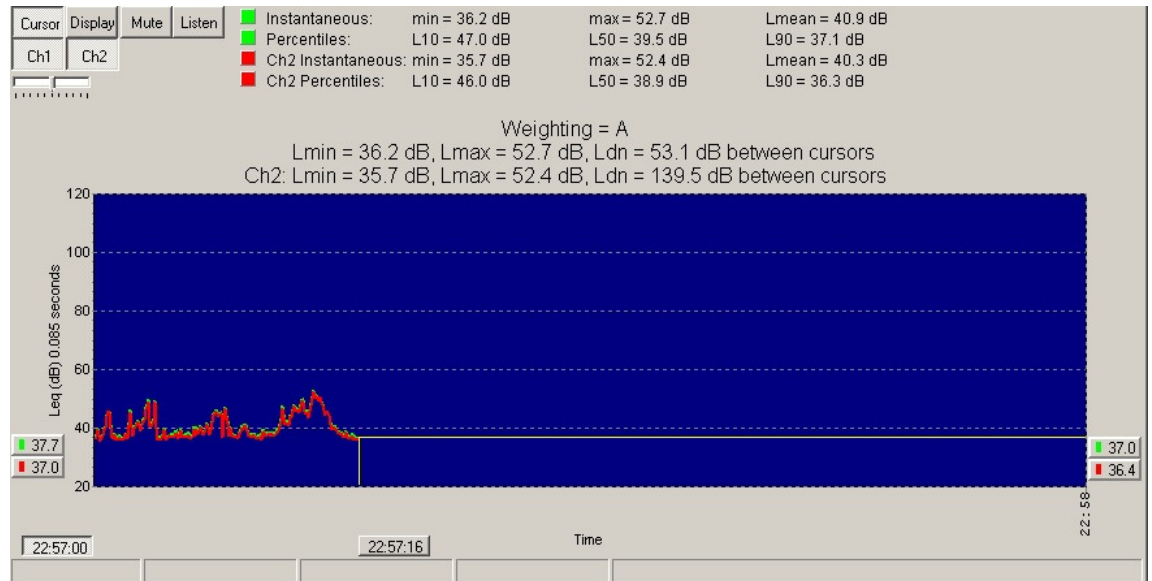
This is an example of an NLA display during the WAV Import function. Information about maximum and minimum values are displayed with statistics about the import process is shown at the bottom.



NLA display during a WAV import of a stereo WAV file

New features in NLA enhanced

The NLA enhanced package offers new features, first introduced in version 6.8.14. The original standard version of NLA had a **Mute** control. This would allow a user that was monitoring a measurement to inform NLA that a section of the measurement contained data that should be excluded from the measurement, such as the sound made when moving the microphone or the expected noise of a door closing. It required that you knew the noise was going to occur ahead of time. It was not possible to do this when the equipment was left running for a 24 hour measurement.



NLA display during the middle of a short 2-channel NLA measurement

Also, it was not always possible to determine what was happening acoustically when the microphone was located away from the user. These problems were both resolved with the addition of two new functions which were added to the optional NLA enhanced package. A new button, **Listen**, is available when WAV Capture is enabled in NLA Parameters. The **Listen** button plays the signal currently seen at the microphone during an ongoing NLA measurement. A slide bar allows up to a 20 dB gain boost or reduction of level

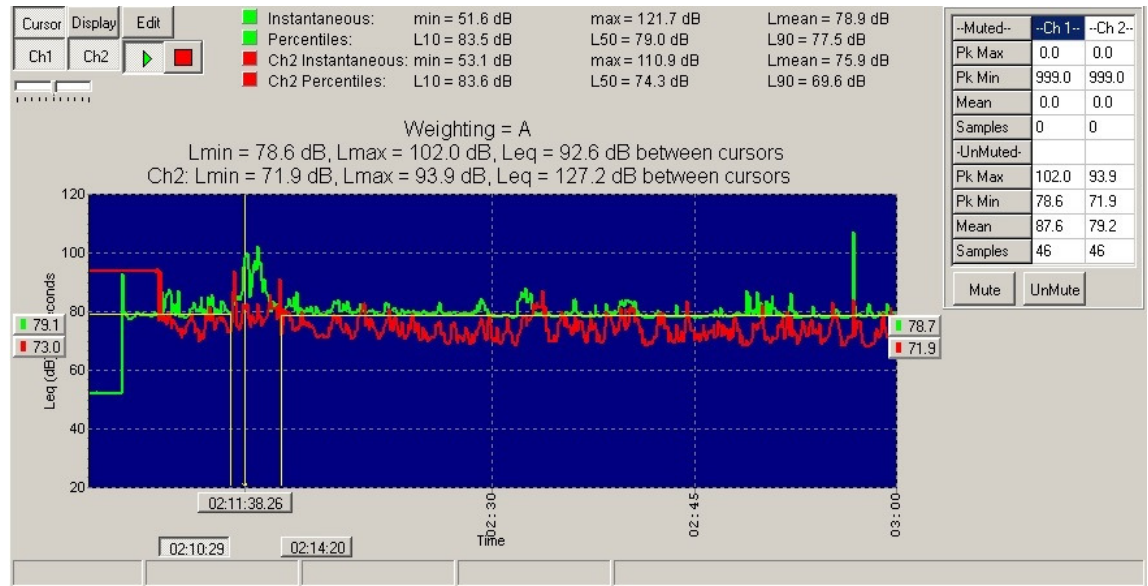
at the computer speakers. The user is responsible for preventing the computer audio output from getting back into the measurement through the microphone, preferably by using headphones.

The new NLA offers the ability to make a one or two channel measurement. This feature was added in version 6.8.14 or later. Two new buttons will show, when appropriate, on the NLA display form. The Ch1 and Ch2 buttons allow the user to control which channels are active for display or audio playback. The ongoing data measurement is unaffected by use of the channel buttons.

This picture illustrates several of the additional features that are available in the NLA enhanced edition.

Edit

Clicking the Edit button displays the Edit Summary.



The Edit summary

NLA display of a 2-channel measurement with Media Player and post process Edit

window is shown on the right with two buttons, **Mute** and **UnMute**. The Mute button is available in the standard edition of NLA and is normally displayed during the recording of a measurement. It allows the user to exclude a noise event from the data, but it requires that the user is expecting the noise and is monitoring the measurement while it occurs. The **Edit** function allows a user to post process Mute or UnMute a specific range of data. The cursors are set to surround the unwanted noise event and the **Mute** button will set the affected area to muted. The muted part of the data would be displayed in the cursor color instead of the plot 1 or plot 2 color. The cursors could be moved to affect a different range of points. The statistics window shows the number of muted and unmuted samples in between the cursors and the effective Peak and Leq values.

Media Player and Gain control

The Media Player (Green arrow and Red box) are used to listen to the original audio that produced this NLA measurement. This data is saved when the WAV Capture option is selected in the NLA parameters window. The Media Player will play the audio that is selected between the cursors. The audio is played through the computer speakers, optionally modified by the Gain control shown beneath the Ch1 and Ch2 button. A vertical media position cursor appears during playback with a readout of the time that the currently playing audio occurred. This tool allows a user to correctly assess which areas of data should be muted, unmuted or annotated to improve the NLA document.

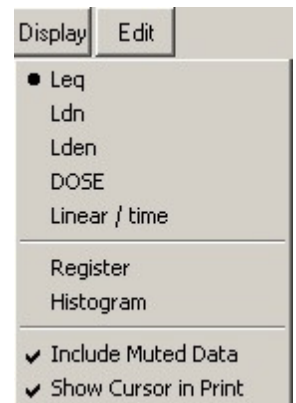
Annotations

Parameters	Ctrl+E
Display	Ctrl+D
Add Annotation	Ins
Delete Annotation	Ctrl+Del
Undo Zoom	Ctrl+Z
Copy to Clipboard	Ctrl+C
Save	Ctrl+S

An important tool in documenting an NLA measurement is the Annotation function. This allows you to click on a specific point on the NLA display and add a text caption to explain the significance of that data point. The caption can be edited, deleted or moved. There is no limit to the number of annotations. An annotation is added by pressing the Insert key on the keyboard after clicking the mouse on the relevant point. The Ctrl and Delete keyboard combination is used to remove a selected annotation. The right mouse click brings up a shortcut menu to add and remove annotations. Also, a shortcut to the NLA parameter and Display parameters are available on this control.

Display Controls and Menus

The display of the NLA measurement can be customized in several ways to show the data in different ways and to customize the appearance. The Display button allows access to a menu which can alter the type of statistics that the NLA measurement is displaying. These options were explained earlier in the document in the description of the NLA parameters.



The image shows the 'NLA Display Settings' dialog box. It has several sections with input fields and checkboxes:

- Magnitude:** Bottom of Scale (20) dB, Divisions (10) dB
- Linear:** Bottom of Scale (0) mU, Divisions (1000) mU
- Time:** Start Time (02:00), Duration (01:00), Auto (checked)
- Dose:** Criterion level (90.0) dB, Threshold Level (80.0) dB, Exchange level (5.0) dB / 2t, Work day Length (08:00)
- Percentiles:** 10, 50, 90
- Cursor:** (checked)

Buttons at the bottom: OK, Undo, Apply.

The colors shown in the NLA display can be adjusted in the Adjust Colors control. The settings for Magnitude, Phase, Grid, Background and Cursor affect the colors for Ch1, Ch2 and the cursors and background. The Adjust Colors control can be accessed under the Display menu on the main menu bar.

The settings for DOSE limits and thresholds can be modified on the NLA Display Settings. These settings are accessed by selecting Noise Level Analysis on the Display menu, selected from the main menu, or by right clicking and selecting Display.

This control also lets you select the dB range on the NLA display form and the percentiles. The selected percentile values will calculate the SPL level that was exceeded (Ln). For example, the third selection in this example is 90. The NLA display readout will show the SPL level that was exceeded 90% of the time. This value indicates the noise level that was present most of the time and is a good indicator of the noise floor or true ambient level of the room. Excessive background noise can inhibit intelligibility

Feature matrix: Comparison of NLA versions

Name of Feature	TEF20	TEF25	Standard NLA	New Standard NLA	NLA Enhanced w/ WAV
One channel measurement	*	*	*	*	*
Mute data during measurement	*	*	*	*	*
Zoom data for printing	*	*	*	*	*
Text annotations	*	*	*	*	*
Merge NLA files into summary	*	*		*	*
New NLA data files backwards compatible	*	*		*	*
Two channel measurement		*		*	*
Select data to display / hide during print		*		*	*
Listen to audio during measurement	1	*			*
Capture a WAV output during measurement	2	*			*
Listen to selected audio after measurement		*			*
Mute / UnMute data after measurement		*			*
Convert WAV file into NLA measurement		*			*

- 1 NLA on the TEF20 can monitor the audio on the signal generator jack in all versions.
- 2 A recording device can be attached to the signal generator jack of the TEF20 (see note 1)