

WELL Building

Acoustic Performance Verification



WELL is the leading tool for advancing health and well-being in buildings globally. The WELL Building Standard offers a roadmap for creating and certifying spaces that advance human health and well-being.

This application notes describes how to perform the required acoustic measurements in accordance with WELL using the XL2 Acoustic Analyzer.



XL2
Sound Level Meter >>>

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1. Getting Ready

Configuration

The sound level meter shall meet the requirements of a class 1 instrument in accordance with the IEC 61672-1 standard. The recommended configuration consists of

- XL2 Sound Level Meter
- M2230 Measurement Microphone
- Optional Extended Acoustic Pack installed in XL2 (LAS90% required for sound masking measurement)
- Optional Room Acoustics Option installed in XL2
- Optional Sound Insulation Option installed in XL2
- Dodecahedron Speaker Set including DS3, PA3 and Speaker Stand
- Software Room Acoustics Reporter installed on Tablet/PC with uploaded noise curve tolerances
- Software Sound Insulation Reporter installed on Tablet/PC
- Calibration certificate of latest annual sound level meter calibration in accordance with ANSI/ASA S1.4-2014 or IEC 61672-1:2013



DS3 Dodecahedron Loudspeaker
and PA3 Power Amplifier

Calibration

At the beginning and at the end of each measurement day, the entire sound pressure level measurement system shall be checked with the NTi Audio Class 1 Sound Calibrator. This calibrator meets the class 1 requirements specified in the standard IEC 60942.

Notes:

- The sound pressure level measuring system shall be calibrated annually.
- Wear hearing protection for all measurements when operating loudspeakers.
- Avoid transient interior noise (e.g., people talking, doors closing) during the measurement periods. The measurement should be deleted and restarted in case of such disturbing noise.
- The testing should occur when the space is unoccupied.

2. Background Noise Levels

All spaces have some degree of ambient background noise from HVAC equipment, exterior sources (e.g., traffic, outdoor equipment, pedestrians) or other building services. When the sum of these noise sources exceeds comfortable levels, the space may not function as intended. Interior noise sources can be controlled by selecting HVAC equipment with lower sound ratings and by designing the system to reduce sound within ducts. Exterior noise can be controlled by providing sound reduction at the building façade, windows and any exterior penetrations.

Requirements

For all spaces except dwelling units, the measured background noise level shall not exceed the following thresholds:

Tier	Sound Pressure Level (SPL)		Category 1	Category 2	Category 3	Category 4	Tolerance
1	Leq	dBA	40	45	50	55	+4
		dBC	60	65	70	75	+4
	Lmax	dBA	50	55	60	65	+9
		dBC	70	75	80	85	+9
2	Leq	dBA	35	40	45	50	+4
		dBC	55	60	65	70	+4
	Lmax	dBA	45	50	55	60	+9
		dBC	65	70	75	80	+9

with

- Category 1 - Areas for conferencing, learning or speaking
- Category 2 - Enclosed areas for concentration
- Category 3 - Open areas for concentration, areas with regularly used PA systems, and areas for dining
- Category 4 - Areas with machinery and appliances used by occupants (e.g., baggage handling areas, security, commercial kitchens, labs where spoken lectures do not take place)

For dwelling units, the maximum average background noise level LAeq in bedrooms is 35 dB. (reference WELL v2: Feature S02)

Test Locations & Conditions

- Measurement position: 1 m [3.3 ft] away from the window or wall
- Measurement height: 1.2 m [4 ft] above the finished floor
- Minimum distance between measurement points: 3 m [10 ft]
- It is recommended to measure the spatial average by rotating the sound level meter at arm's length at a speed of 15 cm [6 in] per second.
- The HVAC system must be on during the measurement periods.
- Sound masking systems must be off during the measurement period.
- The windows shall be in the typical normal position, e.g. closed.

Measurement

- Power on XL2 Sound Level Meter
- Select profile
 - Open workspaces «Backgrnd-OpenWork-S02»
 - Common spaces «Backgrnd-Common-S02»
 - Dwellings «Backgrnd-Dwelling-S02»
- Start the measurement
- The measurement ends automatically after
 - 30 seconds for open workspaces
 - 5 minutes for common spaces
 - 12 hours for dwellings
(the measurement must include the hours 10 pm to 7 am)
- The result is stored in the memory.
- Test quantity
 - Common spaces: one measurement in the room
 - Open workspaces: one measurement for every 46 m² (500 ft²)
 - Dwellings: one measurement in the bedroom



Background Noise Measurement by
XL2 Sound Level Meter

Reporting

- Note the readings manually in your measurement report
- Average all measurements for open workspaces.

3. Sound Insulation

Walls and doors shall meet a minimum degree of acoustical separation to provide adequate sound isolation and improve speech privacy. Sound that transmits from one room to another through walls or doors can be distracting or annoying and also disturb sleep.

Requirements

For all spaces the interior walls shall meet the following minimum weighted level difference (Dw).

Interior Wall Type	Dw
Between loud zones and other occupiable spaces.	55
Between areas for conferencing, learning or sleep and other regularly occupied spaces.	50
Between adjacent quiet zones.	45
Between rooms for concentration and other regularly occupied spaces.	40
Between circulation zones and regularly occupied spaces.	35

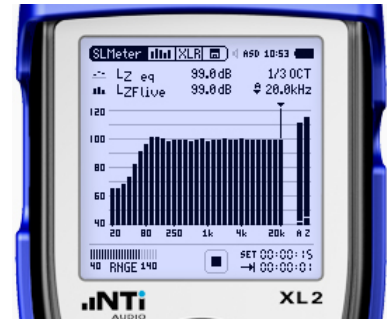
(reference WELL v2: Feature S03, Part 2)

Test Locations & Conditions

- Measurement position: where an occupant would typically be situated within the space at a minimum distance of 1.5 m to the noise source
- Measurement height: 1.2 m [4 ft] above the finished floor
- Minimum distance between measurement points: 3 m [10 ft]
- The HVAC system must be on during the measurement periods.
- Sound masking system must be on during the measurement periods.
- Windows and doors in the measurement location must be closed.
- Loudspeaker should be placed near the wall at the opposite side of the room from the wall that is being tested.
- It is recommended to measure the spatial average by rotating the sound level meter at arm's length at a speed of 15 cm [6 in] per second.

Measurement

- Power on XL2 Sound Level Meter
- Select profile «Insulatn-Send-S03»
 - Power on the Dodecahedron Speaker DS3 and set to maximum level as applicable.
 - Start the measurement in the sending room.
 - The measurement ends automatically after 15 seconds – the result is stored in the memory.
- Select profile «Insulatn-Receive-S03»
 - Keep the Dodecahedron Speaker DS3 at the same level.
 - Start the measurement in the receiving room.
 - The measurement ends automatically after 30 seconds – the result is stored in the memory.
 - Repeat the same measurement at the minimum 5 positions in the receiving room.
- Select profile «Insulatn-Backgrnd-S03»
 - Power off the Dodecahedron Speaker DS3.
 - Start the measurement in the receiving room.
 - The measurement ends automatically after 30 seconds – the result is stored in the memory.
 - Repeat the same measurement at two other positions in the receiving room.



Sending Room Measurement by
XL2 Sound Level Meter

Reporting

- Open the software «Sound Insulation Reporter» on the PC
- Open a new project
- Select
 - Standard «ISO 16283»
 - Type «Airborne»
 - Speaker position «1»
 - Results «D»
 - Rating format «1.0 dB ...»

- Confirm the settings by pressing «OK»
- Drag and drop your measurement data into the software
- Assign the measurements to sending room (L1), receiving room (L2) and background noise (B2) by clicking with the right-mouse button onto each reading in the right-hand table
- Select the «Result View» for the measurement result
- Complete the header data and print the report

XL2 Airborne-Sound-Insulation-Demo-Project-Test - XL2 Sound Insulation Reporter 1.36

File Edit View Measure Help

Measurements Calculations Results L1-1, L2-1

Client: Demo Date of test: 3/15/2016

Location: Partition from Sample Room 1 to Sample Room 2 Image:

Description: xxx

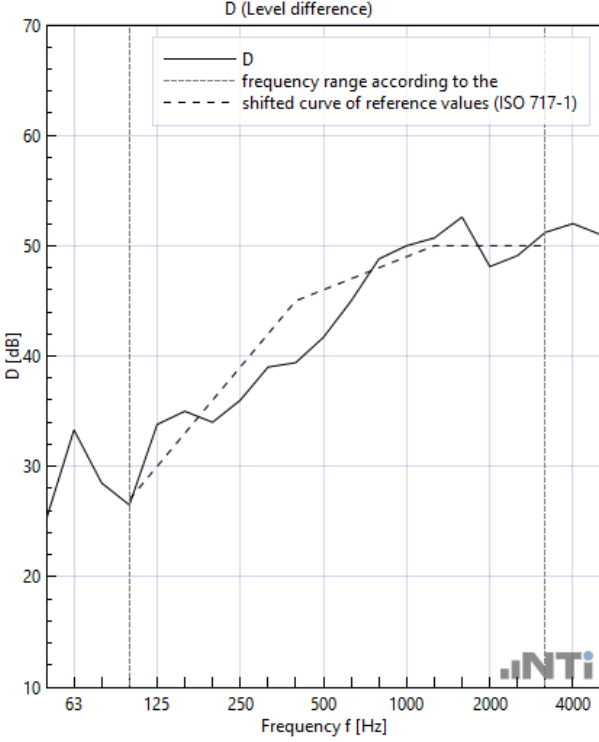
Area of common partition: 15.00 m²

Source room volume: 50.00 m³ Report No.: 1234

Receiving room volume: 50.00 m³ Date: 11/20/2017

Frequency f [Hz]	D 1/3 octave dB
50	25.2
63	33.3
80	28.5
100	26.5
125	33.8
160	35.0
200	34.0
250	36.0
315	39.0
400	39.4
500	41.7
630	45.0
800	48.8
1000	50.0
1250	50.7
1600	52.6
2000	48.1
2500	49.1
3150	51.2
4000	≥ 52.0
5000	≥ 51.0

≥: 1.3 dB correction applied, value at the limit of measurement



Results

D

Rating

$D_w(C;C_{tr}) = 46 (-1; -5) \text{ dB}$

Spectrum Adaption Terms

Name	Value dB
C ₁₀₀₋₃₁₅₀	-1
C ₅₀₋₃₁₅₀	-1
C ₅₀₋₅₀₀₀	0
C ₁₀₀₋₅₀₀₀	0
C _{tr,100-3150}	-5
C _{tr,50-3150}	-6
C _{tr,50-5000}	-6
C _{tr,100-5000}	-5

ISO 16283-1 (Airborne) Speaker positions=1 D_w=46

Sound Insulation Reporter Software

4. Reverberation Time

Acoustical comfort shall be achieved by controlling reverberation time based on room functionality. Spaces with high reverberation may have increased ambient noise levels and reduce speech intelligibility (e.g., public address, speech reinforcement and unamplified speech). Reverberation time can be controlled by adding absorptive surface finishes at ceilings, walls and furniture.

Requirements

For all spaces except dwellings, the following requirements shall be met:

Space Type	Room Volume V [m3]	Room Volume V [ft3]	Reverberation Time T [seconds]
Areas for learning, lectures and conferencing	$V < 280$	$V < 10'000$	$T \leq 0.6$
	$280 \leq V \leq 570$	$10'000 \leq V \leq 20'000$	$0.5 \leq T \leq 0.8$
	$V > 570$	$V > 20'000$	$0.6 \leq T \leq 1.0$
Areas with regularly used PA systems	N/A	N/A	$T \leq 1.5$
Areas for dining	N/A	N/A	$T \leq 1.0$
Areas for fitness	$V < 280$	$V < 10'000$	$0.7 \leq T \leq 0.8$
	$280 \leq V \leq 570$	$10'000 \leq V \leq 20'000$	$0.8 \leq T \leq 1.1$
	$V > 570$	$V > 20'000$	$1.0 \leq T \leq 1.8$
Areas for music rehearsal	$V < 280$	$V < 10'000$	$T \leq 1.1$
	$280 \leq V \leq 570$	$10'000 \leq V \leq 20'000$	$1.0 \leq T \leq 1.4$

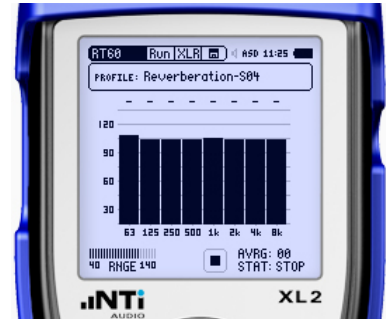
(reference WELL v2: Feature S04, Part 1)

Test Locations & Conditions

- Measurement position: at minimum distance of 1 m to the noise source and at least 1 m [3.3 ft] from any sound-reflecting surfaces.
- Measurement height: 1.2 m [4 ft] above the finished floor
- Minimum distance between measurement points: 3 m [10 ft]
- Switch of any internal noise sources, such as HVAC or sound masking system.
- The Dodecahedron Speaker DS3 must be at least 1 m [3.3 ft] from both the sound measuring device and sound-reflecting surfaces.

Measurement

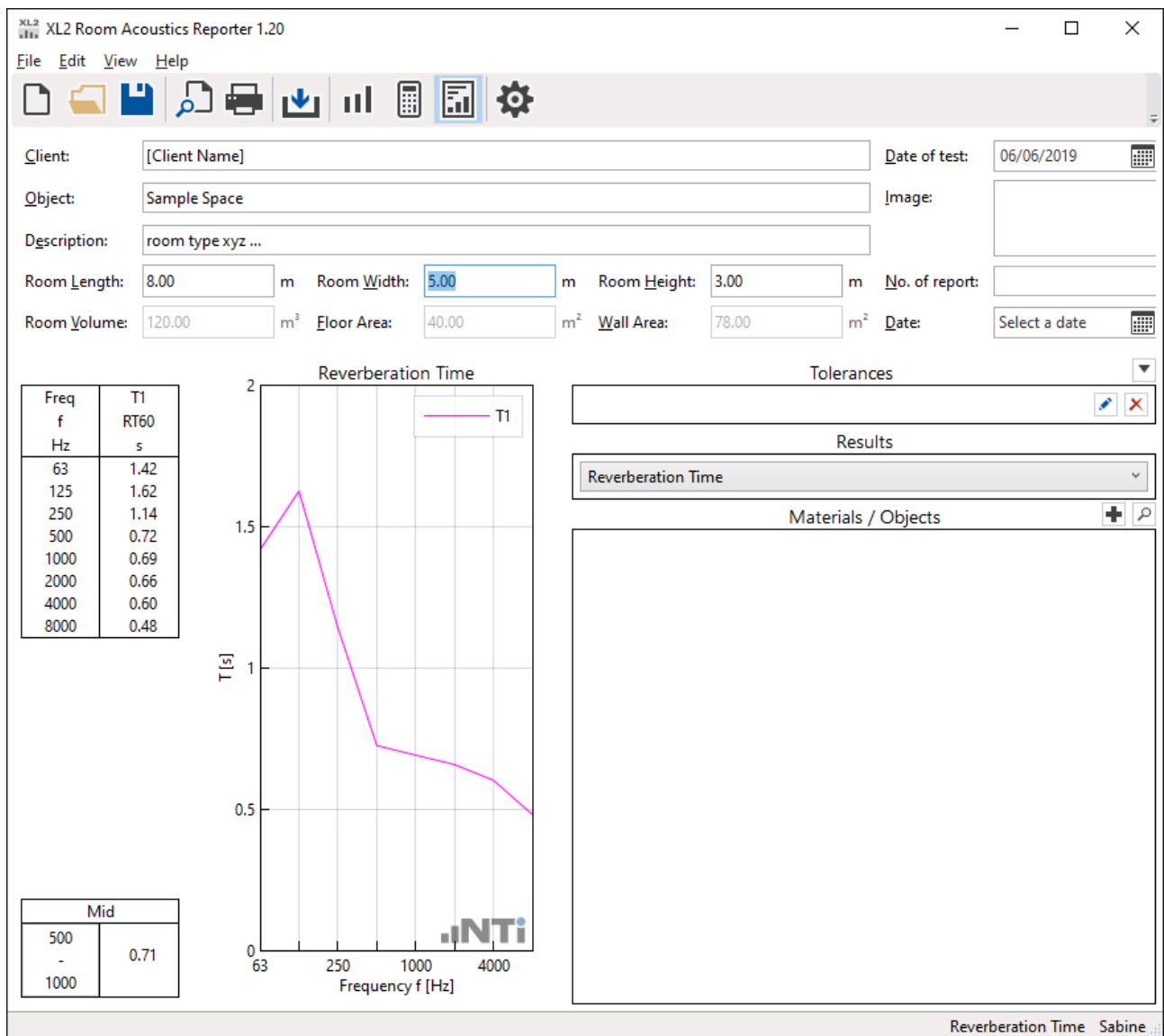
- Power on XL2 Sound Level Meter
- Select profile «Reverberation-S04»
- Start the measurement
- Start the test signal at the Dodecahedron Speaker DS3 at maximum level
- After 5 seconds stop the test signal of the Dodecahedron Speaker DS3
- Wait 5 seconds, then start the test signal again
- Perform at least 3 measurement cycles.
- Stop the measurement – the result is stored in the memory.
- Repeat the same measurement at the next position.



Reverberation Time Measurement by
XL2 Sound Level Meter

Reporting

- Open the software «Room Acoustics Reporter» on the PC
- Open a new project
- Select
 - Standard «ISO 3382-2»
 - Resolution «1/1 Octave»
- Confirm the settings by pressing «OK»
- Drag and drop your measurement data into the software
- Select the «Result View»
- Select the frequency range for «Mid» reverberation time to 500 – 1000 Hz
- Compare the resulting «Mid» reading with the requirements
- Complete the header data and print the report



Room Acoustics Reporter Software

5. Sound Masking

Dedicated artificial sound may be used in open plan offices to uniformly increase speech privacy between occupied spaces. Consistent background sound can be delivered to a space using an adjustable array of loudspeakers located such that sound is uniformly distributed.

Requirements

The sound masking system is commissioned such that the following sound pressure levels are not exceeded:

Area	Maximum Sound Pressure Level LAS90 [dB]
Open areas with quiet zones and/or circulation zones	48
Enclosed rooms labeled as quiet zones	42

(reference WELL v2: Feature S06)

Test Locations & Conditions

- Measurement position: where an occupant would typically be situated within the space
- Measurement height: 1.2 m [4 ft] above the finished floor
- The measurements must not be taken within 1.5 m [5 ft] of noise sources, fenestration or other exterior penetration (e.g., piping or other externally ducted HVAC equipment).
- It is recommended to measure the spatial average by rotating the sound level meter at arm's length at a speed of 15 cm [6 in] per second.
- The HVAC system must be on during the measurement periods.
- Sound masking system must be on during the measurement periods.

Measurement

- Power on XL2 Sound Level Meter
- Select profile «Sound-Masking-S06»
- Start the measurement
- The measurement ends automatically after 30 seconds – the result is stored in the memory.
- Repeat the same measurement at the next position.



Reverberation Time Measurement by
XL2 Sound Level Meter

Reporting

- Note the readings manually in your measurement report

6. References

Background Noise Levels	WELL v2 and WELL v2 pilot: Feature S02 https://v2.wellcertified.com/wellv2/en/sound/feature/2
Sound Insulation	WELL v2 pilot: Feature S03, Part 1 https://v2.wellcertified.com/wellv2/en/sound/feature/3
Reverberation Time	WELL v2: Feature S04, Part 1 https://v2.wellcertified.com/wellv2/en/sound/feature/4
Sound Masking	WELL v2: Feature S06, Part 1 https://v2.wellcertified.com/wellv2/en/sound/feature/6

more at <https://www.wellcertified.com>