# WIRELESS LOUDSPEAKER TECHNOLOGY FOR MORE EFFICIENT SOUND TRANSMISSION TESTING

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## 1 Introduction/Background

In architectural acoustics consulting, field sound transmission tests in buildings are commonly undertaken to verify the as-built performance of the construction. These tests involve measurements of the sound attenuation provided by the separating assembly between two rooms, the "source" room and the "receiver" room, by playing a calibrated noise spectrum in the source room and measuring the corresponding sound pressure levels in both the source and receiver rooms. To produce a test signal, a loudspeaker (or loudspeakers) placed in the source room and connected to a sound source such as a dedicated signal generator, smartphone or laptop computer is typically used. When the sound source uses a wired connection to the loudspeaker, the user has to physically travel back and forth between rooms to turn on and off the sound source. The logistics of this type of test setup inherently involve a certain amount of extra time to travel between rooms to manipulate the equipment.

The ability to wirelessly control the sound source would overcome the need to travel back and forth between rooms to switch on and off the signal, thereby saving time. For some projects, many partitions are tested in the same day and the time savings would be significant. Aside from time savings, other advantages of wireless control include eliminating the need for using hearing protection to enter the source room to turn off the sound source (since sound pressure levels may exceed 90 dBA), and not having the sound source on when the door is open to minimize the disturbance to building occupants. We reviewed options including power amplifiers with remote control, loudspeakers with Bluetooth audio streaming capability, and loudspeakers with built-in wireless control via smartphone or tablet.

The ASTM Standard E336-20, "Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings", which governs the test methodologies for Apparent Sound Transmission Class (ASTC), Noise Isolation Class (NIC) and other common sound transmission tests, states that "Ideally, loudspeaker systems should be omnidirectional. In practice, using multiple driver elements to cover different frequency ranges and placing and aiming sources into trihedral corners of the room will normally be adequate". Both omnidirectional and directional loudspeaker equipment were reviewed since in our experience, both are used in practice by consultants in Canada.

Wireless power amplifiers with remote control are one means of wirelessly controlling a sound source, but typically cost thousands of dollars. Bluetooth is another method of wireless audio transmission. However, until recent years, the Bluetooth protocol was limited in its bandwidth and signal strength to an extent that could limit its ability to maintain audio fidelity, penetrate walls and reach significant distances. Bluetooth 5.0 was released in 2016 and enabled twice the data bandwidth and 4 times the range compared to earlier versions. Some manufacturers of professional audio equipment have begun to include Bluetooth 5.0 in their products. Current smartphones and tablets similarly include Bluetooth 5.0 as a standard feature. Compared to earlier versions of the standard, Bluetooth 5.0 presents a more viable solution for wireless signal transmission in building acoustics testing between rooms due to its higher data bandwidth and increased range.

Some recent Bluetooth-enabled loudspeakers also allow direct control the loudspeaker settings via a smartphone app, so a wired signal generator could be used to avoid any concern about degradation of the wireless audio signal since Bluetooth is only used to turn on and off the loudspeaker.

everal equipment options were reviewed, and tests undertaken to assess the potential benefit of wireless loudspeaker technology in sound transmission testing.

## 2 Méthode/Method

### 2.1 Review of Available Technologies

A review of currently available equipment and technologies to enable wireless control of the sound source during field sound transmission tests was undertaken. The criteria for inclusion in this review were that the equipment must be available for shipment to Canada and allow the audio signal from the loudspeaker in the source room to be switched on and off by a user located in the receiver room. The selections included in Section 3.1 are representative and not necessarily an exhaustive list covering all manufacturers.

### 2.2 Sound Level Measurements of Wired vs. Wireless Audio Signal

Using an NTi Audio XL2 Sound Analyzer, measurements of the equivalent continuous sound pressure level (Leq) were taken for both Bluetooth 5.0 transmitted audio from an iPhone 11 and for a wired signal generator (NTi Audio Minirator MR-PRO) connected to the same loudspeaker (JBL EON710) and playing the same pink noise sound file for 30 seconds using fixed microphone and speaker locations. The output from the Bluetooth sound source was adjusted to produce approximately the same overall A-weighted sound pressure level as the wired source. The measurements were compared to determine whether both

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methods produce approximately the same sound level across the frequency range (125-4000 Hz) used in ASTM E336.

### 2.3 Time Required to Complete Sound Transmission Measurements using Wired vs. Wireless Loudspeaker Control

Tests were undertaken to assess the time savings associated with wireless loudspeaker control. Two room configurations were tested, one side-by-side (a wall) and one vertically stacked (a floor-ceiling). Tests were carried out according to ASTM E336, and the time to complete the tests was recorded, from the beginning of the first measurement (source level) to the end of the last measurement (background level). Measurements were carried out for 30 seconds each using an NTi Audio XL2 Analyzer, NTi Minirator MR-PRO signal generator and JBL EON710 loudspeaker with its output turned on and off remotely via the JBL ProConnect iOS app for the wireless tests.

## 3 Results

### 3.1 Review of Available Technologies

Several powered loudspeakers with Bluetooth audio and/or wireless control were identified, as well as a power amplifier with signal generator and wireless remote intended for use with an omnidirectional sound source as listed in Table 1. The prices for 10" loudspeaker models are listed.

**Table 1:** Wireless audio equipment available in Canada

| Manufacturer | Model | Price ($CAD) |
|---|---|---|
| JBL | EON710 | $739 |
| Mackie | SRT210 | $755 |
| Electro-Voice | ELX200-10P | $899 |
| NTi Audio | PA3 Power Amp. | $3268* |

*Approximate based on CAD/USD exchange rate

### 3.2 Sound Level Measurements of Wired vs. Wireless Audio Signal

Sound pressure level measurements of the same pink noise source file transmitted to the loudspeaker via wired and wireless connections are illustrated in Figure 1.

The results are within measurement uncertainty of each other across the frequency range measured.

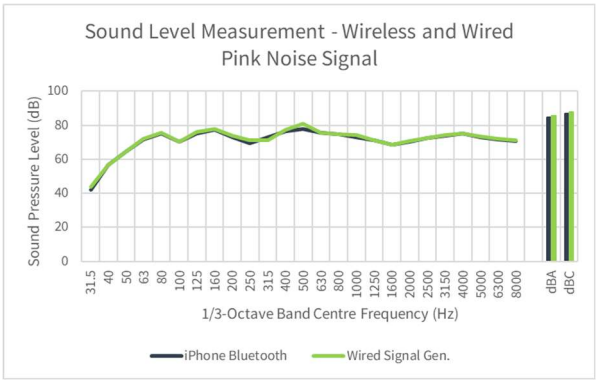


**Figure 1:** Comparison of wired and wireless audio signal

### 3.3 Time Required to Complete Sound Transmission Measurements using Wired vs. Wireless Loudspeaker Control

The time required to complete sound level measurements for each test for side-by-side rooms and vertically stacked rooms are listed in Table 2.

**Table 2:** Time to complete wired and wireless tests

| Test Type | Method | Time (s) |
|---|---|---|
| Horizontal | Wired | 191 |
| Horizontal | Wireless | 134 (29.8% faster) |
| Vertical | Wired | 248 |
| Vertical | Wireless | 167 (32.7% faster) |

As expected, the ability to switch the sound source on and off remotely from the receiver room resulted in significant time savings. The results are based on one user conducting tests in one building, and may vary substantially for different users, equipment and building configurations.

## 4 Discussion

The cost of recent professional Bluetooth-enabled directional loudspeakers is similar to previous loudspeaker models without wireless capability, and significantly less than a wireless power amplifier which would have previously been perhaps the only method of conducting sound transmission tests with wireless control.

Bluetooth audio transmission can evidently produce nominally the same source room sound level spectrum as a wired signal generator across the frequency range used for sound transmission testing in buildings. Still, our preferred method is to use Bluetooth control via smartphone of the loudspeaker output with a wired signal generator connected, to ensure there is no loss of signal quality or interruption during measurement.

The tests conducted using wireless technology indicate that the time required to complete measurements for sound transmission testing could be up to 30% less than for the wired method.

## 5 Conclusion

Wireless loudspeaker technology is available in Canada and our tests show that it can be used for sound transmission testing in building acoustics with little potential downside compared to the wired equivalent. Acoustical consultants and engineers should consider these options when purchasing new equipment since in consulting, time savings are cost savings.

## References

[1] ASTM E336-20: Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings.