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Firearm Noise Test Comparison
Model LXT1-QPR vs Model 800B

Test Objective

Larson Davis performed a comparison study between the Model LXT1-QPR to the Model 800B Sound Level Meter when measuring firearm noise. This comparison test was performed as these sound level meters have specification differences that pertain to MIL-STD-1474E, which offers requirements for measuring impulsive noise. The LXT1-QPR has an approximate measurement rise time of 30 µs and a 51.2 kHz sampling rate, which does not meet MIL-STD-1474E because it requires a 192 kHz sampling rate. The 800B has an analog peak detector and a rise time of approximately 10 µs, meaning it is hypothesized to be more accurate when measuring firearm noise. This comparison study also used a digital oscilloscope, which samples at 78.1 MHz to serve as a reference for the two different sound level meters.

Test Description

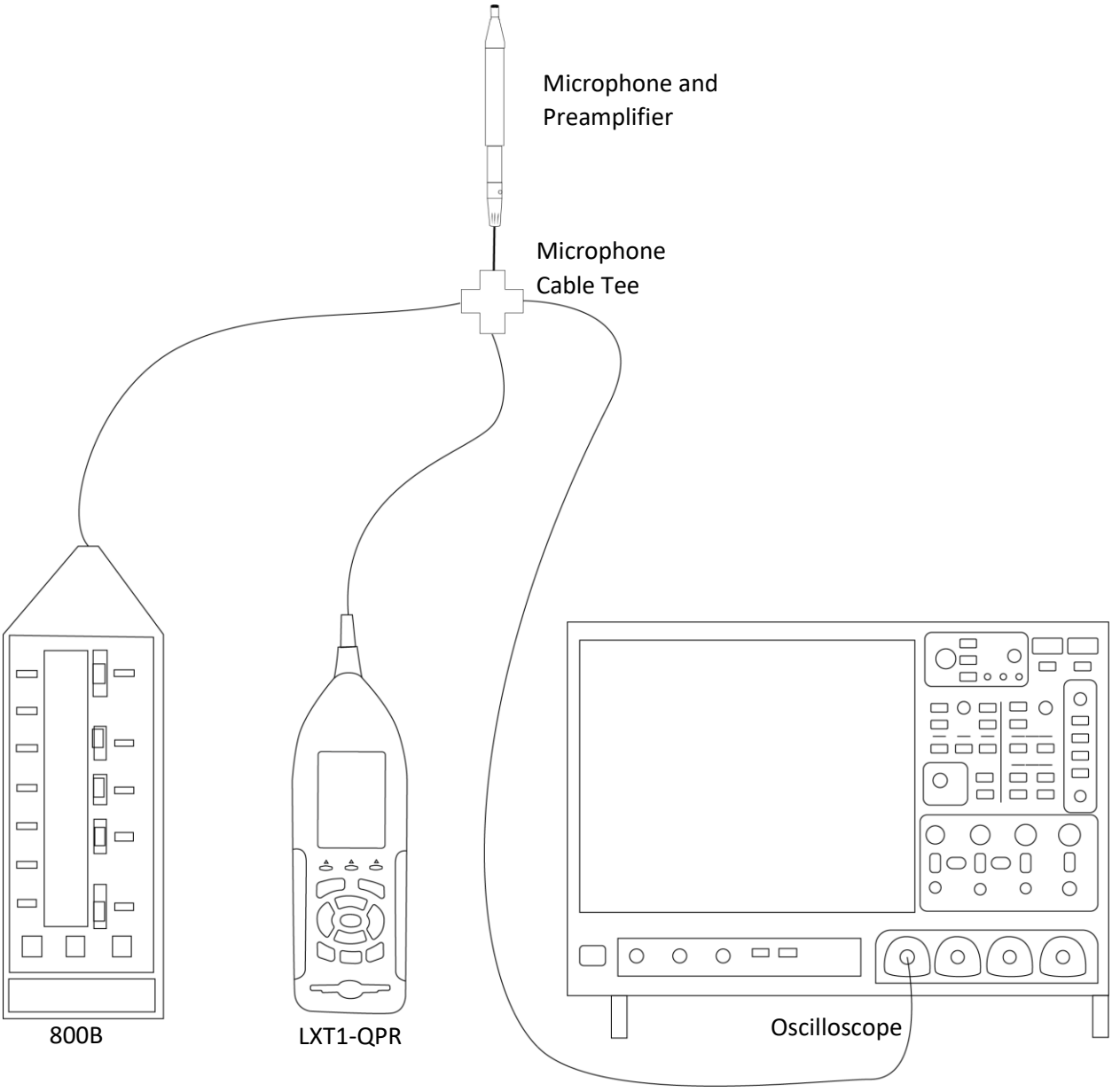
Firearm noise was measured at Big Hollow Gun Range in Daniel, Utah on September 5, 2018 using an AR-15 rifle as the sound source. The measurement microphone was oriented vertically and was placed 1 meter to the side of the firearm muzzle end.

The following equipment was used for the measurements:

- AR-15 Rifle
- Model 800B Sound Level Meter (SN 1370)
- 2530 ¼" externally polarized microphone (SN 1531) with associated 826B Preamplifier (SN 1262)
- ADP043 - ½" to ¼" microphone adapter
- Model LXT1-QPR (SN 0001152)
- 377C10 ¼" prepolarized microphone (SN 152423) with PRMLXT1 Preamplifier (SN 042474)
- Keysight MSO-X 4034A Digital Oscilloscope (SN MY53110101)
- ADP015 Microphone cable tee

In an effort to test the meters' response to the same noise, the signal coming from the microphone and preamplifier was split three ways to the LXT1-QPR, 800B, and an oscilloscope simultaneously per the graphic below. This setup made it possible to isolate data differences that were caused by microphone and preamplifiers differences. This is necessary because the 800B is built with a unique preamplifier and an externally polarized microphone, while the LXT1-QPR has a different type of preamplifier and a pre-polarized microphone.

LARSON DAVIS
3425 Walden Avenue
Depew, New York 14043 USA
+1 716 926 8243 | larsondavis.com



Forty rounds were fired from the AR-15 rifle. Twenty were measured using the 377C10 microphone with the PRMLXT1 preamplifier and twenty were measured with the 2530 microphone and the 826B preamplifier. The peak levels were recorded from the 800B, LXT1-QPR, and the Oscilloscope. The digital Oscilloscope has <1 ns rise time and was sampling at 78.1 MHz. This provided the most accurate peak measurement.

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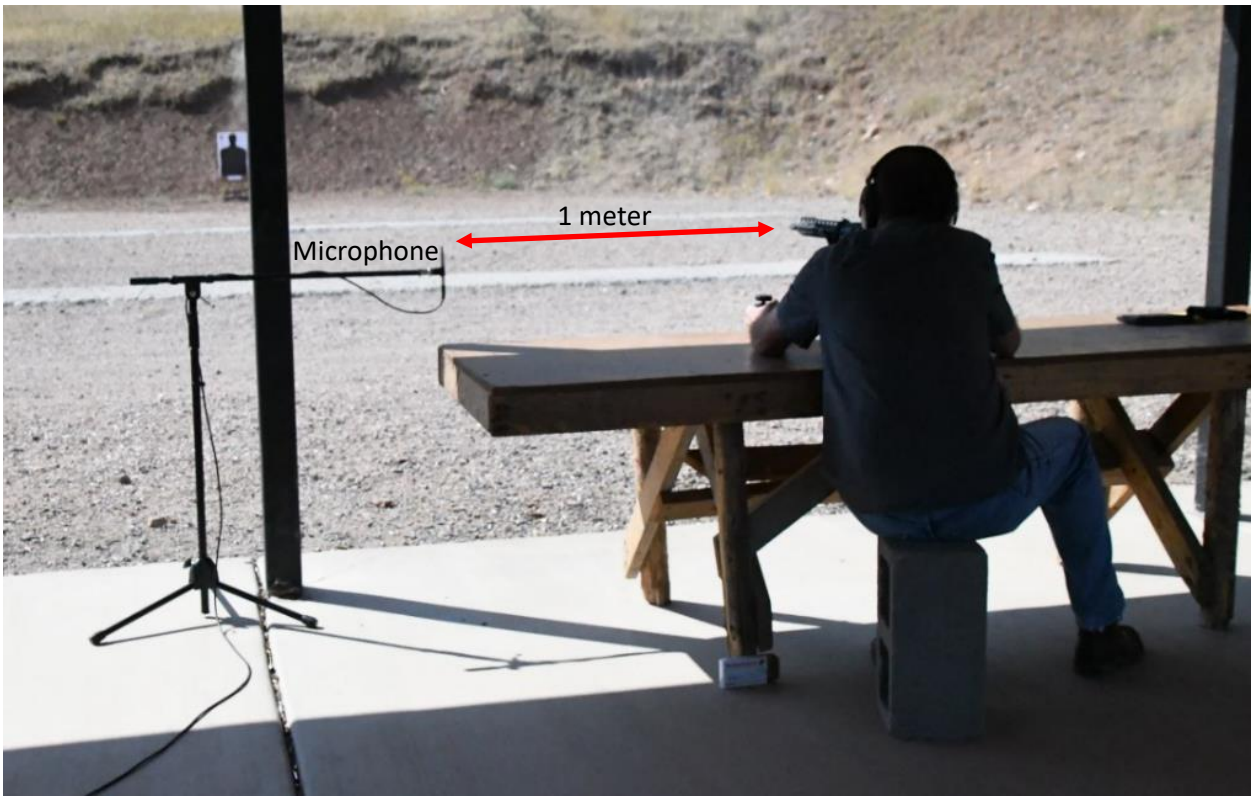
Depew, New York 14043 USA
+1 716 926 8243 | larsondavis.com



Results

Initially, the peak sound levels measured on the oscilloscope were evaluated for all of the gunshots. On average, the oscilloscope measured 3 dB higher peak levels when the 377C10 microphone and PRMLXT1 preamplifier were used for the measurement. This difference can be seen by analyzing the different waveform shapes captured on the oscilloscope as shown below. Note that the peaks are inverted in measurement sets with each type of microphone. This does not influence the overall value measured and exists because one microphone type is pre-polarized and the other is externally polarized.

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377C10/PRMLXT1 Waveform from AR-15

Figure 1 - Oscilloscope waveform from 377C10/PRMLXT1

2530/826B Waveform from AR-15

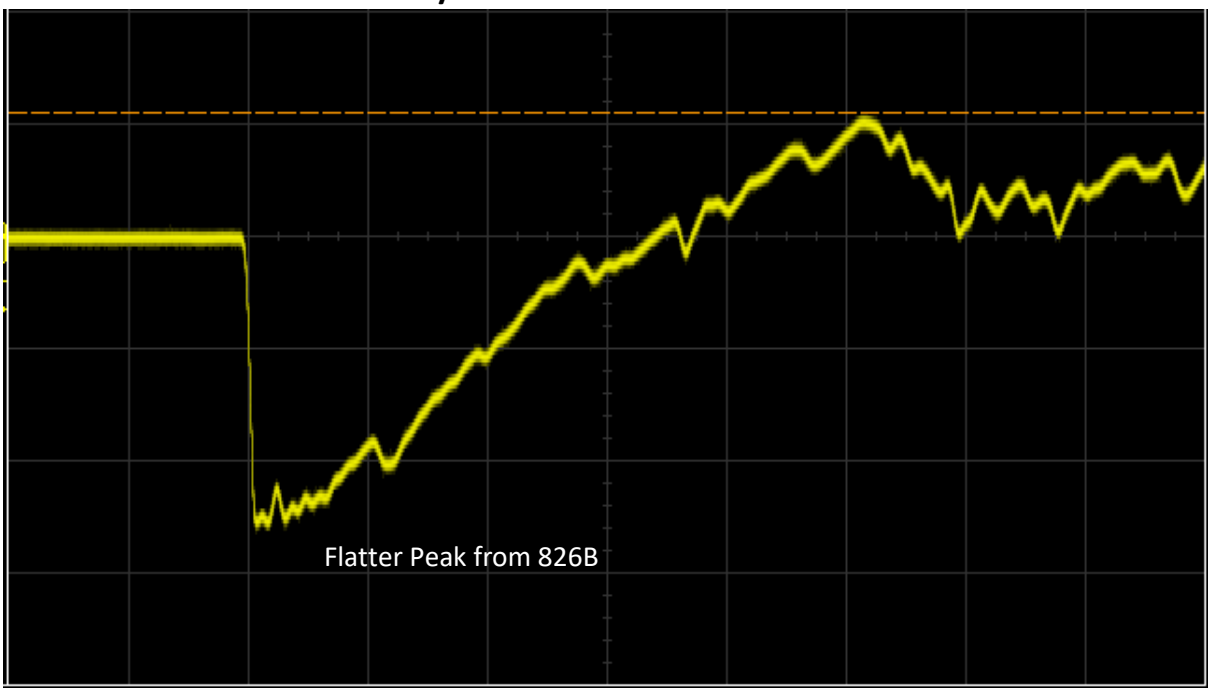

Figure 2 - Oscilloscope waveform from 2530/826B

LARSON DAVIS
3425 Walden Avenue
Depew, New York 14043 USA
+1 716 926 8243 | larsondavis.com
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It is apparent from these waveforms that a sharper (and ultimately higher amplitude) peak is captured when using the PRMLXT1. The 826B preamp fails to capture this sharp peak, even though the sound source was the same. Hence, the oscilloscope using the 377C10 microphone and PRMLXT1 preamplifier appear to be the most accurate measurement of the firearm noise.

Oscilloscope Measurement Results

Microphone/Preamplifier	Mean Peak Sound Pressure Level on Oscilloscope (dB SPL)	Standard Deviation	QTY of Shots Measured
377C10/PRMLXT1	170.1	0.46	20
2530/826B	167.1	0.14	20

To answer the original question regarding the comparison of the LXT1-QPR to the 800B, twenty shots were measured and compared - the peak levels measured by each meter in its "as-sold" configuration. The tabulated results are below.

Meter	Microphone/Preamplifier	Mean Peak Sound Pressure Level (dB SPL)	Standard Deviation	QTY of Shots Measured
Oscilloscope	377C10/PRMLXT1	170.1	0.46	20
LXT1-QPR	377C10/PRMLXT1	166.4	0.24	20
800B	2530/826B	166.7	0.18	20

Conclusions

Both the LXT1-QPR and the 800B showed excellent repeatability from shot to shot. The LXT1-QPR measurements had a standard deviation of 0.24 dB across twenty shots, and the 800B had a standard deviation of 0.18 dB across twenty shots. The oscilloscope had the largest standard deviation at 0.46 dB, likely explained by its ability to capture the steepest portion of the waveform peak.

Although the Model 800B has an analog peak detector and ~10 µs rise time, the Model LXT1-QPR measured a peak level only 0.3 dB lower, which for most acoustical applications is an insignificant difference. Both meters underestimated the true peak, as measured by the oscilloscope via the 377C10 microphone and PRMLXT1 preamplifier. The 800B measured 3.4 dB lower and the LXT1-QPR measured 3.7 dB lower.