AUDIOLOGY
DEFENSE

Advancing Firearm Suppressor Testing with GRAS Measurement Solutions

Customer

Researchers from Stephenson and Stephenson Research and Consulting (SASRAC) joined forces with experts from the University of Northern Colorado, Northern Illinois University, and Central Michigan University to address a growing challenge in hearing conservation. Bringing together expertise in acoustics, occupational health, and firearm noise research, the team set out to develop more reliable methods for evaluating the effectiveness of firearm suppressors in reducing harmful impulse noise.

Their work contributes to ongoing efforts within the acoustics community to establish standardized testing methods that can support future ANSI standards and improve hearing protection for recreational shooters, hunters, and professionals alike.

The Challenge

Firearms generate some of the highest impulse noise levels encountered in everyday environments, with peak sound pressure levels reaching well above 170 dB SPL. Exposure to these extreme sound levels can result in immediate and permanent hearing damage if adequate protection is not used.



The complete GRAS measurement setup combined the GRAS 45CB Acoustic Test Fixture, GRAS 40BP and 40BH microphones, the GRAS 26AC preamplifier, and the GRAS 42AP Intelligent Pistonphone for accurate firearm suppressor testing.

✓ **RESEARCHERS**
From Stephenson and Stephenson Research and Consulting (SASRAC)

✓ **PRODUCT**
GRAS 45CB
GRAS 40BP
GRAS 40BH
GRAS 26AC
GRAS 42AP

✓ **ARTICLE**
AIP Publishing >

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While hearing protectors remain the primary method of protecting users, they rely heavily on proper and consistent use. In many real-world situations—particularly during hunting or recreational shooting—hearing protection is often worn incorrectly or not at all. This has increased interest in firearm suppressors as an engineering solution that reduces noise directly at the source.

Despite decades of suppressor development, researchers faced a significant obstacle: there was no accepted civilian industry or ANSI standard for measuring suppressor noise reduction. Existing military methods were designed for specific weapon systems and testing environments and were not well suited for civilian firearms or recreational shooting scenarios.

The research team therefore set out to answer an important question: Could proven measurement techniques already used to evaluate hearing protection devices be adapted to accurately assess firearm suppressor performance? Achieving this required highly accurate instrumentation capable of capturing extremely short, high-level impulse events while reproducing the acoustic conditions experienced by the human ear.

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GRAS Solution

To perform the demanding measurements required for the study, the researchers selected a complete GRAS measurement solution designed for high-level impulse noise testing.

At the heart of the setup was the GRAS 45CB Acoustic Test Fixture (ATF), equipped with GRAS 40BP ¼-inch microphones mounted inside IEC 60318-4 ear simulators to reproduce the acoustic response of the human ear. A GRAS 40BH ¼-inch field microphone, fitted with a GRAS 26AC preamplifier, was positioned close to the fixture to capture the free-field impulse, while a GRAS 42AP Pistonphone ensured precise calibration before testing began.



The complete system allowed researchers to record simultaneous measurements both at the ear and in the surrounding sound field with exceptional accuracy. Sampling at 200 kHz, the GRAS solution captured the full dynamics of firearm impulses, enabling the team to analyse not only peak sound pressure levels but also frequency-dependent insertion loss and accumulated acoustic energy.

This measurement capability formed the foundation for evaluating two innovative approaches to suppressor assessment: an adapted version of the ANSI/ASA S12.42 Impulse Peak Insertion Loss (IPIL) method and a new methodology based on maximum accumulated A-weighted energy. Both approaches relied on the precision, repeatability, and wide dynamic range of the GRAS measurement equipment to produce reliable and repeatable data.

The Outcome

The study demonstrated that established hearing protector measurement principles can successfully be adapted to evaluate firearm suppressors, providing valuable insight into how future suppressor standards may be developed.

Using the GRAS measurement system, the researchers found that the modified ANSI/ASA S12.42 method produced consistent suppressor attenuation measurements and created a direct link between suppressor performance and traditional hearing protector evaluation. At the same time, the alternative A-weighted energy approach showed considerable promise as a simpler and more practical measurement technique, requiring only a single field microphone while still providing meaningful information about auditory risk reduction.

Beyond validating these measurement methods, the project demonstrated that GRAS instrumentation is capable of accurately capturing impulse noise levels exceeding 170 dB SPL, while maintaining the precision necessary to distinguish subtle differences between suppressed and unsuppressed firearm events.

The research represents an important step toward standardized suppressor testing, helping manufacturers, researchers, and standards organizations develop objective methods for comparing suppressor performance. Ultimately, this work supports improved hearing conservation by providing better tools for assessing engineering controls that reduce hazardous impulse noise before it reaches the user.





GRAS PRODUCTS USED

GRAS 45CB Acoustic Test Fixture.
The GRAS 45CB Acoustic Test Fixture is specified and designed for measuring sound isolation of hearing-protectors and ear- and headphones according to the ANSI/ASA S12.42 standard. For testing in accordance with the ISO 4869-3 standard, choose GRAS 45CA.

GRAS 45CB >

GRAS 40BP 1/4" Ext. Polarized Pressure Microphone
The 40BP is an IEC 61094 WS3P 1/4" externally polarized pressure microphone with rear-venting. It is a high-precision condenser microphone made according to IEC 61094-4 requirements. It is a low-sensitivity microphone for sound measurements at high levels and high frequencies. Its low sensitivity makes it ideal for measuring high sound pressure levels of up to 174 dB. Its small size reduces the effects of diffraction and reflections around the microphone resulting in a frequency range extending up to 70 kHz.

GRAS 40BP >



GRAS 40BH 1/4" Ext. Polarized Pressure Microphone, High Pressure

The 40BH is an IEC 61094 WS3P ¼" externally polarized high-pressure microphone with rear-venting. It is a high-precision condenser microphone made according to IEC 61094-4 requirements. Its very low sensitivity and wide frequency response make it ideal for measuring very high sound pressure levels of up to 194 dB. It is extremely robust and reliable and can handle acoustic impulse measurements in frequencies of up to 20 kHz.

GRAS 40BH >



GRAS 26AC-1 1/4" Standard Preamplifier with Integrated Miniconnector

The GRAS 26AC-1 1/4" Preamplifier is a small robust unit optimised for acoustic measurements using condenser microphones. It has a very low inherent noise level, a wide dynamic range and a frequency response from below 2 Hz to above 200 kHz. If you require the GRAS 26AC preamplifier (instead of the 26AC-1), we recommend the GRAS 26TC preamplifier as a direct alternative.

GRAS 26AC >



GRAS 42AP Intelligent Pistonphone Class 0

The GRAS 42AP Pistonphone is a battery-operated, precision sound source for accurate and reliable calibration of measurement microphones, sound level meters and other sound measuring equipment.

GRAS 42AP >

For more information,
please contact marketing@grasacoustics.com.

About GRAS Acoustics

GRAS is a worldwide leader in the sound and vibration industry. We develop and manufacture state-of-the-art measurement microphones to industries where acoustic measuring accuracy and repeatability is of the utmost importance in R&D, QA and production. This includes applications and solutions for customers within the fields of aerospace, automotive, audiology, and consumer electronics. GRAS microphones are designed to live up to the high quality, durability and accuracy that our customers have come to expect and trust.
GRAS Acoustics is represented through subsidiaries and distributors in more than 40 countries and is part of Axiometrix Solutions, a leading test solutions provider comprised of globally recognized measurement brands.

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