

PARTICULATE HOOD PERFORMANCE: TESTING THE IMPACT OF NOISE



Abstract: Since particulate hoods were first introduced in the fire industry, firefighters have been concerned that adding the particulate-blocking layer would affect their ability to hear fireground signals and sounds accurately. As part of the W. L. Gore & Associates (Gore) commitment to fitness-for-use, the development team tested the GORE® Particulate Hood and the GORE® Particulate Hood GEN2 to determine the impact, if any, of noise from these hoods. Qualitative and quantitative results from Gore's testing indicate both hoods do not compromise firefighters' abilities to hear.

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INTRODUCTION

Ever since particulate hoods were first introduced in the fire industry, firefighters have been concerned that adding the particulate-blocking layer would affect their ability to hear fireground signals and sounds accurately. Their concern is twofold: first, that the layer would dampen noise (i.e., impair their ability to hear such sounds as a child's scream or a PASS alarm) and second, that the material used to make the particulate-blocking layer might create additional noise that could interfere with their hearing. Current standards for firefighters' hoods do not currently include testing to evaluate noise.

As part of the W. L. Gore & Associates (Gore) commitment to fitness-for-use, the development team tested the GORE® Particulate Hood as well as the GORE® Particulate Hood GEN2 to determine the impact, if any, of noise from these hoods. Before the release of Gore's original hood, the team performed qualitative testing with positive results. For the GEN2 hood, the team built on these results by performing more quantitative testing.

GORE® PARTICULATE HOOD TESTING

In 2017, Gore performed two phases of testing on its original GORE® Particulate Hood. The first phase was conducted in Gore's world-class environmental chamber and the second phase at two separate fire department training facilities.

Environmental Chamber

Gore's development team chose to conduct its first round of testing in its environmental chamber because the team could maintain consistent conditions and isolate noise between tests. For this test, Gore set the conditions at a constant temperature and relative humidity. Selected participants were active firefighters ranging in age from mid-20s to mid-60s.

To reduce bias in the evaluation, Gore created hoods that looked identical but contained different materials inside. Some designs had no particulate-blocking layer, while others had different prototypes of particulate-blocking layers.

For each test sequence, the participant wore a different hood design that was randomly selected, along with a helmet, mask, and turnout coat. A soundtrack simulating fireground scenarios was played through loudspeakers at elevated volume similar to what a firefighter would experience in the field. While the soundtrack played, a Gore engineer asked participants to respond when they heard various commands and alarms, including

- a PASS alarm
- a low-air alarm
- requests of gross motor skills (i.e., take a knee)
- requests of fine motor skills (i.e., raise two fingers)
- a series of commands given in a loud voice
- a series of commands given in a softer voice (i.e., conference-room volume)

To reduce vocal variation, the same Gore engineer served as leader during each test. Commands were given in a random order, with participants facing the engineer. Participants then turned their backs to the engineer. Commands were repeated, again in random order, to negate any physical cue that a command had been given.

Each participant was assigned a technician to record whether he or she responded to an instruction and how long it took to respond. This test was repeated multiple times so that all participants could evaluate the various hood designs.

When wearing variations of Gore's particulate-blocking hood prototypes, all participants responded successfully to every alarm and command with no time lag observed. None noted any concerns about noise, even when prompted.

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Training Facilities

Gore held its second phase of noise testing at two facilities that use different types of live-fire training — one that used pallets as its flame source and another that used propane. Participants followed the normal training protocols at these academies.

Gore provided additional personal protective equipment (PPE) items as well as identical-looking traditional and particulate-blocking hood prototypes for all firefighters so they would not focus only on the hoods. In the evaluation, Gore also included seed questions about the hood’s overall performance so participants would not focus on noise.

Also, Gore measured other attributes of PPE, again to keep focus off of noise.

The evaluations indicated that the firefighters could hear commands and alarms and they did not experience any interference with noises from any of the hoods’ materials while on the fireground. After the testing was completed, the firefighters were asked directly about the noise factor, and none responded negatively.

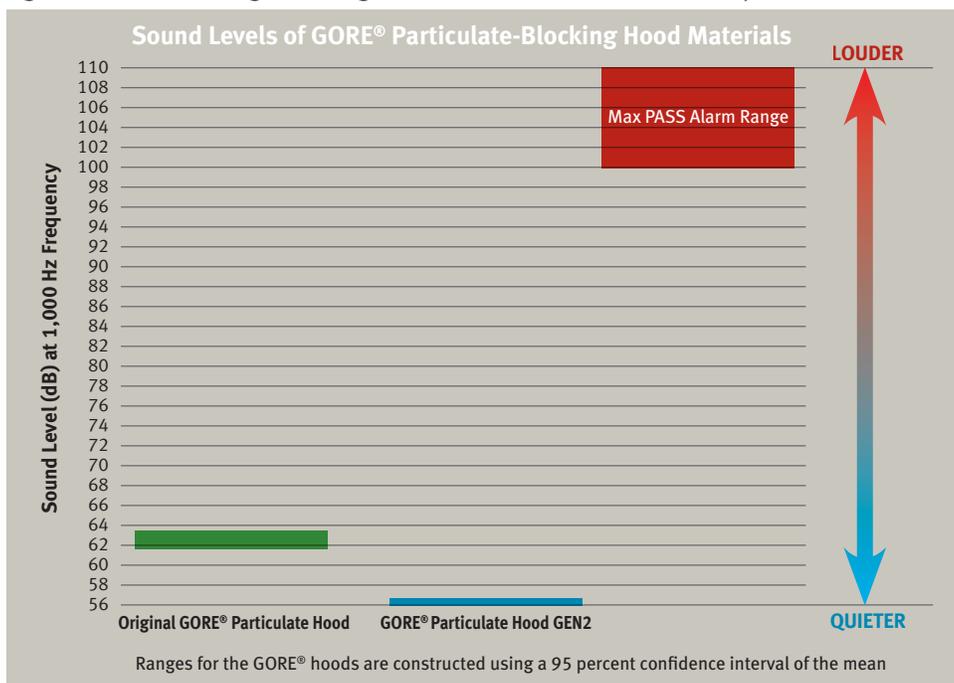
GORE® PARTICULATE HOOD GEN2 TESTING

While designing the next generation of Gore’s particulate hood, the development team built on the test results of the original product by introducing a quantitative sound measurement for GEN2. Tests included the original GORE® Particulate Hood to serve as a baseline.

The primary metric Gore used to evaluate sound generation was decibels (dB) at a frequency of 1,000 hertz (Hz). This is the metric commonly used in the acoustics industry to quantify sound. For reference, a decibel level of 50 corresponds to background noise in a quiet suburb. A decibel level of 60 corresponds to the environment in a busy restaurant. A difference of less than 1 dB at 1,000 Hz is not considered noticeable, while a difference of 10 dB at 1,000 Hz is considered to be twice as loud.

Multiple samples of the hoods’ materials were subjected to mechanical movement that represented head and neck motions, while a nearby microphone recorded the decibels emitted. The testing showed a significant difference in loudness between the two hoods, a difference that could be perceptible in the field (see Figure 1).

Figure 1. Noise Testing: The Original GORE® Particulate Hood Compared With the GEN2 Hood



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CONCLUSION

Gore evaluated its various prototypes for the original GORE® Particulate Hood and the GORE® Particulate Hood GEN2. Qualitative and quantitative results from Gore's testing indicate both hoods do not compromise firefighters' abilities to hear. While the original hood performed well in qualitative noise testing, the GEN2 hood performed even better in additional quantitative testing.

W. L. Gore & Associates continues to ensure that GORE® Particulate Hoods are fit for their intended use by delivering comfortable, durable protection that exceeds requirements of the particulate-blocking option of the NFPA 1971 Standard, 2018 edition.

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