April 4, 2007

Mr. Tim White
Acoustical Solutions, Inc.
2852 E. Parham Road
Richmond, VA 23228

Re: SoundScape Insertion Loss Test

Mr. White:

Hush Acoustics LLC has completed an insertion loss test for the SoundScape wall. This report summarizes the test and results.

Background

We understand the SoundScape wall is being considered by the New Jersey Department of Transportation (NJDOT) for use along the Garden State Parkway. Hush Acoustics LLC was contracted by Acoustical Solutions, Inc. to perform an insertion loss test in accordance with ANSI standard S12.8-1998. The site of the test of the SoundScape wall is at the Sturgis Iron and Metal Company, Inc. in Elkhart, Indiana. Since this location is not along a highway, it was necessary to use the Indirect Measured Method and a Controlled Artificial Sound Source.

Site Layout

The Sturgis site encompasses a large site in an industrial area which is adjacent to a residential community and a railroad. The site is quite flat. The operations on the facility include using trucks, cranes, shredders, grinders, and crushers to process scrap metal.

The SoundScape Classic Series wall is 15 feet tall and was constructed around the eastern portion of the site along a portion of the northern, eastern, and southern property lines. The portion of noise wall along the northern property line was deemed the most suitable for the insertion loss test, since it is not along a local street (which would disrupt the test, without providing a usable sound source due to low traffic volumes), not near many residences (which would be disturbed by our noise), and not near buildings (which would reflect sound and affect the results). There is a railroad yard opposite the noise wall in this location. The ground in this location is compacted earth on the Sturgis site side of the wall, and compacted earth with some gravel areas on the railroad side of the wall.

For the tests without a noise wall, a location on the Sturgis site was selected which was as far from buildings and large vehicles as possible, and had a similar ground surface to that used for the test with the noise wall. The selected location was closer to the middle of the facility.

Test Procedure

The noise source consisted of two side-by-sided JBL Professional EON15 G2 amplified loudspeakers in upright position with the speaker cones oriented vertically facing perpendicular to the noise wall, at a distance of 56 feet (17.1m) from the noise wall. This distance complies with the ANSI standard requirement that the noise source be placed between 15m and 30m from the noise wall. The noise source for one of the speakers consisted of a GTC Industries Inc. Noise Plug Pink Noise Signal Generator, an MCM Custom Audio 48V Phantom Power Supply Model #35-1825, and an XLR audio cable. The signal was fed from that speaker to the other speaker using an XLR audio cable; only one signal generator was used in order to form a single coherent sound source. The gain was raised as high as possible and no signal filtering was used for the pink noise signal.

A Larson Davis Model 831 sound level meter was used to measure sound levels at the reference position. The position was 22 feet (6.7m) above the ground directly above the noise wall; this works out to 7 feet (2.1m) above the top of the noise wall. This complies with the ANSI standard requirement that the reference microphone be placed at least 1.5m above the top of the wall. The microphone was attached to a pole which was attached to the noise wall. The meter was programmed to report the maximum, average, and minimum sound levels during each one-minute interval in one-third octave bands.

Two Larson Davis System 824 sound level meters were used to measure sound levels on the far side of the noise wall, opposite the loudspeakers. The microphones were attached to a pole at two heights: 5 feet (1.5m) and 22 feet (6.7m) above the ground. Sound levels were measured simultaneously at both heights, sequentially at three distances from the noise wall: 5m, 20m, and 50m. These sound level meters were programmed to report the average, maximum, and minimum one-third octave band during each five-second interval. After completing the tests it was noted that the 22-foot height was greater than called for in the ANSI standard. The standard calls for the height to be set at the boundary of the shadow zone for the location 5m from the wall, and this height is to be used at the other locations as well (20m and 50m from the wall). Assuming the acoustic center of the loudspeakers is approximately 1.5 feet above the ground, the boundary of the shadow zone is 19 feet above the ground at a distance of 5m from the wall. For this reason, the insertion loss results at the height of 22 feet for the 5m location will not be as meaningful, and the results at the height of 22 feet at the 20m and 50m locations will be conservative.

Sound levels were measured for five minutes at each distance from the noise wall (5m, 20m and 50m) with the sound system operating. Then, the loudspeaker were shut off and sound levels were measured for 2 to 4 minutes at 20m and 50m from the wall; due to passing trains this time of day longer periods were not possible.

One-Third Octave Band Insertion Losses

The ANSI standard defines the insertion loss as follows:

ILi = (LAR – LAi) – (LBR – LBi); where

LAR is the sound level with a noise wall ("A" is for "after" the noise wall is constructed) at the reference microphone

LAi is the sound level behind the noise wall (i.e., the receiver position)

LBR is the sound level without a noise wall ("B" is for "before" the noise wall is constructed) at the reference microphone

LBi is the sound level the same distance from the source as the location behind the noise wall

Per the ANSI standard each of these four values were adjusted to account for background noise. When the measured sound level was greater than 10 dB above the background sound level no adjustment was used. When the measured sound level was between 4 and 10 dB above the background sound level, the measured sound level was adjusted according to the formula in the ANSI standard. When the measured sound level was between 0 and 4 dB above the background sound level, the background sound level is said to "mask" the sound from the speakers and no insertion losses are reported in the figures below.

Per the ANSI standard LAR and LAR were adjusted downward 0.5 dB, since they were between 1.5m and 3m above the top of a noise wall.

The resulting sound levels and insertion losses for the receiver positions 5m, 20m and 50m from the noise wall are presented in Table 1 below.

A-weighted Insertion Loss

The first step in calculating the A-weighted insertion loss for each receiver position is subtracting the one-third octave band insertion losses from the reference highway noise spectrum to yield the shielded highway noise spectrum. Next, the A-weighted sound level is calculated for both the reference highway noise spectrum and the shielded highway noise spectrum. The A-weighted insertion loss is simply the difference between these two A-weighted sound levels. For frequency bands in which background noise masked sound from the speakers, insertion losses were interpolated to determine the A-weighted insertion losses. The resulting A-weighted insertion losses are summarized in Table 1.

Table1. A-weighted Insertion Losses

	5' high	22' high
5m from wall	24.2 dB	5.6 dB
20m from wall	25.0 dB	19.1 dB
50m from wall	25.4 dB	22.5 dB

As noted above, the 22-foot high receiver 5m from the wall was not in the shadow zone (it was 3' above the edge of the shadow zone). The measured 5.6 dB A-weighted insertion loss for this location is indicative of what one would expert for a location near the edge of the shadow zone.

It can be seen from Table 1 that the A-weighted insertion losses for the remaining five locations were between 19.1 and 25.4 dB. These insertion losses demonstrate that the wall provides excellent acoustical performance. In fact, the results are greater than would have been expected for a noise wall based on geometric noise models. A simplified analysis was performed using the Traffic Noise Model (TNM) and the Environmental Noise Model (ENM) to try to replicate the results for the location 5m from the wall 5 feet high. The measured insertion loss was approximately 4 to 6 dB greater than the predicted insertion losses. One considered reason for this result is the presence of a possible temperature inversion for the tests with no wall, which might not have been present 2 hours earlier for the tests with the wall. This was considered since the sun set between the two sets of tests, and temperature inversions are more likely after dark. This possibility was ruled out by using ENM to evaluate the effects of the temperature inversion. At such short distances a relatively large temperature inversion of 10 degrees Fahrenheit per 100 feet yielded only a 0.9 dB increase in predicted A-weighted insertion loss. The more likely reason for this difference between measured and predicted insertion losses is that the noise models are slightly conservative.

These results demonstrate that the SoundScape wall performs effectively as a noise wall.

Sincerely,

Gary Ehrlich, P.E.
Principal

For the complete test reports, please contact Custom Fiberglass Forms – designteam@customfiberglassforms.com