



MADRID
inter.noise 2019
June 16 - 19

NOISE CONTROL FOR A BETTER ENVIRONMENT

Optimization of Sound absorption Item and Mounting Position for Interior Noise Reduction of Motorized Car Alert Sound Generator

KuiBum Noh¹

HyungKyu Mo²

Seung Lee³

Daehan Solution Co., LTD.

30, Namdongdae-ro 369 Beon-Gil, Namdong-Gu

Incheon, South Korea

ABSTRACT

The National Highway Traffic Safety Administration (NHTSA) regulates all motorized vehicles to be recognized by pedestrians by generating a alert sound when travelling at speeds below 30 kph by September 2020. because there is a collision risk of a pedestrian due to the characteristic that the motorized vehicles have low noise when traveling at a lower speed than the internal combustion engine vehicles. However, the alert sound is transmitted not only to the outside of the vehicle but also to the inside of the vehicle while traveling at low speed. and continuous alert sound occurs and the driver can recognizes it as a noise. Therefore, in this study, we analyze the transmission path for the noise reduction of the electric car alert sound generator system and optimization its the mounting position. For this purpose, pink noises were generated through a alert sound generator and the sound transmission path was analyzed through acoustic transfer function (ATF) measurement. The results show that the dash panel and the floor panel are the most important contributors to the noise transfer. Therefore, noise reduction is improved by optimizing the specifications of the sound - absorbing items attached to the two panels in order to reduce interior noise. In addition, ATF was measured to optimize the mounting position of the alert sound generator, and the alert sound generator was installed at a position that satisfies the exterior noise control regulations based on the evaluation result.

Keywords: Motorized Car, Alert Sound, ATF, Sound absorption Item

¹ kbnoh@dhsc.co.kr

² hkmo1@dhsc.co.kr

³ slee@dhsc.co.kr

1. INTRODUCTION

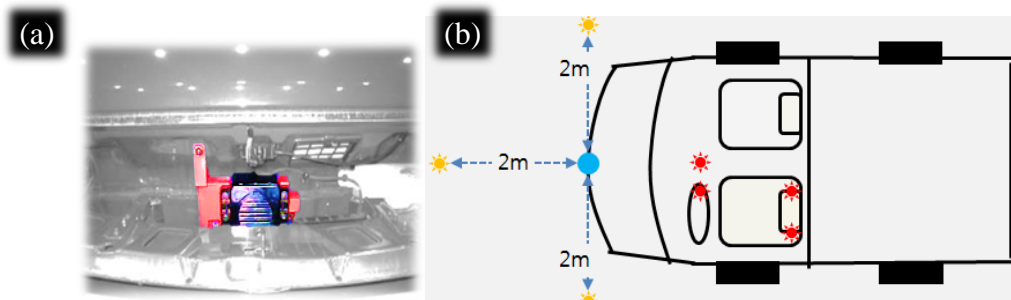
Recently, the automobile industry has actively developed motorized vehicles in preparation for exhaust gas regulation and depletion of petroleum resources. As motorized vehicles become popular, low noise which is an advantage of motorized is rather a disadvantage. because there is a risk of a pedestrian collision due to the characteristic that the motorized vehicle has low noise when traveling at a lower speed than the internal combustion engine vehicle. As shown in Table 1, NHTSA(National Highway Traffic Safety Administration) has been designed to allow pedestrians to recognize vehicles by generating alert sound above a certain level when driving less than 30 kph. However, the alert sound is transmitted not only to the car but also to the interior of car, a situation where the driver is aware of this as a noise when the vehicle is driving at low speed. In the study motorized car alert sound generator's interior noise reduce to determine absorption item and generator mounting location on optimization. In research used the vehicle small type of commercial truck. In front of the motor room equipped alert sound generator(alert device) through pink noise and Acoustic Transfer Function (ATF) measurements through interior noise. through interior noise transfer path analyze , sound absorption items and mounting location was determined.

Motorized vehicle Exterior noise regulation	Republic of Korea	U. S. A	Europe
<i>Legal name</i>	Quiet car Alert sound Generator install standard	FMVSS 141	ECR R 138 / 540-2014-EU
Applied date	July 2020	September 2019	September 2019
Alert Occur Section	R / D(20kph↓)	P / R / D(30kph↓)	R / D(20kph↓)
Remarks	July 18 Law Fermentation	September 17 Law Fermentation	October 16 Law Fermentation

Table 1 Motorized vehicles' Exterior noise Regulations

2. NOISE MEASUREMENTS

The sound source generated by the alert device is made up of a sound source unique to each automobile company in accordance with the local regulations. However, in this study, pink noise was used as a sound source to characterize overall noise. The initial position of the alert sound generator is shown in Fig. 1 in the motor room. For the noise measurement, a G.R.A.S microphone was used. In the semi-anechoic condition, there are 3 places at a distance of 2m, height 1.5m from the center of the bumper. In indoor of car microphone position was left and right ears of the driver's seat, top and bottom of instrument panel was secured.



*Fig. 1 (A) Initial mounting location of alert sound generator
(B) Noise measure location*

3. EXPERIMENTAL & RESULTS

The evaluation was divided into three categories. First, we evaluated the driving noise of the sound absorbing items and the contribution to the noise of the alert device. Second, the evaluation was performed to determine the optimum position of the alert device considering the noise inside and outside the vehicle. Finally, we optimized the interior noise by tuning the sound absorption items and changing the position of the alert device.

3.1 ABSORPTION SOUND ITEM CONTRIBUTION EVALUATION

The contribution evaluation was conducted through the window test. Window test is a method for assessing contribution by dividing the vehicle panel into sections, each of which is viewed as a single window, and measuring the noise level when the window is opened in turn, as shown in Figure 2. PBNR (Power Based Noise Reduction) test method was used to compare the interior noise of the vehicle with or without the sound absorption item. PBNR is able to quantify the noise transfer path because it uses sound power (Q) from the volume source and sound pressure (P) from the response point to obtain the ATF (Air Transfer Function).

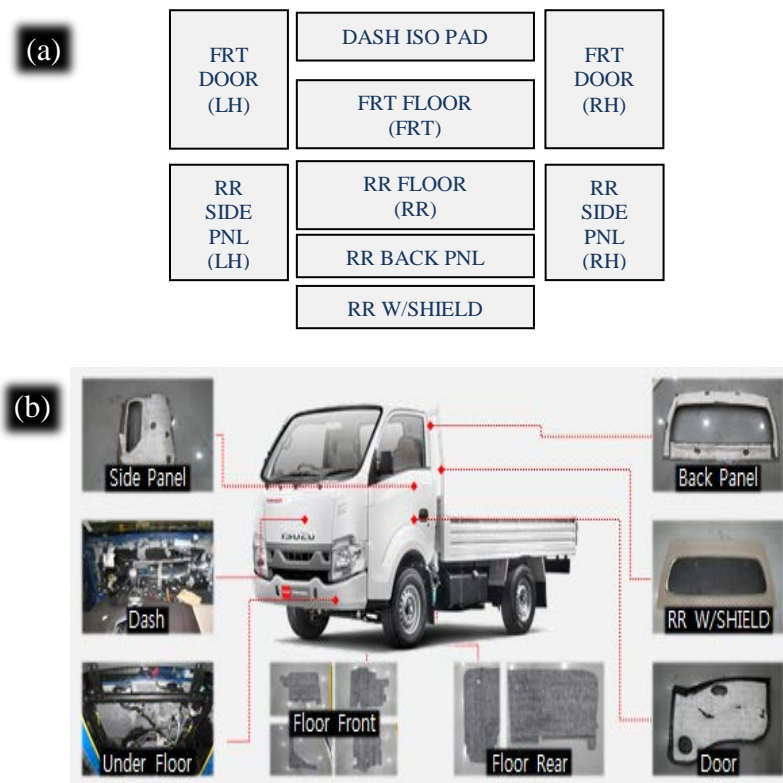


Fig. 2 (A) Vehicle section Configuration
(B) Sound absorption item

The contribution to the sound absorption components for indoor noise measured through PBNR is shown in Figure 3. The results show that the sound absorption items of the floor section and the rear panel section contribute significantly to noise reduction because the powertrain is located at the lower part of the vehicle. It has been confirmed that the sound absorption items of the dash section of the vehicle and the door section contribute primarily to the alert device.

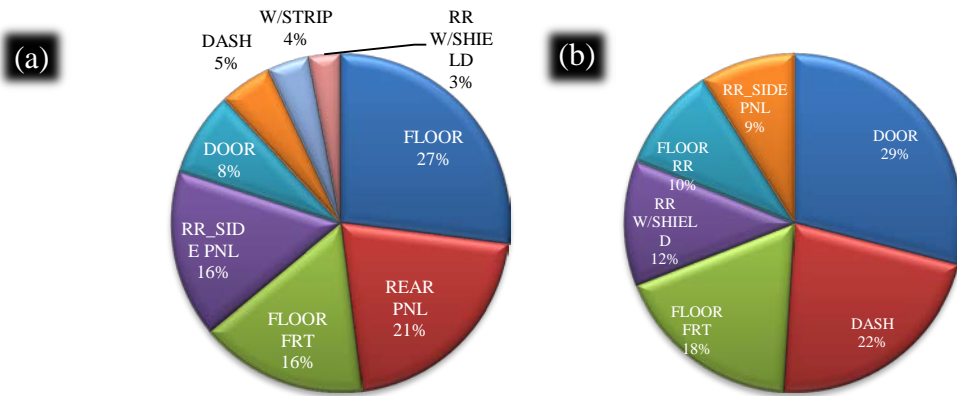


Fig. 3 (A) Contribution of sound absorption in P/T Noise
 (B) Contribution of sound absorption in Alert device

3.2 EVALUATION OF THE MOUNTING POSITION OF THE ALERT SOUND GENERATOR

The evaluation of the mounting position optimization of the alert device also used the same evaluation method as the contribution assessment. The PBNR for indoor noise was measured by changing the mounting position of the alert device. The mounting position is evaluated in three locations, including the front of the motor room, the bottom of the bumper frame and the bottom of the floor, taking into account the location where the warning device can be mounted on the vehicle as shown in Figure 4.

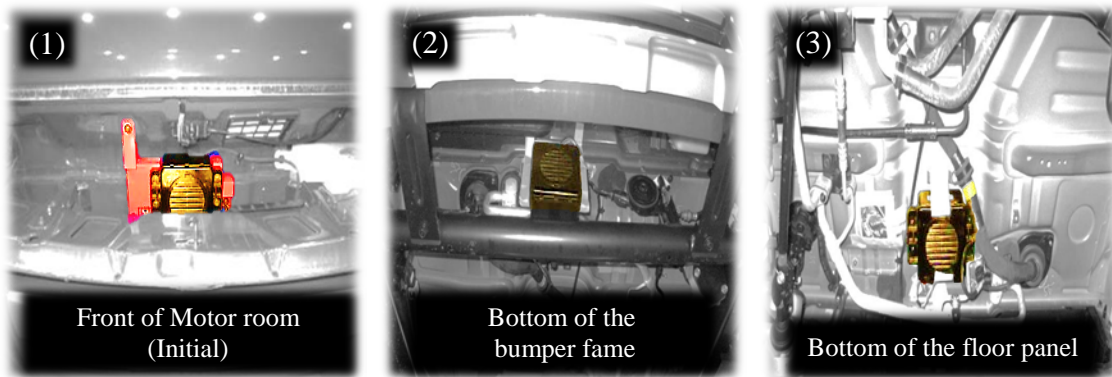


Fig.4 Alert sound generator mounting location

Although the evaluation did not significantly change the exterior noise depending on the location of the alert sound generator, it was considered most advantageous when installed in a bumper frame with a larger opening area, as shown in Figure 5.

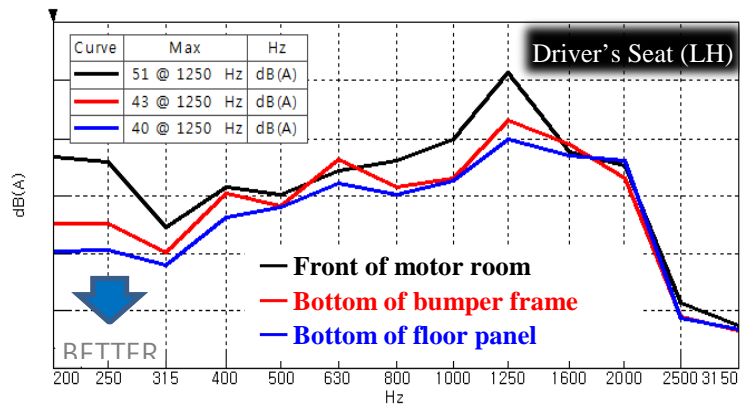


Fig. 5 Noise evaluation results from changes in mounting position

3.3 OPTIMIZING THE LOCATION OF THE ALERT SOUND GENERATOR AND SOUND ABSORPTION ITEMS

Using the above two evaluation results, Figure 6 shows that the mounting position of the alert sound generator is moved to the bottom of the bumper frame and optimised the sound absorption item. Noise generated by the alert sound generator is reduced by up to 15 dBA compared to the initial noise level of interior.

- Initial
- Initial + sound absorption item
- Initial + sound absorption item + Adjust mounting position

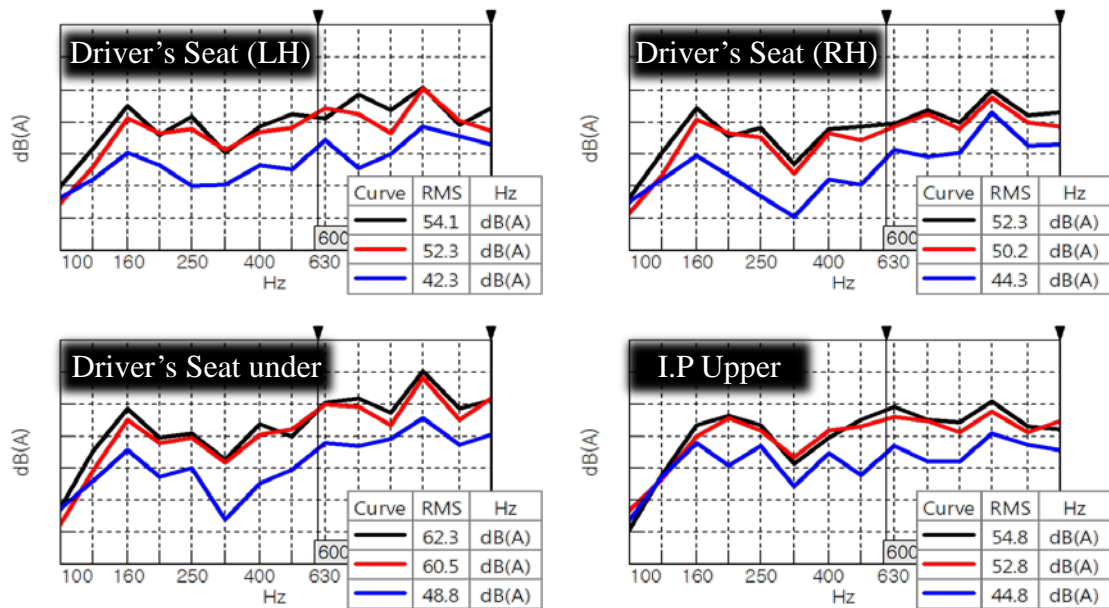


Fig. 6 Results of indoor noise optimization of alert sound generator

4. CONCLUSIONS

In this study, to minimize the effect of interior noise on the alert sound generator of motorized vehicles, we conducted a study on the optimization of the location of the installation of sound absorption items and alert sound generator.

1) The external noise variation depending on the location of the alert sound generator was not significant. However, it has been confirmed that the installation of alert sound generator in an open area such as the front bumper significantly improves interior noise.

2) The motor of the electric vehicle is located at the bottom of the vehicle. It has been identified that the sound absorbing items on the underside of the vehicle contributes to the reduction of interior noise. In the case of noise from the alert sound generator, the ATF evaluation confirms that it is introduced into the front and side items of the vehicle. The contribution of the sound absorption item also confirmed that the items located on the sidewall of the vehicle are the most contributing.

3) Based on the above results, the purpose of reducing the noise of the alert sound generator into the room is to be used. The sound absorption item and mounting position optimization were performed, and the noise reduction effect of up to 15 dBA was determined. The results of this assessment will be useful for the development and location of alert sound generator in the future.

5. REFERENCES

1. “*Minimum Sound Requirements for Hybrid and Electric Vehicles*”, NHTSA(National Highway Traffic Safety Administration), (2016)