

## PASS-BY NOISE CONTRIBUTION ANALYSIS ACCORDING TO 70/157/EEC DIRECTIVE

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### ABSTRACT

Pass-by noise regulation is one of the major directives for the approval before the mass-production. This paper will show pass-by noise contribution analyses for proper treatment of a vehicle exceeding the limiting values of 70/157/EEC Directive. The noise contribution analysis is performed by windowing the noise sources of exhaust, powertrain and tires. According to the main contributing sources, the treatments were suggested and confirmed with the vehicle. As a result, the product meets the limiting values of 70/157/EEC Directive.

**Keywords:** 70/157/EEC Directive, pass-by, noise contribution analysis

### 70/157/EEC DİREKTİFİNE GÖRE DIŞ GÜRÜLTÜ KAYNAĞININ AYRIŞTIRILMASI ANALİZİ

### ÖZET

Seri üretim araçlarda dış gürültü regülasyonu en önemli regülasyonlardan biridir. Bu çalışmada 70/157/EEC regülasyonuna göre dış gürültü sınırının üstünde olan bir aracın, gürültü kaynaklarının ayrıştırılması ve uygun iyileştirme seçeneklerinin uygulanmasını göstermektedir. Gürültü kaynaklarının ayrıştırılması yöntemi egsoz, güç aktarma sistemi ve lastik gibi gürültü kaynaklarını filtrelenmesi yardımıyla uygulanmıştır. Toplam gürültüye en yüksek etkisi olan kaynaklar için çözüm önerileri sunarak 70/157/EEC direktifi sağlanmıştır.

**Anahtar kelimeler:** 70/157/EEC Direktifi, dış gürültü, gürültü kaynağının ayrıştırılması

### 1. INTRODUCTION

Noise pollution has escalated mainly in the urban areas and represents a danger for the citizens. As a result, exterior noise level reductions of road vehicles have been playing an ever increasing role in the development exterior noise level and will increase in new product developments that will take place for the next years [1]. That's why this laborious shielding method is performed instead of temporary solution.

Although the base gasoline derivative of the examined vehicle satisfy the 70/157/EEC Directive for M1 class, the CNG derivative exceed the required sound pressure level (SPL).

According to 70/157/EEC directive, for

measurements, the A-weighted sound level of sound sources other than those of the vehicle to be tested and of wind effects must be at least 10 dB(A) below the sound level produced by the vehicle.

The measurements are considered valid if the difference between two consecutive measurements on the same side of the vehicle does not exceed 2 dB (A).

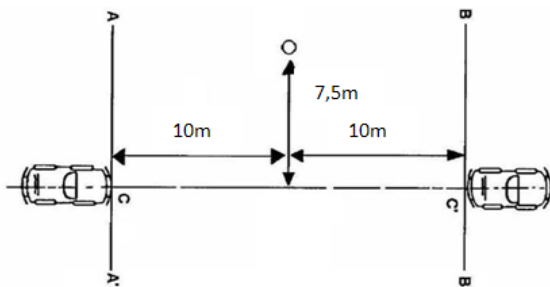
Results are calculated as the arithmetic mean of the highest SPLs recorded in 2<sup>nd</sup> Gear and 3<sup>rd</sup> Gear.

The measurement maneuver was performed on the track as seen in Figure1. The vehicle approaches to the line AA' at a steady speed of 50kph. When the front side of the vehicle reaches the AA' line, the throttle is completely opened until the vehicle rear end pass the BB'

line. Between these two lines, the gear is not shifted. The test maneuver is performed in 2nd and 3rd gear positions. The vehicle maximum SPL is acquired between AA' and BB' lines. This maneuver performs for both sides of the vehicle [2-3].

**Table1:** Limiting Values of 70/157/EEC Directive [2]

Vehicle Categories	Values Expressed in dB(A)
Vehicles intended for the carriage of passengers, and comprising not more than nine seats including the driver's seat	74
To take account of inaccuracies in the measuring instruments, the result obtained from each measurement is determined by deducting 1 dB(A) from the meter reading.	



**Figure 1:** Microphone Position for the Measurements of the Moving Vehicle

The CNG derivative of the vehicle has changes in design of transmission and exhaust line and the main noise sources of the vehicle are considered to be the engine, exhaust, intake and tires. That's why the first aim is to determine the most dominant noise sources of the vehicle during this study.

## 2. VISUALIZING THE CONTRIBUTION FACTORS OF THE SOURCES

The determination of the source contribution of the vehicle was performed by windowing as seen in Figure2 and Table2.

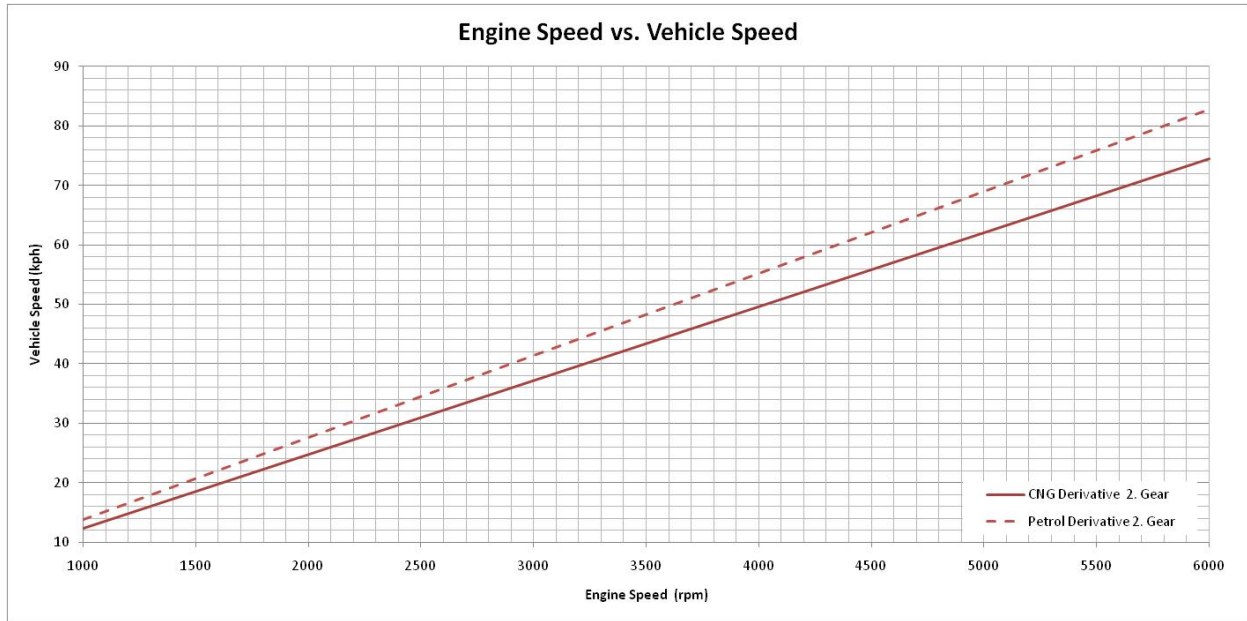
The transmission had been changed for the CNG derivative. This leads final drive and transmission ratios to be changed too as seen on Figure3. That is why for the same entrance speed the radiated noise level observed to be increased



**Figure 2:** The Applications of Undershield and Total Exhaust Muffler

**Table2:** Contribution Analyses Test Conditions

Iteration ID	Total Exhaust muffler	Undershield	Silent Tires	Aim of Measurement
Base				Visualize the Baseline
All Silence	X	X	X	-
Tire	X	X		Visualize Contribution of Tires Radiated Noise
Undershield	X		X	Visualize Contribution of Powertrain (P/T) Radiated Noise
Exhaust		X	X	Visualize Contribution of Exhaust Muffler Radiated Noise



**Figure3:** Calculated Engine Speed vs. Vehicle Speed for CNG Derivative and Petrol Derivatives

### 3.RESULTS

**Table3:** Results of Contribution Analyses Test Conditions

		Results [dB(A)]
Base	CNG	77,93
	Petrol	78,47
All Silence	CNG	74,27
	Petrol	73,98
Tires	CNG	74,66
	Petrol	75,27
Exhaust	CNG	76,89
	Petrol	77,54
Undershield	CNG	75,89
	Petrol	74,54

Maximum ambient noise level is measured as 55,3 dB(A) during these tests.

**Table4:** Contribution of Noise Sources

	CNG [dB(A)]	Petrol [dB(A)]
Contribution of the exhaust	73,45	75,02
Contribution of the P/T	70,82	65,40
Contribution of the tires	64,00	69,37

Undershield and exhaust total muffler brings the best improvement for pass-by noise. That's why the treatments are primarily aimed to reduce their contributions as seen in Table4.

#### List of Treatments:

After the identifying and isolating the sources of the failure following treatments were applied on to the vehicle:

- Optimization of the muffler design
- Increase in tailpipe radius
- Undershield application

Applying the above treatments to the base configuration, the new test results met the target pass by noise levels.(Table 6)

**Table6:** Pass-By Test Results After Treatments

Results	CNG	Petrol
[dB(A)/E]	72,94	73,35

Ambient noise level is measured as 51,9 dB(A).

### 4. CONCLUSION

During this study, the contribution of the sources determined by shielding techniques over the sources one by one. After verifying the main sources for this study, the treatments were applied. By this way new CNG derivative vehicle with new exhaust system design and engine undershield application can pass the limiting values of 70/157/EEC directive.

## REFERENCES

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