Using ISO 5130and ISO 362 for determination of both stationary and pass–by vehicles noise and discuss the difference between them.

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Abstract: The traffic noise is considered as one of the most important public annoyances. Using ISO 362 measurements of vehicles pass- by noise are needed to predict any change in traffic sound levels. Also, ISO 5130 is used for determination the noise emitted by stationary road vehicles. The difference between the two cases, namely, stationary and pass-by, depends on different parameters (tires-road surface – etc). From the measurements carried out on vehicles, using the two mentioned methods, the parameters values could be evaluated.
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1- Introduction

The parameters, which have an influence on vehicle noise emission, are well known: vehicle type, speed, driving behaviour (acceleration), road surface, road gradient. A complete prediction method should provide an emission value for each combination of these parameters [1]. A vehicle's acoustic signal consists of a combination of various noise signals generated by the engine, the tires, the exhaust system, aerodynamic effects, and mechanical effects (e.g., axle rotation, brake pads, and suspension). It has a spatial distribution because the noise sources are at different locations on the vehicle. The mixture weighting of these spectral components at any given location is dependent on the vehicle's speed, whether the vehicle is accelerating, decelerating, turning, and whether the vehicle is in good mechanical condition [2]. In general, one can approximate a well maintained vehicle's signal as consisting of four noise components:

a) *Engine Noise:* The noise from an internal combustion engine, the engine noise is largely due to the turbulent air flow in the air intake (or intercooler), the engine cooling systems, and the alternator fans, The strongest tone in the engine noise is called the engine fire rate. Car manufacturers try to suppress the engine noise as much as possible for the passengers' comfort inside the vehicle cabin, also the manufacturers try to suppress the noise levels outside the car. To achieve this, the interior of the engine compartment is usually treated with material for acoustical attenuation . Hence, in some cases, the engine noise might be stronger on the side and at the very front of the car than other directions, because sound propagation through the axle, the front grill, and the bottom of the engine block cannot be filtered effectively.
b) *Tire Noise:* The term tire noise is defined as the noise emitted from a rolling tire as a result of its interaction with the road surface. The tire noise is the main source of a vehicle's total noise at speeds higher than 50km/h. It consists of two components: Vibrational noise and air noise. The vibrational component is caused by the contact between the tire threads and the pavement texture. Its spectrum is most dominant between 100 − 1000Hz. The air noise is generated by the air being sucked-in or forced out of the rubber blocks of a tire and is dominant in the frequency ranges between 1000 and 3000Hz.
c) *Exhaust Noise:* The exhaust system consists of the exhaust manifold, catalytic converter, resonator, exhaust pipe, muffler, and the tail pipe. The system goes from the engine compartment to the back of the car generating the exhaust noise. Due to the system's spatial distribution, this noise is less prominent in the front of a vehicle. Unlike the engine block noise, the exhaust system noise increases significantly with the engine load. The exhaust noise is also affected by engine turbo/super chargers and after-coolers. Manufacturers use a combination of reactive and absorptive silencers to keep the exhaust noise level down. The exhaust noise has broadband characteristics with most of its power concentrated around low frequencies.
d) *Air Turbulence Noise:* Vehicle induced turbulence can become an important factor in the overall perceived loudness of a vehicle as the vehicle speed increases. This noise is due to air flow

generated by the boundary layer of the vehicle. The turbulence noise depends on the aerodynamics of the vehicle as well as the ambient wind speed and its orientation.

A new method to determine sound power levels (PWLs) [4], used for modeling outdoor sound simulations, are obtained from sounds that are emitted by various types of vehicles and cause road traffic noise. Several PWL determination methods have been suggested based on the SPLs obtained from a receiver. These methods require environmental correction and consideration of the influence of the SPL measurement surface where the noise, caused by stationary machines or vehicles, is applied.

The effects of vehicles and pavement surface types on noise have been investigated [5], at the Korea Highway Corporation's Test Road along the southbound side of the Jungbu Inland Expressway, South Korea. The study was conducted in 2005 and 2006 through field measurements were carried out at nine surface sections of asphalt concrete and Portland cement concrete pavements using eleven vehicles. For the road noise analysis, the sound power levels PWLs of combined noise (e.g., tire/pavement interaction noise and power-train noise together) and tire/pavement interaction noise using various vehicles were calculated based on the novel close proximity and pass-by methods. Then, the characteristics of the PWLs were evaluated according to surface type, vehicle type, and vehicle speed. The results show that the PWLs of vehicles are diversely affected by vehicle speed and the condition of the road surface. The nine pavement surface types evaluated in this study were compared according to vehicle type and speed. Comparisons were made using the regression equation that is based on several noise prediction models.

2- Test Methods and Measurement

2-1 Procedures to determine the vehicle's L_{Amax} , from the pass-by method (6,7)

The vehicle's L_{Amax} was determined by using the sound level meter, A-weighted maximum noise level obtained from the pass-by method. The L_{Amax} can be simply measured when the distance between a moving vehicle and a microphone measuring SPLs is the closest during a pass-by.

2-1-1 Measurement Site

The data was collected on 6-October highway, on a sunny day. The test track site pavement is drain asphalt, in the portion of the area between the vehicle path and the microphone location (Figure 1). The test track and the surface of the site were dry.

2-1-2. Measurements of meteorological conditions and background noise

Meteorological conditions (temperature, humidity, pressure and the wind speed at the height of microphone did not exceed 5 m/s during the sound measurement intervals) were measured to ascertain the influence of weather or other environmental conditions on noise emission. It is observed that the A-weighted back ground noise was more than 15 dBA below the emission produced by the vehicle under test. As the back ground noise was much below the noise emissions from the vehicle, we can say that the noise recording from the microphone when the vehicle was in the test region is due to the noise from the vehicle only.

It is to be noted that the porous asphalt has noise absorbing characteristics. The large size aggregates increase lightly the noise due to tire road contact; whereas the noise absorbing characteristics (due to porosity and touristy) of the drain asphalt decrease largely the noise

Microphones, located at a height of 1.2 meters and 7.5 meters away from the centre line of the running track, were used to record the noise level during the study period.

2-2 Procedures to determine the vehicle's A-weighted sound pressure levels, from the stationary method (8)

The vehicle's A-weighted sound pressure levels was determined by using the sound level meter, A-weighted maximum noise level obtained from the stationary vehicle method. The height of the microphone above the ground is 0.2m and pointed towards the outlet orifice and located at a distance of 0.5 from the outlet orifice. This international standard specifies a test method for the determination of noise emitted by stationary road vehicles in use, the noise being measured in proximity to the exhaust.

2-2-1 Measurement Site

Any open space may be considered as a suitable test site if it consists of a flat area made of asphalt or hard material having a high acoustical reflectivity. The stationary test were carried out at way, that is no edges of the test site nearer than 3 m from the extremities of the vehicle and there is no any obstacle closer than 3m to the microphone during test with the exception of the observer and driver, no person whose presence influences the meter readings are present during the test.

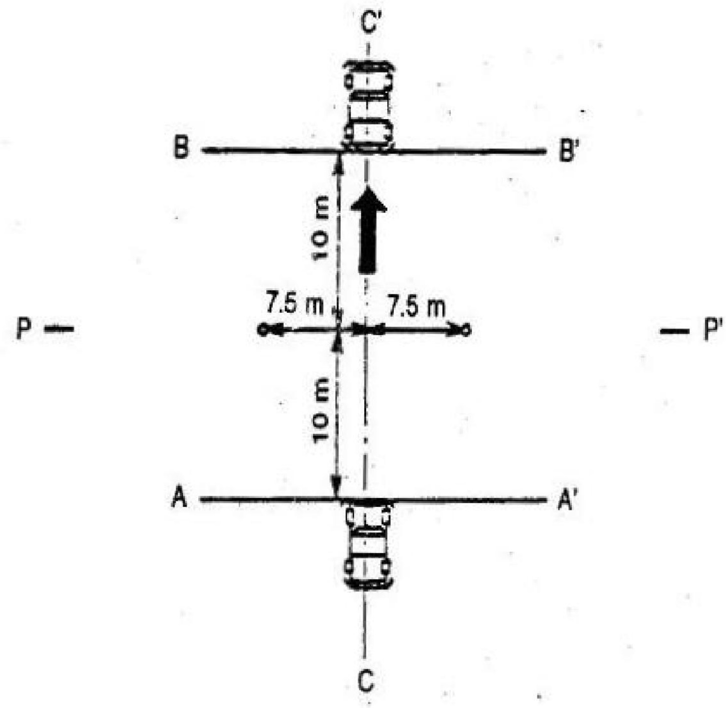

Figure 1. Measurement site and its test track for the pass-by method

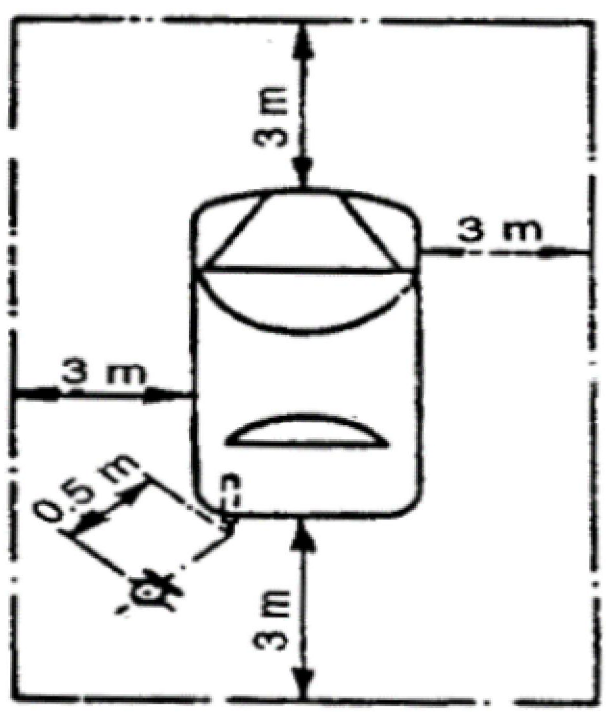

Figure 2. Measurement site and test for the stationary method

3-Measurement and evaluation of the A-weighted sound pressure levels of each vehicle

The results obtained for the sound pressure level of 5 different vehicles represents in figure 3, different vehicles passing with constant speed 50km/hour. The sound pressure level of 5 vehicles were recorded, the tire/road noise and mechanical noise are involved in the measurements when the vehicle is passing. Figure 4, shows the one-third octave band spectrum for vehicles approaching at a constant speed 50km/hour. The relationship between sound pressure level and vehicles speeds illustrated in fig. 5. The noise emitted from vehicles increases as vehicle speed increased. This means that, vehicles speeds only have a limited influence on generated sound pressure level, it is about 10dB per doubling speeds. Also fig 5; illustrates the effect of vehicle acceleration on its noise emission (Lamax), the evaluation of tire/road and motor-noise for each vehicle are involved in measurements, and the noise levels emitted for various engine speeds. The total noise levels are overestimated when the vehicle is running. Figure 6, illustrates the relation between the overall LAmax of pass-by and overall LAmax of stationary, the results appears that, the sound pressure level (SPLs) of stationary are larger than those of LAmax of pass-by. In statistical analyses for stationary case, the standard deviations in overall values are less than 1 dBA but for pass-by case it is about 2.4dBA.

The difference in values obtained from subtracting LAmax of pass-by from LAmax of stationary, the difference in values were calculated based on the measured data. The international standard 5130, specifies a test method for the determination of noise emitted by stationary road vehicles in use, the noise being measured in proximity to the exhaust. However, the purpose of 362, is the measurement of noise emitted by accelerating road vehicles, and the purpose of this study is to evaluate the difference in noise emissions between the two cases. the two methods are slightly different. The main differences are that: the 5130 standard places a single microphone at 0.5m from the outlet orifice (the noise being measured in proximity to the exhaust) at a height of 0.2 m above the ground . For 362 standard, two microphones, located at a height of 1.2 meters and 7.5 meters away from the centre line of the running track.

4- Conclusion

Measurements were made using the 5 vehicles .A comparison of the results is shown in Figure 6, based on the curves of measurements of stationary and pass-by vehicles, the difference between the sound pressure levels in stationary and pass-by methods, the trend lines of vehicles were nearly the same on test vehicles. This means that characteristic of the difference in sound levels between the two methods was very consistent with the behaviour of two curves, it ranged from 30-33 dBA. Average results at stationary case is a 30-33 dBA to the exhaust noise, higher than the level for the accelerating road vehicles.

Figure 3. Effect of vehicle type on its LAmax of pass-by noise emission at 50Km/hpur speed

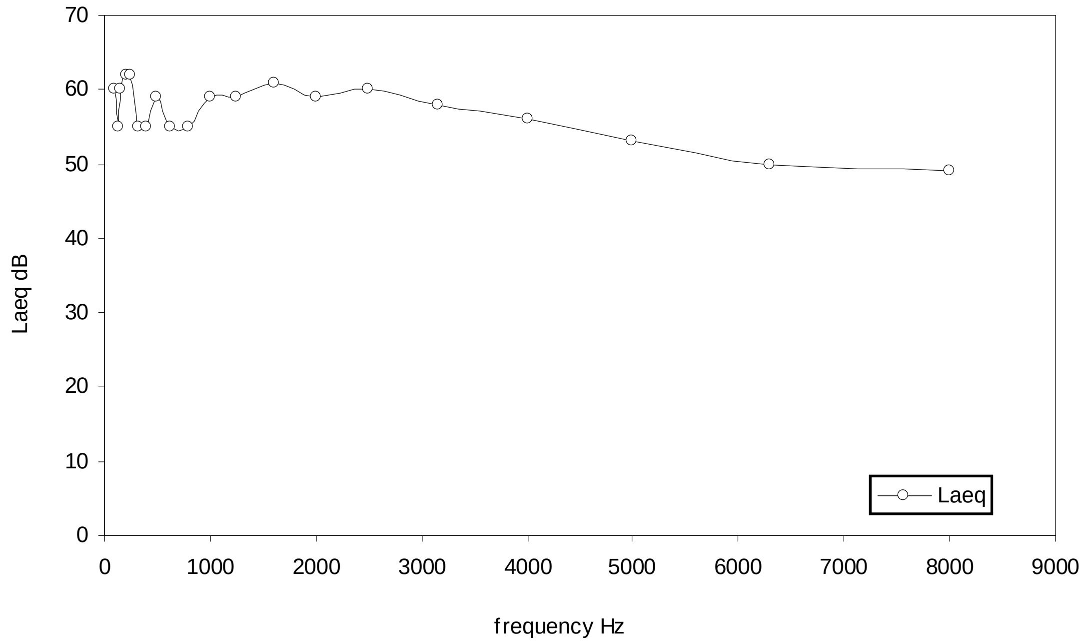

Figure 4. shown the noise emission spectrum of vehicle

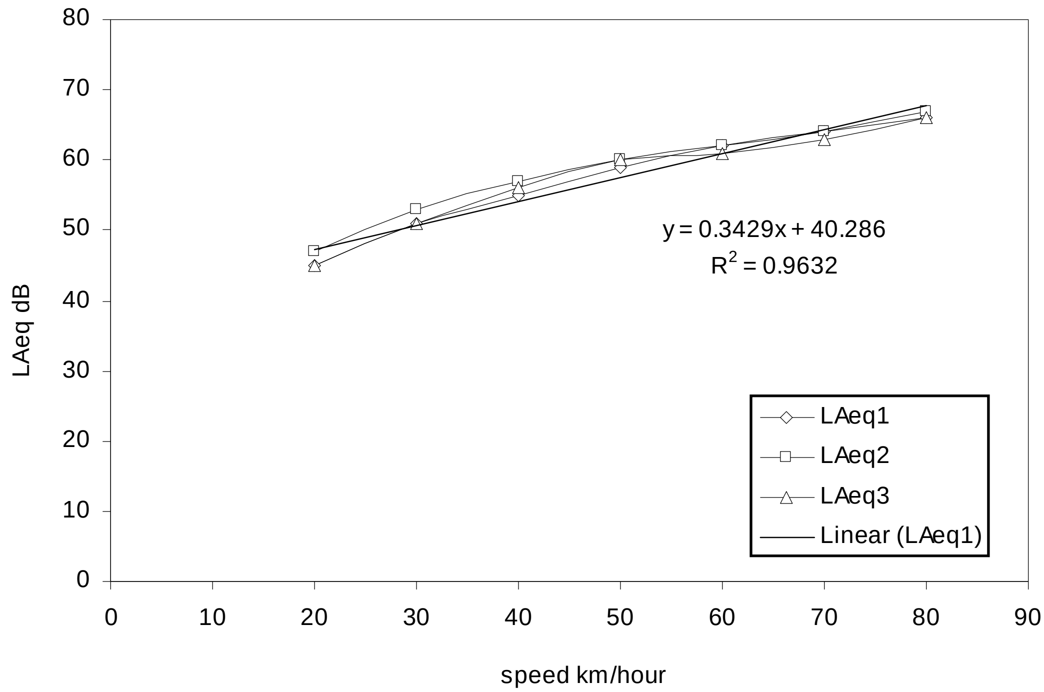

Figure 5. Effect of vehicle acceleration on its noise emission Lamax

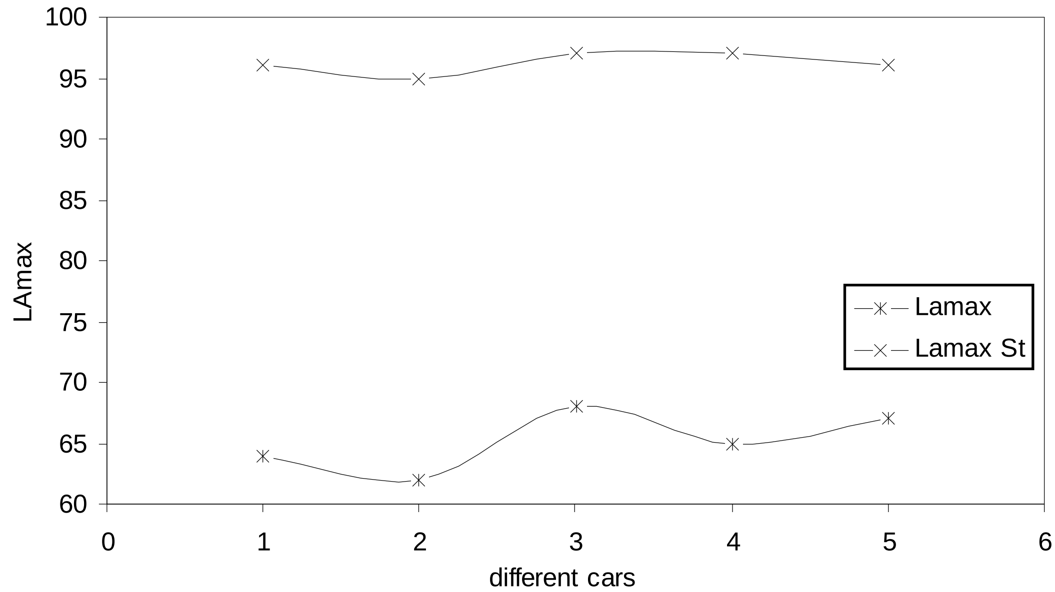

Figure 6. Relation between the overall LAmax of pass-by and overall LAmax of stationary,

5- References

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