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ACOUSTIC COMFORT IN CONVENTIONAL (ICE) AND ELECTRIC VEHICLES – ASSESSMENT METHODS

Bernardo José Mirones Gómez
(University of Valladolid – Spain)

INTRODUCTION: ELECTRIC MOBILITY IS EXPANDING AT A RAPID RATE

Electric car deployment has been growing rapidly over the past ten years, global sales of electric vehicles (EVs) in 2020 increased by 43% year on year to 3.24 million units (4.2 % of new passenger cars). This compares with a sales decline of 14% of the total passenger car market in 2020.

EV sales will continue to grow throughout the decade, forecasting that all EVs will represent 43% of all new cars sold in 2035. Figure 2:

OBJETIVE – GENERAL PURPOSE:

1. Description of the experimental procedure for the study of automobile acoustics, according to (ISO 5128 – 1980), carrying out comparative experimental measurements in vehicles equipped with ICE and VE.

2. Know the acoustic behavior of the car in general, making special mention of the differences between a vehicle equipped with an Alternative Internal Combustion Engine and an Electric Vehicle, objectively, highlighting what a customer will "hear and feel" on both types of vehicles.

MATERIALS AND METHODS: MEASUREMENT CHAIN (SEE FIGURE 3)

Registration according to the procedure to measure interior vehicle noise in BS 6086 1981 (ISO 5128 - 1980). BS 6086 requires:

- Microphones in a horizontal position and pointing their direction of maximum sensitivity in the direction that an occupant would normally face forward.
- Microphones at not less than 150 mm from the body or trim.
- Microphones must be mounted in such a way that they are not affected by vehicle vibrations.

Through the Siemens PLM Software, the LMS TestLAB Durability Acquisition program, we made a temporary recording during the Road Test. Although Standard BS6086 requires recording at various constant speeds in the range of 60-120 km/h, from idling to full load, it has been chosen to make a measurement in 3rd gear from idling to full load and another at a sustained speed of 100 km. /h. The application is built around three basic steps, which constitute a typical RLDA (road load data acquisition) process: establish channels, measure, and validate.

RESULTS

Comparative graphs of the average pressure dB(A) at point D as a function of speed and for each third of an octave (Figures 4-5) and comparative spectrograms (pt. D) for both types of motor are shown (Figures 6-7)

CONCLUSIONS:

1. FULL THROTTLE: The noise level difference between the two vehicles at full throttle can be up to 8 dB. This marked contrast is due to the predominant presence of the heat engine when requesting its maximum performance, and it is more noticeable the higher the engine rotation speed - Figure 4

2. The main source of noise is the combustion engine, proportional to its speed of rotation and with levels above 70 dB(A) for some low harmonics. In the spectrograms those narrow bands where the sound emission is concentrated are clearly observed. It is maximum near the limit of rotation (5000 rpm) – Figure 6

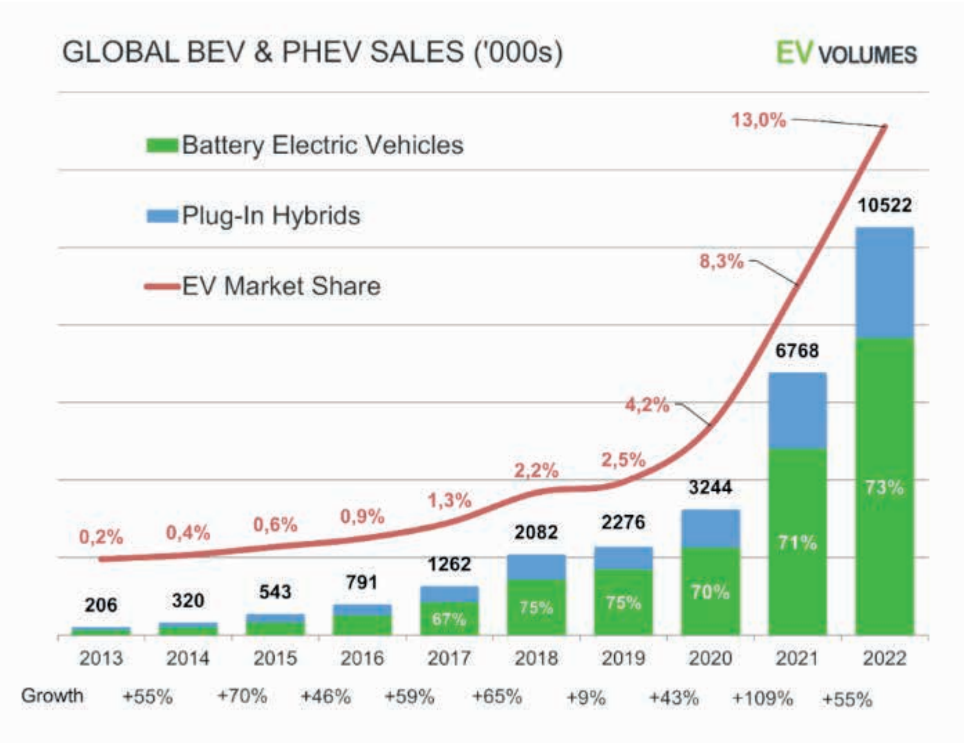


Fig. 1 – Global BEV & PHEV Light Vehicles Deliveries

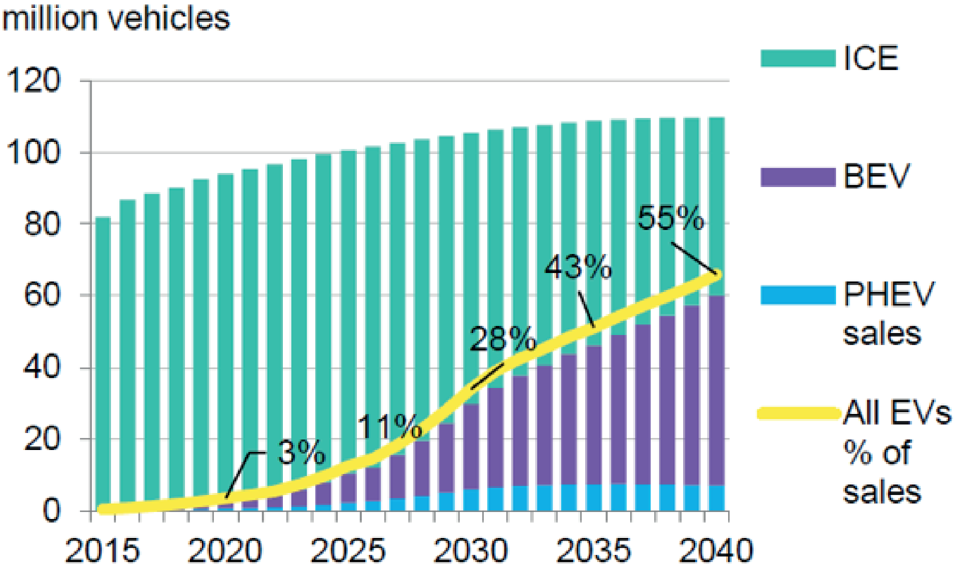
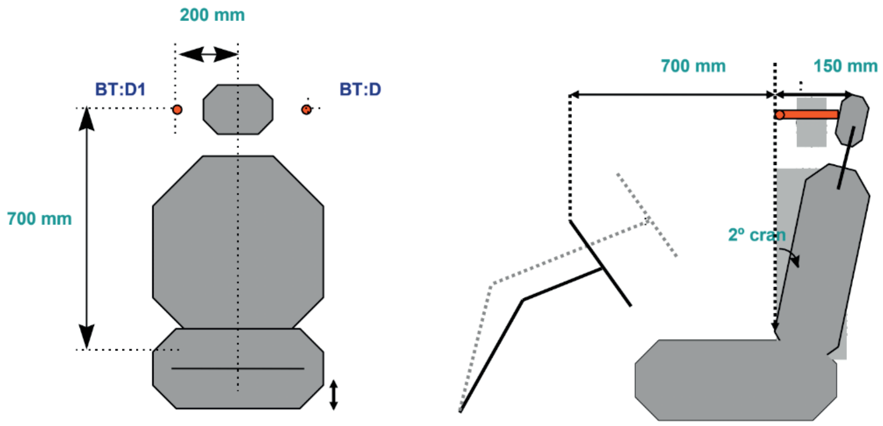


Fig. 2 – EV Sales and % Growth Forecast 2040



For a “left-hand drive” vehicle:

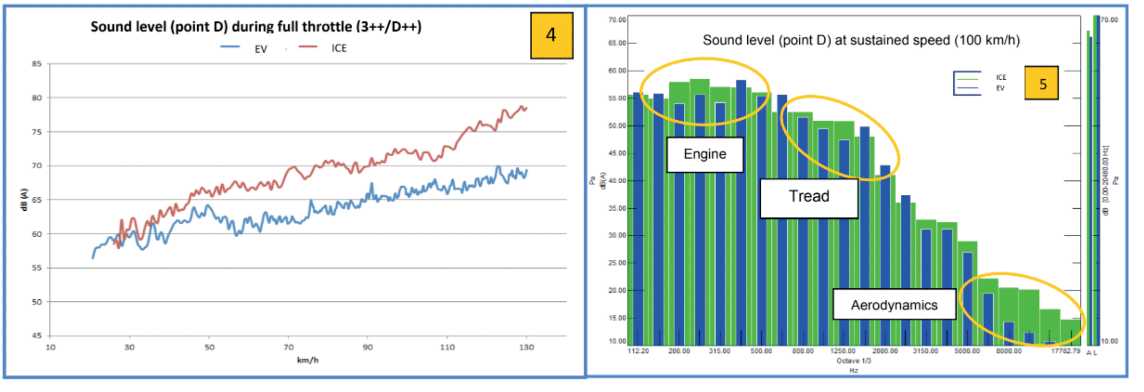
BT:D driver left ear

BT:D1 Right ear driver

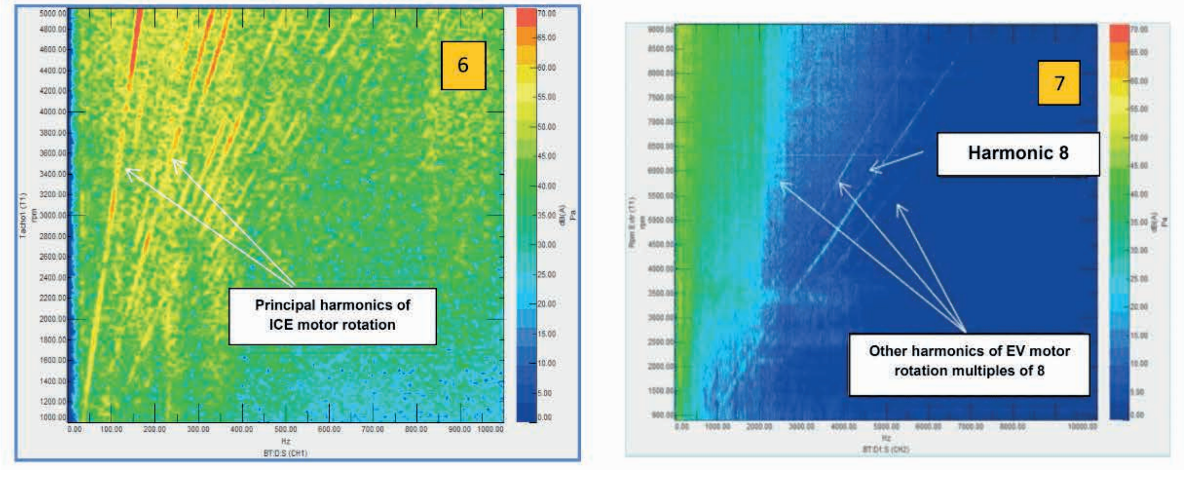
BT:F Passenger right ear

BT:K Center rear seat

Figure 3 – Measurement Chain



Figures 4-5: Comparisons of the mean pressure dB(A) at point D as a function of velocity (4) and for each third of an octave (5)



Figures 6 – 7: comparison of the spectrograms (point D): ICE engine (6) and VE (7)

3. In the case of the EV there are no major sources of noise. At low speed the rolling noise predominates while from 80 km/h the aerodynamic noise becomes important. The spectrogram shows the absence of intense low-frequency noise, but the 48th harmonic (and multiples of 8) does stand out, originating in the rotor (8-pole) – Figure 7

4. In conclusion, the electric vehicle enjoys greater acoustic comfort compared to its combustion equivalent, but at the same time requires more demanding work in reducing noise not linked to GMP, present in all types of automobiles.