

CSI S.p.A. - CERTIFICATION of SAFETY INSTITUTE

**Pass-by noise, from the Real to the Simulated.
The Analysis and Development for the ECE
Certification**

MOTORCYCLES

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CSI S.p.A. – An overview of the ECE R41

Scope:

This Regulation contains provisions relating to the noise made by vehicles of category L3.

Methods of measurement:

There are two methods, the first is a dynamic test – **Pass-by test**, and the second is a stationary test - **Measuring of noise in proximity to the exhaust**

Limits:

Category	Engine cylinder capacity (cc)	Value expressed in dB(A)
First Category	$cc \leq 80 \text{ cm}^3$	75
Second Category	$80 \text{ cm}^3 \leq cc \leq 175 \text{ cm}^3$	77
Third Category	$cc > 175 \text{ cm}^3$	80

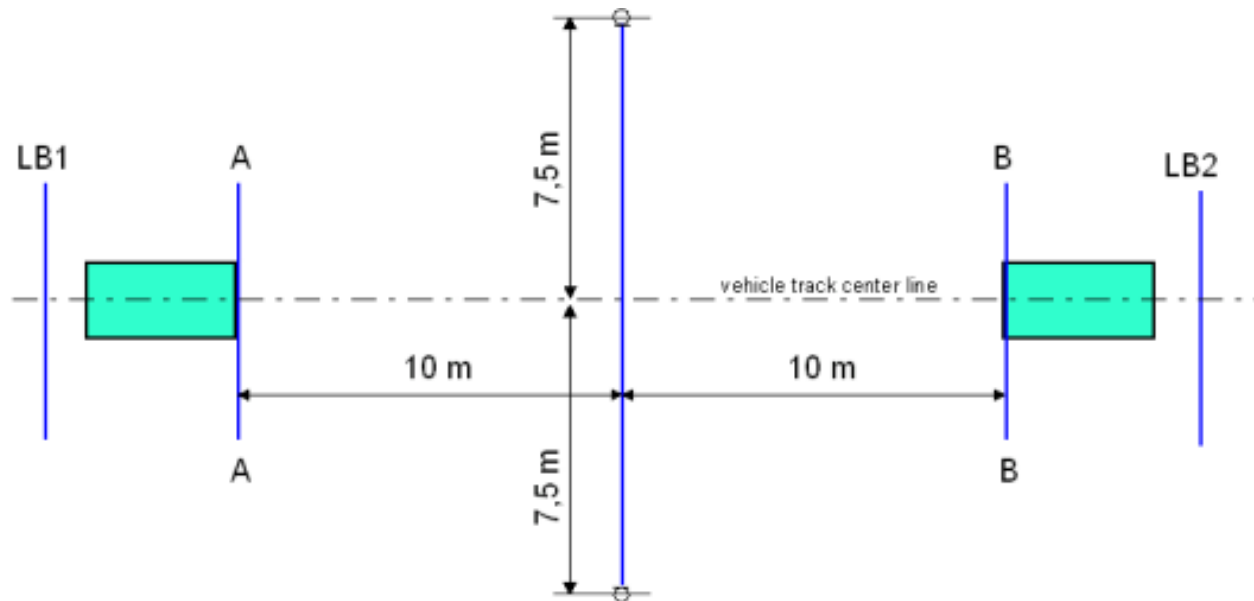
CSI S.p.A. – Test Method

Pass-by Test

The Pass-by tests are carried out in accordance with “Uniform provisions concerning the approval of motor cycles with regard to noise” of ECE R41, which covers also the analysis, based on the following factors:

- the distance covered by the vehicle
- vehicle speed
- engine rpm

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The left-hand side of the figure shows the situation at vehicle entry, while the right-hand side of the figure shows the situation at vehicle exit. The dimensions shown relate to ECE 41 (it's the same also for the ECE 51). Accordingly, the distance to be covered starts at -10 m (front of vehicle) and ends at +10 m (rear of vehicle). LB1 and LB2 mark the position of the light barriers. The sound pressure level of the passing vehicle is measured by two microphones facing each other.

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Approach speed:

The motor cycle shall approach the line AA' at a uniform speed corresponding to $V_A = 50$ km/h.

Interpretation of results:

The maximum sound level expressed in A-weighted decibels (dB(A)) shall be measured as the motorcycle travels between lines AA and BB. This value should not exceed by more than 1 dB(A) the maximum sound level authorized for the category of motor cycle tested

Selection of gear ratio:

Motorcycles fitted with engines having a cylinder capacity of more than 175 cm³ and a gearbox with five ratios or more shall be tested once in second gear and once in third gear. The result used must be the average of the two tests. If, during the test carried out in second gear the engine speed on the approach to the line marking the end of the test track exceeds 100 per cent of the speeds the test must be carried out in third gear and the sound level measured shall be the only one recorded as the test result.

CSI S.p.A. – Test Method

Measuring of Noise in Proximity to the Exhaust

Positions of the microphone:

The height of the microphone above the ground should be equal to that of the outlet pipe of the exhaust gases, but in any event shall be limited to a minimum value of 0.2 m.

The microphone must be pointed towards the orifice of the gas flow and located at a distance of 0.5 m from the latter with an angle of $45^{\circ} \pm 10^{\circ}$.

In the case of an exhaust provided with two or more outlets spaced less than 0.3 m apart, only one measurement is made; the microphone position is related to the outlet nearest to the external side of the motorcycle or, when such an outlet does not exist, to the outlet which is the highest above the ground.

For motor cycles having an exhaust provided with outlets spaced more than 0.3 m apart, one measurement is made for each outlet as if it were the only one, and the highest level is noted.

CSI S.p.A. – Measuring of Noise in Proximity to the Exhaust

Operating conditions of the engine:

The engine speed shall be held steady at the following value:

1/2 of the engine rotation speed if it exceeds 5,000 min⁻¹.

When constant engine speed is reached, the throttle shall be returned swiftly to the idle position. The sound level shall be measured during a period of operation consisting of a brief maintenance of constant engine speed and throughout the deceleration period, the maximum deflection of the needle being taken as the test value.

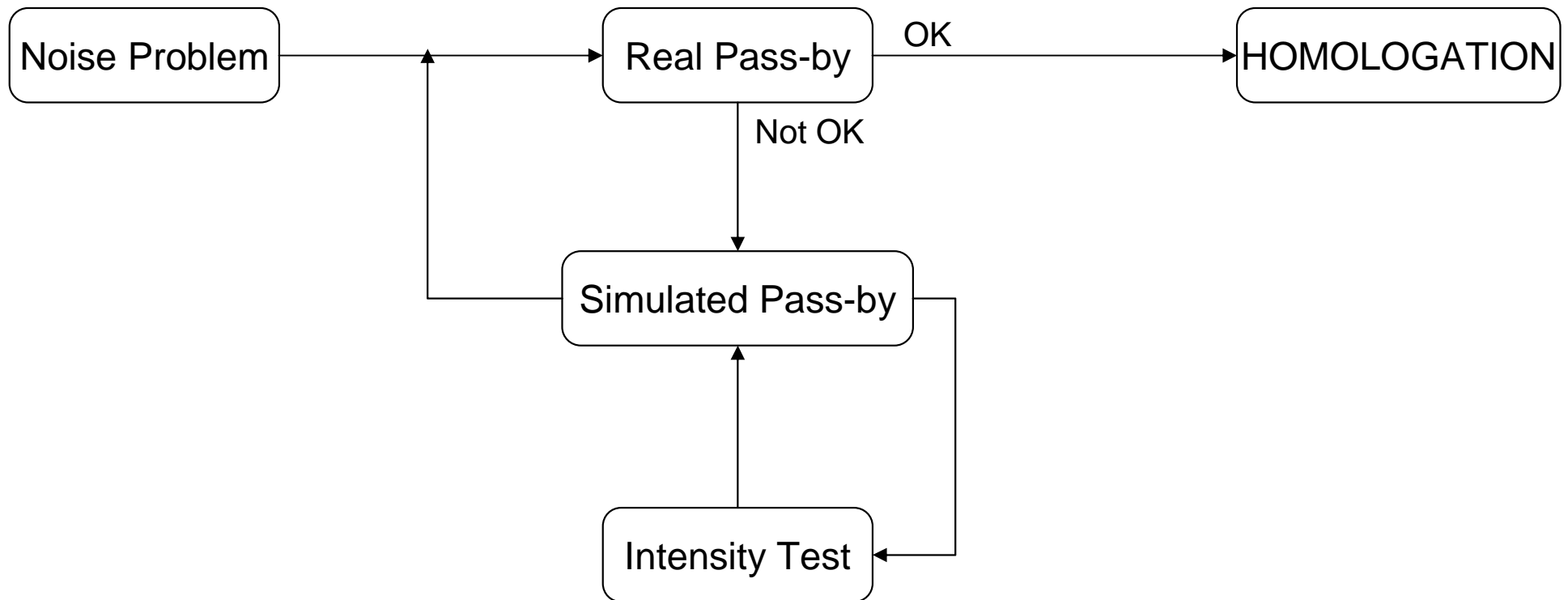
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A project in partnership with Yamaha Motor R&D Europe



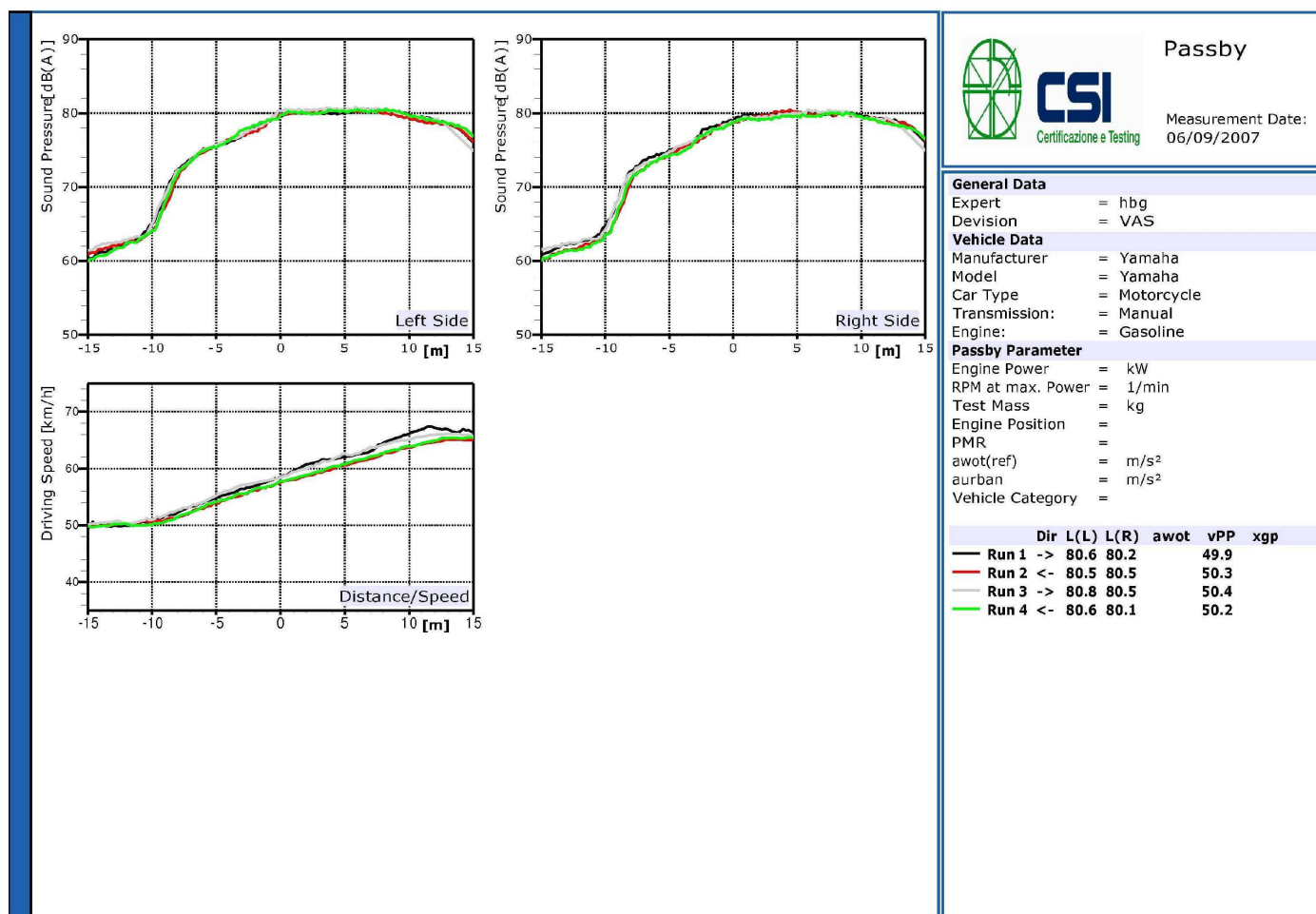
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The step-by-step procedure



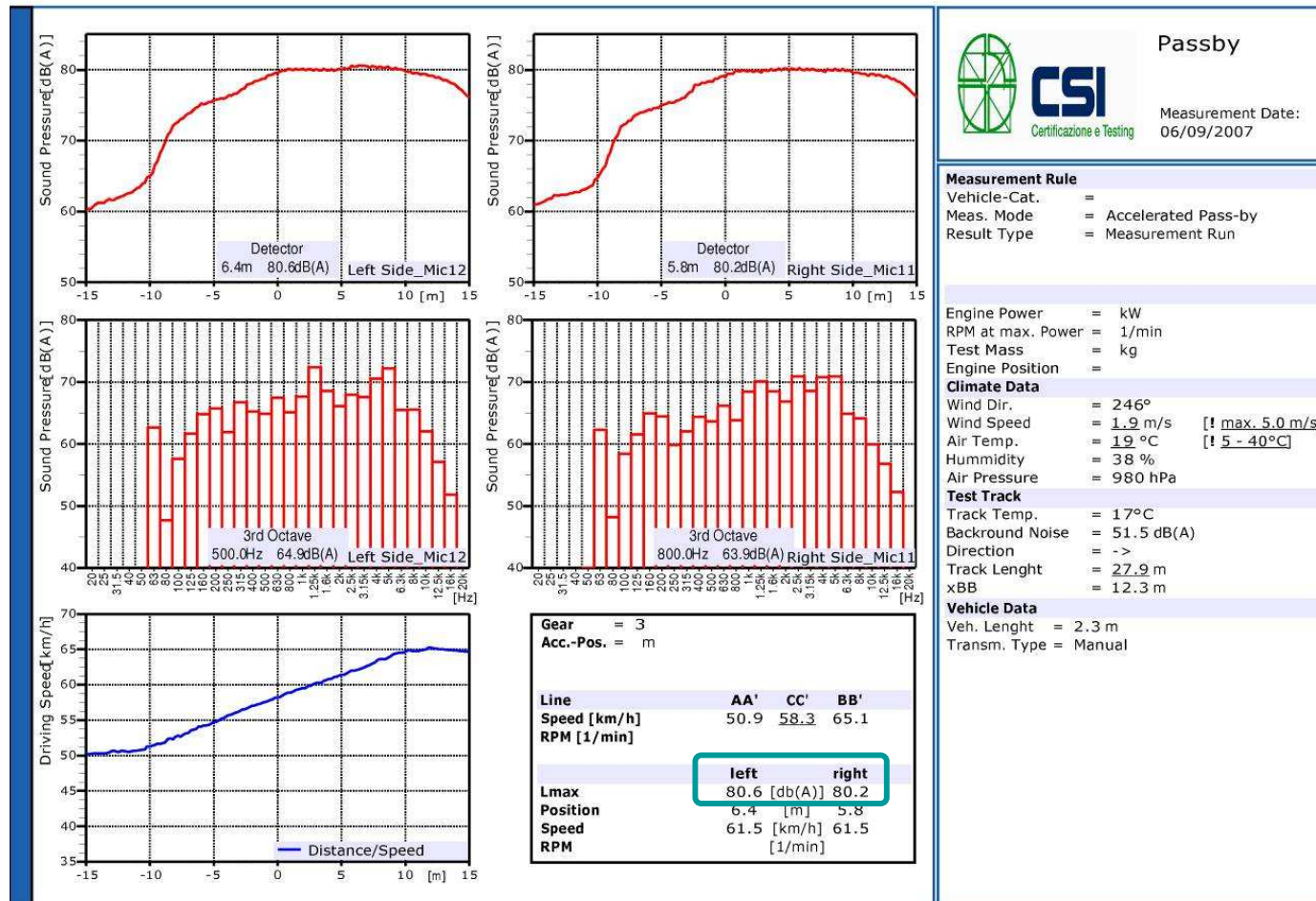
CSI S.p.A. – The Analysis and the Development

Real Pass-by Tests – On the proving ground homologation track

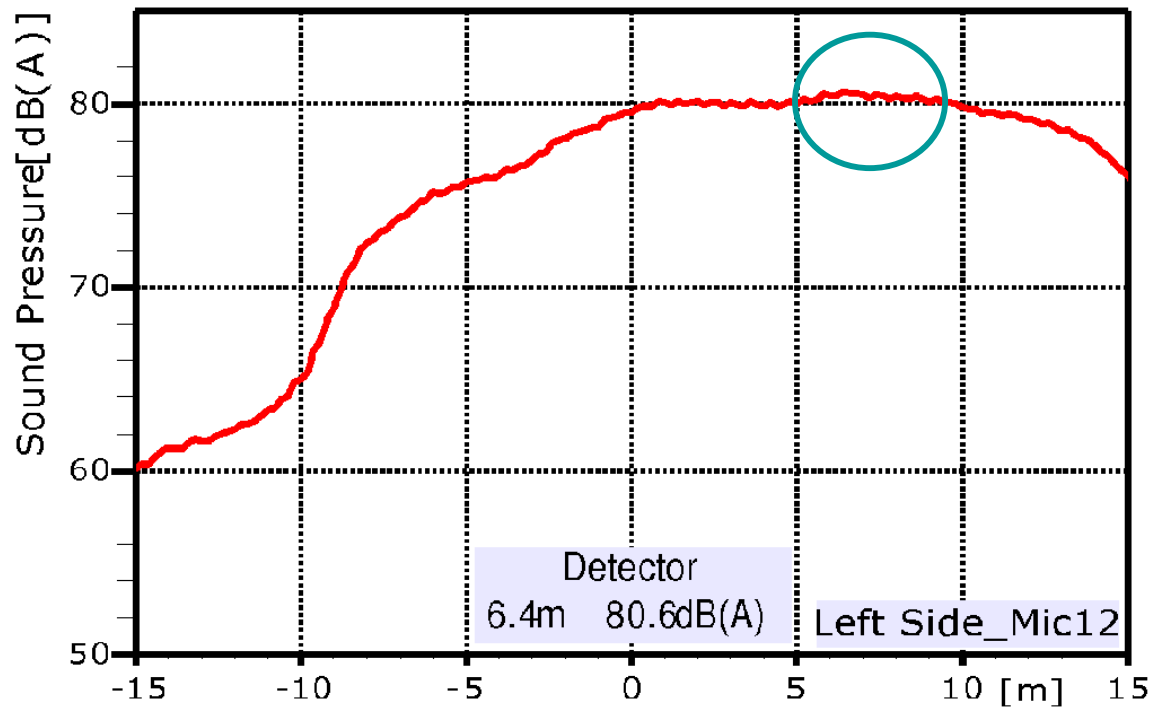


CSI S.p.A. – The Analysis and the Development

Real Pass-by Tests – On the proving ground homologation track



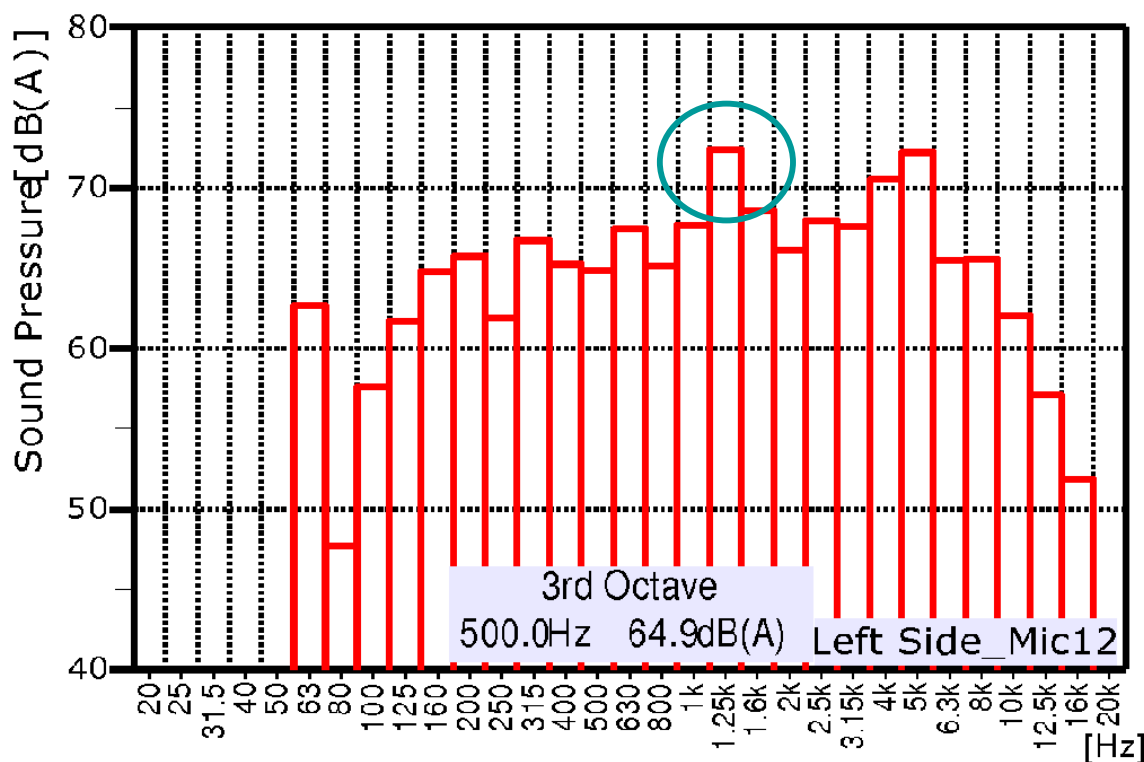
CSI S.p.A. – Real Pass-by Test



PROBLEM

The SPL exceeds the maximum value allowed:
 $80.6 \text{ dB(A)} > 80.0 \text{ dB(A)}$

CSI S.p.A. – Real Pass-by Test



ANALYSIS

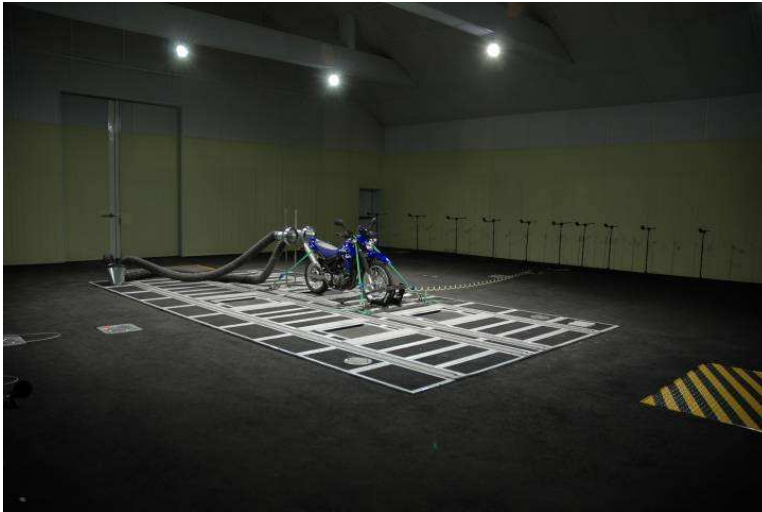
The problem is in the 3rd octave of 1250 Hz

INVESTIGATION

Simulated Pass-by and Intensity Test

CSI S.p.A. – The Analysis and the Development

Hemi – Anechoic Chamber



Chamber dimensions – 15 x 15 x 8 m (entrance in m. w3 x h4)

Floor Surface – ISO road surface

Fully Air-Conditioned – constant temperature

Data acquisition and analyses: Müller BBM-VAS

24 Microphones 1/2"

Full field Pass-By data acquisition station (weather, velocity, photocell gates)

CSI S.p.A. – Hemi – Anechoic Chamber



NVH Chassis Dynamometer 2 Axle – 4 Separate Drives

Max Velocity – 250 km/h

Max Axle load – 2.500 kg

Drum Diameter – 1 591 mm

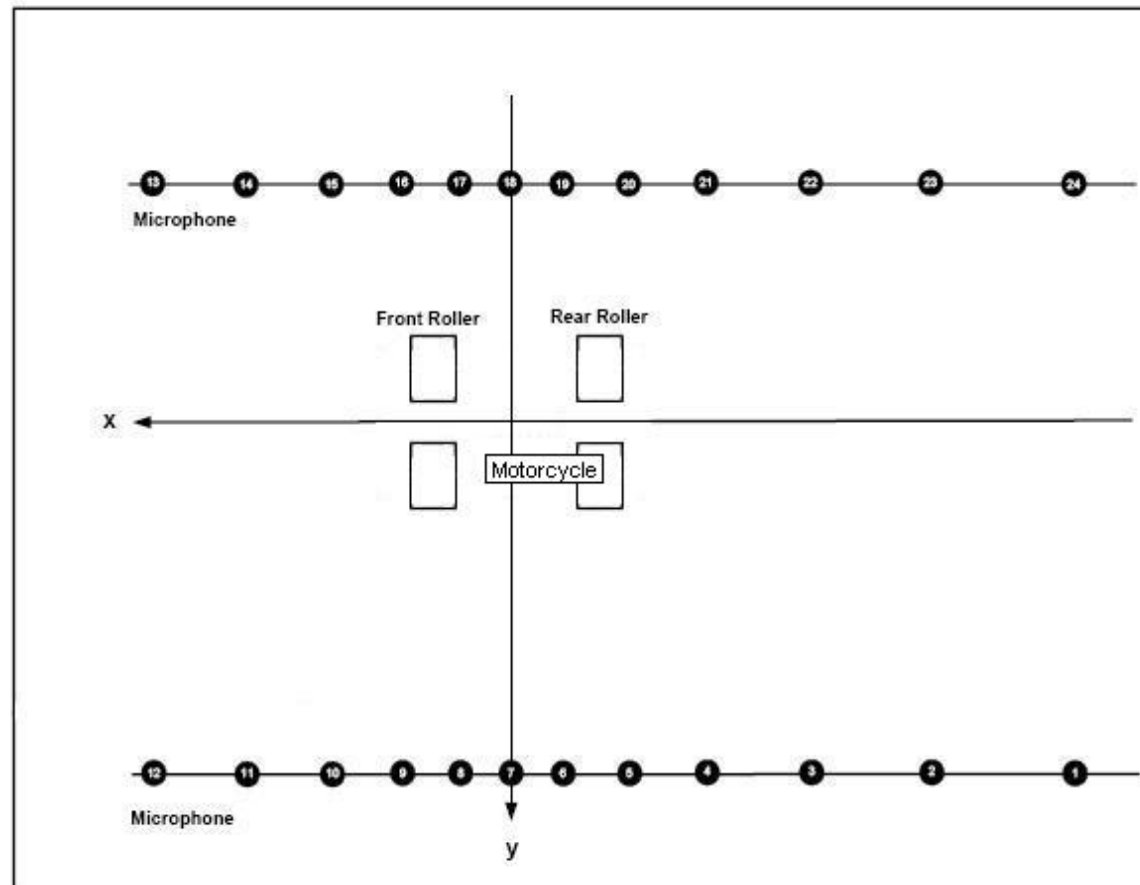
Drum Width – 700 mm

Min./Max Wheel Base – 1800/3920

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Development Tests in the Laboratory

Test set-up:



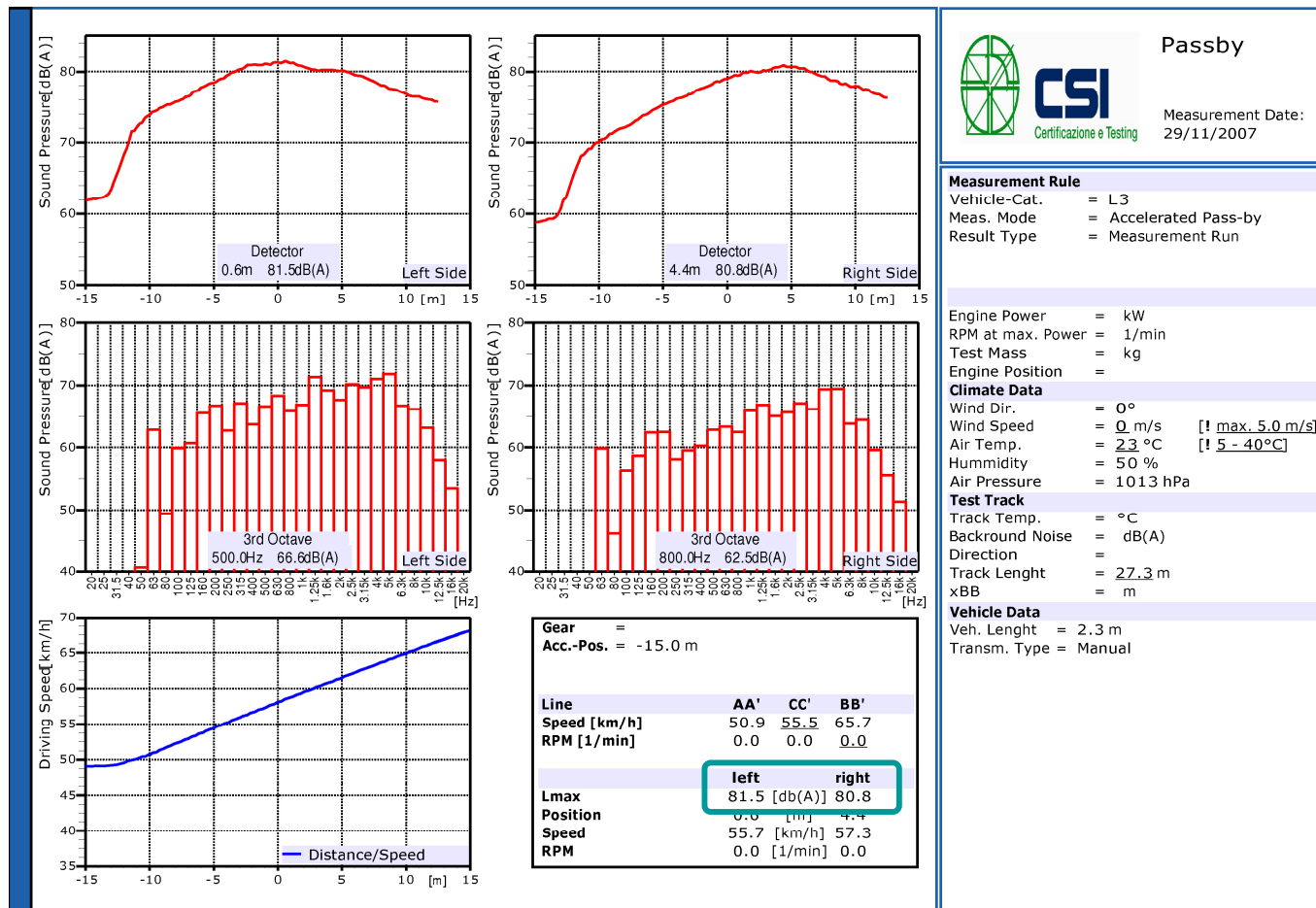
CSI S.p.A. – Development Tests in the Laboratory

Reproducibility of vehicle characteristics (coast down, vehicle inertial)



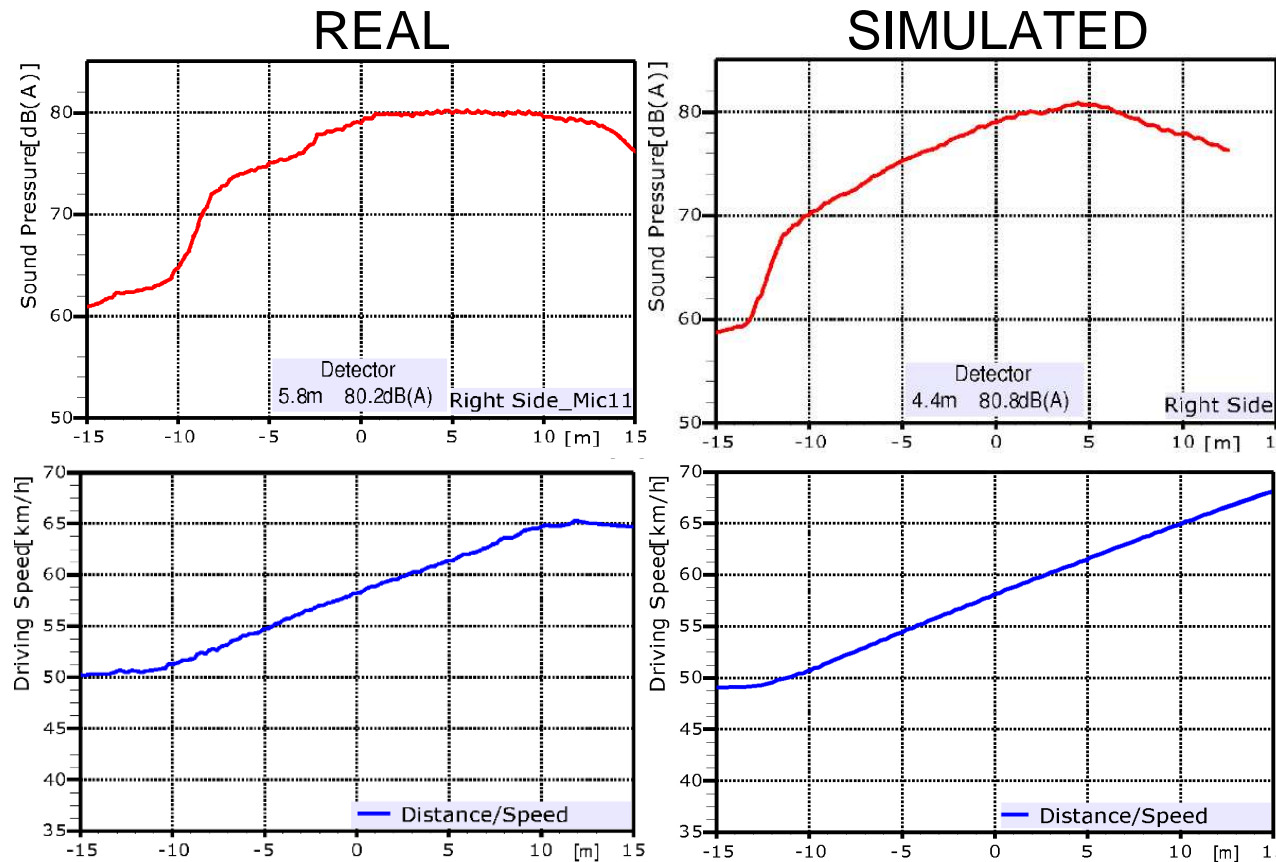
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Simulated Pass-by – In Chamber



CSI S.p.A. – Simulated Pass-by – In Chamber

Check the COHERENCY between the real test and the simulated test:



CHECK

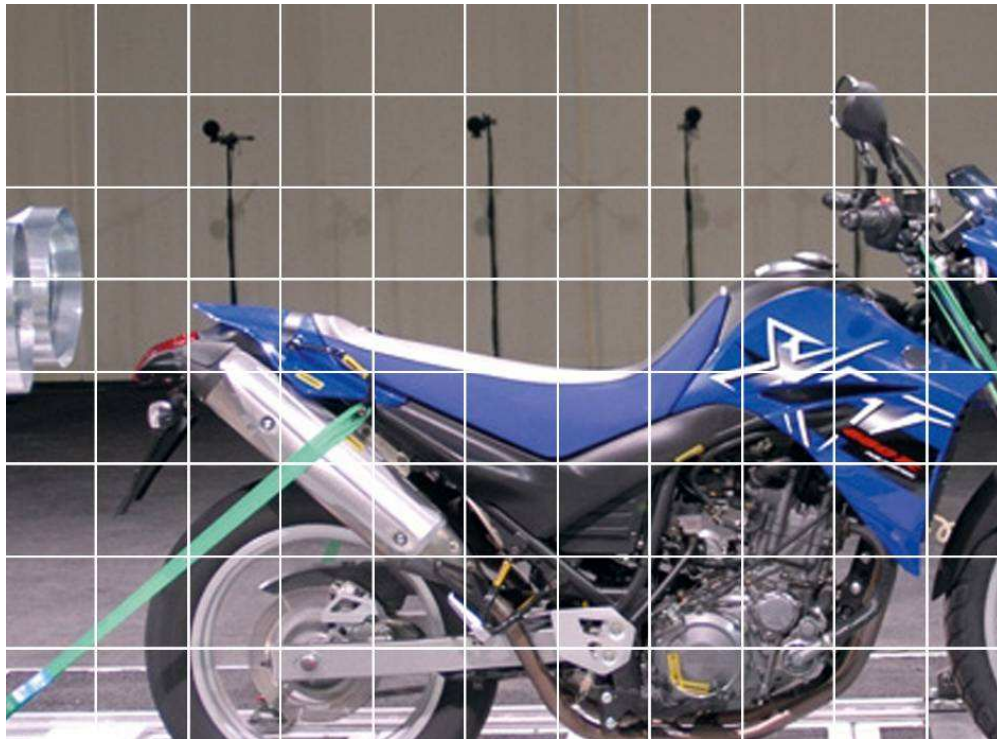
SPL is OK:
80.2 dB(A) vs 80.8 dB(A)

Speed is OK:
 ΔS : 14 km/h vs 15 km/h

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Intensity Test

Now it is possible to run the Intensity test with the confidence that in the chamber is reproduce the real motorcycle's behavior.

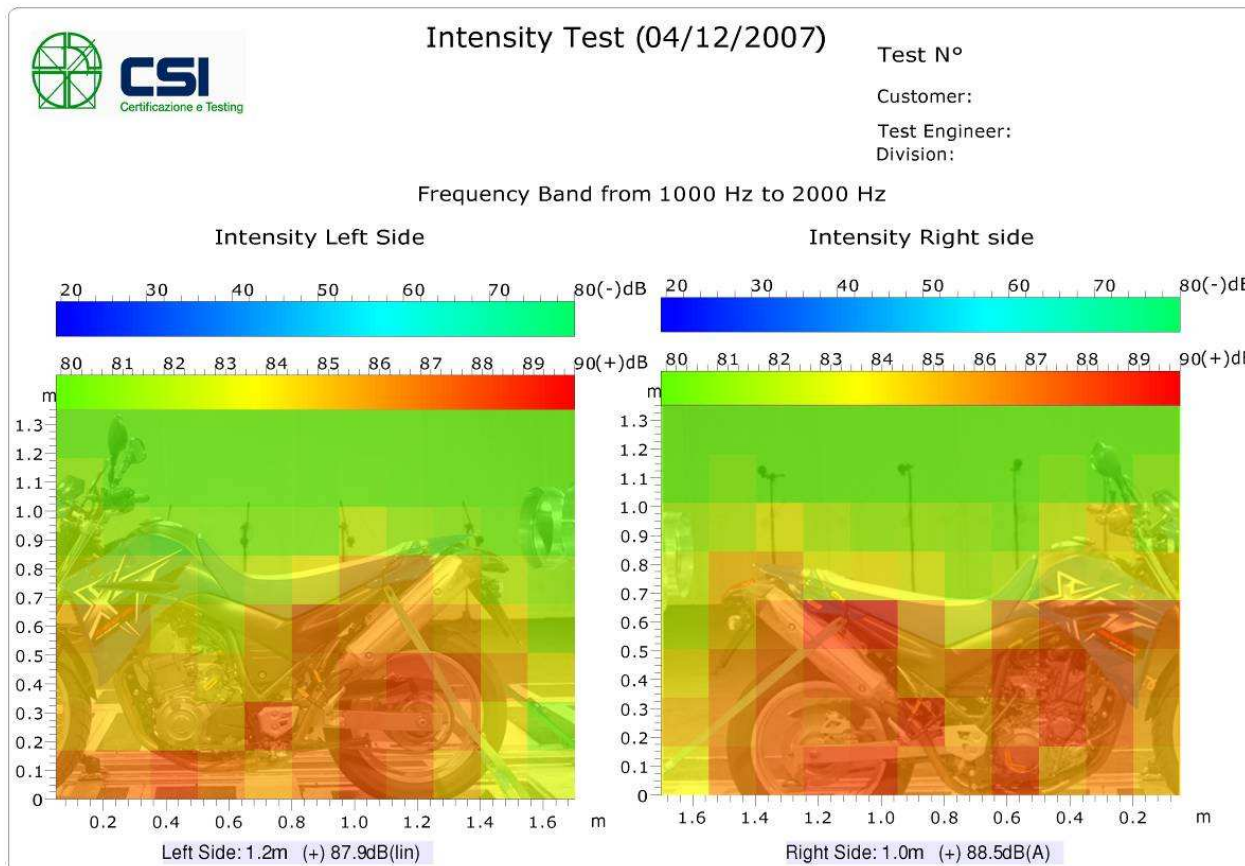


The scope of the test is to investigate the sources of noise and it is done with a dual-channel sound intensity probe.

For this purpose a grid is set-up on both sides of the vehicle, and then, for every square of the grid, is performed the sound intensity analysis to obtain the sound power P .

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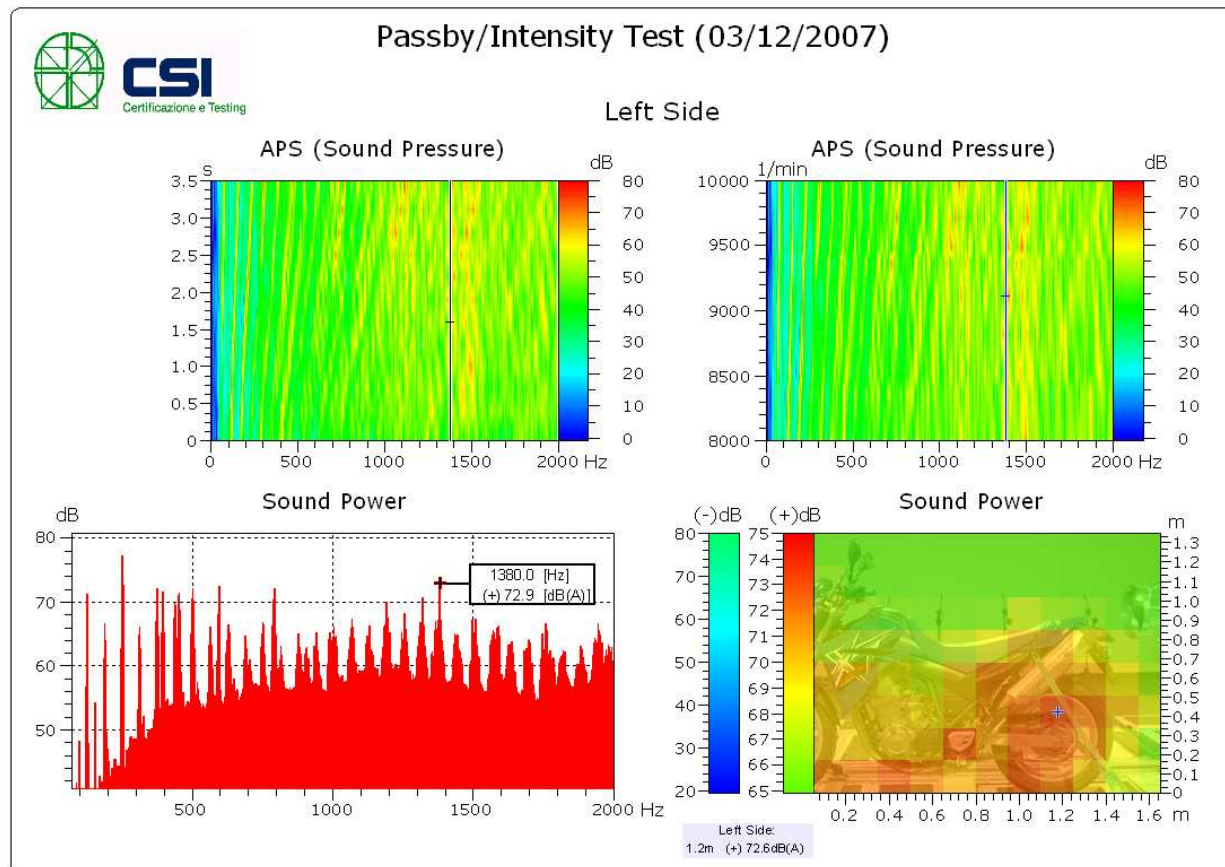
From the Real and Simulated Pass-by test it has found that the 3rd octave band to be investigated was that of 1250 Hz.



The results of the intensity test is showed only for the frequency band of interest (1000 – 2000 Hz).

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We can find the general sound frequency that generates the noise, and then we zoom on the specific frequency band and perform the fine analysis.



ANALYSIS

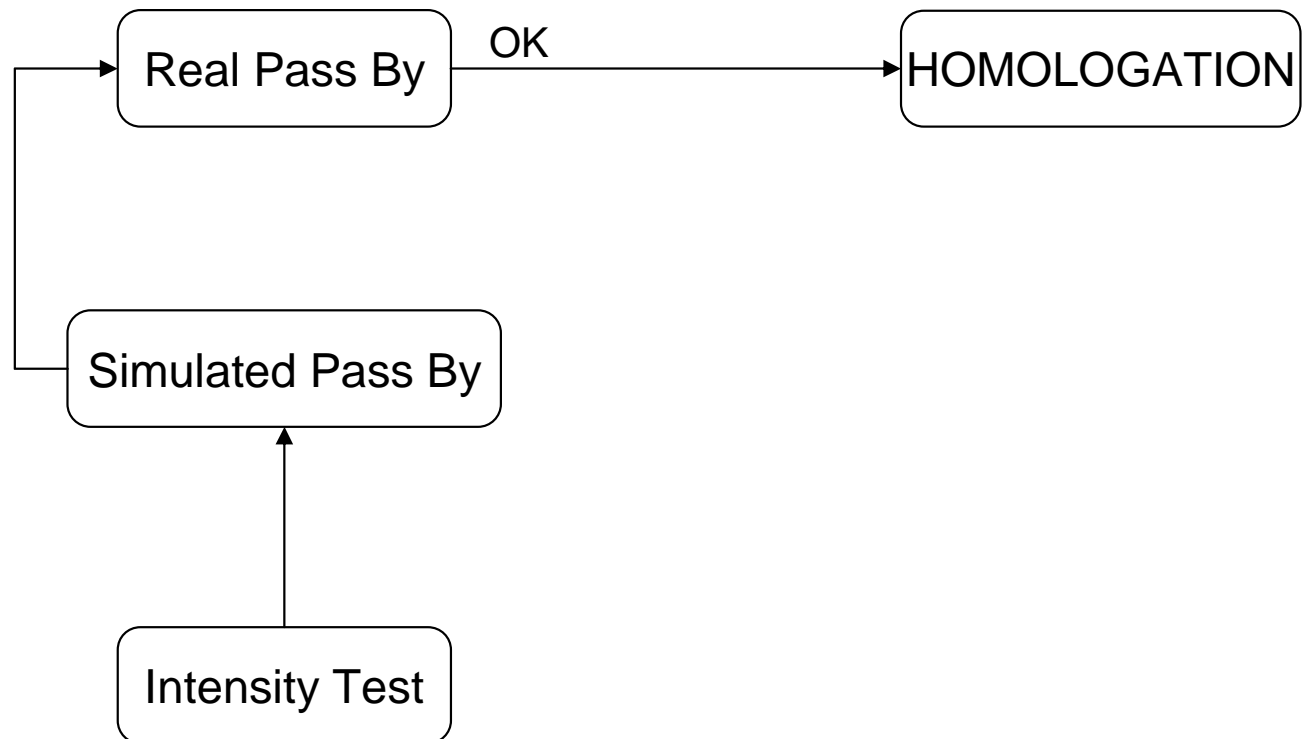
The frequency at 1380 Hz is the highest in the 3rd octave investigated.

It 's an own frequency of a component and not of a rotational source.

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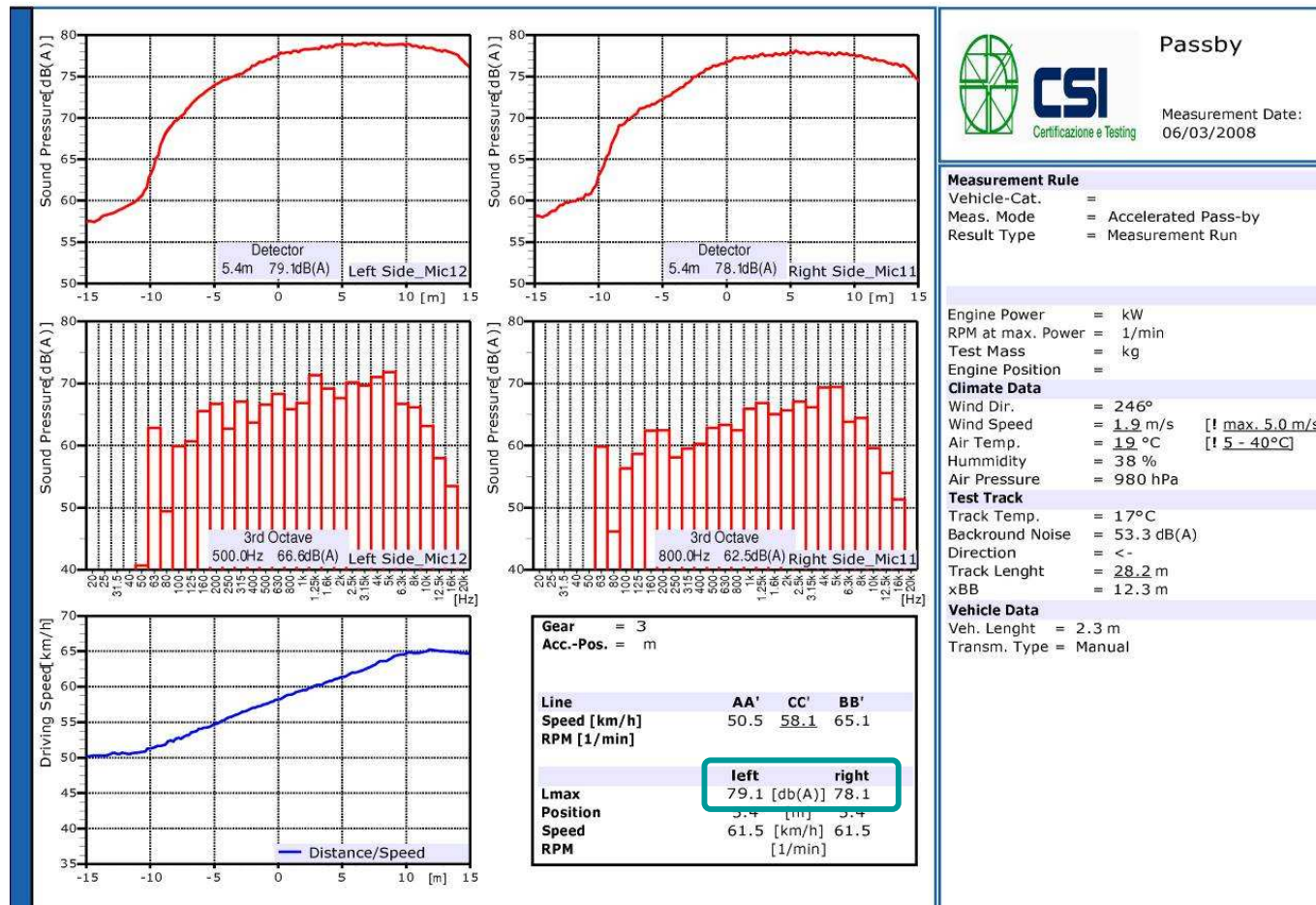
Once has been identified the cause of the noise generation, the vehicle prototype is modified and the Vehicle is subjected to verification tests.

If the test results meet the limit targets then we can go ahead with the homologation tests.



CSI S.p.A. – The Analysis and the Development

Homologation



CSI S.p.A. – Conclusions

- ✓ **Optimized Solution**
- ✓ **Product development over-all time reduction**
- ✓ **Significant costs savings**



CSI S.p.A. – NVH Services for cars and motorcycles

- ✓ **Noise and vibrations testing in accordance with client's specifications**
- ✓ **Pass-by noise simulations**
- ✓ **Power train derived noise and vibration measurements**
- ✓ **Vehicle Running Mode Analysis**
- ✓ **Intensity Analyses**



CSI S.p.A. – Other Services

✓ FULL-SCALE CRASH

frontal, side, rear – max. V 90 km/h, 10 video, 270 channels, “underview” and “on-board” films



✓ BODY & COMPONENTS

anchorage resistance, crush, fatigue, front rails, “crush box”, interior trim – video, post-test analysis, seats, steering wheels, instrument panels, seat belts, airbags

✓ VEHICLE VALIDATION

noise testing, endurance, interior trim validation, from -40°C to +80°C, either IR or UV solar simulation, suspension fatigue and anchorage resistance



✓ FRONTAL RESTRAINT SYSTEMS & OUT-OF-POSITION

sled with “bar-bending” breaks – good “crash pulse” reproduction, “on board” films, post-test analysis, OOP certification

✓ OCCUPANT & PEDESTRIAN PROTECTION

FMH certification, Euro NCAP, EEC – head and leg impacts



✓ HOMOLOGATIONS

EC, USA, JAPAN, TAIWAN, CHINA type approval & certification



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**FOR ANY FURTHER INFORMATION, PLEASE
SEE US AT THE STAND 1600, IN HALL 1**

THANK YOU FOR YOUR ATTENTION

