Case Study: **Royal Enfield**

Royal Enfield - Motorbike Pass-by Noise

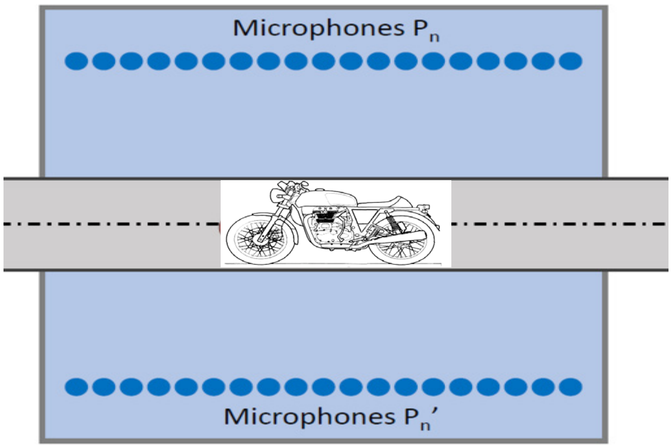
Industry Challenge

Indian motorcycle manufacturer Royal Enfield holds the distinction of being the oldest global motorcycle brand in continuous production. In production since 1901, the company is well known for its iconic Royal Enfield Bullet and other single-cylinder motorcycles.

As part of its growth drive, the company was in the midst of expanding its portfolio across the overseas markets. To achieve this, the company was keen to launch multiple variants of their bikes to cater to newer markets. The company was not only exploring bikes in newer styles, it was also keen to launch bikes across different capacities and price points. At the same time, it was looking to launch bikes in niche categories such as electric bikes.

One of the standout characteristics of Royal Enfield bikes is the distinctive engine noise that its ardent fans swear by. However, newer noise regulations such as Euro 4 R41 and ISO 9028 on pass by noise require that each bike manufacturer needs to meet the standard in order to launch their products into the market.

The iconic engine noise of Royal Enfield is one of its Unique Selling Points (USPs). The challenge therefore was to ensure that the signature sound would remain while meeting the required noise standards. The company needed to find a way to record noise levels for each part of the engine even before the manufacturing process started.



Passby Noise Simulation Approach:
Microphone arrays on LH & RH Side of 20 Meter Test Track

MSC Solution

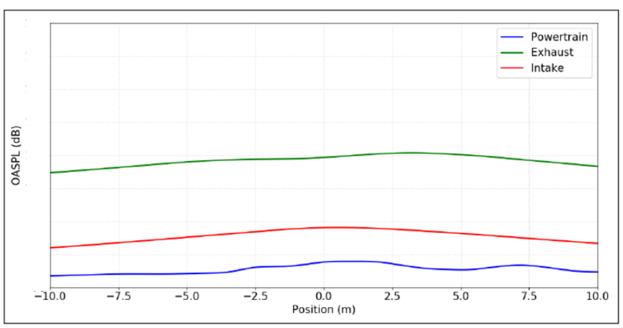
There are three dominant noise sources that are responsible for the distinctive Royal Enfield engine sound. They are the power train (engine and gear box), exhaust (muffler), and intake system. Royal Enfield used software from MSC Software to simulate the environments for the various noise sources.

Adams, a multibody software, was used to calculate the load generated inside the engine under the operating conditions, especially to understand the forces acting on the bearings and the crankshaft.

In addition, MSC Nastran, which is a finite element analysis (FEA) program was used to analyse surface vibrations generated on the surface of the engine. The company also used MSC's premier acoustics software Actran to predict sound levels in the acoustic cavity. Vibrations are sent to Actran where they are used for excitation of the acoustic cavity, which can help predict the sound levels.

Simulation was done at the system level using MSC Software tools in conjunction with other third-party tools. Simulation was done at the system level, which means that each component was simulated separately and assembled into full vehicle.

The simulation was followed by actual physical testing on the prototypes, which was conducted by Royal Enfield's India and UK R&D teams jointly with the MSC software teams. When the results derived from simulation were correlated with physical results, the engine noise correlation was found to be at 70-80 percent.



Passby Noise: Overall Sound Pressure Levels vs. Length of the test track (20 meters)

Key Highlights:

Product: Adams, MSC Nastran, Actran

Industry: Automotive

Challenge: To design a variety of bikes meeting the Pass by noise regulation standards in European markets while maintaining RE's signature rumble

Solution: Simulation with Adams Car, MSC Nastran and Actran to help predict noise levels from three dominant noise sources

> *At Royal Enfield, the focus for us is to ensure top-notch quality of products. By providing a fairly accurate insight into expected noise levels even at early design stages, Adams and MSC Nastran software enabled us to adhere to project delivery timelines, while helping us maintain our stringent quality standards and meet regulatory requirements easily*
>
> Rod Giles, Lead CAE & CAD,
> Royal Enfield A unit of Eicher Motors Ltd.

Benefits

When it comes to designing for optimum engine noise, testing directly at the prototype stage is quite inefficient since there is generally very little scope to make significant changes especially if there are changes required in the engine or exhaust. Only minor changes are possible and even those can significantly delay project timelines.

Typically, the entire process from design till launch is a 24-month cycle. Even a minor change requirement at the testing stage can delay the enter process by 3-4 months. For a manufacturer like Royal Enfield, which typically launches a new product every 6-8 months, this can lead to considerable disruption in launch schedules.

Through simulation using MSC Software products, Royal Enfield was able to bring greater predictability to their new vehicle launch cycles, not to mention savings in cost and time.

For more information on Actran and for additional Case Studies, please visit: **www.mscsoftware.com/en-indopacific/product/actran-acoustics**

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