Diesel Engine Mounting Configuration for Reduced Vibration In Vehicle Using the Analytical Approach

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Abstract

The diesel power train (engine and transmission) is the most significant mass contributor in vehicle. High idling vibrations from the engine get transmitted to the structure and the body panels through the engine mounts. Isolation of these vibrations by proper design of rubber mounts is the most effective engineering approach to improve ride quality of vehicle. In the present study, a mathematical model of the power train and mount system is developed with the engine and transmission being assumed to behave as a rigid body (6 degrees-of-freedom) and the compliance comes from the mounts. As a first step, the modes and natural frequencies are obtained. Following this the response to unbalanced inertial forces for an excitation frequency range of 8-40 Hz (500-2300 rpm) has been obtained. Also, motoring experiments are conducted on a baseline configuration to obtain the vibration response at mounts and mode shapes through ODS (Operational Deflection Shape) for validating the math model. A detailed parametric study is conducted and a new combination of mount system design variables were arrived as proposed solution which in comparison with baseline configuration showed that the vibration response reduces by 40% at idling and 60% in the engine operating range. Experiments conducted on the improved design show similar improvement. Thus, using this validated analytical math model, a closer-to-optimal design can be obtained with minimal dependency on iterative experimental methods which are costlier and time consuming.

Key word: Vibrations, Rigid body, and Mounting

1. Introduction

The power train is a significant source of vibration in vehicle and possesses a significant percentage of the total weight of the vehicle. The power train is also a potential aid in reducing vehicle vibrations. Mounts that are carefully designed can respond at the system level by coupling into the resonant frequencies of the vehicle suspension, chassis and body to serve as a dynamic absorber to attenuate unwanted vibration. Simultaneously, the mounts must also be designed to isolate the chassis and body of the vehicle from the power train. Many different mounting configurations have been developed to support the power train as the vehicle has