BAD VIBRATIONS

The reduction of noise, vibration and harshness has become a technology in itself. Vehicle manufacturers strive to refine their vehicles with insulators and vibration countermeasures to reduce these characteristics, but what exactly are they?

Noise is defined as an unpleasant or disruptive sound that causes some sort of disturbance, such as the rattling of a worn bearing.

Vibration is defined as the off-putting, repetitive motion of an object, such as a tyre out of balance which causes the steering wheel to oscillate at certain driven speeds.

Harshness is more difficult to define as this is very subjective. However, it could be defined as a sudden, aggressive feeling, such as the response from the vehicles suspension when driving into a pothole.

The largest source of these characteristics in the vehicle is from the internal combustion engine, with its rotating parts, combustion events, and variation in speed during operation. These features are magnified even more in engines equipped with stop/start technology, cylinder deactivation and increased compression ratios.

The transfer path through the vehicles body is via the engine mounts and any responding fuel, exhaust or air conditioning pipe, or interior trim. These are felt by us as either sounds that can be heard or vibrations that can be felt.

Vehicle manufacturers use a variation of shapes, sizes and types of mount to insulate the engine from the body in order to counteract these features. However, this very much depends on the vehicles engine characteristics, the costs involved and brand quality perception.

The three main types of mounting used are rubber, hydraulic and electronically active.

The traditional and most commonly used is the rubber mount. This is available in numerous shapes and sizes from a simple cotton real shape to a very complex rubber and metal formation.

Stiffness is regulated within the properties of the elastomeric material used, and the direction of movement is determined by the fixed links within the design of the mount.

The more dynamic hydraulic mount combines the acoustic isolation functions of a conventional rubber engine mount, but with a balanced damping performance.

Hydraulic engine mounts can adapt their characteristics depending on the induced load. The viscous liquid in the hydraulic mount acts as a damper to ensure optimum insulation.

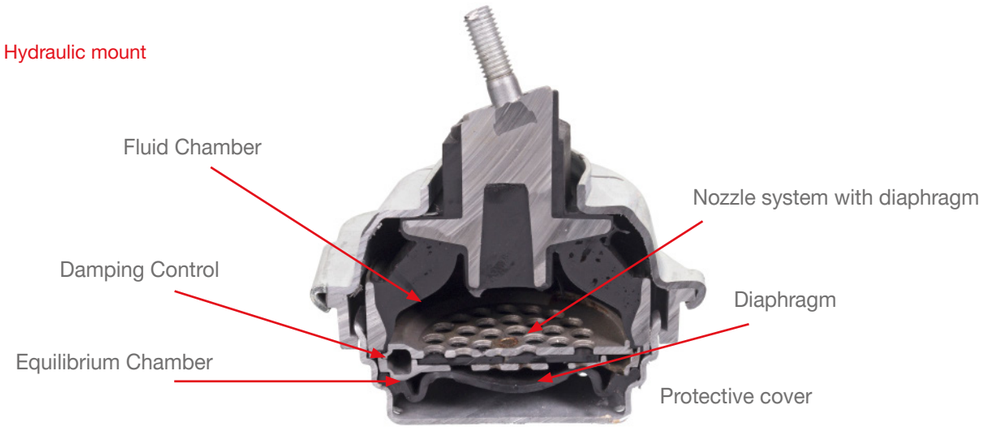
Inside a hydraulic engine mount, the main rubber spring has an upper and lower chamber. The chambers are connected by a series of canals and separated by a rubber valve. The mainspring is filled with a viscous liquid which acts as a secondary damper. During impacts that generate shock and vibrations, the rubber valve opens and closes the bypass channel redirecting the viscous liquid flow between the two chambers. This changes the stiffness of the mount, creating optimum damping characteristics for any road conditions. (Fig 1)

With greater control required, one option to provide better regulation for the hydraulic engine mount was to use vacuum produced by the engine. The negative pressure produced keeps the mounting soft at idle speed and in the lower rpm range, and firm in the higher rpm range.

The evolution of hydraulic engine mount dampening control is electronically switchable mounts, which can be coupled with the vehicles engine management system. (Fig 2)

An electronically controlled engine mount meets dampening requirements, but with more control. The switching function causes the air suspension in the mount to be utilised in the neutral position, providing soft suspension when at idle or low rpm. Then, when the vehicle is being driven, the mount switches to hydraulic suspension, and provides a firmer suspension between the engine and the vehicle's body.

Fig.1 Hydraulic mount



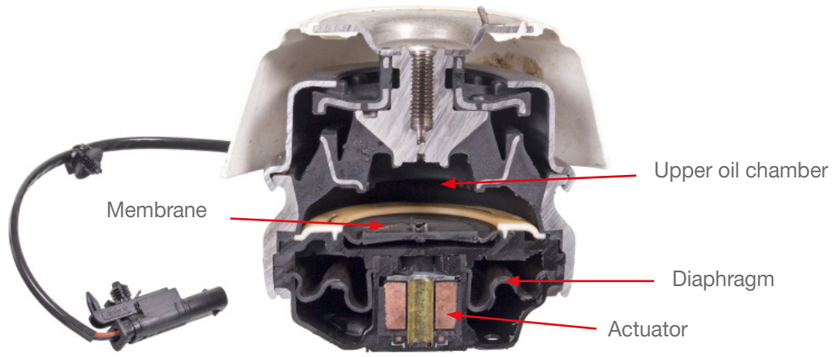


Fig.2 Electronically Switchable Hydraulic Mount

The latest development for engine mountings is the active intelligent mounting, which is designed to meet the requirements of more demanding functionality. These are designed to save fuel, and be more in tune with driving dynamics to offer maximum comfort in the passenger compartment - reducing noise, vibration and harshness.

An active, electronically switchable hydraulic mount is equipped with an actuator and sensors to feedback to the control unit, and can be actively controlled according to the dampening required. This is driven by the actuator excitation frequency; the active mount dampens either hydraulically, passively or actively. The isolation characteristics are calculated by the vehicle's control unit and converted by the actuator so that no vibration is transmitted to the body of the car.

In time all engine mountings have the potential to fail or wear, reducing their dampening countermeasures which then causes unwanted vibration, noise and harshness. This can be caused by the mounting deteriorating through time and stress, or in the case of hydraulic mountings the fluid can leak out.

The vacuum controlled mountings can have issues with leaking air and the vacuum system that controls them can perish or stop working. This can cause more than a vibration issue, and may also give engine management problems, induced by an air leak in the system.

The electronic controlled mountings can also suffer from the fatigue issues of the other mountings. However, they have the added complexity of the electronics built within them. Any electrical issues can be detected by the control unit, and fault codes logged accordingly. This aides with any diagnosis regarding these mountings.

When replacing any engine or transmission mounting, ensure that all correct procedures are carried out to avoid reducing the life of the replacement part.

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