



A Review of Different Vehicle Tests in the Automobile Industry

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ABSTRACT

-Automotive testing is the most important aspect of the automobile industry for assuring the safety of the driver and the passenger. In this review paper, we are going to discuss what is automotive testing, why automotive testing is important and various methods of vehicle testing such as performance tests, coast down tests, NVH tests, road load acquisition tests, durability tests, ergonomic tests, AC/demister test, corrosion test, emission test, crash test.

1. INTRODUCTION

Automotive testing puts full vehicles, components, and systems through a series of laboratory, virtual, and 'real-world' assessments to ensure it is safe, reliable, and compliant with safety regulations. Automotive testing is a requirement for accessing global automotive markets and manufacturers must show they have put their product through rigorous assessment. Testing covers a wide range of vehicle features, from individual components analysis and emissions testing, to buzz, squeak and rattle tests, crash simulations, and extensive automotive electronics testing.

Keywords: - Automotive testing, NVH test, Crash test.

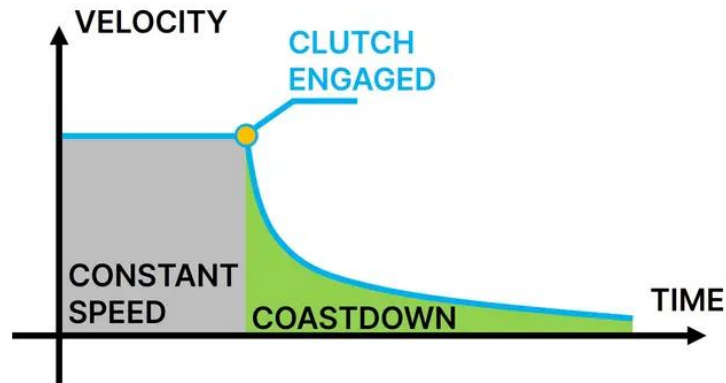
2. WHY IS AUTOMOTIVE TESTING IMPORTANT

Automotive testing offers a wealth of benefits, including:

- **Regulatory compliance:** global market access requires automotive component testing and compliance according to relevant global regulations to ensure overall safety
- **Early discovery of faults:** automotive component testing helps to discover faults in the development phase, which avoids expensive product recalls and saves you money
- **Enhance safe technology development:** developing new automated mobility technologies makes it important to ensure safety from the early stage of development to become a reality
- **Ensure product safety:** testing solutions for various kinds of vehicle components and systems put the product through a rigorous assessment to ensure maximum safety for customers
- **Boost brand reputation:** testing your product can iron out faults and enhance your reputation as a provider of quality vehicle

3. VARIOUS METHODS OF AUTOMOTIVE TESTING –

- **Performance test-** Performance testing is the assessment of ride and handling behaviors that will optimize the quality and performance of a module or a full vehicle. This type of test involves extremely fast and precise measurements and can include a human-in-the-loop. The test is conducted in test tracks to evaluate acceleration, top speed, braking power, and high-speed handling.
- **Coast Down test-** A coast-down test is one of the most common tests in the automotive industry. It is a way of measuring the mechanical and aerodynamic resistance that acts on a vehicle. The vehicle is accelerated to a particular speed and once constant, the clutch is engaged. The vehicle is then allowed to slow or 'coast' down in neutral. By recording the distance travelled and the time is taken, the Aerodynamic drag can be calculated.



- **NVH Test** - NVH test is a means of testing noise, vibration and harshness. NVH testing is widely used in the automotive industry to reduce, design and ensure the quality of internal and external vehicle noise or vibration. The process usually takes place in the development of passenger car vehicles. NVH can be tonal, such as engine noise, or broadband, such as road noise or wind noise. It is everything that the driver or passengers can hear and feel from the car while driving, such as wind noise, road noise, shocks from the suspension or vibrations from the engine.
- Noise, vibration and harshness (NVH) testing involves subjecting an entire vehicle, component or sub-assembly to vibration at various frequencies as a means of determining mode shapes and isolating hums, screeches and rattles. Typical instruments used to measure NVH include microphones, accelerometers, and load cells or strain gauges. NVH testing of components and sub-assemblies is most often carried out using a vibration vibrator, while whole vehicles are usually on a test track or road simulator test surfaces.
- **Road Load Data Acquisitions test**- The Road Load Data Collection (RLDA) test is performed to analyze the load on components such as



suspension and chassis. To this end, engineers have attached sensors such as strain gauges and accelerometers to the aforementioned component and run the vehicle on both good and bad roads. These sensors help to understand the impact on these components when the vehicle falls into different types of potholes. Because of this, manufacturers can choose to reduce the size of components where the stress is less, thereby reducing the weight of the vehicle. In the virtual world, the load cycle necessary to simulate the vehicle components is generated using the RLDA test

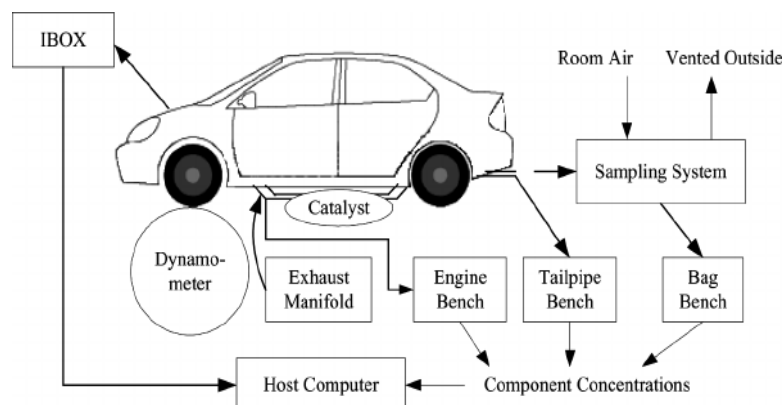
- **Durability test**- Durability tests help manufacturers gauge the lifespan of a vehicle and its components
 - General durability** Vehicle durability testing involves driving the vehicle and subjecting it to inputs similar to those normally encountered during its expected lifetime. It is easy to find photos and videos of camouflaged vehicles on highways and other roads. They can usually take a year to complete. In most cases, these vehicles travel more than a thousand kilometres during the test.
 - Accelerated durability test** Accelerated durability life tests are designed to quantify problems that could occur in 10-15 years of a vehicle by testing at a higher stress level to accelerate the occurrence of failure in as little as three months. These tests are conducted on specially prepared tracks that are designed to contain various surfaces including bumps, cobblestones, resonance, undulating roads, etc. A four-hour drive on these tracks would be equivalent to driving 1000 km on normal roads. This test

MAST

Multi-Axis Shaking Table, or MAST, is a dynamic system designed to perform R&D tests at the system level. (System level means a group of components that must work together, eg dashboard, seats). The MAST system moves up, down and sideways at a very high

frequency. MAST can help avoid testing the entire vehicle for small parts. MAST can also analyze the operation of seats, doors and switches. There is a device designed to detect problems that could arise over the years in various components. It was possible to simulate 10-15 years of use within days.

- **Mileage:** Fuel efficiency is one of the most appealing parts of a vehicle. It is tested in two ways by manufacturers
- **Dyno test:** This is performed by running the vehicle on the cylinder in the laboratory. During the test, the vehicle will be stationary, but the tires will roll. Several road conditions can be easily simulated with this method. Top secret vehicles can be tested on the roads of Mumbai and Chennai without taking them out of the factory with the help of this system. The ARAI mileage that is usually shown in car advertisements is generated by such dyno tests. These tests are a localized version of the New European Driving Cycle (NEDC). In cycles lasting 1,180 seconds, the laboratory creates city and highway situations that the vehicle must handle.
- **Road test:** These are the tests conducted on the roads. The vehicle is run on cities, highways, and rural areas. Sometimes, rival companies' vehicles in the same segment are taken along during such tests for comparisons. The fuel tank will be full when the test starts and when it ends, the distance covered and the fuel used are measured to arrive at fuel efficiency. The use of a fuel flow meter that can accurately monitor the flow of fuel to the engine increases the efficiency of the test.
- **Ergonomic tests:** People of all heights should be able to get in and out of vehicles. Ergonomic tests are conducted to ensure that. Dummies of several sizes and body structures are used for the tests. These dummies are known as mannequins.
- **Cooling trials:** Overheating engine/motors could damage the vehicle. Tests conducted to study the cooling system in a vehicle are known as cooling tests. They must ensure that the vehicle does not suffer any damage in the worst situations. For this purpose, the vehicle is operated for hours in extremely hot weather areas, at high speeds, uphill and with excessive loads. These tests can also be performed on chassis dynos.
- **AC/ Demister tests:** These tests are carried out to check the functioning of the air conditioner and related components. The tests that include finding the time taken to cool down the cabin after the vehicle is parked under 50 degrees Centigrade in bumper-to-bumper traffic do not necessarily be done on the roads. These tests can be done in modern climatic chambers that can recreate such climatic conditions.
- **Regulatory tests:** These tests take place before the vehicle is put on the market. Indian regulations are known as the Central Motor Vehicle Rules and are categorized according to the use, size and weight of the vehicle. Rules vary by category. While two-wheelers and three-wheelers fall under categories L1 to L5, passenger vehicles with four or more tires are under categories M1, M2 or M3, and commercial vehicles are under categories N1 and N2. Group M1, under which passenger vehicles fall, has the strictest rules. Here's a look at the main regulatory tests:
- **Emission tests:** This is one of the main regulatory tests. Emission norms for automobiles came into force in India in 2000. Bharat Stage or BS emission norms are based on European emission norms. The tests are carried out by running the vehicle on a dyno in a laboratory. All the fumes produced by the vehicles are collected and the proportion of carbon monoxide, nitrogen oxides, hydrocarbons and particulate matter is measured to arrive at the result. The tests are mainly conducted at the ARAI facility in Pune and VRDE in Ahmednagar. Since the amount of fuel used is also studied, fuel efficiency can also be found in the tests.
- **Safety tests:** A group of extremely important tests fall into this category of tests. The most important of these is the crash test. These include a frontal offset test that simulates a head-on collision with another vehicle at 56 mph, a side impact test at 50 mph, and a pedestrian



test that analyzes the injuries a person might suffer if hit by a car. Crash tests are very expensive; facilities like ARAI charge around 10,000,000 rupees for conducting the frontal offset test. Other safety tests include seat belt anchorage tests to see if the seat belts are working, seat anchorage tests to check how tightly the seats are attached to the body, luggage impact test to check if luggage penetrates the cabin from the luggage compartment. accident and tests to assess the functionality of the interior and exterior mirrors. Electromagnetic compatibility tests ensure that electromagnetic waves do not affect the operation of the vehicle. All these tests are done in laboratories.

Apart from these tests, a vehicle needs to clear several other major and minor regulatory tests to be allowed to be sold in the market. And, all these tests have to be carried out in a government-approved facility like the ARAI. The CMVR tests of an M1 category vehicle will alone cost Rs 1.2 crore in fees

- **Quality tests:** Once production starts, several quality tests are held in the factories. Before they hit the market, most companies make 100-200 vehicles for field evaluation and they are known as field evaluation units. This is aimed at ensuring the functionality of the manufacturing plant. These vehicles are given to company staffers and help detect any deficiencies during the manufacturing process. These vehicles usually run for 1,000 km to 10,000 km and are often sold off to staffers at a reduced price or used for company purposes.
- **Final tests:** Most manufacturing plants have smaller tracks behind them. Vehicles run on these tracks to check for any unusual noises. If any defects are found, the examiner must bring the vehicle to the rework areas and ensure that quality standards are met. In short, testing is a long process from design to delivery of the vehicle to the customer. Before the vehicles reach the market, they undergo approximately 1,000 small or large tests. However, only a few important tests have been mentioned above. Approximately 20 to 30% of vehicle development costs go into testing its components. Even if issues are identified during testing, due to time and financial constraints, the Company may not be able to resolve all issues. Companies may not be able to individually inspect all thousands of components that come from hundreds of small manufacturing units and ensure that quality standards are met. This is why problems appear even in modern vehicles.

5. CONCLUSION

Automotive testing is one of the most important parts of the manufacturing of automobiles. There are various methods of testing the vehicle after which the vehicle is introduced in the market for the customers. Helps the manufacturer assess the vehicle based on performance, durability, efficiency, and safety. In the above article, we studied the importance of automobile testing in this huge automobile industry, and various methods of automobile testing such as performance tests, durability tests, emission tests, coast-down tests, etc.

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