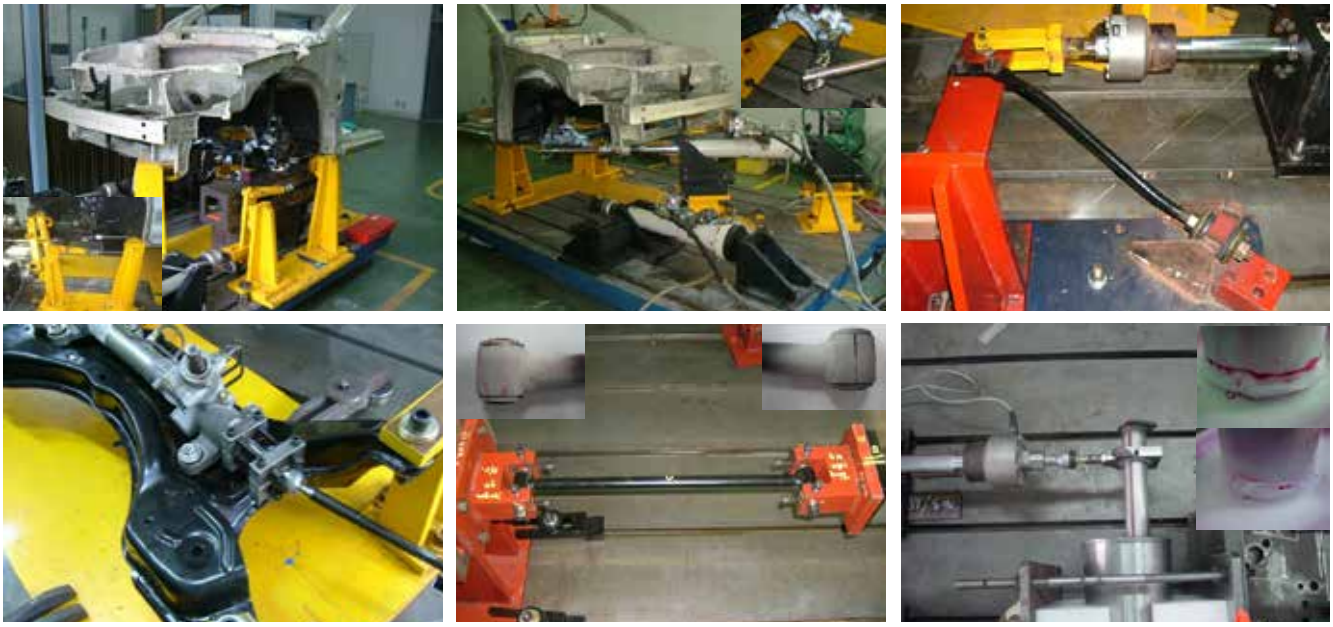
The Development of Automotive Parts Testing and Analysis

by Thailand Automotive Institute (TAI)

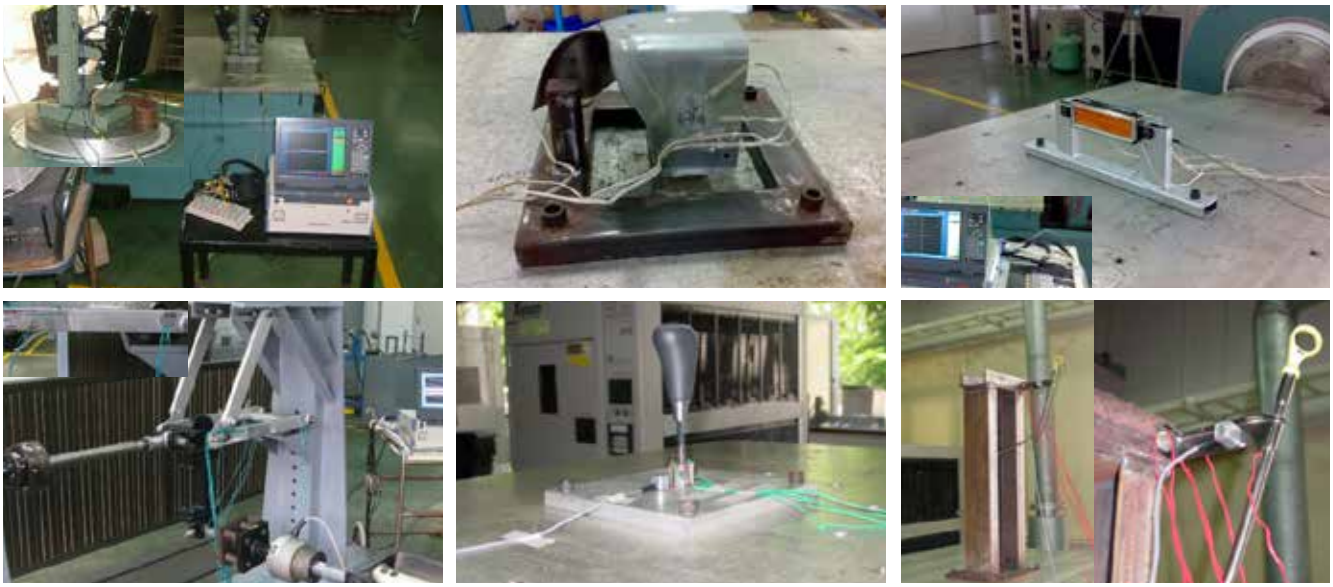


Nowadays, motor vehicle has been developed, continuously, with the objective to fulfill consumer's need which causes production of many kinds of vehicle. The key of development are considered from economy, safety and useful Life (longevity of vehicle), which are related. The economy is deliberated over engine and chassis. Engine is studied and developed to obtain more efficient and powerful driving engine unit while the weight of chassis, as a burden of engine, is needed to be decreased.

The concept of automobile weight reduction is limited by vehicle safety that needs to consider the strength of parts. Basically, there are two methods for weight reduction which is either the replacement by using light weight materials such as aluminum, plastic, composite and such alike or part size reduction by using a higher strength grade steel.

Pressure to reduce fuel consumption in vehicle design has been the driving force behind High strength steel development for more than two decades now. Simultaneously, the substitution of other metals (non-ferrous) has been applied to some parts of car. For example aluminum alloys having superior mechanical properties have been implemented on chassis, engine block and other suspension parts. However physical and mechanical tests of aluminum parts are still required to ensure the performance of using aluminum alloys on automotive parts.

On the other hand, the use of ultra high performance steel range of versatile and advanced and ultra high-strength steels has been developed primarily to meet the needs of the automotive industry – increasing strength or reducing weight to achieve optimal performance parameters. Most of global steel makers and providers are focusing on further steel grade development known as UltraLight Steel Auto Body Project (ULSAB). The purpose of ULSAB project is to decrease part dimension, thickness of material and use high strength steel grade. Whereas, the ability of forming metal and process of high strength steel forming are also considered. More than 90% of the vehicle was composed of high-strength steel defined by the Auto/Steel Partnership (A/SP) as steel with an incoming yield strength of 210 MPa (30 ksi) or greater. The ULSAB body showed dramatic results in safety and structural testing, exceeding project benchmarks in some cases by significant margins.



As a result, these high strength steel applications are leading to the material testing for automotive part properties. The automotive part material testing is then necessary to assure the formed automotive part qualifications and standards.

The main objective of automotive parts testing is to understand the durability of those parts from cyclic applied load and deterioration from environment; including metal corrosion and decrepitude of polymer.

Automotive Material Durability Tests

Tensile test is a common mechanical testing method for automotive materials. Metals and polymer are usually tested to determine the yield stress value (the maximum applied load) at room temperature. However some parts are tested to know a magnitude of fatigue strength to describe a property of materials: the amplitude of cyclic stress that can be applied to the material without causing fatigue failure. However temperature and humidity also affect the durability of materials; especially, plastic, rubber and polymer are required to test in a specific chamber with controlled humidity and temperature.

Why It Needs the Work Piece for Testing

It is realized that material testing is able to indicate the durability of material and environment resistance. Automotive part specification can be found by an actual testing while the calculation of part shape factor is performed as a function of stress value by a simple method called Finite Element Method (FEM). However, FEM results need to be proved by the actual test. Therefore the actual automotive part testing is mandatory to the further development of automotive parts.

Testing for mechanical property and durability of automotive parts

Durability of automotive part is a key for longer service lifetime. Normally, most of all automotive parts have to assist the repeating load from the vehicle utilization; the testing for durability called as fatigue testing which composed of several testing factors as calculating repeated load, a set of jig and fixture, a proper fatigue test equipment and a testing standard is applied. At higher temperature, thermal fatigue test using a heating furnace to elevate the testing temperature can be also applied to analyze the fatigue strength variation. Moreover impact and drop weight tests are alternative methods to obtain the impact absorb energy for material damage.

The Significance of Automotive Part Testing for Product Development

Automotive part testing is not only to indicate the ability of the tested part but also to improve the material selection and design to develop the part materials. Automotive material testing is now developing in term of engineering design and simulated testing atmosphere, testing equipment technology and skilled tester. One of most important factor is an ambient testing control. Testing within controlled chamber has been widely used. It is able to control temperature and humidity leading to the testing result accuracy. In term of engine, all engine parts made of various metal alloys are inspected for material durability. Ferrous and non-ferrous materials are encouraged to test in the same condition to determine their service lifetime and safety factor.

At present, car and part making technology has been extensively developed through automotive supply chain since the demand of high performance materials is also increasing. Hence, automotive parts are needed to improve and develop to enhance the superior automotive part quality. Automotive test results is used to convey the necessary data for automotive part design and process improvements However, only individual automotive part testing results are not enough, the component or assembly part testing is essential to be done.