Will the New Crash Test Rating System Help Improve Auto Safety in the US?

The New Car Assessment Program (NCAP) conducted by the National Highway Traffic Safety Administration (part of the U.S Department of Transportation) underwent major changes recently. For automobiles designated as model years 2011 and later, the changes involve both what is measured and what is published. These changes are substantive enough that the ratings from previous years (model years 2010 and earlier) cannot be compared to the ratings obtained from the new NCAP tests.

As a background, the NHTSA conducts a series of crash tests every year for automobiles sold in the USA and publishes the results from these tests as a comparative rating of the vehicle. These tests involve three different crash modes - frontal crashes, side impacts and rollovers - and the vehicle's performance is rated as 'stars', ranging from one star (★) to five stars (★ ★ ★ ★ ★) with the higher count denoting a 'safer' vehicle, according to NHTSA. In addition to the published ratings, the NHTSA also makes available the test reports, measurements, photographs and videos through its websites.

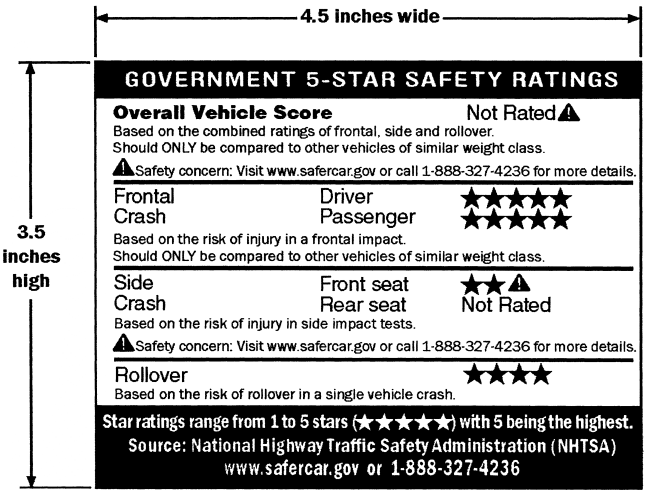
The NCAP program has two main intents - one, to encourage automakers to design their vehicles to higher levels of safety than that required by the Federal Motor Vehicle Safety Standards (FMVSS), and two, to help customers make purchase decisions based on the published safety ratings of vehicles. Thus, the NCAP program uses market-based incentives rather than legislative requirements to encourage automakers to engineer their vehicles to get more stars.

What are the main changes and what do they mean for automotive safety? Here is a brief description of some of these new features.

With the new NCAP system, a customer will see an 'overall' crashworthiness rating for the vehicle which combines the results from all the crash tests (frontal, lateral, rollover) according to a formula determined by NHTSA. This overall rating as well as the various details will be posted on a label affixed to every new vehicle. An overall rating which quantifies an automobile's crashworthiness has been debated for many years by researchers in this field and the NHTSA's decision in this regard – to define a combined rating based on relative risks of injuries computed for the statistical distribution of types of crashes presently on US roads - may or may not receive wider acceptance.

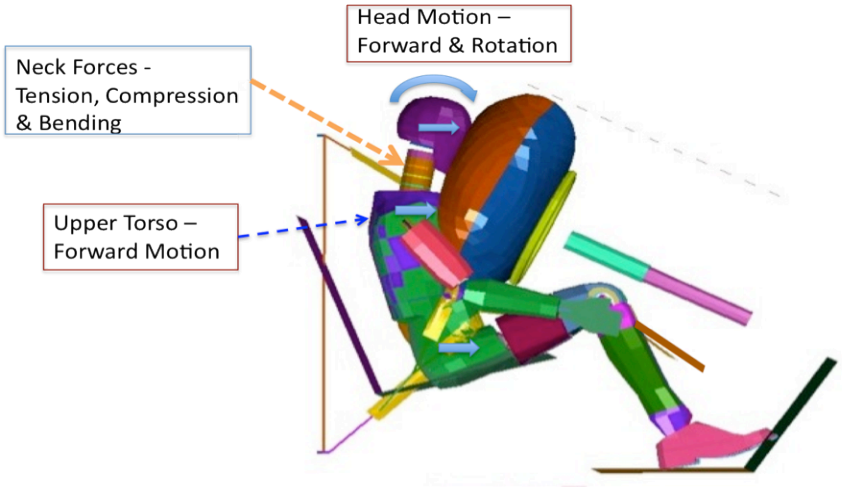
Figure 1 to § 575.302

Sample Label for a Vehicle with At Least One Government 5-Star Safety Rating



The individual rating systems for each crash mode – frontal, lateral and rollover - have also undergone drastic changes for vehicles of model years 2011 and later. For example, the frontal crash rating is obtained for the driver from measurements on an anthropomorphic test device (also called a 'test dummy') representing the fiftieth percentile male size in the US while the passenger side rating is for a test dummy representing a fifth percentile female in the US. The impact velocity and test configuration – a 35 miles per hour impact into a fixed and rigid barrier – remain the same as before.

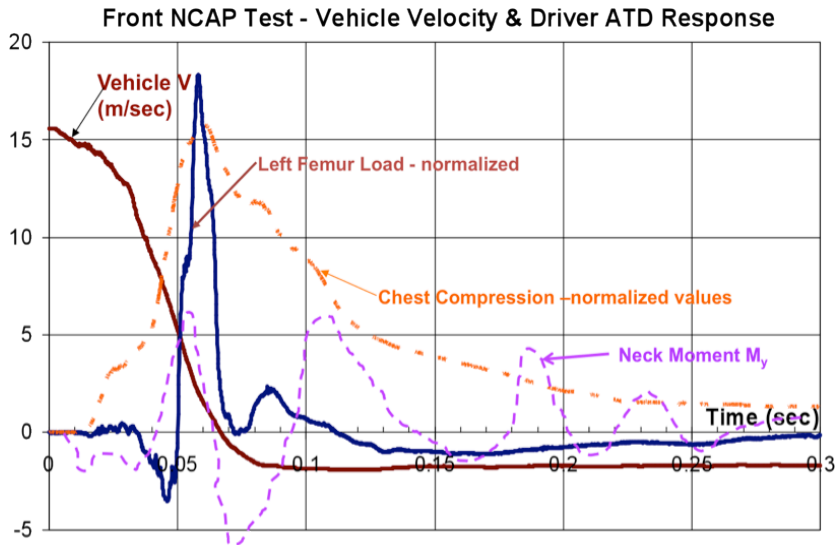
One of the more interesting aspects of the new NCAP is that for both the driver and the passenger in the frontal crash, the forces on the neck are also measured and used in calculating the star ratings. This measurement of neck forces is believed by many to be one of the more difficult ones to improve because of the dynamics of the neck of the test dummy. Since the neck functions as a link between the head and the upper body, the forces on the neck are determined by the motion of the head relative to the motion of the upper torso.



Overall, the dynamics of an occupant's body in frontal crash is a function of the properties of the seatbelts as well as of the airbag, along with the properties of other parts of the vehicle. Therefore, as a simplified example, neck forces may be lowered if both the head and the upper torso impact the airbag at the same instant so that the differential motion of the head and its angular deceleration with respect to the upper torso are minimized. However, achieving the above-mentioned patterns of motion of an occupant's head and torso requires appropriately engineering the restraint systems (airbag shape, size, inflation pressure, etc. and seatbelt properties) as well as the rest of the vehicle which determines this motion – the vehicles' structural deformation, seat's force-deflection properties, the design of the knee bolsters, etc.

In addition to the neck forces, other measurements used in calculating the frontal crash NCAP ratings are the head acceleration, the chest deflection, and the femur loads. All of these are also functions of the integrated safety system – the vehicle structure, the interior

components, the airbag and the seatbelts. Thus, achieving lower response values on a test dummy (which equates to higher star rating for the car) will necessitate that all these are designed integrally and not as separate parts. The illustration below is an example of some of the measured responses of the driver side test dummy in such a frontal crash test.



All of the above-mentioned response parameters for the test dummies are used in formulae, along with the 'recommended' values of injury measures, to calculate ' relative risk scores', which are further translated into the 'probability of injury' for the driver and the passenger. According to the NHTSA, the star ratings are related to the following injury probabilities:

= 10% or less chance of serious injury

= 11% to 20% chance of serious injury

= 21% to 35% chance of serious injury

= 36% to 45% chance of serious injury

= 46% or greater chance of serious injury

It can thus be observed that the new NCAP system has addressed some of the criticisms of the previous systems by including a small occupant (a fifth percentile female) in the test regimen and by including more response parameters of the test dummies in calculating the crashworthiness ratings. These changes in the test and rating systems are likely to lead to significant changes in the design of the vehicle structure, interior parts and the restraint systems in order to obtain more stars.

However, there are other issues (such as the fixed test speed and the relationship between NCAP test score and vehicle-to-vehicle crash compatibility) that have not yet been addressed and will continue to pose challenges.