D38 Seat Belt Load Marks on Aged Restraint Systems

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Learning Overview: The goal of this presentation is to show that loading patterns on aged restraint systems are lighter as compared to new systems when exposed to the same crash forces.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by investigating the relative difference in restraint system loading patterns on new versus aged restraint system components. A difference in loading patterns is expected as a result of typical aging characteristics on polymer materials and their respective response to impact loading.

Polymer-coated components used on the typical seat belt system are the D-ring or B-pillar guide loop and the latch plate which inserts into the buckle. The D-ring provides a turning and load surface for the webbing as it exits the locking retractor and forms the upper anchor for the shoulder belt. The latch plate controls the confluence of webbing between the lap and shoulder belt. The primary purpose of the coating is to provide a low-friction surface for the polyester seat belt webbing to slide on. The polymer surface on the D-ring and latch plate permits the webbing to slide freely in response to normal occupant motion while driving in addition to providing proper coupling of the occupant to the vehicle during a crash.

A dynamic horizontal accelerator test program was conducted to evaluate documented older seat belt systems as compared to new replacement restraint systems in a controlled manner. In an effort to isolate the differences in loading patterns on the restraint systems, as many variables as possible are to be controlled. New seat belt systems and older seat belt systems are mounted on the horizontal accelerator platform using identical generic, but typical, restraint system geometries. Two surrogates are used and ballasted to a 50th percentile male or approximately 167 pounds.

The main purpose of this study is to attempt to show the difference in loading patterns on aged seat belt polymer components that have been exposed to the same crash forces compared to new seat belts. Physical properties of polymers typically will change as a result of exposure to heat, humidity, ultraviolet light, and sunlight through, in some part, the photo-oxidative degradation process. Leaching of plasticizers, if used, whose purpose is to maintain flexibility of polymer chains, also results in increased surface hardness as the material ages.

It is suggested that because the new polymer materials are softer, the load surfaces will be more prominent and heavier loading patterns will be visible on surfaces that have been exposed to crash forces, as compared to aged and therefore harder, seat belt components for a given acceleration and delta-V. Conversely, the presumption is that aged polymers tend to increase in surface hardness and therefore will display lighter load marks as compared to new seat belts for a given impact.

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