D20 Evaluating the Effect of the Crash Locking Tongue on the Breaking Strength of Seat Belt Webbing

Kurt D. Weiss, MS, Case Study Collision Science, LLC, Santa Barbara, CA 93190*

Learning Overview: The goal of this presentation is to demonstrate through rigorous laboratory testing the effect of a cinch-type latch plate on reducing the breaking strength of automotive seat belt webbing.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing test results obtained through rigorous laboratory testing that clearly demonstrates the failure mode and load of a cinch-type latch plate.

On January 10, 2018, the National Highway Traffic Safety Administration's (NHTSA) Office of Defects Investigation (ODI) began investigating two incidents of seat belt separation. The separations occurred in two New Car Assessment Program (NCAP) tests conducted on the 2018 Volkswagen® (VW) Tiguan®, the first year of a new vehicle platform. The NCAP test is a 35mph, full frontal, rigid barrier crash with a belted 50th percentile male Anthropomorphic Test Device (ATD) driver and a belted 5th percentile female ATD front passenger. The tests were conducted on December 8, 2017, at MGA in Wisconsin, and December 13, 2017, at TRC of Ohio. The test reports are not currently available on NHTSA's website. During the crash tests, the driver seat belt webbing completely separated in tension at the latch plate, a device that VW calls a Crash Locking Tongue (CLT) (Figure 1). The CLT is a device that switches under load and the webbing is clamped, resulting in greater loads applied to the lap belt. Approximately 290,000 Tiguan® vehicles use the CLT device.

Figure 2 - The Crash Locking Tongue of the 2018 Volkswagen Tiguan.

Figure 1 - The front outboard seat belt sill-end pretensioner of the 2018 Volkswagen Tiguan.

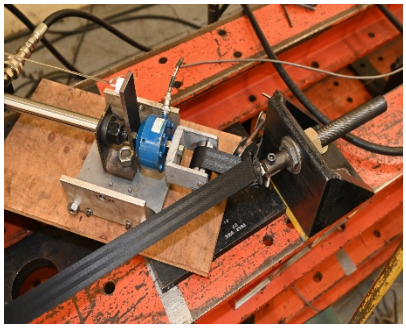

Figure 3 - Three-point anchoring held the webbing with an included angle of approximately 45 degrees.

On July 3, 2018, ODI upgraded their analysis to further examine the seat belt behavior to determine, in part, a root cause for the seat belt separation. Their research included a review of any vehicle and seat belt design changes for the 2018 Tiguan® platform and their effects on the performance of the seat belt system. Based on its analysis of the NCAP test results and numerous sled tests, VW asserted that the ATD umbilical cord exerted additional forces on the seat belt system, causing the separation. However, a micro analysis conducted by the National Transportation Safety Board (NTSB) verified the seat belts had failed in tension and not due to cuts or abrasion. To date, a safety recall campaign has not been opened to address this potential safety hazard.

Testing was performed on new seat belt assemblies to investigate the effect of the CLT design on reducing the breaking strength of the webbing. The type-2, dual-pretensioner (sill-end and retractor) assembly features 47mm-wide polyester webbing and a dual-locking, switchable load-limiting retractor. The sill-end pretensioner is capable of producing a peak force of approximately 6,228N in the lap belt (Figure 2). Three-point anchoring held the seat belt webbing in a "V" shape with an included angle of approximately 45 degrees, similar to in-vehicle geometry (Figure 3). The end of the lap belt webbing was held using the stitched loop end for the first test and subsequently by a split-drum grip. The lap belt was preloaded to between approximately 3,959N and 4,448N. The latch plate tongue was held by a clevis pin. The end of the shoulder belt webbing was held by a split-drum grip secured to a hydraulic cylinder. The shoulder belt web-grip displacement rate was between approximately 89 and 94mm/s. Data was sampled at 1,000Hz.

Federal Motor Vehicle Safety Standards (FMVSS) 209 S4.4(b)(6) requirements for type-2 assembly performance hardware specifies that any webbing cut by the hardware shall have a breaking strength of not less than 15,569N for the lap belt or not less than 12,455N for the shoulder belt. In this study, separation occurred at the CLT with peak lap belt webbing loads between approximately 6,993N and 8,203N (SD 512N) and peak shoulder belt webbing loads of between approximately 10,280N and 11,521N (SD 519N). Pre-loading the lap belt (which occurs with sill-end pretensioner activation) caused the CLT to clamp the webbing. The clamping edge of the CLT appears to have caused the webbing separation.

The test series demonstrated the CLT design reduced the breaking strength of the seat belt webbing so the assembly no longer passed applicable standards. The reduction in restraint load capacity results in a vulnerability to total loss of seat belt restraint in traffic collisions.

Crash Locking Tongue, Webbing Breaking Strength, FMVSS 209 S4.4(b)(6)

*Presenting Author