Head & Neck Restraints

By Trevor Ashline - Restraint System Engineer

What is the purpose of a head and neck restraint in today's racecars? The primary reason for using a head and neck restraint in today's racecars is to reduce neck tension in a frontal or angular frontal impacts. The restraint should also help in all other impact situations, certainly not harm.

Baseline Impact

Because the point of highest neck tension happens early in the event, as the head is being redirected by the neck, it is important that the head and neck restraint be adjusted to start taking load away from the head and neck as soon as possible in the event. As with any restraint system, a head and neck restraint works better when it is allowed to start restraining the head early in the event. With strap harnesses, this is no different.

Strap harnesses have been shown in sled testing to reduce neck tension in frontal and angular frontal impacts. Since they do not rely on the seat belts to provide the restraint, like current carbon devices, they will not become dislodged or loosen the seat belt system during an impact. In fact, the harness devices have never failed during a sled test. Other devices, the HANS and SRS-1, have come loose from the seat belts during a single impact in a laboratory environment. In the real world, the set-up in your racecar may be nothing like the ideal conditions in the sled lab, which can increase the chances of the restraints to fail in use. Reports of injuries during multiple impact situations while using current carbon devices date back to the early 900s. Bob Hubbard, of Hubbard Downing Inc. said Òwe have had reports of the belts coming off the HANS under racing conditions, while addressing ASA drivers.

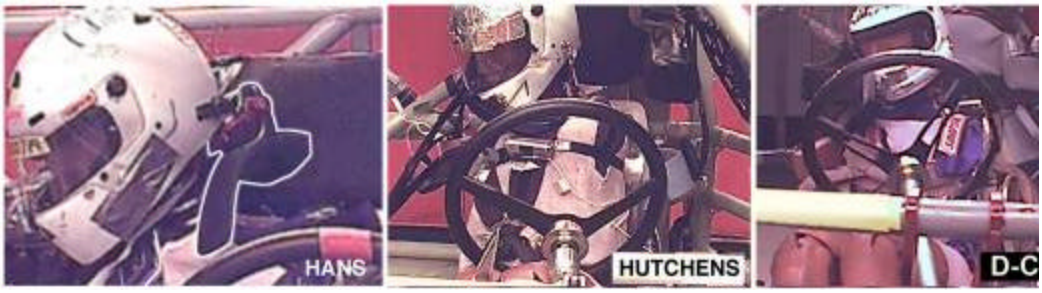
The best head and neck restraints on the market, ride with the occupant to help keep the relationship between the head and the upper torso. The only two head and neck restraints approved by NASCAR, the HUTCHENS DEVICE and the HANS Device have this in common. Trying to restrain the occupant by anchoring the driver's head to the chassis makes the restraint unpredictable in off angle and multiple impacts. This is because the manufacturer of the head and neck restraint cannot guarantee the configuration of the rest of the safety system. For example; in a typical late model that races as the top class in many small towns, the seat will be a single layer rib support seat, nylon seat belts, probably a 5-point system with questionable mounting and no shoulders and headrest. This set-up is much different than the test set-up in today's lab testing. What can be tuned to work in the test lab after repeated tests will not react the same in a variety of conditions in the real world and can thus be dangerous.

A head and neck restraint needs to be tested dynamically in multiple seat set-ups and approach angles to fully understand how the restraint reacts to the forces applied to it in front, side and rear impacts. A restraint that works very well in frontal impacts, may fail completely in high G impacts. A failure at over 50 G's can cause significant damage to the occupant. If the failure of the head and neck restraint also causes failure of the other occupant safety systems, such as the seat belts or helmet, by dislodging them from their original position making them inoperable, the restraint needs to be modified or the concept scrapped until a suitable change is made to correct the situation.

A number of commercially available head and neck restraints have little to no testing done on them to determine their effectiveness in all impact situations. A single test or a single series of tests done at a non-Ð certified lab, like Wayne State, does not give the manufacturer enough information to truly evaluate a head and neck restraint. What makes sense in theory, rarely works exactly like the inventor intends in all situations. Dynamics is not intuitive; tests have to be run in order to see the interactions of the different systems in the safety cell.

Harness systems have proven their worth in hundreds of impacts in racing from Winston Cup to Banderol's, from Daytona to Australia to England. The harness system benefits are shown well in sled testing and out in the field in open wheel sprint cars. In a racecar that normally has a very confined seat system, the occupant does not get a lot of movement in a 50 + G impact. In a common system found in short track America, the occupant is allowed to move much more and belt mounting is not optimal for restraints that rely on the belts. The impacts can be made much worse than what would happen without the restraint.

Head and Neck Restraint Comparison in 45 G, Side Impacts



HANS Device **Hutchens Device** **D-cel**

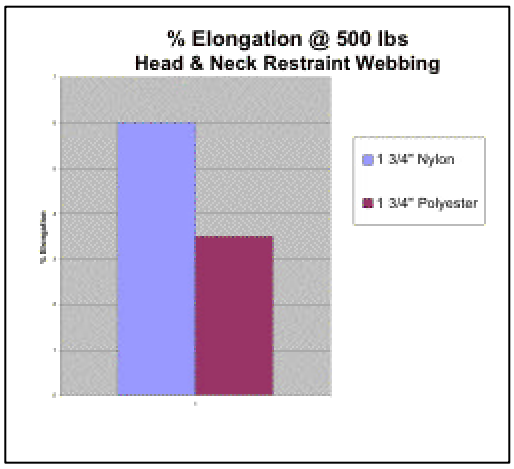
A head and neck restraint needs to compliment the system that it is working in. Early testing on HANS Devices show an increase in both neck tension and HIC when used in an entire system with a headrest. (SAE Motorsports: Melvin / Hubert Gramling). This has also been shown to be the case in independent testing done on stock car set-ups with the HANS device. In back-to-back tests run on the same safety cell, have shown that the differences between carbon devices and strap harnesses is greatly reduced. The strap device systems normally decrease neck tension vs. the baseline, while the HANS device neck tension has been shown to increase because of the interaction with the entire system.

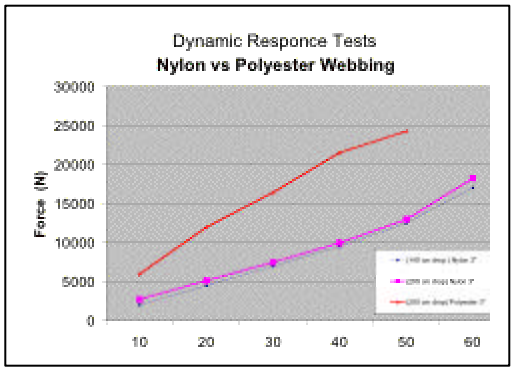
Added benefits with the Simpson Head and Neck Restraint are that it can not only reduce neck tension in frontal and angular frontal impacts but it can help control helmet movement in side impacts and rollovers, and it stays with the driver in multiple impact situations.

A harness type head and neck restraint has been proven to be beneficial in multiple impact situations as well as rollovers. They are being widely used in racecars from asphalt to dirt.

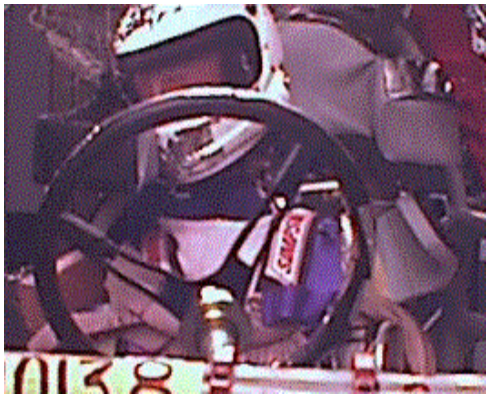
IMPROVEMENTS

In lab testing, it has been shown that harness devices benefit greatly from reduced elongation in the strap material. The Simpson Head and Neck Restraint for 2004 have been changed from 1_Nylon to 1_Polyester to take advantage of the reduced elongation in the Polyester material. Polyester material not only manages energy better than Nylon, it also shows better wear characteristics and does not stretch when it gets wet. What this means to the consumer is a more stable, better wearing harness.





Simpson Head and Neck Restraint
Pulse: 45 G, 60 mph.



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