

HOPS

Horton Occupant Protection System



for Rollover Collisions

About HOPS

Emergency medical vehicles responding to calls present a unique paradox.

Medical personnel rush to help someone in need, but at the same time put their own lives at risk. Danger lurks at every intersection. Ambulance accidents and deaths occur at a higher rate than in other professions. According to the National Highway Traffic Safety Administration, rollover accidents are the most violent of all types of motor vehicle crashes typically causing over 10,000 fatalities and 24,000 injuries per year. Head trauma is the most frequent type of non-fatal injury. That figure represents about 32

percent of all occupant injuries. According to the NHTSA Crash Analysis Center, as a class, rollover injuries constitute one third of all vehicle accident injury costs.

Long known for its leadership in safety and testing in the ambulance industry, Horton Emergency Vehicles has invested years of research to develop an advanced occupant protection system for these severe rollover crashes. Horton's Occupant Protection System (HOPS)

combines advanced research on airbag protection, head strike dissipation and occupant restraint devices into its ambulance interior. As always, Horton has performed extensive, fully documented research to verify the results. And even more important, the HOPS system is standard on every ambulance that Horton builds.



The Horton Occupant Protection System (HOPS) is fully tested and combines advanced restraints, multi-density head protection, tubular airbags and head curtain airbags to protect attendants in side impact rollover crashes.



Like any collision protection system, HOPS is effective only when occupants are wearing seat belts. CPR, head and aft bench seat belts have detachable four point belts to enhance mobility.



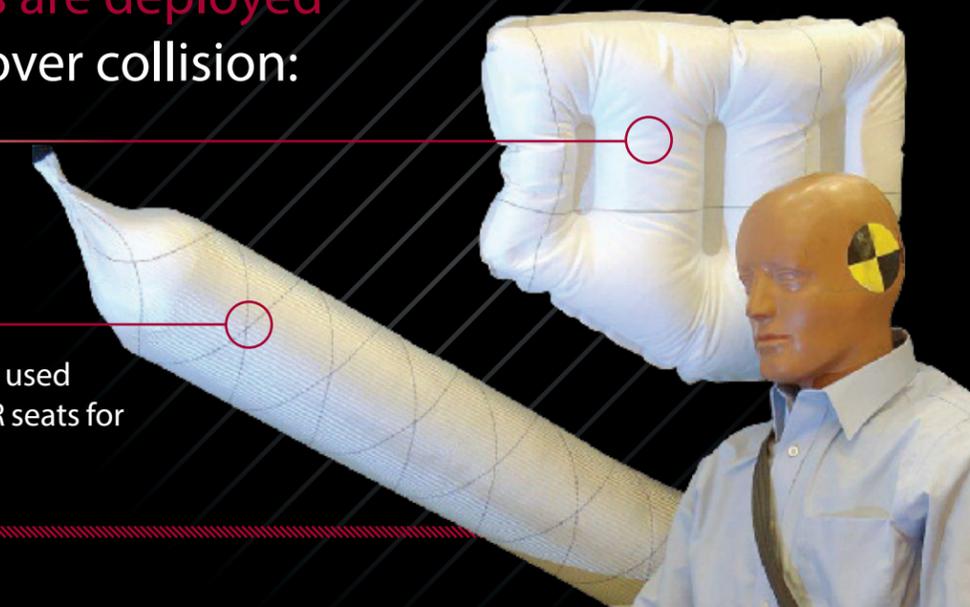
The dynamic rollover test machine enables engineers to simulate a rollover event while recording significant test data from inside the vehicle. The Hybrid III test dummies are fully instrumented to check head strike impacts, G loads, neck loading and seat belt forces. Comparisons are made to evaluate baseline data against data collected with new experimental systems to ensure the solution is successful.

The Horton body was subjected to 14 rollover impacts while establishing a baseline, and then testing HOPS. The body retained its structural integrity through it all.

Two types of airbags are deployed in a side impact rollover collision:

The Inflatable Head Curtain protects the attendant from the inhalation area cabinet

The Tubular Structure airbag is used with the attendant and the CPR seats for additional head protection.



Why HOPS

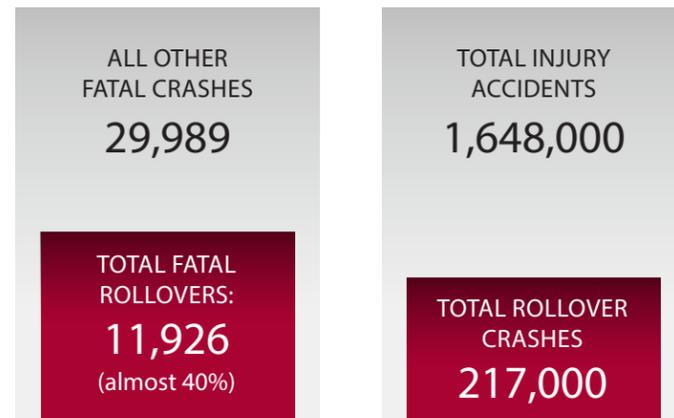
The ambulance industry has long recognized the exposure to danger faced by vehicle occupants.

NHTSA, NIOSH, GSA and other agencies are actively involved in investigating occupant safety in ambulances, as are various special interest groups. Building a comprehensive safety system for the ambulance is challenging. The difficulty lies in the very nature of the ambulance patient compartment. It is a large unrestricted space around which attendants must move to perform their emergency functions. It is filled with hard cabinets and other obstacles and seating positions vary widely.

The potential of rollover crashes and severe head injuries demands a comprehensive safety solution. As an industry leader, Horton Emergency Vehicles has long committed its resources to the development of substantive solutions backed by thorough and exhaustive third party testing programs.



More than 30 years of impact testing did more than create a baseline for HOPS development. Horton testing validated the structural integrity of the body, as well as the patient area. This validation is unmatched by any other ambulance manufacturer.



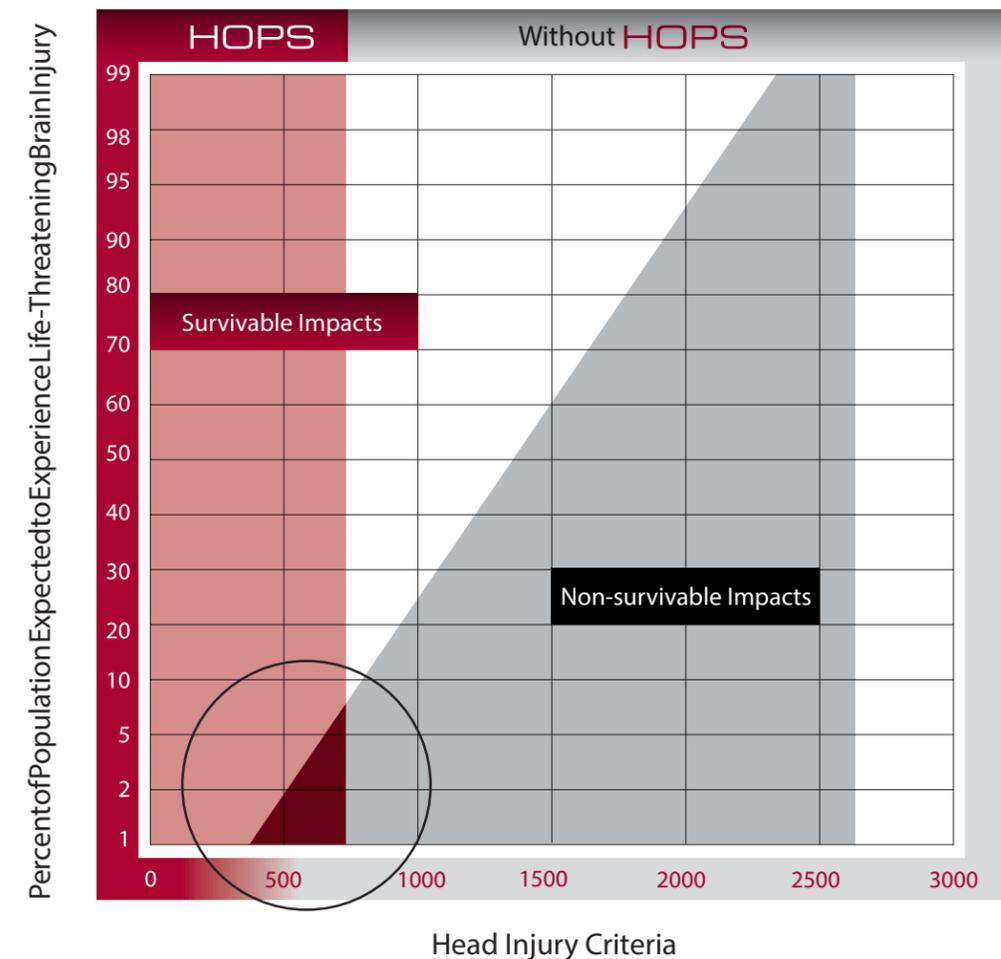
source: NHTSA, Traffic Safety Facts 2014

While total rollover crashes make up a low percentage of injury accidents, the severity of injury is much higher. Fatal rollovers account for about 40 percent of all fatal crashes.



Violent head strikes against hard surface cabinets represent one of the most significant dangers within the ambulance interior.

Horton's baseline testing, as shown in red in the chart below, indicates these forces can be non-survivable in 100 percent of the impacts. These same tests run with HOPS installed show the increased occupant protection reduces the fatality risk from head strikes by 95 percent. The black circle on the chart illustrates this reduction of risk for all but the most vulnerable 5 percent of the population who may be infirm, suffer from prior injury, or who may be extremely feeble due to advanced age.



H. Mertz, "Injury Assessment Values Used to Evaluate Hybrid III Response Measurement; Hybrid III: The First Human-Like Crash Test Dummy, SAE PT-44, 1984

What's behind HOPS

We have employed extensive dynamic impact rollover testing, Hyge Sled testing, direct impact crash testing, L-DYNA-MADYMO computer simulation models, and cannon impact tests for head strike and restraint verification with state of the art Hybrid III fully instrumented test mannequins.

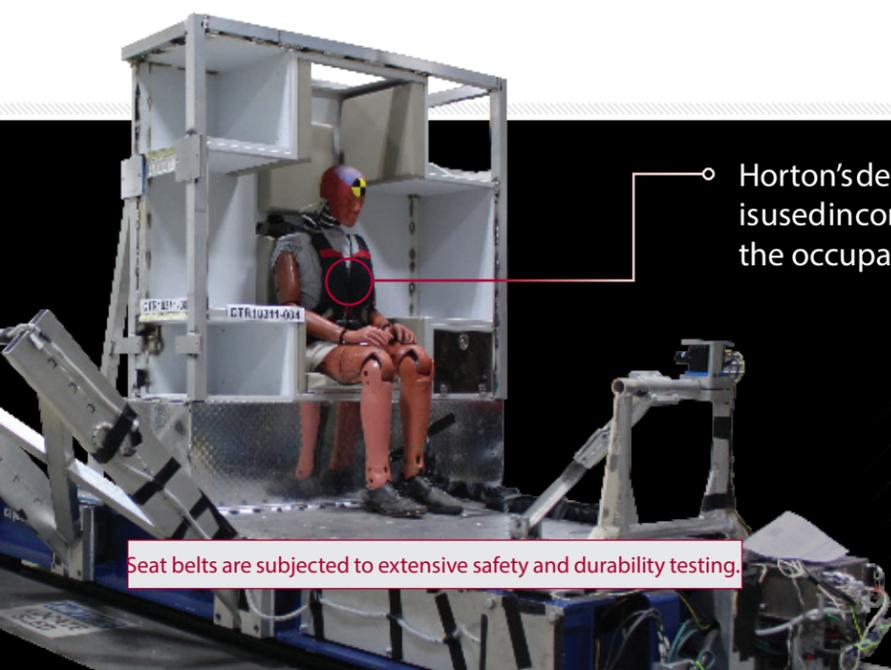
Tests were conducted to verify body to chassis mounting integrity, cabinet retention, seating stability, contact surfaces, and compliance to ECE and SAE cabin integrity requirements. Using solid engineering and verification testing, a comprehensive safety system for ambulance rollover accidents is formed.



A head-strike cannon is used to test the HOPS cushion system



In a side impact rollover collision, both computer modeling and high speed film show how occupants rise out of their seats changing head strike areas.



Horton's detachable four-point seat belt harness system is used in conjunction with barrier seat bolsters to confine the occupant in fairly open spaces.

Seat belts are subjected to extensive safety and durability testing.



The 4-point seat belt and vest are designed to allow an EMT to move forward and access a patient without removing his or her seat belt.

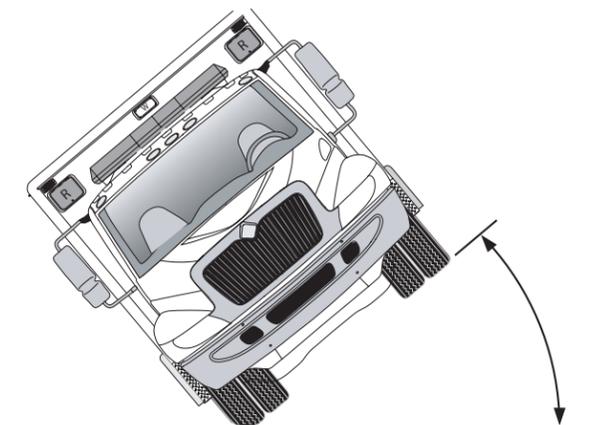
What you'll find in a HOPS equipped ambulance

If you respond to an accident involving a Horton ambulance, look for HOPS warning labels. HOPS will not deploy during a frontal or side-impact crash. A roll sensor (pictured below) calculates both the angle of the vehicle and the speed at which it's rolling to determine when to fire the airbag restraints.

If occupants require emergency extrication after a frontal or side-impact crash, special caution must be taken by rescue personnel, as HOPS may still be active and ready to deploy.

The airbags are filled with a pressurized stored gas cylinder with a small quantity of a solid pyrotechnic fuel. When fired, the gas is warmed slightly and expands to fill the head curtain or tube airbag.

European and SAE standards dictate a series of tests to address survivable space around its occupants. Reasoning that if a cab occupant is entitled to certain crash protection, then certainly someone in an ambulance patient compartment should enjoy the same protection, Horton applied these same tests.



WARNING
TO AVOID SERIOUS INJURY:
• Do not sit or lean unnecessarily close to the airbag.
• Do not place objects over the airbag or between the airbag and yourself.
• For maximum safety protection, you must always wear your seat belt.

DO NOT TAMPER

WARNING
PRESSURIZED GAS AND/OR PYROTECHNICS contained behind this panel or in cylinder. Release of gas can cause serious injury.
• NEVER service, salvage or reuse.
• NEVER weld, apply heat, grind, puncture or drill.
• Contact manufacturer for disposal instructions.



Far exceeding any structural requirements of the KKK specifications, this testing marked the first time in history such survivability testing was done on an ambulance body and clearly demonstrated the structural integrity of the Horton body. The tests were run with all cabinetry in place to demonstrate they would not detach and injure the occupants.

In addition to the inflatable cushion system, the HOPS system includes Horton's new progressive resistance headrests at all squad bench and CPR seating positions. While traditional foam padding feels quite soft, tests show that severe headstrikes are transmitted completely through the foam padding, literally "bottoming out" on the mounting surface and offering very little protection.

The progressive resistance product dissipates the energy throughout a laminated protective surface to eliminate the bottoming effect and offer additional protection much like that provided by high impact sports and racing helmets. Numerous combinations and materials were evaluated using high tech cannon fires at the test laboratory.

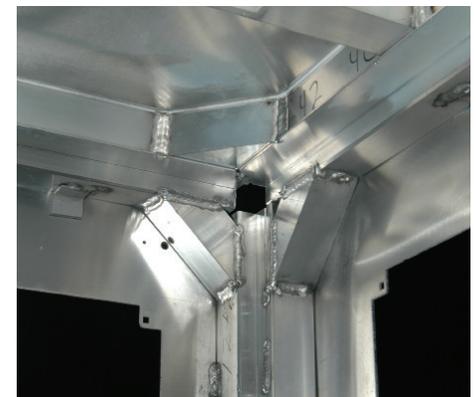
WE DIDN'T GET HERE OVERNIGHT

How does an ambulance company create one of the world's safest ambulances?

It didn't happen overnight. It started more than 30 years ago with a desire to build an ambulance body that would not only stand up to day-to-day driving rigors, but would protect its occupants.

The only solution is to test. Decades of testing has brought Horton to this point: two types of advanced airbag protection, custom restraint systems and sophisticated head protection. Modeled on computers and then tested with real impacts, HOPS is truly Safety With Substance.

Real world solutions backed by extensive research engineering and testing – it's what you have come to expect from us. See your Horton dealer today and let them show you how you can use HOPS, the most advanced ambulance occupant protection system ever designed for rollover crashes, to protect your staff.



HOPS testing was conducted at the Center for Advanced Product Evaluation (CAPE), a modern crash-test facility on the campus of IMMI. Above: a technician preps the sensors, high speed cameras and data collectors before a side impact test. Right: rollover impacts are created with this massive frame, the only one of its kind in the world.