

Trailer Stability Research

Vehicles towing horse floats, caravans, boat and camper trailers are under-represented in accidents, but when they are, the consequences can be particularly nasty. In Europe, vehicle makers and lawmakers are doing something about this situation.



Across the EEC, virtually every new vehicle that's likely to tow a trailer can leave the showroom with a trailer-compatible electronic stability control (ESC) program incorporated in its ESC package and known as trailer stability programming (TSP). Where it's optional, TSP pricing is around 600 Euros (\$1200).

In addition to on-board towing vehicle systems, several European trailer chassis makers have developed electro-mechanical stability devices that work without car ESC.

European legislation also takes note of the fact that car drivers pulling trailers need special training. In the EEC, you can't drive a vehicle and trailer combination in which the loaded trailer mass exceeds the unladen towing vehicle mass, or a vehicle and trailer combination mass over 3500kg, without a special 'B+E' licence.

The trailer driving test takes approximately two hours, beginning with a reversing exercise, followed by a braking exercise and a one-hour, on-road test. After the road test the driver is required to uncouple and re-couple the trailer, and then demonstrate pre-trip safety checks.

In Australia, there's no legal requirement for trailer stability technology, or even driver training.

Trailer Stability R&D

Until this year there has been virtually nothing published anywhere in the world on the topic of real-world, light vehicle and trailer towing stability, although it's known that some vehicle makers have done considerable R&D in this area. In contrast heavy truck and trailer R&D is well documented and all new semi-trailers sold in Europe can be ordered with stability control.

A paper entitled "An experimental investigation of car-trailer high-speed stability" has just been published by the Department of Mechanical Engineering at Bath University in the UK. It's a US\$30 download.

The paper, by J Darling, D Tilley and B Gao, summarises the findings of tests carried out on a standard UK-built caravan and on an adjustable trailer, in which different dimensional and mass factors could be evaluated.

The tests began with matching the adjustable trailer so that it replicated the dynamic behaviour of the caravan, then altering one dimension change and one mass change at a time, to evaluate the results of the changes. More than 600 different trailer parameters were examined.

In summary, the engineers discovered that the three most significant parameters affecting trailer stability were trailer yaw inertia, nose mass and trailer axle position. Interestingly, the total weight of the trailer wasn't a stability issue of itself, but weight distribution was critical.

The researchers concluded that the best way to minimise trailer yaw inertia was to position any trailer load at or near the centre of gravity. Loads fore and aft of that position increased the likelihood of towing instability.

The optimum nose mass (ball load) was found to be 6-8 percent of the trailer's gross mass.

Provided the measurement didn't increase the ball weight beyond eight percent of trailer gross mass the greater the distance between the coupling and the axle, the more stable the trailer.

The researchers evaluated car ESC, by performing stability manoeuvres with ESC alternately switched on and off. The systems did not have TSP, yet even without this program, car-only ESC produced more stable behaviour than did the non-ESC tests.

TSP and ATC

Trailer Stability Program is an extension of ESC and is designed to intervene when vehicle sensors detect a dangerous yawing ('snaking') movement of the trailer. If a yawing movement begins and exceeds a certain limit, the towing vehicle is decelerated within milliseconds by throttle closure and brake application, until stability is restored.

AL-KO is best known in Australia for its rubber-bushed, independently-suspended, torsion-bar trailer axles, but the company produces a range of caravan and motorhome chassis in Europe and is well advanced in trailer dynamics R&D. A recent product release is a stand-alone trailer stability system called AL-KO Trailer Control (ATC), consisting of an axle-mounted sensor connected to an electro-mechanical actuator.

ATC monitors trailer stability in a similar manner to vehicle ESC and if a snaking motion starts the ATC sensor activates the trailer brakes, to slow the combination and eliminate the yawing action of the trailer.

If Australia ever emerges from its third world trailer-towing mentality these European initiatives might get a look in. You never know!

