

## **Crash Cushion Trailer Protects Workers, Doubles Production Thru Added Security**

Members of the work force maintaining Texas highways are carrying out their duties with a new sense of security, thanks to an inexpensive protective device designed at the Texas Transportation Institute in College Station. Although accidents to maintenance workers are comparatively infrequent, occasions do arise when vehicles in lanes adjacent to the work area go out of control and hit construction equipment and workers, despite warning signs and traffic cones placed before and around the work site. Use of the new crash cushion trailer in Texas has resulted in doubled productivity by maintenance crews, because they can concentrate on their work without having to watch out for traffic.

The crash cushion trailer consists of thirty 55-gallon steel barrels, welded together at the bottom and top rims, riding on a single axle and two wheels and connected by a hitch to a truck. The truck, which doubles as a supply or equipment truck, moves behind the work crew at a distance of approximately 200 feet. Out-of-control vehicles traveling in the direction of the work site are likely to

impact the trailer instead of the men and machinery. The steel drums crumple in a controlled manner, bringing the errant car to a safe stop and at the same time saving the workmen from injury.

The prototype trailer was built at the District 17 facilities in College Station and put into service in August 1972. It has been constantly in use since that time on Interstate 45 near Huntsville. Nine others are now in use throughout the state, three of which are in the Houston area. Six of these units have been put into service during the last 6 months.

Each trailer would cost about \$1,500 if all new materials were used, but costs can be cut considerably by using second-hand equipment. For instance, used paint drums can be used instead of new drums. In this case, 11-inch holes must be cut in the top and bottom in place of the regular 8-inch holes to allow for the heavier gauge metal of the used paint drum (16 gauge instead of 20 gauge). This saves around \$9.00 a drum, or a total of \$270 for the whole unit.

Modifications continue to be made in later models. In Houston, provision has been made for the unit to be given a 12-inch clearance while it is towed, then lowered to 6 inches while in use. Normally, a conventional one-



The crash cushion trailer, consisting of 30 barrels welded together and mounted on a single axle, is shown before testing at the Texas Transportation Institute facility.



Damage to the front of the test automobile was minimal even after crashing into the rear of the attenuator at 60 miles per hour.

point hitch is used to tow the trailer behind the truck.

In use, the trailer is attached to the truck by a special five-point hitch that braces it laterally and prevents it from jack-knifing if it is hit at an angle. In this configuration, the truck and trailer can negotiate a 20 percent curve at 25 miles per hour.

The trailer was derived from the static Texas Crash Cushion designed to protect errant vehicles from collisions with fixed objects such as bridge piers, elevated gores, and light poles. The crash cushion trailer varies from the usual crash cushion in that the object supporting the crash cushion is itself movable rather than firmly fixed in space. This reduces the number of steel drums required but introduces a new variable in the form of the distance that the trailer and back-up maintenance truck will travel if impacted by an errant vehicle.

Texas Transportation Institute researchers obtained data to solve this problem by setting up a crash test in which a remotely controlled automobile crashed into the back of the trailer at 63 miles per hour. Results showed that the towing truck was virtually stationary until the barrels were crushed to nearly the maximum occurring during the test, which proved that most of the energy was absorbed by the drums before reaching the truck. Examination of the truck revealed no damage whatever.

Discussing the tests at the recent 53rd Annual Meeting of HRB, TTI Assistant Research Engineer Eugene L. Marquis demonstrated a set of graphs that were developed as a result. These graphs can be used to determine the number of barrels required for crash cushions and to establish desirable minimum distances between cushion trailers and the vehicle, personnel, and equipment they are to protect.

Marquis and his co-authors, TTI Research Engineer T. J. Hirsch and John F. Nixon, who is Engineer of Research for the Texas Highway Department, conclude that the crash cushion trailer is a practical, valuable unit for alleviating the seriousness of certain types of highway accidents involving maintenance vehicles, equipment, and personnel. They cite three basic possible uses for the trailer in maintenance or construction operations:



Eugene L. Marquis, Assistant Research Engineer, Texas Transportation Institute, shows slides of the crash cushion trailer during his presentation at the 53rd Annual Meeting of the Highway Research Board.



Checking out welds between the barrels are, from left, John F. Nixon, Engineer of Research, Texas Highway Department; T. J. Hirsch, Research Engineer, Texas Transportation Institute; and Eugene L. Marquis, Assistant Research Engineer, Texas Transportation Institute. The three men co-authored the paper given at the 53rd Annual Meeting of HRB.



Walter C. Jones, District Equipment Supervisor for District 17 of the Texas Highway Department, explains the trailer's five-point hitch system to District Engineer Joe Hanover (right) and Assistant District Engineer Carrol Zigler.

- Protection of maintenance workers and motorists at detour locations, where the crash cushion trailer could be stationed beyond the detour sign on a temporary basis;
- Protection of workers performing routine maintenance on traffic lanes or shoulders--as in mowing, guardrail repair, chuckhole filling, or trash collection; and
- Protection during maintenance operations in traffic, as for lane-striping, placement of pavement "buttons," etc.

The authors note that a crash trailer for local street operations can be much smaller than that needed on highways where greater vehicle speeds prevail.

## **Symposium on Tire-Pavement Interaction Explores Skid Resistance, Tread Design**

The 17th General Motors Research Symposium, the Physics of Tire Traction: Theory and Experiment, was held at the GM Research Laboratories in Warren, Michigan, October 8-9, 1973. Adrian G. Clary, Lawrence F. Spaine, and Harry R. Smith of the HRB staff were among the 172 people from 13 countries invited to attend and participate in the meeting. A total of 15 formal papers plus several panel discussions reviewed the role of the tire, the role of the pavement, and the complex nature of their interaction with other factors, such as contaminants and weather, to affect tire-pavement traction.

An overall impression from the meeting is that the tire-pavement traction problem is far from being resolved. Much research effort has gone into studies