

**A Field Evaluation of the S-1 Pedestrian Gard:  
Transit and Shuttle Bus Applications**

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# A Field Evaluation of the S-1 Pedestrian Gard: Transit and Shuttle Bus Applications

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## ABSTRACT

The need to reduce the injury to pedestrians that are run over or pinned beneath a bus is an ongoing concern for transit authorities and other operators. Occasionally, a pedestrian will be run over by the right rear wheel while exiting the rear door. This accident occurs in various scenarios such as when people exit the bus and become entangled in the door grab bars, or when they fall between the curb and the bus while it approaches or departs. With all scenarios, the S-1 Gard acts similar to a cow catcher, pushing the fallen pedestrian out and away from the rear tire. This paper will: outline various incident scenarios, evaluate the S-1 Gard's performance in a city environment, review installation of the guard as well as its maintenance requirements. The purpose of this paper is to bring to the attention of transit authorities and shuttle operators the overall value of this device.

## INTRODUCTION

Research indicates that approximately 85% of bus wheel accidents occur at the right hand drive wheel (curbside rear wheel) (see diagram 1).

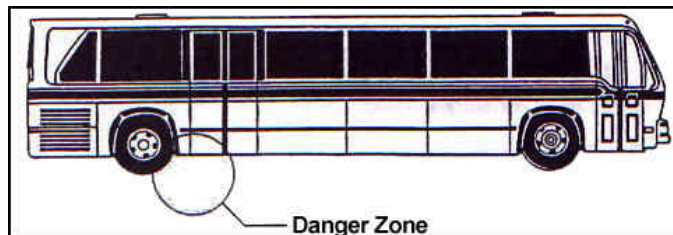


Diagram 1

Several circumstances contribute to these accidents. Some examples are pedestrians in the crosswalk; operator's obstructed view due to crowded buses; pedestrians tripping or falling while chasing the bus; and passengers becoming entangled in the rear exit door. In 1993 the concept of the S-1 Gard was formulated, and in 1997 the device was patented. The inventor, Public Transportation Safety, Inc (P.T.S.), brought to the transit industry, the first danger zone deflector for rear wheels.

The seriousness of this type of accident is what fueled the research and development of the S-1 Gard.

## S-1 GARD BACKGROUND

The S-1 Gard is a polyurethane rear wheel danger zone deflector approximately two feet wide by one foot high. The guard clamps onto the car-line (structure) of the bus near the rear right side wheels (Photo 1A and 1B).

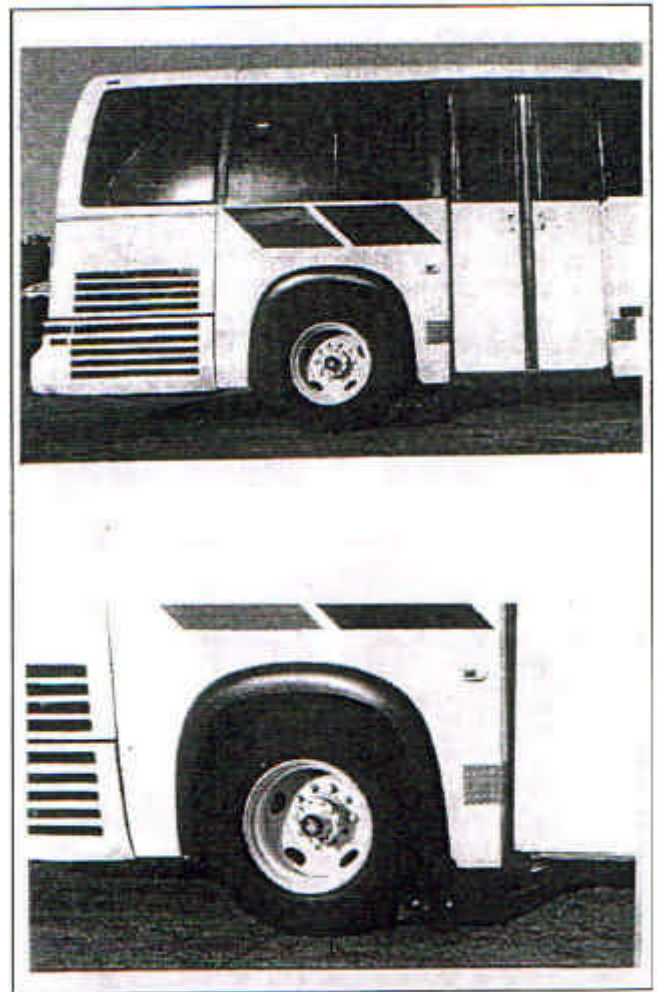


Photo 1A & 1B

First the receiver is secured to the bus' structure with fasteners. The guard is then secured to the receiver with fasteners. The red wear strip is attached to the boot with fasteners. No welding is needed to attach any part of the system to the bus.

For maintenance purposes, the guard is equipped with a quick release locking mechanism that allows mechanics to easily remove and replace the guard.

### TRANSIT LOGISTICS

Transit buses can travel up to 200 miles per day. Each mile includes numerous stops to load and unload passengers. Each stop has to be executed properly and carefully to ensure the safety of the passengers.

Because of **safety** concerns, some basic rules must apply. Some transit authorities mandate the driver not to stop unless at the designated bus stop. The bus is forbidden to stop once away from this location.

Obviously this is a good safety policy, however it is somewhat inconvenient for passengers. This situation creates the opportunity for the would-be passenger to chase the bus, maybe only briefly, and put himself in danger, if a subsequent fall or mishap was to take place. The guard provides protection for situations like this or for circumstances that may go without notice to the operators.

### INJURY REDUCTION

The S-1 Gard does not eliminate the accident. Its purpose is to deflect a fallen body away from the drive wheels. Depending on the circumstances, the body may still be partially under the bus and not completely deflected away from the vehicle. This device is only intended to reduce the injury. Driver training must still take place along with awareness of passenger and pedestrian placement.

### FUNCTION

The guard is constructed in two pieces; the boot (upper) and the wear strip (lower) (Photo 2).

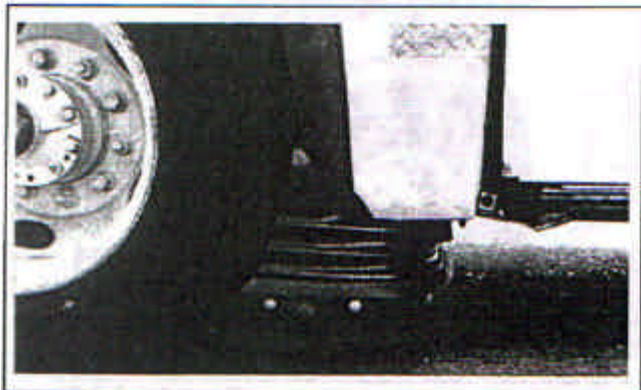


Photo 2

The boot portion has an accordion like cross-section that facilitates flexing and compliant behavior when obstacles are encountered. The wear strip is bolted to the boot and provides a replaceable wear surface to the assembly.

These two parts, as a system, create a deflector that pushes a body forward and to the right of the bus. The guard is curved (convex) so that the force vector is always outward and to the right, moving the fallen body out from under the bus.

The flexibility of the boot allows the guard system to move while the bus crosses over a high street crown, a curb, or a storm drain without becoming damaged. It can also pass through an automatic wash rack without damage. The system can even withstand moderate dragging on the pavement during a suspension failure.

### INSTALLATION

The position of the guard is just in front of the curbside rear wheels and behind the rear door (see diagram 1). The installation of the guard is facilitated by attaching a fabricated steel receiver to the car line of the structure. (see diagram 2)

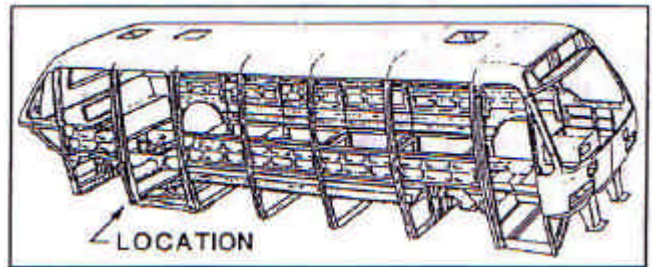


Diagram 2

This requires the removal of the outer body panel and the drilling of four mounting holes. Once this is done the receiver can be attached to the structure and the urethane boot pushed into position and bolted. When installed properly the guard is free from contact with the curbside rear wheels (Photo 3).

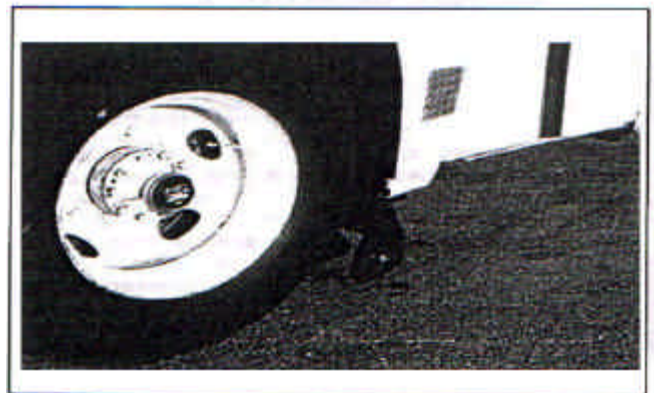


Photo 3



The entire process takes approximately one and one half hours. The S-1 Gard can be mounted to a variety of vehicles. Specifically, its main application is for semi-monocoque structures but there are also options for body-on-frame technology.

### CHICAGO PILOT TESTING

Starting in February 1998, three S-1 Gards were installed on 1981 RTS II (40ft.) model buses (Photo 4) operated by American Sightseeing Chicago.



Photo 4

These buses are operated by a private company, and service expositions held at Chicago's McCormick Place Exposition Hall as well as sporting events at Soldiers Field Stadium. The routes are through high density, pedestrian filled parking lots. The buses operate at relatively slow speeds but with extremely high passenger ridership. Passengers exit from the rear door, which is typical of transit operations.

Passengers are picked up at dedicated loading zones and kiosks. This situation creates advantages and disadvantages. One advantage is that the operator has special pick up points that allow large groups of people to enter and exit the bus at one location. This causes the disadvantage of overcrowding near the curb that can easily lead to an accidental push or stumble of an awaiting passenger putting them into the path of the oncoming bus. Furthermore, since the density of the ridership in some cases, is greater than vehicle capacity, an overflow of passengers are left behind. These people are adjacent to the vehicle as it pulls away from the loading area. It is for these reasons that the guard was installed and tested at American Sightseeing.

During the testing, daily logs were kept to track the performance of the guard (Appendix A). To determine the durability of the guard, aggregate mileage, general guard condition and wear were tracked. Maintenance of the guard was also part of the pilot test. Time studies

were conducted to determine average installation time, as well as, periodic removal times due to wheel or body service.

### TEST RESULTS

As of the date of this publication, testing remains ongoing. The results of these tests are positive for the guard.

Driver Acceptance - Drivers interviewed state that they are in favor of the device and that they are already aware of the potential danger that this guard can help avoid. Furthermore, they stated that the guard did not interfere with the operation of the bus in any way.

Wheelchair Lift - The three 1981 RTS II buses are equipped with New York style, center exit doors with wheelchair lifts (Photo 5A, 5B, 5C).

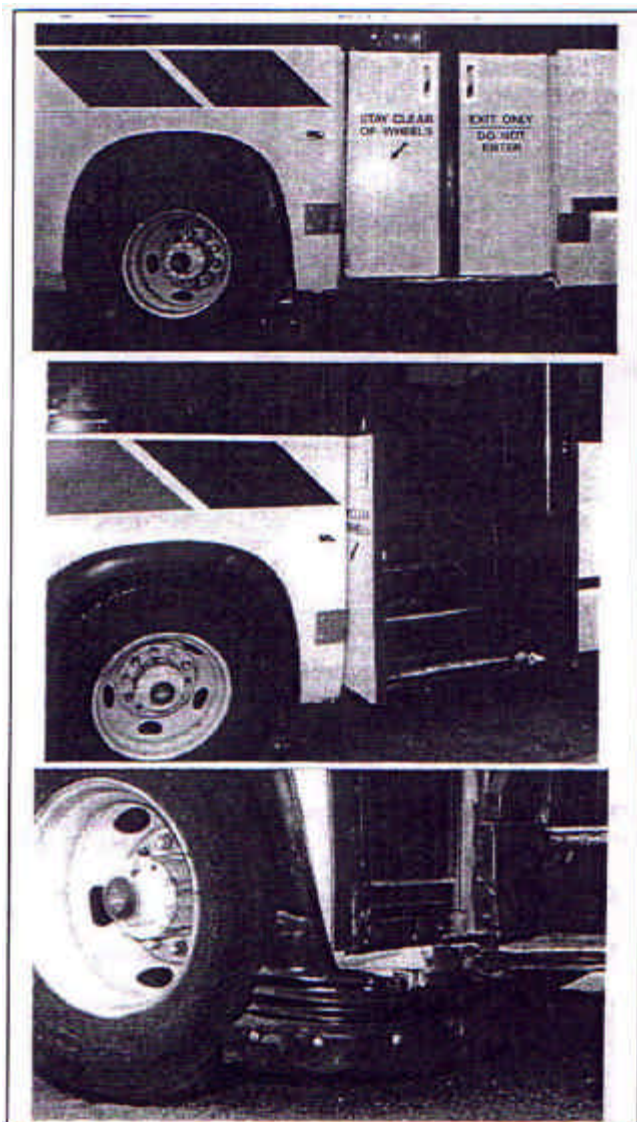


Photo 5 A, 5B, & 5C

The lifts were repeatedly tested with the guards in place. At no time did the guard interfere with the lift function (Photo 6A, 6B).

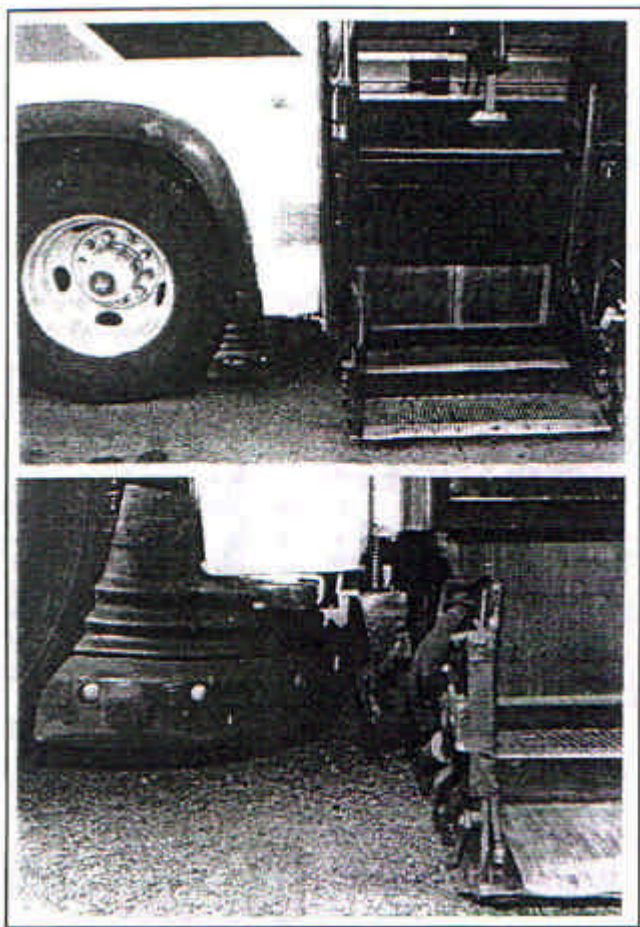


Photo 6A & 6B

## CONCLUSION

The Chicago pilot testing proves that the S-1 Gard can function within a large metropolitan environment while delivering all the necessary performance characteristics that are expected.

- During the test period it has been determined that the guard:
- Does not interfere with vehicle operation
- Does not produce any maintenance interference
- Does not create any utility interruption
- Is accepted by the vehicle operators
- Does not become entangled on the roadway or in vehicle equipment.

Videotaped testing, using a live stuntman, indicates that the guard will push a human body out from under the bus and away from the right hand drive wheel. It is this final piece of test data that the author relies on for the conclusion that the guard is functional and effective.

Author's Note: "S-1 Gard" is a trade name used by P.T.S. We apologize for any confusion this may have caused.