

QuadGuard[®] HS System

GENERAL SPECIFICATIONS

I. GENERAL

All QuadGuard HS Systems shall be designed and manufactured by Energy Absorption Systems, Incorporated, of Chicago, Illinois.

II. DESCRIPTION OF SYSTEM

A. General

The QuadGuard HS System shall consist of energy absorbing cartridges surrounded by a framework of steel Quad-beam[™] guardrail which can telescope rearward during head-on impacts. The QuadGuard HS System shall have a center monorail which will resist lateral movement during side angle impacts and a backup which will resist movement during head-on impacts. The nose shall consist of a flexible plastic nose belt. Transitions are available and may be required depending on site conditions.

B. Component Description

1. A bay describes a section of the QuadGuard HS System consisting of an energy absorbing cartridge, a diaphragm, two fender panels and fasteners.
 - a. There are two types of cartridges, referred to as Type I and Type II. The front two bays of the system shall not have cartridges. Bays three and four shall be fitted with Type I cartridges. The rear five bays of the system shall be fitted with Type II cartridges. The outside of each cartridge shall be fabricated from a weather resistant plastic.
 - b. The diaphragms for bays one, two and three shall be a light weight, space frame design utilizing 11 gauge steel c-channel and tubing members. The diaphragms for bays four through nine shall be made from 10 gauge, steel Quad-beam sections. Two support legs shall be welded to the bottom of both diaphragms main section. Ski-shaped plates shall be welded to the bottom of the support legs. The diaphragms shall be designed to lock onto and be guided by a ground-mounted, center monorail support structure.
 - c. The fender panels shall be fabricated from 10 gauge steel Quad-beam sections. The rear of each fender panel (the panel end furthest from the nose of the assembled system) shall be tapered to help maximize performance

during wrong-way, redirective impacts. Each fender panel shall be drilled and slotted in accordance with the manufacturer's specifications so that when assembled in the field, the front end (the end closest to the nose of the assembled system) shall be bolted to a diaphragm or hinge plate (depending on width of system) by means of 5/8" bolts. The rear of each Quad-beam™ fender panel shall overlap the next rearward fender panel and be connected to the diaphragm or hinge plate of the next bay by means of a bolt and "mushroom" washer. The bolt fits through the long horizontal slot in the forward fender panel. This permits the movement, front to back, of one set of fender panels relative to the panels in the underlying, next rearward bay.

2. The monorail support structure shall be made of steel and be anchored per manufacturers instructions, to a specified concrete pad. The monorail shall prevent lateral movement, vertical movement and overturning of the diaphragms during design impacts.
3. The nose section shall contain a nose belt assembly that is not counted as a bay. The nose belt shall be made from a woven polyester material covered with polyvinyl chloride to resist weathering. The nose belt shall attach to the front diaphragm. Standard colors shall be gray or yellow.
4. The backup shall be made of steel and be attached to concrete or an integral tension strut framework, and shall be available in nominal widths of 610mm (24"), 762mm (30"), 915mm (36").
5. Several transition panels are available as required by site conditions including: Quad-beam to Safety Barrier, Quad-beam to Thrie-beam, Quad-beam to W-beam, and Quad-beam End Shoe. Contact Energy Absorption Systems, Inc. for specific applications.

C. Material Specifications

1. Metal work shall be fabricated from either M1020 Merchant Quality or ASTM A-36 steel. After fabrication, metal work shall be galvanized in accordance with ASTM A-123. All welding shall be done by or under the direction of a certified welder.
2. The system shall be assembled with galvanized fasteners. All bolts, nuts, and washers shall be Commercial Quality "American National Standard" unless otherwise specified.

III. TEST CRITERIA

The QuadGuard HS System has successfully passed the National Cooperative Highway Research Program (NCHRP) Report 350, 1993, Test Level 3 for redirective, non-gating terminals and crash cushions with both the light car and pickup truck at speeds up to 113 km/h [70 mph] at angles up to 20°.

NCHRP 350 (TL-3) specifies the following evaluation criteria:

- A. For head-on impacts into the nose, a crash cushion should be capable of meeting the Occupant Risk Criteria as recommended in NCHRP 350. For vehicles weighing between 820 and 2000 kg [1,810 and 4,410 lbs.], the theoretical impact velocity of a hypothetical front seat passenger against the vehicle's interior (calculated from vehicle acceleration and 600mm [24"] forward displacement) shall be less than 12m/s [39.4 ft/sec], and the vehicle's highest 10 millisecond average acceleration subsequent to the instant of the hypothetical passenger impact shall be less than 20 G's.
- B. At angles up to 20°, a crash cushion should be capable of redirecting 2000 kg [4,410 lbs] vehicles that impact the sides of the system at speeds up to 100 km/h [62 mph]. This criteria is for both normal traffic direction and reverse traffic direction impacts (angles measured for system's longitudinal centerline) assuming appropriate transition hardware is properly installed. At angles up to 15°, a crash cushion should be capable of redirecting 820 kg [1,810 lbs.] vehicles that impact the sides of the system at speeds up to 100 km/h [62 mph] at angles of 15°. (Note that the QuadGuard HS was tested at nominal speeds of 113 [70 mph] instead of the 100 km/h [62 mph] required by NCHRP 350)
- C. The crash cushion should be designed and constructed so no solid debris is present from the system that can create a hazard on the roadway after either head-on or side angle design impacts.

IV. DESIGN AND SELECTION CRITERIA

- A. Design, selection and placement of crash cushions shall conform to The American Association of State Highway and Transportation Officials (AASHTO) Publication, "Roadside Design Guide" 1996.
- B. Installation of the QuadGuard HS System attenuators shall be accomplished in accordance with the recommendations of Energy Absorption Systems, Incorporated.