

**TECHNICAL
BRIEF**180 River Road • Rio Vista, CA 94571 • Tel 707-374-6800 • Fax 707-374-6801
Email: info@barriersystemsinc.com • Website: barriersystemsinc.com**Product Specification****X-TENUator™
Redirective, Non-Gating, Crash Cushion****I. General**

The X-TENUator system is a Redirective, Non-Gating Crash Cushion in accordance with the definitions in the National Cooperative Highway Research Program Report 350 (NCHRP 350). The system has been tested and performs in an acceptable manner in accordance with the guidelines of NCHRP 350 at Test Level 3 (100 km/h).

II. Performance

The X-TENUator system is designed to absorb the impact energy of an errant vehicle in accordance with NCHRP 350 guidelines for Redirective, Non-Gating Crash Cushions. The system is designed to shield the ends of median barriers and other narrow fixed objects up to a width of 21 inches (535 mm); larger hazards may be treated using transition segments. When installed in accordance with the manufacturers instructions, the X-TENUator system is capable of safely stopping a 4,400 lb (2000 kg) pickup truck impacting the system at 100 km/h (62.3 mph), 0 degrees and an 1800 lb (820 kg) compact vehicle impacting the system at 100 km/h (62.3 mph), 0 degrees and with an offset of the vehicle and the system centerlines of one-fourth the vehicle width.

- A. When properly installed according to the manufacturer's recommendations, the system shall be able to meet the recommended structural adequacy, occupant risk, and vehicle trajectory criteria set forth in the NCHRP 350 for Test Level 3 (100 km/h) Redirective, Non-Gating Crash Cushions (NCHRP 350 TL-3). The NCHRP 350 TL-3 Test Matrix includes the following conditions:
1. A 2000 kg vehicle at -20 degrees (reverse direction) impact to the midpoint of the system. (Test 3-39)

2. A 2000 kg vehicle at 20 degrees impacting at the Critical Impact Point of the system. The Critical Impact Point was determined to be the front of the backstop along the centerline of the system (Test 3-38).
 3. A 2000 kg vehicle at 20 degrees impacting the side, near the front of the system (Test 3-37).
 4. An 820 kg vehicle at 20 degrees impacting the side, near the front of the system (Test 3-36).
 5. A 2000 kg vehicle at 15 degrees impacting the front of the system (Test 3-33).
 6. An 820 kg vehicle at 15 degrees impacting the front of the system (Test 3-32).
 7. A 2000 kg vehicle at 0 degrees and centered on the front of the system (Test 3-31).
- B. The impact velocity of a hypothetical front seat passenger against the vehicle interior as calculated from the longitudinal vehicle acceleration and 23 5/8 inches (600 mm) forward displacement, and the lateral vehicle acceleration and 12 inches (300 mm) lateral displacement, shall be less than or equal to 39.3 ft/sec (12 m/s). The highest 10 ms average vehicle acceleration in the longitudinal and lateral directions subsequently to the instant of hypothetical occupant impact shall be less than or equal to 20 g's in the NCHRP 350 testing matrix of the X-TENUator system.

Detached debris shall not show potential to penetrate the vehicle occupant compartment or present a hazard to other traffic, pedestrians, or workers in a work zone. The vehicle shall remain upright during and after the collision, although moderate roll, pitch, and yaw may occur. Vehicle deformations shall not cause intrusion into the occupant compartment in excess of 6 inches (150 mm)

III. Description of System

- A. The X-TENUator system shall be made up of the following components and the system shall be fabricated from materials conforming to the following specifications:
1. The foundation system for the X-TENUator consists of two cables, front cable anchors, a back support and individual posts.

- a. All steel structural components of these assemblies shall be fabricated from mild steel in conformance with ASTM A-36 specifications or equivalent. These components shall be hot dipped galvanized per ASTM-123.
 - b. Fasteners shall be Class 5.8 (Grade 2) or greater and hot dipped or mechanically galvanized in accordance with ASTM 123 or ASTM-153. Washers shall be hardened and galvanized.
 - c. The steel cables shall be 19 mm 3 x 7 strand. The cables shall be DSR galvanized 320 and galvanized per ASTM A-603.
2. The impact head for the X-TENUator is composed of two head unit weldments and a connector brace.
 - a. The impact head shall be fabricated from hot rolled steel in accordance with ASTM A-36 or equivalent and hot dipped galvanized in accordance with ASTM A-123.
3. The rail elements for the X-TENUator consist of W profile beams with slider brackets.
 - a. The rail elements shall conform to AASHTO RWM02B Class B guardrail. The slider bracket shall be fabricated from hot rolled steel in accordance with ASTM A-36 or equivalent and hot dipped galvanized in accordance with ASTM A-123.
4. The blockouts for the X-TENUator consist of standard timber or composite blockouts.
 - a. The composite blockouts shall be fabricated from polyethylene.
 - b. Timber blockout shall conform to AASHTO PDE01.
5. The nose components of the X-TENUator consist of a nose cartridge and a nose cover.
 - a. The nose cartridge consists of an outer shell fabricated from 2 mm polyethylene and polyurethane foam and backing backing plate fabricated of hot rolled steel in accordance with ASTM A-569 or equivalent and hot dipped galvanized in accordance with ASTM A-123.
 - b. The nose cover shall be fabricated from 3 mm polyethylene.

6. Fasteners

- a. All Fasteners shall be Class 5.8 (Grade 2) or greater and mechanically galvanized in accordance with ASTM 153. Washers shall be hardened and galvanized.
- B. The X-TENUator shall require attachment to a foundation. Anchoring of the system will require attachment in accordance with the manufacturer's drawings and instructions.
- C. The X-TENUator shall be assembled and installed in accordance with the manufacturer's instructions.

IV. Application of Safety Appurtenances

Highway safety appurtenances should be applied to hazardous sites in accordance with the guidelines and recommendations in the American Association of State Highway Transportation Officials (AASHTO), "Roadside Design Guide", and other Federal Highway Administration and State Department of Transportation requirements. Placement of the X-TENUator system must comply with these specifications and guidelines as well as those of the manufacturer.