

# **BRAKEMASTER® 350 SYSTEM**

## **GENERAL SPECIFICATIONS**

### **I. GENERAL**

All BRAKEMASTER 350 Systems (BRS 350), shall be designed and manufactured by, or under the direction of, Energy Absorption Systems, Incorporated, of Chicago, Illinois.

### **II. DESCRIPTION OF SYSTEM**

#### **A. General**

The BRAKEMASTER 350 System shall consist of a rigid front anchor assembly, a breakaway assembly, a brake/tension support, a cable/brake assembly, panel/strap assemblies, diaphragms, and transition straps. It can be installed in a unidirectional or bi-directional configuration. When impacted on the side, the system is restrained from lateral movement by dynamic tension developed between end restraints. The system is flexible and redirects vehicles during side impacts within the length of need. When impacted on the nose, the system telescopes and impact energy is absorbed through momentum transfer, friction, and metalworking.

#### **B. Component Descriptions**

1. A foundation tube anchor assembly or concrete pile anchor shall anchor the BRAKEMASTER 350 System at the front. The top of the rigid front anchor shall have steel tubes for attaching the threaded end of the cable/brake assembly and for attaching the two threaded rods of the breakaway assembly. The threaded rods shall also attach the brake/tension support assembly to the anchor assembly.
2. The breakaway assembly shall consist of a galvanized sheet metal nose, which bolts to a lever arm and wraps around the arm to attach to the panels on the brake/tension support assembly. The lever arm shall have two steel tube ends connected by two threaded rods to the rigid front anchor assembly.

3. The brake/tension support (BTS) shall consist of a rigid channel structure at the front of the system and shall attach to the rigid front anchor with threaded rods.
4. The cable/brake assembly shall consist of two brakes positioned on a galvanized wire rope cable and supported within the brake/tension support. One end of the cable shall attach to the rigid front anchor. The cable shall then pass through holes in the diaphragms, through holes in the downstream guardrail posts and shall be secured with a large plate washer and nut.

The brakes shall consist of spring plates & brake sleeves. The spring plates and brake sleeves shall provide a friction resistance, which decelerates a vehicle impacting the system on the nose. The spring plates shall be made of high strength steel.

5. A panel/strap assembly shall consist of twelve gauge W-beam section panels provided with holes on each end for assembly. The tension straps shall be used to connect panels to diaphragm assemblies.
6. The diaphragms shall consist of tubular steel posts with feet, side plates and a cable grommet. Side plates shall be welded to the ends of the top cap of the posts.
7. A transition strap shall consist of a flat bar strap which attaches to the diaphragm, panel/strap and downstream guardrail.

#### C. Material Specifications

1. All metal work shall be made in the U.S.A. After fabrication, all metal work except the brake assemblies and tension straps shall be galvanized in accordance with ASTM A-123 or ASTM A-525. All welding shall be done by or under the direction of a certified welder.
2. All bolts, nuts and washers used within BRAKEMASTER® 350 Systems shall be galvanized per ASTM 153 Commercial Quality "American National Standard" unless otherwise specified.

3. Brake assembly shall be coated with an environmental protective coating. The tension straps shall be pre-galvanized sheet steel to prevent corrosion.

### **III. PERFORMANCE CRITERIA**

A. The BRAKEMASTER® 350 System shall perform as a redirective gating crash cushion as specified in the NCHRP 350 Test Level 3. The test matrix is specified in the NCHRP 350 as follows:

1. Test 3-30 Impact at 0° into the nose of the device (w/4 offset from centerline of the device) at 100 kph with a 820C vehicle. The BRAKEMASTER System was previously tested to NCHRP 230 Test 45, and those test conditions are effectively representative of NCHRP 350, Test 3-30.
2. Test 3-31 Impact at 0° into the center nose of the device (0 offset from centerline of the device) at 100 kph with a 2000P vehicle.
3. Test 3-32 Impact at 15° into the center nose of the device (0 offset from centerline of the device) at 100 kph with a 820C vehicle.
4. Test 3-33 Impact at 15° into the center nose of the device (0 offset from centerline of the device) at 100 kph with a 2000P vehicle.
5. Test 3-34 Impact at 15° along the side of the system, at the critical impact point (CIP) at 100 kph with a 820C vehicle. The BRAKEMASTER System was previously tested to NCHRP 230 Test 44, and those test conditions are effectively representative of NCHRP 350, Test 3-34.
6. Test 3-35 Impact at 20° at the beginning of length of need (BLON) at 100 kph with a 2000P vehicle.
7. Test 3-39 Impact in the reverse direction at 20° at the mid-point (L/2) at 100 kph with a 2000P vehicle. The BRAKEMASTER System was previously tested to NCHRP 230 Test S31, and those test conditions are effectively representative of NCHRP 350, Test 3-39.

B. Evaluation Criteria

1. The BRAKEMASTER® 350 System shall meet the occupant risk criteria as recommended in NCHRP 350 for vehicles weighing between 820 to 2000 kg [1810 to 4,410 lbs]. For the applicable tests, the impact velocity of a hypothetical front seat passenger who travels 600mm [24"] against the vehicle interior (calculated from vehicle acceleration) shall be less than 12 m/s [39.4 ft/sec]. The highest 10 millisecond vehicle average acceleration subsequent to the passenger impact with the interior surface shall be less than 20 g's in the longitudinal direction.
2. The BRAKEMASTER 350 System shall meet the structural adequacy criteria as recommended in NCHRP 350 for vehicles weighing between 820 to 2000 kg [1810 to 4,410 lbs]. The BRAKEMASTER 350 System shall be capable of redirecting vehicles which impact the side of the system at speeds of up to 100 kph [62.5 mph] at an angle of 20°.
3. The BRAKEMASTER 350 System shall meet the following vehicle trajectory criteria, as recommended in NCHRP 350, for applicable tests for vehicles weighing between 820 to 2000 kg [1810 to 4,410 lbs]. After collision, the vehicle trajectory and final stopping position shall intrude a minimum distance into adjacent or opposing traffic lanes. For design angle impacts, the exit angle from the unit shall not exceed 60 percent of the impact angle.

#### **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 BRAKEMASTER® System attenuators shall be accomplished in accordance with the recommendations of Energy Absorption Systems, Incorporated.