Mr. Joseph M. Bowman, P.E.  
Director of research and Development  
Hapco Aluminum Pole Products  
26252 Hillman Highway  
Abington, VA 24210

Dear Mr. Bowman:

This letter is in response to your requests for the Federal Highway Administration (FHWA) acceptance of specific Hapco roadside safety systems for use on the National Highway System (NHS).

Name of system: Various breakaway bases and decorative covers for lighting and luminaire support posts as described below  
Type of system: Breakaway Hardware/Decorative Covers for Various Lighting Poles and Luminaire Supports  
Test Level: NCHRP Report 350 Test Level 3 (Pendulum Testing)  
Testing conducted by: Texas Transportation Institute for Hapco  
Date of requests: December 21 and 28, 2010  
Request acknowledged: December 22, 2010

You requested that we find five (5) breakaway post designs and three (3) decorative base covers used with previously-accepted breakaway post designs acceptable for use on the NHS under the provisions of the National Cooperative Highway Research Program (NCHRP) Report 350 “Recommended Procedures for the Safety Performance Evaluation of Highway Features.”

Requirements  

Decision  
The Hapco designs/configurations shown in the Test Summary below were tested by TTI and found acceptable as indicated. In four cases, design modifications were made to the hardware initially used in failed tests and the tests were repeated with successful results.
Test Descriptions

TTI Tests P15, 16, and 17: These tests were run using HAPCO’s modified breakaway coupling 67238A (Enclosure 1). Test P15 was not successful because the post did not breakaway and the occupant impact velocity was 10.5 m/s, well over the allowable maximum of 5 m/s. It was determined the failure was caused by improper installation. Specifically, there was no gap left between the breakaway couplings and the foundation/support base. This deficiency was corrected and drawings B18836 and B18859 (Enclosures 1A and 1B) were revised to show the required gap. Test P16, using a tapered aluminum pole with a 55-foot mounting height, resulted in an occupant impact velocity of 3.3 m/s. Test P17, using a tapered aluminum pole with a 50-foot mounting height, resulted in an occupant impact velocity of 3.2 m/s. The calculated high
speed changes in velocity were reported to be 3.6 m/s and 2.4 m/s for Tests P16 and P17, respectively.

TTI Tests P18 and 24: Test P18 was run using HAPCO’s Decorative Pedestal (18357) to support its Sample-515 lighting pole. This test produced an occupant impact velocity of 5.4 m/s, slightly above the maximum value allowed. The Pedestal was modified by drilling two 6 millimeters (0.25-inch) holes 19 millimeters (0.75 inches) above the base and 146 millimeters (5.75 inches) apart. These holes were connected by a 3 millimeters (0.125 inch) slot to create a shear plan when the base is impacted by a vehicle. The modified design is designated as part 25090 and is shown as Enclosure 2. Test P24 was a test of the modified design with the tapered aluminum tube shown in Enclosure 2A. The low-speed occupant impact velocity was reported to be 3.6 m/s and the calculated high-speed OIV was reported to be 2.4 m/s.

TTI Tests P19 and 25: Test P19 was run using HAPCO’s Decorative Pedestal (17642) to support its Sample-513 lighting pole. This test resulted in an unacceptable low-speed OIV of 5.9 m/s. The Pedestal was modified by drilling two 6 millimeters (0.25-inch) holes 22 millimeters (0.875 inches) above the base and 152 millimeters (6 inches) apart. These holes were connected by a 3 millimeters (0.125 inch) slot to create a shear plan when the base is impacted by a vehicle. The modified design is designated as part 25088 and is shown as Enclosure 3. Test P25 was a test of the modified design with the tapered aluminum tube shown in Enclosure 3A. The low-speed occupant impact velocity was reported to be 5.0 m/s and the calculated high-speed OIV was reported to be 2.6 m/s.

TTI Test P20: Test P20 was run on HAPCO’s Sample-514 lighting pole supported by a Decorative Pedestal made from 356-T6 aluminum and modified from the previously-accepted part 13172 to add a machined groove. The modified design, part 25089, is shown as Enclosure 4 and the tested set-up is Enclosure 4A. Upon impact with the pendulum, the pole separated from the base. Although this separation is not desirable, the test video showed that the sheared pole continued to move away from the impact point and thus was not likely to impact the windshield of a vehicle in an actual crash. The reported OIV was 3.1 m/s and the calculated high-speed value was 3.1 m/s.

TTI Test P21: This test was conducted to verify acceptable crash performance of a decorative base cover installed over a previously-accepted breakaway design. This cover is a two-piece cast aluminum design bolted together with 10-millimeters (0.375 inch) nylon hex screws and nuts to ensure separation of the two halves in a crash. The reported low-speed OIV was 2.9 m/s and the calculated high-speed value was 1.4 m/s. The tested set-up with pole Sample-512 is shown in Enclosure 5.

TTI Test P22: This test was also conducted to verify acceptable crash performance of a decorative base cover installed over a previously-accepted breakaway design. This cover is a two-piece cast aluminum design bolted together with 10-millimeters (0.375 inch) nylon hex screws and nuts to ensure separation of the two halves in a crash. The reported low-speed OIV was 3.3 m/s and the calculated high-speed value was 1.8 m/s. The tested set-up with pole Sample-511 is shown in Enclosure 6.
TTI Tests P23 and 26: Test P23 was conducted to verify acceptable crash performance of a decorative base cover installed over a previously-accepted breakaway design. This cover was also a two-piece aluminum design bolted together with 10-millimeters (0.375 inch) nylon hex screws and nuts to ensure separation of the two halves in a crash. The test failed with a reported low-speed OIV of 6.0 m/s. Post-impact analysis indicated that the previously-accepted breakaway base failed to yield as designed because of an oversized fillet weld. This error was corrected and the system was re-tested under test P26. In the second test, the reported low-speed OIV was 2.9 m/s and the calculated high-speed value was 1.7 m/s. The tested set-up with pole Sample-510 is shown in Enclosure 7. Note #3 was added to this drawing to address the aforementioned weld problem.

TTI Tests P27 and 28: Both of these tests used HAPCO’s Modular T-base Assembly as shown in Enclosures 8 and 8A. Test P27 used a 55-foot luminaire mounting height as shown in Enclosure 8B and Test P28 shown in Enclosure 8C used a similar set-up, but with a 50-foot mounting height. For Test P27, the low-speed actual and high-speed calculated OIV values were 4.5 m/s and 4.4 m/s, respectively. For Test P28, these values were 4.8 m/s and 3.3 m/s, respectively. Although both test installations used a 14.5-inch bolt circle, you requested the Modular T-base be accepted for use with bolt circles from 10 inches to 17.5 inches. For a traditional cast aluminum transformer base, FHWA acceptance is limited to the largest diameter bolt circle that was actually tested. However, in your design, each “leg” of the breakaway structure functions independently of the remaining three. Therefore, a bolt “circle” ranging from 10 inches to 17.5 inches is acceptable.

Crash Testing
Pendulum testing was conducted on the test articles described above by the Texas Transportation Institute (TTI) at their outdoor pendulum testing facility. All tests were conducted according to NCHRP 350 test designation 3-60. The FHWA accepts pendulum tests as surrogates for this low-speed small car test. The FHWA also allows the results of the high speed tests to be estimated using data from the low-speed pendulum test in combination with an analytical extrapolation method described in the FHWA memorandum “Identifying Acceptable Highway Safety Features” dated on July 25, 1997.

Findings
For all eight test articles, the low speed test results and the high speed test extrapolation analysis resulted in change in velocity values less than the upper limit of 5.0 m/s.

It should be noted that the pole, luminaire arm, and clamshell base covers must meet the conditions and limitations of TRANSPO Industries breakaway couplings identified in FHWA acceptance letter LS-45B particularly the followings:

- All supports shall be mounted to a structural concrete foundation that will not move in the soil if the support is struck by a vehicle.
- Luminaire mounting height should not exceed 15.7 meters (55 feet).
- Mass of pole, mast arm, luminaire and other hardware above the couplings shall not exceed 454 kg (1000 lbs.).
Therefore, the systems described above and detailed in the enclosed drawings are acceptable for use on the NHS under the range of conditions tested, when such use is acceptable to a highway agency.

Please note the following standard provisions that apply to FHWA letters of acceptance:

- This acceptance is limited to the crashworthiness characteristics of the tested features and does not cover their structural features, such as resistance to wind loads.
- Any design or material changes that may adversely influence the crashworthiness of the Dent system will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the system being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke our acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance, and that it will meet the crashworthiness requirements of the FHWA and the NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance is designated as number LS-74 and shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed at our office upon request.
- The Hapco products identified above are patented products and considered proprietary. If proprietary systems are specified by a highway agency for use on Federal-aid projects, except exempt, non-NHS projects, (a) they must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with the existing highway facilities or that no equally suitable alternative exists; or (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.
- This acceptance letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented system for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate system, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely yours,

Michael S. Griffith
Office of Safety Technologies
Office of Safety

Enclosures
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Requirements

Decision
The Hapco designs/configurations shown in the Test Summary below were tested by TTI and found acceptable as indicated. In four cases, design modifications were made to the hardware initially used in failed tests and the tests were repeated with successful results.
Test Summary
Hapco TTI Breakaway Device Tests October – November 2010

<table>
<thead>
<tr>
<th>Drawing</th>
<th>TTI Test</th>
<th>Test Date</th>
<th>Results</th>
<th>Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>B18836</td>
<td>P15</td>
<td>10/6/2010</td>
<td>Fail</td>
<td>67238A coupling</td>
</tr>
<tr>
<td>B18836</td>
<td>P16</td>
<td>10/6/2010</td>
<td>Pass</td>
<td>67238A coupling</td>
</tr>
<tr>
<td>B18859</td>
<td>P17</td>
<td>10/6/2010</td>
<td>Pass</td>
<td>67238A coupling</td>
</tr>
<tr>
<td>Sample-515</td>
<td>P18</td>
<td>10/7/2010</td>
<td>Fail</td>
<td>18357 casting assembly</td>
</tr>
<tr>
<td>Sample-513</td>
<td>P19</td>
<td>10/7/2010</td>
<td>Fail</td>
<td>17642 casting assembly</td>
</tr>
<tr>
<td>Sample-514</td>
<td>P20</td>
<td>10/7/2010</td>
<td>Pass</td>
<td>25089 (13172 casting with machined groove)</td>
</tr>
<tr>
<td>Sample-512</td>
<td>P21</td>
<td>10/7/2010</td>
<td>Pass</td>
<td>Hapco Energy Transfer Profile with 2-pc decorative cover at impact point w/nylon fasteners for use with previously accepted breakaway devices</td>
</tr>
<tr>
<td>Sample-511</td>
<td>P22</td>
<td>10/7/2010</td>
<td>Pass</td>
<td>Hapco 2-piece decorative cover below impact point w/nylon fasteners for use with previously accepted breakaway devices</td>
</tr>
<tr>
<td>Sample-510</td>
<td>P23</td>
<td>10/7/2010</td>
<td>Fail</td>
<td>Hapco 2-piece decorative cover below impact point w/nylon fasteners for use with previously accepted breakaway devices</td>
</tr>
<tr>
<td>Sample-515</td>
<td>P24</td>
<td>11/23/2010</td>
<td>Pass</td>
<td>25090 (18357 casting assembly modified with machined groove)</td>
</tr>
<tr>
<td>Sample-510</td>
<td>P26</td>
<td>11/23/2010</td>
<td>Pass</td>
<td>Hapco 2-piece decorative cover below impact point w/nylon fasteners for use with previously accepted breakaway devices</td>
</tr>
<tr>
<td>19880</td>
<td>P27</td>
<td>11/23/2010</td>
<td>Pass</td>
<td>Hapco Modular t-base assemble using 15190 corner casting</td>
</tr>
<tr>
<td>19881</td>
<td>P28</td>
<td>11/23/2010</td>
<td>Pass</td>
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Sincerely yours,

Michael S. Griffith
Office of Safety Technologies
Office of Safety

Enclosures
Enclosure 1
Enclosure 1A
Enclosure 1B
Remove First Step For Use With 8" O.D. Tubes

Cast Base Per C16777 (Modified)

Door Per C16793

Drill 5/16" Dia. Hole In Door To Accept 1/4"-20NC Button Hd. Socket S.S. Screw (72499)
( Drill & Tap Base 1/4"-20NC)

See Detail (Located Opposite Door)

1/4" Drill (2 Places)

5 3/4"

5 13/16"

1/8" Maximum Saw Cut Thru Wall

11" To 16" Dia. Bolt Circle

1/8"

Ref. 18357

hapco
Abingdon, Va.

Enclosure 2
Drill 5/16" Dia. Hole In Door To Accept 1/4"-20NC Button Hd. Socket Stainless Steel Screws (72499) Drill & Tap Base 1/4"-20NC

Cast Door Per 13480

3 1/4" x 7 1/8" x 5 5/8" High Door Opening

Cast Base 13479 (Modified)

See Detail (Located Opposite Door) 1/4" Drill (2 Places)

1/8" Maximum Saw Cut Thru Wall

12" Dia. Bolt Circle

Enclosure 3
Enclosure 3A
Enclosure 4
Note:
Dimensional Location Of Spun Section
Of Shaft Is Critical In Order For Pole
To Meet Breakaway Requirement.

2 1/2" Sch. 40 Pipe
Alloy 6063-16

Cost Alum. Cap
(7061-T1)

Ground Lug Opposite Handhole &
Reinforced Handhole (3 x 5")
With Cover And Stainless Steel Screws

Tapered Alum. Tube
Weld Built To .188" Max.
Alloy 6063-16

Mylar Label Installed

Cost Alum. Breakaway Base Flange
(47380) Alloy 356-10 Welded per
AP6407

Hapco Energy Transfer Profile

20'-0"

1/4"-0"

6" O.D.

4" O.D.

2'-3 5/8"

17" Dia.

9" to 10" Dia.

Bolt Circle

3 1/2" Thread

2 2/4"

30"

3 5"

19" Dia.

Two Piece Cost Alum. Decorative
Base Cover With Door And Stainless
Steel Screws (72113). Base Holes To
Alloch With 3/8"-16NC Nytron Screws
(16974), Nytron Hex Nuts (16976) and
Stainless Steel Flatwashers (45370-010).

(4) 3/4"-10NC Galv. S11 Anchor Bolts,
MSHTO M314-90 Grade 65, 10" Of
Threaded End Galv. Per ASTM A185.
(4) 3/4"-10NC Galv. S11 Hex. Nuts
(4) 3/4" Galv. S11 Lockwashers
(4) 3/4" Galv. S11 Flawwashers

Ref: Sample-505

Hapco Energy Transfer Profile

Hapco

Enclosure 5