U.S. Department of Transportation
Federal Highway Administration

1200 New Jersey Ave., S.E.
Washington, DC 20590

October 9, 2007

In Reply Refer To:
HSSD/LS-65

Mr. Joseph M. Bowman
HAPCO
26252 Hillman Highway
Abingdon, VA 24210

Dear Mr. Bowman:

This letter is a reply to your mail correspondence of September 2, 2007, requesting the Federal Highway Administration (FHWA) acceptance of your company's HAPCO Lighting Poles Embed Breakaway Joints for use on the National Highway System (NHS) under the provisions of National Cooperative Highway Research Program (NCHRP) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features." Accompanying your letter was a report on testing of your system conducted by the Texas Transportation Institute (TTI) and test videos.

Requirements
Luminaire supports should meet the guidelines contained in the NCHRP Report 350, "Recommended Procedures for the Safety Performance Evaluation of Highway Features." FHWA Memorandum "ACTION: Identifying Acceptable Highway Safety Features" of July 25, 1997, provides further guidance on crash testing of luminaire supports and on use of low-speed pendulum tests as a surrogate for full-scale crash testing.

Product description
The following three 40 ft (12.19 m) HAPCO Lighting Poles were tested at the TTI outdoor pendulum testing facility:

1) *HAPCO Breakaway Joint 12591* is at the ground line and consists of a cast aluminum ring (Alloy 356-T6) placed inside the foundation tube and tapered support tube. This ring was welded to each mating surface using groove and fillet welds. The thickness of the ring varied from 3/8 inches to 13/16 inches. A drawing is enclosed for reference. The joint was tested using *HAPCO A89961 Lighting Pole.* The lighting pole including foundation tube is a 46 foot - 11 inches long tapered aluminum tube (Alloy 6063-T6) with a 10 inch diameter at ground level, 6 inch diameter at the top, and wall thickness of 0.156 inches. The total height with light fixture is 45 feet. The weight of the pole with base is 211 pounds, the luminaire arm is 42.5 pounds, and the light fixture is 38 pounds, totaling a weight of 291.5 pounds. The pole was installed to a depth of 7 feet in crushed limestone.

2) *HAPCO Breakaway Joint 12592* is at the ground line and consists of the 10 inch diameter tapered tube fitting onto a 9 11/16 inch outside diameter machine rabbet joint in the 10 inch diameter by 3/8 inch thick foundation tube. A drawing is enclosed for reference. The joint was tested using *HAPCO B89962 Lighting Pole.* The lighting pole including foundation tube is a 46 foot - 11 inches long tapered aluminum tube (Alloy 6063-T6) with a 10 inch diameter at ground level and a 6 inch diameter at the top. The total height with light fixture is 45 feet. The weight of the pole with base is 263 pounds, the luminaire arm is 42.5 pounds, and the light fixture is 38 pounds, totaling a weight of 343.5 pounds. The pole was installed to a depth of 7 feet in crushed limestone.
3) *HAPCO Breakaway Joint 12593* is at the ground line and consists of the 1/2 inch thick plate welded to the bottom of the tapered support tube. The plate is also welded to the top of the foundation tube. Fillet welds (5/8 inch) are used to weld the plate to the support tube and the foundation tube. A drawing is enclosed for reference. The joint was tested using *HAPCO B89963 Lighting Pole.* The lighting pole including foundation tube is a 46 foot - 11 inches long tapered aluminum tube (Alloy 6063-T6) with a 10 inch diameter at ground level and a 6 inch diameter at the top. The total height with light fixture is 45 feet. The weight of the pole with base is 211 pounds, the luminaire arm is 42.5 pounds, and the light fixture is 38 pounds, totaling a weight of 291.5 pounds. The pole was installed to a depth of 7 feet in crushed limestone.

Testing

Your company's Lighting Poles Embed Breakaway Joints were tested at the TTI outdoor pendulum testing facility as a surrogate for full-scale crash testing. The pendulum bogie was built according to the specifications of the Federal Outdoor Impact Laboratory's (FOIL) pendulum, and the frontal crush of the aluminum honeycomb nose of the bogie simulated the crush of an actual vehicle. Tests with pendulums are acceptable for most breakaway supports, exceptions being base bending or yielding supports.

Three low speed pendulum tests were conducted on your company's Lighting Poles to test each varying breakaway joint design and summaries of the test results are enclosed:

1.) The test of *HAPCO Breakaway Joint 12591* yielded an occupant impact velocity of 4.1 m/s, ridedown acceleration -0.6 g's , and a maximum change in velocity of 4.5 m/s.
2.) The test of *HAPCO Breakaway Joint 12592* yielded an occupant impact velocity of 2.5 m/s, ridedown acceleration -0.6 g's , and a maximum change in velocity of 2.2 m/s.
3.) The test of *HAPCO Breakaway Joint 12593* yielded an occupant impact velocity of 2.9 m/s, ridedown acceleration -0.7 g's , and a maximum change in velocity of 3 m/s.

The three breakaway joint designs as described above met the NCHRP Report 350 occupant risk criteria. In addition, the TTI extrapolated the high-speed performance of these three lighting poles installation from the low speed pendulum tests. I agree that the test articles appear to perform appropriately to make such high-speed extrapolations. All high speed extrapolations yielded lower change in velocity values than the paired low speed pendulum test. In each test the breakaway joint functioned as intended as the support tube fractured at joint near ground level and left no appreciable stub height remaining. This performance satisfies the FHWA limit of a maximum 4 inch (100 mm) stub height remaining after a support breaks away.

In summary, we agree that *HAPCO 12591, HAPCO 12592 and HAPCO 12593* breakaway joints as described above, meet the appropriate evaluation criteria for NCHRP 350 Test Level 3 devices and may be used at all appropriate locations on the NHS when selected by the contracting authority, subject to the provisions of Title 23, Code of Federal Regulations, Section 635.411 as they pertain to proprietary products. This acceptance is limited to round aluminum poles (alloy 6063-T6 heat treated after welding) with luminaire mounting heights up to 45 ft. with shafts of up to .156 inches wall thickness with diameters of up to 10 inches and embedment lengths not less than 7 feet. The condition of each lighting pole is classified as not being repairable due to the damage from impacts. All electrical wiring connectors must be breakaway for the poles that will be wired in the ground for power.

Standard provisions

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

- This acceptance is limited to the crashworthiness characteristics of the devices and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the device 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 device being marketed is significantly different from the version that was crash tested, it reserves the right to modify or revoke its 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 they will meet the crashworthiness requirements of the FHWA and the NCHRP Report 350.
- To prevent misunderstanding by others this letter of acceptance designated as number LS-65 shall not be reproduced except in full. This letter and the test documentation upon which this letter is based, is public information. All such letters and documentation may be reviewed at our office upon request.
- The HAPCO devices are patented products and considered proprietary. If proprietary devices are specified by a highway agency for use on Federal-aid projects, except exempt, non-NHS projects, they: (a) 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 device for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate device, 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,

George E. Rice, Jr.
Acting Director, Office of Safety Design
Office of Safety

Enclosures

APPENDIX C. DETAILS OF TEST ARTICLES

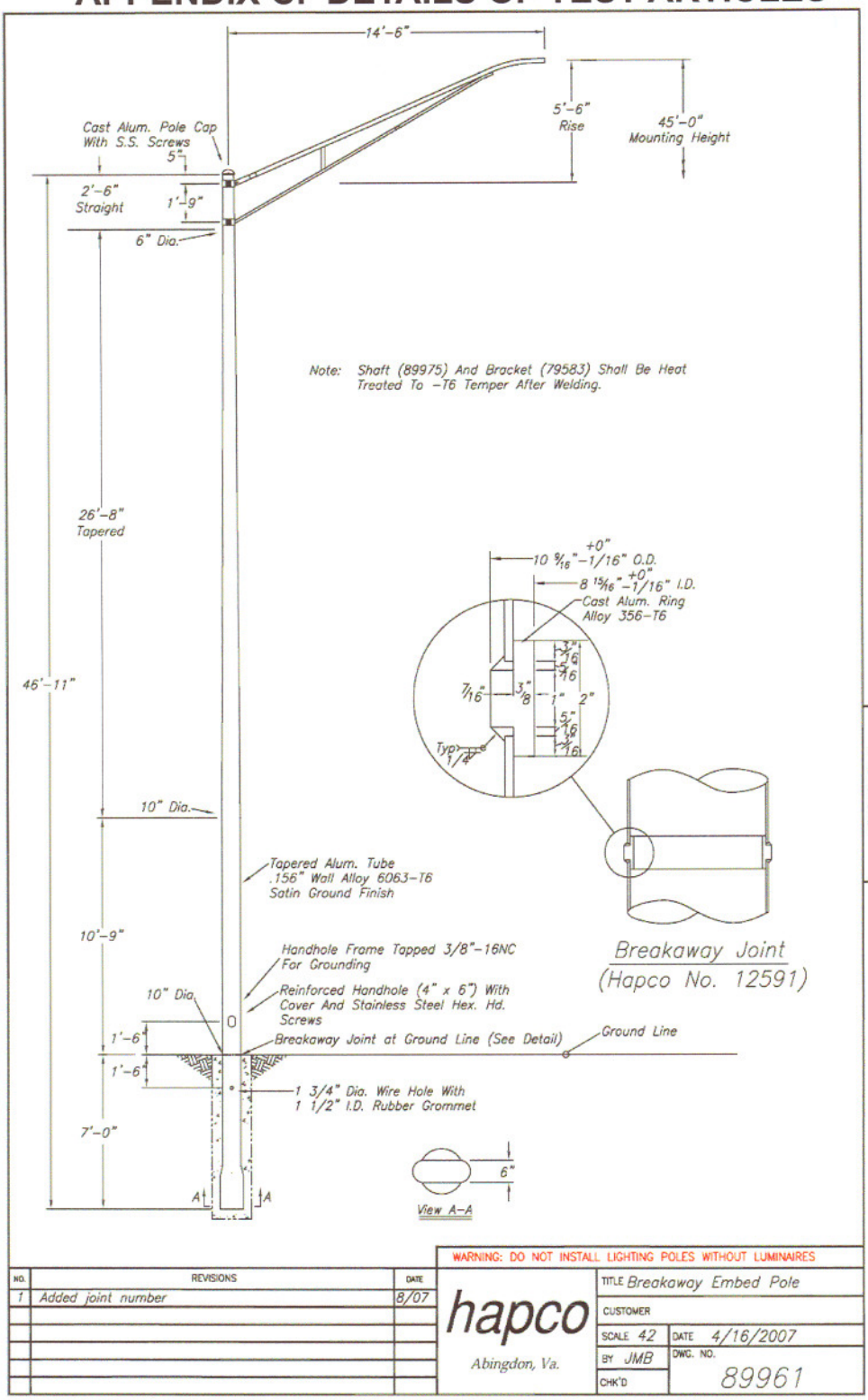


Figure C1. HAPCO A89961 lighting pole.

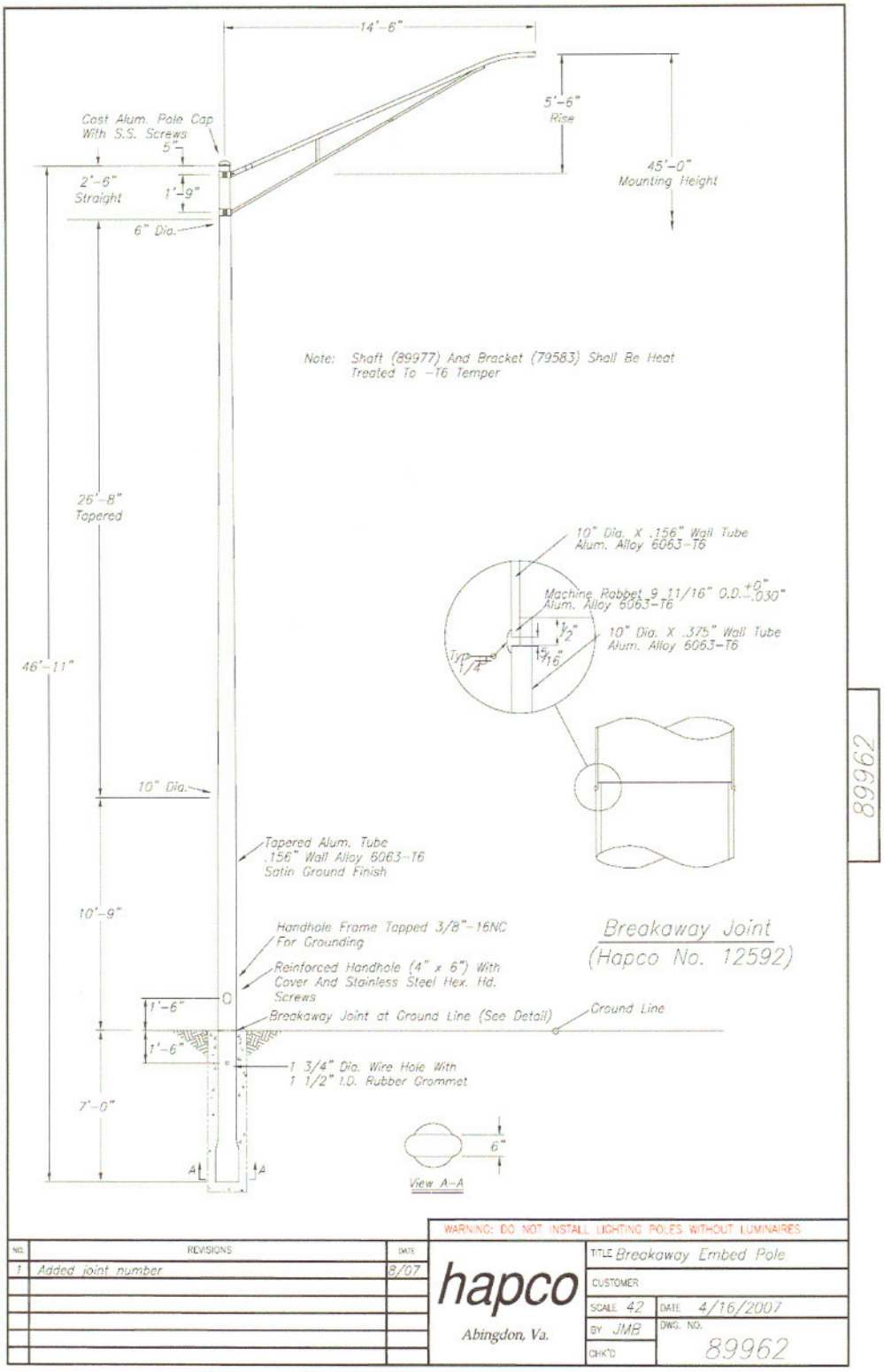


Figure C2. HAPCO B89962 lighting pole.

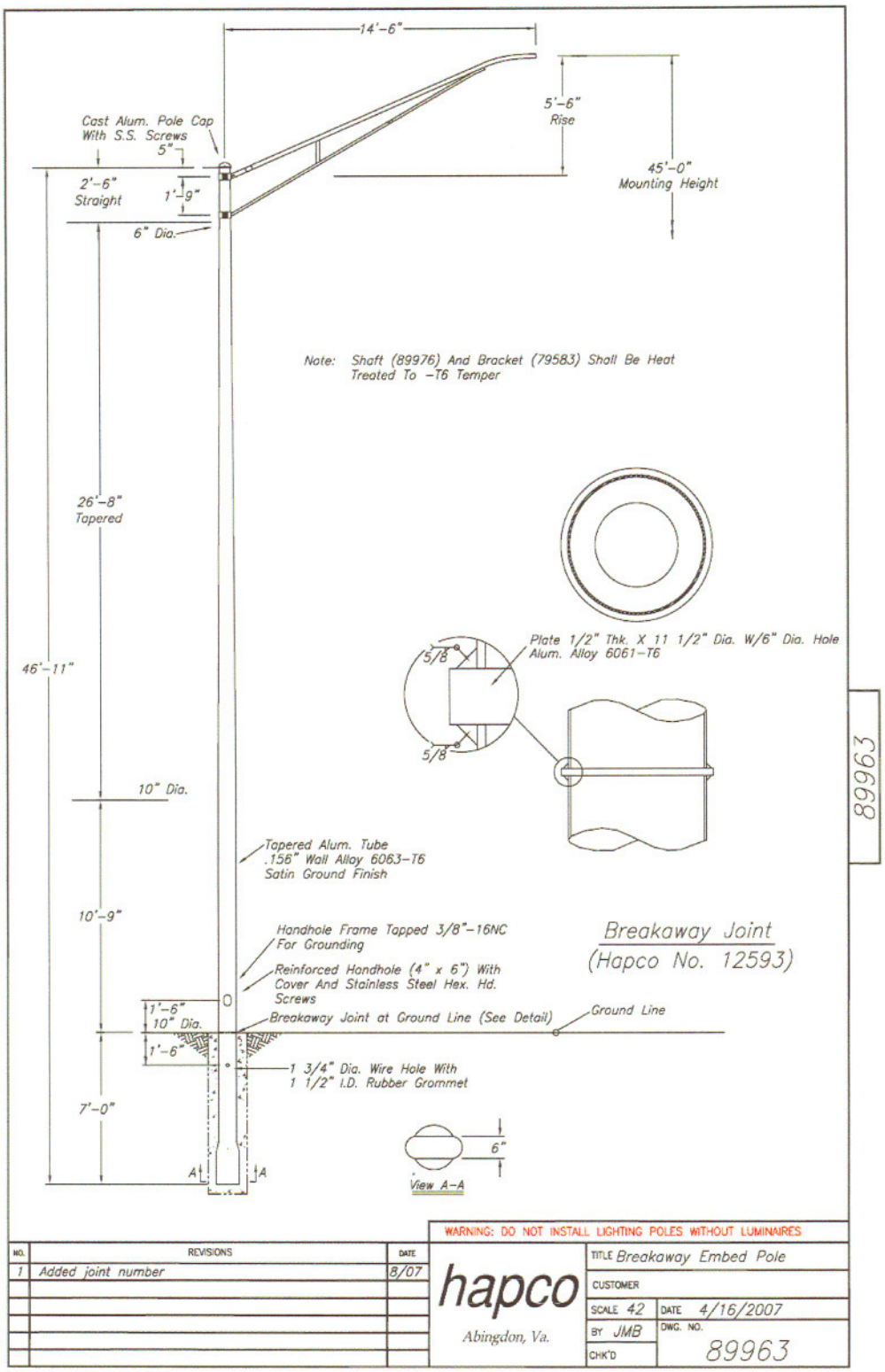
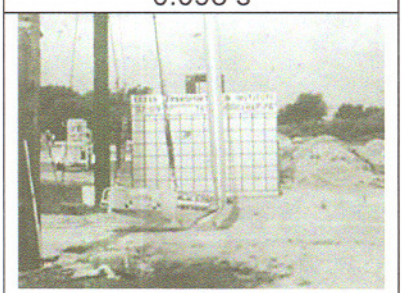


Figure C3. HAPCO B89963 lighting pole.

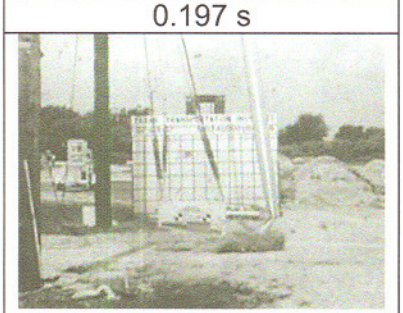
Table D1. Summary of results for pendulum test 400001-HAP P6.

0.000 s

0.098 s



0.197 s



0.295 s

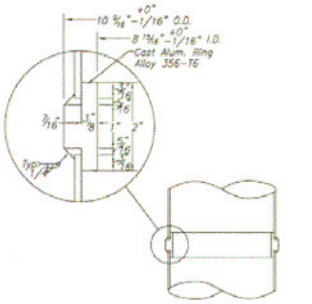
General Information
Test Agency ..... Texas Transportation Institute
Test No. 400001-HAP P6
Date 07-09-2007

Test Article
Type ..... Luminaire
Name ..... HAPCO A89961 Lighting Pole
Installation Height (m) ..... 12.2 m (40 ft)
Material of Key Element ..... Cast Aluminum (Alloy 6063-T6)
Tapered 6-10-inch Diameter
with Breakaway Joint HAPCO No. 12591
Soil Type ..... Standard Soil (Crushed Limestone)

Test Vehicle
Type ..... Bogie
Designation ..... Pendulum
Test Inertia Mass ..... 839 kg

Impact Conditions
Speed ..... 34.9 km/h
Angle ..... 90 deg

Occupant Risk Values
Impact Velocity
Longitudinal direction ..... 4.1 m/s
Ridedown Accelerations
Longitudinal direction ..... -0.6 g's
Maximum change in Velocity ..... 4.5 m/s
Predicted High-Speed Change in Velocity ..... 2.7 m/s



Breakaway Joint
(Hapco No. 12591)

Table D2. Summary of results for pendulum test 400001-HAP P7.

0.000 s

0.098 s

0.197 s

0.296 s

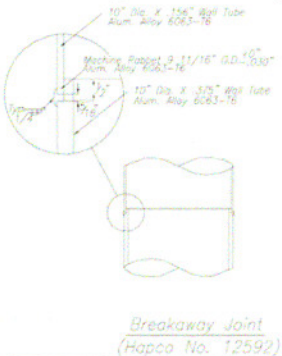
General Information
Test Agency ..... Texas Transportation Institute
Test No. 400001-HAP P7
Date 07-09-2007

Test Article
Type ..... Luminarie
Name ..... HAPCO B89962 Lighting Pole
Installation Height (m) ..... 12.2 m (40 ft)
Material of Key Element ..... Cast Aluminum (Alloy 6063-T6)
Tapered 6-10-inch Diameter
with Breakaway Joint HAPCO No. 12592
Soil Type ..... Standard Soil (Crushed Limestone)

Test Vehicle
Type ..... Bogie
Designation ..... Pendulum
Test Inertia Mass ..... 839 kg

Impact Conditions
Speed ..... 35.1 km/h
Angle ..... 90 deg

Occupant Risk Values
Impact Velocity
Longitudinal direction ..... 2.5 m/s
Ridedown Accelerations
Longitudinal direction ..... -0.6 g's
Maximum change in Velocity ..... 2.2 m/s
Predicted High-Speed Change in Velocity ..... 1.9 m/s



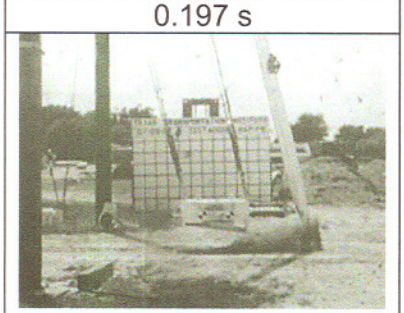
Breakaway Joint
(Hapco No. 12592)

Table D3. Summary of results for pendulum test 400001-HAP P8.

0.000 s

0.098 s

0.197 s



0.296 s

General Information

Test Agency ..... Texas Transportation Institute
Test No. 400001-HAP P8
Date 07-09-2007

Test Article

Type ..... Luminaire
Name ..... HAPCO B89963 Lighting Pole
Installation Height (m) ..... 12.2 m (40 ft)
Material of Key Element ..... Cast Aluminum (Alloy 6063-T6)
Tapered 6-10-inch Diameter
with Breakaway Joint HAPCO No. 12593
Soil Type ..... Standard Soil (Crushed Limestone)

Test Vehicle

Type ..... Bogie
Designation ..... Pendulum
Test Inertia Mass ..... 839 kg

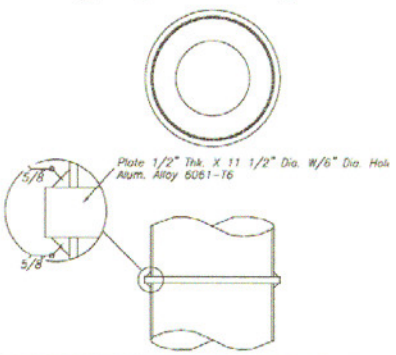
Impact Conditions

Speed ..... 34.9 km/h
Angle ..... 90 deg

Occupant Risk Values

Impact Velocity
Longitudinal direction ..... 2.9 m/s
Ridedown Accelerations
Longitudinal direction ..... -0.7 g's

Maximum change in Velocity ..... 3.0 m/s
Predicted High-Speed Change in Velocity ..... 2.1 m/s



Breakaway Joint
(Hapco No. 12593)