March 26, 1999

CC58

Keith R. Lane, P.E.
Director of Research and Materials
Connecticut Department of Transportation
280 West Street
Rocky Hill, CT  06067-3502

Dear Mr. Lane:

In your February 22 letter to the Director of the Federal Highway Administration’s Office of Engineering, you requested acceptance of the Narrow Connecticut Impact Attenuation System (NCIAS) as an NCHRP Report 350 test level 3 (TL-3) crash cushion for use on the National Highway System (NHS). To support your request, you also sent us two copies each of crash test reports prepared by the Texas Transportation Institute on Report 350 tests 3-32, 3-33, 3-37, 3-38, and 3-39. These were the tests recommended by Mr. Dwight A. Horne in his April 18, 1997 response to Dr. Charles E. Dougan.

The NCIAS consists of eight steel cylinders in a single row with two anchored wire ropes along each side. All cylinders are 900 mm in diameter and 1200 mm tall. Wall thicknesses vary from 3.2 mm to 9.5 mm. Enclosure 1 shows the general configuration and details of the first two cylinders.

We have reviewed the information you submitted and concur that the appropriate Report 350 evaluation criteria were met for tests 3-32, 3-33, and 3-37. We noted that test 3-38 was repeated after an initial failure (excessive passenger compartment deformation) and that the additional stiffening of cylinder No. 8 produced satisfactory results. We noted also that the reverse-direction hit (test 3-39) resulted in vehicle snagging and unacceptable passenger compartment intrusion. In lieu of additional design changes and further testing, you opted to prohibit the use of the NCIAS in locations where wrong-way hits are likely. Enclosure 2 consists of summary sheets of the tests run under Report 350.

Based on our review, we consider the NCIAS to meet the evaluation criteria for an NCHRP Report 350 crash cushion at TL-3 and it may be used on the NHS (at locations where reverse-direction impacts are unlikely) when selected by a transportation agency. Although the NCIAS is patented, we understand that the rights to manufacture and use the system are non-proprietary and that plans and specifications may be obtained through your office.

Sincerely yours,

(Original signed by Dwight A. Horne)

Dwight A. Horne
Director, Office of Highway Safety Infrastructure
2 Enclosures
General Information
Test Agency: Texas Transportation Institute
Test No.: 404231-2
Date: 12/15/97

Test Article
Type: Crash Cushion
Name or Manufacturer: Narrow Cntr. Imp. Attm. System
Installation Length (m): 7.3
Size and/or Dimensions (mm): 6 each 914 O.D. x 1219 mm tall steel pipe cylinders of various wall thickness and material of key elements
Sol Type and Condition: Concrete pavement dry

Test Vehicle
Type: Production
Designation: 820C
Model: 1990 Ford Festiva
Mass (kg): Curb 810
Test Initial: 820
Dummy: 75
Gross Static: 895

Impact Conditions
Speed (km/h): 98.92
Angle (deg): 14.38

Exit Conditions
Speed (km/h): 12.59
Angle (deg): 11.38

Occupant Hisk Values
Impact Velocity (m/s):
\[ \begin{align*}
\text{x direction} & : 9.98 \\
\text{y direction} & : 2.77
\end{align*} \]
Ridedown Accelerations (g/s):
\[ \begin{align*}
\text{x direction} & : -12.44 \\
\text{y direction} & : -3.17 \\
\text{z direction} & : -2.07 \\
\text{Max. 0.050-s Average (g/s)} & : -12.74
\end{align*} \]

Test Article Deflections (mm)
Dynamic: 3.94
Permanent: 3.44

Vehicle Damage
Exterior
VDS: 11LFQ4
CDC: 11: FEW3

Maximum Exterior
Vehicle Crush (mm): 310

Interior
ODI: LF0000000C

Max. Occ. Compartment Deformation (mm): 8

Post-Impact Behavior
(during 1.0 s after impact)
Max. Yaw Angle (deg): -109
Max. Pitch Angle (deg): -8
Max. Roll Angle (deg): 29

Figure 12. Summary of results for test 404231-2.
Figure 12. Summary of results for test 404231-1.
**General Information**
- **Test Agency**: Texas Transportation Institute
- **Test No.**: 404231-3
- **Date**: 12/16/97

**Test Article**
- **Type**: Crash Cushion
- **Name**: Narrow Conn. Imp. Attenu. System
- **Installation Length (m)**: 7.31
- **Size and/or dimension**:
  - 8 each 914 O.D. x 1219 mm tall steel pipe cylinders of various length and material of key elements
  - wall thickness
- **Soil Type and Condition**: Concrete Pavement, dry
- **Test Vehicle**
  - **Type**: Production
  - **Designation**: 2000P
  - **Model**: 1994 Chevrolet 2500 pickup
  - **Mass (kg) Curb**: 1885
  - **Dummy**: 76
  - **Gross Static**: 2076

**Impact Conditions**
- **Speed (km/h)**: 97.15
- **Angle (deg)**: 20.23

**Exit Conditions**
- **Speed (km/h)**: 61.45
- **Angle (deg)**: 11.63

**Occupant Risk Values**
- Impact Velocity (m/s)
  - x-direction: 7.69
  - y-direction: 5.37
  - z-direction: 6.19
- Redefinition Accelerations (g's)
  - x-direction: -17.68
  - y-direction: -15.47
  - z-direction: -6.35
- Max. 0.050-s Average [g's]
  - x-direction: -8.52
  - y-direction: -7.57
  - z-direction: 7.35

**Vehicle Damage**
- Exterior
  - VDS: 01RGC5
  - CDC: 01FREK3
  - M6: 01REW3
- Vehicle Crush (mm): 550
- Interior
  - OCDI: 050103000
  - Max. Occ. Compart. Deflection (mm): 39

**Post-Impact Behavior**
- (during 1.0 s after impact)
  - Max. Yaw Angle (deg): -25
  - Max. Pitch Angle (deg): 7
  - Max. Roll Angle (deg): -11

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**Figure 12. Summary of results for test 404231-3.**
Figure 13. Summary of results for test 404231-5, NCHRP Report 350 test 3-38.
Figure 13. Summary of results for test 404231-6, NCHRP Report 350 test 3-39.

* Note: unacceptable passenger compartment deformation