US Department
of Transportation
Federal Highway
Administration

400 Seventh St., S.W.
Washington, D.C. 20590

November 18, 1999

Refer to: HMHS-B37A

King K. Mak, P.E.
Research Engineer
The Texas A&M University System
Texas Transportation Institute
College Station, Texas 77843-3135

Dear Mr. Mak

In your October 12 letter, you requested the Federal Highway Administration's (FHWA) acceptance of two transition designs. 'These designs will be used to connect a standard box beam approach guardrail to two Wyoming Department of Transportation bridge railing designs that were accepted for use on the National Highway System in Mr. Seppo Sillan's July I, 1998 memorandum to Mr. Vincent Schimmoler. Mr. Schimmoler was the FHWA Regional Administrator in Denver at that time. Included with your request were two copies of the September 1999 Texas Transportation Institute report, "NCHRP REPORT 350 TESTING AND EVALUTAION OF THE WYOMING TL-3 AND TL-4 BRIDGE RAIL TO BOX BEAM GUARDRAIL TRANSITION DESIGNS,'" by Mak, Buth, Bligh, and Menges, and videotapes of the crash tests you conducted to verify acceptable impact performance.

Both transition designs use the same components to the extent practical, the only significant differences being the connection details at the bridge railings and adjustments to the mounting heights to match the two different bridge railing designs. These details are shown in Enclosure 1. The ground-mounted post sizes and spacing are the sane for both transitions, i.e., five W150 x 13 (W6 x 9) x 1625-mm (till-inches) steel posts with soil plates on 1220-mm (4-foot) centers, one same-size post at 1830 mm (6-feet), followed by standard S75 x 8.5 (x 5.7) box beam line posts on 1830-mm (h-foot) centers. The lower bridge rail element for both bridge railing designs is continued off the bridge to serve as a rub rail until it is terminated behind the ninth guardrail post off the bridge.

Both of the transition designs were tested to NCHRP Report 350 test level 3 (TL-3). Test 3-20 was successfuIly run on the transition to the TL-3 bridge railing, which is essentially the same as the transition to the TL-4 bridge railing. We agreed previously that both tests would not be needed. Test 3-21 was run at two locations: the first to check for a snagging potential at the point where the Lower rail is terminated behind post nine, and the second to test the transition to the TL-4 bridge railing itself. Again, we agreed earlier that the transition to the TL-4 bridge railing presented the greater likelihood of snagging and a successful test of this design would eliminate the need to run test 3-21 on the transition to the TL-3 bridge railing. Summary reports of each of the tests run are shown **in Enclosure 2.**

Based on our review of the information you submitted, we fmd that the two designs for attaching a standard box beam guardrail to the Wyoming Z-tube, curb-mounted TL-3 and TL-4 bridge railings meet the appropriate crash test evaluation criteria for NCHRP Report 350 test level 3 (TL-3) transitions. They may be used on the National Highway System when such use is requested by a State transportation agency. We understand that neither the bridge railing designs nor the transition designs are proprietary and that plans and specifications for both can be obtained directly from the Wyoming Department of Transportation.

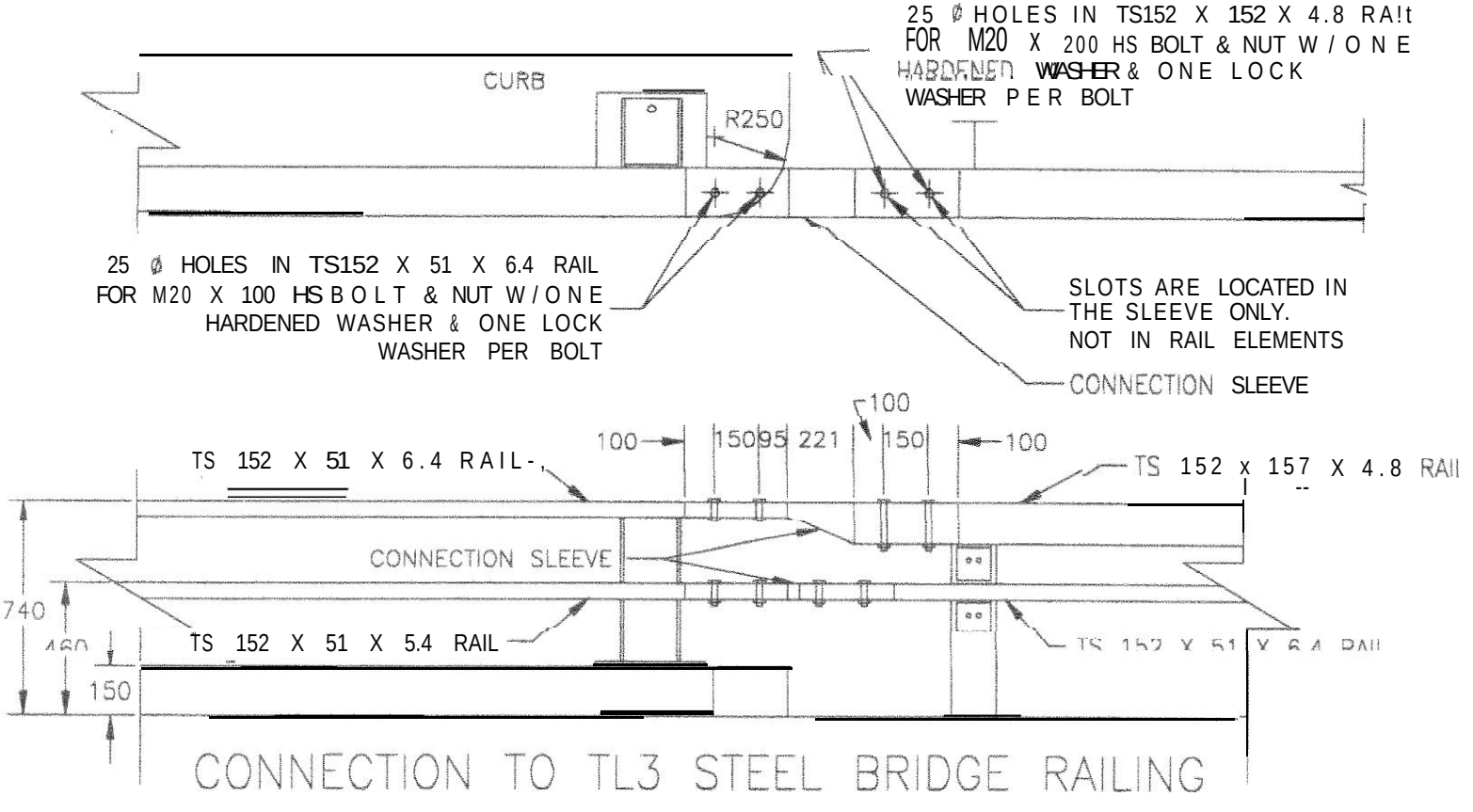
Finally, you stated that minor changes were made to the TL-4 bridge railing design to accommodate the transition design. The most significant changes were the thickness reduction of the upper bridge rail element from 7.9 mm (5/16 inch) to 6.4 mm (t/4 inch) and the cross-section reduction at the ends of both the upper and lower bridge rail elements to match the connection sleeves. We concur with your assessment that these changes are not likely to lessen the performance of the TL-4 bridge railing. Please call Mr. Richard Powers of my staff at (202) 366-1320 if you have any questions or wish to discuss any of the above in more detail.

Sincerely yours,

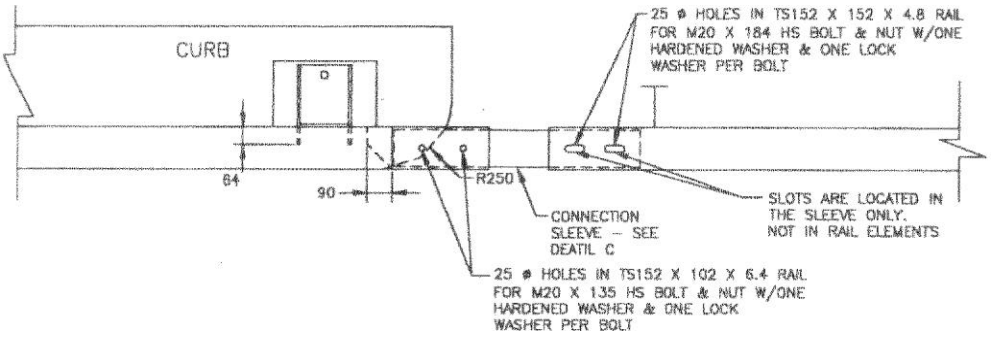
Dwight A. Home

Dwight A. Home
Director, Office of Highway Safety Infrastructure

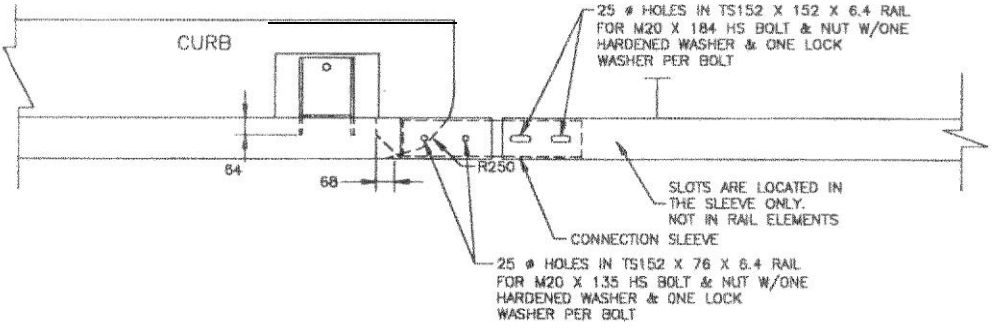
2 Enclosures



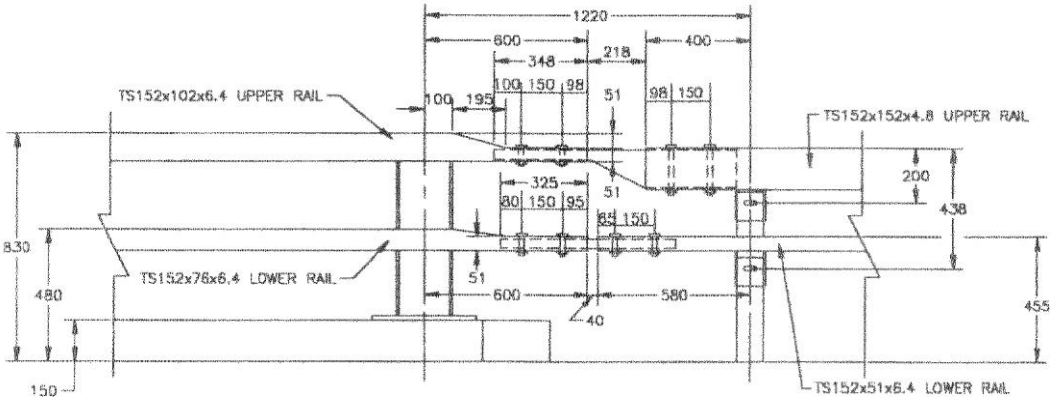
CONNECTION TO TL3 STEEL BRIDGE RAILING



UPPER RAIL PLAN

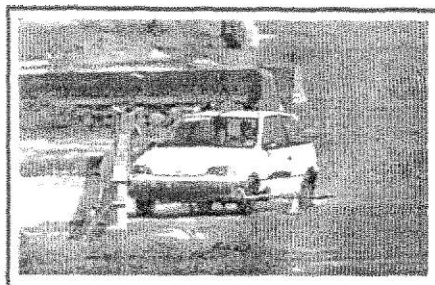


LOWER RAIL PLAN



ELEVATION

CONNECTION TO TL4 STEEL BRIDGE RAILING



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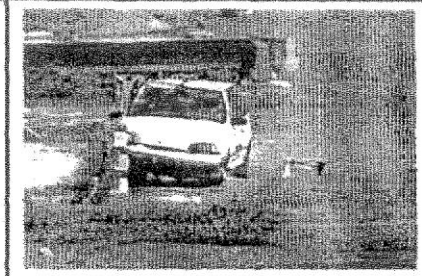

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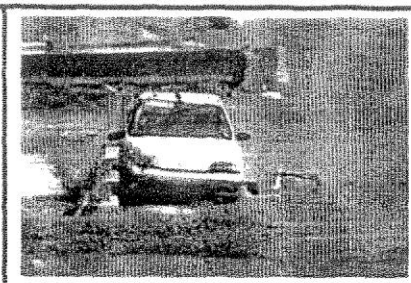

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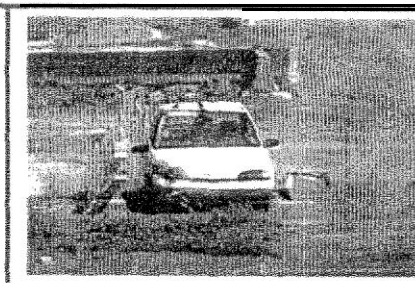

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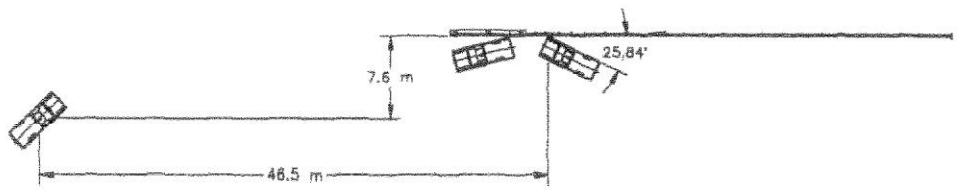
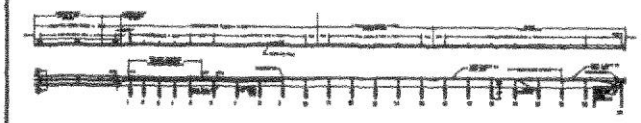




General Information

Test Agency	Texas Transportation Institute
Test No.	473160-8
Date	09/01/98

Test Article

Type	Transition
Name or Manufacturer	Wyoming TL-3 Transition
Installation Length (m)	46.8
Material or Key Elements	TS51x152x4.8 Rail & TS152x51x6.4 Rub-Rail on S75x8.5x1625 Posts
Soil Type and Condition	Standard Soil, Dry

Test Vehicle

Type	Production
Designation	820C
Model	1994 Geo Metro
Mass (kg)	
Curb	766
Test Inertial	820
Dummy	76
Gross Static	896

Impact Conditions

Speed (km/h)	96.9
Angle (deg)	13.8

Exit Conditions

Speed (km/h)	79.9
Angle (deg)	1.9

Occupant Risk Values

Impact Velocity (m/s)	
x-direction	4.9
y-direction	7.3
THIV (km/h)	29.9
Ridedown Accelerations (g's)	
x-direction	-6.0
y-direction	-8.0
PHD (g's)	12.5
ASI	1.55
Max. 0.050-s Average (g's)	
x-direction	-8.4
y-direction	-12.7
z-direction	-1.8

Test Article Deflections (m)

Dynamic	0.06
Permanent	0.04

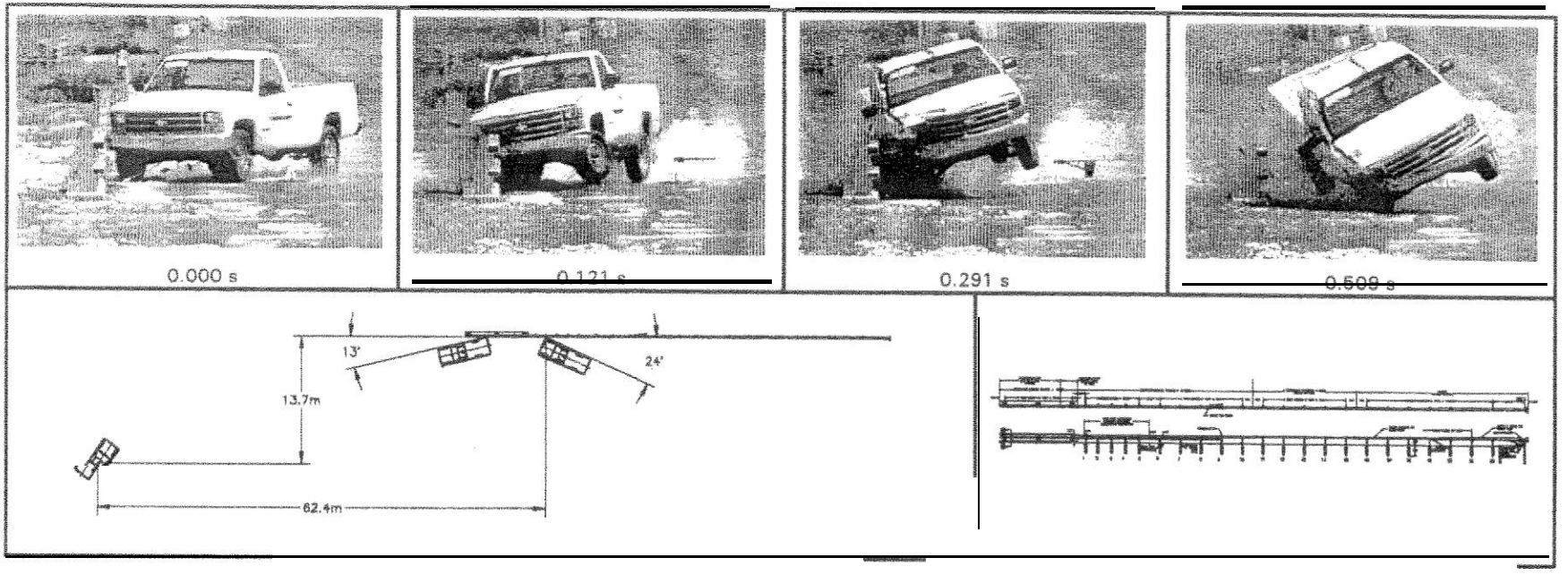
Vehicle Damage

Exterior	
VDS	01RFQ7
CDC	01FREK4 &01RDEW4
Maximum Exterior Vehicle Crush (mm)	240
Interior	
OCDI	FR0030000
Max. Occ. Compart. Deformation (mm)	155

Post-Impact Behavior (during 1.0 s after impact)

Max. Yaw Angle (deg)	-21
Max. Pitch Angle (deg)	-8
Max. Roll Angle (deg)	4

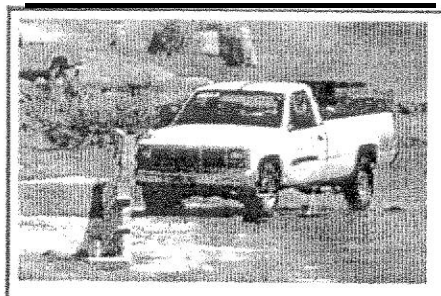
Summary of results for test 473160-8, *NCHRP Report 350* test 3-20.



General Information		**Impact Conditions**	
Test Agency	Texas Transportation Institute	Speed (km/h)	102.5
Test No.	473160-12	Angle (deg)	24.1
Date	04113199	**Exit Conditions**	
Test Article		Speed (km/h)	75.8
Type	Transition	Angle (deg)	13.5
Name or Manufacturer	Wyoming TL-4 Transition	**Occupant Risk Values**	
Installation Length (m)	46.8	**Impact Velocity** (m/s)	
Material or Key Elements	TS152x152x4.8 Rail & TS152x51x6.4 Rub-Rail on W150x13x1625 Posts	x-direction	4.8
Soil Type and Condition	Standard So,,, Dry	y-direction	6.6
Test Vehicle		THIV (km/h)	27.8
Type	Production	Ridedown Accelerations (g's)	
Designation	2000P	x-direction	-19.1
Model	1993 Chevrolet 2500 pickup truck	y-direction	-10.6
Mass (kg)		PHD (g's)	23.8
Curb	2059	ASI	1.36
Test Inertial	2000	Max. 0.050-s Average (g's)	
Dummy	No Dummy	x-direction	-9.5
Gross Static	2000	y-direction	-11.2
		z-direction	4.4

Test Article Deflections (m)	
Dynamic	0.12
Permanent	0.06
Vehicle Damage	
Exterior	
"DS	01RFQ4
CDC	01FREK3 &01RYEW3
Maximum Exterior	
Vehicle Crush (mm)	510
Interior	
OCDI	RF01050001
Max. Occ. Compart. Deformation (mm)	92
Post-Impact Behavior	
(during 1.0 s after impact)	
Max. Yaw Angle (deg)	-42
Max. Pitch Angle (deg)	-10
Max. Roll Angle (deg)	27

Summary of results for test 473160-12, *NCHRP Report 350* test 3-21



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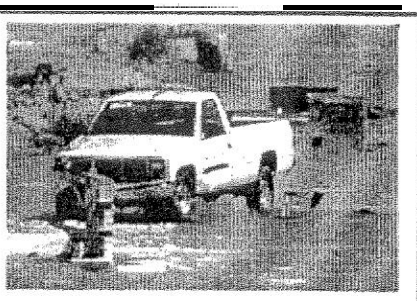

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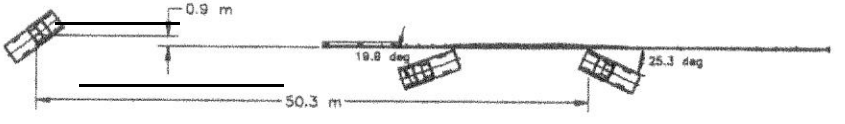

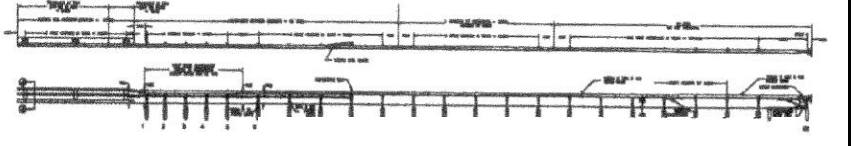

General Information

Test Agency	Texas Transportation Institute
Test No.	473160-7
Date	07/31/98

Test Article

Type	Transition
Name	Wyoming Transition
Installation Length (m)	46.8
Material or Key Elements	TS152x152x4.8 Rail & TS152x51x6.4 Rub-Rail on S75x8.5x1625 Posts
Soil Type and Condition	Standard Soil, Dry

Test Vehicle

Type	Production
Designation	2000P
Model	1993 GMC 2500 pickup truck
Mass (kg)	
Curb	2041
Test Inertial	2000
Dummy	No dummy
Gross Static	2000

Impact Conditions

Speed (km/h)	100.4
Angle (deg)	25.3

Exit Conditions

Speed (km/h)	63.5
Angle (deg)	19.9

Occupant Risk Values

Impact Velocity (m/s)	
x-direction	3.5
y-direction	4.5
THIV (km/h)	15.6
Ridedown Accelerations (g's)	
x-direction	-7 8
y-direction	-3.5
PHD (g's)	10.2
ASI	0.67
Max. 0.050-s Average (g's)	
x-direction	-4.1
y-direction	-5.5
z-direction	3.0

Test Article Deflections (m)

Dynamic	1.17
Permanent	0.87

Vehicle Damage

Exterior	
VDS	01RFQ
CDC	01FREK3 & 01RYEW3
Maximum Exterior Vehicle Crush (mm)	370
Interior	
OCDI	FS0004000
Max. Occ. Compart. Deformation (mm)	25

Post-Impact Behavior (during 1.0 s after impact)

Max. Yaw Angle (deg)	-32
Max. Pitch Angle (deg)	4
Max. Roll Angle (deg)	4

Summary of results for test 473160-7, *NCHRP Report 350* test 3-21

Enclosure 2 (3 of 3)