V4438

Vehicle Research and Test Center
2001 Mitsubishi Montero Sport into Left Front of
1997 Honda Accord - 50% Offset - Oblique 30°
TRC Inc. Test Number: 020921

Prepared By:
Transportation Research Center Inc.
10820 State Route 347
East Liberty, OH 43319

Final Report
October 2002

Prepared For:
Vehicle Research and Test Center
P. O. Box 37
East Liberty, OH 43319

Notice

Transportation Research Center Inc. does not endorse or certify products of manufacturers. The manufacturer's name appears solely to identify the test article. Transportation Research Center Inc. assumes no liability for the report or use thereof. It is responsible for the facts and the accuracy of the data presented herein. This report does not constitute a standard, specification, or regulation.

This publication is distributed by the U. S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturers' names or products are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement. The United State Government does not endorse products or manufacturers.

Table of Contents

List of Tables

List of Figures

List of Photographs

List of Photographs, Cont'd.

List of Photographs, Cont'd.

List of Photographs, Cont'd.

Section 1.0

Purpose and Test Procedure

Purpose

This 56.3 km/h (35 mph), 50% offset, 30° oblique, vehicle-to-vehicle impact test was conducted for the National Highway Traffic Safety Administration (NHTSA) and Vehicle Research and Test Center (VRTC) by Transportation Research Center Inc. (TRC Inc.).

The test mode was defined with both vehicles moving at 56.3 km/h to impact the bullet vehicle into the left front corner of the target, offset 50%, at an impact angle of 30 degrees. The purpose of this test was to evaluate the aggressiveness of the bullet vehicle, a 2001 Mitsubishi Montero Sport MPV, and the vehicle and occupant response of the target vehicle, a 1997 Honda Accord 4-door sedan, in this vehicle-to-vehicle impact mode.

Test Procedure

This test was conducted in accordance with VRTC instructions for a 50% offset 30° oblique, vehicle-to-vehicle test. Data was obtained relative to FMVSS 208, "Occupant Crash Protection" (December 18, 2001) performance for the 35 mph test mode.

The target vehicle, a 1997 Honda Accord 4-door sedan, was instrumented with twenty-four (24) accelerometers to measure longitudinal, lateral and vertical axis accelerations. The driver's airbag signal was monitored with inductive pickups. The vehicle's specified impact velocity range was 55.5 to 57.1 km/h.

The bullet vehicle, a 2001 Mitsubishi Montero Sport MPV, was instrumented with twenty-four (24) accelerometers to measure longitudinal, lateral and vertical axis accelerations. The driver's and passenger's primary and secondary airbag signals were monitored with inductive pickups. The vehicle's specified impact velocity range was 55.5 to 57.1 km/h.

The bullet vehicle impacted the left front corner of the target, offset 50%, at an impact angle of 30 degrees. The bullet vehicle's left edge was aligned with the target vehicle's centerline.

One (1) 50^{th} percentile adult male Hybrid III dummy was placed in the target vehicle's left front designated seating position, according to FMVSS 208 procedures (December 18, 2001). The driver dummy was belted and was restrained with a front single stage airbag. No dummy was placed in the target vehicle right front passenger position, but the weight of a 5^{th} percentile female dummy was used to obtain fully loaded weight and calculate test weight.

The target vehicle's driver dummy was instrumented with six (6) accelerometers in the head, plus six (6) chest, and three (3) pelvis accelerometers to measure longitudinal, lateral, and vertical accelerations (primary and redundant in the head and chest). The driver dummy was also instrumented with upper neck moment and force load cells, a chest deflection potentiometer, left and right 6-channel femur load cells to measure moments and forces, and

tibia to femur displacement potentiometers at each knee. The driver dummy was also equipped with upper and lower tibia load cells to measure forces and moments.

One (1) 50th percentile adult male Hybrid III dummy and one (1) 5th percentile adult female dummy were placed in the bullet vehicle's front outboard designated seating positions according to FMVSS 208 (December 18, 2001). The driver dummy and passenger dummies were both belted and were restrained with front dual stage airbags.

The bullet vehicle driver dummy was instrumented with an array of three (3) accelerometers in the head, plus three (3) chest, and three (3) pelvis accelerometers to measure longitudinal, lateral, and vertical accelerations. The driver dummy was also instrumented with upper neck moment and force load cells, a chest deflection potentiometer, left and right 6-channel femur load cells to measure axial moments and forces, and a tibia to femur displacement potentiometer at each knee.

The bullet vehicle's passenger dummy was instrumented with an array of six (6) accelerometers in the head, plus six (6) chest and three (3) pelvis accelerometers to measure longitudinal, lateral, and vertical accelerations. The bullet passenger dummy was also instrumented with upper neck moment and force load cells, and a tibia to femur displacement potentiometer at each knee.

The 157 data channels were digitally sampled and recorded at 12,500 samples per second and processed per SAE J211 March 1995.

The crash event was recorded by one (1) real-time panning motion picture camera and fourteen (14) high-speed motion picture cameras. The pre- and post-test conditions were recorded by one (1) real-time motion picture camera.

The test summary data are presented in Section 2.0. The summary of FMVSS 208 data are presented in Section 3.0. The occupant, camera, and vehicle measurements are presented in Section 4.0. Appendix A contains the still photographic prints. Appendix B contains the

dummy and vehicle data plots. Appendix C contains the dummy verification data. Appendix D contains miscellaneous test information. Appendix E contains an INSIA report which was the basis for the Structural Measurements presented in Tables 13 and 16 of this report. Appendix F contains the vehicle manufacturer's information.

Section 2.0

Left Front Oblique Impact Test Summary

Test Results Summary

This 56.3 km/h 30° left front oblique, 50% offset, vehicle-to-vehicle impact test was conducted by TRC Inc. on September 21, 2002.

The target test vehicle, a 1997 Honda Accord 4-door sedan, was equipped with a 2.2-liter transverse engine, automatic transmission, power steering, power brakes, and single stage front airbags. The target vehicle's test weight was 1499.2 kg. The target vehicle's impact speed was 55.8 km/h. The target vehicle sustained 1005 mm of static crush during the impact. The bullet test vehicle, a 2001 Mitsubishi Montero Sport MPV, was equipped with a 3-liter inline engine, automatic transmission, power steering, power brakes, and dual stage front airbags. The bullet vehicle's test weight was 2143.0 kg. The bullet vehicle's impact speed was 56.3 km/h. The bullet vehicle sustained 408 mm of static crush during the impact (measured without bumper fascia).

The target vehicle driver dummy's 36-millisecond Head Injury Criteria (HIC) was 847. The target vehicle driver dummy's 15-millisecond HIC was 480. The target vehicle driver dummy's chest maximum resultant acceleration with three (3) milliseconds minimum duration was 70.6 g. The target vehicle driver dummy's maximum chest deflection was 58 mm. The target vehicle driver dummy's left and right femur maximum axial compressive forces were 6853 N and 10,904 N, respectively. The target vehicle driver dummy's upper neck injury calculations were as follows: neck tension-flexion (NTF), .17; neck tension-extension (NTE), .61; neck compression-flexion (NCF), .29; and neck compression-extension (NCE), .01. The target vehicle driver dummy's peak upper neck tension force was 1683 N and peak upper neck compression force was 255 N.

The bullet vehicle driver dummy's 36-millisecond HIC was 96. The bullet vehicle driver dummy's 15-millisecond HIC was 51. The bullet vehicle driver dummy's chest maximum resultant acceleration with three (3) milliseconds minimum duration was 32.2 g. The bullet vehicle driver dummy's maximum chest deflection was 29 mm. The bullet vehicle driver dummy's left and right femur maximum axial compressive forces were 681 N and 2318 N, respectively. The bullet vehicle driver dummy's upper neck injury calculations were as follows:

NTF, 0.12; NTE, 0.23; NCF, 0.05; and NCE, 0.09. The bullet vehicle driver dummy's peak upper neck tension force was 732 N and peak upper neck compression force was 148 N.

The bullet vehicle right front passenger dummy's 36-millisecond HIC was 126. The bullet vehicle passenger dummy's 15-millisecond HIC was 91. The bullet vehicle passenger dummy's chest maximum resultant acceleration with three (3) milliseconds minimum duration was 33.5 g. The bullet vehicle passenger dummy's maximum chest deflection was 22 mm. The bullet vehicle passenger dummy's left and right femur maximum axial compressive forces were 2630 N and 2522 N, respectively. The bullet vehicle right front passenger dummy's upper neck injury calculations were as follows: NTF, 0.07; NTE, 1.00; NCF, 0.01; and NCE, 0.00. The bullet vehicle right front passenger dummy's peak upper neck tension force was 1147 N and peak upper neck compression force was 47 N.

Data Acquisition Explanations

The target vehicle driver's head redundant Z-axis acceleration data channel, HEDZR1, exceeded full-scale and lost data after approximately 106 milliseconds. This affected the redundant resultant acceleration calculation, HEDRR1.

The target vehicle driver's right upper tibia moment about X-axis data channel, TBRXM1, recorded questionable data between approximately 50 and 75 milliseconds and exceeded the data acquisition system full-scale at approximately 70 milliseconds. This affected the tibia index calculation.

The target vehicle's center of gravity X-axis, Y-axis, and Z-axis acceleration data channels, VCGXG1, VCGYG1, and VCGZG1, recorded no valid data after approximately 66 milliseconds. The accelerometer mount dislodged. This affected the resultant acceleration channel calculation, VCGRG1.

The bullet vehicle passenger's pelvis Y-axis acceleration data channel, PEVYGB, recorded questionable data after approximately 138 milliseconds. This affected the resultant acceleration calculation, PEVRGB.

There is no record to identify Wire A or Wire B as either the primary or secondary stage of the bullet vehicle airbags.

Table 1 Crash Test Summary

Test mode:	Left Front Oblique Impact	
Test date:	9/21/02	
Test time:	1250	
Ambient temperature:	25° C	
Target vehicle year/make/ model/body style:	1997/Honda/Accord/4-door sedan	
Target vehicle test weight:	1499.2 kg	
Bullet vehicle year/make/ model/body style:	2001/Mitsubishi/Montero Sport/MPV	
Bullet vehicle test weight:	2143.0 kg	
Impact angle[1]:	330°	
Impact velocity[2]:	Target vehicle = 55.8 km/h[3] Bullet vehicle = 56.3 km/h	
Target vehicle maximum static crush:	1005 mm	
Bullet vehicle maximum static crush:[4]	408 mm	
Total number of data channels:	157	
Number of cameras:	High-speed 14	Real-time 1
Target vehicle dummies:	Driver #168	Passenger
Type:	HIII-50 (Part 572E)	None
Location:	Left Front	
Restraint:	3 point belt/airbag	
Bullet vehicle dummies:	Driver #169	Passenger #421
Type:	HIII-50 (Part 572E)	HIII-5 (Part 572O)
Location:	Left Front	Right Front
Restraint:	3-pt belt/dual stage airbag	3-pt belt/dual stage airbag

[1] With respect to tow track centerline.
[2] Speed trap measurement (± .08 km/h accuracy)
[3] Target vehicle speed determined from photo analysis.
[4] Measured (pre and post) with bumper fascia removed.

Table 1 Crash Test Summary, Cont'd.

Target vehicle seat track position for test:		
Driver:	Mid	
Passenger:	N/A	
Target vehicle seat back position for test:		
Driver:	13.8°	(5^{th} latch position from full upright latch)
Passenger:	N/A	
Target vehicle head restraint position for test:		
Driver:	Full up	
Passenger:	N/A	
Steering column position:	Mid	
Bullet vehicle seat track position for test:		
Driver:	Mid	
Passenger:	Forward	
Bullet vehicle seat back position for test:		
Driver:	23.2°	
Passenger:	11.2°	
Bullet vehicle head restraint position for test:		
Driver:	Up	
Passenger:	Down	
Steering column position:	Mid	

Table 2 Target General Test and Vehicle Parameter Data

Vehicle year/make/ model/body style:	1997/Honda/Accord/4-door sedan
VIN:	1HGCD5639VA134105
Model year:	1997
Body style:	4-door sedan
Color:	Green
Engine data:	
Cylinders:	4
Displacement	2.2 liters
Cylinder placement:	straight
Engine placement:	transverse
Transmission data:	_4_ speed, ___ manual, _X_ automatic, _X_ overdrive
Final drive:	_X_ FWD, __ RWD, ___ 4WD
Date vehicle received:	8/26/02
Odometer reading:	95,379
Dealer's name and address:	N/A (Supplied by VRTC)

Accessories:

Power steering	Yes	Automatic transmission	Yes
Power brakes	Yes	Automatic speed control	Yes
Power seats	No	Tilting steering wheel	Yes
Power windows	Yes	Telescoping steering wheel	No
Tinted glass	No	Air conditioning	Yes
Radio	Yes	Anti-skid brake	Yes
Clock	Yes	Rear window defroster	Yes
Power door locks	Yes	Other: Front side airbags	

Certification data from vehicle's label:

Vehicle manufactured by:		Honda of America	
Date of manufacture:		02/97	
VIN:		1HGCD5639VA134105	
GVWR:		3915 lbs	(1775.8 kg)
GAWR:	Front:	2140 lbs	(970.6 kg)
	Rear:	1880 lbs	(821.0 kg)

Table 2 Target General Test and Vehicle Parameter Data, Cont'd.

Tires on vehicle (mfr., line, size):	Dunlop, D60 A2, P185/65R15	
Tire pressure with maximum capacity vehicle load:		
Front:	35 psi	(240 kPa)
Rear:	35 psi	(240 kPa)
Spare tire (mfr., line, size):	Goodyear, Temporary, T115/70D14	
Type of seats:		
Front	Bucket	
Rear	Split bench	
Maximum width:	1780 mm	
Wheelbase:	2715 mm	

Location of "Recommended Tire Pressure" label:

The label was located on B-pillar.

Data from vehicle's "Recommended Tire Pressure" label":

Recommended tire size:	185/65R15	
Recommended cold tire pressure:		
Front:	32 psi	(220 kPa)
Rear:	32 psi	(220 kPa)

Vehicle Capacity Data:

Number of Occupants (Designated seating capacity):		
Front	2	
Rear	3	
Total	5	
Vehicle capacity weight:	850.0 lbs	(385.5 kg)
Rated cargo/luggage weight:[1]	45.5 lbs	(99.2 kg)

Test vehicle attitude:

Delivered attitude:	LF	695 mm;	RF	685 mm;	LR	690 mm;	RR	681 mm
Fully loaded attitude:	LF	679 mm;	RF	671 mm;	LR	659 mm;	RR	649 mm
Pre-test attitude:	LF	672 mm;	RF	670 mm;	LR	652 mm;	RR	648 mm
Post-test attitude:	LF	555 mm;	RF	625 mm;	LR	630 mm;	RR	743 mm

[1] By calculation; not on label.

Table 2 Target General Test and Vehicle Parameter Data, Cont'd.

Weight of test vehicle as received (with maximum fluids)=UDW:

Right front	409.5 kg	Right rear	256.5 kg
Left front	412.5 kg	Left rear	255.0 kg
Total front weight	822.0 kg	(66.6 % of total vehicle weight)	
Total rear weight	511.5 kg	(33.4 % of total vehicle weight)	
Total delivered weight	1333.5 kg		

Calculation of test vehicle's target test weight:

Total Delivered Weight (UDW) =	1233.5 kg
Rated Cargo/Luggage Weight (RCLW)[1] =	45.7 kg
Weight of 1 Part 572E Dummy @ 76 kg	
And 1 Part 572O Dummy @ 49 kg =	125.0 kg
Target test weight =	1504.2 kg

Weight of test vehicle with required dummies and 40.7 kg of cargo weight:

Right front	430.0 kg	Right rear	309.2 kg
Left front	444.4 kg	Left rear	315.6 kg
Total front weight	874.4 kg	(58.3% of total vehicle weight)	
Total rear weight	624.8 kg	(41.7% of total vehicle weight)	
Total test weight	1499.2 kg	(0.3% under target test weight)	

Weight of ballast secured in vehicle: None

Components removed to meet target test weight: Deck lid, rear fascia, rear door glass, passenger front door glass and muffler, front passenger and rear seats.

Location of Vehicle's CG: 1131 mm rearward of front wheel centerline

Fuel System Data:

Usable fuel system capacity	64.4 liters (from manufacturer's information)
Actual test volume:[2]	0.0 liters (0 % of usable)

[1] Cargo weight for multipurpose passenger vehicles, trucks, and buses is the vehicle's rated cargo and luggage weight from the vehicle's label or 136 kilograms, whichever is less.

[2] Fuel drained to achieve test weight.

Table 3 Bullet General Test and Vehicle Parameter Data

Vehicle year/make/ model/body style:	2001/Mitsubishi/Montero Sport/MPV
VIN:	JA4MT21H81P049555
Model year:	2001
Body style:	MPV
Color:	Beige
Engine data:	
Cylinders:	6
Displacement	3 liters
Cylinder placement:	V
Engine placement:	inline
Transmission data:	_4_ speed, ___ manual, _X_ automatic, ___ overdrive
Final drive:	__ FWD, __ RWD, _X_ 4WD
Date vehicle received:	8/26/02
Odometer reading:	28,516
Dealer's name and address:	N/A (Supplied by VRTC)

Accessories:

Power steering	Yes	Automatic transmission	Yes
Power brakes	Yes	Automatic speed control	Yes
Power seats	No	Tilting steering wheel	Yes
Power windows	Yes	Telescoping steering wheel	No
Tinted glass	Yes	Air conditioning	Yes
Radio	Yes	Anti-skid brake	Yes
Clock	Yes	Rear window defroster	Yes
Other	None	Power door locks	Yes

Certification data from vehicle's label:

Vehicle manufactured by:		Mitsubishi Motors Corporation	
Date of manufacture:		02/01	
VIN:		JA4MT21H81P049555	
GVWR:		2427 kg	(5350 lbs.)
GAWR:	Front:	1200 kg	(2645 lbs.)
	Rear:	1600 kg	(3525 lbs.)

Table 3 Bullet General Test and Vehicle Parameter Data, Cont'd.

Tires on vehicle (mfr., line, size): Goodyear, Conquest, P255/70R16

Tire pressure with maximum capacity vehicle load:

Front:	44 psi	(300 kPa)
Rear:	44 psi	(300 kPa)

Spare tire (mfr., line, size): Yokohama, Geolander, P255/70R16

Type of seats:

Front	Bucket
Rear	Split bench

Maximum width: 1700 mm

Wheelbase: 2725 mm

Location of "Recommended Tire Pressure" label:

The label was located on B-pillar.

Data from vehicle's "Recommended Tire Pressure" label":

Recommended tire size: P255/70R16

Recommended cold tire pressure:

Front:	26 psi	(180 kPa)
Rear:	26 psi	(180 kPa)

Vehicle Capacity Data:

Number of Occupants (Designated seating capacity) - by seat belt count; not on label:

Front	2
Rear	3
Total	5

Vehicle capacity weight: 536.0 kg (calculated; not on label)

Rated cargo/luggage weight N/A

Test vehicle attitude:

Delivered attitude:	LF	888 mm;	RF	894 mm;	LR	900 mm;	RR	908 mm
Fully loaded attitude:	LF	862 mm;	RF	875 mm;	LR	848 mm;	RR	854 mm
Pre-test attitude:	LF	857 mm;	RF	879 mm;	LR	850 mm;	RR	870 mm
Post-test attitude:	LF	908 mm;	RF	853 mm;	LR	822 mm;	RR	888 mm

Table 3 Bullet General Test and Vehicle Parameter Data Cont'd

Weight of test vehicle as received (with maximum fluids)=UDW:

Right front	503.0 kg	Right rear	414.5 kg
Left front	531.5 kg	Left rear	442.0 kg
Total front weight	1034.5 kg	(54.7 % of total vehicle weight)	
Total rear weight	856.5 kg	(45.3 % of total vehicle weight)	
Total delivered weight	1891.0 kg		

Calculation of test vehicle's target test weight:

Total Delivered Weight (UDW) =	1891.0 kg
Rated Cargo/Luggage Weight (RCLW)[1] =	136.0 kg
Weight of 1 Part 572O Dummy @ 49 kg	
And 1 Part 572E Dummy @ 76 kg =	125.0 kg
Target test weight =	2152.0 kg

Weight of test vehicle with required dummies and 127.0 kg of cargo weight:

Right front	524.6 kg	Right rear	493.2 kg
Left front	571.8 kg	Left rear	553.4 kg
Total front weight	1096.4 kg	(51.2% of total vehicle weight)	
Total rear weight	1046.6 kg	(48.8% of total vehicle weight)	
Total test weight	2143.0 kg	(0.4% under target test weight)	

Weight of ballast secured in vehicle: None

Components removed to meet target test weight: Muffler, rear fascia, rear door glass and rear window.

Location of Vehicle's CG: 1331 mm rearward of front wheel centerline

Fuel System Data:

Usable fuel system capacity	73.8 liters (from manufacturer's information)
Actual test volume:	68.5 liters (93% of usable)

[1] Cargo weight for multipurpose passenger vehicles, trucks, and buses is the vehicle's rated cargo and luggage weight from the vehicle's label or 136 kilograms, whichever is less.

Table 4 Post-Impact Data

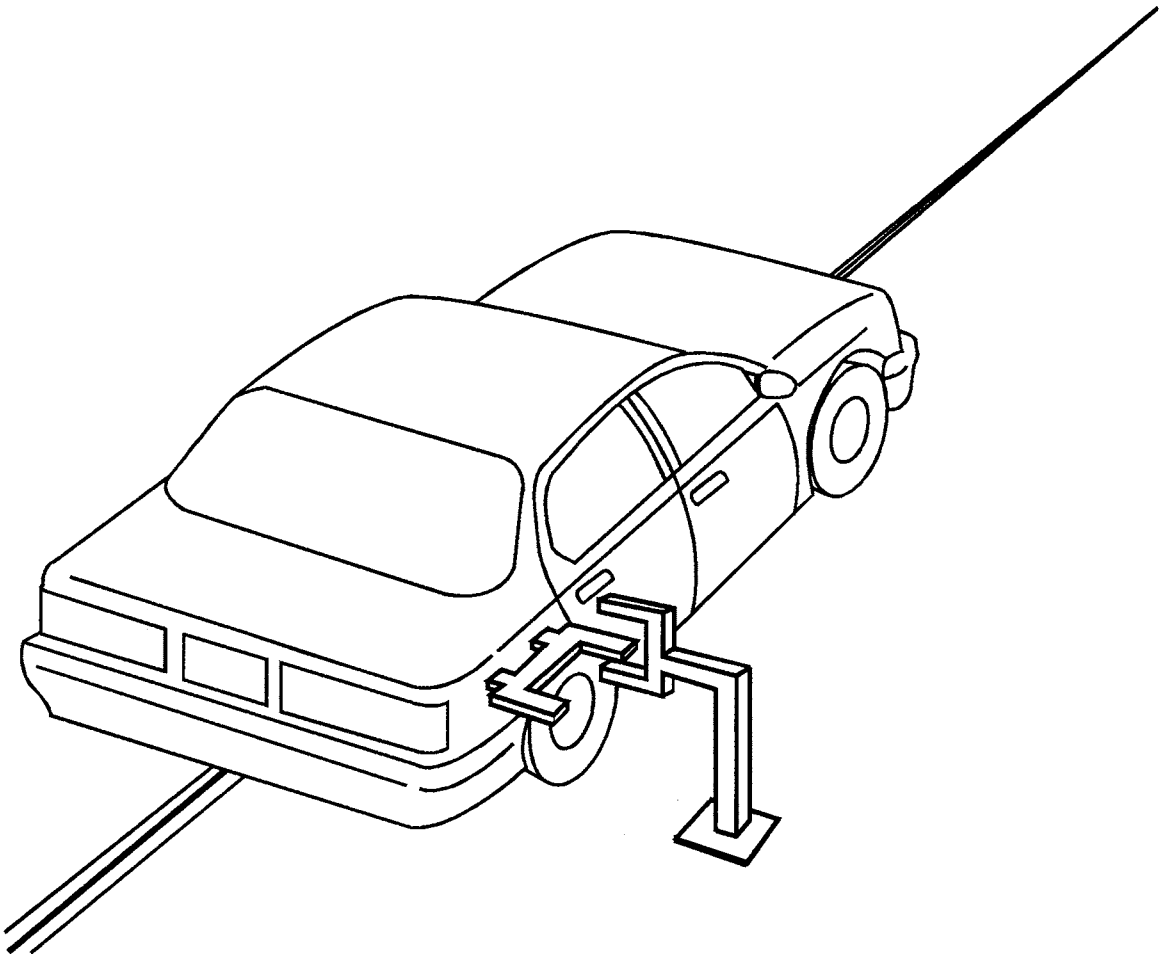
Test number:	020921
Test date:	09/21/02
Test time:	1250
Test type:	30 Degree Car Into Car
Impact angle:	30°
Ambient temperature at impact area:	25° C
Impact velocity:	
Target vehicle:	55.8 km/h
Bullet vehicle:	56.3 km/h
Required impact velocity range:	55.5 to 57.1 km/h

Distance from each vehicle to intended impact point:

Entering velocity trap:	661 mm
Exiting velocity trap:	51 mm, approximately

Impact point: 25 mm right of intended impact point (referenced to target vehicle coordinate system)

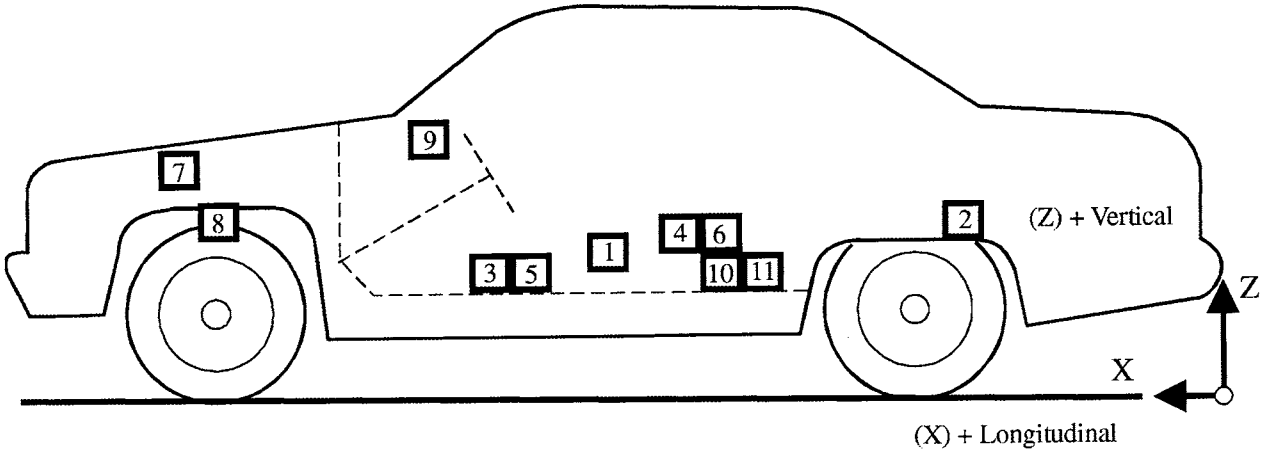
Figure 1 Impact Velocity Measurement System



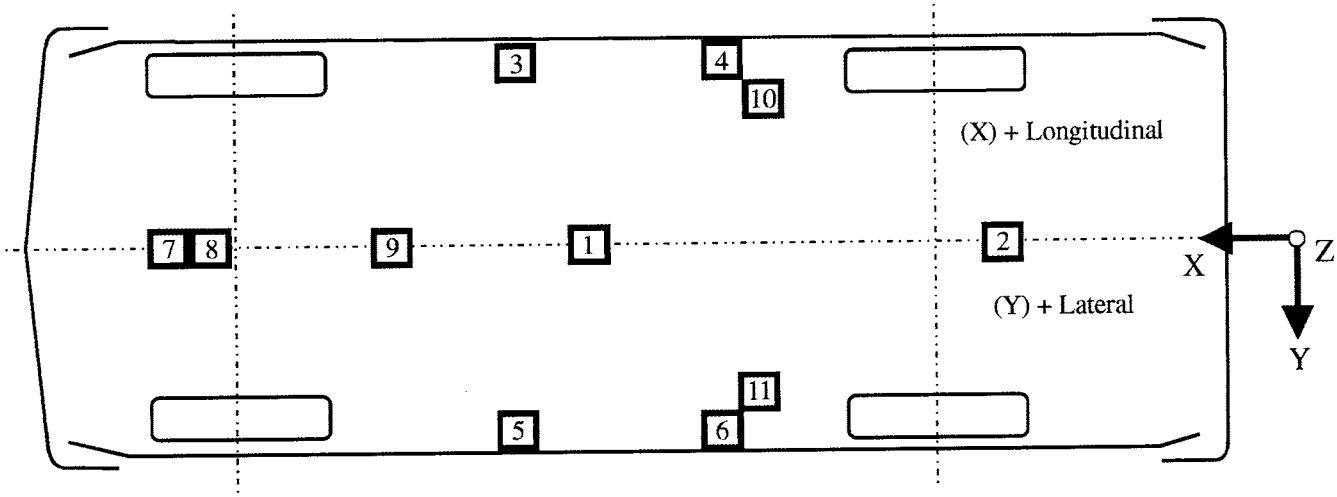
The final vane clears the final emitter/receiver pair approximately 51 millimeters before impact.

The vanes have 610-millimeter spacing.

Figure 2 Target Vehicle Accelerometer Placement



Side View



Bottom View

Table 5 Target Vehicle Accelerometer Locations and Data Summary

TEST NUMBER: 020921 No. LOCATION	X	Y	Z	POSITIVE DIRECTION		NEGATIVE DIRECTION	
1 VEHICLE CENTER OF GRAVITY	2607 mm	0 mm	421 mm				
LONGITUDINAL[1]				8.8 g	@ 69.0 ms	86.4 g	@ 78.6 ms
LATERAL[1]				31.6 g	@ 57.1 ms	10.6 g	@ 122.5 ms
VERTICAL[1]				88.8 g	@ 86.7 ms	20.5 g	@ 65.2 ms
RESULTANT[1]				94.0 g	@ 86.8 ms		
2 REAR DECK	NA	NA	NA				
LONGITUDINAL				11.7 g	@ 32.1 ms	36.8 g	@ 61.1 ms
LATERAL				13.4 g	@ 83.1 ms	5.9 g	@ 40.8 ms
VERTICAL				11.6 g	@ 112.1 ms	21.8 g	@ 46.2 ms
RESULTANT				37.4 g	@ 61.0 ms		
3 LEFT FRONT SILL[2]	2705 mm	NA	NA				
LONGITUDINAL				16.0 g	@ 91.2 ms	53.4 g	@ 71.8 ms
LATERAL				25.5 g	@ 90.9 ms	21.4 g	@ 74.5 ms
4 LEFT REAR SILL[2]	1835 mm	NA	NA				
LONGITUDINAL				6.6 g	@ 93.3 ms	40.7 g	@ 57.0 ms
LATERAL				20.9 g	@ 58.3 ms	8.3 g	@ 65.2 ms
5 RIGHT FRONT SILL[3]	2735 mm	NA	NA				
LONGITUDINAL				1.2 g	@ 217.7 ms	30.5 g	@ 53.7 ms
LATERAL				24.5 g	@ 35.3 ms	4.8 g	@ 104.1 ms
6 RIGHT REAR SILL[3]	1855 mm	NA	NA				
LONGITUDINAL				1.1 g	@ 218.1 ms	28.3 g	@ 51.8 ms
LATERAL				19.1 g	@ 57.5 ms	0.9 g	@ 105.1 ms

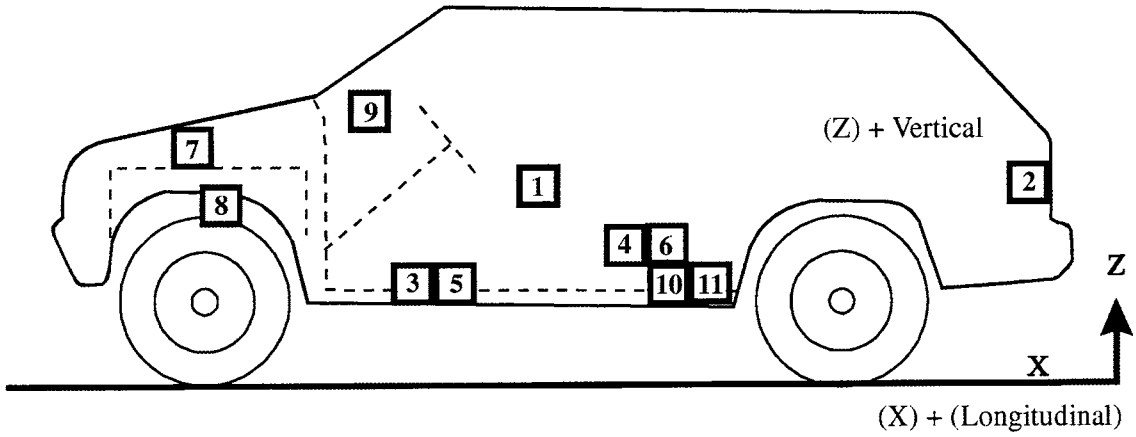
Table 5 Target Vehicle Accelerometer Locations and Data Summary, Cont'd.

TEST NUMBER: 020921 No. LOCATION	X	Y	Z	POSITIVE DIRECTION		NEGATIVE DIRECTION	
7 ENGINE TOP	NA	NA	NA				
LONGITUDINAL				7.9 g	@ 67.9 ms	72.7 g	@ 26.7 ms
LATERAL				55.3 g	@ 32.4 ms	9.2 g	@ 55.0 ms
8 ENGINE BOTTOM	NA	NA	NA				
LONGITUDINAL				1.8 g	@ 79.7 ms	78.8 g	@ 39.5 ms
LATERAL				26.8 g	@ 18.5 ms	24.8 g	@ 29.2 ms
9 INSTRUMENT PANEL CENTER	NA	NA	NA				
LONGITUDINAL				19.8 g	@ 111.0 ms	77.6 g	@ 51.3 ms
LATERAL				41.9 g	@ 64.8 ms	16.6 g	@ 107.4 ms
10 LEFT REAR SEAT CROSSMEMBER	NA	NA	NA				
LONGITUDINAL				1.0 g	@ 14.2 ms	42.0 g	@ 54.6 ms
LATERAL				21.5 g	@ 55.8 ms	5.0 g	@ 65.0 ms
11 RIGHT REAR SEAT CROSSMEMBER	NA	NA	NA				
LONGITUDINAL				1.3 g	@ 218.6 ms	28.3 g	@ 51.0 ms
LATERAL				17.1 g	@ 57.6 ms	0.7 g	@ 248.3 ms

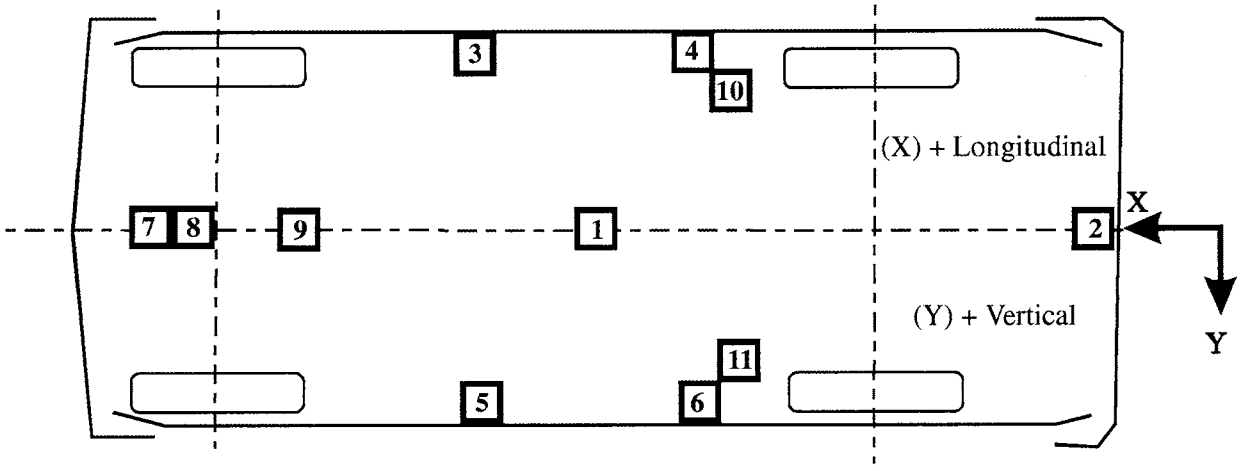
LOCATION REFERENCE: X: + FORWARD OF REAR BUMPER
Y: + RIGHTWARD FROM VEHICLE CENTERLINE
Z: + UPWARD FROM GROUND LEVEL

[1] See DATA ACQUISITION EXPLANATIONS
[2] The X-axis distance between the left front sill and left rear sill accelerometer locations is 870 mm.
[3] The X-axis distance between the right front sill and right rear sill accelerometer locations is 880 mm.

Figure 3 Bullet Vehicle Accelerometer Placement



Side View



Bottom View

Table 6 Bullet Vehicle Accelerometer Locations and Data Summary

TEST NUMBER: 020921 No. LOCATION	X	Y	Z	POSITIVE DIRECTION		NEGATIVE DIRECTION	
1 VEHICLE CENTER OF GRAVITY	2530 mm	0 mm	670 mm				
LONGITUDINAL				1.6 g	@ 147.0 ms	29.1 g	@ 52.4 ms
LATERAL				13.1 g	@ 41.2 ms	16.7 g	@ 72.6 ms
VERTICAL				9.2 g	@ 46.9 ms	13.5 g	@ 69.7 ms
RESULTANT				29.5 g	@ 52.2 ms		
2 REAR DECK	NA	NA	NA				
LONGITUDINAL				3.2 g	@ 174.6 ms	18.0 g	@ 45.1 ms
LATERAL				15.3 g	@ 75.8 ms	3.8 g	@ 183.7 ms
VERTICAL				9.2 g	@ 95.5 ms	7.6 g	@ 47.9 ms
RESULTANT				20.2 g	@ 45.9 ms		
3 LEFT FRONT SILL[1]	3160 mm	NA	NA				
LONGITUDINAL				0.4 g	@ 180.2 ms	28.6 g	@ 57.3 ms
LATERAL				15.9 g	@ 49.0 ms	16.1 g	@ 67.3 ms
4 LEFT REAR SILL[1]	1586 mm	NA	NA				
LONGITUDINAL				2.2 g	@ 179.5 ms	24.8 g	@ 57.4 ms
LATERAL				15.2 g	@ 39.0 ms	5.4 g	@ 69.9 ms
5 RIGHT FRONT SILL[2]	3146 mm	NA	NA				
LONGITUDINAL				9.4 g	@ 13.8 ms	19.0 g	@ 43.7 ms
LATERAL				11.8 g	@ 78.5 ms	7.6 g	@ 43.3 ms
6 RIGHT REAR SILL[2]	1671 mm	NA	NA				
LONGITUDINAL				1.1 g	@ 247.9 ms	20.7 g	@ 43.8 ms
LATERAL				13.7 g	@ 43.1 ms	7.2 g	@ 67.0 ms

Table 6 Bullet Vehicle Accelerometer Locations and Data Summary, Cont'd.

TEST NUMBER: 020921 No. LOCATION	X	Y	Z	POSITIVE DIRECTION		NEGATIVE DIRECTION	
7 ENGINE TOP	NA	NA	NA				
LONGITUDINAL				9.7 g	@ 61.9 ms	44.5 g	@ 34.1 ms
LATERAL				16.8 g	@ 32.9 ms	30.3 g	@ 47.0 ms
8 ENGINE BOTTOM	NA	NA	NA				
LONGITUDINAL				0.0 g	@ 7.3 ms	33.8 g	@ 33.5 ms
LATERAL				17.4 g	@ 49.2 ms	28.4 g	@ 33.4 ms
9 INSTRUMENT PANEL CENTER	NA	NA	NA				
LONGITUDINAL				2.4 g	@ 110.1 ms	38.7 g	@ 48.0 ms
LATERAL				10.6 g	@ 55.2 ms	12.3 g	@ 83.0 ms
10 LEFT REAR SEAT CROSSMEMBER	NA	NA	NA				
LONGITUDINAL				2.2 g	@ 179.8 ms	21.6 g	@ 57.4 ms
LATERAL				11.0 g	@ 45.6 ms	6.7 g	@ 70.2 ms
11 RIGHT REAR SEAT CROSSMEMBER	NA	NA	NA				
LONGITUDINAL				0.9 g	@ 247.8 ms	20.3 g	@ 44.0 ms
LATERAL				13.4 g	@ 43.0 ms	5.6 g	@ 67.3 ms

LOCATION REFERENCE: X: + FORWARD OF REAR BUMPER
Y: + RIGHTWARD FROM VEHICLE CENTERLINE
Z: + UPWARD FROM GROUND LEVEL

[1] The X-axis distance between the left front sill and left rear sill accelerometer locations is 1574 mm.
[2] The X-axis distance between the right front sill and right rear sill accelerometer locations is 1475 mm.

Section 3.0

Summary of FMVSS 208 Data

Table 7 Target Vehicle Dummy Injury Criteria Data

Maximum Acceleration[1]

	Head				Chest			
	X	Y	Z	R	X	Y	Z	R
Driver	73.8 g	84.4 g	36.0 g	113.5 g	-70.2 g	38.0 g	22.1 g	77.0 g

Maximum Femur Compressive Force

	Left Femur	Right Femur
Driver	6853 N	10904 N

Head Injury Criteria[2]

36 millisecond

	HIC	Start Time t_1	End Time t_2
Driver	847	67.44 ms	103.44 ms

15 millisecond

	HIC	Start Time t_1	End Time t_2
Driver	480	82.88 ms	97.92 ms

Chest Maximum Resultant Acceleration[3]

	Acceleration	Start Time t_1	End Time t_2
Driver	70.6 g	73.69 ms	78.98 ms

Table 7 Target Vehicle Dummy Injury Criteria Data, Cont'd.

Maximum Chest Deflection

Driver	58 mm

Neck Injury Calculations (Nij)[2]

	NTF	NTE	NCF	NCE
Driver	0.17	0.61	0.29	0.01

Upper Neck Axial Force

	Tension	Compression
Driver	1683 N	255 N

Tibia Index

	Upper Tibia	Lower Tibia
Driver-left	0.88	1.77
Driver-right	2.07[4]	1.52

[1] See Report Sign Convention in Appendix D.
[2] As defined in FMVSS No. 208.
[3] Defined as equal to or exceeding 0.003 sec. duration.
[4] See Data Acquisition Explanation in Section 2.0.

Table 8 Bullet Vehicle Dummy Injury Criteria Data

Maximum Acceleration[1]

	Head				Chest			
	X	Y	Z	R	X	Y	Z	R
Driver	-26.9 g	26.8 g	9.7 g	35.7 g	-32.0 g	7.3 g	-8.8 g	32.6 g
Passenger	-36.5 g	-6.6 g	12.3 g	36.6 g	-33.7 g	-2.3 g	6.7 g	34.1 g

Maximum Femur Compressive Force

	Left Femur	Right Femur
Driver	681 N	2318 N
Passenger	2630 N	2522 N

Head Injury Criteria[2]

36 millisecond

	HIC	Start Time t_1	End Time t_2
Driver	96	73.12 ms	109.12 ms
Passenger	126	60.88 ms	94.64 ms

15 millisecond

	HIC	Start Time t_1	End Time t_2
Driver	51	89.36 ms	104.40 ms
Passenger	91	65.92 ms	80.96 ms

Chest Maximum Resultant Acceleration[3]

	Acceleration	Start Time t_1	End Time t_2
Driver	32.2 g	73.27 ms	76.23 ms
Passenger	33.5 g	70.97 ms	73.93 ms

Table 8 Bullet Vehicle Dummy Injury Criteria Data, Cont'd.

Maximum Chest Deflection	
Driver	29 mm
Passenger	22 mm

Upper Neck Injury Calculations (Nij)[2]

	NTF	NTE	NCF	NCE
Driver	0.12	0.23	0.05	0.09
Passenger	0.07	1.00	0.01	0.00

Upper Neck Axial Force

	Tension	Compression
Driver	732 N	148 N
Passenger	1147 N	47 N

[1] See Report Sign Convention in Appendix D.
[2] As defined in FMVSS No. 208.
[3] Defined as equal to or exceeding 0.003 sec. duration.

Table 9 Target Vehicle Post-Impact Dummy/Vehicle Data

Visible Dummy Contact Points:

	Driver
Head	Airbag, head restraint, top of door above window
Chest	Airbag
Abdomen	None
Left knee	Instrument panel
Right knee	Instrument panel

Door opening:

	Left	Right
Front	Tools required	Easy
Rear	Tools required	Easy

Seat movement:

	Seat back failure	Seat shift
Left Front	No	Yes
Right Front	N/A	N/A
Left Rear	N/A	N/A
Right Rear	N/A	N/A

Glazing damage: Entire windshield damaged

Other notable impact effects: None

Table 10 Bullet Vehicle Post-Impact Dummy/Vehicle Data

Visible Dummy Contact Points:

	Driver	Passenger
Head	Head restraint, airbag	Head restraint, airbag
Chest	Airbag	Airbag
Abdomen	None	None
Left knee	Instrument panel	Instrument panel
Right knee	Instrument panel	Instrument panel

Door opening:

	Left	Right
Front	Easy	Easy
Rear	Easy	Easy

Seat movement:

	Seat back failure	Seat shift
Left Front	None	None
Right Front	None	None
Left Rear	N/A	N/A
Right Rear	N/A	N/A

Glazing damage: Cracks on driver's and passenger's side of windshield.

Other notable impact effects: None

Section 4.0

Occupant, Camera, and Vehicle Information

Target Vehicle Dummy Kinematic Summary

Driver Dummy

Upon impact, the target driver dummy translated forward with the head and chest initially going squarely into the airbag. The knees contacted the dash panel. The dummy was then forced outboard. The head and neck extended beyond the door's frame and contacted the top of the deformed door, above the window. The dummy head also contacted the driver head restraint. The dummy came to rest jammed down in the driver's seat with the pelvis to the outboard side and the upper torso leaning inboard.

Bullet Vehicle Dummy Kinematic Summary

Driver Dummy

Upon impact, the bullet driver dummy translated forward with the head and neck flexing slightly forward as the head and chest contact the airbag. The knees contacted the dash panel. The head and neck straightened and then extend slightly on rebound. The driver dummy's head contacted the inboard side of the head restraint. The dummy came to rest seated upright in the driver's seat.

Right Front Passenger Dummy

Upon impact, the bullet passenger dummy translated forward with the head and chest contacting the airbag. The knees contacted the dash panel. The dummy rebounded into the seatback with the head contacting the outboard side of the passenger head restraint. The dummy came to rest seated upright in the passenger seat.

Figure 4 Vehicle Dummy Measurement Locations for Front Seat Occupants

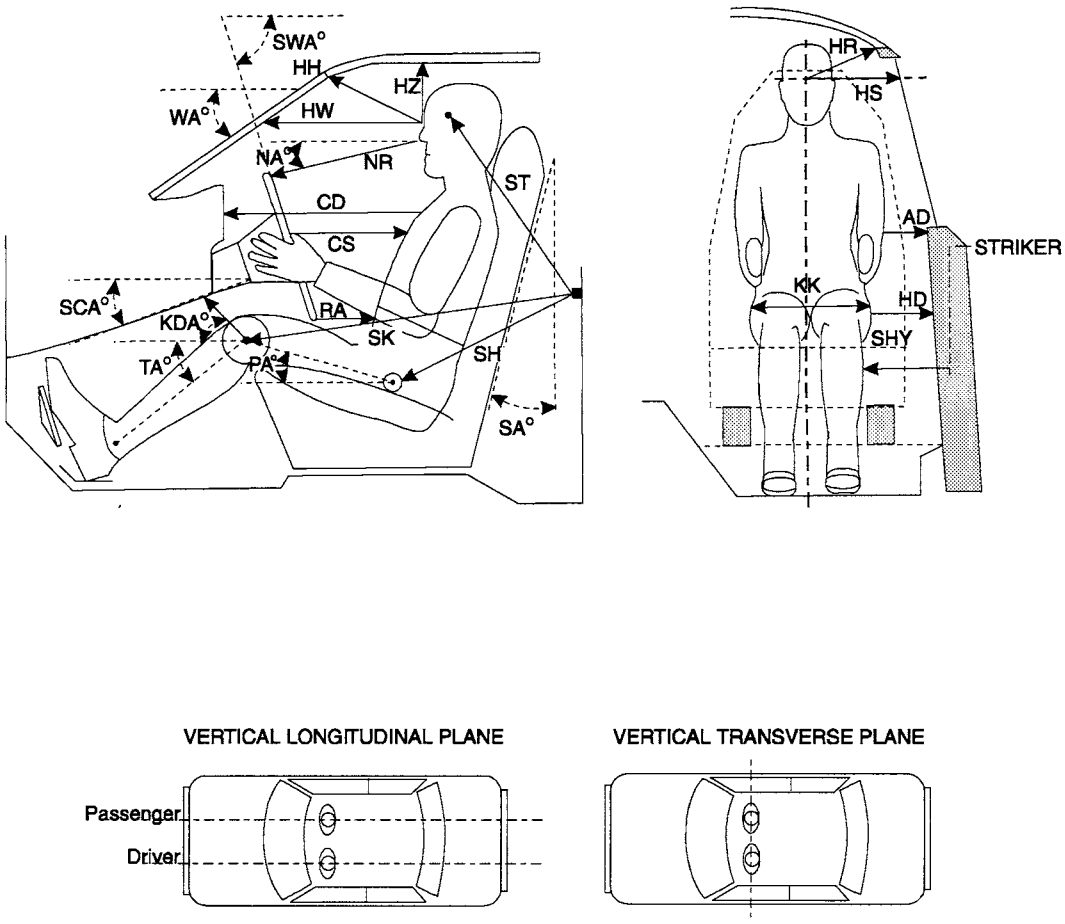


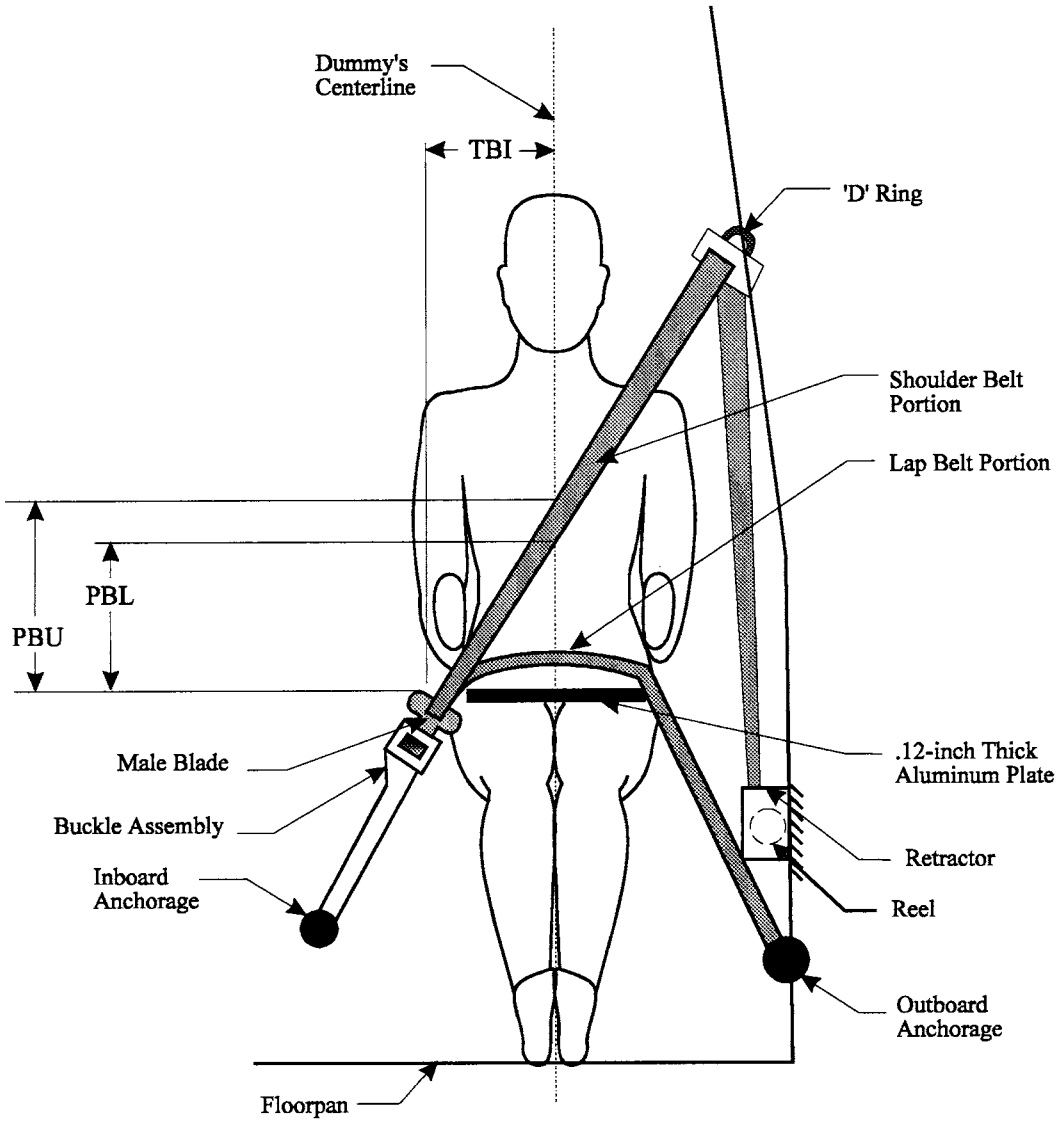
Table 11 Target Vehicle Dummy Measurement Data For Front Seat Occupants

Designation	Type of Measurement	Driver (Serial # 168)	Passenger (Serial # N/A)
WA	Windshield angle	27.5°	
SWA	Steering wheel angle	63.7°	
SCA	Steering column angle	26.3°	
SA	Seat back angle	13.8°	
HZ	Head to roof	210 mm	
HH	Head to header	350 mm	
HW	Head to windshield	576 mm	
HR	Head to side header	201 mm	
NR	Nose to rim	435 mm	
NA	Nose to rim angle	13.8°	
CD	Chest to dash	572 mm	
CS	Steering wheel to chest	340 mm	
RA	Rim to abdomen	230 mm	
KDL	Left knee to dash	225 mm	
KDR	Right knee to dash	226 mm	
KDA	Outboard knee to dash angle	22.5°	
PA	Pelvic angle	24.6°	
TA	Tibia angle	39.6°	
KK	Knee to knee	275 mm	
ST[1]	Striker to head	490 mm	
	Striker to head angle	-88.3°	
SK[1]	Striker to knee	535 mm	
	Striker to knee angle	0.3°	
SH[1]	Striker to H-point	241 mm	
	Striker to H-point angle	45.5°	
SHY	Striker to H-point (Y dir.)	270 mm	
HS	Head to side window	320 mm	
HD	H-point to door	150 mm	
AD	Arm to door	106 mm	

The seat back angle (SA°) is measured relative to vertical, all other angles are measured relative to horizontal.

[1] A negative angle indicates the measurement point was above the striker.

Figure 5 Target Vehicle Seat Belt Positioning Data



	Driver Dummy	Passenger Dummy
PBU - Top surface of aluminum plate to belt upper edge	375 mm	N/A
PBL - Top surface of aluminum plate to belt lower edge	295 mm	N/A
TBI - Dummy centerline to intersection of upper torso belt and lap belt	265 mm	N/A

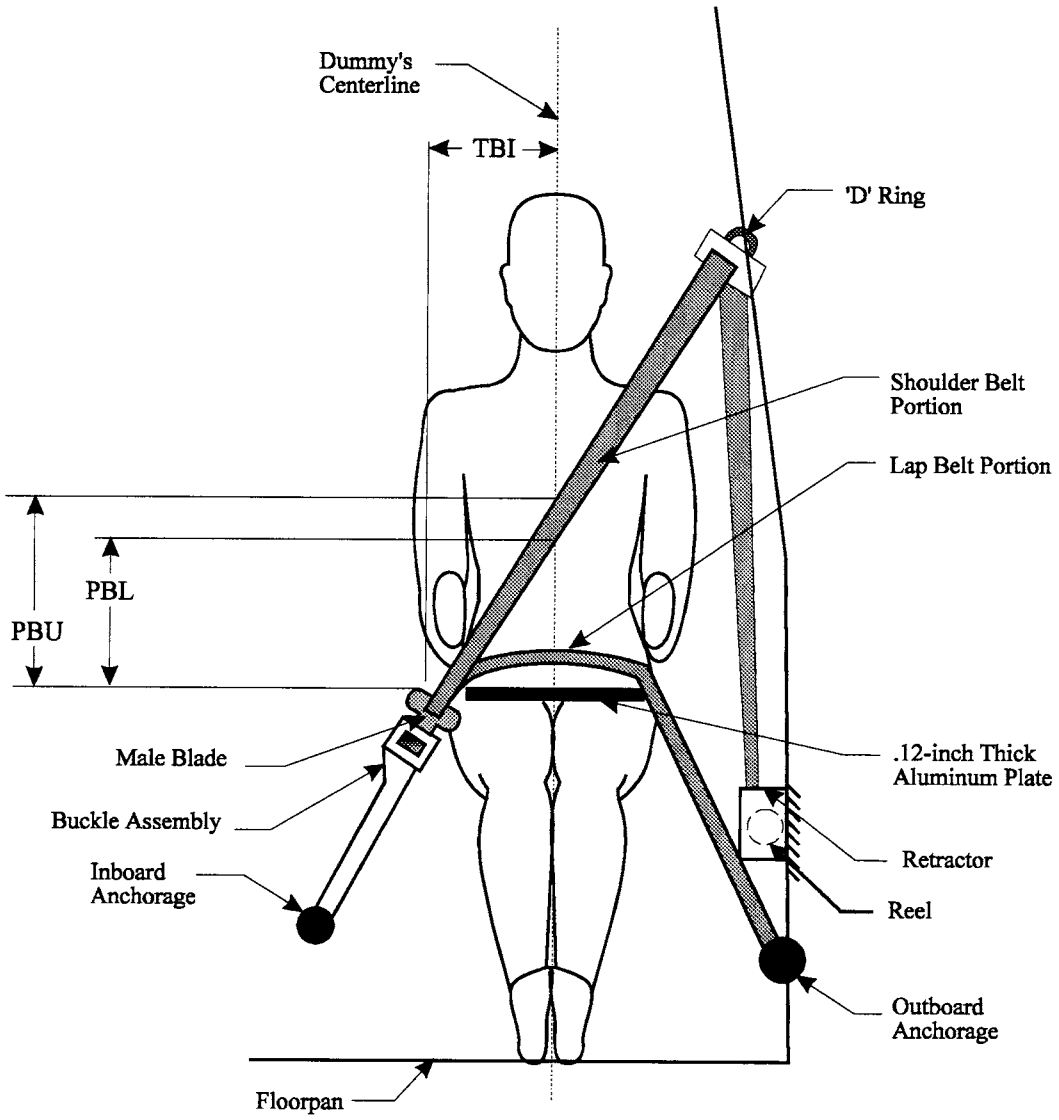
Table 12 Bullet Vehicle Dummy Measurement Data For Front Seat Occupants

Designation	Type of Measurement	Driver (Serial # 169)	Passenger (Serial # 421)
WA	Windshield angle	34.9°	N/A
SWA	Steering wheel angle	59.6°	N/A
SCA	Steering column angle	30.4°	N/A
SA	Seat back angle	23.2°	11.2°
HZ	Head to roof	195 mm	270 mm
HH	Head to header	458 mm	359 mm
HW	Head to windshield	625 mm	566 mm
HR	Head to side header	232 mm	280 mm
NR	Nose to rim	435 mm	N/A
NA	Nose to rim angle	19°	N/A
CD	Chest to dash	622 mm	440 mm
CS	Steering wheel to chest	303 mm	N/A
RA	Rim to abdomen	180 mm	N/A
KDL	Left knee to dash	180 mm	70 mm
KDR	Right knee to dash	175 mm	68 mm
KDA	Outboard knee to dash angle	18.3°	65.7°
PA	Pelvic angle	21.1°	22.6°
TA	Tibia angle	42.1°	63.5°
KK	Knee to knee	347 mm	225 mm
ST[1]	Striker to head	579 mm	508 mm
	Striker to head angle	-84.7°	-72.0°
SK[1]	Striker to knee	562 mm	675 mm
	Striker to knee angle	0.3°	-6.3°
SH[1]	Striker to H-point	194 mm	356 mm
	Striker to H-point angle	33.9°	7.2°
SHY	Striker to H-point (Y dir.)	235 mm	254 mm
HS	Head to side window	288 mm	335 mm
HD	H-point to door	180 mm	209 mm
AD	Arm to door	120 mm	84 mm

The seat back angle (SA°) is measured relative to vertical, all other angles are measured relative to horizontal.

[1] A negative angle indicates the measurement point was above the striker.

Figure 6 Bullet Vehicle Seat Belt Positioning Data



	Driver Dummy	Passenger Dummy
PBU - Top surface of aluminum plate to belt upper edge	363 mm	290 mm
PBL - Top surface of aluminum plate to belt lower edge	275 mm	198 mm
TBI - Dummy centerline to intersection of upper torso belt and lap belt	272 mm	258 mm

Table 13 Target Vehicle Structural Measurements[1]

	Elements	Pre-Test[2]
1	Total Length	4680
2	Total Width	1780
3	Bumper Top Height	529
4	Bumper Bottom Height	389
5	Longitudinal Member Top Height	469
6	Longitudinal Member Bottom Height	459
7	Distance Between Longitudinal Members	1100
7′	Longitudinal Member Width	80
8	Engine Top Height	735
9	Engine Bottom Height	154
10	Engine and Gearbox Width	930
11	Front Bumper - Engine Distance	450
12	Front Shock Absorber Fixing Height	894
13	Bonnet Leading Edge Height	609
14	Front Shock Absorber Fixing Width	788
15	Front Bumper - Front Axle Distance	910
16	Front Axle - A Pillar Distance	540
17	A Pillar - B Pillar Distance	1105
18	B Pillar - Rear Axle Distance	1104
19	B Pillar - C Pillar Distance	1440
20	Roof Sill Bottom Height	1058
21	Roof Sill Top Height	1193
22	Floor Sill Bottom Height	169
23	Floor Sill Top Height	316

All distance measurements are in millimeters.

[1] Taken from INSIA report, "Structural Survey of Cars, Methodology of the Main Resistant Elements in the Car Body", March 1999. This report is included in Appendix E.

[2] These structural measurements, except total length and width, are taken from a different 1997 Honda Accord; the vertical measurements from ground are adjusted based on this test vehicle's pre-test attitude measurements.

Figure 7 Target Vehicle Pre-Test And Post-Test Measurement Points

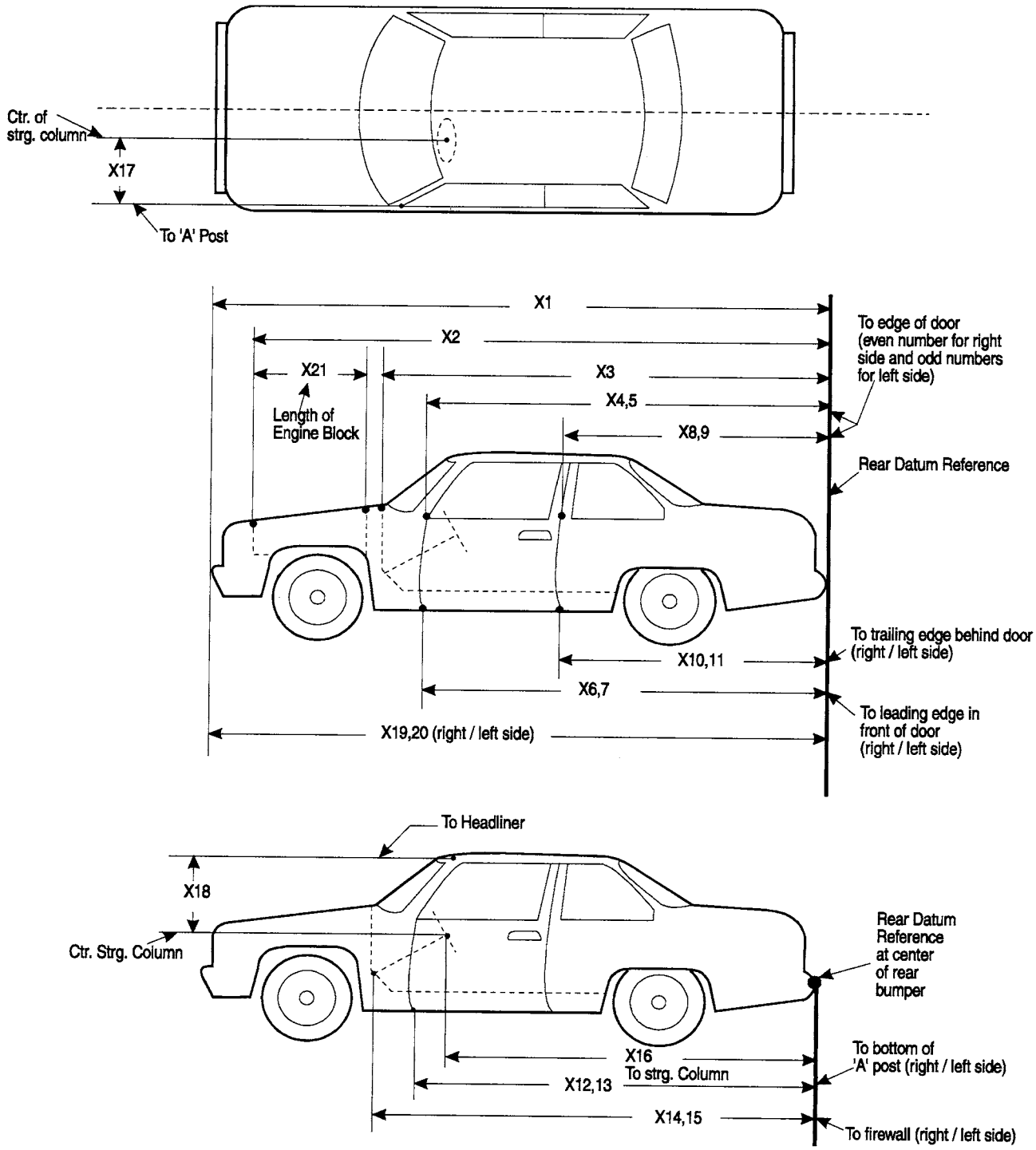


Table 14 Target Vehicle Impacted Measurements

Test number: 020921

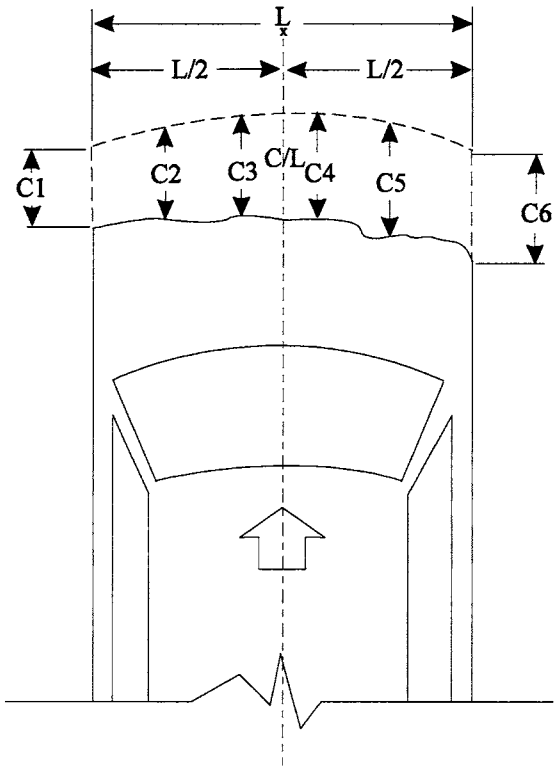
Vehicle year/make/model/body style: 1997/Honda/Accord/4-door sedan

No.	Type of measurement	Pre-Test	Post-Test	Difference
X1	Total Length of Vehicle at Centerline	4680	4199	481
X2	Rear Surface of Vehicle to Front of Engine Block	4017	3610	407
X3	Rear Surface of Vehicle to Firewall	3568	N/A[1]	N/A[1]
X4	Rear Surface of Veh. to Upper Leading Edge of Right Door	3219	3218	1
X5	Rear Surface of Veh. to Upper Leading Edge of Left Door	3225	N/A[2]	N/A[2]
X6	Rear Surface of Veh. to Lower Leading Edge of Right Door	3245	3206	39
X7	Rear Surface of Veh. to Lower Leading Edge of Left Door	3246	N/A[2]	N/A[2]
X8	Rear Surface of Veh. to Upper Trailing Edge of Right Door	2170	2168	2
X9	Rear Surface of Veh. to Upper Trailing Edge of Left Door	2175	N/A[2]	N/A[2]
X10	Rear Surface of Veh. to Lower Trailing Edge of Right Door	2185	2145	40
X11	Rear Surface of Veh. to Lower Trailing Edge of Left Door	2194	N/A[2]	N/A[2]
X12	Rear Surface of Veh. to Bottom of " A " Post on Right Side	3235	3213	22
X13	Rear Surface of Veh. to Bottom of " A " Post on Left Side	3235	2882	353
X14	Rear Surface of Vehicle to Firewall - Right Side	3527	3417	110
X15	Rear Surface of Vehicle to Firewall - Left Side	3521	2895	626
X16	Rear Surface of Vehicle to Steering Wheel Center	2745	2373	372
X17	Center of Steering Column to " A " Post	293	370	-77
X18	Center of Steering Column to Headliner	426	479	-53
X19	Rear Surface of Vehicle to Right Side of Front Bumper	4520	4585	-65
X20	Rear Surface of Vehicle to Left Side of Front Bumper	4515	3510	1005
X21	Length of Engine Block	470	470	0
RD	Rear Surface of Vehicle to Right Side of Dash Panel	3025	2981	44
CD	Rear Surface of Vehicle to Center of Dash Panel	3060	2810	250
LD	Rear Surface of Vehicle to Left Side of Dash Panel	3021	2628	393

All distance measurements are in millimeters.

[1] Measurement point could not be located.
[2] Door panel with targets separated during impact.

Figure 8 Target Vehicle Crush

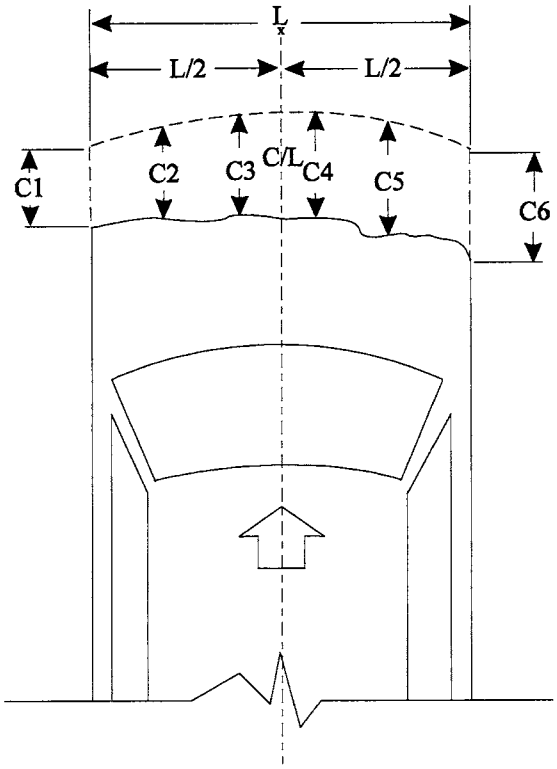


Notes: L is pre-test length of contact surface.
C1 through C6 are spaced equally apart.
CL is vehicle centerline.

Vehicle: 1997 Honda Accord
Measured with bumper fascia:

Location	Pre-test	Post-test	Difference
L	1535 mm		
C1	4515 mm	3510 mm	1005 mm
C2	4621 mm	3849 mm	772 mm
C3	4675 mm	4086 mm	589 mm
C4	4675 mm	4302 mm	373 mm
C5	4625 mm	4473 mm	152 mm
C6	4520 mm	4585 mm	-65 mm
CL	4680 mm	4199 mm	481 mm

Figure 8 Target Vehicle Crush, Cont'd.



Notes: L is pre-test length of contact surface.
C1 through C6 are spaced equally apart.
CL is vehicle centerline.

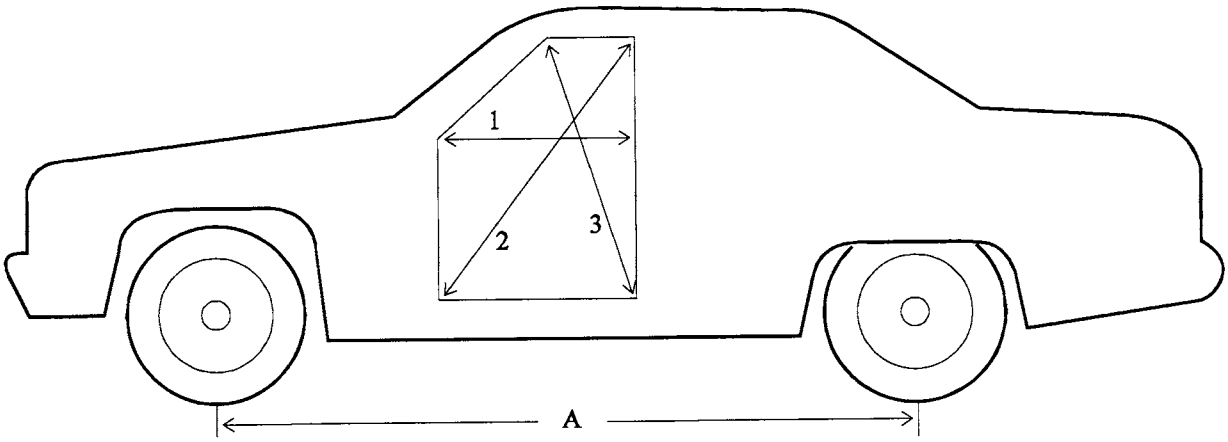
Vehicle: 1997 Honda Accord
Measured to front without bumper fascia:

Location	Pre-test	Post-test	Difference
L	1525 mm		
C1	4435 mm	N/A[1]	N/A[1]
C2	4580 mm	3835 mm	745 mm
C3	4635 mm	4063 mm	572 mm
C4	4635 mm	4265 mm	370 mm
C5	4585 mm	4426 mm	159 mm
C6	4435 mm	4502 mm	-67 mm
CL	4635 mm	4161 mm	474 mm

[1] Measurement point obscured during impact.

Figure 9 Target Vehicle Intrusion Measurements

Door Opening Width

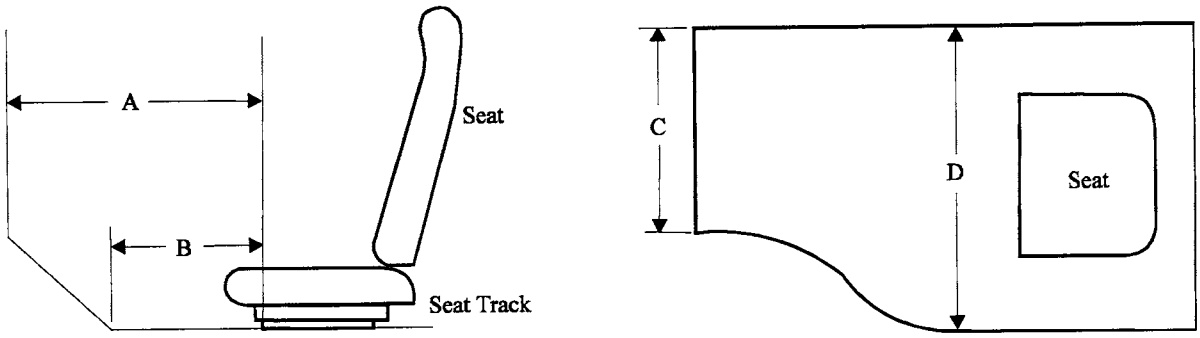


Units (mm)	Left			Right		
Measurement	1	2	3	1	2	3
Pre-Test	1016 mm	1466 mm	956 mm	1020 mm	1465 mm	955 mm
Post-Test	783 mm	1269 mm	1228 mm	1007 mm	1465 mm	960 mm
Difference	233 mm	197 mm	-272 mm	13 mm	0 mm	-5 mm

Units (mm)	A = Wheelbase Left	A = Wheelbase Right
Pre-Test	2715 mm	2715 mm
Post-Test	2247 mm	2840 mm
Difference	468 mm	-125 mm

Figure 10 Target Vehicle Intrusion Measurements

Static Footwell Deformation



Driver's Side

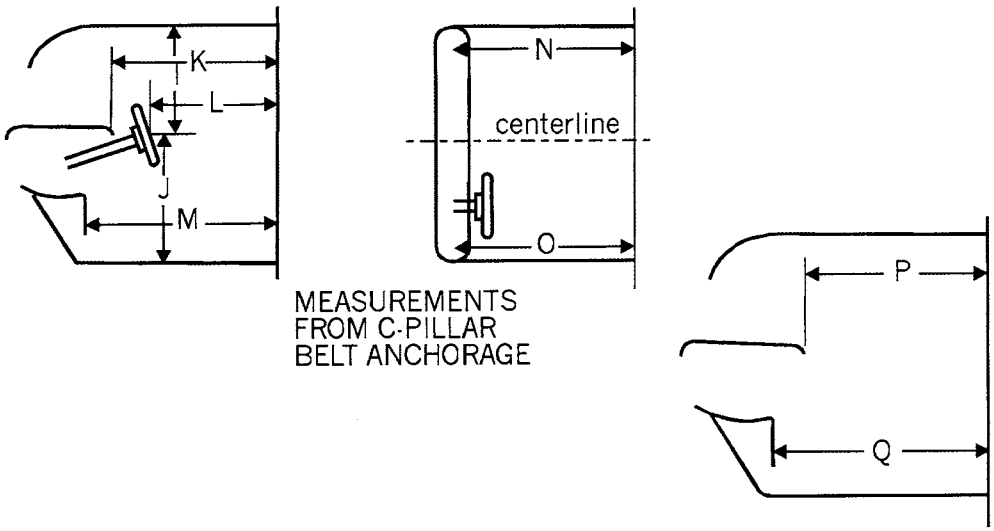
Measurement	Pre-Test	Post-Test	Difference
A	810 mm	580 mm	230 mm
B	635 mm	564 mm	71 mm
C	370 mm	405 mm	-35 mm
D	437 mm	450 mm	-13 mm

Passenger's Side

Measurement	Pre-Test	Post-Test	Difference
A	715 mm	716 mm	-1 mm
B	601 mm	615 mm	-14 mm
C	380 mm	315 mm	65 mm
D	351 mm	355 mm	-4 mm

Figure 11 Target Vehicle Intrusion Measurements

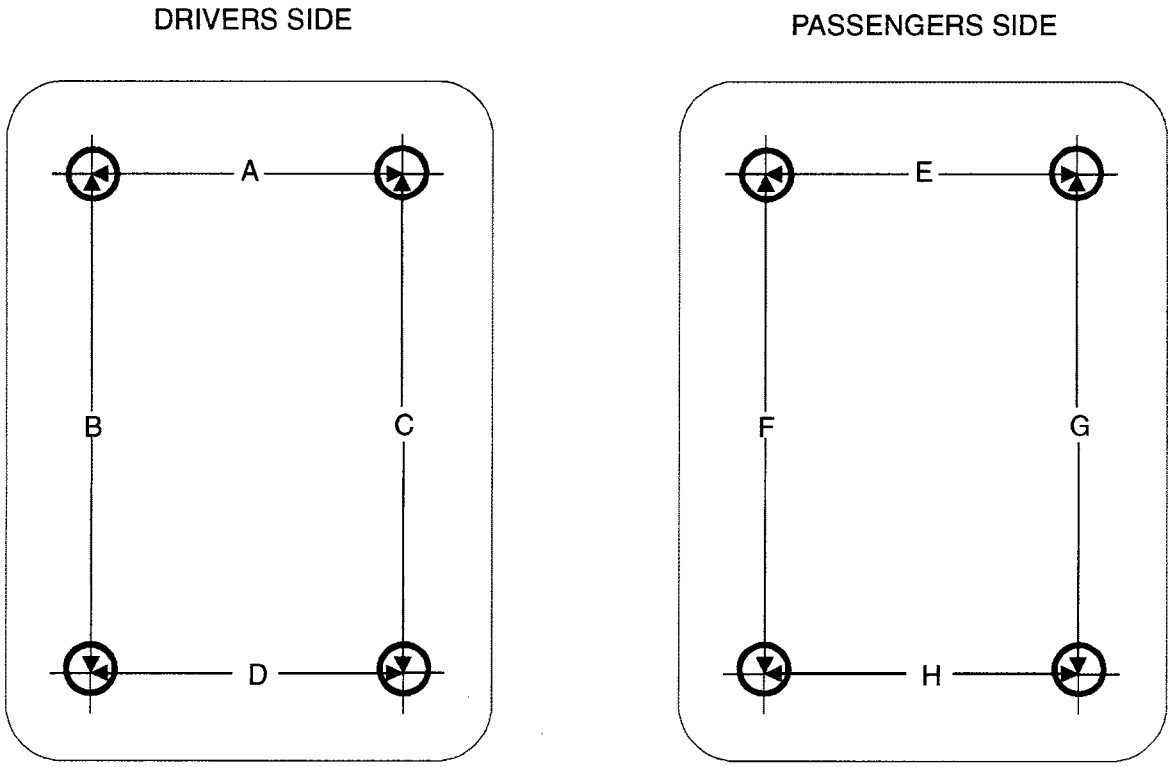
Static Passenger Compartment Intrusion



Measurement	Pre-Test	Post-Test	Difference
I	436 mm	462 mm	-26 mm
J	656 mm	775 mm	-119 mm
K (driver's side)	1542 mm	1177 mm	365 mm
L	1333 mm	980 mm	353 mm
M (driver's side)	1610 mm	N/A[1]	N/A[1]
N (passenger's side)	1555 mm	1488 mm	67 mm
O (driver's side)	1464 mm	N/A[1]	N/A[1]
P (passenger's side)	1474 mm	1555 mm	-81 mm
Q (passenger's side)	1620 mm	1630 mm	-10 mm

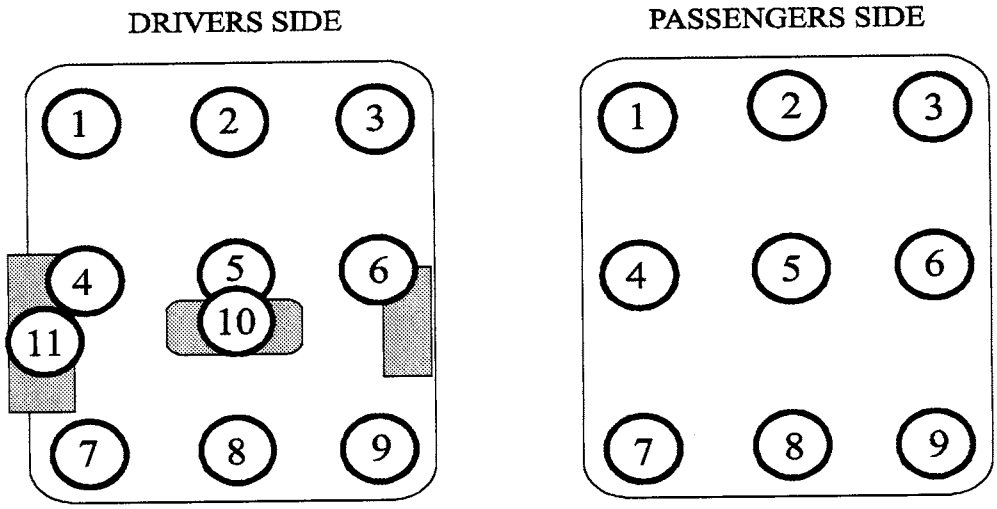
[1] Instrument panel target destroyed during impact.

Figure 12 Target Vehicle Floorboard Deformation



Measurement	Pre-Test	Post-Test	Difference
A	370 mm	405 mm	-35 mm
B	557 mm	540 mm	17 mm
C	550 mm	533 mm	17 mm
D	437 mm	450 mm	-13 mm
E	314 mm	315 mm	-1 mm
F	515 mm	519 mm	-4 mm
G	510 mm	510 mm	0 mm
H	353 mm	355 mm	-2 mm

Figure 13 Target Vehicle Toeboard Measurements



Driver's Side Toeboard Measurements in Millimeters

Toeboard Location	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
1	3468	520	370	3174	537	320	294	-17	50
2	3459	350	367	3127	380	280	332	-30	87
3	3457	180	361	3245	218	N/A[2]	212	-38	N/A[2]
4	3400	520	302	3176	555	210	224	-35	92
5	3391	350	302	3131	381	192	260	-31	110
6	3374	180	297	3240	233	240	134	-53	57
7	3315	520	205	3192	558	118	123	-38	87
8	3313	350	202	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]
9	3323	180	208	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]
10	3275	335	396	2931	444	325	344	-109	71
11	3393	576	285	3168	625	285	225	-49	0

Passenger's Side Toeboard Measurements in Millimeters

Toeboard Location	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
1	3400	210	374	3332	162	340	68	48	34
2	3398	370	380	3344	295	355	54	75	25
3	3395	575	386	3385	492	355	10	83	31
4	3355	210	336	3298	162	270	57	48	66
5	3350	370	327	3306	292	280	44	78	47
6	3351	575	340	3338	480	285	13	95	55
7	3304	210	267	3263	153	180	41	57	87
8	3300	370	265	3263	285	204	37	85	61
9	3291	575	264	3289	490	202	2	85	62

Pre- and post-test measurements reference: +X forward from rear bumper; +Y from centerline; +Z upward from ground level

[1] Target measurement points obscured during impact.

[2] Measurement not available.

Table 15 Target Vehicle Intrusion of Upper Instrument Panel

Pre-Test	X	Y	Z
Driver Left Knee	3885	535	642
Driver Right Knee	3885	195	676
Passenger Left Knee	3889	280	244
Passenger Right Knee	3890	555	246
Steering Wheel	2745	345	833
Driver Front Outboard Seat Attachment Bolt	2665	582	244
Pass. Front Outboard Seat Attachment Bolt	2668	582	246

Post-Test	X	Y	Z
Driver Left Knee	N/A[1]	N/A[1]	N/A[1]
Driver Right Knee	N/A[1]	N/A[1]	N/A[1]
Passenger Left Knee	3704	295	80
Passenger Right Knee	3843	571	235
Steering Wheel	2373	430	818
Driver Front Outboard Seat Attachment Bolt	2583	705	80
Pass. Front Outboard Seat Attachment Bolt	2608	530	235

Difference	X	Y	Z
Driver Left Knee	N/A[1]	N/A[1]	N/A[1]
Driver Right Knee	N/A[1]	N/A[1]	N/A[1]
Passenger Left Knee	185	-15	164
Passenger Right Knee	47	-16	11
Steering Wheel	372	-85	15
Driver Front Outboard Seat Attachment Bolt	82	-123	164
Pass. Front Outboard Seat Attachment Bolt	60	52	11

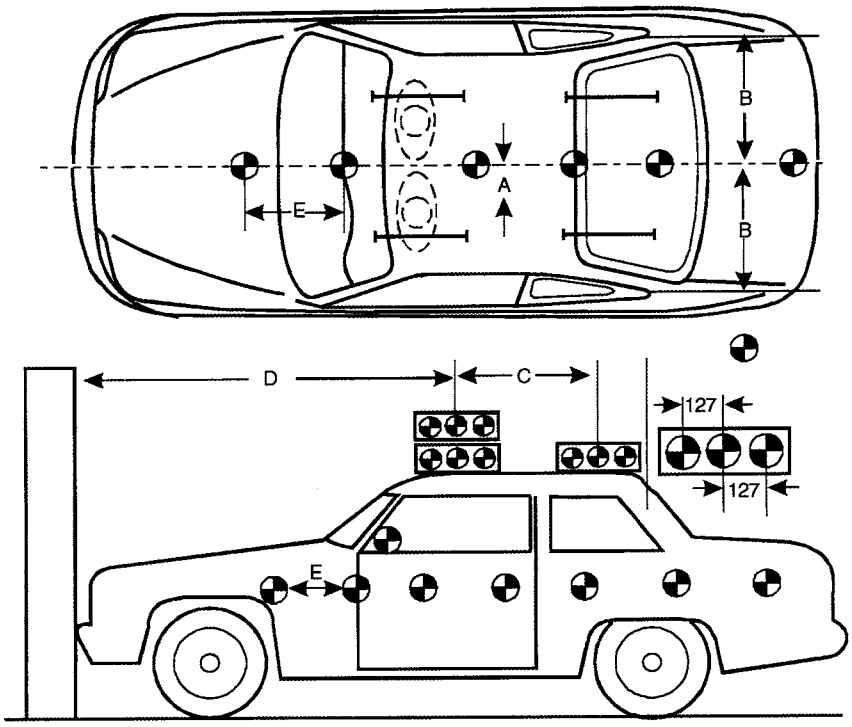
All measurements are in millimeters.

Knee intrusions are points measured pre-test and post-test, which are located just above where the four knees would be expected to contact the instrument panel.

Pre-test and post-test measurement references: +X, forward of rear bumper; +Y, from vehicle centerline; +Z, upward from ground level.

[1] Instrument panel surface containing measurement targets separated during impact.

Figure 14 Target Vehicle Reference Photo Target Locations



Measurement	Pre-Test
A	Left 395 mm Right 395 mm
B	N/A
C[1]	Left N/A Right N/A
D	N/A
E[2]	300 mm

[1] Distance between target trios was not recorded; distance between adjacent targets within a trio is 254 mm.

[2] The first side target is placed 600 mm from front edge of bumper, and others are at 300 mm intervals.

Table 16 Bullet Vehicle Structural Measurements[1]

	Elements	Pre-Test
1	Total Length	4585
2	Total Width	1750
3	Bumper Top Height	600
4	Bumper Bottom Height	525
5	Longitudinal Member Top Height	512
6	Longitudinal Member Bottom Height	441
7	Distance Between Longitudinal Members	810
7´	Longitudinal Member Width	55
8	Engine Top Height	1137
9	Engine Bottom Height	239
10	Engine and Gearbox Width	605
11	Front Bumper - Engine Distance	505
12	Front Shock Absorber Fixing Height	658
13	Bonnet Leading Edge Height	1006
14	Front Shock Absorber Fixing Width	867
15	Front Bumper - Front Axle Distance	785
16	Front Axle - A Pillar Distance	546
17	A Pillar - B Pillar Distance	970
18	B Pillar - Rear Axle Distance	1182
19	B Pillar - C Pillar Distance	1025
20	Roof Sill Bottom Height	1510
21	Roof Sill Top Height	1605
22	Floor Sill Bottom Height	393
23	Floor Sill Top Height	550

All distance measurements are in millimeters.

[1] Taken from INSIA report, "Structural Survey of Cars, Methodology of the Main Resistant Elements in the Car Body", March 1999. This report is included in Appendix E.

Figure 15 Bullet Pre-Test And Post-Test Measurement Points

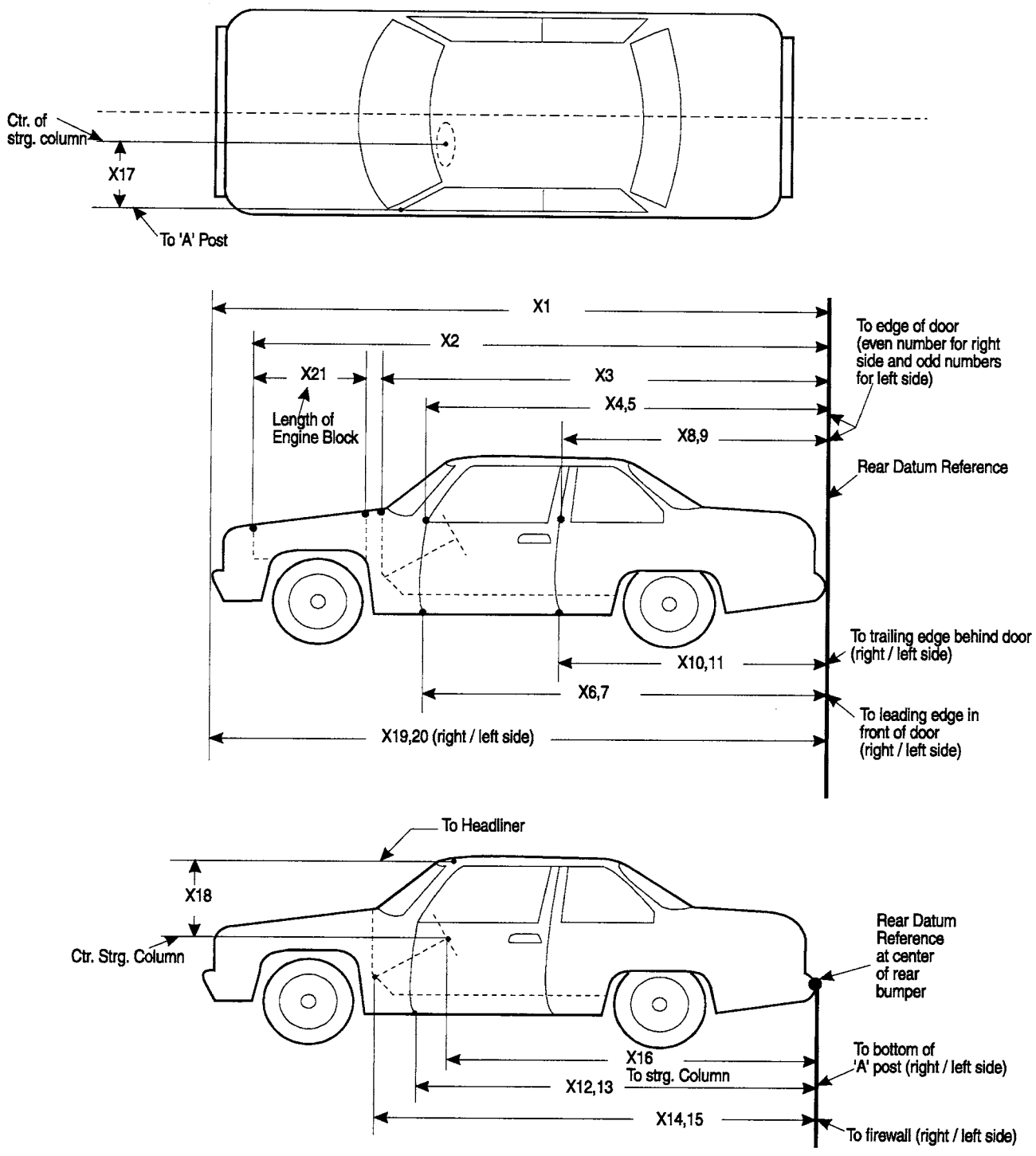


Table 17 Bullet Vehicle Impacted Measurements

Test number: 020921

Vehicle year/make/model/body style: 2001/Mitsubishi/Montero Sport/4-door sedan

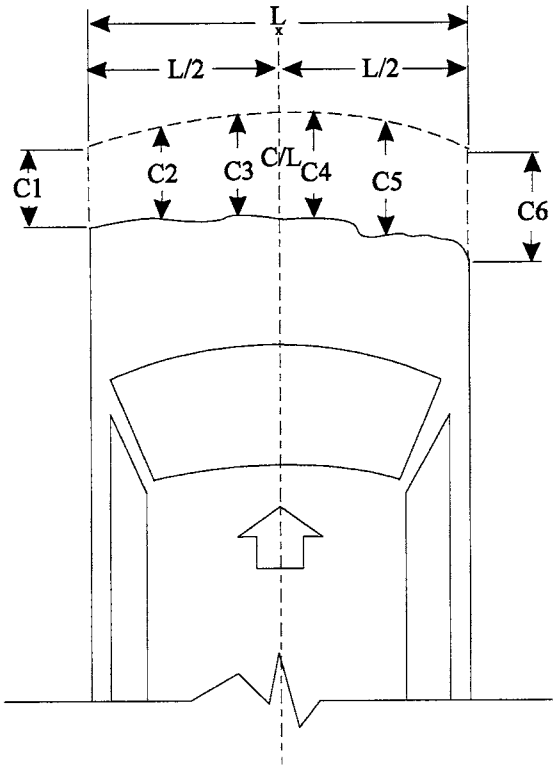
No.	Type of measurement	Pre-Test	Post-Test	Difference
X1	Total Length of Vehicle at Centerline	4585	4223[1,2]	362[1,2]
X2	Rear Surface of Vehicle to Front of Engine Block	4017	3932	85
X3	Rear Surface of Vehicle to Firewall	3539	3487	52
X4	Rear Surface of Veh. to Upper Leading Edge of Right Door	3186	3190	-4
X5	Rear Surface of Veh. to Upper Leading Edge of Left Door	3192	3161	31
X6	Rear Surface of Veh. to Lower Leading Edge of Right Door	3201	3179	22
X7	Rear Surface of Veh. to Lower Leading Edge of Left Door	3212	3168	44
X8	Rear Surface of Veh. to Upper Trailing Edge of Right Door	2244	2248	-4
X9	Rear Surface of Veh. to Upper Trailing Edge of Left Door	2252	2221	31
X10	Rear Surface of Veh. to Lower Trailing Edge of Right Door	2248	2226	22
X11	Rear Surface of Veh. to Lower Trailing Edge of Left Door	2258	2209	49
X12	Rear Surface of Veh. to Bottom of " A " Post on Right Side	3211	3211	0
X13	Rear Surface of Veh. to Bottom of " A " Post on Left Side	3223	3184	39
X14	Rear Surface of Vehicle to Firewall - Right Side	3486	3473	13
X15	Rear Surface of Vehicle to Firewall - Left Side	3490	3461	29
X16	Rear Surface of Vehicle to Steering Wheel Center	2789	2762	27
X17	Center of Steering Column to " A " Post	304	302	2
X18	Center of Steering Column to Headliner	444	448	-4
X19	Rear Surface of Vehicle to Right Side of Front Bumper	4466	4460	6
X20	Rear Surface of Vehicle to Left Side of Front Bumper	4472	N/A[1]	N/A[1]
X21	Length of Engine Block	500	500	0
RD	Rear Surface of Vehicle to Right Side of Dash Panel	3081	3089	-8
CD	Rear Surface of Vehicle to Center of Dash Panel	3036	3030	6
LD	Rear Surface of Vehicle to Left Side of Dash Panel	3062	3041	21

All distance measurements are in millimeters.

[1] Left and center portion of bumper separated during impact.

[2] The post-test measurement reported here is taken to the bumper beam without fascia; the reported difference is also affected.

Figure 16 Bullet Vehicle Crush



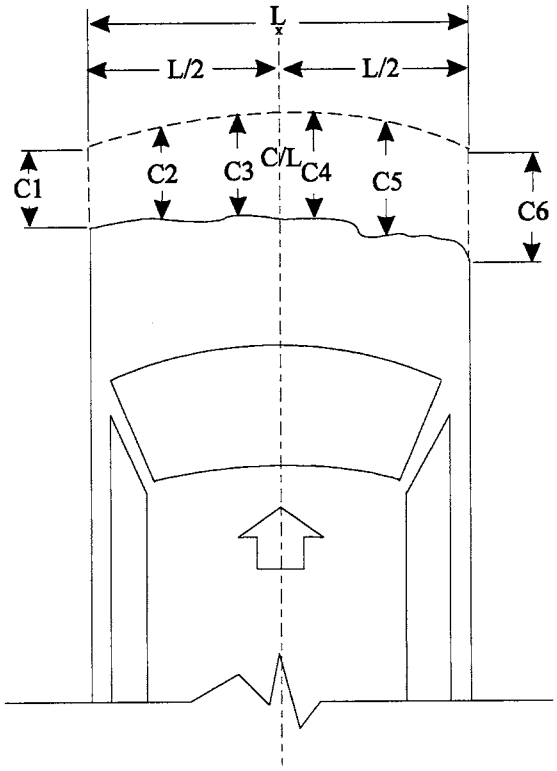
Notes: L is pre-test length of contact surface.
C1 through C6 are spaced equally apart.
CL is vehicle centerline.

Vehicle: 2001 Mitsubishi Montero Sport
Measured with bumper fascia:

Location	Pre-test	Post-test	Difference
L	1525 mm		
C1	4472 mm	N/A[1]	N/A[1]
C2	4554 mm	N/A[1]	N/A[1]
C3	4571 mm	N/A[1]	N/A[1]
C4	4569 mm	N/A[1]	N/A[1]
C5	4553 mm	4508 mm	45 mm
C6	4466 mm	4460 mm	6 mm
CL	4585 mm	N/A[1]	N/A[1]

[1] Fascia separated during impact.

Figure 16 Bullet Vehicle Crush, Cont'd.



Notes: L is pre-test length of contact surface.
C1 through C6 are spaced equally apart.
CL is vehicle centerline.

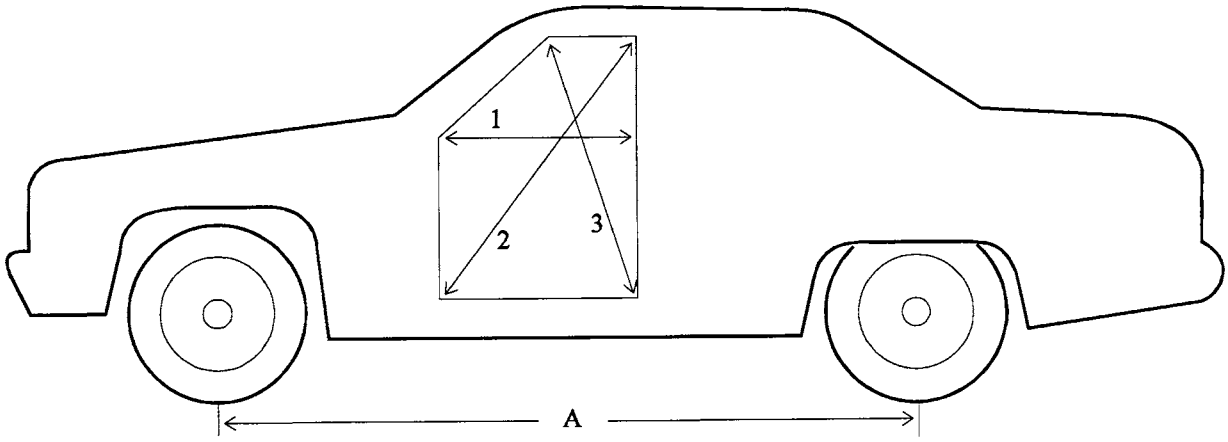
Vehicle: 2001 Mitsubishi Montero Sport
Measured to bumper beam without bumper fascia:

Location	Pre-test	Post-test	Difference
L[1]	1400 mm		
C1[1]	4484 mm	4076 mm	408 mm
C2	4536 mm	4153 mm	383 mm
C3	4570 mm	4217 mm	353 mm
C4	4568 mm	4241 mm	327 mm
C5	4536 mm	4338 mm	198 mm
C6	4484 mm	4420 mm	64 mm
CL[1]	4601 mm	4223 mm	378 mm

[1] Measurement points C1 and C6 were moved inboard to catch the end of the bumper beam.

Figure 17 Bullet Vehicle Intrusion Measurements

Door Opening Width

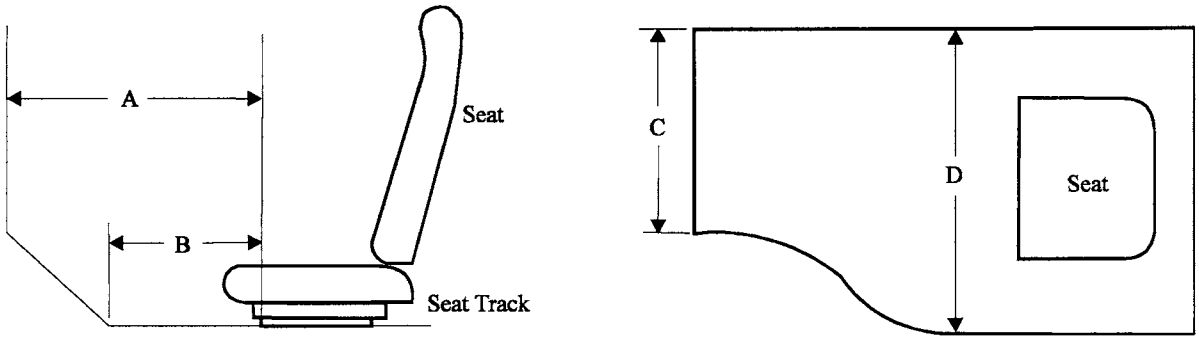


Units (mm)	Left			Right		
Measurement	1	2	3	1	2	3
Pre-Test	920 mm	1380 mm	1076 mm	920 mm	1380 mm	1070 mm
Post-Test	903 mm	1362 mm	1128 mm	924 mm	1375 mm	1077 mm
Difference	17 mm	18 mm	-52 mm	-4 mm	5 mm	-7 mm

Units (mm)	A = Wheelbase Left	A = Wheelbase Right
Pre-Test	2725 mm	2725 mm
Post-Test	2653 mm	2733 mm
Difference	72 mm	-8 mm

Figure 18 Bullet Vehicle Intrusion Measurements

Static Footwell Deformation



Driver's Side

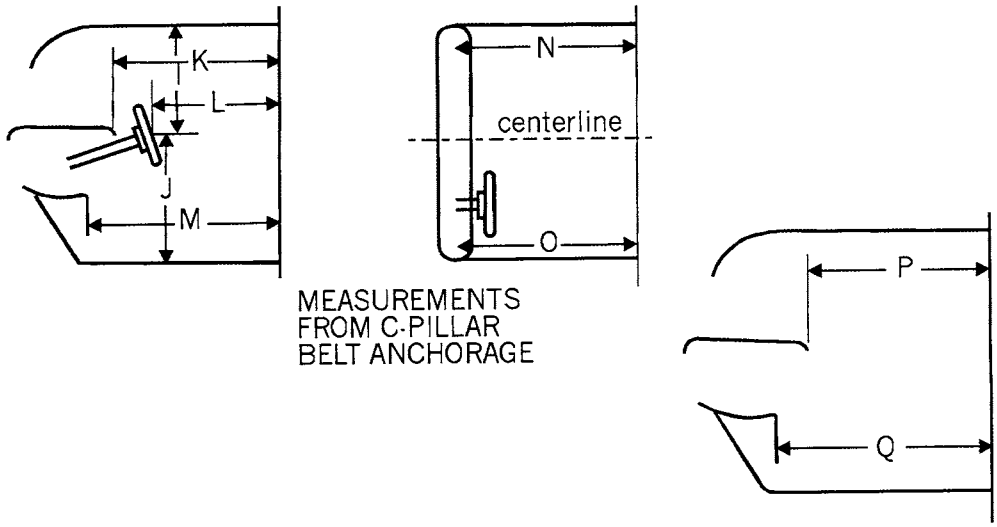
Measurement	Pre-Test	Post-Test	Difference
A	776 mm	760 mm	16 mm
B	539 mm	535 mm	4 mm
C	385 mm	375 mm	10 mm
D	435 mm	435 mm	0 mm

Passenger's Side

Measurement	Pre-Test	Post-Test	Difference
A	770 mm	758 mm	12 mm
B	565 mm	545 mm	20 mm
C	398 mm	395 mm	3 mm
D	434 mm	432 mm	2 mm

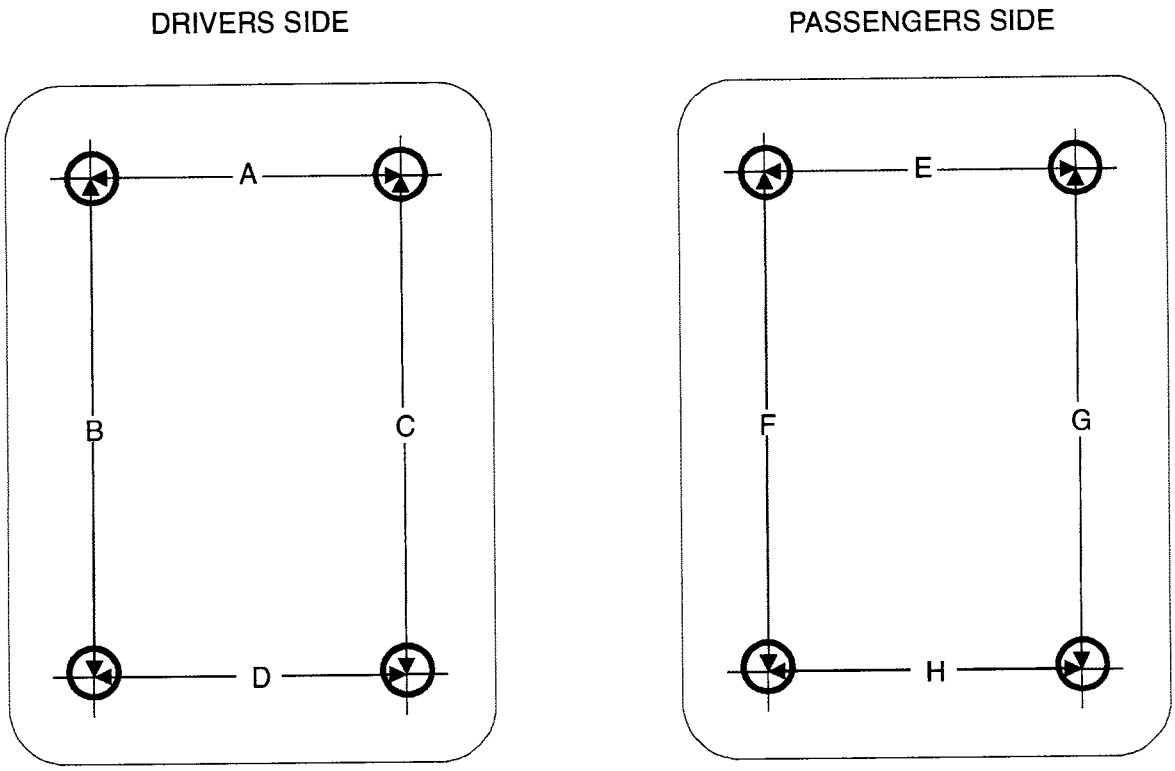
Figure 19 Bullet Vehicle Intrusion Measurements

Static Passenger Compartment Intrusion



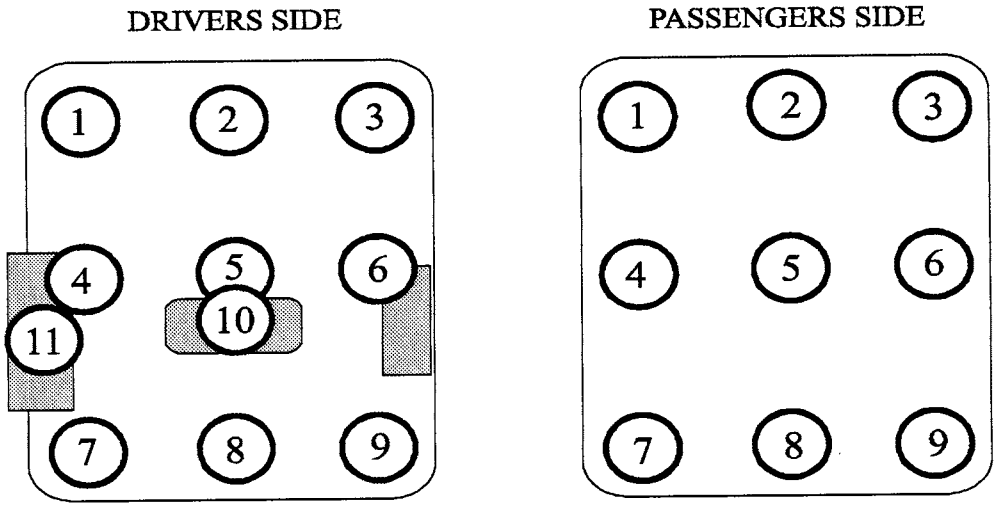
Measurement	Pre-Test	Post-Test	Difference
I	442 mm	417 mm	25 mm
J	648 mm	707 mm	-59 mm
K (driver's side)	1533 mm	1543 mm	-10 mm
L	1287 mm	1302 mm	-15 mm
M (driver's side)	1580 mm	1573 mm	7 mm
N (passenger's side)	1493 mm	1522 mm	-29 mm
O (driver's side)	1480 mm	1480 mm	0 mm
P (passenger's side)	1544 mm	1575 mm	-31 mm
Q (passenger's side)	1565 mm	1580 mm	-15 mm

Figure 20 Bullet Vehicle Floorboard Deformation



Measurement	Pre-Test	Post-Test	Difference
A	385 mm	375 mm	10 mm
B	475 mm	472 mm	3 mm
C	470 mm	475 mm	-5 mm
D	435 mm	435 mm	0 mm
E	398 mm	395 mm	3 mm
F	483 mm	483 mm	0 mm
G	483 mm	480 mm	3 mm
H	434 mm	432 mm	2 mm

Figure 21 Bullet Vehicle Toeboard Measurements



Driver's Side Toeboard Measurements in Millimeters

Toeboard Location	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
1	3456	454	614	3441	441	632	15	13	-18
2	3457	333	597	3448	323	579	9	10	18
3	3443	184	599	3446	185	613	-3	-1	-14
4	3416	454	565	3399	450	535	17	4	30
5	3392	333	555	3385	329	526	7	4	29
6	3396	184	555	3396	185	530	0	-1	25
7	3362	454	530	3351	441	515	11	13	15
8	3345	333	530	3340	335	485	5	-2	45
9	3345	184	537	3345	185	480	0	-1	57
10	3290	335	670	3280	339	669	10	-4	1
11	3347	546	593	3312	523	663	35	23	-70

Passenger's Side Toeboard Measurements in Millimeters

Toeboard Location	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
1	3472	233	635	3470	225	660	2	8	-25
2	3471	353	615	3470	341	648	1	12	-33
3	3473	468	625	3470	458	617	3	10	8
4	3418	233	570	3415	225	578	3	8	-8
5	3413	343	555	3410	335	575	3	8	-20
6	3422	468	575	3421	460	575	1	8	0
7	3359	233	511	3353	225	515	6	8	-4
8	3354	348	506	3351	340	515	3	8	-9
9	3373	478	536	3375	470	528	-2	8	8

Pre- and post-test measurement reference: +X forward from rear bumper; +Y from centerline; +Z upward from ground level

Table 18 Bullet Vehicle Intrusion of Upper Instrument Panel

Pre-Test	X	Y	Z
Driver Left Knee	3012	485	958
Driver Right Knee	3009	187	920
Passenger Left Knee	3012	250	N/A
Passenger Right Knee	3009	481	N/A
Steering Wheel	2789	370	1115
Driver Front Outboard Seat Attachment Bolt	2766	570	545
Pass. Front Outboard Seat Attachment Bolt	2754	566	545

Post-Test	X	Y	Z
Driver Left Knee	2981	484	950
Driver Right Knee	2979	195	958
Passenger Left Knee	3004	251	N/A
Passenger Right Knee	3009	483	N/A
Steering Wheel	2762	370	1202
Driver Front Outboard Seat Attachment Bolt	2705	549	544
Pass. Front Outboard Seat Attachment Bolt	2721	559	545

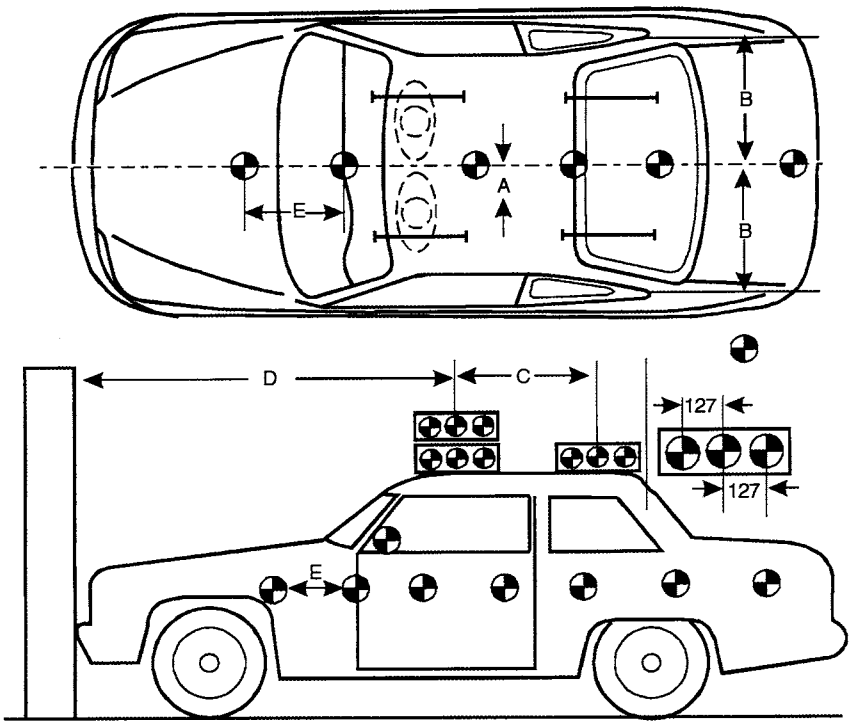
Difference	X	Y	Z
Driver Left Knee	31	1	8
Driver Right Knee	30	-8	-38
Passenger Left Knee	8	-1	N/A
Passenger Right Knee	0	-2	N/A
Steering Wheel	27	0	-87
Driver Front Outboard Seat Attachment Bolt	61	21	1
Pass. Front Outboard Seat Attachment Bolt	33	7	0

All measurements are in millimeters.

Knee intrusions are points measured pre-test and post-test, which are located just above where the four knees would be expected to contact the instrument panel.

Pre-test and post-test measurement references: +X, forward of rear bumper; +Y, from vehicle centerline; +Z, upward from ground level.

Figure 22 Bullet Vehicle Reference Photo Target Locations



Measurement	Pre-Test
A	Left 395 mm Right 395 mm
B	N/A
C	Left 614 mm Right 615 mm
D	N/A
E[1]	300 mm

[1] The first side target is placed 600 mm from front edge of bumper, and others are at 300 mm intervals.

Figure 23 Camera Positions

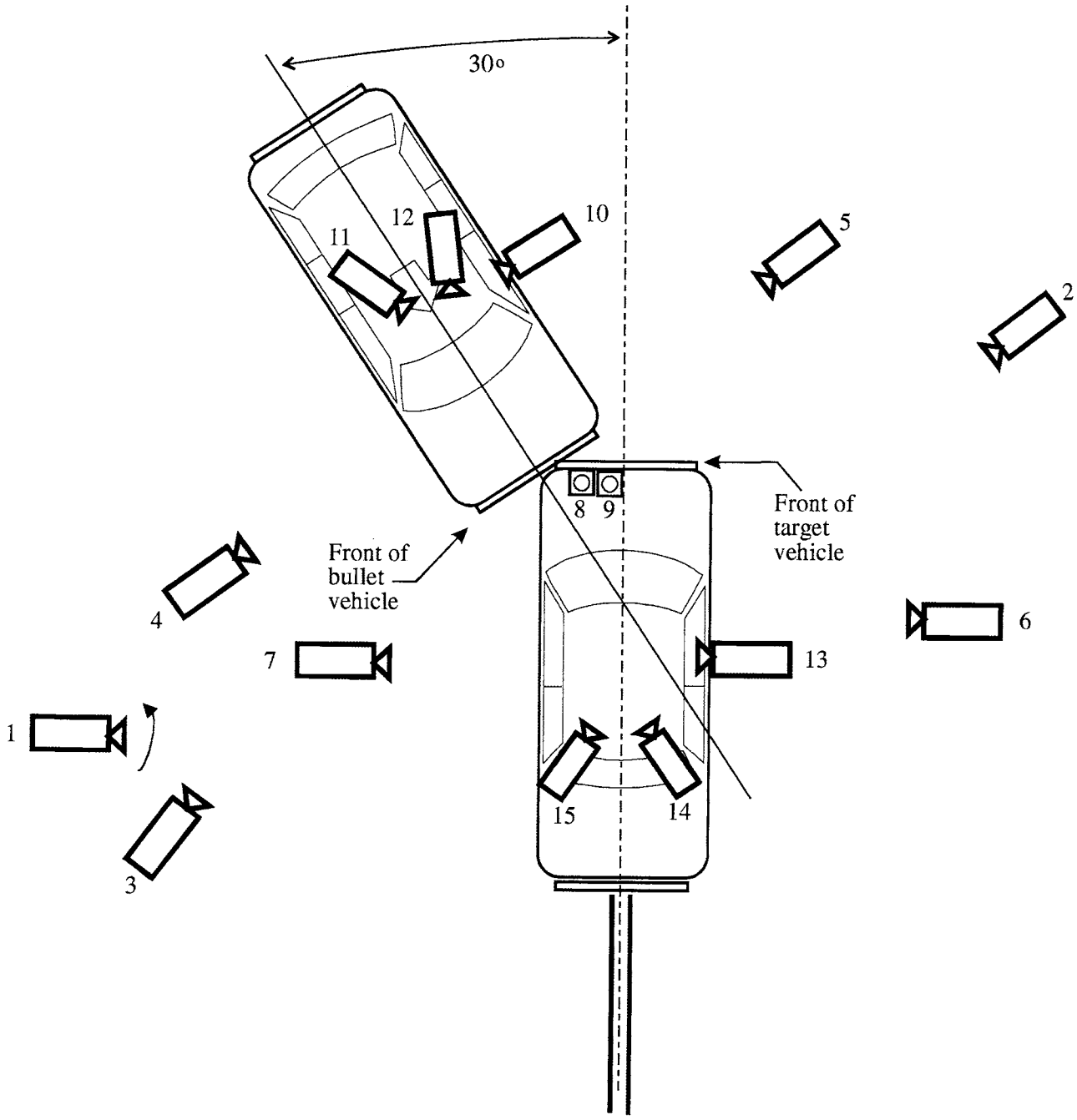


Table 19 Camera Information

Camera Number	Location	Type	Lens (mm)	Speed (fps)	Purpose of camera data
1	Panning	Bolex		24	Vehicle dynamics
2	Right wide (referenced to target vehicle)	Photosonic	13	1005	Vehicle dynamics
3	Left wide (referenced to target vehicle)	Photosonic	13	997	Vehicle dynamics
4	Bullet vehicle right medium	Photosonic	25	N/A[1]	Vehicle dynamics
5	Bullet vehicle left medium	Photosonic	25	N/A[1]	Vehicle dynamics
6	Target vehicle right medium	Photosonic	25	990	Vehicle dynamics
7	Target vehicle left medium	Photosonic	25	985	Vehicle dynamics
8	Overhead wide	Photosonic	8.5	N/A[2]	Vehicle dynamics
9	Overhead tight	Photosonic	25	N/A[2]	Vehicle crush
10	Onboard bullet vehicle - side	Digital HG	8	1000	Dummy kinematics
11	Onboard bullet vehicle - driver	Digital HG	8	1000	Dummy kinematics
12	Onboard bullet vehicle - passenger	Digital HG	8	1000	Dummy kinematics
13	Onboard target vehicle - driver torso	Digital HG	8	1000	Dummy kinematics
14	Onboard target vehicle - driver legs	Digital HG	8	1000	Dummy kinematics
15	Onboard target vehicle - driver over shoulder	Digital HG	8	1000	Dummy kinematics

[1] Camera did not run or started too late to view crash event.
[2] No LEDs to time film.

Appendix A

Photographs

Figure A-1 Pre-Test Overall - View 1

Figure A-2 Pre-Test Overall - View 2

Figure A-3 Pre-Test Overall - View 3

Figure A-4 Pre-Test Overall - View 4

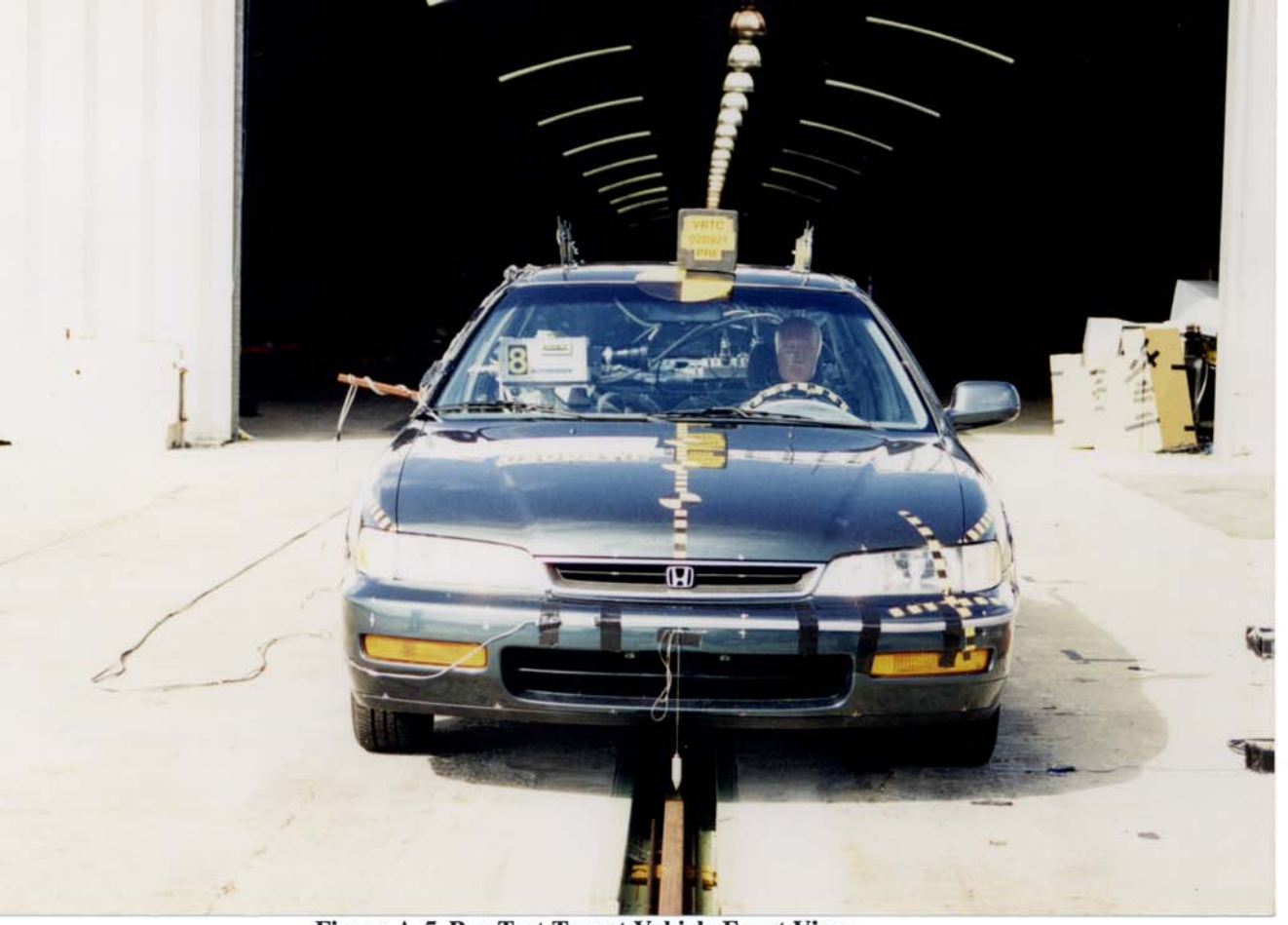


Figure A-5 Pre-Test Target Vehicle Front View

Figure A-6 Post-Test Target Vehicle Front View

Figure A-7 Pre-Test Target Vehicle Left Front View

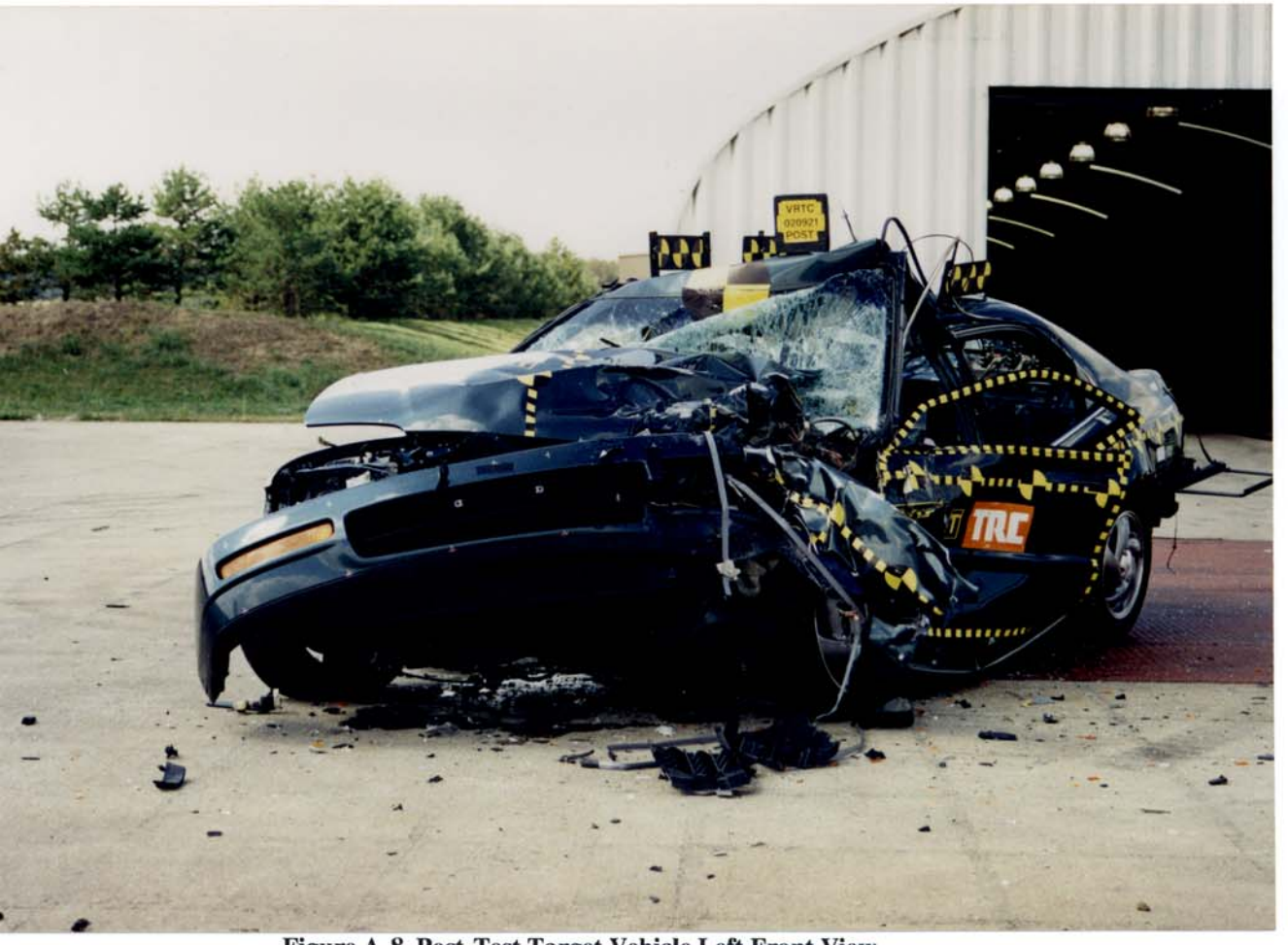


Figure A-8 Post-Test Target Vehicle Left Front View

Figure A-9 Pre-Test Target Vehicle Left Side View

Figure A-10 Post-Test Target Vehicle Left Side View

Figure A-11 Pre-Test Target Vehicle Left Rear View

Figure A-12 Post-Test Target Vehicle Left Rear View

Figure A-13 Pre-Test Target Vehicle Rear View

Figure A-14 Post-Test Target Vehicle Rear View

Figure A-15 Pre-Test Target Vehicle Right Side View

Figure A-16 Post-Test Target Vehicle Right Side View

Figure A-17 Pre-Test Target Vehicle Right Front View

Figure A-18 Post-Test Target Vehicle Right Front View

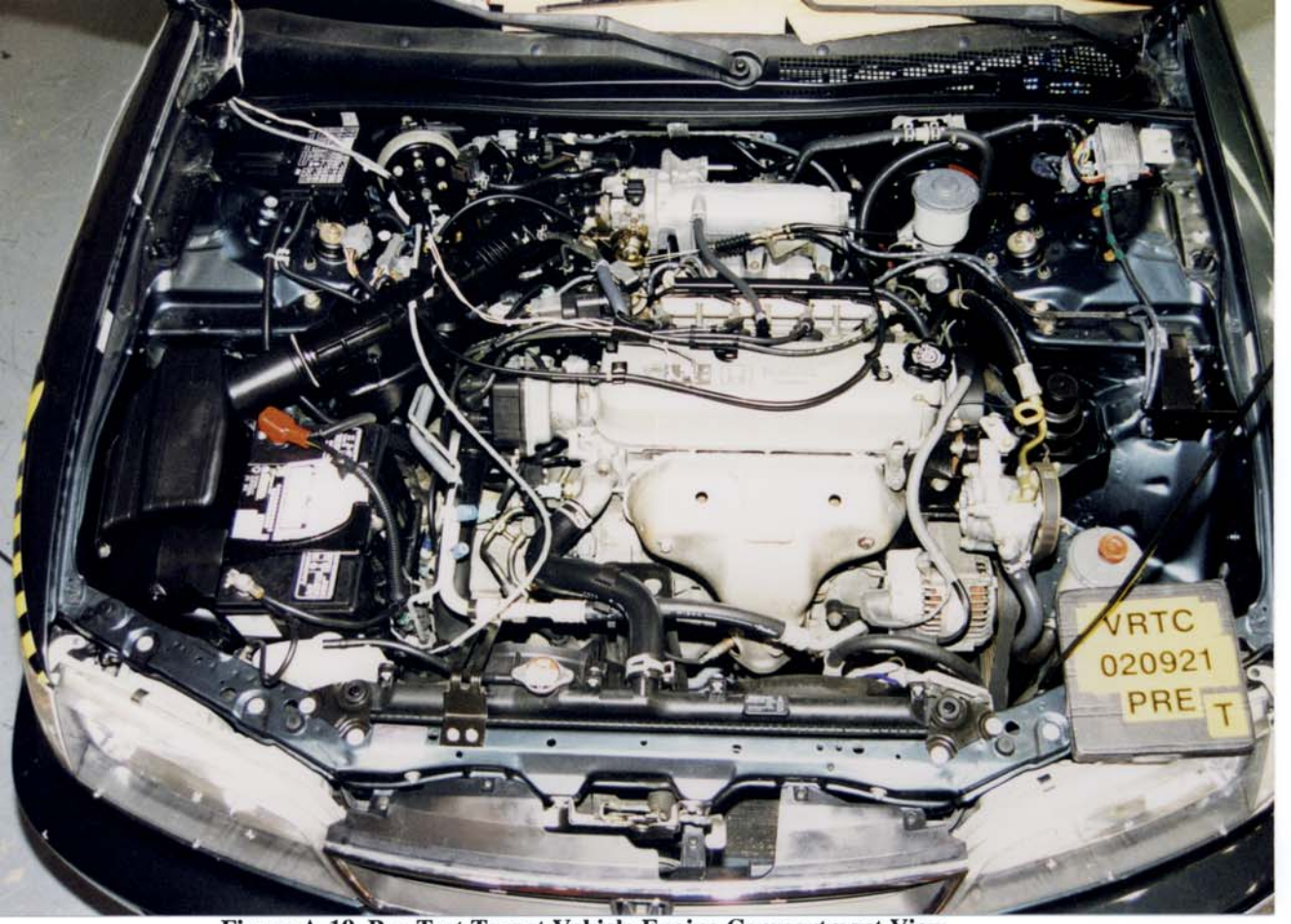


Figure A-19 Pre-Test Target Vehicle Engine Compartment View

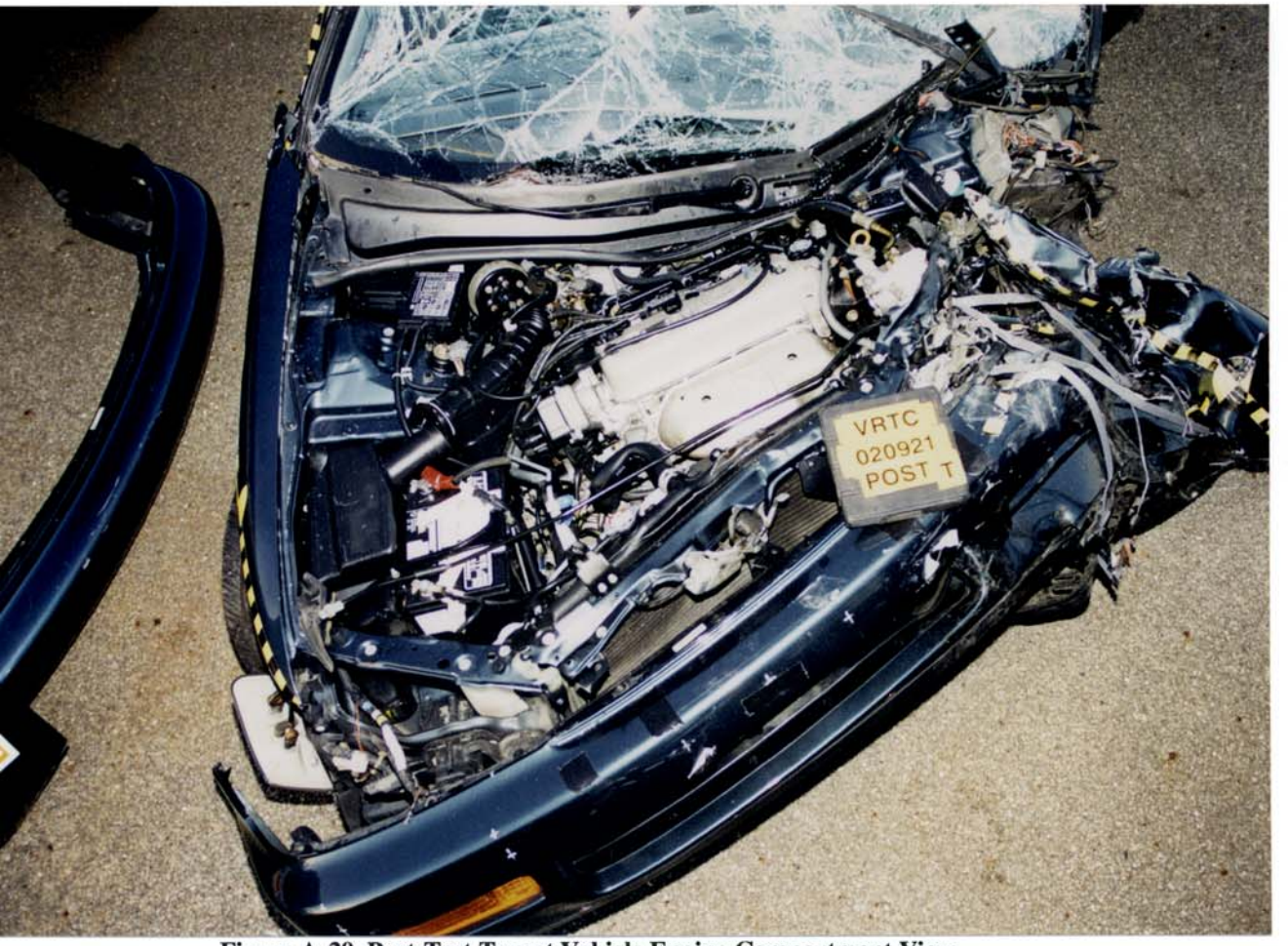


Figure A-20 Post-Test Target Vehicle Engine Compartment View

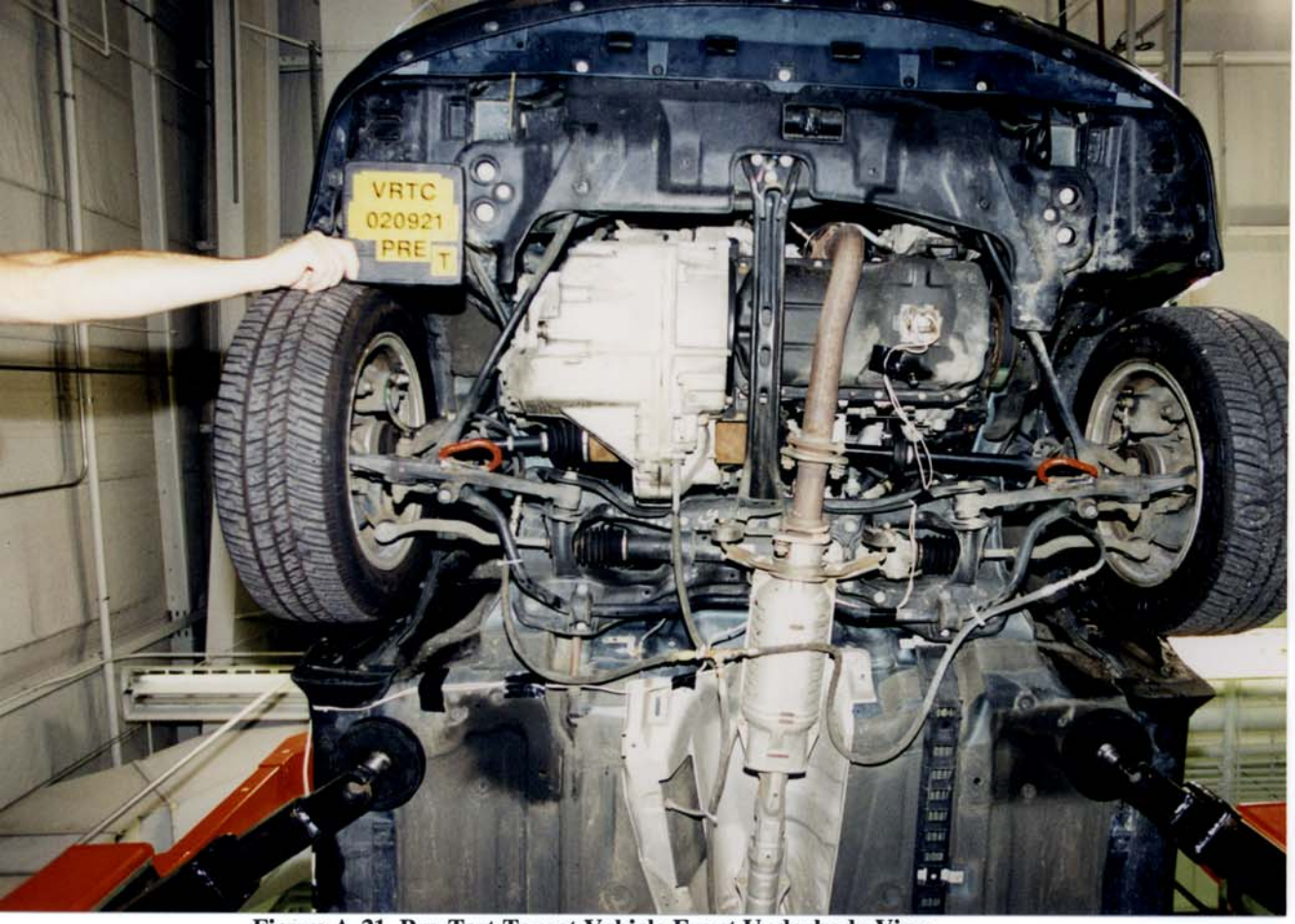


Figure A-21 Pre-Test Target Vehicle Front Underbody View

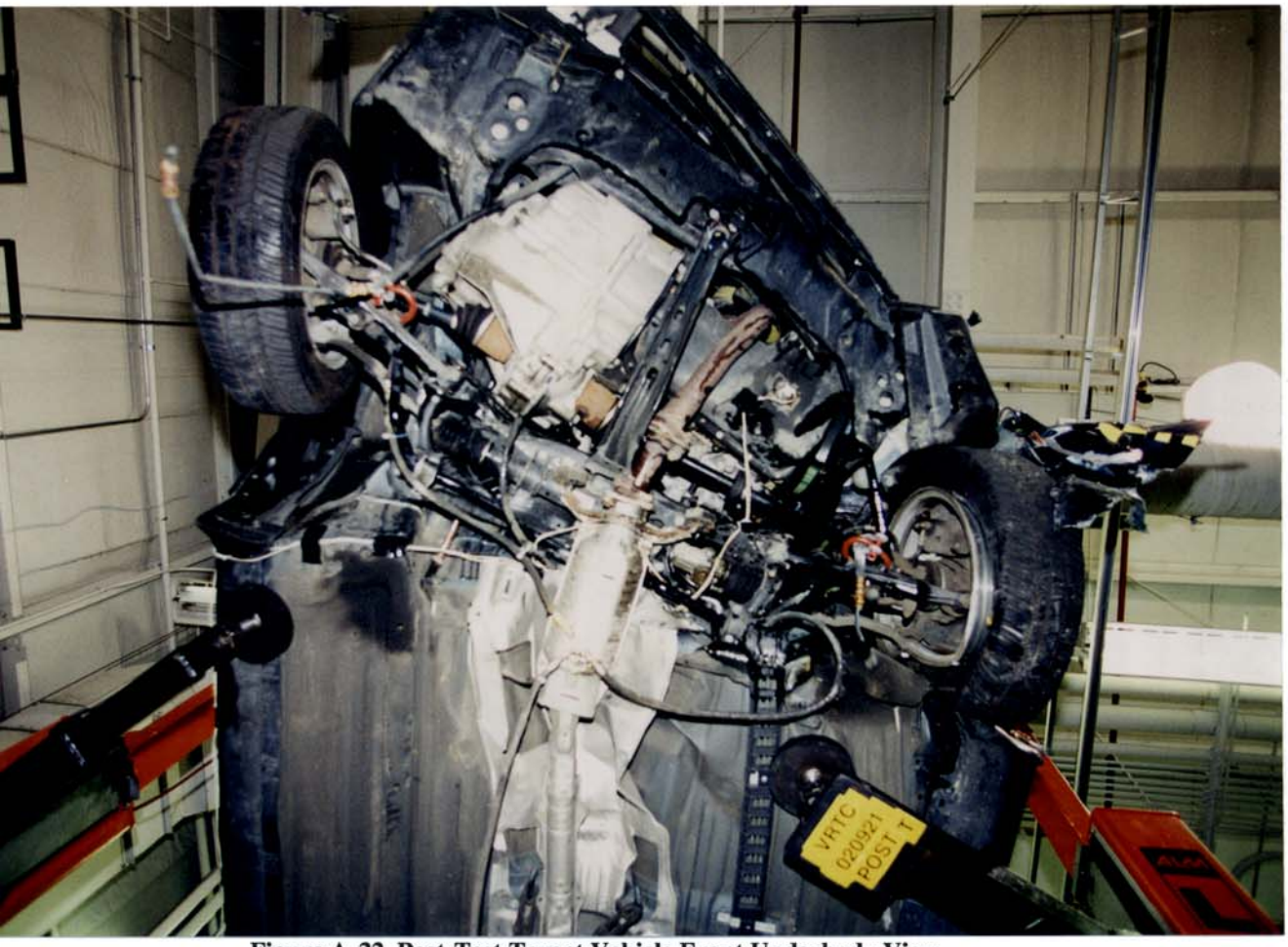


Figure A-22 Post-Test Target Vehicle Front Underbody View

Figure A-23 Pre-Test Target Vehicle Mid Underbody View

Figure A-24 Post-Test Target Vehicle Mid Underbody View

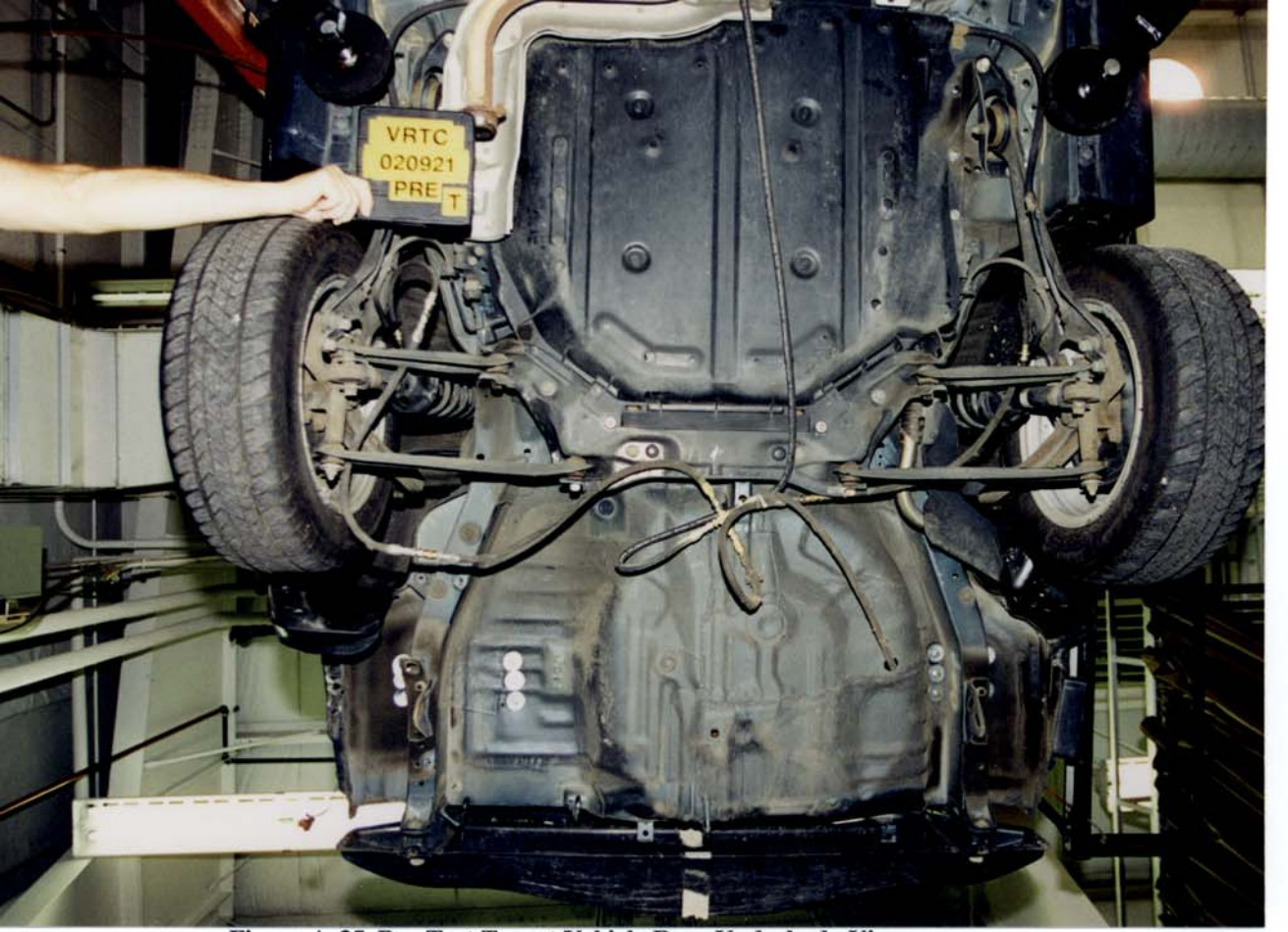


Figure A-25 Pre-Test Target Vehicle Rear Underbody View

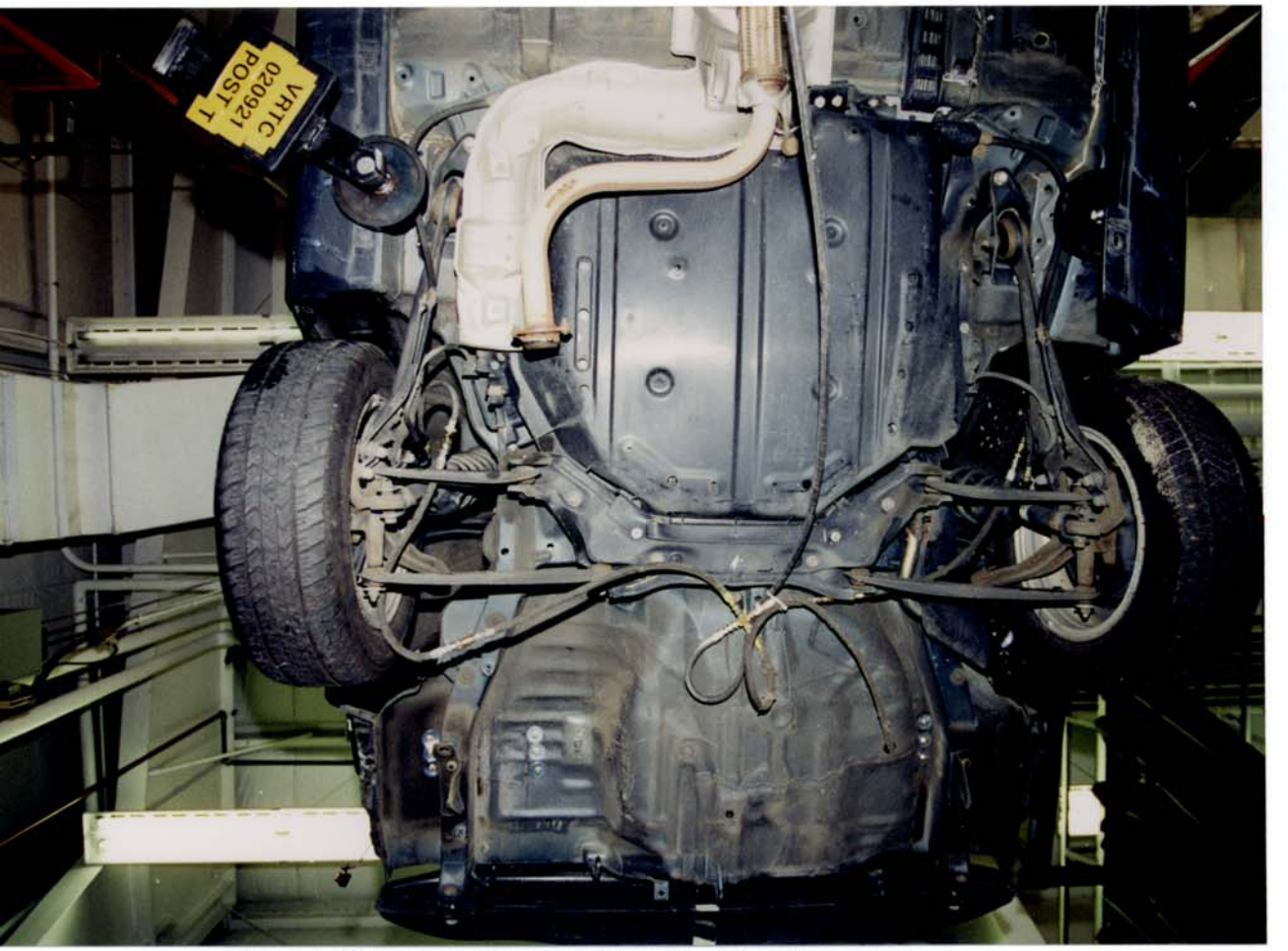


Figure A-26 Post-Test Target Vehicle Rear Underbody View

Figure A-27 Pre-Test Bullet Vehicle Front View

Figure A-28 Post-Test Bullet Vehicle Front View

Figure A-29 Pre-Test Bullet Vehicle Left Front View

Figure A-30 Post-Test Bullet Vehicle Left Front View

Figure A-31 Pre-Test Bullet Vehicle Left Side View

Figure A-32 Post-Test Bullet Vehicle Left Side View

Figure A-33 Pre-Test Bullet Vehicle Left Rear View

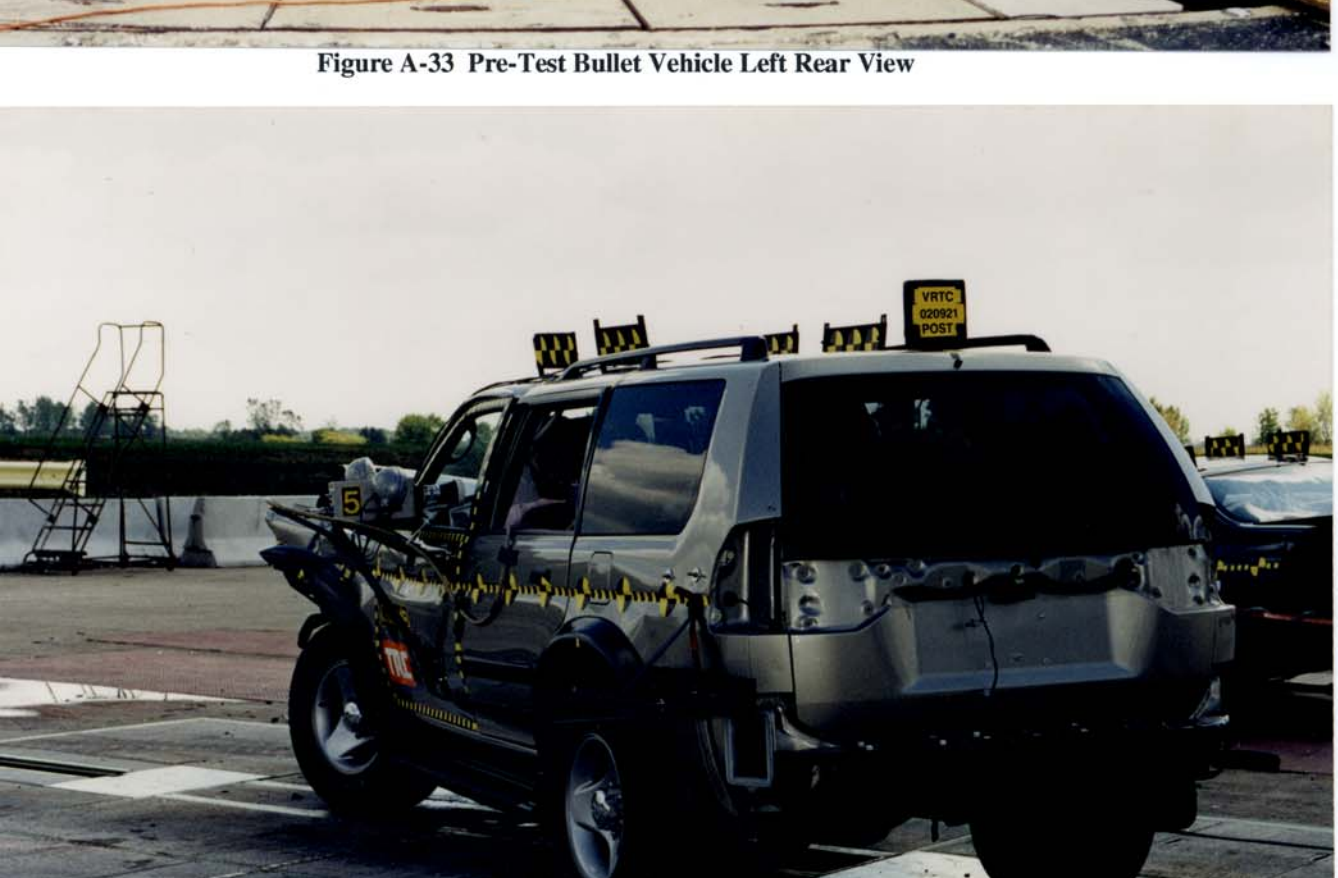


Figure A-34 Post-Test Bullet Vehicle Left Rear View

Figure A-35 Pre-Test Bullet Vehicle Rear View

Figure A-36 Post-Test Bullet Vehicle Rear View

Figure A-37 Pre-Test Bullet Vehicle Right Rear View

Figure A-38 Post-Test Bullet Vehicle Right Rear View

Figure A-39 Pre-Test Bullet Vehicle Right Side View

Figure A-40 Post-Test Bullet Vehicle Right Side View

Figure A-41 Pre-Test Bullet Vehicle Right Front View

Figure A-42 Post-Test Bullet Vehicle Right Front View

Figure A-43 Pre-Test Windshield View

Figure A-44 Post-Test Windshield View

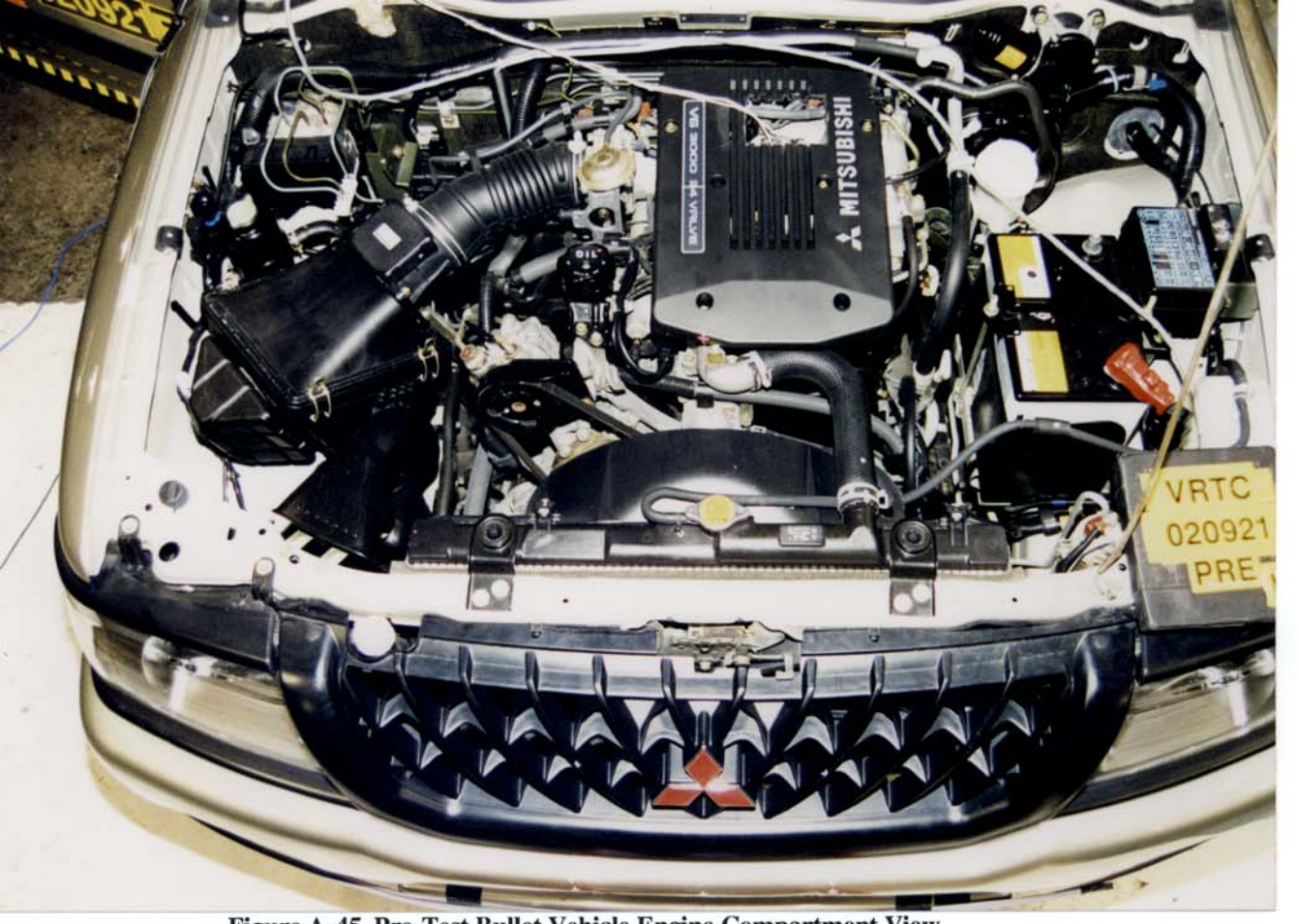


Figure A-45 Pre-Test Bullet Vehicle Engine Compartment View

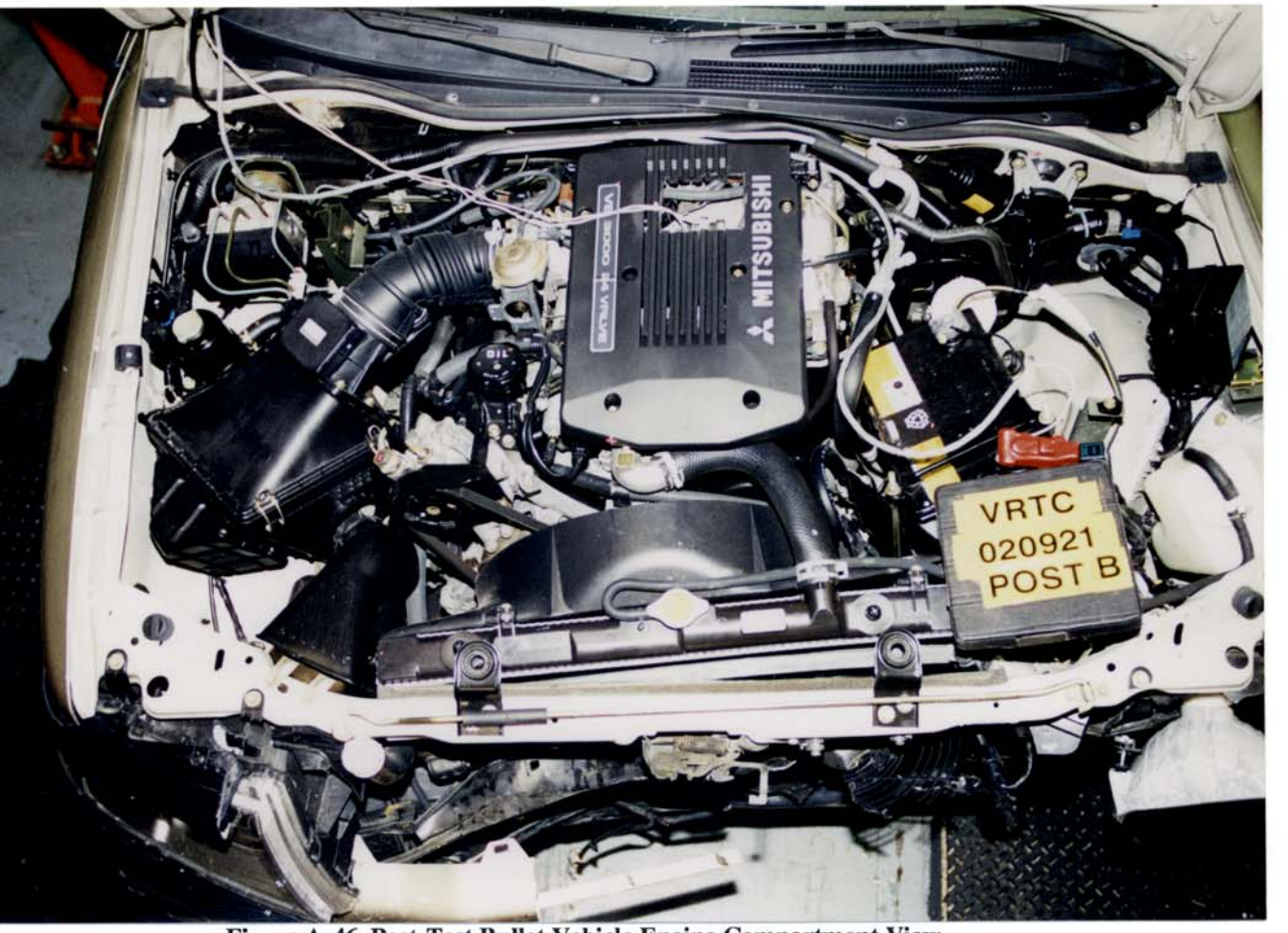


Figure A-46 Post-Test Bullet Vehicle Engine Compartment View

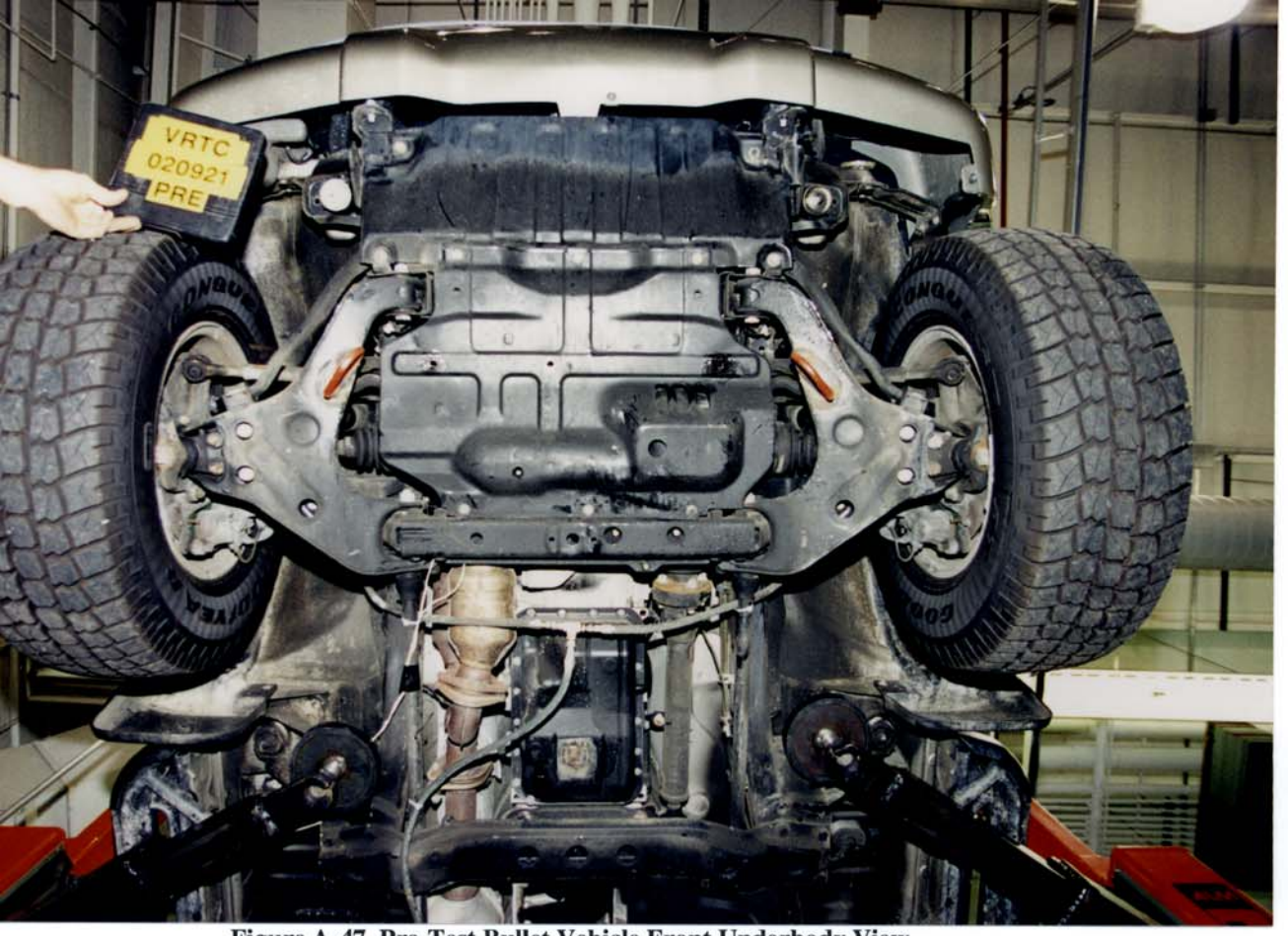


Figure A-47 Pre-Test Bullet Vehicle Front Underbody View

Figure A-48 Post-Test Bullet Vehicle Front Underbody View

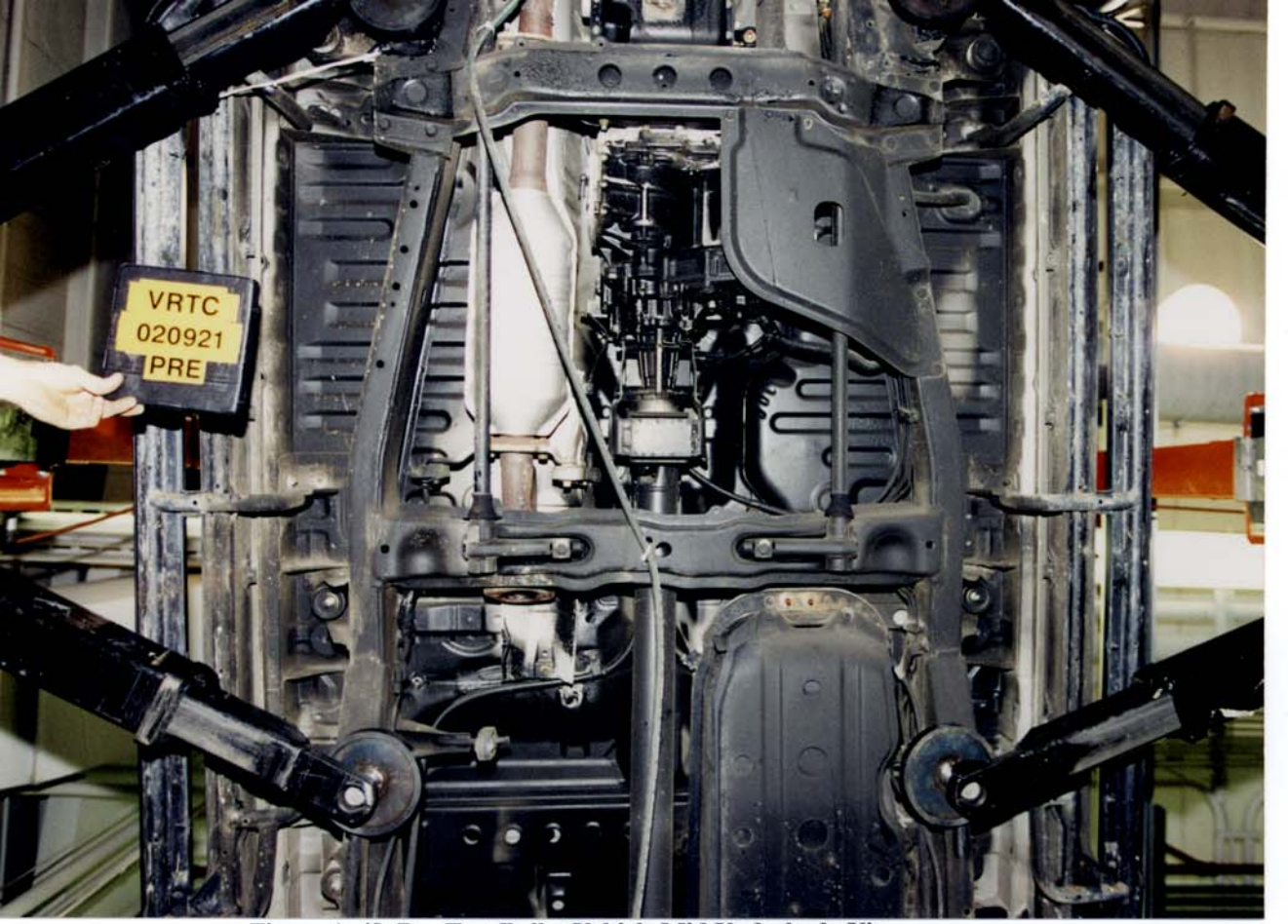


Figure A-49 Pre-Test Bullet Vehicle Mid Underbody View

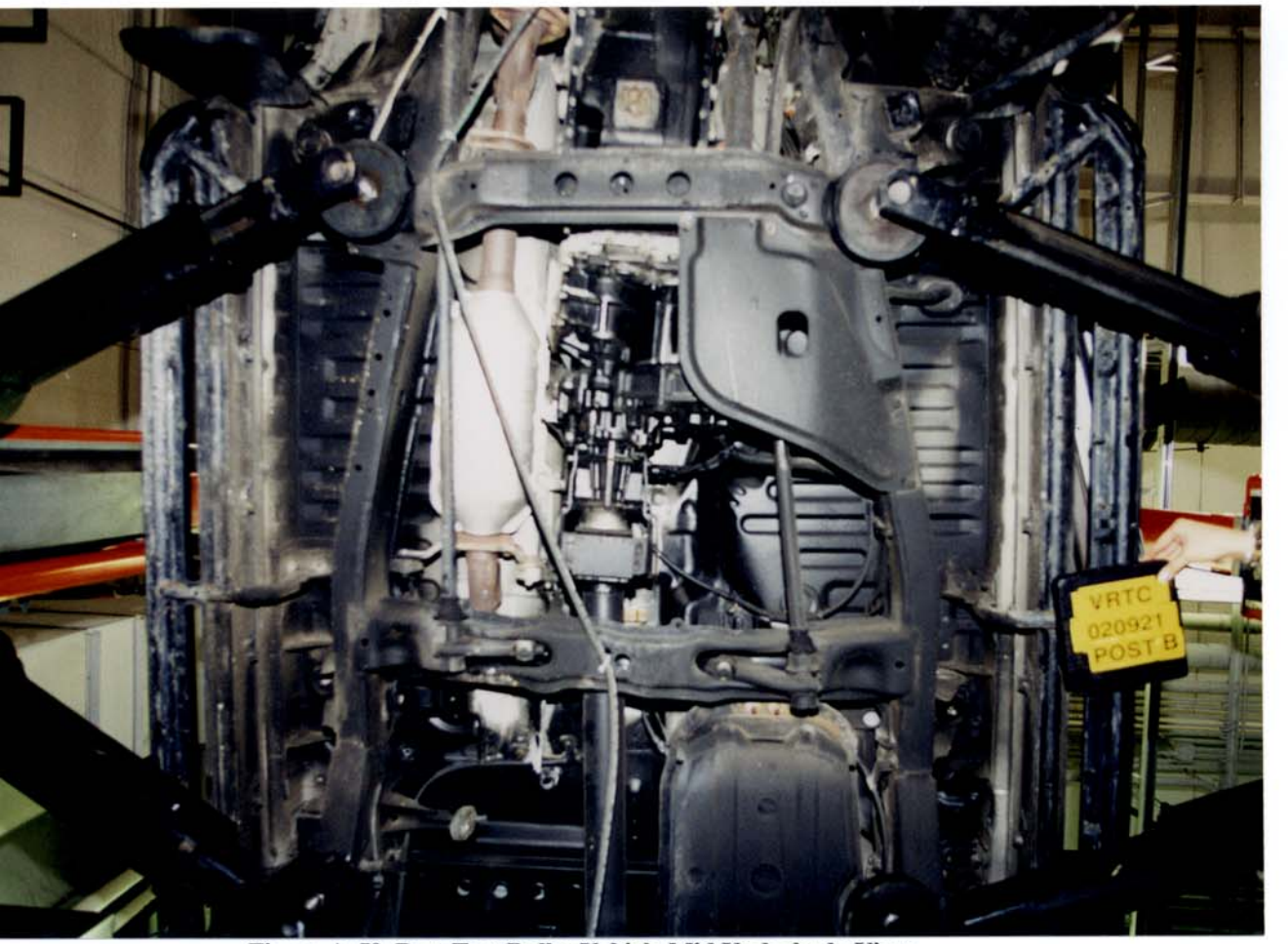


Figure A-50 Post-Test Bullet Vehicle Mid Underbody View

Figure A-51 Pre-Test Bullet Vehicle Rear Underbody View

Figure A-52 Post-Test Bullet Vehicle Rear Underbody View

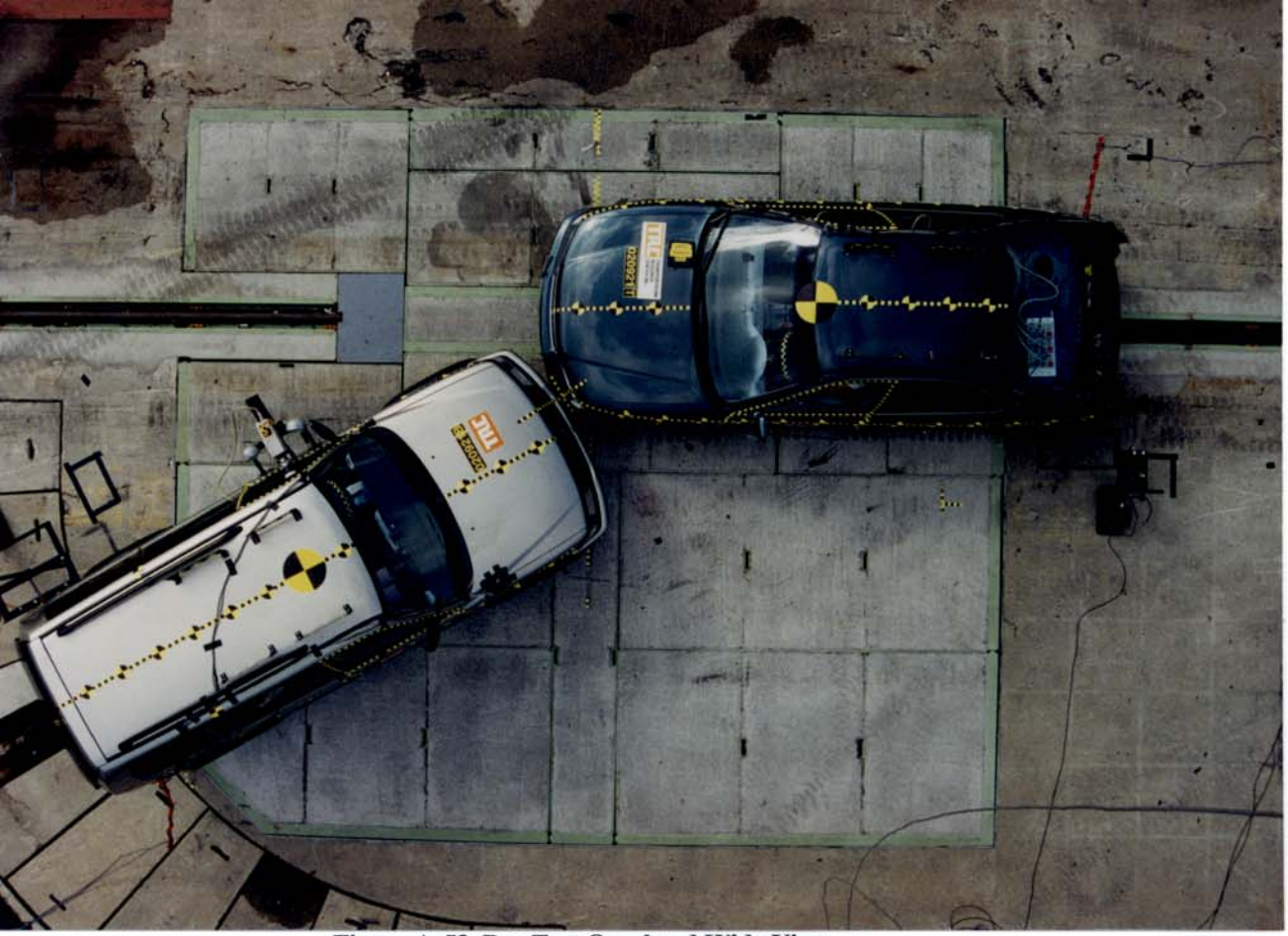


Figure A-53 Pre-Test Overhead Wide View

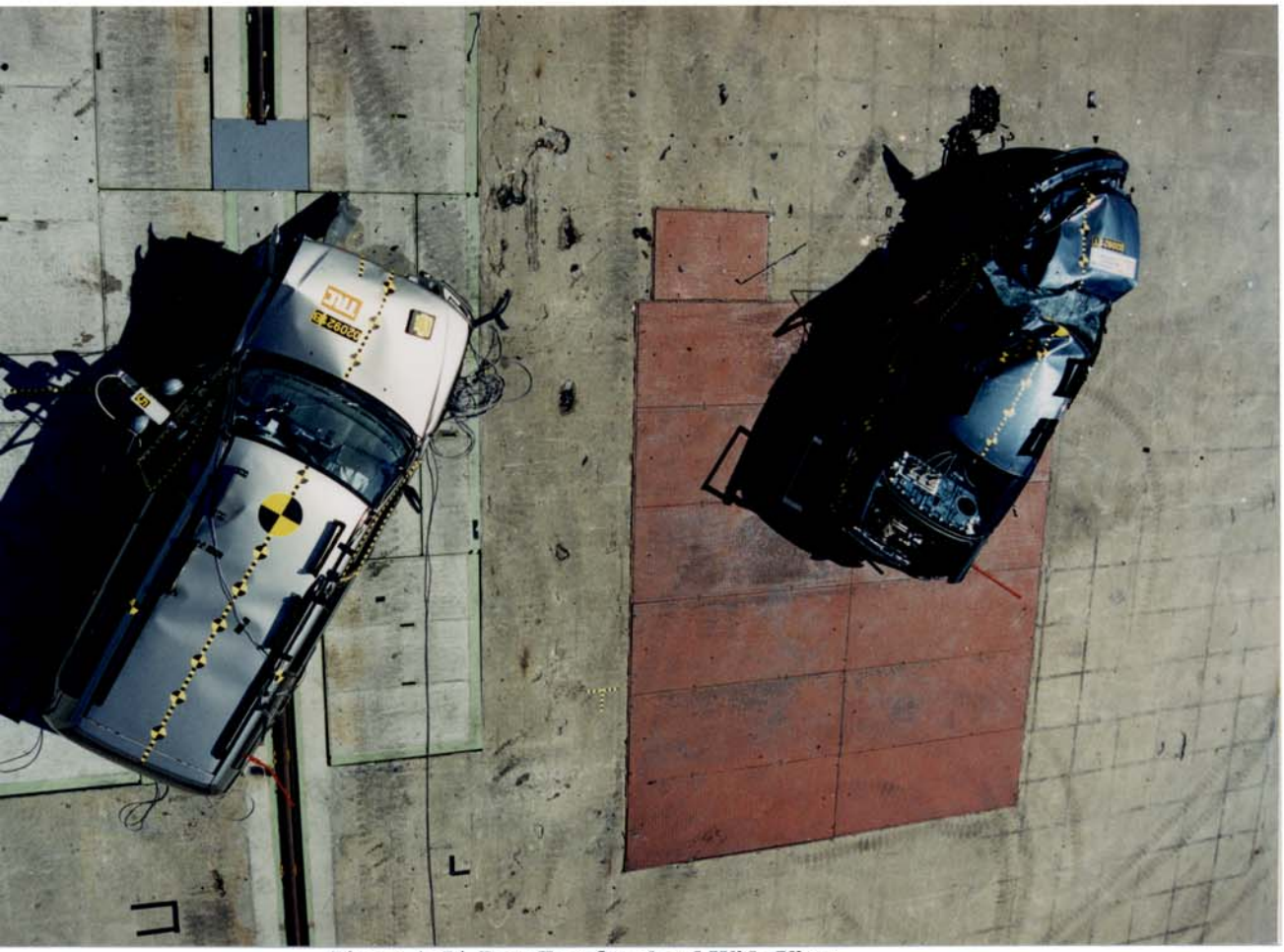


Figure A-54 Post-Test Overhead Wide View

Figure A-55 Pre-Test Overhead Close-Up View

Intentionally Left Blank

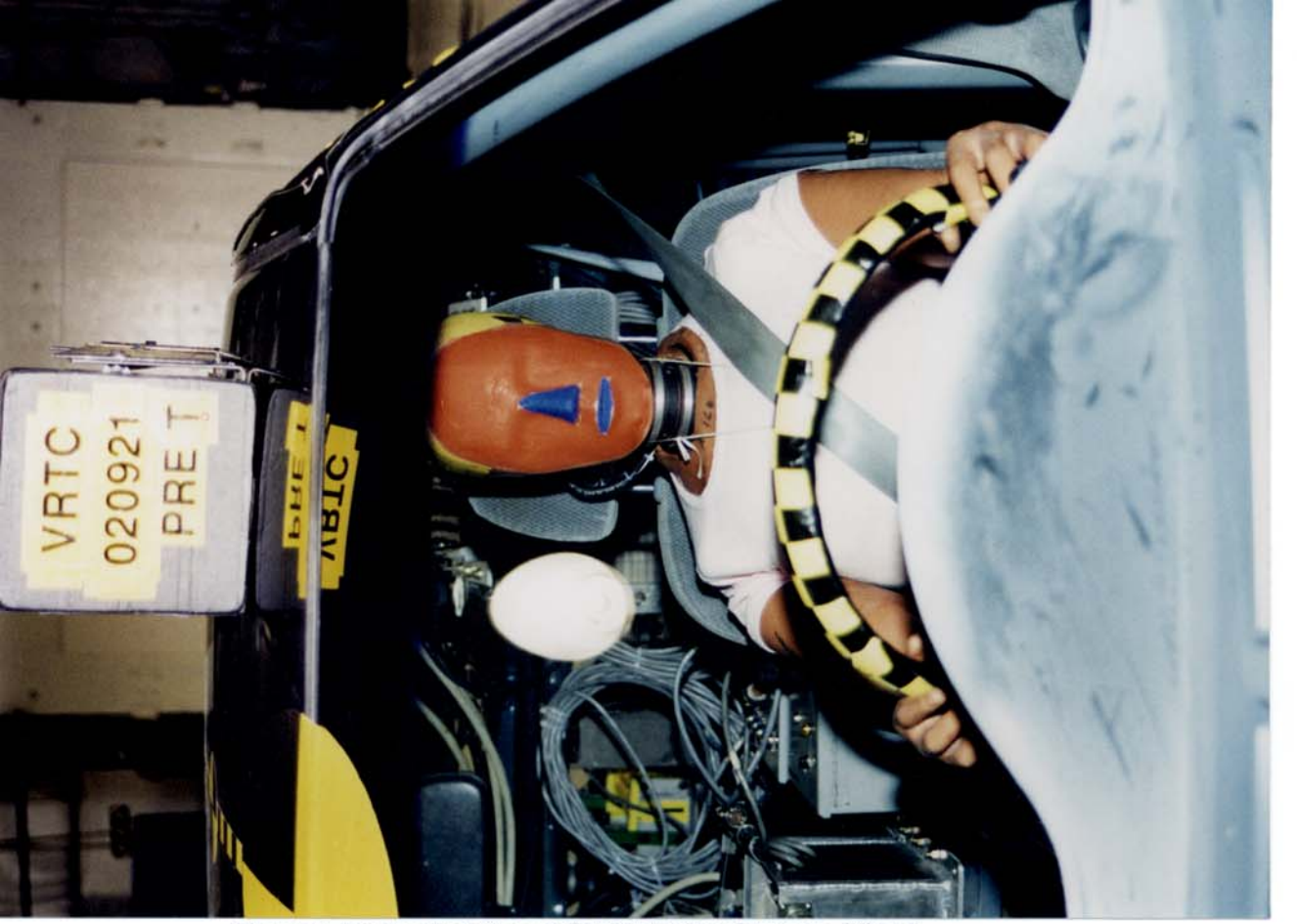


Figure A-56 Pre-Test Target Vehicle Driver Dummy - View 1

Figure A-57 Post-Test Target Vehicle Driver Dummy - View 1

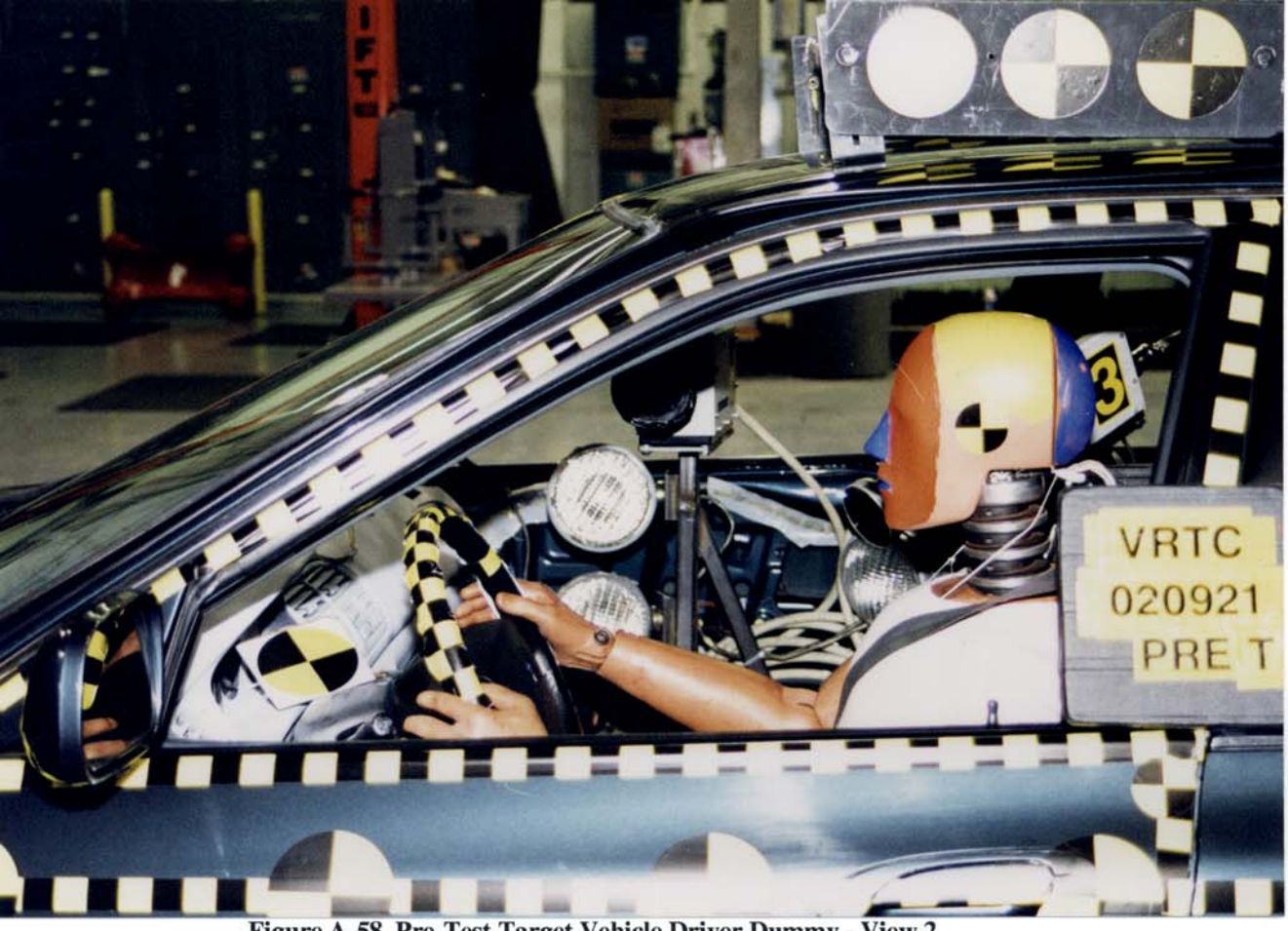


Figure A-58 Pre-Test Target Vehicle Driver Dummy - View 2

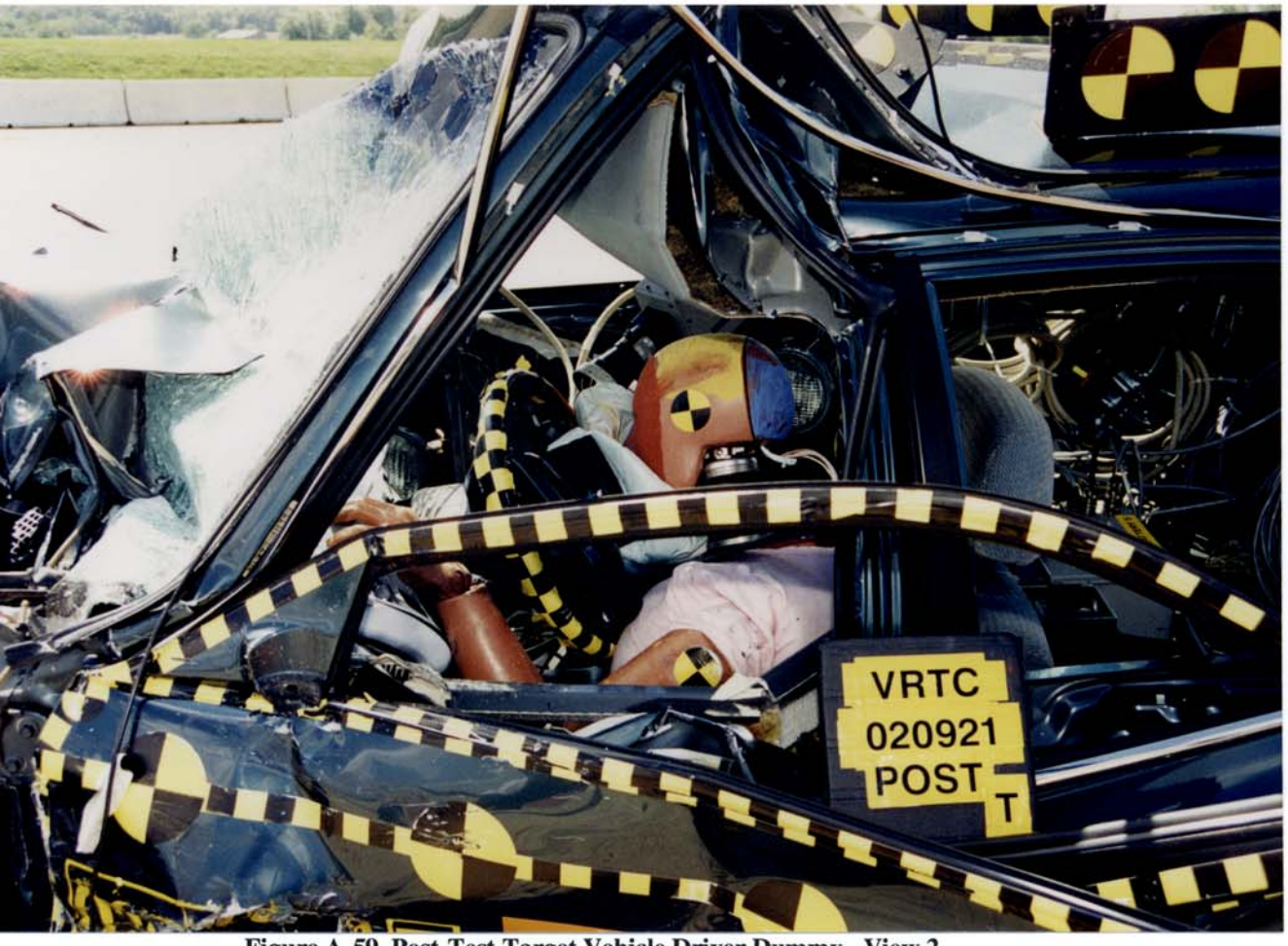


Figure A-59 Post-Test Target Vehicle Driver Dummy - View 2

Figure A-60 Pre-Test Target Vehicle Driver Dummy - View 3

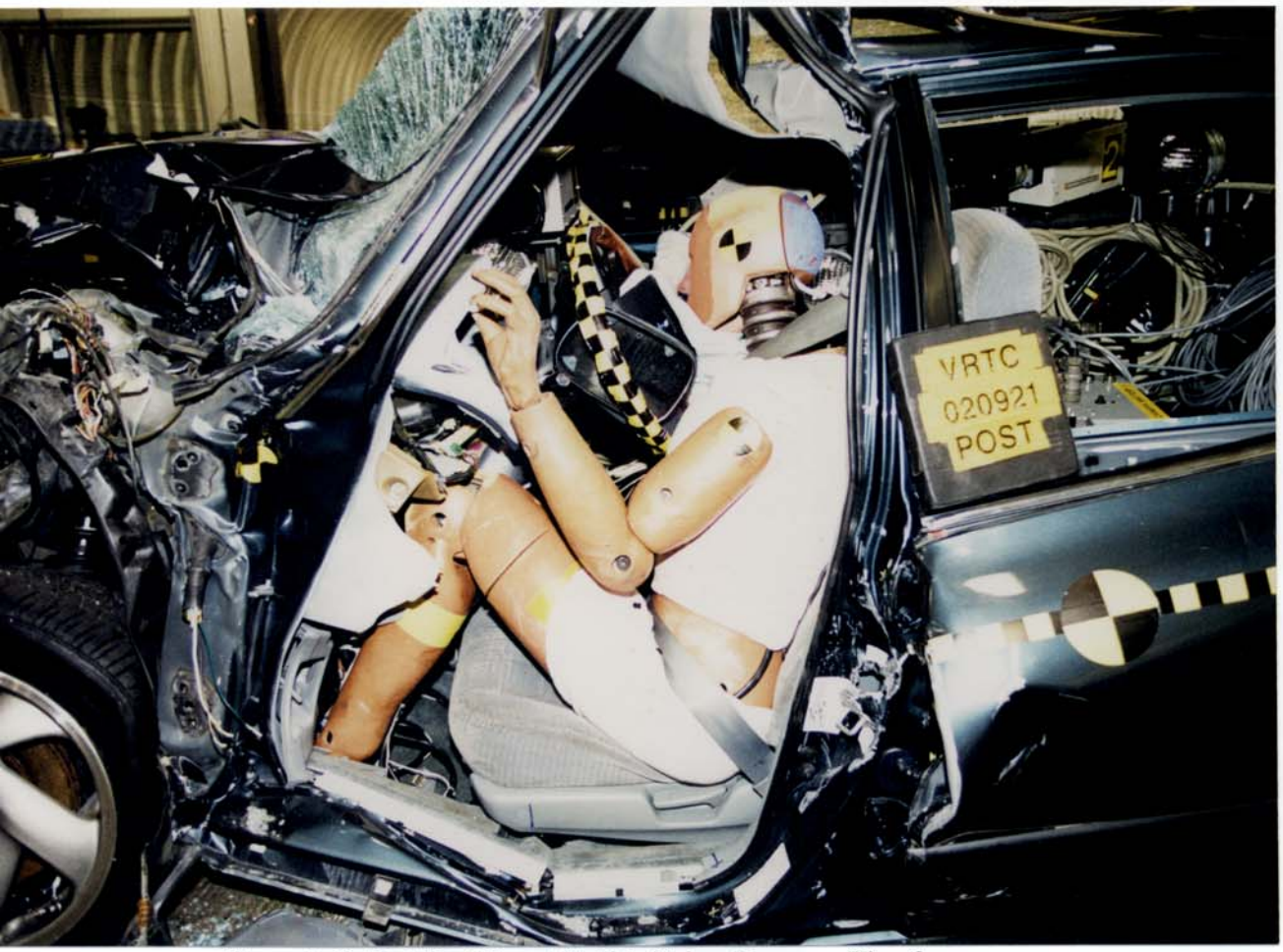


Figure A-61 Post-Test Target Vehicle Driver Dummy - View 3

Figure A-62 Pre-Test Target Vehicle Driver Dummy - View 4

Figure A-63 Post-Test Target Vehicle Driver Dummy - View 4

Figure A-64 Pre-Test Bullet Vehicle Driver and Passenger Dummies through Windshield View

Figure A-65 Post-Test Bullet Vehicle Driver and Passenger Dummies through Windshield View

Figure A-66 Pre-Test Bullet Vehicle Driver Dummy - View 1

Figure A-67 Post-Test Bullet Vehicle Driver Dummy - View 1

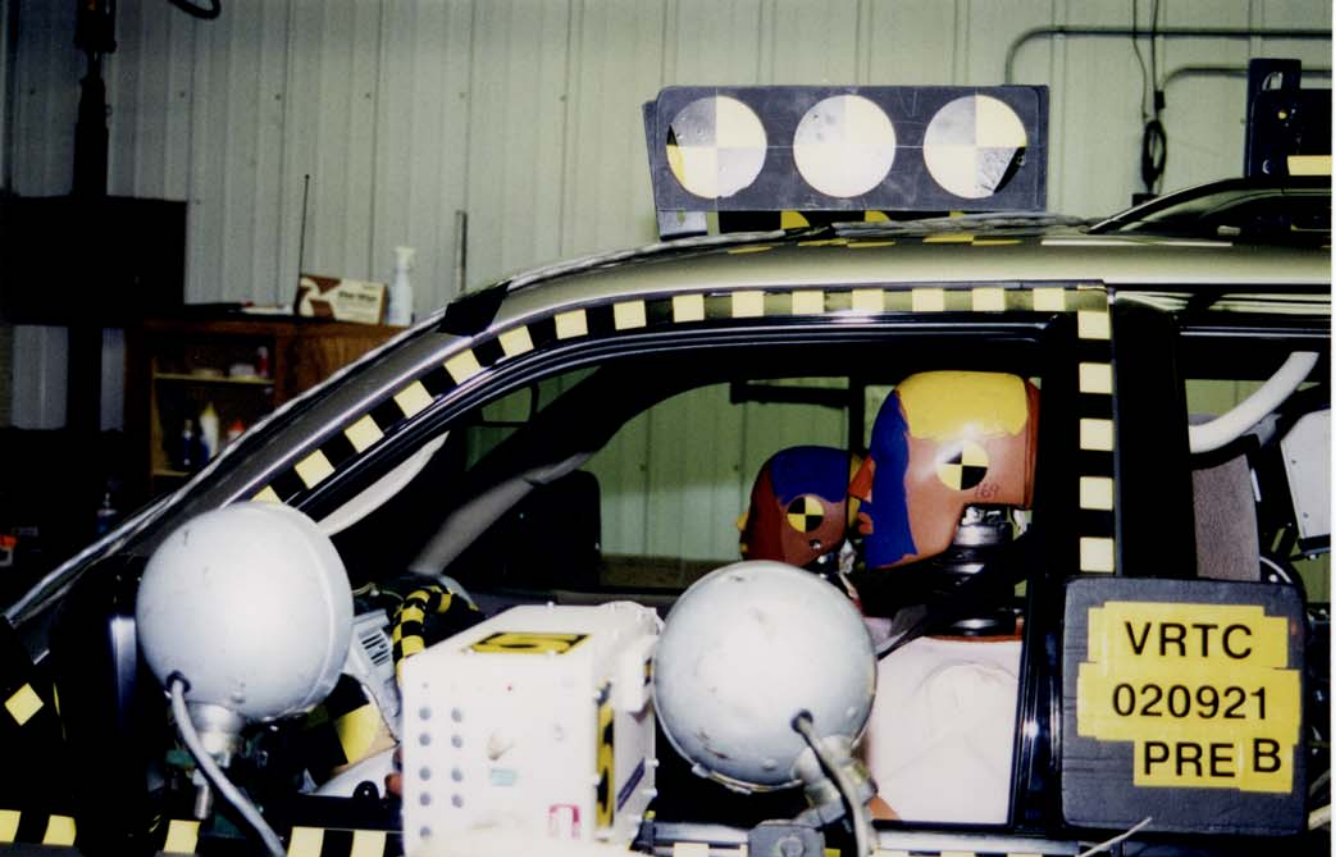


Figure A-68 Pre-Test Bullet Vehicle Driver Dummy - View 2

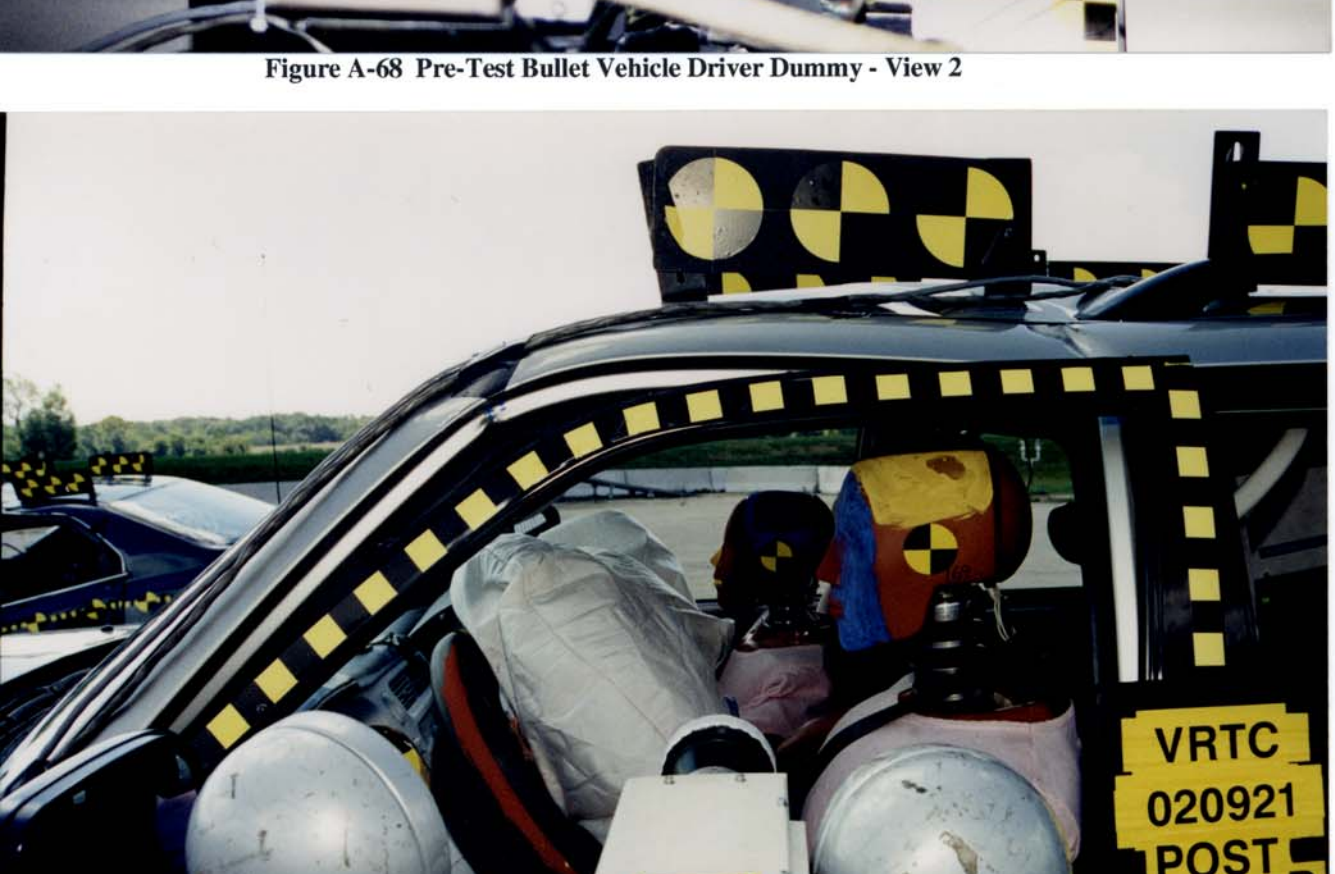


Figure A-69 Post-Test Bullet Vehicle Driver Dummy - View 2

Figure A-70 Pre-Test Bullet Vehicle Driver Dummy - View 3

Figure A-71 Post-Test Bullet Vehicle Driver Dummy - View 3

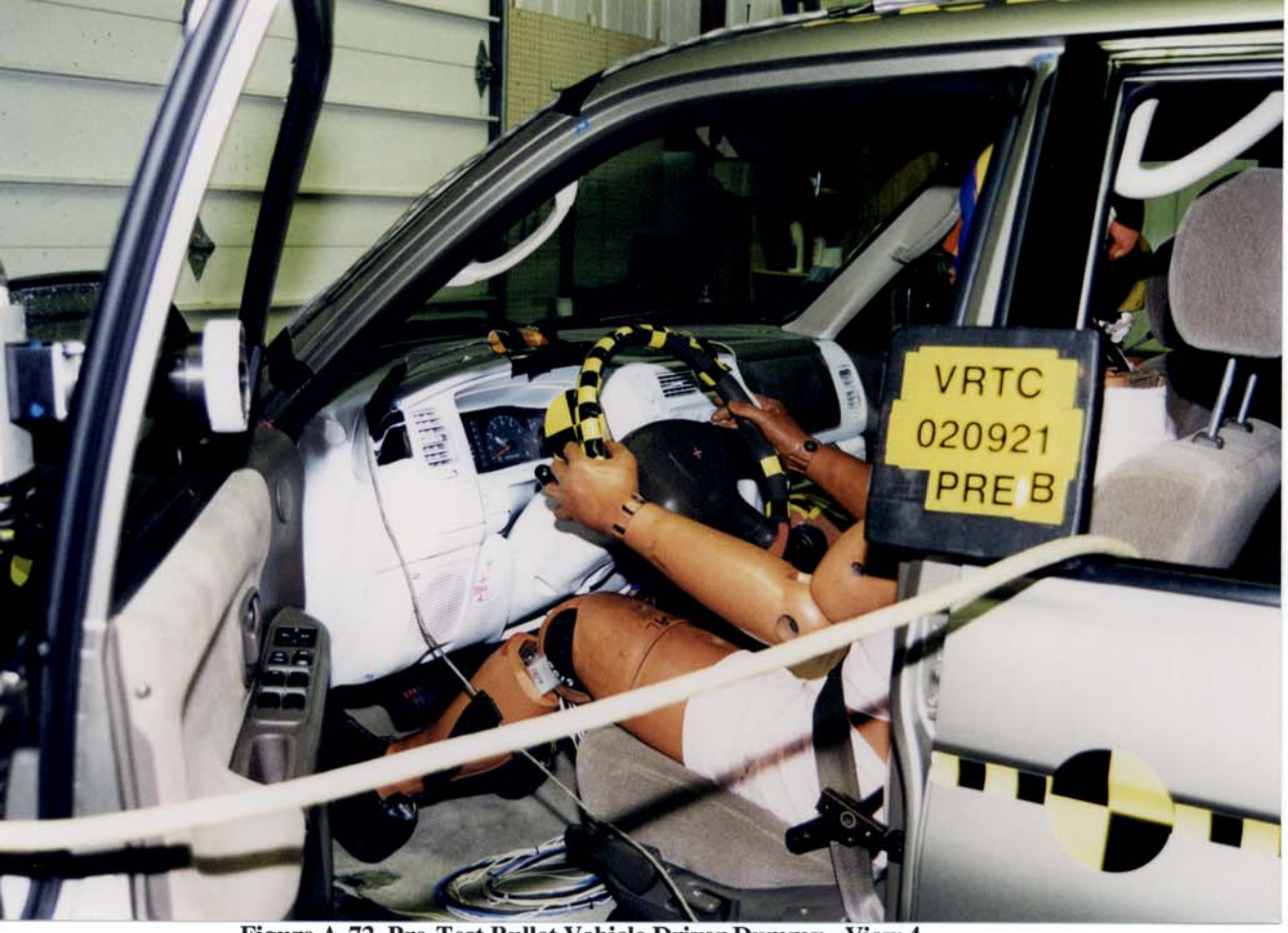


Figure A-72 Pre-Test Bullet Vehicle Driver Dummy - View 4

Figure A-73 Post-Test Bullet Vehicle Driver Dummy - View 4

Figure A-74 Pre-Test Bullet Vehicle Passenger Dummy - View 1

Figure A-75 Post-Test Bullet Vehicle Passenger Dummy - View 1

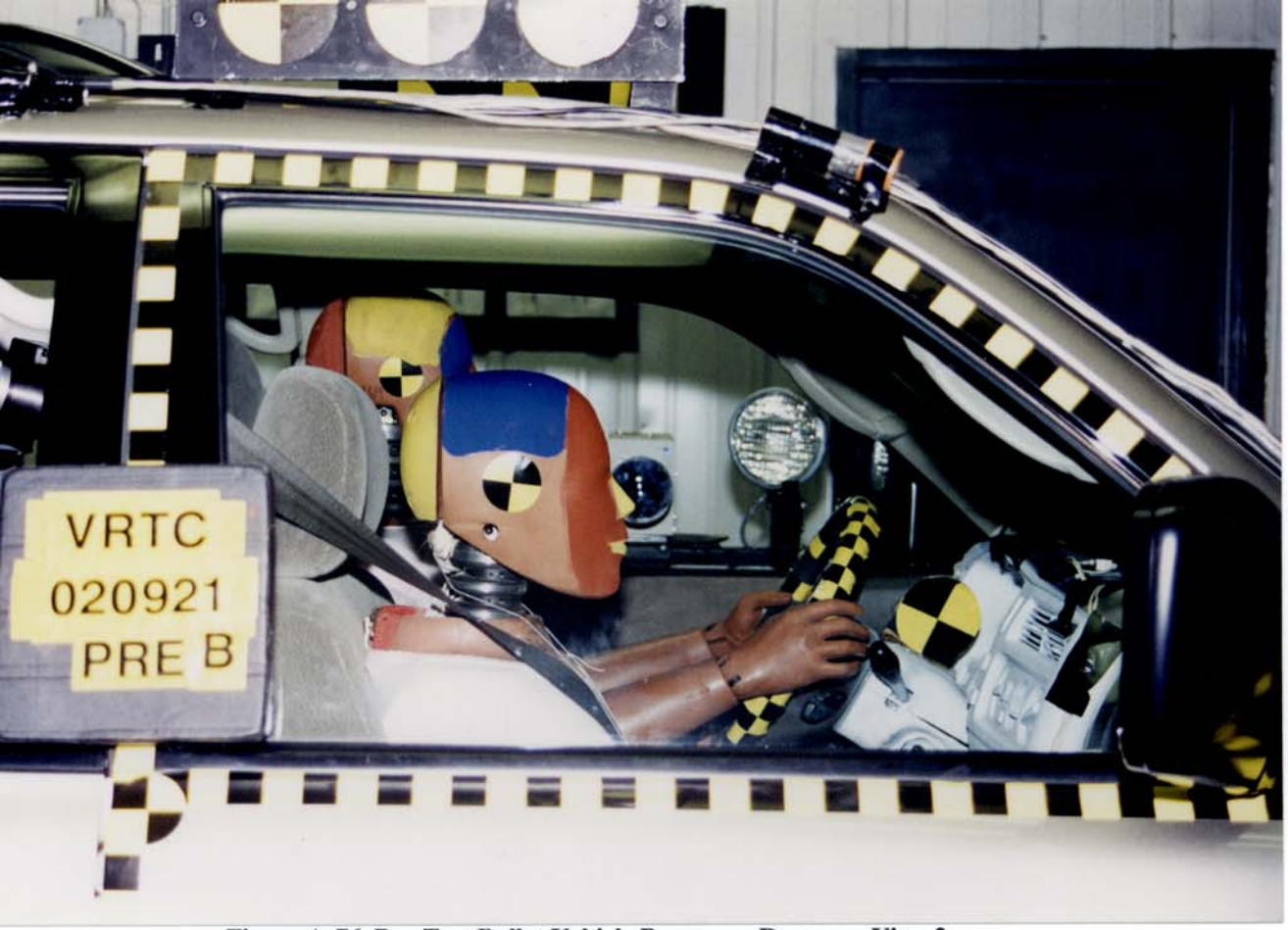


Figure A-76 Pre-Test Bullet Vehicle Passenger Dummy - View 2

Figure A-77 Post-Test Bullet Vehicle Passenger Dummy - View 2

Figure A-78 Pre-Test Bullet Vehicle Passenger Dummy - View 3

Figure A-79 Post-Test Bullet Vehicle Passenger Dummy - View 3

Figure A-80 Pre-Test Bullet Vehicle Passenger Dummy - View 4

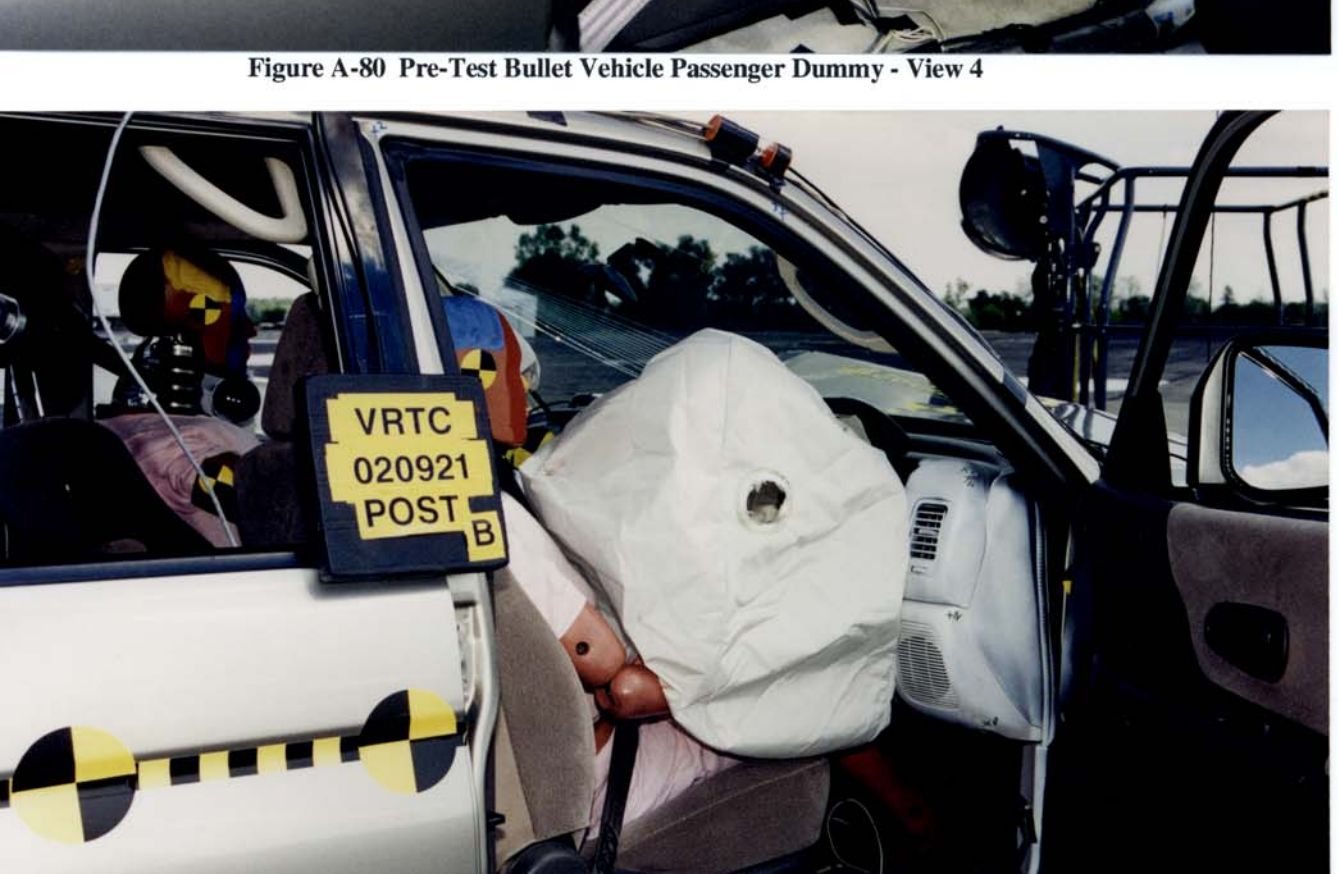


Figure A-81 Post-Test Bullet Vehicle Passenger Dummy - View 4

Figure A-82 Post-Test Target Vehicle Driver Dummy Overall Contact View

Intentionally Left Blank

Figure A-83 Post-Test Target Vehicle Driver Dummy Head Contact - View 1

Figure A-84 Post-Test Target Vehicle Driver Dummy Head Contact - View 2

Figure A-85 Post-Test Target Vehicle Driver Dummy Head Contact - View 3

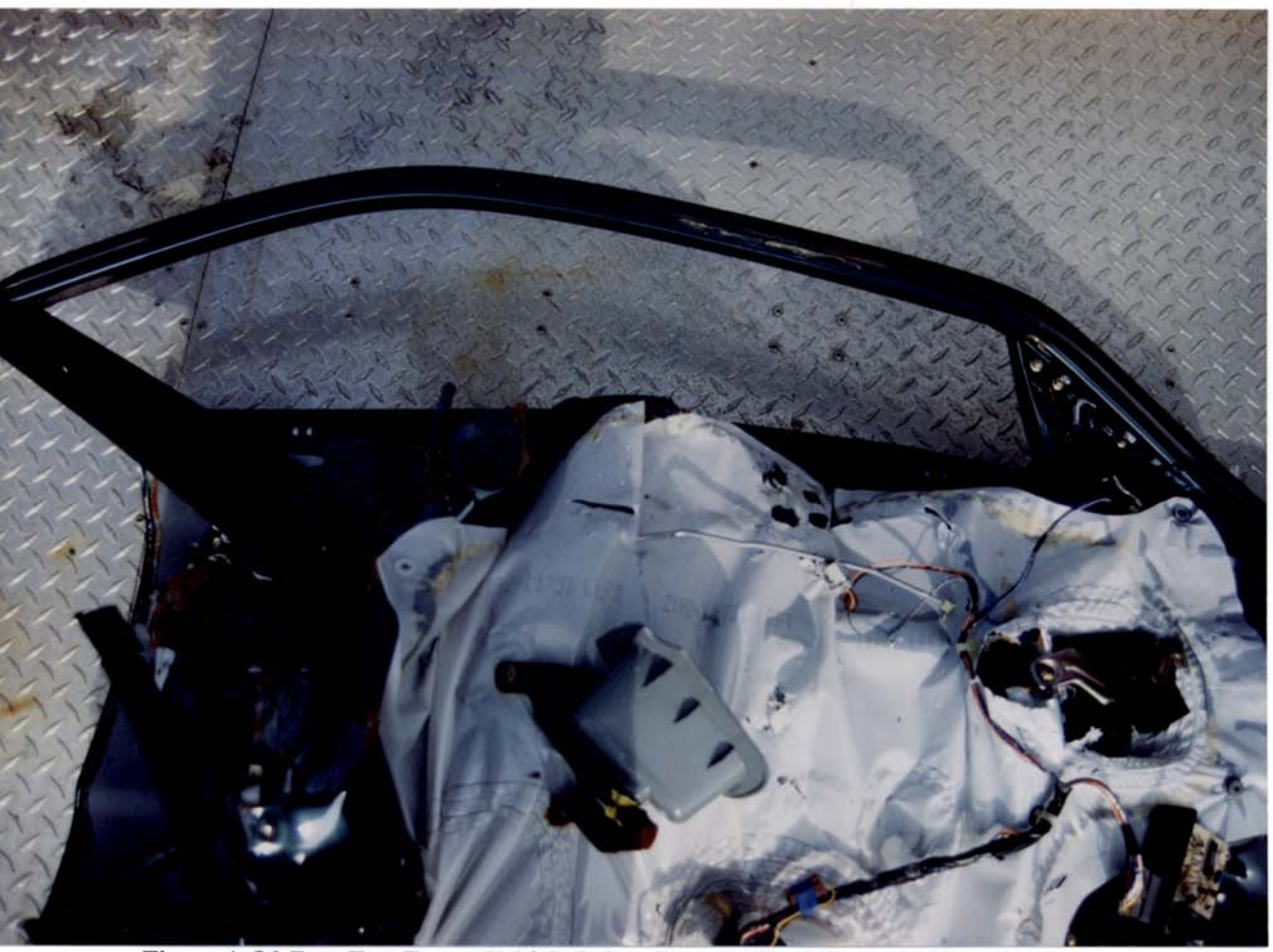


Figure A-86 Post-Test Target Vehicle Driver Dummy Head Contact - View 4

Figure A-87 Post-Test Target Vehicle Driver Dummy Knee Contact - View 1

Figure A-88 Post-Test Target Vehicle Driver Dummy Knee Contact - View 2

Figure A-89 Post-Test Target Vehicle Driver Dummy Knee Contact - View 3

Figure A-90 Post-Test Target Vehicle Driver Floorpan Deformation

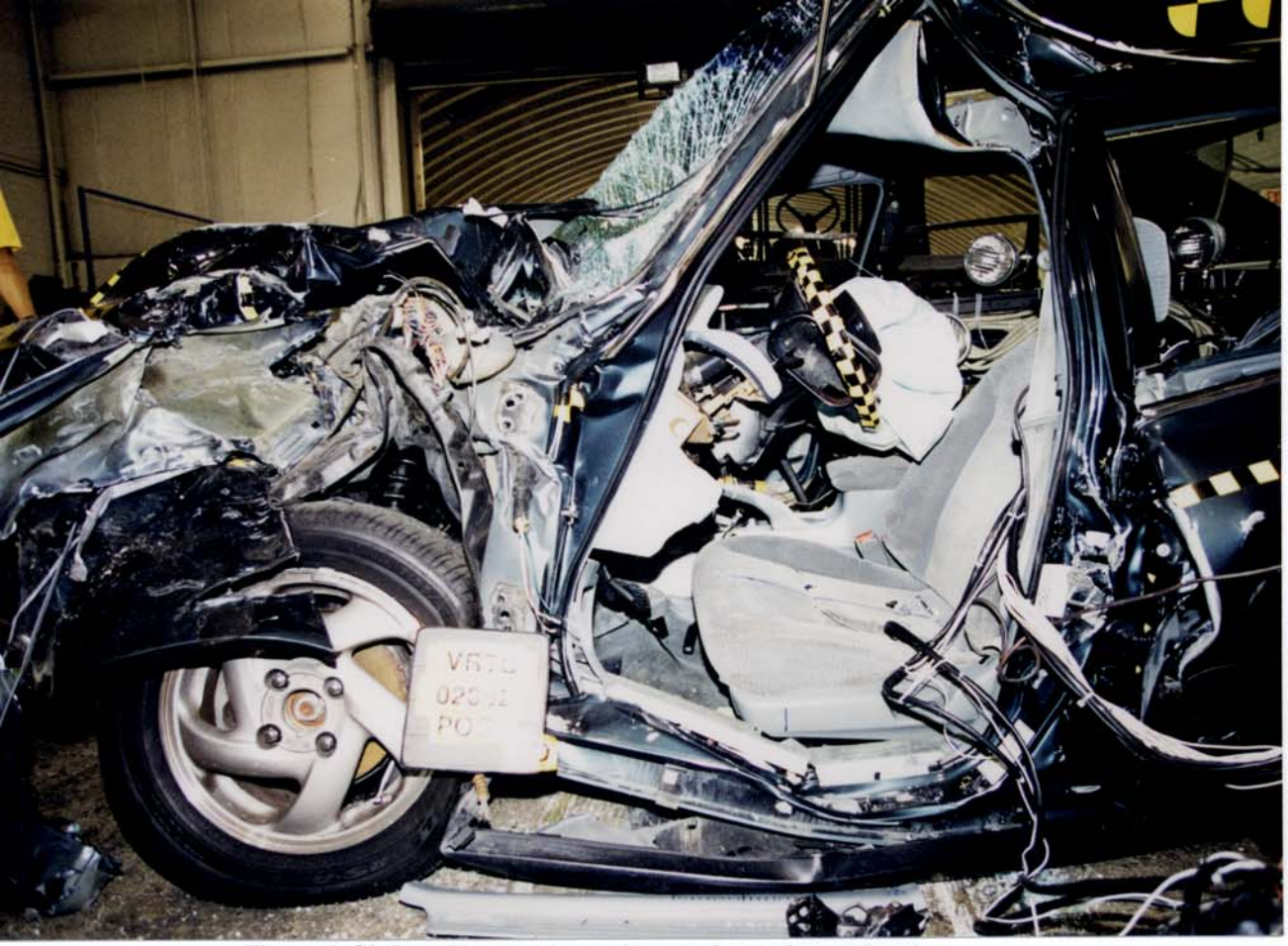


Figure A-91 Post-Test Target Vehicle Deformation - View 1

Figure A-92 Post-Test Target Vehicle Deformation - View 2

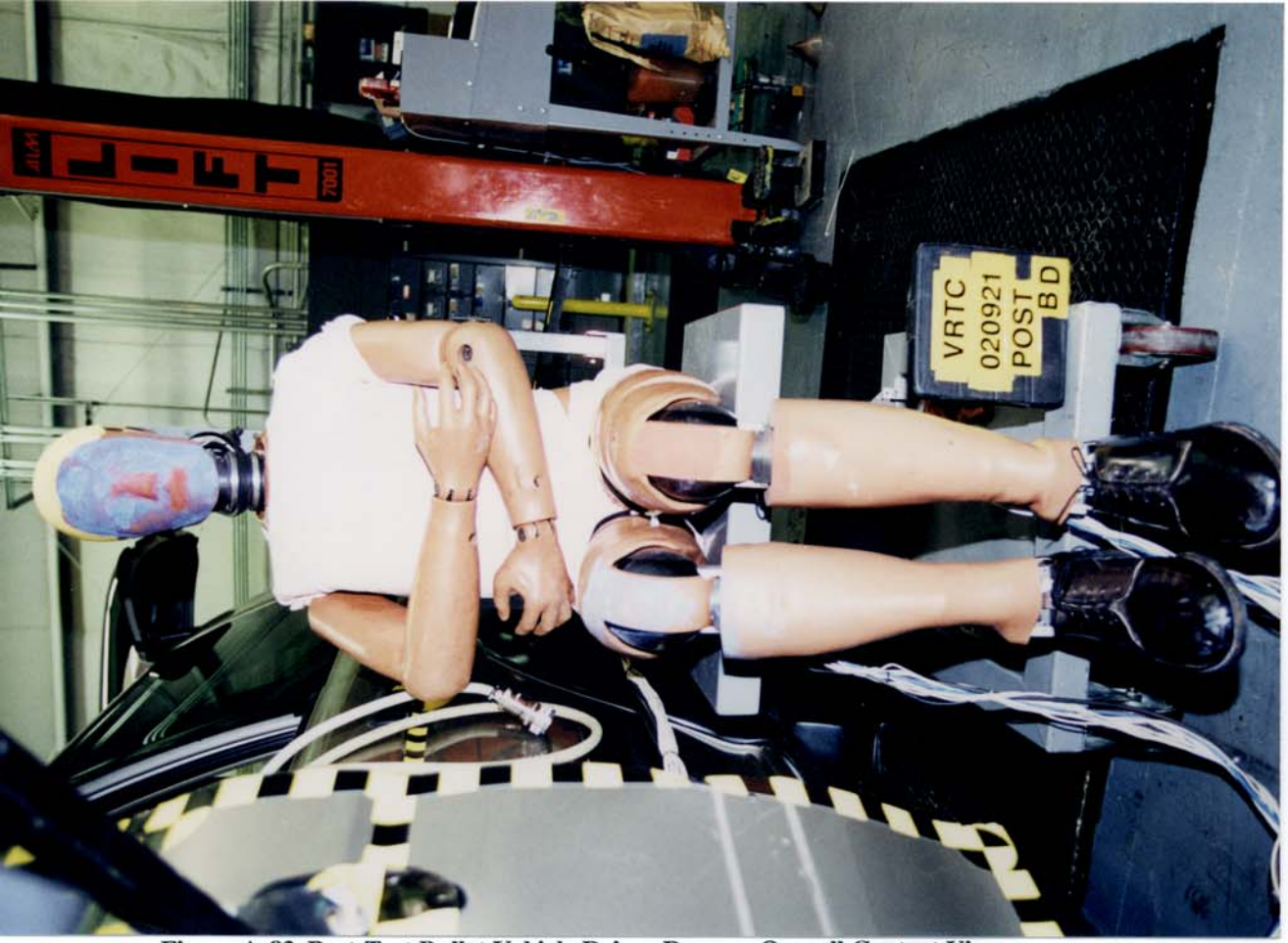


Figure A-93 Post-Test Bullet Vehicle Driver Dummy Overall Contact View

Figure A-94 Post-Test Bullet Vehicle Driver Dummy Head Contact - View 1

Figure A-95 Post-Test Bullet Vehicle Driver Dummy Head Contact - View 2

Figure A-96 Post-Test Bullet Vehicle Driver Dummy Head Contact - View 3

Figure A-97 Post-Test Bullet Vehicle Driver Dummy Knee Contact - View 1

Figure A-98 Post-Test Bullet Vehicle Driver Dummy Knee Contact - View 2

Figure A-99 Post-Test Bullet Vehicle Driver Floorpan Deformation View

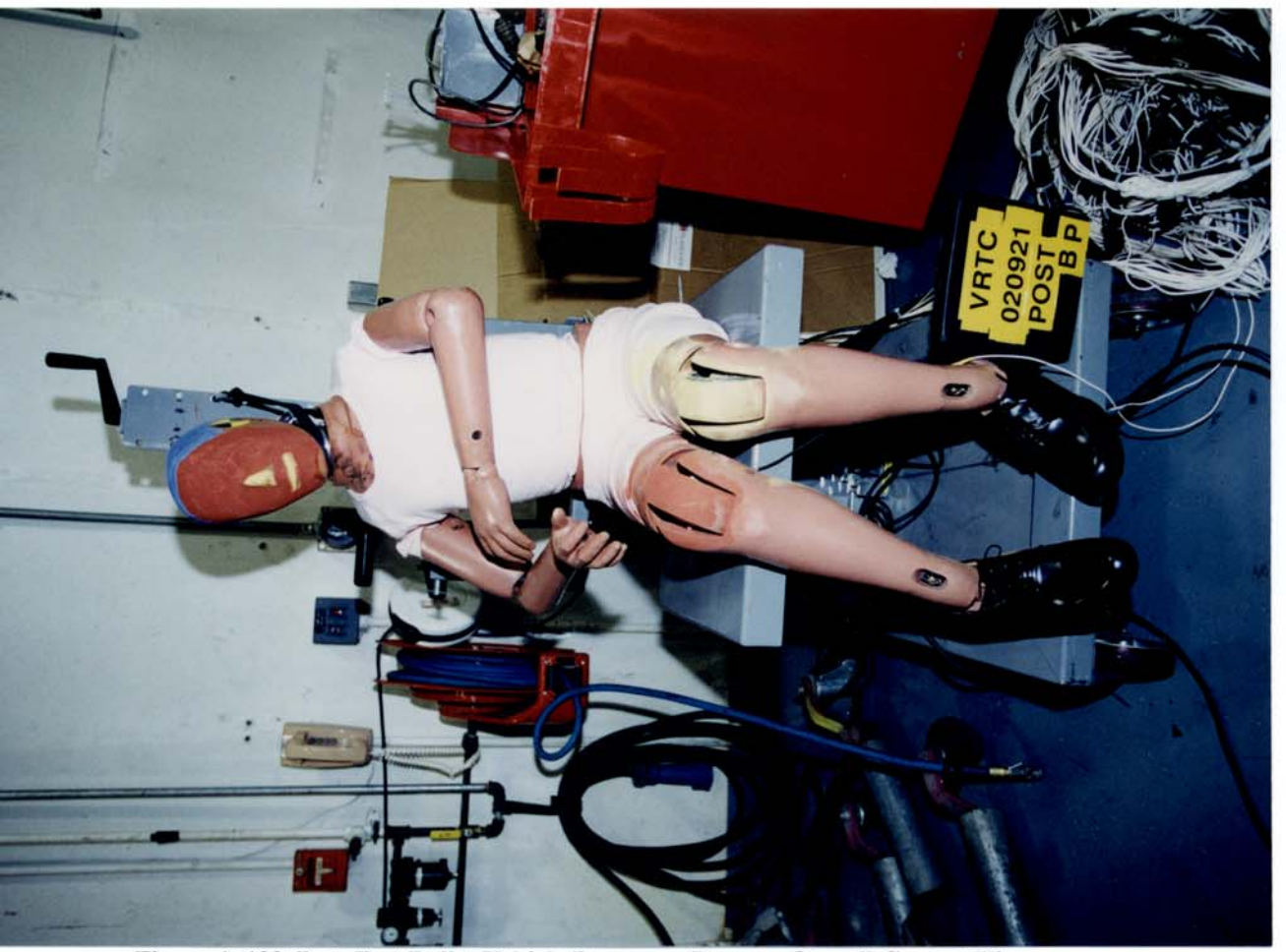


Figure A-100 Post-Test Bullet Vehicle Passenger Dummy Overall Contact View

Figure A-101 Post-Test Bullet Vehicle Passenger Dummy Head Contact - View 1

Figure A-102 Post-Test Bullet Vehicle Passenger Dummy Head Contact - View 2

Figure A-103 Post-Test Bullet Vehicle Passenger Dummy Head Contact - View 3

Figure A-104 Post-Test Bullet Vehicle Passenger Dummy Head Contact - View 4

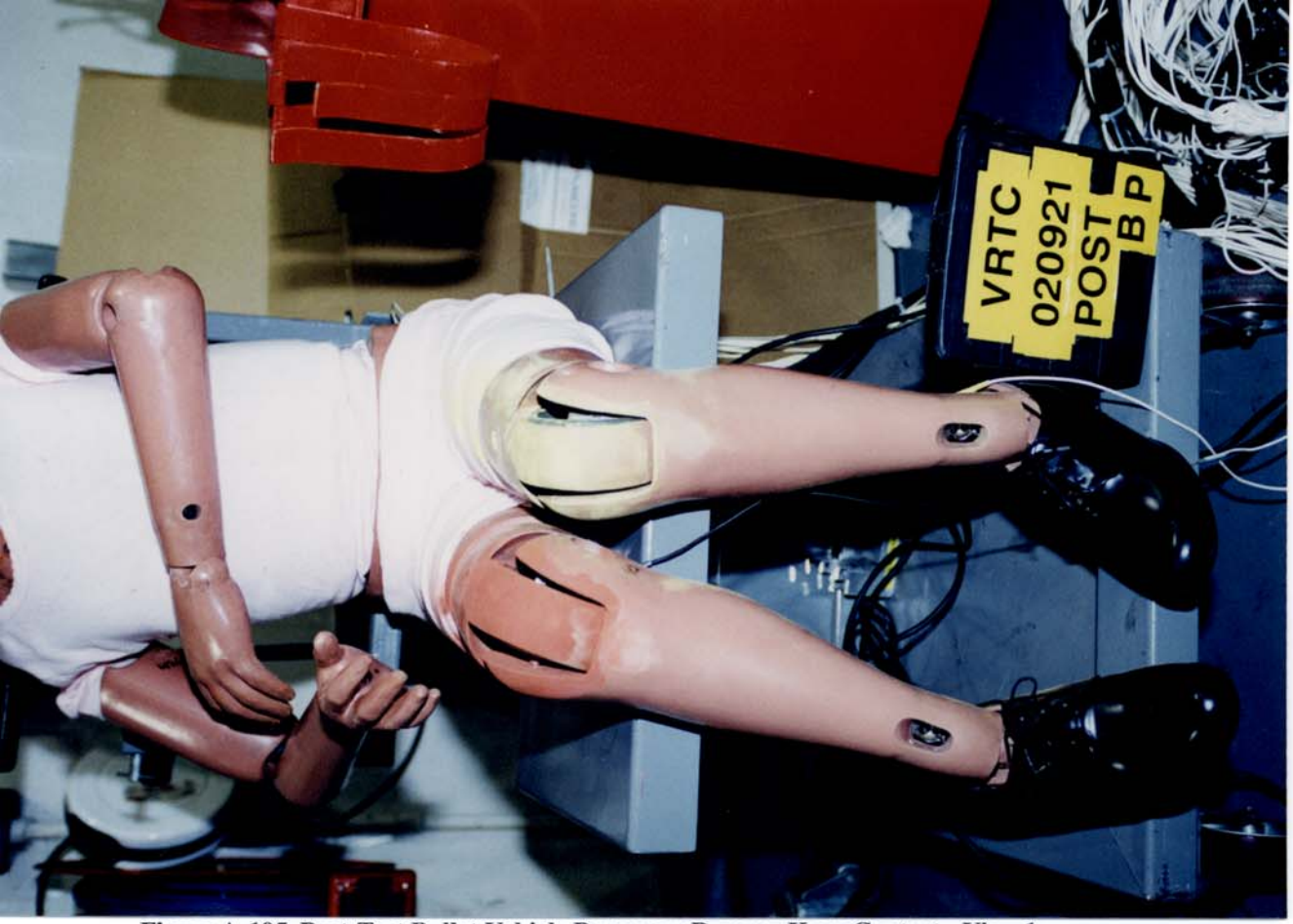


Figure A-105 Post-Test Bullet Vehicle Passenger Dummy Knee Contact - View 1

Figure A-106 Post-Test Bullet Vehicle Passenger Dummy Knee Contact - View 2

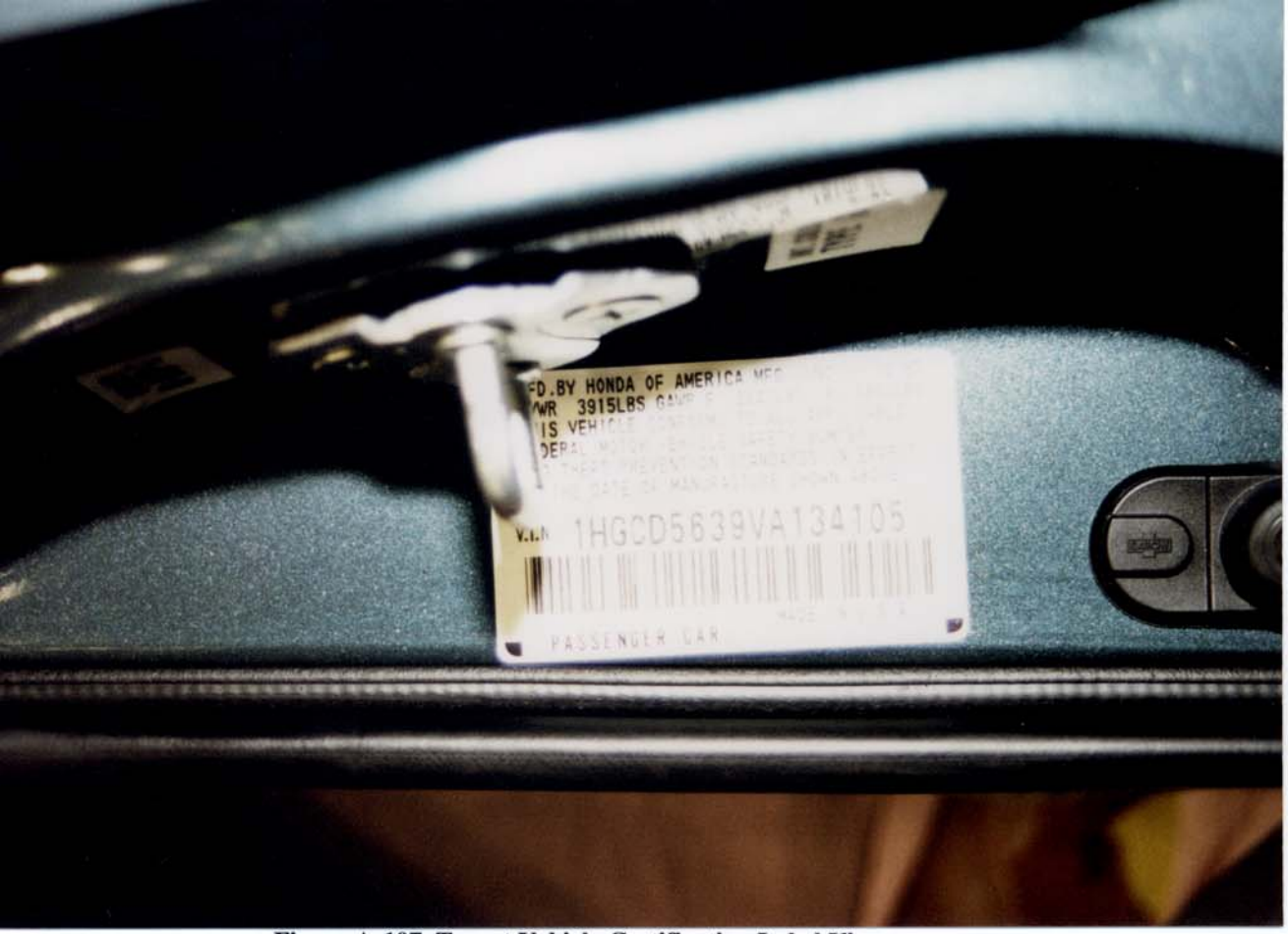


Figure A-107 Target Vehicle Certification Label View

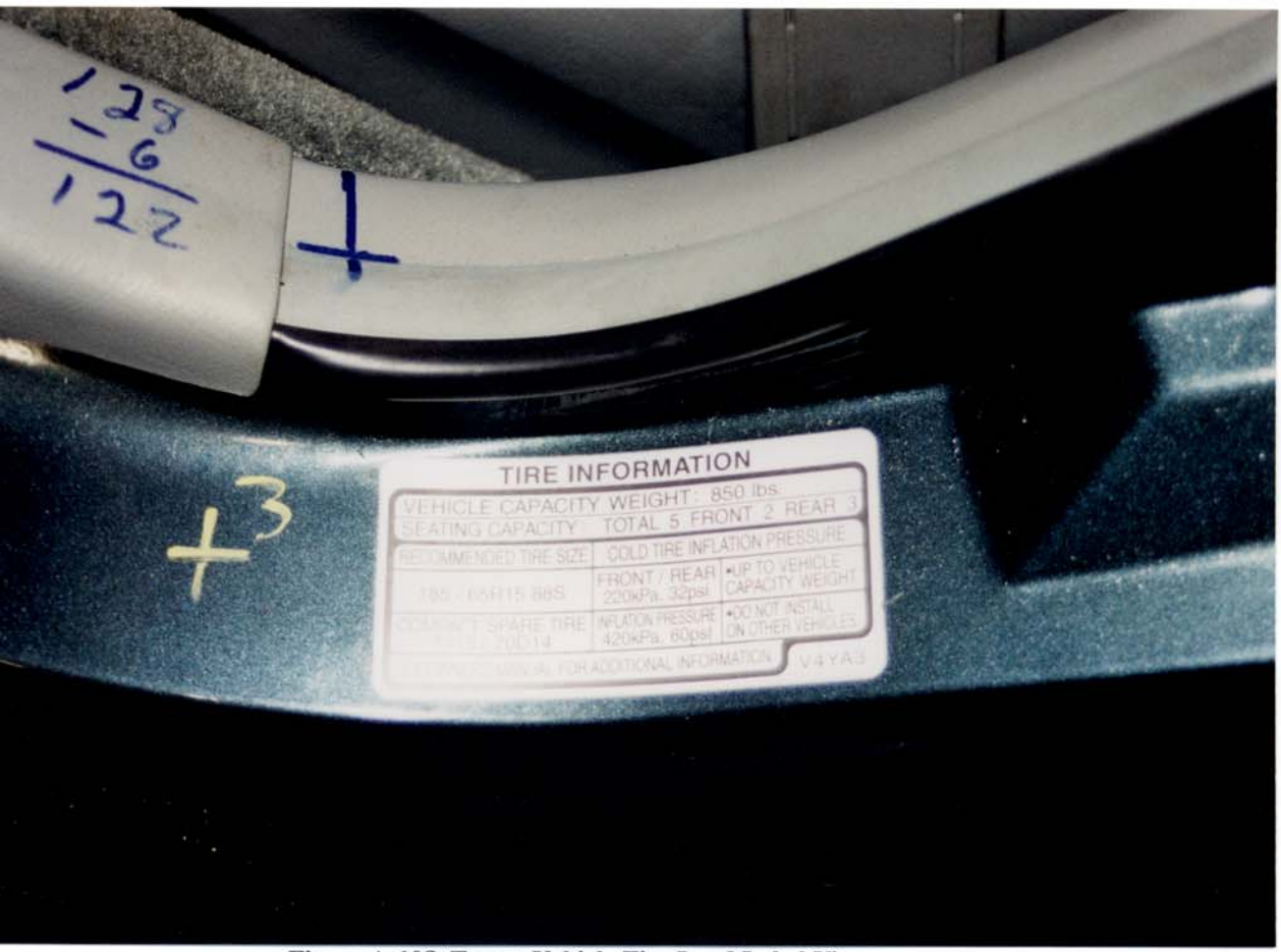


Figure A-108 Target Vehicle Tire Load Label View

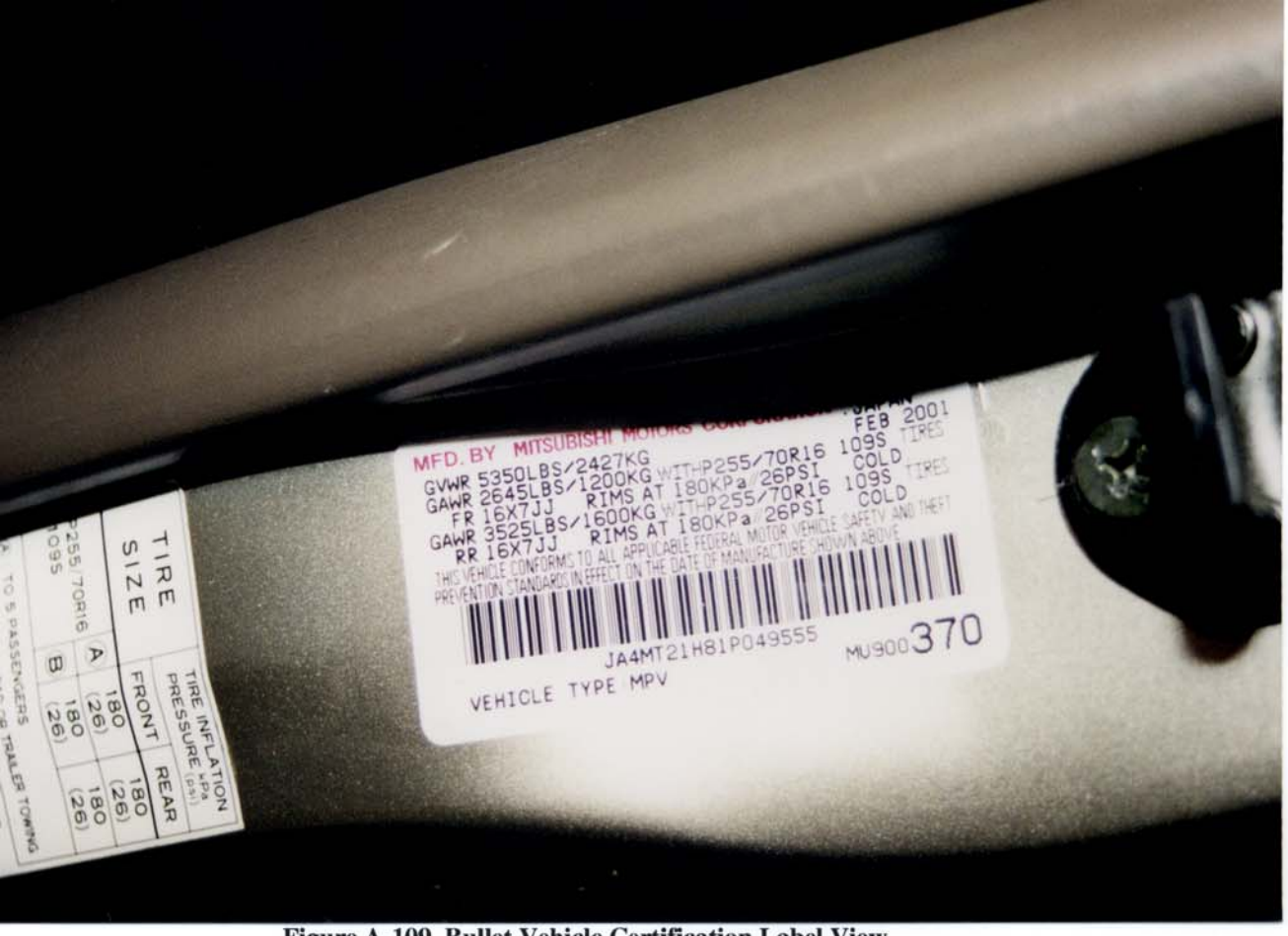


Figure A-109 Bullet Vehicle Certification Label View

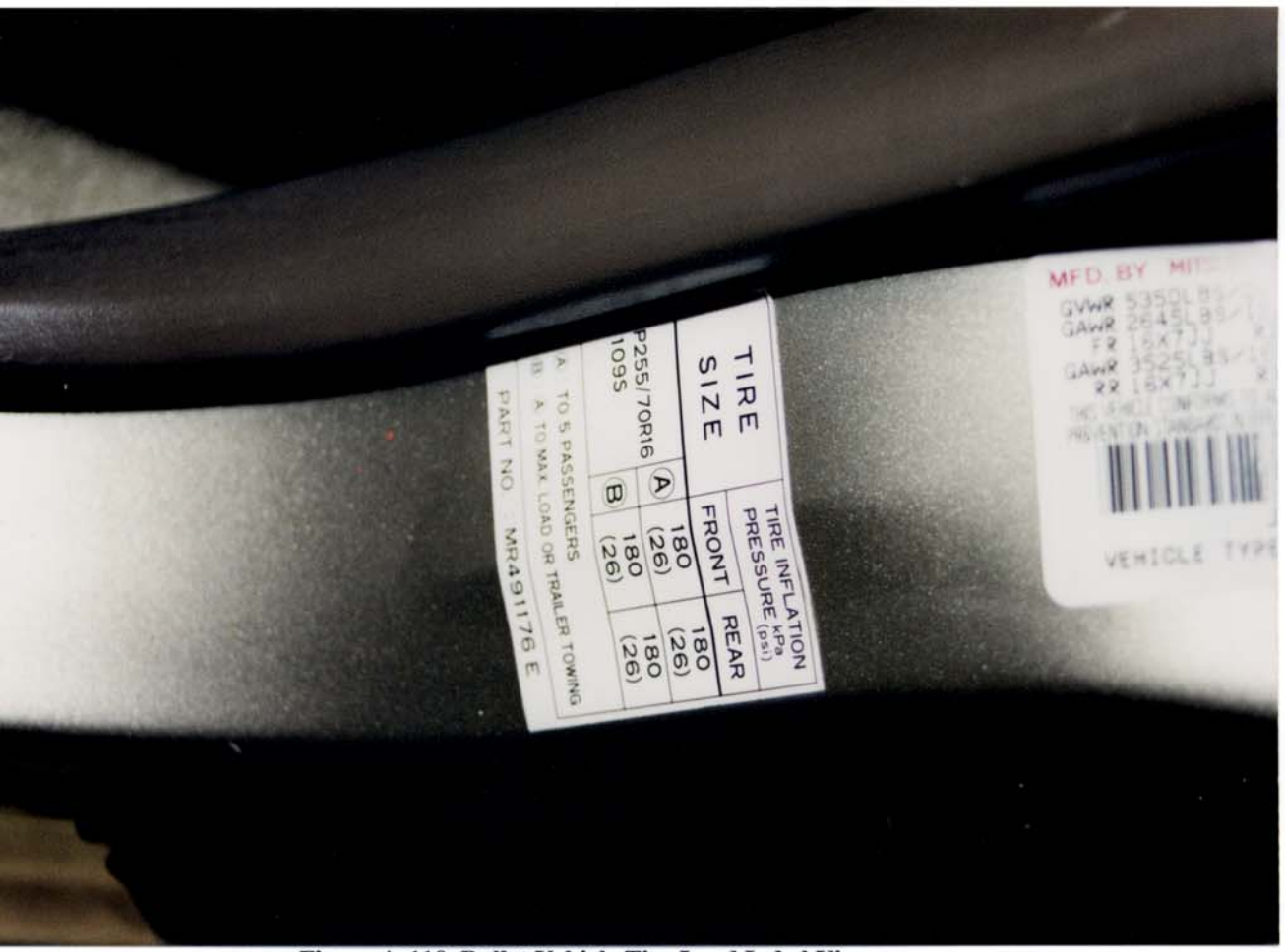


Figure A-110 Bullet Vehicle Tire Load Label View