

REPORT NUMBER: 301-CAL-03-03

**SAFETY COMPLIANCE TESTING FOR FMVSS 301
FUEL SYSTEM INTEGRITY**

HYUNDAI MOTOR COMPANY
2003 HYUNDAI ELANTRA
4-DOOR SEDAN

NHTSA NUMBER: C30503

VERIDIAN TEST NUMBER: 8655-F301-12

July 30, 2003

VERIDIAN ENGINEERING
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BUFFALO, NEW YORK 14225



FINAL REPORT

PREPARED FOR:

U. S. Department of Transportation
National Highway Traffic Safety Administration
Safety Assurance
Office of Vehicle Safety Compliance
400 Seventh Street, S. W.
Room No. 6115 (NVS-220)
Washington, DC 20590

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16. Abstract Compliance tests were conducted on the subject 2003 Hyundai Elantra 4-Door Sedan in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-301-03 for the determination of FMVSS 301 compliance. For the purpose of acquiring information for applied research, two instrumented Anthropomorphic Test Devices (ATDs) were placed in the front occupant seating positions and various instrumentation was added to the test vehicle. Test failures identified were as follows: The test vehicle appeared to comply with all requirements of FMVSS 301 "Fuel System Integrity."					
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SECTION 1

PURPOSE OF COMPLIANCE TEST

This 30 mph rear moving barrier impact test is part of the Federal Motor Vehicle Safety Standard (FMVSS) 301 Compliance Test Program conducted for the National Highway Traffic Safety Administration (NHTSA) by Veridian Engineering under Contract No. DTNH22-01-C-01025. The purpose of this test was to determine if the subject vehicle, a 2003 Hyundai Elantra 4-Door Sedan, meets the performance requirements of FMVSS No. 301, "Fuel System Integrity." This compliance test was conducted using the requirements found in the OVSC Laboratory Test Procedure No. TP-301-03, dated February 28, 2003.

SECTION 2

COMPLIANCE TEST RESULTS SUMMARY

A 1465.6 kg 2003 Hyundai Elantra 4-Door Sedan was impacted from the rear by an 1797 pound moving barrier at a velocity of 48.12 kph (29.9 mph). The test was performed by Veridian Engineering on July 30, 2003.

The test vehicle was equipped with a 54.9 liter fuel tank which was filled to 92 percent capacity with stoddard fluid prior to impact. Additional ballast was not required to achieve vehicle test weight. For the purpose of acquiring information for applied research, one instrumented Part 572 O 5th percentile female Anthropomorphic Test Device (ATD) and one instrumented Part 572 E 50th percentile male ATD were placed in the front occupant seating positions and various instruments were added to the test vehicle. Research data is presented in a separate report.

The crash event was recorded by ten high-speed cameras and one real-time camera. Camera locations and other pertinent camera information are found on pages 3-9 and 3-10 of this report. Pre- and post-test photographs of the vehicle can be found in Appendix A.

There was no fuel system fluid spillage following the impact or during any portion of the static rollover test. The average vehicle longitudinal crush was 471 millimeters. The vehicle appeared to comply with all the requirements of FMVSS No. 301 "Fuel System Integrity."

SECTION 3
COMPLIANCE TEST DATA

DATA SHEET 1

TEST VEHICLE SPECIFICATIONS

TEST VEHICLE INFORMATION:

Year/Make/Model/Body Style: 2003 Hyundai Elantra 4-Door Sedan

NHTSA No.: C30503; Color: Black

Engine Data: 4 Cylinders; - CID; 2.0 Liters; - cc

Placement: - Longitudinal or In-Line; X Transverse or Lateral

Transmission Data: 5 Speeds; X Manual; - Automatic; - Overdrive

Final Drive: - Rear Wheel Drive; X Front Wheel Drive; - Four Wheel Drive

Major Options: X A/C; X Power Steering; X Power Brakes

X Power Windows; X Power Door Locks; X Tilt Wheel

Date Received: 10/31; Odometer Reading 24 km

Selling Dealer: Northtown Hyundai

& Address: 3675 Sheridan Drive, Amherst, NY 14226

DATA FROM VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured by: Hyundai Motor Company

Date of Manufacture: SEP/14/02

VIN: KMHDN45D73U509422

GVWR: 1740 kg; GAWR-FRONT: 939 kg; GAWR-REAR: 839 kg

DATA FROM VEHICLE'S TIRE LABEL:

Location of Placard on Vehicle: Driver door

Recommended Tire Size: P185/65R15 86T or P195/60R15 87H

* Recommended Cold Tire Pressure: FRONT: 210 kPa; REAR: 210 kPa

DATA FROM TIRE SIDEWALL:

Size of Tires on Test Vehicle: P195/60R15 88H Manufacturer: Michelin

Tire Pressure with Maximum Capacity Vehicle Load: FRONT: 300 kPa; REAR: 300 kPa

Type of Spare Tire: Temporary T125/70R15

VEHICLE CAPACITY DATA:

Type of Front Seats: - Bench; X Bucket; - Split Bench

Number of Occupants: 2 Front; 3 Rear; 5 Total

Vehicle Capacity Weight (VCW) = 385 kg

No. of Occupants x 68.04 kg = 340.2 kg

Rated Cargo/Luggage Weight (RCLW) = 44.8 kg

*Tire pressure used for test

DATA SHEET 2

PRE-TEST DATA

WEIGHT OF TEST VEHICLE AS RECEIVED FROM DEALER (with maximum fluids)= UDW:

Right Front	=	<u>401.0</u>	kg	Right Rear	=	<u>238.0</u>	kg
Left Front	=	<u>393.5</u>	kg.	Left Rear	=	<u>247.5</u>	kg
TOTAL FRONT	=	<u>794.5</u>	kg	TOTAL REAR	=	<u>485.5</u>	kg
TOTAL DELIVERED WEIGHT =		<u>1280</u>	kg				
% of Total Front of Vehicle Weight =		<u>62.1%</u>		of Total Rear Weight =		<u>37.9%</u>	

CALCULATION OF VEHICLE'S TARGET TEST WEIGHT:

Total Delivered Weight	=	<u>1280</u>	kg
Rated Cargo/Luggage Weight (RCLW)	=	<u>44.8</u>	kg
Weight of 2 p.572 Dummies, 74.4 kg	=	<u>148.8</u>	kg
TARGET TEST WEIGHT	=	<u>1473.6</u>	kg

WEIGHT OF TEST VEHICLE WITH TWO DUMMIES AND 36.8 KG OF CARGO WEIGHT:

Right Front	=	<u>460.4</u>	kg	Right Rear	=	<u>281.7</u>	kg
Left Front	=	<u>448.6</u>	kg	Left Rear	=	<u>274.9</u>	kg
TOTAL FRONT	=	<u>909</u>	kg	TOTAL REAR	=	<u>556.6</u>	kg
TOTAL TEST WEIGHT =		<u>1465.6</u>	kg				
% of Total Front of Vehicle Weight =		<u>62.0%</u>		of Total Rear Weight =		<u>38.0%</u>	

* Weight of Ballast Secured in Vehicle Trunk Area = 0 kg

Type of Ballast: None

Method of Securing Ballast: -

Vehicle Components Removed for Weight Reduction: Bumper cover, radiator, rear door trim and glass, engine air intake ducts.

VEHICLE ATTITUDE (all dimension in millimeters):

AS DELIVERED:	RF	<u>678</u>	LF	<u>679</u>	RR	<u>670</u>	LR	<u>667</u>
AS TESTED:	RF	<u>659</u>	LF	<u>652</u>	RR	<u>649</u>	LR	<u>652</u>
Vehicle's Wheel Base:		<u>2605</u>	mm					
Location of Vehicle's C.G.:		<u>989</u>	millimeters rearward of front wheel center.					

FUEL SYSTEM DATA:

Fuel System Capacity From Owner's Manual	=	<u>54.9</u>	liters
Usable Capacity Figure Furnished by COTR	=	<u>54.9</u>	liters
Test Volume Range (91 to 94% of Usable Capacity)	=	<u>49.96</u>	to <u>51.61</u> liters

ACTUAL TEST VOLUME= 50.3 liters (with entire fuel system filled)

* Ballast weight includes the RCLW, the weight of drained vehicle fluids and the weight of any removed vehicle components less the weight of onboard instrumentation, cameras, and hardware.

DATA SHEET 2 (continued)

PRE-TEST DATA

FUEL SYSTEM DATA (continued):

Test Fluid Type:	Stoddard Solution
Test Fluid Specific Gravity:	0.764
Test Fluid Kinematic Viscosity:	0.96 centistokes
Test Fluid Color:	Orange ("red" is preferred)
Type of Vehicle Fuel Pump:	Electric
Electric Fuel Pump Operation with Ignition Switch ON and Engine OFF -	
When ignition is switched on without starting the engine, the fuel pump operates for several seconds then shuts off.	
Details of Fuel System: Fuel filler is located on the left rear quarter panel aft of the rear axle; Fuel tank is located on the vehicle underbody beneath the rear seat and forward of the rear axle; Fuel lines are routed along the left side of the vehicle underbody.	
Comments: None	

DATA SHEET 3

MOVING BARRIER DATA

WEIGHT OF MOVING BARRIER:

Right Front	=	<u>504.9</u>	kg	Right Rear	=	<u>393.7</u>	kg.
Left Front	=	<u>499.9</u>	kg	Left Rear	=	<u>398.3</u>	kg
TOTAL FRONT	=	<u>1004.8</u>	kg	TOTAL REAR	=	<u>792.0</u>	kg
TOTAL BARRIER WEIGHT =		<u>1796.8</u>	kg				

MOVING BARRIER DIMENSIONS:

Barrier Face Height: 1524 mm

Barrier Face Width: 1981 mm

Barrier Face Ground Clearance: 127 mm

Tread Width: 1511 mm

Wheel Base: 3048 mm

Location of C.G.: X: 1344 mm rearward of front wheel center.

Y: 0 mm from longitudinal-vertical plane of symmetry.

Z: 414 mm above ground.

MOVING BARRIER TIRES:

Manufacturer: Classic

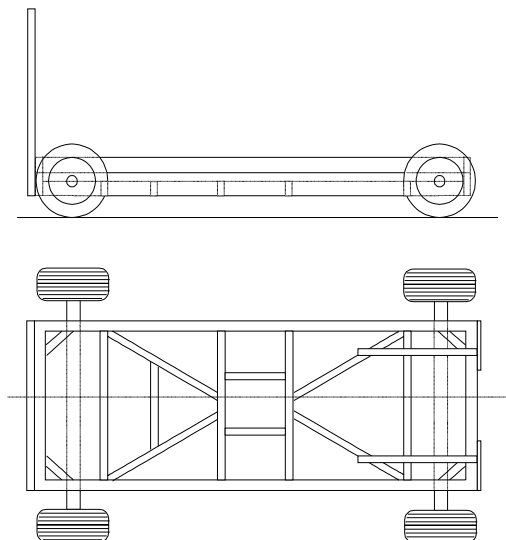
Model: Poly IV

Size: 215/75D15

Recommended Max Pressure: 240 kPa:

MOVING BARRIER ABORT SYSTEM:

Type: Trailing cable



DATA SHEET 4

POST TEST DATA

TYPE OF TEST:

Type of Test: Rear Barrier Impact Angle: 0°
Test Date: July 30, 2003 Time: 15:21 Temperature: 30.6 °C
Vehicle NHTSA No.: C30503 VIN: KMHDN45D73U509422
Required Impact Velocity Range: 46.51 to 48.12 kph

BARRIER IMPACT VELOCITY: (Speed traps within 5 feet of impact plane.)

Trap No. 1 = 48.12 kph; Trap No. 2 = 48.12 kph
Average Impact Speed = 48.12 kph

VEHICLE STATIC CRUSH:

Vehicle Length:

Pre-Test	Left =	<u>4408</u>	; C/L =	<u>4512</u>	Right =	<u>4408</u>
Post-Test	Left =	<u>3936</u>	; C/L =	<u>4031</u>	Right =	<u>3948</u>
Crush	Left =	<u>472</u>	; C/L =	<u>481</u>	Right =	<u>460</u>
AVERAGE	=	<u>471</u>	millimeters			

DATA SHEET 4 (continued)

POST TEST DATA

TEST VEHICLE NHTSA NO.: C30503 TEST DATE: July 30, 2003

Vehicle Mfgr./Make/Model: 2003 Hyundai Elantra 4-Door Sedan

Test vehicle fuel tank filled to 91% to 94% of manufacturer's "usable" capacity and with electric fuel pump operating (if it will operate without engine operation). Part 572 test dummies located at each front designated seating position.

TEST VEHICLE IMPACT TYPE:

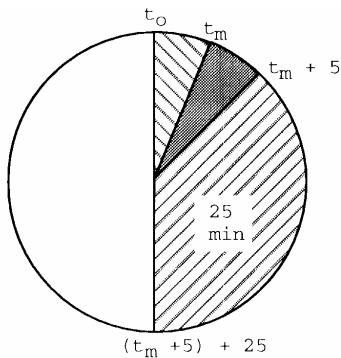
- Frontal (42.28 kph target velocity)

- Oblique (42.28 kph target velocity) with - ° barrier face first contacting - (driver/passenger) side

X Rear Moving Barrier (42.28 kph target velocity)

- Lateral Moving Barrier (32.19 kph target velocity)

FUEL SPILLAGE MEASUREMENT:



1. From impact until vehicle motion ceases
2. For five minute period after vehicle motion ceases
3. For next 25 minutes

ACTUAL	MAX ALLOWED
0	28 g
0	28 g.
0	28 g/min.

SOLVENT SPILLAGE DETAILS:

None

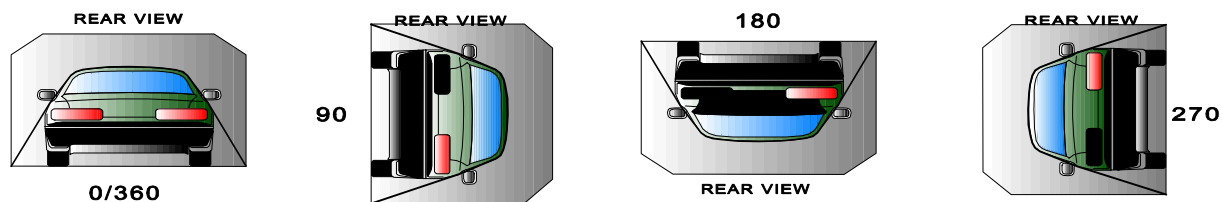
DATA SHEET 5

STATIC ROLLOVER TEST DATA

Table 7 FMVSS NO. 301 - STATIC ROLLOVER DATA SHEET

Vehicle: 2003 Hyundai Elantra 4-Door Sedan

NHTSA No.: C30503



I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

Rollover Stage	Rotation Time (spec. 1 -3 min)				FMVSS 301 Hold Time		Total Time				Next Whole Minute Interval	
0° - 90°	1	minutes	10	seconds	5	minutes	6	minutes	10	seconds	7	minutes
90° - 180°	1	minutes	9	seconds	5	minutes	6	minutes	9	seconds	7	minutes
180°-270°	1	minutes	4	seconds	5	minutes	6	minutes	4	seconds	7	minutes
270°-360°	1	minutes	9	seconds	5	minutes	6	minutes	9	seconds	7	minutes

II. FMVSS 301 REQUIREMENTS: (Maximum allowable solvent spillage):

First 5 minutes from onset of rotation	6th min.	7th min.	8th min. (if required)
142 g	28 g	28 g	28 g

III. ACTUAL TEST VEHICLE SOLVENT SPILLAGE:

Rollover Stage	First 5 minutes from onset of rotation (g)	6th min. (g)	7th min. (g)	8th min. (if required) (g)
0° - 90°	0	0	0	-
90° - 180°	0	0	0	-
180°-270°	0	0	0	-
270°-360°	0	0	0	-

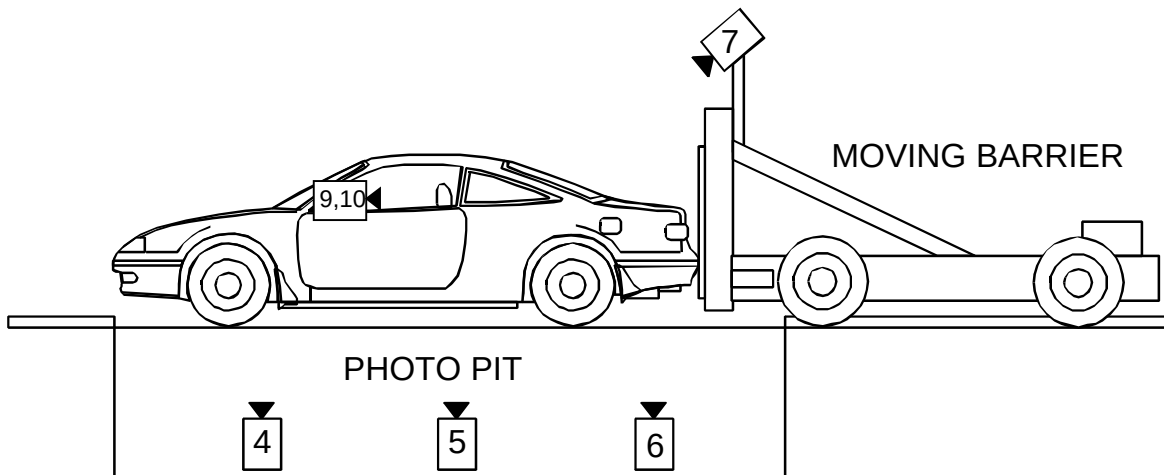
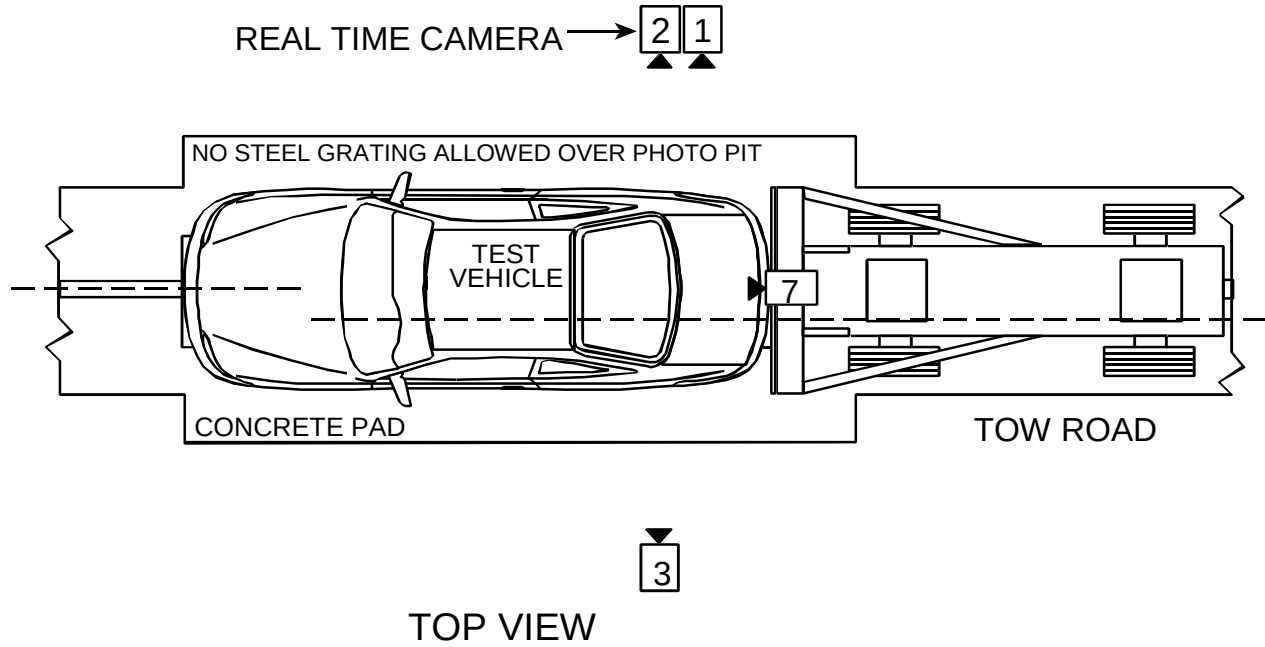
Note: Record spillage for whole minute intervals only as determined above.

IV. SOLVENT SPILLAGE LOCATION(S):

Rollover Stage	Spillage Location
0° - 90°	None
90° - 180°	None
180°-270°	None
270°-360°	None

DATA SHEET 6

HIGH SPEED CAMERA LOCATIONS



LEFT SIDE VIEW

DATA SHEET 6 (continued)

HIGH SPEED CAMERA LOCATIONS

NHTSA No. : C30503

Vehicle : 2003 Hyundai Elantra 4-Door Sedan

CAMERA NO.	VIEW	CAMERA POSITIONS (mm)*			ANGLE** (degrees)	LENS (mm)	SPEED (fps)
		X	Y	Z			
1	Real-Time Camera	-	-	-	-	-	24
2	Right Side View	15455	1885	1070	0	35	1000
3	Left Side View	16550	1985	1130	0	35	1000
4	Vehicle Front Underbody View	0	3395	-1956	90	13	1000
5	Vehicle Mid-Section Underbody View	0	1942	-1956	90	13	1030
6	Vehicle Rear Underbody View	0	996	-1956	90	13	1000
7	Moving Barrier View	0	0	2515	-105	13	1000
8	Overhead Overall View	-508	0	9804	-90	13	1000
9†	Onboard Driver View	805	2597	1014	-11	8	1000
10†	Onboard Passenger View	760	2607	1023	-10	8	1000

* X = film plant to monorail centerline (+ to left of rail)
 Y = film plane to impact location (+ ahead of impact location)
 Z = film plane to ground (+ above ground)
 ** = referenced to horizontal plane

† Research cameras.

Appendix A
PHOTOGRAPHS

LIST OF PHOTOGRAPHS

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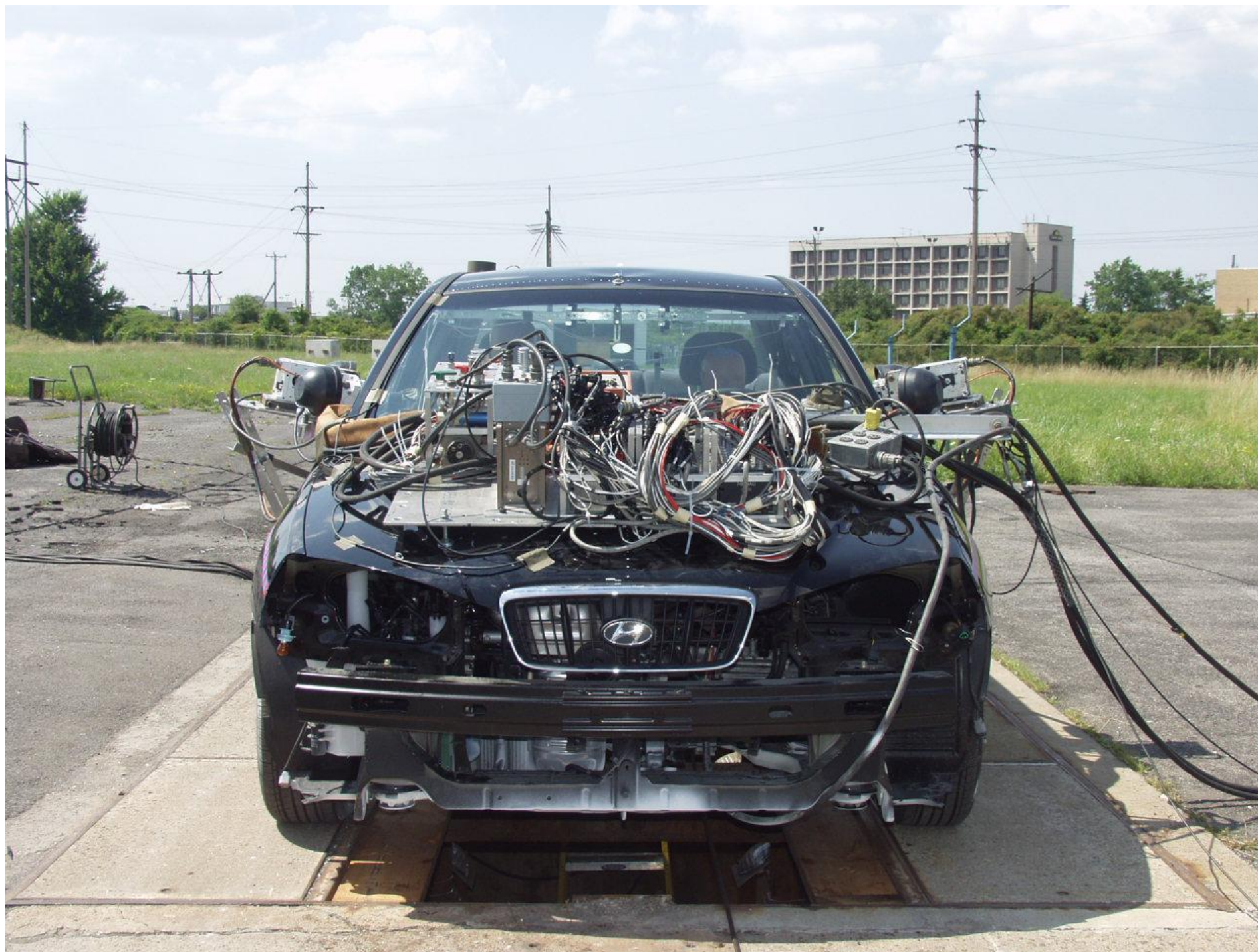


Figure A-1 PRE-TEST FRONT VIEW

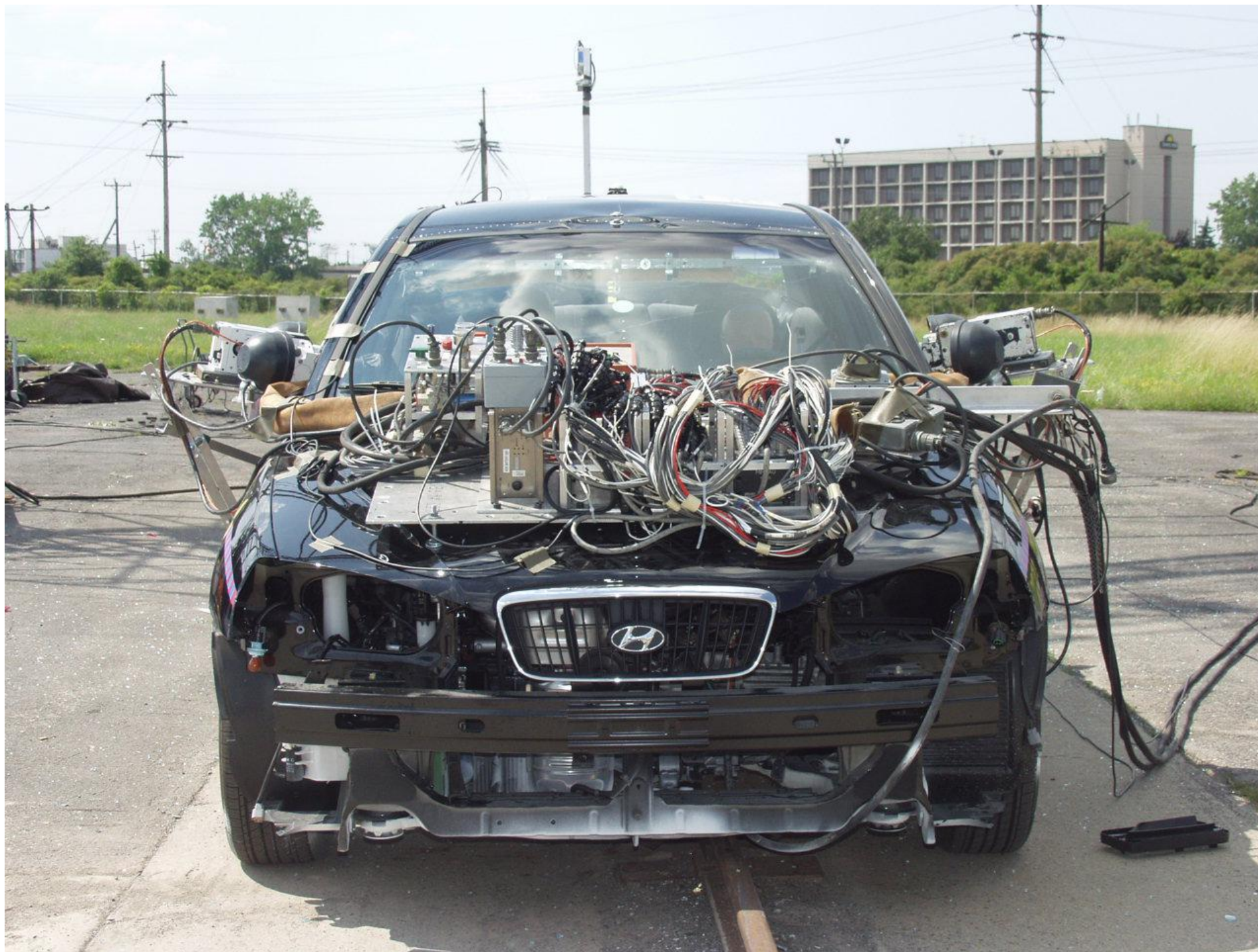


Figure A-2 POST-TEST FRONT VIEW



Figure A-3 PRE-TEST LEFT SIDE VIEW



Figure A-4 POST-TEST LEFT SIDE VIEW



Figure A-5 PRE-TEST RIGHT SIDE VIEW



Figure A-6 POST-TEST RIGHT SIDE VIEW



Figure A-7 PRE-TEST REAR VIEW



Figure A-8 POST-TEST REAR VIEW



Figure A-9 PRE-TEST LEFT FRONT THREE-QUARTER VIEW



Figure A-10 POST-TEST LEFT FRONT THREE-QUARTER VIEW



Figure A-11 PRE-TEST RIGHT REAR THREE-QUARTER VIEW



Figure A-12 POST-TEST RIGHT REAR THREE-QUARTER VIEW



Figure A-13 PRE-TEST FRONT UNDERBODY VIEW



Figure A-14 POST-TEST FRONT UNDERBODY VIEW



Figure A-15 PRE-TEST REAR UNDERBODY VIEW



Figure A-16 POST-TEST REAR UNDERBODY VIEW

MANUFACTURED IN KOREA BY
HYUNDAI MOTOR COMPANY
SEP/14/02 GVWR 3835 LBS PAINTED

GAWR FRONT 2070 LBS GAWR REAR 1850 LBS TRIM OH

THIS VEHICLE CONFORMS TO ALL APPLICABLE U.S.A. FEDERAL
MOTOR VEHICLE SAFETY, BUMPER AND THEFT PREVENTION STANDARDS
IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE

V.I.N KMHDN45D73U509422
PASSENGER CAR

Figure A-17 CERTIFICATION PLACARD

1		TIRE INFLATION PRESSURE(COLD)	
STANDARD INFLATION PRESSURE FOR ALL LOAD			
1ST SEAT		2 PASS.	
2ND SEAT		3 PASS.	
TOTAL		5 PASS.	
LUGGAGE		45kg(100LBS)	
VEHICLE CAPACITY WT.		385kg(850LBS)	
TIRE SIZE		P185/65R15 86T P195/60R15 87H	
FRONT		REAR	
210kPa (30psi)		210kPa (30psi)	
TIRE SIZE T125/70D15 T125/70R15 TEMPORARY USE ONLY			
420kPa		(60psi)	

Figure A-18 TIRE PLACARD



Figure A-19 ROLLOVER 90°



Figure A-20 ROLLOVER 180°

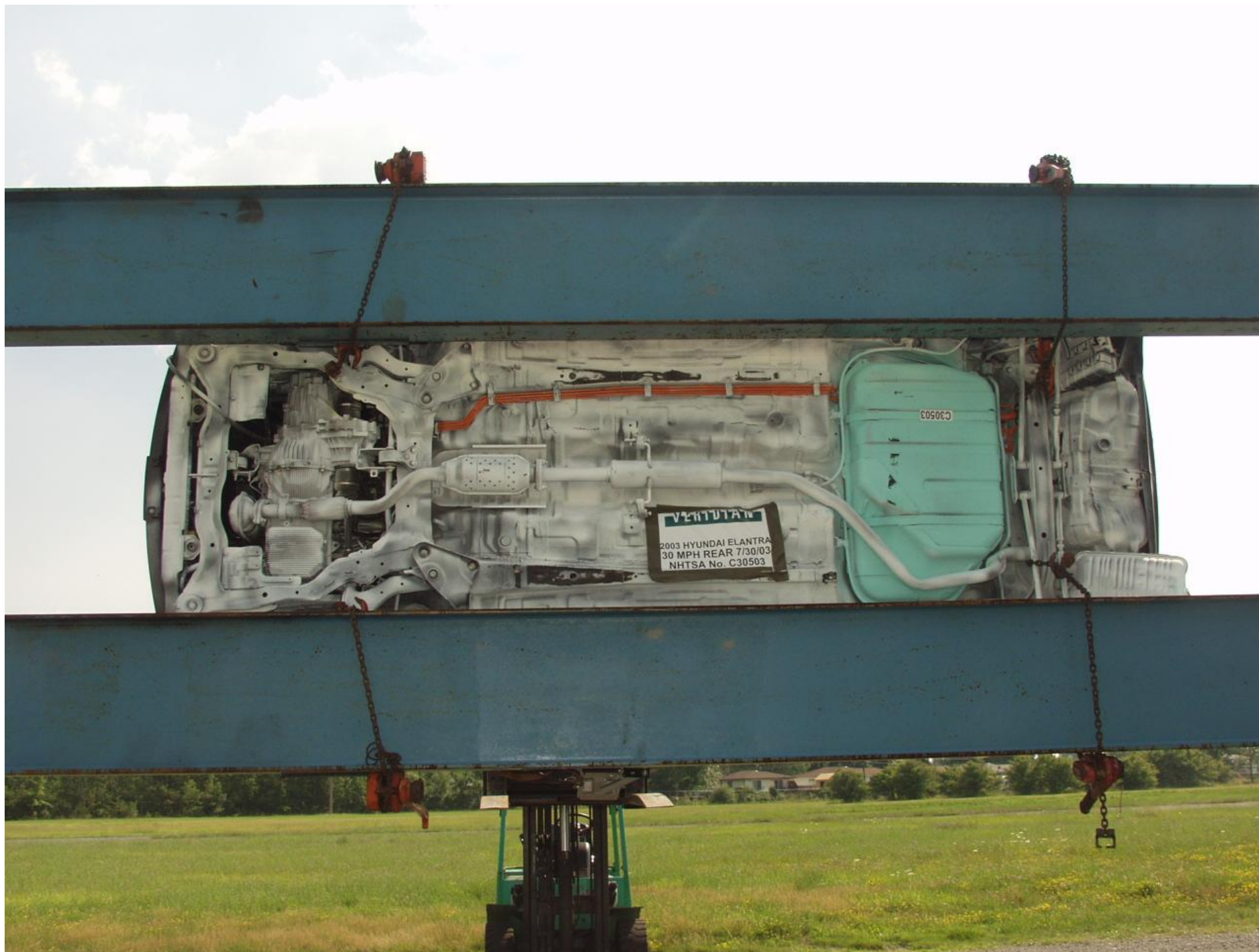


Figure A-21 ROLLOVER 270°



Figure A-22 ROLLOVER 360°