

REPORT NUMBER: 301-CAL-03-05

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

SATURN CORPORATION
2003 SATURN ION
4-DOOR SEDAN

NHTSA NUMBER: C30112

VERIDIAN TEST NUMBER: 8655-F301-14

August 7, 2003

VERIDIAN ENGINEERING
P.O. BOX 400
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 Saturn Ion 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 Saturn Ion 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 1431.5 kg 2003 Saturn Ion 4-Door Sedan was impacted from the rear by an 1797 pound moving barrier at a velocity of 48.1 kph (29.9 mph). The test was performed by Veridian Engineering on August 7, 2003.

The test vehicle was equipped with a 51.5 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 E 50th percentile male Anthropomorphic Test Device (ATD) and one instrumented Part 572 O 5th percentile female 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 403 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 Saturn Ion 4-Door Sedan
NHTSA No.: C30112 ; Color: Silver
Engine Data: 4 Cylinders; - CID; 2.2 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: - A/C; X Power Steering; X Power Brakes
- Power Windows; - Power Door Locks; X Tilt Wheel
Date Received: 04/10/03 ; Odometer Reading 187 km
Selling Dealer: Saturn of Orchard Park
& Address: 3559 Southwestern Blvd., Orchard Park, NY 14127

DATA FROM VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured by: Saturn Corporation
Date of Manufacture: 01/03
VIN: 1G8AF52F03Z138200
GVWR: 1644 kg; GAWR-FRONT: 833 kg; GAWR-REAR: 811 kg

DATA FROM VEHICLE'S TIRE LABEL:

Location of Placard on Vehicle: Glove compartment door
Recommended Tire Size: P185/70R14 S

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

DATA FROM TIRE SIDEWALL:

Size of Tires on Test Vehicle: P185/70R14 87S Manufacturer: _____
Tire Pressure with Maximum Capacity Vehicle Load: FRONT: 300 kPa; REAR: 300 kPa
Type of Spare Tire: Temporary T115/70R14

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) = 408 kg
No. of Occupants x 68.04 kg = 340.2 kg
Rated Cargo/Luggage Weight (RCLW) = 67.8 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>359.5</u>	kg	Right Rear	=	<u>247.0</u>	kg
Left Front	=	<u>364.5</u>	kg.	Left Rear	=	<u>249.0</u>	kg
TOTAL FRONT	=	<u>724.0</u>	kg	TOTAL REAR	=	<u>496.0</u>	kg
TOTAL DELIVERED WEIGHT	=	<u>1220.0</u>	kg				
% of Total Front of Vehicle Weight	=	<u>59.3%</u>		of Total Rear Weight	=	<u>40.7%</u>	

CALCULATION OF VEHICLE'S TARGET TEST WEIGHT:

Total Delivered Weight	=	<u>1220.0</u>	kg
Rated Cargo/Luggage Weight (RCLW)	=	<u>67.8</u>	kg
Weight of 2 p.572 Dummies, 74.4 kg	=	<u>148.8</u>	kg
TARGET TEST WEIGHT	=	<u>1436.6</u>	kg

WEIGHT OF TEST VEHICLE WITH TWO DUMMIES AND 62.7 KG OF CARGO WEIGHT:

Right Front	=	<u>430.5</u>	kg	Right Rear	=	<u>267.5</u>	kg
Left Front	=	<u>449.5</u>	kg	Left Rear	=	<u>284.0</u>	kg
TOTAL FRONT	=	<u>880.0</u>	kg	TOTAL REAR	=	<u>551.5</u>	kg
TOTAL TEST WEIGHT	=	<u>1431.5</u>	kg				
% of Total Front of Vehicle Weight	=	<u>61.5%</u>		of Total Rear Weight	=	<u>38.5%</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, front door glass, rear door trim and glass, engine air intake ducts.

VEHICLE ATTITUDE (all dimension in millimeters):

AS DELIVERED: RF 715 LF 714 RR 714 LR 711

AS TESTED: RF 673 LF 663 RR 700 LR 698

Vehicle's Wheel Base: 2622 mm

Location of Vehicle's C.G.: 1010 millimeters rearward of front wheel center.

FUEL SYSTEM DATA:

Fuel System Capacity From Owner's Manual = 51.1 liters

Usable Capacity Figure Furnished by COTR = 51.5 liters

Test Volume Range (91 to 94% of Usable Capacity) = 46.87 to 48.41 liters

ACTUAL TEST VOLUME= 47.3 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:

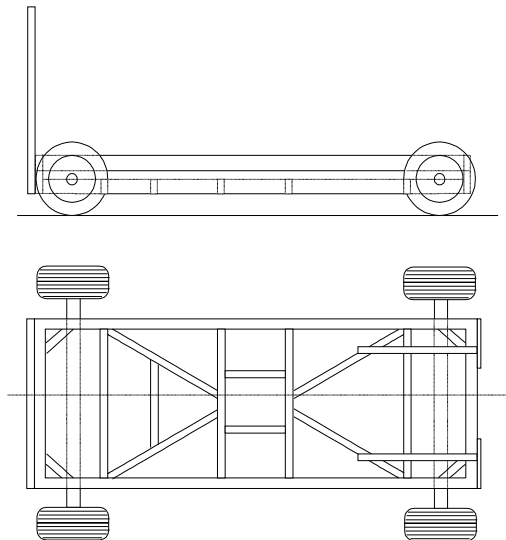
Barrier Face Height: 1524 mm
Barrier Face Width: 1981 mm
Barrier Face Ground Clearance: 127 mm
Tread Width: 1511 mm
Wheel Base: 3048 mm
Location of C.G.: X: 1344 mm rearward of front wheel center.
Y: 0 mm from longitudinal-vertical plane of symmetry.
Z: 414 mm above ground.

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: August 7, 2003 Time: 11:58 Temperature: 26.1 °C
Vehicle NHTSA No.: C30112 VIN: 1G8AF52F03Z138200
Required Impact Velocity Range: 46.51 to 48.12 kph

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

Trap No. 1 = 48.1 kph; Trap No. 2 = 48.1 kph
Average Impact Speed = 48.1 kph

VEHICLE STATIC CRUSH:

Vehicle Length:

Pre-Test Left = 4523 ; C/L = 4683 Right = 4525
Post-Test Left = 4112 ; C/L = 4212 Right = 4198
Crush Left = 411 ; C/L = 471 Right = 327
AVERAGE = 403 millimeters

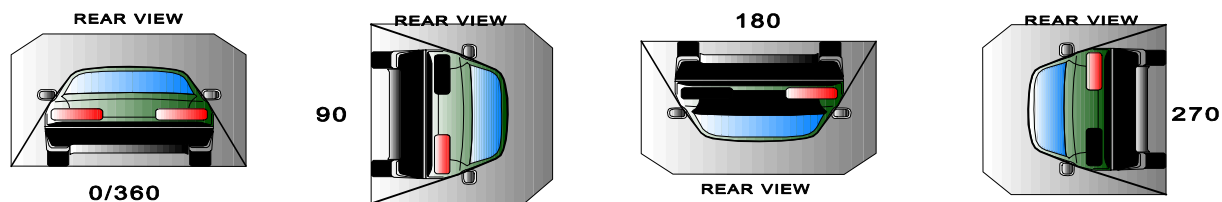
DATA SHEET 5

STATIC ROLLOVER TEST DATA

Table 7 FMVSS NO. 301 - STATIC ROLLOVER DATA SHEET

Vehicle: 2003 Saturn Ion 4-Door Sedan

NHTSA No.: C30112



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	
	1	minutes	14	seconds	5	minutes	6	minutes	14	seconds	7	minutes
0° - 90°	1	minutes	4	seconds	5	minutes	6	minutes	4	seconds	7	minutes
90° - 180°	1	minutes	2	seconds	5	minutes	6	minutes	2	seconds	7	minutes
180°-270°	1	minutes	10	seconds	5	minutes	6	minutes	10	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	-

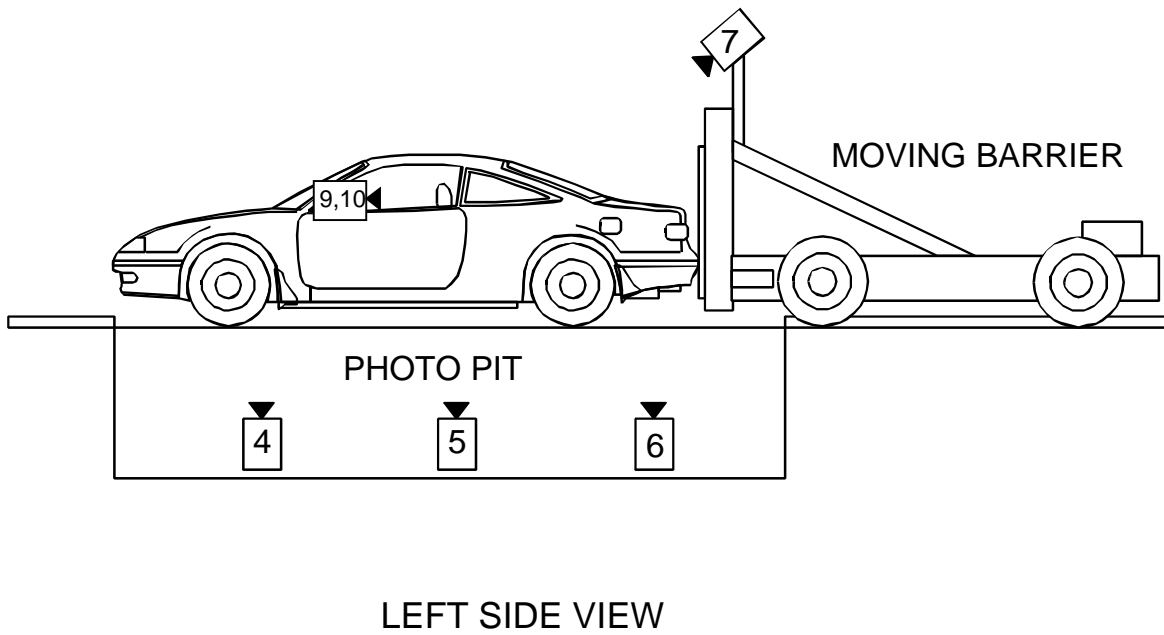
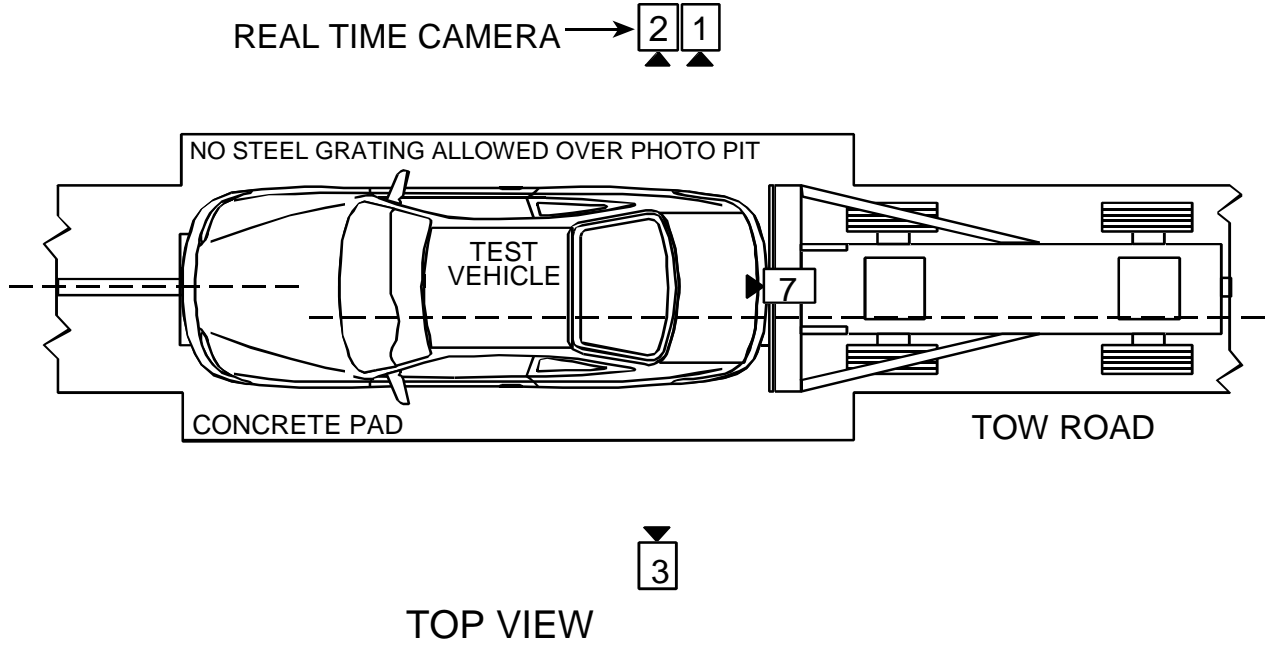
Note: Record spillage for whole minute intervals only as determined above.

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



DATA SHEET 6 (continued)

HIGH SPEED CAMERA LOCATIONS

NHTSA No. : C30112

Vehicle : 2003 Saturn Ion 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	15480	1690	1095	-1	35	1000
3	Left Side View	16512	2078	1000	1	35	1000
4	Vehicle Front Underbody View	0	3380	-1956	90	13	995
5	Vehicle Mid-Section Underbody View	0	1938	-1956	90	13	1005
6	Vehicle Rear Underbody View	0	992	-1956	90	13	1030
7	Moving Barrier View	0	0	2515	-105	13	1000
8	Overhead Overall View	-508	0	9804	-90	13	1000
9†	Onboard Driver View	855	2715	970	-6	8	1000
10†	Onboard Passenger View	855	2702	975	-5	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

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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

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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



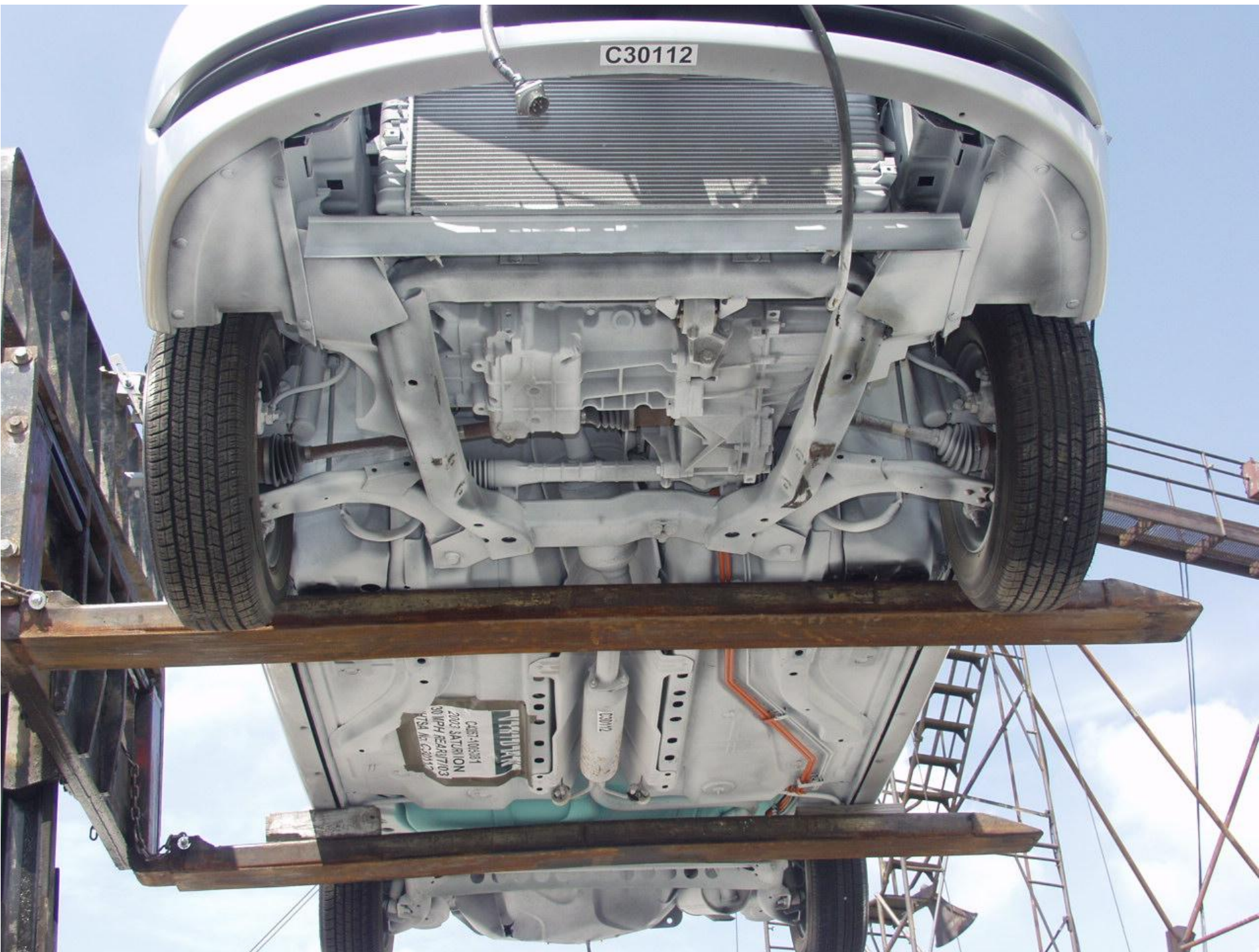
Figure A-12 POST-TEST RIGHT REAR THREE-QUARTER VIEW



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Figure A-13 PRE-TEST FRONT UNDERBODY VIEW



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Figure A-14 POST-TEST FRONT UNDERBODY VIEW



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Figure A-15 PRE-TEST REAR UNDERBODY VIEW



Figure A-16 POST-TEST REAR UNDERBODY VIEW



MFD BY SATURN CORPORATION

DATE	GVWR	GAWR FRT	GAWR RR
01/03	3625LB 1644KG	1836LB 0833KG	1789LB 0811KG

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

1G8AF52F03Z138200

PASS CAR



Figure A-17 CERTIFICATION PLACARD



TIRE-LOADING INFORMATION

OCCUPANTS VEHICLE CAPACITY WT.
 FRT. CTR. RR. TOTAL LBS KG.
 2 0 3 5 899 408
 MAXIMUM LOADING AT GVWR:
 SAME AS VEHICLE CAPACITY WEIGHT

ZZHB COLD TIRE PRESSURE

	TIRE SIZE	SPEED RATING	PSI/KPA
FRONT	P185/70R14	S	30/210
REAR	P185/70R14	S	30/210
SPARE	T115/70R14	M	60/420

IF TIRES ARE HOT, ADD 4 PSI (28 KPA)
 SEE OWNER'S MANUAL FOR ADDITIONAL
 INFORMATION

Figure A-18 TIRE PLACARD

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Figure A-19 ROLLOVER 90°



Figure A-20 ROLLOVER 180°



Figure A-21 ROLLOVER 270°



Figure A-22 ROLLOVER 360°