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REPORT NO. 111-KAR-04-002

SAFETY COMPLIANCE TESTING FOR FMVSS 111

REARVIEW MIRRORS (Other Than School Buses)

2004 SATURN ION
4 DOOR SEDAN

NHTSA NO. C40104

PREPARED BY:
KARCO ENGINEERING
9270 HOLLY ROAD
ADELANTO, CALIFORNIA 92301

June 28, 2004

FINAL REPORT

PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
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WASHINGTON, D.C. 20590

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15. *Supplementary Notes*		

16. *Abstract*

Compliance tests were conducted on the subject 2004 Saturn Ion 4 Door Sedan on May 26 and 27, 2004 in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP111V00 for the determination of FMVSS 111 compliance. There were no apparent test failures.

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1. PURPOSE OF COMPLIANCE TEST

Tests were conducted on a 2004 Saturn Ion 4 Door Sedan, manufactured by Saturn Corporation, to determine compliance with FMVSS 111, "Rearview Mirrors (Other than School Buses)". The purpose of this standard is to reduce the number of deaths and injuries that occur when the driver of a motor vehicle does not have a clear and reasonably unobstructed view to the rear.

All tests were conducted based on the current National Highway Traffic Safety Administration (NHTSA), Office of Vehicle Safety Compliance (OVSC) Laboratory Procedures, TP-111V-00, dated October 28, 1999, and corresponding KARCO Engineering test procedure KTP-111, dated April 18, 2001. Detailed procedures for receiving, inspecting, testing and reporting of test results are described in the test procedures and are not repeated in this report.

This report is organized in sections containing pertinent test information and data tables as follows:

Section 2	-	Compliance Test Procedure and Data Summary
Section 3	-	Test Results
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Appendix D	-	Manufacturer Eyelipse Locations

SECTION 2

COMPLIANCE TEST PROCEDURE AND DATA SUMMARY

2. COMPLIANCE TEST PROCEDURE AND DATA SUMMARY

A 2004 Saturn Ion 4 Door Sedan was subjected to FMVSS 111 compliance testing. The tests were conducted at KARCO Engineering in Adelanto, California on May 26 and 27, 2004. Summary data is shown on page 23, Data Sheet No. 8. The following tests were performed:

- Inspection
- Mounting Adequacy Test
- Field-of-View Test, Inside Rearview Mirror
- Field-of-View Test, Driver's Side Outside Mirror
- Reflectance Test
- Breakaway Test
- Unit Magnification and Convex Mirror Tests

The tests were conducted per the FMVSS 111 test procedure. The significant aspects of the test procedure are described in the following paragraphs.

A. INSPECTION

Inspect the installation of the inside and outside rearview mirrors.

B. MOUNTING ADEQUACY TEST – ALL REARVIEW MIRRORS

B.1 INSIDE MIRROR (S5.1.2)

Determine that the mirror is securely mounted and determine the positive and negative angles of adjustment for both the vertical and horizontal directions.

B.2 OUTSIDE MIRROR(S) (S5.2.2 and S5.3)

Determine that the mirror(s) is (are) securely mounted. Determine that the driver's side mirror can be tilted in both horizontal and vertical directions from the driver's seated position. Determine that the passenger's side mirror is capable of adjustment by tilting in both the horizontal and vertical directions. Determine the positive and negative angles of adjustment for both horizontal and vertical directions for all outside mirrors. Determine that all outside mirrors are free of sharp points or edges that could contribute to pedestrian injury.

C. FIELD-OF-VIEW TEST – INSIDE REARVIEW MIRROR

C.1 REQUIREMENTS (S5.1.1)

The mirror shall provide a field of view with an included horizontal angle measured from the projected eye point of at least 20 degrees, and sufficient vertical angle to provide a view of a level road surface extending to the horizon beginning at a point not greater than 61m (200 feet) to the rear of the vehicle when the vehicle is occupied by the driver and four passengers or the designated occupant capacity, if less. The line of sight may be partially obscured by seated occupants or by head restraints.

Each car whose inside mirror does not meet the field of view requirements of S5.1.1 shall have an outside mirror of unit magnification or a convex mirror installed on the passenger's side. (S5.3)

D. FIELD-OF-VIEW TEST, DRIVER'S SIDE OUTSIDE REARVIEW MIRROR

D.1 REQUIREMENTS (S5.2)

Each passenger car shall have an outside mirror of unit magnification. The mirror shall provide the driver a view of a level road surface extending to the horizon from a line, perpendicular to a longitudinal plane tangent to the driver's side of the vehicle at the widest point, extending 2.4 meters (8 feet) out from the tangent plane 10.7 meters (35 feet) behind the driver's eyes, with the seat in the rearmost position. The line of sight may be partially obscured by rear body or fender contours. (S5.2.1)

Neither the mirror nor the mounting shall protrude farther than the widest part of the vehicle body except to the extent necessary to produce a field of view meeting or exceeding the requirements of S5.2.1. The mirror shall not be obscured by the un-wiped portion of the windshield. (S5.2.2)

E. REFLECTANCE TEST – ALL MIRRORS

E.1 REQUIREMENT (S11)

All single reflectance mirrors shall have an average reflectance of at least 35 percent. If a mirror is capable of multiple reflectance levels, the minimum reflectance level in the day mode shall be at least 35 percent and the minimum reflectance level in the night mode shall be at least 4 percent. The average reflectance of any mirror required by this standard shall be determined in accordance with SAE Recommended Practice J964, OCT 84.

F. BREAKAWAY TEST – INSIDE REARVIEW MIRROR

F.1 REQUIREMENTS (S5.1.2)

If the mirror is in the head impact area, the mounting shall deflect, collapse, or break away without leaving sharp edges when the reflective surface of the mirror is subjected to a force of 400 N (90 lb) in any forward direction that is not more than 45 degrees from the longitudinal direction.

G. UNIT MAGNIFICATION AND CONVEX MIRROR TESTS

G.1 REQUIREMENTS FOR PASSENGER CARS (S5.3 and S5.4)

The driver's side rearview mirror and the inside rearview mirror shall be unit magnification. If the field-of-view requirements are not met with the inside rearview mirror then the passenger's side rearview mirror is required. It can be either unit magnification or convex.

If the passenger's side mirror is convex, the average radius of curvature shall be not less than 889 mm (35 inches) and not more than 1651 millimeters (65 inches) and shall not deviate from the average by more than plus or minus 12.5 percent. The convex mirror shall have permanently and indelibly marked at the lower edge of the mirror's reflective surface in letters not less than 4.8 mm (3/16 inch) nor more than 6.4 mm (0.25 inch) high the words, **"Objects In Mirror Are Closer Than They Appear."**

SECTION 3

TEST DATA

3. TEST DATA

The results of FMVSS 111 compliance tests that were conducted on the 2004 Saturn Ion 4 Door Sedan on May 26 and 27, 2004 to determine compliance with FMVSS 111, "Rearview Mirrors (other than School Buses)" are presented in this section.

DATA SHEET NO. 1

VEHICLE INSPECTION AND IDENTIFICATION

TEST VEHICLE INFORMATION			
Manufacturer	SATURN CORPORATION	VIN	1G8AF52F94Z129223
Manufacturing Date	09/03	Delivery Date	05/10/04
Dealer	SATURN OF SANTA CLARITA	NHTSA No.	C40104
Odometer Reading (mi.)	106	Fuel Type	GAS
Engine Displacement	2.2	Cylinders	4
Transmission	MANUAL	Final Drive	FRONT
Engine Placement	TRANSVERSE	Color	SILVER
Tire Press./Max. Cap. Front	44	Cold Tire Press. Front	30
Tire Press./Max. Cap. Rear	44	Cold Tire Press. Rear	30
Recommend Tire Size	P185/70R14	Type of Spare	T115/70R14
Tire Size on Vehicle	P185/70R14	Manufacturer	FIRESTONE
GVWR	3667	Cargo Capacity	899
GAWR Front	1869	GAWR Rear	1798
Air Conditioning	YES	Power Steering	YES
Power Brakes	YES	AM/FM/Cassette	YES
Disc Brakes (Front)	YES	Disc Brakes (Rear)	NO
Power Windows	NO	Tilt Steering	YES
Anti-lock Brakes (ABS)	NO	Power Seats	NO
Driver Airbag	YES	Passenger Airbag	YES

TEST VEHICLE ATTITUDE (mm)

ATTITUDE	LF	RF	LR	RR
As Delivered	702	704	714	712
As Tested	683	678	662	660
Rear View Mirror	1295			

DATA SHEET NO. 1... (Continued)

VEHICLE			
YEAR	2004	MAKE	SATURN
MODEL	ION	BODY STYLE	4 DOOR SEDAN
NHTSA NO.	C40104	VIN	1G8AF52F94Z129223
TEST DATE:	05/26/04	TEMPERATURE:	84°F

LEGEND: LE = Left Eye; RE = Right Eye; P = Neck Pivot Point, SRP = Seating Reference Point

COORDINATE SYSTEM:

X = Longitudinal Dimension
Y = Lateral Dimension
Z = Vertical Dimension

Positive Values are as follows:

X = Forward of Reference Point
Y = Outboard of Reference Point (to driver's side)
Z = Above Reference Point

Provide Reference Point or Body Fiduciary Point that dimensions below are measured from. (Point should be usable by laboratory personnel, i.e., center of an anchorage bolt, door jam latch, etc.).

COORDINATES	LEFT SIDE MIRROR			INSIDE MIRROR			RIGHT SIDE MIRROR			SRP
	P1	LE1	RE1	P2	LE2	RE2	P3	LE3	RE3	
X		-292	-292		-292	-292		-292	-292	
Y		-205.5	-270.5		-205.5	-270.5		-205.5	-270.5	
Z		815.05	815.05		815.05	815.05		815.05	815.05	
Mirror Mfr., Model And Part No.	FICOSA NA Corp. GMX357 22726678, 22726680, 22720620, 22720618			MAGNE DONNELLY GMX357 10327271, 15170979, 25603373			FICOSSA NA Corp. GMX357 22726677, 22726679, 22720627, 22720619			
SRP Travel and Eye-llipse	N/A									

Reference Point- Front Outer seat track mounting bolt. Co-ordinates X = 2823.89, Y= 578.0, Z = 280.94

DATA SHEET NO. 1... (Continued)

DATE OF INSPECTION/IDENTIFICATION:		05/26/04
TYPES OF REARVIEW MIRRORS:		
	INSIDE REARVIEW–	WINDSHIELD MOUNTED DAY/NIGHT
	DRIVER'S SIDE OUTSIDE–	FLAT
	PASSENGER'S SIDE OUTSIDE–	CONVEX
LOCATION AND DESCRIPTION OF FIDUCIAL MARKS:		SEE PREVIOUS PAGE
MAXIMUM NUMBER OF OCCUPANTS:		5

RESULTS OR RECEIVING INSPECTION:

PASS - - X

FAIL - -

CONDITIONAL - -

CONDITIONS:

DISPOSITION/ACTION:

REMARKS:

RECORDED BY: PABLO VEGA DATE: 05/26/04

APPROVED BY: MATTHEW A. IVORY DATE: 05/26/04

DATA SHEET NO. 2

MOUNTING AND TILTING ADEQUACY TEST

VEHICLE			
YEAR	2004	MAKE	SATURN
MODEL	ION	BODY STYLE	4 DOOR SEDAN
NHTSA NO.	C40104	VIN	1G8AF52F94Z129223
TEST DATE:	05/26/04	TEMPERATURE:	84°F

MIRROR MOUNTING PROVIDES A STABLE SUPPORT	PASS	FAIL	CONDITIONAL
INSIDE REARVIEW MIRROR	X		
DRIVER SIDE OUTSIDE MIRROR	X		
PASSENGER SIDE OUTSIDE MIRROR	X		NOT REQUIRED

OUTSIDE MIRRORS FREE OF SHARP POINTS OR EDGES	PASS	FAIL
DRIVER SIDE OUTSIDE MIRROR	X	
PASSENGER SIDE OUTSIDE MIRROR	X	

MIRROR IS ADJUSTABLE VERTICALLY & HORIZONTALLY	PASS	FAIL	CONDITIONAL
INSIDE REARVIEW MIRROR	X		
DRIVER SIDE OUTSIDE MIRROR	X		
PASSENGER SIDE OUTSIDE MIRROR	X		NOT REQUIRED

DRIVER'S OUTSIDE MIRROR ADJUSTABLE FROM THE DRIVER'S SEATED POSITION	PASS	FAIL
DRIVER SIDE OUTSIDE MIRROR	X	

MIRROR ADJUSTMENT ANGLE	V+	V-	H+	H-
INSIDE REARVIEW MIRROR	8°	-59°	24°	-23°
DRIVER SIDE OUTSIDE MIRROR	18.5°	-6.4°	32°	-14°
PASSENGER SIDE OUTSIDE MIRROR	18.5°	-9.7°	36°	-16°

THIS SECTION IS RESERVED FOR MPVs, TRUCKS AND BUSES, OTHER THAN SCHOOL BUSES, NOT CONFORMING TO PASSENGER CAR REQUIREMENTS

MIRROR PROVIDES A VIEW TO THE REAR ALONG BOTH SIDES OF THE VEHICLE	PASS	FAIL	CONDITIONAL
DRIVER SIDE OUTSIDE MIRROR	N/A		
PASSENGER SIDE OUTSIDE MIRROR	N/A		

TEST STATUS:	PASSED —	x	FAILED —	

RECORDED BY: PABLO VEGA DATE: 05/26/04

APPROVED BY: MATTHEW A. IVORY DATE: 05/26/04

DATA SHEET NO. 3

FIELD OF VIEW TEST - INSIDE REARVIEW MIRROR

VEHICLE			
YEAR	2004	MAKE	SATURN
MODEL	ION	BODY STYLE	4 DOOR SEDAN
NHTSA NO.	C40104	VIN	1G8AF52F94Z129223
TEST DATE:	05/26/04	TEMPERATURE:	85°F

E Distance from center of mirror to projected eye point location = **582.0 mm**

A Distance from rear of vehicle to projected eye point location = **3117.0 mm**

X1 Distance from rear of vehicle to field of view grid = **8382.0 mm**

Z1 Vertical distance to lowest point of field of view at distance X1 **635.0 mm**

Z2 Height of center of mirror = **1295.0 mm**

X2 Distance from rear of vehicle where the road surface is first visible
X2 = [(Z2 x X1) + (Z1 x A)]/(Z2 - Z1) =
(S111 REQUIREMENT = 61m maximum) **19445.43 mm (19.44 m)**

EYE LOCATION	MONOCULAR DATA (ALR & ARL ARE ANGLES)			
	YL (mm)	YR (mm)	ALR (°)	ARL (°)
LEFT EYE POINT	YLL =2052	YRL =2627		13.2
RIGHT EYE POINT	YLR =2738	YRR = 2038	13.7	

CALCULATED HORIZONTAL AMBINOCULAR VIEW ANGLE (AB)

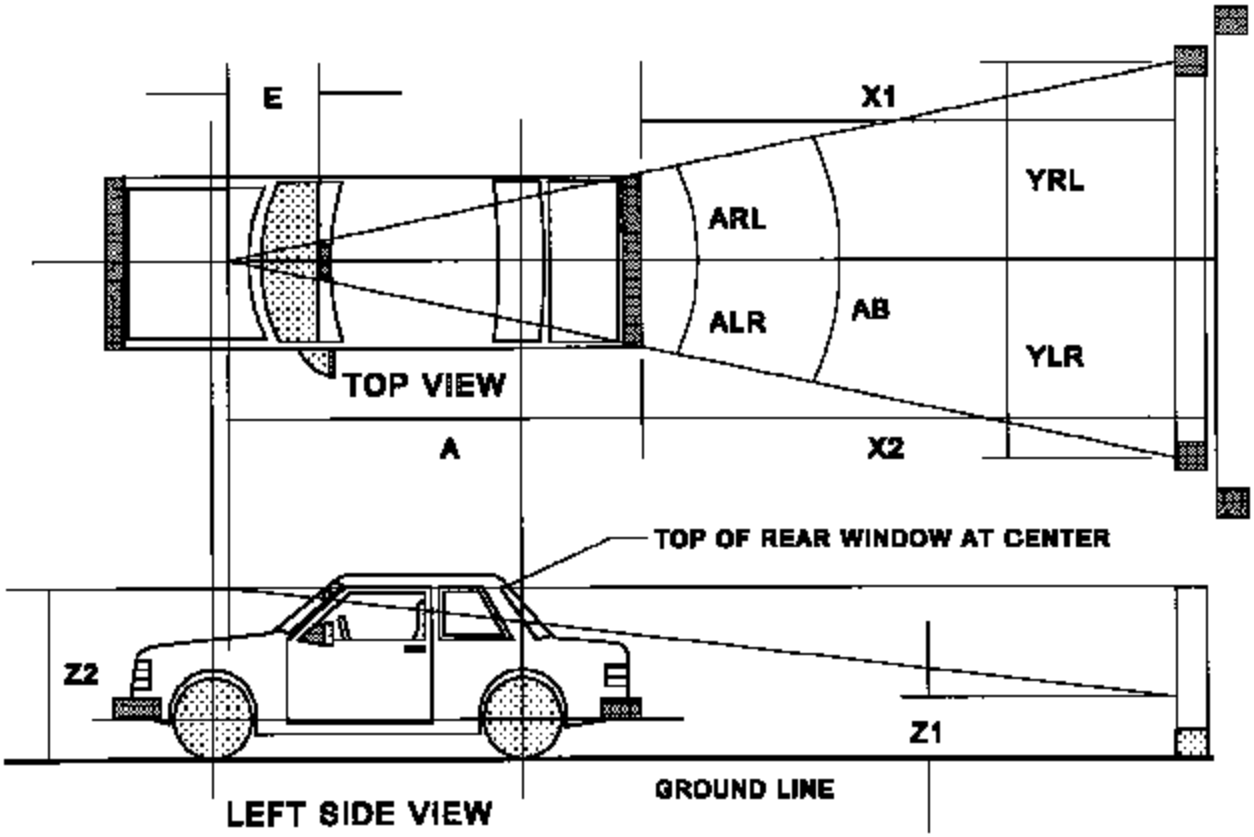
ANGLE AB = ANGLE ALR + ANGLE ARL

ALR = TAN - [1YLR/(X1 + A)] ARL = TAN - [1YRL/(X1 + A)]

ANGLE AB = **26.9°** (S111 REQUIREMENT = 20 degrees minimum)

TEST STATUS:	PASSED —	x	FAILED —	

INSIDE REARVIEW MIRROR FIELD OF VIEW TEST GRID AND MARKER SETUP



DATA SHEET NO. 3... (Continued)

DRIVER SIDE MIRROR (S5.2)

MIRROR OBSCURED BY UNWIPED PORTION OF WINDSHIELD YES ____ NO __X__.

HEIGHT OF TARGET DISC ON MIRROR 1077 mm

DISTANCE OF TARGET DISC ON MIRROR FROM VEHICLE TANGENT PLANE 84 mm

TARGET DISC LOCATION RELATIVE TO VEHICLE TANGENT PLANE INBOARD (Inboard or Outboard)

ENTIRE TRIANGULAR TEST TARGET AREA ON SCREEN VISIBLE YES __X__ NO ____

MIRROR PROTRUDES BEYOND VEHICLE TANGENT PLANE YES __X__ NO ____

PROTRUSION REQUIRED TO MEET FIELD OF VIEW REQUIREMENT YES __X__ NO ____

TEST STATUS:	PASSED —		FAILED —	

PASSENGER SIDE MIRROR (S5.3 or MFG. OPTION)

PASSENGER SIDE MIRROR TYPE (convex or unit magnification) CONVEX

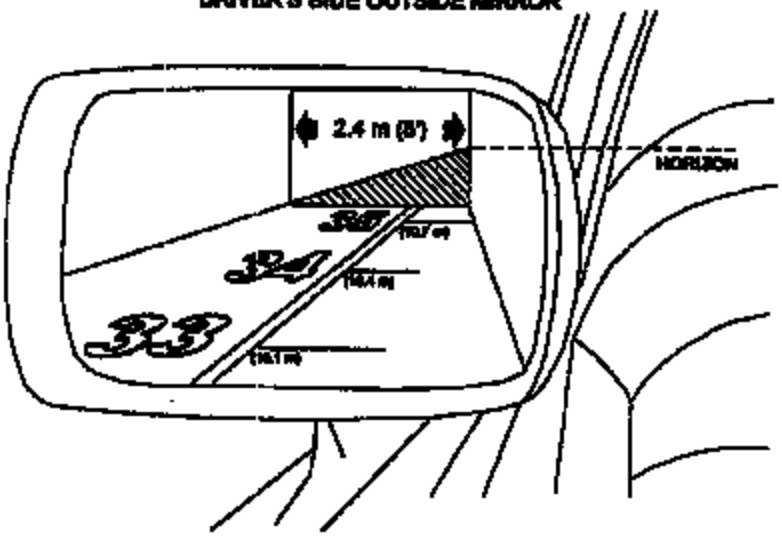
REMARKS:

VEHICLE ATTITUDE AND GROUND LEVEL WERE RAISED 4". (101.6)

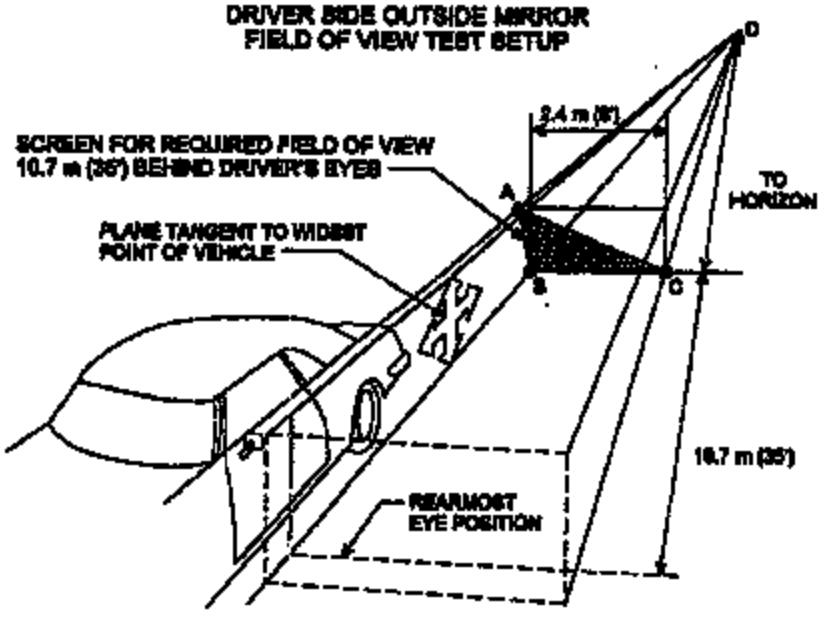
RECORDED BY: PABLO VEGA DATE: 05/26/04

APPROVED BY: MATTHEW A. IVORY DATE: 05/26/04

REQUIRED FIELD OF VIEW AS SEEN IN DRIVER'S SIDE OUTSIDE MIRROR

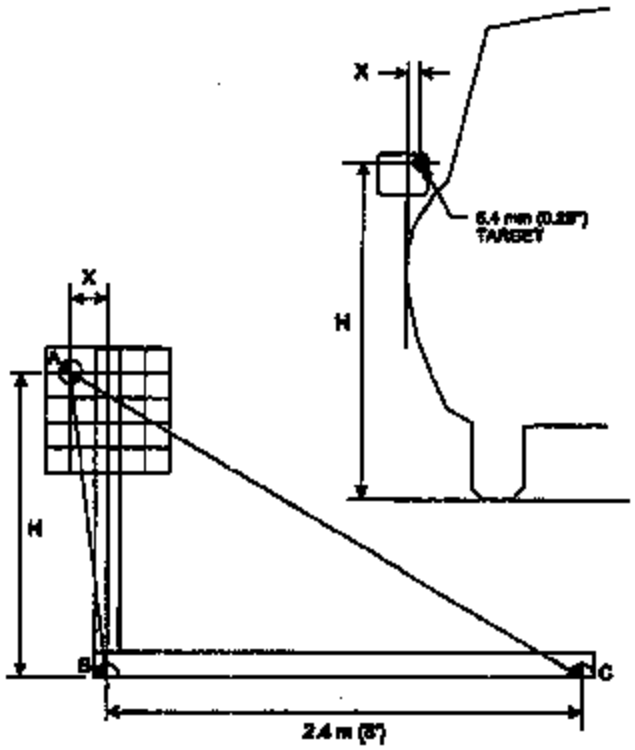


DRIVER SIDE OUTSIDE MIRROR FIELD OF VIEW TEST SETUP

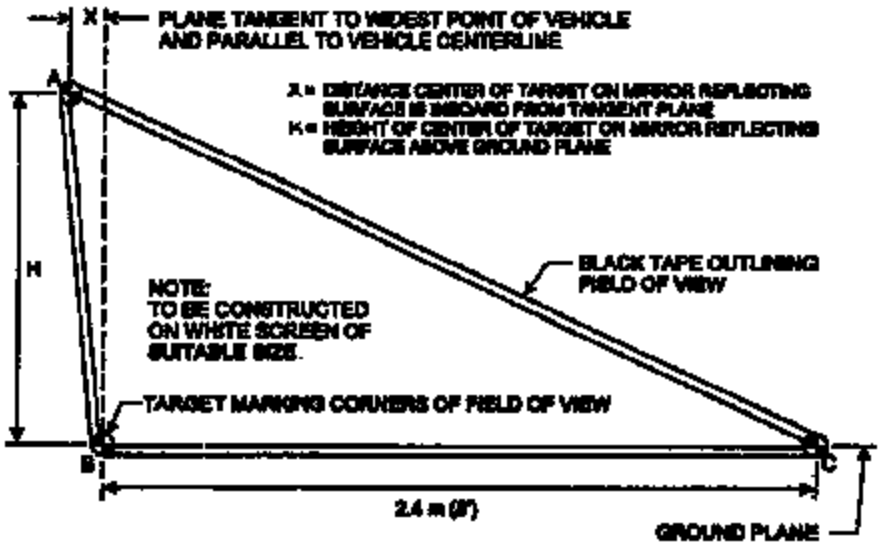


DATA SHEET NO. 3... (Continued)

DRIVER SIDE OUTSIDE MIRROR TARGET DISC
LOCATION WITH X AND H DIMENSIONS



DRIVER SIDE OUTSIDE MIRROR REQUIRED
FIELD OF VIEW TRIANGLE



DATA SHEET NO. 4

REFLECTANCE TEST

VEHICLE			
YEAR	**2004**	MAKE	**SATURN**
MODEL	**ION**	BODY STYLE	**4 DOOR SEDAN**
NHTSA NO.	**C40104**	VIN	**1G8AF52F94Z129223**
TEST DATE:	**05/26/04**	TEMPERATURE:	**72°F**

DESCRIPTION OF TEST APPARATUS: **THE APPARATUS CONSISTS OF AN INCANDESCENT TUNGSTEN FILAMENT LAMP OPERATING AT A NOMINAL COLOR TEMPERATURE OF 2,856 K, COLLIMATING OPTICS, A SAMPLE HOLDER POSITIONED AT 25°, A SILICON PHOTOCELL, AND A FLUKE 45 DUAL DISPLAY MULTIMETER (CALIBRATION DUE DATE 3-21-05). REFLECTANCE TESTS ARE CONDUCTED IN A 4'X6' WOODEN CABINET PAINTED FLAT BLACK.**

MIRROR DESCRIPTION: **INTERIOR DAY/NIGHT REAR VIEW MIRROR**

VOLTAGE READING FROM CALIBRATION (Average Value): **277 mV**

VOLTAGE READING FROM LIGHT REFLECTED BY DAY MIRROR (Average Value): **268 mV**

REFLECTOMETER VOLTAGE READINGS		
	DAY MIRROR	NIGHT MIRROR
TEST NO. 1	**268 mV**	**191 mV**
TEST NO. 2	**268 mV**	**192 mV**
TEST NO. 3	**268 mV**	**192 mV**
TEST NO. 4	**268 mV**	**192 mV**
TEST NO. 5	**268 mV**	**191 mV***

*Day/night portion of mirror was electronic and required a voltage to keep the night portion active. As the tests progressed, the voltage of our supply battery dropped causing the reflectance level to increase. The mirror still met the reflectance requirements of FMVSS 111.

REFLECTANCE (Day) = Voltage (Refl)/Voltage (Cal) = **0. 967** x 100 = **96.7** percent
(Min. Required = 35%)

VOLTAGE READING FROM CALIBRATION (Average Value) = **277 mV**

VOLTAGE READING FROM LIGHT REFLECTED BY NIGHT MIRROR (Average Value): **192 mV**

REFLECTANCE (Night) = Voltage (Refl)/Voltage (Cal) = **0. 693** x 100 = **69.3** percent
(Min. Required = 4%)

NOTE: If meter reading directly in percent is used, record only percent

DATA SHEET NO. 4... (Continued)

MIRROR DESCRIPTION: **DRIVER SIDE OUTSIDE MIRROR.**

VOLTAGE READING FROM CALIBRATION (Average Value): **279 mV**

VOLTAGE READING FROM LIGHT REFLECTED BY DAY MIRROR (Average Value): **266 mV**

REFLECTOMETER VOLTAGE READINGS	
TEST NO. 1	**266 mV**
TEST NO. 2	**266 mV**
TEST NO. 3	**267 mV**
TEST NO. 4	**266 mV**
TEST NO. 5	**267 mV**

REFLECTANCE (Day) = Voltage (Refl)/Voltage (Cal) = 0. **.953** x 100 = **95.3** percent
(Min. Required = 35%)

VOLTAGE READING FROM CALIBRATION (Average Value) = **279 mV**

NOTE: If meter reading directly in percent is used, record only percent

TEST STATUS:	PASSED —	X	FAILED —	

RECORDED BY: **PABLO VEGA** DATE: **05/26/04**

APPROVED BY: **MATTHEW A. IVORY** DATE: **05/26/04**

DATA SHEET NO. 5

BREAKAWAY TEST - INSIDE REARVIEW MIRROR

VEHICLE			
YEAR	2004	MAKE	SATURN
MODEL	ION	BODY STYLE	4 DOOR SEDAN
NHTSA NO.	C40104	VIN	1G8AF52F94Z129223
TEST DATE:	5/26/04	TEMPERATURE:	86° F

MOUNTING OF MIRROR (INSIDE) DESCRIPTION: **TAB GLUED TO WINDSHIELD. MIRROR BASE SLIPS OVER BASE AND HELD IN PLACE WITH SET SCREW.**

(Requirement: the mirror shall deflect, collapse or break away when it is subjected to a force of 400 N or less)

TEST NO.	LOAD DIRECTION VERTICAL/HORIZONTAL	MAXIMUM FORCE (N)	DISPLACEMENT (MM)	PASS	FAIL
1	0-90 DEGREES	135.9	6.6	X	
2	+45/90 DEGREES	227.3	8.0	X	
3	-45/90 DEGREES	58.5	7.1	X	
4	-45/+45 DEGREES	186.0	53.0	X	
5	+45/+45 DEGREES	189.6	56.2	X	
6	+45/-45 DEGREES	21.7	5.2	X	
7	-45/-45 DEGREES	87.5	21.3	X	

REMARKS:

DATA SHEET NO. 5... (Continued)

BREAKAWAY TEST - INSIDE REARVIEW MIRROR FAILURE TYPE – DESCRIPTION:

FAILURE TYPE – DESCRIPTION:

NONE

TEST STATUS:	PASSED —	X	FAILED —	

REMARKS:

RECORDED BY: **MICHAEL DUNLAP** DATE: **05/26/04**

APPROVED BY: **MATTHEW A. IVORY** DATE: **05/26/04**

DATA SHEET NO. 6

UNIT MAGNIFICATION AND CONVEX MIRROR TESTS

VEHICLE			
YEAR	2004	MAKE	SATURN
MODEL	ION	BODY STYLE	4 DOOR SEDAN
NHTSA NO.	C40104	VIN	1G8AF52F94Z129223
TEST DATE:	05/26/04	TEMPERATURE:	82°F

DESCRIPTION OF TEST APPARATUS: **3-POINT LINEAR SPHEROMETER MANUFACTURED BY AMERICAN OPTICAL CORPORATION, GENEVA LENS MEASURE M667 1.53. SERIAL NUMBER 78622. THE SPHEROMETER USED DID NOT MEET THE ACCURACY REQUIREMENTS OF FMVSS 111. GAGE MEASURED IN DIOPTERS. RADIUS OF CURVATURE WAS CALCULATED USING THE EQUATION :**

RADIUS IN INCHES = (530)(0.03937)/GAGE READING

DRIVER'S SIDE & INSIDE REARVIEW MIRRORS:

DRIVER SIDE MIRROR	
TEST POSITION	DIAL READINGS
1	0
2	0
3	0
4	0
5	0
6	0
7	0
8	0
9	0
10	0

INSIDE MIRROR	
TEST POSITION	DIAL READINGS
1	0
2	0
3	0
4	0
5	0
6	0
7	0
8	0
9	0
10	0

All dial indicator readings for unit magnification mirrors must be zero.

DATA SHEET NO. 6... (Continued)

UNIT MAGNIFICATION AND CONVEX MIRROR TESTS

PASSENGER SIDE REARVIEW MIRROR:

CONVERSION TABLE FROM SPHEROMETER DIAL READING TO RADIUS OF CURVATURE

TEST POSITION	DIAL READINGS (DIOPTERS) Passenger	RADIUS OF CURVATURE (mm)	DEVIATION BETWEEN THE AVERAGE RADIUS OF CURVATURE AND THE TEST POSITION RADIUS OF CURVATURE (mm)	PERCENT DEVIATION FROM THE AVERAGE RADIUS OF CURVATURE
1	0.300	1778.0	0	0
2	0.300	1778.0	0	0
3	0.300	1778.0	0	0
4	0.300	1778.0	0	0
5	0.300	1778.0	0	0
6	0.300	1778.0	0	0
7	0.300	1778.0	0	0
8	0.300	1778.0	0	0
9	0.300	1778.0	0	0
10	0.300	1778.0	0	0
Average Radius of Curvature		1778.0	Greatest Percent Deviation	0

REMARKS:

MIRROR NOT REQUIRED TO MEET FMVSS 111 REQUIREMENTS.

DATA SHEET NO. 6... (Continued)

UNIT MAGNIFICATION AND CONVEX MIRROR TESTS

PASSENGER'S SIDE REARVIEW MIRROR

IF CONVEX, ARE THERE ANY DISCONTINUITIES IN THE SLOPE OF THE MIRROR SURFACE	YES ____ NO __X__
IF CONVEX, ARE THE WORDS, **"OBJECTS IN THE MIRROR ARE CLOSER THAN THEY APPEAR"** PRESENT	YES __X__ NO ____
IF CONVEX, MEASURE LETTER HEIGHT OF WORDS	**5.0** mm
IF CONVEX, LETTERS ARE NOT < 4.8 mm OR > 6.4 mm HIGH	YES __X__ NO ____
IF CONVEX, RADIUS OF CURVATURE NOT < 889 mm OR > 1651 mm	YES ____ NO __X__
IF CONVEX, THE GREATEST PERCENT DEVIATION FROM AVERAGE RADIUS OF CURVATURE IS ± 12.5 %	YES __X__ NO ____
IF UNIT MAGNIFICATION, ALL DIAL READINGS ARE ZERO ± 0.	YES __N/A__ NO ____

NOTE: **PASSENGER SIDE MIRROR NOT REQUIRED TO MEET REQUIREMENTS OF FMVSS 111.**

TEST STATUS:	PASSED —	**N/A**	FAILED —	

RECORDED BY: **PABLO VEGA** DATE: **05/26/04**

APPROVED BY: **MATTHEW A. IVORY** DATE: **05/26/04**

DATA SHEET NO. 7

MIRROR REFLECTIVE SURFACE AREA TEST

VEHICLE			
YEAR	2004	MAKE	SATURN
MODEL	ION	BODY STYLE	4 DOOR SEDAN
NHTSA NO.	C40104	VIN	1G8AF52F94Z129223
TEST DATE:	05/26/04	TEMPERATURE:	82°F

MPVs, TRUCKS & BUSES (OTHER THAN SCHOOL BUSES)

DATA TABLE FOR SURFACE AREA

MIRRORS	AREA (cm^2)	REQUIREMENT		RESULTS	
		GVWR ≤ 4536 kg	GVWR ≥ 4536 kg	PASS	FAIL
Outside Driver's Side	**162.19 cm^2**	126 cm^2	323cm^2	**N/A**	
Outside Passenger Side	**154.06 cm^2**	126 cm^2	323 cm^2	**N/A**	

MIRRORS LOCATED SO AS TO PROVIDE DRIVER A VIEW TO THE REAR:

LEFT SIDE YES __X__ NO ____

RIGHT SIDE YES __X__ NO ____

TEST STATUS:	PASSED —	N/A	FAILED —	

REMARKS: **NO SURFACE AREA REQUIREMENTS**

RECORDED BY: **PABLO VEGA** DATE: **05/26/04**

APPROVED BY: **MATTHEW A. IVORY** DATE: **05/26/04**

DATA SHEET NO. 8

TEST SUMMARY-FMVSS 111-REARVIEW MIRRORS

VEHICLE			
YEAR	2004	MAKE	SATURN
MODEL	ION	BODY STYLE	4 DOOR SEDAN
NHTSA NO.	C40104	VIN	1G8AF52F94Z129223
TEST DATE:	05/26/04	TEMPERATURE:	N/A

PASSENGER VEHICLE TESTING:

OUTSIDE DRIVER SIDE MIRROR	PASS	FAIL	COMMENTS
STABLE SUPPORT	X		
DOES NOT PROTRUDE BEYOND VEHICLE BODY	X		
NOT OBSCURED BY UNWIPED PORTION OF WINDSHIELD	X		
ADJUSTABLE BY TILTING	X		
ADJUSTABLE FROM DRIVER SEAT	X		
FREE OF SHARP EDGES	X		
FIELD-OF-VIEW	X		
REFLECTANCE	X		
UNIT MAGNIFICATION	X		

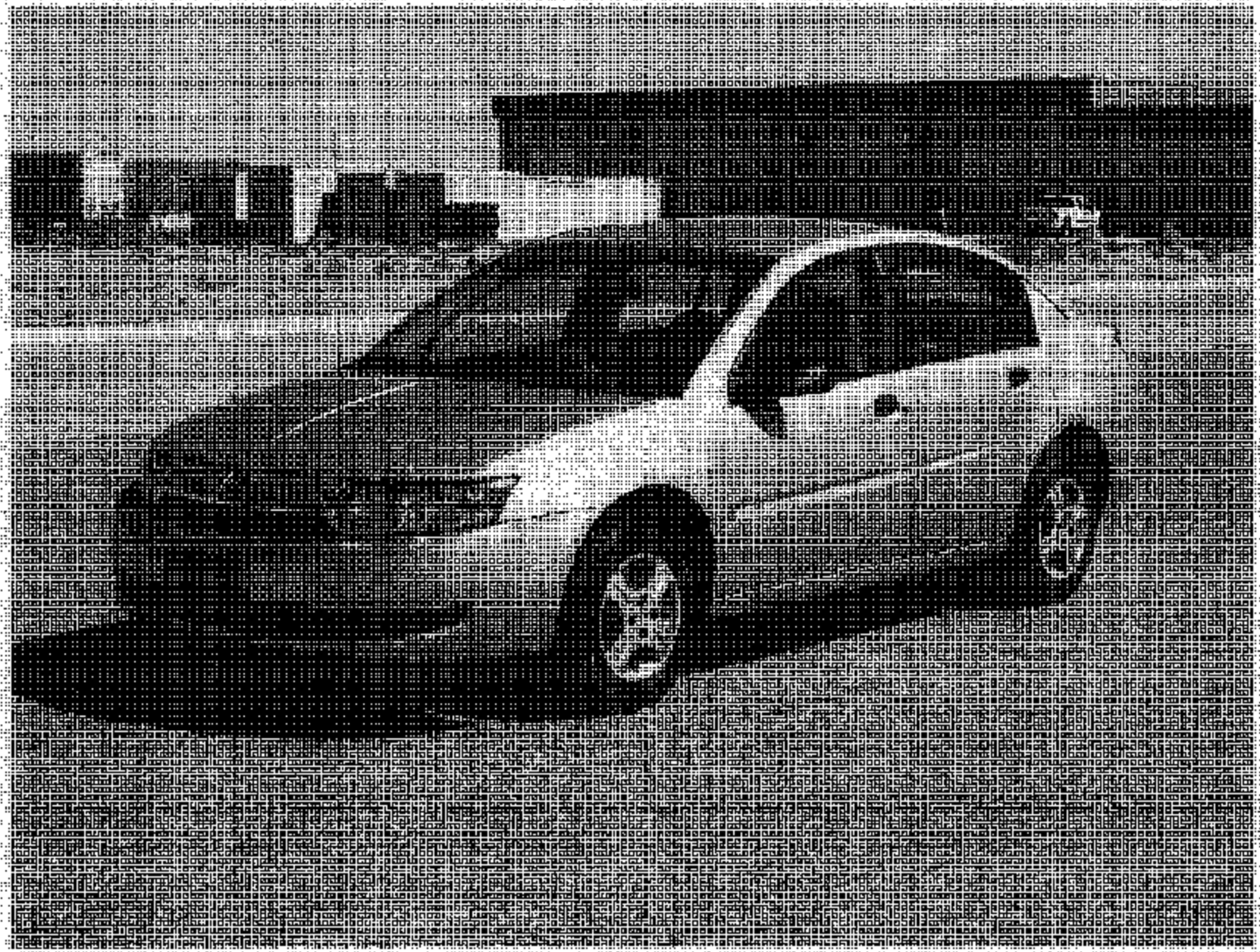
INSIDE REARVIEW MIRROR	PASS	FAIL	COMMENTS
STABLE SUPPORT	X		
ADJUSTABLE BY TILTING	X		
FIELD-OF-VIEW	X		
REFLECTANCE	X		
BREAK AWAY	X		
UNIT MAGNIFICATION	X		

OUTSIDE PASSENGER MIRROR * (IF REQUIRED)	PASS	FAIL	COMMENTS
STABLE SUPPORT	X		
ADJUSTABLE BY TILTING	X		
FREE OF SHARP EDGES	X		
UNIT OR CONVEX			Convex
LABELING	X		
REFLECTANCE	N/A		

*NOT REQUIRED

APPENDIX A

PHOTOGRAPHS

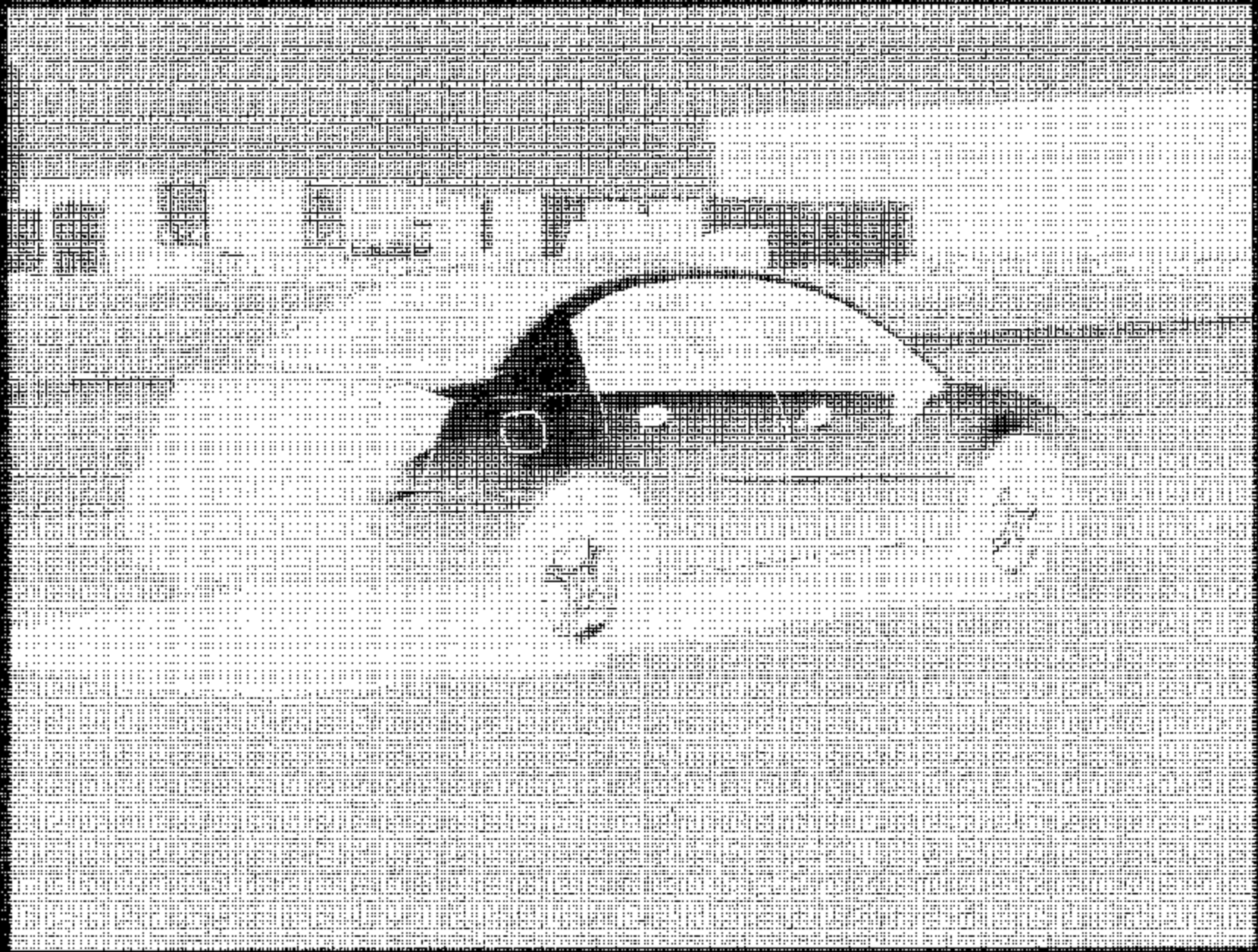


2004 SATURN ION
NHTSA NO. C40104
FMVSS NO. 111

FIGURE 1: LEFT FRONT ¾ VIEW

FIGURE 2: LEFT SIDE VIEW

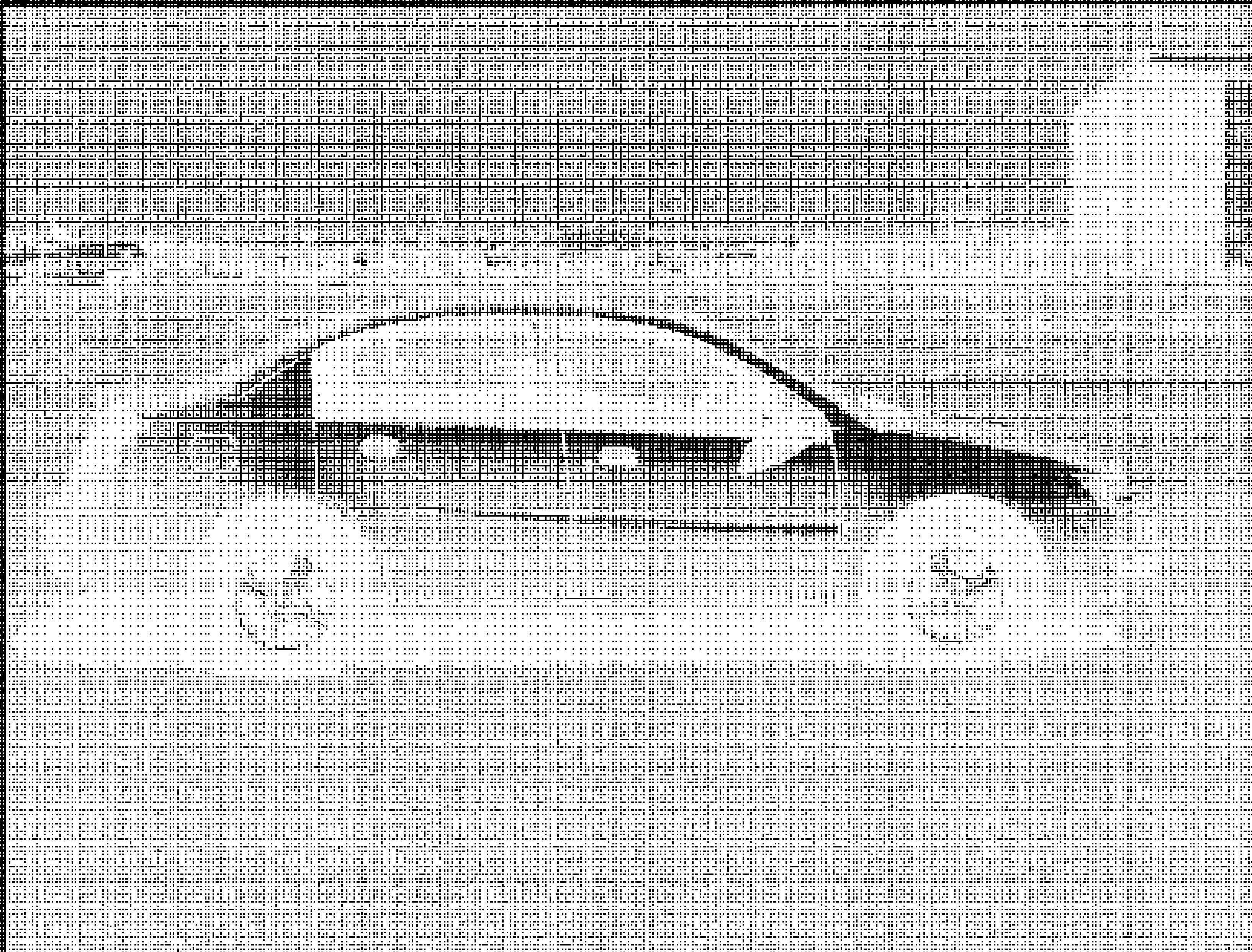
2004 SATURN ION
NHTSA NO. C46104
FMVSS NO. 111



2004 SATURN ION
NHTSA NO. C40104
FMVSS NO. 111

FIGURE 3: RIGHT REAR ¾ VIEW

111-KAR-04-002

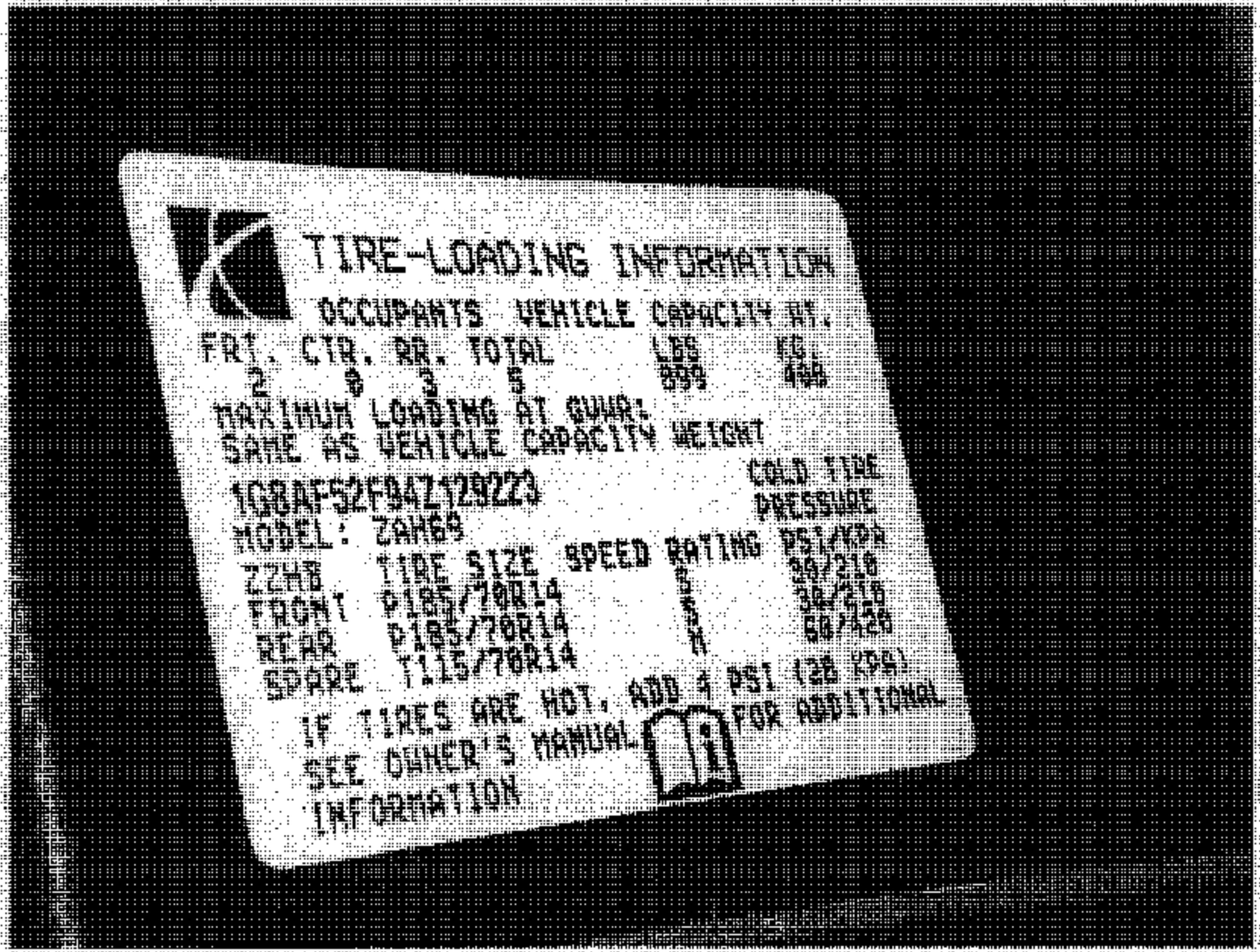


2004 SATURN ION
NHTSA NO. C40104
FMVSS NO. 111

FIGURE 4: RIGHT SIDE VIEW

2004 SATURN ION
NHTSA ID: 040104
FMVSS NO. 111

FISHER & MANUFACTURERS LABEL



2004 SATURN ION
NHTSA NO. C40104
FMVSS NO. 111

FIGURE 6:TIRE PLACARD

FIGURE 7: DRIVER SIDE REAR VIEW MIRROR AND MOUNTING

2004 SATURN ION
NHTSA NO. C40104
FMVSS NO. 111

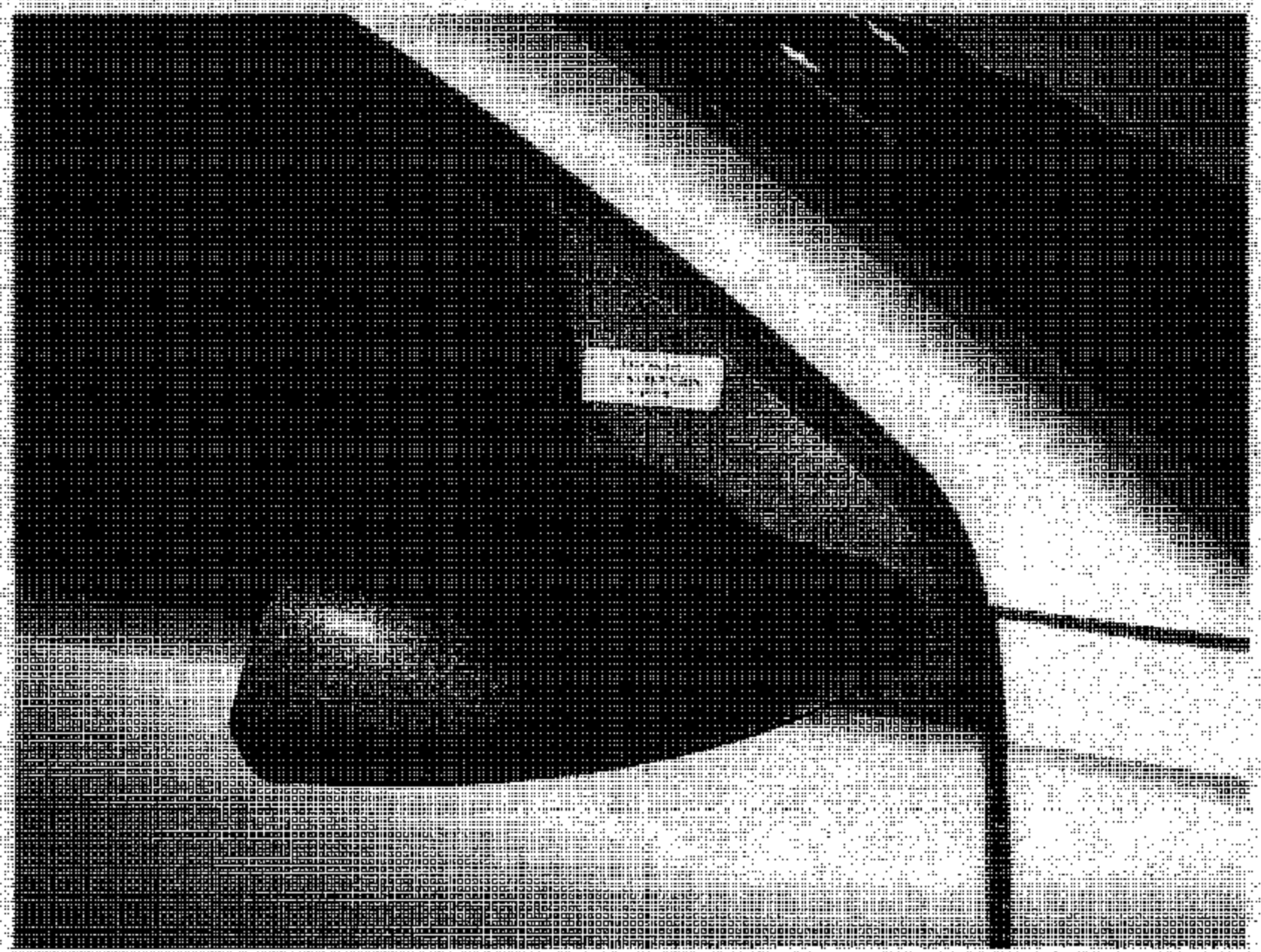


FIGURE 8: PASSENGER SIDE REAR VIEW MIRROR AND MOUNTING

2004 SATURN ION
NHTSA NO. C40104
FMVSS NO. 111

2004 SATURN ION
NHTSA NO. C40104
FMVSS NO. 111

FIGURE 9: INSIDE REAR VIEW MIRROR AND MOUNTING

2004 SATURN ION
NHTSA NO. C40104
FMVSS NO. 111

FIGURE 10: TEST SET-UP

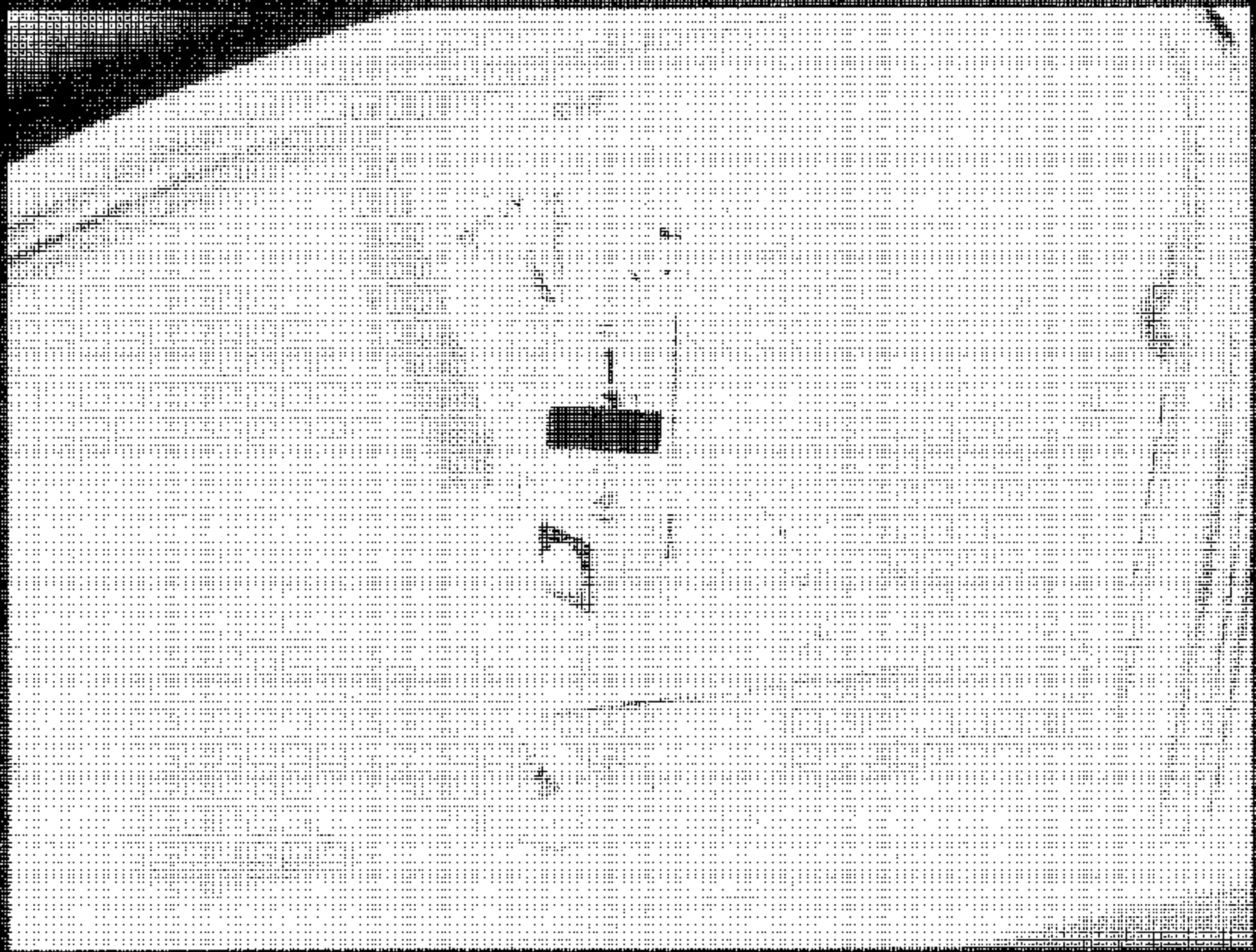


FIGURE 11:CAMERA SET-UP FOR PHOTOGRAPHING REFERENCE BOARD

2004 SATURN ION
NHTSA NO. C40104
FMVSS NO. 111

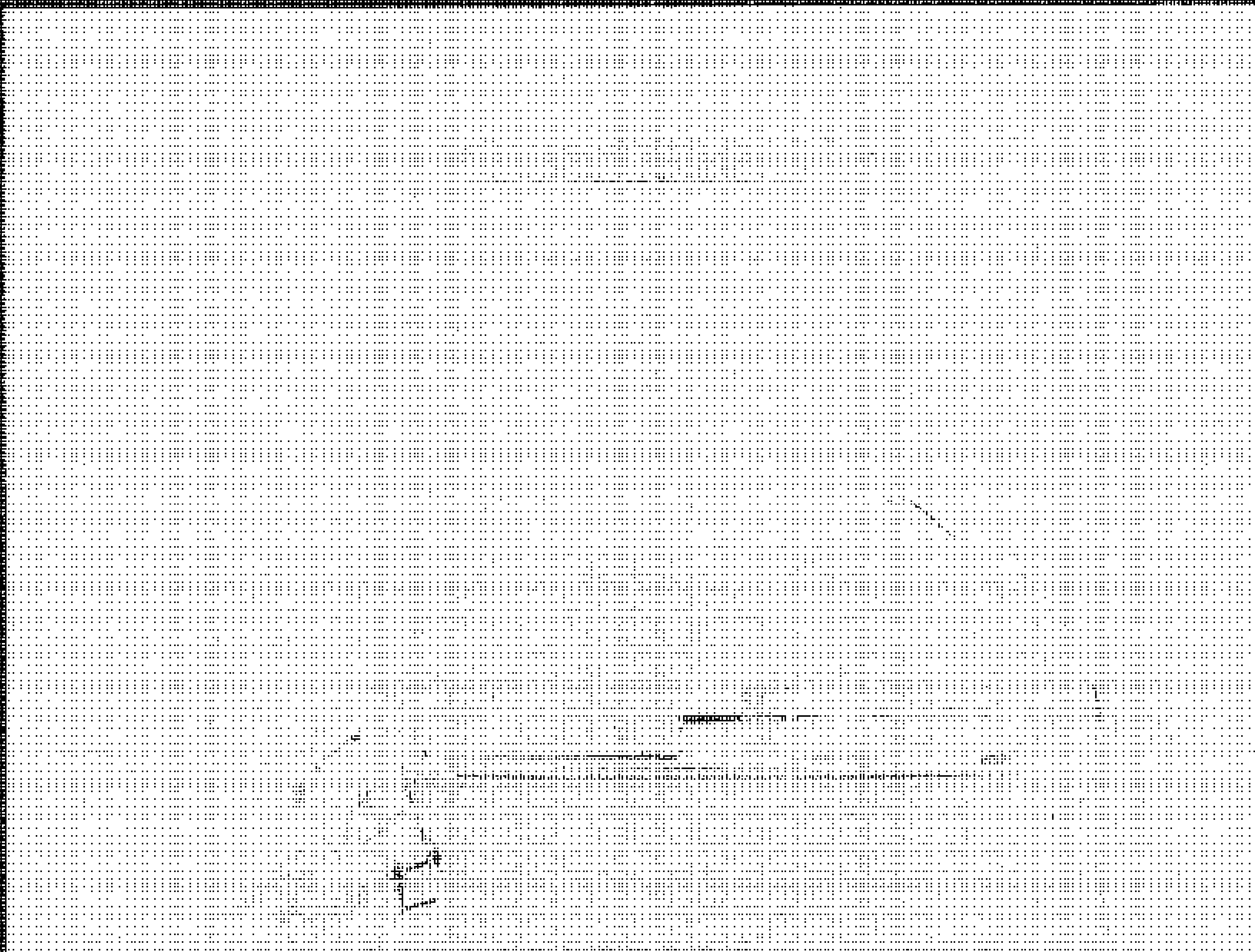
A-111

111-MAR-04-A02

2004 SATURN ION
NHTSA NO. C40104
FMVSS NO. 111

FIGURE 12: OVERALL SET-UP AND INSTRUMENTATION FOR MIRROR BREAK-AWAY TEST

FIGURE 10: CLOSE-UP OF MIRROR BREAK AWAY TEST
2004 SATURN ION
NHTSA NO. C40104
FMVSS NO. 111



2004 SATURN ION
NHTSA NO. C40104
FMVSS NO. 111

FIGURE 14 - REFLECTION TEST SET-UP

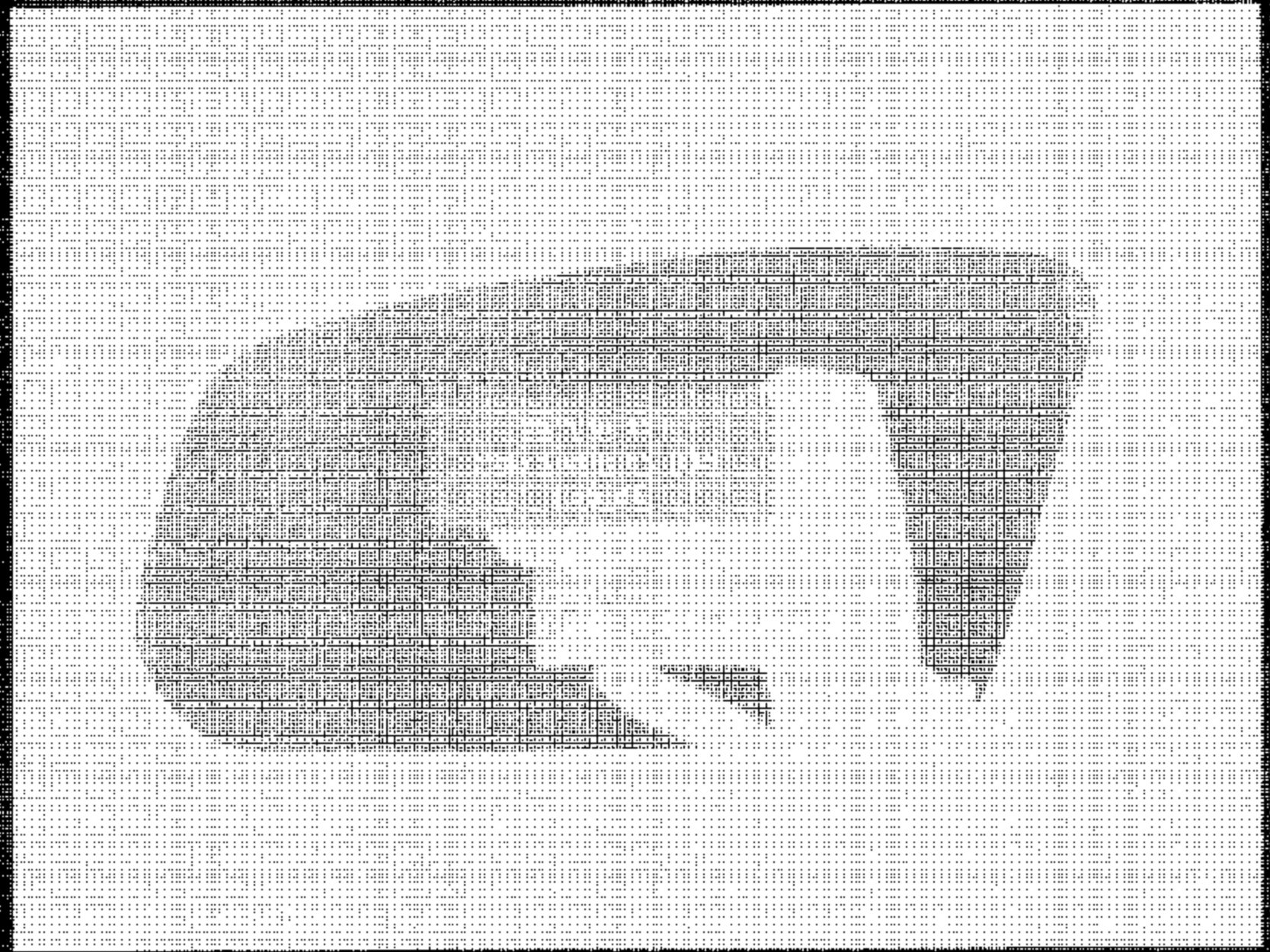
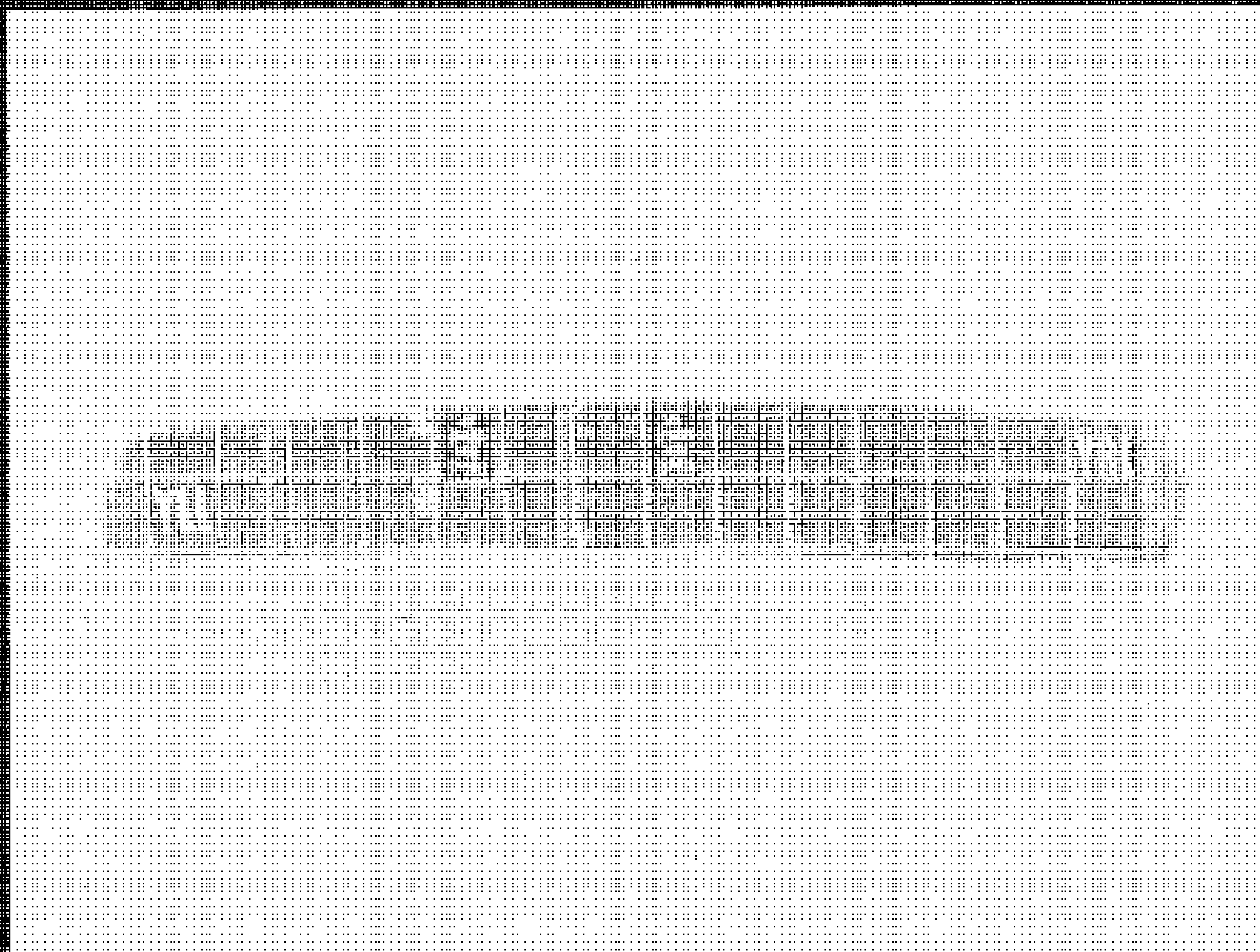


FIGURE 15: MIRROR SET-UP FOR AREA MEASUREMENT

2004 SATURN ION
NHTSA NO. C40104
FMVSS NO. 111



2004 SATURN ION
NHTSA NO. C40104
FMVSS NO. 111

FIGURE 16 LEFT EYE FIELD OF VIEW TEST (INSIDE MIRROR)

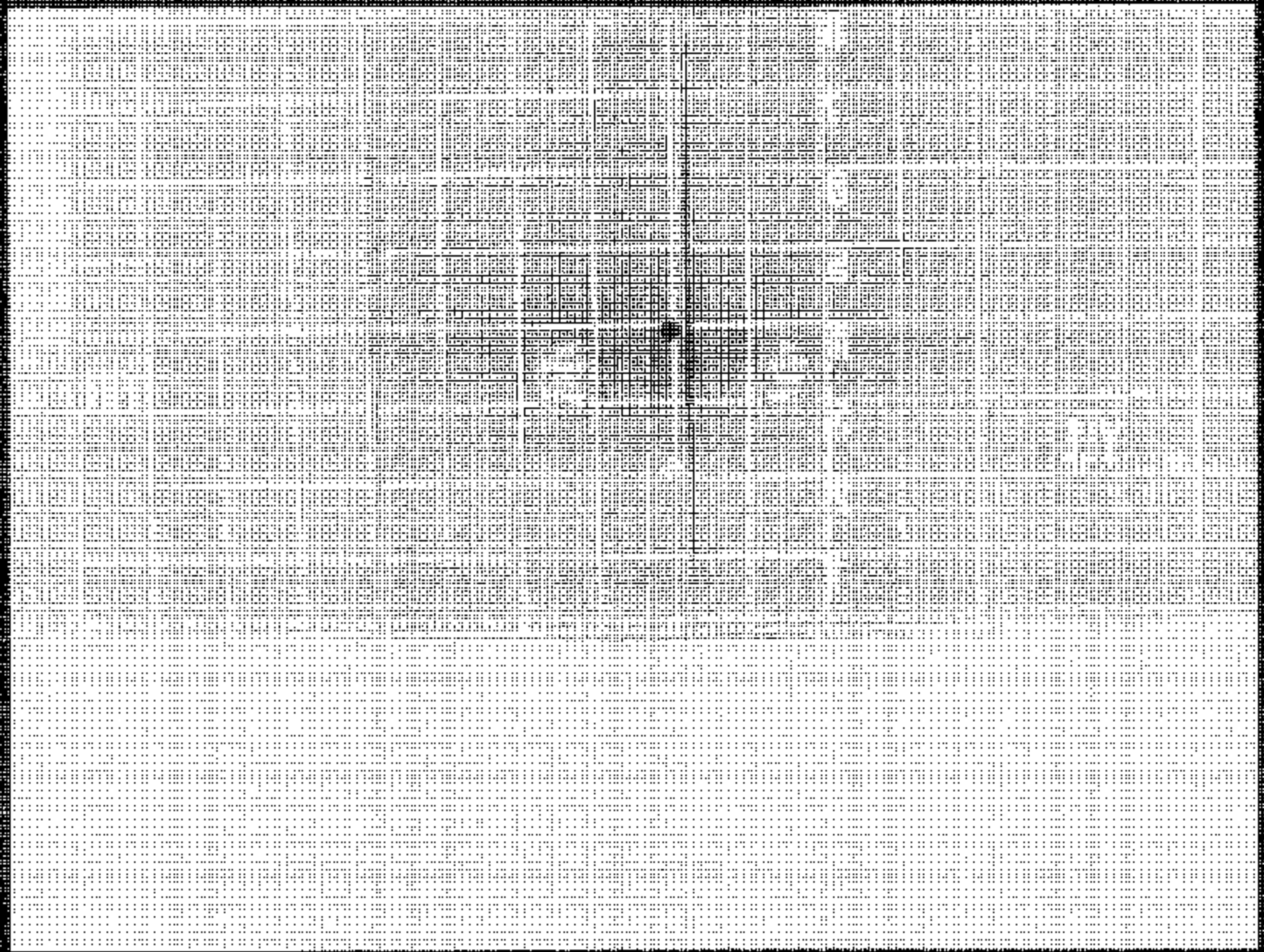
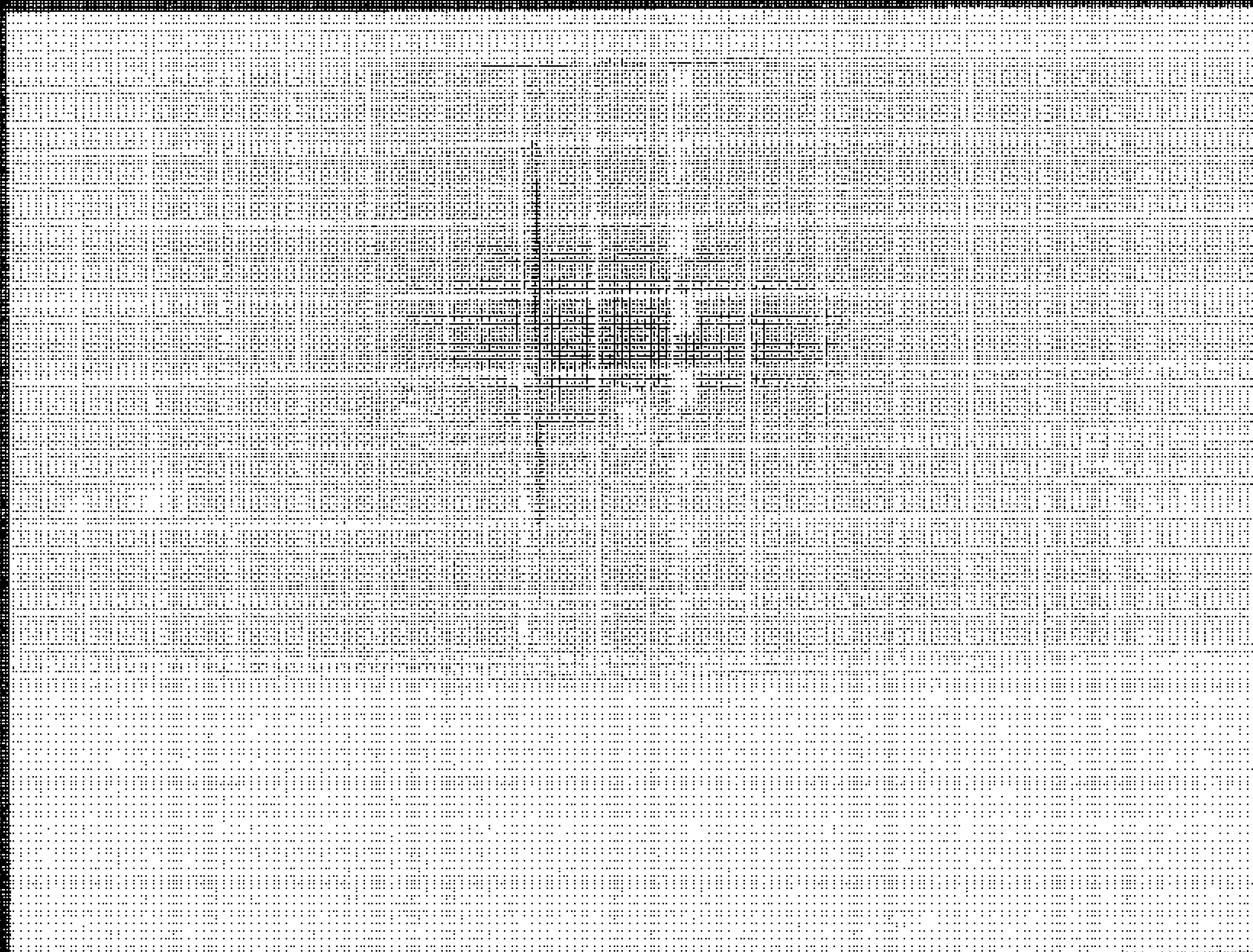


FIGURE 17.REFERENCE BOARD FOR INSIDE MIRROR, LEFT EYE

2004 SATURN ION
NHTSA NO. C40104
FMVSS NO. 111

FIGURE 18:RIGHT EYE FIELD OF VIEW TEST (INSIDE MIRROR)

2004 SATURN ION
NHTSA NO. C40104
FMVSS NO. 111



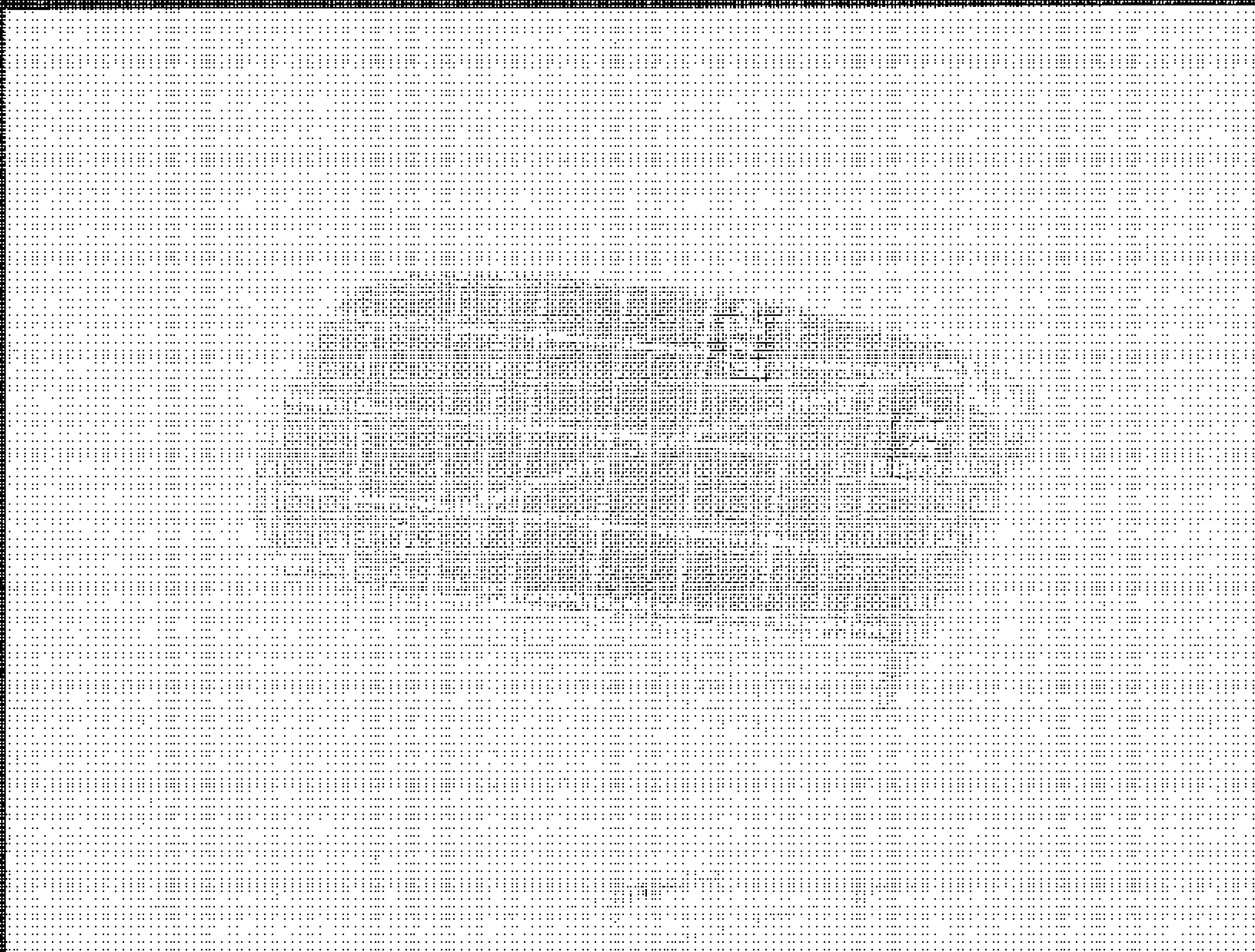
2004 SATURN ION
NHTSA NO. C40104
FMVSS NO. 111

FIGURE 19: REFERENCE BOARD FOR INSIDE MIRROR, RIGHT EYE

2004 SATURN ION
NHTSA No. 040104
FMVSS No. 111

A-20

111-KAR-04-002



2004 SATURN ION
NHTSA NO. C40104
FMVSS NO. 111

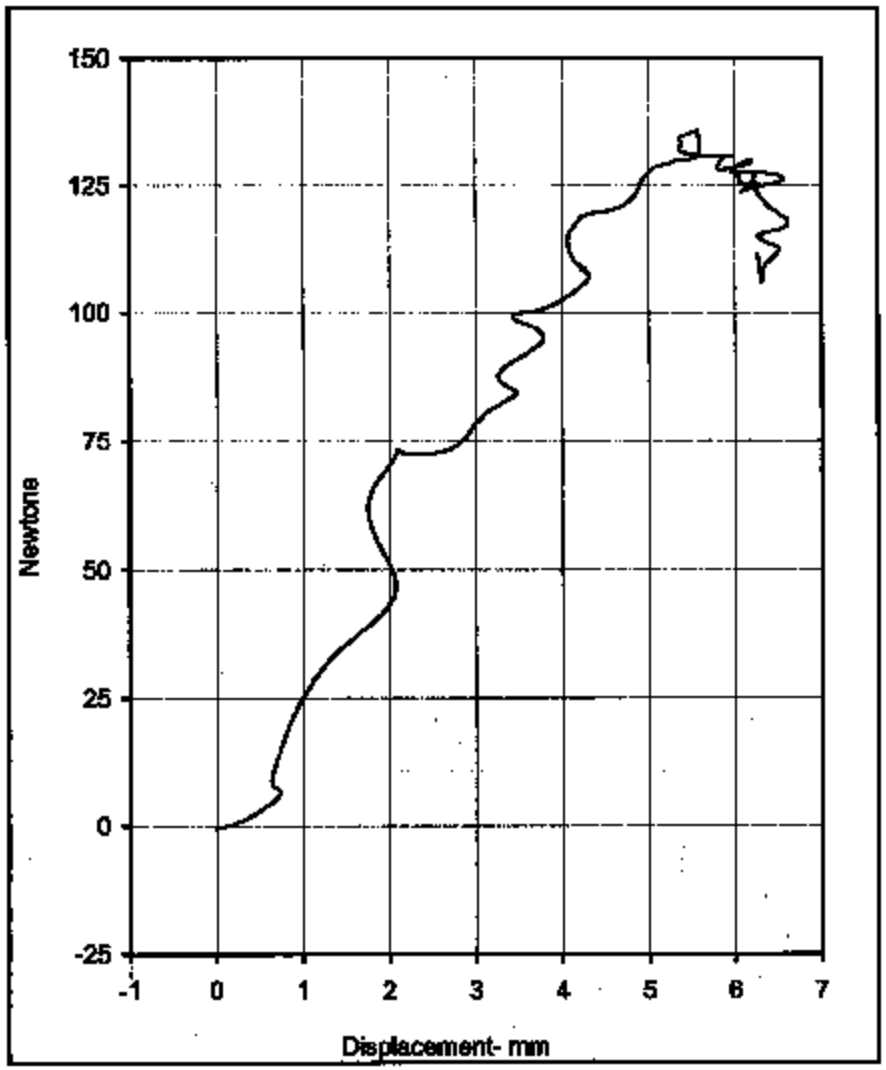
FIGURE 21 RIGHT EYE FIELD OF VIEW TEST (DRIVER SIDE MIRROR)

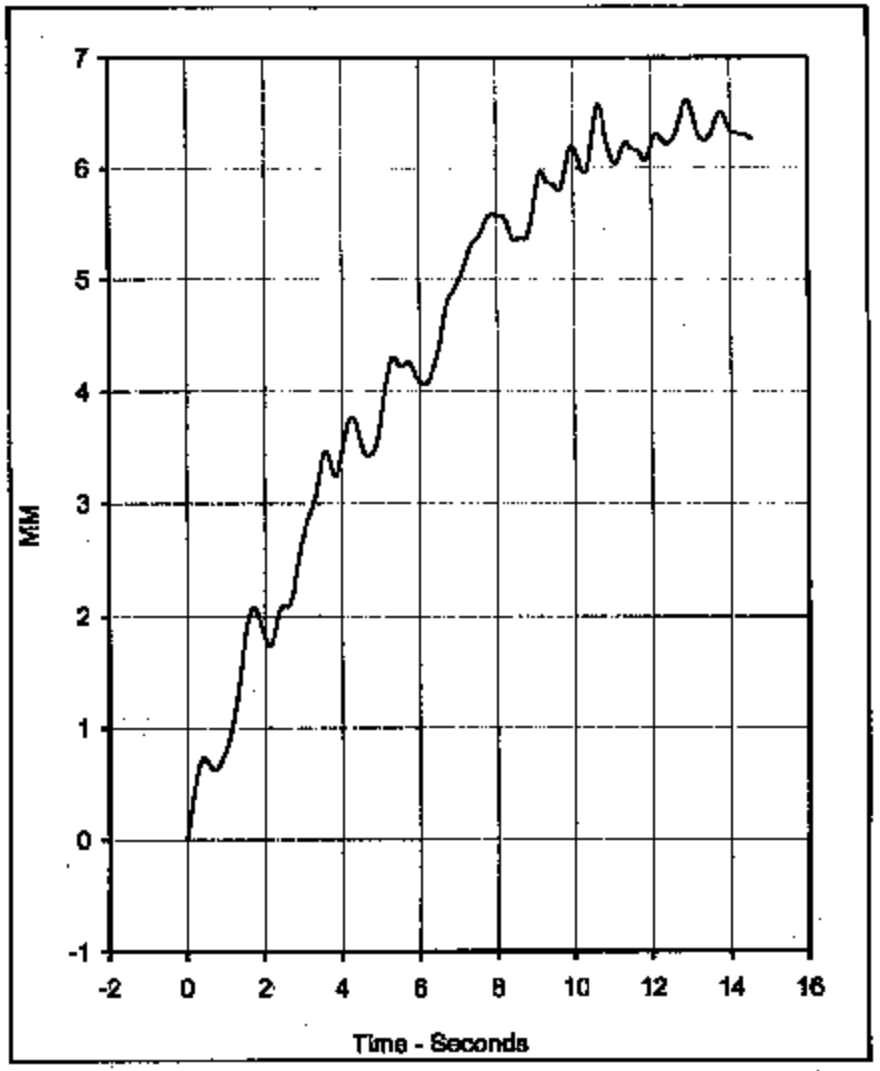
FIGURE 22 REFERENCE BOARD FOR DRIVER SIDE MIRROR

2006 SATURN ION
NHTSA NO. 240164
FMVSS NO. 111

APPENDIX B

DATA PLOTS





Curve Description	CURNO	Type
Force vs. Displacement	001	FIL

Units	Peak Force	Displacement	Filter (Hz)
Newtons	135.9	5.6	1

Curve Description	CURNO	Type
Displacement vs. Time	002	FIL

Units	Max	Time	Displ. Rate (mm/min.)	Filter (Hz)
MM	6.6	12.9	36.9	1

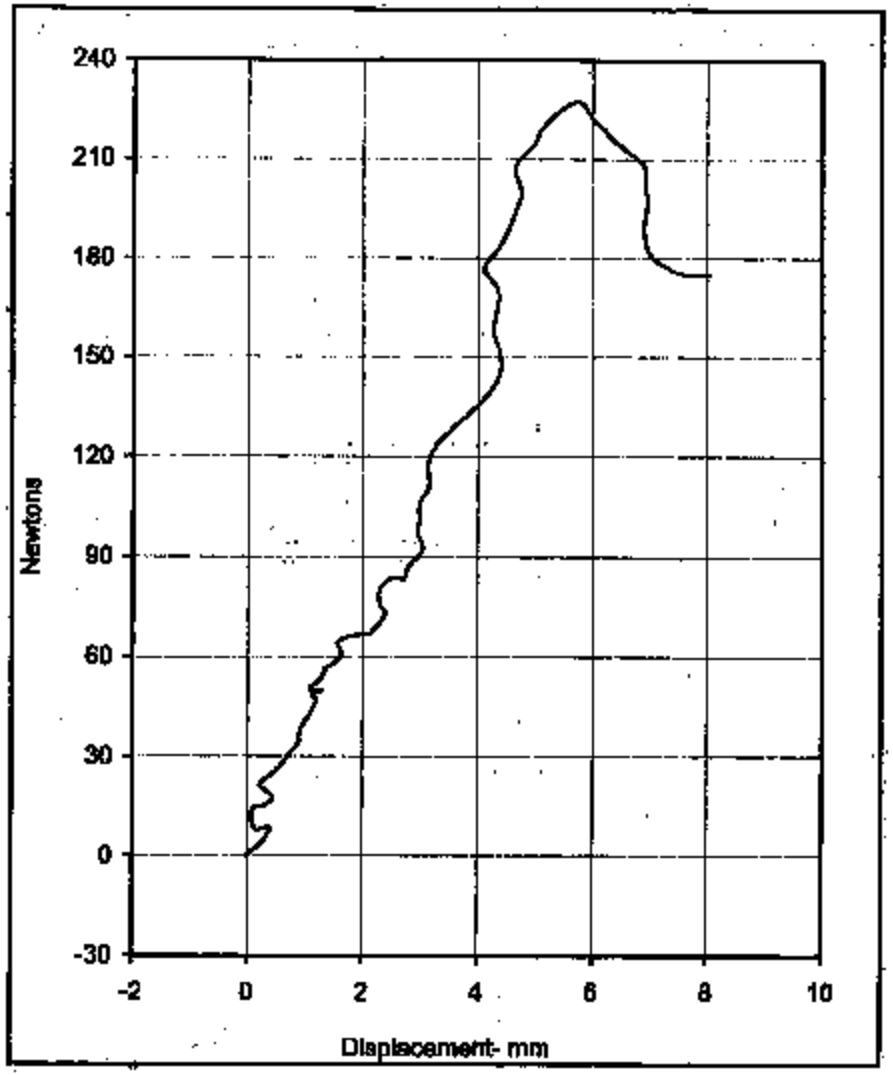
Test Program: 2004 FMVSS 111 Rearview Mirrors Test No.: 1

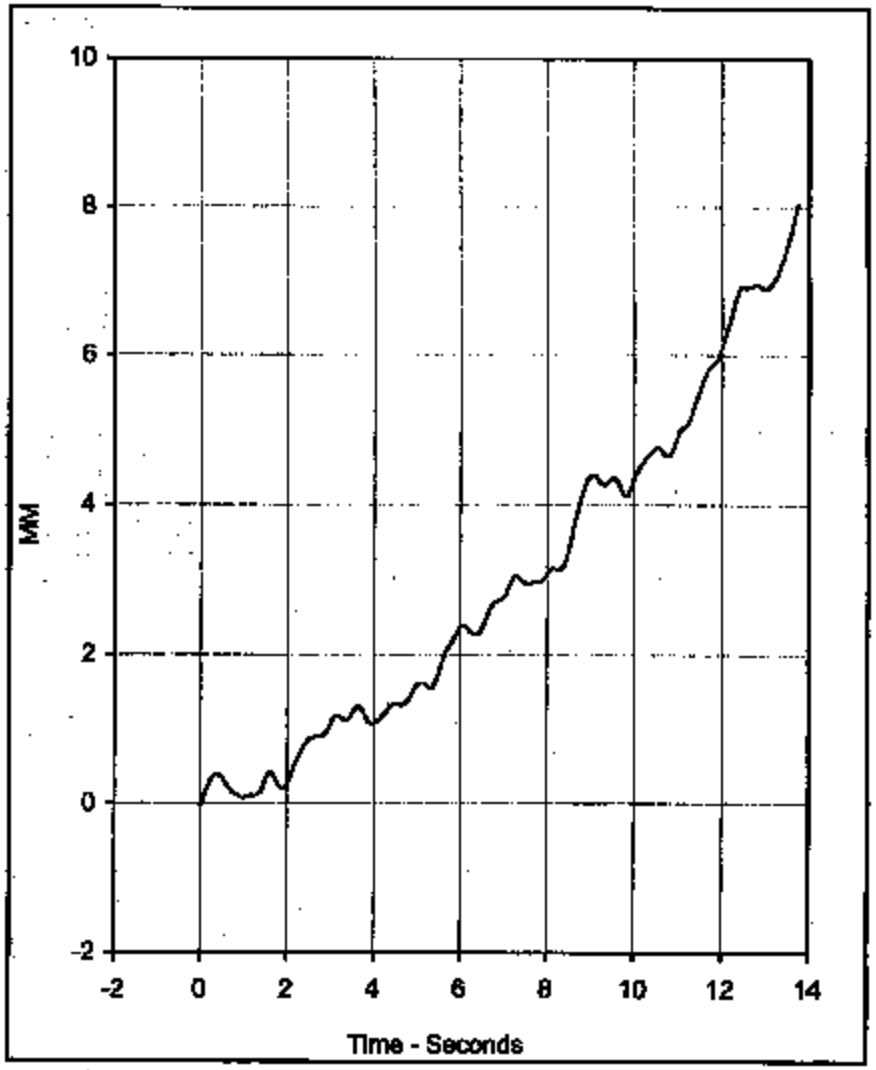
Test Vehicle: 2004 Saturn Ion No.: C40104

Load Direction: 0 / 90

Test Date: 5/26/04

KARCO Engineering





Curve Description	CURNO	Type
Force vs. Displacement	001	FIL

Units	Peak Force	Displacement	Filter (Hz)
Newtons	227.3	5.7	1

Curve Description	CURNO	Type
Displacement vs. Time	002	FIL

Units	Max	Time	Displ. Rate (mm/min.)	Filter (Hz)
MM	8.0	13.8	35.0	1

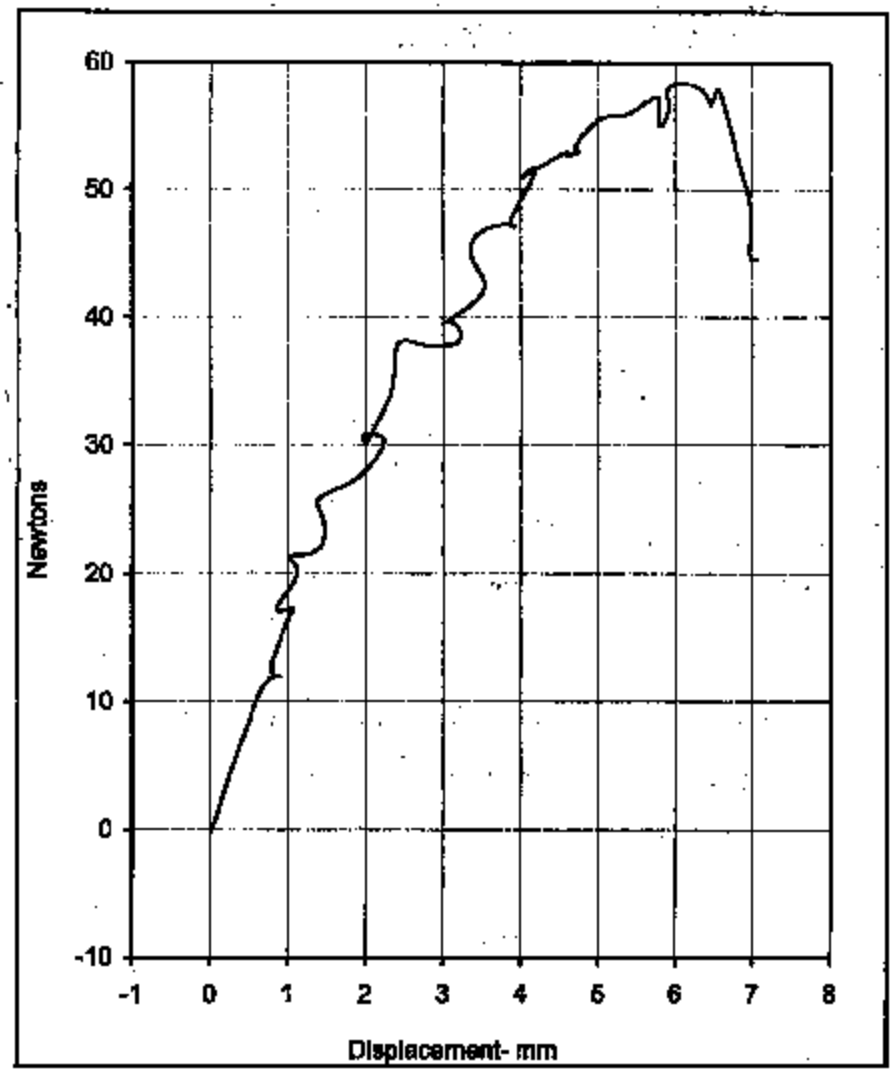
Test Program: 2004 FMVSS 111 Rearview Mirrors Test No.: 2

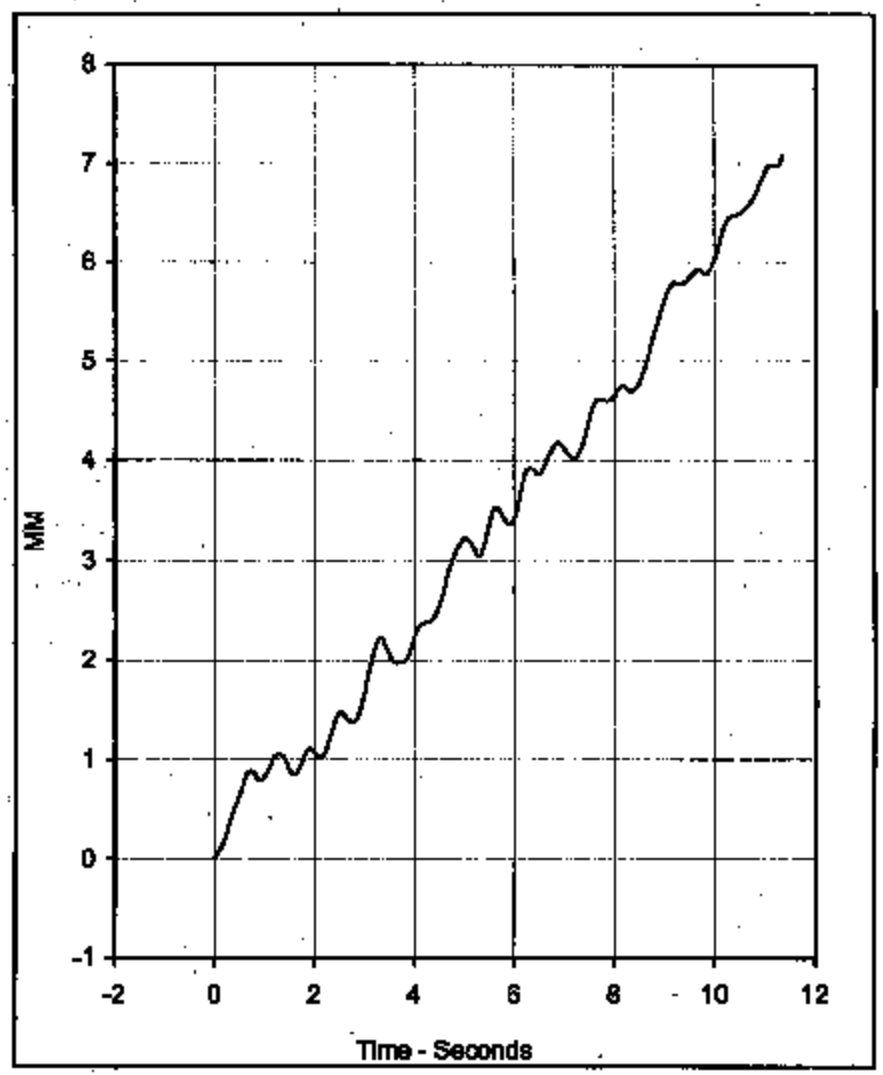
Test Vehicle: 2004 Saturn Ion No.: C40104

Load Direction: +45 / 90

Test Date: 5/26/04

KARCO Engineering





Curve Description	CURNO	Type
Force vs. Displacement	001	FIL

Units	Peak Force	Displacement	Filter (Hz)
Newtons	58.5	6.0	1

Curve Description	CURNO	Type
Displacement vs. Time	002	FIL

Units	Max	Time	Displ. Rate (mm/min.)	Filter (Hz)
MM	7.1	11.4	36.2	1

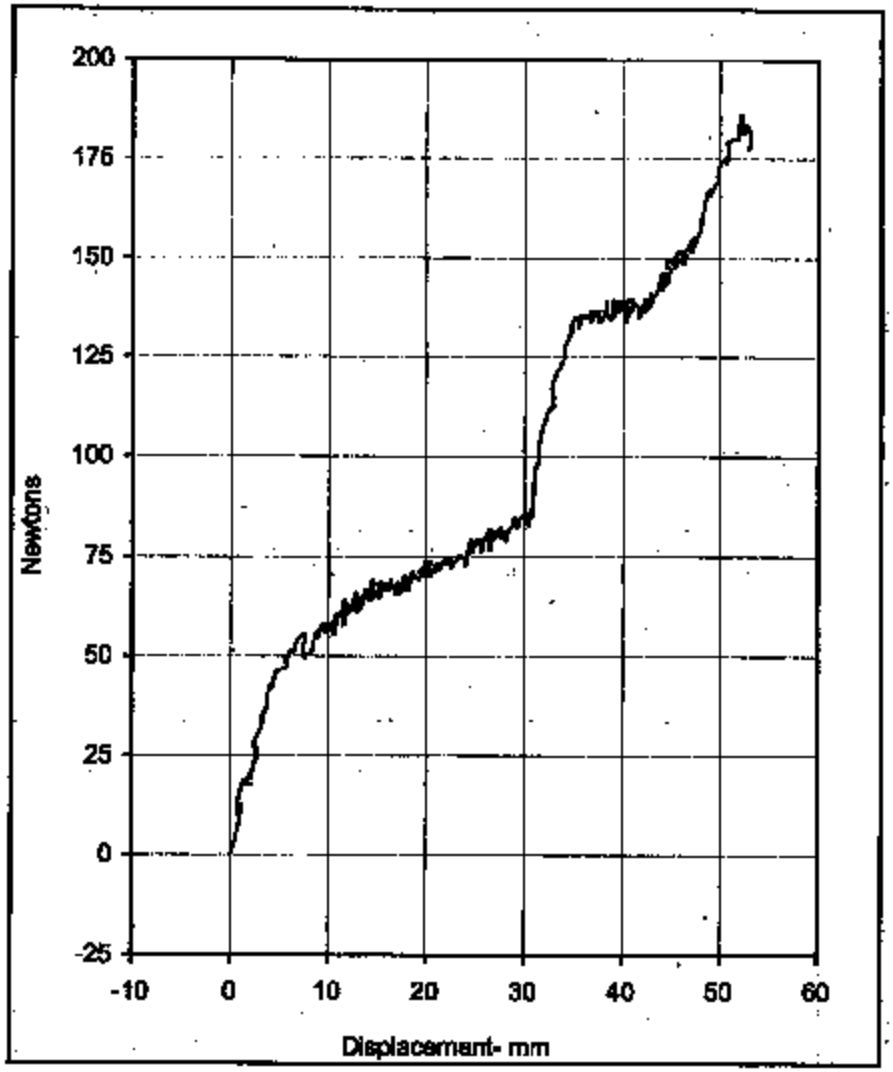
Test Program: 2004 FMVSS 111 Rearview Mirrors Test No.: 3

Test Vehicle: 2004 Saturn Ion No.: C40104

Load Direction: -45 / 90

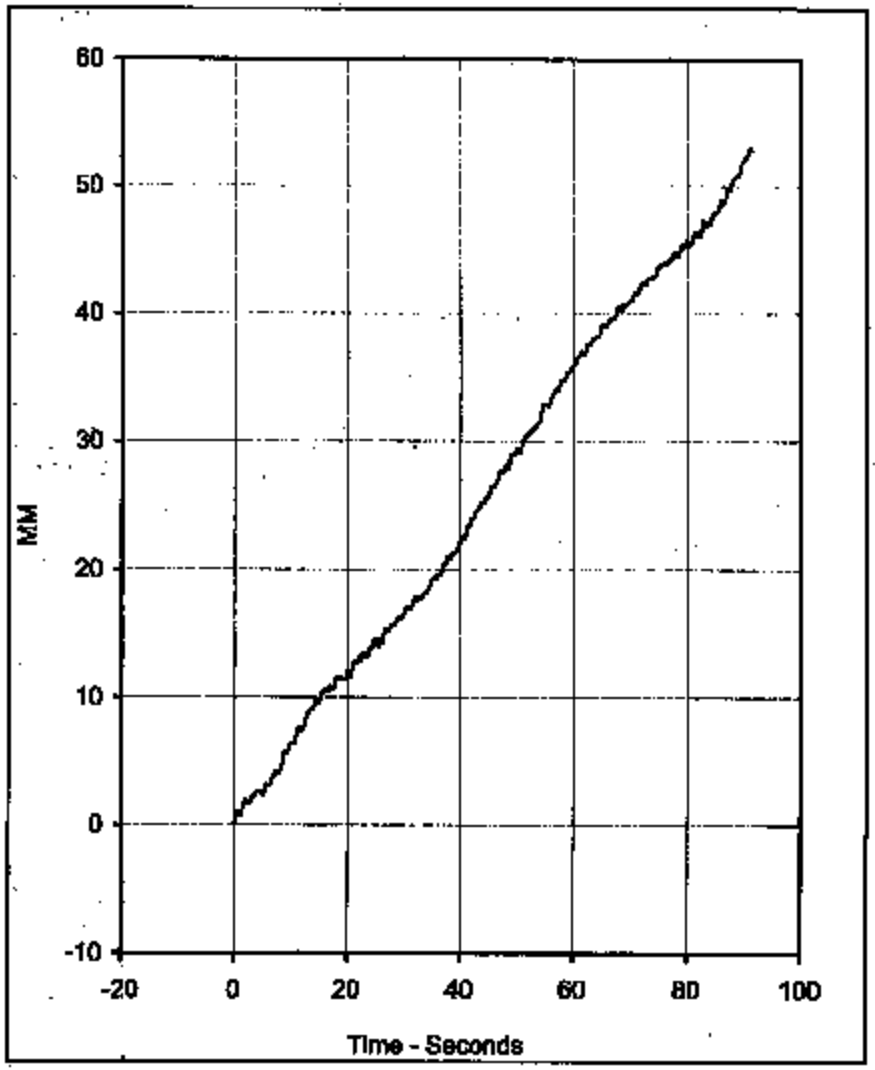
Test Date: 5/27/04

KARCO Engineering



Curve Description	CURNO	Type
Force vs. Displacement	001	FIL

Units	Peak Force	Displacement	Filter (Hz)
Newtons	186.0	52.1	1



Curve Description	CURNO	Type
Displacement vs. Time	002	FIL

Units	Max	Time	Displ. Rate (mm/min.)	Filter (Hz)
MM	53.0	91.2	34.7	1

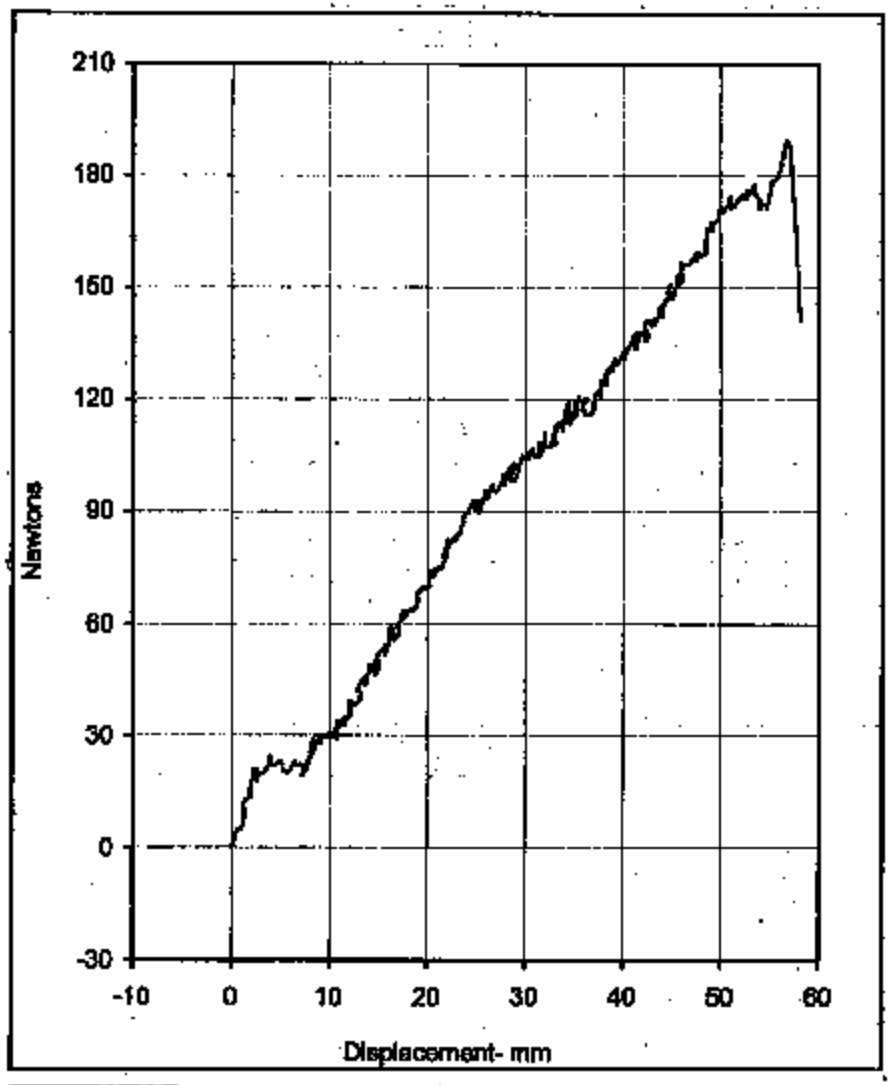
Test Program: 2004 FMVSS 111 Rearview Mirrors Test No.: 4

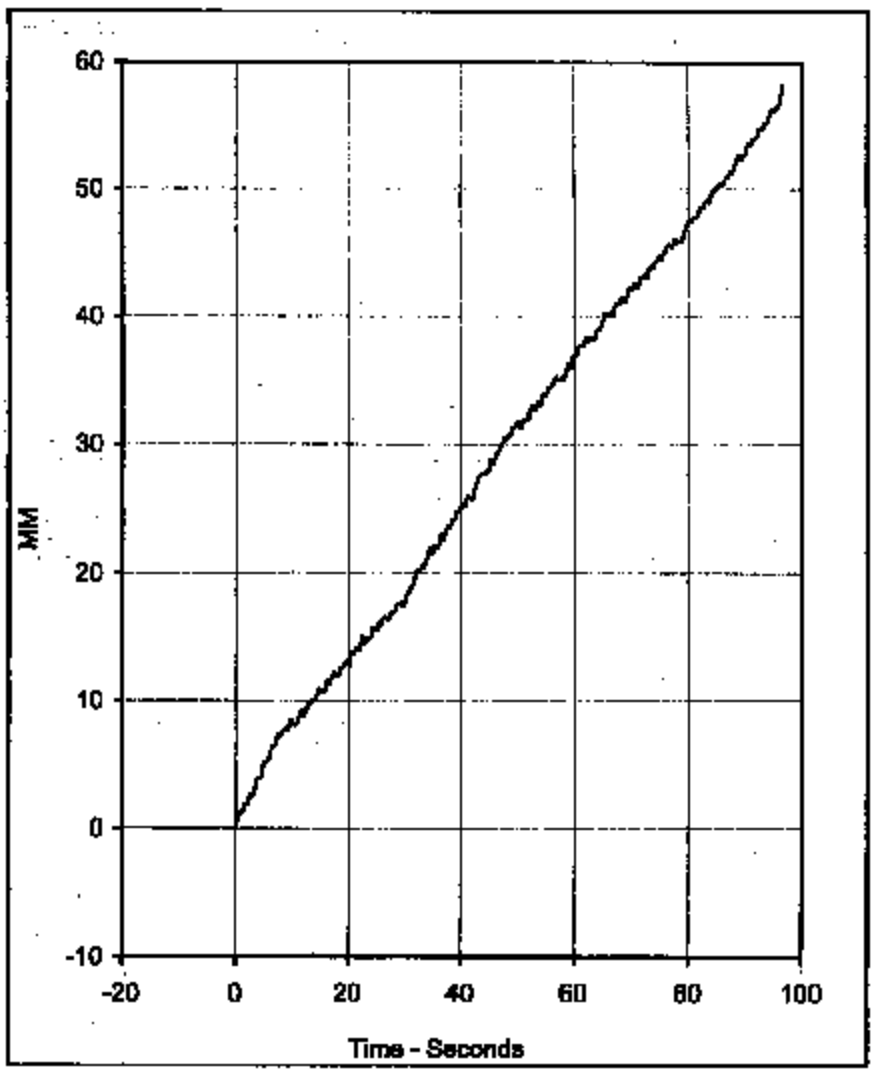
Test Vehicle: 2004 Saturn Ion No.: C40104

Load Direction: -45 / +45

Test Date: 5/27/04

MARC Engineering





Curve Description	CURNO	Type
Force vs. Displacement	001	FIL

Units	Peak Force	Displacement	Filter (Hz)
Newtons	189.6	56.9	1

Curve Description	CURNO	Type
Displacement vs. Time	002	FIL

Units	Max	Time	Displ. Rate (mm/min.)	Filter (Hz)
MM	58.2	96.6	36.1	1

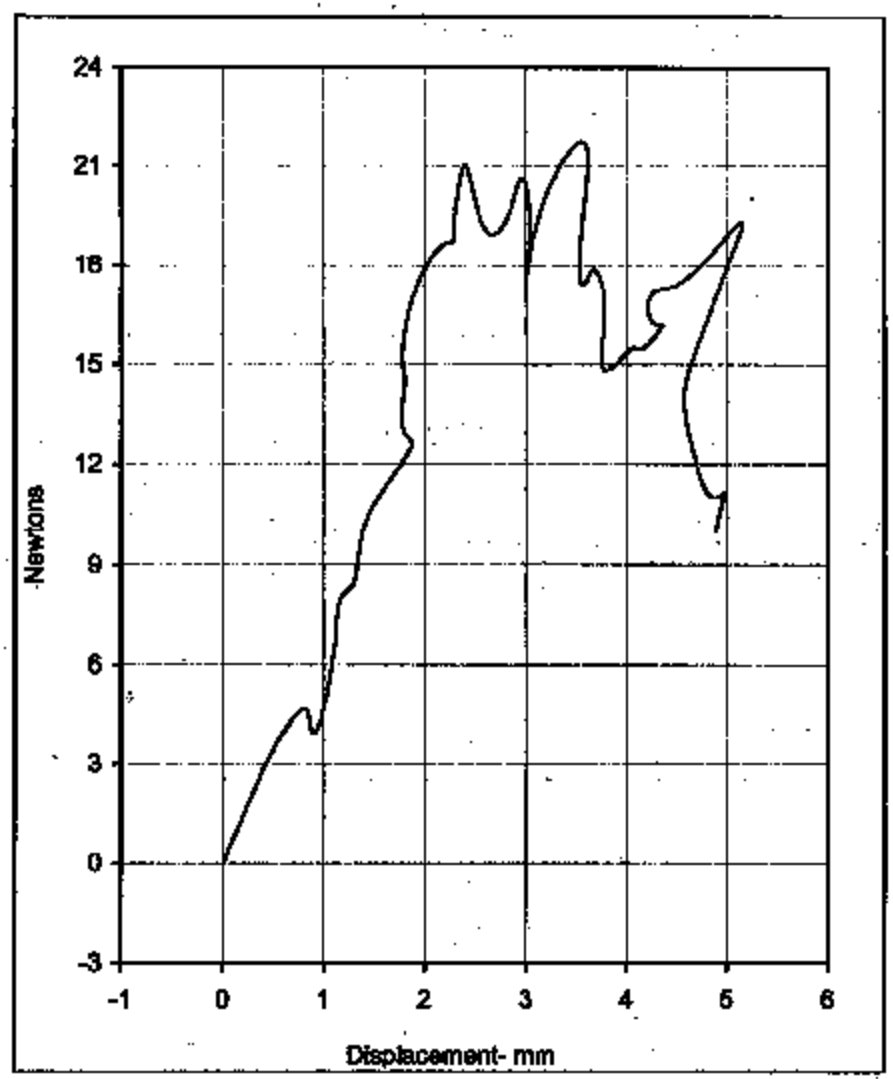
Test Program: 2004 FMVSS 111 Rearview Mirrors Test No.: 5

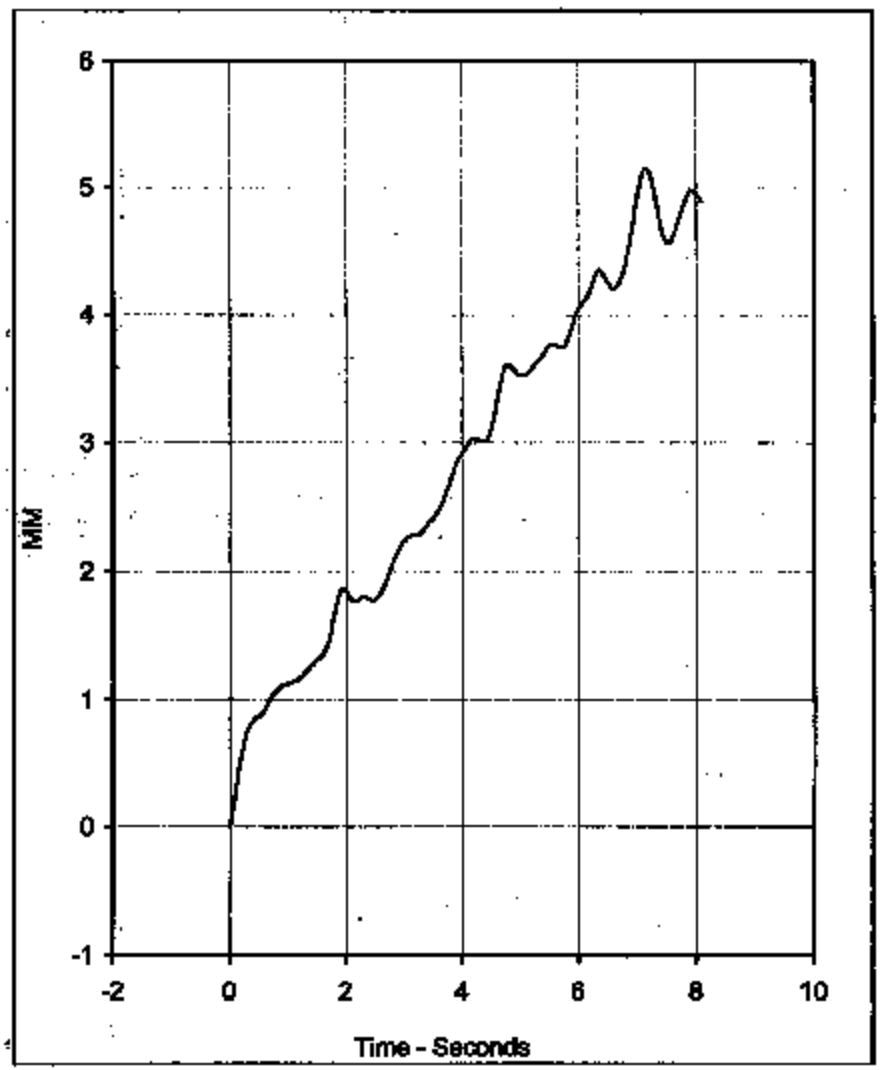
Test Vehicle: 2004 Saturn Ion No.: C40104

Load Direction: +45 / +45

Test Date: 5/27/04

KARCO Engineering





Curve Description	CURNO	Type
Force vs. Displacement	001	FIL

Units	Peak Force	Displacement	Filter (Hz)
Newtons	21.7	3.5	1

Curve Description	CURNO	Type
Displacement vs. Time	002	FIL

Units	Max	Time	Displ. Rate (mm/min.)	Filter (Hz)
MM	5.2	7.2	40.7	1

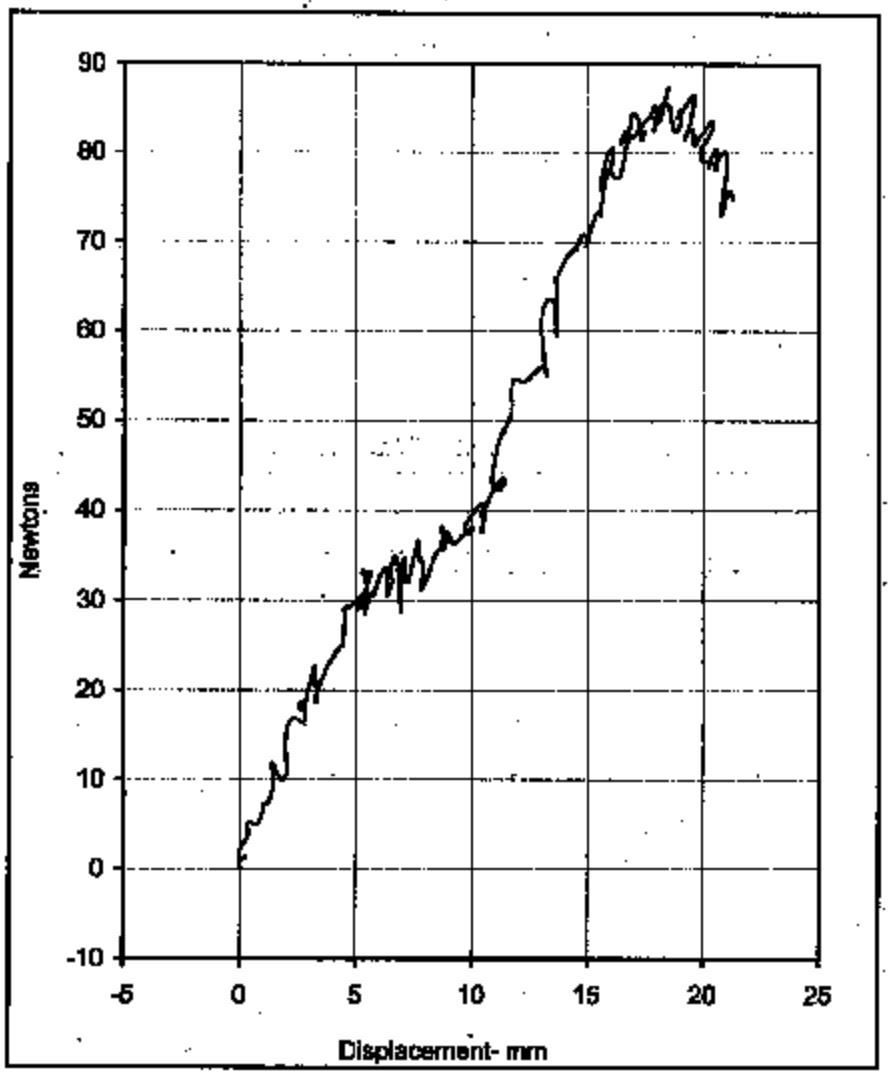
Test Program: 2004 FMVSS 111 Rearview Mirrors Test No.: 6

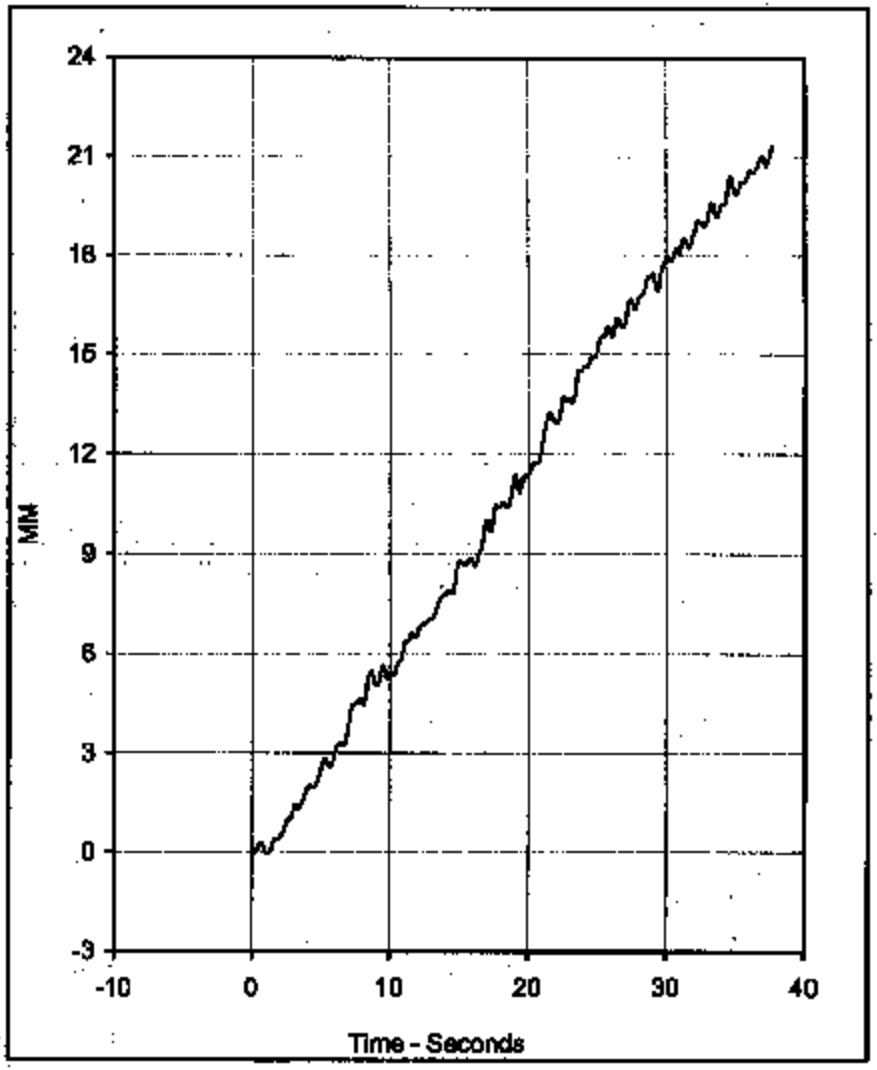
Test Vehicle: 2004 Saturn Ion No.: C40104

Load Direction: +45 / -45

Test Date: 5/27/04

KARCO Engineering





Curve Description	CURNO	Type
Force vs. Displacement	001	FIL

Units	Peak Force	Displacement	Filter (Hz)
Newtons	87.5	18.5	1

Curve Description	CURNO	Type
Displacement vs. Time	002	FIL

Units	Max	Time	Displ. Rate (mm/min.)	Filter (Hz)
MM	21.3	37.7	34.1	1

Test Program: 2004 FMVSS 111 Rearview Mirrors Test No.: 7

Test Vehicle: 2004 Saturn Ion No.: C40104

Load Direction: -45 / -45

Test Date: 5/27/04

KARCO Engineering

APPENDIX C

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

APPENDIX D

EYELIPSE LOCATIONS SUPPLIED BY MANUFACTURER

FORM 11

FMVSS 111 EYE POINT LOCATIONS

Make: Saturn Model: Ion Sedan Year: 2004

Coordinate System:
X = Longitudinal Dimension
Y = Lateral Dimension
Z = Vertical Dimension

Positive Values are as follows:
X = Forward of Reference Point
Y = Outboard of Reference Point (to driver's side)
Z = Above Reference Point

Provide Reference/Body Fiducial Point that dimensions below are measured from. **Point must be easily accessible and usable by test laboratory personnel, i.e. seat track mounting bolt, seat belt anchorage bolt, door latch "B" pillar striker.** (Provide sketch of reference point if necessary.)

COORDINATES	LEFT SIDE MIRROR		INSIDE MIRROR		RIGHT SIDE MIRROR	
	LE1 (left eye)	RE1 (right eye)	LE2	RE2	LE3	RE3
X	3116.0	3116.0	3116.0	3116.0	3116.0	3116.0
Y	-372.5	-307.5	-372.5	-307.5	-372.5	-307.5
Z	1096	1096	1096	1096	1096	1096
Mirror Mfr., Model Part No.	Ficosa NA Corp GMX357 22726678, 22726680 22720620, 22720618		Magna Donnelly GMX357 10327271, 15170979, 25603373		Ficosa NA Corp GMX357 22726677, 22726679 22720621, 22720619	

Attachment G

Saturn Ion Fiducial Point Location

Saturn Ion Driver's Seat front outboard fractional part