REPORT NUMBER 111-GTL-06-001

SAFETY COMPLIANCE TESTING FOR FMVSS NO. 111 REARVIEW MIRRORS

HYUNDAI MOTOR COMPANY
2006 HYUNDAI SONATA, PASSENGER CAR
NHTSA NO. C60502

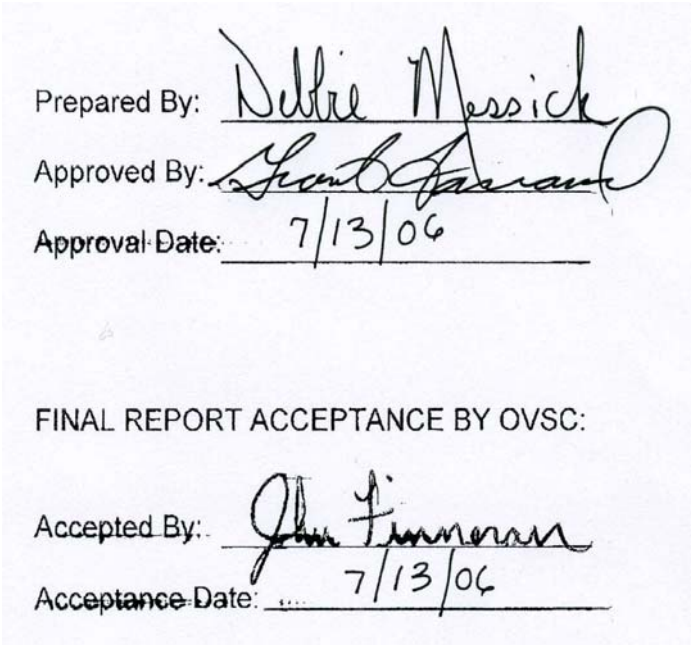
GENERAL TESTING LABORATORIES, INC.
1623 LEEDSTOWN ROAD
COLONIAL BEACH, VIRGINIA 22443

JULY 13, 2006

FINAL REPORT

PREPARED FOR

U. S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
400 SEVENTH STREET, SW
ROOM 6111 (NVS-220)
WASHINGTON, D.C. 20590



Technical Report Documentation Page

1. Report No. 111-GTL-06-001	2. Government Accession No. N/A	3. Recipient's Catalog No. N/A
4. Title and Subtitle Final Report of FMVSS 111 Compliance Testing of 2006 HYUNDAI SONATA, PASSENGER CAR NHTSA No. C60502		5. Report Date July 13, 2006 6. Performing Organ. Code GTL
7. Author(s) Grant Farrand, Project Engineer Debbie Messick, Project Manager		8. Performing Organ. Rep# GTL-DOT-06-111-001
9. Performing Organization Name and Address General Testing Laboratories, Inc. 1623 Leedstown Road Colonial Beach, Va 22443		10. Work Unit No. (TRAIS) N/A 11. Contract or Grant No. DTNH22-01-C-11025
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Admin. Enforcement Office of Vehicle Safety Compliance (NVS-220) 400 7th Street, S.W., Room 6111 Washington, DC 20590		13. Type of Report and Period Covered Final Test Report May 25-30, 2006 14. Sponsoring Agency Code NVS-220
15. Supplementary Notes		
16. Abstract Compliance tests were conducted on the subject, 2006 Hyundai Sonata Passenger Car in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-111V-00 for the determination of FMVSS 111 compliance. Test failures identified were as follows: None		
17. Key Words Compliance Testing Safety Engineering FMVSS 111	18. Distribution Statement Copies of this report are available from NHTSA Technical Information Services (TIS) Room 2336 (NP0-405) 400 7th St., S.W. Washington, DC 20590 Telephone No. (202) 366-4947	
19. Security Classif. (of this report) UNCLASSIFIED	21. No. of Pages 52	22. Price
20. Security Classif. (of this page) UNCLASSIFIED		

Form DOT F 1700.7 (8-72)

TABLE OF CONTENTS

SECTION 1

PURPOSE OF COMPLIANCE TEST

1.0 PURPOSE OF COMPLIANCE TEST

A 2006 Hyundai Sonata Passenger Car was subjected to Federal Motor Vehicle Safety Standard (FMVSS) No. 111 testing to determine if the vehicle was in compliance with the requirements of the standard. All tests were conducted in accordance with NHTSA, Office of Vehicle Safety Compliance (OVSC) Laboratory Procedure, TP-111V-00 dated 28 October 1999 and General Testing Laboratories, Inc. (GTL) Test Procedure, "Rearview Mirrors – Passenger Vehicles, Mulitpurpose Vehicles, Trucks, Buses and Motorcycles".

1.1 TEST VEHICLE

The test vehicle was a 2006 Hyundai Sonata Passenger Car. Nomenclature applicable to the test vehicle are:

A. Vehicle Identification Number: KMHET46C96A162388

B. NHTSA No.: C60502

C. Manufacturer: HYUNDAI MOTOR COMPANY

D. Manufacture Date: OCT/31/05

1.2 TEST DATE

The test vehicle was subjected to FMVSS No. 111 testing on May 25-30, 2006.

SECTION 2

COMPLIANCE TEST PROCEDURE AND SUMMARY OF RESULTS

2.0 COMPLIANCE TEST PROCEDURE

The Hyundai Sonata was subjected to FMVSS 111 compliance testing on May 25-30, 2006. The following tests were conducted using the FMVSS 111 test procedure.

2.1 INSPECTION

Inspected the installation of the inside and outside rearview mirrors. Made note of mirror types and any evidence of defects or imperfections that could influence test results.

2.2 MOUNTING ADEQUACY TEST

INSIDE MIRROR (S5.1.2)

Determined that the mirror was securely mounted and measured the positive and negative angles of adjustment for both the vertical and horizontal directions.

OUTSIDE MIRRORS (S5.2.2 and S5.3)

Determined that the mirrors were securely mounted and that the driver's side mirror could be tilted in both horizontal and vertical directions from the driver's seating position. Determined that the passenger's side mirror could be horizontally and vertically adjusted and measured the positive and negative horizontal and vertical angles of adjustment for all outside mirrors. Inspected all outside mirrors to ensure they were free of sharp points or edges that could contribute to pedestrian injury.

2.3 FIELD OF VIEW TEST

INSIDE REARVIEW MIRROR (S5.1.1)

Determined that the mirror provided a field of view with an included horizontal angle measured from the projected eye point of at least 20 degrees, and a 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 was occupied by the driver and four passengers or the designed occupant capacity, if less.

SECTION 2 CONTINUED

OUTSIDE REARVIEW MIRROR - DRIVER'S SIDE (S5.2)

Determined that the mirror provided 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.

Verified that the mirror was not obscured by the un-wiped portion of the windshield.

2.4 REFLECTANCE TEST

The average reflectance of each mirror was determined in accordance with SAE Recommended Practice J954, OCT 84. Reflectance of the inside rear view mirror was determined for both the day and night mode settings.

2.5 BREAKAWAY TEST

INSIDE REARVIEW MIRROR (S5.1.2)

The mirror was subjected to longitudinal forces not exceeding 400 N (90 lb) to verify that the mirror mounting would deflect, collapse, or breakaway without leaving sharp edges.

2.6 UNIT MAGNIFICATION AND CONVEX MIRROR TESTS

PASSENGER CARS (S5.3 AND S5.4)

Utilizing a spherometer, the radius of curvature of all mirrors was measured. The test verified that the driver’s side rearview mirror and inside rearview mirror were flat mirrors of unit magnification.

The passenger’s side mirror was a convex mirror and was properly marked at the lower edge of the mirror’s reflective surface with the words, **“Objects in Mirror Are Closer Than They Appear.”**

2.7 SUMMARY OF RESULTS

Based on the tests performed, the test vehicle appears to be in compliance with the requirements of FMVSS 111.

SECTION 3

COMPLIANCE TEST DATA

3.0 TEST RESULTS

The following data sheets document the results of testing on the 2006 Hyundai Sonata.

DATA SUMMARY SHEET
FMVSS 111 – REARVIEW MIRRORS

VEH. MOD YR/MAKE/MODEL/BODY: 2006 HYUNDAI SONATA PASSENGER CAR
VEH. NHTSA NO: C60502; VIN: KMHET46C96A162388
VEH. BUILD DATE: OCT/31/05 TEST DATE: MAY 25-30, 2006
TEST LABORATORY: GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE

OUTSIDE DRIVER SIDE MIRROR

	PASS	FAIL	COMMENTS
STABLE SUPPORT	X		
DOES NOT PROTRUDE BEYOND VEHICLE BODY	X		Mirror does protrude farther than the widest part of the vehicle body but the protrusion is required to meet the field of view requirements.
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		
BREAKAWAY	X		
UNIT MAGNIFICATION	X		

OUTSIDE PASSENGER SIDE MIRROR (if required)

	PASS	FAIL	COMMENTS
STABLE SUPPORT	X		See Remarks
ADJUSTABLE BY TILTING	X		
REFLECTANCE	X		
FREE OF SHARP EDGES	X		
UNIT MAGNIFICATION or			
CONVEX	X		

REMARKS: This vehicle is equipped with an outside passenger side rear view mirror that is not required by FMVSS No. 111. Each passenger car whose inside rear view mirror does not meet the field of view requirements of the standard shall have an outside mirror of unit magnification or a convex mirror installed on the passenger's side.

DATA SHEET 1 (1 of 2)
VEHICLE INSPECTION AND IDENTIFICATION

VEH. MOD YR/MAKE/MODEL/BODY: 2006 HYUNDAI SONATA PASSENGER CAR
VEH. NHTSA NO: C60502; VIN: KMHET46C96A162388
VEH. BUILD DATE: OCT/31/05 TEST DATE: MAY 25-30, 2006
TEST LABORATORY: GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE

TYPES OF REARVIEW MIRRORS:

INSIDE REARVIEW: MANUAL DAY/NIGHT FLAT GLASS MIRROR

DRIVER'S SIDE OUTSIDE: 4-WAY POWER FLAT GLASS MIRROR

PASSENGER'S SIDE OUTSIDE: 4-WAY POWER CONVEX GLASS MIRROR

OTHER:

DESIGNATED SEATING CAPACITY: 5

LOCATION AND DESCRIPTION OF MANUFACTURER PROVIDED REFERENCE POINT FOR EYE POINT MEASUREMENT: LEFT FRONT DRIVER SEAT MOUNTING BOLT CENTERLINE.

LOCATION OF DRIVER SEATING REFERENCE POINT (SRP): N/A

REMARKS: No defects or imperfections of the mirrors were noted.

DATA SHEET 1 (2 of 2)

MANUFACTURER EYE POINT LOCATION COORDINATES (SEE SECTION 7)

	X	Y	Z
LEFT EYE	-346 mm	-212 mm	895 mm
RIGHT EYE	-346 mm	-272 mm	895 mm

RESULTS OF RECEIVING INSPECTION:

PASS X
FAIL
CONDITIONAL

CONDITIONS:

GENERAL VEHICLE INFORMATION:

GVWR: 1950 kg
FRONT GAWR: 1140 kg
REAR GAWR: 970 kg
UNLOADED WEIGHT: 1498 kg
CARGO WEIGHT: 49.9 kg
TOTAL RATED LOAD: 390 kg

REMARKS:

RECORDED BY: Grant Farrand DATE: 05/25/06

APPROVED BY: Debbie Messick

DATA SHEET 2 (1 of 2)
FMVSS 111 MOUNTING ADEQUACY TEST

VEH. MOD YR/MAKE/MODEL/BODY: 2006 HYUNDAI SONATA PASSENGER CAR
VEH. NHTSA NO: C60502; VIN: KMHET46C96A162388
VEH. BUILD DATE:OCT/31/05 TEST DATE: MAY 25, 2006
TEST LABORATORY:GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE

MIRROR MOUNTING PROVIDES A STABLE SUPPORT:

	PASS	FAIL	CONDITIONAL
INSIDE REARVIEW MIRROR	X		
DRIVER'S SIDE OUTSIDE MIRROR	X		
PASSENGER SIDE OUTSIDE MIRROR	X		

CONDITIONS:

OUTSIDE MIRRORS FREE OF SHARP POINTS OR EDGES (PASS/FAIL): PASS

MIRRORS ARE ADJUSTABLE IN BOTH THE VERTICAL AND HORIZONTAL DIRECTIONS:

	PASS	FAIL	CONDITIONAL
INSIDE REARVIEW MIRROR	X		
DRIVER'S SIDE OUTSIDE MIRROR	X		
PASSENGER SIDE OUTSIDE MIRROR	X		

CONDITIONS:

DRIVER'S SIDE OUTSIDE MIRROR ADJUSTABLE FROM THE DRIVER'S SEATED POSITION (PASS/FAIL): PASS

DATA SHEET 2 (2 of 2)

ADJUSTMENT ANGLE	V+	V-	H+	H-
INSIDE REARVIEW MIRROR	12°	36°	90°	90°
DRIVER'S SIDE OUTSIDE MIRROR	11.5°	8°	10°	8°
PASSENGER SIDE OUTSIDE MIRROR	11.5°	8°	8°	10°

CONDITIONS: OUTSIDE MIRROR HORIZONTAL REFERENCED TO REAR FACE OF PLASTIC MIRROR HOUSING.

CONDITIONS:

TEST RESULTS: PASS X FAIL_____

REMARKS:

RECORDED BY: Grant Farrand DATE: 05/30/06

APPROVED BY: Debbie Messick

DATA SHEET 3 (1 of 2)
FMVSS 111 FIELD-OF-VIEW TEST

VEH. MOD YR/MAKE/MODEL/BODY: 2006 HYUNDAI SONATA PASSENGER CAR
VEH. NHTSA NO: C60502; VIN: KMHET46C96A162388
VEH. BUILD DATE: OCT/31/05 TEST DATE: MAY 26, 2006
TEST LABORATORY: GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE

INSIDE REARVIEW MIRROR (S5.1.1)

E = Distance from center of mirror to projected eye point= .518 m

A = Distance from rear of vehicle to projected eye point location= 3.48 m

X1 = Distance from rear of vehicle to field to view grid = 8.23 m

Z1 = Vertical distance to lowest point of field of view at distance X1= . 495 m

Z2 = Height of center of mirror = 1.26 m

X2 = Distance from rear of vehicle where the road surface is first visible

X2 = [(Z2 x X1) + (Z1 x A)]/(Z2 - Z1) = 15.8 m (61 m maximum)

YL,YR = Distance to driver's left or right of vehicle's centerline at the location of the field of view grid or markers

MONOCULAR DATA (ALR & ARL Are Angles)

EYE LOCATION	YL	YR	ALR	ARL
LEFT EYE POINT	2.45 m	2.45 m		11.8°
RIGHT EYE POINT	2.99 m	1.50 m	14.4°	

REMARKS:

DATA SHEET 3 (2 of 2)

CALCULATED HORIZONTAL AMBINOCULAR VIEW ANGLE (AB)

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

ANGLE AB = ANGLE ALR + ANGLE ARL = 26.2° (20 degrees minimum)

TEST RESULTS: PASS X FAIL

DRIVER SIDE MIRROR (S5.2)

MIRROR OBSCURED BY UNWIPED PORTION OF WINDSHIELD? (Y/N) NO

HEIGHT OF TARGET DISC ON MIRROR: 1061 mm

DISTANCE OF TARGET DISC ON MIRROR FROM VEHICLE TANGENT PLANE: 61mm

TARGET DISC LOCATION RELATIVE TO VEHICLE TANGENT PLANE: _____ outboard
X Inboard

ENTIRE TRIANGULAR TEST TARGET AREA ON SCREEN VISIBLE? (Y/N) NO*

MIRROR PROTRUDES BEYOND VEHICLE TANGENT PLANE? (Y/N) YES

PROTRUSION REQUIRED TO MEET FIELD OF VIEW REQUIREMENTS? (Y/N) YES

TEST RESULTS PASS X FAIL

PASSENGER SIDE MIRROR (S5.3 OR MFG. OPTION) – MFG. OPTION

PASSENGER SIDE MIRROR TYPE (convex or unit magnification) CONVEX

REMARKS: *The triangular test target area is partially obscured by a rear body contour that is allowed by FMVSS No. 111.

RECORDED BY: Grant Farrand DATE: 05/30/06

APPROVED BY: Debbie Messick

DATA SHEET 4 (1 of 4)
FMVSS 111 REFLECTANCE TEST

VEH. MOD YR/MAKE/MODEL/BODY: 2006 HYUNDAI SONATA PASSENGER CAR
VEH. NHTSA NO: C60502; VIN: KMHET46C96A162388
VEH. BUILD DATE: OCT/31/05 TEST DATE: MAY 30, 2006
TEST LABORATORY: GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE

INSIDE MIRROR:

TYPE OF MIRROR:

2 POSITION PRISMATIC X ; ELECTROCHROMATIC

ELECTRO/MECHANICAL ; LIQUID CRYSTAL

OTHER: (Specify)

DESCRIPTION OF TEST APPARATUS: GTL REFLECTOMETER

MIRROR DESCRIPTION: 2 POSITION PRISMATIC FLAT GLASS MIRROR

VOLTAGE READING FROM CALIBRATION (Average Value): 10.000

VOLTAGE READING FROM LIGHT REFLECTED BY DAY MIRROR (Average Value): 7.14

REFLECTANCE (Day) = Voltage (Refl)/Voltage (Cal) = 0. 714 x 100 = 71.4 percent
(Minimum Requirement = 35 percent)

VOLTAGE READING FROM CALIBRATION (Average Value) = 10.000

VOLTAGE READING FROM LIGHT REFLECTED BY NIGHT MIRROR (Average Value): 5.440

REFLECTANCE (Night) = Voltage (Refl)/Voltage (Cal) = 0. 544 x 100 = 54.4 percent
(Minimum Requirement = 4 percent)

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

DATA SHEET 4 (2 of 4)

INSIDE MIRROR WITH MULTIPLE REFLECTANCE LEVELS:

Does the mirror have a manual adjustment to achieve day mode operation?

YES__X__ NO_____

If “NO” above, test for reflectance in the event of electrical failure:

VOLTAGE READING FROM CALIBRATION (Average Value)=_____N/A_____

VOLTAGE READING FROM LIGHT REFLECTED BY ELECTRICALLY FAILED MIRROR (Average Value):
_____N/A_____

REFLECTANCE (Failed electrical, manually adjusted)
= Voltage (Refl)/Voltage (Cal) = 0._____ x 100 = _____ percent
(Minimum Requirement = 35 percent)

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

OBSERVATIONS:_____

TEST RESULTS FOR INSIDE MIRROR:

PASS__X__ FAIL_____

DATA SHEET 4 (3 of 4)

DRIVER'S SIDE MIRROR:

TYPE OF MIRROR: UNIT MAGNIFICATION X

OTHER (Specify):

MIRROR DESCRIPTION: 119.4 mm high X 190.5 mm wide FLAT GLASS MIRROR

VOLTAGE READING FROM CALIBRATION (Average Value): 10.000

VOLTAGE READING FROM LIGHT REFLECTED BY MIRROR (Average Value): 4.903

REFLECTANCE = Voltage (Refl)/Voltage (Cal) = 0. 490 x 100 = 49.0 percent
(Minimum Requirement = 35 percent)

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

OBSERVATIONS:

TEST RESULTS FOR DRIVER SIDE MIRROR:

PASS X FAIL

DATA SHEET 4 (4 of 4)

PASSENGER'S SIDE MIRROR:

TYPE OF MIRROR: UNIT MAGNIFICATION_____ CONVEX___X____

OTHER (Specify):_____

DESCRIPTION OF TEST APPARATUS:_____GTL REFLECTOMETER_____

MIRROR DESCRIPTION:_119.4 mm high X 190.5 mm wide CONVEX GLASS_____

VOLTAGE READING FROM CALIBRATION (Average Value):_____10.000_____

VOLTAGE READING FROM LIGHT REFLECTED BY DAY MIRROR (Average Value):_____
3.614

REFLECTANCE (Day) = Voltage (Refl)/Voltage (Cal) = 0._361_ x 100 =_36.1_ percent
(Minimum Requirement = 35 percent)

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

OBSERVATIONS:_____

TEST RESULTS FOR PASSENGER SIDE MIRROR:

PASS__X___ FAIL_____

REMARKS:

RECORDED BY:___Grant Farrand_____ DATE:__05/30/06___

APPROVED BY:___Debbie Messick____

DATA SHEET 5
FMVSS 111 BREAKAWAY TEST

VEH. MOD YR/MAKE/MODEL/BODY: 2006 HYUNDAI SONATA PASSENGER CAR
VEH. NHTSA NO: C60502; VIN: KMHET46C96A162388
VEH. BUILD DATE: OCT/31/05 TEST DATE: MAY 25-30, 2006
TEST LABORATORY: GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE

MOUNTING OF MIRROR (INSIDE) DESCRIPTION:
MIRROR IS MOUNTED TO A LINK ARM WITH A BALL PIVOT WHICH LETS THE MIRROR PIVOT UP/DOWN AND LEFT/RIGHT. THE LINK ARM IS MOUNTED TO THE HEADLINER WITH A SPRING CLIP TO ALLOW BREAKAWAY PROTECTION.

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)	PASS	FAIL
1 (GTL 5538)	0°/90°	155	X	
2 (GTL 5539)	-45°/90°	38	X	
3 (GTL 5540)	-45°/-45°	40	X	
4 (GTL 5541)	-45°/+45°	160	X	
5* (GTL 5542)	10°/+45°	222	X	
6* (GTL 5543)	10°/90°	125	X	
7* (GTL 5544)	10°/-45°	160	X	

REMARKS: * THE +45° APPROACH ANGLE COULD NOT BE TESTED DUE TO THE DESIGN OF THE MIRROR/MIRROR MOUNT/HEADLINER OF THE VEHICLE. THE GREATEST ANGLE THAT COULD BE REACHED WAS 10°.

DESCRIPTION OF MIRROR MOVEMENT (DEFLECT COLLAPSE OR BREAKAWAY):
FIRST MOVEMENT OF MIRROR WITHOUT INCREASE IN LOAD WAS MIRROR PIVOTING ON BALL JOINT. IF LOADING WAS CONTINUED, THE MIRROR ARM WOULD SEPARATE FROM THE HEADLINER MOUNT DUE TO THE SPRING LOADED MOUNTING CLIP.

X-Y PLOTTER DATA I.D. NUMBER GTL TEST #5538 THROUGH 5544

TEST RESULTS: PASS X FAIL

RECORDED BY: Grant Farrand DATE: 05/30/06

APPROVED BY: Debbie Messick

DATA SHEET 6 (1 of 3)
FMVSS 111 UNIT MAGNIFICATION AND CONVEX MIRROR TESTS

VEH. MOD YR/MAKE/MODEL/BODY: 2006 HYUNDAI SONATA PASSENGER CAR
VEH. NHTSA NO: C60502; VIN: KMHET46C96A162388
VEH. BUILD DATE: OCT/31/05 TEST DATE: MAY 30, 2006
TEST LABORATORY: GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE

DESCRIPTION OF TEST APPARATUS: GTL SPHEROMETER

DRIVER'S SIDE and INSIDE REARVIEW MIRRORS:

DRIVER SIDE MIRROR:

TEST POSITION	DIAL READINGS
1	.0000
2	.0000
3	.0000
4	.0000
5	.0000
6	.0000
7	.0000
8	.0000
9	.0000
10	.0000

INSIDE MIRROR:

TEST POSITION	DIAL READINGS
1	.0000
2	.0000
3	.0000
4	.0000
5	.0000
6	.0000
7	.0000
8	.0000
9	.0000
10	.0000

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

TEST RESULTS: PASS X FAIL

DATA SHEET 6 (2 of 3)

PASSENGER'S SIDE REARVIEW MIRROR:

CONVERSION DATA TABLE FROM SPHEROMETER DIAL READING TO RADIUS OF CURVATURE

TEST POSITION	DIAL READINGS (Inches)	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	.0058	1231.9		
2	.0053	1333.5		
3	.0057	1262.4		
4	.0051	1394.5	+102.1	+7.9%
5	.0059	1206.5	-85.9	-6.6%
6	.0051	1394.5		
7	.0059	1206.5		
8	.0054	1313.2		
9	.0055	1290.3		
10	.0055	1290.3		
Average Radius of Curvature – A summation of Column 3 divided by 10: 1292.4 (mm)			Greatest percent Deviation From the Average Radius Of Curvature – From Column 5: +7.9 %	

IF CONVEX, ARE THERE ANY DISCONTINUITIES IN THE SLOPE OF THE SURFACE OF THE MIRROR:

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 ABOVE WORDS: 5.0 mm

IF CONVEX, LETTERS ARE NOT LESS THAN 4.8 mm OR MORE THAN 6.4 mm HIGH

YES___X___ NO_____

IF CONVEX, THE AVERAGE RADIUS OF CURVATURE IS NOT LESS THAN 889 mm AND NOT MORE THAN 1651 mm:

YES___X___ NO_____

DATA SHEET 6 (3 of 3)

IF CONVEX, THE GREATEST PERCENT DEVIATION FROM THE AVERAGE RADIUS OF CURVATURE IS ± 12.5 PERCENT:

YES___X___ NO_____

IF UNIT MAGNIFICATION, ALL DIAL READINGS ARE ZERO +/_0.

YES_____ NO_____ N/A___X___

TEST RESULTS:

PASS__X___ FAIL_____

RECORDED BY:___Grant Farrand_____ DATE:__05/30/06___

APPROVED BY:___Debbie Messick___

DATA SHEET 7
FMVSS 111 MIRROR REFLECTIVE SURFACE AREA TEST

VEH. MOD YR/MAKE/MODEL/BODY: 2006 HYUNDAI SONATA PASSENGER CAR
VEH. NHTSA NO: C60502; VIN: KMHET46C96A162388
VEH. BUILD DATE: OCT/31/05 TEST DATE: MAY 30, 2006
TEST LABORATORY: GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE

DATA TABLE FOR SURFACE AREA

MIRRORS	AREA	REQUIREMENT MPVs, TRUCKS, BUSES (OTHER THAN SCHOOL), GVWR ≤ 4536 kg	REQUIREMENT MPVs, TRUCKS, BUSES (OTHER THAN SCHOOL), GVWR 4536 kg	PASS/FAIL
Driver Outside	176 cm^2	126 cm^2	323 cm^2	PASS
Passenger Outside	176 cm^2	126 cm^2	323 cm^2	PASS

MIRRORS LOCATED SO AS TO PROVIDE DRIVER A VIEW TO THE REAR:
LEFT SIDE (Y/N) YES
RIGHT SIDE (Y/N) YES

TEST RESULTS: PASS X FAIL

REMARKS:

RECORDED BY: Grant Farrand DATE: 05/30/06

APPROVED BY: Debbie Messick

SECTION 4
INSTRUMENTATION AND EQUIPMENT LIST

TABLE 1 - INSTRUMENTATION & EQUIPMENT LIST

EQUIPMENT	DESCRIPTION	MODEL/ SERIAL NO.	CAL. DATE	NEXT CAL. DATE
COMPUTER	AT&T	U86D66	BEFORE USE	BEFORE USE
CAMERA MOUNT TEST FIXTURE	GTL	N/A	BEFORE USE	BEFORE USE
A/D INTERFACE	METRABYTE	CT91	BEFORE USE	BEFORE USE
SIGNAL CONDITIONER	METRYBYTE	EXP-RES	BEFORE USE	BEFORE USE
LOAD CELL	SENSOTEC	41/571-07 257818	01/06	01/07
INCLINOMETER	MITYTOYO	PRO 360	BEFORE USE	BEFORE USE
LINEAR POTENTIOMETER	CELESCO	15/369	BEFORE USE	BEFORE USE
PRECISION STEEL SCALE	STARRETT	C416R	05/06	05/07
CAMERA	NIKON	N/A	N/A	N/A
REFLECTOMETER	GTL	N/A	BEFORE USE	BEFORE USE
SPHEROMETER	GTL	N/A	BEFORE USE	BEFORE USE

SECTION 5

PHOTOGRAPHS

2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 111

FIGURE 5.1
LEFT SIDE VIEW OF VEHICLE

2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 111

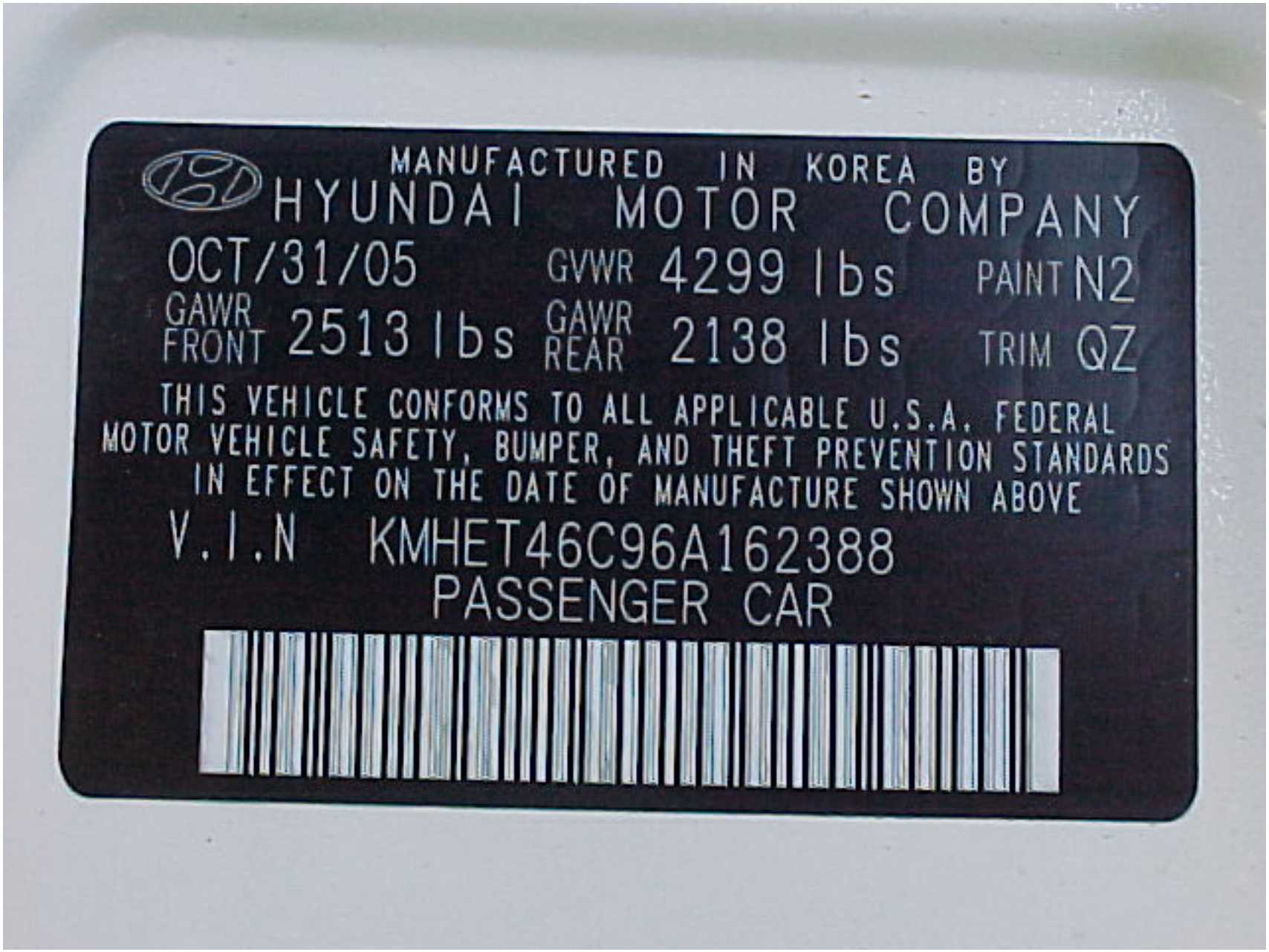
FIGURE 5.2
RIGHT SIDE VIEW OF VEHICLE

2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 111

FIGURE 5.3
¾ FRONTAL VIEW FROM LEFT SIDE OF VEHICLE

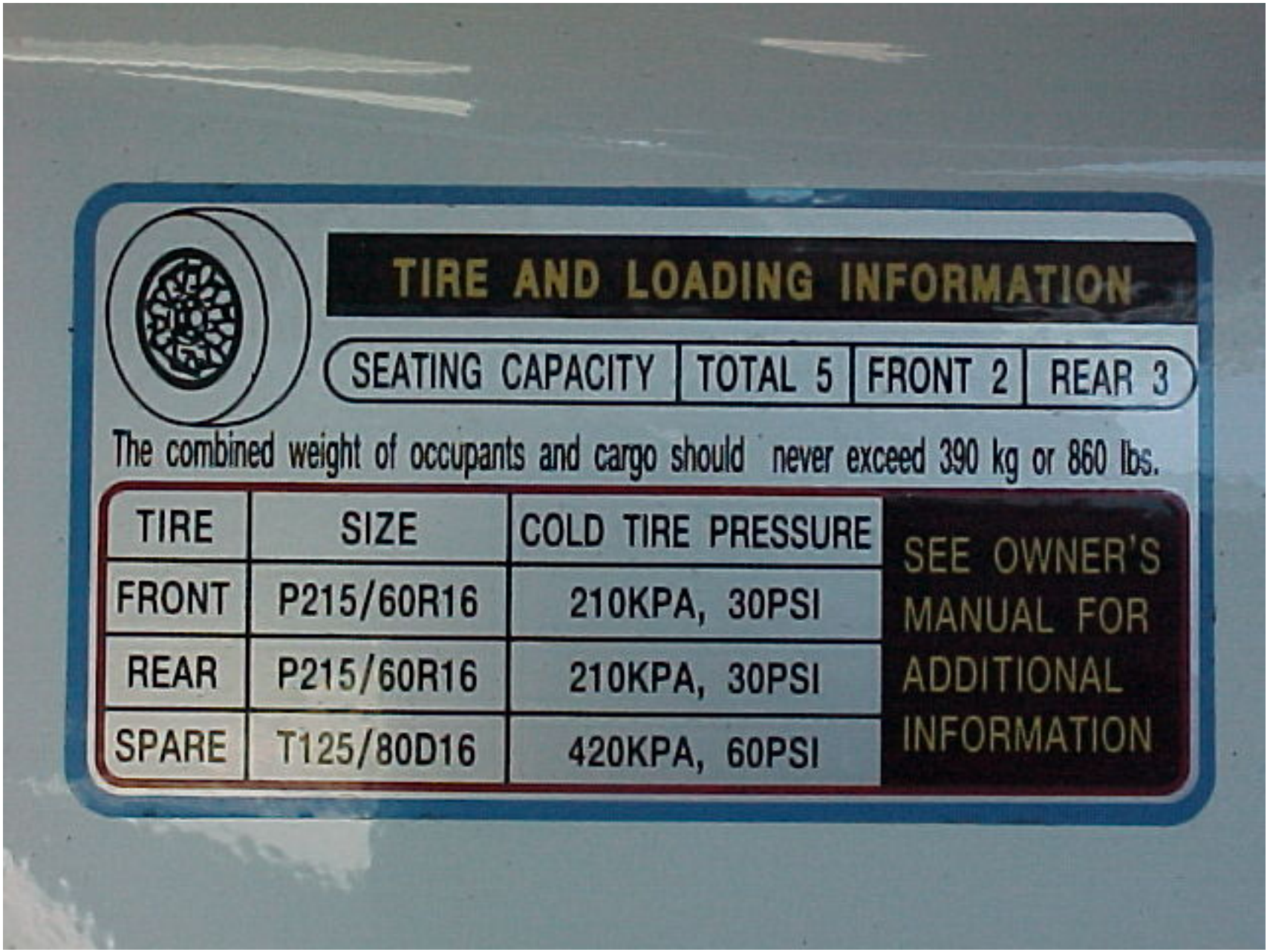
2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 111

FIGURE 5.4
¾ REAR VIEW FROM RIGHT SIDE OF VEHICLE



2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 111

FIGURE 5.5
VEHICLE CERTIFICATION LABEL



2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 111

FIGURE 5.6
VEHICLE TIRE INFORMATION LABEL

2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 111

FIGURE 5.7
DRIVER SIDE REAR VIEW MIRROR AND MOUNTING

2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 111

FIGURE 5.8
PASSENGER SIDE REAR VIEW MIRROR AND MOUNTING

2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 111

FIGURE 5.9
INSIDE REARVIEW MIRROR AND MOUNTING

2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 111

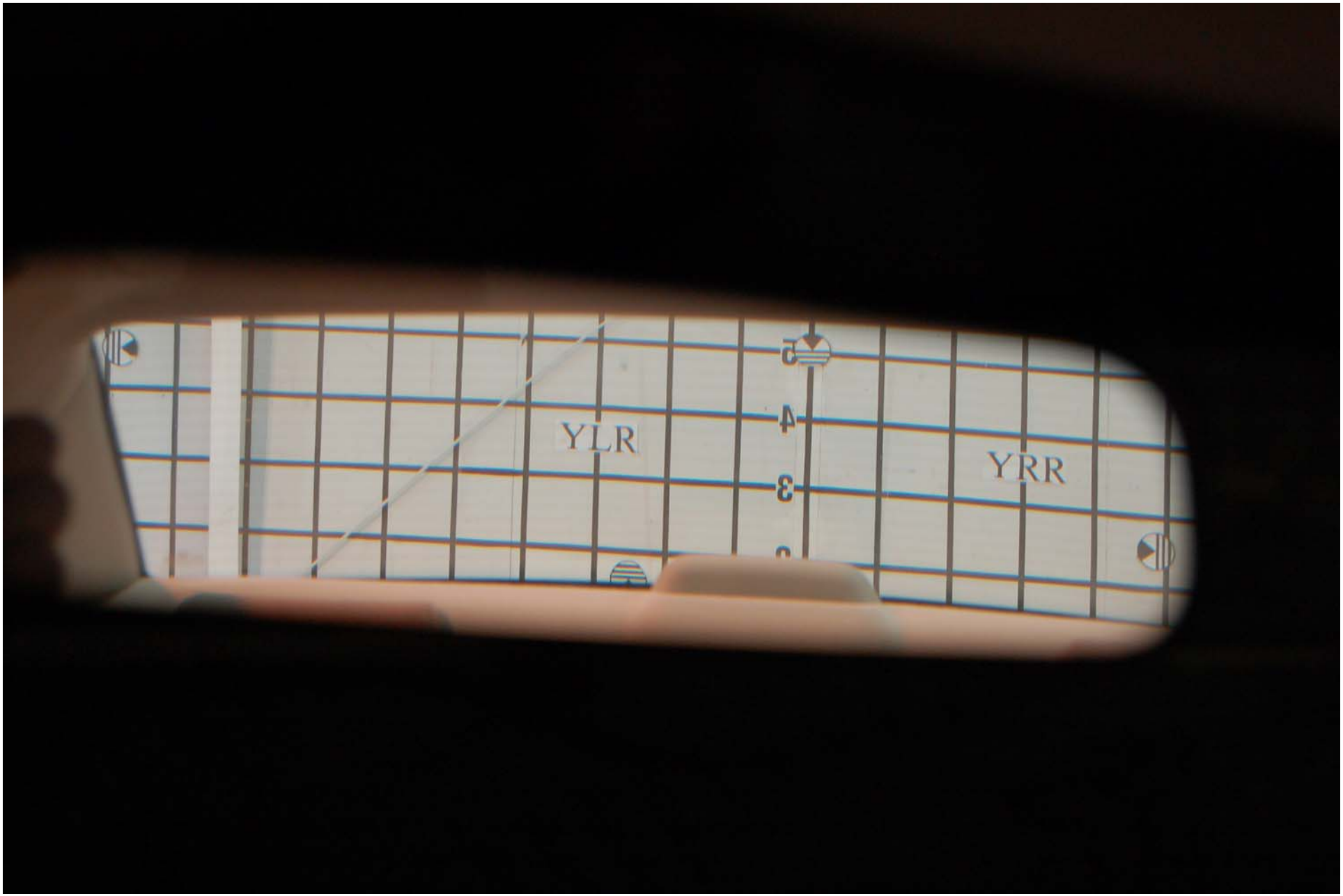
FIGURE 5.10
PHOTO OF VEHICLE IN TEST SET-UP WITH
VIEWING INSTRUMENT

2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 111

FIGURE 5.11
REFLECTANCE TEST SET-UP

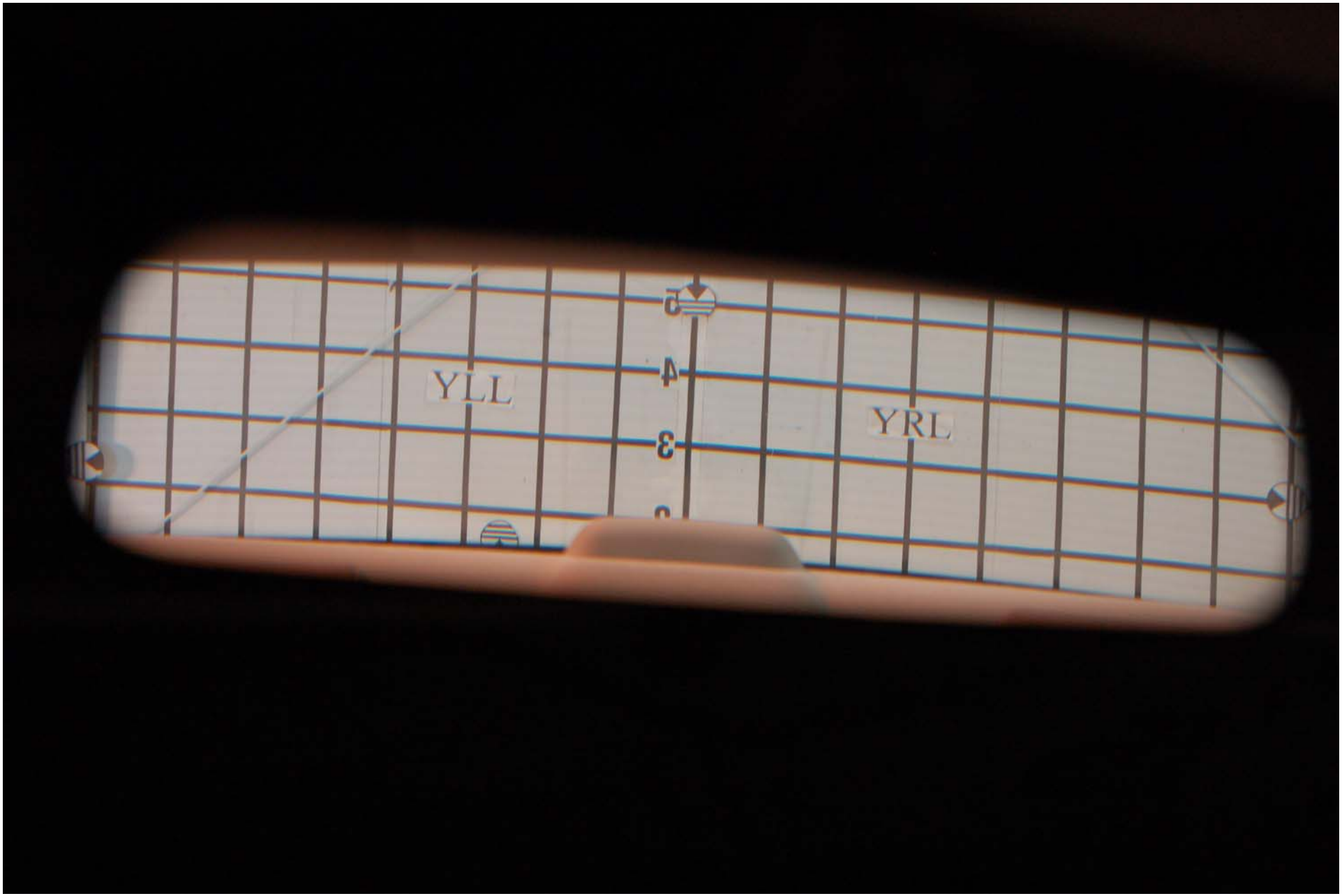
2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 111

FIGURE 5.12
BREAK AWAY TEST SET-UP



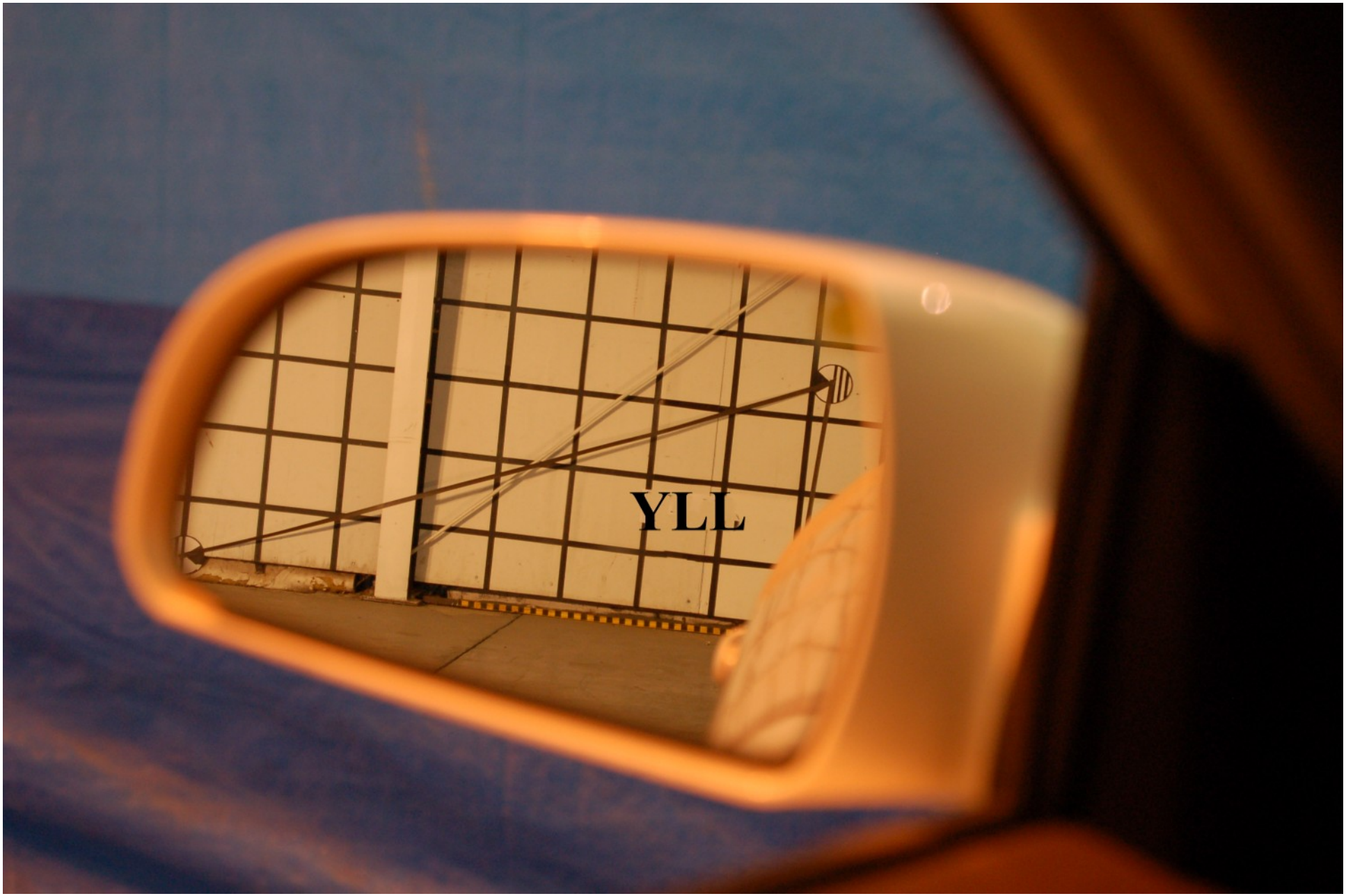
2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 111

FIGURE 5.13
INSIDE MIRROR RIGHT EYE FIELD OF VIEW



2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 111

FIGURE 5.14
INSIDE MIRROR LEFT EYE FIELD OF VIEW



2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 111

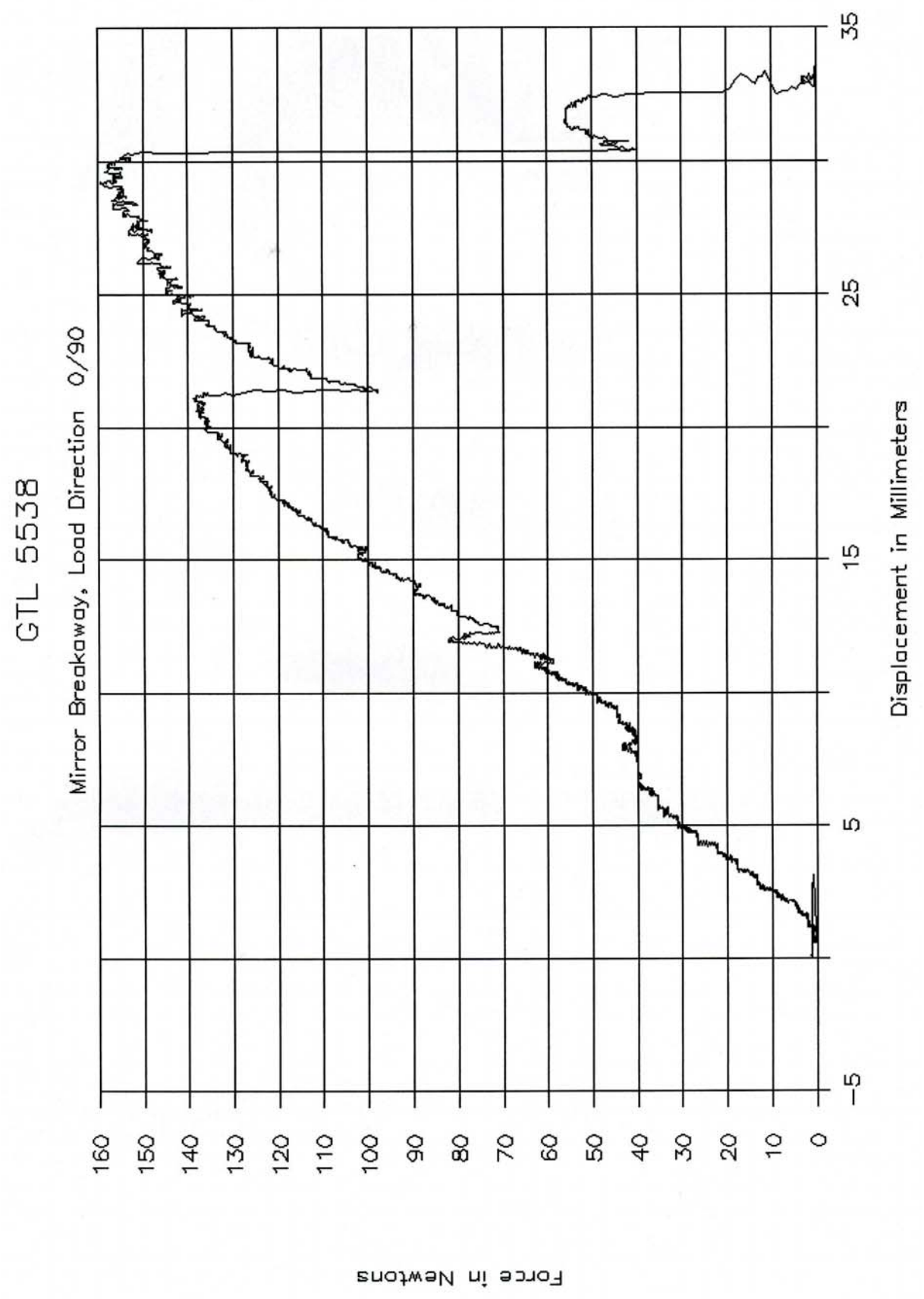
FIGURE 5.15
OUTSIDE MIRROR LEFT EYE FIELD OF VIEW

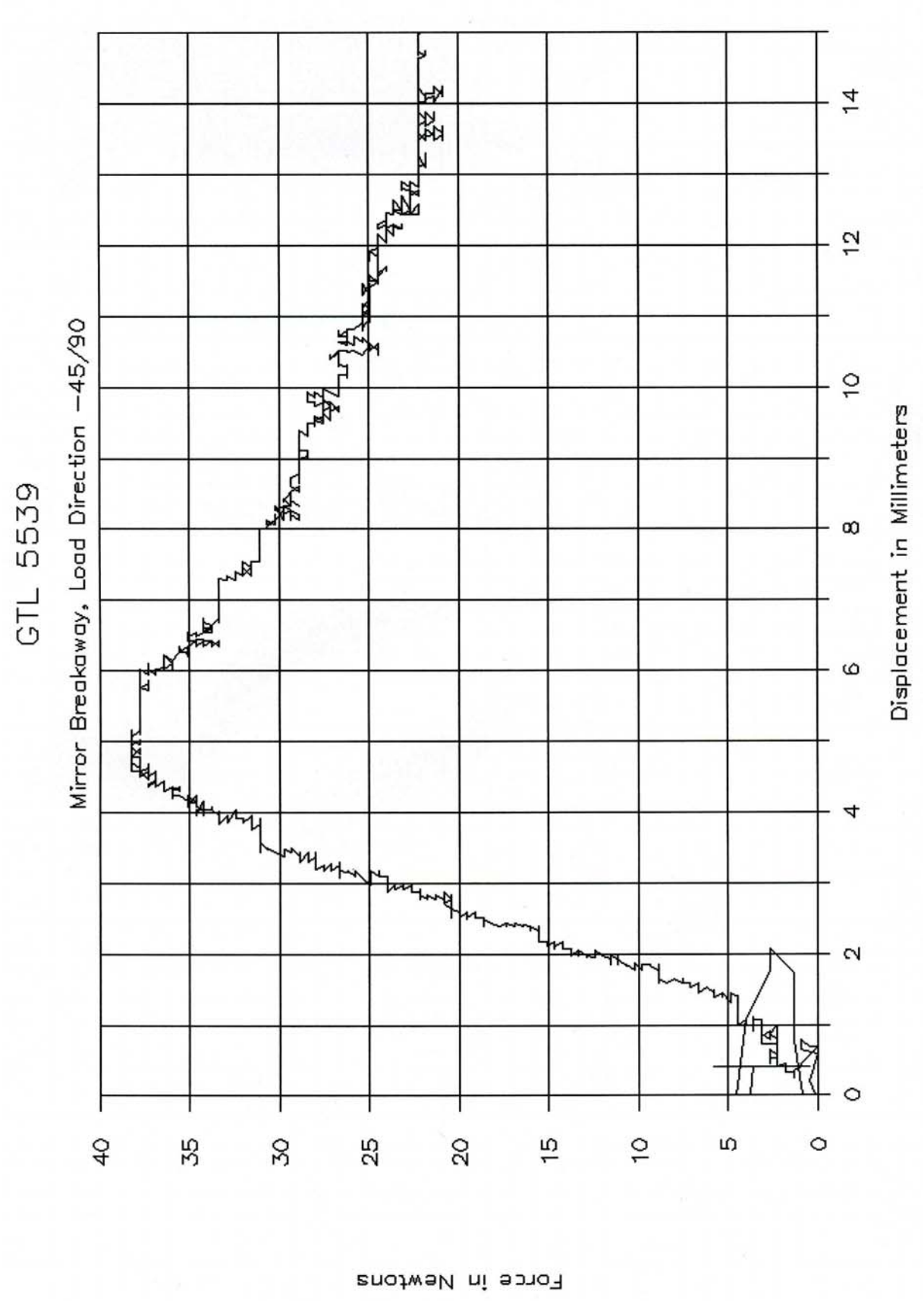
2006 HYUNDAI SONATA
NHTSA NO. C60502
FMVSS NO. 111

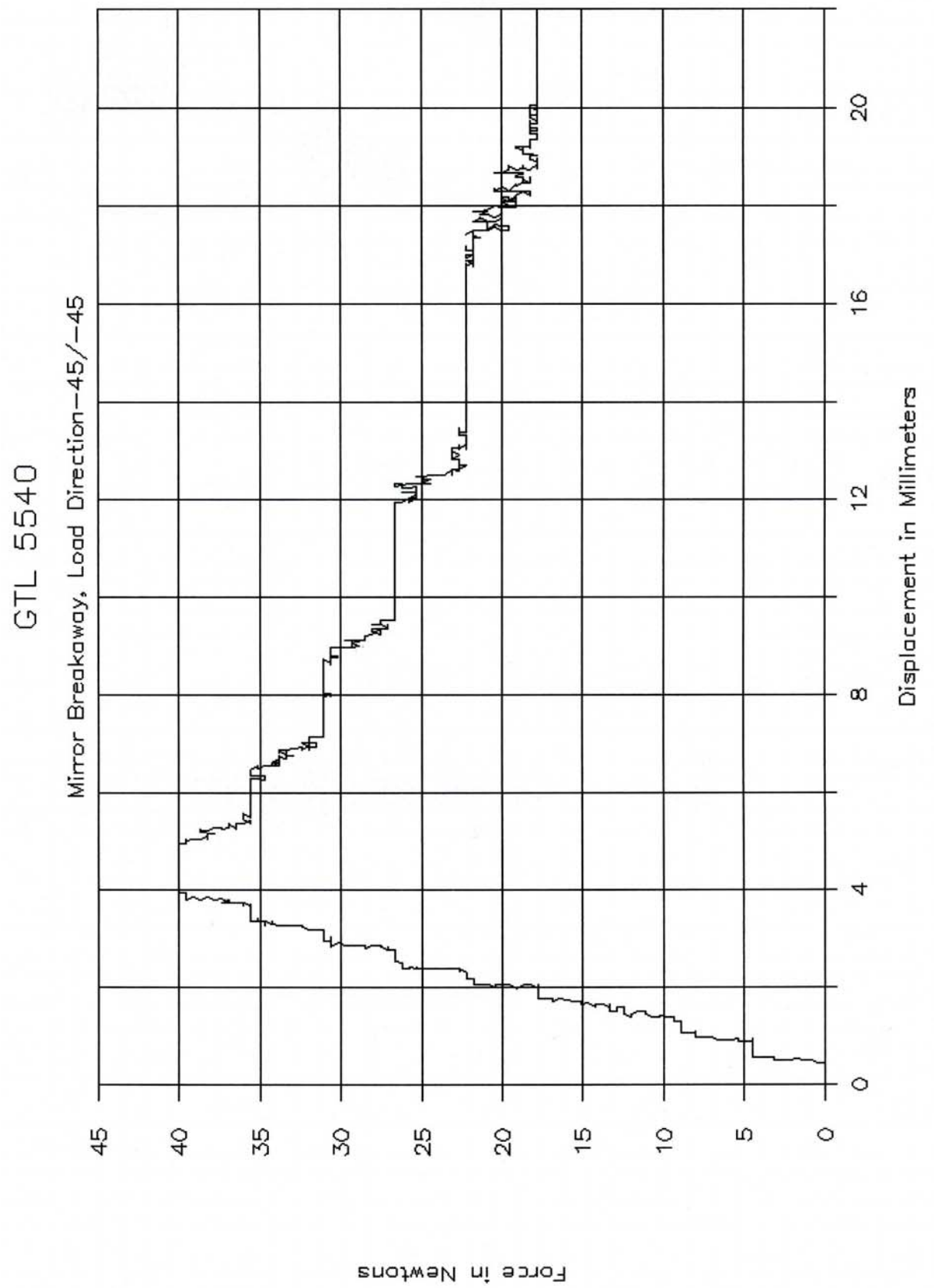
FIGURE 5.16
OUTSIDE MIRROR RIGHT EYE FIELD OF VIEW

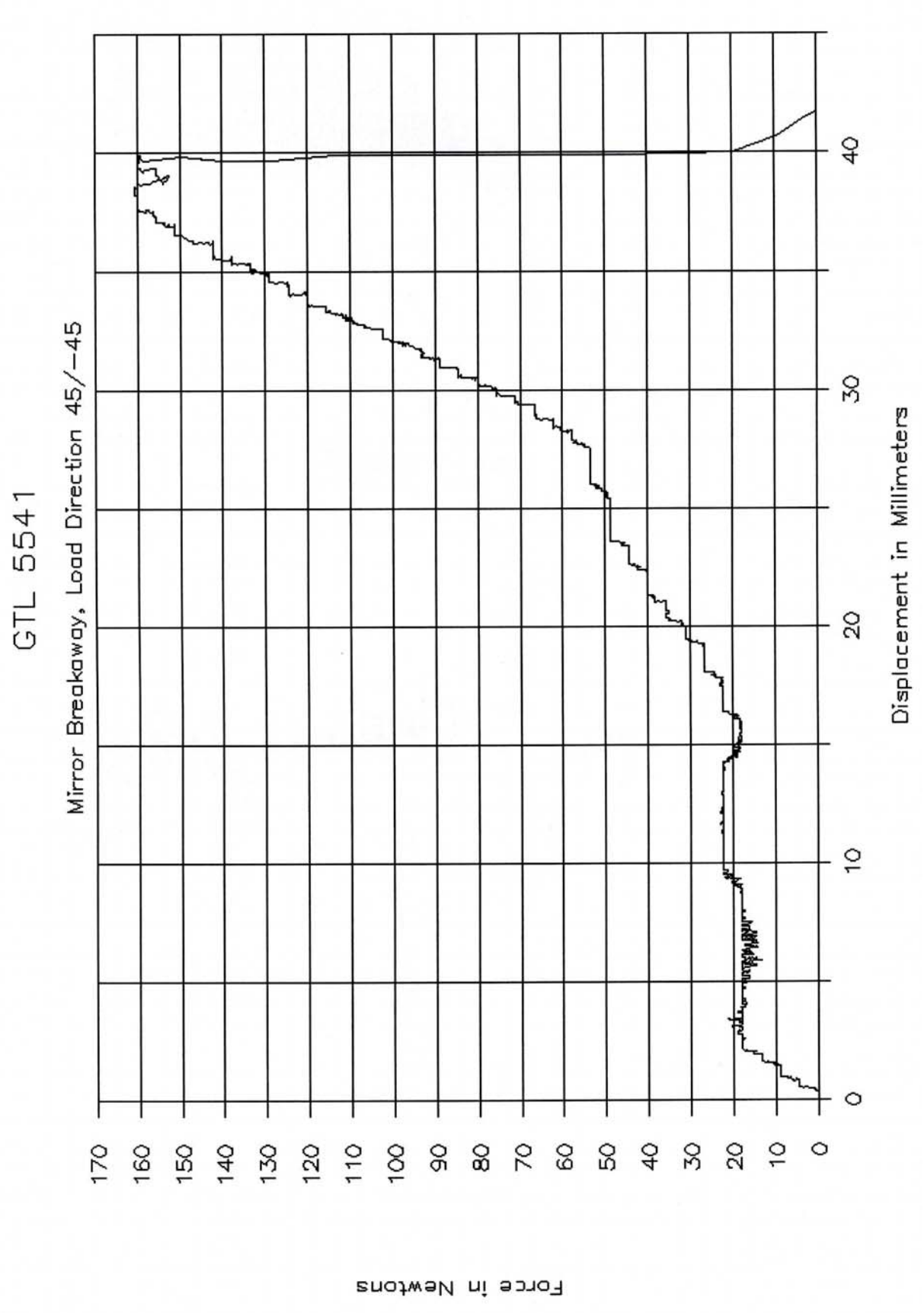
SECTION 6

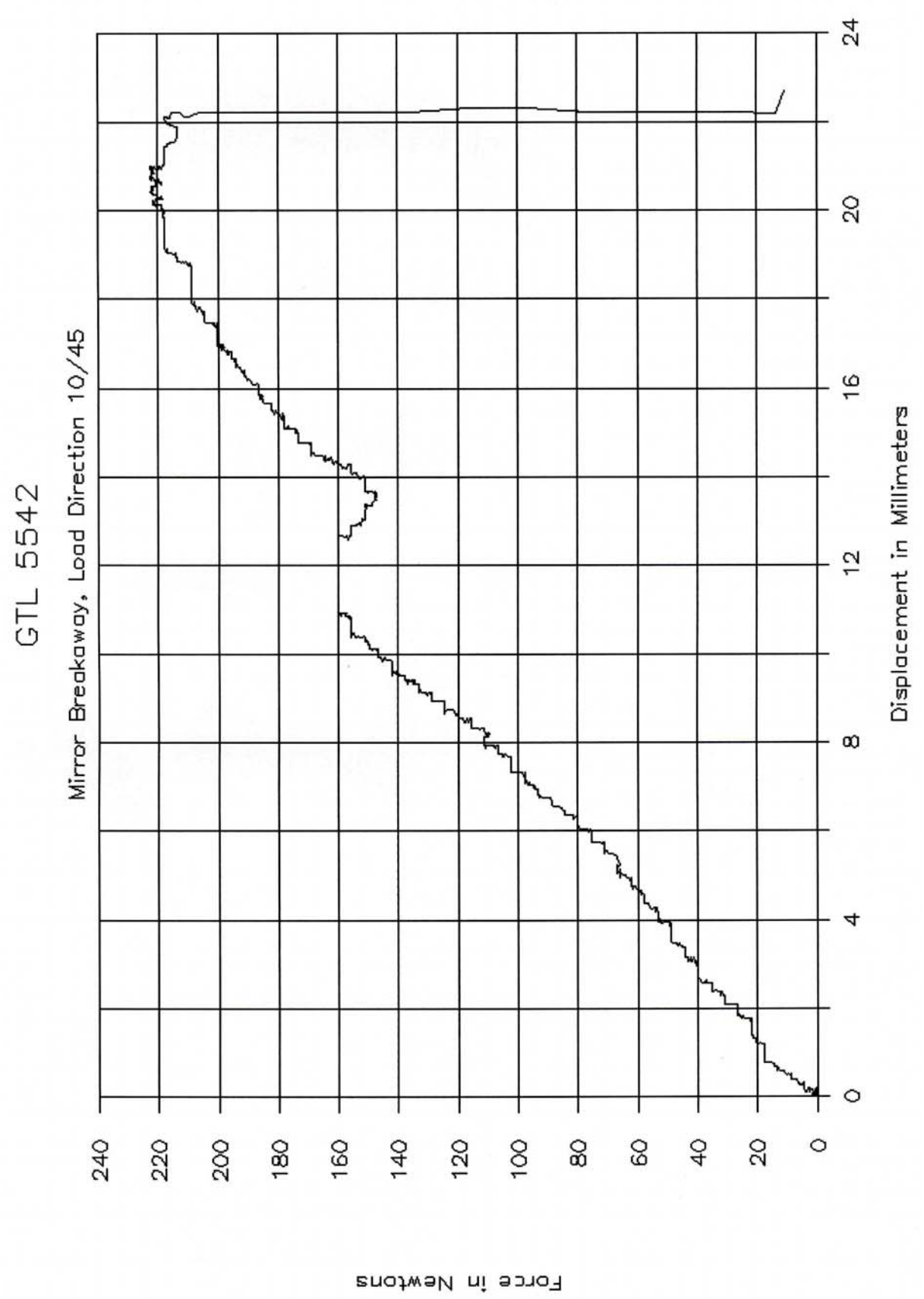
FORCE VS. DISPLACEMENT PLOTS

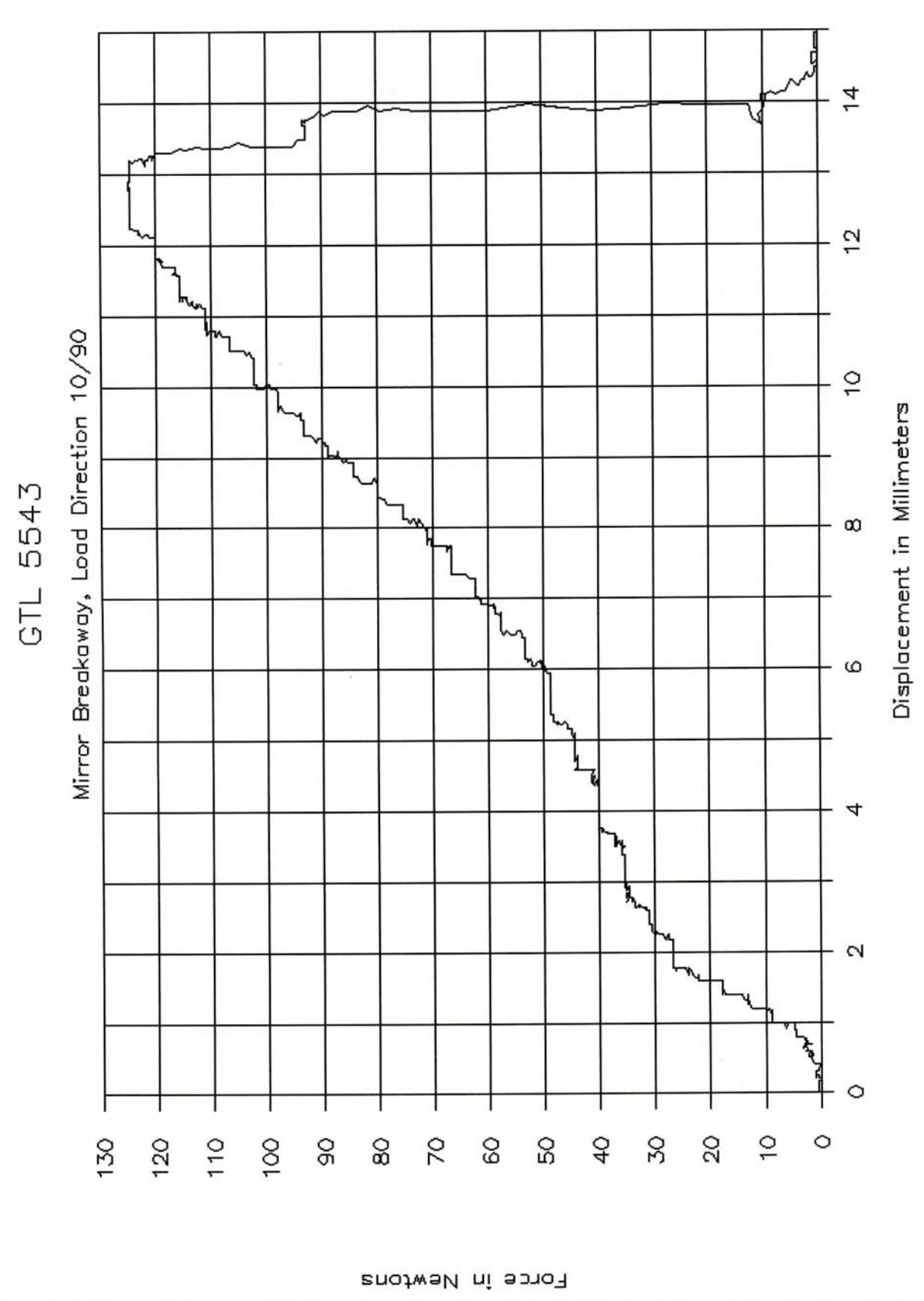

GTL 5538
Mirror Breakaway, Load Direction 0/90
Force in Newtons
Displacement in Millimeters
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-5
5
15
25
35

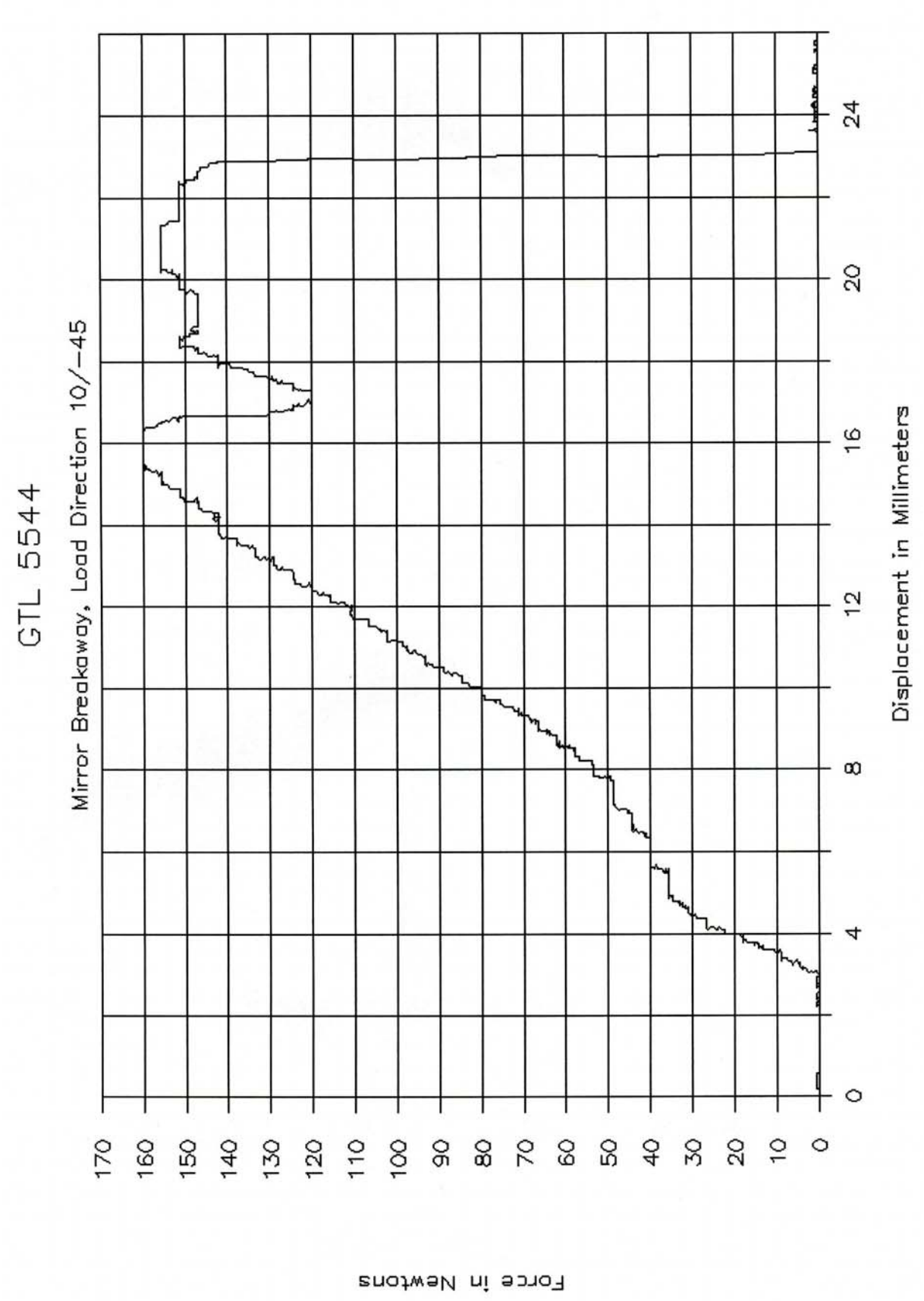

GTL 5539
Mirror Breakaway, Load Direction -45/90
Force in Newtons
Displacement in Millimeters
0
5
10
15
20
25
30
35
40
0
2
4
6
8
10
12
14


GTL 5540
Mirror Breakaway, Load Direction=45/-45
Force in Newtons
Displacement in Millimeters
0
5
10
15
20
25
30
35
40
45
0
4
8
12
16
20


GTL 5541
Mirror Breakaway, Load Direction 45/--45
Force in Newtons
Displacement in Millimeters
0
10
20
30
40
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170


GTL 5542
Mirror Breakaway, Load Direction 10/45
Force in Newtons
Displacement in Millimeters
0
20
40
60
80
100
120
140
160
180
200
220
240
0
4
8
12
16
20
24


GTL 5543
Mirror Breakaway, Load Direction 10/90
Force in Newtons
Displacement in Millimeters
0
10
20
30
40
50
60
70
80
90
100
110
120
130
0
2
4
6
8
10
12
14


GTL 5544
Mirror Breakaway, Load Direction 10/-45
Force in Newtons
Displacement in Millimeters
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
0
4
8
12
16
20
24

SECTION 7

EYE POINT LOCATIONS SUBMITTED BY THE VEHICLE MANUFACTURER

FORM 11
10/11/01

FMVSS 111 EYE POINT LOCATIONS

Make: HYUNDAI Model: Sonata Year: 2006

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 AB@ pillar striker.** (Provide sketch of reference point if necessary.)
REFERENCE POINT : LEFT FRONT SEAT MOUNTING BOLT HOLE CTR OF

THE DRIVER'S SEAT

COORDINATES	LEFT SIDE MIRROR		INSIDE MIRROR		RIGHT SIDE MIRROR	
	LE1 (left eye)	RE1 (right eye)	LE2	RE2	LE3	RE3
X	-346	-346	-346	-346	N/A	N/A
Y	-212	-272	-212	-272	N/A	N/A
Z	895	895	895	895	N/A	N/A
Mirror Mfr., Model Part No.	MURAKAMI USA 87610-0A000		Schefenacker Poong Jeong 85101-27000 : STD (Day/Night) Gentex 85101-0A200 : OPT (HOMELINK/COMPASS)		MURAKAMI USA 87620-0A000	