

**SAFETY COMPLIANCE TESTING FOR
FMVSS NO. 216
ROOF CRUSH RESISTANCE**

**MAZDA MOTOR CORPORATION
2003 MAZDA 6, PASSENGER CAR
NHTSA NO. C35401**

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



JULY 23, 2003

FINAL REPORT

PREPARED FOR

**U. S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
SAFETY ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
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SECTION 1

PURPOSE OF COMPLIANCE TEST

1.0 PURPOSE OF COMPLIANCE TEST

A 2003 Mazda 6 was subjected to Federal Motor Vehicle Safety Standard (FMVSS) No. 216 testing to determine if the vehicle was in compliance with the requirements of the standard. The purpose of this standard is to reduce deaths and injuries due to the crushing of the roof into the occupant compartment in rollover crashes.

1.1 The test vehicle was a 2003 Mazda 6. Nomenclature applicable to the test vehicle are:

A. Vehicle Identification Number: 1YVFP80C335M20688

B. NHTSA No.: C35401

C. Manufacturer: MAZDA MOTOR CORPORATION

D. Manufacture Date: 01/03

1.2 TEST DATE

The test vehicle was subjected to FMVSS No. 216 testing on July 11, 2003.

SECTION 2

COMPLIANCE TEST RESULTS SUMMARY

2.0 TEST RESULTS

All tests were conducted in accordance with NHTSA, Office of Vehicle Safety Compliance (OVSC) Laboratory Procedure, TP-216-05 and General Testing Laboratories Procedure, TP-216-05B with the following modifications requested by the COTR:

- 1) The vehicle was rigidly mounted in the test fixture by welding vertical supports to the vehicle jack points to prevent any vehicle movement. Chains were not used in an effort to reduce and/or eliminate "pre-stressing" of the vehicle due to the tightening of chains.
- 2) Dial gauges were placed at the vehicle corners and at the passenger door to track overall vehicle motion and the ability of the alternate tie-down procedure to restrict motion of the vehicle.
- 3) String potentiometers were placed at the driver's designated seat position and attached to the interior surface of the roof above a normally positioned 50th percentile Hybrid III ATD head. The string potentiometers tracked the interior motion of the roof.
- 4) Performed the roof crush test to a loading ram displacement of 127 mm or 44,482 N force, whichever comes first.

The data for this portion of the test can be found on Data Sheets 6 and 7.

Based on the test performed, the 2003 Mazda 6 appears to meet the requirements of FMVSS 216 testing.

SECTION 3
COMPLIANCE TEST DATA

3.0 TEST RESULTS

The following data sheets document the results of testing on the 2003 Mazda 6.

DATA SHEET 1
FMVSS 216
SUMMARY OF RESULTS

VEH. MOD YR/MAKE/MODEL/BODY: 2003 MAZDA 6 PASSENGER CAR
VEH. NHTSA NO: C35401; VIN: 1YVFP80C335M20688
VEH. BUILD DATE: 01/03; TEST DATE: JULY 11, 2003
TEST LABORATORY: GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE, AMANDA PRESCOTT

A. VISUAL INSPECTION OF TEST VEHICLE

Upon receipt, inspect vehicle for completeness, function, and discrepancies or damage which might influence the testing.

RESULTS:

B. VEHICLE DATA

- (1) Vehicle type as shown on certification label: Passenger Car
- (2) Vehicle UVW as recorded on Data Table 2: 1421 kg

C. STATIC LOAD TEST OF DRIVER SIDE OF ROOF

Minimum roof crush resistance required by FMVSS 216 for the vehicle tested:

MCCR as recorded on Data Table 2: 20,889 N

	PASS	FAIL
Maximum roof crush resistance measured during test was <u>47,563</u> N at <u>67.3</u> mm	<u>X</u>

D. POST TEST VISUAL INSPECTION

Flattened area above driver's side front door approximately 600mm long x 150 mm wide and pushed down 20 mm. Small dent above driver side rear door approximately 300 mm long x 150 mm wide and pushed down 4 mm. Windshield glass has multiple cracks but is still intact. All doors and side glass windows still operate.

RESULTS:

REMARKS:

RECORDED BY: [Signature]
APPROVED BY: [Signature]

DATE: 07/11/03

DATA SHEET 2
FMVSS 216
RECEIVING INSPECTION

VEH. MOD YR/MAKE/MODEL/BODY: 2003 MAZDA 6 PASSENGER CAR
VEH. NHTSA NO: C35401; VIN: 1YVFP80C335M20688
VEH. BUILD DATE: 01/03; TEST DATE: JULY 11, 2003
TEST LABORATORY: GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE, AMANDA PRESCOTT

Upon receipt, the vehicle will be examined visually for completeness, function, and damage. The roof and supporting structures such as the doors and windows should be checked for proper operation and any discrepancies which may influence the testing. The vehicle will be weighed and the minimum roof crush resistance determined.

RESULTS:

(1) Unloaded Vehicle Weight (UVW)

Left Front	<u>432</u>	kg	Left Rear	<u>286</u>	kg
Right Front	<u>418</u>	kg	Right Rear	<u>285</u>	kg
Front Axle	<u>850</u>	kg	Rear Axle	<u>571</u>	kg
TOTAL UVW			<u>1421</u>	kg	

(2) Vehicle type as shown on vehicle certification label: Passenger Car

(3) Minimum Roof Crush Resistance (MCRR):

Passenger Car:

$UVW \times 1.5 \times 9.8 = \underline{20,889} \text{ N}$
 $MCRR = \underline{20,889} \text{ N (UVW} \times 1.5 \times 9.8 \text{ or } 22,241 \text{ N whichever is less)}$

MPV, Truck or Bus:

$MCRR = UVW \times 1.5 \times 9.8 = \underline{N/A} \text{ N}$

(4) Other Comments: _____

REMARKS:

RECORDED BY: [Signature]
APPROVED BY: [Signature]

DATE: 07/11/03

DATA SHEET 3
FMVSS 216
PRE-TEST PREPARATION

VEH. MOD YR/MAKE/MODEL/BODY: 2003 MAZDA 6 PASSENGER CAR
VEH. NHTSA NO: C35401; VIN: 1YVFP80C335M20688
VEH. BUILD DATE: 01/03; TEST DATE: JULY 11, 2003
TEST LABORATORY: GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE, AMANDA PRESCOTT

Prior to testing, the following will be accomplished:

- A. Secure any convertible top, movable or removable roof structure in their weather tight positions OK
- B. Close all windows OK
- C. Close and lock all doors OK
- D. State Side of Roof Tested Driver
- E. Measure the lateral angle of the test device at sufficient points to determine that it has a 25 degree (plus zero degree, minus one degree) angle 25°
- F. Measure the longitudinal angle of the loading device at sufficient points to determine that it has a 5 degree (plus zero minutes, minus 20 minutes) 5°
- G. The test device will initially contact the roof at 365 mm aft of windshield
- H. If the test device was relocated based on the requirements of Chapter 12.3 paragraph F, describe where the test device will initially contact the roof as relocated N/A
- I. Ambient temperature 51 mm from the vehicle roof in the immediate area of the test device: 26.1 degrees C.

REMARKS:

RECORDED BY: [Signature]
APPROVED BY: [Signature]

DATE: 07/11/03

DATA SHEET 4
FMVSS 216

VEH. MOD YR/MAKE/MODEL/BODY: 2003 MAZDA 6 PASSENGER CAR
VEH. NHTSA NO: C35401; VIN: 1YVFP80C335M20888
VEH. BUILD DATE: 01/03; TEST DATE: JULY 11, 2003
TEST LABORATORY: GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE, AMANDA PRESCOTT

RESULTS: Plots of load versus displacement and time versus displacement showed that:

- (1) The maximum roof crush resistance was 47,563 N at 67.3 mm
- (2) The rate of loading was 5.08 mm/sec (.2 in/sec)
- (3) The required roof crush resistance of 20,889 N was at 24.6 mm

REMARKS:

RECORDED BY: *G. Farrand*
APPROVED BY: *D. Prescott*

DATE: 07/11/03

DATA SHEET 5
FMVSS 216
POST TEST VISUAL INSPECTION

VEH. MOD YR/MAKE/MODEL/BODY: 2003 MAZDA 6 PASSENGER CAR
VEH. NHTSA NO: C35401; VIN: 1YVFP80C335M20688
VEH. BUILD DATE: 01/03; TEST DATE: JULY 11, 2003
TEST LABORATORY: GENERAL TESTING LABORATORIES
OBSERVERS: GRANT FARRAND, JIMMY LATANE, AMANDA PRESCOTT

Upon completion of testing, a detailed visual inspection of the vehicle shall be made. Describe all damage and deformation that occurred during the test.

RESULTS: Flattened area above driver's side front door approximately 600mm long x 150 mm wide and pushed down 20 mm. Small dent above driver side rear door approximately 300 mm long x 150 mm wide and pushed down 4 mm. Windshield glass has multiple cracks but is still intact. All doors and side glass windows still operate.

RECORDED BY: *G. Farrand*
APPROVED BY: *D. Merrick*

DATE: 07/11/03

DATA SHEET 6
FMVSS 216 MODIFIED PORTION PRE-TEST

VEH. MOD YR/MAKE/MODEL/BODY: 2003 MAZDA 6 PASSENGER CAR
 VEH. NHTSA NO: C35401; VIN: 1YVFP80C335M20688
 VEH. BUILD DATE: 01/03; TEST DATE: JULY 11, 2003
 TEST LABORATORY: GENERAL TESTING LABORATORIES
 OBSERVERS: GRANT FARRAND, JIMMY LATANE, AMANDA PRESCOTT

Driver Seat Torso Angle: 20°

Driver Seat "H" Point Location at Mid Travel:

X= 217 mm aft from centerline of front outboard seat mounting bolt
 Y= 224 mm inboard from centerline of front outboard seat mounting bolt
 Z= 212 mm up from centerline of front outboard seat mounting bolt

Point VRL (Vertical Measurement from H-Point to Headliner): 853 mm
 Point VRi (Vertical Measurement from H-Point to Structure above Headliner): 894 mm
 Point RE (Distance from H-Point to a point 112mm behind point VRi): 914 mm

#1 LVDT (R.F.) Length: 910 mm
 #2 LVDT (R.R.) Length: 877 mm
 #3 LVDT (L.R.) Length: 880 mm

Distance from LVDT #1 (R.F.) to LVDT #2 (R.R.) = 270 mm
 Distance from LVDT #2 (R.R.) to LVDT #3 (L.R.) = 250 mm
 Distance from LVDT #1 (R.F.) to LVDT #3 (L.R.) = 370 mm

All LVDT's are located on a 185 mm radius from a vertical line passing through the seat "H" point. Using the forward direction as 0° reference and measuring clockwise, LVDT #1 is located at 43°, LVDT #2 is located at 137° and LVDT #3 is located at 222°.

NOTES:

RECORDED BY: *G. Farrand*
 APPROVED BY: *D. Manica*

DATE: 07/11/03

SECTION 4
INSTRUMENTATION AND EQUIPMENT LIST

TABLE 1 - INSTRUMENTATION & EQUIPMENT LIST

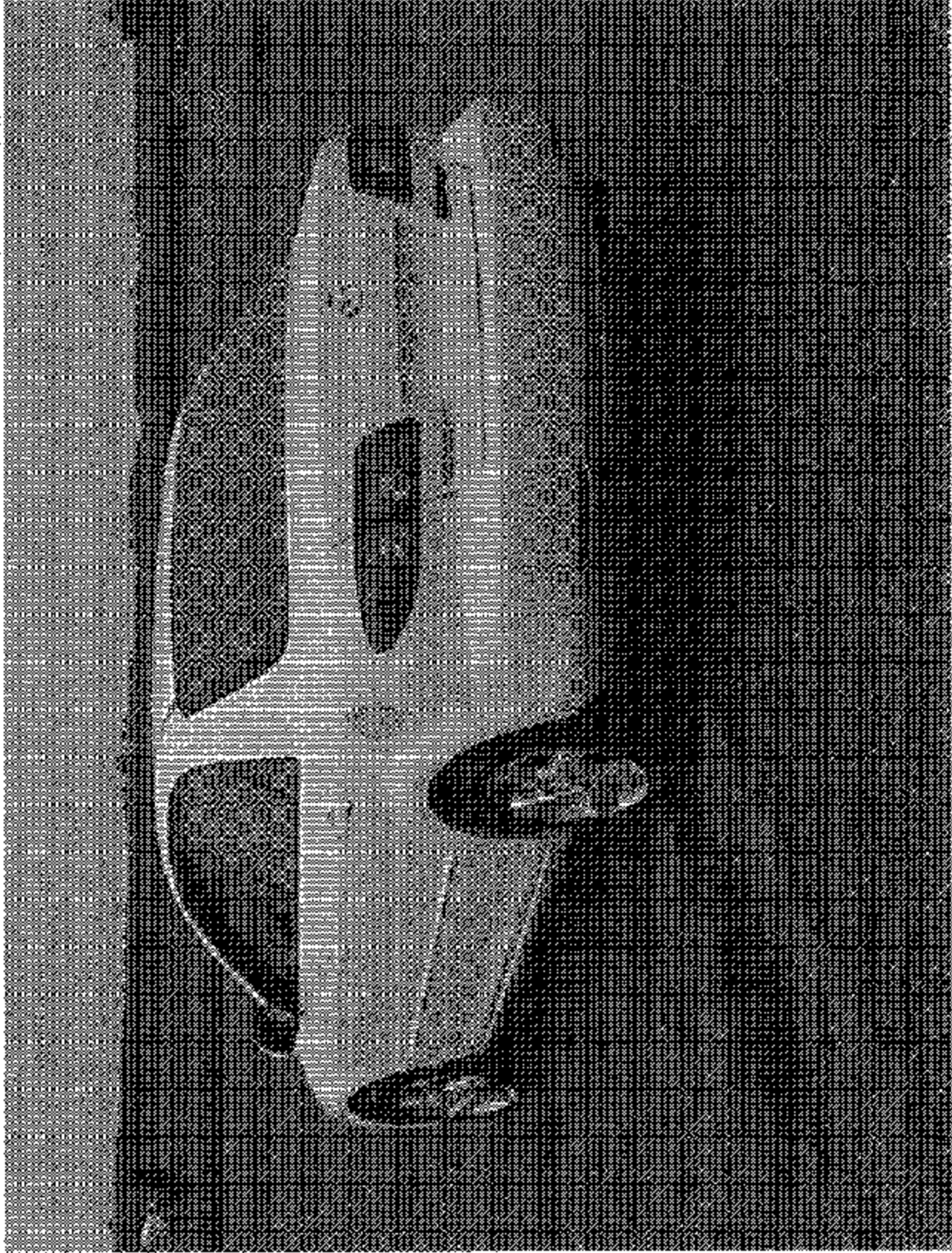
EQUIPMENT	DESCRIPTION	MODEL/ SERIAL NO.	CAL. DATE	NEXT CAL. DATE
COMPUTER	AT&T	486D66	BEFORE USE	BEFORE USE
TEST FIXTURE	GTL	N/A	N/A	N/A
A/D INTERFACE	METRABYTE	DAS-16(F)	BEFORE USE	BEFORE USE
SIGNAL CONDITIONER	METRABYTE	EXP-RES	BEFORE USE	BEFORE USE
LOAD CELL	REVERE	USP2/46024	06/03	06/04
DIAL INDICATOR	MITUTOYO	2424-10	BEFORE USE	BEFORE USE
LINEAR POTENTIOMETER	SERVO SYSTEMS	20/69	BEFORE USE	BEFORE USE
LINEAR POTENTIOMETER	SERVO SYSTEMS	20/70	BEFORE USE	BEFORE USE
LINEAR POTENTIOMETER	SERVO SYSTEMS	20/72	BEFORE USE	BEFORE USE
LINEAR POTENTIOMETER	ELECTRIC ASSOC. INC.	11A4A6	BEFORE USE	BEFORE USE

SECTION 5
PHOTOGRAPHS



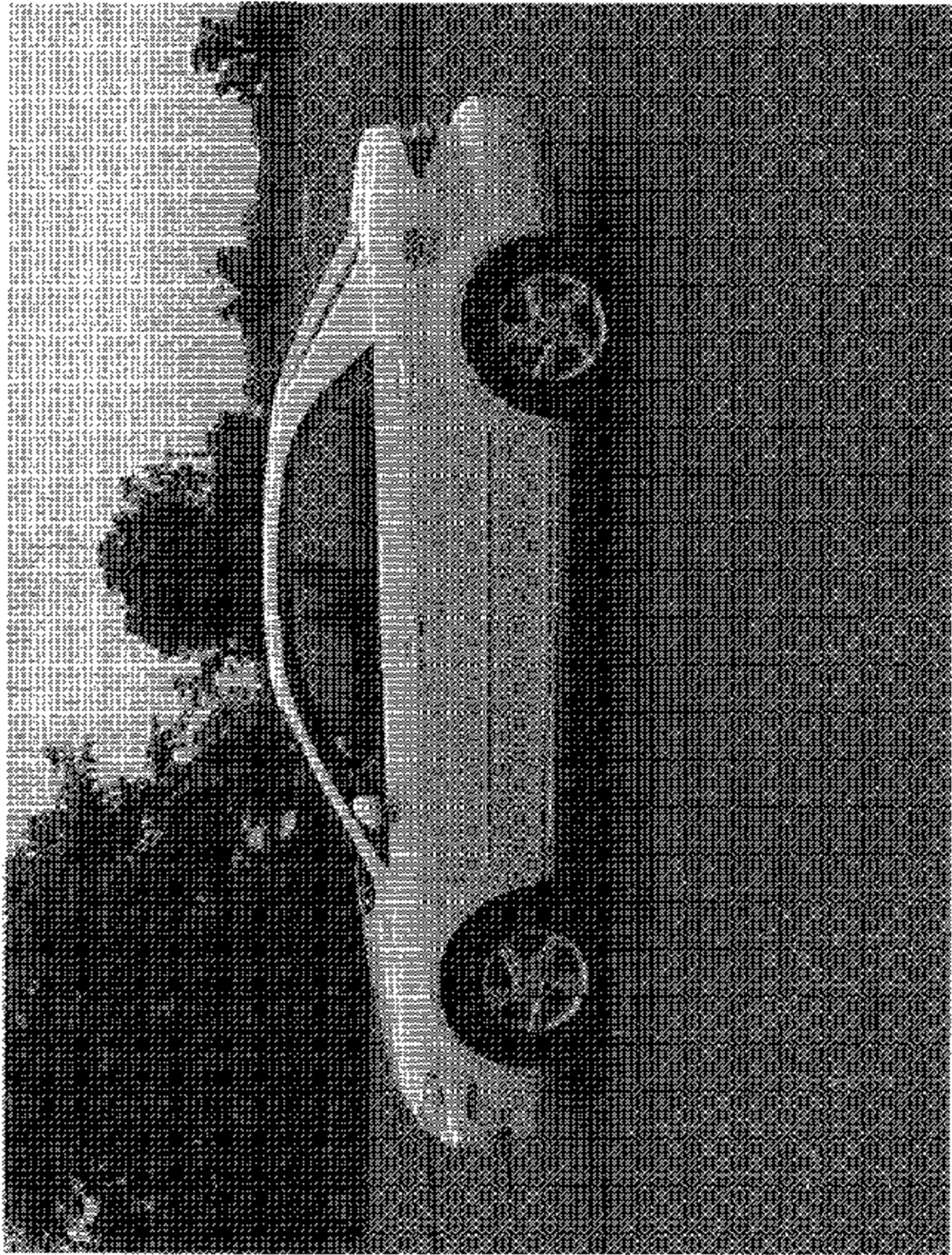
2003 MAZDA 6
NHISA NO. C35401
FMVSS NO. 216

FIGURE 5.1
¾ FORWARD VIEW OF VEHICLE ON TESTED
SIDE BEFORE TESTING



2000 MAZDA 6
NHISA NO. C35401
FMVSS NO. 216

FIGURE 5.2
¾ REARWARD VIEW OF VEHICLE ON TESTED
SIDE BEFORE TESTING



2009 MAZDA 6
NIHSA NO. C35401
FMVSS NO. 216

FIGURE 5.2
LEFT SIDE VIEW OF VEHICLE BEFORE TESTING

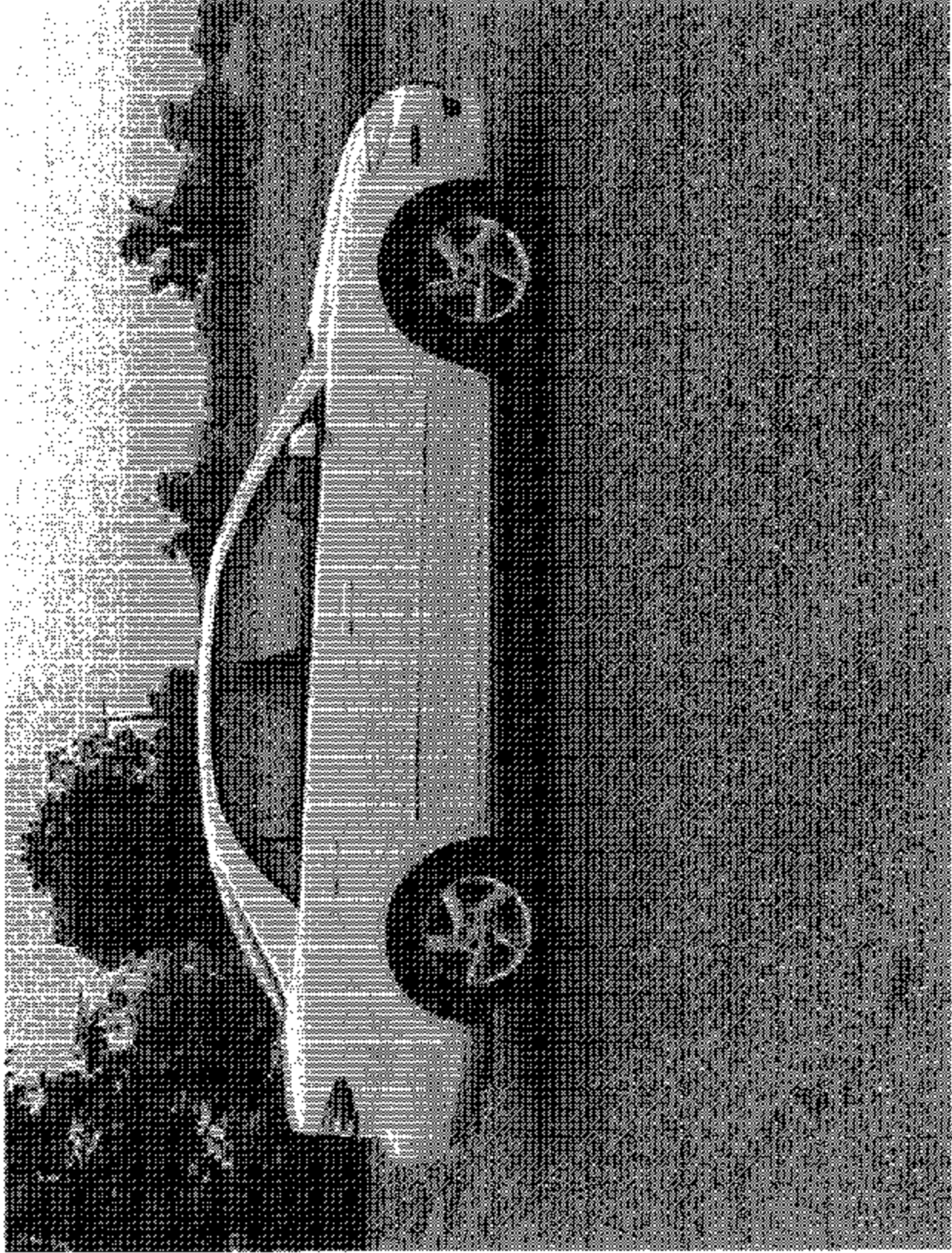
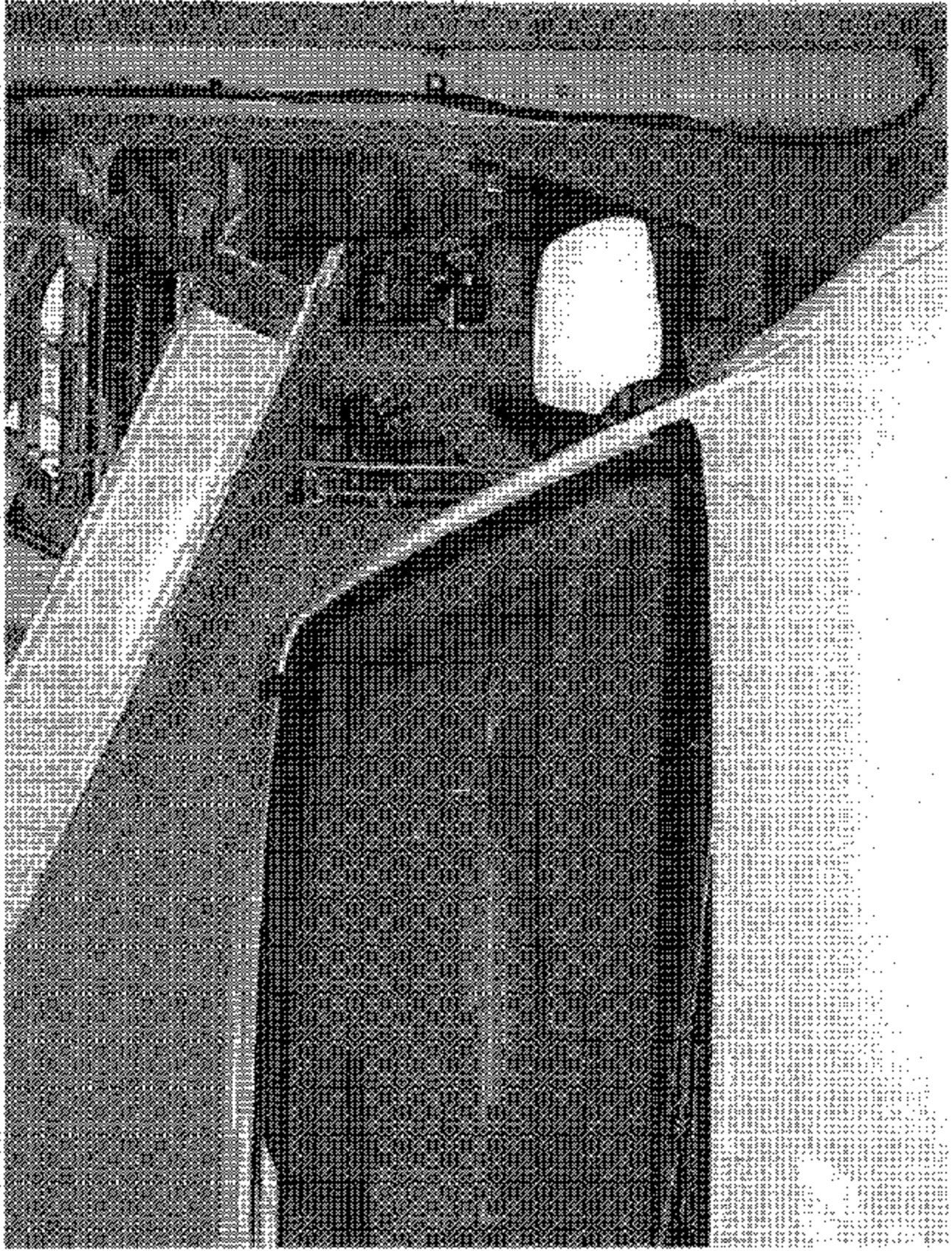


FIGURE 5.4
RIGHT SIDE VIEW OF VEHICLE BEFORE TESTING

2003 MAZDA 6
NHISA NO. C3S401
EMVSS NO. 216



2003 MAZDA 6
NH/SA NO. C35401
FMVSS NO. 216

FIGURE 5.5
FRONT VIEW OF TEST SET-UP PRE-TEST

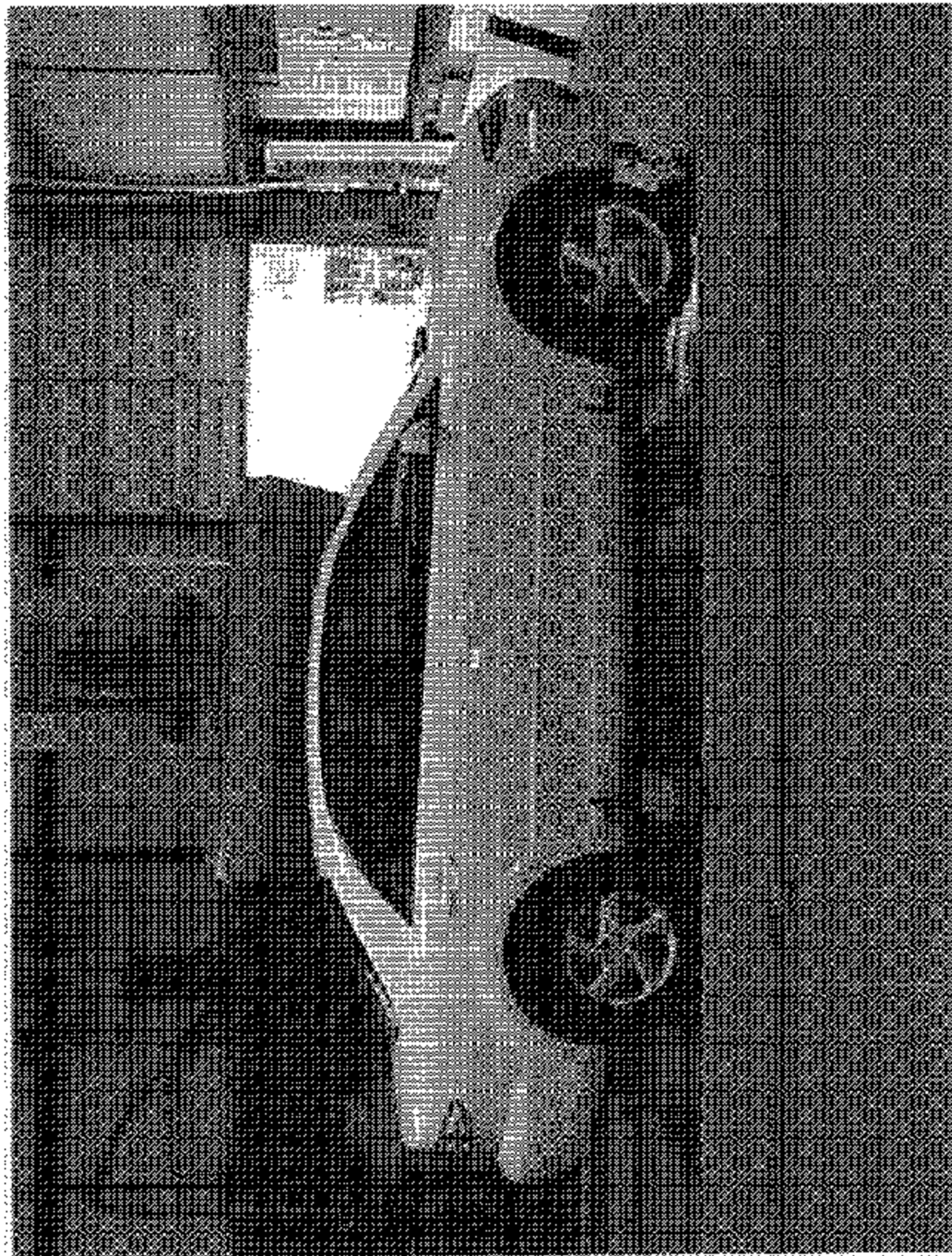
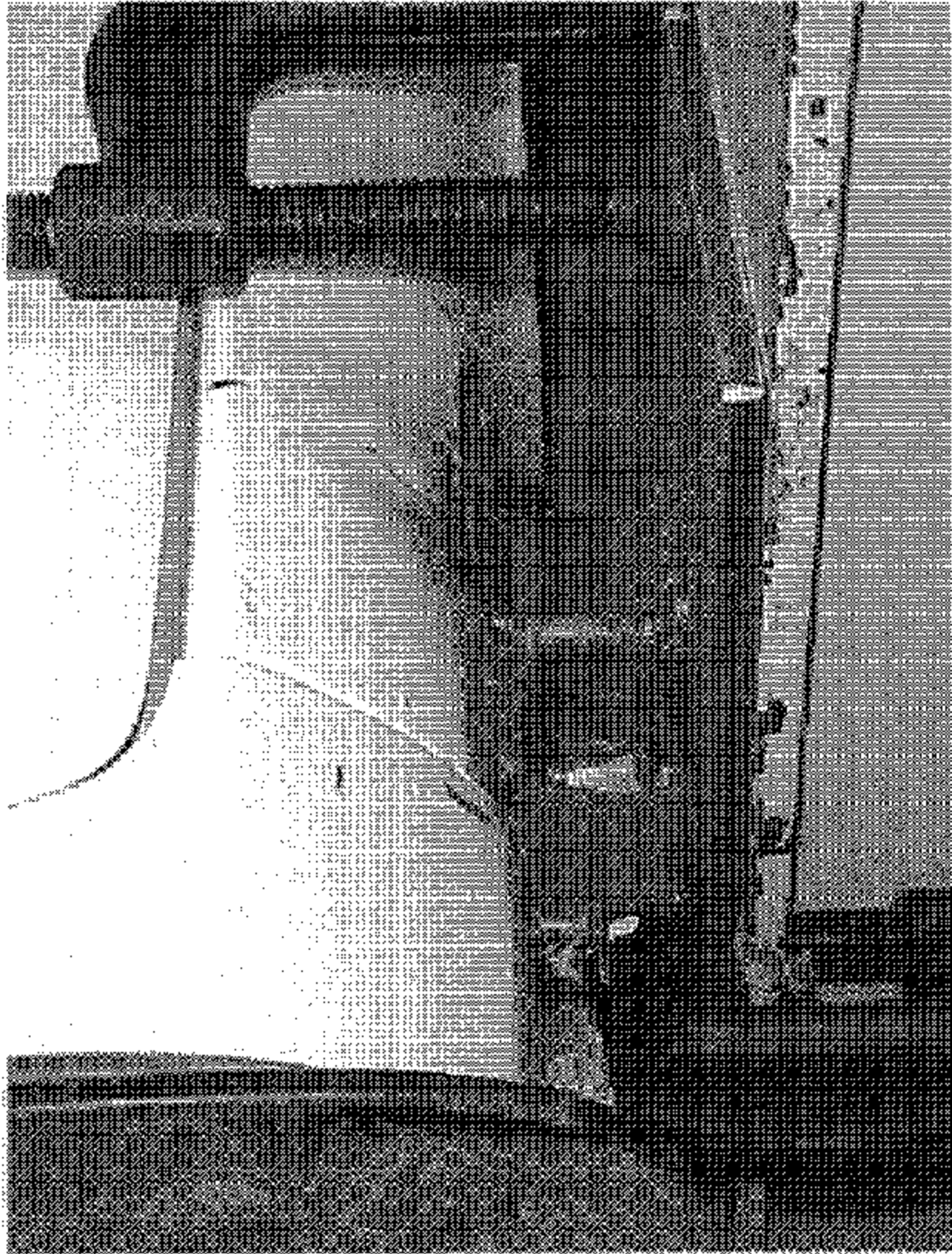


FIGURE 5.6
VEHICLE IN 216 TEST RIG

2003 MAZDA 6
NHISA NO. C35401
FMVSS NO. 216



2003 MAZDA 6
NHTSA NO. C35401
FMVSS NO. 216

FIGURE 5.7
LEFT FRONT VEHICLE MOUNTING



2003 MAZDA 6
NHISA NO. C35401
FMVSS NO. 216

FIGURE 5.8
RIGHT FRONT VEHICLE MOUNTING

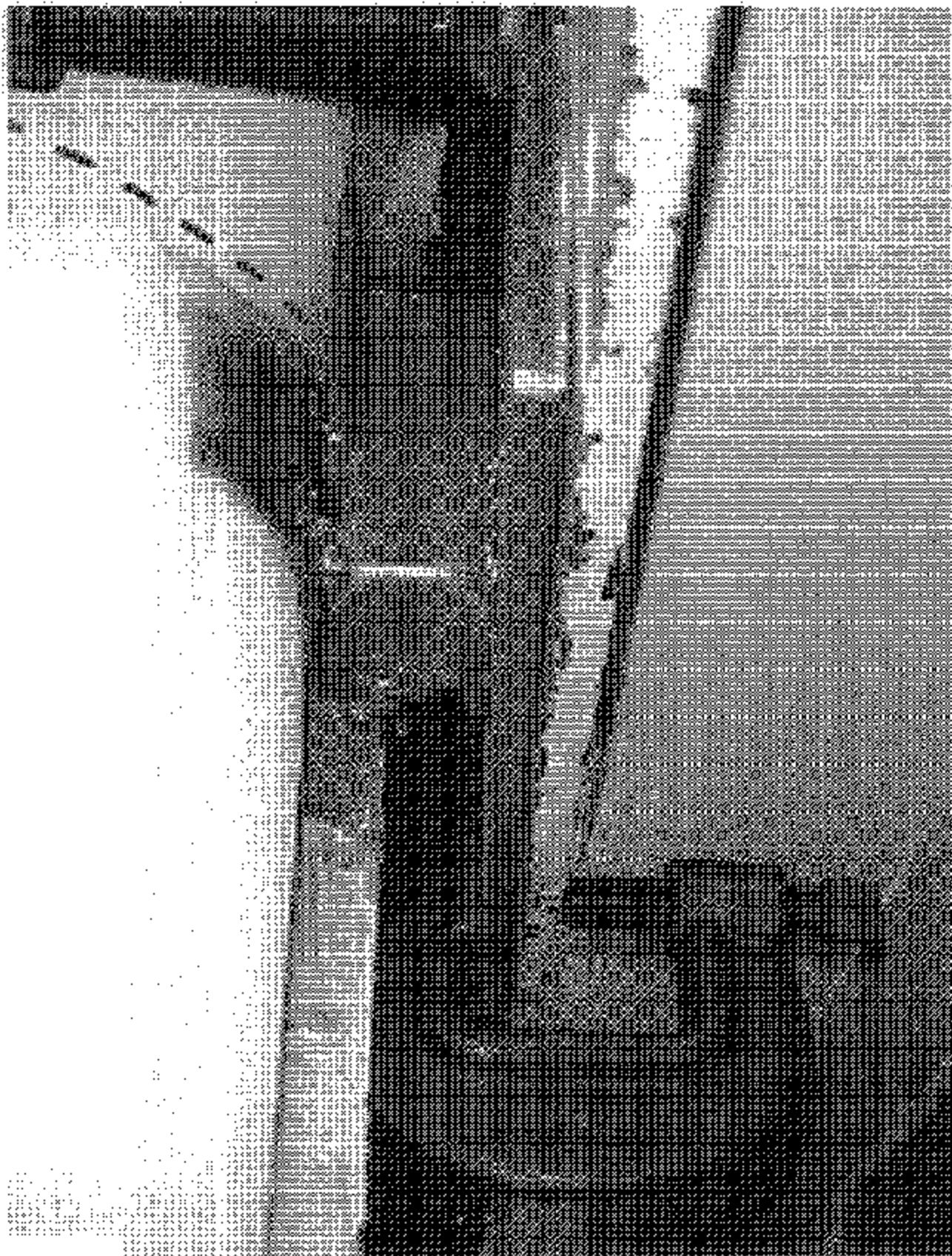


FIGURE 5.9
LEFT REAR VEHICLE MOUNTING

2003 MAZDA 6
NHTSA NO. C35401
FMVSS NO. 216

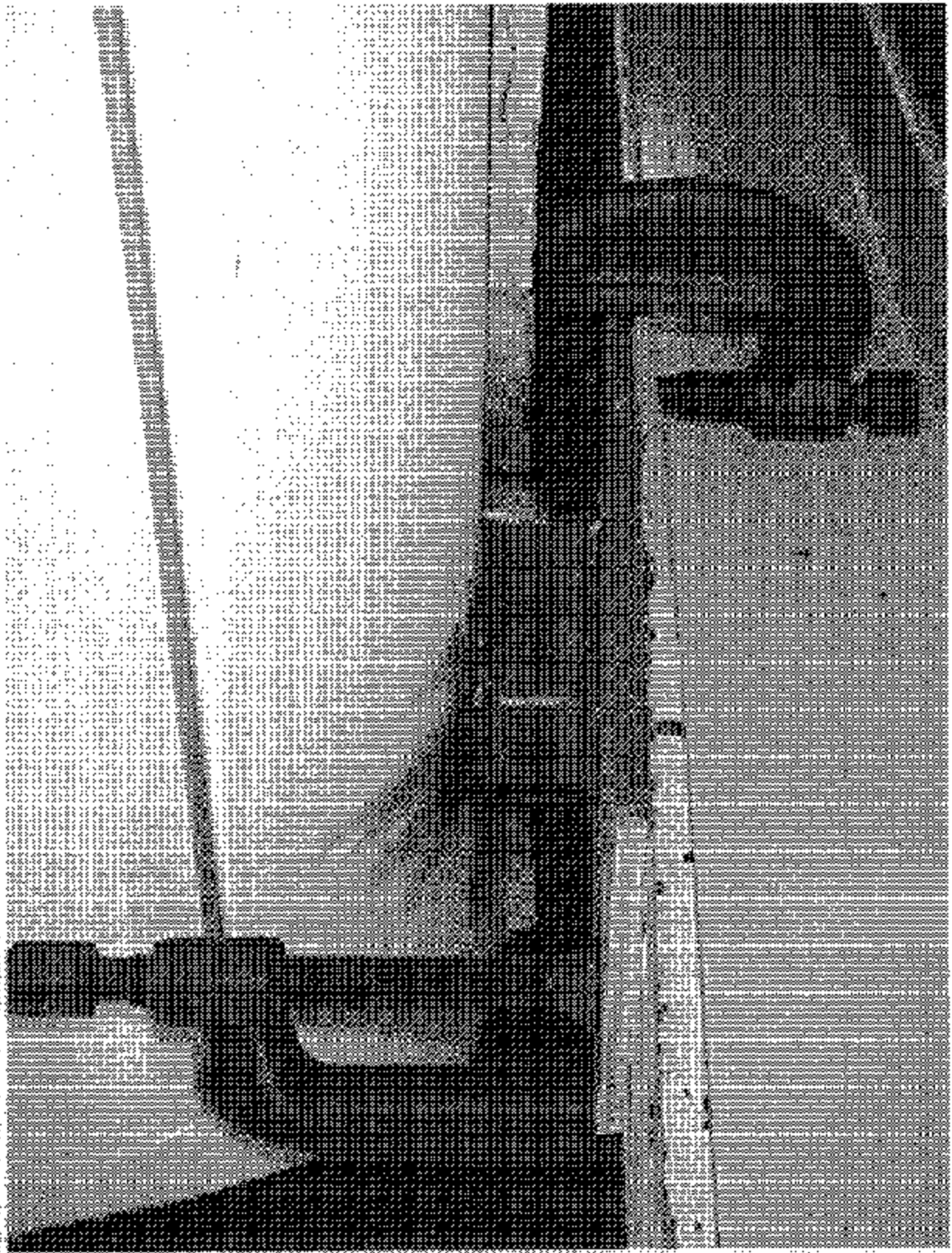
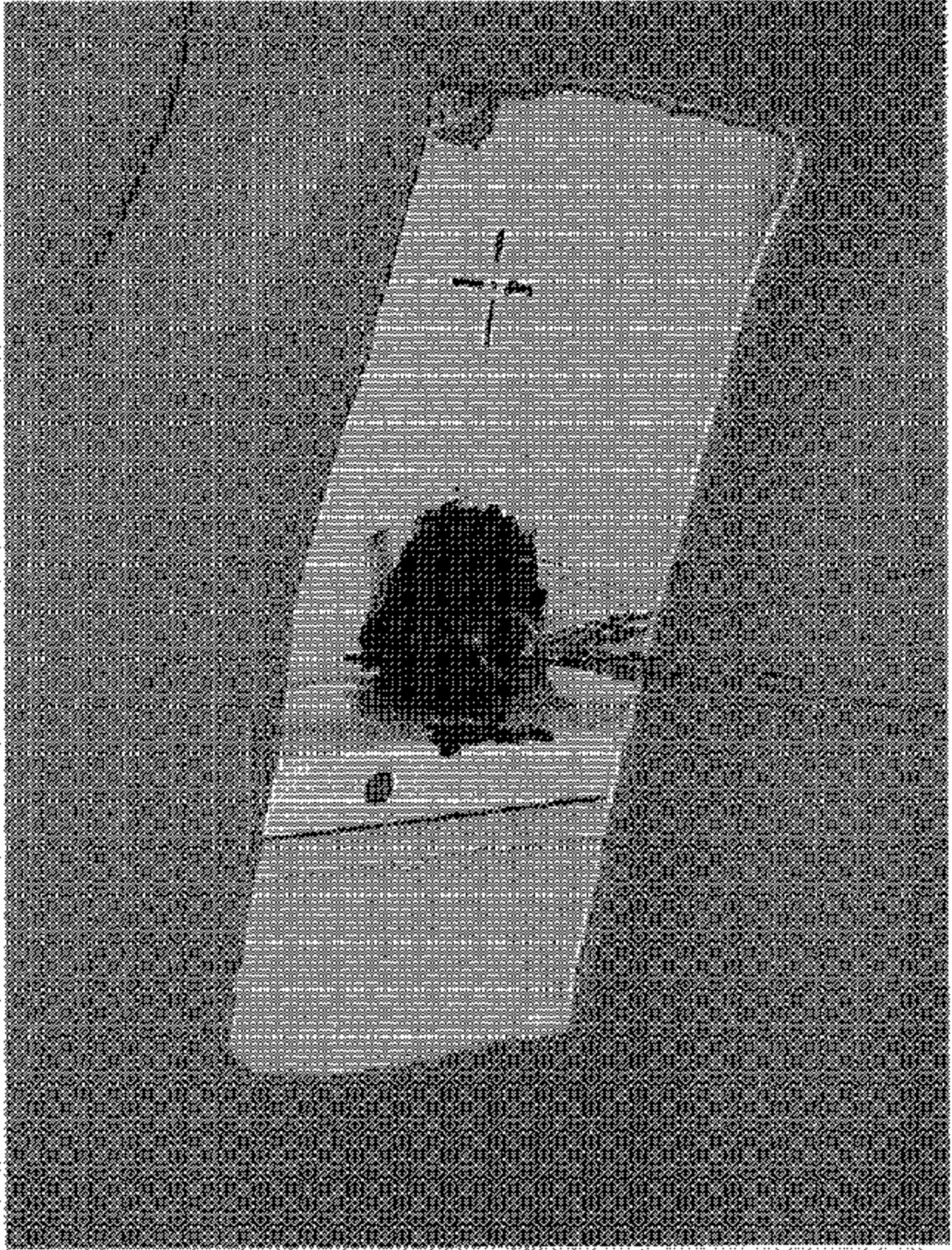


FIGURE 5.10
RIGHT REAR VEHICLE MOUNTING

2005 MAZDA 6
NIJISA NO. C35401
FMVSS NO. 216



2009 MAZDA 6
NHTSA NO. C35401
FMVSS NO. 216

FIGURE 5.11
LVDT DISPLACEMENT MOUNTING TO ROOF

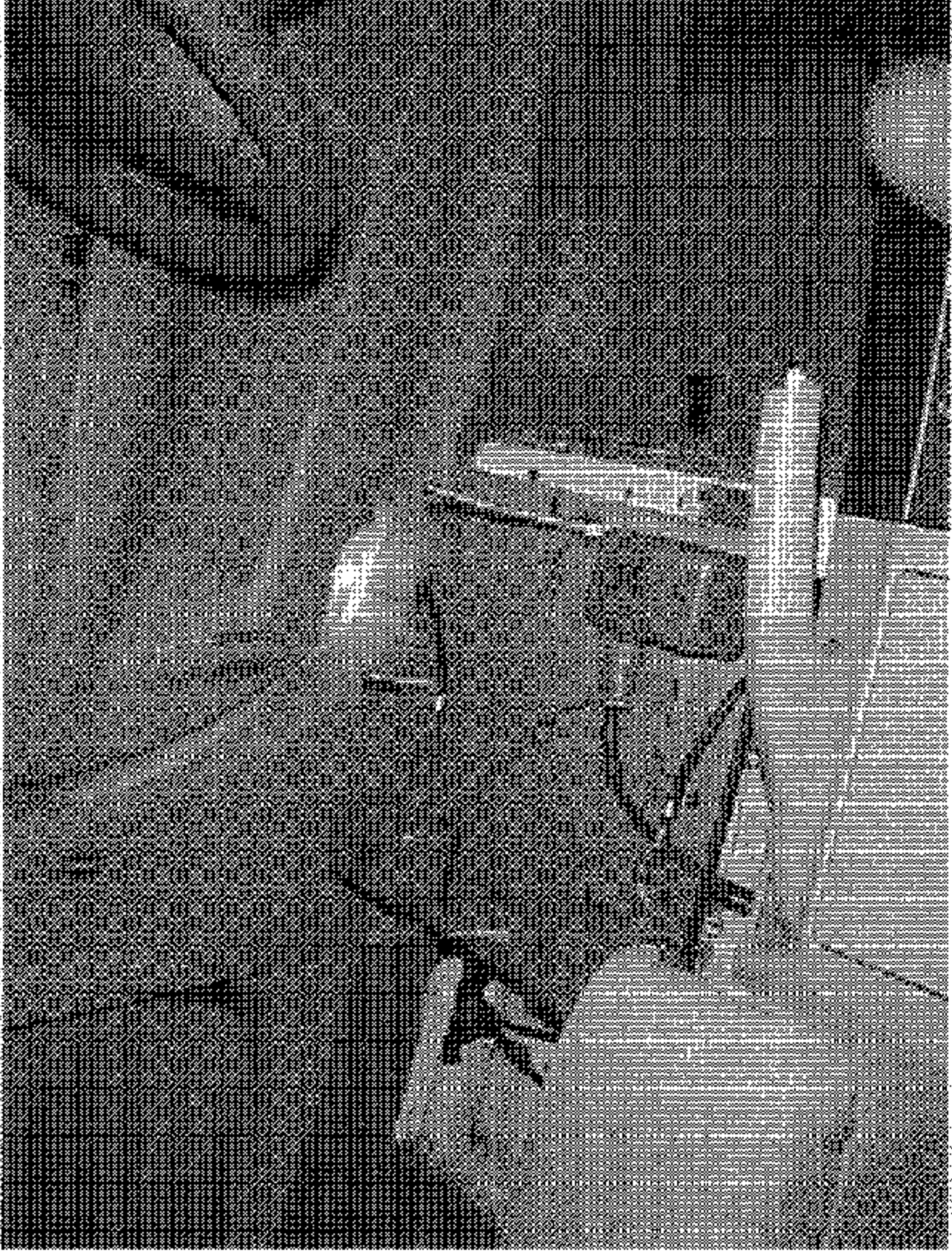
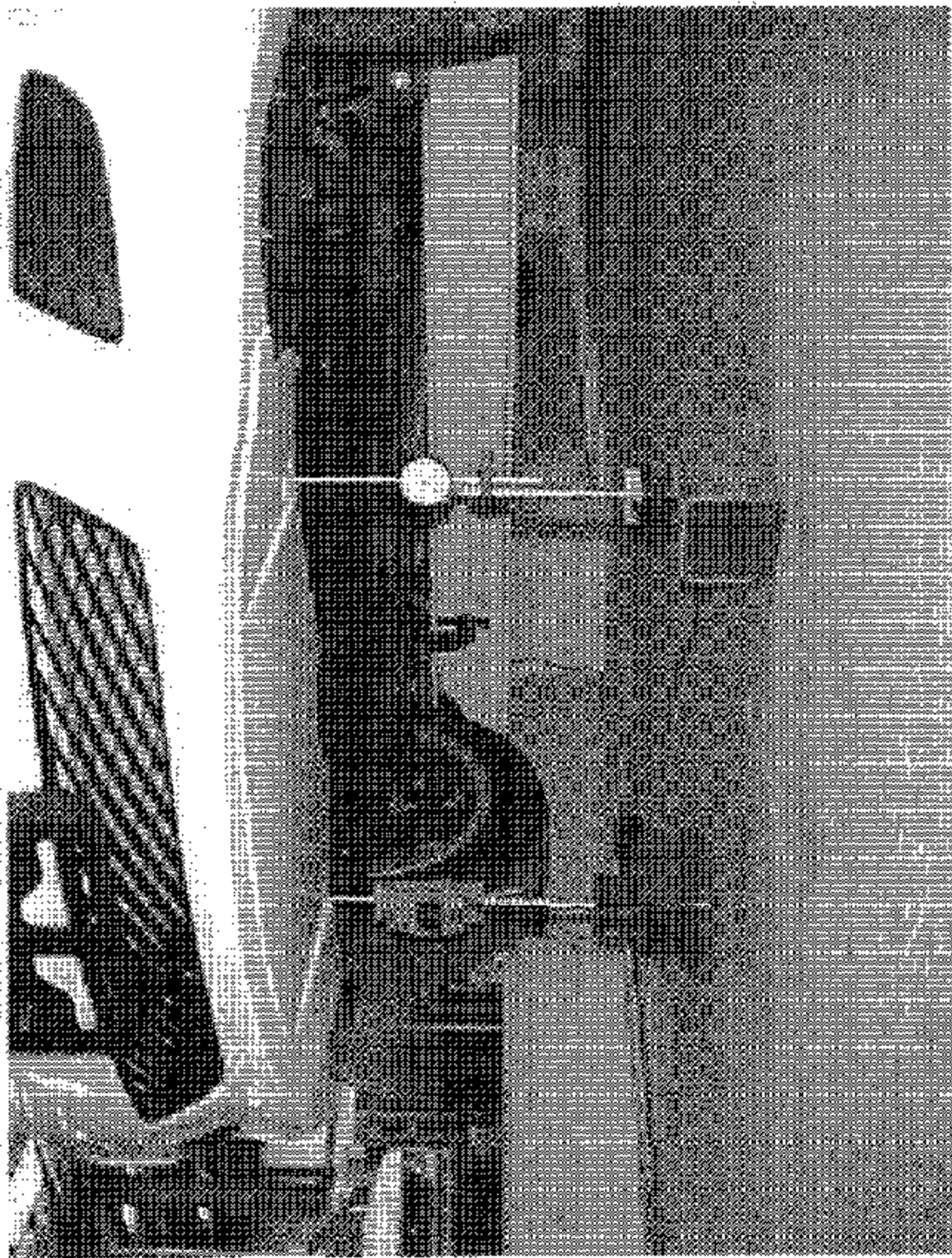


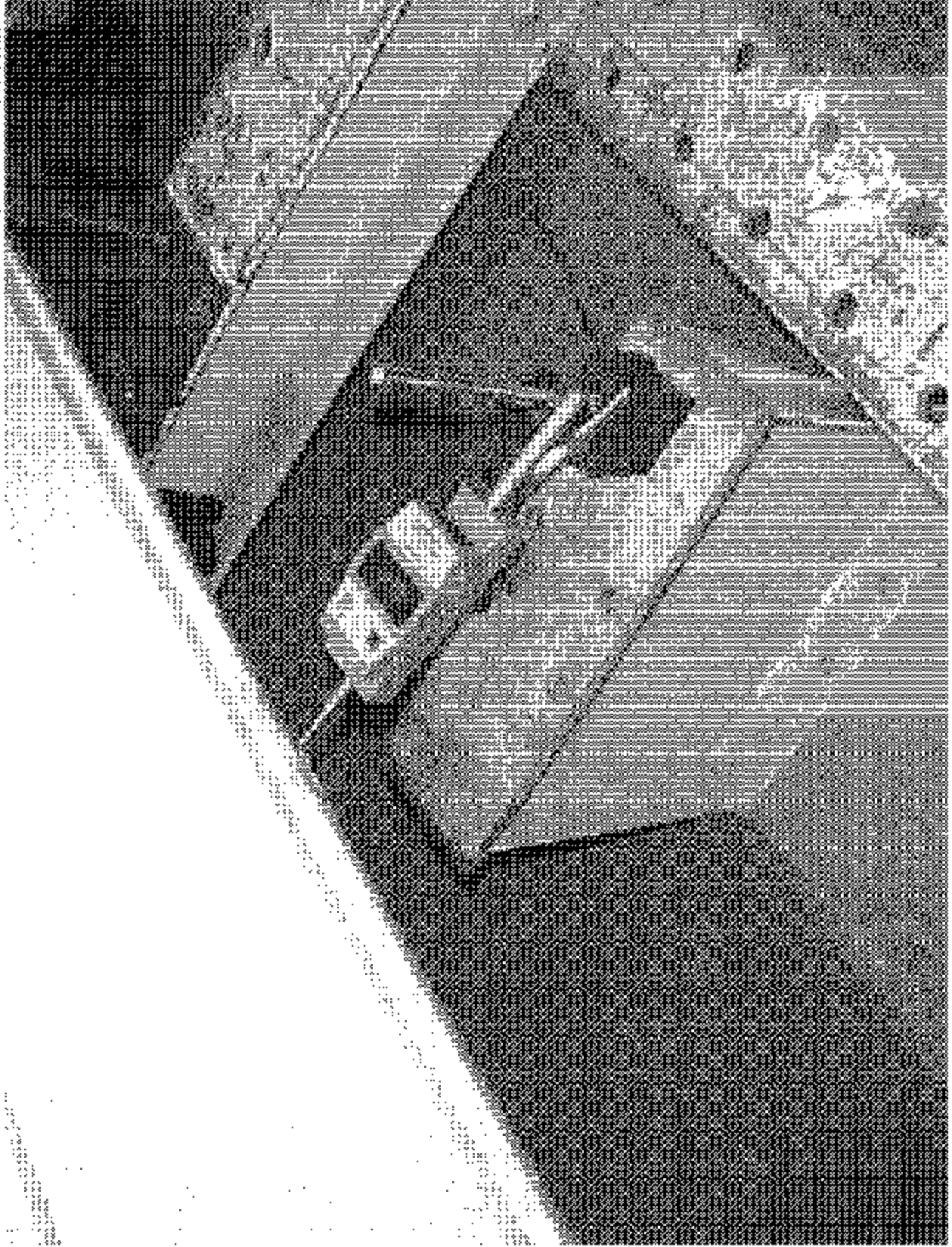
FIGURE 5.12
LVDT TRANSDUCER MOUNTING AT "H" POINT

2003 MAZDA 6
NHISA NO. C35401
FMVSS NO. 216



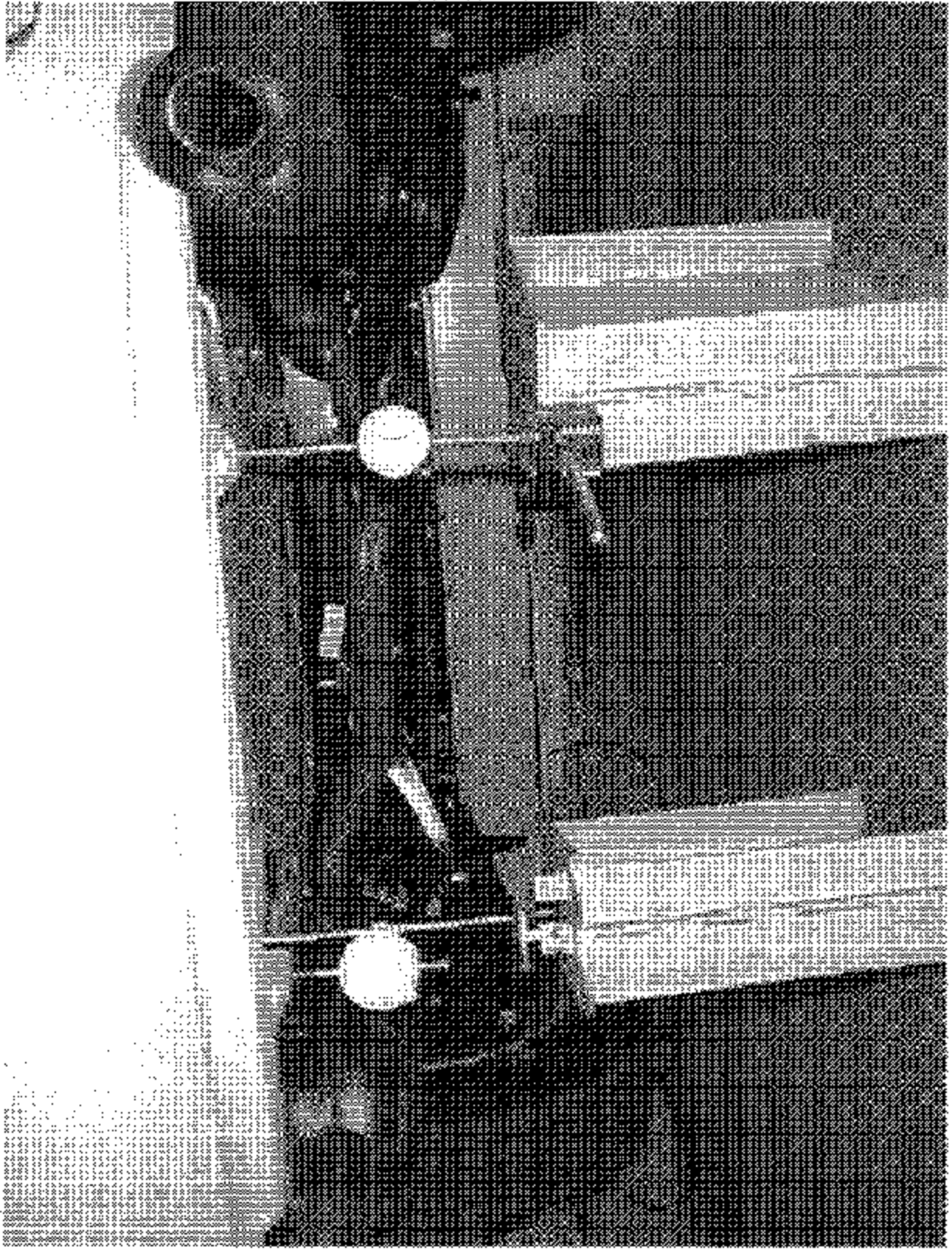
2003 MAZDA 6
NIHTSA NO. C35401
FMVSS NO. 216

FIGURE 5.13
DISPLACEMENT INDICATORS AT FRONT OF
VEHICLE



2003 MAZDA 6
NHTSA NO. C35401
FMVSS NO. 216

FIGURE S.14
DISPLACEMENT INDICATORS AT PASSENGER
DOOR SILL



2003 MAZDA 6
NHTSA NO. C35401
FMVSS NO. 216

FIGURE S.15
DISPLACEMENT INDICATORS AT REAR OF
VEHICLE

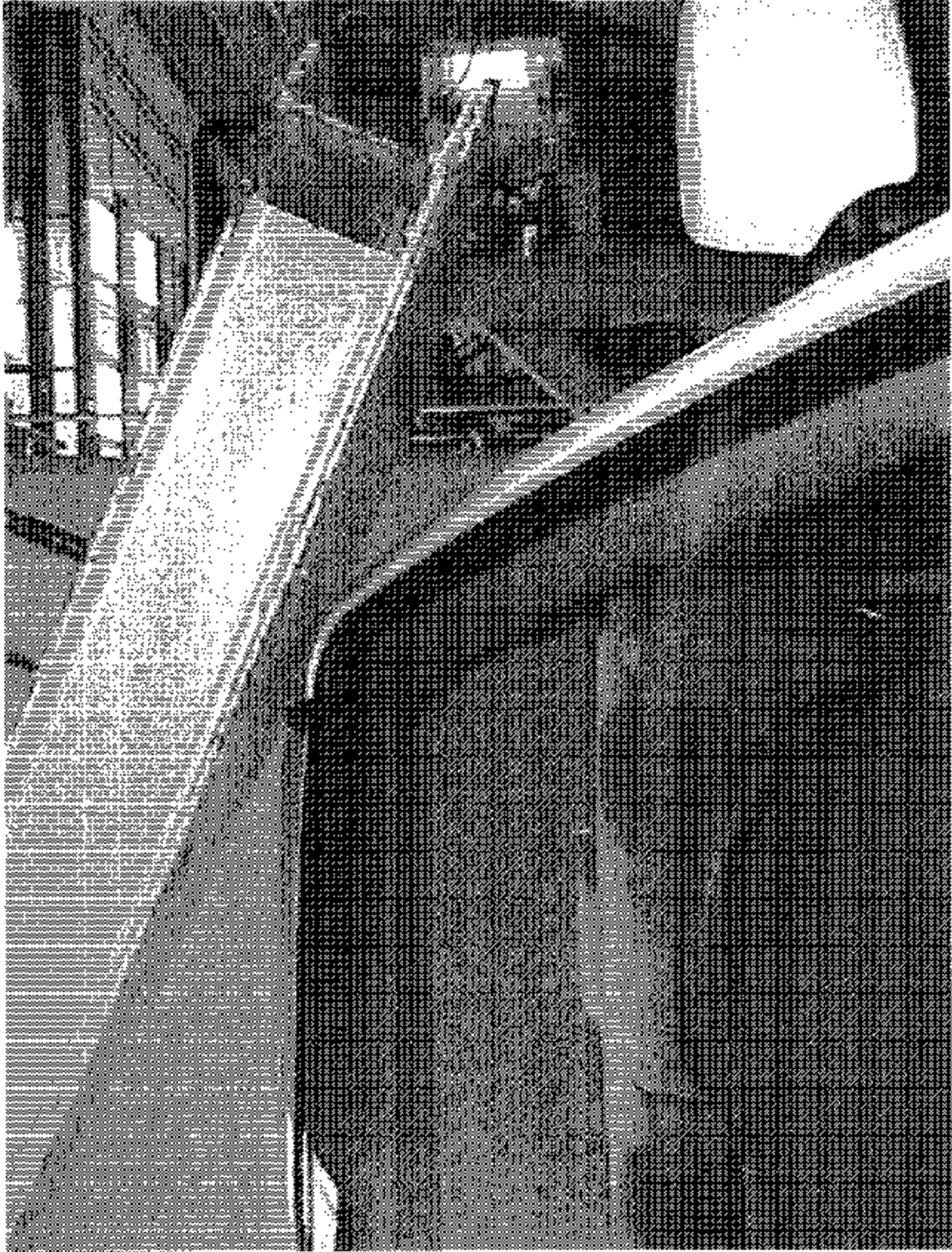


FIGURE 5.16
FRONT VIEW OF LOADING DEVICE PLACED
AGAINST VEHICLE ROOF

2003 MAZDA 6
NHISA NO. C35401
FMVSS NO. 216



FIGURE 5.17
SIDE VIEW OF LOADING DEVICE PLACED
AGAINST VEHICLE ROOF

2003 MAZDA 6
NHTSA NO. C35401
FMVSS NO. 216

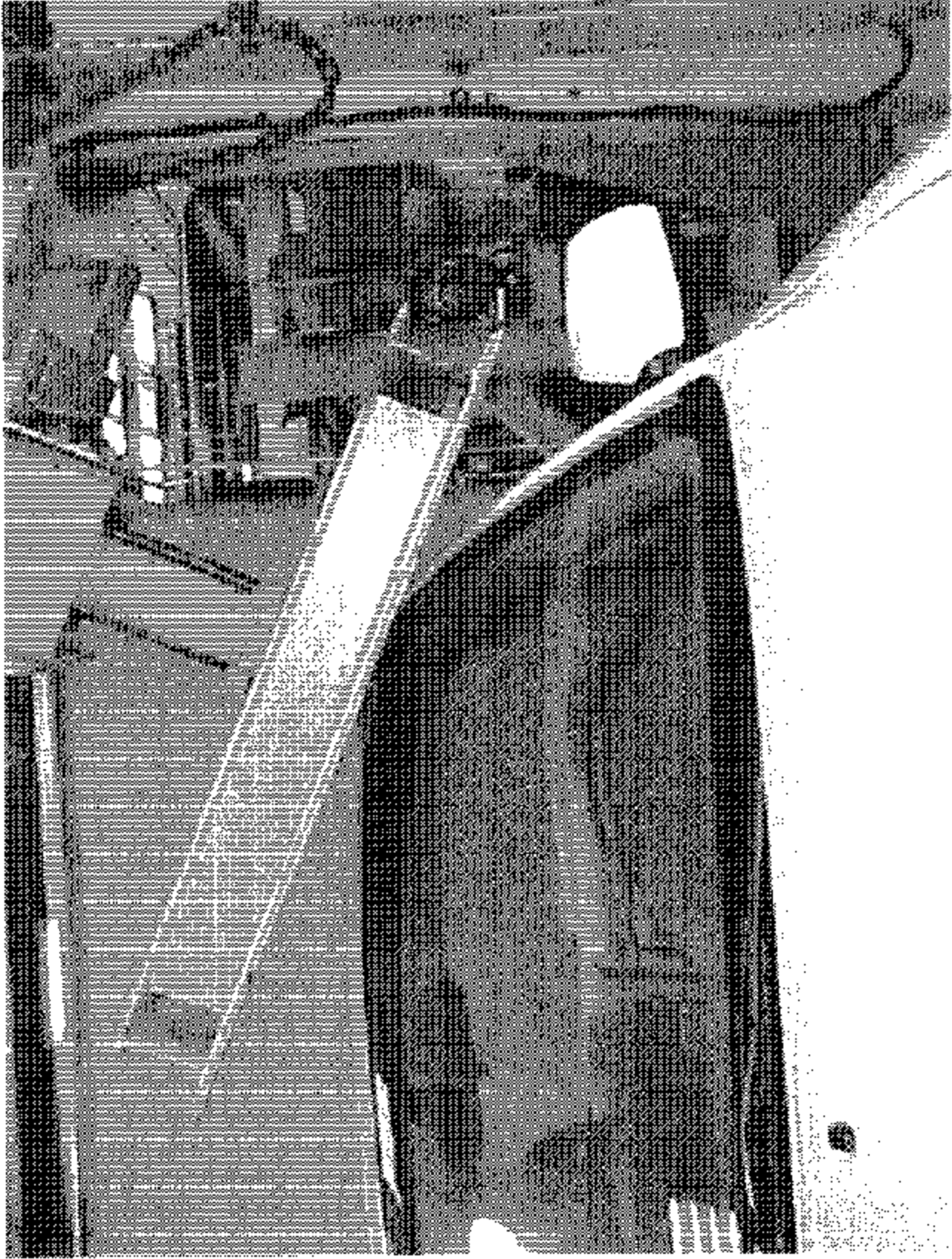
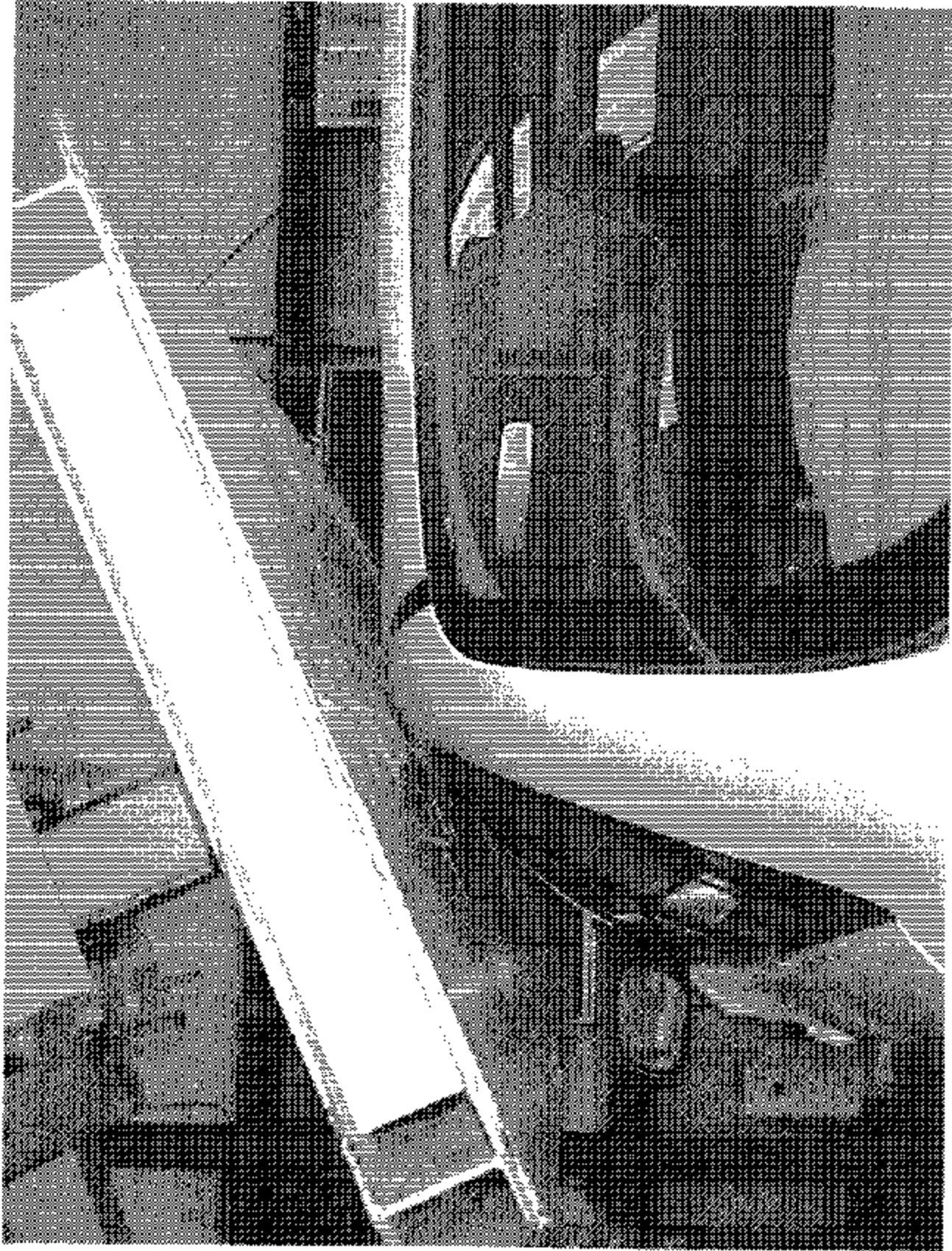


FIGURE 5.18
FRONT VIEW OF LOADING DEVICE PLACED
AGAINST VEHICLE ROOF AT FULL LOAD

2003 MAZDA 6
NHISA NO. C75401
FMVSS NO. 216



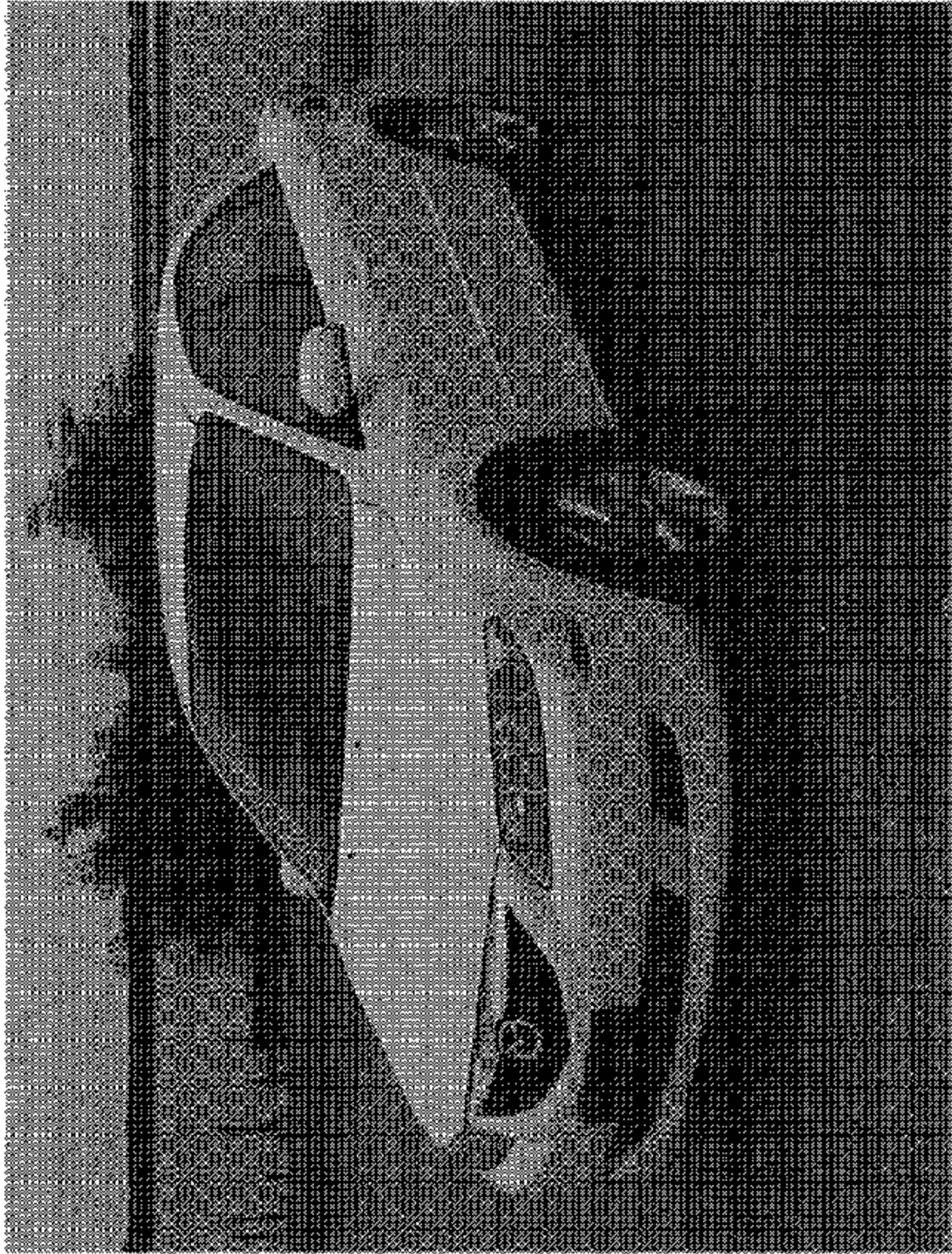
2003 MAZDA 6
NHTSA NO. C35401
FMVSS NO. 216

FIGURE S.19
REAR VIEW OF LOADING DEVICE PLACED
AGAINST VEHICLE ROOF AT FULL LOAD



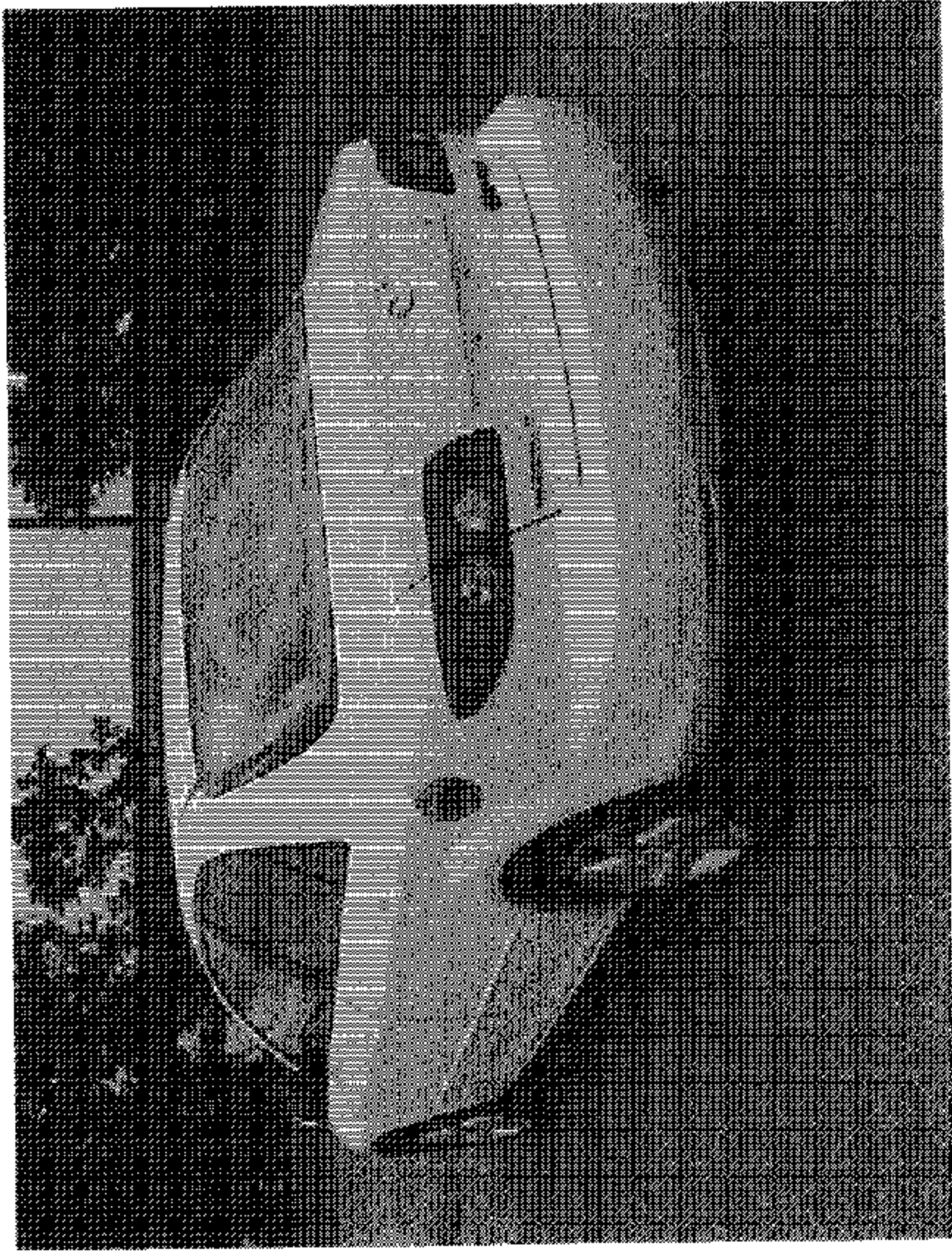
2003 MAZDA 6
NHISA NO. C35401
FMVSS NO. 210

FIGURE S.20
SIDE VIEW OF LOADING DEVICE PLACED
AGAINST VEHICLE ROOF AT FULL LOAD



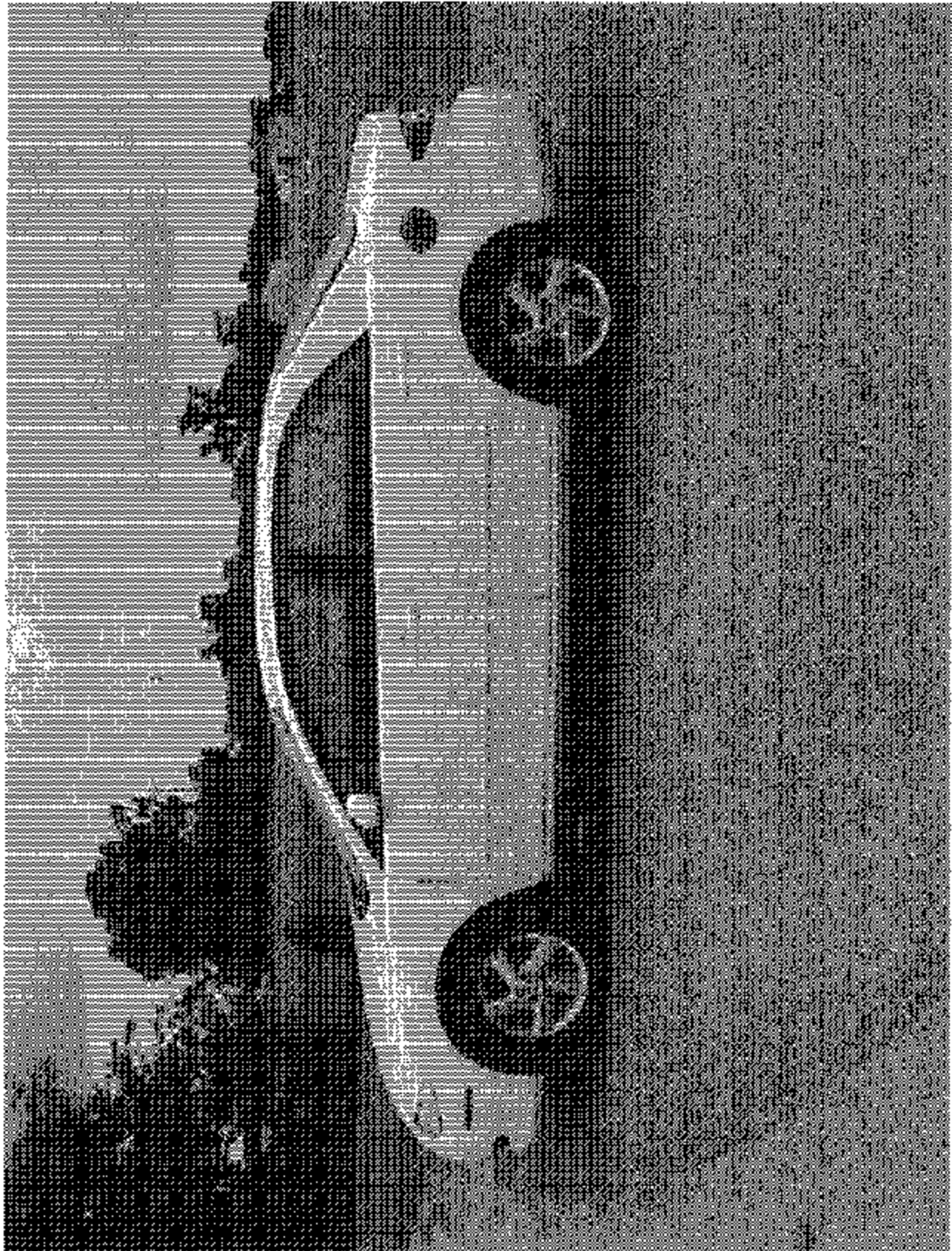
2003 MAZDA 6
NJITSA NO. C35401
YMVSS NO. 216

FIGURE 5.21
3/4 FORWARD VIEW OF VEHICLE ON TESTED
SIDE AFTER TESTING



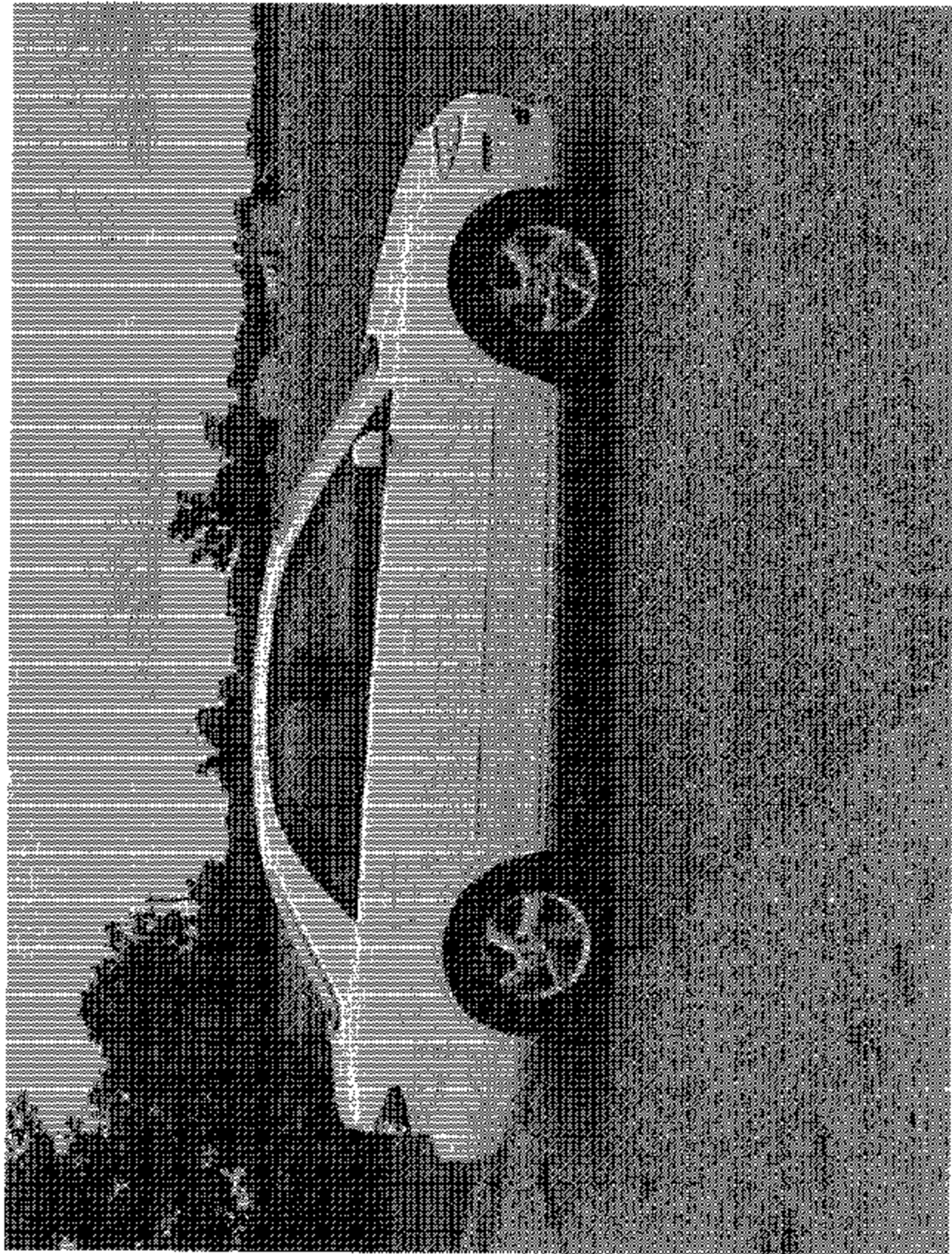
2009 MAZDA 6
NHTSA NO. C35-401
FMVSS NO. 216

FIGURE 5.22
3/4 REARWARD VIEW OF VEHICLE ON TESTED
SIDE AFTER TESTING



2003 MAZDA 6
NHTSA NO. C35401
FMVSS NO. 216

FIGURE 5.23
LEFT SIDE VIEW OF VEHICLE AFTER TESTING



2003 MAZDA 6
NHTSA NO. C35401
FMVSS NO. 216

FIGURE 5.24
RIGHT SIDE VIEW OF VEHICLE AFTER TESTING

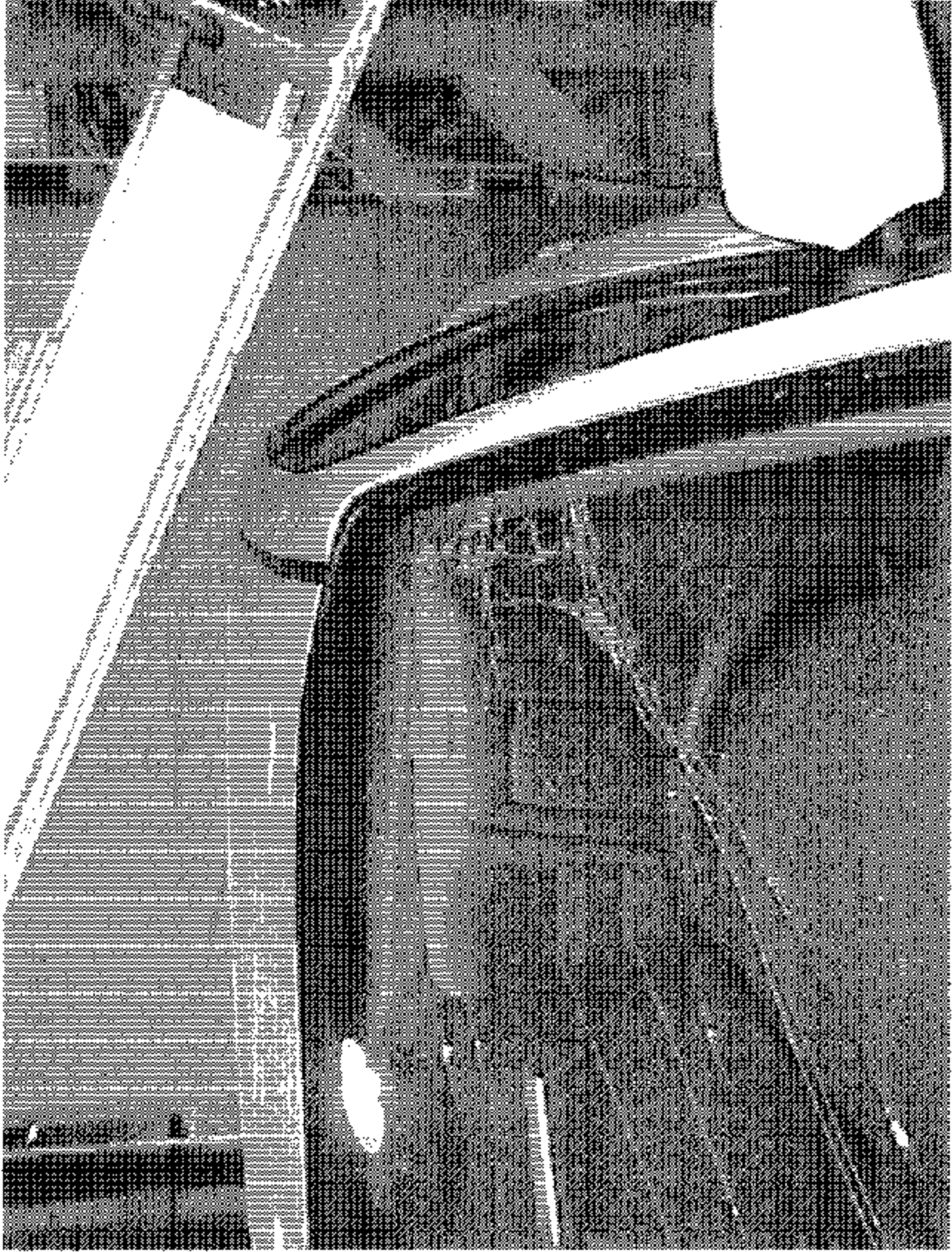
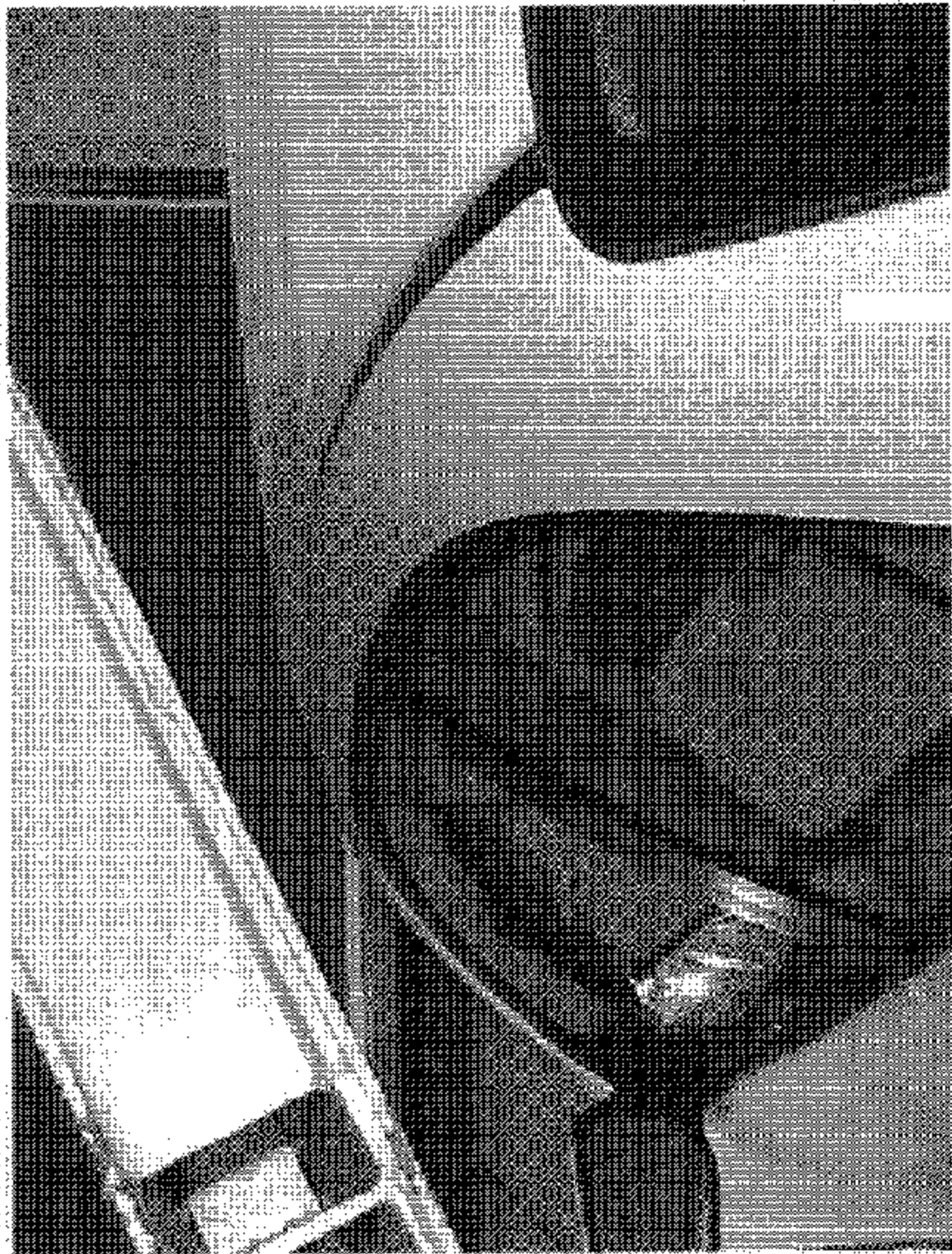


FIGURE 5-25
FRONT VIEW OF VEHICLE ROOF AFTER
REMOVAL OF LOADING DEVICE

2003 MAZDA 6
NHTSA NO. C35401
FMVSS NO. 216



2003 MAZDA 6
NHISA NO. C35401
FMVSS NO. 216

FIGURE S.26
REAR VIEW OF VEHICLE ROOF AFTER REMOVAL
OF LOADING DEVICE

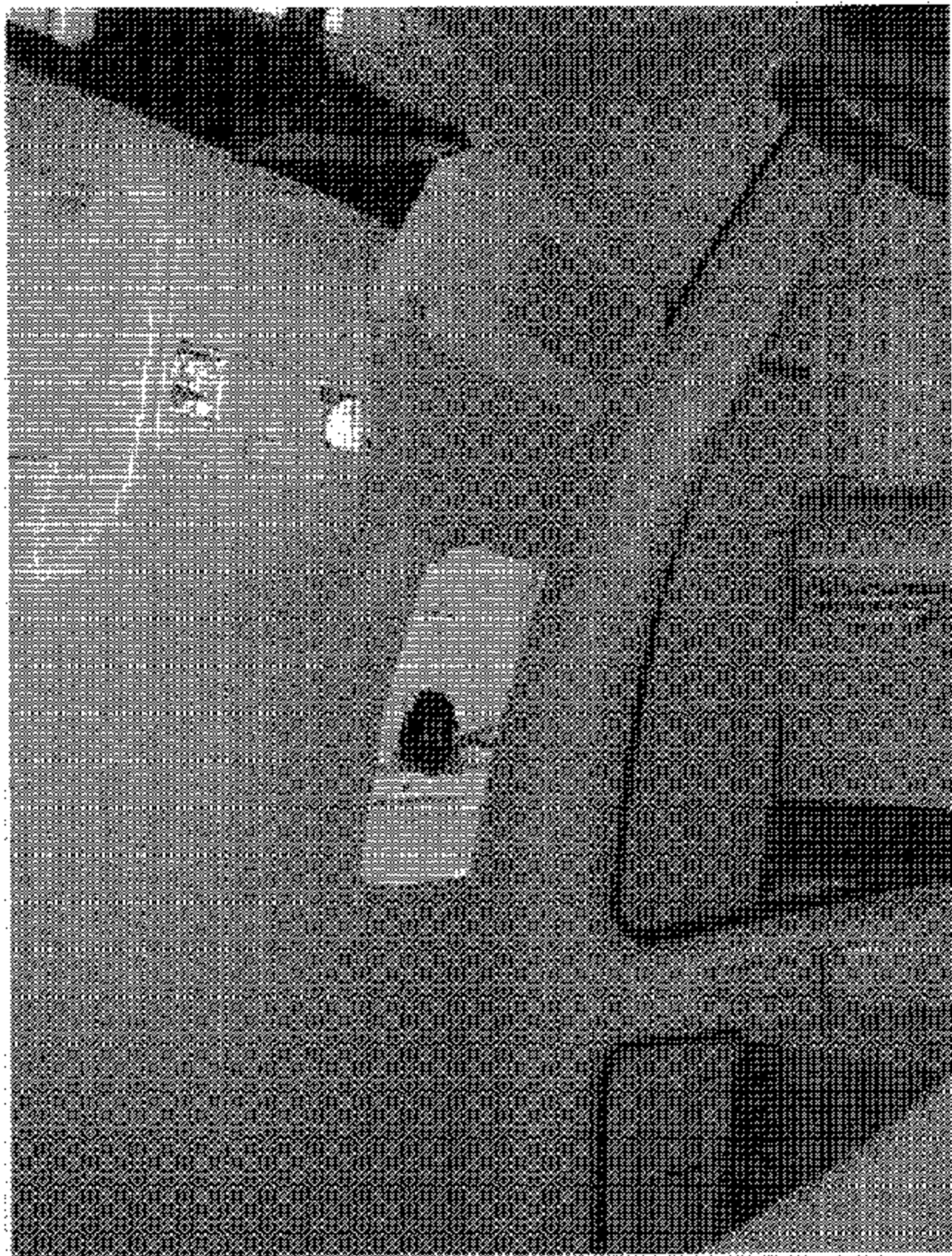


FIGURE 5.27
INTERIOR VIEW OF ROOF PRE-TEST

2008 MAZDA 6
NHTSA NO. C35401
FMVSS NO. 216



FIGURE 5.28
INTERIOR VIEW OF ROOF POST TEST

2003 MAZDA 6
NHTSA NO. C35401
FMVSS NO. 216



FIGURE 5.29
INSTRUMENTATION SET-UP

2003 MAZDA 6
NHTSA NO. C35401
FMVSS NO. 216

VEHICLE CAPACITY WEIGHT
CAPACITÉ PORTEUSE DU VEHICULE

FRONT SEAT
SIEGE AVANT
REAR SEAT
SIEGE ARRIERE

SEATING CAPACITY
NOMBRE DE PLACES

TOTAL

TIRE INFLATION PRESSURE
PRESSION DE GONFLEMENT DES
PNEUS

TIRE SIZE
TAILLE DES PNEUS

FRONT REAR
FRONT REAR
FRONT REAR

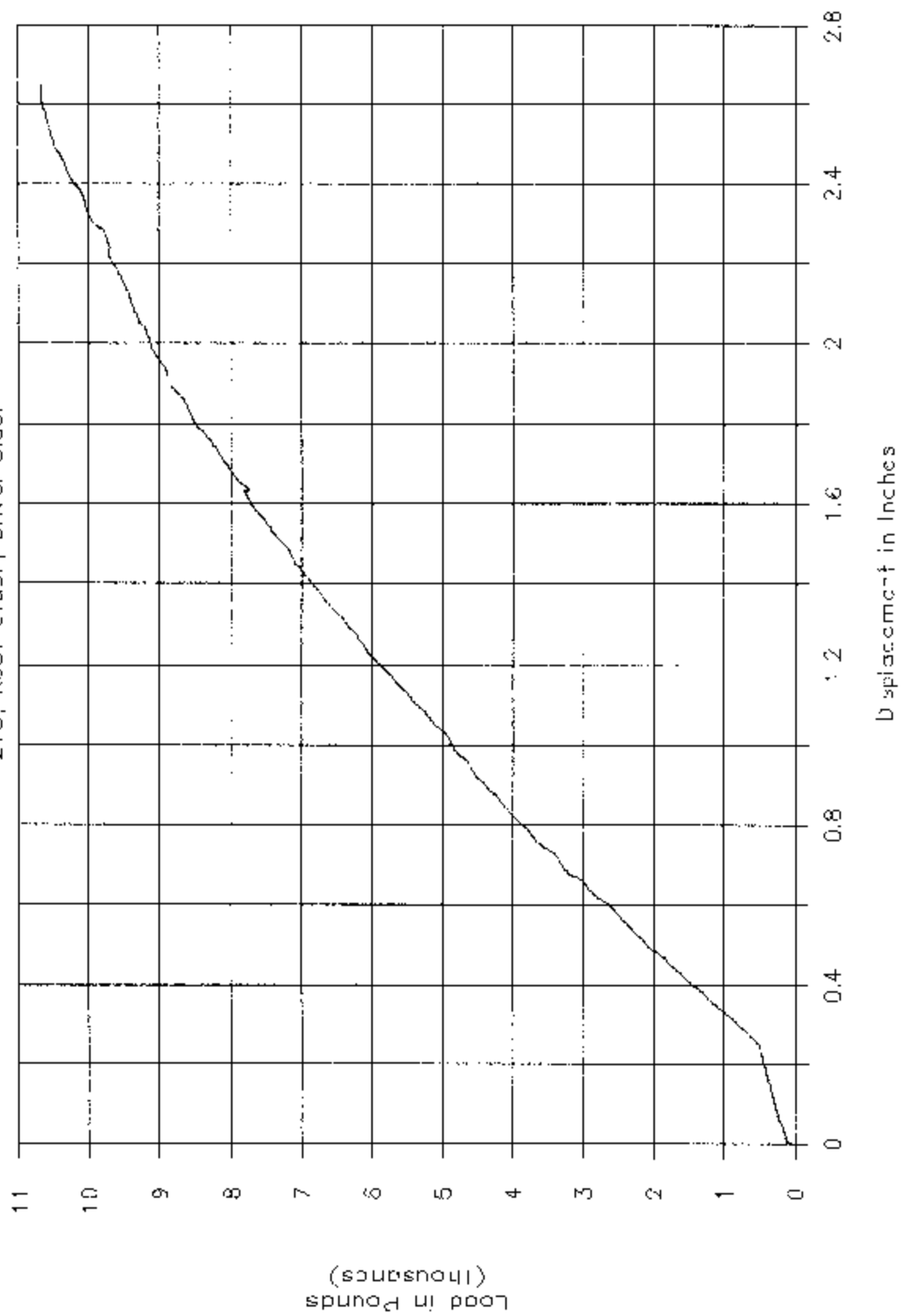
2003 MAZDA 6
NHTSA NO. C35401
FMVSS NO. 216

FIGURE 5/21
CLOSE-UP VIEW OF VEHICLE TIRE
INFORMATION LABEL

SECTION 6
TEST PLOTS

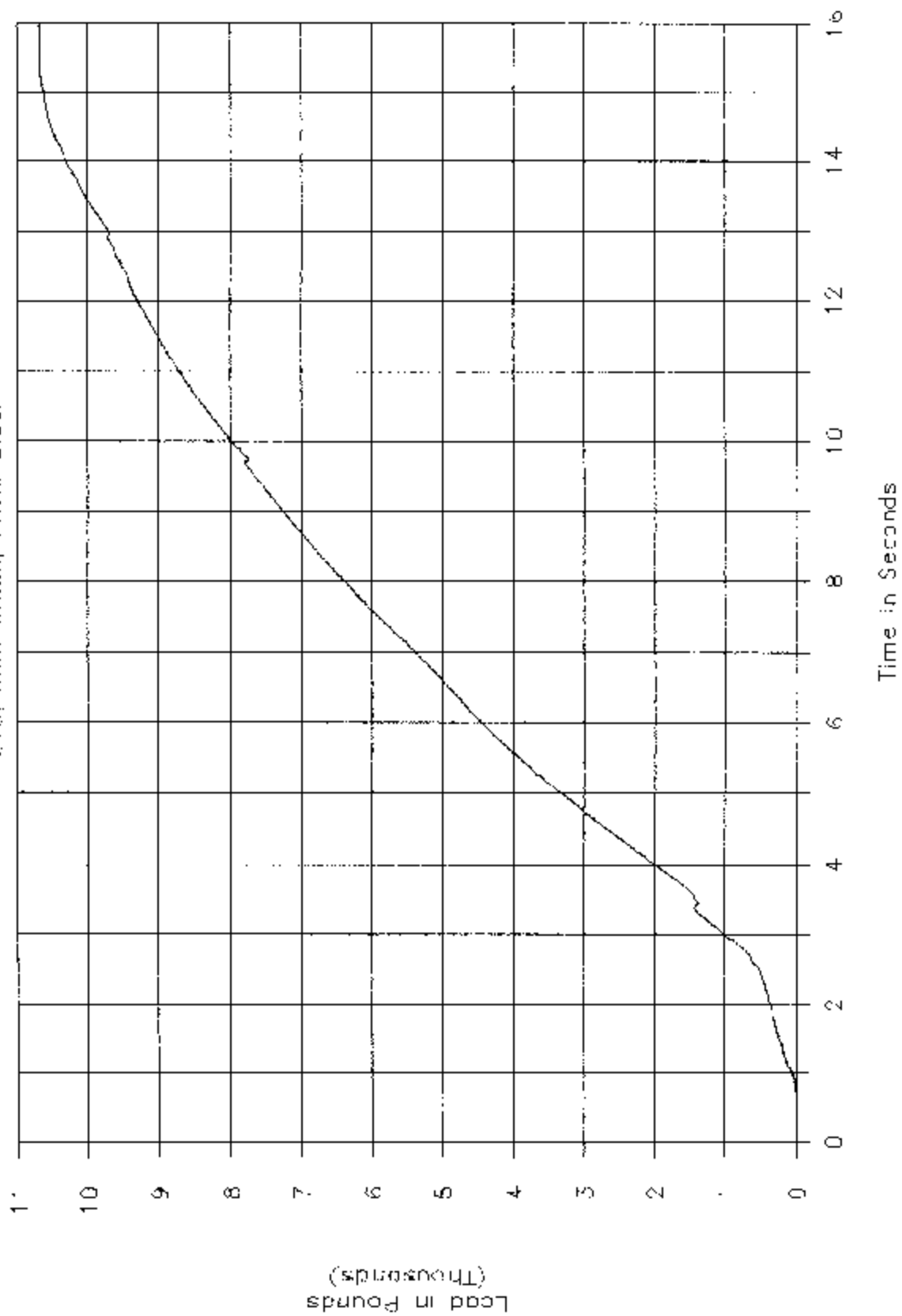
GTL 5046

216, Roof Crush, Driver Side.



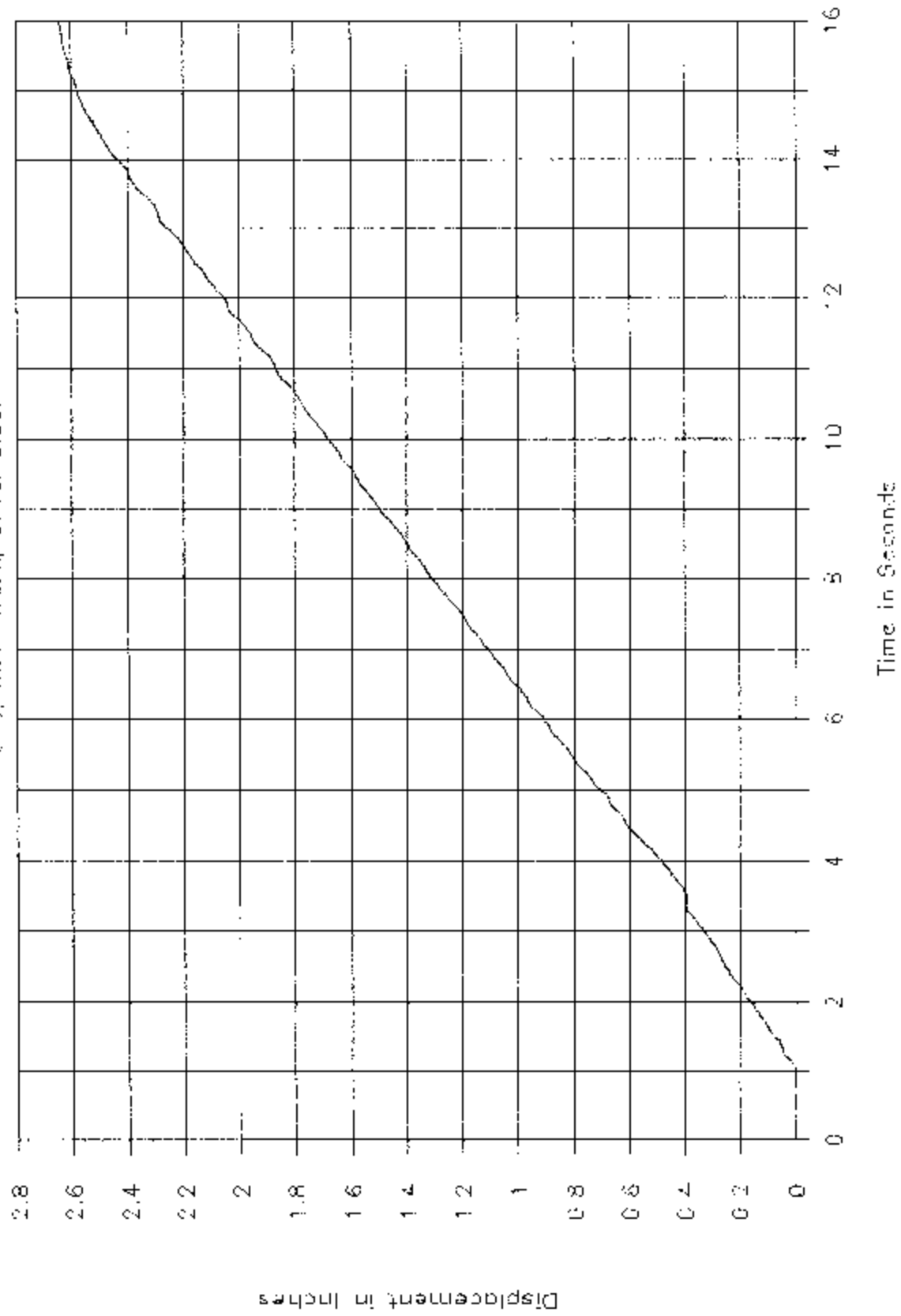
GTI 5045

216, Roof Crush, Driver Side.



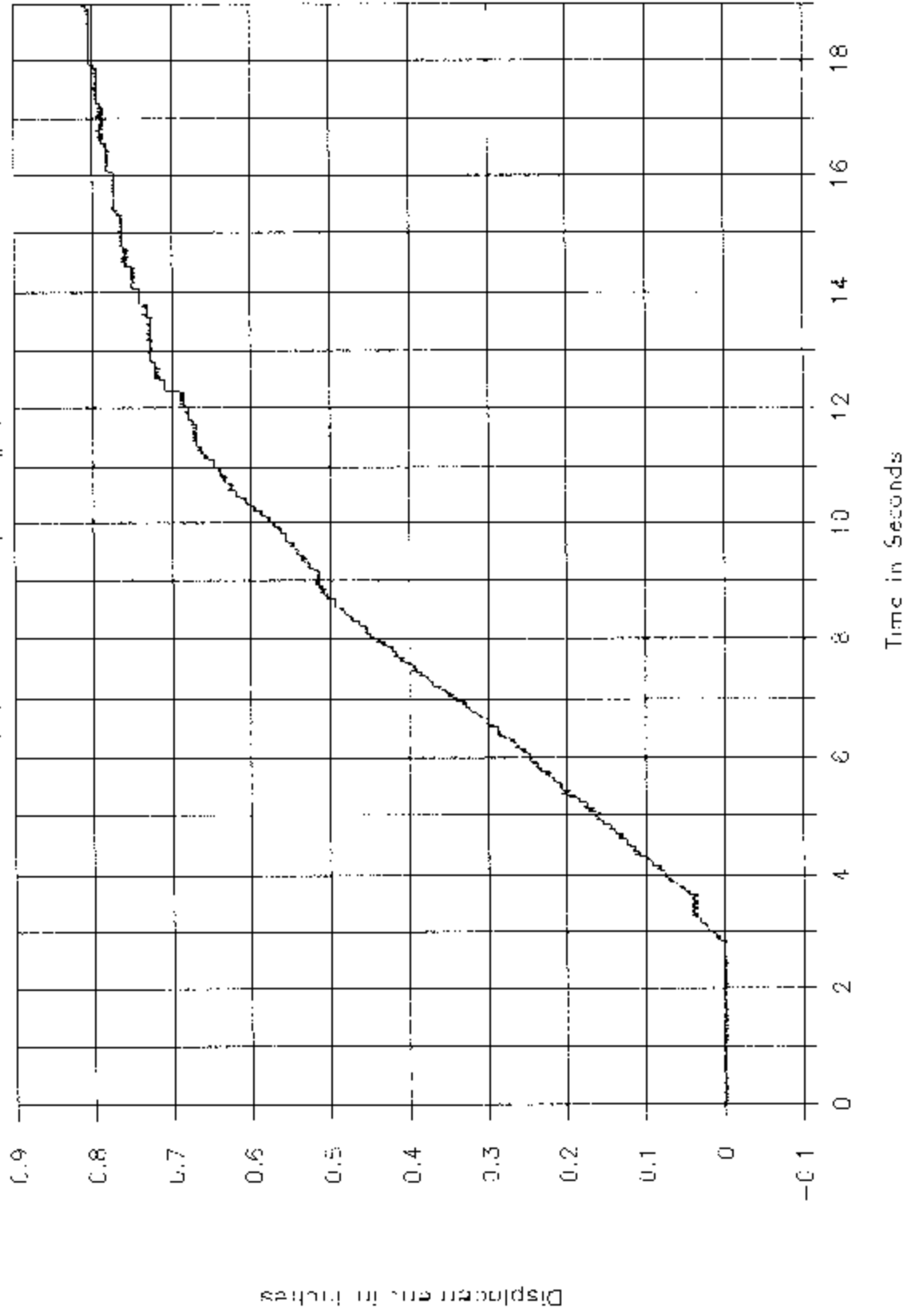
GTI 5046

216, Roof Crush, Driver Side.



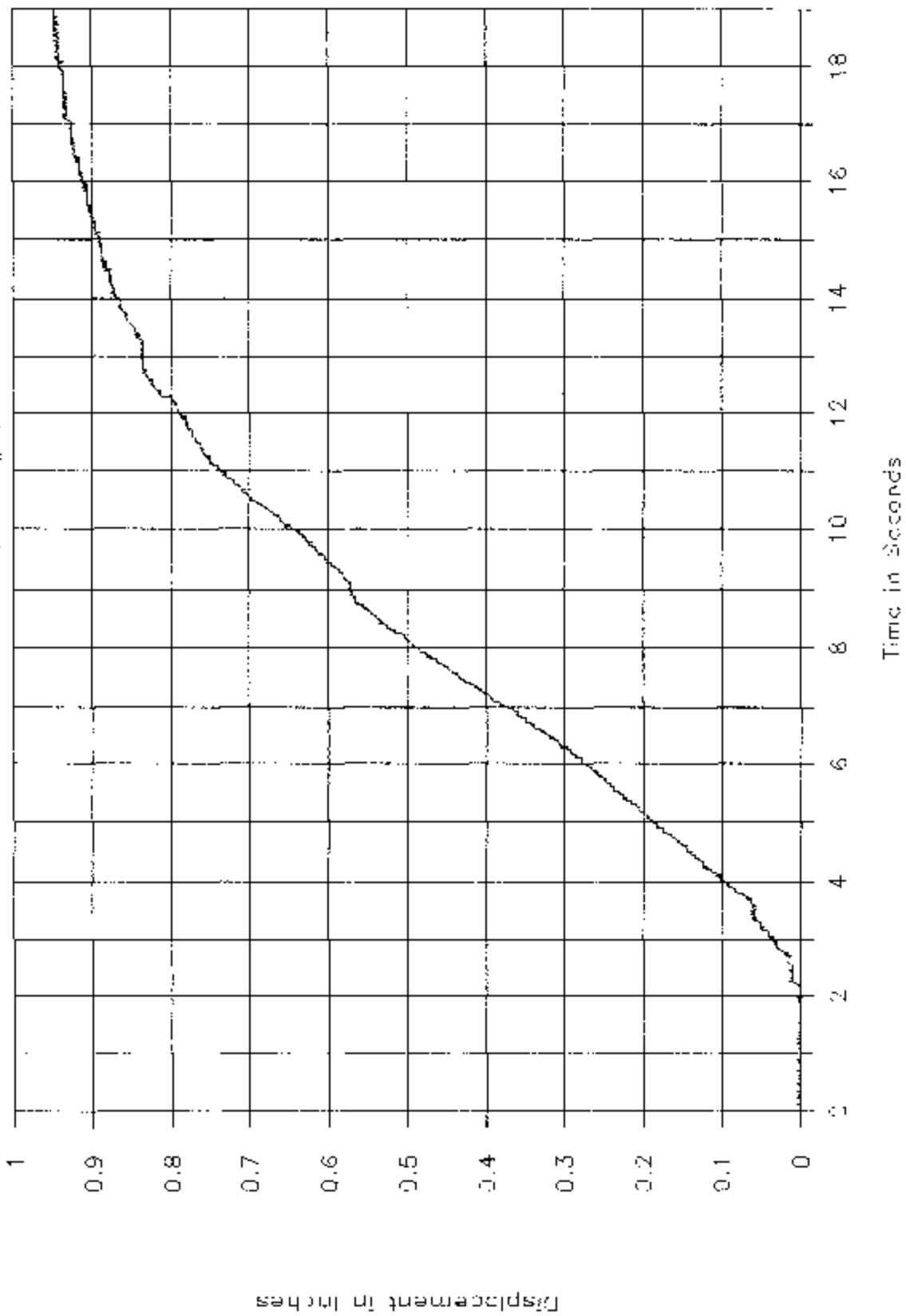
GTL 5846

216 Root Crush, LVDT #1, R.F.



GTL 5046

216 Roof Crush, LVDT #3, R.R.



GTI. 5046

216, Roof Crush, LVDT #3, L.R.

