

REPORT NUMBER 216-GTL-03-005

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

**FORD MOTOR CO.
2003 FORD WINDSTAR, MPV
NHTSA NO. C30208**

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



AUGUST 19, 2003

FINAL REPORT

PREPARED FOR

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

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TABLE OF CONTENTS

SECTION		PAGE
1	Purpose of Compliance Test	1
2	Compliance Test Results Summary	2
3	Compliance Test Data	3
4	Test Equipment List	11
5	Photographs	12
	5.1 $\frac{3}{4}$ Forward View of Vehicle on Tested Side Before Testing	
	5.2 $\frac{3}{4}$ Rearward View of Vehicle on Tested Side Before Testing	
	5.3 Left Side View of Vehicle Before Testing	
	5.4 Right Side View of Vehicle Before Testing	
	5.5 Front View of Test Set-up Pre-Test	
	5.6 Vehicle in 216 Test Rig	
	5.7 Left Front Vehicle Mounting	
	5.8 Right Front Vehicle Mounting	
	5.9 Left Rear Vehicle Mounting	
	5.10 Right Rear Vehicle Mounting	
	5.11 LVDT Displacement Mounting to Roof	
	5.12 LVDT Transducer Mounting at H-Point	
	5.13 View Showing Measurement of VRL	
	5.14 View Showing Measurement of VRi and RE	
	5.15 Displacement Indicators at Front of Vehicle	
	5.16 Displacement Indicators at Passenger Door Sill	
	5.17 Displacement Indicators at Rear of Vehicle	
	5.18 Front View of Loading Device Placed Against Vehicle Roof	
	5.19 Rear View of Loading Device Placed Against Vehicle Roof	
	5.20 Side View of Loading Device Placed Against Vehicle Roof	
	5.21 Front View of Loading Device Placed Against Vehicle Roof at Full Load	
	5.22 Rear View of Loading Device Placed Against Vehicle Roof at Full Load	
	5.23 Side View of Loading Device Placed Against Vehicle Roof at Full Load	
	5.24 $\frac{3}{4}$ Forward View of Vehicle on Tested Side After Testing	
	5.25 $\frac{3}{4}$ Rearward View of Vehicle on Tested Side After Testing	
	5.26 Left Side View of Vehicle After Testing	
	5.27 Right Side View of Vehicle After Testing	
	5.28 Front View of Vehicle Roof After Removal of Loading Device	
	5.29 Rear View of Vehicle Roof After Removal of Loading Device	
	5.30 Side View of Vehicle Roof After Removal of Loading Device	
	5.31 Interior View of Roof Pre-Test	
	5.32 Interior View of Roof Post Test	
	5.33 Instrumentation Set-Up	
	5.34 Close-Up of Vehicle Certification and Tire Information Label	
6	Test Plots	47

SECTION 1

PURPOSE OF COMPLIANCE TEST

1.0 PURPOSE OF COMPLIANCE TEST

A 2003 Ford Windstar MPV 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 Ford Windstar MPV. Nomenclature applicable to the test vehicle are:

A. Vehicle Identification Number: 2FMZA53493BA03994

B. NHTSA No.: C30208

C. Manufacturer: FORD MOTOR CO.

D. Manufacture Date: 08/02

1.2 TEST DATE

The test vehicle was subjected to FMVSS No. 216 testing on July 30, 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 Ford Windstar 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 Ford Windstar.

DATA SHEET 1
FMVSS 216
SUMMARY OF RESULTS

VEH. MOD YR/MAKE/MODEL/BODY: 2003 FORD WINDSTAR MPV

VEH. NHTSA NO: C30208; VIN: 2FMZA53493BA03994

VEH. BUILD DATE: 08/02; TEST DATE: JULY 30, 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: MPV
(2) Vehicle UVW as recorded on Data Table 2: 1952.2 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: 28,697 N

Maximum roof crush resistance measured during test was
42,132 N at 75.7 mm

PASS	FAIL
<u>X</u>	

D. POST TEST VISUAL INSPECTION

Driver's side roof flattened from "A" pillar rearward approximately 2010 mm and approximately 500 mm wide. "A" pillar, "B" pillar and "C" pillar are bent in and down. Windshield, driver door glass and side door glass are shattered. Driver's door opening pushed down approximately 70 mm.

RESULTS:

REMARKS:

RECORDED BY: [Signature]

APPROVED BY: [Signature]

DATE: 07/30/03

DATA SHEET 2
FMVSS 216
RECEIVING INSPECTION

VEH. MOD YR/MAKE/MODEL/BODY: 2003 FORD WINDSTAR MPV

VEH. NHTSA NO: C30208; VIN: 2FMZA53493BA03994

VEH. BUILD DATE: 08/02; TEST DATE: JULY 30, 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	581.9	kg	Left Rear	405.6	kg
Right Front	567.9	kg	Right Rear	396.8	kg
Front Axle	1149.8	kg	Rear Axle	802.4	kg

TOTAL UVW 1952.2 kg

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

(3) Minimum Roof Crush Resistance (MCRR):

Passenger Car:

UVW x 1.5 x 9.8 = N/A N

MCRR = N/A N (UVW x 1.5 x 9.8 or 22,241 N whichever is less)

MPV, Truck or Bus:

MCRR = UVW x 1.5 x 9.8 = 28,697 N

(4) Other Comments: _____

REMARKS:

RECORDED BY: [Signature]

APPROVED BY: [Signature]

DATE: 07/30/03

DATA SHEET 3
FMVSS 216
PRE-TEST PREPARATION

VEH. MOD YR/MAKE/MODEL/BODY: 2003 FORD WINDSTAR MPV

VEH. NHTSA NO: C30208; VIN: 2FMZA53493BA03994

VEH. BUILD DATE: 08/02; TEST DATE: JULY 30, 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 Roof Rack Removed
- 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 318 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: 25 degrees C.

REMARKS:

RECORDED BY: [Signature]

DATE: 07/30/03

APPROVED BY: [Signature]

DATA SHEET 4
FMVSS 216

VEH. MOD YR/MAKE/MODEL/BODY: 2003 FORD WINDSTAR MPV

VEH. NHTSA NO: C30208; VIN: 2FMZA53493BA03994

VEH. BUILD DATE: 08/02; TEST DATE: JULY 30, 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 42,132 N at 75.7 mm
- (2) The rate of loading was 5.08 mm/sec (.2 in/sec)
- (3) The required roof crush resistance of 28,697 N was at 43.2 mm

REMARKS:

RECORDED BY: 

APPROVED BY: D. Messick

DATE: 07/30/03

DATA SHEET 5
FMVSS 216
POST TEST VISUAL INSPECTION

VEH. MOD YR/MAKE/MODEL/BODY: 2003 FORD WINDSTAR MPV

VEH. NHTSA NO: C30208; VIN: 2FMZA53493BA03994

VEH. BUILD DATE: 08/02; TEST DATE: JULY 30, 2003

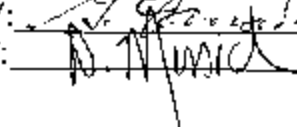
TEST LABORATORY: GENERAL TESTING LABORATORIES

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: Driver's side roof flattened from "A" pillar rearward approximately 2010 mm and approximately 500 mm wide. "A" pillar, "B" pillar and "C" pillar are bent in and down. Windshield, driver door glass and side door glass are shattered. Driver's door opening pushed down approximately 70 mm.

RECORDED BY: 

APPROVED BY: 

DATE:

07/30/03

DATA SHEET 6
FMVSS 216 MODIFIED PORTION PRE-TEST

VEH. MOD YR/MAKE/MODEL/BODY: 2003 FORD WINDSTAR MPV

VEH. NHTSA NO: C30208; VIN: 2FMZA53493BA03994

VEH. BUILD DATE: 08/02; TEST DATE: JULY 30, 2003

TEST LABORATORY: GENERAL TESTING LABORATORIES

OBSERVERS: GRANT FARRAND, JIMMY LATANE, AMANDA PRESCOTT

Driver Seat Torso Angle: 21°

Driver Seat "H" Point Location at Mid Travel:

X= 205 mm aft from centerline of front outboard seat mounting bolt

Y= 180 mm inboard from centerline of front outboard seat mounting bolt

Z= 350 mm up from centerline of front outboard seat mounting bolt

Point VRL(Vertical Measurement from H-Point to Headliner): 894.1 mm

Point VRi (Vertical Measurement from H-Point to Structure Above Headliner): 927.1 mm

Point RE(Distance from H-Point to a point 112mm behind point VRi): 927.1 mm

#1 LVDT (R.F.) Length: 925 mm

#2 LVDT (R.R.) Length: 892 mm

#3 LVDT (L.R.) Length: 892 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: [Signature]

APPROVED BY: [Signature]

DATE: 07/30/03

DATA SHEET 7
FMVSS 216 MODIFIED PORTION POST TEST

VEH. MOD YR/MAKE/MODEL/BODY: 2003 FORD WINDSTAR MPV

VEH. NHTSA NO: C30208; VIN: 2FMZA53493BA03994

VEH. BUILD DATE: 08/02 TEST DATE: JULY 30, 2003

TEST LABORATORY: GENERAL TESTING LABORATORIES

OBSERVERS: GRANT FARRAND, JIMMY LATANE, AMANDA PRESCOTT

Maximum Load Applied = 42,132 N @ 75.7 mm

Maximum Displacement = 139.0 mm @ 33.044 N

#1 LVDT (RF) Displacement = 55.4 mm

#2 LVDT (RR) Displacement = 61.4 mm

#3 LVDT (LR) Displacement = 52.0 mm

Left Front Dial Indicator Displacement = 2.6 mm

Right Front Dial Indicator Displacement = 0.7 mm

Left Rear Dial Indicator Displacement = 0.0 mm

Right Rear Dial Indicator Displacement = 8.6 mm

Right Door Sill Dial Indicator Displacement = 7.4 mm

NOTES:

RECORDED BY: 

APPROVED BY: 

DATE: 07/30/03

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



FIGURE 1
3. FORWARD VIEW OF VEHICLE ON TESTED SITE
BEFORE TESTING

2003 FORD WINDSTAR
FHTSA NC C30269
INVEST NO 216

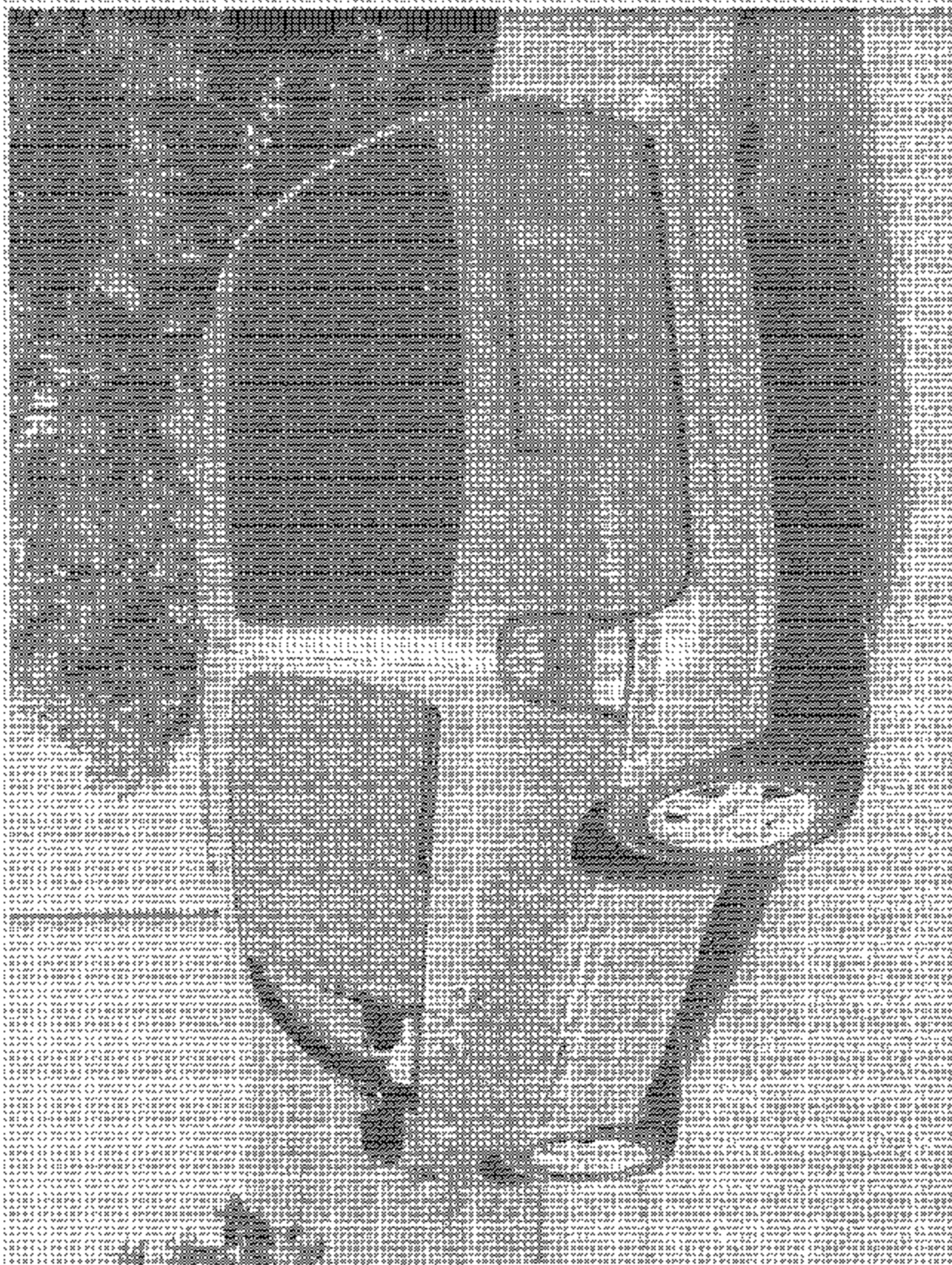
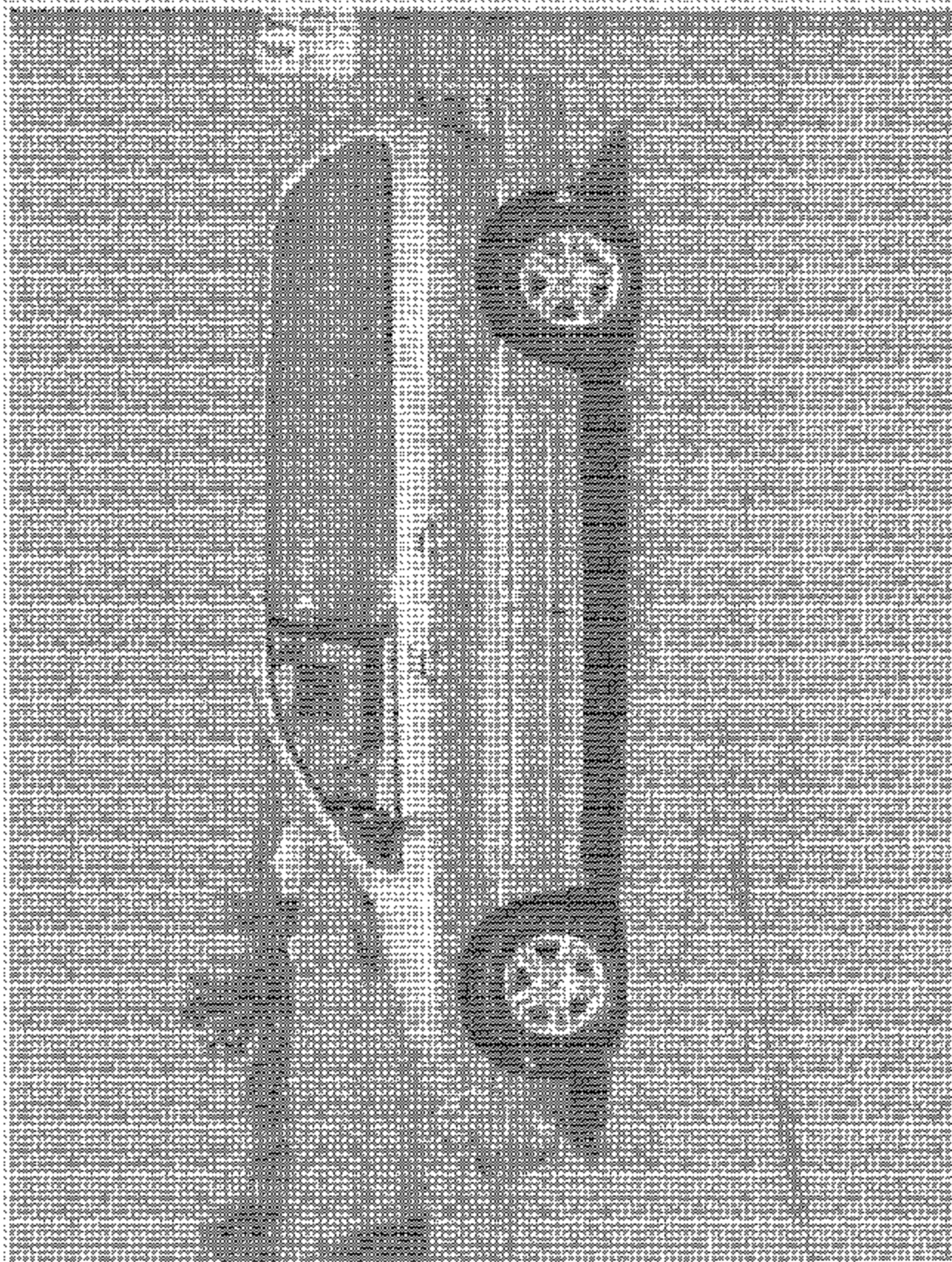


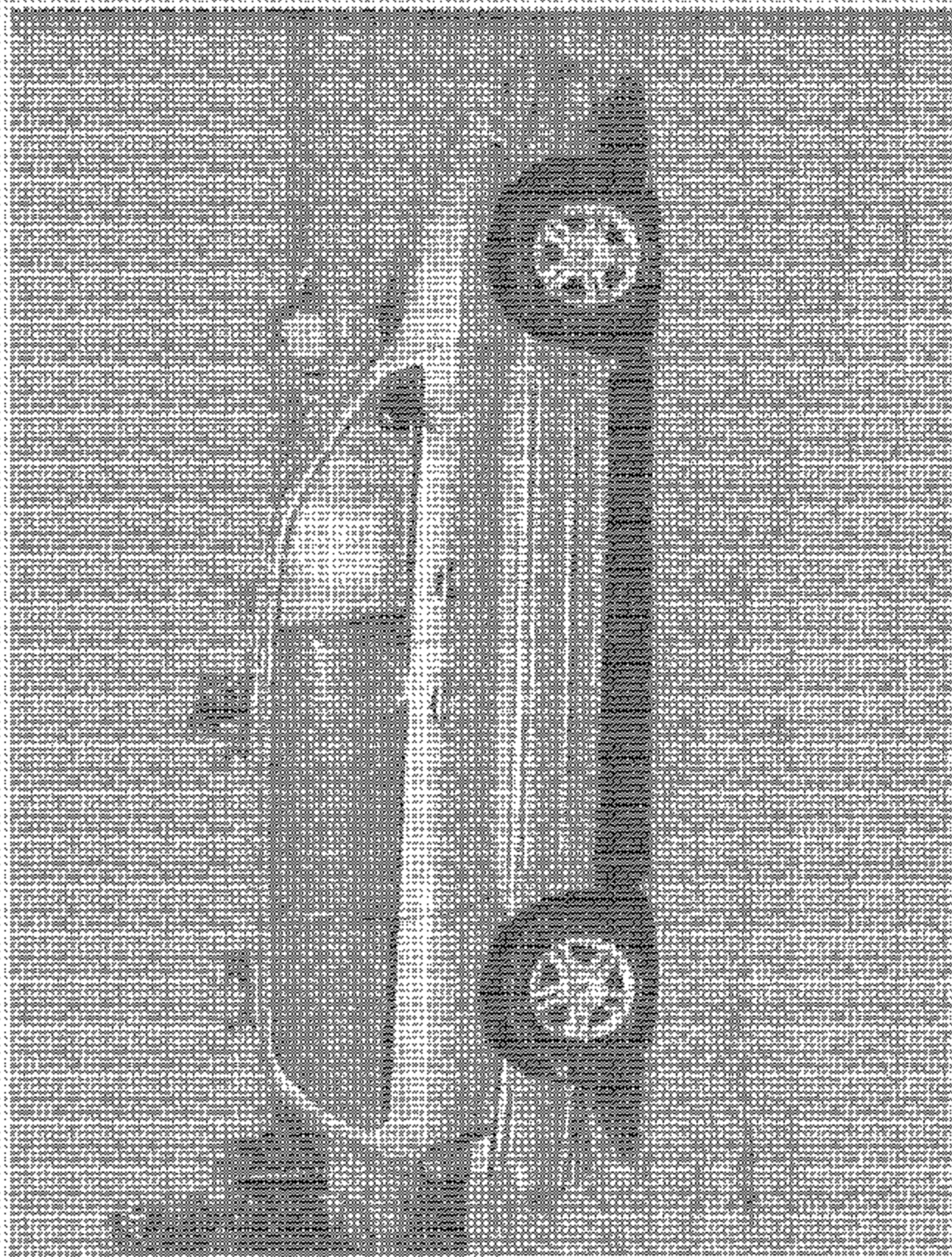
FIGURE 2
REARWARD VIEW OF VEHICLE ON TESTED SITE
BEFORE TESTING

2008 FORD MONDEO
MOTSA NO. 00000
PASS NO. 215



2003-FORD WINDSTAR
NHTSA NO. C300203
FMVSS NO. 216

FIGURE 5.3
LEFT SIDE VIEW OF VEHICLE BEFORE TESTING



2003 FORD MUSTANG
NHTSA NO. C20208
FMVSS NO. 215

FIGURE 4
RIGHT SIDE VIEW OF VEHICLE BEFORE TESTING

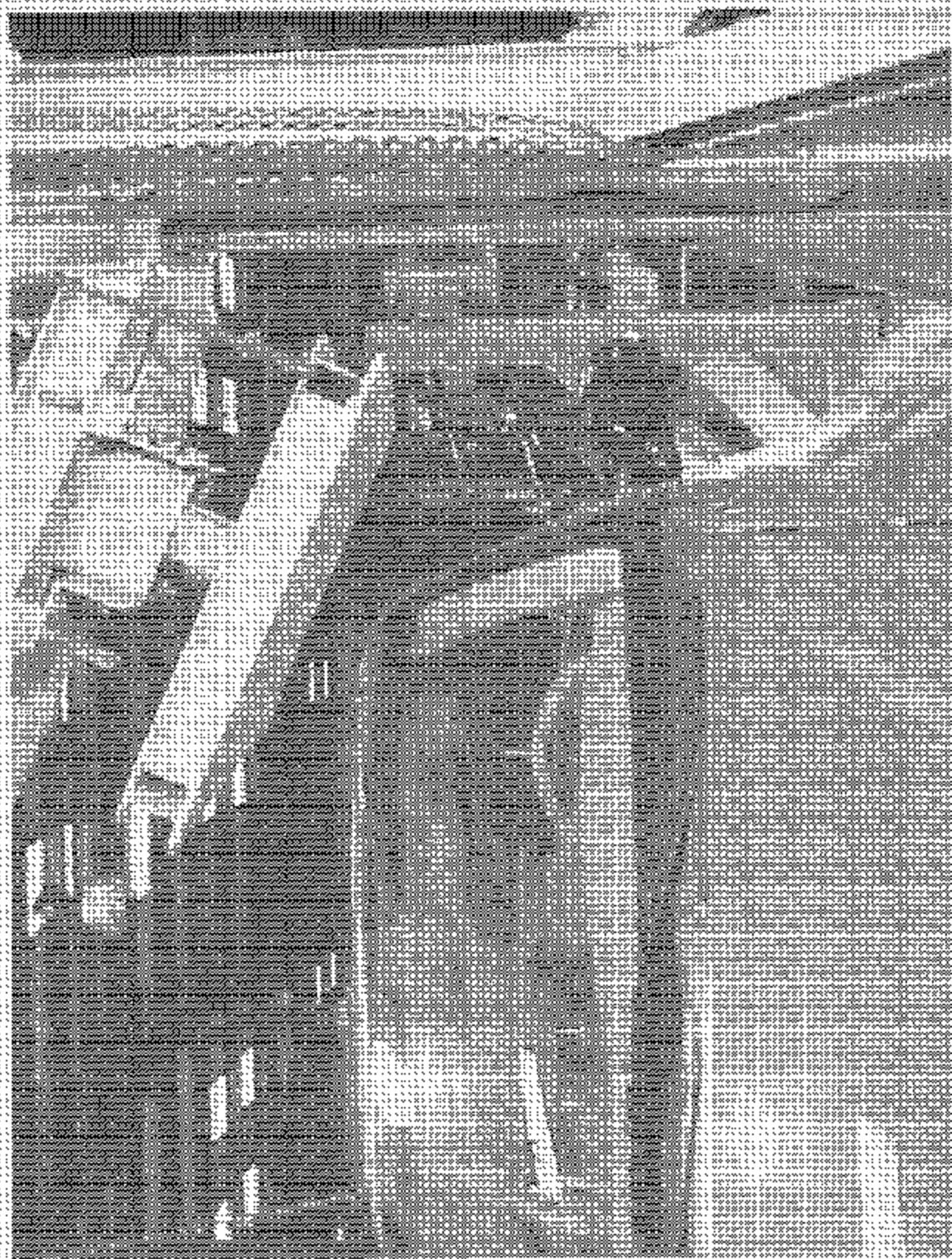
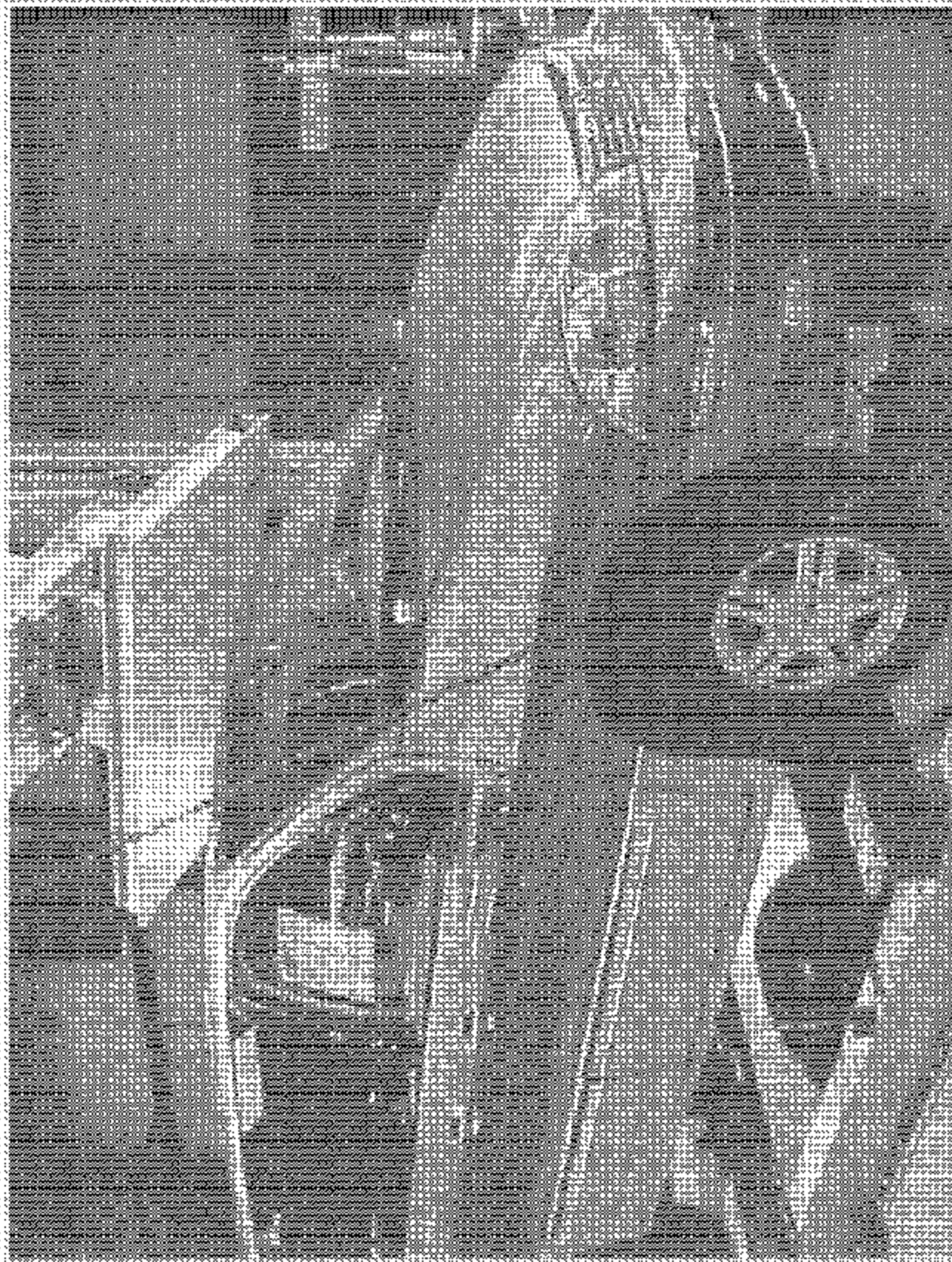


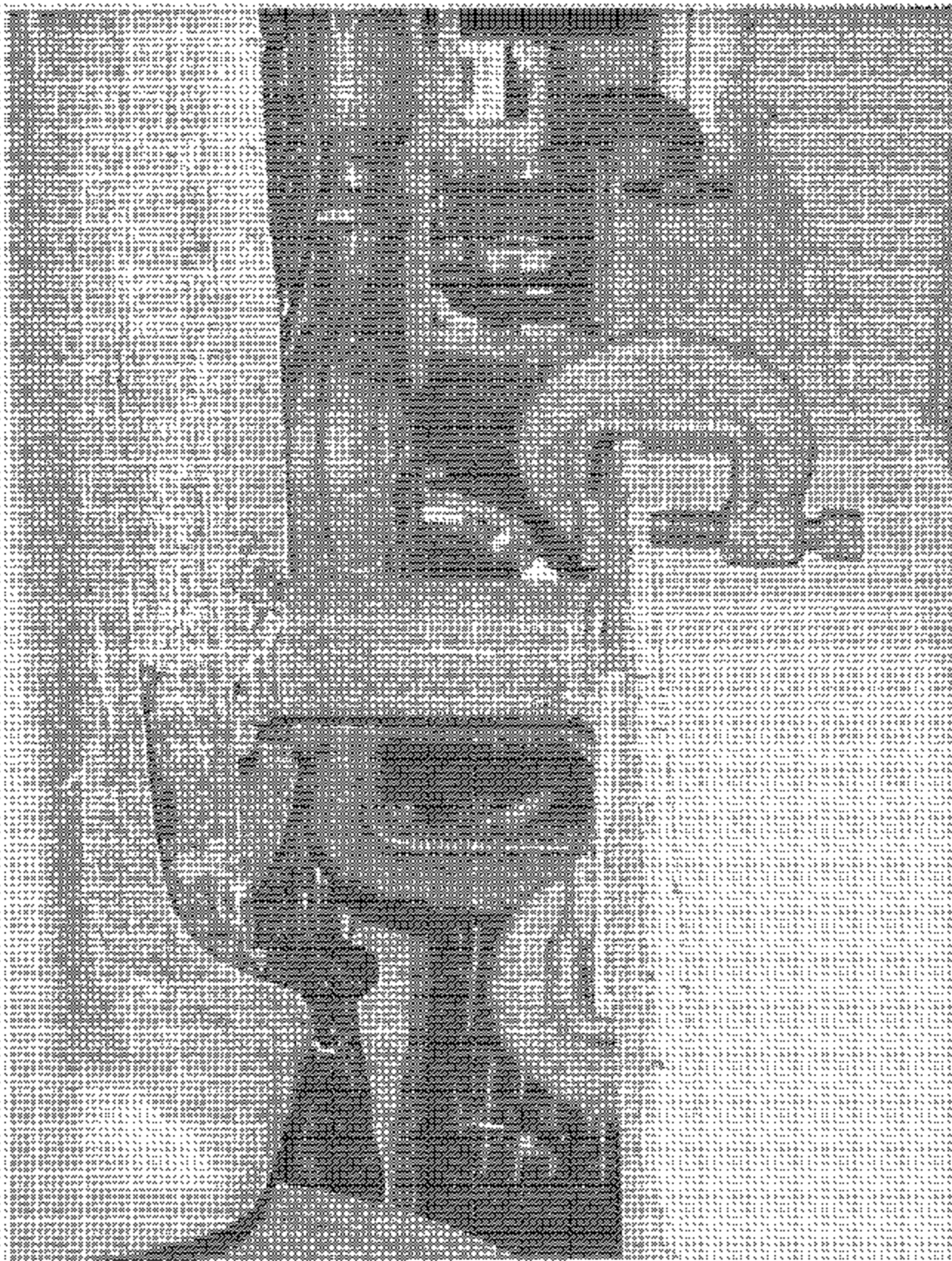
FIGURE 3
FRONT VIEW OF TEST SET UP PRE-TEST

2008 FORD VANDERSTAR
NHTSA NO. CEC206
PASE NC 21F



2008-04-10 14:05:10
NHTSA NO. G30008
IMVSS NO. 215

FIGURE 50
VEHICLE IN 2008



2005 FORD WINDSTAR
MHTSA NO. C4203
PLATE NO. 216

FIGURE 1
LEFT FRONT VEHICLE WOUND

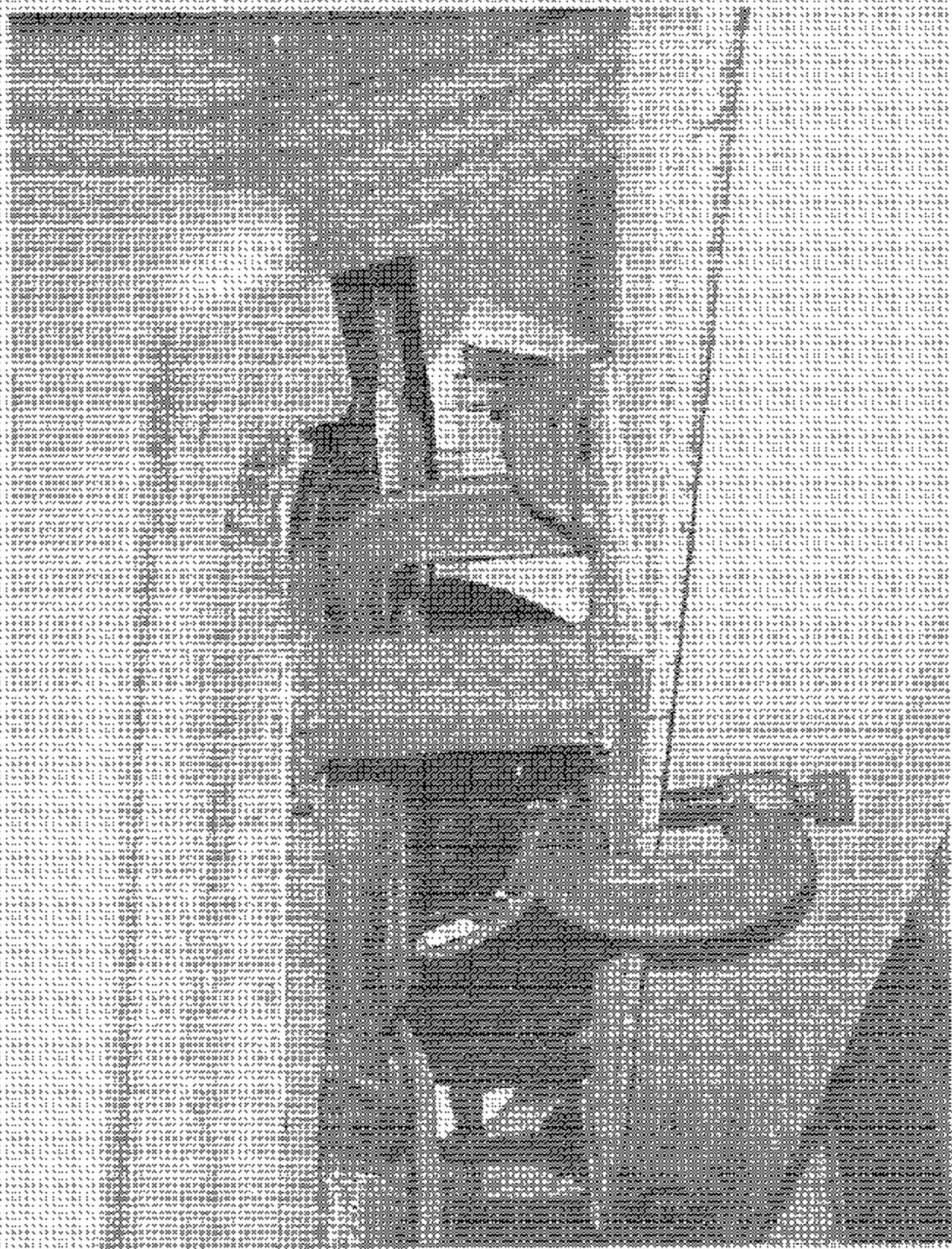


FIGURE 5.8
RIGHT FRONT VEHICLE MOUNTING

2003 FORD WINDSTAR
NHTSA NO. CUGA08
FMVSS NO. 216

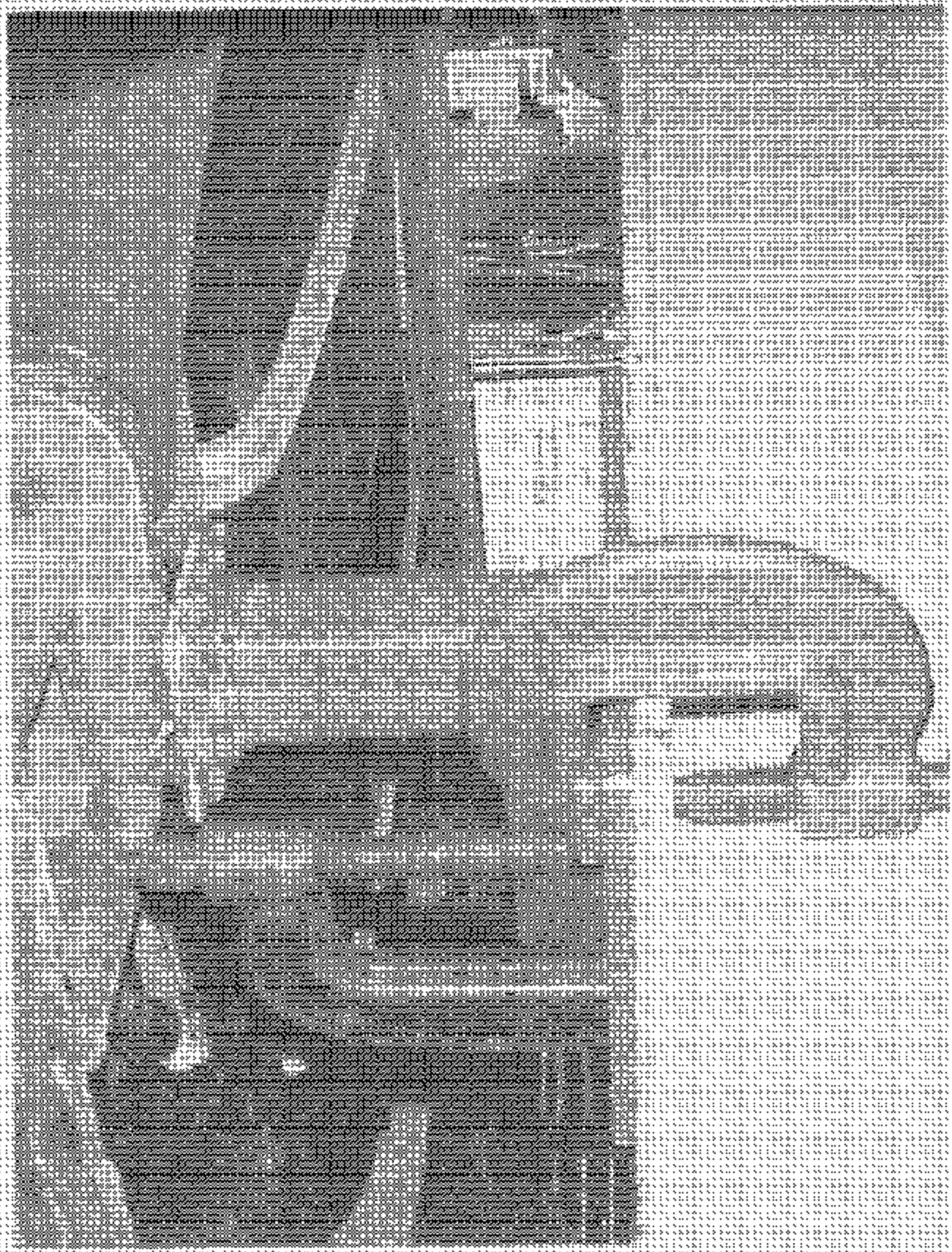


FIGURE 5.8
LEFT REAR VEHICLE MOUNTINGS

2003 FORD WINDSTAR
NHTSA NHTSA
FMVSS NHTSA

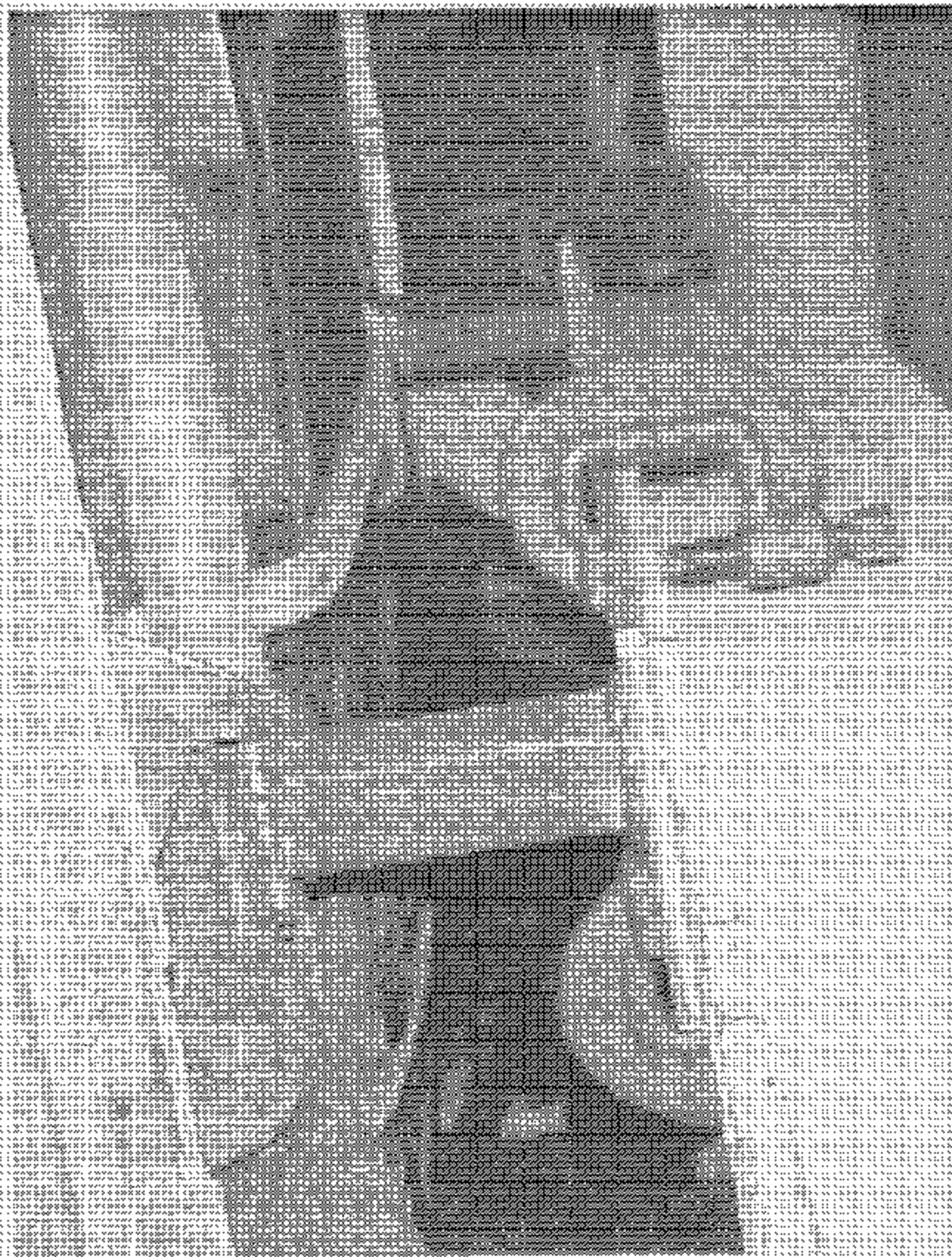


FIGURE 5.12
RIGHT REAR VEHICLE MOUNTING

FOR A MORE DETAILED
VIEW OF THE
REAR VEHICLE MOUNTING
SEE FIGURE 5.13

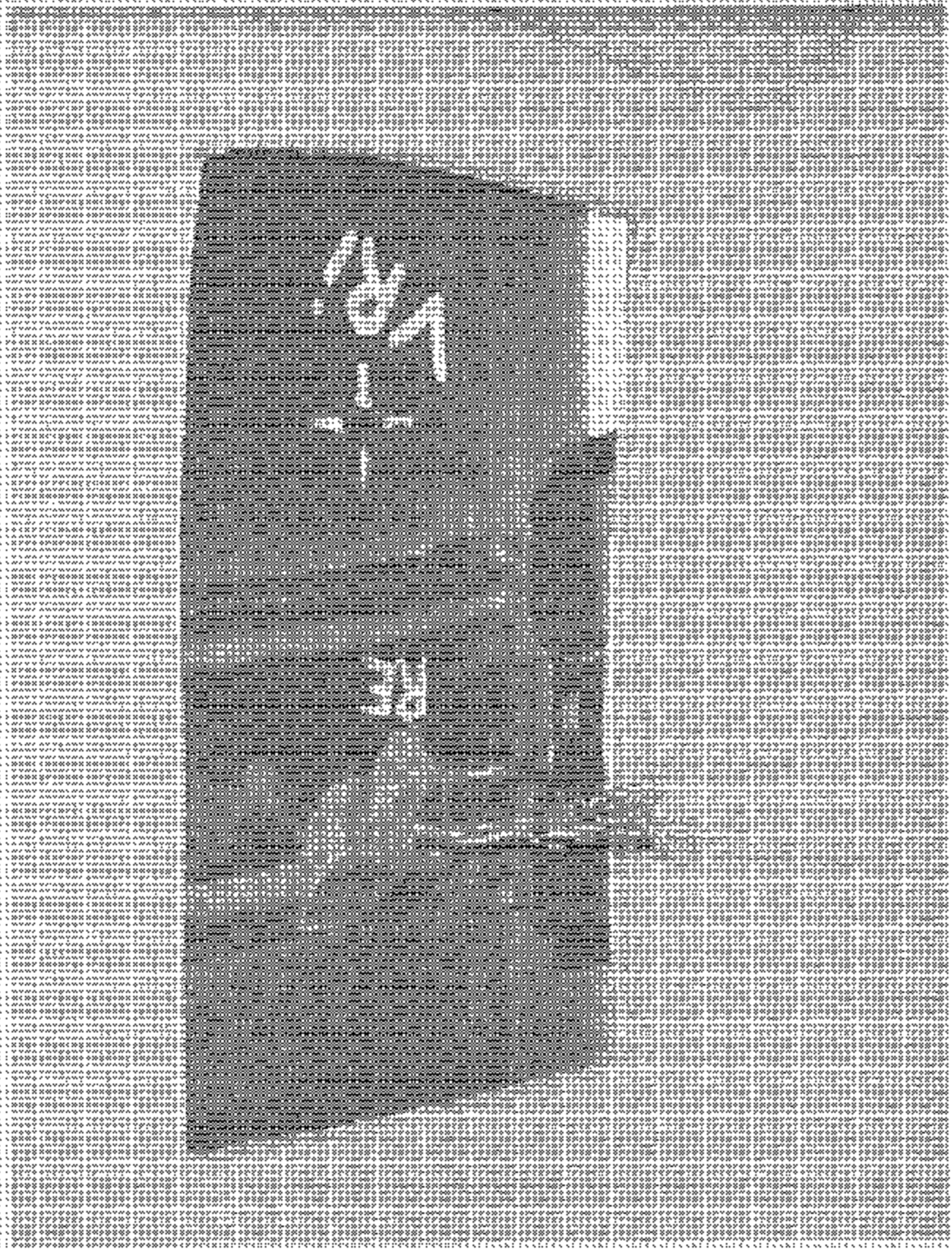


FIGURE 1
LVDI DISPLACEMENT MOUNTING TO FOOT

2005 FORD WINDSTAR
NHTSA NO. C32928
STAYS NO. 215

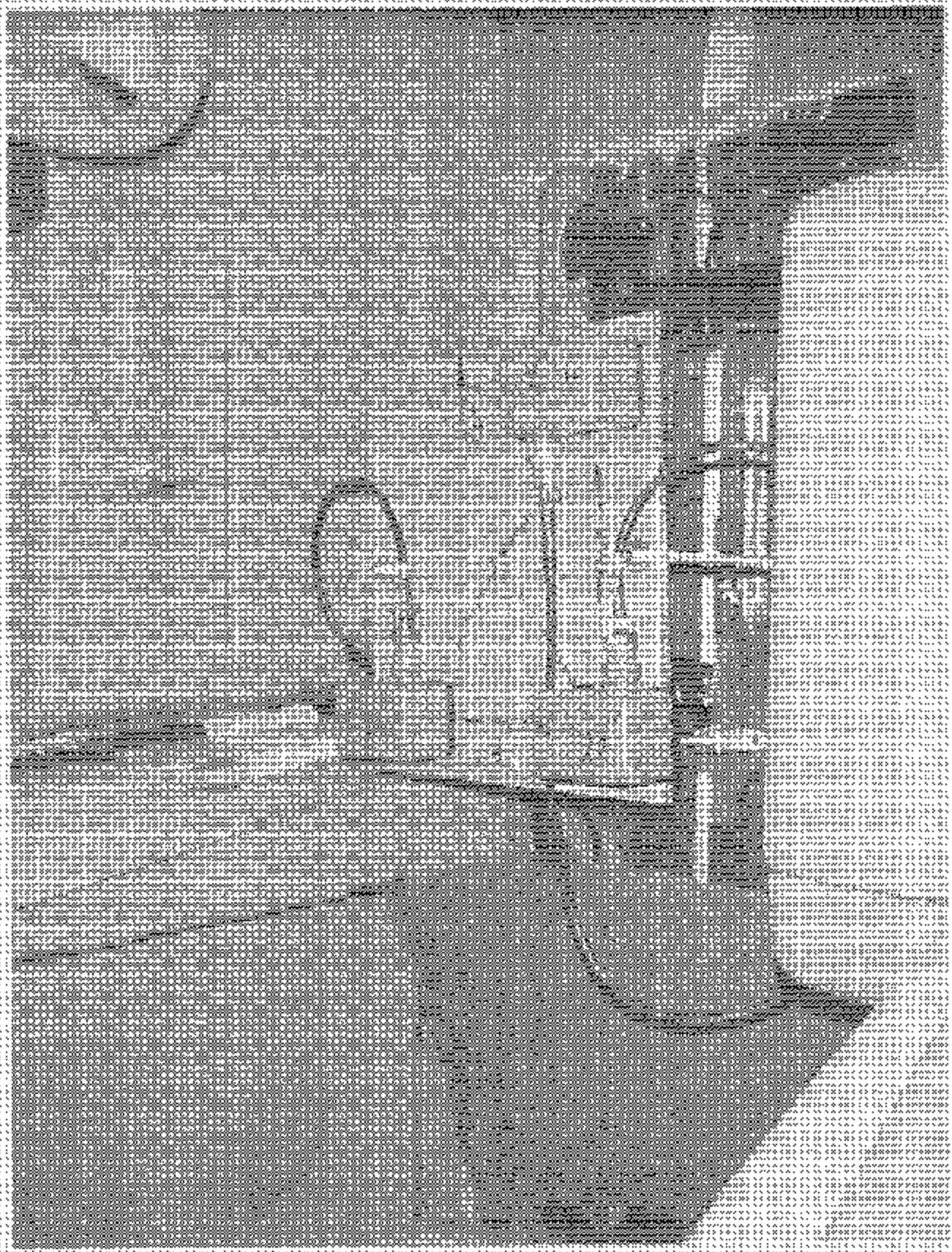


FIGURE 6.12
LVDT TRANSDUCER MOUNTING AT J1 POINT

UNIVERSITY OF VIRGINIA
NHE SA NO. C00208
NHE SA NO. 316

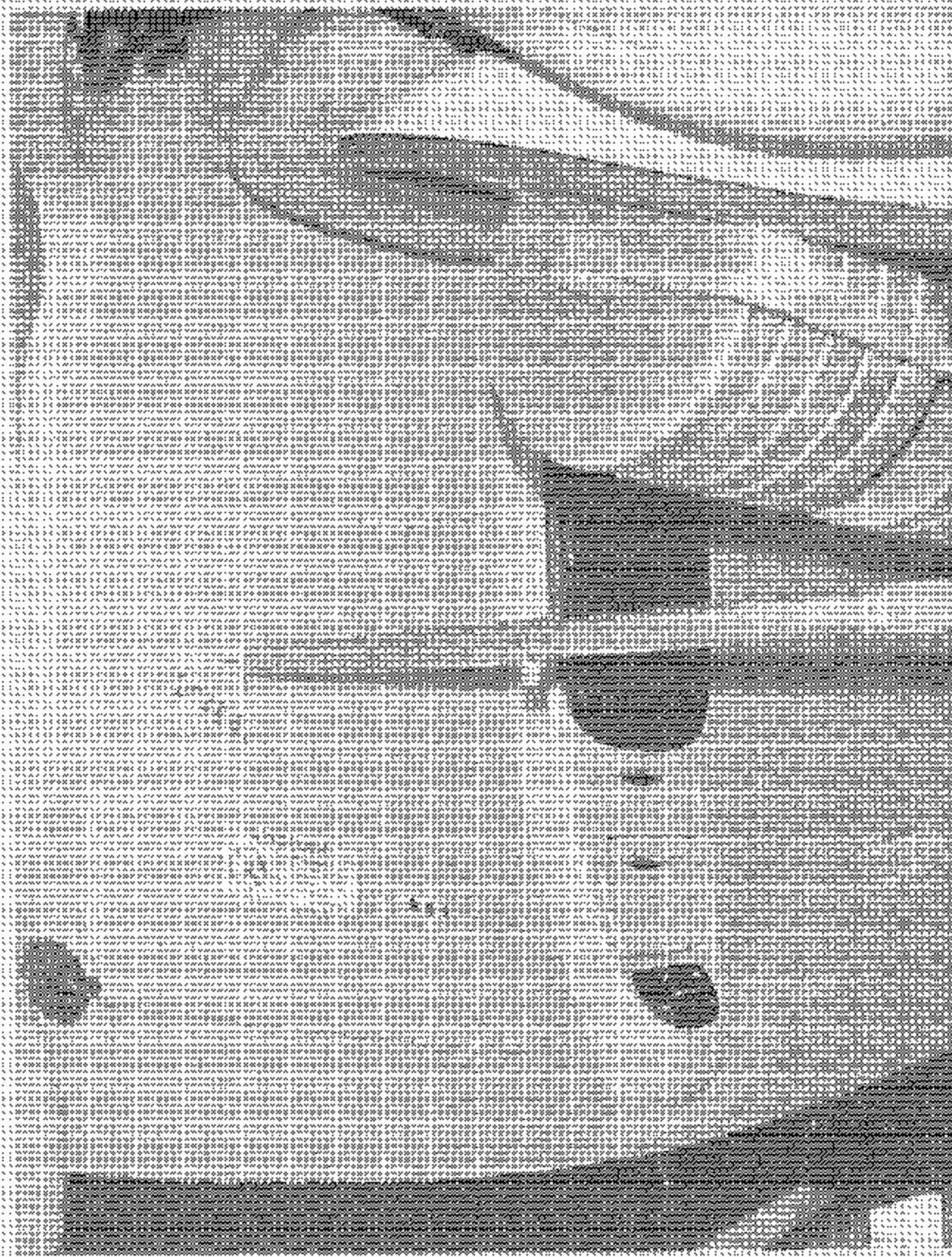


FIGURE 8-3
VIEW SHOWING MEASUREMENT OF VKI

UNIVERSITY OF WINDSTARS
WINDSA NO. C20208
WINDSA NO. 316

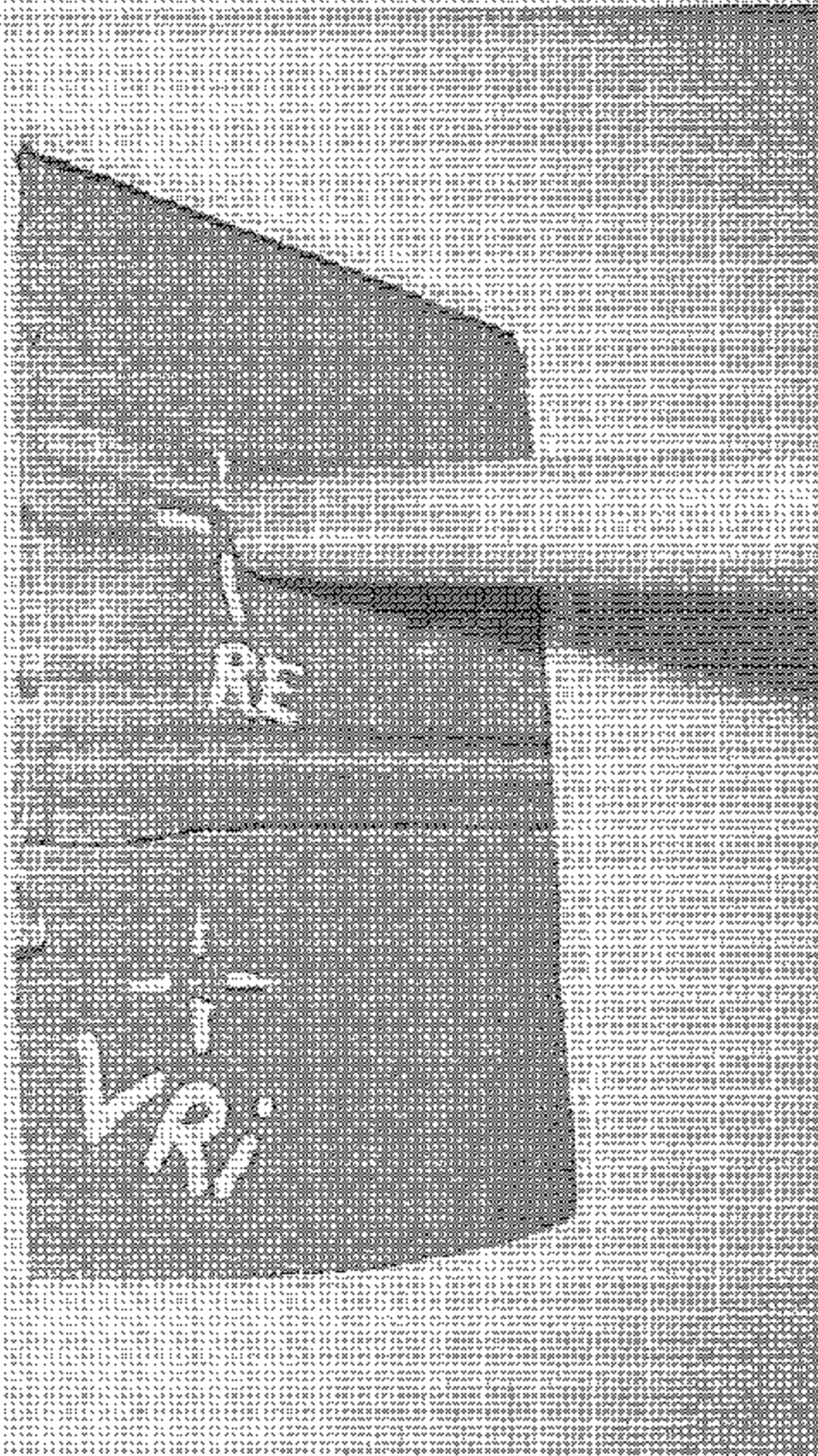


FIGURE 14
VIEW SHOWING AREA ELEMENT OF VARI AND RE

2003 FORD VARIATION
NHTSA NO. 2003-01
FMVSS NO. 216

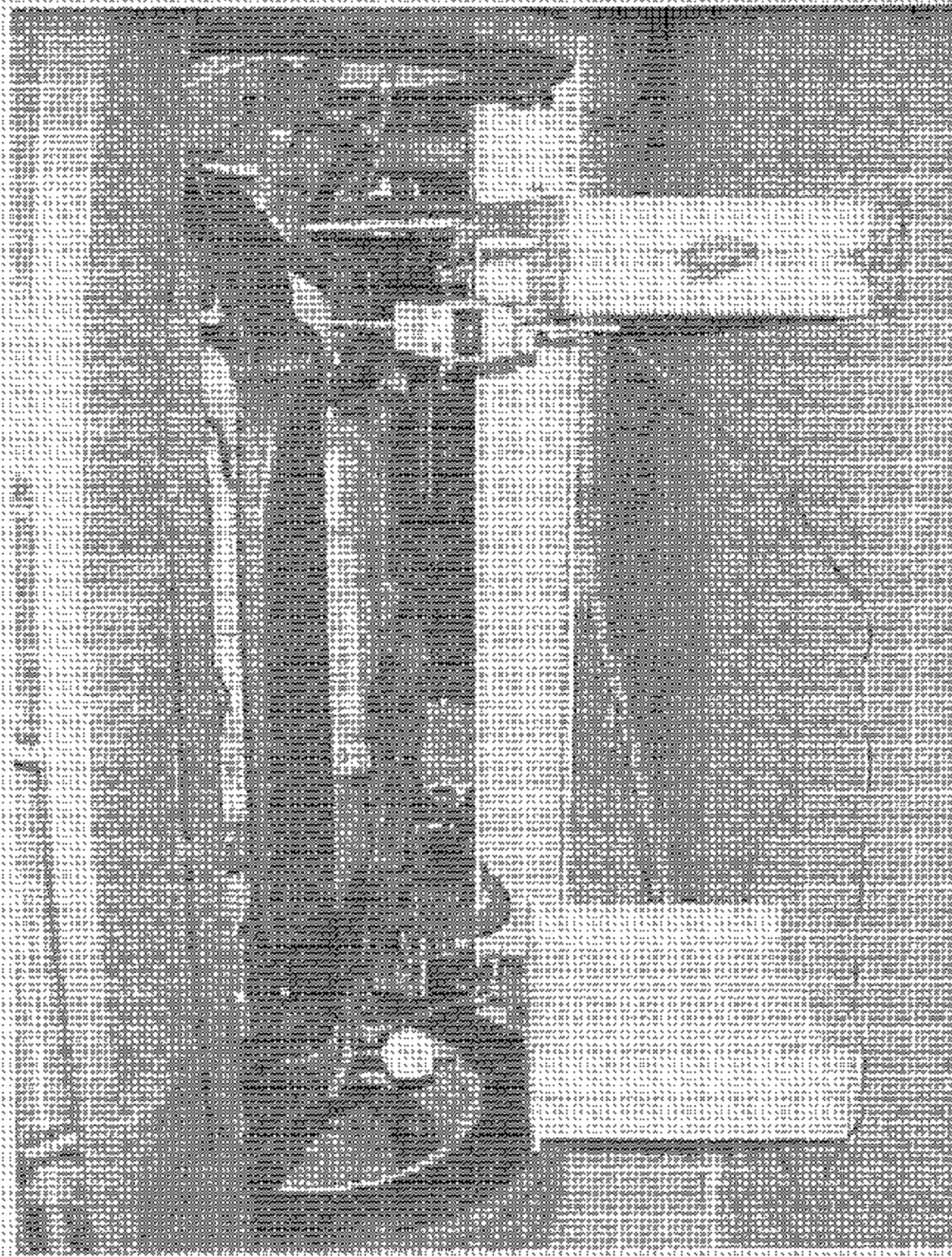


FIGURE 6-10
DISPLACEMENT INDICATORS AT FRONT OF VEHICLE

2005 FORD SUPER DUTY
AMT SA NO 05026
FWBSS NO 216

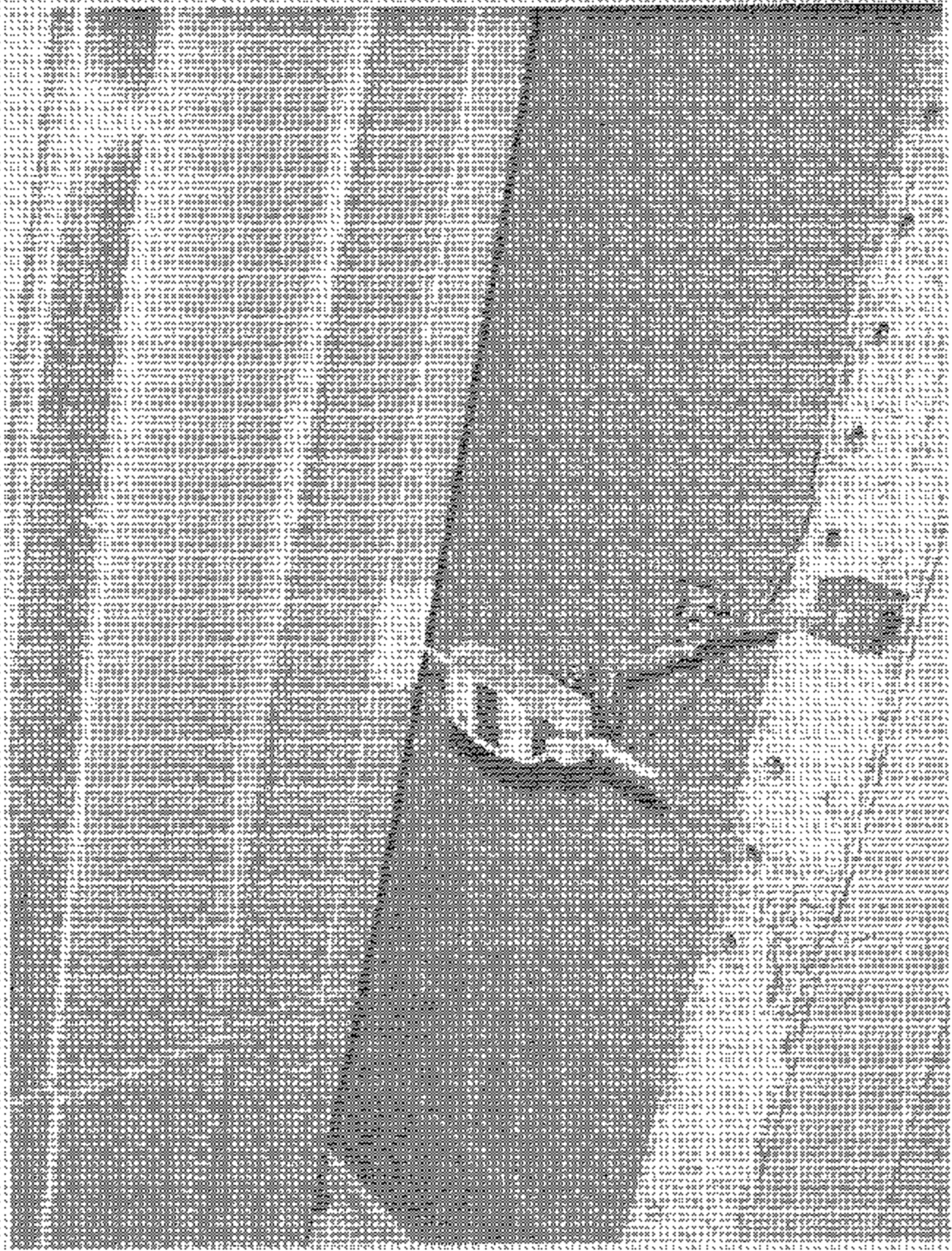


FIGURE 6-15
DISPLACEMENT INDICATIONS AT PASSENGER DOOR
SITE

2004-01-01 00:00:00
NM 5400 CH 256
FLYSSAD 216

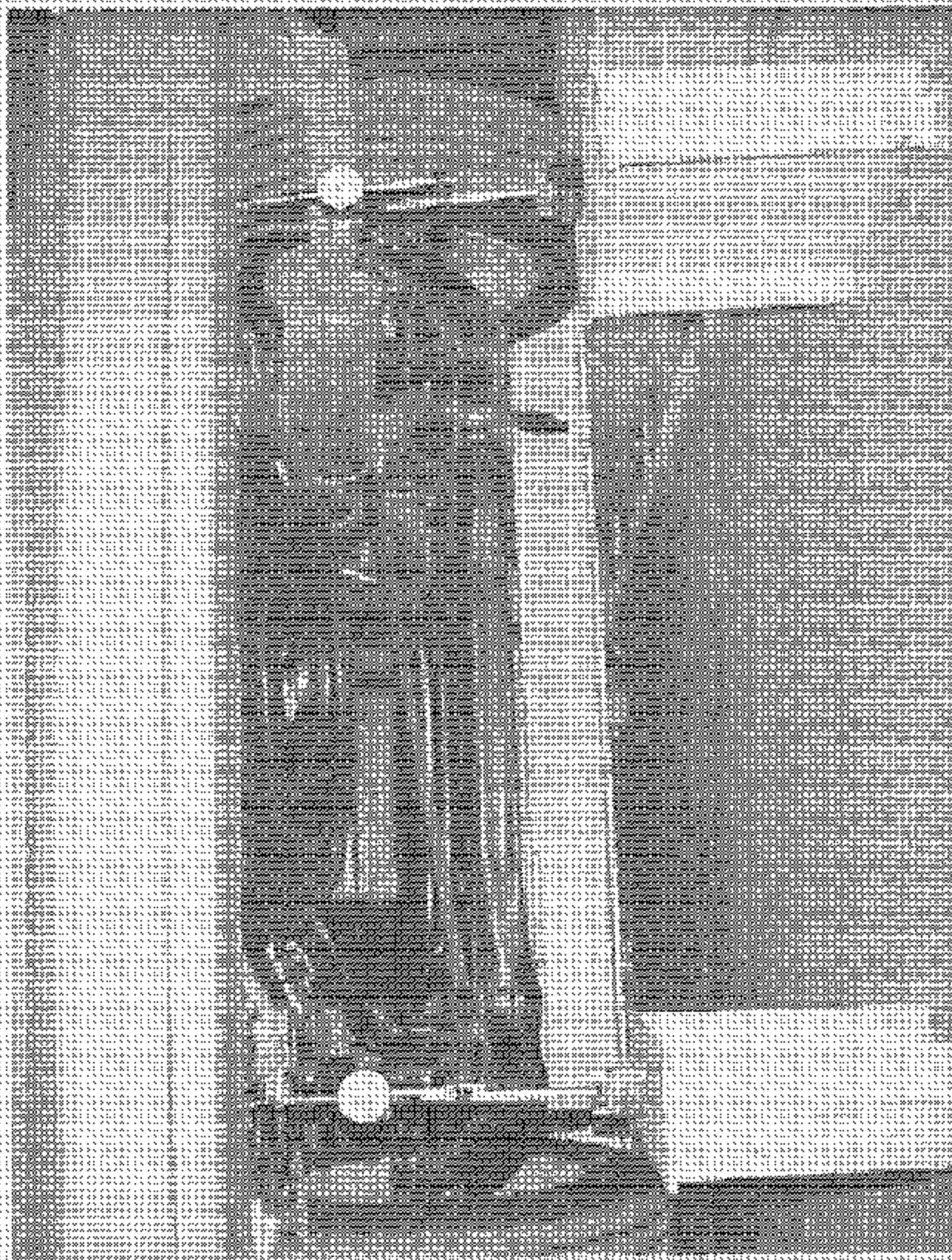


FIGURE 8.7
DISPLACEMENT INDICATORS AT REAR OF VEHICLE

2013 FORD WINDSTAR
NHTSA NO. C300208
EPA NO. 216



2003 FORD WINDSTAR
NHTSA NO. C-0253
FLYSS NO. 219

FIGURE 6-15
FRONT VIEW OF LOADING DEVICE PLACED AGAINST
VEHICLE ROOF

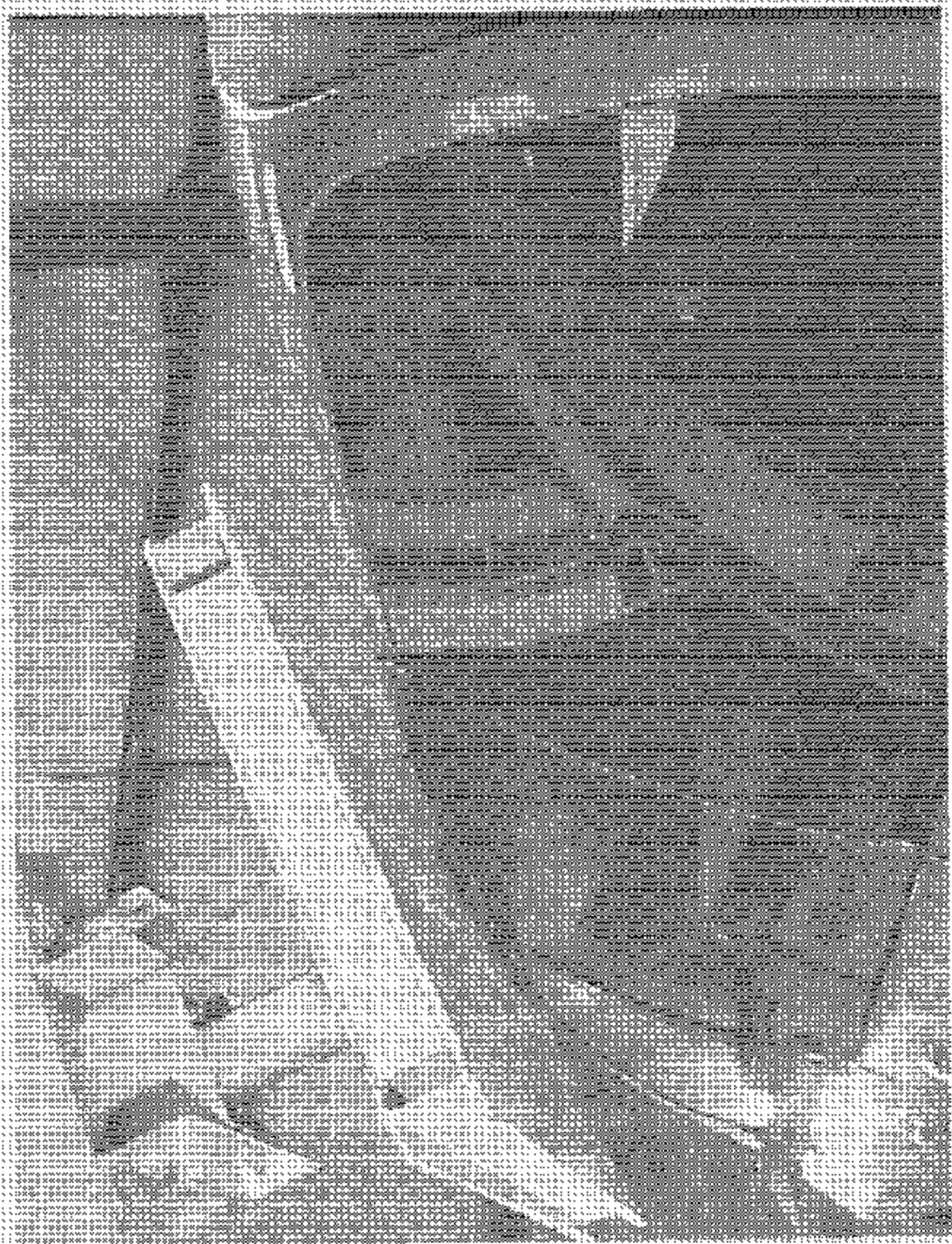


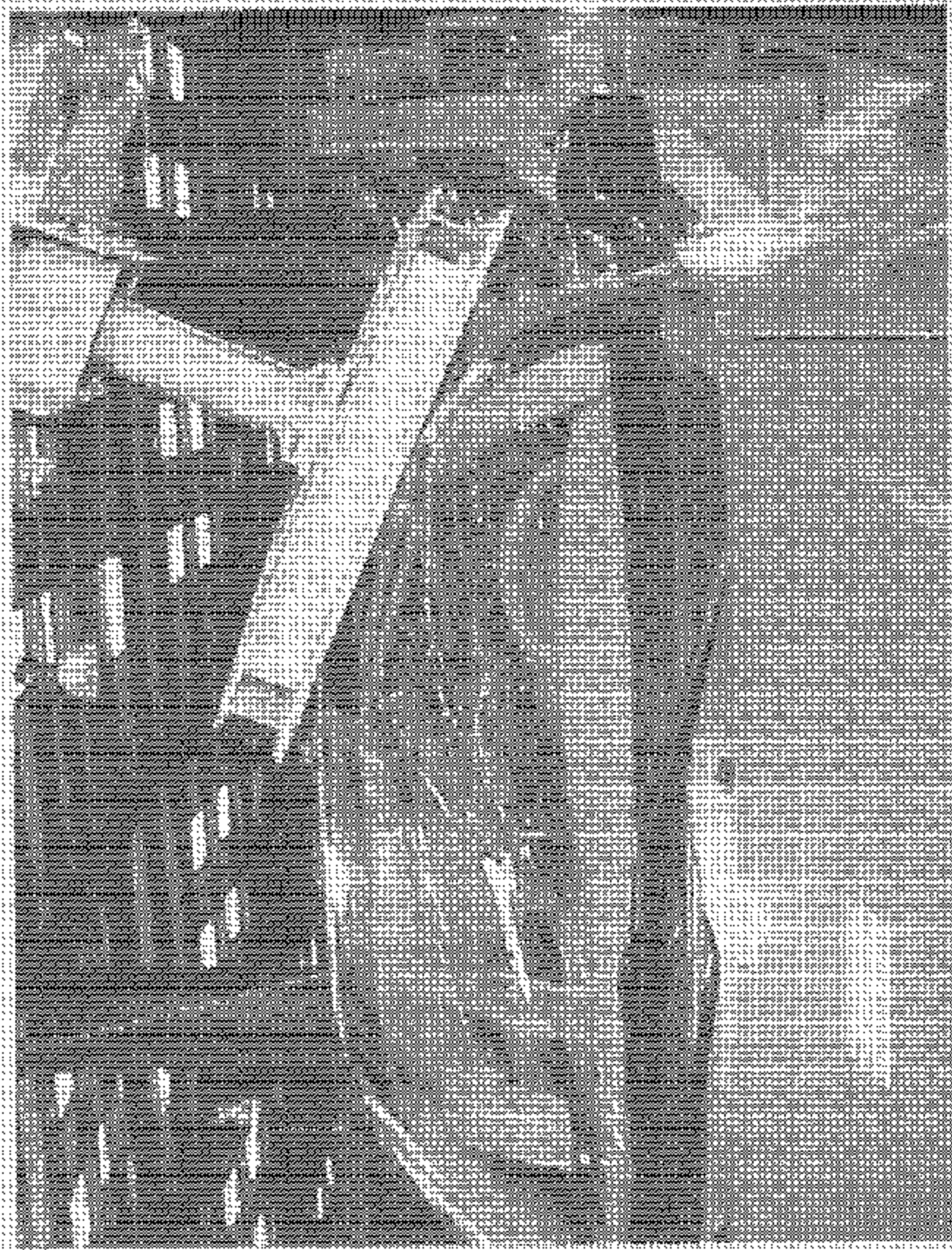
FIGURE 1
REAR VIEW OF LOADING DEVICE PLACED AGAINST
VEHICLE ROOF

2003 FORD WINDSTAR
NHTSA NEX CAR 208
EMVSS NY 2-0



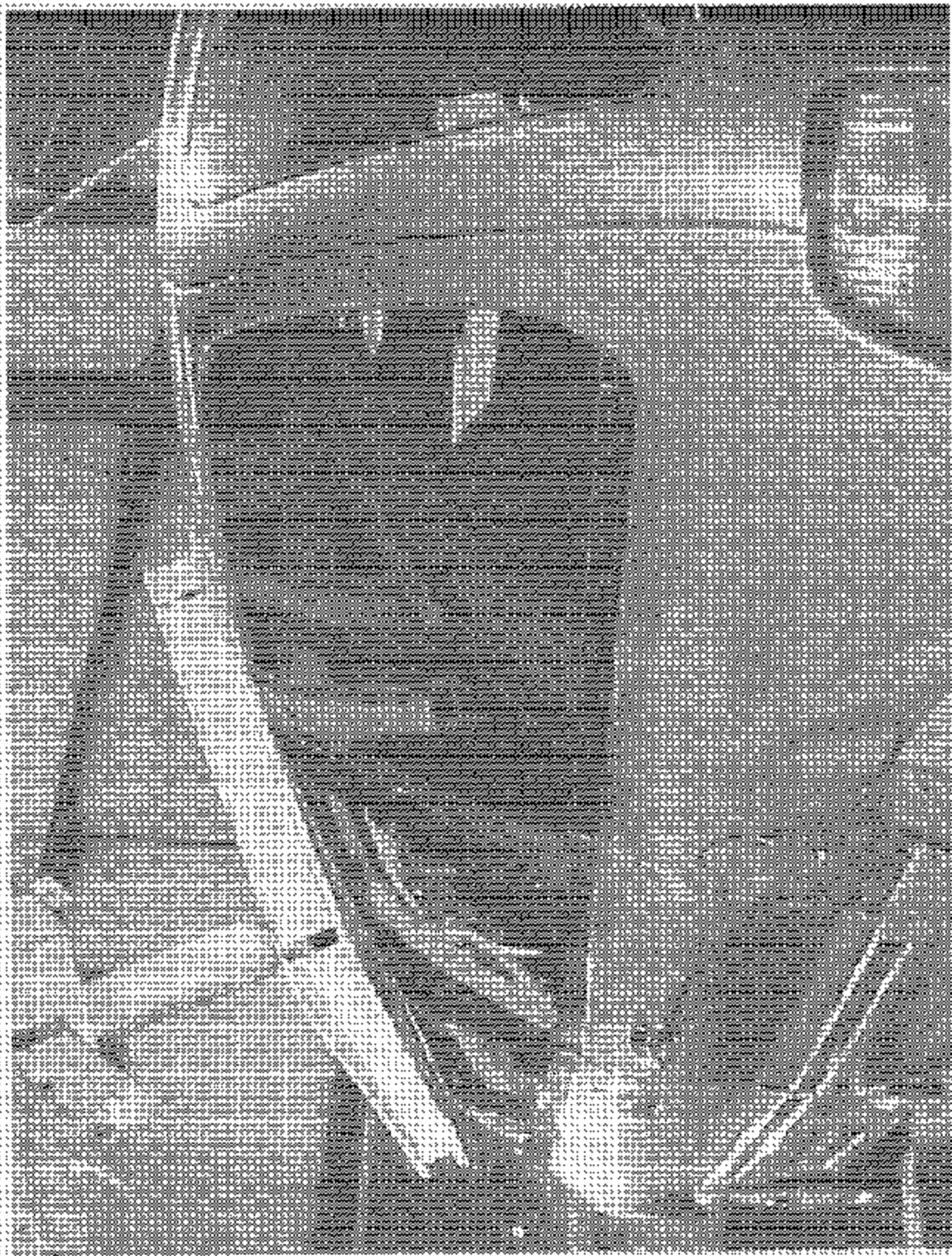
2003 FORD WINDSTAR
NHTSA NO. 030308
EMVSS NO. 216

FIGURE 6-20
SIDE VIEW OF VEHICLE DRIVER PLACED AGAINST
VEHICLE ROOF



MANUFACTURING BUILDING
SHEET NO. 200234
PROJECT NO. 216

FIGURE 6-21
FRONT VIEW OF BUILDING PLACED AGAINST
VEHICLE ROOF AT FULL LOAD



FORD TAUROS
NHTSA NO. C00258
MASS NO. 218

ENGINE 5.0L
REAR VIEW OF LOSSING DEVICE PLACED AGAINST
VEHICLE AT FULL LOAD

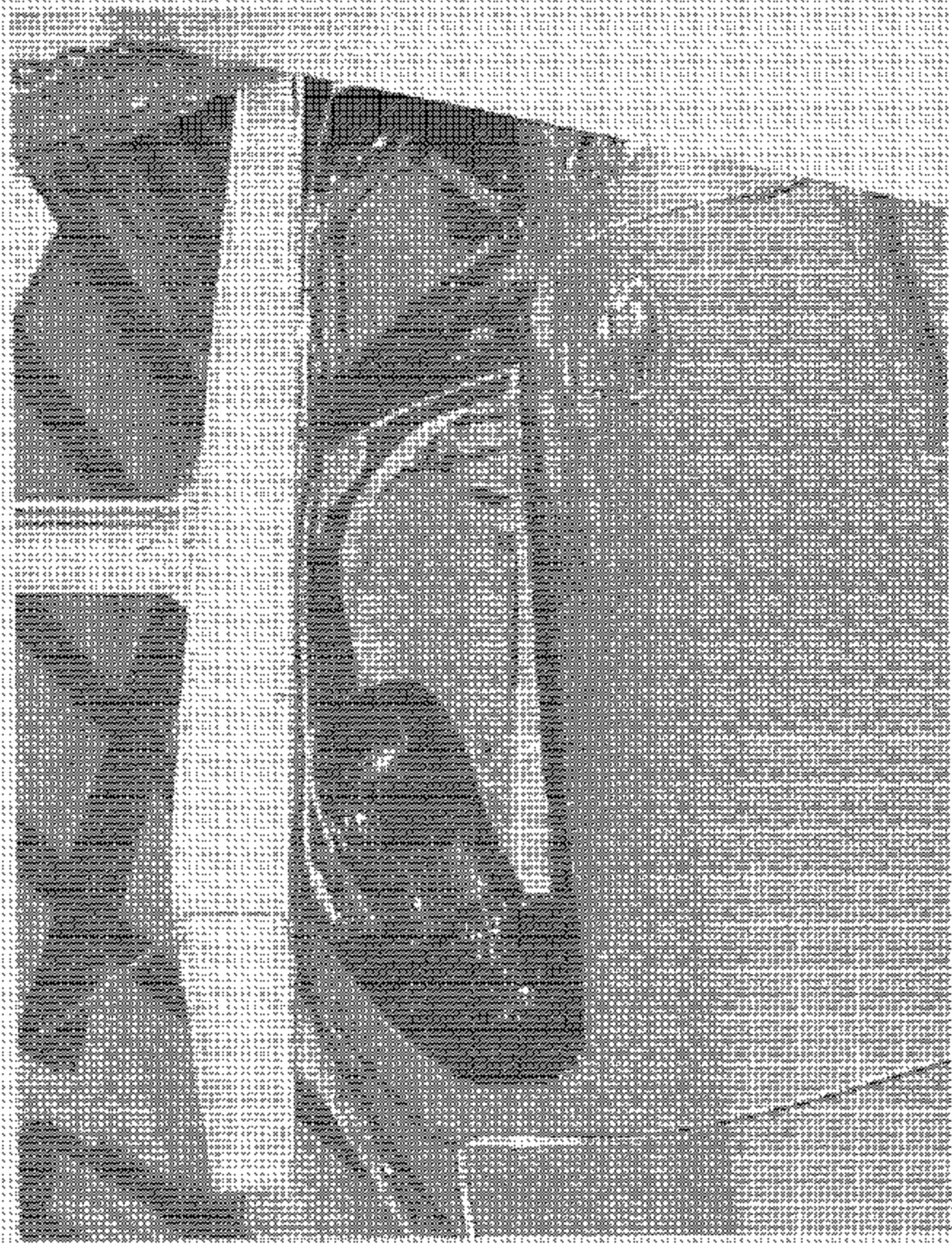
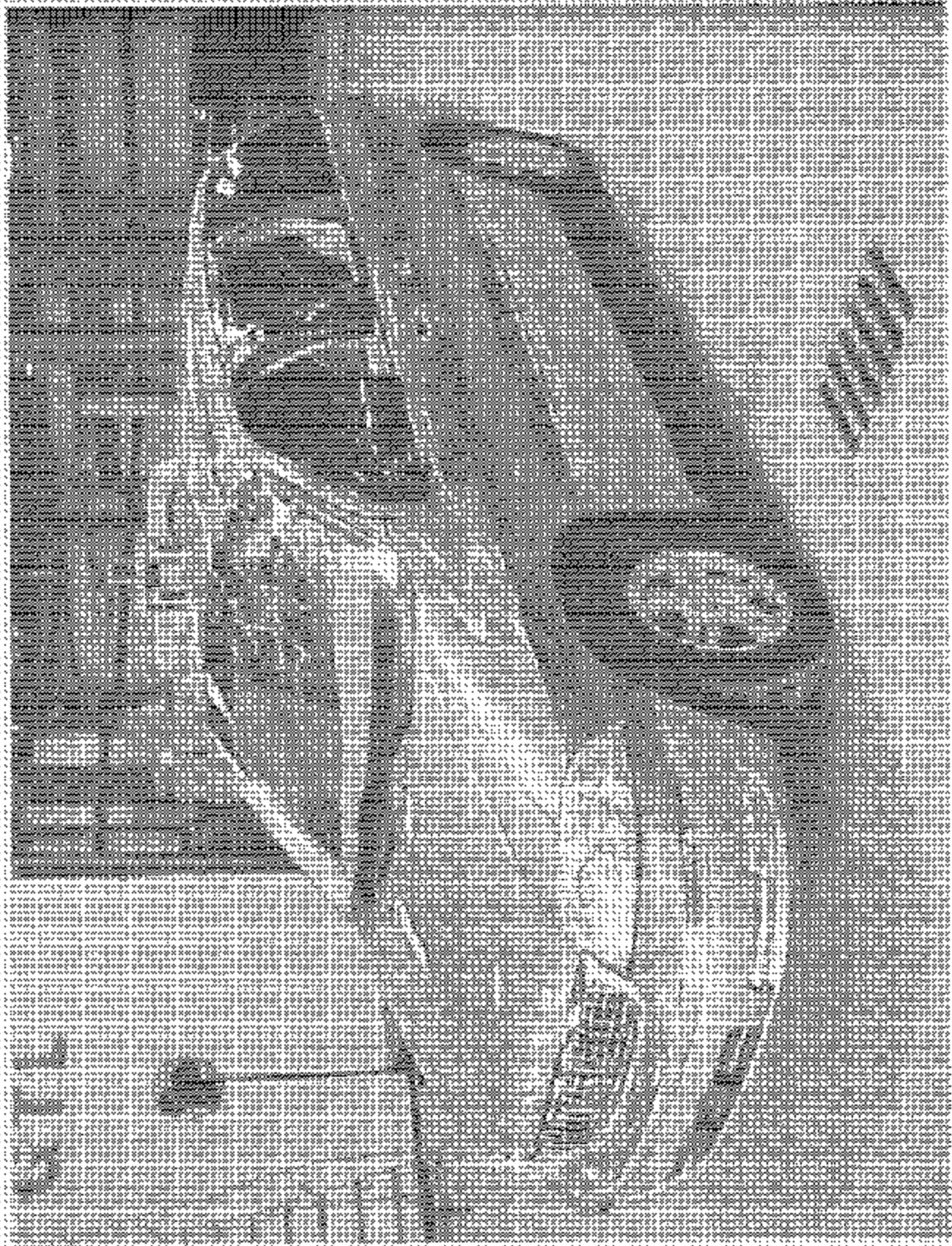


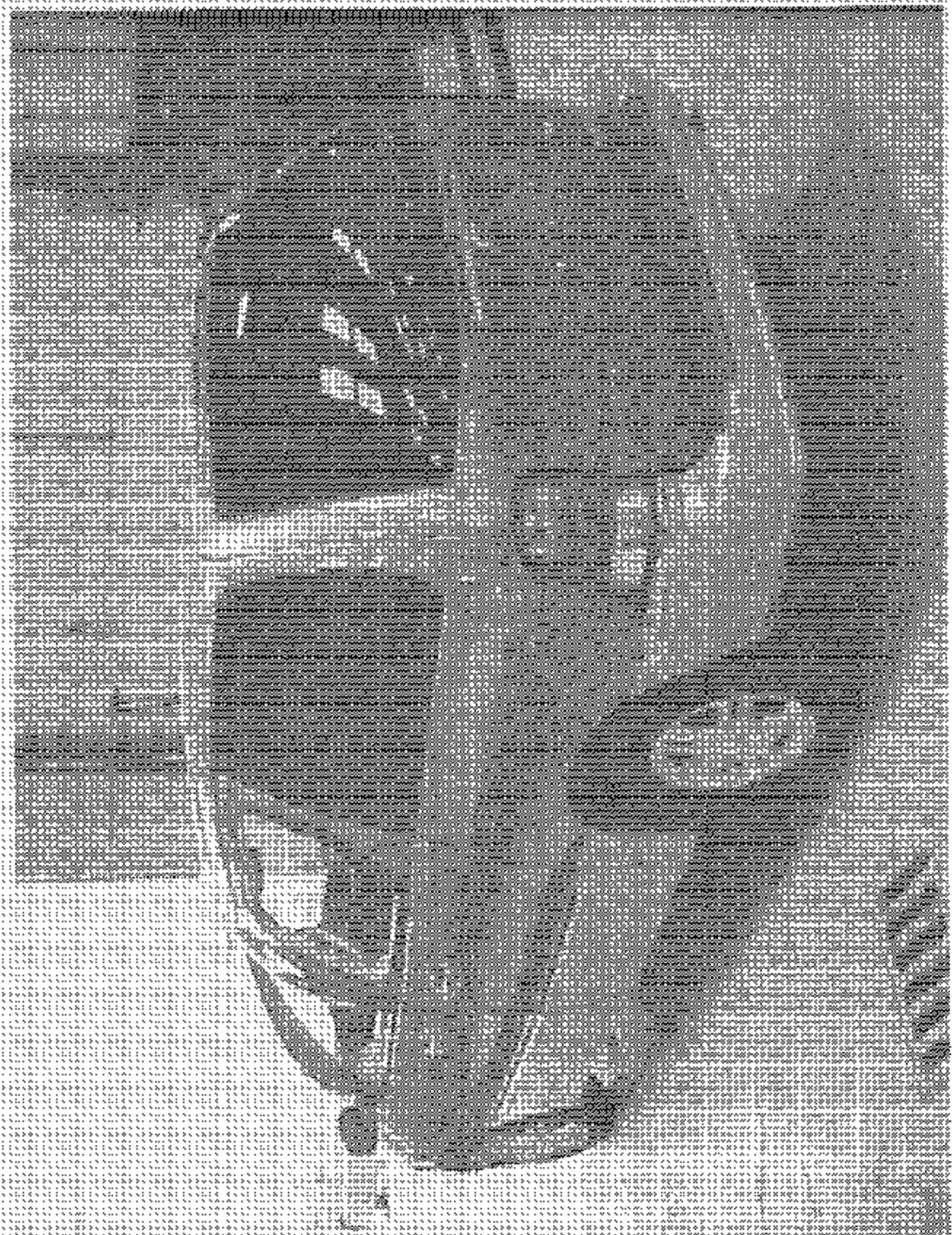
FIGURE 4-23
SIDE VIEW OF LOADING DEVICE PLACED AGAINST
VEHICLE ROOF AT FULL LOAD

2002-03-06 08:53:20
HHS-10 030208
MUS-10 030208



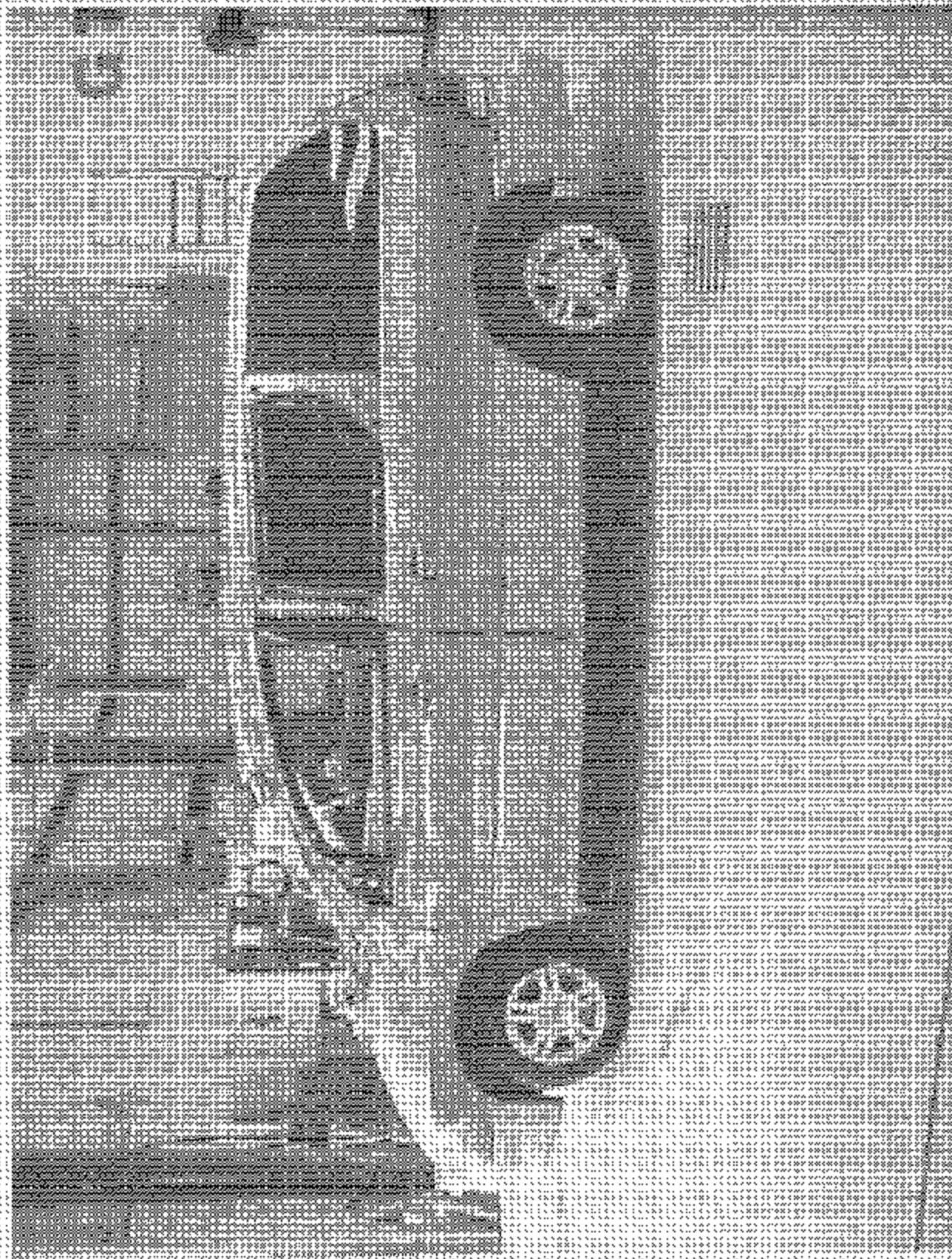
2002 FORD MUSTANG
 VIN: 1F150A0100204
 PLATE NO: 2-6

FIGURE 1004
 1/4 FORWARD VIEW OF VEHICLE ON TESTED SIDE
 AFTER TESTING



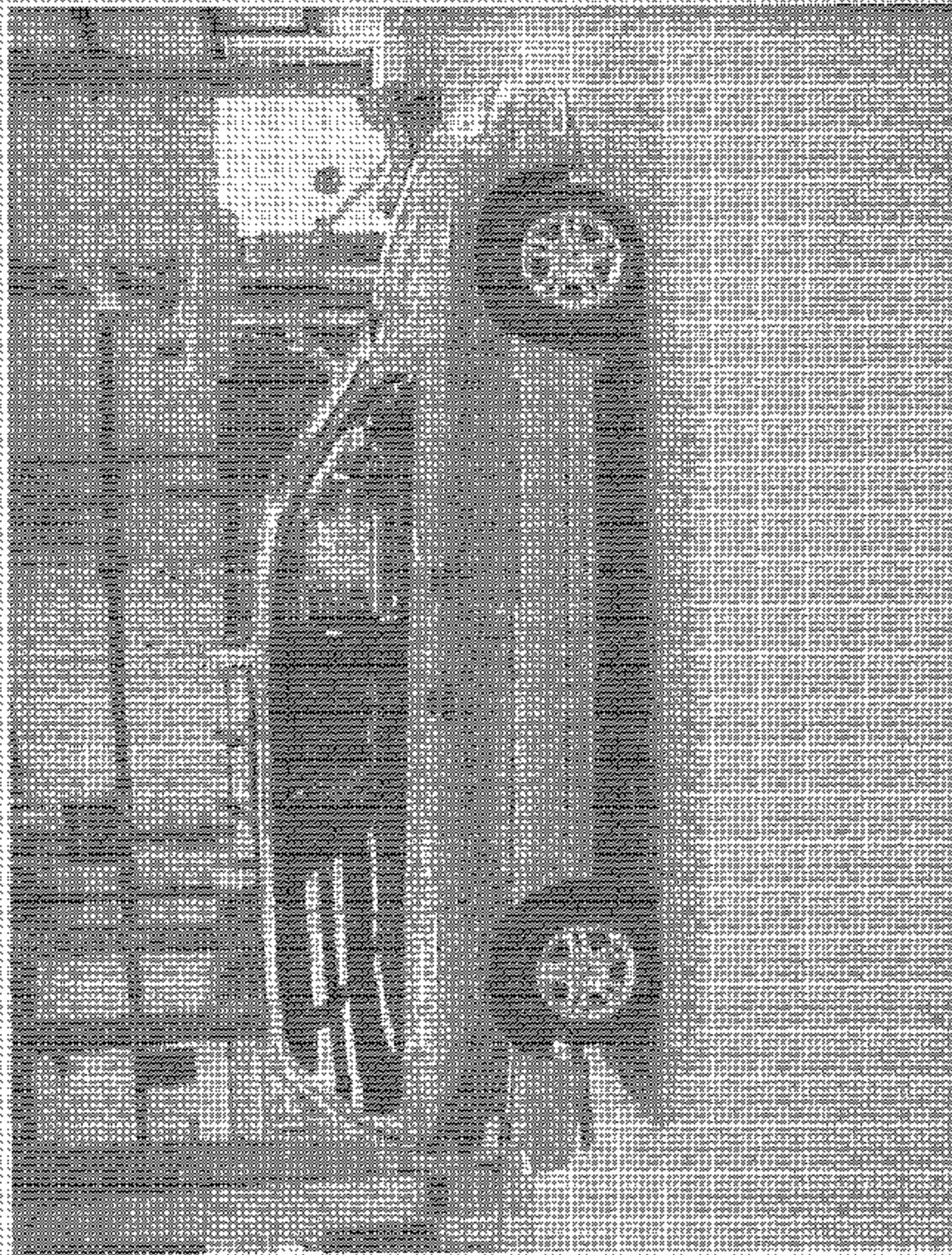
2003-POIND VINCENTIA
NHTSA NO. C10204
FMVSS NO. 216

FIGURE 6-25
REARWARD VIEW OF VENTILATION TESTED 8/21
AFTER TESTING



2003 FORD WINDSTAR
VIN: 1F150G6C300026
FMS NO. 216

FIGURE 6-26
LEFT SIDE VIEW OF VEHICLE AFTER TESTING



FORD WINDSTAR
NHTSA NO. 330486
FM9590 Z16

FIGURE 6-23
RIGHT SIDE VIEW OF WINDSTAR TEST CAR



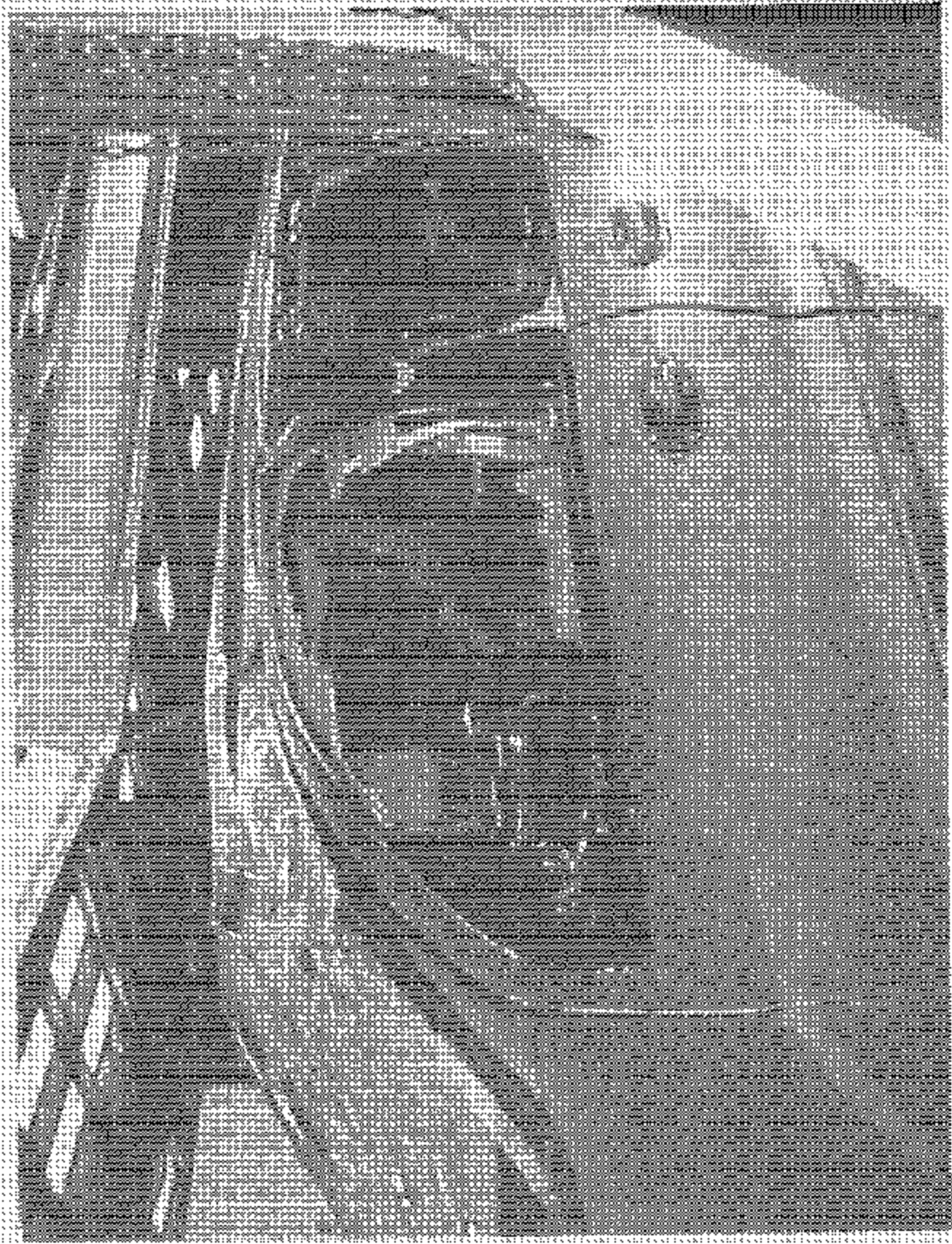
PC03F03D1WHESTAR
W/ISA, NO. 51046
EMISS 20 216

FIGURE 01
FRONT VIEW OF VEHICLE ROOF AFTER REMOVAL
W/ISA, NO. 51046



95-2 ON SCA 1
MEXICO DIVISION
2041 EDWINA DR HOUSTON TX 77058

95-2041-1000
MEXICO DIVISION
2041 EDWINA DR HOUSTON TX 77058



2013 FORD WINDSTAR
WIEBANO 100318
PAGES NO 246

FIGURE 530
SIDE VIEW OF VEHICLE ROOF AFTER REMOVAL OF
LOADING DEVICE

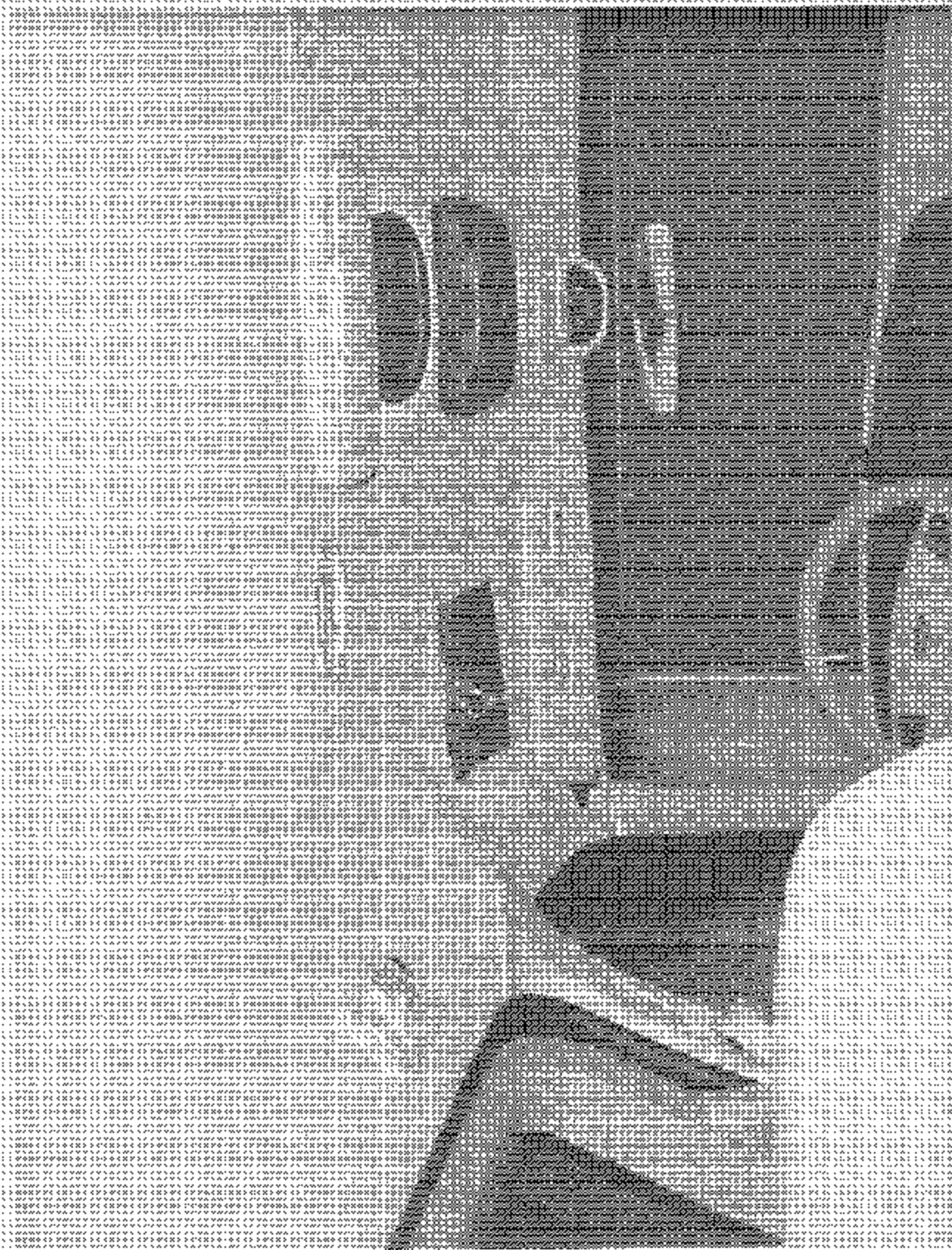


FIGURE 6-01
INTERIOR VIEW OF ROOF OF THE TRUCK

2003 FORD WINDSTAR
UNIT NO. C30258
INVEST NO. 216

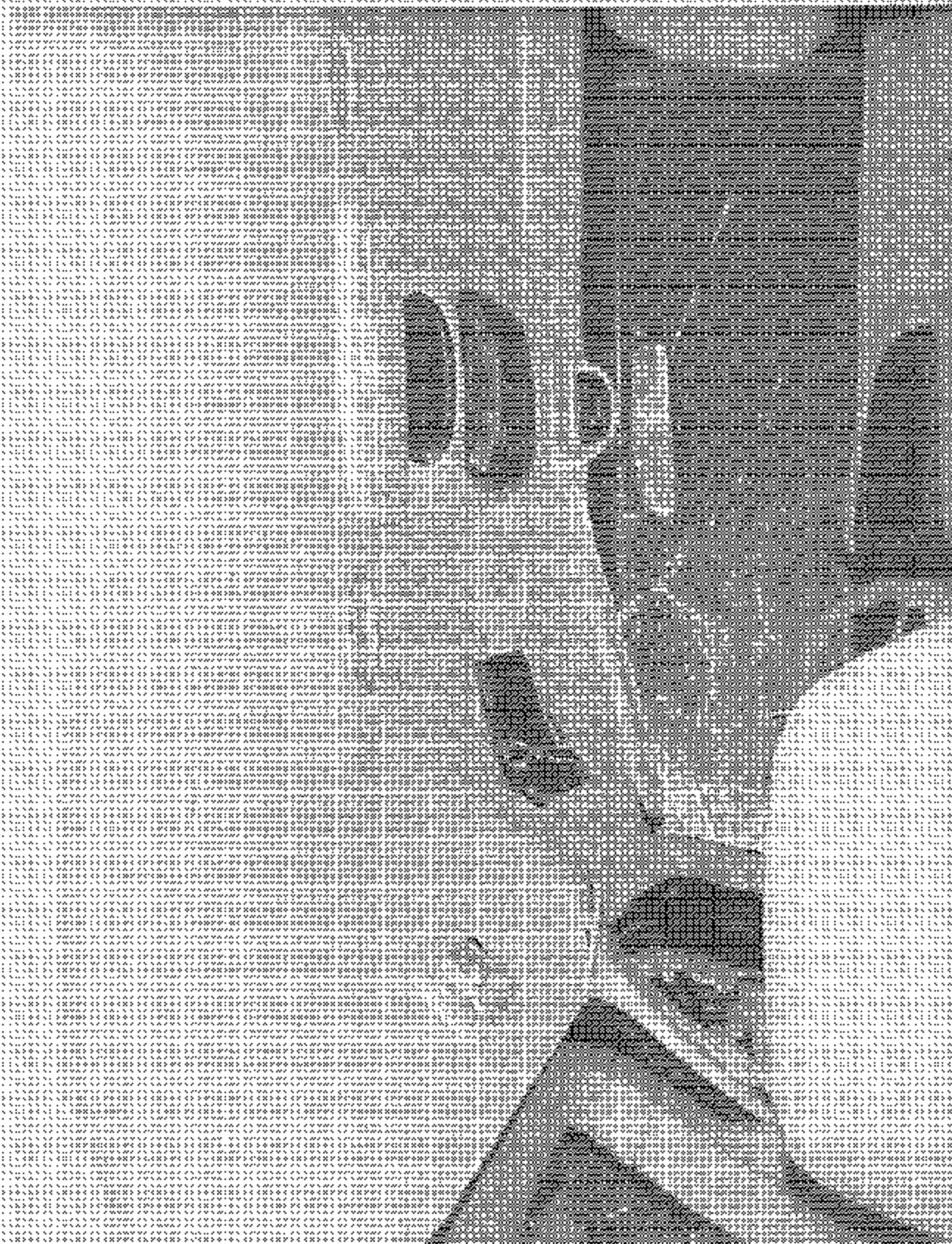
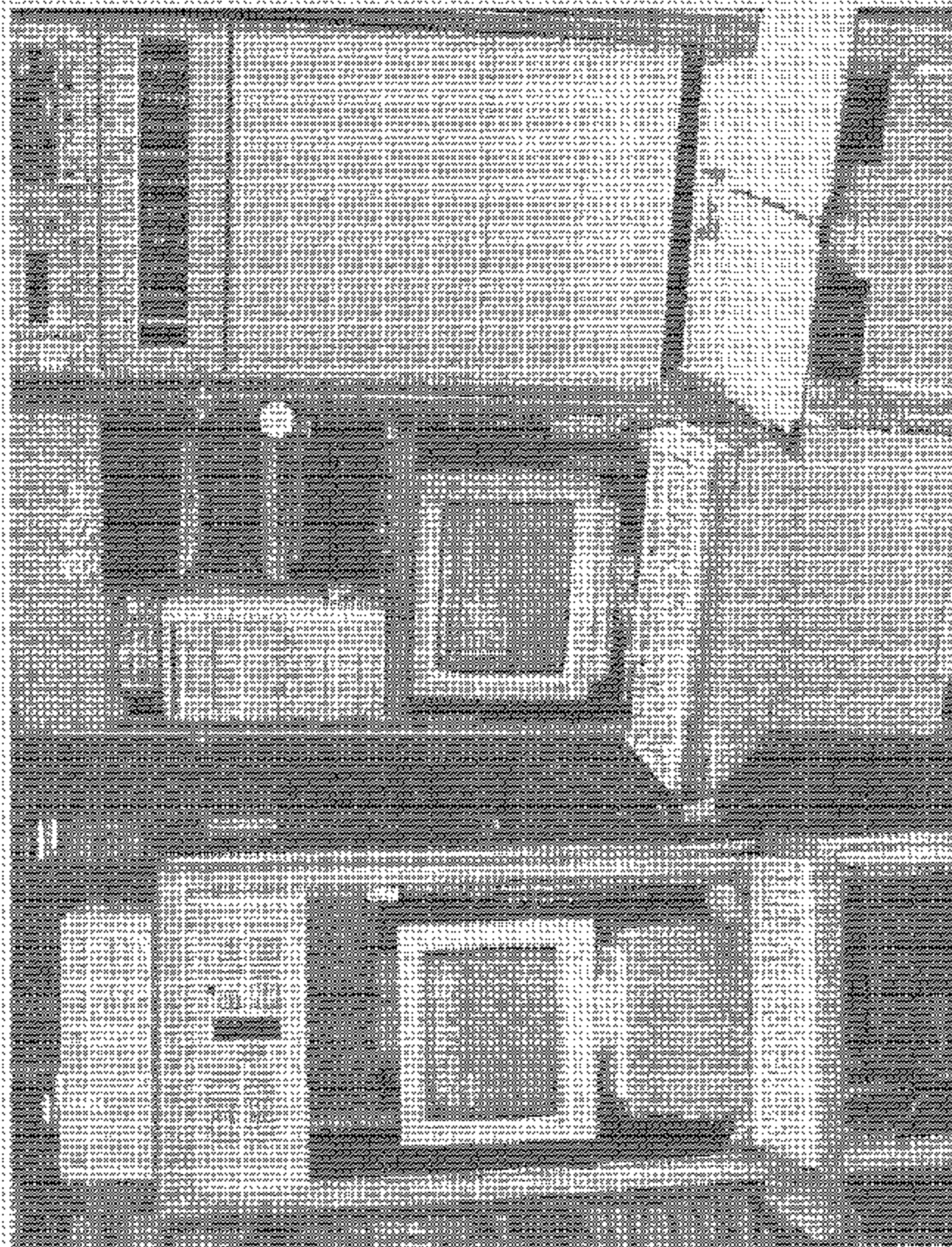


FIGURE 6-32
INTERIOR VIEW OF FRONT SEATS

2003 FORD WINDSTAR
NHTSA NO. C30235
FMVSS NO. 215



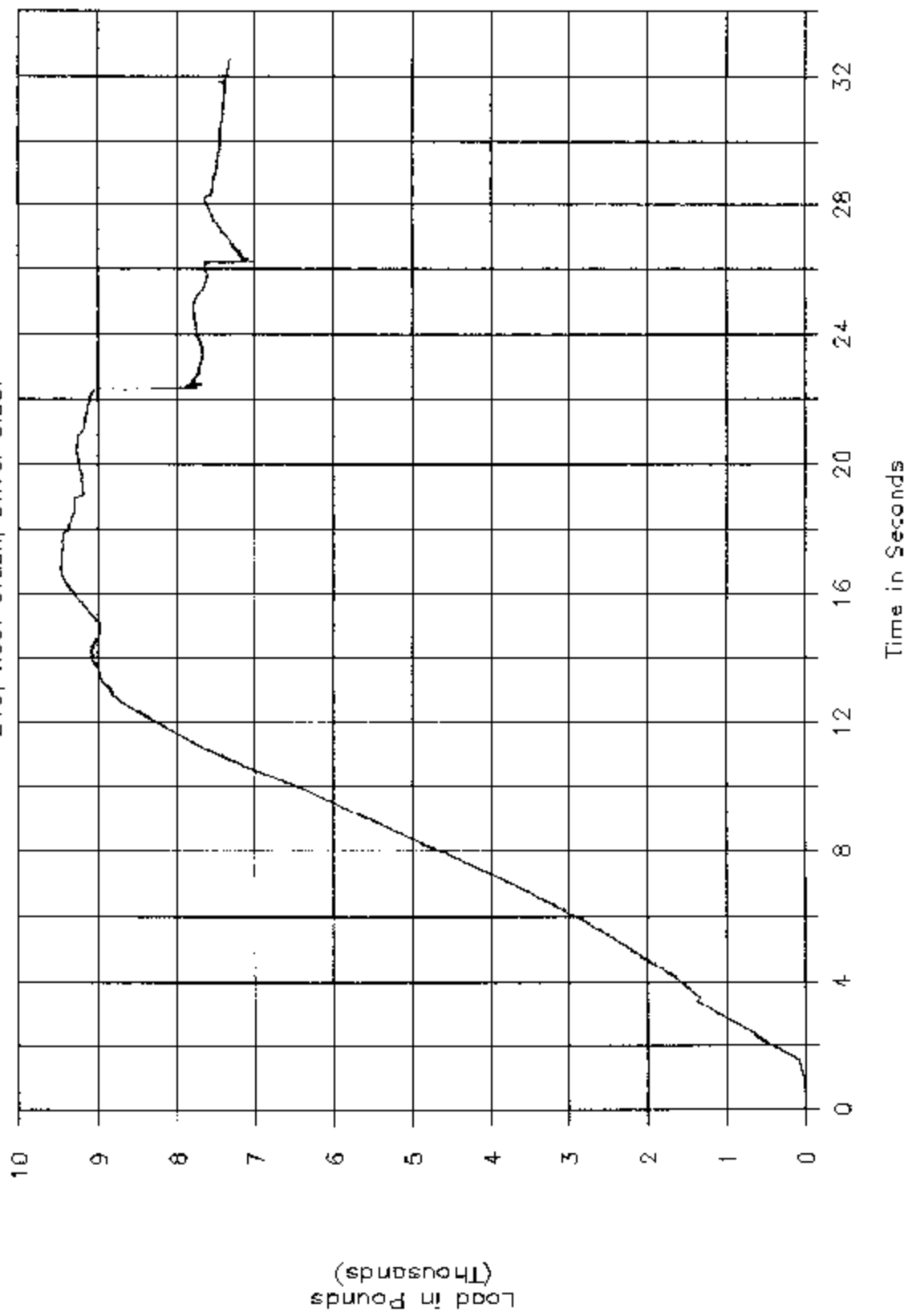
41136001XN7M01SM
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03005 0125JAN
M15E1AR 08102002

SECTION 6
TEST PLOTS

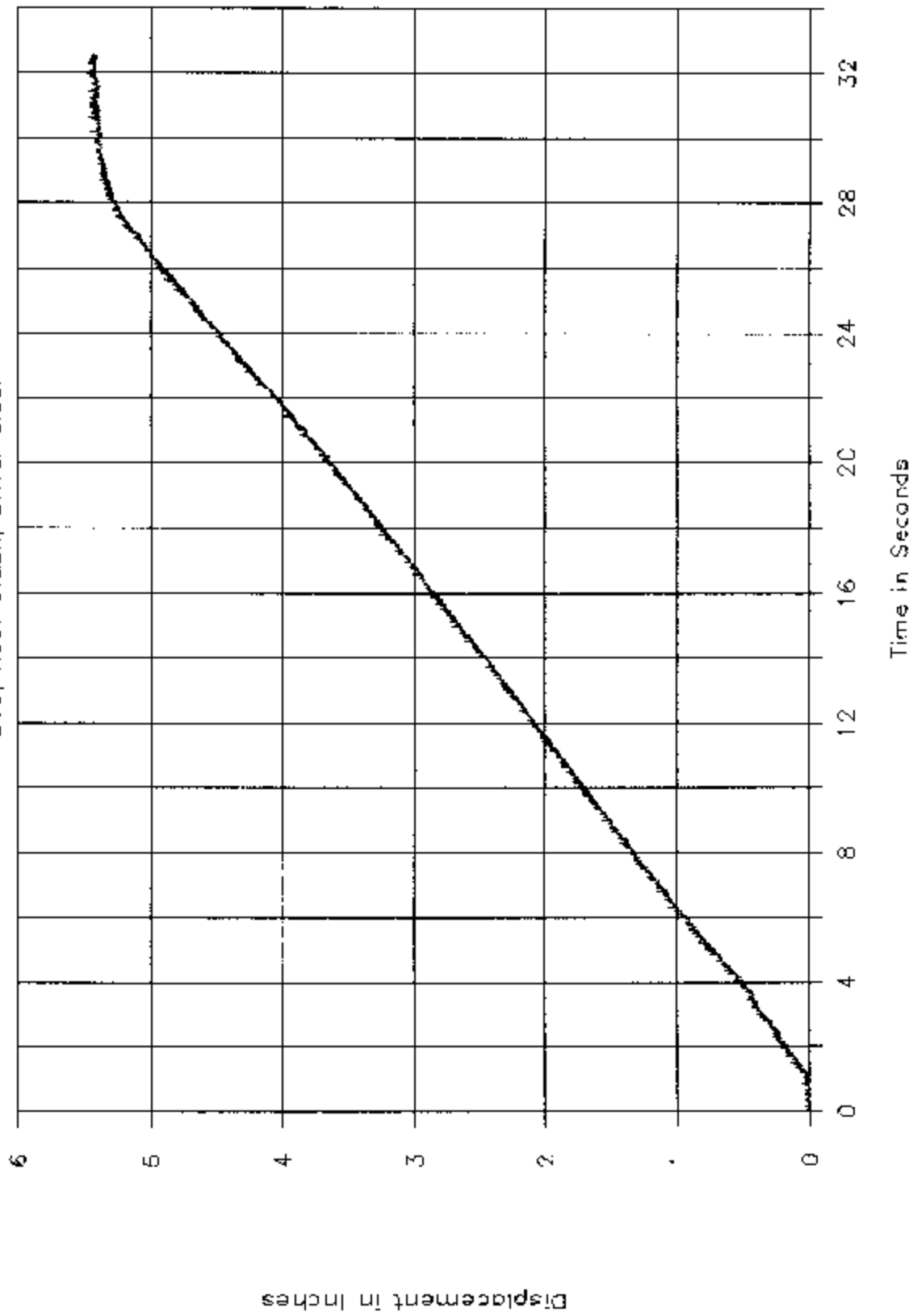
GTL 5102

216, Roof Crush, Driver Side.



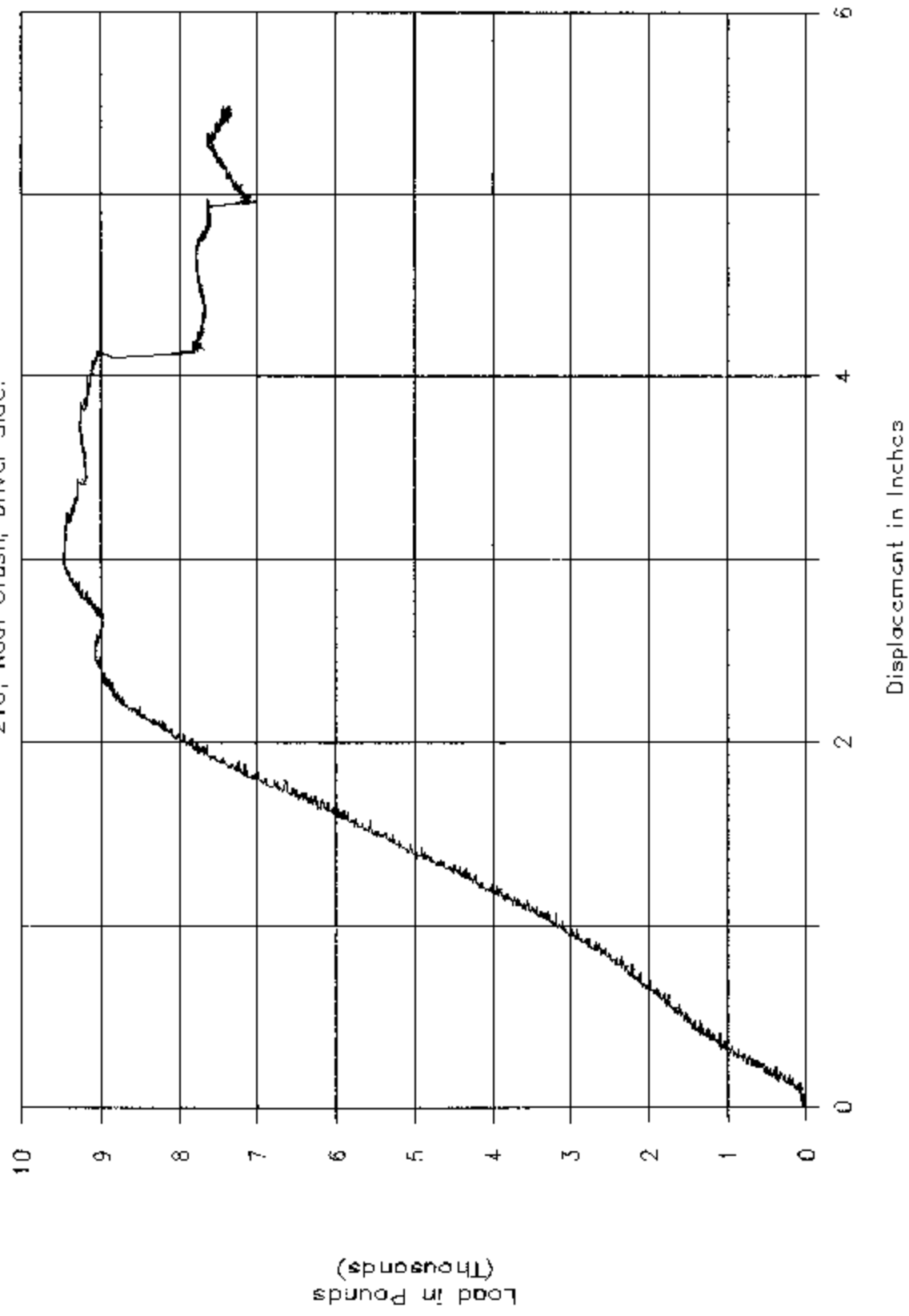
GTL 5102

216, Root Crush, Driver Side.



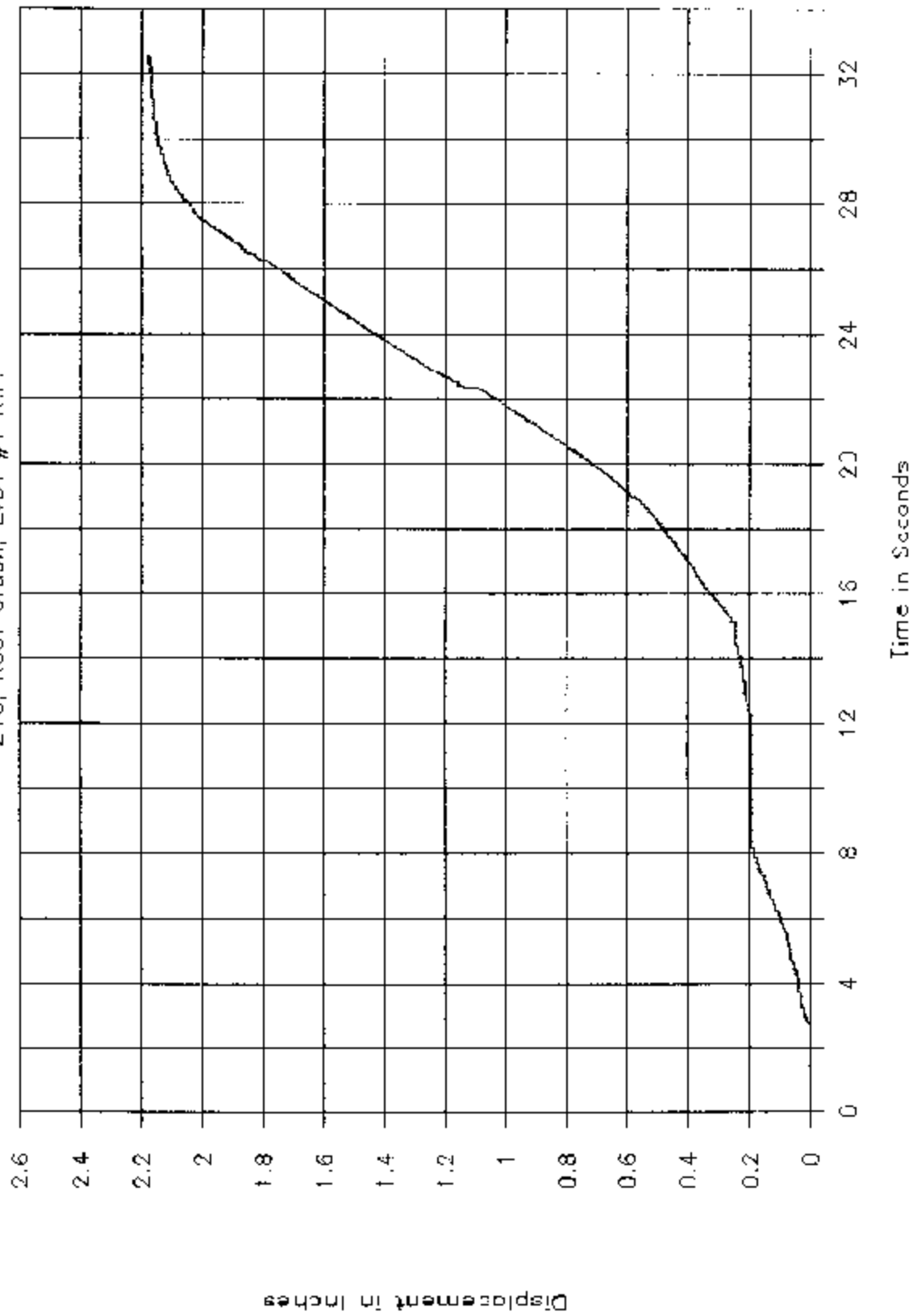
GTL 5102

216, Roof Crush, Driver Side.



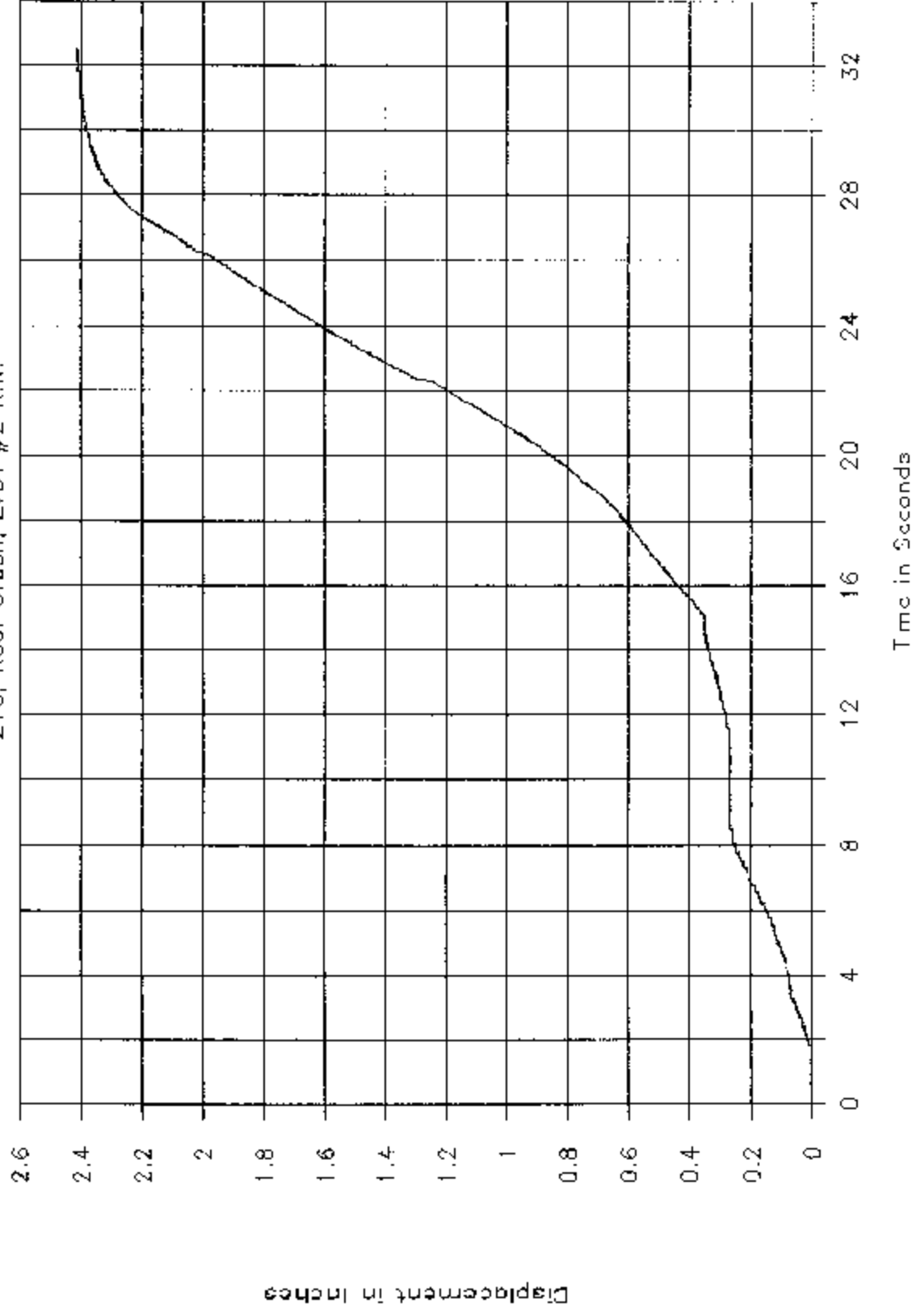
GTL 5102

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



GTL 5102

216, Roof Crush, LVDT #2 R.R.



GTL 5102

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

