

REPORT NUMBER 216-GTL-03-001

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

**BAYERISCHE MOTOREN WERKE AG  
2003 MINI COOPER, PASSENGER CAR  
NHTSA NO. C30506**

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



JULY 21, 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 8111 (NVS-220)  
WASHINGTON, D.C. 20590**

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## SECTION 1

### PURPOSE OF COMPLIANCE TEST

#### 1.0 PURPOSE OF COMPLIANCE TEST

A 2003 Mini Cooper 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 Mini Cooper. Nomenclature applicable to the test vehicle are:

A. Vehicle Identification Number: WMWRC33493TC41282

B. NHTSA No.: C30506

C. Manufacturer: BAYERISCHE MOTOREN WERKE AG

D. Manufacture Date: 11/02

#### 1.2 TEST DATE

The test vehicle was subjected to FMVSS No. 216 testing on July 01, 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 50<sup>th</sup> 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 4536 KG 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 Mini Cooper 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 Mini Cooper.

DATA SHEET 1  
FMVSS 216  
SUMMARY OF RESULTS

VEH. MOD YR/MAKE/MODEL/BODY: 2003 MINI COOPER PASSENGER CAR  
VEH. NHTSA NO: C30506; VIN: WMWRC33493TC41282  
VEH. BUILD DATE: 11/02; TEST DATE: JULY 1, 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: 1165 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: 1713 N

	PASS	FAIL
Maximum roof crush resistance measured during test was <u>26,550</u> N at <u>130.9</u> mm	<u>X</u>	

D. POST TEST VISUAL INSPECTION

500mm wide x 1200 mm long flattened area above driver. Center of roof between driver and passenger pushed up approximately 30 mm. Driver "A" pillar pushed toward passenger side approximately 80 mm. Windshield shattered.

RESULTS:

REMARKS:

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

DATE: 07/01/03



DATA SHEET 2  
FMVSS 216  
RECEIVING INSPECTION

VEH. MOD YR/MAKE/MODEL/BODY: 2003 MINI COOPER PASSENGER CAR  
 VEH. NHTSA NO: C30506; VIN: WMWRC33493TC41282  
 VEH. BUILD DATE: 11/02; TEST DATE: JULY 1, 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>348.35</u>	kg	Left Rear	<u>230.42</u>	kg
Right Front	<u>356.52</u>	kg	Right Rear	<u>229.97</u>	kg
Front Axle	<u>704.88</u>	kg	Rear Axle	<u>460.39</u>	kg

TOTAL UVW 1165 kg

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

(3) Minimum Roof Crush Resistance (MCRR):

Passenger Car:

UVW x 1.5 x 9.8 = 17,135 N

MCRR = 17,135 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 = N/A N

(4) Other Comments: \_\_\_\_\_

REMARKS:

RECORDED BY: *G. Farrand*  
 APPROVED BY: *D. M. [Signature]*

DATE: 07/01/03

DATA SHEET 3  
FMVSS 216  
PRE-TEST PREPARATION

VEH. MOD YR/MAKE/MODEL/BODY: 2003 MINI COOPER PASSENGER CAR  
 VEH. NHTSA NO: C30506; VIN: WMWRC33493TC41282  
 VEH. BUILD DATE: 11/02; TEST DATE: JULY 1, 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 228 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: 26.7 degrees C.

REMARKS:

RECORDED BY: [Signature]

DATE: 07/01/03

APPROVED BY: [Signature]

DATA SHEET 4  
FMVSS 216

VEH. MOD YR/MAKE/MODEL/BODY: 2003 MINI COOPER PASSENGER CAR  
VEH. NHTSA NO: C30506; VIN: WMWRC33493TC41282  
VEH. BUILD DATE: 11/02; TEST DATE: JULY 1, 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 26,550 N at 130.9 mm
- (2) The rate of loading was 5.08 mm/sec (.2 in/sec)
- (3) The required roof crush resistance of 17,125 N was at 23.6 mm

REMARKS:

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

DATE: 07/01/03

DATA SHEET 5  
FMVSS 216  
POST TEST VISUAL INSPECTION

VEH. MOD YR/MAKE/MODEL/BODY: 2003 MINI COOPER PASSENGER CAR

VEH. NHTSA NO: C30506; VIN: WMWRC33493TC41282

VEH. BUILD DATE: 11/02; TEST DATE: JULY 1, 2003

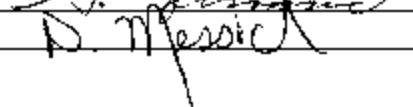
TEST LABORATORY: GENERAL TESTING LABORATORIES

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: 500 mm wide x 1200 mm long flattened area above driver. Center of roof between driver and passenger pushed up approximately 30 mm. Driver "A" pillar pushed toward passenger side approximately 80 mm. Windshield shattered.

RECORDED BY: 

APPROVED BY: 

DATE: 07/01/03

DATA SHEET 6  
FMVSS 216 MODIFIED PORTION PRE-TEST

VEH. MOD YR/MAKE/MODEL/BODY: 2003 MINI COOPER PASSENGER CAR

VEH. NHTSA NO: C30506; VIN: WMWRC33493TC41282

VEH. BUILD DATE: 11/02; TEST DATE: JULY 1, 2003

TEST LABORATORY: GENERAL TESTING LABORATORIES

OBSERVERS: GRANT FARRAND, JIMMY LATANE, AMANDA PRESCOTT

Driver Seat Torso Angle: 25°

Driver Seat "H" Point Location at Mid Travel:

X= 250 mm aft of front outboard seat mounting bolt center line

Y= 204 mm inboard of front outboard seat mounting bolt center line

Z= 250 mm up from front outboard seat mounting bolt center line

Point VRL (Vertical Measurement from H-Point to Headliner): 893 mm

Point VRi (Vertical Measurement from H-Point to Structure Above Headliner): 921 mm

Point RE (Distance from H-Point to a point 112mm behind point VRi): 930 mm

#1 LVDT (R.F.) Length: 927 mm

#2 LVDT (R.R.) Length: 895 mm

#3 LVDT (L.R.) Length: 895 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 185 mm from a vertical line passing through the seat "H" point.

NOTES:

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RECORDED BY: *[Signature]*

APPROVED BY: *[Signature]*

DATE: 07/01/03



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



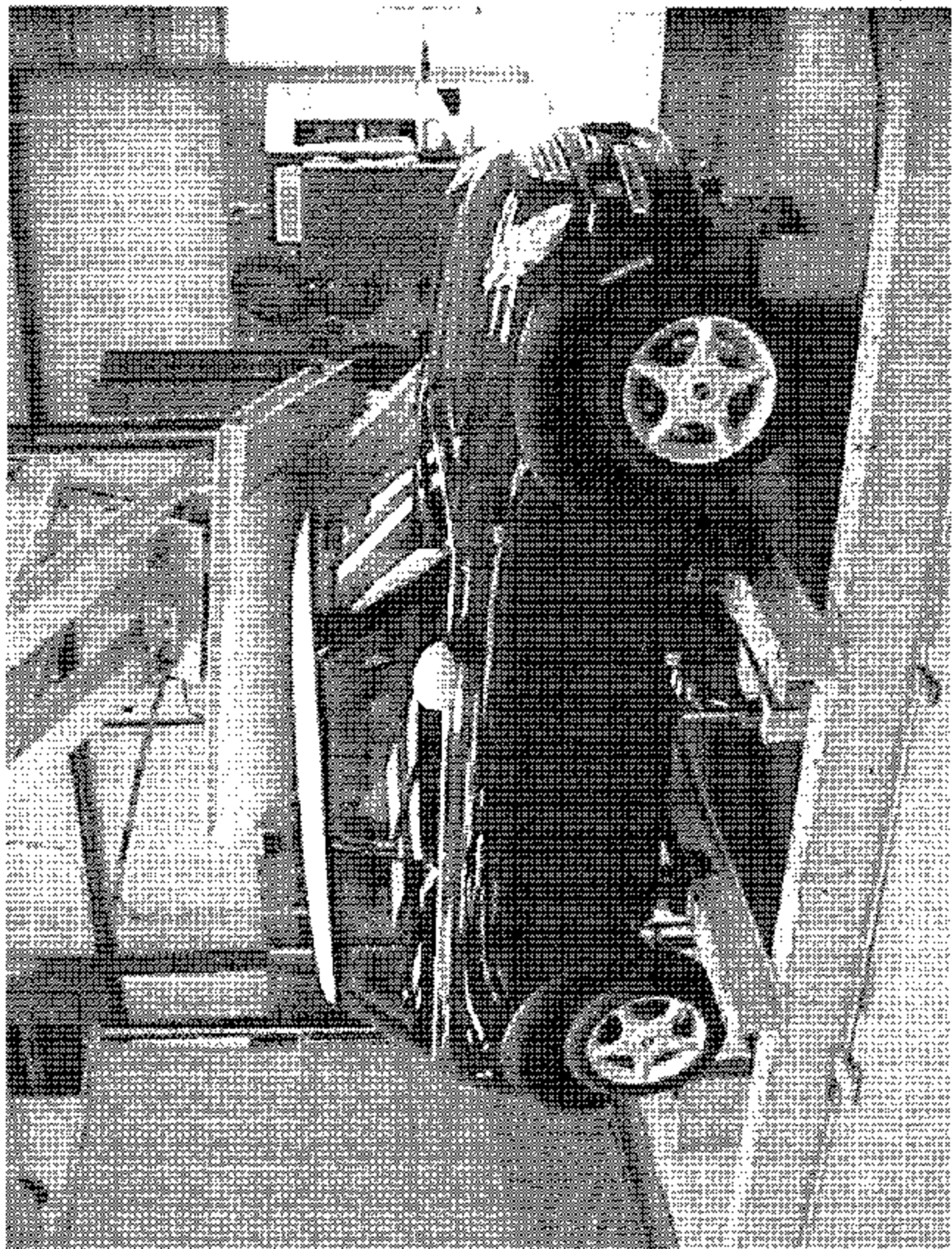
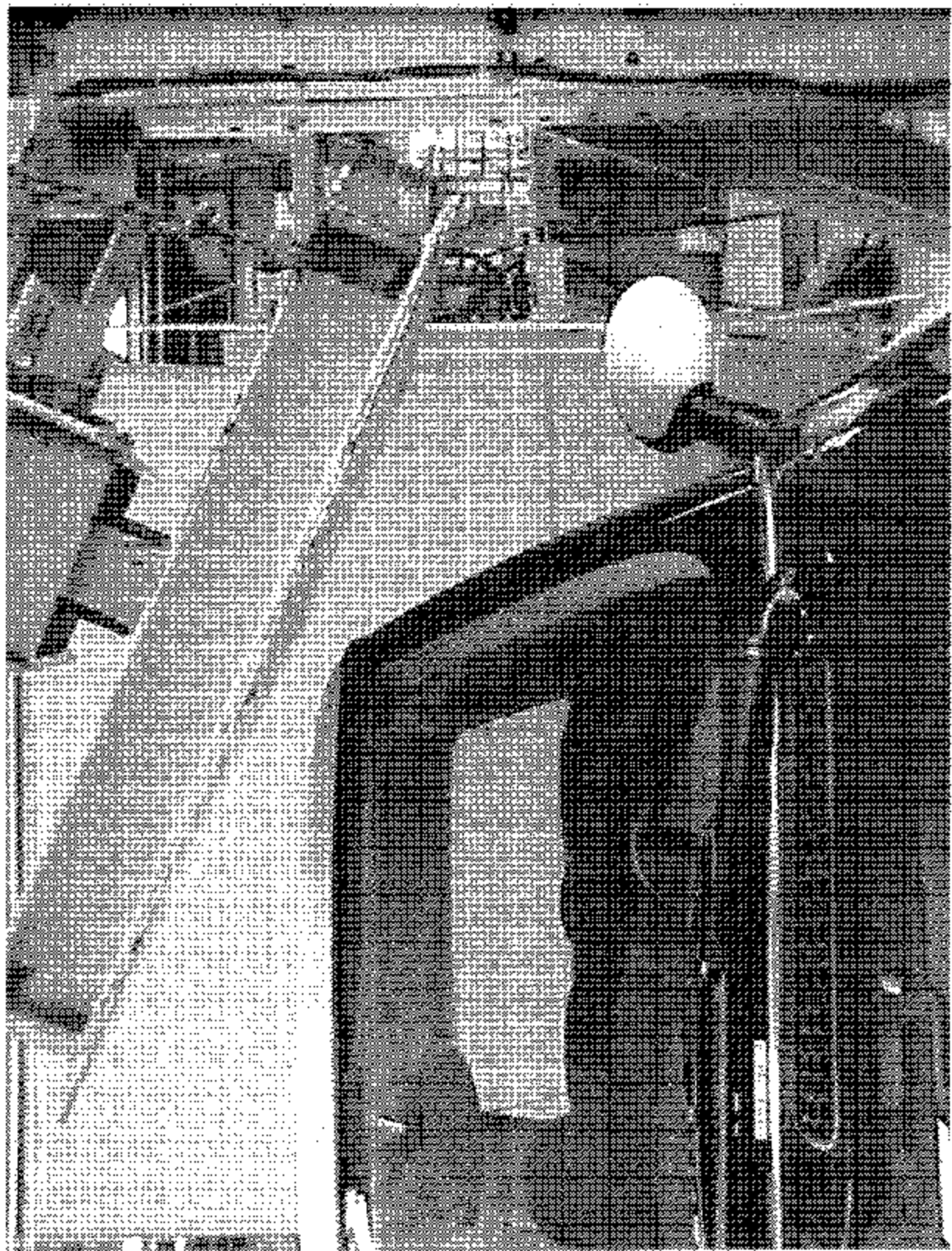


FIGURE 5.1  
RIGHT SIDE VIEW OF VEHICLE BEFORE  
TESTING

2003 MINI COOPER  
NHISA NO. C30506  
FMVSS NO. 216



2003 MINI COOPER  
NJLISA NO. C70506  
FMVSS NO. 216

FIGURE 5.2  
FRONT VIEW OF TILT SETUP PRE-TEST

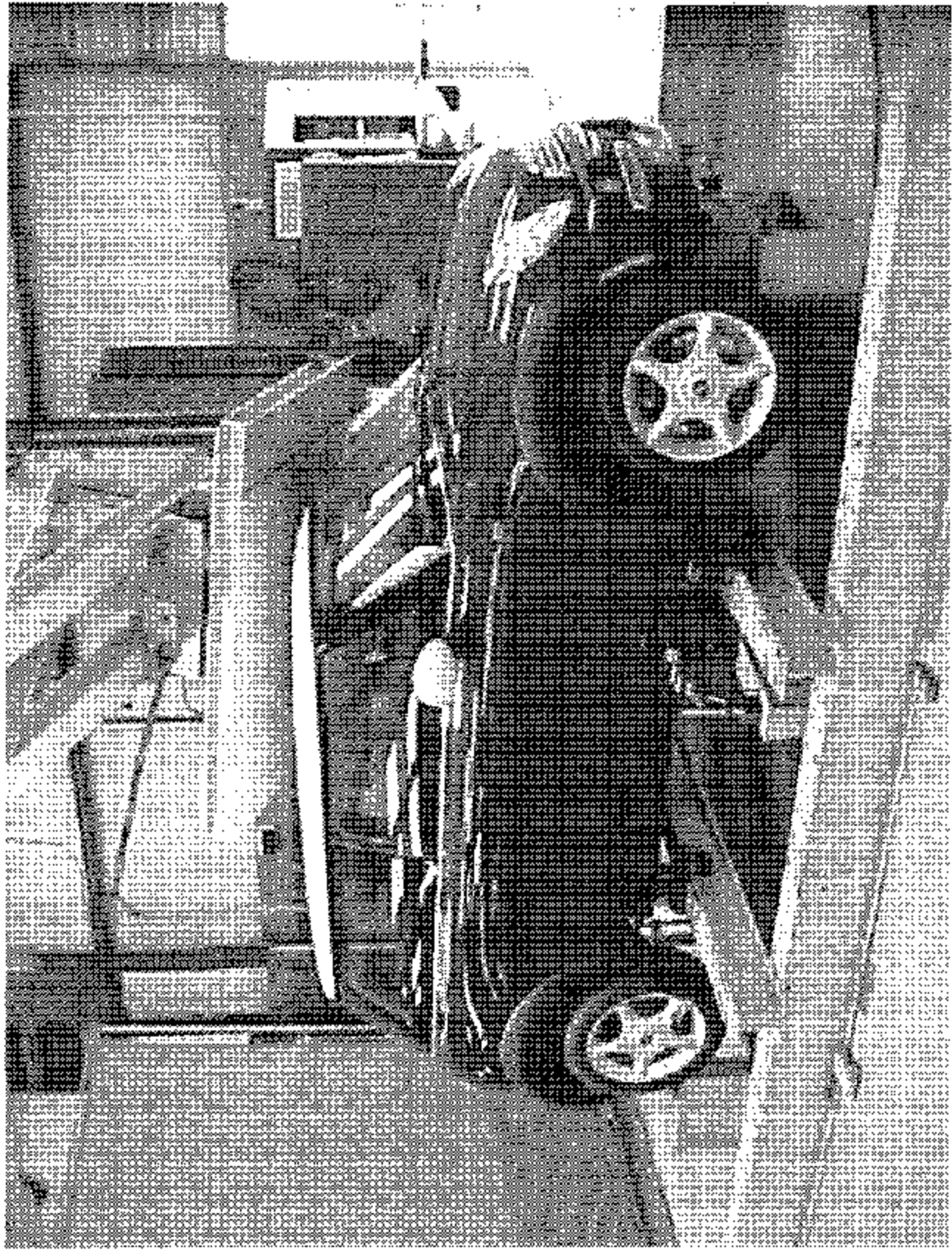


FIGURE 5.5  
VEHICLE IN 216 TEST RIG

2003 MINI COOPER  
NHTSA NO. C30506  
FMVSS NO. 216

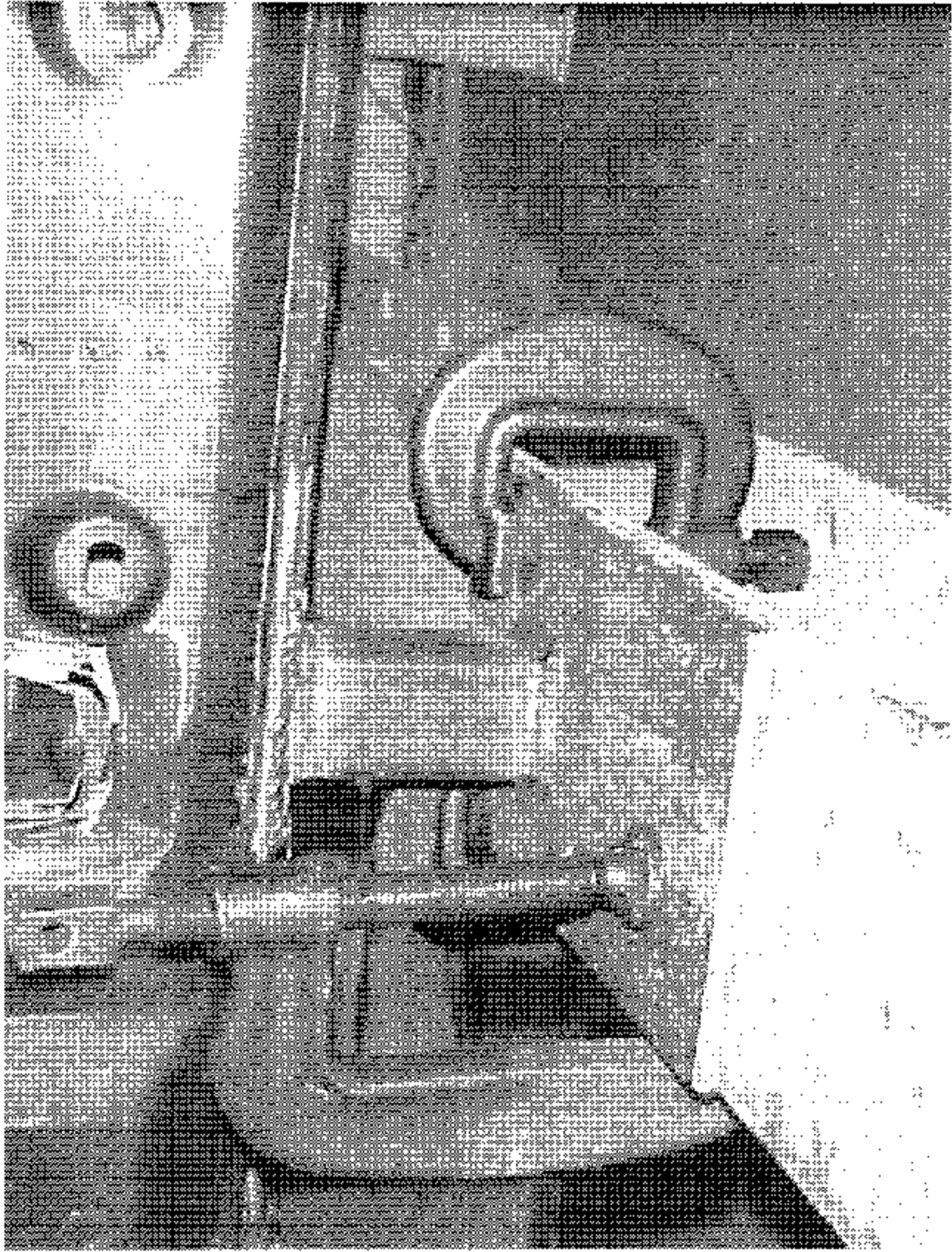
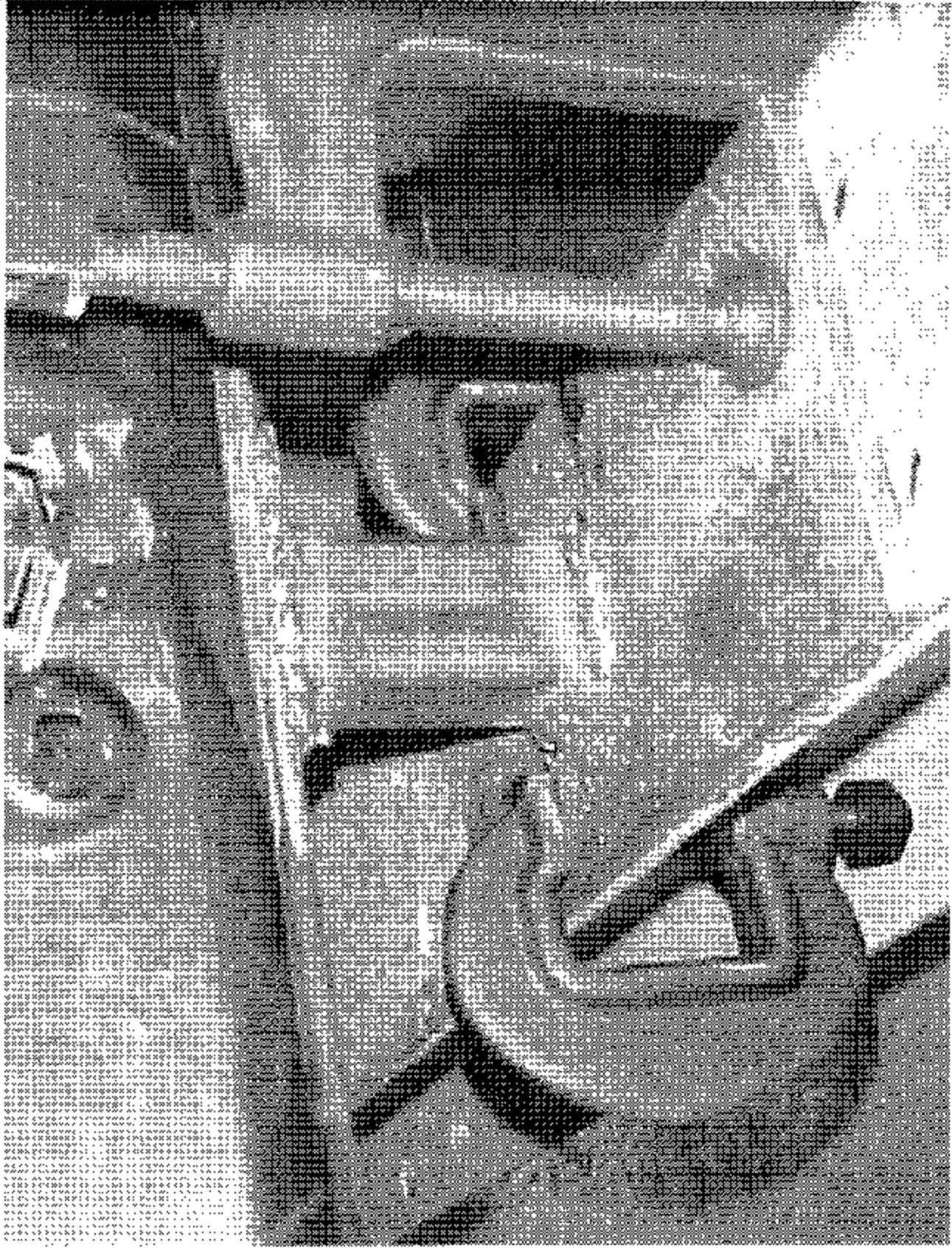


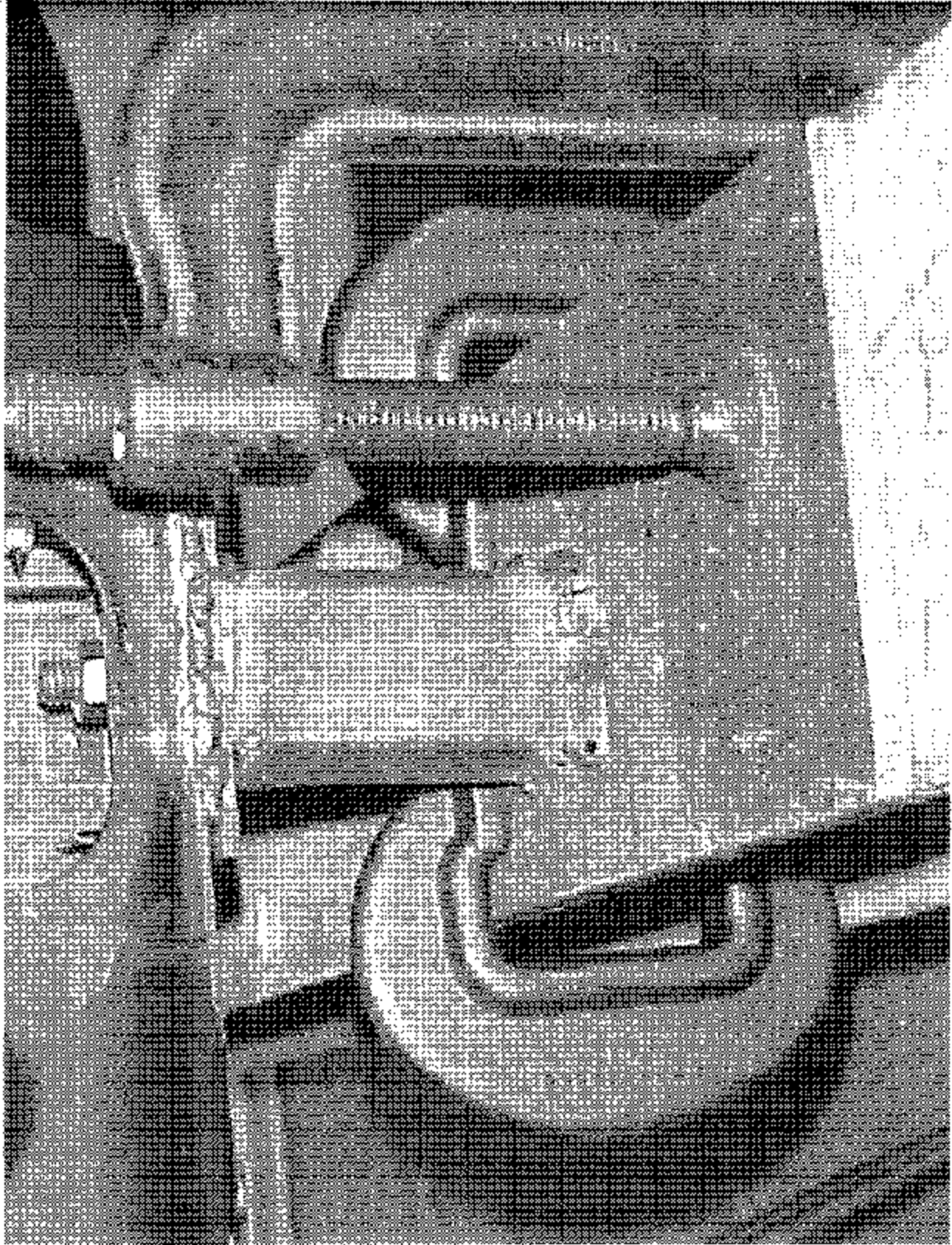
FIGURE 5.4  
LEFT FRONT VEHICLE TIE DOWN

2003 MINI COOPER  
NHTSA NO. C.30506  
FMVSS NO. 216



2003 MINI COOPER  
NHTSA NO. C.30506  
FMVSS NO. 216

FIGURE 5.5  
RIGHT FRONT VEHICLE JIFF DOWN



2003 MINI COOPER  
NHISA NO. C30506  
FMVSS NO. 216

FIGURE 5.6  
LEFT REAR VEHICLE TILT DOWN

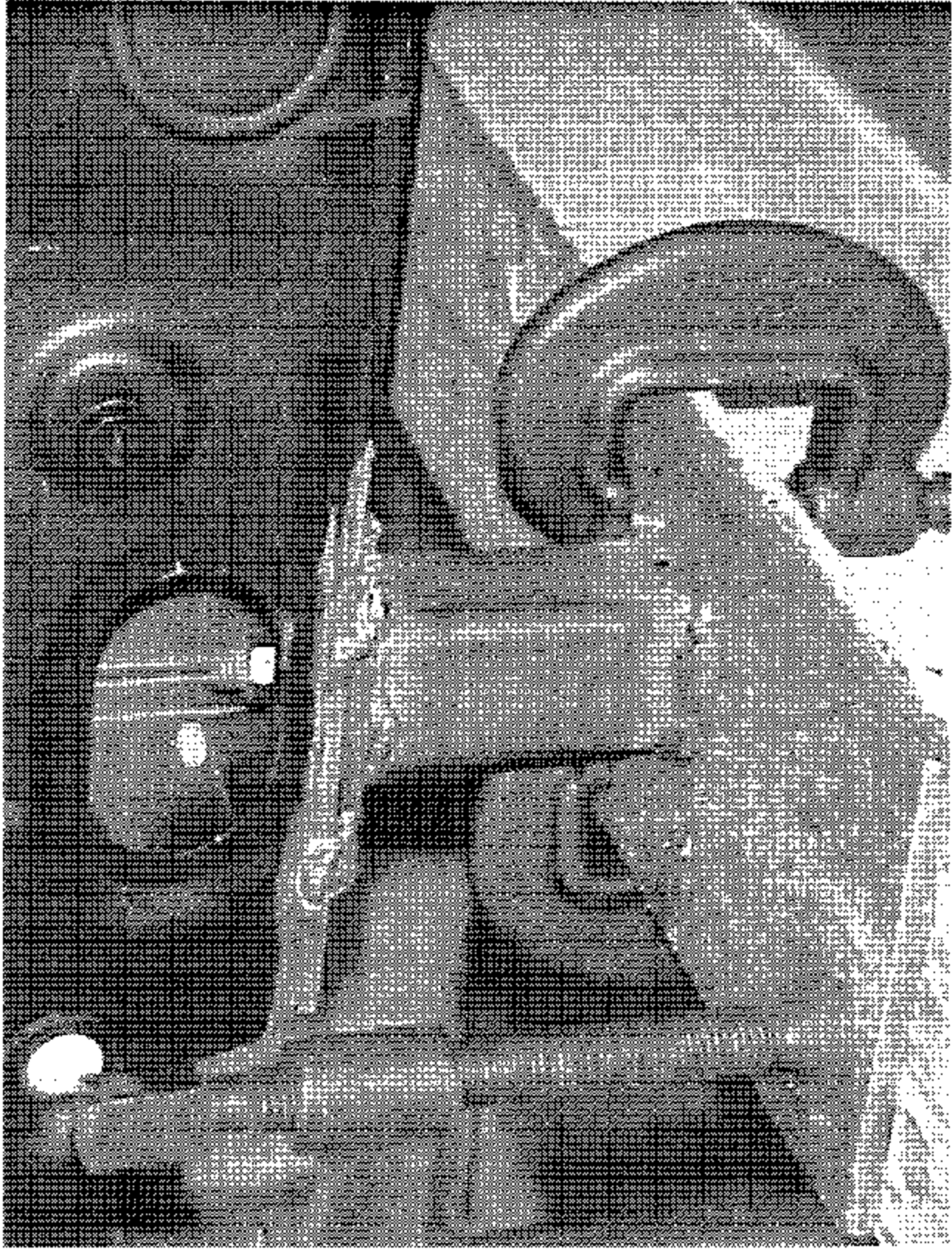


FIGURE 57  
RIGHT REAR VEHICLE SEAT, DOWN

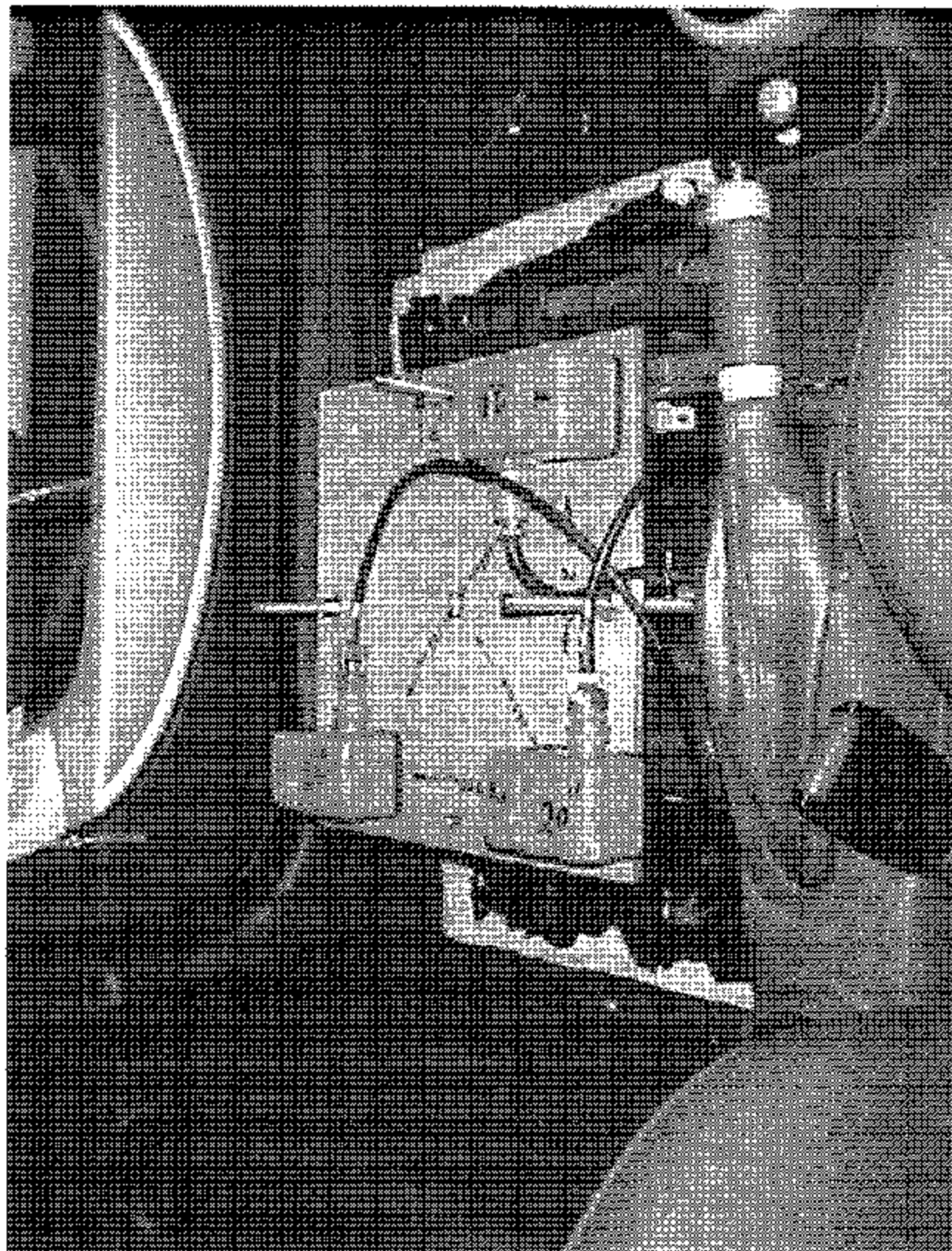
2003 MINI COOPER  
NHITSA NO. C30506  
FMVSS NO. 216



FIGURE 5.8  
LVDI DISPLACEMENT MOUNTING TO  
ROOF

2003 MINI COOPER  
NHSTA NO. C30S06  
EMVSS NO. 216





2003 MENTICOOPER  
NHISA NO. C30506  
JMVSS NO. 216

FIGURE 5.9  
LVDT TRANSDUCER MOUNTING AT  
"H" POINT

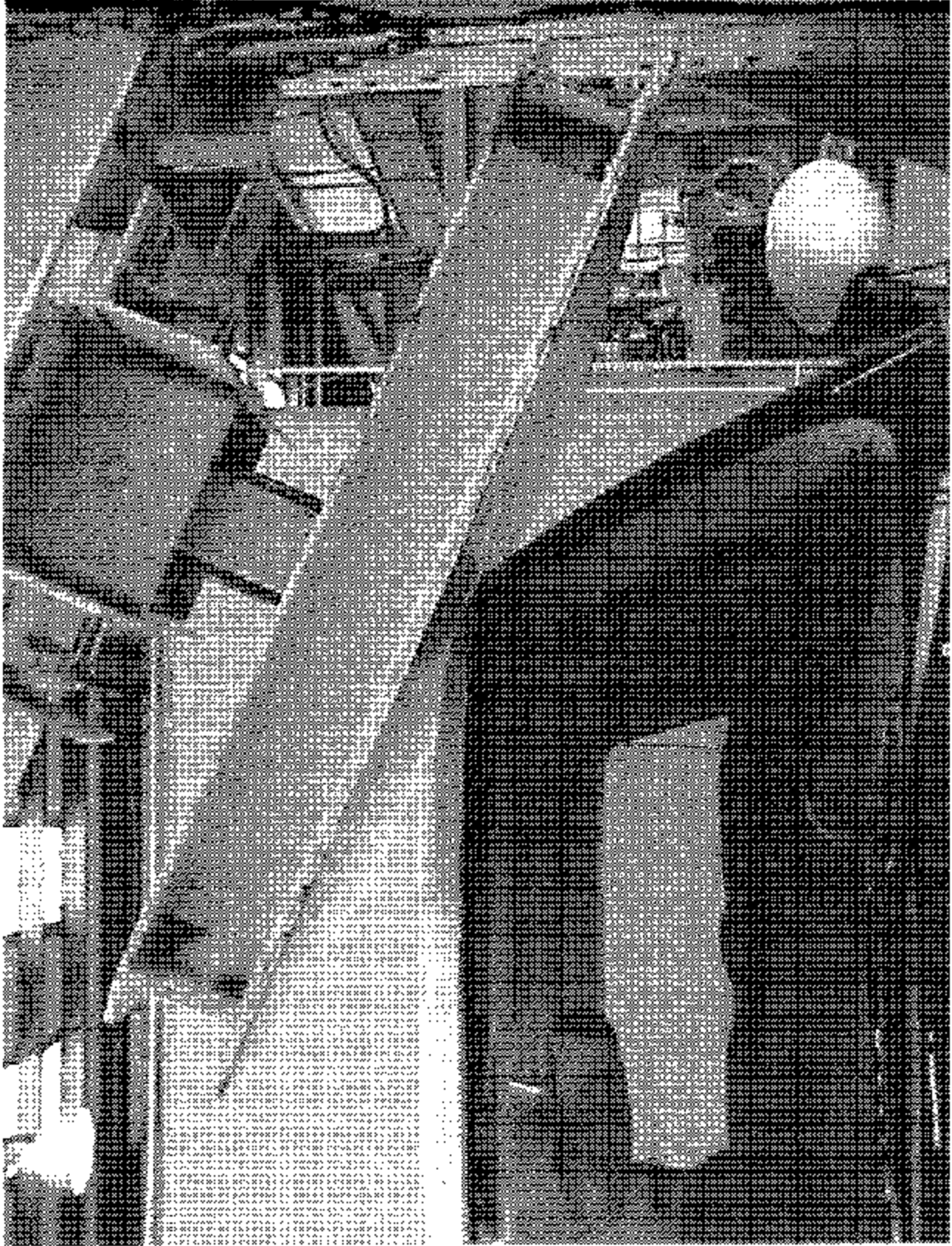


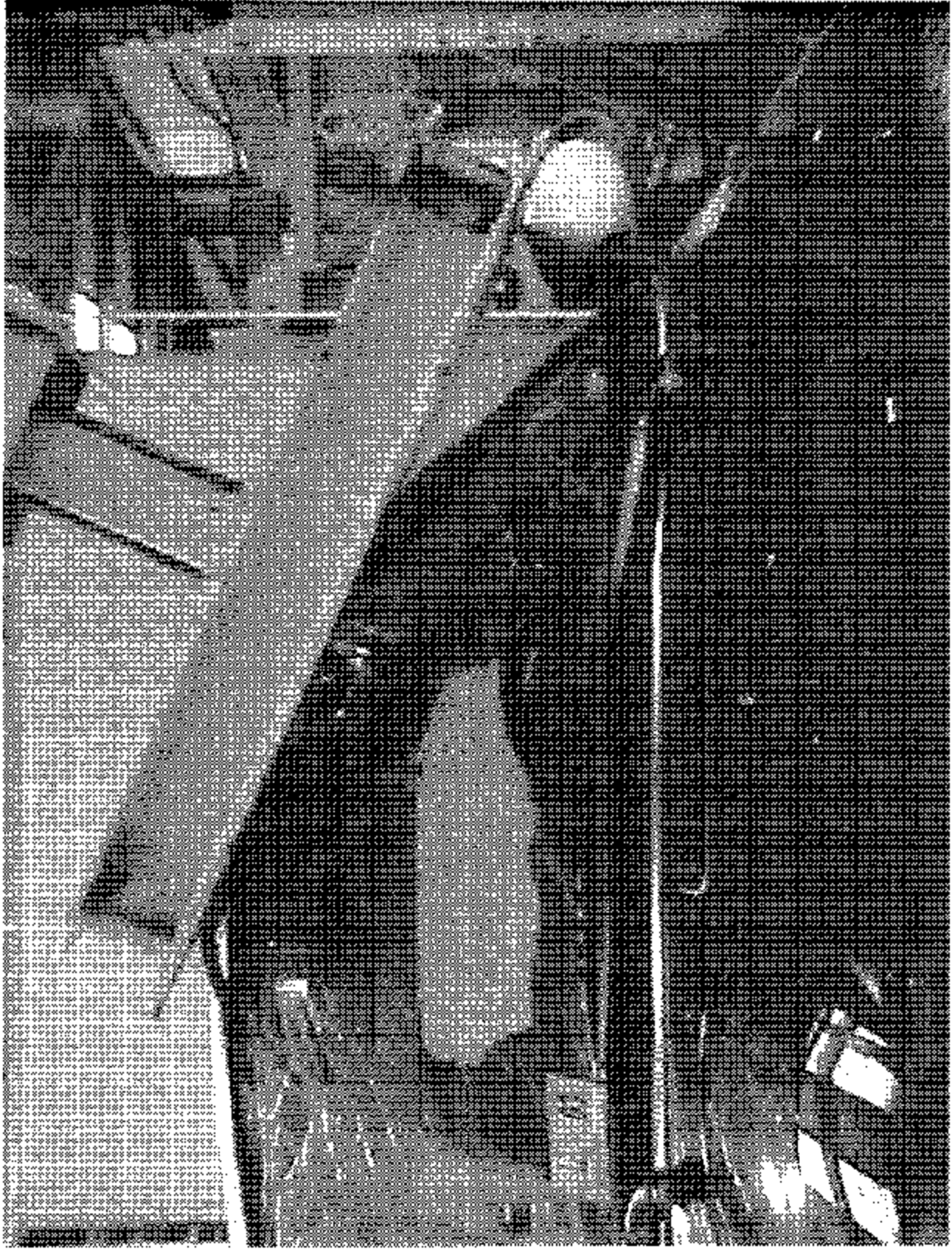
FIGURE S-16  
FRONT VIEW OF LOADING DEVICE  
PLACED AGAINST VEHICLE ROOF

2003 MINI COOPER  
NHTSA NO. C30506  
FMVSS NO. 216



2003 MINI COOPER  
NHTSA NO. C30506  
FMVSS NO. 216

FIGURE 5.11  
REAR VIEW OF LOADING DEVICE PLACED  
AGAINST VEHICLE ROOF



2003 MINI COOPER  
NHTSA NO. C30506  
FMVSS NO. 216

FIGURE 5.12  
FRONT VIEW OF LOADING DEVICE  
PLACED AGAINST VEHICLE ROOF A1  
FULL LOAD

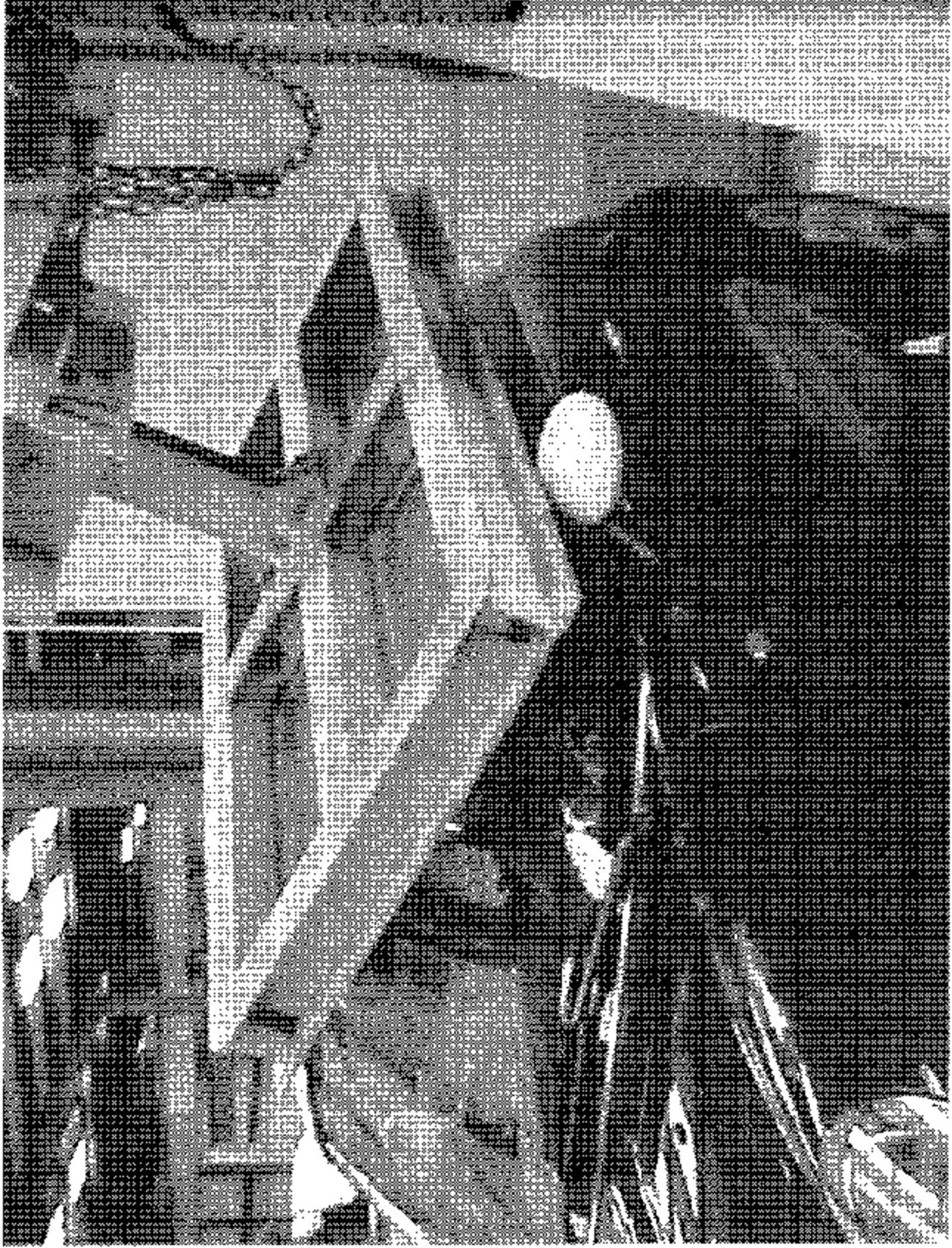


FIGURE 5.13  
SIDE VIEW OF LOADING DEVICE PLACED  
AGAINST VEHICLE ROOF AT FULL LOAD

2003 MINI COOPER  
NHISA NO. C30506  
FMVSS NO. 216



2003 MINI COOPER  
NJHSA NO. C30506  
CMVSS NO. 216

FIGURE 5.14  
3/4 FRONT LEFT SIDE VIEW OF VEHICLE ON  
TESTED SIDE AFTER TESTING



FIGURE 5.15  
CLOSE-UP ¼ FRONT VIEW OF ROOF AFTER  
TESTING

2003 MINI COOPER  
NHTSA NO. C30506  
FMVSS NO. 216

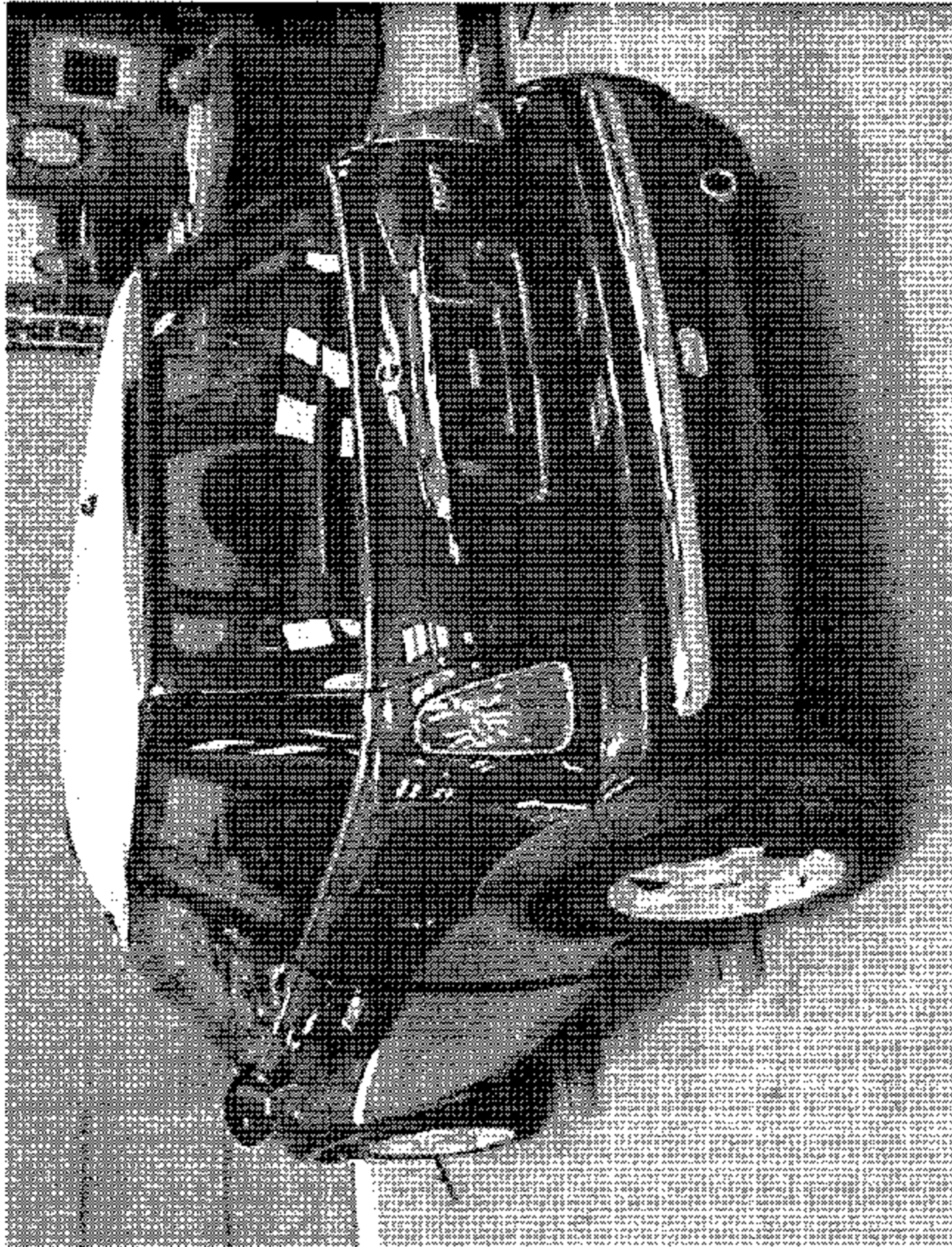


FIGURE 5.16  
¾ REAR LEFT SIDE VIEW OF VEHICLE ON  
TESTED SIDE AFTER TESTING

2003 MINI COOPER  
NHTSA NO. C30506  
FMVSS NO. 216



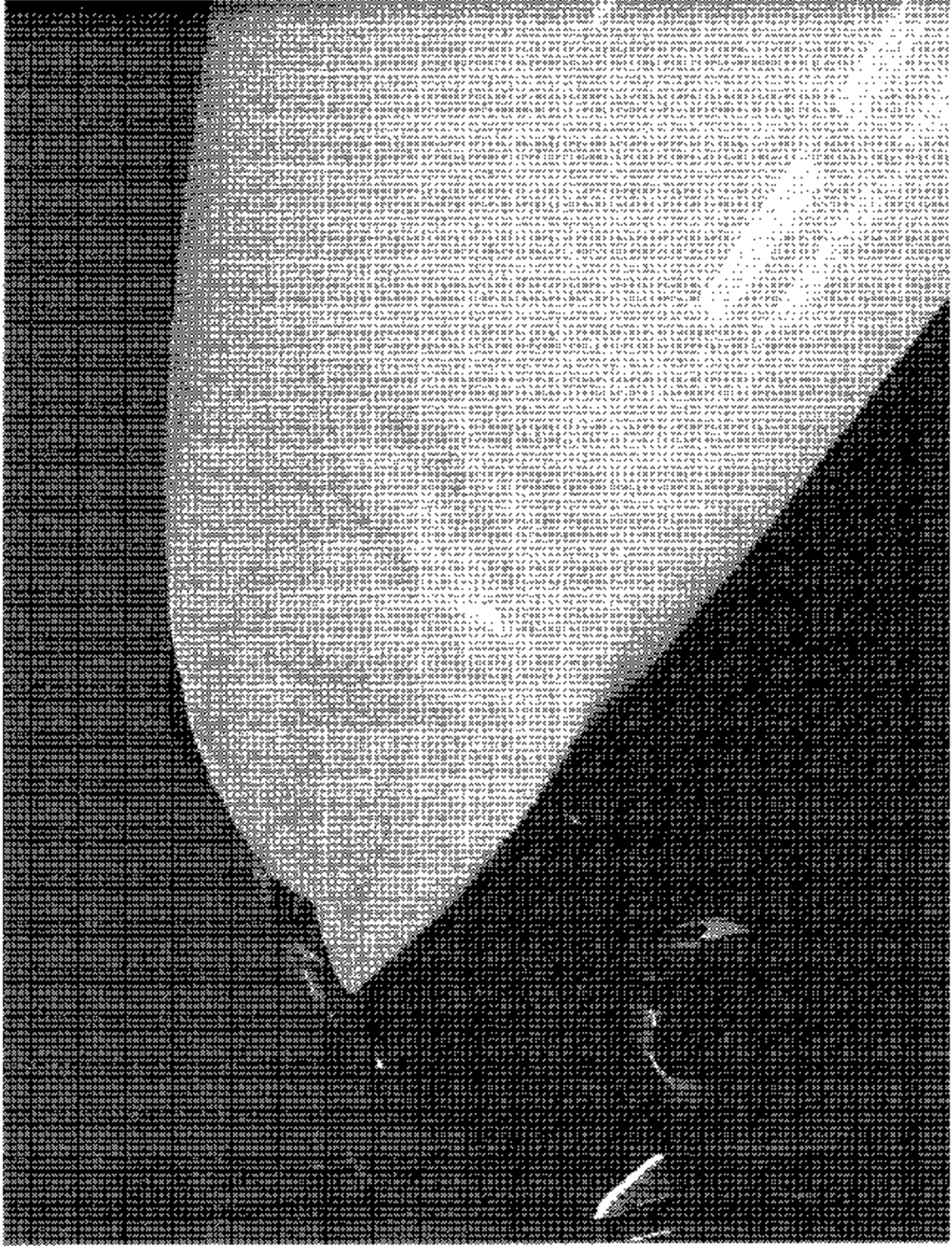
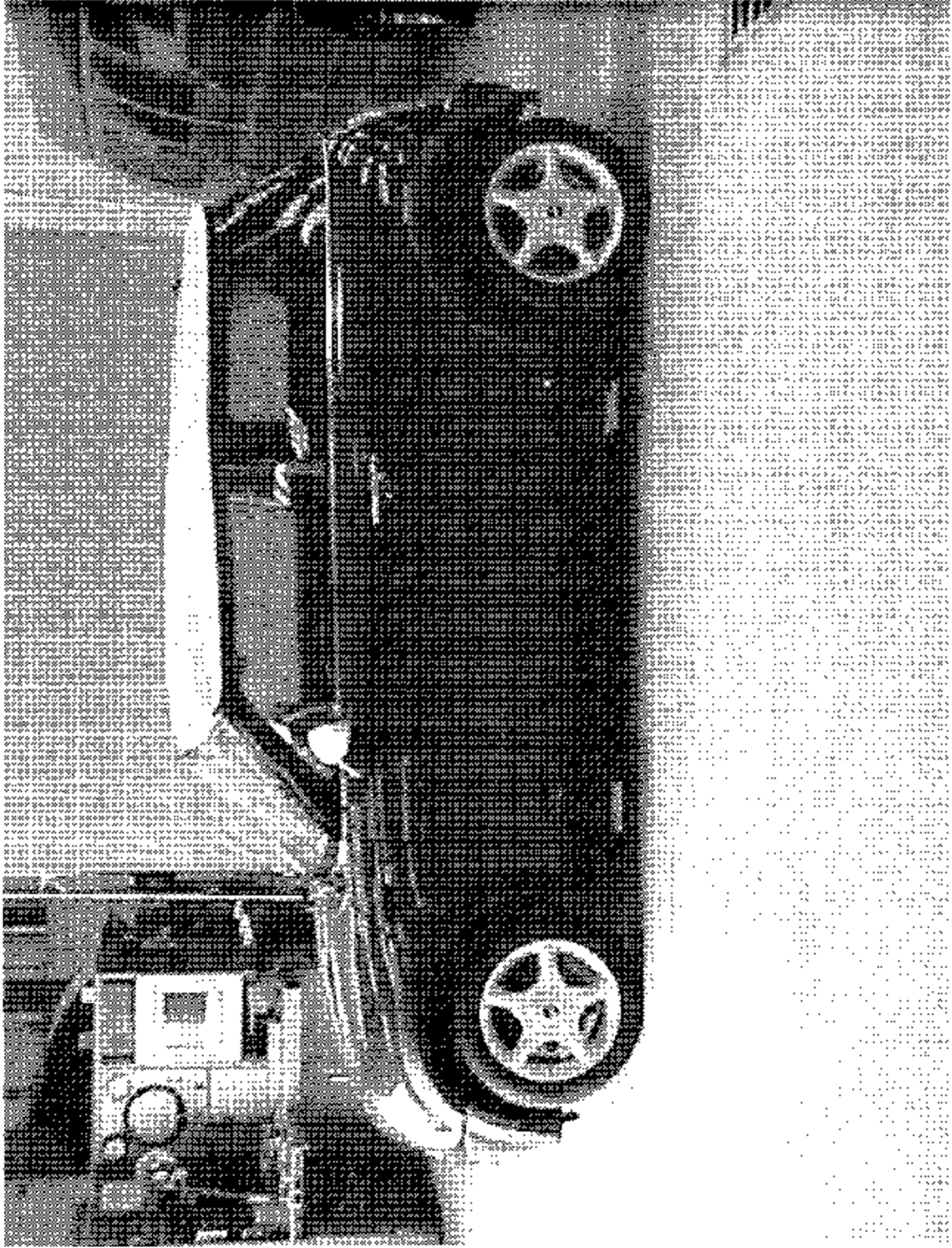


FIGURE 5.17  
CLOSE-UP, REAR LEFT SIDE VIEW OF  
ROOF AFTER TESTING

2003 MINI COOPER  
NHTSA NO. C30S06  
FMVSS NO. 216



2003 MINI COOPER  
NJHSA NO. C30506  
FMVSS NO. 216

FIGURE 5.18  
LEFT SIDE VIEW OF VEHICLE AFTER  
TESTING

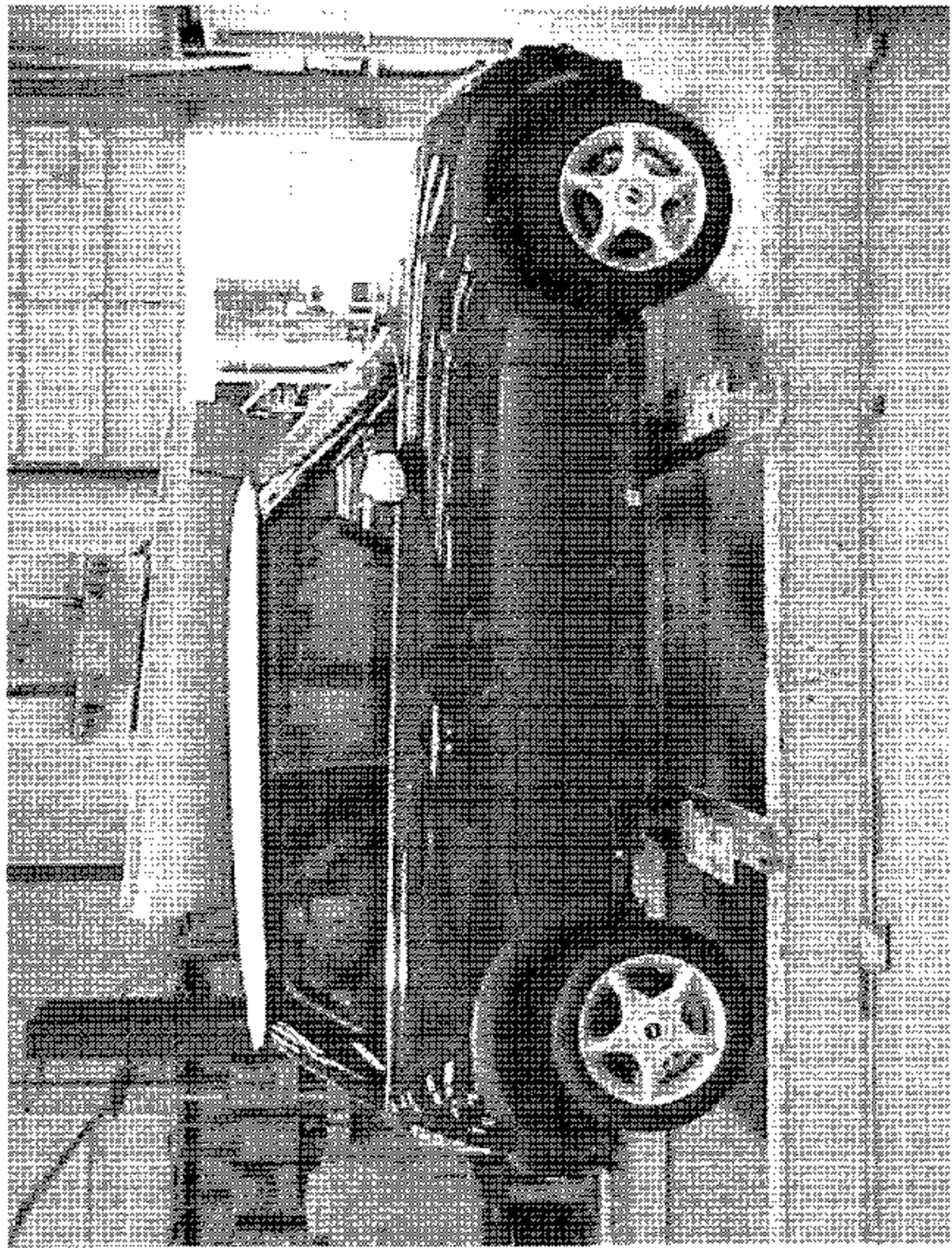


FIGURE 5.19  
RIGHT SIDE VIEW OF VEHICLE AFTER  
TESTING

2003 MINI COOPER  
NHTSA NO. C34566  
FMVSS NO. 216

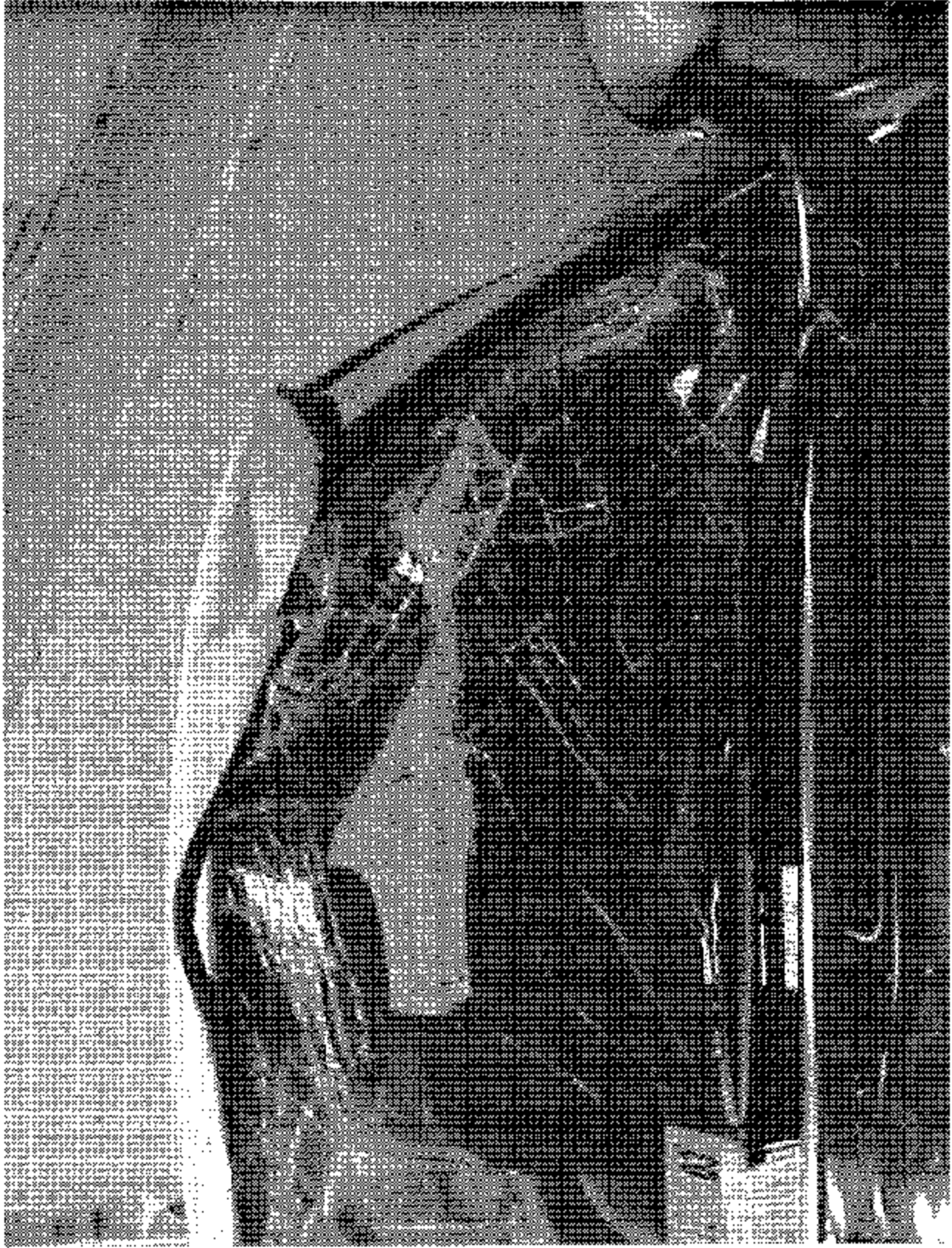
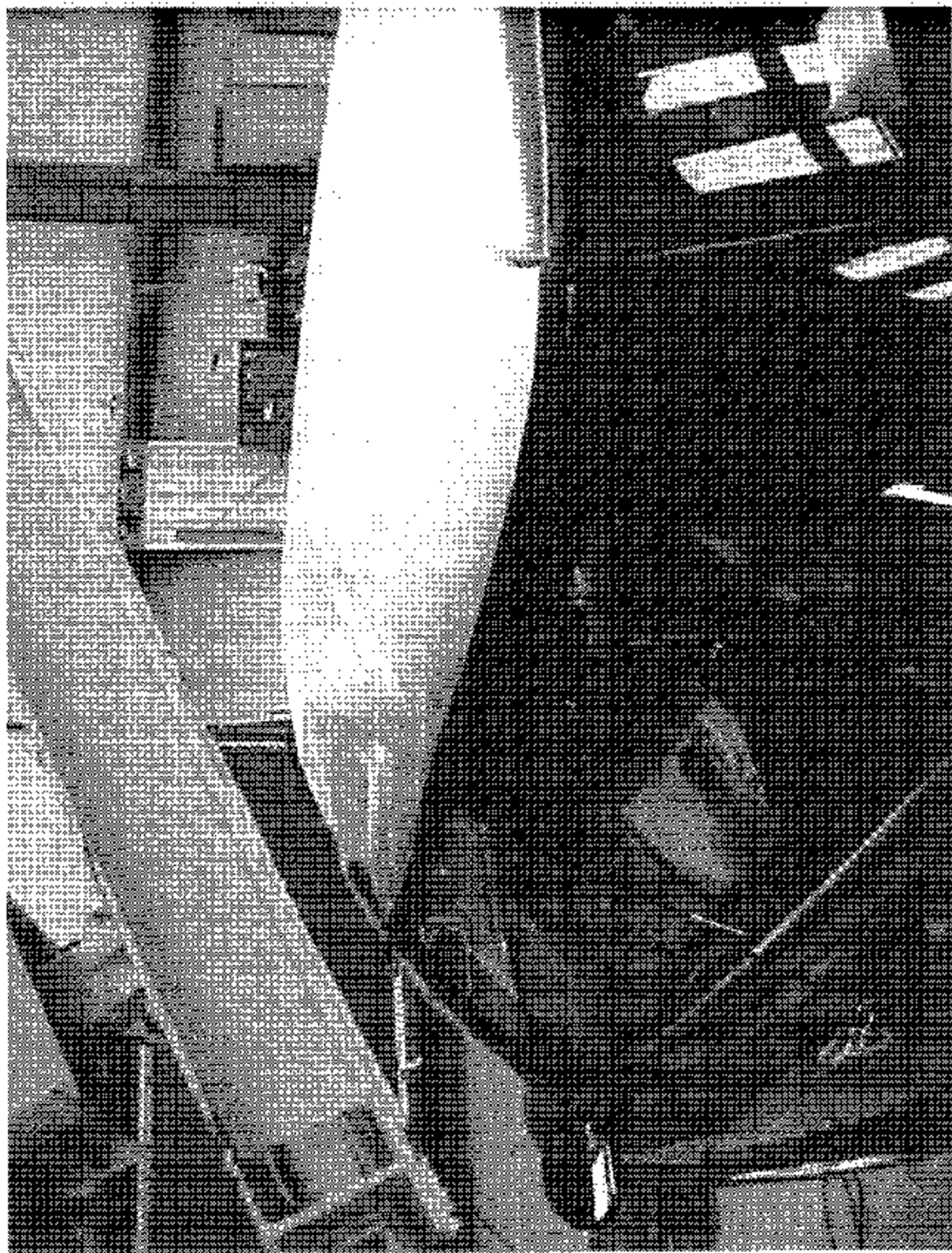


FIGURE 5.20  
FRONT VIEW OF VEHICLE ROOF AFTER  
REMOVAL OF LOADING DEVICE

2003 MINI COOPER  
NIJ/SA NO. C.30506  
FMVSS NO. 216



2003 MINI COOPER  
NIJSA NO. C30506  
FMVSS NO. 216

FIGURE 5.21  
REAR VIEW OF VEHICLE ROOF AFTER  
REMOVAL OF LOADING DEVICE



FIGURE 5.22  
INTERIOR VIEW OF ROOF PRE-TEST

2003 MINI COOPER  
NH/SA NO. C30506  
FMVSS NO. 216

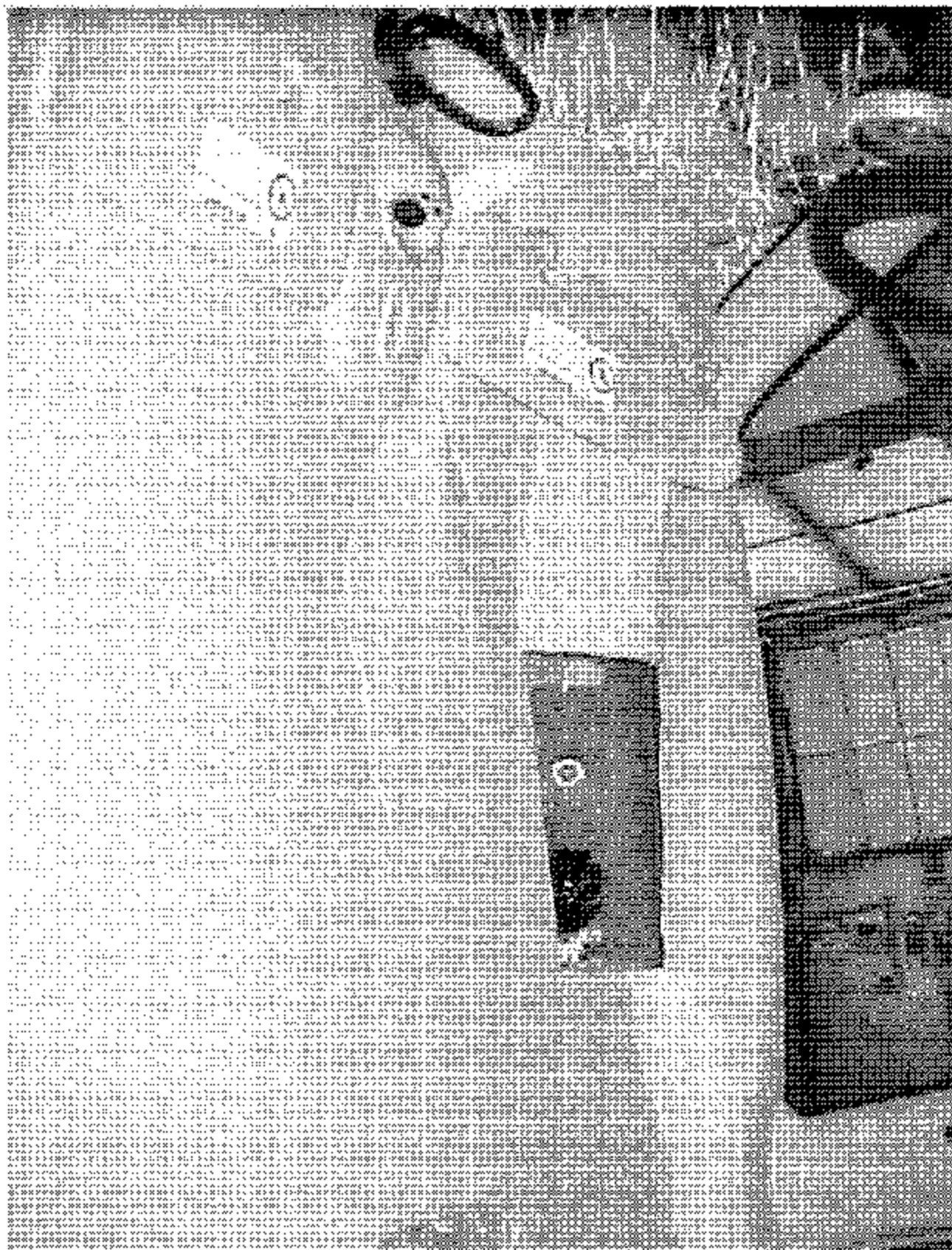


FIGURE 5.23  
INTERIOR VIEW OF ROOF POST TEST

2003 MINI COOPER  
NHFTA NO. C30506  
FMVSS NO. 216

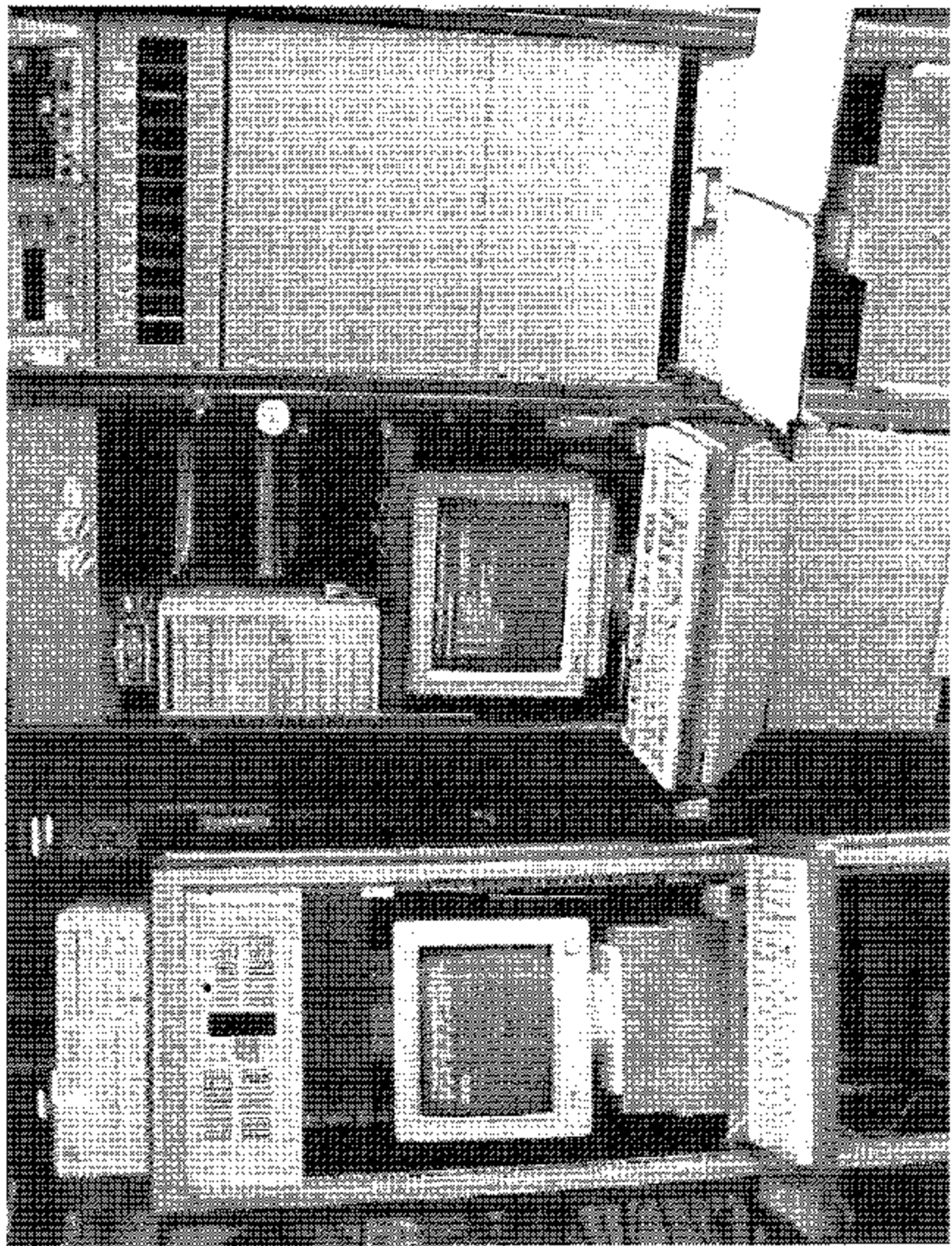
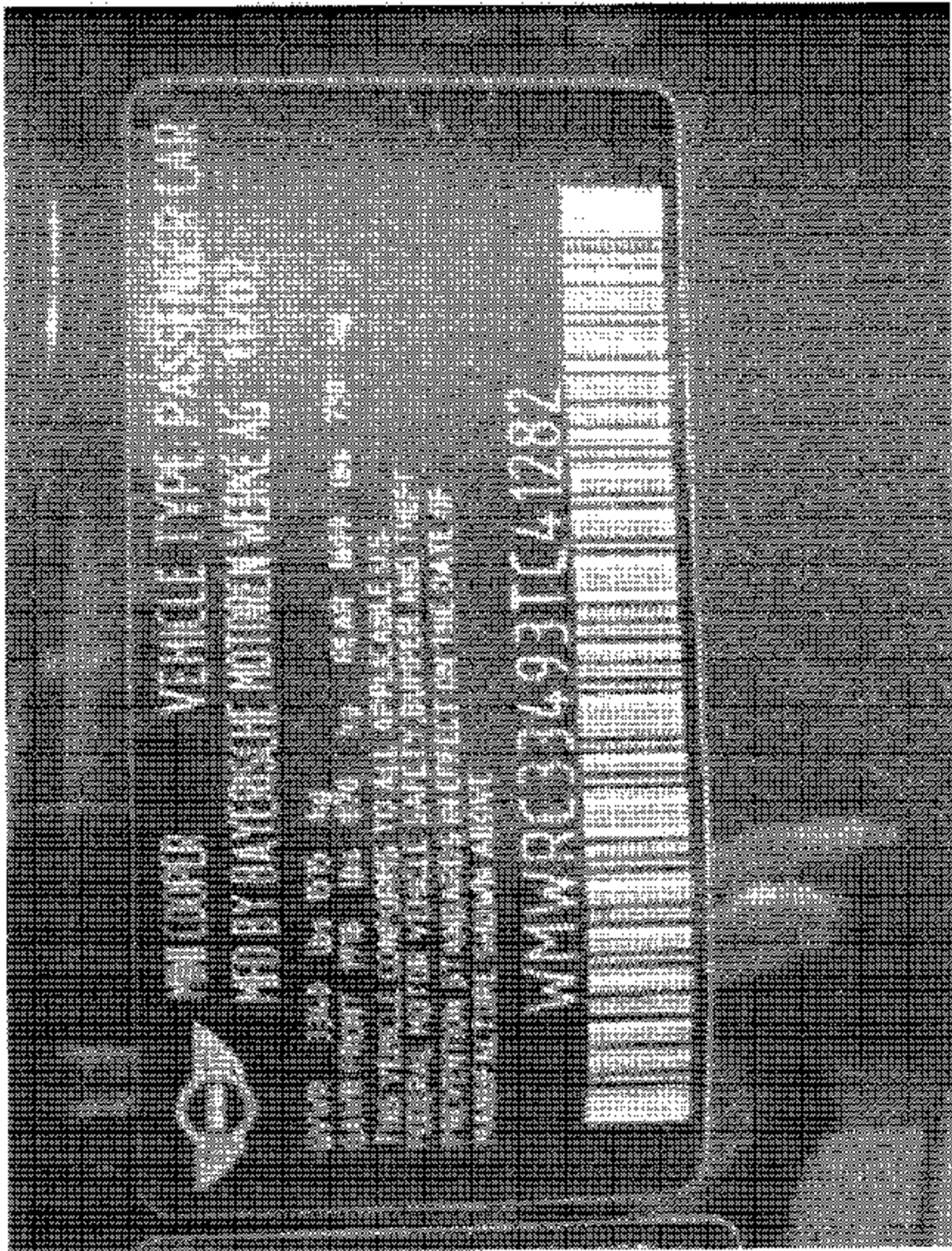


FIGURE 5.24  
INSTRUMENTATION SET-UP

2003 MINI COOPER  
NHTSA NO. C30506  
FMVSS NO. 216





2003 MINI COOPER  
NHTSA NO. C30506  
FMVSS NO. 216

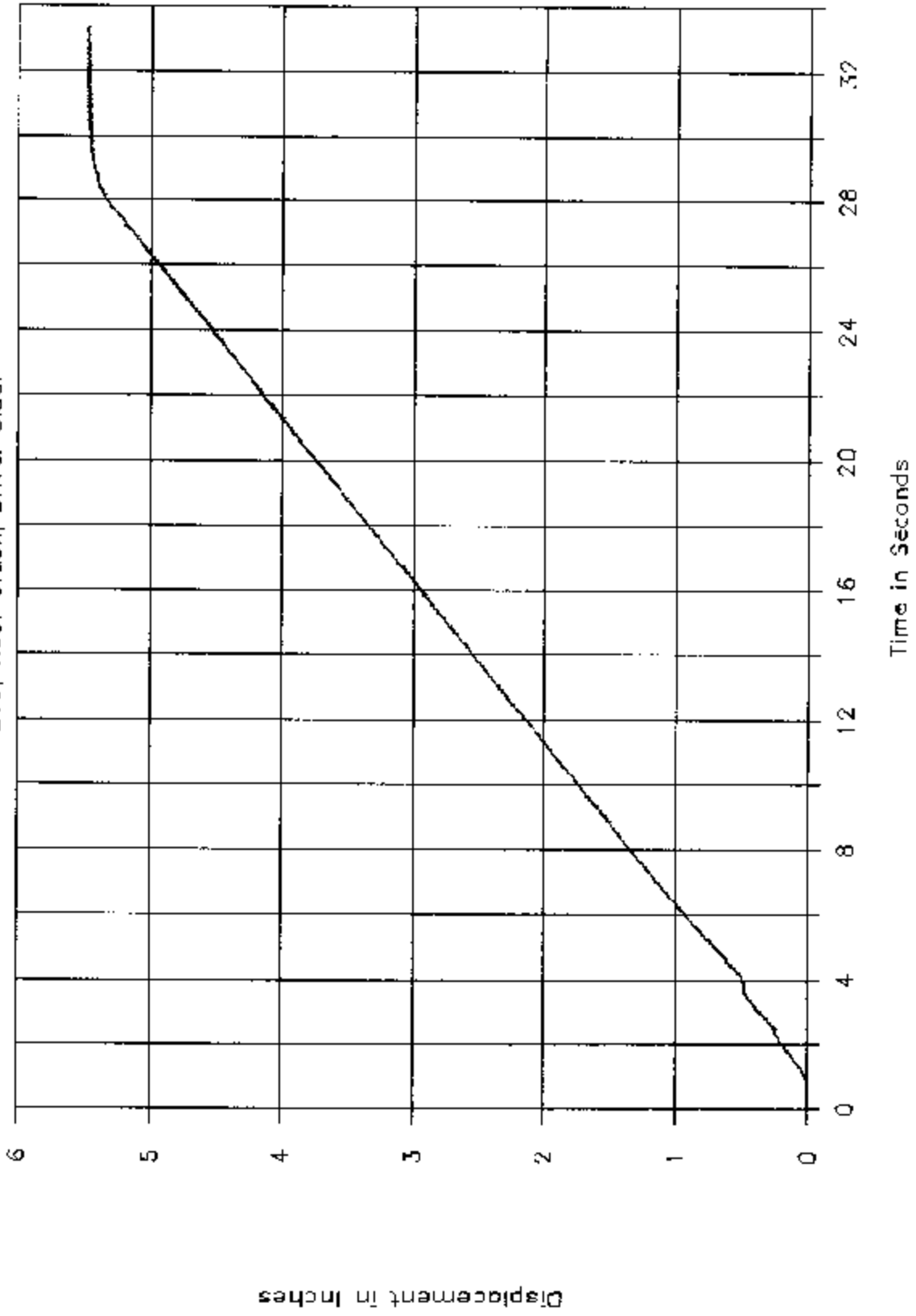
FIGURE 5.25  
CLOSE-UP VIEW OF VEHICLE  
CERTIFICATION LABEL.





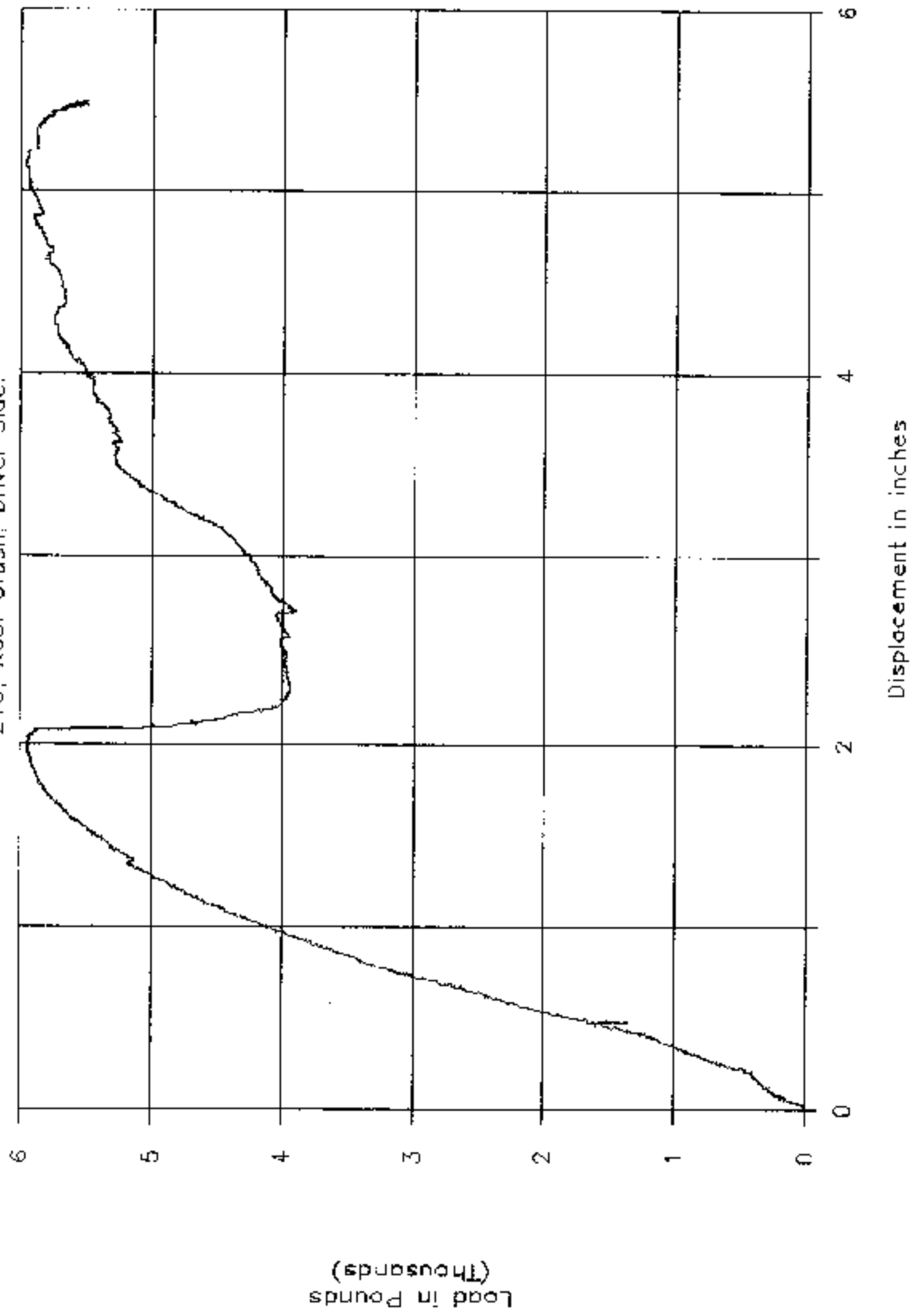
# GTL 5017

216, Roof Crush, Driver Side.



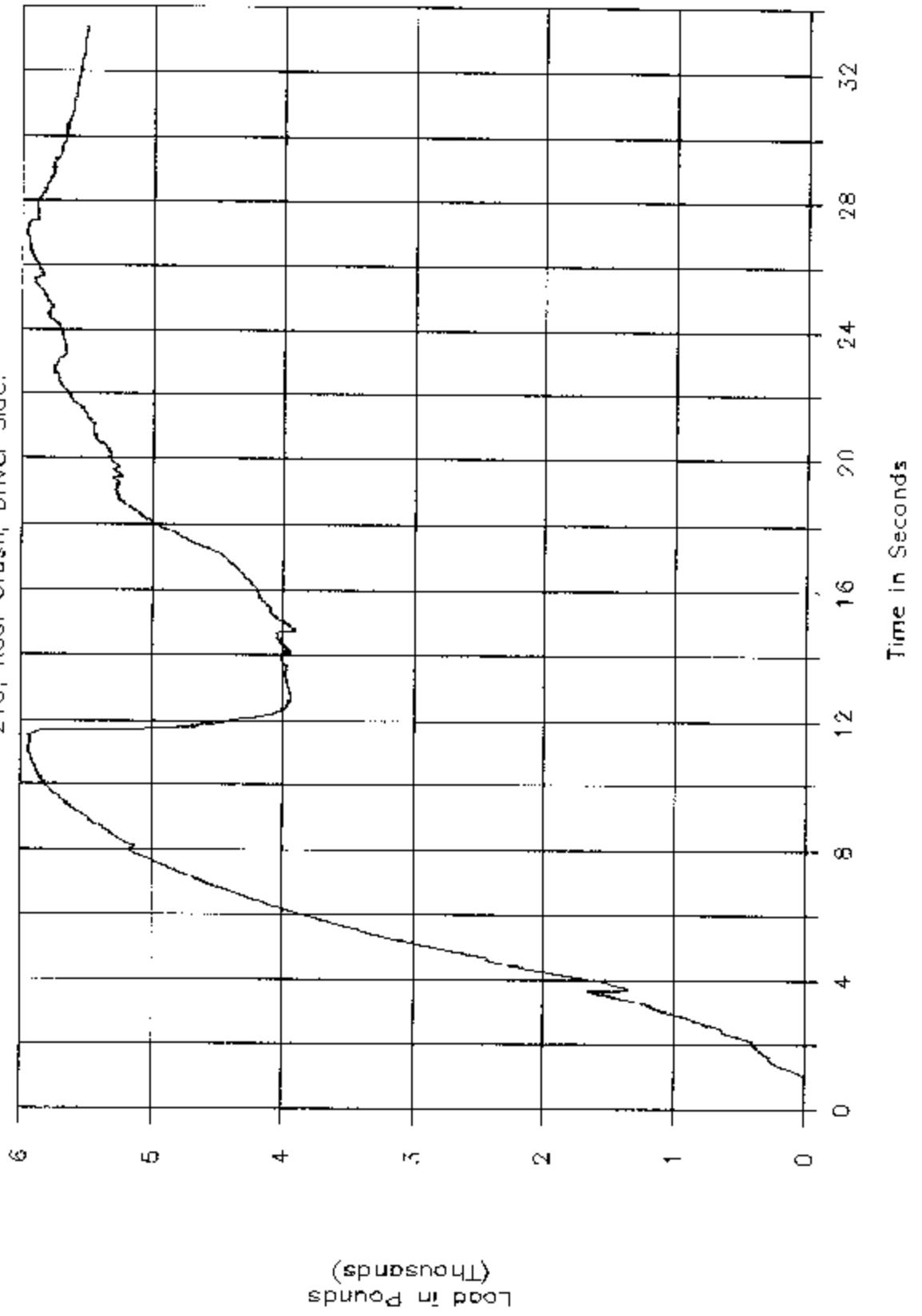
# GTL 5017

216, Roof Crush, Driver Side.



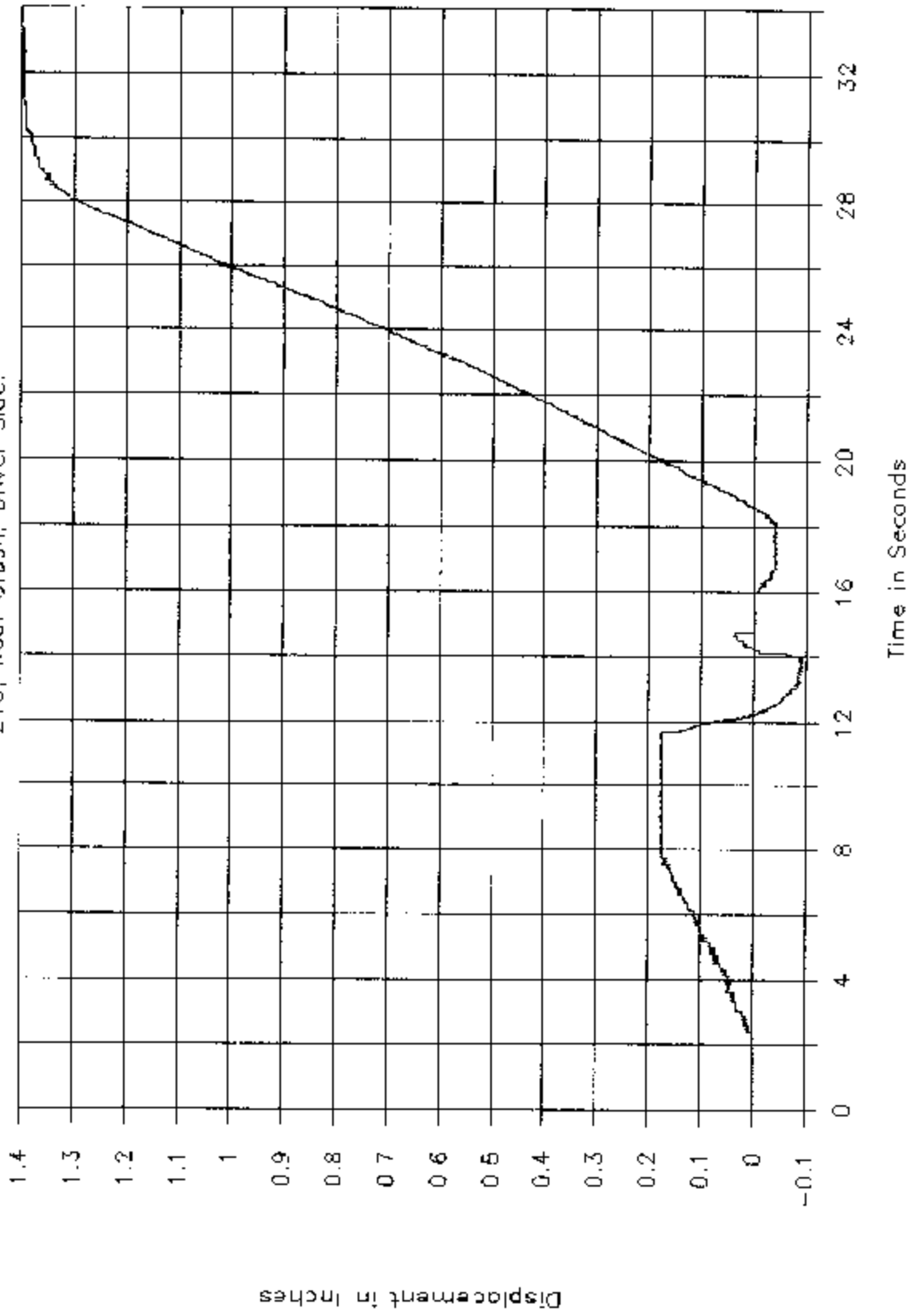
GTL 5017

216, Roof Crush, Driver Side.



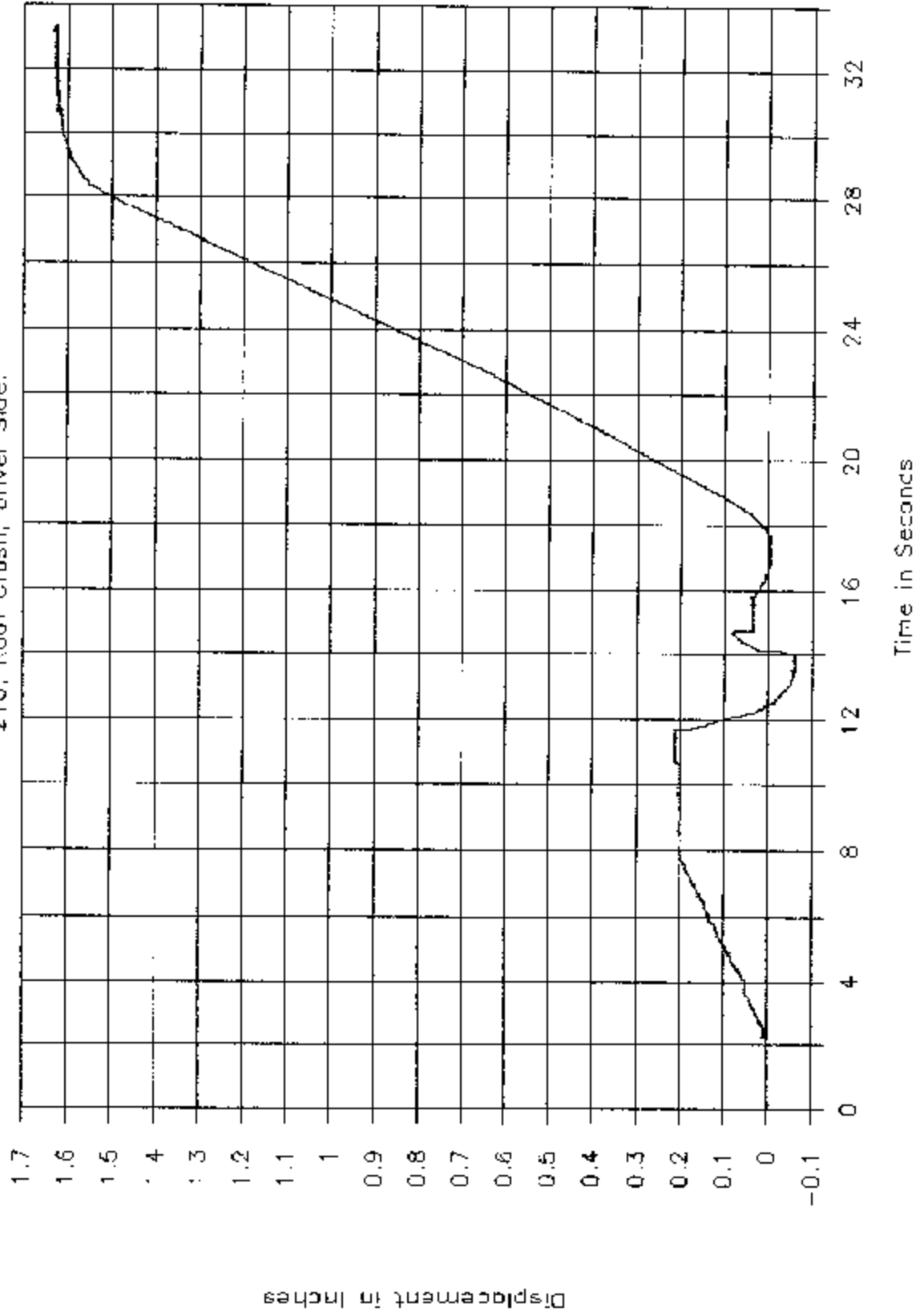
# GTL 5017, LVDT #1,R.F.

216, Roof Crush, Driver Side.



GT- 5017, LVDT #2, R.R.

216, Roof Crush, Driver Side.





# GTL 5017, LVDT #3, L.R.

216, Roof Crush, Driver Side.

