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REPORT NOS. 208-TRC-92-003

212-TRC-92-003

301-TRC-92-003

VEHICLE SAFETY COMPLIANCE TESTING
FOR OCCUPANT CRASH PROTECTION,
WINDSHIELD MOUNTING, WINDSHIELD ZONE
INTRUSION, AND FUEL SYSTEM INTEGRITY

HYUNDAI MOTOR COMPANY

1992 HYUNDAI ELANTRA

4-DOOR SEDAN

NHTSA NO. CN0501

TRC TEST NO. 911018

THE TRANSPORTATION RESEARCH CENTER OF OHIO

10820 STATE ROUTE 347

EAST LIBERTY, OHIO 43319



NOVEMBER 5, 1991

FINAL REPORT

PREPARED FOR:

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
OFFICE OF VEHICLE SAFETY COMPLIANCE (NEF-31)
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16. Abstract A 30 mph flat frontal barrier impact test was conducted on a 1992 Hyundai Elantra 4-door sedan, NHTSA No. CN0501, at the Transportation Research Center of Ohio on October 18, 1991. This test was conducted to determine compliance with Federal Motor Vehicle Safety Standards: FMVSS 208, "Occupant Crash Protection"; FMVSS 212, "Windshield Mounting"; FMVSS 219 (partial), "Windshield Zone Intrusion"; FMVSS 301, "Fuel System Integrity." The barrier impact velocity was 29.5 mph. The vehicle's maximum static crush was 17.8 inches. The ambient temperature was 78° F. The driver's head injury criteria (HIC) was 704. The driver's chest maximum resultant acceleration with three (3) milliseconds minimum duration was 53.9 g. The driver's left and right femur maximum axial forces were 1422 pounds and 999 pounds, respectively. The passenger's head injury criteria (HIC) was 385. The passenger's chest maximum resultant acceleration with three (3) milliseconds minimum duration was 44.3 g. The passenger's left and right femur maximum axial forces were 753 pounds and 1855 pounds, respectively. The vehicle appears to comply with the applicable requirements of FMVSS 208, 212, 219 (partial), and 301.					
17. Key Words Frontal Impact 30 mph Vehicle Safety Compliance Testing: FMVSS 208, "Occupant Crash Protection" FMVSS 212, "Windshield Mounting" FMVSS 219P, "Windshield Zone Intrusion" FMVSS 301, "Fuel System Integrity"			18. Distribution Statement Available from: NHTSA Technical Reference Division Room 5108, (NAD-52) 400 Seventh Street, SW Washington, DC 20590 Attn: Mr. Robert Hornickle		
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METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	m
yd	yards	0.9	meters	km
mi	miles	1.6	kilometers	
AREA				
in ²	square inches	6.5	square centimeters	cm ²
ft ²	square feet	0.09	square meters	m ²
yd ²	square yards	0.8	square meters	km ²
mi ²	square miles	2.6	square kilometers	ha
	acres	0.4	hectares	
MASS (weight)				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons	0.9	tonnes	t
	(2000 lb)			
VOLUME				
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	l
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft ³	cubic feet	0.03	cubic meters	m ³
yd ³	cubic yards	0.76	cubic meters	m ³
TEMPERATURE (exact)				
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NIST Spec. Publ. 286, Units of Weights and Measures, Price \$2.25, SD Catalog No. C13.10-286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
AREA				
cm ²	square centimeters	0.16	square inches	in ²
m ²	square meters	1.2	square yards	yd ²
km ²	square kilometers	0.4	square miles	mi ²
ha	hectares (10,000 m ²)	2.5	acres	
MASS (weight)				
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
VOLUME				
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m ³	cubic meters	35	cubic feet	ft ³
m ³	cubic meters	1.3	cubic yards	yd ³
TEMPERATURE (exact)				
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

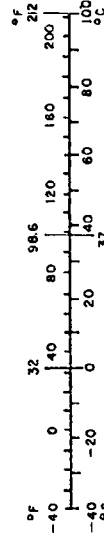


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SECTION 1.0

PURPOSE & TEST PROCEDURE

PURPOSE

This 30 mph flat frontal barrier impact test is part of the Federal Motor Vehicle Safety Standard (FMVSS) 208, 212, 219 (partial), and 301 compliance test program conducted for the National Highway Traffic Safety Administration (NHTSA) by the Transportation Research Center of Ohio (TRC) under Contract No. DTNH22-90-C-21003. The purpose of this test was to determine if the subject vehicle, a 1992 Hyundai Elantra 4-door sedan, NHTSA No. CN0501, meets the performance requirements of FMVSS 208, "Occupant Crash Protection"; FMVSS 212, "Windshield Mounting"; FMVSS 219 (partial), "Windshield Zone Intrusion"; and FMVSS 301, "Fuel System Integrity," in the flat frontal barrier impact mode.

TEST PROCEDURE

This test was conducted in accordance with NHTSA's Office of Vehicle Safety Compliance (OVSC) Laboratory Test Procedure No. TP-208-08. Data was obtained relative to FMVSS 208, "Occupant Crash Protection"; FMVSS 212, "Windshield Mounting"; FMVSS 219 (partial), "Windshield Zone Intrusion"; and FMVSS 301, "Fuel System Integrity," performance.

The test vehicle was instrumented with seven (7) accelerometers to measure longitudinal axis accelerations. The vehicle's specified impact velocity range was 28.9 to 29.9 mph. The vehicle impacted a flat frontal barrier.

The test vehicle contained two (2) Part 572 B 50th percentile adult male anthropomorphic test devices (dummies). The dummies were positioned in the front outboard designated seating positions according to the dummy placement procedure specified in Appendices B and C of the Laboratory Test Procedure.

Both dummies were instrumented with head and chest accelerometers to measure longitudinal, lateral, and vertical accelerations, and with left and right femur load cells to measure axial forces.

The twenty-three (23) data channels were multiplexed and recorded on a 14-track tape drive. The data was digitally sampled at 8000 samples per second and processed per sections 12.8 and 12.9 of the Laboratory Test Procedure.

The crash event was recorded by one (1) real-time panning motion picture camera and fourteen (14) high-speed motion picture cameras. The pre-test and post-test conditions were recorded by one (1) real-time motion picture camera.

The vehicle and occupant data are summarized in Section 2.0. The FMVSS 208, 212, 219 (partial) and 301 data are presented in Section 3.0. The vehicle, occupant, and camera measurements are presented in Section 4.0. Appendix A contains the still photographic prints. Appendix B contains the dummy and vehicle data plots.

SECTION 2.0

FRONTAL BARRIER IMPACT TEST SUMMARY

TEST RESULTS SUMMARY

This flat frontal barrier test was conducted at TRC on October 18, 1991.

The test vehicle, a 1992 Hyundai Elantra 4-door sedan, NHTSA No. CN0501, appeared to comply with the performance requirements of FMVSS 208, 212, 219 (partial), and 301 in the flat frontal barrier impact mode. The Head Injury Criteria (HIC) calculations were less than 1000, the chest resultant accelerations did not exceed 60 g's, and the axial forces transmitted through the upper legs did not exceed 2,250 pounds as measured by Part 572 B dummies seated in the front outboard designated seating positions. The vehicle's restraint system met the applicable comfort and convenience requirements. The windshield periphery retention was 99.0 percent. There was no penetration into any portion of the windshield. No fluid spilled from the vehicle's fuel system following the impact or during the static rollover test.

The test vehicle was equipped with a 1.6 liter, transverse engine, manual transmission, power steering, and power brakes. The vehicle's test weight was 2861 pounds. The vehicle's impact speed was 29.5 mph. The vehicle's maximum static crush was 17.8 inches.

The driver's head injury criteria (HIC) was 704. The driver's chest maximum resultant acceleration with three (3) milliseconds minimum duration was 53.9 g. The driver's left and right femur maximum axial forces were 1422 pounds and 999 pounds, respectively.

The right front passenger's HIC was 385. The right front passenger's chest maximum resultant acceleration with three (3) milliseconds minimum duration was 44.3 g. The right front passenger's left and right femur maximum axial forces were 753 pounds and 1855 pounds, respectively.

Loss of windshield periphery retention length was 1.5 inches extending from 6.5 to 8.0 inches from the lower right corner.

There was no intrusion through the windshield.

No fluid spilled from the vehicle's fuel system following the crash test event or during the static rollover test.

TABLE 1 CRASH TEST SUMMARY

NHTSA NO.: CN0501 TEST TYPE: Frontal Barrier Impact

TEST DATE: 10/18/91 TEST TIME: 1432 AMBIENT TEMP. (°F): 78

VEHICLE YEAR/MAKE/MODEL/BODY STYLE: 1992/Hyundai/Elantra/4-door sedan

VEHICLE TEST WEIGHT (LBS): 2861

IMPACT ANGLE (DEG)*: 0

IMPACT VELOCITY (MPH)**: PRIMARY = 29.5 SECONDARY = 29.5

MAXIMUM STATIC CRUSH (IN): 17.8

AVERAGE REBOUND (IN): 30.1

DUMMIES: Driver #353 Passenger #354

TYPE: Part 572 B Part 572 B

LOCATION: Left front Right front

RESTRAINT: Three-point passive belt Three-point passive belt

NUMBER OF DATA CHANNELS: 23

NUMBER OF CAMERAS: HIGH-SPEED 14 REAL-TIME 2

*With respect to tow track centerline.

**Speed trap measurement ($\pm$.05 mph accuracy)

TABLE 2 TEST VEHICLE INFORMATION

VEHICLE MANUFACTURER: Hyundai Motor Company

MAKE/MODEL: Hyundai/Elantra

VIN: KMHJF22R8NU079665

BODY STYLE: 4-door sedan

MODEL YEAR: 1992

NHTSA NO.: CN0501

COLOR: Blue

ENGINE DATA: TYPE: transverse CYLINDERS: 4 DISPLACEMENT: 1.6 liter

TRANSMISSION DATA: 5 SPEED, X MANUAL, AUTOMATIC, X FWD, RWD, 4WD

DATE VEHICLE RECEIVED: 10/15/91

ODOMETER READING: 67.0

DEALER'S NAME AND ADDRESS: Hatfield Hyundai, Inc.

1400 Automall Drive

Columbus, OH 43228

ACCESSORIES:

POWER STEERING Yes
POWER BRAKES Yes
POWER SEATS No
POWER WINDOWS No
TINTED GLASS Yes
RADIO No
CLOCK Yes
OTHER None

AUTOMATIC TRANSMISSION No
AUTOMATIC SPEED CONTROL No
TILTING STEERING WHEEL No
TELESCOPING STEERING WHEEL No
AIR CONDITIONING No
ANTI-SKID BRAKE No
REAR WINDOW DEFROSTER Yes

REMARKS:

1. IS THE VEHICLE STOCK THROUGHOUT? Yes
2. DOES VEHICLE SHOW EVIDENCE OF PRIOR ACCIDENT HISTORY? No
3. DOES VEHICLE SHOW ANY SIGNIFICANT CORROSION? No
4. CONDITION OF THE FRONT/REAR BUMPER AND FRAME: Good

CERTIFICATION DATA FROM VEHICLE'S LABEL:

VEHICLE MANUFACTURED BY: Hyundai Motor Company

DATE OF MANUFACTURE: 07/91

VIN: KMHJF22R8NU079665

GVWR: 3560 LBS

GAWR: FRONT: 1896 LBS., REAR: 1752 LBS.

TABLE 2 TEST VEHICLE INFORMATION CONT'D

TIRES ON VEHICLE (MFR., LINE, SIZE): Goodyear Invicta GL P175/65R14

TIRE PRESSURE WITH MAXIMUM CAPACITY VEHICLE LOAD: FRONT: 35 PSI
REAR: 35 PSI

SPARE TIRE (MFR., LINE, SIZE): T125/70D15

TYPE OF SEATS: FRONT: Bucket
REAR: Bench

TYPE OF FRONT SEAT BACKS: Manually Adjustable

MAXIMUM WIDTH: 67.0 INCHES

WHEELBASE: 98.0 INCHES

LOCATION OF LABEL STATING TIRE & CAPACITY DATA: THE LABEL WAS LOCATED ON
THE DRIVER'S DOOR.

TIRE & CAPACITY DATA FROM VEHICLE'S LABEL:

RECOMMENDED TIRE SIZE: FRONT: P175/65TR14
REAR: P185/60HR14

RECOMMENDED COLD TIRE PRESSURE: FRONT: 29 PSI; REAR: 29 PSI

DESIGNATED SEATING CAPACITY: 2 FRONT 3 REAR 5 TOTAL

VEHICLE CAPACITY WEIGHT: 860 LBS.

TEST VEHICLE ATTITUDE (ALL MEASUREMENTS ARE IN INCHES):

DELIVERED ATTITUDE: LF 26.8; RF 26.8; LR 25.6; RR 25.4

FULLY LOADED ATTITUDE: LF 26.2; RF 26.1; LR 24.0; RR 23.9

PRE-TEST ATTITUDE: LF 25.5; RF 25.5; LR 23.4; RR 23.2

POST-TEST ATTITUDE: LF 27.1; RF 27.2; LR 23.2; RR 23.1

TABLE 2 TEST VEHICLE INFORMATION CONT'D

WEIGHT OF TEST VEHICLE AS RECEIVED (WITH MAXIMUM FLUIDS):

RIGHT FRONT	750 LBS.	RIGHT REAR	448 LBS.
LEFT FRONT	779 LBS.	LEFT REAR	461 LBS.
TOTAL FRONT WEIGHT	1529 LBS.	(62.7% OF TOTAL VEHICLE WEIGHT)	
TOTAL REAR WEIGHT	909 LBS.	(37.3% OF TOTAL VEHICLE WEIGHT)	
TOTAL DELIVERED WEIGHT 2438 LBS.			

CALCULATION OF TEST VEHICLE'S TARGET TEST WEIGHT:

RCLW = RATED CARGO AND LUGGAGE WEIGHT*

UDW = UNLOADED DELIVERED WEIGHT (2438 LBS)

VCW = VEHICLE CAPACITY WEIGHT (860 LBS)

DSC = DESIGNATED SEATING CAPACITY (5)

$RCLW* = VCW - 150 (DSC) = 860 - 150 (5) = 110$

$TARGET\ TEST\ WEIGHT = UDW + RCLW* + (NO.\ OF\ HYBRID\ II\ DUMMIES\ X\ 164\ LBS/DUMMY)$

$TARGET\ TEST\ WEIGHT = 2438 + 110 + 328$

$TARGET\ TEST\ WEIGHT = 2876\ LBS$

WEIGHT OF TEST VEHICLE WITH REQUIRED DUMMIES AND 95 LBS. OF CARGO WEIGHT:

RIGHT FRONT	801 LBS.	RIGHT REAR	614 LBS.
LEFT FRONT	827 LBS.	LEFT REAR	619 LBS.
TOTAL FRONT WEIGHT	1628 LBS.	(56.9% OF TOTAL VEHICLE WEIGHT)	
TOTAL REAR WEIGHT	1233 LBS.	(43.1% OF TOTAL VEHICLE WEIGHT)	
TOTAL TEST WEIGHT	2861 LBS.	(0.5% UNDER TARGET TEST WEIGHT)	

WEIGHT OF BALLAST SECURED IN VEHICLE CARGO AREA: 0 LBS.

COMPONENTS REMOVED TO MEET TARGET TEST WEIGHT: Rear seat belts, tail light assembly and rear trim panels

CG = 42.2 INCHES REARWARD OF FRONT WHEEL CENTERLINE

*Cargo weight for multi-purpose passenger vehicles, trucks, and buses is the vehicle's rated cargo and luggage weight from the vehicle's label or 300 pounds, whichever is less.

TABLE 3 POST-IMPACT DATA

TEST NUMBER: 911018 NHTSA NO.: CN0501
TEST DATE: 10/18/91 TEST TIME: 1432
TEST TYPE: Frontal Barrier Impact IMPACT ANGLE: 0
AMBIENT TEMPERATURE AT IMPACT AREA: 78° F
TEMPERATURE IN OCCUPANT COMPARTMENT: 71° F
IMPACT VELOCITY: PRIMARY = 29.5 MPH SECONDARY = 29.5 MPH
(SPECIFIED RANGE = 28.9 TO 29.9 MPH)
DISTANCE FROM VEHICLE TO BARRIER: ENTERING VELOCITY TRAP = 26.0 IN.
EXITING VELOCITY TRAP = 2.0 IN.

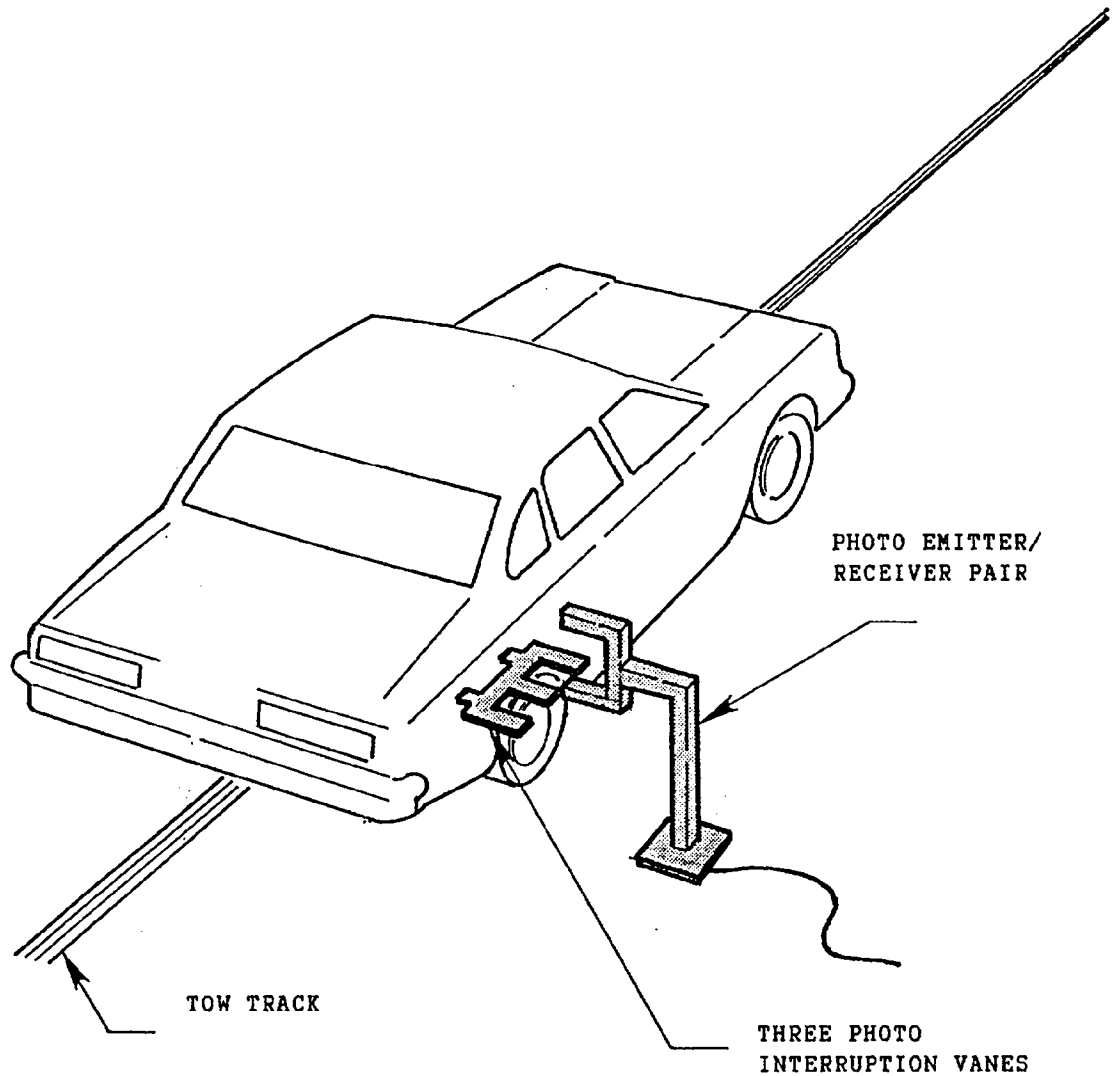
TEST VEHICLE STATIC CRUSH (ALL MEASUREMENTS ARE IN INCHES):

OVERALL LENGTH OF TEST VEHICLE: PRE-TEST: L 166.0; C 172.0; R 166.0
POST-TEST: L 151.0; C 155.0; R 151.6
TOTAL CRUSH: L 15.0; C 17.0; R 14.4
AVERAGE CRUSH: 15.5

TEST VEHICLE REBOUND FROM FLAT BARRIER (ALL MEASUREMENTS ARE IN INCHES):

DISTANCE FROM TEST VEHICLE TO BARRIER: L 23.2; C 31.0; R 36.0; AVG. 30.1

FIGURE 1 IMPACT VELOCITY MEASUREMENT SYSTEM



The final vane clears emitter/receiver two inches before impact.

The vanes have one foot spacing.

FIGURE 2 ACCIDENT INVESTIGATION DIVISION DATA
FOR 30 MPH FRONTAL BARRIER IMPACT

VEHICLE MAKE/MODEL/BODY STYLE: Hyundai/Elantra/4-door sedan

VEHICLE NHTSA NO.: CN0501; VIN: KMHJF22R8NU079665

MODEL YEAR: 1992; BUILD DATE: 07/91; TEST DATE: 10/18/91

VEHICLE SIZE CATEGORY: Compact; TEST WEIGHT: 2861 LBS.

VEHICLE WHEELBASE: 98.0 INCHES

MAXIMUM WIDTH: 66.2 INCHES

FRONT OVERHANG: 34.0 INCHES

COLLISION DEFORMATION
CLASSIFICATION (CDC) CODE: 12FDEW3

CRUSH DEPTH
MEASUREMENTS:

C1 =	<u>15.0</u>	INCHES
C2 =	<u>17.5</u>	INCHES
C3 =	<u>17.8</u>	INCHES
C4 =	<u>17.0</u>	INCHES
C5 =	<u>17.0</u>	INCHES
C6 =	<u>14.4</u>	INCHES

MIDPOINT OF DAMAGE: D = VEHICLE CENTERLINE
(LONGITUDINAL)

LENGTH OF DAMAGED
REGION: L = 57.0 INCHES

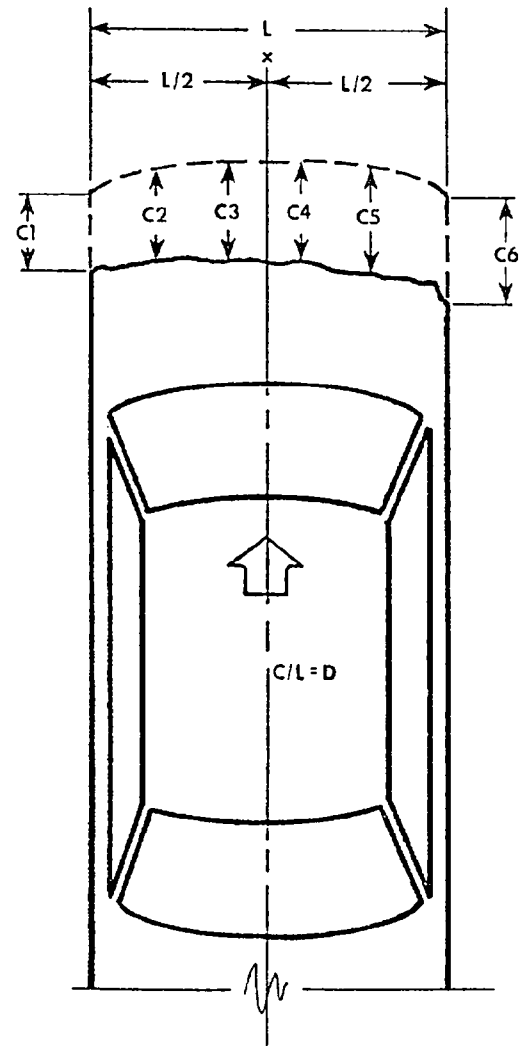
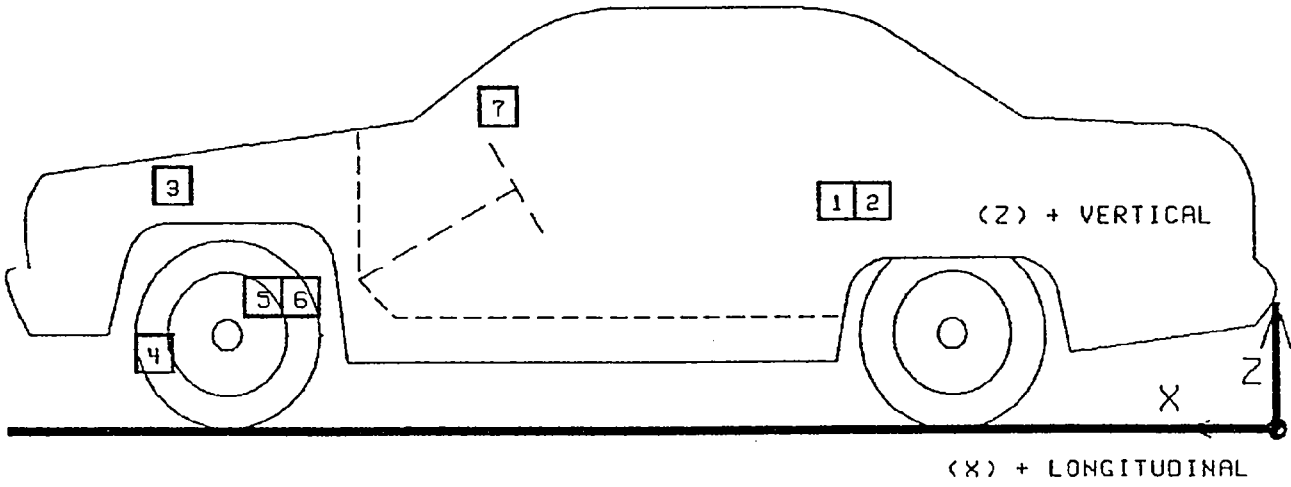
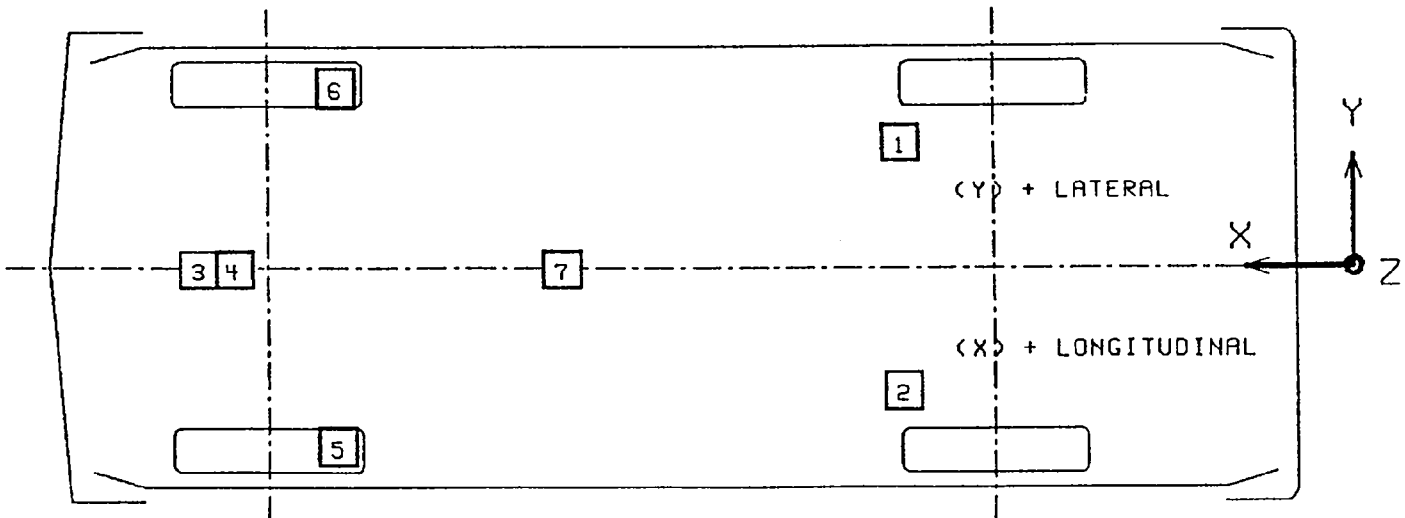


FIGURE 3
VEHICLE ACCELEROMETER PLACEMENT



SIDE VIEW



BOTTOM VIEW

TABLE 4

VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

TEST NUMBER 911018

No.	LOCATION		X*	Y*	Z*	POSITIVE DIRECTION		NEGATIVE DIRECTION	
						MAX	G MSEC	MAX	G MSEC
1	LEFT REAR SEAT CROSSMEMBER LONGITUDINAL	PRE	67.8	14.2	15.1				
		POST	67.6	14.5	14.8				
						3.5	125.9	35.7	39.3
2	RIGHT REAR SEAT CROSSMEMBER LONGITUDINAL	PRE	67.2	-14.5	15.0				
		POST	67.2	-14.6	15.1				
						1.9	128.8	37.2	39.4
3	ENGINE TOP LONGITUDINAL	PRE	144.0	1.8	31.9				
		POST	137.8	4.0	30.0				
						36.6	42.5	113.5	32.1
4	ENGINE BOTTOM LONGITUDINAL	PRE	144.0	10.2	6.9				
		POST	133.2	12.1	5.0				
						31.1	37.5	126.6	25.0
5	RIGHT BRAKE CALIPER LONGITUDINAL	PRE	142.0	-24.9	11.8				
		POST	136.4	-25.4	10.5				
						44.8	66.6	188.6	43.5
6	LEFT BRAKE CALIPER LONGITUDINAL	PRE	142.0	25.0	11.6				
		POST	132.5	24.8	10.6				
						40.1	62.6	90.7	46.3
7	INSTRUMENT PANEL CENTER LONGITUDINAL	PRE	119.0	0.0	37.0				
		POST	119.0	0.0	37.2				
						40.0	65.3	48.0	73.3

* ALL MEASUREMENTS OF ACCELEROMETER LOCATIONS ARE IN INCHES.

REFERENCE: X: + FORWARD FROM REAR BUMPER
Y: + LEFTWARD FROM VEHICLE CENTERLINE
Z: + UPWARD FROM GROUND LEVEL

REPORT OF VEHICLE CONDITION AT THE
COMPLETION OF TESTING

CONTRACT NO.: DTNH22-90-C-21003

FROM: The Transportation Research Center of Ohio
10820 State Route 347
East Liberty, OH 43319

TO: Mr. Charles Case
COTR
Office of Vehicle Safety Compliance

The following vehicle has been subjected to testing for FMVSS 208. The vehicle was inspected upon arrival at the laboratory for the test and found to contain all of the equipment listed below. All variances have been reported within 2 working days of vehicle arrival, by letter, to the NHTSA Industrial Property Manager/NAD-30, with a carbon copy to the responsible testing office. The vehicle is again inspected, after the above test has been conducted, and all changes are noted below. The final condition of the vehicle is also noted in detail.

NHTSA NO.: CN0501
MAKE/MODEL/BODY STYLE: Hyundai/Elantra/4-door sedan
MODEL YEAR: 1992 BODY COLOR: Blue
VIN: KMHJF22R8NU079665
ODOMETER (ARRIVAL): 67 DATE: 10/15/91
ODOMETER (COMPLETION): 76 DATE: 10/18/91
COST: \$9,392.00

☐ AIR CONDITIONER	☒ CONSOLE	BRAKES: ☒ POWER
☒ TINTED GLASS	☐ TACHOMETER	FRONT: Disc
☒ POWER STEERING	☐ SPEED CONTROL	REAR: Drum
☐ POWER WINDOWS	☒ REAR WINDOW DEF.	
☐ POWER DOOR LOCKS	☐ SUN/MOON ROOF	FRONT SEATS: ☐ POWER
☐ RADIO	☐ T-TOP	SEAT TYPE: Bucket
☒ CLOCK	☐ TILT STEERING WHEEL	NO. OF SEATS: 5
☐ ROOF RACK	☐ OTHER OPTIONS: _____	

ENGINE: 4 CYLINDERS; 1.6 LITERS
TRANSMISSION: Manual; DRIVE TYPE: Front wheel
TIRE SIZE: P175/65R14
GASOLINE TYPE: Unleaded

EQUIPMENT THAT IS NO LONGER ON THE VEHICLE AS NOTED ABOVE: None

EXPLANATION: NA

VEHICLE CONDITION: Vehicle has been subjected to a 30 mph frontal
barrier crash test.

SECTION 3.0

FMVSS 208, 212, 219 (partial), & 301 DATA

TABLE 5 DUMMY INJURY CRITERIA

MAXIMUM ACCELERATION (G)

	HEAD				CHEST			
	X	Y	Z	R	X	Y	Z	R*
DRIVER	-169.0	-18.9	-60.1	173.4	-56.1	13.4	-6.3	53.9
PASSENGER	-22.0	-24.3	-57.8	59.5	-46.3	-24.4	15.8	44.3

MAXIMUM FEMUR COMPRESSIVE FORCE (LBS)

	LEFT FEMUR	RIGHT FEMUR
DRIVER	1422	999
PASSENGER	753	1855

HEAD INJURY CRITERIA**

	HIC	TIME t_1 (MSEC) ¹	TIME t_2 (MSEC) ²
DRIVER	704	76.1	112.1
PASSENGER	385	72.6	108.6

*Defined as exceeding 0.003 sec. duration

**As defined in FMVSS No. 208

TABLE 6 POST-IMPACT DUMMY/VEHICLE DATA

VISIBLE DUMMY CONTACT POINTS:

	DRIVER #353	PASSENGER #354
HEAD	<u>Steering wheel</u>	<u>Chest</u>
CHEST	<u>Steering wheel</u>	<u>Head</u>
ABDOMEN	<u>None</u>	<u>None</u>
LEFT KNEE	<u>Instrument panel</u>	<u>Instrument panel</u>
RIGHT KNEE	<u>Instrument panel</u>	<u>Instrument panel</u>

DOOR OPENING:

	LEFT	RIGHT
FRONT	<u>Easy</u>	<u>Easy</u>
REAR	<u>Easy</u>	<u>Easy</u>

SEAT MOVEMENT:

	SEAT BACK FAILURE	SEAT SHIFT
FRONT	<u>None</u>	<u>None</u>
REAR	<u>NA</u>	<u>NA</u>

GLAZING DAMAGE:

The entire windshield cracked upon impact.

OTHER NOTABLE IMPACT EFFECTS:

None

DUMMY KINEMATIC SUMMARY

Driver Dummy

Upon impact, the driver dummy translated forward on the seat impacting both knees into the instrument panel. The dummy's lower chest then impacted the lower rim of the steering wheel followed by the dummy's head rotating downward impacting the steering wheel hub and upper rim. The driver dummy was restrained by the 3-point passive unbelt. The dummy then rebounded rearward into the seat back as the dummy's head rotated rearward. The driver dummy came to rest in the driver's seat restrained by the 3-point passive unbelt.

Right Front Passenger Dummy

Upon impact, the right front passenger dummy translated forward on the seat impacting both knees into the instrument panel. The dummy's upper torso rotated slightly to the right as the dummy's head rotated downward into the dummy's chest. The right front passenger dummy was restrained by the 3-point passive unbelt. The dummy then rebounded rearward, with the upper torso still rotated slightly to the right, and the lower torso rotating to the right, while the dummy's head rotated rearward. The right front passenger dummy came to rest in the right front passenger's seat rotated slightly to the right, and restrained by the 3-point passive unbelt.

TABLE 7 FMVSS 208 COMFORT & CONVENIENCE DATA FOR AUTOMATIC SEAT BELTS

MAKE/MODEL: Hyundai/Elantra

VIN: KMHJF22R8NU079665

BODY STYLE: 4-door sedan

NHTSA NO.: CN0501

DATE OF MANUFACTURE: 07/91

CONVENIENCE HOOKS:

DEVICE TO STOW SEAT BELT WEBBING TO FACILITATE ENTERING OR EXITING THE VEHICLE AUTOMATICALLY RELEASES THE WEBBING WHEN THE IGNITION IS TURNED TO THE "ON" OR "START" POSITION AND (check one):

- ☐ The vehicle's drivetrain is engaged
- ☐ The vehicle's parking brake is in the released mode
- ☒ Not applicable, the vehicle's restraint system does not include convenience hooks or devices to stow seat belt webbing.

WEBBING TENSION - RELIEVING DEVICE:

DO OUTBOARD SEATING POSITION SEAT BELTS HAVE WEBBING TENSION - RELIEVING DEVICES?(check one): ☐ YES ☒ No

BELT CONTACT FORCE:

BELT CONTACT FORCE ON CHEST OF TEST DUMMY: 0.2 POUNDS

TABLE 8 FMVSS 208 SEAT BELT WARNING SYSTEM DATA

WITH OCCUPANT IN DRIVER'S POSITION AND UNIBELT IN STOWED POSITION AND
IGNITION SWITCH PLACED IN "START/ON" POSITION:

Duration of audible warning signal = 6 sec.

Duration of reminder light operation = 65 sec.

WITH OCCUPANT IN DRIVER'S POSITION AND UNIBELT IN USE AND THE IGNITION
SWITCH PLACED IN "START/ON" POSITION:

Duration of audible warning signal = 0 sec.

(NOTE: audible warning should not operate)

Duration of reminder light operation = 7 sec.

WORDING OF VISUAL WARNING:

 Fasten Seat Belt

 Fasten Belt

 X Symbol 101-80

 Other:

TABLE 9 FMVSS 208 LABELING AND DRIVER'S MANUAL DATA

DESCRIBE LOCATION OF LABEL WHICH DESCRIBES MANUFACTURER'S MAINTENANCE OR
REPLACEMENT SCHEDULE FOR CRASH-DEPLOYED OCCUPANT PROTECTION SYSTEM:

Not applicable, vehicle did not contain a crash-deployed occupant protection
system.

TABLE 10 FMVSS 208 READINESS INDICATOR DATA

AN OCCUPANT RESTRAINT SYSTEM THAT DEPLOYS IN THE EVENT OF A CRASH SHALL HAVE A MONITORING SYSTEM WITH A READINESS INDICATOR. A TOTALLY MECHANICAL SYSTEM IS EXEMPT FROM THIS REQUIREMENT.

Not applicable, vehicle did not contain a crash-deployed occupant protection system.

FIGURE 4 FMVSS 212 TEST DATA

DETAILS OF WINDSHIELD MOUNTING SUCH AS RETENTION METHOD, TRIM TYPE, ETC.:

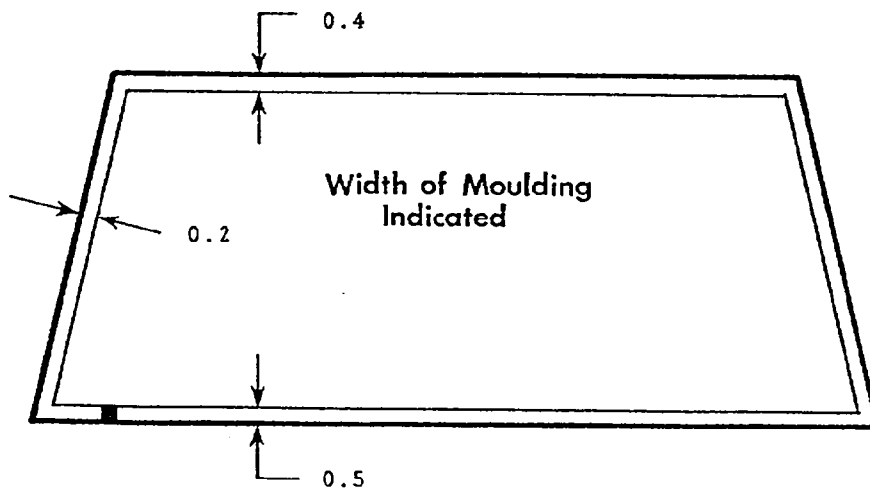
Plastic trim around outer perimeter, adhesive trim around inner perimeter.

FMVSS 212 REQUIREMENTS: The post-test periphery retention amount must be at least 75% of the pre-test periphery measurement for vehicles NOT equipped with automatic restraints, and 50% for each side of windshield for vehicles equipped with automatic restraint systems for front occupants.

WINDSHIELD PERIPHERY MEASUREMENTS:

	PRE-TEST	POST-TEST	PERCENT RETENTION
RIGHT SIDE	78.2	76.7	98.1
LEFT SIDE	78.2	78.2	100.0
TOTAL	156.4	154.9	99.0

PRE-TEST WINDSHIELD MOUNTING MATERIAL TEMPERATURE: 71° F



FRONT VIEW OF WINDSHIELD*

LOSS OF WINDSHIELD RETENTION LENGTHS: Loss of retention occurred from 6.5 inches to 8.0 inches along the lower edge of the windshield measured from the lower right corner.

ALL DISTANCE MEASUREMENTS ARE IN INCHES.

*INDICATE AREAS OF LOSS OF RETENTION, IF ANY, ON WINDSHIELD DIAGRAM.

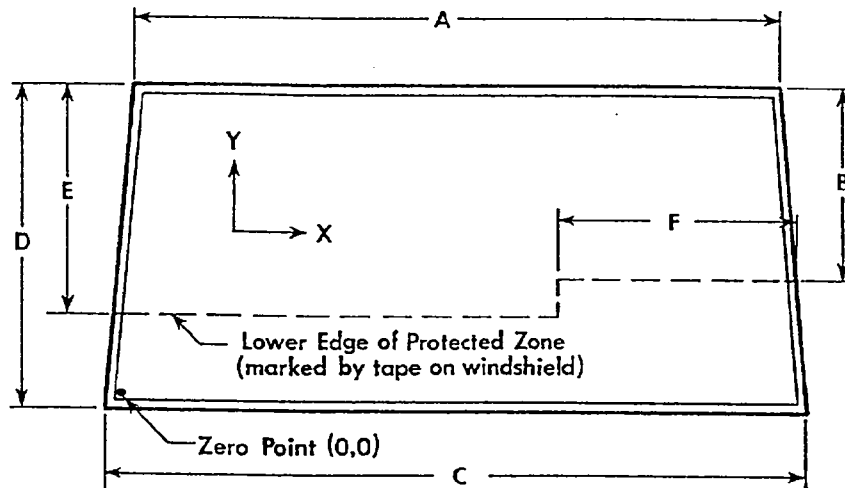
FIGURE 5 FMVSS 219 TEST DATA

PROTECTED ZONE LOWER EDGE REQUIREMENT:

The lower edge of the protected zone is determined by placing a 6.5 inch diameter rigid sphere weighing 15 pounds in a position such that it simultaneously contacts the inner surface of the windshield and the top surface of the instrument panel including padding. Draw the locus of points on the inner surface of the windshield contactable by the sphere across the width of the instrument panel. From the outermost contactable points, extend the locus line horizontally to the edges of the windshield, and then draw a line on the inner surface of the windshield below and 0.5 inch from the locus line. The LOWER EDGE OF THE PROTECTED ZONE is the longitudinal projection onto the outer surface of the windshield of this line.

WINDSHIELD MEASUREMENTS:

A = 42.5
B = 16.8
C = 58.0
D = 31.0
E = 22.4
F = 33.0



FRONT VIEW

METHOD OF ADHERING PROTECTED ZONE TEMPLATE TO WINDSHIELD: NA

AREAS OF WINDSHIELD TEMPLATE PENETRATION
GREATER THAN 0.25 IN.: NA

COORDINATES

	X	Y
1.		
2.		
3.		

AREAS OF WINDSHIELD PENETRATION, BELOW THE PROTECTED ZONE,
THROUGH THE INNER SURFACE OF THE WINDSHIELD: None

1.
2.
3.

ALL MEASUREMENTS ARE IN INCHES.

TABLE 11 FUEL SYSTEM DATA

MAKE/MODEL: Hyundai/Elantra

NHTSA NO.: CN0501

FUEL SYSTEM CAPACITY: 13.7 GALLONS (FROM OWNER'S MANUAL)

USABLE CAPACITY: 13.7 GALLONS (FURNISHED BY COTR)

TEST VOLUME RANGE: 12.6 GALLONS TO 12.9 GALLONS (92-94% OF USABLE)

ACTUAL TEST VOLUME: 12.7 GALLONS (WITH ENTIRE FUEL SYSTEM FILLED)

TEST FLUID TYPE: STODDARD SOLVENT

SPECIFIC GRAVITY: 0.764

KINEMATIC VISCOSITY: 0.99 CENTISTOKES

TEST FLUID COLOR: PURPLE

DETAILS OF FUEL SYSTEM: The fuel tank is located in front of the rear
axle. The fuel lines run along the right side to the front. The fuel
filler is located on the right side.

ELECTRIC FUEL PUMP: Yes FUEL INJECTION: Yes

DOES ELECTRIC FUEL PUMP OPERATE WITH IGNITION SWITCH "ON" AND THE ENGINE NOT
OPERATING? No

TABLE 12 FMVSS 301 POST-IMPACT TEST DATA

TEST VEHICLE NHTSA NO.: CN0501; TEST DATE: 10/18/91
VEHICLE MAKE/MODEL/BODY STYLE: Hyundai/Elantra/4-door sedan

TEST REQUIREMENTS:

Test vehicle fuel tank filled to 92 to 94% of manufacturer's usable capacity and with electric fuel pump operating (if it will operate without engine operation). Part 572 test dummies located at each front designated seating position.

TEST VEHICLE IMPACT TYPE:

 X FRONTAL (30 MPH)
 OBLIQUE (30 MPH) WITH ° BARRIER FACE
FIRST CONTACTING (DRIVER/PASS.) SIDE.
 REAR MOVING BARRIER (30 MPH)
 LATERAL MOVING BARRIER (20 MPH)

FUEL SYSTEM FLUID SPILLAGE MEASUREMENTS:

	<u>TEST</u> <u>RESULTS</u>	<u>MAXIMUM</u> <u>ALLOWABLE</u>
1. FROM IMPACT UNTIL VEHICLE MOTION CEASES - - -	0 OZ.	1 OZ.
2. 5 MINUTE PERIOD AFTER VEHICLE MOTION CEASES -	0 OZ.	5 OZ.
3. NEXT 25 MINUTES AFTER 5 MINUTE PERIOD - - - -	0 OZ.	1 OZ./1 MIN.

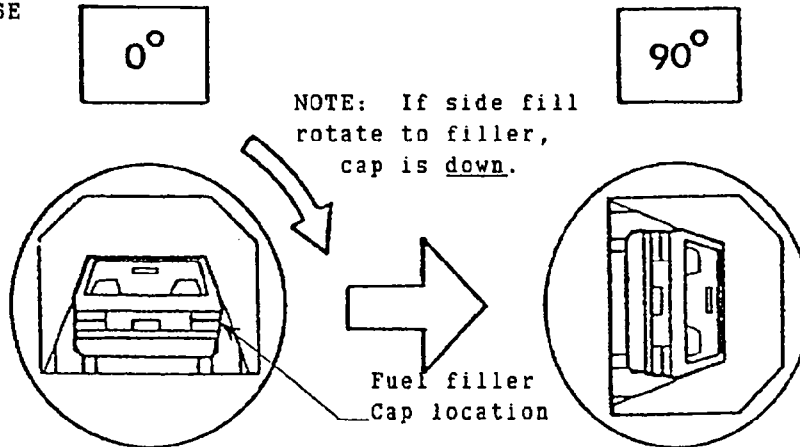
FUEL SYSTEM FLUID SPILLAGE LOCATION(S):

None

FIGURE 6 FMVSS 301 STATIC ROLLOVER TEST DATA

NHTSA NO.: CN0501

TEST PHASE



STATIC ROLLOVER MACHINE ROTATION TIME INFORMATION: (Spec. Range = 1-3 min.)

TIME REQ. FOR MACHINE TO ROTATE 90° = 2 minutes, 00 seconds

FMVSS 301 POSITION HOLD TIME = 5 minutes, 00 seconds

TOTAL - - - - - = 7 minutes, 00 seconds

NEXT WHOLE MINUTE INTERVAL - - - - = 7 minutes

FUEL SYSTEM FLUID SPILLAGE MEASUREMENTS:

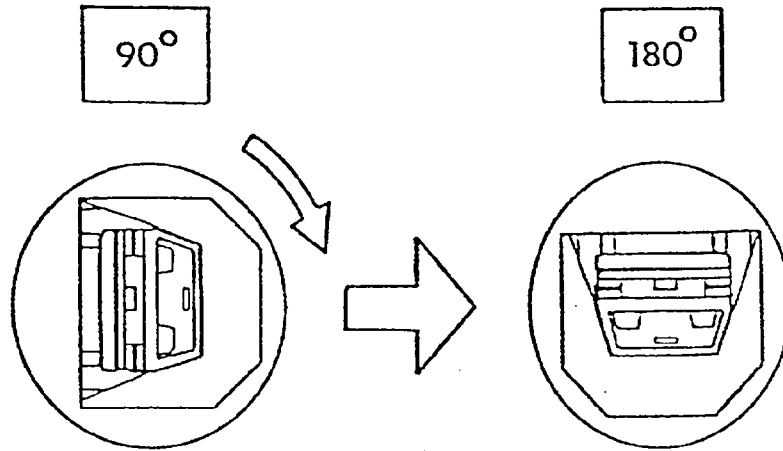
<u>0° TO 90° ROTATION (FUEL FILLER CAP DOWN)</u>	<u>TEST RESULTS</u>	<u>MAXIMUM ALLOWABLE</u>
1. FIRST 5 MINUTES FROM ONSET OF ROTATION - - - - -	0 oz.	5 oz.
2. 6TH MINUTE FROM ONSET OF ROTATION - - - - -	0 oz.	1 oz.
3. 7TH MINUTE FROM ONSET OF ROTATION - - - - -	0 oz.	1 oz.

FUEL SYSTEM FLUID SPILLAGE LOCATION(S):

None

FIGURE 6 FMVSS 301 STATIC ROLLOVER TEST DATA, CONT'D.

NHTSA NO.: CN0501
TEST PHASE



STATIC ROLLOVER MACHINE ROTATION TIME INFORMATION: (Spec. Range = 1-3 min.)

TIME REQ. FOR MACHINE TO ROTATE 90° = 2 minutes, 00 seconds

FMVSS 301 POSITION HOLD TIME = 5 minutes, 00 seconds

TOTAL - - - - - = 7 minutes, 00 seconds

NEXT WHOLE MINUTE INTERVAL - - - - = 14 minutes

FUEL SYSTEM FLUID SPILLAGE MEASUREMENTS:

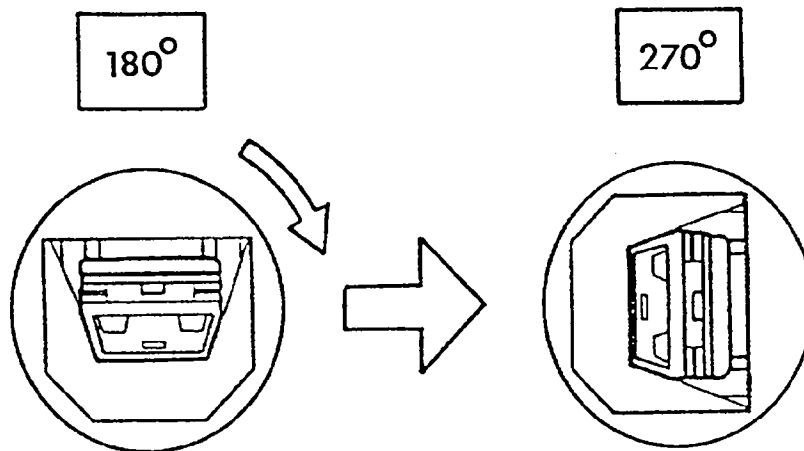
<u>90° TO 180° ROTATION</u>	<u>TEST RESULTS</u>	<u>MAXIMUM ALLOWABLE</u>
1. FIRST 5 MINUTES FROM ONSET OF ROTATION - - - - -	0 oz.	5 oz.
2. 6TH MINUTE FROM ONSET OF ROTATION - - - - -	0 oz.	1 oz.
3. 7TH MINUTE FROM ONSET OF ROTATION - - - - -	0 oz.	1 oz.

FUEL SYSTEM FLUID SPILLAGE LOCATION(S):

None

FIGURE 6 FMVSS 301 STATIC ROLLOVER TEST DATA, CONT'D.

NHTSA NO.: CN0501
TEST PHASE



STATIC ROLLOVER MACHINE ROTATION TIME INFORMATION: (Spec. Range = 1-3 min.)

TIME REQ. FOR MACHINE TO ROTATE 90° = 2 minutes, 00 seconds

FMVSS 301 POSITION HOLD TIME = 5 minutes, 00 seconds

TOTAL - - - - - = 7 minutes, 00 seconds

NEXT WHOLE MINUTE INTERVAL - - - - = 21 minutes

FUEL SYSTEM FLUID SPILLAGE MEASUREMENTS:

<u>180° TO 270° ROTATION</u>	<u>TEST RESULTS</u>	<u>MAXIMUM ALLOWABLE</u>
1. FIRST 5 MINUTES FROM ONSET OF ROTATION - - - - -	0 oz.	5 oz.
2. 6TH MINUTE FROM ONSET OF ROTATION - - - - -	0 oz.	1 oz.
3. 7TH MINUTE FROM ONSET OF ROTATION - - - - -	0 oz.	1 oz.

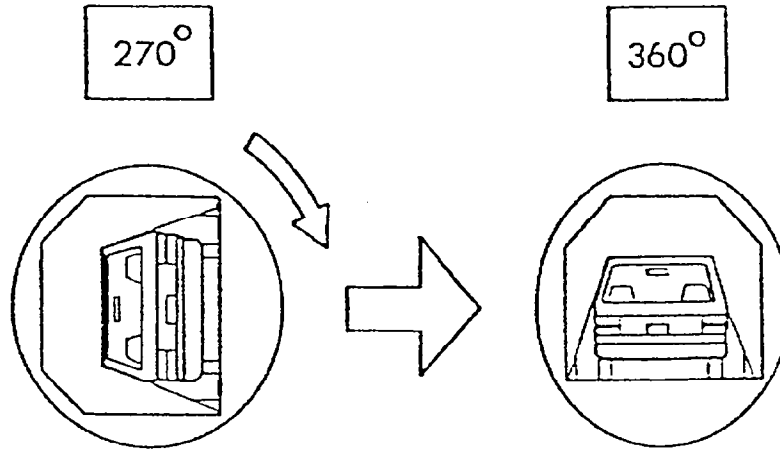
FUEL SYSTEM FLUID SPILLAGE LOCATION(S):

None

FIGURE 6 FMVSS 301 STATIC ROLLOVER TEST DATA, CONT'D.

NHTSA NO.: CN0501

TEST PHASE



STATIC ROLLOVER MACHINE ROTATION TIME INFORMATION: (Spec. Range = 1-3 min.)

TIME REQ. FOR MACHINE TO ROTATE 90° = 2 minutes, 00 seconds

FMVSS 301 POSITION HOLD TIME = 5 minutes, 00 seconds

TOTAL - - - - - = 7 minutes, 00 seconds

NEXT WHOLE MINUTE INTERVAL - - - - = 28 minutes

FUEL SYSTEM FLUID SPILLAGE MEASUREMENTS:

<u>270° TO 360° ROTATION</u>	<u>TEST RESULTS</u>	<u>MAXIMUM ALLOWABLE</u>
1. FIRST 5 MINUTES FROM ONSET OF ROTATION - - - - -	0 oz.	5 oz.
2. 6TH MINUTE FROM ONSET OF ROTATION - - - - -	0 oz.	1 oz.
3. 7TH MINUTE FROM ONSET OF ROTATION - - - - -	0 oz.	1 oz.

FUEL SYSTEM FLUID SPILLAGE LOCATION(S):

None

SECTION 4.0

VEHICLE, OCCUPANT, AND CAMERA MEASUREMENTS

FIGURE 7

PRE-TEST AND POST-TEST MEASUREMENT POINTS

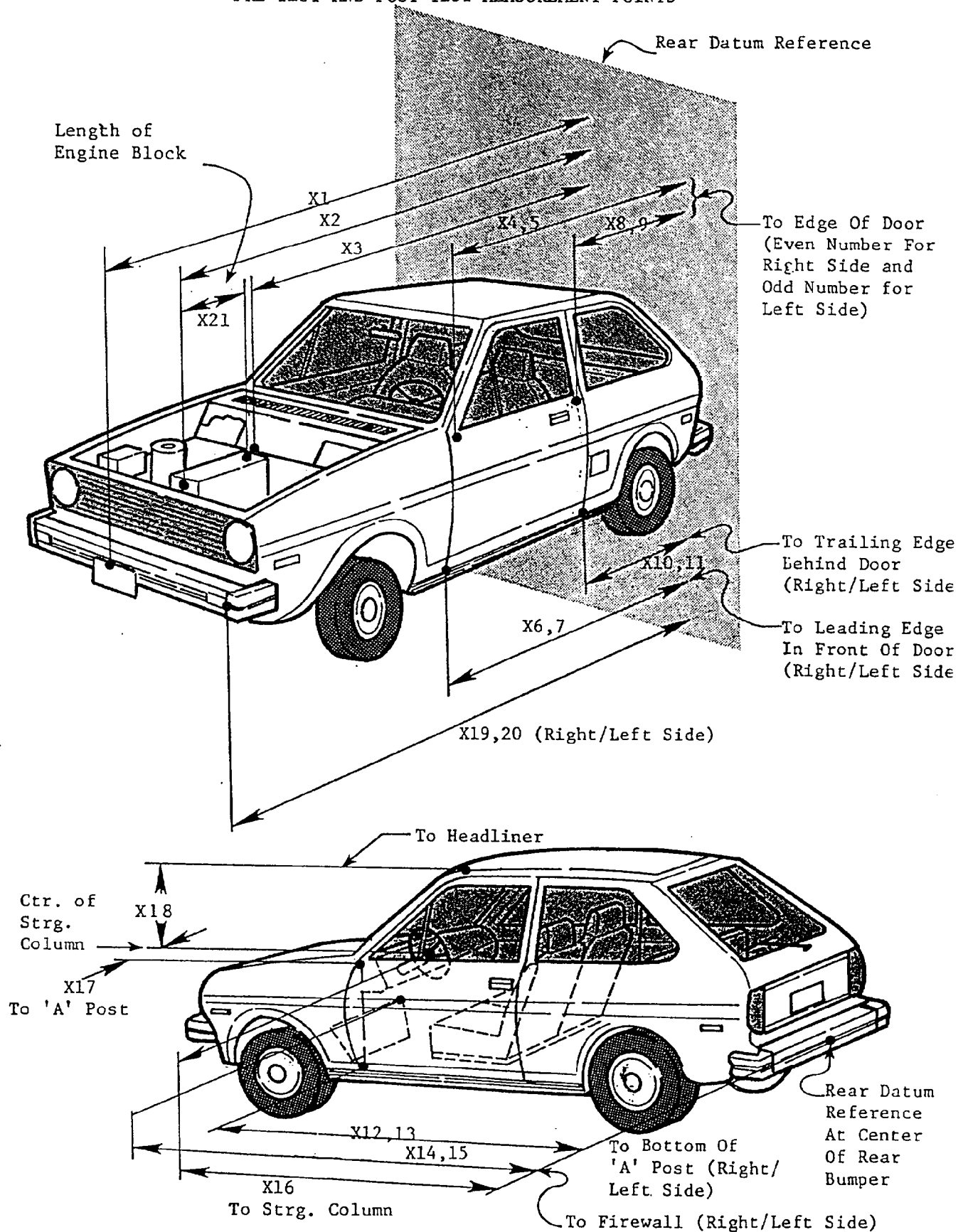


TABLE 13 IMPACTED VEHICLE MEASUREMENTS

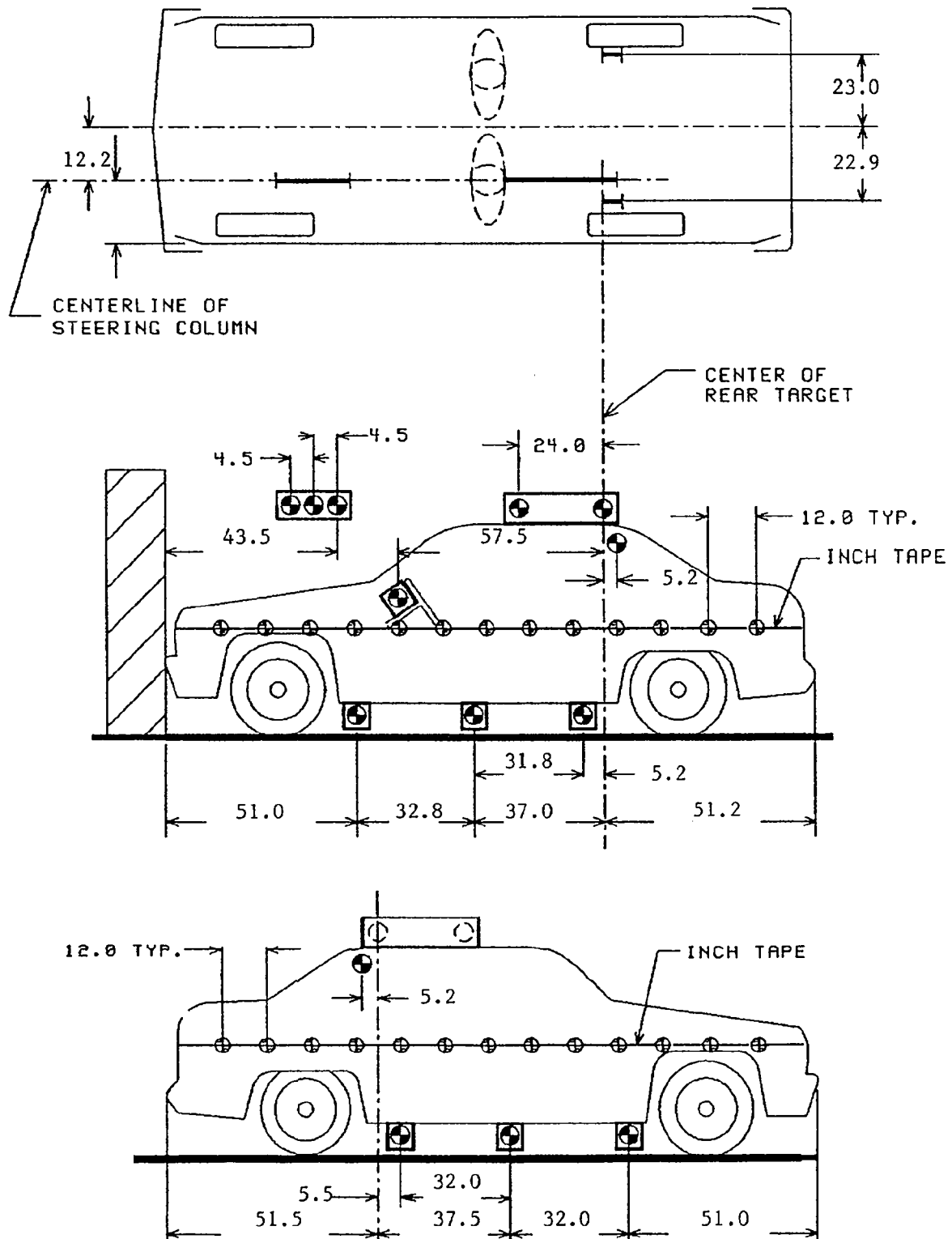
VEHICLE MAKE/MODEL: Hyundai/Elantra

TEST NUMBER: 911018

NO.	TYPE OF MEASUREMENT	ALL MEASUREMENTS ARE IN INCHES			
		PRE-TEST	POST-TEST	DIFE.	
X1	TOTAL LENGTH OF VEHICLE AT CENTERLINE	172.0	155.0	17.0	
X2	REAR SURFACE OF VEHICLE TO FRONT OF ENGINE BLOCK	153.0	147.5	5.5	
X3	REAR SURFACE OF VEHICLE TO FIREWALL	130.8	128.5	2.3	
X4	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF RIGHT DOOR	119.4	119.4	0.0	
X5	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF LEFT DOOR	119.5	119.1	0.4	
X6	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF RIGHT DOOR	118.4	118.4	0.0	
X7	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF LEFT DOOR	118.5	118.6	-0.1	
X8	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF RIGHT DOOR	78.2	78.3	-0.1	
X9	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF LEFT DOOR	78.2	77.1	1.1	
X10	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF RIGHT DOOR	78.2	78.1	0.1	
X11	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF LEFT DOOR	78.1	78.2	-0.1	
X12	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON RIGHT SIDE	117.1	117.4	-0.3	
X13	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON LEFT SIDE	117.0	117.1	-0.1	
X14	REAR SURFACE OF VEHICLE TO FIREWALL - RIGHT SIDE	130.5	128.0	2.5	
X15	REAR SURFACE OF VEHICLE TO FIREWALL - LEFT SIDE	130.4	129.5	0.9	
X16	REAR SURFACE OF VEHICLE TO STEERING WHEEL CENTER	101.8	100.8	1.0	
X17	CENTER OF STEERING COLUMN TO "A" POST	11.2	10.5	0.7	
X18	CENTER OF STEERING COLUMN TO HEADLINER	17.8	18.4	-0.6	
X19	REAR SURFACE OF VEHICLE TO RIGHT SIDE OF FRONT BUMPER	166.0	151.6	14.4	
X20	REAR SURFACE OF VEHICLE TO LEFT SIDE OF FRONT BUMPER	166.0	151.0	15.0	
X21	LENGTH OF ENGINE BLOCK	16.0	16.0	0.0	

FIGURE 8

VEHICLE TARGET LOCATIONS



ALL DISTANCE MEASUREMENTS ARE IN INCHES.

FIGURE 9 DUMMY AND SEAT POSITIONING DATA

PRE-IMPACT DATA:

MAKE/MODEL: Hyundai/Elantra
 BODY STYLE: 4-door sedan MODEL YEAR: 1992
 NHTSA NO.: CN0501 COLOR: Blue

DATA FROM CERTIFICATION LABEL:

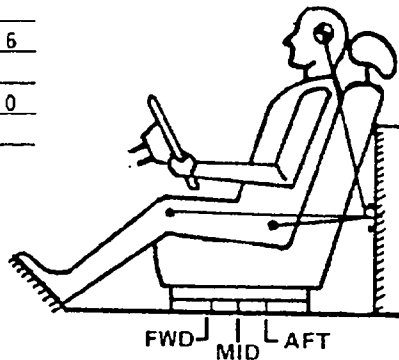
VEHICLE MANUFACTURER: Hyundai Motor Company
 DATE OF MANUFACTURE: 07/91 VIN: KMHJF22R8NU079665
 GVWR: 3560 LBS.; GAWR: FRONT = 1896 LBS.; REAR = 1752 LBS.

POST-IMPACT DATA:

DATE OF TEST: 10/18/91 TIME: 1432 TEMPERATURE: 78° F
 IMPACT VELOCITY: PRIMARY = 29.5 MPH SECONDARY = 29.5 MPH
 REQUIRED IMPACT VELOCITY RANGE: 28.9 TO 29.9 MPH
 SEAT TYPE: Bucket ADJUSTER TYPE: Manual
 FRONT SEAT BACK TYPE: Manually adjustable
 TECHNICIANS: B. Fishbaugh, J. Walters, P. Cummins

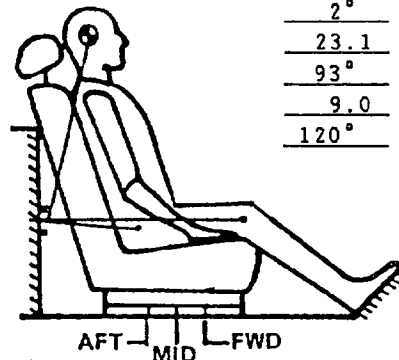
DRIVER DUMMY # 353 TYPE: HII

HEAD 20.8
 TARGET 4°
 KNEE 22.6
 JOINT 95°
 APPROX-
 IMATE 8.0
 "H" 134°
 POINT



PASSENGER DUMMY # 354 TYPE: HII

HEAD 21.0
 TARGET 2°
 KNEE 23.1
 JOINT 93°
 APPROX-
 IMATE 9.0
 "H" 120°
 POINT



A = 50.0

B = 39.0

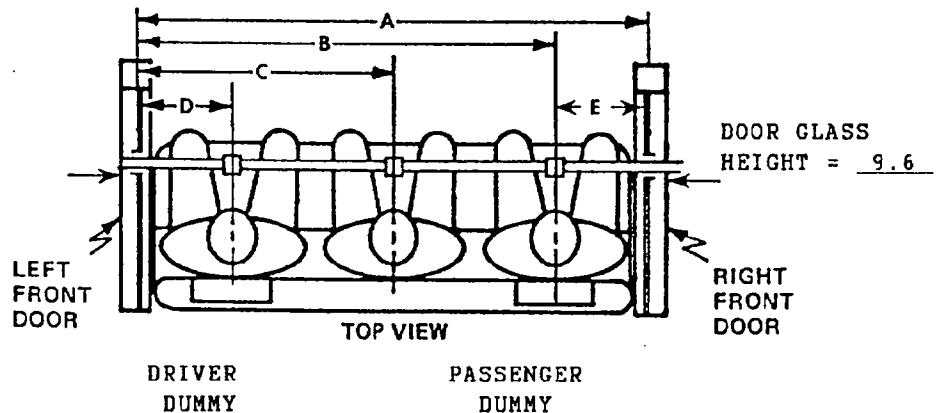
C = 25.0

D = 12.2

E = 11.0

DOOR GLASS

HEIGHT = 9.6



ALL ANGLES ARE RELATIVE TO VERTICAL PLANE THROUGH DOOR STRIKER.
 ALL DISTANCE MEASUREMENTS ARE IN INCHES/MILLIMETERS.

FIGURE 10 DUMMY IN VEHICLE POSITIONING DATA

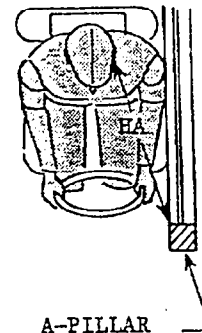
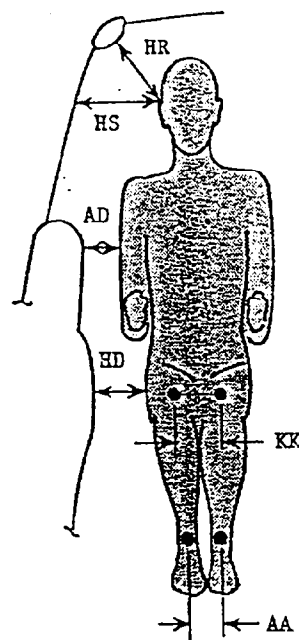
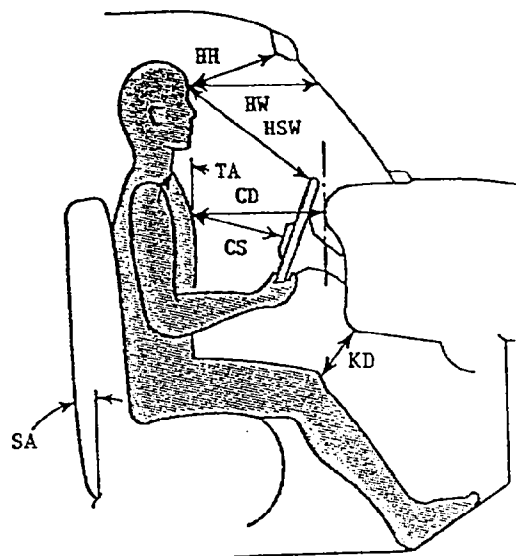
	DRIVER	PASSENGER
HH	14.5	13.2
HW	18.8	19.4
CD	23.1	23.1
CS	15.6	NA
KDL	5.8	7.2
KDR	6.4	6.6
TA	23°	24°
SA	18°	18°
HSW	22.3	NA

	DRIVER	PASSENGER
HR	6.0	5.4
HS	8.7	8.9
AD	4.6	4.6
HD	5.2	5.2
KK	10.2	7.8
AA	12.9	8.0
HA	22.0	20.6

KNEE OUTER BOLT HEAD TO OUTER
BOLT HEAD SPACING:

DRIVER = 14.5

PASSENGER = 11.8

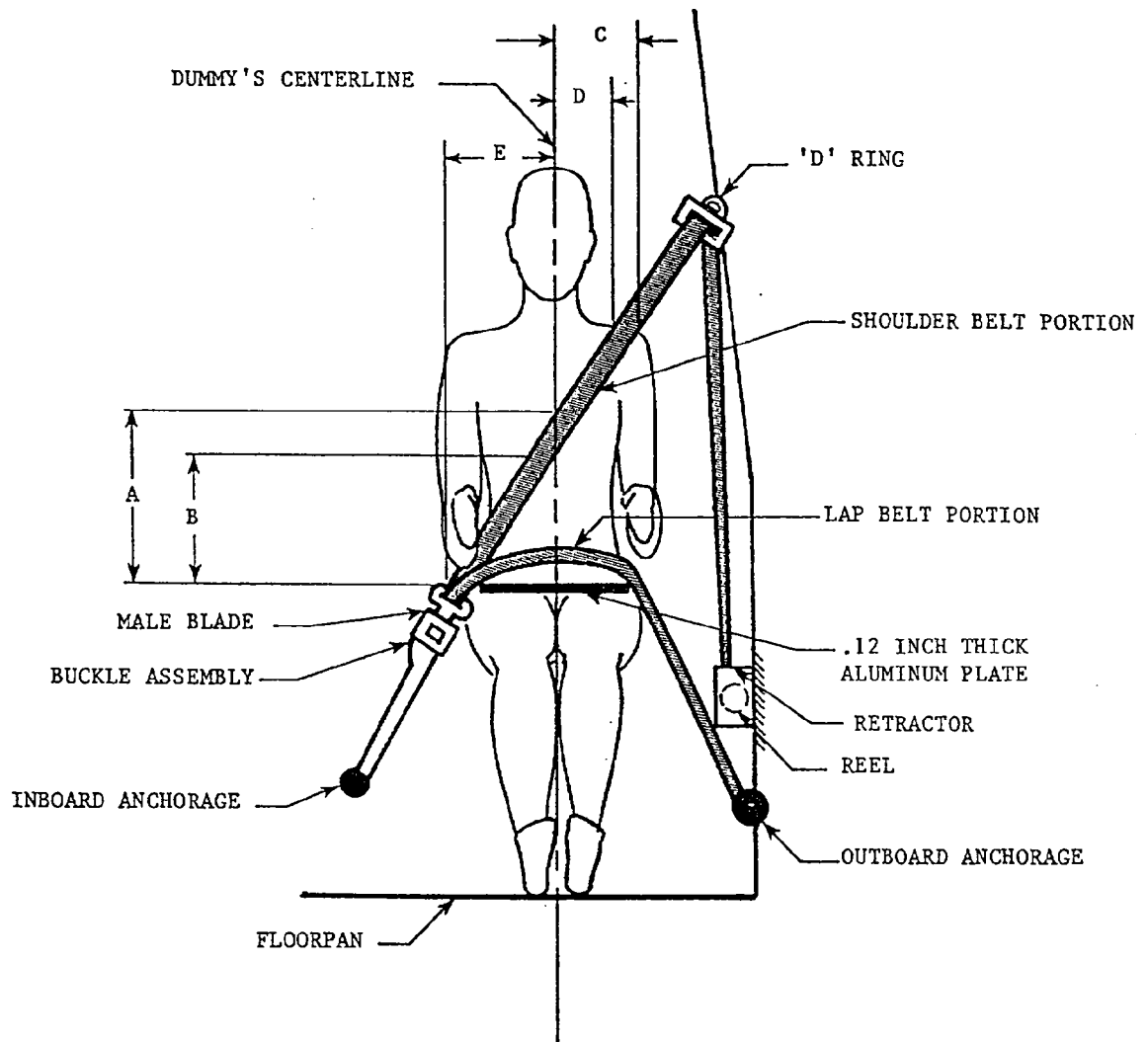


HH = HEAD TO WINDSHIELD HEADER
HW = HEAD TO WINDSHIELD
CD = CHEST TO DASH
CS = CHEST TO STEERING WHEEL
KD = KNEE TO DASH
TA = TORSO ANGLE
SA = SEAT BACK ANGLE
HSW = HEAD TO STEERING WHEEL

HR = HEAD C.G. TARGET TO SIDE ROOF HEADER
HS = HEAD C.G. TARGET TO SIDE WINDOW
AD = ARM TO DOOR
HD = HIP TO DOOR
KK = KNEE TO KNEE
AA = ANKLE TO ANKLE
HA = HEAD C.G. TARGET TO A-PILLAR

TORSO AND SEAT BACK ANGLES ARE RELATIVE TO VERTICAL.
ALL DISTANCE MEASUREMENTS ARE IN INCHES.

FIGURE 11 SEAT BELT POSITIONING DATA

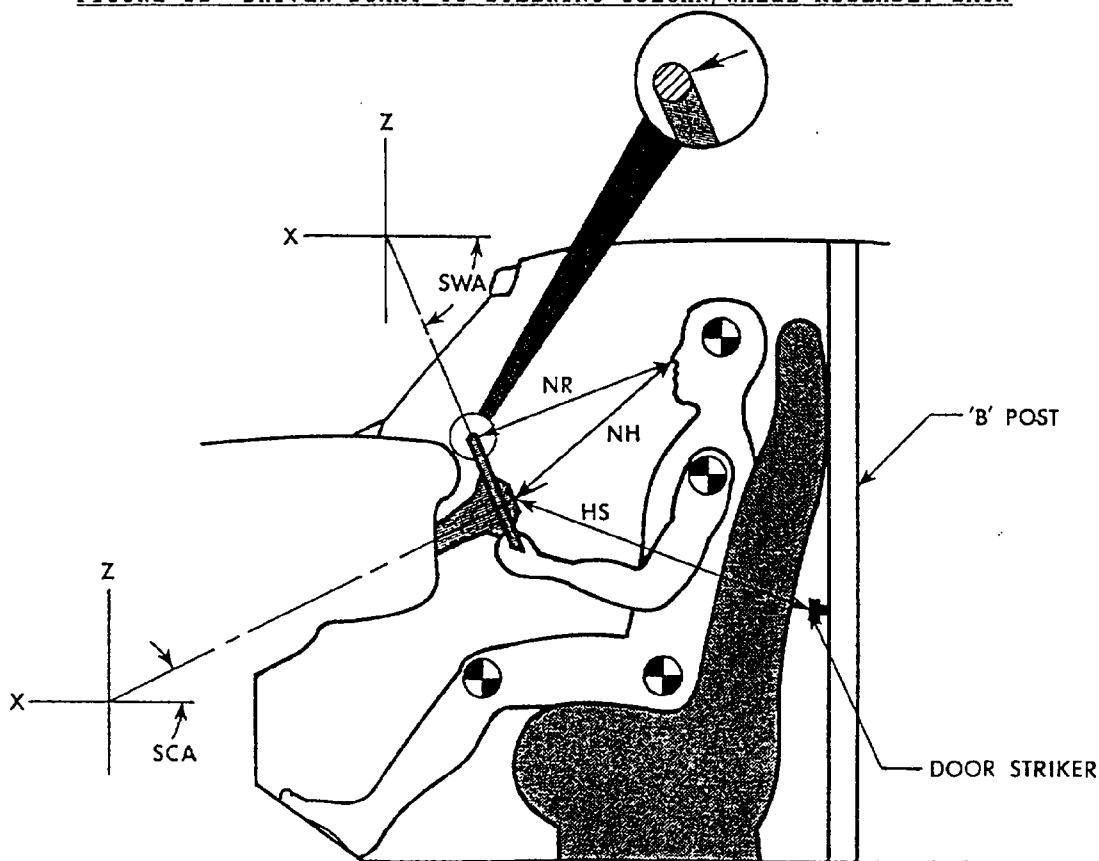


	DRIVER DUMMY	PASSENGER DUMMY
A - TOP SURFACE OF ALUM. PLATE TO BELT UPPER EDGE	12.0	12.9
B - TOP SURFACE OF ALUM. PLATE TO BELT LOWER EDGE	9.2	9.6
C - DUMMY CENTERLINE TO OUTER EDGE OF BELT AT CHEST FLESH TOP	8.5	7.2
D - DUMMY CENTERLINE TO INNER EDGE OF BELT AT CHEST FLESH TOP	6.2	4.8
E - DUMMY CENTERLINE TO INTERSECTION OF UPPER TORSO BELT AND LAP BELT	12.2	9.8

ALL DISTANCE MEASUREMENTS ARE IN INCHES.
4-7

911018

FIGURE 12 DRIVER DUMMY TO STEERING COLUMN/WHEEL ASSEMBLY DATA



POSITION OF STEERING COLUMN TILTING AND TELESCOPING ADJUSTMENTS, IF ANY:
THE STEERING COLUMN WAS NOT ADJUSTABLE.

MEASUREMENTS

NR	- DISTANCE FROM TIP OF DUMMY'S NOSE TO TOP REAR SURFACE OF STEERING WHEEL RIM.	19.8
NH	- DISTANCE FROM TIP OF DUMMY'S NOSE TO CENTER OF STEERING COLUMN HUB.	20.3
HS	- DISTANCE FROM CENTER OF STEERING COLUMN HUB TO THE FORWARD SURFACE OF THE DOOR LOCK STRIKER PIN.	24.9
SCA	- ANGLE OF STEERING COLUMN RELATIVE TO THE HORIZONTAL X AXIS	24°
SWA	- ANGLE OF STEERING WHEEL RELATIVE TO THE HORIZONTAL X AXIS	66°

ALL DISTANCE MEASUREMENTS ARE IN INCHES.

FIGURE 13
CAMERA POSITIONS

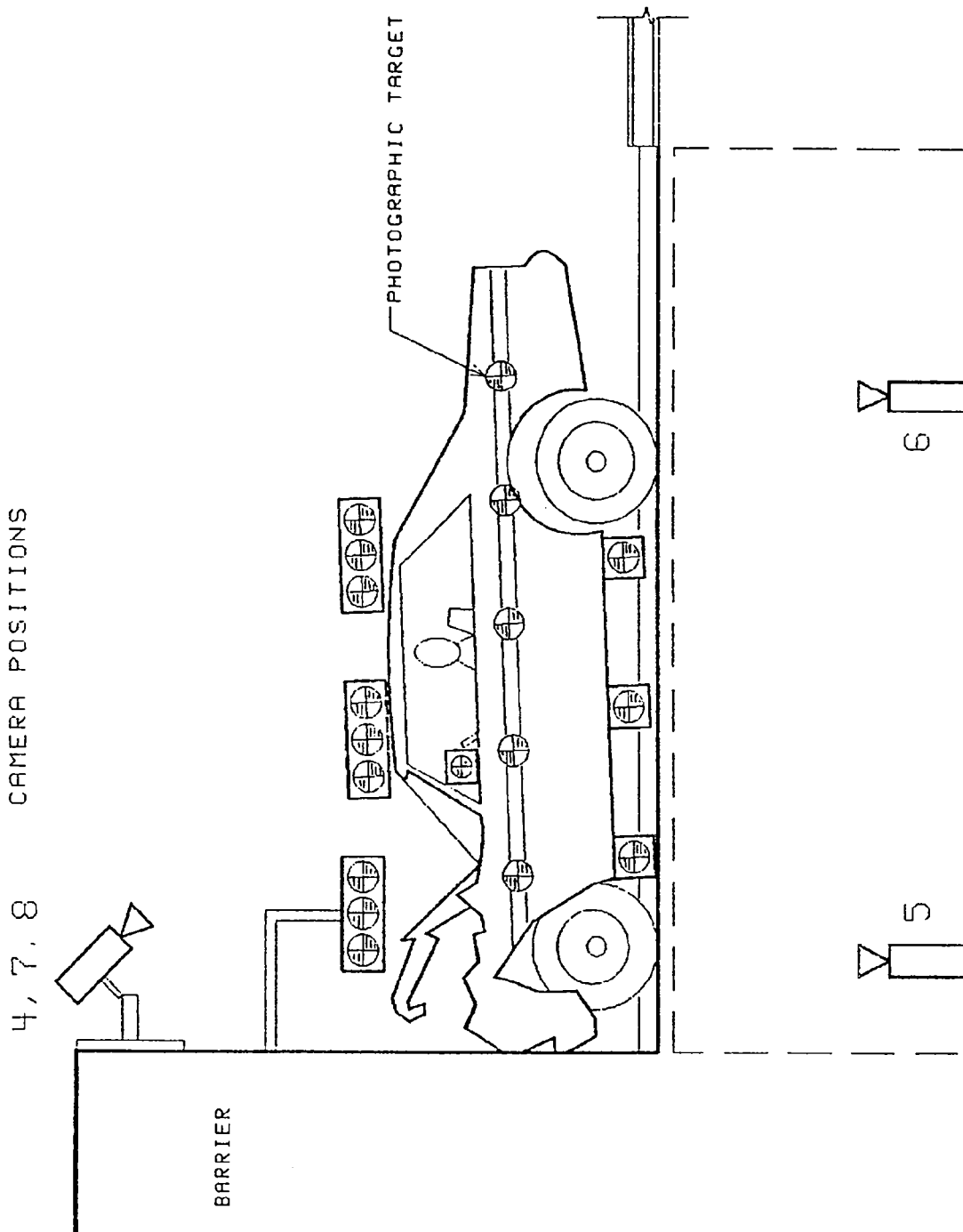


FIGURE 13

CAMERA POSITIONS, CONTINUED

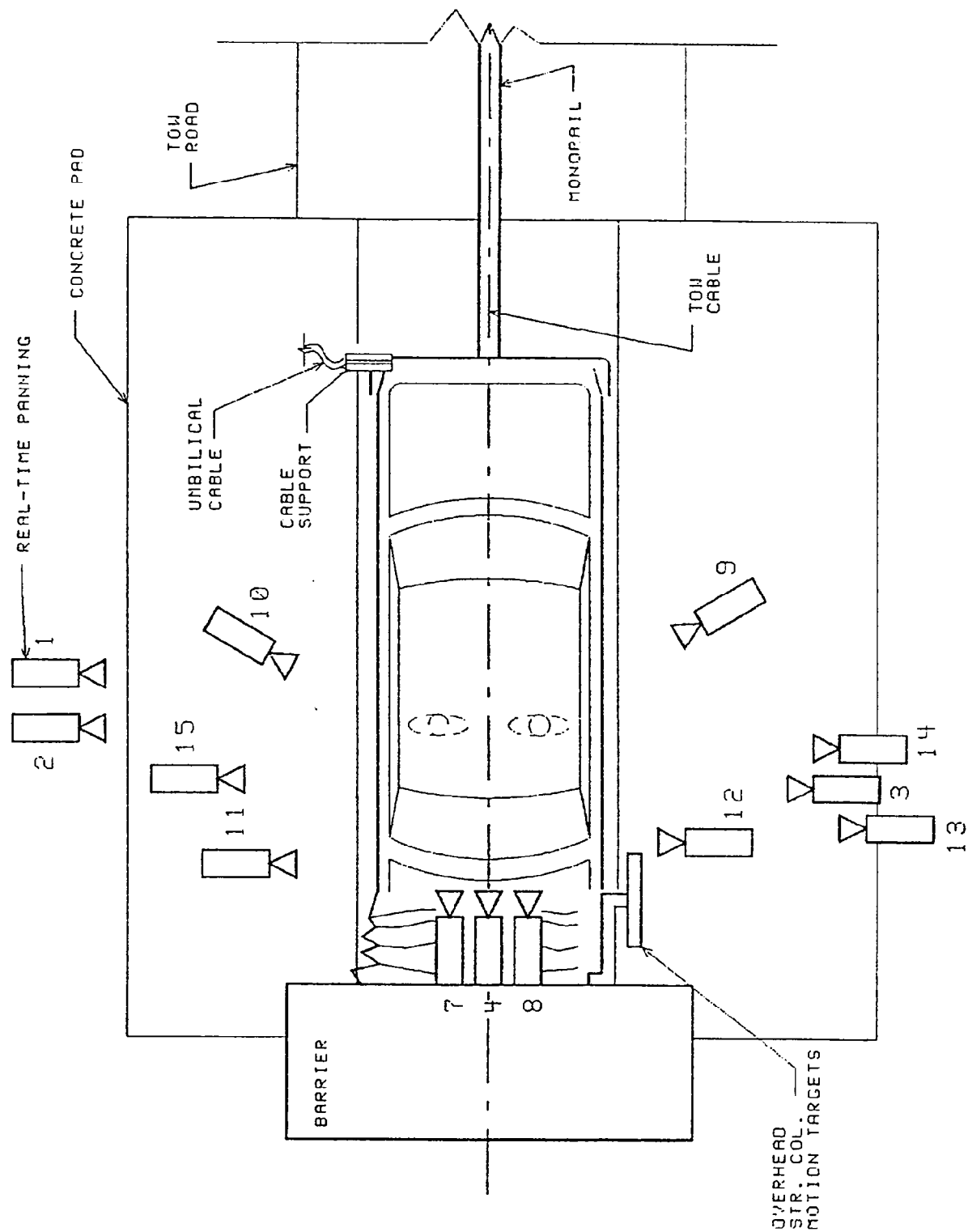


TABLE 14 MOTION PICTURE CAMERA LOCATIONS

TEST NO.: 911018		VEHICLE: Hyundai/Elantra/4-door sedan		CAMERA POSITIONS (IN)*		ANGLE** (DEG)	FILM PLANE TO HEAD TARGET (IN)		FILM SPEED (FPS)
CAMERA NO.	VIEW	X	Y	Z				LENS (MM)	
1	Real-time panning	-142.0	-504.0	61.0	NA		NA	16	24
2	Right overall	-81.3	-266.4	37.1	-2		NA	13	498
3	Left vehicle crush	-41.5	295.0	44.0	-4		230.0	25	498
4	Windshield front view	-6.0	0.0	84.0	-40		NA	13	495
5	Pit front position	-50.5	0.0	-92.4	90		NA	13	1000
6	Pit rear position	-99.3	0.0	-99.0	90		NA	13	1000
7	Passenger front view	-4.5	-13.8	93.0	-50		NA	17	500
8	Driver front view	-6.8	14.5	93.0	-50		NA	17	500
9	Driver kinematics	-157.3	116.0	87.0	-27		101.0	25	500
10	Passenger kinematics	-152.1	-116.0	87.0	-26		107.0	25	502
11	Right windshield intrusion	-38.1	-306.1	44.0	0		NA	50	498
12	Left windshield intrusion	-53.0	309.4	42.3	0		NA	50	498
13	Steering column motion	-110.0	285.0	103.0	-14		NA	25	500
14	Steering column motion	-110.0	285.0	75.1	-9		NA	25	500
15	Passenger kinematics	-38.8	-293.0	45.3	-4		225.0	25	505
16	Real-time documentation	NA	NA	NA	NA		NA	12-120	24

* +X = Film plane forward of barrier face

+Y = Film plane to left of monorail centerline

+Z = Film plane above ground level

** +Angle = Film plane angled upward from horizontal plane

APPENDIX A

PHOTOGRAPHS



FIGURE A-1. PRE-TEST FRONT VIEW

A-2

911018

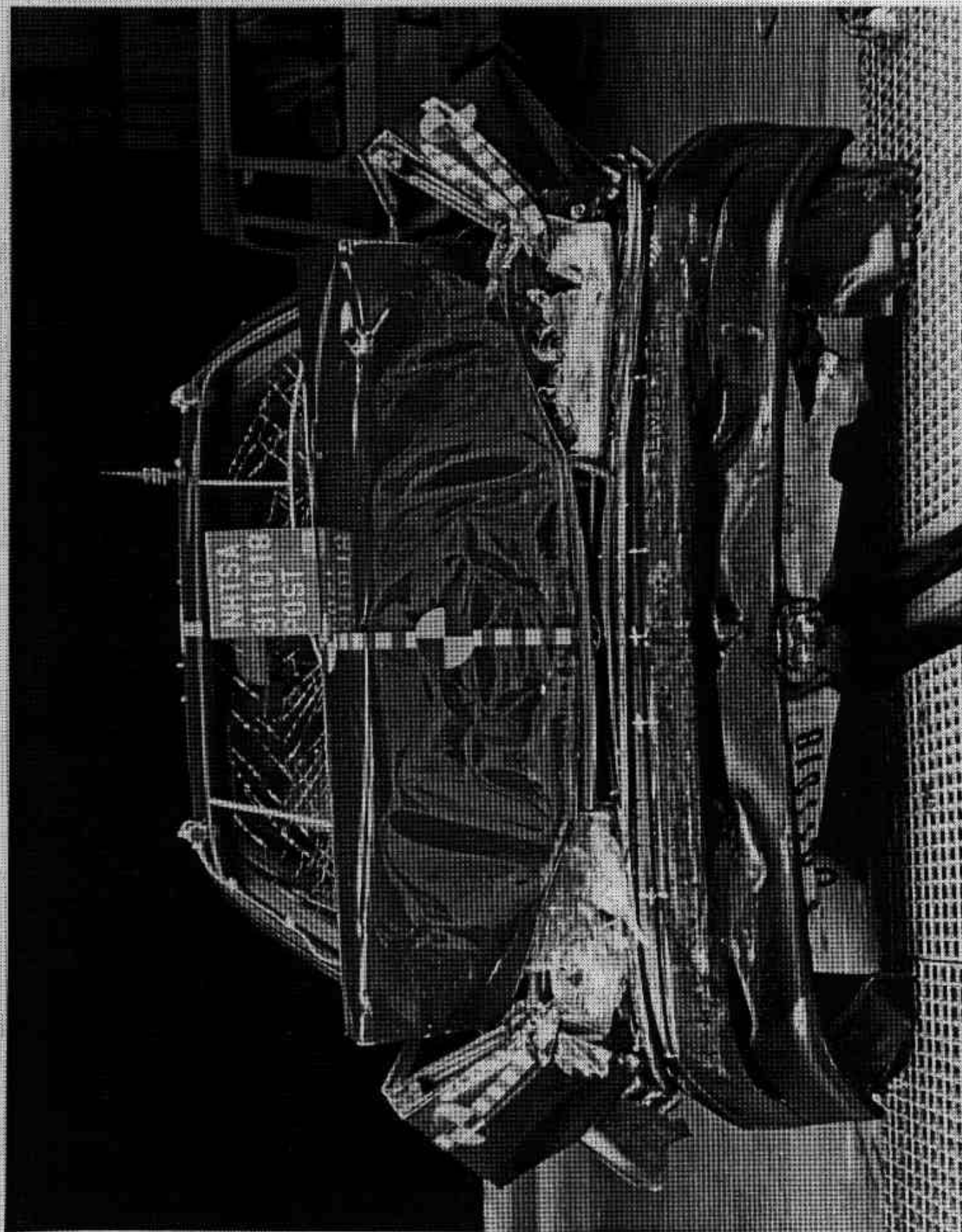


FIGURE A-2. POST-TEST FRONT VIEW

A-3

911018

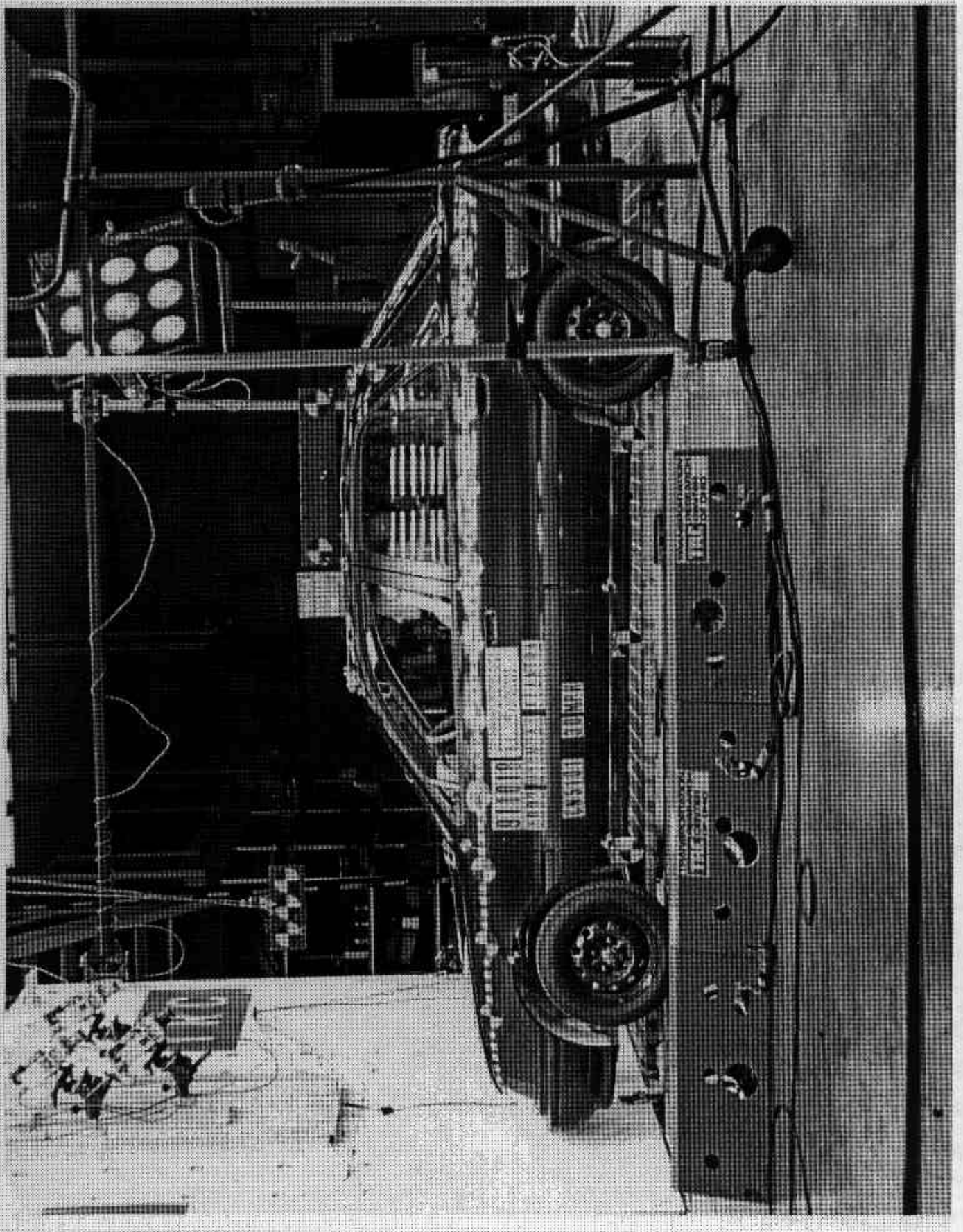


FIGURE A-3. PRE-TEST LEFT SIDE VIEW
A-4

911018

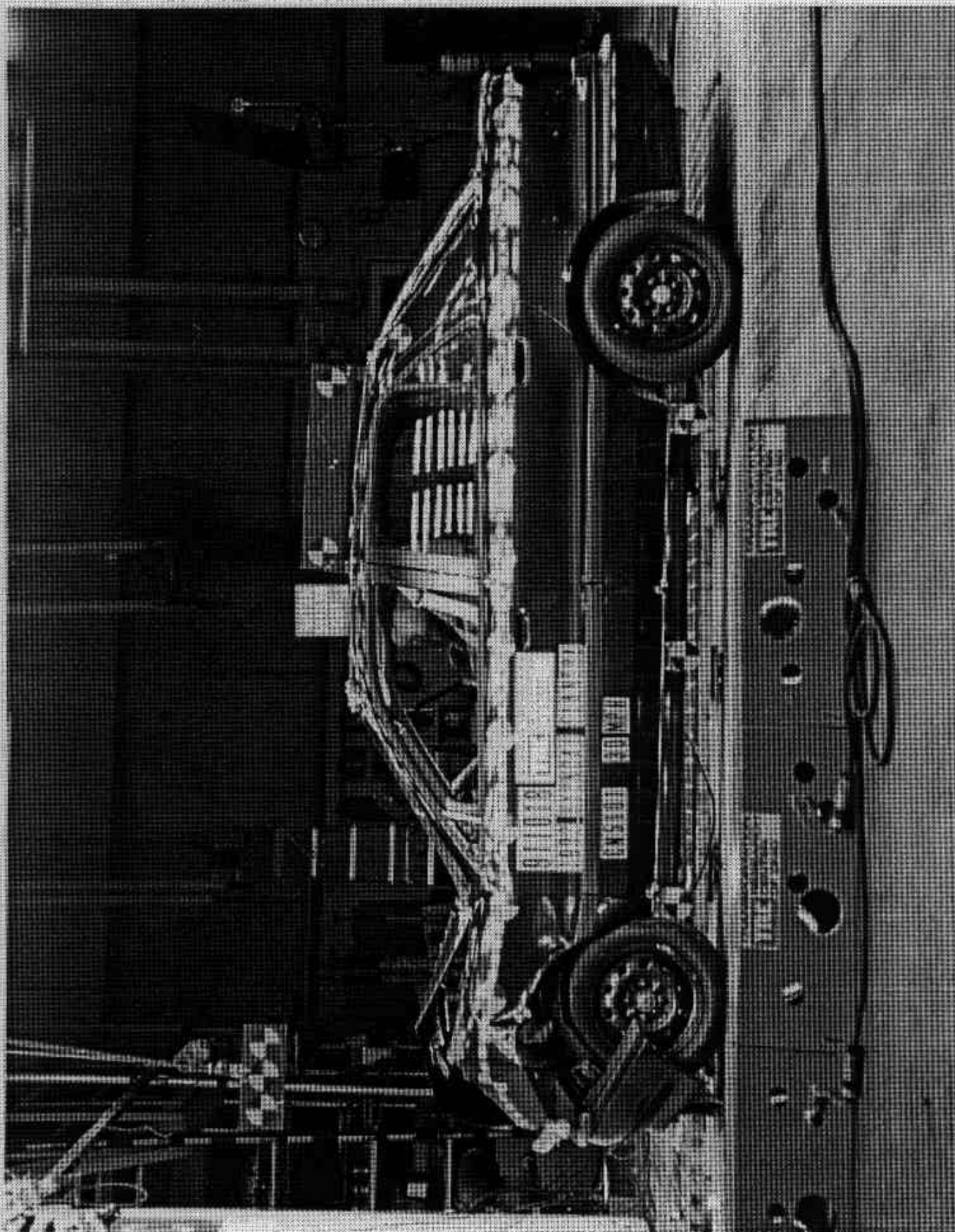


FIGURE A-4. POST-TEST LEFT SIDE VIEW
A-5

911018

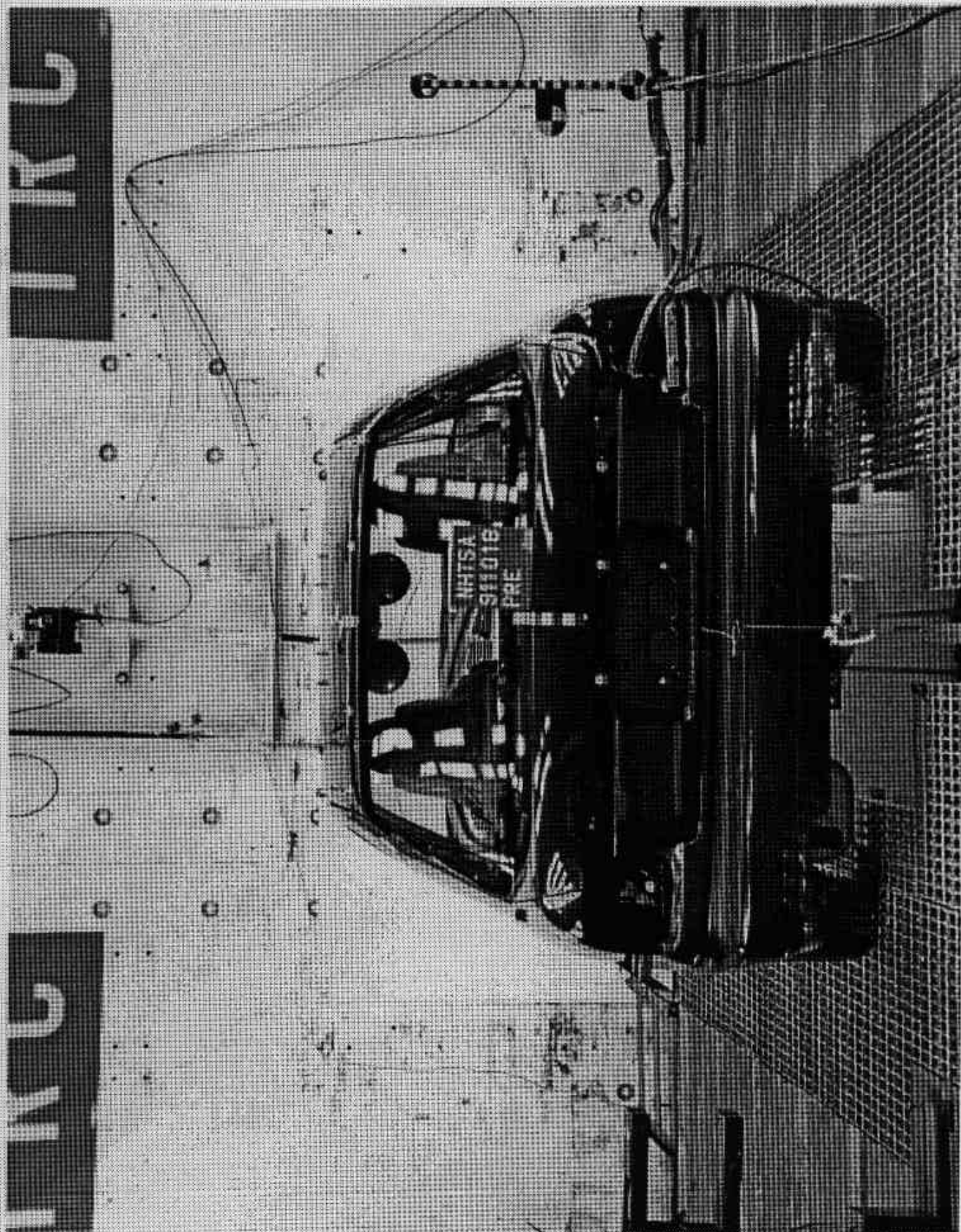


FIGURE A-5. PRE-TEST REAR VIEW

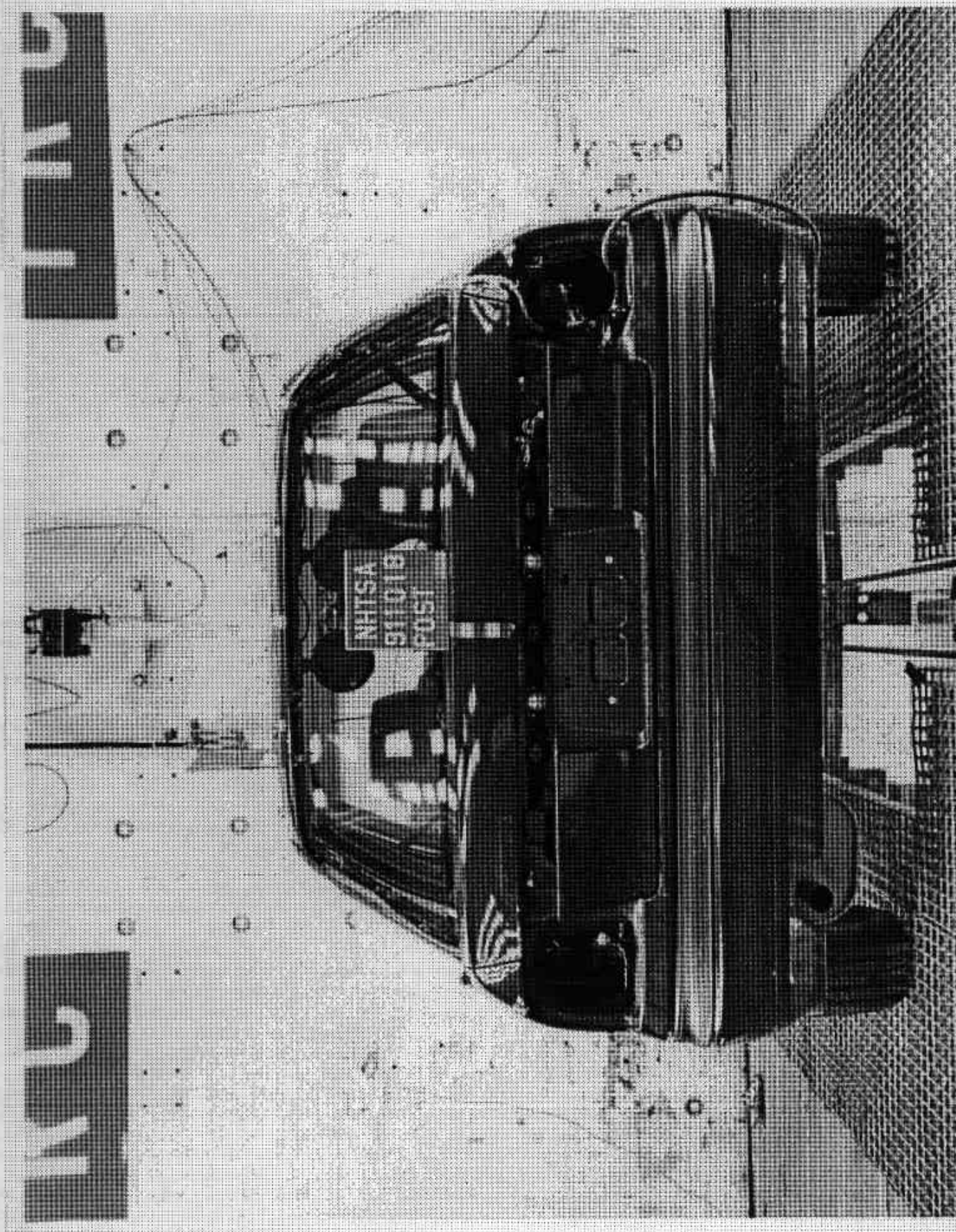


FIGURE A-6. POST-TEST REAR VIEW

A-7

911018

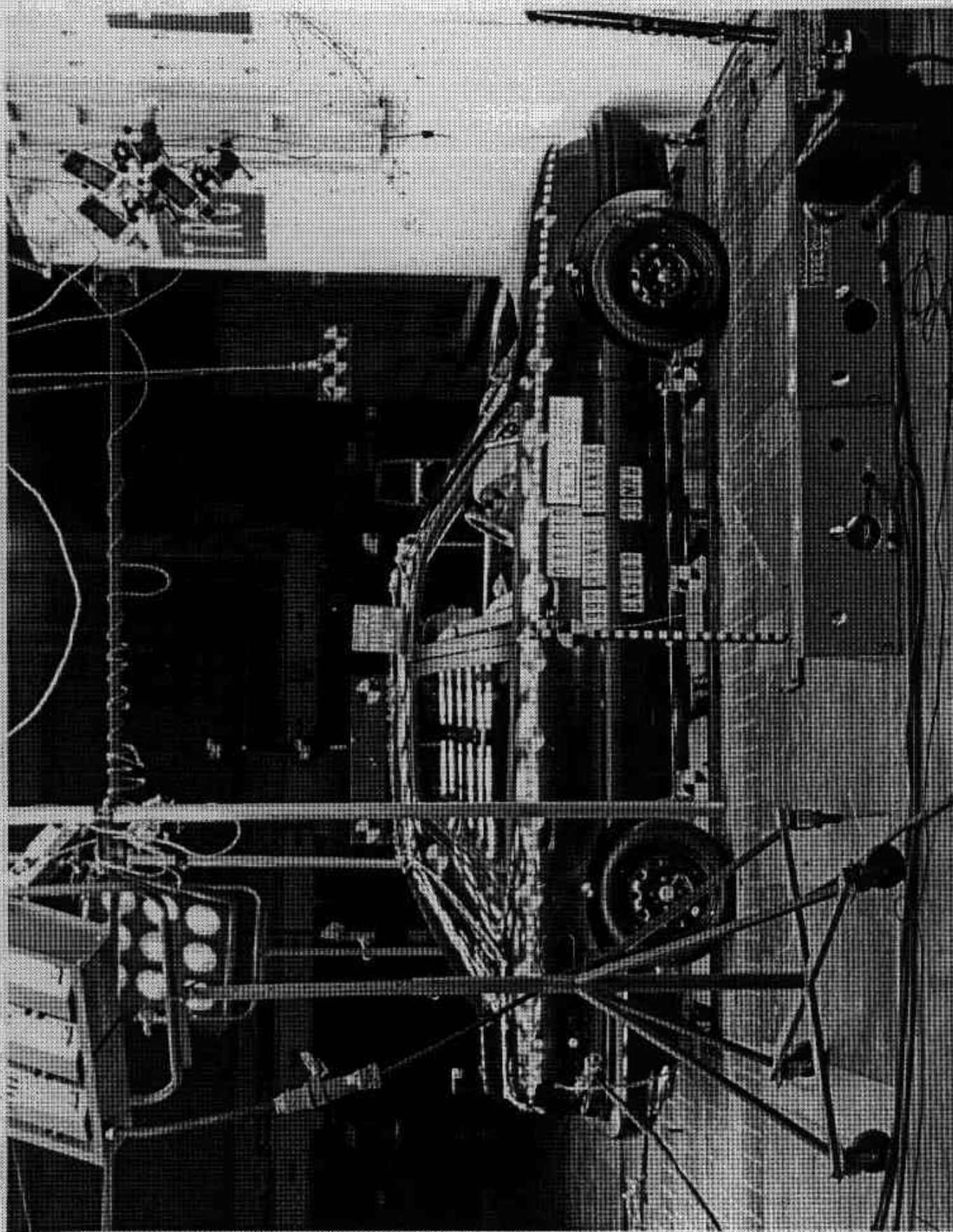


FIGURE A-7. PRE-TEST RIGHT SIDE VIEW
A-8

911018

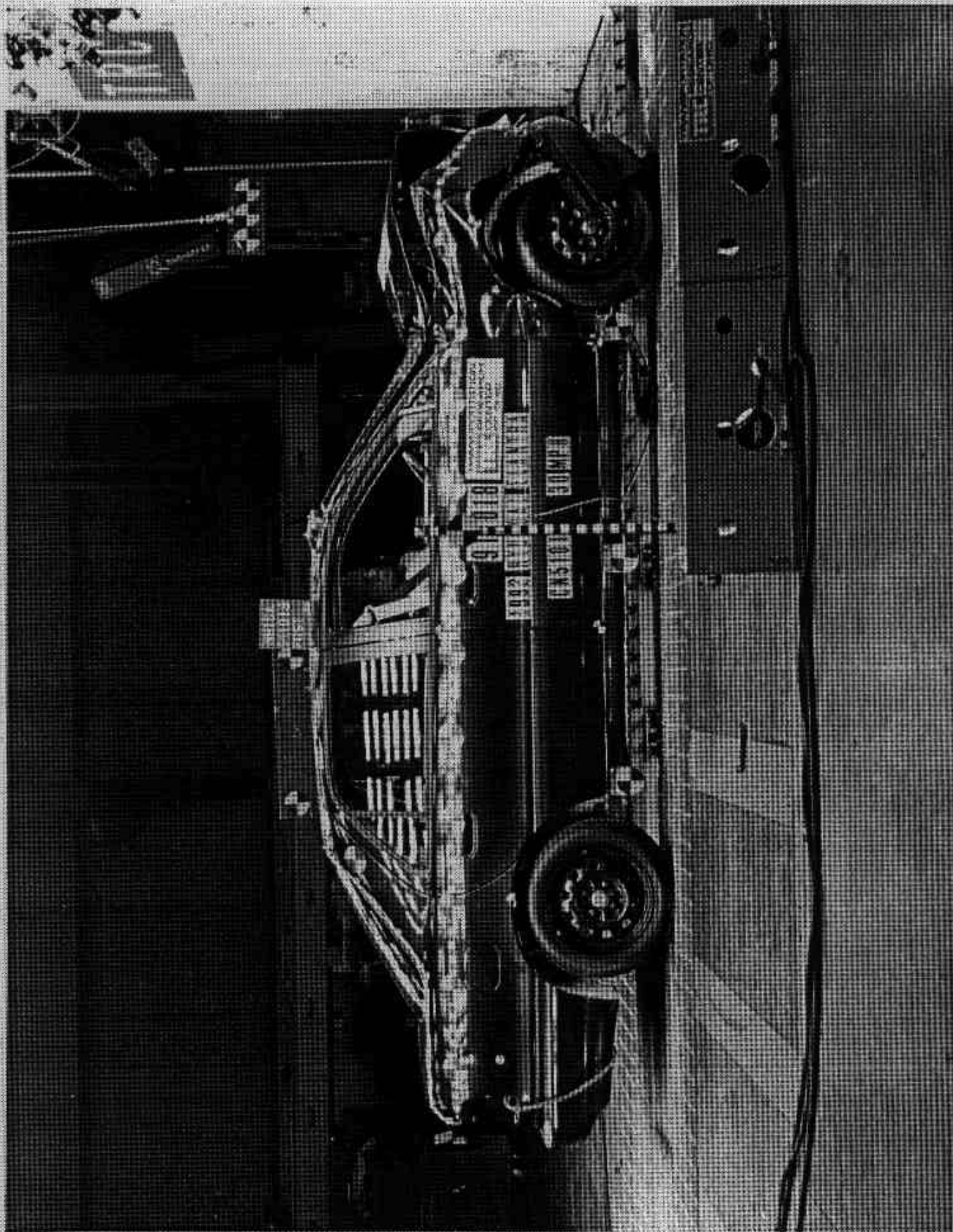


FIGURE A-8. POST-TEST RIGHT SIDE VIEW

A-9

911018



FIGURE A-9. PRE-TEST RIGHT FRONT THREE-QUARTER VIEW

A-10

911018



FIGURE A-10. POST-TEST RIGHT FRONT THREE-QUARTER VIEW

A-11

911018

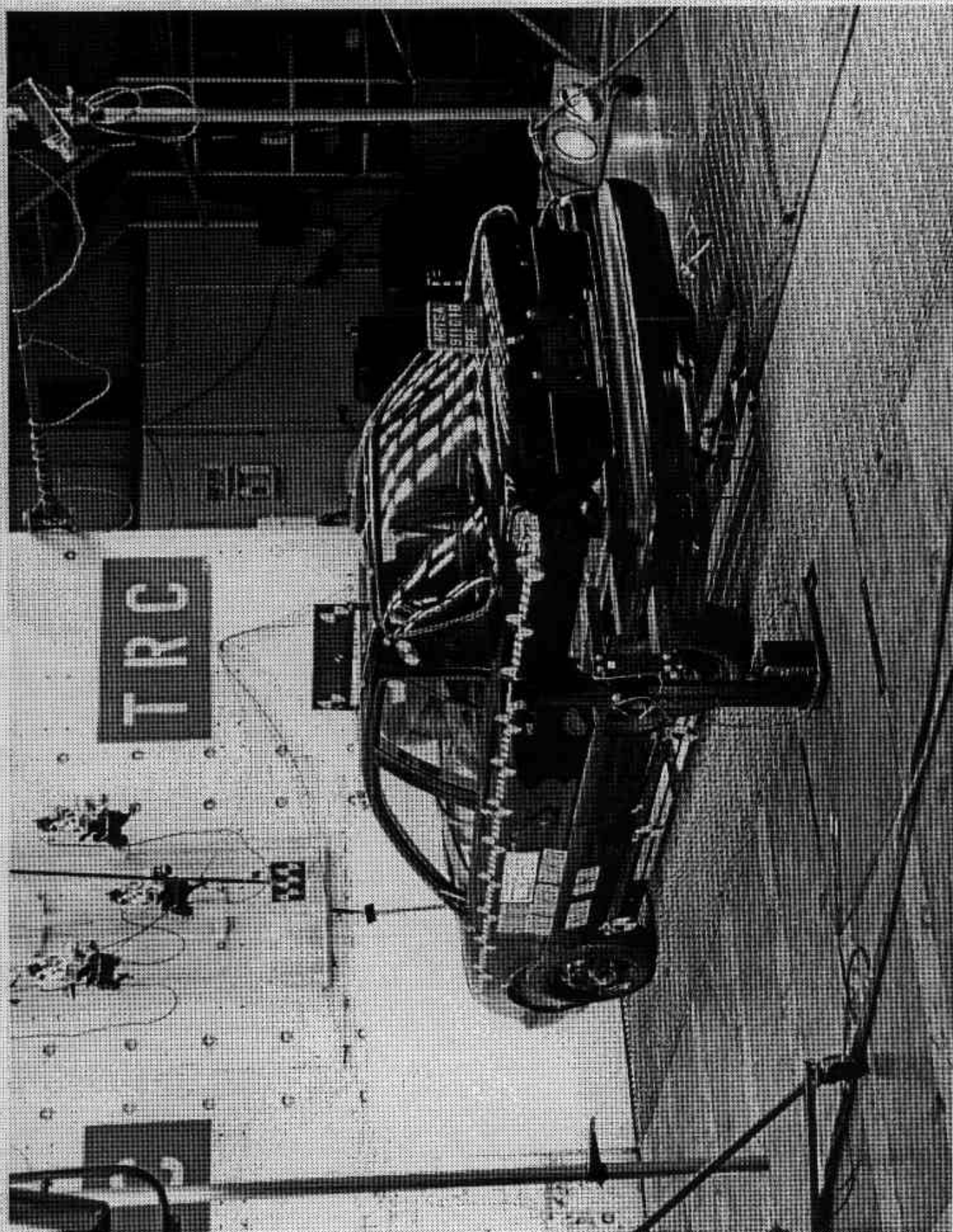


FIGURE A-11. PRE-TEST LEFT REAR THREE-QUARTER VIEW
A-12

911018

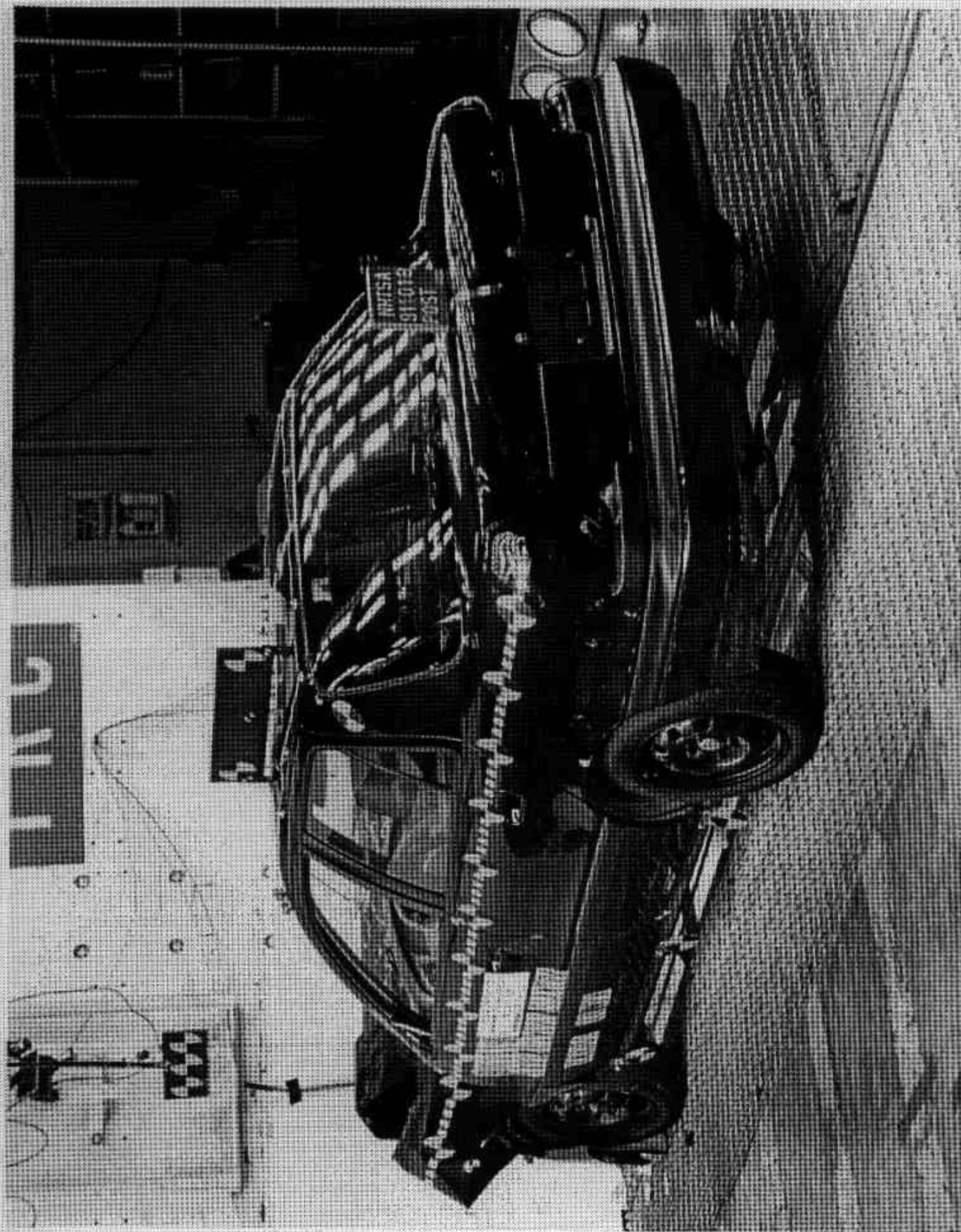


FIGURE A-12. POST-TEST LEFT REAR THREE-QUARTER VIEW

A-13

911018

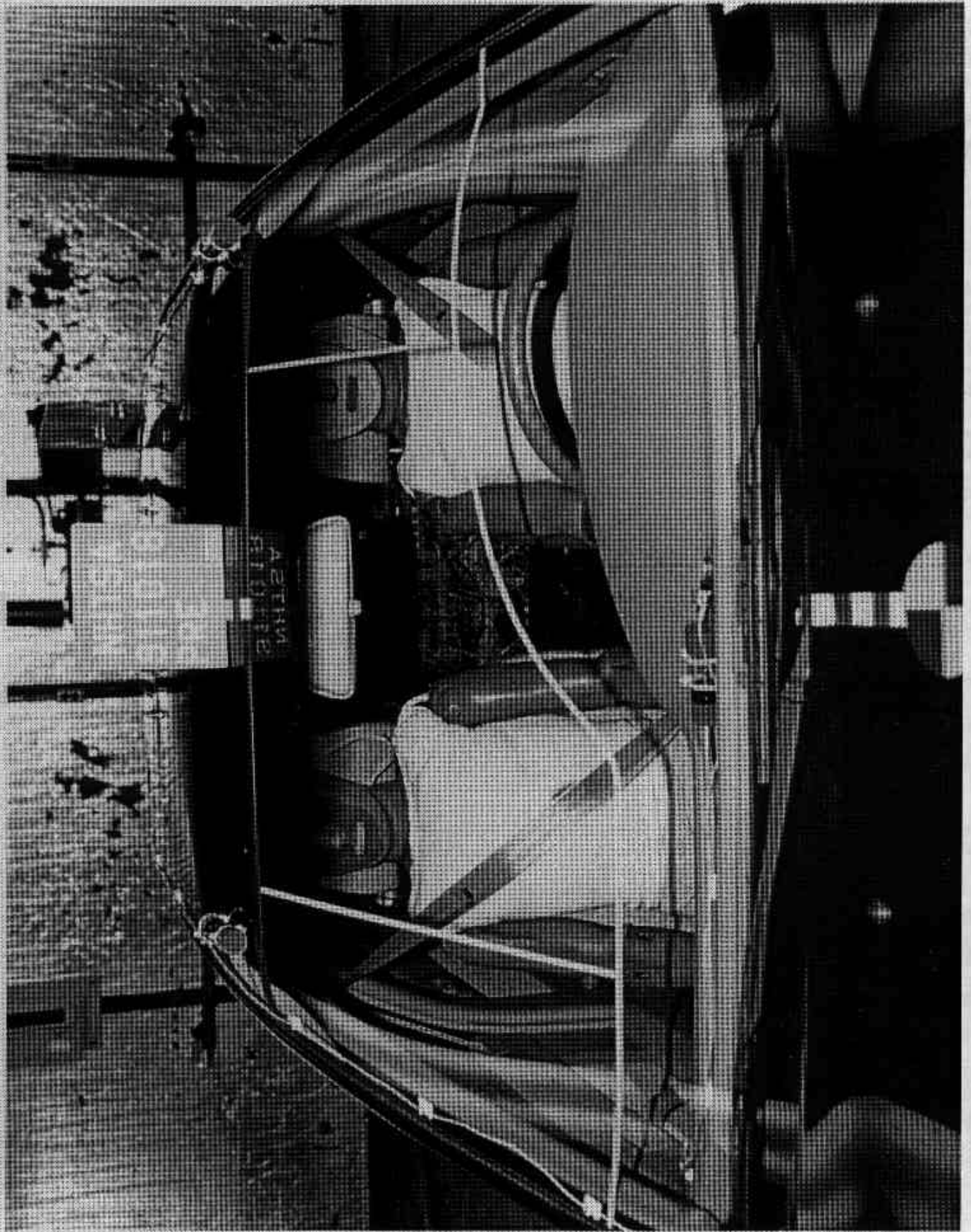


FIGURE A-13. PRE-TEST WINDSHIELD VIEW
A-14

911018

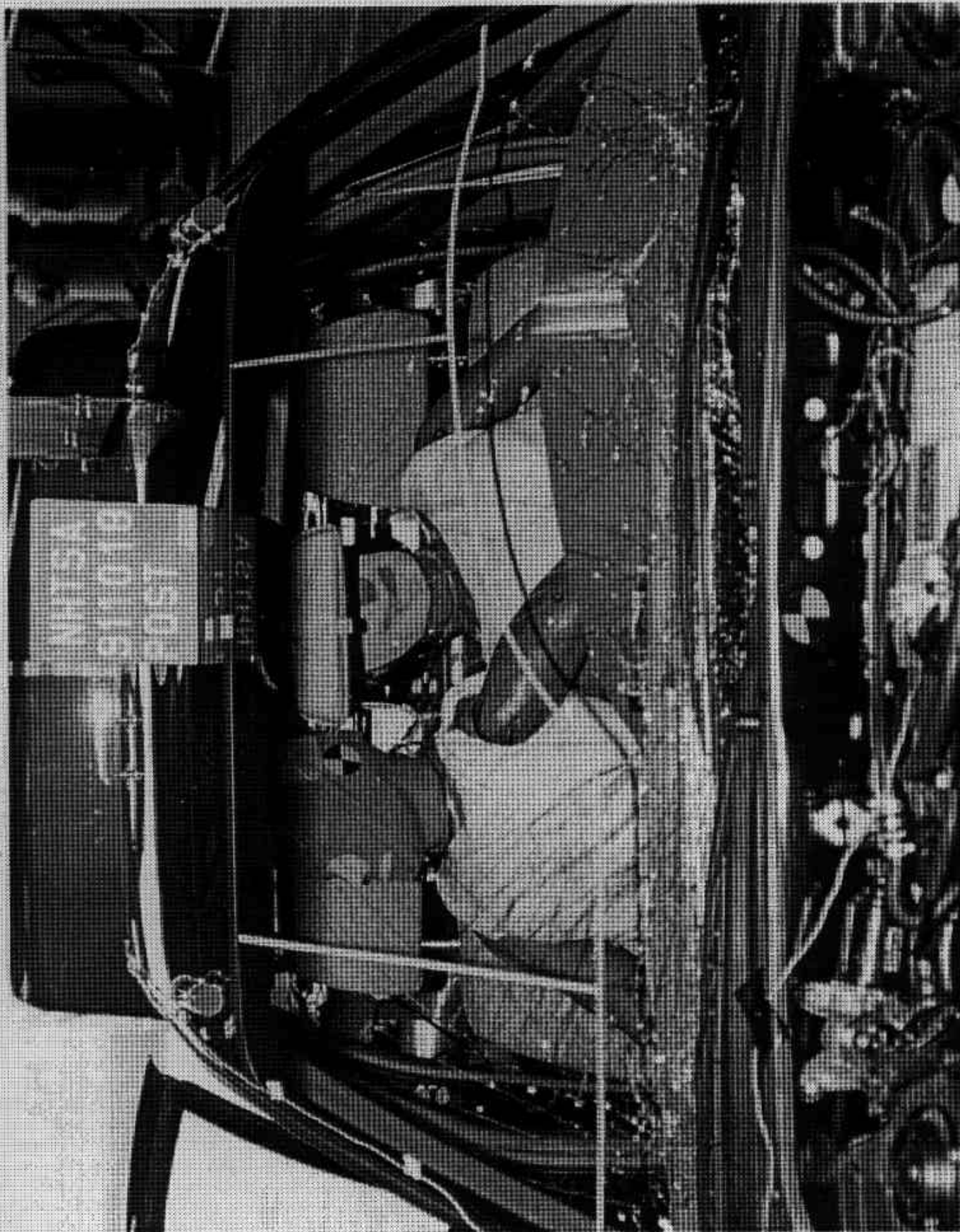


FIGURE A-14. POST-TEST WINDSHIELD VIEW
A-15

911018

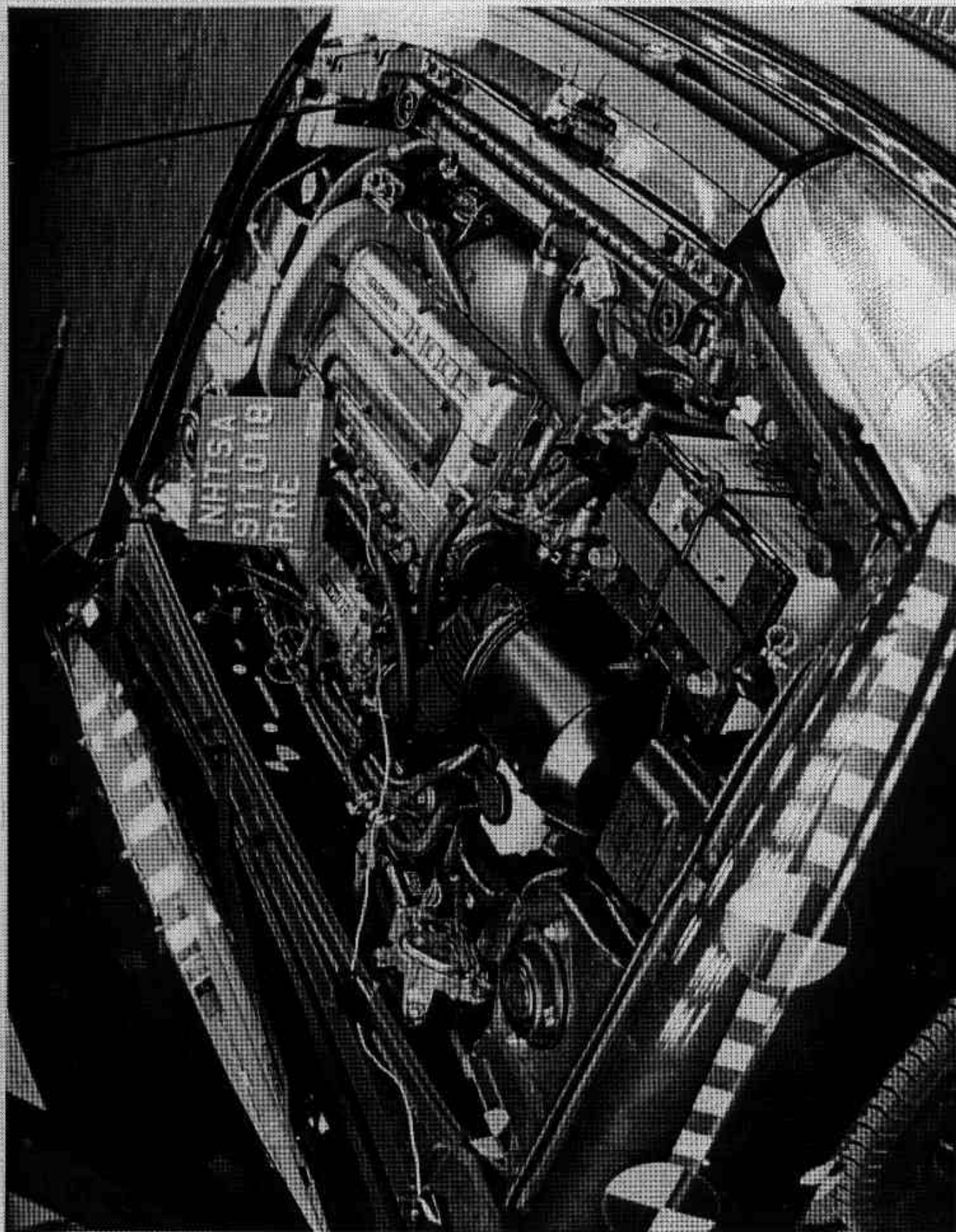


FIGURE A-15. PRE-TEST ENGINE COMPARTMENT VIEW

A-16

911018

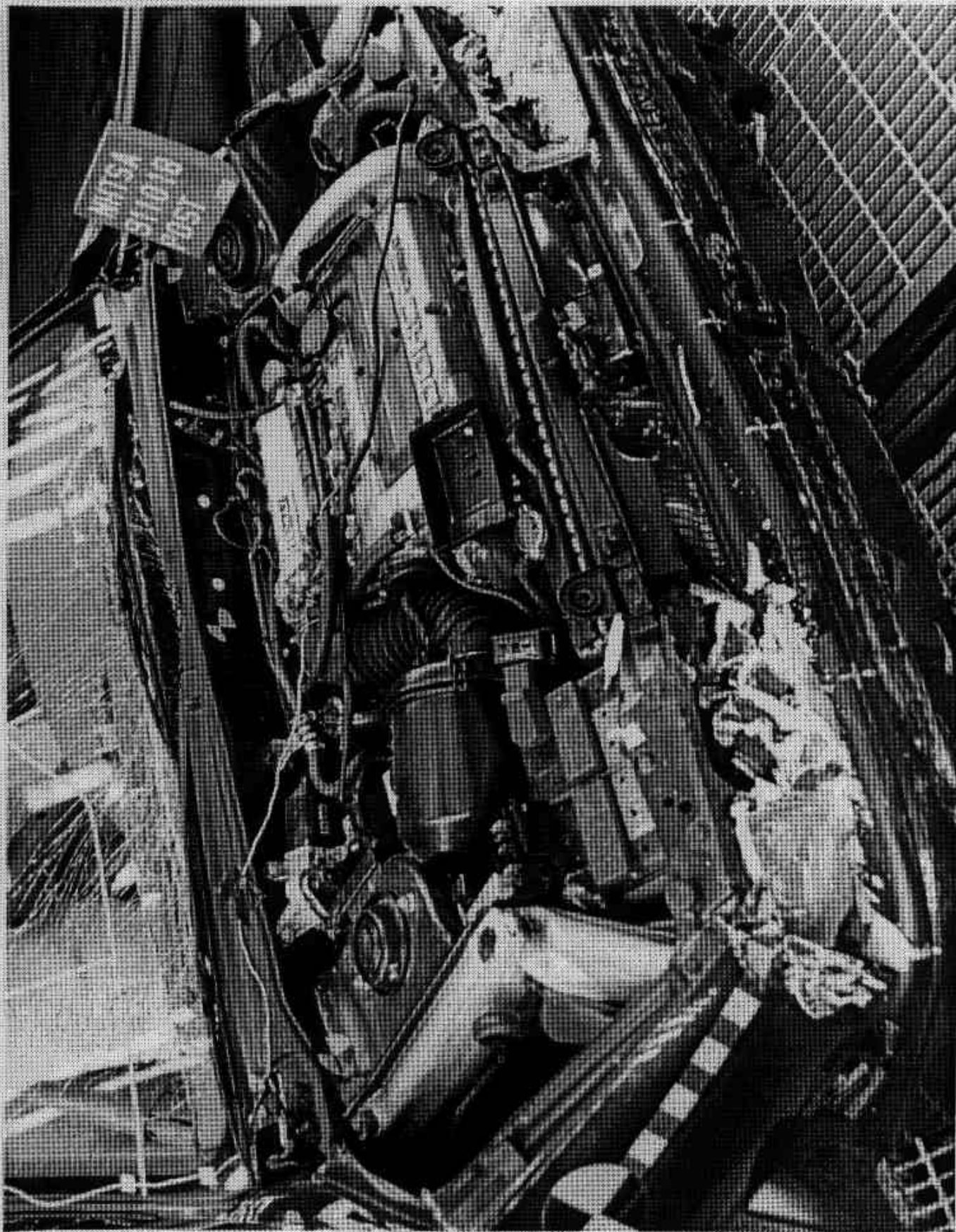


FIGURE A-16. POST-TEST ENGINE COMPARTMENT VIEW
A-17

911018

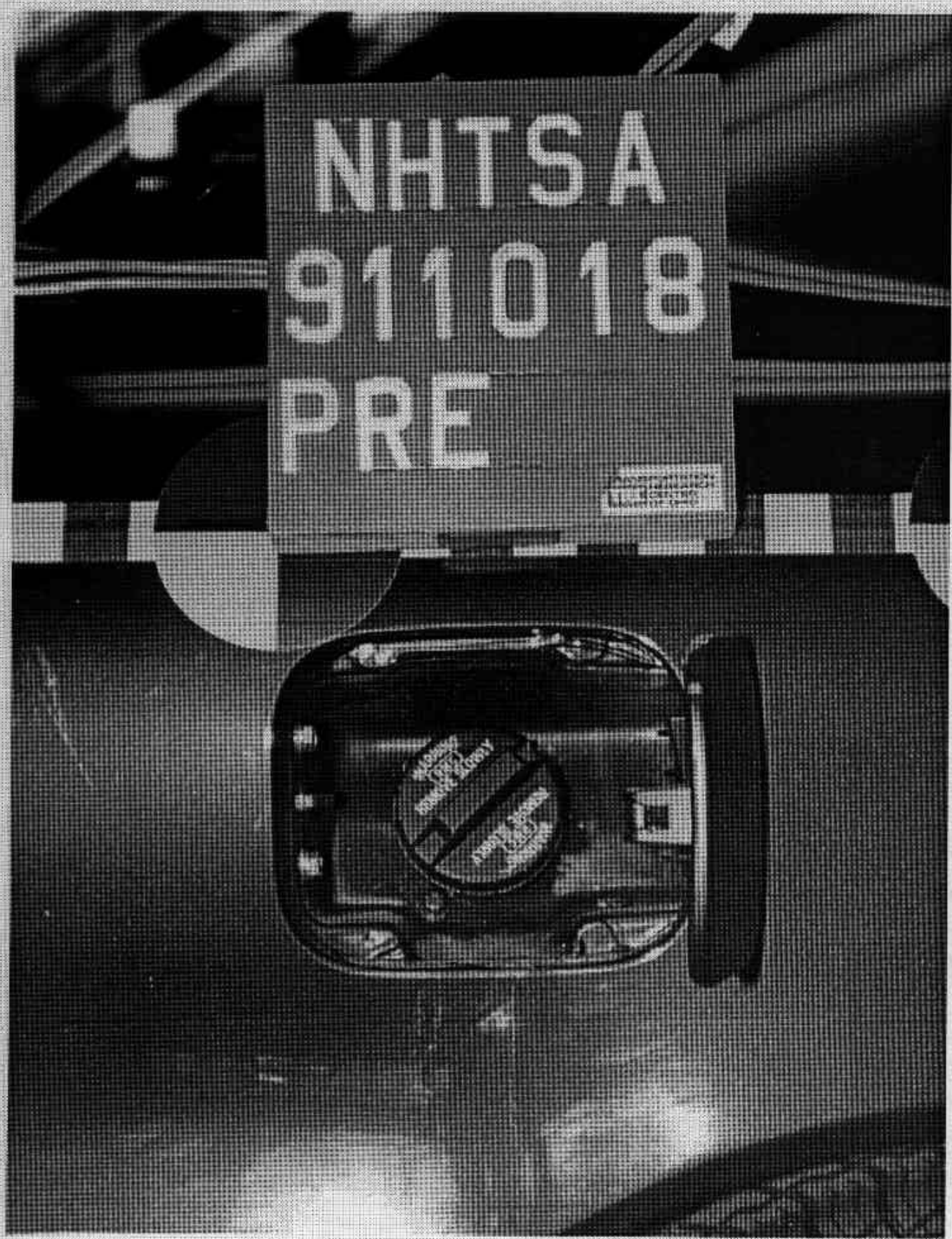


FIGURE A-17. PRE-TEST FUEL FILLER CAP VIEW
A-18

911018

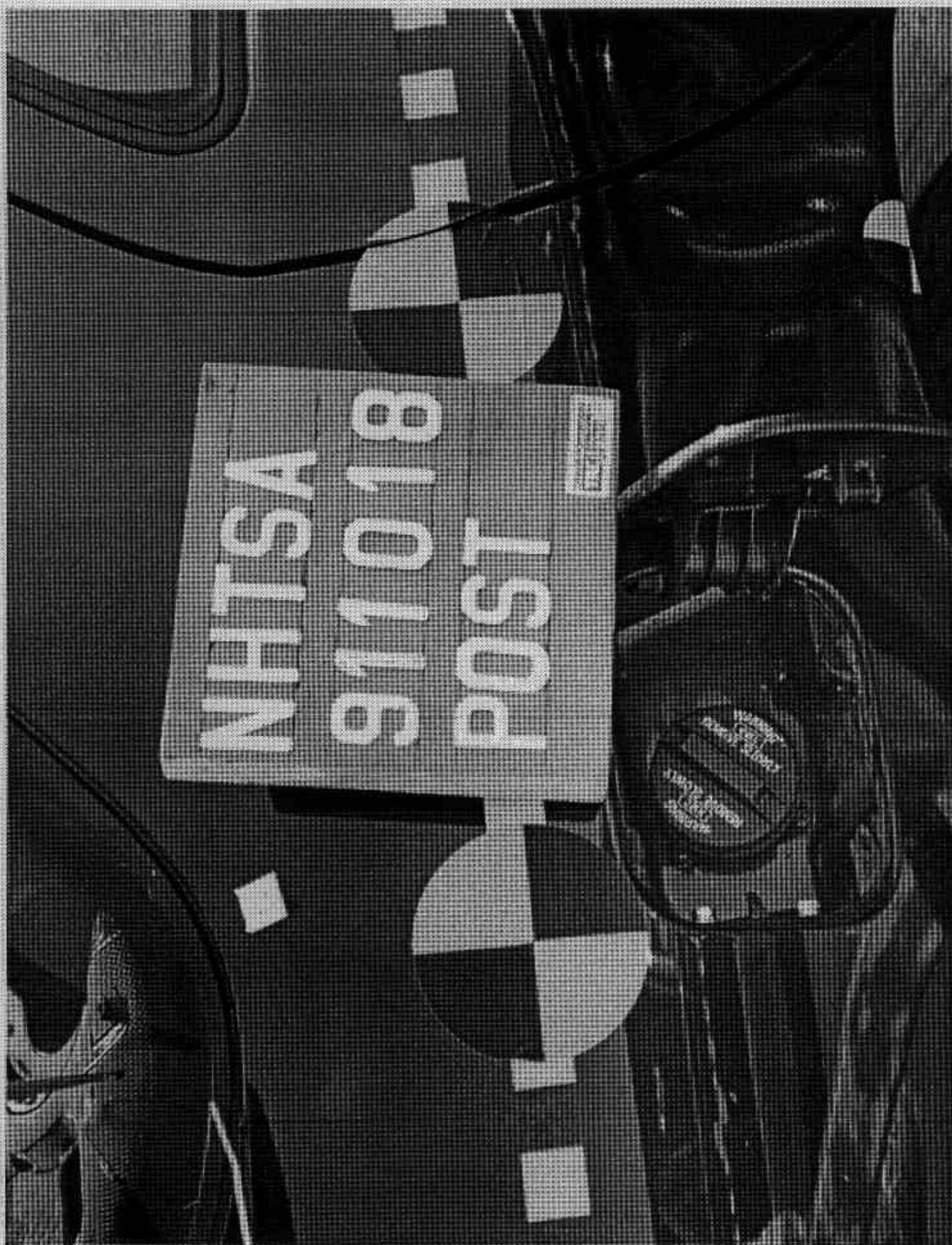


FIGURE A-18. POST-TEST FUEL FILLER CAP VIEW
A-19

911018



FIGURE A-19. PRE-TEST FUEL FILLER NECK VIEW

A-20

911018



FIGURE A-20. POST-TEST FUEL FILLER NECK VIEW
A-21

911018



FIGURE A-21. PRE-TEST FUEL TANK VIEW
A-22

911018



FIGURE A-22. POST-TEST FUEL TANK VIEW
A-23

911018

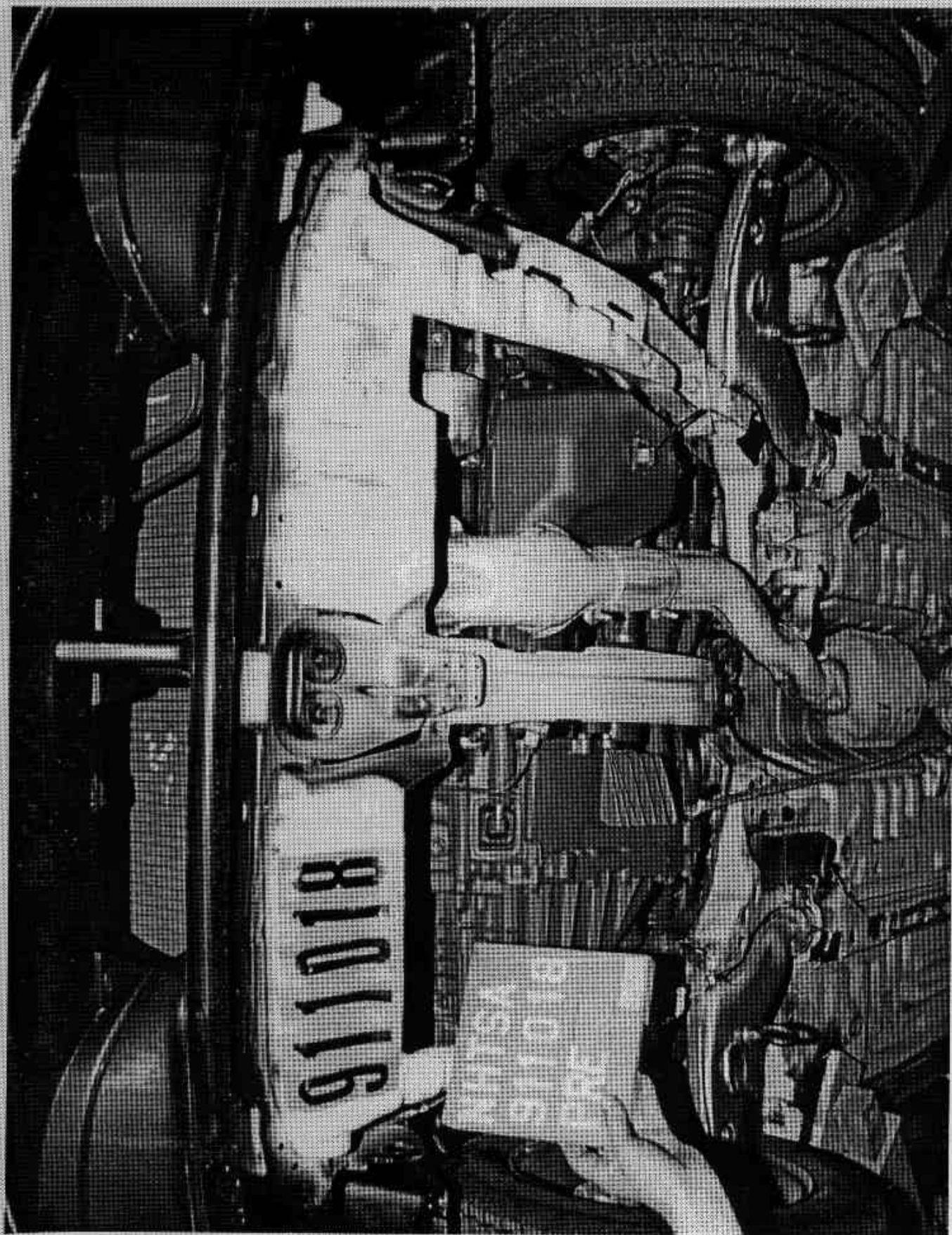


FIGURE A-23, PRE-TEST FRONT UNDERBODY VIEW

A-24

911018

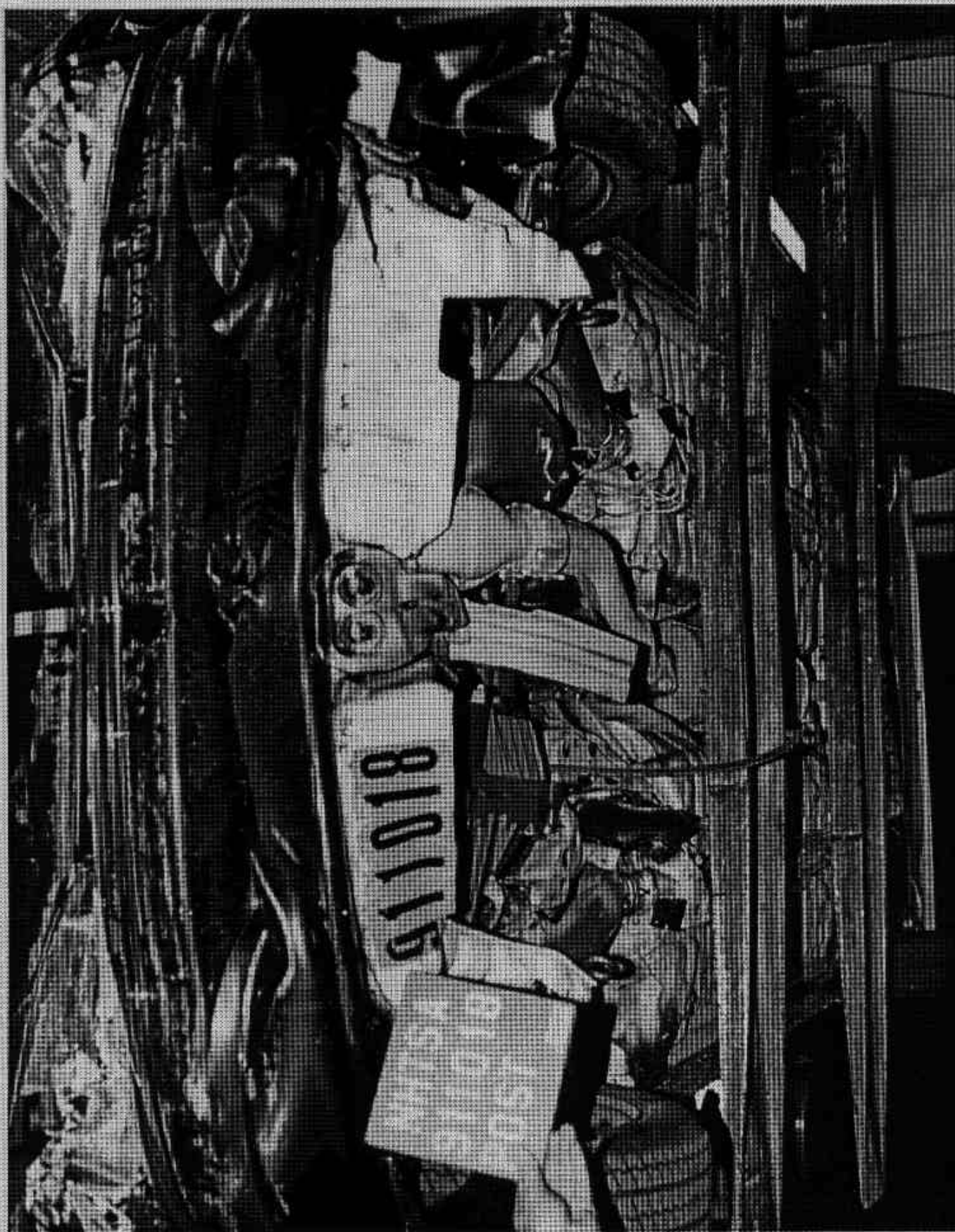


FIGURE A-24. POST-TEST FRONT UNDERBODY VIEW
A-25

911018

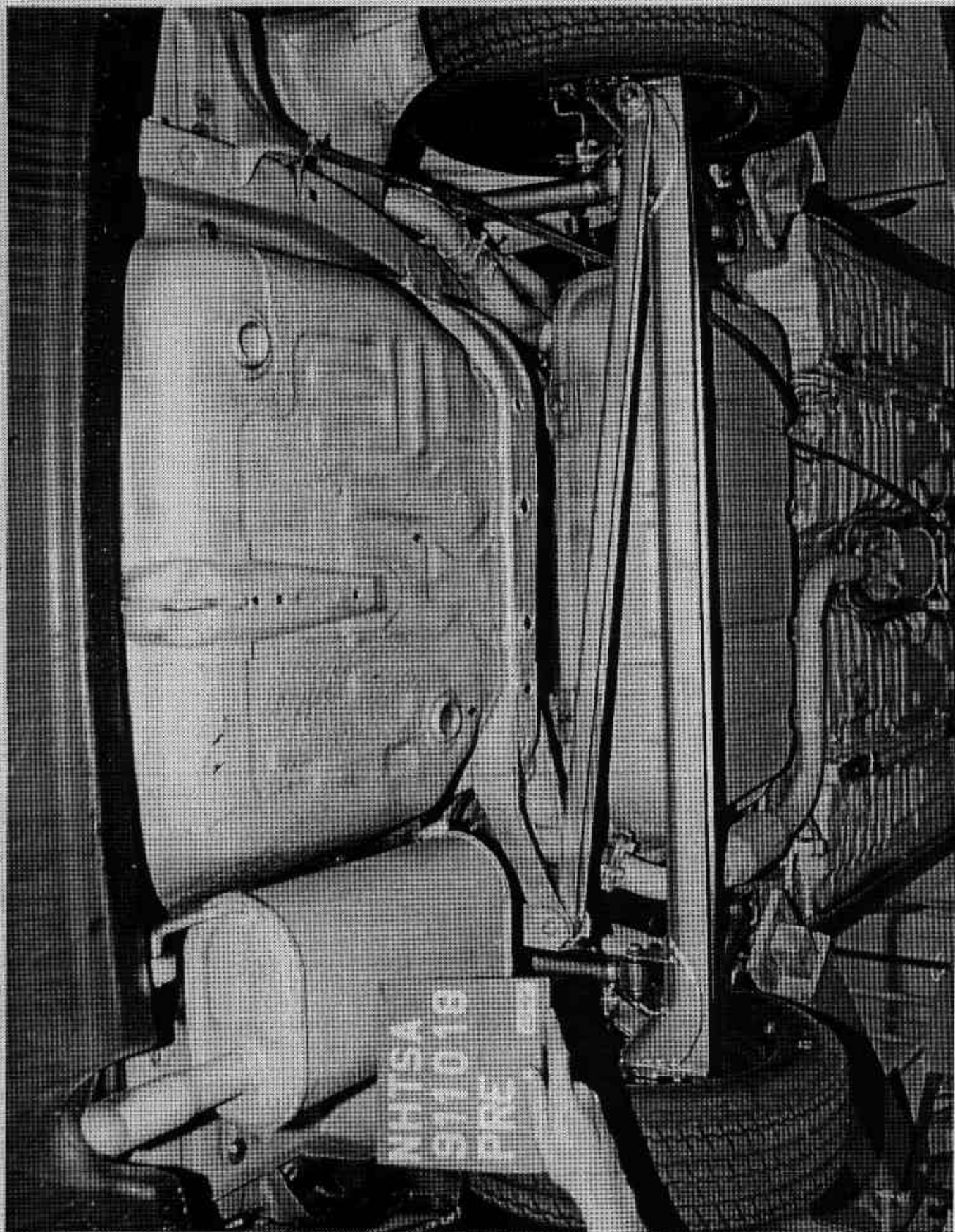


FIGURE A-25. PRE-TEST REAR UNDERBODY VIEW
A-26

911018

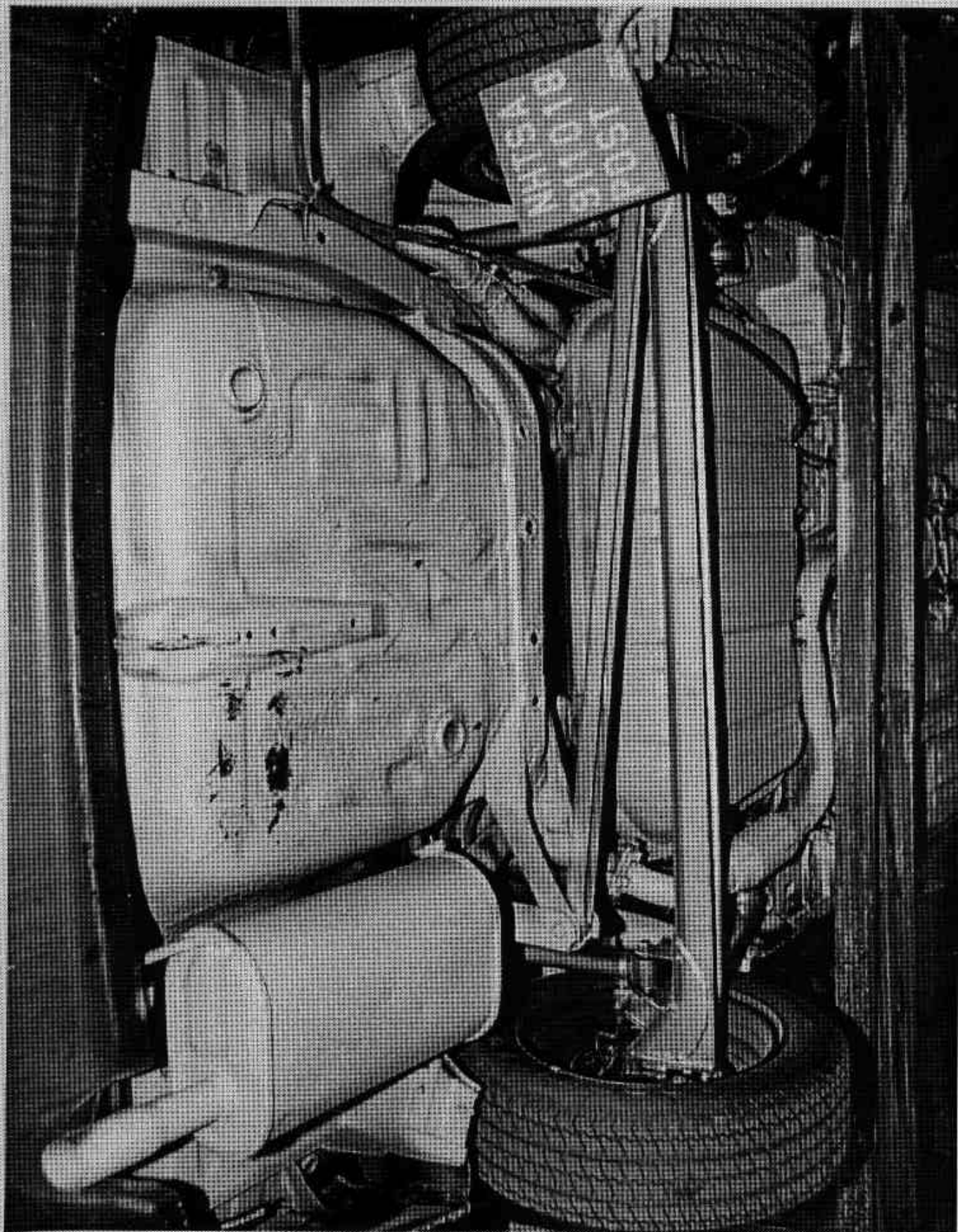


FIGURE A-26. POST-TEST REAR UNDERBODY VIEW
A-27

911018



FIGURE A-27. PRE-TEST DRIVER DUMMY POSITION VIEW

A-28

911018

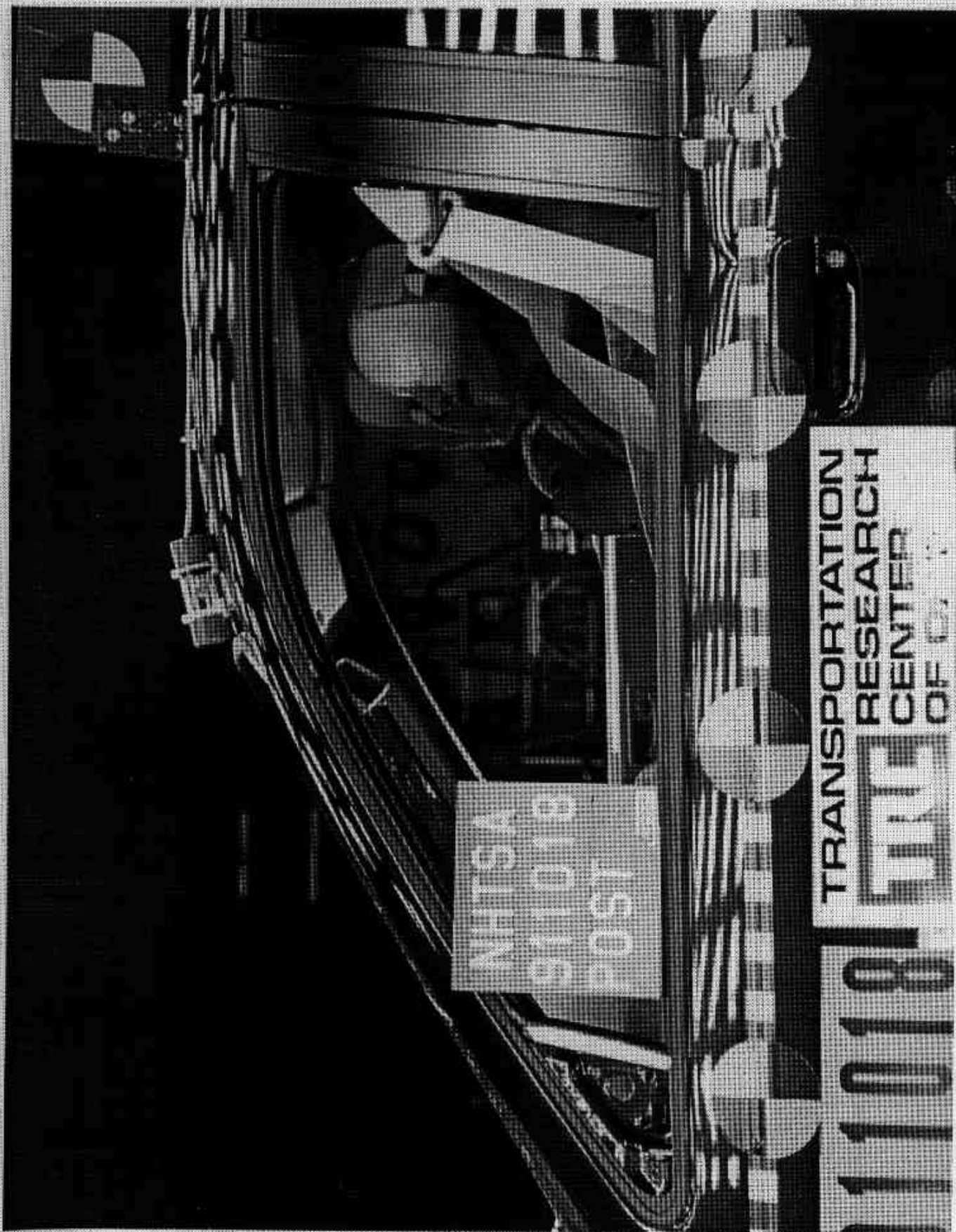


FIGURE A-28, POST-TEST DRIVER DUMMY POSITION VIEW

A-29

911018

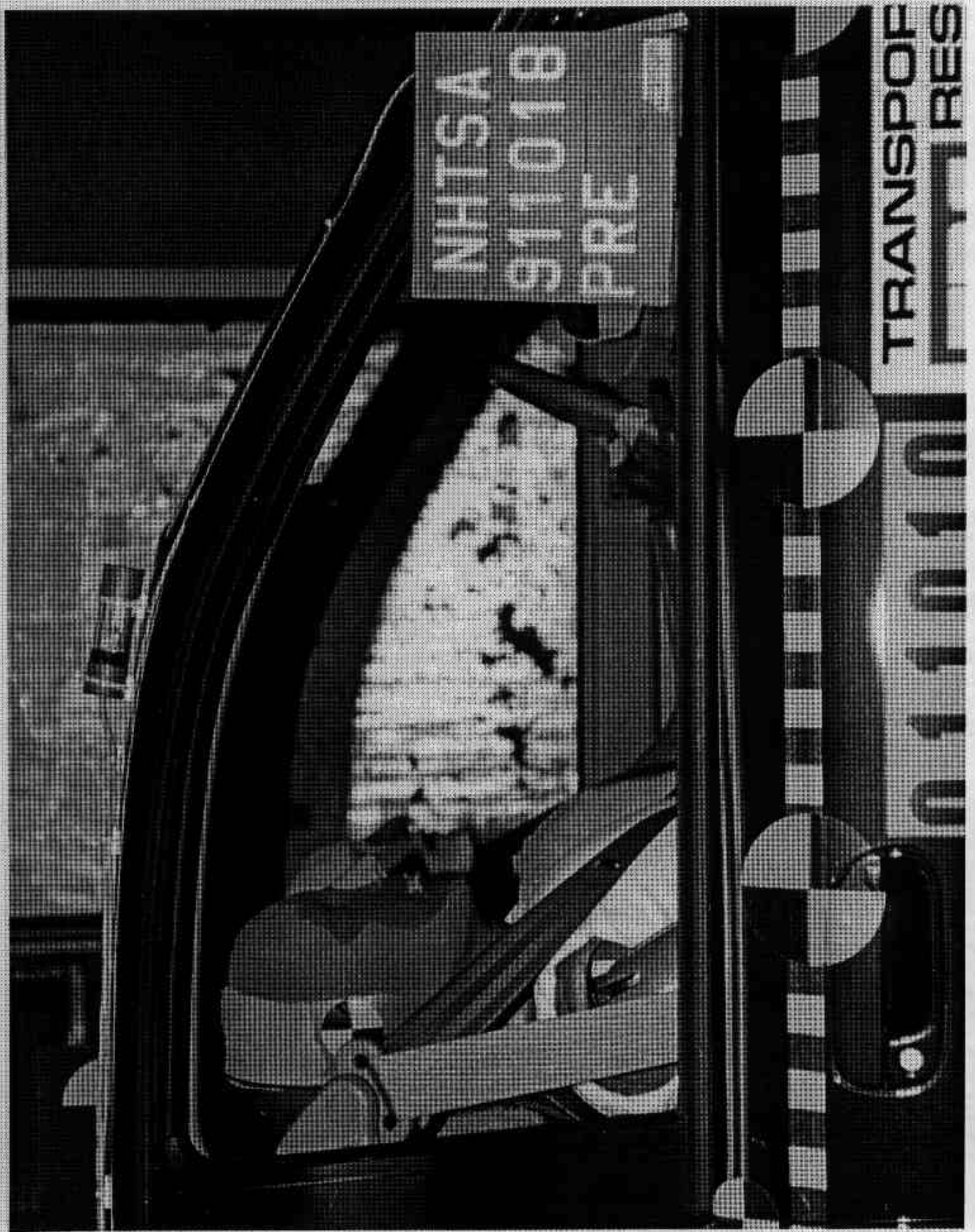


FIGURE A-29. PRE-TEST PASSENGER DUMMY POSITION VIEW

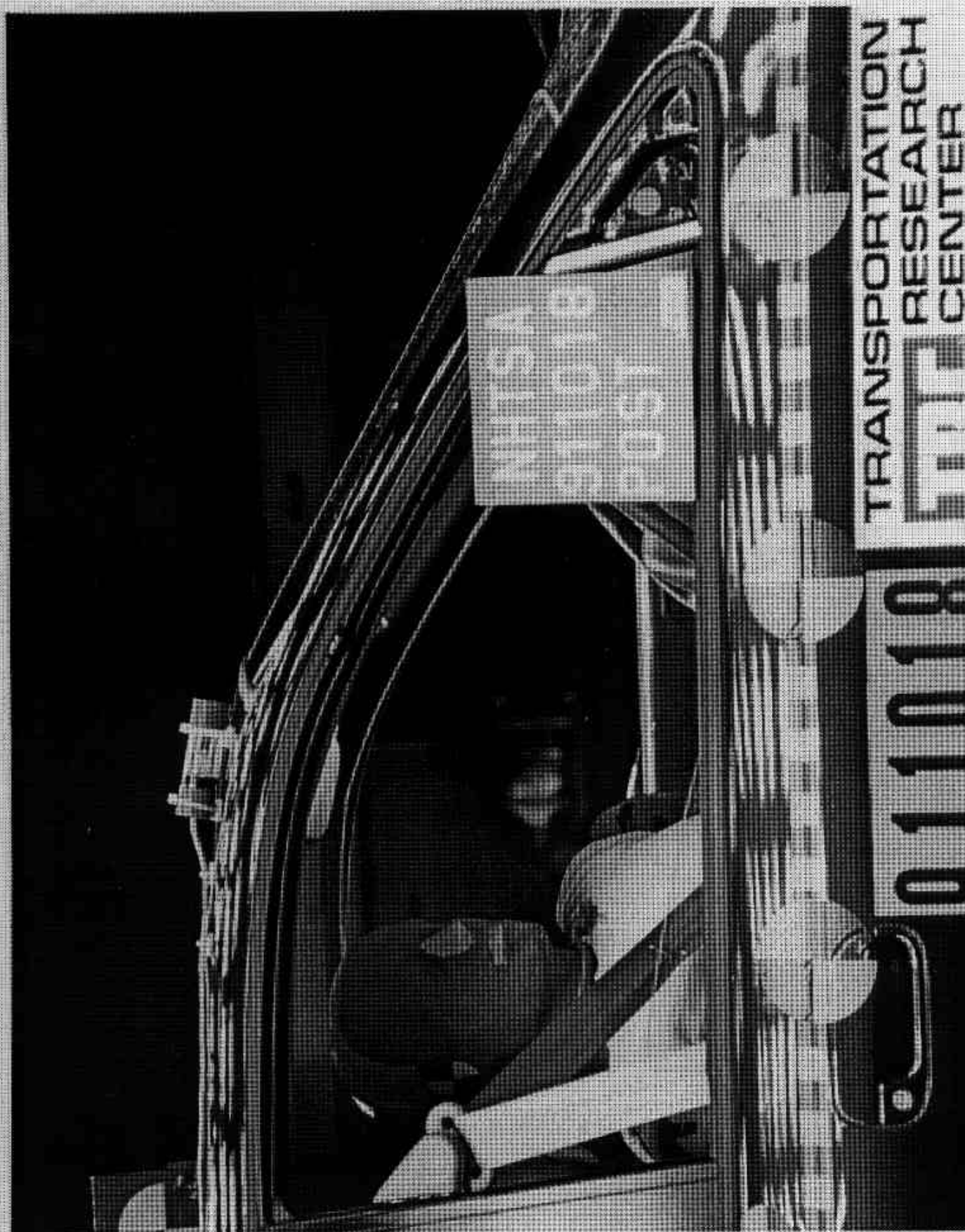


FIGURE A-30. POST-TEST PASSENGER DUMMY POSITION VIEW

A-31

911018

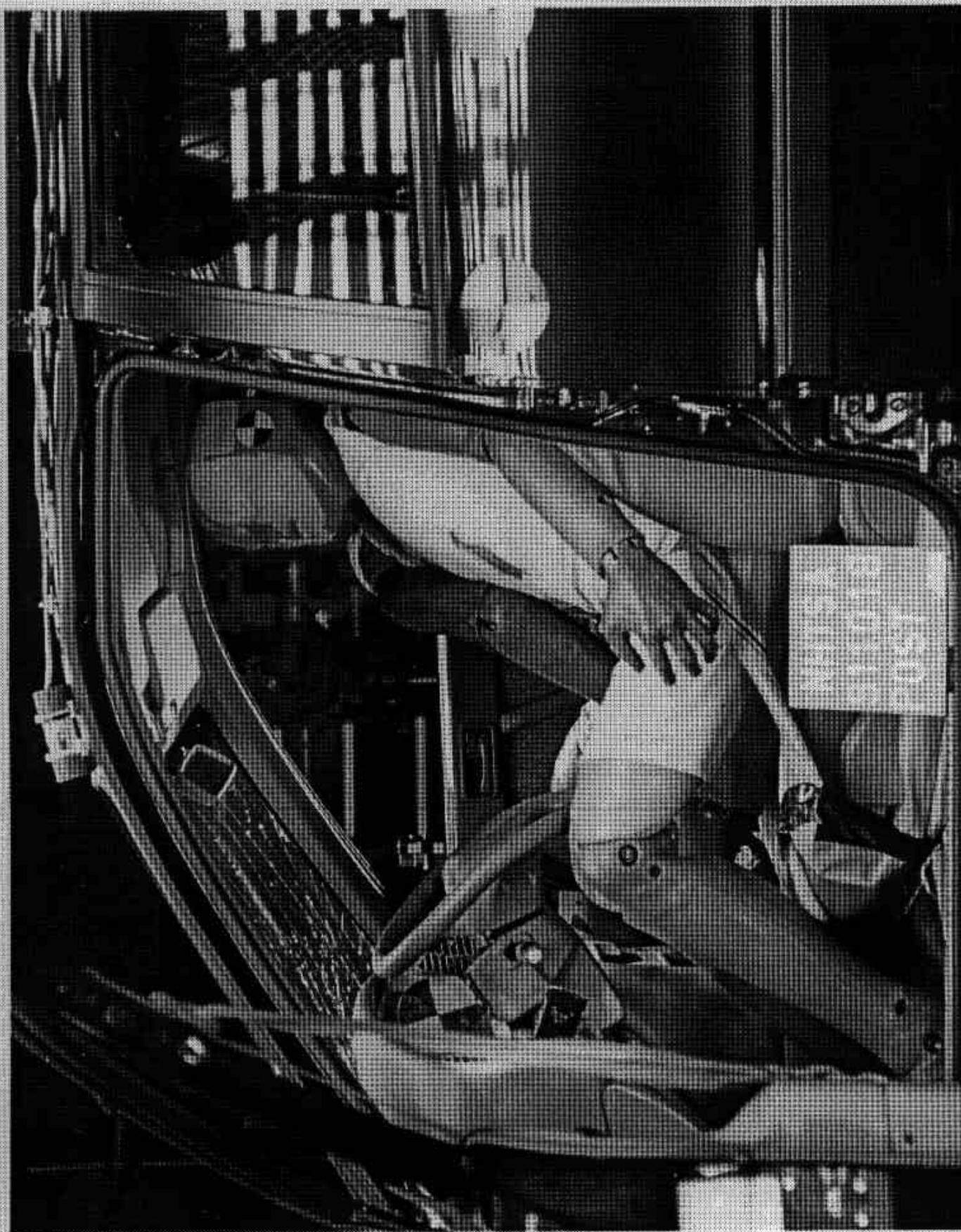


FIGURE A-31. POST-TEST DRIVER DUMMY & VEHICLE INTERIOR - VIEW 1

A-32

911018



FIGURE A-32. POST-TEST DRIVER DUMMY & VEHICLE INTERIOR - VIEW 2

A-33

911018



FIGURE A-33. PRE-TEST PASSENGER DUMMY & VEHICLE INTERIOR VIEW

A-34

911018



FIGURE A-34. POST-TEST PASSENGER DUMMY & VEHICLE INTERIOR - VIEW 1
A-35 911018



FIGURE A-35. POST-TEST PASSENGER DUMMY & VEHICLE INTERIOR - VIEW 2
A-36 911018



FIGURE A-36. POST-TEST DRIVER DUMMY HEAD CONTACT VIEW

A-37

911018

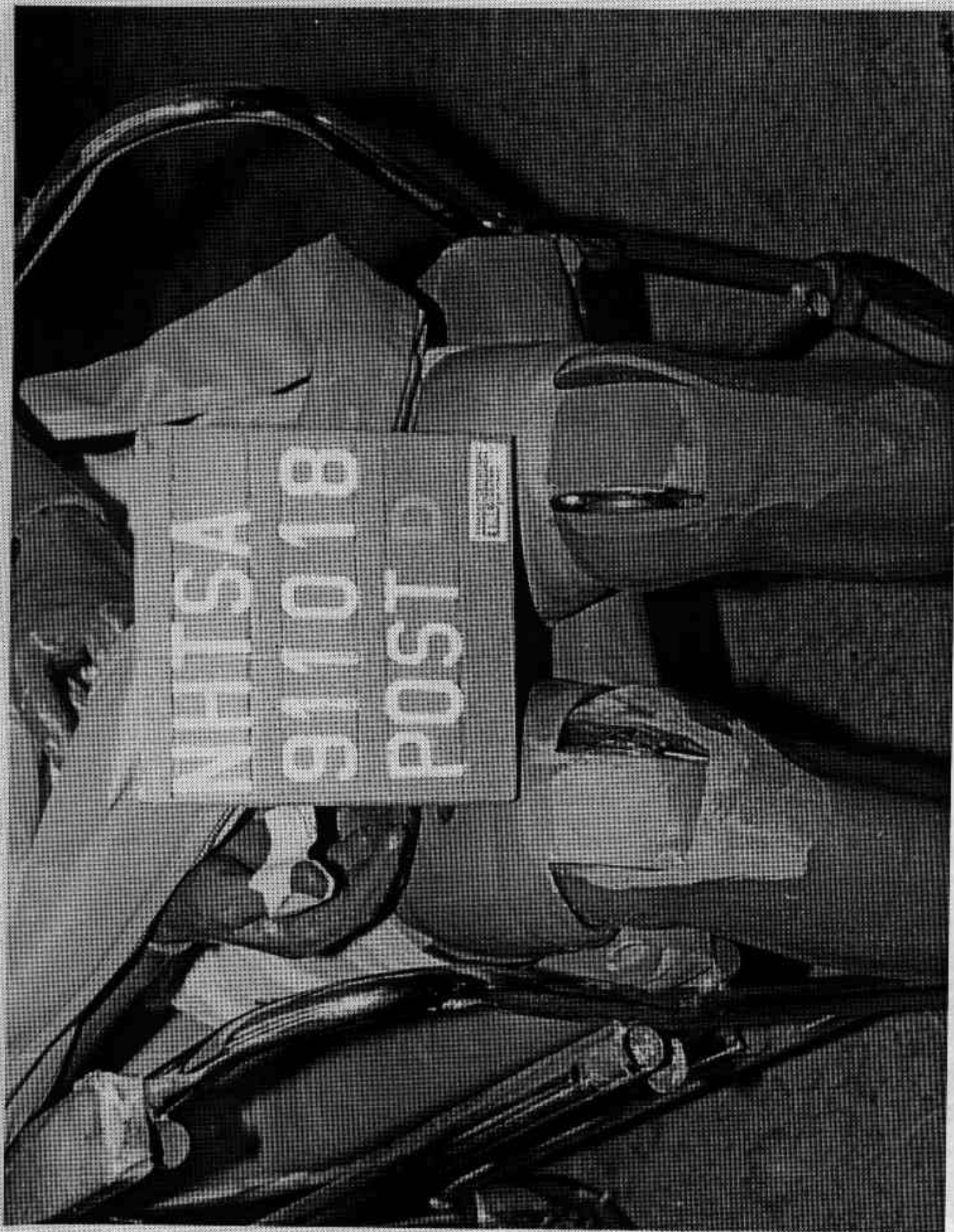


FIGURE A-37. POST-TEST DRIVER DUMMY KNEE CONTACT VIEW

A-38

911018

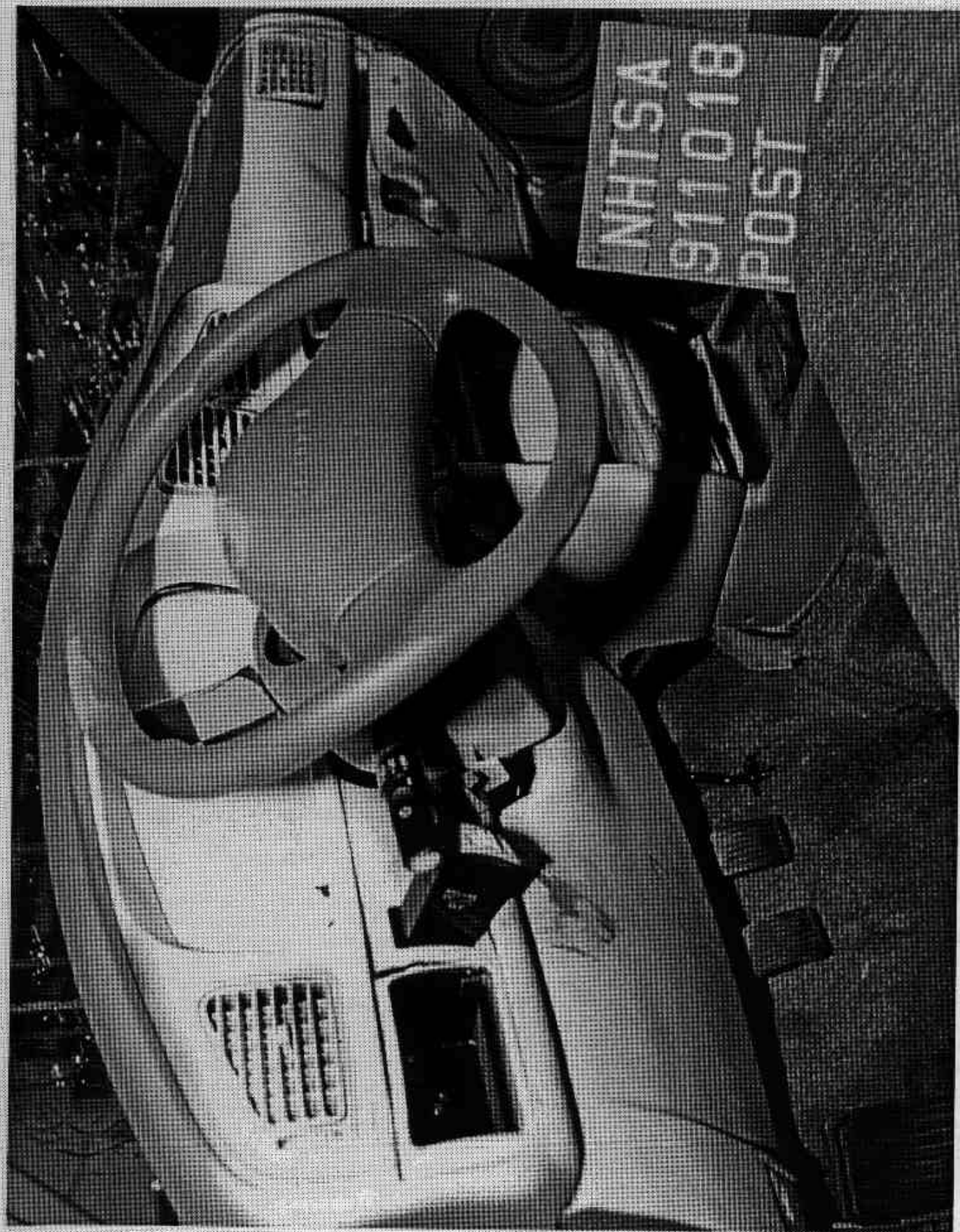


FIGURE A-38. POST-TEST DRIVER DUMMY HEAD AND KNEE CONTACT VIEW

A-39

911018

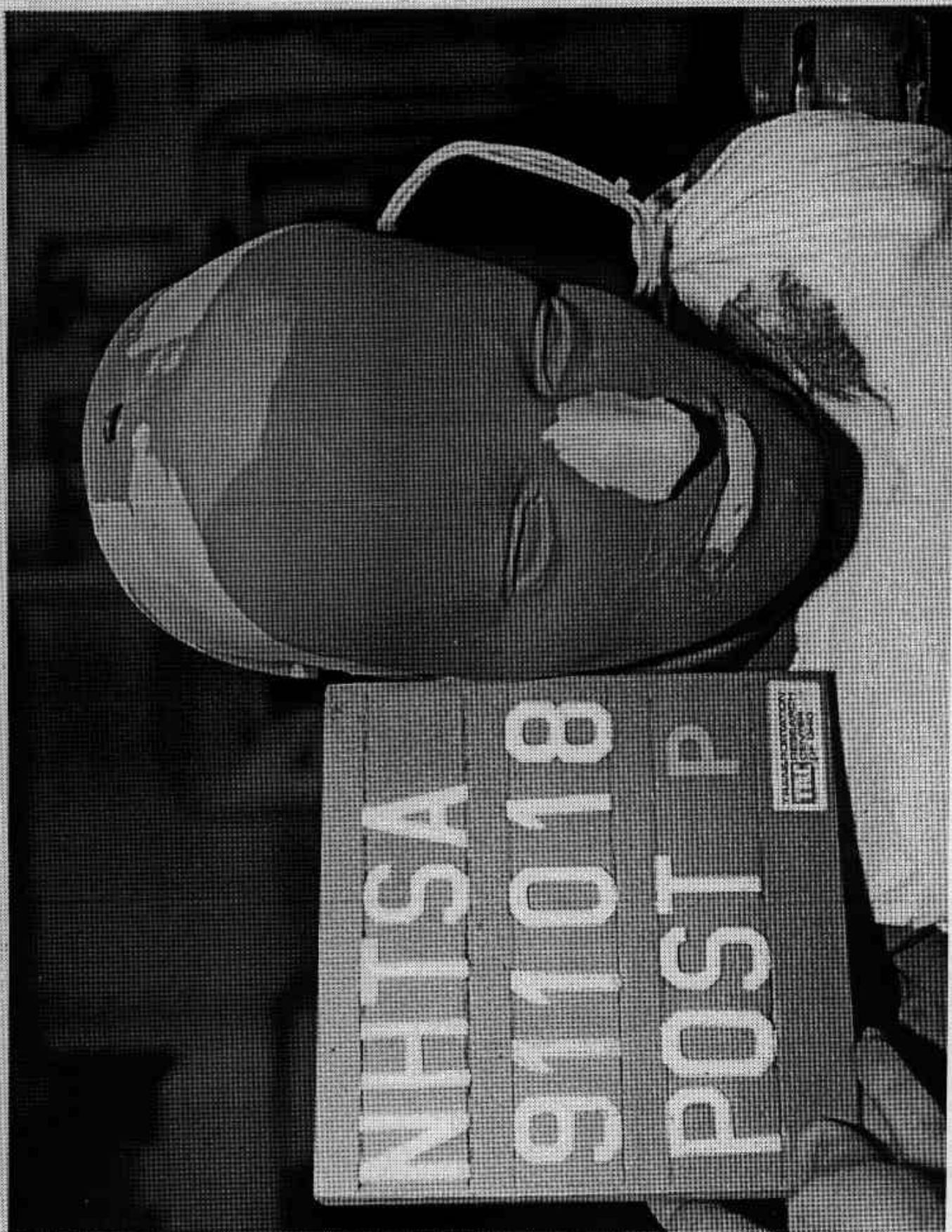


FIGURE A-39. POST-TEST PASSENGER DUMMY HEAD CONTACT VIEW



FIGURE A-40. POST-TEST PASSENGER DUMMY KNEE CONTACT - VIEW 1

A-41

911018



FIGURE A-41. POST-TEST PASSENGER DUMMY KNEE CONTACT - VIEW 2

A-42

911018

MANUFACTURED IN KOREA BY
HYUNDAI MOTOR COMPANY
JUL/10/91 GVWR 3560 LBS
GAWR FRONT 1896 LBS GAWR REAR 1752 LBS
THIS VEHICLE CONFORMS TO ALL APPLICABLE U.S.A. FEDERAL
MOTOR VEHICLE SAFETY, BUMPER, AND THEFT PREVENTION STANDARDS
IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE
V.I.N. KMHJF22R8NU079665
PASSENGER CAR

FIGURE A-42, PRE-TEST VEHICLE CERTIFICATION LABEL VIEW



TIRE INFLATION PRESSURE		
VEHICLE CAPACITY WEIGHT LBS. 860		
SEATING CAPACITY: TOTAL 5 FRONT 2 REAR 3		
TIRE PRESSURES-COLD: KPA (PSI) :		
TIRE SIZE	FRONT	REAR
P175/65TR14	200 (29)	200 (29)
P185/60HR14	200 (29)	200 (29)
T125/70D15	420 (60)	420 (60)

FIGURE A-43. PRE-TEST VEHICLE RECOMMENDED TIRE PRESSURE LABEL VIEW

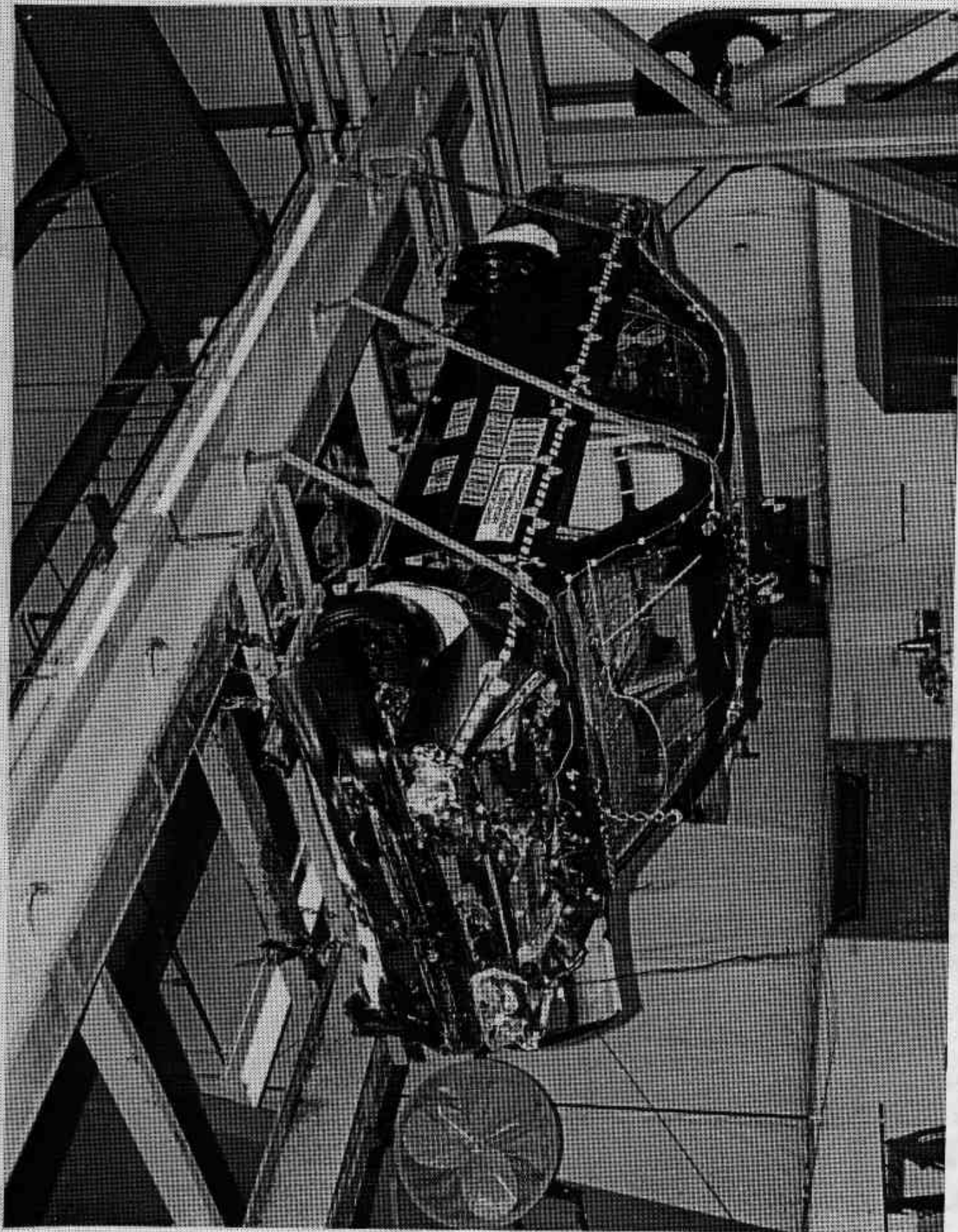


FIGURE A-44. POST-TEST VEHICLE ON STATIC ROLLOVER MACHINE VIEW

A-45

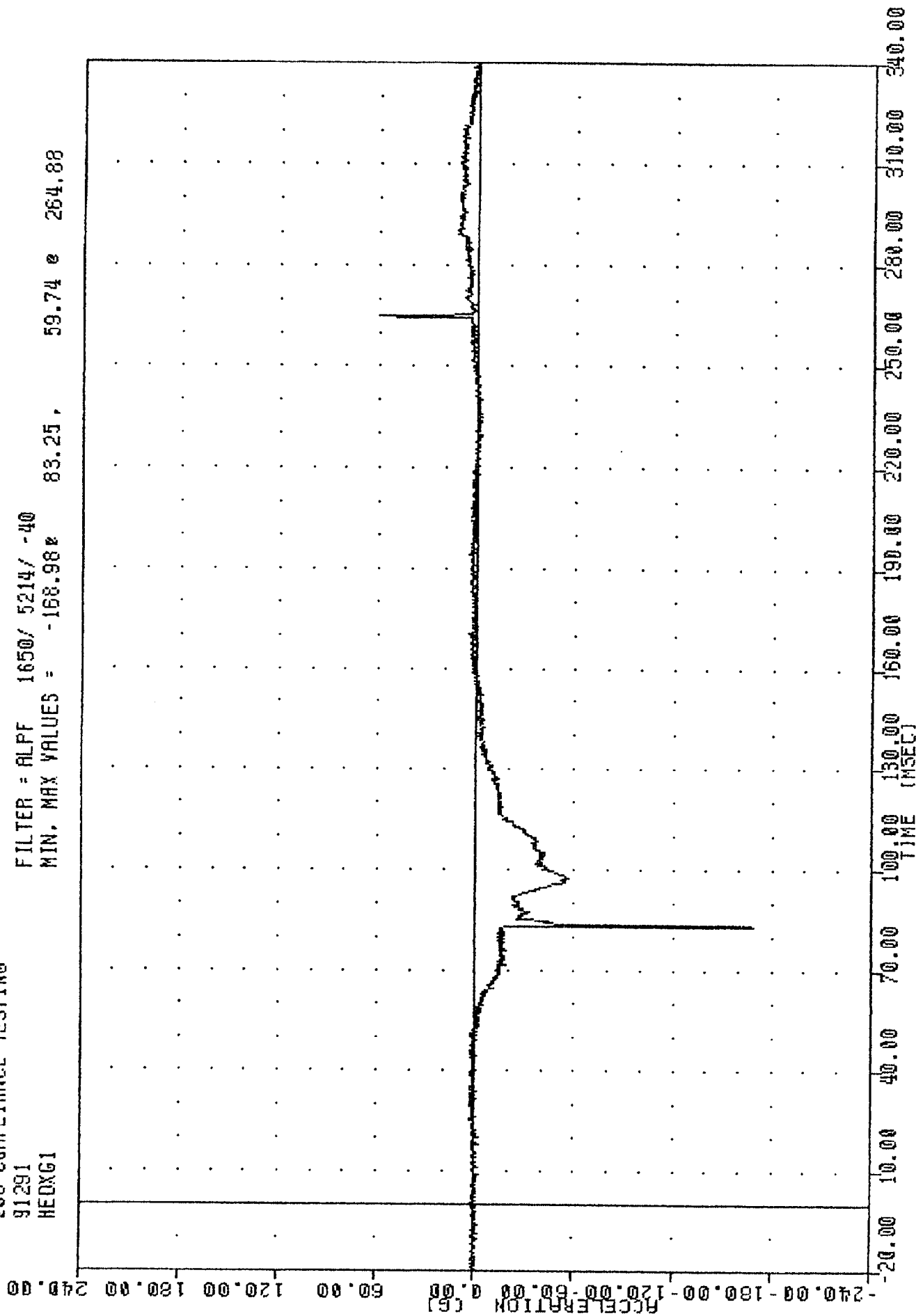
911018

APPENDIX B

DATA PLOTS

TRC 911018
200 COMPLIANCE TESTING
91291
HEDXG1

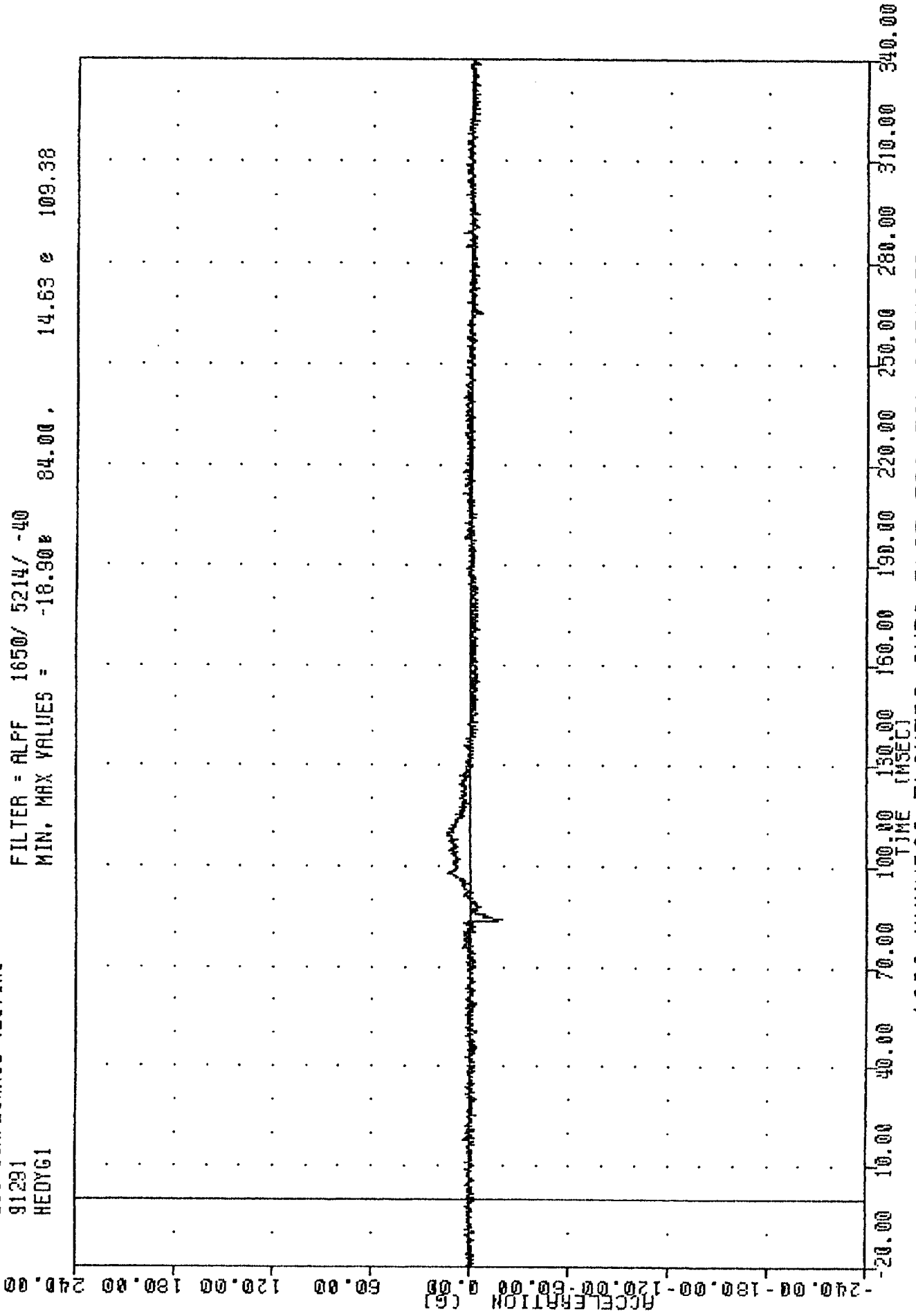
FILTER = ALPF 1650/ 5214/ -40
MIN. MAX VALUES = -168.98 83.25 , 59.74 264.88



1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
DRIVER HEAD X-AXIS ACCELERATION

TRC 911018
200 COMPLIANCE TESTING
91291
HEDYG1

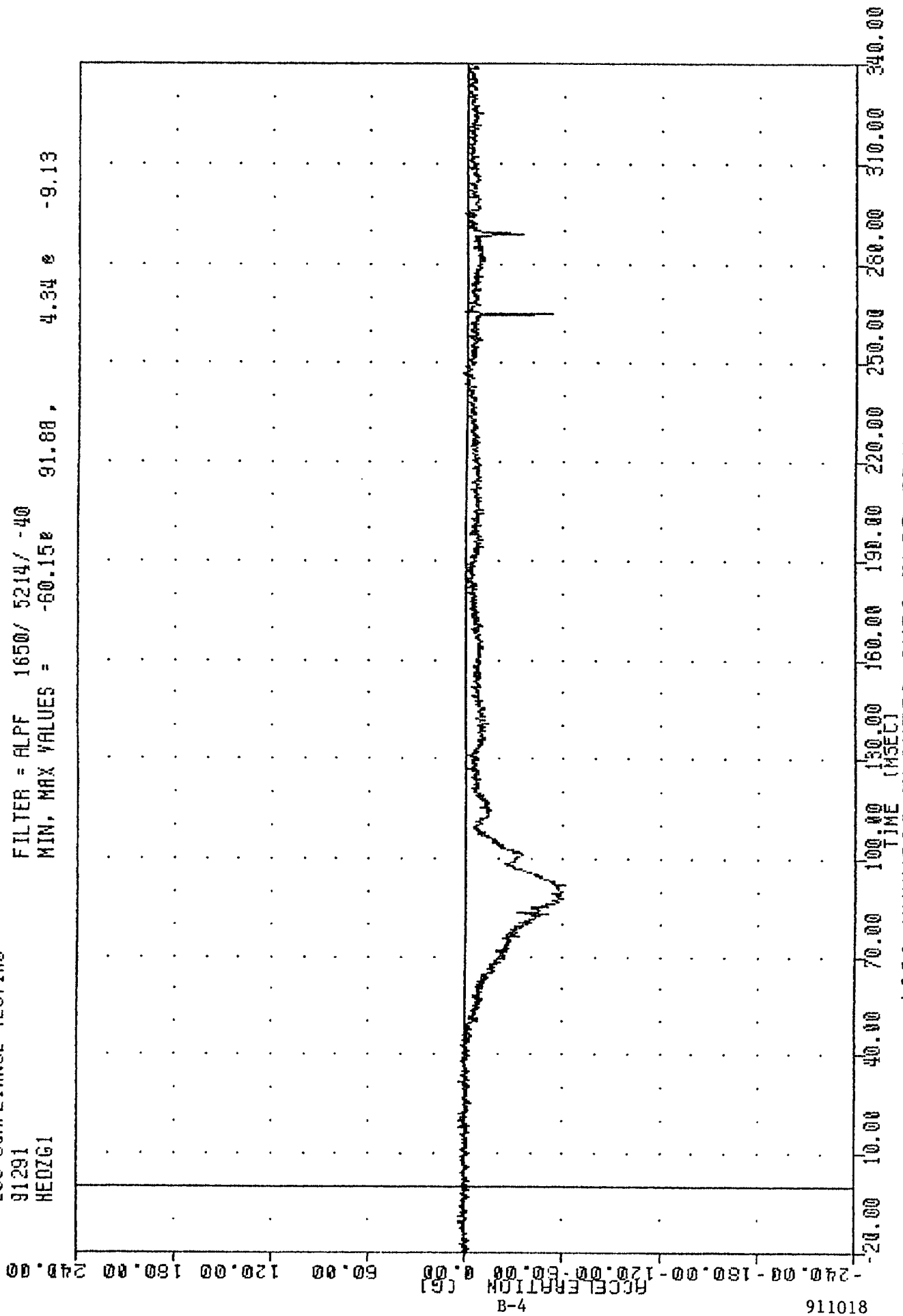
FILTER = ALPF 1650/ 5214/ -40
MIN. MAX VALUES = -18.90% 84.00 , 14.63 e 109.38



1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
DRIVER HEAD Y-AXIS ACCELERATION

TRC , 911018
200 COMPLIANCE TESTING
91291
HEDZG1

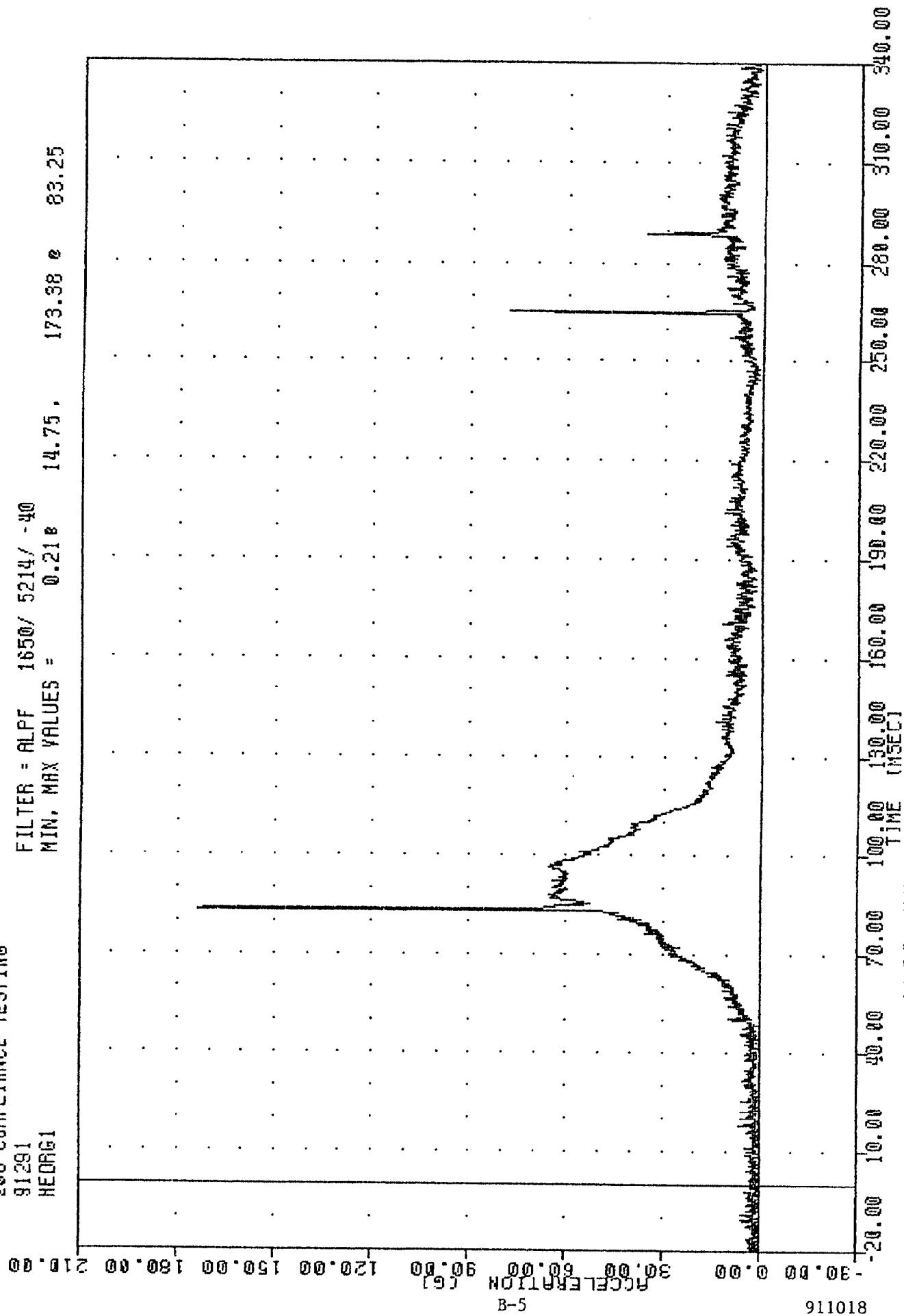
FILTER = ALPF 1650/ 5214/ -40
MIN, MAX VALUES = -60.15e 91.80, 4.34 e -9.13



1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
DRIVER HEAD Z-AXIS ACCELERATION

TRC 911018
 208 COMPLIANCE TESTING
 91291
 HEORG1

FILTER = ALPF 1650/ 5214/ -40
 MIN, MAX VALUES = 0.21e 14.75. 173.38 e 83.25



1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
 DRIVER HEAD RESULTANT ACCELERATION

TRC 911018

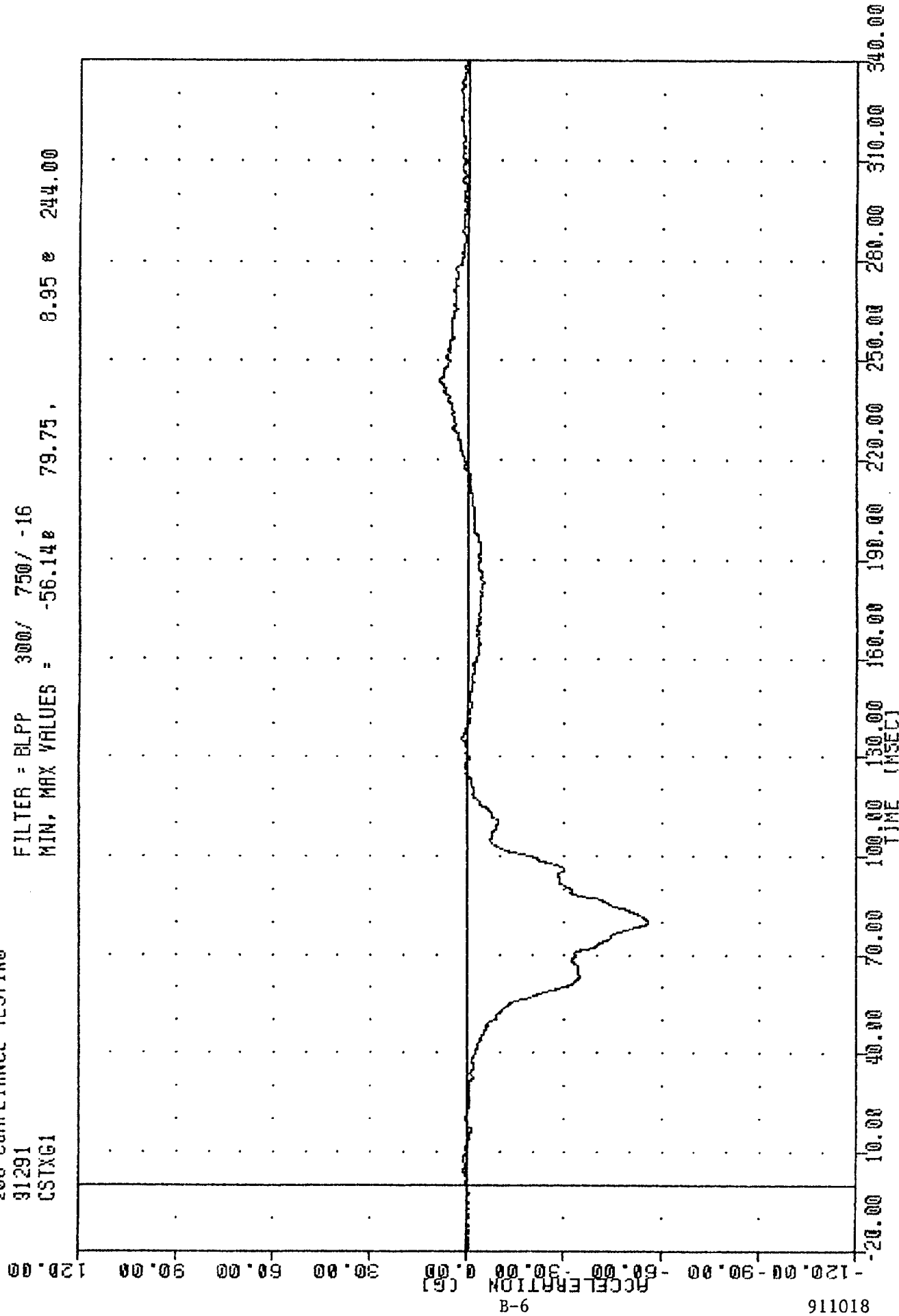
200 COMPLIANCE TESTING

91291

CSTXG1

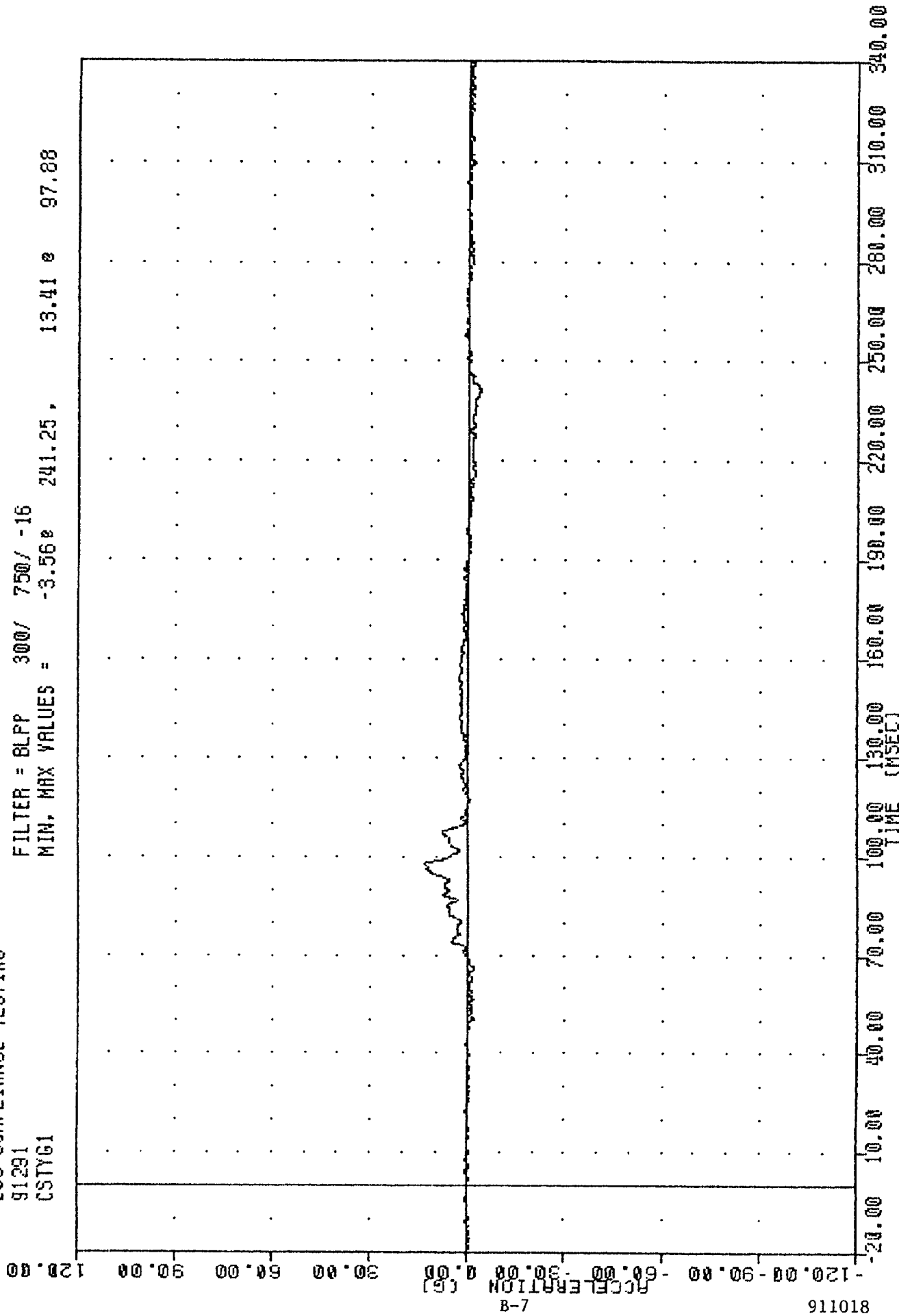
FILTER = BLPP 300/ 750/ -16

MIN. MAX VALUES = -56.14 79.75, 8.95 244.00



TRC , 911018
 208 COMPLIANCE TESTING
 91291
 CSTYG1

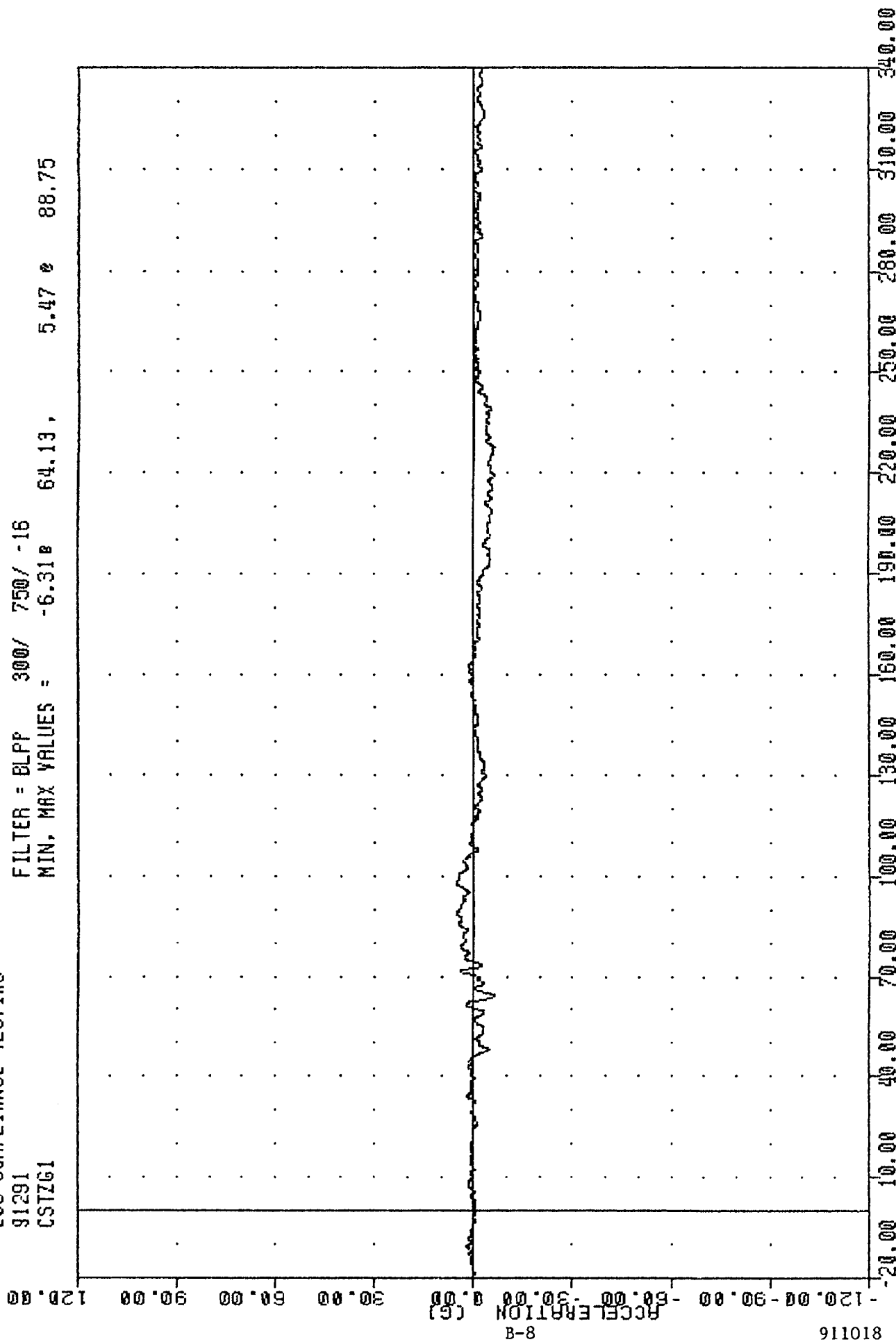
FILTER = BLPP 300/ 750/ -16
 MIN. MAX VALUES = -3.56e 241.25 , 13.41 e 97.88



1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
 DRIVER CHEST Y-AXIS ACCELERATION

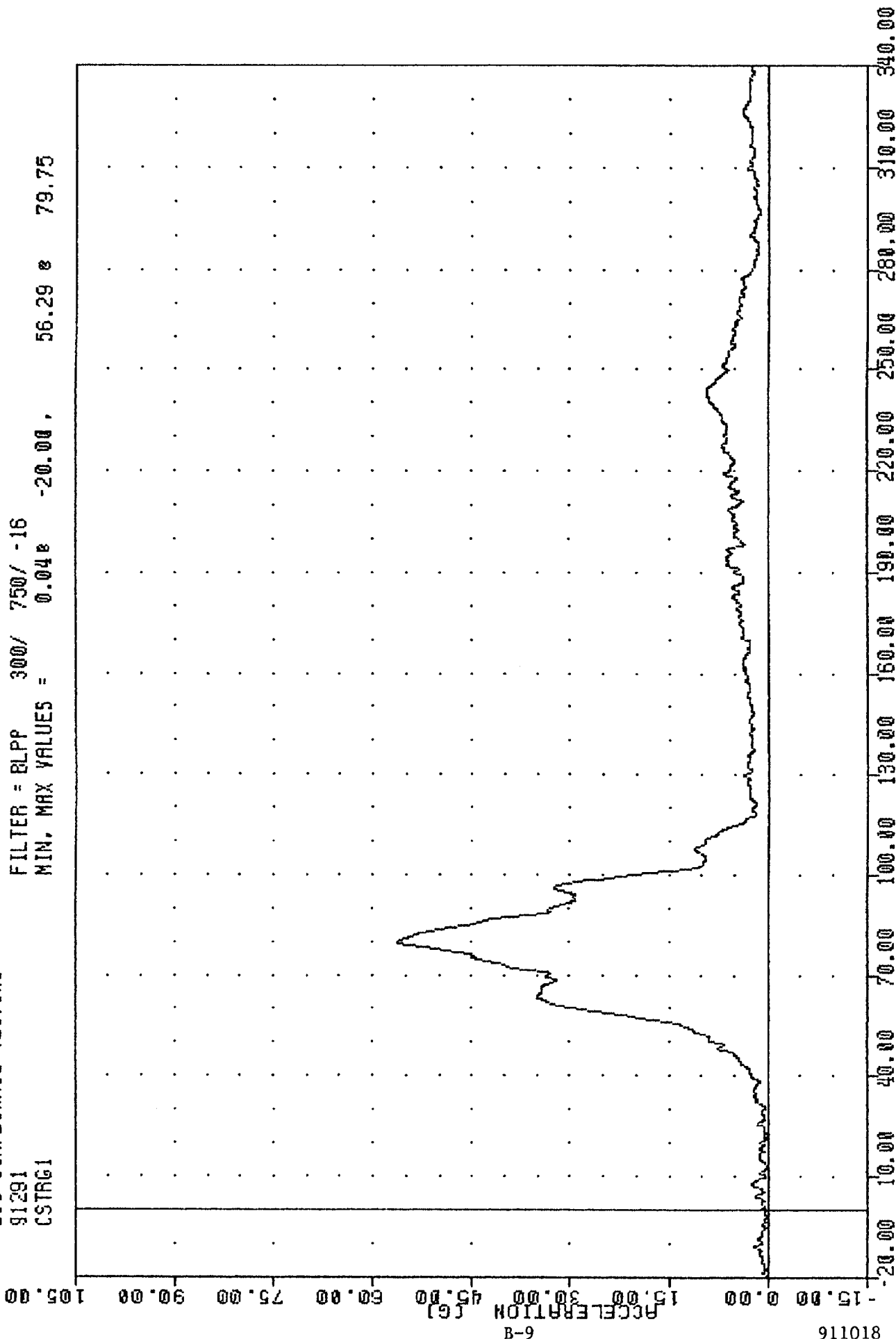
TRC , 911018
 200 COMPLIANCE TESTING
 91291
 CSTZG1

FILTER = BLPP 300/ 750/ -16
 MIN, MAX VALUES = -6.31 64.13, 5.47 88.75



TRC
200 COMPLIANCE TESTING
91291
CSTRG1

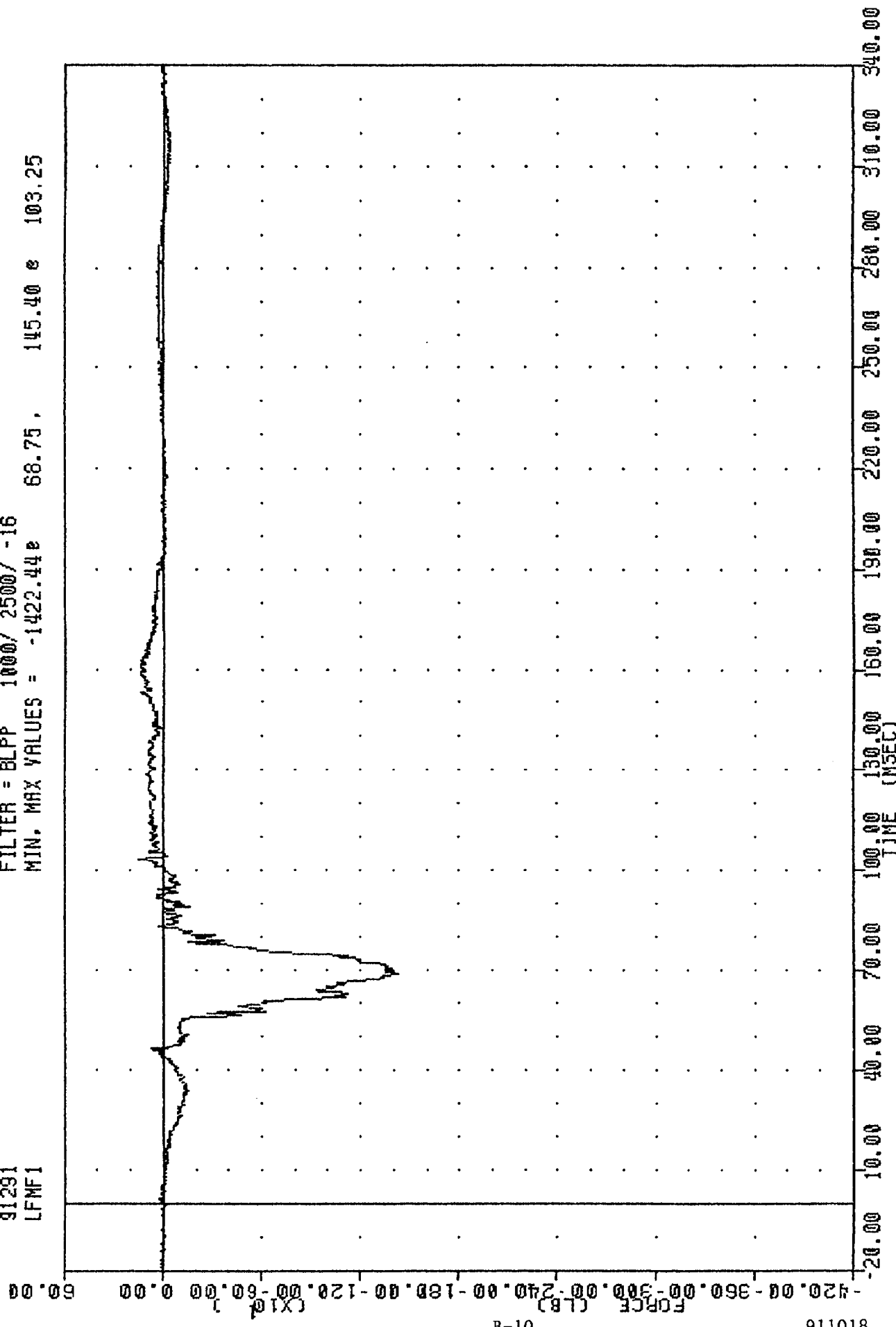
FILTER = BLPP 300/ 750/ -16
MIN, MAX VALUES = 0.048 -20.00, 56.29 & 79.75



1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
DRIVER CHEST RESULTANT ACCELERATION

TRC , 911018
 200 COMPLIANCE TESTING
 91291
 LFMF1

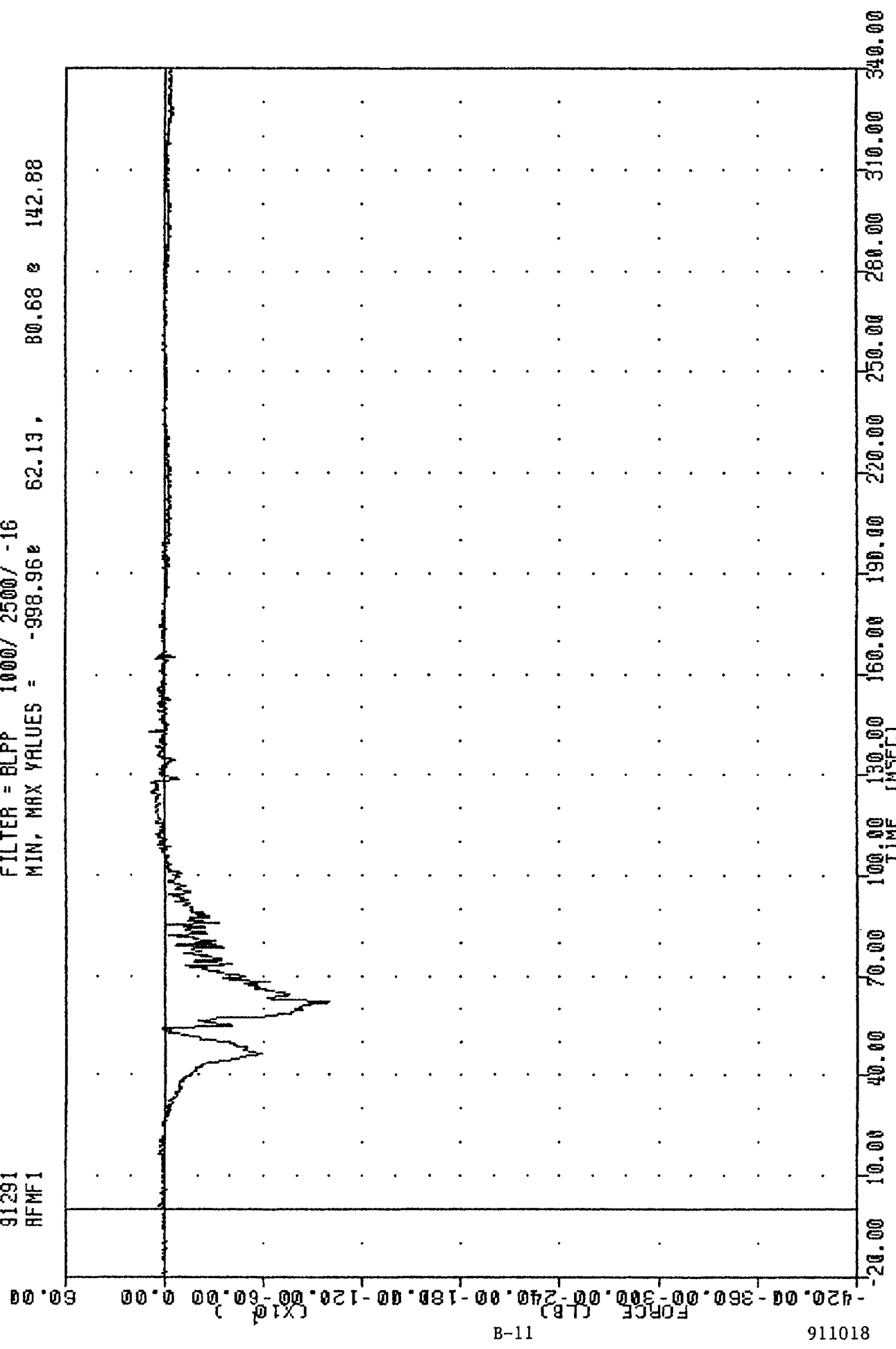
FILTER = BLPP 1000/ 2500/ -16
 MIN. MAX VALUES = -1422.44e 68.75 , 145.40 e 103.25



1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
 DRIVER LEFT FEMUR FORCE

TRC , 911018
 200 COMPLIANCE TESTING
 91291
 AFMF1

FILTER = BLPP 1000/ 2500/ -16
 MIN, MAX VALUES = -998.96e 62.13, 80.68 e 142.88



1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
 DRIVER RIGHT FEMUR FORCE

TRC 911018

208 COMPLIANCE TESTING

91291

HEDXG2

FILTER = ALPF 1650/ 5214/ -40

MIN. MAX VALUES = -21.98 73.88, 8.09 310.00

240.00

180.00

120.00

60.00

0.00

-60.00

-120.00

-180.00

-240.00

ACCELERATION (G)

B-12

811016

10.00

40.00

70.00

100.00

130.00

160.00

190.00

220.00

250.00

280.00

310.00

340.00

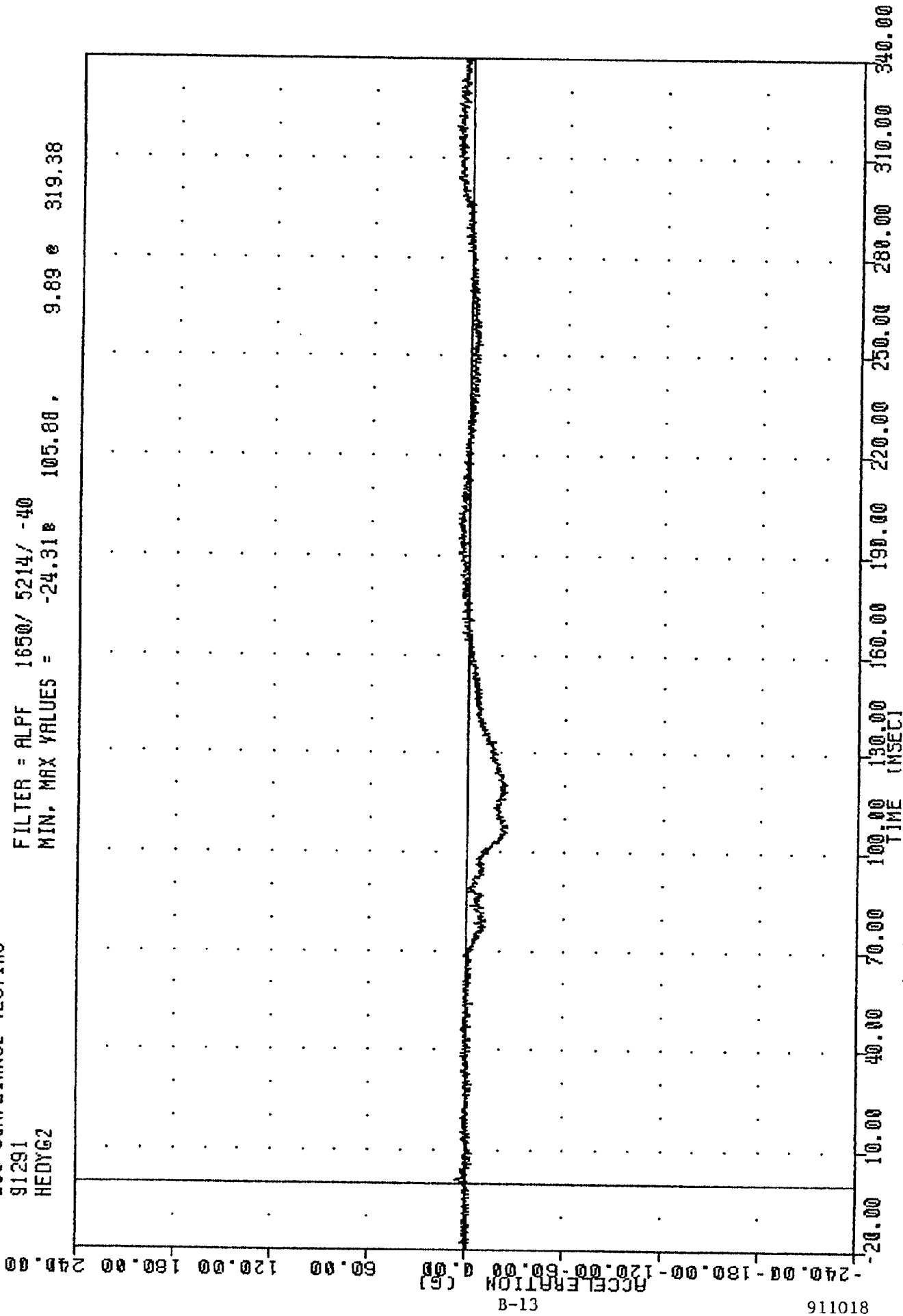
TIME (MSEC)

1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER

RIGHT FRONT PASSENGER HEAD X-AXIS ACCELERATION

TRC , 911018
 208 COMPLIANCE TESTING
 91291
 HEDYG2

FILTER = ALPF 1650/ 5214/ -40
 MIN. MAX VALUES = -24.318 105.88 , 9.89 319.38



B-13

9110116

TRC 911018

200 COMPLIANCE TESTING

91291

HEADZG2

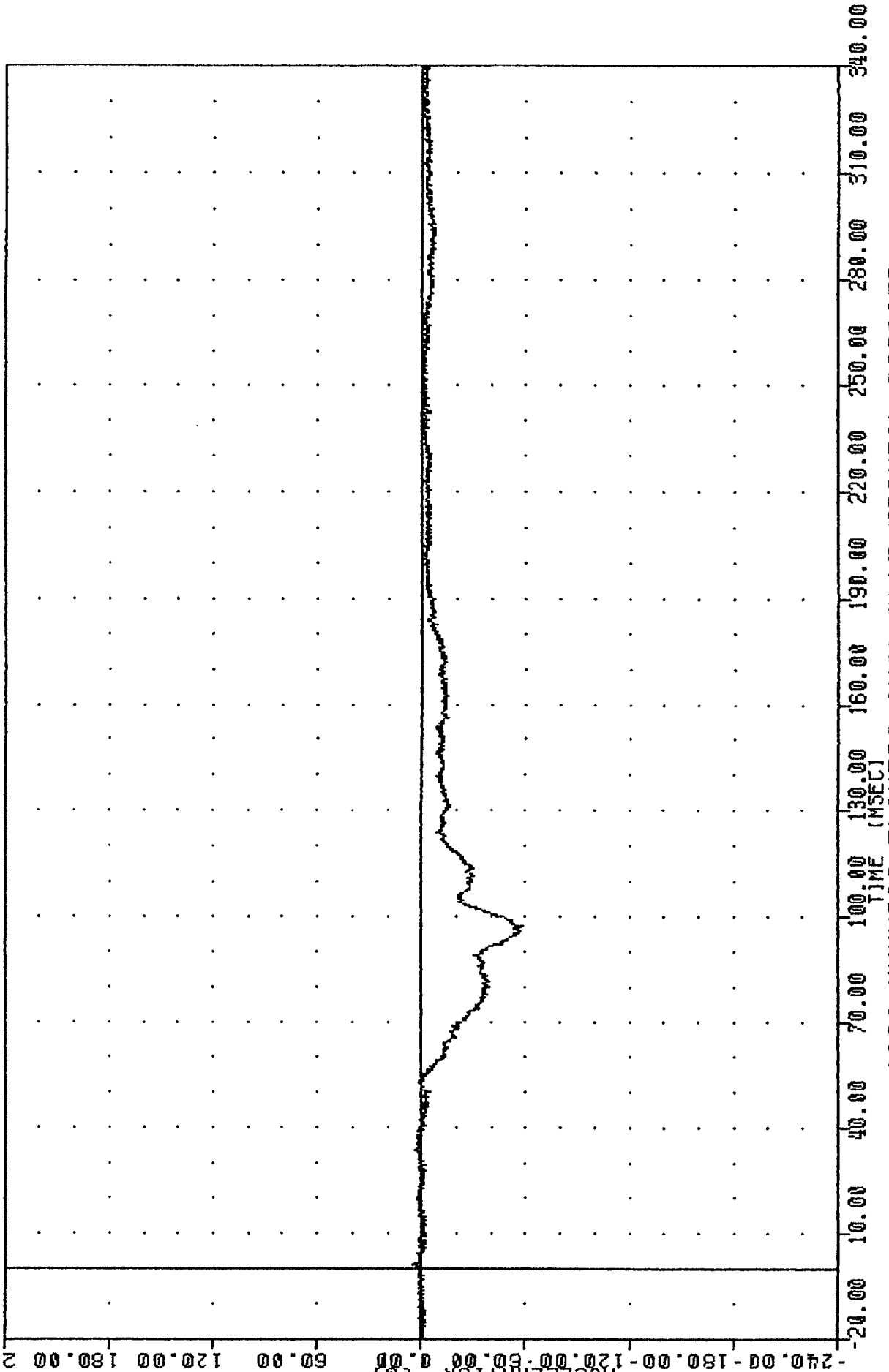
FILTER = ALPF 1650/ 5214/ -40

MIN. MAX VALUES = -57.83 97.13, 5.37 1.25

ACCELERATION (G)

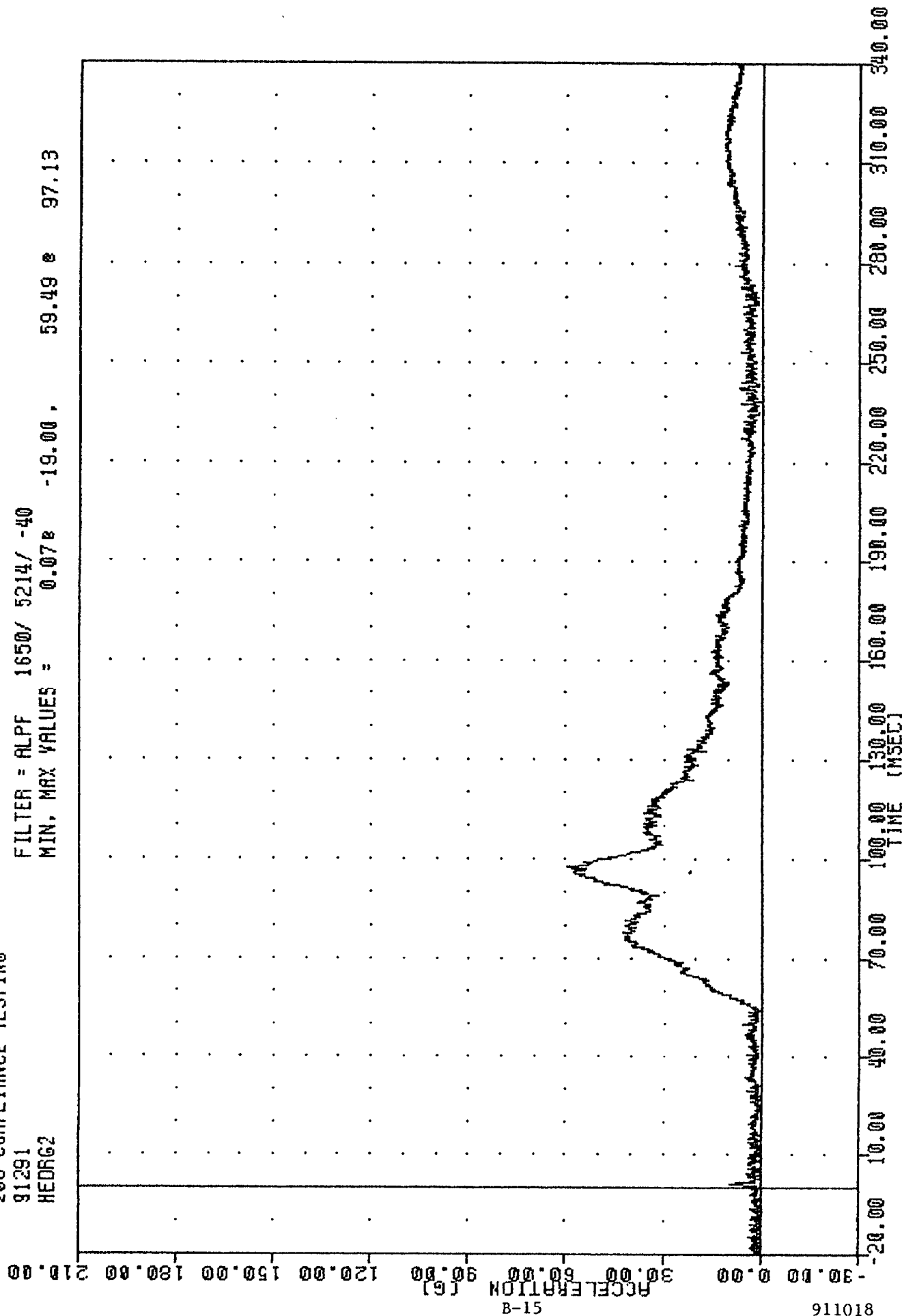
B-14

911018



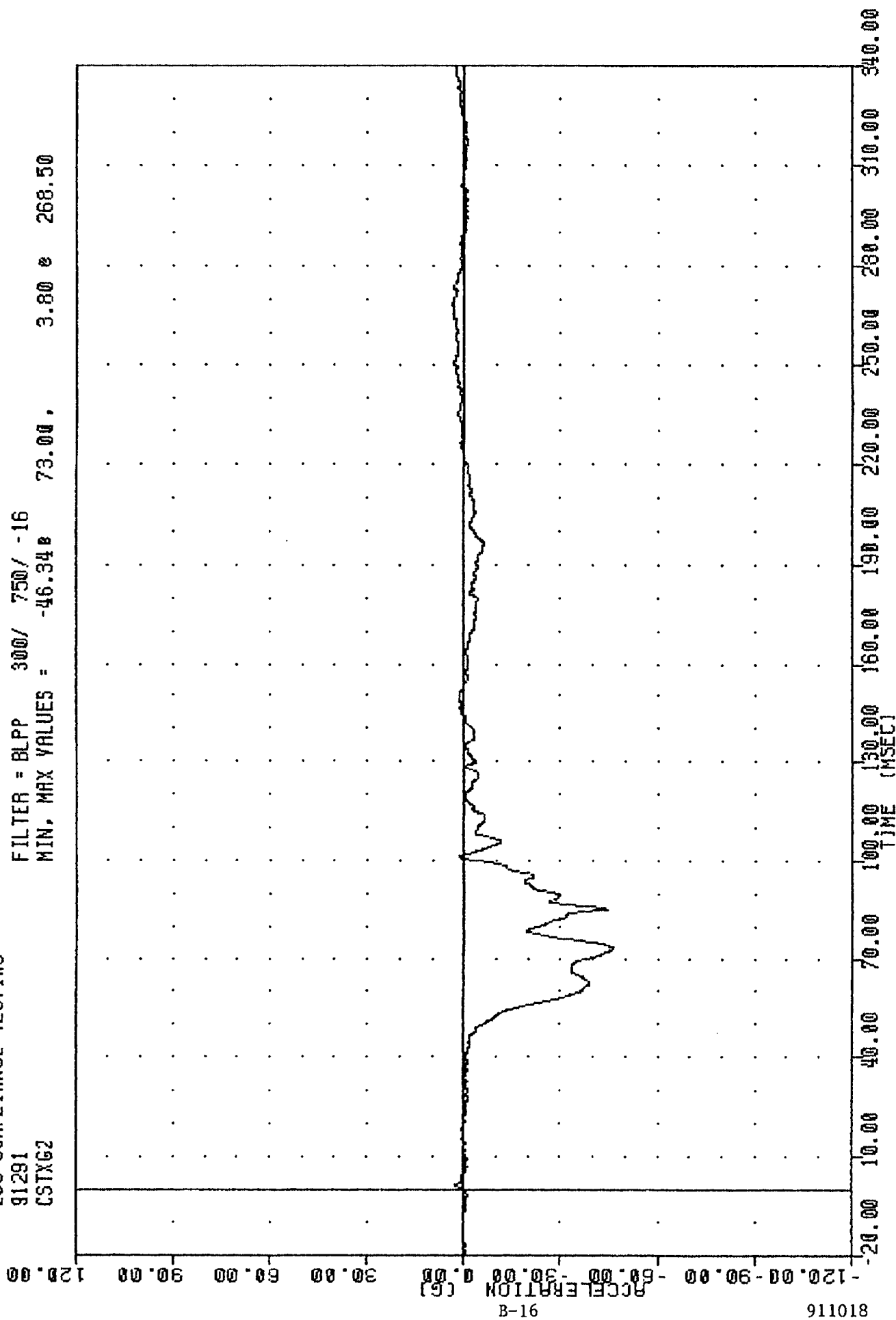
TRC , 911018
 206 COMPLIANCE TESTING
 91291
 HEDR62

FILTER = ALPF 1650/ 5214/ -40
 MIN, MAX VALUES = 0.078 -19.00 , 59.49 @ 97.13



TRC , 911018
208 COMPLIANCE TESTING
91291
CSTXG2

FILTER = BLPP 300/ 750/ -16
MIN. MAX VALUES = -46.34 73.00, 3.80 268.50



B-16

911018

1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER CHEST X-AXIS ACCELERATION

TRC , 911018

200 COMPLIANCE TESTING

91291

CSTYG2

FILTER = BLPP 300/ 750/ -16

MIN, MAX VALUES = -24.420 89.13, 4.74 & 86.00

120.00

90.00

60.00

30.00

0.00

-30.00

-60.00

-90.00

-120.00

-20.00

10.00

40.00

70.00

100.00

130.00

160.00

190.00

220.00

250.00

280.00

310.00

340.00

ACCELERATION (G)

B-17

911018

TIME (MSEC)

1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER CHEST Y-AXIS ACCELERATION

TRC, 911018

200 COMPLIANCE TESTING

91291

CS1ZG2

FILTER = BLPP 300/ 750/ -16

MIN, MAX VALUES = -6.00e 129.63, 15.78 e 86.63

120.00

90.00

60.00

30.00

0.00

-30.00

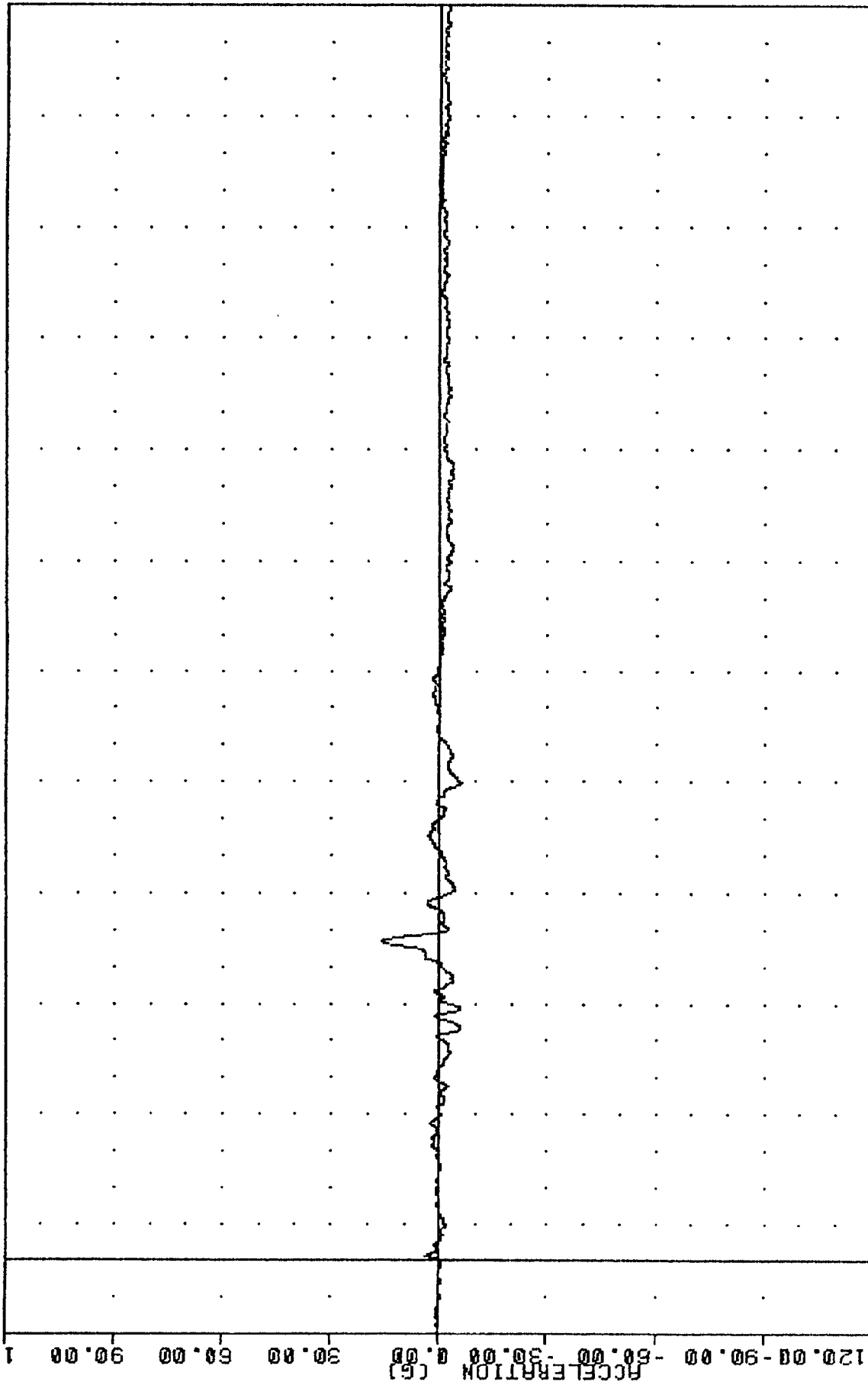
-60.00

-90.00

-120.00

911018

B-18



-20.00 10.00 40.00 70.00 100.00 130.00 160.00 190.00 220.00 250.00 280.00 310.00 340.00

1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER CHEST Z-AXIS ACCELERATION

TRC

, 911018

200 COMPLIANCE TESTING

91291

CSTRG2

FILTER = BLPP 300/ 750/ -16

MIN, MAX VALUES = 0.058 8.00, 47.97 e 73.13

105.00

90.00

75.00

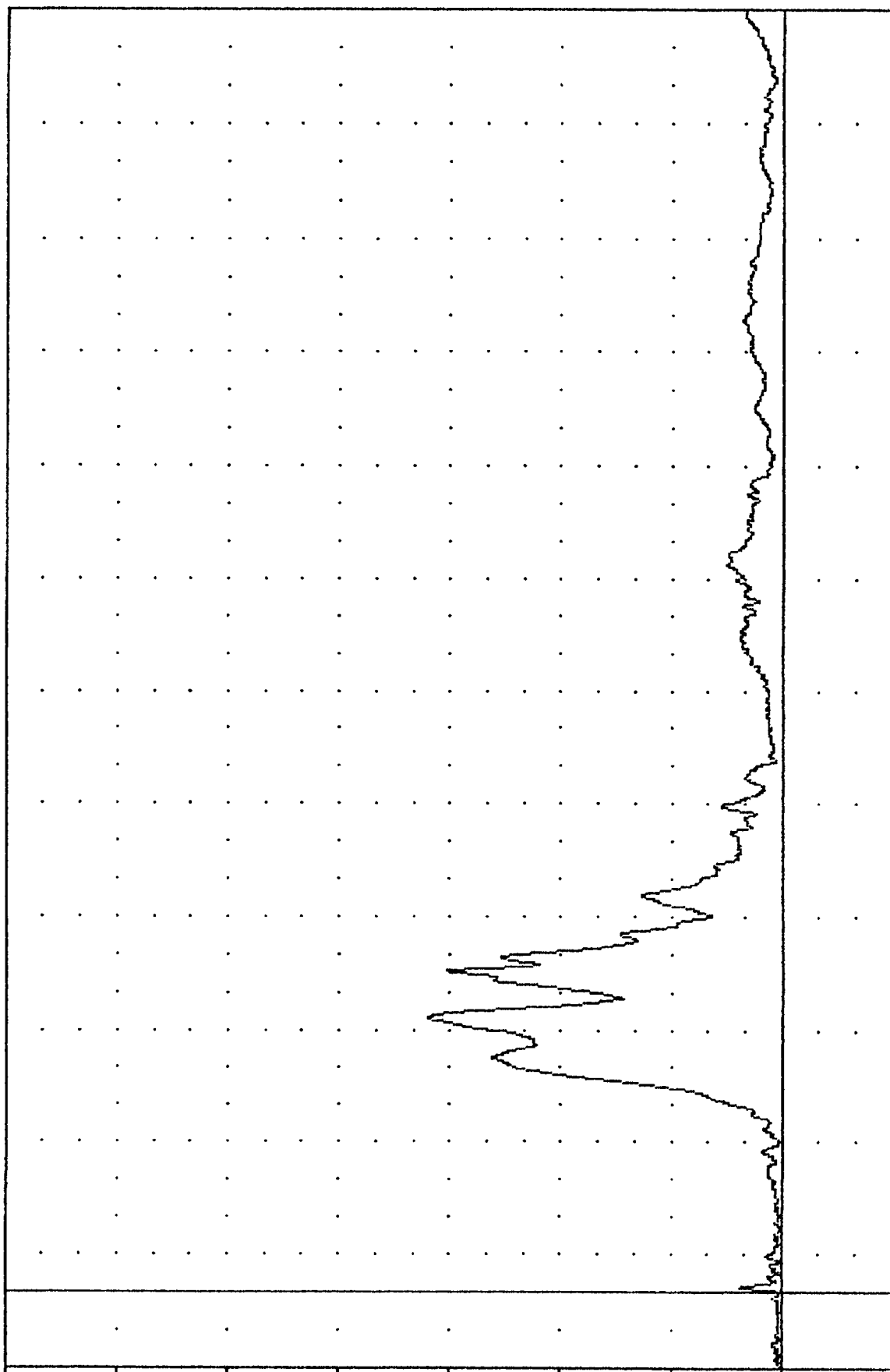
60.00

45.00

ACCELERATION (G)

B-19

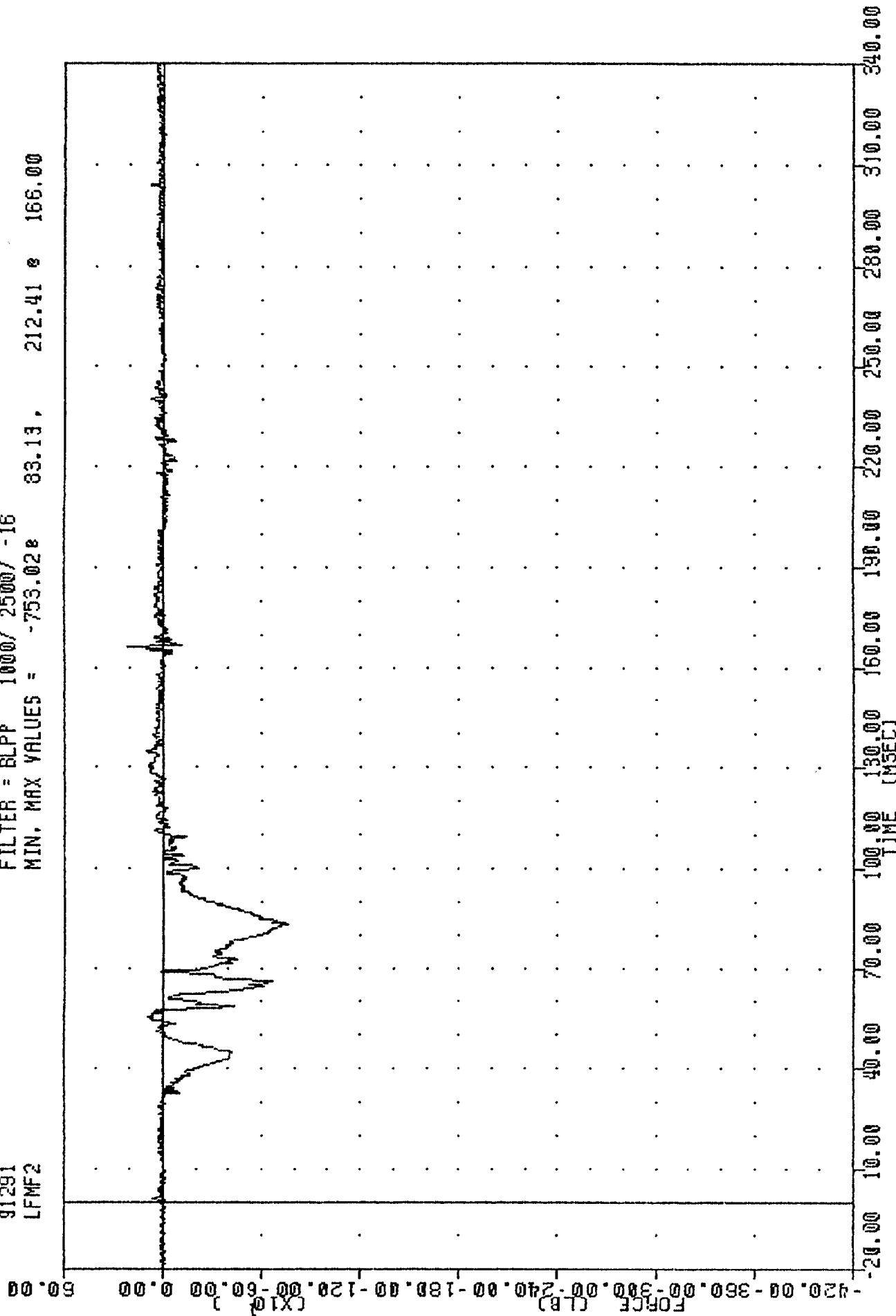
911018



1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER CHEST RESULTANT ACCELERATION

TRC , 911018
 206 COMPLIANCE TESTING
 91291
 LFMF2

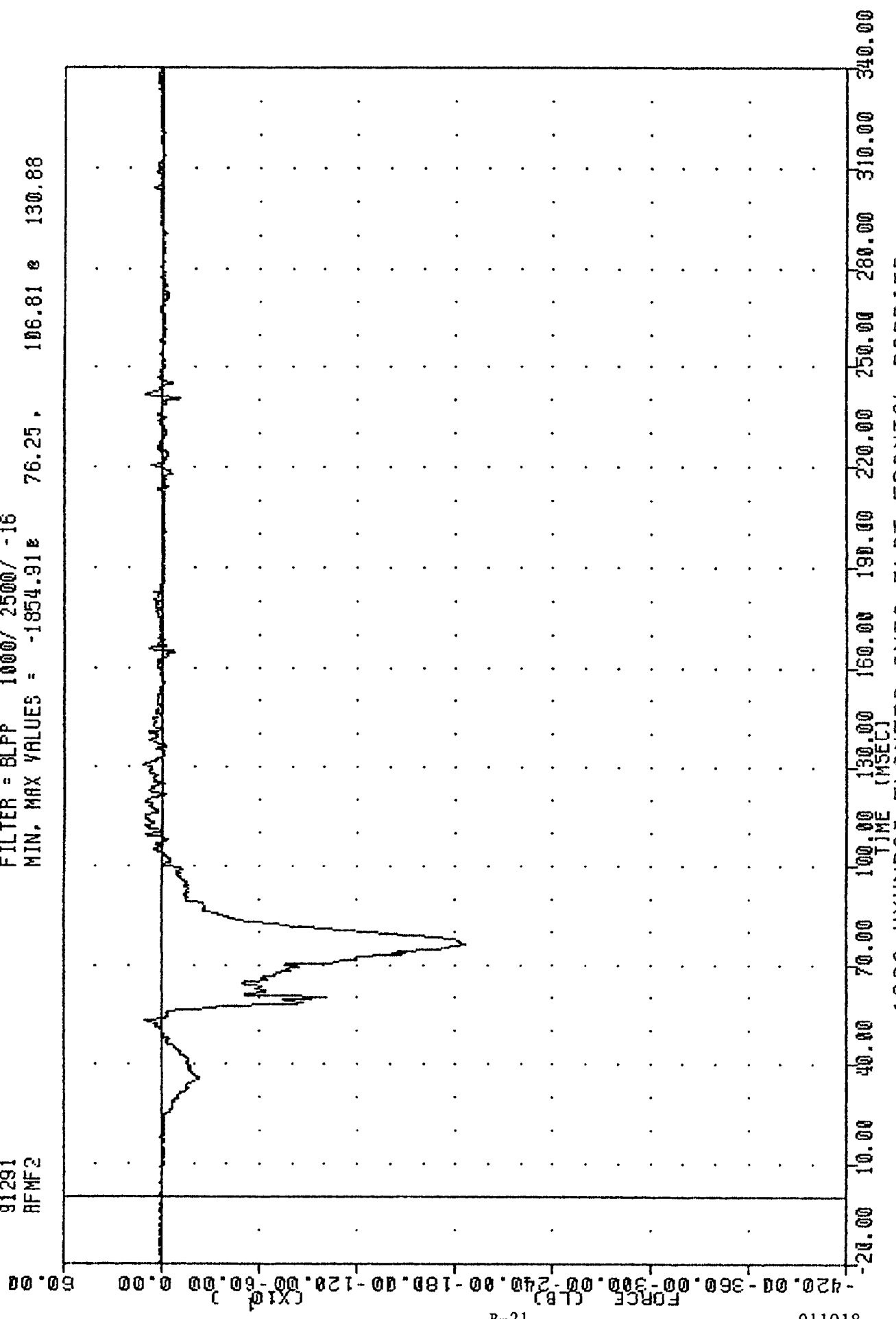
FILTER = BLPP 1000/ 2500/ -16
 MIN. MAX VALUES = -753.028 83.13, 212.41 e 166.00



1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER LEFT FEMUR FORCE

IRC, 911018
 208 COMPLIANCE TESTING
 91291
 AFMF2

FILTER = BLPP 1000/ 2500/ -16
 MIN. MAX VALUES = -1854.91 76.25 106.81 130.88



1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER RIGHT FEMUR FORCE

TRC 911018

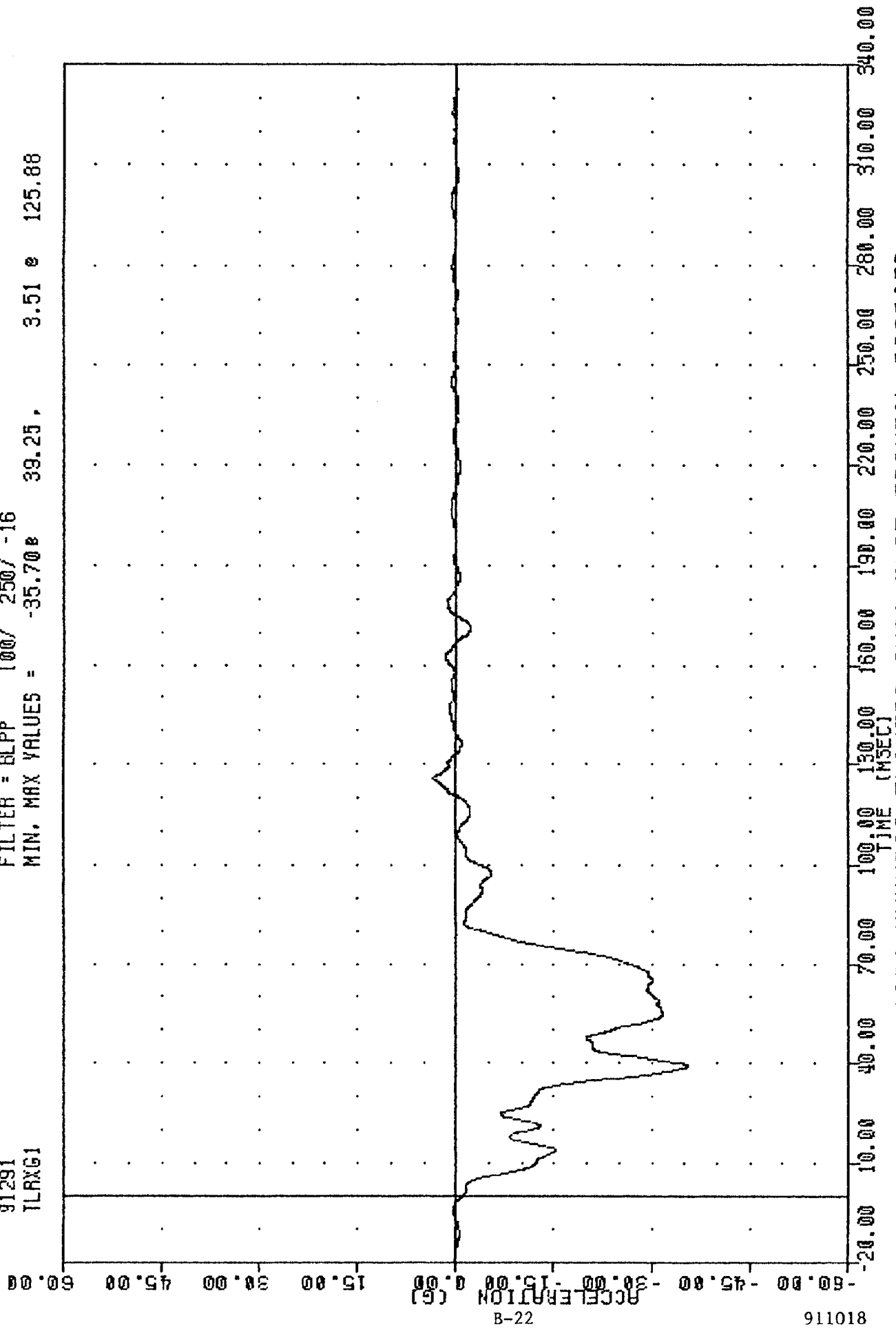
200 COMPLIANCE TESTING

91291

TLRXG1

FILTER = BLPP 100/ 250/ -16

MIN. MAX VALUES = -35.70 39.25, 3.51 125.88

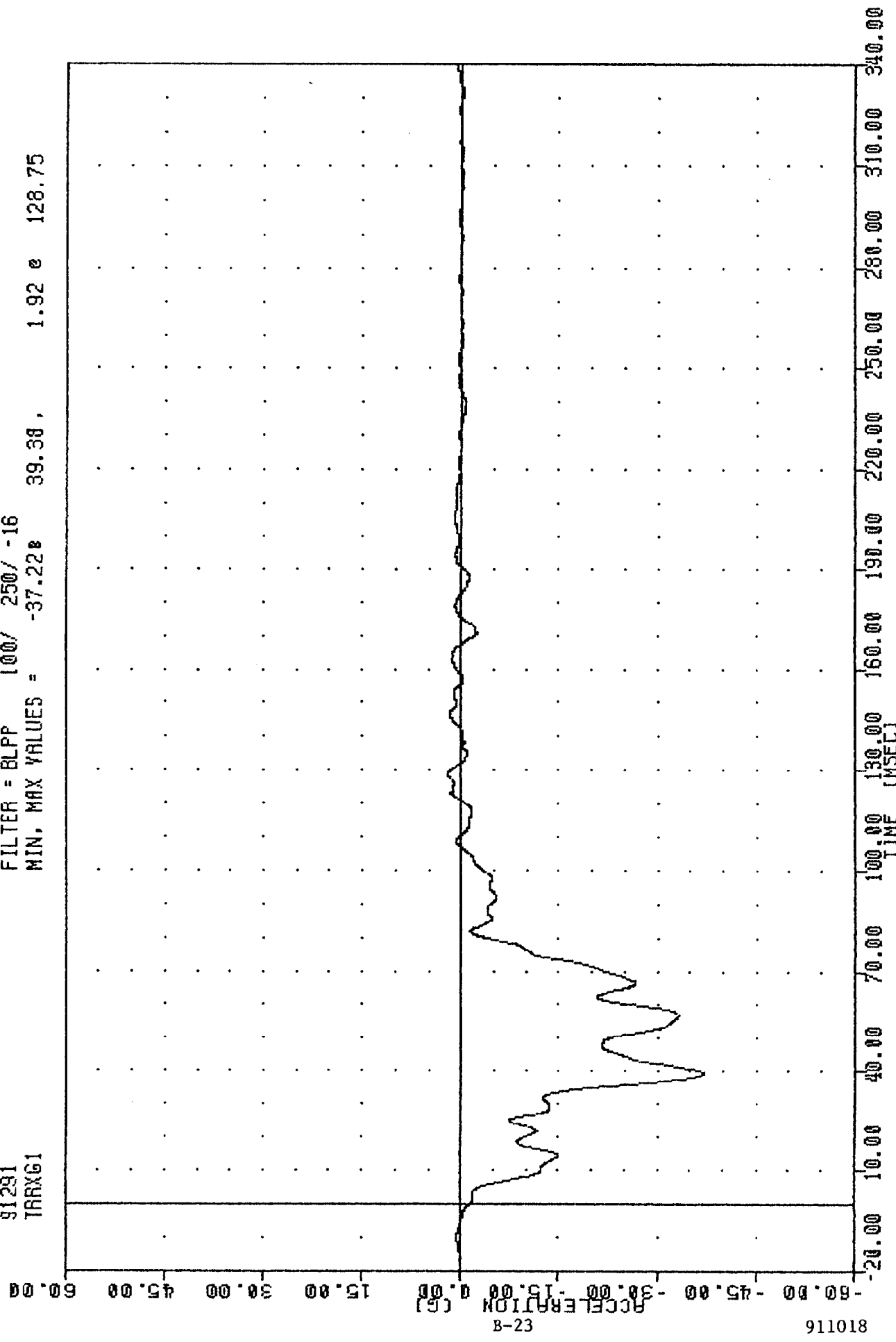


1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER

LEFT REAR SEAT X-AXIS ACCELERATION

TRC , 911018
200 COMPLIANCE TESTING
91291
TARX61

FILTER = BLPP 100/ 250/ -16
MIN. MAX VALUES = -37.228 39.38, 1.92 e 128.75



1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
RIGHT REAR SEAT X-AXIS ACCELERATION

TRC, 911018

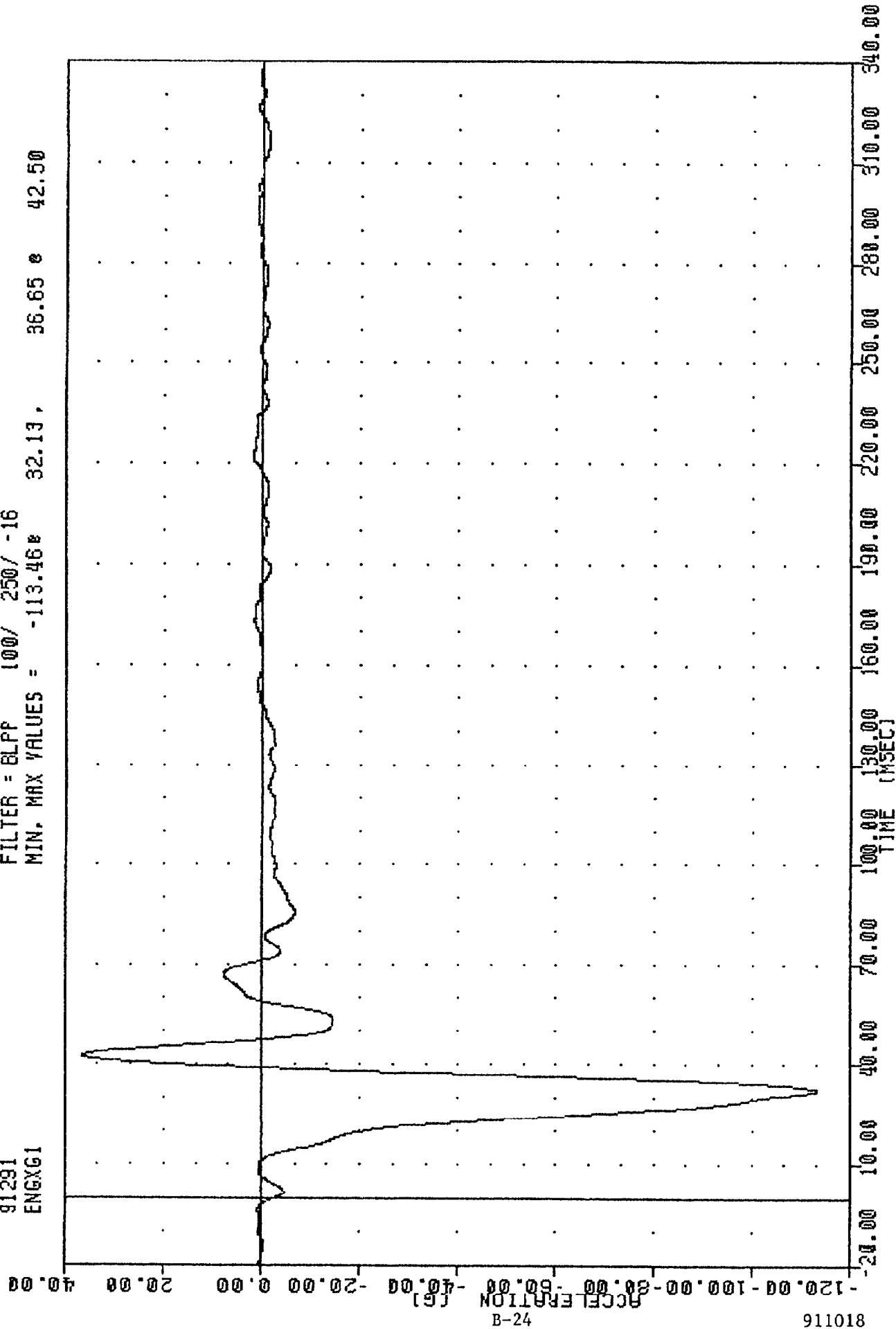
200 COMPLIANCE TESTING

91291

ENGXG1

FILTER = BLPP 100/ 250/ -16

MIN. MAX VALUES = -113.46 32.13, 36.65 42.50



1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
ENGINE TOP X-AXIS ACCELERATION

TRC 911018

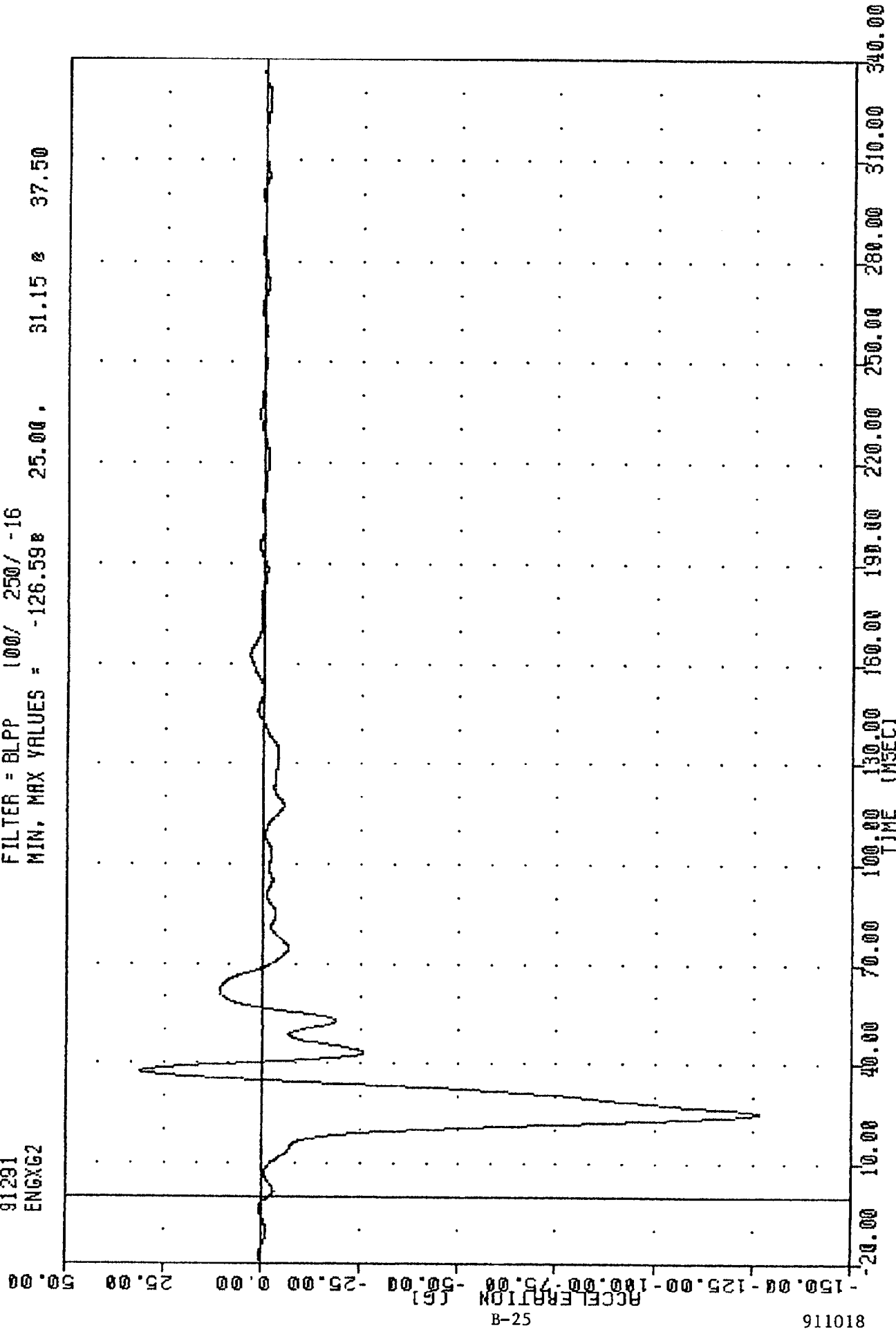
200 COMPLIANCE TESTING

91291

ENGXG2

FILTER = BLPP 100/ 250/ -16

MIN, MAX VALUES = -126.59 25.00 31.15 37.50



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911018

1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
ENGINE BOTTOM X-AXIS ACCELERATION

TRC 911018

208 COMPLIANCE TESTING

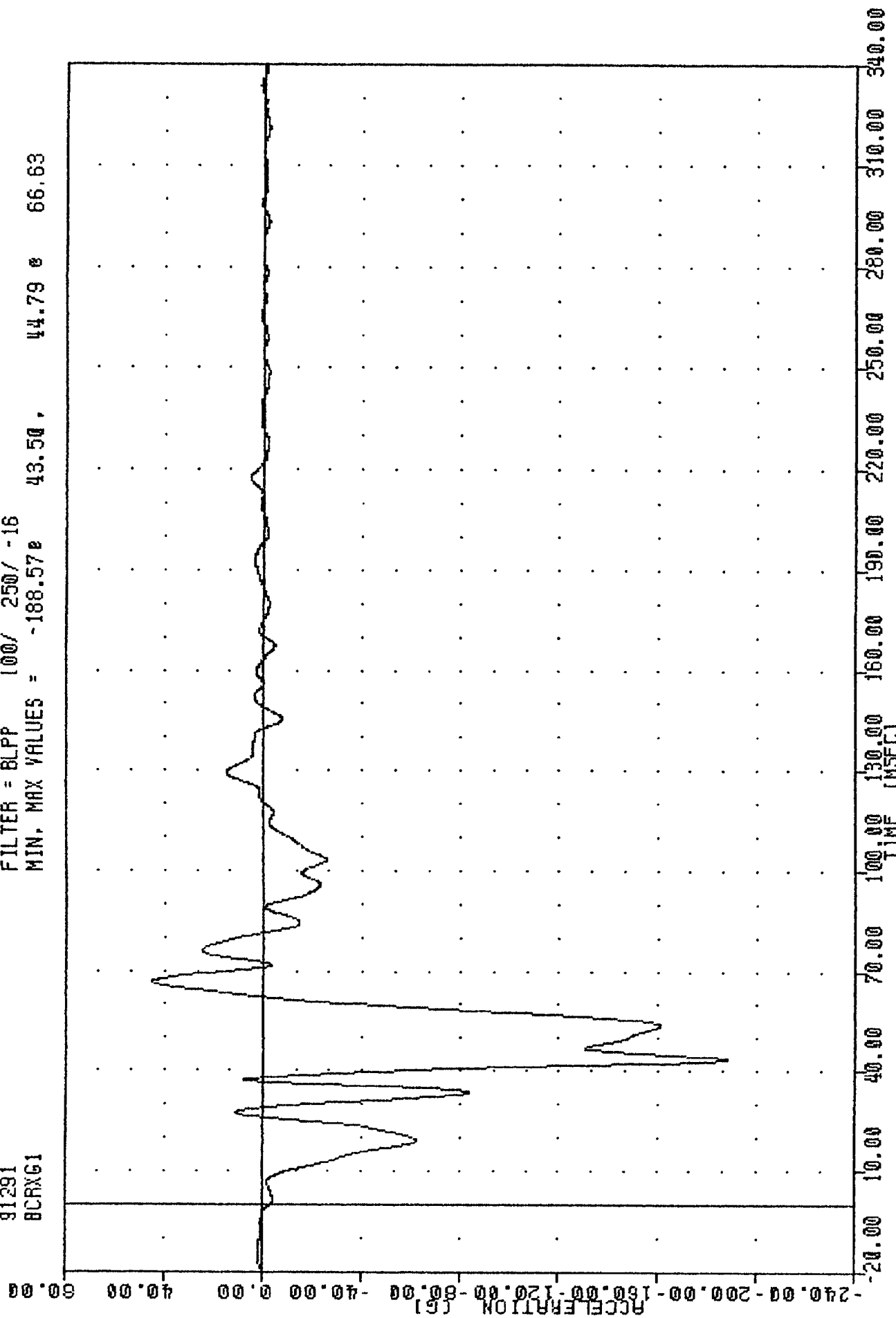
91291

BCRXG1

FILTER = BLPP 100/ 250/ -16

MIN. MAX VALUES = -188.57 43.50

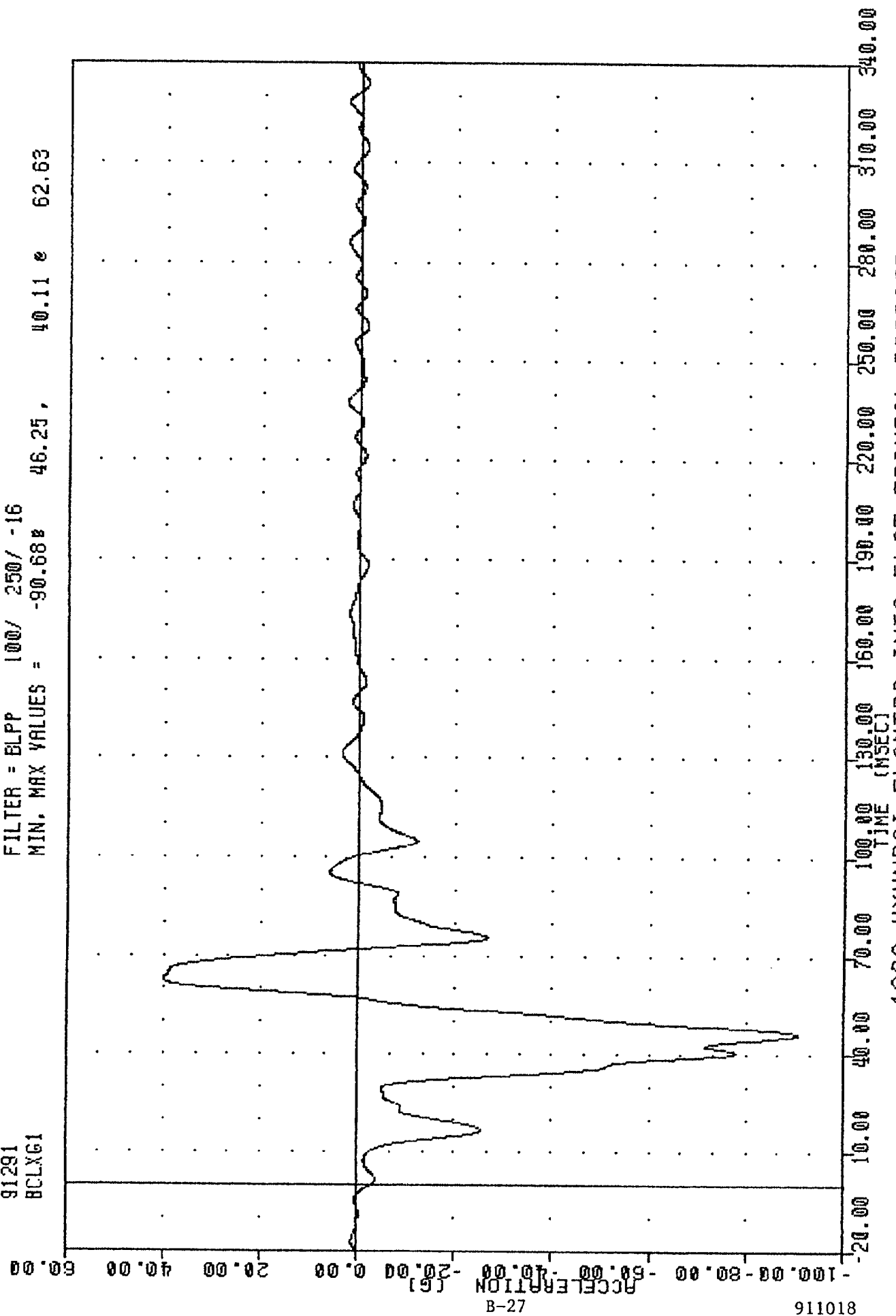
44.79 66.63



1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
RIGHT BRAKE CALIPER X-AXIS ACCELERATION

TRC, 911018
208 COMPLIANCE TESTING
91291
BCLXG1

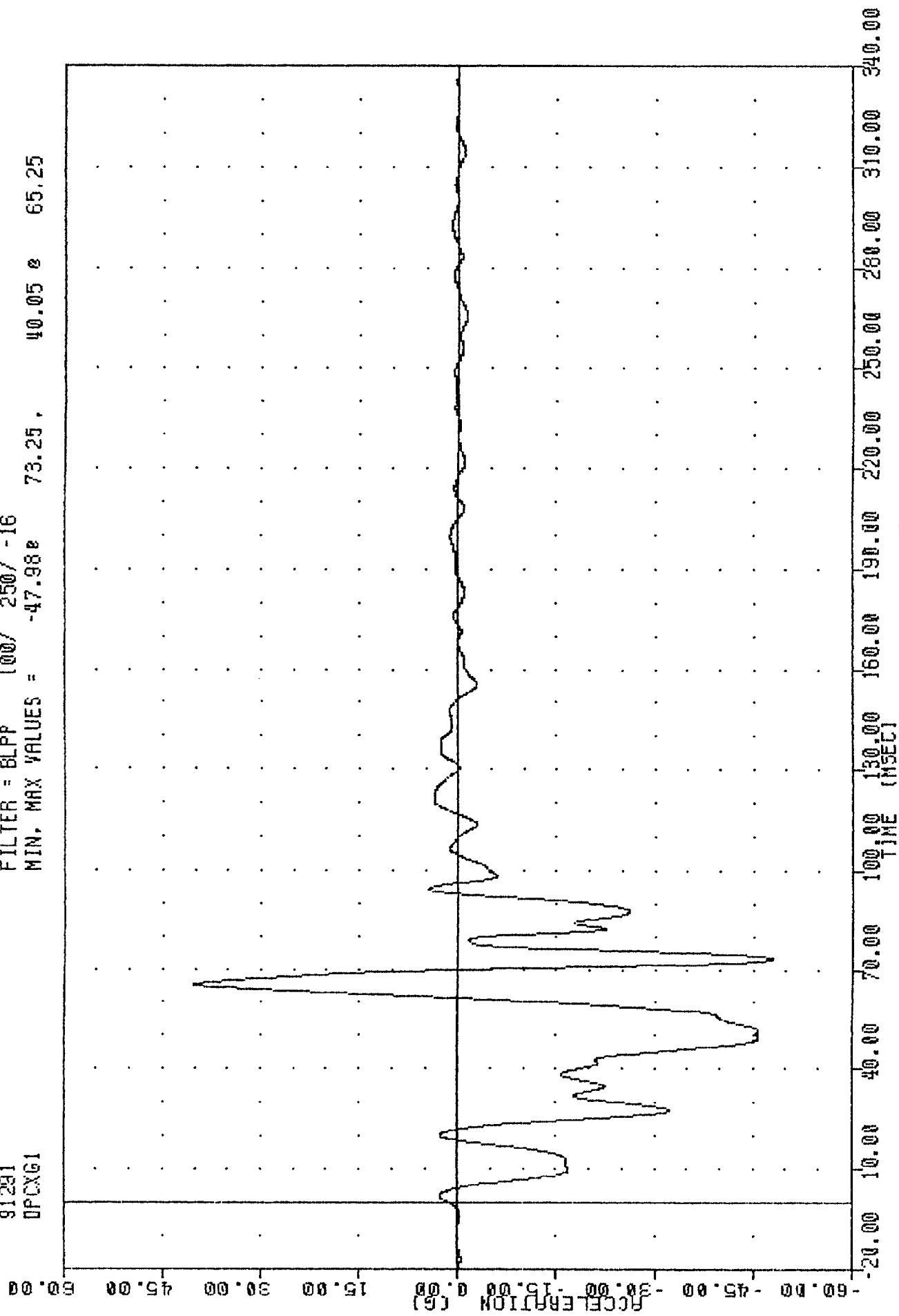
FILTER = BLPP 100/ 250/ -16
MIN. MAX VALUES = -90.68 46.25, 40.11 62.63



1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
LEFT BRAKE CALIPER X-AXIS ACCELERATION

TRC , 911018
200 COMPLIANCE TESTING
91291
DPCXG1

FILTER = BLPP 100/ 250/ -16
MIN. MAX VALUES = -47.98e 73.25, 40.05 e 65.25



B-28

911018

1992 HYUNDAI ELANTRA INTO FLAT FRONTAL BARRIER
INSTRUMENT PANEL CENTER X-AXIS ACCELERATION