

V 2317

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212-TRC-96-001
301-TRC-96-001

Vehicle Safety Compliance Testing
for Occupant Crash Protection,
Windshield Mounting, Windshield Zone Intrusion,
and Fuel System Integrity

General Motors Corporation

1996 Pontiac Bonneville

4-door sedan

NHTSA Number: CT0103

TRC Test Number: 951018

Transportation Research Center Inc.

10820 State Route 347

East Liberty, Ohio 43319



November 10, 1995

Final Report

Prepared For:

U.S. Department of Transportation
National Highway Traffic Safety Administration
Office of Vehicle Safety Compliance (NEF-30)
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Washington, DC 20590

David
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16. Abstract A 30 mph flat frontal barrier impact test was conducted on a 1995 Pontiac Bonneville 4-door sedan, NHTSA No. CT0103, at Transportation Research Center Inc. on October 18, 1995. This test was conducted to determine compliance with Federal Motor Vehicle Safety Standards: FMVSS 208, "Occupant Crash Protection"; 212, "Windshield Mounting"; 219 (partial), "Windshield Zone Intrusion"; and 301 "Fuel System Integrity." The barrier impact velocity was 29.6 mph. The vehicle's maximum static crush was 23.6 inches. The ambient temperature was 74° F. The driver's Head Injury Criteria (HIC) was 209. The driver's chest maximum resultant acceleration with three (3) milliseconds minimum duration was 41.7 g. The driver's chest maximum deflection was 1.3 inches. The driver's left and right femur maximum axial forces were 1216 pounds and 1453 pounds, respectively. The passenger's HIC was 453. The passenger's chest maximum resultant acceleration with three (3) milliseconds minimum duration was 50.4 g. The passenger's chest maximum deflection was 0.5 inch. The passenger's left and right femur maximum axial forces were 1270 pounds and 1099 pounds, respectively.			
17. Key Words Frontal Impact 30 mph Vehicle Safety Compliance Testing: FMVSS 208, "Occupant Crash Protection" FMVSS 212, "Windshield Retention" FMVSS 219, "Windshield Zone Intrusion" FMVSS 301, "Fuel System Integrity"		18. Distribution Statement Copies of this report are available from: NHTSA Technical Reference Division Nassif Building, Room 5108 400 Seventh Street, S.W. Washington, DC 20590	
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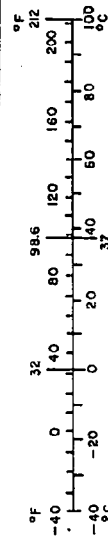
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
in	inches	2.5	centimeters	cm
ft	feet	30	meters	m
yd	yards	0.9	kilometers	km
mi	miles	1.6		
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	m ²
mi ²	square miles	2.6	square kilometers	km ²
	acres	0.4	hectares	ha
MASS (weight)				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
VOLUME				
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
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

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



*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 280, Units of Weights and Measures, Price \$2.25, SD Catalog No. C13.10286.

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Section 1.0

Purpose and Test Procedure

Purpose

This 30 mph flat frontal barrier impact test is part of the Federal Motor Vehicle Safety Standards (FMVSS) 208, 212, 219 (partial), and 301 compliance test program conducted for the National Highway Traffic Safety Administration (NHTSA) by the Transportation Research Center Inc. (TRC) under Contract No. DTNH22-93-D-01089. The purpose of this test was to determine if the subject vehicle, a 1996 Pontiac Bonneville 4-door sedan, NHTSA No. CT0103, 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-208-09. 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 and one (1) accelerometer to measure vertical axis acceleration. 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 E 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 Appendix 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. Each Part 572 E dummy's instrumentation also included a chest potentiometer to measure longitudinal deflection. The driver dummy was instrumented with upper and lower tibia load cells to measure moments, shear, and axial forces.

The thirty-six (36) data channels were multiplexed and recorded on a 14-track tape drive. The data was digitally sampled at 12,500 samples per second and processed per Sections 11.13 through 11.15 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. Appendix C contains the manufacturer's vehicle information.

Section 2.0

Frontal Barrier Impact Test Summary

Test Results Summary

This flat frontal barrier test was conducted at TRC on October 18, 1995.

The test vehicle, a 1996 Pontiac Bonneville 4-door sedan, NHTSA No. CT0103, 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 compressive forces transmitted through the upper legs did not exceed 2,250 pounds as measured by Part 572 E dummies seated in the front outboard designated seating positions. For each Part 572 E dummy the chest deflection did not exceed 3.0 inches. The vehicle's restraint system met the applicable comfort and convenience requirements. The windshield periphery retention was 100 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 airbags at the driver's and right front passenger's seating position. The vehicle's test weight was 3979 pounds. The vehicle's impact speed was 29.6 mph. The vehicle's maximum static crush was 23.6 inches.

The driver's HIC was 209. The driver's chest maximum resultant acceleration with three (3) milliseconds minimum duration was 41.7 g. The driver's chest maximum deflection was 1.3 inches. The driver's left and right femur maximum compressive forces were 1216 pounds and 1453 pounds, respectively.

The right front passenger's HIC was 453. The right front passenger's chest maximum resultant acceleration with three (3) milliseconds minimum duration was 50.4 g. The right front passenger's chest maximum deflection was 0.5 inch. The right front passenger's left and right femur maximum compressive forces were 1270 pounds and 1099 pounds, respectively.

There was no loss of windshield periphery retention and no penetration through the windshield. Following the impact, no fluid spilled from the vehicle's fuel system prior to the static rollover test or during any portion of the static rollover test.

Table 1 Crash Test Summary

NHTSA number:	CT0103
Test type:	Frontal barrier impact
Test date:	10/18/95
Test time:	1520
Ambient temperature at impact area:	74° F
Vehicle year/make/ model/body style:	1996/Pontiac/Bonneville/4-door sedan
Vehicle test weight:	3979 lb
Impact angle ¹ :	0°
Impact velocity ² :	
Primary:	29.6 mph
Secondary:	29.6 mph
Maximum static crush:	23.6 in
Average rebound:	17.4 in
Number of cameras:	
Real-time:	2
High-speed:	14
Door opening data:	
Left-front:	Easy
Right-front:	Easy

¹ With respect to tow track centerline.

² Speed trap measurement ($\pm .05$ mph accuracy)

Table 1 Crash Test Summary, Cont'd.

Dummies:	<u>Driver #229</u>	<u>Passenger #230</u>
Type:	Part 572 E	Part 572 E
Location:	Left front	Right front
Restraint:	Airbag	Airbag
Number of data channels:	19	9
Front seat data:		
Seat track failure:	None	None
Seat back failure:	None	None
Visible dummy contact points:		
Head:	Airbag, head restraint	Airbag & head restraint
Chest:	Airbag	Airbag
Abdomen:	None	None
Left knee:	Instrument panel	Instrument panel
Right knee:	Instrument panel	Instrument panel

Table 2 Test Vehicle Information

Vehicle year/make/
model/body style: 1996/Pontiac/Bonneville/4-door sedan

Color: Green

VIN: 1G2HX52K5TH200537

NHTSA number: CT0103

Engine data:

Placement: Transverse/Lateral

Cylinders: 6

Displacement: 3.8 liters

Transmission data: 4 speed, manual, X automatic, overdrive

Final drive: X fwd, rwd, 4wd

Date vehicle received: 09/19/95

Odometer reading: 89

Dealer's name
and address: Indian Mound Pontiac
70 Airport Parkway
Heath, OH 43056

Accessories:

Power steering	Yes	Automatic transmission	Yes
Power brakes	Yes	Automatic speed control	Yes
Power seats	Yes	Tilting steering wheel	Yes
Power windows	Yes	Telescoping steering wheel	No
Tinted glass	Yes	Air conditioning	Yes
Radio	Yes	Anti-skid brake	Yes
Clock	Yes	Rear window defroster	Yes
Power door locks	Yes	Other: Option Group 15B, spoiler, keyless entry, 6-speaker sound system	

Certification data from vehicle's label:

Vehicle manufactured by: General Motors Corporation

Date of manufacture: 08/95

VIN: 1G2HX52K5TH200537

GVWR: 4593 lb

GAWR: Front: 2530 lb

Rear: 2063 lb

Table 2 Test Vehicle Information, Cont'd.

Size of tires on vehicle: P225/60R16
Spare tire: Space saver
Type of front seats: Bucket

Tire & capacity data from vehicle's label:

Recommended tire size: P225/60R16

Recommended cold tire pressure:

Front: 30 psi

Rear: 30 psi

Designated Seating Capacity:

Front 3

Rear 3

Total 6

Vehicle Capacity Weight: 1076 lbs.

Test vehicle attitudes:

Delivered attitude:	LF: 28.6 in.	RF: 28.4 in	LR: 29.8 in	RR: 29.5 in
Fully loaded attitude:	LF: 28.1 in	RF: 27.8 in	LR: 27.6 in	RR: 27.1 in
Pre-test attitude:	LF: 28.0 in	RF: 27.7 in	LR: 27.7 in	RR: 27.4 in

Table 2 Test Vehicle Information, Cont'd.

Weight of test vehicle as received (with maximum fluids):

Right front	1099	lb	Right rear	642	lb
Left front	1132	lb	Left rear	612	lb
Total front weight	2231	lb	(64.0% of total vehicle weight)		
Total rear weight	1254	lb	(36.0% of total vehicle weight)		
Total delivered weight	3485	lb			

Calculation of test vehicle's target test weight:

RCLW = Rated Cargo and Luggage Weight

UDW = Unloaded Delivered Weight (3485 lb)

VCW¹ = Vehicle Capacity Weight = 1076

DSC = Designated Seating Capacity (6)

RCLW = VCW - 150 (DSC) = 176

Target test weight = UDW + RCLW¹ + (Number of Hybrid III dummies x 167 lb per dummy)

Target test weight = 3485 + 176 + 334 = 3995 lb

Weight of test vehicle with required dummies and 160 lb of cargo weight:

Right front	1174	lb	Right rear	798	lb
Left front	1230	lb	Left rear	777	lb
Total front weight	2404	lb	(60.4% of total vehicle weight)		
Total rear weight	1575	lb	(39.6% of total vehicle weight)		
Total test weight	3979	lb	(0.4% under target test weight)		

Weight of ballast secured in vehicle cargo area: 50 lb

Components removed to meet target test weight: Tail lights, rear speakers

CG rearward of front wheel centerline: 43.9 in

Vehicle Wheelbase: 110.9 in

¹ From vehicle's tire load label.

Table 3 Post-Impact Data

Test number: 951018
NHTSA number: CT0103
Test date: 10/18/95
Test time: 1520
Test type: Frontal barrier impact
Impact angle: 0°
Ambient temperature
at impact area: 74° F
Temperature in
occupant compartment: 68° F
Impact velocity:
Primary: 29.6 mph
Secondary: 29.6 mph
Specified range: 28.9 to 29.9 mph

Distance from vehicle to barrier:

Entering velocity trap: 14.0 in
Exiting velocity trap: 2.0 in

Test vehicle static crush:

Overall length of test vehicle:

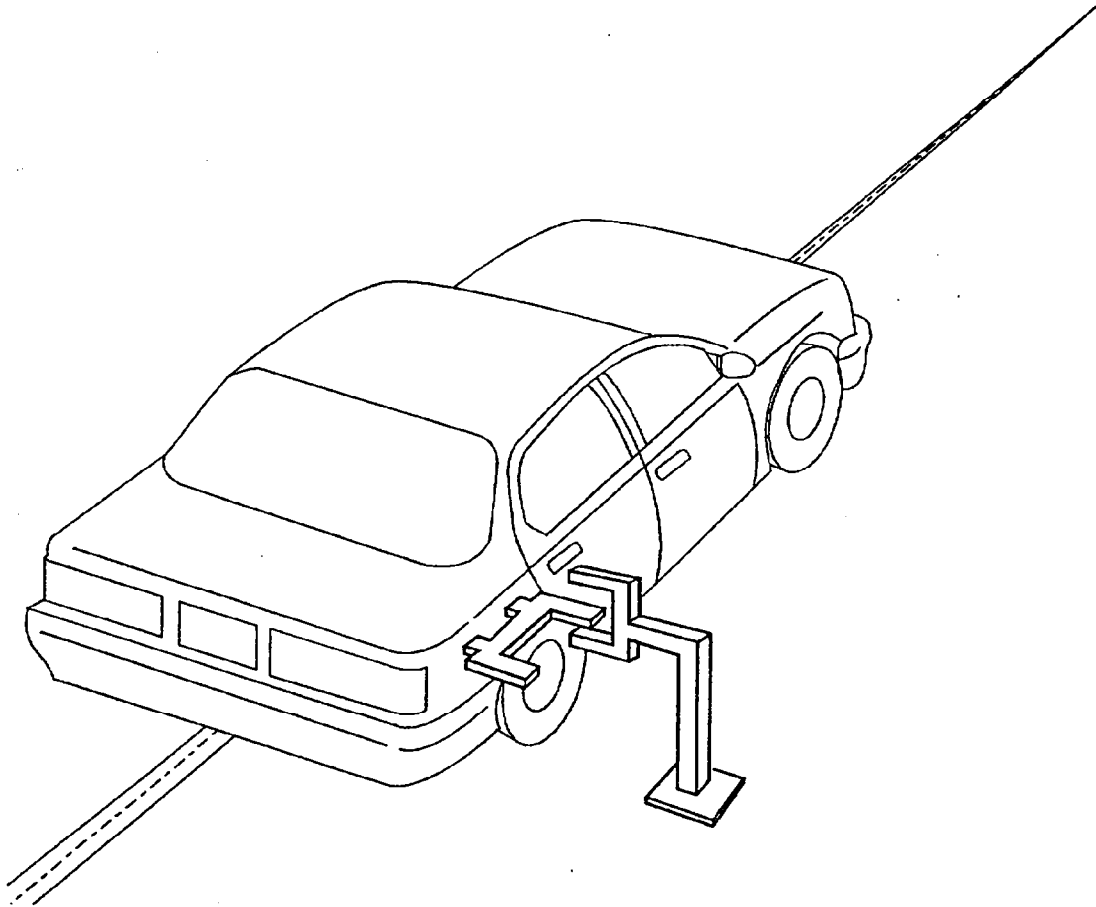
Pre-test:	L:	194.4 in	C:	202.4 in	R:	194.6 in
Post-test:	L:	175.4 in	C:	178.8 in	R:	176.9 in
Total crush:	L:	19.0 in	C:	23.6 in	R:	17.7 in
Average crush:		20.1 in				

Test vehicle rebound from flat barrier:

Distance from test vehicle to barrier:

Post-test:	L:	18.0 in	C:	16.4 in	R:	17.8 in
Average rebound:		17.4 in				

Figure 1 Impact Velocity Measurement System



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

The vanes have a one-foot spacing.

Figure 2 Accident Investigation Division Data for 30 mph Frontal Barrier Impact

NHTSA number: CT0103
 Test date: 10/18/95
 Vehicle year/make/
 model/body style: 1996/Pontiac/Bonneville/4-door sedan
 Vehicle size category: Large
 VIN: 1G2HX52K5TH200537
 Build date: 08/95
 Test weight: 3979 lb
 Vehicle wheelbase: 110.9 in
 Maximum width: 75.8 in
 Front overhang: 43.5 in

Collision Deformation

Classification (CDC) Code: 12FDEW3

Crush depth
 measurements:

C1:	19.0 in
C2:	20.1 in
C3:	22.5 in
C4:	23.0 in
C5:	20.9 in
C6:	17.7 in

Midpoint of damage: D: Vehicle Longitudinal Centerline

Length of damaged
 region: L: 60.0 in

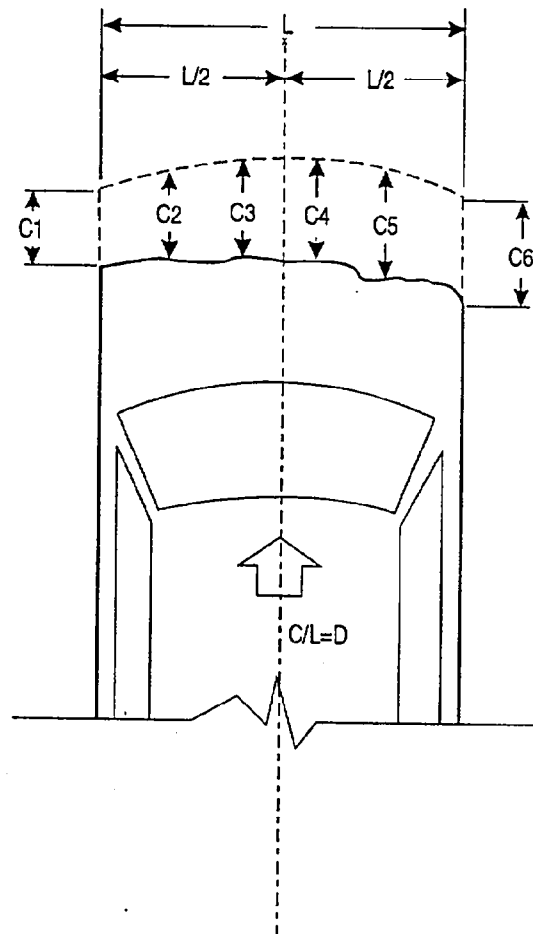


Table 4 Post-test Airbag Data

NHTSA number: CT0103
Test date: 10/18/95
Technician: Markusic
Vehicle year/make/
model/body style: 1996/Pontiac/Bonneville/4-door sedan

A. Number of airbag vent holes:

Driver: 2
Passenger: 2

B. Size of airbag vent holes:

Driver: 1.0 in dia.
Passenger: 1.5 in dia.

C. Total airbag vent area:

Driver: 1.6 in²
Passenger: 3.5 in²

D. Deflated airbag length and width dimensions or, if round, diameter

Driver:	Length	NA
	Width	NA
	Diameter	24.0 in
Passenger:	Length:	30.0 in
	Width:	23.0 in
	Diameter:	NA

Table 4 Post-test Airbag Data, Cont'd.

E. Is the airbag tethered?

Driver: No

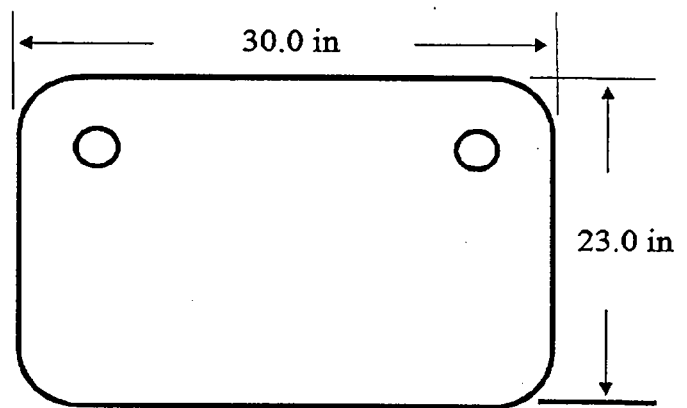
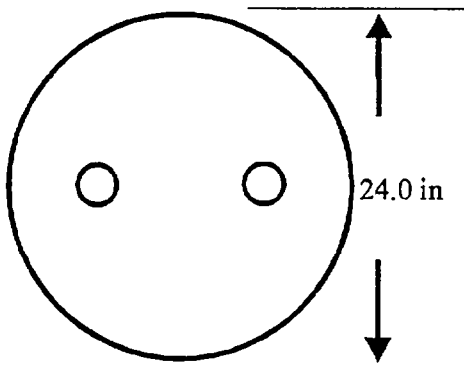
If yes, record length of tether: NA

Passenger: No

If yes, record length of tether: NA

Driver's airbag:

Passenger's airbag:

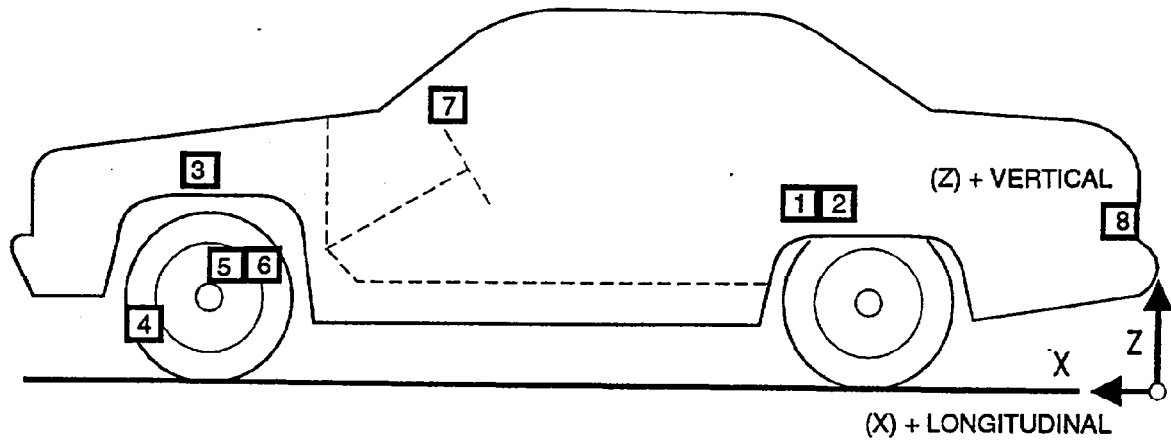


F. Airbag and gas generator part numbers and manufacturer's names.

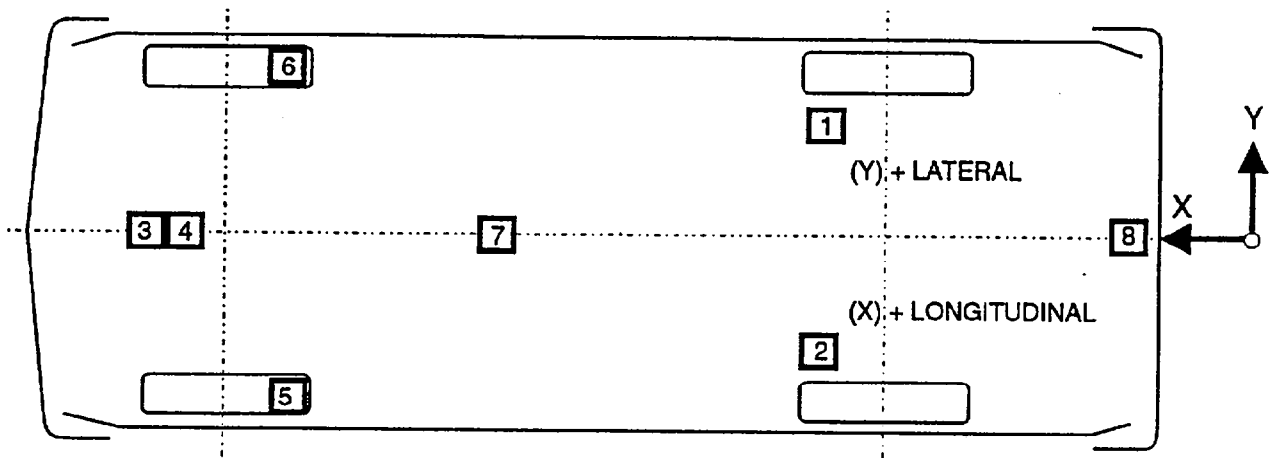
Driver: Mfr.: NA; Airbag: TCUA30489326; Inflator: AB733415P27E0S

Passenger: Mfr.: NA; Airbag: NA; Inflator: GPHF6T2BB0U

Figure 3 Vehicle Accelerometer Placement



SIDE VIEW



BOTTOM VIEW

Table 5 Vehicle Accelerometer Locations and Data Summary

TEST NUMBER: 951018 No. LOCATION	X	Y	Z	POSITIVE DIRECTION	NEGATIVE DIRECTION
1 LEFT REAR SEAT CROSSMEMBER LONGITUDINAL	PRE 78.9 in POST 78.4 in	26.4 in 26.4 in	11.4 in 13.1 in	1.8 g @ 157.1 ms	23.0 g @ 83.0 ms
2 RIGHT REAR SEAT CROSSMEMBER LONGITUDINAL	PRE 78.8 in POST 78.8 in	-20.8 in -20.8 in	14.1 in 15.9 in	2.0 g @ 182.4 ms	21.7 g @ 48.6 ms
3 ENGINE TOP LONGITUDINAL ¹	PRE 175.9 in POST 168.8 in	-3.0 in -5.2 in	27.0 in 29.5 in	---	---
4 ENGINE BOTTOM LONGITUDINAL	PRE 166.6 in POST 159.6 in	-7.5 in -8.8 in	7.6 in 9.1 in	23.2 g @ 57.5 ms	71.0 g @ 45.8 ms
5 RIGHT BRAKE CALIPER LONGITUDINAL	PRE 163.9 in POST 158.9 in	-25.6 in -26.4 in	14.2 in 13.1 in	29.9 g @ 80.2 ms	77.2 g @ 61.8 ms
6 LEFT BRAKE CALIPER LONGITUDINAL	PRE 163.5 in POST 178.9 in	25.6 in 26.4 in	14.3 in 14.0 in	12.8 g @ 84.6 ms	68.2 g @ 63.3 ms
7 INSTRUMENT PANEL CENTER LONGITUDINAL	PRE 136.3 in POST 136.3 in	0.0 in 0.0 in	37.2 in 29.4 in	13.9 g @ 43.0 ms	53.2 g @ 31.7 ms
8 VEHICLE REAR CENTER VERTICAL	PRE 13.4 in POST 13.4 in	0.0 in 0.0 in	18.4 in 21.6 in	12.7 g @ 72.8 ms	7.1 g @ 214.7 ms

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

¹See DATA ACQUISITION EXPLANATIONS

Section 3.0

FMVSS 208, 212, 219 (partial), and 301 Data

Table 6 Dummy Injury Criteria

<u>Maximum Acceleration</u>							
	<u>Head</u>				<u>Chest</u>		
	X	Y	Z	R	X	Y	Z
Driver	-42.0 g	6.5 g	28.2 g	42.7 g	-42.1 g	3.4 g	5.8 g
Passenger	-49.0 g	24.4 g	-33.1 g	56.7 g	-48.0 g	8.3 g	-24.3 g

<u>Maximum Femur Compressive Force</u>		
	<u>Left Femur</u>	<u>Right Femur</u>
Driver	1216 lbf	1453 lbf
Passenger	1270 lbf	1099 lbf

<u>Head Injury Criteria¹</u>			
	<u>HIC</u>	<u>Time t₁</u>	<u>Time t₂</u>
Driver	209	84.2 ms	120.2 ms
Passenger	453	80.4 ms	116.4 ms

<u>Chest Maximum Resultant Acceleration²</u>			
	<u>Acceleration</u>	<u>Time t₁</u>	<u>Time t₂</u>
Driver	41.7 g	100.6 ms	103.5 ms
Passenger	50.4 g	91.8 ms	94.8 ms

<u>Maximum Chest Deflection</u>	
Driver	1.3 in
Passenger	0.5 in

¹ As defined in FMVSS No. 208

² Defined as equal to or exceeding 0.003 sec. duration

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 head and chest impacted the airbag with the dummy's head rotating rearward. The dummy was restrained by the airbag. The dummy rebounded rearward into the seat back with the dummy's head rotating forward and then rearward contacting the head restraint. The driver dummy came to rest seated in the driver's seat.

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 head and chest impacted the airbag as the dummy's head rotated slightly forward. The dummy was restrained by the passenger's airbag. The dummy rebounded rearward into the seat back as the dummy's head contacted the head restraint. The right front passenger dummy came to rest seated in the right front passenger's seat leaning slightly to the left.

Table 7 FMVSS 208 Seat Belt Comfort and Convenience Test Summary
Front Outboard Designated Seating Positions

NHTSA number: CT0103

Vehicle model year/make/model/body style: 1996/Pontiac/Bonneville/4-door sedan

Date of comfort/convenience check: 10/18/95

Technician performing check: Markusic

GVWR: 4593 lb

Automatic seat belts installed in any vehicle, other than a walk-in van-type vehicle which has a gross vehicle weight rating of 10,000 pounds or less, and is manufactured on or after September 1, 1986, shall meet the requirements for convenience hooks, webbing tension-relieving devices, and belt contact force.

Manual seat belts installed for compliance with this standard in front outboard designated seating positions of any vehicle, other than a walk-in van-type vehicle which has a gross vehicle rating of 10,000 pounds or less, and is manufactured after September 1, 1989, shall meet the requirements for belt contact force, plate access, retraction and seat belt guides, and hardware.

Vehicle Equipment:

The vehicle's front outboard seating positions were equipped with manual Type 2 seat belts which must comply with the dynamic test requirements of S5.1; requirements for webbing tension-relieving devices (S7.4.2), belt contact force (S7.4.3), latchplate access (S7.4.4), retraction (S7.4.5), and seat belt guides and hardware (S7.4.6) apply.

Convenience Hooks (S7.4.1):

Not applicable, the vehicle was not equipped with automatic seat belts.

Table 7 FMVSS 208 Seat Belt Comfort and Convenience Test Summary
Front Outboard Designated Seating Positions, Cont'd.

NHTSA number: CT0103

Vehicle model year/make/model/body style: 1996/Pontiac/Bonneville/4-door sedan

Date of comfort/convenience check: 10/18/95

Technician performing check: Markusic

GVWR: 4593 lb

Webbing Tension-Relieving Device (S7.4.2):

The front outboard seating position assemblies do not have webbing tension-relieving devices.

Belt Contact Force (S7.4.3):

The belt contact force on the chest of the test dummy is 0.2 pound.

Latchplate Access (S7.4.4):

The seat belt latchplates, in their normal stowed position, are within the reach envelope.

The clearance test block moves unhindered to the latchplate or buckle.

Retraction (S7.4.5):

The seat belt automatically retracts when the seat belt latchplate is released.

The stowed seat belt webbing and hardware are not pinched when the door is closed.

Table 7 FMVSS 208 Seat Belt Comfort and Convenience Test Summary
Front Outboard Designated Seating Positions, Cont'd.

NHTSA number: CT0103

Vehicle model year/make/model/body style: 1996/Pontiac/Bonneville/4-door sedan

Date of comfort/convenience check: 10/18/95

Technician performing check: Markusic

GVWR: 4593 lb

Seat Belt Guides and Hardware (S7.4.6):

The seat cushion is not removable.

The seat back does not serve a function other than seating.

The seat is not removable.

The seat is movable but the space formerly occupied by the seat cannot be used for a secondary function.

Note: If the seat or seat cushion is removable or if the seat is movable so the space formerly occupied by the seat can be used for a secondary function, the seat belt guides and hardware requirements do not apply.

The webbing is not designed to pass through the seat cushion or between the cushion and seat back.

The restraint system does not include webbing guides.

The seat belt receptacles were accessible without moving the center arm rest for access.

Table 8 FMVSS 208 Equipment Data

FMVSS 208 Seat Belt Warning System Data

With an occupant in the driver's position and the unbelt in stowed position and ignition switch placed in the "start/on" position, the duration of audible warning signal is 6 s and the reminder light operates continuously.

With an occupant in the driver's position and the unbelt in use and the ignition switch placed in the "start/on" position the duration of audible warning signal is 0 s and the duration of the reminder light operation is 0 s.

NOTE: the audible warning should not operate.

The wording of the visual seat belt warning is "Fasten Belts" and the symbol from Table 2 of FMVSS 101.

Table 8 FMVSS 208 Equipment Data, Cont'd.

FMVSS 208 Labeling and Driver's Manual Data

The labels which describe the manufacturer's maintenance or replacement schedule for the crash-deployed occupant protection system were located on the driver's and passenger's sunvisors.

The manufacturer's recommended regular airbag maintenance is to check the system if the light does not come on after you start the vehicle, stays on, or if the light comes on as you drive.

Appropriate instructions concerning maintenance and/or replacement of this system were provided in the owner's manual on page 2-63.

A description of the functional operation of the system was provided in the owner's manual on pages 1-19 through 1-21.

A reference to the instructions and description of the system was included on the label.

An owner's manual was provided.

The owner's manual contained appropriate information concerning maintenance and/or replacement and a description of the functional operation of the systems on pages 1-19 through 1-21, and 2-63.

Table 8 FMVSS 208 Equipment Data, Cont'd.

FMVSS 208 Readiness Indicator Data

The vehicle contained a crash-deployed occupant protection system which was not totally mechanical. The readiness indicator was a light stating "airbag" located on the left portion of the instrument cluster.

The readiness indicator was clearly visible to the driver.

A list of the elements in the occupant restraint system, being monitored by the readiness indicator was provided in the owner's manual on pages 2-63.

FMVSS 208 Rear Outboard Seating Position Seat Belts

All rear outboard seating positions had Type 2 seat belts.

Figure 4 FMVSS 212 Test Data

Details of windshield mounting such as retention method, trim type, etc.:

Plastic trim around outer perimeter and adhesive around inner perimeter.

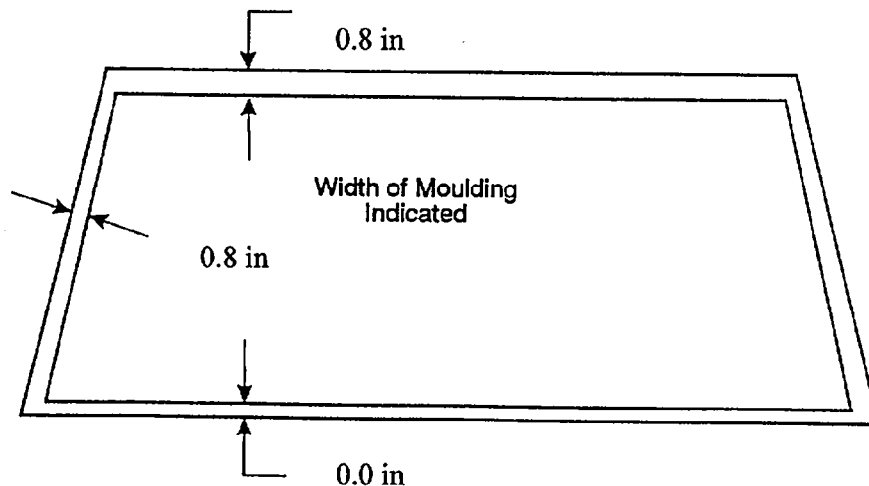
Clips or brackets used to retain windshield: None

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	89.9 in	89.9 in	100.0
Left side	89.9 in	89.9 in	100.0
Total	179.8 in	179.8 in	100.0

Pre-test windshield mounting material temperature: 68° F



Front view of windshield¹

Loss of windshield retention lengths: None

¹ 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: 52.0 in

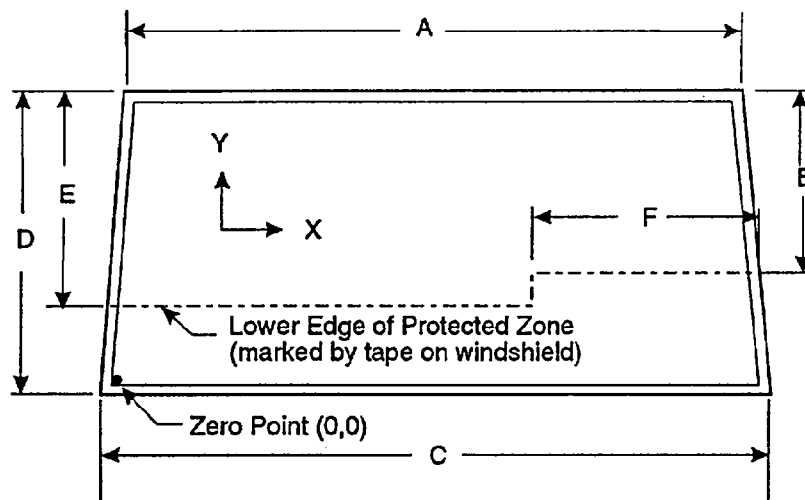
B: 22.0 in

C: 73.0 in

D: 31.2 in

E: 22.5 in

F: 31.4 in



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.

Table 9 Fuel System Data

Vehicle year/make/ model/body style:	1996/Pontiac/Bonneville/4-door sedan
NHTSA number:	CT0103
Fuel system capacity:	18.0 gal (from owner's manual)
Usable capacity:	18.0 gal (furnished by COTR)
Test volume range:	16.6 gal to 16.9 gal (92-94% of usable)
Actual test volume:	16.7 gal (with entire fuel system filled)
Test fluid type:	Stoddard solvent
Specific gravity:	0.764
Kinematic viscosity:	0.99 centistoke
Test fluid color:	purple
Type of fuel pump:	electric

The electric fuel pump did not operate with ignition switch "on" and the engine not operating.

Details of fuel system:

The fuel tank was located in front of the rear axle. The fuel filler neck was located on the left side. The fuel lines run along the right side to the front.

Table 10 FMVSS 301 Post-Impact Test Data

NHTSA number: CT0103
Test date: 10/18/95
Vehicle year/make/
model/body style: 1996/Pontiac/Bonneville/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:

- ☒ Frontal (30 mph)
☐ Oblique (30 mph) with ___° barrier face first contacting (driver's/passenger's) side
☐ Rear moving barrier (30 mph)
☐ Lateral moving barrier (20 mph)

Fuel system fluid spillage measurements:

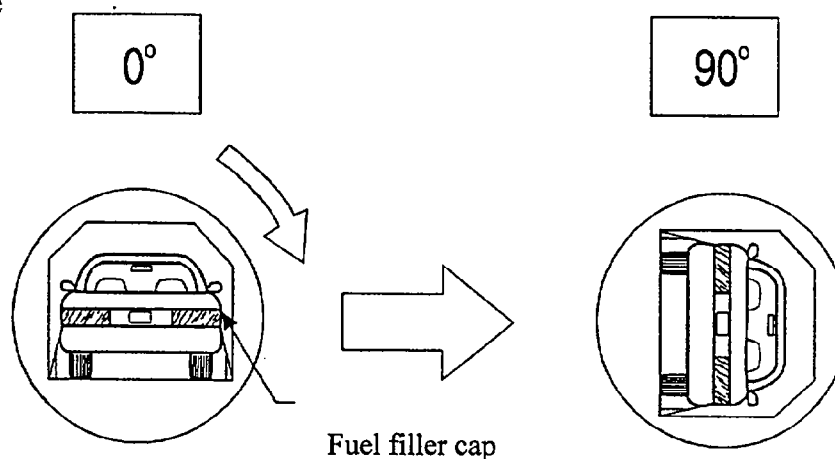
	Test Results	Maximum Allowable
1. From impact until vehicle motion ceases	0 oz	1 oz
2. 5-Minute period after vehicle motion ceases	0 oz	5 oz
3. Next 25 minutes after 5-minute period	0 oz	1 oz/1 min

Fuel system fluid spillage location(s): None

Figure 6 FMVSS 301 Static Rollover Test Data

NHTSA number: CT0103

Test phase



Static rollover machine rotation time information: (specified range is 1-3 minutes)

Time required for machine to rotate 90° = 2 minutes, 0 seconds

FMVSS 301 position hold time = 5 minutes, 0 seconds

Total = 7 minutes, 0 seconds

Next whole minute interval = 7 minutes

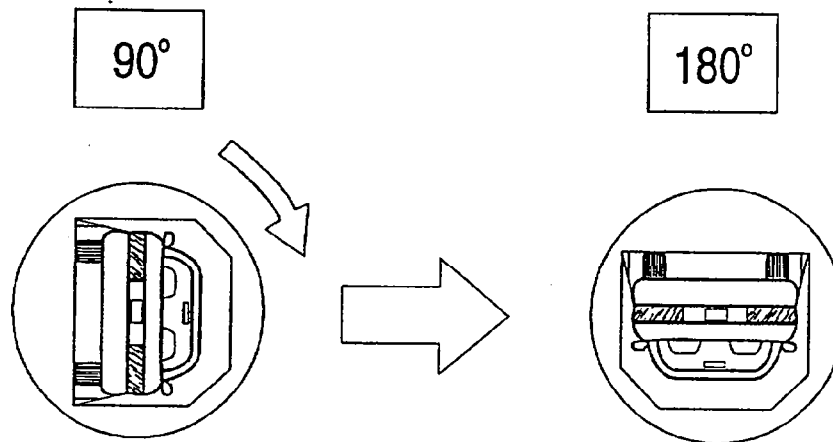
Fuel system fluid spillage measurements:

0° to 90° rotation (fuel filler cap down)	Test Results	Maximum Allowable
1. First five minutes from onset of rotation	0 oz	5 oz
2. Sixth minute from onset of rotation	0 oz	1 oz
3. Seventh 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.

Test phase



Static rollover machine rotation time information: (specified range is 1-3 minutes)

Time required for machine to rotate 90°	=	2 minutes, 0 seconds
FMVSS 301 position hold time	=	5 minutes, 0 seconds
Total	=	7 minutes, 0 seconds
Next whole minute interval	=	14 minutes

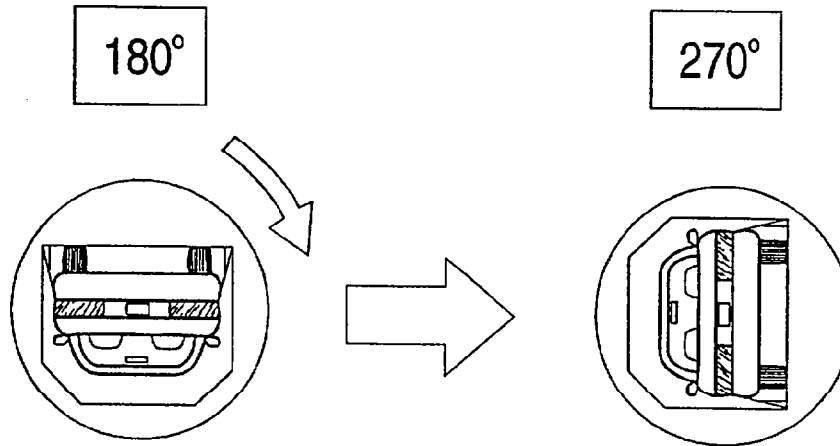
Fuel system fluid spillage measurements:

90° to 180° rotation	Test Results	Maximum Allowable
1. First five minutes from onset of rotation	0 oz	5 oz
2. Sixth minute from onset of rotation	0 oz	1 oz
3. Seventh 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.

Test phase



Static rollover machine rotation time information: (specified range is 1-3 minutes)

Time required for machine to rotate 90° = 2 minutes, 0 seconds

FMVSS 301 position hold time = 5 minutes, 0 seconds

Total = 7 minutes, 0 seconds

Next whole minute interval = 21 minutes

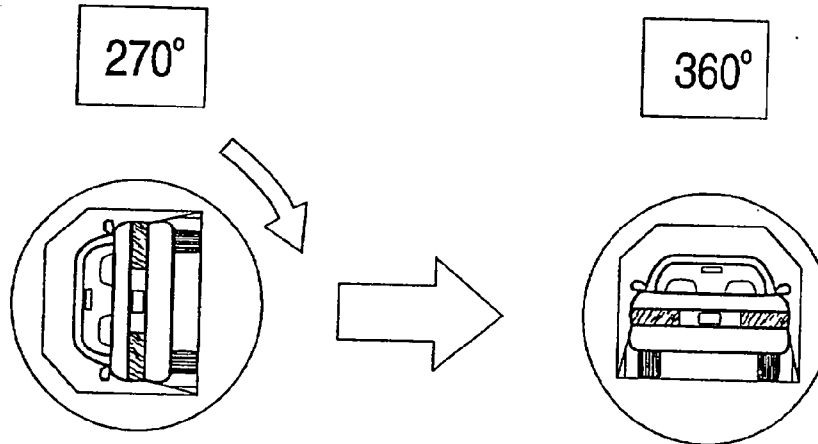
Fuel system fluid spillage measurements:

<u>180 to 270° rotation</u>	<u>Test Results</u>	<u>Maximum Allowable</u>
1. First five minutes from onset of rotation	0 oz	5 oz
2. Sixth minute from onset of rotation	0 oz	1 oz
3. Seventh 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.

Test phase



Static rollover machine rotation time information: (specified range is 1-3 minutes)

Time required for machine to rotate 90° = 2 minutes, 0 seconds

FMVSS 301 position hold time = 5 minutes, 0 seconds

Total = 7 minutes, 0 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 five minutes from onset of rotation	0 oz	5 oz
2. Sixth minute from onset of rotation	0 oz	1 oz
3. Seventh 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

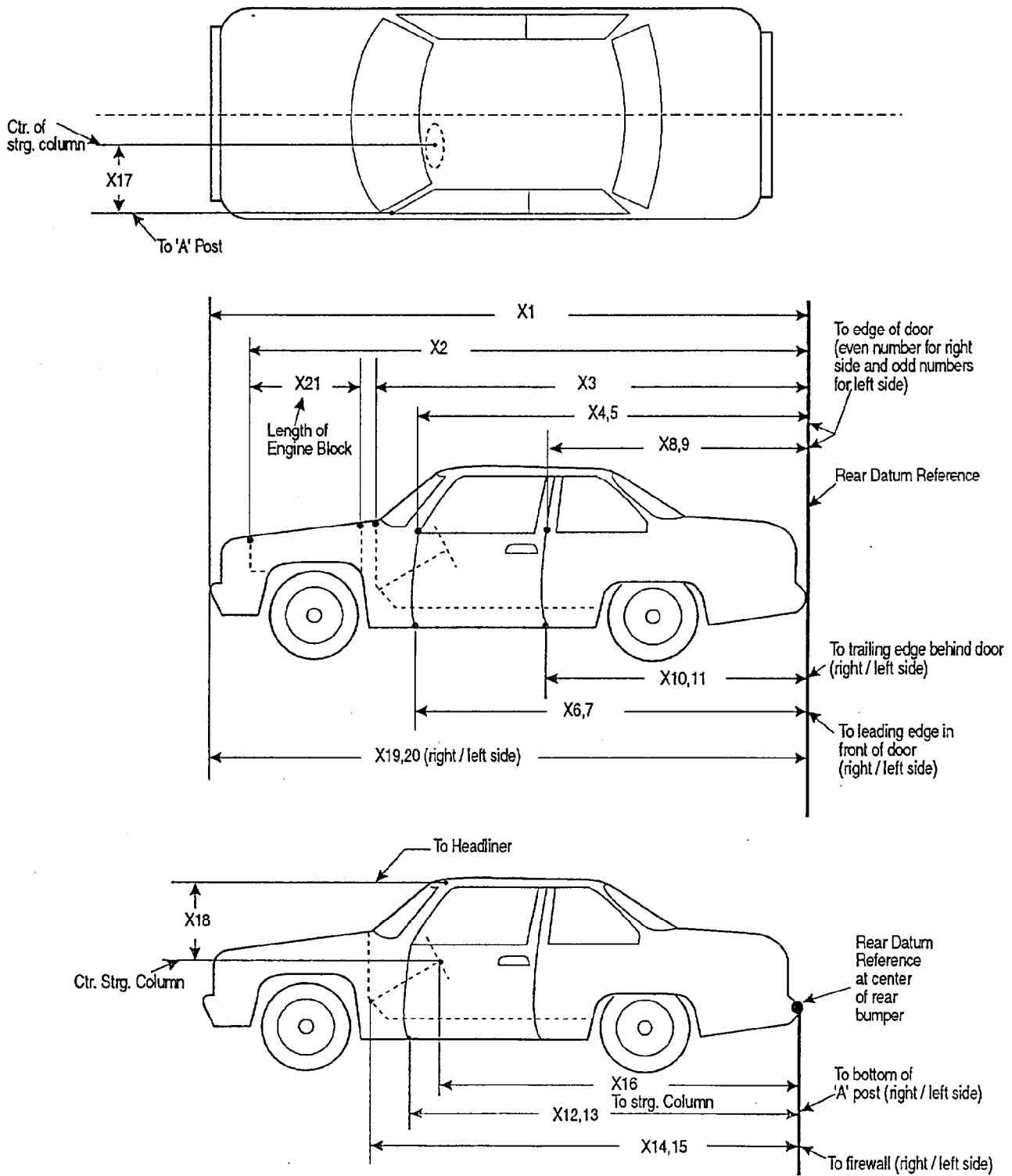


Table 11 Impacted Vehicle Measurements

Vehicle year/make/model/body style: 1996/Pontiac/Bonneville/4-door sedan Test Number: 951018

No.	Type of measurement	Pre-test		Post-test		Diff.
X1	Total length of vehicle at centerline	202.4	in	178.8	in	23.6 in
X2	Rear surface of vehicle to front of engine block	177.4	in	169.5	in	7.9 in
X3	Rear surface of vehicle to firewall	149.6	in	149.2	in	0.4 in
X4	Rear surface of vehicle to upper leading edge of right door	137.7	in	137.6	in	0.1 in
X5	Rear surface of vehicle to upper leading edge of left door	137.8	in	137.1	in	0.7 in
X6	Rear surface of vehicle to lower leading edge of right door	137.5	in	137.0	in	0.5 in
X7	Rear surface of vehicle to lower leading edge of left door	137.9	in	136.2	in	1.7 in
X8	Rear surface of vehicle to upper trailing edge of right door	95.6	in	95.3	in	0.3 in
X9	Rear surface of vehicle to upper trailing edge of left door	95.5	in	94.7	in	0.8 in
X10	Rear surface of vehicle to lower trailing edge of right door	95.9	in	95.3	in	0.6 in
X11	Rear surface of vehicle to lower trailing edge of left door	95.9	in	94.2	in	1.7 in
X12	Rear surface of vehicle to bottom of "A" post on right side	135.0	in	134.9	in	0.1 in
X13	Rear surface of vehicle to bottom of "A" post on left side	134.9	in	133.8	in	1.1 in
X14	Rear surface of vehicle to firewall - right side	145.5	in	145.4	in	0.1 in
X15	Rear surface of vehicle to firewall - left side	146.2	in	146.4	in	-0.2 in
X16	Rear surface of vehicle to steering wheel center	117.0	in	120.1	in	-3.1 in
X17	Center of steering column to "A" post	12.8	in	12.7	in	0.1 in
X18	Center of steering column to headliner	18.5	in	15.3	in	3.2 in
X19	Rear surface of vehicle to right side of front bumper	194.6	in	176.9	in	17.7 in
X20	Rear surface of vehicle to left side of front bumper	194.4	in	175.4	in	19.0 in
X21	Length of engine block	18.0	in	18.0	in	0.0 in

Figure 8 Vehicle Target Locations

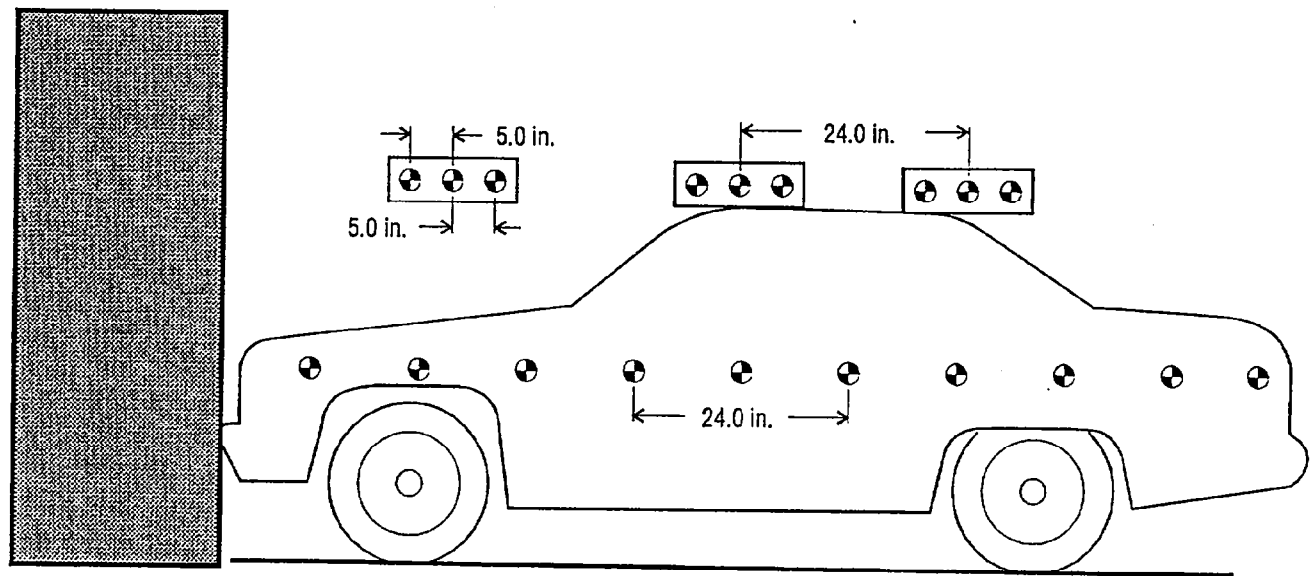
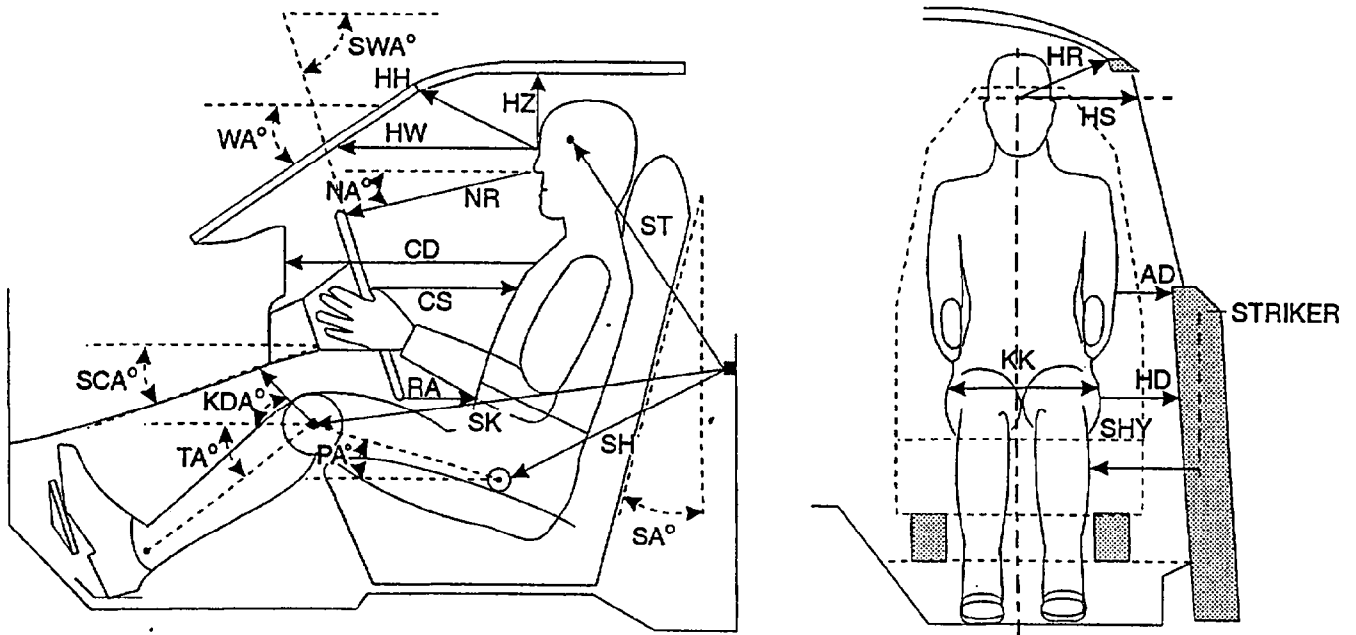
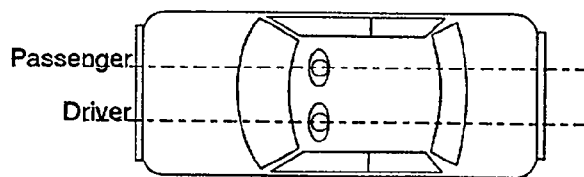


Figure 9 Dummy Measurement Locations for Front Seat Occupants



VERTICAL LONGITUDINAL PLANE



VERTICAL TRANSVERSE PLANE

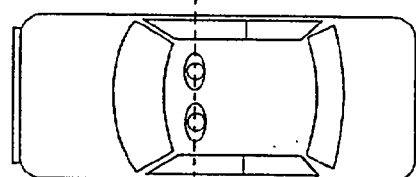


Table 12 Dummy Measurement Data for Front Seat Occupants

<u>Designation</u>	<u>Type of Measurement</u>	<u>Driver (Serial #229)</u>	<u>Passenger (Serial #230)</u>
WA	Windshield angle	29°	NA
SWA	Steering wheel angle	71°	NA
SCA	Steering column angle	19°	NA
SA	Seat back angle	26°	26°
HZ	Head to roof	8.8 in	7.5 in
HH	Head to header	14.1 in	12.6 in
HW	Head to windshield	23.6 in	24.1 in
HR	Head to side header	8.6 in	8.1 in
NR	Nose to rim	15.4 in	NA
NA	Nose to rim angle	12°	NA
CD	Chest to dash	19.2 in	20.9 in
CS	Steering wheel to chest	10.4 in	NA
RA	Rim to abdomen	7.1 in	NA
KDL	Left knee to dash	7.6 in	7.1 in
KDR	Right knee to dash	8.1 in	6.5 in
KDA	Outboard knee to dash angle	34°	30°
PA	Pelvic angle	25°	24°
TA	Tibial angle	33°	30°
KK	Knee to knee	11.2 in	10.6 in
ST ¹	Striker to head	18.8 in	19.6 in
	Striker to head angle	-83°	-75°
SK ¹	Striker to knee	23.8 in	25.1 in
	Striker to knee angle	3°	6°
SH ¹	Striker to H-point	10.1 in	10.7 in
	Striker to H-point angle	37°	37°
SHY	Striker to H-point (Y dir.)	10.2 in	5.5 in
HS	Head to side window	11.0 in	11.2 in
HD	H-point to door	6.8 in	5.1 in
AD	Arm to door	5.2 in	2.4 in

The seat back angle (SA°) is measured relative to vertical, all other angles are measured relative to horizontal.

¹ A negative angle indicates the measurement point was located above the striker.

Figure 10 Camera Positions

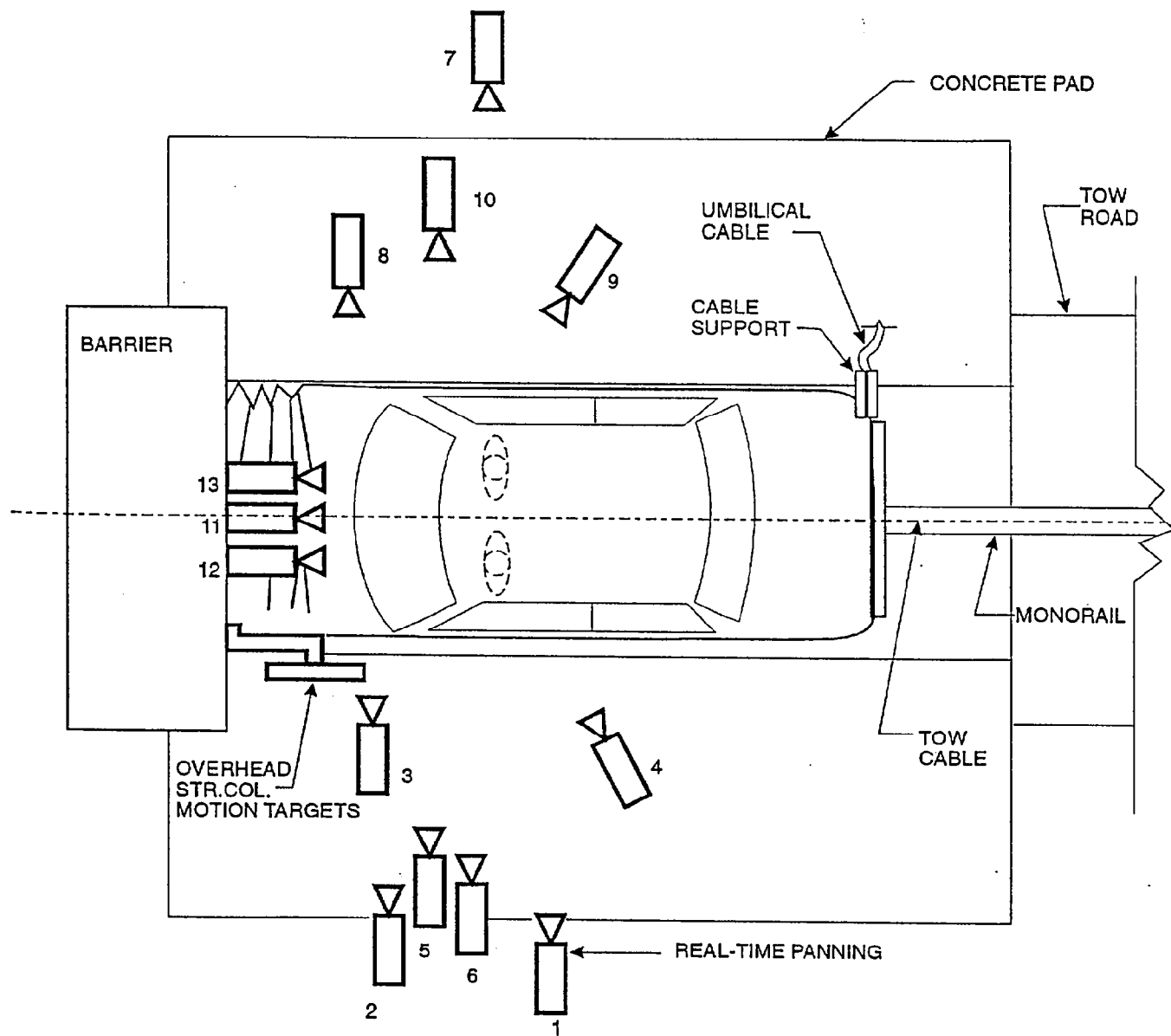


Figure 10 Camera Positions, Cont'd.

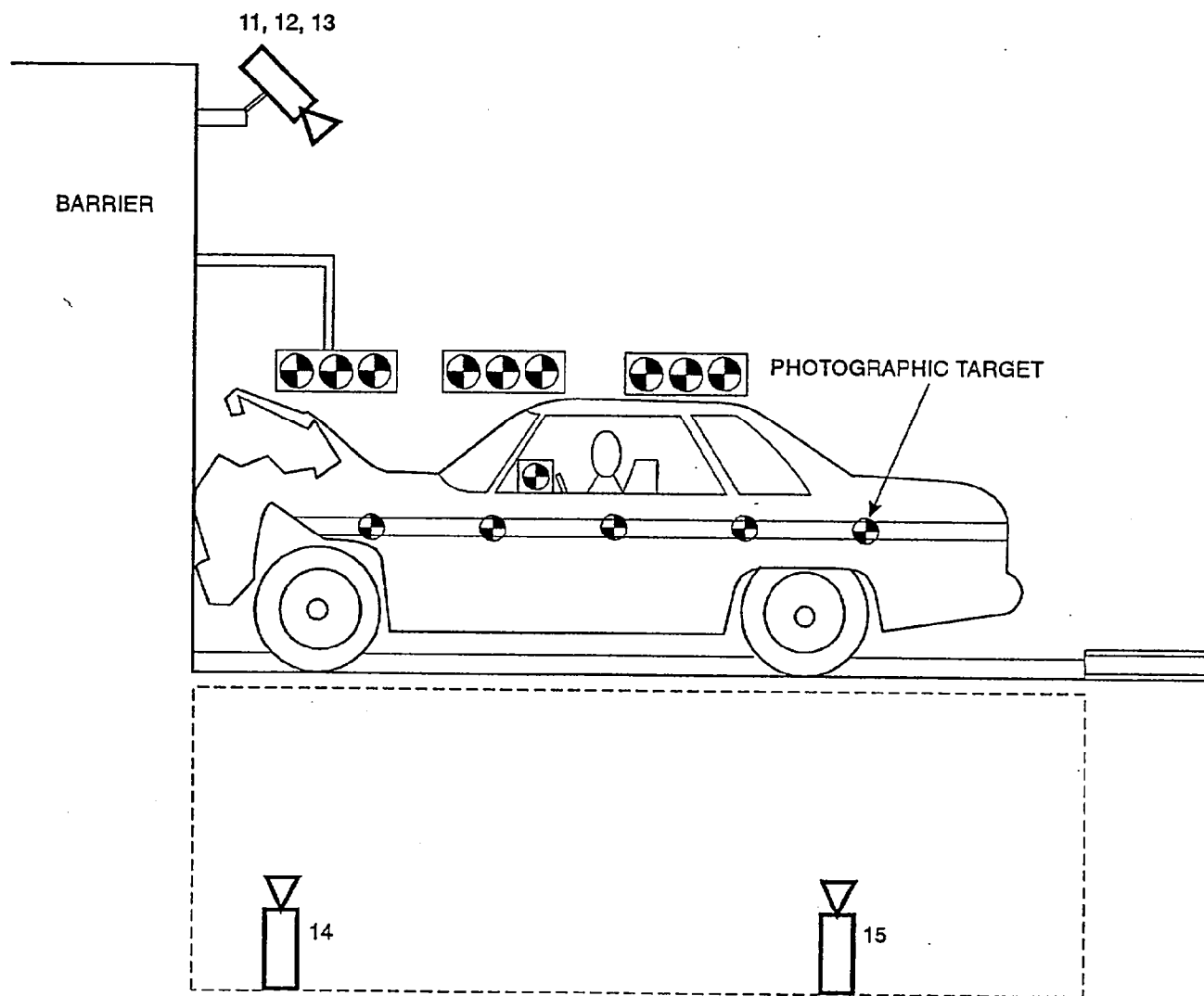


Table 13 Motion Picture Camera Locations

Vehicle year/make/model/body style: 1996/Pontiac/Bonneville/4-door sedan

Test number: 951018

Camera Number	View	Camera Positions ¹			Camera Angle ²	Film Plane to Head Target	Camera Lens	Film Speed
		X	Y	Z				
1	Real-time panning	-142.0 in	504.0 in	61.0 in	NA	NA	16 mm	24 frames/s
2	Left vehicle crush	-41.5 in	295.0 in	44.0 in	-4°	337.0 in	25 mm	992 frames/s
3	Left windshield intrusion	-53.0 in	309.4 in	42.3 in	0°	NA	50 mm	1005 frames/s
4	Driver kinematics	-157.3 in	116.0 in	87.0 in	-27°	86.0 in	25 mm	980 frames/s
5	Steering column motion	-96.0 in	286.0 in	103.0 in	-14°	NA	25 mm	1000 frames/s
6	Steering column motion	-96.0 in	286.0 in	75.1 in	-9°	NA	25 mm	982 frames/s
7	Right overall	-81.3 in	-266.4 in	37.1 in	-2°	NA	13 mm	1012 frames/s
8	Right windshield intrusion	-38.1 in	-306.1 in	44.0 in	0°	NA	50 mm	NA ³ frames/s
9	Passenger kinematics	-152.1 in	-116.0 in	87.0 in	-26°	75.0 in	25 mm	985 frames/s
10	Passenger kinematics	-38.8 in	-293.0 in	45.3 in	-4°	224.0 in	25 mm	1000 frames/s
11	Windshield front view	-6.0 in	0.0 in	88.0 in	-40°	NA	13 mm	1002 frames/s
12	Driver - front view	-6.8 in	14.5 in	93.0 in	-50°	NA	17 mm	1010 frames/s
13	Passenger - front view	-4.5 in	-13.8 in	93.0 in	-50°	NA	17 mm	1008 frames/s
14	Pit - front position	-50.5 in	0.0 in	-92.4 in	90°	NA	13 mm	1005 frames/s
15	Pit - rear position	-99.3 in	0.0 in	-99.0 in	90°	NA	13 mm	995 frames/s
16	Real-time documentation	NA	NA	NA	NA	NA	12-120 mm	24 frames/s

¹ +X: Film plane forward of barrier face

+Y: Film plane to left of monorail centerline

+Z: Film plane above ground level

² +Angle: Film plane angled upward from horizontal plane³ The camera did not run as a result of shredding its film on start-up.

Appendix A

Photographs

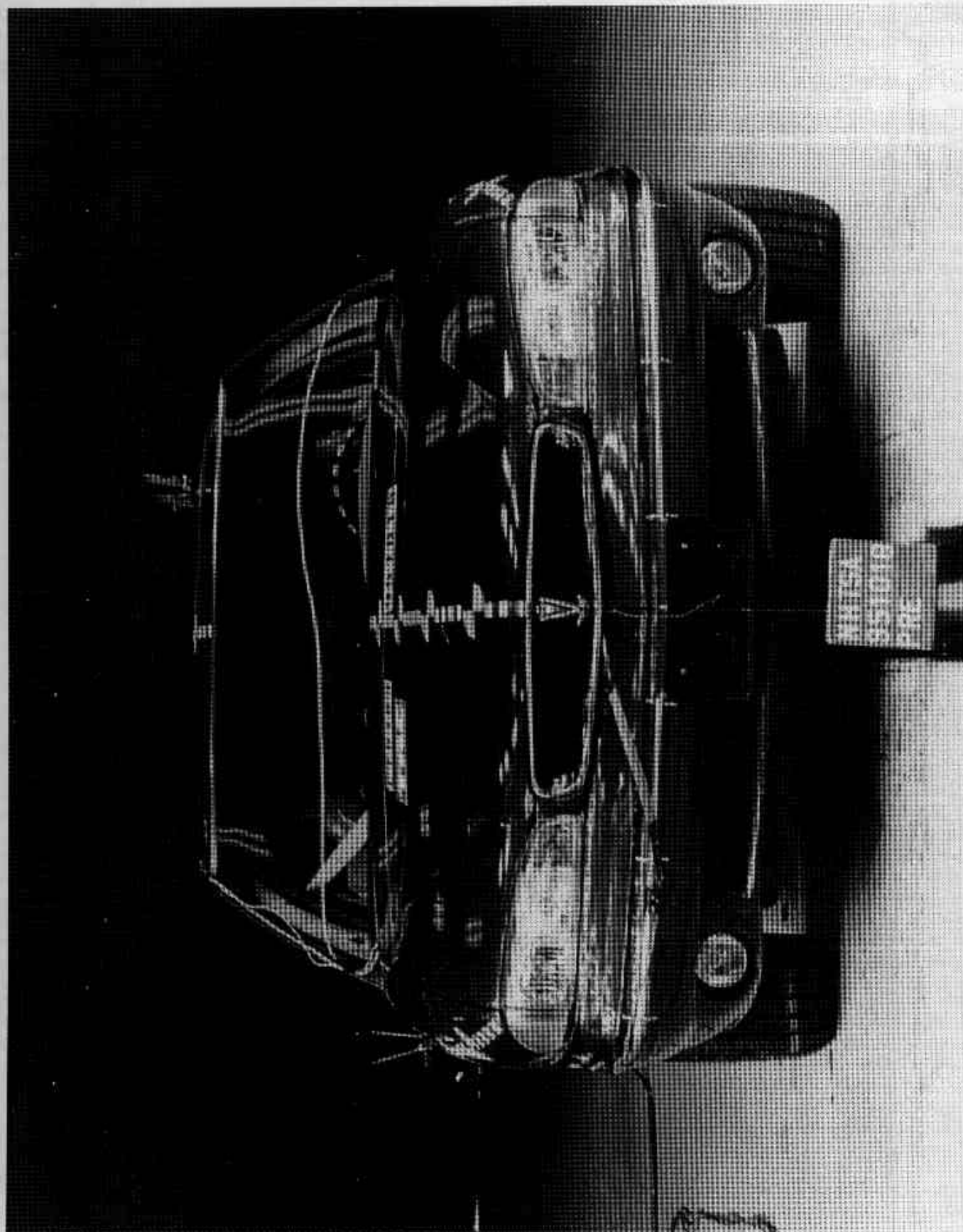


Figure A-1. Pre-Test Front View
A-2

951018

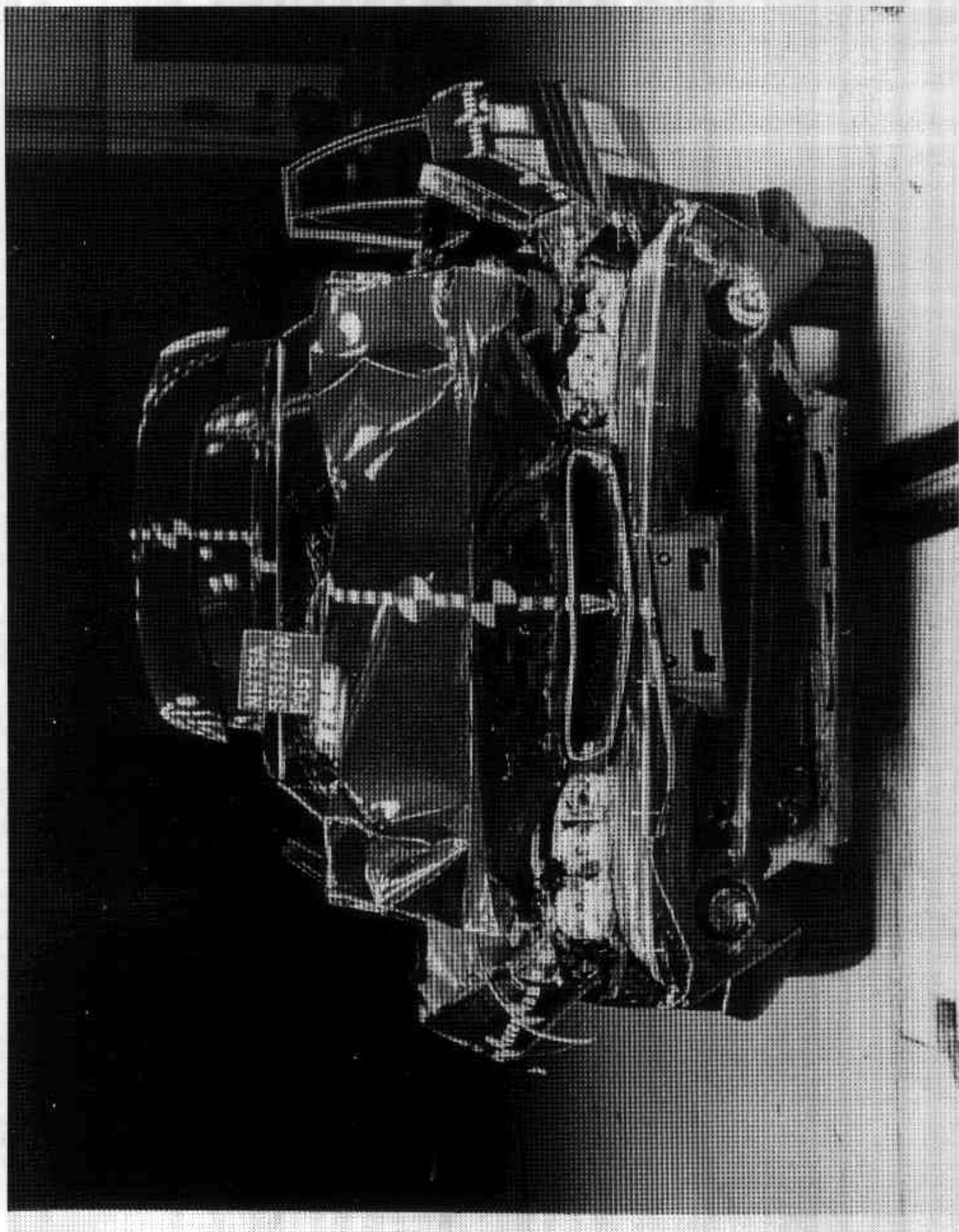


Figure A-2. Post-Test Front View
A-3

951018

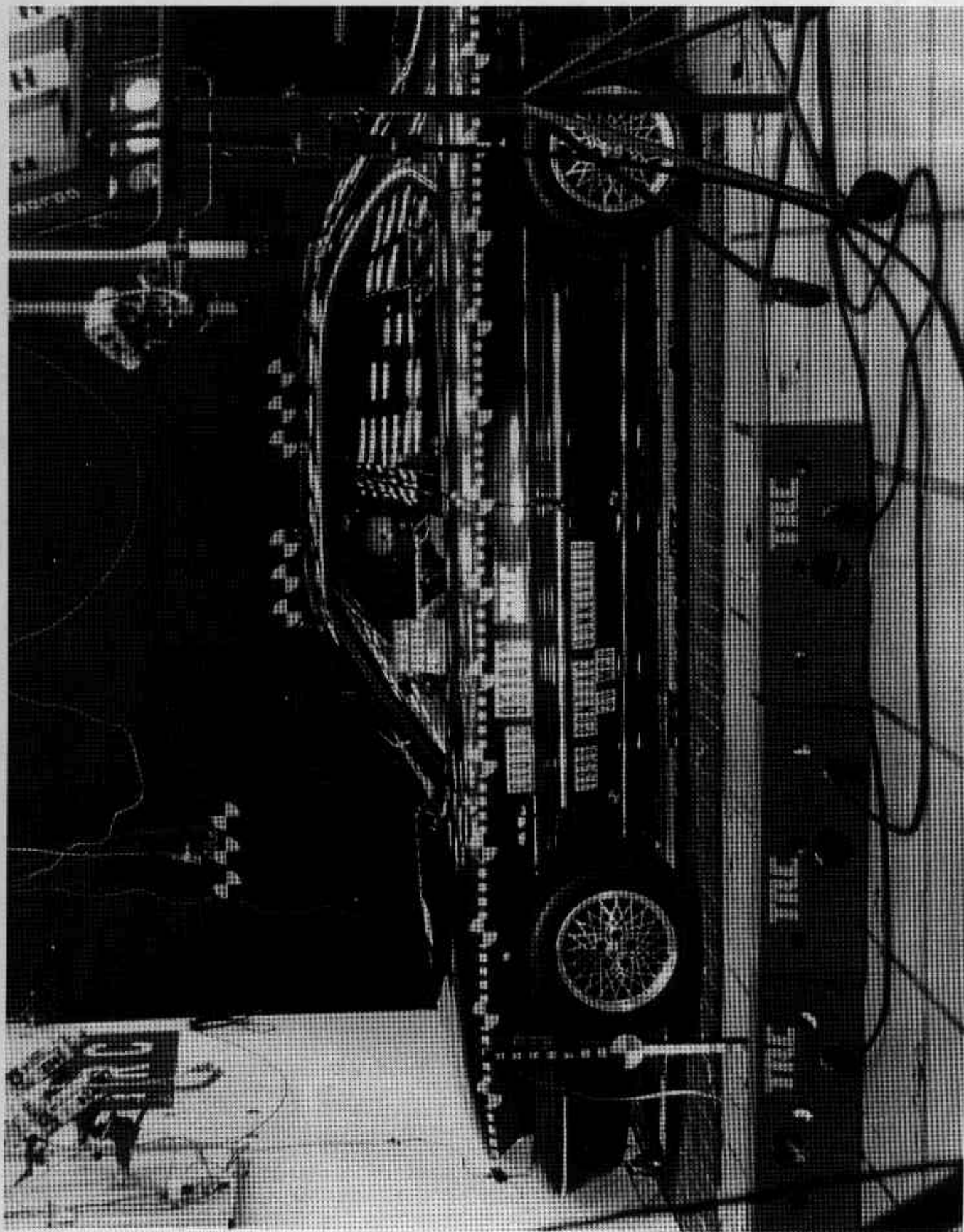


Figure A-3. Pre-Test Left Side View
A-4

951018

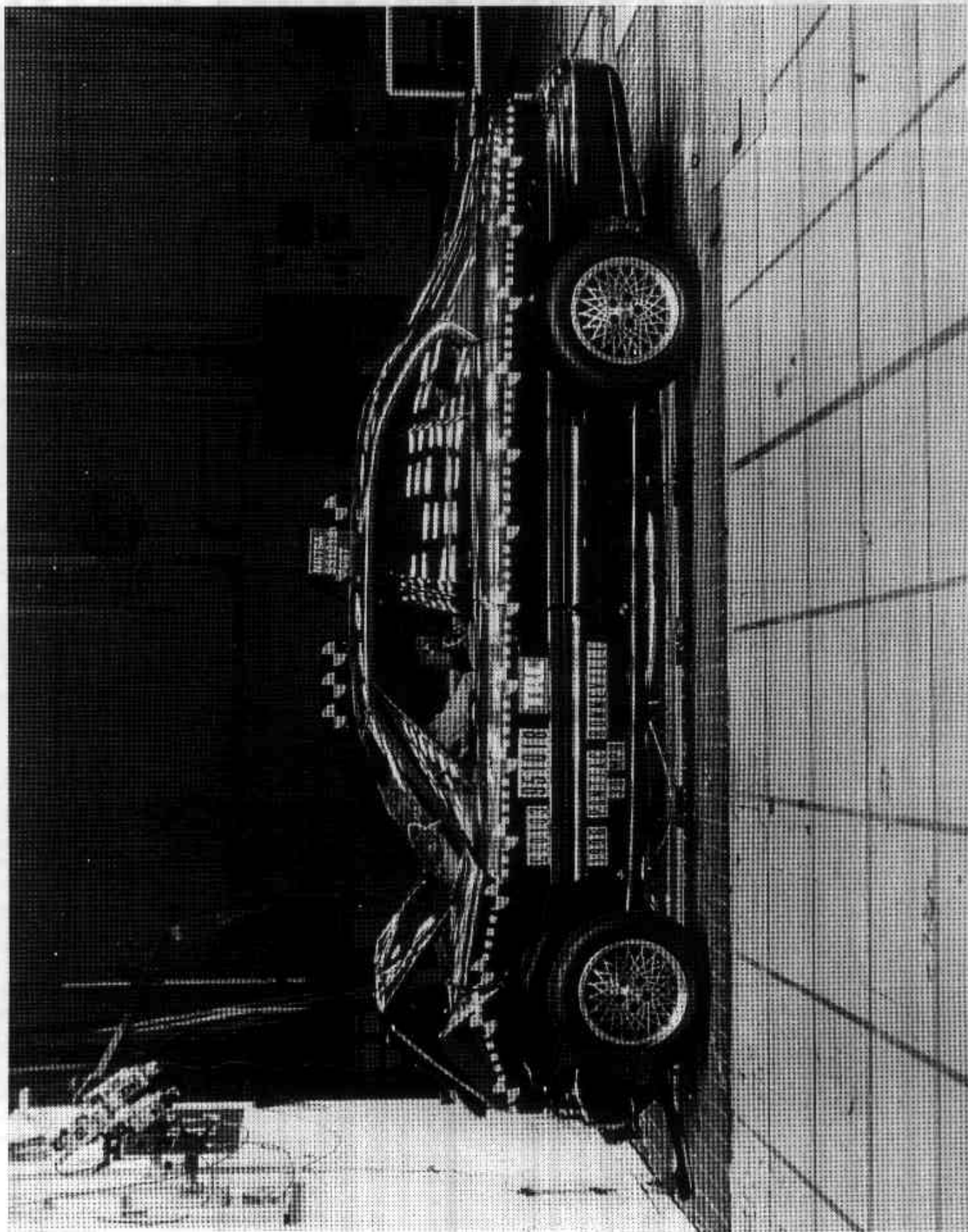


Figure A-4. Post-Test Left Side View
A-5

951018

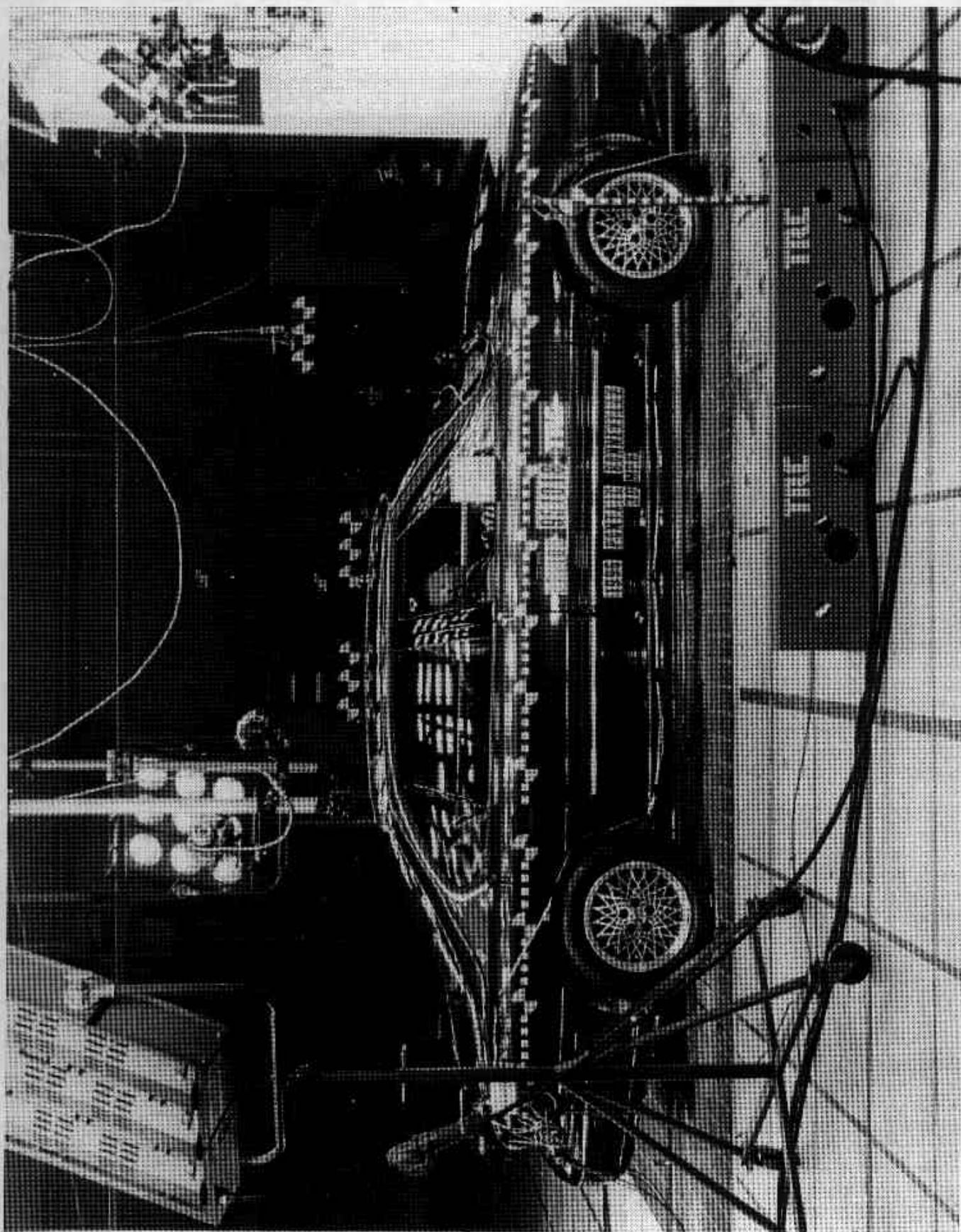


Figure A-5. Pre-Test Right Side View
A-6

951018

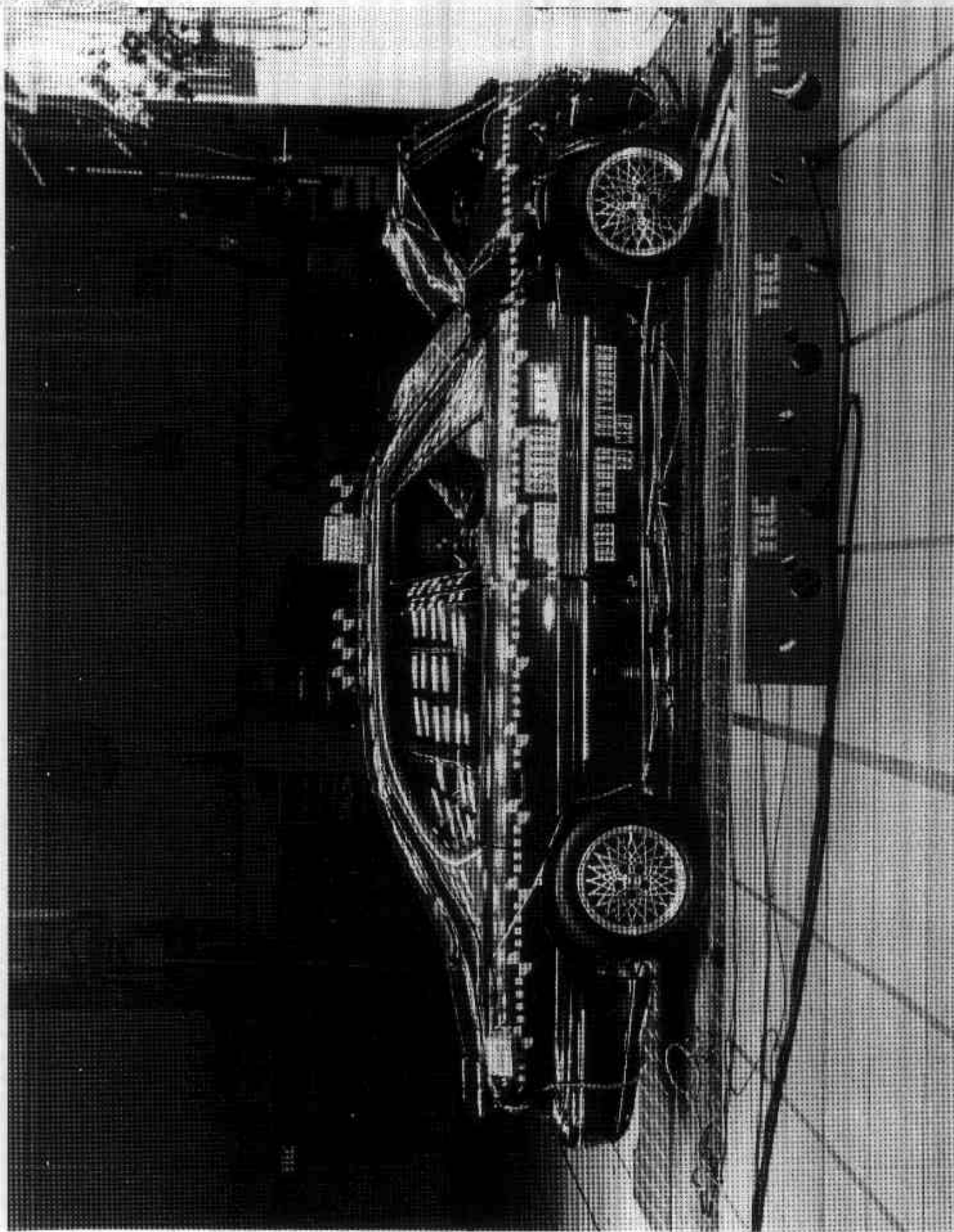


Figure A-6. Post-Test Right Side View
A-7

951018

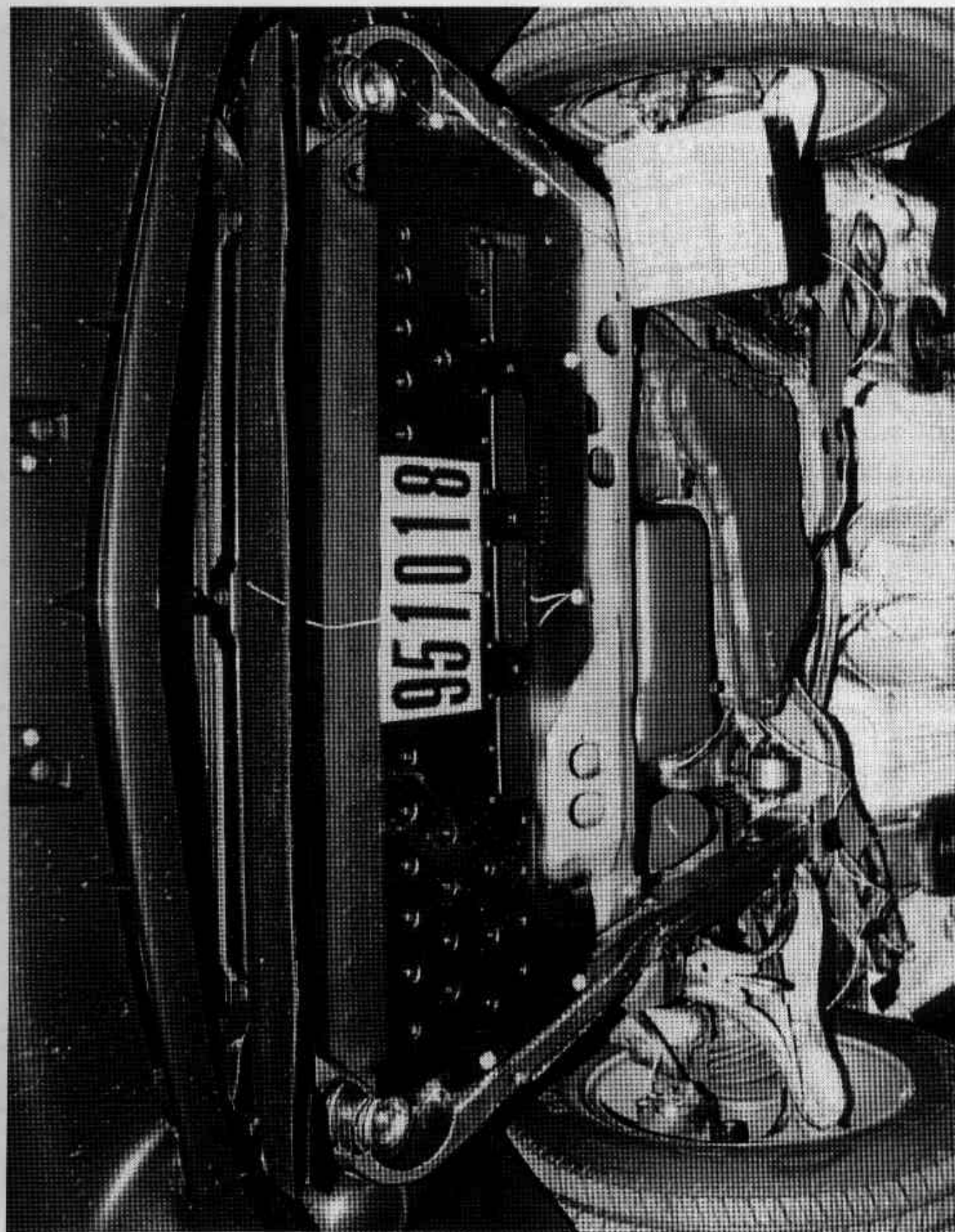


Figure A-7. Pre-Test Front Underbody View

A-8

951018

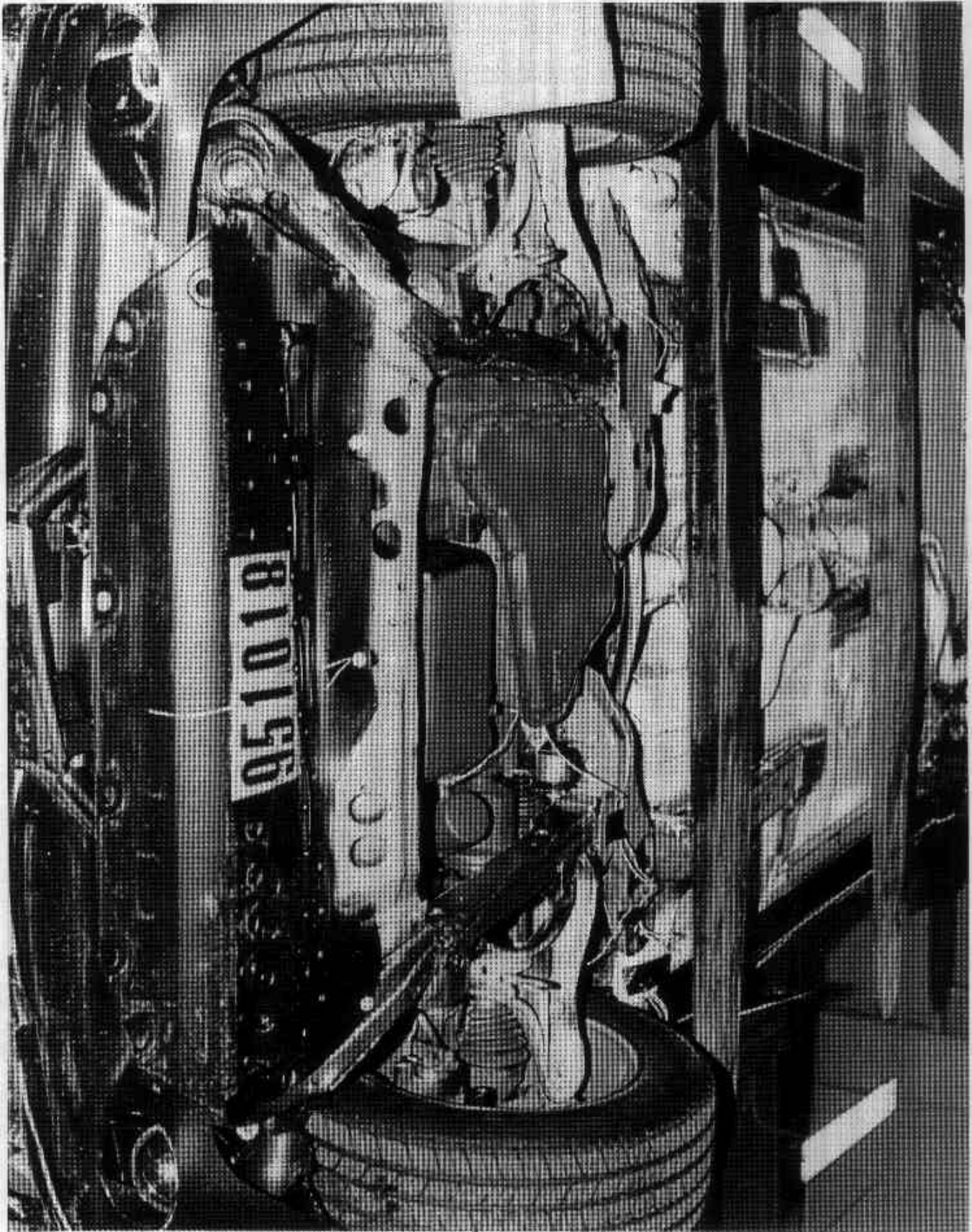


Figure A-8. Post-Test Front Underbody View
A-9

951018

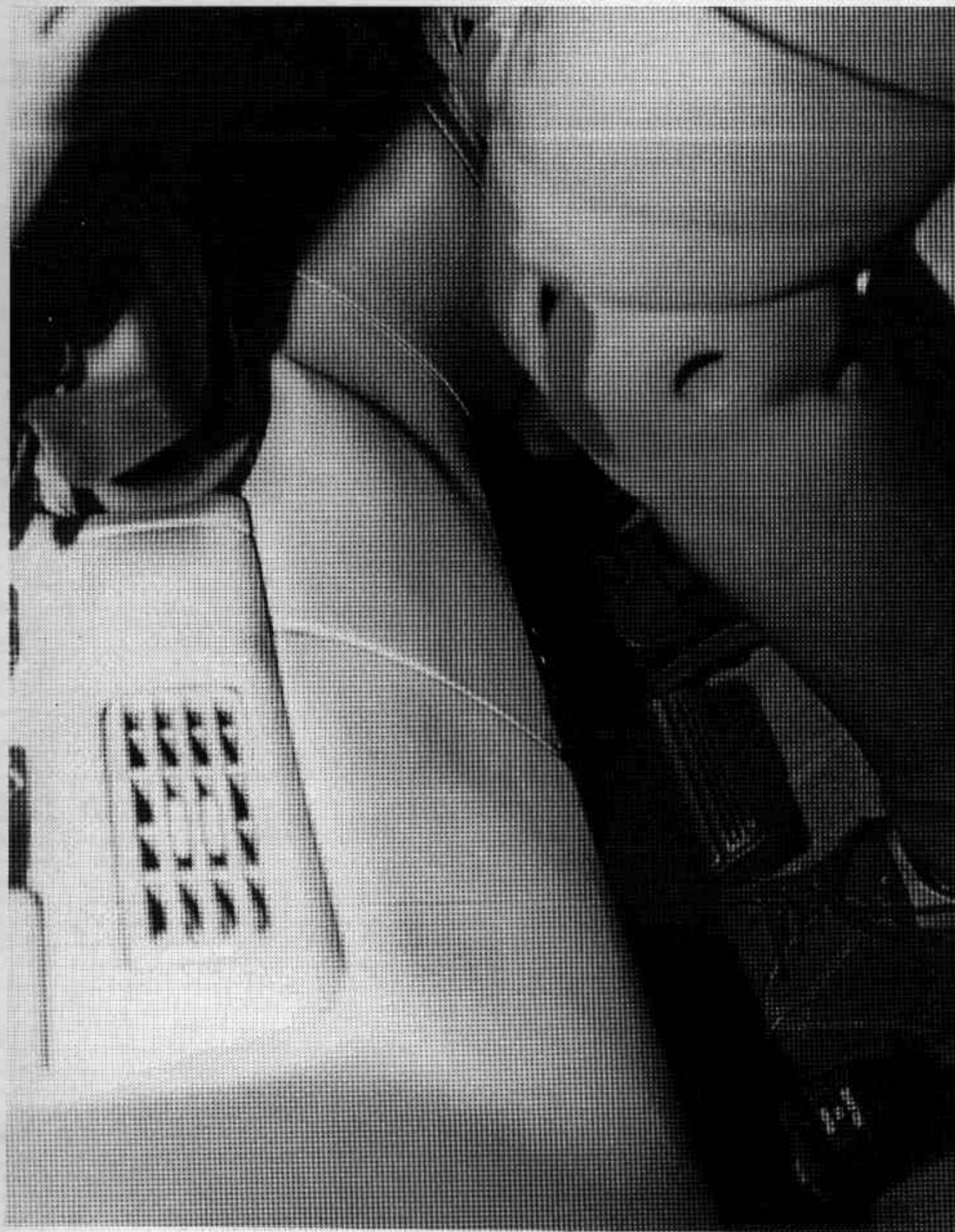


Figure A-9. Pre-Test Driver's Knee Bolster View
A-10

951018

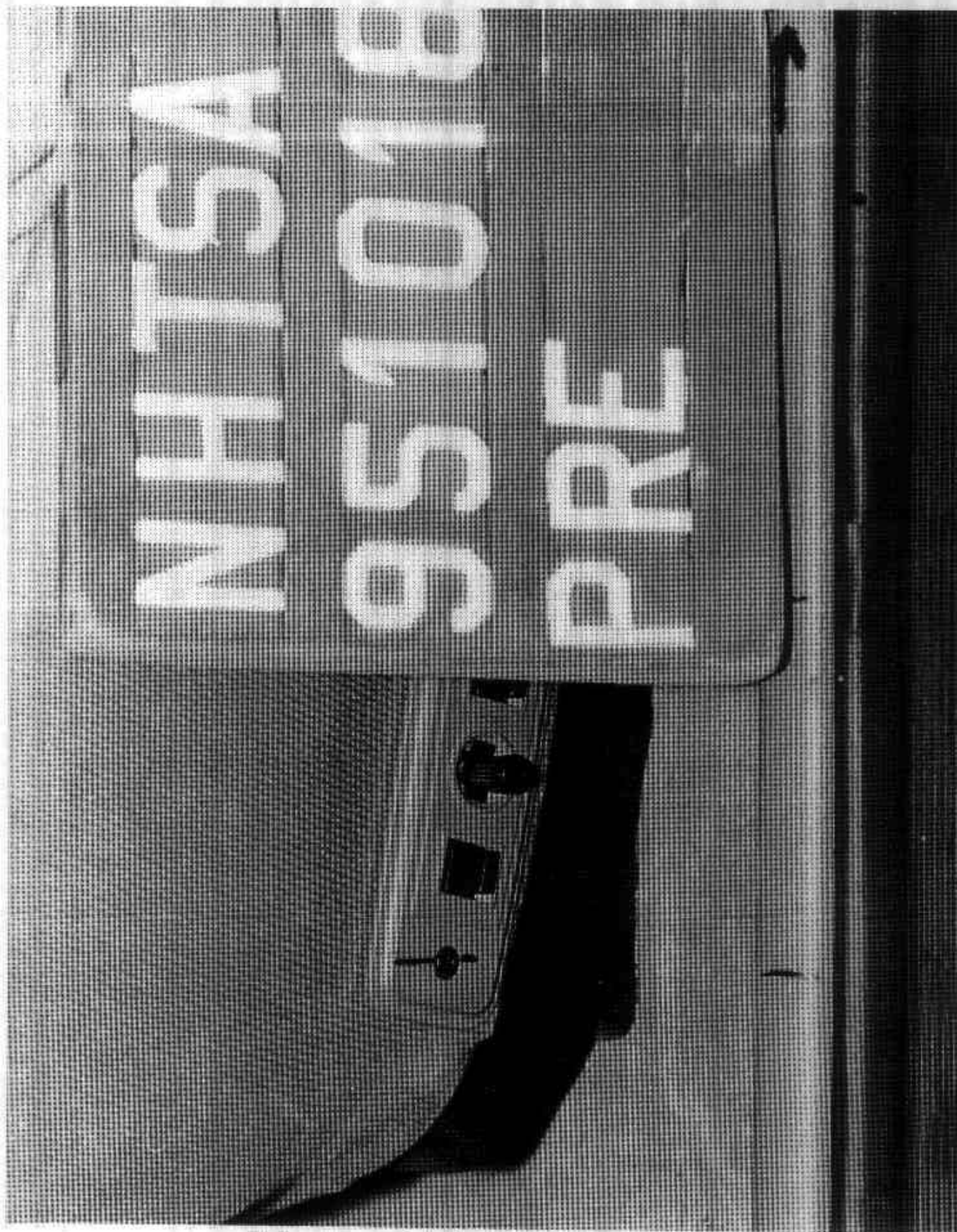


Figure A-10. Pre-Test Driver's Seat Location View
A-11

951018

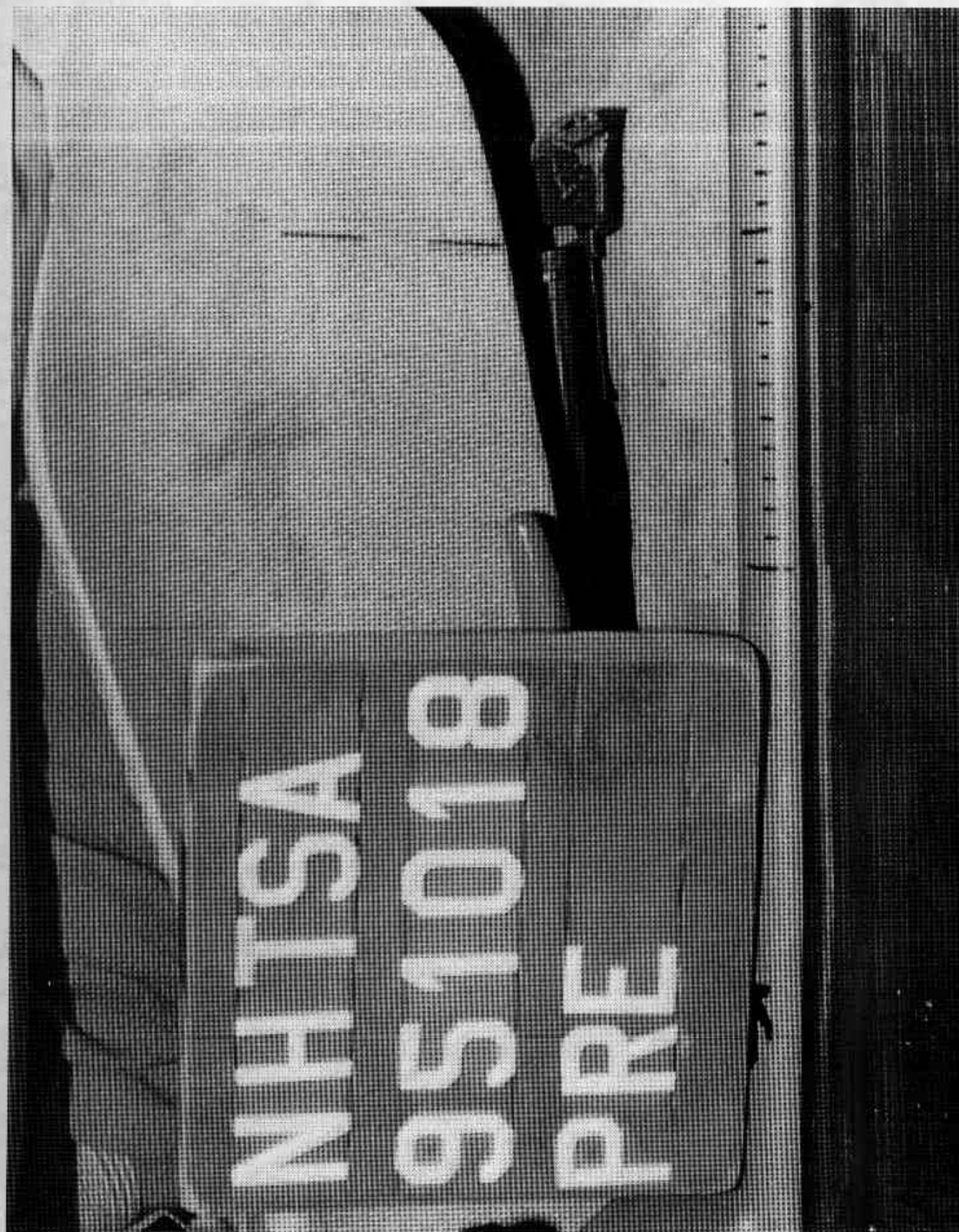


Figure A-11. Pre-Test Passenger's Seat Location View
A-12

951018

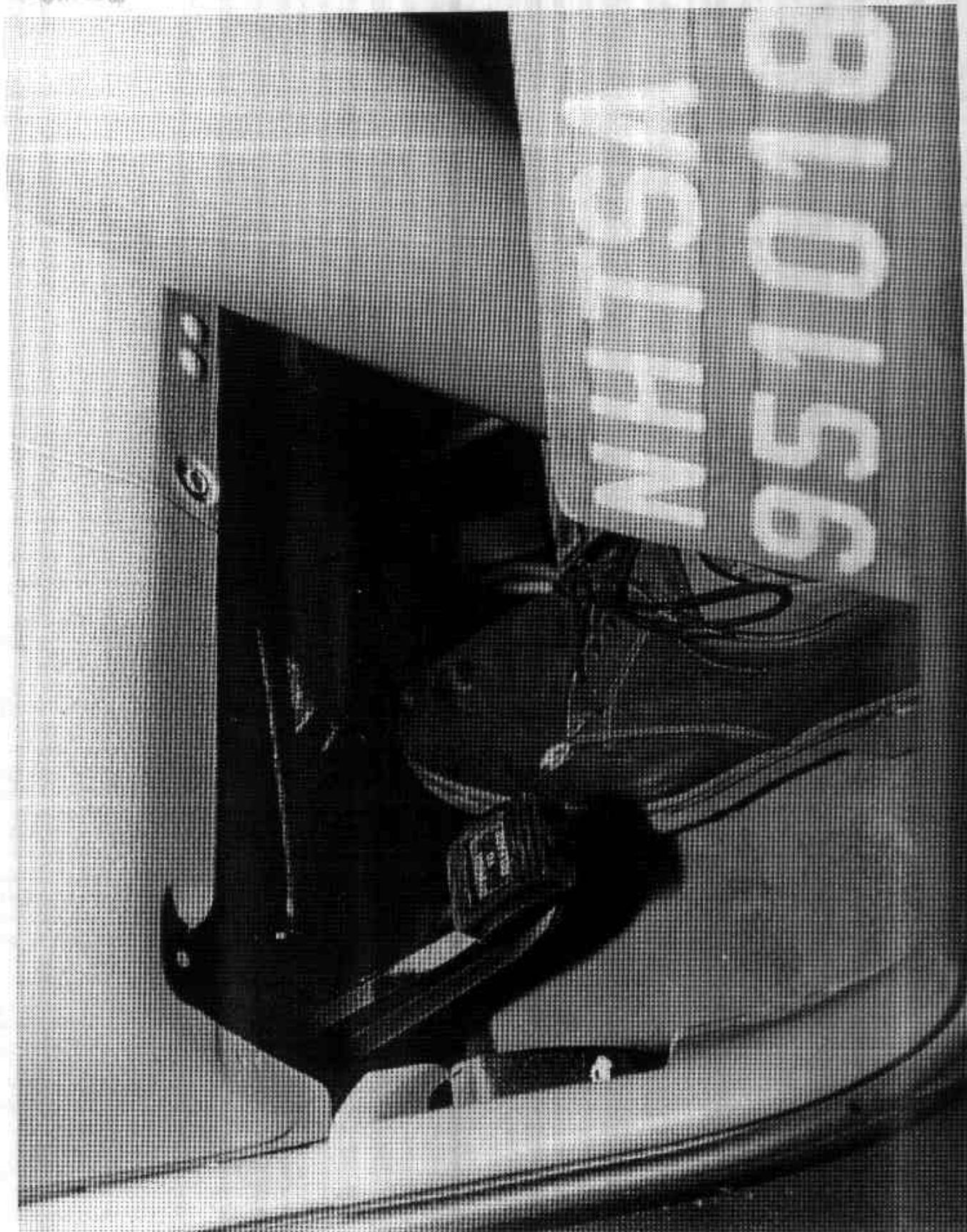


Figure A-12. Pre-Test Steering Column at Firewall View - Interior
A-13

951018

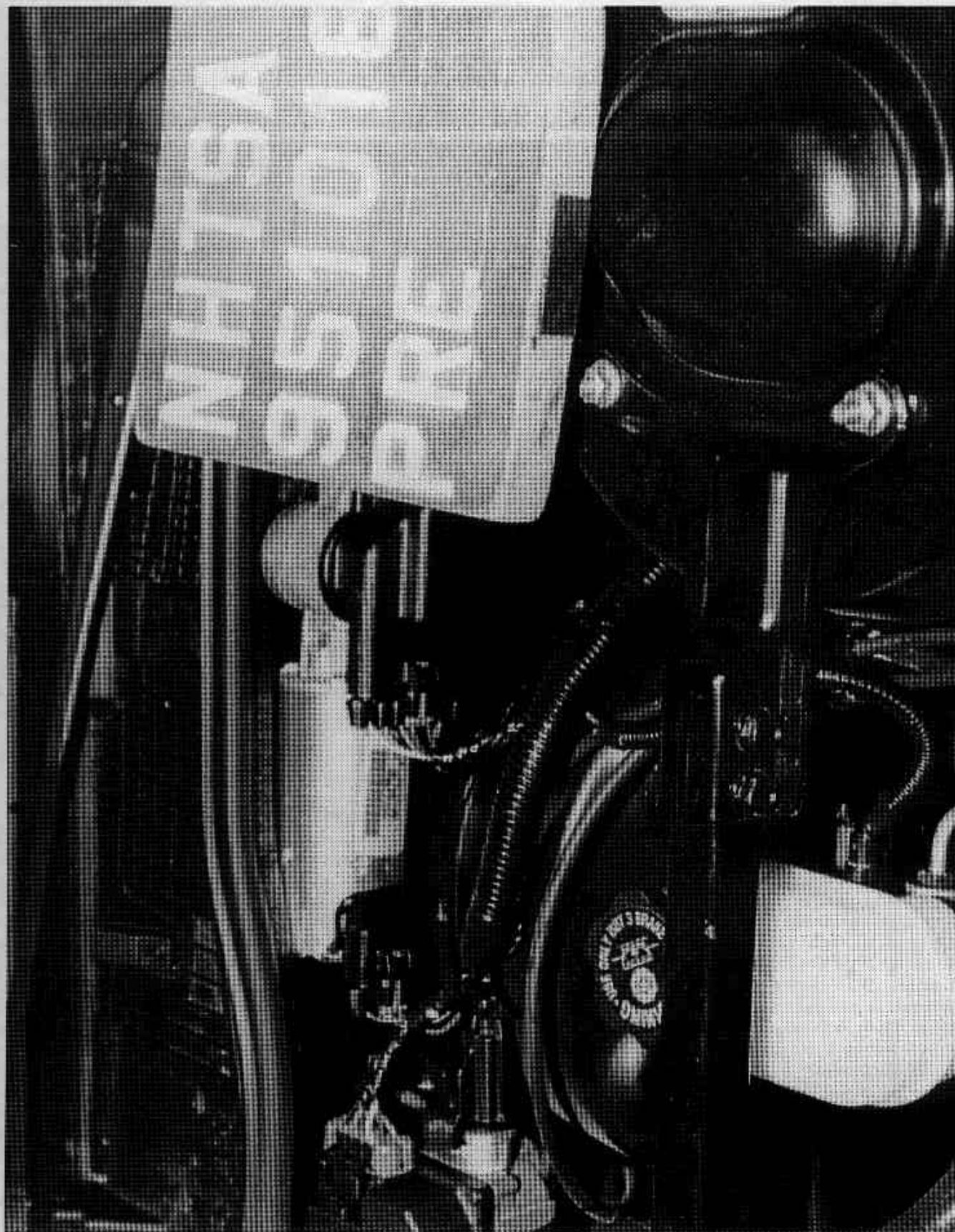


Figure A-13. Pre-Test Steering Column at Firewall View - Exterior

A-14

951018

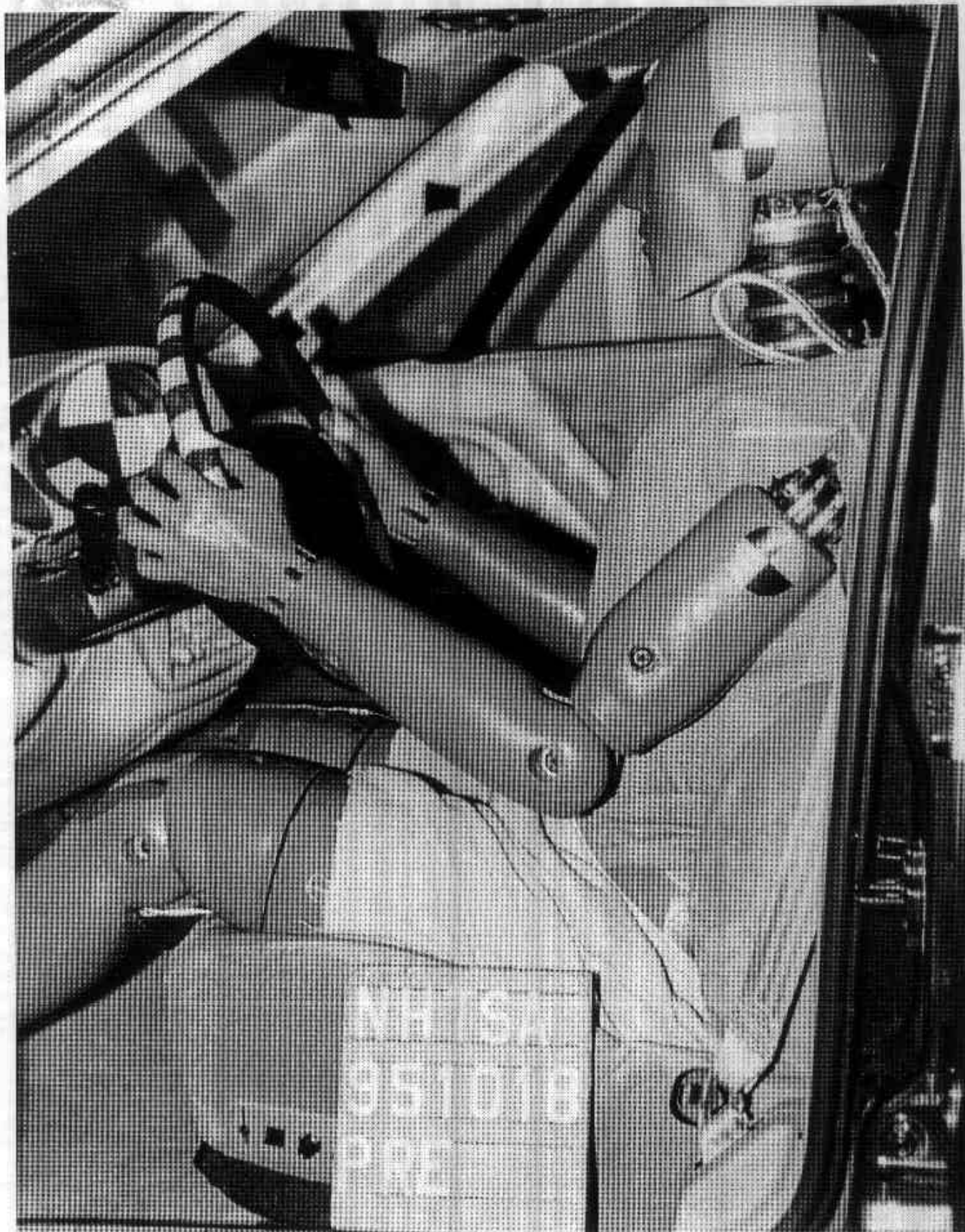


Figure A-14. Pre-Test Driver Dummy & Vehicle Interior View
A-15

951018



Figure A-15. Post-Test Driver Dummy & Vehicle Interior View
A-16

951018



Figure A-16. Post-Test Passenger Dummy & Vehicle Interior View

A-17

951018



Figure A-17. Post-Test Driver Dummy Head Contact - View 1

A-18

951018



Figure A-18. Post-Test Driver Dummy Head Contact - View 2

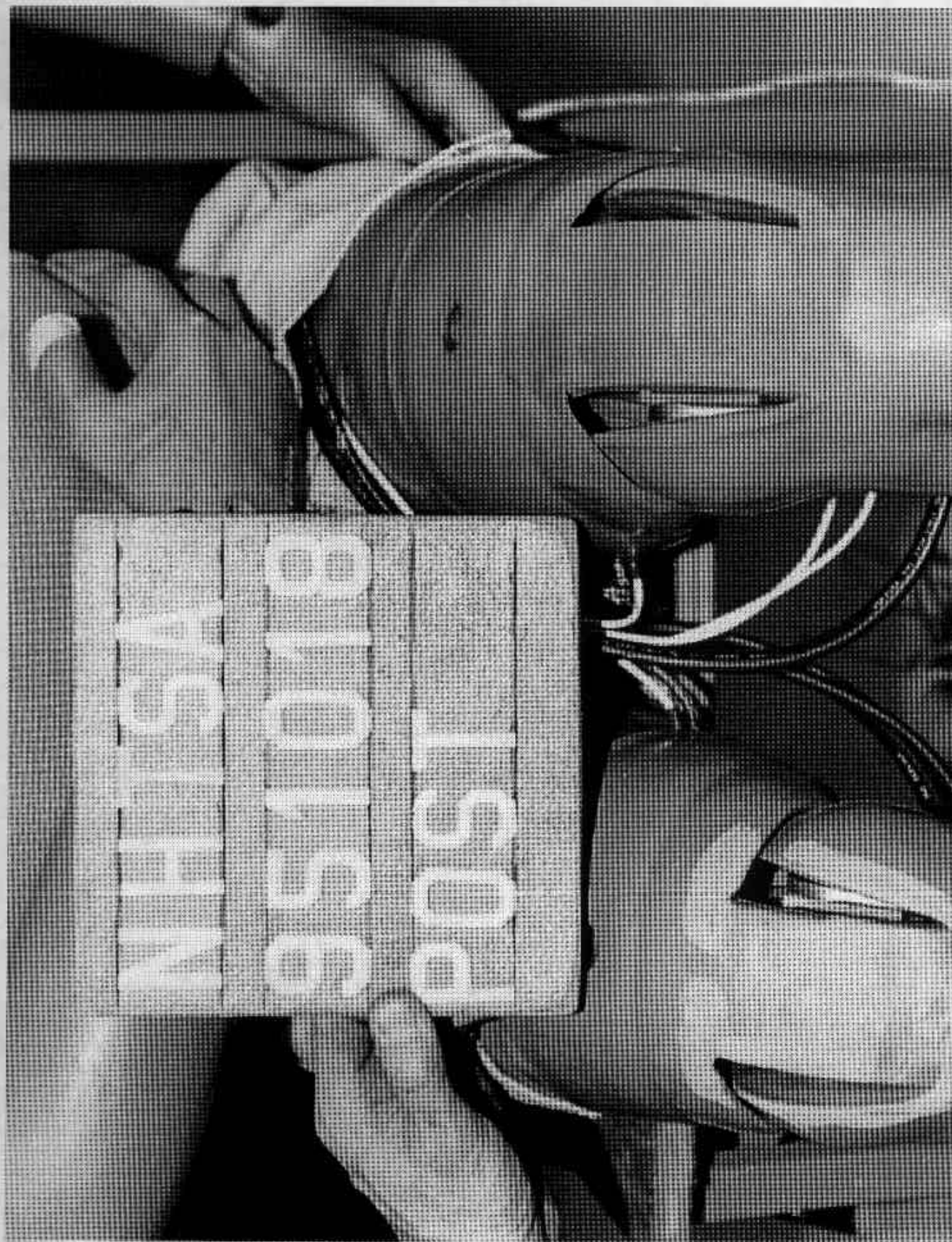


Figure A-19. Post-Test Driver Dummy Knee Contact - View 1
A-20

951018

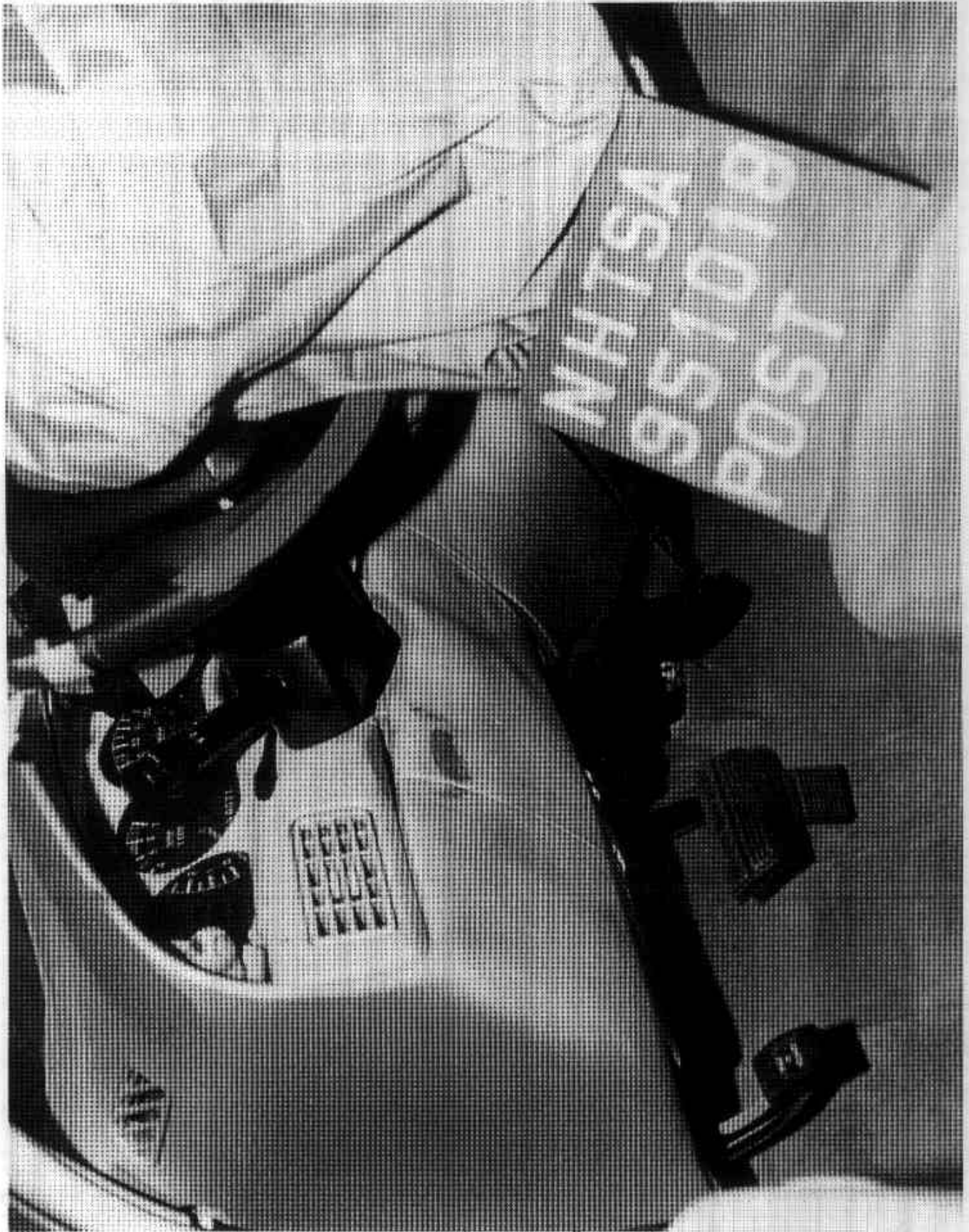


Figure A-20. Post-Test Driver Dummy Knee Contact - View 2
A-21

951018

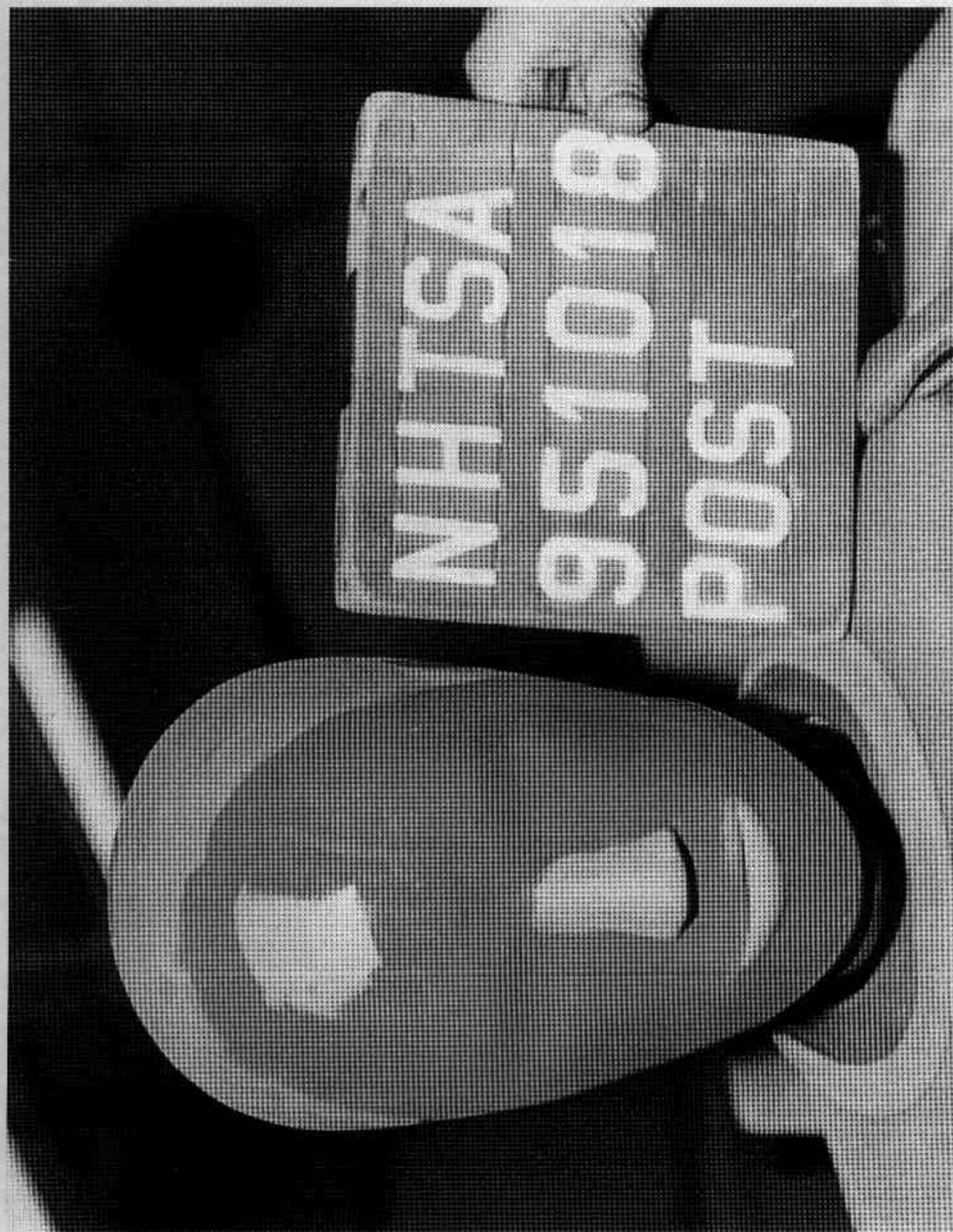


Figure A-21. Post-Test Passenger Dummy Head Contact - View 1
A-22

951018

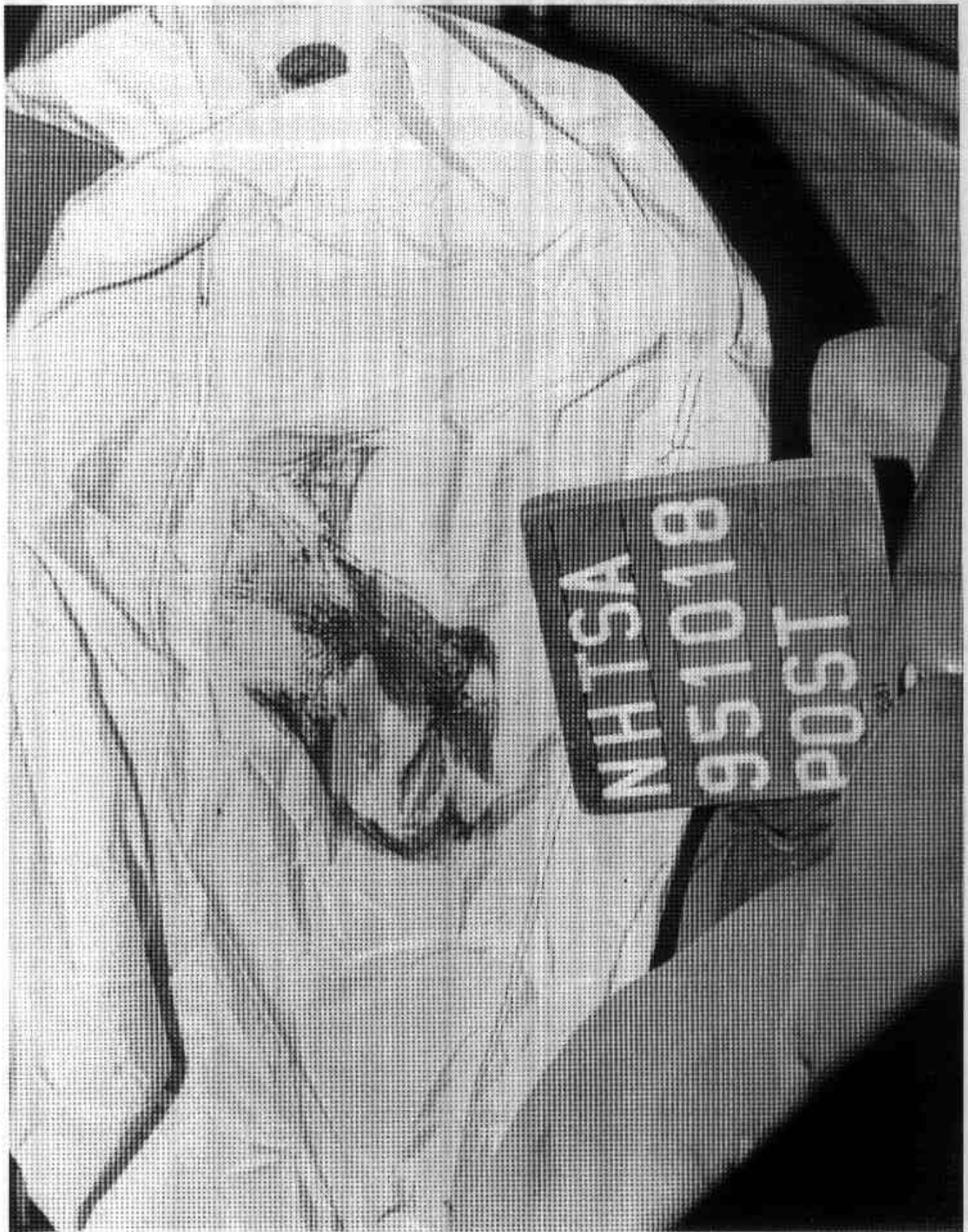


Figure A-22. Post-Test Passenger Dummy Head Contact - View 2

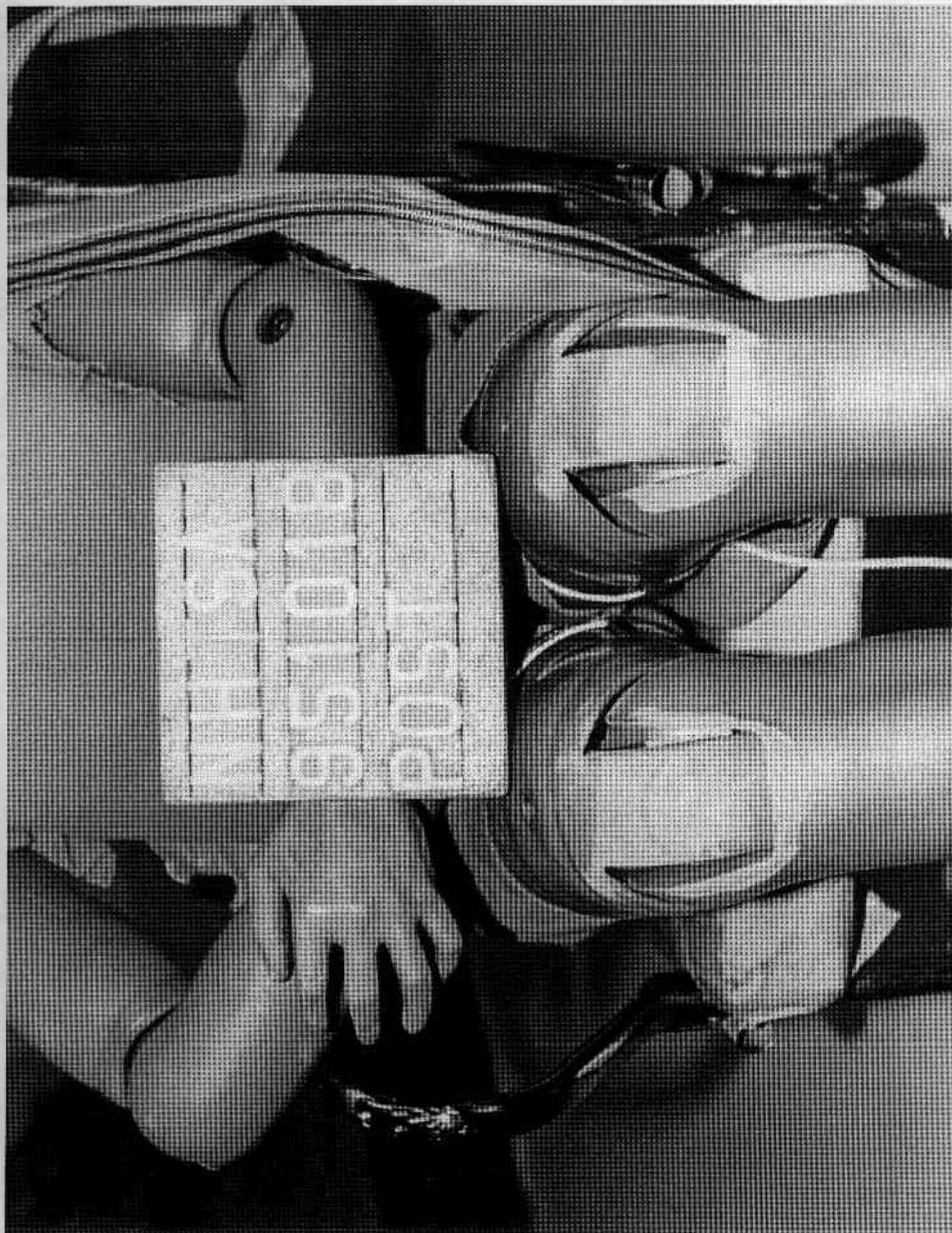


Figure A-23. Post-Test Passenger Dummy Knee Contact - View 1

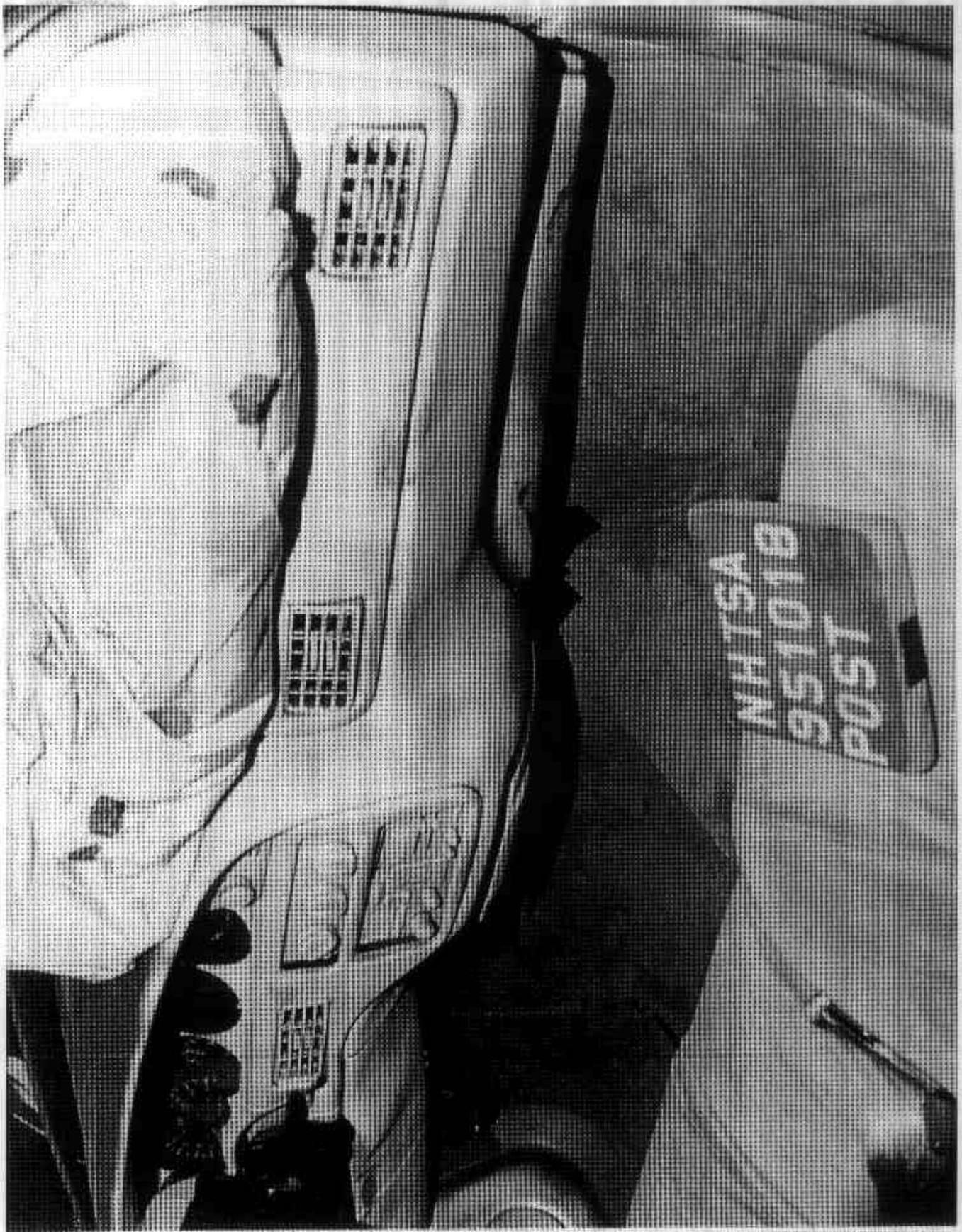


Figure A-24. Post-Test Passenger Dummy Knee Contact - View 2
A-25

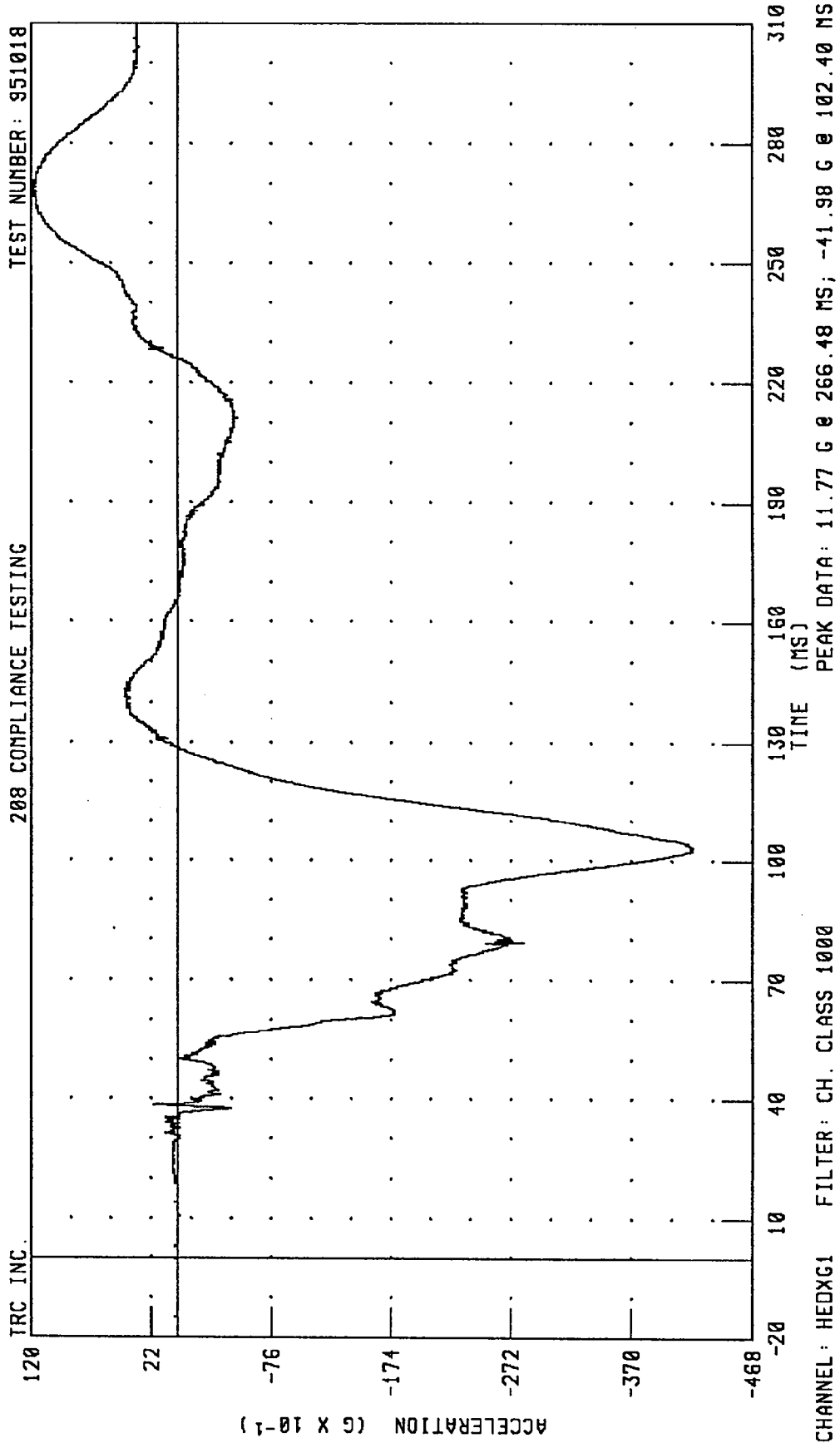
951018

Appendix B

Data Plots

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
 DRIVER HEAD X-AXIS ACCELERATION
 208 COMPLIANCE TESTING

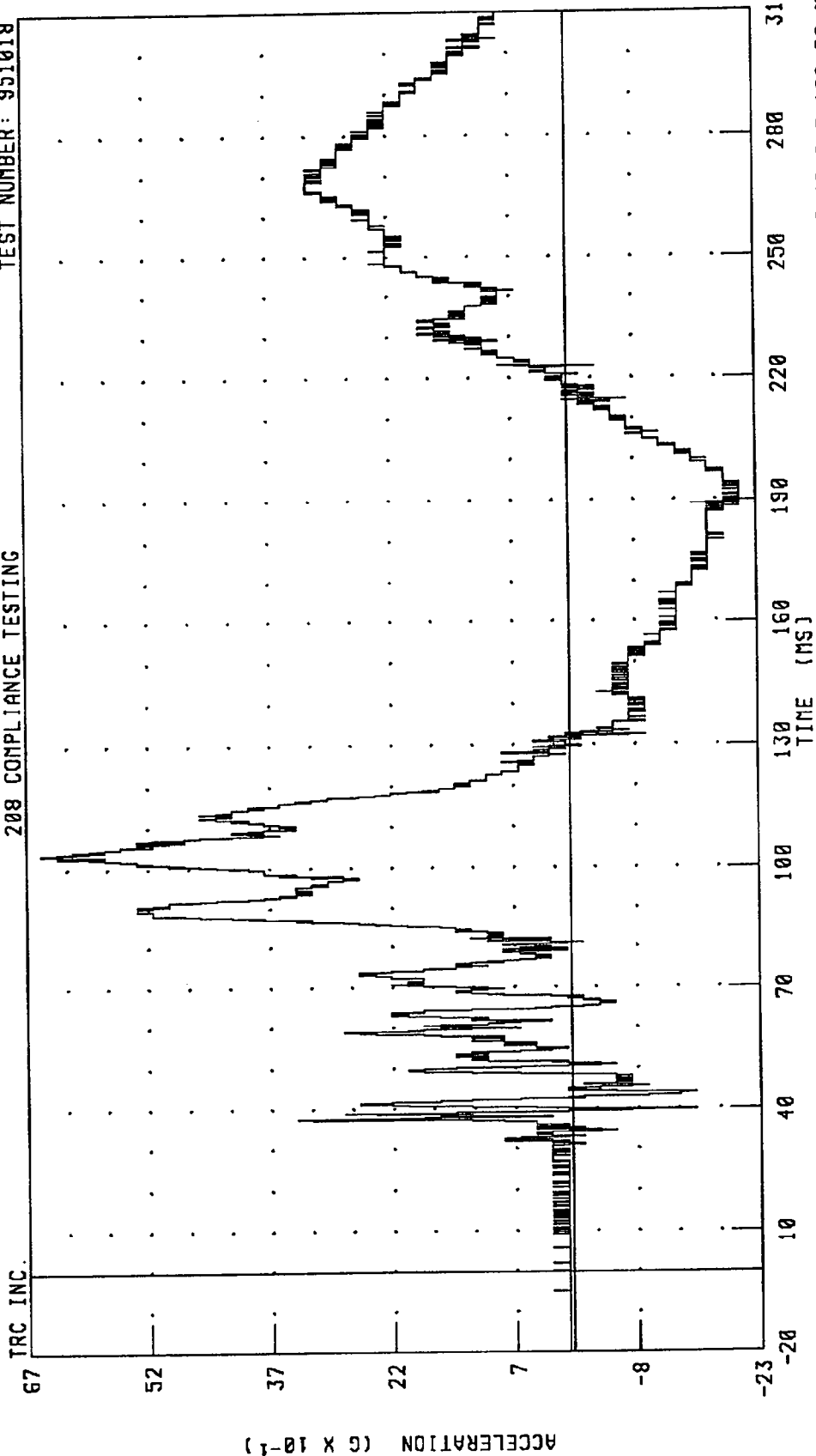
TEST NUMBER: 951018



1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
DRIVER HEAD Y-AXIS ACCELERATION

208 COMPLIANCE TESTING

TEST NUMBER: 951018



CHANNEL: HEDYG1 FILTER: CH. CLASS 1000

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
DRIVER HEAD Z-AXIS ACCELERATION

TEST NUMBER: 951018

208 COMPLIANCE TESTING

TRC INC.

309

246

183

120

57

-5

-69

ACCELERATION (G X 10⁻¹)

TIME (MS)

310

280

250

220

190

160

130

100

70

40

10

-20

CHANNEL: HEDZG1 FILTER: CH. CLASS 1000

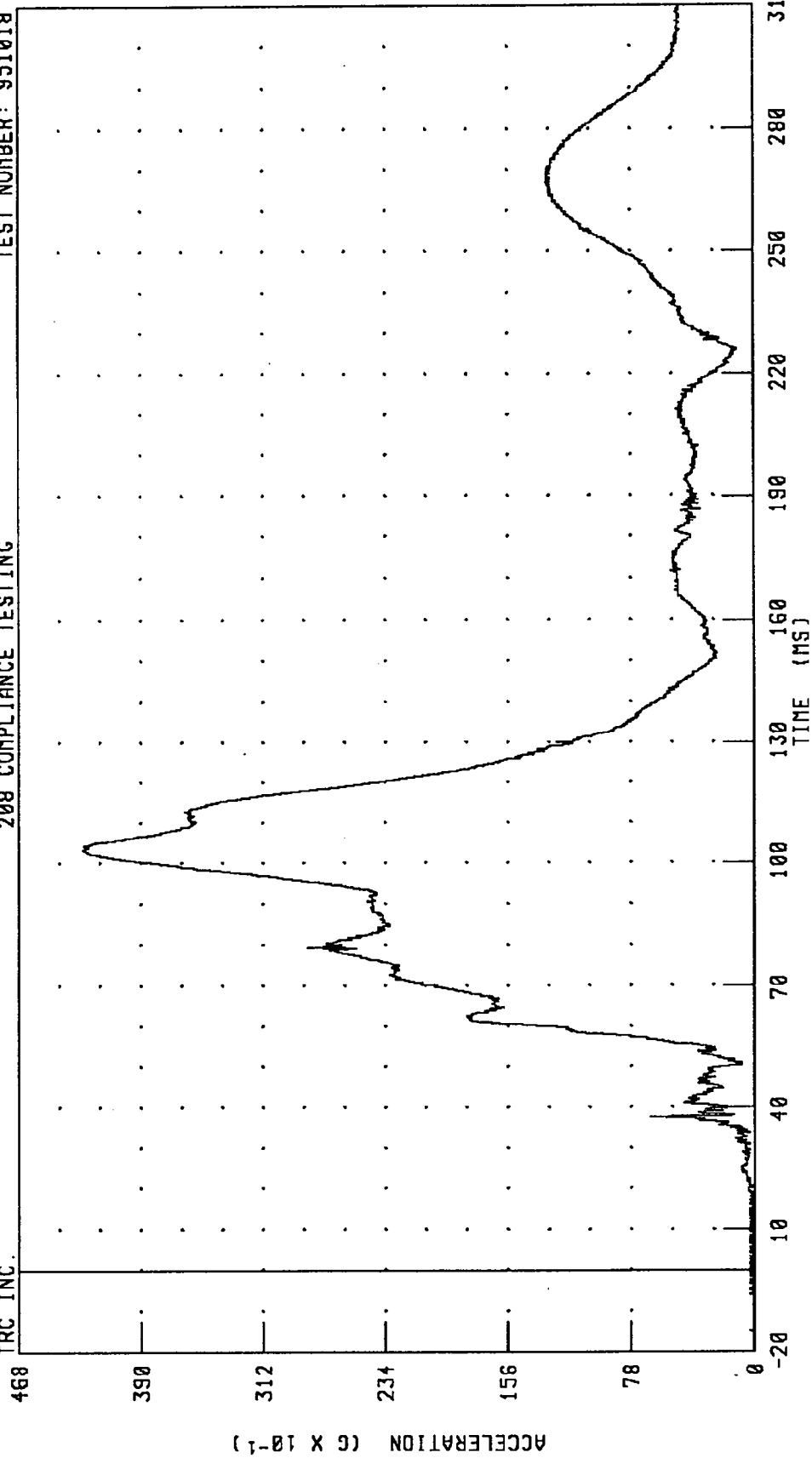
PEAK DATA: 28.20 G @ 114.88 MS; -6.36 G @ 96.08 MS

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
DRIVER HEAD RESULTANT ACCELERATION

TEST NUMBER: 951018

208 COMPLIANCE TESTING

TRC INC.



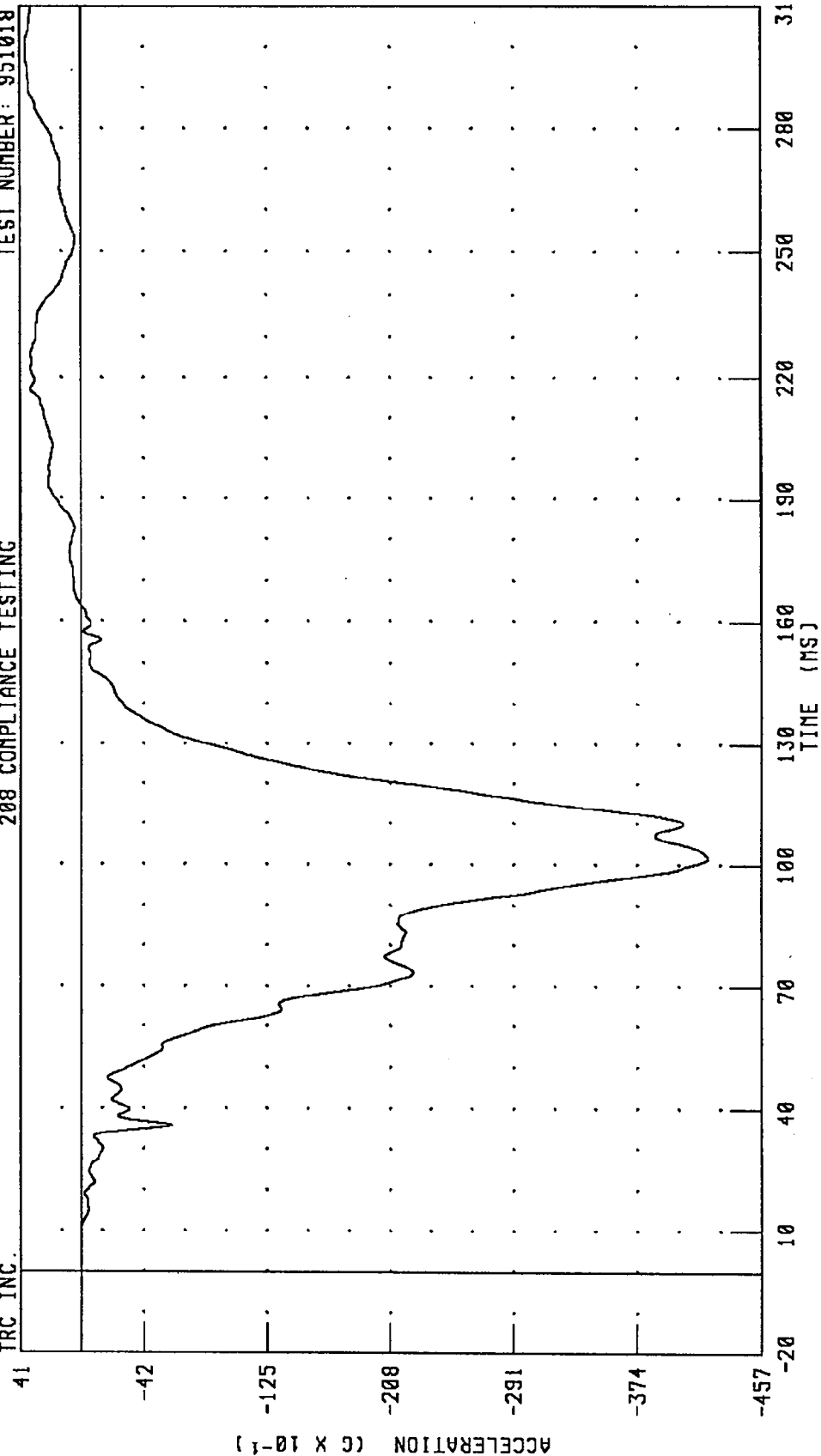
CHANNEL: HEDRG1 FILTER: CH. CLASS 1000

PEAK DATA: 42.68 G @ 103.36 MS; 0.11 G @ -20.00 MS

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
 DRIVER CHEST X-AXIS ACCELERATION
 208 COMPLIANCE TESTING

TEST NUMBER: 951018

TRC INC.



CHANNEL: CSTXG1 FILTER: CH. CLASS 180

PEAK DATA: 3.74 G @ 301.20 MS; -42.07 G @ 101.84 MS

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
DRIVER CHEST Y-AXIS ACCELERATION
208 COMPLIANCE TESTING

TEST NUMBER: 951018

TRC INC.

340

256

173

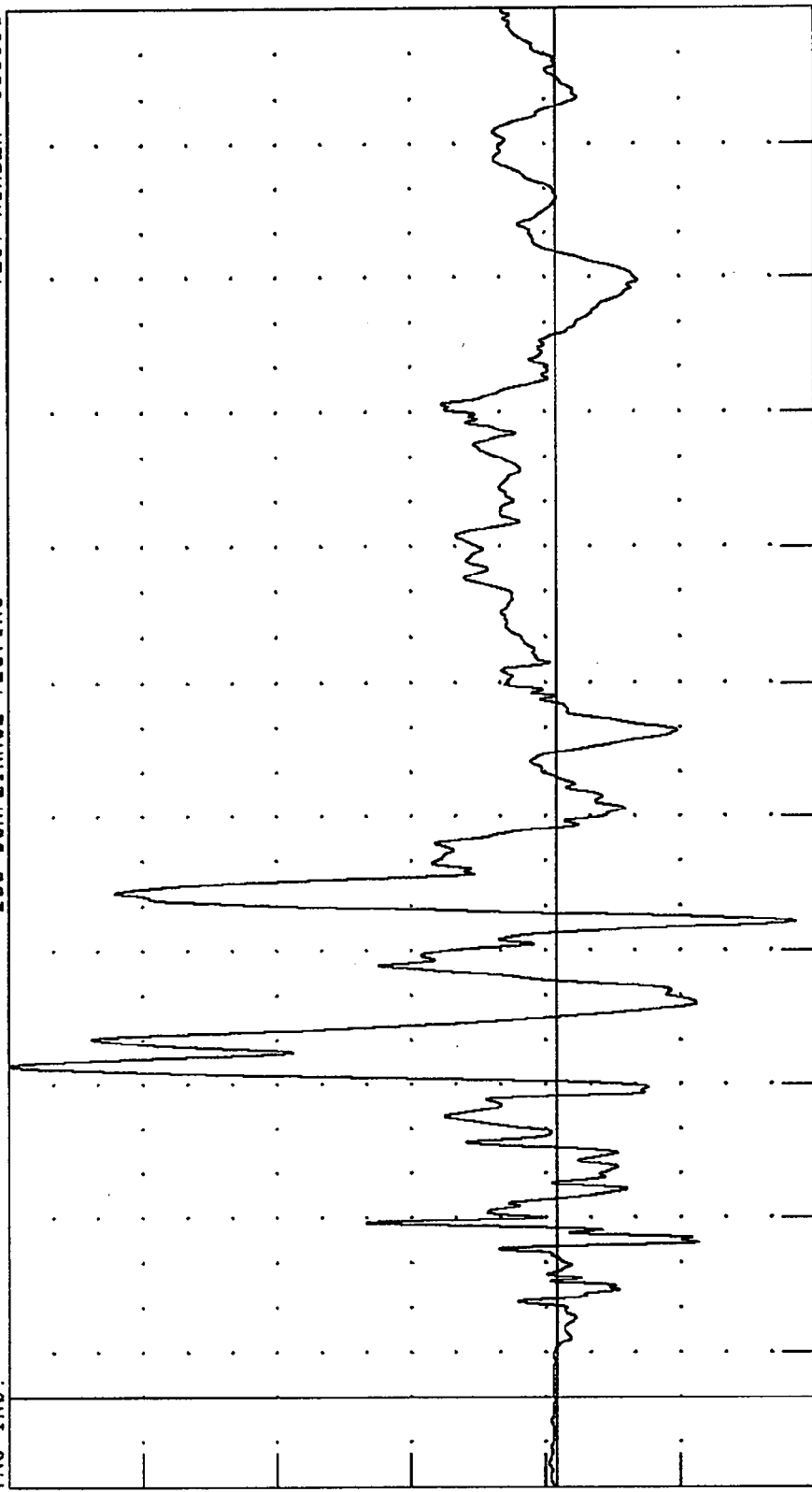
90

6

-76

-160

ACCELERATION (G X 10⁻²)



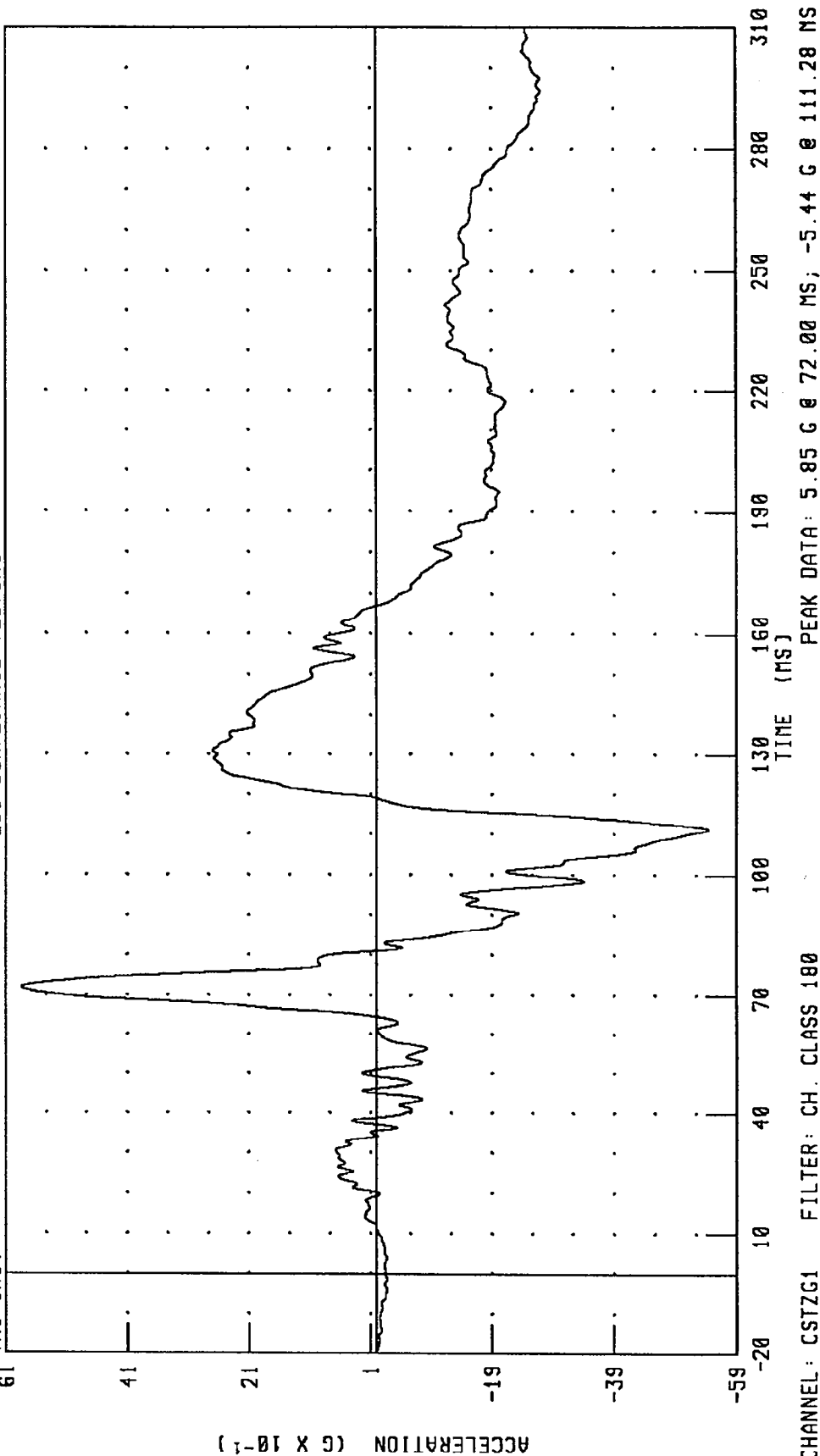
PEAK DATA: 3.39 G @ 74.32 MS; -1.47 G @ 106.48 MS

CHANNEL: CSTYGI FILTER: CH. CLASS 180

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
 DRIVER CHEST Z-AXIS ACCELERATION
 208 COMPLIANCE TESTING

TEST NUMBER: 951018

61 TRC INC.



CHANNEL: CS17G1 FILTER: CH. CLASS 180

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
DRIVER CHEST RESULTANT ACCELERATION

TEST NUMBER: 951018

208 COMPLIANCE TESTING

TRC INC.

462

385

ACCELERATION (G X 10⁻¹)

308

231

154

77

0

-20

10

40

70

100

130

160

190

220

250

280

310

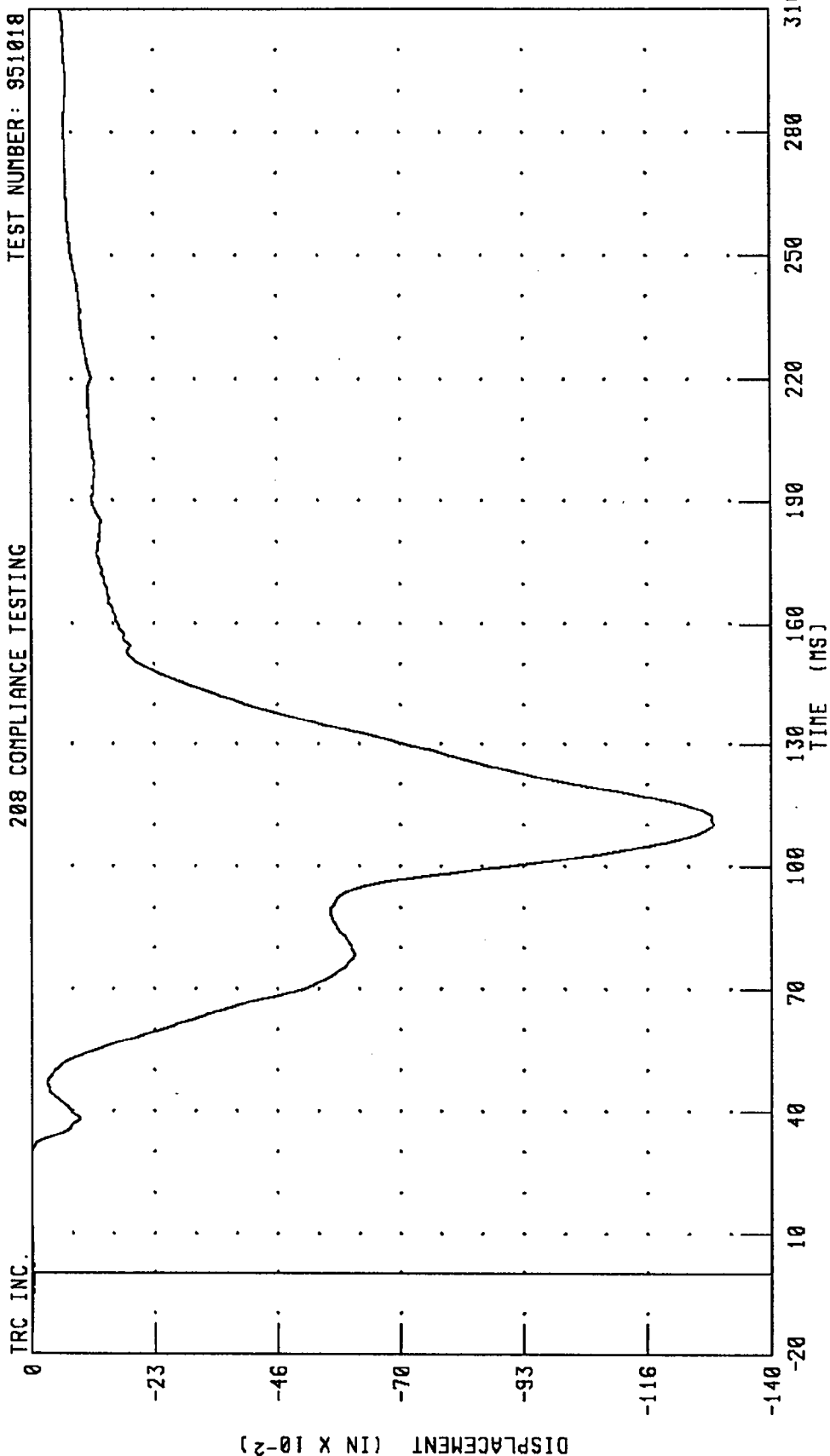
TIME (MS)

CHANNEL: CSTRG1 FILTER: CH. CLASS 180

PEAK DATA: 42.15 G @ 102.00 MS; 0.00 G @ -20.00 MS

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
 DRIVER CHEST DEFLECTION
 208 COMPLIANCE TESTING

TEST NUMBER: 951018

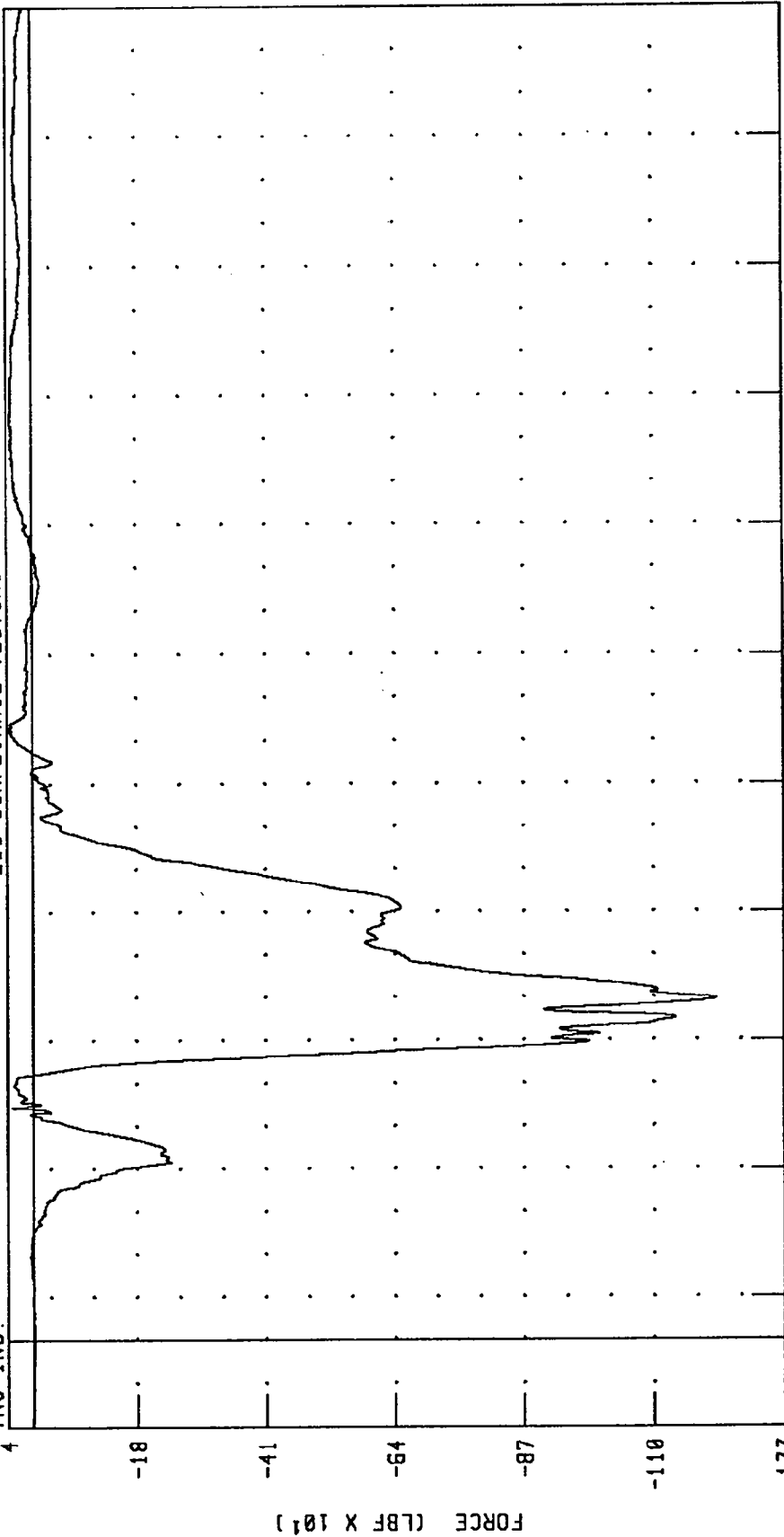


1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
 DRIVER LEFT FEMUR FORCE
 208 COMPLIANCE TESTING

TEST NUMBER: 951018

TRC INC.

4



PEAK DATA: 41.26 LBF @ 142.88 MS; -1215.78 LBF @ 79.76 MS

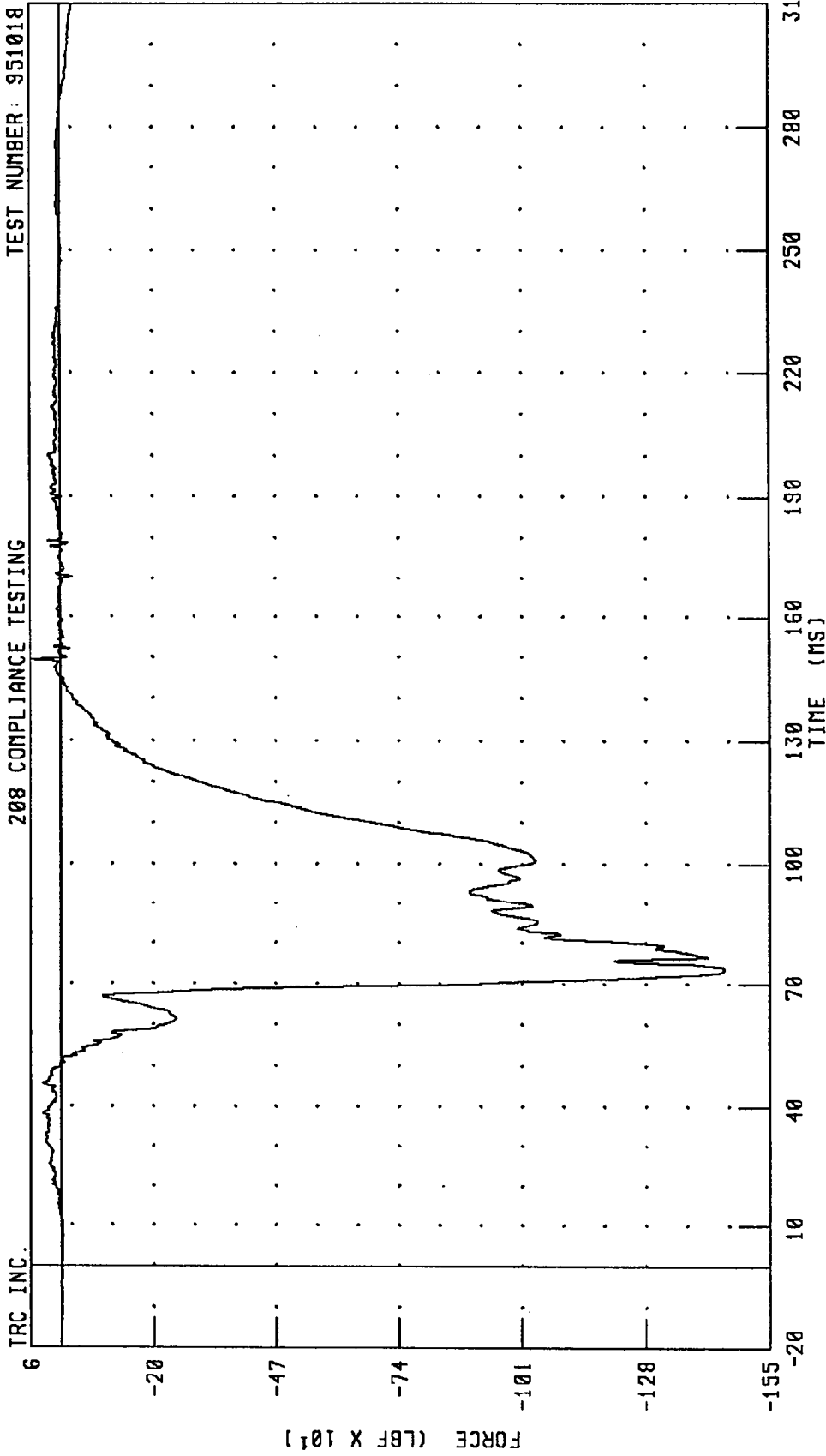
CHANNEL: LFMF1 FILTER: CH. CLASS 600

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER

DRIVER RIGHT FEMUR FORCE

208 COMPLIANCE TESTING

TEST NUMBER: 951018



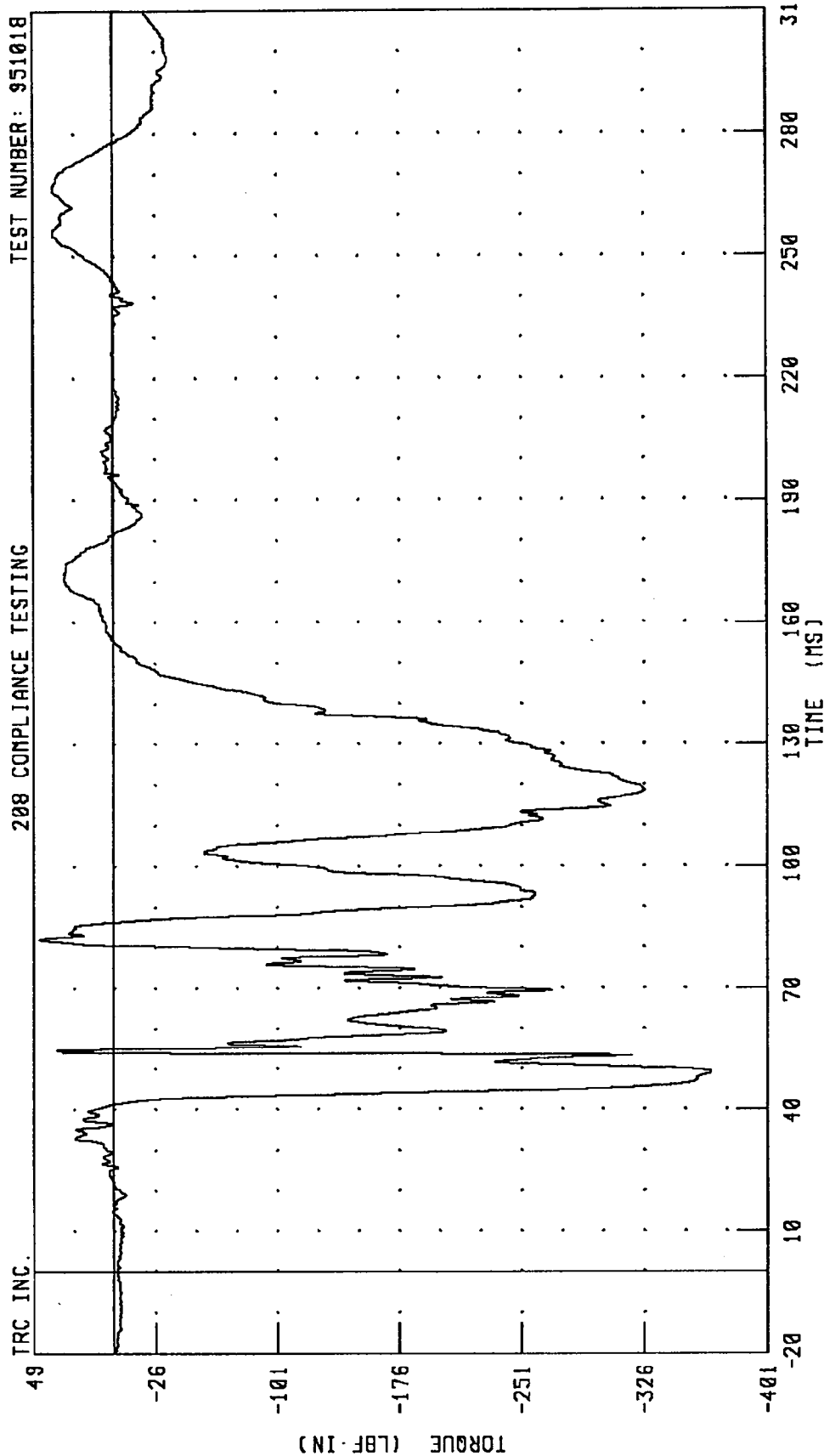
PEAK DATA: 62.69 LBF @ 149.44 MS; -1452.66 LBF @ 73.76 MS

CHANNEL: RFMF1 FILTER: CH. CLASS 600

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
DRIVER LEFT UPPER TIBIA MOMENT ABOUT X-AXIS

TEST NUMBER: 951018

208 COMPLIANCE TESTING



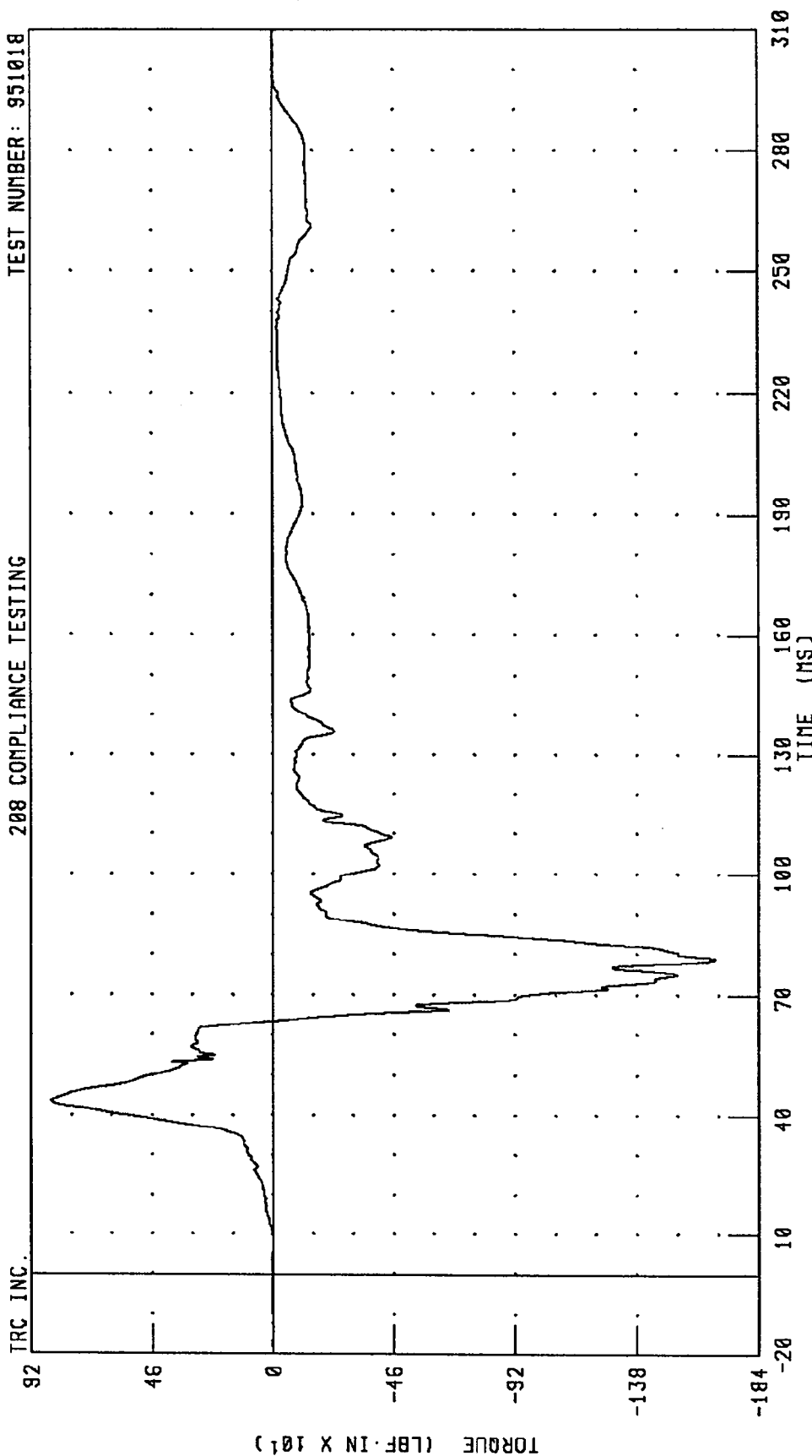
PEAK DATA: 45.45 LBF-IN @ 82.16 MS; -366.74 LBF-IN @ 49.04 MS

CHANNEL: TBLXM1 FILTER: CH. CLASS 600

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
DRIVER LEFT UPPER TIBIA MOMENT ABOUT Y-AXIS

TEST NUMBER: 951018

208 COMPLIANCE TESTING



PEAK DATA: 844.60 LBF·IN @ 43.60 MS; -1676.26 LBF·IN @ 78.88 MS

CHANNEL: TBLYM1 FILTER: CH. CLASS 600

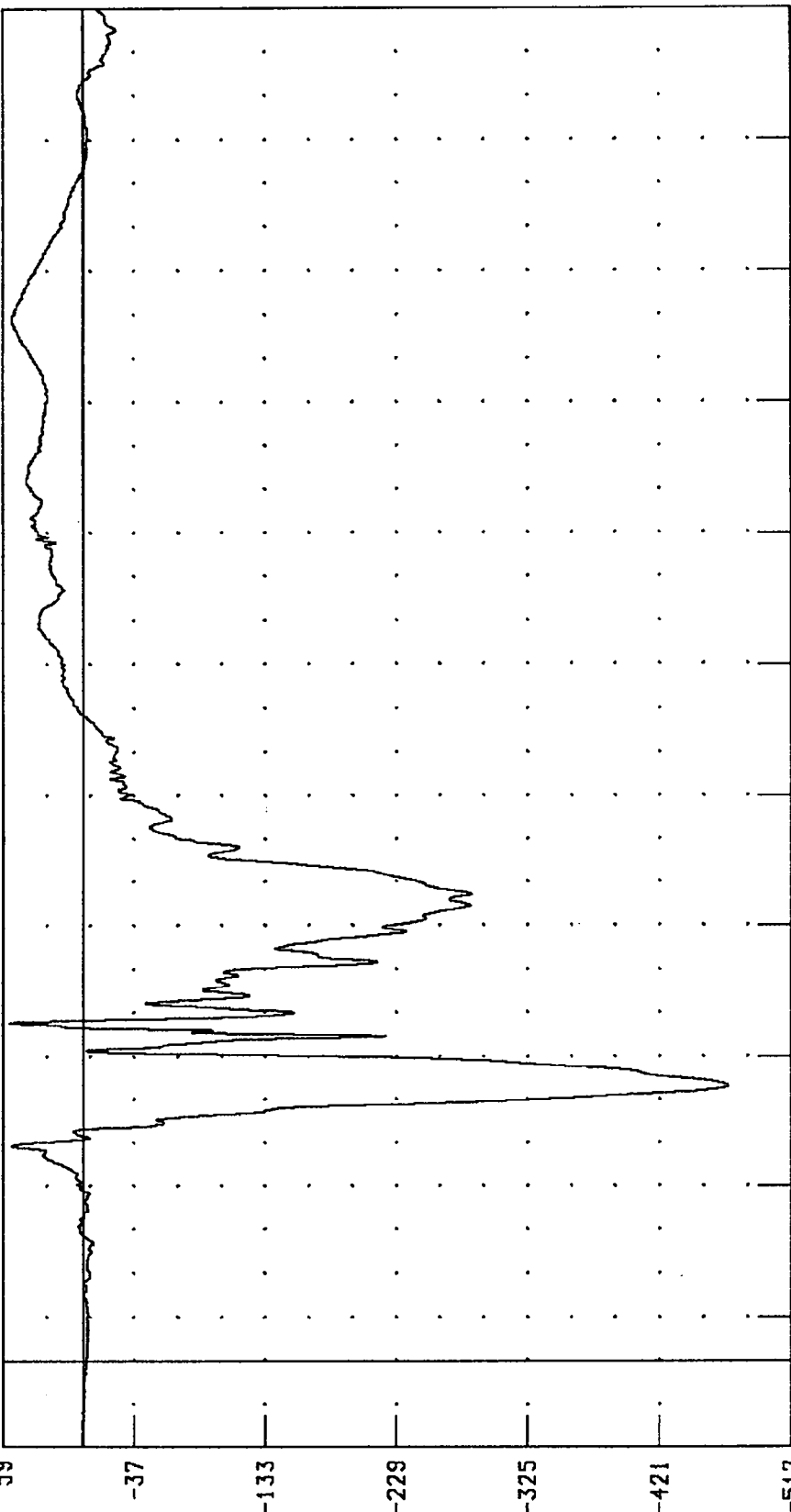
1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
DRIVER RIGHT UPPER TIBIA MOMENT ABOUT X-AXIS

200 COMPLIANCE TESTING

TEST NUMBER: 951018

TRC INC.

59



-517

-20

10

40

70

100

130

160

190

220

250

280

310

TIME (MS)

PEAK DATA: 54.28 LBF-IN @ 77.84 MS; -471.40 LBF-IN @ 63.12 MS

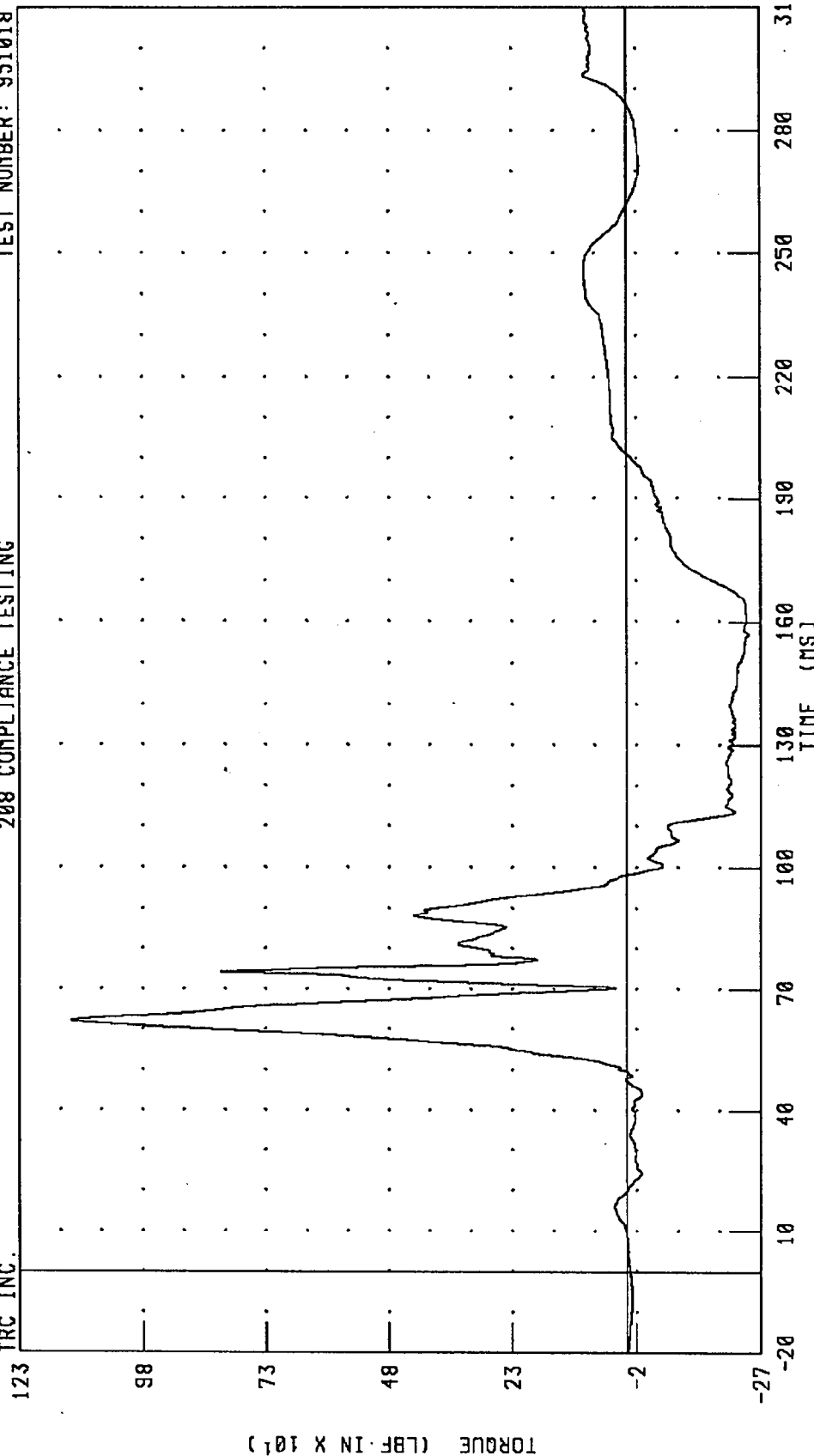
CHANNEL: TBRXM1 FILTER: CH. CLASS 600

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
DRIVER RIGHT UPPER TIBIA MOMENT ABOUT Y-AXIS

TEST NUMBER: 951018

208 COMPLIANCE TESTING

TRC INC.



PEAK DATA: 1125.08 LBF-IN @ 62.16 MS; -245.66 LBF-IN @ 156.96 MS

CHANNEL: TBRYM1 FILTER: CH. CLASS 600

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
 DRIVER LEFT LOWER TIBIA X-AXIS FORCE
 208 COMPLIANCE TESTING

TEST NUMBER: 951018

TRC INC.

130

81

32

-17

-66

-115

-164

FORCE (LBF)

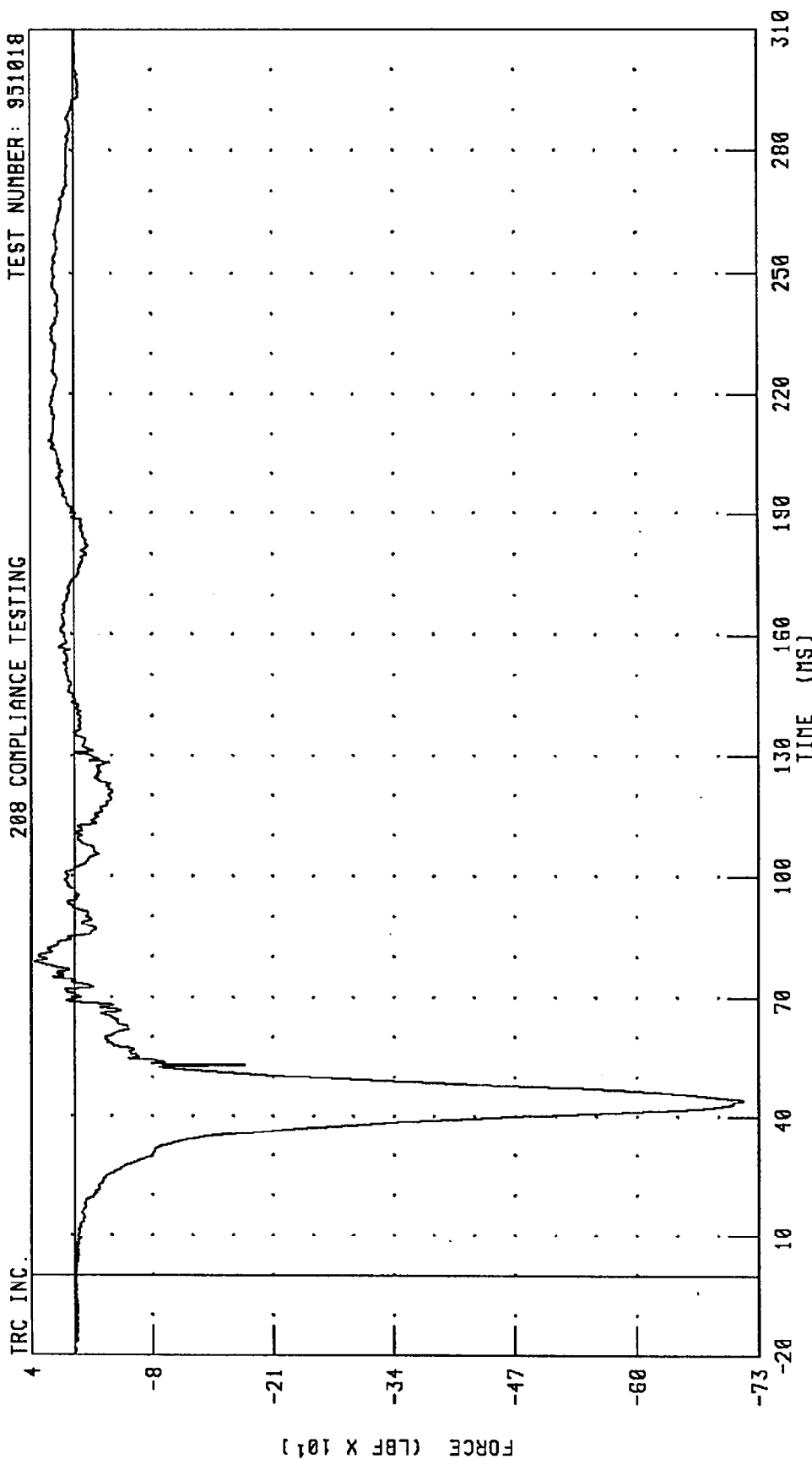
TIME (MS) 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310

PEAK DATA: 123.91 LBF @ 73.84 MS; -147.03 LBF @ 44.00 MS

CHANNEL: ANLXF1 FILTER: CH. CLASS 600

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
 DRIVER LEFT LOWER TIBIA Z-AXIS FORCE
 208 COMPLIANCE TESTING

TEST NUMBER: 951018



PEAK DATA: 43.52 LBF @ 78.80 MS; -715.94 LBF @ 44.16 MS

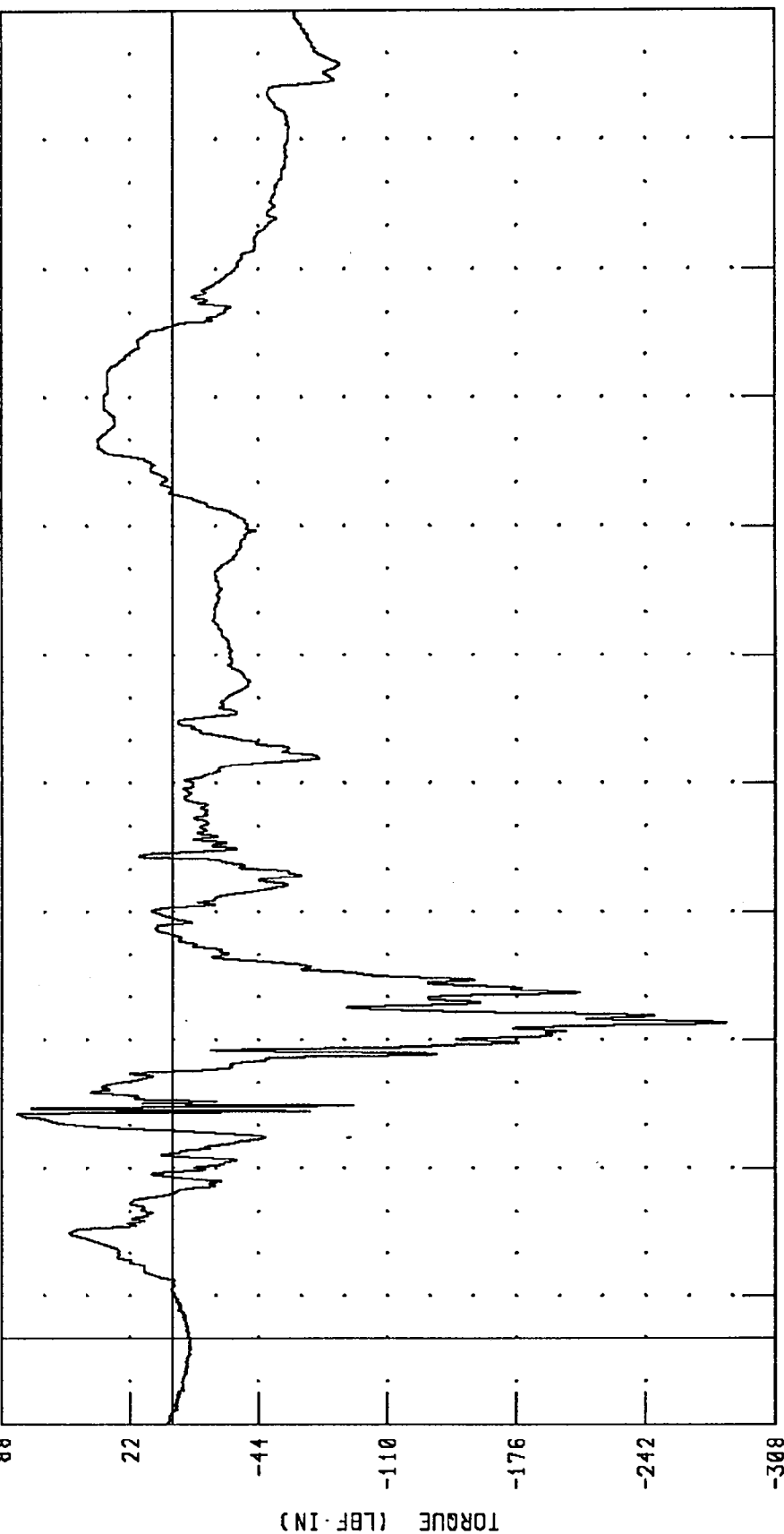
CHANNEL: ANLZF1 FILTER: CH. CLASS 600

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
DRIVER LEFT LOWER TIBIA MOMENT ABOUT Y-AXIS

208 COMPLIANCE TESTING

TEST NUMBER: 951018

TRC INC.



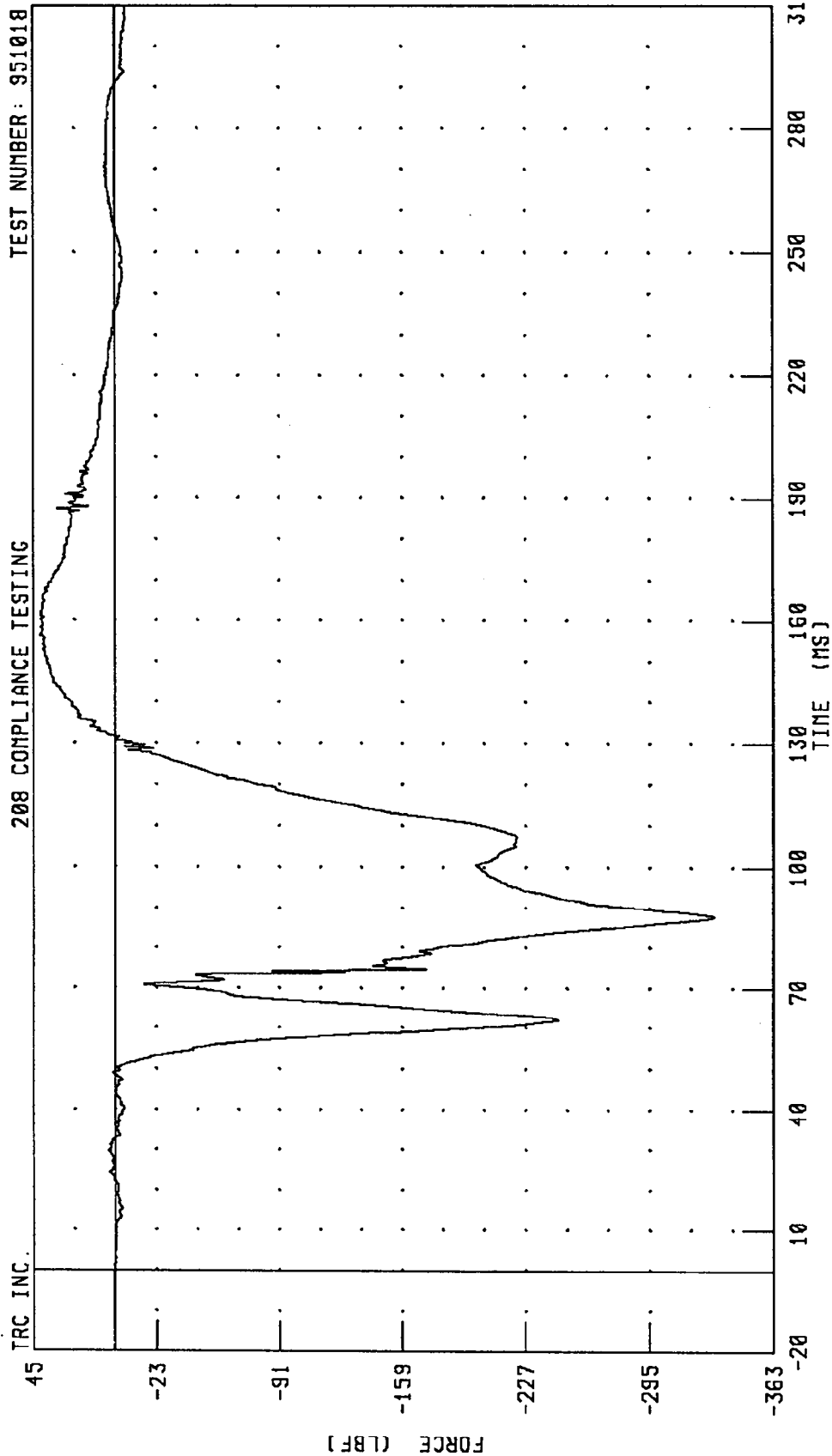
PEAK DATA: 80.01 LBF-IN @ 52.48 MS; -283.14 LBF-IN @ 74.00 MS

CHANNEL: ANLYM1 FILTER: CH. CLASS 600

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
DRIVER RIGHT LOWER TIBIA X-AXIS FORCE

TEST NUMBER: 951018

208 COMPLIANCE TESTING



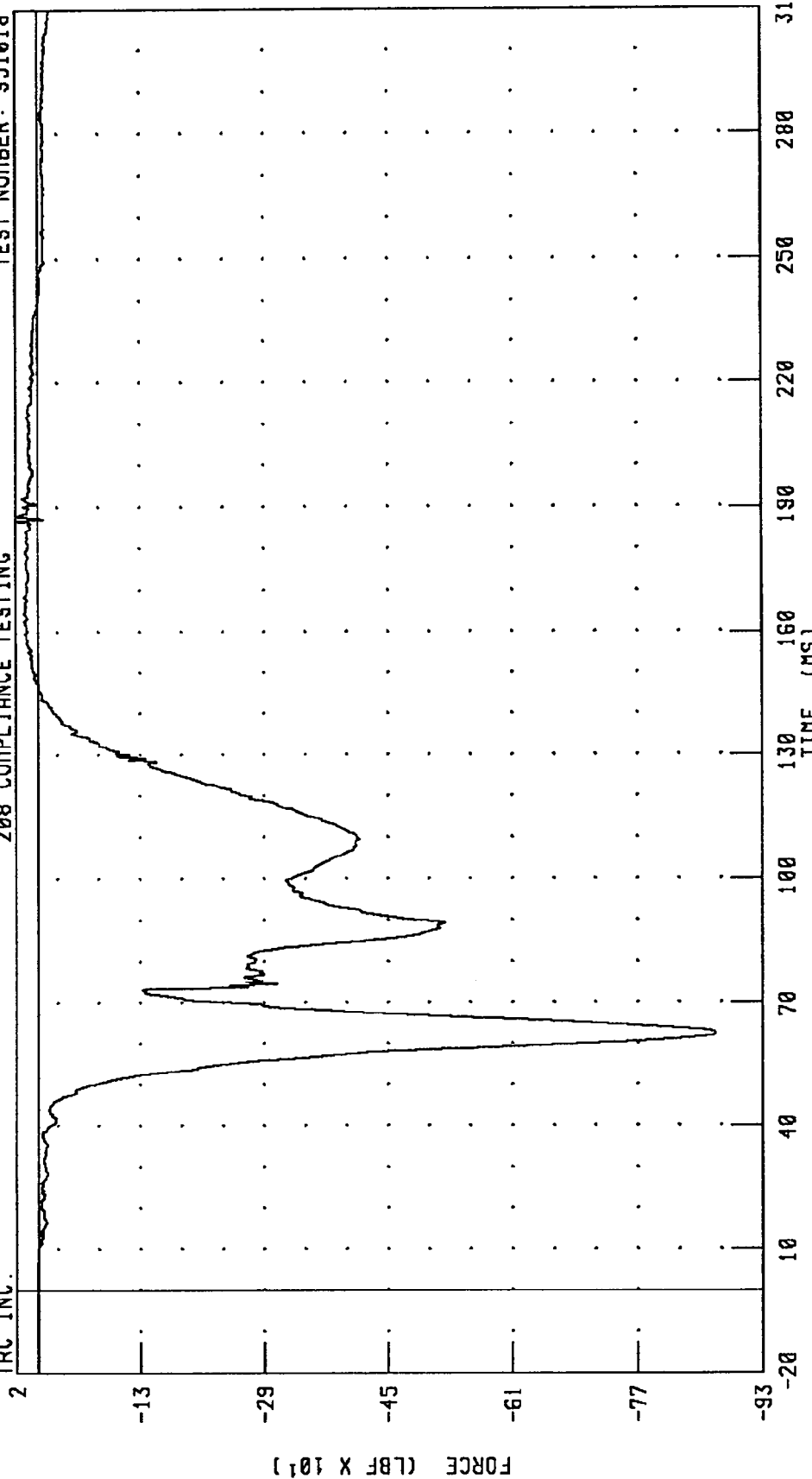
PEAK DATA: 41.15 LBF @ 156.56 MS; -330.36 LBF @ 87.92 MS

CHANNEL: ANRXF1 FILTER: CH. CLASS 600

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
 DRIVER RIGHT LOWER TIBIA Z-AXIS FORCE
 208 COMPLIANCE TESTING

TEST NUMBER: 951018

TRC INC.

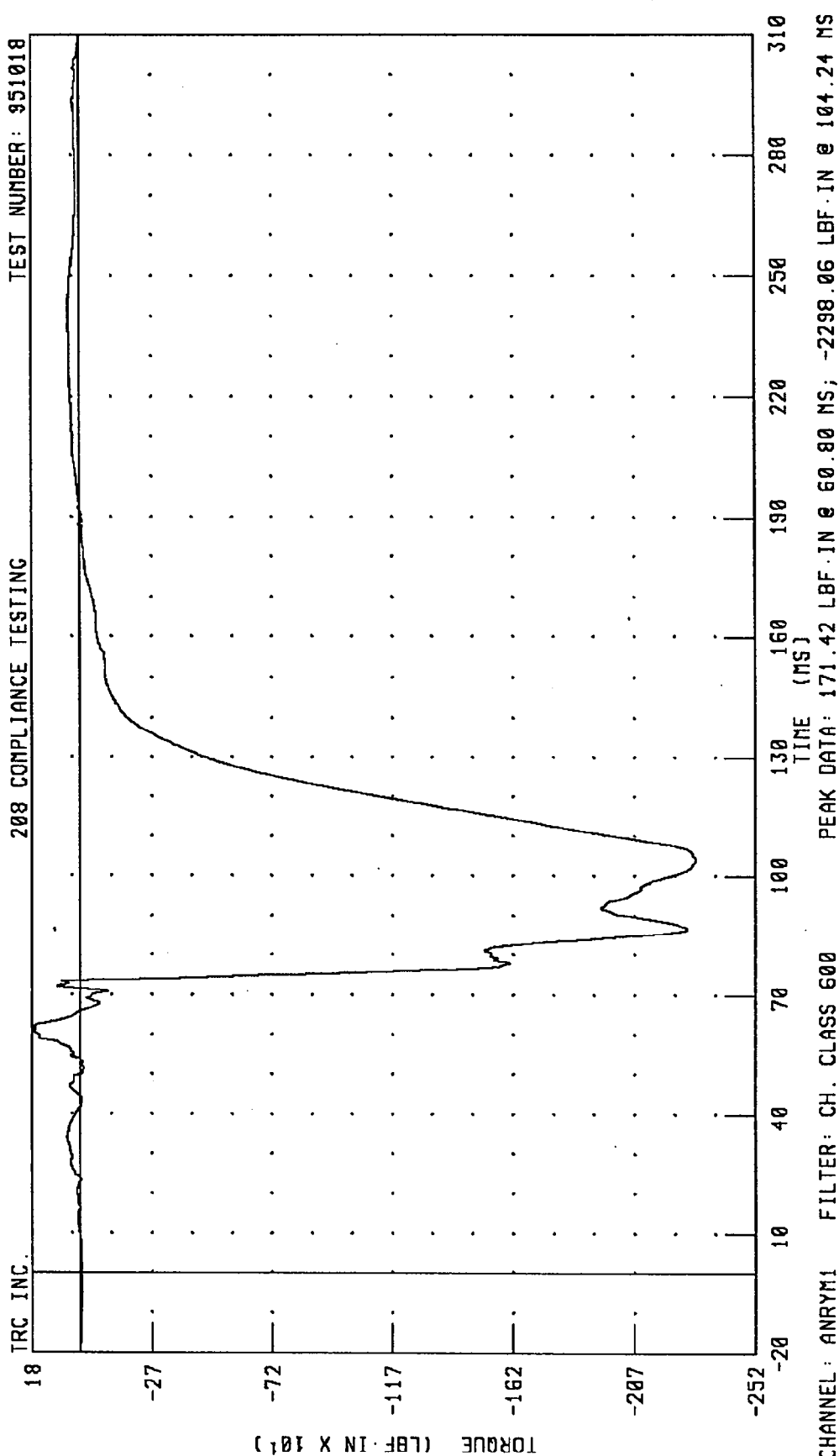


CHANNEL: ANRZF1 FILTER: CH. CLASS 600

951018

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
DRIVER RIGHT LOWER TIBIA MOMENT ABOUT Y-AXIS
208 COMPLIANCE TESTING

TEST NUMBER: 951018



CHANNEL: ANRYM1 FILTER: CH. CLASS 600 PEAK DATA: 171.42 LBF-IN @ 60.80 MS; -2298.06 LBF-IN @ 104.24 MS

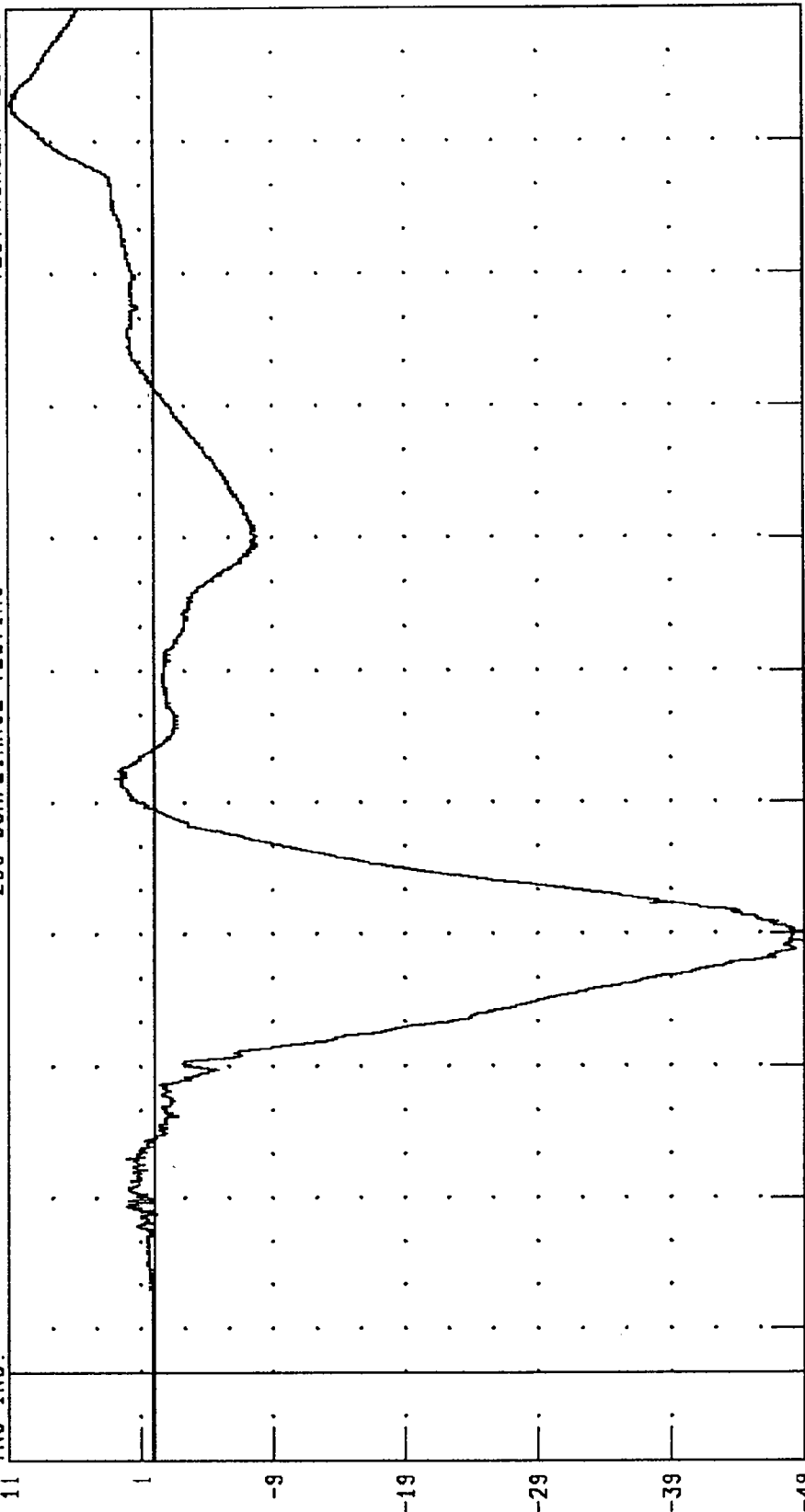
1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER HEAD X-AXIS ACCELERATION

TEST NUMBER: 951018

208 COMPLIANCE TESTING

TRC INC.

11



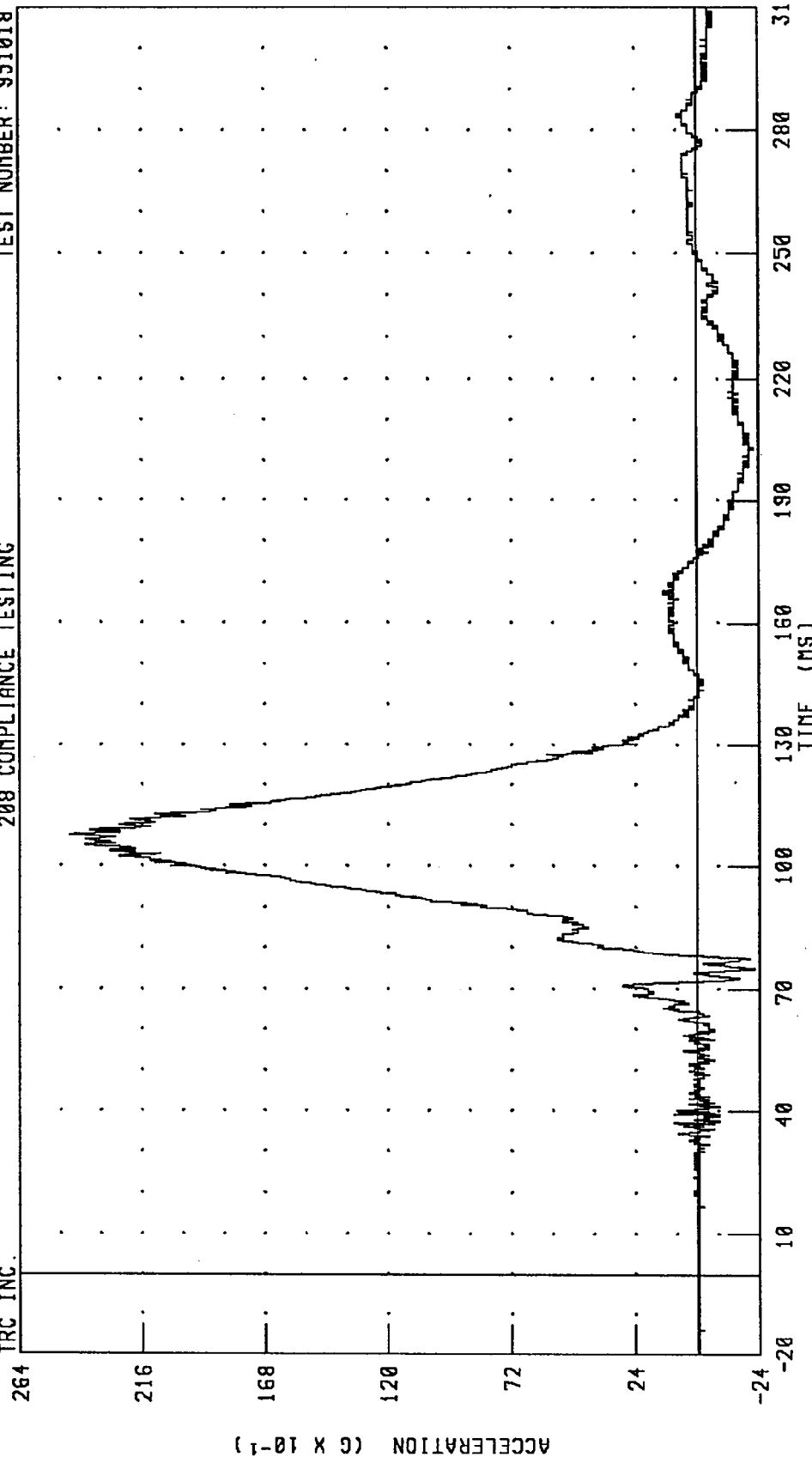
PEAK DATA: 10.72 G @ 288.08 MS; -49.00 G @ 100.08 MS

CHANNEL: HEDXG2 FILTER: CH. CLASS 1000

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER HEAD Y-AXIS ACCELERATION
 208 COMPLIANCE TESTING

TEST NUMBER: 951018

TRC INC.



CHANNEL: HEDYG2 FILTER: CH. CLASS 1000

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER HEAD Z-AXIS ACCELERATION

TEST NUMBER: 951018

208 COMPLIANCE TESTING

TRC INC.

180

88

ACCELERATION (G X 10⁻¹)

-4

-96

-188

-280

-372

TIME (MS)

310

280

250

220

190

160

130

100

70

40

10

-20

CHANNEL: HEDZG2 FILTER: CH. CLASS 1000

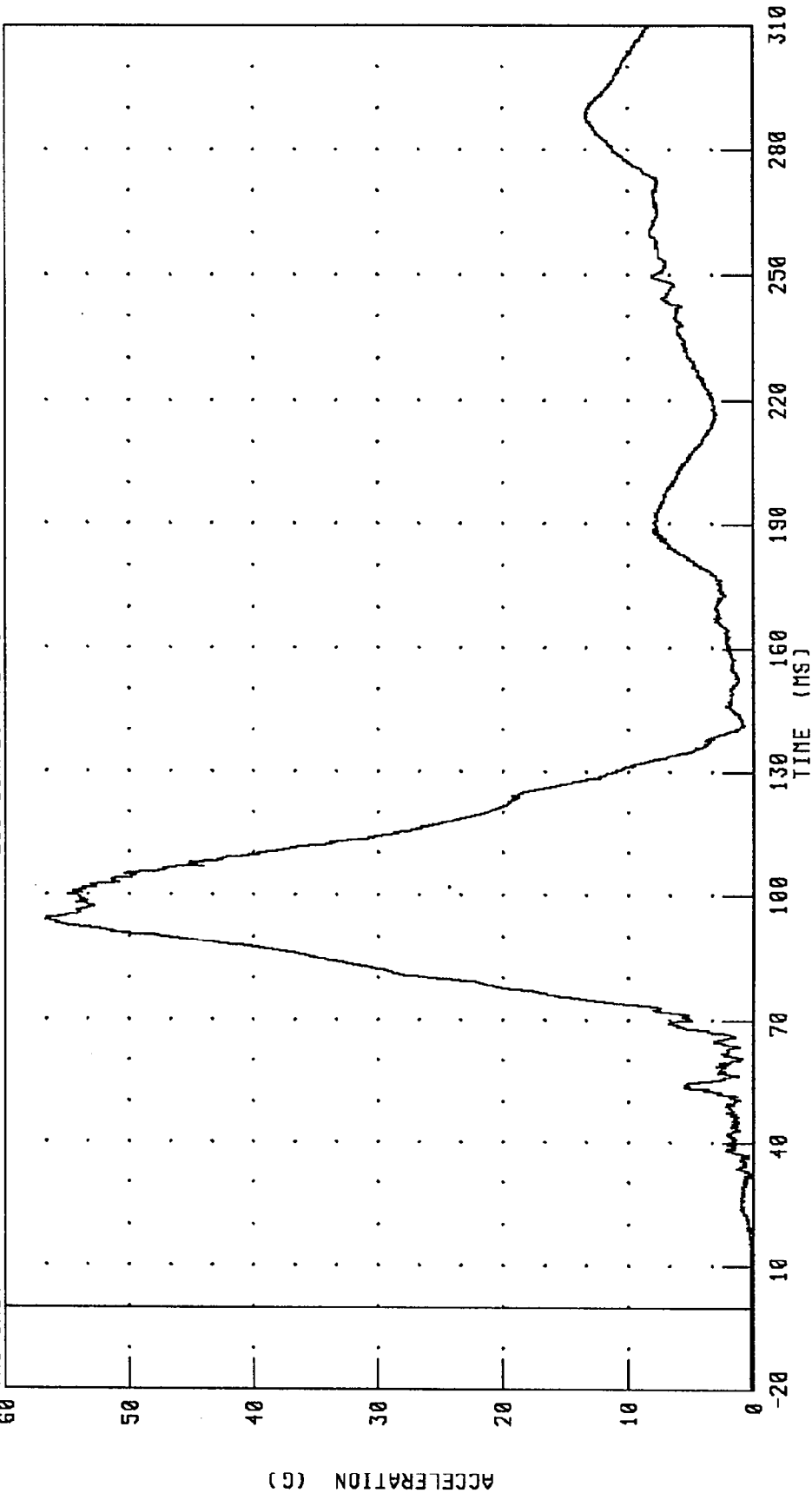
PEAK DATA: 17.18 G @ 123.92 MS; -33.15 G @ 93.20 MS

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER HEAD RESULTANT ACCELERATION

TEST NUMBER: 951018

200 COMPLIANCE TESTING

TRC INC.



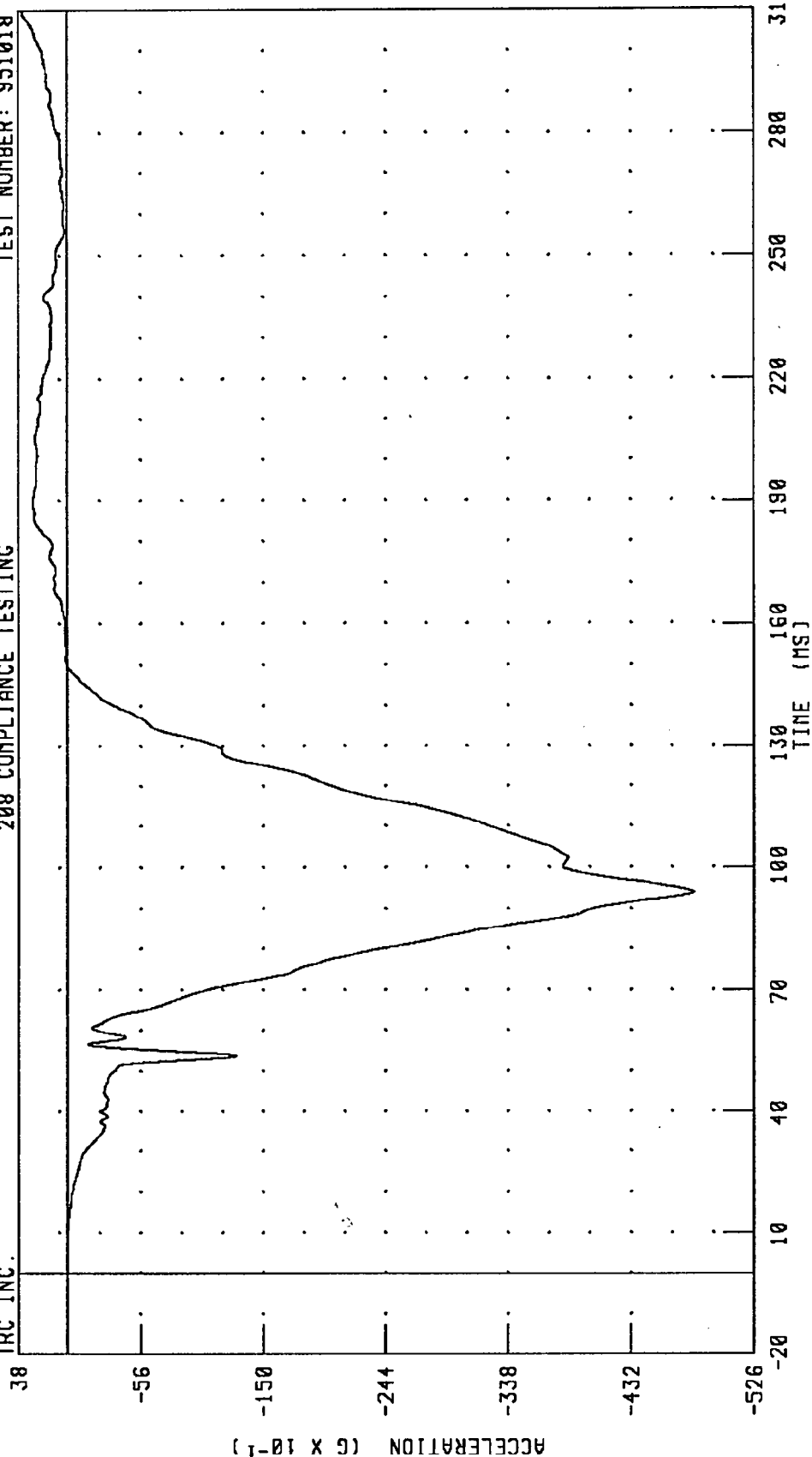
CHANNEL: HEDRC2 FILTER: CH. CLASS 1000

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER CHEST X-AXIS ACCELERATION

TEST NUMBER: 951018

208 COMPLIANCE TESTING

TRC INC.



CHANNEL: CSTXG2 FILTER: CH. CLASS 180

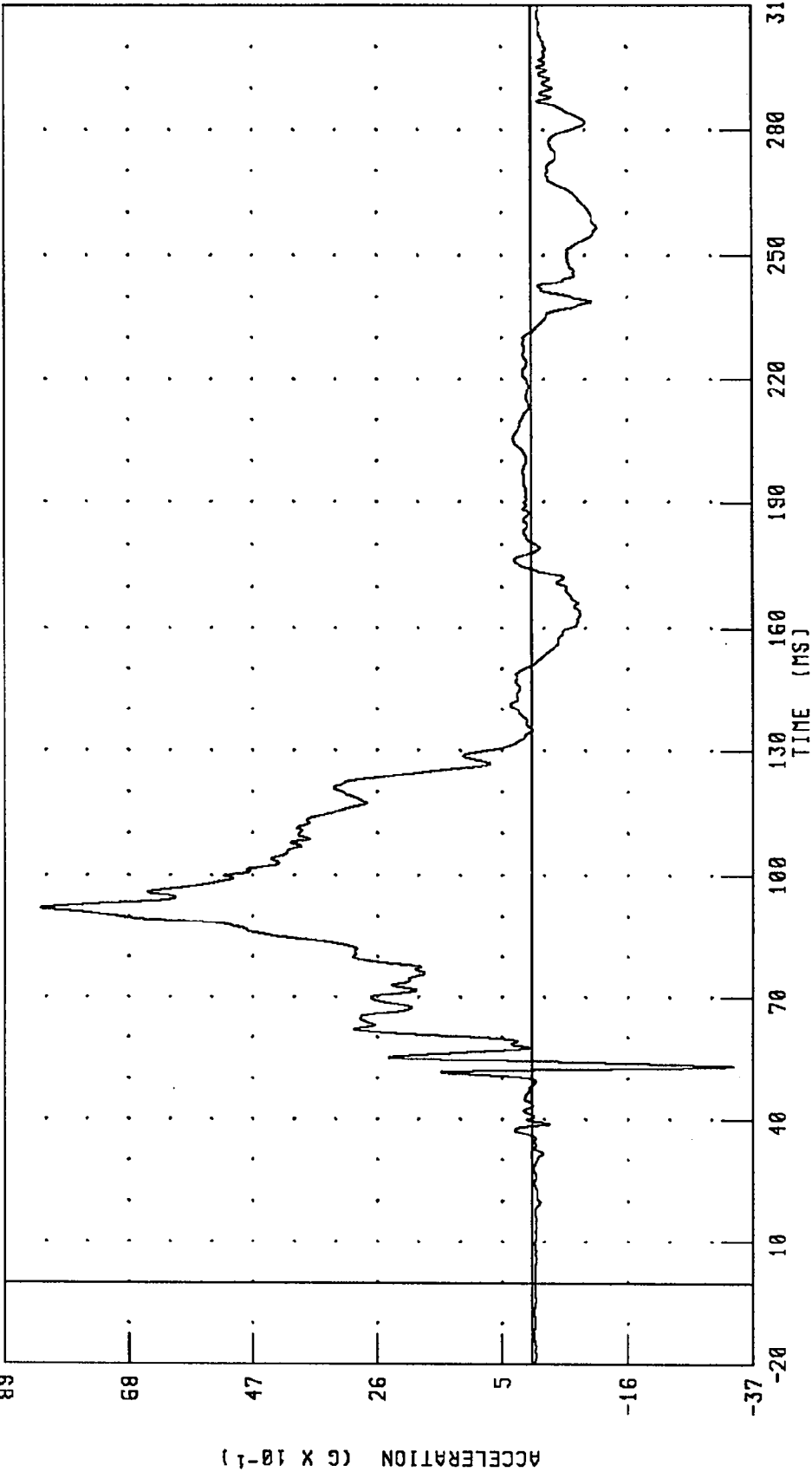
PEAK DATA: 3.47 G @ 309.44 MS; -48.01 G @ 94.00 MS

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER CHEST Y-AXIS ACCELERATION

TEST NUMBER: 951018

208 COMPLIANCE TESTING

TRC INC.



PEAK DATA: 8.29 G @ 92.08 MS; -3.37 G @ 52.96 MS

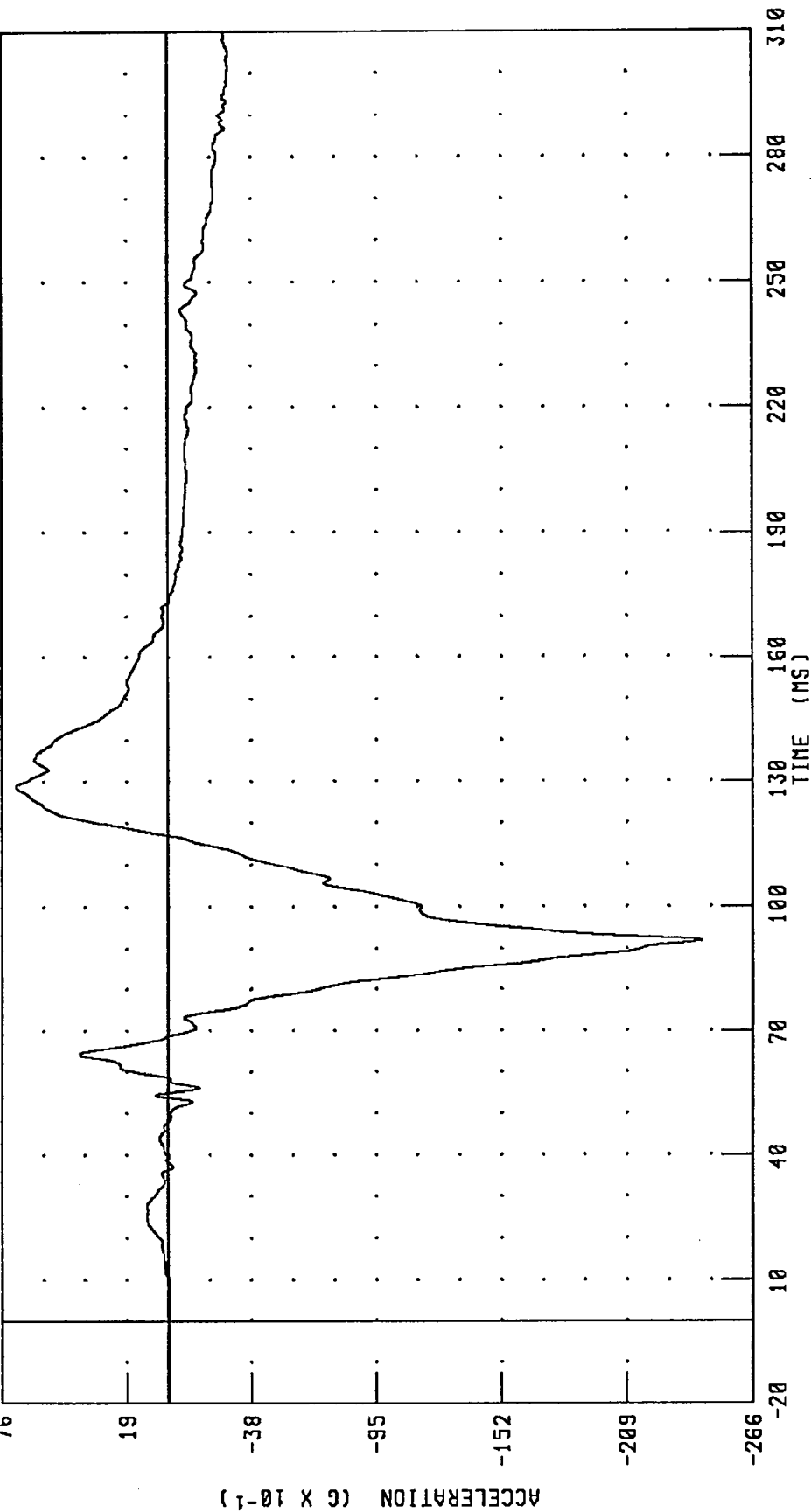
CHANNEL: CSTYG2 FILTER: CH. CLASS 180

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER CHEST Z-AXIS ACCELERATION

TEST NUMBER: 951018

208 COMPLIANCE TESTING

TRC INC.



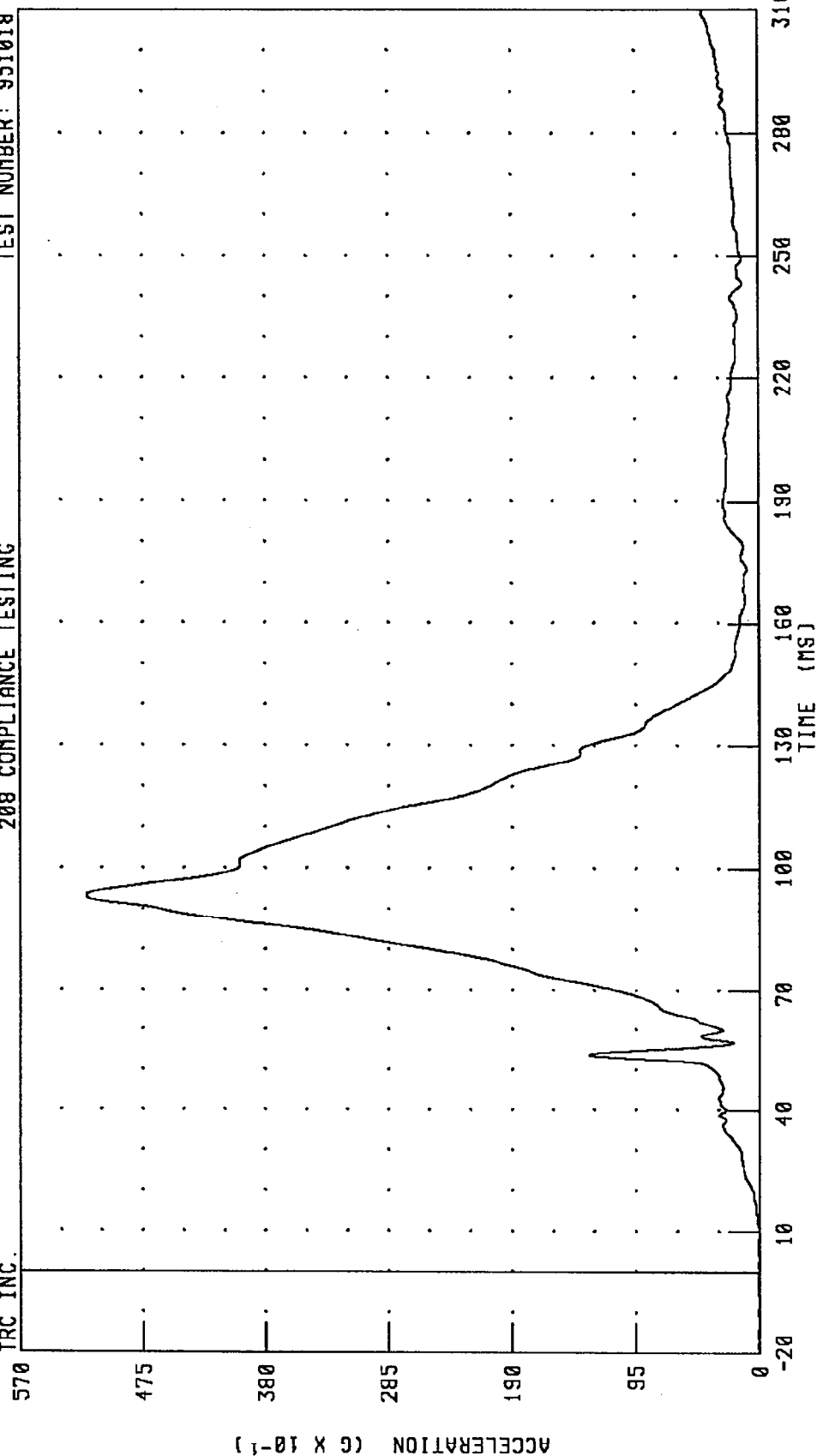
PEAK DATA: 6.98 G @ 128.88 MS; -24.27 G @ 92.00 MS

CHANNEL: CSTG2 FILTER: CH. CLASS 180

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER CHEST RESULTANT ACCELERATION
 208 COMPLIANCE TESTING

TEST NUMBER: 951018

TRC INC.



CHANNEL: CSTRG2 FILTER: CH. CLASS 180

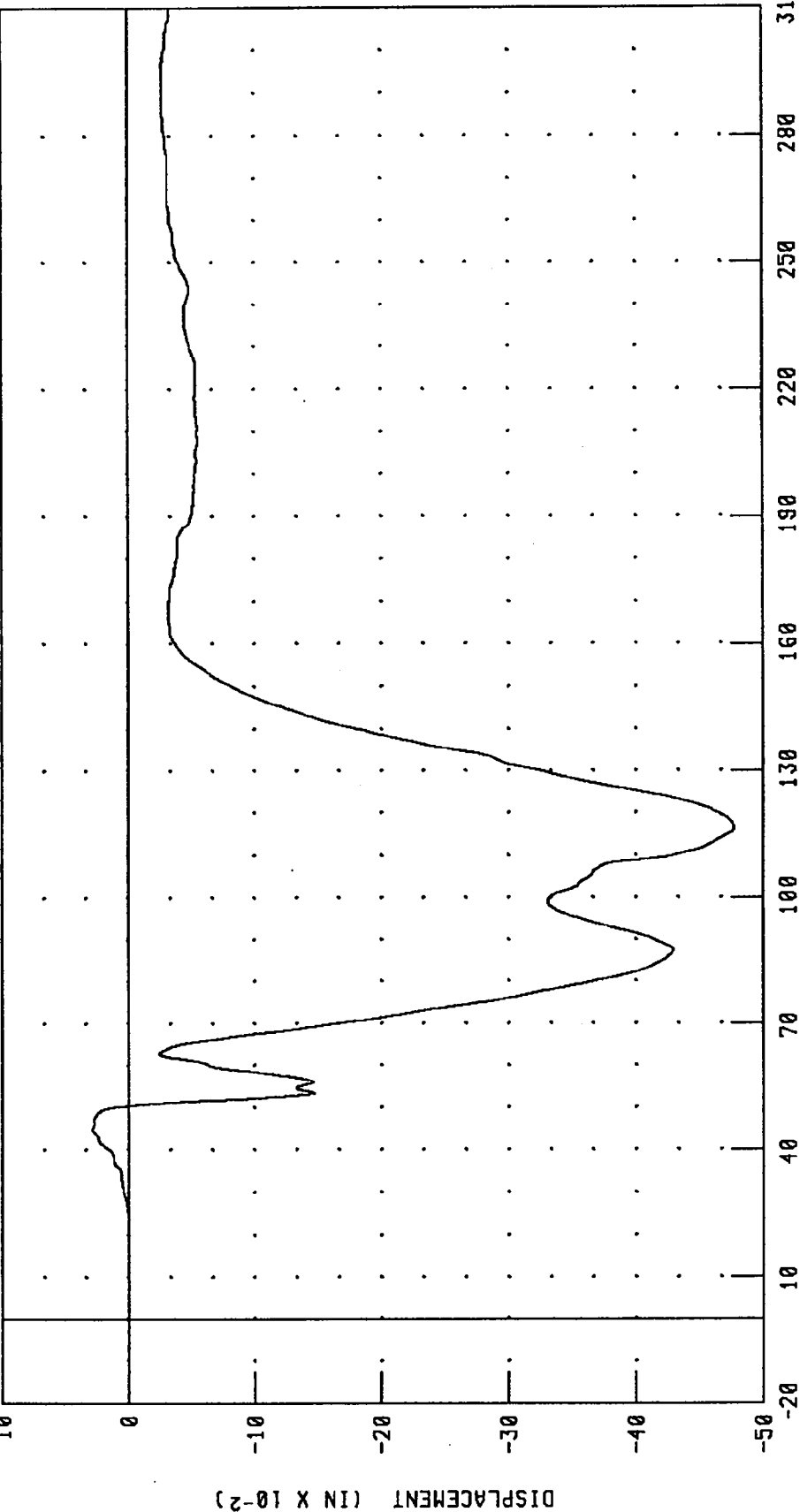
PEAK DATA: 51.86 G @ 93.28 MS; 0.00 G @ -20.00 MS

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER CHEST DEFLECTION

TEST NUMBER: 951018

208 COMPLIANCE TESTING

TRC INC.



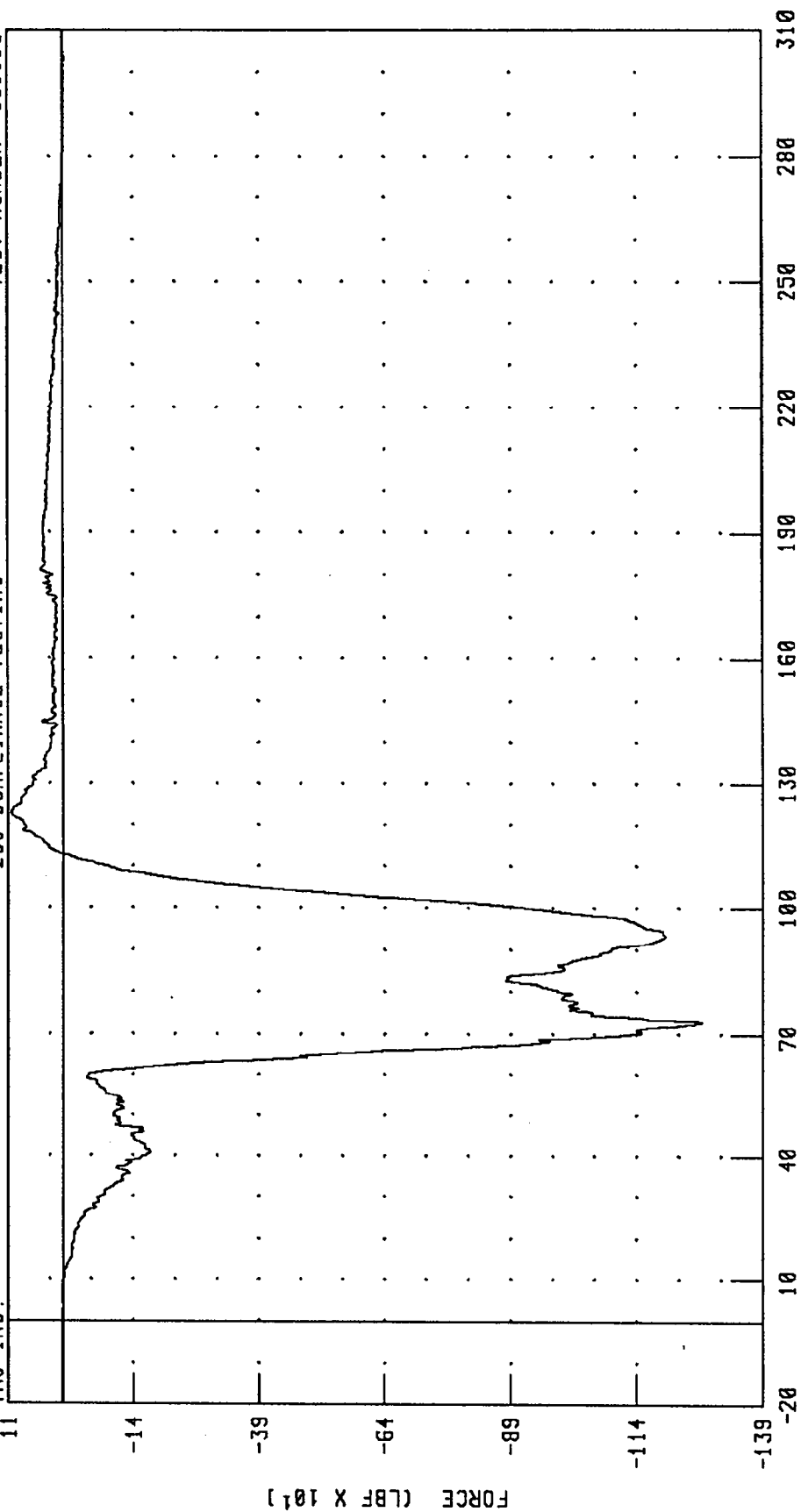
PEAK DATA: 0.03 IN @ 44.72 MS; -0.48 IN @ 116.32 MS

CHANNEL: CSTXD2 FILTER: CH. CLASS 180

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER LEFT FEMUR FORCE
 208 COMPLIANCE TESTING

TEST NUMBER: 951018

11 IRC INC.

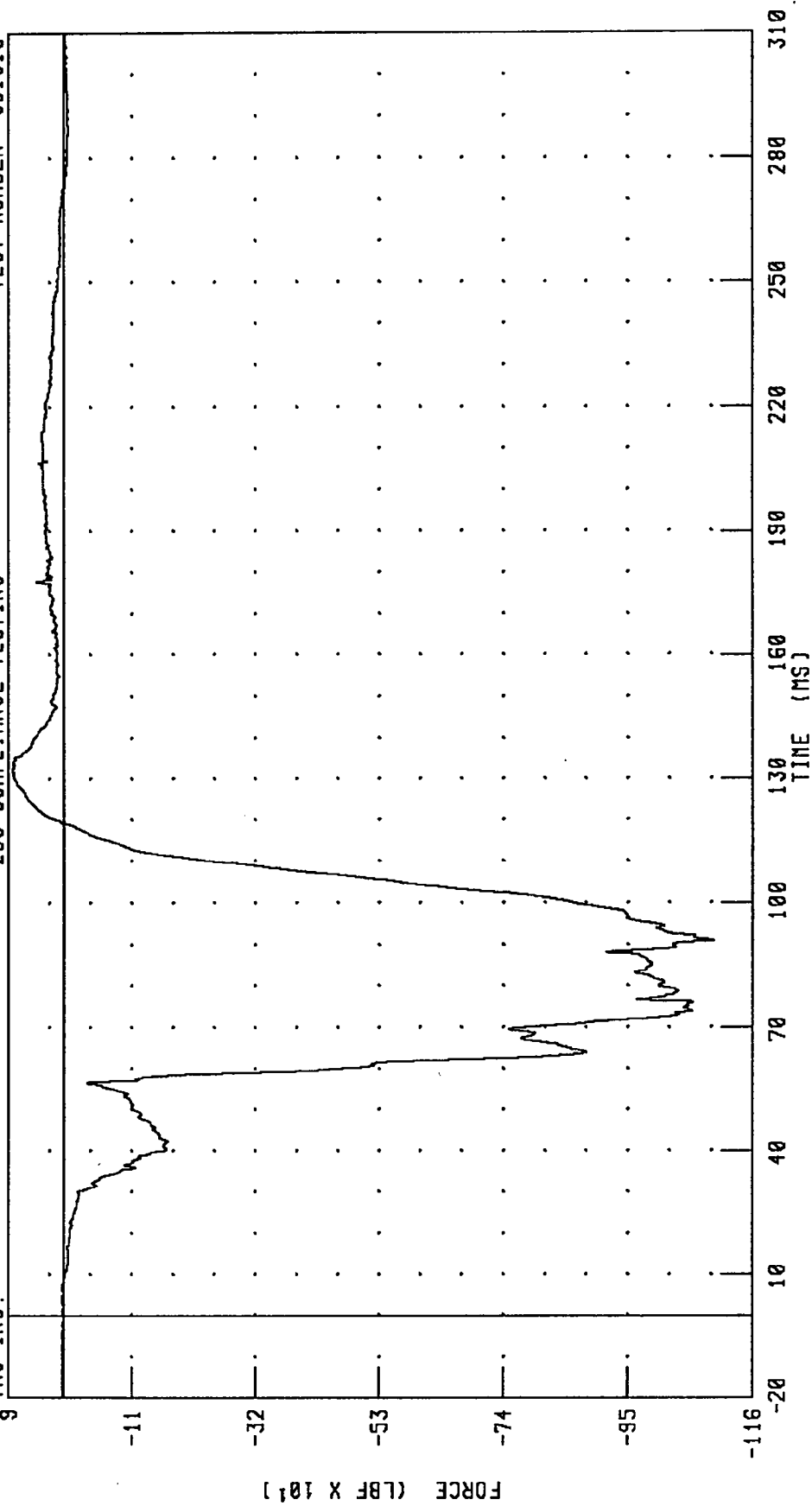


1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER RIGHT FEMUR FORCE

TEST NUMBER: 951018

208 COMPLIANCE TESTING

TRC INC.

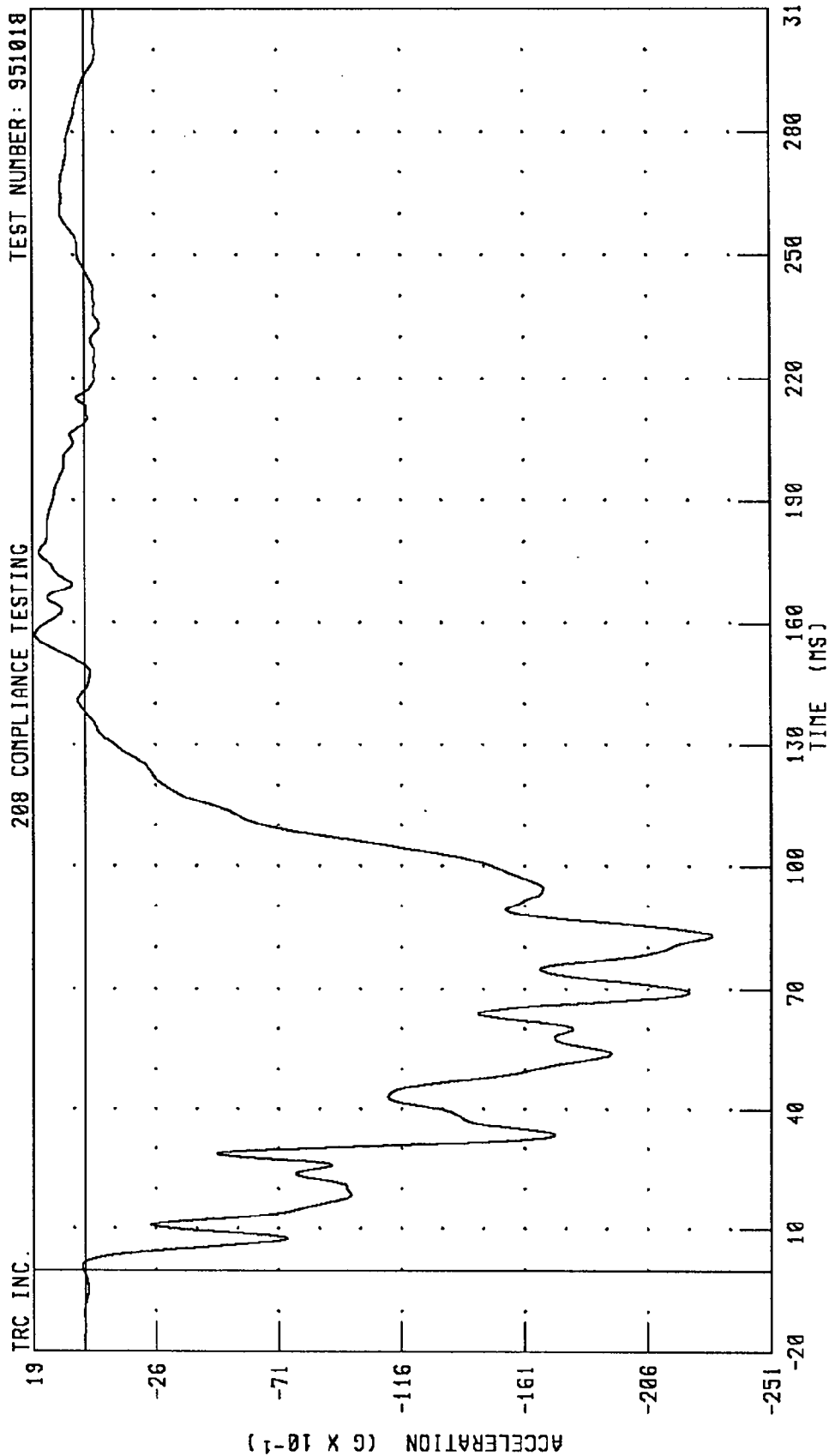


PEAK DATA: 86.29 LBF @ 132.00 MS; -1098.90 LBF @ 90.96 MS

CHANNEL: RFMF2 FILTER: CH. CLASS 600

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
 LEFT REAR SEAT X-AXIS ACCELERATION
 200 COMPLIANCE TESTING

TEST NUMBER: 951018

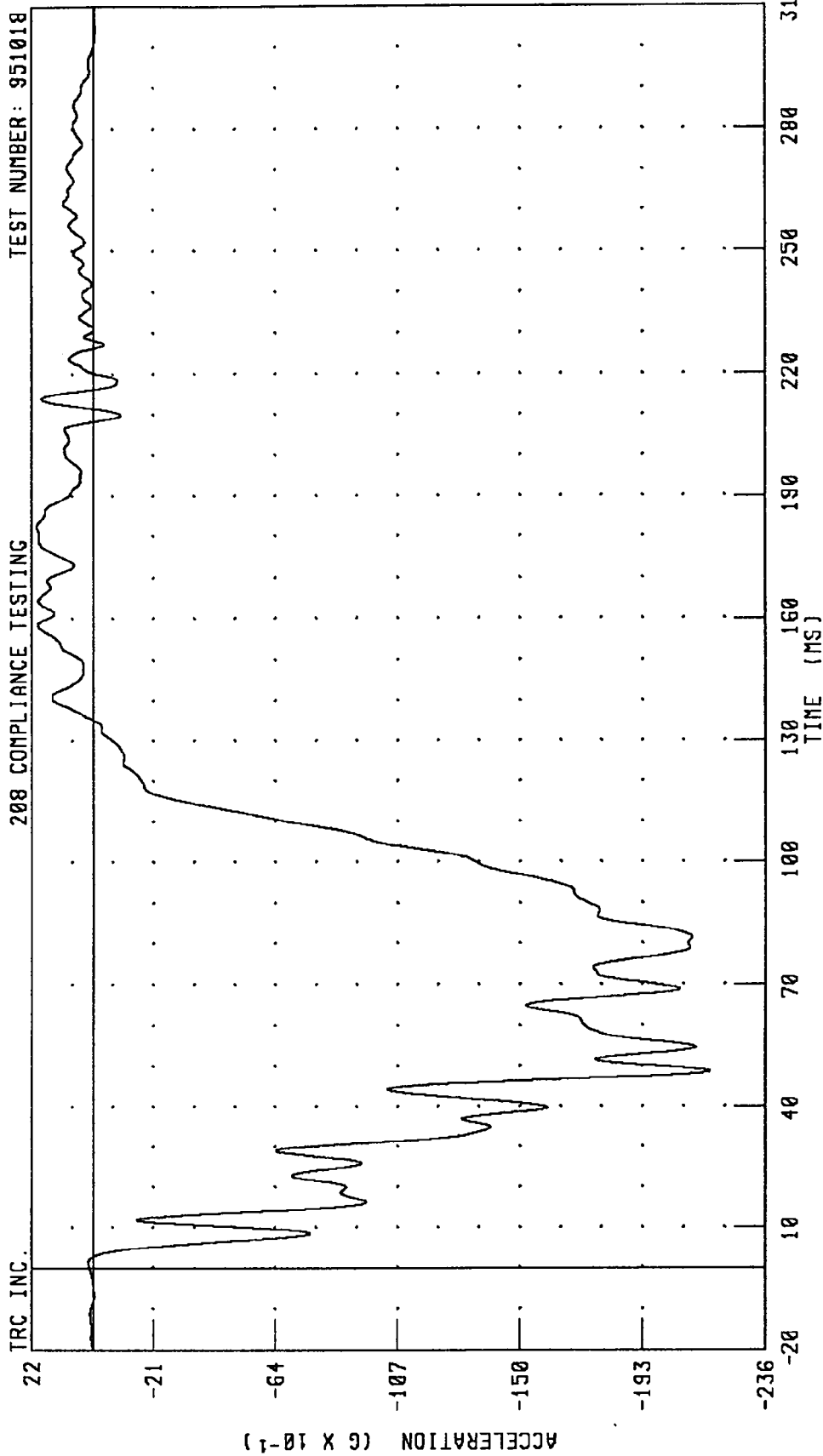


PEAK DATA: 1.81 G @ 157.12 MS; -22.96 G @ 82.96 MS

CHANNEL: TLRXG1 FILTER: CH. CLASS 60

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
 RIGHT REAR SEAT X-AXIS ACCELERATION
 208 COMPLIANCE TESTING

TEST NUMBER: 951018



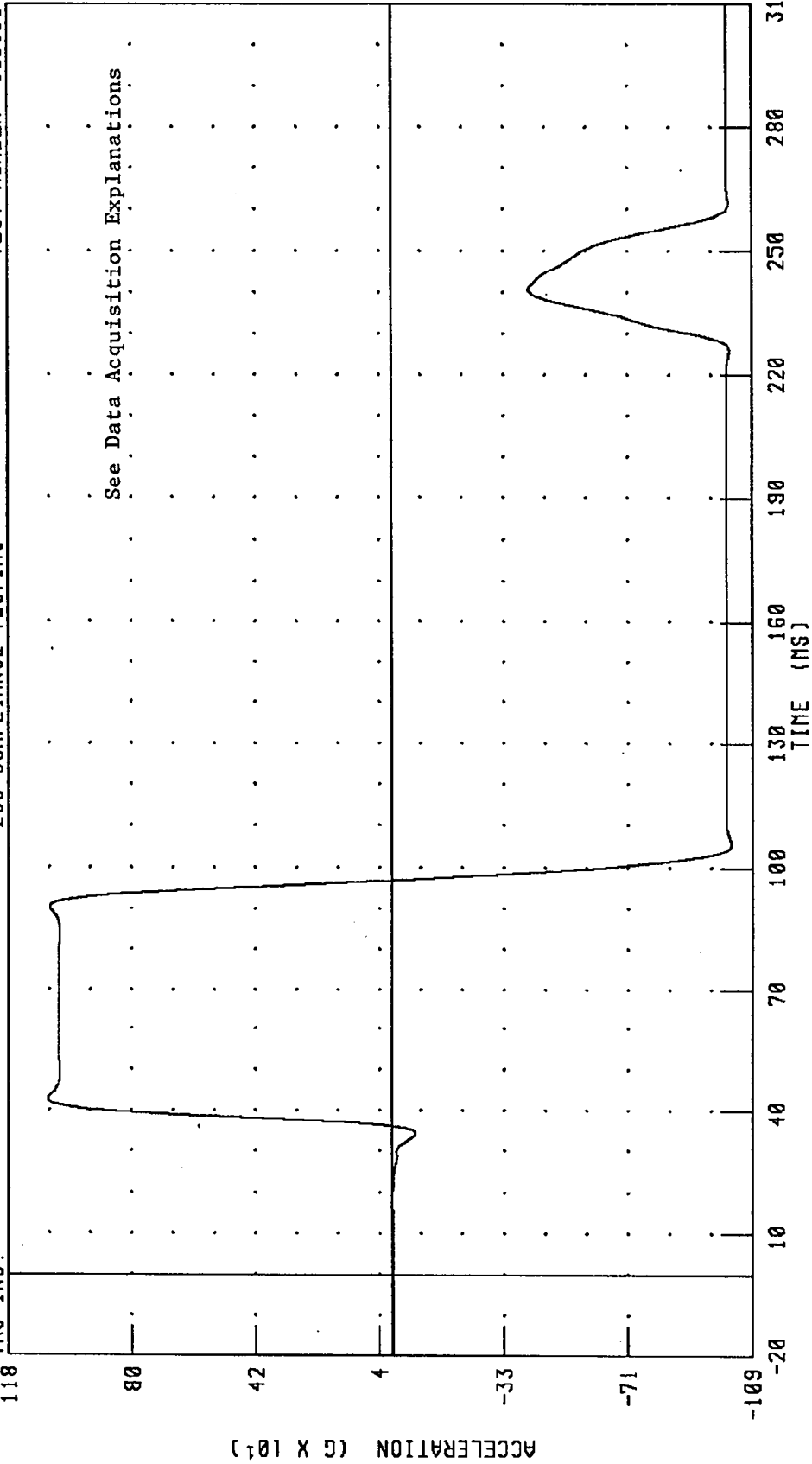
PEAK DATA: 2.01 G @ 182.40 MS; -21.67 G @ 48.64 MS

CHANNEL: TRRXG1 FILTER: CH. CLASS 60

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
ENGINE UPPER BLOCK X-AXIS ACCELERATION
208 COMPLIANCE TESTING

TEST NUMBER: 951018

TRC INC.



PEAK DATA: 1057.17 G @ 42.72 MS; -1035.33 G @ 105.60 MS

CHANNEL: ENGCG1 FILTER: CH. CLASS 60

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
ENGINE BOTTOM BLOCK X-AXIS ACCELERATION

TEST NUMBER: 951018

208 COMPLIANCE TESTING

TRC INC.

25

8

-9

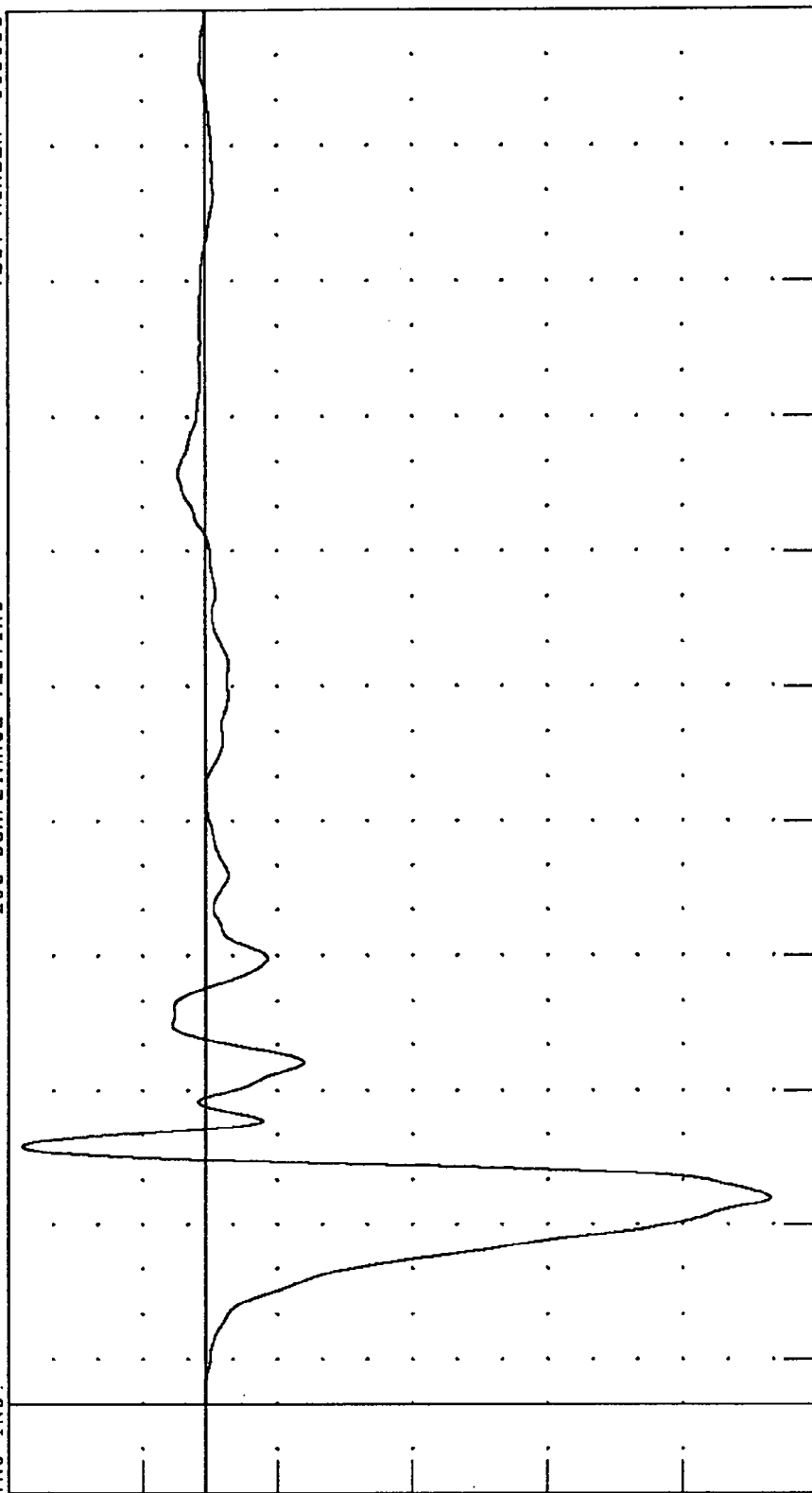
-26

-43

-60

-77

ACCELERATION (G)



TIME (MS)

310

280

250

220

190

160

130

100

70

40

10

-20

CHANNEL: ENGXC2 FILTER: CH. CLASS 60

PEAK DATA: 23.25 G @ 57.52 MS; -71.01 G @ 45.84 MS

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
RIGHT BRAKE CALIPER X-AXIS ACCELERATION

TEST NUMBER: 951018

208 COMPLIANCE TESTING

TRC INC.

32

13

-6

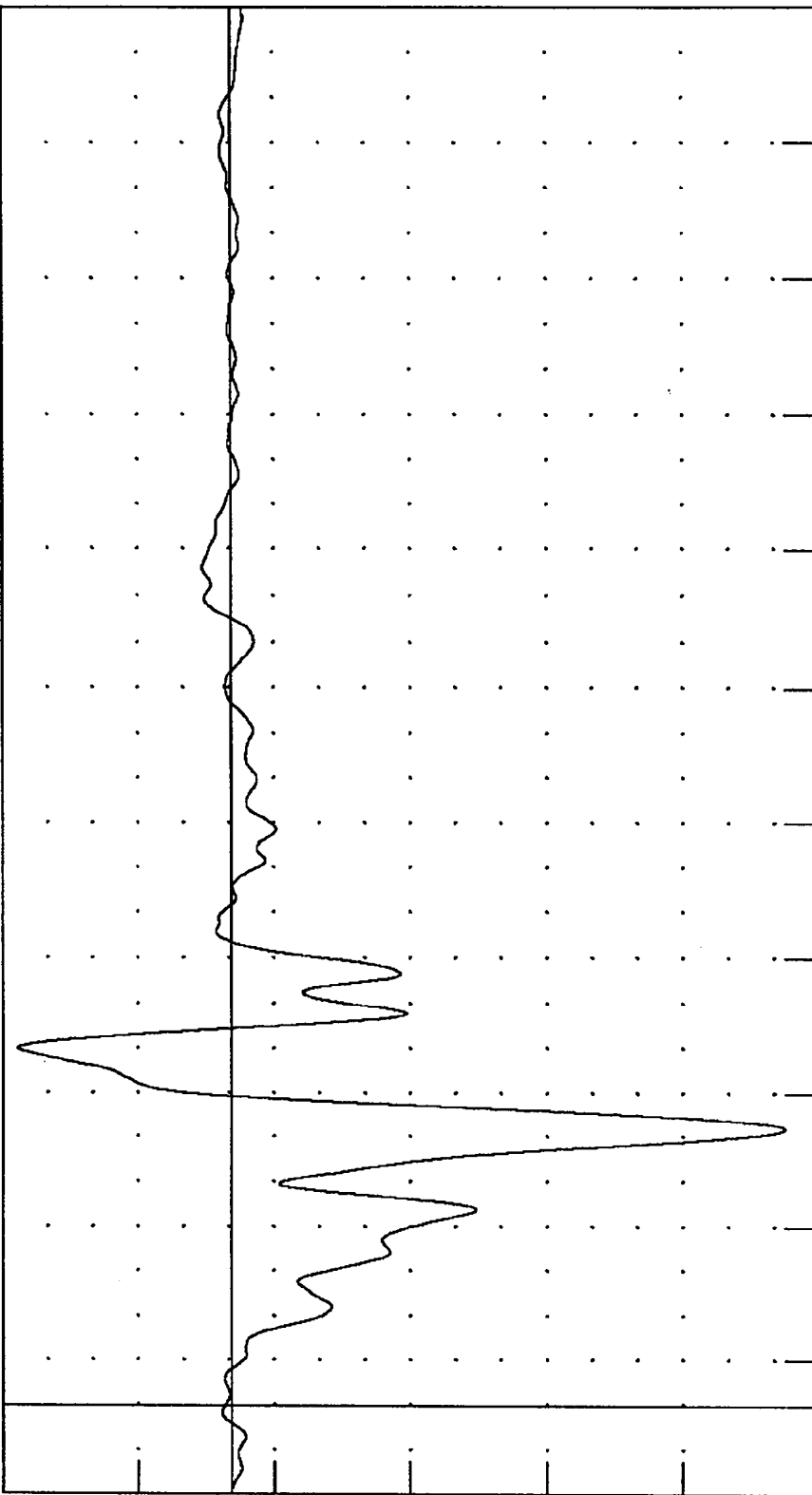
-25

-44

-63

-82

ACCELERATION (G)



TIME (MS)

310

280

250

220

190

160

130

100

70

40

10

-20

-40

-60

-80

-100

-120

-140

-160

-180

-200

-220

-240

-260

-280

-300

-320

-340

-360

-380

-400

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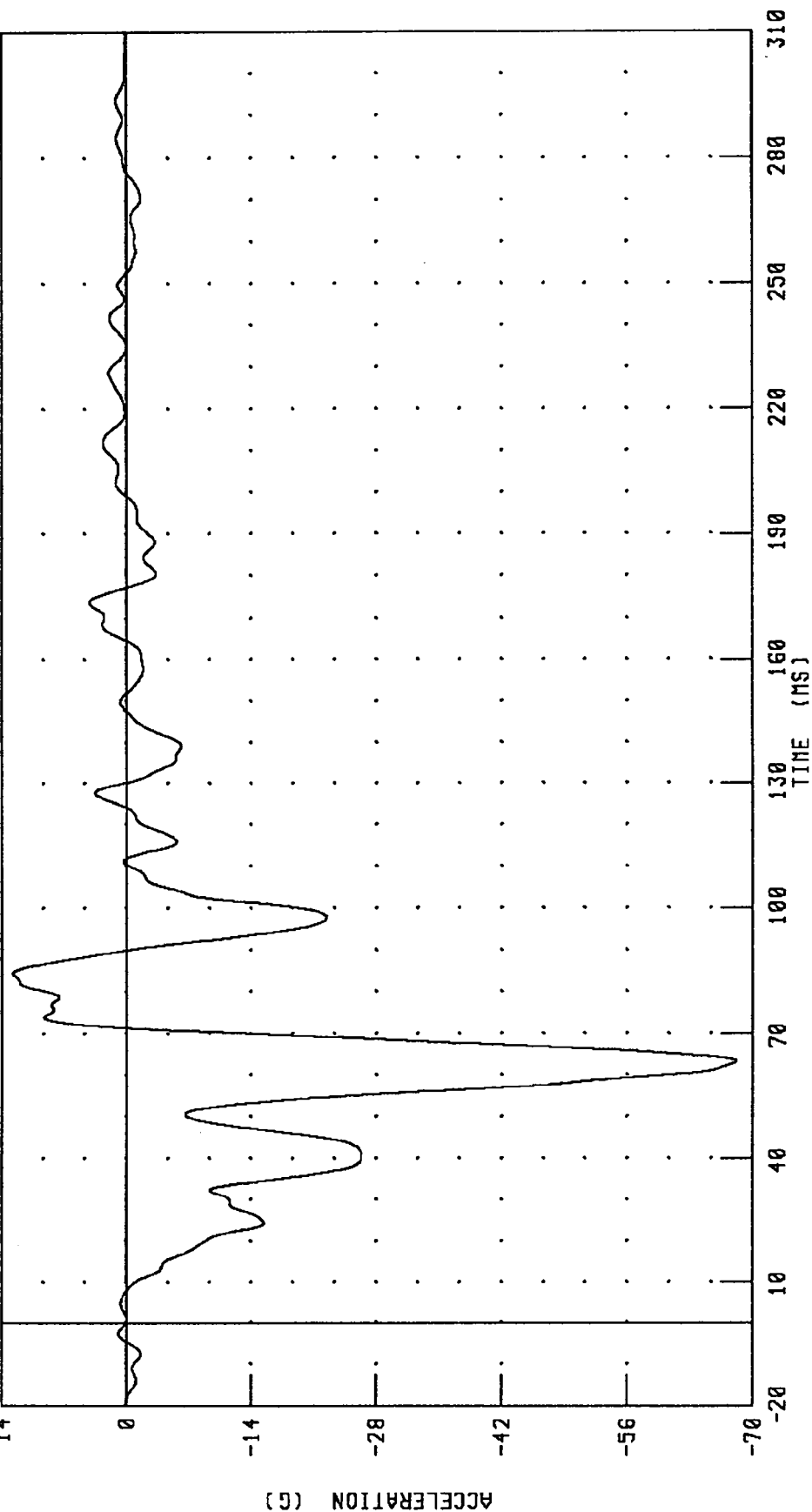
-4960

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
LEFT BRAKE CALIPER X-AXIS ACCELERATION

TEST NUMBER: 951018

200 COMPLIANCE TESTING

TRC INC.



CHANNEL: BCLXG1 FILTER: CH. CLASS 60

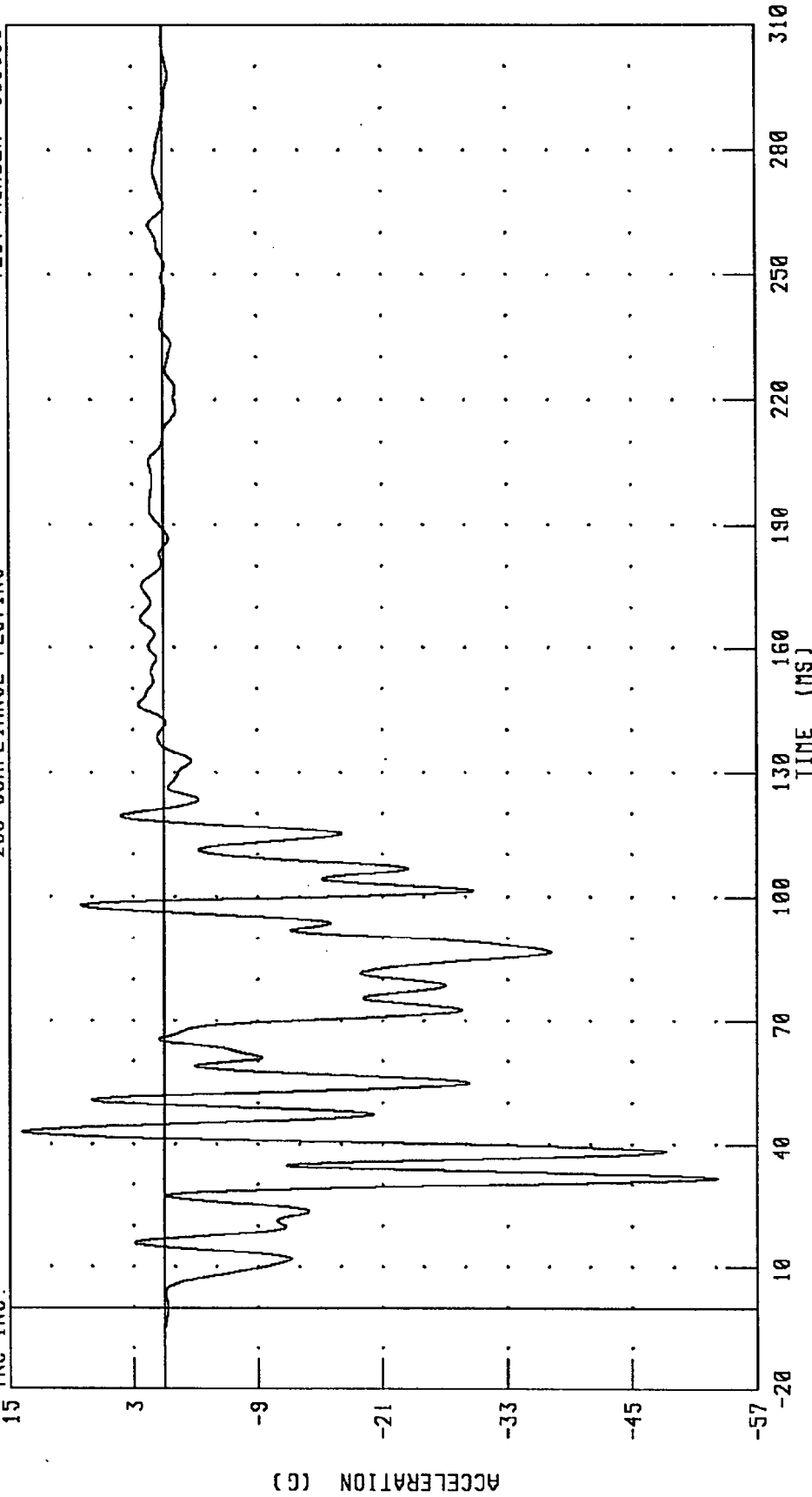
PEAK DATA: 12.76 G @ 84.56 MS; -68.23 G @ 63.28 MS

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
DASH PANEL CENTER X-AXIS ACCELERATION

TEST NUMBER: 951018

208 COMPLIANCE TESTING

TRC INC.



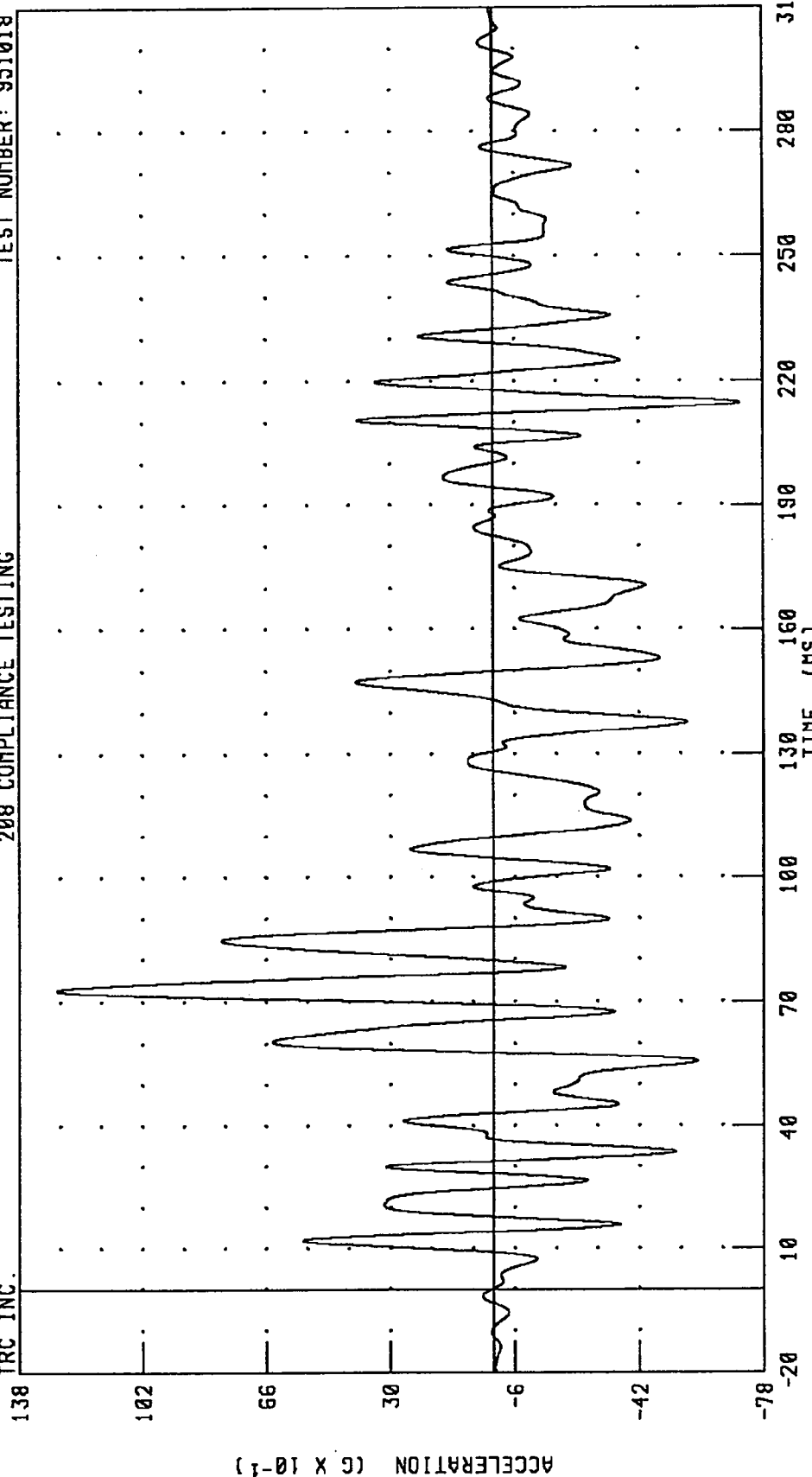
CHANNEL: DPCXG1 FILTER: CH. CLASS 60

1996 PONTIAC BONNEVILLE INTO FLAT FRONTAL BARRIER
VEHICLE REAR CENTER Z-AXIS ACCELERATION

TEST NUMBER: 951018

200 COMPLIANCE TESTING

TRC INC.



CHANNEL: TFCZG1 FILTER: CH. CLASS 60

PEAK DATA: 12.70 G @ 72.80 MS; -7.12 G @ 214.72 MS

Appendix C

Manufacturer's Vehicle Information

Enclosure 1
USG 3198

OVSC QUESTIONS & GM RESPONSES
REGARDING FMVSS 208 INFORMATION REQUEST
1996 Pontiac Bonneville (all models)
NSA-31CCa/IR-1628

Item 1

Please inform OVSC whether the air bag automatic restraint system provided at the driver's and passenger's seating positions in your vehicle is certified to meet the requirements of S4.1.2.1(c)(1) or S4.1.2.1(c)(2) for FMVSS No. 208.

GM Response

The air bags provided at the driver's and passenger's designated seating positions in the subject vehicle, along with the manual 3-point safety belt, were installed to meet the requirements of paragraphs S4.1.2.1(a) and S4.1.2.1(c)(2) of FMVSS 208.

Item 2

If the automatic restraint system provided at the driver's and passenger's seating positions in the subject vehicle was installed to meet the requirements of S4.1.2.1(c)(1), please provide a copy of the certification test reports for each of the test configurations required by that section of the standard (i.e., moving barrier lateral impact and dynamic rollover) and a copy of the certification reports for the frontal/angular barrier impact test required by S4.1.2.1.

GM Response

Since the subject vehicle's front outboard restraint systems are installed to meet the requirements of S4.1.2.1(c)(2), no response is required.

Item 3

If a manual 3-point safety belt is provided with the driver's and passenger's automatic restraint system in order to meet the requirements of S4.1.2.1(c)(2), please provide a copy of the certification test reports for each of the test configurations required by that section of the standard (i.e., frontal/angular barrier impact test of the automatic restraint system with the manual safety belt unfastened and frontal/angular barrier impact test of the automatic restraint system with the manual safety belt fastened).

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Enclosure 1
USG 3198GM Response

Engineering analysis was used for the associated certification testing to FMVSS 208 for the 1996 Pontiac Bonneville models. Continuous improvement of the driver air bag, steering wheel, passenger air bag and knee bolster have been incorporated into the Bonneville models, including the 1996 model year, subsequent to the full-scale barrier testing reported to OVSC in USG 2915, dated September 30, 1991. These changes were evaluated on developmental tests, including HYGE sled tests, which provided the engineering analysis.

Item 4

If the manual safety belt provided at the driver's and passenger's seating positions was not installed to meet the requirements of S4.1.2.1(c)(2), please provide a copy of a crash test report or engineering analysis showing that the use of the manual safety belt with the automatic restraint system does not affect the ability of the vehicle to meet the requirements FMVSS No. 208.

GM Response

Since the manual safety belt is installed to meet the requirements of S4.1.2.1(c)(2) of FMVSS 208, no response is required.

Item 5

If the vehicle uses a pressure vessel to inflate the air bag, provide a copy of the test reports or engineering analysis to demonstrate that it meets all the requirements of S9.1.

GM Response

The air bag installed in this vehicle does not incorporate a pressure vessel to inflate the system. Therefore, no response is required.

Item 6

If the vehicle uses an explosive device to inflate the air bag, provide a copy of the test reports or engineering analysis to demonstrate that it meets all of the requirements of S9.2.

GM Response

The air bag installed in this vehicle does not incorporate an explosive device to inflate the system. Therefore, no response is required.

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Enclosure 1
USG 3198Item 7

State, for any safety belt system in this vehicle, whether or not it is equipped with a tension-relieving device. Provide a copy of the information furnished in accordance with S7.4.2, if the tension-relieving device is used.

GM Response

This vehicle is not equipped with a tension-relieving device on the safety belt systems.

Item 8

FMVSS No. 208, S8.1.5 allows the manufacturer the option of having movable vehicle windows and vents placed in the closed position. State whether the vehicle's movable windows and vents were opened or closed for the certification tests.

GM Response

See response to item 3.

Item 9

FMVSS No. 208, S5.1 provides a manufacturer with the option of using either a Part 572(B) or 572(E) test dummy. Please inform OVSC which test dummy was used in each seat for each certification test. Submit dummy placement measurements including diagrams or photographs which show exactly where measurements were taken. Enclosed is a diagram of some of OVSC's dummy measurements. Where possible, use the dimension shown in the diagram to provide the individual dummy placement measurements.

State whether the vehicle has a foot rest for the driver.

If the vehicle can be equipped with a split front bench seat, state whether the driver dummy was located so that the midsagittal plane was centered on the steering wheel rim or the center of the seat cushion. Also, state whether the passenger dummy was located so the midsagittal plane was centered the same distance from the longitudinal centerline of the vehicle as the driver dummy or in the center of the seat cushion.

GM Response

Attachment A includes the available dummy placement information.

The driver position is not equipped with a foot rest.

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Enclosure 1
USG 3198

The driver dummy was located in certification testing so the midsagittal plane was centered on the steering wheel rim and the center of the seat cushion. The passenger dummy was located in certification testing so the midsagittal plane was centered the same distance from the longitudinal centerline of the vehicle as the driver dummy and in the center of the seat cushion.

Item 10

Provide the seat positioning, steering column positioning, and fuel tank data on the enclosed form. If more than one front seating configuration, steering column or fuel tank are available on this vehicle, provide separate information for each.

GM Response

Attachment B includes the requested information.

Item 11

If the vehicle is equipped with adjustable seat belt anchorages, provide the manufacturer's nominal design position for a 50th percentile adult male occupant.

GM Response

The nominal design position for the adjustable shoulder belt anchorage for a 50th percentile adult male occupant is the mid-position.

Item 12

Provide the speed at impact, vehicle test weight, and resulting injury criteria (i.e., HIC, chest acceleration, chest compression for the Part 572(E) dummy and femur loads) recorded for all certification tests conducted to meet the requirements of S4.1.2.1.

In addition, include each dummy's head and chest acceleration versus time plots and femur load versus time plots for the full frontal barrier impact tests.

GM Response

See response to item 3.

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Enclosure 1
USG 3198Item 13

When vehicle components must be removed to obtain the proper test weight, what components do you recommend for removal and in what priority order do you recommend removal?

GM Response

GM does not typically prioritize which components are to be removed from a test vehicle to accommodate test weight. However, components that have been removed during our testing include trunk interior trim, spare tire and jack, rear seats and rear carpeting. Additional components that may have been removed during specific tests include rear door trim, rear bumper facia, rear bumper and the deck lid.

Item 14

Please provide FMVSS No. 204, "Steering Control Rearward Displacement" certification data. Include a copy of the test report and any engineering analysis forming the basis of the certification. The report should document the vehicle test weight, impact velocity, and the horizontal and vertical displacements of the steering control. Pre and post test photographs are also requested.

Discuss the test procedure detailing the vehicle preparation and the measurement technique used to determine the steering control rearward displacement.

Provide a diagram of the steering control system and describe how the components of the steering control system work to provide energy management in a frontal impact.

GM Response

The FMVSS 204 certification data for the 1996 Pontiac Bonneville (all models) are summarized in the table below. Certification data are determined by film analysis.

Test No.	Weight (lb) *	Speed (mph)	Max. Dynamic Rearward Steering Column Displacement (in)
C8430	3861	30.7	0.5

* = includes test dummies

Attachment C provides the test report which forms the basis of the FMVSS 204 certification for these vehicles. The FMVSS 204 certification is carryover from (and based on testing from)

-6-

Enclosure 1
USG 3198

preceding model years. Also provided in Attachment C are plots of the steering column horizontal and vertical displacement data, and pre- and post-test photographs as requested.

Attachment D provides a general description of the test procedure. The basic General Motors Uniform Test Specification (GMUTS test procedure) used in conducting this FMVSS 204 testing is identified as "Steering Control Rearward Displacement, R-9A-204G-81." A copy of this procedure previously was provided to the NHTSA in GM's August 15, 1989 letter (USG 2691, Part III) to Mr. Robert F. Hellmuth in response to NHTSA IR 526.1, NEF-31ZFr. Additionally, details of the GM vehicle preparation and film analysis procedure used to obtain steering column displacement data previously were provided to NHTSA representatives (Messrs. W.E. Smith, R.A. Krauss, and C. L. Ragland) during a September 19, 1985 meeting at GM's Milford (MI) Proving Ground.

GM's overall procedures for obtaining this film analysis data have not changed significantly since this information was provided to the NHTSA in 1985. However, new film analysis hardware and software have been implemented, resulting in improved efficiency.

Attachment E provides the steering column assembly diagram and description of how the assembly works to provide energy management in a frontal impact.

Item 15

Inform OVSC if these vehicles have built-in child restraints either as standard equipment or optional equipment. If they do, provide a copy of the certification test reports and any engineering analysis forming the basis for certification to FMVSS No. 213, "Child Restraint Systems."

GM Response

The subject vehicle does not incorporate a built-in child restraint.

Attachment A

USG 3198

2 pages
(including this cover)

Attachment A

DUMMY PLACEMENT MEASUREMENTS

The following values reflect the dummy location in the test vehicle in corporate body coordinates. The location is determined relative to the vehicle front fiducial mark coordinates (front outboard seat anchor stud):

<u>Longitude</u>	<u>Vertical</u>	<u>Crosscar</u>
2776	564	374

Body Coordinates (mm)

	Left Passenger		Right Passenger	
<u>Degree Frontal</u>	<u>Longitude</u>	<u>Vertical</u>	<u>Longitude</u>	<u>Vertical</u>
8430				
lead	3176	1328		
hip	3066	674		
nee	2680	765		
elvic Angle	23°			
8567				
lead			3184	1313
hip			3012	667
nee			2684	793
elvic Angle			24°	
8561				
lead	3166	1337		
hip	307	677		
nee	2688	779		
elvic Angle	21°			

Attachment B

USG 3198

3 pages
(including this cover)



US Department
of Transportation
National Highway
Traffic Safety
Administration

TEST VEHICLE INFORMATION

Page 1 of 2

Vehicle Model Year & Make: 1996 Pontiac BonnevilleVehicle Model & Body Style: Four Door Sedan (2HY69)

1. NOMINAL DESIGN RIDING POSITION --

For adjustable driver and passenger seat backs.
Please describe how to position the inclinometer to
measure the seat back angle. Include description of
the location of the adjustment latch detents if applicable.
Indicate, if applicable, how the detents are numbered
(Is the first detent "0" or "1"?).

Seat back angle for driver's seat = 26 degrees

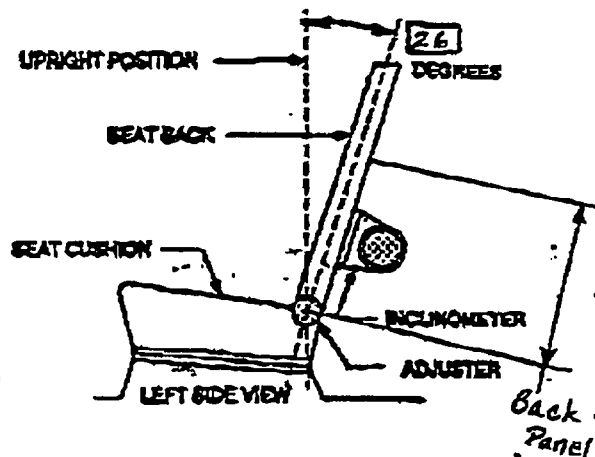
Measurement Instructions:

Position inclinometer against seat back
adjust back to 26° (Seat back has a hard back
panel underneath trim cover)

Seat back angle for passenger's seat = 26 degrees

Measurement Instructions:

Same as above



2. SEAT FORE & AFT POSITIONS --

Provide instructions for positioning the driver and front outboard passenger seat(s) in the center of fore and aft travel. For example, indicate how the detents are numbered (Is the first detent "0" or "1"?). Provide information to locate the detent in which the seat track is to be locked.

Positioning of the driver's seat:

Move seat to full rearward or forward travel and full down position. Then move
seat forward or rearward 100 mm to obtain midpoint of travel.

Positioning of the passenger's seat (if applicable):

Same as above.

3. FUEL TANK CAPACITY DATA --

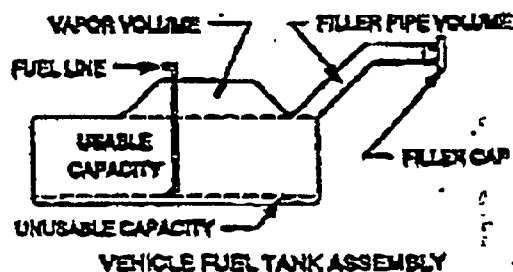
3.1 A. "Usable Capacity" of standard equipment fuel tank = 18.0 gallons.

B. "Usable Capacity" of optional equipment fuel tank = N/A (B) gallons.

C. "Usable Capacity" of vehicle(s) used for certification testing to requirements of FMVSS 301 = 17.7 gallons.

$$95\% (18.0 \text{ gal}) + .6 = 17.7$$

Operational Instructions:



Page 2 of 2

TEST VEHICLE INFORMATION

- 3.2 Amount of Stoddard solvent added to vehicle(s) used for certification test(s) = 17.7 gallons
 $95.2 (18.0 \text{ gal}) + .6 = 17.7$
- 3.3 Is vehicle equipped with electric fuel pump? ☒ YES ☐ NO
 If YES, explain the vehicle operating conditions under which the fuel pump will pump fuel.
see note below.

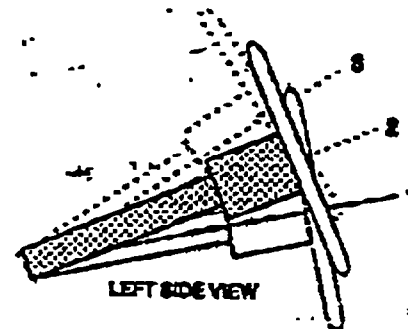
4. STEERING COLUMN ADJUSTMENTS --

Steering wheel and column adjustments are made so that the steering wheel hub is at the geometric center of the locus it describes when it is moved through its full range of driving positions.

If the tested vehicle has any of these adjustments, does your company use any specific procedures to determine the geometric center.

Operational Instructions:

- 5 The optional tilt steering column has
six (6) positions. The mid point is located
at the third position up from the bottom.



STEERING COLUMN ASSEMBLY

3.3 NOTE:

When the key is first turned "ON" without the engine running, the ECM turns a fuel pump relay "ON" for two seconds. This builds up the fuel pressure quickly. If the engine is not started within two seconds, the ECM shuts the fuel pump "OFF" and waits until the engine starts. As soon as the engine is cranked, the ECM turns the relay "ON" and runs the fuel pump.

When the engine is cranking or running, the ECM receives distributor reference pulses which in turn energize the fuel injectors.

As a backup system to the fuel pump relay, the fuel pump can also be turned on by an oil pressure switch. When the engine oil pressure reaches about 28 kPa (4psi), through cranking and the fuel pump relay does not complete the circuit, the oil pressure switch will close to complete the circuit to run the fuel pump.