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REPORT NOS. 208-TRC-91-009

212-TRC-91-009

301-TRC-91-009

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

SATURN CORPORATION

1991 SATURN SL2

4-DOOR SEDAN

NHTSA NO. CM0107

TRC TEST NO. 910305

THE TRANSPORTATION RESEARCH CENTER OF OHIO

10820 STATE ROUTE 347

EAST LIBERTY, OHIO 43319



MARCH 21, 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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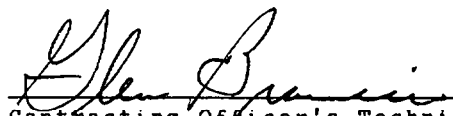
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16. Abstract A 30 mph flat frontal barrier impact test was conducted on a 1991 Saturn SL2 4-door sedan, NHTSA No. CM0107, at the Transportation Research Center of Ohio on March 5, 1991. This test was conducted to determine compliance with Federal Motor Vehicle Safety Standards: FMVSS No. 208, "Occupant Crash Protection"; FMVSS No. 212, "Windshield Mounting"; FMVSS No. 219 (partial), "Windshield Zone Intrusion"; FMVSS 301, "Fuel System Integrity." The barrier impact velocity was 29.5 mph. The vehicle's maximum crush was 17.4 inches. The ambient temperature was 72° F. The driver's head injury criteria (HIC) was 636. The driver's maximum chest deceleration over three (3) milliseconds was 40.1 g. The driver's chest displacement was 2.0 inches. The driver's maximum left and right femur forces were 755 pounds and 1068 pounds, respectively. (See DATA ACQUISITION EXPLANATIONS.) The passenger's head injury criteria (HIC) was 633. The passenger's maximum chest deceleration over three (3) milliseconds was 39.2 g. The passenger's chest displacement was 1.9 inches. The passenger's maximum left and right femur forces were 1109 pounds and 1076 pounds, respectively. (See DATA ACQUISITION EXPLANATIONS.) 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 Hornickie		
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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	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
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	0.9	metric ton	t
	(2000 lb)			
VOLUME				
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
in ³	cubic inches	16	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	degrees Fahrenheit	5/9 (after subtracting 32)	degrees Celsius	°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	2.5	acres	
	(10 000 m ²)			
MASS (weight)				
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	metric ton	1.1	short tons	
	(1000 kg)			
VOLUME				
ml	milliliters	0.03	fluid ounces	fl oz
ml	milliliters	0.06	cubic inches	in ³
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	degrees Celsius	9/5 (then degrees add 32)	Fahrenheit	°F

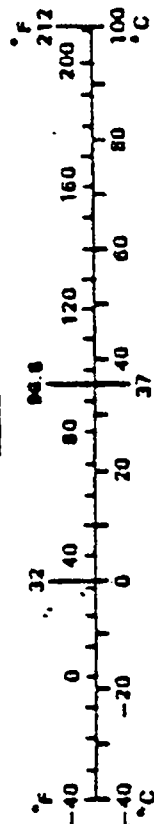


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SECTION 1.0

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 1991 Saturn SL2 4-door sedan, NHTSA No. CM0107, 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 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 B and Optional 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 displacement.

The twenty-five (25) 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 March 5, 1991.

The test vehicle, a 1991 Saturn SL2 4-door sedan, NHTSA No. CM0107, appeared to comply with the performance requirements of FMVSS test Nos. 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. The chest displacements 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 a 1.9 liter, transverse engine, automatic transmission, power steering, and power brakes. The vehicle's test weight was 2885 pounds. The vehicle's impact speed was 29.5 mph. The vehicle's maximum crush was 17.4 inches.

The driver's head injury criteria (HIC) was 636. The driver's maximum chest resultant acceleration over three (3) milliseconds was 40.1 g. The driver's chest displacement was 2.0 inches. The driver's maximum left and right femur forces were 755 pounds and 1068 pounds, respectively. (See DATA ACQUISITION EXPLANATIONS.)

The right front passenger's HIC was 633. The right front passenger's maximum chest resultant acceleration over three (3) milliseconds was 39.2 g. The right front passenger's chest displacement was 1.9 inches. The right front passenger's maximum left and right femur forces were 1109 pounds and 1076 pounds, respectively. (See DATA ACQUISITION EXPLANATIONS.)

There was no loss of windshield periphery retention.

There was no intrusion through the windshield.

There was no fluid spillage from the vehicle's fuel system following the crash test event or during the static rollover test.

DATA ACQUISITION EXPLANATIONS

The following data channels recorded a data spike at 233 milliseconds:

LFMF1, driver's left femur force

RFMF1, driver's right femur force

CSTXD2, right front passenger's chest displacement

LFMF2, right front passenger's left femur force

RFMF2, right front passenger's right femur force

TABLE 1 CRASH TEST SUMMARY

NHTSA NO.: CM0107 TEST TYPE: Frontal Barrier Impact

TEST DATE: 03/05/91 TEST TIME: 1338 AMBIENT TEMP. (°F): 72

VEHICLE YEAR/MAKE/MODEL/BODY STYLE: 1991 Saturn SL2 4-door sedan

VEHICLE TEST WEIGHT (LBS): 2885

IMPACT ANGLE (DEG)*: 0

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

MAXIMUM STATIC CRUSH (IN): 17.4

AVERAGE REBOUND (IN): 26.3

DUMMIES: Driver #230 Passenger #229

TYPE: Part 572 E Part 572 E

LOCATION: Left front Right front

RESTRAINT: 2-point passive belt 2-point passive belt

NUMBER OF DATA CHANNELS: 25

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: Saturn Corporation

MAKE/MODEL: Saturn SL2

VIN: 1G8ZK5476MZ108074

BODY STYLE: 4-door sedan

MODEL YEAR: 1991

NHTSA NO.: CM0107

COLOR: White

ENGINE DATA: TYPE: transverse CYLINDERS: 4 DISPLACEMENT: 1.9 liter

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

DATE VEHICLE RECEIVED: 02/05/91

ODOMETER READING: 48.0

DEALER'S NAME AND ADDRESS: Saturn/North
8600 North High Street
Worthington, OH 43085

ACCESSORIES:

POWER STEERING	Yes	AUTOMATIC TRANSMISSION	Yes
POWER BRAKES	Yes	AUTOMATIC SPEED CONTROL	No
POWER SEATS	No	TILTING STEERING WHEEL	Yes
POWER WINDOWS	No	TELESCOPING STEERING WHEEL	No
TINTED GLASS	Yes	AIR CONDITIONING	Yes
RADIO	Yes	ANTI-SKID BRAKE	Yes
CLOCK	Yes	REAR WINDOW DEFROSTER	Yes
OTHER	None		

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 ALTERED BY: Saturn Corporation

DATE OF MANUFACTURE: 01/91

VIN: 1G8ZK5476MZ108074

GVWR: 3376 LBS

GAWR: FRONT: 1766 LBS., REAR: 1610 LBS.

TABLE 2 TEST VEHICLE INFORMATION CONT'D

TIRES ON VEHICLE (MFR., LINE, SIZE): Firestone Firehawk GTA P195/60R15

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

SPARE TIRE (MFR., LINE, SIZE): Firestone Temp T115/70R14

TYPE OF SEATS: FRONT: Bucket
REAR: Bench

TYPE OF FRONT SEAT BACKS: Manual adjustable

MAXIMUM WIDTH: 67.2 INCHES

WHEELBASE: 102.0 INCHES

LOCATION OF LABEL STATING TIRE & CAPACITY DATA: THE LABEL WAS LOCATED ON
THE TRUNK LID.

TIRE & CAPACITY DATA FROM VEHICLE'S LABEL:

RECOMMENDED TIRE SIZE: FRONT: P195/60R15

RECOMMENDED COLD TIRE PRESSURE: FRONT: 30 PSI; REAR: 26 PSI

DESIGNATED SEATING CAPACITY: 2 FRONT 3 REAR 5 TOTAL

VEHICLE CAPACITY WEIGHT: 864 LBS.

TEST VEHICLE ATTITUDE (ALL MEASUREMENTS ARE IN INCHES):

DELIVERED ATTITUDE: LF 27.0; RF 26.8; LR 26.8; RR 27.0

FULLY LOADED ATTITUDE: LF 26.2; RF 26.0; LR 26.2; RR 26.0

PRE-TEST ATTITUDE: LF 26.0; RF 26.4; LR 25.5; RR 25.8

POST-TEST ATTITUDE: LF 27.4; RF 25.5; LR 24.4; RR 24.2

TABLE 2 TEST VEHICLE INFORMATION CONT'D

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

RIGHT FRONT	745 LBS.	RIGHT REAR	465 LBS.
LEFT FRONT	758 LBS.	LEFT REAR	480 LBS.
TOTAL FRONT WEIGHT	1503 LBS.	(61.4% OF TOTAL VEHICLE WEIGHT)	
TOTAL REAR WEIGHT	945 LBS.	(38.6% OF TOTAL VEHICLE WEIGHT)	
TOTAL DELIVERED WEIGHT 2448 LBS.			

CALCULATION OF TEST VEHICLE'S TARGET TEST WEIGHT:

RCLW = RATED CARGO AND LUGGAGE WEIGHT*

UDW = UNLOADED DELIVERED WEIGHT (2448 LBS)

VCW = VEHICLE CAPACITY WEIGHT (864 LBS)

DSC = DESIGNATED SEATING CAPACITY (5)

$RCLW* = VCW - 150 (DSC) = 864 - 150 (5) = 114$

TARGET TEST WEIGHT = UDW + RCLW* + (NO. OF HYBRID III DUMMIES X 167 LBS/DUMMY)

TARGET TEST WEIGHT = 2448 + 114 + 334

TARGET TEST WEIGHT = 2896 LBS

WEIGHT OF TEST VEHICLE WITH REQUIRED DUMMIES AND 103 LBS. OF CARGO WEIGHT:

RIGHT FRONT	792 LBS.	RIGHT REAR	624 LBS.
LEFT FRONT	829 LBS.	LEFT REAR	640 LBS.
TOTAL FRONT WEIGHT	1621 LBS.	(56.2% OF TOTAL VEHICLE WEIGHT)	
TOTAL REAR WEIGHT	1264 LBS.	(43.8% OF TOTAL VEHICLE WEIGHT)	
TOTAL TEST WEIGHT	2885 LBS.	(0.4% UNDER TARGET TEST WEIGHT)	

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

COMPONENTS REMOVED TO MEET TARGET TEST WEIGHT: None

CG = 44.7 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: 910305 NHTSA NO.: CM0107
TEST DATE: 03/05/91 TEST TIME: 1338
TEST TYPE: Frontal Barrier Impact IMPACT ANGLE: 0
AMBIENT TEMPERATURE AT IMPACT AREA: 72° F
TEMPERATURE IN OCCUPANT COMPARTMENT: 69° 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.

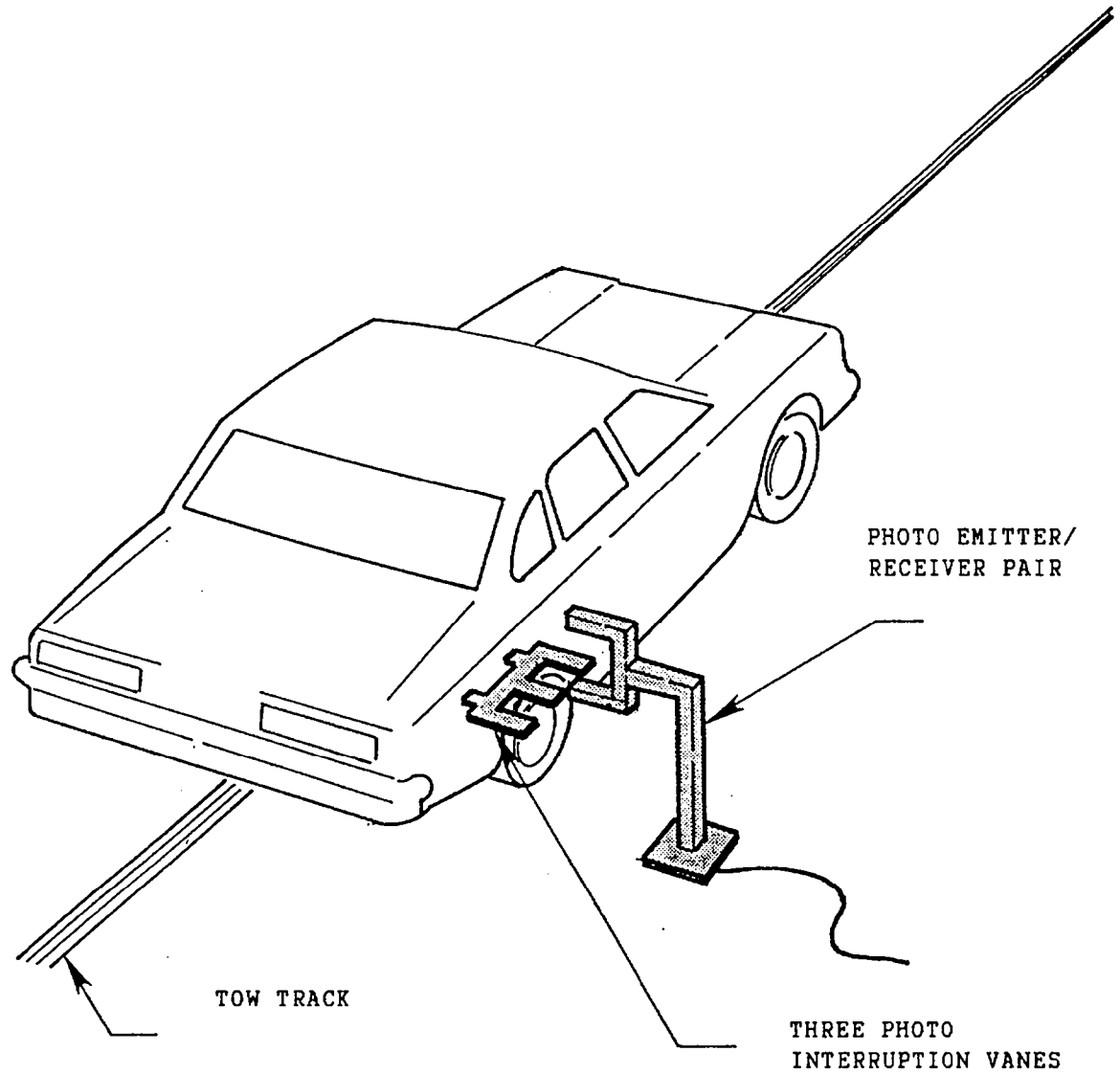
TEST VEHICLE STATIC CRUSH (ALL MEASUREMENTS ARE IN INCHES):

OVERALL LENGTH OF TEST VEHICLE: PRE-TEST: L 171.0; C 176.0; R 171.0
POST-TEST: L 157.8; C 158.8; R 157.6
TOTAL CRUSH: L 13.2; C 17.2; R 13.4
AVERAGE CRUSH: 14.6

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

DISTANCE FROM TEST VEHICLE TO BARRIER: L 27.1; C 23.9; R 27.8; AVG. 26.3

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: Saturn/SL2/4-door sedan

VEHICLE NHTSA NO.: CM0107; VIN: 1G8ZK5476MZ108074

MODEL YEAR: 1991; BUILD DATE: 10/90; TEST DATE: 03/05/91

VEHICLE SIZE CATEGORY: Compact; TEST WEIGHT: 2885 LBS.

VEHICLE WHEELBASE: 102.0 INCHES

MAXIMUM WIDTH: 67.2 INCHES

FRONT OVERHANG: 39.2 INCHES

COLLISION DEFORMATION

CLASSIFICATION (CDC) CODE: 12FDEW2

CRUSH DEPTH

MEASUREMENTS:

C1 = 13.2 INCHES

C2 = 14.8 INCHES

C3 = 17.4 INCHES

C4 = 17.3 INCHES

C5 = 15.6 INCHES

C6 = 13.4 INCHES

MIDPOINT OF DAMAGE: D = VEHICLE CENTERLINE
(LONGITUDINAL)

LENGTH OF DAMAGED
REGION:

L = 49.0 INCHES

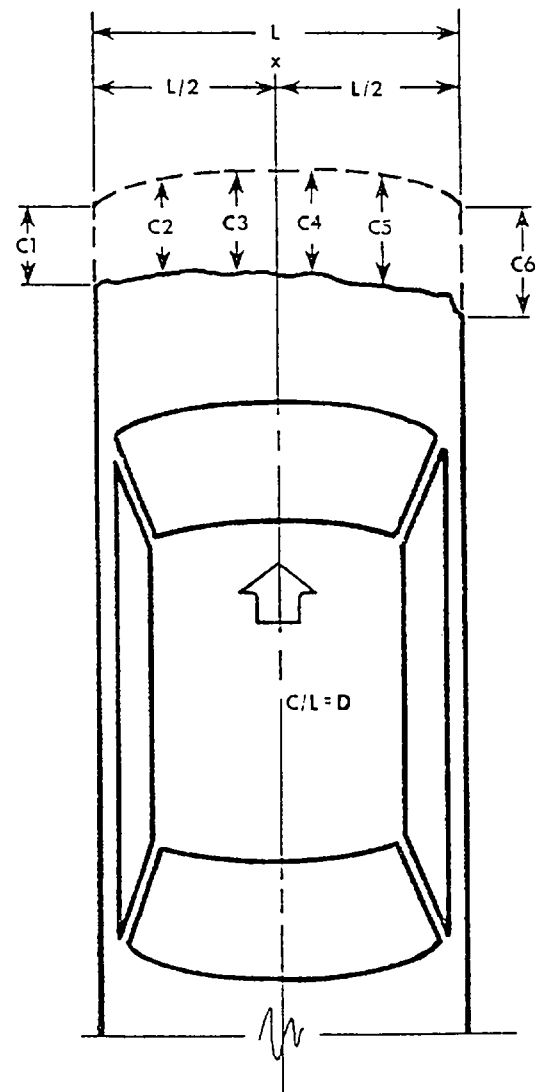
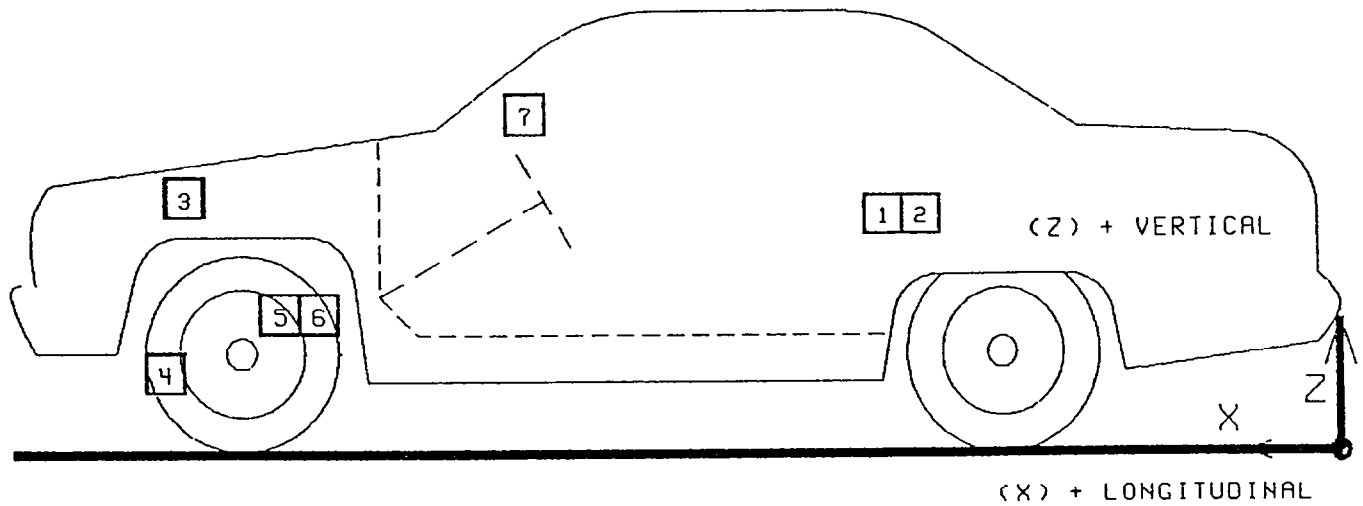
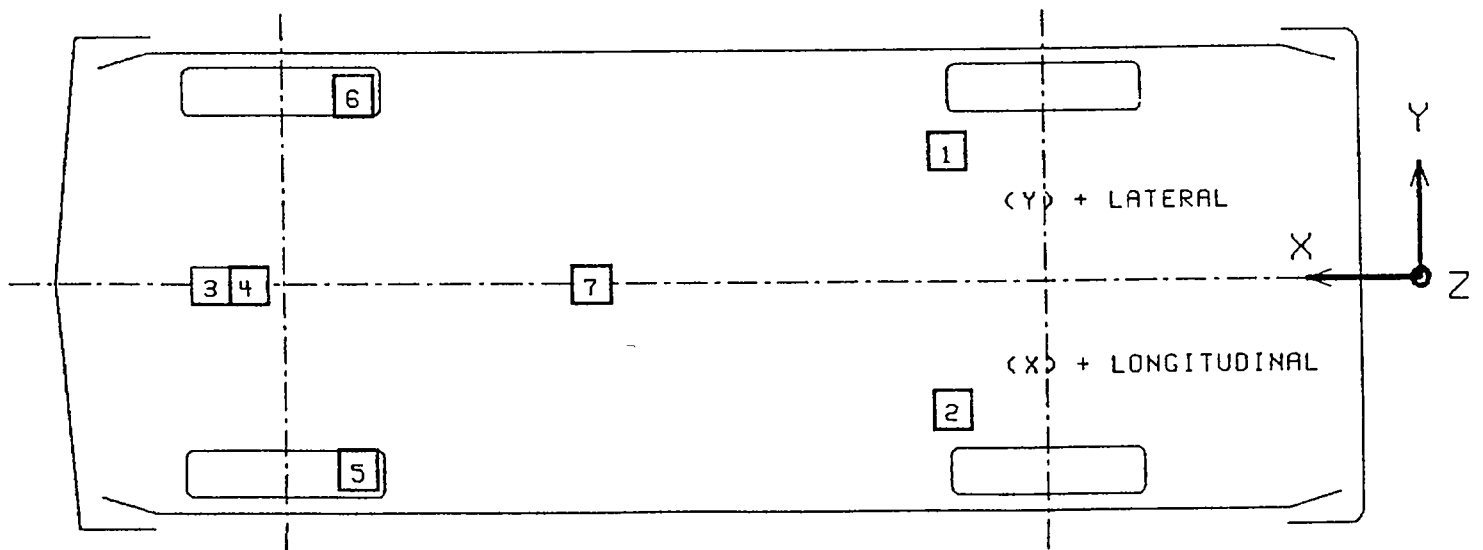


FIGURE 3
VEHICLE ACCELEROMETER PLACEMENT



SIDE VIEW



BOTTOM VIEW

TABLE 4

VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

TEST NUMBER 910305

No.	LOCATION		X*	Y*	Z*	POSITIVE DIRECTION		NEGATIVE DIRECTION	
						MAX G MSEC		MAX G MSEC	
1	LEFT REAR SEAT CROSSMEMBER LONGITUDINAL	PRE	66.1	13.2	12.5				
		POST	62.0	13.2	13.0				
						2.5	292.1	20.9	68.1
2	RIGHT REAR SEAT CROSSMEMBER LONGITUDINAL	PRE	60.9	-16.0	12.9				
		POST	60.4	-16.0	13.5				
						2.8	292.5	21.0	79.3
3	ENGINE TOP LONGITUDINAL	PRE	147.0	-2.0	31.2				
		POST	141.5	-2.0	30.5				
						23.8	83.6	93.4	44.9
4	ENGINE BOTTOM LONGITUDINAL	PRE	143.5	7.5	6.8				
		POST	139.0	7.5	5.6				
						7.5	81.5	62.1	41.0
5	RIGHT BRAKE CALIPER LONGITUDINAL	PRE	142.5	-24.6	12.8				
		POST	139.8	-26.6	11.8				
						37.4	73.9	65.1	58.1
6	LEFT BRAKE CALIPER LONGITUDINAL	PRE	142.8	24.8	12.6				
		POST	139.9	26.8	11.5				
						45.4	74.5	71.2	57.6
7	INSTRUMENT PANEL CENTER LONGITUDINAL	PRE	117.0	-0.8	34.1				
		POST	115.9	-0.8	36.9				
						8.7	123.6	33.9	84.5

* 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. Glen Brammeier
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.: CM0107

MAKE/MODEL/BODY STYLE: Saturn/SL2/4-door sedan

MODEL YEAR: 1991 BODY COLOR: White

VIN: 1G8ZK5476MZ108074

ODOMETER (ARRIVAL): 48 DATE: 02/05/91

ODOMETER (COMPLETION): 54 DATE: 03/05/91

COST: \$12,040.00

☒ 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; 1.9 LITERS

TRANSMISSION: Automatic; DRIVE TYPE: Front wheel

TIRE SIZE: P195/60R15

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	-62.6	-8.0	-51.4	77.7	-40.3	-7.8	17.5	40.1
PASSENGER	-43.4	15.0	-51.3	62.2	-41.0	11.7	11.7	39.2

MAXIMUM FEMUR COMPRESSIVE FORCE (LBS)

	LEFT FEMUR	RIGHT FEMUR
DRIVER	755 Y	1068 Y
PASSENGER	1109 Y	1076 Y

HEAD INJURY CRITERIA**

	HIC	TIME t_1 (MSEC) ¹	TIME t_2 (MSEC) ²
DRIVER	636	73.0	102.9
PASSENGER	633	75.2	111.2

MAXIMUM CHEST DISPLACEMENT (IN)

DRIVER	2.0
PASSENGER	1.9 Y

*Defined as exceeding 0.003 sec. duration

**As defined in FMVSS No. 208

Y See DATA ACQUISITION EXPLANATIONS

TABLE 6 POST-IMPACT DUMMY/VEHICLE DATA

VISIBLE DUMMY CONTACT POINTS:

	DRIVER #230	PASSENGER #229
HEAD	<u>Upper steering wheel rim</u>	<u>Chest</u>
CHEST	<u>None</u>	<u>None</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 was 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 head rotated forward and contacted the upper steering wheel rim as the dummy's chest was restrained by the two-point passive belt. The dummy's head rotated rearward into the head restraint as the dummy rebounded into the seat back. The dummy came to rest seated upright in the driver's seat, restrained by the two-point passive belt.

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 rotated forward and contacted the dummy's chest, as the dummy's chest was restrained by the two-point passive belt. The dummy's head rotated rearward into the head restraint as the dummy rebounded into the seat back. The dummy came to rest seated in the right front passenger's seat, restrained by the two-point passive belt.

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

MAKE/MODEL: Saturn/SL2

VIN: 1G8ZK5476MZ108074

BODY STYLE: 4-door sedan

NHTSA NO.: CM0107

DATE OF MANUFACTURE: 01/91

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.
- ☒ Whenever the switch is turned to the "ON" or "START" position.

WEBBING TENSION - RELIEVING DEVICE:

DO OUTBOARD SEATING POSITION SEAT BELTS HAVE WEBBING TENSION - RELIEVING DEVICES? No

BELT CONTACT FORCE:

BELT CONTACT FORCE ON CHEST OF TEST DUMMY: .1 POUNDS

TABLE 8 FMVSS 208 SEAT BELT WARNING SYSTEM DATA

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

Duration of audible warning signal = 6 sec.

Duration of reminder light operation = continuous sec.

WITH OCCUPANT IN DRIVER'S POSITION AND LAP BELT 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 = 2 sec.

WORDING OF VISUAL WARNING:

Fasten Seat Belt _____

Fasten Belt _____

Symbol 101-80 X

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 PROTECTON SYSTEM:

 X 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.

 X 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.:

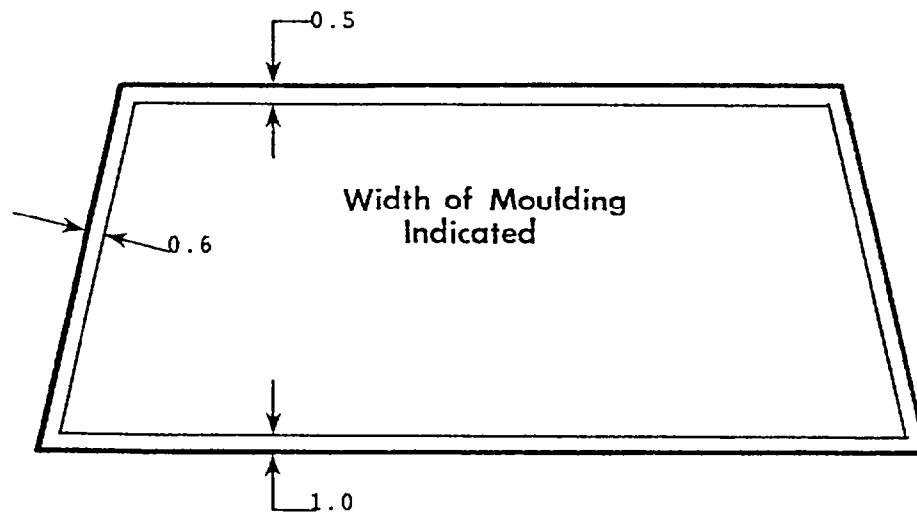
Plastic trim around outer perimeter, adhesive around inner perimeter.

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	86.9	86.9	100%
LEFT SIDE	86.9	86.9	100%
TOTAL	173.8	173.8	100%

PRE-TEST WINDSHIELD MOUNTING MATERIAL TEMPERATURE: 69° F



FRONT VIEW OF WINDSHIELD*

LOSS OF WINDSHIELD RETENTION LENGTHS: None

ALL DISTANCE MEASUREMENTS ARE IN INCHES.

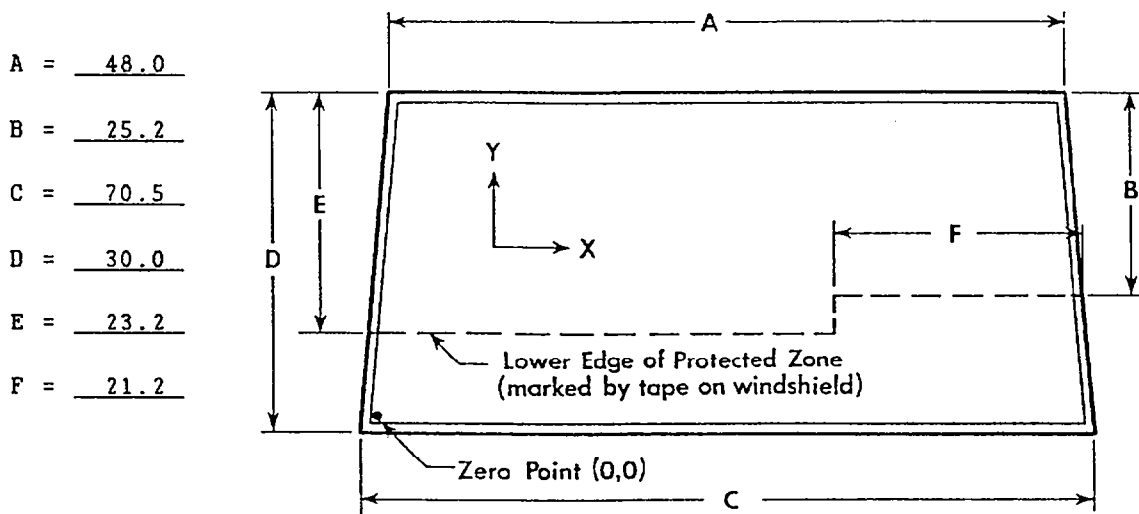
*INDICATE AREAS OF LOSS OF RETENTION, IF ANY, ON WINDSHIELD DIAGRAM.

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:



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: Saturn/SL2 NHTSA NO.: CM0107

FUEL SYSTEM CAPACITY: 13.5 GALLONS (FROM OWNER'S MANUAL)

USABLE CAPACITY: 12.875 GALLONS (FURNISHED BY COTR)

TEST VOLUME RANGE: 11.8 GALLONS TO 12.1 GALLONS (92-94% OF USABLE)

ACTUAL TEST VOLUME: 11.5 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 was located in front of the rear
axle. The fuel filler neck was located on the left side and entered the
left rear corner of the tank. The fuel lines ran along the left frame
rail to the front.

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.: CM0107; TEST DATE: 03/05/91

VEHICLE MAKE/MODEL/BODY STYLE: Saturn/SL2/4-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.

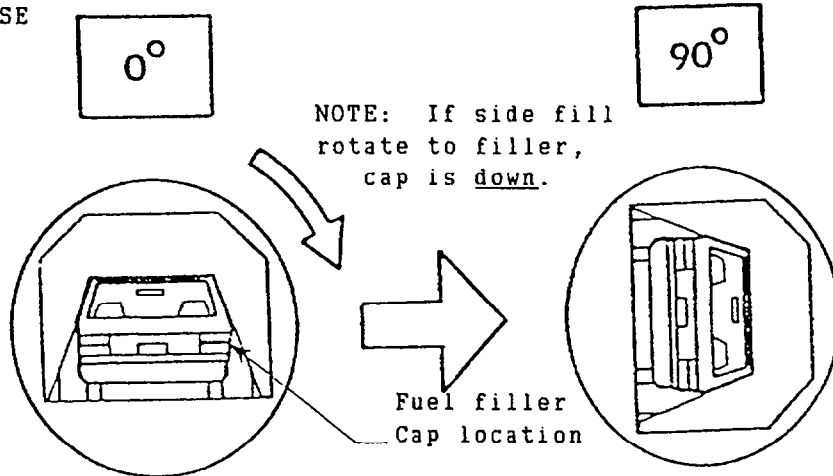
FUEL SYSTEM FLUID SPILLAGE LOCATION(S):

None

FIGURE 6 FMVSS 301 STATIC ROLLOVER TEST DATA

NHTSA NO.: CM0107

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.

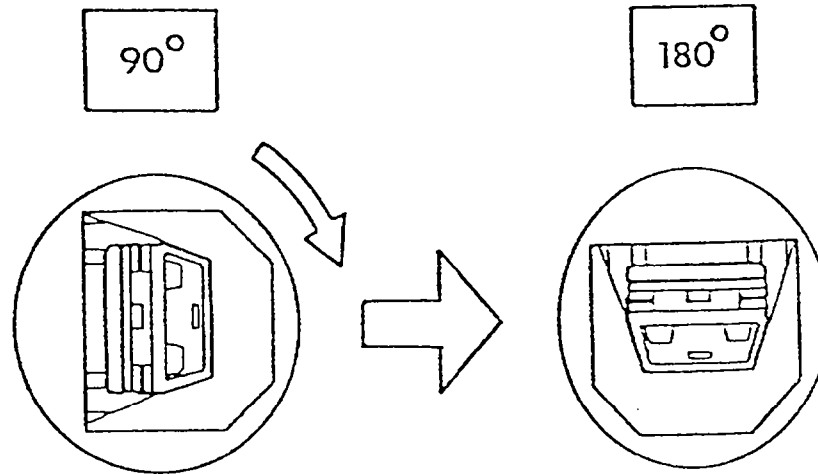
FUEL SYSTEM FLUID SPILLAGE LOCATION(S):

None

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

NHTSA NO.: CM0107

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.

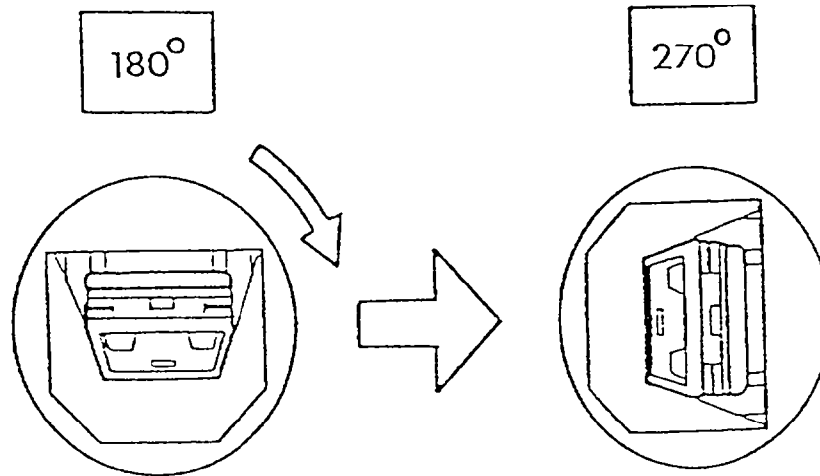
FUEL SYSTEM FLUID SPILLAGE LOCATION(S):

None

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

NHTSA NO.: CM0107

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.

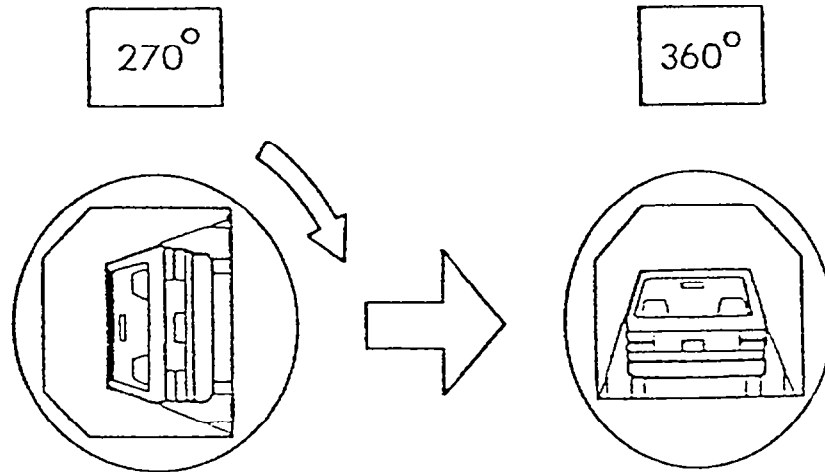
FUEL SYSTEM FLUID SPILLAGE LOCATION(S):

None

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

NHTSA NO.: CM0107

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

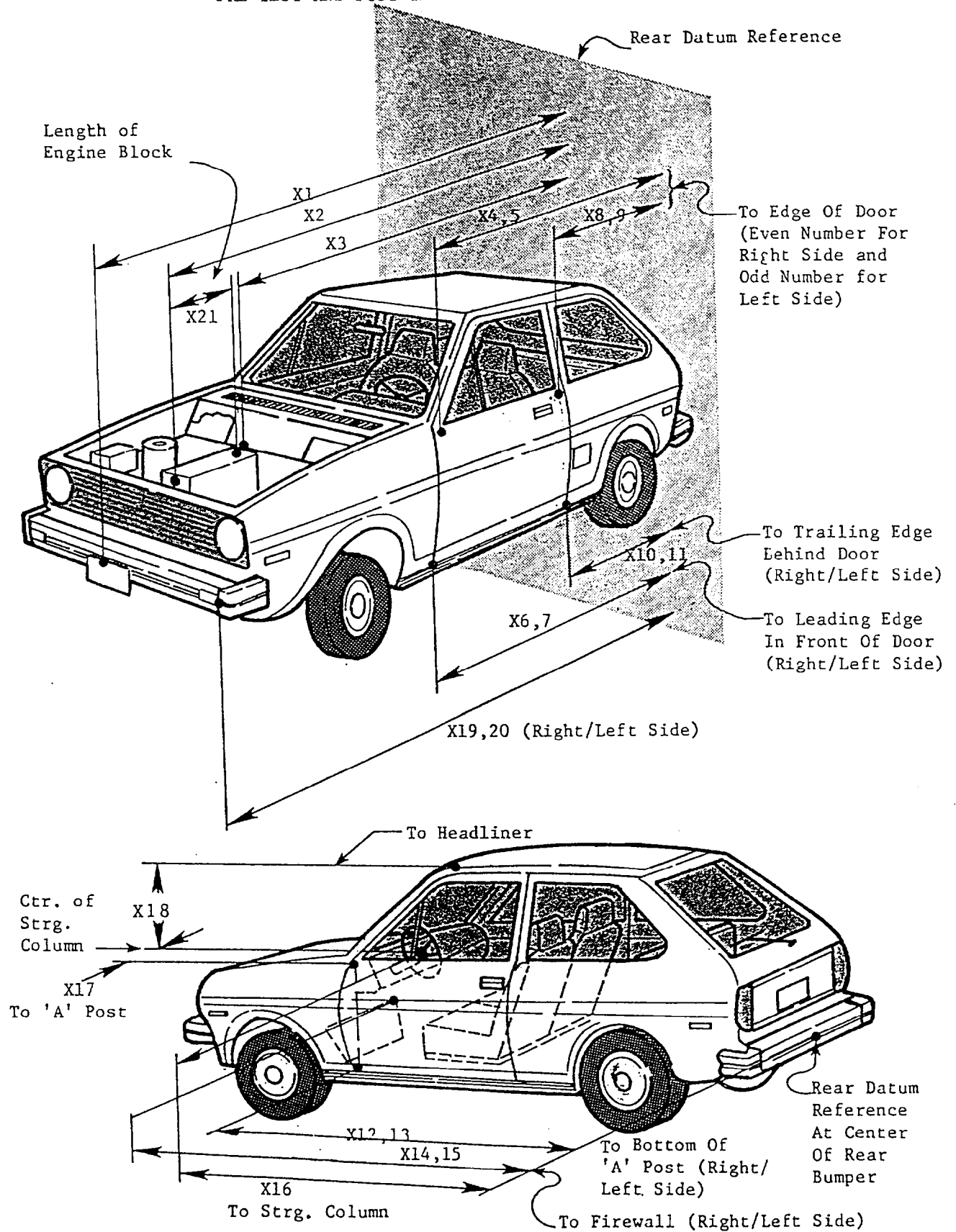
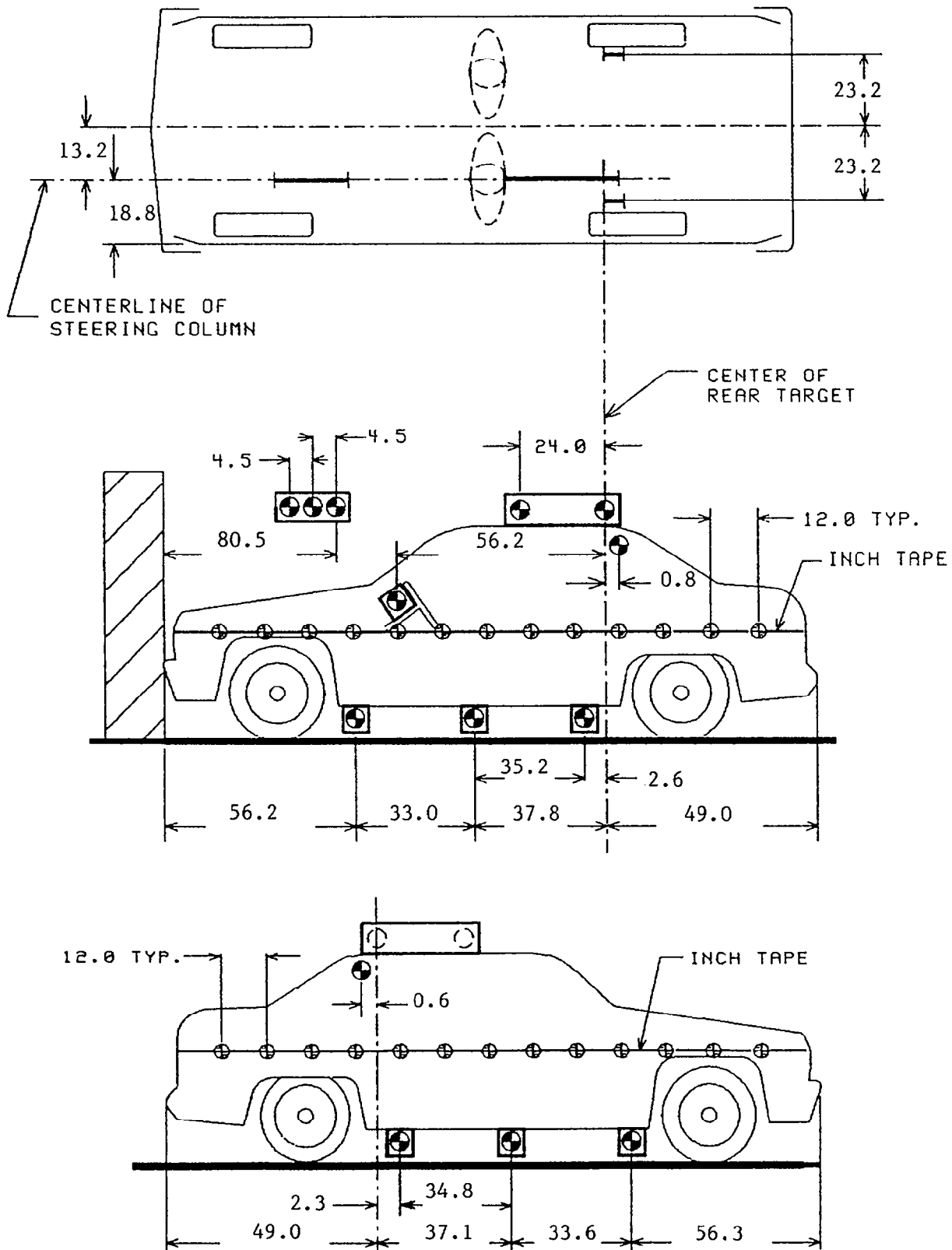


TABLE 13 IMPACTED VEHICLE MEASUREMENTS

VEHICLE MAKE/MODEL: Saturn/SL2		TEST NUMBER: 910305		ALL MEASUREMENTS ARE IN INCHES		
NO.	TYPE OF MEASUREMENT	PRE-TEST	POST-TEST	DIFF.		
X1	TOTAL LENGTH OF VEHICLE AT CENTERLINE	176.0	158.8	17.2		
X2	REAR SURFACE OF VEHICLE TO FRONT OF ENGINE BLOCK	148.2	142.2	6.0		
X3	REAR SURFACE OF VEHICLE TO FIREWALL	131.5	126.4	5.1		
X4	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF RIGHT DOOR	116.6	116.5	0.1		
X5	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF LEFT DOOR	116.5	116.6	-0.1		
X6	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF RIGHT DOOR	116.2	116.0	0.2		
X7	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF LEFT DOOR	116.6	116.4	0.2		
X8	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF RIGHT DOOR	76.2	76.1	0.1		
X9	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF LEFT DOOR	76.0	76.1	-0.1		
X10	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF RIGHT DOOR	77.1	76.8	0.3		
X11	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF LEFT DOOR	77.4	77.2	0.2		
X12	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON RIGHT SIDE	115.5	115.4	0.1		
X13	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON LEFT SIDE	115.8	115.8	0.0		
X14	REAR SURFACE OF VEHICLE TO FIREWALL - RIGHT SIDE	130.4	125.3	5.1		
X15	REAR SURFACE OF VEHICLE TO FIREWALL - LEFT SIDE	129.6	129.3	0.3		
X16	REAR SURFACE OF VEHICLE TO STEERING WHEEL CENTER	99.5	98.0	1.5		
X17	CENTER OF STEERING COLUMN TO "A" POST	10.6	12.4	-1.8		
X18	CENTER OF STEERING COLUMN TO HEADLINER	16.9	16.4	0.5		
X19	REAR SURFACE OF VEHICLE TO RIGHT SIDE OF FRONT BUMPER	171.0	157.6	13.4		
X20	REAR SURFACE OF VEHICLE TO LEFT SIDE OF FRONT BUMPER	171.0	157.8	13.2		
X21	LENGTH OF ENGINE BLOCK	17.0	17.0	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: Saturn/SL2
 BODY STYLE: 4-door sedan MODEL YEAR: 1991
 NHTSA NO.: CM0107 COLOR: White

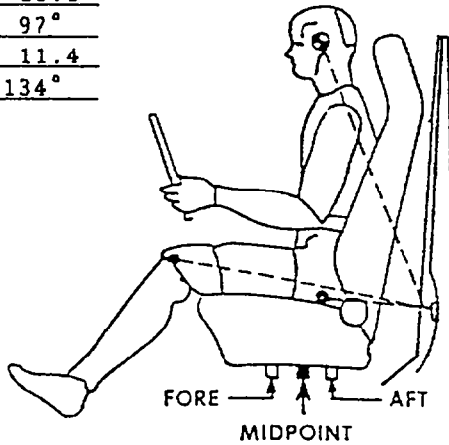
DATA FROM CERTIFICATION LABEL:

VEHICLE MANUFACTURER: Saturn Corporation
 DATE OF MANUFACTURE: 01/91 VIN: 1G8ZK5476MZ108074
 GVWR: 3376 LBS.; GAWR: FRONT = 1766 LBS.; REAR = 1610 LBS.

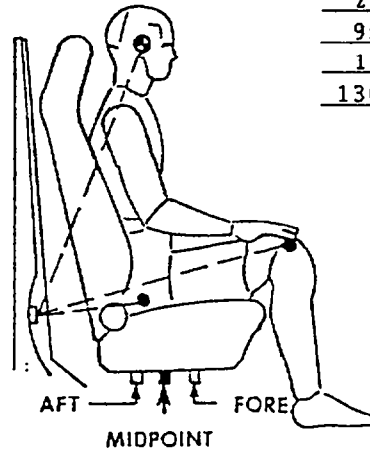
POST-IMPACT DATA:

DATE OF TEST: 03/05/91 TIME: 1338 TEMPERATURE: 72° 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: Manual adjustable
 TECHNICIANS: R. Benavides, S. Ericksen

DRIVER DUMMY # 230 TYPE: HIII
 HEAD 18.8
 TARGET 9°
 KNEE 23.3
 JOINT 97°
 APPROX- 11.4
 IMATE 134°
 "H"
 POINT



PASSENGER DUMMY # 229 TYPE: HIII
 HEAD 18.5
 TARGET 7°
 KNEE 25.1
 JOINT 95°
 APPROX- 12.1
 IMATE 130°
 "H"
 POINT



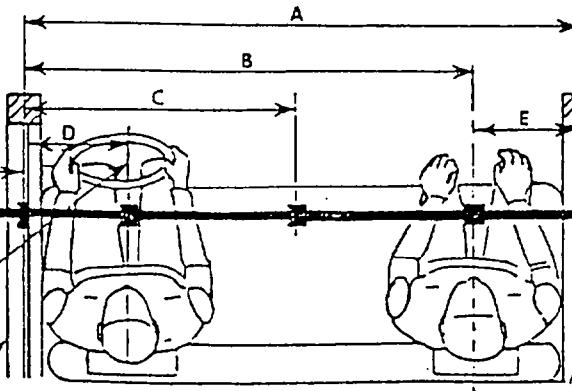
A = 54.7
 B = 40.2
 C = 27.4
 D = 13.8
 E = 14.5

DOOR GLASS
 HEIGHT = 8.6

LATERAL BAR

ADJUSTABLE
 POINTER

LEFT
 FRONT
 DOOR



DRIVER
 DUMMY

PASSENGER
 DUMMY

DOOR GLASS
 HEIGHT = 8.6

RIGHT
 FRONT
 DOOR

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

FIGURE 10 DUMMY IN VEHICLE POSITIONING DATA

	DRIVER	PASSENGER
HH	14.2	14.3
HW	22.0	22.7
CD	20.2	21.9
CS	12.9	NA
KDL	4.7	3.8
KDR	5.0	3.5
TA	15°	18°
SA	10°	10°
HSW	16.9	NA

	DRIVER	PASSENGER
HR	5.7	5.8
HS	10.2	10.7
AD	3.9	4.3
HD	5.2	6.0
KK	8.3	8.1
AA	8.7	8.8
HA	21.8	19.0

KNEE OUTER CLEVIS TO OUTER
CLEVIS SPACING:

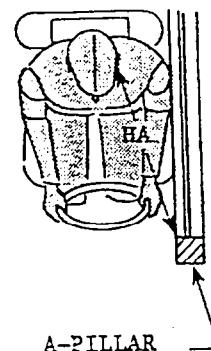
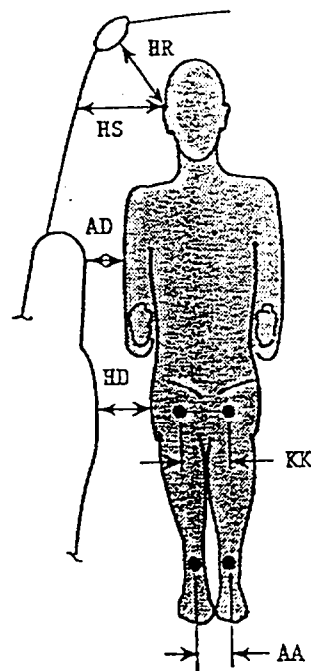
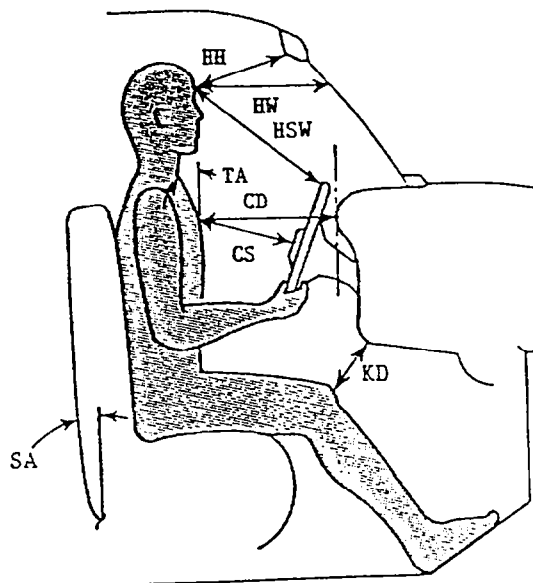
DRIVER = 10.6

PASSENGER = 10.6

PELVIS ANGLE:

DRIVER = 20°

PASSENGER = 25°

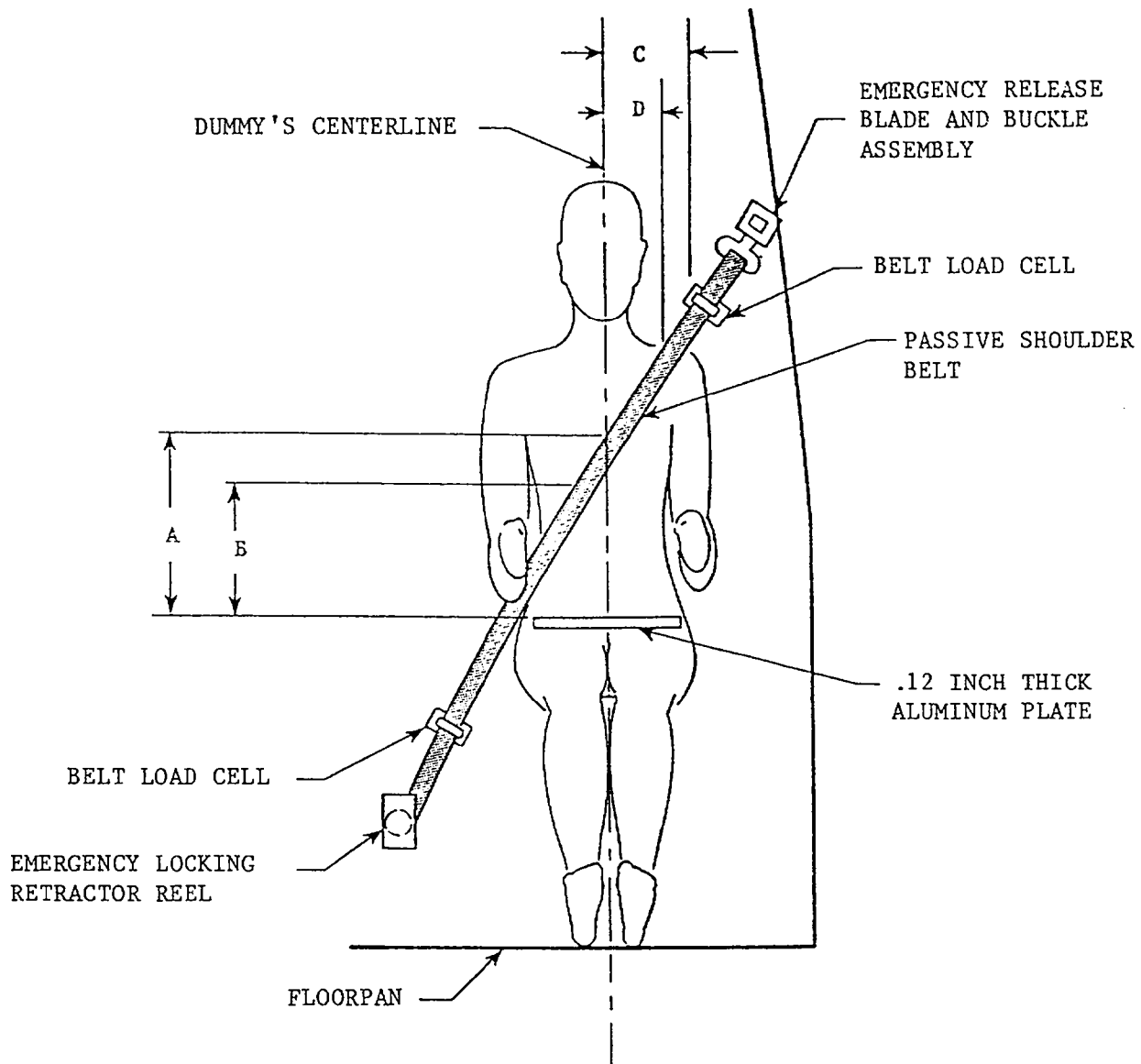


HH = HEAD TO WINDSHIELD HEADER
HW = HEAD TO WINDSHIELD
CD = CHEST TO DASH
CS = CHEST TO STEERING WHEEL
KD = KNEE TO DASH
TA = TORSO ANGLE
SA = SEAT BACK ANGLE
HSW = HEAD TO STEERING WHEEL

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.

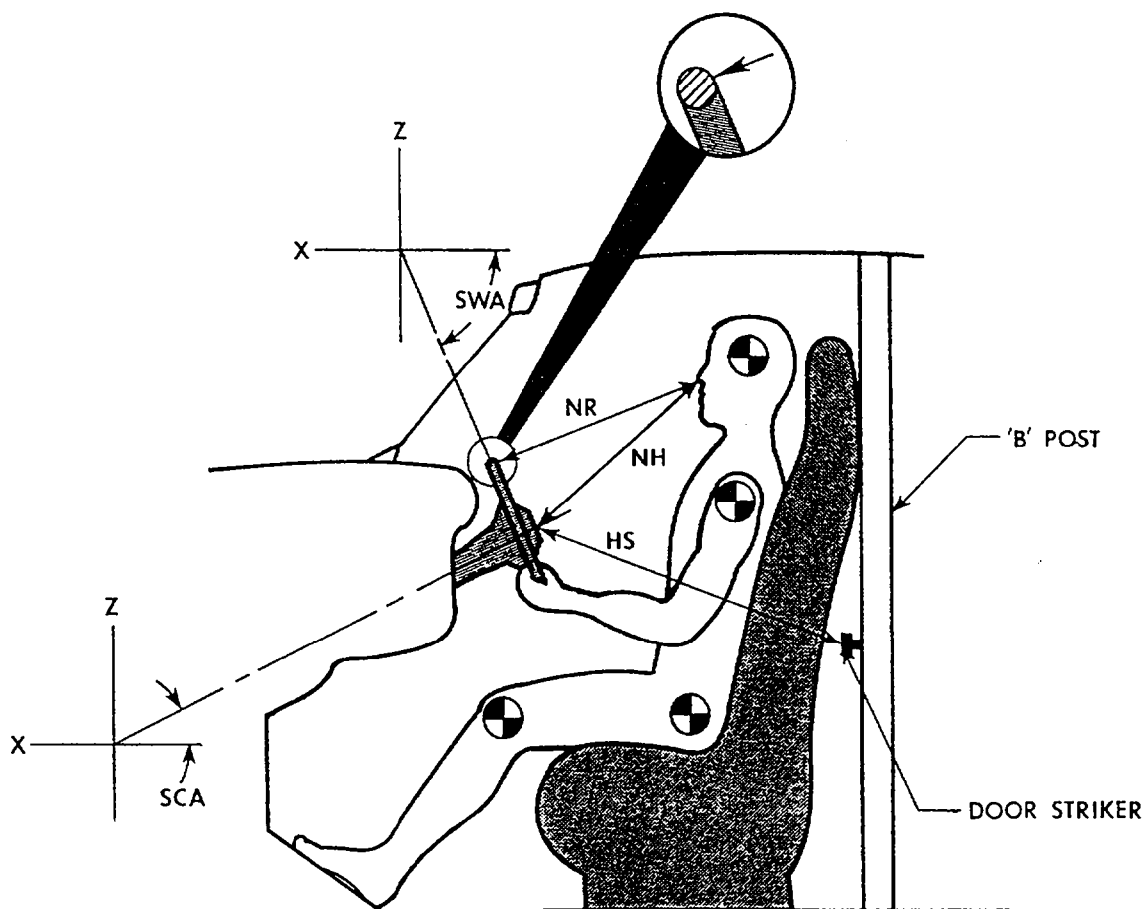
FIGURE 11 SEAT BELT POSITIONING DATA



	DRIVER DUMMY	PASSENGER DUMMY
A - Top surface of alum. plate to belt upper edge (in)	13.0	13.0
B - Top surface of alum. plate to belt lower edge (in)	10.2	10.2
C - Dummy centerline to outer edge of belt at chest flesh top (in)	5.0	4.8
D - Dummy centerline to inner edge of belt at chest flesh top (in)	2.5	2.0

ALL MEASUREMENTS ARE IN INCHES.

FIGURE 12 DRIVER DUMMY TO STEERING COLUMN/WHEEL ASSEMBLY DATA



POSITION OF STEERING COLUMN TILTING AND TELESCOPING ADJUSTMENTS, IF ANY:
The steering column was latched in the mid-point of the infinitely-adjustable tilt range.

MEASUREMENTS

NR	- DISTANCE FROM TIP OF DUMMY'S NOSE TO TOP REAR SURFACE OF STEERING WHEEL RIM.	14.9
NH	- DISTANCE FROM TIP OF DUMMY'S NOSE TO CENTER OF STEERING COLUMN HUB.	16.8
HS	- DISTANCE FROM CENTER OF STEERING COLUMN HUB TO THE FORWARD SURFACE OF THE DOOR LOCK STRIKER PIN.	22.2
SCA	- ANGLE OF STEERING COLUMN RELATIVE TO THE HORIZONTAL X AXIS	20°
SWA	- ANGLE OF STEERING WHEEL RELATIVE TO THE HORIZONTAL X AXIS	70°

ALL DISTANCE MEASUREMENTS ARE IN INCHES.

FIGURE 13
CAMERA POSITIONS

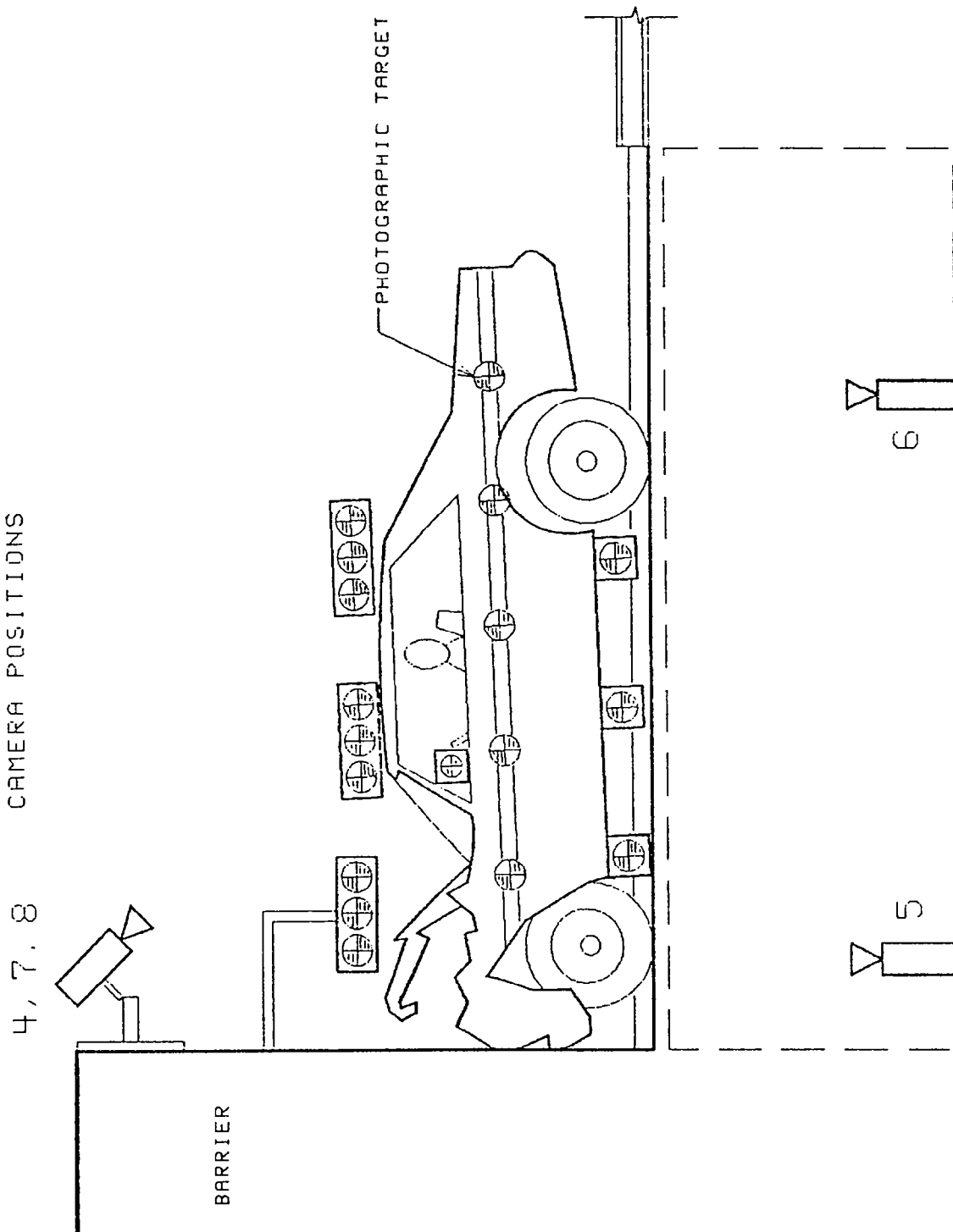


FIGURE 13

CAMERA POSITIONS, CONTINUED

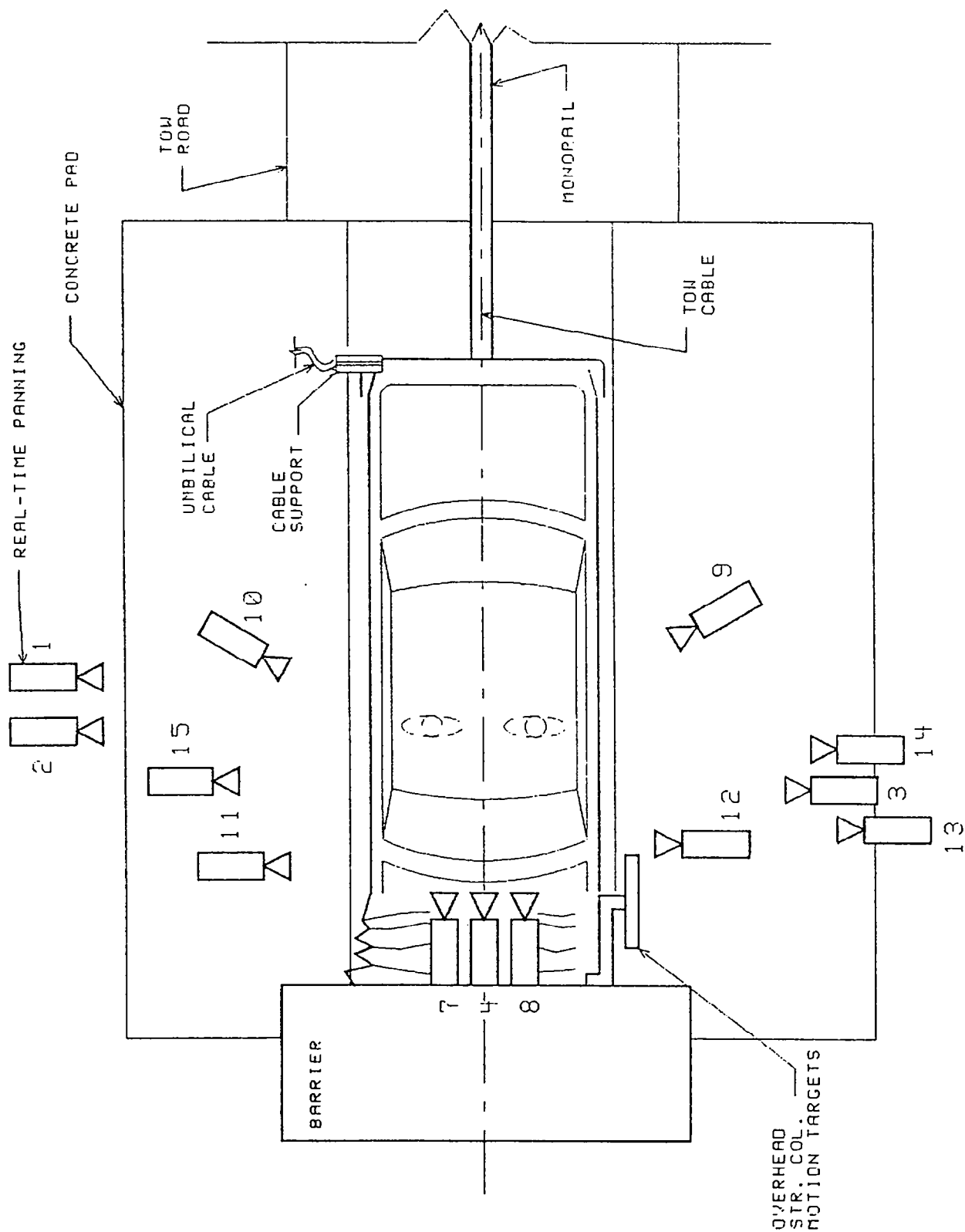


TABLE 14 MOTION PICTURE CAMERA LOCATIONS

TEST NO.: 910305		VEHICLE: Saturn/SL2/4-door sedan					FILM PLANE			FILM
CAMERA NO.	VIEW	CAMERA POSITIONS (IN)*			ANGLE** (DEG)	TO HEAD TARGET(IN)	LENS (MM)	SPEED (FPS)		
		X	Y	Z						
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	490		
3	Left vehicle crush	-41.5	295.0	44.0	-4	222.0	25	1010		
4	Windshield front view	-6.0	0.0	98.0	-40	NA	8.5	500		
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	998		
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	91.0	25	500		
10	Passenger kinematics	-152.1	-116.0	87.0	-26	85.0	25	502		
11	Right windshield intrusion	-38.1	-306.1	44.0	0	NA	50	500		
12	Left windshield intrusion	-53.0	309.4	42.3	0	NA	50	505		
13	Steering column motion	-120.0	262.0	103.0	-14	NA	25	498		
14	Steering column motion	-120.0	262.0	75.1	-9	NA	25	500		
15	Passenger kinematics	-38.8	-293.0	45.3	-4	233.0	25	485		
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

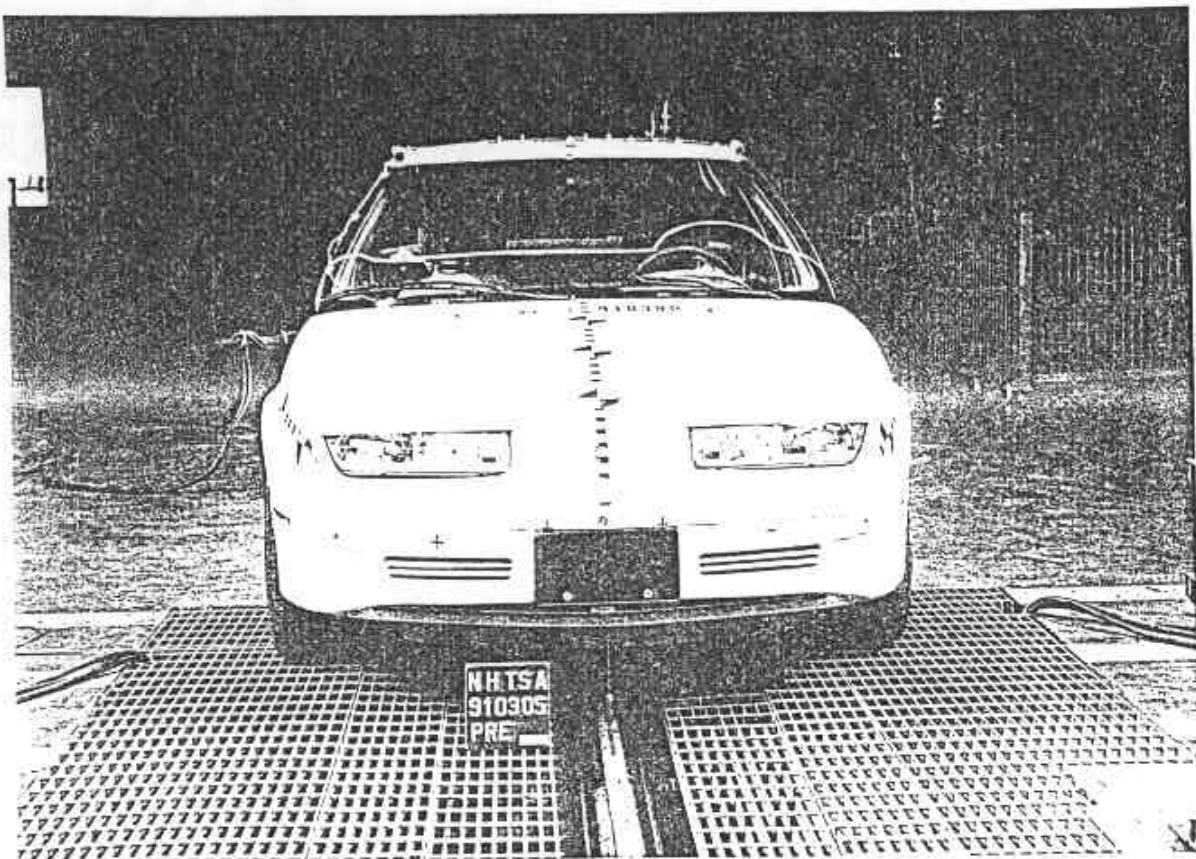


Figure A-1. PRE-TEST FRONT VIEW



Figure A-2. POST-TEST FRONT VIEW



Figure A-3. PRE-TEST LEFT SIDE VIEW



Figure A-4. POST-TEST LEFT SIDE VIEW

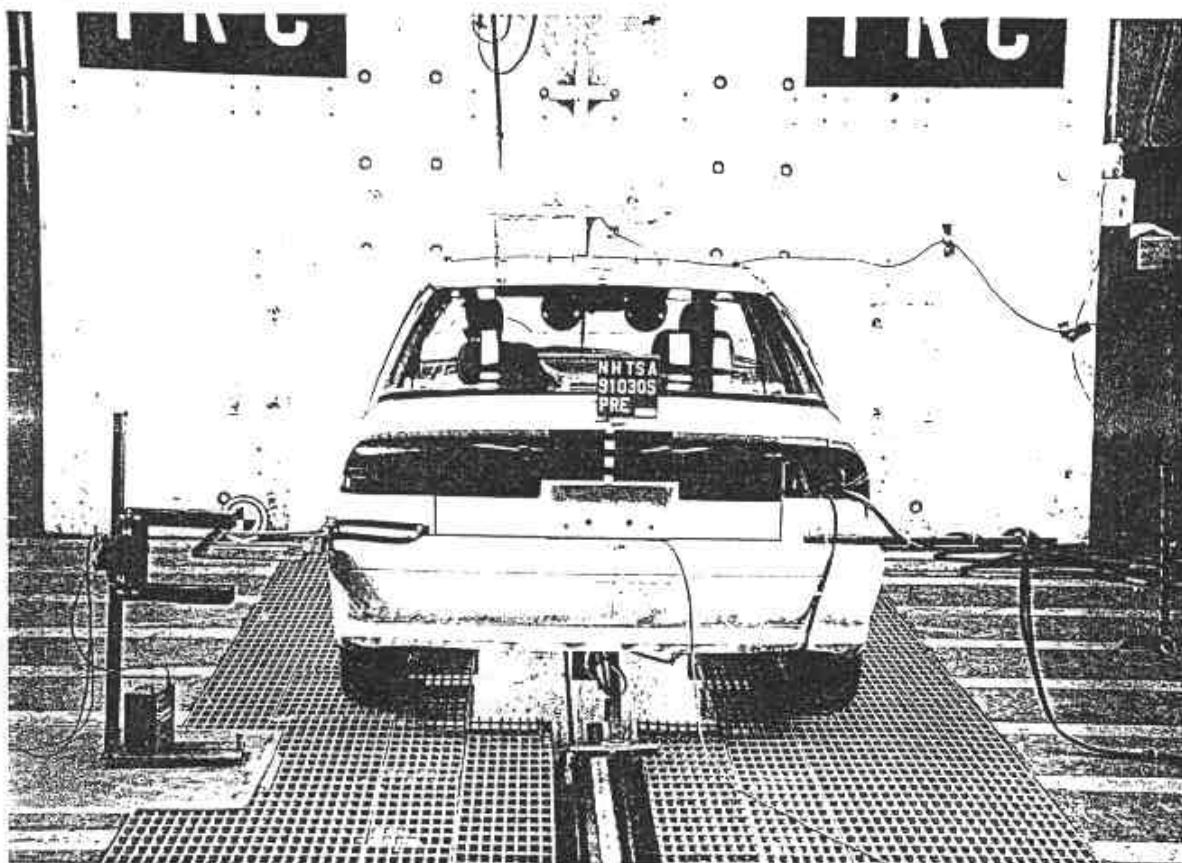


Figure A-5. PRE-TEST REAR VIEW



Figure A-6. POST-TEST REAR VIEW

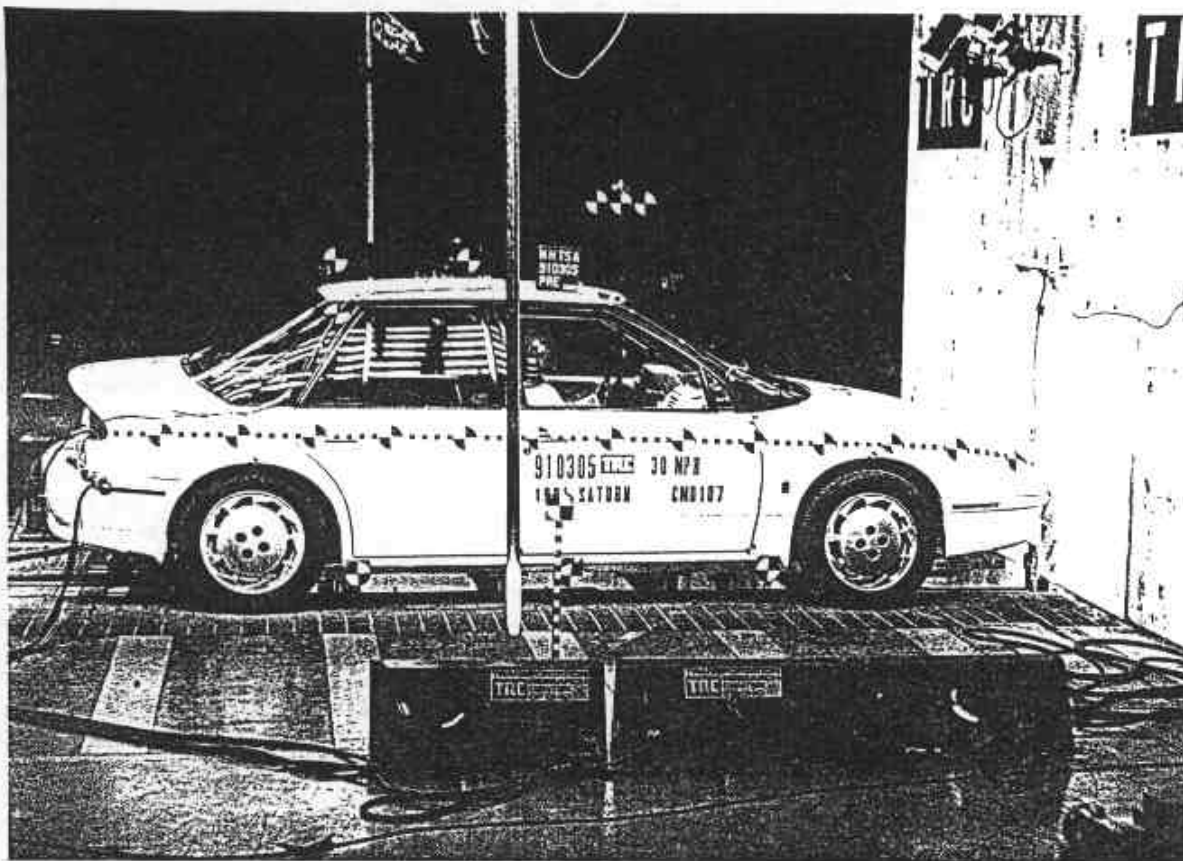


Figure A-7. PRE-TEST RIGHT SIDE VIEW



Figure A-8. POST-TEST RIGHT SIDE VIEW

A-5

310305

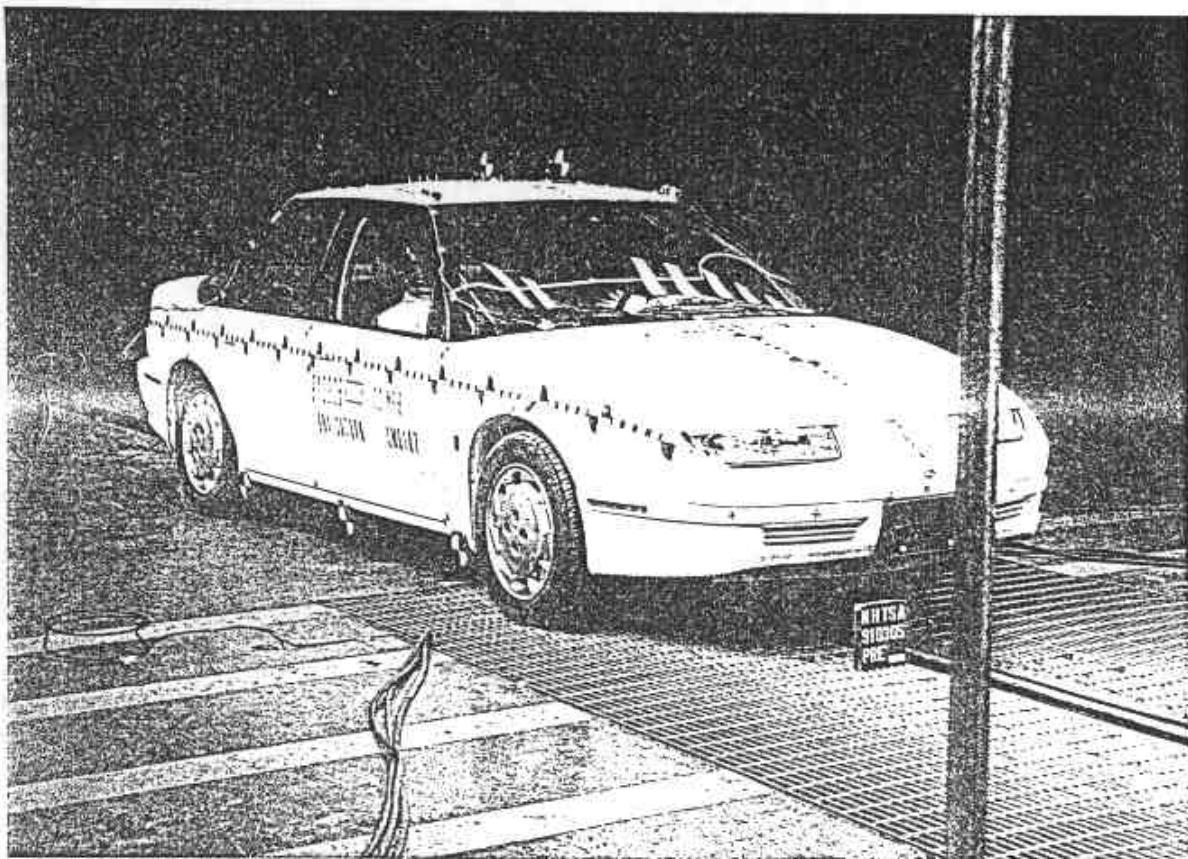


Figure A-9. PRE-TEST RIGHT FRONT THREE-QUARTER VIEW

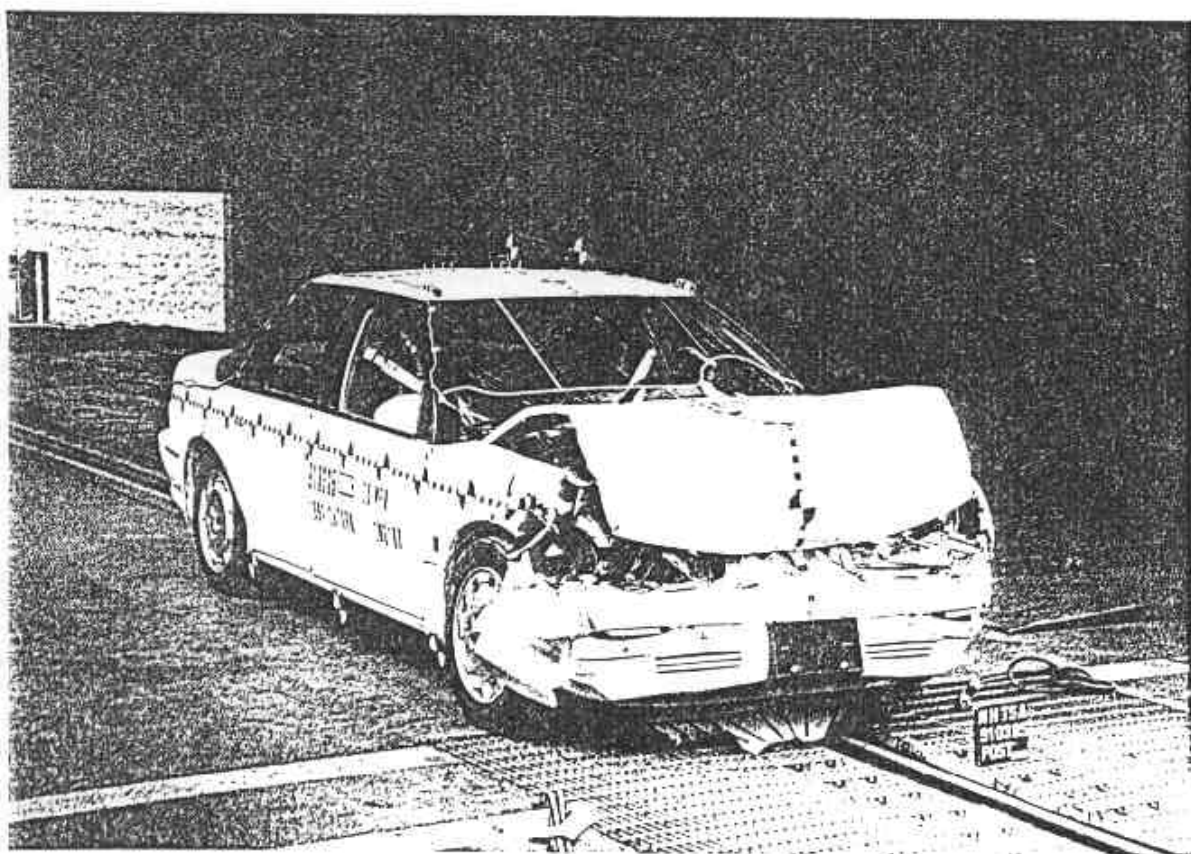


Figure A-10. POST-TEST RIGHT FRONT THREE-QUARTER VIEW



Figure A-11. PRE-TEST LEFT REAR THREE-QUARTER VIEW



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

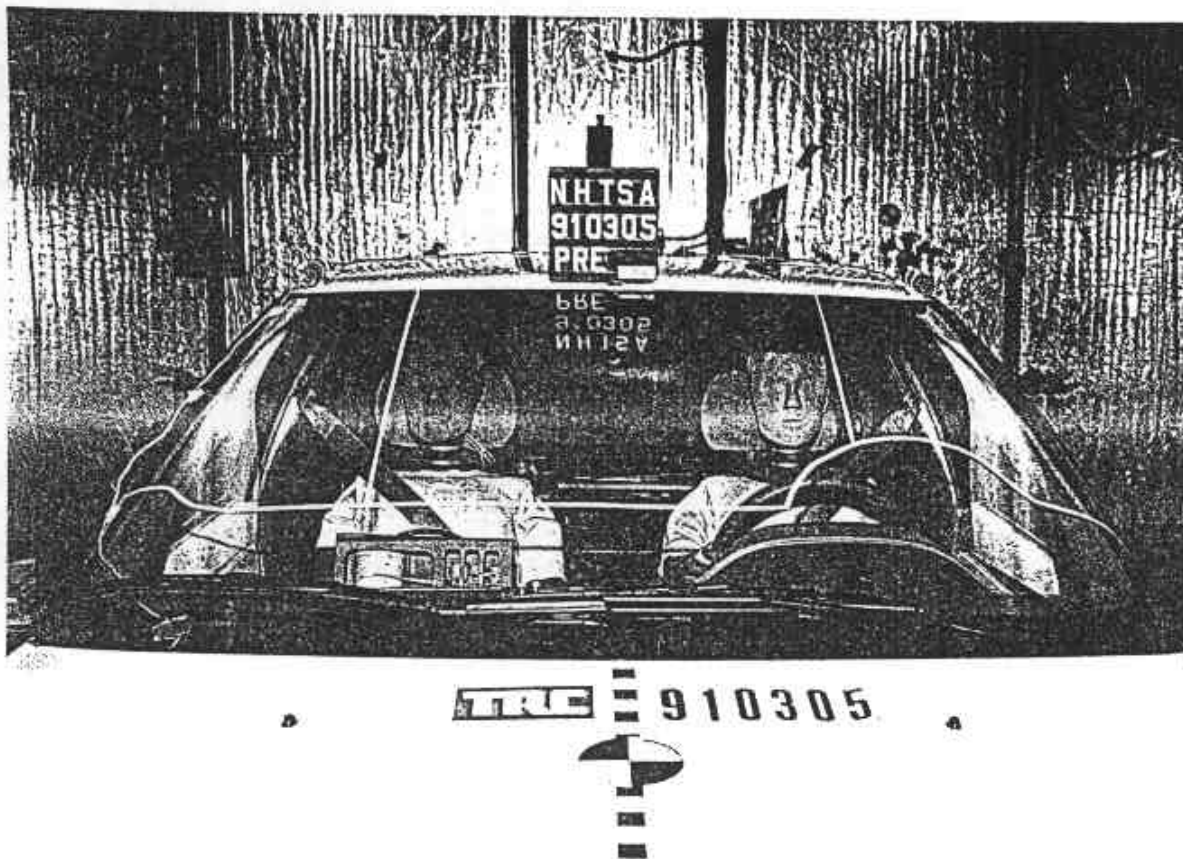


Figure A-13. PRE-TEST WINDSHIELD VIEW

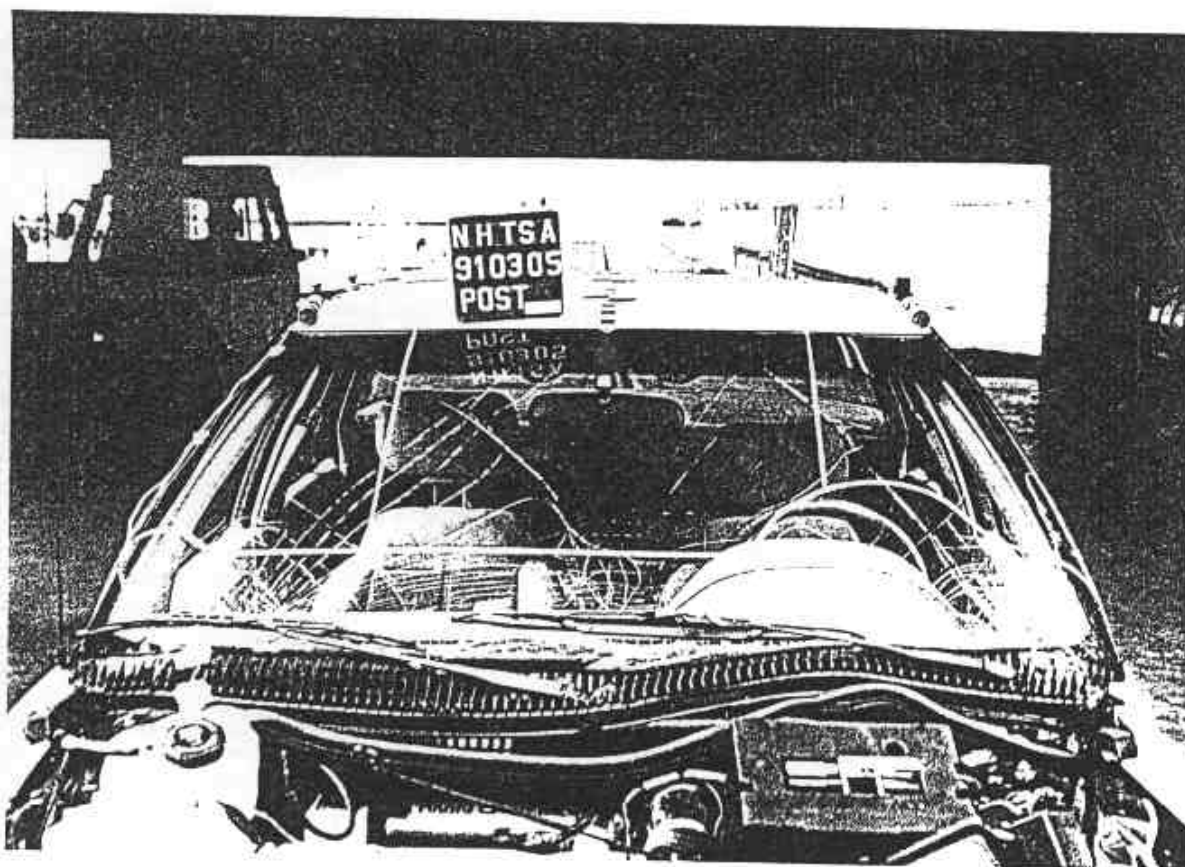


Figure A-14. POST TEST WINDSHIELD VIEW

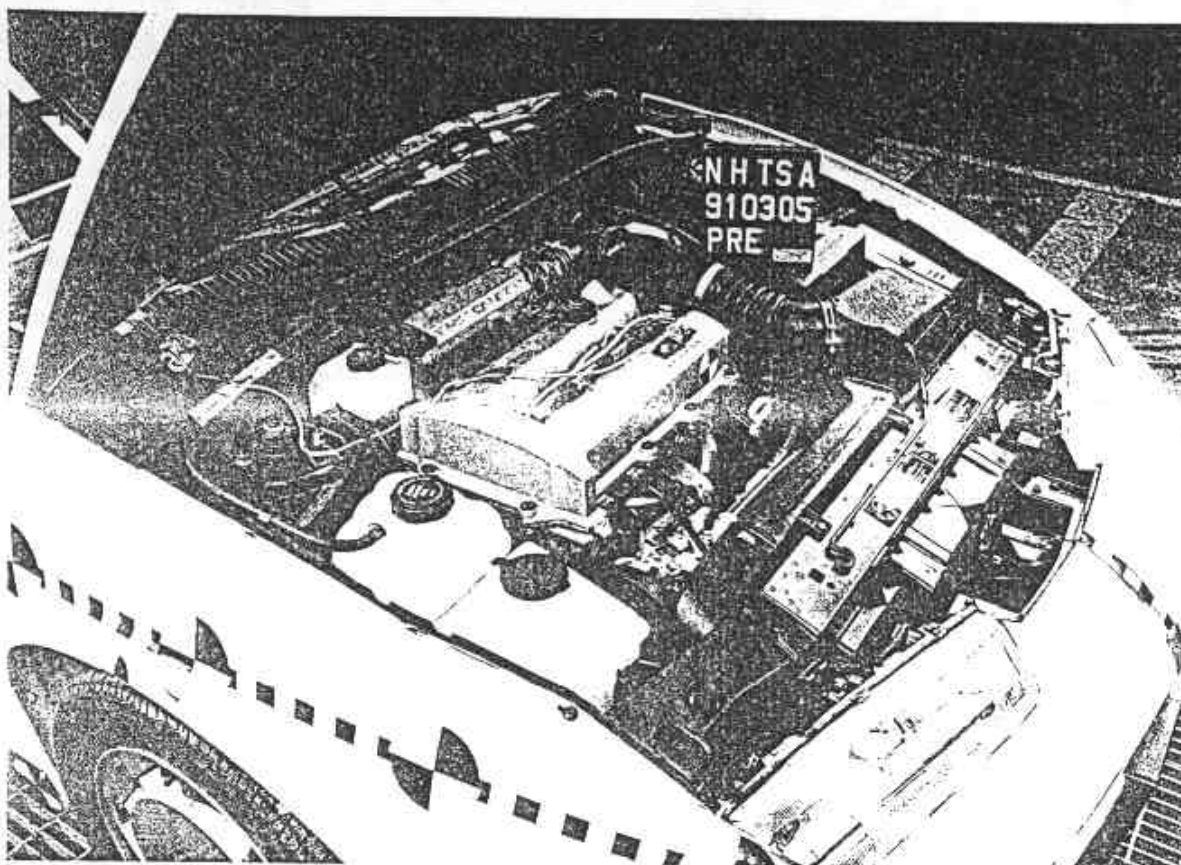


Figure A-15. PRE-TEST ENGINE COMPARTMENT VIEW

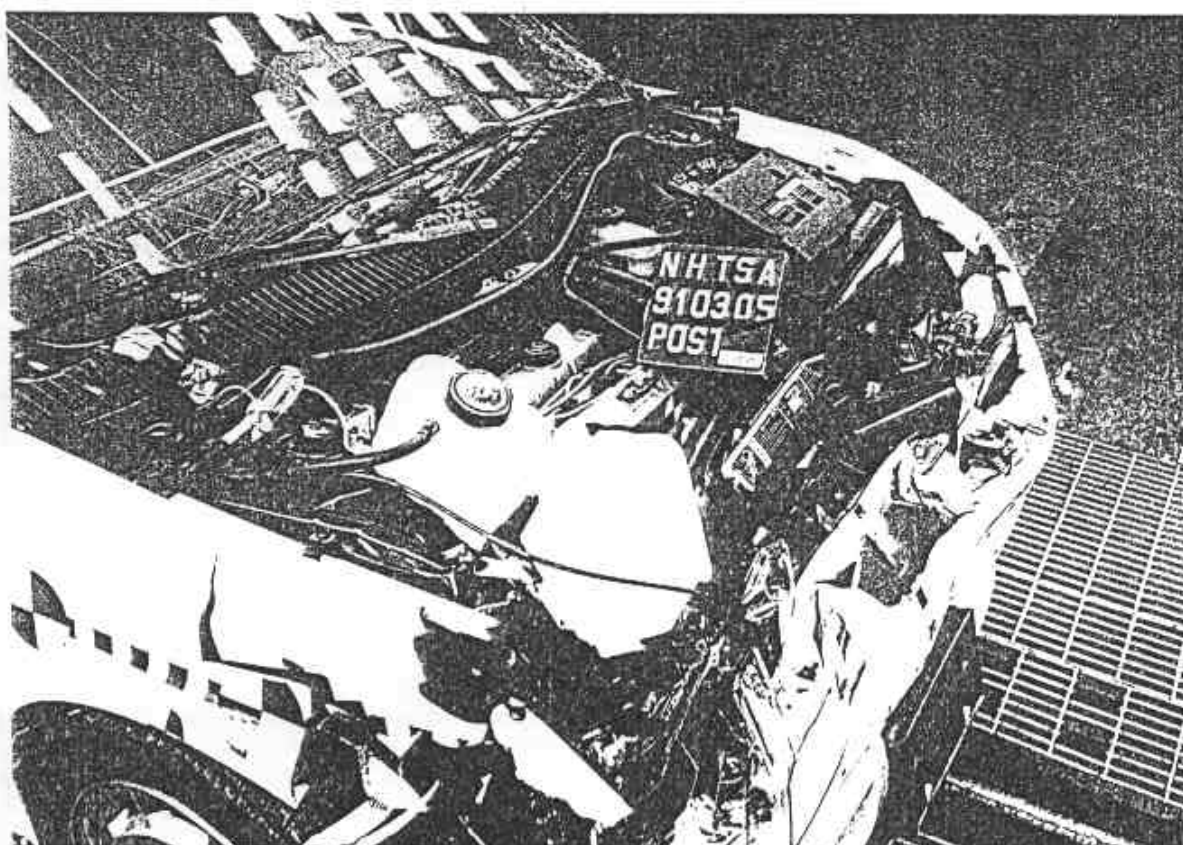


Figure A-16. POST-TEST ENGINE COMPARTMENT VIEW

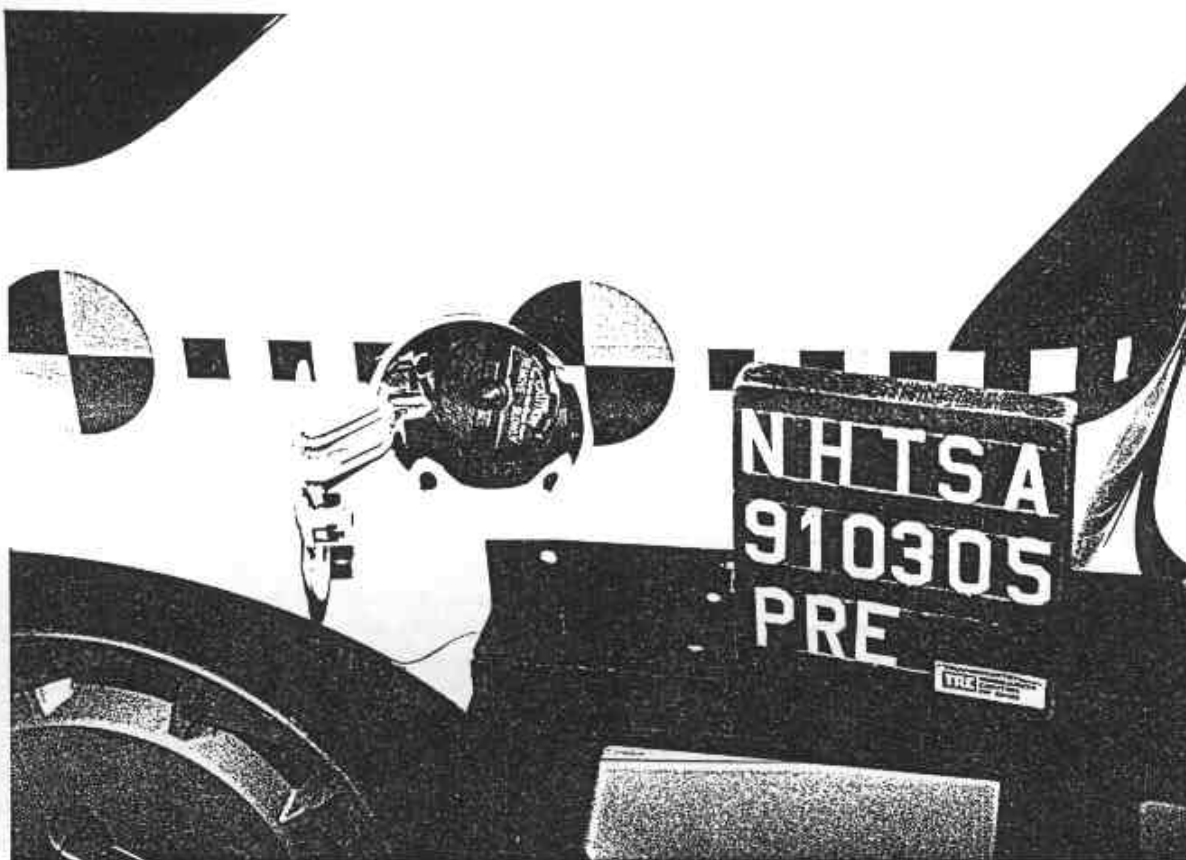


Figure A-17. PRE-TEST FUEL FILLER CAP VIEW

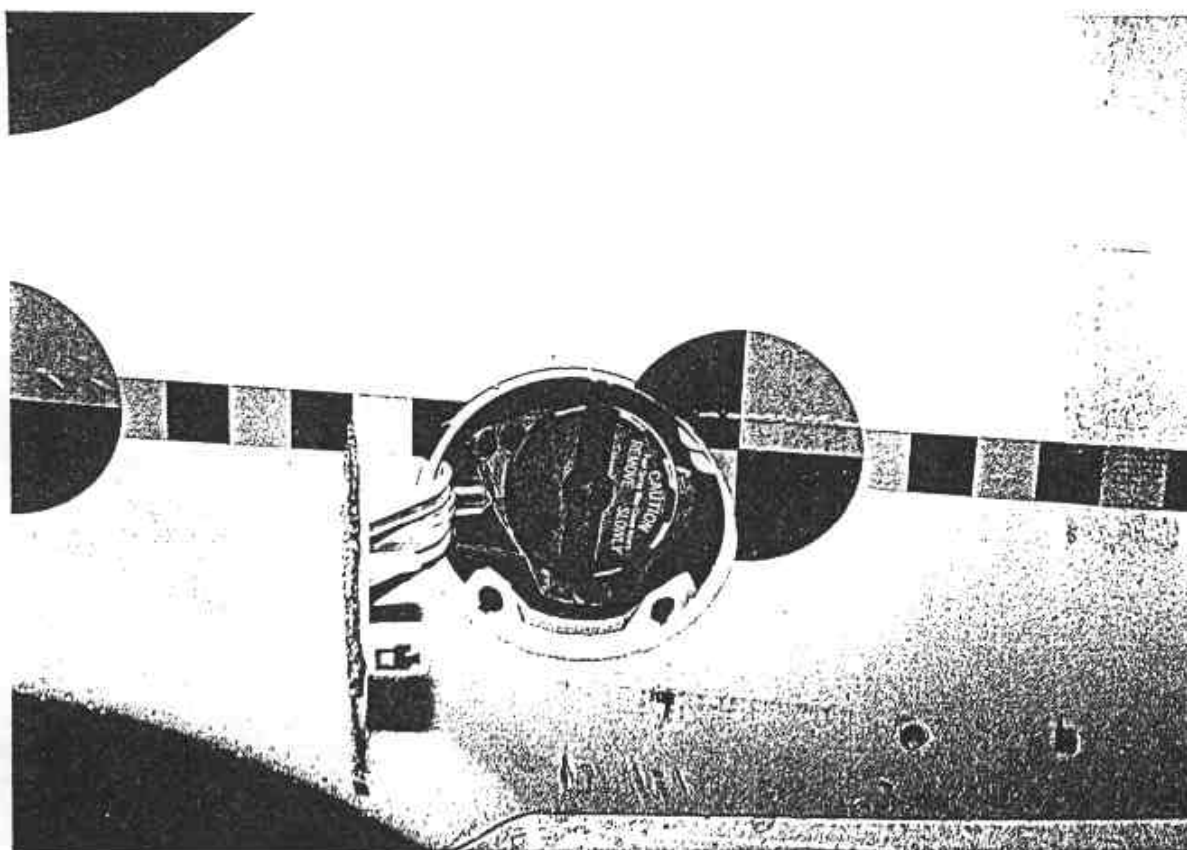


Figure A-18. POST-TEST FUEL FILLER CAP VIEW

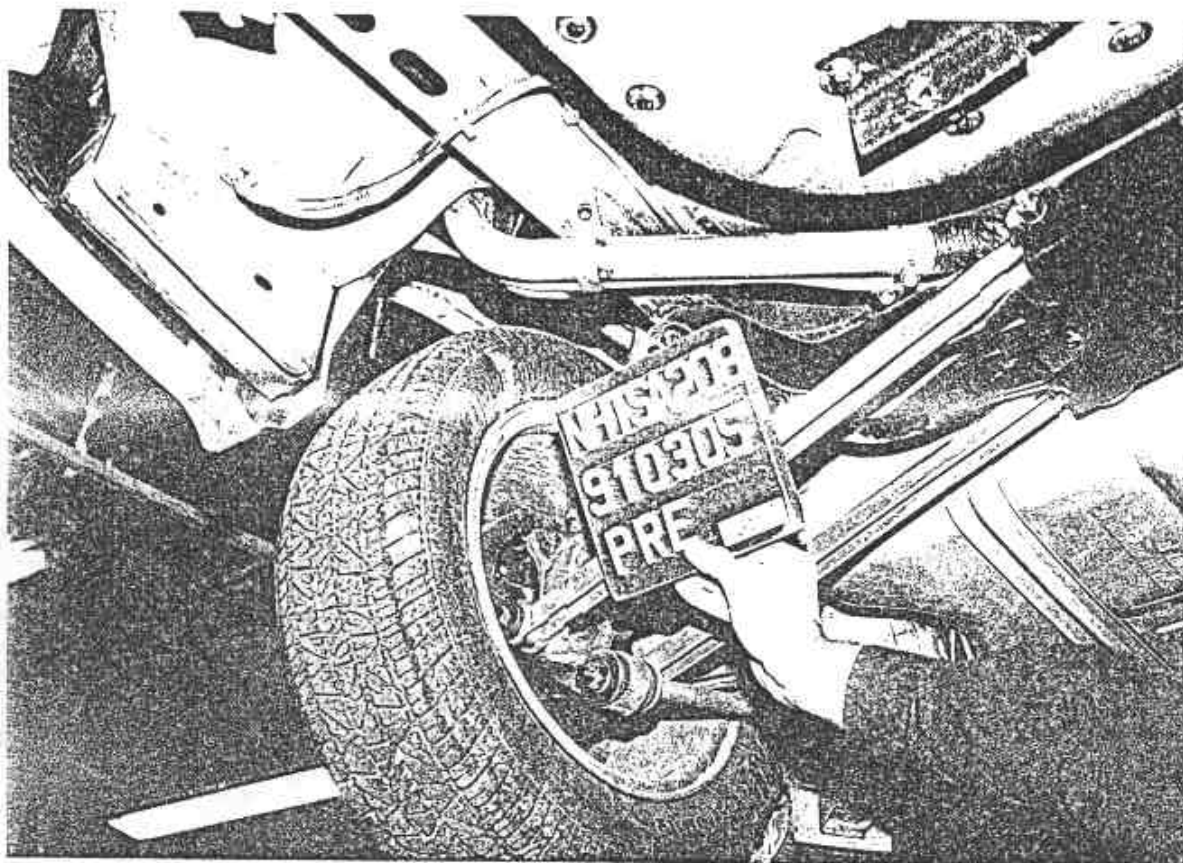


Figure A-19. PRE-TEST FUEL FILLER NECK VIEW

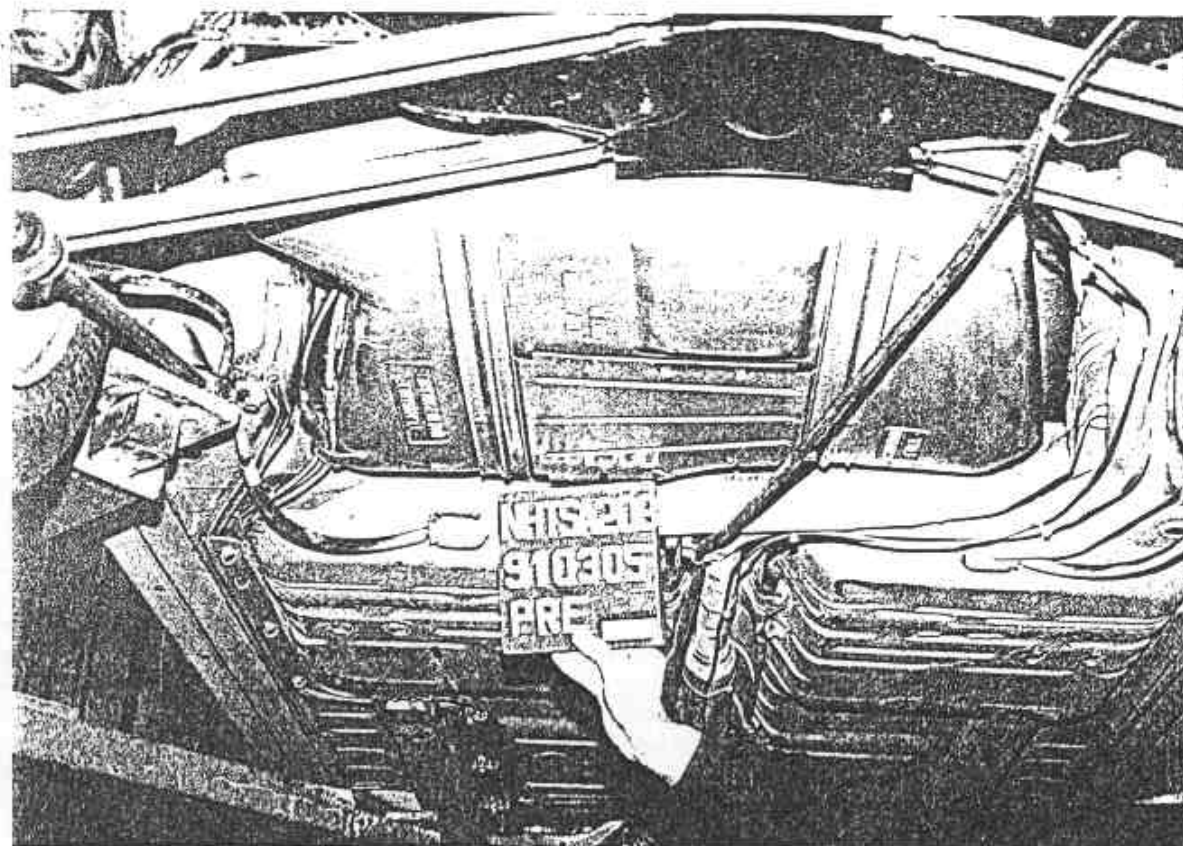


Figure A-20. PRE-TEST FUEL TANK VIEW
A 11

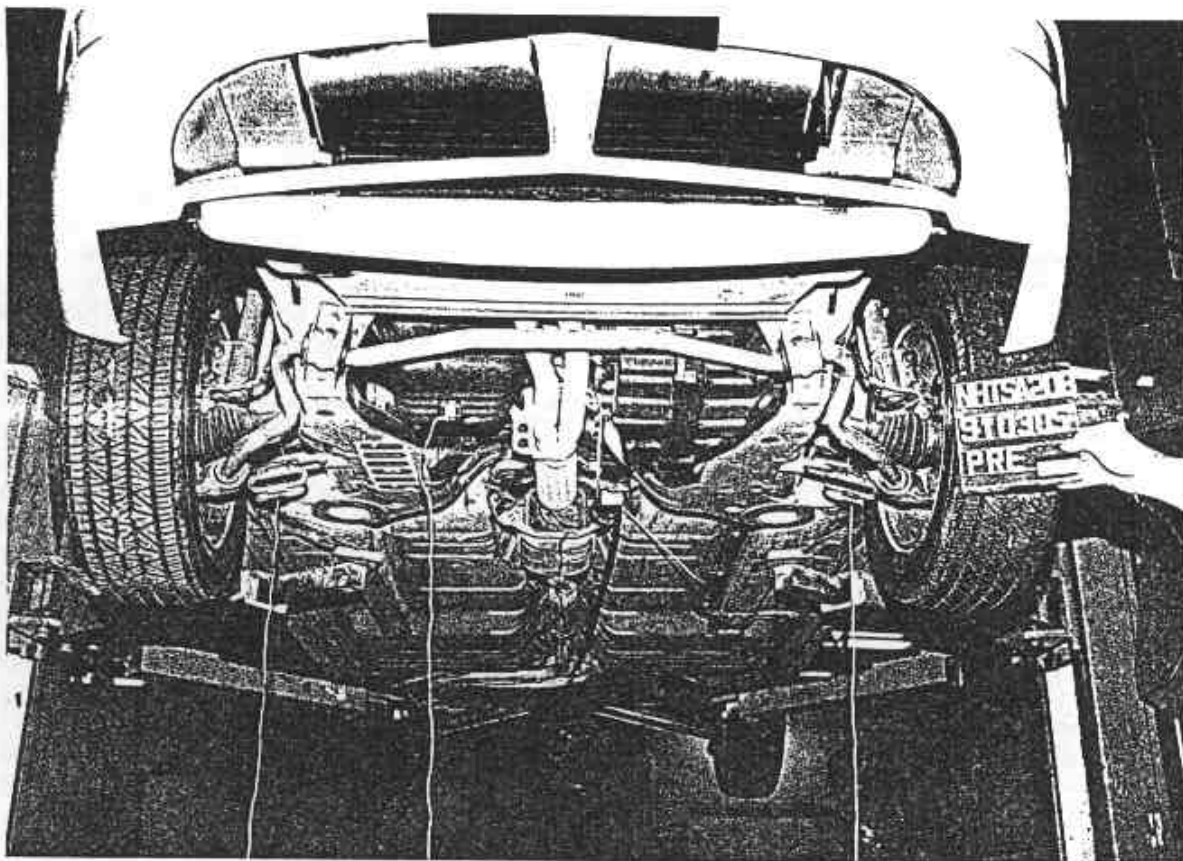


Figure A-21. PRE-TEST FRONT UNDERBODY VIEW

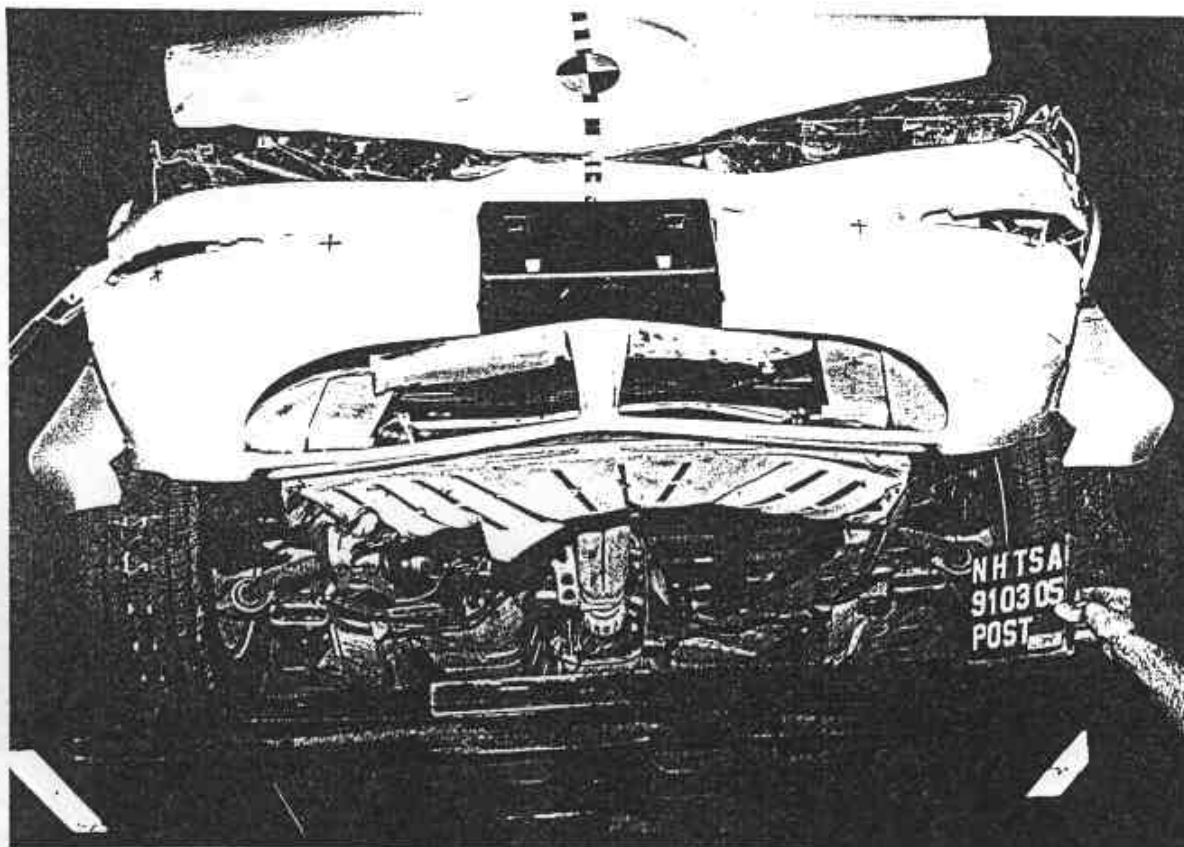


Figure A-22. POST-TEST FRONT UNDERBODY VIEW

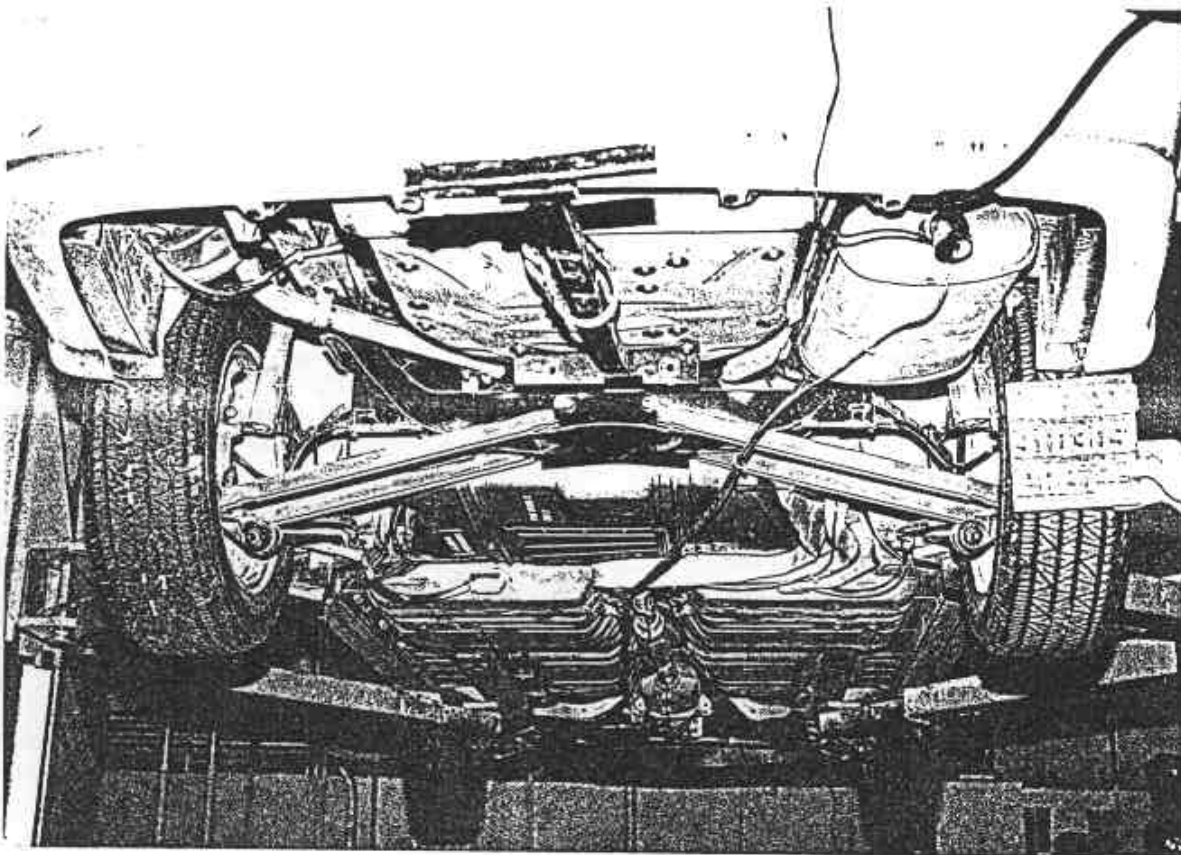


Figure A-23. PRE-TEST REAR UNDERBODY VIEW

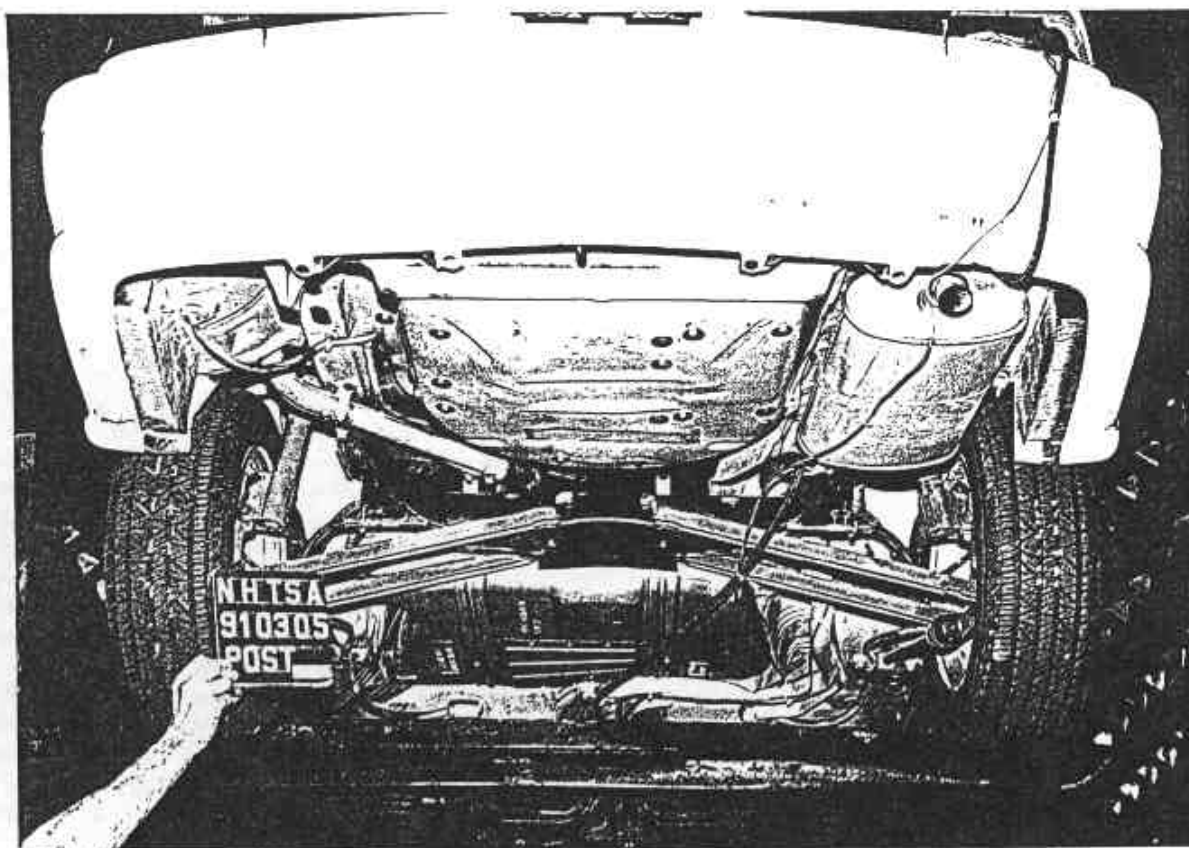


Figure A-24. POST-TEST REAR UNDERBODY VIEW



Figure A-25. PRE-TEST DRIVER DUMMY POSITION VIEW



Figure A-26. POST TEST DRIVER DUMMY POSITION VIEW
A-14

910305

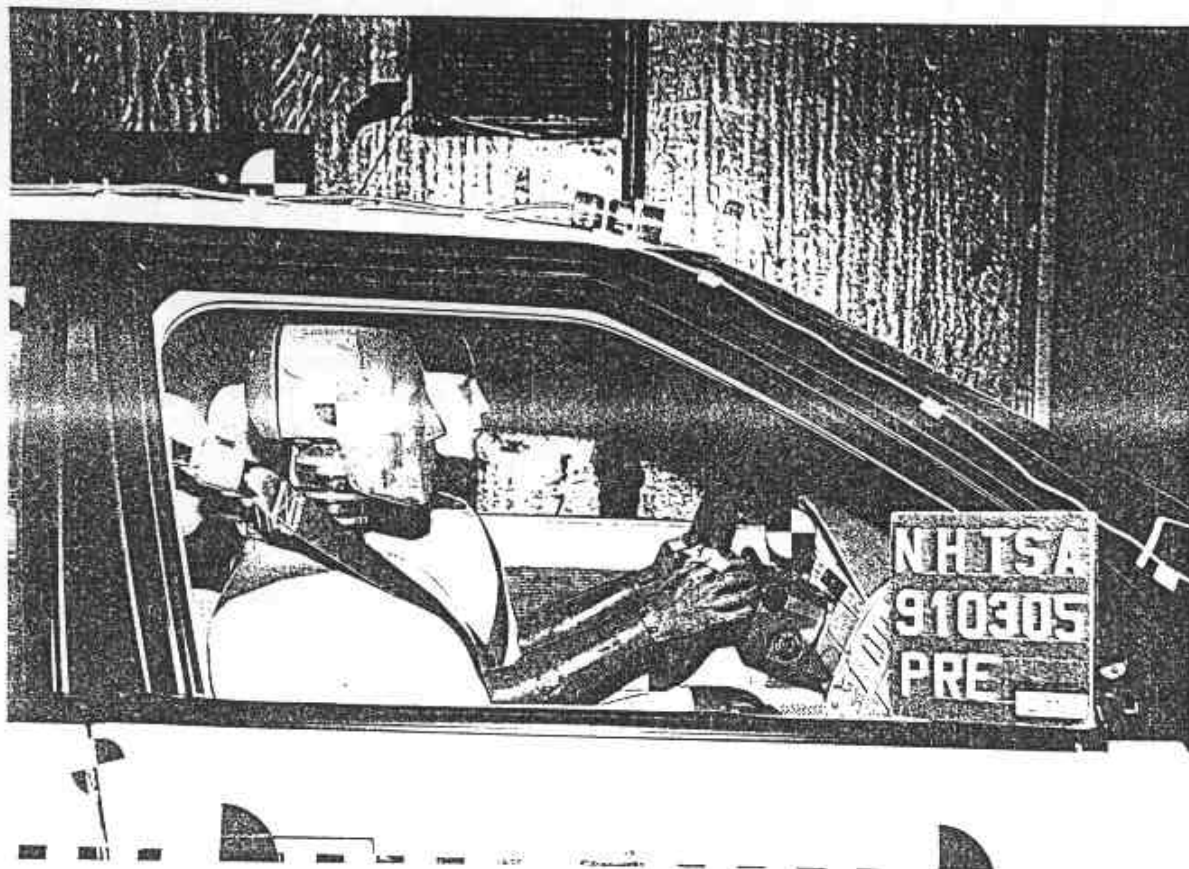


Figure A-27. PRE-TEST PASSENGER DUMMY POSITION VIEW



Figure A-28. POST TEST PASSENGER DUMMY POSITION VIEW

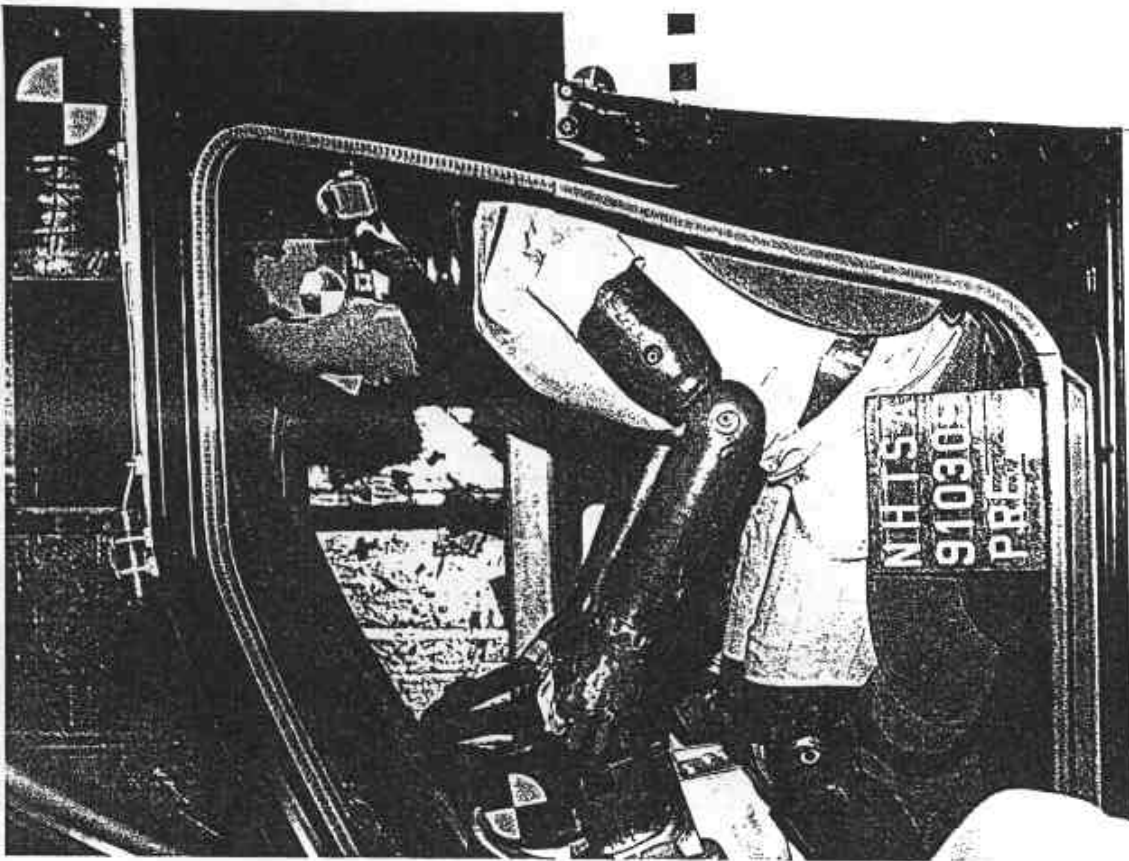


Figure A-29. PRE-TEST DRIVER DUMMY & VEHICLE INTERIOR - VIEW 1

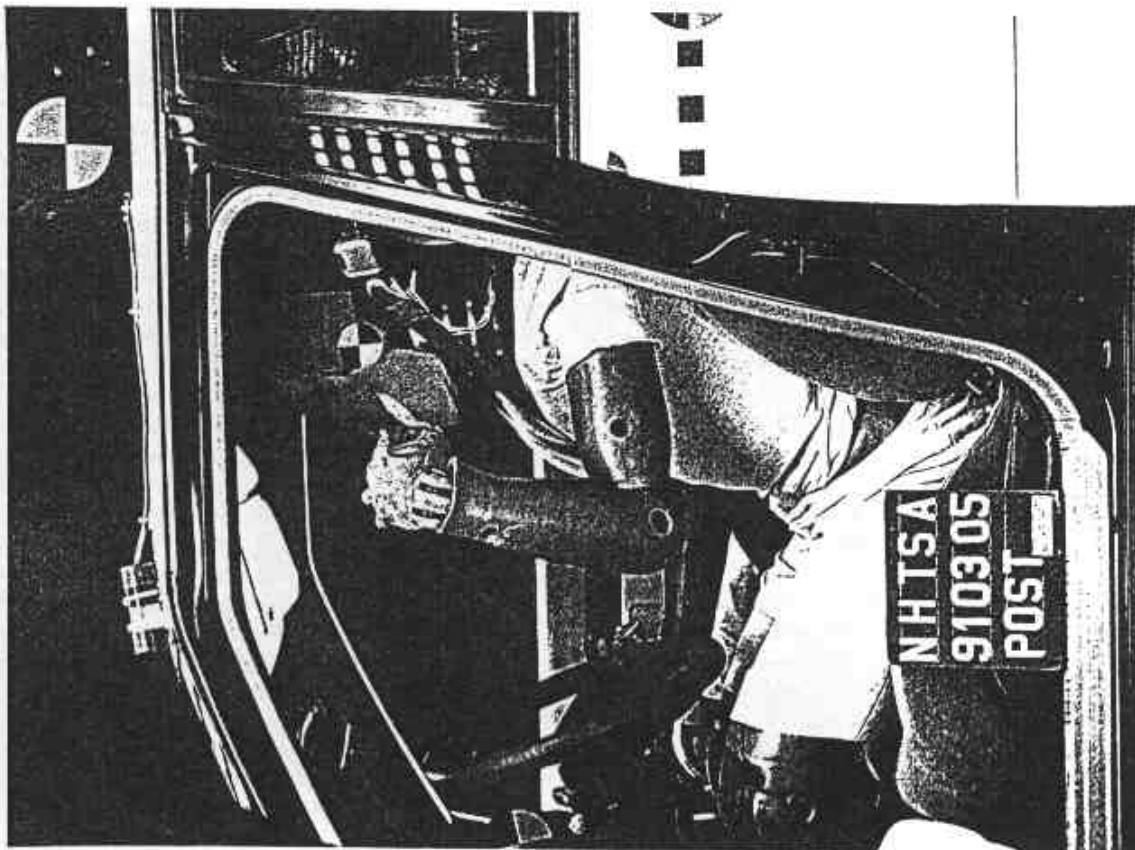


Figure A-30. POST-TEST DRIVER DUMMY & VEHICLE INTERIOR - VIEW 1

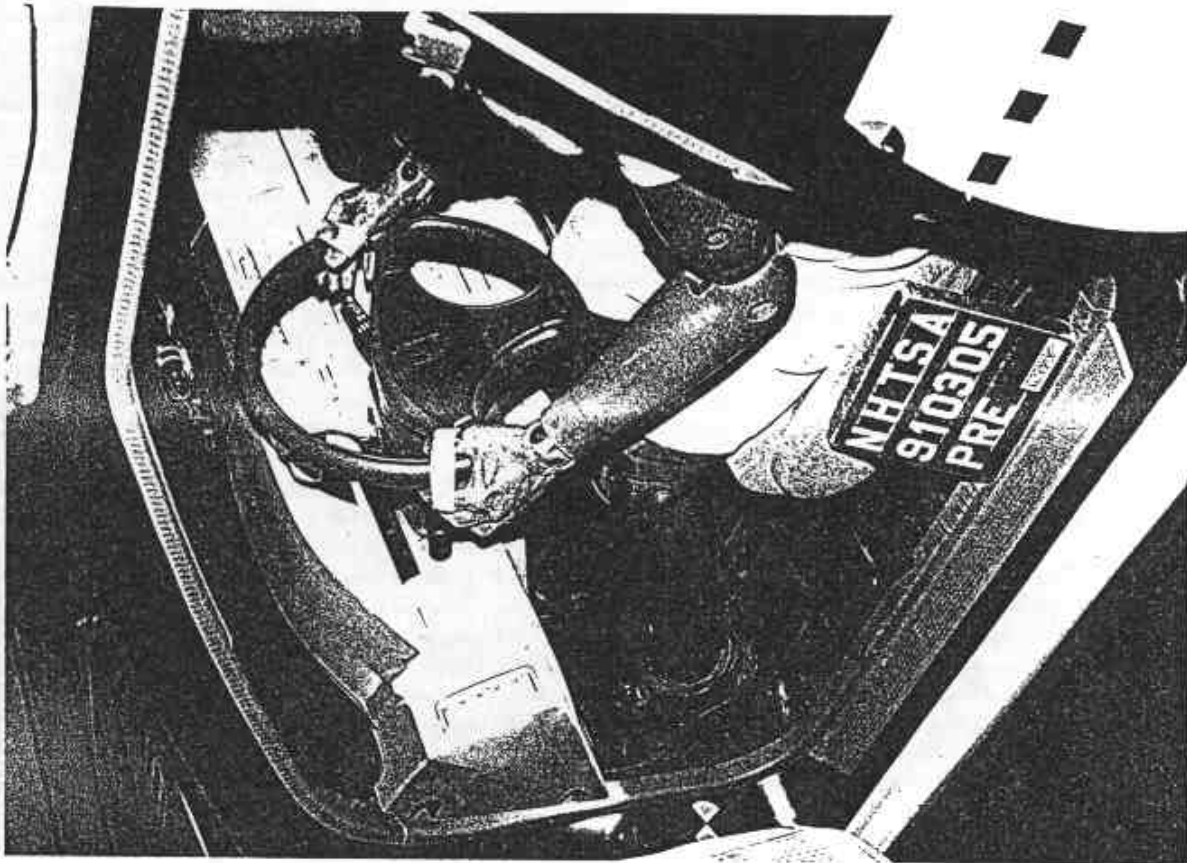


Figure A-31. PRE-TEST DRIVER DUMMY & VEHICLE INTERIOR - VIEW 2

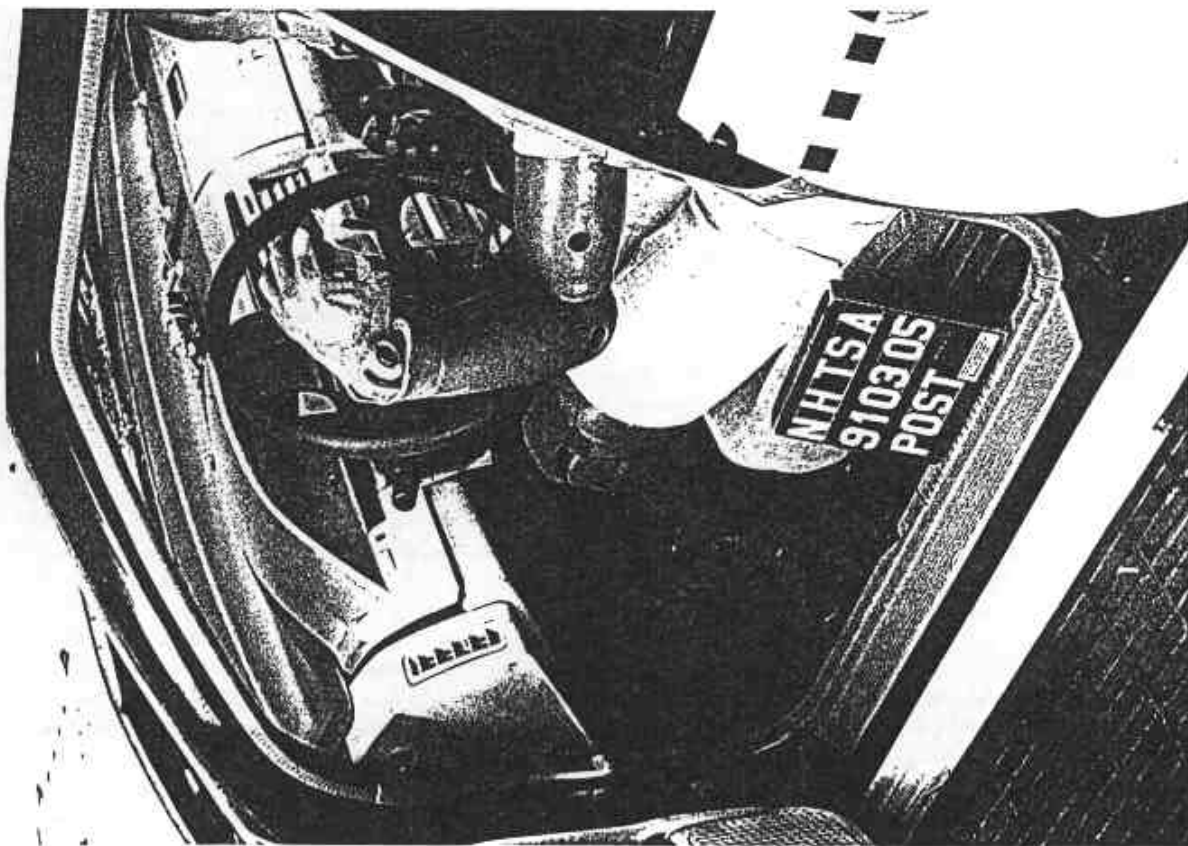


Figure A-32. POST-TEST DRIVER DUMMY & VEHICLE INTERIOR - VIEW 2

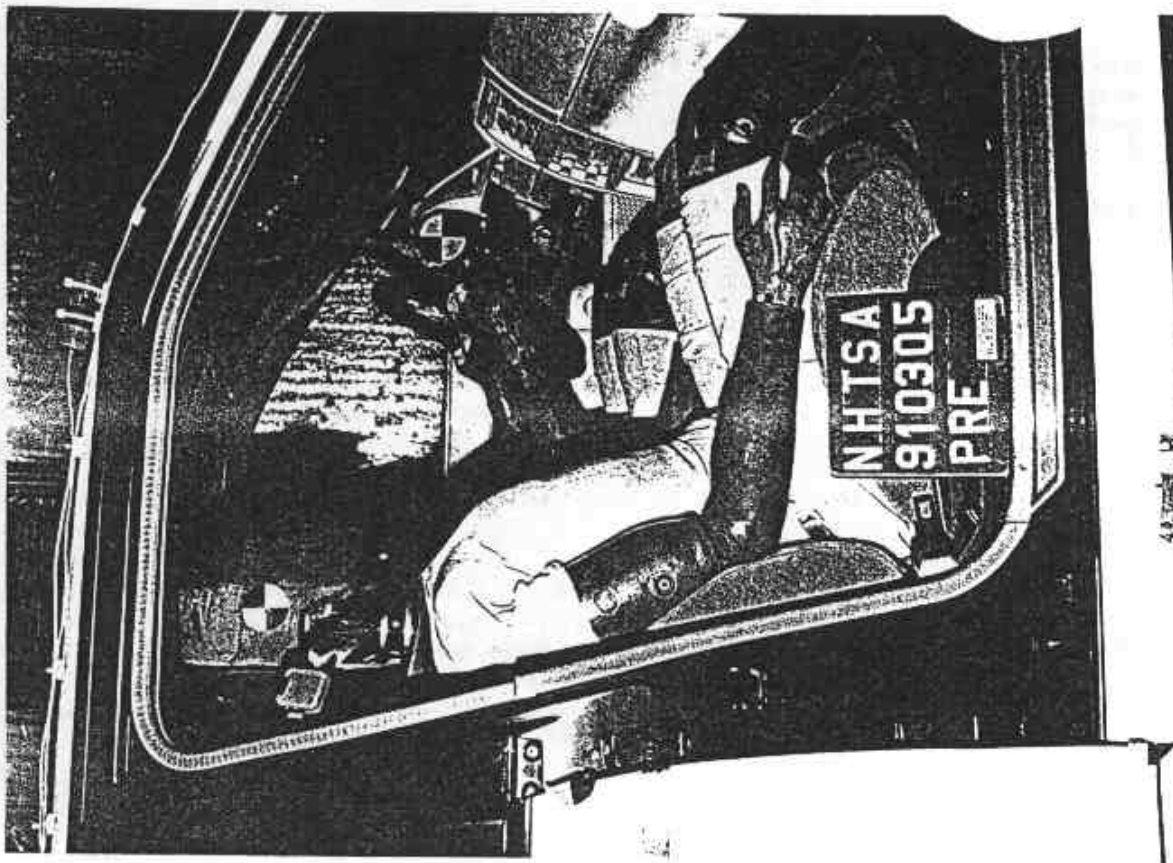


Figure A-33. PRE-TEST PASSENGER DUMMY & VEHICLE INTERIOR - VIEW 1

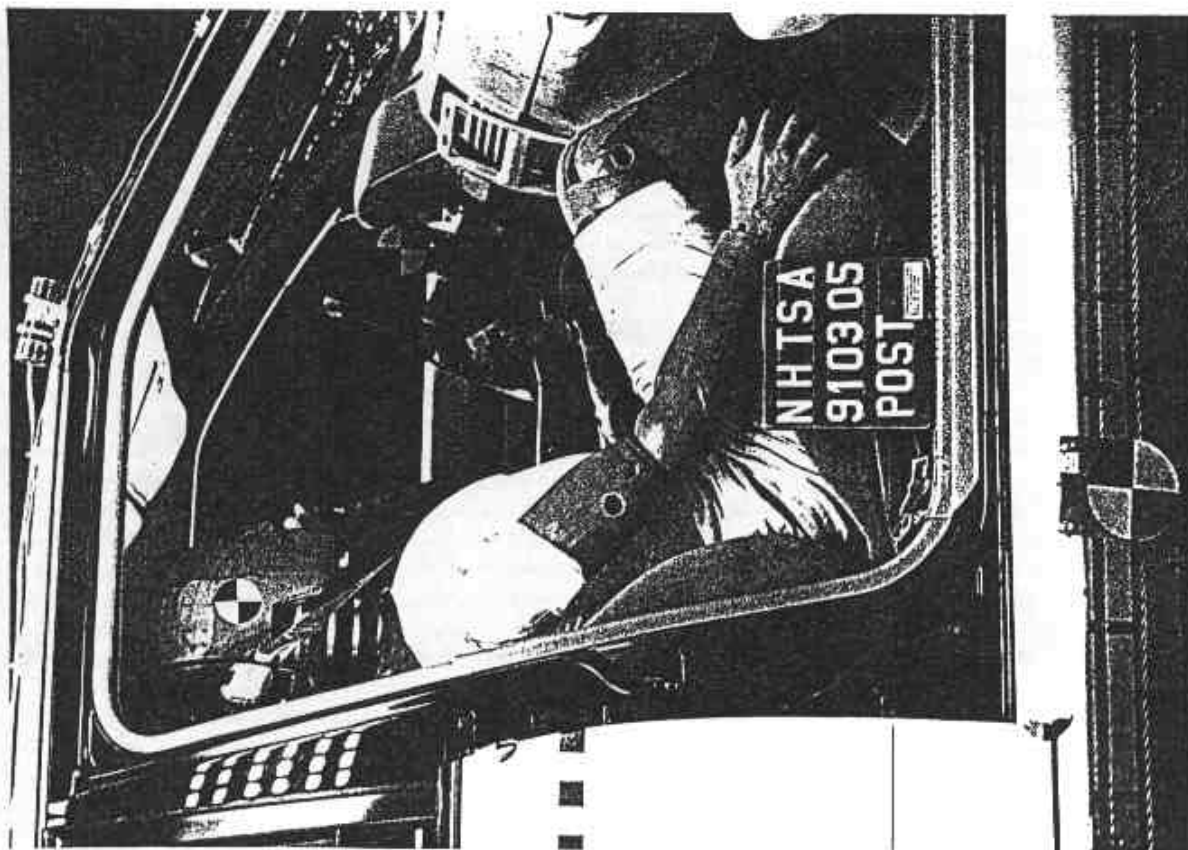


Figure A-34. POST-TEST PASSENGER DUMMY & VEHICLE INTERIOR - VIEW 1

A-18

910305

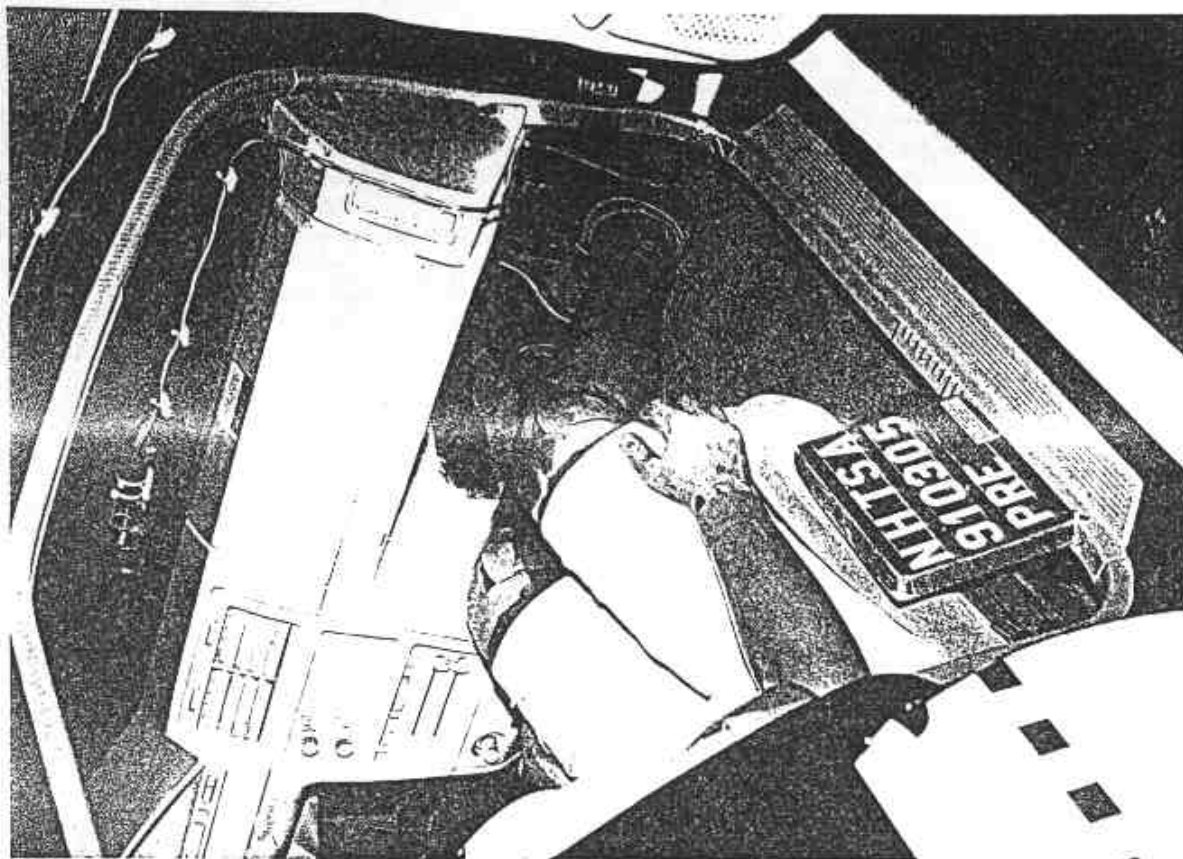


Figure A-35. PRE-TEST PASSENGER DUMMY & VEHICLE INTERIOR - VIEW 2



Figure A-36. POST-TEST PASSENGER DUMMY & VEHICLE INTERIOR - VIEW 2

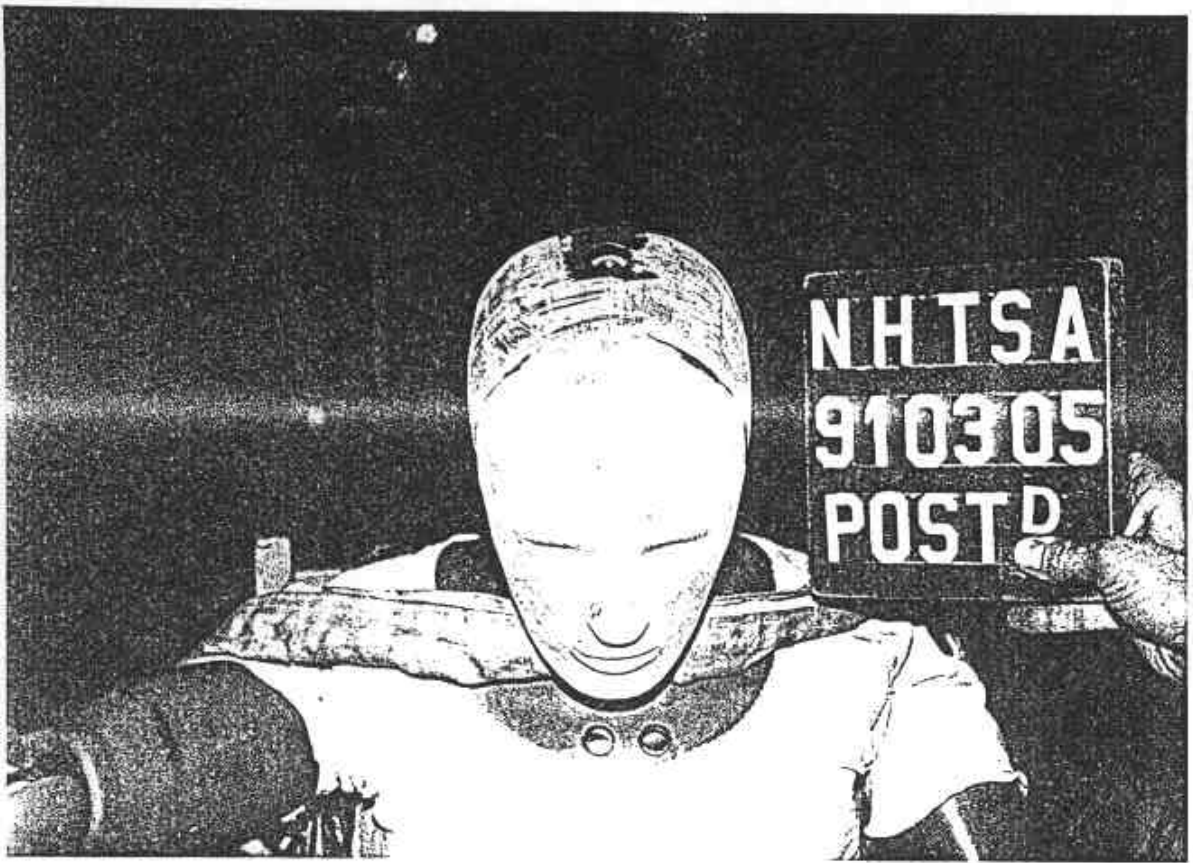


Figure A-37. POST-TEST DRIVER DUMMY HEAD CONTACT VIEW



Figure A-38. POST-TEST DRIVER DUMMY KNEE CONTACT - VIEW 1

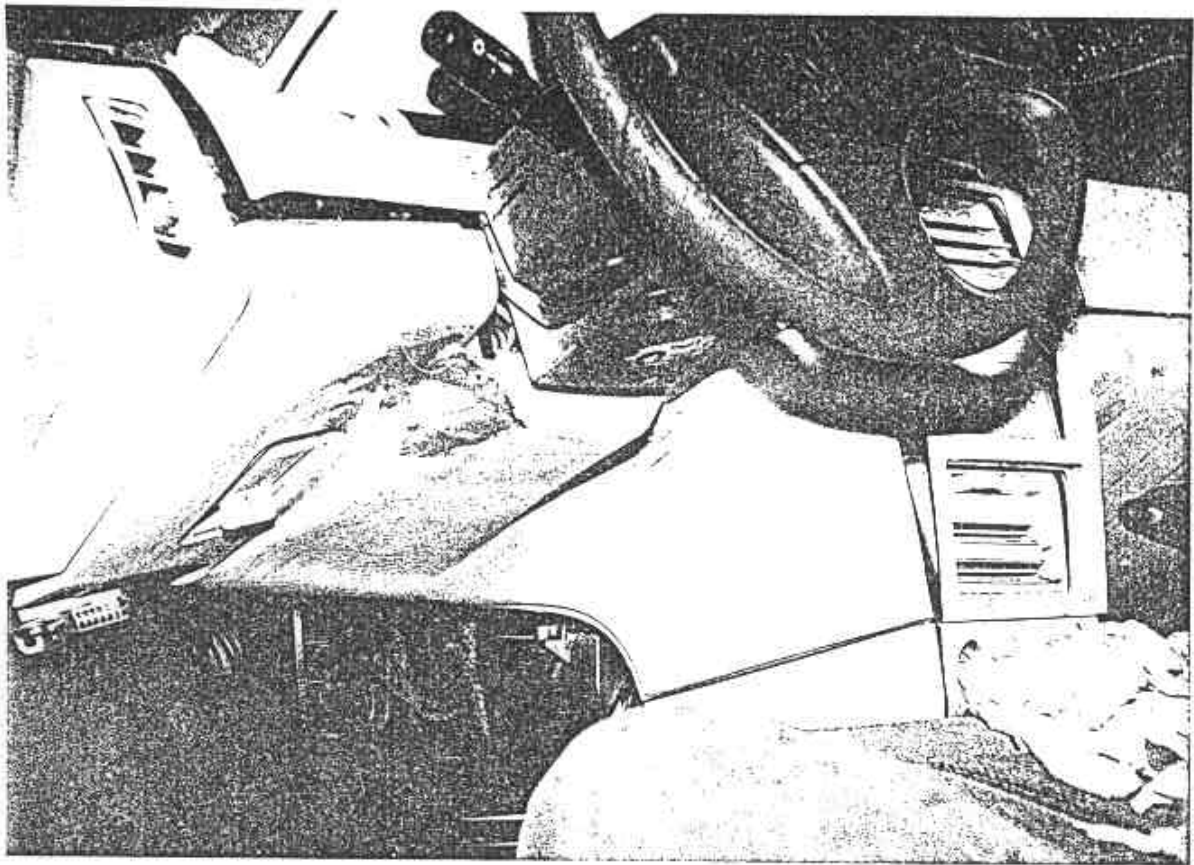


Figure A-39. POST-TEST DRIVER DUMMY KNEE CONTACT - VIEW 1

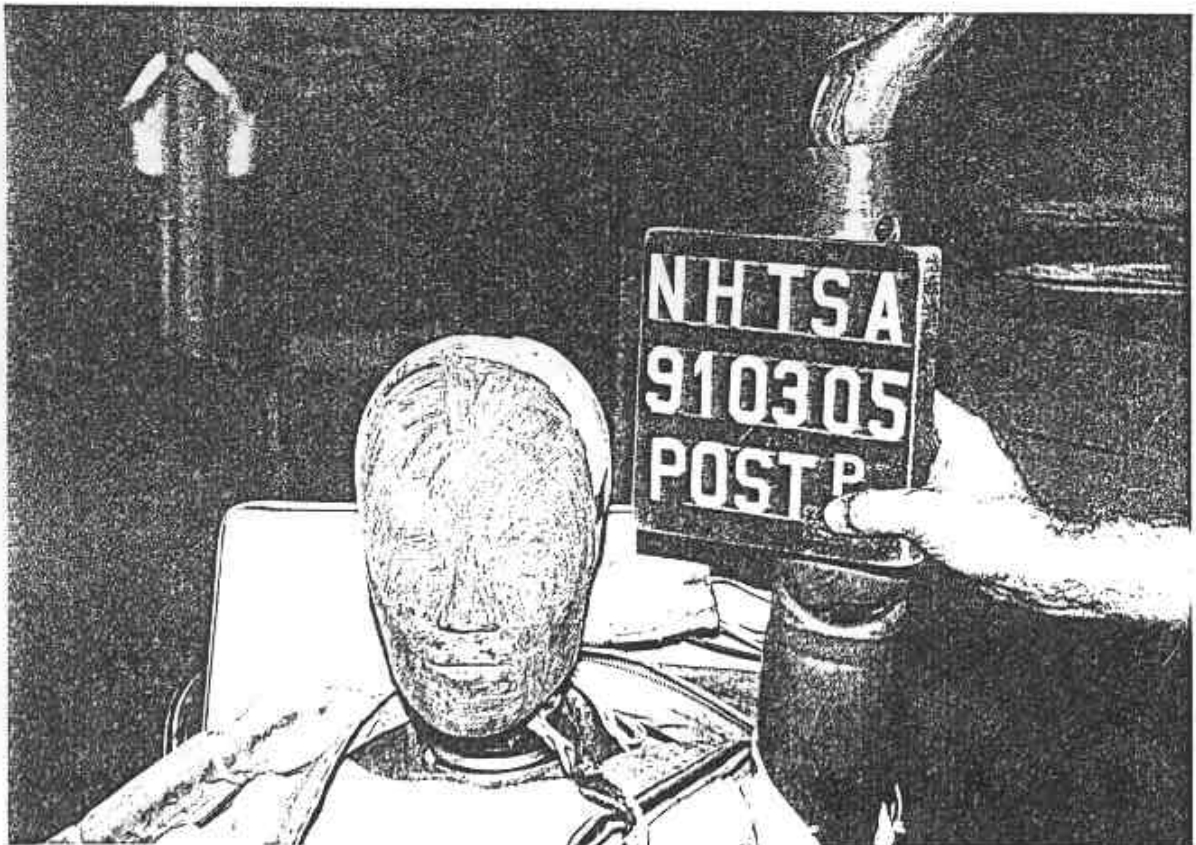


FIGURE A-40. POST-TEST PASSENGER DUMMY HEAD CONTACT VIEW

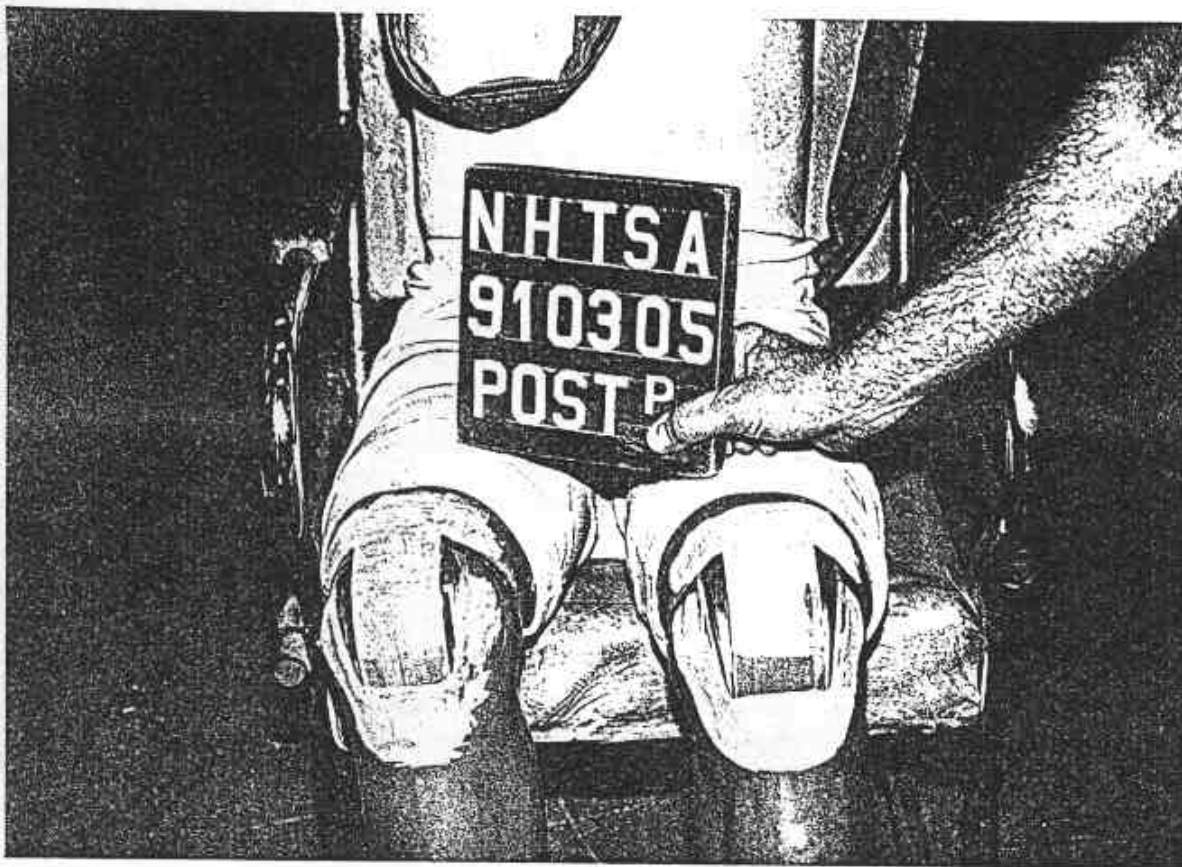


Figure A-41. POST-TEST PASSENGER DUMMY KNEE CONTACT - VIEW 1

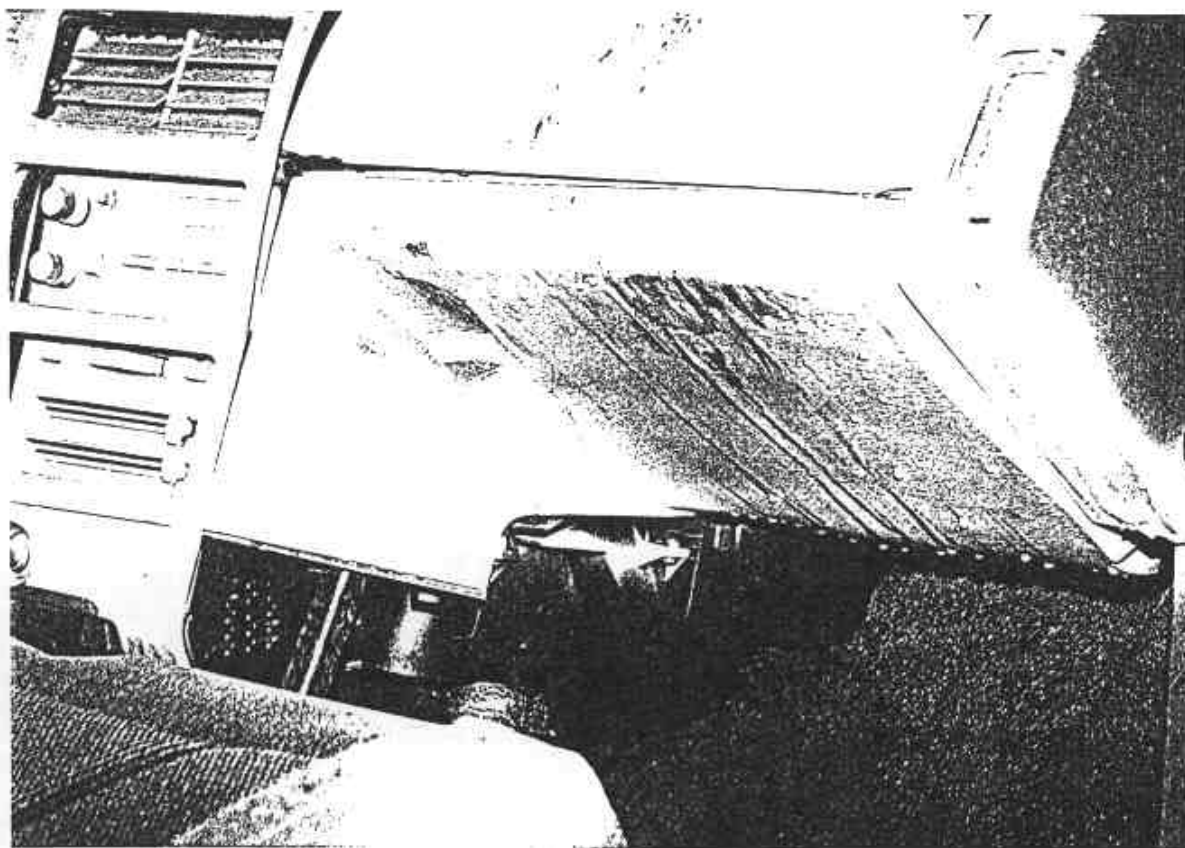


Figure A-42. POST-TEST PASSENGER DUMMY KNEE CONTACT - VIEW 2

A-22

910305



Figure A-43. PRE-TEST VEHICLE CERTIFICATION LABEL VIEW

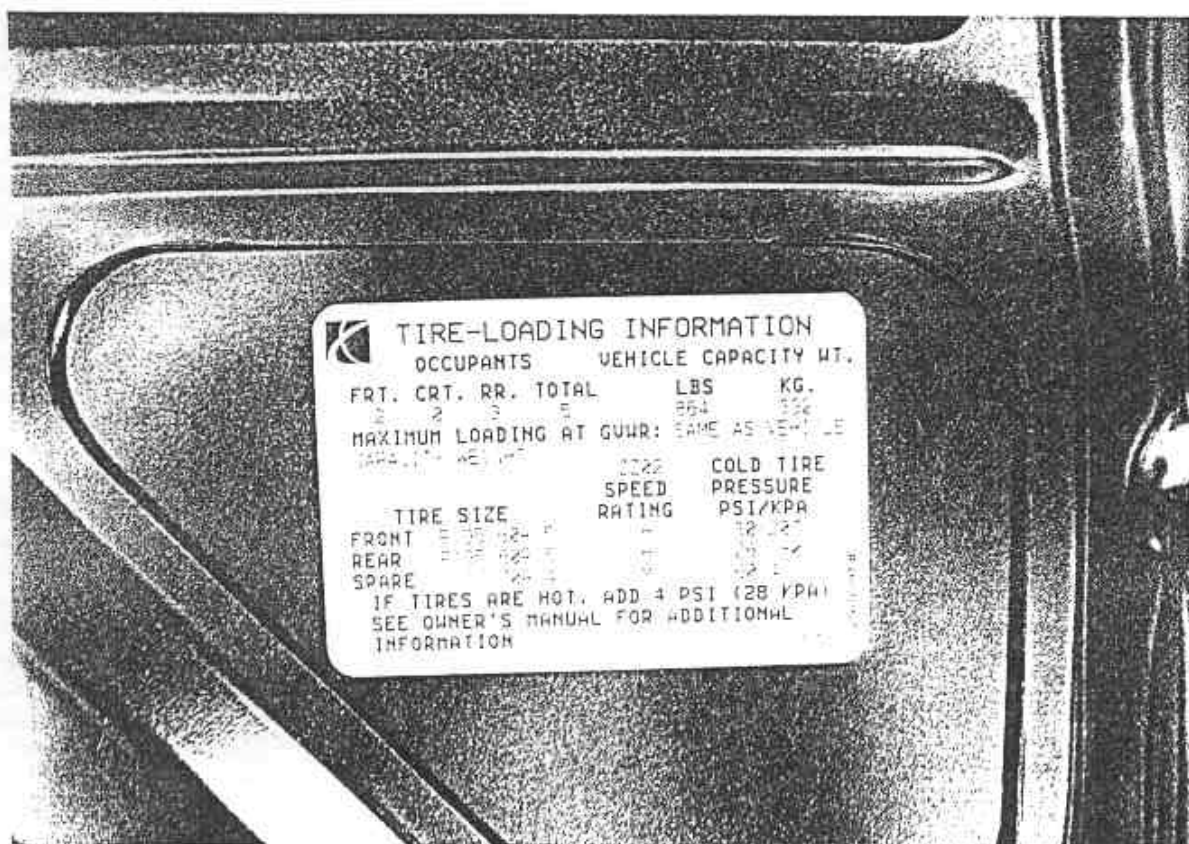


Figure A-44. POST-TEST VEHICLE RECOMMENDED TIRE PRESSURE LABEL VIEW

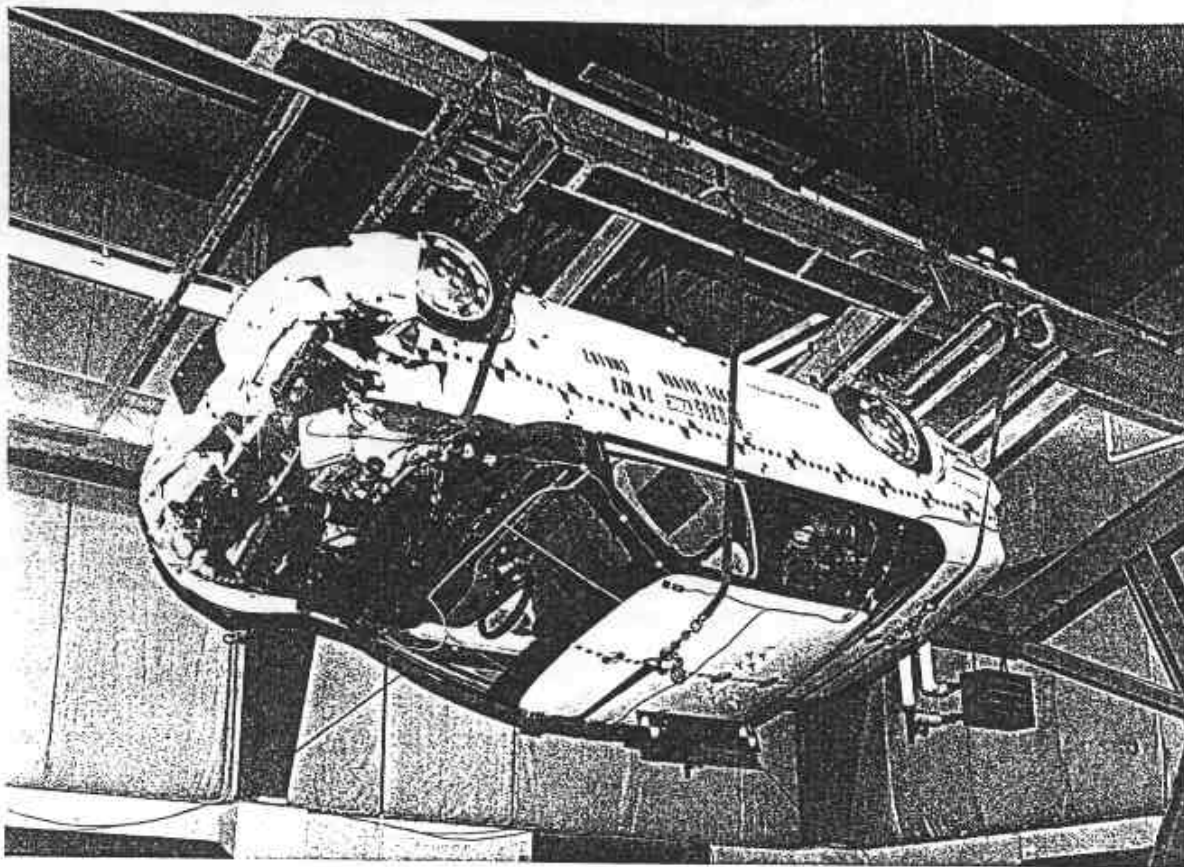


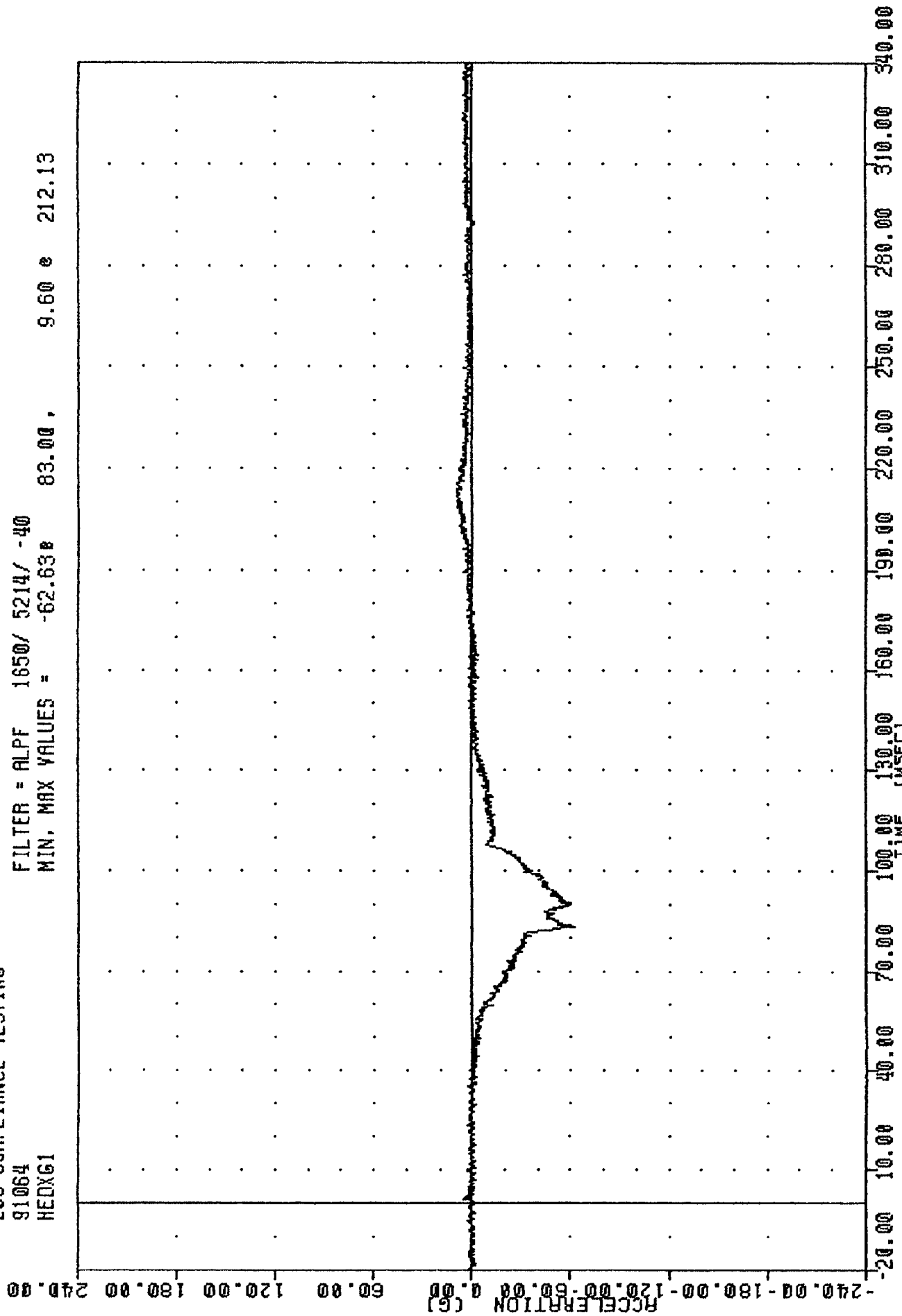
Figure A-45. PRE-TEST VEHICLE ON STATIC ROLLOVER MACHINE VIEW

APPENDIX B

DATA PLOTS

TRC , 910305
200 COMPLIANCE TESTING
91064
HEDXG1

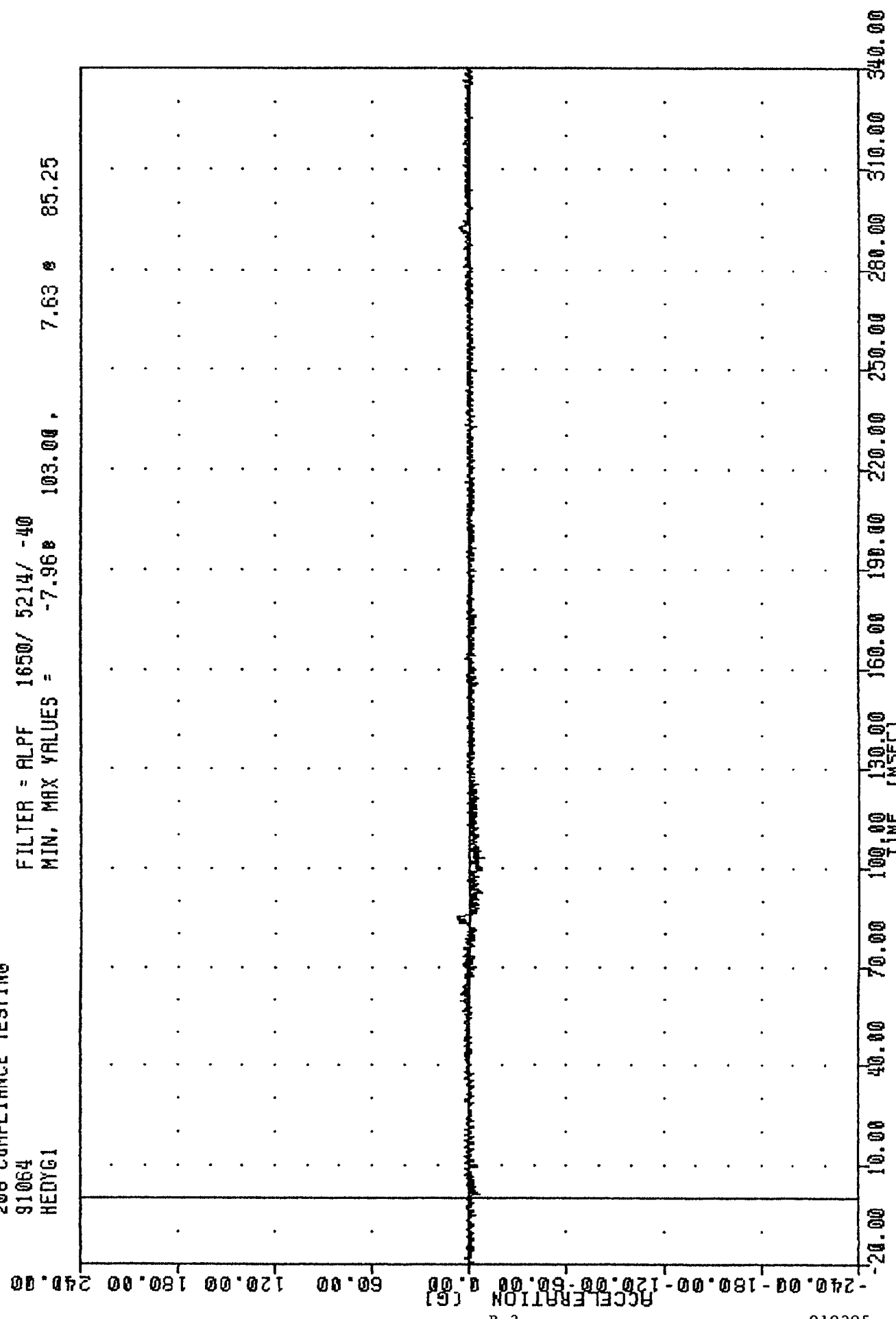
FILTER = ALPF 1650/ 5214/ -40
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1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
DRIVER HEAD X-AXIS ACCELERATION

TRC , 910305
 200 COMPLIANCE TESTING
 91064
 HEDY61

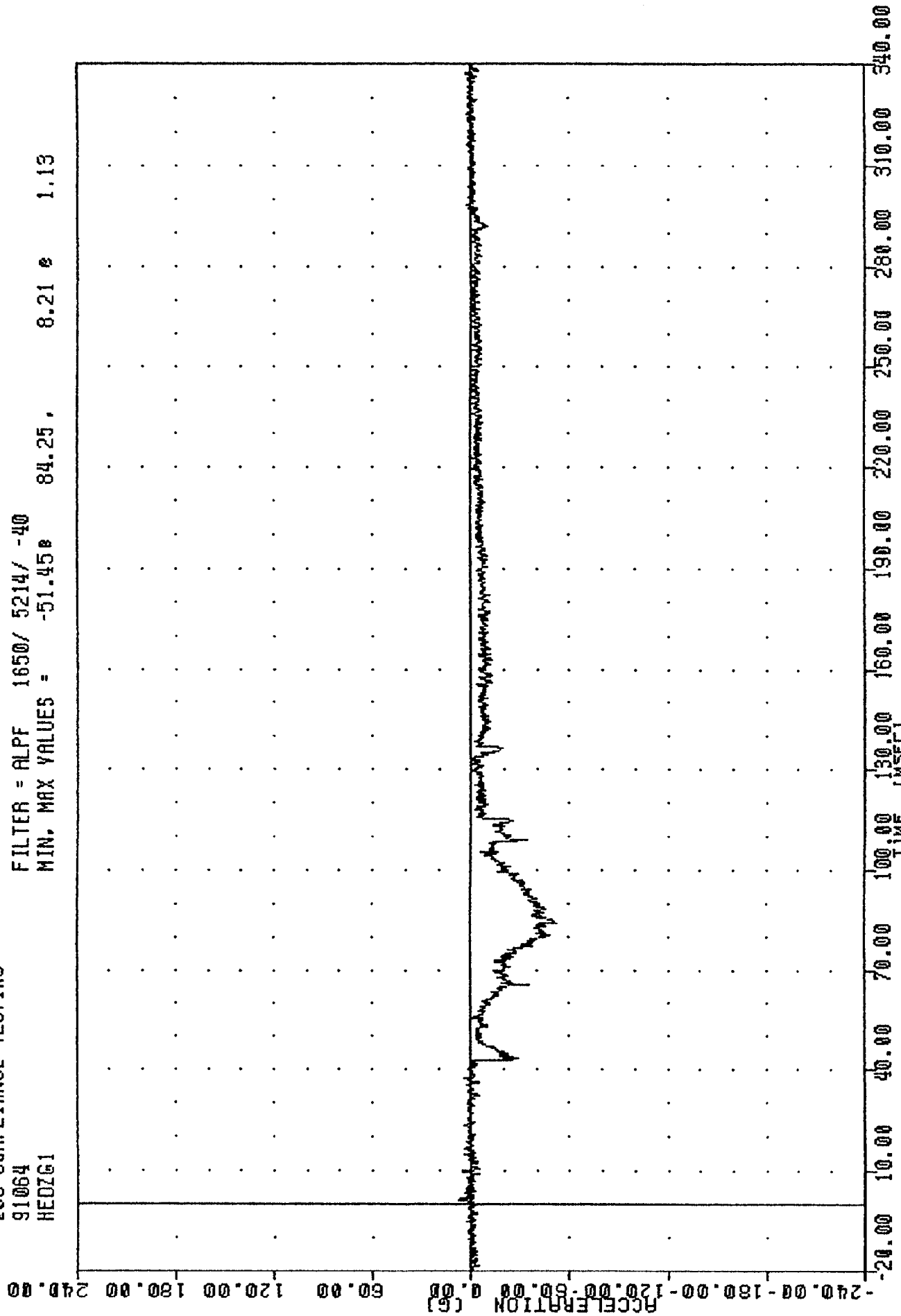
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1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 DRIVER HEAD Y-AXIS ACCELERATION

TRC , 910305
 208 COMPLIANCE TESTING
 91064
 HEDZG1

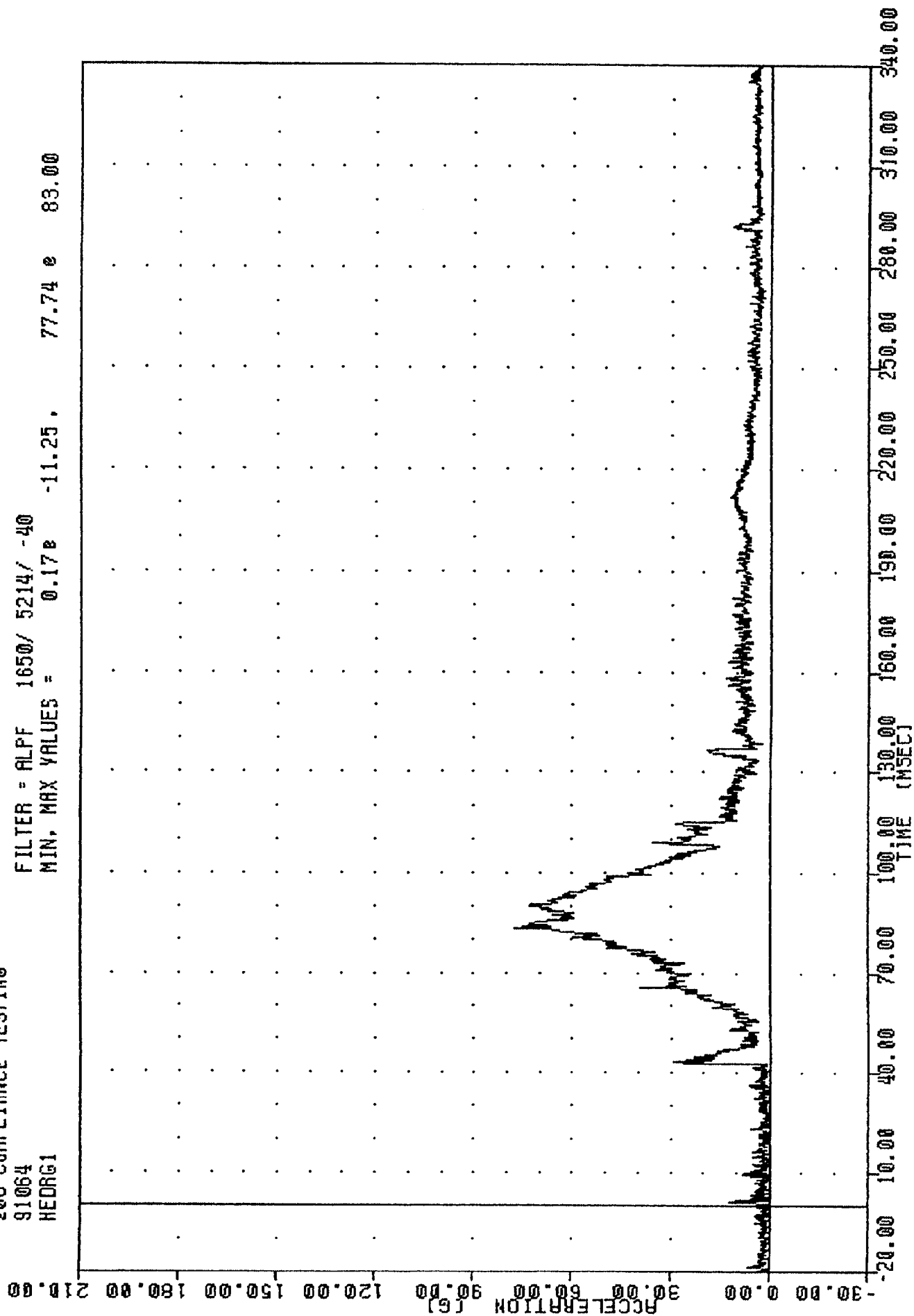
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1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 NATVFR HFAD 7-AXIS ACCFIFRATION

TRC , 910305
 208 COMPLIANCE TESTING
 91064
 HEDRG1

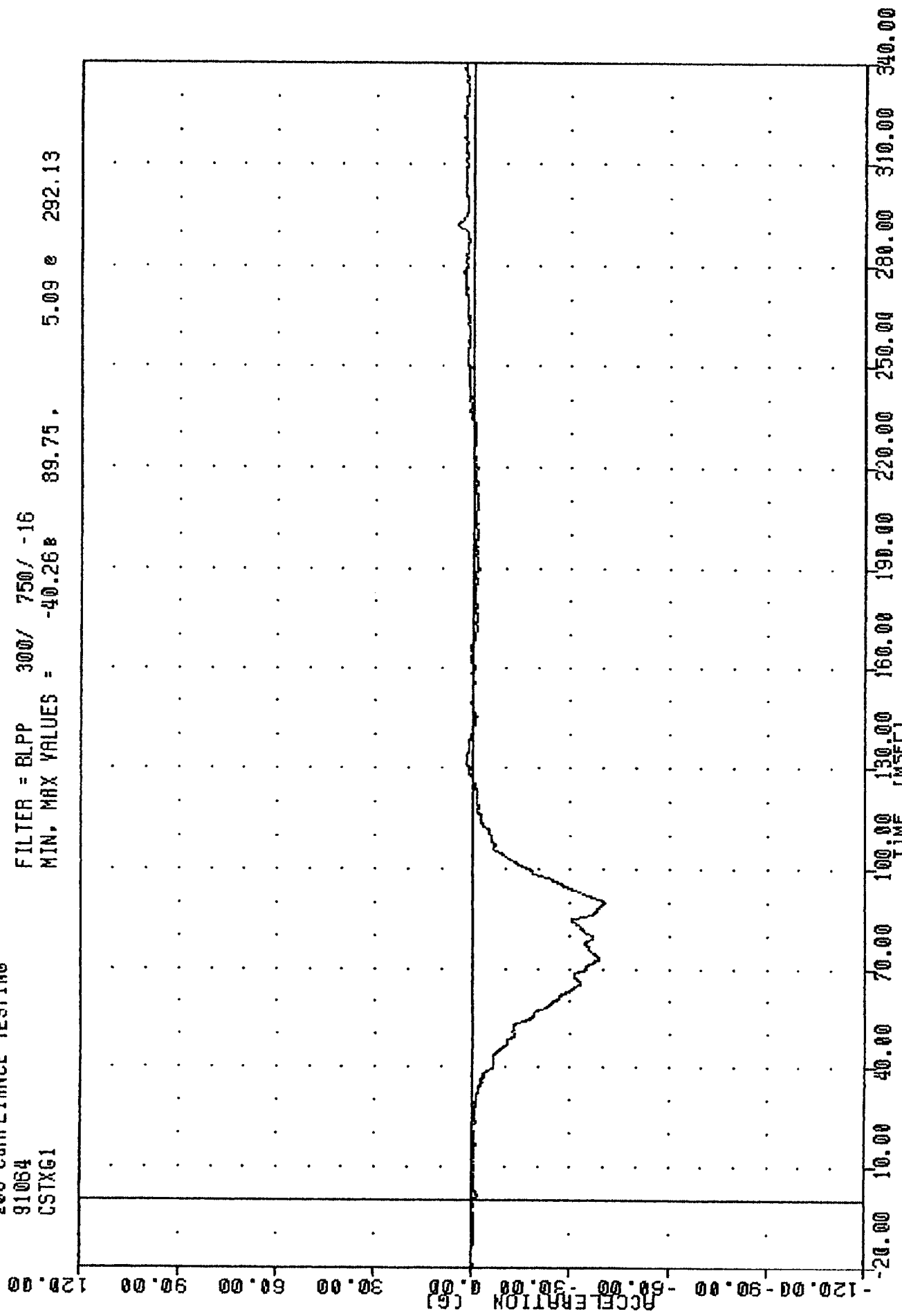
FILTER = ALPF 1650/ 5214/ -40
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1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 DRIVER HEAD RESUJ TANT ACCFI FRATION

TRC , 910305
208 COMPLIANCE TESTING
91054
CSTXG1

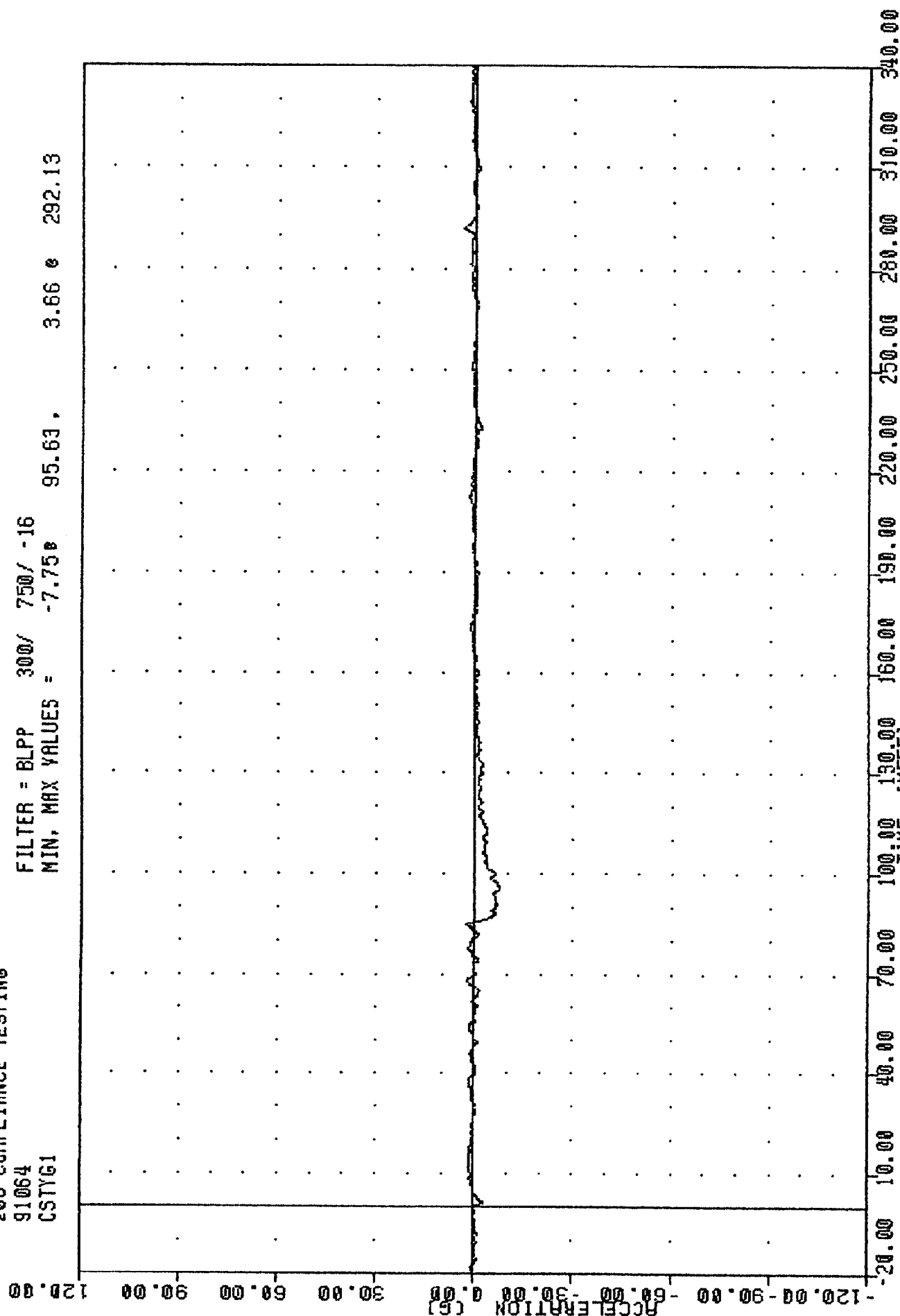
FILTER = BLPP 300/ 750/ -16
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1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
DRIVER CHEST X-AXIS ACCELERATION

TRC , 910305
 208 COMPLIANCE TESTING
 91064
 CSTYG1

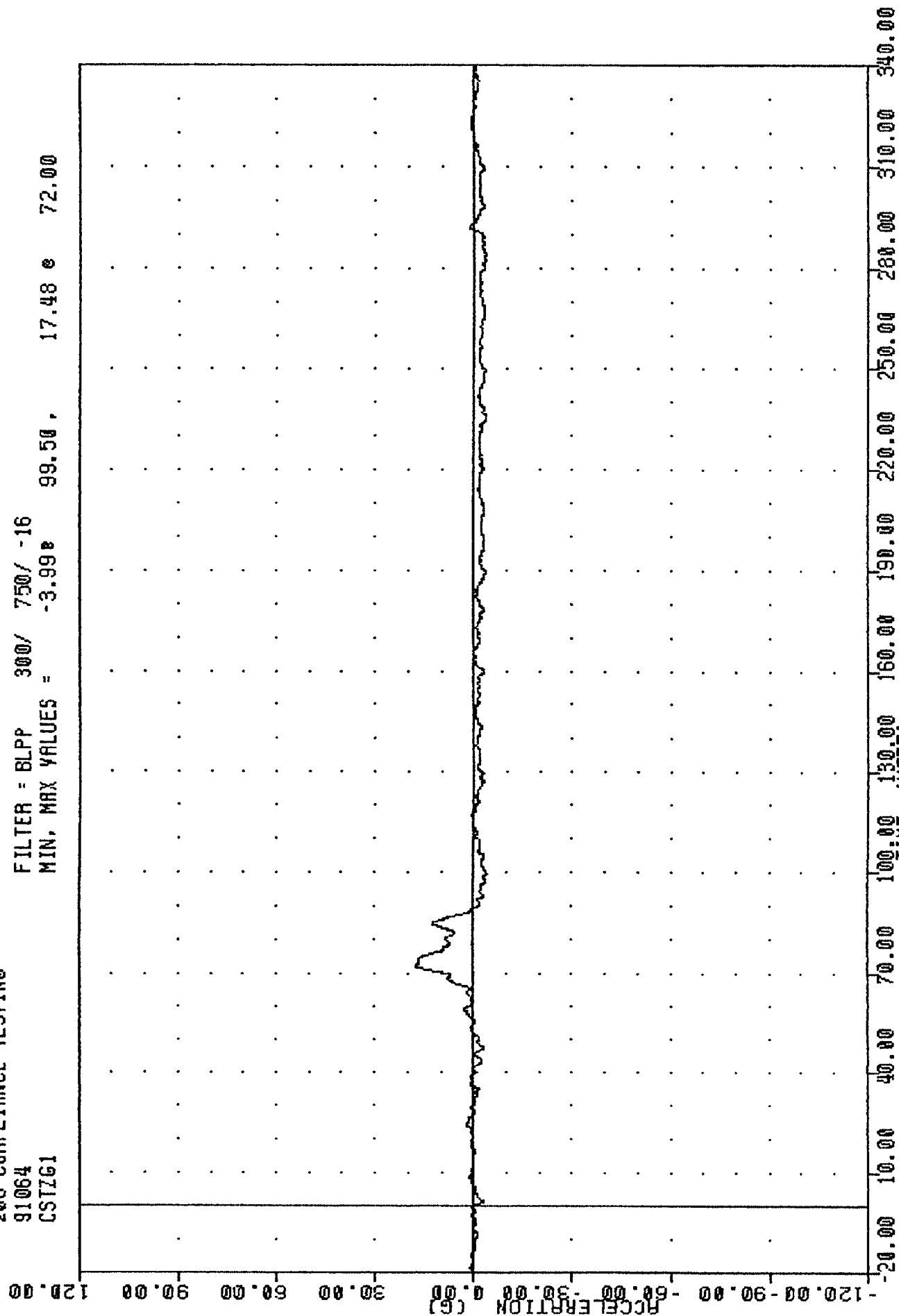
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1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 DRIVER CHEST Y-AXIS ACCELERATION

TRC , 910305
 200 COMPLIANCE TESTING
 91064
 CSTZG1

FILTER = BLPP 300/ 750/ -16
 MIN, MAX VALUES = -3.99e 99.50 , 17.48 e 72.00

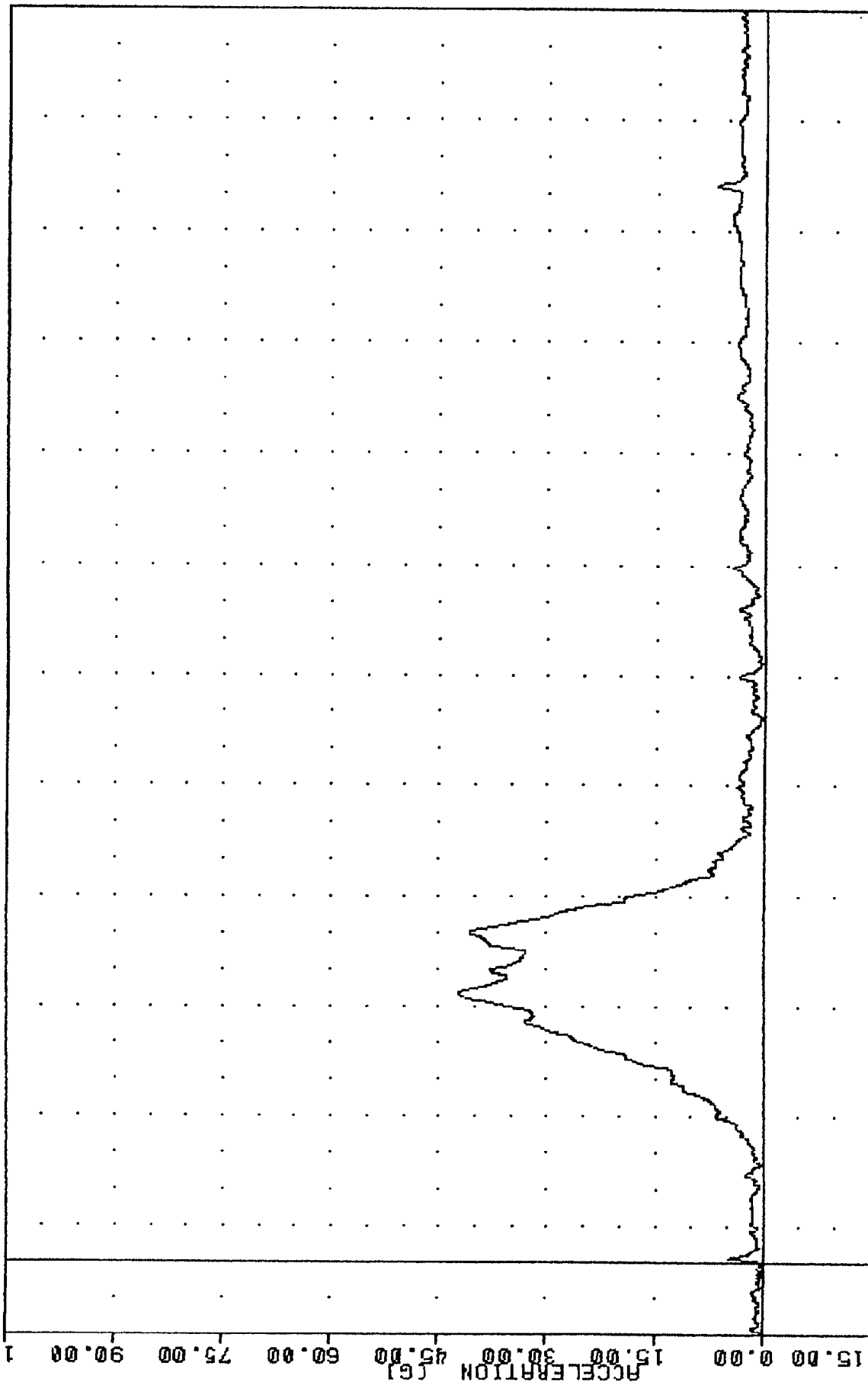


1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 DRIVER CHEST 7-AXIS ACCELERATION

TRC , 910305
 200 COMPLIANCE TESTING
 91064
 CSTRG1

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105.00

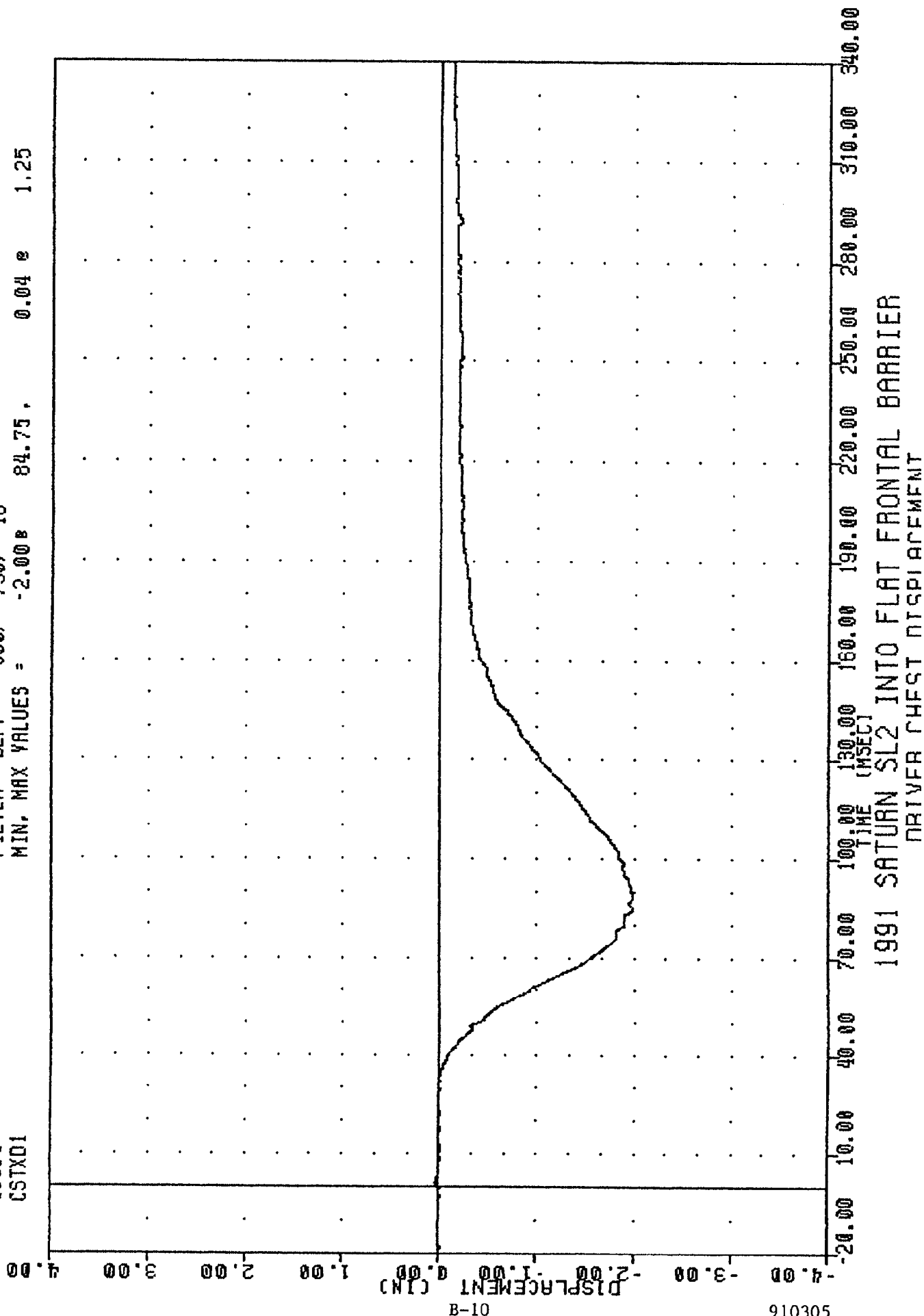


1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 DRIVER CHEST RESISTANT ACCELERATION

TRC
208 COMPLIANCE TESTING
91064
CSTXD1

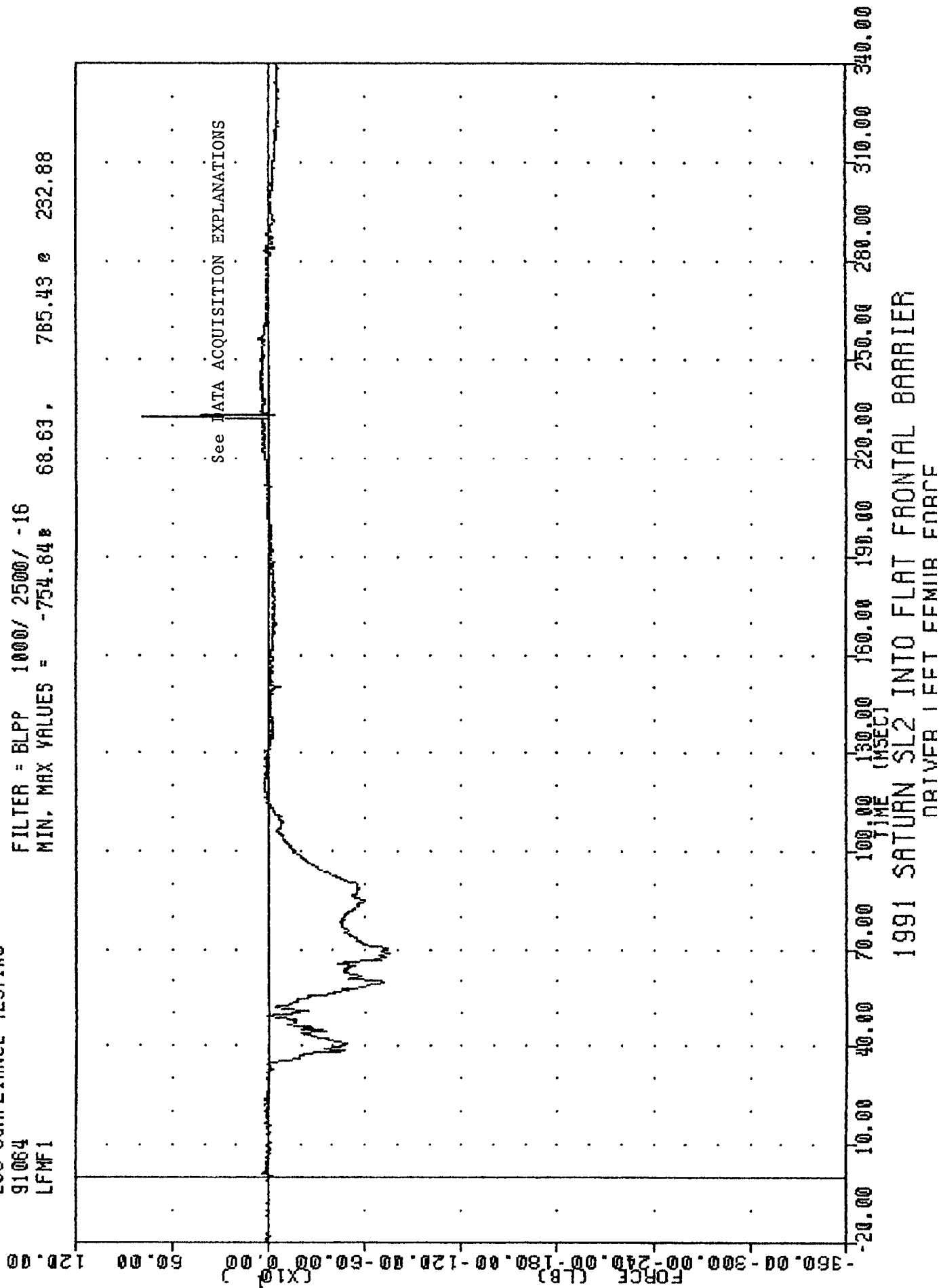
, 910305

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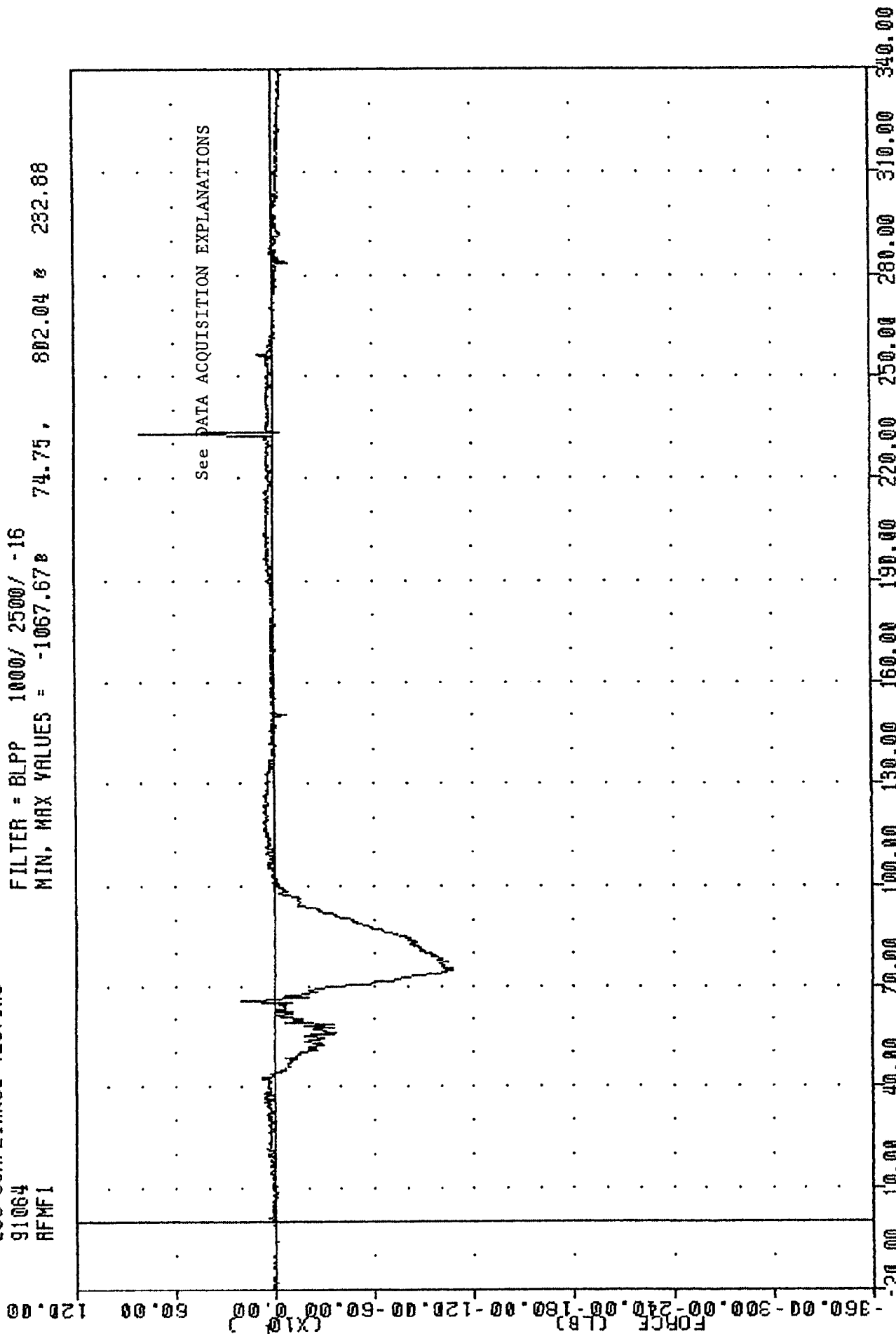
TRC , 910305
 208 COMPLIANCE TESTING
 91064
 LFMF1

FILTER = BLPP 1000/ 2500/ -16
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TRC , 910305
 208 COMPLIANCE TESTING
 91064
 RFMF1

FILTER = BLPP 1000/ 2500/ -16
 MIN, MAX VALUES = -1067.67 802.04 232.88



1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 DRIVER RIGHT FFMIR FORCE

TRC , 910305
208 COMPLIANCE TESTING

91064

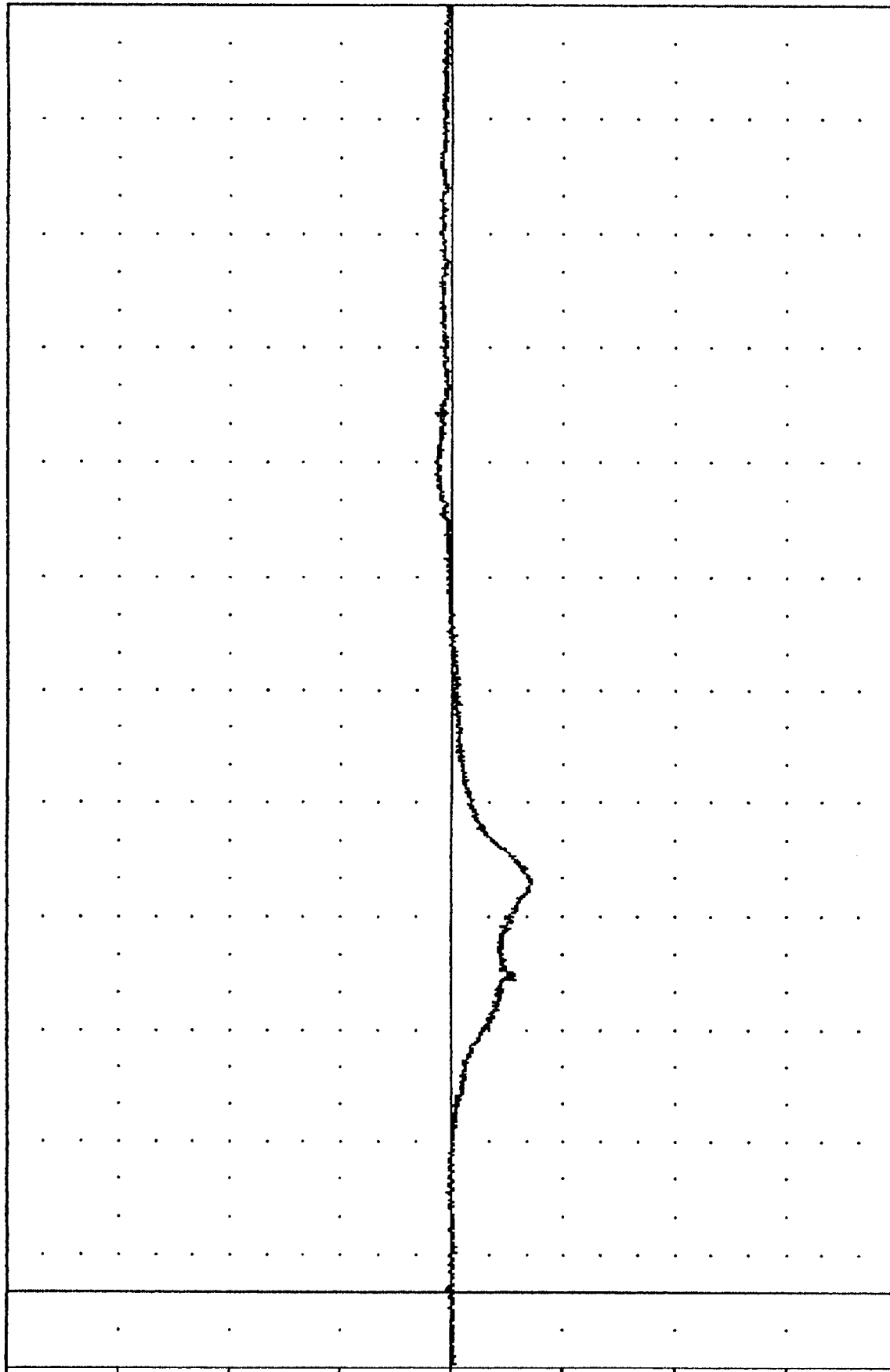
HEDXG2

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9.04 e 232.88

ACCELERATION (G)



B-13

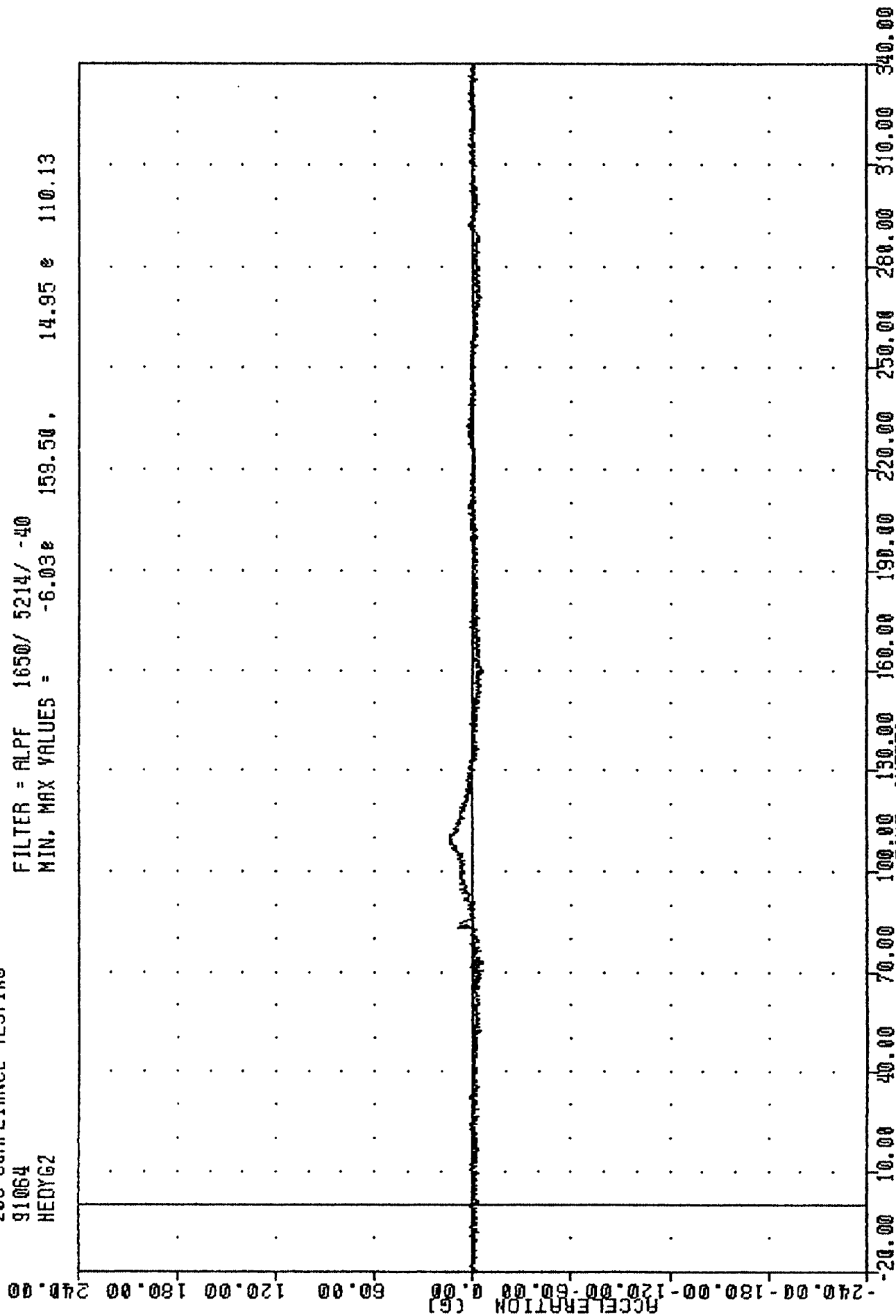
910305

-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

1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER HEAD Y-AXIS ACCELERATION

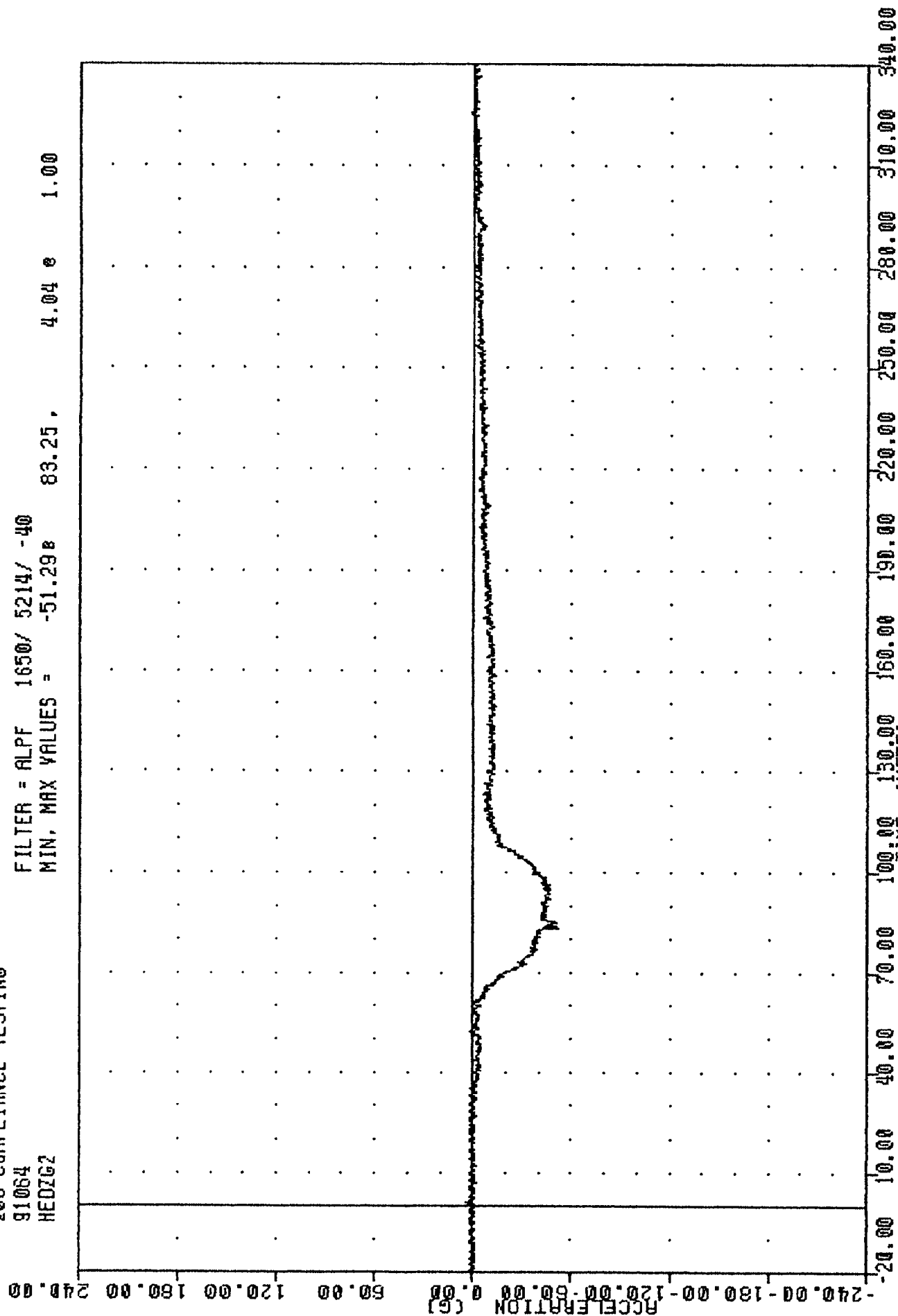
TRC , 910305
 208 COMPLIANCE TESTING
 91064
 HEDYG2

FILTER = ALPF 1650/ 5214/ -40
 MIN, MAX VALUES = -6.03e 159.50, 14.95 e 110.13



TRC , 910305
 208 COMPLIANCE TESTING
 91064
 HEDIG2

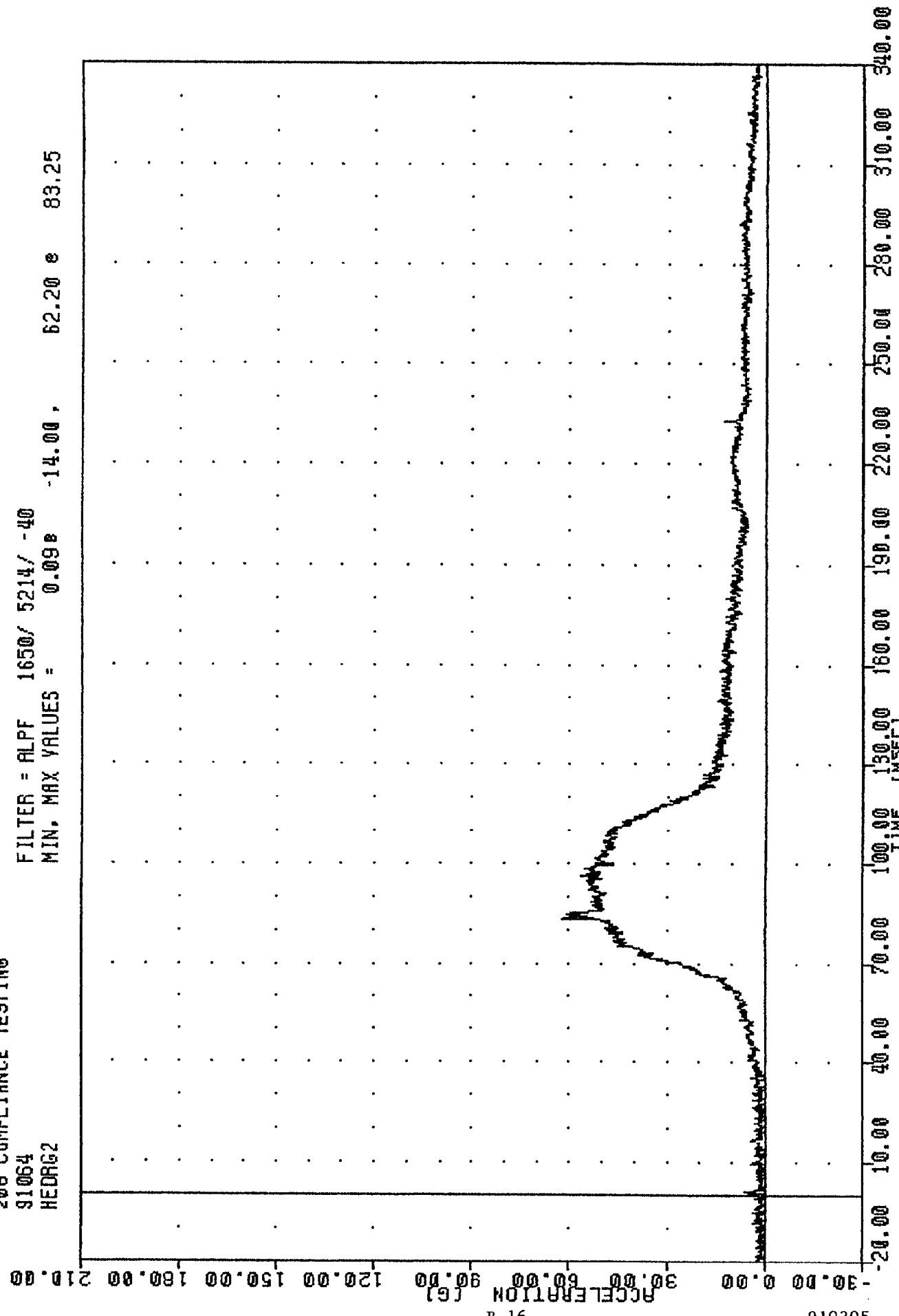
FILTER = ALPF 1650/ 5214/ -40
 MIN, MAX VALUES = -51.298 83.25, 4.04 e 1.00



1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER HEAD 7-AXIS ACCELERATION

TRC , 910305
 200 COMPLIANCE TESTING
 91064
 HEDRG2

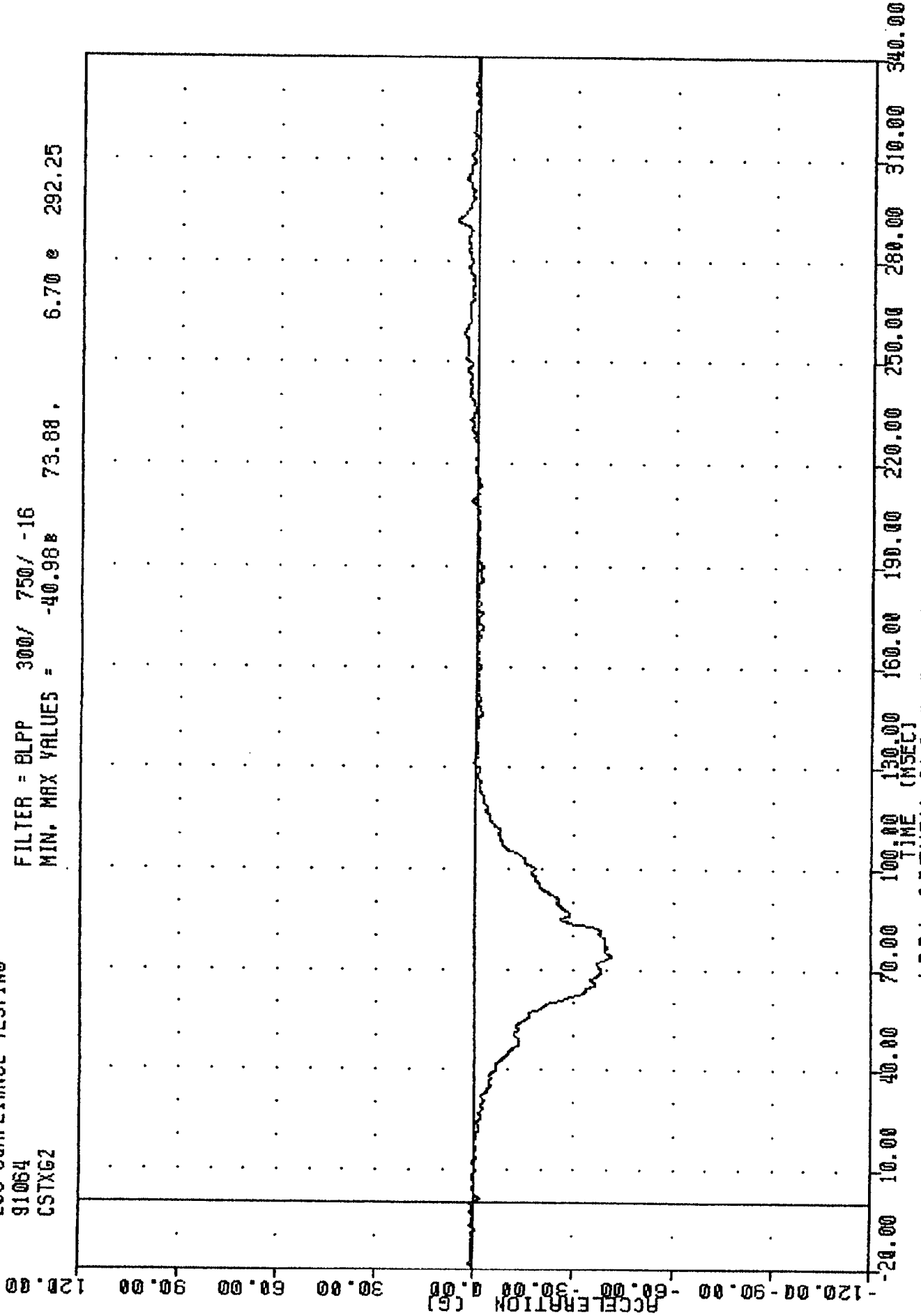
FILTER = ALPF 1650/ 5214/ -40
 MIN. MAX VALUES = 0.090 -14.00 , 62.20 e 83.25



1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER HEAD REINFORCEMENT

TRC , 910305
 208 COMPLIANCE TESTING
 91064
 CSTXG2

FILTER = BLPP 300/ 750/ -16
 MIN. MAX VALUES = -40.98 73.88 , 6.70 e 292.25



1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER CHEST X-AXIS ACCELERATION

TRC , 910305
 208 COMPLIANCE TESTING
 91064
 CSTYG2

FILTER = BLPF 300/ 750/ -16
 MIN. MAX VALUES = -4.96e 61.13, 11.70 e 84.50

120.00

90.00

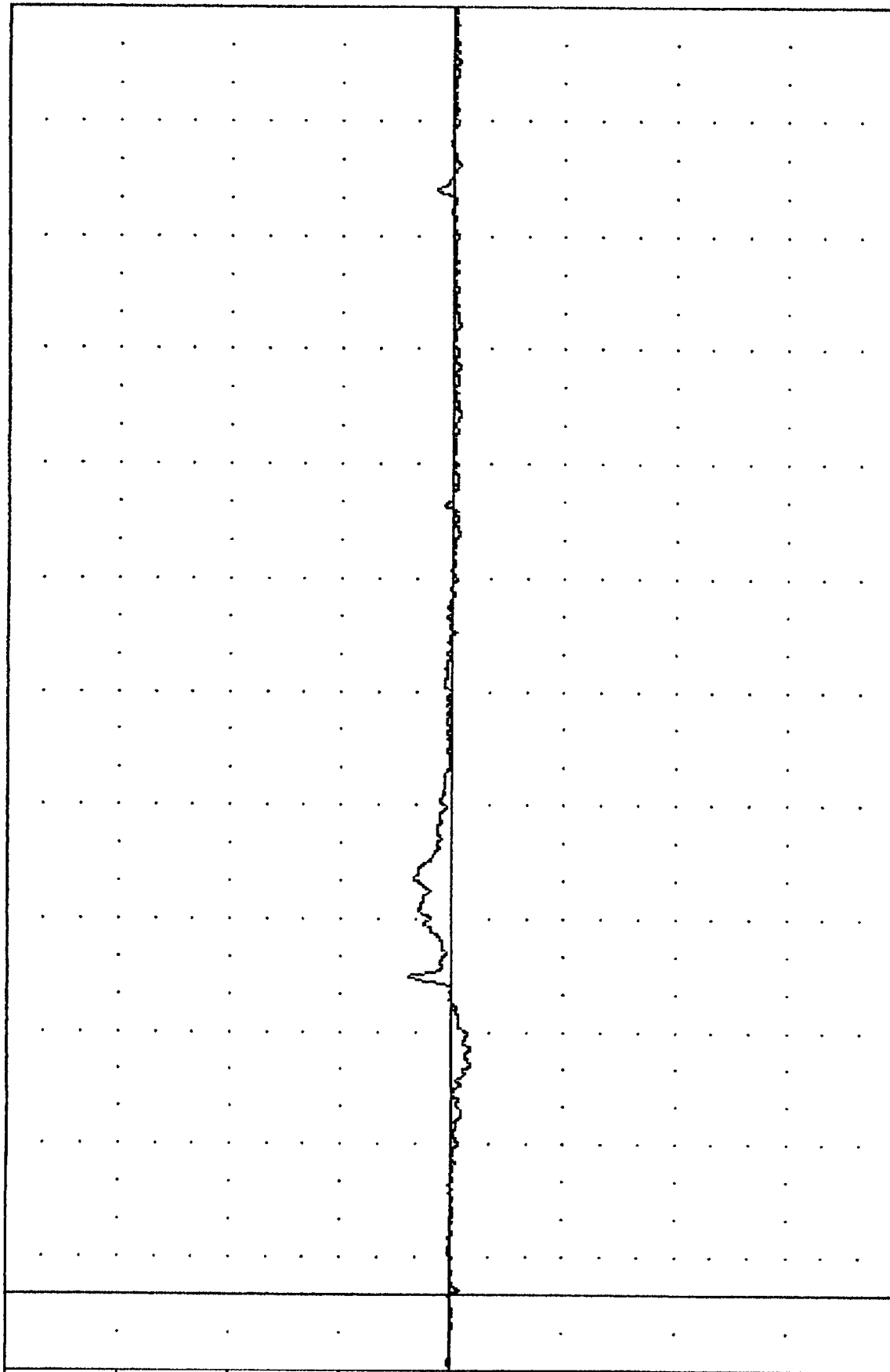
60.00

30.00

ACCELERATION (G)

B-18

910305

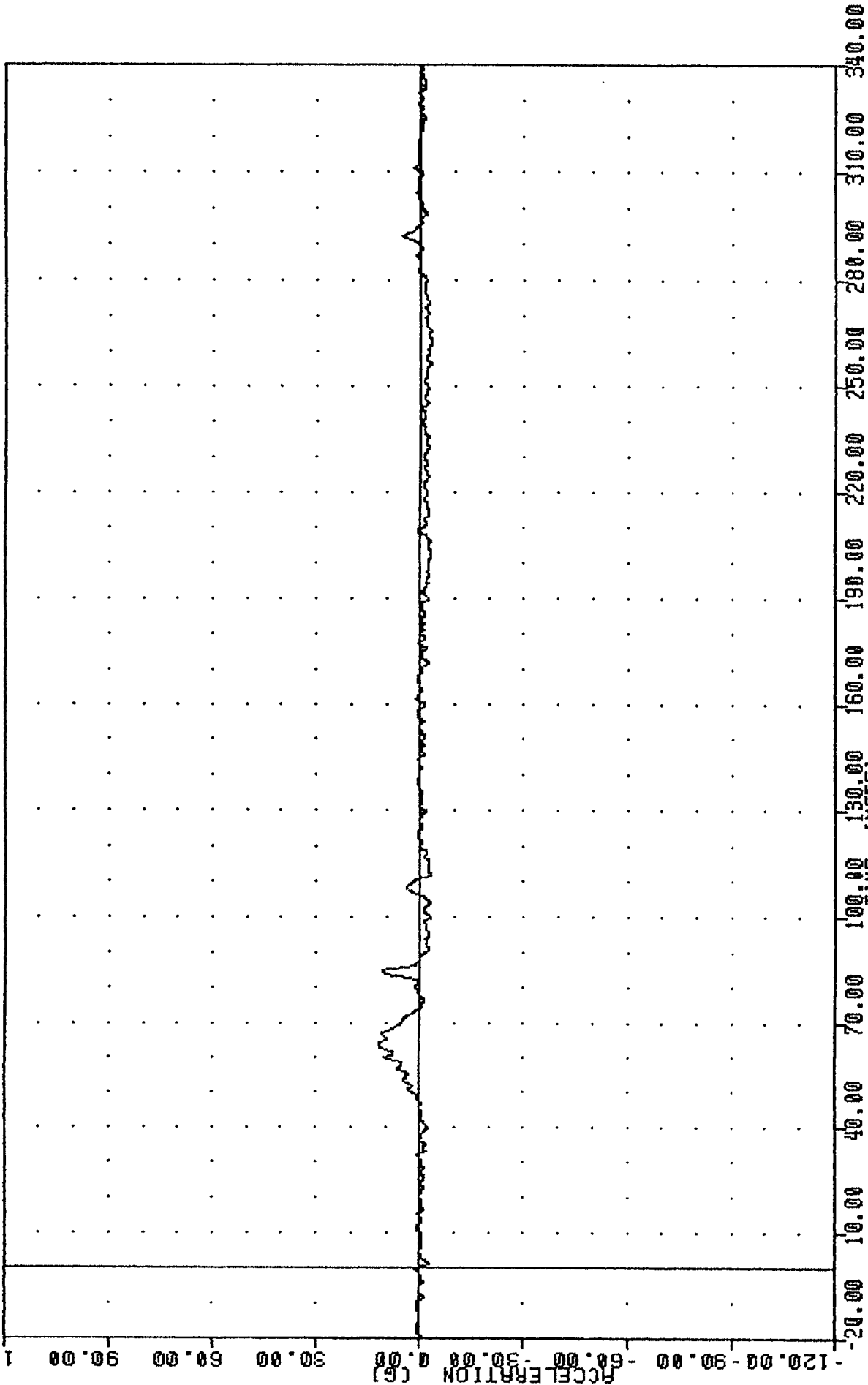


-20.00 10.00 40.00 70.00 100.00 130.00 160.00 190.00 220.00 250.00 280.00 310.00 340.00

1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER CHEST V-Axis ACCELERATION

TRC , 910305
 208 COMPLIANCE TESTING
 91064
 CST762

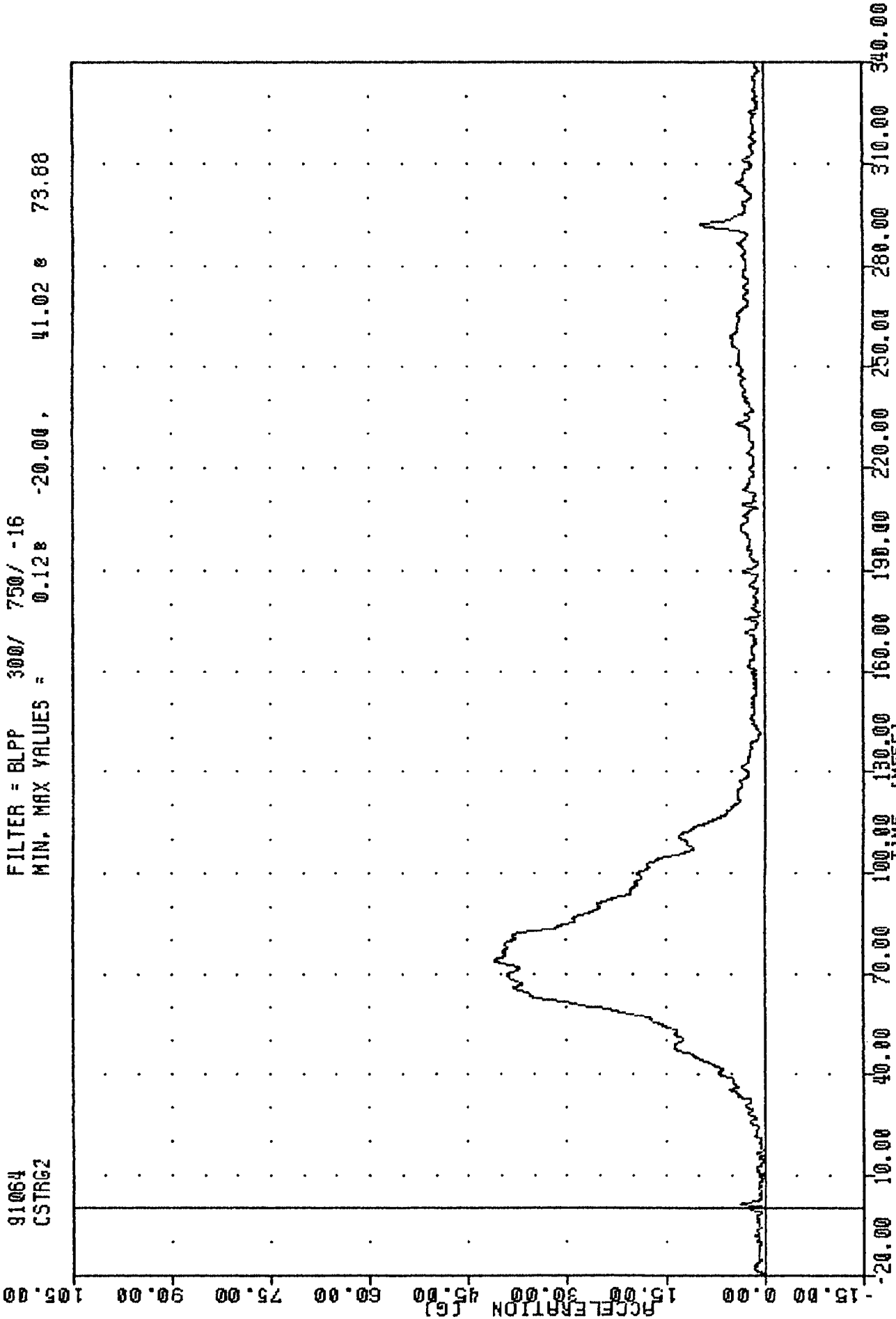
FILTER = BLPP 300/ 750/ -16
 MIN. MAX VALUES = -3.28 112.00 11.74 63.88



1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER CHEST 7-AXIS ACCELERATION

TRC , 910305
 208 COMPLIANCE TESTING
 91064
 CSTRG2

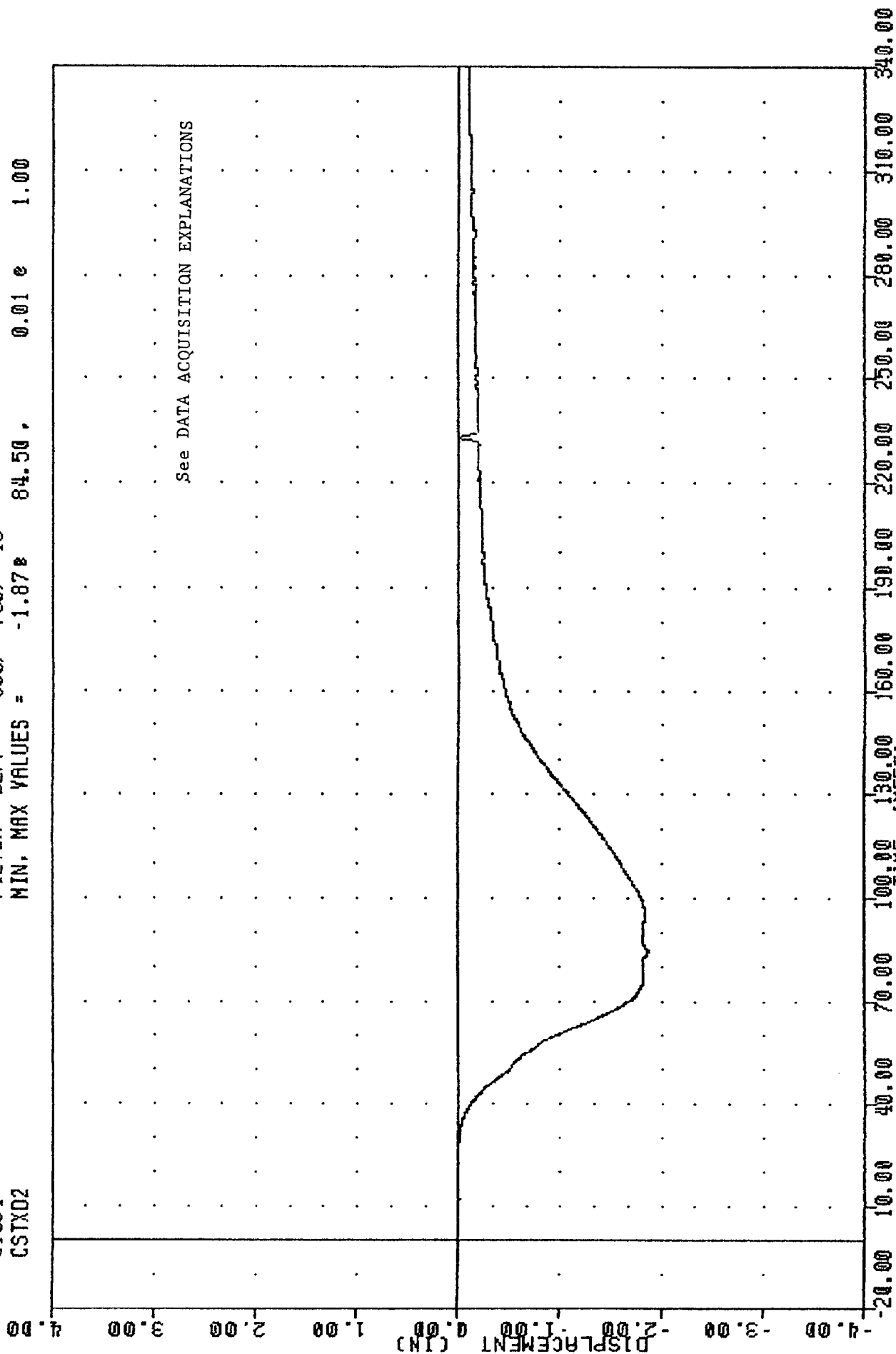
FILTER = BLPP 300/ 750/ -16
 MIN. MAX VALUES = 0.128 -20.00, 41.02 & 73.88



1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER CHEST RESISTANT ACCIFFRATION

TRC , 910305
 208 COMPLIANCE TESTING
 91064
 CSTXD2

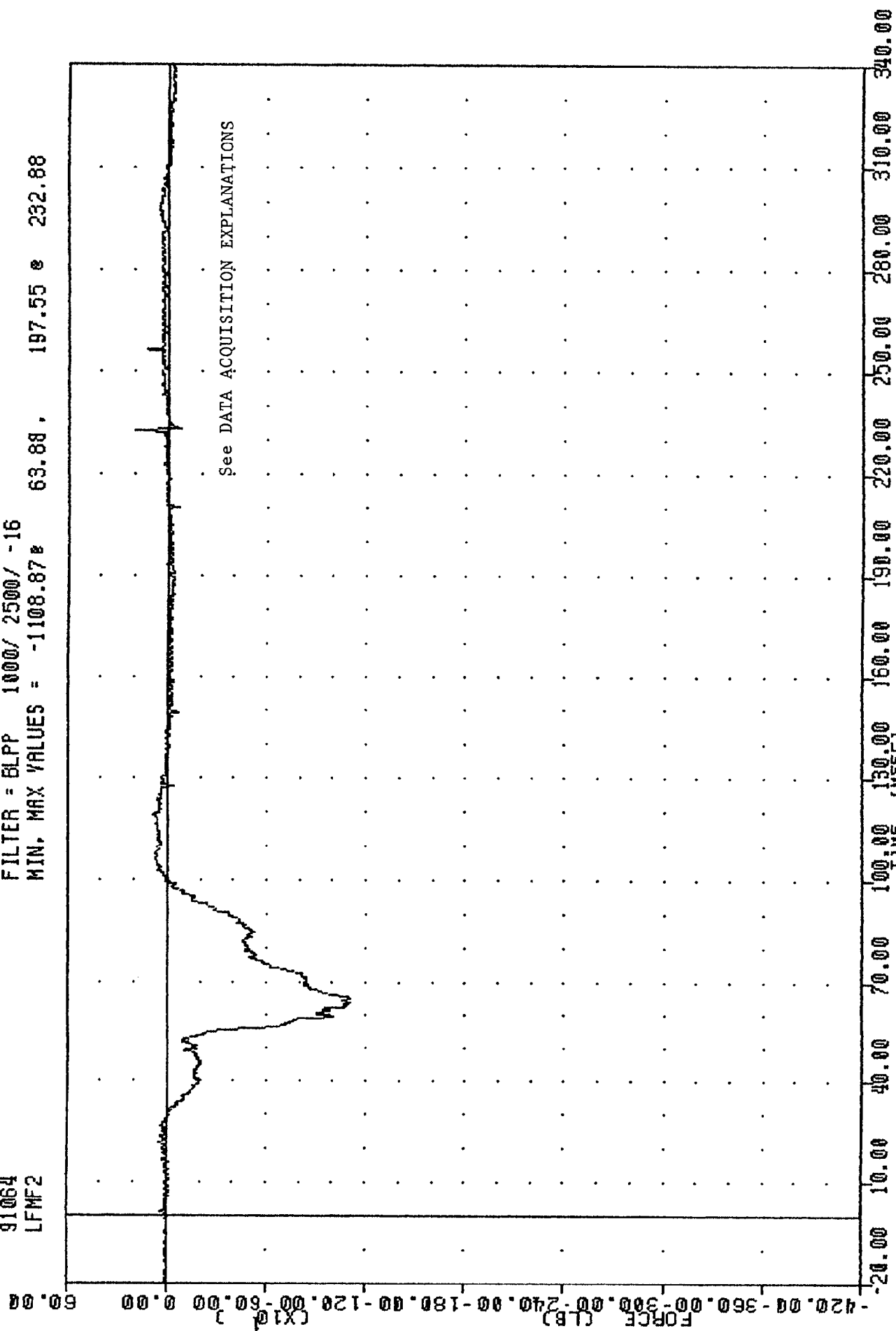
FILTER = BLPP 300/ 750/ -16
 MIN, MAX VALUES = -1.878 84.50, 0.01 e 1.00



1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER CHEST DISPLACEMENT

TRC , 910305
 208 COMPLIANCE TESTING
 91064
 LFMF2

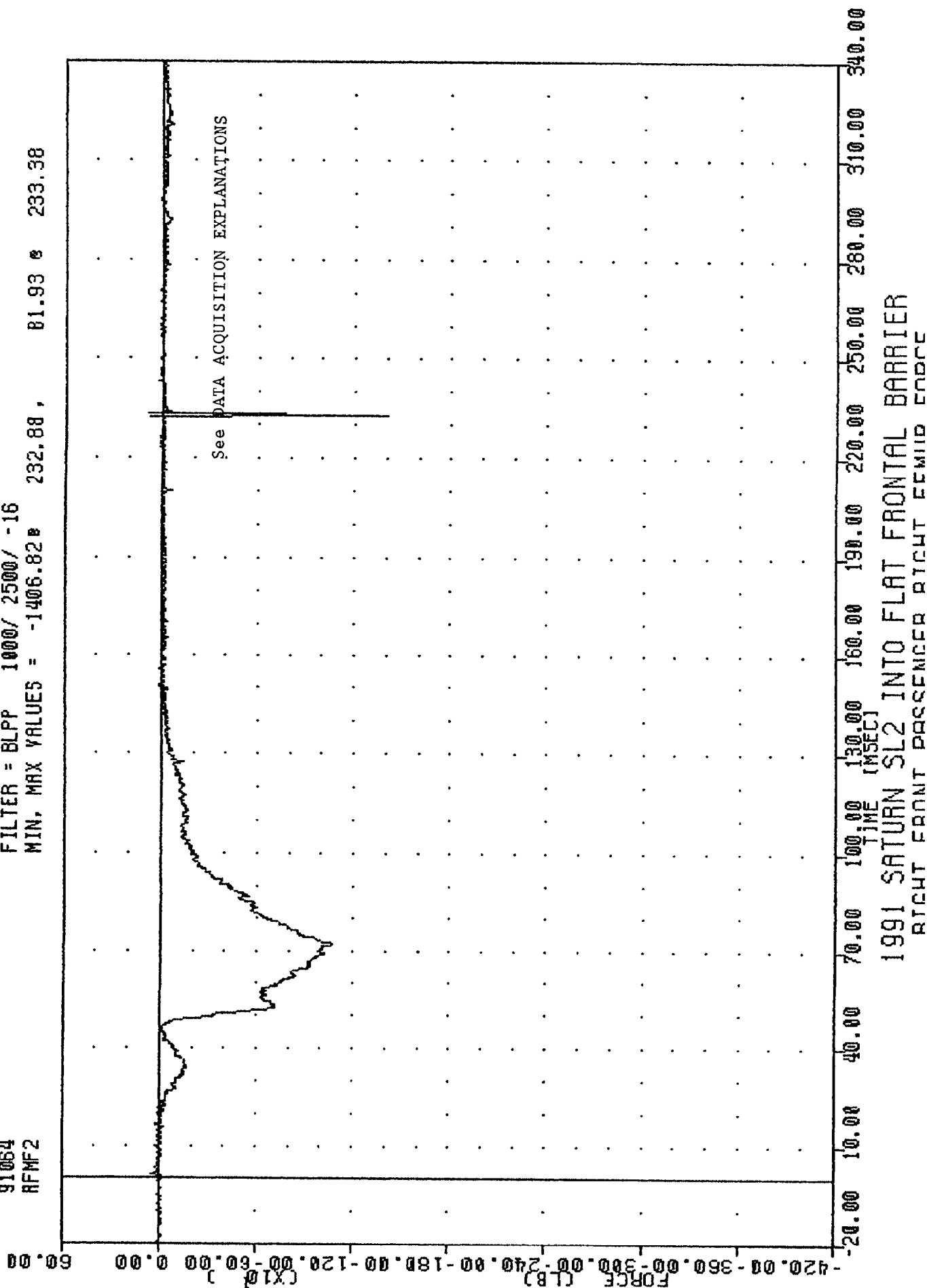
FILTER = BLPP 1000/ 2500/ -16
 MIN, MAX VALUES = -1108.87 63.88 , 197.55 232.88



1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 RIGHT FRONT PASSENGER LEFT FEMUR FORCE

TRC 910305
 208 COMPLIANCE TESTING
 91064
 RFMF2

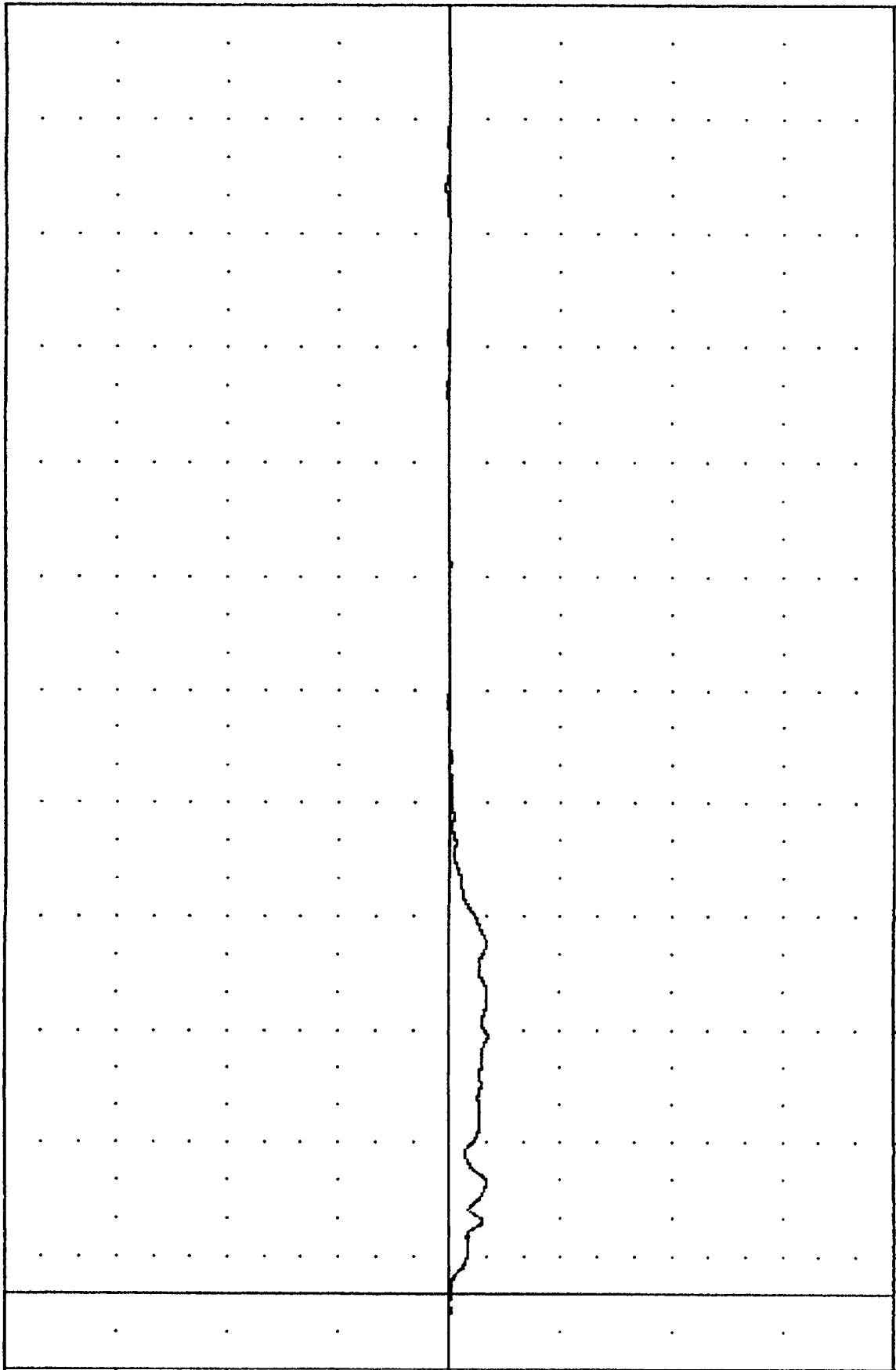
FILTER = BLPP 1000/ 2500/ -16
 MIN, MAX VALUES = -1406.82 232.88, 81.93 233.38



TRC , 910305
 208 COMPLIANCE TESTING
 91064
 TLRXG1

FILTER = BLPP 100/ 250/ -16
 MIN. MAX VALUES = -20.93 68.13 , 2.53 292.13

ACCELERATION (G)
 240.00
 180.00
 120.00
 60.00
 0.00
 -60.00
 -120.00
 -180.00
 -240.00



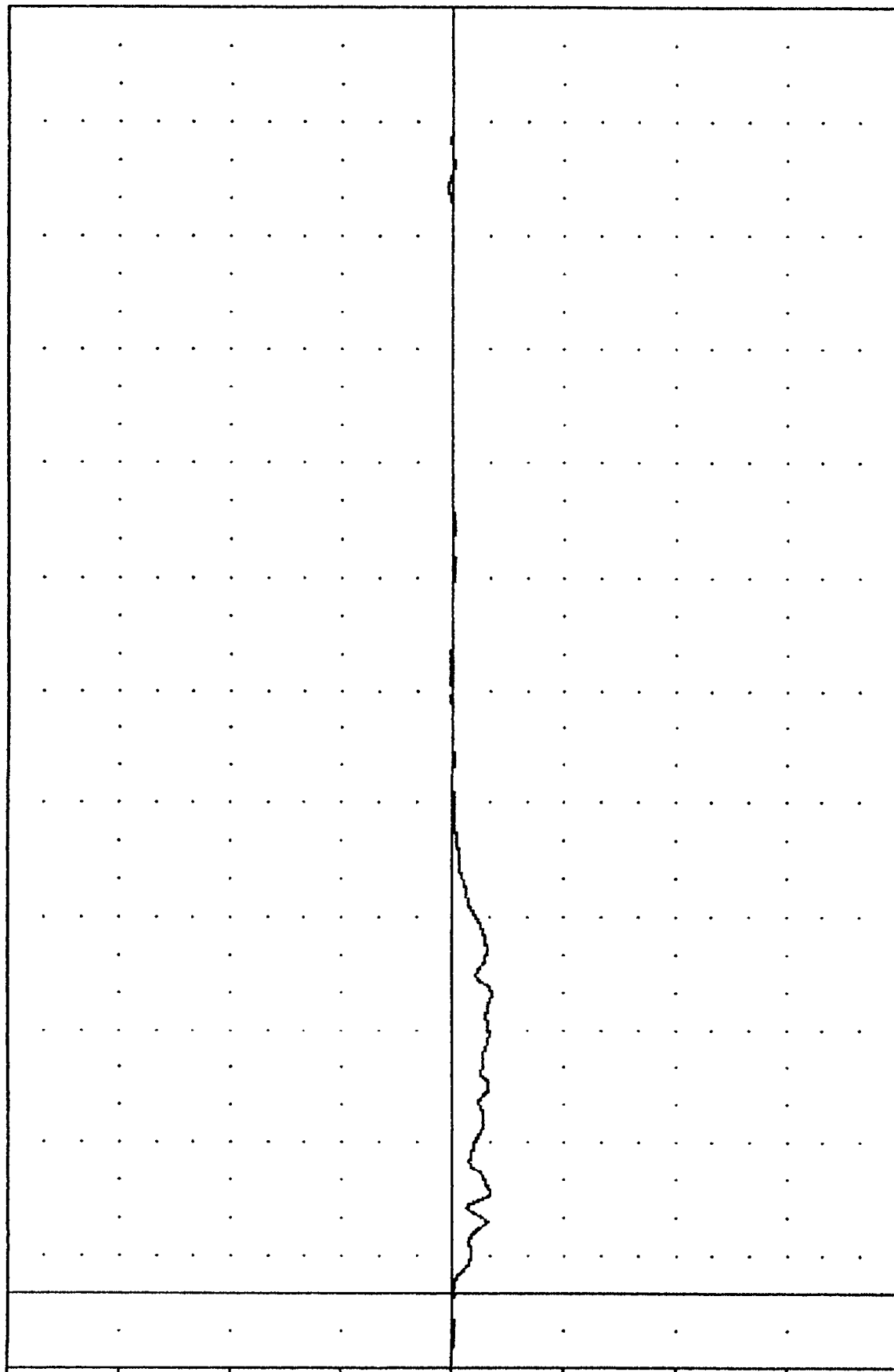
-20.00 10.00 40.00 70.00 100.00 130.00 160.00 190.00 220.00 250.00 280.00 310.00 340.00

1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 LEFT REAR SEAT Y-AXIS ACCELERATION

TRC , 910305
 208 COMPLIANCE TESTING
 91064
 TRRXG1

FILTER = BLPP 100/ 250/ -16
 MIN, MAX VALUES = -20.98 79.25, 2.75 e 292.50

ACCELERATION (G)



-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

1991 SATURN SL2 INTO FLAT FRONTAL BARRIER

FRONT REAR LEFT V. AUTO OCCUPANT POSITION

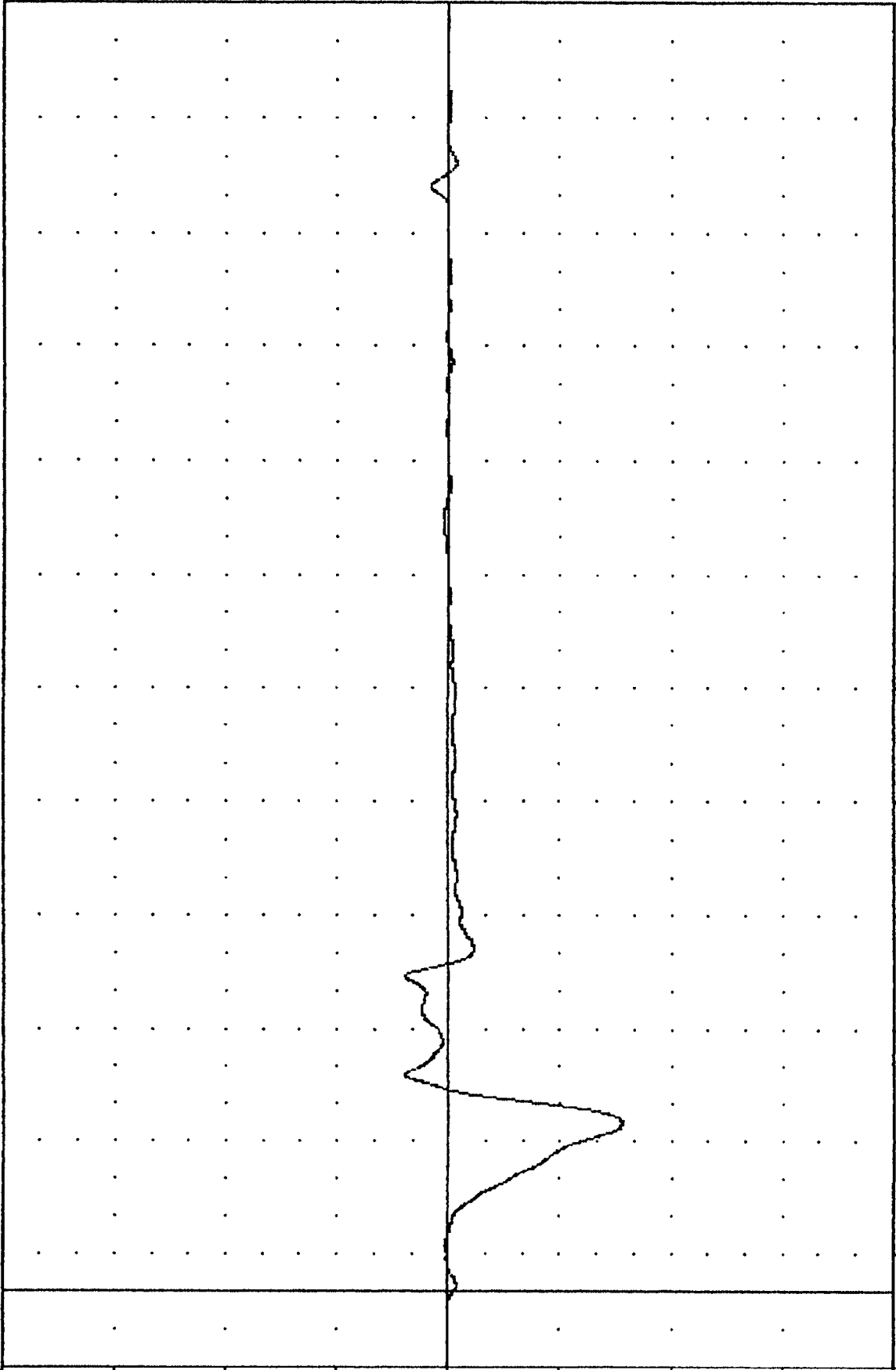
TRC , 910305
208 COMPLIANCE TESTING

91064
ENGXG1

FILTER = BLPP 100/ 250/ -16
MIN. MAX VALUES = -93.41e 44.88.

23.78 e 83.63

ACCELERATION [G]



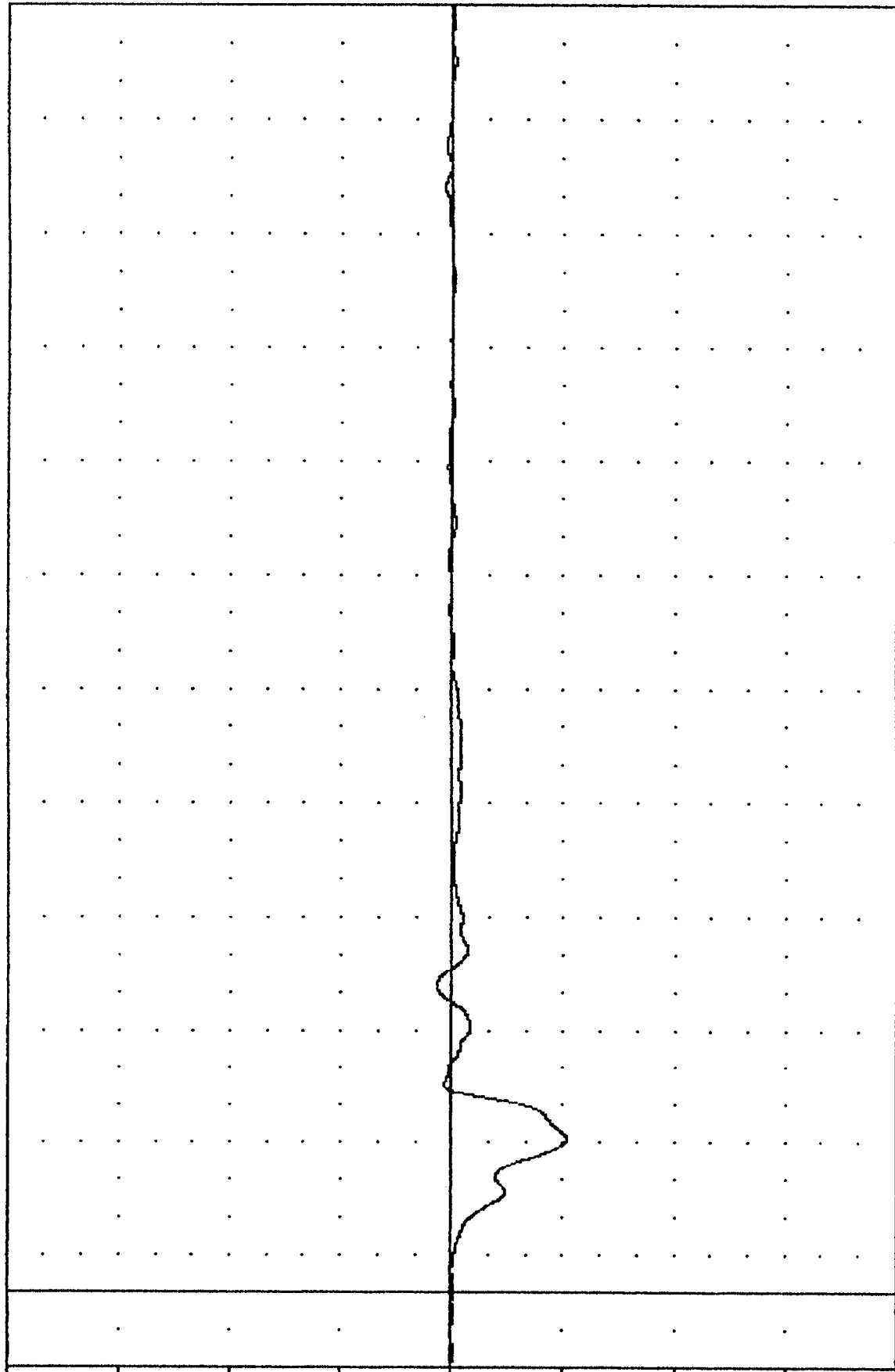
-20.00 10.00 40.00 70.00 100.00 130.00 160.00 190.00 220.00 250.00 280.00 310.00 340.00

1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
ENGINE TOP Y-Axis ACCELERATION

TAC , 910305
 208 COMPLIANCE TESTING
 91064
 ENGCG2

FILTER = BLPP 100/ 250/ -16
 MIN. MAX VALUES = -62.13 41.00 7.53 81.50

ACCELERATION (G)

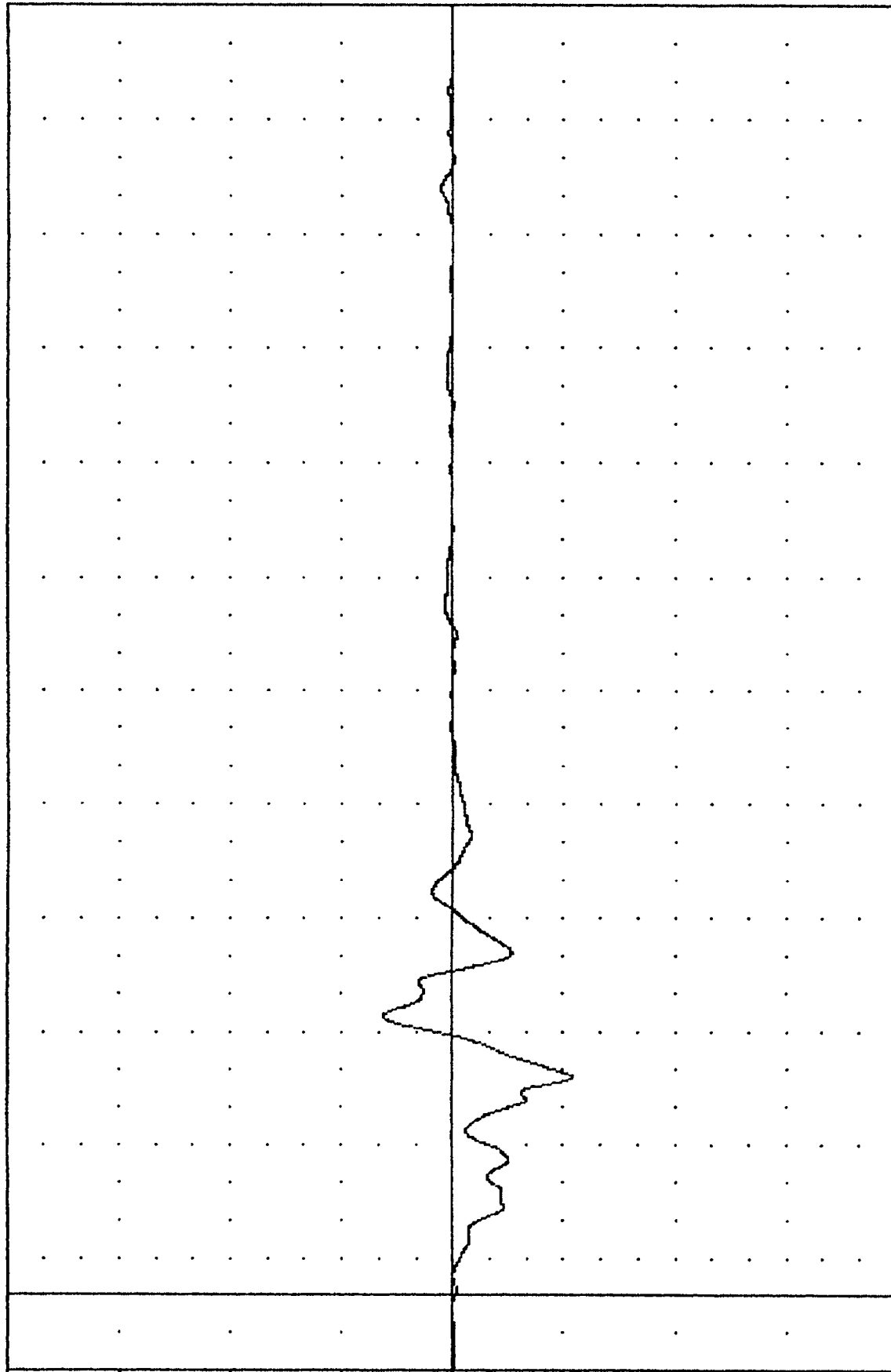


1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 ENGINE BOTTOM Y-AXIS ACCELERATION

TRC , 910305
 208 COMPLIANCE TESTING
 91064
 BCRXG1

FILTER = BLPP 100/ 250/ -16
 MIN, MAX VALUES = -65.08e 58.13, 37.42 e 73.88

ACCELERATION (G)

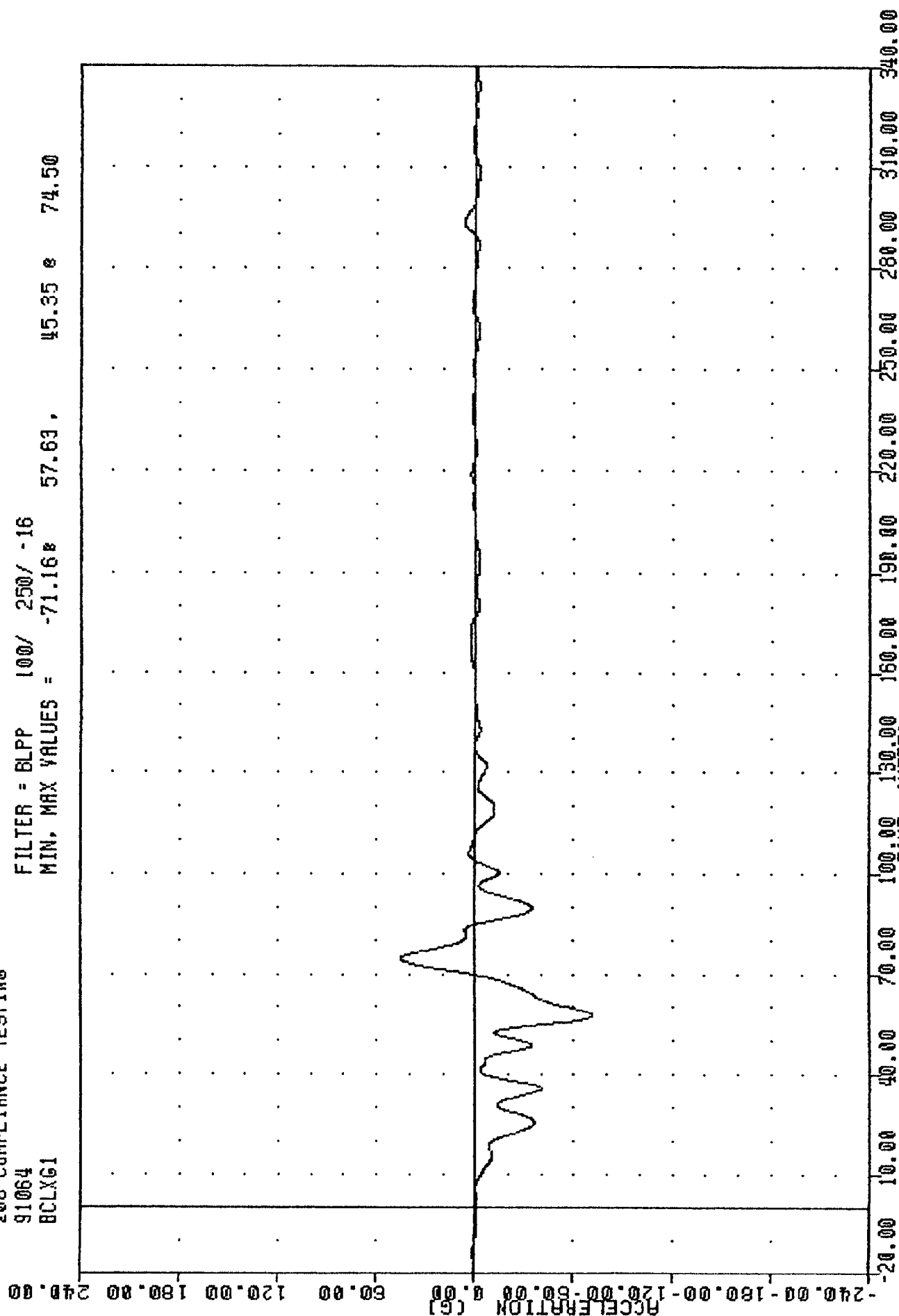


-20.00 10.00 40.00 70.00 100.00 130.00 160.00 190.00 220.00 250.00 280.00 310.00 340.00

1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 RIGHT BRAKE CALIPER Y-Axis ACCELERATION

TRC . 910305
 208 COMPLIANCE TESTING
 91064
 BCLXG1

FILTER = BLPP 100/ 250/ -16
 MIN. MAX VALUES = -71.16% 57.63, 45.35 & 74.50

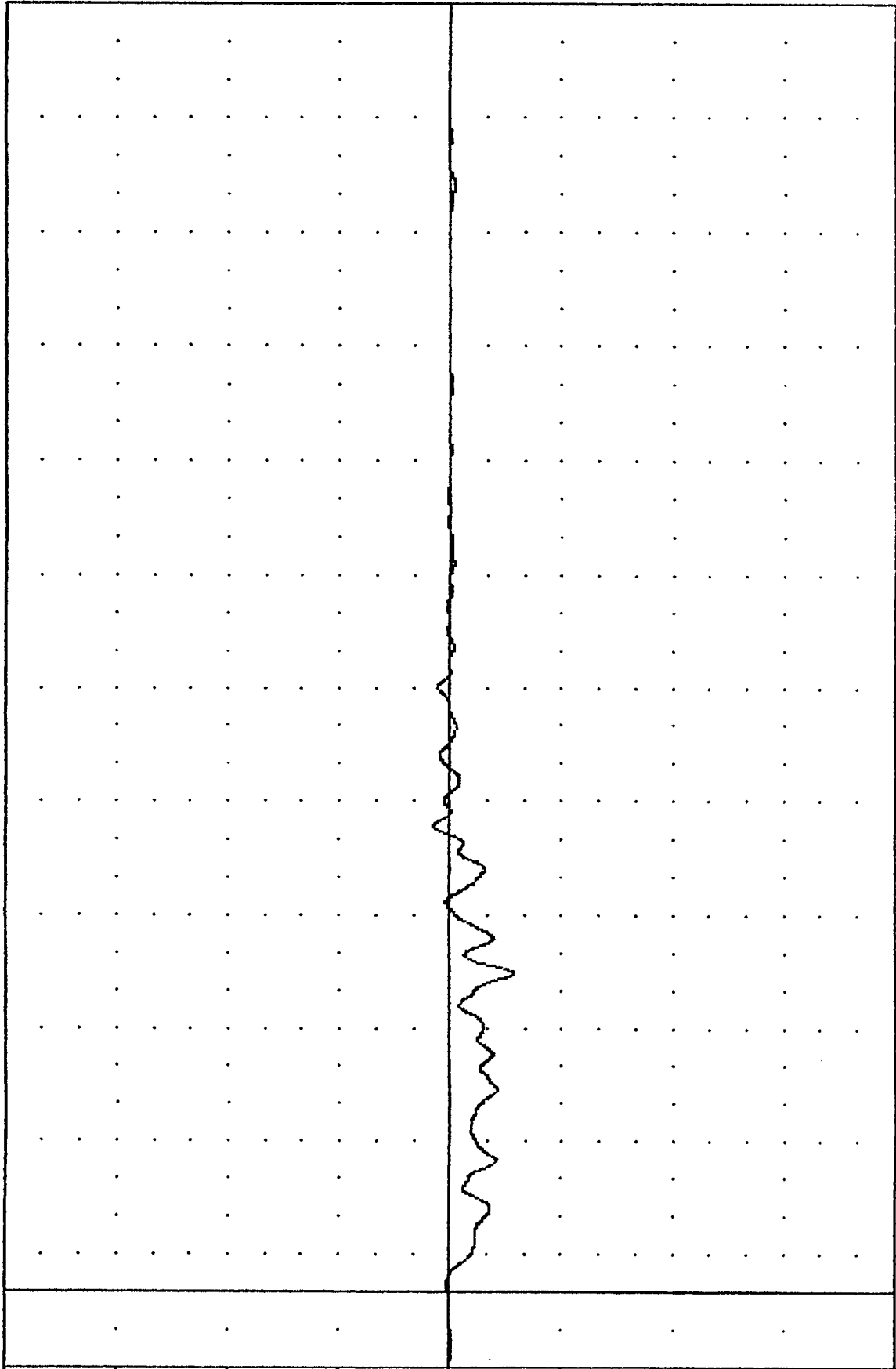


1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 LEFT BRAKE CALIPER Y-AXIS ACCELERATION

TRC , 910305
 208 COMPLIANCE TESTING
 91064
 DPCXG1

FILTER = BLPP 100/ 250/ -16
 MIN, MAX VALUES = -33.86 84.50 , 8.69 123.63

ACCELERATION (G)
 -240.00 -180.00 -120.00 -60.00 0.00 60.00 120.00 180.00 240.00



910305

B-30

1991 SATURN SL2 INTO FLAT FRONTAL BARRIER
 INSTRUMENT PANEL CENTER V-Axis ACCELERATION