DOT HS 808 304

June 1995

Final Report

Final Report of a 1995 Solectria 4-Door Sedan into Flat Frontal Barrier at 48.1 kph

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Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS 808 304		VRTC-83-0287

4. Title and Subtitle	5. Report Date
Final report of a 1995 Solectria 4-door sedan into flat frontal barrier at 48.1 kph.	June 1995
	6. Performing Organization Code: TRC
7. Author(s): Jeffery W. Sankey, Engineer Supervisor, TRC	8. Performing Organization Report No.: 950522
9. Performing Organization Name and Address: National Highway Traffic Safety Administration, Vehicle Research and Test Center, P. O. Box 37, East Liberty, OH 43319	10. Work Unit No. (TRAIS)
	11. Contract or Grant No.: DTNH22-88-C-07292
12. Sponsoring Agency Name and Address: U.S. Department of Transportation, National Highway Traffic Safety Administration, 400 Seventh St., Washington, DC 20590	13. Type of Report and Period Covered: Final Report, May - June 1995
	14. Sponsoring Agency Code: DOT/NHTSA/VRTC

15. Supplemental Notes

16. Abstract

A 48 kph flat frontal barrier impact test was conducted on a 1995 Solectria 4-door sedan at Transportation Research Center Inc. on May 22, 1995. This test was conducted to gather data concerning the application of the following Federal Motor Vehicle Safety Standards to electric vehicles: FMVSS 208, "Occupant Crash Protection"; FMVSS 212, "Windshield Mounting"; and FMVSS 219 (partial), "Windshield Zone Instrusion."

The impact velocity was 48.1 kph. The vehicle's maximum static crush was 495 millimeters. The ambient temperature was 21° C.

The driver's Head Injury Criteria (HIC) was 575. The driver's chest maixmum resultant acceleration with three milliseconds minimum duration was 43.0 g. The driver's chest maximum deflection was 32 mm. The driver's left and right femur maximum axial forces were 2013 N and 6002 N, respectively.

The passenger's HIC was 312. The passenger's chest maximum resultant acceleration with three (3) milliseconds minimum duration was 40.2 g. The passenger's chest maximum deflection was 28 millimeters. The passenger's left and right femur maximum axial forces were 2819 N and 2683 N, respectively

17. Key Words	18. Distribution Statement
1995 Solectria Force 48 kph Flat Frontal Barrier Impact Test FMVSS 208, "Occupant Crash Protection" FMVSS 212, "Windshield Retention" FMVSS 219 (partial), "Windshield Zone Intrusion"	Document is available to the public through the National Technical Information Service. Springfield, VA 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. Number of Pages	22. Price
Unclassified	Unclassified	181	

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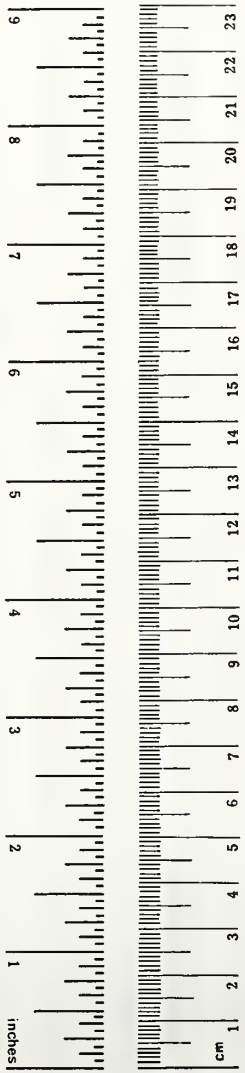
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

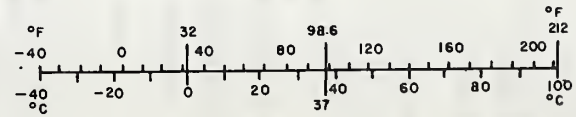
Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	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 (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

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



Approximate Conversions from Metric Measures

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



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Section 1.0

Purpose and Test Procedure

Purpose

This 48 kph flat frontal barrier impact test was conducted for Vehicle Research and Test Center by Transportation Research Center Inc. (TRC). The purpose of this test was to gather data concerning the application of the following Federal Motor Vehicle Safety Standards to electric vehicles: FMVSS 208, "Occupant Crash Protection"; FMVSS 212, "Windshield Mounting"; FMVSS 219 (partial), "Windshield Zone Intrusion."

Test Procedure

This test was conducted using NHTSA's Office of Vehicle Safety Compliance (OVSC) Laboratory Test Procedure No. TP-208-09 as a guideline with the addition of a post-impact static rollover test to determine if electrolyte leakage occurred into the passenger's compartment or outside the vehicle. Data was obtained relative to FMVSS 208, "Occupant Crash Protection"; FMVSS 212, "Windshield Retention"; and FMVSS 219 (partial), "Windshield Zone Intrusion."

The test vehicle was instrumented with thirteen (13) accelerometers to measure longitudinal and vertical axis accelerations. The vehicle's specified impact velocity range was 46.5 to 48.1 kph. 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 procedures 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 thirty-one (31) data channels were digitally sampled and recorded 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 operating at approximately 1000 frames per second. The pre- and post-test conditions were recorded by one (1) real-time motion picture camera.

The vehicle and occupant data are presented in Section 2.0. The FMVSS 208, 212, and 219 (partial) 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 dummy certification data. Appendix D contains miscellaneous test information.

Section 2.0

Frontal Barrier Impact Test Summary

Test Results Summary

This flat frontal barrier test was conducted at TRC on May 22, 1995.

The test vehicle, a 1995 Solectria Force 4-door sedan, appeared to comply with the performance requirements of FMVSS 208, 212, and 219 (partial) in the flat frontal barrier impact mode. The Head Injury Criteria (HIC) calculations were less than 1000, the chest resultant accelerations did not exceed 60 g's, and the axial forces transmitted through the upper legs did not exceed 10,008 N 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 76 millimeters. There was no penetration into any portion of the windshield and no loss of windshield retention.

The vehicle's test weight was 1334 kg. The vehicle's impact speed was 48.1 kph. The vehicle sustained 495 millimeters of static crush during the impact.

The driver's HIC was 575. The driver's chest maximum resultant acceleration with three (3) milliseconds minimum duration was 43.0 g. The driver's chest maximum deflection was 32 mm. The driver's left and right femur maximum axial forces were 2013 N and 6002 N, respectively.

The passenger's HIC was 312. The passenger's chest maximum resultant acceleration with three (3) milliseconds minimum duration was 40.2 g. The passenger's chest maximum deflection was 28 mm. The passenger's left and right femur maximum axial forces were 2819 N and 2683 N, respectively.

There was no loss of windshield retention. There was no penetration through the windshield. No electrolyte was found in the passenger's compartment after completion of the static rollover test.

Data Acquisition Explanations

The left rear seat X-axis accelerometer, TLRXG1, recorded questionable data spikes at 47 milliseconds.

Table 1 Crash Test Summary

Test type:	Flat Frontal Barrier Impact	
Test date:	05/22/95	
Test time:	1612	
Ambient temperature:	21° C	
Vehicle year/make/ model/body style:	1995/Solectria/Force/4-door sedan	
Vehicle test weight:	1334 kg	
Impact angle[1]:	0°	
Impact velocity[2]:	Primary = 48.1 kph Secondary = 48.1 kph	
Maximum static crush:	495 mm	
Average rebound:	589 mm	
Dummies:	Driver #083	Passenger #177
Type:	Part 572 E	Part 572 E
Location:	Left front	Right front
Restraint:	3-point unibelt and airbag	3-point unibelt and airbag
Number of data channels:	31	
Number of cameras:	High-speed 14 Real-time 2	

[1] With respect to tow track centerline.
[2] Speed trap measurement (± .08 kph accuracy)

Table 2 Test Vehicle Information

Vehicle manufactured by:	CAMI Automotive, Inc.
Vehicle altered by:	Solectria Corporation
Vehicle year/make/ model/body style:	1995/Solectria/Force/4-door sedan
Color:	Purple
VIN:	2C1MR5295S6700099
Electric motor data:	
Placement:	Transverse/lateral
Type:	One A.C. motor and gear box
Final drive:	X fwd, __rwd, __4wd
Date vehicle received:	05/16/95
Odometer reading:	5,692
Dealer's name and address:	NA

Accessories:

Power steering	No	Automatic transmission	Yes
Power brakes	Yes	Automatic speed control	No
Power seats	No	Tilting steering wheel	No
Power windows	No	Telescoping steering wheel	No
Tinted glass	Yes	Air conditioning	No
Radio	No	Anti-skid brake	Yes
Clock	No	Rear window defroster	Yes
Power door locks	No	Other	None

Certification data from vehicle's label:

Vehicle manufactured by:	CAMI Automotive Inc.
Date of manufacture:	03/94
VIN:	2C1MR5295S6700099
GVWR:	1110 kg
GAWR: Front:	565 kg
Rear:	545 kg

Table 2 Test Vehicle Information, Cont'd.

Size of tires:	P155/80R13
Spare tire:	None
Type of front seats:	Buckets

Tire & capacity data from vehicle's label:

Recommended tire size:	P155/80R13
Recommended cold tire pressure:	
Front:	220 kPa
Rear:	220 kPa
Designated seating capacity:	
Front	2
Rear	2
Total	4
Vehicle capacity weight:	312

Test vehicle attitude:

Delivered attitude:	LF 629 mm;	RF 630 mm;	LR 661 mm;	RR 656 mm
Fully loaded attitude:	LF 625 mm;	RF 623 mm;	LR 650 mm;	RR 641 mm
Pre-test attitude:	LF 612 mm;	RF 614 mm;	LR 647 mm;	RR 649 mm
Post-test attitude:	LF 704 mm;	RF 678 mm;	LR 625 mm;	RR 634 mm

Tire pressure for test:	Front:	303 kPa
	Rear:	303 kPa

Table 2 Test Vehicle Information, Cont'd

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

Right front	267	kg	Right rear	298	kg
Left front	283	kg	Left rear	297	kg
Total front weight	550	kg	(48.0% of total vehicle weight)		
Total rear weight	595	kg	(52.0% of total vehicle weight)		
Total delivered weight	1145	kg			

Calculation of test vehicle's target test weight:

RCLW = Rated cargo and luggage weight

UDW = Unloaded delivered weight (1145 kg)

VCW[1] = Vehicle capacity weight (312kg)

DSC = Designated Seating Capacity (4)

RCLW = VCW - 150 (DSC) = 312 - 68 (4) = 40 kg

Target test weight = UDW + RCLW[1] + (Number of Hybrid III dummies x 76 kg/dummy)

Target test weight = 1145 + 40 + 152 = 1337 kg

Weight of test vehicle with required dummies and 37 kg of cargo weight:

Right front	317	kg	Right rear	338	kg
Left front	332	kg	Left rear	347	kg
Total front weight	649	kg	(48.7% of total vehicle weight)		
Total rear weight	685	kg	(51.3% of total vehicle weight)		
Total test weight	1334	kg	(0.2% under target test weight)		

Weight of ballast secured in vehicle: None

Components removed to meet target test weight: Rear bumper, rear door glass & door trim

CG rearward of front wheel centerline: 1212 mm

Vehicle wheelbase: 2362 mm

Front overhang: 755 mm

Maximum width: 1565 mm

[1] From the vehicle's tire load label.

Table 3 Post-Impact Data

Test number:	950522
Test date:	05/22/95
Test time:	1612
Test type:	Flat frontal barrier impact
Impact angle:	0°
Ambient temperature at impact area:	21° C
Temperature in occupant compartment:	22° C
Impact velocity:	
Primary	48.1 kph
Secondary	48.1 kph
Specified range	47.5 to 49.1 kph

Distance from vehicle to barrier:

Entering velocity trap	356 mm
Exiting velocity trap	51 mm

Test vehicle static crush:

Overall length of test vehicle:

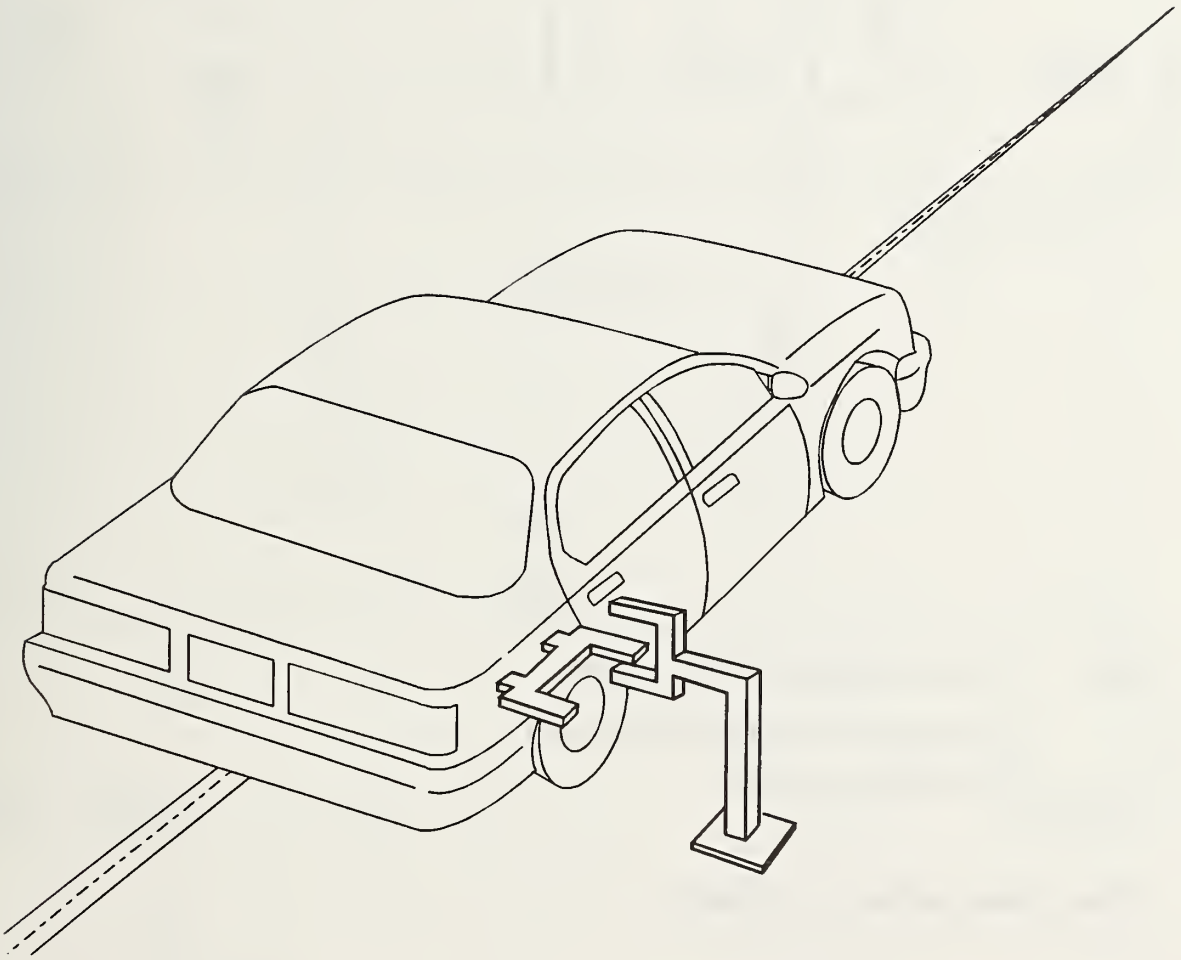
Pre-test:	L	3870 mm;	C	4042 mm;	R	3885 mm
Post-test:	L	3514 mm;	C	3553 mm;	R	3490 mm
Total crush:	L	356 mm;	C	489 mm;	R	395 mm
Average crush:	413 mm					

Test vehicle rebound from flat barrier:

Distance from test vehicle to barrier:

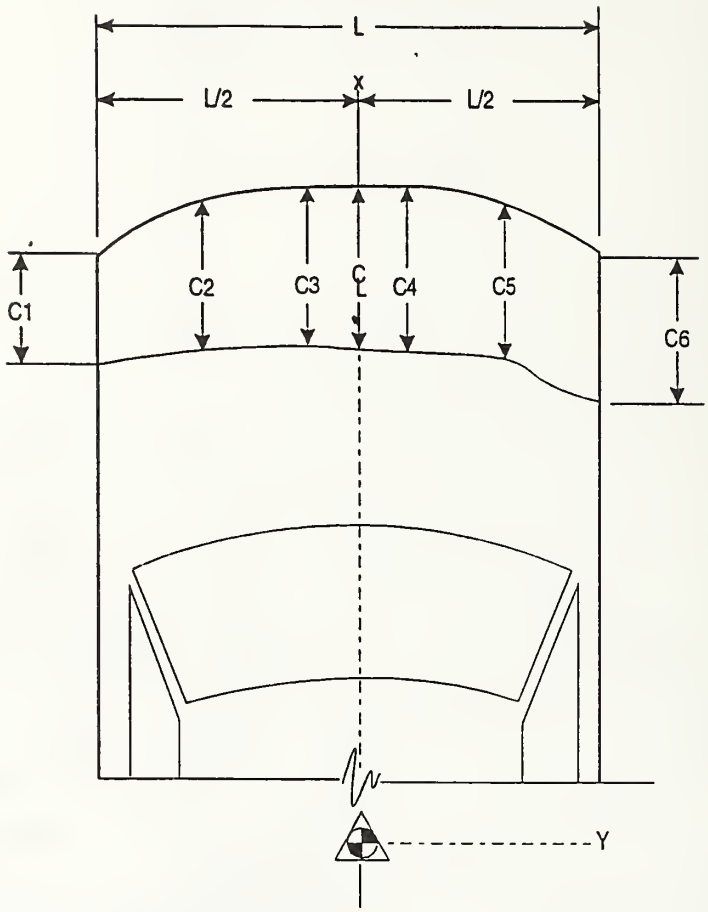
Post-test:	L	584 mm;	C	572 mm;	R	610 mm
Average rebound	589 mm					

Figure 1 Impact Velocity Measurement System



The final vane clears the final emitter/receiver pair 51 millimeters before impact. The vanes have 305-millimeter spacing.

Figure 2 Vehicle Crush



Notes: L is pre-test length of contact surface.

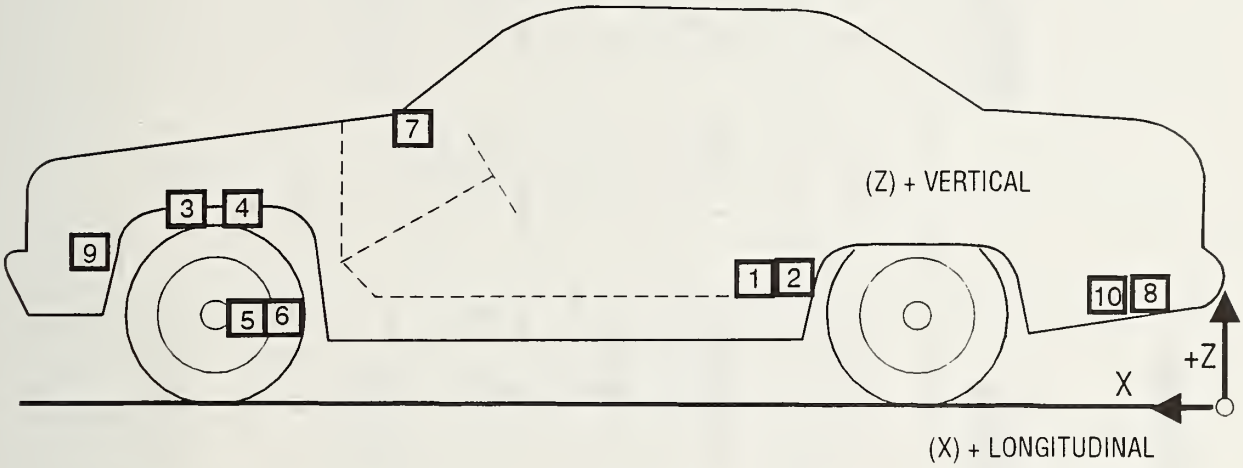
C1 through C6 are spaced equally apart.

CL is vehicle centerline.

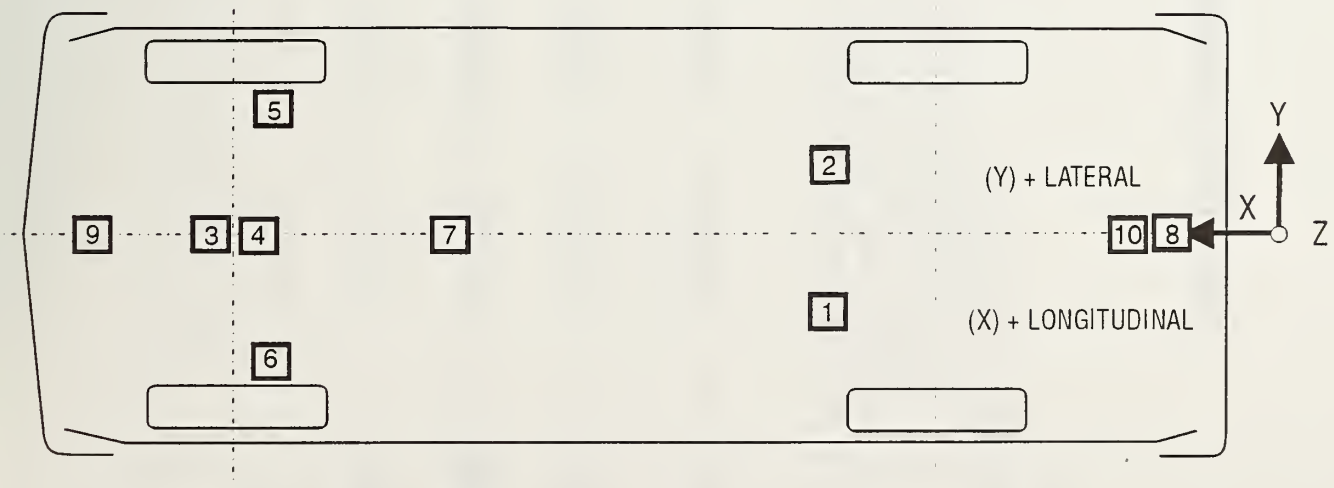
Vehicle: Solectria Force 4-door sedan

	Pre-test	Post-test	Crush
L	1424 mm		
C1	3870 mm	3514 mm	356 mm
C2	3988 mm	3524 mm	464 mm
C3	4032 mm	3537 mm	495 mm
C4	4032 mm	3545 mm	487 mm
C5	3992 mm	3521 mm	471 mm
C6	3885 mm	3490 mm	395 mm
CL	4042 mm	3553 mm	489 mm

Figure 3 Vehicle Accelerometer Placement



SIDE VIEW



BOTTOM VIEW

Table 4 Vehicle Accelerometer Locations and Data Summary

TEST NUMBER: 950522 No. LOCATION	X	Y	Z	POSITIVE DIRECTION		NEGATIVE DIRECTION	
1 LEFT REAR SEAT CROSSMEMBER	1370 mm	465 mm	352 mm				
LONGITUDINAL[1]				19.4 g	@ 47.0 ms	31.6 g	@ 39.8 ms
2 RIGHT REAR SEAT CROSSMEMBER	1375 mm	-498 mm	336 mm				
LONGITUDINAL				1.5 g	@ 304.2 ms	31.9 g	@ 38.6 ms
3 MOTOR TOP	3240 mm	76 mm	714 mm				
LONGITUDINAL				13.6 g	@ 66.8 ms	83.9 g	@ 35.8 ms
4 GEAR BOX	3125 mm	30 mm	200 mm				
LONGITUDINAL				29.6 g	@ 38.2 ms	186.5 g	@ 32.5 ms
VERTICAL				30.4 g	@ 30.7 ms	20.5 g	@ 54.6 ms
5 RIGHT BRAKE CALIPER	3335 mm	-607 mm	280 mm				
LONGITUDINAL				26.1 g	@ 64.6 ms	82.6 g	@ 42.4 ms
6 LEFT BRAKE CALIPER	3335 mm	607 mm	293 mm				
LONGITUDINAL				20.6 g	@ 66.6 ms	95.1 g	@ 42.2 ms
7 INSTRUMENT PANEL CENTER	2824 mm	0 mm	905 mm				
LONGITUDINAL				30.3 g	@ 24.9 ms	55.0 g	@ 28.3 ms

Table 4 Vehicle Accelerometer Locations and Data Summary, Cont'd.

TEST NUMBER: 950522 No. LOCATION	X	Y	Z	POSITIVE DIRECTION		NEGATIVE DIRECTION	
8 TRUNK FLOOR CENTER	114 mm	-15 mm	647 mm				
VERTICAL				10.9 g	@ 21.1 ms	10.9 g	@ 79.9 ms
9 FRONT BATTERY BOX	3345 mm	122 mm	225 mm				
LONGITUDINAL				49.5 g	@ 40.2 ms	126.4 g	@ 31.3 ms
VERTICAL				58.3 g	@ 24.8 ms	72.2 g	@ 31.6 ms
10 REAR BATTERY BOX	635 mm	365 mm	393 mm				
LONGITUDINAL				2.3 g	@ 144.4 ms	24.6 g	@ 43.0 ms
VERTICAL				3.5 g	@ 38.9 ms	4.7 g	@ 68.4 ms

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

[1] See DATA ACQUISITION EXPLANATIONS

Section 3.0

FMVSS 208, 212, and 219 (partial) Data

Table 5 Dummy Data Summary

TEST NUMBER: 950522 DRIVER DUMMY SERIAL NUMBER: 83

	POSITIVE DIRECTION		NEGATIVE DIRECTION	
HEAD ACCELERATION				
LONGITUDINAL	4.7 g	@ 295.2 ms	64.7 g	@ 75.3 ms
LATERAL	13.8 g	@ 81.2 ms	2.0 g	@ 38.2 ms
VERTICAL	8.9 g	@ 87.5 ms	17.2 g	@ 53.3 ms
RESULTANT	65.5 g	@ 76.2 ms		
HIC	575 from 61.0 to 89.1			
CHEST ACCELERATION				
LONGITUDINAL	3.5 g	@ 243.7 ms	43.4 g	@ 71.7 ms
LATERAL	6.3 g	@ 56.6 ms	3.4 g	@ 79.5 ms
VERTICAL	11.9 g	@ 78.6 ms	12.3 g	@ 52.6 ms
RESULTANT	43.9 g	@ 63.0 ms		
3 MSEC	43.0			
CHEST DEFLECTION				
LONGITUDINAL	0.1 mm	@ 25.4 ms	31.6 mm	@ 70.3 ms
FEMUR LOAD				
LEFT	209.9 N	@ 29.2 ms	2013.0 N	@ 57.4 ms
RIGHT	416.4 N	@ 40.0 ms	6001.9 N	@ 53.9 ms

POSITIVE DIRECTION		NEGATIVE DIRECTION	
LONGITUDINAL:	FORWARD	LONGITUDINAL:	REARWARD
LATERAL:	LEFTWARD	LATERAL:	RIGHTWARD
VERTICAL:	UPWARD	VERTICAL:	DOWNWARD
FORCE:	COMPRESSION	FORCE:	TENSION

Table 5 Dummy Data Summary, Cont'd.

TEST NUMBER: 950522 PASSENGER DUMMY SERIAL NUMBER: 177

	POSITIVE DIRECTION		NEGATIVE DIRECTION	
HEAD ACCELERATION				
LONGITUDINAL	6.5 g	@ 45.3 ms	41.1 g	@ 66.0 ms
LATERAL	14.2 g	@ 35.5 ms	5.3 g	@ 54.6 ms
VERTICAL	27.6 g	@ 83.2 ms	17.1 g	@ 37.0 ms
RESULTANT	43.3 g	@ 67.8 ms		
HIC	312 from 52.2 to 88.2			
CHEST ACCELERATION				
LONGITUDINAL	3.4 g	@ 205.4 ms	40.3 g	@ 67.5 ms
LATERAL	6.6 g	@ 83.0 ms	2.3 g	@ 72.8 ms
VERTICAL	19.1 g	@ 79.6 ms	9.4 g	@ 53.3 ms
RESULTANT	41.7 g	@ 67.6 ms		
3 MSEC	40.2			
CHEST DEFLECTION				
LONGITUDINAL	0.0 mm	@ 7.0 ms	28.5 mm	@ 67.3 ms
FEMUR LOAD				
LEFT	1036.5 N	@ 81.4 ms	2819.0 N	@ 49.6 ms
RIGHT	1651.5 N	@ 83.8 ms	2683.1 N	@ 61.0 ms

POSITIVE DIRECTION		NEGATIVE DIRECTION	
LONGITUDINAL:	FORWARD	LONGITUDINAL:	REARWARD
LATERAL:	LEFTWARD	LATERAL:	RIGHTWARD
VERTICAL:	UPWARD	VERTICAL:	DOWNWARD
FORCE:	COMPRESSION	FORCE:	TENSION

Table 6 Post-Impact Dummy/Vehicle Data

Visible Dummy Contact Points:

	Driver #083	Passenger #177
Head	Airbag	Airbag
Chest	Airbag	Airbag
Abdomen	None	None
Left knee	Instrument panel	Instrument panel
Right knee	Instrument panel	Instrument panel

Door Opening:

	Left	Right
Front	Easy	Easy
Rear	NA	NA

Seat Movement:

	Seat Back Failure	Seat Shift
Front	None	None
Rear	NA	NA

Glazing Damage: None

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 and chest were restrained by the driver's airbag as the dummy's torso was restrained by the three-point unibelt. The dummy rebounded into the seat back and came to rest seated in the driver's seat, restrained by the three-point unibelt.

Right Front Passenger Dummy

Upon impact, the right front passenger dummy translated forward on the set impacting both knees into the instrument panel. The dummy's head and chest were restrained by the passenger's airbag as the dummy's torso was restrained by the three-point unibelt. The dummy rebounded into the seat back and came to rest seated in the right front passenger's seat, restrained by the three-point unibelt.

Figure 4 FMVSS 212 Test Data

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

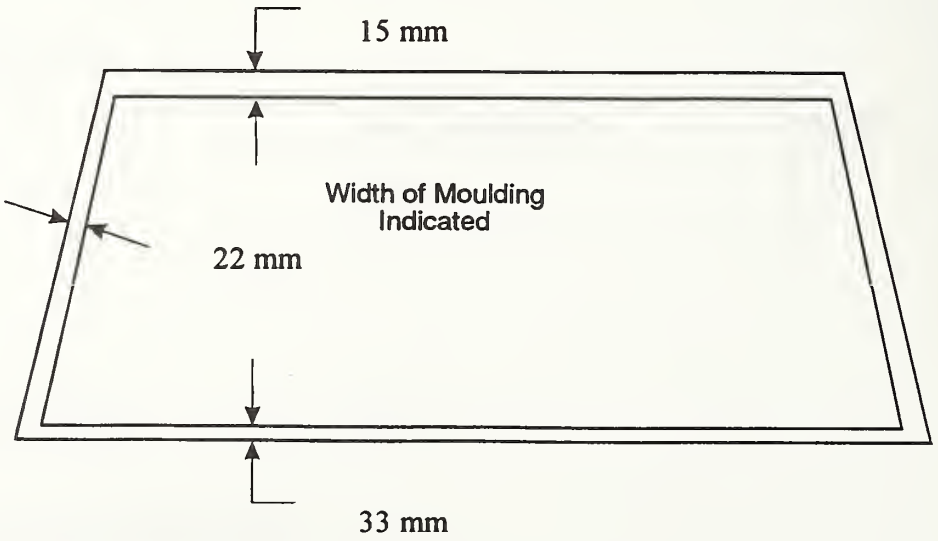
Plastic trim around outer perimeter, adhesive around inner perimeter.

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	1962 mm	1962 mm	100
Left side	1962 mm	1962 mm	100
Total	3924 mm	3924 mm	100

Pre-test windshield mounting material temperature: 22° C



Front view of windshield[1]

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 165-millimeter diameter rigid sphere weighing 6.8 kg 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 13 millimeters 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 = 1062 mm

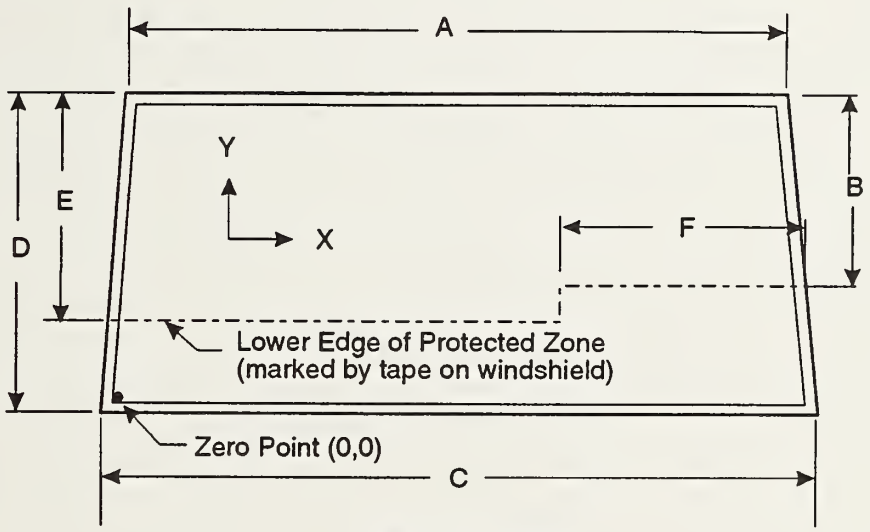
B = 535 mm

C = 1466 mm

D = 761 mm

E = 528 mm

F = 569 mm



FRONT VIEW

Method of adhering protected zone template to windshield: NA

Areas of windshield template penetration greater than 6 mm: NA

	Coordinates X	Y
1.		
2.		
3.		

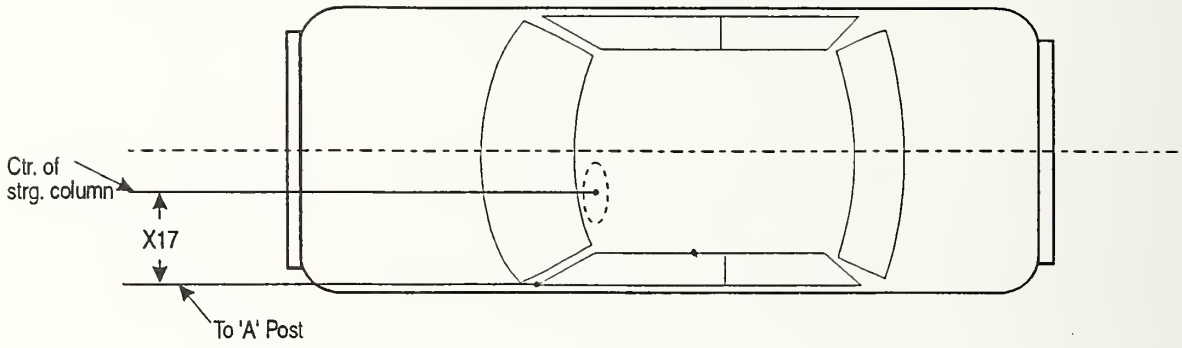
Areas of windshield penetration, below the protected zone, through the inner surface of the windshield: None

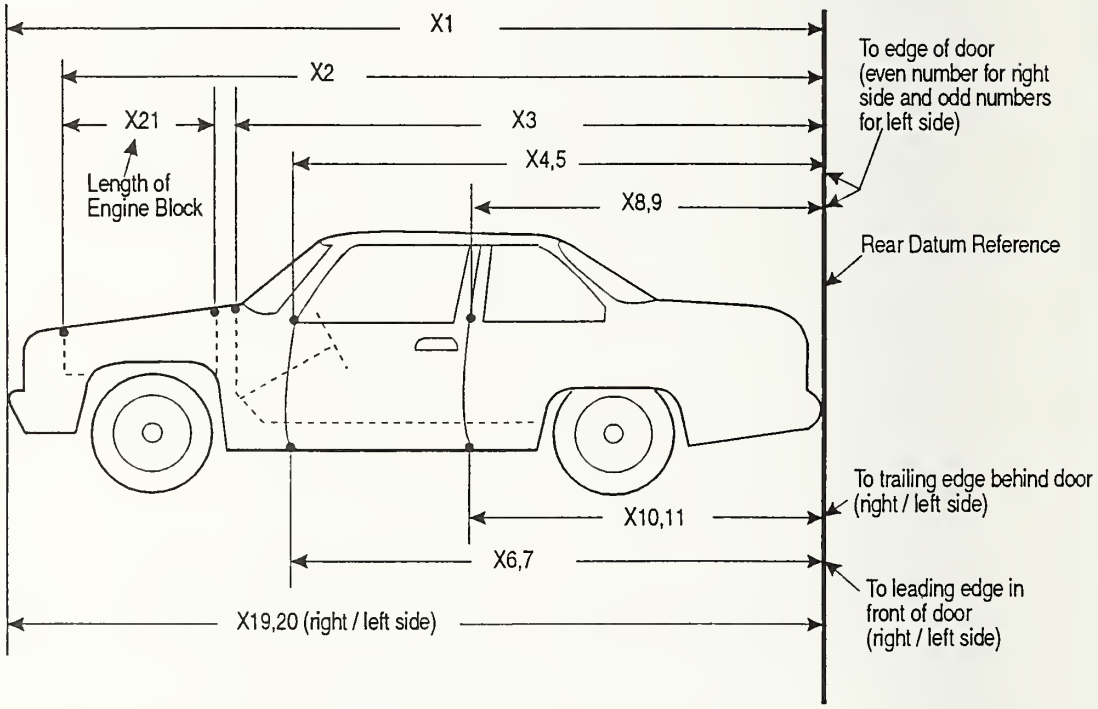
1.
2.
3.

Section 4.0

Vehicle, Occupant, and Camera Information

Figure 6 Pre-test and Post-test Measurements Points





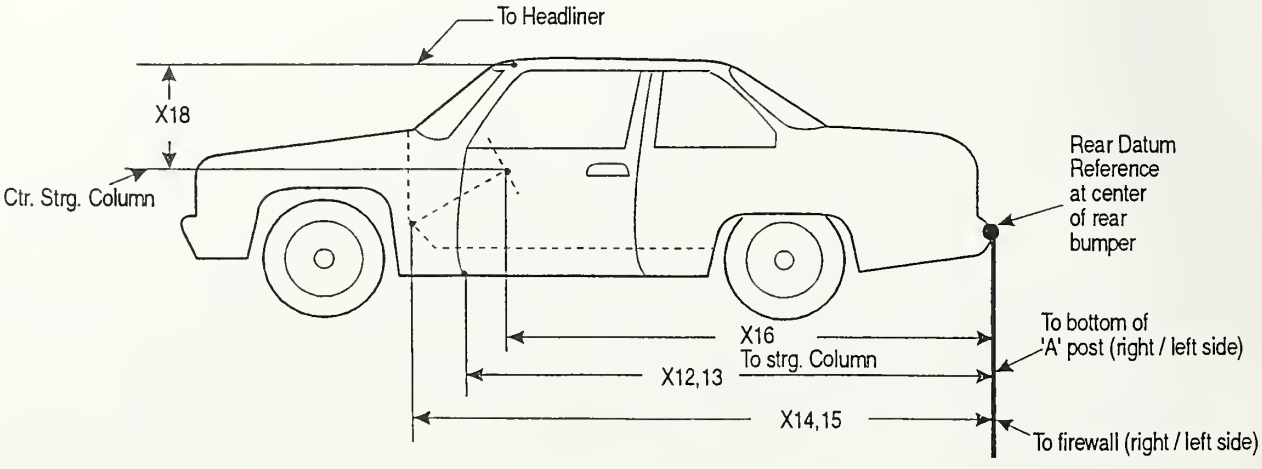


Table 7 Impacted Vehicle Measurements

Vehicle Make/Model: Solectria/Force/4-door sedan Test Number: 950522

No.	Type of measurement	Pre-test	Post-test	Diff.
X1	Total length of vehicle at centerline	4042 mm	3553 mm	489 mm
X2	Rear surface of vehicle to front of engine block	3575 mm	3249 mm	326 mm
X3	Rear surface of vehicle to firewall	3112 mm	3019 mm	93 mm
X4	Rear surface of vehicle to upper leading edge of right door	2790 mm	2772 mm	18 mm
X5	Rear surface of vehicle to upper leading edge of left door	2787 mm	2785 mm	2 mm
X6	Rear surface of vehicle to lower leading edge of right door	2775 mm	2745 mm	30 mm
X7	Rear surface of vehicle to lower leading edge of left door	2775 mm	2748 mm	27 mm
X8	Rear surface of vehicle to upper trailing edge of right door	1788 mm	1777 mm	11 mm
X9	Rear surface of vehicle to upper trailing edge of left door	1785 mm	1788 mm	-3 mm
X10	Rear surface of vehicle to lower trailing edge of right door	1787 mm	1754 mm	33 mm
X11	Rear surface of vehicle to lower trailing edge of left door	1775 mm	1760 mm	15 mm
X12	Rear surface of vehicle to bottom of "A" post on right side	2788 mm	2762 mm	26 mm
X13	Rear surface of vehicle to bottom of "A" post on left side	2790 mm	2750 mm	40 mm
X14	Rear surface of vehicle to firewall - right side	3068 mm	3048 mm	20 mm
X15	Rear surface of vehicle to firewall - left side	3086 mm	2997 mm	89 mm
X16	Rear surface of vehicle to steering wheel center	2385 mm	2340 mm	45 mm
X17	Center of steering column to "A" post	290 mm	278 mm	12 mm
X18	Center of steering column to headliner	415 mm	410 mm	5 mm
X19	Rear surface of vehicle to right side of front bumper	3885 mm	3490 mm	395 mm
X20	Rear surface of vehicle to left side of front bumper	3870 mm	3514 mm	356 mm
X21	Length of engine block	390 mm	390 mm	0 mm

Figure 7 Vehicle Target Locations

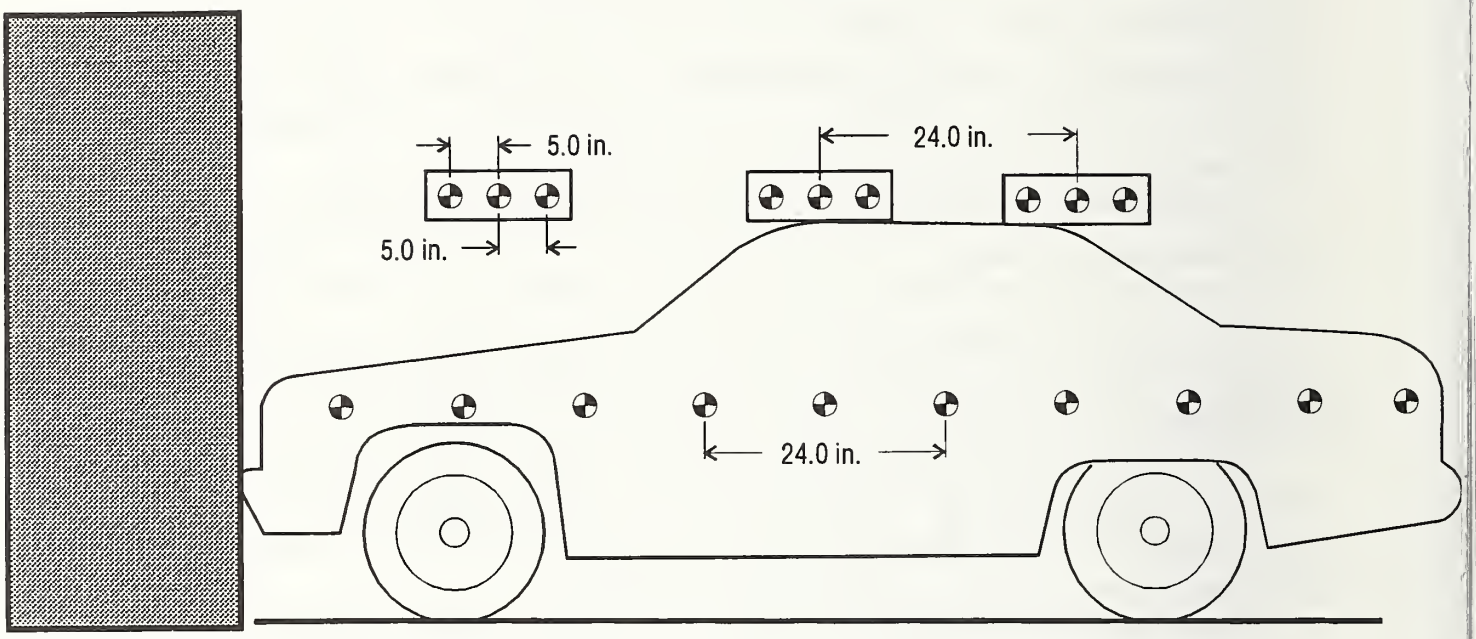
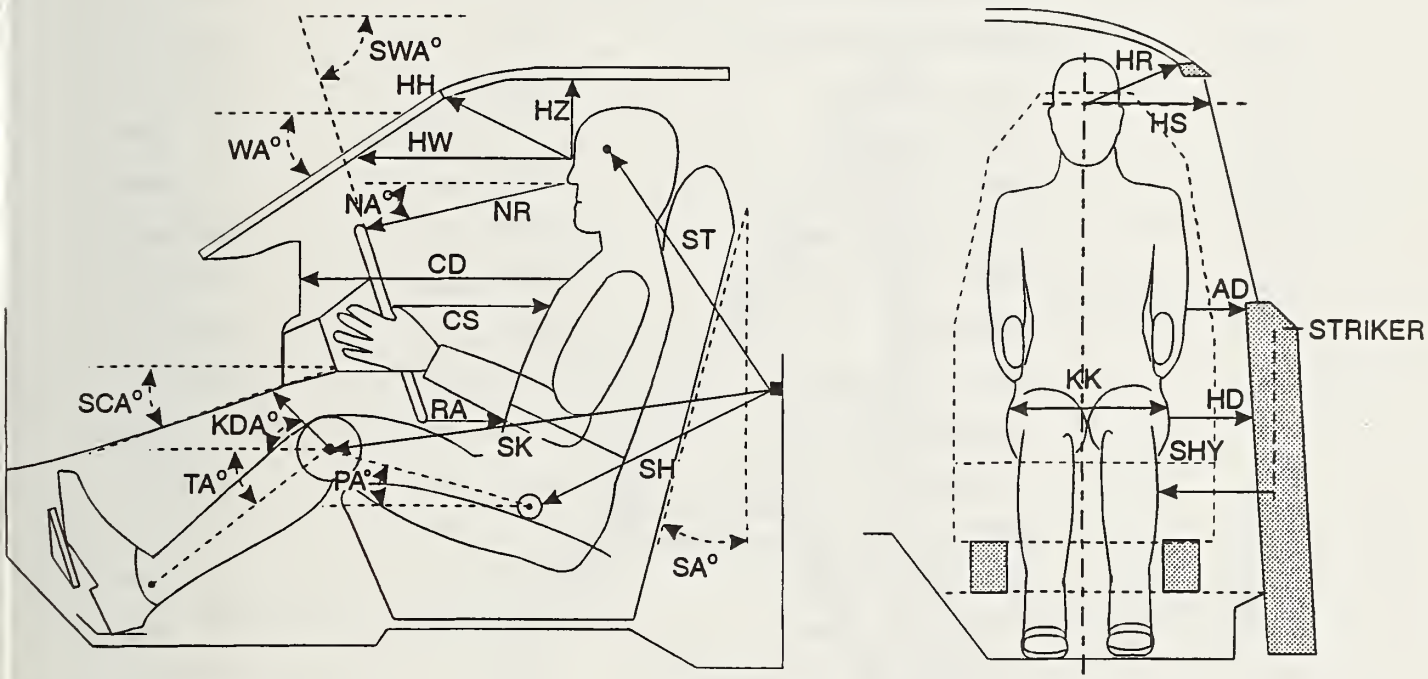


Figure 8 Dummy Measurement Locations for Front Seat Occupants



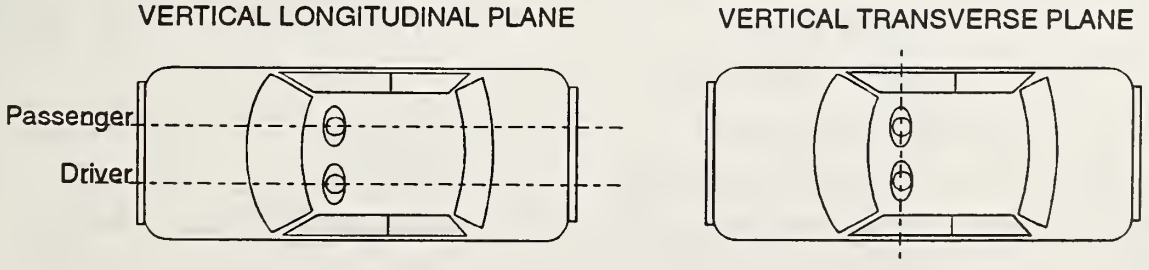


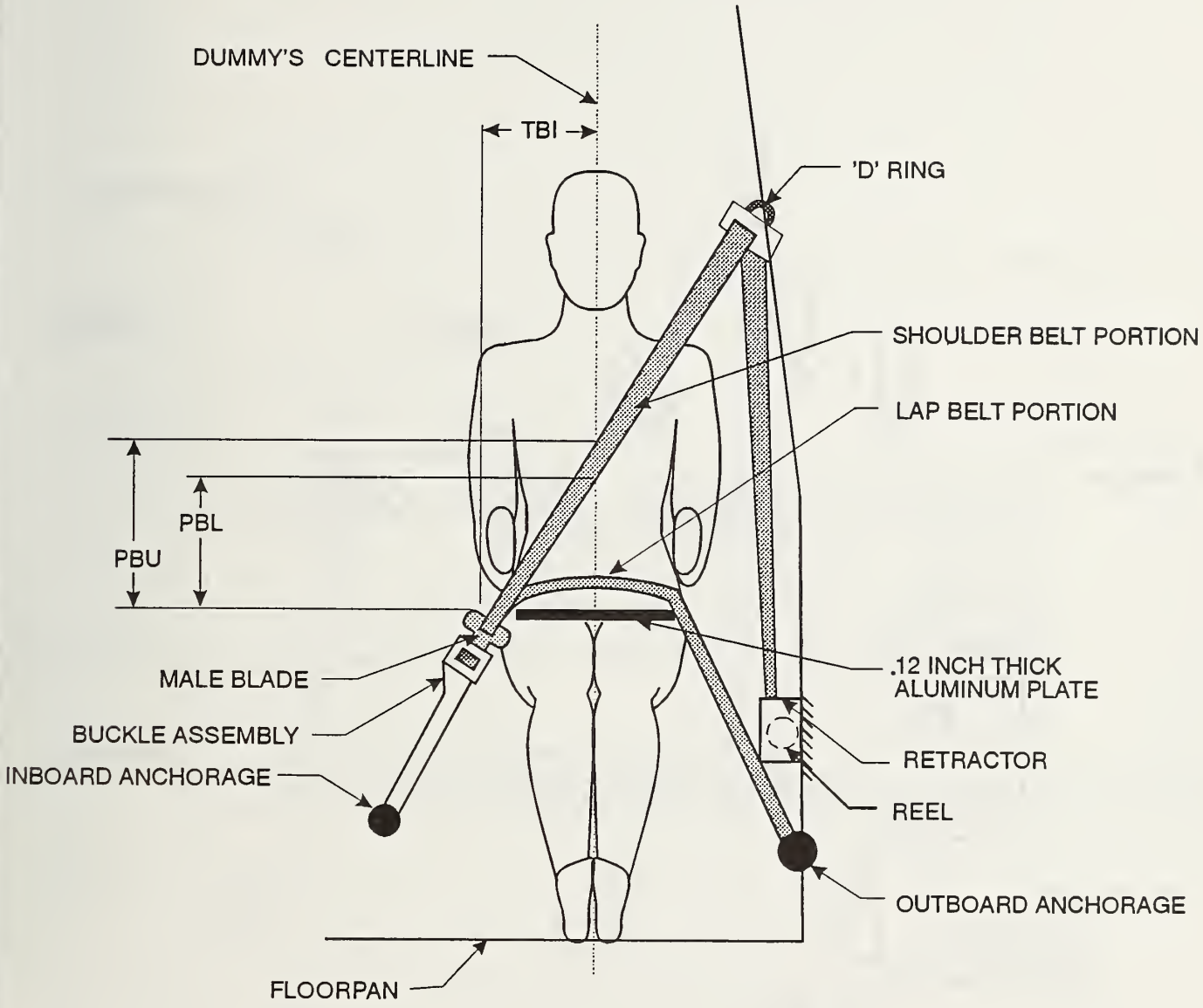
Table 8 Dummy Measurement Data for Front Seat Occupants

Designation	Type of Measurement	Driver (Serial #083)	Passenger (Serial #177)
WA	Windshield angle	28°	NA
SWA	Steering wheel angle	64°	NA
SCA	Steering column angle	26°	NA
SA	Seat back angle	23.5°	23.5°
HZ	Head to roof	217 mm	205 mm
HH	Head to header	355 mm	326 mm
HW	Head to windshield	565 mm	564 mm
HR	Head to side header	200 mm	187 mm
NR	Nose to rim	419 mm	NA
NA	Nose to rim angle	8°	NA
CD	Chest to dash	532 mm	511 mm
CS	Steering wheel to chest	342 mm	NA
RA	Rim to abdomen	198 mm	NA
KDL	Left knee to dash	159 mm	128 mm
KDR	Right knee to dash	167 mm	127 mm
KDA	Outboard knee to dash angle	27°	29°
PA	Pelvic angle	24°	24°
TA	Tibial angle	36°	44°
KK	Knee to knee	283 mm	270 mm
ST[1]	Striker to head	450 mm	471 mm
	Striker to head angle	-88°	-76°
SK[1]	Striker to knee	579 mm	562 mm
	Striker to knee angle	2°	3°
SH[1]	Striker to H-point	246 mm	267 mm
	Striker to H-point angle	131°	41°
SHY	Striker to H-point (Y dir.)	190 mm	194 mm
HS	Head to side window	282 mm	290 mm
HD	H-point to door	103 mm	92 mm
AD	Arm to door	80 mm	65 mm

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

[1] The seat was not positioned at the design midtrack location. See Test Procedure page.

Figure 9 Seat Belt Positioning Data



		Driver	Passenger
PBU -	Top surface of aluminum plate to belt upper edge	351 mm	360 mm
PBL -	Top surface of aluminum plate to belt lower edge	272 mm	270 mm
TBI -	Dummy centerline to intersection of upper torso belt and lap belt	280 mm	275 mm

Figure 10 Camera Positions

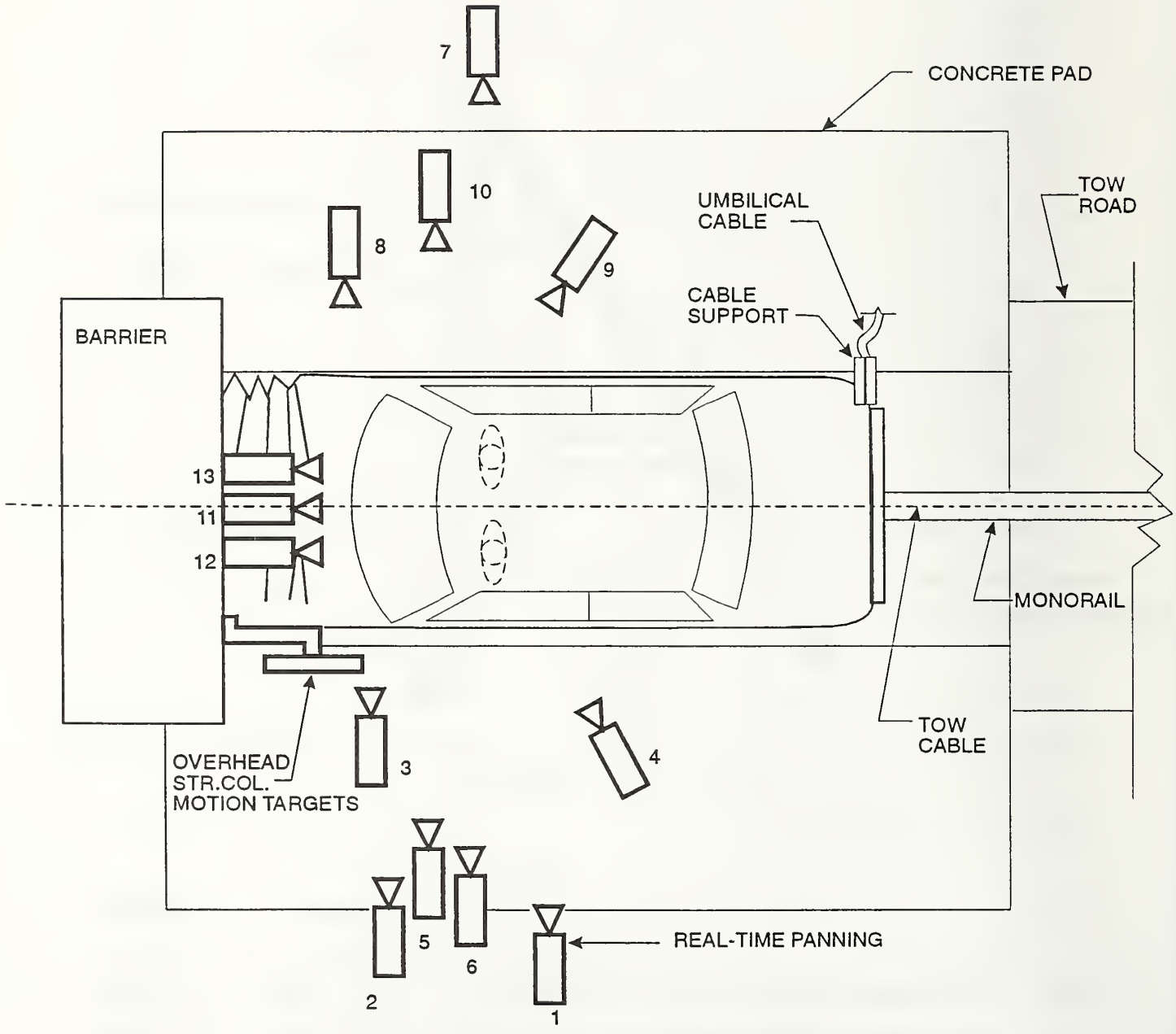


Figure 10 Camera Positions, Cont'd.

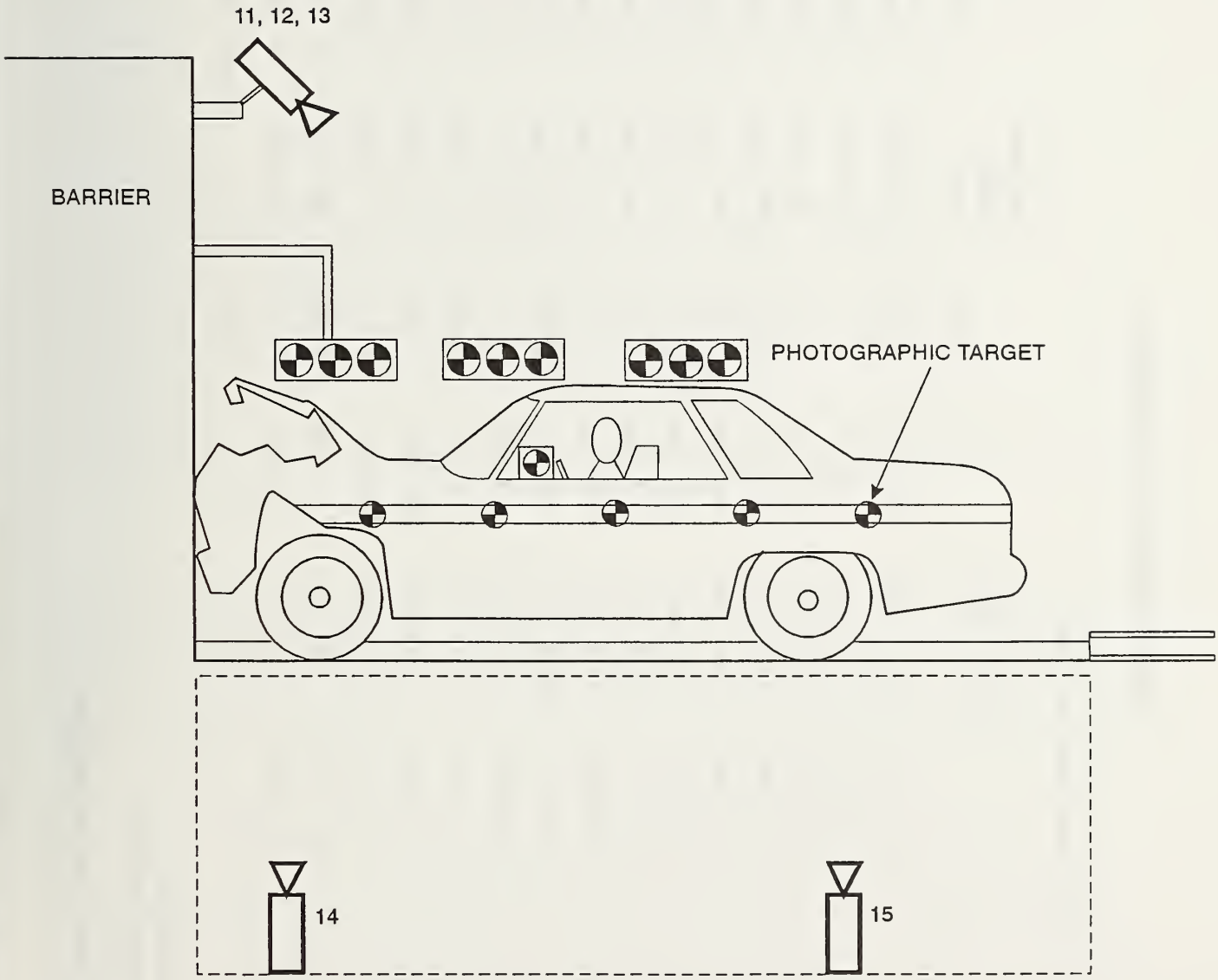


Table 9 Motion Picture Camera Locations

Test Number: 950522

Vehicle year/make/model/body style: 1995/Solectria/Force/4-door sedan

Camera Number	View	Camera Positions[1] X	Y	Z	Angle[2]	Film Plane to Head Target	Lens	Film Speed
1	Real-time panning	-3607 mm	12802 mm	1549 mm	NA	NA mm	16 mm	24 frames/s
2	Left vehicle crush	-1029 mm	7493 mm	1118 mm	4°	5486 mm	25 mm	1030 frames/s
3	Left windshield intrusion	-1346 mm	7859 mm	1074 mm	0°	NA mm	50 mm	1005 frames/s
4	Driver kinematics	-3995 mm	2946 mm	2210 mm	-27°	2388 mm	25 mm	1005 frames/s
5	Steering column motion	-1829 mm	7264 mm	2616 mm	-14°	NA mm	25 mm	1010 frames/s
6	Steering column motion	-1829 mm	7264 mm	1908 mm	-9°	NA mm	25 mm	1000 frames/s
7	Right overall	-2065 mm	-6767 mm	942 mm	-2°	NA mm	13 mm	1002 frames/s
8	Right windshield intrusion	-968 mm	-7775 mm	1118 mm	0°	NA mm	50 mm	505 frames/s
9	Passenger kinematics	-3863 mm	-2946 mm	2210 mm	-26°	2489 mm	25 mm	998 frames/s
10	Passenger kinematics	-986 mm	-7442 mm	1151 mm	-4°	5182 mm	25 mm	1010 frames/s
11	Windshield front view	-152 mm	0 mm	2235 mm	-40°	NA mm	13 mm	1000 frames/s
12	Driver - front view	-173 mm	368 mm	2362 mm	-50°	NA mm	17 mm	1005 frames/s
13	Passenger - front view	-114 mm	-351 mm	2362 mm	-50°	NA mm	17 mm	1002 frames/s
14	Pit - front position	-1283 mm	0 mm	-2347 mm	90°	NA mm	13 mm	1000 frames/s
15	Pit - rear position	-2522 mm	0 mm	-2515 mm	90°	NA mm	13 mm	998 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 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

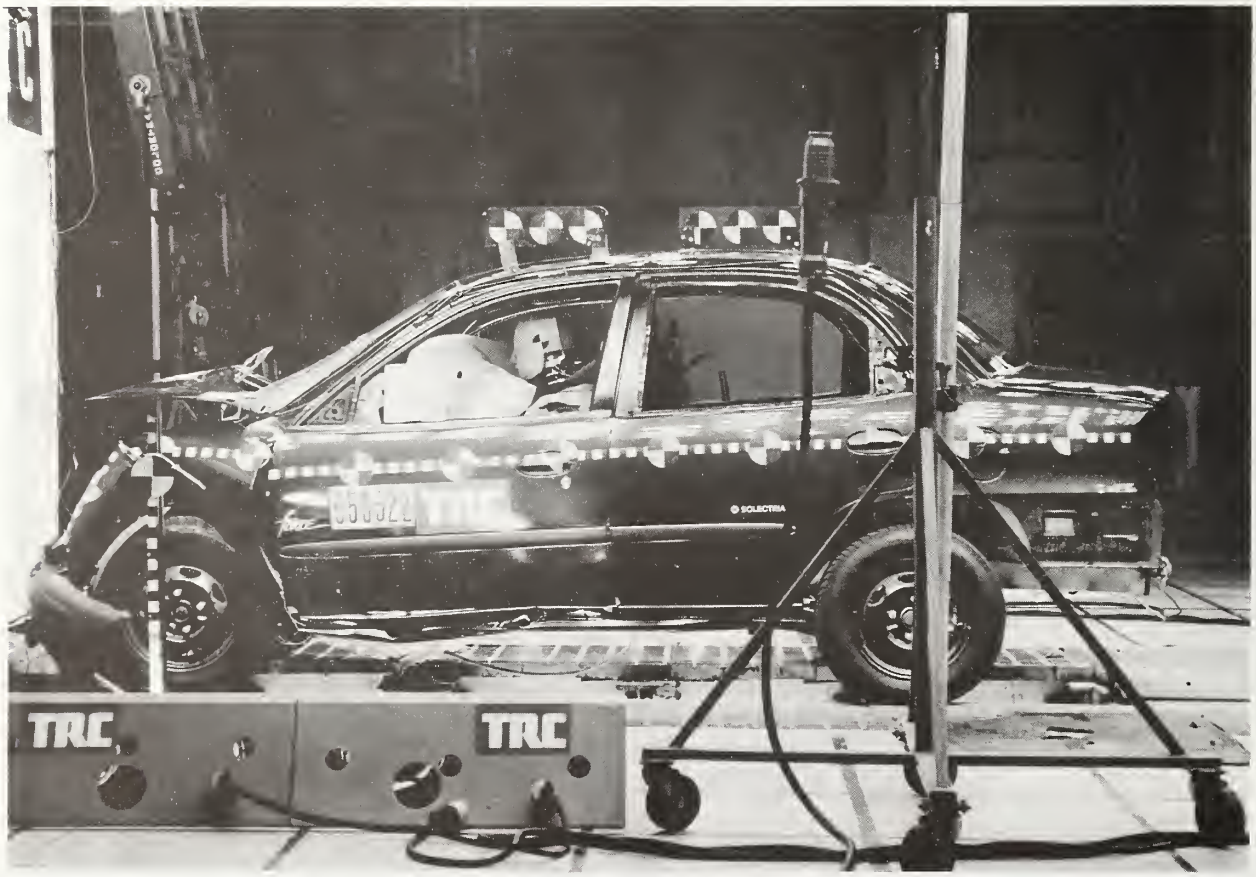


Figure A-4 Post-test Left Side View

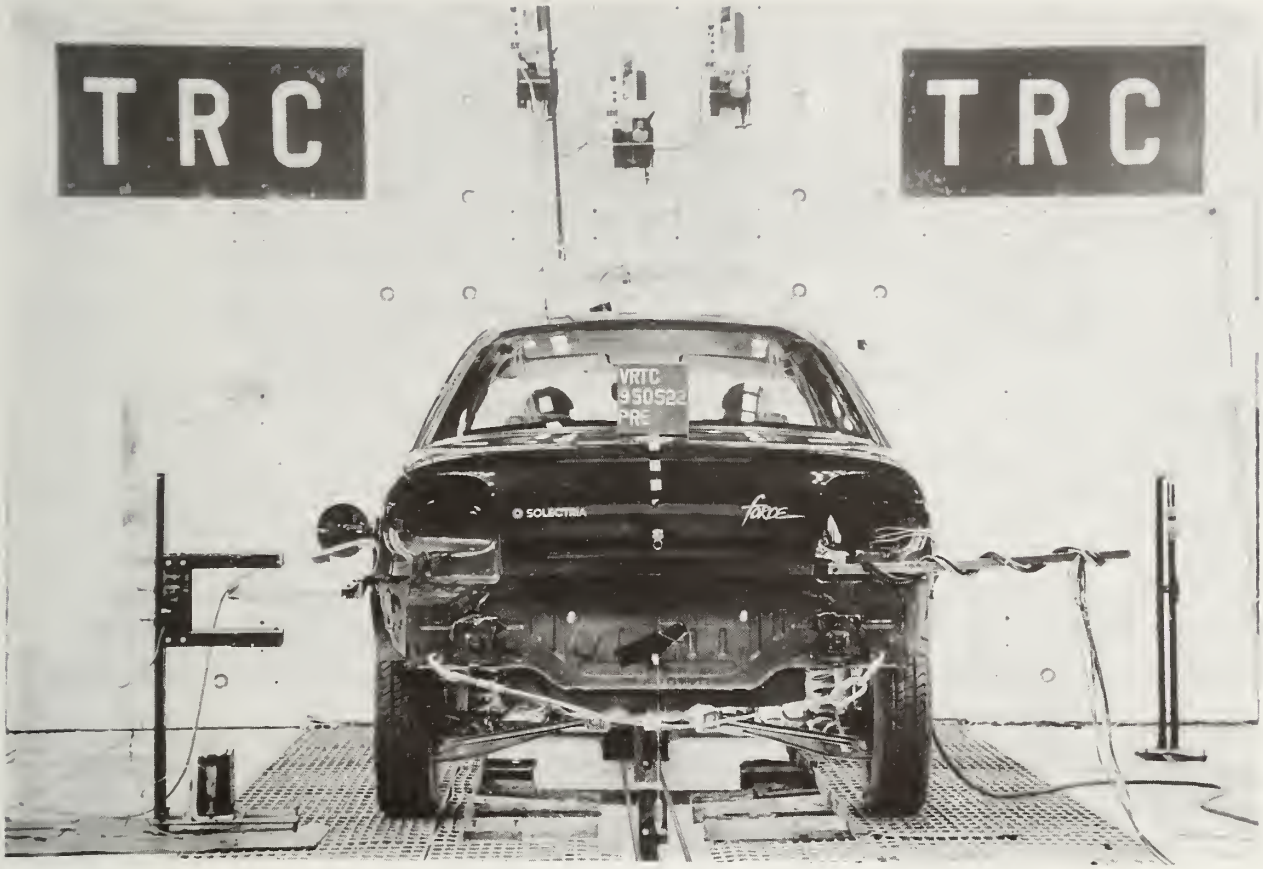


Figure A-5 Pre-test Rear View

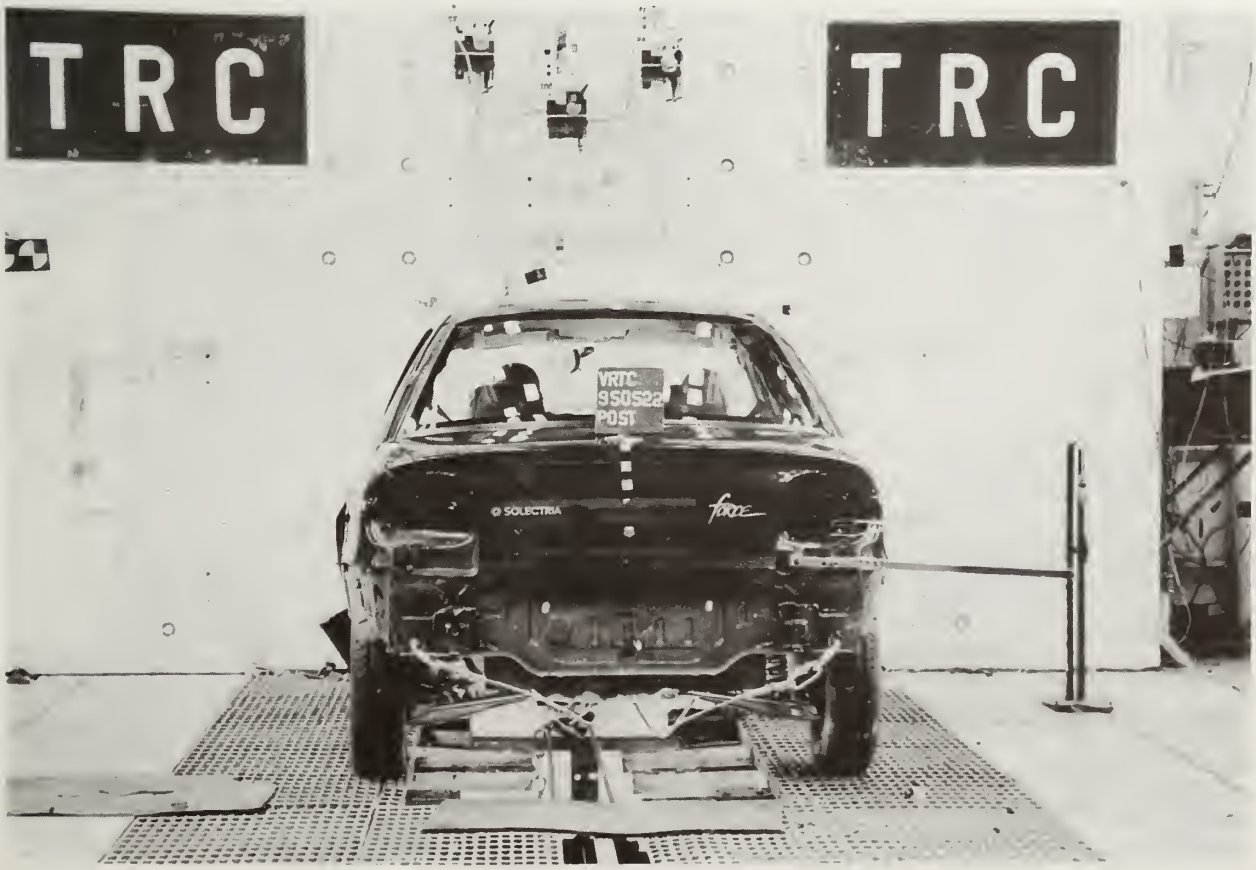


Figure A-6 Post-test Rear View

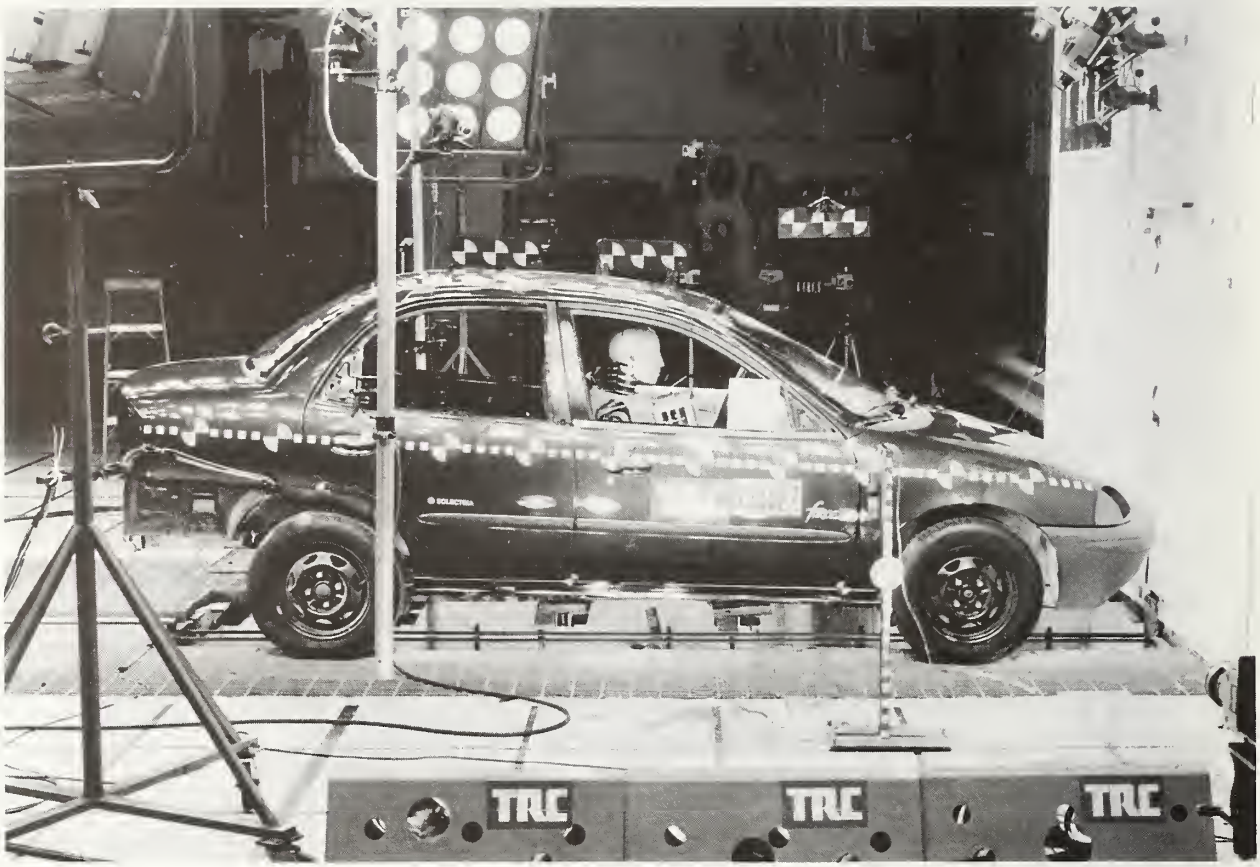


Figure A-7 Pre-test Right Side View

Figure A-8 Post-test Right Side View

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

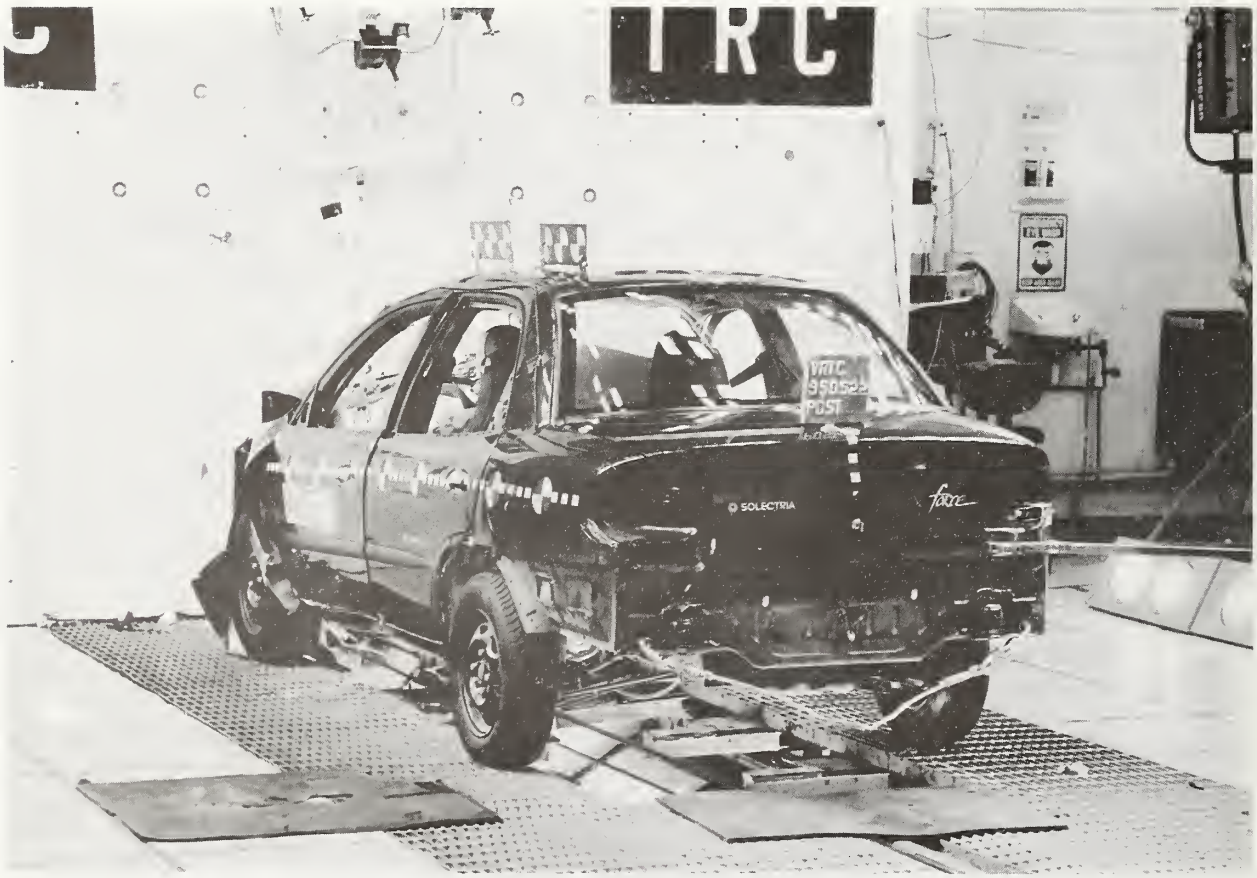


Figure A-12 Post-test Left Rear Three-quarter View

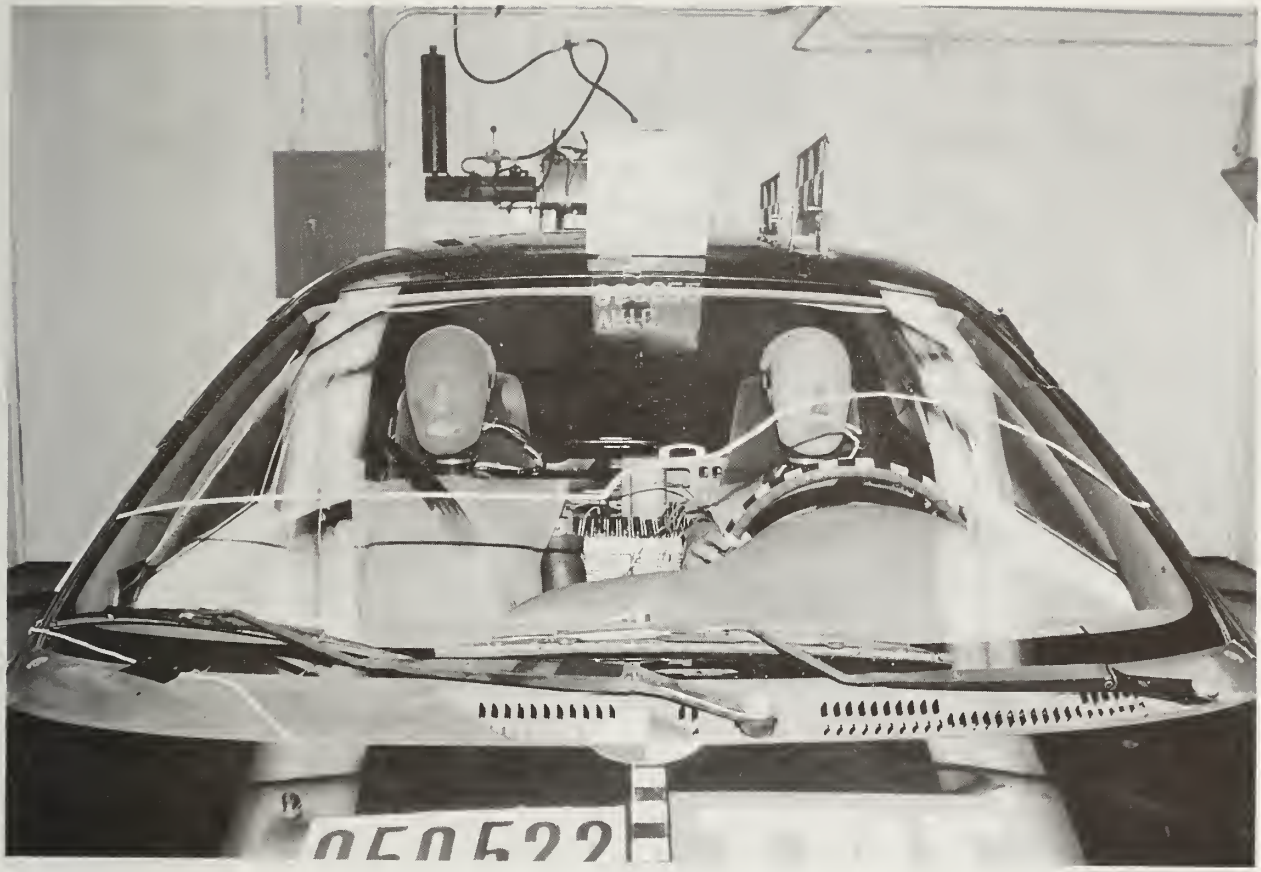


Figure A-13 Pre-test Windshield View

Figure A-14 Post-test Windshield View

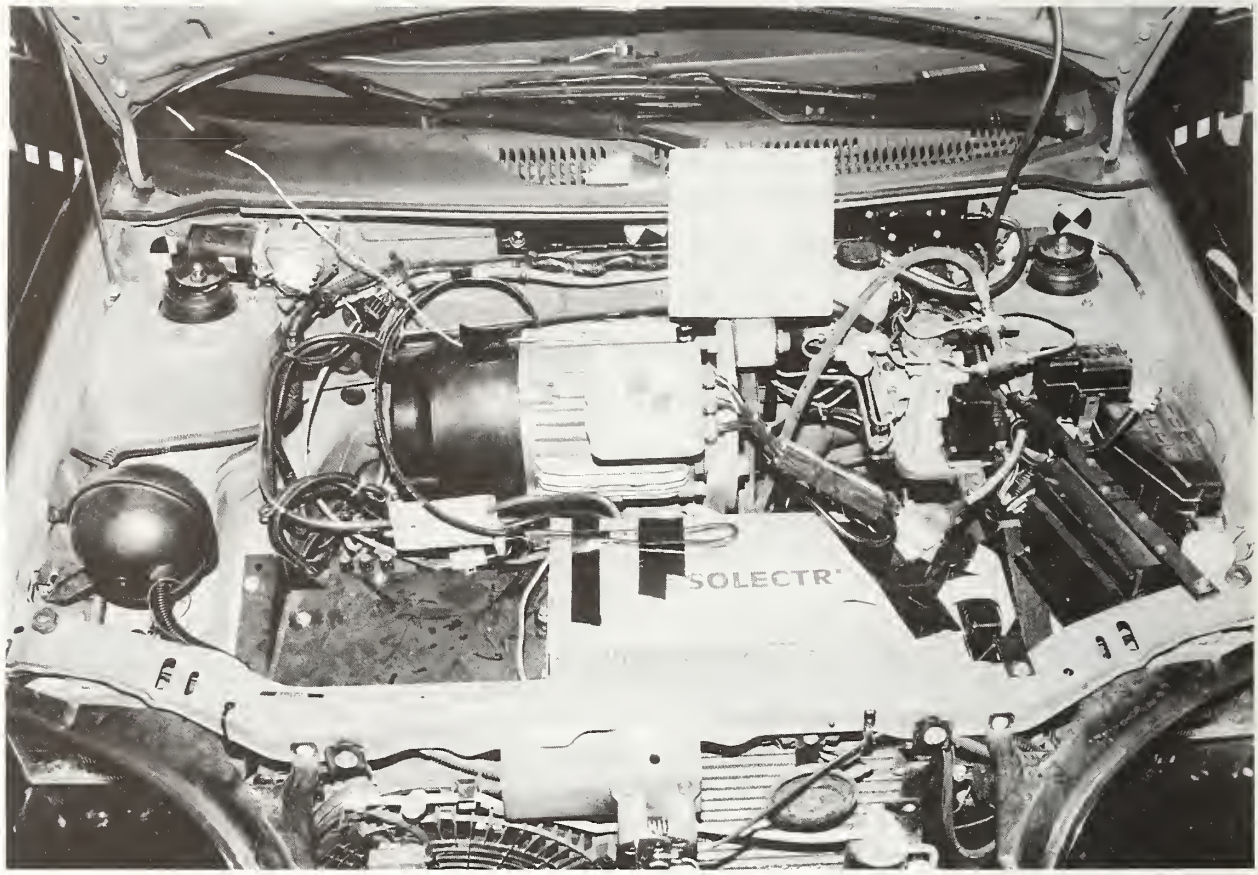


Figure A-15 Pre-test Underhood View

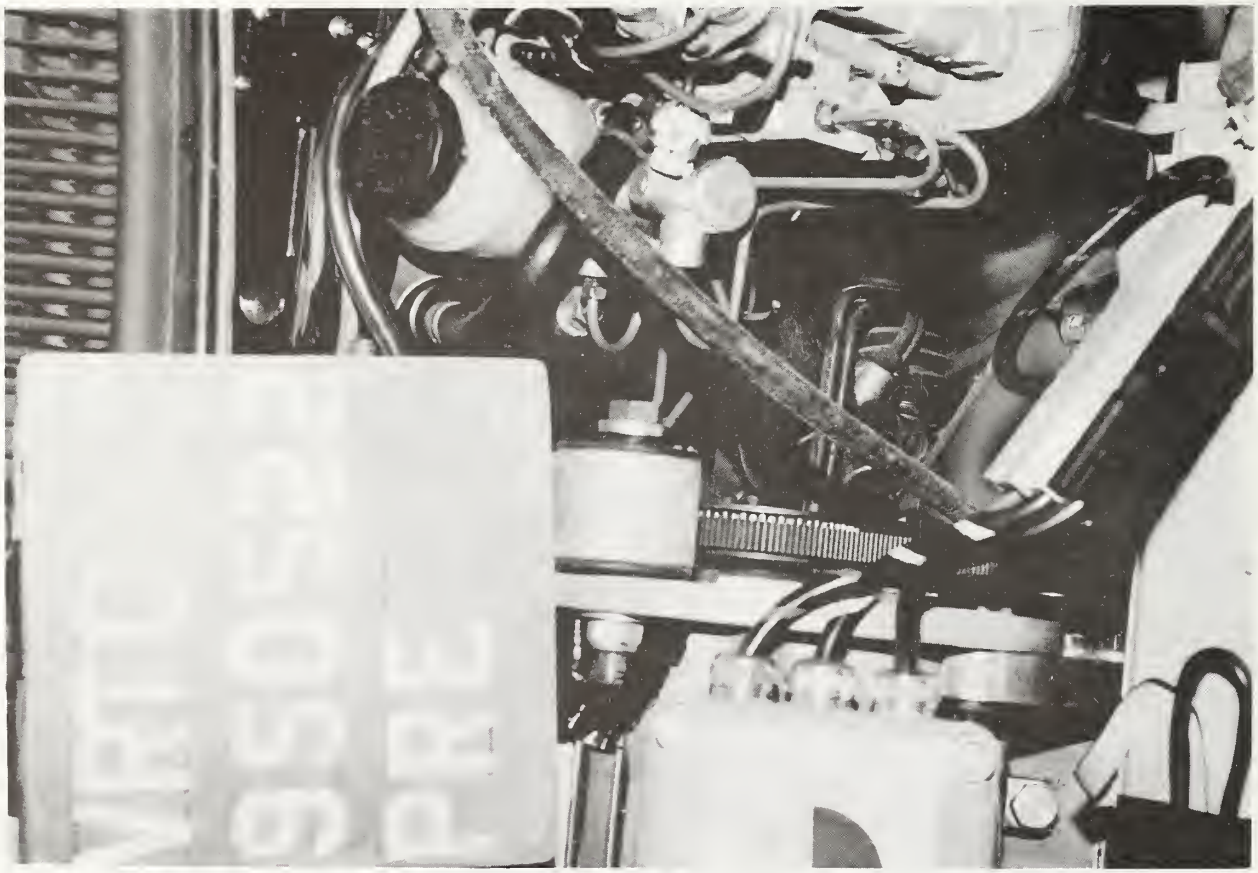


Figure A-16 Pre-test Underhood Close-up View

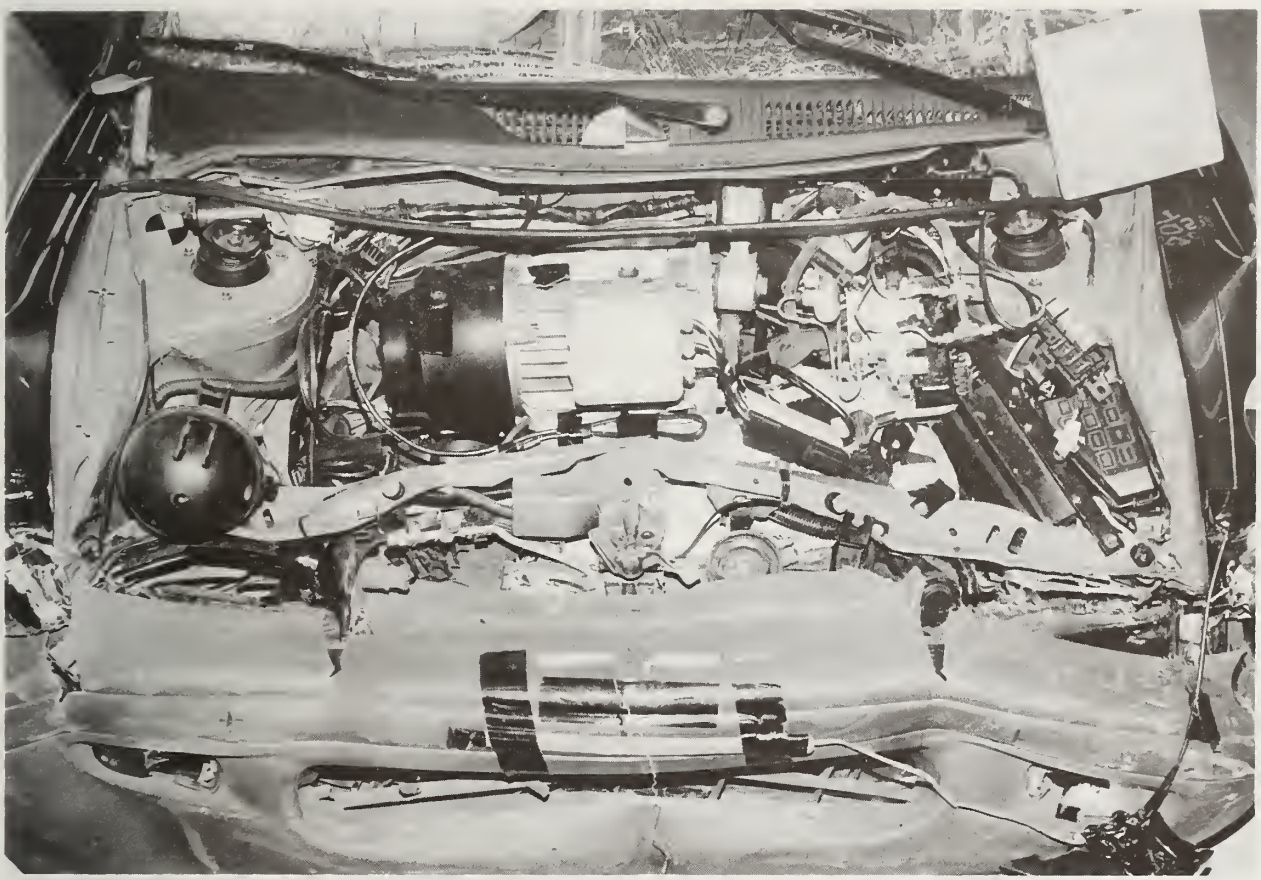


Figure A-17 Post-test Underhood View

Intentionally Left Blank

Figure A-18 Pre-test Front Underbody View

Figure A-19 Post-test Front Underbody View

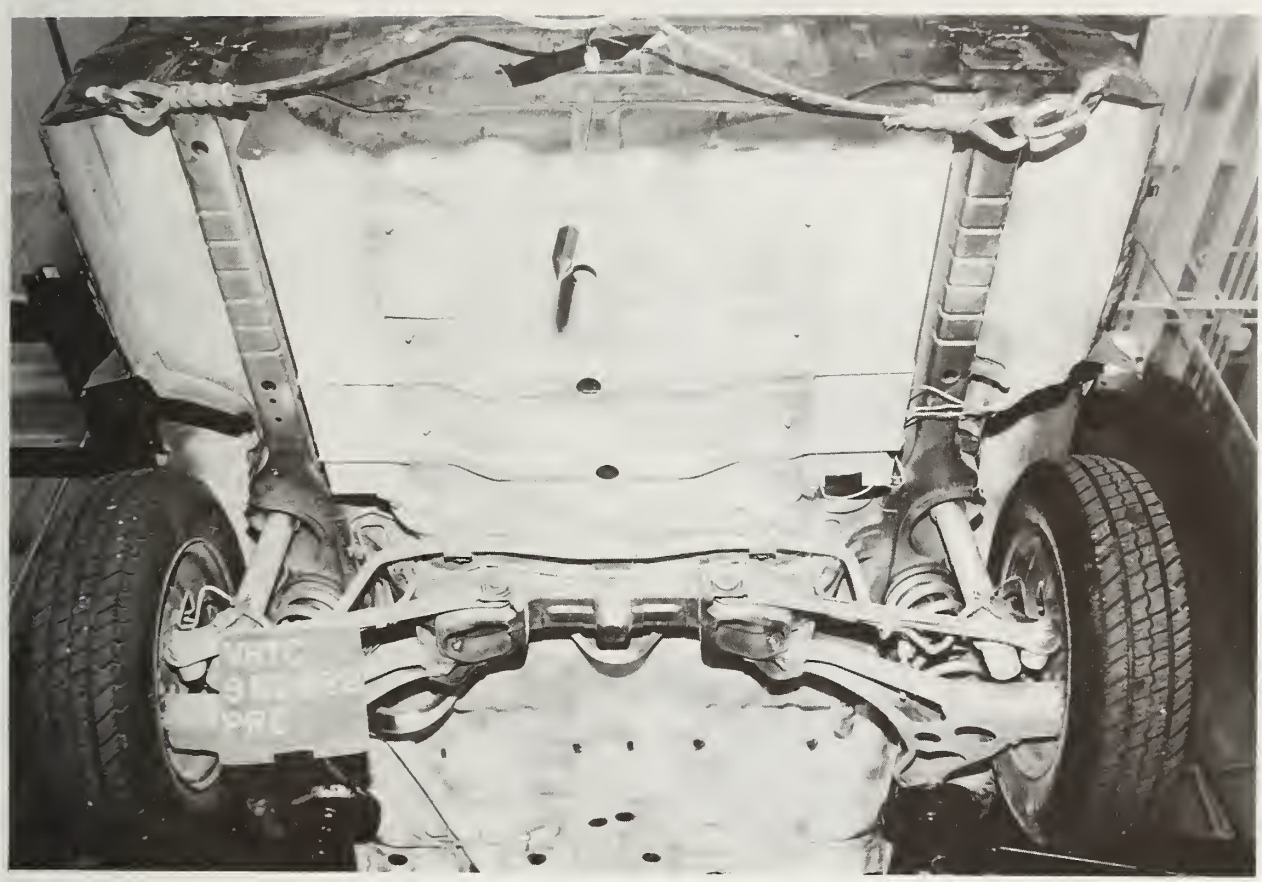


Figure A-20 Pre-test Rear Underbody View

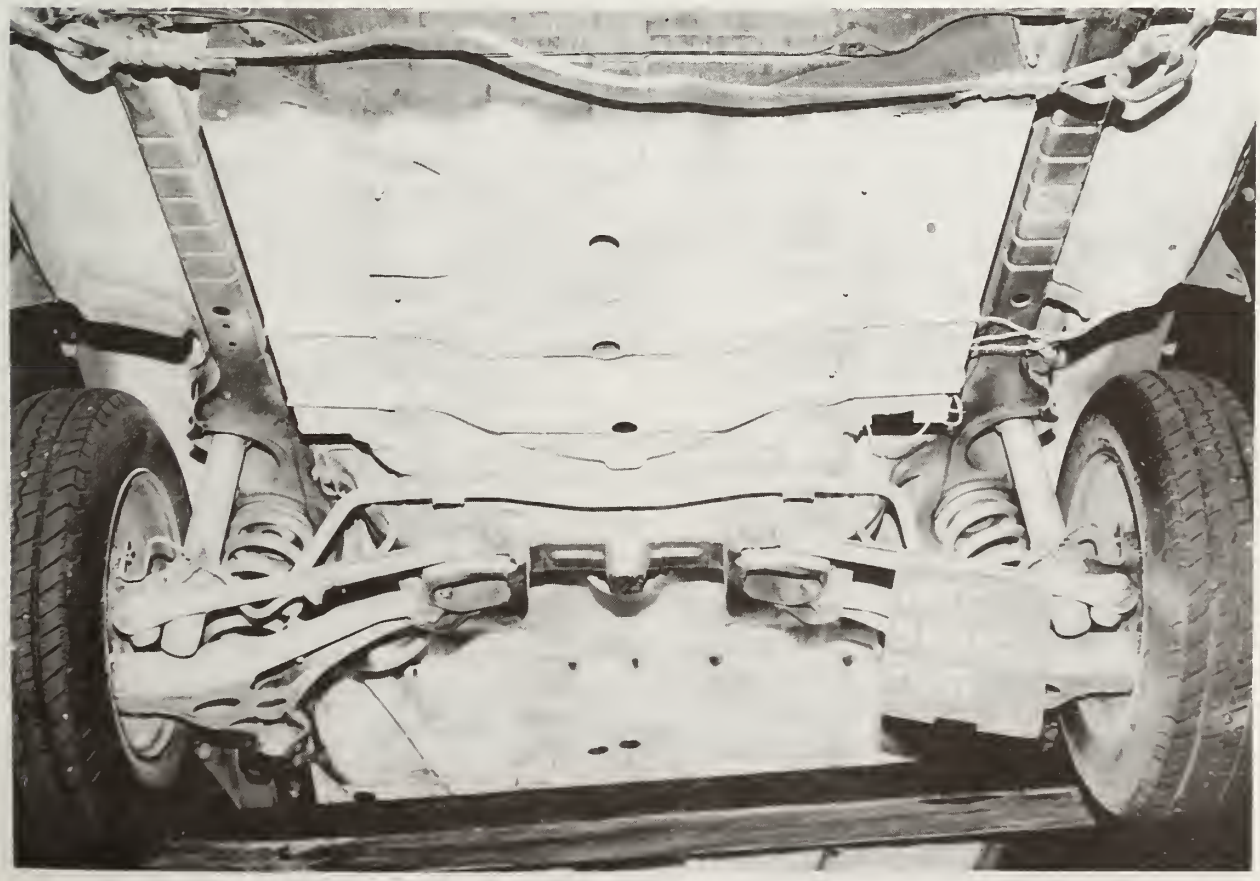


Figure A-21 Post-test Rear Underbody View

Figure A-22 Pre-test Driver Dummy Position View

Intentionally Left Blank

Figure A-23 Pre-test Passenger Dummy Position View

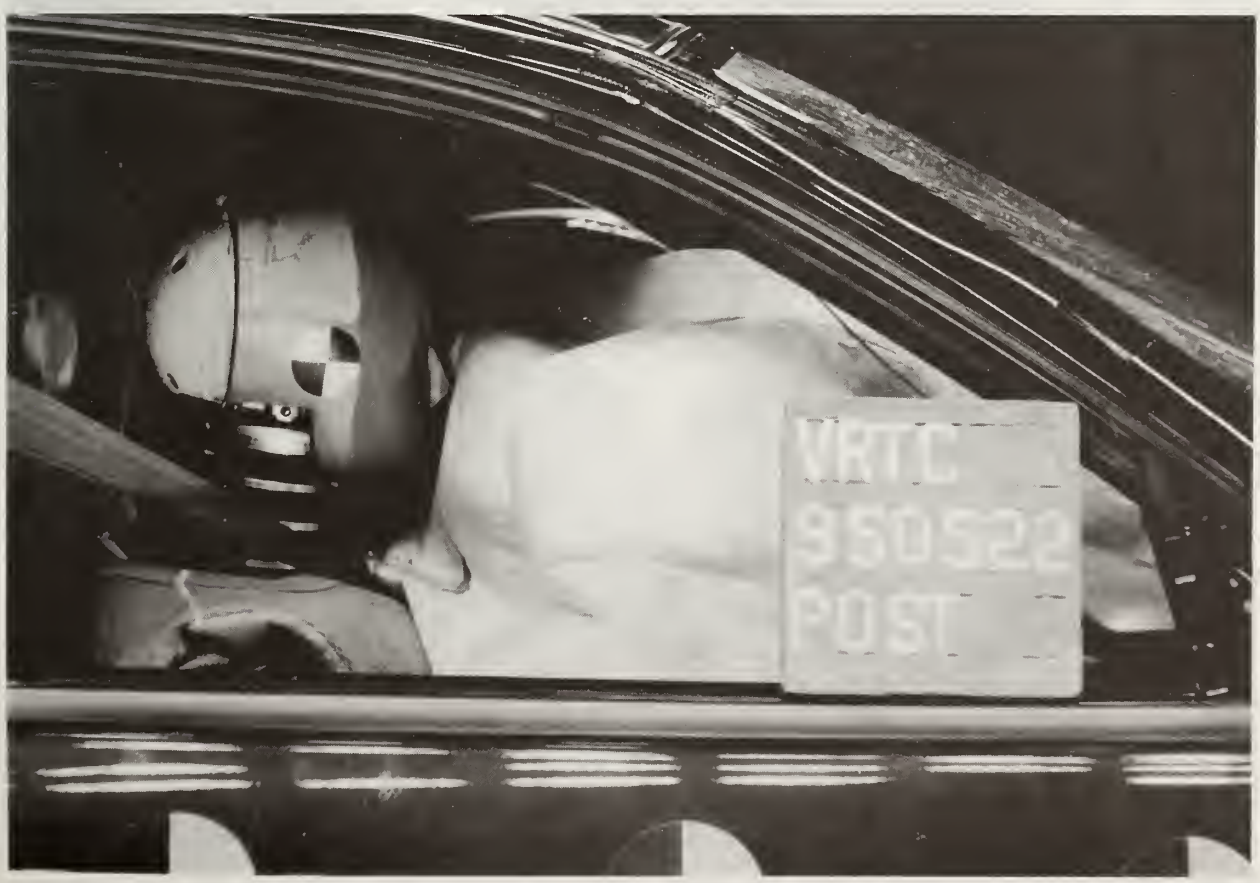


Figure A-24 Post-test Passenger Dummy Position View

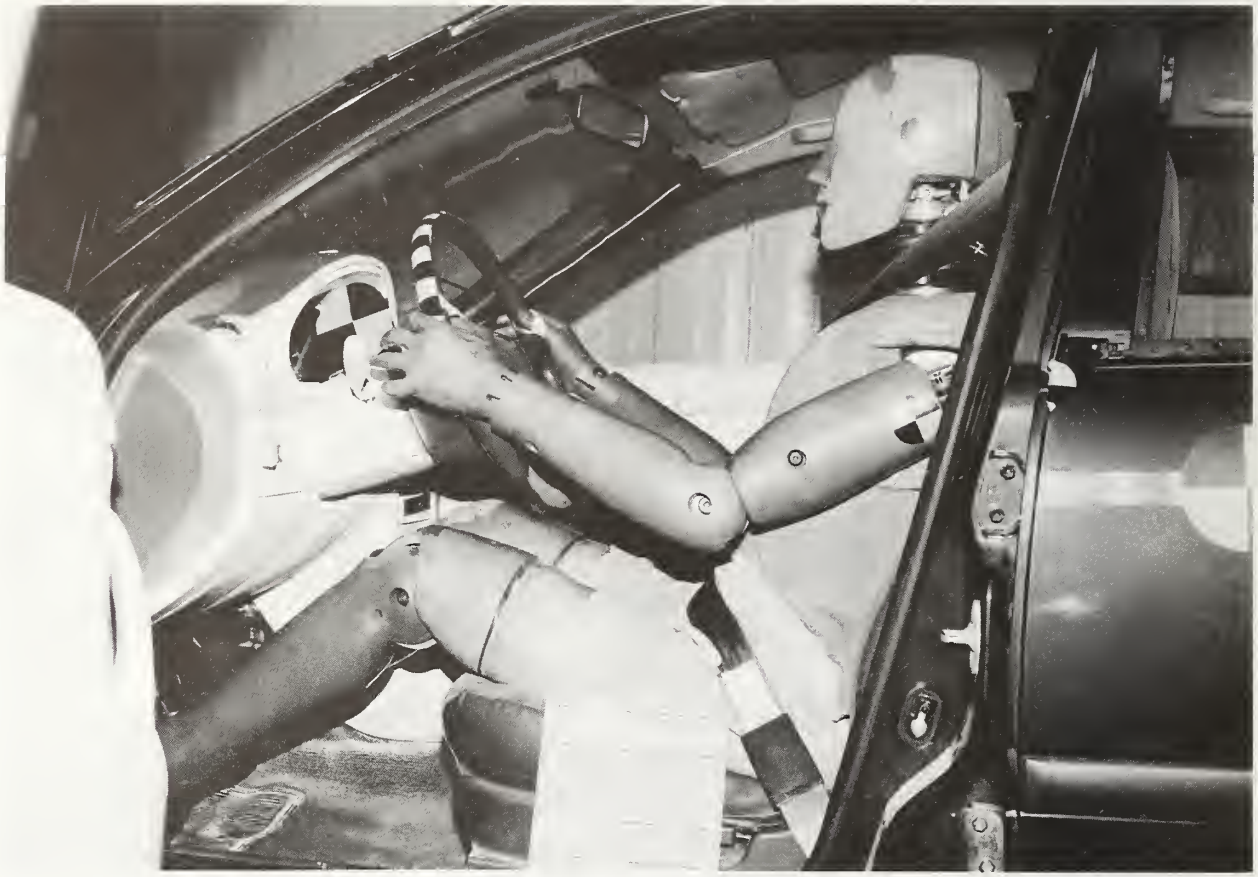


Figure A-25 Pre-test Driver Dummy and Vehicle Interior - View 1

Figure A-26 Post-test Driver Dummy and Vehicle Interior - View 1

Figure A-27 Pre-test Driver Dummy and Vehicle Interior - View 2

Figure A-28 Post-test Driver Dummy and Vehicle Interior - View 2

Figure A-29 Pre-test Passenger Dummy and Vehicle Interior - View 1

Figure A-30 Post-test Passenger Dummy and Vehicle Interior - View 1

Figure A-31 Pre-test Passenger Dummy and Vehicle Interior - View 2

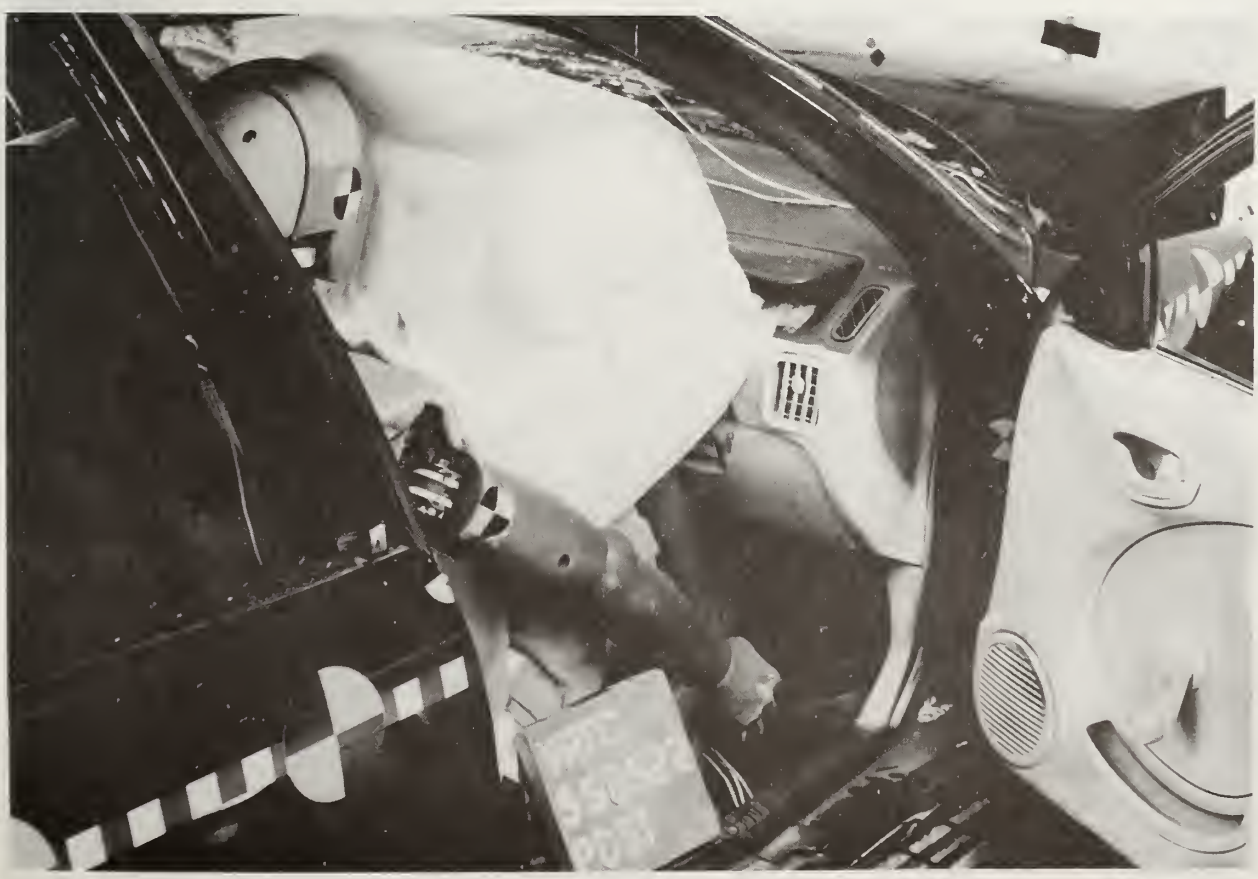


Figure A-32 Post-test Passenger Dummy and Vehicle Interior - View 2

Figure A-33 Pre-test Driver Dummy's Knee Bolster View

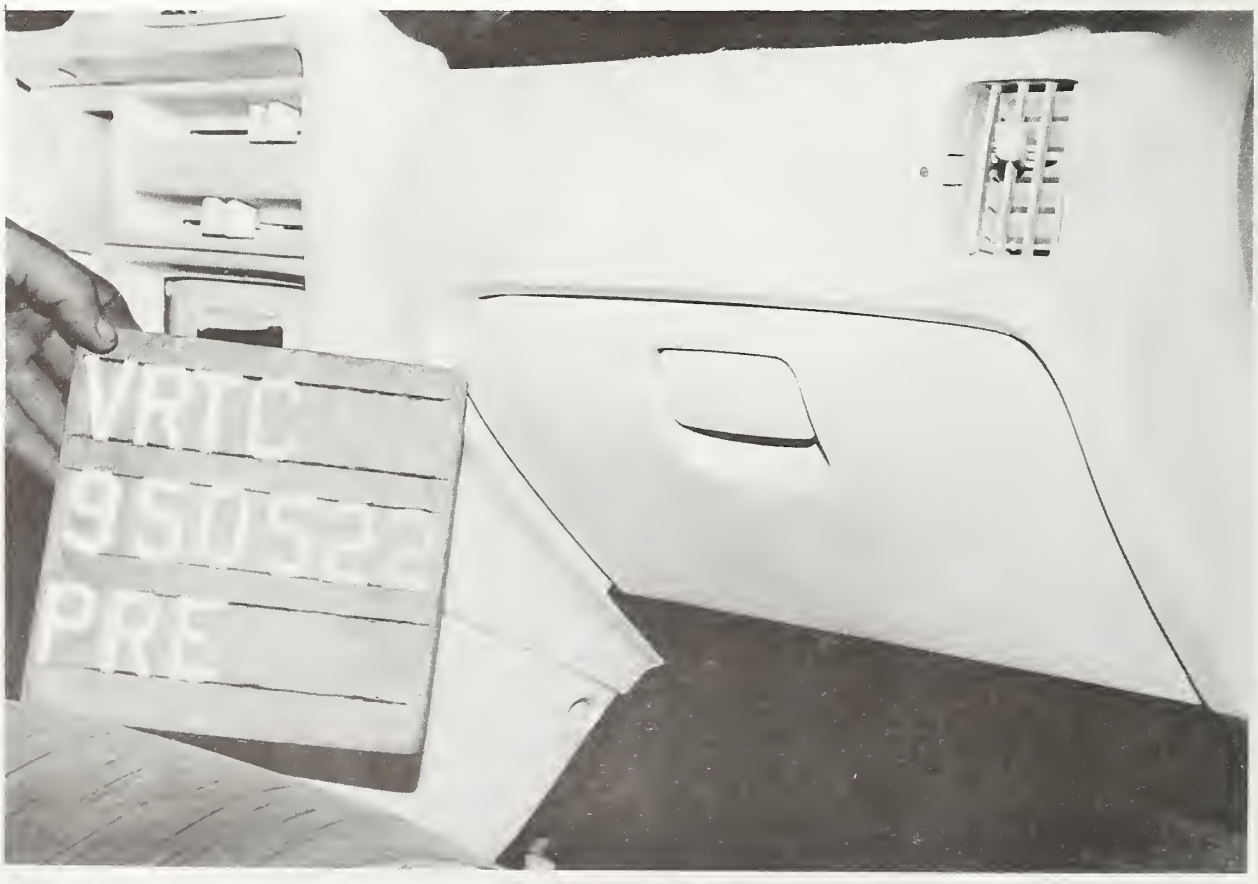


Figure A-34 Pre-test Passenger Dummy's Knee Bolster View

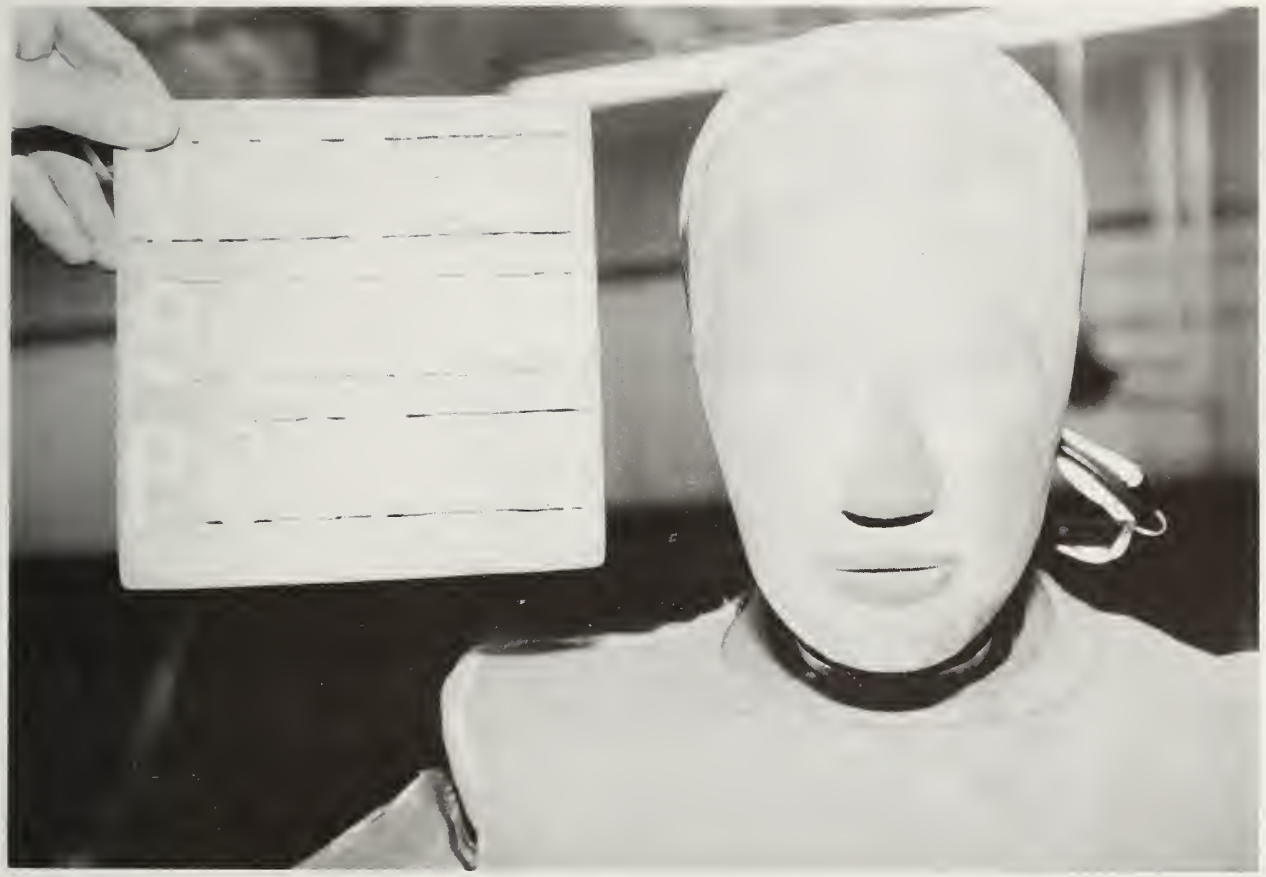


Figure A-35 Post-test Driver Dummy Head Contact - View 1

Figure A-36 Post-test Driver Dummy Head Contact - View 2

Figure A-37 Post-test Driver Dummy Knee Contact - View 1

Figure A-38 Post-test Driver Dummy Knee Contact - View 2

Figure A-39 Post-test Passenger Dummy Head Contact - View 1

Figure A-40 Post-test Passenger Dummy Head Contact - View 2

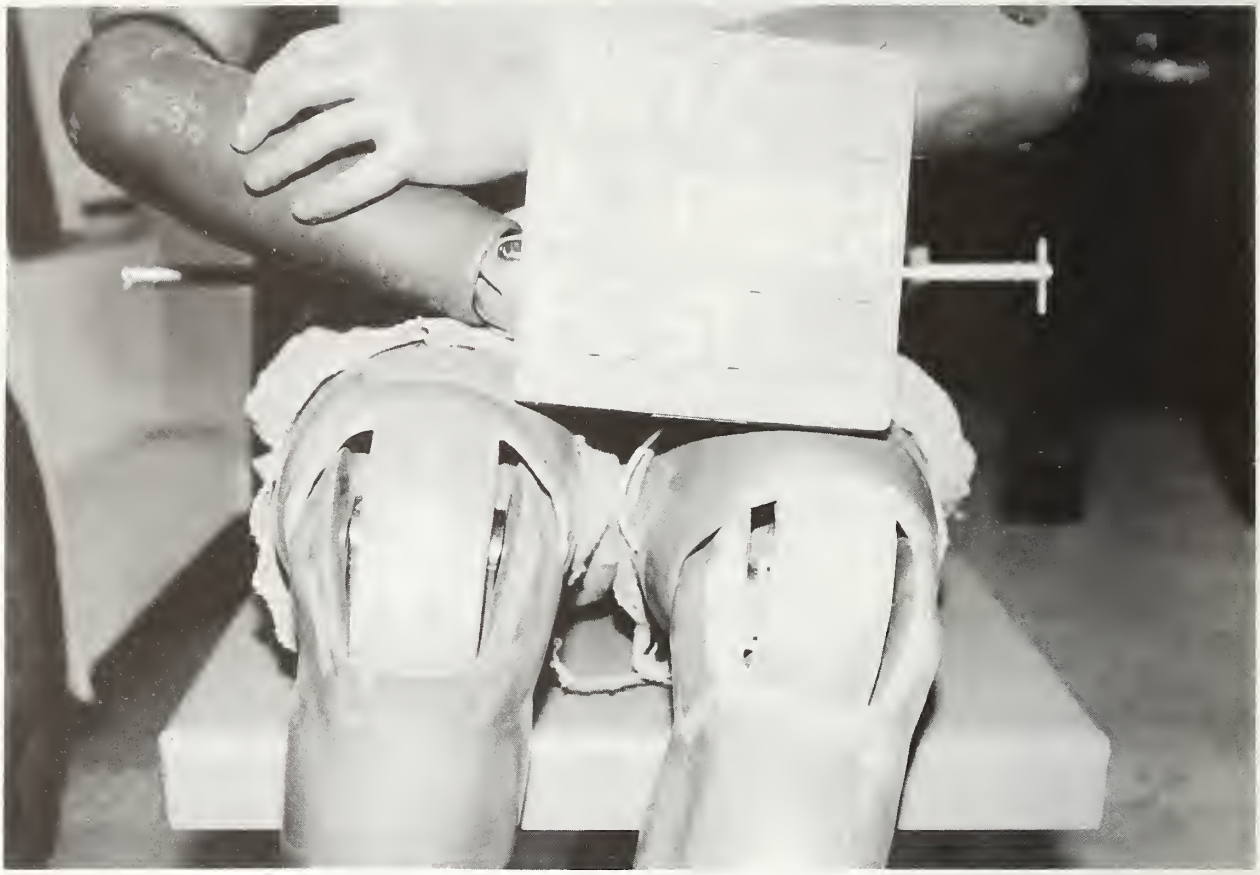


Figure A-41 Post-test Passenger Dummy Knee Contact - View 1

Figure A-42 Post-test Passenger Dummy Knee Contact - View 2

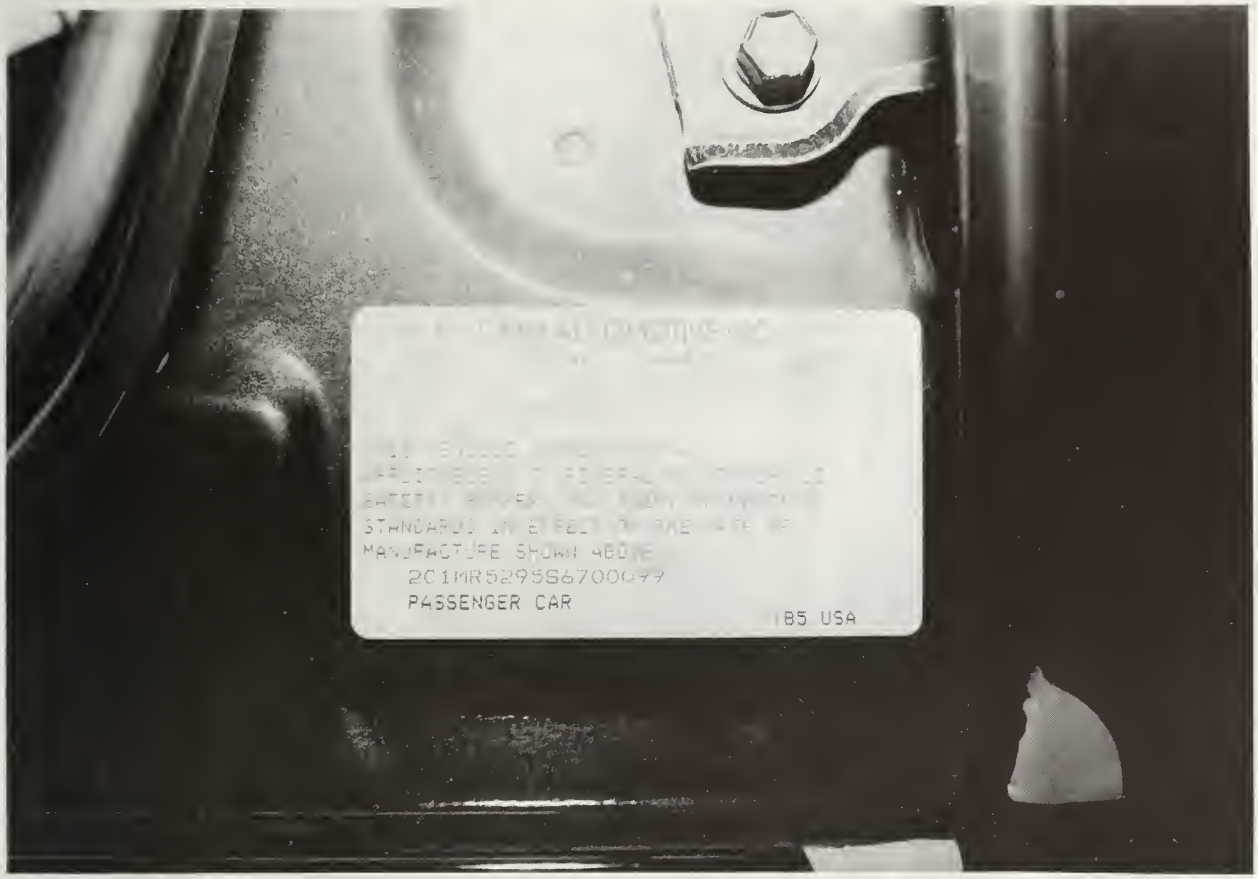


Figure A-43 Pre-test Vehicle Certification Label

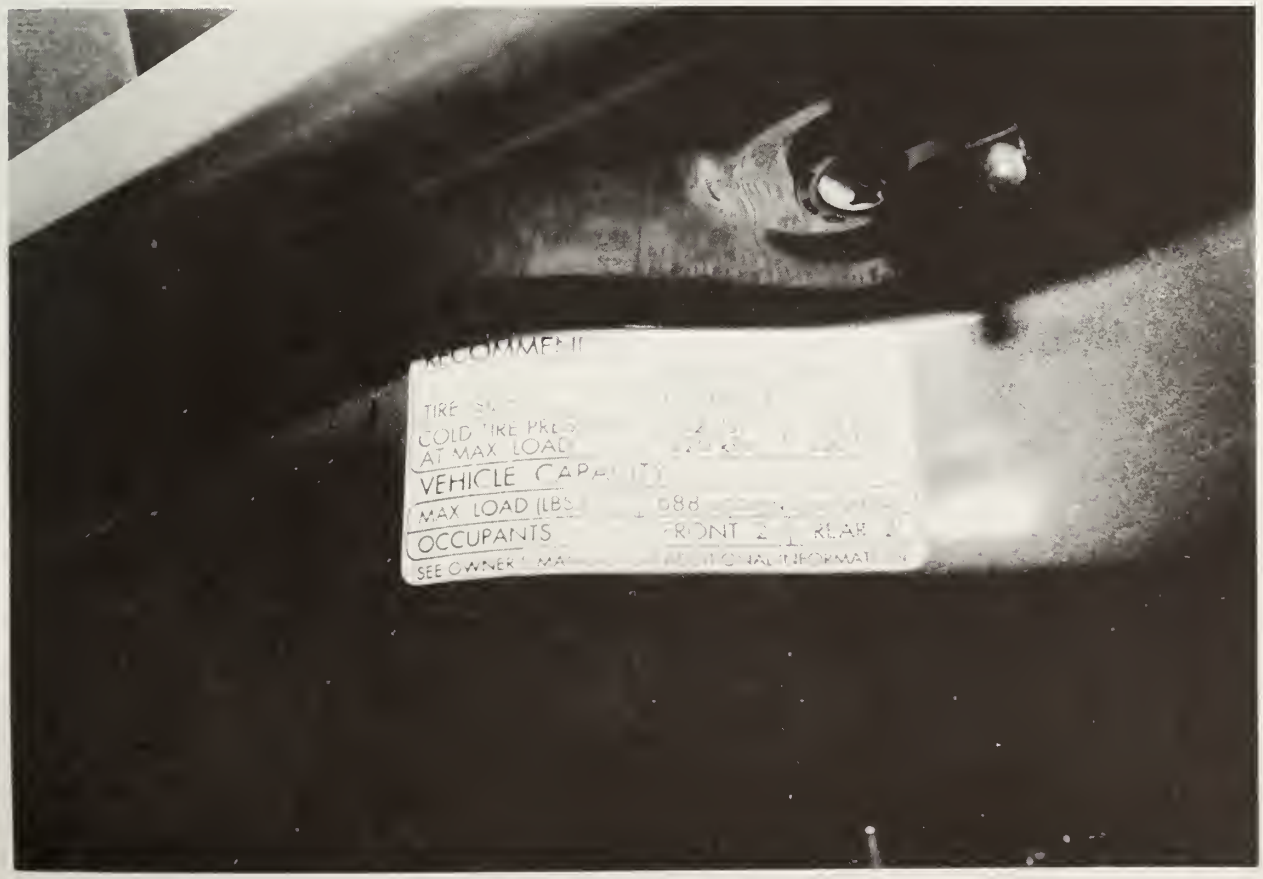


Figure A-44 Pre-test Recommended Tire Pressure Label

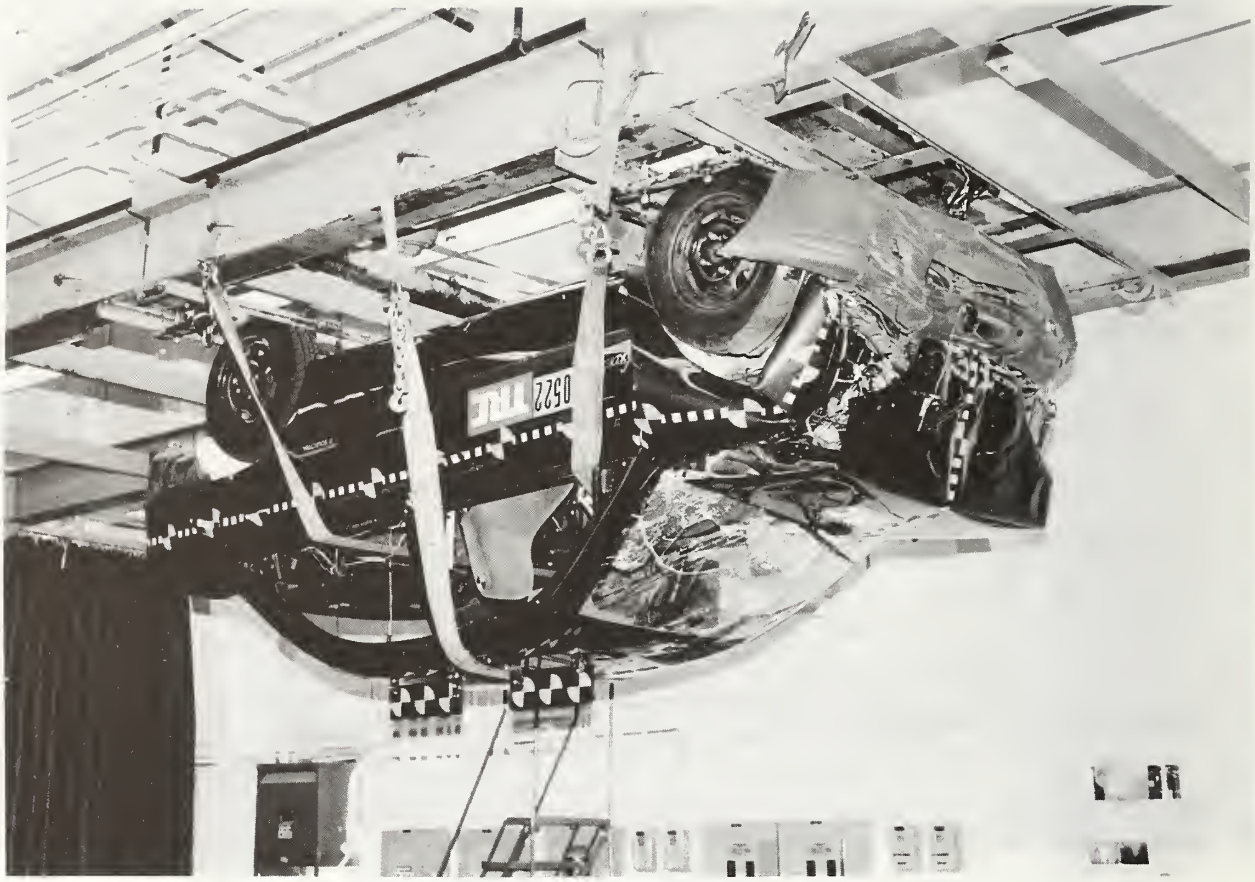
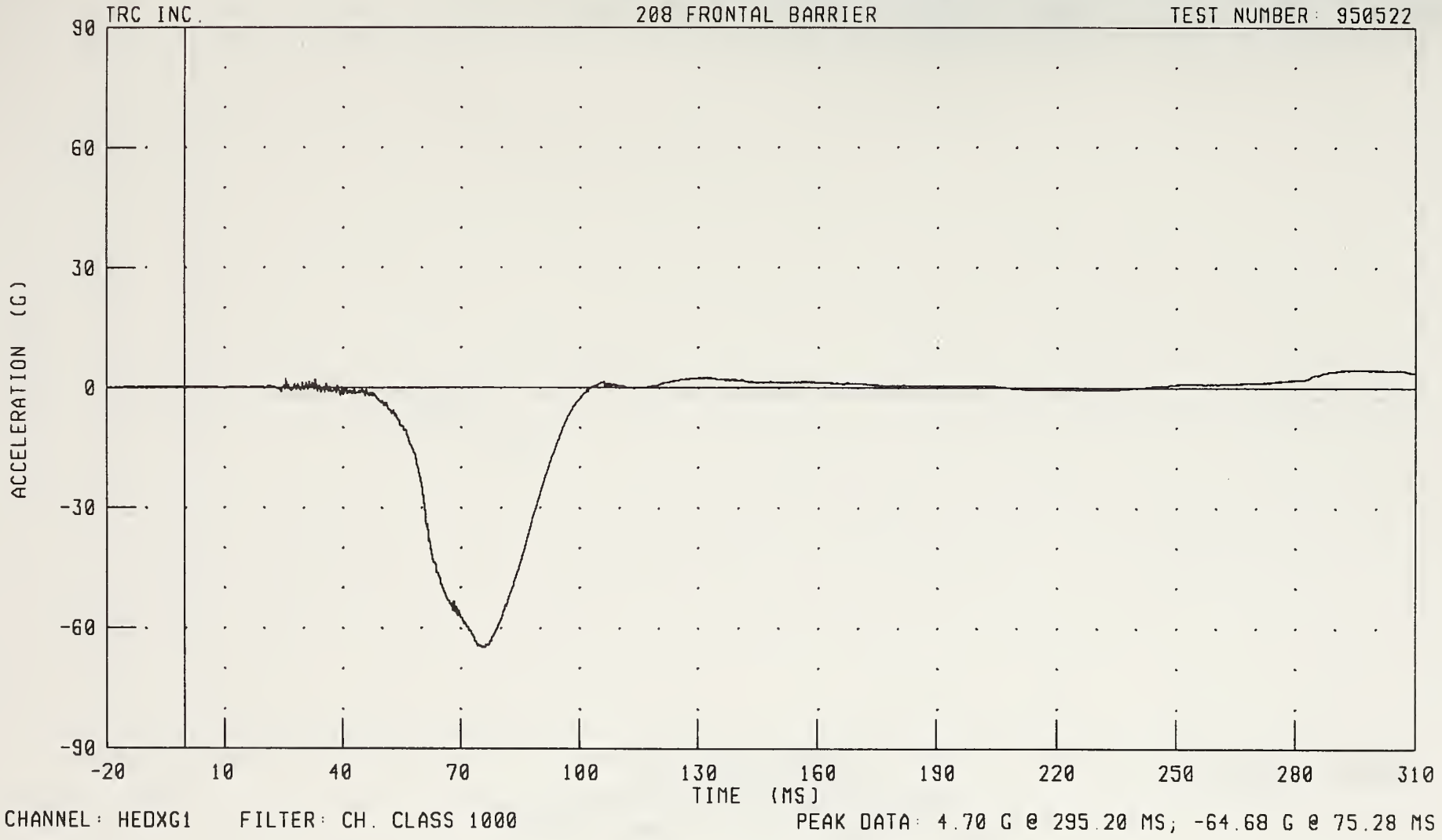


Figure A-45 Post-test Vehicle on Static Rollover Machine View

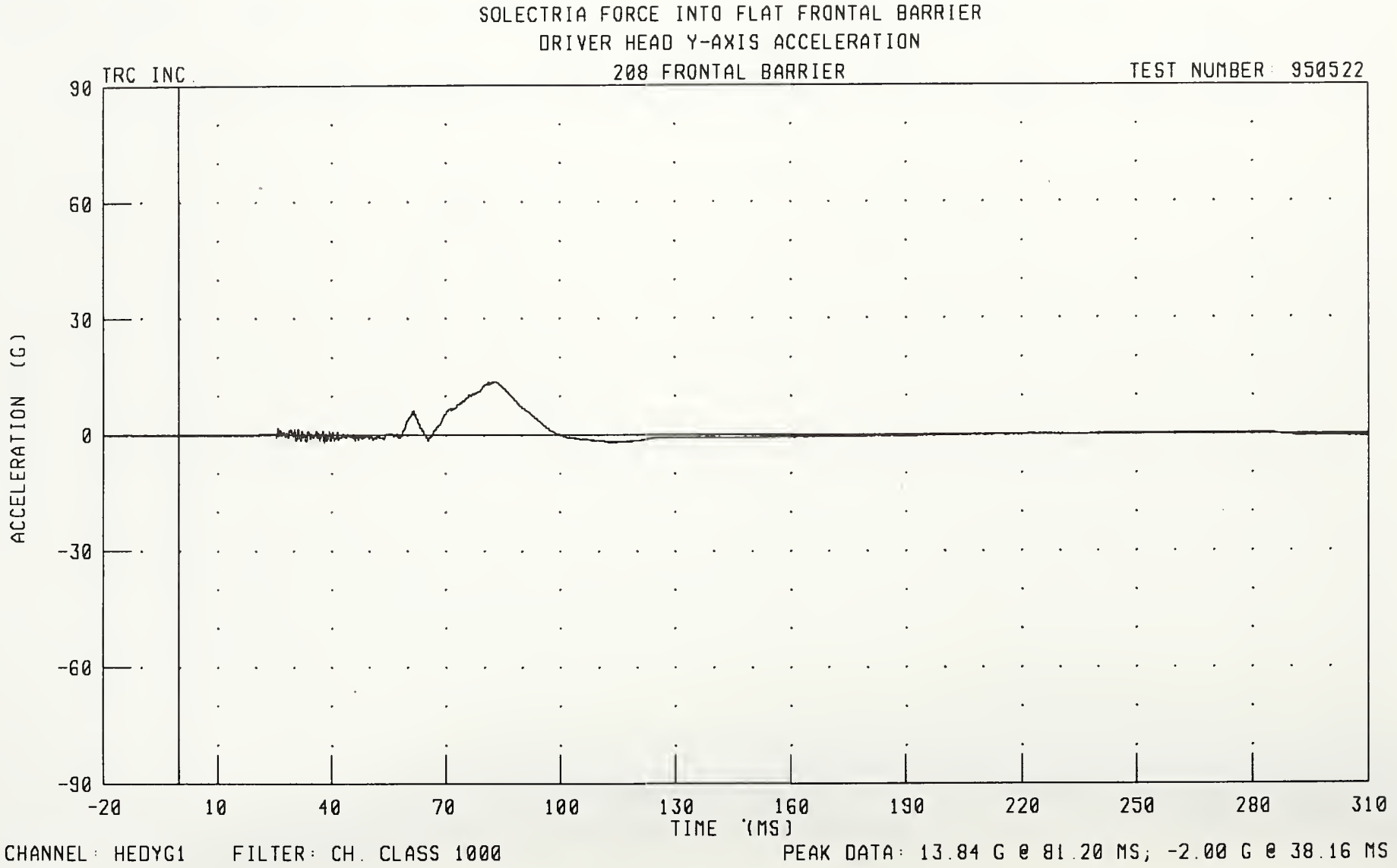
Pre-test Certification Data

Passenger Dummy S/N: 177

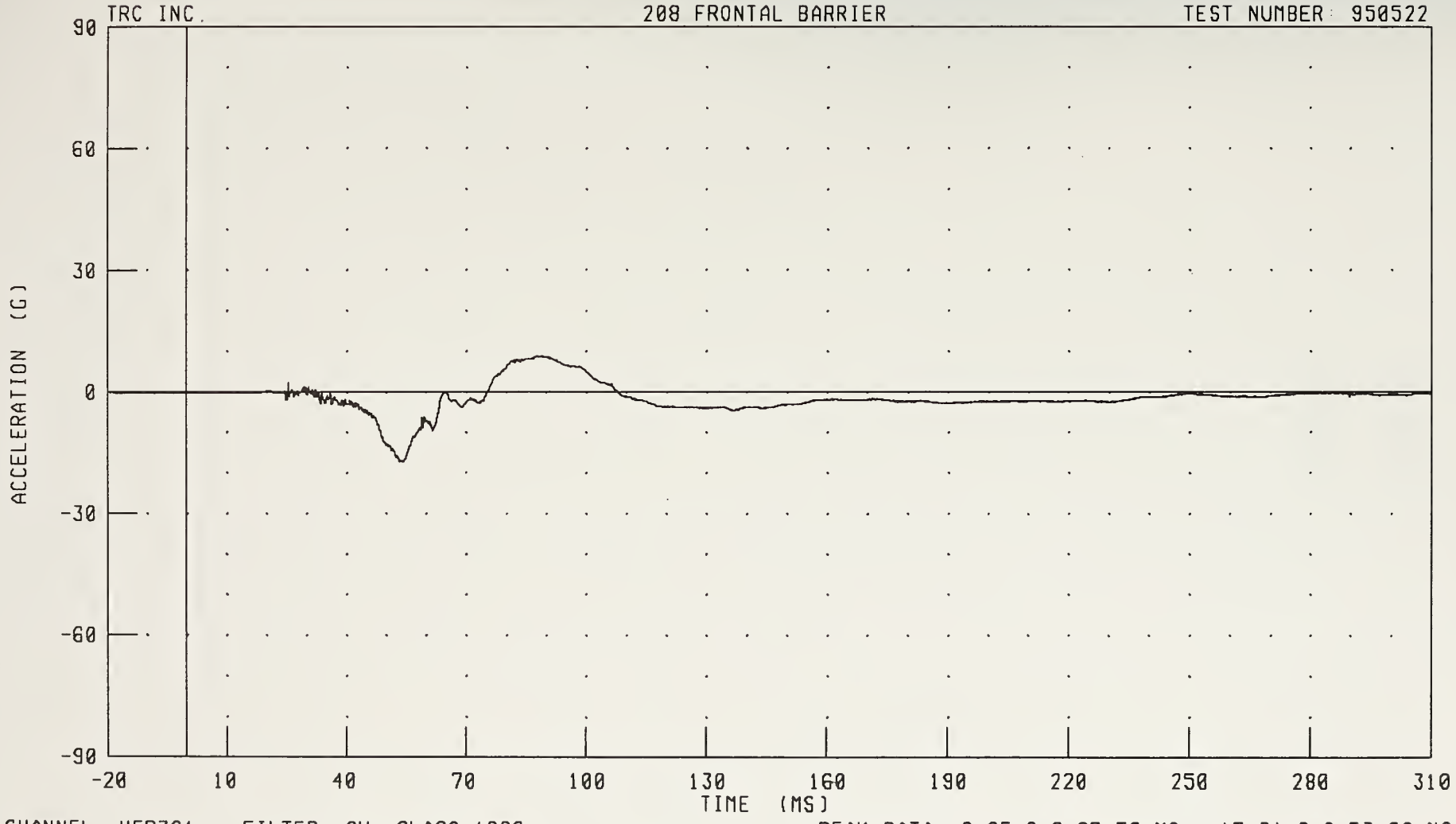
SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER HEAD X-AXIS ACCELERATION



CHANNEL: HEDXG1 FILTER: CH. CLASS 1000 PEAK DATA: 4.70 G @ 295.20 MS; -64.68 G @ 75.28 MS


SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER HEAD Y-AXIS ACCELERATION
208 FRONTAL BARRIER
TRC INC.
TEST NUMBER: 950522
ACCELERATION (G)
90
60
30
0
-30
-60
-90
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: HEDYG1
FILTER: CH. CLASS 1000
PEAK DATA: 13.84 G @ 81.20 MS; -2.00 G @ 38.16 MS

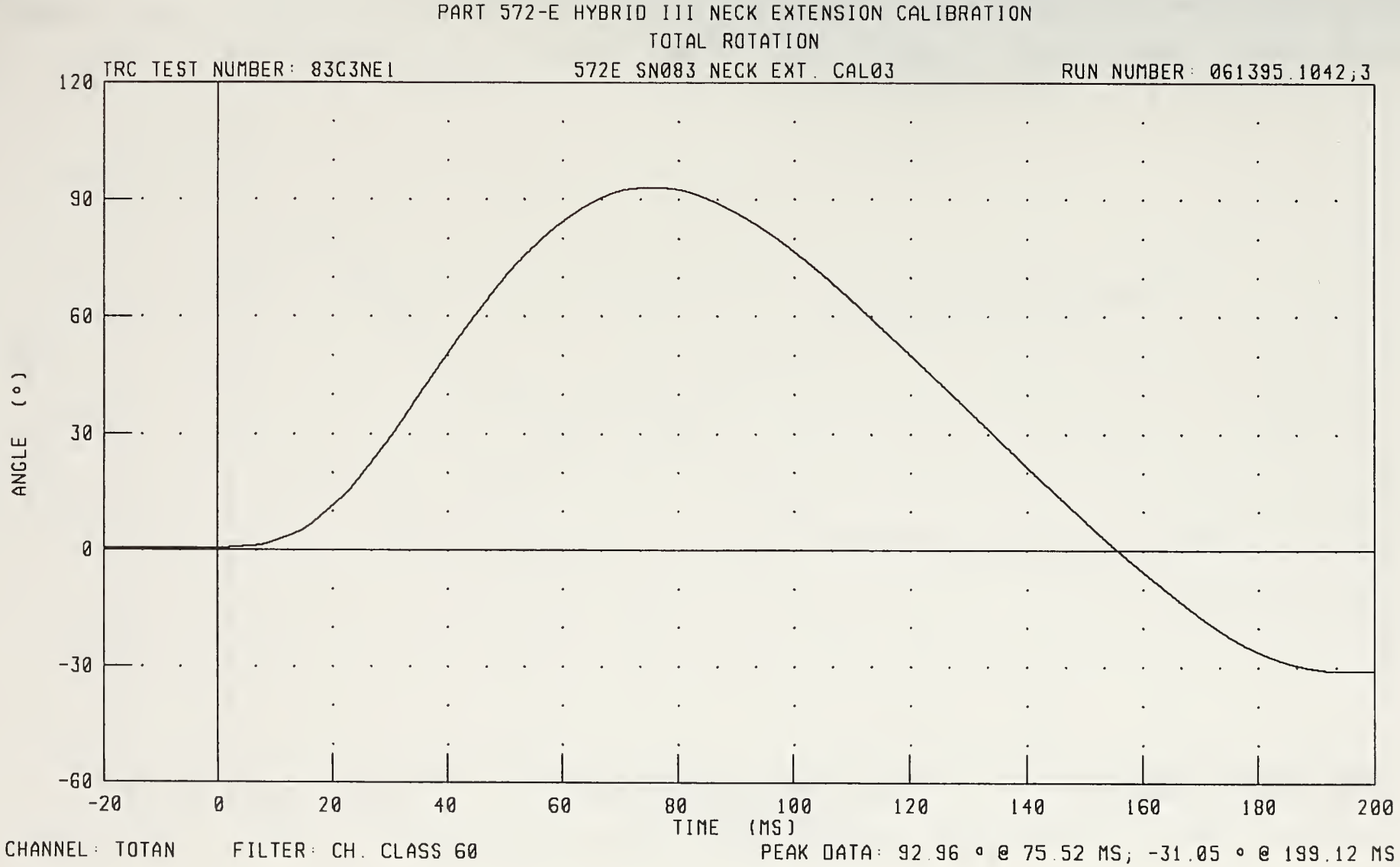
SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER HEAD Z-AXIS ACCELERATION

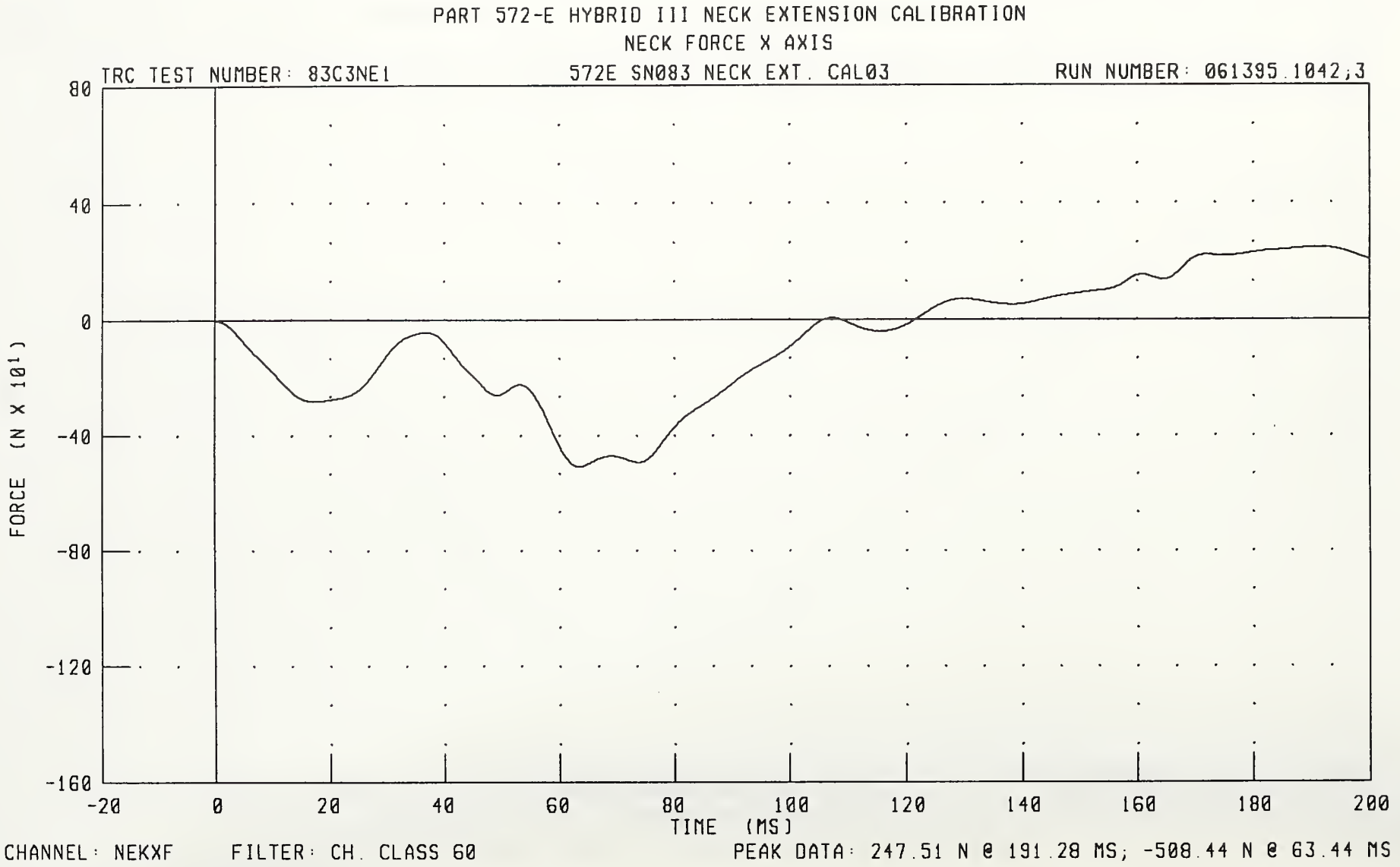


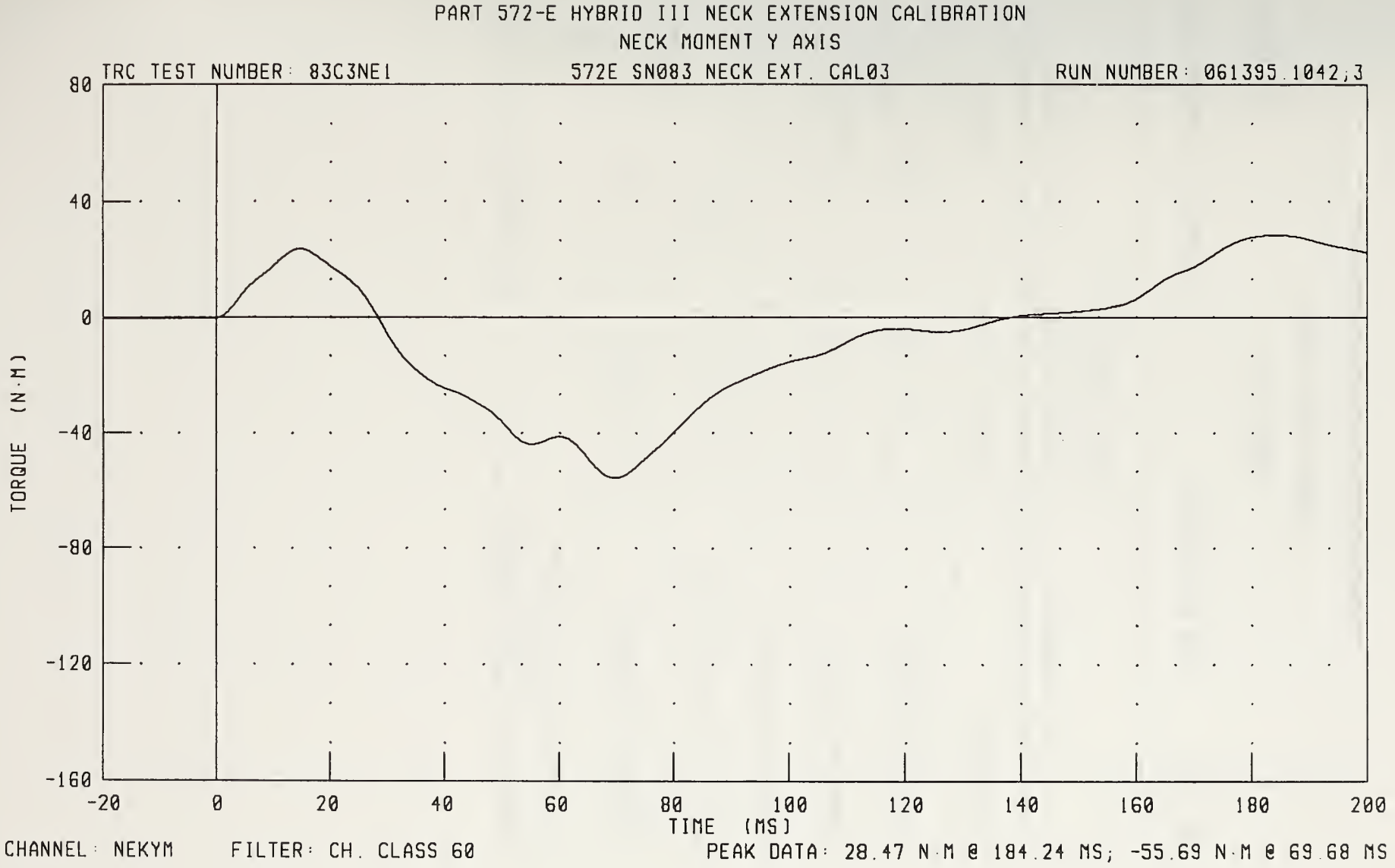
CHANNEL: HEDZG1 FILTER: CH. CLASS 1000 PEAK DATA: 8.85 G @ 87.52 MS; -17.21 G @ 53.28 MS

Appendix B

Data Plots


PART 572-E HYBRID III NECK EXTENSION CALIBRATION
TOTAL ROTATION
TRC TEST NUMBER: 83C3NE1
572E SN083 NECK EXT. CAL03
RUN NUMBER: 061395.1042;3
120
90
60
30
0
-30
-60
ANGLE (°)
-20
0
20
40
60
80
100
120
140
160
180
200
TIME (MS)
CHANNEL: TOTAN
FILTER: CH. CLASS 60
PEAK DATA: 92.96 ° @ 75.52 MS; -31.05 ° @ 199.12 MS


PART 572-E HYBRID III NECK EXTENSION CALIBRATION
NECK FORCE X AXIS
TRC TEST NUMBER: 83C3NE1
572E SN083 NECK EXT. CAL03
RUN NUMBER: 061395.1042;3
80
40
0
-40
-80
-120
-160
FORCE (N X 10¹)
-20
0
20
40
60
80
100
120
140
160
180
200
TIME (MS)
CHANNEL: NEKXF
FILTER: CH. CLASS 60
PEAK DATA: 247.51 N @ 191.28 MS; -508.44 N @ 63.44 MS


PART 572-E HYBRID III NECK EXTENSION CALIBRATION
NECK MOMENT Y AXIS
TRC TEST NUMBER: 83C3NE1
572E SN083 NECK EXT. CAL03
RUN NUMBER: 061395.1042;3
80
40
0
-40
-80
-120
-160
TORQUE (N·M)
-20
0
20
40
60
80
100
120
140
160
180
200
TIME (MS)
CHANNEL: NEKYM
FILTER: CH. CLASS 60
PEAK DATA: 28.47 N·M @ 184.24 MS; -55.69 N·M @ 69.68 MS

TRANSPORTATION RESEARCH CENTER INC.

THORAX IMPACT TEST

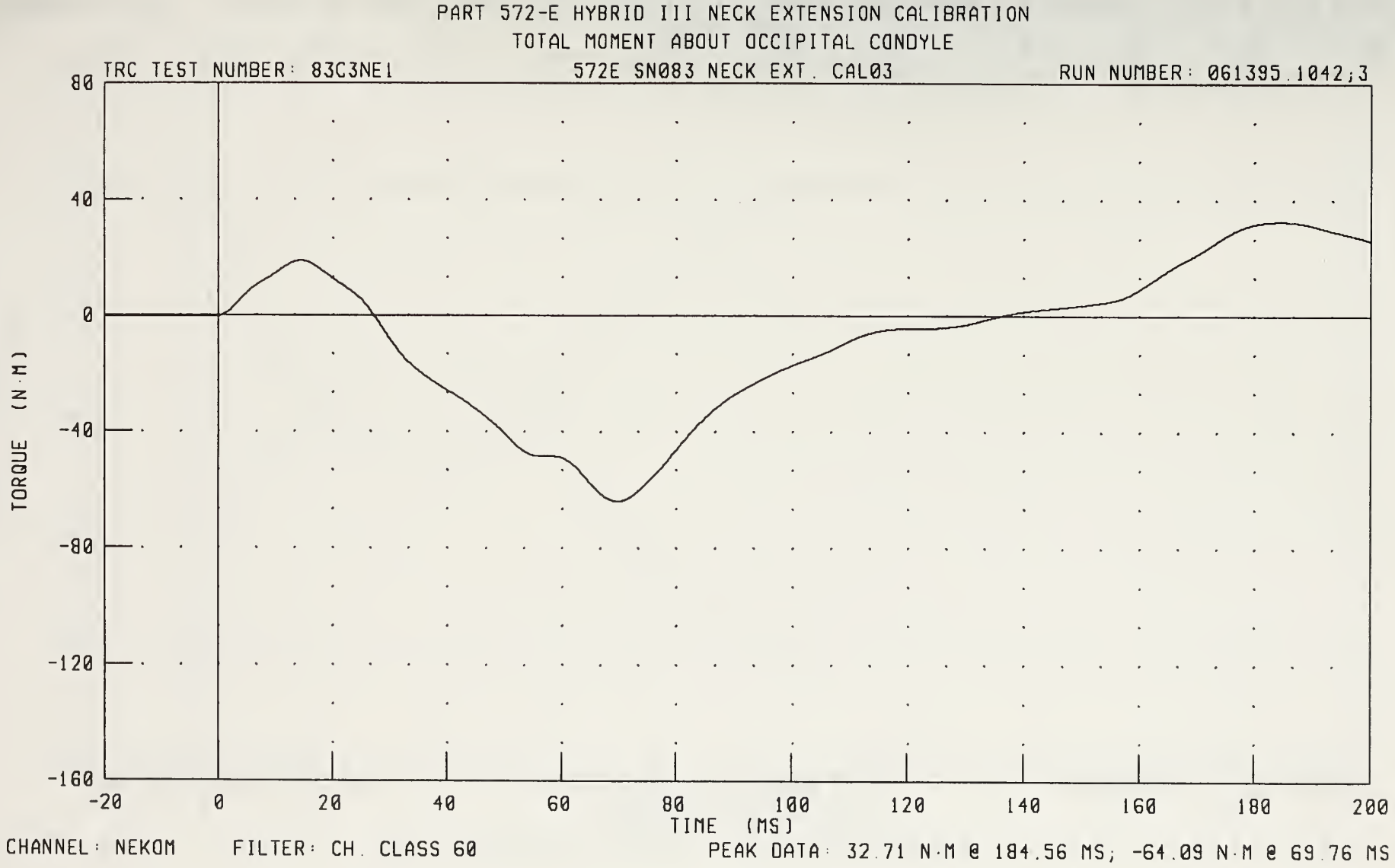
HYBRID III 18-MAY-95

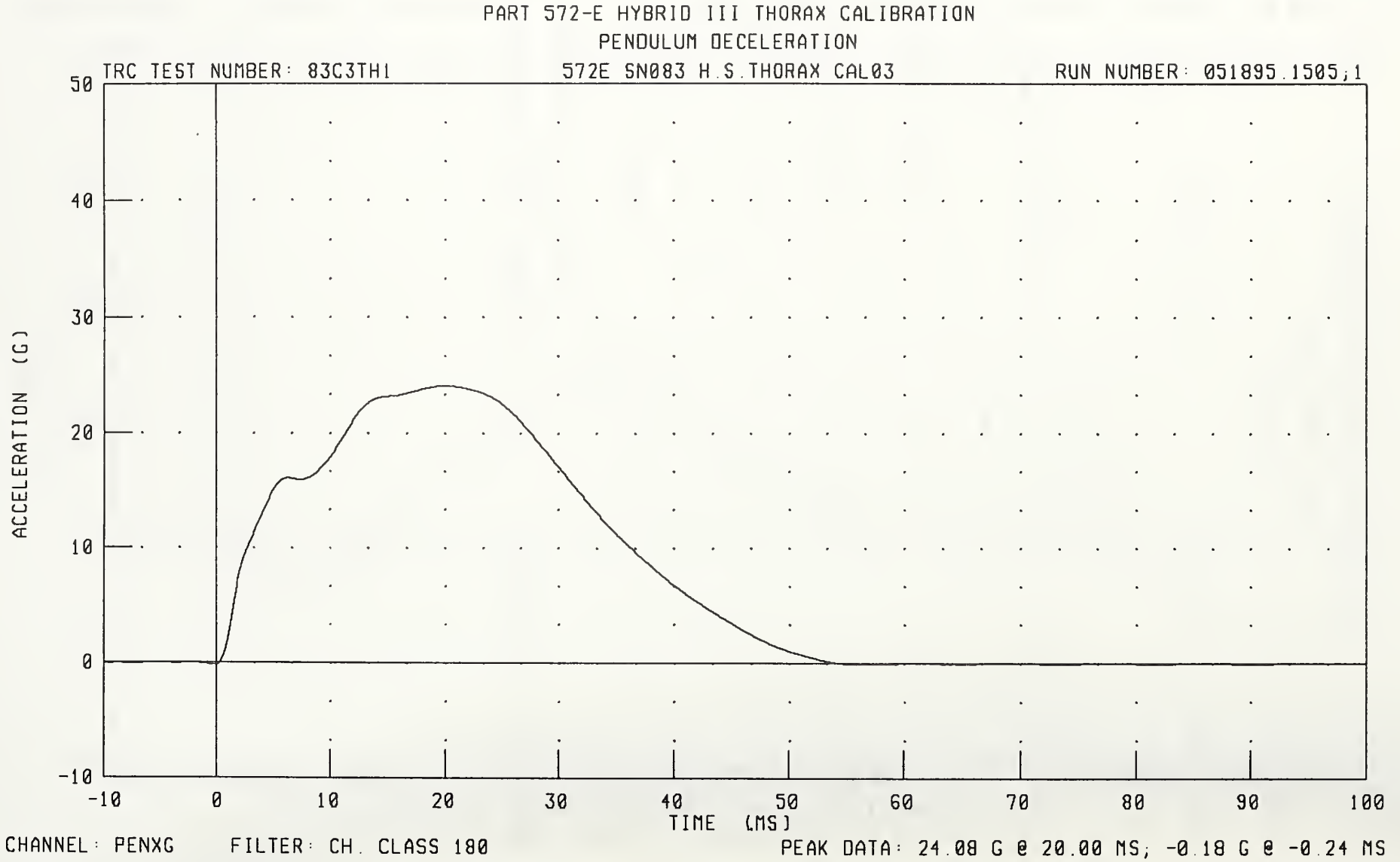
TRC INC. TEST NO: 83C3TH1 572E SN083 H.S.THORAX CAL03

TEST PARAMETER	HIGH SPEED TEST SPECIFICATION	TEST RESULTS
TEMPERATURE	20.6-22.2 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10 - 70 %	50.0 %
PENDULUM VELOCITY	6.59 - 6.83 M/S	6.68 M/S
MAXIMUM DEFLECTION	63.5 - 72.6 MM	66.7 MM
MAXIMUM RESISTIVE FORCE	5159 - 5894 N	5516. N
INTERNAL HYSTERESIS	69% - 85%	72.8%

TEST MEETS SPECIFICATIONS

TECHNICIAN _____ RUN NUMBER: 051895.1505;1

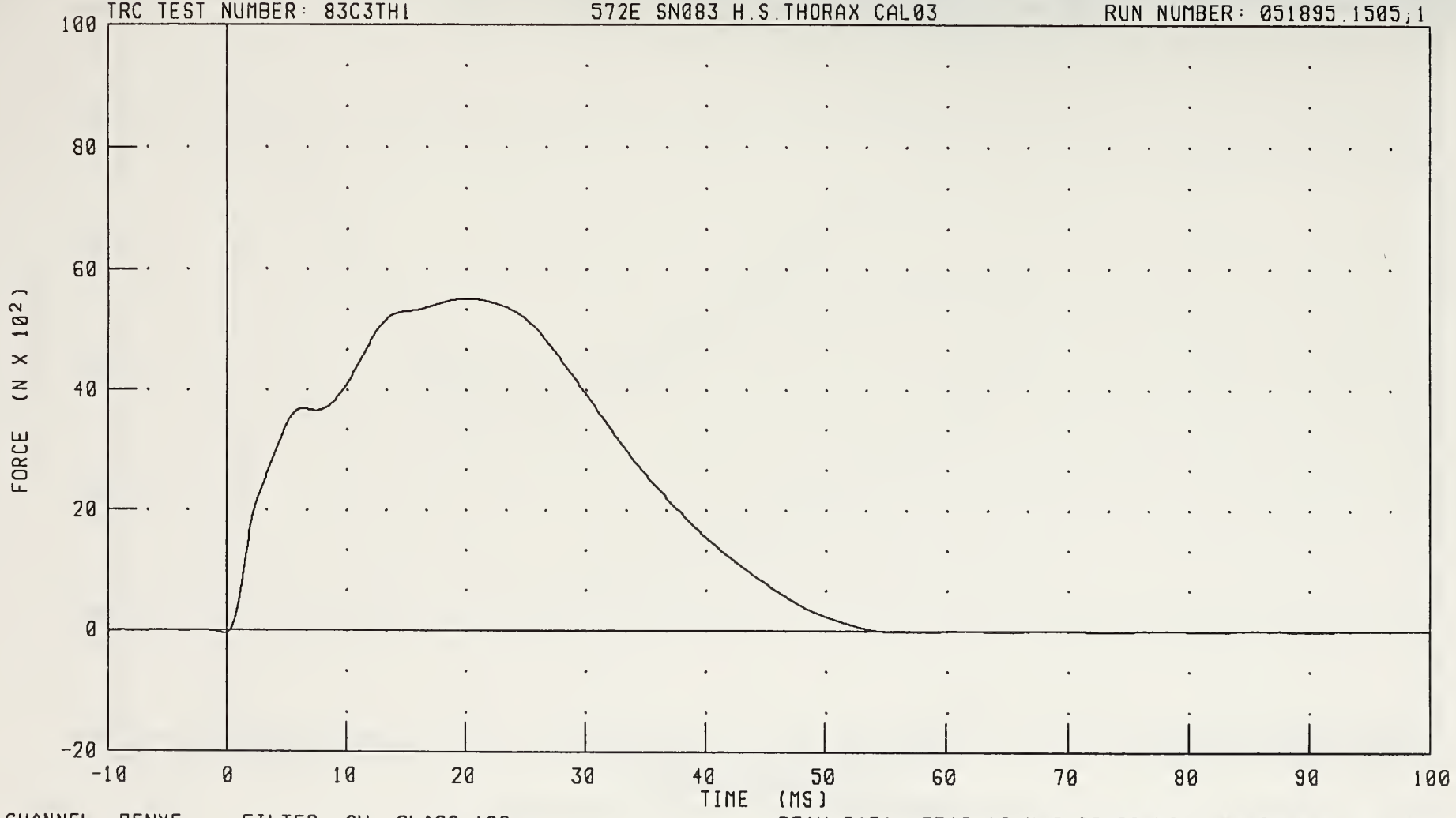

PART 572-E HYBRID III NECK EXTENSION CALIBRATION
TOTAL MOMENT ABOUT OCCIPITAL CONDYLE
TRC TEST NUMBER: 83C3NE1
572E SN083 NECK EXT. CAL03
RUN NUMBER: 061395.1042;3
80
40
0
-40
-80
-120
-160
TORQUE (N·M)
-20
0
20
40
60
80
100
120
140
160
180
200
TIME (MS)
CHANNEL: NEKOM
FILTER: CH. CLASS 60
PEAK DATA: 32.71 N·M @ 184.56 MS; -64.09 N·M @ 69.76 MS


PART 572-E HYBRID III THORAX CALIBRATION
PENDULUM DECELERATION
TRC TEST NUMBER: 83C3TH1
572E SN083 H.S.THORAX CAL03
RUN NUMBER: 051895.1505;1
ACCELERATION (G)
50
40
30
20
10
0
-10
-10
0
10
20
30
40
50
60
70
80
90
100
TIME (MS)
CHANNEL: PENXG
FILTER: CH. CLASS 180
PEAK DATA: 24.08 G @ 20.00 MS; -0.18 G @ -0.24 MS

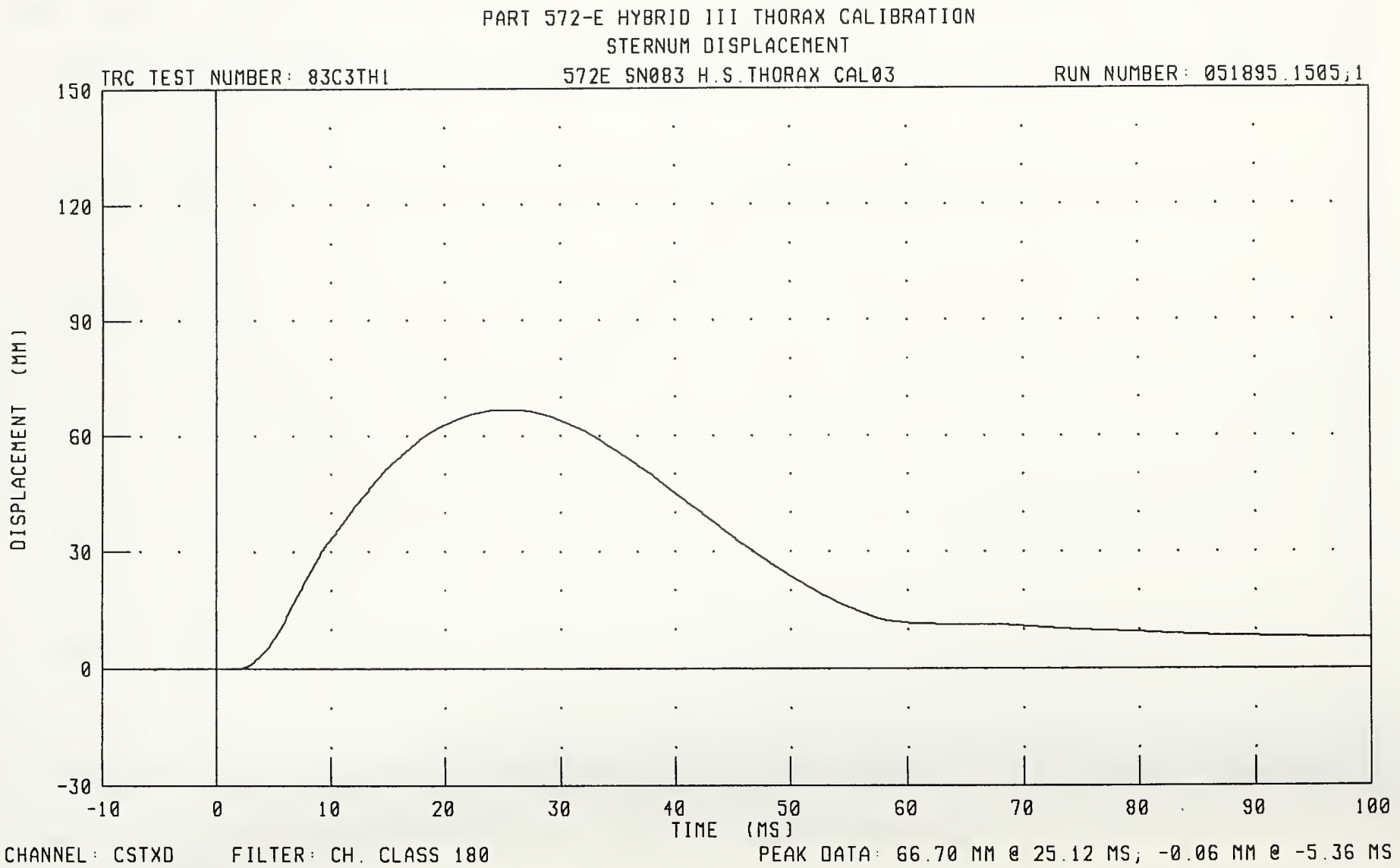
PART 572-E HYBRID III THORAX CALIBRATION

PENDULUM FORCE

TRC TEST NUMBER: 83C3TH1 572E SN083 H.S.THORAX CAL03 RUN NUMBER: 051895.1505;1

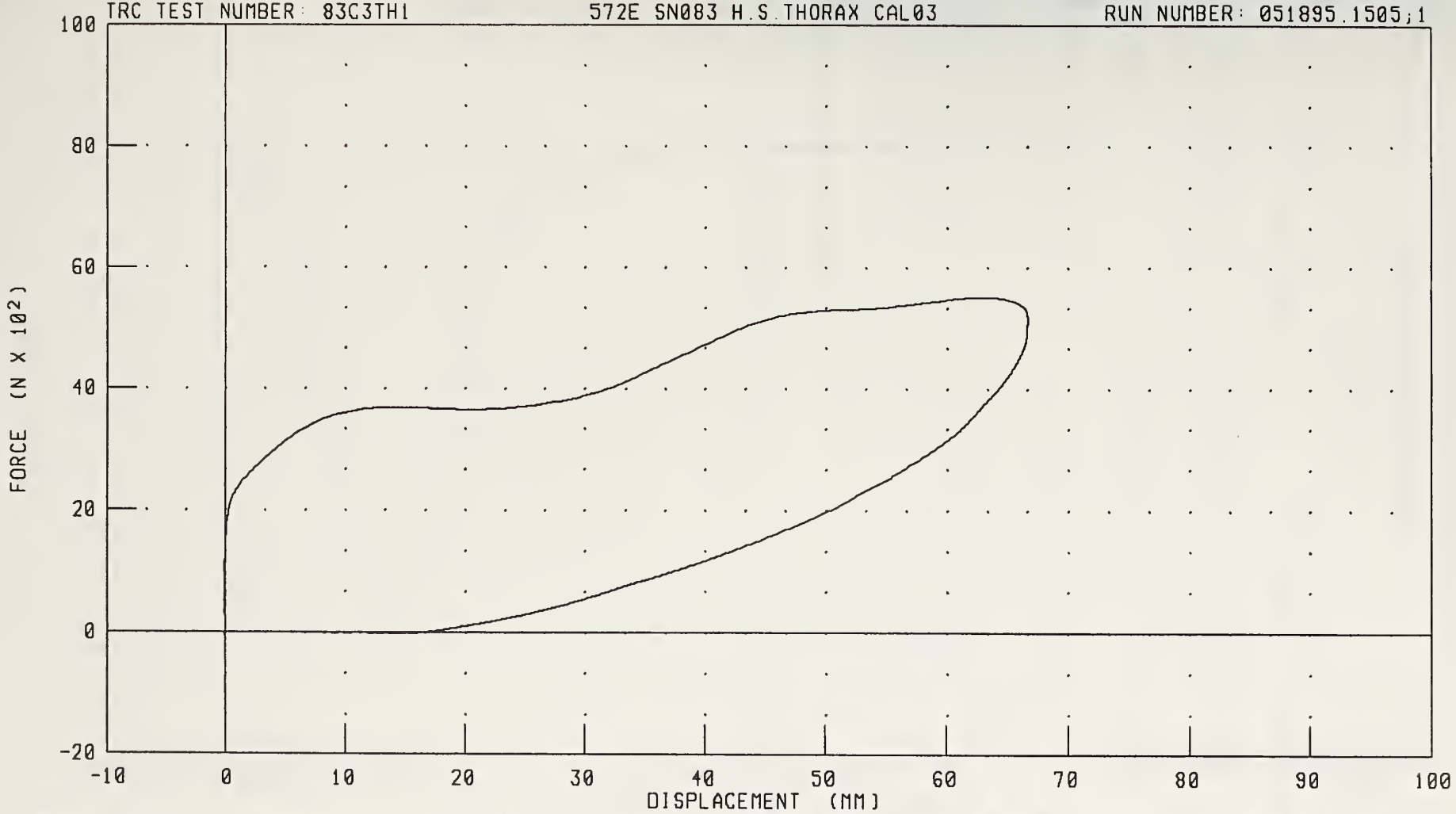


CHANNEL: PENXF FILTER: CH. CLASS 180 PEAK DATA: 5516.16 N @ 20.00 MS; -41.04 N @ -0.24 MS


PART 572-E HYBRID III THORAX CALIBRATION
STERNUM DISPLACEMENT
TRC TEST NUMBER: 83C3TH1
572E SN083 H.S.THORAX CAL03
RUN NUMBER: 051895.1505;1
DISPLACEMENT (MM)
150
120
90
60
30
0
-30
-10
0
10
20
30
40
50
60
70
80
90
100
TIME (MS)
CHANNEL: CSTXD
FILTER: CH. CLASS 180
PEAK DATA: 66.70 MM @ 25.12 MS; -0.06 MM @ -5.36 MS

PART 572-E HYBRID III THORAX CALIBRATION
CHEST DISPLACEMENT VS PENDULUM FORCE

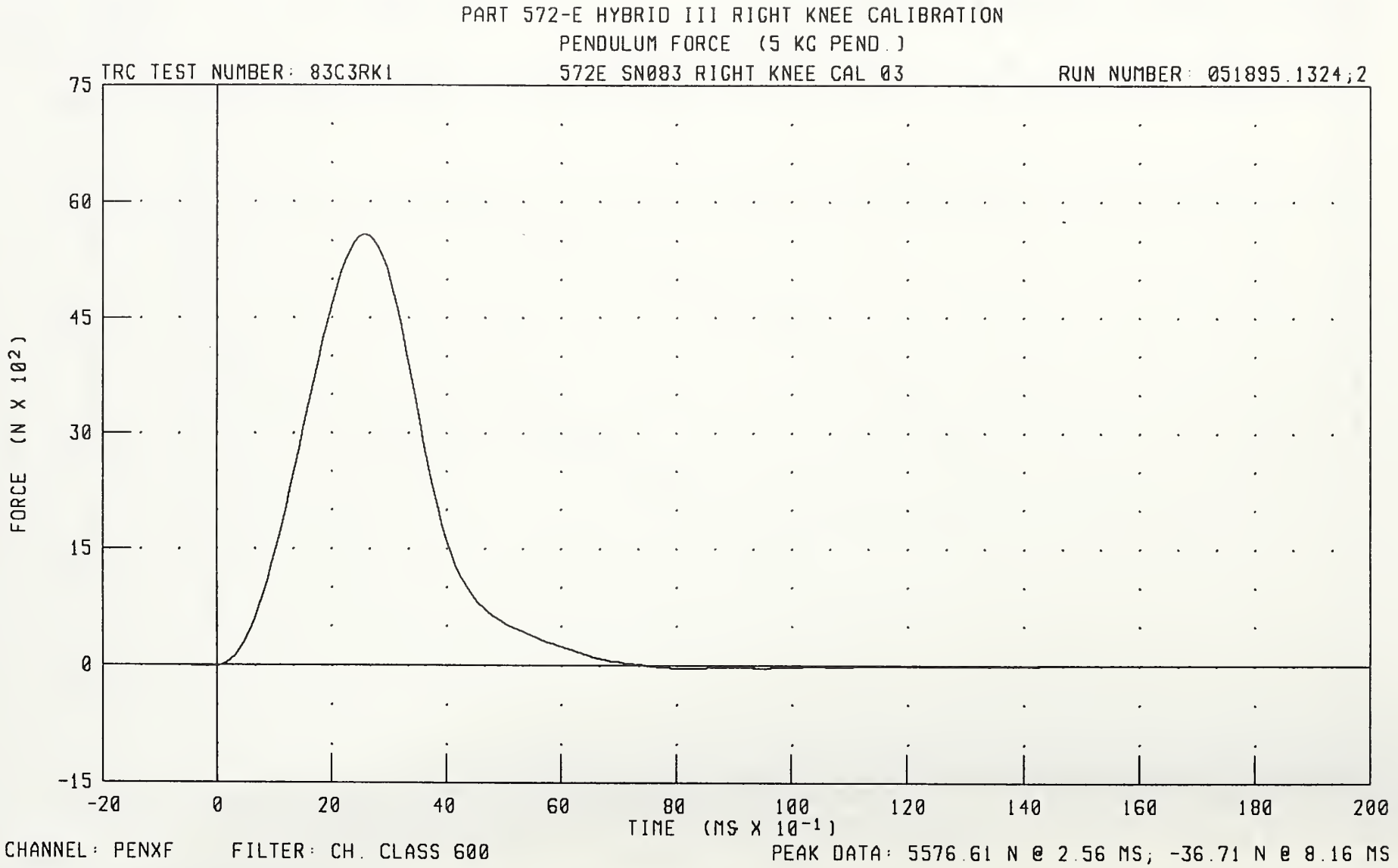
TRC TEST NUMBER: 83C3THI
572E SN083 H.S.THORAX CAL03
RUN NUMBER: 051895.1505;1



CHANNEL: CSTXD
PENXF

FILTER: CH. CLASS 180
CH. CLASS 180

PEAK DATA: 66.70 MM @ 25.12 MS; -0.06 MM @ -5.36 MS
5516.16 N @ 20.00 MS; -41.04 N @ -0.24 MS


PART 572-E HYBRID III RIGHT KNEE CALIBRATION
PENDULUM FORCE (5 KG PEND.)
TRC TEST NUMBER: 83C3RK1
572E SN083 RIGHT KNEE CAL 03
RUN NUMBER: 051895.1324;2
FORCE (N X 10²)
75
60
45
30
15
0
-15
-20
0
20
40
60
80
100
120
140
160
180
200
TIME (MS X 10⁻¹)
CHANNEL: PENXF
FILTER: CH. CLASS 600
PEAK DATA: 5576.61 N @ 2.56 MS; -36.71 N @ 8.16 MS

TRANSPORTATION RESEARCH CENTER INC.

LEFT KNEE IMPACT TEST

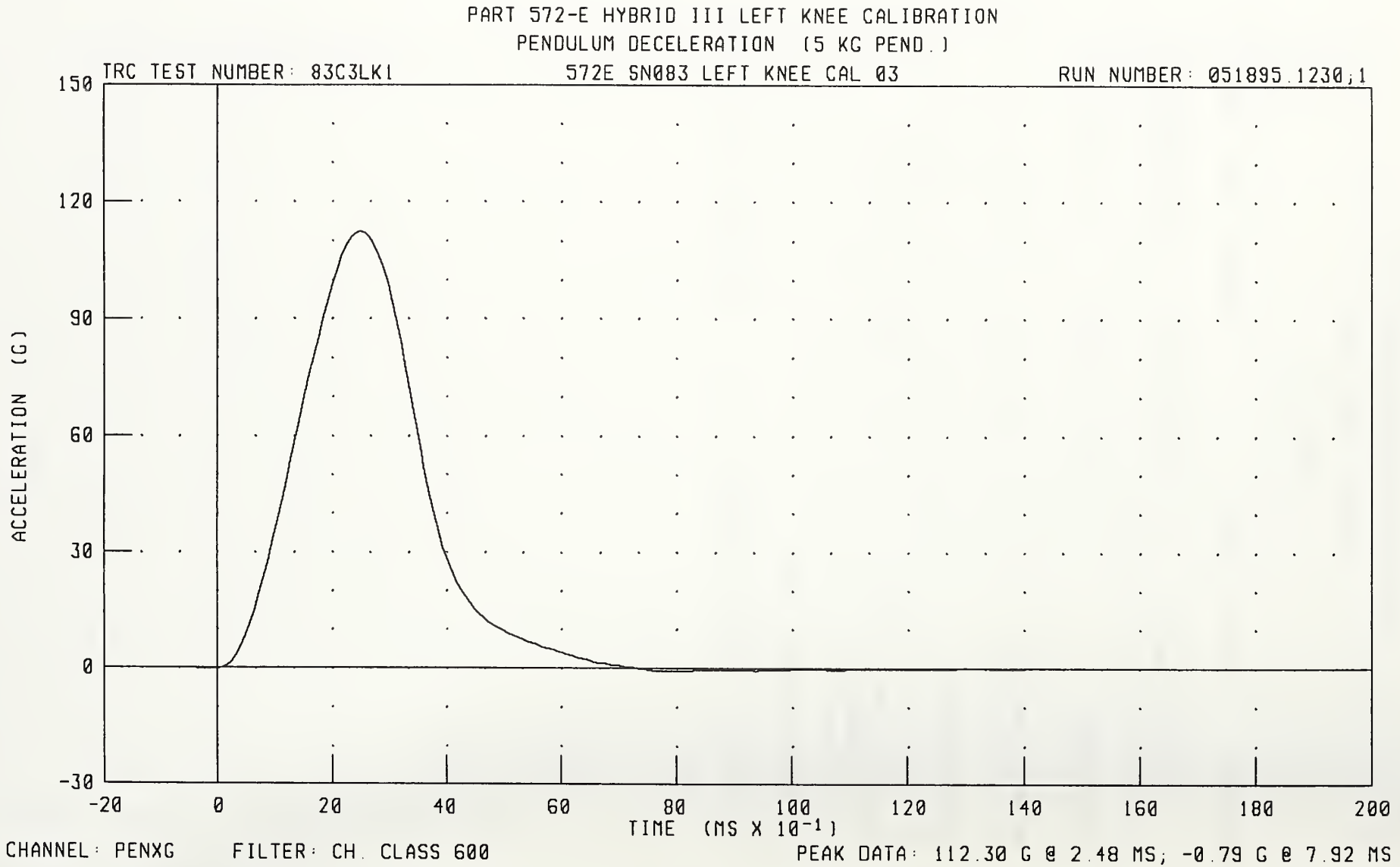
HYBRID III 18-MAY-95

TRC INC. TEST NO: 83C3LK1 572E SN083 LEFT KNEE CAL 03

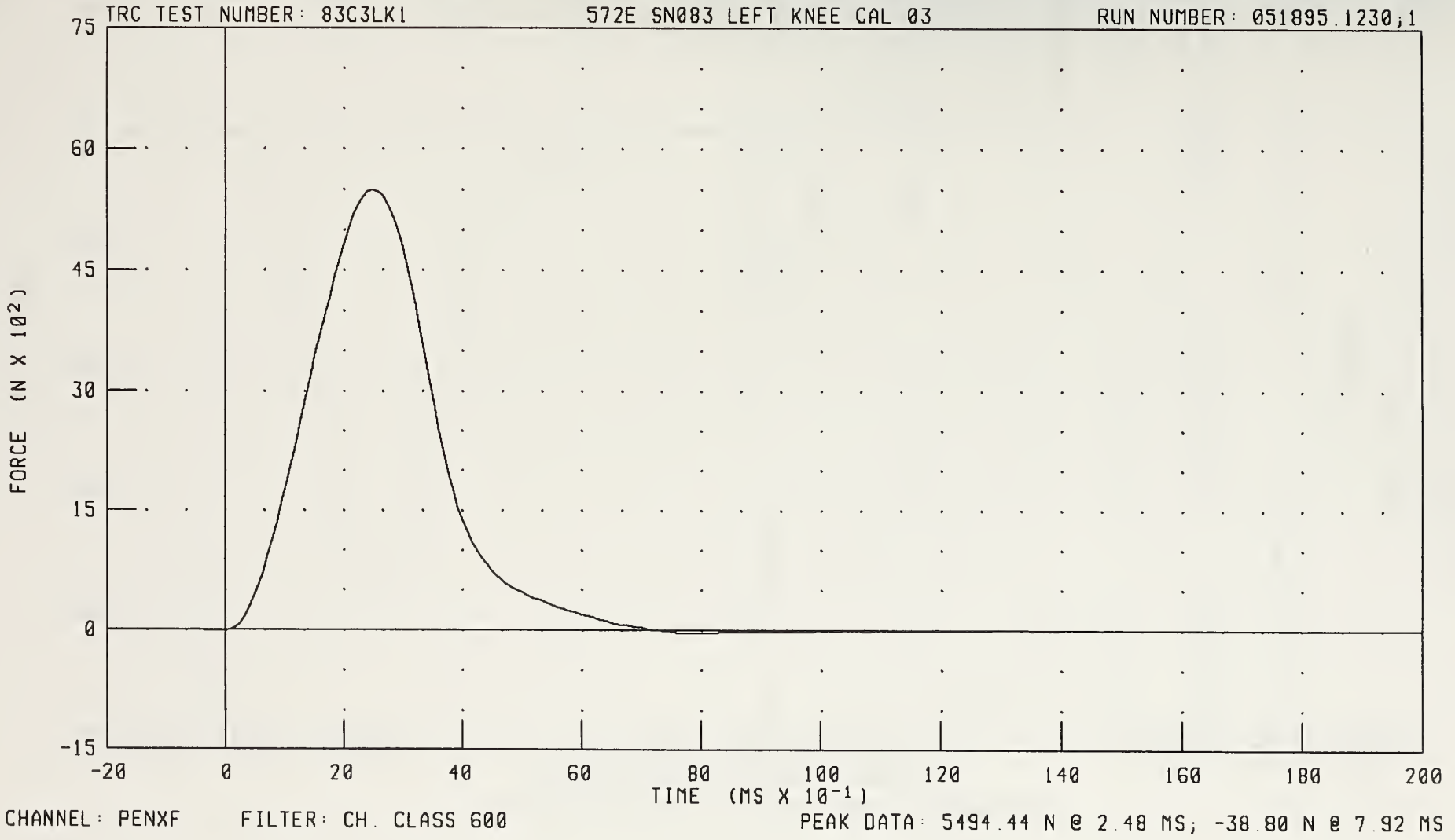
TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10 - 70 %	50.0 %
PROBE VELOCITY	2.07 - 2.13 M/S	2.11 M/S
PEAK KNEE IMPACT FORCE 5.0 KG PENDULUM	4715 - 5782 N	5494.4 N

TEST MEETS SPECIFICATIONS

TECHNICIAN Pete ES RUN NUMBER: 051895.1229;1


PART 572-E HYBRID III LEFT KNEE CALIBRATION
PENDULUM DECELERATION (5 KG PEND.)
TRC TEST NUMBER: 83C3LK1
572E SN083 LEFT KNEE CAL 03
RUN NUMBER: 051895.1230;1
ACCELERATION (G)
150
120
90
60
30
0
-30
-20
0
20
40
60
80
100
120
140
160
180
200
TIME (MS X 10⁻¹)
CHANNEL: PENXG
FILTER: CH. CLASS 600
PEAK DATA: 112.30 G @ 2.48 MS; -0.79 G @ 7.92 MS

PART 572-E HYBRID III LEFT KNEE CALIBRATION
PENDULUM FORCE (5 KG PEND.)

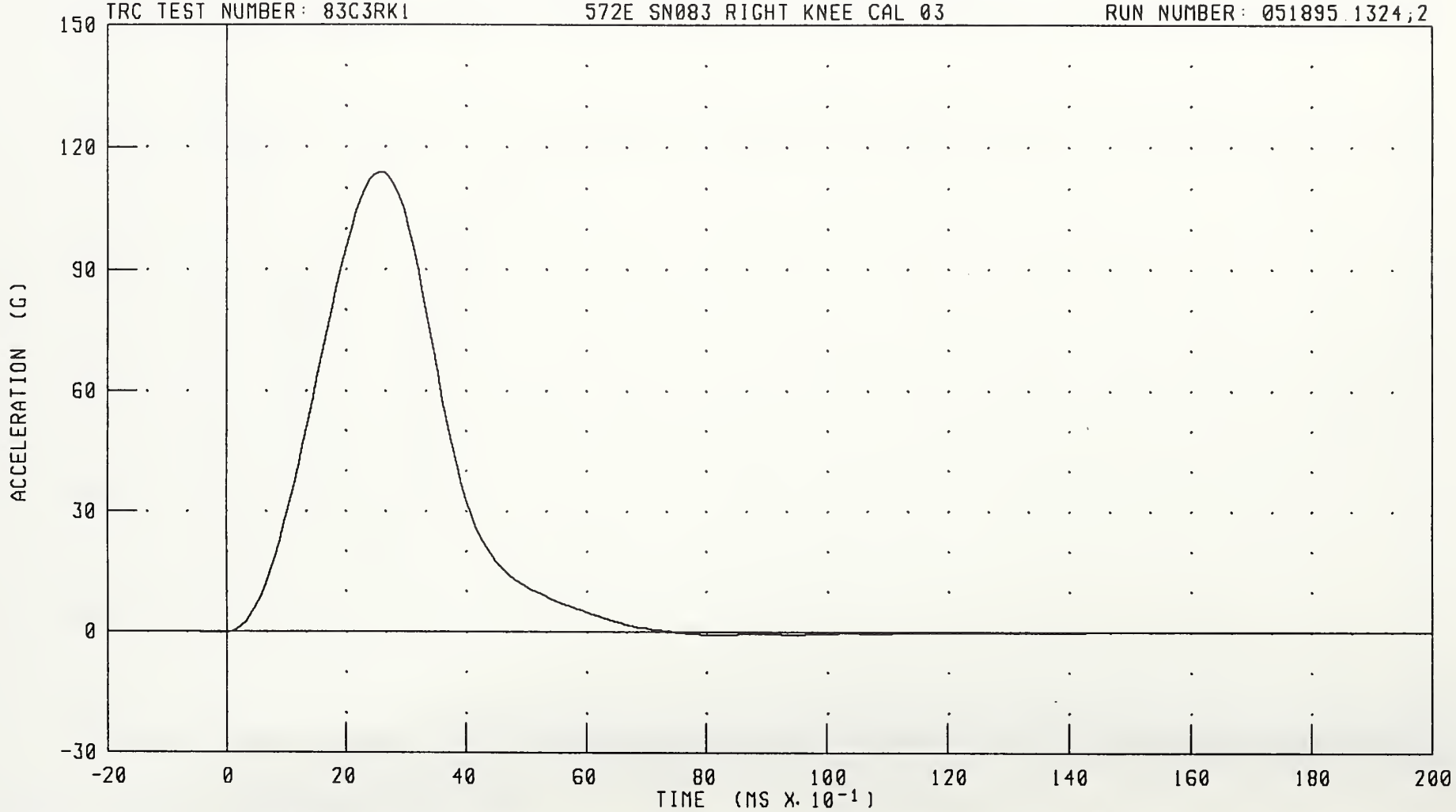


CHANNEL: PENXF FILTER: CH. CLASS 600

PEAK DATA: 5494.44 N @ 2.48 MS; -38.80 N @ 7.92 MS

PART 572-E HYBRID III RIGHT KNEE CALIBRATION
PENDULUM DECELERATION (5 KG PEND.)

TRC TEST NUMBER: 83C3RK1 572E SN083 RIGHT KNEE CAL 03 RUN NUMBER: 051895.1324;2



CHANNEL: PENXG FILTER: CH. CLASS 600 PEAK DATA: 113.98 G @ 2.56 MS; -0.75 G @ 8.16 MS

TRANSPORTATION RESEARCH CENTER INC.

RIGHT KNEE IMPACT TEST

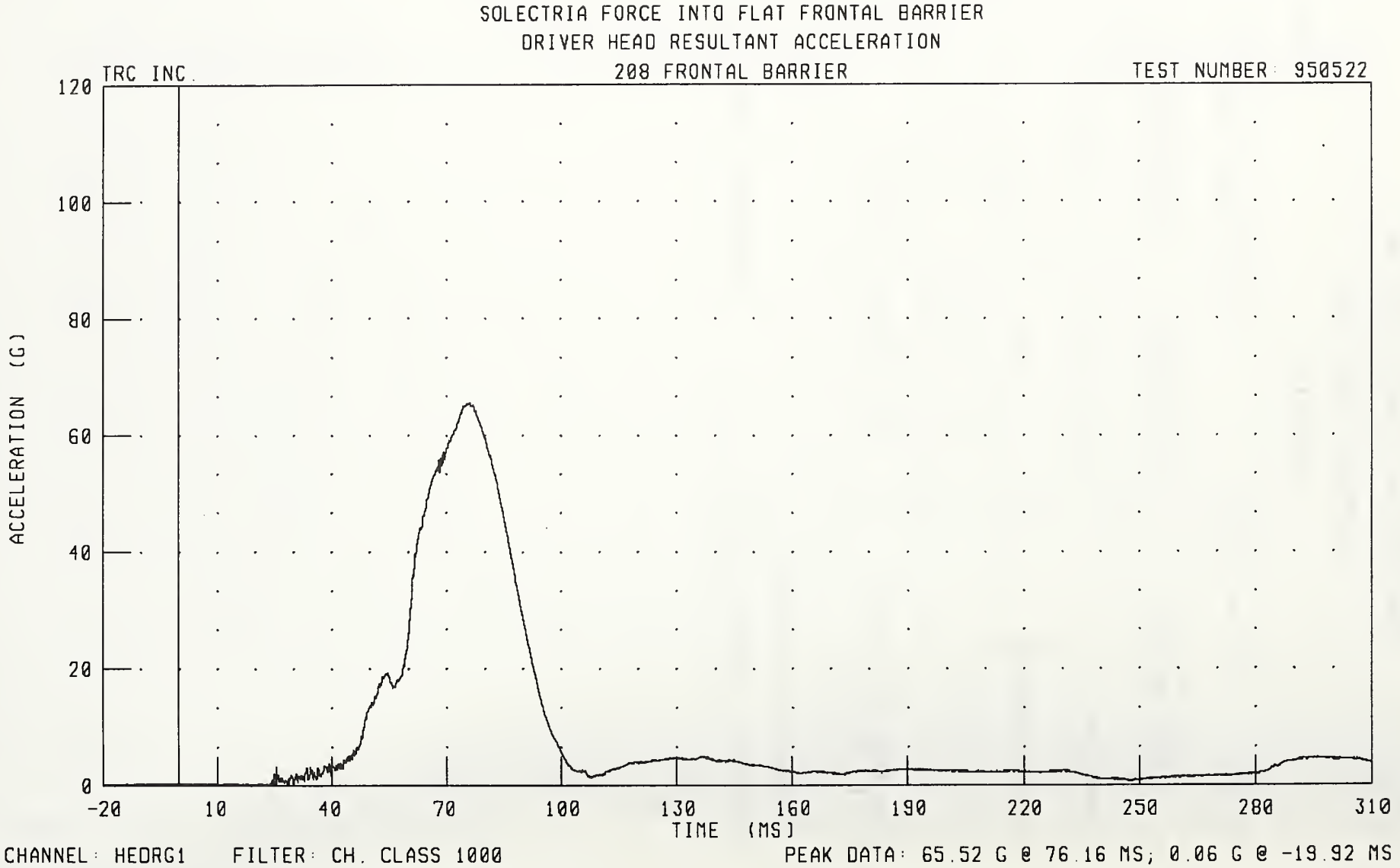
HYBRID III 18-MAY-95

TRC INC. TEST NO: 83C3RK1 572E SN083 RIGHT KNEE CAL 03

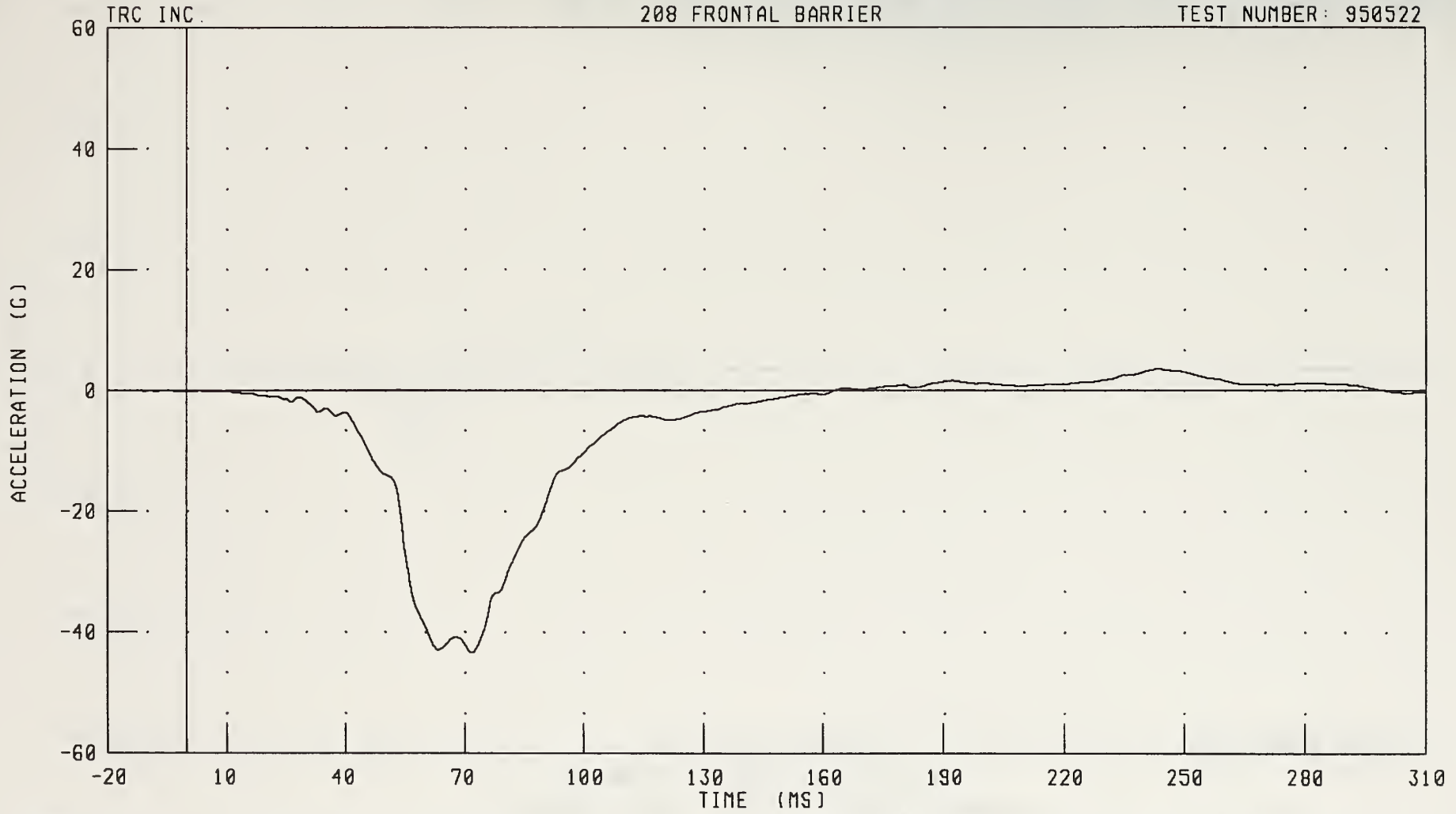
TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10 - 70 %	50.0 %
PROBE VELOCITY	2.07 - 2.13 M/S	2.11 M/S
PEAK KNEE IMPACT FORCE 5.0 KG PENDULUM	4715 - 5782 N	5576.6 N

TEST MEETS SPECIFICATIONS

TECHNICIAN Pete Foss RUN NUMBER: 051895.1250;2

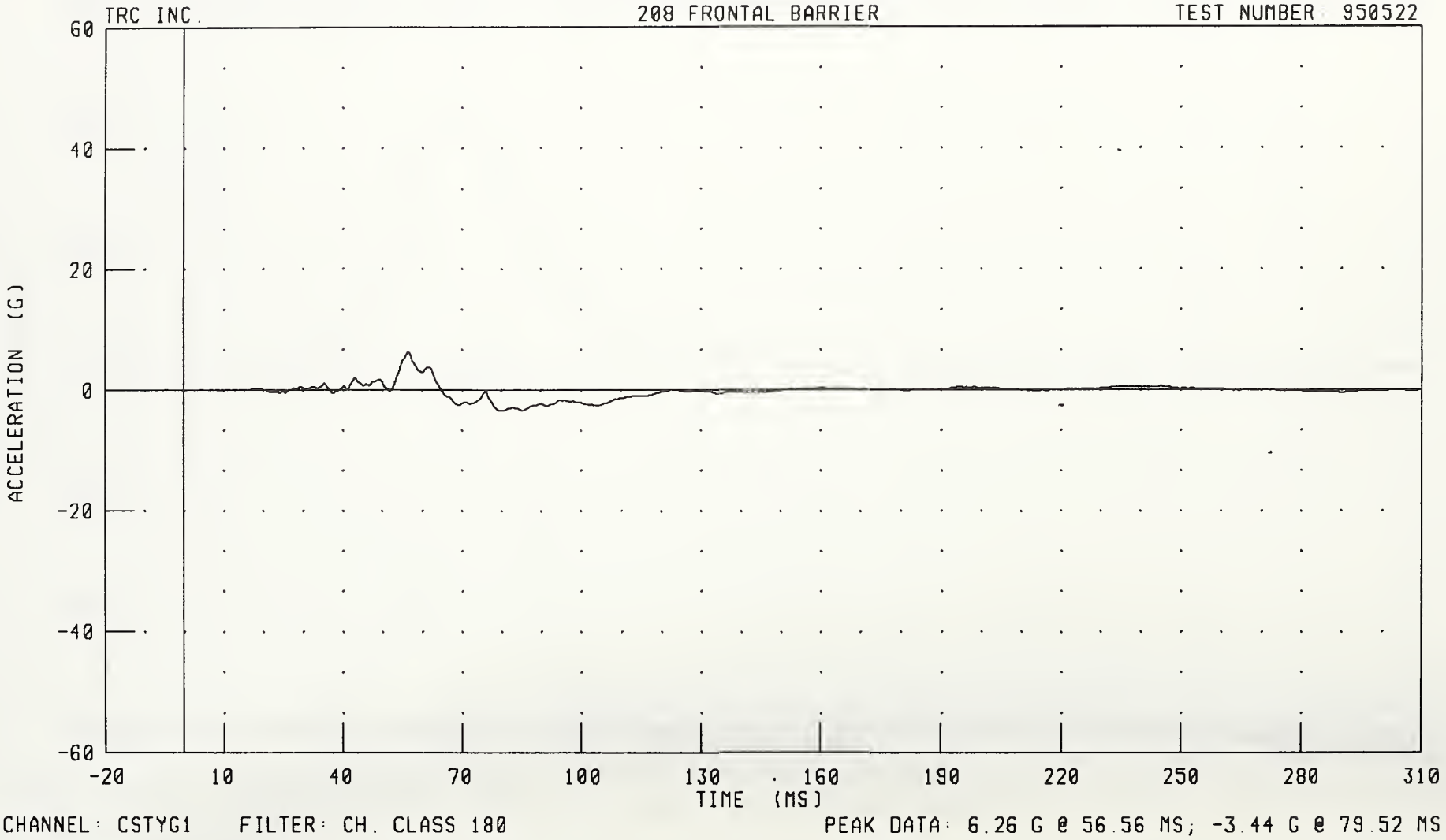

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER HEAD RESULTANT ACCELERATION
TRC INC.
208 FRONTAL BARRIER
TEST NUMBER: 950522
ACCELERATION (G)
120
100
80
60
40
20
0
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: HEDRG1
FILTER: CH. CLASS 1000
PEAK DATA: 65.52 G @ 76.16 MS; 0.06 G @ -19.92 MS

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER CHEST X-AXIS ACCELERATION

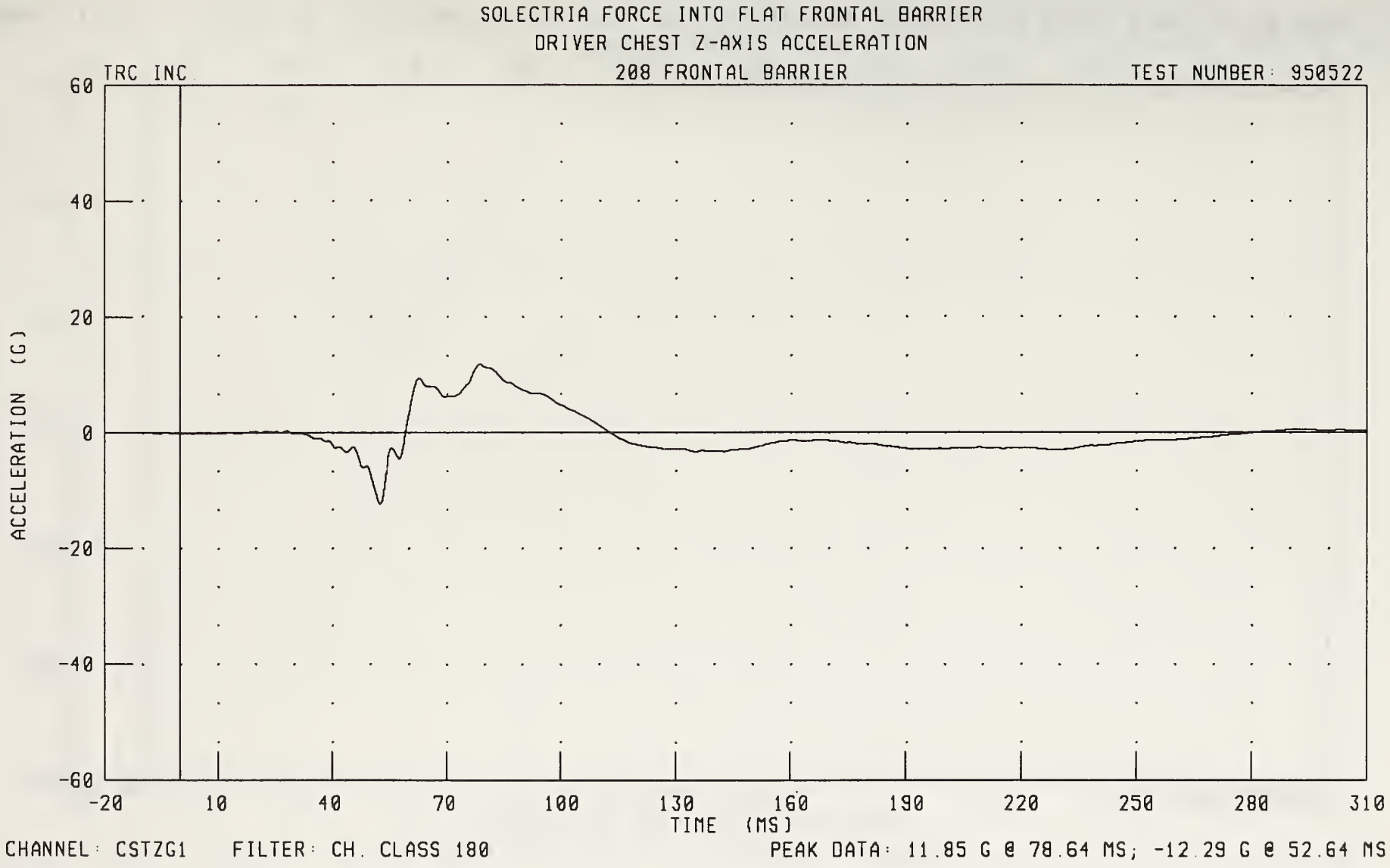


CHANNEL: CSTXG1 FILTER: CH. CLASS 180 PEAK DATA: 3.52 G @ 243.68 MS; -43.41 G @ 71.68 MS

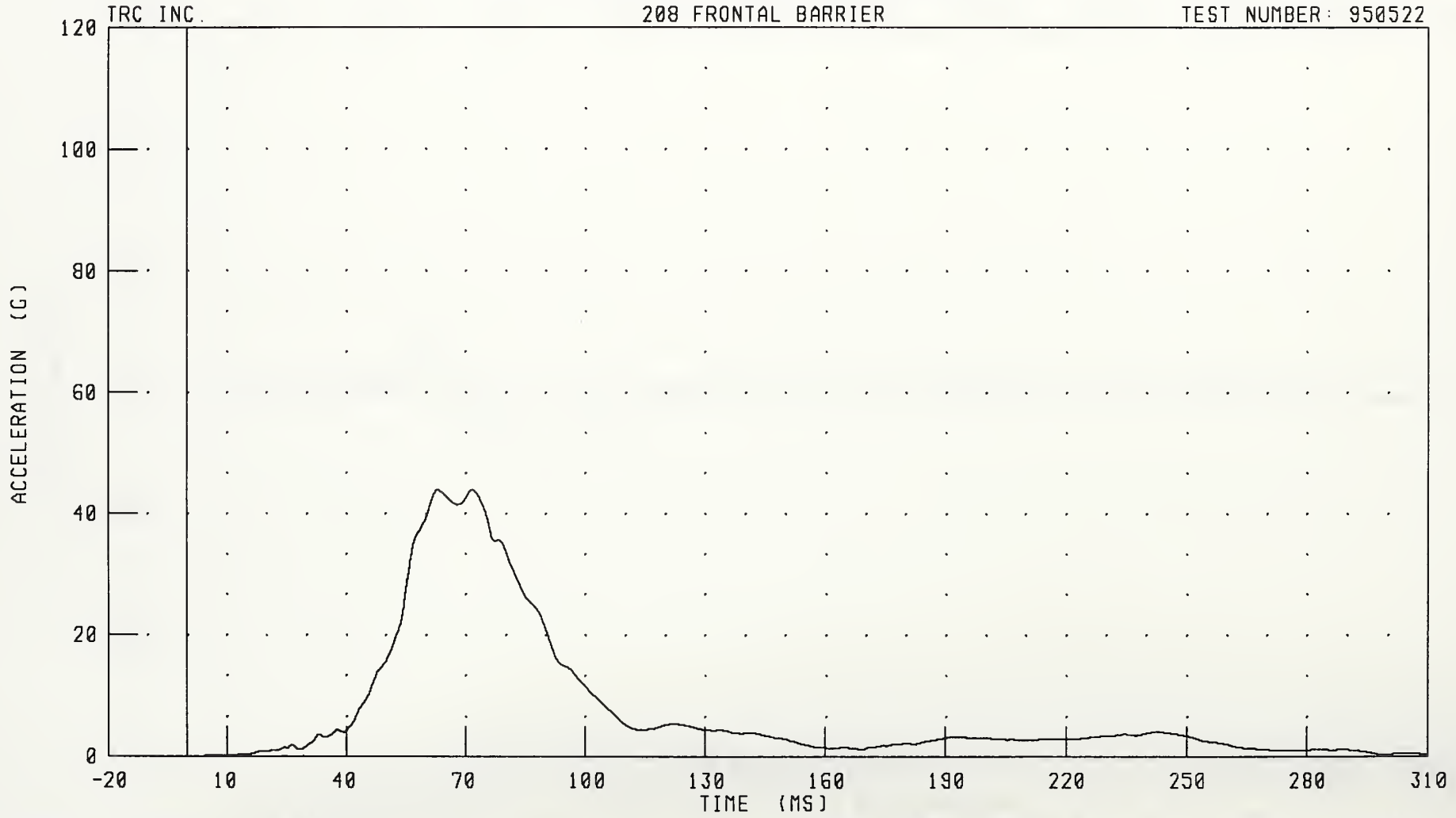
SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER CHEST Y-AXIS ACCELERATION



CHANNEL: CSTYG1 FILTER: CH. CLASS 180 PEAK DATA: 6.26 G @ 56.56 MS; -3.44 G @ 79.52 MS

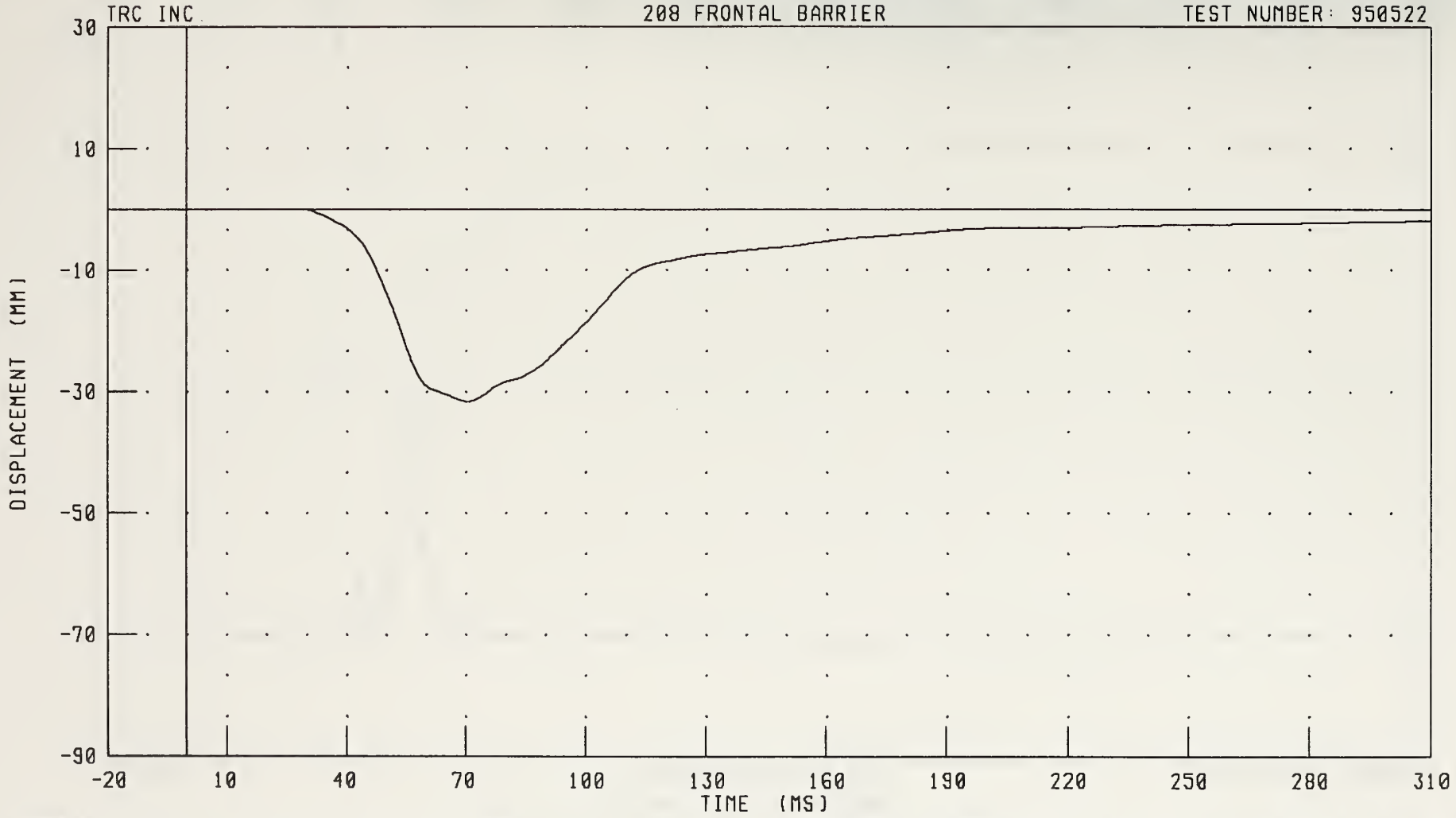

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER CHEST Z-AXIS ACCELERATION
TRC INC
208 FRONTAL BARRIER
TEST NUMBER: 950522
60
40
20
0
-20
-40
-60
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: CSTZG1
FILTER: CH. CLASS 180
PEAK DATA: 11.85 G @ 78.64 MS; -12.29 G @ 52.64 MS

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER CHEST RESULTANT ACCELERATION

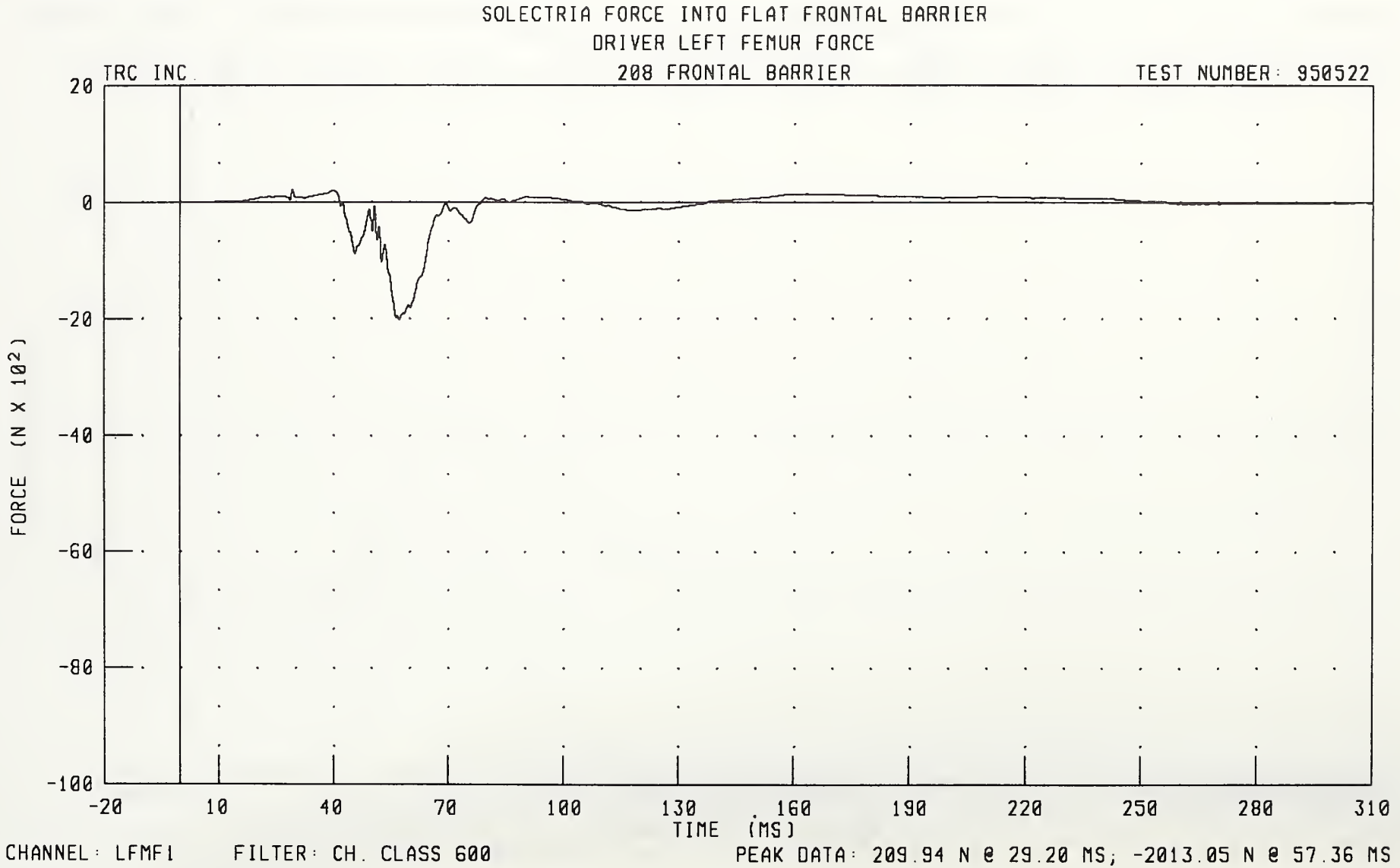


CHANNEL: CSTRG1 FILTER: CH. CLASS 180 PEAK DATA: 43.95 G @ 63.04 MS; 0.00 G @ -20.00 MS

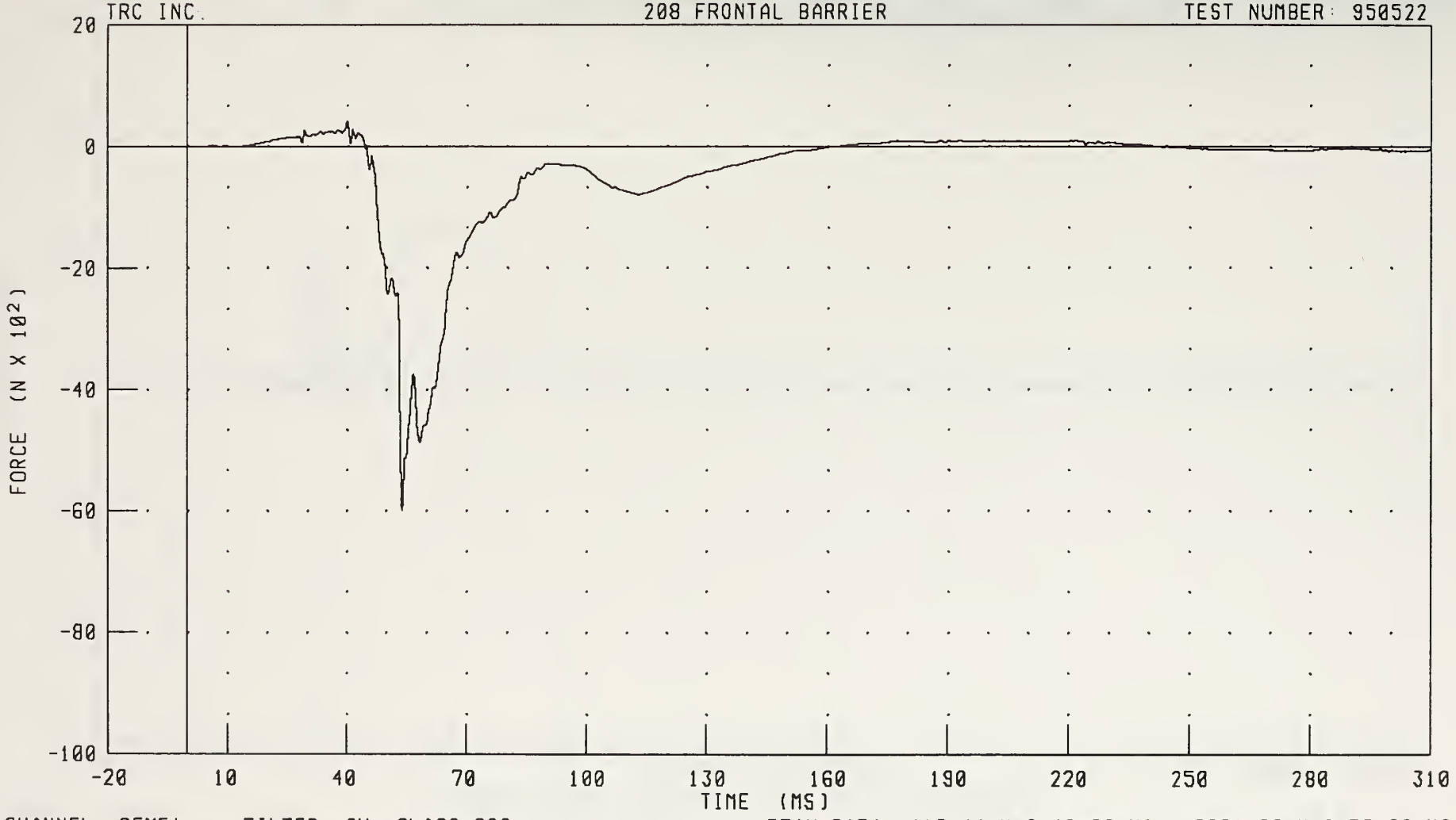
SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER CHEST DEFLECTION
208 FRONTAL BARRIER



CHANNEL: CSTXD1 FILTER: CH. CLASS 180 PEAK DATA: 0.05 MM @ 25.44 MS; -31.63 MM @ 70.32 MS

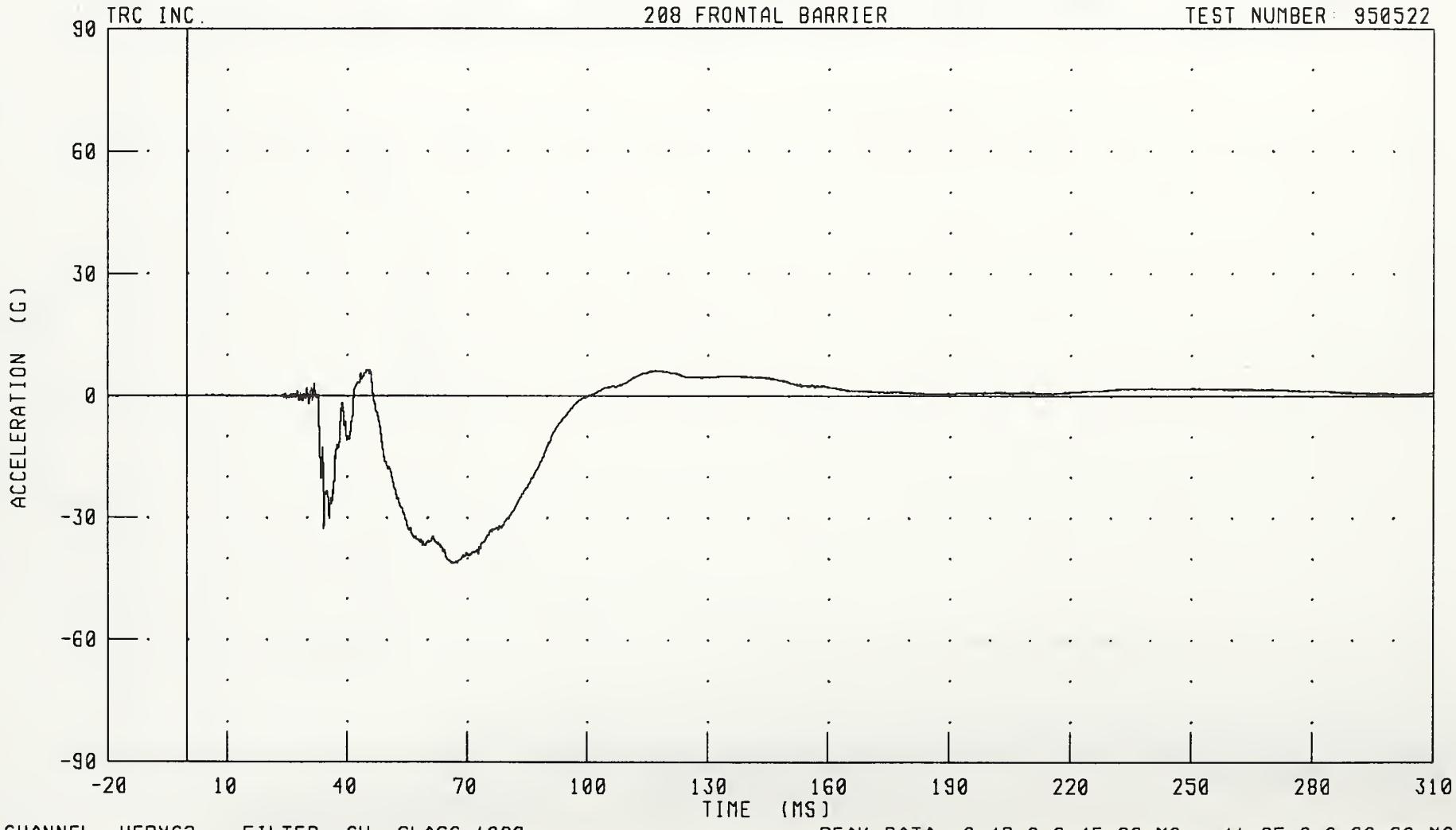

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER LEFT FEMUR FORCE
208 FRONTAL BARRIER
TRC INC.
TEST NUMBER: 950522
20
0
-20
-40
-60
-80
-100
FORCE (N X 10²)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: LFMF1
FILTER: CH. CLASS 600
PEAK DATA: 209.94 N @ 29.20 MS; -2013.05 N @ 57.36 MS

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER RIGHT FEMUR FORCE



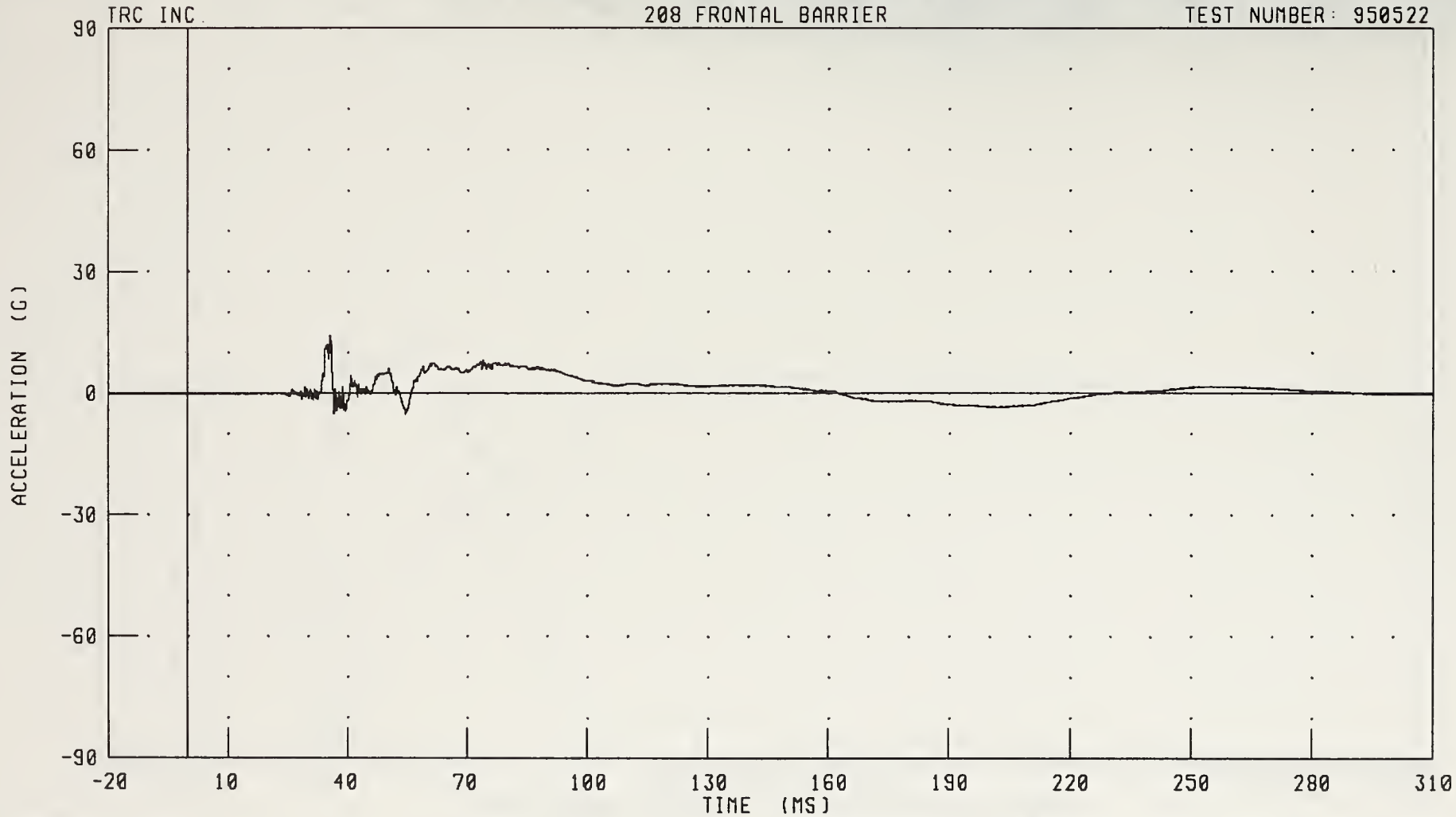
CHANNEL: RFMF1 FILTER: CH. CLASS 600 PEAK DATA: 416.44 N @ 40.00 MS; -6001.89 N @ 53.92 MS

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER HEAD X-AXIS ACCELERATION



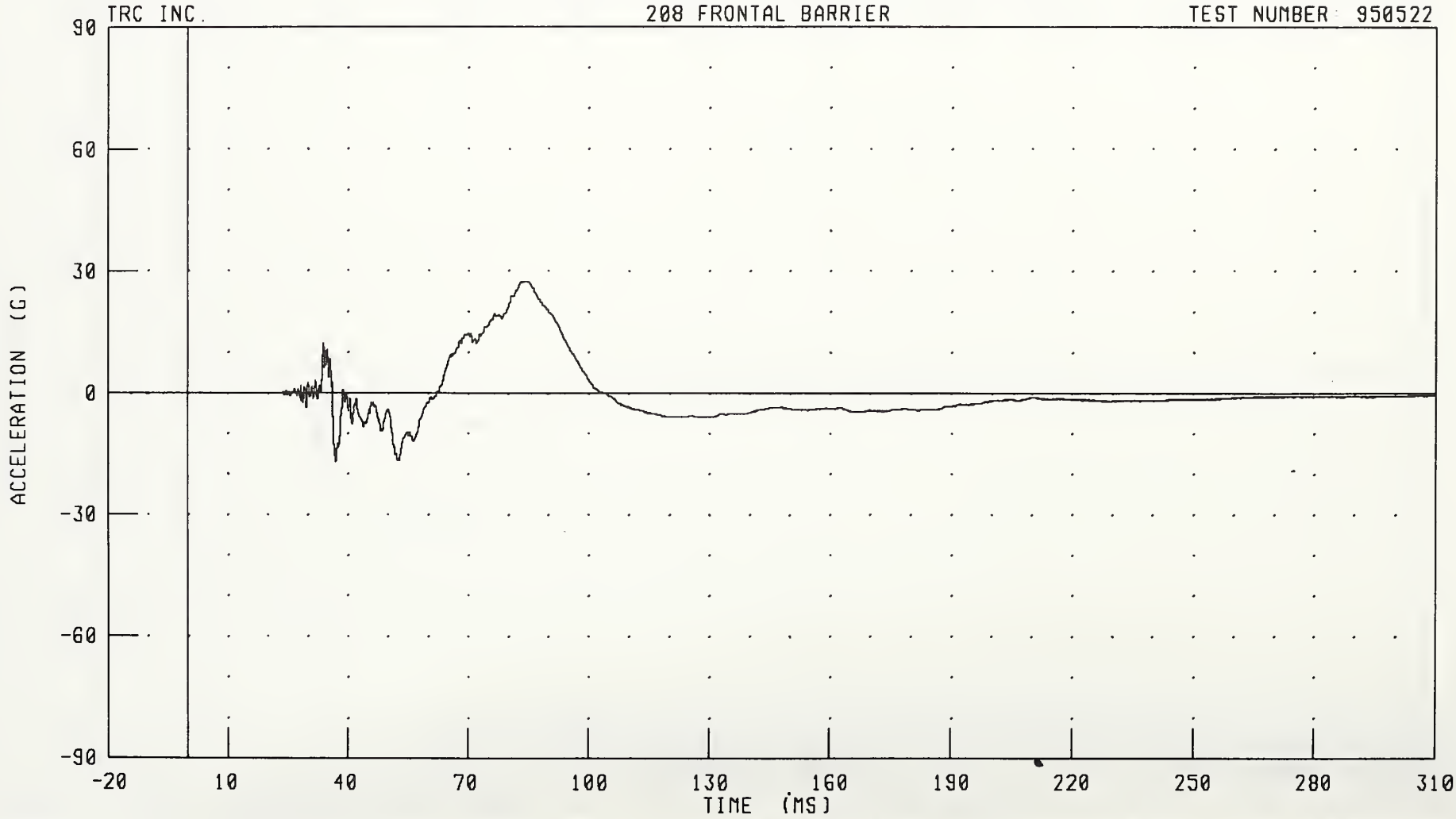
CHANNEL: HEDXG2 FILTER: CH. CLASS 1000 PEAK DATA: 6.47 G @ 45.28 MS; -41.05 G @ 66.00 MS

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER HEAD Y-AXIS ACCELERATION



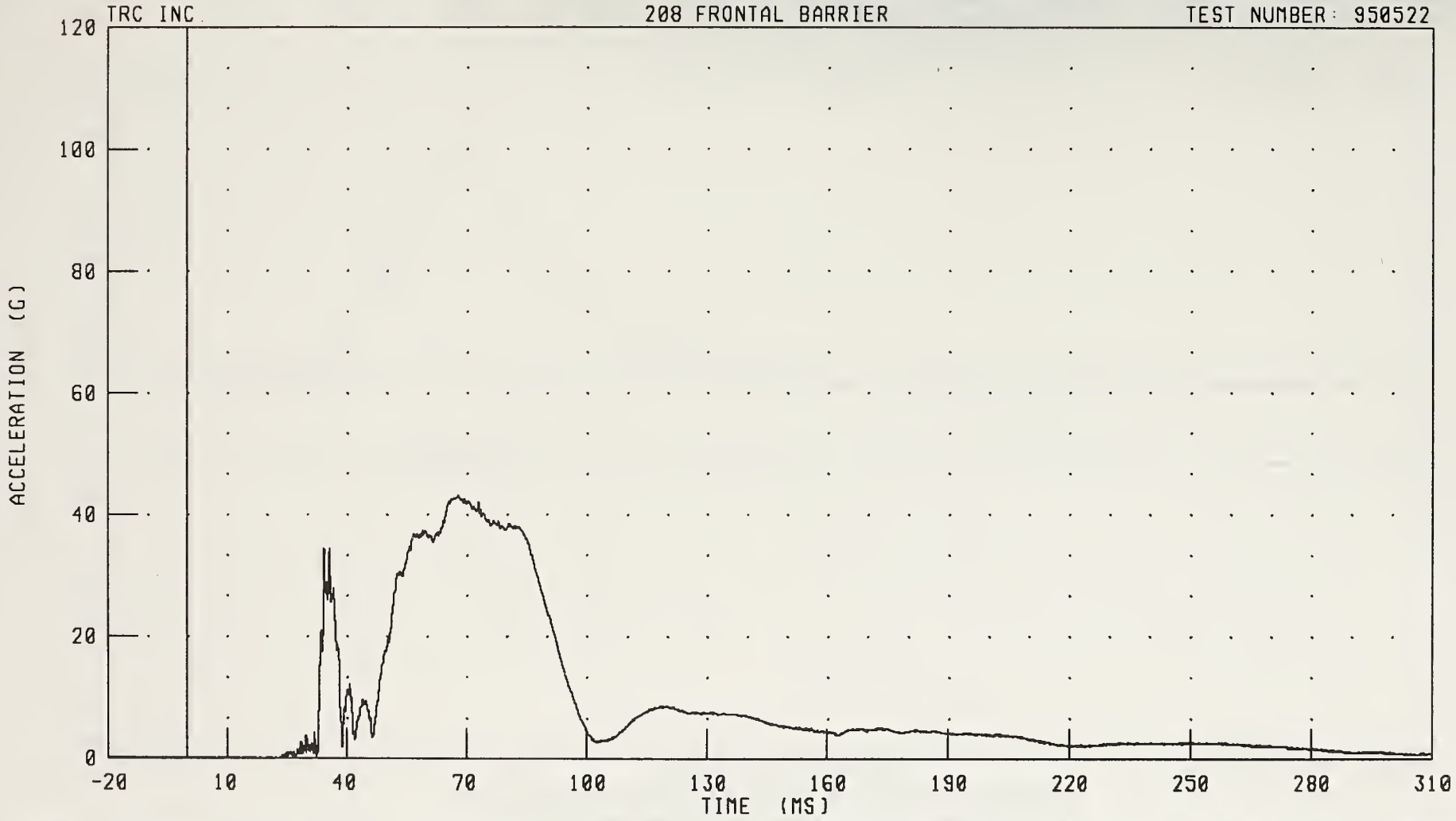
CHANNEL: HEDYG2 FILTER: CH. CLASS 1000 PEAK DATA: 14.18 G @ 35.52 MS; -5.26 G @ 54.56 MS

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER HEAD Z-AXIS ACCELERATION



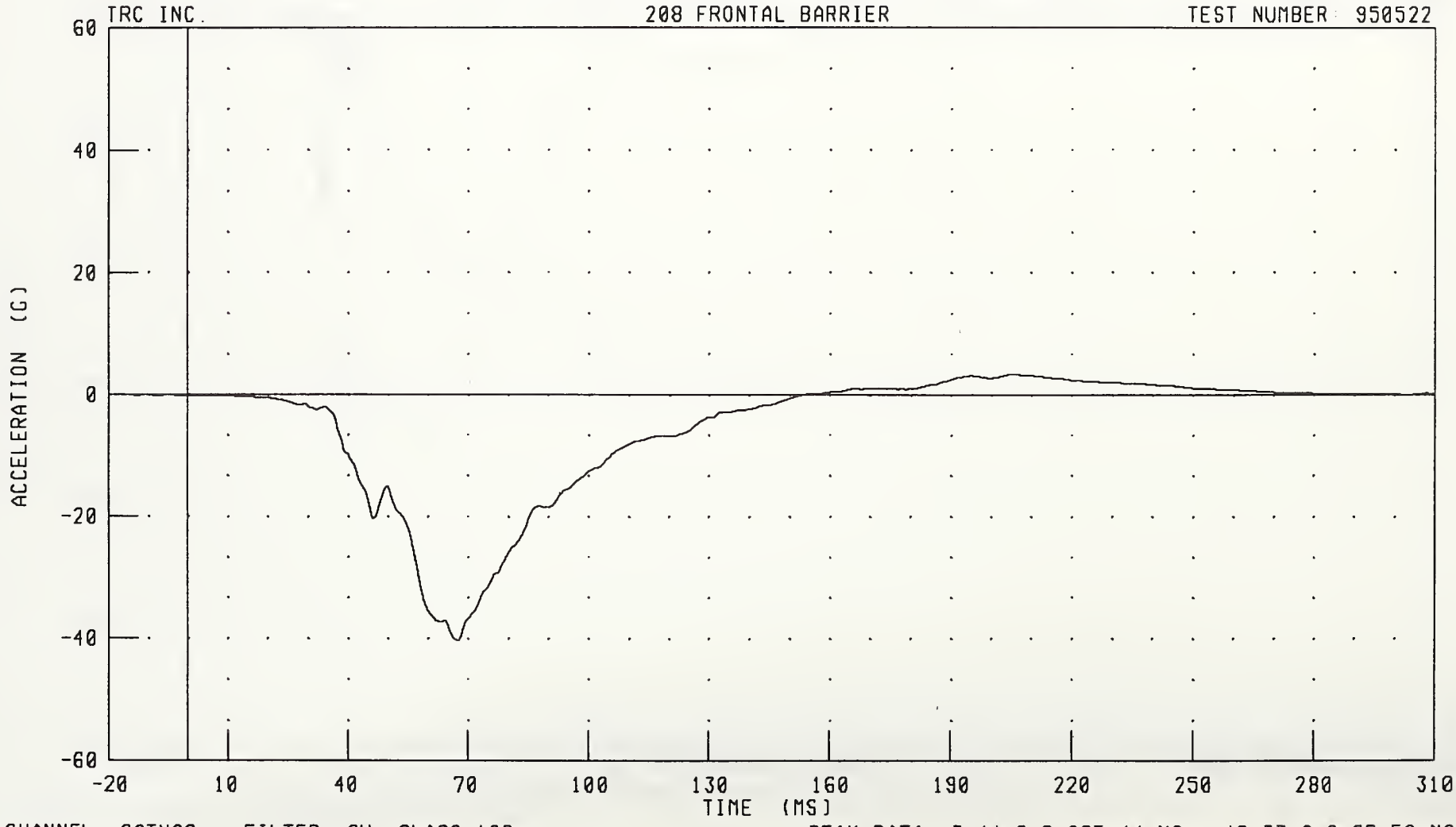
CHANNEL: HEDZG2 FILTER: CH. CLASS 1000 PEAK DATA: 27.56 G @ 83.20 MS; -17.09 G @ 36.96 MS

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER HEAD RESULTANT ACCELERATION

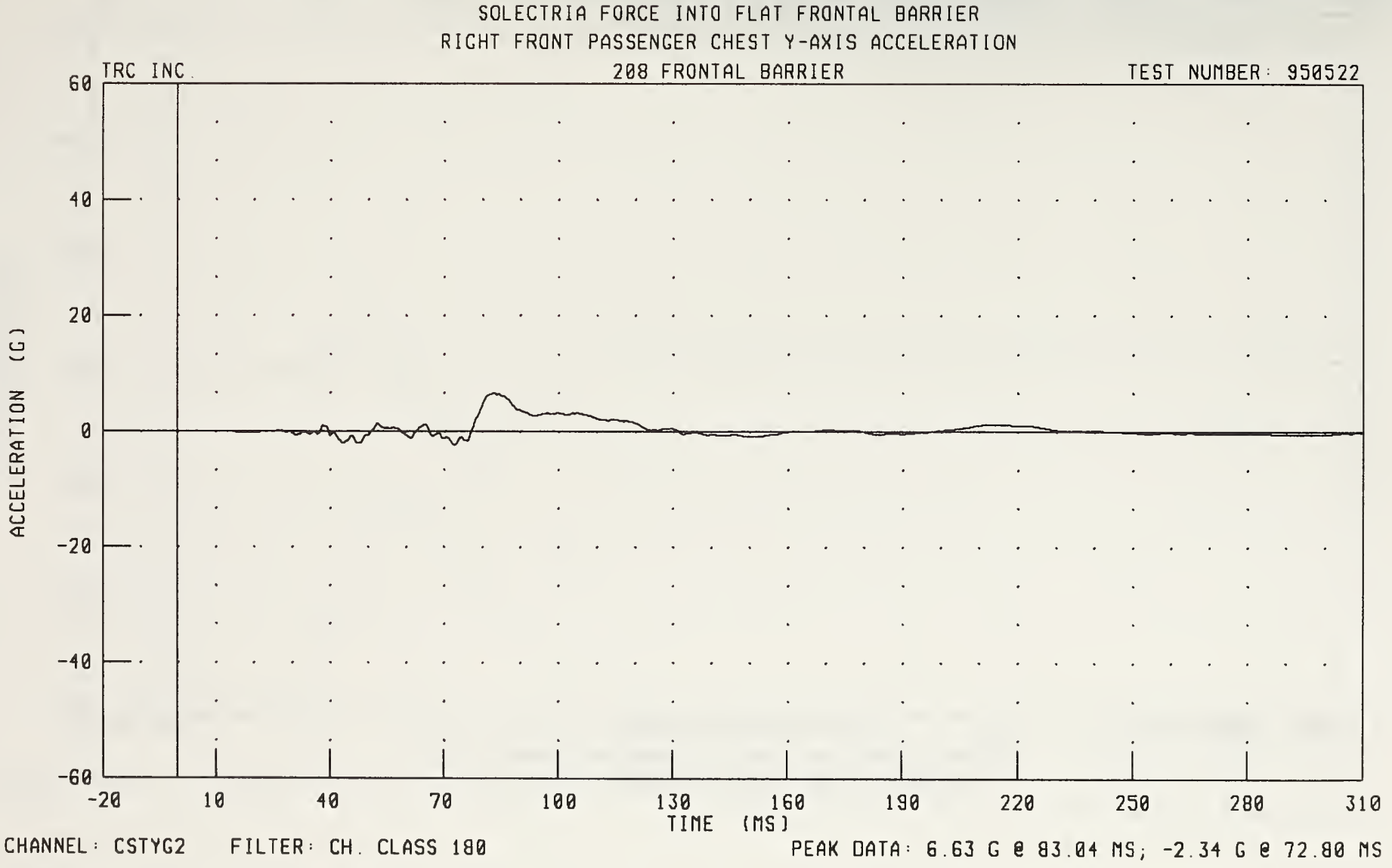


CHANNEL: HEDRG2 FILTER: CH. CLASS 1000 PEAK DATA: 43.29 G @ 67.76 MS; 0.07 G @ -16.40 MS

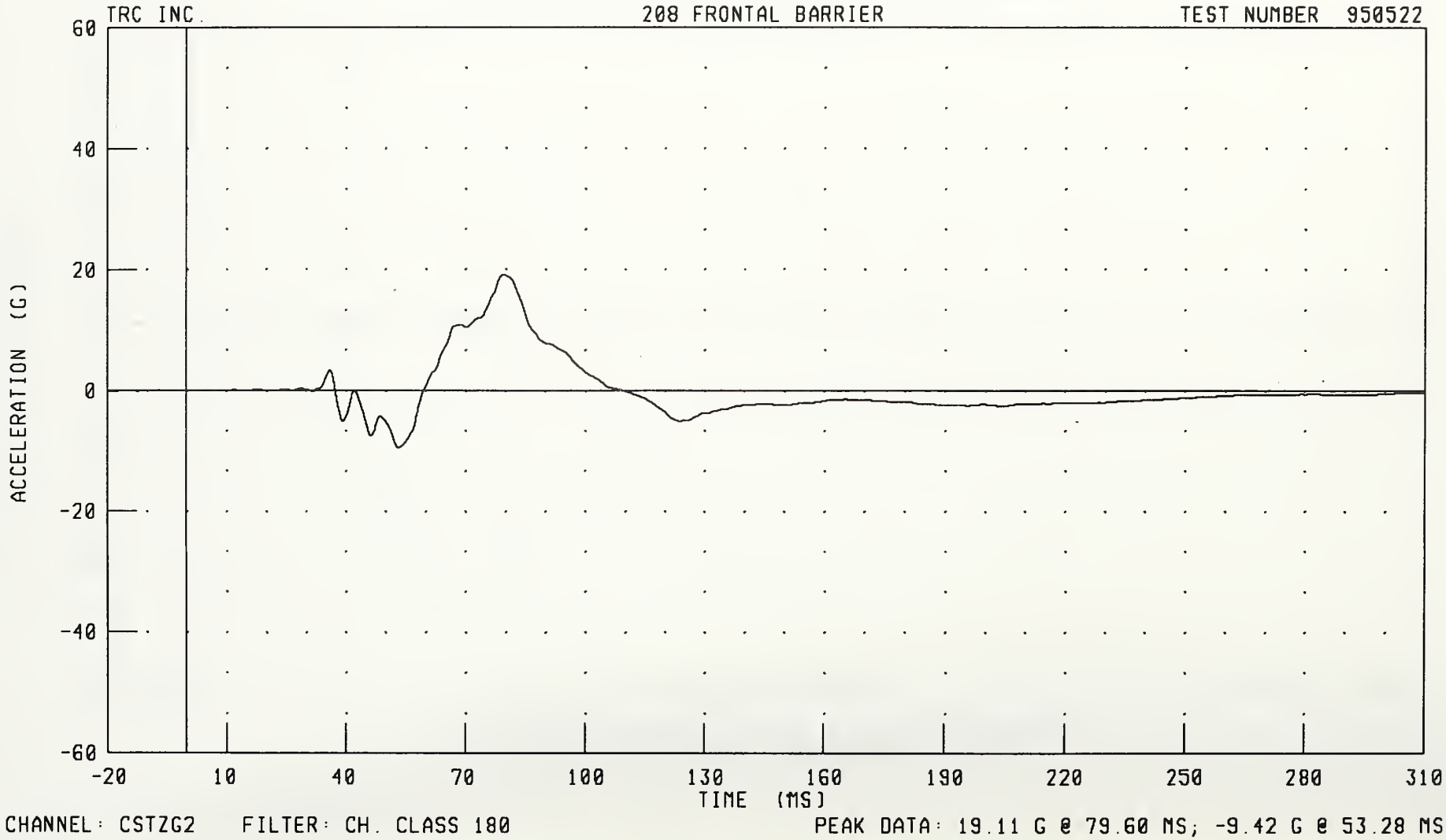
SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER CHEST X-AXIS ACCELERATION



CHANNEL: CSTXG2 FILTER: CH. CLASS 180 PEAK DATA: 3.44 G @ 205.44 MS; -40.33 G @ 67.52 MS

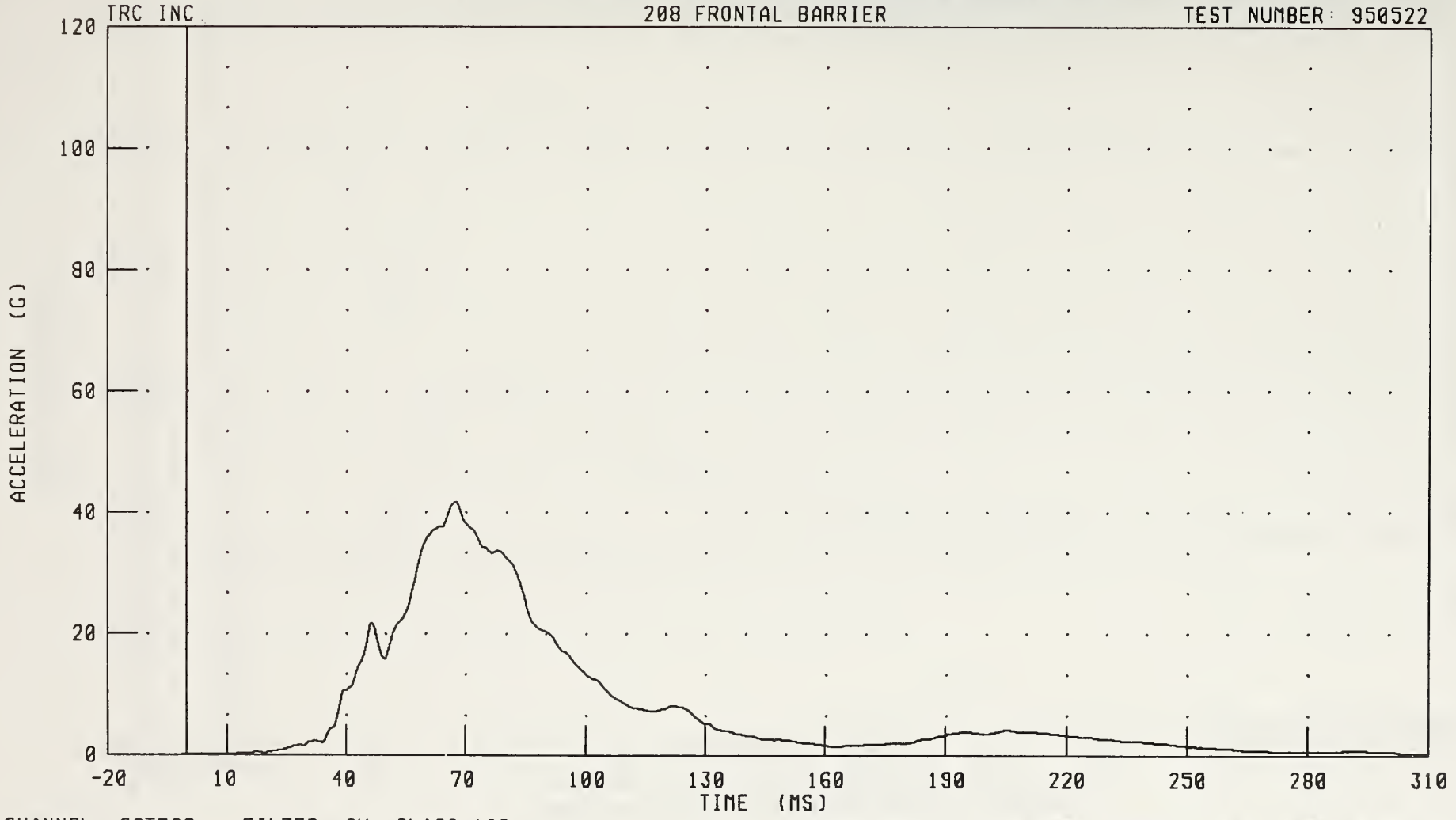

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER CHEST Y-AXIS ACCELERATION
TRC INC.
208 FRONTAL BARRIER
TEST NUMBER: 950522
60
40
20
0
-20
-40
-60
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: CSTYG2
FILTER: CH. CLASS 180
PEAK DATA: 6.63 G @ 83.04 MS; -2.34 G @ 72.80 MS

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER CHEST Z-AXIS ACCELERATION



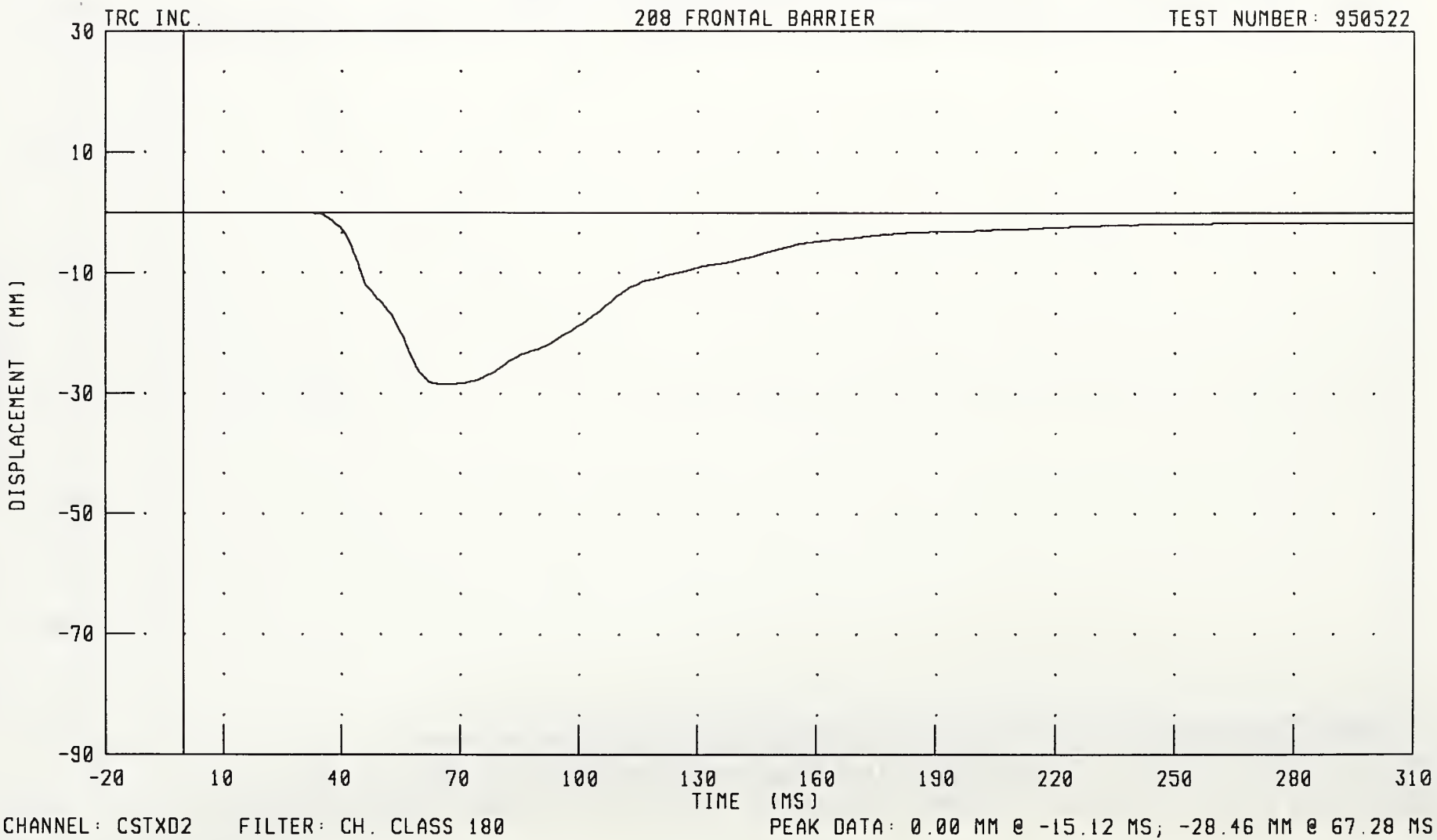
CHANNEL: CSTZG2 FILTER: CH. CLASS 180 PEAK DATA: 19.11 G @ 79.60 MS; -9.42 G @ 53.28 MS

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER CHEST RESULTANT ACCELERATION



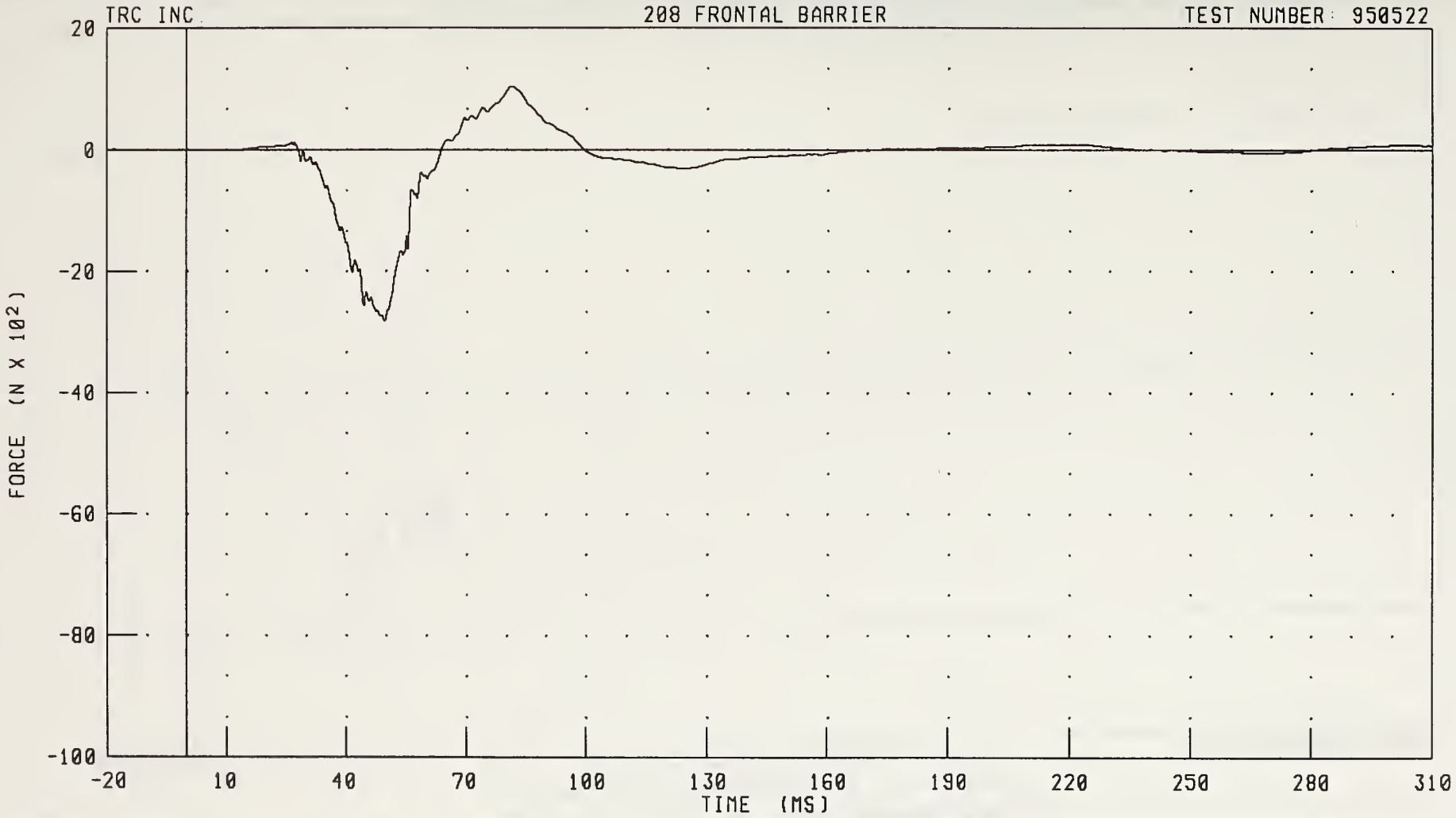
CHANNEL: CSTRG2 FILTER: CH. CLASS 180 PEAK DATA: 41.75 G @ 67.60 MS; 0.01 G @ -20.00 MS

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER CHEST DEFLECTION

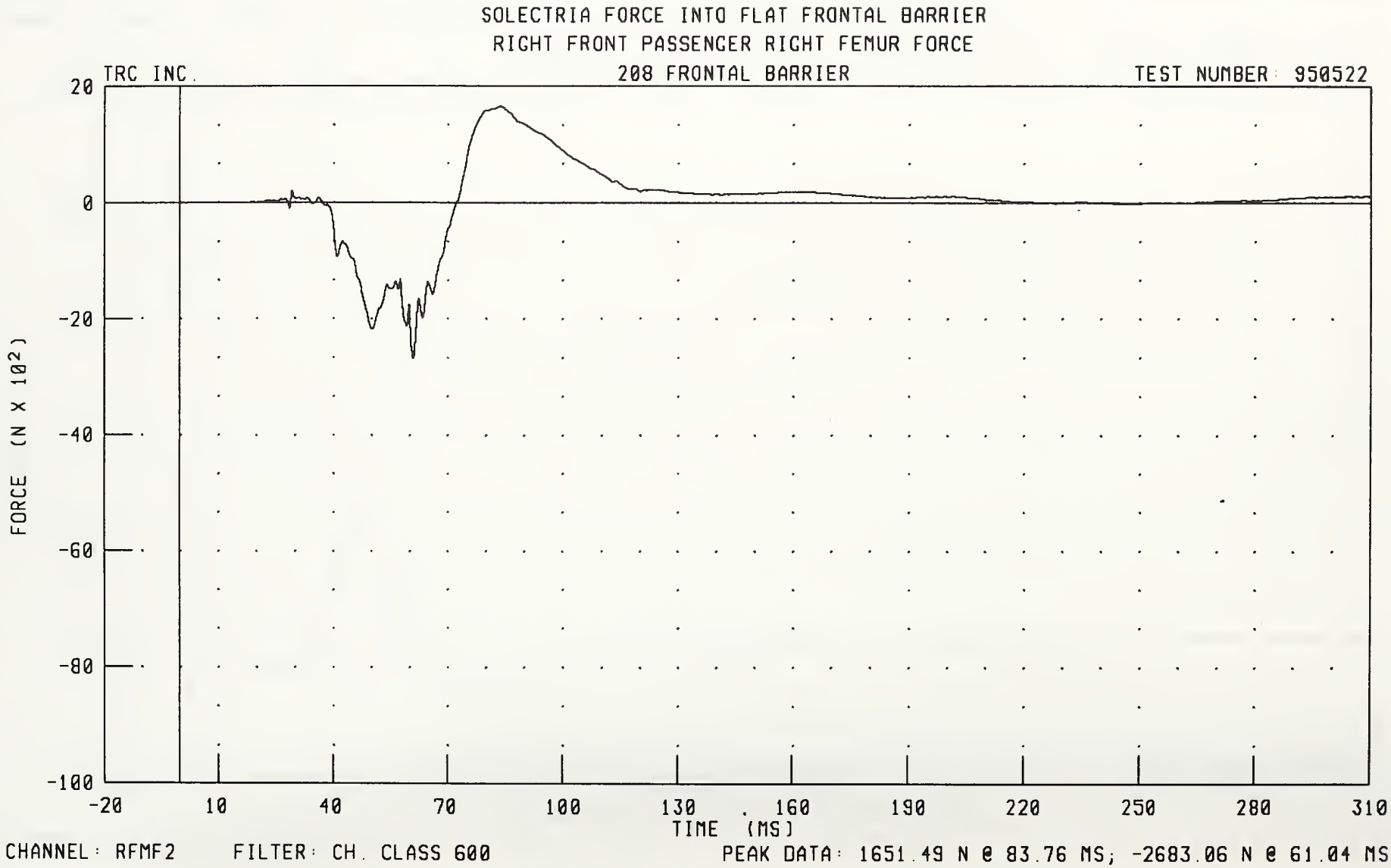


CHANNEL: CSTXD2 FILTER: CH. CLASS 180 PEAK DATA: 0.00 MM @ -15.12 MS; -28.46 MM @ 67.28 MS

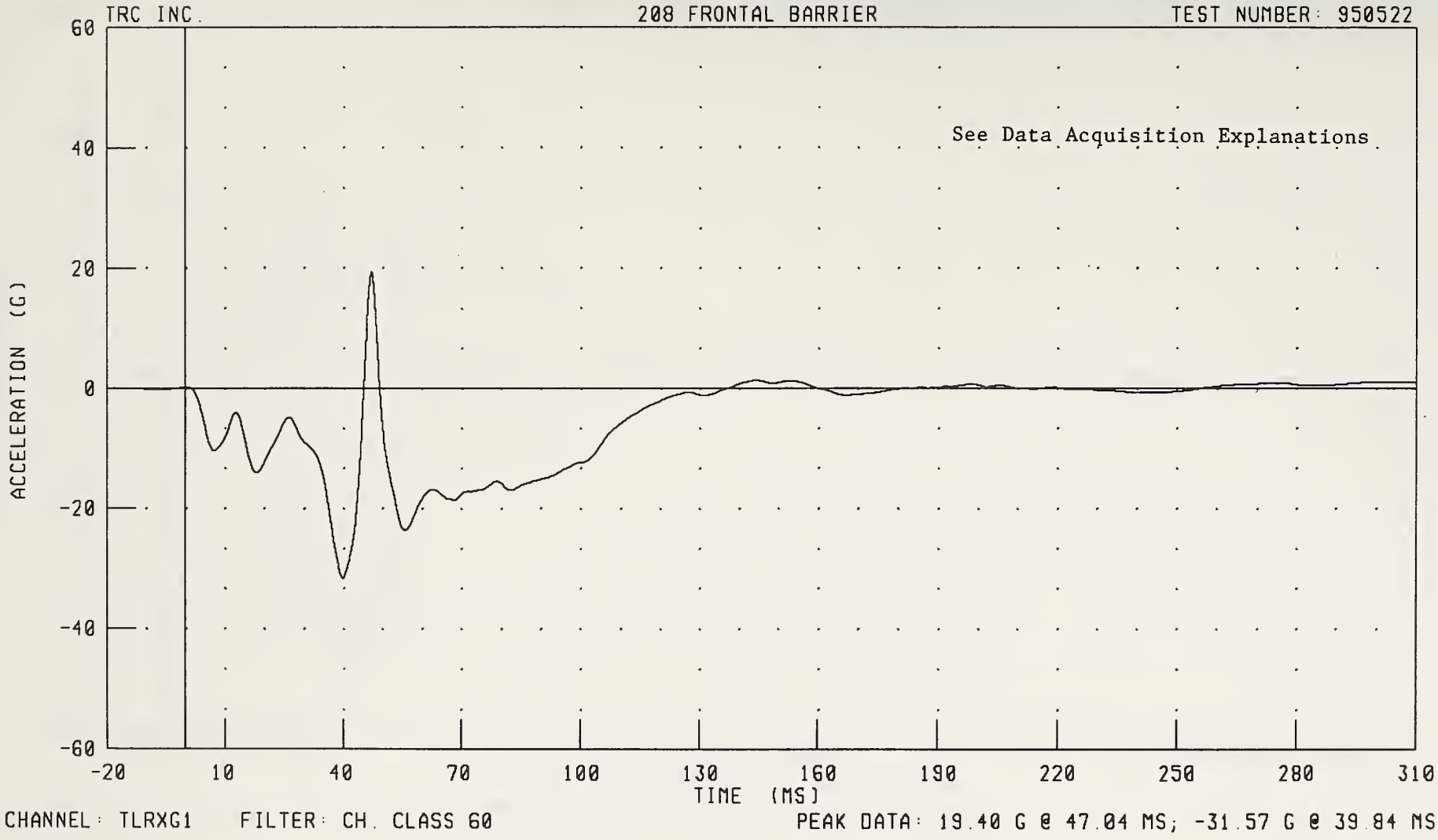
SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER LEFT FEMUR FORCE



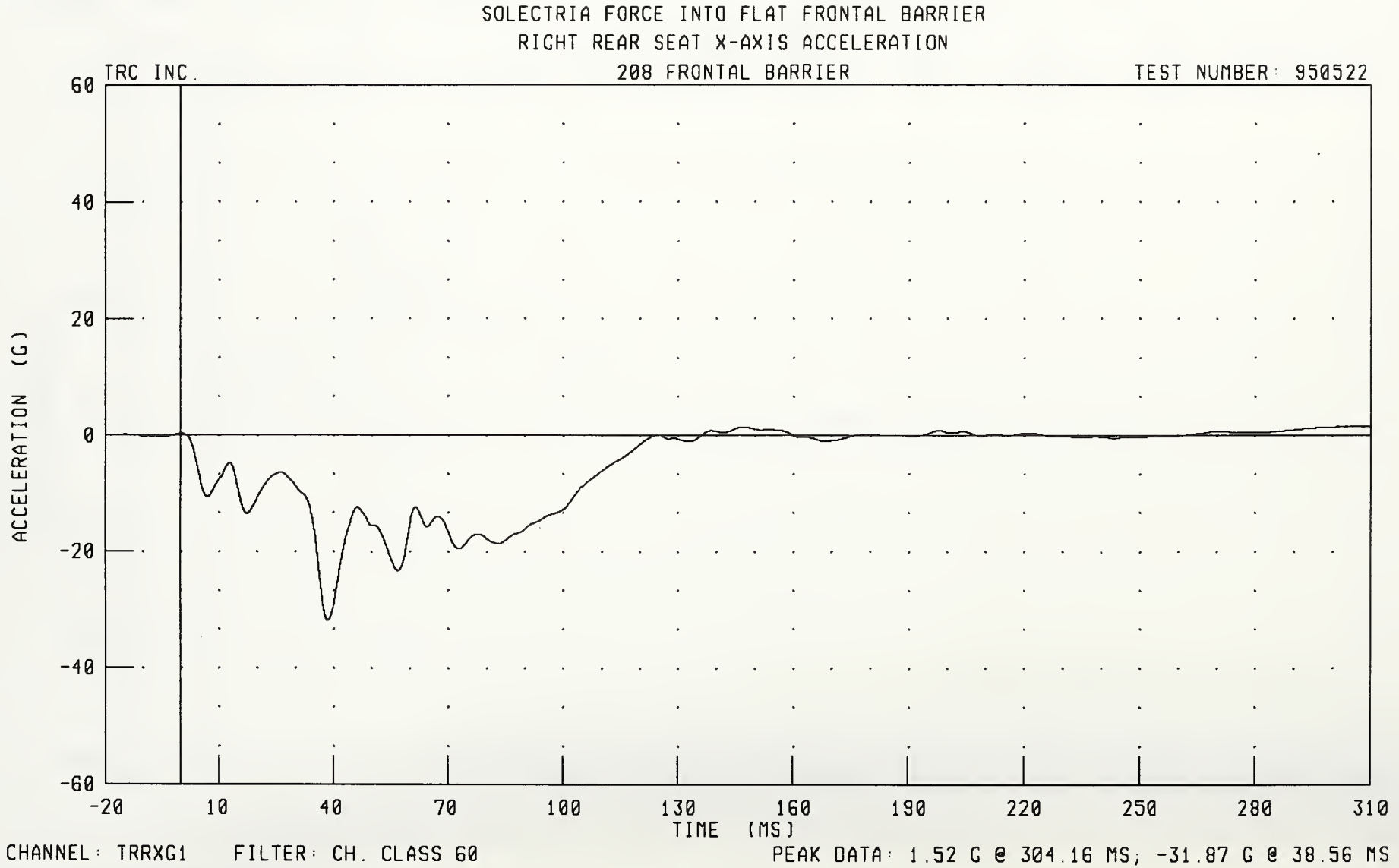
CHANNEL: LFMF2 FILTER: CH. CLASS 600 PEAK DATA: 1036.46 N @ 81.36 MS; -2818.98 N @ 49.60 MS


SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER RIGHT FEMUR FORCE
TRC INC.
208 FRONTAL BARRIER
TEST NUMBER: 950522
20
0
-20
-40
-60
-80
-100
FORCE (N X 10²)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: RFMF2
FILTER: CH. CLASS 600
PEAK DATA: 1651.49 N @ 83.76 MS; -2683.06 N @ 61.04 MS

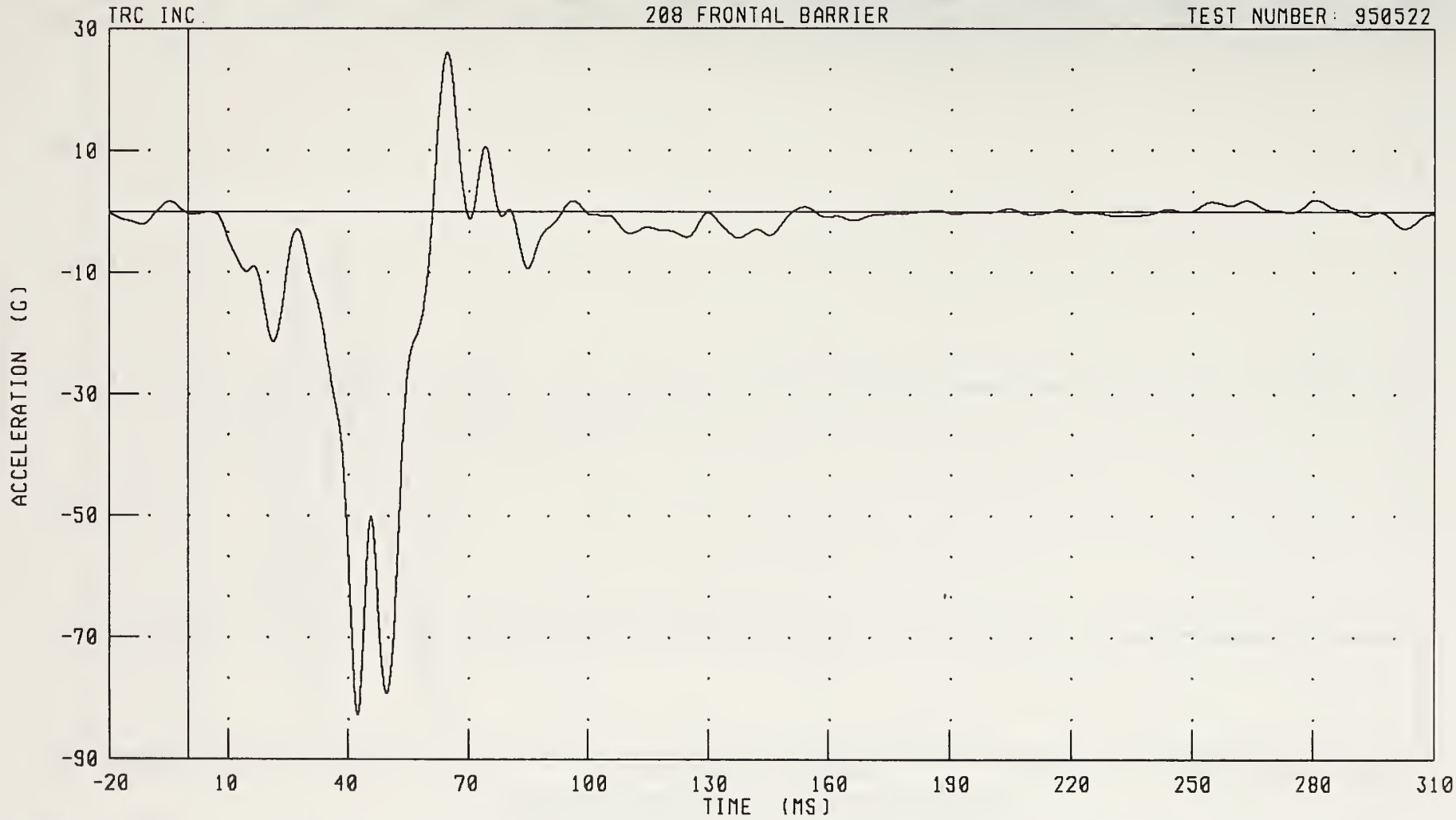
SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
LEFT REAR SEAT X-AXIS ACCELERATION



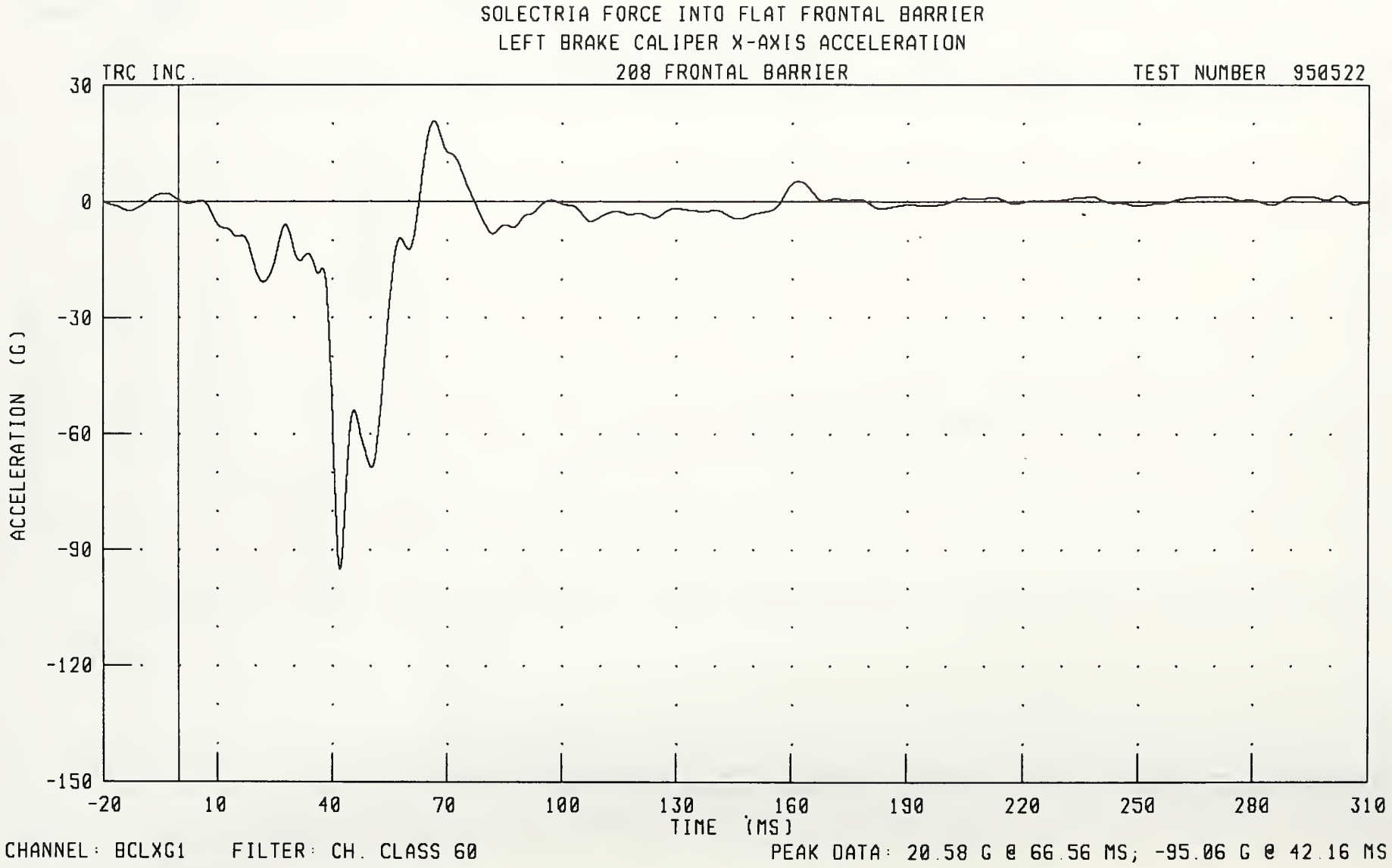
CHANNEL: TLRXG1 FILTER: CH. CLASS 60 PEAK DATA: 19.40 G @ 47.04 MS; -31.57 G @ 39.84 MS


SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT REAR SEAT X-AXIS ACCELERATION
TRC INC.
208 FRONTAL BARRIER
TEST NUMBER: 950522
60
40
20
0
-20
-40
-60
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: TRRXG1
FILTER: CH. CLASS 60
PEAK DATA: 1.52 G @ 304.16 MS; -31.87 G @ 38.56 MS

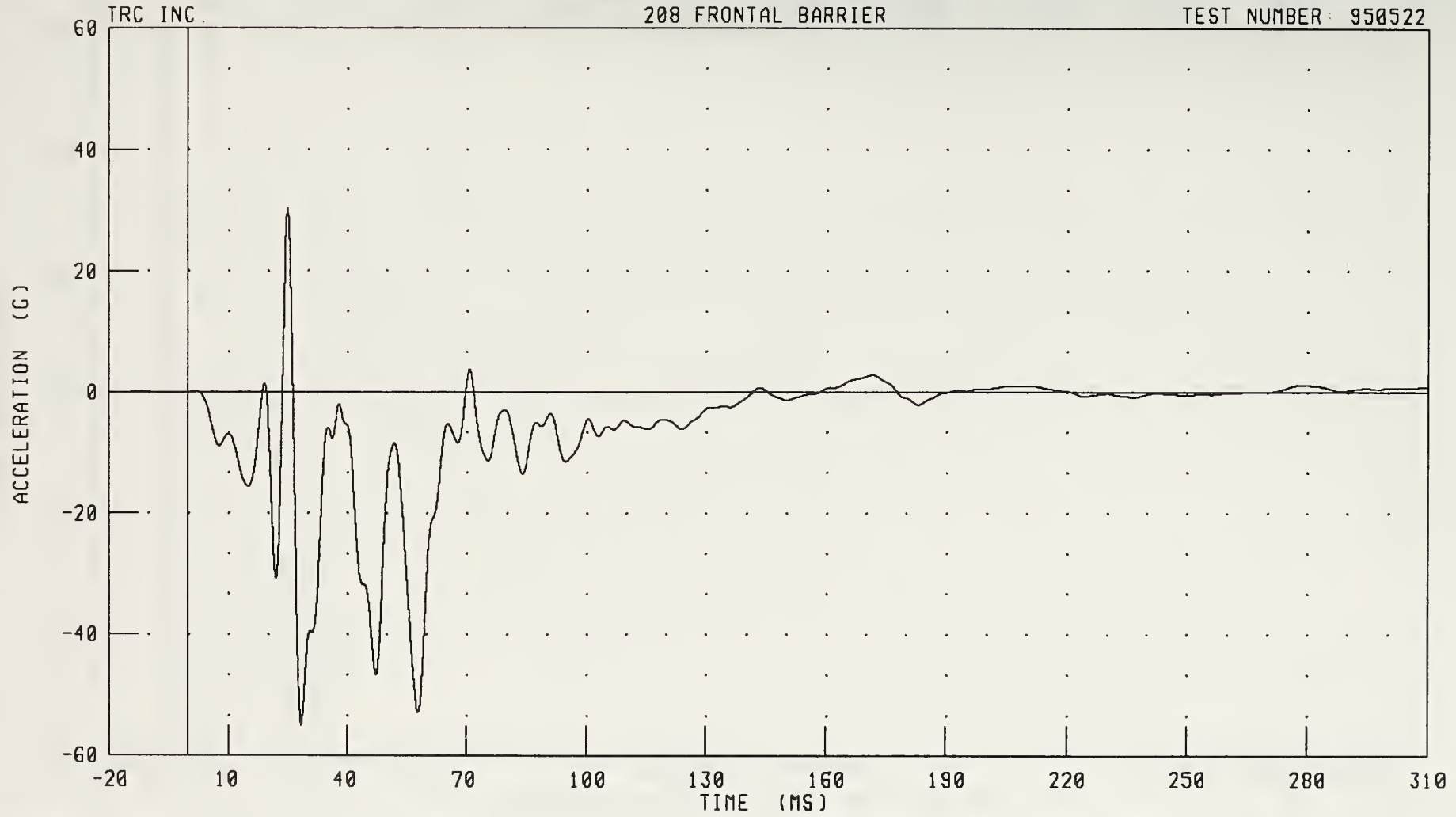
SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT BRAKE CALIPER X-AXIS ACCELERATION



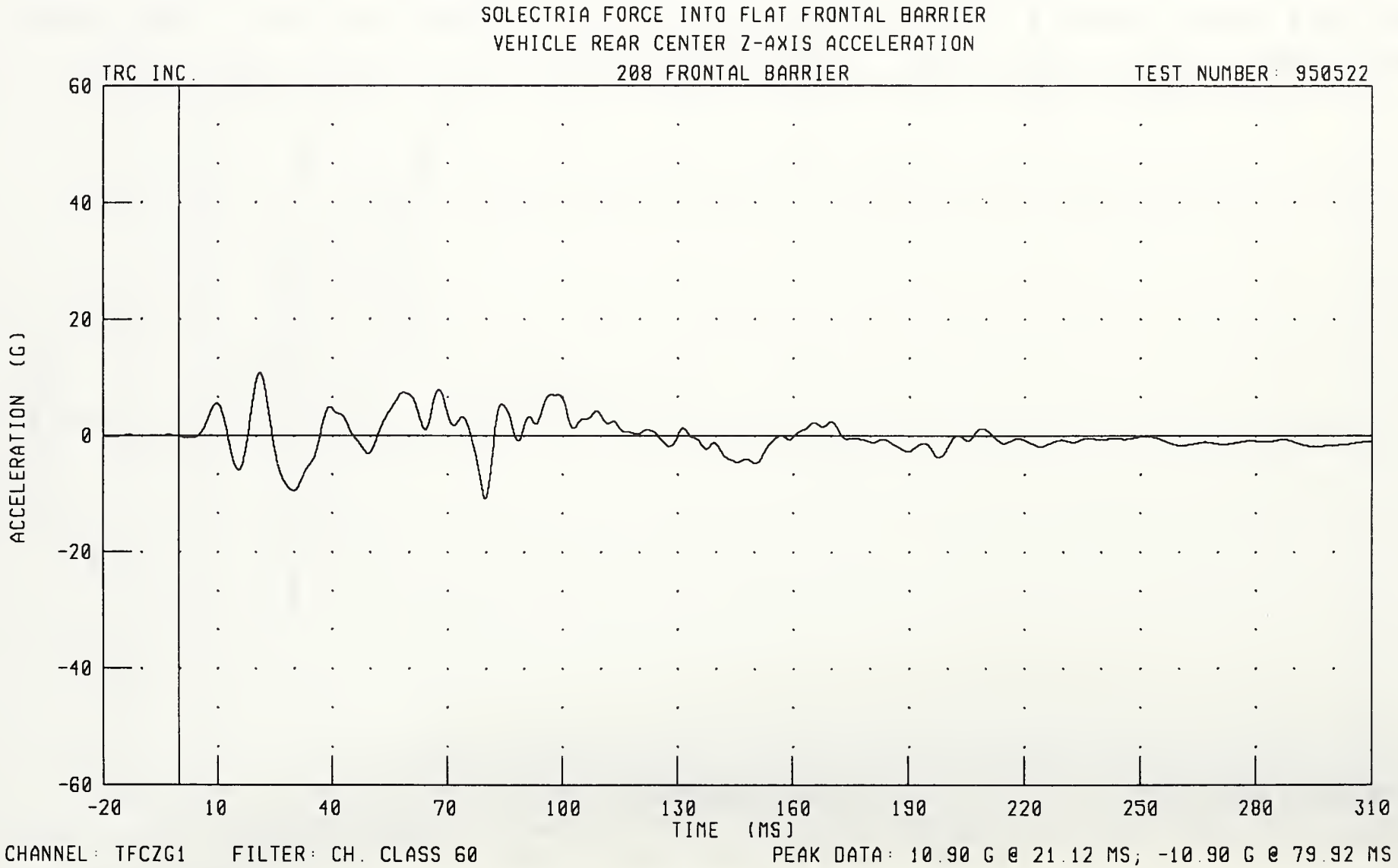
CHANNEL: BCRXG1 FILTER: CH. CLASS 60 PEAK DATA: 26.07 G @ 64.56 MS; -82.59 G @ 42.40 MS

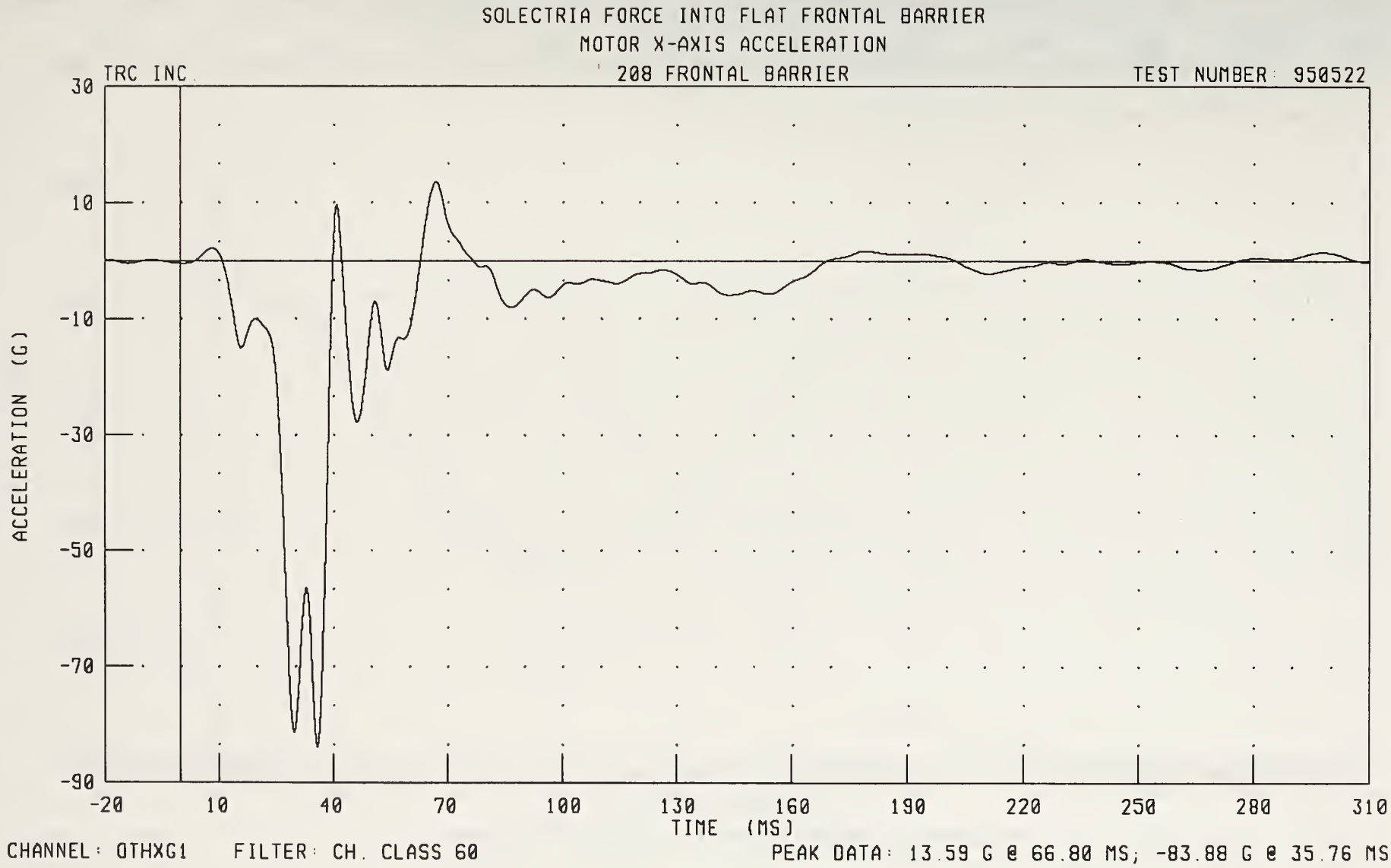

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
LEFT BRAKE CALIPER X-AXIS ACCELERATION
TRC INC.
208 FRONTAL BARRIER
TEST NUMBER 950522
30
0
-30
-60
-90
-120
-150
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: BCLXG1
FILTER: CH. CLASS 60
PEAK DATA: 20.58 G @ 66.56 MS; -95.06 G @ 42.16 MS

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DASH PANEL CENTER X-AXIS ACCELERATION

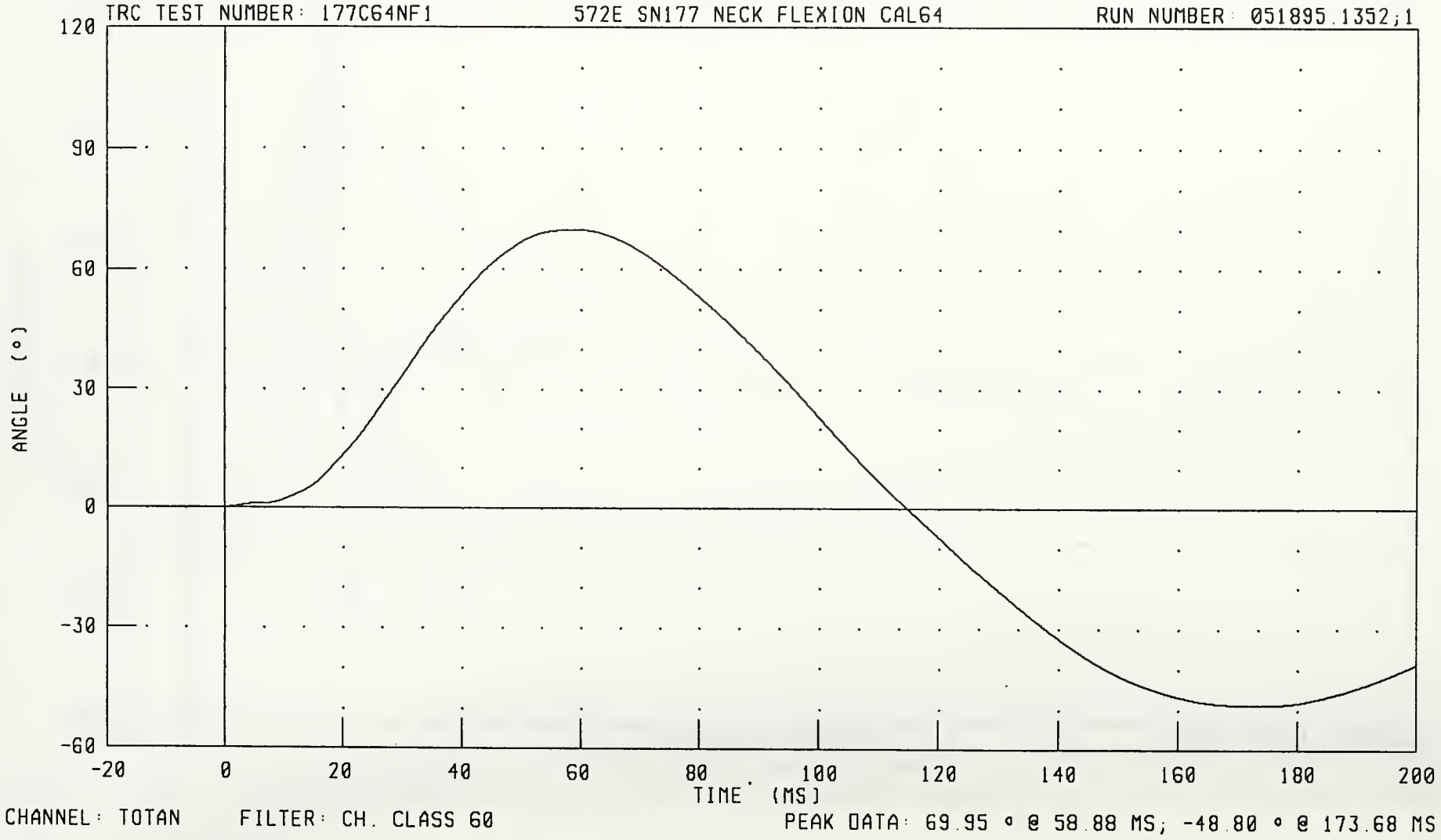


CHANNEL: DPCXG1 FILTER: CH. CLASS 60 PEAK DATA: 30.33 G @ 24.88 MS; -54.98 G @ 28.32 MS


SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
VEHICLE REAR CENTER Z-AXIS ACCELERATION
TRC INC.
208 FRONTAL BARRIER
TEST NUMBER: 950522
60
40
20
0
-20
-40
-60
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: TFCZG1
FILTER: CH. CLASS 60
PEAK DATA: 10.90 G @ 21.12 MS; -10.90 G @ 79.92 MS


SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
MOTOR X-AXIS ACCELERATION
TRC INC
208 FRONTAL BARRIER
TEST NUMBER: 950522
30
10
-10
-30
-50
-70
-90
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: 0THXG1
FILTER: CH. CLASS 60
PEAK DATA: 13.59 G @ 66.80 MS; -83.88 G @ 35.76 MS

PART 572-E HYBRID III NECK FLEXION CALIBRATION
TOTAL ROTATION

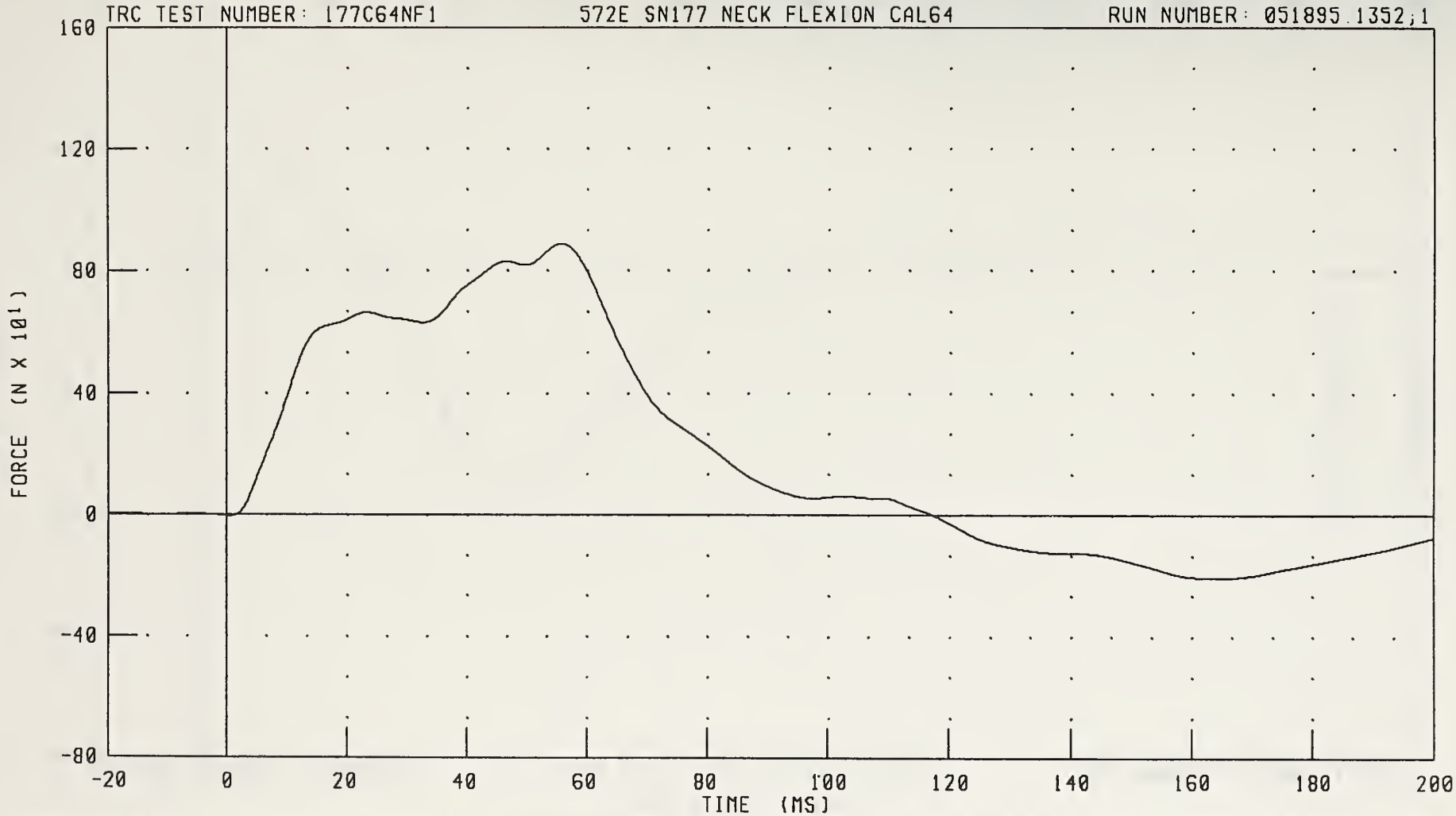


CHANNEL: TOTAN FILTER: CH. CLASS 60

PEAK DATA: 69.95 ° @ 58.88 MS; -48.80 ° @ 173.68 MS

PART 572-E HYBRID III NECK FLEXION CALIBRATION

NECK FORCE X AXIS



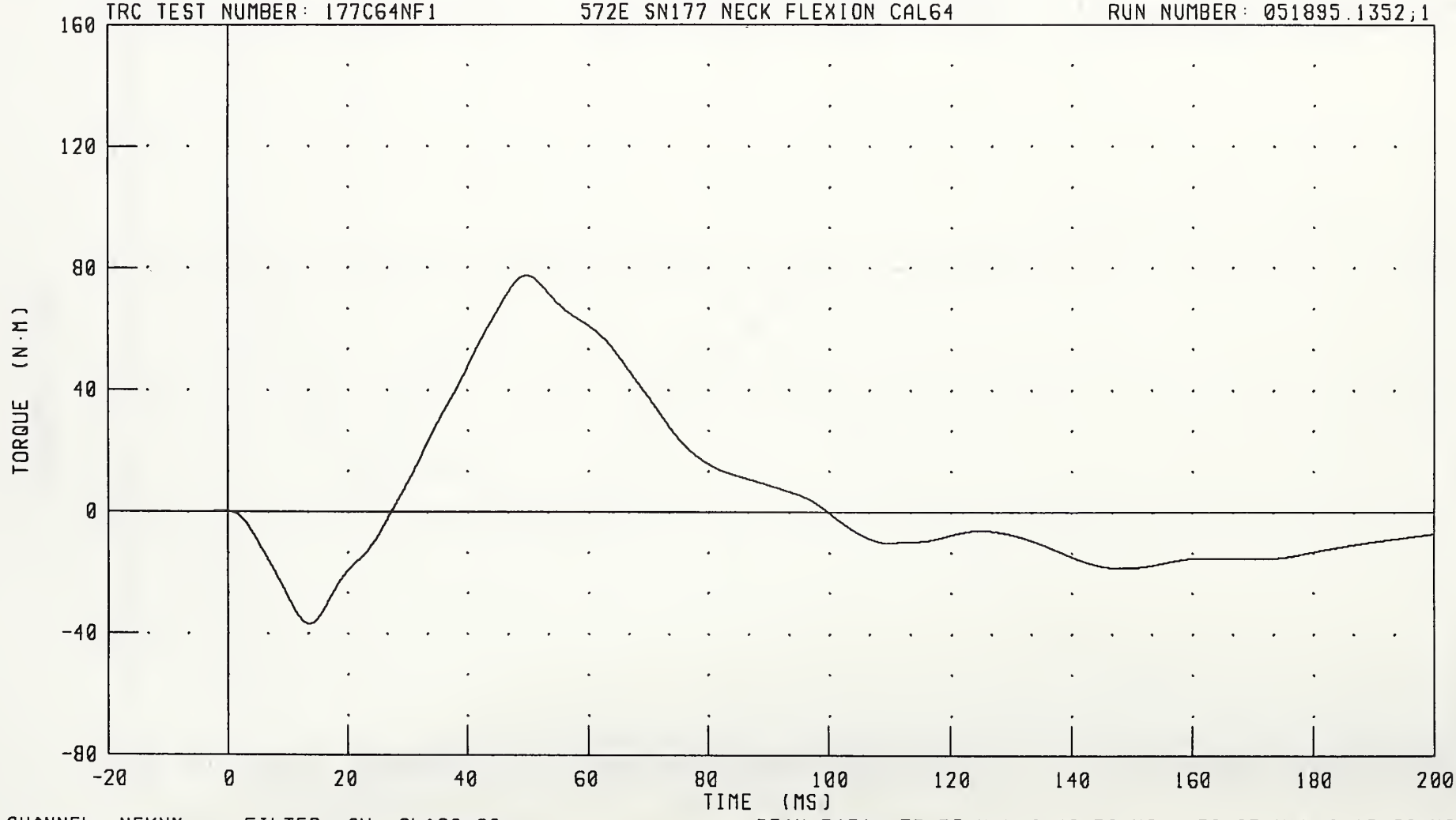
CHANNEL: NEKXF FILTER: CH. CLASS 60

PEAK DATA: 888.93 N @ 55.68 MS; -206.90 N @ 165.04 MS

PART 572-E HYBRID III NECK FLEXION CALIBRATION

NECK MOMENT Y AXIS

TRC TEST NUMBER: 177C64NF1 572E SN177 NECK FLEXION CAL64 RUN NUMBER: 051895.1352;1



CHANNEL: NEKYM FILTER: CH. CLASS 60 PEAK DATA: 77.53 N·M @ 49.76 MS; -36.85 N·M @ 13.60 MS

Appendix C

Dummy Certification Data

TRANSPORTATION RESEARCH CENTER INC.
HYBRID III EXTERNAL DIMENSIONS
083 HUMANOID 18-MAY-95

TRC INC. TEST NO: 83C3ED1 572E SN083 EXT.DIMENSION CAL03

TEST PARAMETER (DIMEN.)	SPECIFICATION	TEST RESULTS
LOCATION FOR CHEST CIRCUMFERENCE (AA)	429 - 434 MM	432. MM
LOCATION FOR WAIST CIRCUMFERENCE (BB)	226 - 231 MM	229. MM
CHEST CIRCUMFERENCE (Y)	970 -1001 MM	983. MM
WAIST CIRCUMFERENCE (Z)	836 - 866 MM	853. MM
CHEST DEPTH (O)	213 - 229 MM	216. MM
H-POINT HEIGHT (C)	84 - 89 MM	89. MM
H-POINT FROM SEATBACK (D)	135 - 140 MM	140. MM
SKULL CAP TO BACKLINE (H)	41 - 46 MM	43. MM
TOTAL SITTING HEIGHT (A)	879 - 889 MM	884. MM
THIGH CLEARANCE (F)	140 - 155 MM	145. MM
BUTTOCK KNEE LENGTH (K)	579 - 605 MM	597. MM
BUTTOCK POPLITEAL LENGTH (N)	452 - 478 MM	470. MM
POPLITEAL HEIGHT (L)	429 - 455 MM	439. MM
KNEE PIVOT HEIGHT (M)	485 - 500 MM	493. MM
FOOT LENGTH (P)	252 - 267 MM	259. MM
FOOT BREADTH (W)	91 - 107 MM	102. MM
SHOULDER PIVOT FROM BACKLINE (E)	84 - 94 MM	89. MM
SHOULDER BREADTH (V)	422 - 437 MM	429. MM
SHOULDER PIVOT HEIGHT (B)	506 - 521 MM	516. MM
ELBOW REST HEIGHT (J)	191 - 211 MM	208. MM
SHOULDER-ELBOW LENGTH (I)	330 - 345 MM	343. MM
BACK OF ELBOW TO WRIST PIVOT (G)	290 - 305 MM	297. MM

DUMMY MEETS SPECIFICATIONS
TECHNICIAN Pete Foss

RUN NUMBER: 051995.0828

TRANSPORTATION RESEARCH CENTER INC.

HEAD DROP TEST

HYBRID III 18-MAY-95

TRC INC. TEST NO: 83C3HD1 572E SN083 HEAD DROP CAL 03

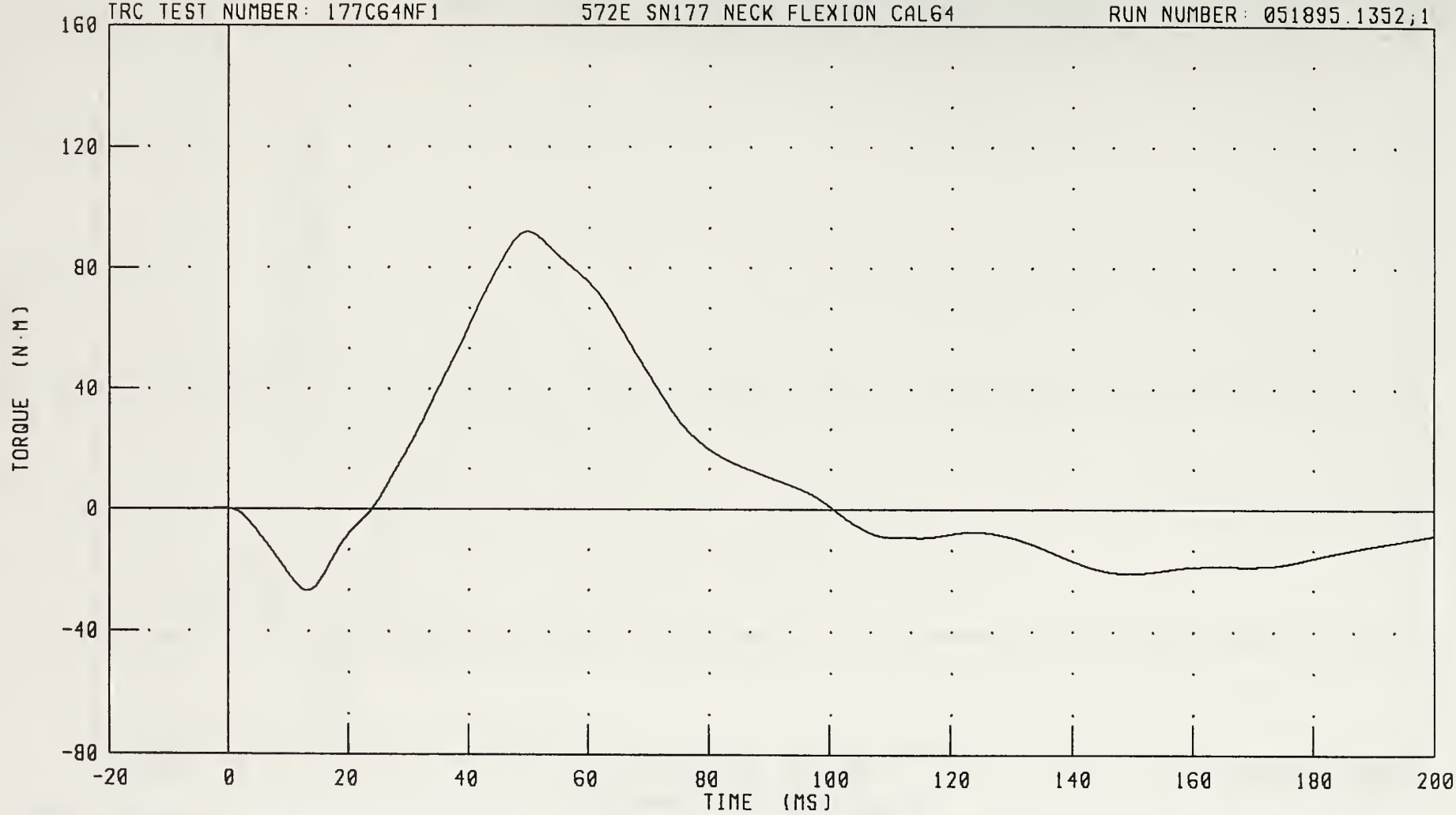
TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10 - 70 %	50.0 %
PEAK RESULTANT ACCELERATION	225 - 275 G	252.54 G
PEAK LATERAL ACCELERATION	15 G MAX	2.11 G
IS ACCELERATION CURVE UNIMODAL?	YES	YES

TEST MEETS SPECIFICATIONS

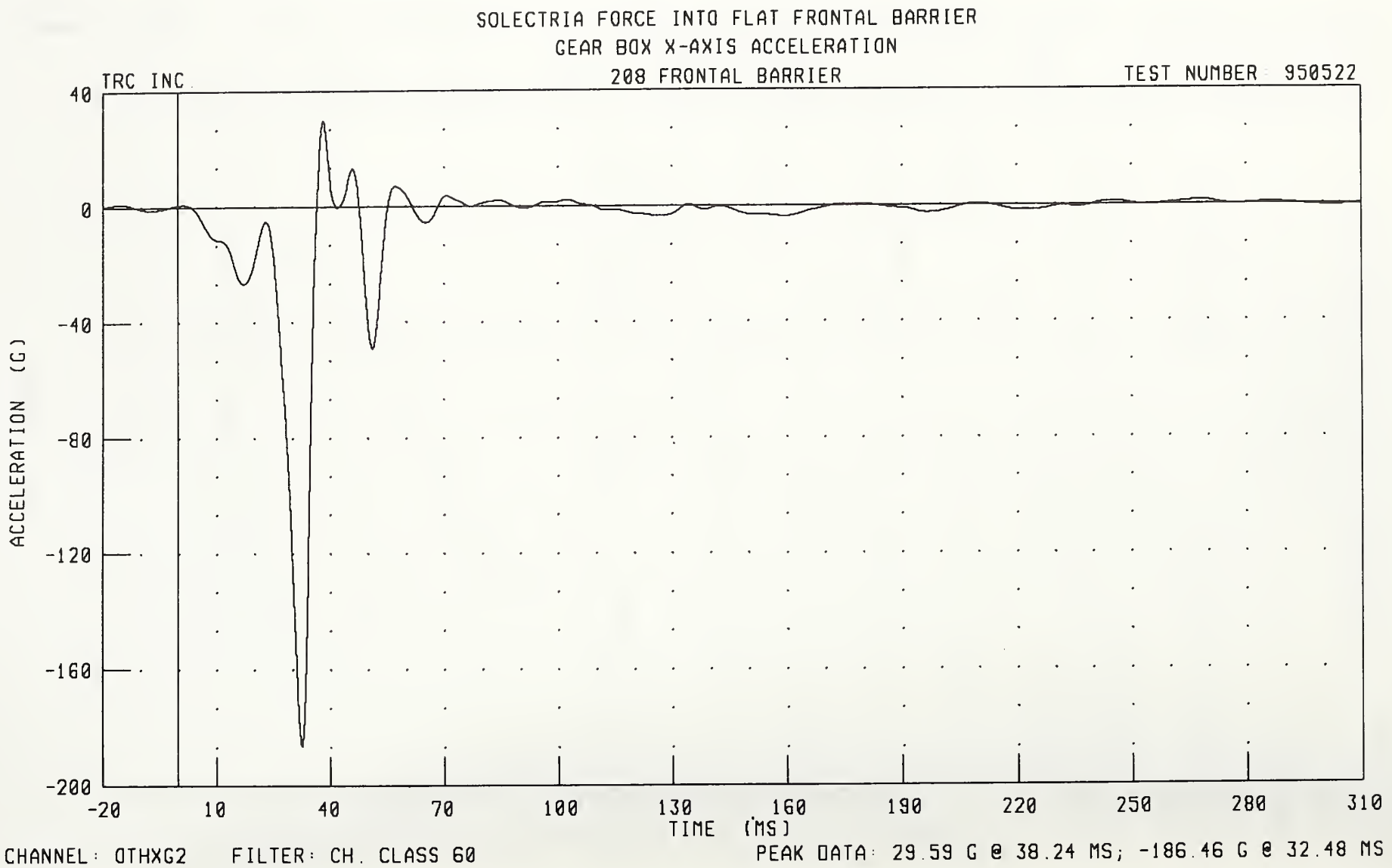
TECHNICIAN _____ RUN NUMBER: 051895.0922;1

PART 572-E HYBRID III NECK FLEXION CALIBRATION
TOTAL MOMENT ABOUT OCCIPITAL CONDYLE

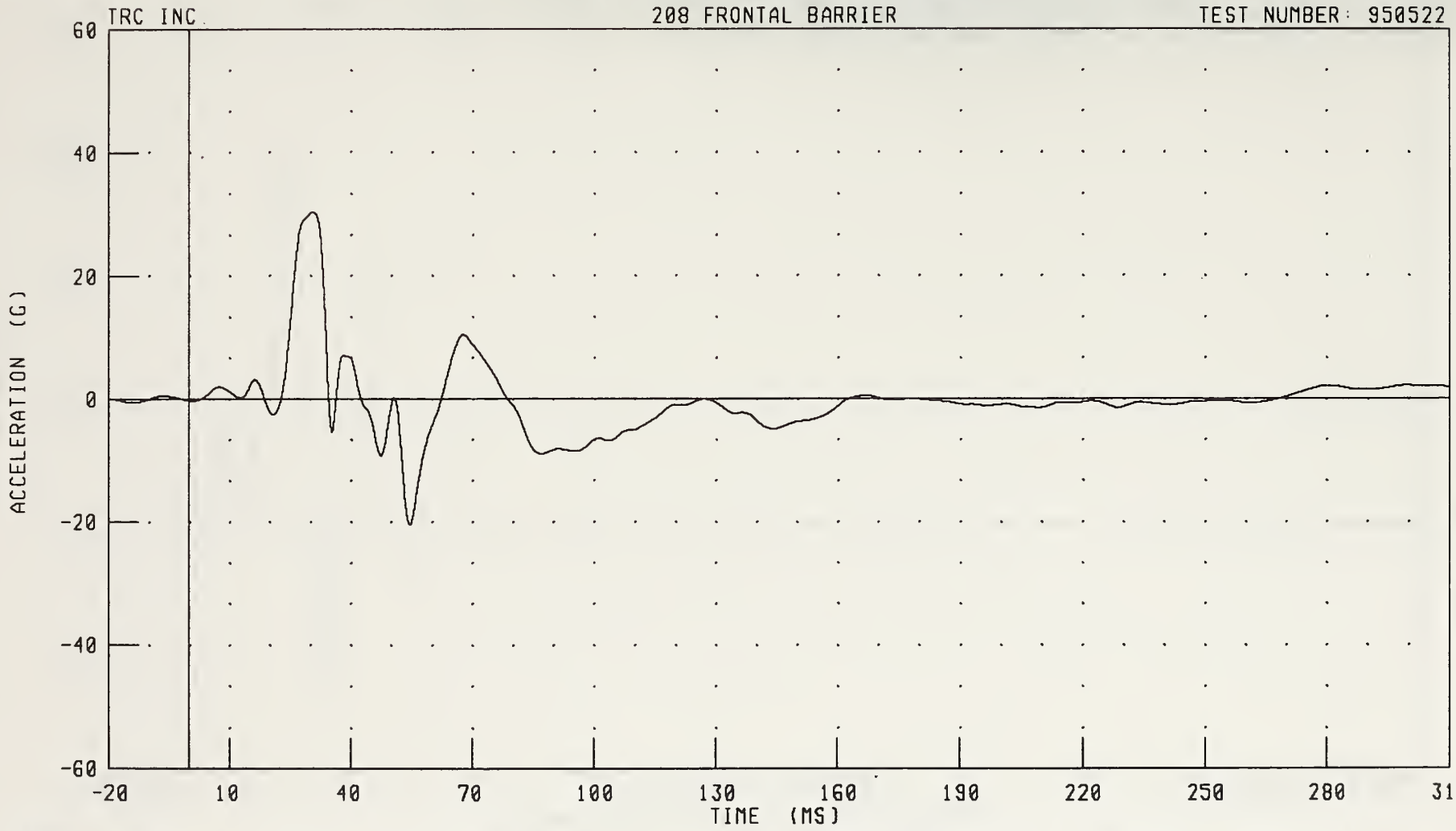
TRC TEST NUMBER: 177C64NF1 572E SN177 NECK FLEXION CAL64 RUN NUMBER: 051895.1352;1



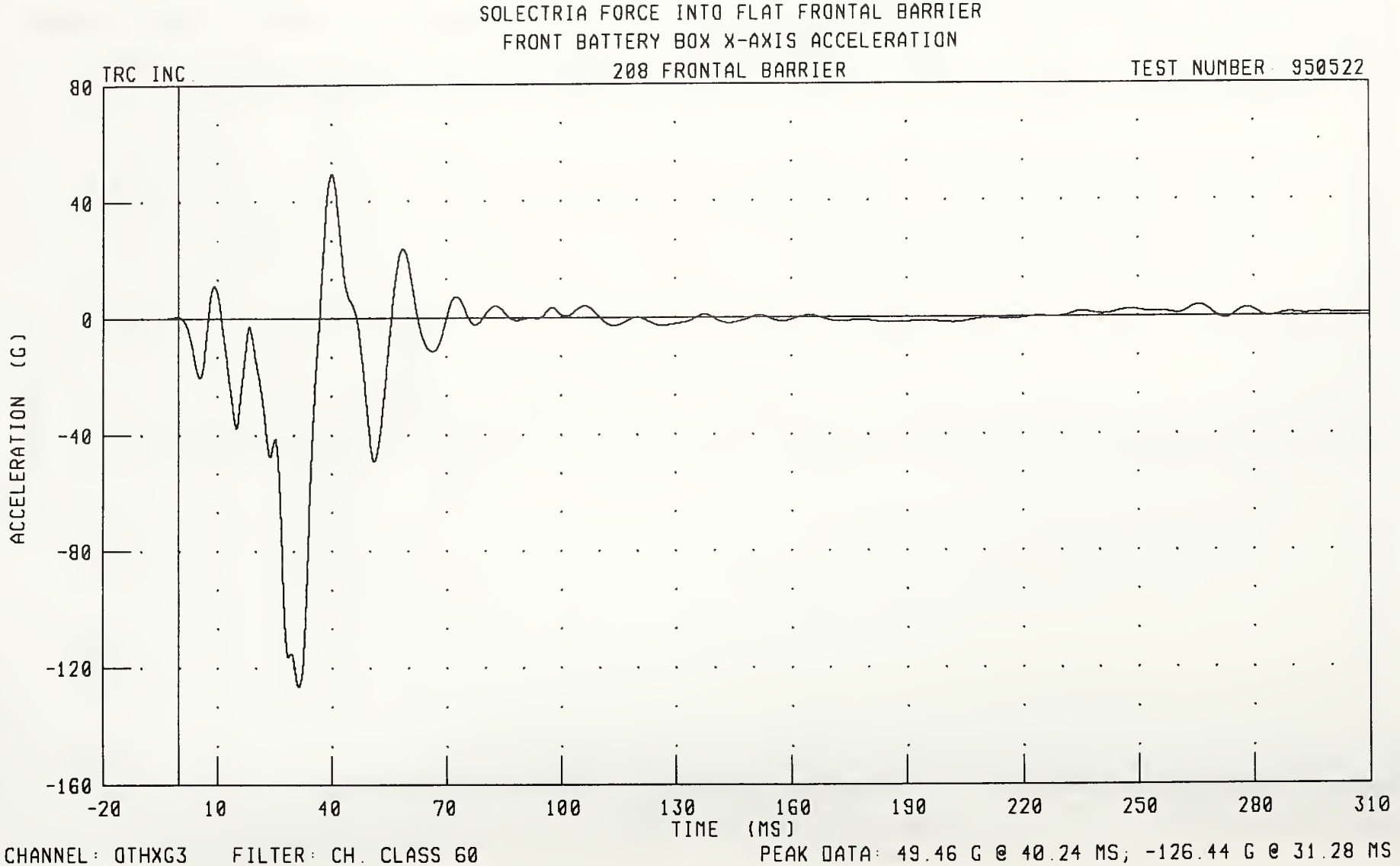
CHANNEL: NEKOM FILTER: CH. CLASS 60 PEAK DATA: 92.09 N·M @ 49.76 MS; -26.80 N·M @ 13.20 MS


SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
GEAR BOX X-AXIS ACCELERATION
208 FRONTAL BARRIER
TRC INC.
TEST NUMBER: 950522
ACCELERATION (G)
40
0
-40
-80
-120
-160
-200
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: 0THXG2
FILTER: CH. CLASS 60
PEAK DATA: 29.59 G @ 38.24 MS; -186.46 G @ 32.48 MS

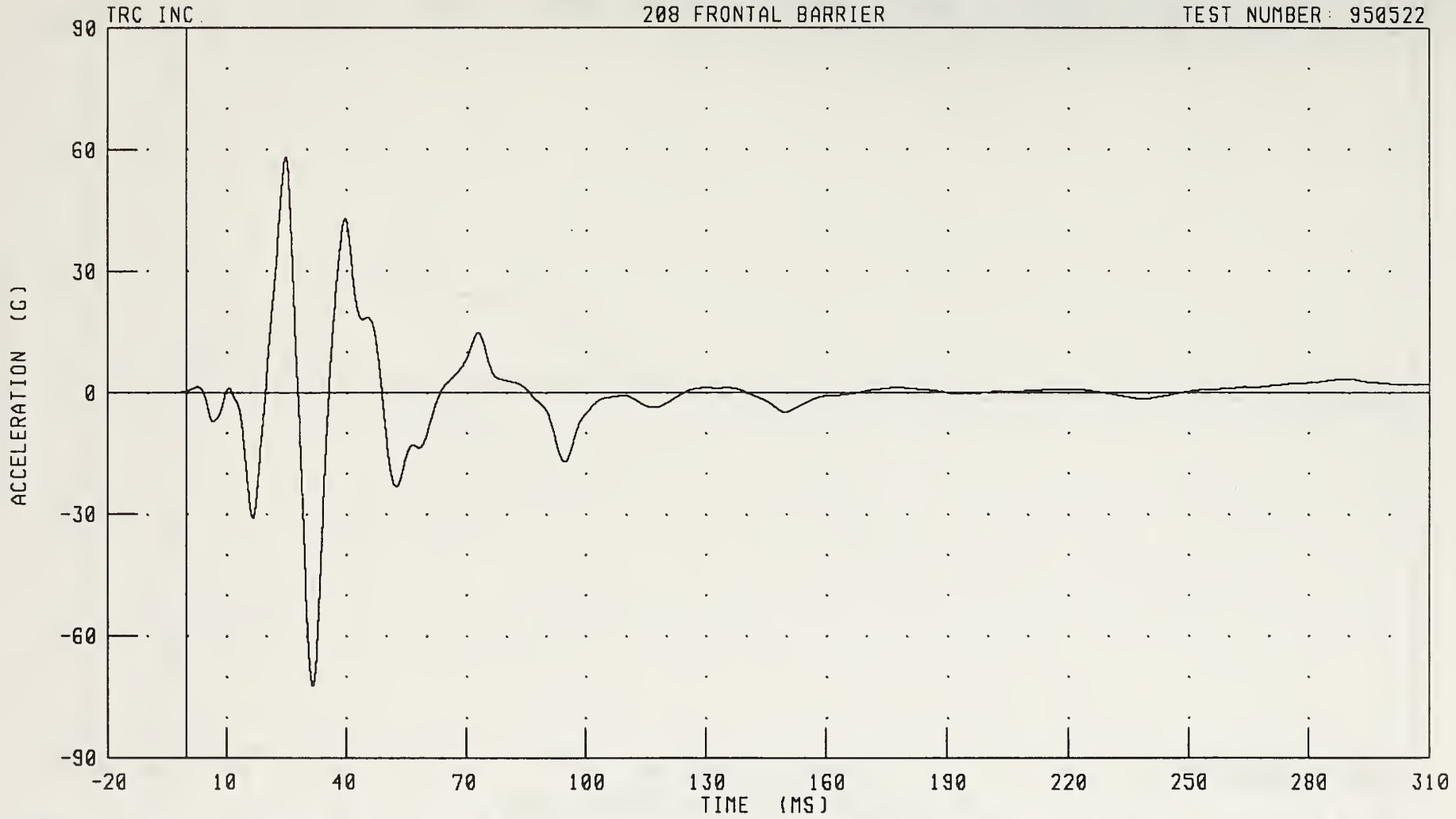
SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
GEAR BOX Z-AXIS ACCELERATION



CHANNEL: 0THZG2 FILTER: CH. CLASS 60 PEAK DATA: 30.36 G @ 30.72 MS; -20.53 G @ 54.56 MS

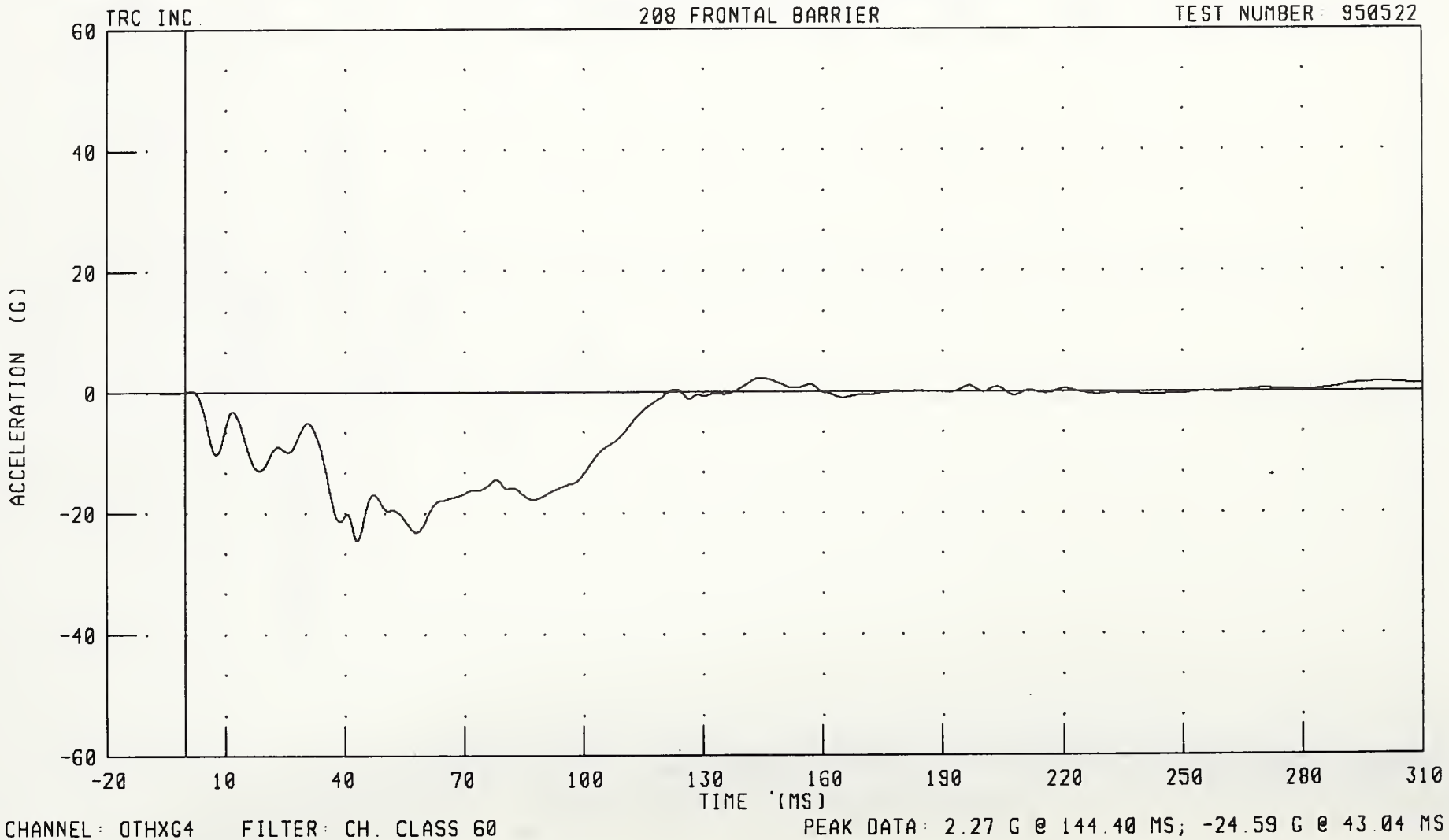

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
FRONT BATTERY BOX X-AXIS ACCELERATION
208 FRONTAL BARRIER
TRC INC
TEST NUMBER 950522
80
40
0
-40
-80
-120
-160
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: 0THXG3
FILTER: CH. CLASS 60
PEAK DATA: 49.46 G @ 40.24 MS; -126.44 G @ 31.28 MS

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
FRONT BATTERY BOX Z-AXIS ACCELERATION



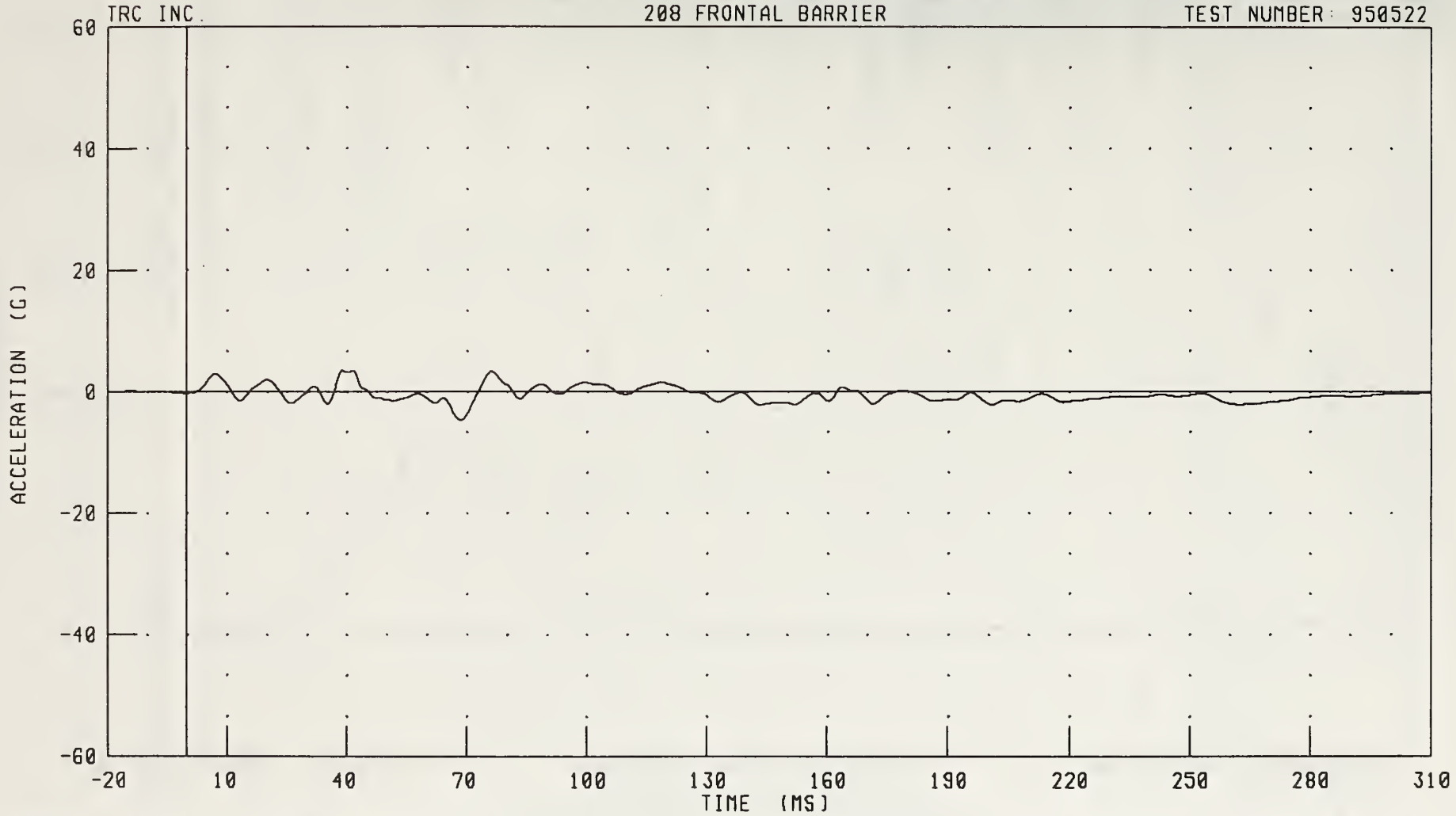
CHANNEL: OTHZG3 FILTER: CH. CLASS 60 PEAK DATA: 58.26 G @ 24.80 MS; -72.17 G @ 31.60 MS

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
REAR BATTERY BOX X-AXIS ACCELERATION
208 FRONTAL BARRIER

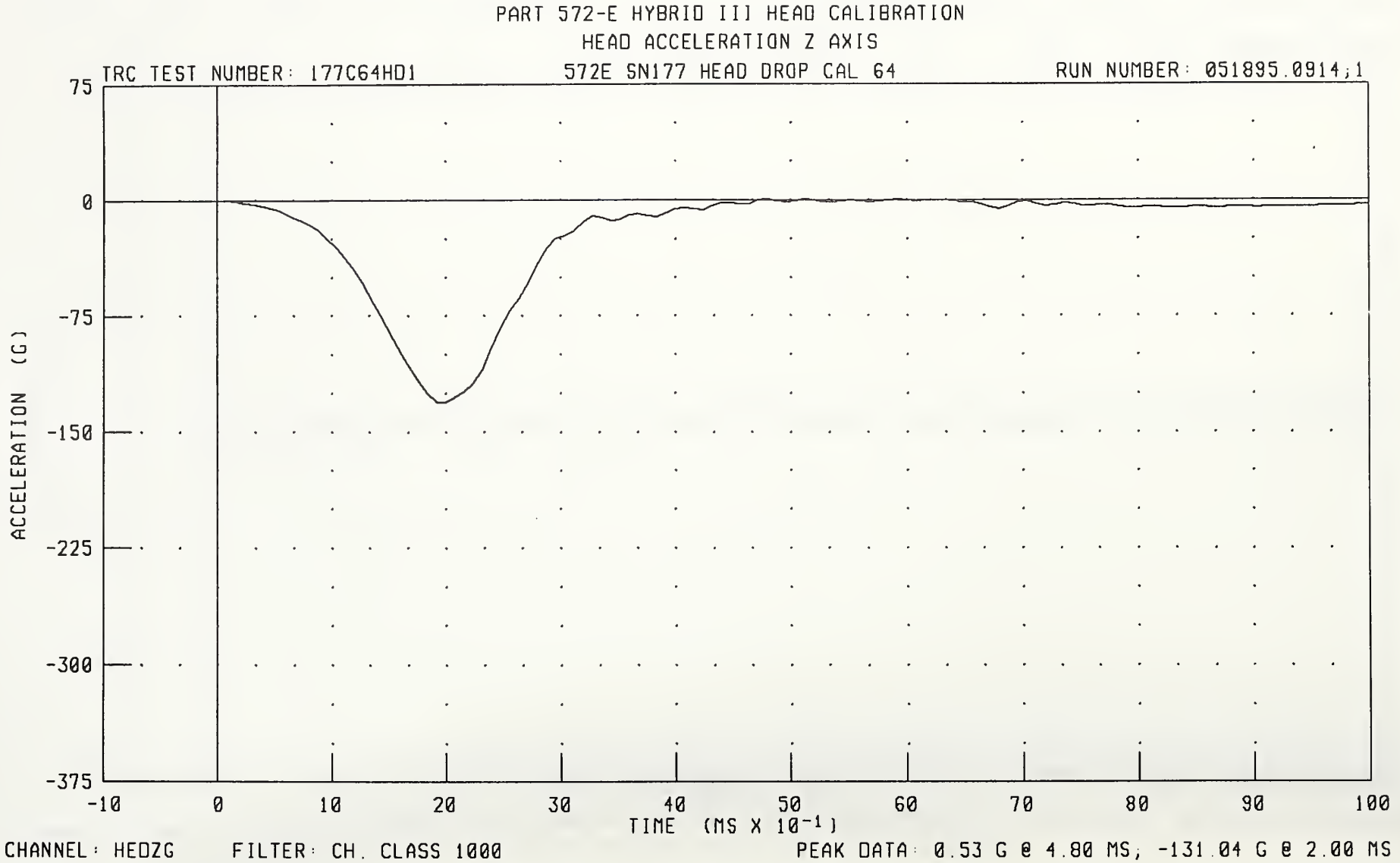


CHANNEL: OTHXG4 FILTER: CH. CLASS 60 PEAK DATA: 2.27 G @ 144.40 MS; -24.59 G @ 43.04 MS

SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
REAR BATTERY BOX Z-AXIS ACCELERATION



CHANNEL: 0THZG4 FILTER: CH. CLASS 60 PEAK DATA: 3.50 G @ 38.88 MS; -4.69 G @ 68.40 MS


PART 572-E HYBRID III HEAD CALIBRATION
HEAD ACCELERATION Z AXIS
TRC TEST NUMBER: 177C64HD1
572E SN177 HEAD DROP CAL 64
RUN NUMBER: 051895.0914;1
75
0
-75
-150
-225
-300
-375
ACCELERATION (G)
-10
0
10
20
30
40
50
60
70
80
90
100
TIME (MS X 10-1)
CHANNEL: HEDZG
FILTER: CH. CLASS 1000
PEAK DATA: 0.53 G @ 4.80 MS; -131.04 G @ 2.00 MS

TRANSPORTATION RESEARCH CENTER INC.

NECK FLEXION TEST - 6 CHANNEL TRANSDUCER

HYBRID III 18-MAY-95

TRC INC. TEST NO: 177C64NF1 572E SN177 NECK FLEXION CAL64

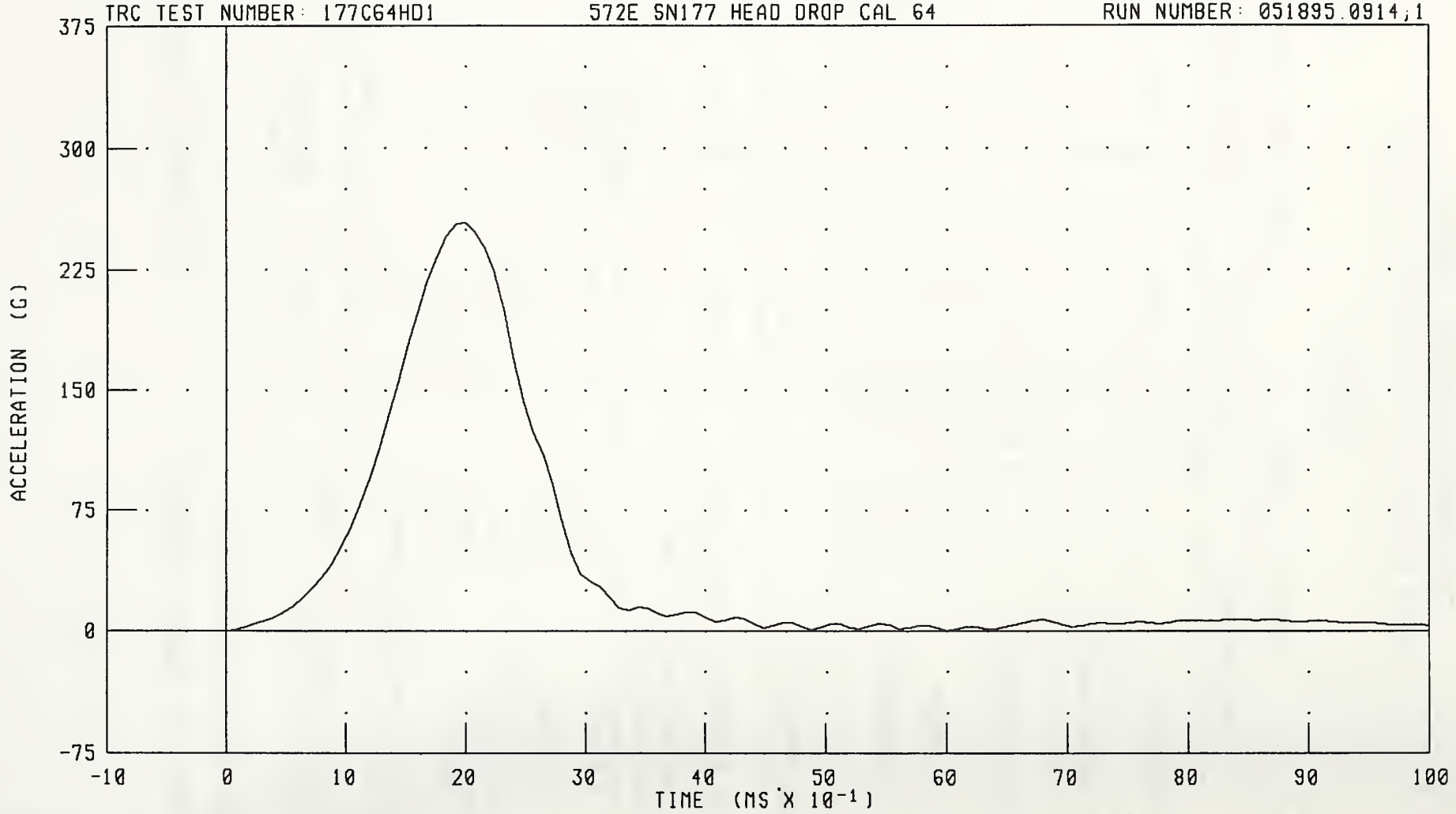
TEST PARAMETER		SPECIFICATION	TEST RESULTS
TEMPERATURE		20.6-22.2 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY		10 - 70 %	50.0 %
IMPACT VELOCITY		6.89 - 7.13 M/S	6.99 M/S
PENDULUM DECELERATION	10 MS	22.50 - 27.50 G	23.14 G
	20 MS	17.60 - 22.60 G	20.15 G
	30 MS	12.50 - 18.50 G	16.04 G
MAX PENDULUM G		29 G MAX	23.98 G
MAX PENDULUM G ABOVE 30 MS		29 G MAX	16.00 G
DECELERATION-TIME CURVE DECAY TIME TO 5 G		34 - 42 MS	36.56 MS
D PLANE ROTATION	MAX	64 - 78 DEG.	69.94 DEG.
	TIME	57 - 64 MS	58.88 MS
MOMENT ABOUT OCCIPITAL CONDYLE	MAX	88.2 - 108.5 NM	92.09 NM
	TIME	47 - 58 MS	49.76 MS
ROTATION ANGLE-TIME CURVE DECAY TIME TO ZERO		113 - 128 MS	114.80 MS
POSITIVE MOMENT-TIME CURVE DECAY TIME TO ZERO		97 - 107 MS	100.64 MS

TEST MEETS SPECIFICATIONS

TECHNICIAN Peter Foss RUN NUMBER: 051895.1352;1

PART 572-E HYBRID III HEAD CALIBRATION
HEAD RESULTANT ACCELERATION

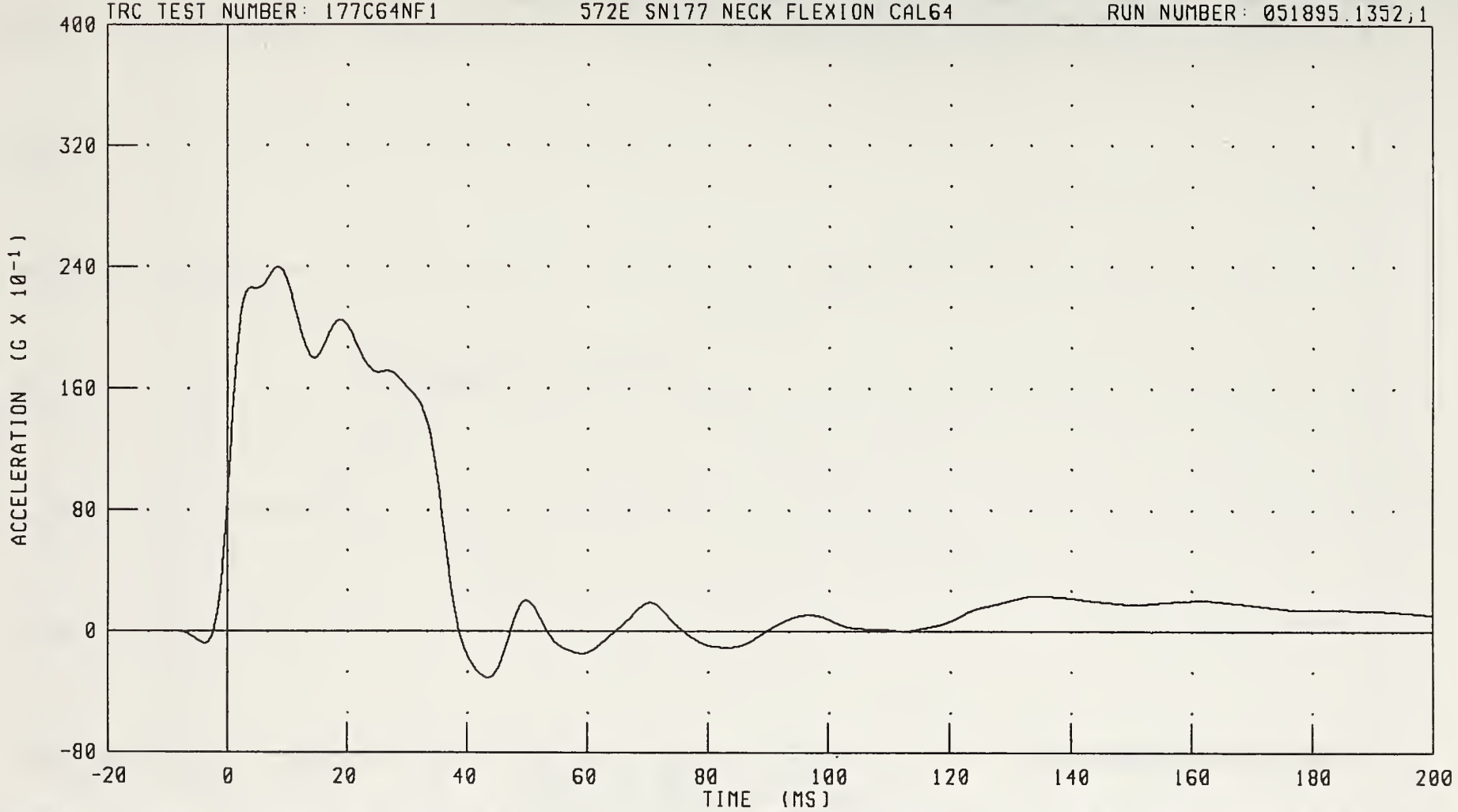
TRC TEST NUMBER: 177C64HD1 572E SN177 HEAD DROP CAL 64 RUN NUMBER: 051895.0914;1



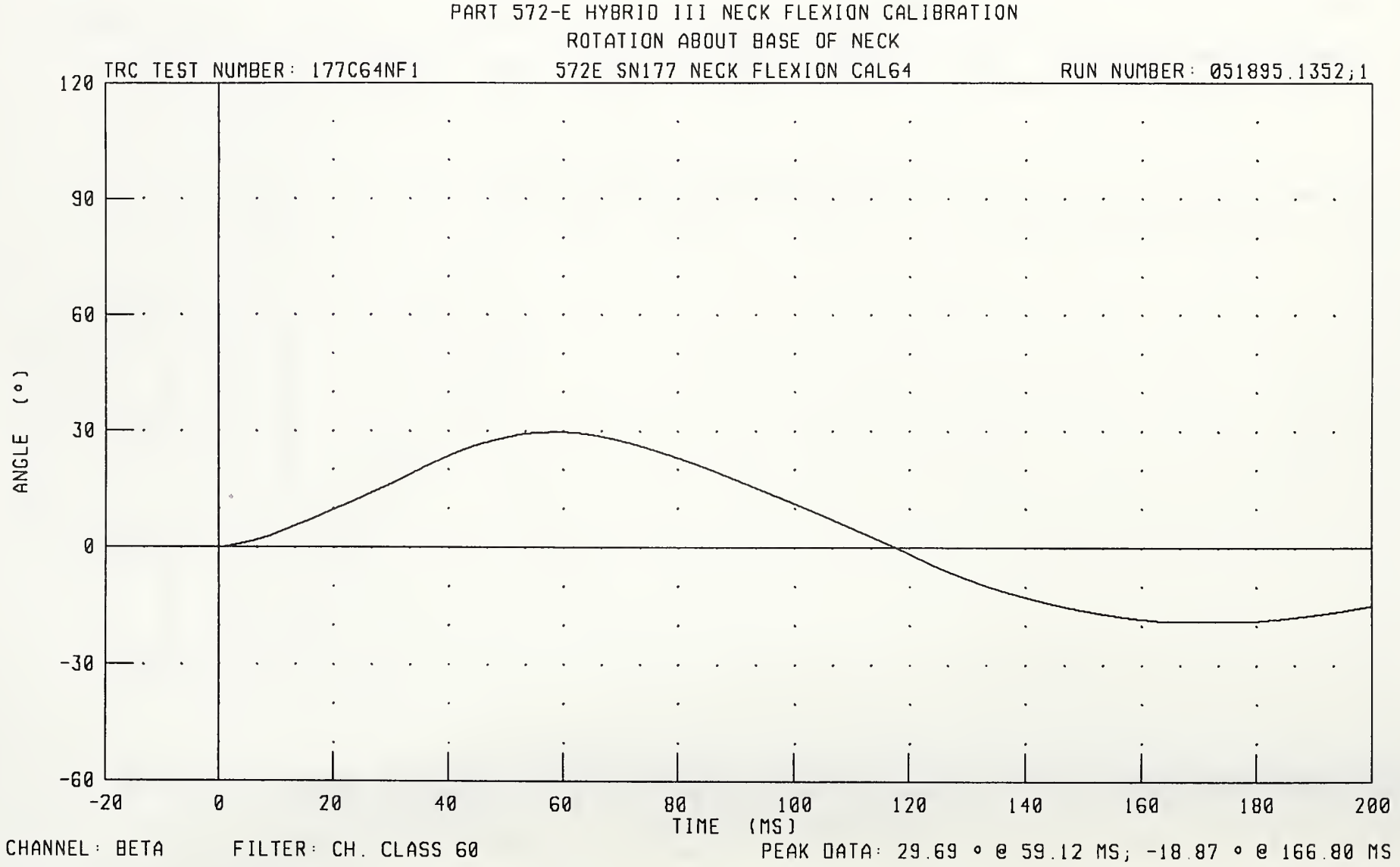
CHANNEL: HEDRG FILTER: CH. CLASS 1000 PEAK DATA: 254.26 G @ 2.00 MS; 0.24 G @ 6.00 MS

PART 572-E HYBRID III NECK FLEXION CALIBRATION
PENDULUM DECELERATION

TRC TEST NUMBER: 177C64NF1 572E SN177 NECK FLEXION CAL64 RUN NUMBER: 051895.1352;1

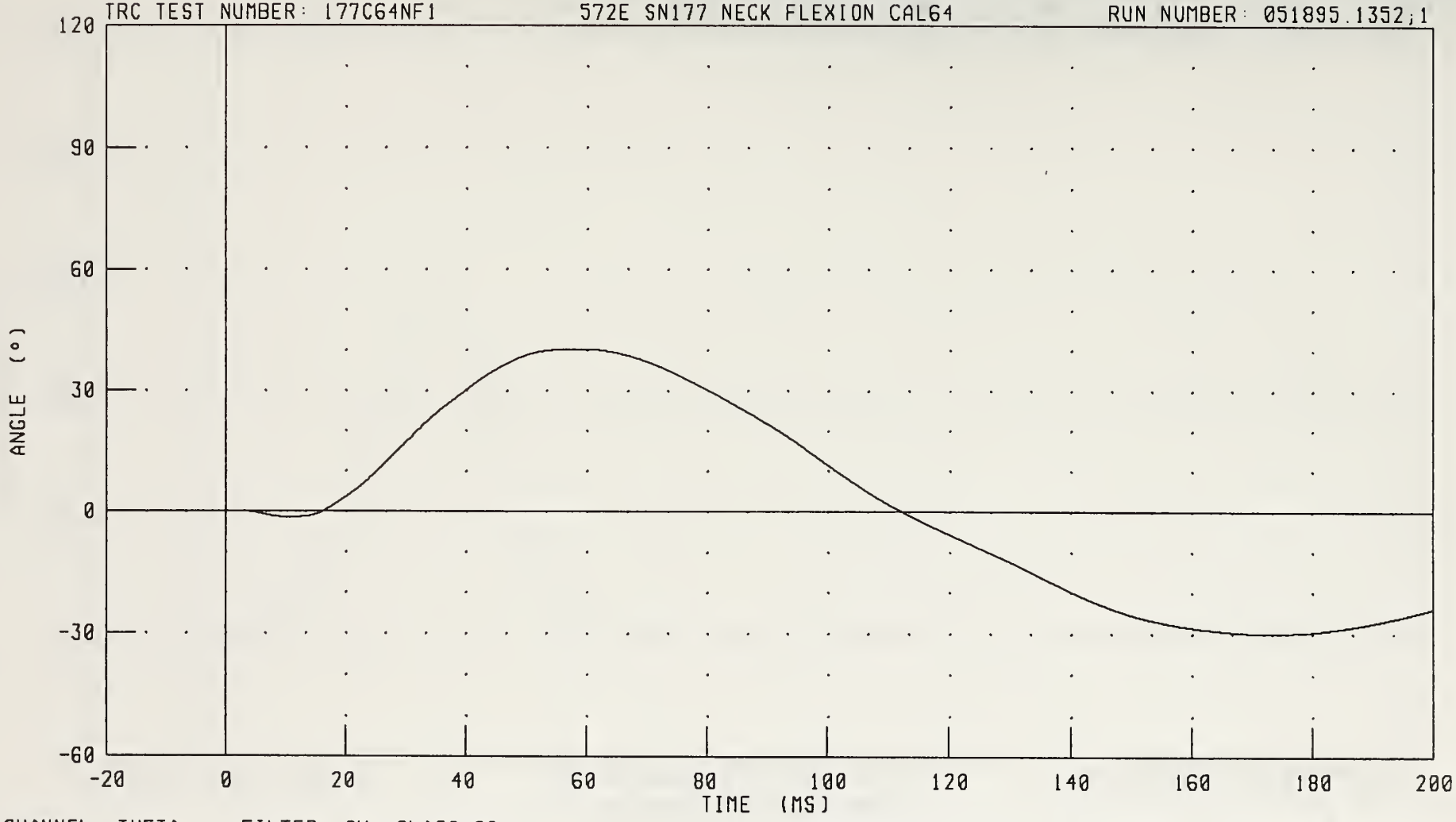


CHANNEL: PENXG FILTER: CH. CLASS 60 PEAK DATA: 23.98 G @ 8.48 MS; -3.03 G @ 43.44 MS


PART 572-E HYBRID III NECK FLEXION CALIBRATION
ROTATION ABOUT BASE OF NECK
TRC TEST NUMBER: 177C64NF1
572E SN177 NECK FLEXION CAL64
RUN NUMBER: 051895.1352;1
120
90
60
30
0
-30
-60
ANGLE (°)
-20
0
20
40
60
80
100
120
140
160
180
200
TIME (MS)
CHANNEL: BETA
FILTER: CH. CLASS 60
PEAK DATA: 29.69 ° @ 59.12 MS; -18.87 ° @ 166.80 MS

PART 572-E HYBRID III NECK FLEXION CALIBRATION
ROTATION ABOUT OCCIPITAL CONDYLE

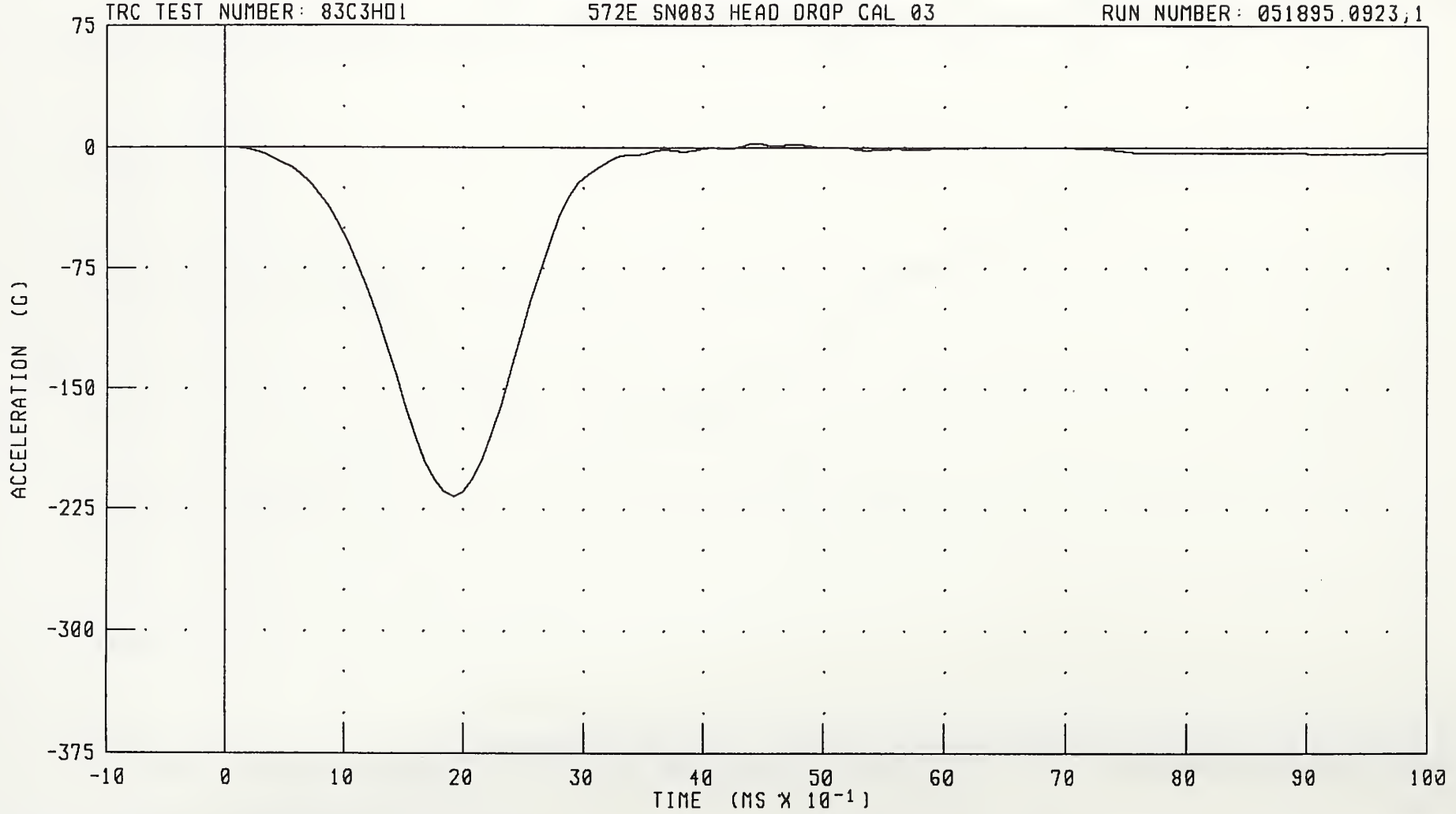
TRC TEST NUMBER: 177C64NF1 572E SN177 NECK FLEXION CAL64 RUN NUMBER: 051895.1352;1



CHANNEL: THETA FILTER: CH. CLASS 60 PEAK DATA: 40.27 ° @ 58.16 MS; -29.94 ° @ 173.52 MS

PART 572-E HYBRID III HEAD CALIBRATION
HEAD ACCELERATION X AXIS

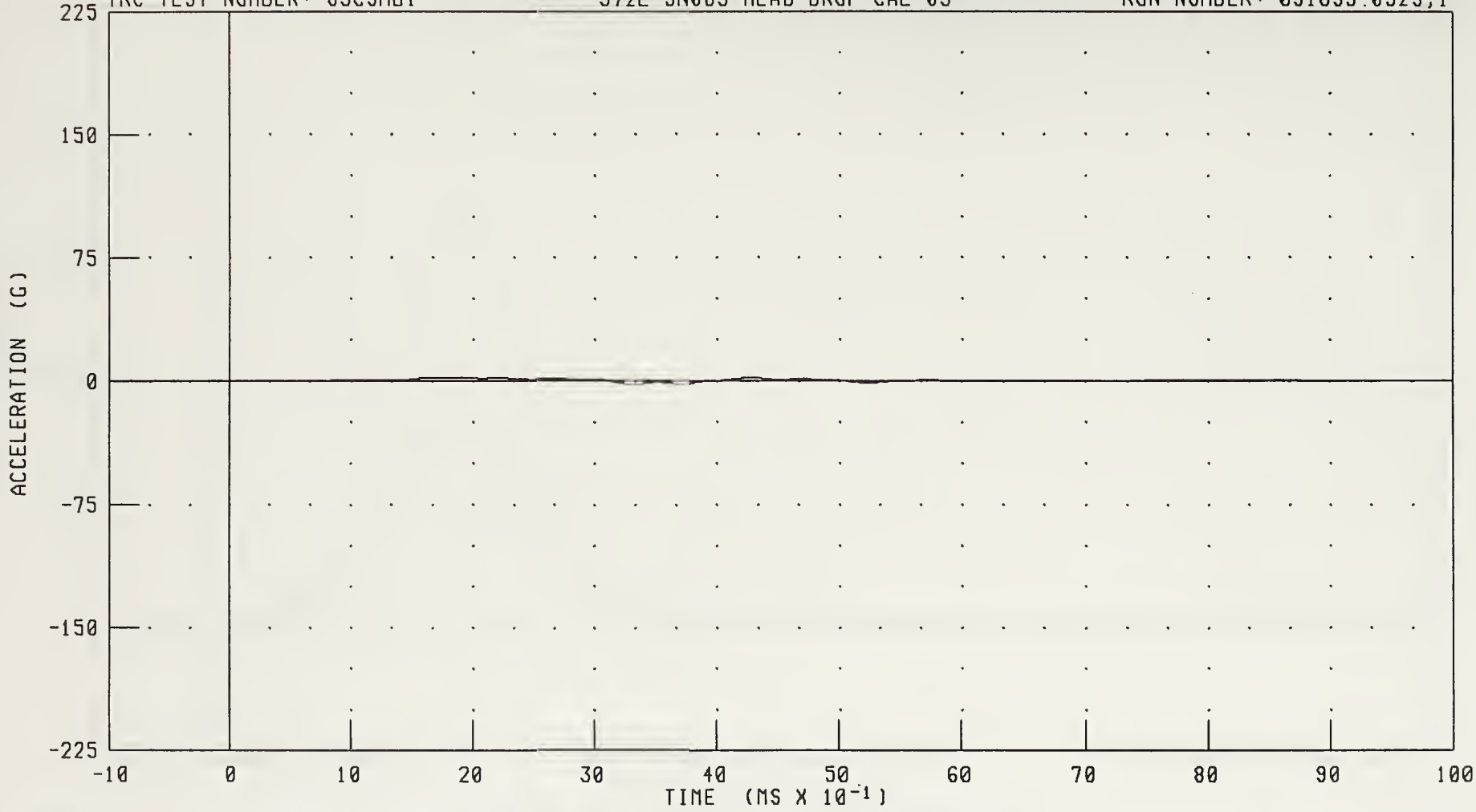
TRC TEST NUMBER: 83C3HD1 572E SN083 HEAD DROP CAL 03 RUN NUMBER: 051895.0923;1



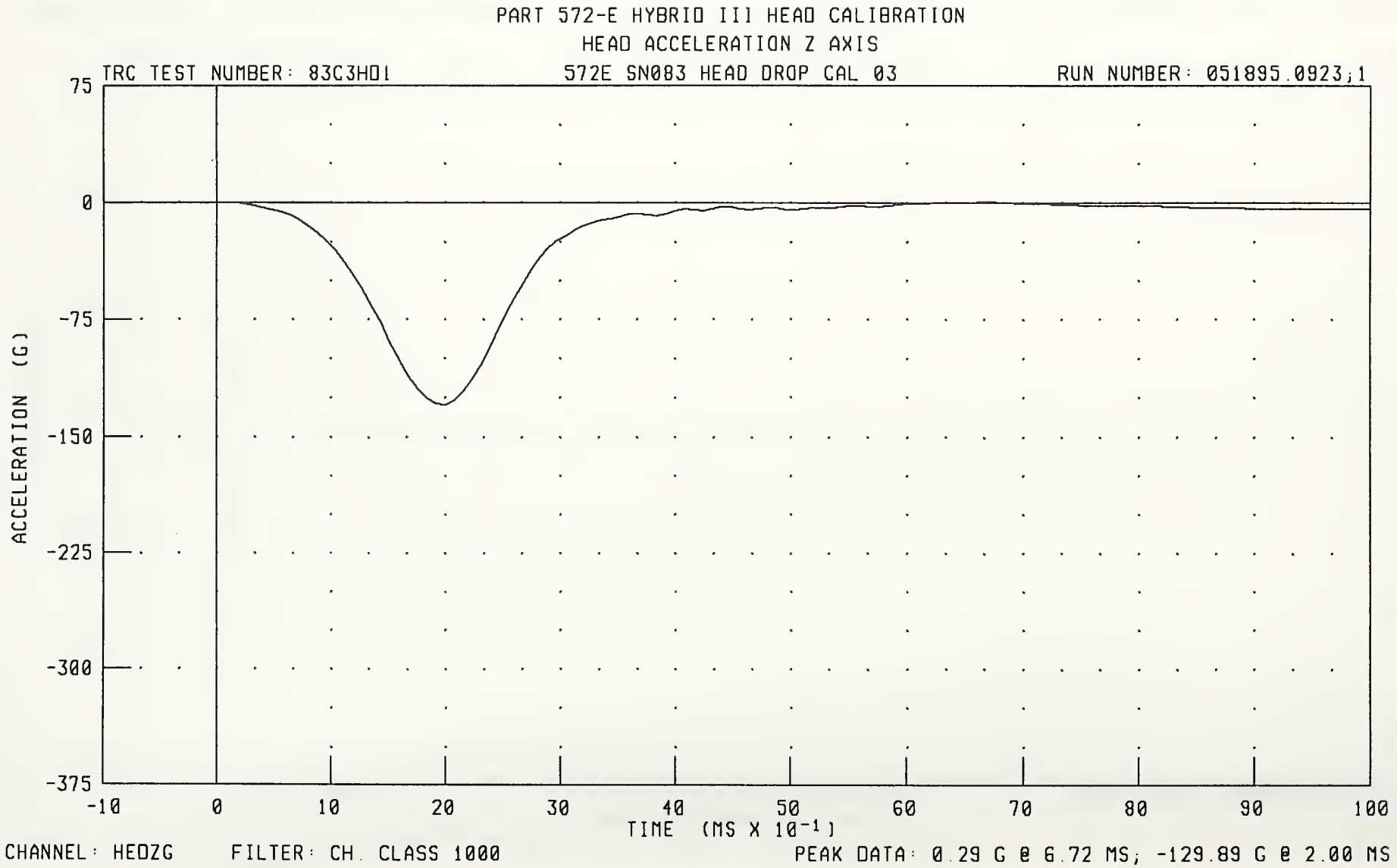
CHANNEL: HEDXG FILTER: CH. CLASS 1000 PEAK DATA: 2.24 G @ 4.48 MS; -216.95 G @ 1.92 MS

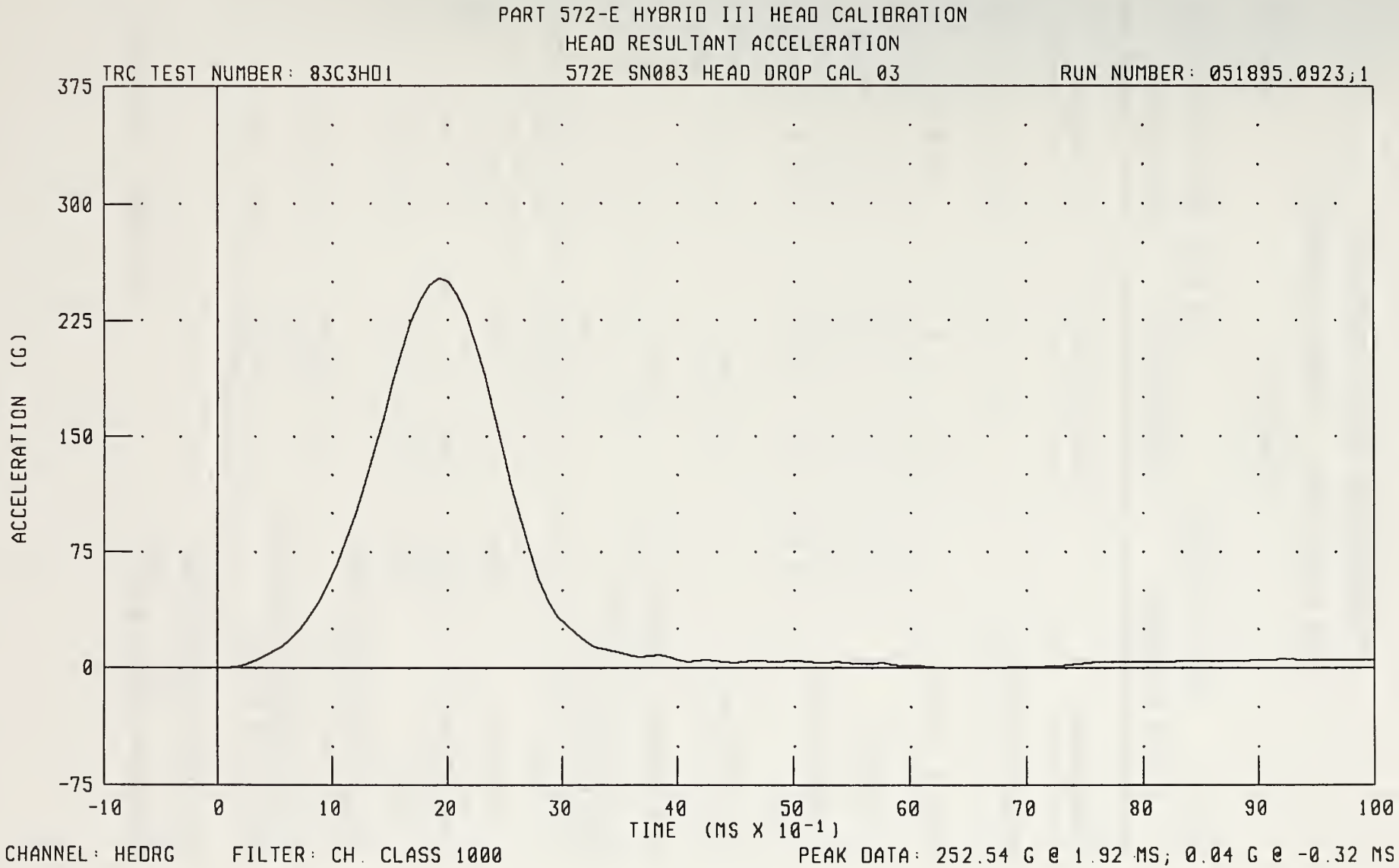
PART 572-E HYBRID III HEAD CALIBRATION
HEAD ACCELERATION Y AXIS

TRC TEST NUMBER: 83C3H01 572E SN083 HEAD DROP CAL 03 RUN NUMBER: 051895.0923;1



CHANNEL: HEDYG FILTER: CH. CLASS 1000 PEAK DATA: 2.11 G @ 1.84 MS; -1.89 G @ 3.68 MS


PART 572-E HYBRID III HEAD CALIBRATION
HEAD ACCELERATION Z AXIS
TRC TEST NUMBER: 83C3H01
572E SN083 HEAD DROP CAL 03
RUN NUMBER: 051895.0923;1
75
0
-75
-150
-225
-300
-375
ACCELERATION (G)
-10
0
10
20
30
40
50
60
70
80
90
100
TIME (MS X 10-1)
CHANNEL: HEDZG
FILTER: CH. CLASS 1000
PEAK DATA: 0.29 G @ 6.72 MS; -129.89 G @ 2.00 MS


PART 572-E HYBRID III HEAD CALIBRATION
HEAD RESULTANT ACCELERATION
TRC TEST NUMBER: 83C3H01
572E SN083 HEAD DROP CAL 03
RUN NUMBER: 051895.0923;1
375
300
225
150
75
0
-75
ACCELERATION (G)
-10
0
10
20
30
40
50
60
70
80
90
100
TIME (MS X 10⁻¹)
CHANNEL: HEDRG
FILTER: CH. CLASS 1000
PEAK DATA: 252.54 G @ 1.92 MS; 0.04 G @ -0.32 MS

TRANSPORTATION RESEARCH CENTER INC.

NECK FLEXION TEST - 6 CHANNEL TRANSDUCER

HYBRID III 18-MAY-95

TRC INC. TEST NO: 83C3NF1 572E SN083 NECK FLEXION CAL03

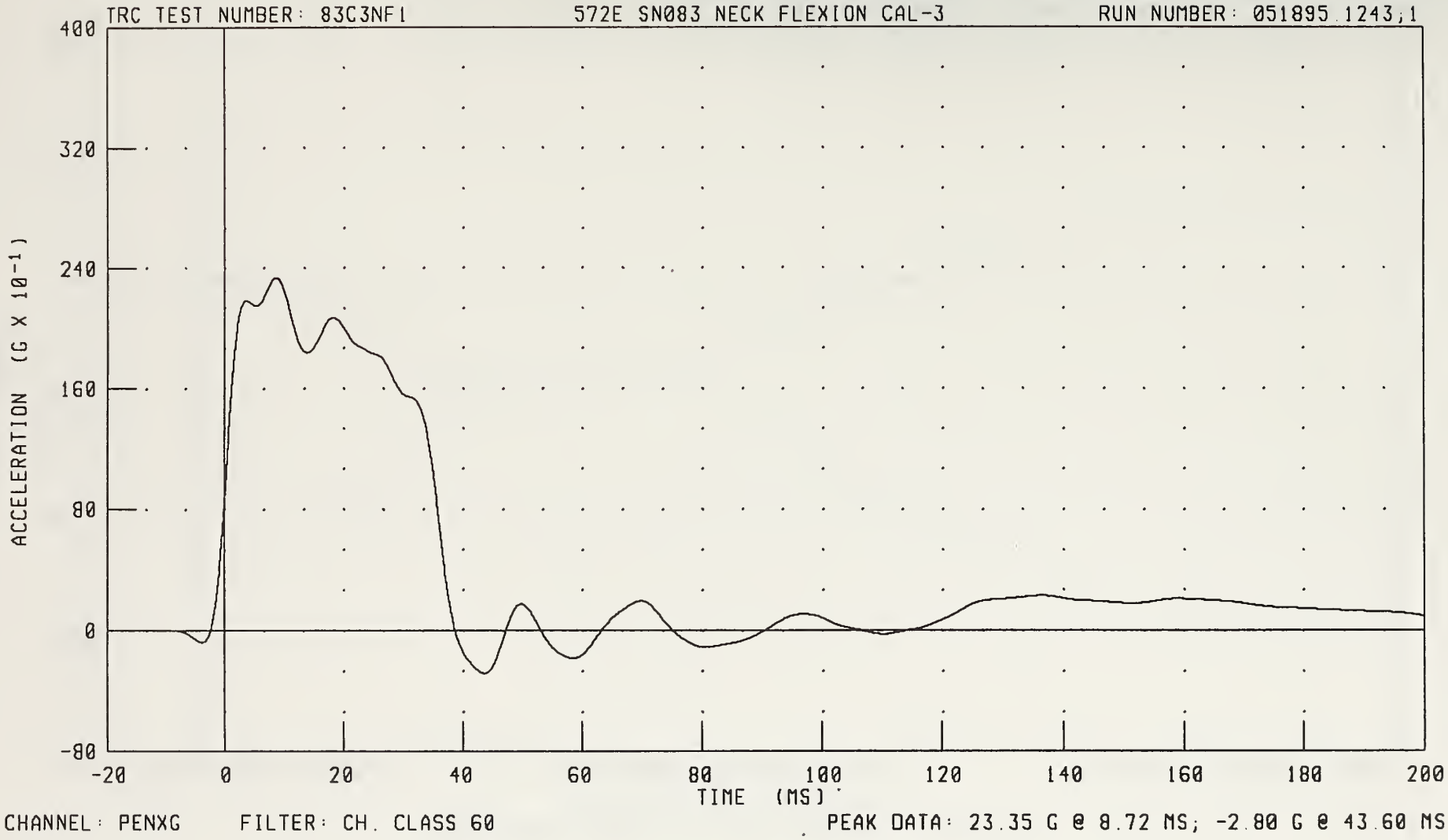
TEST PARAMETER		SPECIFICATION	TEST RESULTS
TEMPERATURE		20.6-22.2 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY		10 - 70 %	50.0 %
IMPACT VELOCITY		6.89 - 7.13 M/S	6.99 M/S
PENDULUM DECELERATION	10 MS	22.50 - 27.50 G	22.55 G
	20 MS	17.60 - 22.60 G	20.03 G
	30 MS	12.50 - 18.50 G	15.59 G
MAX PENDULUM G		29 G MAX	23.34 G
MAX PENDULUM G ABOVE 30 MS		29 G MAX	15.57 G
DECELERATION-TIME CURVE DECAY TIME TO 5 G		34 - 42 MS	36.56 MS
D PLANE ROTATION	MAX	64 - 78 DEG.	68.26 DEG.
	TIME	57 - 64 MS	58.80 MS
MOMENT ABOUT OCCIPITAL CONDYLE	MAX	88.2 - 108.5 NM	93.13 NM
	TIME	47 - 58 MS	48.96 MS
ROTATION ANGLE-TIME CURVE DECAY TIME TO ZERO		113 - 128 MS	115.92 MS
POSITIVE MOMENT-TIME CURVE DECAY TIME TO ZERO		97 - 107 MS	101.44 MS

TEST MEETS SPECIFICATIONS

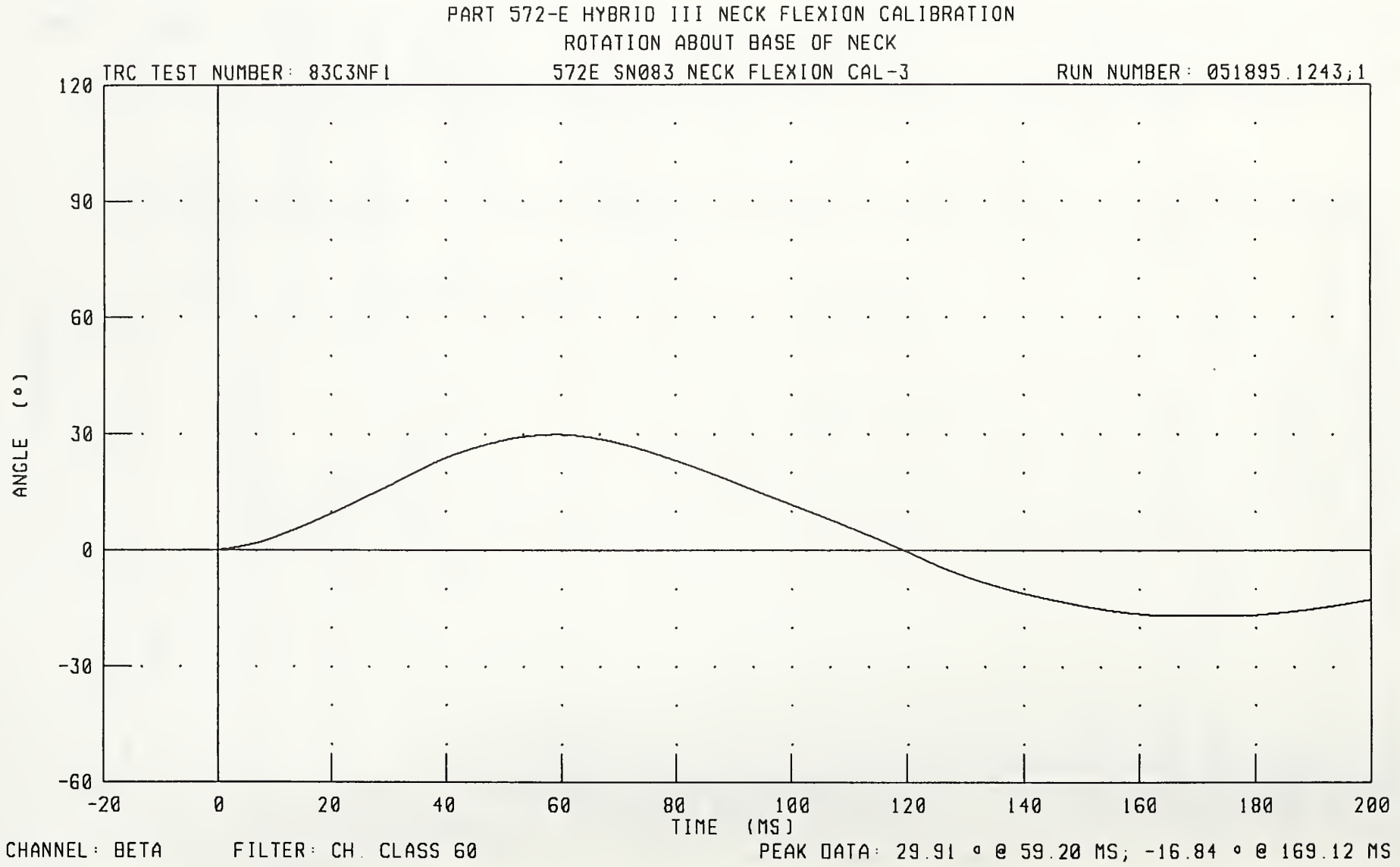
TECHNICIAN Pete Fox RUN NUMBER: 051895.1243;1

PART 572-E HYBRID III NECK FLEXION CALIBRATION

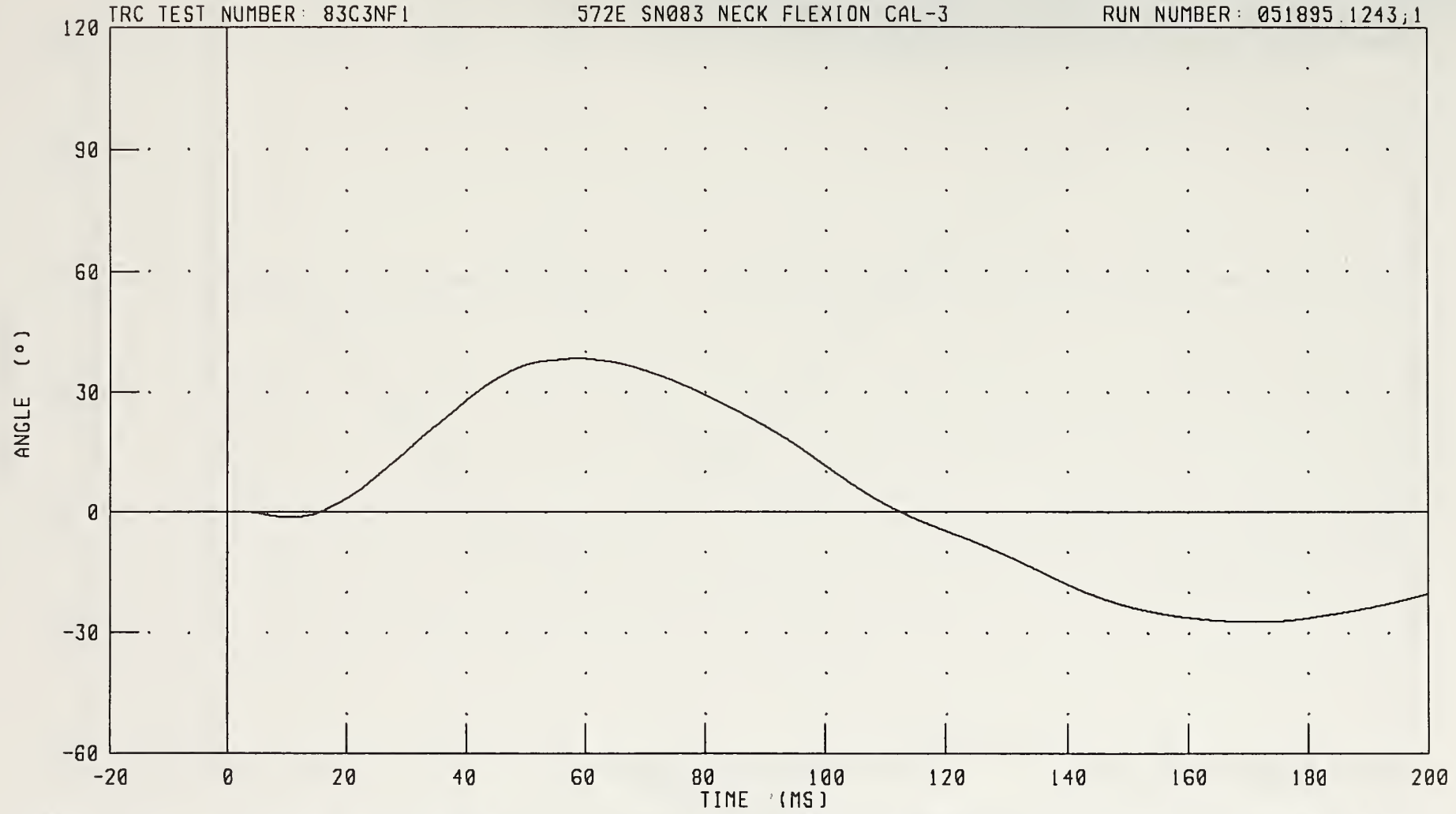
PENDULUM DECELERATION



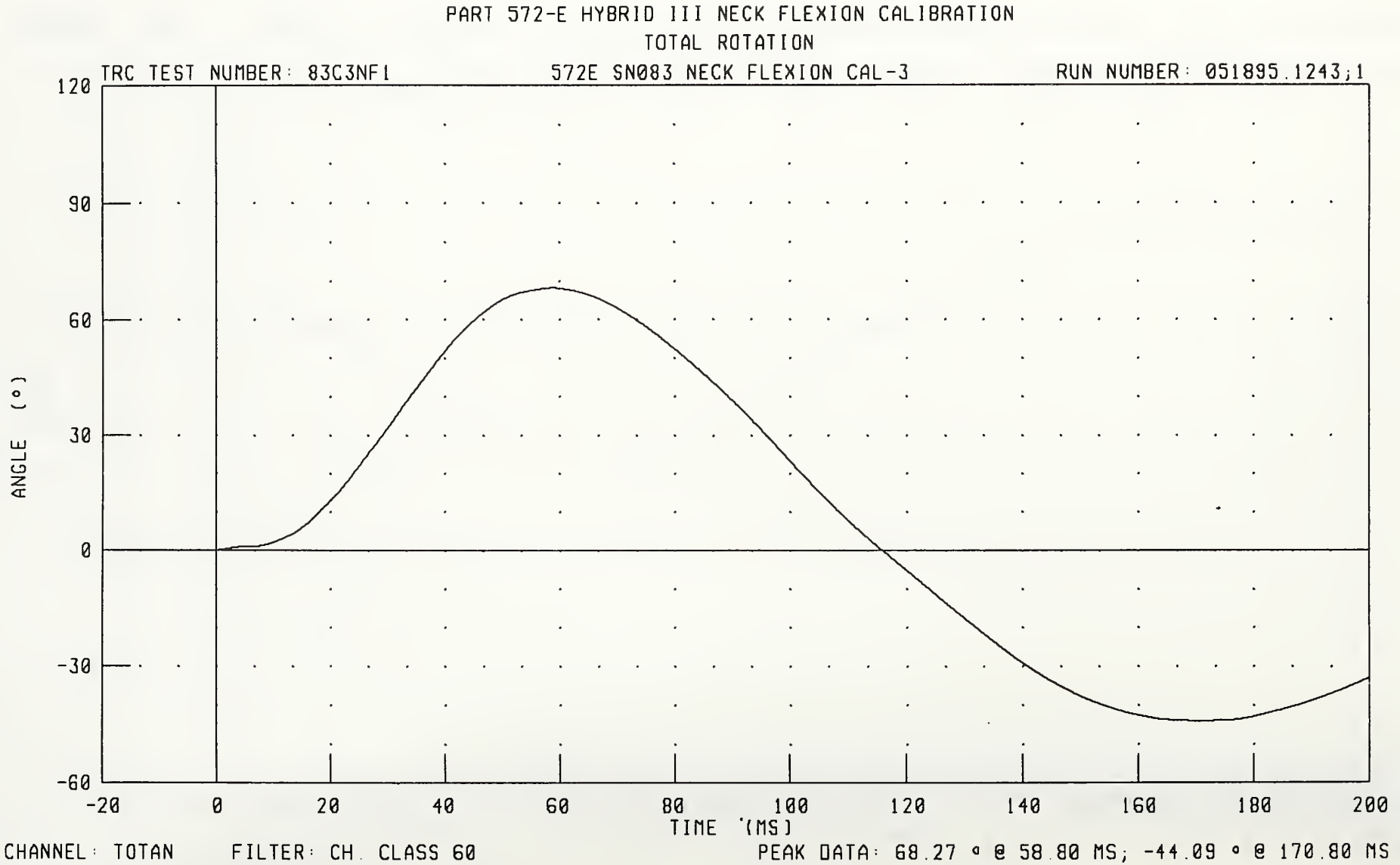
CHANNEL: PENXG FILTER: CH. CLASS 60 PEAK DATA: 23.35 G @ 8.72 MS; -2.80 G @ 43.60 MS


PART 572-E HYBRID III NECK FLEXION CALIBRATION
ROTATION ABOUT BASE OF NECK
TRC TEST NUMBER: 83C3NF1
572E SN083 NECK FLEXION CAL-3
RUN NUMBER: 051895.1243;1
120
90
60
30
0
-30
-60
ANGLE (°)
-20
0
20
40
60
80
100
120
140
160
180
200
TIME (MS)
CHANNEL: BETA
FILTER: CH. CLASS 60
PEAK DATA: 29.91 ° @ 59.20 MS; -16.84 ° @ 169.12 MS

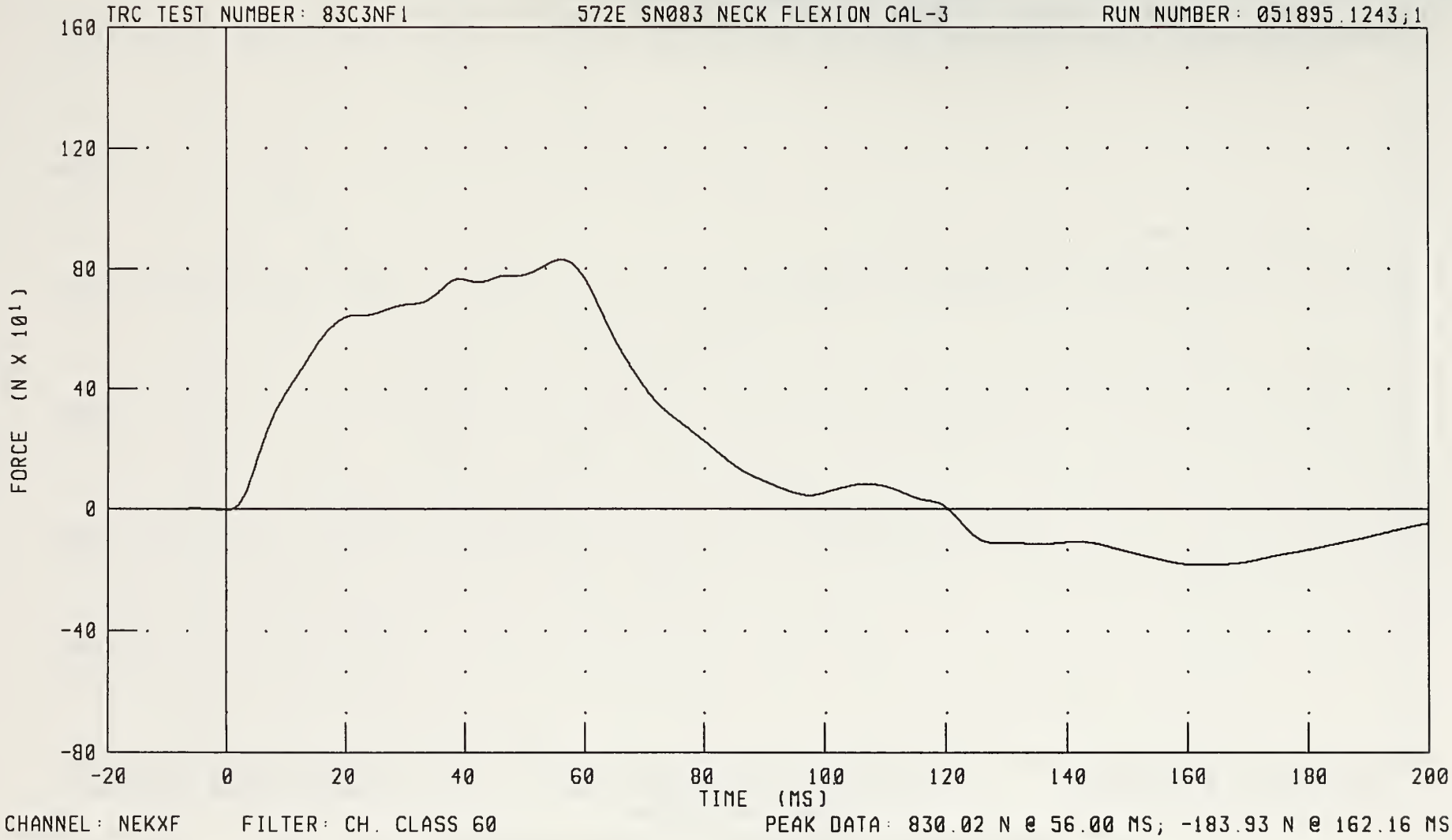
PART 572-E HYBRID III NECK FLEXION CALIBRATION
ROTATION ABOUT OCCIPITAL CONDYLE



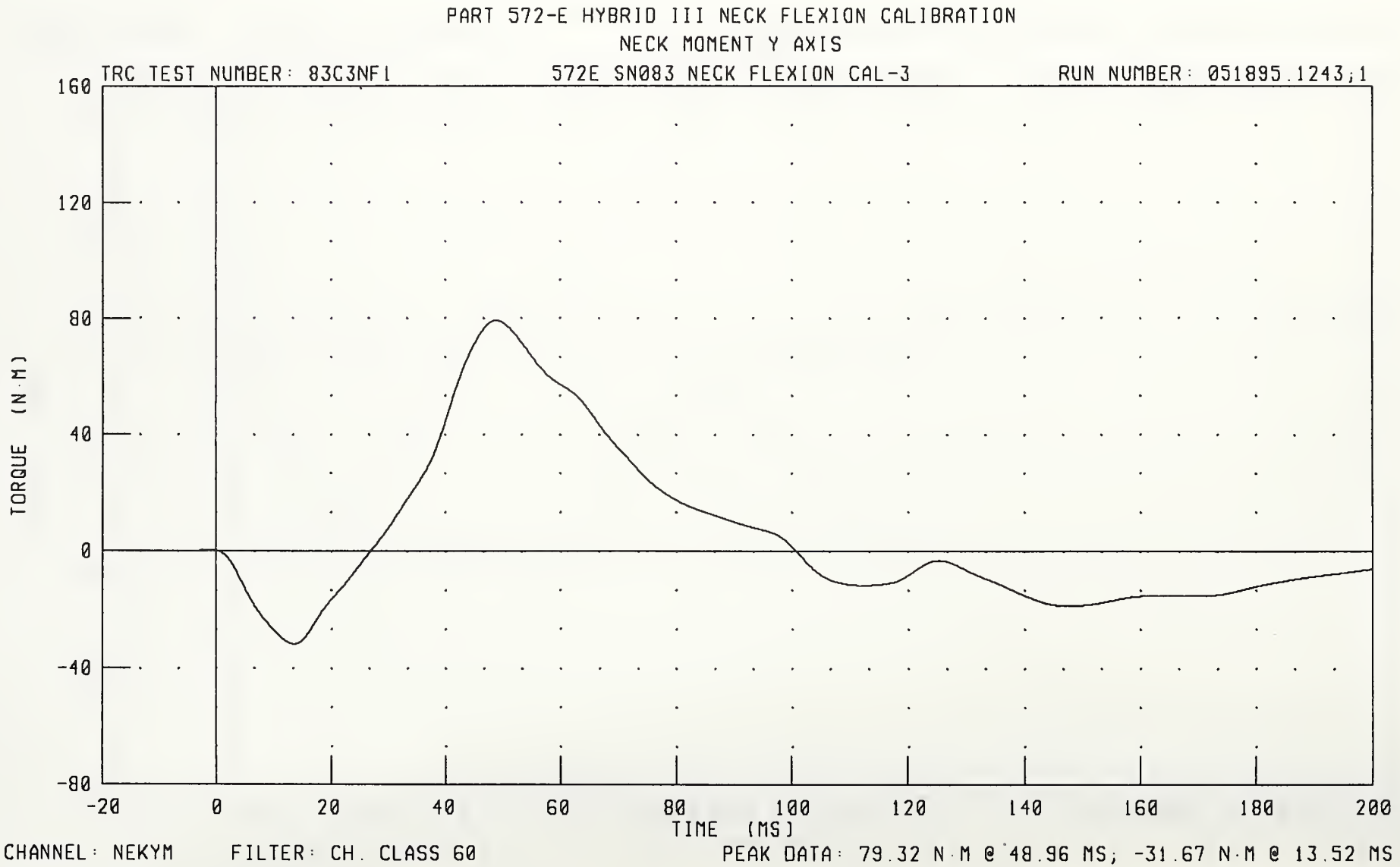
CHANNEL: THETA FILTER: CH. CLASS 60 PEAK DATA: 38.37 ° @ 58.64 MS; -27.25 ° @ 170.96 MS


PART 572-E HYBRID III NECK FLEXION CALIBRATION
TOTAL ROTATION
TRC TEST NUMBER: 83C3NF1
572E SN083 NECK FLEXION CAL-3
RUN NUMBER: 051895.1243;1
120
90
60
30
0
-30
-60
ANGLE (°)
-20
0
20
40
60
80
100
120
140
160
180
200
TIME (MS)
CHANNEL: TOTAN
FILTER: CH. CLASS 60
PEAK DATA: 68.27 ° @ 58.80 MS; -44.09 ° @ 170.80 MS

PART 572-E HYBRID III NECK FLEXION CALIBRATION
NECK FORCE X AXIS

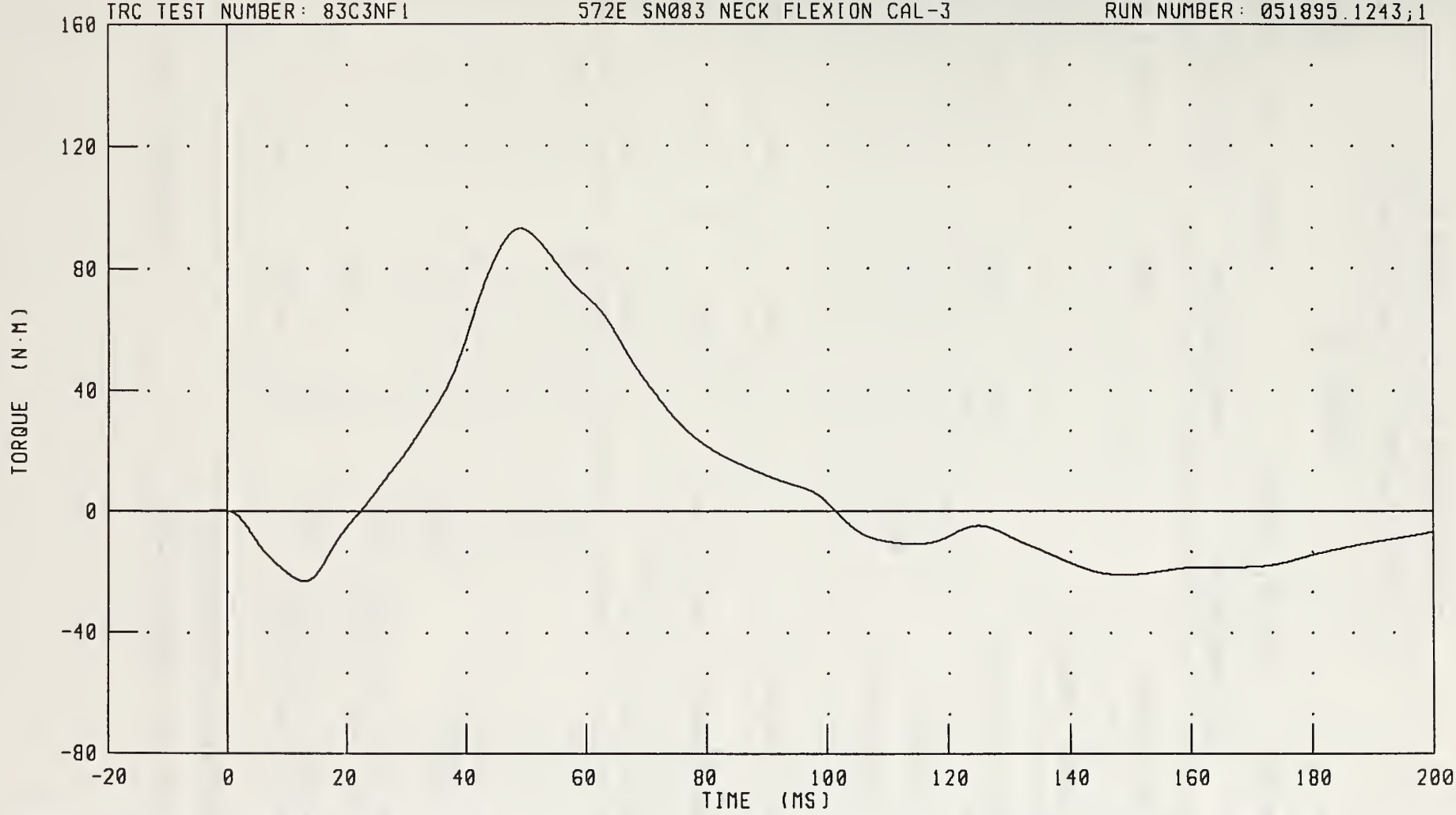


CHANNEL: NEKXF FILTER: CH. CLASS 60 PEAK DATA: 830.02 N @ 56.00 MS; -183.93 N @ 162.16 MS


PART 572-E HYBRID III NECK FLEXION CALIBRATION
NECK MOMENT Y AXIS
TRC TEST NUMBER: 83C3NF1
572E SN083 NECK FLEXION CAL-3
RUN NUMBER: 051895.1243;1
160
120
80
40
0
-40
-80
TORQUE (N·M)
-20
0
20
40
60
80
100
120
140
160
180
200
TIME (MS)
CHANNEL: NEKYM
FILTER: CH. CLASS 60
PEAK DATA: 79.32 N·M @ 48.96 MS; -31.67 N·M @ 13.52 MS

PART 572-E HYBRID III NECK FLEXION CALIBRATION
TOTAL MOMENT ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 83C3NF1 572E SN083 NECK FLEXION CAL-3 RUN NUMBER: 051895.1243;1



CHANNEL: NEKOM FILTER: CH. CLASS 60 PEAK DATA: 93.13 N·M @ 48.96 MS; -23.05 N·M @ 12.96 MS

TRANSPORTATION RESEARCH CENTER INC.

NECK EXTENSION TEST - 6 CHANNEL TRANSDUCER

HYBRID III 18-MAY-95

TRC INC. TEST NO: 83C3NE1 572E SN083 NECK EXT. CAL03

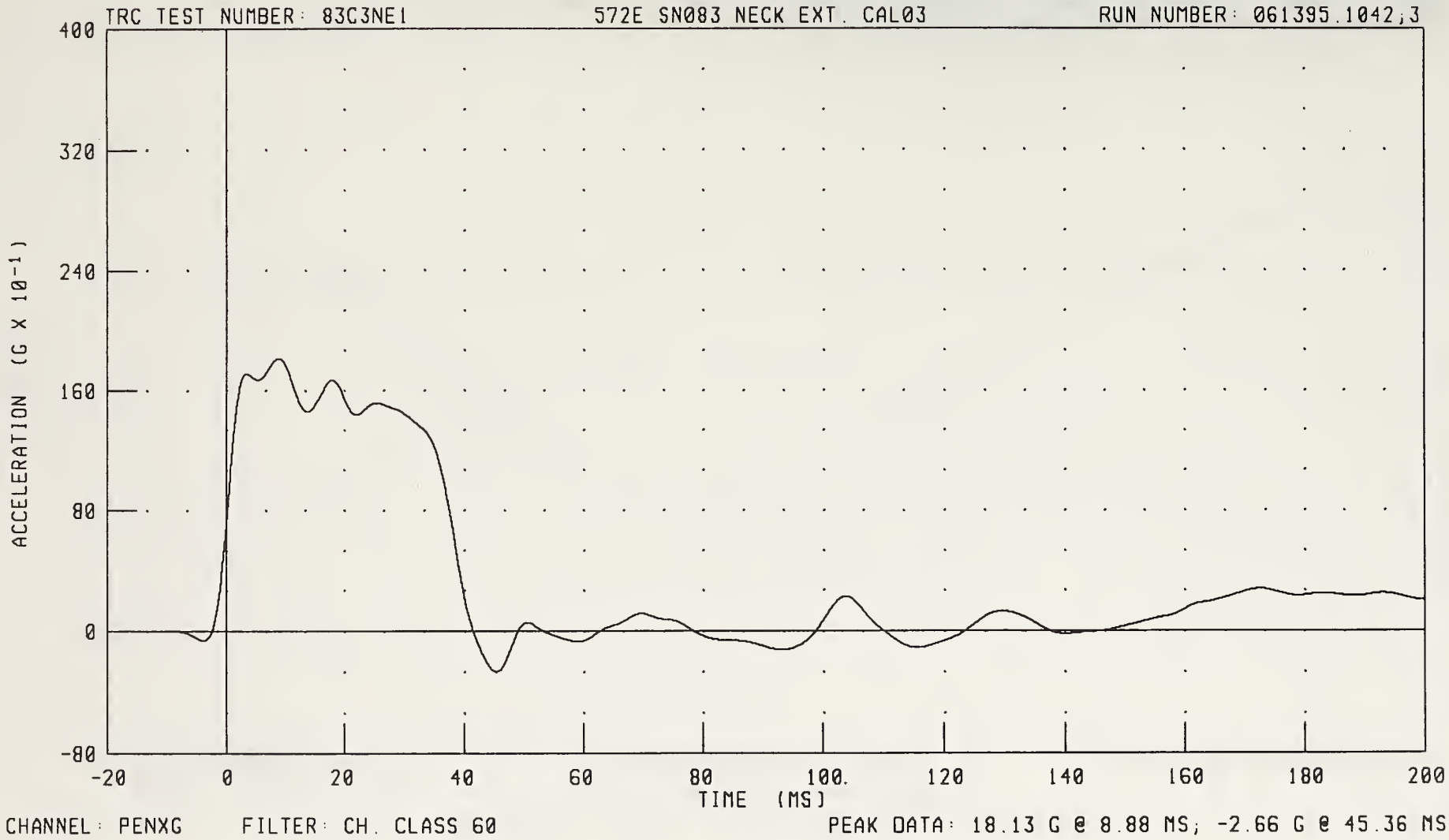
TEST PARAMETER		SPECIFICATION	TEST RESULTS
TEMPERATURE		20.6 - 22.2 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY		10 - 70 %	50.0 %
IMPACT VELOCITY		5.95 - 6.19 M/S	6.00 M/S
PENDULUM DECELERATION	10 MS	17.20 - 21.20 G	17.71 G
	20 MS	14.00 - 19.00 G	15.47 G
	30 MS	11.00 - 16.00 G	14.43 G
MAX PENDULUM G		22 G MAX	18.13 G
MAX PENDULUM G ABOVE 30 MS		22 G MAX	14.41 G
DECELERATION-TIME CURVE DECAY TIME TO 5 G		38 - 46 MS	38.72 MS
D PLANE ROTATION	MAX	81 - 106 DEG.	92.96 DEG.
	TIME	72 - 82 MS	75.52 MS
MOMENT ABOUT OCCIPITAL CONDYLE	MIN	-80.0/-52.9 NM	-64.09 NM
	TIME	65 - 79 MS	69.76 MS
ROTATION ANGLE-TIME CURVE DECAY TIME TO ZERO		147 - 174 MS	155.68 MS
NEGATIVE MOMENT-TIME CURVE DECAY TIME TO ZERO		120 - 148 MS	136.16 MS

TEST MEETS SPECIFICATIONS

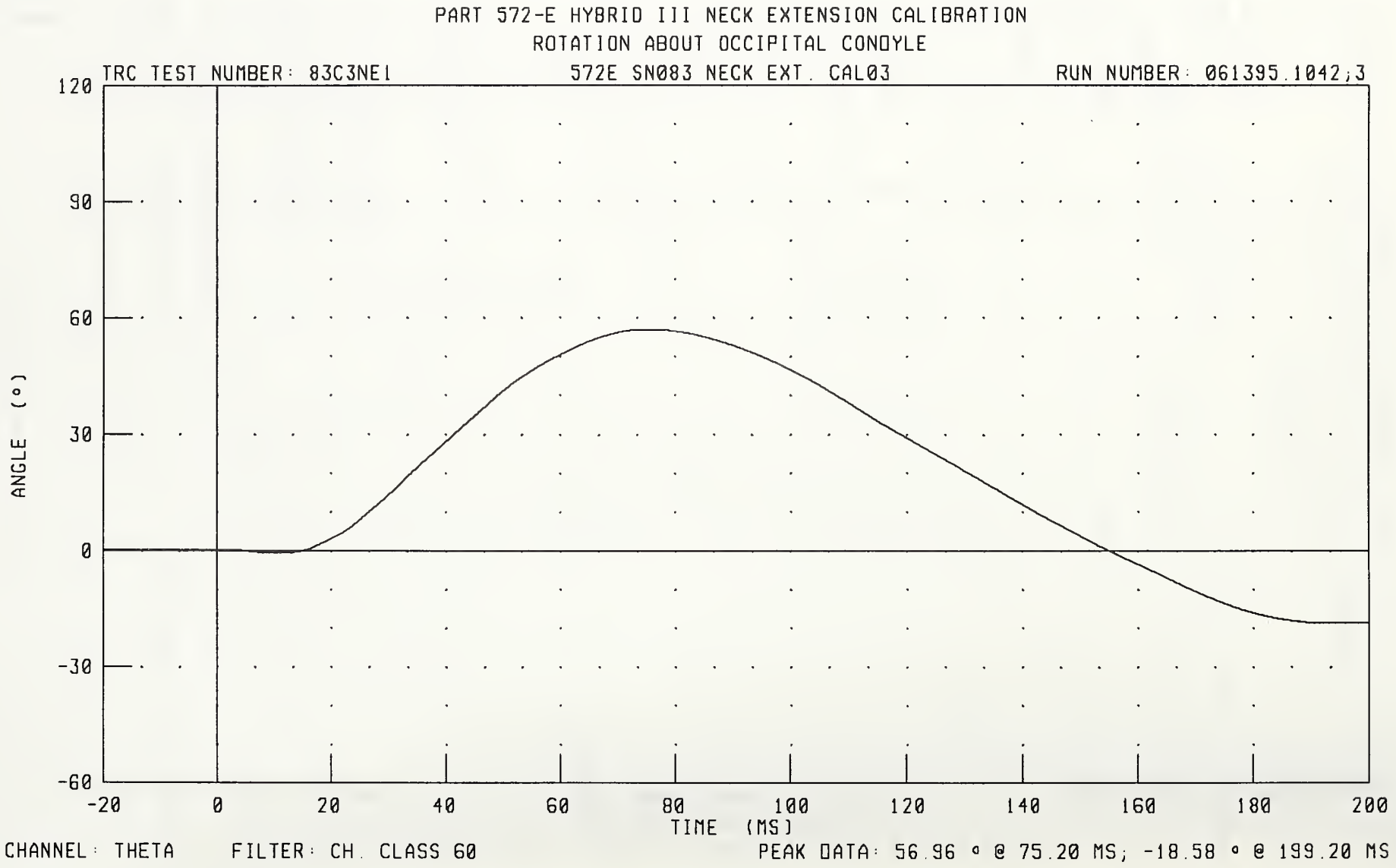
TECHNICIAN Peter S

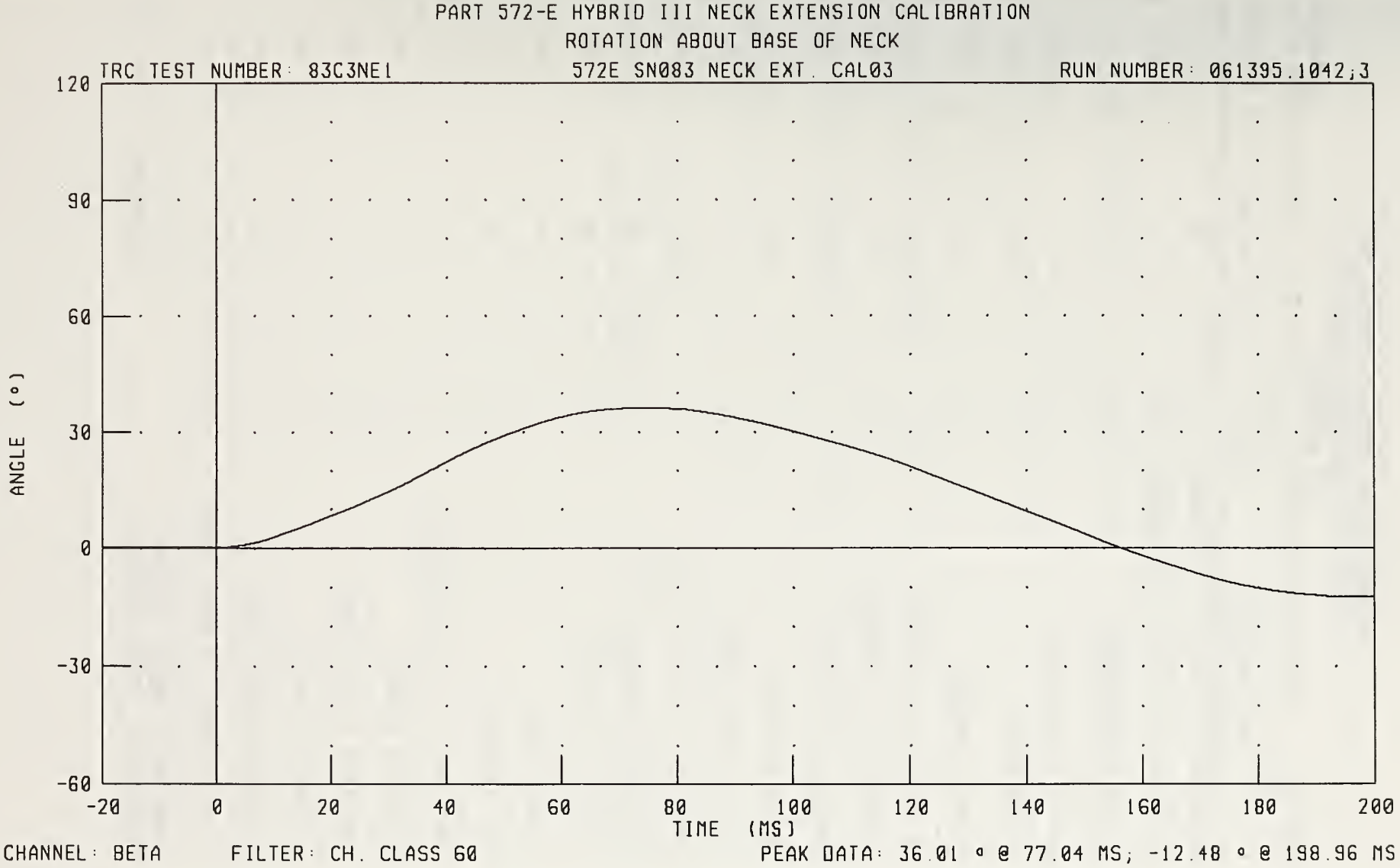
RUN NUMBER: 051895.1334;3

PART 572-E HYBRID III NECK EXTENSION CALIBRATION
PENDULUM DECELERATION



CHANNEL: PENXG FILTER: CH. CLASS 60 PEAK DATA: 18.13 G @ 8.88 MS; -2.66 G @ 45.36 MS


PART 572-E HYBRID III NECK EXTENSION CALIBRATION
ROTATION ABOUT OCCIPITAL CONDYLE
TRC TEST NUMBER: 83C3NE1
572E SN083 NECK EXT. CAL03
RUN NUMBER: 061395.1042;3
120
90
60
30
0
-30
-60
ANGLE (°)
-20
0
20
40
60
80
100
120
140
160
180
200
TIME (MS)
CHANNEL: THETA
FILTER: CH. CLASS 60
PEAK DATA: 56.96 ° @ 75.20 MS; -18.58 ° @ 199.20 MS


PART 572-E HYBRID III NECK EXTENSION CALIBRATION
ROTATION ABOUT BASE OF NECK
TRC TEST NUMBER: 83C3NE1
572E SN083 NECK EXT. CAL03
RUN NUMBER: 061395.1042;3
120
90
60
30
0
-30
-60
ANGLE (°)
-20
0
20
40
60
80
100
120
140
160
180
200
TIME (MS)
CHANNEL: BETA
FILTER: CH. CLASS 60
PEAK DATA: 36.01 ° @ 77.04 MS; -12.48 ° @ 198.96 MS

TRANSPORTATION RESEARCH CENTER INC.
HYBRID III EXTERNAL DIMENSIONS
177 ALDERSON 18-MAY-95

TRC INC. TEST NO: 177C64ED1 572E SN177 EXT.DIMENSION CAL64

TEST PARAMETER (DIMEN.)	SPECIFICATION	TEST RESULTS
LOCATION FOR CHEST CIRCUMFERENCE (AA)	429 - 434 MM	432. MM
LOCATION FOR WAIST CIRCUMFERENCE (BB)	226 - 231 MM	229. MM
CHEST CIRCUMFERENCE (Y)	970 -1001 MM	983. MM
WAIST CIRCUMFERENCE (Z)	836 - 866 MM	846. MM
CHEST DEPTH (O)	213 - 229 MM	216. MM
H-POINT HEIGHT (C)	84 - 89 MM	86. MM
H-POINT FROM SEATBACK (D)	135 - 140 MM	137. MM
SKULL CAP TO BACKLINE (H)	41 - 46 MM	43. MM
TOTAL SITTING HEIGHT (A)	879 - 889 MM	884. MM
THIGH CLEARANCE (F)	140 - 155 MM	145. MM
BUTTOCK KNEE LENGTH (K)	579 - 605 MM	602. MM
BUTTOCK POPLITEAL LENGTH (N)	452 - 478 MM	475. MM
POPLITEAL HEIGHT (L)	429 - 455 MM	450. MM
KNEE PIVOT HEIGHT (M)	485 - 500 MM	493. MM
FOOT LENGTH (P)	252 - 267 MM	262. MM
FOOT BREADTH (W)	91 - 107 MM	102. MM
SHOULDER PIVOT FROM BACKLINE (E)	84 - 94 MM	91. MM
SHOULDER BREADTH (V)	422 - 437 MM	429. MM
SHOULDER PIVOT HEIGHT (B)	506 - 521 MM	511. MM
ELBOW REST HEIGHT (J)	191 - 211 MM	208. MM
SHOULDER-ELBOW LENGTH (I)	330 - 345 MM	338. MM
BACK OF ELBOW TO WRIST PIVOT (G)	290 - 305 MM	295. MM

DUMMY MEETS SPECIFICATIONS

TECHNICIAN Pete Foss

RUN NUMBER: 051995.0823

TRANSPORTATION RESEARCH CENTER INC.

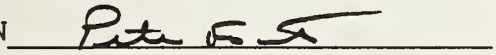
HEAD DROP TEST

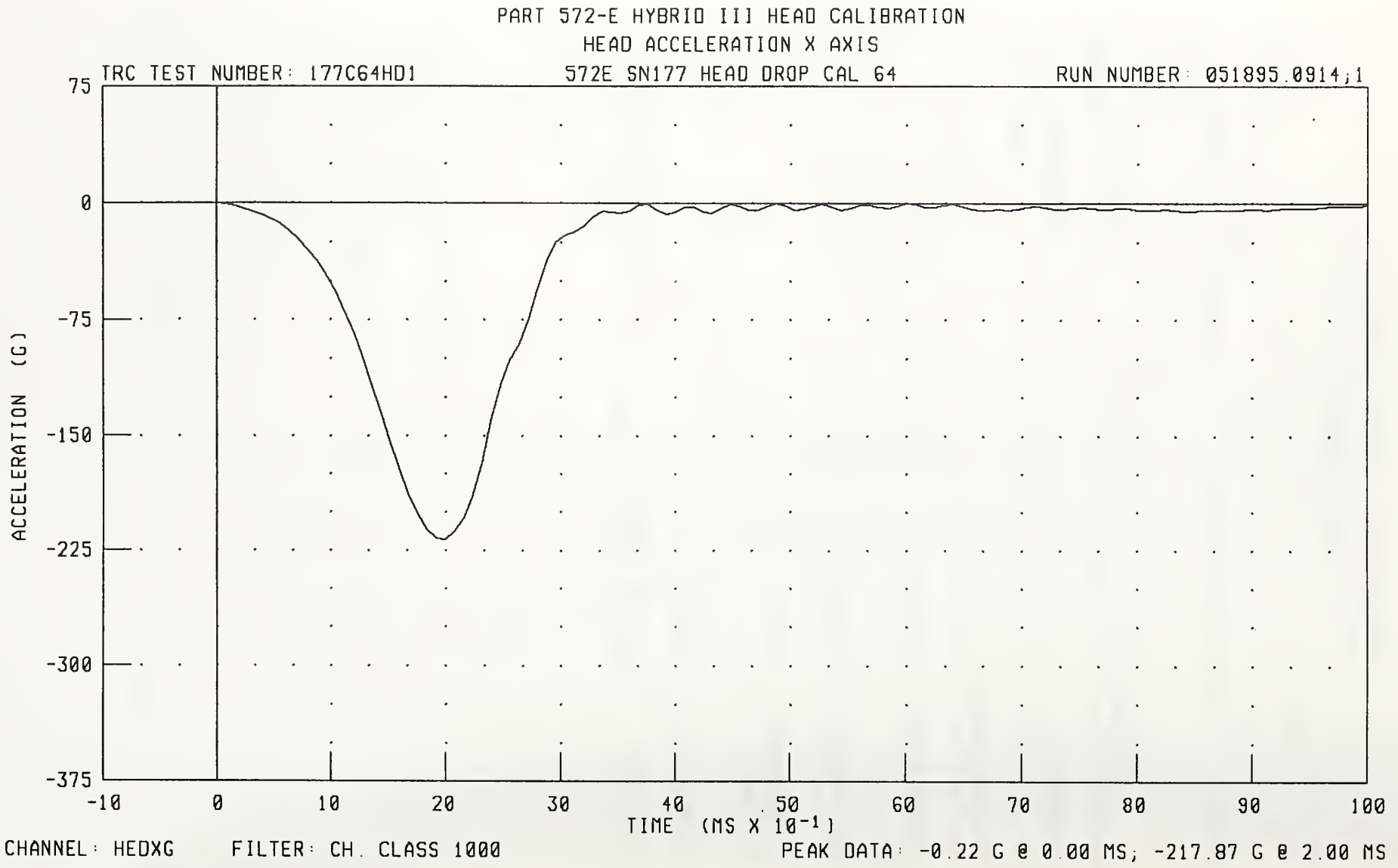
HYBRID III 18-MAY-95

TRC INC. TEST NO: 177C64HD1 572E SN177 HEAD DROP CAL 64

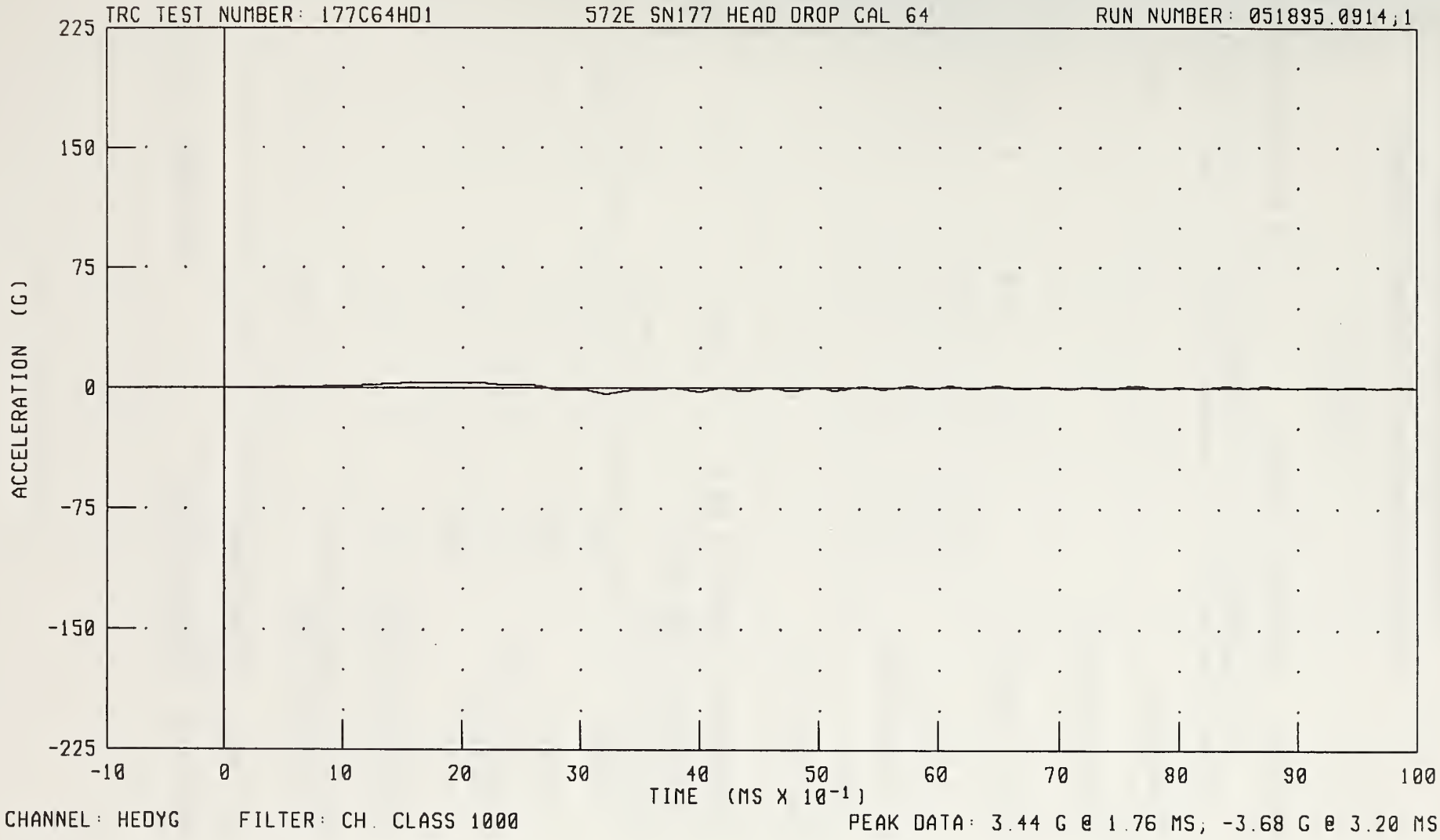
TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10 - 70 %	50.0 %
PEAK RESULTANT ACCELERATION	225 - 275 G	254.25 G
PEAK LATERAL ACCELERATION	15 G MAX	-3.67 G
IS ACCELERATION CURVE UNIMODAL?	YES	YES

TEST MEETS SPECIFICATIONS

TECHNICIAN  RUN NUMBER: 051895.0914;1


PART 572-E HYBRID III HEAD CALIBRATION
HEAD ACCELERATION X AXIS
TRC TEST NUMBER: 177C64HD1
572E SN177 HEAD DROP CAL 64
RUN NUMBER: 051895.0914;1
75
0
-75
-150
-225
-300
-375
ACCELERATION (G)
-10
0
10
20
30
40
50
60
70
80
90
100
TIME (MS X 10-1)
CHANNEL: HEDXG
FILTER: CH. CLASS 1000
PEAK DATA: -0.22 G @ 0.00 MS; -217.87 G @ 2.00 MS

PART 572-E HYBRID III HEAD CALIBRATION
HEAD ACCELERATION Y AXIS



CHANNEL: HEDYG FILTER: CH. CLASS 1000 PEAK DATA: 3.44 G @ 1.76 MS; -3.68 G @ 3.20 MS

TRANSPORTATION RESEARCH CENTER INC.

NECK EXTENSION TEST - 6 CHANNEL TRANSDUCER

HYBRID III 18-MAY-95

TRC INC. TEST NO: 177C64NE1 572E SN177 NECK EXT. CAL64

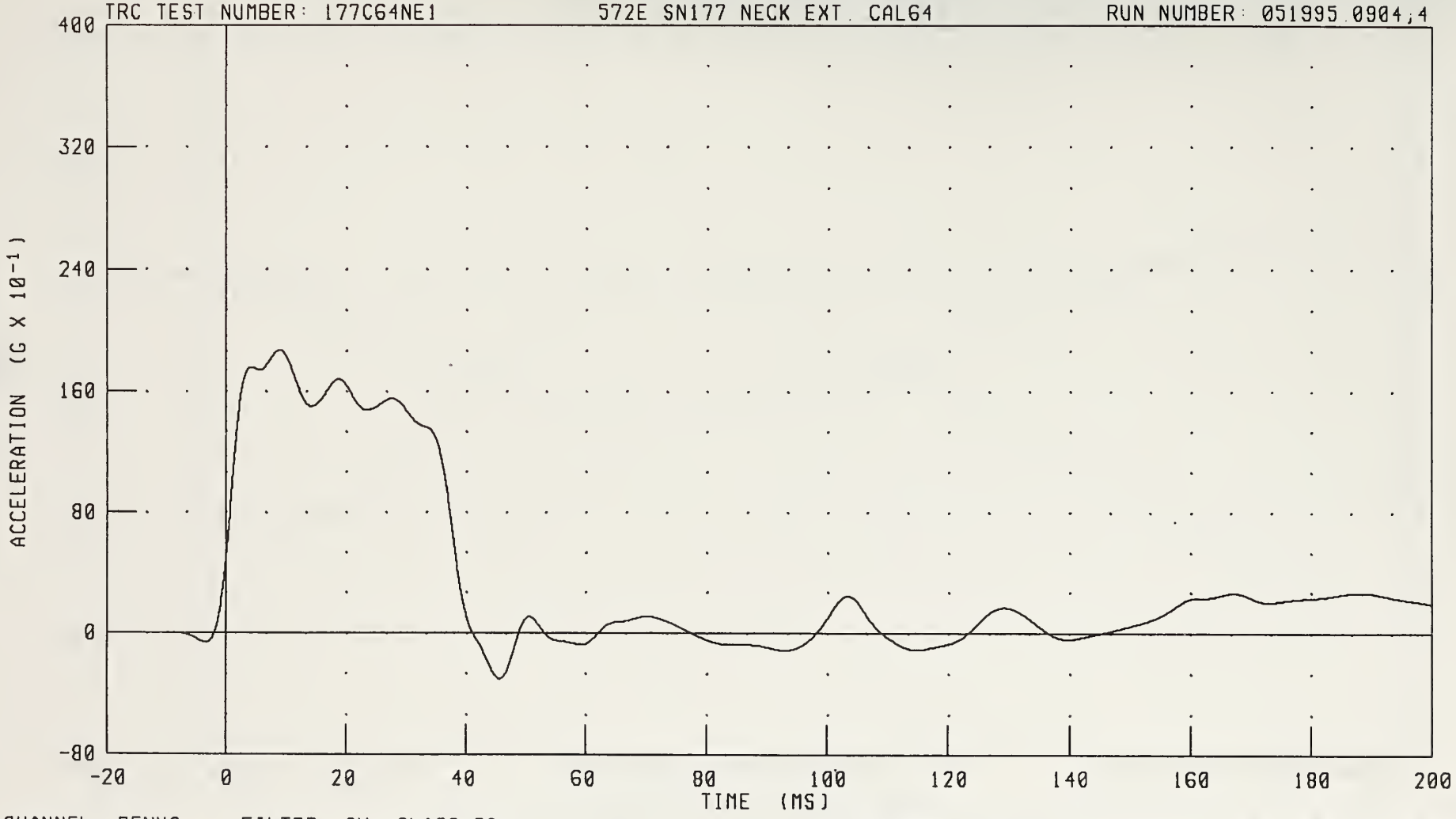
TEST PARAMETER		SPECIFICATION	TEST RESULTS
TEMPERATURE		20.6 - 22.2 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY		10 - 70 %	50.0 %
IMPACT VELOCITY		5.95 - 6.19 M/S	6.00 M/S
PENDULUM DECELERATION	10 MS	17.20 - 21.20 G	18.32 G
	20 MS	14.00 - 19.00 G	16.39 G
	30 MS	11.00 - 16.00 G	14.70 G
MAX PENDULUM G		22 G MAX	18.70 G
MAX PENDULUM G ABOVE 30 MS		22 G MAX	14.66 G
DECELERATION-TIME CURVE DECAY TIME TO 5 G		38 - 46 MS	38.24 MS
D PLANE ROTATION	MAX	81 - 106 DEG.	96.33 DEG.
	TIME	72 - 82 MS	75.76 MS
MOMENT ABOUT OCCIPITAL CONDYLE	MIN	-80.0/-52.9 NM	-70.51 NM
	TIME	65 - 79 MS	70.48 MS
ROTATION ANGLE-TIME CURVE DECAY TIME TO ZERO		147 - 174 MS	154.72 MS
NEGATIVE MOMENT-TIME CURVE DECAY TIME TO ZERO		120 - 148 MS	137.12 MS

TEST MEETS SPECIFICATIONS

TECHNICIAN Pete R S

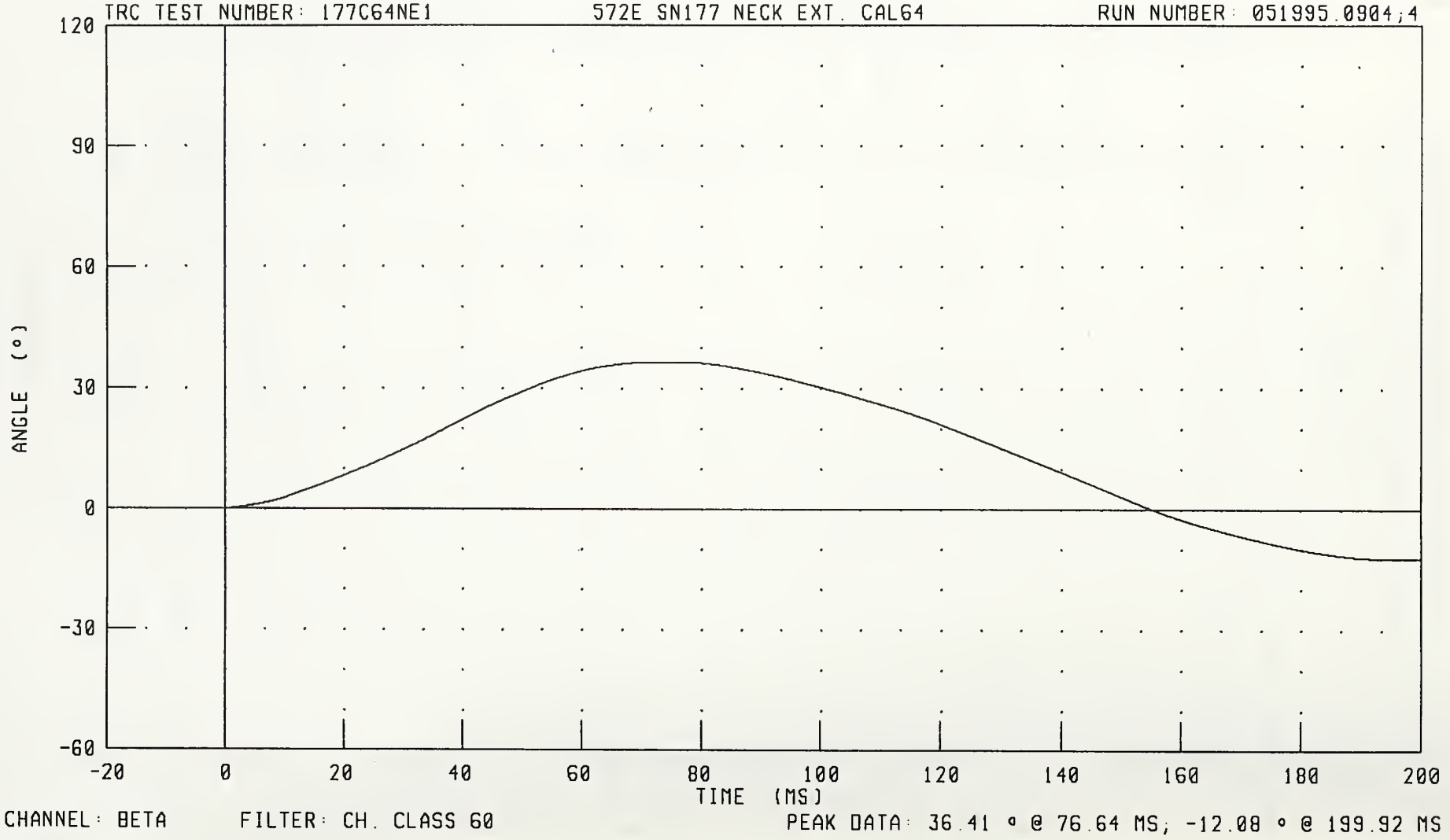
RUN NUMBER: 051995.0903;4

PART 572-E HYBRID III NECK EXTENSION CALIBRATION
PENDULUM DECELERATION

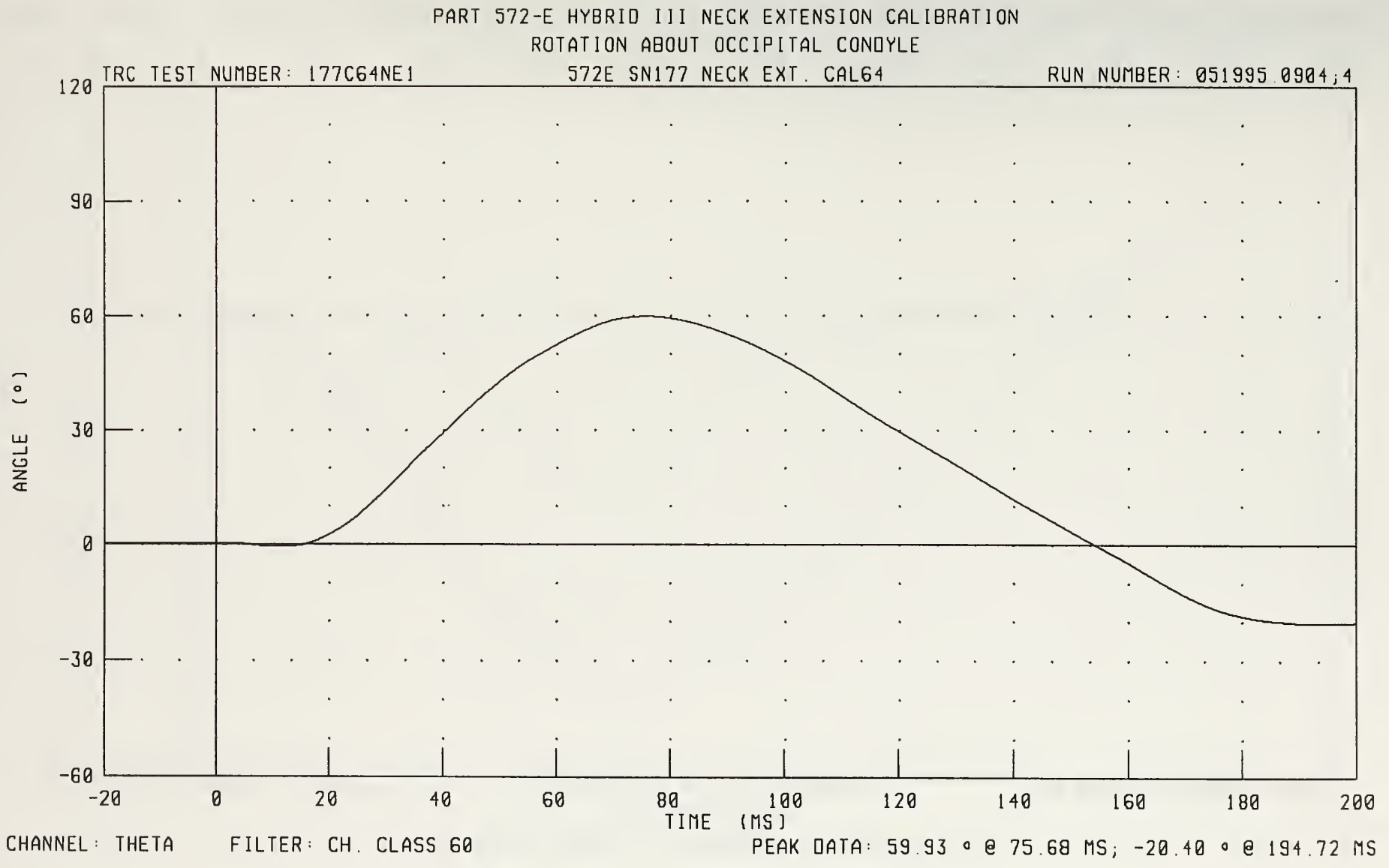


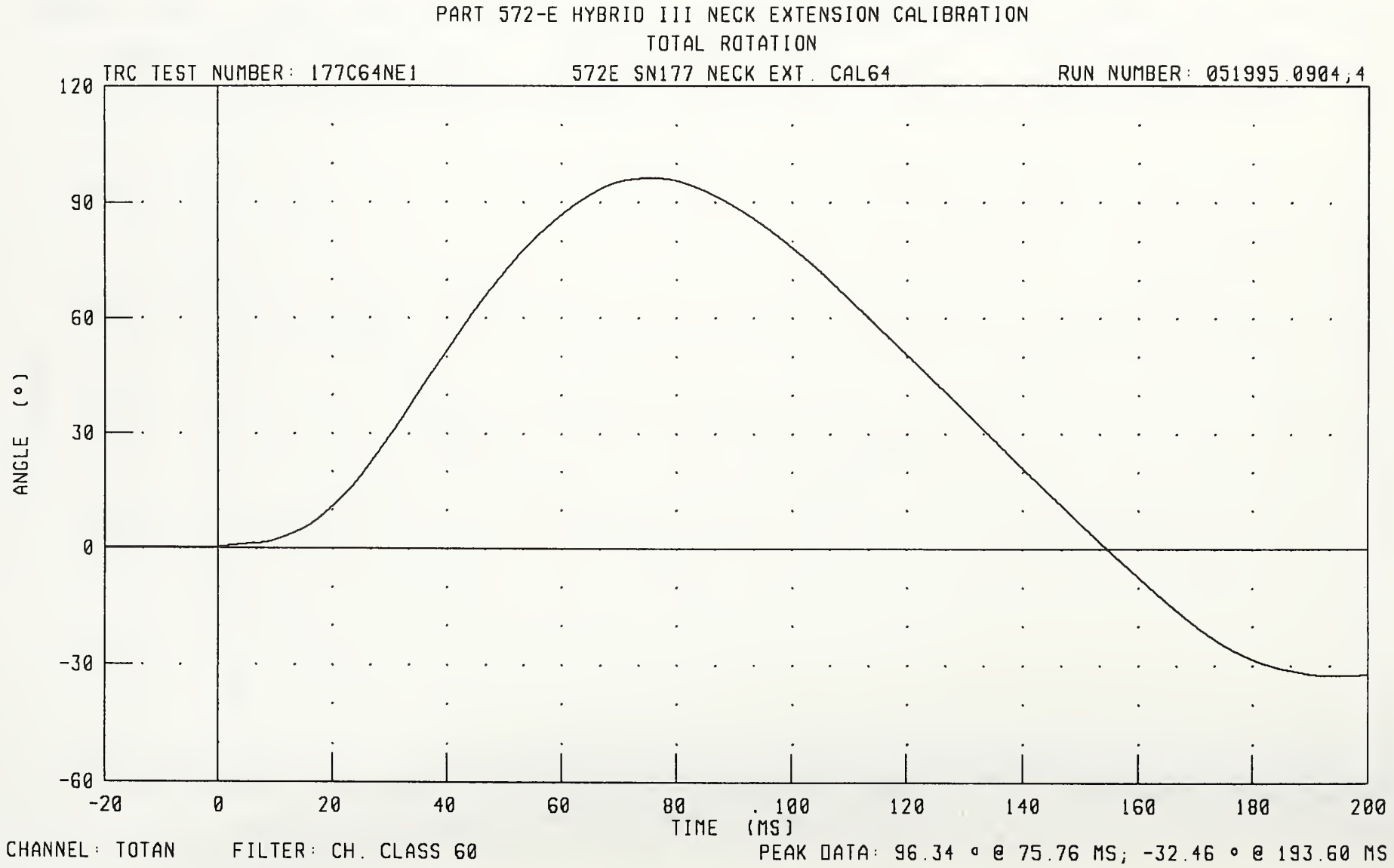
CHANNEL: PENXG FILTER: CH. CLASS 60 PEAK DATA: 18.71 G @ 8.96 MS; -3.01 G @ 45.60 MS

PART 572-E HYBRID III NECK EXTENSION CALIBRATION
ROTATION ABOUT BASE OF NECK



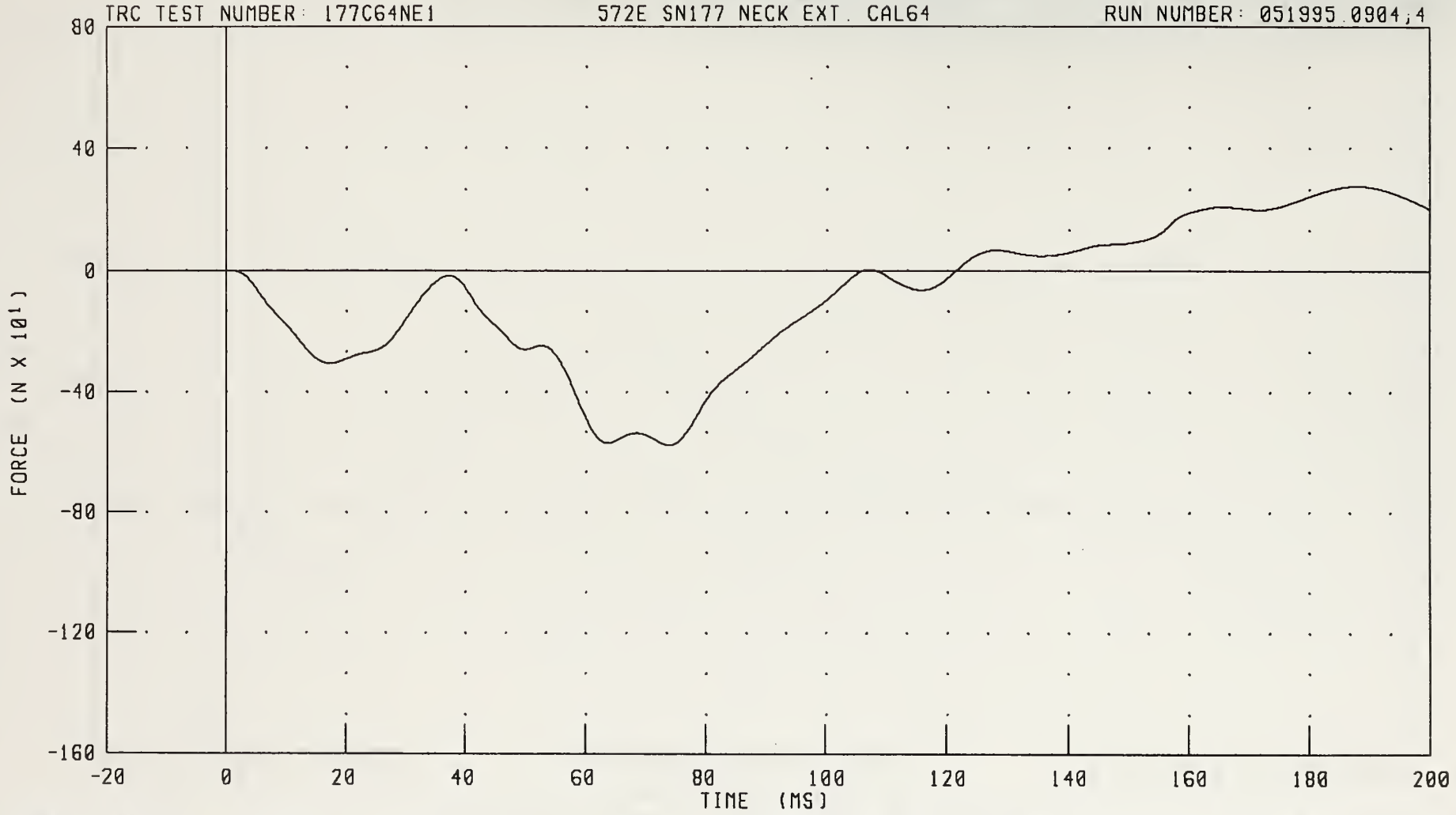
CHANNEL: BETA FILTER: CH. CLASS 60 PEAK DATA: 36.41 ° @ 76.64 MS; -12.08 ° @ 199.92 MS


PART 572-E HYBRID III NECK EXTENSION CALIBRATION
ROTATION ABOUT OCCIPITAL CONDYLE
TRC TEST NUMBER: 177C64NE1
572E SN177 NECK EXT. CAL64
RUN NUMBER: 051995.0904;4
120
90
60
30
0
-30
-60
ANGLE (°)
-20
0
20
40
60
80
100
120
140
160
180
200
TIME (MS)
CHANNEL: THETA
FILTER: CH. CLASS 60
PEAK DATA: 59.93 ° @ 75.68 MS; -20.40 ° @ 194.72 MS


PART 572-E HYBRID III NECK EXTENSION CALIBRATION
TOTAL ROTATION
TRC TEST NUMBER: 177C64NE1
572E SN177 NECK EXT. CAL64
RUN NUMBER: 051995.0904;4
120
90
60
30
0
-30
-60
ANGLE (°)
-20
0
20
40
60
80
100
120
140
160
180
200
TIME (MS)
CHANNEL: TOTAN
FILTER: CH. CLASS 60
PEAK DATA: 96.34 ° @ 75.76 MS; -32.46 ° @ 193.60 MS

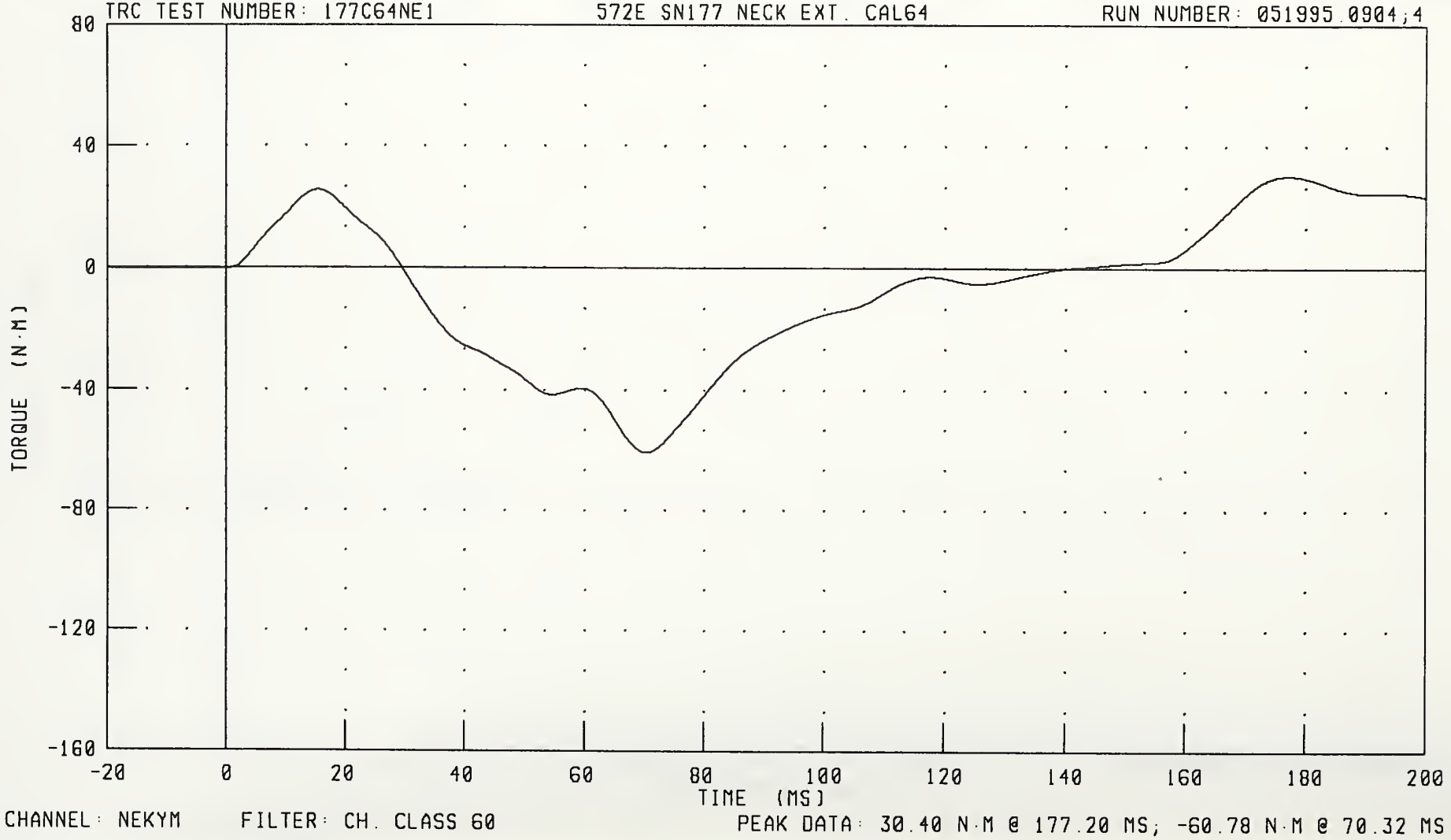
PART 572-E HYBRID III NECK EXTENSION CALIBRATION

NECK FORCE X AXIS



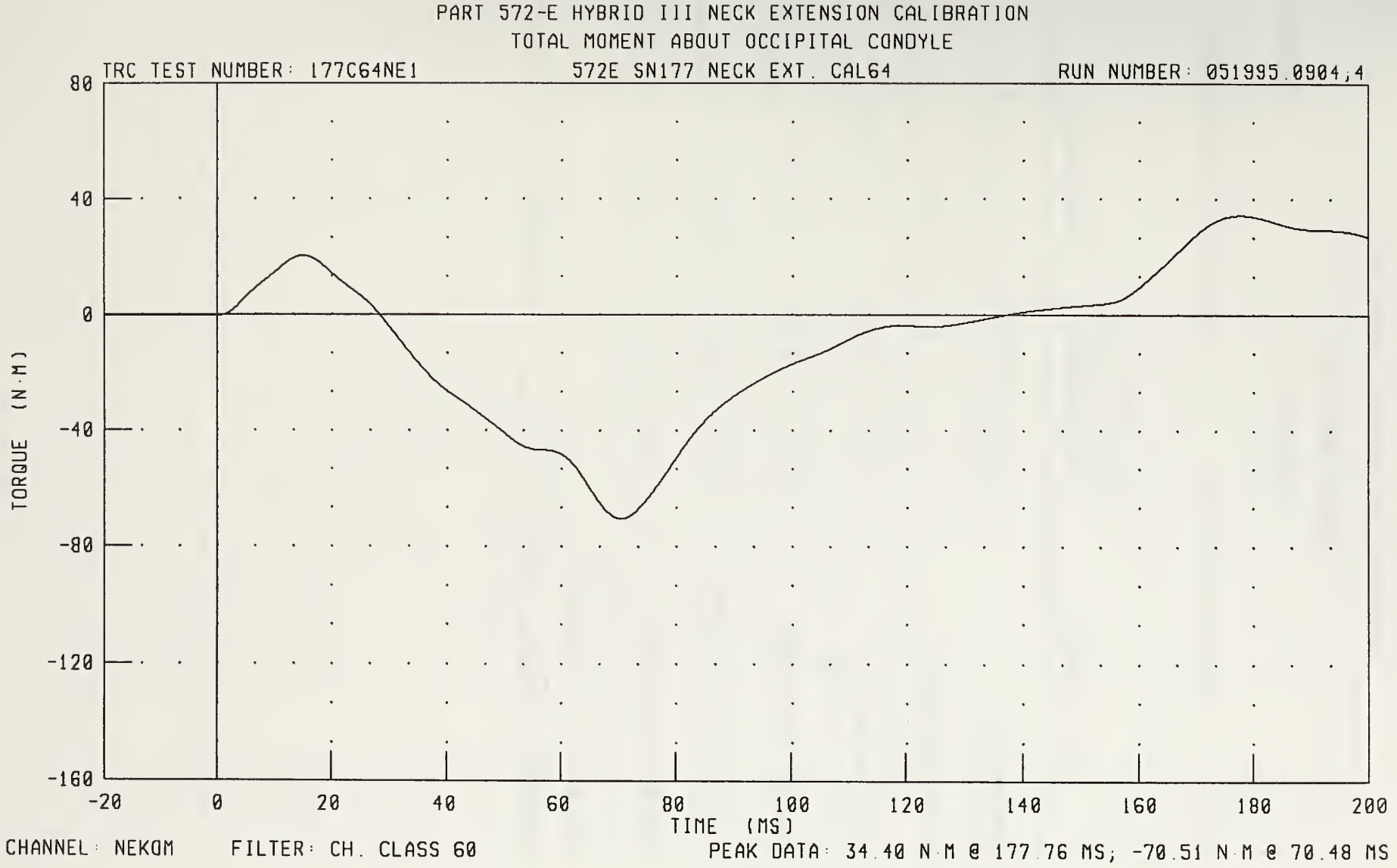
CHANNEL: NEKXF FILTER: CH. CLASS 60 PEAK DATA: 277.23 N @ 187.84 MS; -577.13 N @ 73.76 MS

PART 572-E HYBRID III NECK EXTENSION CALIBRATION
NECK MOMENT Y AXIS



CHANNEL: NEKYM FILTER: CH. CLASS 60

PEAK DATA: 30.40 N-M @ 177.20 MS; -60.78 N-M @ 70.32 MS


PART 572-E HYBRID III NECK EXTENSION CALIBRATION
TOTAL MOMENT ABOUT OCCIPITAL CONDYLE
TRC TEST NUMBER: 177C64NE1
572E SN177 NECK EXT. CAL64
RUN NUMBER: 051995.0904;4
80
40
0
-40
-80
-120
-160
TORQUE (N·M)
-20
0
20
40
60
80
100
120
140
160
180
200
TIME (MS)
CHANNEL: NEKOM
FILTER: CH. CLASS 60
PEAK DATA: 34.40 N·M @ 177.76 MS; -70.51 N·M @ 70.48 MS

TRANSPORTATION RESEARCH CENTER INC.

THORAX IMPACT TEST

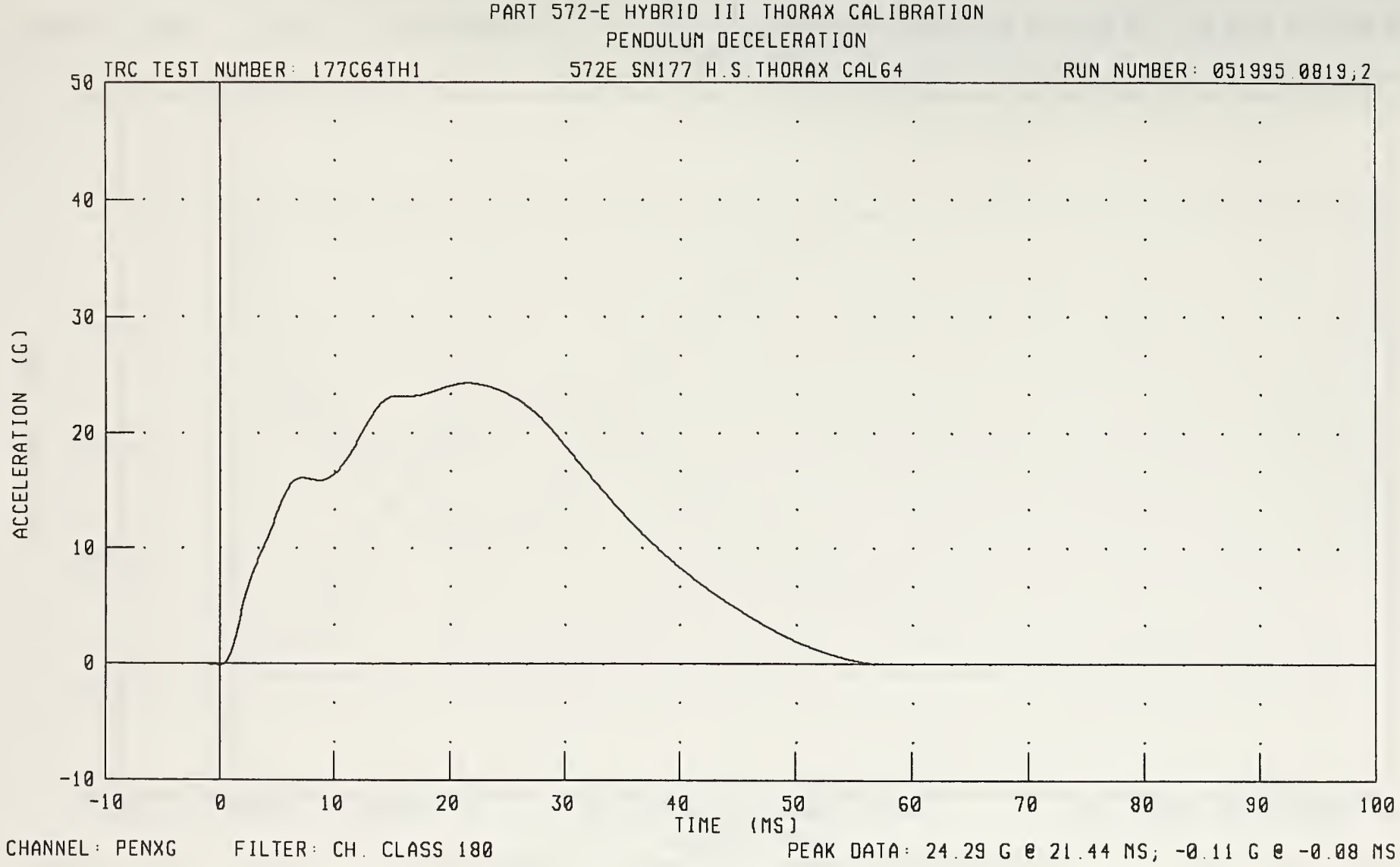
HYBRID III 19-MAY-95

TRC INC. TEST NO: 177C64TH1 572E SN177 H.S.THORAX CAL64

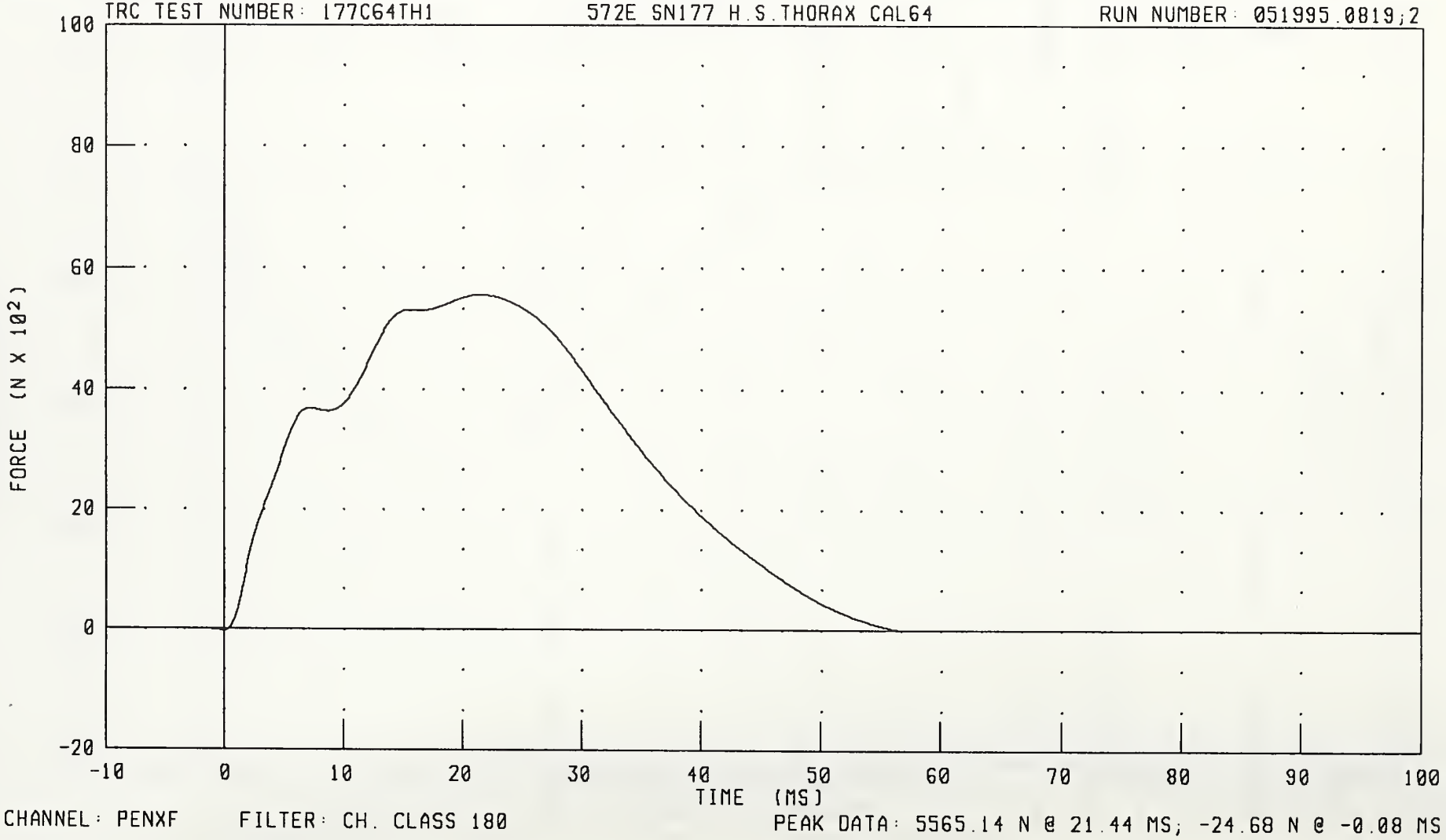
TEST PARAMETER	HIGH SPEED TEST SPECIFICATION	TEST RESULTS
TEMPERATURE	20.6-22.2 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10 - 70 %	50.0 %
PENDULUM VELOCITY	6.59 - 6.83 M/S	6.71 M/S
MAXIMUM DEFLECTION	63.5 - 72.6 MM	68.8 MM
MAXIMUM RESISTIVE FORCE	5159 - 5894 N	5565. N
INTERNAL HYSTERESIS	69% - 85%	71.5%

TEST MEETS SPECIFICATIONS

TECHNICIAN _____ RUN NUMBER: 051995.0818;2

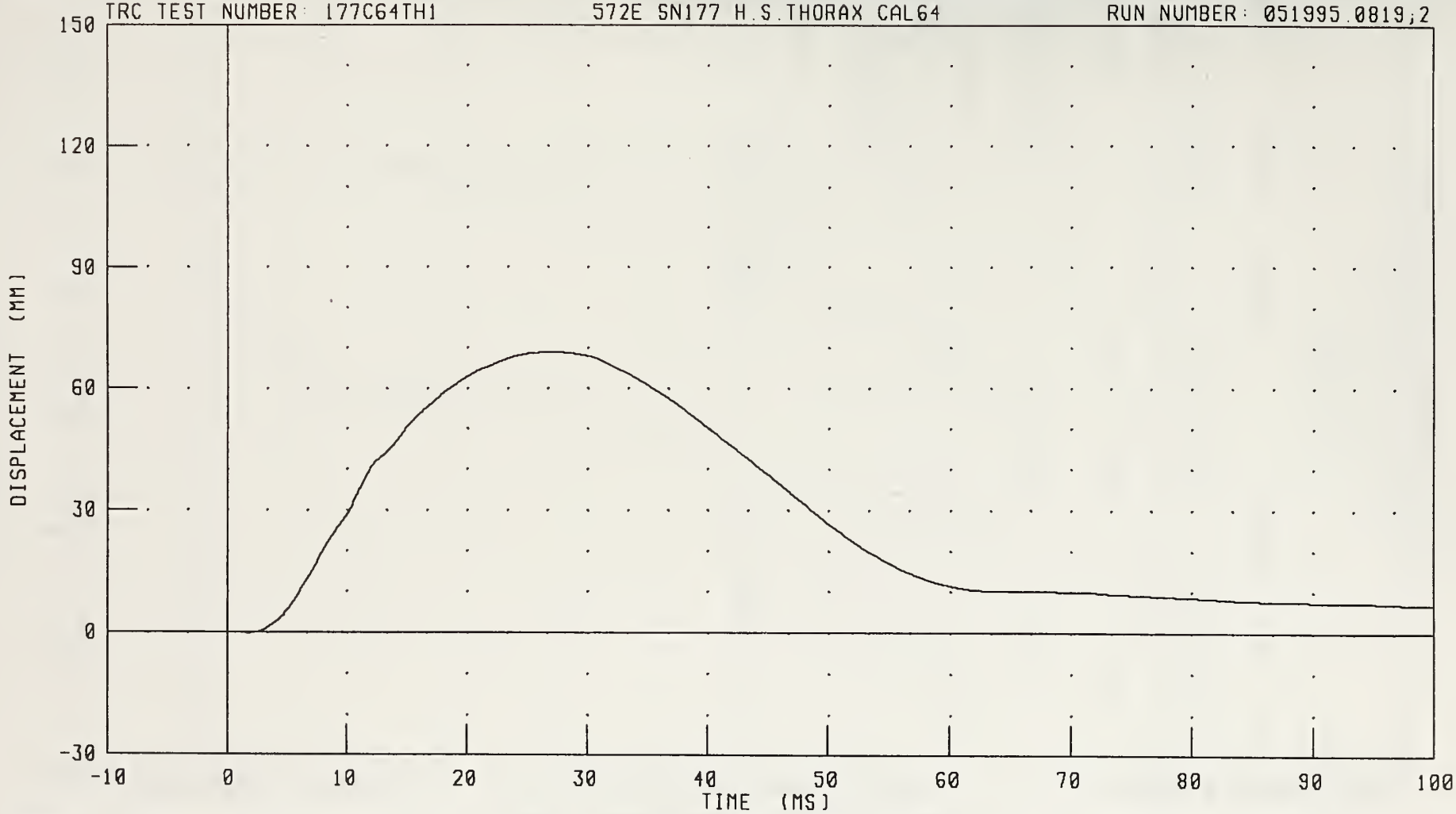

PART 572-E HYBRID III THORAX CALIBRATION
PENDULUM DECELERATION
TRC TEST NUMBER: 177C64TH1
572E SN177 H.S.THORAX CAL64
RUN NUMBER: 051995.0819;2
ACCELERATION (G)
50
40
30
20
10
0
-10
-10
0
10
20
30
40
50
60
70
80
90
100
TIME (MS)
CHANNEL: PENXG
FILTER: CH. CLASS 180
PEAK DATA: 24.29 G @ 21.44 MS; -0.11 G @ -0.08 MS

PART 572-E HYBRID III THORAX CALIBRATION
PENDULUM FORCE



PART 572-E HYBRID III THORAX CALIBRATION
STERNUM DISPLACEMENT

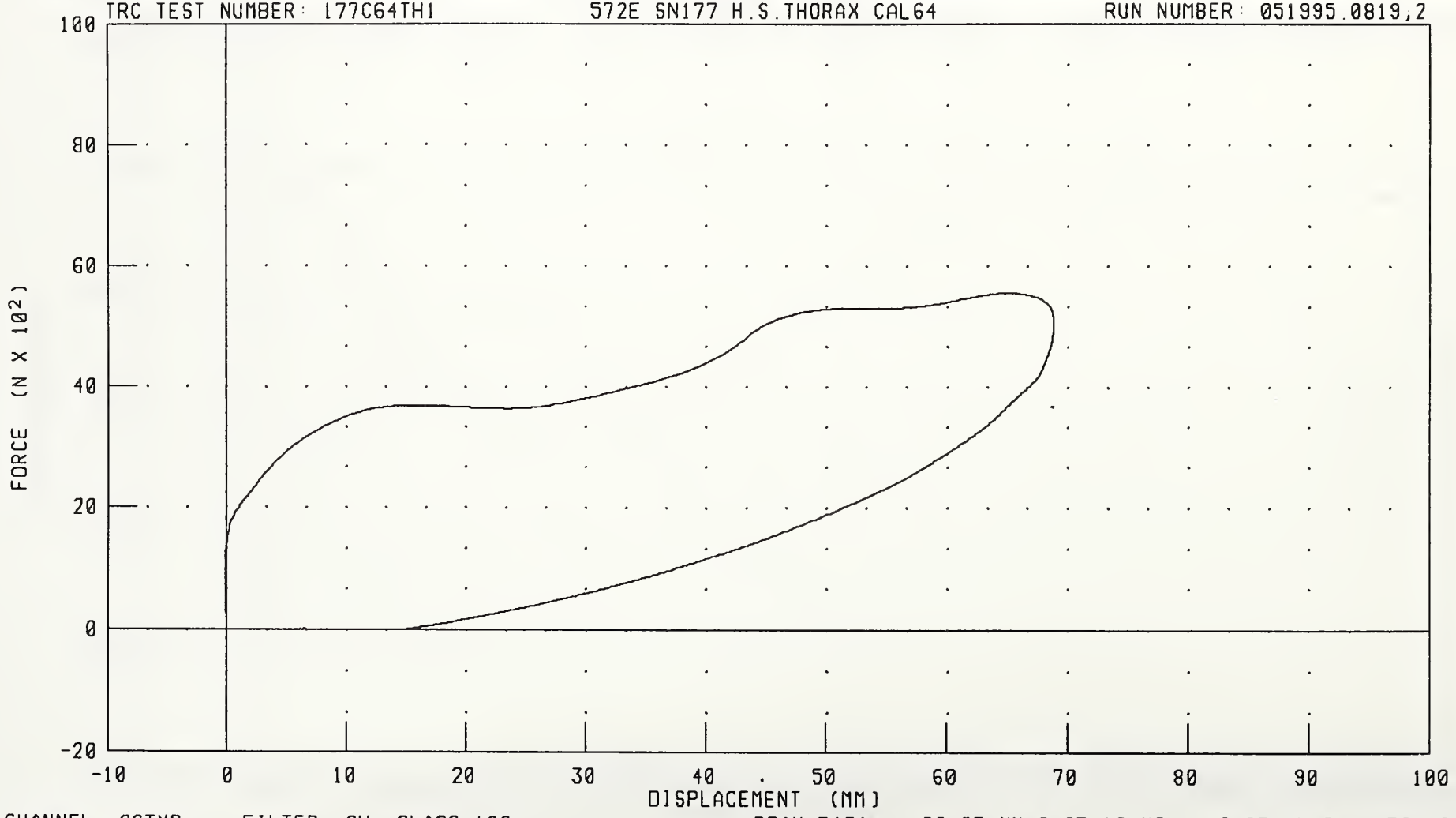
TRC TEST NUMBER: 177C64TH1 572E SN177 H.S.THORAX CAL64 RUN NUMBER: 051995.0819;2



CHANNEL: CSTXD FILTER: CH. CLASS 180 PEAK DATA: 68.85 MM @ 27.12 MS; -0.07 MM @ 1.76 MS

PART 572-E HYBRID III THORAX CALIBRATION
CHEST DISPLACEMENT VS PENDULUM FORCE

TRC TEST NUMBER: 177C64TH1 572E SN177 H.S.THORAX CAL64 RUN NUMBER: 051995.0819,2



CHANNEL: CSTXD FILTER: CH. CLASS 180 PEAK DATA: 68.85 MM @ 27.12 MS; -0.07 MM @ 1.76 MS
PENXF CH. CLASS 180 5565.14 N @ 21.44 MS; -24.68 N @ -0.08 MS

TRANSPORTATION RESEARCH CENTER INC.

RIGHT KNEE IMPACT TEST

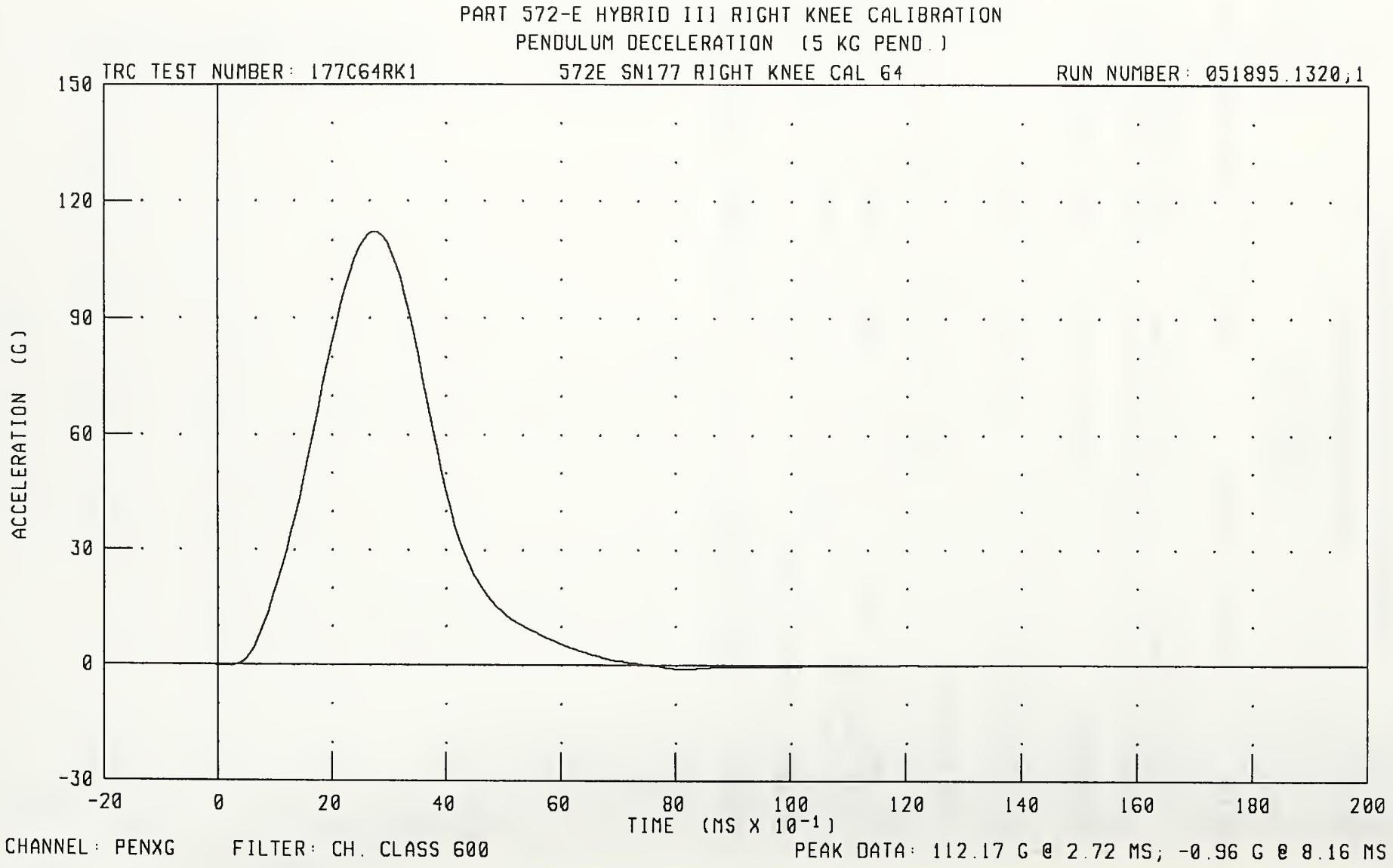
HYBRID III 18-MAY-95

TRC INC. TEST NO: 177C64RK1 572E SN177 RIGHT KNEE CAL 64

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10 - 70 %	50.0 %
PROBE VELOCITY	2.07 - 2.13 M/S	2.11 M/S
PEAK KNEE IMPACT FORCE 5.0 KG PENDULUM	4715 - 5782 N	5488.1 N

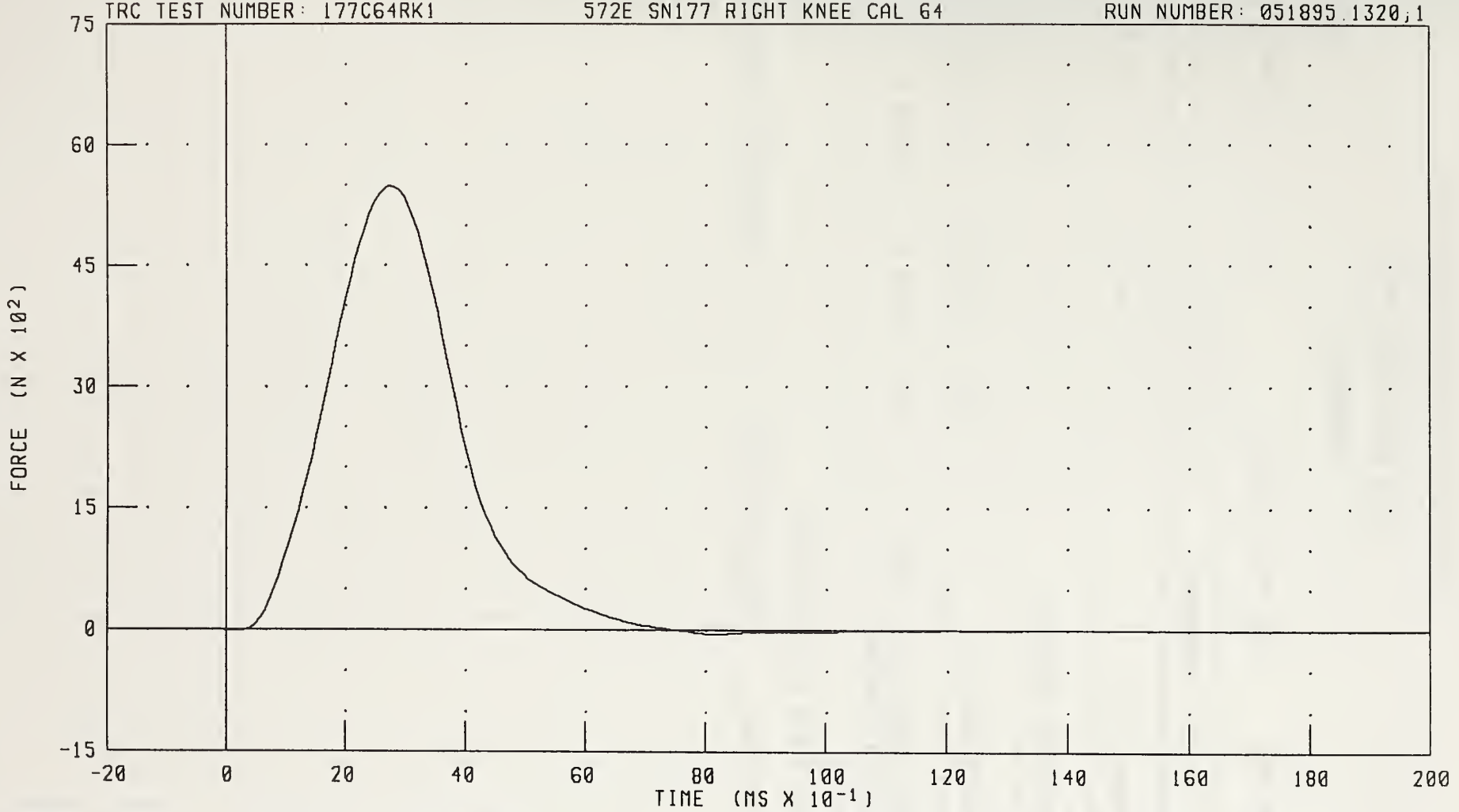
TEST MEETS SPECIFICATIONS

TECHNICIAN Pete Fast RUN NUMBER: 051895.1318;1


PART 572-E HYBRID III RIGHT KNEE CALIBRATION
PENDULUM DECELERATION (5 KG PEND.)
TRC TEST NUMBER: 177C64RK1
572E SN177 RIGHT KNEE CAL 64
RUN NUMBER: 051895.1320,1
150
120
90
60
30
0
-30
ACCELERATION (G)
-20
0
20
40
60
80
100
120
140
160
180
200
TIME (MS X 10⁻¹)
CHANNEL: PENXG
FILTER: CH. CLASS 600
PEAK DATA: 112.17 G @ 2.72 MS; -0.96 G @ 8.16 MS

PART 572-E HYBRID III RIGHT KNEE CALIBRATION
PENDULUM FORCE (5 KG PEND.)

TRC TEST NUMBER: 177C64RK1
572E SN177 RIGHT KNEE CAL 64
RUN NUMBER: 051895.1320;1



CHANNEL: PENXF FILTER: CH. CLASS 600
PEAK DATA: 5488.20 N @ 2.72 MS; -46.99 N @ 8.16 MS

TRANSPORTATION RESEARCH CENTER INC.

LEFT KNEE IMPACT TEST

HYBRID III 18-MAY-95

TRC INC. TEST NO: 177C64LK1 572E SN177 LEFT KNEE CAL 64

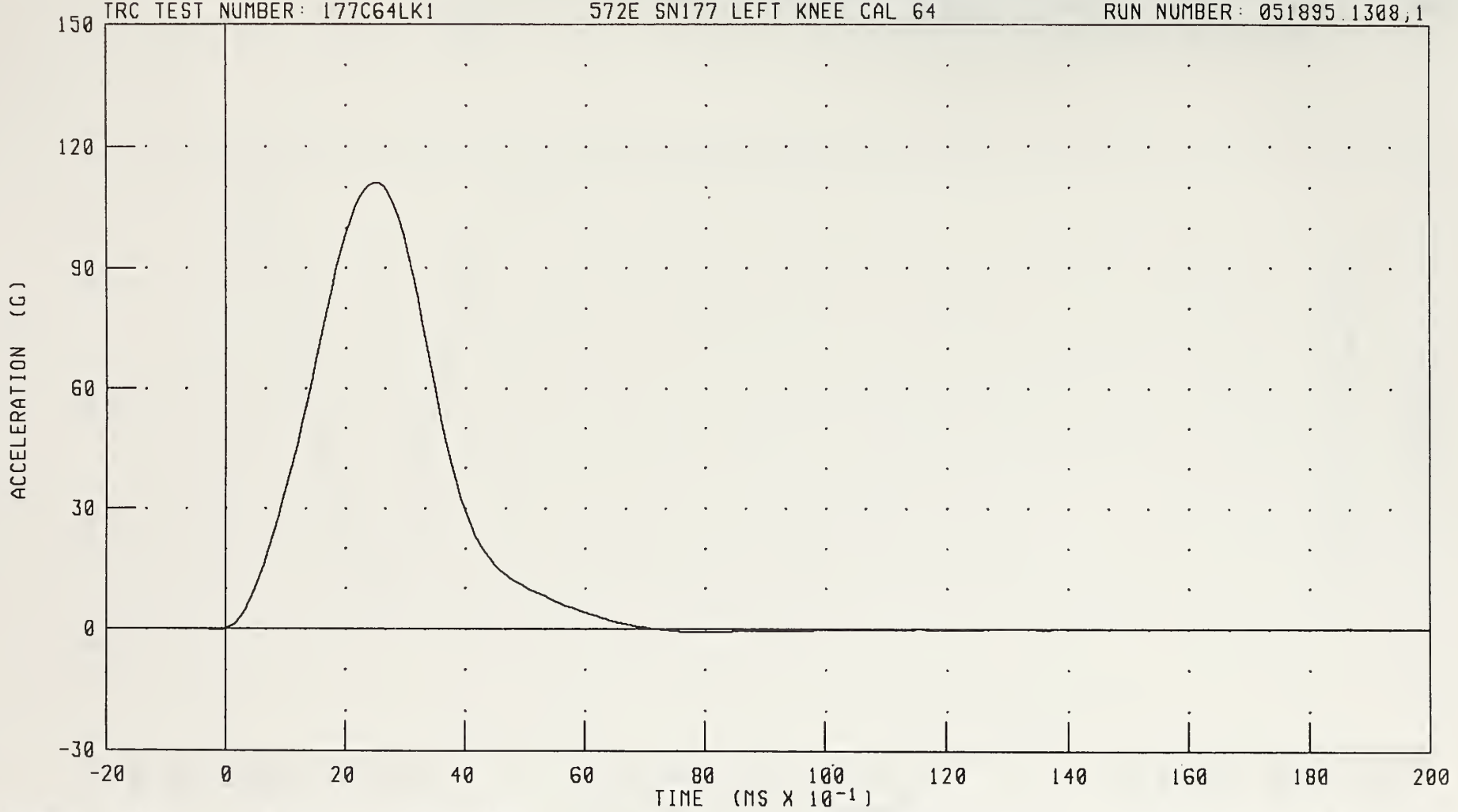
TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10 - 70 %	50.0 %
PROBE VELOCITY	2.07 - 2.13 M/S	2.11 M/S
PEAK KNEE IMPACT FORCE 5.0 KG PENDULUM	4715 - 5782 N	5439.8 N

TEST MEETS SPECIFICATIONS

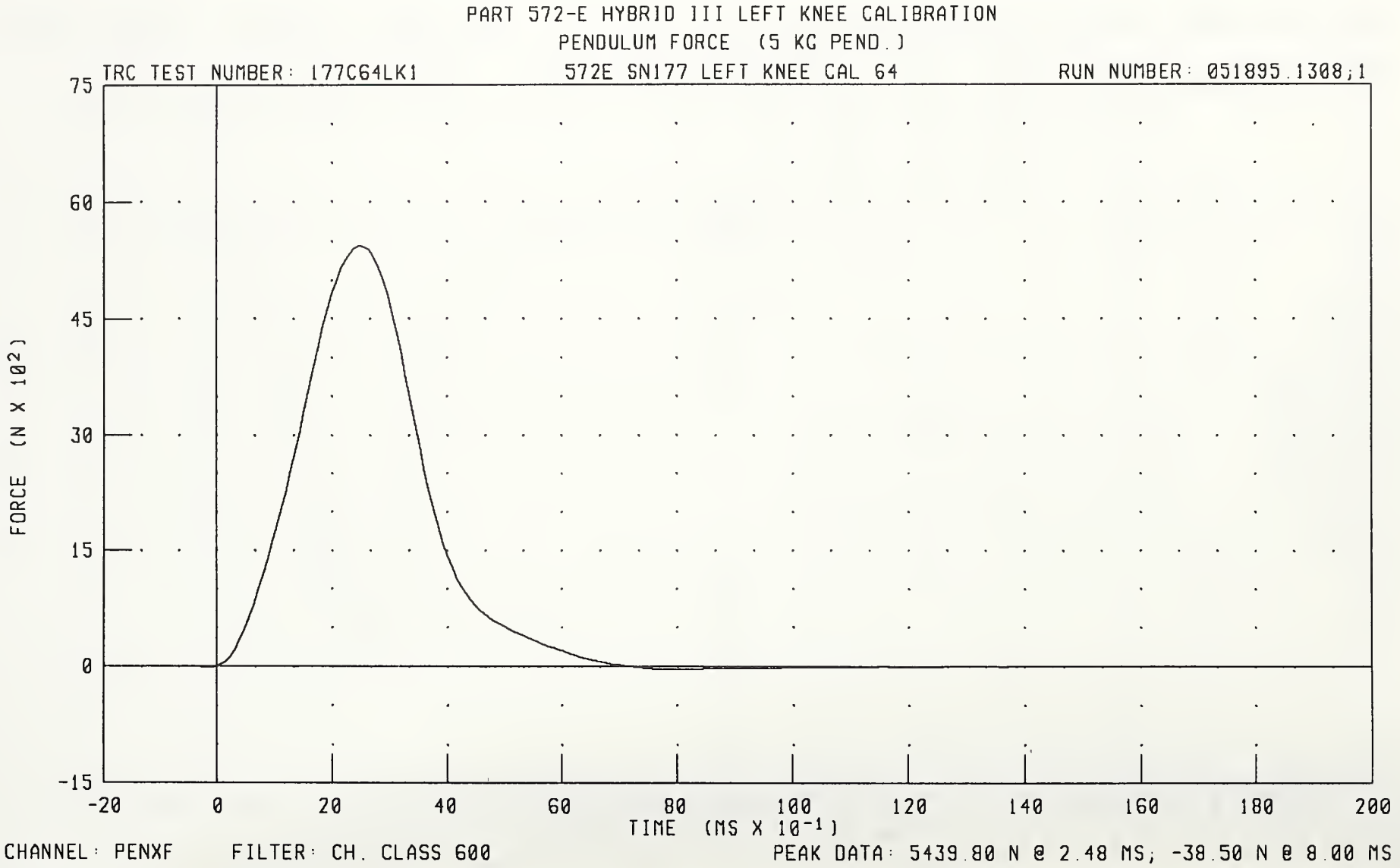
TECHNICIAN  RUN NUMBER: 051895.1308;1

PART 572-E HYBRID III LEFT KNEE CALIBRATION
PENDULUM DECELERATION (5 KG PEND.)

TRC TEST NUMBER: 177C64LK1 572E SN177 LEFT KNEE CAL 64 RUN NUMBER: 051895.1308;1



CHANNEL: PENXG FILTER: CH. CLASS 600 PEAK DATA: 111.18 G @ 2.48 MS; -0.79 G @ 8.00 MS


PART 572-E HYBRID III LEFT KNEE CALIBRATION
PENDULUM FORCE (5 KG PEND.)
TRC TEST NUMBER: 177C64LK1
572E SN177 LEFT KNEE CAL 64
RUN NUMBER: 051895.1308;1
FORCE (N X 10²)
75
60
45
30
15
0
-15
-20
0
20
40
60
80
100
120
140
160
180
200
TIME (MS X 10⁻¹)
CHANNEL: PENXF
FILTER: CH. CLASS 600
PEAK DATA: 5439.80 N @ 2.48 MS; -38.50 N @ 8.00 MS

Appendix D

Miscellaneous Test Information

Dummy Instrumentation Placement

Dummy Manufacturer: Humanoid Systems

Dummy Serial Number: 083

Seating Position: Driver

Mnemonic	Location	Axis	Mfr.	Model	S/N	Orientation (+ Sensing)
HEDXG1	Head Acceleration	X	Endevco	7231C	AH5B6	Rear
HEDYG1	Head Acceleration	Y	Endevco	7231C	AH5G8	Left
HEDZG1	Head Acceleration	Z	Endevco	7231C	AH5H7	Up
CSTXG1	Chest Acceleration	X	Endevco	7231C	AH5B1	Forward
CSTYG1	Chest Acceleration	Y	Endevco	7231C	AH469	Left
CSTZG1	Chest Acceleration	Z	Endevco	7231C	AH425	Down
CSTXD1	Chest Displacement	X	Servo	14CB1-2981	9126	Outward
LFMF1	Left Femur Force		Denton	2121	0162	Tension
RFMF1	Right Femur Force		Denton	2121	0163	Tension

Dummy Instrumentation Placement

Dummy Manufacturer: Alderson Research Labs

Dummy Serial Number: 177

Seating Position: Right Front Passenger

Mnemonic	Location	Axis	Mfr.	Model	S/N	Orientation (+ Sensing)
HEDXG2	Head Acceleration	X	Endevco	7231C	A45E	Rear
HEDYG2	Head Acceleration	Y	Endevco	7231C	A76D	Left
HEDZG2	Head Acceleration	Z	Endevco	7231C	A87F	Up
CSTXG2	Chest Acceleration	X	Endevco	7231C	A01E	Forward
CSTYG2	Chest Acceleration	Y	Endevco	7231C	A28A	Left
CSTZG2	Chest Acceleration	Z	Endevco	7231C	FC02	Down
CSTXD2	Chest Displacement	X	Vernitech	81422A	CP2981	Outward
LFMF2	Left Femur Force		Denton	2121	0160	Tension
RFMF2	Right Femur Force		Denton	2121	0161	Tension

Vehicle Instrumentation Placement

Mnemonic	Location	Axis	Mfr.	Model	S/N	Orientation (+ Sensing)
TLRXG1	Left Rear Seat	X	Endevco	7264	AJ798	Forward
TRRXG1	Right Rear Seat	X	Endevco	7264	AJ454	Forward
BCRXG1	Right Brake Caliper	X	Endevco	7264	AJ8C5	Rearward
BCLXG1	Left Brake Caliper	X	Endevco	7264	AJ7J9	Forward
DPCXG1	Instrument Panel Center	X	Endevco	7264	AJ7F8	Forward
OTHXG3	Front Battery Box	X	Endevco	7264	AE9B7	Rearward
OTHZG3		Z	Endevco	7264	AJ5P0	Up
OTHXG4	Rear Battery Box	X	Endevco	7264	AJ455	Forward
OTHZG4		Z	Endevco	7264	AJ790	Up
OTHXG1	Motor	X	Endevco	7264	AJ5P2	Forward
OTHXG2	Gear Box	X	Endevco	7264	BE69J	Rearward
OTHZG2	Gear Box	Z	Endevco	7264	EJ69J	Up
TFCZG1	Trunk Floor Center	Z	Endevco	7264	AJ708	Down

Sign Convention

All Dummy, Barrier, And Vehicle Channels:

+X: Forward

+Y: Leftward

+Z: Upward

+Force: Tension

Post-test Driver Dummy Inspection Checklist

Type: Hybrid III

Serial Number: 083

Inspected by: John Clarridge

Date: 05/23/95

Part	Items Checked	Comments
Skin	visual inspection	*
Head	visual, ballast, accelerometer mount	*
Neck	visual, cable torque, nodding blocks	OK
Clavicles	visual, bumpers, range of motion	OK
Arms/hands	visual, bumpers, range of motion	OK
Spine box	visual, ballast, weldment, accelerometer mount	OK
Rib cage	visual, measure, stiffeners	OK
Sternum	visual, bumpers	OK
Lumbar spine	visual, cable torque	OK
Abdomen	visual	OK
Pelvis	visual, palpate, accelerometer mount	OK
Upper legs	visual, load cell bolts	OK
Knees	visual, stops, inserts, sliders	OK
Lower legs	visual, range of motion	OK
Ankles	visual, range of motion	OK
Feet	visual, range of motion	OK
Joints	1 to 2 g range	OK
Other		

*Notes: (include component/problem/action/reason): Head skin cut in forehead and on knee skin.

Post-test Passenger Dummy Inspection Checklist

Type: Hybrid III

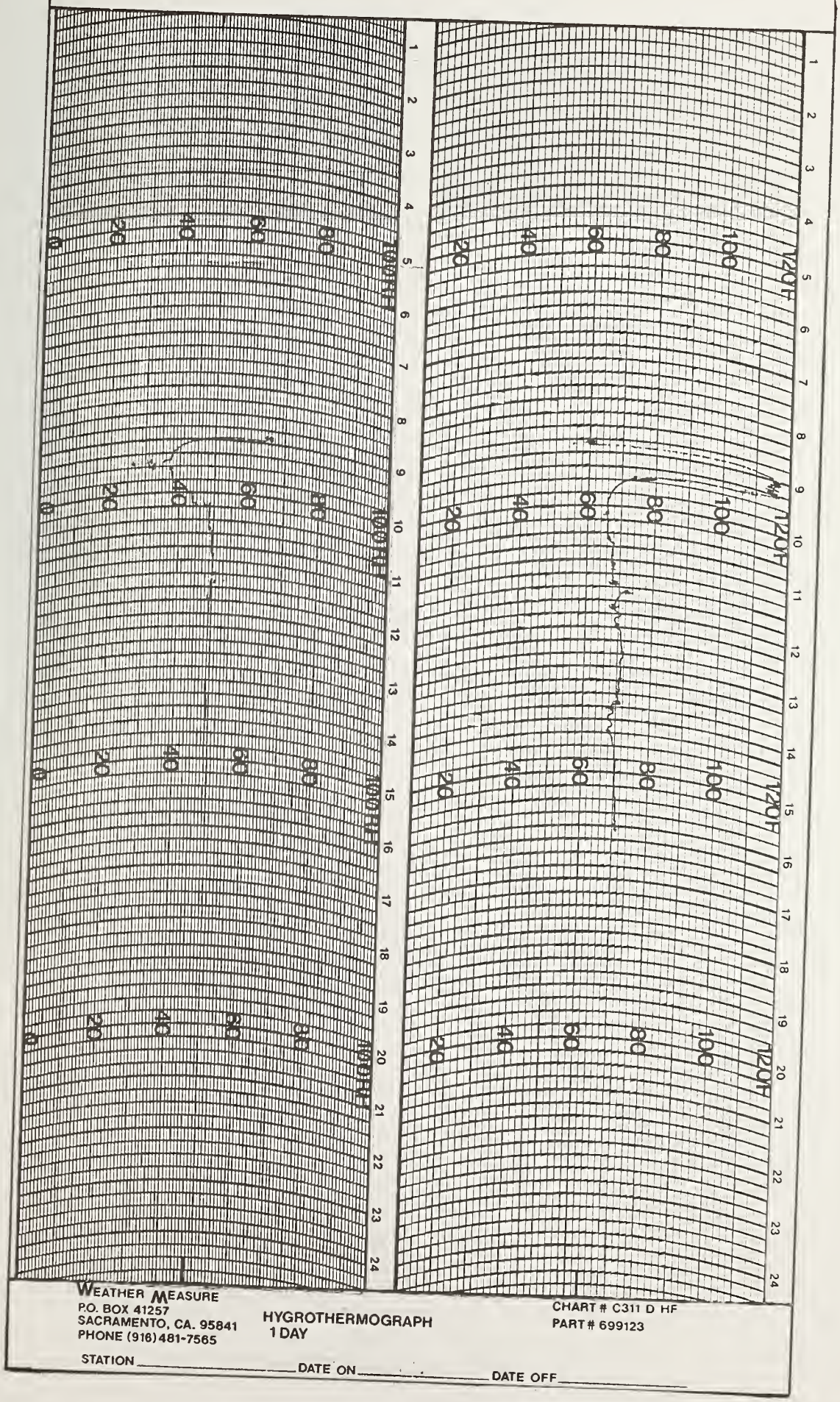
Serial Number: 177

Inspected by: John Clarridge

Date: 05/23/95

Part	Items Checked	Comments
Skin	visual inspection	*
Head	visual, ballast, accelerometer mount	OK
Neck	visual, cable torque, nodding blocks	OK
Clavicles	visual, bumpers, range of motion	OK
Arms/hands	visual, bumpers, range of motion	OK
Spine box	visual, ballast, weldment, accelerometer mount	OK
Rib cage	visual, measure, stiffeners	OK
Sternum	visual, bumpers	OK
Lumbar spine	visual, cable torque	OK
Abdomen	visual	OK
Pelvis	visual, palpate, accelerometer mount	*
Upper legs	visual, load cell bolts	OK
Knees	visual, stops, inserts, sliders	OK
Lower legs	visual, range of motion	OK
Ankles	visual, range of motion	OK
Feet	visual, range of motion	OK
Joints	1 to 2 g range	OK
Other		

*Notes: (include component/problem/action/reason): Abrasions on forehead and chin, chair pelivc pins not in the pelvic block. Pelvic skin was supporting entire dummy.



Occupant Compartment Thermograph