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October 1993

Final Report

Final Report of a 1993 Solectria Force into a Flat Frontal Barrier

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Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS 808 311		VRTC-83-0285

4. Title and Subtitle	5. Report Date
FINAL REPORT OF A 1993 SOLECTRIA FORCE INTO A FLAT FRONTAL BARRIER	OCTOBER 1993
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
K. W. Looker, Project Engineer, TRC	930923
9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
National Highway Traffic Safety Admin. Vehicle Research and Test Center P. O. BOX 37 East Liberty, OH 43319	11. Contract or Grant No. DTNH22-88-C-07292
12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
U. S. Department of Transportation National Highway Traffic Safety Administration 400 Seventh St., S.W. Washington, DC 20590	FINAL REPORT SEPT. - OCT. 1993
	14. Sponsoring agency Code DOT/NHTSA/VRTC

DEPARTMENT OF TRANSPORTATION
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15. Supplemental Notes

16. Abstract

A 48.3 kph flat frontal barrier impact test was conducted on a 1993 Solectria Force at Transportation Research Center Inc. on September 23, 1993. The 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 Intrusion."

The impact velocity was 47.6 kph. The vehicle's maximum static crush was 439 millimeters. The ambient temperature was 21° C.

The driver's Head Injury Criteria (HIC) was 622. The driver's chest maximum resultant acceleration with three milliseconds minimum duration was 46.1 g. The driver's chest maximum deflection was 37 millimeters (See DATA ACQUISITION EXPLANATIONS). The driver's left and right femur maximum axial forces were 6744 N and 3499 N, respectively.

The passenger's HIC was 509. The passenger's chest maximum resultant acceleration with three milliseconds minimum duration was 32.7 g. The passenger's chest maximum deflection was 33 millimeters (See DATA ACQUISITION EXPLANATIONS). The passenger's left and right femur maximum axial forces were 4772 N and 1539 N, respectively.

17. Key Words	18. Distribution Statement
48.3 kph Frontal Impact Electric Vehicles FMVSS 208, "Occupant Crash Protection" FMVSS 212, "Windshield Mounting" FMVSS 219 (partial), "Windshield Zone Intrusion"	Document is available to the public from the National Technical Information Service, Springfield, VA 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
UNCLASSIFIED	UNCLASSIFIED	174	

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METRIC CONVERSION FACTORS

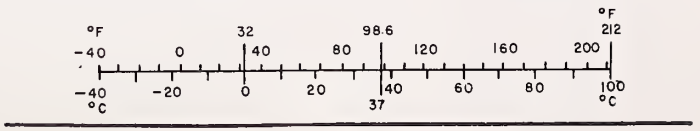
Approximate Conversions to Metric Measures

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 48.3 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 Stnadards 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-208-08 as a guideline. 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 ten (10) accelerometers to measure longitudinal 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 572E 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 B and Optional Appendix C of the Laboratory Test Procedure.

Both dummies were instrumented with head and chest accelerometers to measure longitudinal, lateral, and vertical accelerations, and with left and right femur load cells to measure axial forces. Each Part 572E dummy's instrumentation also included a chest potentiometer to measure longitudinal deflection.

The twenty-eight (28) data channels were multiplexed and recorded on a 14-track tape drive. The data was digitally sampled at 8000 samples per second and processed per Sections 12.8 and 12.9 of the Laboratory Test Procedure.

The crash event was recorded by one (1) real-time panning motion picture camera and fourteen (14) high-speed motion picture cameras 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 September 23, 1993.

The test vehicle, a 1993 Solectria Force, 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 meausred 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 76.2 millimeters. The windshield periphery retention was 92.1 percent. There was no penetration into any portion of the windshield.

The vehicle's test weight was 1168 kg. The vehicle's impact speed was 47.6 kph. The vehicle sustained 439 millimeters of static crush during the impact.

The driver's HIC was 622. The driver's chest maximum resultant acceleration with three (3) milliseconds minimum duration was 46.1 g. The driver's chest maximum deflection was 37 mm (See DATA ACQUISITION EXPLANATIONS). The driver's left and right femur maximum axial forces were 6744 N and 3499 N, respectively.

The passenger's HIC was 509. The passenger's chest maximum resultant acceleration with three (3) milliseconds minimum duration was 32.7 g. The passenger's chest maximum deflection was 33 mm (See DATA ACQUISITION EXPLANATIONS). The passenger's left and right femur maximum axial forces were 4772 N and 1539 N, respectively.

DATA ACQUISITION EXPLANATIONS

The driver dummy's chest deflection data channel, CSTXD1, did not return to zero after the impact event.

The passenger dummy's chest deflection data channel, CSTXD2, did not return to zero after the impact event.

The engine bottom X-axis acceleration data channel, ENGXG2, stopped recording data after 38 milliseconds because the accelerometer's cable was cut by vehicle crush.

TABLE 1 CRASH TEST SUMMARY

TEST TYPE: Flat frontal barrier impact

TEST DATE: 09/23/93 TEST TIME: 1327 AMBIENT TEMP.: 21° C

VEHICLE YEAR/MAKE/MODEL/BODY STYLE: 1993/Solectria/Force/3-door hatchback

VEHICLE TEST WEIGHT (KG): 1168

IMPACT ANGLE[1] (DEG): 0

IMPACT VELOCITY[2] (KPH): PRIMARY = 47.6 SECONDARY = 47.6

MAXIMUM STATIC CRUSH (MM): 439

AVERAGE REBOUND (MM): 901

DUMMIES:	Driver #177	Passenger #134
TYPE:	Part 572 E	Part 572 E
LOCATION:	Left front	Right front
RESTRAINT:	3-point unibelt	3-point unibelt

NUMBER OF DATA CHANNELS: 28

NUMBER OF CAMERAS: HIGH-SPEED 14 REAL-TIME 1

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

TABLE 2 TEST VEHICLE INFORMATION

VEHICLE MANUFACTURER: CAMI-Automotive Inc. Canada

VEHICLE ALTERED BY: Solectria Corporation

MAKE/MODEL: Solectria/Force VIN: 2C1MS2460P6715204

BODY STYLE: 3-door hatchback MODEL YEAR: 1993

COLOR: Green

ELECTRIC MOTOR DATA: 144 Volt AC

TRANSMISSION DATA: AUTOMATIC

DATE VEHICLE RECEIVED: 09/17/93 ODOMETER READING: 766.9

DEALER'S NAME AND ADDRESS: NA

ACCESSORIES:

POWER STEERING	No	AUTOMATIC TRANSMISSION	No
POWER BRAKES	No	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	No
CLOCK	No	REAR WINDOW DEFROSTER	No

REMARKS:

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

CERTIFICATION DATA FROM VEHICLE'S LABEL:

VEHICLE MANUFACTURED BY: CAMI-Automotive Inc. Canada

DATE OF MANUFACTURE: 11/92 VIN: 2C1MS2460P6715204

GVWR: 1110 KG

GAWR: FRONT: 565 KG, REAR: 545 KG

TABLE 2 TEST VEHICLE INFORMATION CONT'D

TIRES ON VEHICLE (MFR., LINE, SIZE): Goodyear, Invicta, P145/80R12

TIRE PRESSURE WITH MAXIMUM CAPACITY VEHICLE LOAD: FRONT: 220 kPa
REAR: 220 kPa

SPARE TIRE (MFR., SIZE): NA

TYPE OF SEATS: FRONT: Bucket
REAR: Bench

TYPE OF FRONT SEAT BACKS: Manually-adjustable

MAXIMUM WIDTH: 1576 MM

WHEELBASE: 2268 MM

LOCATION OF LABEL STATING TIRE DATA:

The label was located on the driver's side B-pillar.

TIRE & CAPACITY DATA FROM VEHICLE'S LABEL:

RECOMMENDED TIRE SIZE: P145/80R12

RECOMMENDED COLD TIRE PRESSURE: FRONT: 220 kPa; REAR: 220 kPa

DESIGNATED SEATING CAPACITY: 2 FRONT 2 REAR
4 TOTAL

VEHICLE CAPACITY WEIGHT: 312 KG

TEST VEHICLE ATTITUDE (ALL MEASUREMENTS ARE IN MILLIMETERS):

DELIVERED ATTITUDE: LF 591; RF 594; LR 575; RR 572

PRE-TEST ATTITUDE: LF 559; RF 566; LR 539; RR 540

POST-TEST ATTITUDE: LF 543; RF 545; LR 541; RR 545

TABLE 2 TEST VEHICLE INFORMATION CONT'D

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

RIGHT FRONT	243 KG	RIGHT REAR	220 KG
LEFT FRONT	252 KG	LEFT REAR	235 KG
TOTAL FRONT WEIGHT	495 KG	(52.1% OF TOTAL VEHICLE WEIGHT)	
TOTAL REAR WEIGHT	455 KG	(47.9% OF TOTAL VEHICLE WEIGHT)	
TOTAL DELIVERED WEIGHT	950 KG		

WEIGHT OF TEST VEHICLE WITH REQUIRED DUMMIES AND 66 KG OF CARGO WEIGHT:

RIGHT FRONT	287 KG	RIGHT REAR	283 KG
LEFT FRONT	295 KG	LEFT REAR	303 KG
TOTAL FRONT WEIGHT	582 KG	(49.8% OF TOTAL VEHICLE WEIGHT)	
TOTAL REAR WEIGHT	586 KG	(50.2% OF TOTAL VEHICLE WEIGHT)	
TOTAL TEST WEIGHT	1168 KG		

WEIGHT OF BALLAST SECURED IN VEHICLE: 0 KG

COMPONENTS REMOVED TO MEET TARGET TEST WEIGHT: Rear tail lights

CG = 1137 MM REARWARD OF FRONT WHEEL CENTERLINE

TABLE 3 POST-IMPACT DATA

TEST NUMBER: 930923

TEST DATE: 09/23/93 TEST TIME: 1327

TEST TYPE: Flat frontal barrier impact IMPACT ANGLE: 0°

AMBIENT TEMPERATURE AT IMPACT AREA: 21° C

TEMPERATURE IN OCCUPANT COMPARTMENT: 21° C

IMPACT VELOCITY: PRIMARY = 47.6 KPH SECONDARY = 47.6 KPH

(SPECIFIED RANGE = 46.5 TO 48.1 KPH)

DISTANCE FROM VEHICLE TO BARRIER: ENTERING VELOCITY TRAP = 381 MM

EXITING VELOCITY TRAP = 51 MM

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

OVERALL LENGTH OF TEST VEHICLE: PRE-TEST: L 3558; C 3643; R 3551

POST-TEST: L 3145; C 3215; R 3121

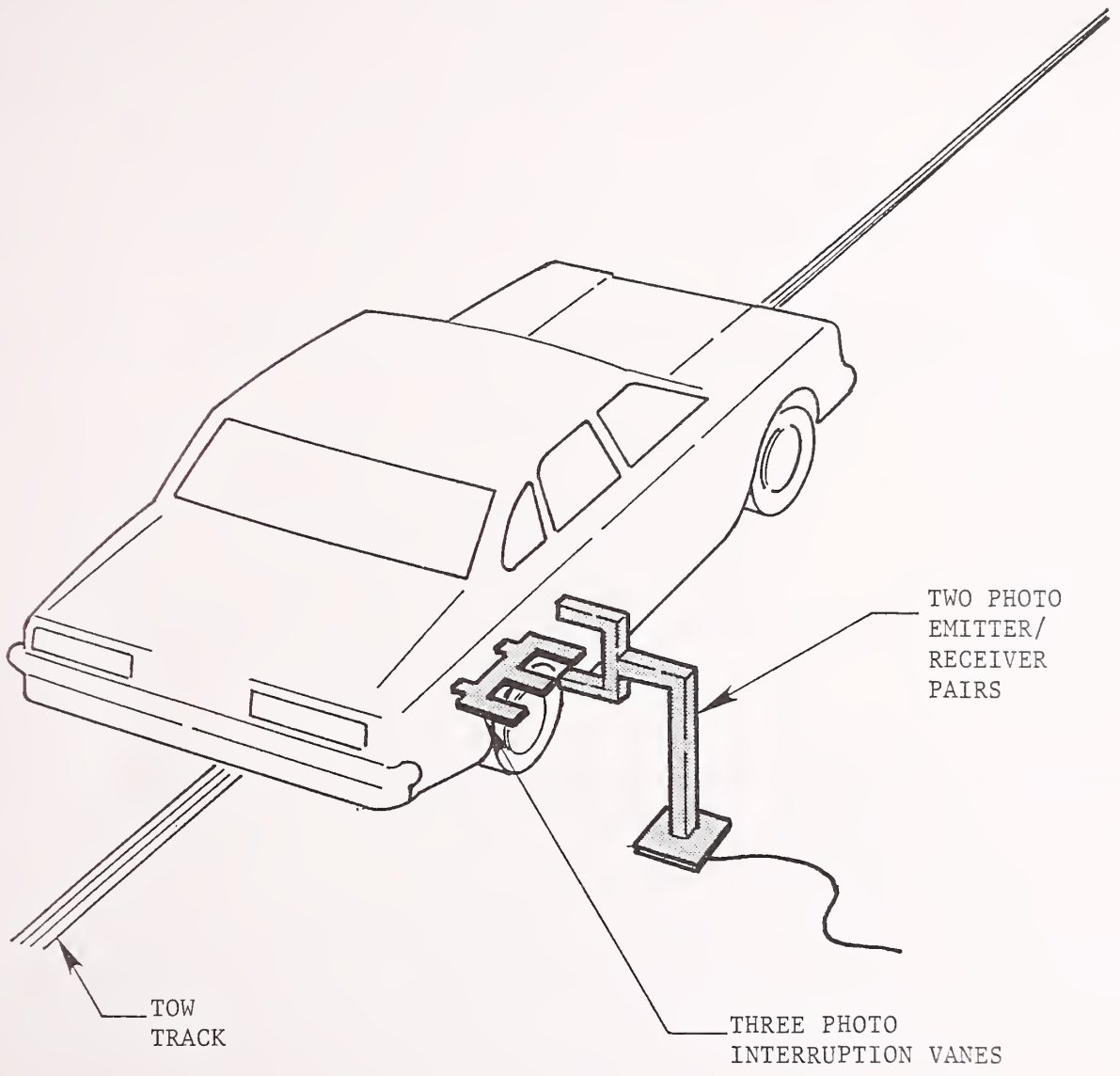
TOTAL CRUSH: L 413; C 428; R 430

AVERAGE CRUSH: 424

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

DISTANCE FROM TEST VEHICLE TO BARRIER: L 930; C 852; R 920; AVG. 901

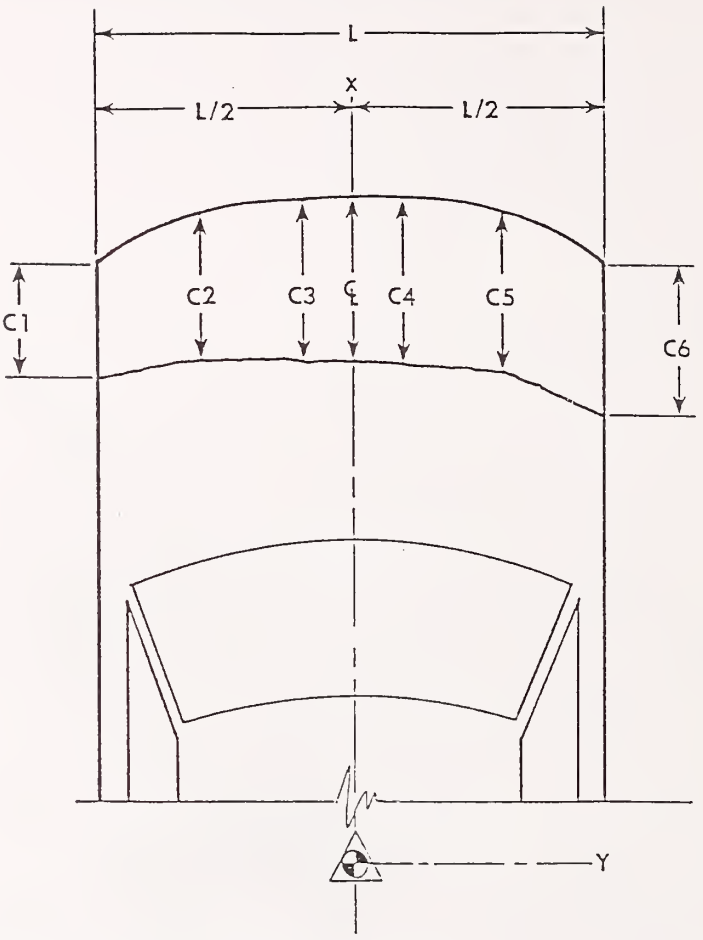
FIGURE 1 IMPACT VELOCITY MEASUREMENT SYSTEM



The final vane clears emitter/receiver 51 millimeters before impact.

The vanes have 305-millimeter spacing.

FIGURE 2 VEHICLE CRUSH

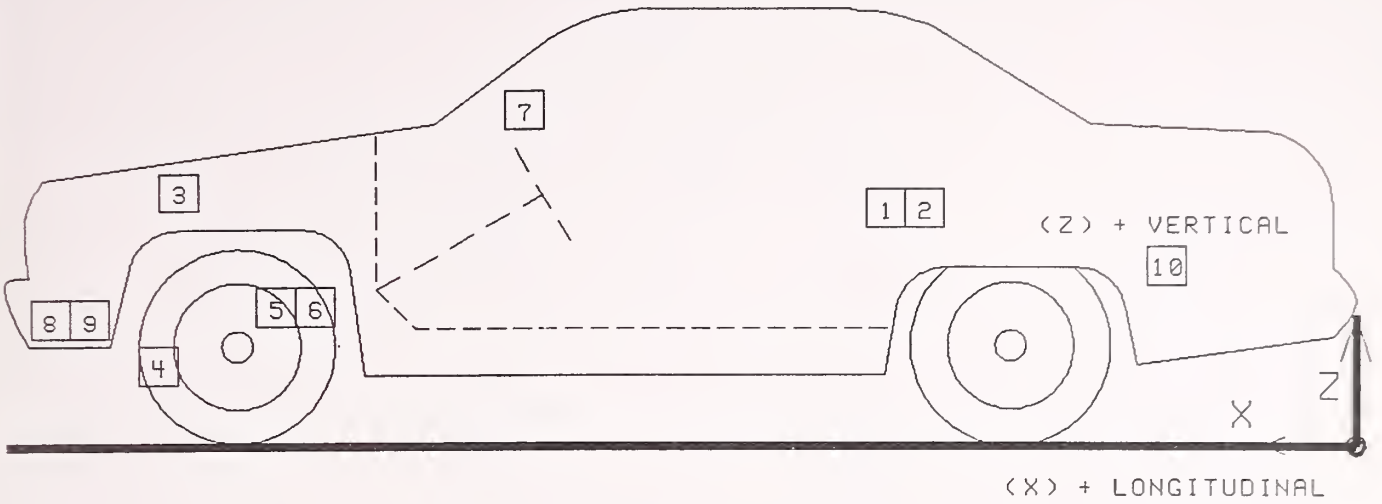


NOTES: L is pre-test length of contact surface.
C1 through C6 are spaced equally apart.
CL is vehicle centerline.
All measurements are in millimeters.

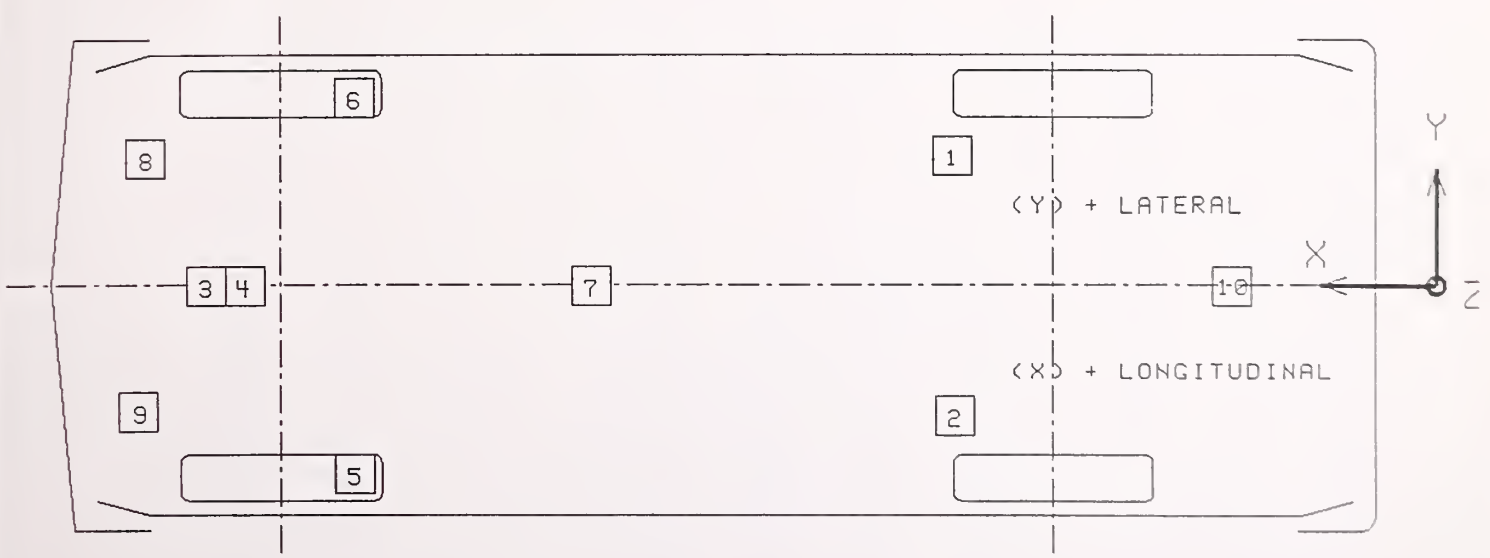
Vehicle Solectria Force

	PRE-TEST		POST-TEST		CRUSH
L	1372				
C1	3558	C1	3145	C1	413
C2	3624	C2	3205	C2	419
C3	3636	C3	3215	C3	421
C4	3632	C4	3215	C4	417
C5	3624	C5	3185	C5	439
C6	3551	C6	3121	C6	430
CL	3643	CL	3215	CL	428

FIGURE 3 VEHICLE ACCELEROMETER PLACEMENT



SIDE VIEW



BOTTOM VIEW

TABLE 4

VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

TEST NUMBER 930923

No.	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION MAX G	POSITIVE DIRECTION MSEC	NEGATIVE DIRECTION MAX G	NEGATIVE DIRECTION MSEC
1	LEFT REAR SEAT CROSSMEMBER LONGITUDINAL	1226	542	261	2.7	137.0	27.2	36.3
2	RIGHT REAR SEAT CROSSMEMBER LONGITUDINAL	1229	-534	270	3.2	159.5	28.3	37.4
3	ENGINE TOP LONGITUDINAL	2893	80	688	17.2	63.9	93.3	30.6
4	ENGINE BOTTOM LONGITUDINAL[1]	2750	33	173	73.7	34.6	131.6	26.5
5	RIGHT BRAKE CALIPER LONGITUDINAL	2914	-607	264	32.0	67.6	58.9	37.1
6	LEFT BRAKE CALIPER LONGITUDINAL	2915	596	256	33.4	62.4	61.2	33.8

TABLE 4

VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY CONTINUED

TEST NUMBER 930923

No.	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION MAX G	POSITIVE DIRECTION MSEC	NEGATIVE DIRECTION MAX G	NEGATIVE DIRECTION MSEC
7	INSTRUMENT PANEL CENTER LONGITUDINAL	2348	10	815	44.6	70.5	50.5	49.3
8	FRONT BATTERY BOX LEFT	2965	277	236	83.1	38.8	175.3	28.9
9	FRONT BATTERY BOX RIGHT	2965	-225	228	88.3	34.8	197.5	30.3
10	REAR BATTERY BOX CENTER	622	0	570	16.8	122.0	24.0	43.0

* ALL MEASUREMENTS OF ACCELEROMETER LOCATIONS ARE IN MILLIMETERS.

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 930923

	DRIVER DUMMY SN: 177				PASSENGER DUMMY SN: 134			
	POSITIVE DIRECTION		NEGATIVE DIRECTION		POSITIVE DIRECTION		NEGATIVE DIRECTION	
	MAX	MSEC	MAX	MSEC	MAX	MSEC	MAX	MSEC
HEAD ACCELERATION (g)								
LONGITUDINAL	13.0	193.0	123.7	68.8	25.2	201.0	49.2	107.9
LATERAL	13.8	69.0	16.9	84.3	5.2	114.9	6.3	241.1
VERTICAL	2.6	11.6	36.5	68.8	2.6	12.5	42.2	101.9
RESULTANT	129.2	68.8			55.6	107.9		
HIC	622	FROM 68.2 TO 98.4			509	FROM 80.9 TO 116.9		
CHEST ACCELERATION (g)								
LONGITUDINAL	3.8	254.3	48.9	68.4	4.0	246.4	34.3	68.9
LATERAL	2.4	122.3	8.8	64.0	7.8	105.0	4.4	81.4
VERTICAL	15.0	85.1	15.2	47.6	11.8	94.8	8.4	48.6
RESULTANT	49.3	68.3			34.3	68.9		
3 MSEC	46.1				32.7			
CHEST DEFLECTION (mm)								
LONGITUDINAL[1]	0.2	6.8	37.0	90.9	7.4	307.0	32.7	88.8

TABLE 5

DUMMY DATA SUMMARY CONTINUED

TEST NUMBER 930923

	DRIVER DUMMY SN: 177				PASSENGER DUMMY SN: 134			
	POSITIVE DIRECTION		NEGATIVE DIRECTION		POSITIVE DIRECTION		NEGATIVE DIRECTION	
	MAX	MSEC	MAX	MSEC	MAX	MSEC	MAX	MSEC
FEMUR LOAD (N)								
LEFT	258.4	30.1	6744.4	61.5	827.4	77.4	4772.0	38.6
RIGHT	116.7	207.1	3499.2	45.4	47.4	239.8	1539.2	42.5

POSITIVE DIRECTION	
LONGITUDINAL:	FORWARD
LATERAL:	LEFTWARD
VERTICAL:	UPWARD
FORCE:	TENSION

NEGATIVE DIRECTION	
LONGITUDINAL:	REARWARD
LATERAL:	RIGHTWARD
VERTICAL:	DOWNWARD
FORCE:	COMPRESSION

[1] See DATA ACQUISITION EXPLANATIONS

TABLE 6 POST-IMPACT DUMMY/VEHICLE DATA

VISIBLE DUMMY CONTACT POINTS:

	DRIVER #177	PASSENGER #134
HEAD	Upper steering wheel rim	Left knee
CHEST	None	None
ABDOMEN	Lower steering wheel rim	None
LEFT KNEE	Lower instrument panel	Glove box door
RIGHT KNEE	Lower instrument panel	Glove box door

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:

Entire windshield cracked upon impact.

OTHER NOTABLE IMPACT EFFECTS:

None

DUMMY KINEMATIC SUMMARY

DRIVER DUMMY

Upon impact, the driver dummy translated forward on the seat impacting both knees into the lower instrument panel. The driver dummy was restrained by the three-point unibelt. The dummy's hands hit the instrument panel and its abdomen hit the lower half of the steering wheel rim. The driver dummy's head rotated downward and struck the top surface of the steering wheel rim. The dummy rebounded rearward into the seat back and came to rest, restrained by the three-point unibelt.

RIGHT FRONT PASSENGER DUMMY

Upon impact, the right front passenger dummy translated forward on the seat impacting both knees into the glove box door. The right front passenger dummy was restrained by the three-point unibelt. The dummy 's upper body rotated forward and its head struck its left knee. The right front passenger dummy rebounded rearward into the seat back and came to rest in the right front passenger's seat restrained by the three-point unibelt.

FIGURE 4 FMVSS 212 TEST DATA

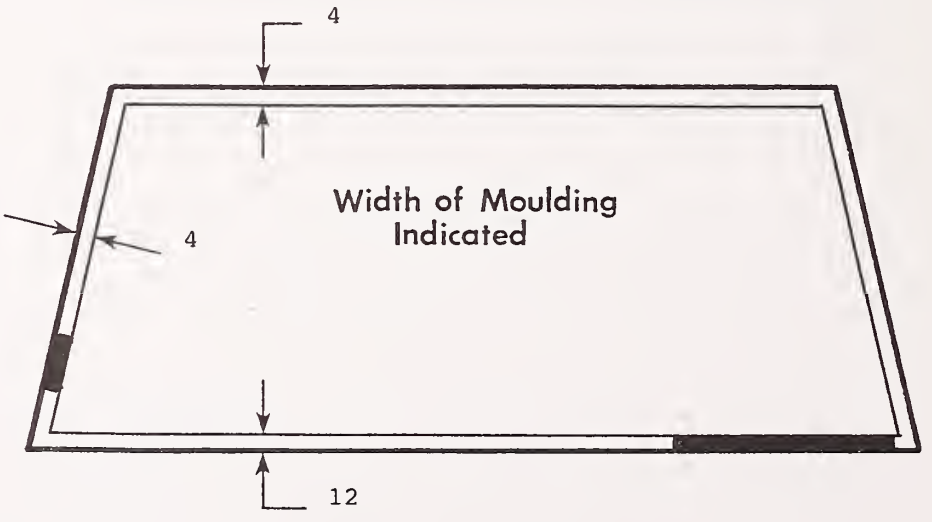
DETAILS OF WINDSHIELD MOUNTING SUCH AS RETENTION METHOD, TRIM TYPE, ETC.:
Plastic trim around outer perimeter, adhesive around inner perimeter.

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	1930	1886	97.7
LEFT SIDE	1930	1669	86.5
TOTAL	3860	3555	92.1

PRE-TEST WINDSHIELD MOUNTING MATERIAL TEMPERATURE: 21° C



FRONT VIEW OF WINDSHIELD[1]

LOSS OF WINDSHIELD RETENTION LENGTHS: The windshield retention failed from 37 to 298 mm and from 1511 to 1575 mm as measured from the lower left hand corner of the windshield around its perimeter in the clockwise direction.

ALL DISTANCE MEASUREMENTS ARE IN MILLIMETERS.
[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 = 1044

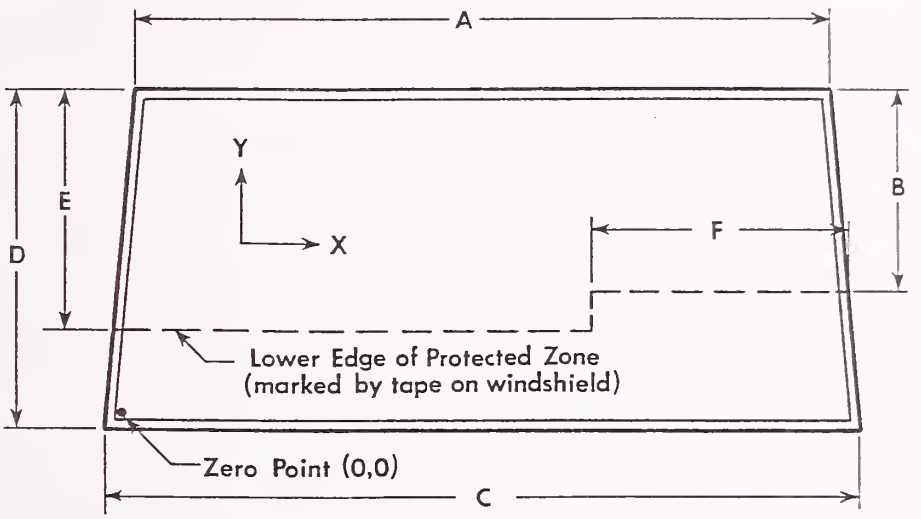
B = 486

C = 1372

D = 771

E = 532

F = 569



FRONT VIEW

METHOD OF ADHERING PROTECTED ZONE TEMPLATE TO WINDSHIELD: NA

AREAS OF WINDSHIELD TEMPLATE PENETRATION GREATER THAN 6.0 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.

ALL MEASUREMENTS ARE IN MILLIMETERS.

SECTION 4.0

VEHICLE, OCCUPANT, AND CAMERA INFORMATION

FIGURE 6 PRE-TEST AND POST-TEST MEASUREMENTS POINTS

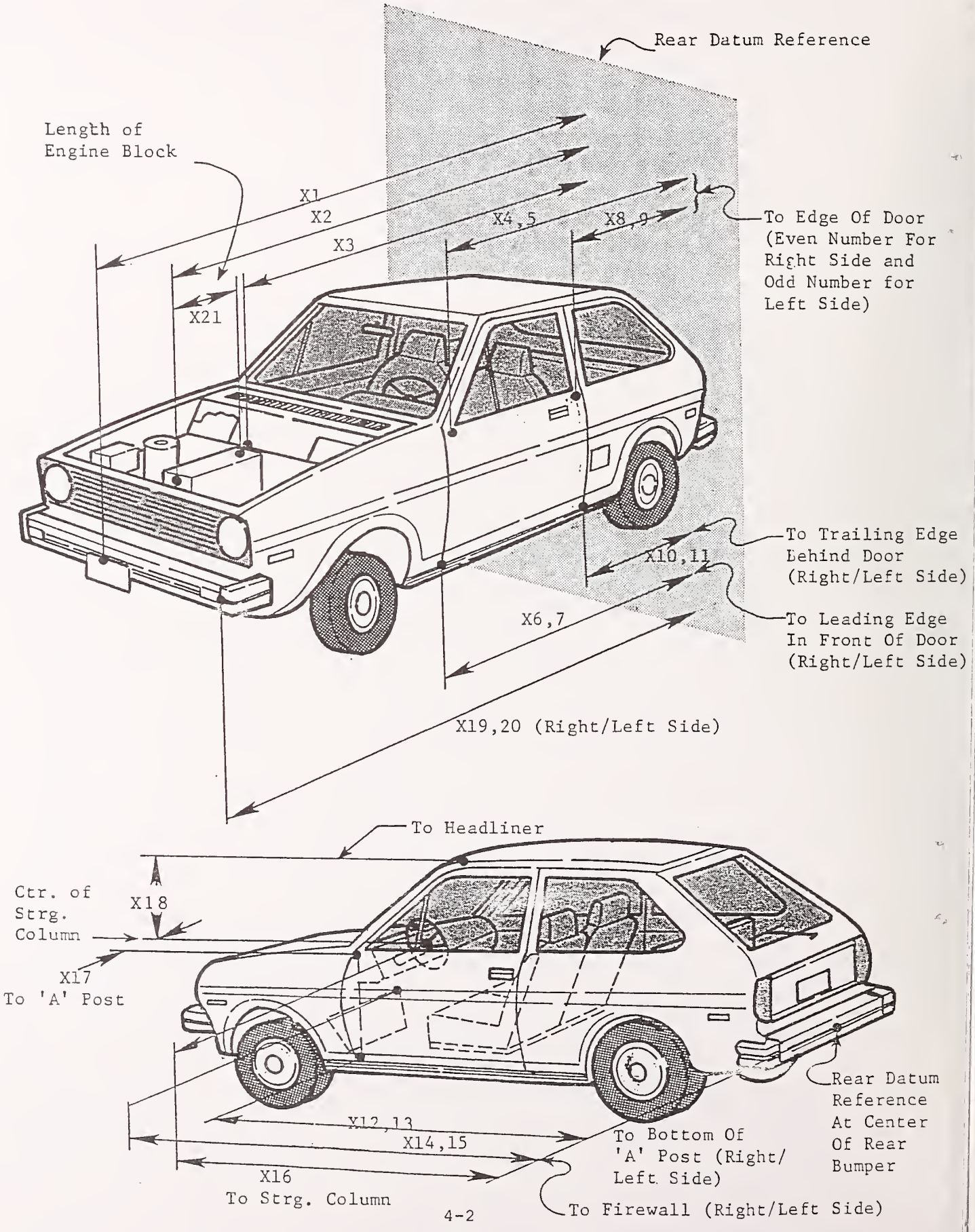


TABLE 7 IMPACTED VEHICLE MEASUREMENTS

VEHICLE MAKE/MODEL: Solectria/Force TEST NUMBER: 930923

NO.	TYPE OF MEASUREMENT	PRE-TEST	POST-TEST	DIFF.
X1	TOTAL LENGTH OF VEHICLE AT CENTERLINE	3643	3215	428
X2	REAR SURFACE OF VEHICLE TO FRONT OF ENGINE BLOCK	3050	2905	145
X3	REAR SURFACE OF VEHICLE TO FIREWALL	2753	2625	128
X4	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF RIGHT DOOR	2452	2431	21
X5	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF LEFT DOOR	2450	2435	15
X6	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF RIGHT DOOR	2442	2410	32
X7	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF LEFT DOOR	2444	2410	34
X8	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF RIGHT DOOR	1208	1188	20
X9	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF LEFT DOOR	1206	1193	13
X10	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF RIGHT DOOR	1222	1188	34
X11	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF LEFT DOOR	1218	1188	30
X12	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON RIGHT SIDE	2434	2384	50
X13	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON LEFT SIDE	2432	2386	46
X14	REAR SURFACE OF VEHICLE TO FIREWALL - RIGHT SIDE	2731	2645	86
X15	REAR SURFACE OF VEHICLE TO FIREWALL - LEFT SIDE	2722	2660	62
X16	REAR SURFACE OF VEHICLE TO STEERING WHEEL CENTER	2014	1928	86
X17	CENTER OF STEERING COLUMN TO "A" POST	285	211	74
X18	CENTER OF STEERING COLUMN TO HEADLINER	420	433	-13
X19	REAR SURFACE OF VEHICLE TO RIGHT SIDE OF FRONT BUMPER	3551	3121	430
X20	REAR SURFACE OF VEHICLE TO LEFT SIDE OF FRONT BUMPER	3558	3145	413
X21	LENGTH OF ENGINE BLOCK	390	390	0

All measurements are in millimeters.

FIGURE 7 VEHICLE TARGET LOCATIONS

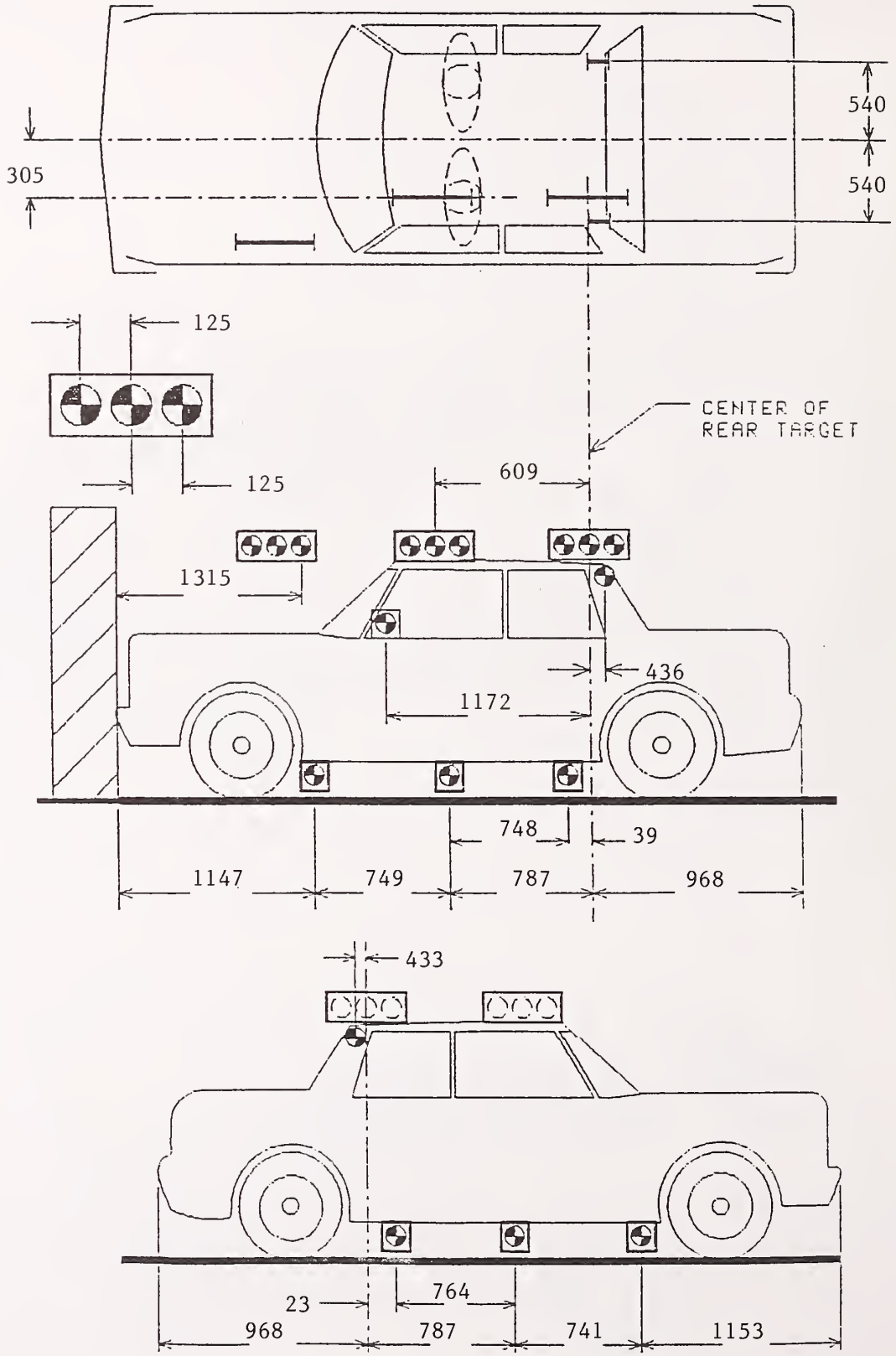
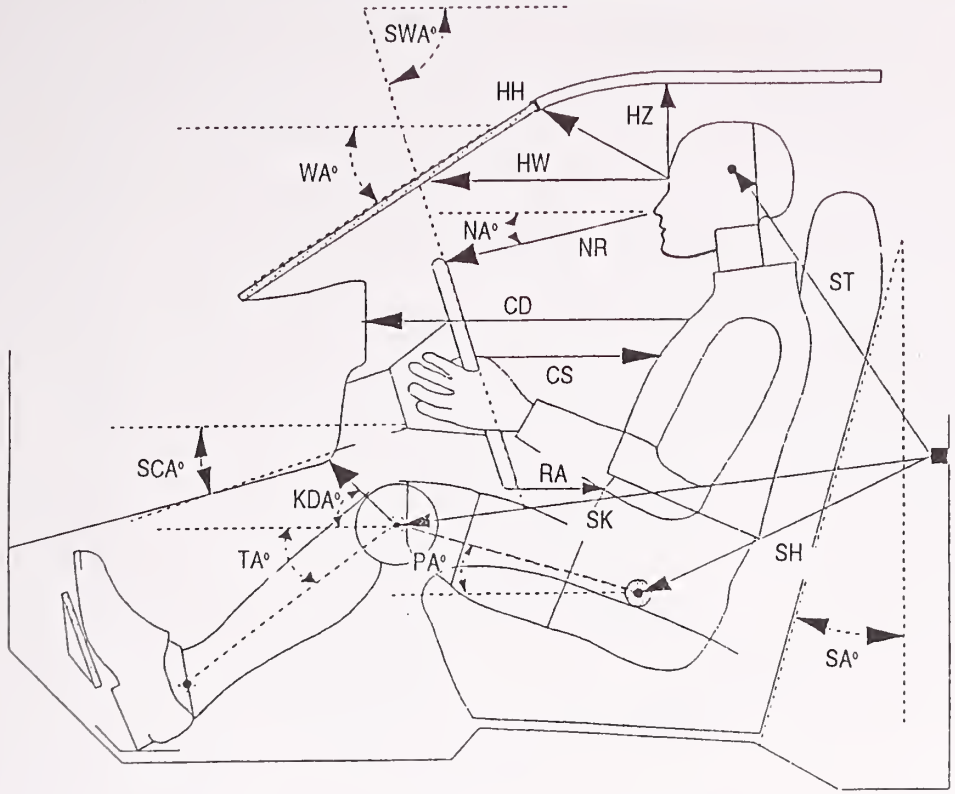
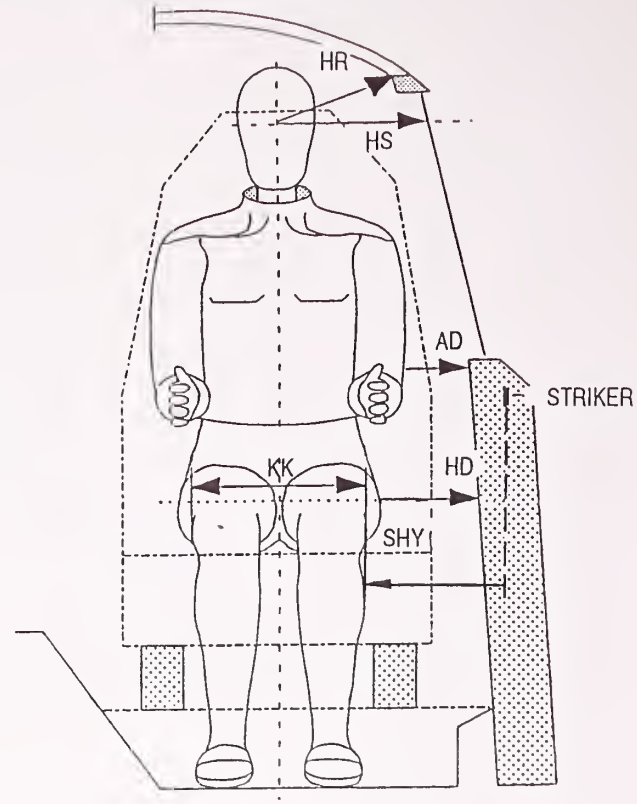
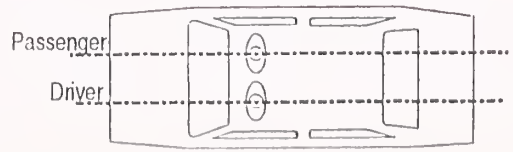


FIGURE 8

DUMMY MEASUREMENT LOCATIONS FOR FRONT SEAT OCCUPANTS







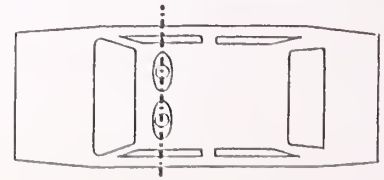
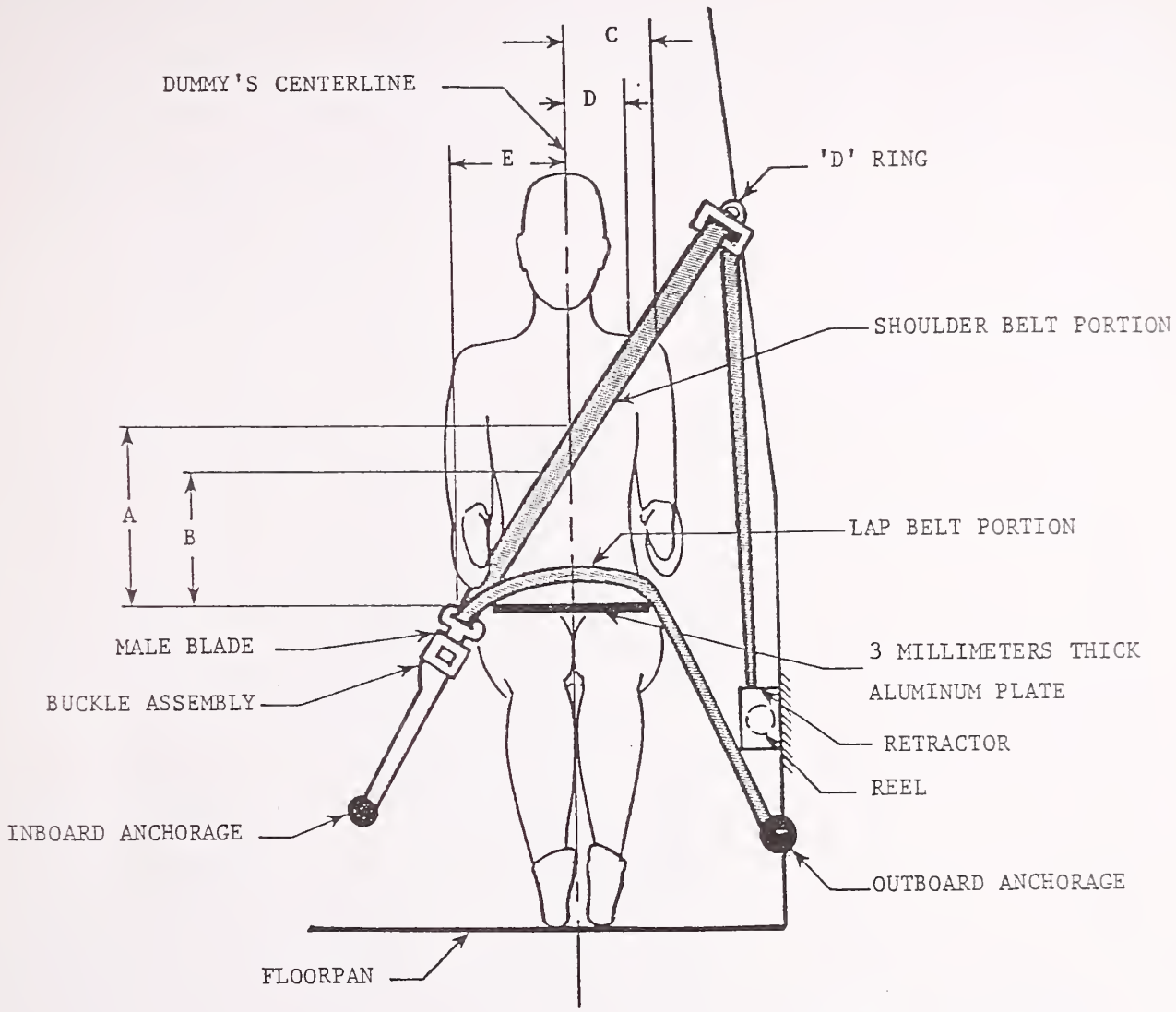


TABLE 8 DUMMY MEASUREMENT DATA FOR FRONT SEAT OCCUPANTS

DESIGNATION	TYPE OF MEASUREMENT	DRIVER (SERIAL #177)	PASSENGER (SERIAL #134)
WA°	WINDSHIELD ANGLE	27	27
SWA°	STEERING WHEEL ANGLE	64	NA
SCA°	STEERING COLUMN ANGLE	30	NA
SA°	SEAT BACK ANGLE	24	24
HZ	HEAD TO ROOF	155	170
HH	HEAD TO HEADER	355	310
HW	HEAD TO WINDSHIELD	515	490
HR	HEAD TO SIDE HEADER	193	215
NR	NOSE TO RIM	462	NA
NA	NOSE TO RIM ANGLE	11	NA
CD	CHEST TO DASH	559	555
CS	STEERING WHEEL TO CHEST	383	NA
RA	RIM TO ABDOMEN	222	NA
KDL	LEFT KNEE TO DASH	212	191
KDR	RIGHT KNEE TO DASH	227	197
KDA	OUTBOARD KNEE TO DASH ANGLE	24	29
PA°	PELVIC ANGLE	24	21
TA°	TIBIAL ANGLE	35	36
KK	KNEE TO KNEE	262	273
ST	STRIKER TO HEAD	576	594
	STRIKER TO HEAD ANGLE	61	60
SK	STRIKER TO KNEE	768	770
	STRIKER TO KNEE ANGLE	-2	-4
SH	STRIKER TO H-POINT	405	400
	STRIKER TO H-POINT ANGLE	-18	-23
SHY	STRIKER TO H-POINT (Y DIR.)	190	190
HS	HEAD TO SIDE WINDOW	284	302
HD	H-POINT TO DOOR	101	147
AD	ARM TO DOOR	82	98

THE SEAT BACK ANGLE (SA°) IS MEASURED RELATIVE TO VERTICAL, ALL OTHER ANGLES ARE MEASURED RELATIVE TO HORIZONTAL.
ALL ANGLE MEASUREMENTS ARE IN DEGREES.
ALL DISTANCE MEASUREMENTS ARE IN MILLIMETERS.

FIGURE 9 SEAT BELT POSITIONING DATA



	DRIVER	PASSENGER
A - TOP SURFACE OF ALUMINUM PLATE TO BELT UPPER EDGE	348	344
B - TOP SURFACE OF ALUMINUM PLATE TO BELT LOWER EDGE	256	260
C - DUMMY CENTERLINE TO OUTER EDGE OF BELT AT CHEST FLESH TOP	117	144
D - DUMMY CENTERLINE TO INNER EDGE OF BELT AT CHEST FLESH TOP	58	77
E - DUMMY CENTERLINE TO INTERSECTION OF UPPER TORSO BELT AND LAP BELT	254	268

ALL DISTANCE MEASUREMENTS ARE IN MILLIMETERS.

FIGURE 10 CAMERA POSITIONS

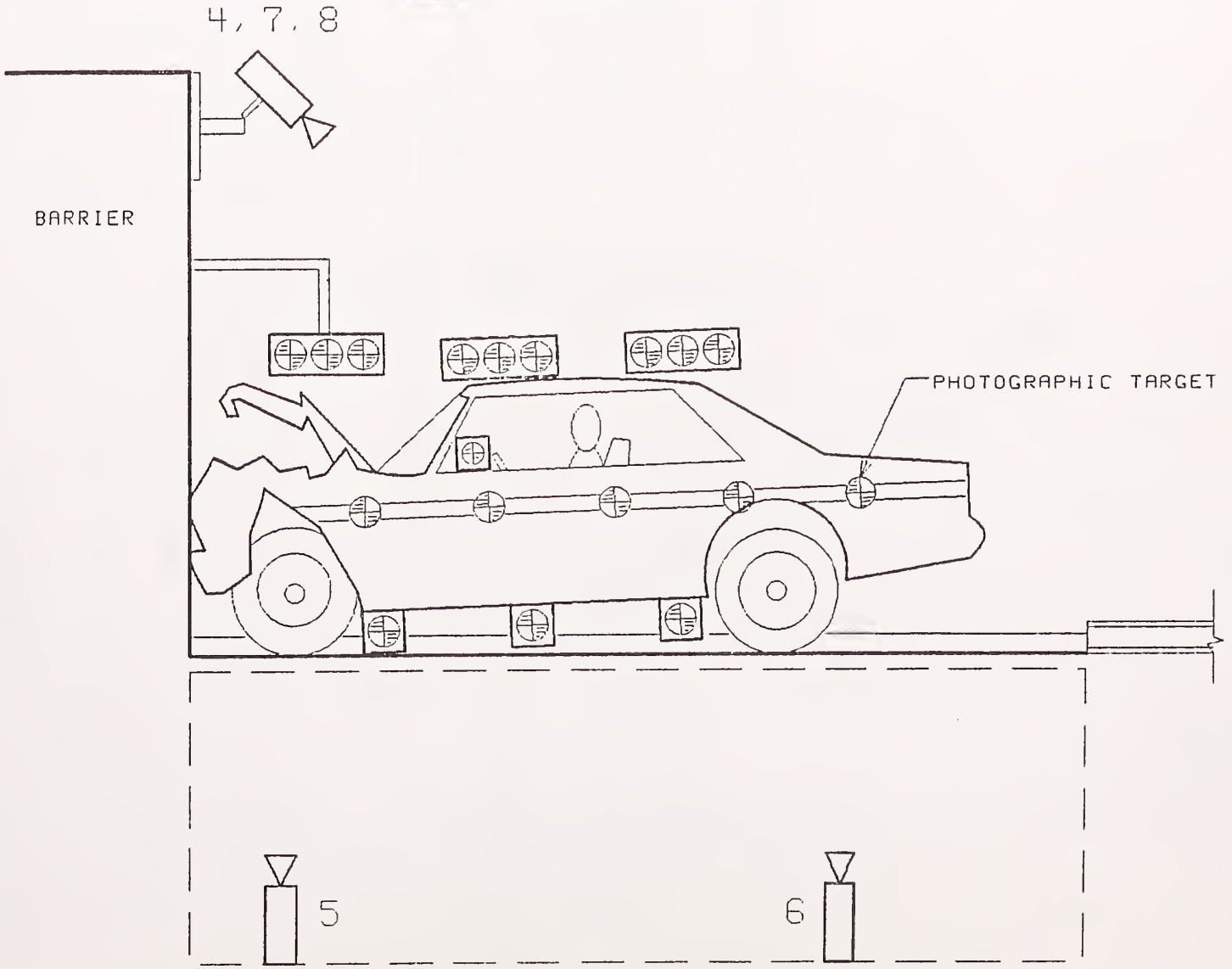


FIGURE 10 CAMERA POSITIONS, CONT'D.

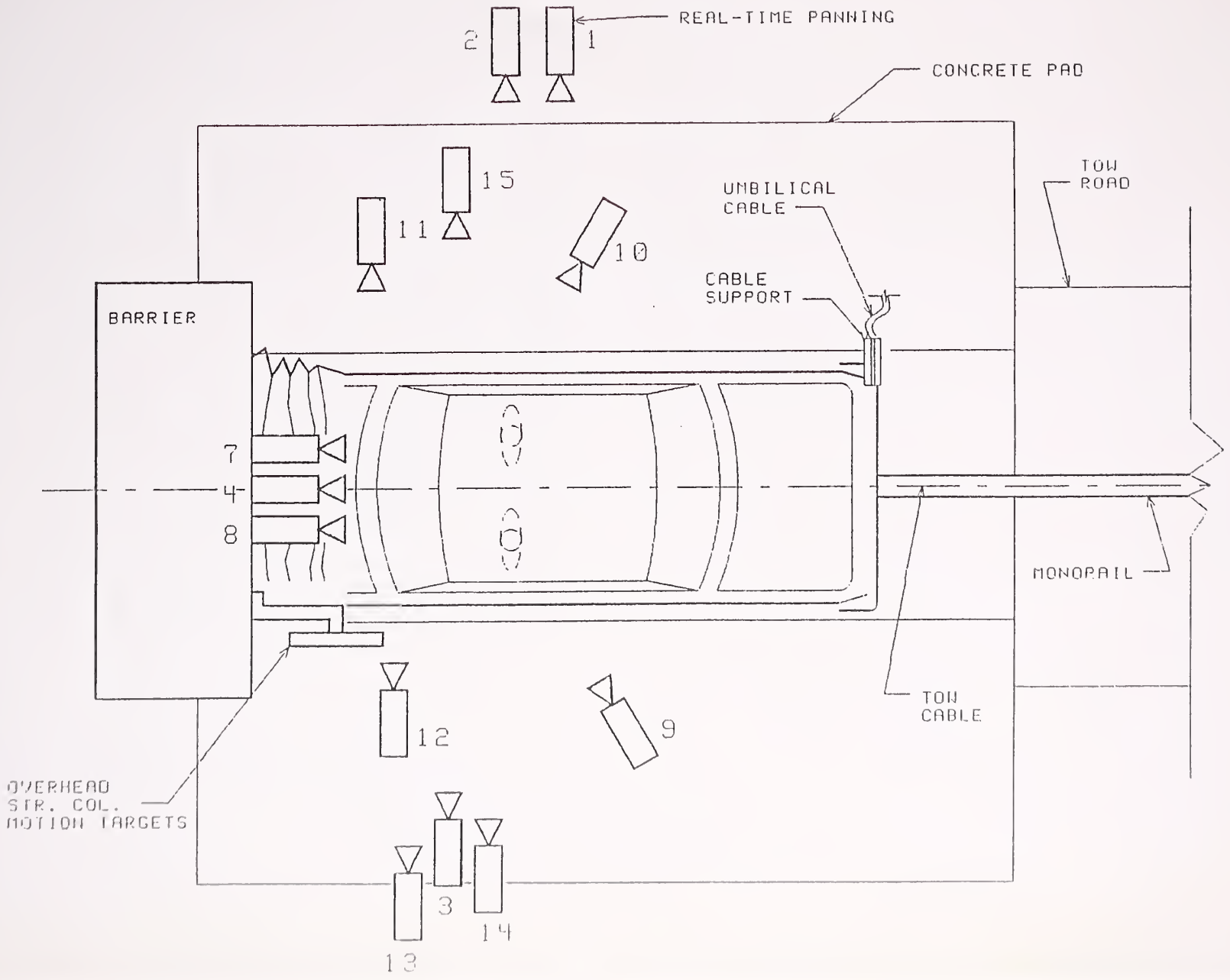


TABLE 9 MOTION PICTURE CAMERA LOCATIONS

TEST NO.: 930923 VEHICLE: 1993 Solectria Force

CAMERA NO.	VIEW	CAMERA POSITIONS (CM)[1] X	Y	Z	ANGLE[2] (DEG)	FILM PLANE TO HEAD TARGET (CM)	LENS (MM)	FILM SPEED (FPS)
1	Real-time panning	-361	-1280	155	NA	NA	16	24
2	Right overall	-207	-677	94	-2	NA	13	1025
3	Left vehicle crush	-105	749	112	-4	612	25	1005
4	Windshield front view	-15	0	213	-40	NA	13	1000
5	Pit - front position	-128	0	-235	90	NA	13	1000
6	Pit - rear position	-252	0	-251	90	NA	13	998
7	Passenger - front view	-11	-35	236	-50	NA	17	998
8	Driver - front view	-17	37	236	-50	NA	17	1015
9	Driver kinematics	-400	295	221	-27	267	25	993
10	Passenger kinematics	-386	-295	221	-26	95	25	985
11	Right windshield intrusion	-97	-777	112	0	NA	50	1020
12	Left windshield intrusion	-135	786	107	0	NA	50	1002
13	Steering column motion	-274	726	262	-14	NA	25	1008
14	Steering column motion	-274	726	191	-9	NA	25	1000
15	Passenger kinematics	-99	-744	115	-4	218	25	1050
16	Real-time documentation	NA	NA	NA	NA	NA	12-120	24

[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

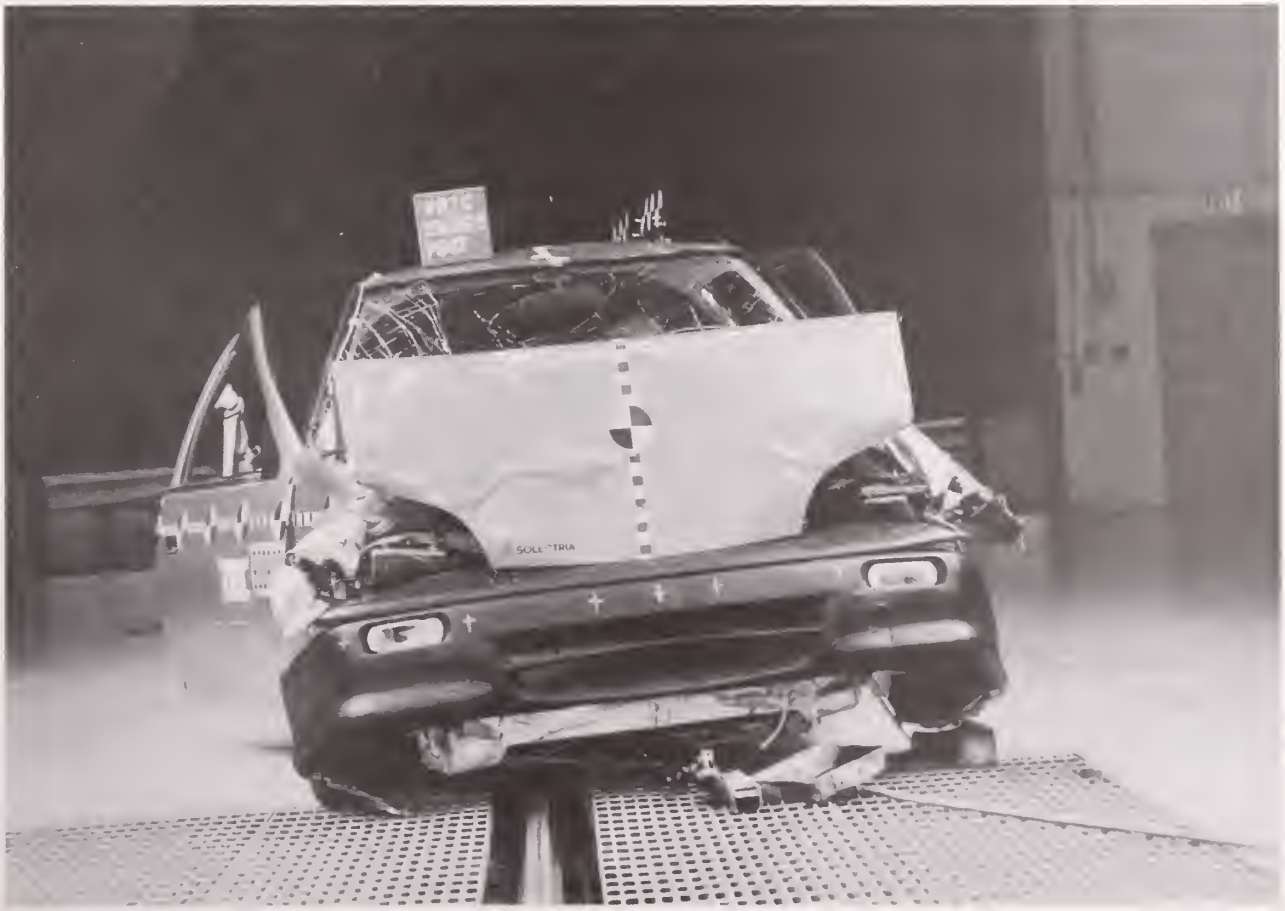


Figure A-2. POST-TEST FRONT VIEW

Figure A-3. PRE-TEST LEFT SIDE VIEW

Figure A-4. POST-TEST LEFT SIDE VIEW

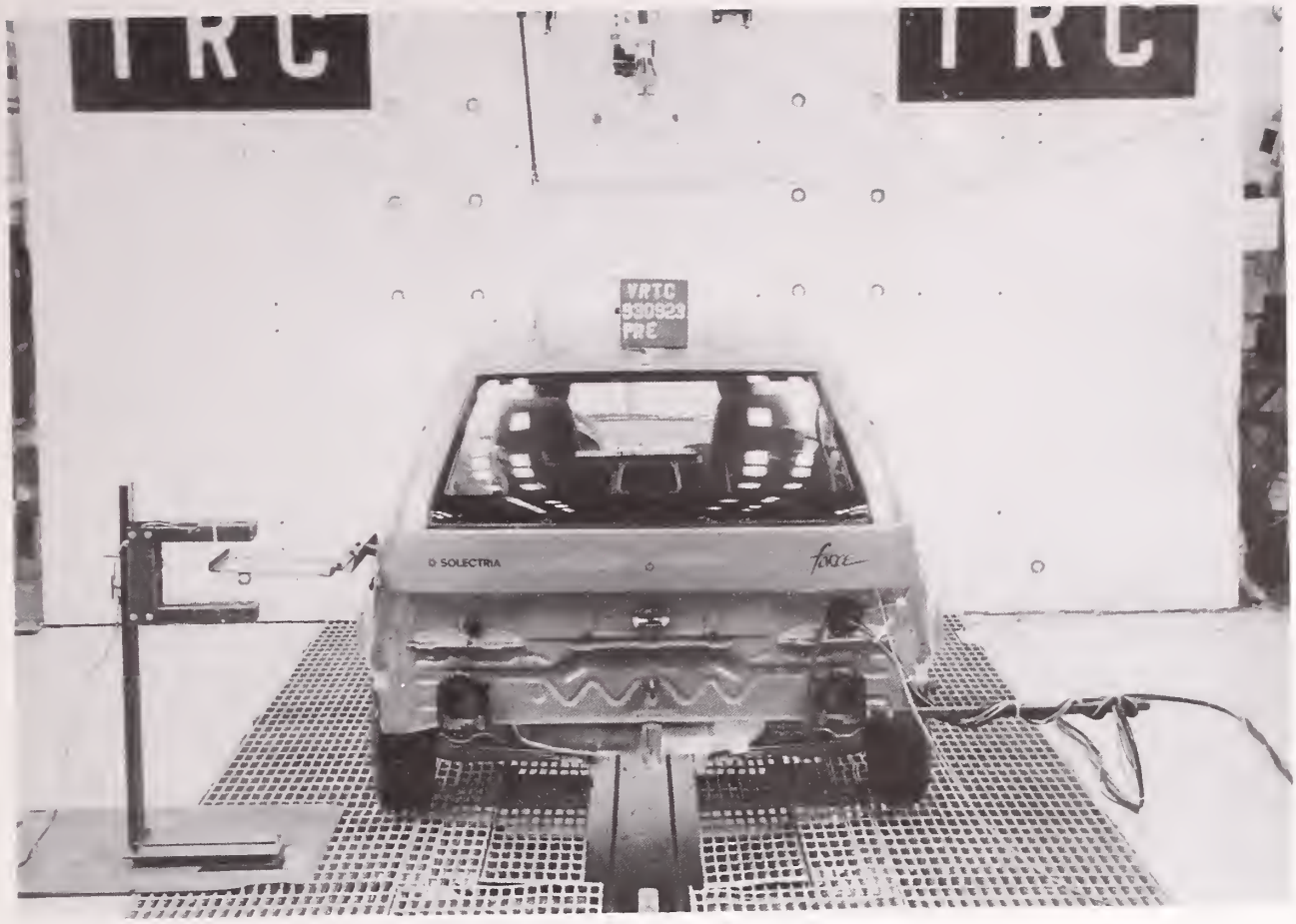


Figure A-5. PRE-TEST REAR VIEW

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

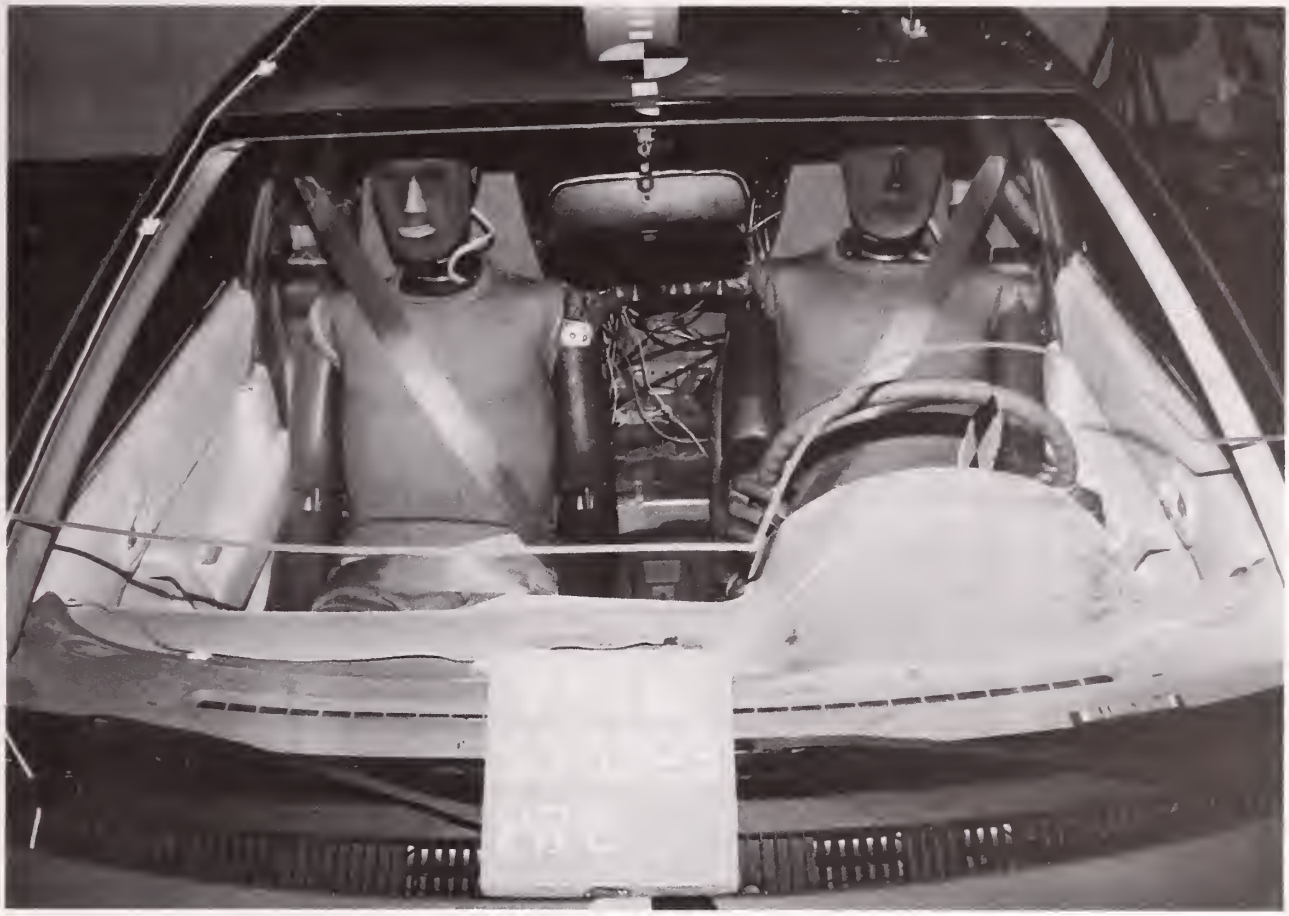


Figure A-13. PRE-TEST WINDSHIELD VIEW

Figure A-14. POST-TEST WINDSHIELD VIEW

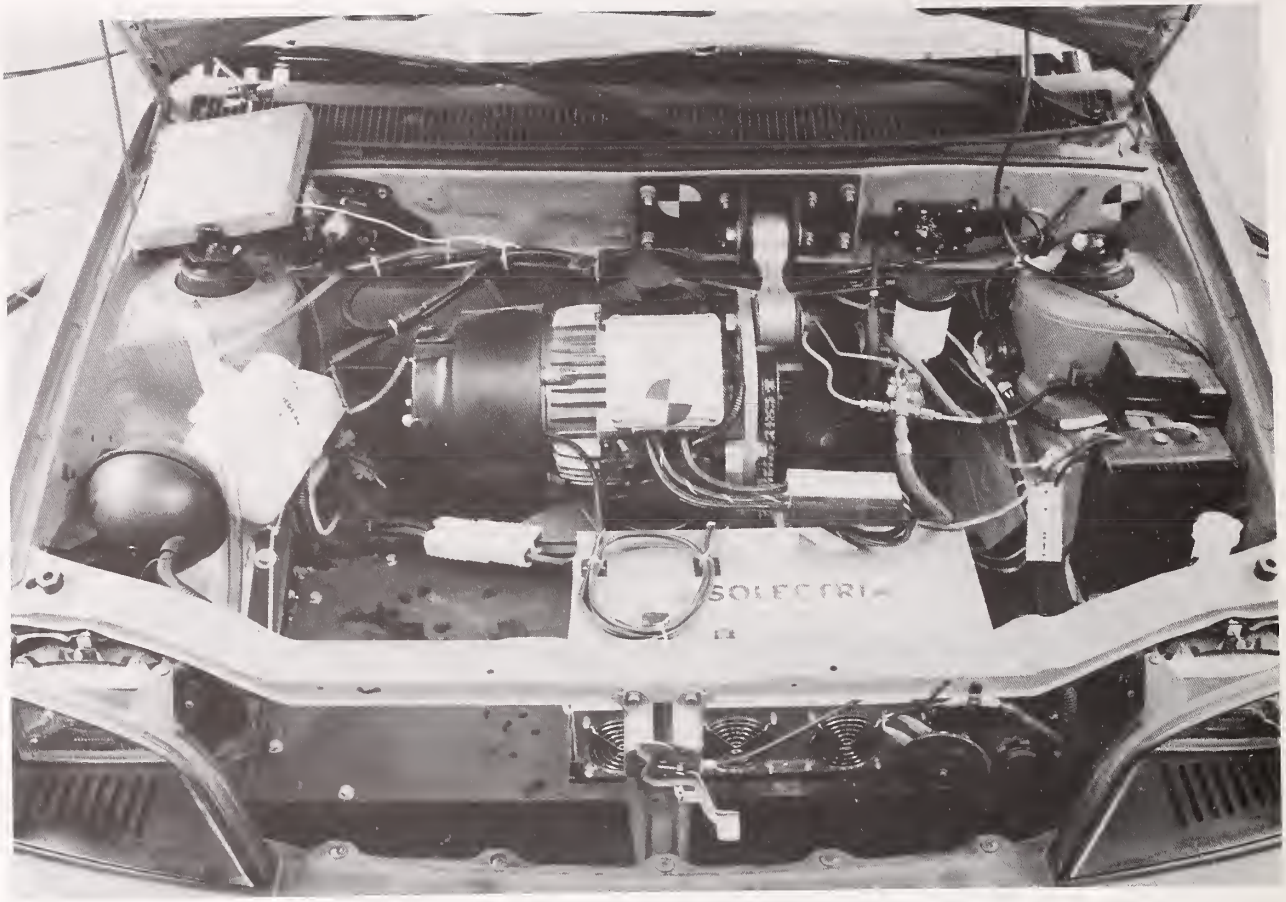


Figure A-15. PRE-TEST ENGINE COMPARTMENT VIEW

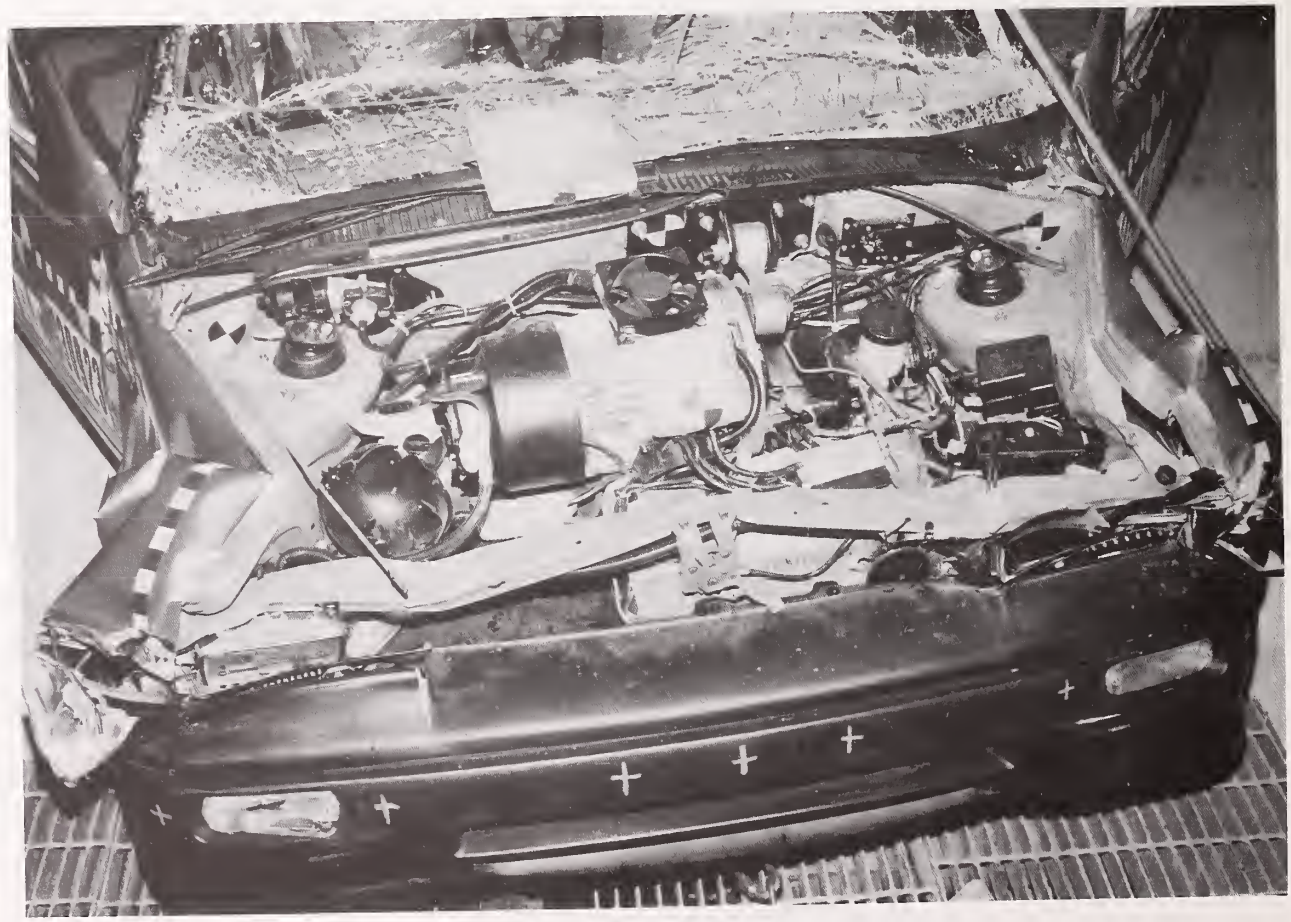


Figure A-16. POST-TEST ENGINE COMPARTMENT VIEW

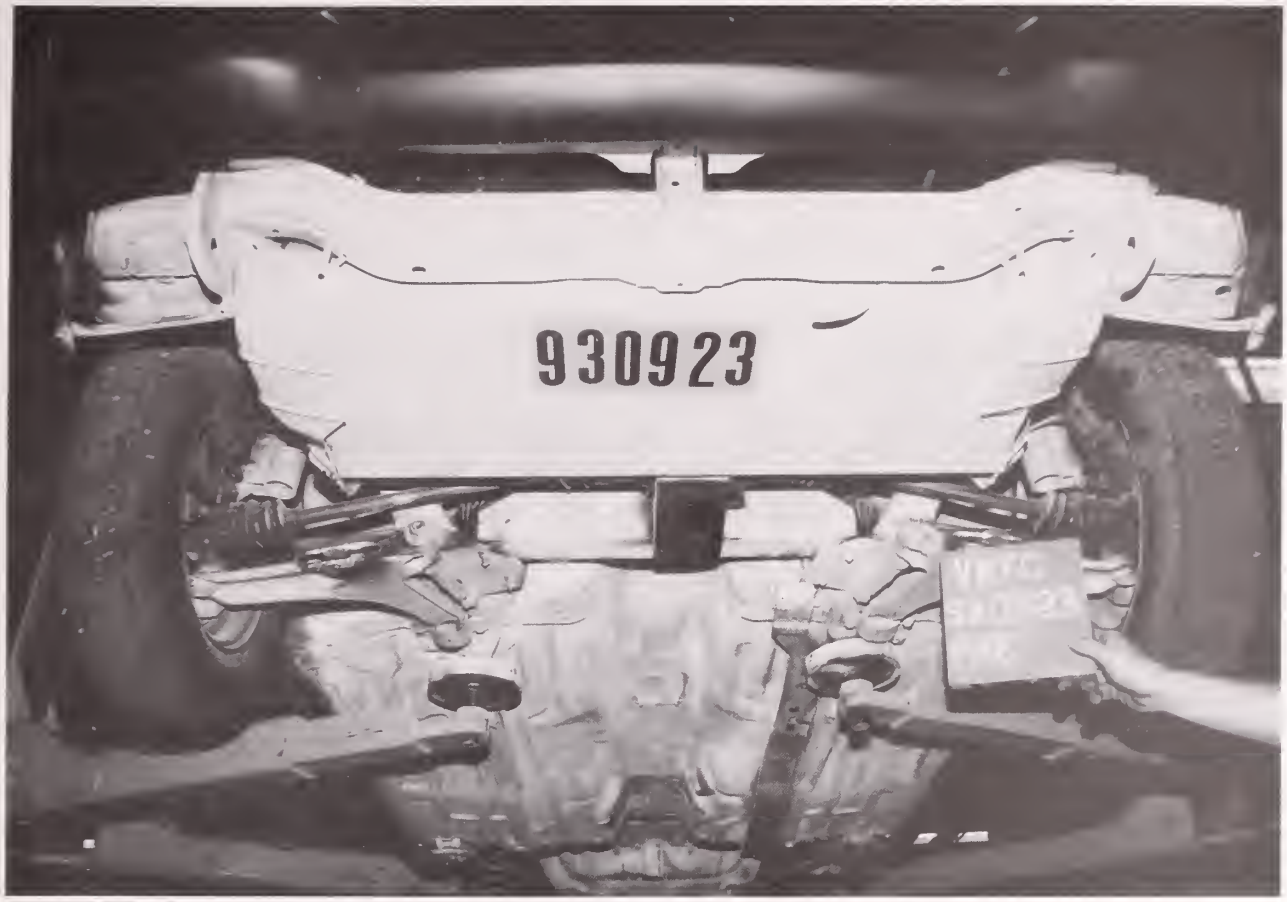


Figure A-17. PRE-TEST FRONT UNDERBODY VIEW

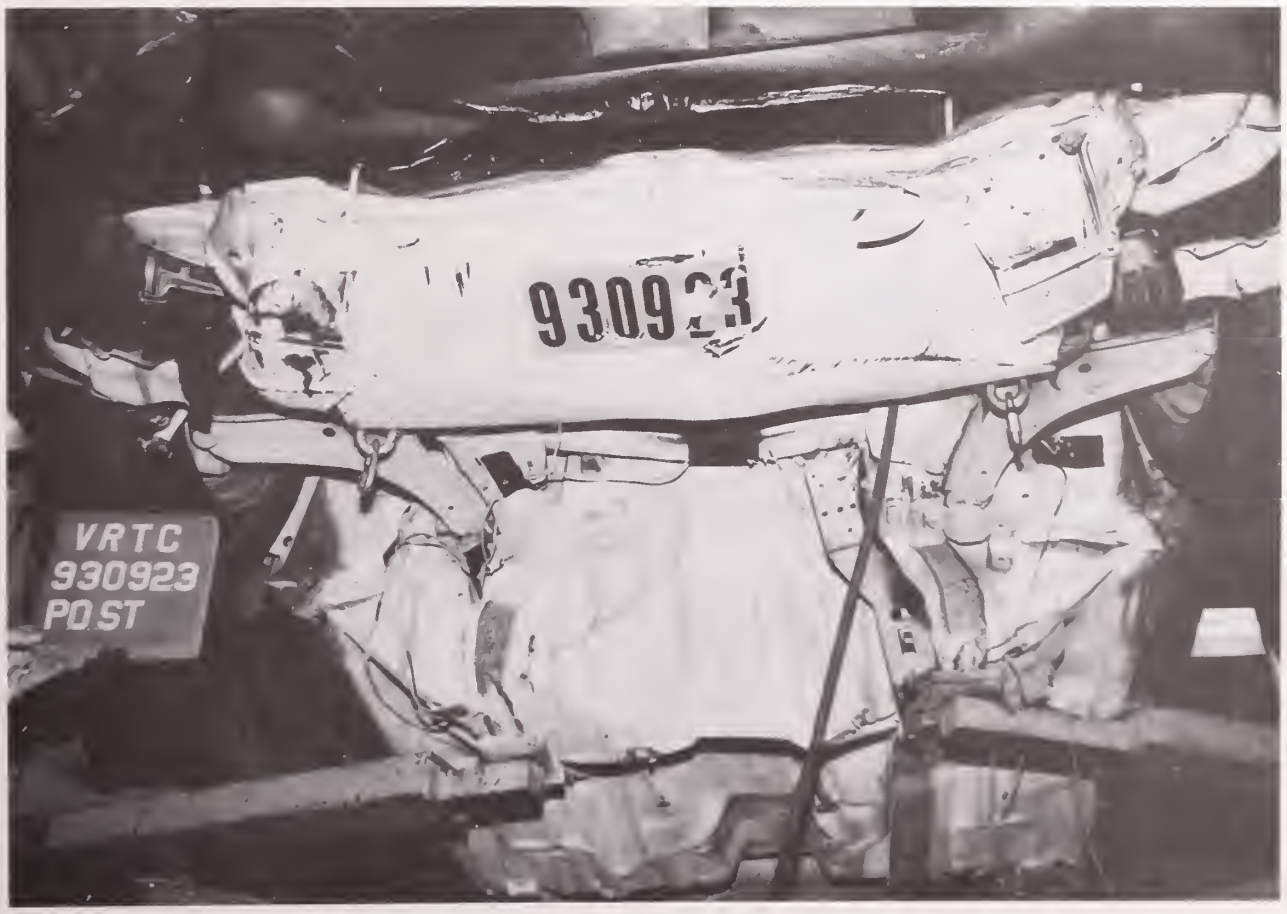


Figure A-18. POST-TEST FRONT UNDERBODY VIEW

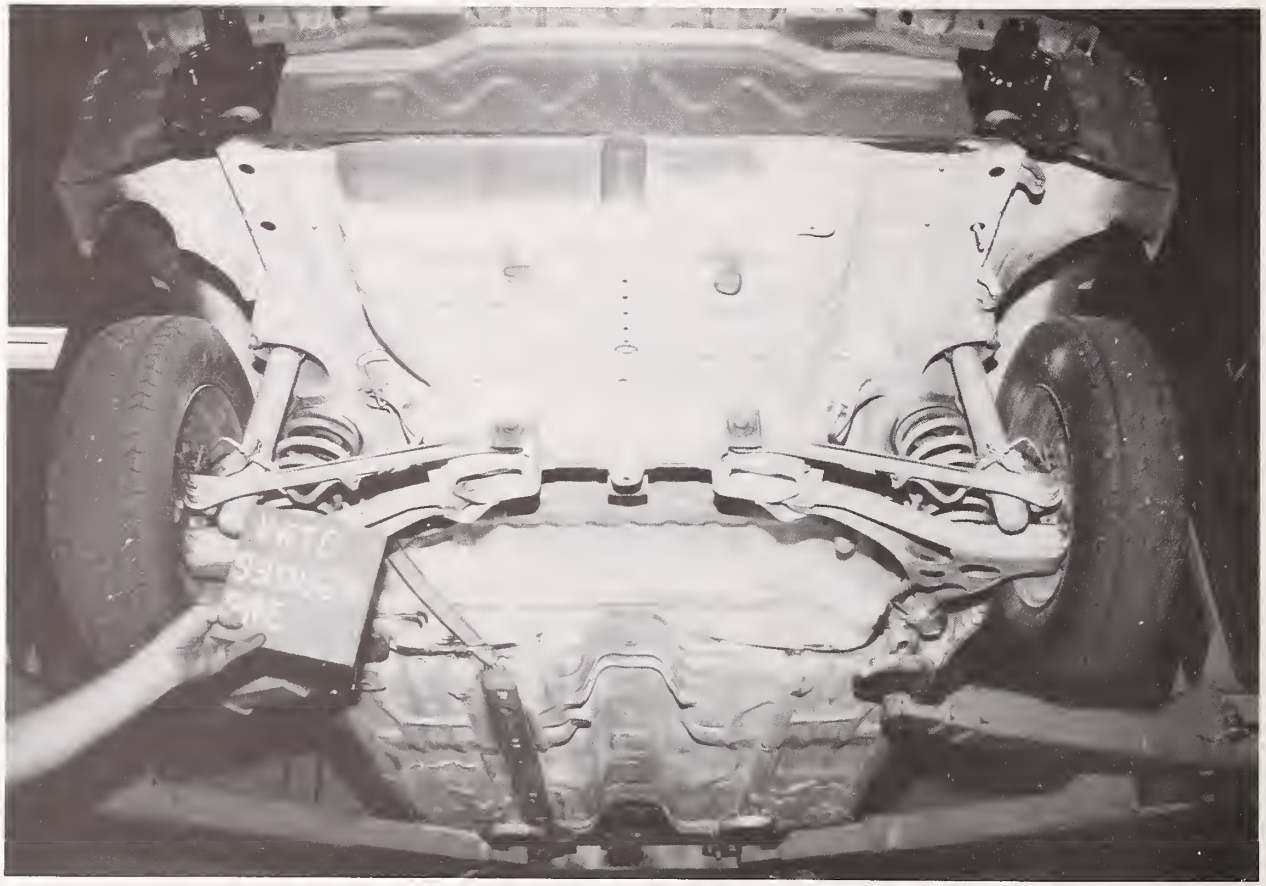


Figure A-19. PRE-TEST REAR UNDERBODY VIEW

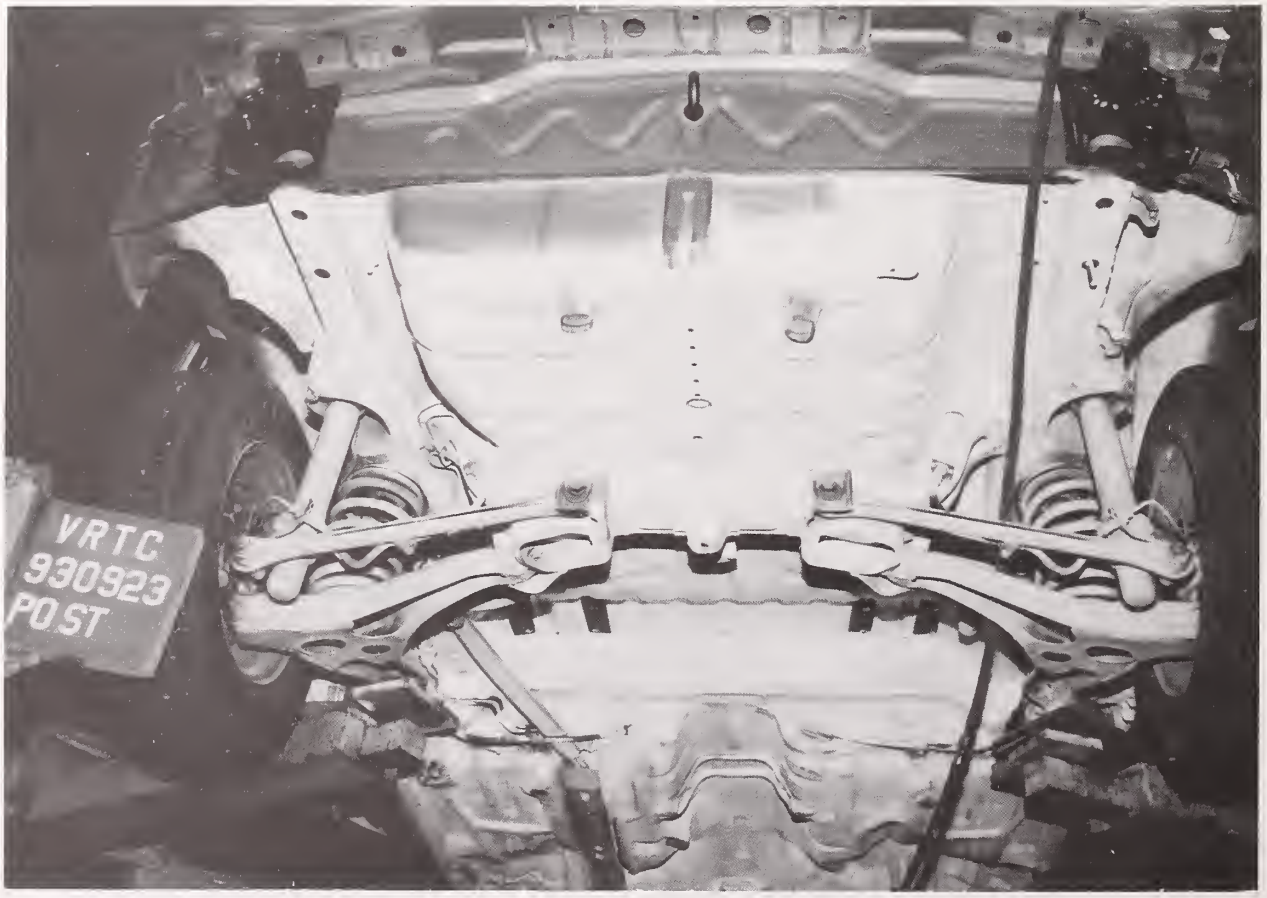


Figure A-20. POST-TEST REAR UNDERBODY VIEW

Figure A-21. PRE-TEST UNDERBODY WIRING - VIEW 1

Figure A-22. PRE-TEST UNDERBODY WIRING - VIEW 2

Figure A-23. PRE-TEST DRIVER DUMMY POSITION VIEW

Figure A-24. POST-TEST DRIVER DUMMY POSITION VIEW

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

Figure A-26. POST-TEST PASSENGER DUMMY POSITION VIEW

Figure A-27. PRE-TEST DRIVER DUMMY & VEHICLE INTERIOR VIEW

Figure A-28. POST-TEST DRIVER DUMMY & VEHICLE INTERIOR - VIEW 1

Figure A-29. POST-TEST DRIVER DUMMY & VEHICLE INTERIOR - VIEW 2

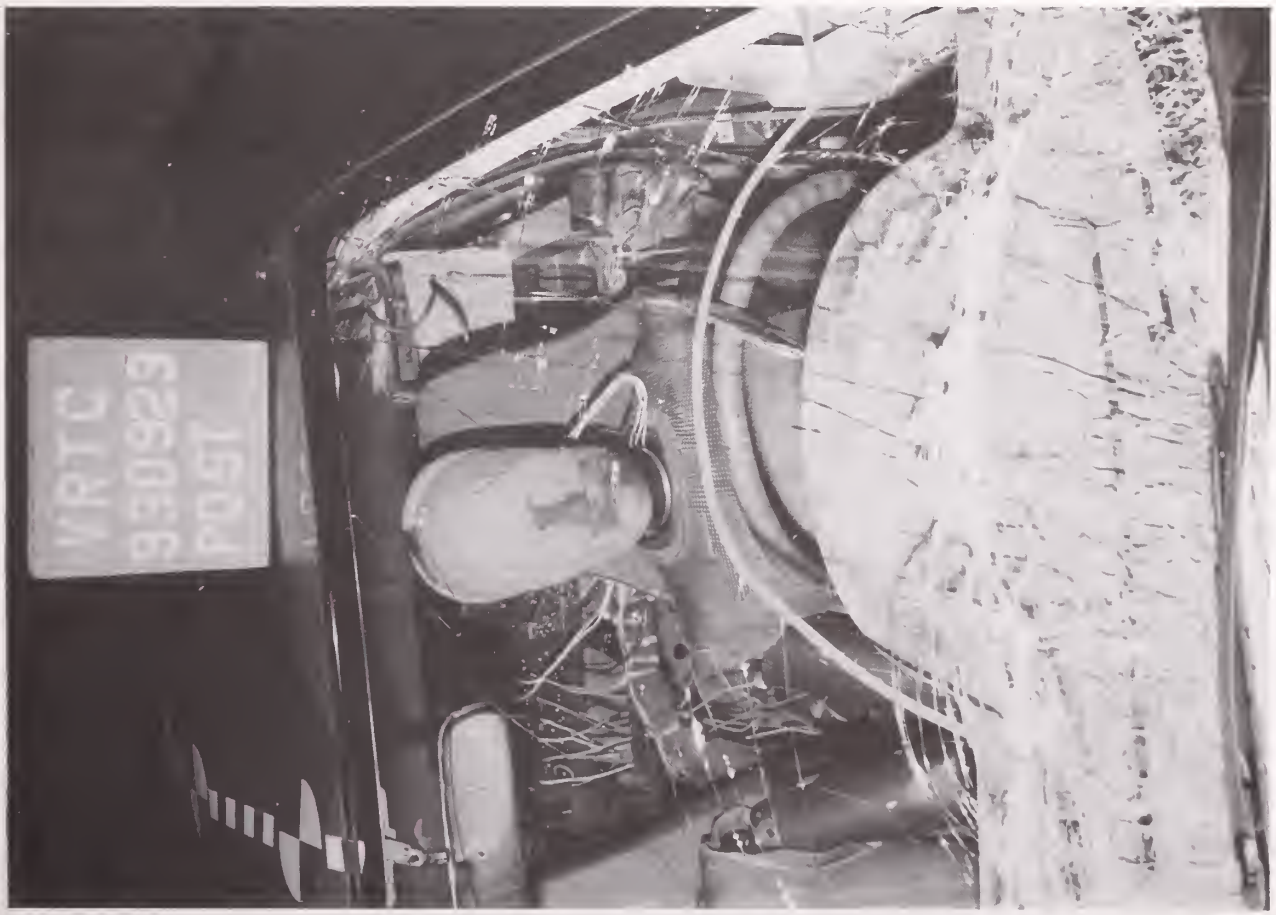


Figure A-30. POST-TEST DRIVER DUMMY THROUGH WINDSHIELD VIEW

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

Figure A-32. POST-TEST PASSENGER DUMMY & VEHICLE INTERIOR - VIEW 1

Figure A-33. POST-TEST PASSENGER DUMMY & VEHICLE INTERIOR - VIEW 2

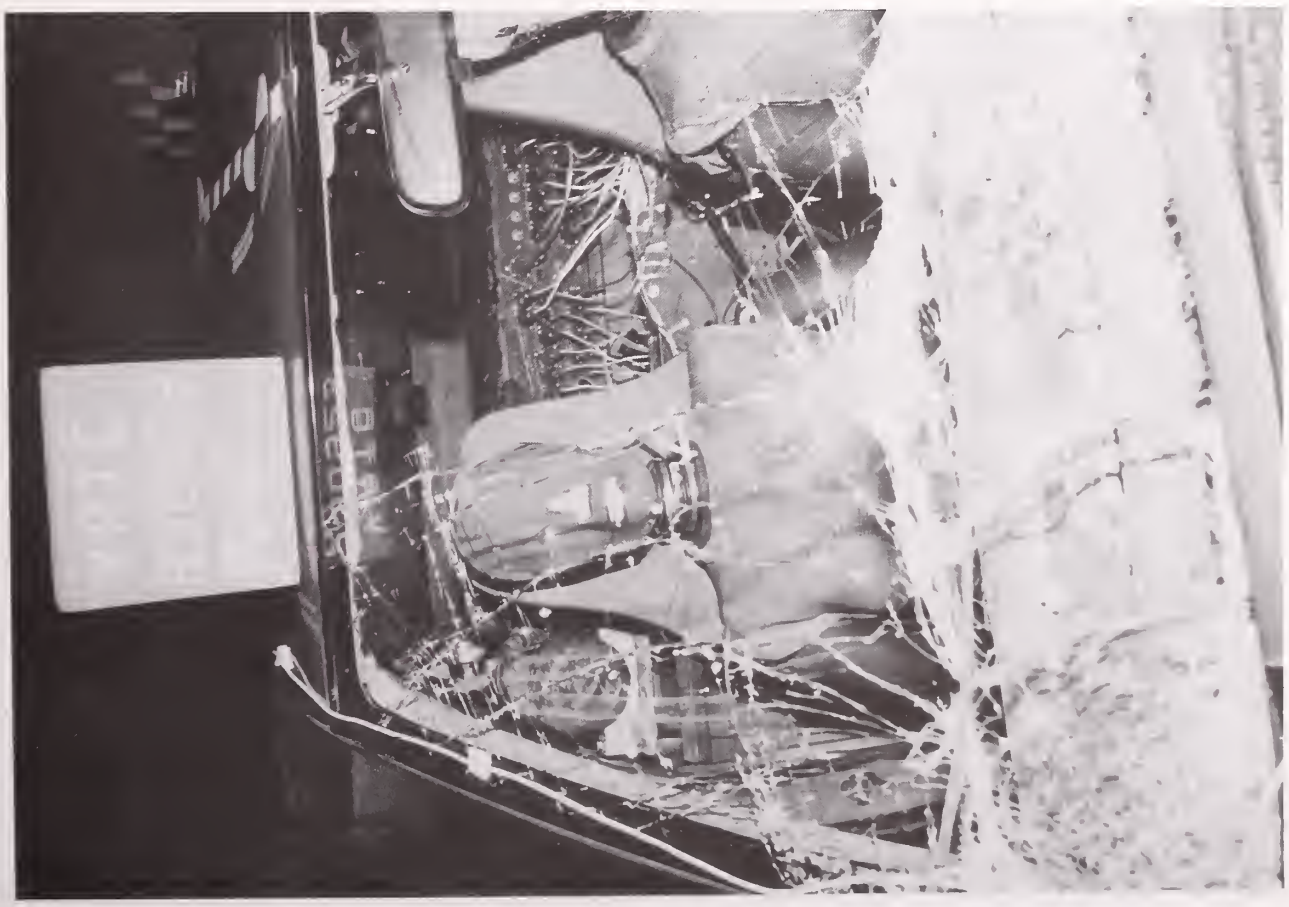


Figure A-34. POST-TEST PASSENGER DUMMY THROUGH WINDSHIELD VIEW

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 ABDOMEN CONTACT VIEW

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

Figure A-39. POST-TEST DRIVER DUMMY KNEE CONTACT - VIEW 2

Figure A-40. POST-TEST PASSENGER DUMMY HEAD CONTACT - VIEW 1

Figure A-41. POST-TEST PASSENGER DUMMY HEAD CONTACT - VIEW 2

Figure A-42. POST-TEST PASSENGER DUMMY HEAD CONTACT - VIEW 3

Figure A-43. POST-TEST PASSENGER DUMMY KNEE CONTACT - VIEW 1

Figure A-44. POST-TEST PASSENGER DUMMY KNEE CONTACT - VIEW 2

Figure A-45. POST-TEST PASSENGER DUMMY KNEE CONTACT - VIEW 3

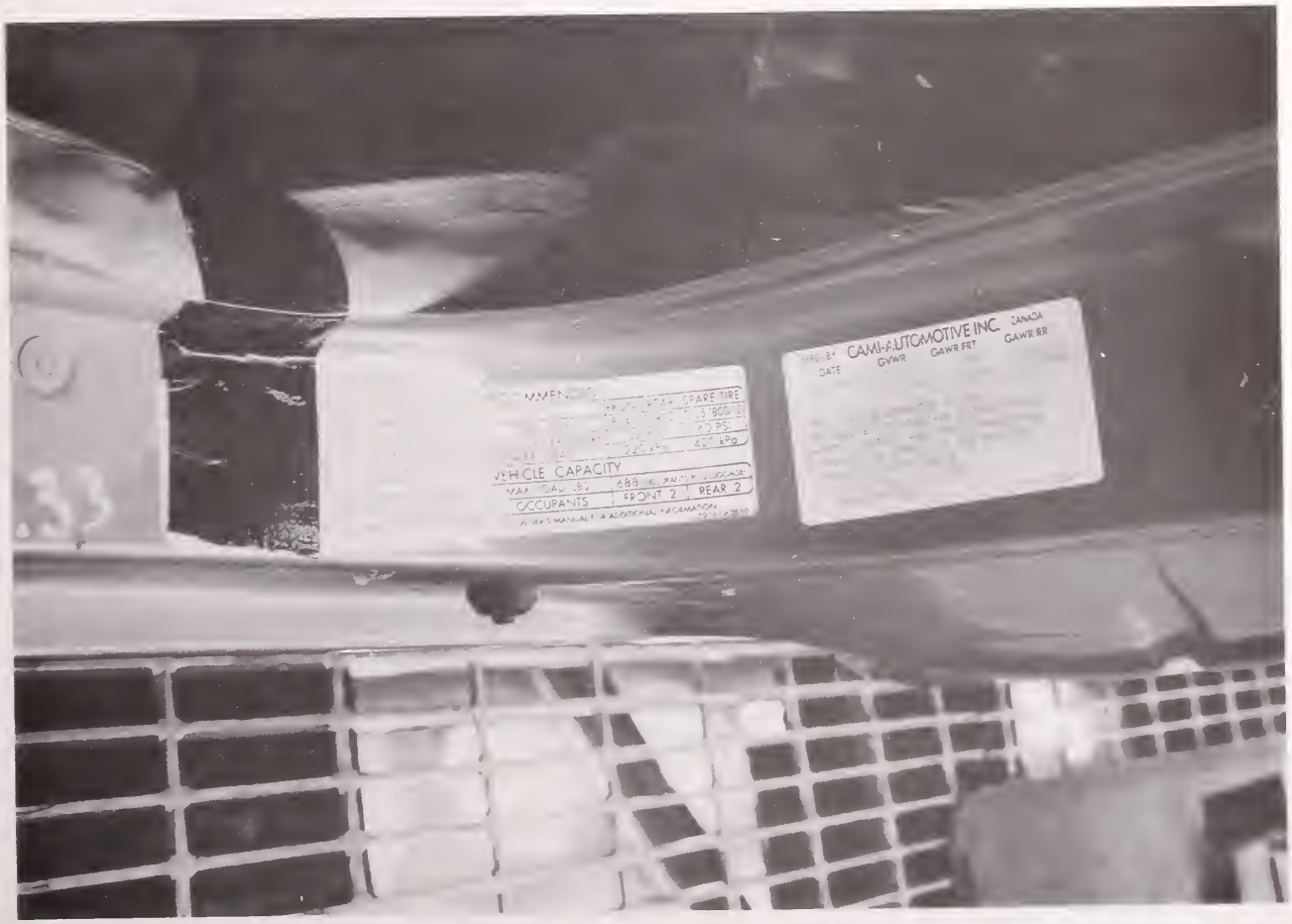
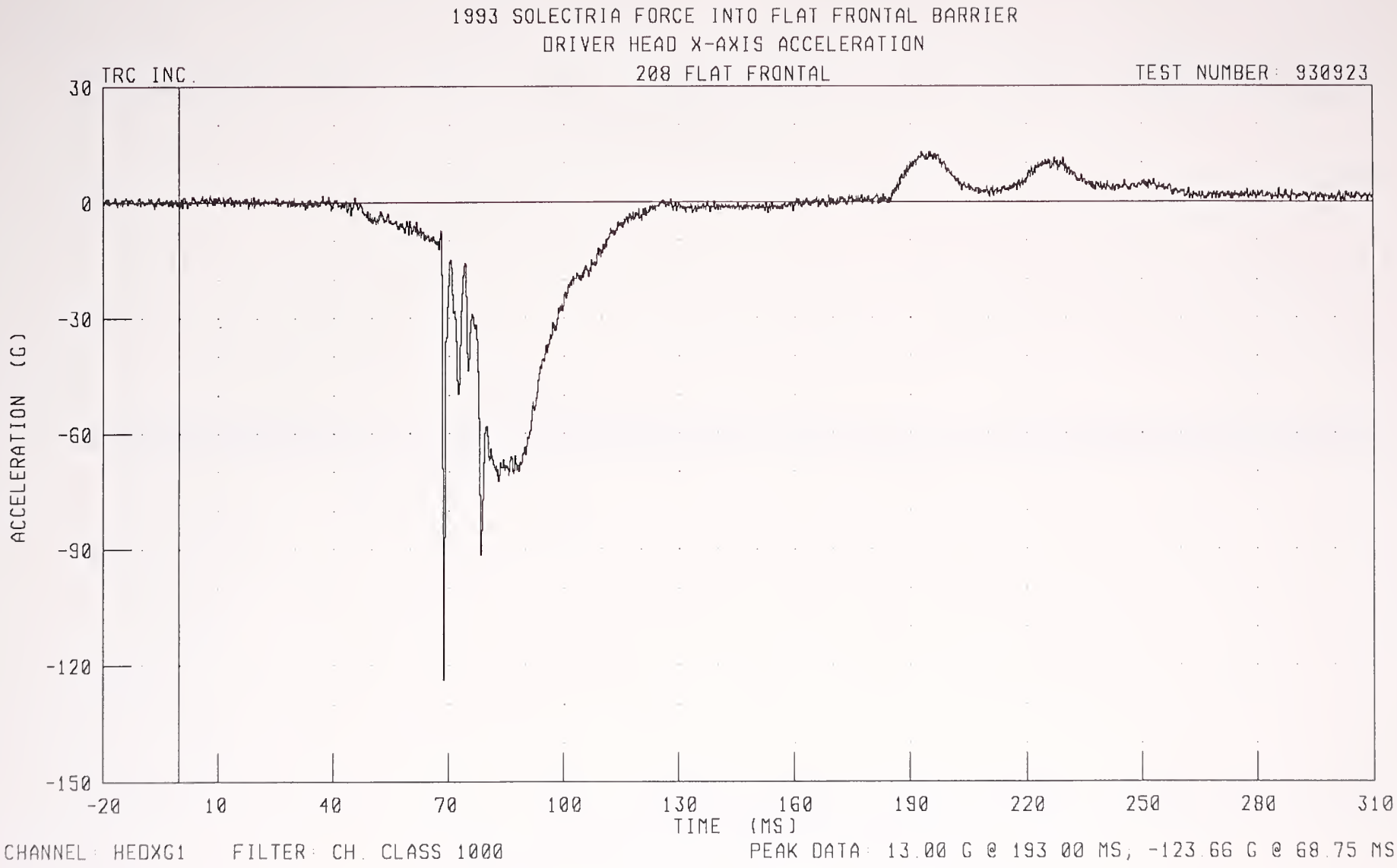


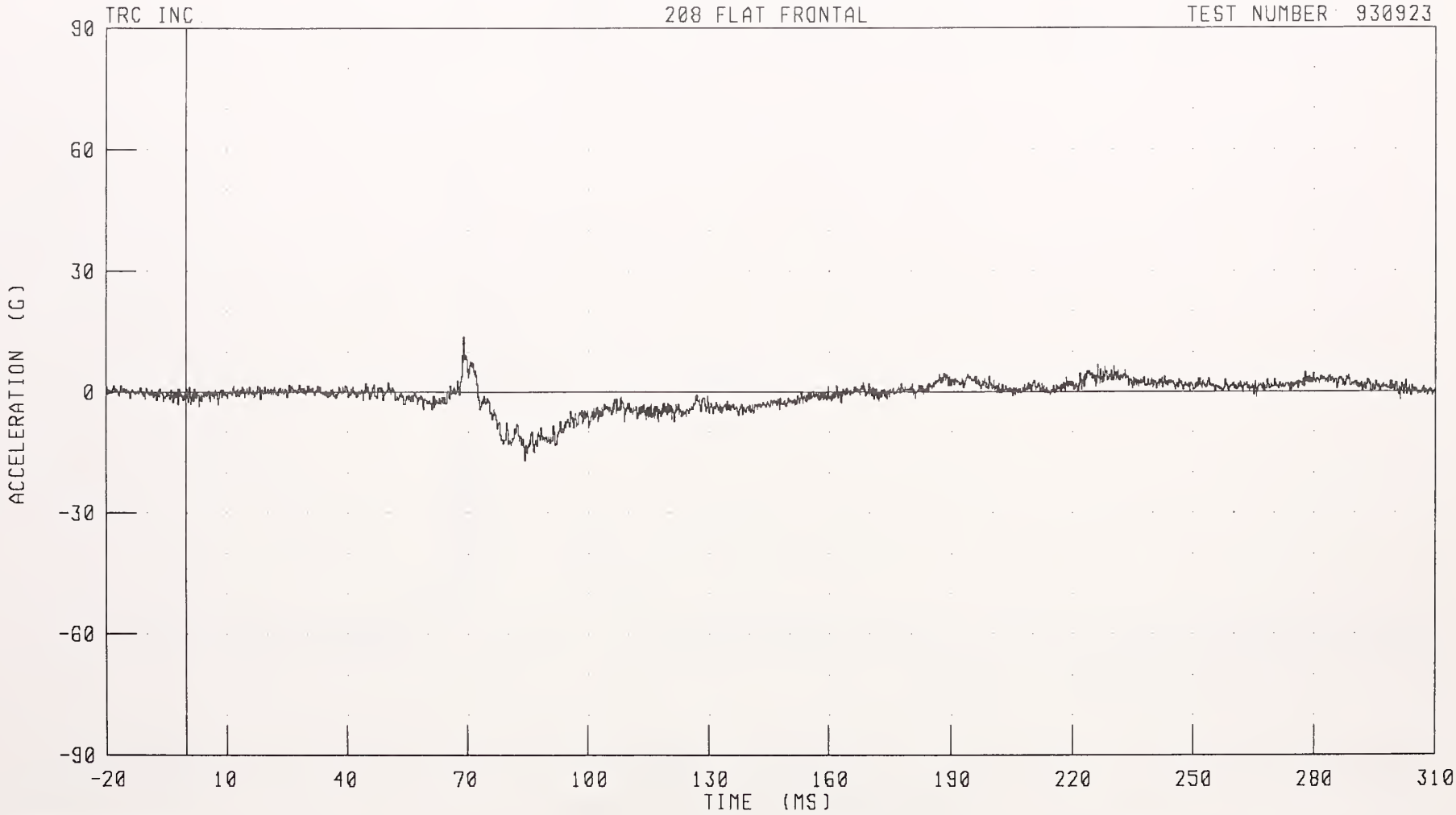
Fig. A-46. POST-TEST VEHICLE CERTIFICATION & RECOMMENDED TIRE PRESSURE LABELS

APPENDIX B

DATA PLOTS

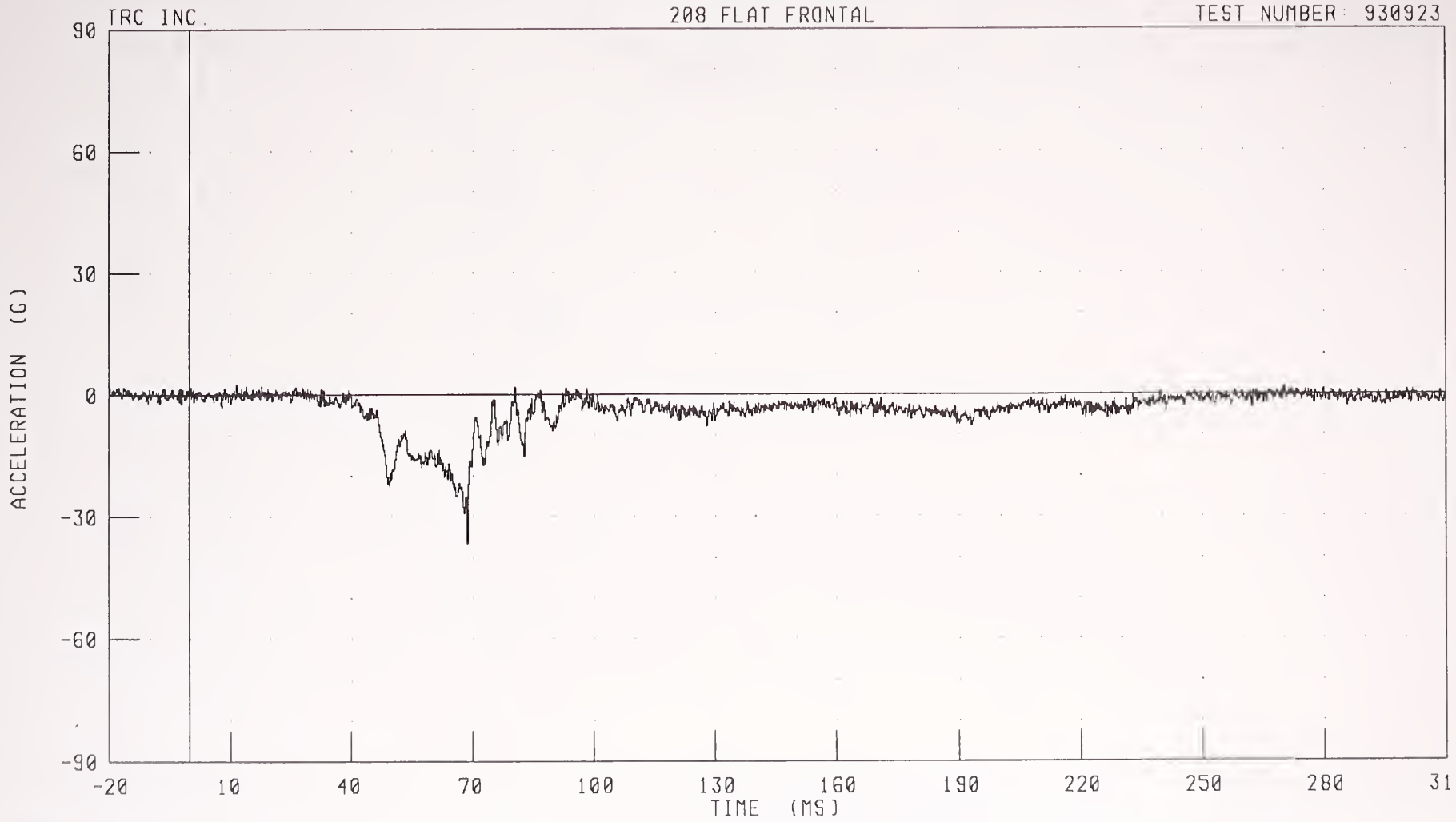

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER HEAD X-AXIS ACCELERATION
TRC INC.
208 FLAT FRONTAL
TEST NUMBER: 930923
30
0
-30
-60
-90
-120
-150
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: HEDXG1
FILTER: CH. CLASS 1000
PEAK DATA: 13.00 G @ 193.00 MS, -123.66 G @ 68.75 MS

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER HEAD Y-AXIS ACCELERATION

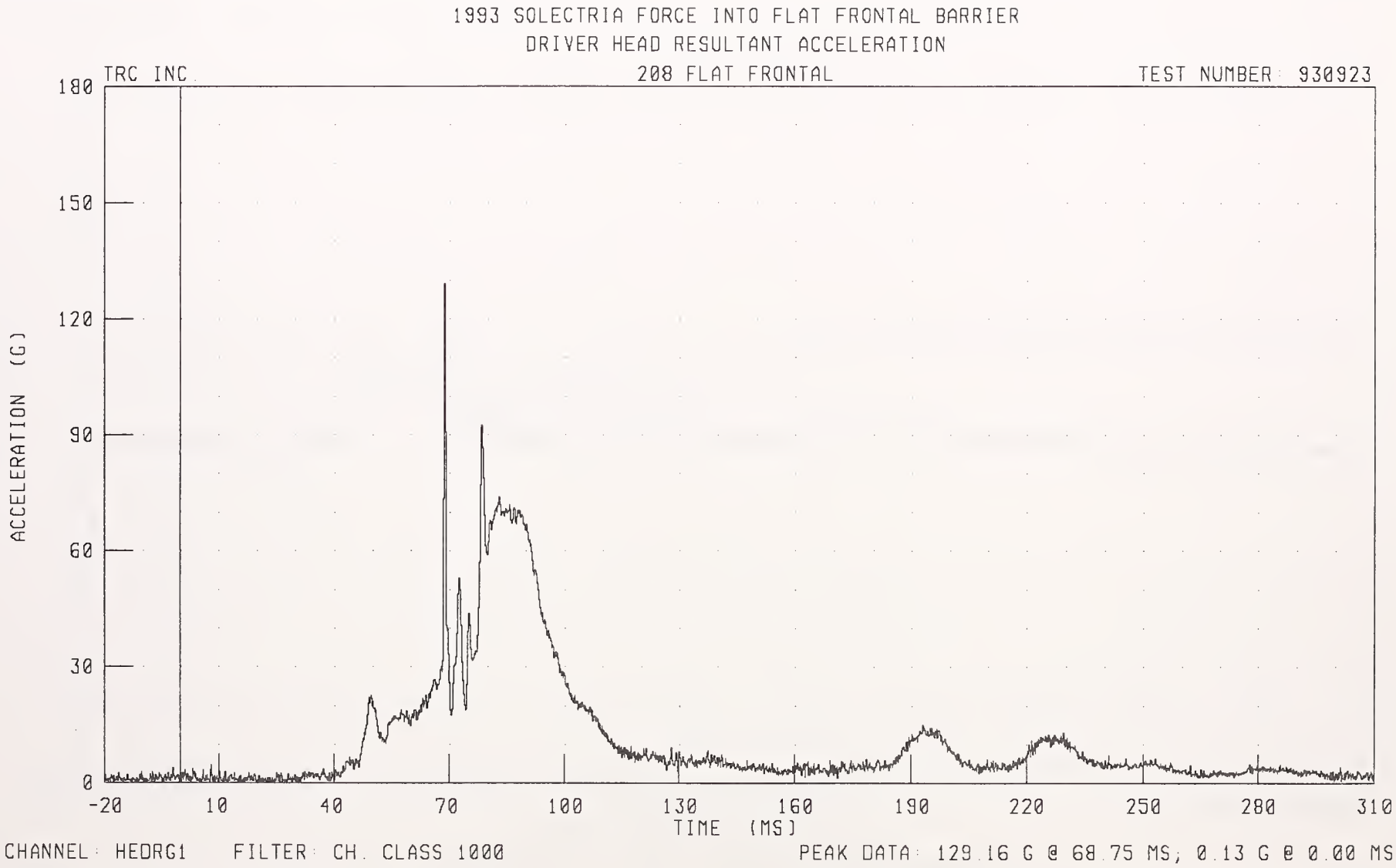


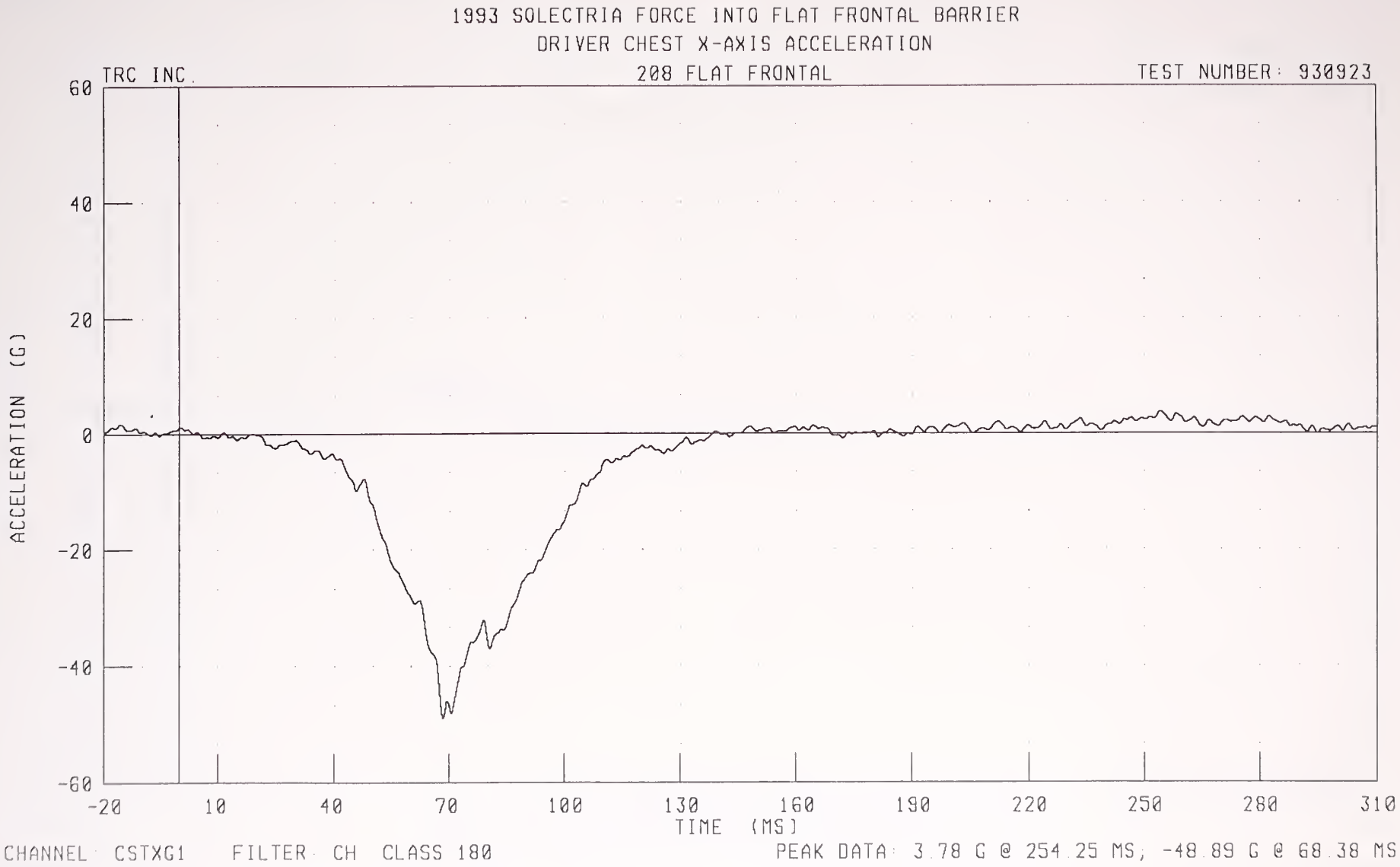
CHANNEL: HEDYG1 FILTER: CH. CLASS 1000 PEAK DATA: 13.77 G @ 69.00 MS; -16.88 G @ 84.25 MS

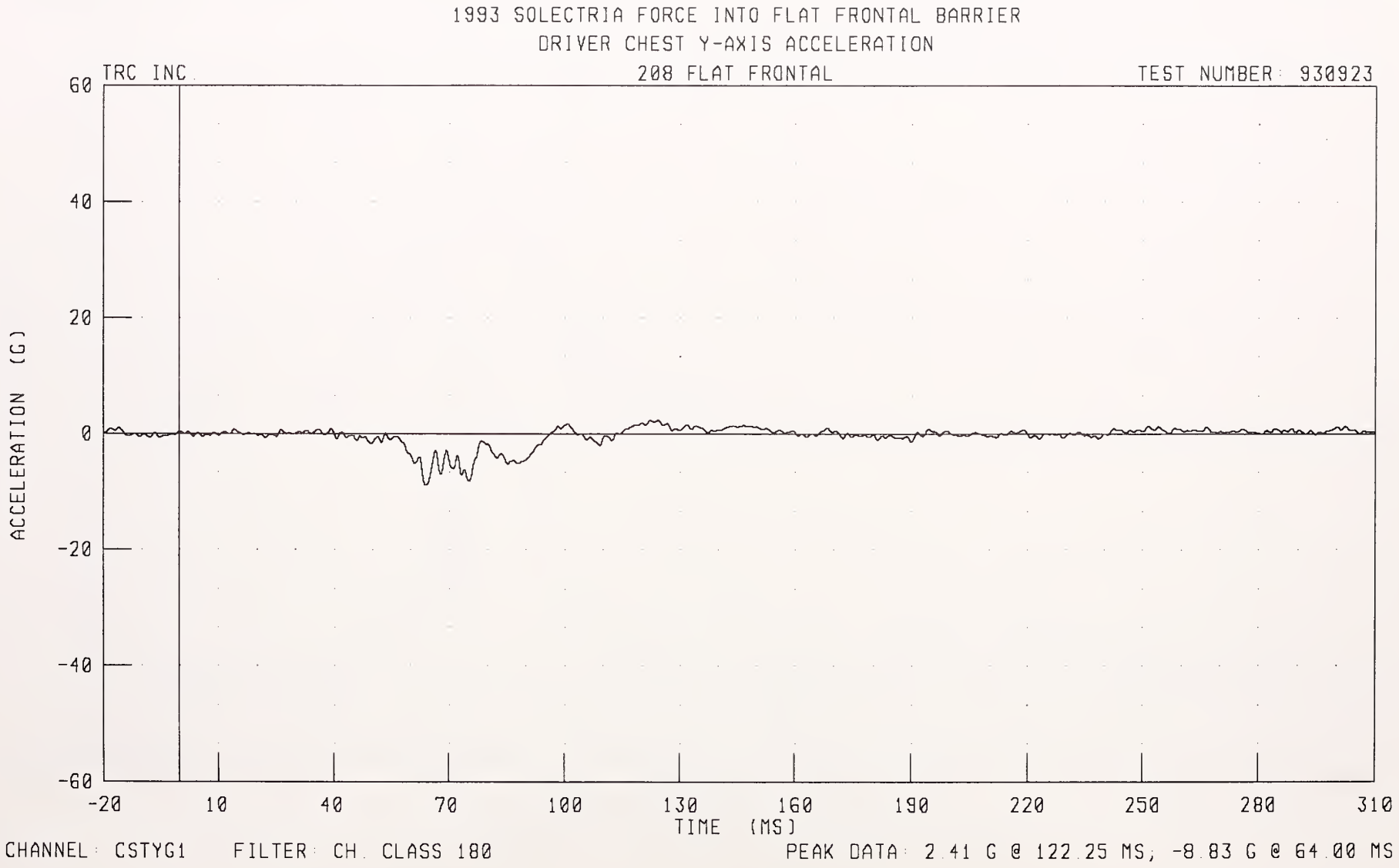
1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER HEAD Z-AXIS ACCELERATION

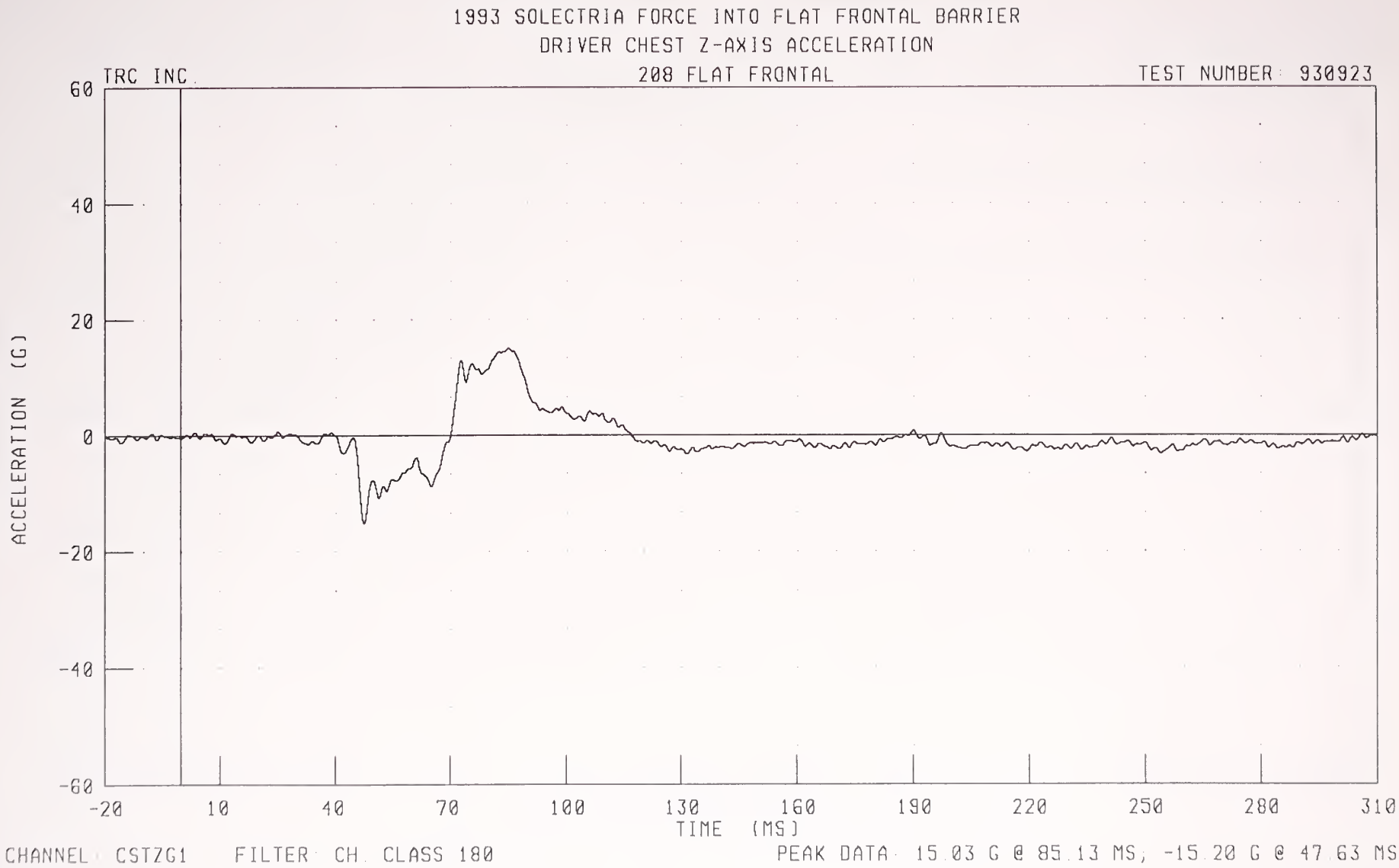


CHANNEL: HEDZG1 FILTER: CH. CLASS 1000 PEAK DATA: 2.58 G @ 11.63 MS; -36.54 G @ 68.75 MS

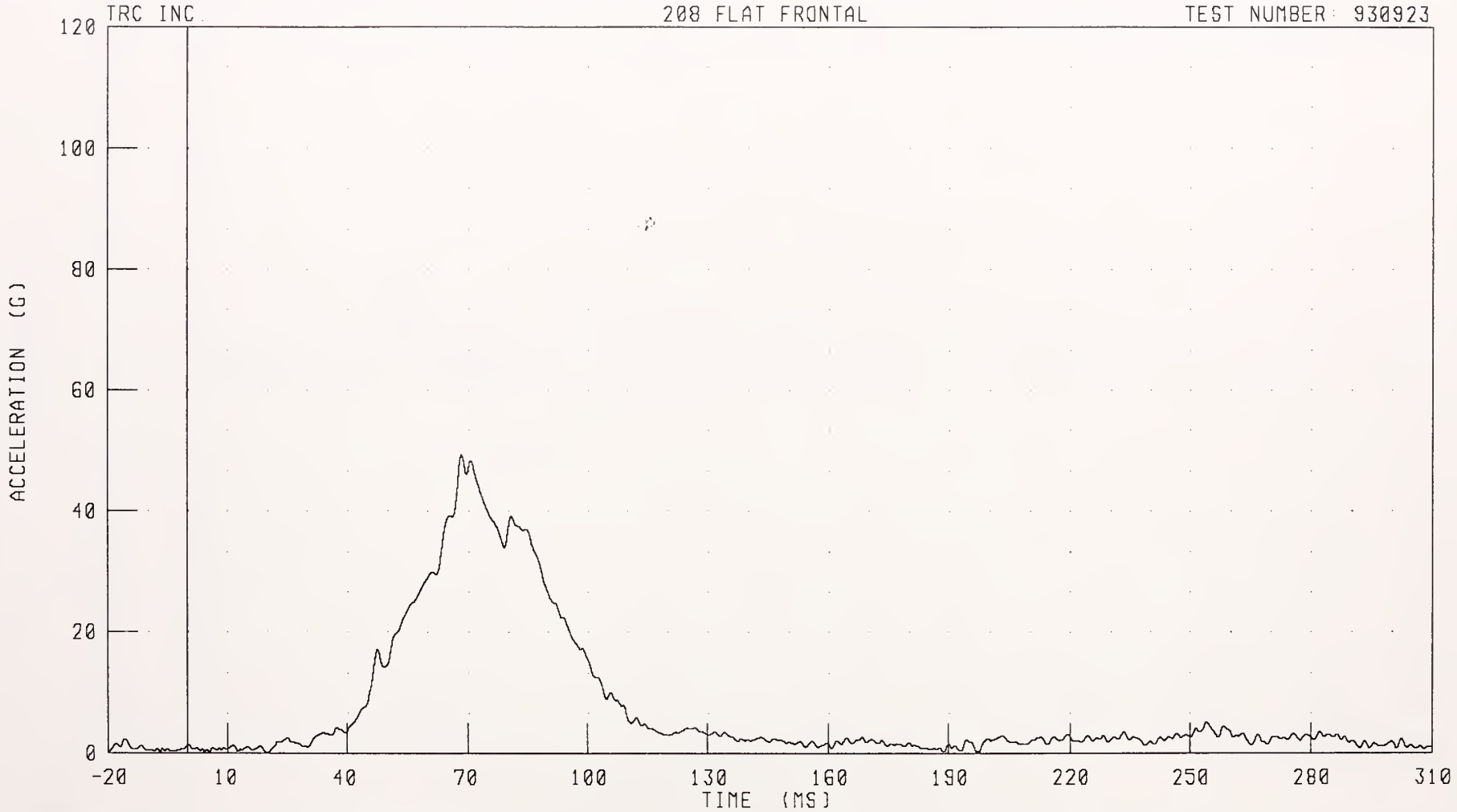

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER HEAD RESULTANT ACCELERATION
TRC INC
208 FLAT FRONTAL
TEST NUMBER: 930923
180
150
120
90
60
30
0
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: HEDRG1
FILTER: CH. CLASS 1000
PEAK DATA: 129.16 G @ 68.75 MS; 0.13 G @ 0.00 MS


1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER CHEST X-AXIS ACCELERATION
TRC INC.
208 FLAT FRONTAL
TEST NUMBER: 930923
60
40
20
0
-20
-40
-60
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: CSTXG1 FILTER: CH CLASS 180
PEAK DATA: 3.78 G @ 254.25 MS, -48.89 G @ 68.38 MS

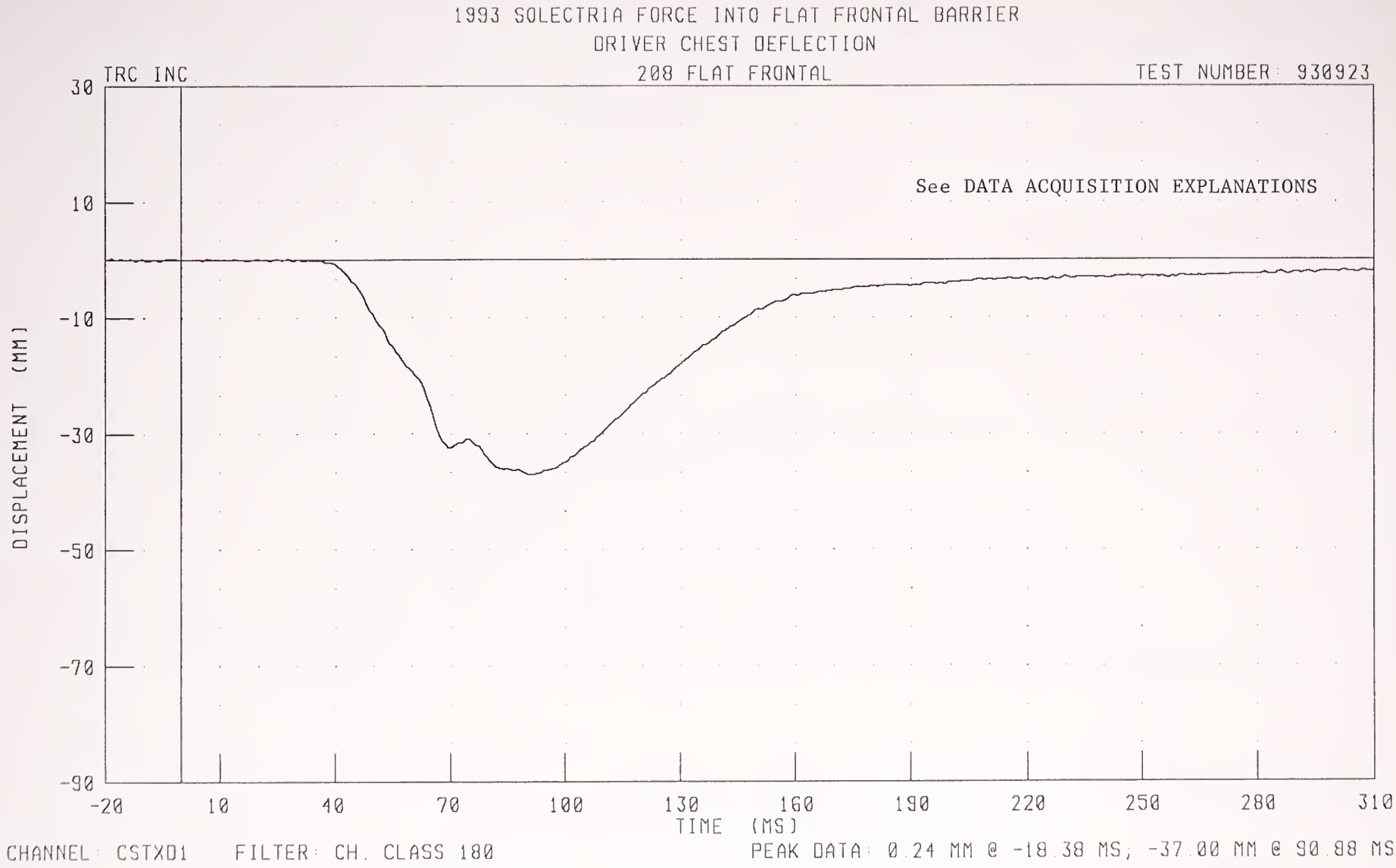

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER CHEST Y-AXIS ACCELERATION
TRC INC
208 FLAT FRONTAL
TEST NUMBER: 930923
60
40
20
0
-20
-40
-60
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: CSTYG1
FILTER: CH. CLASS 180
PEAK DATA: 2.41 G @ 122.25 MS; -8.83 G @ 64.00 MS

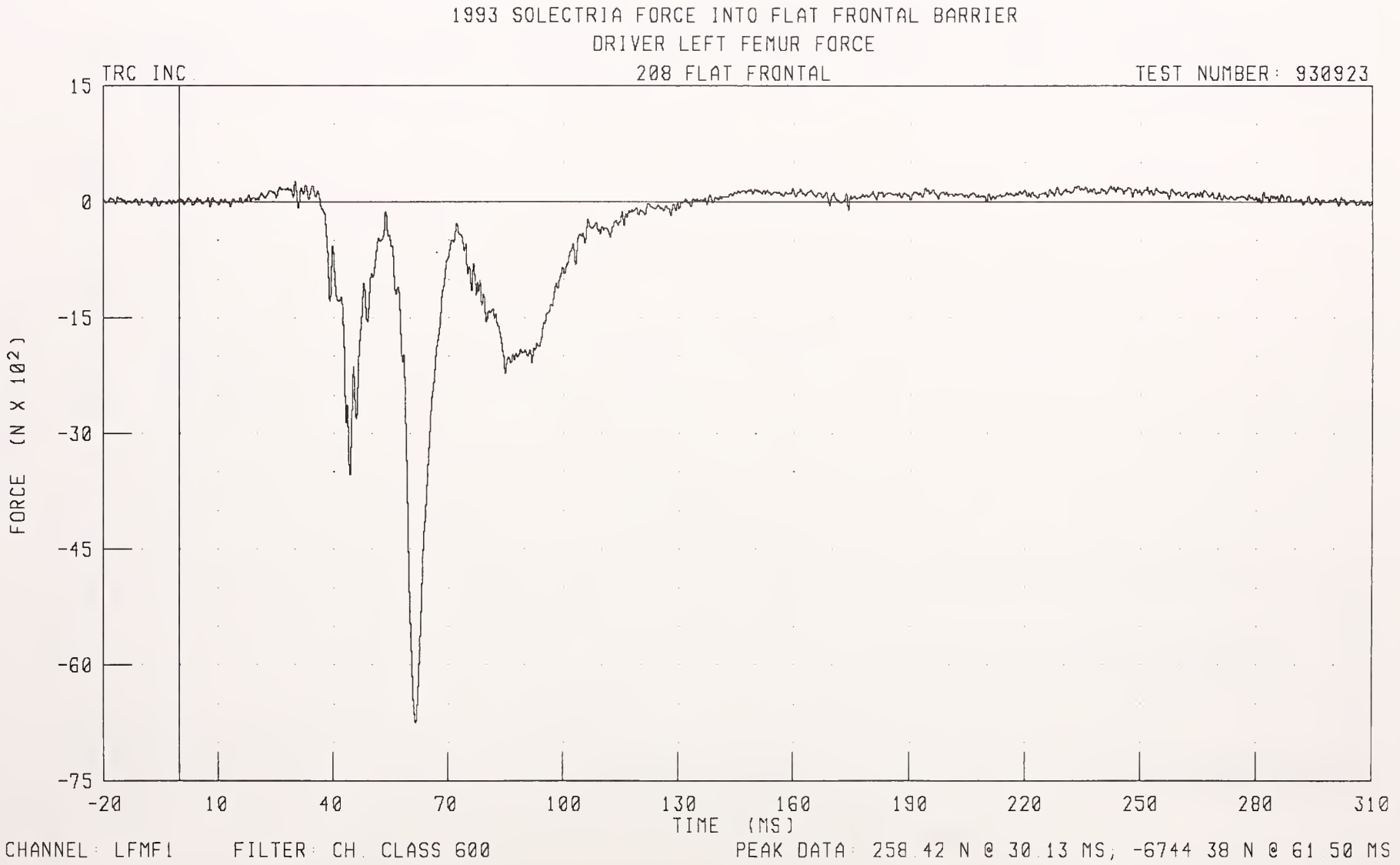

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER CHEST Z-AXIS ACCELERATION
TRC INC
208 FLAT FRONTAL
TEST NUMBER: 930923
60
40
20
0
-20
-40
-60
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: CSTZG1
FILTER: CH CLASS 180
PEAK DATA: 15.03 G @ 85.13 MS; -15.20 G @ 47.63 MS

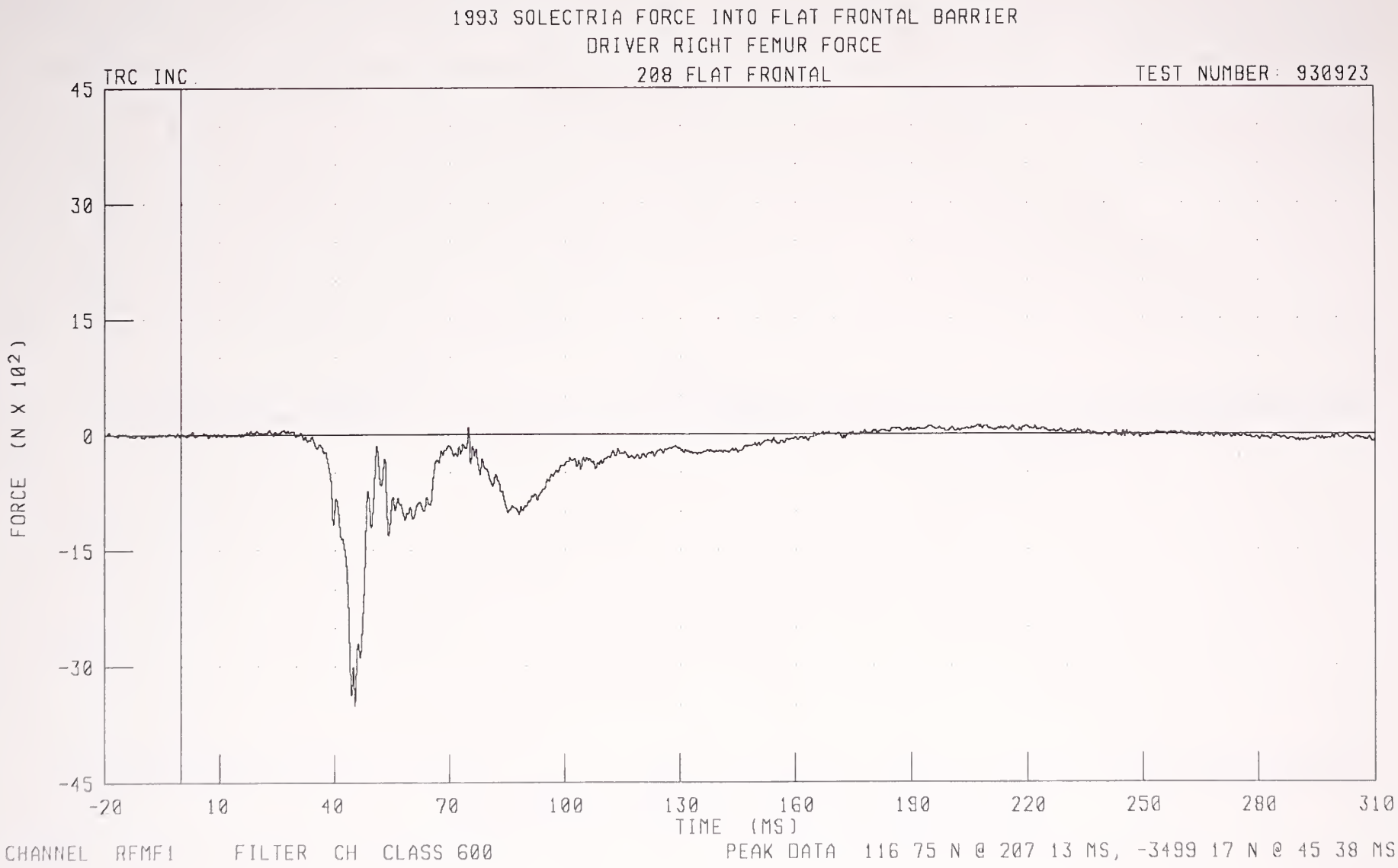
1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER CHEST RESULTANT ACCELERATION



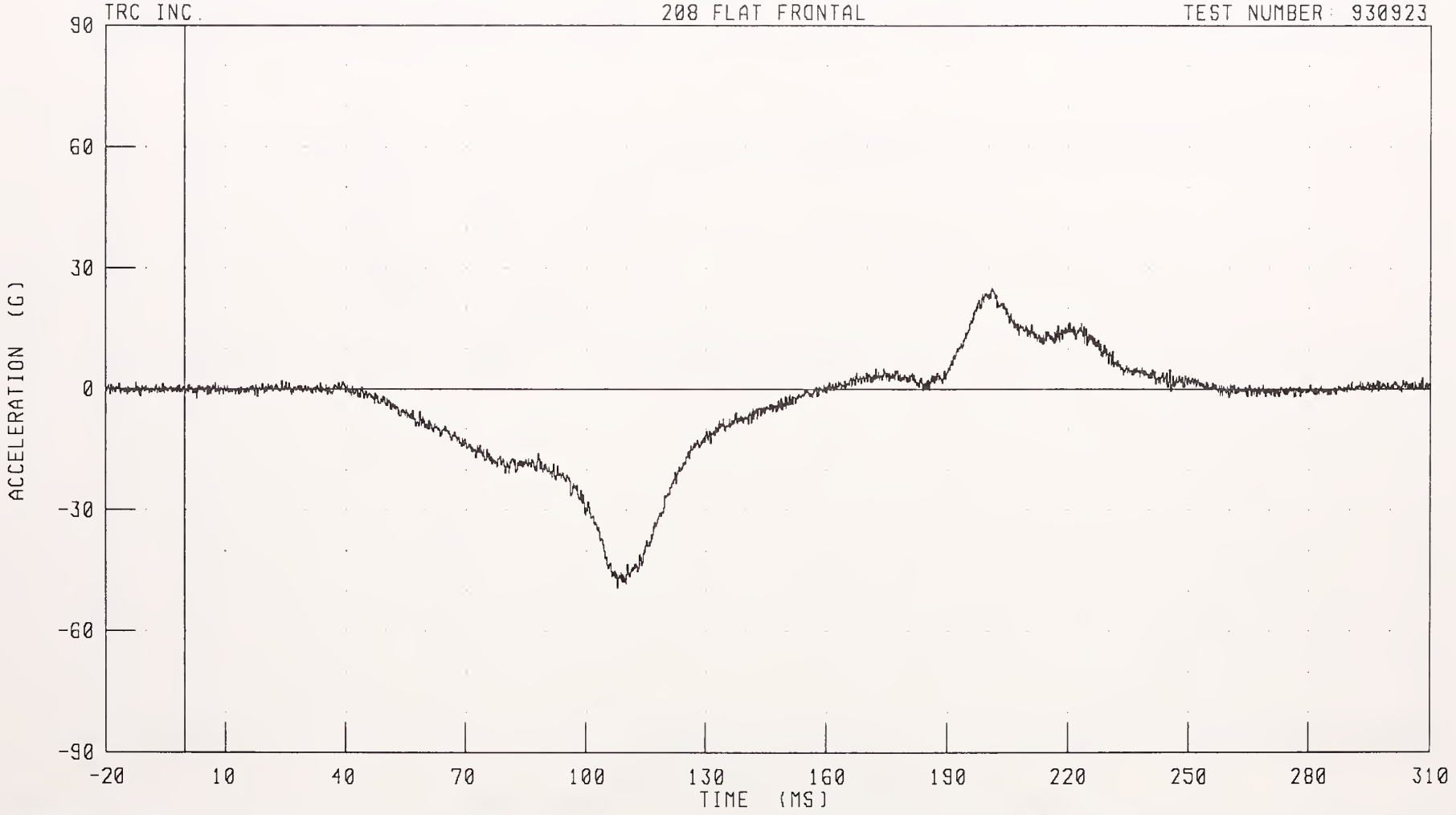
CHANNEL: CSTRG1 FILTER: CH CLASS 180 PEAK DATA: 49.34 G @ 68.25 MS, 0.04 G @ -20.00 MS


1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER CHEST DEFLECTION
TRC INC
208 FLAT FRONTAL
TEST NUMBER: 930923
See DATA ACQUISITION EXPLANATIONS
DISPLACEMENT (MM)
30
10
-10
-30
-50
-70
-90
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: CSTXD1
FILTER: CH. CLASS 180
PEAK DATA: 0.24 MM @ -18.38 MS; -37.00 MM @ 90.88 MS


1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER LEFT FEMUR FORCE
TRC INC
208 FLAT FRONTAL
TEST NUMBER: 930923
15
0
-15
-30
-45
-60
-75
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: 258.42 N @ 30.13 MS; -6744.38 N @ 61.50 MS

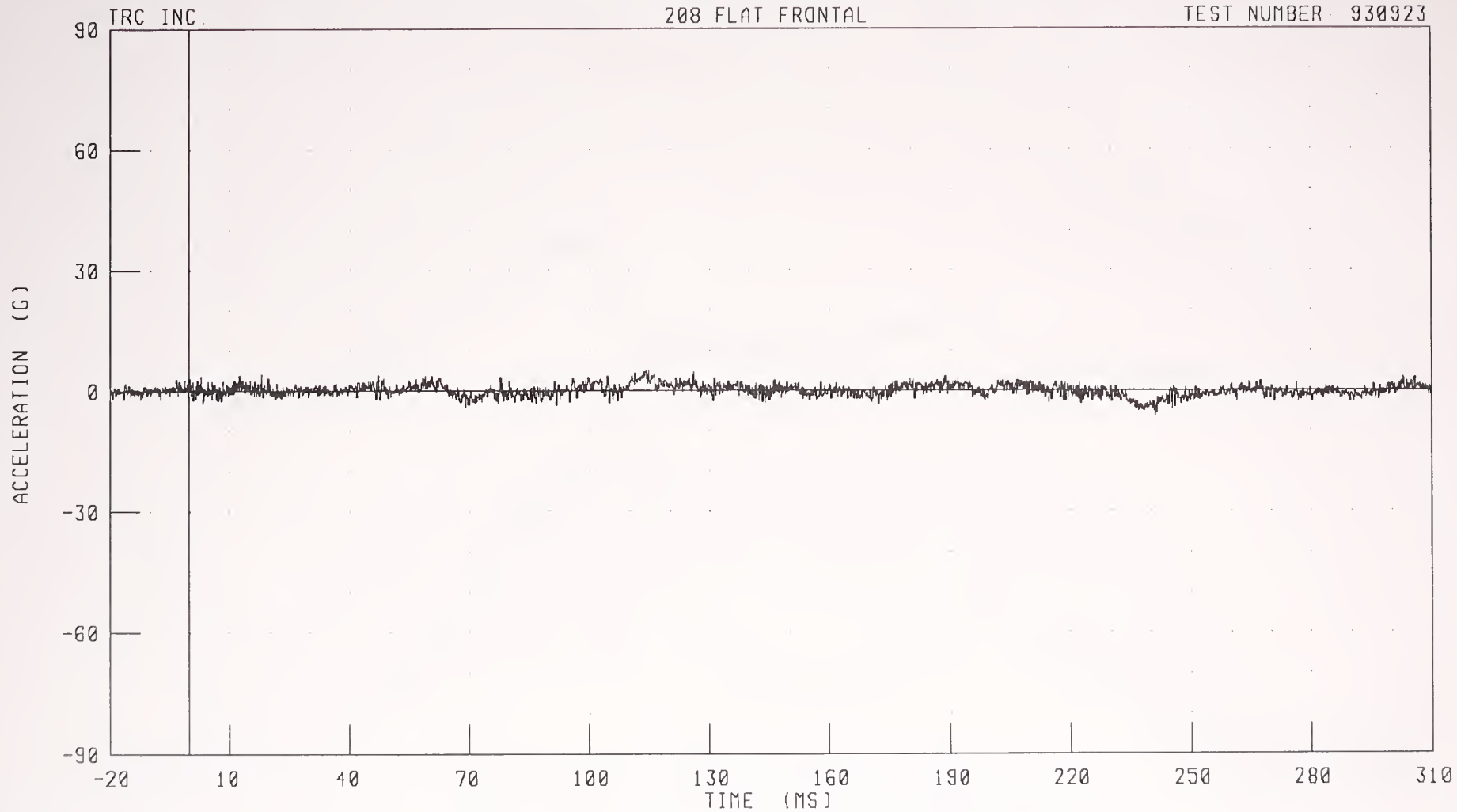

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
DRIVER RIGHT FEMUR FORCE
TRC INC
208 FLAT FRONTAL
TEST NUMBER: 930923
45
30
15
0
-15
-30
-45
FORCE (N X 10²)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL RFMF1
FILTER CH CLASS 600
PEAK DATA 116 75 N @ 207 13 MS, -3499 17 N @ 45 38 MS

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER HEAD X-AXIS ACCELERATION



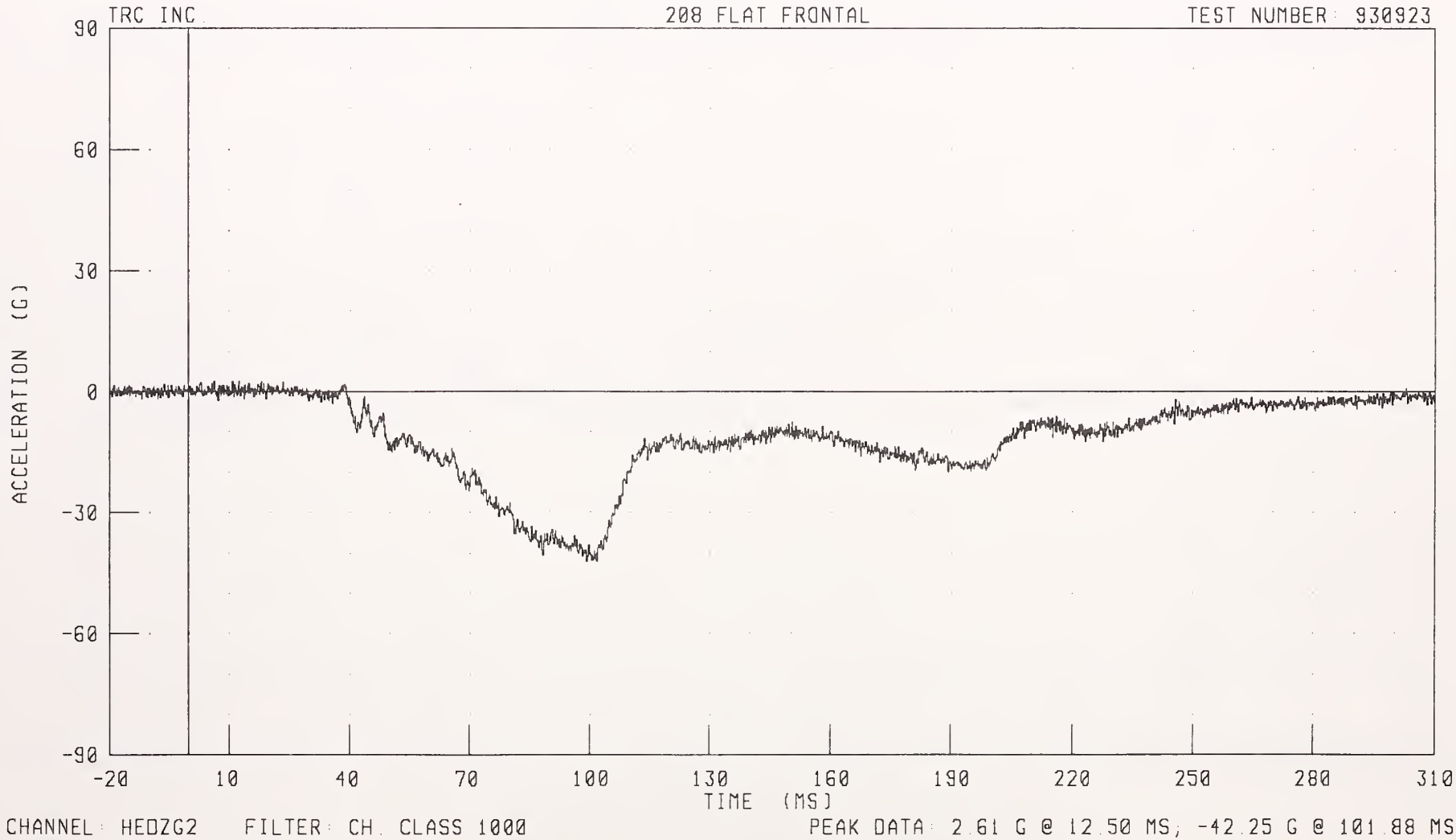
CHANNEL: HEDXG2 FILTER: CH. CLASS 1000 PEAK DATA: 25.20 G @ 201.00 MS; -49.19 G @ 107.88 MS

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER HEAD Y-AXIS ACCELERATION



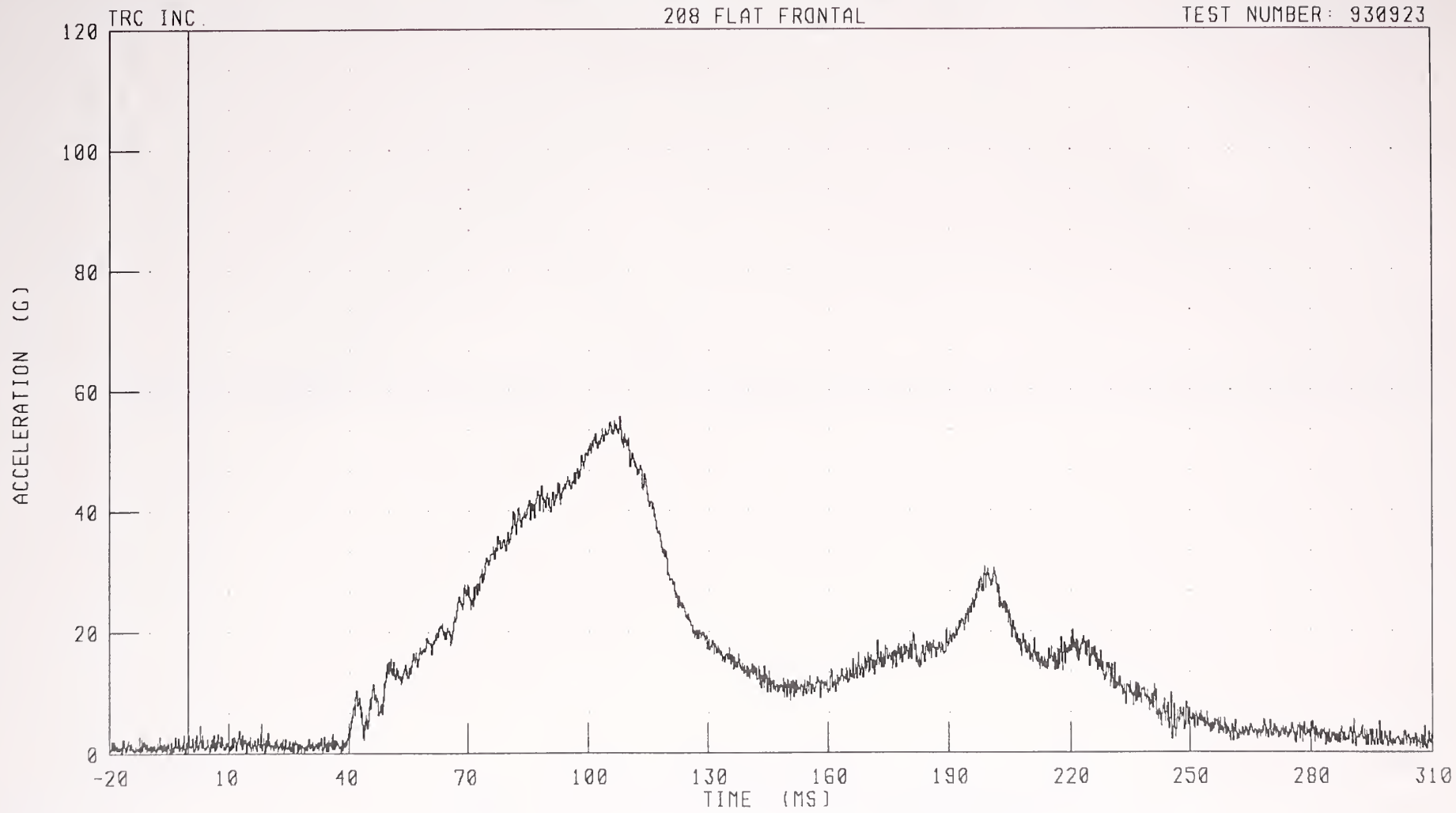
CHANNEL HEDYG2 FILTER CH CLASS 1000 PEAK DATA 5.18 G @ 114.88 MS; -6.32 G @ 241.13 MS

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER HEAD Z-AXIS ACCELERATION

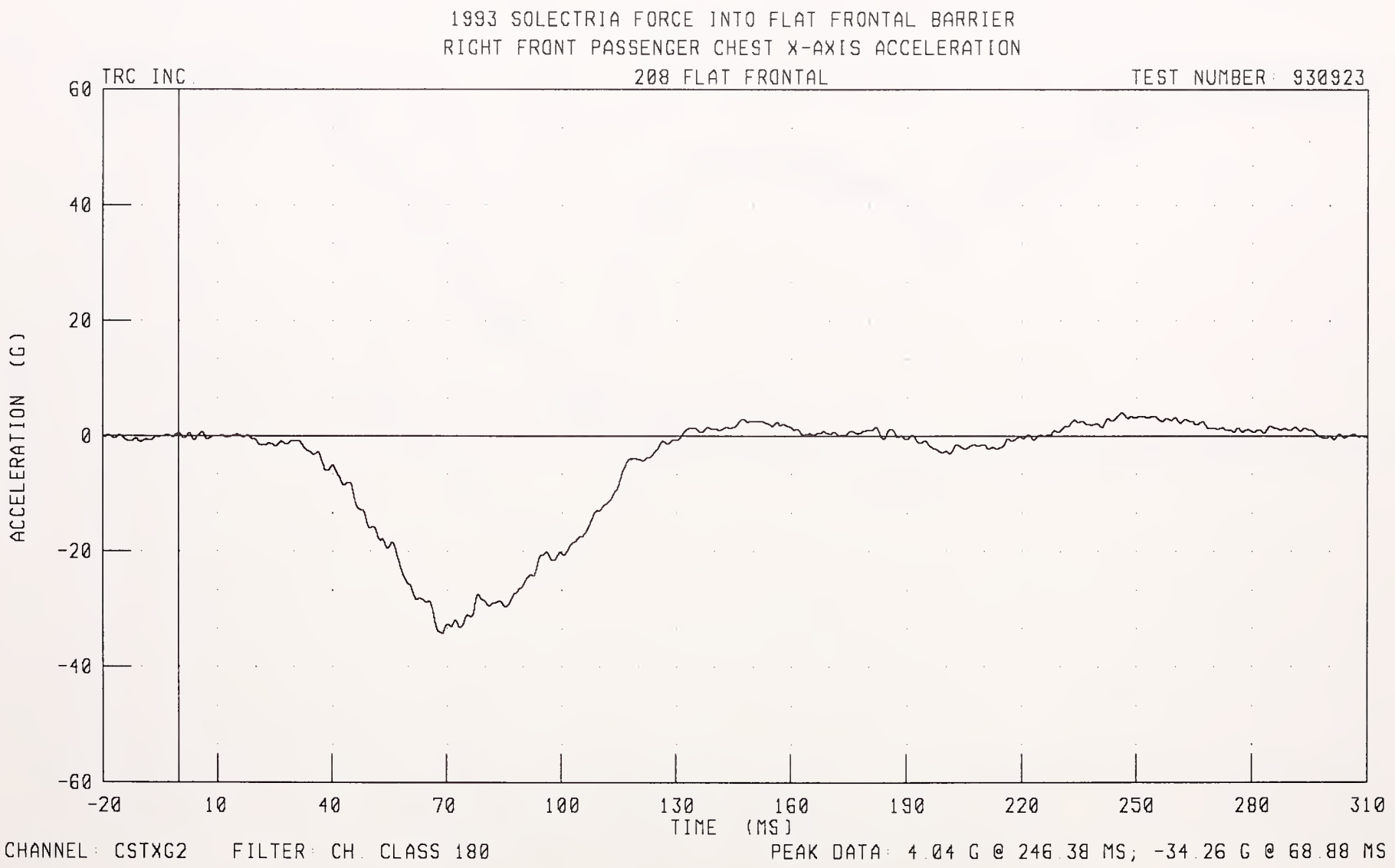


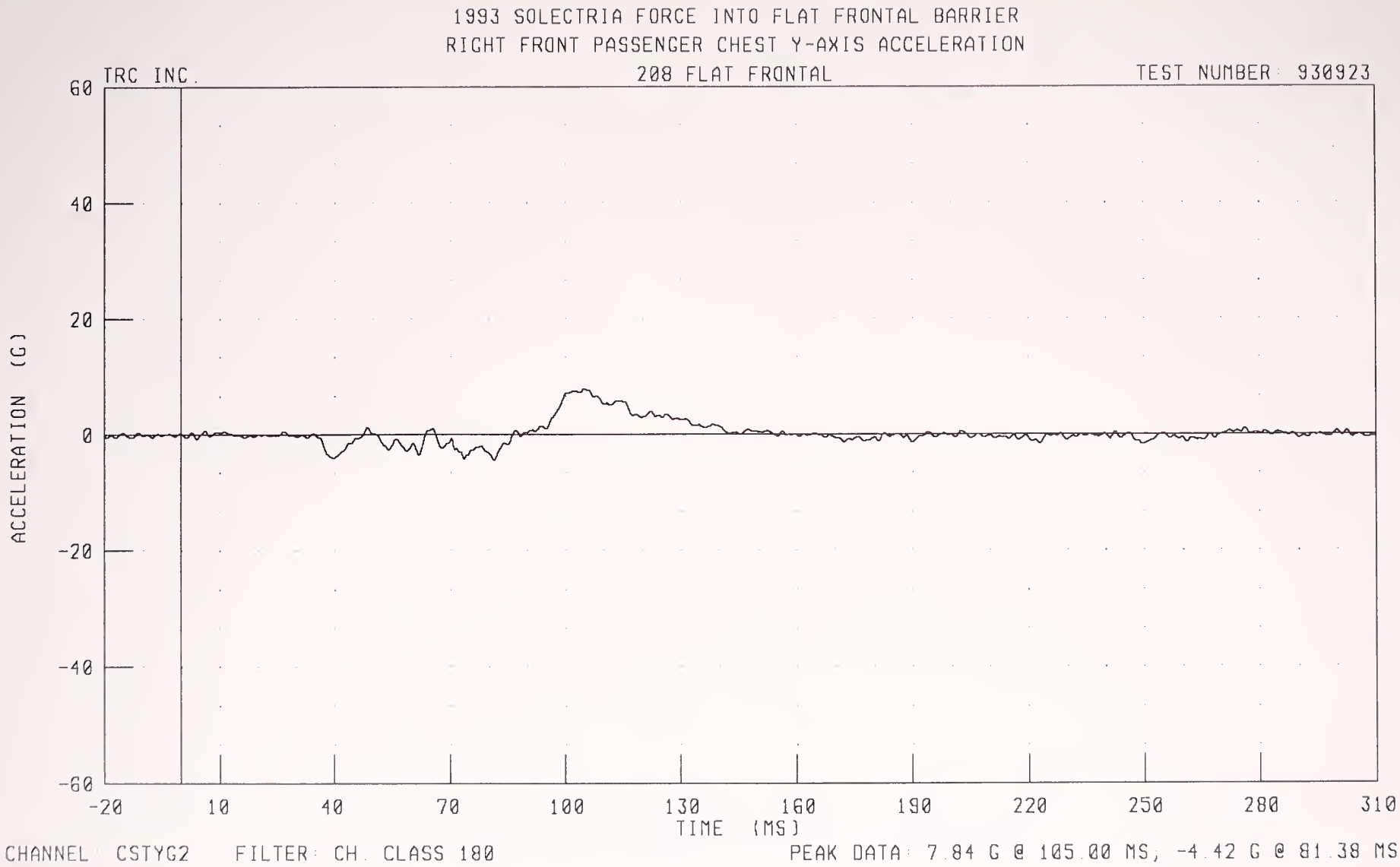
CHANNEL: HEDZG2 FILTER: CH. CLASS 1000 PEAK DATA: 2.61 G @ 12.50 MS; -42.25 G @ 101.88 MS

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER HEAD RESULTANT ACCELERATION

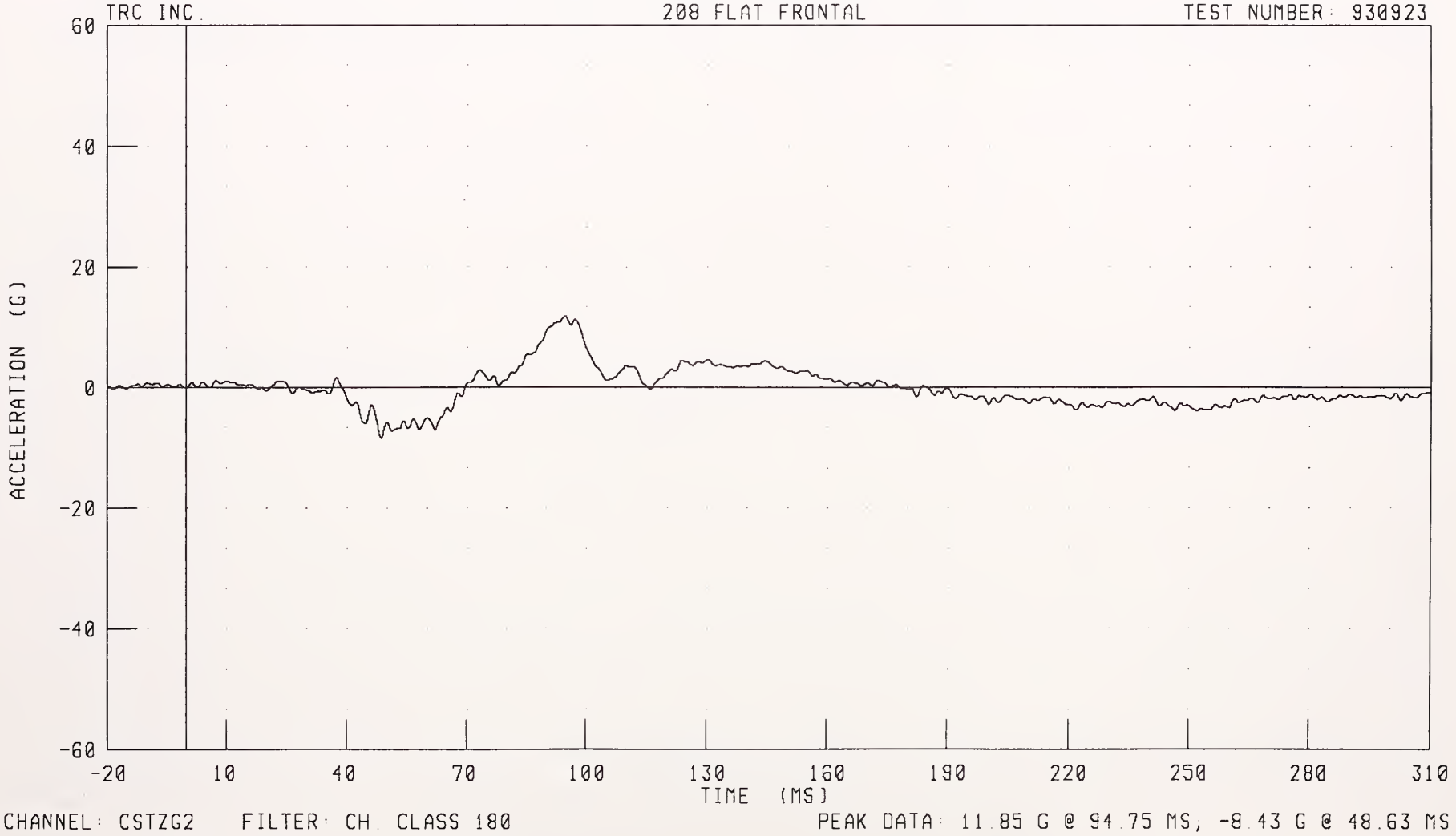


CHANNEL: HEDRG2 FILTER: CH. CLASS 1000 PEAK DATA: 55.62 G @ 107.88 MS; 0.09 G @ 33.38 MS


1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER CHEST X-AXIS ACCELERATION
TRC INC
208 FLAT FRONTAL
TEST NUMBER: 930923
60
40
20
0
-20
-40
-60
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: CSTXG2
FILTER: CH CLASS 180
PEAK DATA: 4.04 G @ 246.38 MS; -34.26 G @ 68.88 MS

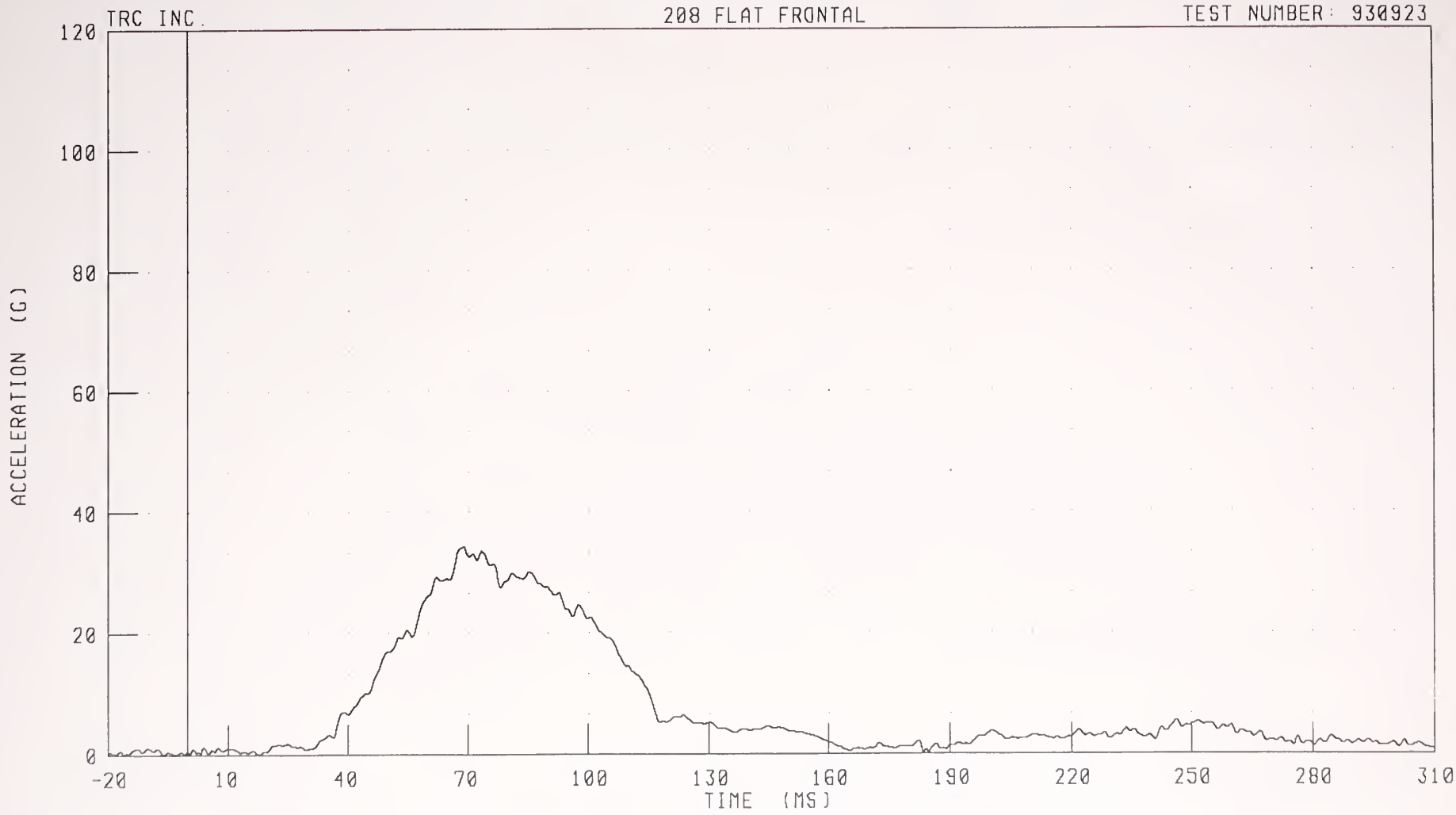

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER CHEST Y-AXIS ACCELERATION
TRC INC.
208 FLAT FRONTAL
TEST NUMBER: 930923
60
40
20
0
-20
-40
-60
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: CSTYG2
FILTER: CH. CLASS 180
PEAK DATA: 7.84 G @ 105.00 MS, -4.42 G @ 81.38 MS

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER CHEST Z-AXIS ACCELERATION



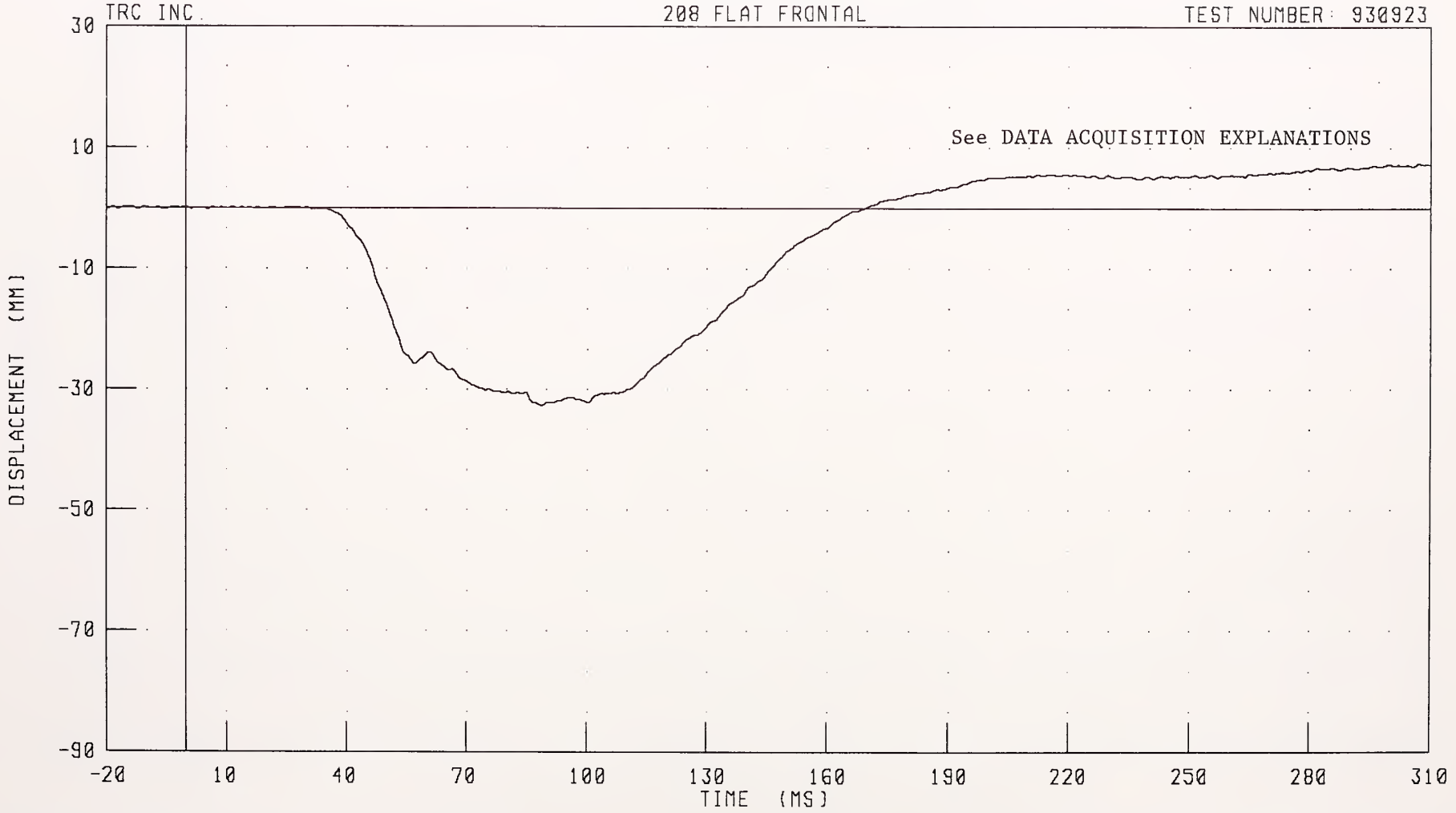
CHANNEL: CSTZG2 FILTER: CH. CLASS 180 PEAK DATA: 11.85 G @ 94.75 MS, -8.43 G @ 48.63 MS

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER CHEST RESULTANT ACCELERATION



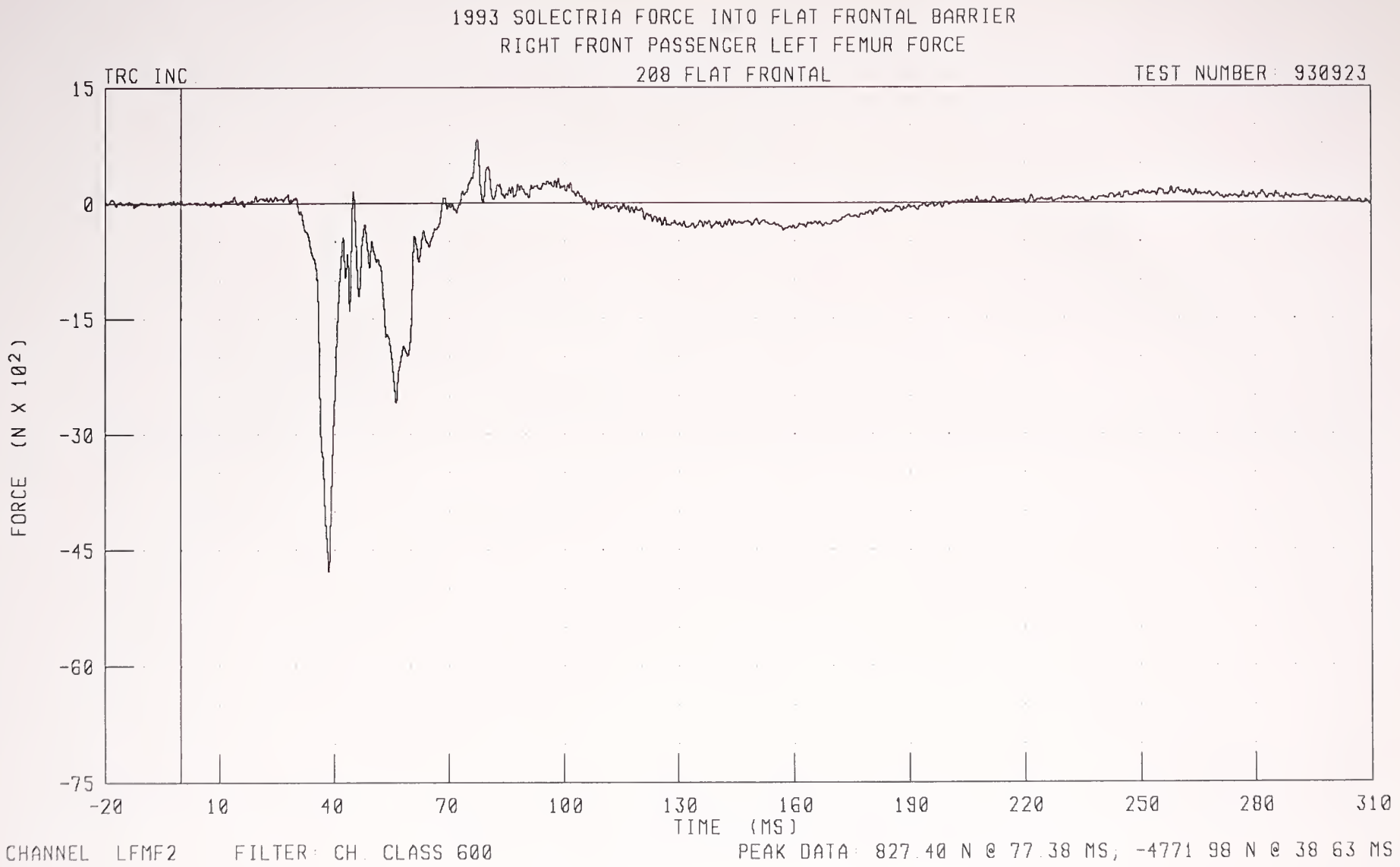
CHANNEL CSTRG2 FILTER CH CLASS 180 PEAK DATA: 34.33 G @ 68.88 MS, 0.05 G @ -16.00 MS

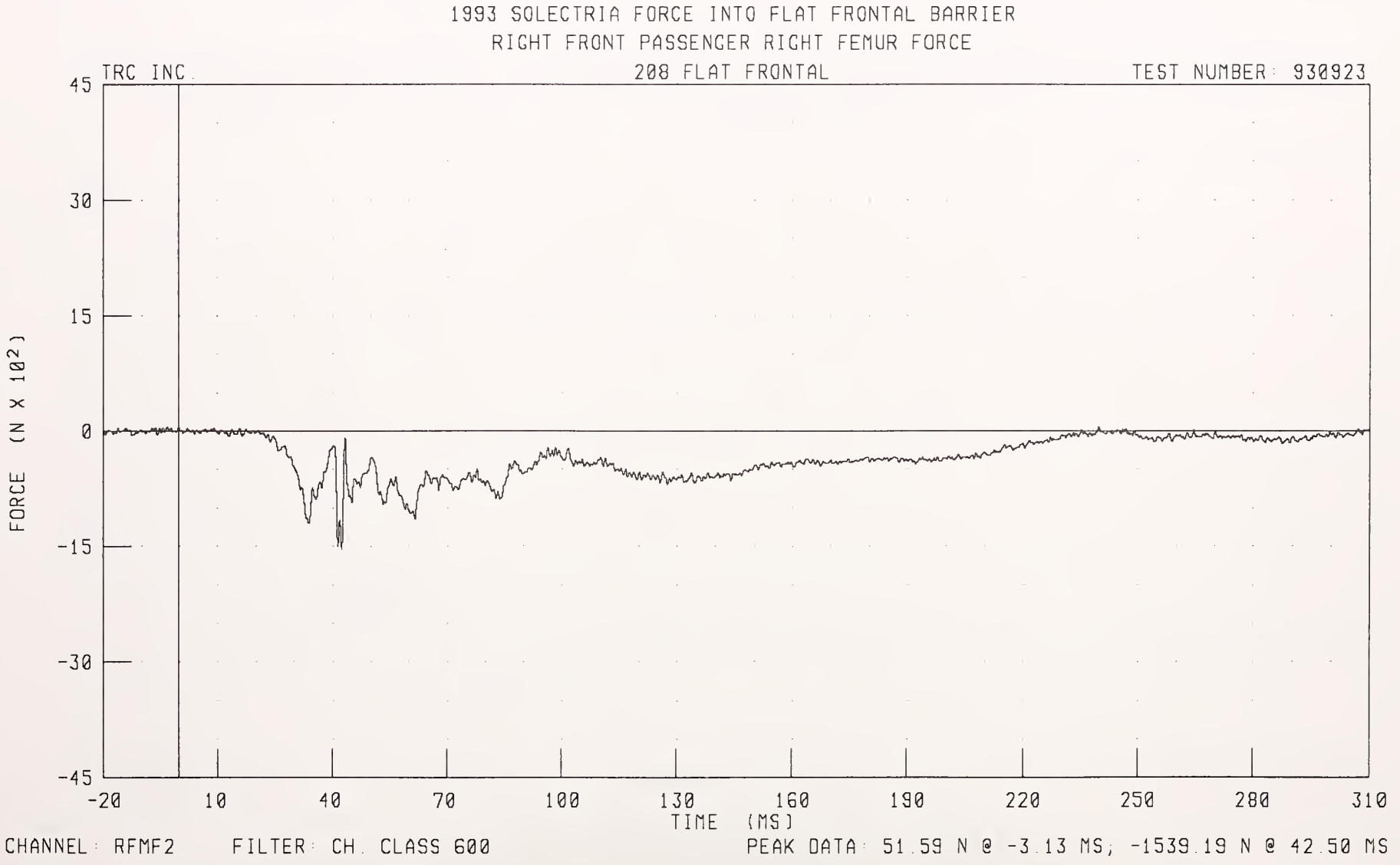
1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER CHEST DEFLECTION



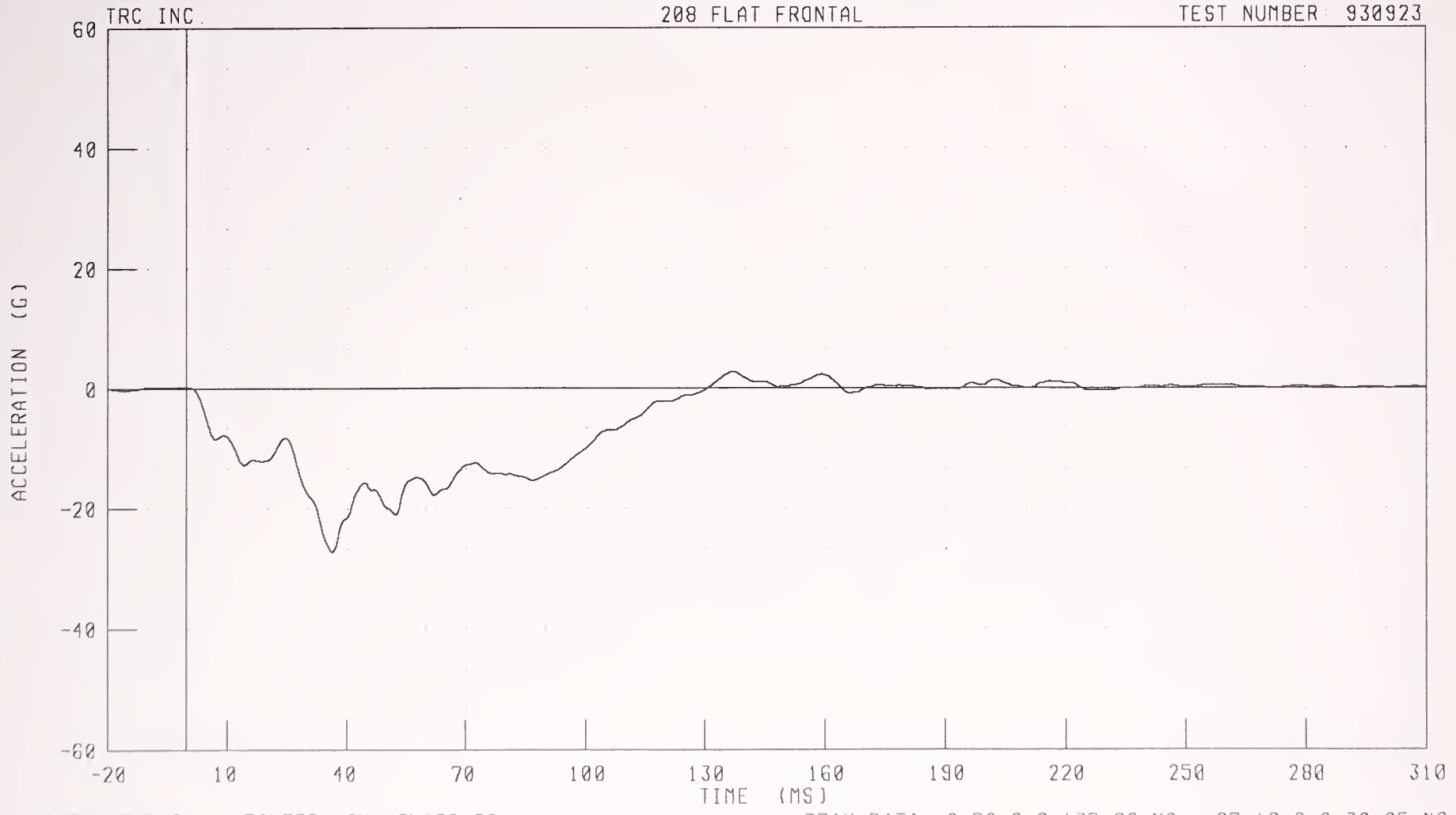
CHANNEL: CSTXD2 FILTER: CH. CLASS 180

PEAK DATA: 7.41 MM @ 307.00 MS; -32.66 MM @ 88.75 MS


1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER LEFT FEMUR FORCE
TRC INC
208 FLAT FRONTAL
TEST NUMBER: 930923
15
0
-15
-30
-45
-60
-75
FORCE (N X 10²)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL LFMF2
FILTER: CH CLASS 600
PEAK DATA: 827.40 N @ 77.38 MS; -4771.98 N @ 38.63 MS

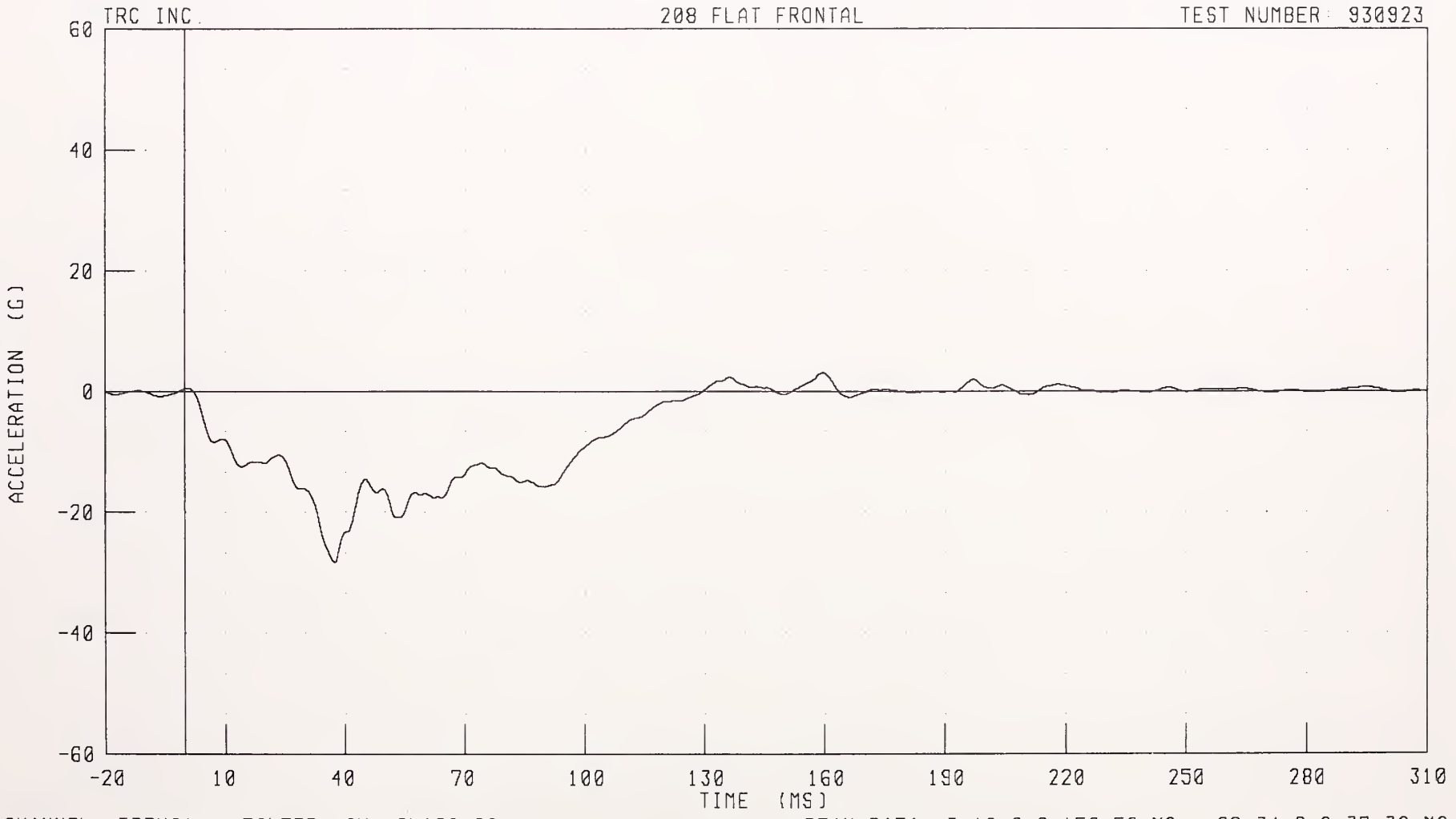

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT FRONT PASSENGER RIGHT FEMUR FORCE
TRC INC.
208 FLAT FRONTAL
TEST NUMBER: 930923
45
30
15
0
-15
-30
-45
FORCE (N X 10²)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: RFMF2
FILTER: CH. CLASS 600
PEAK DATA: 51.59 N @ -3.13 MS, -1539.19 N @ 42.50 MS

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
LEFT REAR SEAT X-AXIS ACCELERATION

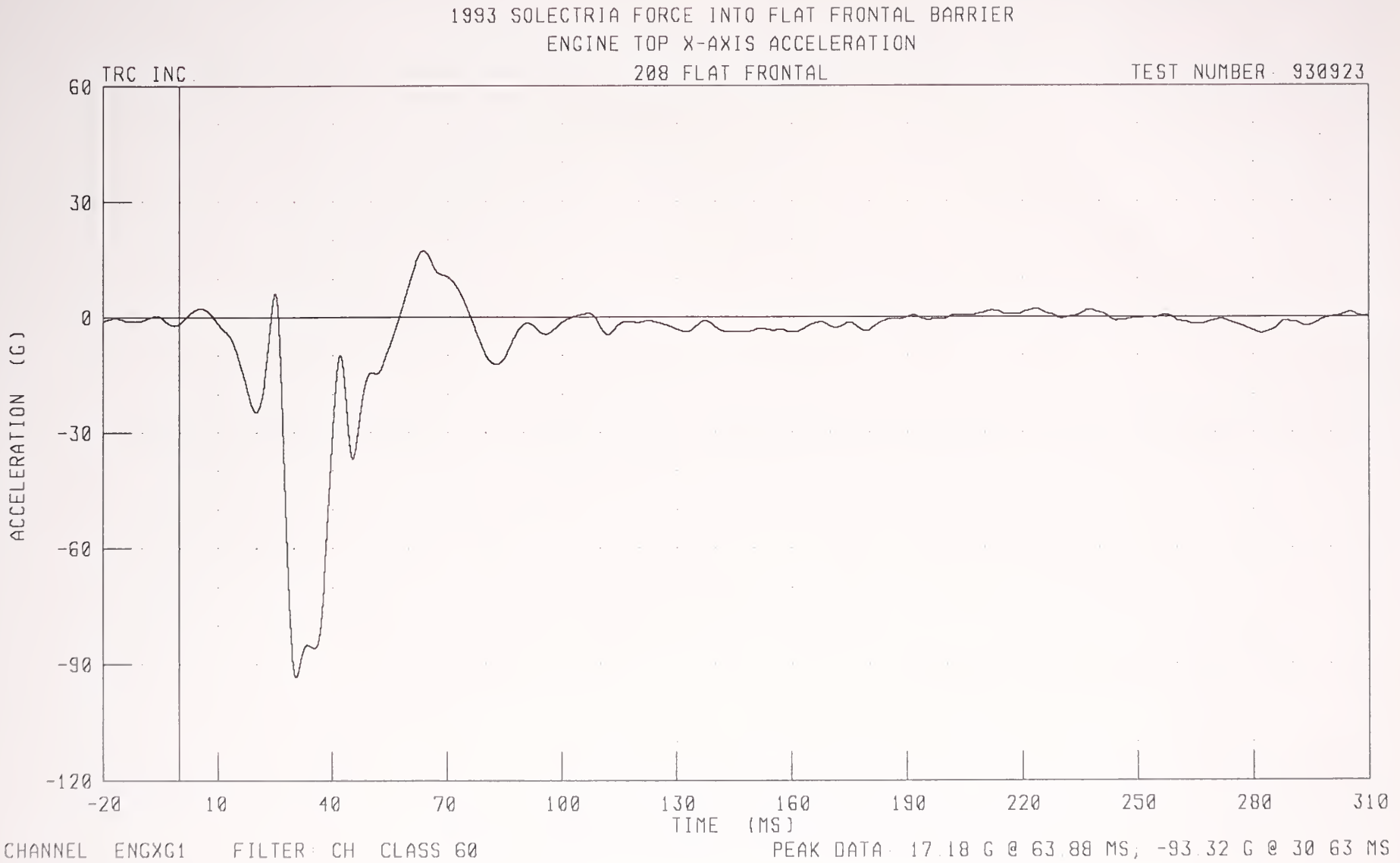


CHANNEL TLRXG1 FILTER CH CLASS 60 PEAK DATA: 2.72 G @ 137.00 MS, -27.19 G @ 36.25 MS

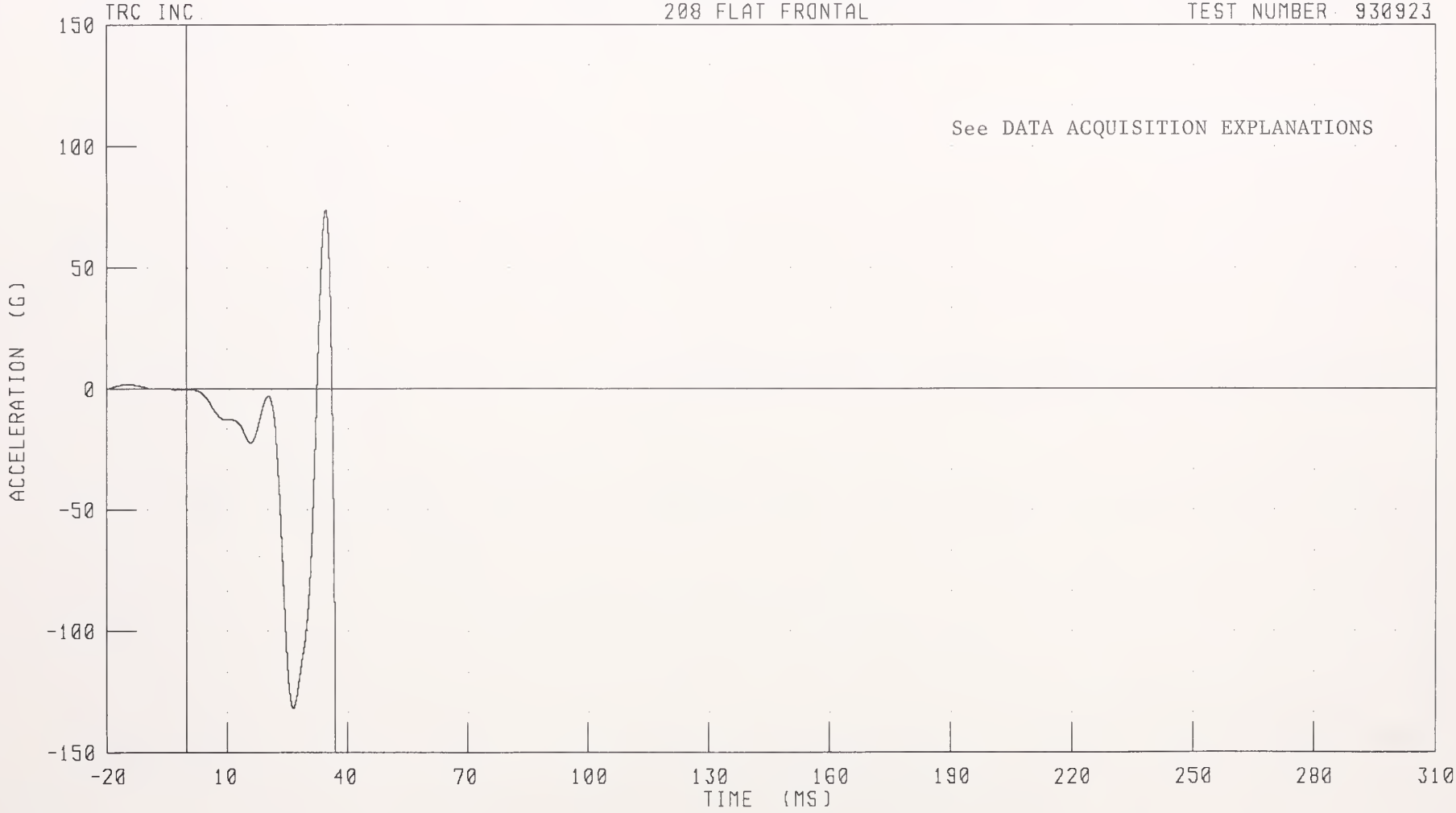
1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT REAR SEAT X-AXIS ACCELERATION



CHANNEL: TRRXG1 FILTER: CH. CLASS 60 PEAK DATA: 3.16 G @ 159.50 MS, -28.34 G @ 37.38 MS

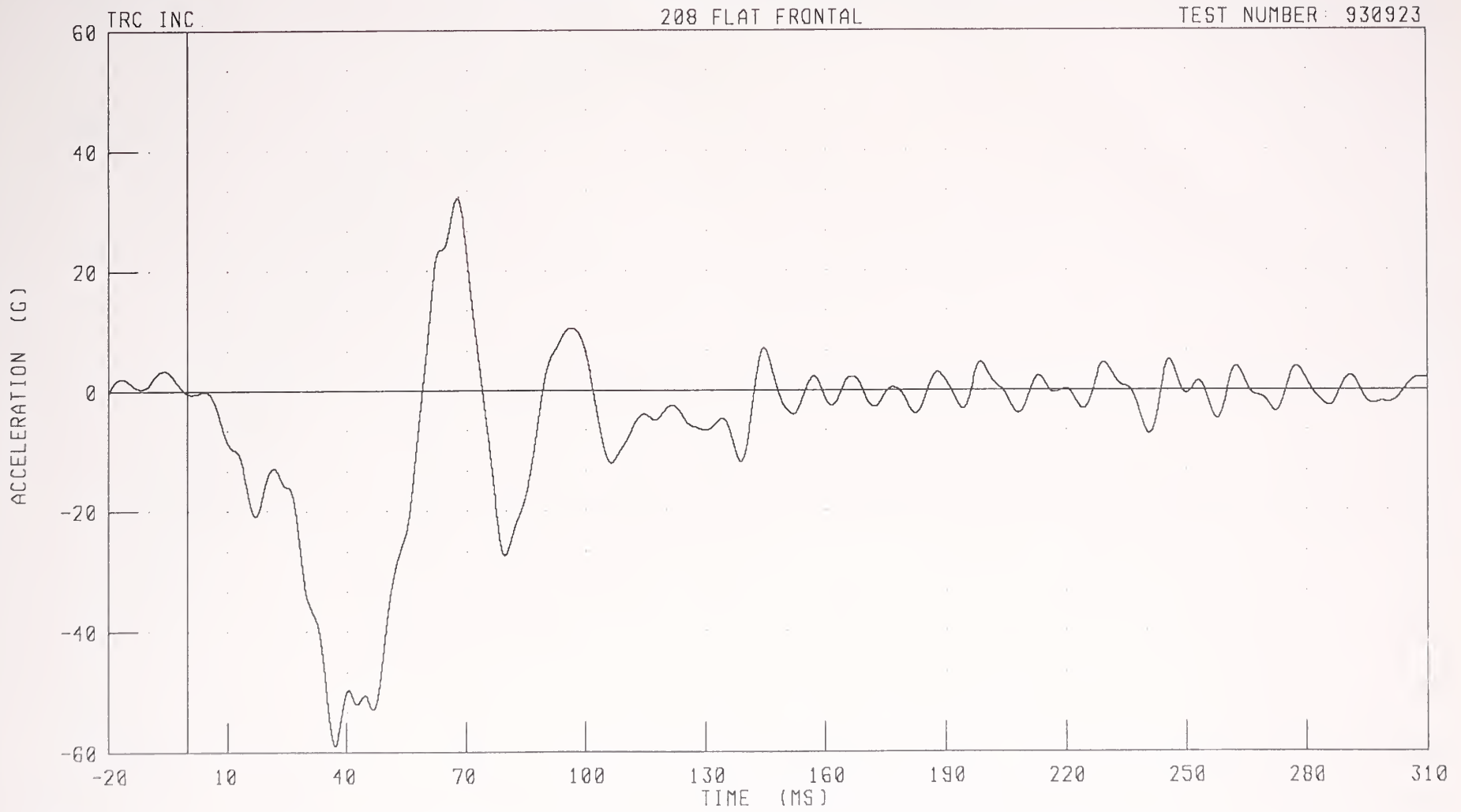

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
ENGINE TOP X-AXIS ACCELERATION
208 FLAT FRONTAL
TRC INC
TEST NUMBER 930923
60
30
0
-30
-60
-90
-120
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL ENGXG1 FILTER CH CLASS 60
PEAK DATA 17.18 G @ 63.88 MS; -93.32 G @ 30.63 MS

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
ENGINE BOTTOM X-AXIS ACCELERATION



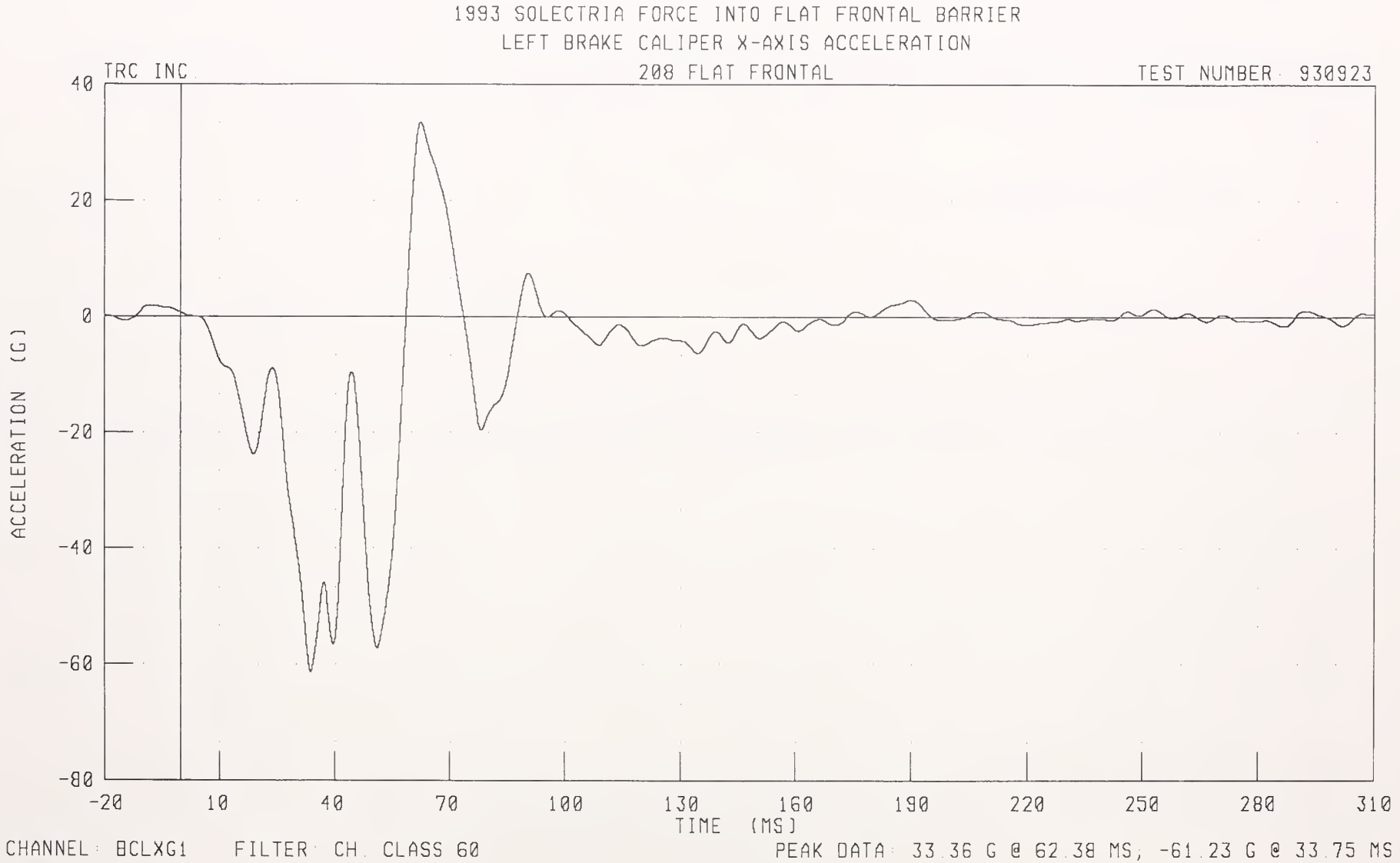
CHANNEL ENGXG2 FILTER CH CLASS 60 PEAK DATA 73.75 G @ 34.63 MS; -1613.99 G @ 43.13 MS

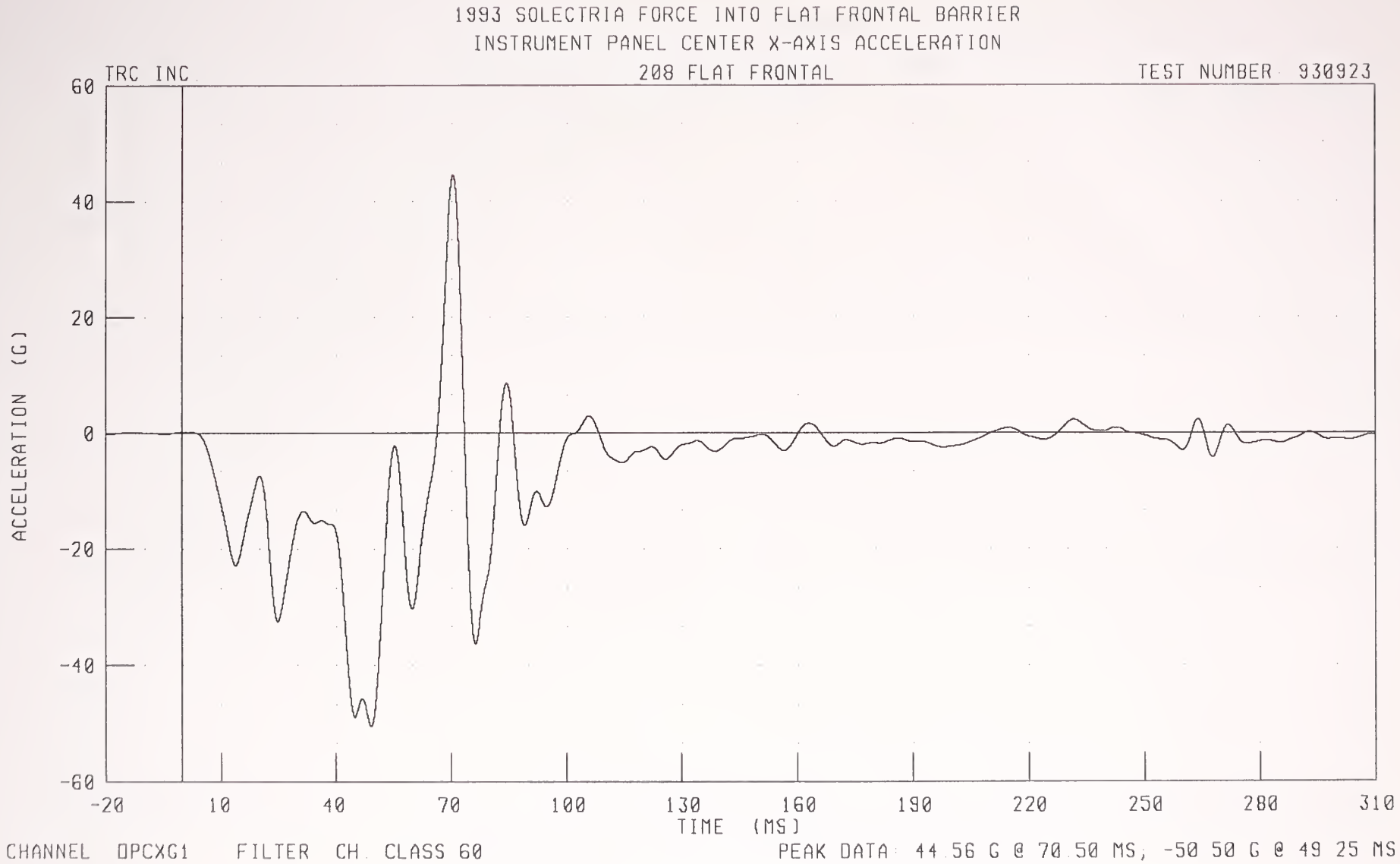
1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
RIGHT BRAKE CALIPER X-AXIS ACCELERATION



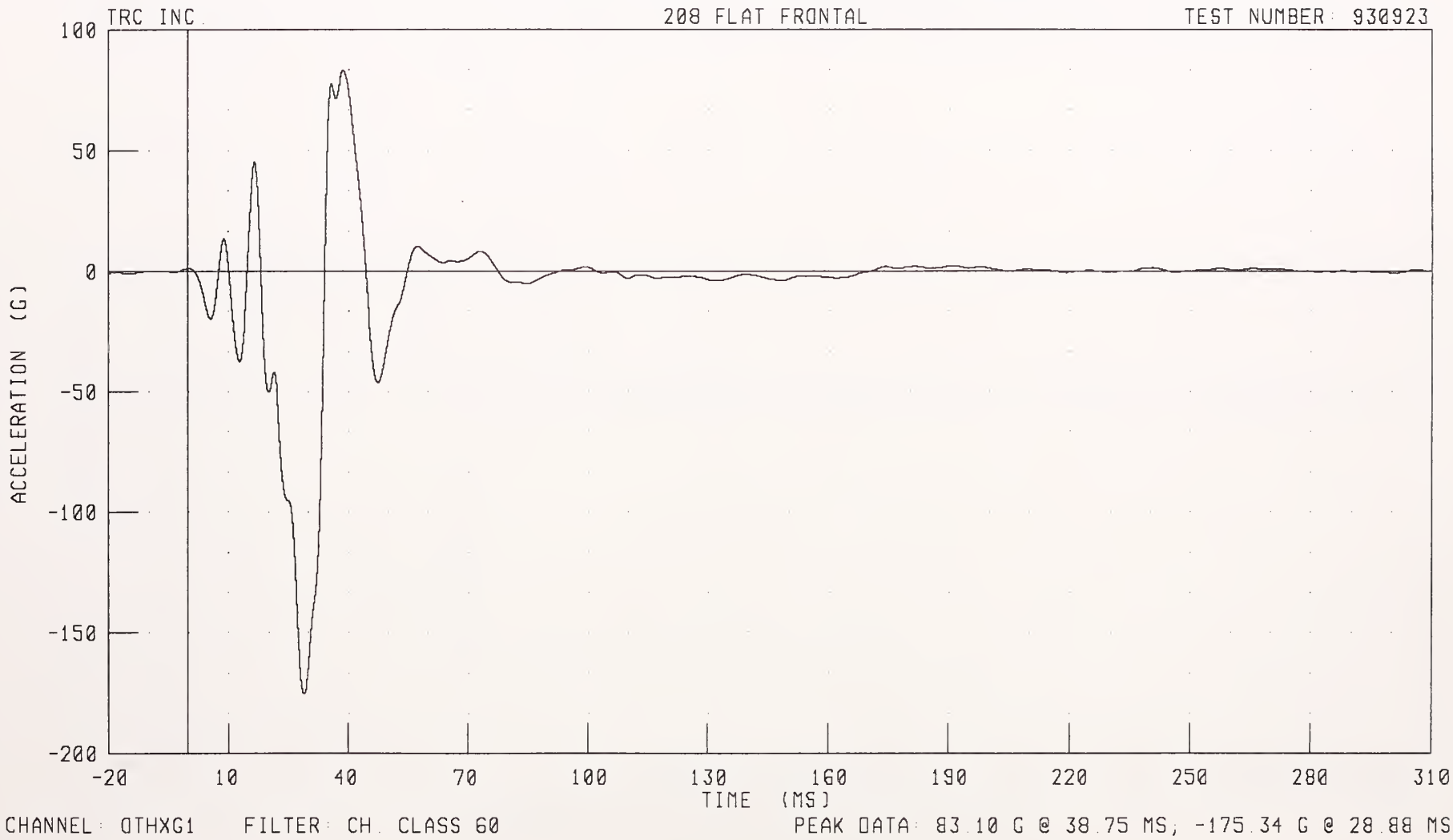
CHANNEL BCRXG1 FILTER CH CLASS 60

PEAK DATA: 32.00 G @ 67.63 MS, -58.94 G @ 37.13 MS


1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
LEFT BRAKE CALIPER X-AXIS ACCELERATION
TRC INC
208 FLAT FRONTAL
TEST NUMBER 930923
ACCELERATION (G)
40
20
0
-20
-40
-60
-80
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL BCLXG1
FILTER CH CLASS 60
PEAK DATA 33.36 G @ 62.38 MS, -61.23 G @ 33.75 MS

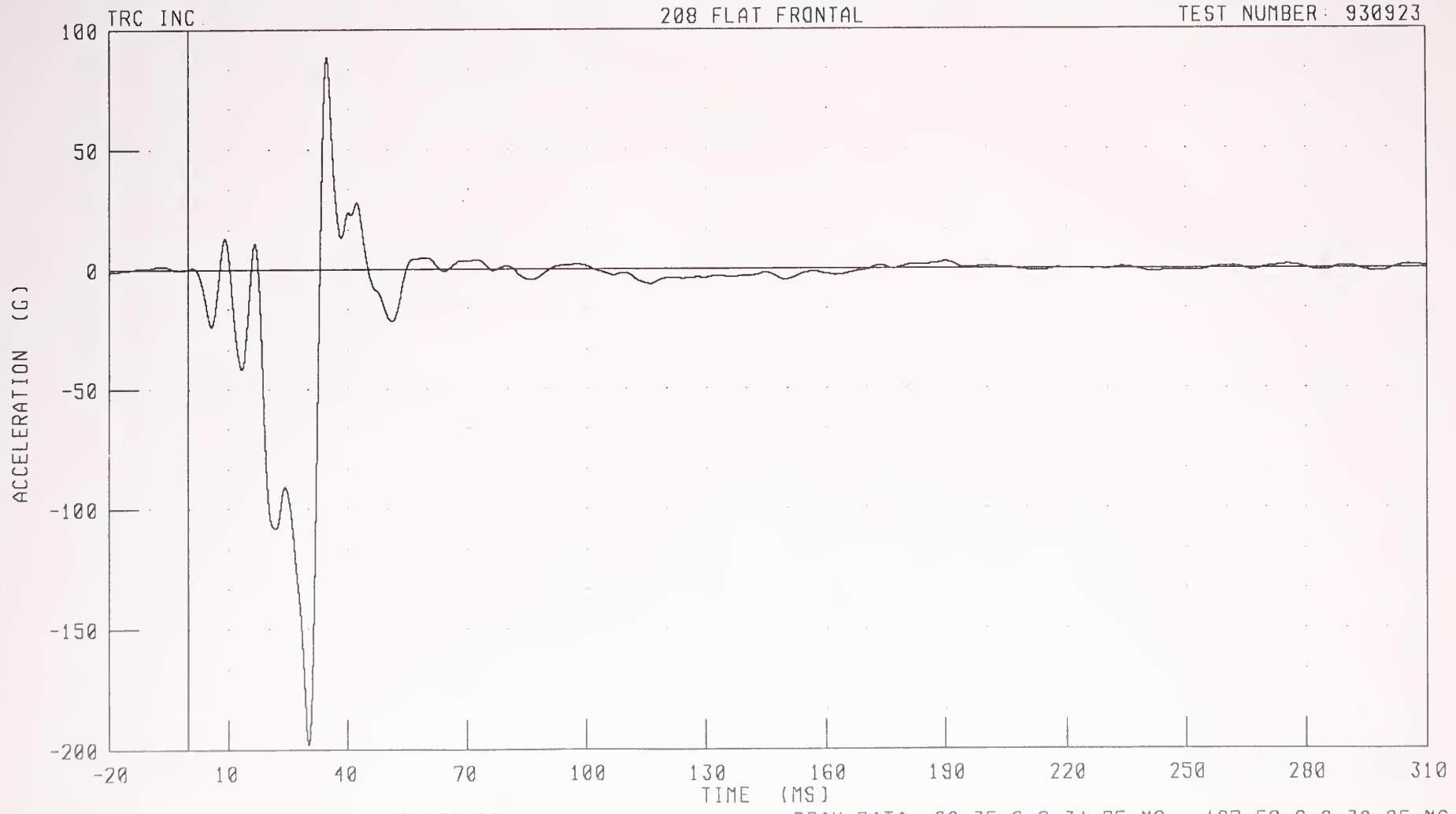

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
INSTRUMENT PANEL CENTER X-AXIS ACCELERATION
TRC INC
208 FLAT FRONTAL
TEST NUMBER 930923
60
40
20
0
-20
-40
-60
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL DPCXG1 FILTER CH CLASS 60
PEAK DATA 44.56 G @ 70.50 MS, -50.50 G @ 49.25 MS

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
FRONT BATTERY BOX LEFT SIDE X-AXIS ACCELERATION



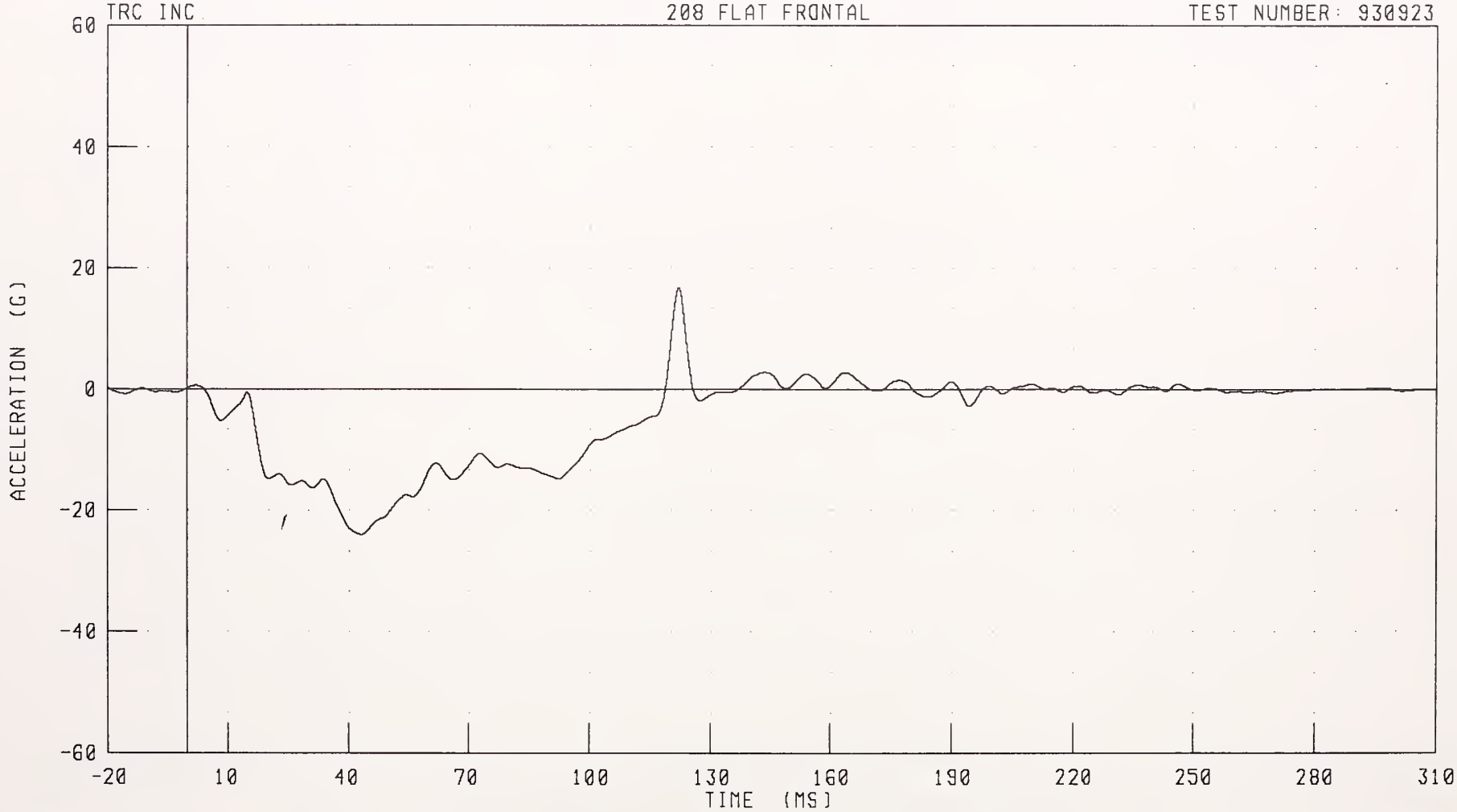
CHANNEL: DTHXG1 FILTER: CH. CLASS 60 PEAK DATA: 83.10 G @ 38.75 MS; -175.34 G @ 28.88 MS

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
FRONT BATTERY BOX RIGHT SIDE X-AXIS ACCELERATION



CHANNEL 0THXG2 FILTER: CH. CLASS 60 PEAK DATA: 88.35 G @ 34.75 MS; -197.50 G @ 30.25 MS

1993 SOLECTRIA FORCE INTO FLAT FRONTAL BARRIER
REAR BATTERY BOX CENTER X-AXIS ACCELERATION



CHANNEL: DTHXG3 FILTER: CH. CLASS 60 PEAK DATA: 16.78 G @ 122.00 MS; -23.98 G @ 43.00 MS

APPENDIX C

DUMMY CERTIFICATION DATA

PRE-TEST CERTIFICATION DATA

DRIVER DUMMY S/N: 177

TRANSPORTATION RESEARCH CENTER INC.
HYBRID III EXTERNAL DIMENSIONS
177 ARL

21-SEP-93

TRC 177C49ED1 572E SN177 EXT. DIMENSION CAL49

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	217. MM
H-POINT HEIGHT (C)	84 - 89 MM	88. MM
H-POINT FROM SEATBACK (D)	135 - 140 MM	138. MM
SKULL CAP TO BACKLINE (H)	41 - 46 MM	43. MM
TOTAL SITTING HEIGHT (A)	879 - 889 MM	881. MM
THIGH CLEARANCE (F)	140 - 155 MM	144. MM
BUTTOCK KNEE LENGTH (K)	579 - 605 MM	603. MM
BUTTOCK POPLITEAL LENGTH (N)	452 - 478 MM	476. 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	203. MM
SHOULDER-ELBOW LENGTH (I)	330 - 345 MM	338. MM
BACK OF ELBOW TO WRIST PIVOT (G)	290 - 305 MM	295. MM

TEST MEETS SPECIFICATIONS

TECHNICIAN Pete Foust

TRANSPORTATION RESEARCH CENTER INC.

HEAD DROP TEST

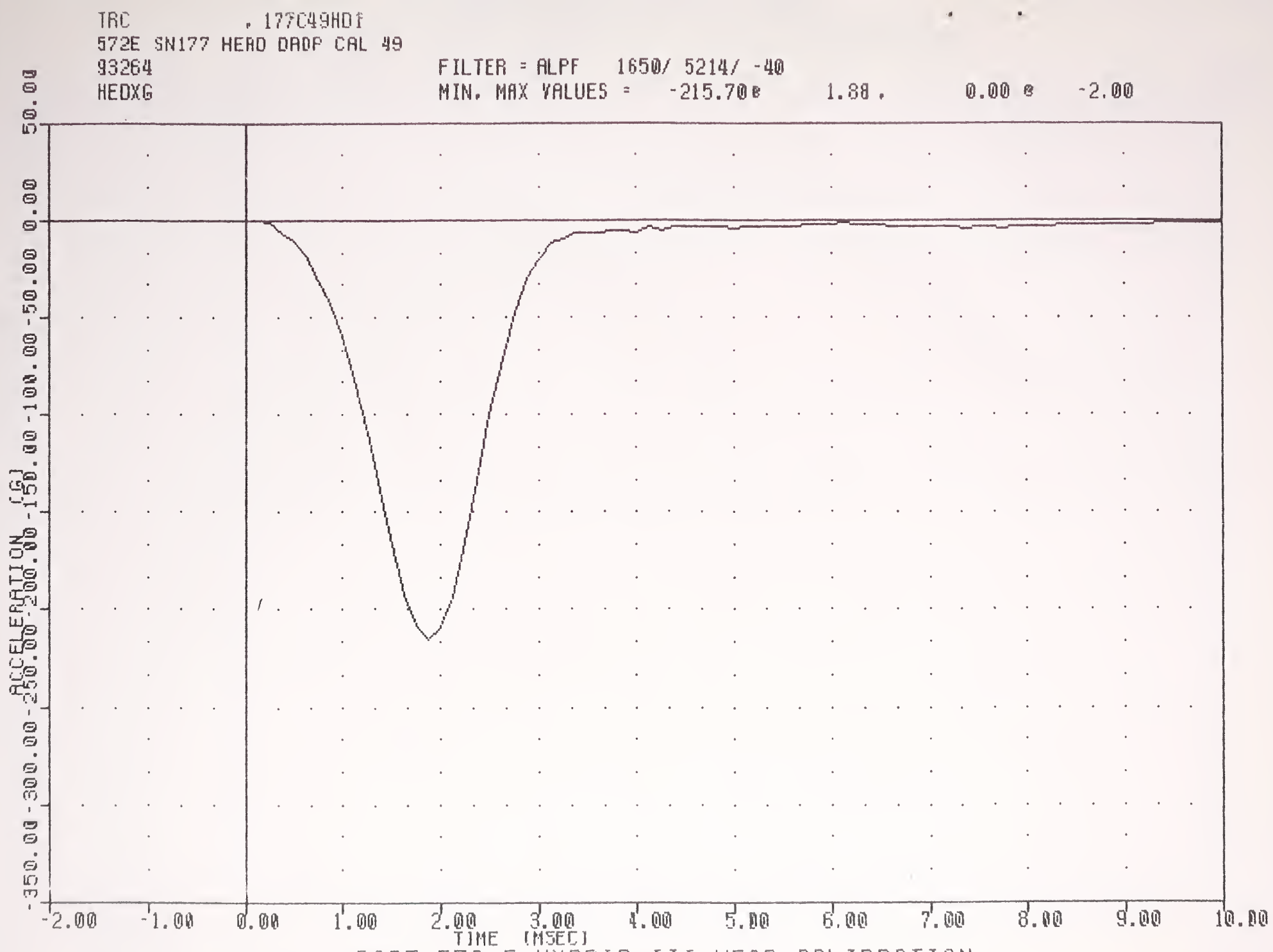
HYBRID III 21-SEP-93

TRC 177C49HD1 572E SN177 HEAD DROP CAL 49

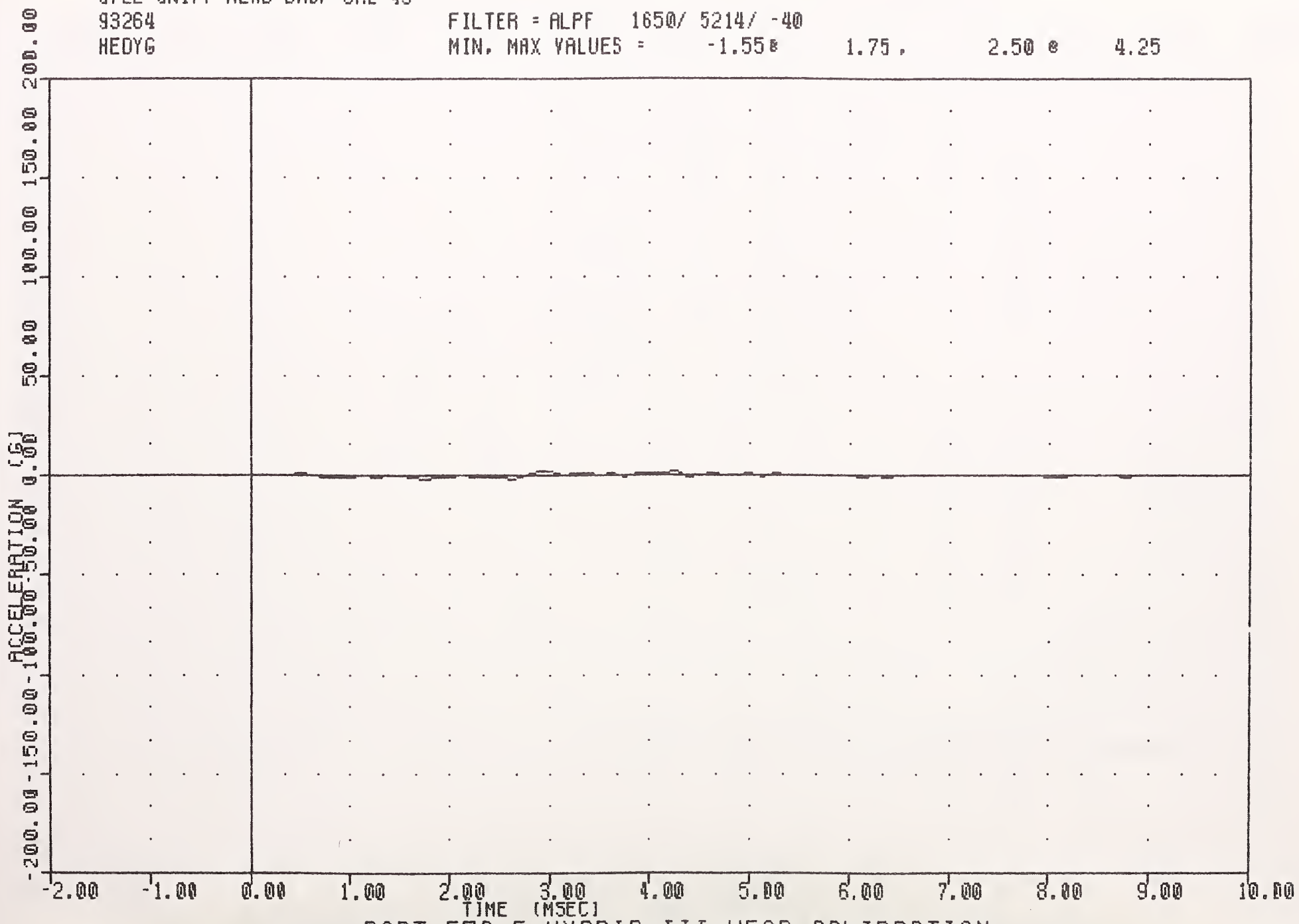
TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	20.6 DEG. C
RELATIVE HUMIDITY	10% - 70%	57.0 %
PEAK RESULTANT ACCELERATION	225 - 275 G	249.67 G
PEAK LATERAL ACCELERATION	15 G MAX	2.50 G
IS ACCELERATION CURVE UNIMODAL?	YES	YES

TEST MEETS SPECIFICATIONS

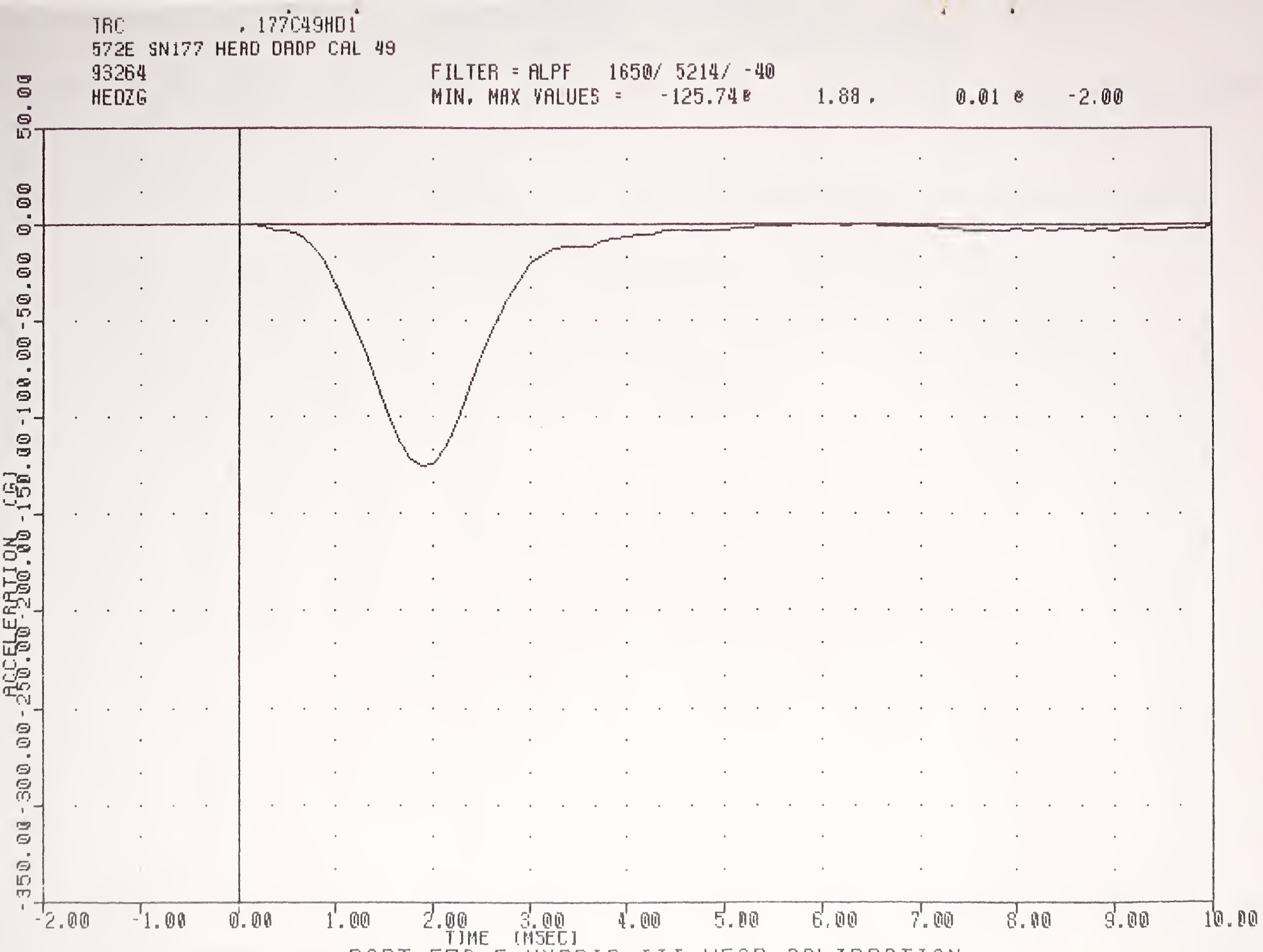
TECHNICIAN Peter Foust



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



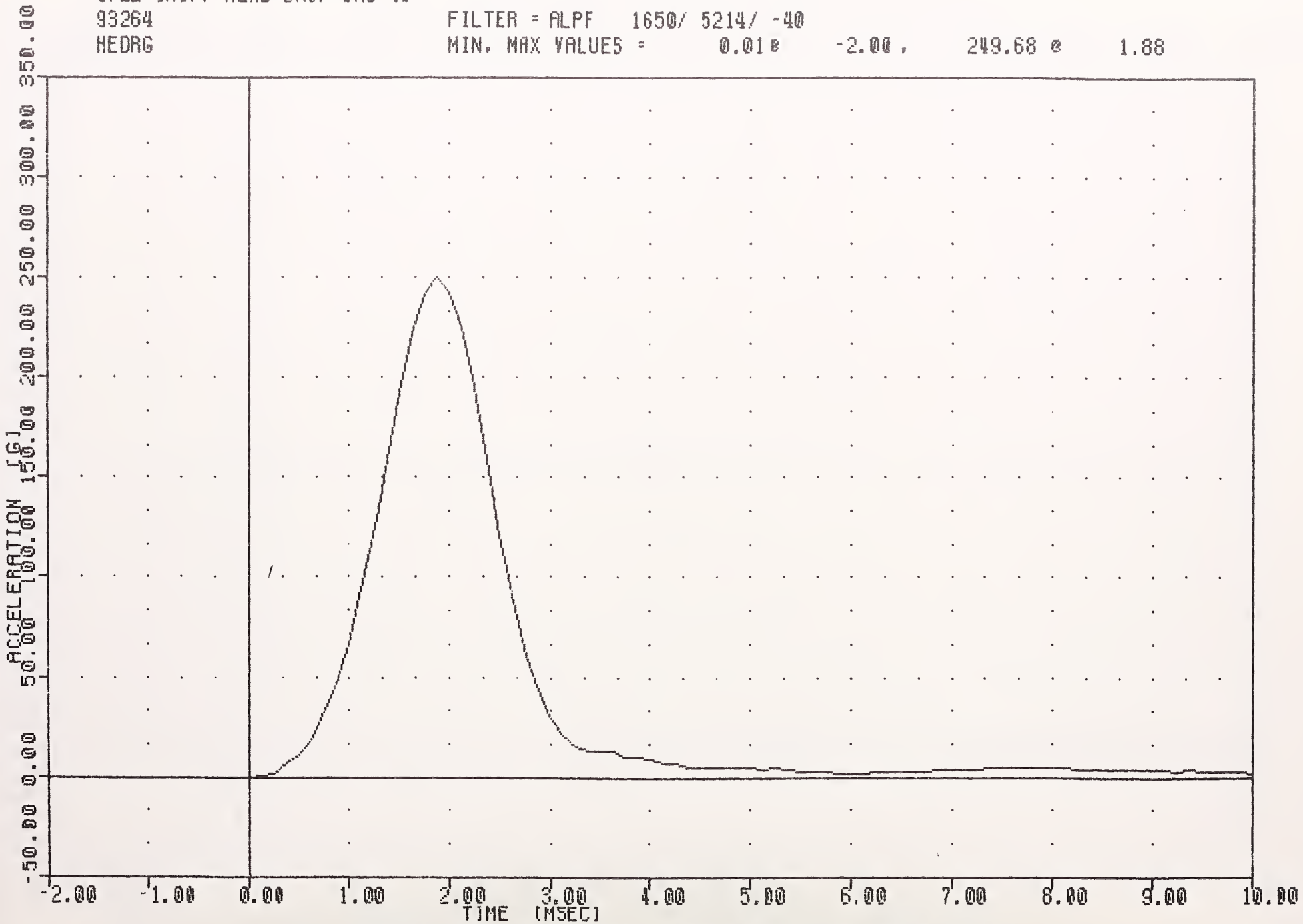
PART 572-E HYBRID III HEAD CALIBRATION
HEAD ACCELERATION Y AXIS



PART 572-E HYBRID III HEAD CALIBRATION

HEAD ACCELERATION Z AXIS

TRC , 177C49HD1
572E SN177 HEAD DROP CAL 49
93264 FILTER = ALPF 1650/ 5214/ -40
HEDRG MIN, MAX VALUES = 0.01 @ -2.00 , 249.68 @ 1.88



PART 572-E HYBRID III HEAD CALIBRATION
HEAD RESULTANT ACCELERATION

TRANSPORTATION RESEARCH CENTER INC.

NECK FLEXION TEST

HYBRID III 22-SEP-93

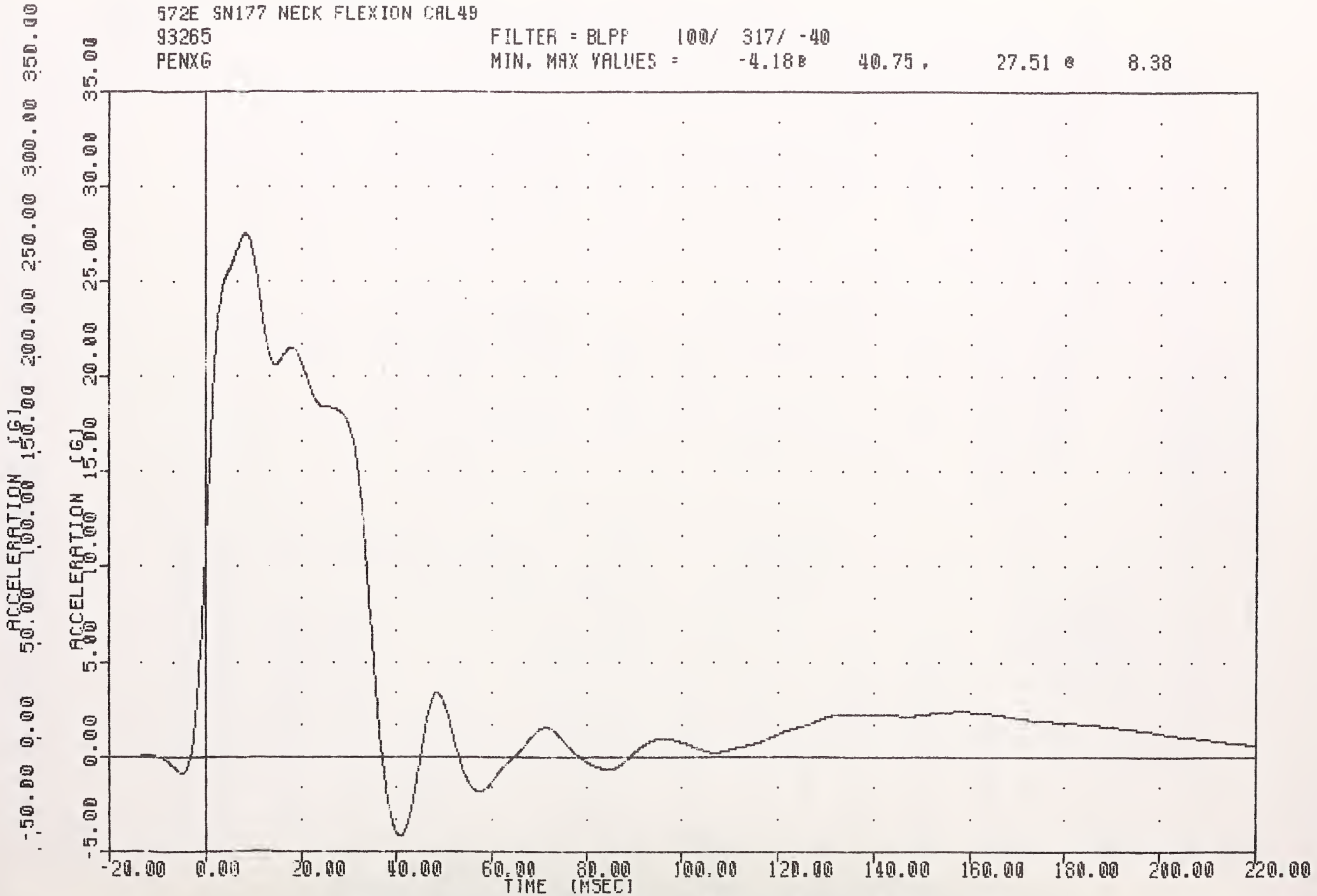
3 AXIS NECK TRANSDUCER
TRC 177C49NF1 572E SN177 NECK FLEXION CAL49

TEST PARAMETER		SPECIFICATION	TEST RESULTS
TEMPERATURE		20.6-22.2 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY		10% - 70%	55.0 %
IMPACT VELOCITY		6.89 - 7.13 M/SEC	7.07 M/SEC
PENDULUM DECELERATION	10 MS	22.50 - 27.50 G	26.36 G
	20 MS	17.60 - 22.60 G	20.77 G
	30 MS	12.50 - 18.50 G	17.46 G
MAX PENDULUM G		29 G MAX	27.51 G
MAX PENDULUM G ABOVE 30 MS		29 G MAX	17.37 G
DECELERATION-TIME CURVE DECAY TIME TO 5 G		34 - 42 MS	35.13 MS
D PLANE ROTATION	MAX	64 - 78 DEG.	72.20 DEG.
	TIME	57 - 64 MS	58.25 MS
MOMENT ABOUT OCCIPITAL CONDYLE	MAX	88.2 - 108.5 NM	89.43 NM
	TIME	47 - 58 MS	48.25 MS
ROTATION ANGLE-TIME CURVE DECAY TIME TO ZERO		113 - 128 MS	118.50 MS
POSITIVE MOMENT-TIME CURVE DECAY TIME TO ZERO		97 - 107 MS	99.63 MS

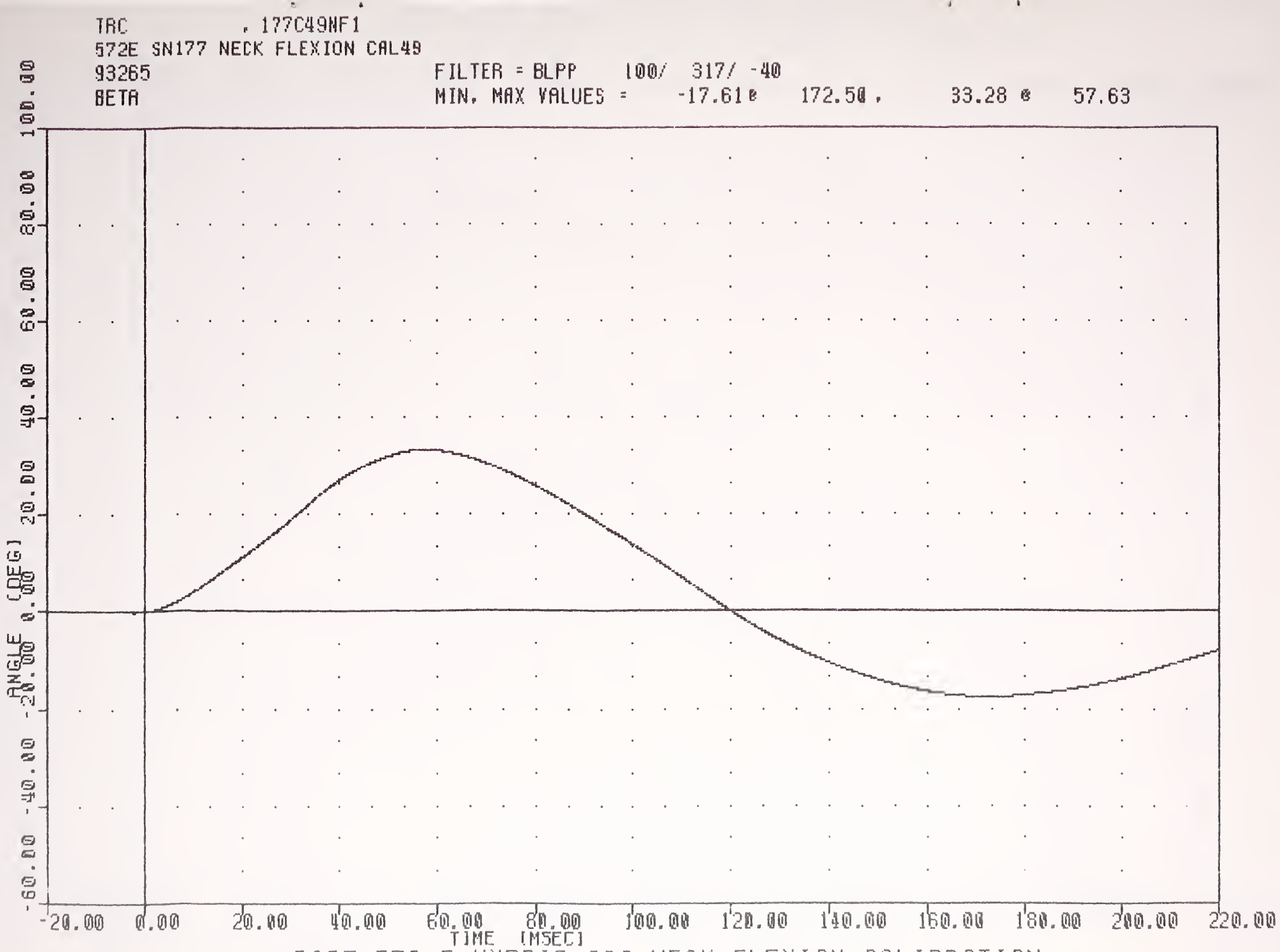
TEST MEETS SPECIFICATIONS

TECHNICIAN Peter Foust

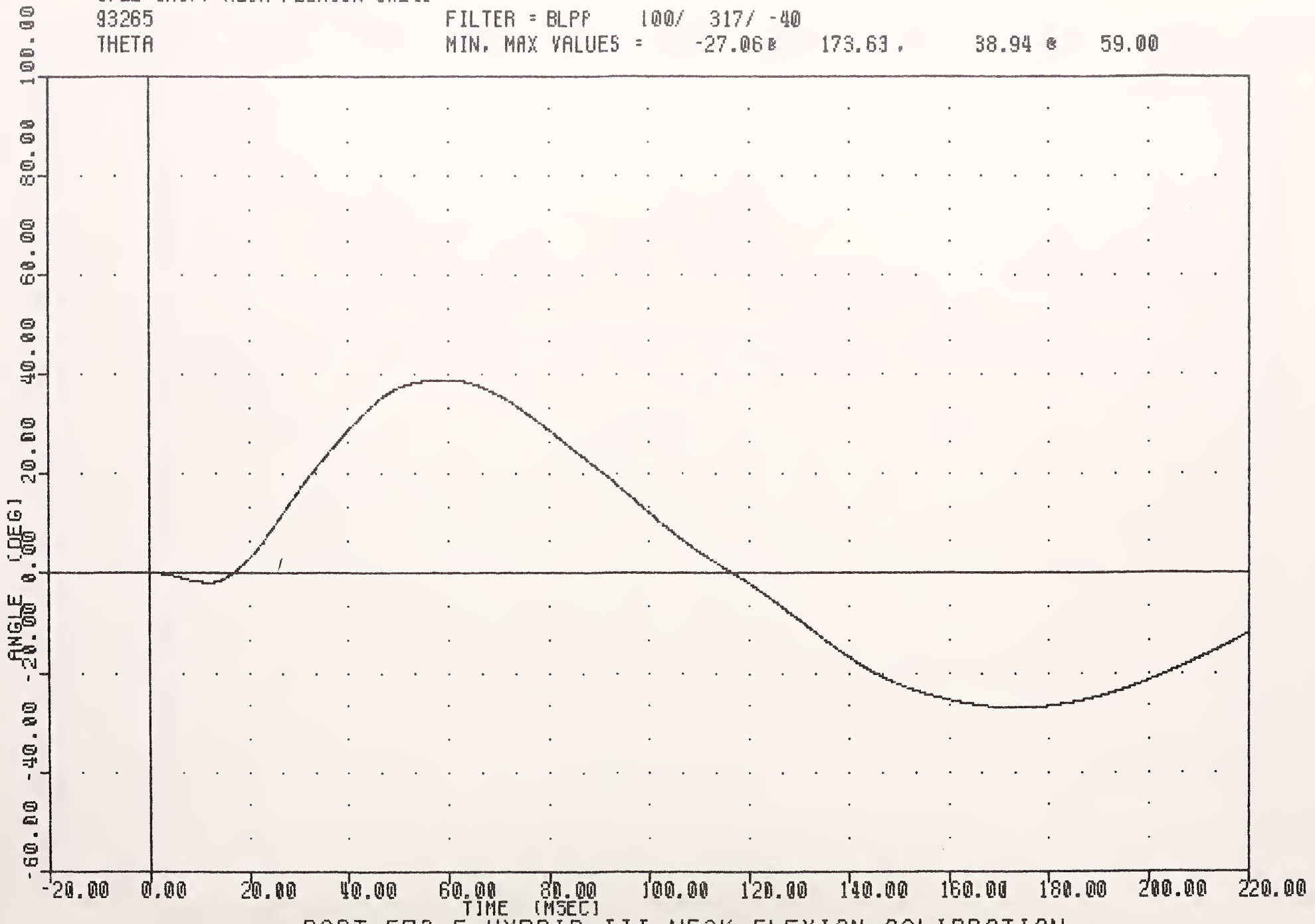
TRC . 177C49NF1
572E SN177 NECK FLEXION CAL49
93265 FILTER = BLPF 100/ 317/ -40
PENXG MIN, MAX VALUES = -4.18 @ 40.75 , 27.51 @ 8.38



PART 572-E HYBRID III NECK FLEXION CALIBRATION
PENDULUM DECELERATION

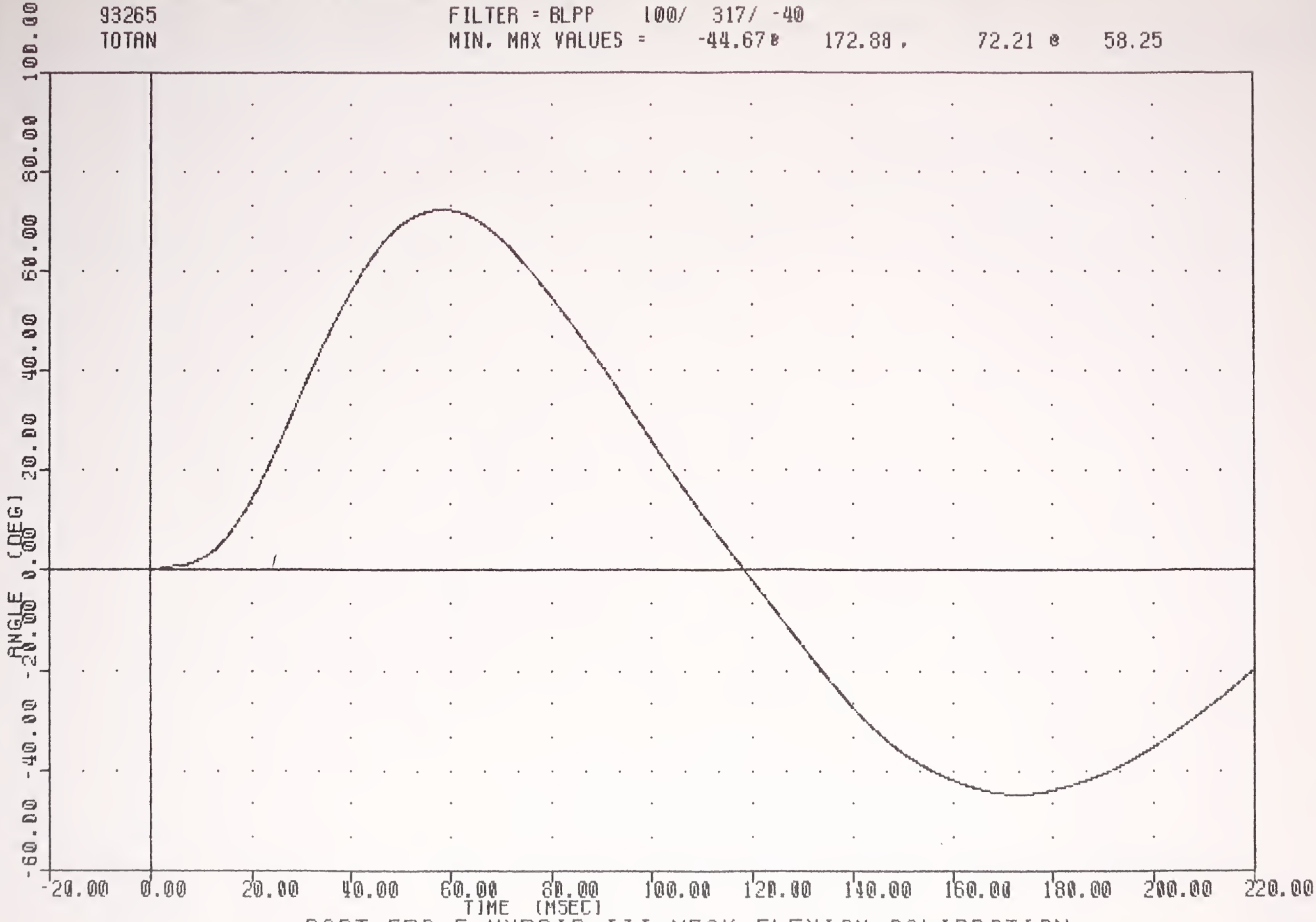


PART 572-E HYBRID III NECK FLEXION CALIBRATION
ROTATION ABOUT BASE OF NECK



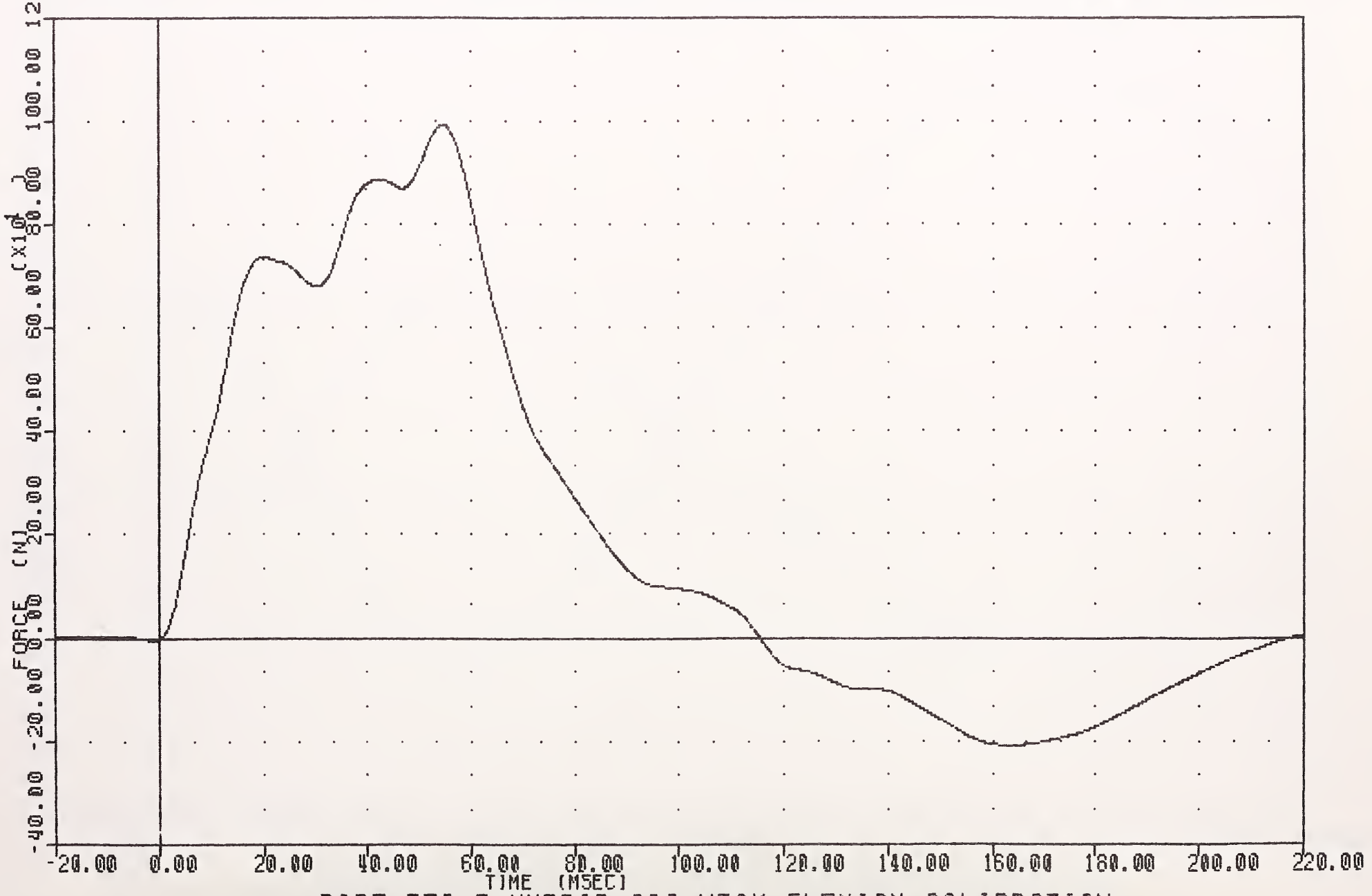
PART 572-E HYBRID III NECK FLEXION CALIBRATION

ROTATION ABOUT OCCIPITAL CONDYLE

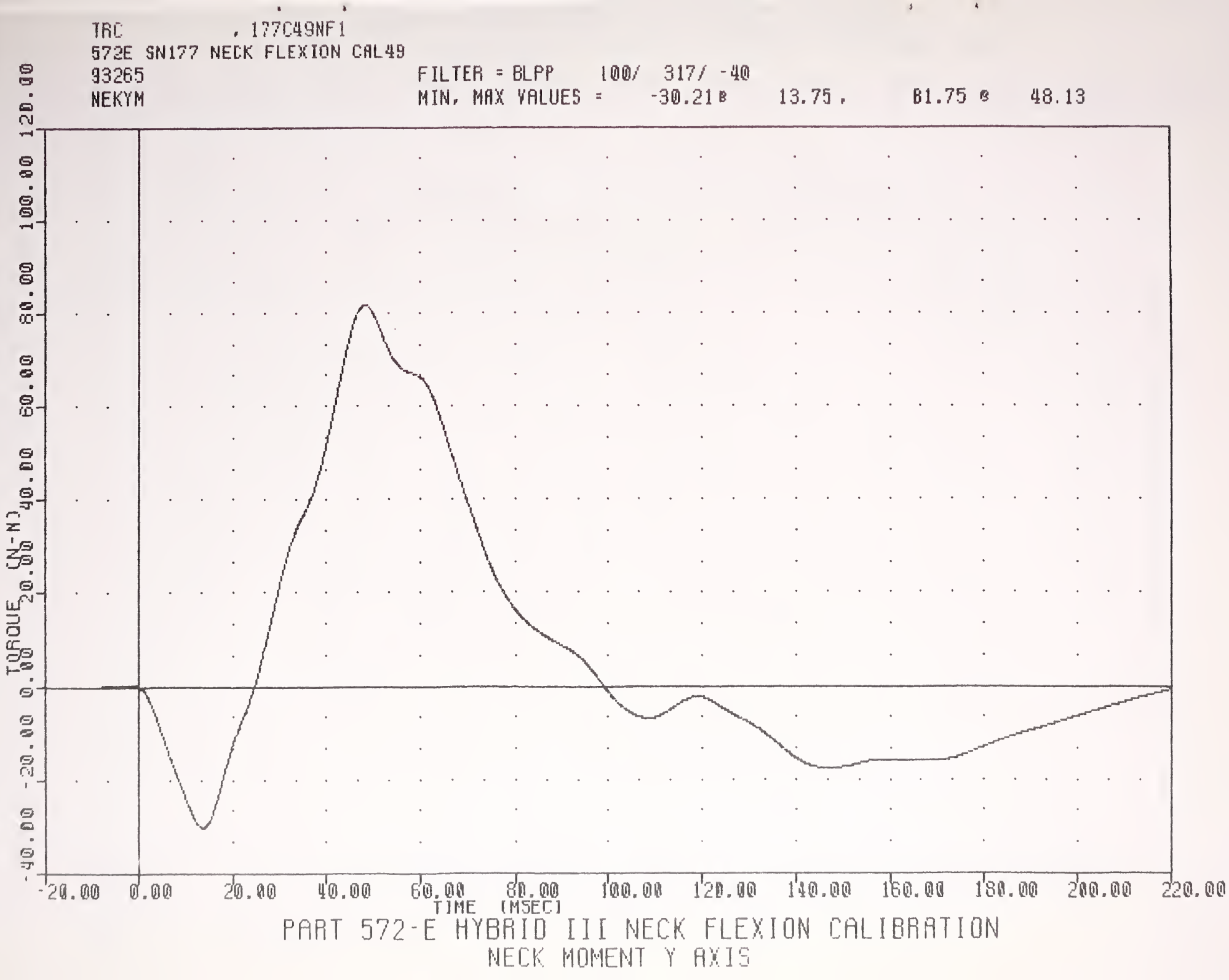


PART 572-E HYBRID III NECK FLEXION CALIBRATION
TOTAL ROTATION

TRC , 177C49NF1
572E SN177 NECK FLEXION CAL49
93265 FILTER = BLPP 100/ 317/ -40
NEKXF MIN, MAX VALUES = -208.33 @ 163.75 , 991.10 @ 54.63



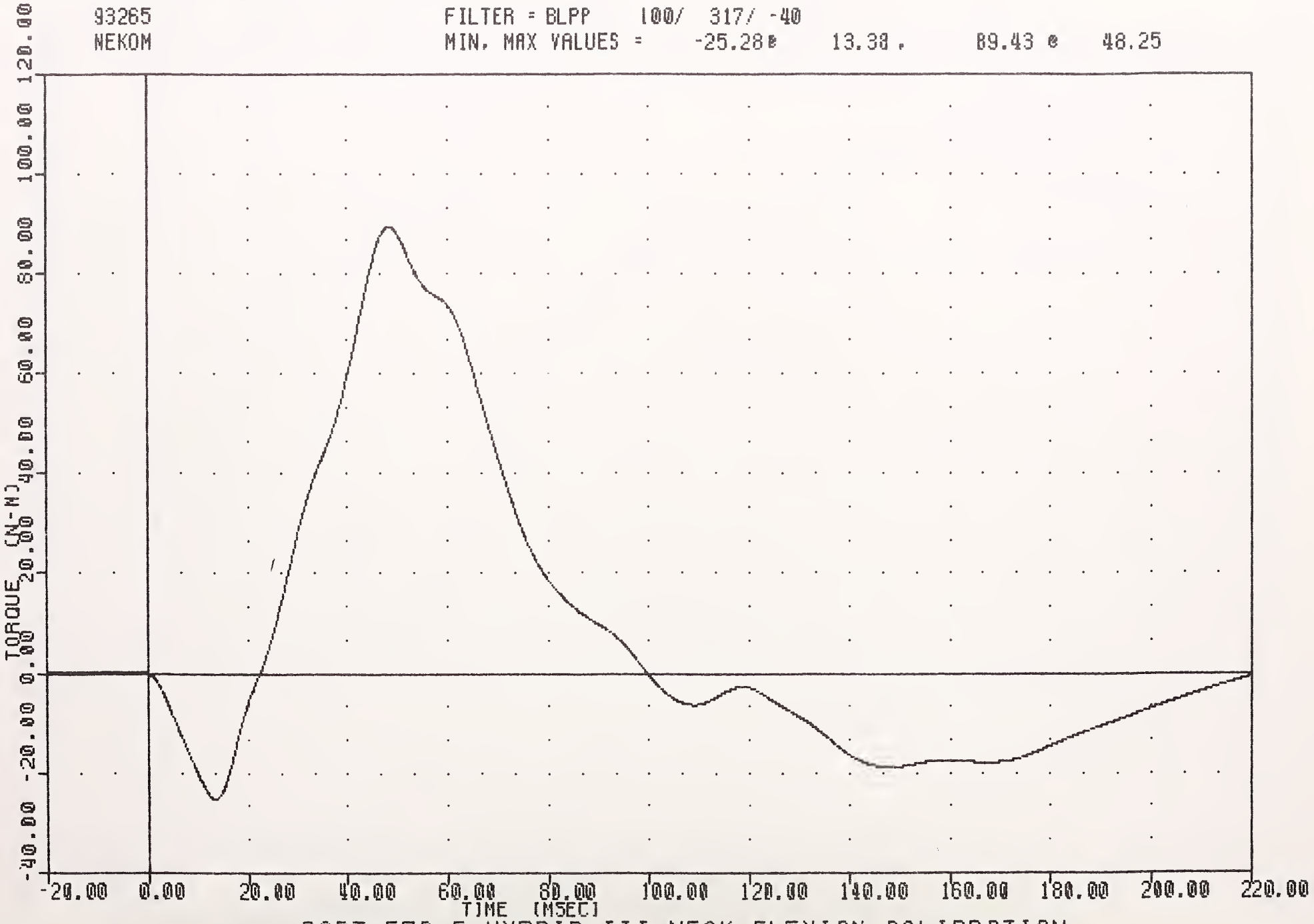
PART 572-E HYBRID III NECK FLEXION CALIBRATION
NECK FORCE X AXIS



PART 572-E HYBRID III NECK FLEXION CALIBRATION

NECK MOMENT Y AXIS

TRC , 177C49NF1
572E SN177 NECK FLEXION CAL49
93265 FILTER = BLPP 100/ 317/ -40
NEKOM MIN, MAX VALUES = -25.28 @ 13.38 , 89.43 @ 48.25



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

TRANSPORTATION RESEARCH CENTER INC.

NECK EXTENSION TEST

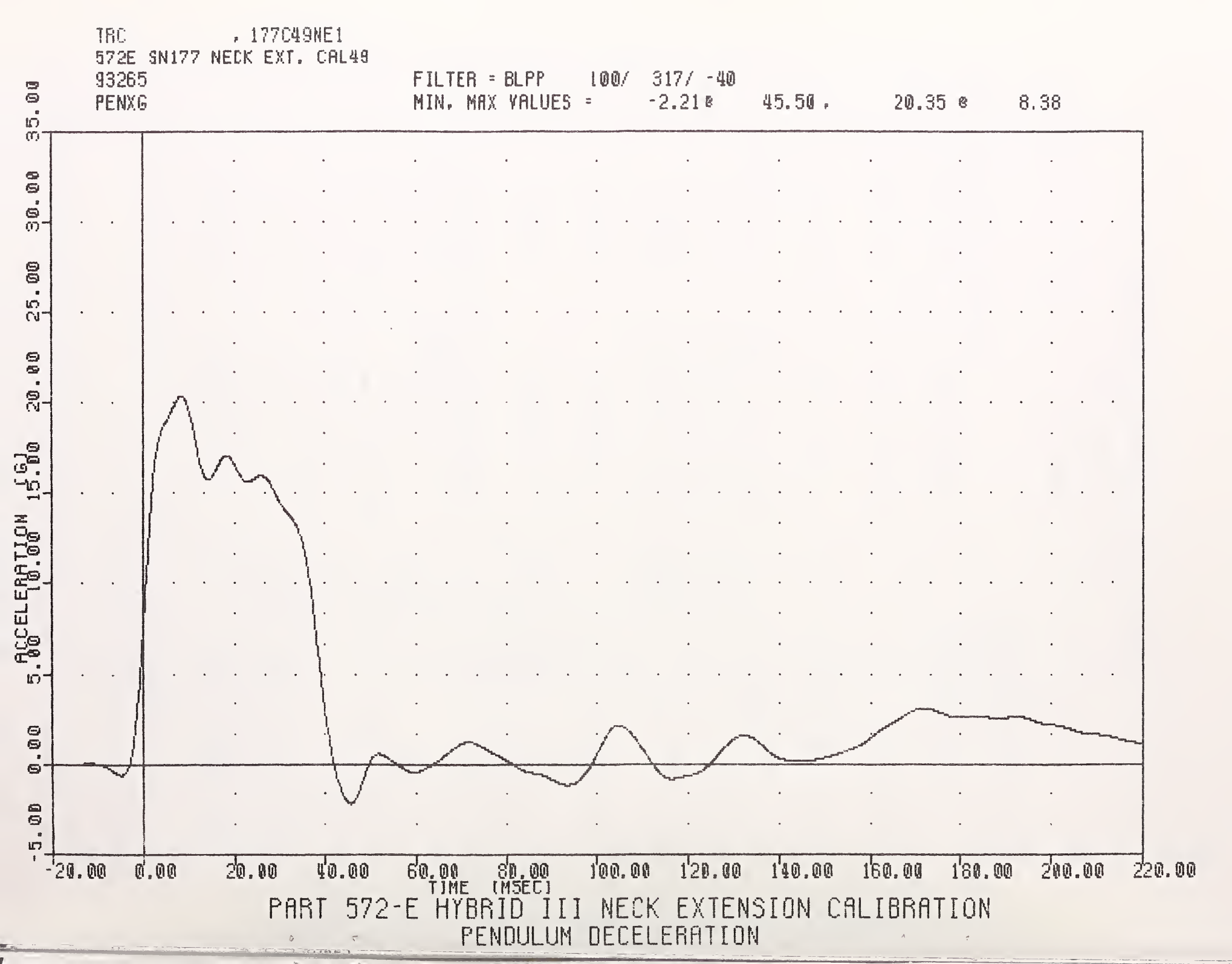
HYBRID III 22-SEP-93

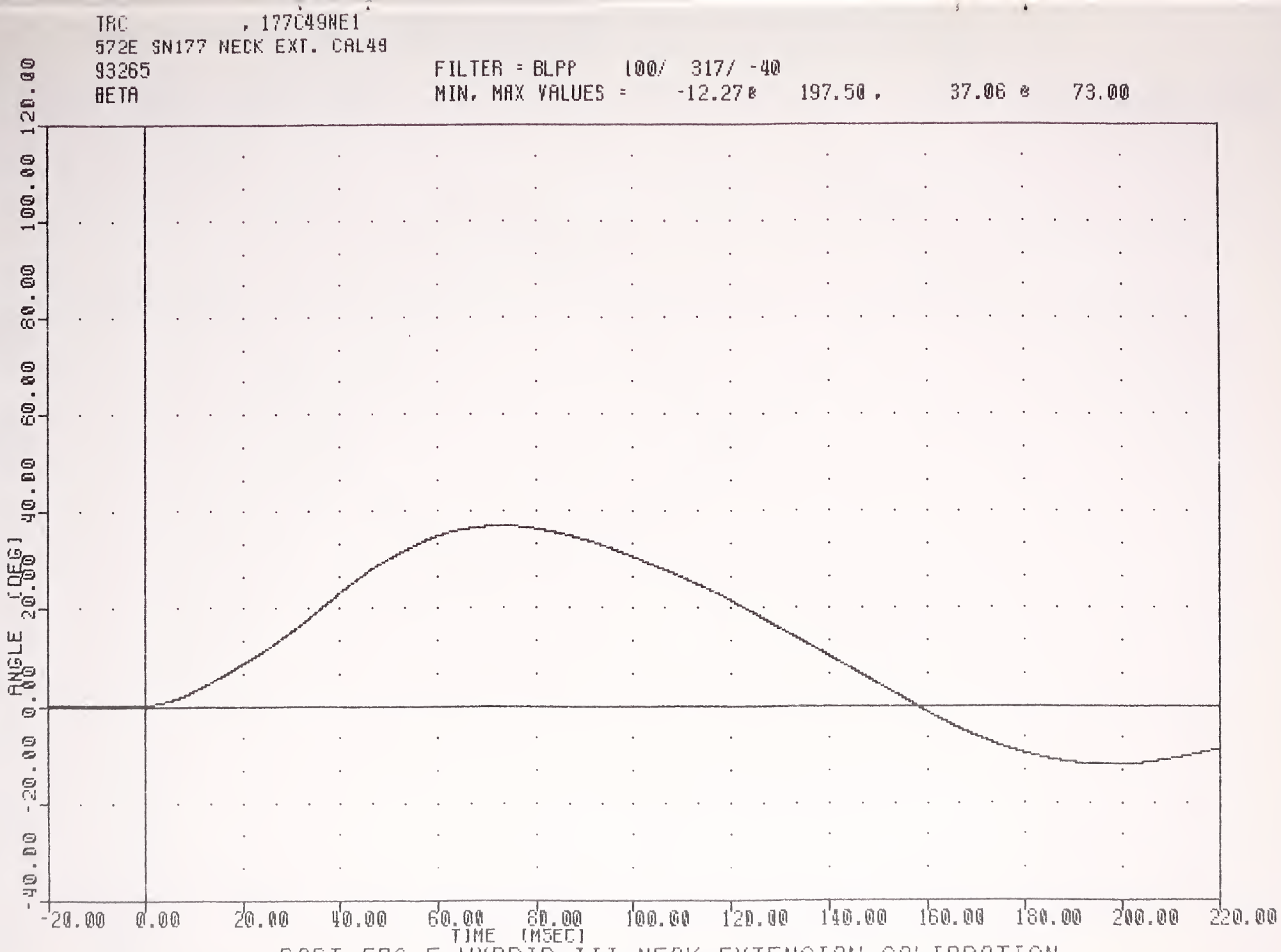
3 AXIS NECK TRANSDUCER
TRC 177C49NE1 572E SN177 NECK EXT. CAL49

TEST PARAMETER		SPECIFICATION	TEST RESULTS
TEMPERATURE		20.6-22.2 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY		10% - 70%	55.0 %
IMPACT VELOCITY		5.95 - 6.19 M/SEC	6.02 M/SEC
PENDULUM DECELERATION	10 MS	17.20 - 21.20 G	19.61 G
	20 MS	14.00 - 19.00 G	16.59 G
	30 MS	11.00 - 16.00 G	14.54 G
MAX PENDULUM G		22 G MAX	20.35 G
MAX PENDULUM G ABOVE 30 MS		22 G MAX	14.48 G
DECELERATION-TIME CURVE DECAY TIME TO 5 G		38 - 46 MS	38.88 MS
D PLANE ROTATION	MAX	81 - 106 DEG.	93.63 DEG.
	TIME	72 - 82 MS	74.25 MS
MOMENT ABOUT OCCIPITAL CONDYLE	MIN	-80.0/-52.9 NM	-60.19 NM
	TIME	65 - 79 MS	69.38 MS
ROTATION ANGLE-TIME CURVE DECAY TIME TO ZERO		147 - 174 MS	156.75 MS
NEGATIVE MOMENT-TIME CURVE DECAY TIME TO ZERO		120 - 148 MS	137.75 MS

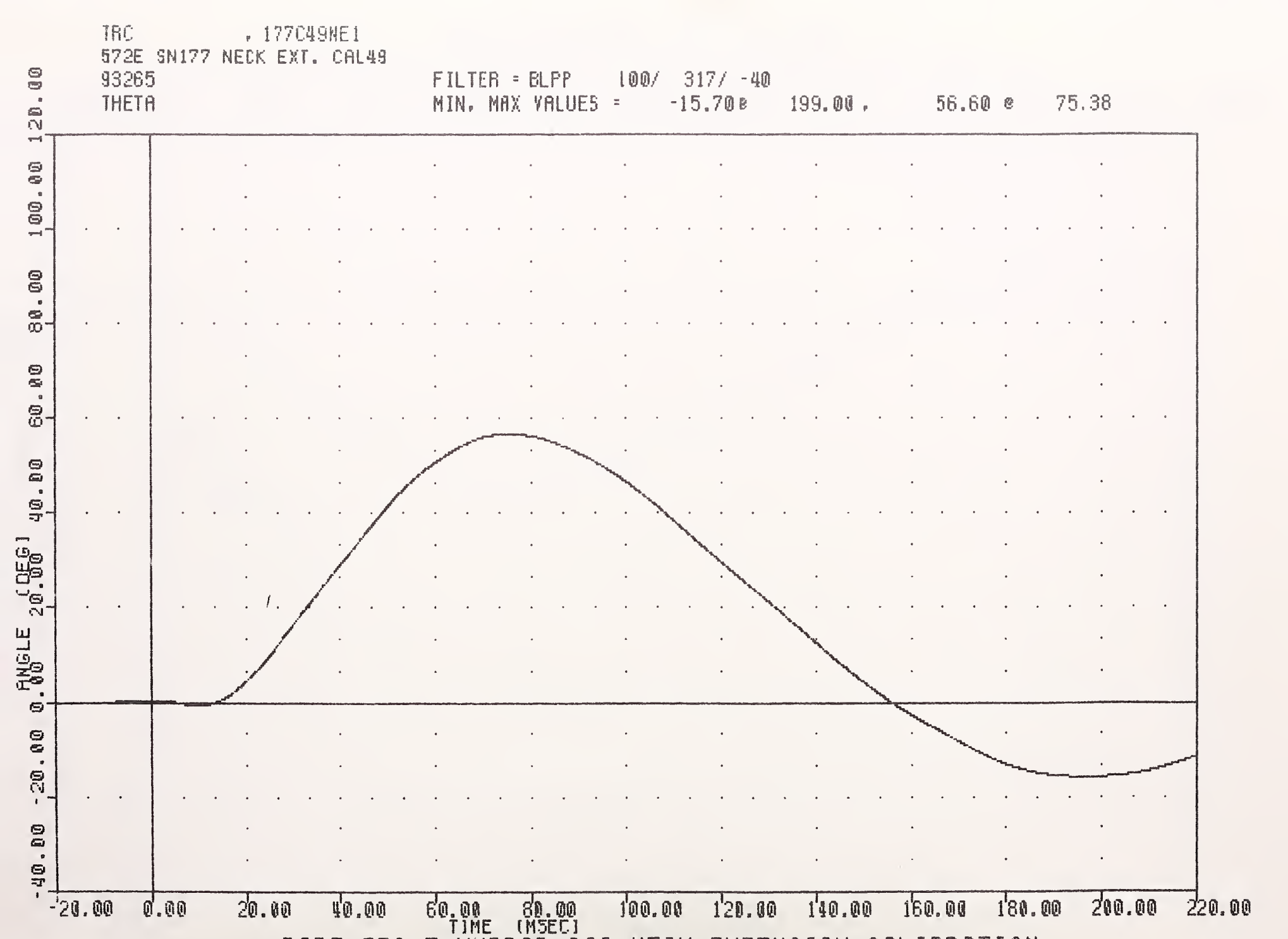
TEST MEETS SPECIFICATIONS

TECHNICIAN Peter Foust

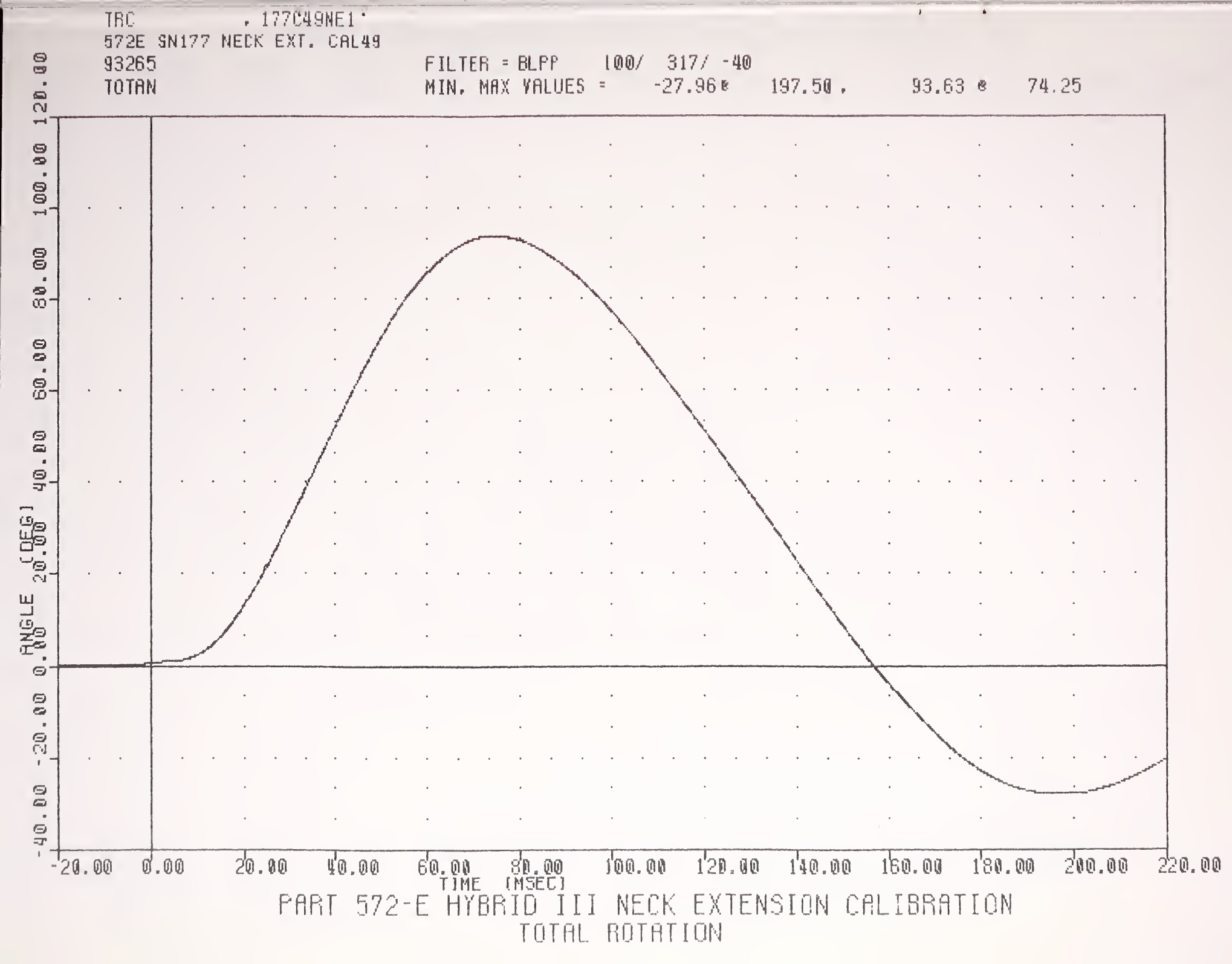

TRC , 177C49NE1
572E SN177 NECK EXT. CAL49
93265
PENXG
FILTER = BLPP 100/ 317/ -40
MIN, MAX VALUES = -2.21 @ 45.50 , 20.35 @ 8.38
ACCELERATION (G)
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
TIME (MSEC)
PART 572-E HYBRID III NECK EXTENSION CALIBRATION
PENDULUM DECELERATION



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

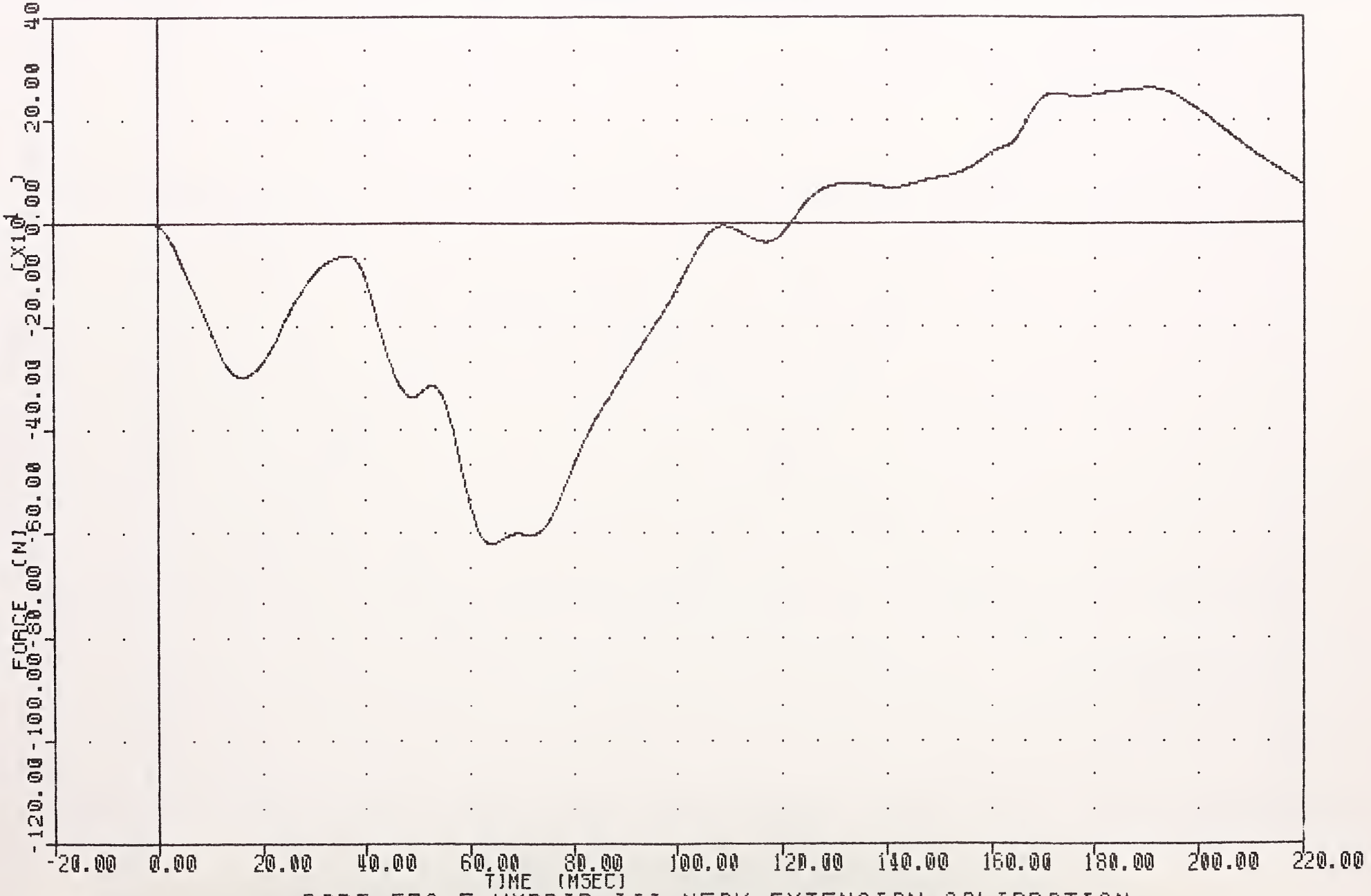


PART 572-E HYBRID III NECK EXTENSION CALIBRATION
ROTATION ABOUT OCCIPITAL CONDYLE

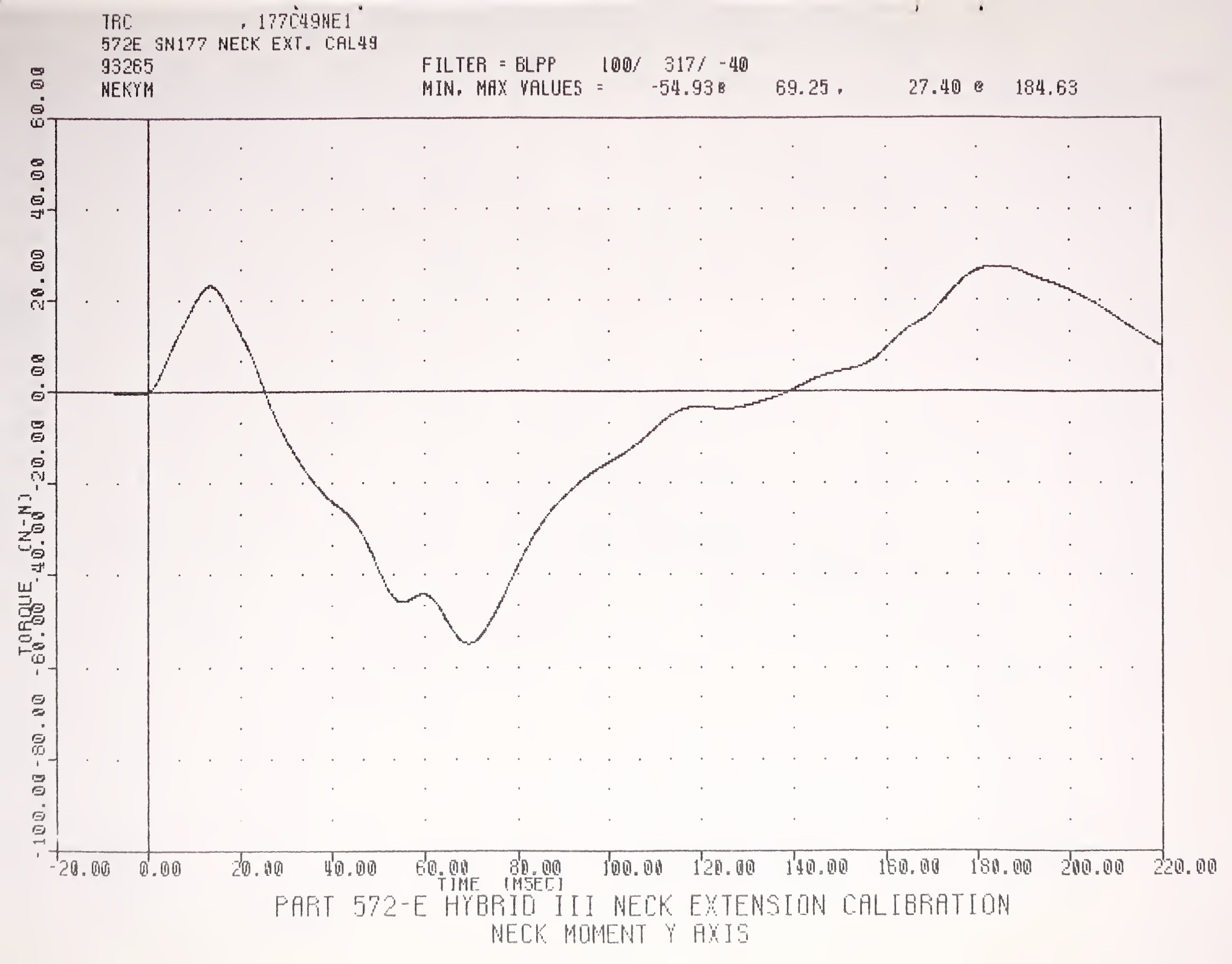

TRC . 177C49NE1'
572E SN177 NECK EXT. CAL49
93265
TOTAN
FILTER = BLPP 100/ 317/ -40
MIN. MAX VALUES = -27.96 @ 197.50 , 93.63 @ 74.25
120.00
100.00
80.00
60.00
40.00
20.00
0.00
-20.00
-40.00
ANGLE (DEG)
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
TIME (MSEC)
PART 572-E HYBRID III NECK EXTENSION CALIBRATION
TOTAL ROTATION

TRC , 177C49NE1
572E SN177 NECK EXT. CAL49
93265
NEKXF

FILTER = BLPF 100/ 317/ -40
MIN, MAX VALUES = -620.44 @ 64.00 , 261.20 @ 190.63

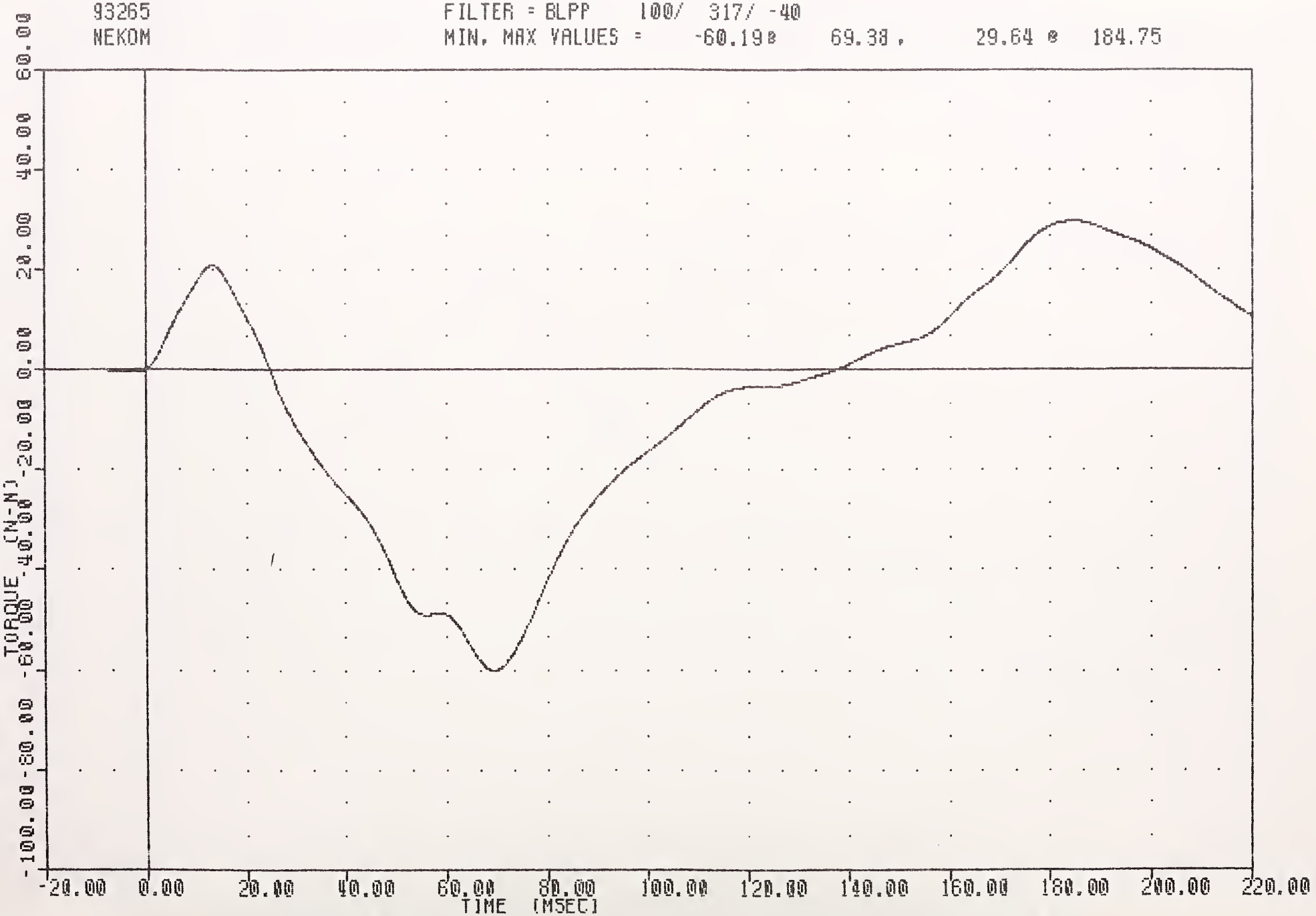


PART 572-E HYBRID III NECK EXTENSION CALIBRATION
NECK FORCE X AXIS



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

TRC , 177C49NE1
572E SN177 NECK EXT. CAL49
93265 FILTER = BLPP 100/ 317/ -40
NEKOM MIN, MAX VALUES = -60.19 @ 69.38 , 29.64 @ 184.75



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

TRANSPORTATION RESEARCH CENTER INC.

THORAX IMPACT TEST

HYBRID III 22-SEP-93

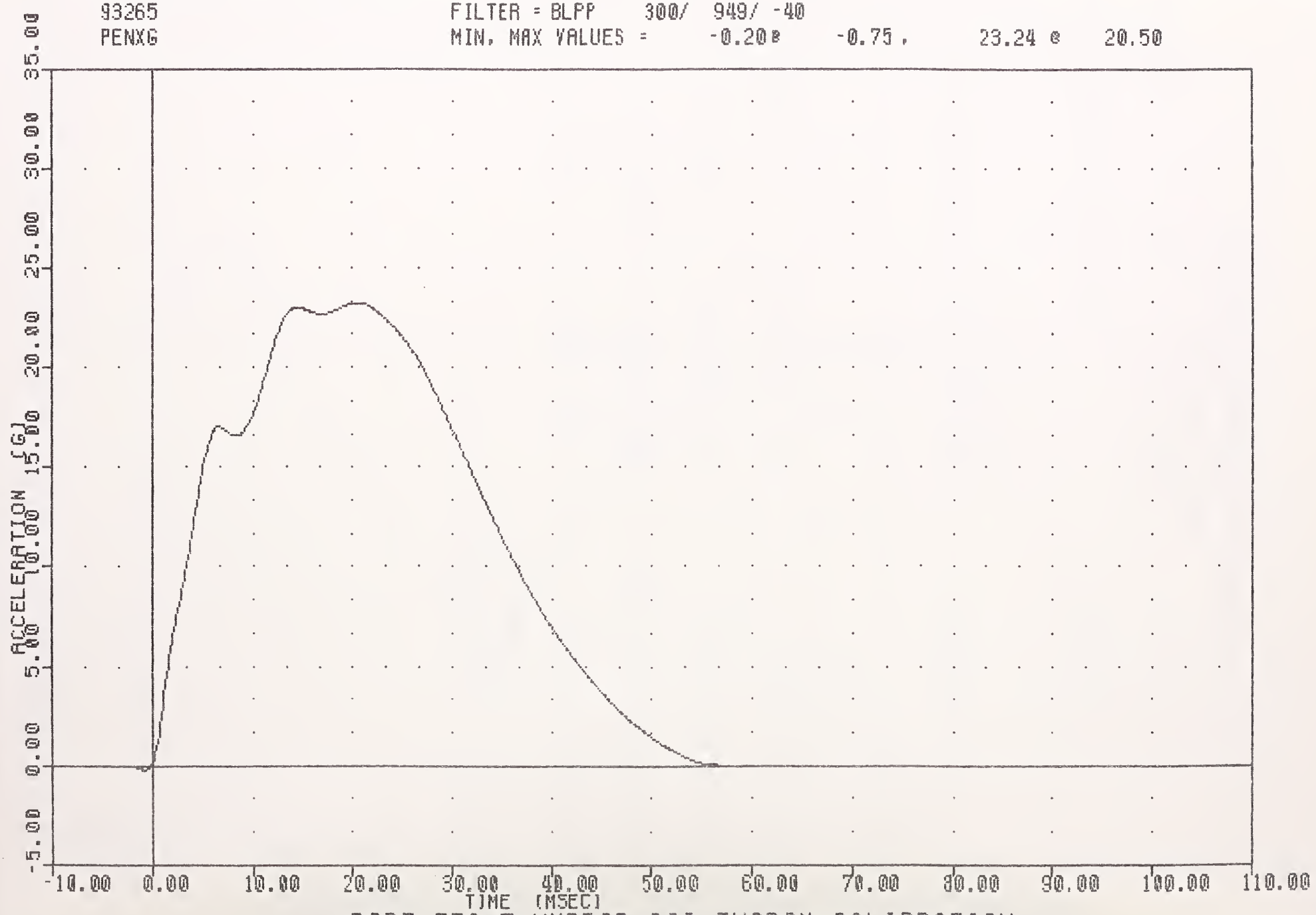
TRC 177C49TH1 572E SN177 H.S.THORAX CAL49

TEST PARAMETER	HIGH SPEED TEST SPECIFICATION	TEST RESULTS
TEMPERATURE	20.6-22.2 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10% - 70%	55.0 %
PENDULUM VELOCITY	6.59 - 6.83 M/SEC	6.68 M/SEC
MAXIMUM DEFLECTION	63.5 - 72.6 MM	65.1 MM
MAXIMUM RESISTIVE FORCE	5159 - 5894 N	5324. N
INTERNAL HYSTERESIS	69% - 85%	73.9%

TEST MEETS SPECIFICATIONS

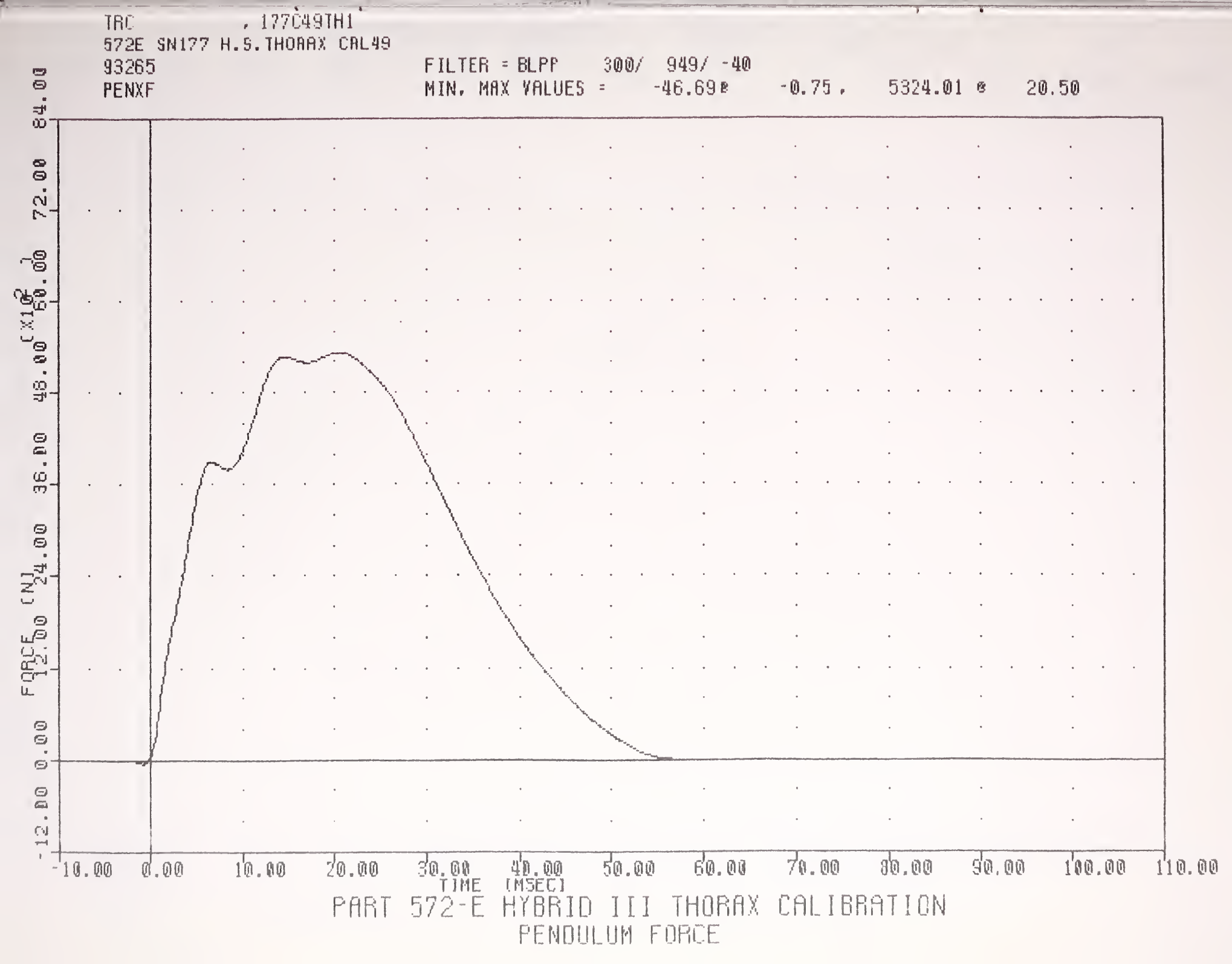
TECHNICIAN Pete Foss

TRC , 177C49TH1
572E SN177 H.S.THORAX CAL49
93265 FILTER = BLPP 300/ 949/ -40
PENXG MIN, MAX VALUES = -0.20 @ -0.75 , 23.24 @ 20.50

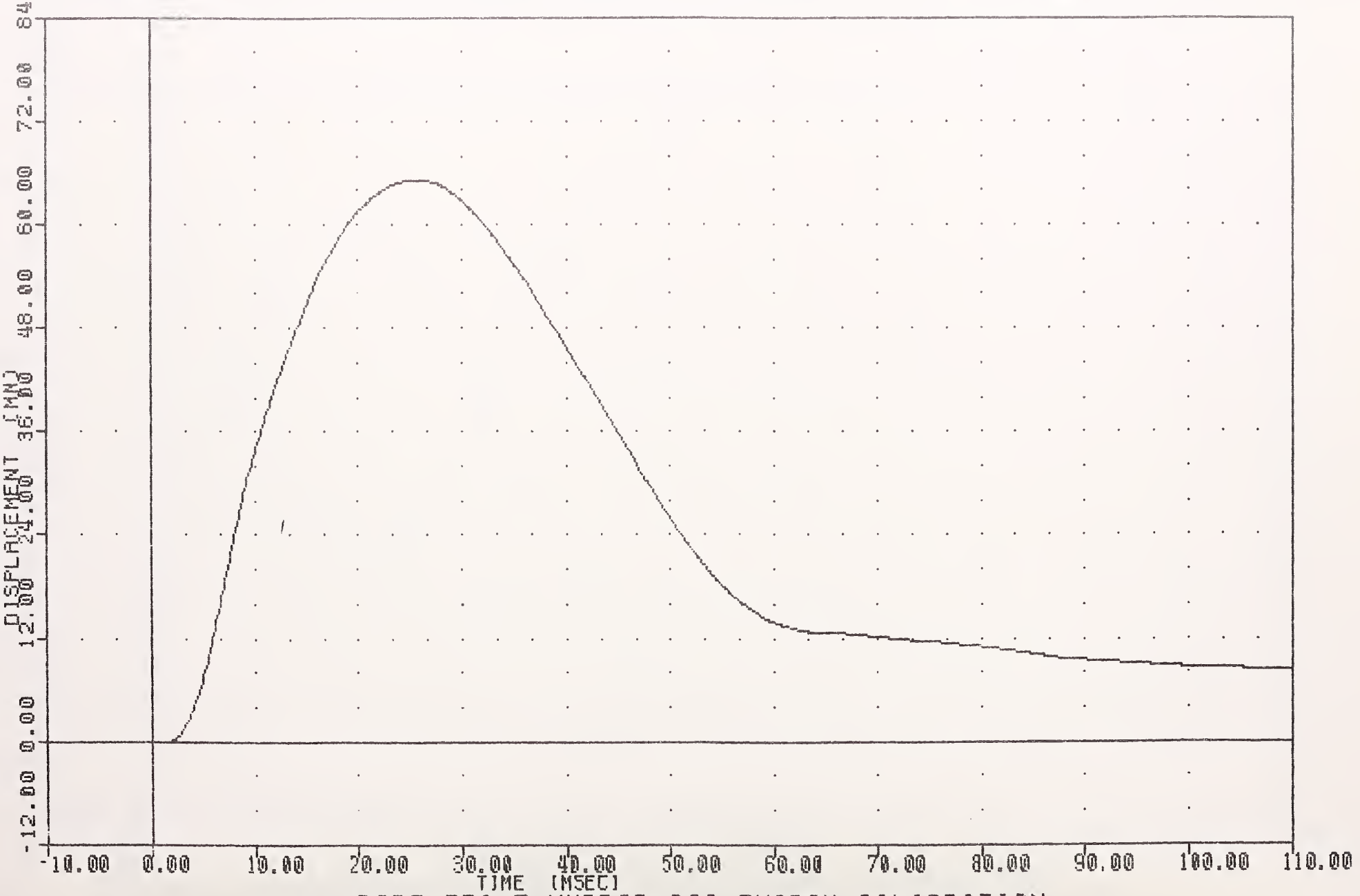


PART 572-E HYBRID III THORAX CALIBRATION
PENDULUM DECELERATION

TRC , 177C49TH1

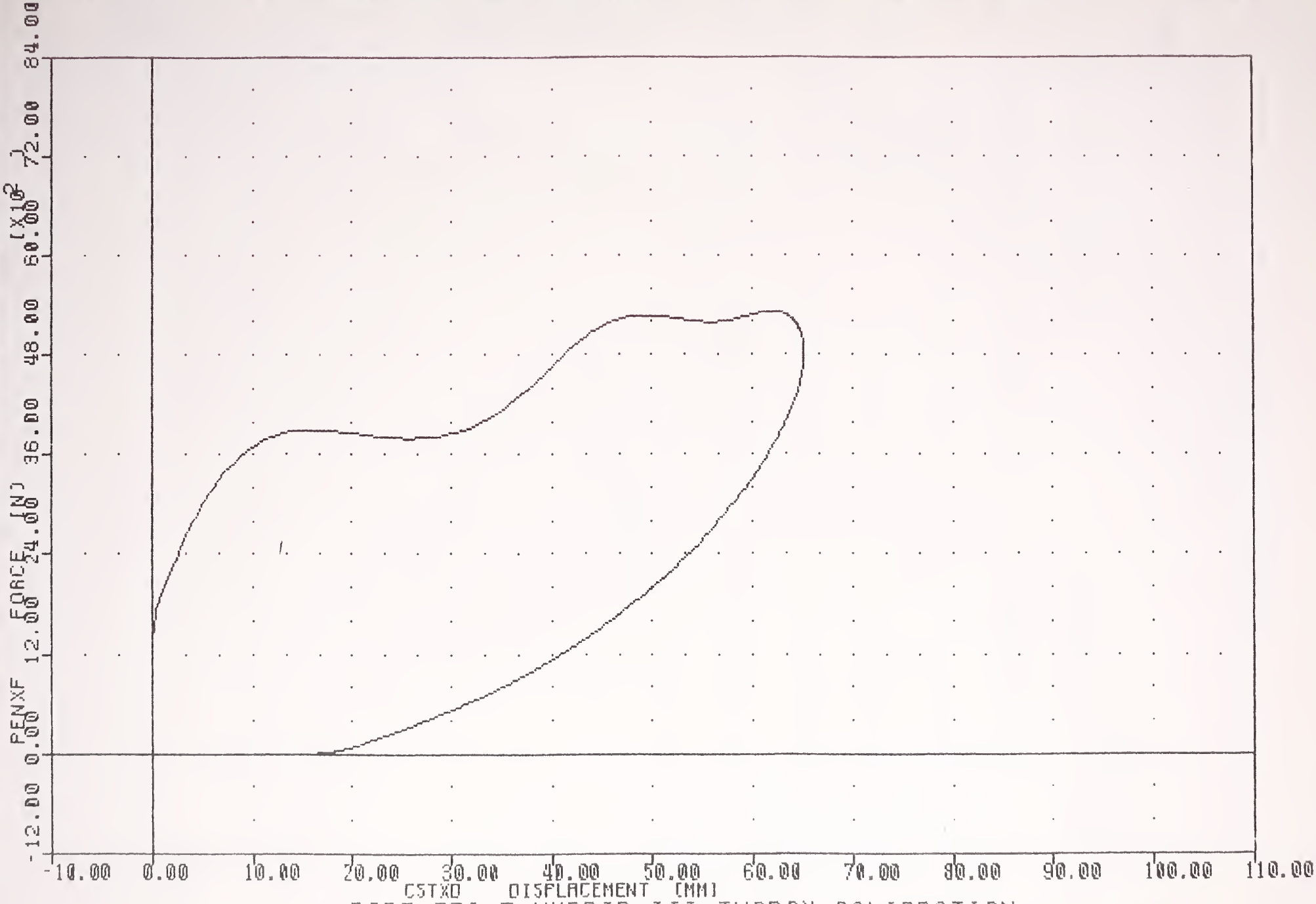

TRC , 177C49TH1
572E SN177 H.S.THORAX CAL49
93265
PENXF
FILTER = BLPP 300/ 949/ -40
MIN, MAX VALUES = -46.69 @ -0.75 , 5324.01 @ 20.50
FORCE (N) (X10^2)
84.00
72.00
60.00
48.00
36.00
24.00
12.00
0.00
-12.00
-10.00
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.00
110.00
TIME (MSEC)
PART 572-E HYBRID III THORAX CALIBRATION
PENDULUM FORCE

TRC , 177C49TH1
572E SN177 H.S.THORAX CAL49
93265 FILTER = BLPF 300/ 949/ -40
CSTXD MIN, MAX VALUES = -0.08 @ 1.13 , 65.14 @ 25.50



PART 572-E HYBRID III THORAX CALIBRATION
STERNUM DISPLACEMENT

TRC	,177C49TH1	572E SN177 H.S.THORAX CAL49		93265			
CSTXD	FILTER = BLPP	300/ 949/ -40	MIN, MAX =	-0.08 @	1.13 ,	65.14 @	25.50
PENXF	FILTER = BLPP	300/ 949/ -40	MIN, MAX =	-46.69 @	-0.75 ,	5324.01 @	20.50



PART 572-E HYBRID III THORAX CALIBRATION

CHEST DISPLACEMENT VS PENDULUM FORCE

TRANSPORTATION RESEARCH CENTER INC.

KNEE IMPACT TEST

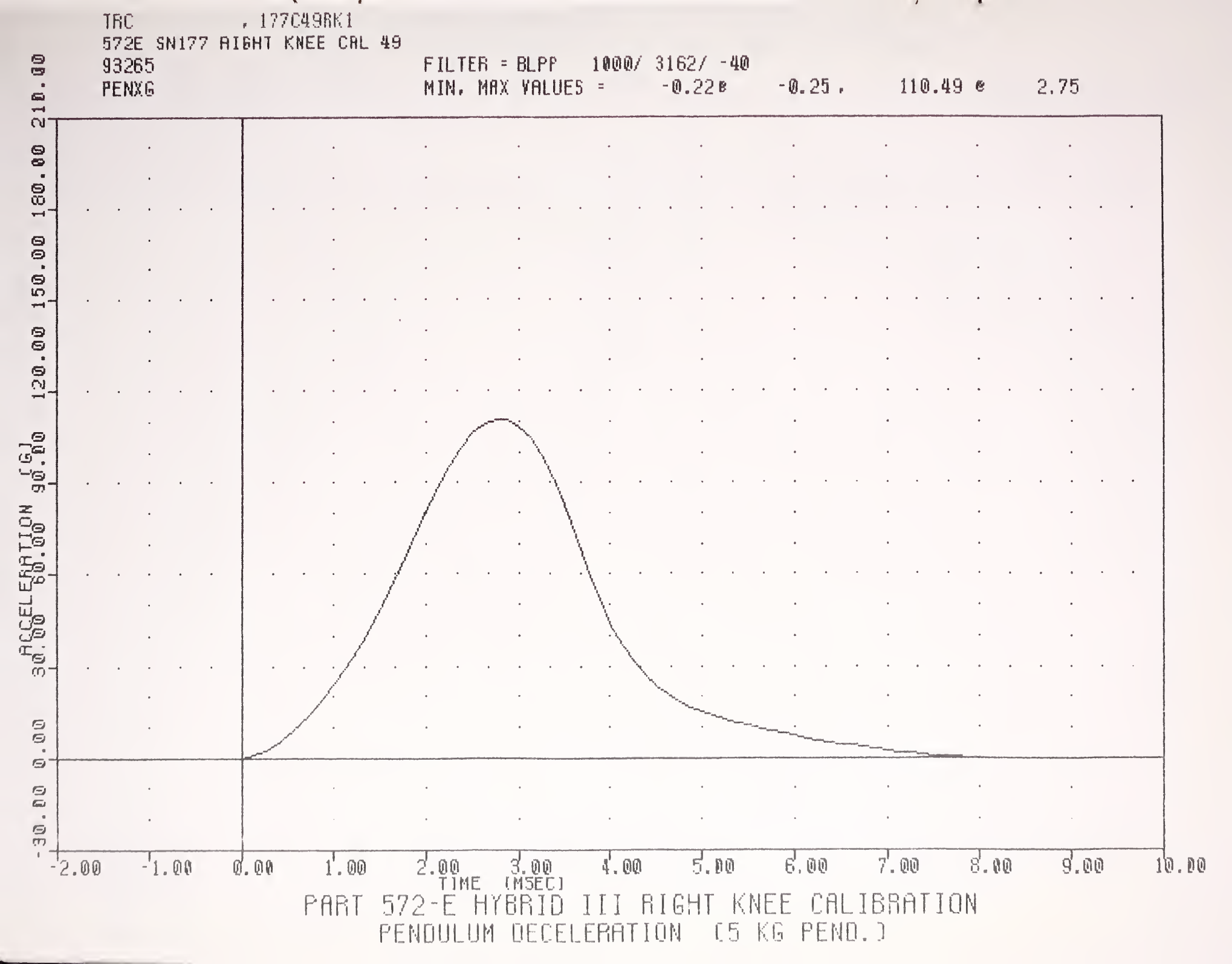
HYBRID III 22-SEP-93

RIGHT KNEE
TRC 177C49RK1 572E SN177 RIGHT KNEE CAL 49

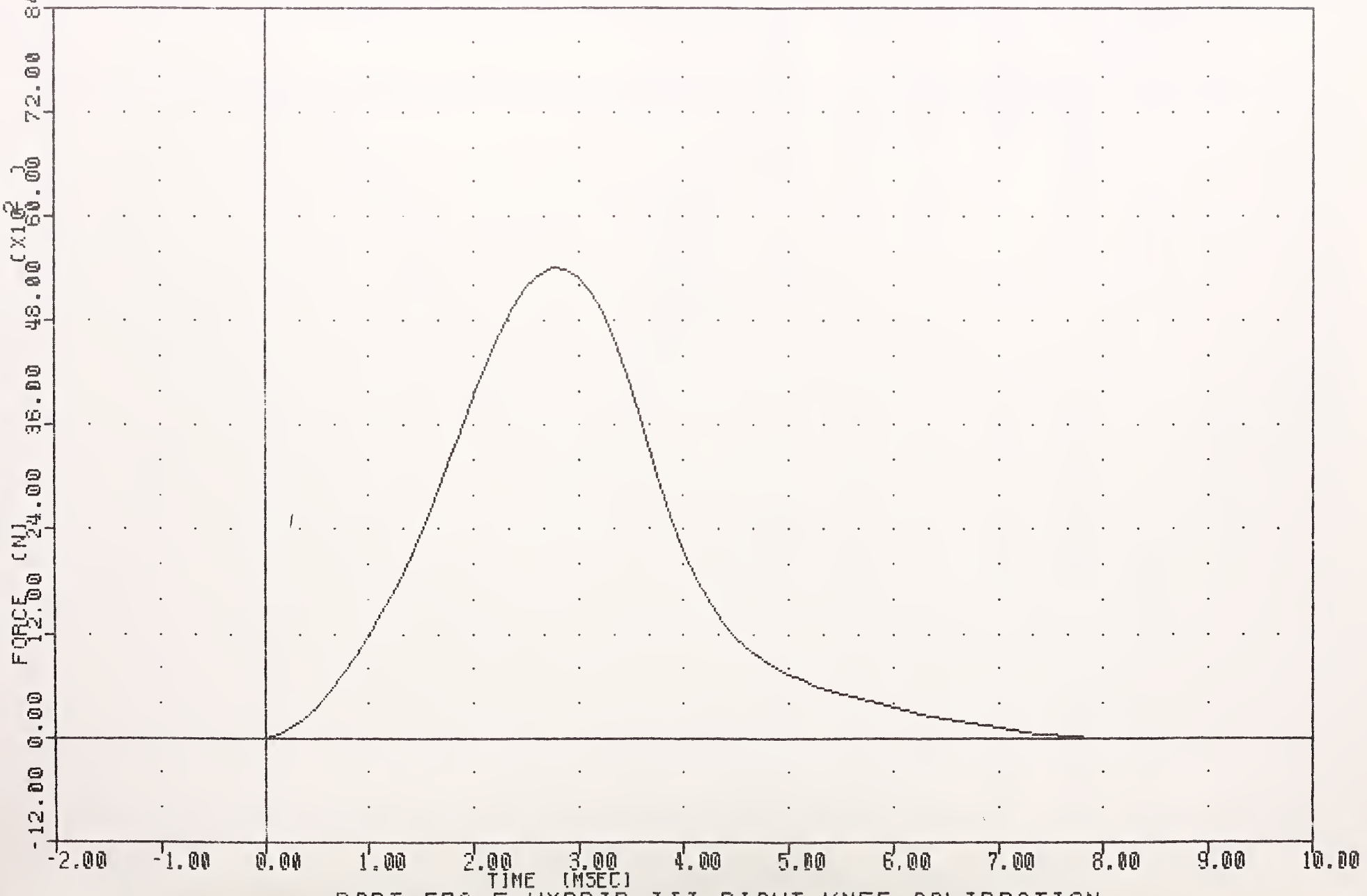
TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10% - 70%	54.0 %
PROBE VELOCITY	2.07 - 2.13 M/SEC	2.09 M/SEC
PEAK KNEE IMPACT FORCE	4714 - 5783 N	5406.2 N
PROBE WEIGHT	5.0 KG	

TEST MEETS SPECIFICATIONS

TECHNICIAN Peter Foust


TRC , 177C49RK1
572E SN177 RIGHT KNEE CAL 49
93265
PENXG
FILTER = BLPF 1000/ 3162/ -40
MIN, MAX VALUES = -0.22 @ -0.25 , 110.49 @ 2.75
ACCELERATION [G]
210.00
180.00
150.00
120.00
90.00
60.00
30.00
0.00
-30.00
-2.00
-1.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
TIME (MSEC)
PART 572-E HYBRID III RIGHT KNEE CALIBRATION
PENDULUM DECELERATION (5 KG PEND.)

TRC , 177C49RK1
572E SN177 RIGHT KNEE CAL 49
93265 FILTER = BLPP 1000/ 3162/ -40
PENXF MIN, MAX VALUES = -10.64 @ -0.25 , 5406.21 @ 2.75



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

TRANSPORTATION RESEARCH CENTER INC.

KNEE IMPACT TEST

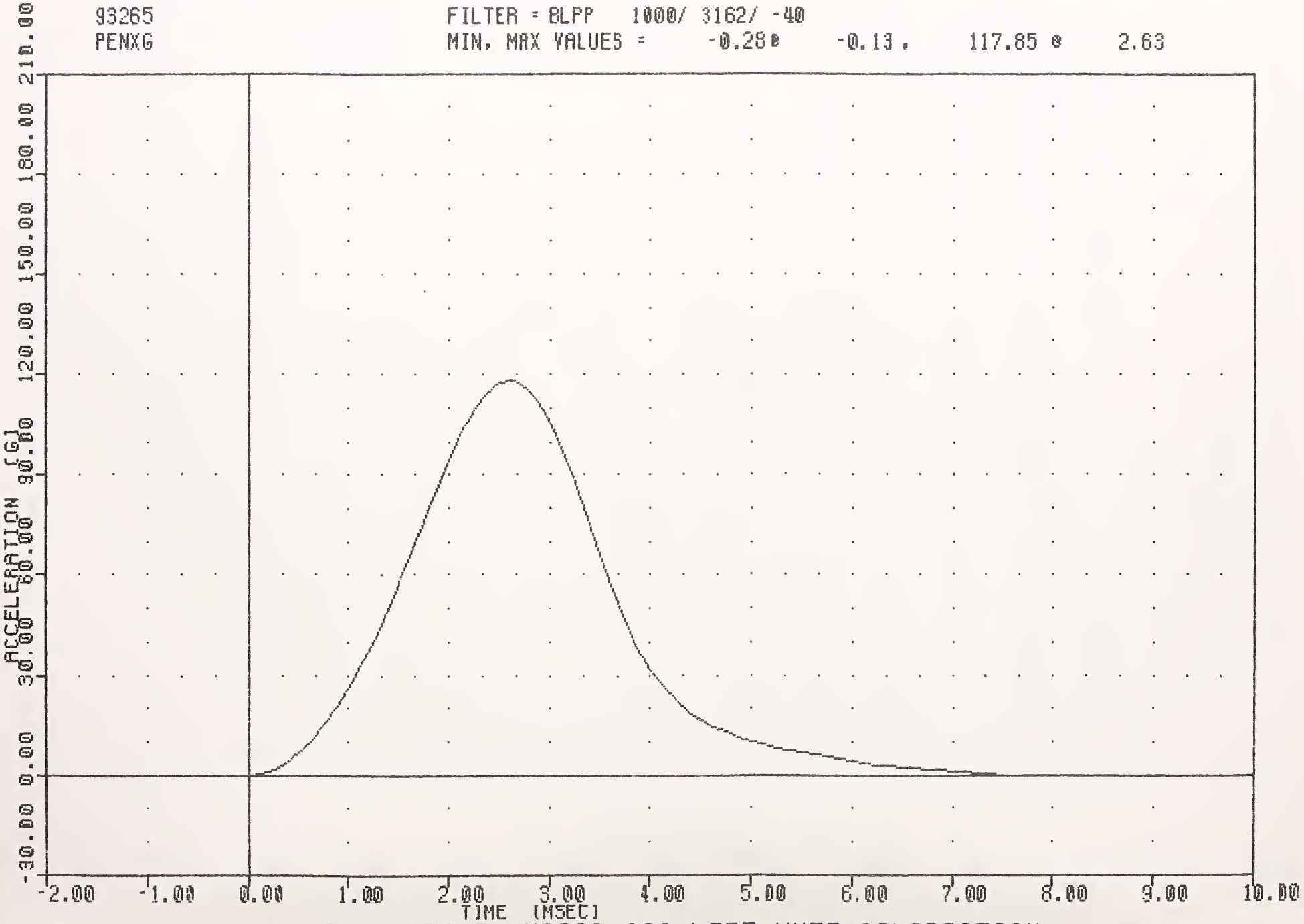
HYBRID III 22-SEP-93

LEFT KNEE
TRC 177C49LK1 572E SN177 LEFT KNEE CAL 49

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10% - 70%	54.0 %
PROBE VELOCITY	2.07 - 2.13 M/SEC	2.07 M/SEC
PEAK KNEE IMPACT FORCE	4714 - 5783 N	5766.0 N
PROBE WEIGHT	5.0 KG	

TEST MEETS SPECIFICATIONS

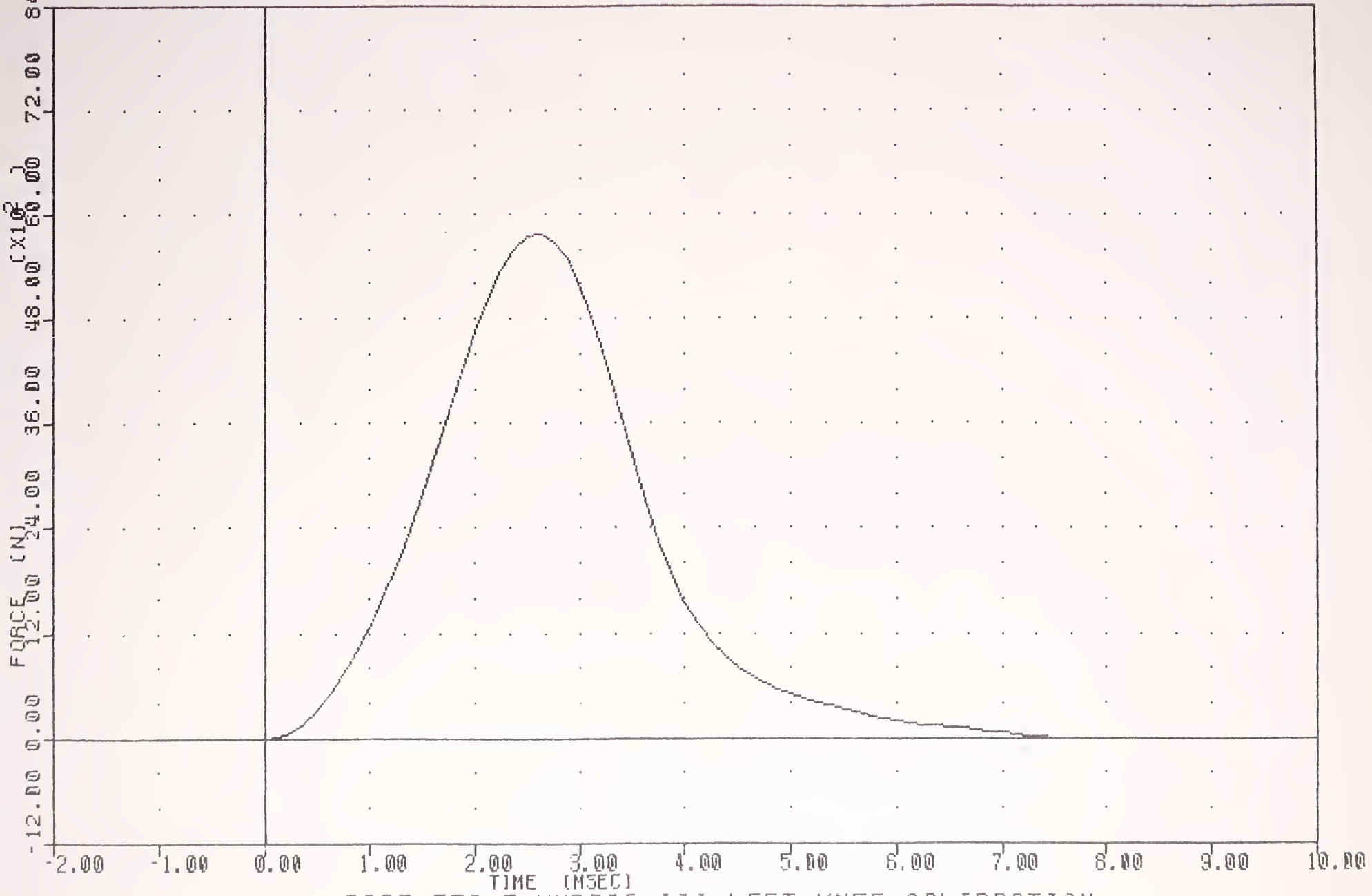
TECHNICIAN Peter Smith



PART 572-E HYBRID III LEFT KNEE CALIBRATION

PENDULUM DECELERATION (5 KG PEND.)

TRC , 177C49LK1
572E SN177 LEFT KNEE CAL 49
93265
PENXF
FILTER = BLPP 1000/ 3162/ -40
MIN, MAX VALUES = -13.58 @ -0.13 , 5766.09 @ 2.63



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

PRE-TEST CERTIFICATION DATA

PASSENGER DUMMY S/N: 134

TRANSPORTATION RESEARCH CENTER INC.
HYBRID III EXTERNAL DIMENSIONS
134 ARL

21-SEP-93

TRC 134C47ED1 572E SN134 EXT. DIMENSION CAL47

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	980. MM
WAIST CIRCUMFERENCE	(Z)	836 - 866 MM	848. MM
CHEST DEPTH	(O)	213 - 229 MM	216. MM
H-POINT HEIGHT	(C)	84 - 89 MM	84. 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	883. MM
THIGH CLEARANCE	(F)	140 - 155 MM	149. MM
BUTTOCK KNEE LENGTH	(K)	579 - 605 MM	597. MM
BUTTOCK POPLITEAL LENGTH	(N)	452 - 478 MM	472. MM
POPLITEAL HEIGHT	(L)	429 - 455 MM	439. MM
KNEE PIVOT HEIGHT	(M)	485 - 500 MM	490. MM
FOOT LENGTH	(P)	252 - 267 MM	262. MM
FOOT BREADTH	(W)	91 - 107 MM	103. MM
SHOULDER PIVOT FROM BACKLINE	(E)	84 - 94 MM	89. MM
SHOULDER BREADTH	(V)	422 - 437 MM	427. MM
SHOULDER PIVOT HEIGHT	(B)	506 - 521 MM	517. MM
ELBOW REST HEIGHT	(J)	191 - 211 MM	211. MM
SHOULDER-ELBOW LENGTH	(I)	330 - 345 MM	340. MM
BACK OF ELBOW TO WRIST PIVOT	(G)	290 - 305 MM	295. MM

TEST MEETS SPECIFICATIONS

TECHNICIAN Pete Foust

TRANSPORTATION RESEARCH CENTER INC.

HEAD DROP TEST

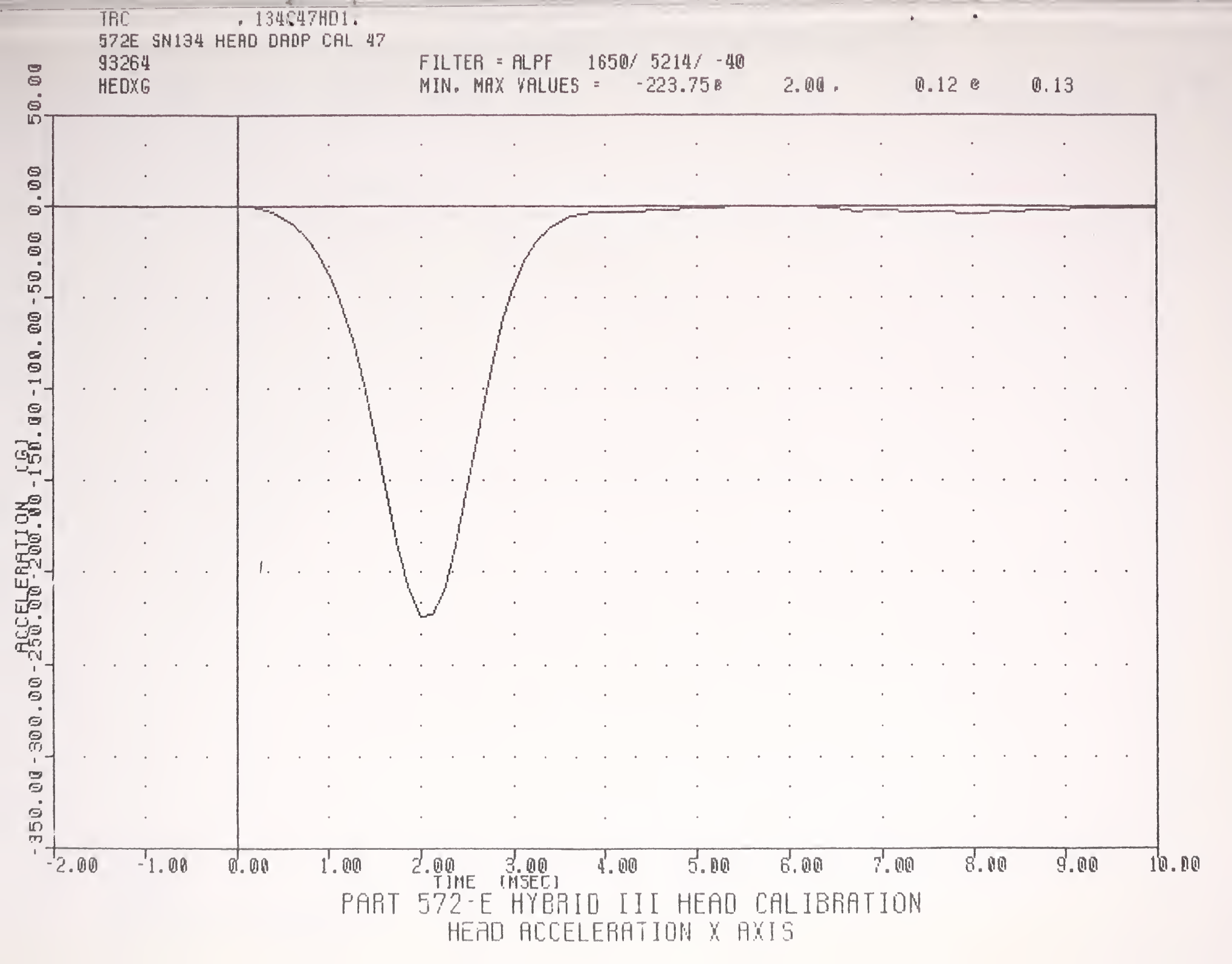
HYBRID III 21-SEP-93

TRC 134C47HD1 572E SN134 HEAD DROP CAL 47

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	20.6 DEG. C
RELATIVE HUMIDITY	10% - 70%	57.0 %
PEAK RESULTANT ACCELERATION	225 - 275 G	235.14 G
PEAK LATERAL ACCELERATION	15 G MAX	2.37 G
IS ACCELERATION CURVE UNIMODAL?	YES	YES

TEST MEETS SPECIFICATIONS

TECHNICIAN Peter Foust

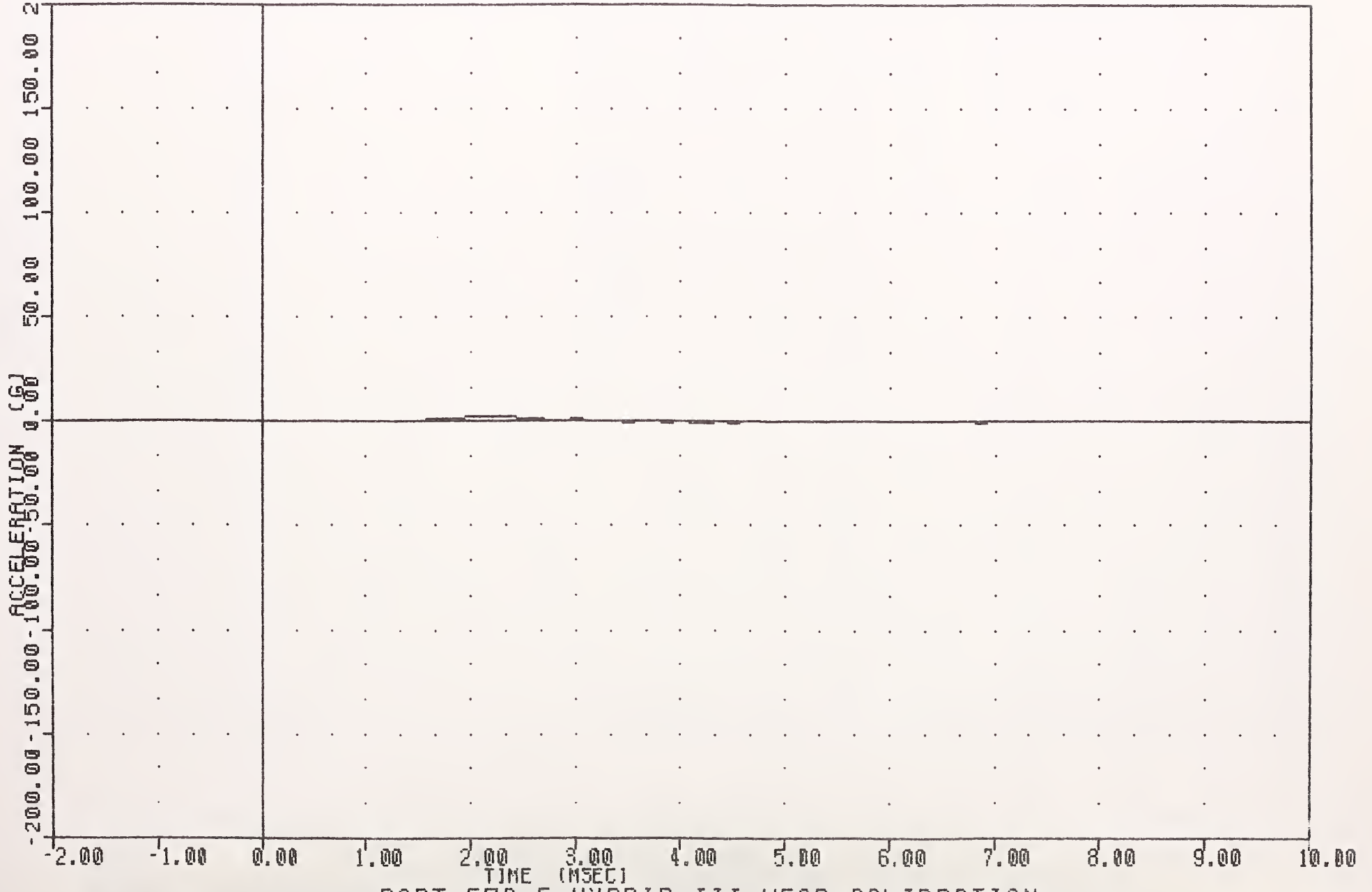


PART 572-E HYBRID III HEAD CALIBRATION

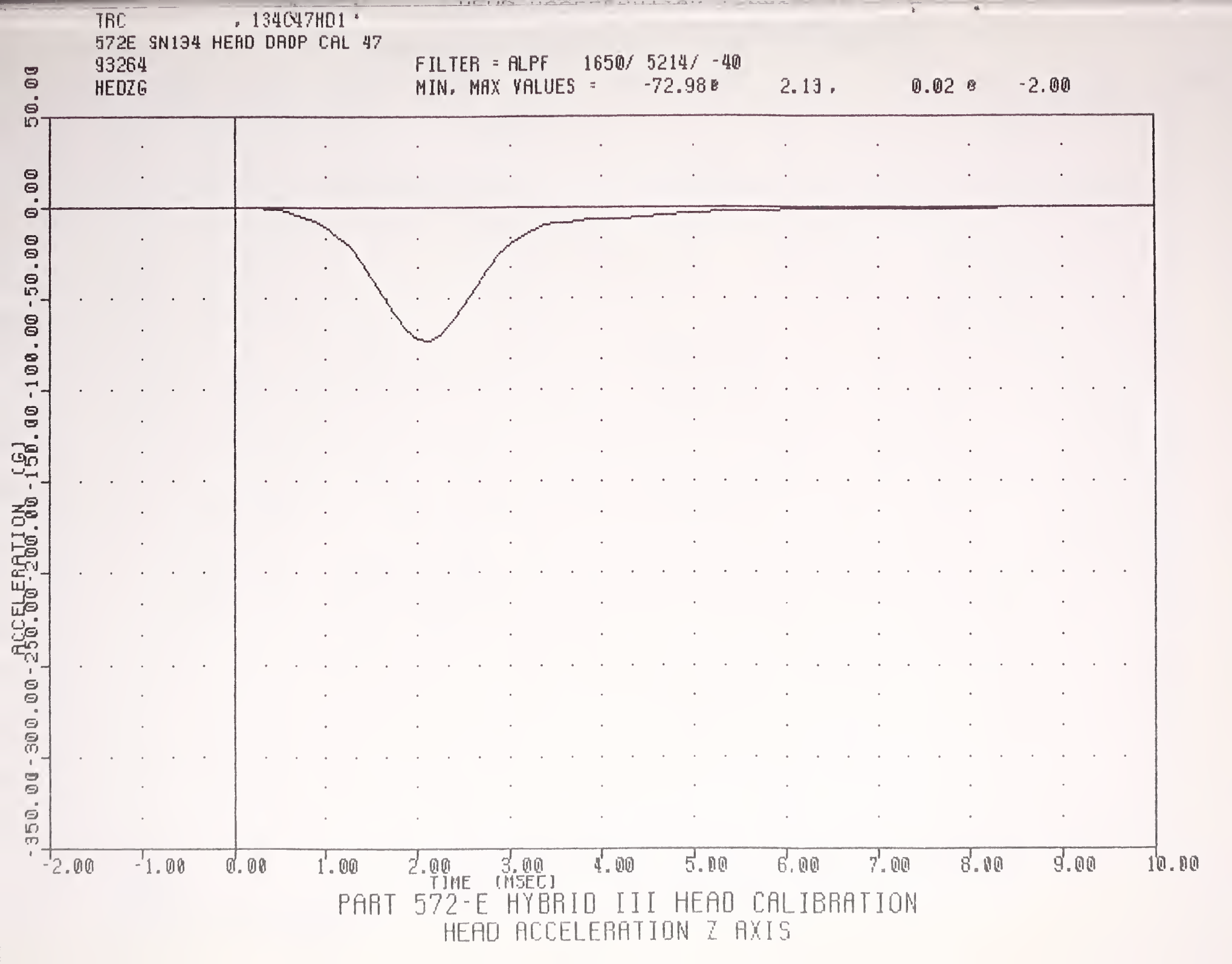
HEAD ACCELERATION X AXIS

TRC , 134C47HD1
572E SN134 HEAD DROP CAL 47
93264
HEDYG

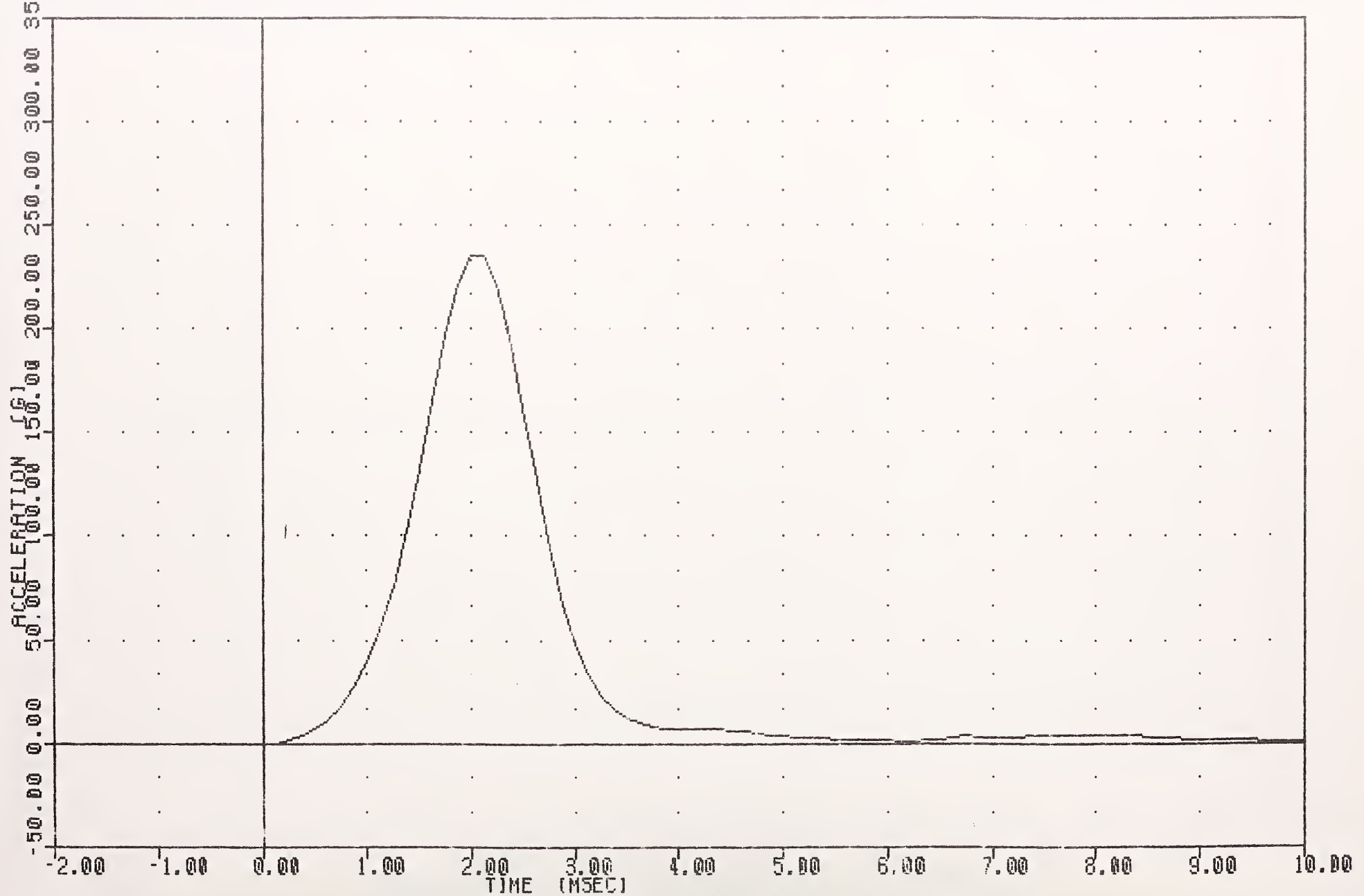
FILTER = ALPF 1650/ 5214/ -40
MIN, MAX VALUES = -0.68 @ 4.13 , 2.38 @ 2.13



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


TRC , 134C47HD1 *
572E SN134 HEAD DROP CAL 47
93264
HEDZG
FILTER = ALPF 1650/ 5214/ -40
MIN, MAX VALUES = -72.98 @ 2.13 , 0.02 @ -2.00
ACCELERATION (G)
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
-2.00
-1.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
TIME (MSEC)
PART 572-E HYBRID III HEAD CALIBRATION
HEAD ACCELERATION Z AXIS

TRC , 134C47HD1
572E SN134 HEAD DROP CAL 47
93264 FILTER = ALPF 1650/ 5214/ -40
HEDRG MIN, MAX VALUES = 0.03 @ -2.00 , 235.14 @ 2.00



PART 572-E HYBRID III HEAD CALIBRATION
HEAD RESULTANT ACCELERATION

TRANSPORTATION RESEARCH CENTER INC.

NECK FLEXION TEST

HYBRID III 22-SEP-93

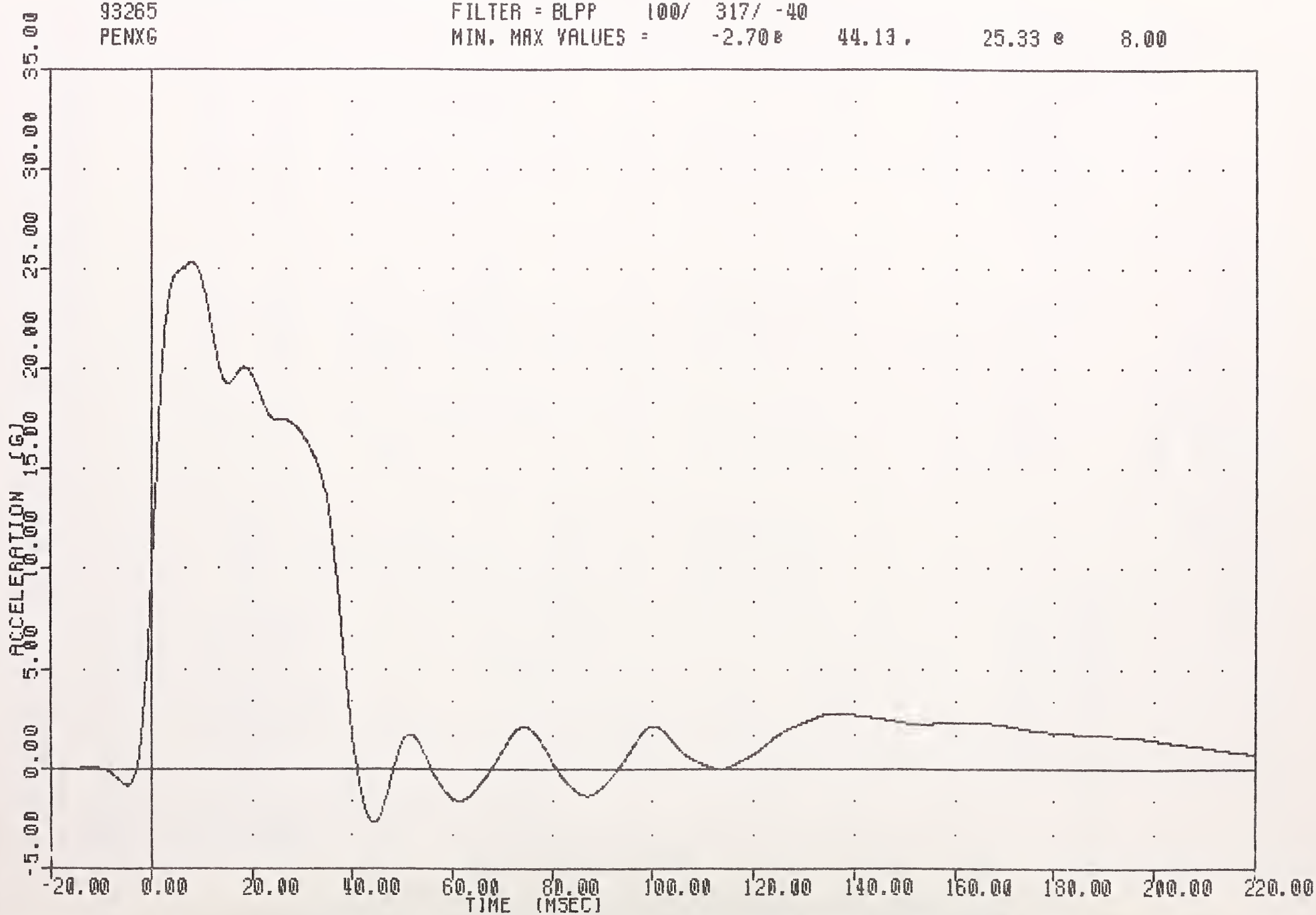
3 AXIS NECK TRANSDUCER
TRC 134C47NF1 572E SN134 NECK FLEXION CAL47

TEST PARAMETER		SPECIFICATION	TEST RESULTS
TEMPERATURE		20.6-22.2 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY		10% - 70%	54.0 %
IMPACT VELOCITY		6.89 - 7.13 M/SEC	7.10 M/SEC
PENDULUM DECELERATION	10 MS	22.50 - 27.50 G	24.44 G
	20 MS	17.60 - 22.60 G	19.68 G
	30 MS	12.50 - 18.50 G	16.74 G
MAX PENDULUM G		29 G MAX	25.33 G
MAX PENDULUM G ABOVE 30 MS		29 G MAX	16.69 G
DECELERATION-TIME CURVE DECAY TIME TO 5 G		34 - 42 MS	38.50 MS
D PLANE ROTATION	MAX	64 - 78 DEG.	71.66 DEG.
	TIME	57 - 64 MS	59.13 MS
MOMENT ABOUT OCCIPITAL CONDYLE	MAX	88.2 - 108.5 NM	90.61 NM
	TIME	47 - 58 MS	52.00 MS
ROTATION ANGLE-TIME CURVE DECAY TIME TO ZERO		113 - 128 MS	114.88 MS
POSITIVE MOMENT-TIME CURVE DECAY TIME TO ZERO		97 - 107 MS	103.38 MS

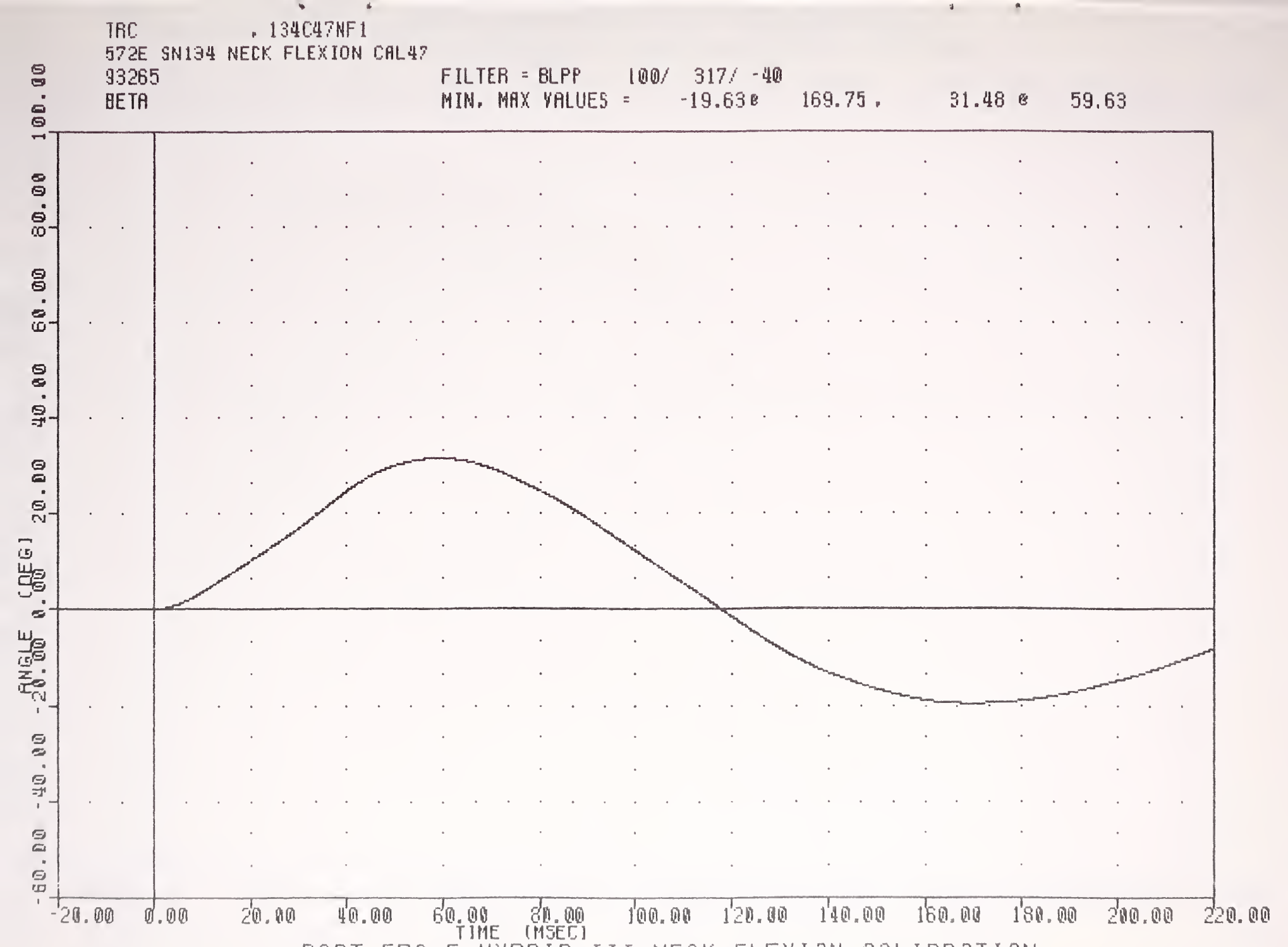
TEST MEETS SPECIFICATIONS

TECHNICIAN Pete Fox

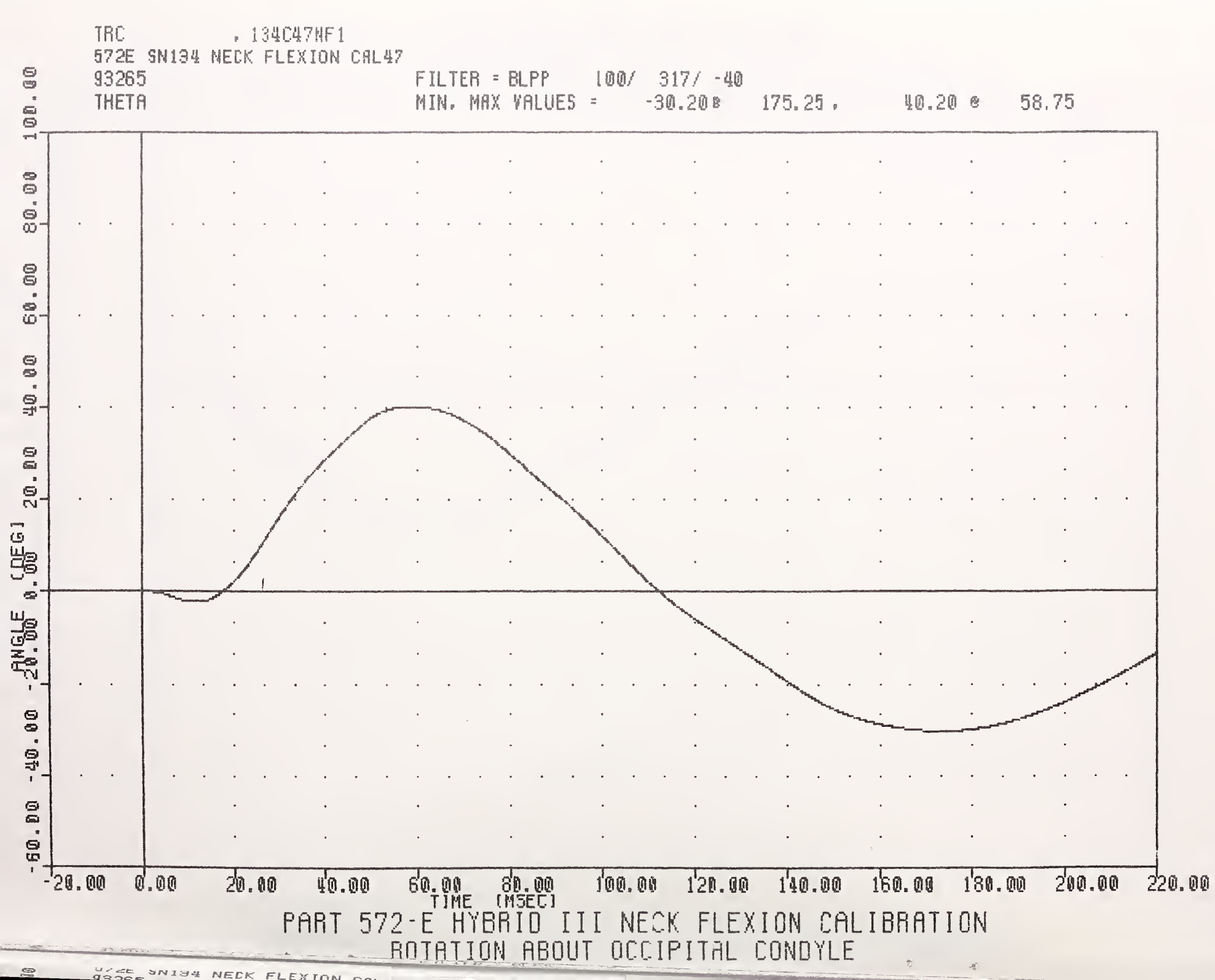
TRC . 134C47NF1
572E SN134 NECK FLEXION CAL47
93265 FILTER = BLPP 100/ 317/ -40
PENXG MIN, MAX VALUES = -2.70 @ 44.13 , 25.33 @ 8.00



PART 572-E HYBRID III NECK FLEXION CALIBRATION
PENDULUM DECELERATION

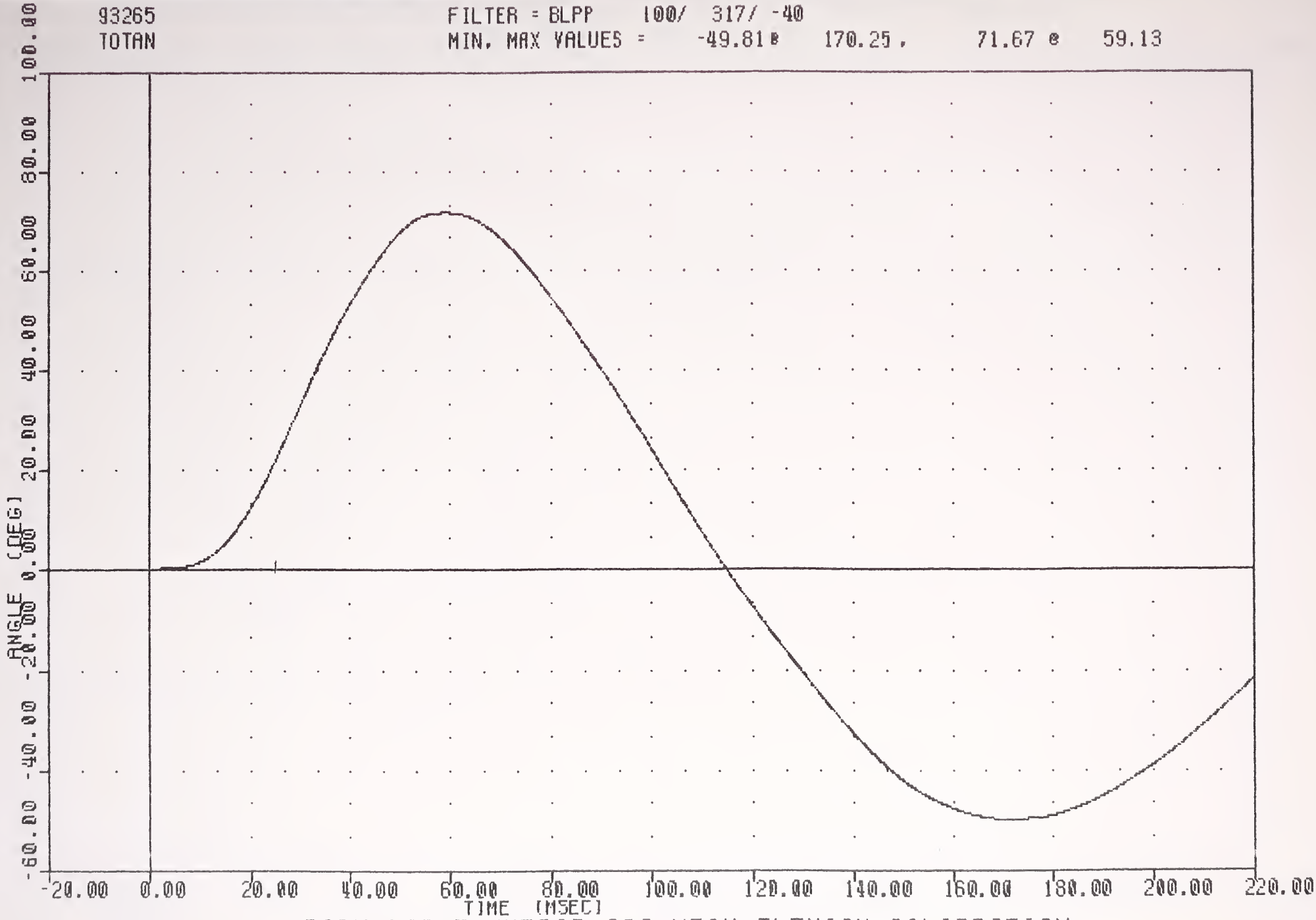


PART 572-E HYBRID III NECK FLEXION CALIBRATION
ROTATION ABOUT BASE OF NECK

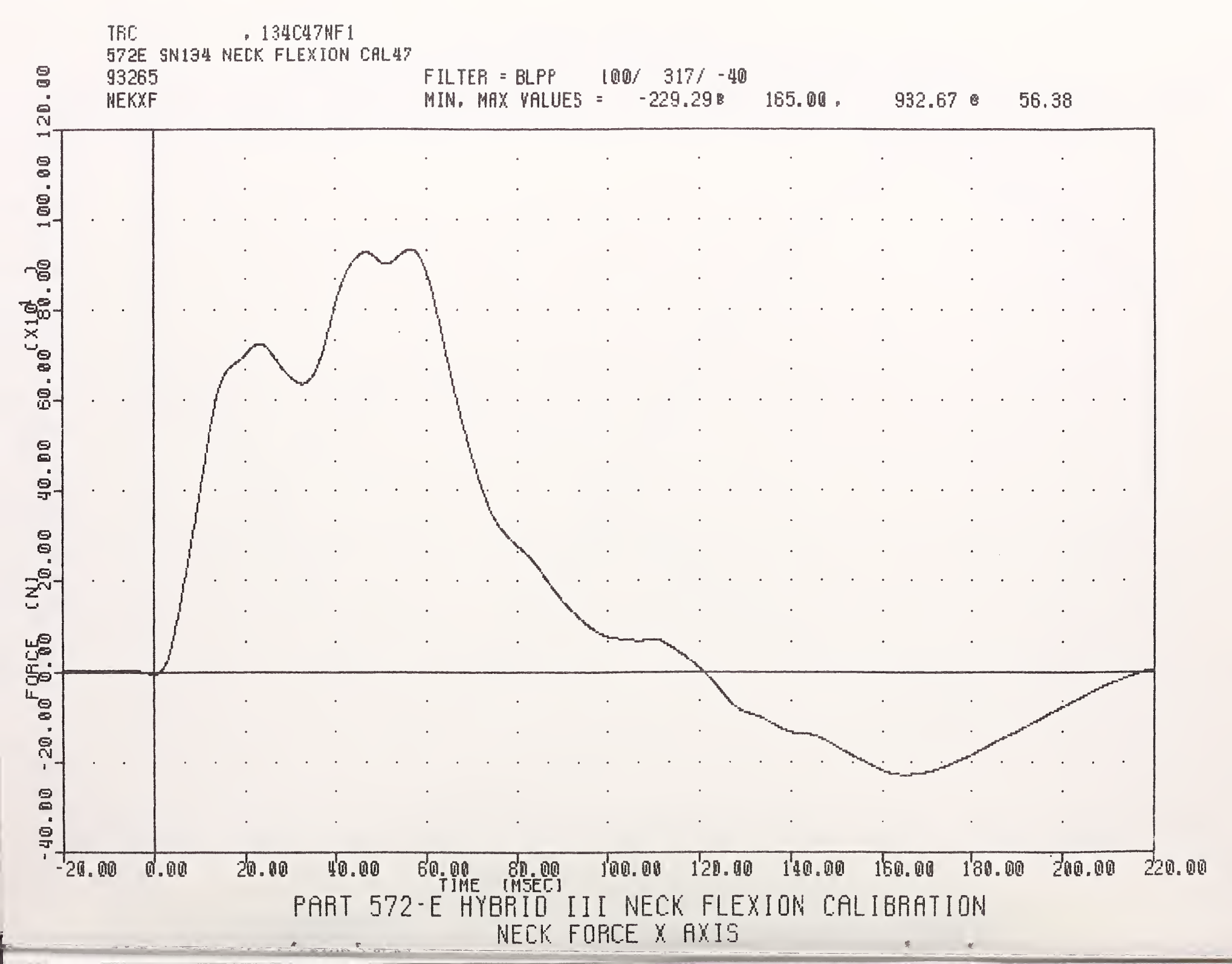


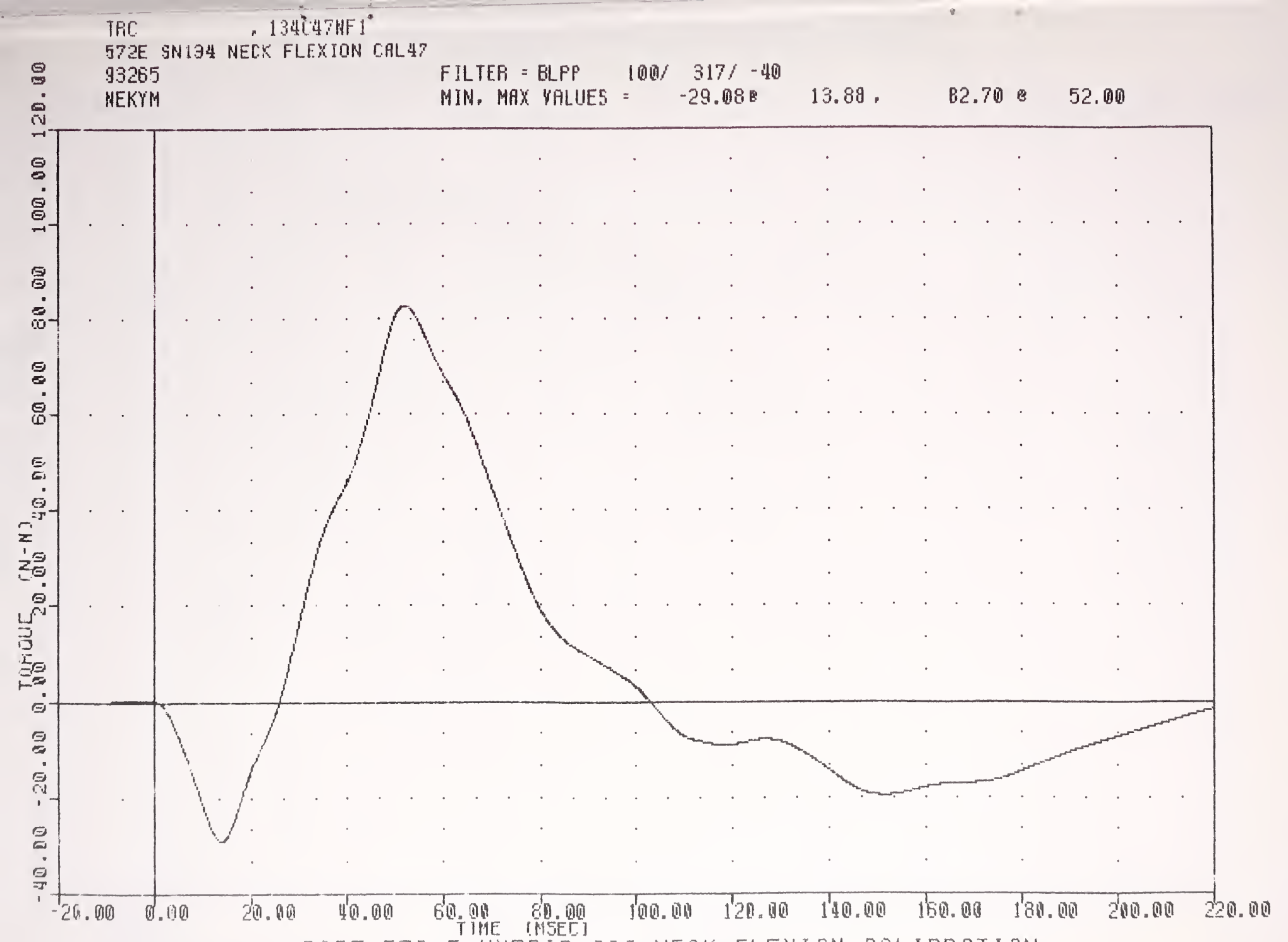
PART 572-E HYBRID III NECK FLEXION CALIBRATION
ROTATION ABOUT OCCIPITAL CONDYLE

572E SN194 NECK FLEXION CAL47
93265
TOTAN
FILTER = BLPP 100/ 317/ -40
MIN, MAX VALUES = -49.81 @ 170.25 , 71.67 @ 59.13



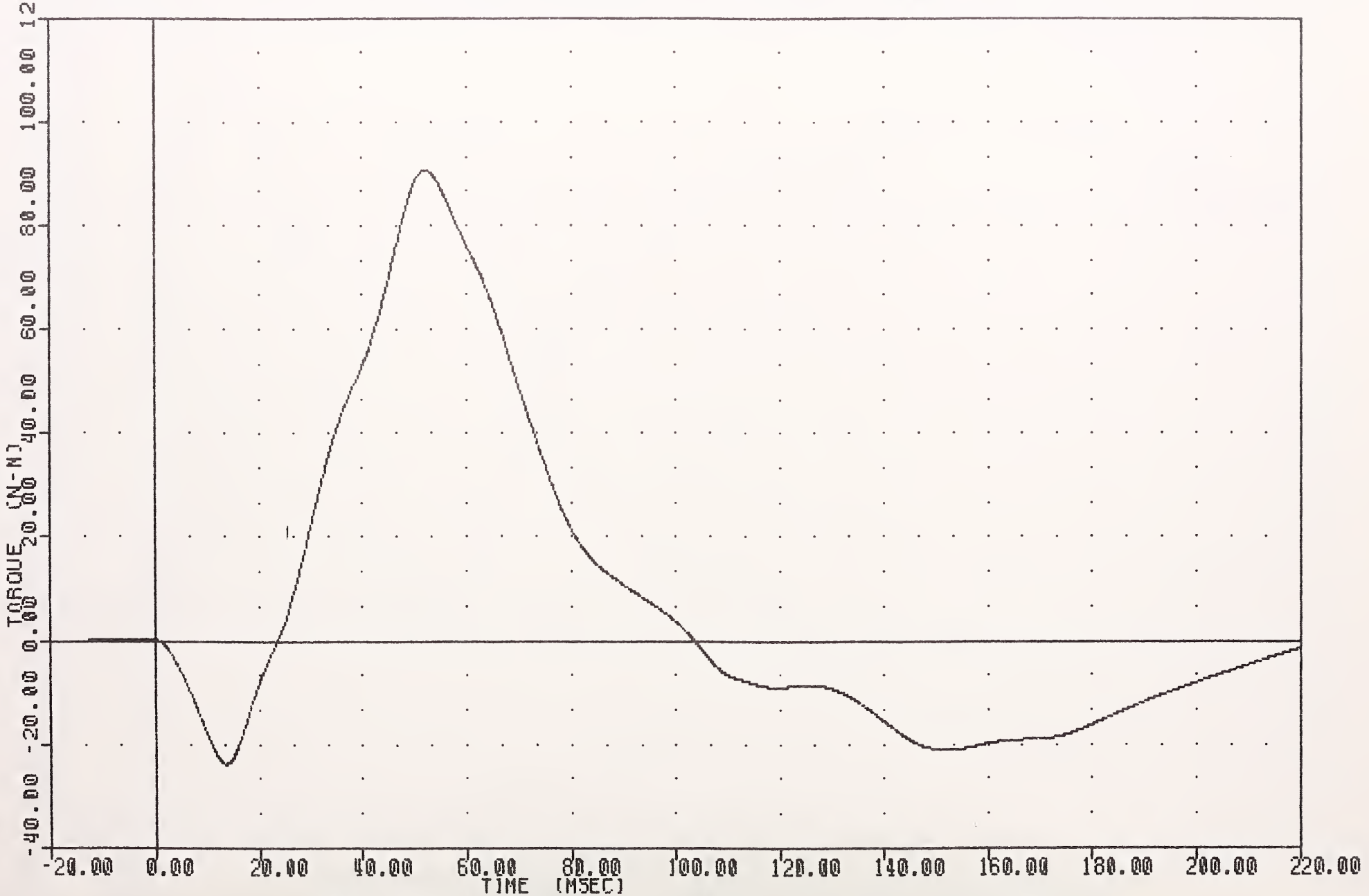
PART 572-E HYBRID III NECK FLEXION CALIBRATION
TOTAL ROTATION


TRC , 134C47NF1
572E SN134 NECK FLEXION CAL47
93265
NEKXF
FILTER = BLPP 100/ 317/ -40
MIN, MAX VALUES = -229.29 @ 165.00 , 932.67 @ 56.38
FORCE (N) (X10)
120.00
100.00
80.00
60.00
40.00
20.00
0.00
-20.00
-40.00
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
TIME (MSEC)
PART 572-E HYBRID III NECK FLEXION CALIBRATION
NECK FORCE X AXIS



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

TRC , 134C47NF1
572E SN134 NECK FLEXION CAL47
93265 FILTER = BLPP 100/ 317/ -40
NEKOM MIN, MAX VALUES = -23.79 @ 13.50 , 90.61 @ 52.00



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

TRANSPORTATION RESEARCH CENTER INC.

NECK EXTENSION TEST

HYBRID III 22-SEP-93

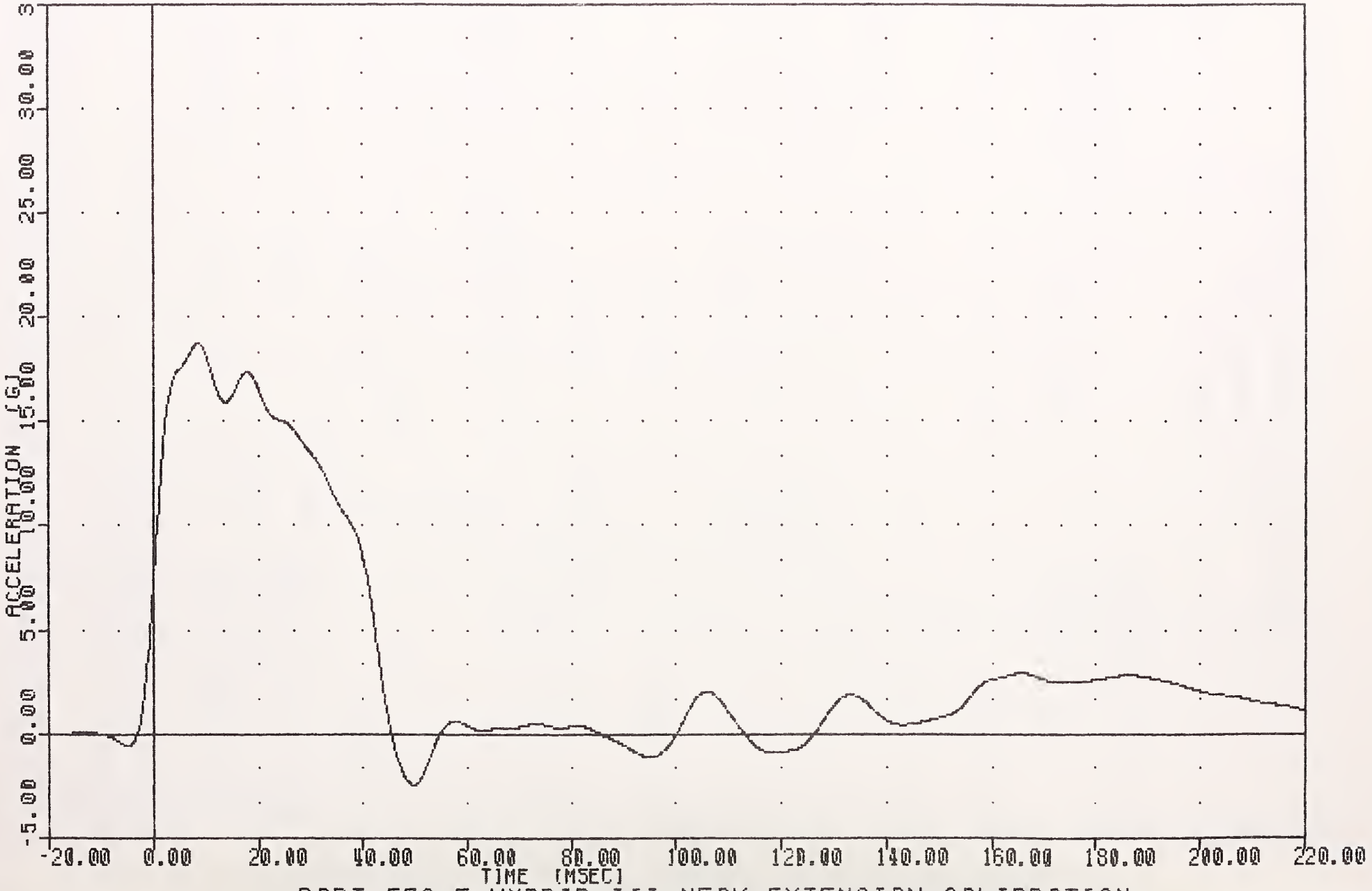
3 AXIS NECK TRANSDUCER
TRC 134C47NE1 572E SN134 NECK EXT. CAL47

TEST PARAMETER		SPECIFICATION	TEST RESULTS
TEMPERATURE		20.6-22.2 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY		10% - 70%	54.0 %
IMPACT VELOCITY		5.95 - 6.19 M/SEC	6.05 M/SEC
PENDULUM DECELERATION	10 MS	17.20 - 21.20 G	18.18 G
	20 MS	14.00 - 19.00 G	16.55 G
	30 MS	11.00 - 16.00 G	13.46 G
MAX PENDULUM G		22 G MAX	18.73 G
MAX PENDULUM G ABOVE 30 MS		22 G MAX	13.42 G
DECELERATION-TIME CURVE DECAY TIME TO 5 G		38 - 46 MS	42.13 MS
D PLANE ROTATION	MAX	81 - 106 DEG.	94.14 DEG.
	TIME	72 - 82 MS	74.00 MS
MOMENT ABOUT OCCIPITAL CONDYLE	MIN	-80.0/-52.9 NM	-69.31 NM
	TIME	65 - 79 MS	70.75 MS
ROTATION ANGLE-TIME CURVE DECAY TIME TO ZERO		147 - 174 MS	151.75 MS
NEGATIVE MOMENT-TIME CURVE DECAY TIME TO ZERO		120 - 148 MS	139.00 MS

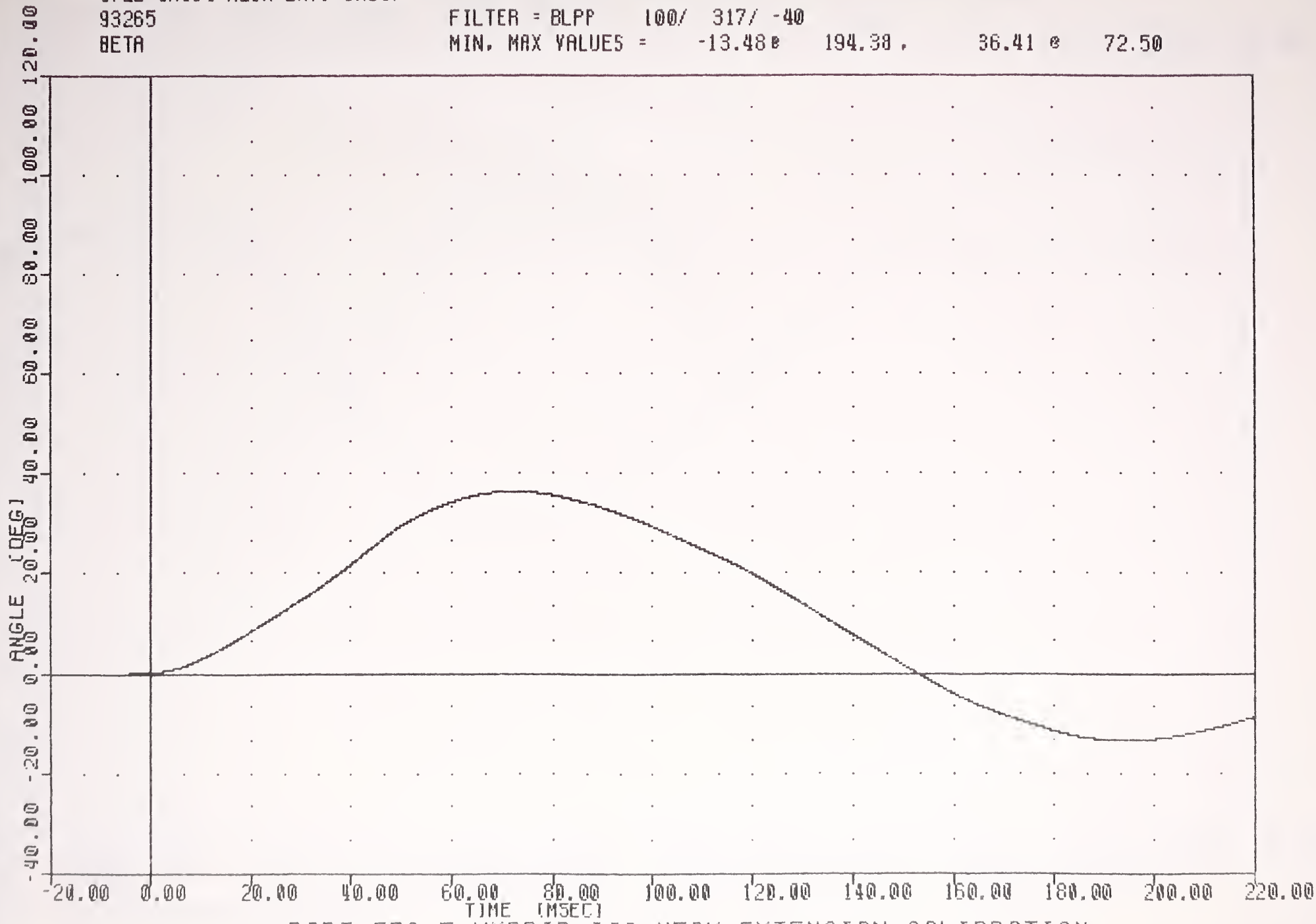
TEST MEETS SPECIFICATIONS

TECHNICIAN Peter Faust

TRC , 134C47NE1
572E SN134 NECK EXT. CAL47
93265 FILTER = BLPP 100/ 317/ -40
PENXG MIN, MAX VALUES = -2.45 @ 49.50 , 18.74 @ 8.50

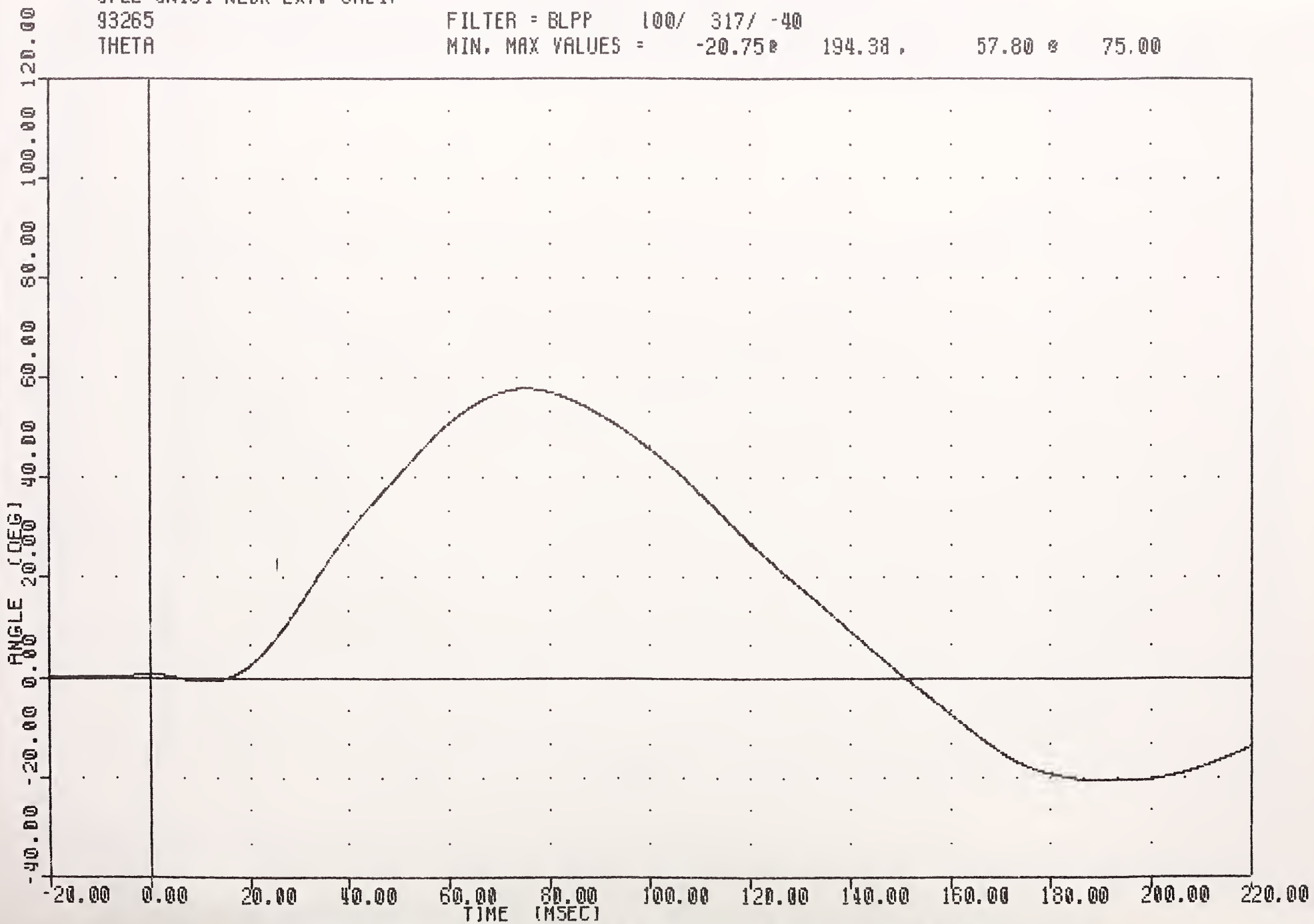


PART 572-E HYBRID III NECK EXTENSION CALIBRATION
PENDULUM DECELERATION

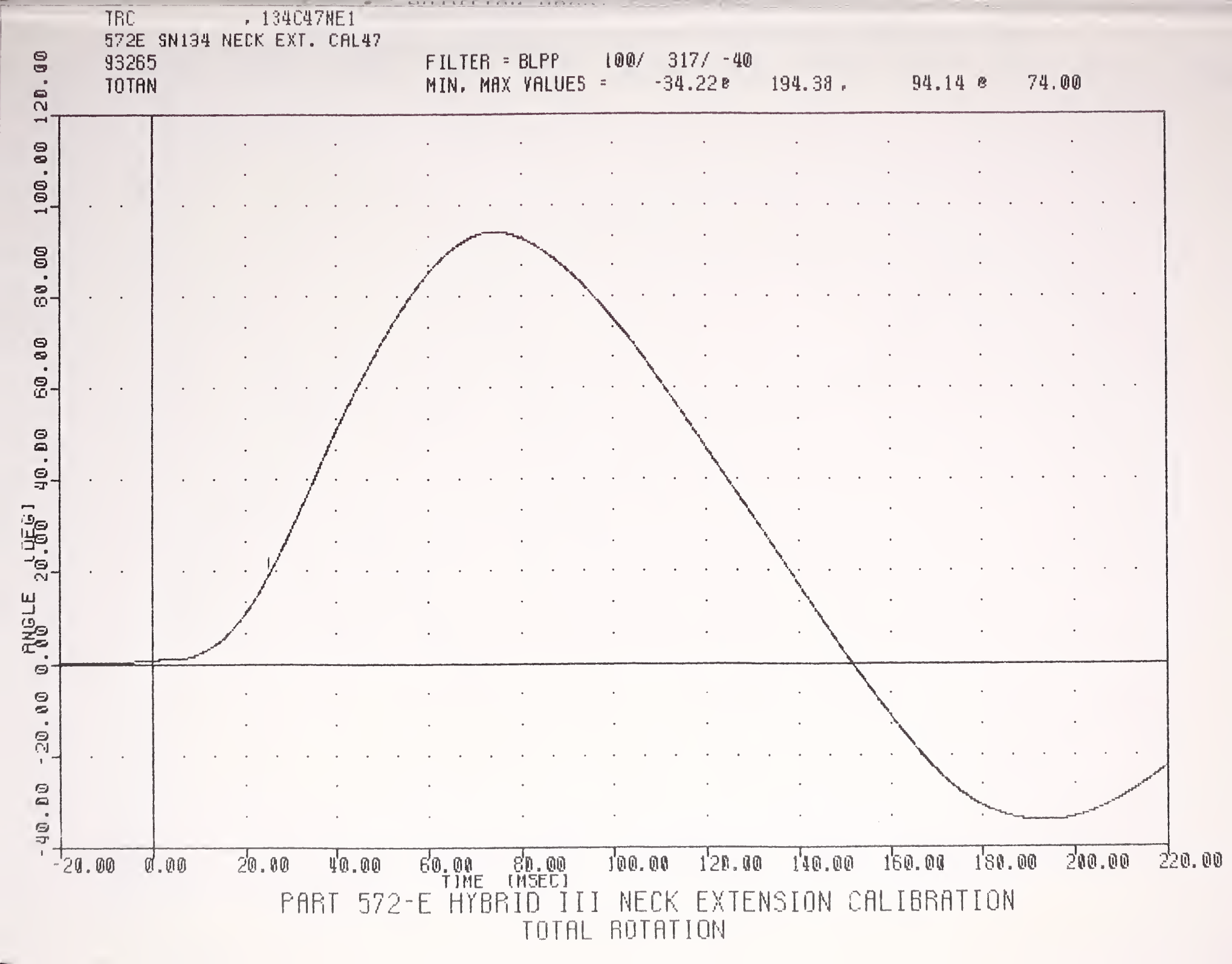


PART 572-E HYBRID III NECK EXTENSION CALIBRATION
ROTATION ABOUT BASE OF NECK

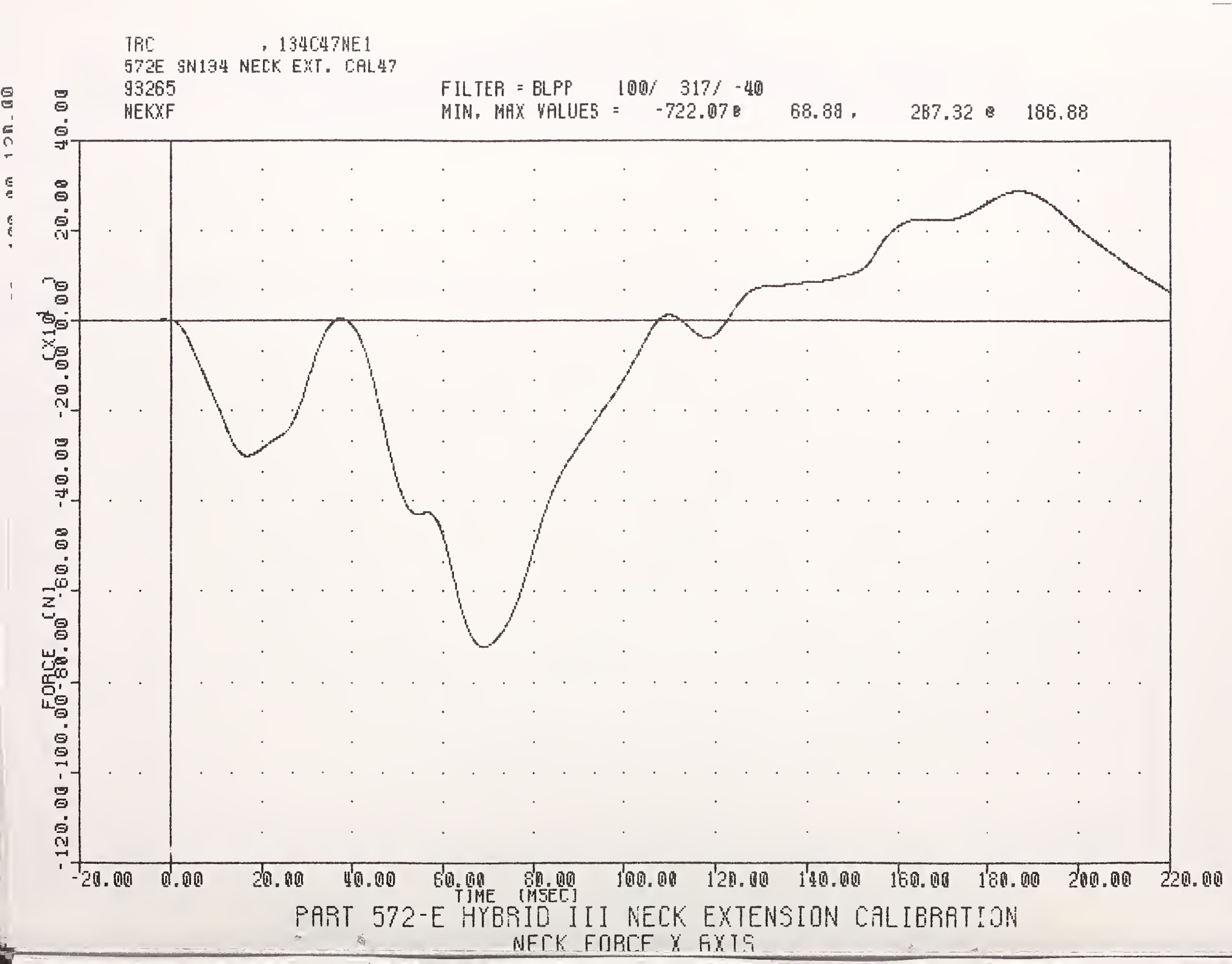
TRC , 134C47NE1
572E SN134 NECK EXT. CAL47
93265 FILTER = BLPP 100/ 317/ -40
THETA MIN, MAX VALUES = -20.75@ 194.38 , 57.80 @ 75.00



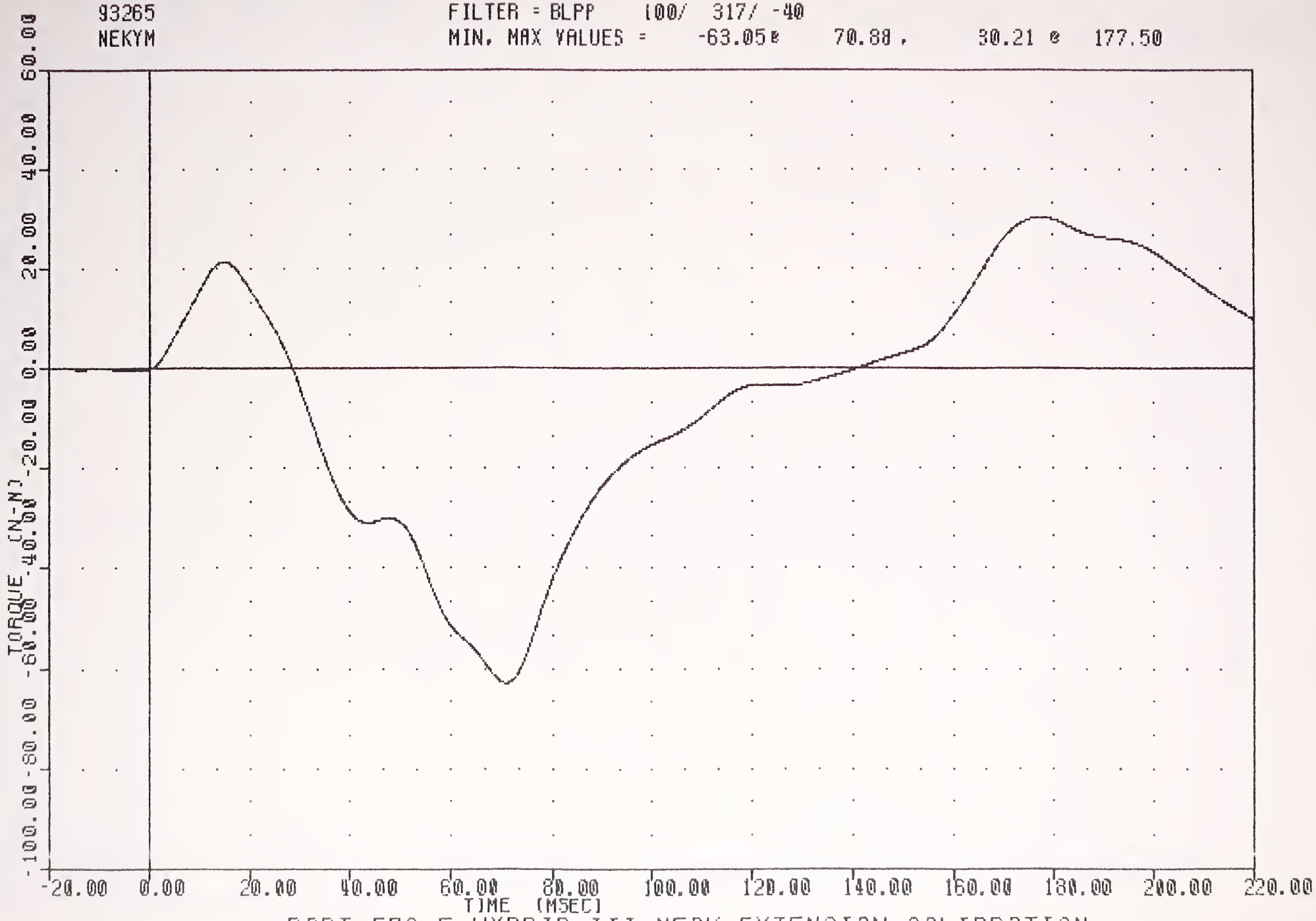
PART 572-E HYBRID III NECK EXTENSION CALIBRATION
ROTATION ABOUT OCCIPITAL CONDYLE



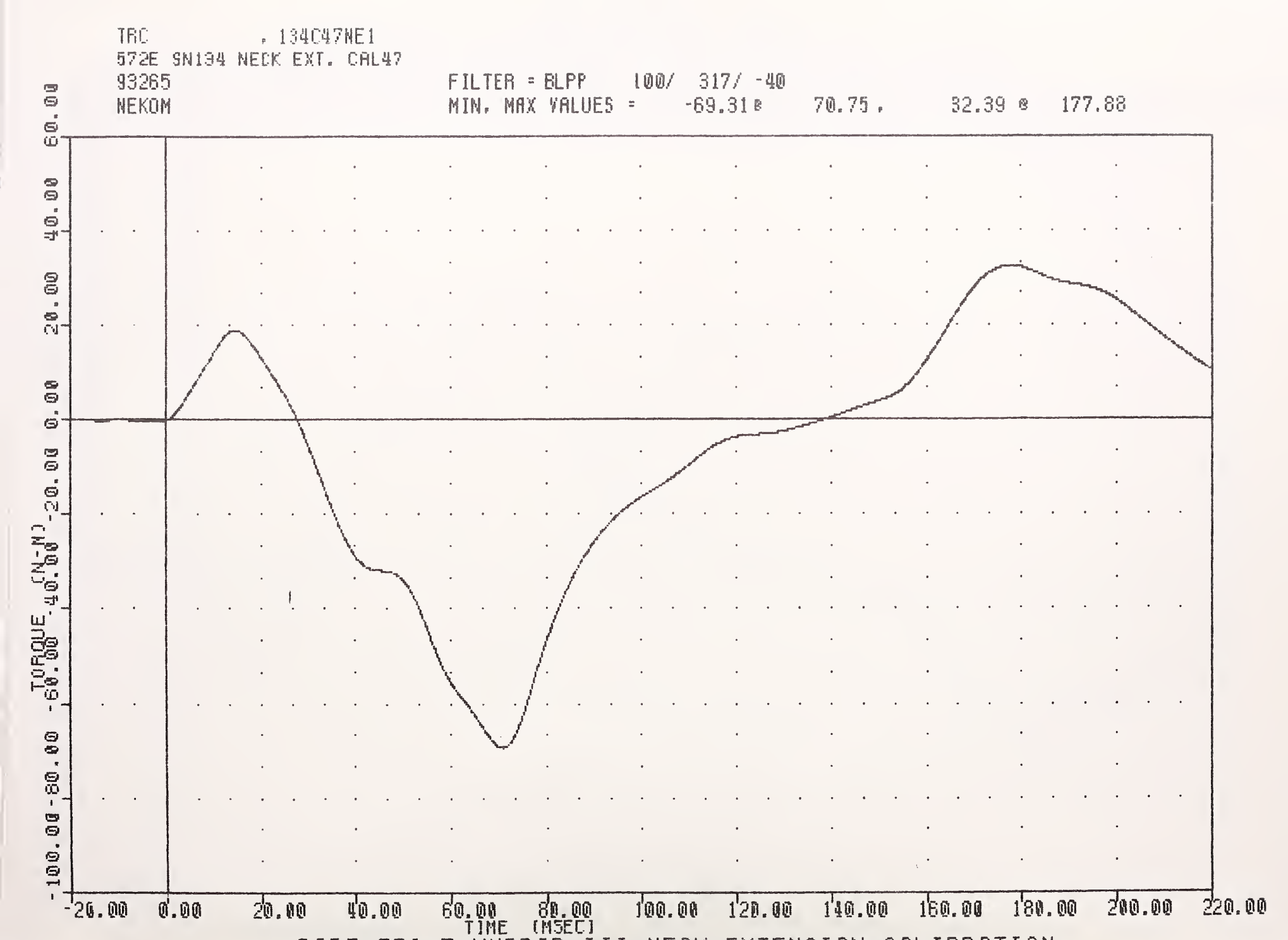
PART 572-E HYBRID III NECK EXTENSION CALIBRATION
TOTAL ROTATION


IRC , 134C47NE1
572E SN134 NECK EXT. CAL47
93265
NEKXF
FILTER = BLPP 100/ 317/ -40
MIN, MAX VALUES = -722.07 @ 68.88 , 287.32 @ 186.88
FORCE (N) (X10)
40.00
20.00
0.00
-20.00
-40.00
-60.00
-80.00
-100.00
-120.00
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
TIME (MSEC)
PART 572-E HYBRID III NECK EXTENSION CALIBRATION
NECK FORCE X AXIS

TRC , 134C47NE1
572E SN134 NECK EXT. CAL47
93265 FILTER = BLPP (00/ 317/ -40
NEKYM MIN, MAX VALUES = -63.05 @ 70.88 , 30.21 @ 177.50



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



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

TRANSPORTATION RESEARCH CENTER INC.

THORAX IMPACT TEST

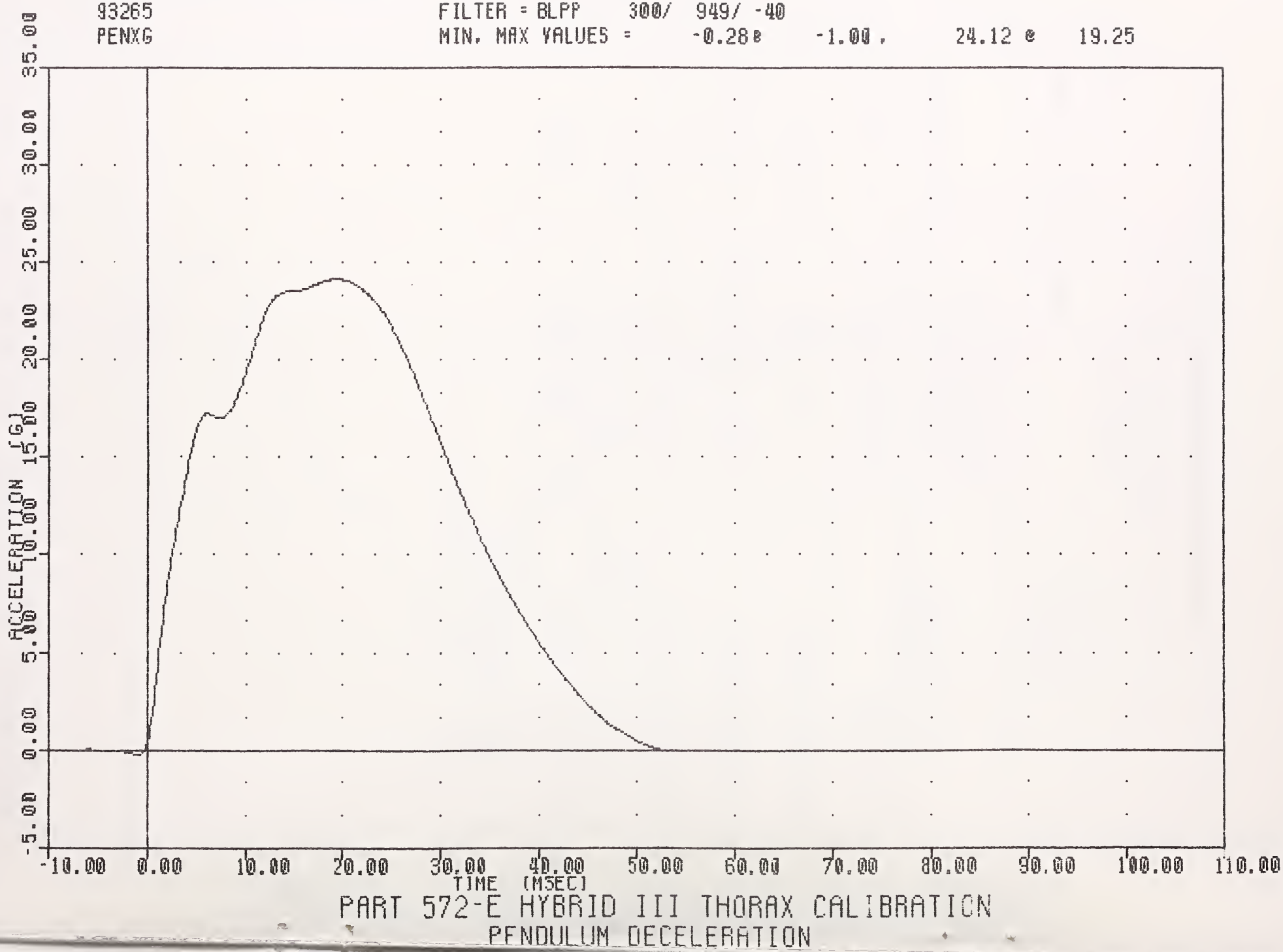
HYBRID III 22-SEP-93

TRC 134C47TH1 572E SN134 H.S.THORAX CAL47

TEST PARAMETER	HIGH SPEED TEST SPECIFICATION	TEST RESULTS
TEMPERATURE	20.6-22.2 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10% - 70%	55.0 %
PENDULUM VELOCITY	6.59 - 6.83 M/SEC	6.68 M/SEC
MAXIMUM DEFLECTION	63.5 - 72.6 MM	66.0 MM
MAXIMUM RESISTIVE FORCE	5159 - 5894 N	5526. N
INTERNAL HYSTERESIS	69% - 85%	76.0%

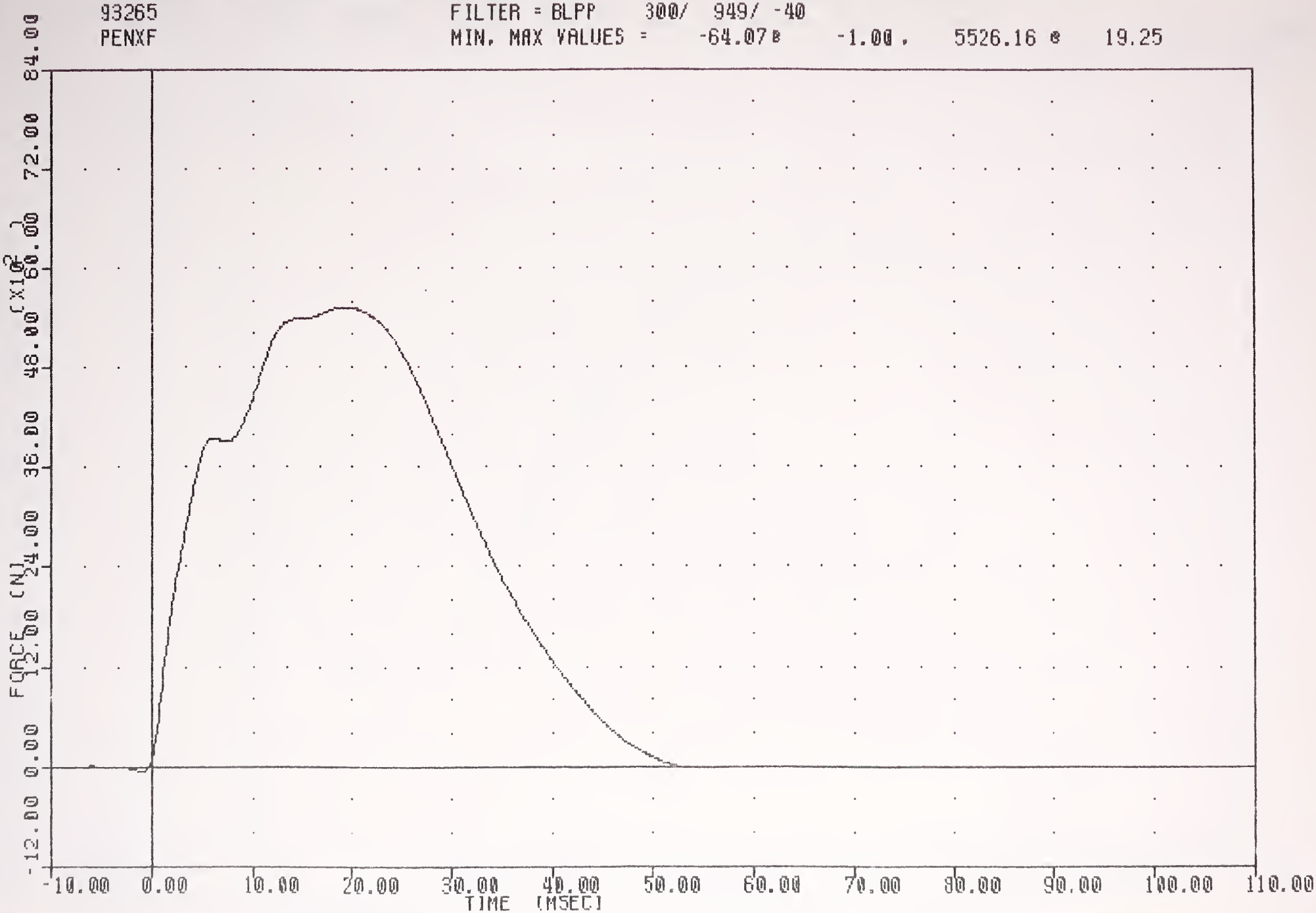
TEST MEETS SPECIFICATIONS

TECHNICIAN Pete Foust



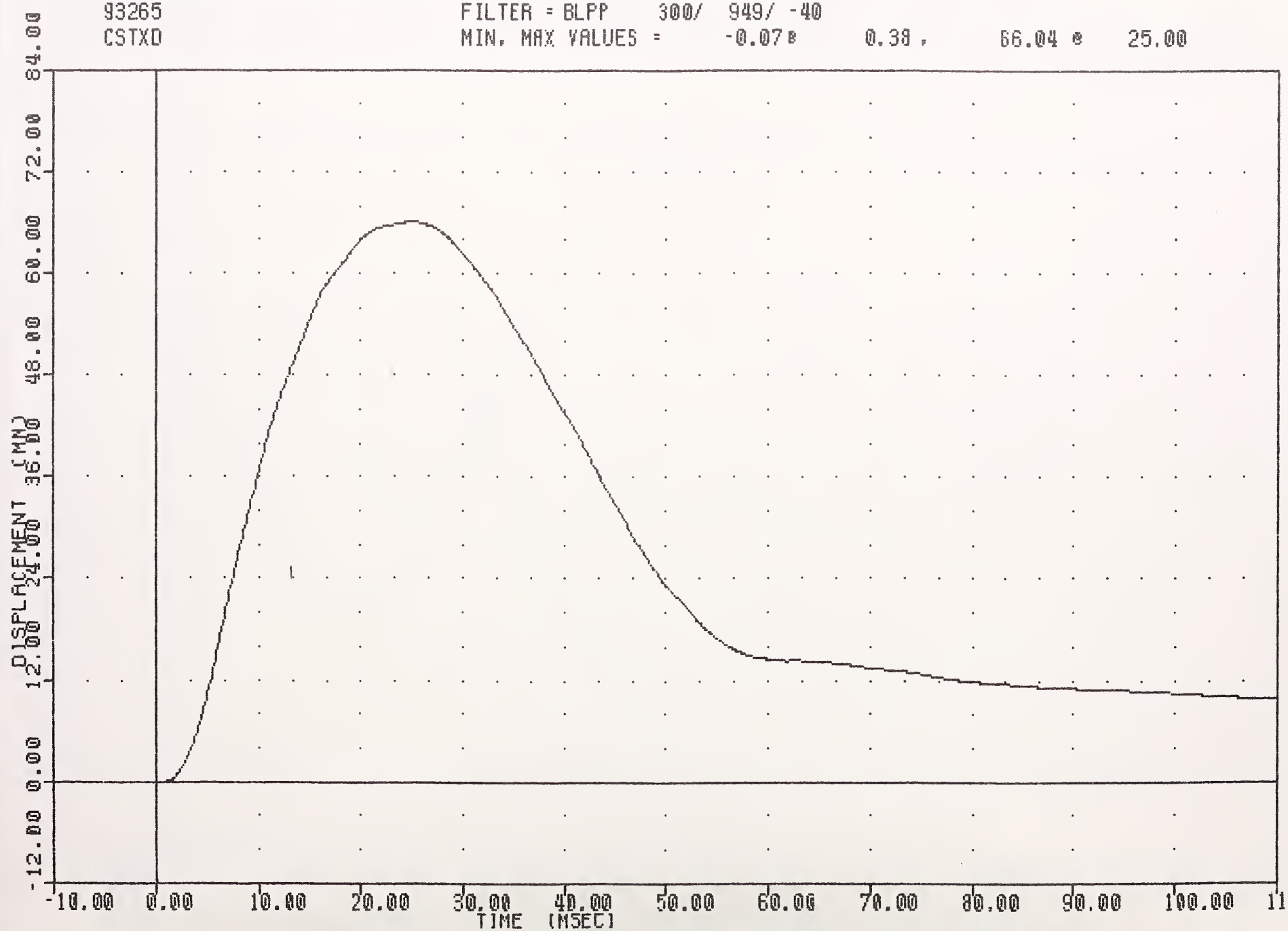
PART 572-E HYBRID III THORAX CALIBRATION

PENDULUM DECELERATION

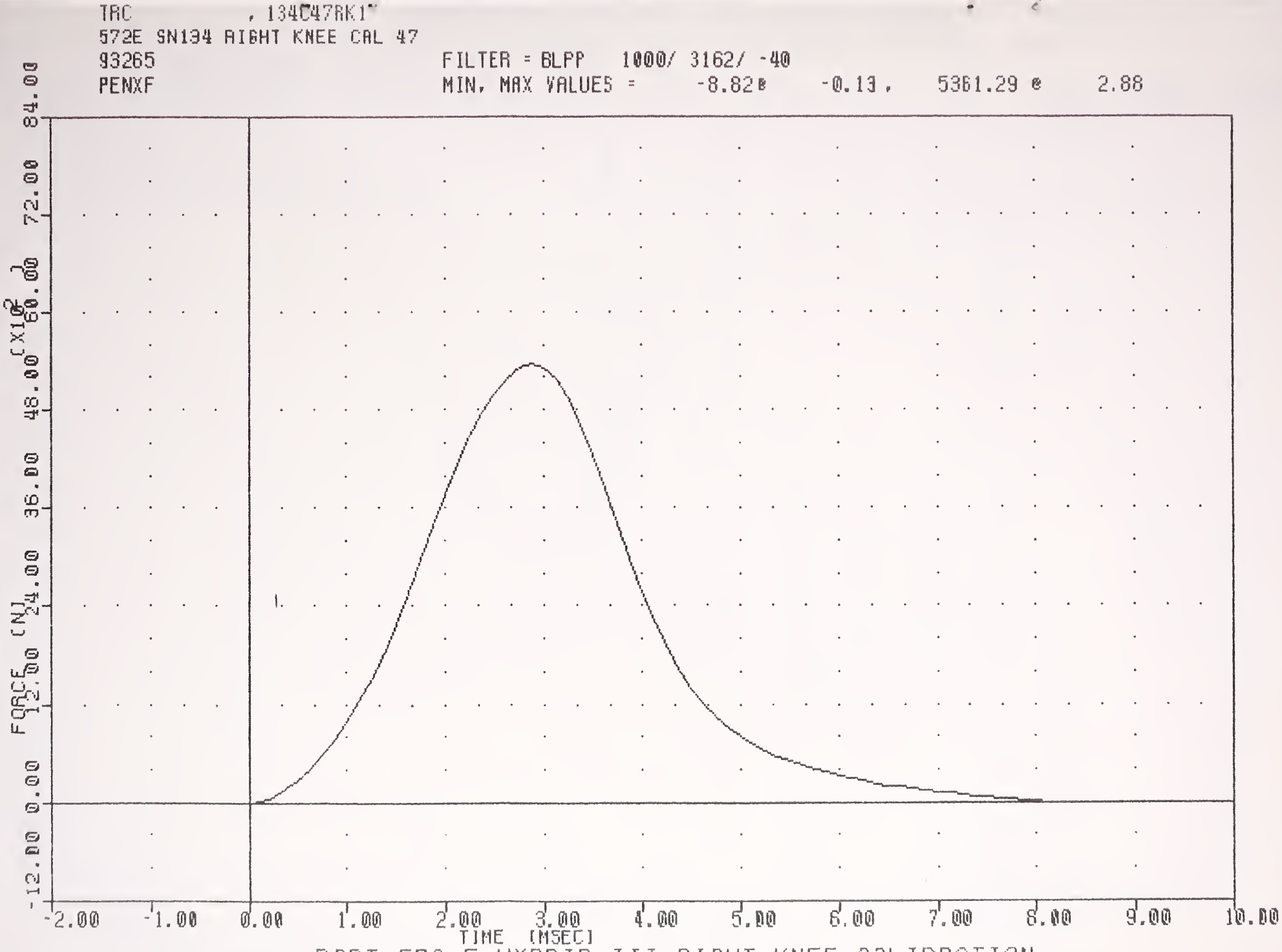


PART 572-E HYBRID III THORAX CALIBRATION
PENDULUM FORCE

TRC , 134C47TH1
572E SN134 H.S.THORAX CAL47
93265 FILTER = BLPP 300/ 949/ -40
CSTXD MIN, MAX VALUES = -0.07 @ 0.38 , 66.04 @ 25.00

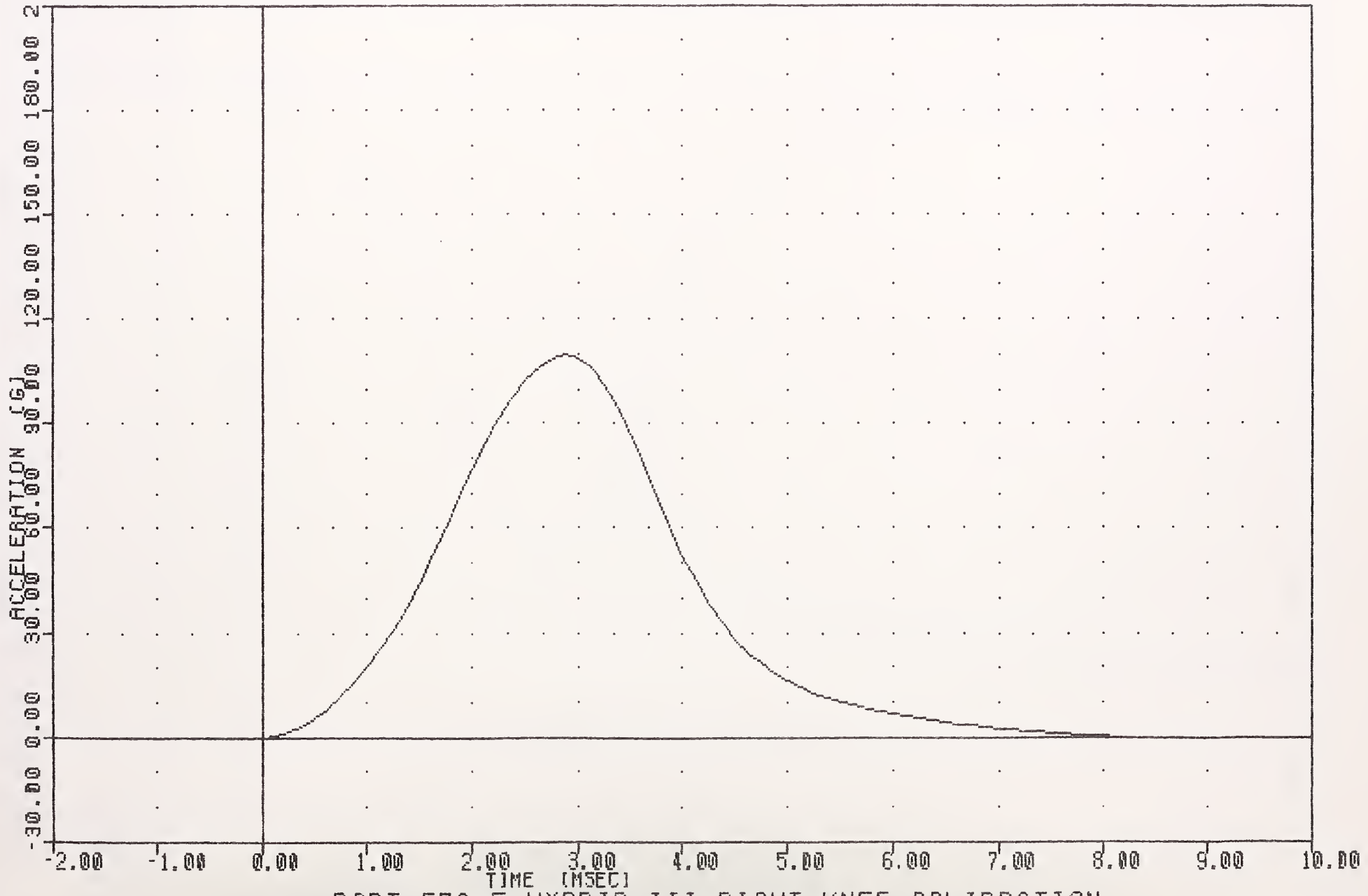


PART 572-E HYBRID III THORAX CALIBRATION
STERNUM DISPLACEMENT



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

TRC , 134C47RK1
572E SN134 RIGHT KNEE CAL 47
93265 FILTER = BLPP 1000/ 3162/ -40
PENXG MIN, MAX VALUES = -0.18 @ -0.13 , 109.58 @ 2.88



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

TRANSPORTATION RESEARCH CENTER INC.

KNEE IMPACT TEST

HYBRID III 22-SEP-93

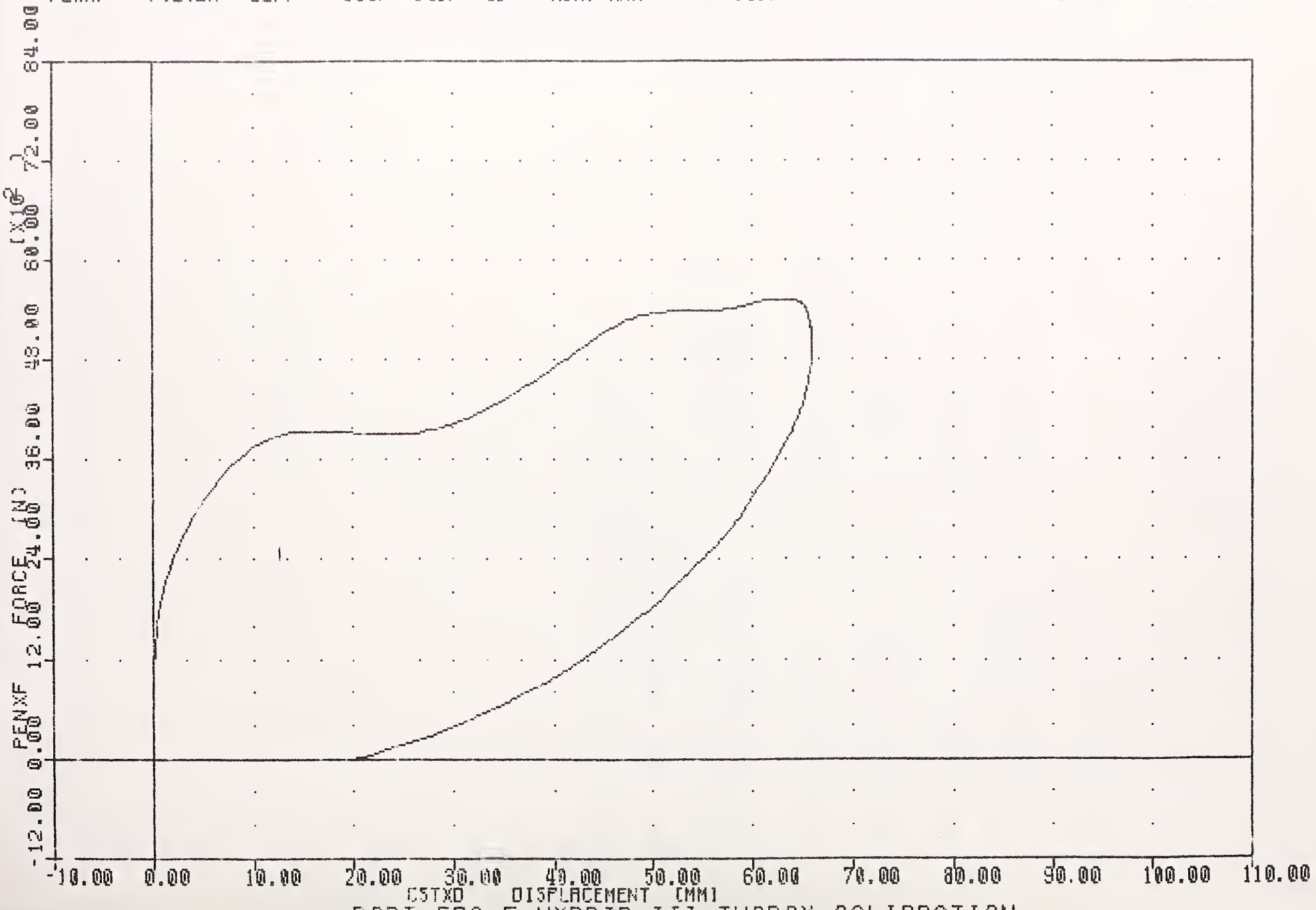
RIGHT KNEE
TRC 134C47RK1 572E SN134 RIGHT KNEE CAL 47

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10% - 70%	54.0 %
PROBE VELOCITY	2.07 - 2.13 M/SEC	2.08 M/SEC
PEAK KNEE IMPACT FORCE	4714 - 5783 N	5361.2 N
PROBE WEIGHT	5.0 KG	

TEST MEETS SPECIFICATIONS

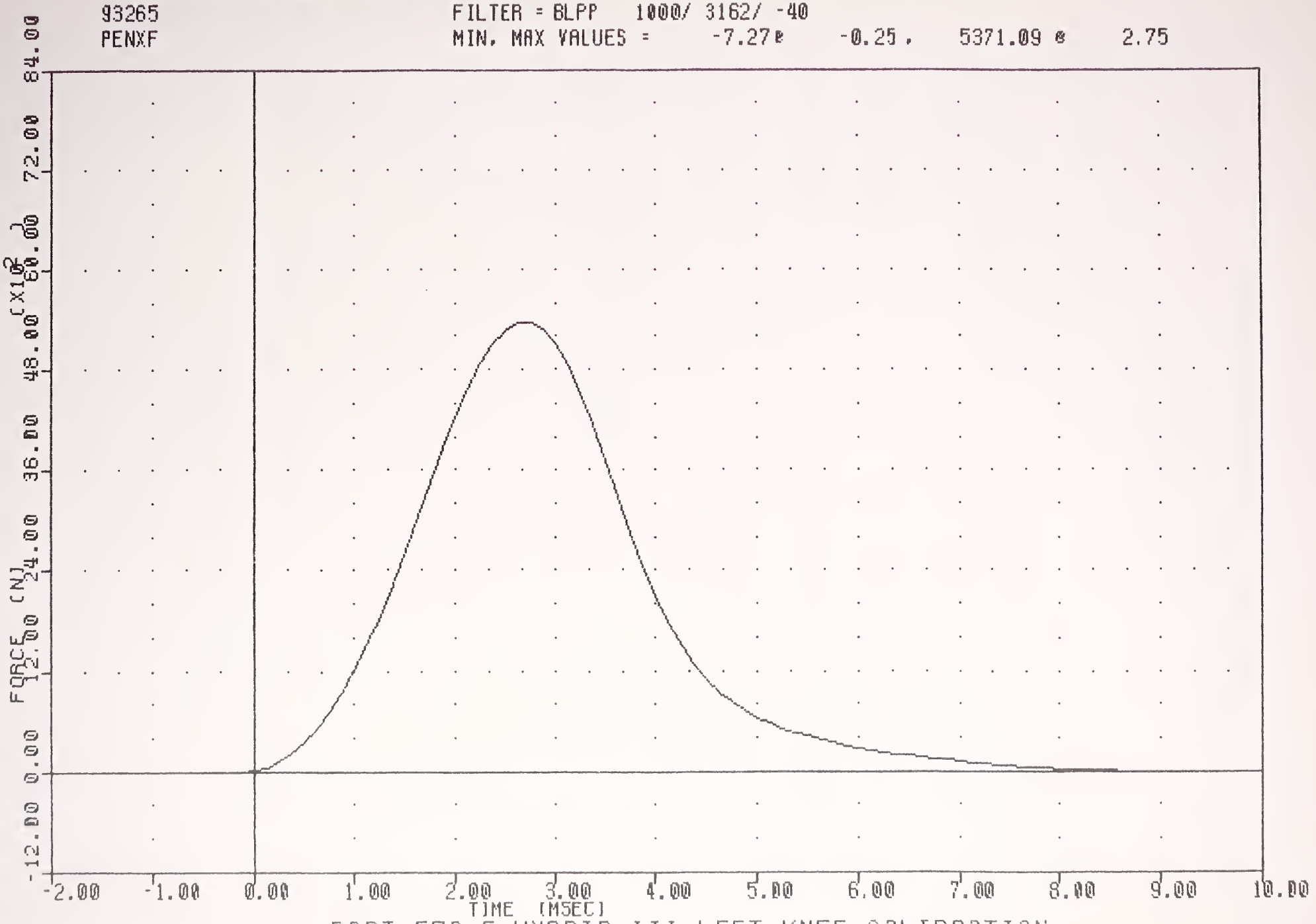
TECHNICIAN Pete Foust

TRL	,134C47TH1	572E SN134 H.S.THORAX CAL47		93265			
CSTXD	FILTER = BLPP	300/ 949/ -40	MIN, MAX =	-0.07 @	0.38 ,	66.04 @	25.00
PENXF	FILTER = BLPP	300/ 949/ -40	MIN, MAX =	-64.07 @	-1.00 ,	5526.16 @	19.25



PART 572-E HYBRID III THORAX CALIBRATION

CHEST DISPLACEMENT VS PENDULUM FORCE



PART 572-E HYBRID III LEFT KNEE CALIBRATION

PENDULUM FORCE (5 KG PEND.)

TRANSPORTATION RESEARCH CENTER INC.

KNEE IMPACT TEST

HYBRID III 22-SEP-93

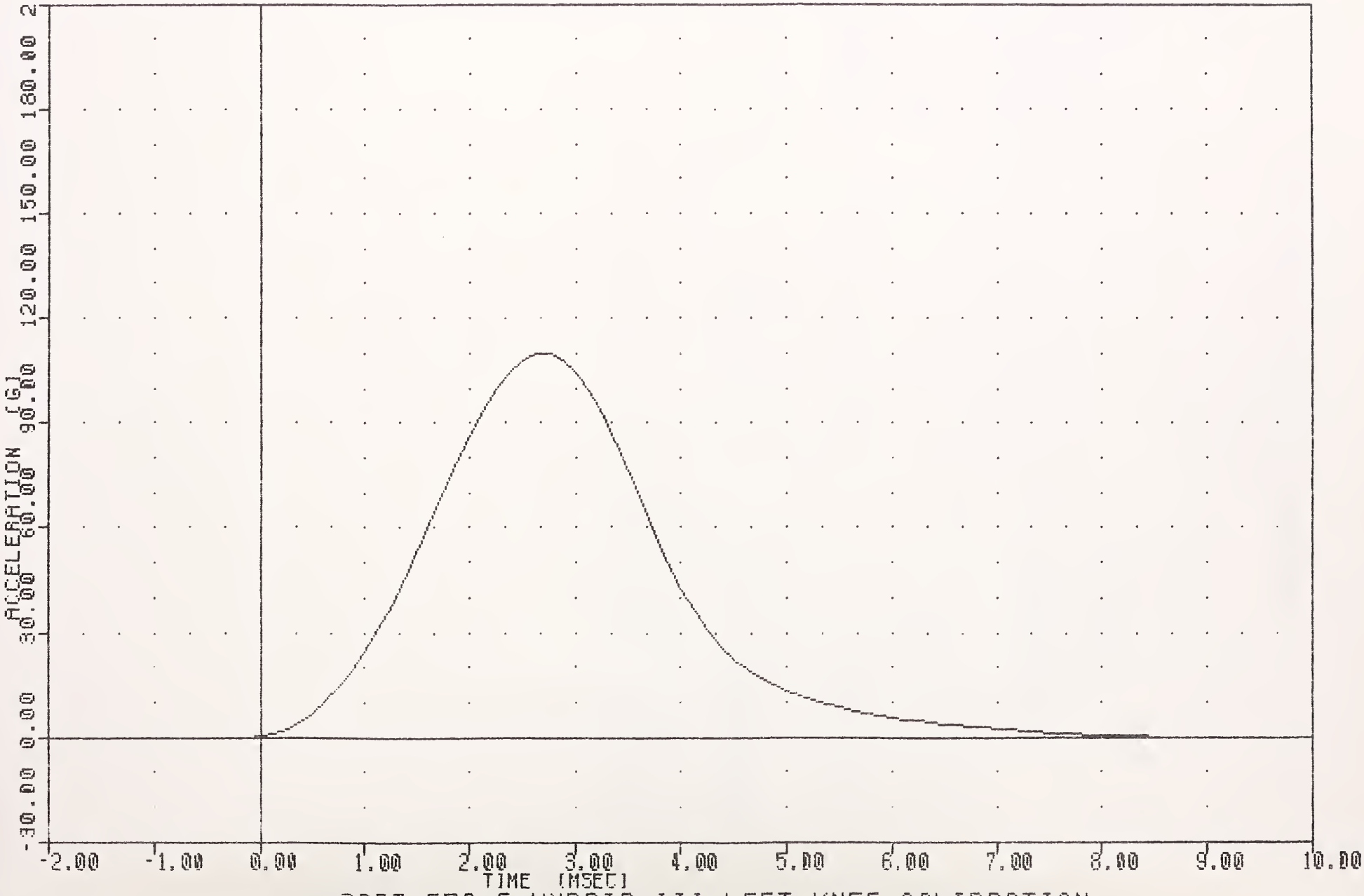
LEFT KNEE
TRC 134C47LK1 572E SN134 LEFT KNEE CAL 47

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10% - 70%	54.0 %
PROBE VELOCITY	2.07 - 2.13 M/SEC	2.08 M/SEC
PEAK KNEE IMPACT FORCE	4714 - 5783 N	5371.0 N
PROBE WEIGHT	5.0 KG	

TEST MEETS SPECIFICATIONS

TECHNICIAN Pete Fuchs

TRC , 134C47LK1
572E SN134 LEFT KNEE CAL 47
93265 FILTER = BLPP 1000/ 3162/ -40
PENXG MIN. MAX VALUES = -0.15 @ -0.25 , 109.78 @ 2.75



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

APPENDIX D

MISCELLANEOUS TEST INFORMATION

DUMMY INSTRUMENTATION PLACEMENT

DUMMY MANUFACTURER & S/N: ALDERSON RESEARCH LABS #177

SEATING POSITION: DRIVER

MNEMONIC	LOCATION	AXIS	MFR.	MODEL	S/N	ORIENTATION (+ SENSING)
HEDXG1	HEAD ACCELERATION	X	ENDEVCO	7231C	A45E	REAR
HEDYG1	HEAD ACCELERATION	Y	ENDEVCO	7231C	A76D	LEFT
HEDZG1	HEAD ACCELERATION	Z	ENDEVCO	7231C	A87F	UP
CSTXG1	CHEST ACCELERATION	X	ENDEVCO	7231C	A01E	FORWARD
CSTYG1	CHEST ACCELERATION	Y	ENDEVCO	7231C	A28A	LEFT
CSTZG1	CHEST ACCELERATION	Z	ENDEVCO	7231C	FC02	DOWN
CSTXD1	CHEST DISPLACEMENT	X	SERVO	14CB1-2981	CP2981	OUTWARD
LFMF1	LEFT FEMUR FORCE		GSE	2430	914	TENSION
RFMF1	RIGHT FEMUR FORCE		GSE	2430	905	TENSION

DUMMY INSTRUMENTATION PLACEMENT

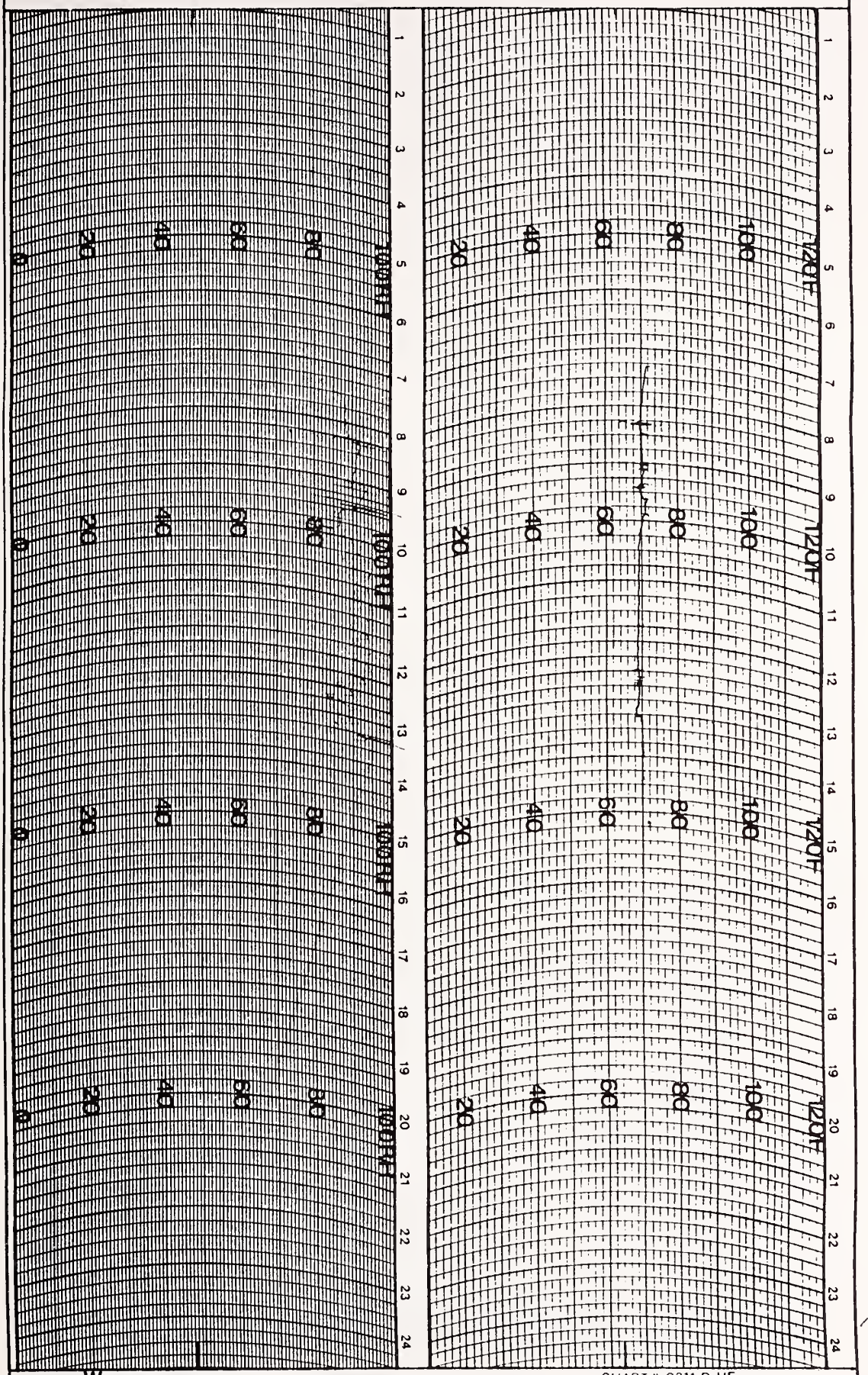
DUMMY MANUFACTURER & S/N: ALDERSON RESEARCH LABS #134

SEATING POSITION: RIGHT FRONT PASSENGER

MNEMONIC	LOCATION	AXIS	MFR.	MODEL	S/N	ORIENTATION (+ SENSING)
HEDXG2	HEAD ACCELERATION	X	ENDEVCO	7231C	GB86	REAR
HEDYG2	HEAD ACCELERATION	Y	ENDEVCO	7231C	A21E	LEFT
HEDZG2	HEAD ACCELERATION	Z	ENDEVCO	7231C	A19E	UP
CSTXG2	CHEST ACCELERATION	X	ENDEVCO	7231C	A17J	FORWARD
CSTYG2	CHEST ACCELERATION	Y	ENDEVCO	7231C	A35D	LEFT
CSTZG2	CHEST ACCELERATION	Z	ENDEVCO	7231C	A18E	DOWN
CSTXD2	CHEST DISPLACEMENT	X	VERNITECH	81422A	85861-25	OUTWARD
LFMF2	LEFT FEMUR FORCE		GSE	2430	608	TENSION
RFMF2	RIGHT FEMUR FORCE		GSE	2430	609	TENSION

VEHICLE INSTRUMENTATION PLACEMENT

MNEMONIC	LOCATION	AXIS	MFR.	MODEL	S/N	ORIENTATION (+ SENSING)
TLRXG1	LEFT REAR SEAT	X	ENDEVCO	2264	AS95	FORWARD
TRRXG1	RIGHT REAR SEAT	X	ENDEVCO	2264	AT38	FORWARD
ENGXG1	ENGINE TOP	X	ENDEVCO	2264	AZ67	REAR
ENGXG2	ENGINE BOTTOM	Y	ENDEVCO	2264	AR49	REAR
BCRXG1	RIGHT BRAKE CALIPER	X	ENDEVCO	2264	AG24	REAR
BCLXG1	LEFT BRAKE CALIPER	X	ENDEVCO	2264	BA68	FORWARD
DPCXG1	INSTRUMENT PANEL CENTER	X	ENDEVCO	2264	AY89	REAR
OTHXG1	FRONT BATTERY BOX - LEFT	X	ENDEVCO	2264	BA46	REAR
OTHXG2	FRONT BATTERY BOX - RIGHT	X	ENDEVCO	2264	AY66	REAR
OTHXG3	REAR BATTERY BOX - CENTER	X	ENDEVCO	2264	AU09	FORWARD



WEATHER MEASURE
P.O. BOX 41257
SACRAMENTO, CA. 95841
PHONE (916)481-7565

HYGROTHERMOGRAPH
1 DAY

CHART # C311 D HF
PART # 699123

STATION 930923 DATE ON _____ DATE OFF _____

OCCUPANT COMPARTMENT THERMOGRAPH

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