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Final Report

Reducing Heavy Truck Aggressiveness 1986 Ford Taurus 4-Door Sedan Into Barrier at 80.5 KPH

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16. Abstract

This test report documents a crash test that was conducted for research and development in support of reducing heavy truck aggressiveness. This test was conducted with a 1986 Ford Taurus 4-door sedan, VIN 1FABP29U4GG209979, at Transportation Research Center Inc. on December 17, 1993. The test vehicle impacted the angled barrier at 80.5 kph. The vehicle contained eight (8) accelerometers and one (1) instrumented Hybrid III driver dummy.

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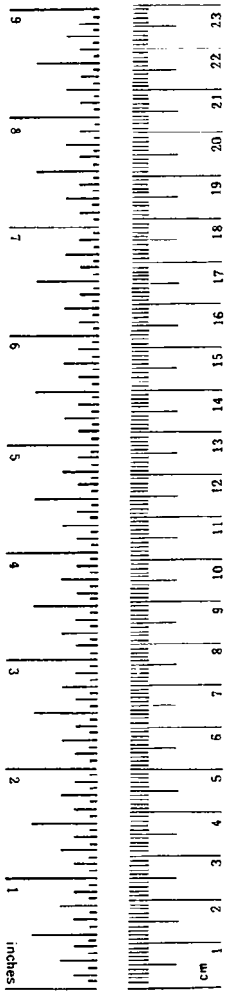
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

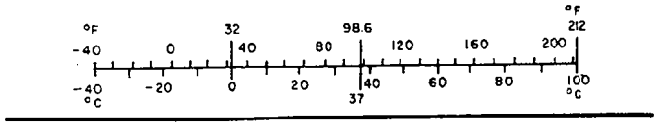
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2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

This test was conducted as research in support of reducing heavy truck aggressiveness. This test was conducted on December 17, 1993.

The test vehicle, a 1986 Ford Taurus 4-door sedan, was equipped with a 3.0-liter, 6-cylinder, transverse gasoline engine and a 3-speed automatic transmission. The test weight of the vehicle was 1559.5 kg. The vehicle was instrumented with six (6) longitudinal axis accelerometers, one (1) lateral axis accelerometer, one (1) vertical axis accelerometer and two (2) seat belt force load cells. One (1) Part 572E dummy was seated in the left front outboard seating position according to the dummy placement procedure specified in Appendix B and Optional Appendix C of Laboratory Procedure TP-208-08. The dummy was instrumented in the head, chest, and pelvis with longitudinal, lateral, and vertical accelerometers. The dummy was also instrumented with a 6-axis neck load cell, two (2) femur load cells, and a chest deflection potentiometer.

The test vehicle impacted a stationary barrier at 80.5 kph. The stationary barrier was set at a 50 degree angle to the rail and a 45 degree angle to the ground. The weight of the barrier ballast was 11,512 kg.

The dummy's head injury criterion, HIC, was 508. The dummy's chest deceleration with 3 milliseconds minimum duration was 42.0 g. The dummy's maximum chest deflection was 13.8 mm. The dummy's maximum left femur force was 1102 N. The dummy's maximum right femur force was 1711 N.

The vehicle, dummy, and heavy truck data were multiplexed and recorded on a 14-channel analog tape deck. The analog data was digitally sampled at 12,500 samples per second. The data was digitally filtered as per SAE J211 OCT88.

The test was filmed by one (1) real-time panning motion picture camera and four (4) high-speed motion picture cameras operating at approximately 500 frames per second.

Section 2.0 contains the vehicle, dummy, truck, and test data. Appendix A contains the pre- and post-test still photographs. Appendix B contains the final test data plots. Appendix C contains dummy certification information. Appendix D contains miscellaneous test information.

SECTION 2.0

VEHICLE, DUMMY, TRUCK AND TEST DATA

DATA ACQUISITION EXPLANATIONS

The driver head X-axis acceleration, HEDXG1, recorded an anomalous spike at 141 milliseconds. The driver head resultant, HEDRG1, and X-axis velocity, HEDXV1, calculations were affected by this test anomaly.

The engine top X-axis accelerometer, ENGXG1, lost data at 2388 milliseconds because the accelerometer cable was cut by vehicle crush. This data loss affected the engine top X-axis velocity calculation, ENGXV1.

The vehicle center of gravity acceleration, VCGXG1, recorded anomalous data spikes throughout the crash test because of a ground fault in the data cable. The vehicle center of gravity resultant acceleration, VCGRG1, and X-axis velocity, VCGXV1, calculations were affected by this test anomaly.

TABLE 1 CRASH TEST SUMMARY

TEST TYPE: Vehicle into barrier

TEST DATE: 12/17/93 TEST TIME: 1433 AMBIENT TEMP. (°C): 1

VEHICLE YEAR/MAKE/MODEL/BODY STYLE: 1986/Ford /Taurus/4-door sedan

VEHICLE TEST WEIGHT (KG): 1559.5

IMPACT ANGLE (DEG)*: 310

IMPACT VELOCITY (KPH)**: PRIMARY = 80.5 SECONDARY = 80.5

MAXIMUM STATIC CRUSH (MM): 58

DUMMY: Driver #048

TYPE: Part 572E

LOCATION: Left front

RESTRAINT: 3-point unibelt

NUMBER OF DATA CHANNELS: 28

NUMBER OF CAMERAS: HIGH-SPEED 4 REAL-TIME 1

*With respect to tow track centerline.
**Speed trap measurement (± .08 kph accuracy)

TABLE 2 TEST VEHICLE INFORMATION

VEHICLE MANUFACTURER: Ford Motor Corporation

MAKE/MODEL: Ford /Taurus VIN: 1FABP29U4GG209979

BODY STYLE: 4-door sedan MODEL YEAR: 1986

COLOR: Blue

ENGINE DATA: TYPE: transverse CYLINDERS: 6 DISPLACEMENT: 3.0 liters

TRANSMISSION DATA: _3_SPEED, ___MANUAL, _X_AUTOMATIC, _X_FWD, ___RWD, ___4WD

DATE VEHICLE RECEIVED: NA ODOMETER READING: NA

DEALER'S NAME AND ADDRESS: NA

ACCESSORIES:

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

REMARKS:

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

CERTIFICATION DATA FROM VEHICLE'S LABEL:

VEHICLE MANUFACTURED BY: Ford Motor Corporation

DATE OF MANUFACTURE: 05/86 VIN: 1FABP29U4GG209979

GVWR: 4550 LBS

GAWR: FRONT: 2514 LBS., REAR: 2071 LBS.

TABLE 2 TEST VEHICLE INFORMATION CONT'D.

TIRES ON VEHICLE (MFR., LINE, SIZE): Goodyear, Invicta GL, P205/70R14

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

SPARE TIRE (MFR., SIZE): Michelin X, T135/80R14

TYPE OF SEATS: FRONT: Bucket
REAR: Bench

TYPE OF FRONT SEAT BACKS: Manually adjustable

MAXIMUM WIDTH: 1805 MILLIMETERS

WHEELBASE: 2693 MILLIMETERS

LOCATION OF LABEL STATING TIRE & CAPACITY DATA:

The label was located on the right rear door.

TIRE & CAPACITY DATA FROM VEHICLE'S LABEL:

RECOMMENDED TIRE SIZE: P205/70R14

RECOMMENDED COLD TIRE PRESSURE: FRONT: 35 PSI; REAR: 32 PSI

DESIGNATED SEATING CAPACITY: 2 FRONT 3 REAR 5 TOTAL

VEHICLE CAPACITY WEIGHT: 700 LBS.

TEST VEHICLE ATTITUDE (ALL MEASUREMENTS ARE IN MILLIMETERS):

DELIVERED ATTITUDE:	LF	683;	RF	691;	LR	625;	RR	630
PRE-TEST ATTITUDE:	LF	676;	RF	683;	LR	602;	RR	607
POST-TEST ATTITUDE:	LF	NA;	RF	NA;	LR	NA;	RR	NA

TABLE 2 TEST VEHICLE INFORMATION CONT'D.

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

RIGHT FRONT	469.5 KG	RIGHT REAR	252.0 KG
LEFT FRONT	477.0 KG	LEFT REAR	257.0 KG
TOTAL FRONT WEIGHT	946.5 KG	(65.0% OF TOTAL VEHICLE WEIGHT)	
TOTAL REAR WEIGHT	509.0 KG	(35.0% OF TOTAL VEHICLE WEIGHT)	
TOTAL DELIVERED WEIGHT	1455.5 KG		
TARGET TEST WEIGHT	1581.0 KG[1]		

WEIGHT OF TEST VEHICLE:

RIGHT FRONT	483.5 KG	RIGHT REAR	281.0 KG
LEFT FRONT	499.5 KG	LEFT REAR	295.5 KG
TOTAL FRONT WEIGHT	983.0 KG	(63.0% OF TOTAL VEHICLE WEIGHT)	
TOTAL REAR WEIGHT	576.5 KG	(37.0% OF TOTAL VEHICLE WEIGHT)	
TOTAL TEST WEIGHT	1559.5 KG	(1.4% UNDER TARGET WEIGHT)	

WEIGHT OF BALLAST SECURED IN VEHICLE CARGO AREA: None

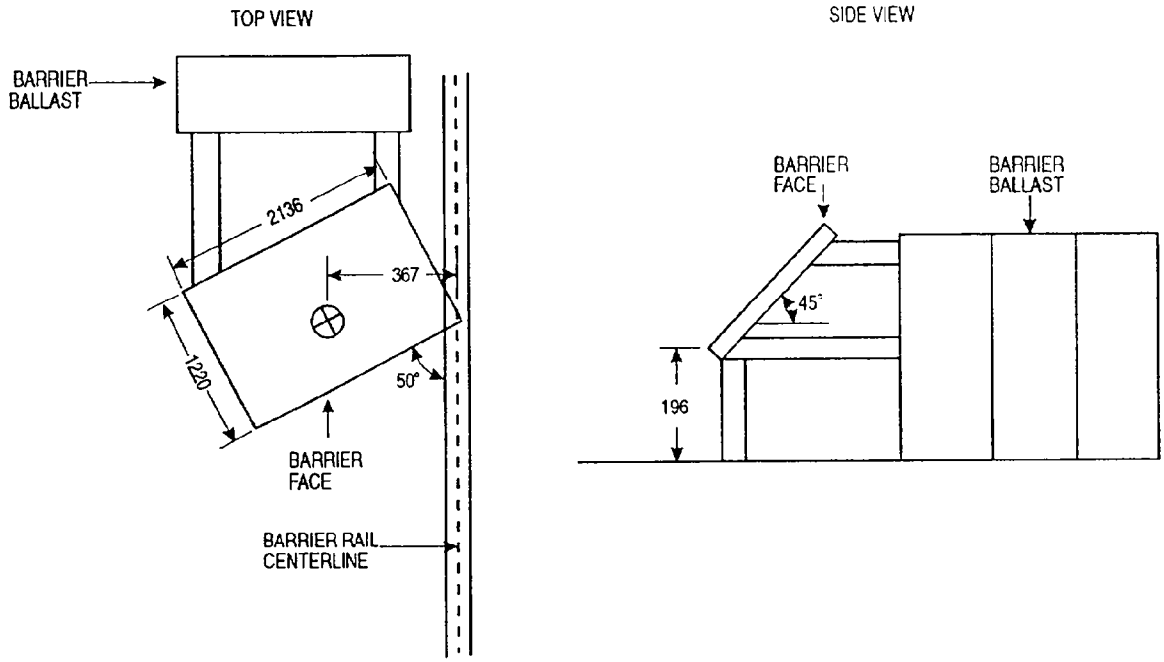
COMPONENTS REMOVED TO MEET TARGET TEST WEIGHT: Rear bumper, muffler

CG = 996 MILLIMETERS REARWARD OF FRONT WHEEL CENTERLINE

[1]The target test weight was established during Test 920507.

TABLE 3 BARRIER INFORMATION

Barrier angle with respect to the rail: 50° C
Barrier angle with respect to the ground: 45° C
Barrier ballast weight: 11,512 kg



All linear measurements are in millimeters.

FIGURE 1 VEHICLE IMPACT AND RESTING POSTION

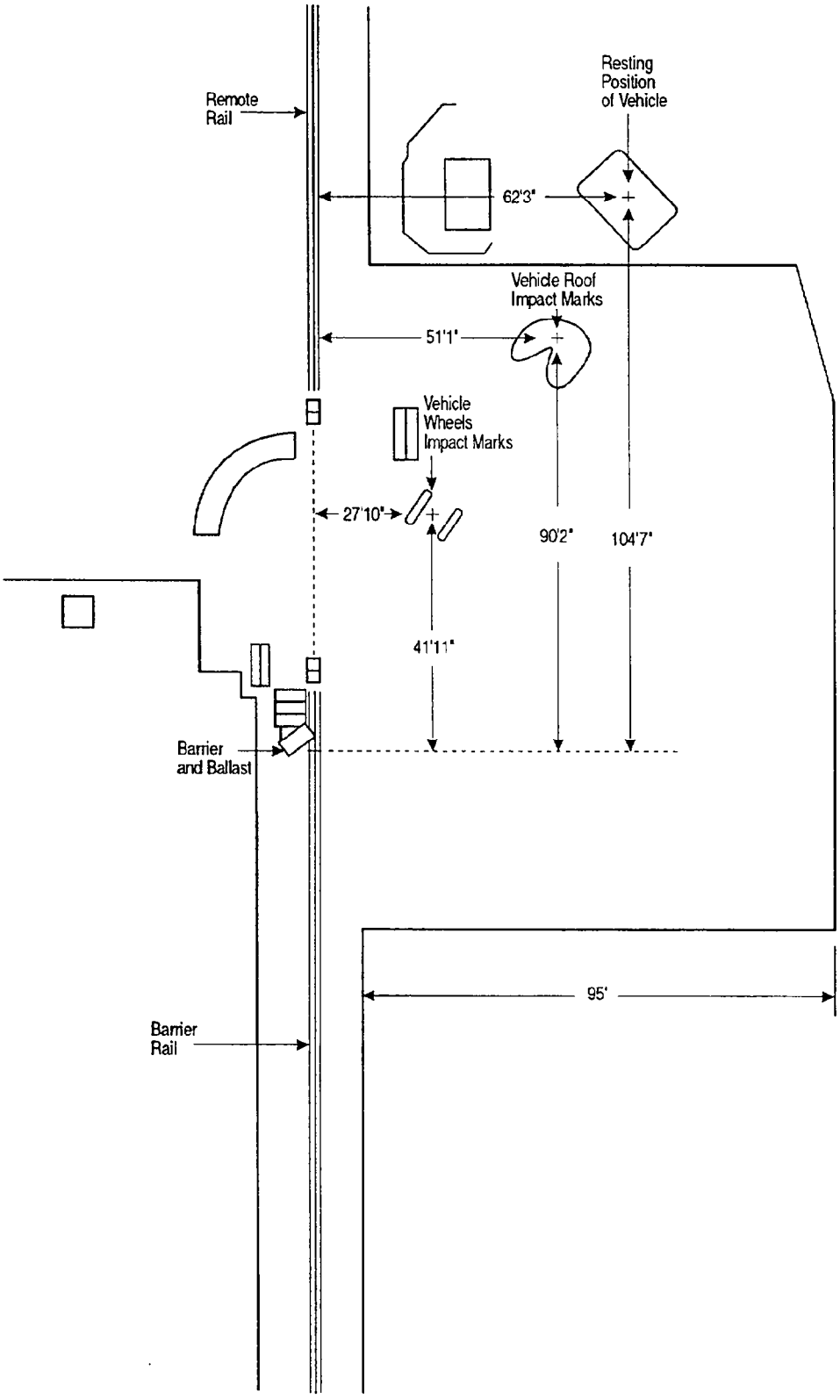


TABLE 4 POST-IMPACT DATA

TEST NUMBER: 931217

TEST DATE: 12/17/93 TEST TIME: 1433

TEST TYPE: Vehicle into barrier IMPACT ANGLE: 310°

AMBIENT TEMPERATURE AT IMPACT AREA: 1° C

TEMPERATURE IN OCCUPANT COMPARTMENT: 20° C

IMPACT VELOCITY: PRIMARY = 80.5 KPH
SECONDARY = 80.5 KPH

(SPECIFIED RANGE = 79.7 TO 81.3 KPH)

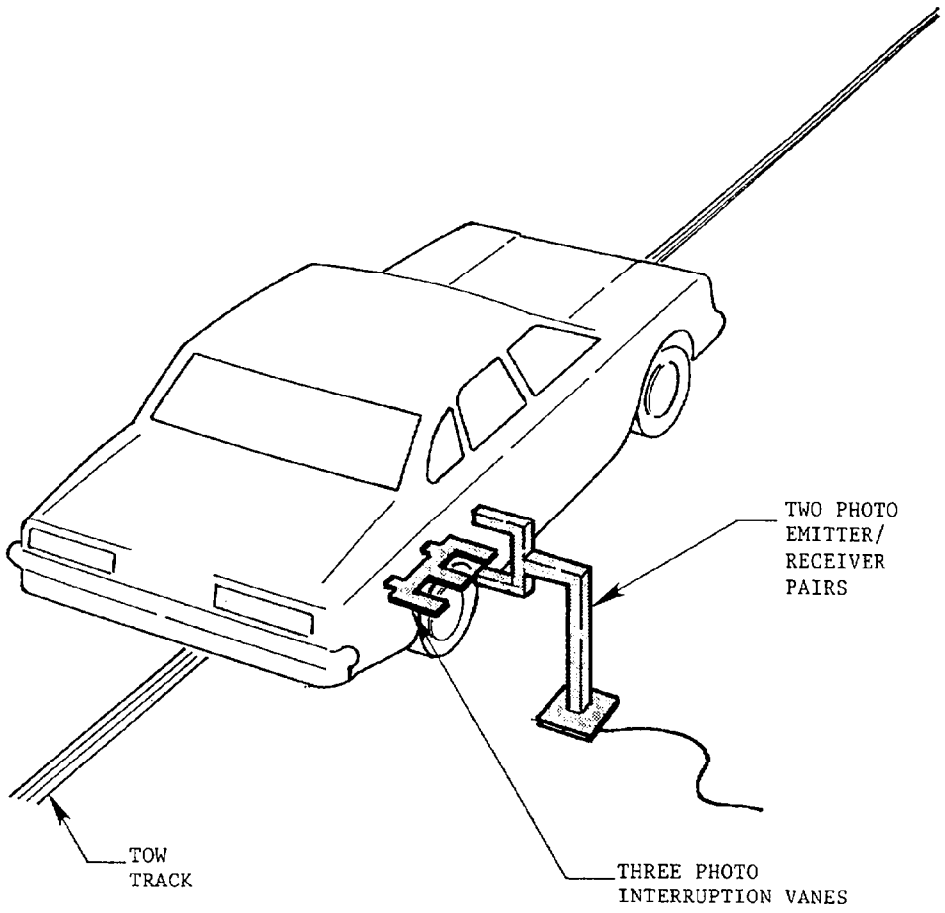
DISTANCE FROM VEHICLE TO BARRIER: ENTERING VELOCITY TRAP = 381 MM

EXITING VELOCITY TRAP = 51 MM

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

OVERALL LENGTH OF TEST VEHICLE:	PRE-TEST:	L	4636;	C	4783;	R 4632
	POST-TEST:	L	4578;	C	4782;	R 4681
	TOTAL CRUSH:	L	58;	C	1;	R -49
	AVERAGE CRUSH:	3				

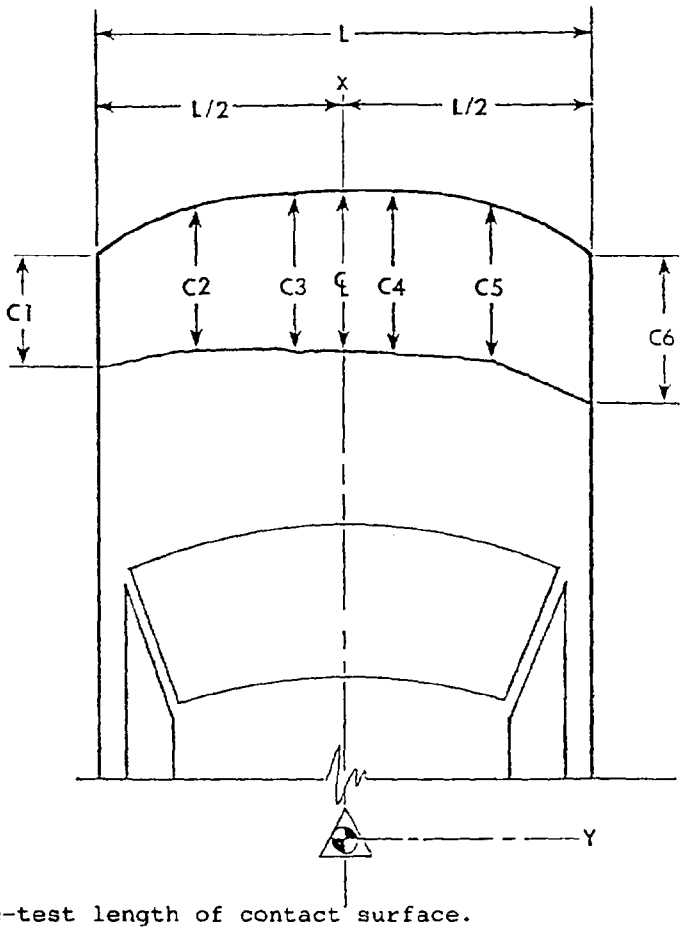
FIGURE 2 IMPACT VELOCITY MEASUREMENT SYSTEM



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

The vanes have 305-millimeter spacing.

FIGURE 3 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 Ford Taurus

	PRE-TEST		POST-TEST		CRUSH
L	1524				
C1	4636	C1	4578	C1	58
C2	4718	C2	4677	C2	41
C3	4751	C3	4752	C3	-1
C4	4751	C4	4772	C4	-21
C5	4712	C5	4753	C5	-41
C6	4632	C6	4681	C6	-49
CL	4783	CL	4782	CL	1

FIGURE 4 PRE-TEST AND POST-TEST MEASUREMENT POINTS

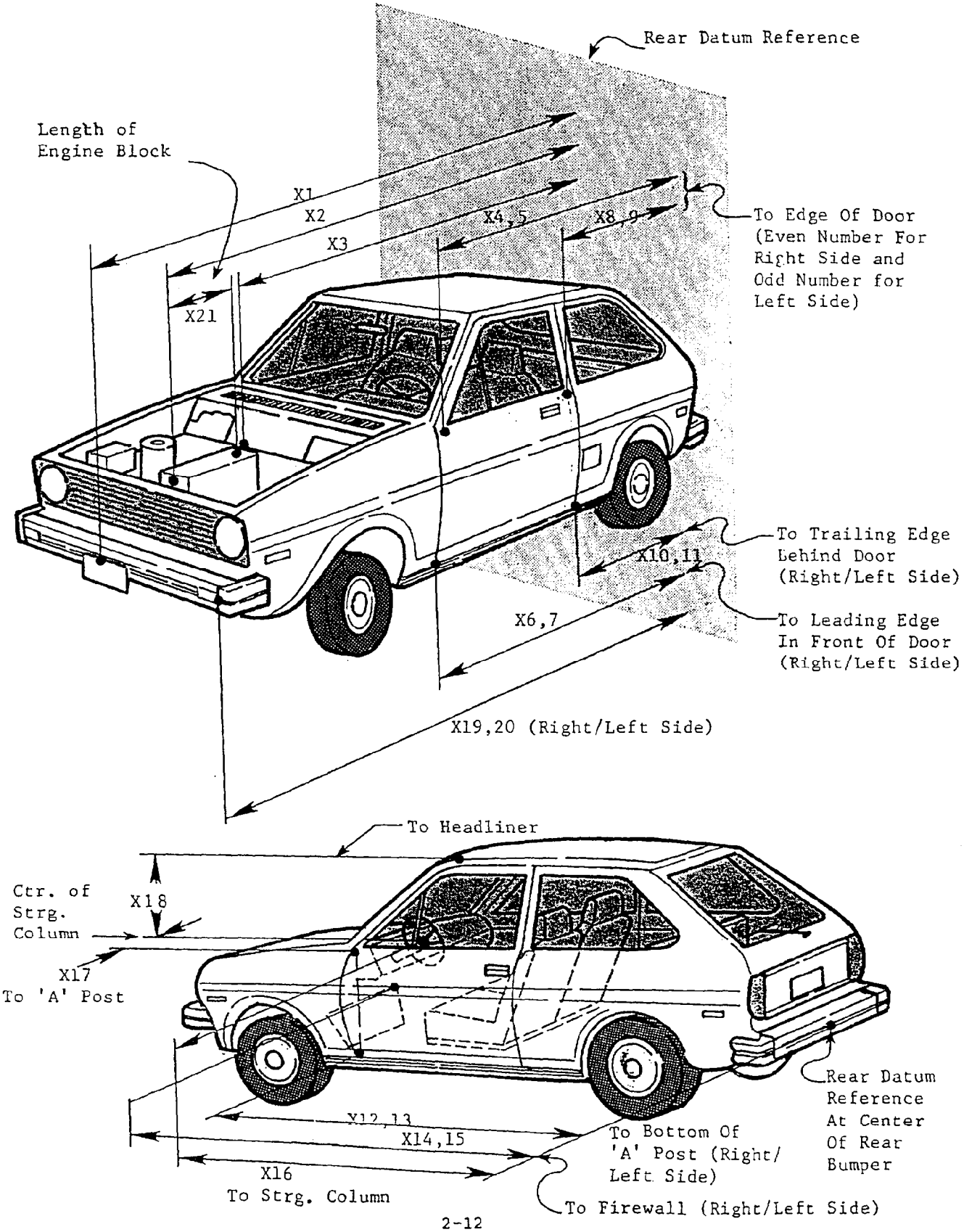


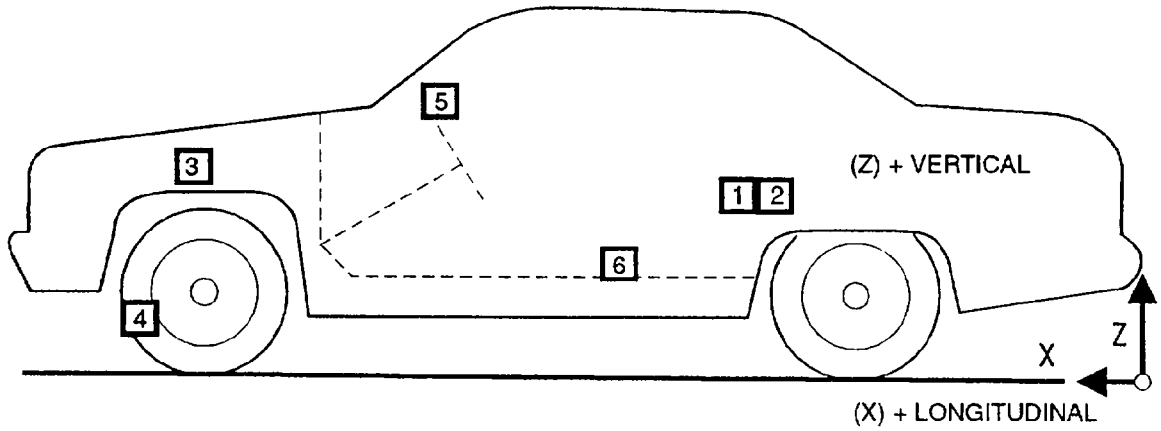
TABLE 5 IMPACTED VEHICLE MEASUREMENTS

VEHICLE MAKE/MODEL: Ford /Taurus TEST NUMBER: 931217

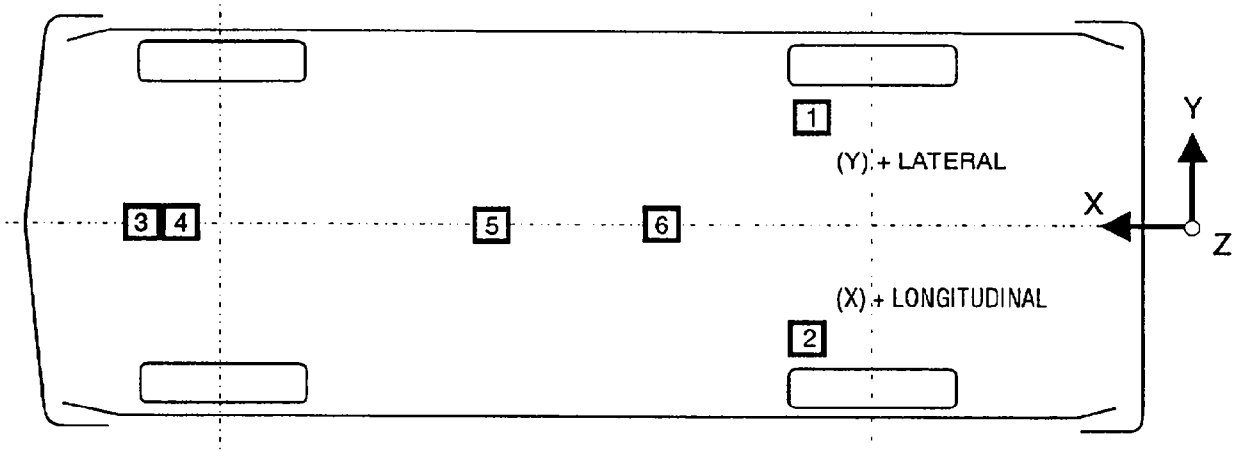
NO.	TYPE OF MEASUREMENT	PRE-TEST	POST-TEST	DIFF.
X1	TOTAL LENGTH OF VEHICLE AT CENTERLINE	4783	4782	1
X2	REAR SURFACE OF VEHICLE TO FRONT OF ENGINE BLOCK	4215	4284	-69
X3	REAR SURFACE OF VEHICLE TO FIREWALL	3594	3611	-17
X4	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF RIGHT DOOR	3296	3331	-35
X5	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF LEFT DOOR	3297	3324	-27
X6	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF RIGHT DOOR	3219	3238	-19
X7	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF LEFT DOOR	3227	3246	-19
X8	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF RIGHT DOOR	2208	2240	-32
X9	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF LEFT DOOR	2216	2241	-25
X10	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF RIGHT DOOR	2174	2201	-27
X11	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF LEFT DOOR	2184	2199	-15
X12	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON RIGHT SIDE	3245	NA	NA
X13	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON LEFT SIDE	3238	3251	-13
X14	REAR SURFACE OF VEHICLE TO FIREWALL - RIGHT SIDE	3556	3576	-20
X15	REAR SURFACE OF VEHICLE TO FIREWALL - LEFT SIDE	3532	3549	-17
X16	REAR SURFACE OF VEHICLE TO STEERING WHEEL CENTER	2775	2779	-4
X17	CENTER OF STEERING COLUMN TO "A" POST	279	321	-42
X18	CENTER OF STEERING COLUMN TO HEADLINER	419	376	-43
X19	REAR SURFACE OF VEHICLE TO RIGHT SIDE OF FRONT BUMPER	4632	4681	-49
X20	REAR SURFACE OF VEHICLE TO LEFT SIDE OF FRONT BUMPER	4636	4578	58
X21	LENGTH OF ENGINE BLOCK	381	381	0

All distance measurements are in millimeters.

FIGURE 5 VEHICLE ACCELEROMETER PLACEMENT



SIDE VIEW



BOTTOM VIEW

TABLE 6

VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

TEST NUMBER 931217

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	1886	610	368	2.7	153.9	14.8	52.8
2	RIGHT REAR SEAT CROSSMEMBER LONGITUDINAL	1886	-616	370	3.0	269.8	23.9	62.4
3	ENGINE TOP LONGITUDINAL[1]	3912	-90	833	---	---	---	---
4	ENGINE BOTTOM LONGITUDINAL	3915	25	191	38.2	69.6	72.2	35.8
5	INSTRUMENT PANEL CENTER LONGITUDINAL	3200	0	942	11.3	125.4	33.2	60.9

TABLE 6

VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY CONTINUED

TEST NUMBER 931217

No.	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION MAX G	POSITIVE DIRECTION MSEC	NEGATIVE DIRECTION MAX G	NEGATIVE DIRECTION MSEC
6	CENTER OF GRAVITY	2184	0	327				
	LONGITUDINAL[1]				---	---	---	---
	LATERAL				5.6	122.4	26.4	63.6
	VERTICAL				30.5	71.4	21.9	53.8
	RESULTANT[1]				---	---	0.2	0.0

* 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

TABLE 7

DUMMY DATA SUMMARY

TEST NUMBER 931217

	DRIVER DUMMY SN: 048			
	POSITIVE DIRECTION		NEGATIVE DIRECTION	
	MAX	MSEC	MAX	MSEC
HEAD ACCELERATION (g)				
LONGITUDINAL[1]	---	---	---	---
LATERAL	7.8	294.2	71.9	116.4
VERTICAL	8.9	75.9	43.9	102.7
RESULTANT[1]	---	---		
HIC	508 FROM 92.0 TO 123.4			
NECK FORCE (N)				
LONGITUDINAL	1105.6	116.2	118.5	279.8
LATERAL	940.8	118.2	192.7	206.6
VERTICAL	1767.6	100.5	282.6	71.0
RESULTANT	1965.4	97.3		
NECK MOMENT (N-M)				
ABOUT X	22.0	94.2	38.7	112.5
ABOUT Y	61.5	113.0	46.2	89.8
ABOUT Z	28.2	117.8	5.1	193.0
RESULTANT	77.0	113.0		

TABLE 7

DUMMY DATA SUMMARY CONTINUED

TEST NUMBER 931217

	DRIVER DUMMY SN: 048			
	POSITIVE DIRECTION		NEGATIVE DIRECTION	
	MAX	MSEC	MAX	MSEC
CHEST ACCELERATION (g)				
LONGITUDINAL	3.0	154.7	25.5	86.8
LATERAL	2.9	294.2	30.4	89.1
VERTICAL	22.4	88.5	12.6	116.2
RESULTANT	43.6	87.4		
3 MSEC	42.0			
CHEST DEFLECTION (mm)				
LONGITUDINAL	13.8	120.3	0.4	58.2
PELVIS ACCELERATION (g)				
LONGITUDINAL	4.9	64.6	16.5	57.9
LATERAL	5.8	189.8	25.5	75.0
VERTICAL	22.1	88.1	11.4	116.5
RESULTANT	30.8	76.3		
FEMUR LOAD (N)				
LEFT	742.5	92.6	1101.9	56.6
RIGHT	853.0	92.4	1711.0	59.8

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

[1] See TEST ANOMALIES

TABLE 8 POST-IMPACT DUMMY/VEHICLE DATA

VISIBLE DUMMY CONTACT POINTS:

	DRIVER #048	PASSENGER # NA
HEAD	Inner door panel, roof	
CHEST	None	
ABDOMEN	None	
LEFT KNEE	None	
RIGHT KNEE	None	

DOOR OPENING:

	LEFT	RIGHT
FRONT	Opened easily	Opened w/ difficulty
REAR	Tools required	Opened w/ difficulty

SEAT MOVEMENT:

	SEAT BACK FAILURE	SEAT SHIFT
FRONT	None	None
REAR	NA	NA

GLAZING DAMAGE:

The entire windshield and all passenger side glass broke during the crash test.

OTHER NOTABLE IMPACT EFFECTS:

Both left side tires were deflated during the crash test.

DUMMY KINEMATIC SUMMARY

The dummy translated forward and to the left at impact. The dummy's head and left arm impacted the inner panel of the driver's door. The dummy rebounded to the rear and right. The driver's side wheels struck the ground and caused the dummy to fall to the left and the vehicle to roll onto it's roof. The dummy came to rest in the driver's seat with the dummy's head in contact with the vehicle's roof. The dummy was restrained by the three point uni-belt.

FIGURE 6 DUMMY AND SEAT POSITIONING DATA

PRE-IMPACT DATA:

MAKE/MODEL/BODY STYLE: Ford /Taurus/4-door sedan
MODEL YEAR: 1986 COLOR: Blue

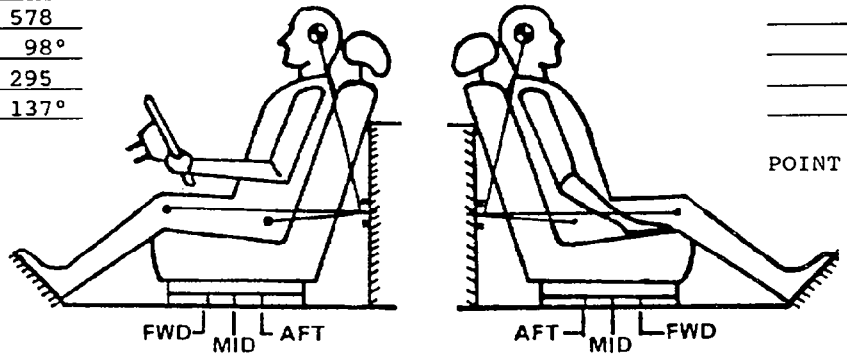
DATA FROM CERTIFICATION LABEL:

VEHICLE MANUFACTURER: Ford Motor Corporation
DATE OF MANUFACTURE: 05/86 VIN: 1FABP29U4GG209979
GVWR: 4550 LBS.; GAWR: FRONT = 2514 LBS.; REAR = 2071 LBS.

POST-IMPACT DATA:

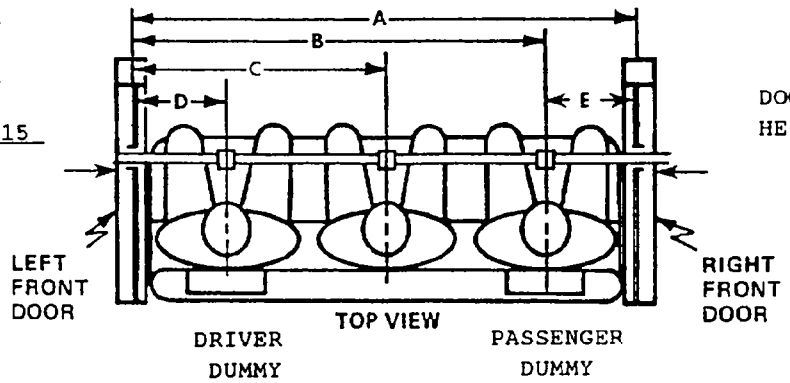
DATE OF TEST: 12/17/93 TIME: 1433 TEMPERATURE: 1° C
IMPACT VELOCITY: PRIMARY = 80.5 MPH SECONDARY = 80.5 MPH
REQUIRED IMPACT VELOCITY RANGE: 79.7 TO 81.3 MPH
SEAT TYPE: Bucket ADJUSTER TYPE: Power
FRONT SEAT BACK TYPE: Manually-adjustable
TECHNICIANS: J. Walters, S. Ericksen, N. Echeverria

DRIVER DUMMY # 048 TYPE: HIII		PASSENGER DUMMY # NA TYPE:	
HEAD	439		HEAD
TARGET	7°		TARGET
KNEE	578		KNEE
JOINT	98°		JOINT
APPROX-	295		APPROX-
IMATE	137°		IMATE
"H"			"H"
POINT			POINT



A = 1402
B = NA
C = NA
D = 349
E = NA
DOOR GLASS HEIGHT = 215

DOOR GLASS HEIGHT = _____



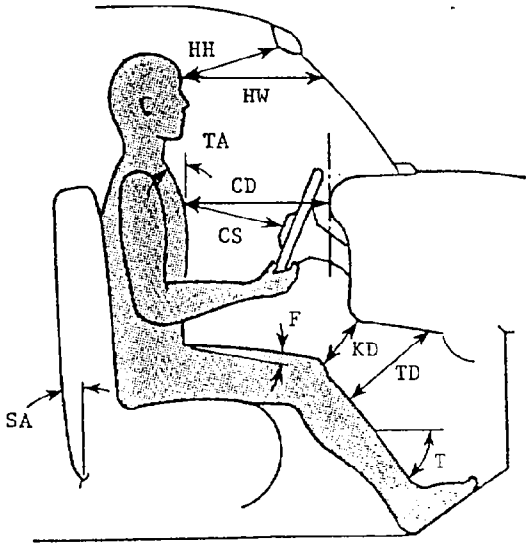
ALL ANGLES ARE RELATIVE TO VERTICAL PLANE THROUGH DOOR STRIKER.
ALL DISTANCE MEASUREMENTS ARE IN MILLIMETERS.

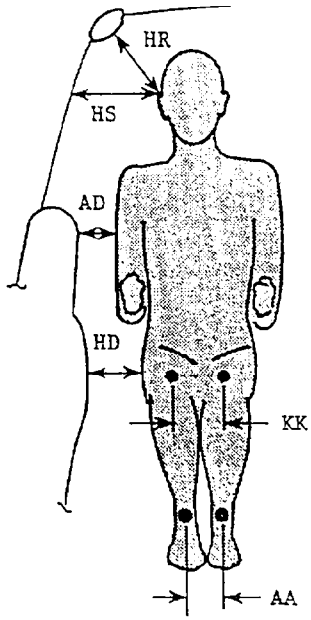
FIGURE 7 DUMMY IN VEHICLE POSITIONING DATA

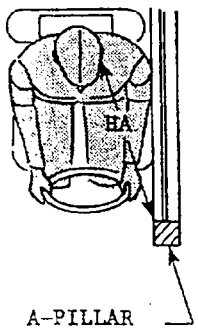
	DRIVER 048	PASSENGER NA
HH	375	
HW	626	
CD	579	
CS	351	
KDL	140	
KDR	141	
TA	19°	
SA	25°	
HSW	456	

	DRIVER 048	PASSENGER NA
HR	206	
HS	275	
AD	106	
HD	185	
KK	200	
AA	240	
HA	593	

KNEE OUTER CLEVIS TO
OUTER CLEVIS SPACING:
DRIVER = 289
PELVIS ANGLE:
DRIVER = 25°





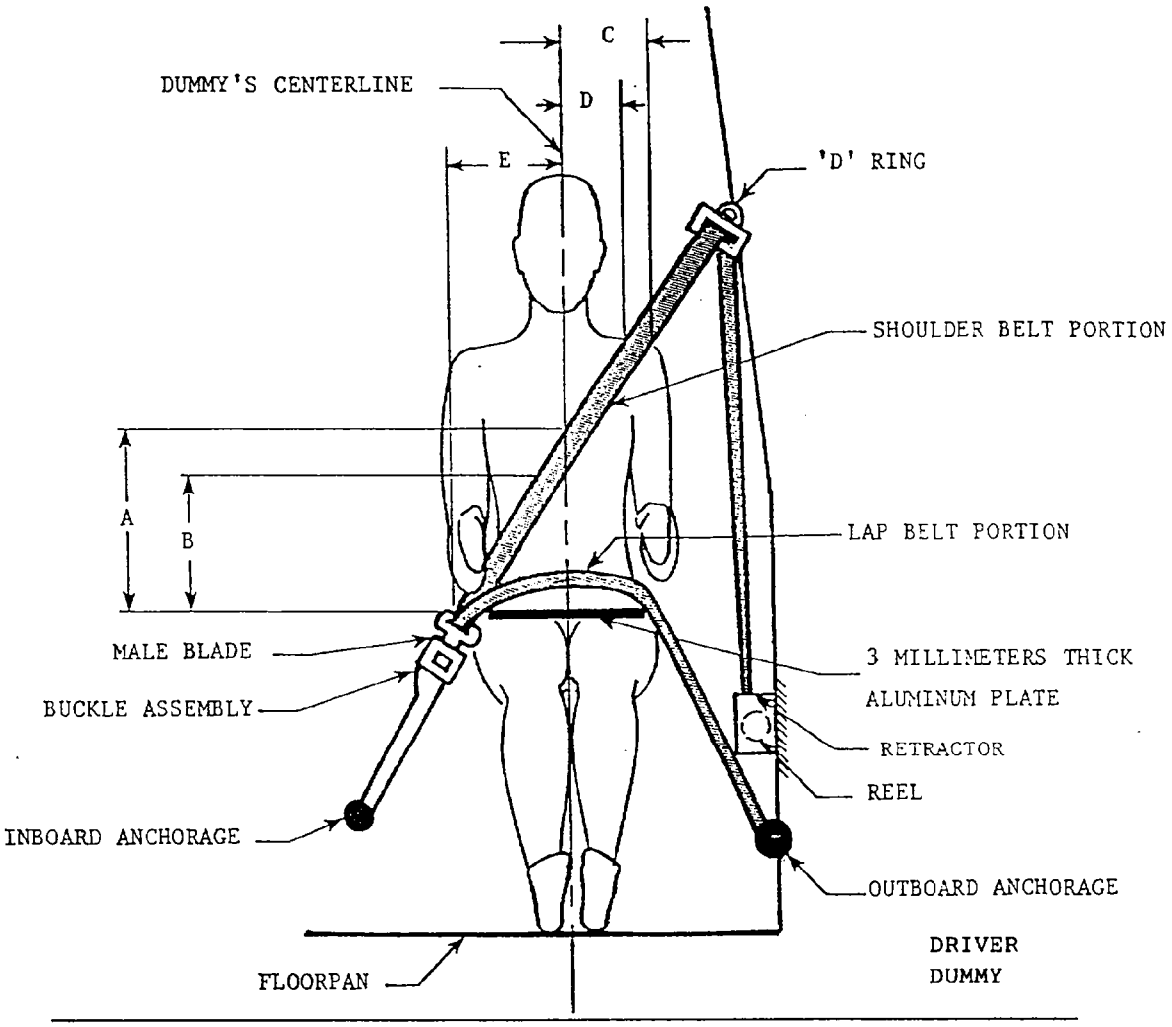


HH = HEAD TO WINDSHIELD HEADER
HW = HEAD TO WINDSHIELD
CD = CHEST TO DASH
CS = CHEST TO STEERING WHEEL
KD = KNEE TO DASH
TA = TORSO ANGLE
SA = SEAT BACK ANGLE
HSW= HEAD TO STEERING WHEEL

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

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

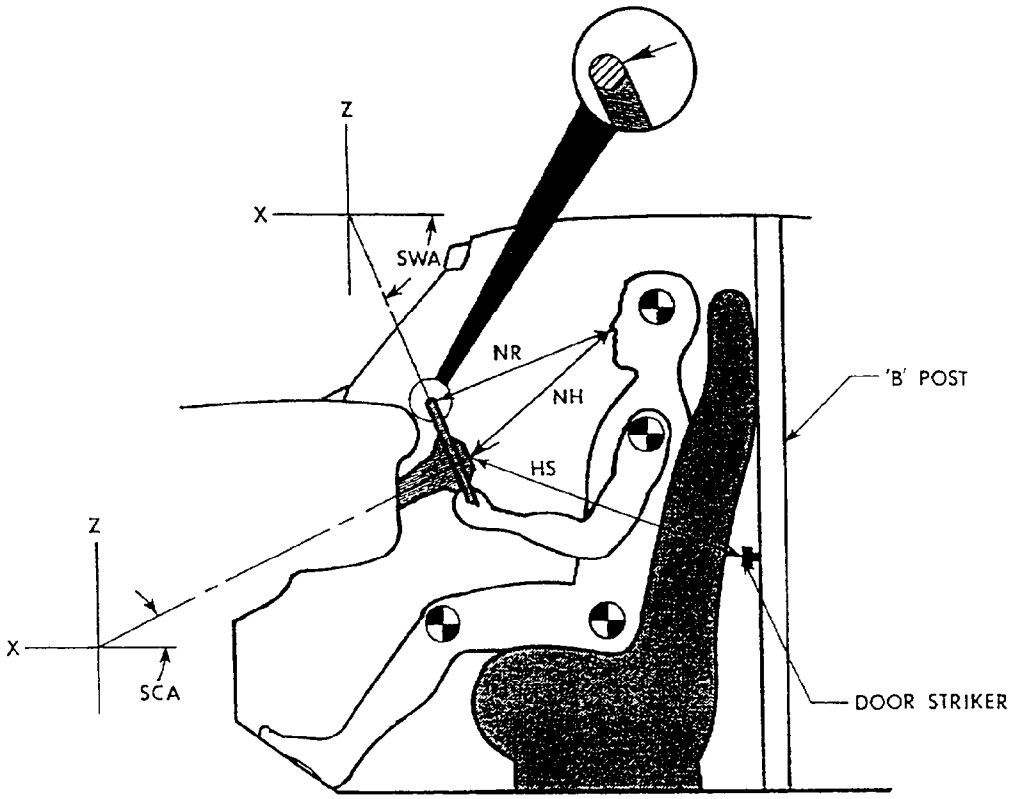
FIGURE 8 SEAT BELT POSITIONING DATA



A - TOP SURFACE OF ALUMINUM PLATE TO BELT UPPER EDGE	320
B - TOP SURFACE OF ALUMINUM PLATE TO BELT LOWER EDGE	239
C - DUMMY CENTERLINE TO OUTER EDGE OF BELT AT CHEST FLESH TOP	114
D - DUMMY CENTERLINE TO INNER EDGE OF BELT AT CHEST FLESH TOP	56
E - DUMMY CENTERLINE TO INTERSECTION OF UPPER TORSO BELT AND LAP BELT	208

ALL MEASUREMENTS ARE IN MILLIMETERS.

FIGURE 9 DRIVER DUMMY TO STEERING COLUMN/WHEEL ASSEMBLY DATA



POSITION OF STEERING COLUMN TILTING AND TELESCOPING ADJUSTMENTS, IF ANY:
The steering column was fastened in the middle position.

	MEASUREMENTS
NR - DISTANCE FROM TIP OF DUMMY'S NOSE TO TOP REAR SURFACE OF STEERING WHEEL RIM.	422
NH - DISTANCE FROM TIP OF DUMMY'S NOSE TO CENTER OF STEERING COLUMN HUB.	423
HS - DISTANCE FROM CENTER OF STEERING COLUMN HUB TO THE FORWARD SURFACE OF THE DOOR LOCK STRIKER PIN.	617
SCA - ANGLE OF STEERING COLUMN RELATIVE TO THE HORIZONTAL X AXIS	28°
SWA - ANGLE OF STEERING WHEEL RELATIVE TO THE HORIZONTAL X AXIS	62°

ALL DISTANCE MEASUREMENTS ARE IN MILLIMETERS.

FIGURE 10 CAMERA POSITIONS

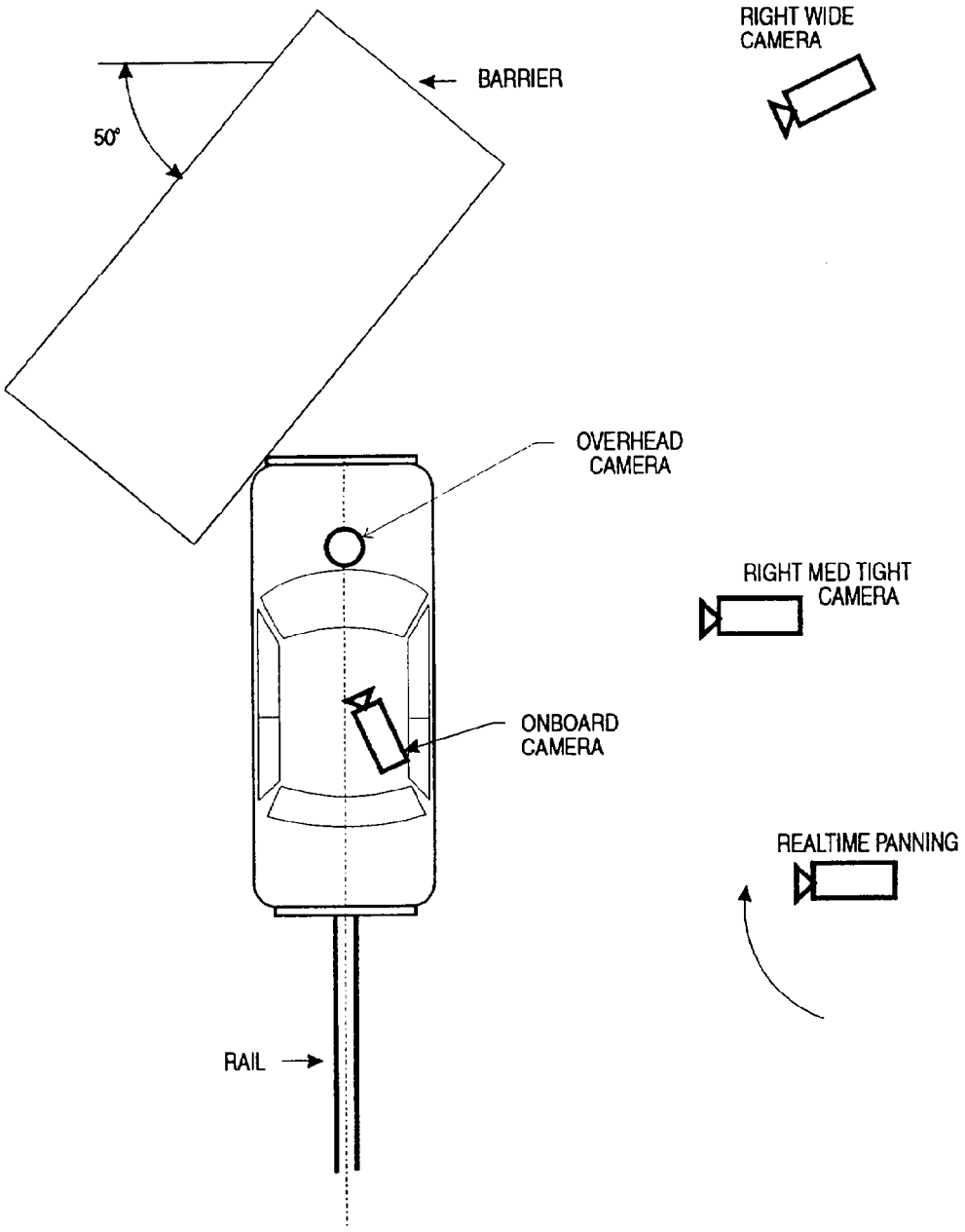


TABLE 9 MOTION PICTURE CAMERA INFORMATION

CAMERA NUMBER	LOCATION	TYPE	LENS (mm)	SPEED (fps)	PURPOSE OF CAMERA DATA
1	Right panning	Bolex	16	24	Real-time documentation
2	Right wide	Photosonic	13	485	Vehicle dynamics
3	Right tight	Photosonic	25	500	Vehicle dynamics
4	Overhead	Photosonic	8.5	428	Vehicle dynamics
5	Onboard car	Photosonic	8.5	498	Dummy kinematics

APPENDIX A

PHOTOGRAPHS

Figure A-1 PRE-TEST FRONT VIEW

Figure A-2 POST-TEST FRONT - VIEW 1

Figure A-3 POST-TEST FRONT - VIEW 2

Figure A-4 PRE-TEST LEFT SIDE VIEW

Figure A-5 POST-TEST LEFT SIDE - VIEW 1

Figure A-6 POST-TEST LEFT SIDE - VIEW 2

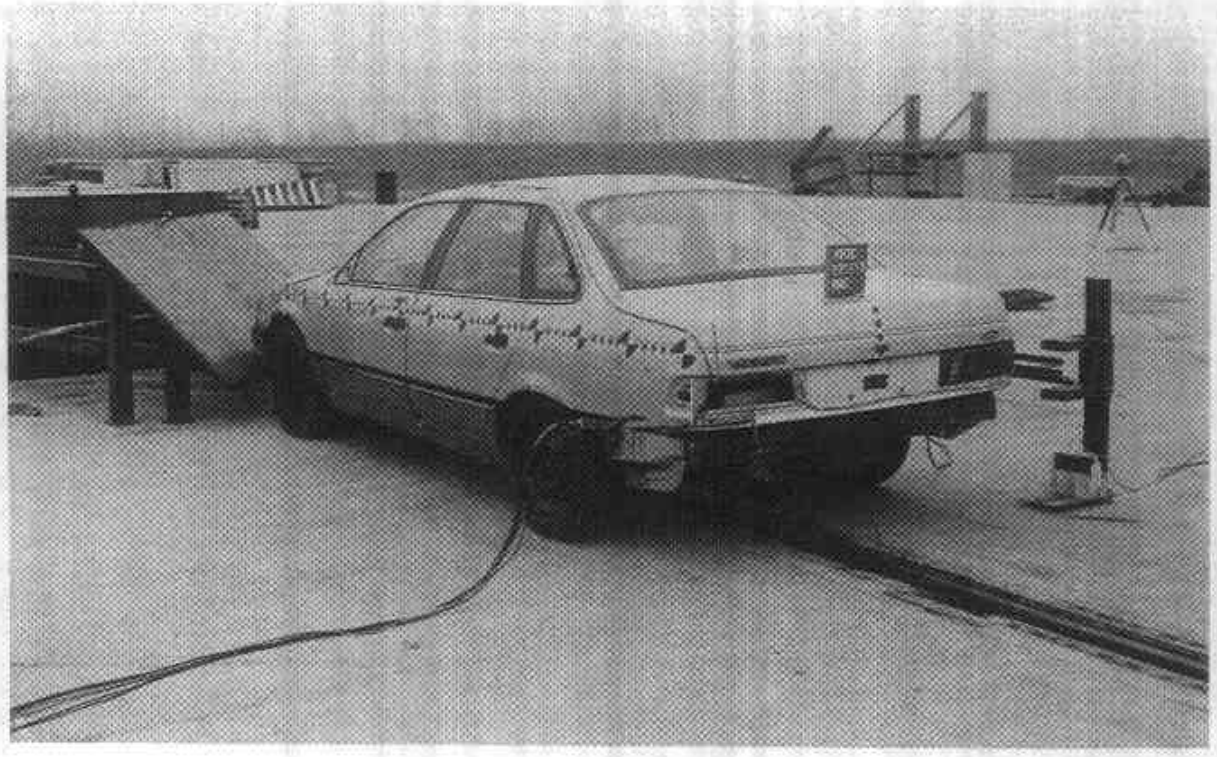


Figure A-7 PRE-TEST LEFT REAR VIEW

Figure A-8 POST-TEST LEFT REAR VIEW

Figure A-9 PRE-TEST REAR VIEW

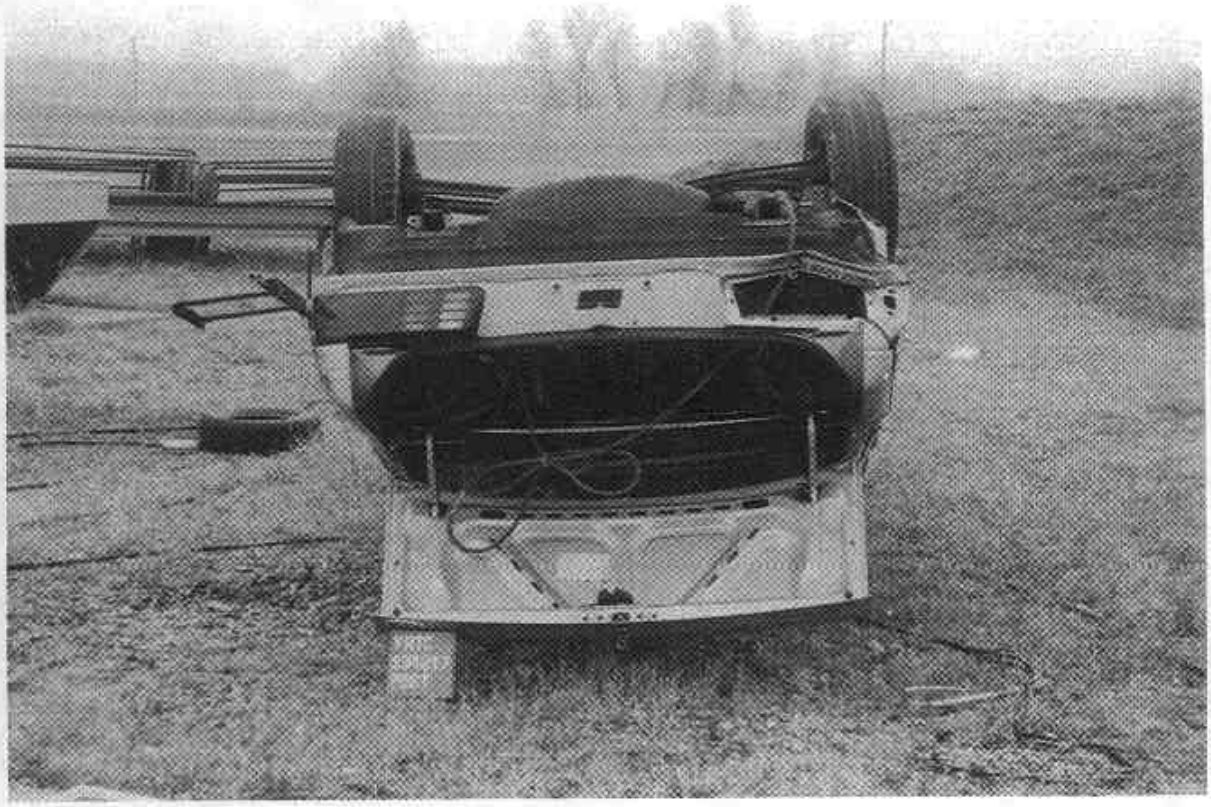


Figure A-10 POST-TEST REAR - VIEW 1

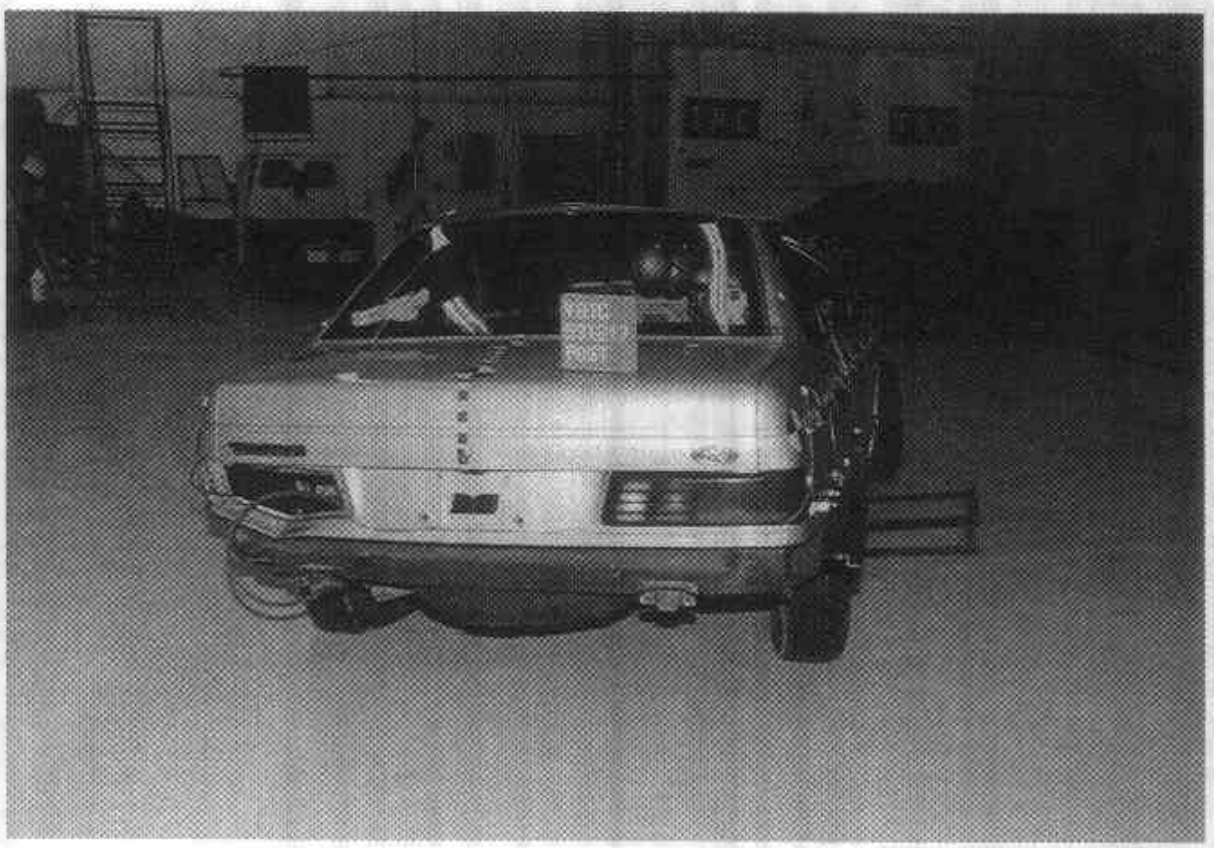


Figure A-11 POST-TEST REAR - VIEW 2

Figure A-12 PRE-TEST RIGHT SIDE VIEW

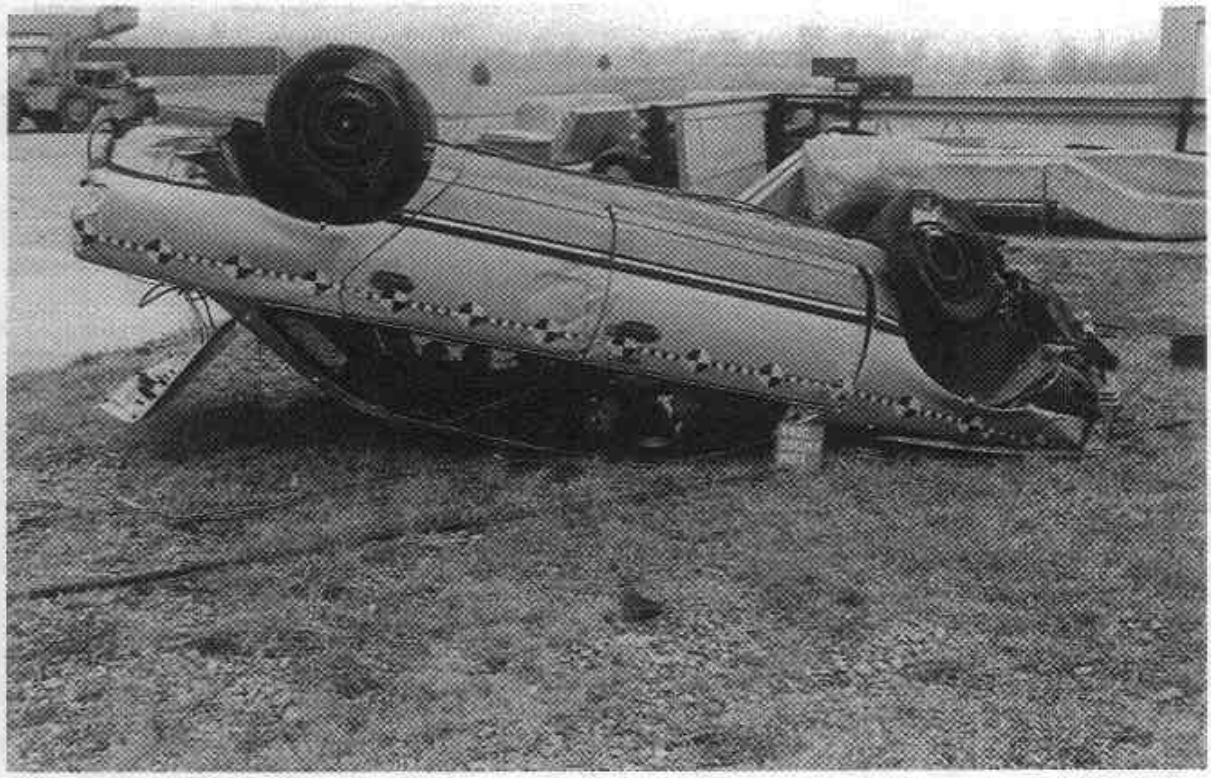


Figure A-13 POST-TEST RIGHT SIDE - VIEW 1

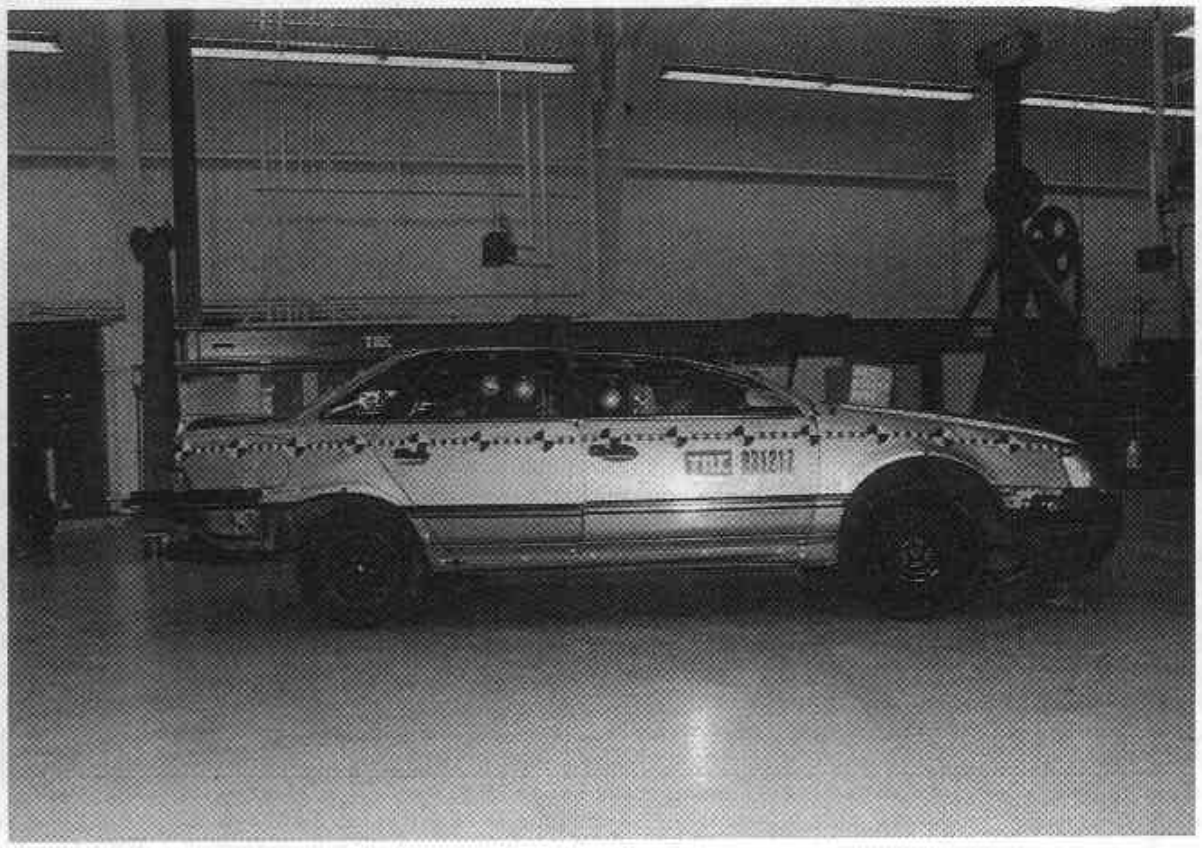


Figure A-14 POST-TEST RIGHT SIDE - VIEW 2

Figure A-15 PRE-TEST RIGHT FRONT VIEW

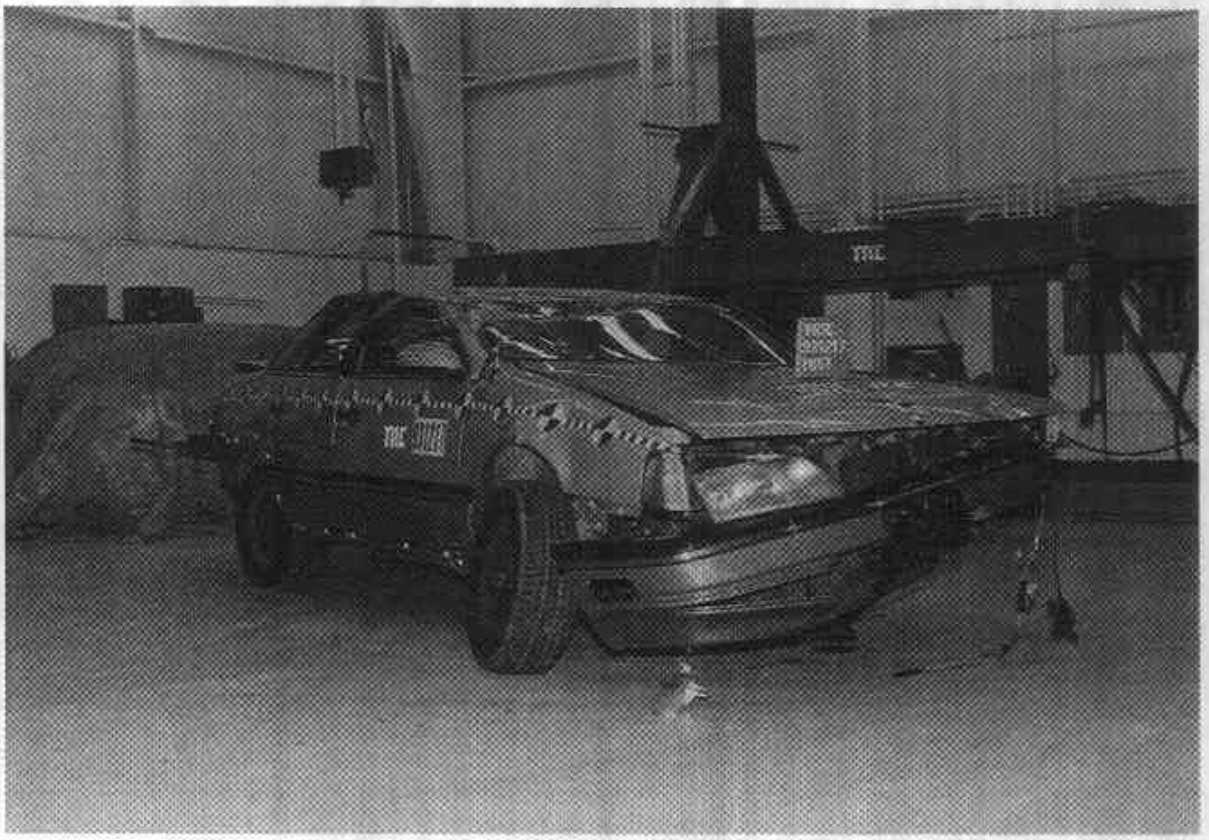


Figure A-16 POST-TEST RIGHT FRONT VIEW

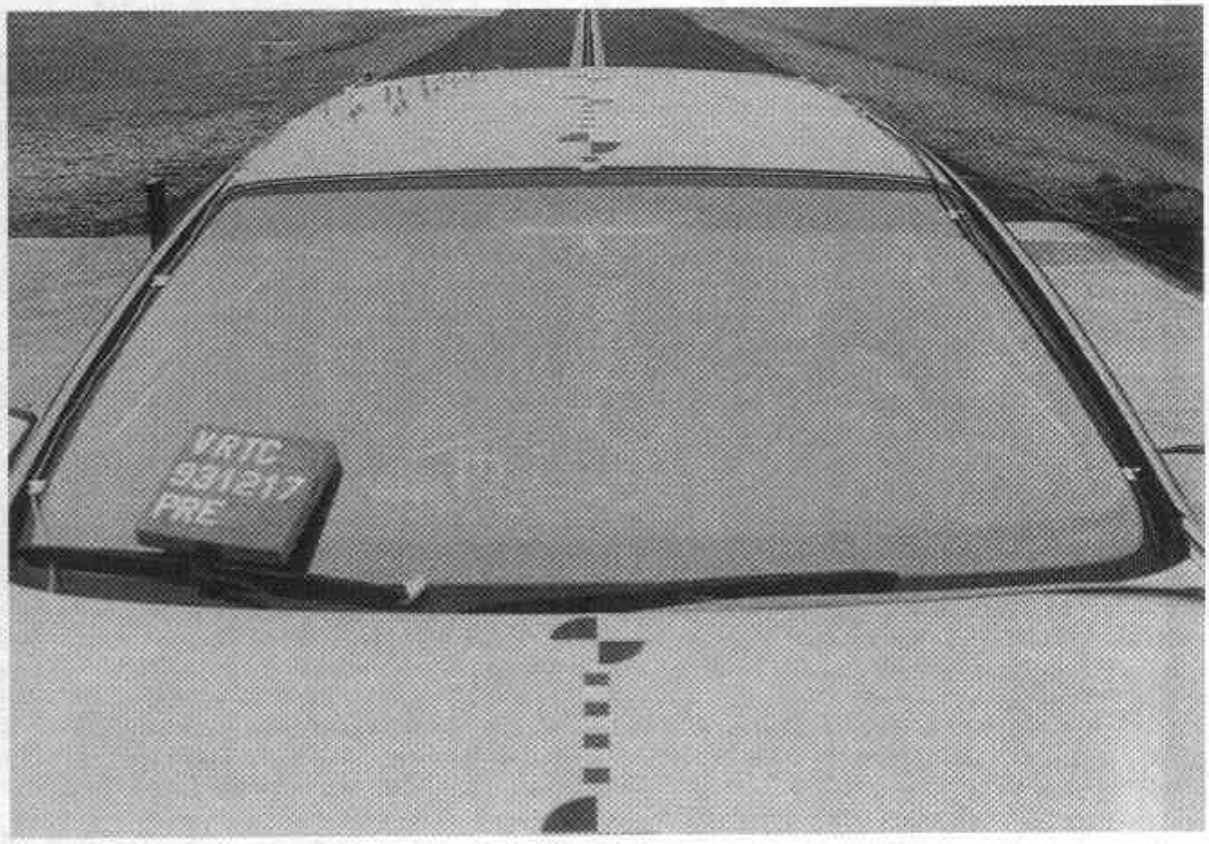


Figure A-17 PRE-TEST WINDSHIELD VIEW

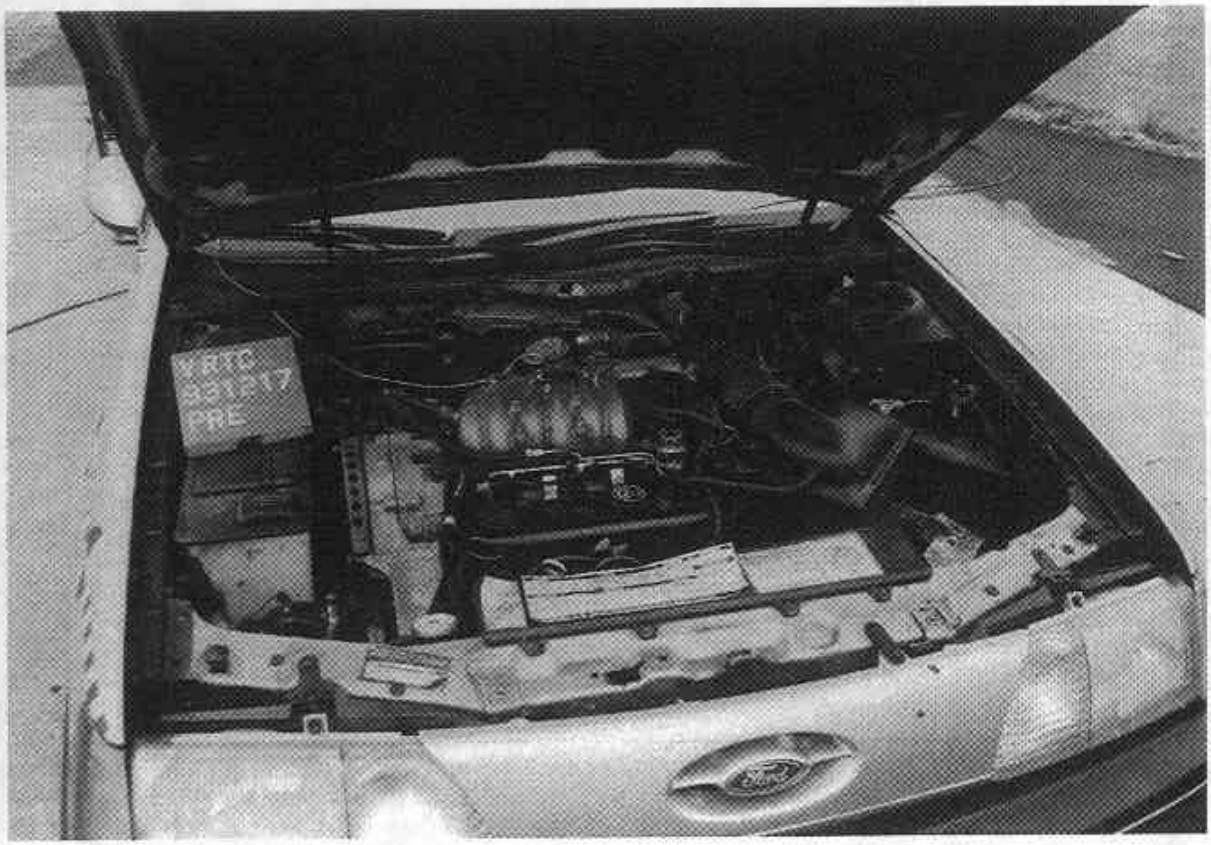


Figure A-18 PRE-TEST ENGINE COMPARTMENT VIEW

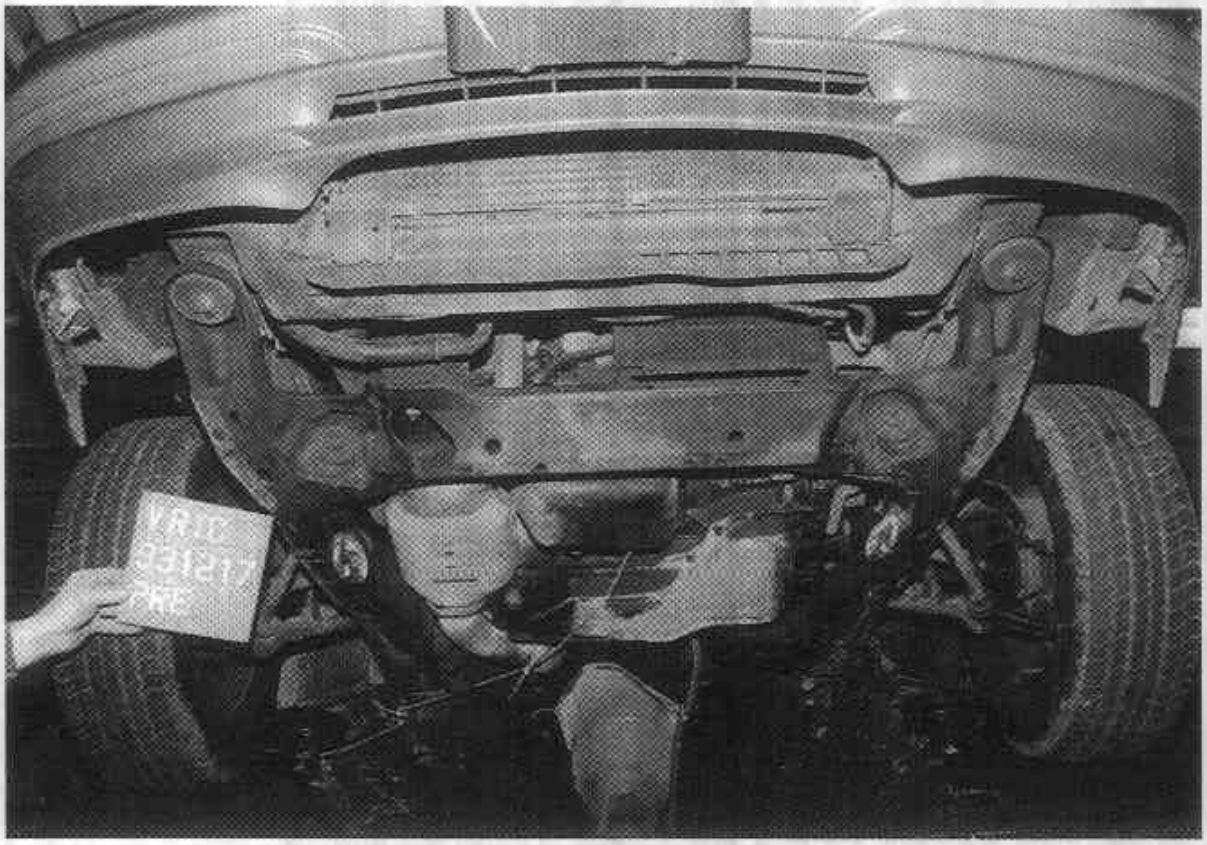


Figure A-19 PRE-TEST FRONT UNDERBODY VIEW

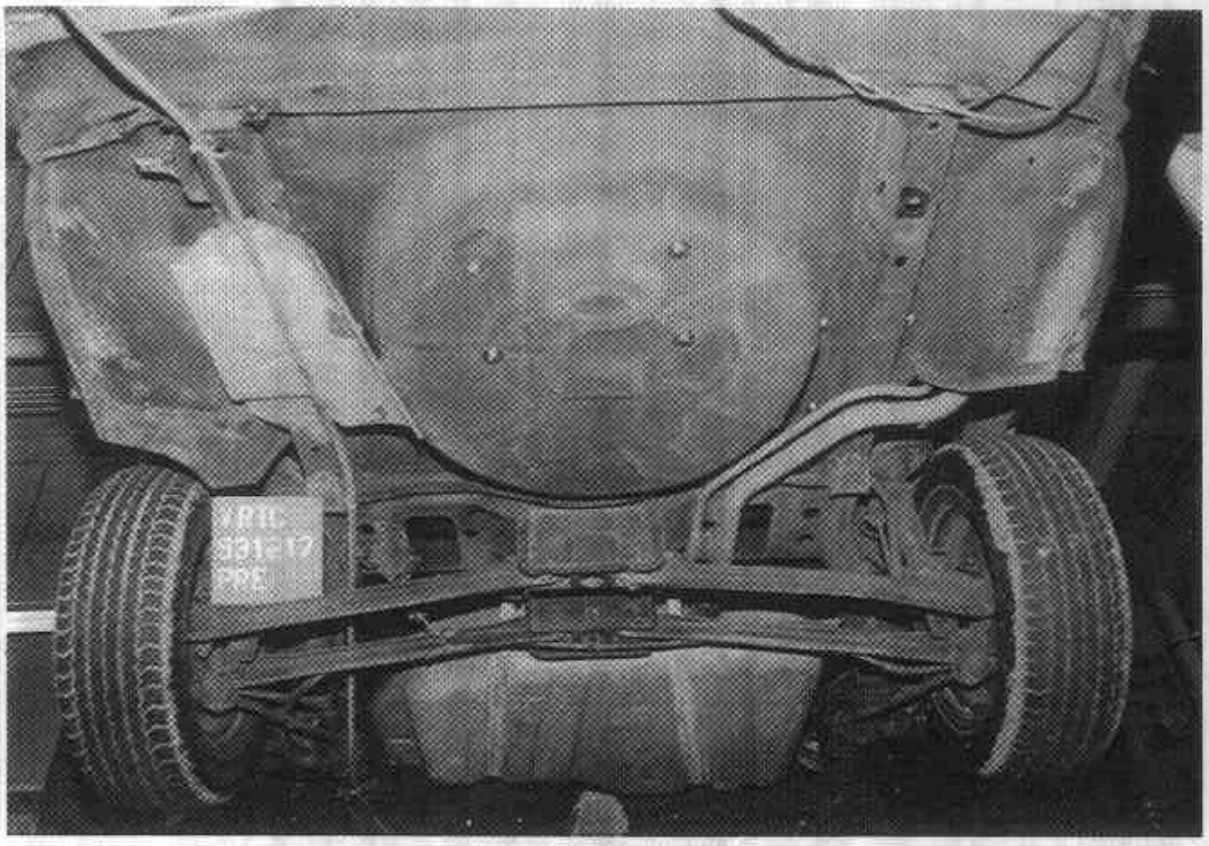


Figure A-22 PRE-TEST REAR UNDERBODY VIEW

Figure A-23 PRE-TEST DRIVER DUMMY POSITION VIEW

Figure A-24 POST-TEST DRIVER DUMMY POSITION VIEW

Figure A-25 PRE-TEST DRIVER DUMMY & VEHICLE INTERIOR - VIEW 1

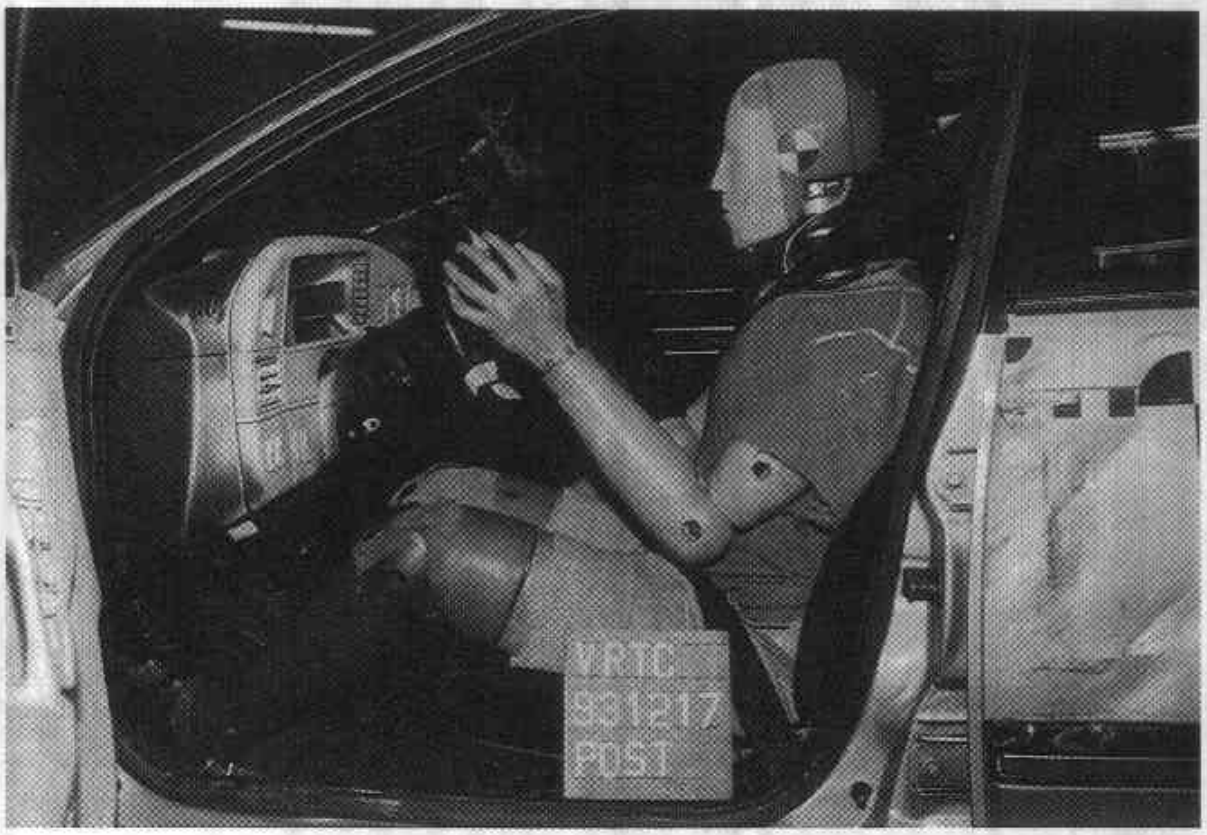


Figure A-26 POST-TEST DRIVER DUMMY & VEHICLE INTERIOR - VIEW 1

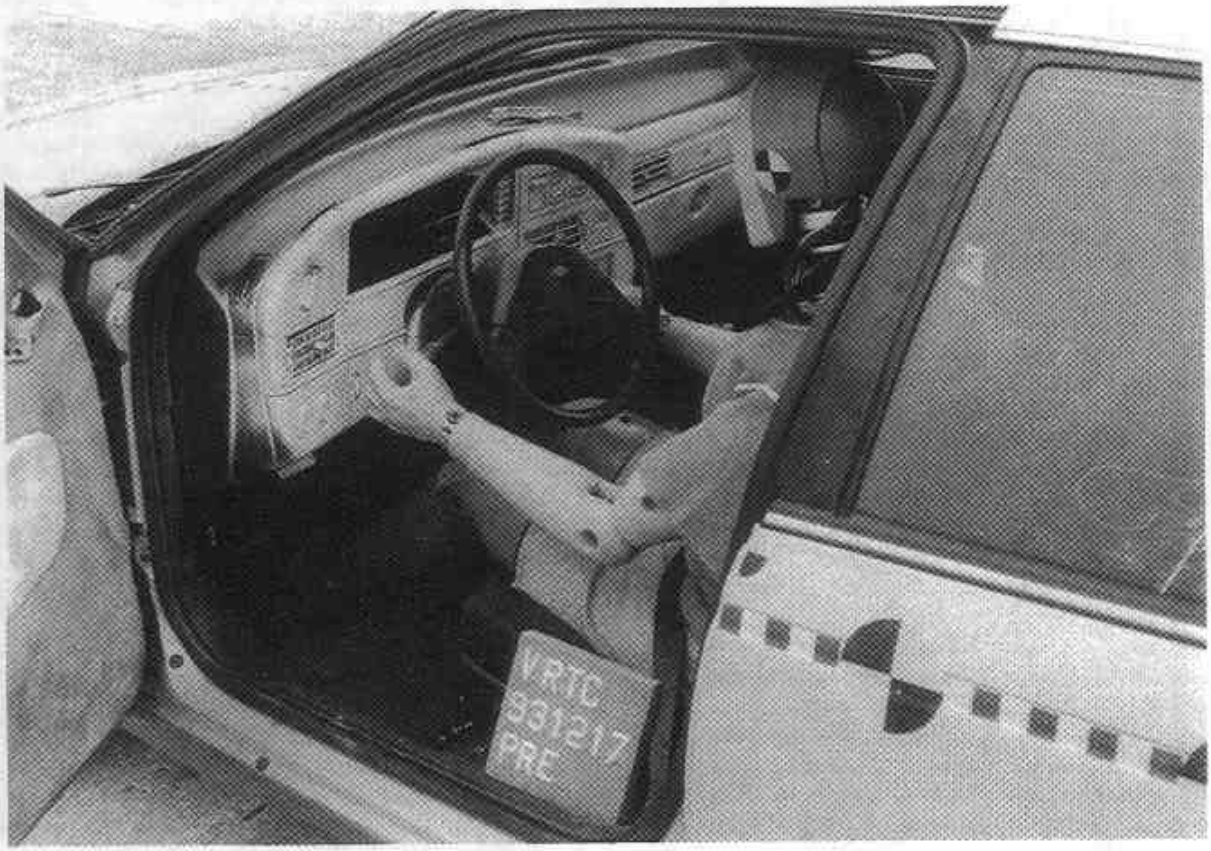


Figure A-27 PRE-TEST DRIVER DUMMY & VEHICLE INTERIOR - VIEW 2

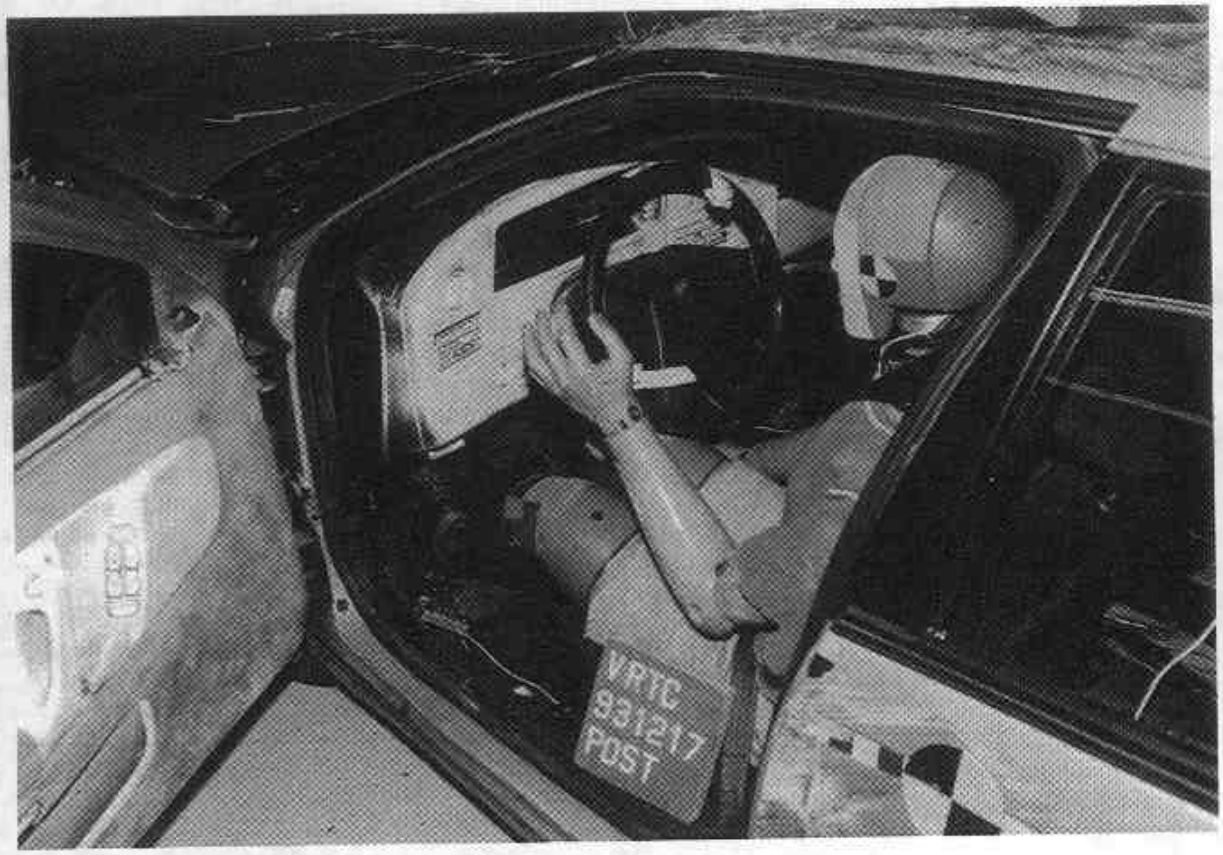


Figure A-28 POST-TEST DRIVER DUMMY & VEHICLE INTERIOR - VIEW 2

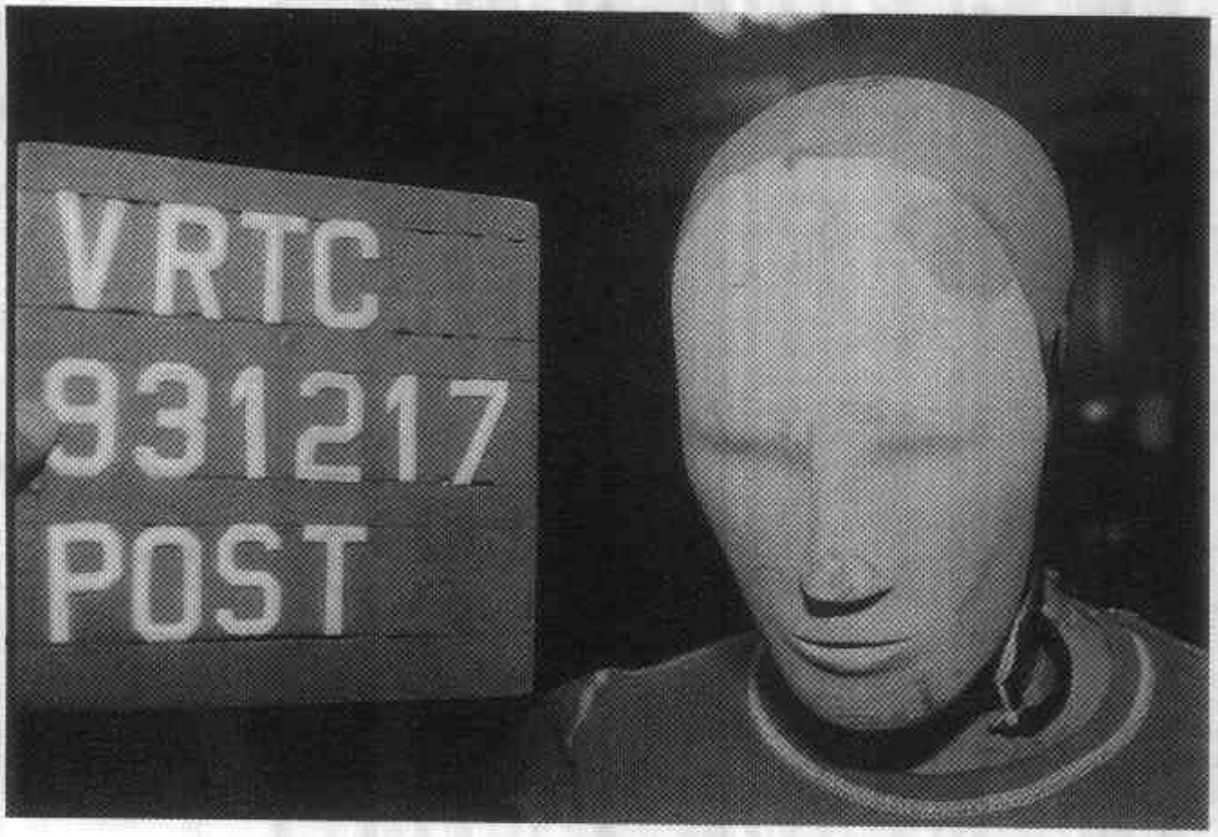


Figure A-29 POST-TEST DRIVER DUMMY HEAD CONTACT - VIEW 1

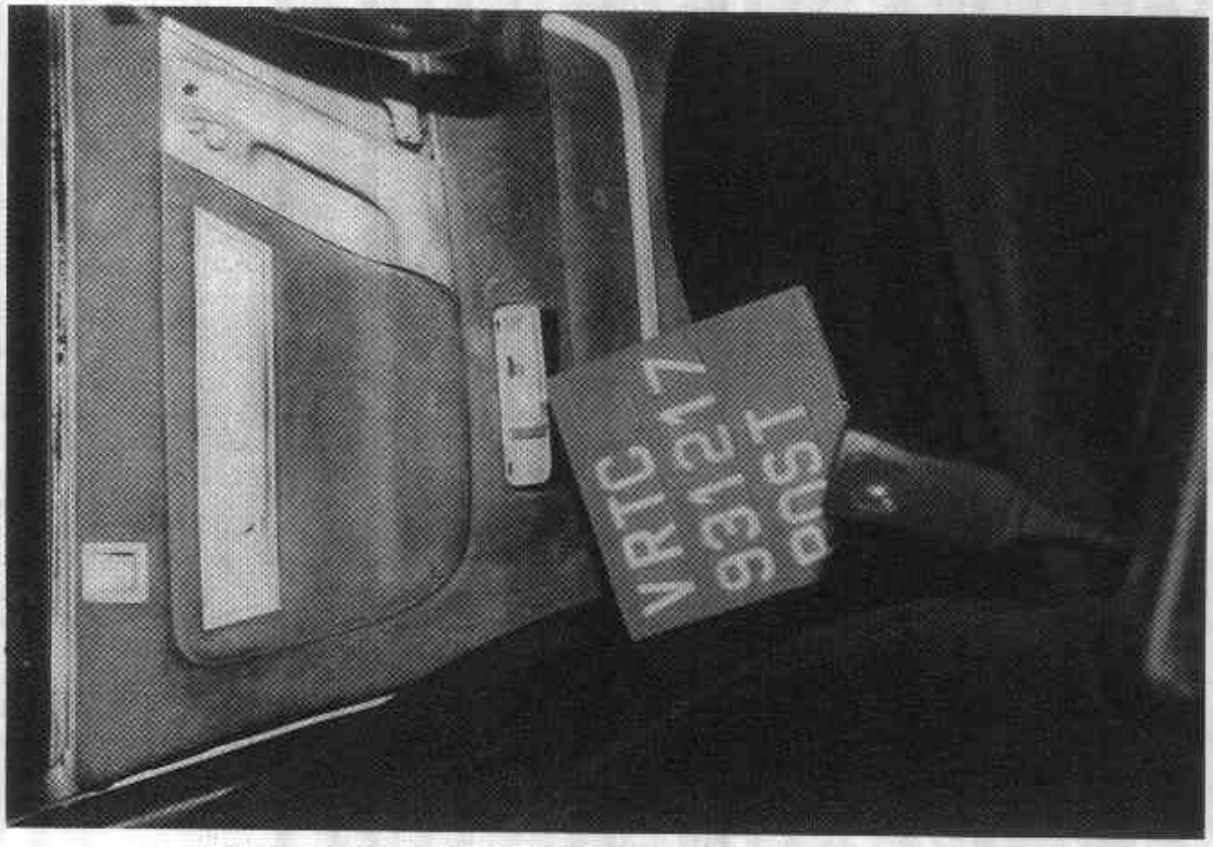


Figure A-30 POST-TEST DRIVER DUMMY HEAD CONTACT - VIEW 2

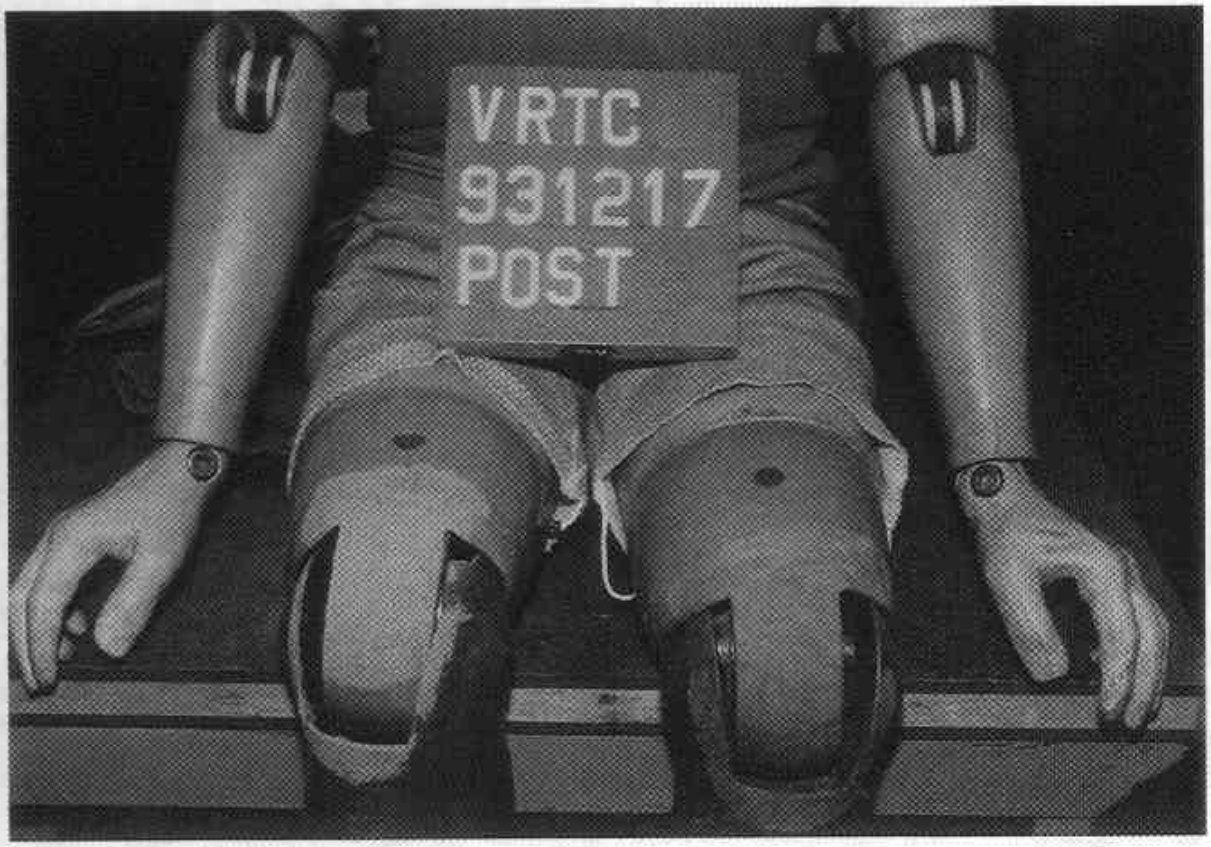


Figure A-31 POST-TEST DRIVER DUMMY KNEE CONTACT VIEW

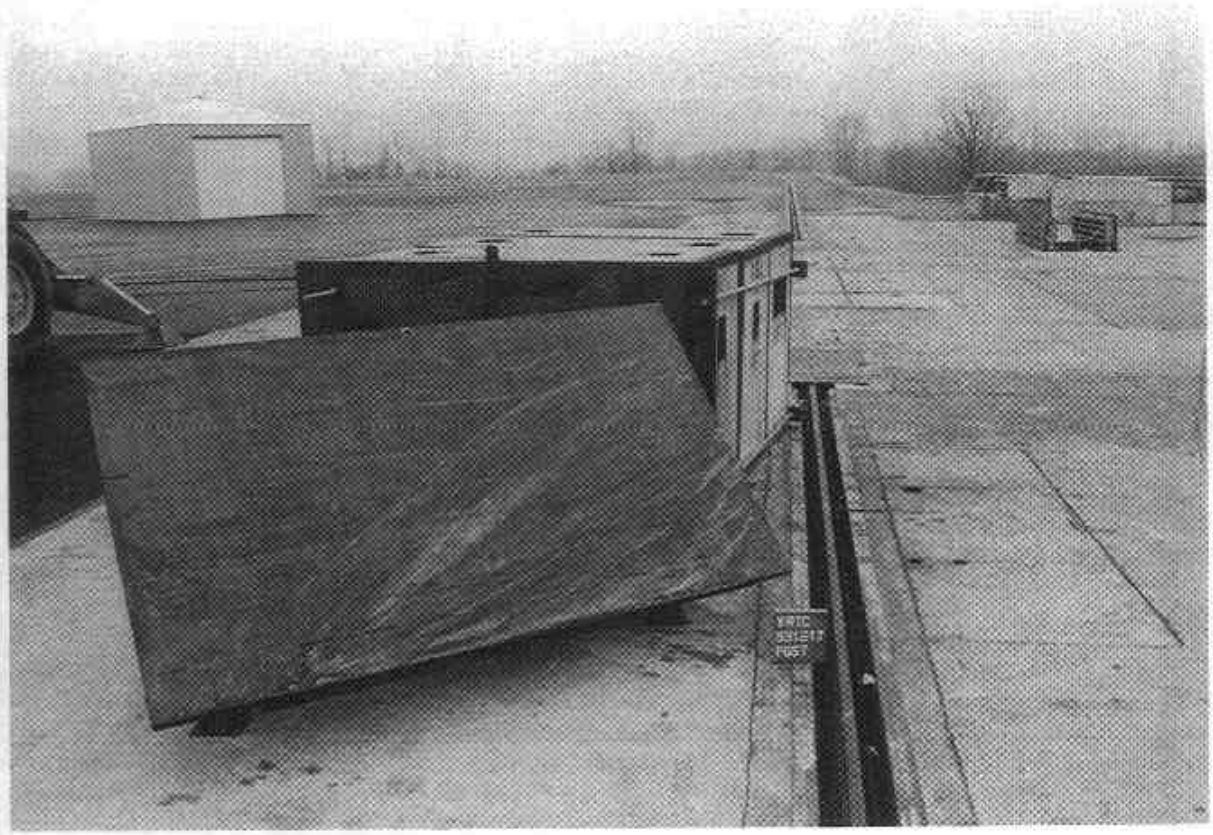


Figure A-32 POST-TEST BARRIER - VIEW 1

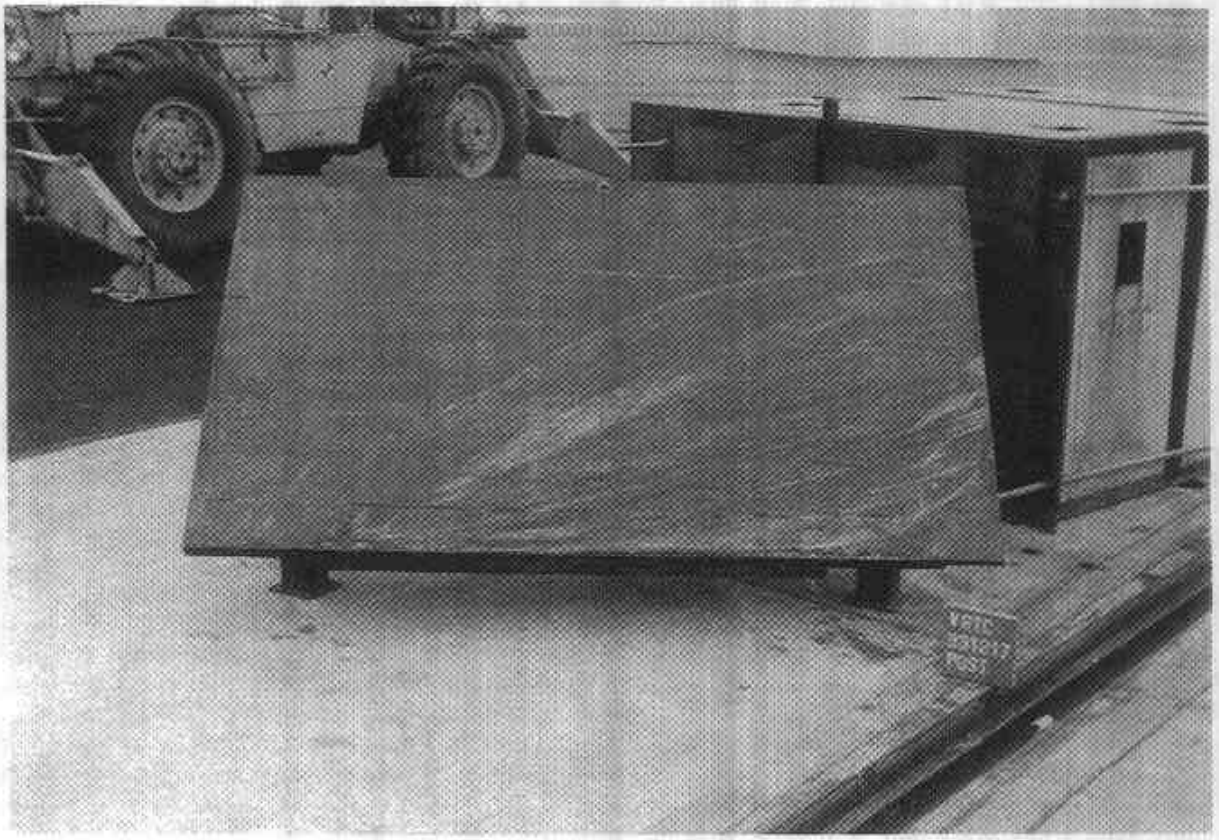


Figure A-33 POST-TEST BARRIER - VIEW 2

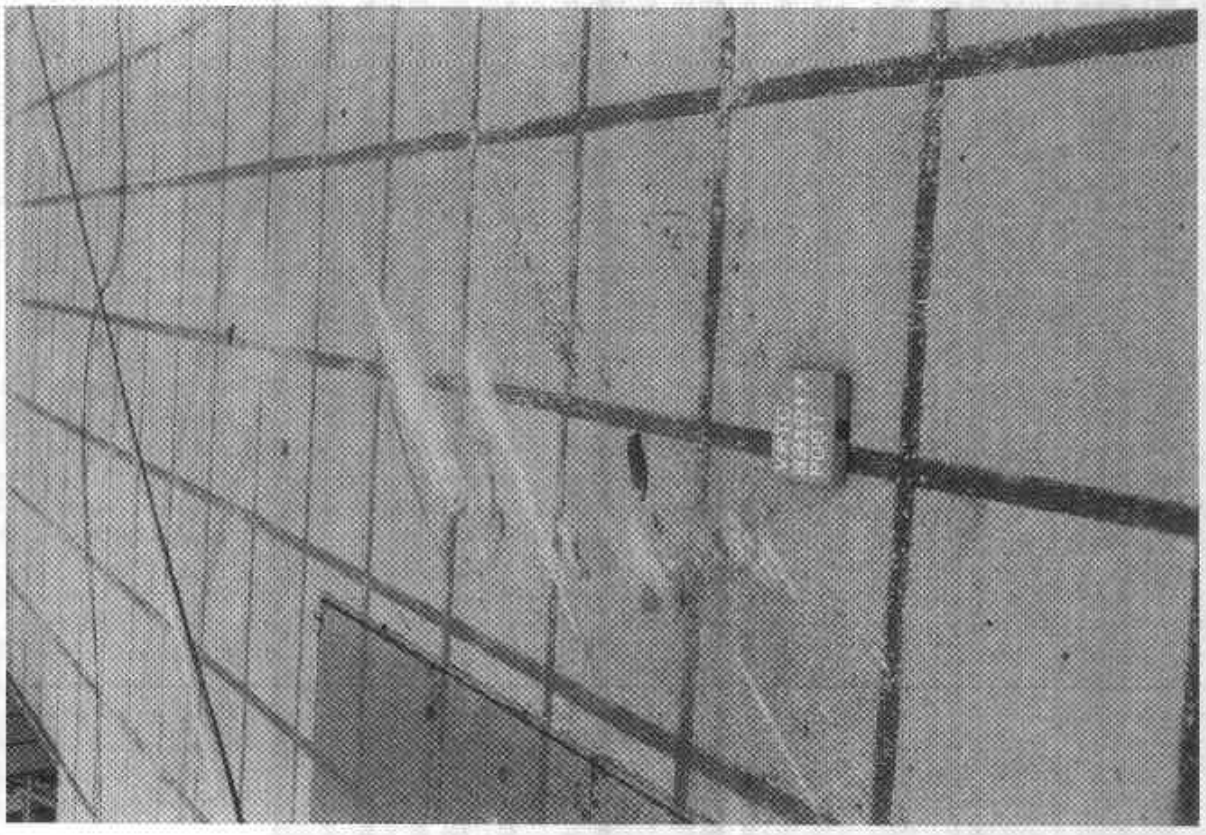
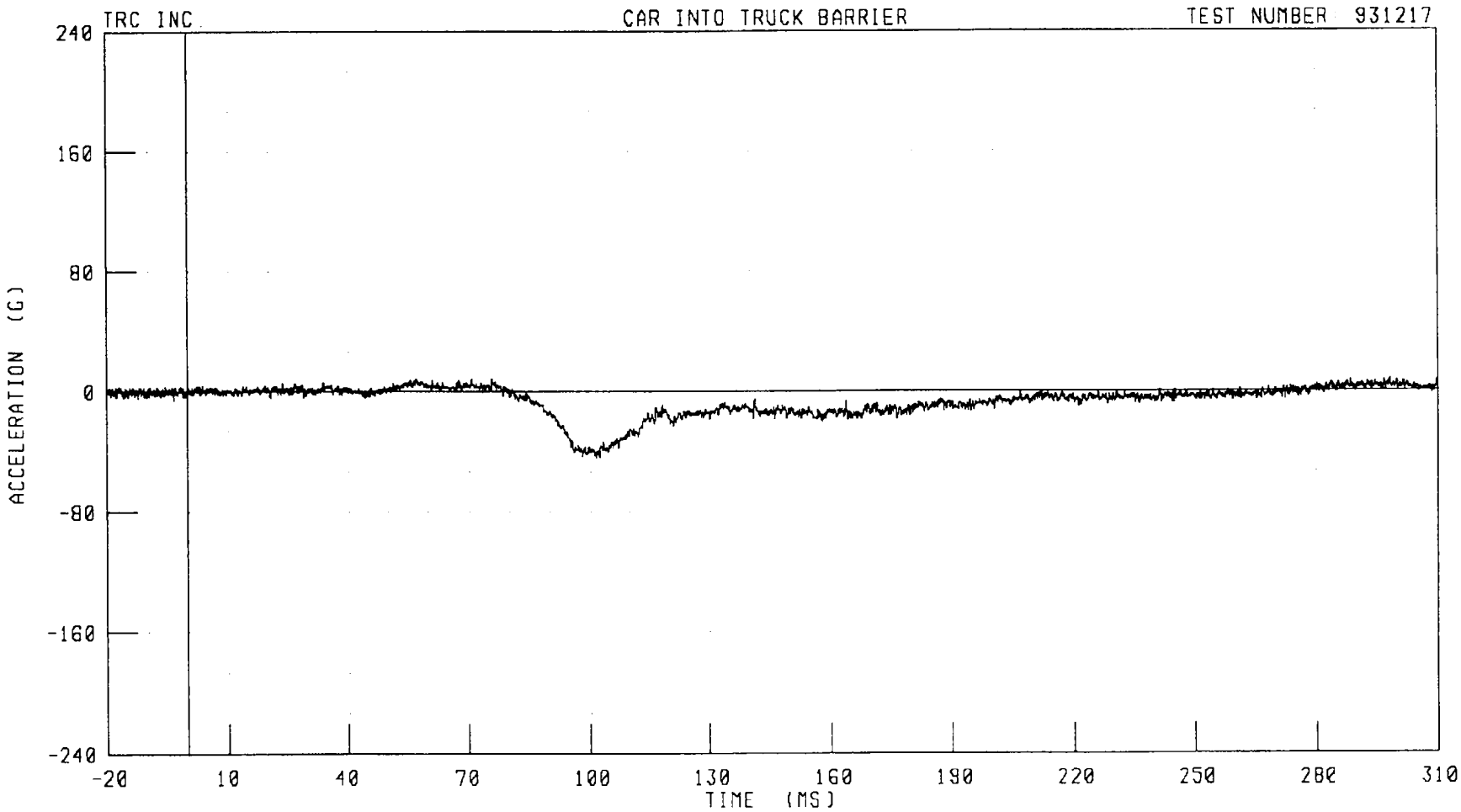


Figure A-34 POST-TEST VEHICLE SKIDMARKS

APPENDIX B

DATA PLOTS

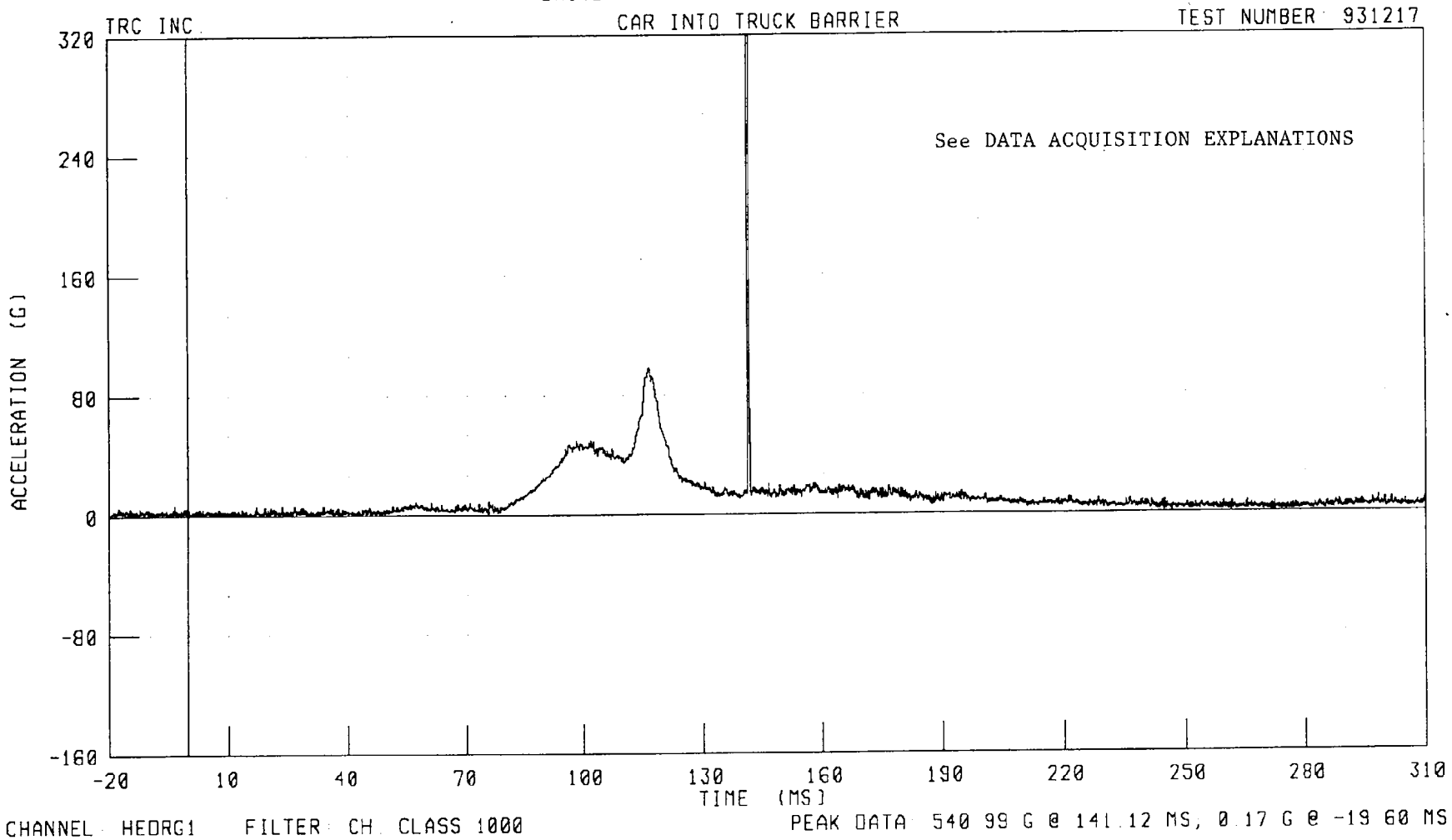
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER HEAD Z-AXIS ACCELERATION
CAR INTO TRUCK BARRIER



CHANNEL HEDZG1 FILTER CH CLASS 1000

PEAK DATA 8 90 G @ 75 92 MS, -43 93 G @ 102 72 MS

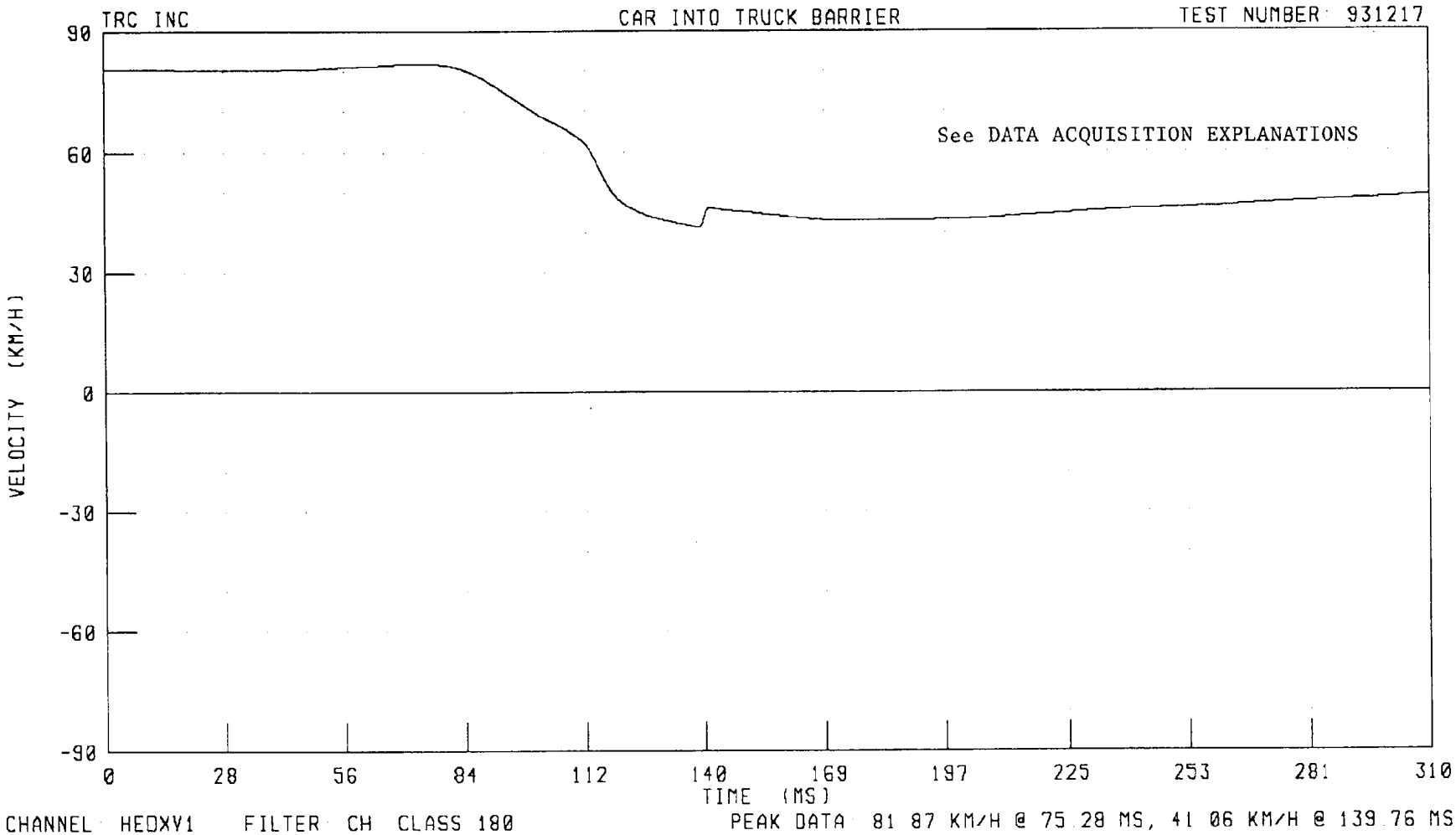
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER HEAD RESULTANT ACCELERATION
CAR INTO TRUCK BARRIER



CHANNEL HEDRG1 FILTER CH CLASS 1000

PEAK DATA 540.99 G @ 141.12 MS, 0.17 G @ -19.60 MS

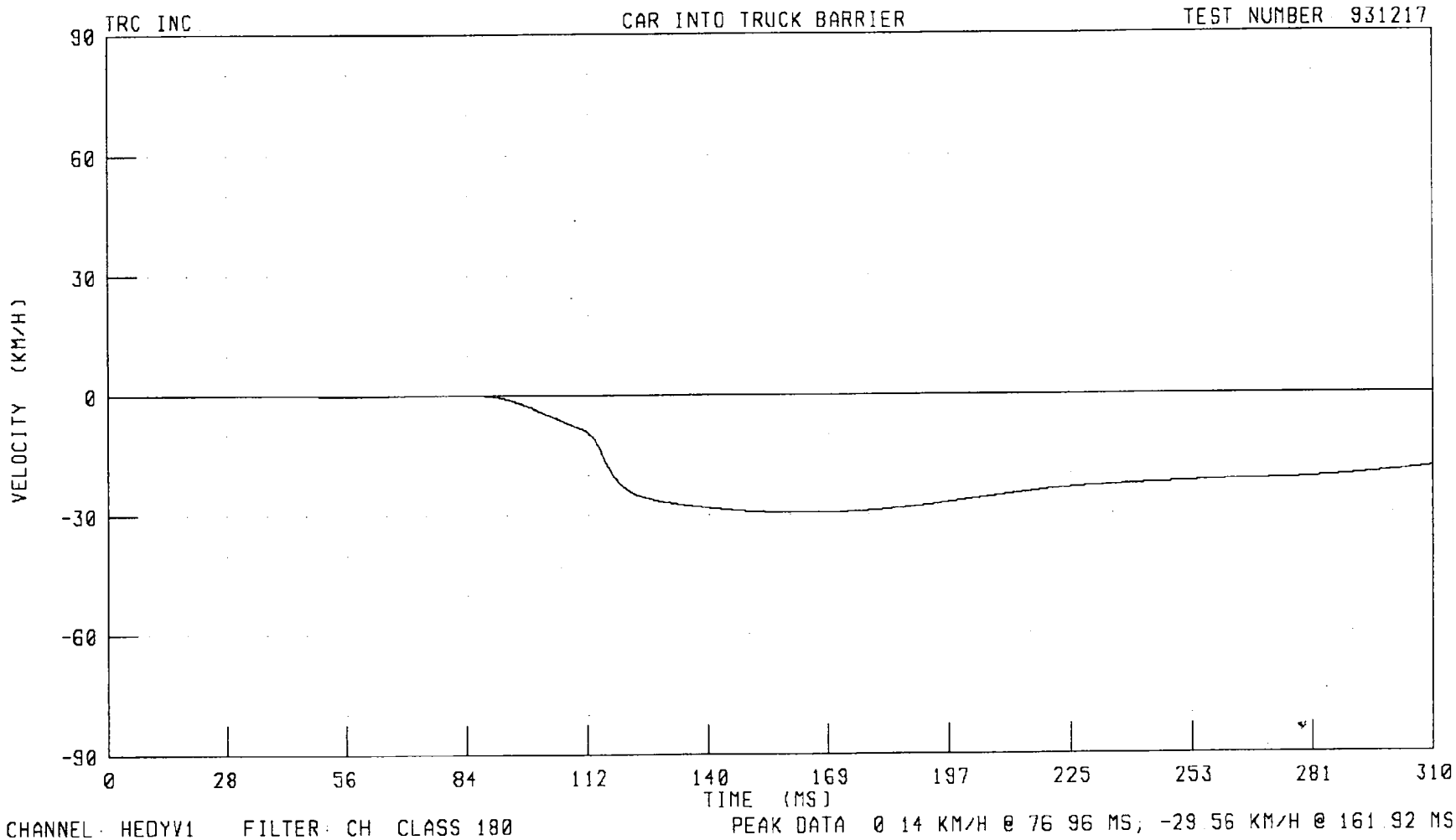
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER HEAD X-AXIS VELOCITY
CAR INTO TRUCK BARRIER



CHANNEL HEDXV1 FILTER CH CLASS 180

PEAK DATA 81 87 KM/H @ 75 28 MS, 41 06 KM/H @ 139 76 MS

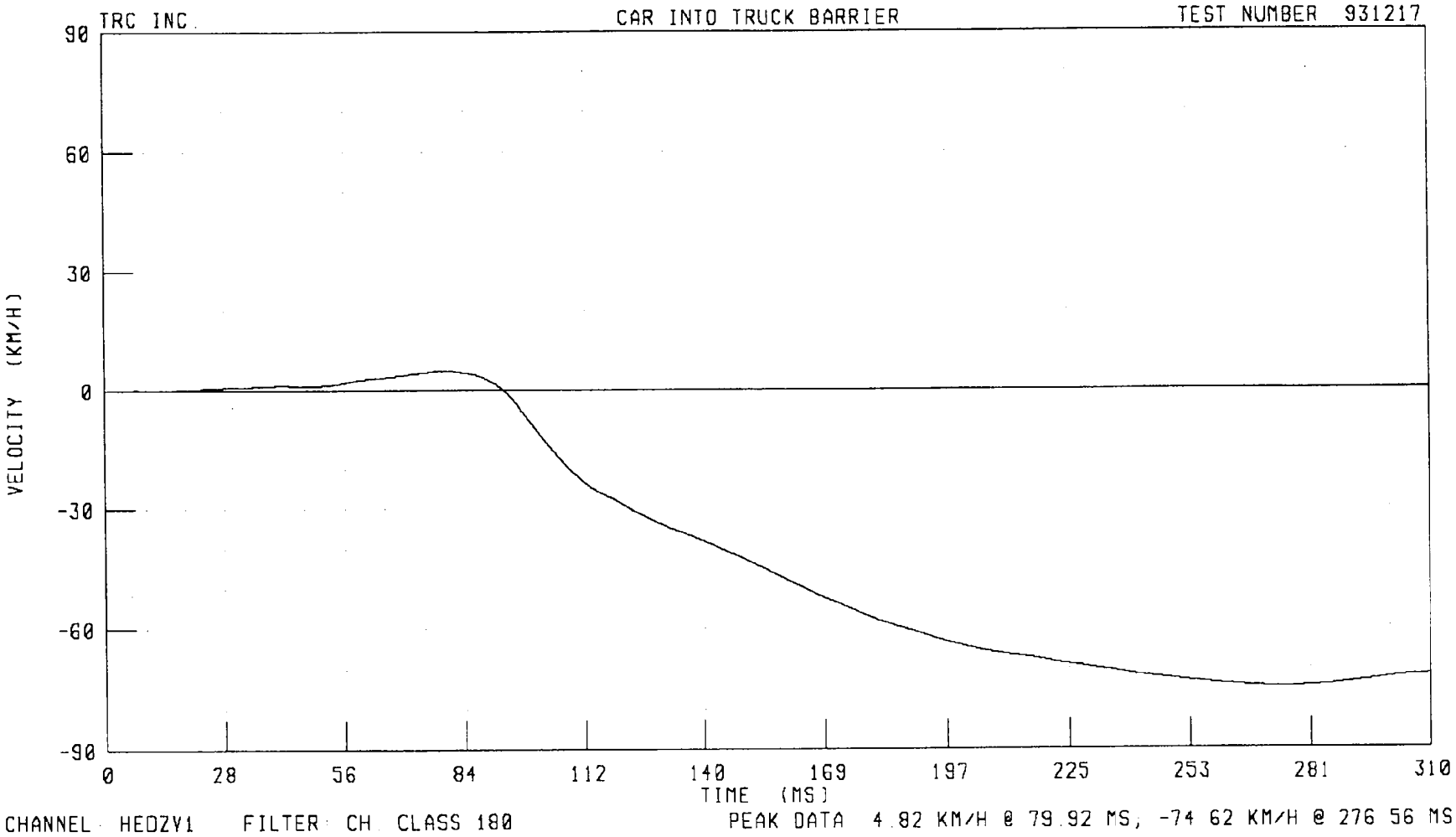
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER HEAD Y-AXIS VELOCITY
CAR INTO TRUCK BARRIER



CHANNEL HEDYV1 FILTER CH CLASS 180

PEAK DATA 0 14 KM/H @ 76 96 MS; -29 56 KM/H @ 161 92 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER HEAD Z-AXIS VELOCITY
CAR INTO TRUCK BARRIER

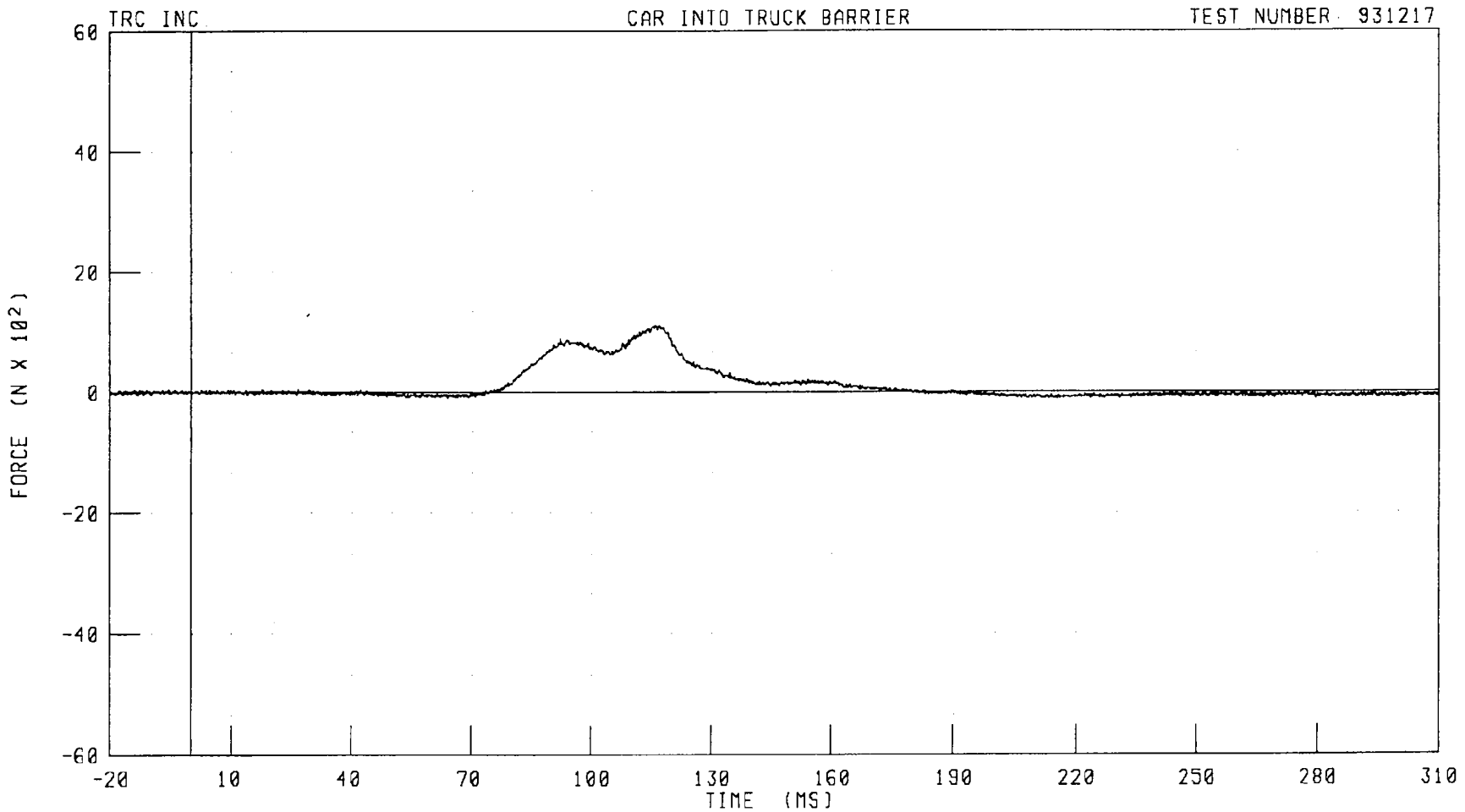


CHANNEL HEDZV1 FILTER CH CLASS 180

PEAK DATA 4.82 KM/H @ 79.92 MS, -74.62 KM/H @ 276.56 MS

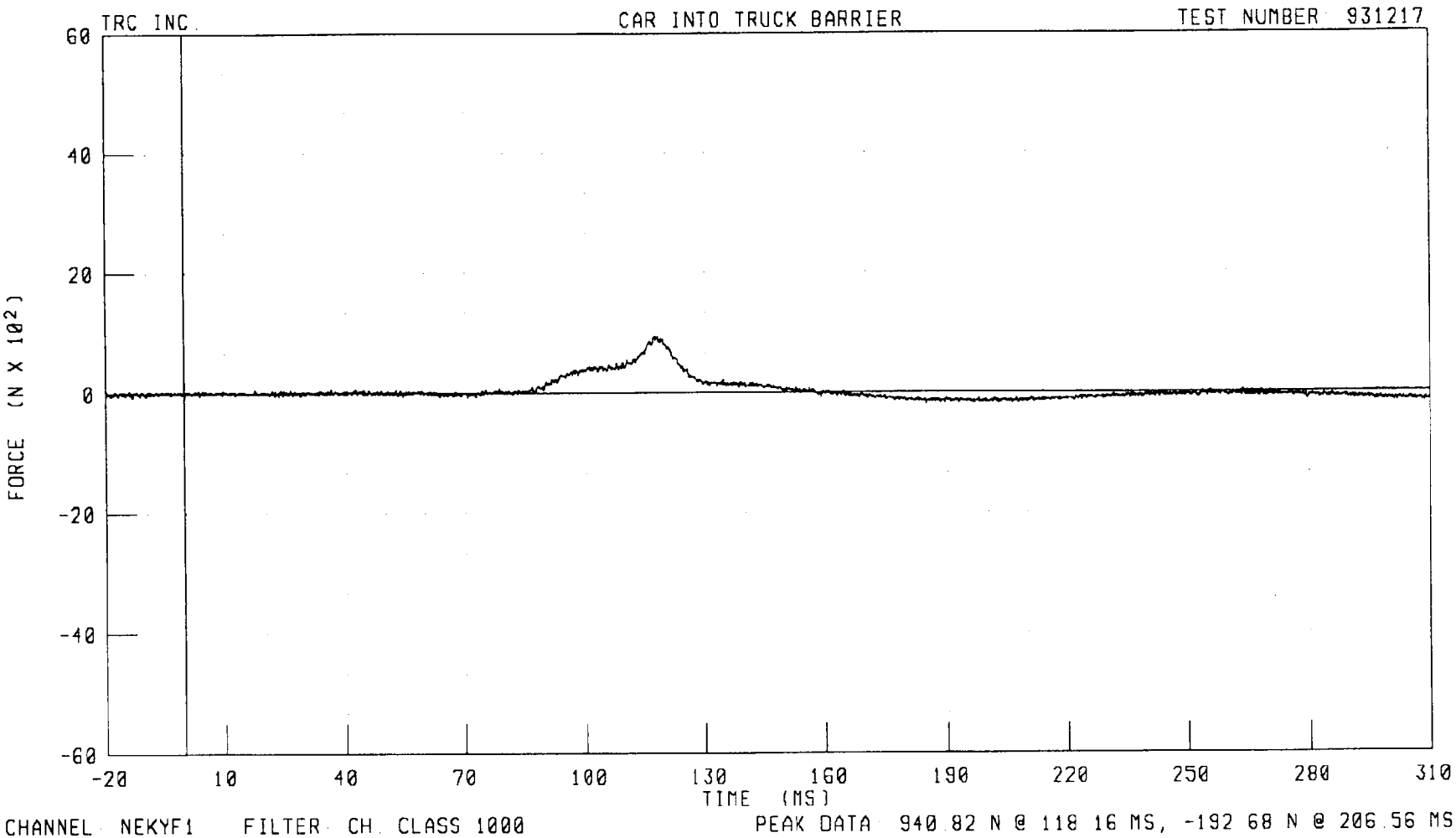
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18

DRIVER NECK X-AXIS SHEAR FORCE



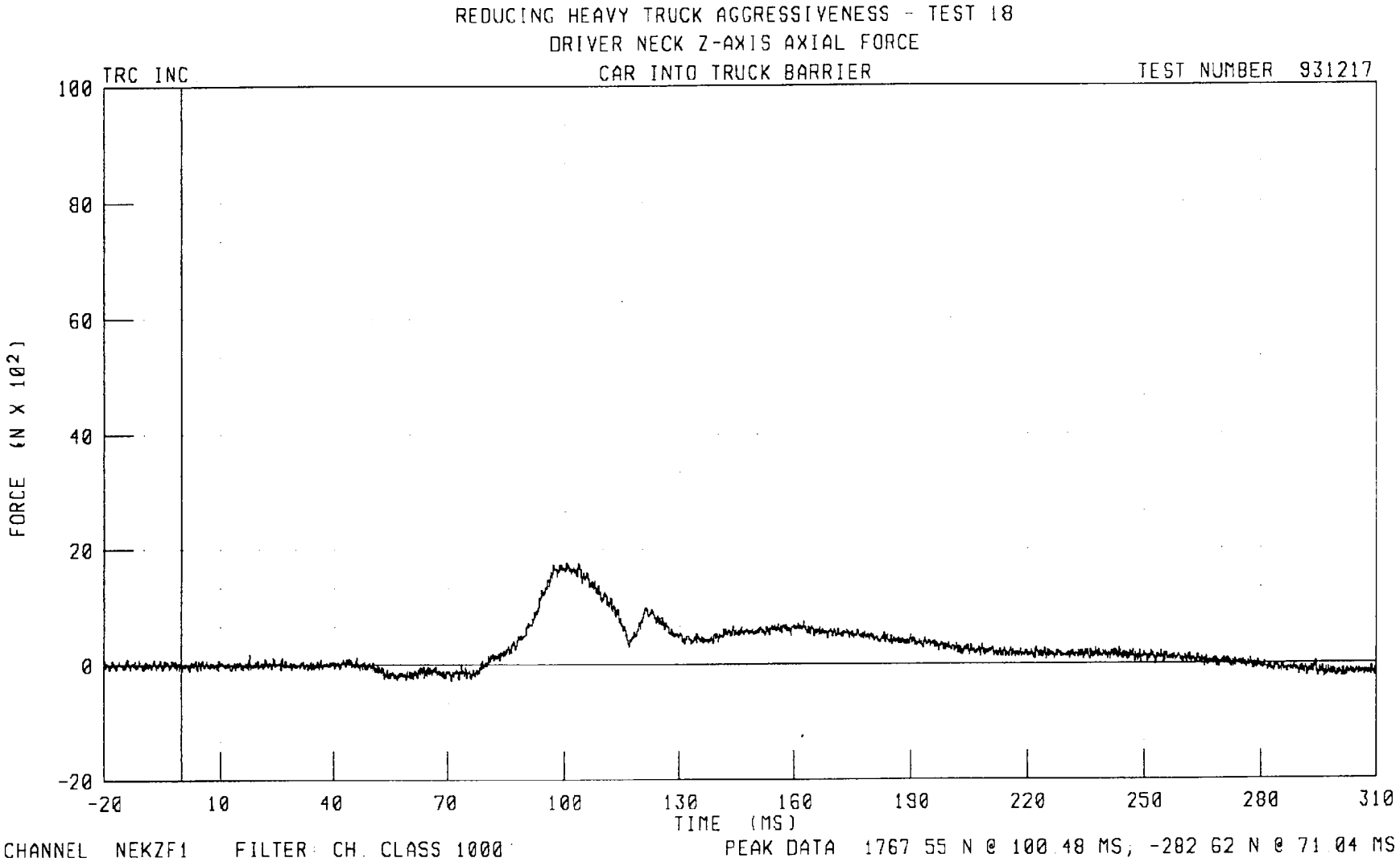
CHANNEL NEKXF1 FILTER CH CLASS 1000 PEAK DATA 1105.59 N @ 116.16 MS, -118.51 N @ 279.76 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER NECK Y-AXIS SHEAR FORCE
CAR INTO TRUCK BARRIER

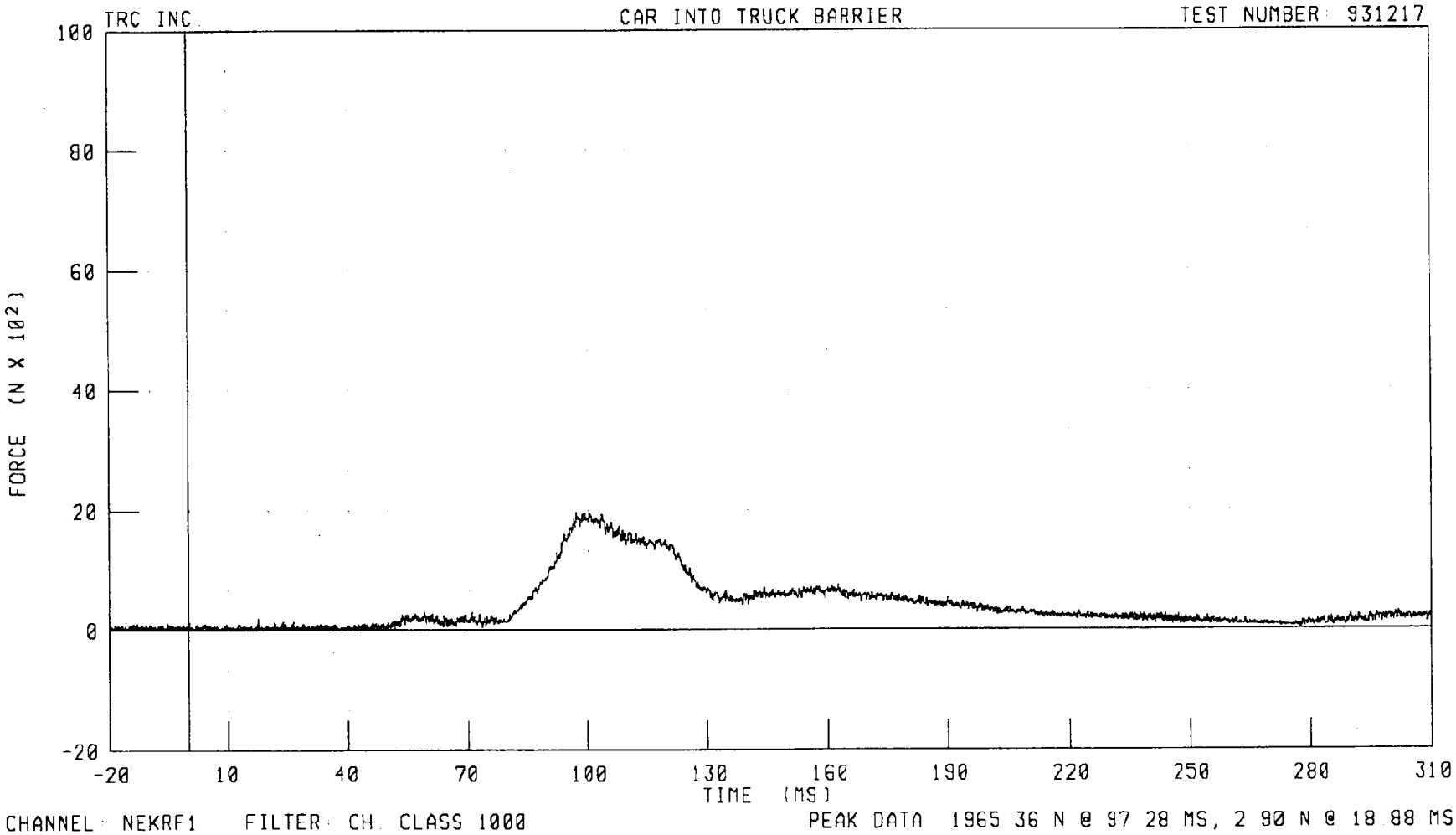


CHANNEL NEKYF1 FILTER CH CLASS 1000

PEAK DATA 940.82 N @ 118.16 MS, -192.68 N @ 206.56 MS

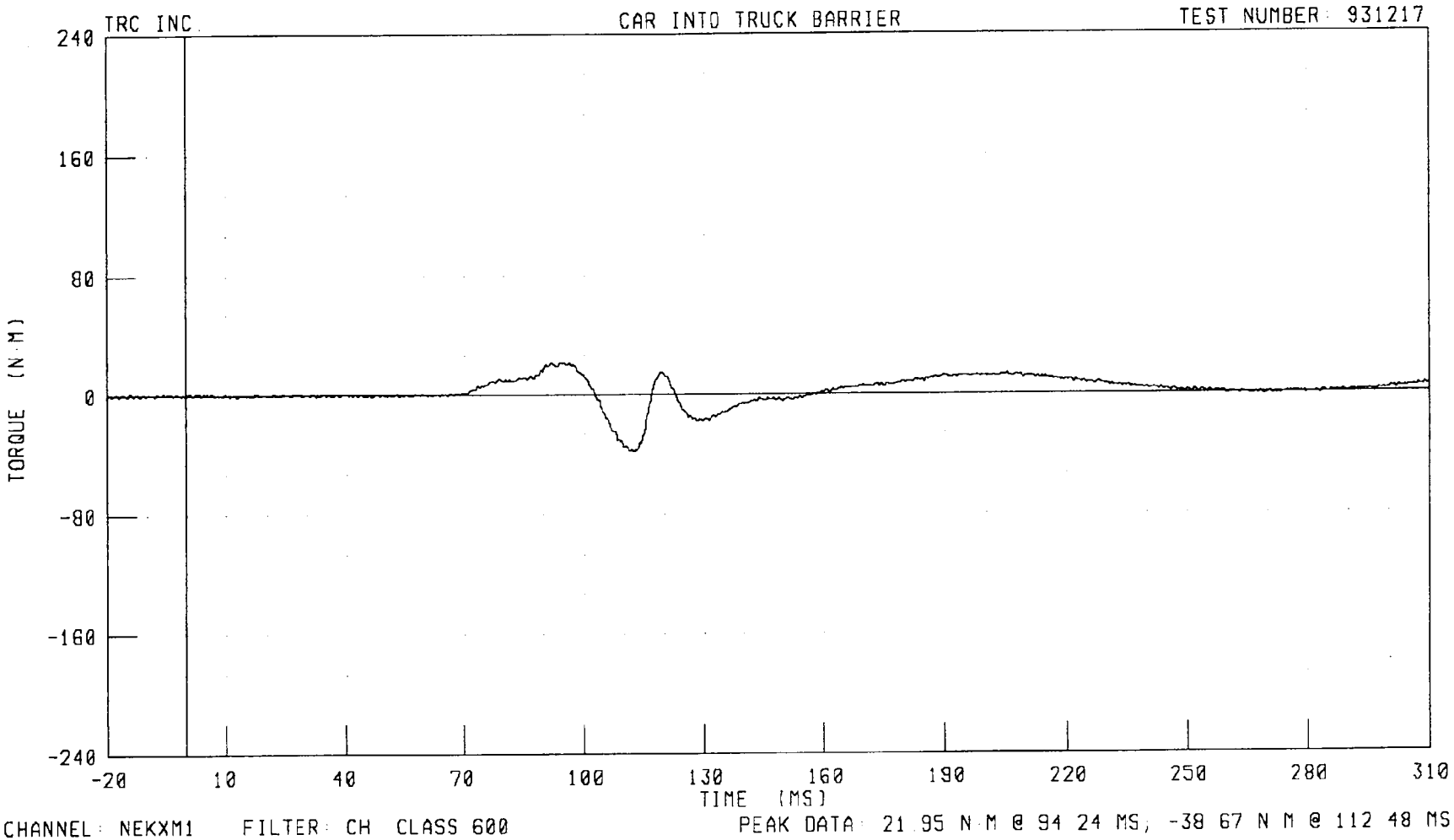

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER NECK Z-AXIS AXIAL FORCE
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
100
80
60
40
20
0
-20
FORCE (N X 10²)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL NEKZF1 FILTER CH CLASS 1000
PEAK DATA 1767 55 N @ 100 48 MS, -282 62 N @ 71 04 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER NECK RESULTANT FORCE
CAR INTO TRUCK BARRIER



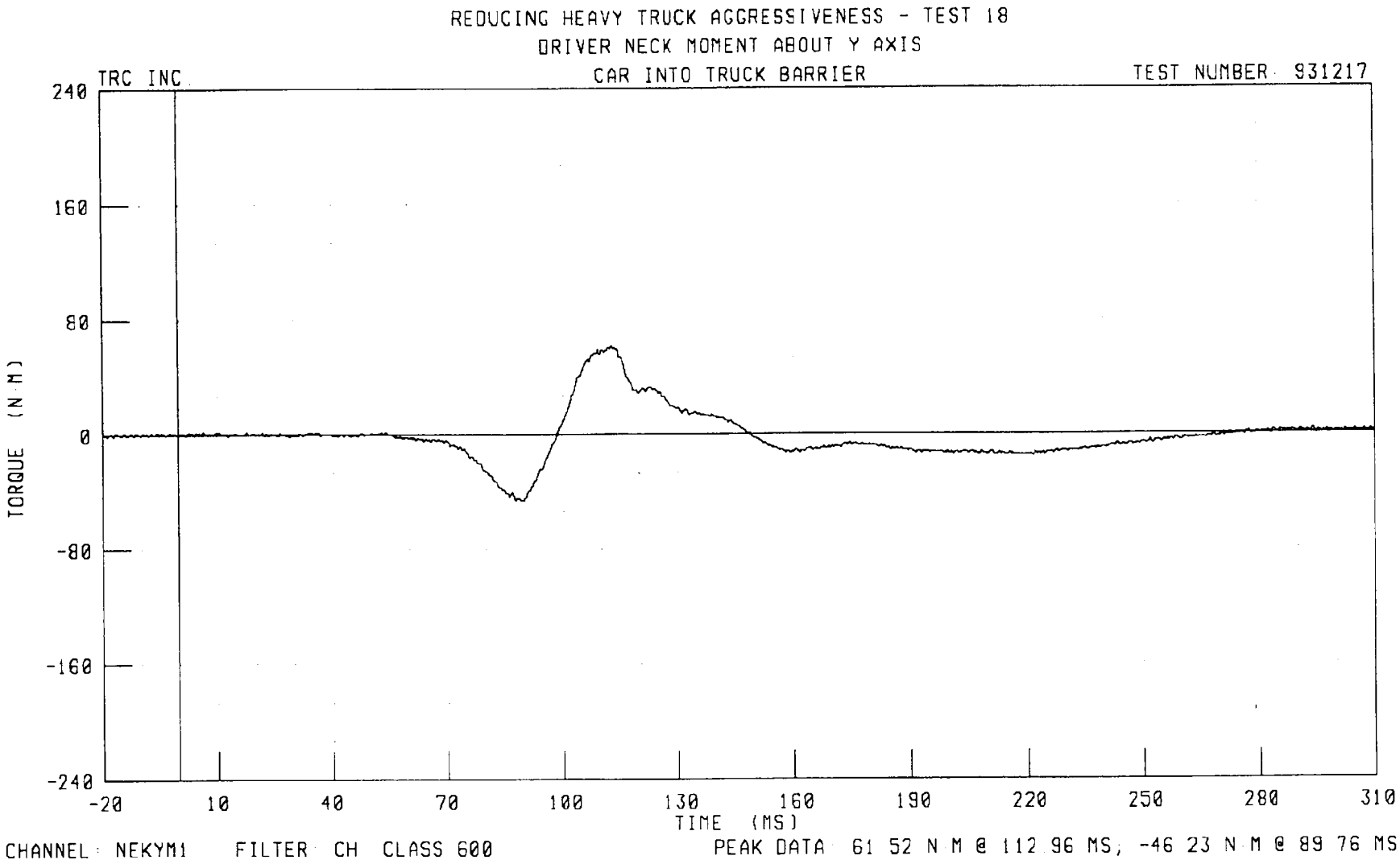
CHANNEL: NEKRF1 FILTER: CH CLASS 1000 PEAK DATA 1965.36 N @ 97.28 MS, 2.90 N @ 18.88 MS

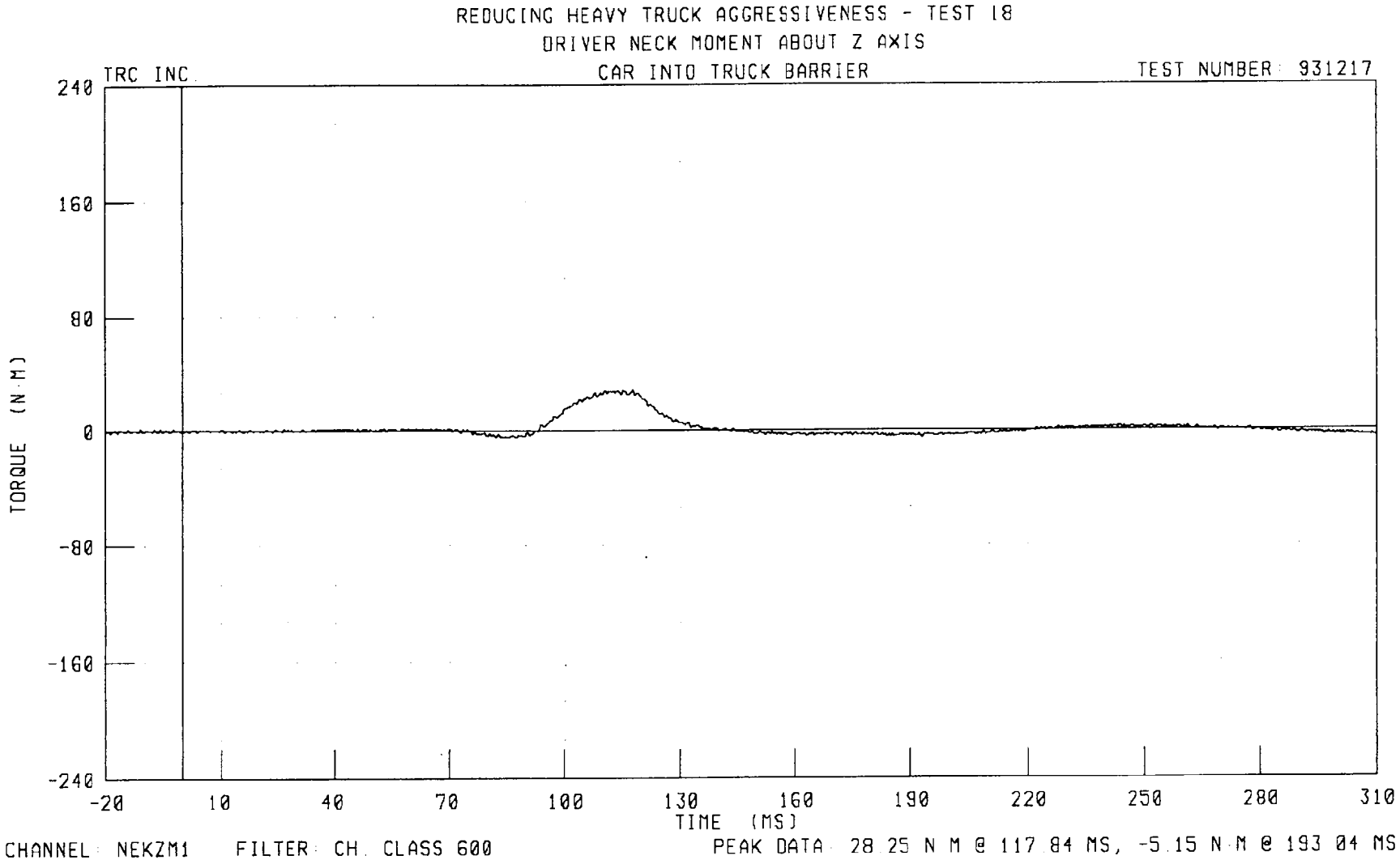
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER NECK MOMENT ABOUT X AXIS
CAR INTO TRUCK BARRIER



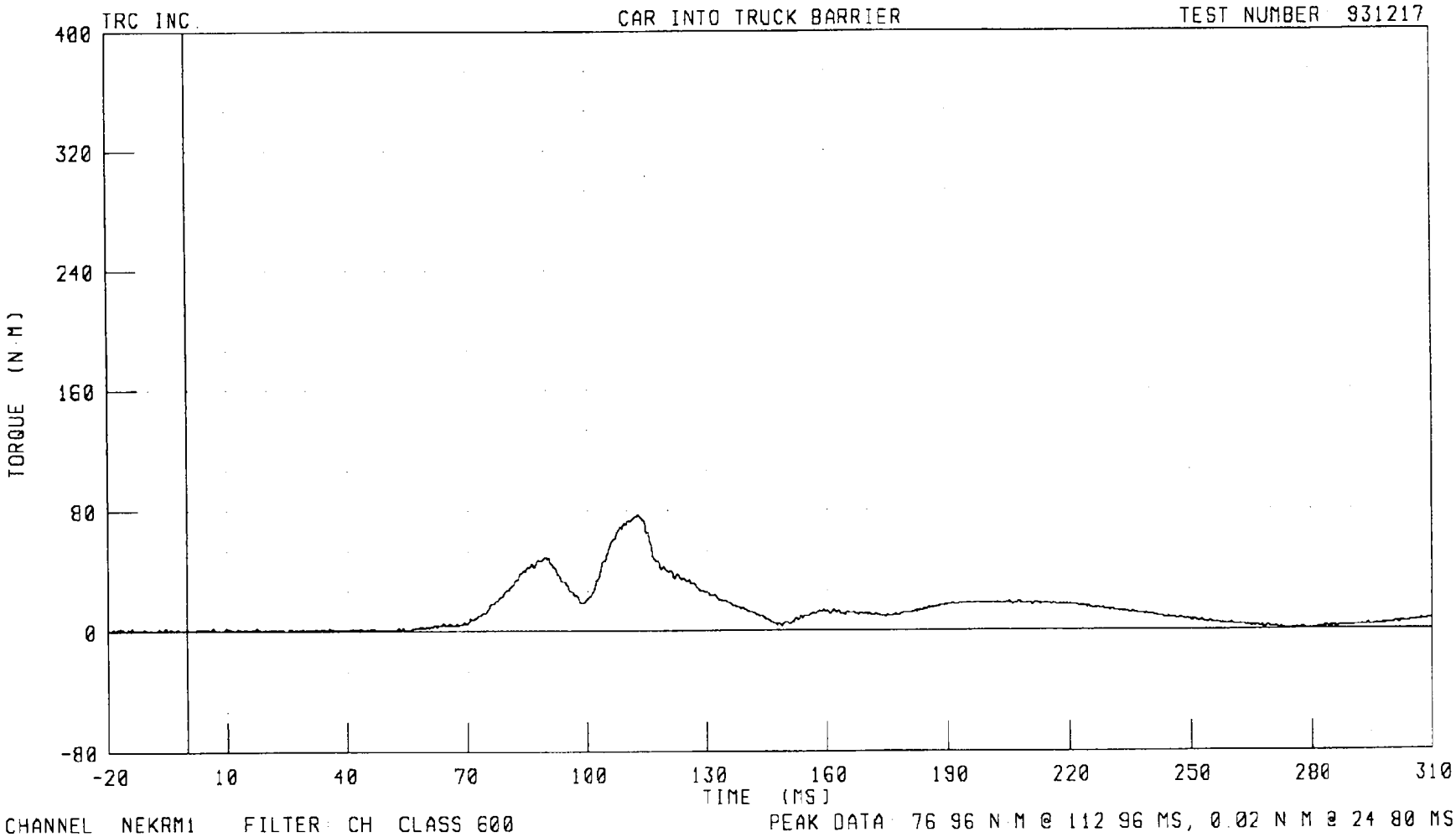
CHANNEL: NEKXM1 FILTER: CH CLASS 600

PEAK DATA: 21.95 N-M @ 94.24 MS, -38.67 N-M @ 112.48 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER NECK MOMENT ABOUT Y AXIS
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
240
160
80
0
-80
-160
-240
TORQUE (N-M)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL NEKYM1 FILTER CH CLASS 600
PEAK DATA 61 52 N M @ 112 96 MS; -46 23 N M @ 89 76 MS

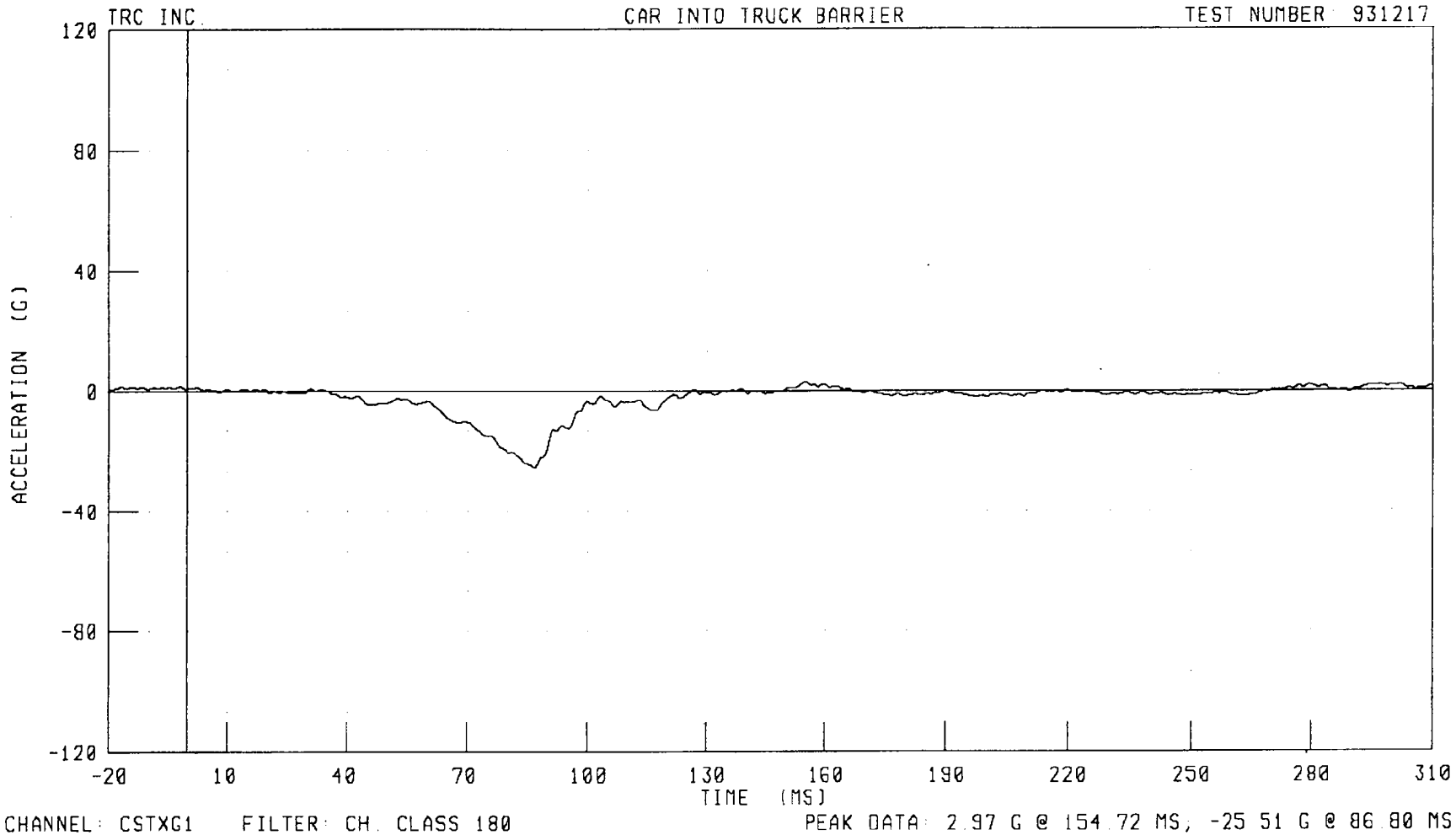

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER NECK MOMENT ABOUT Z AXIS
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER: 931217
240
160
80
0
-80
-160
-240
TORQUE (N-M)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: NEKZM1
FILTER: CH. CLASS 600
PEAK DATA: 28.25 N-M @ 117.84 MS, -5.15 N-M @ 193.04 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER NECK MOMENT RESULTANT
CAR INTO TRUCK BARRIER

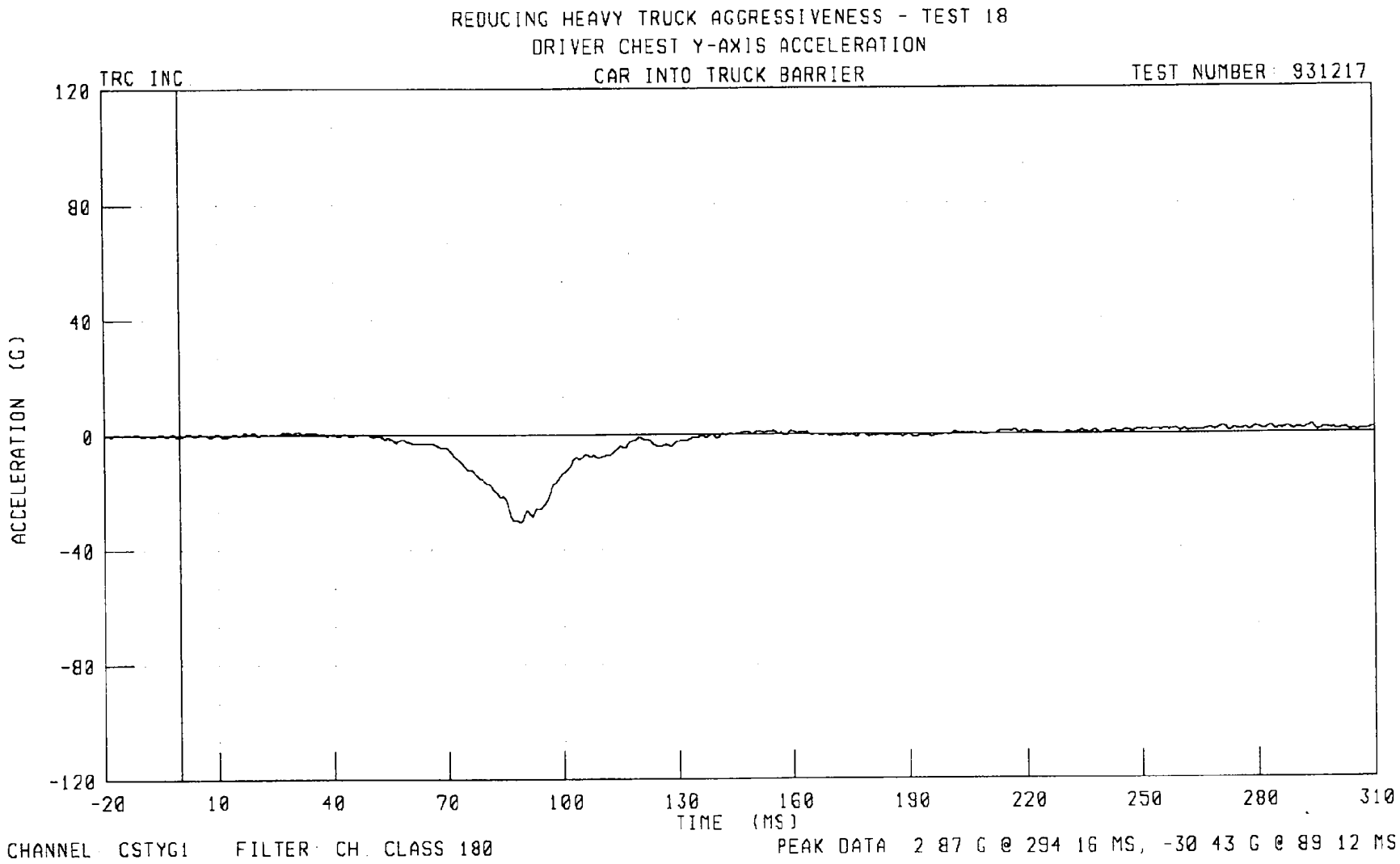


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18

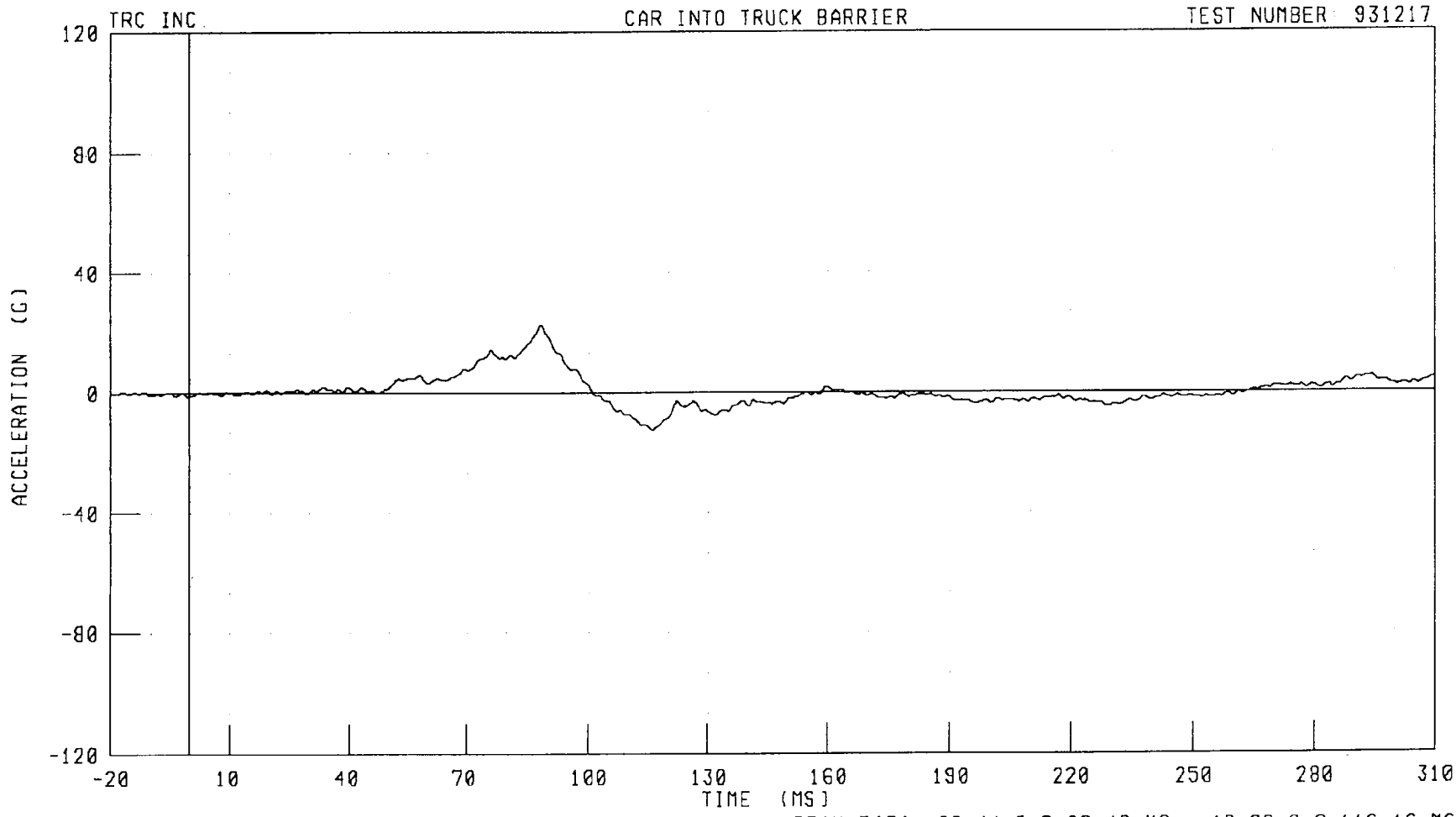
DRIVER CHEST X-AXIS ACCELERATION



CHANNEL: CSTXG1 FILTER: CH. CLASS 180 PEAK DATA: 2.97 G @ 154.72 MS, -25.51 G @ 86.80 MS

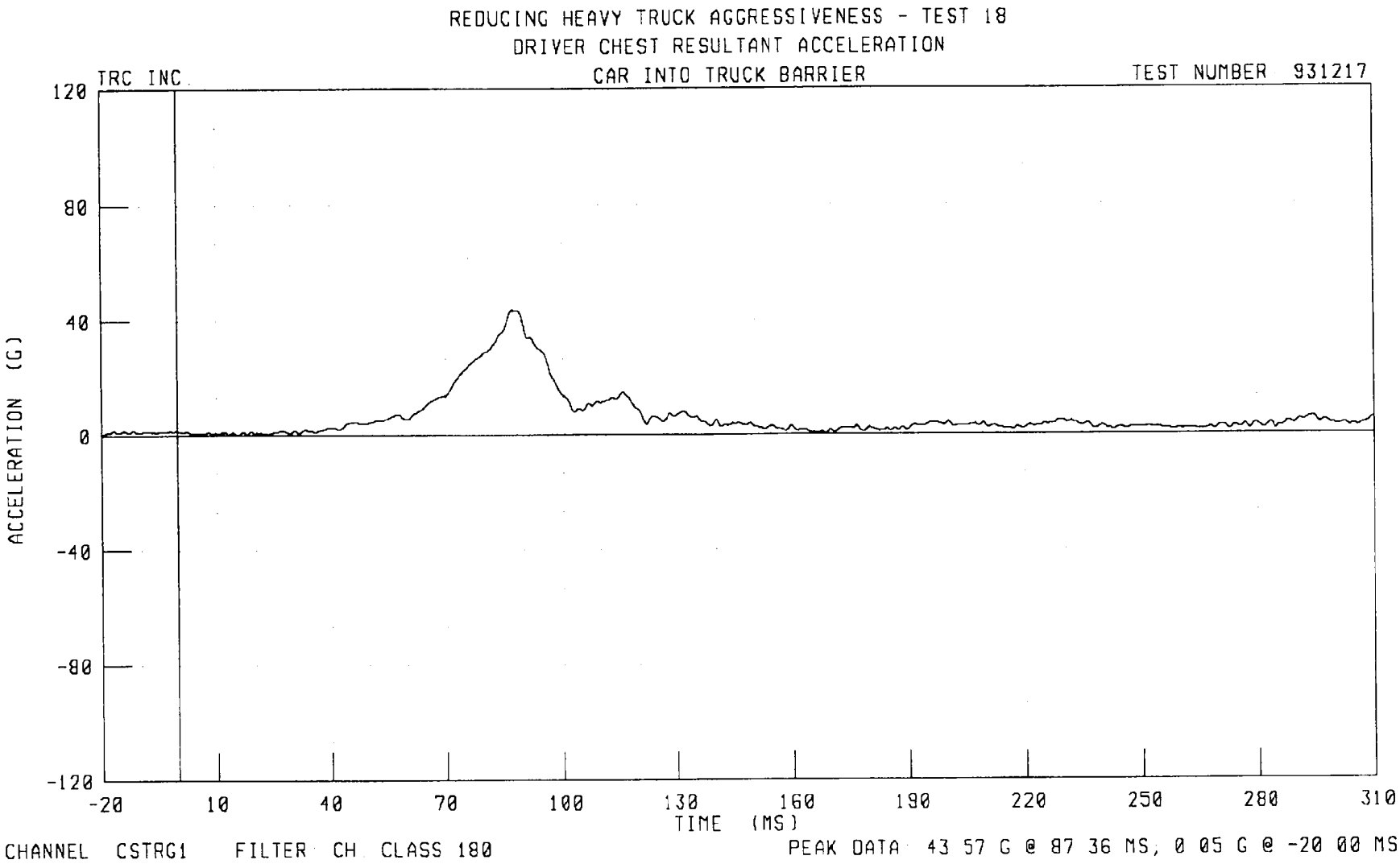

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER CHEST Y-AXIS ACCELERATION
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER: 931217
120
80
40
0
-40
-80
-120
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL CSTYG1
FILTER CH CLASS 180
PEAK DATA 2 87 G @ 294 16 MS, -30 43 G @ 89 12 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER CHEST Z-AXIS ACCELERATION
CAR INTO TRUCK BARRIER

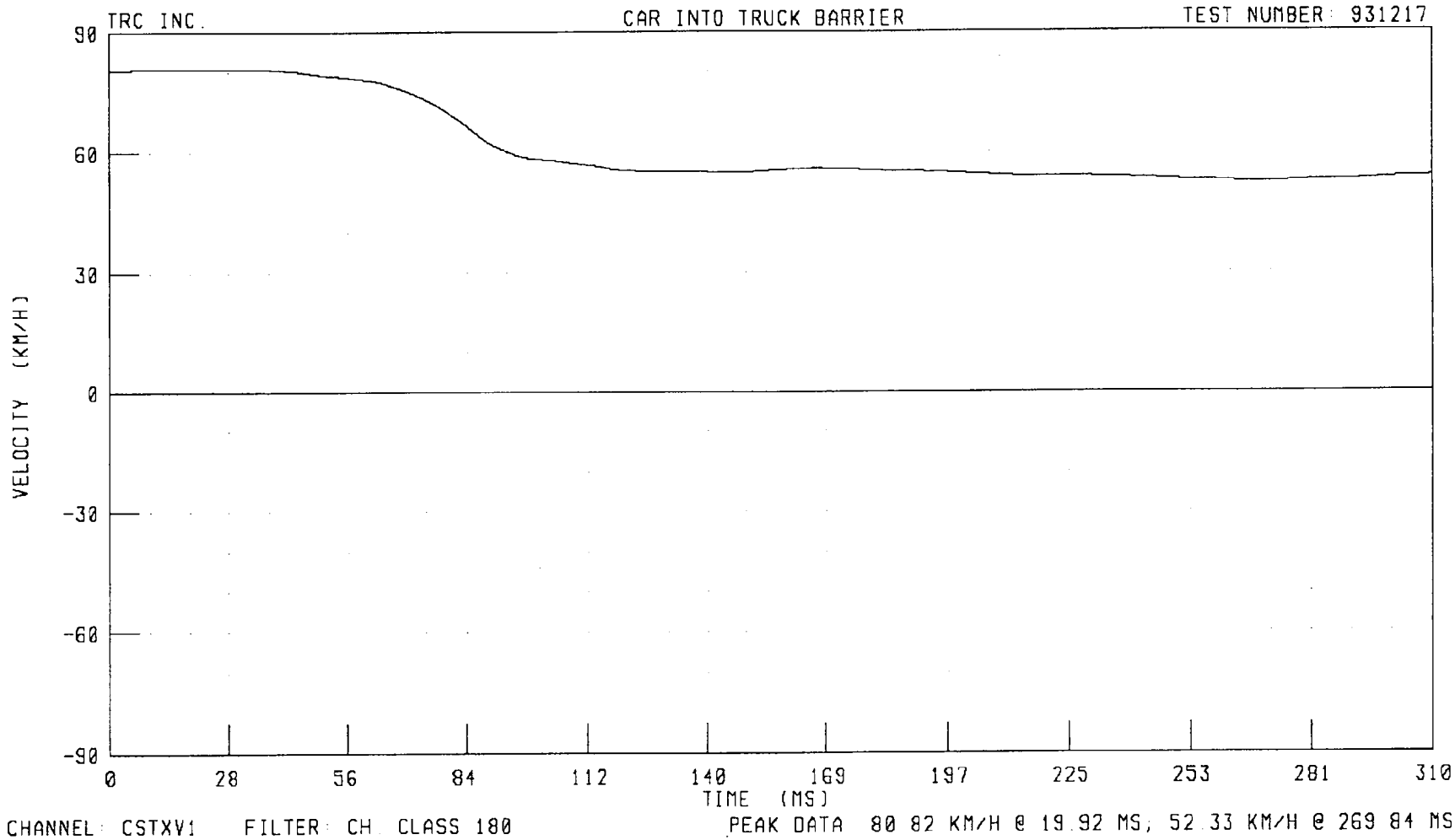


CHANNEL CSTZG1 FILTER CH CLASS 180

PEAK DATA 22.44 G @ 88.48 MS, -12.60 G @ 116.16 MS

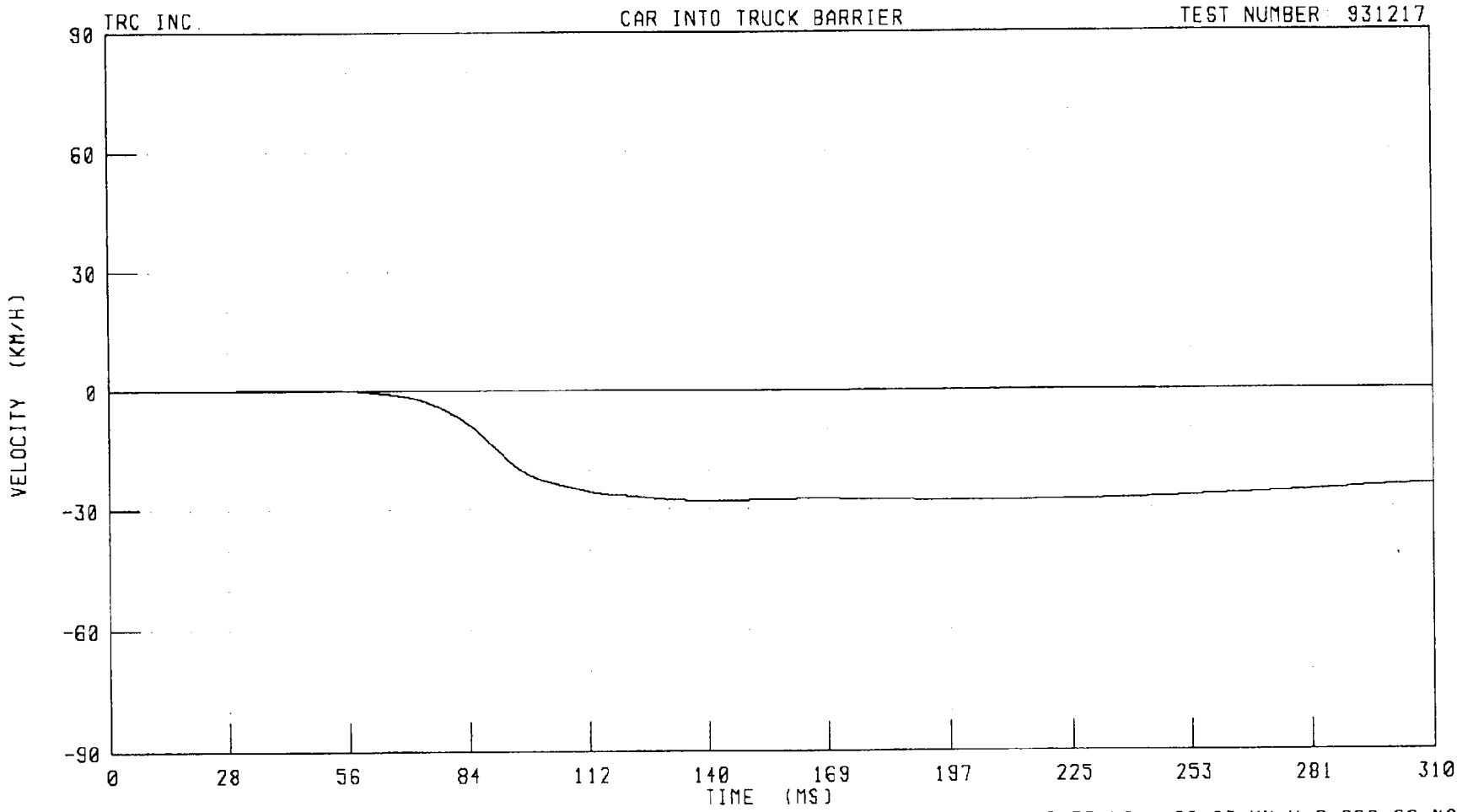

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER CHEST RESULTANT ACCELERATION
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
120
80
40
0
-40
-80
-120
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL CSTRG1 FILTER CH CLASS 180
PEAK DATA 43 57 G @ 87 36 MS, 0 05 G @ -20 00 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER CHEST X-AXIS VELOCITY
CAR INTO TRUCK BARRIER



CHANNEL: CSTXV1 FILTER: CH CLASS 180 PEAK DATA 80.82 KM/H @ 19.92 MS; 52.33 KM/H @ 269.84 MS

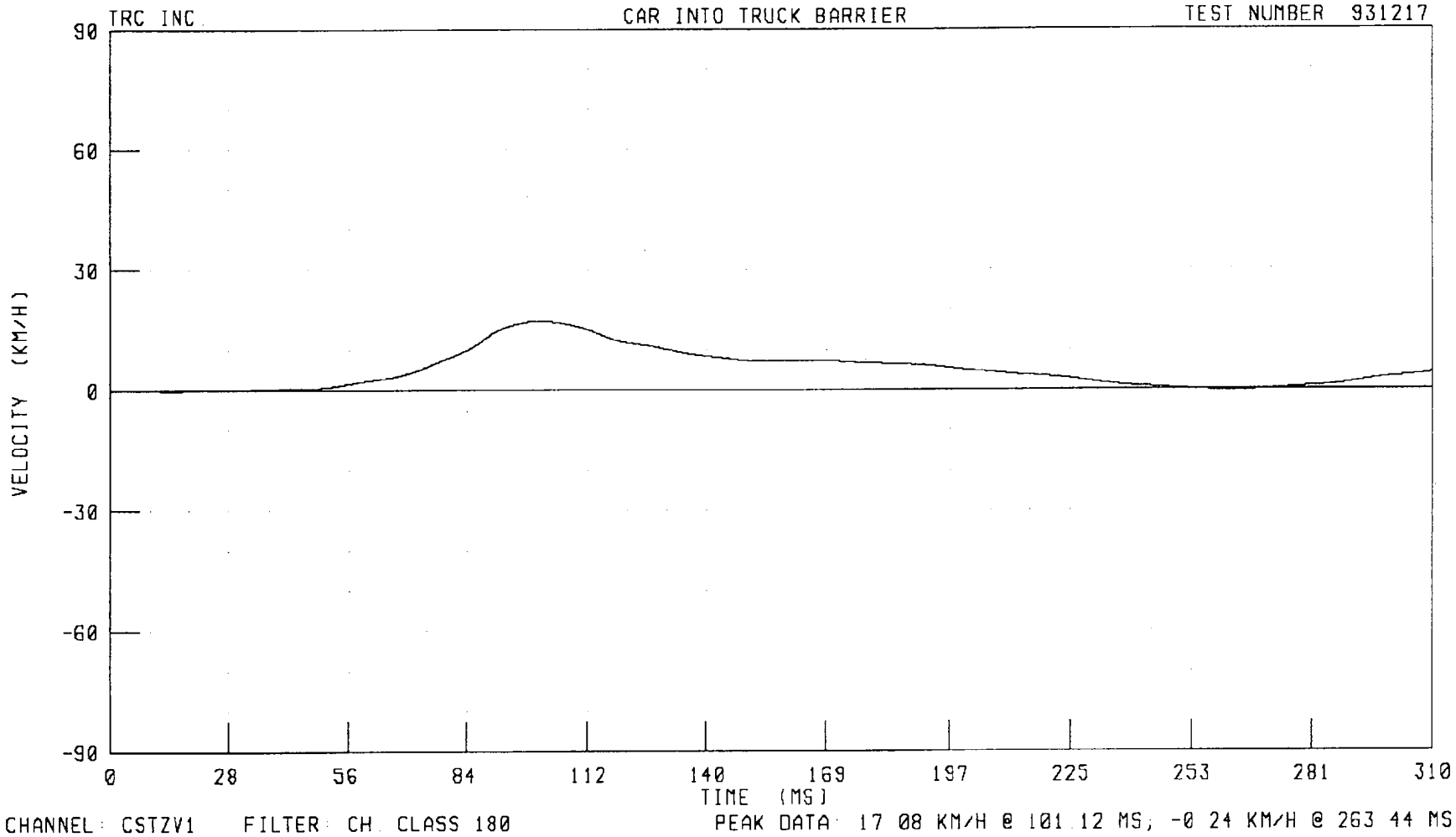
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER CHEST Y-AXIS VELOCITY
CAR INTO TRUCK BARRIER



CHANNEL CSTYV1 FILTER CH CLASS 180

PEAK DATA 0 30 KM/H @ 40 56 MS, -28 03 KM/H @ 200 88 MS

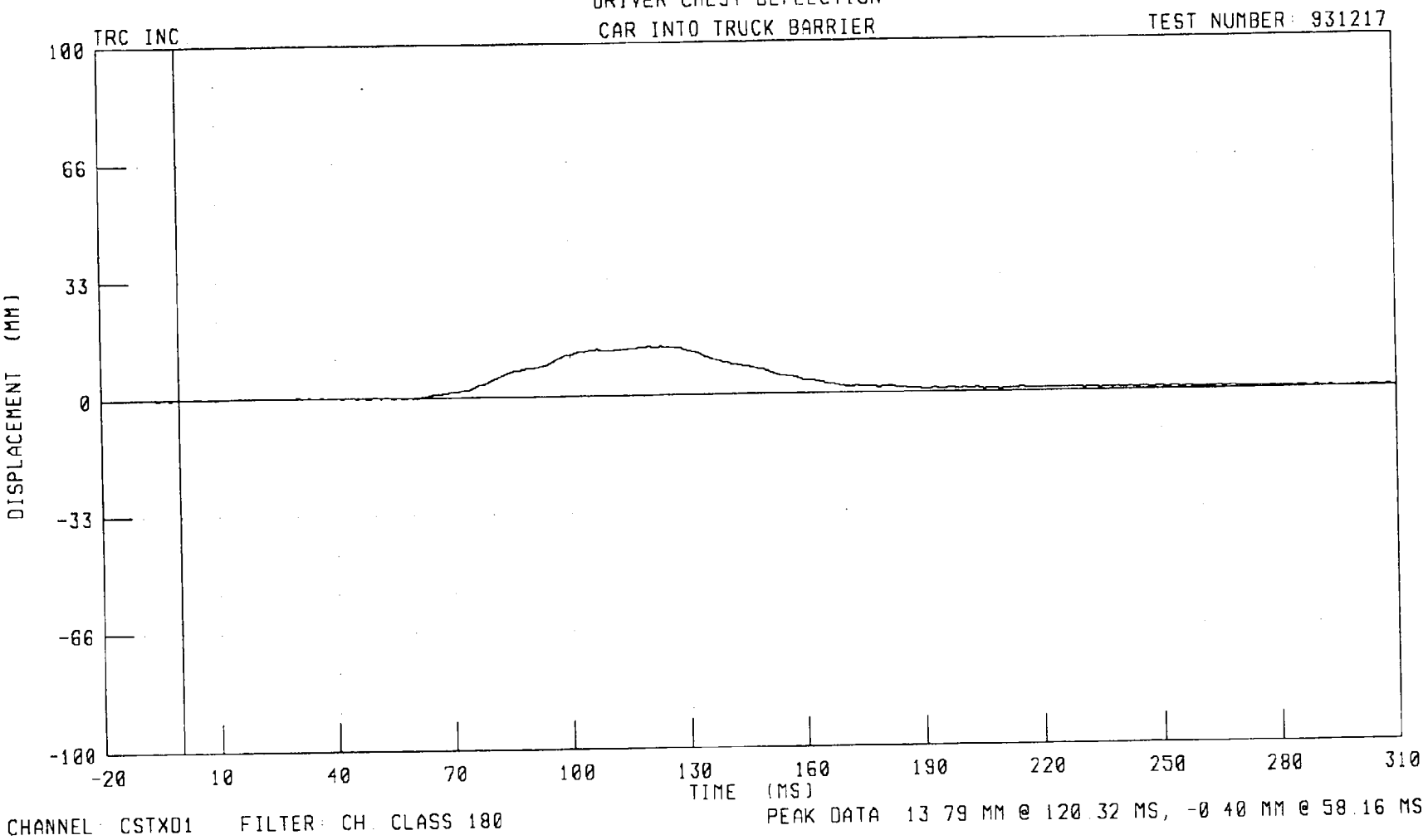
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER CHEST Z-AXIS VELOCITY
CAR INTO TRUCK BARRIER



CHANNEL: CSTZV1 FILTER: CH CLASS 180

PEAK DATA: 17 08 KM/H @ 101 12 MS; -0 24 KM/H @ 263 44 MS

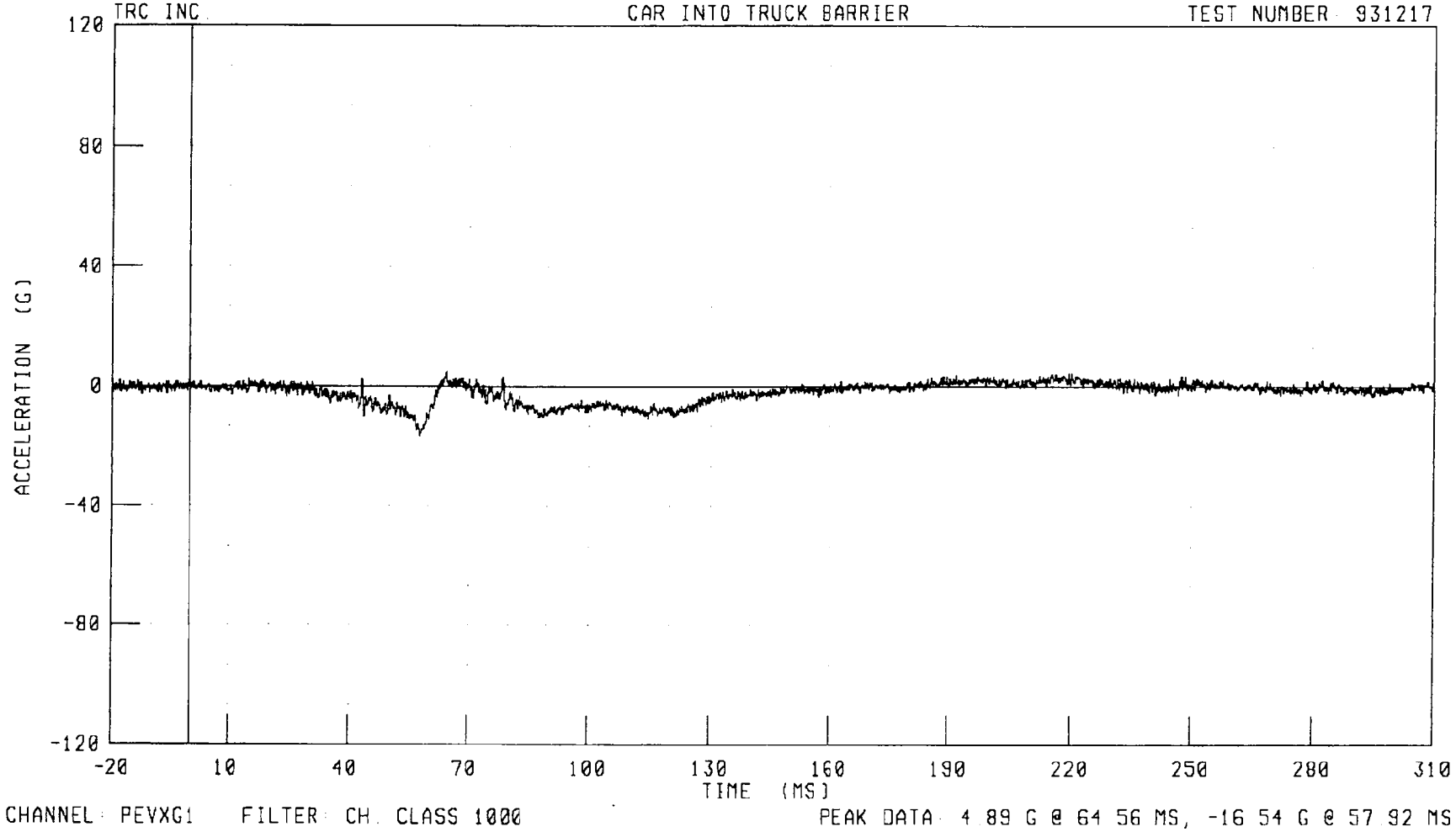
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER CHEST DEFLECTION
CAR INTO TRUCK BARRIER

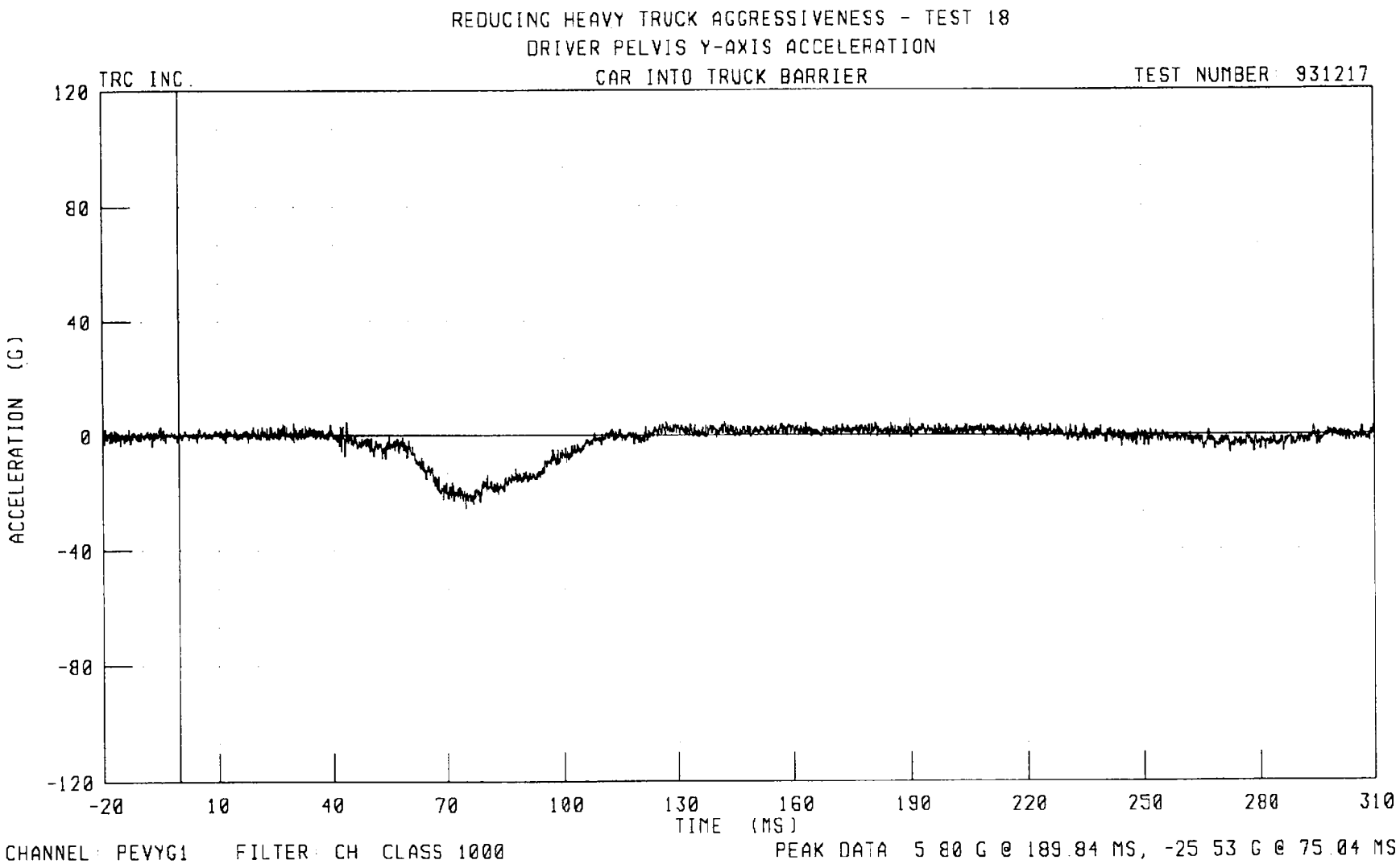


CHANNEL: CSTXD1 FILTER: CH CLASS 180

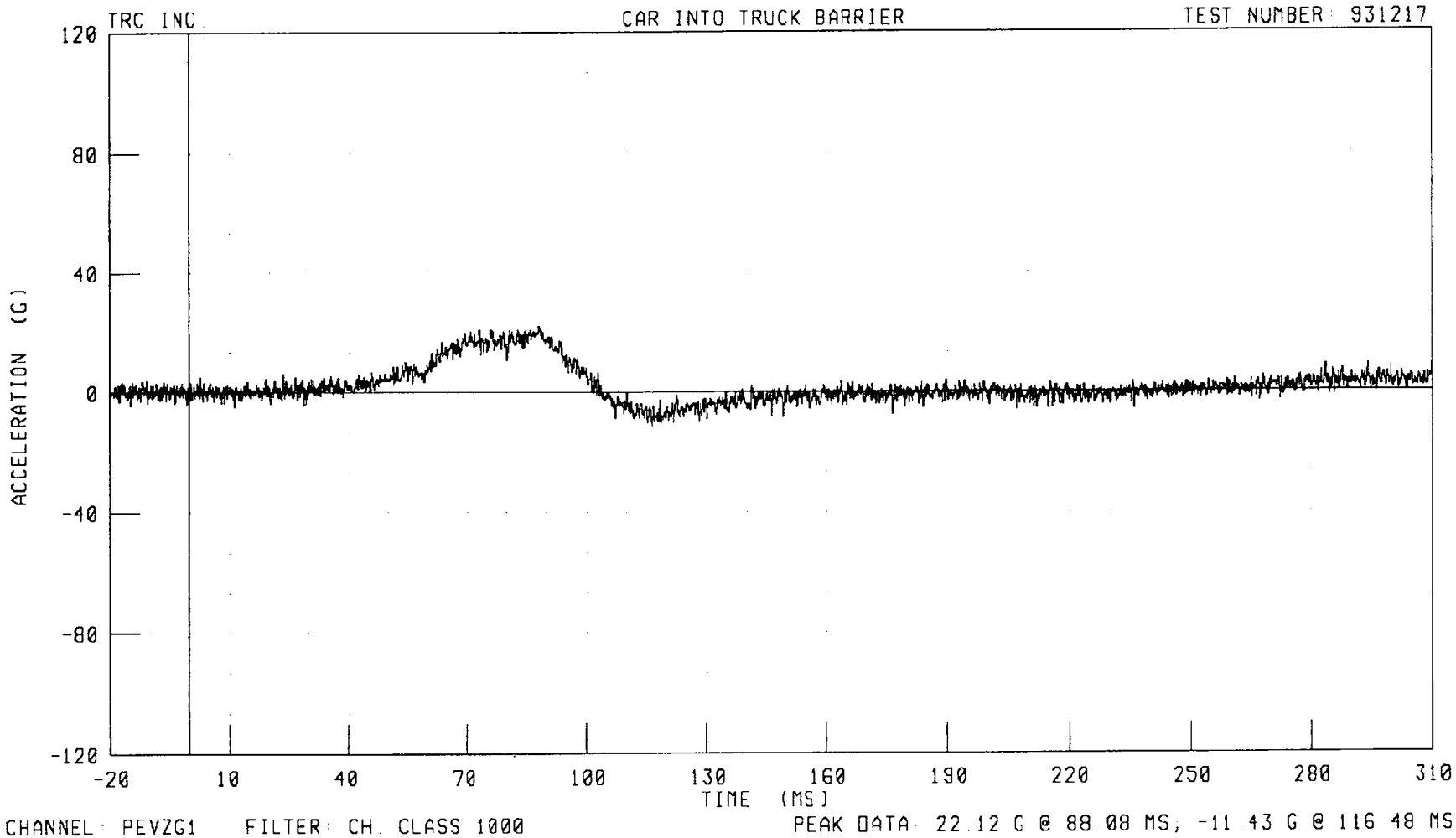
PEAK DATA 13.79 MM @ 120.32 MS, -0.40 MM @ 58.16 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER PELVIS X-AXIS ACCELERATION



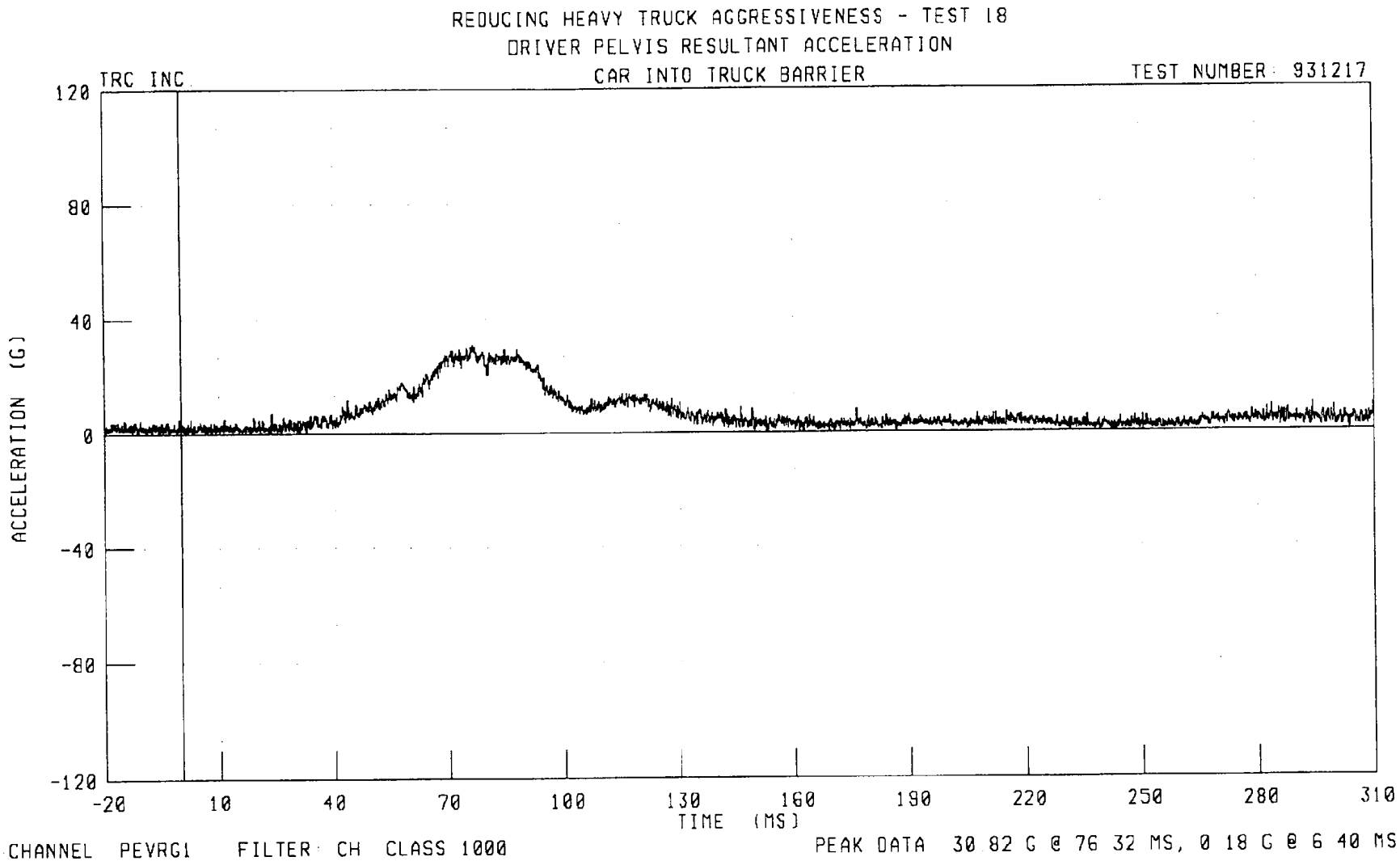

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER PELVIS Y-AXIS ACCELERATION
TRC INC.
CAR INTO TRUCK BARRIER
TEST NUMBER 931217
120
80
40
0
-40
-80
-120
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL PEVYG1 FILTER CH CLASS 1000
PEAK DATA 5 80 G @ 189.84 MS, -25 53 G @ 75.04 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER PELVIS Z-AXIS ACCELERATION
CAR INTO TRUCK BARRIER

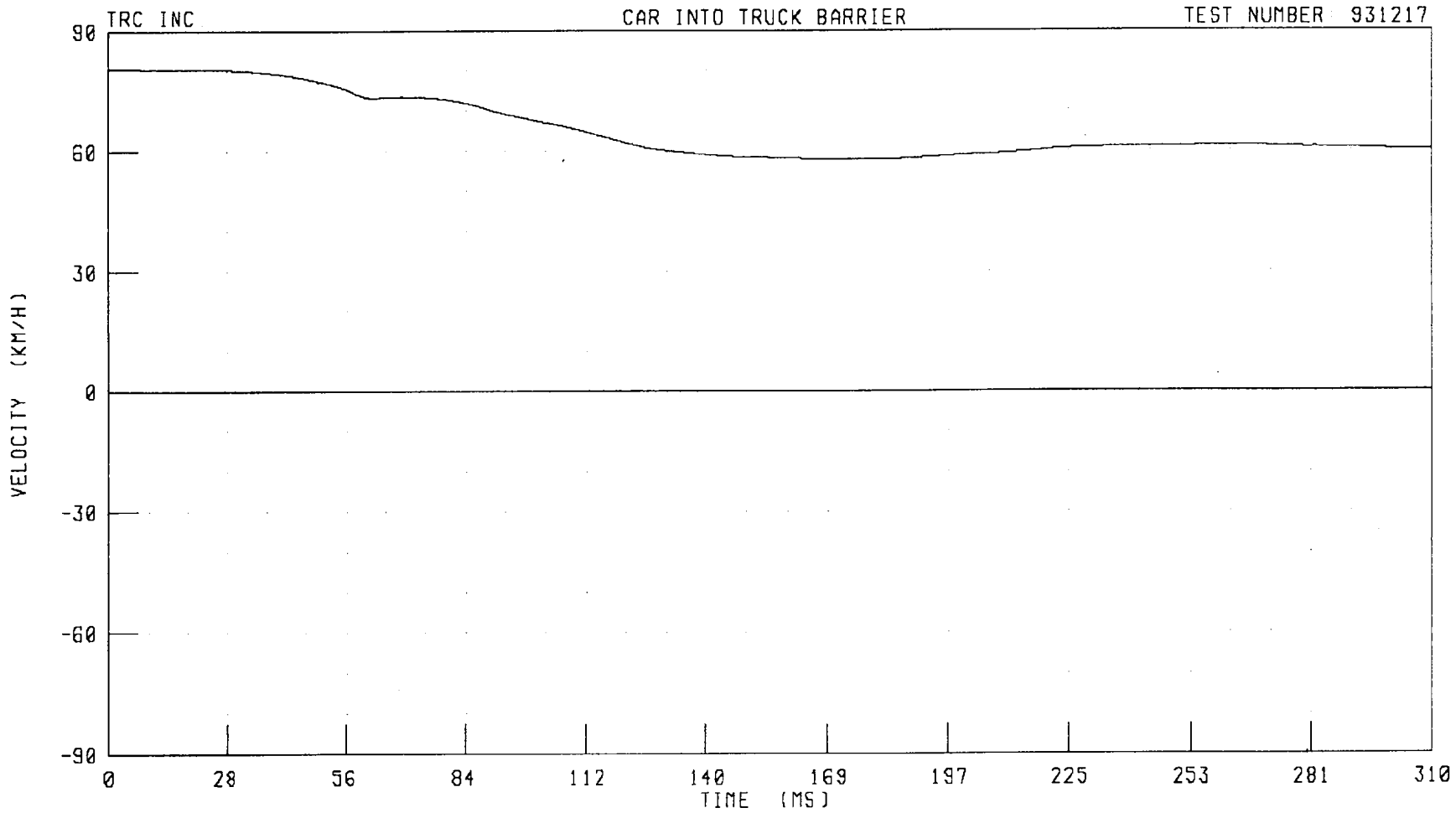


CHANNEL: PEVZG1 FILTER: CH. CLASS 1000

PEAK DATA: 22.12 G @ 88.08 MS, -11.43 G @ 116.48 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER PELVIS RESULTANT ACCELERATION
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER: 931217
120
80
40
0
-40
-80
-120
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL PEVRG1 FILTER CH CLASS 1000
PEAK DATA 30 82 G @ 76 32 MS, 0 18 G @ 6 40 MS

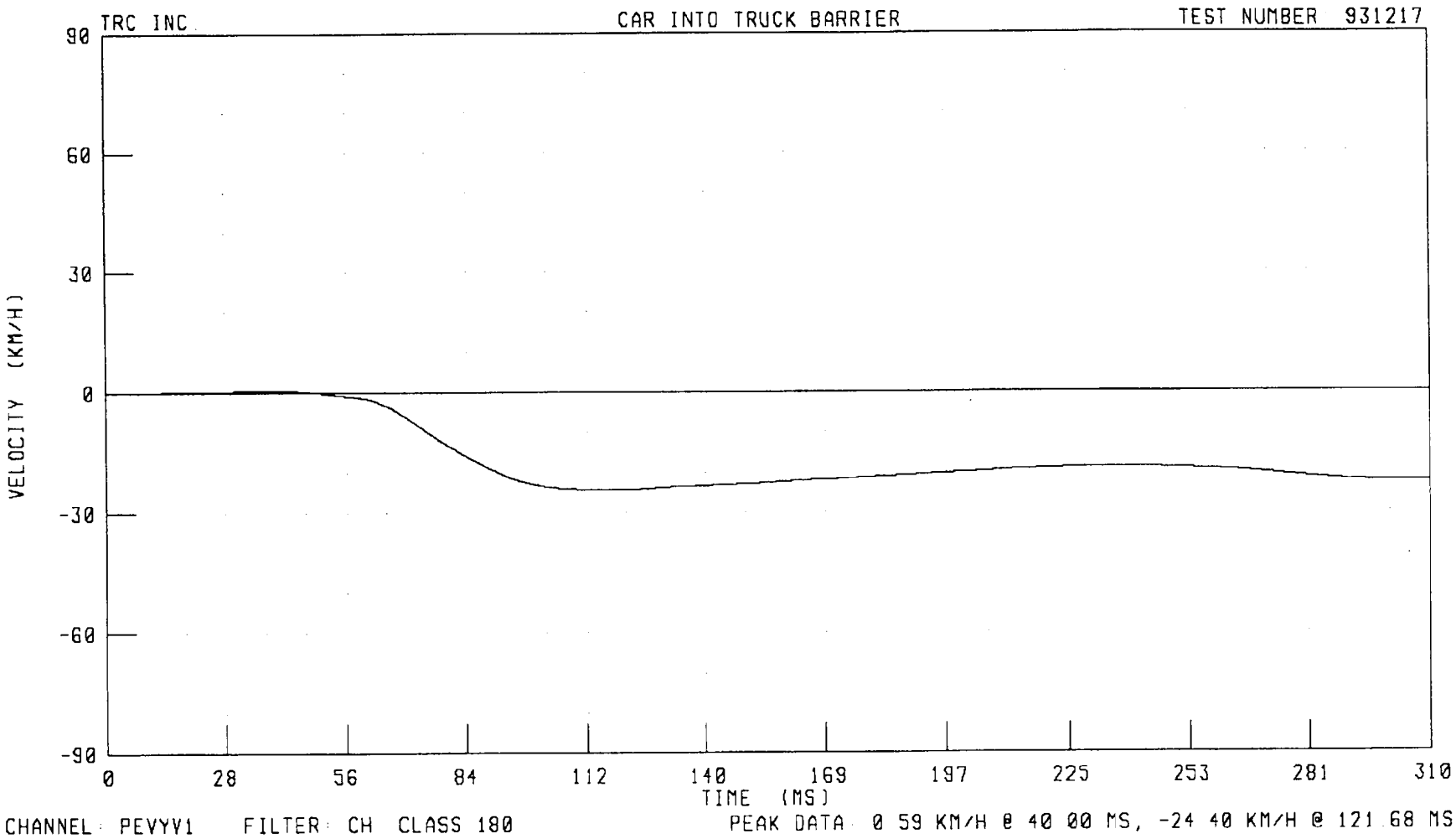
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER PELVIS X-AXIS VELOCITY
CAR INTO TRUCK BARRIER



CHANNEL PEVXV1 FILTER CH CLASS 180

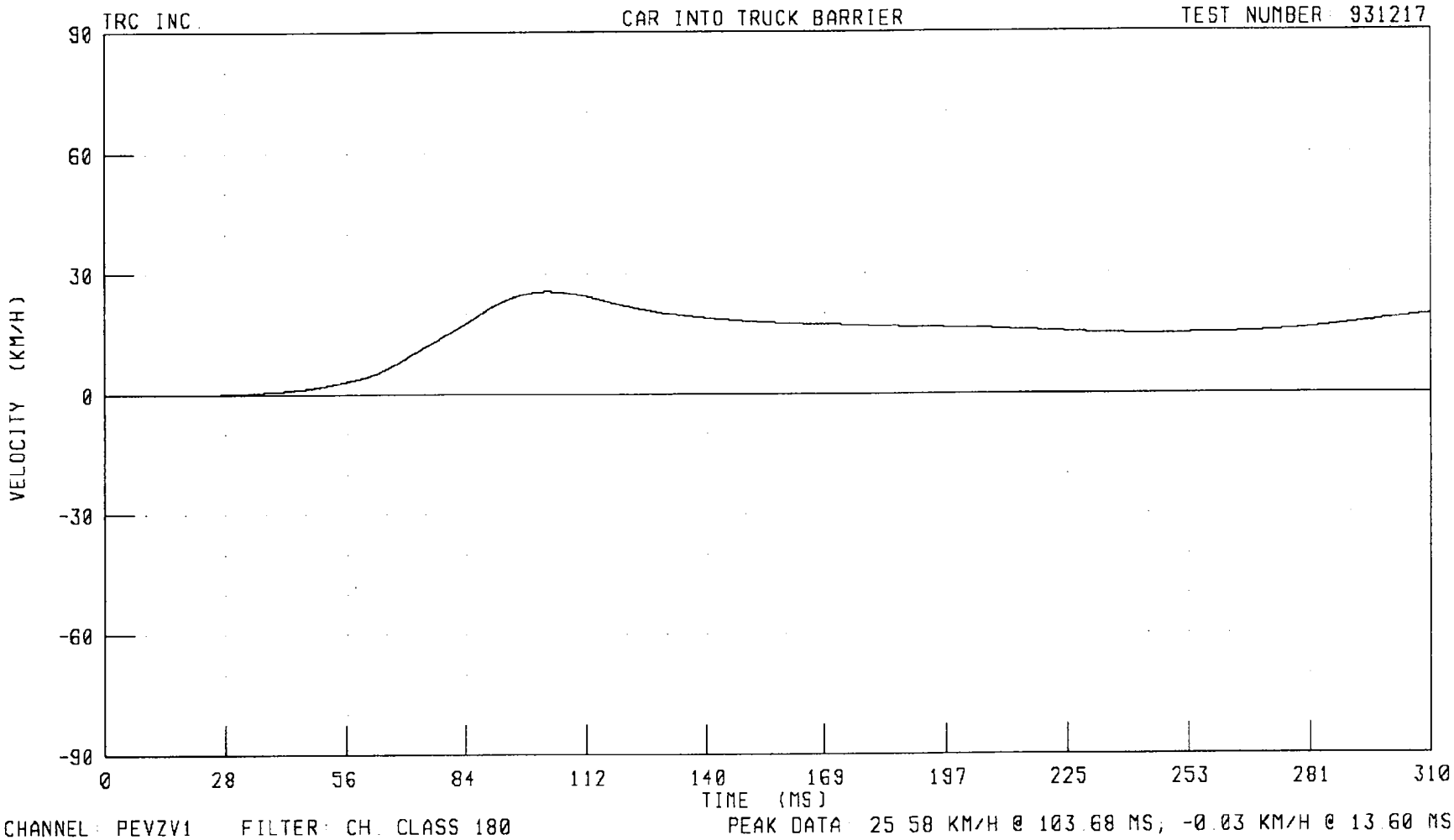
PEAK DATA 80.51 KM/H @ 1.04 MS; 57.94 KM/H @ 181.36 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER PELVIS Y-AXIS VELOCITY
CAR INTO TRUCK BARRIER



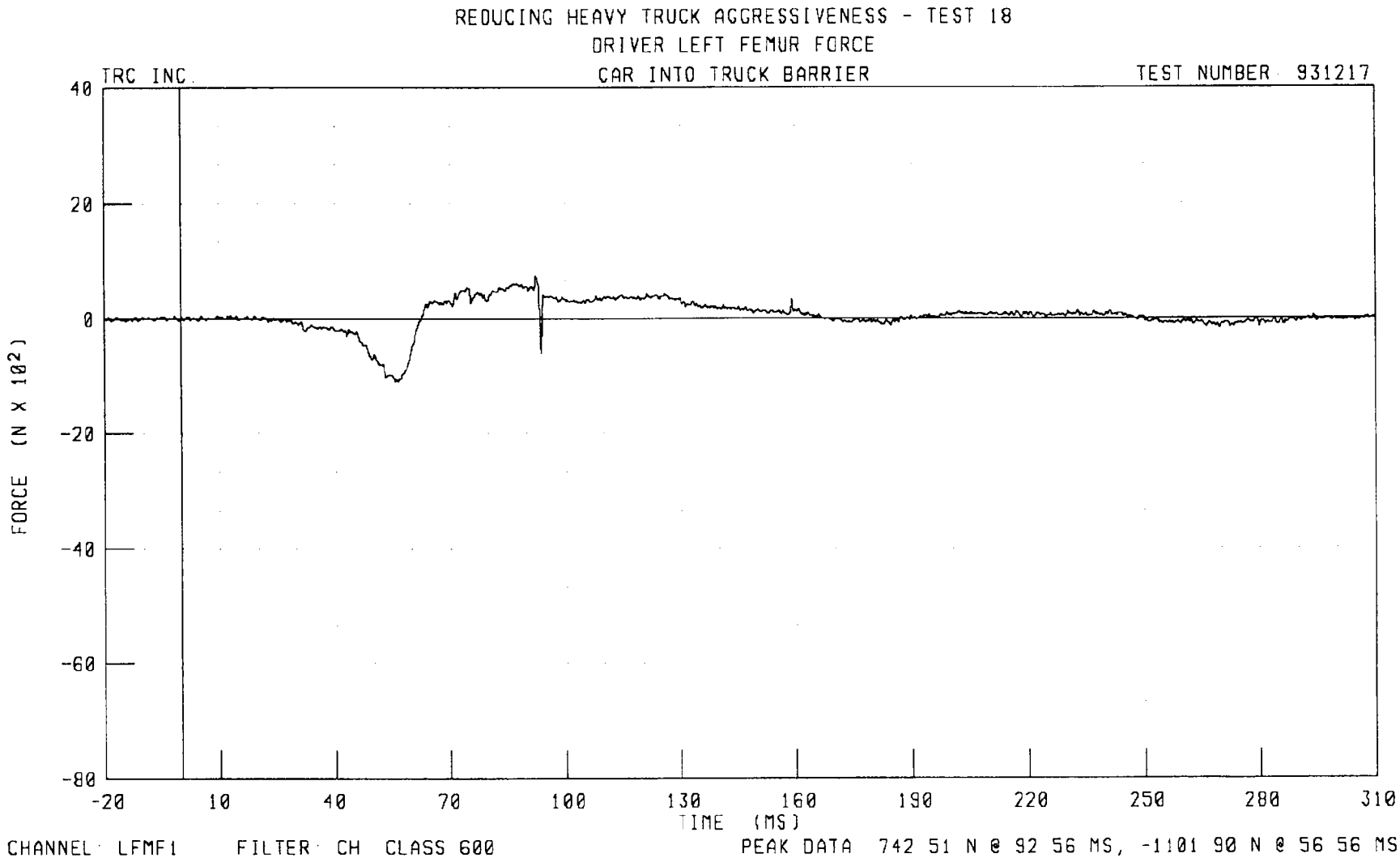
CHANNEL: PEVYV1 FILTER: CH CLASS 180 PEAK DATA: 0 59 KM/H @ 40 00 MS, -24 40 KM/H @ 121 68 MS

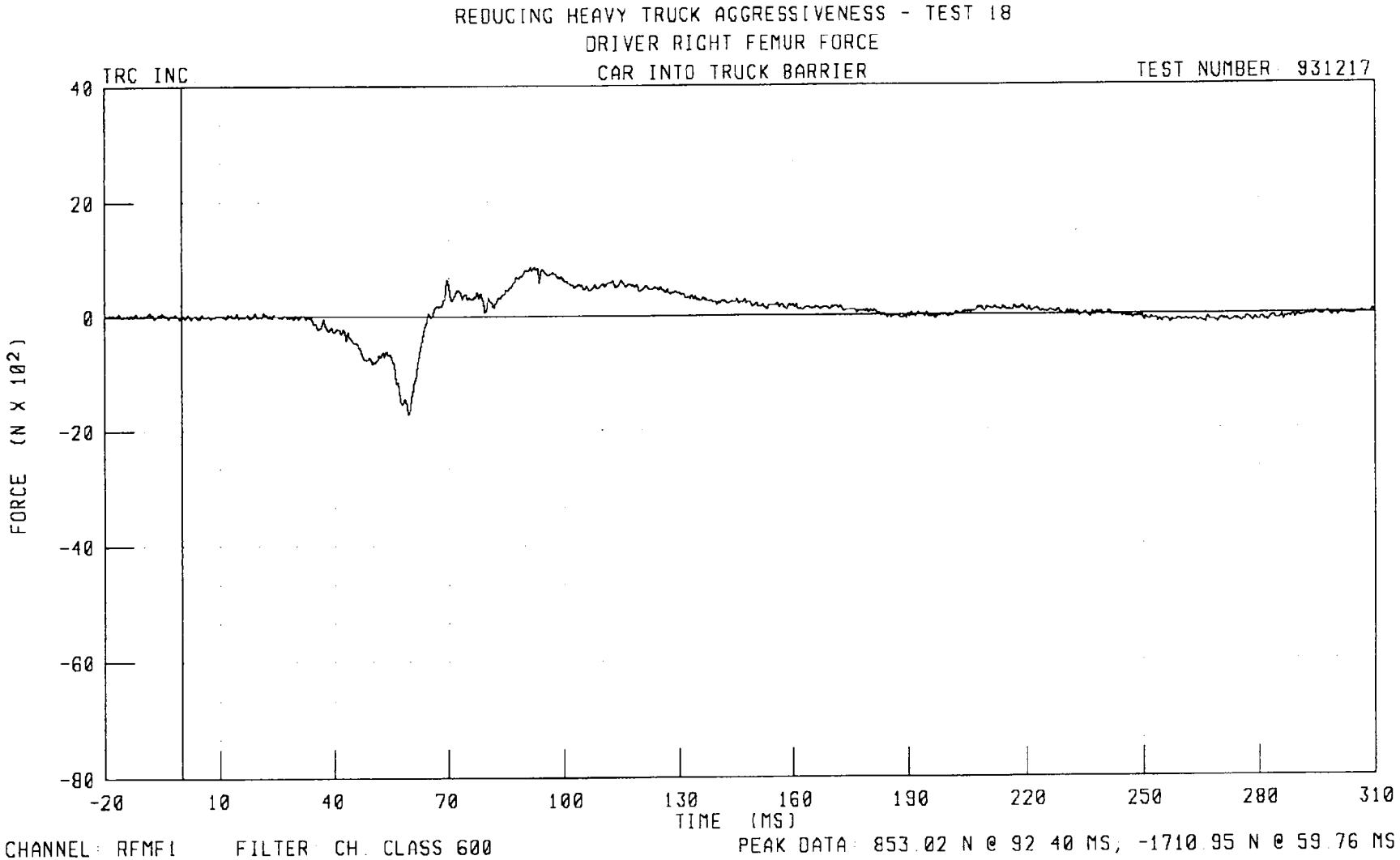
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER PELVIS Z-AXIS VELOCITY
CAR INTO TRUCK BARRIER

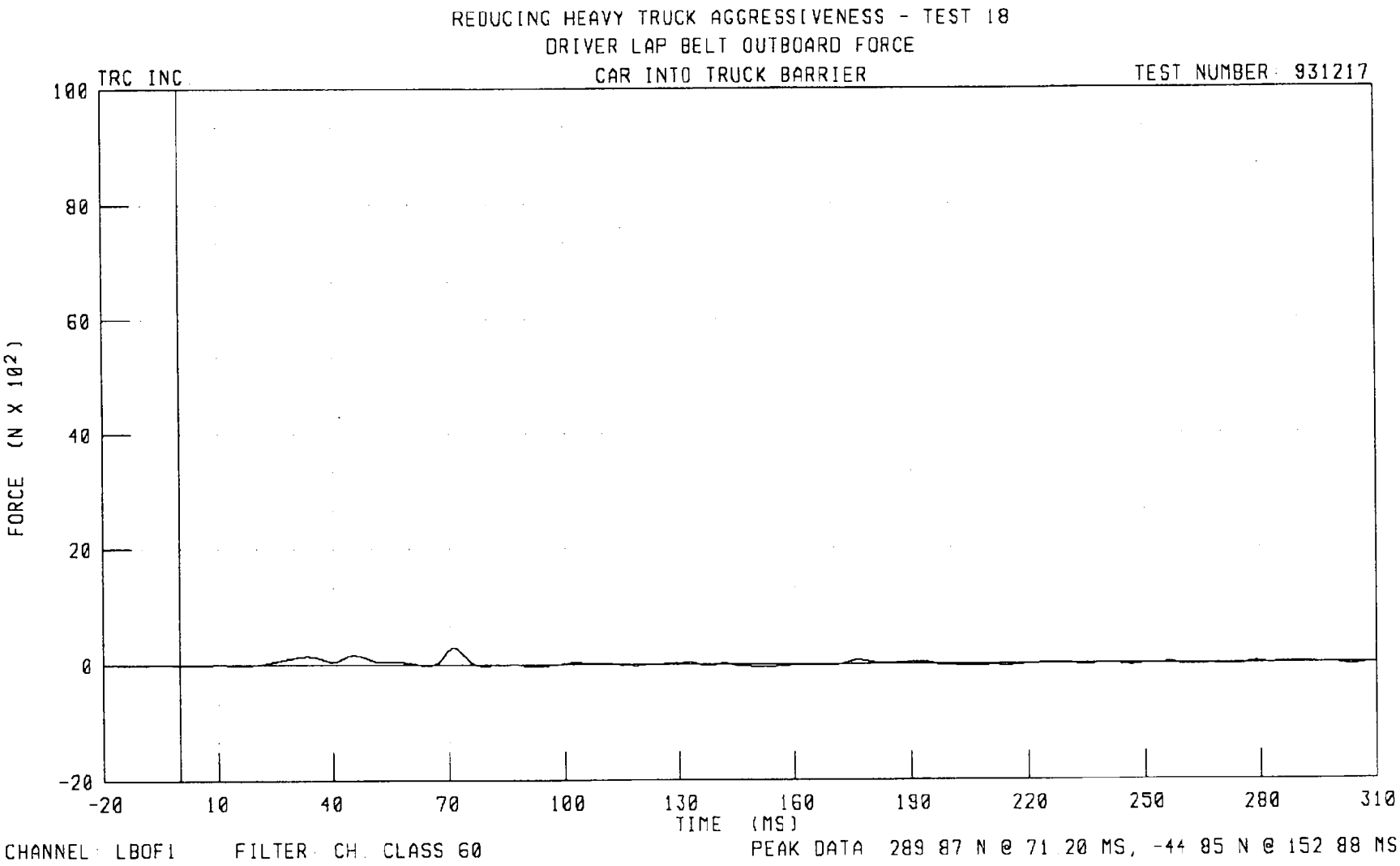


CHANNEL PEVZV1 FILTER CH CLASS 180

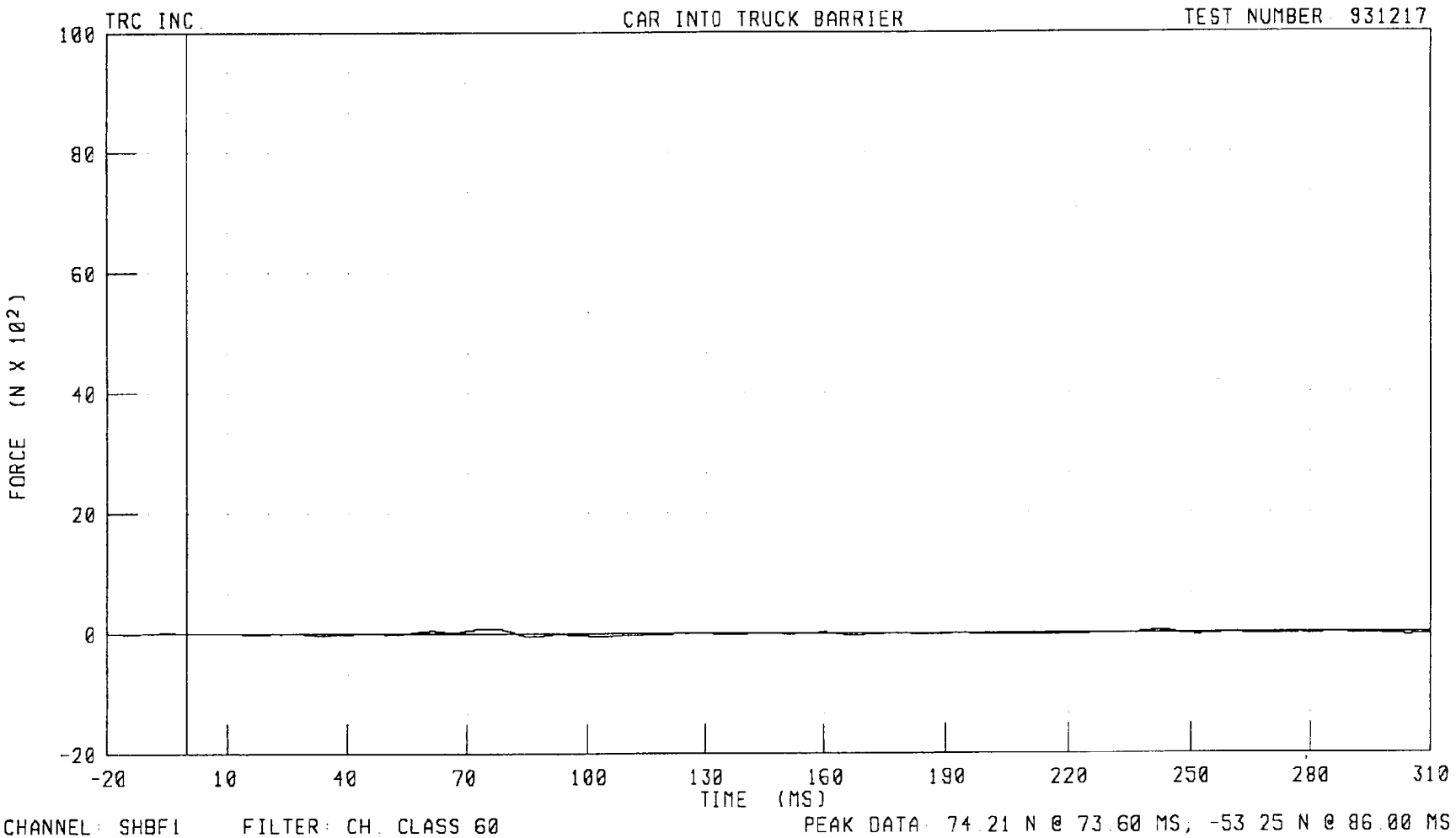
PEAK DATA 25.58 KM/H @ 103.68 MS; -0.03 KM/H @ 13.60 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER LEFT FEMUR FORCE
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
FORCE (N X 10²)
40
20
0
-20
-40
-60
-80
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL LFMF1
FILTER CH CLASS 600
PEAK DATA 742 51 N @ 92 56 MS, -1101 90 N @ 56 56 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER RIGHT FEMUR FORCE
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
40
20
0
-20
-40
-60
-80
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 853.02 N @ 92.40 MS, -1710.95 N @ 59.76 MS

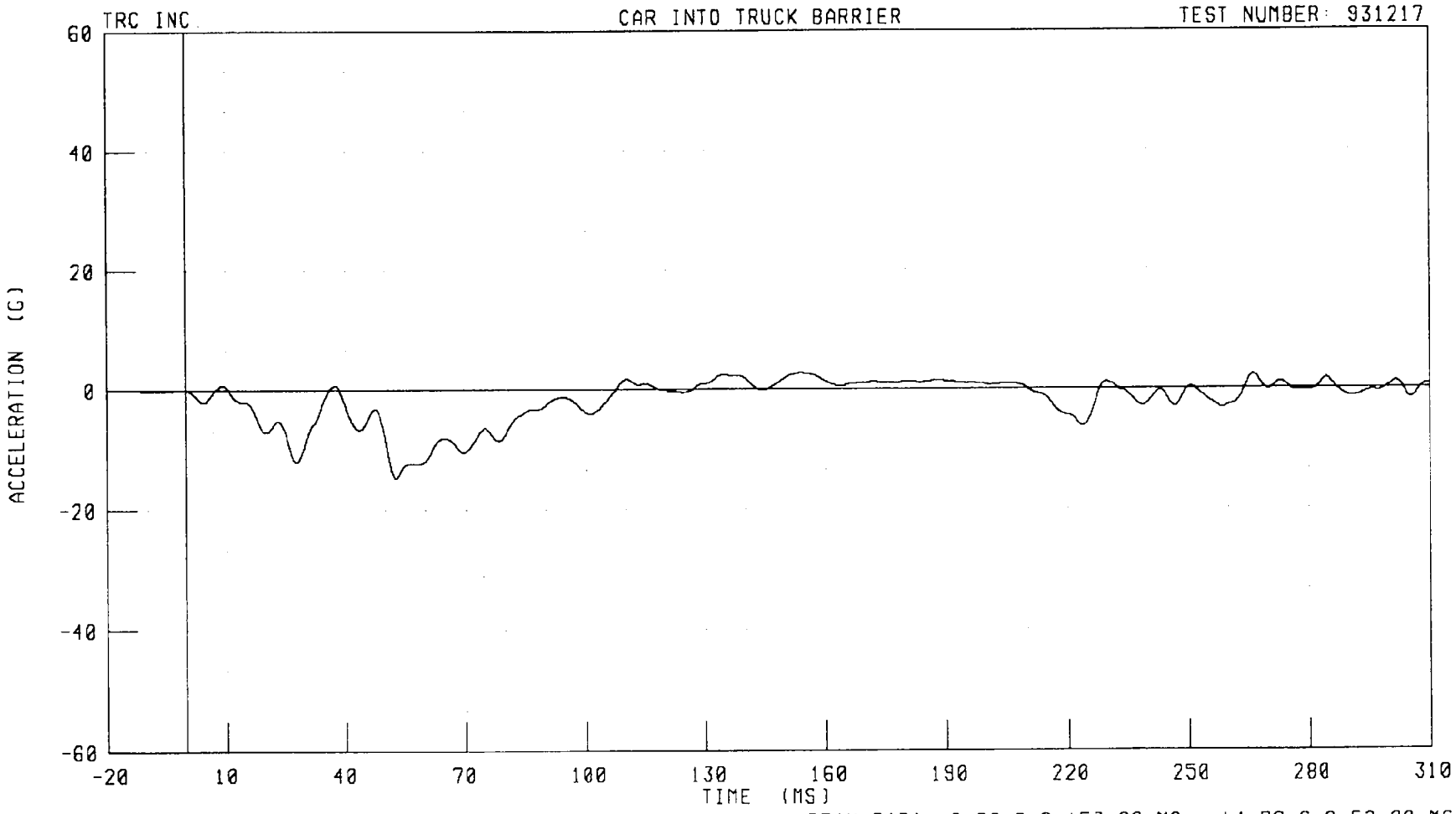

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER LAP BELT OUTBOARD FORCE
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
100
80
60
40
20
0
-20
FORCE (N X 10²)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL LBOF1
FILTER CH CLASS 60
PEAK DATA 289 87 N @ 71 20 MS, -44 85 N @ 152 88 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER SHOULDER BELT FORCE
CAR INTO TRUCK BARRIER



CHANNEL: SHBF1 FILTER: CH CLASS 60 PEAK DATA 74.21 N @ 73.60 MS, -53.25 N @ 86.00 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
LEFT REAR SEAT X-AXIS ACCELERATION
CAR INTO TRUCK BARRIER

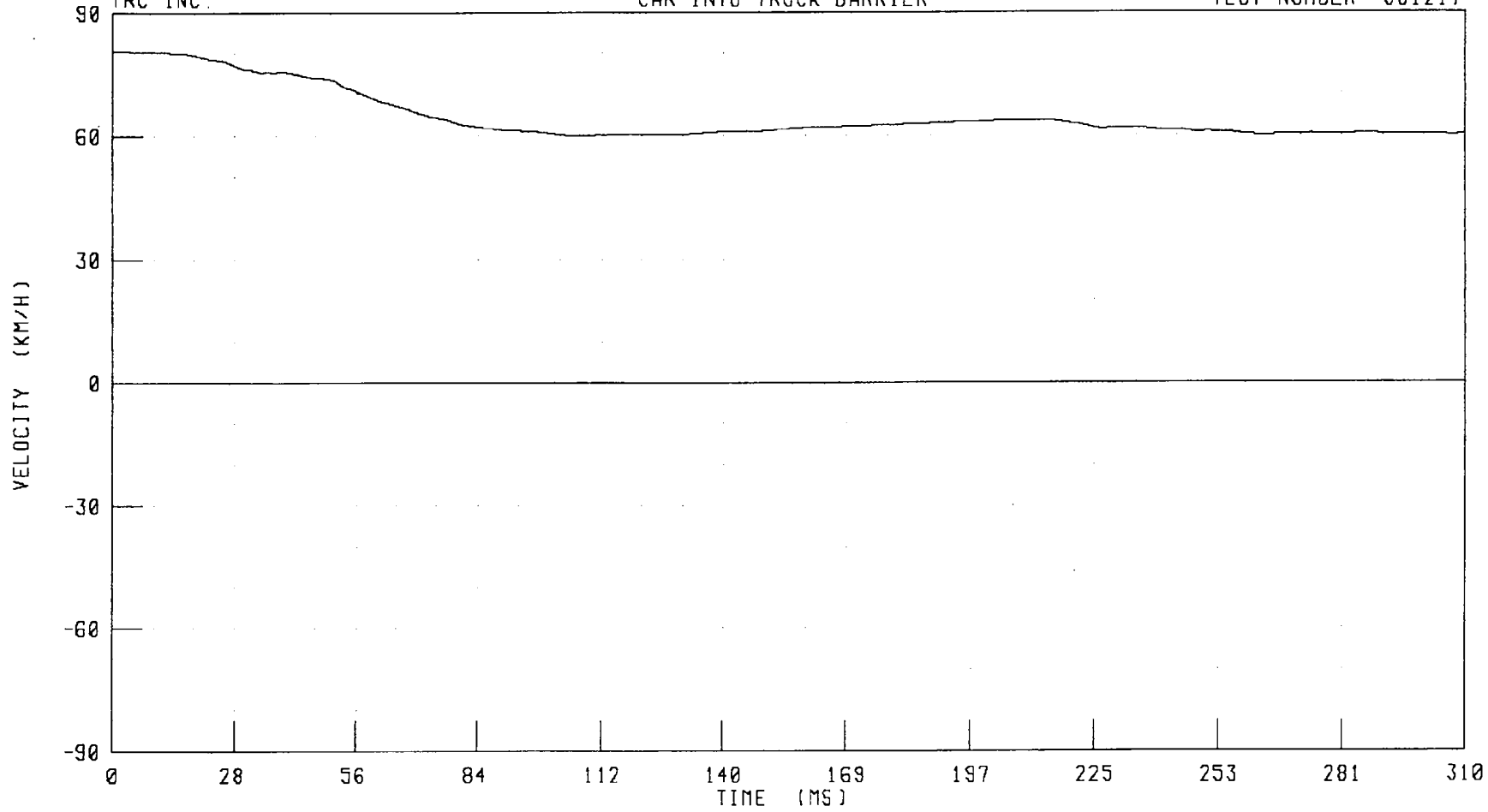


CHANNEL: TLRXG1 FILTER: CH CLASS 60 PEAK DATA 2.66 G @ 153.92 MS, -14.76 G @ 52.80 MS

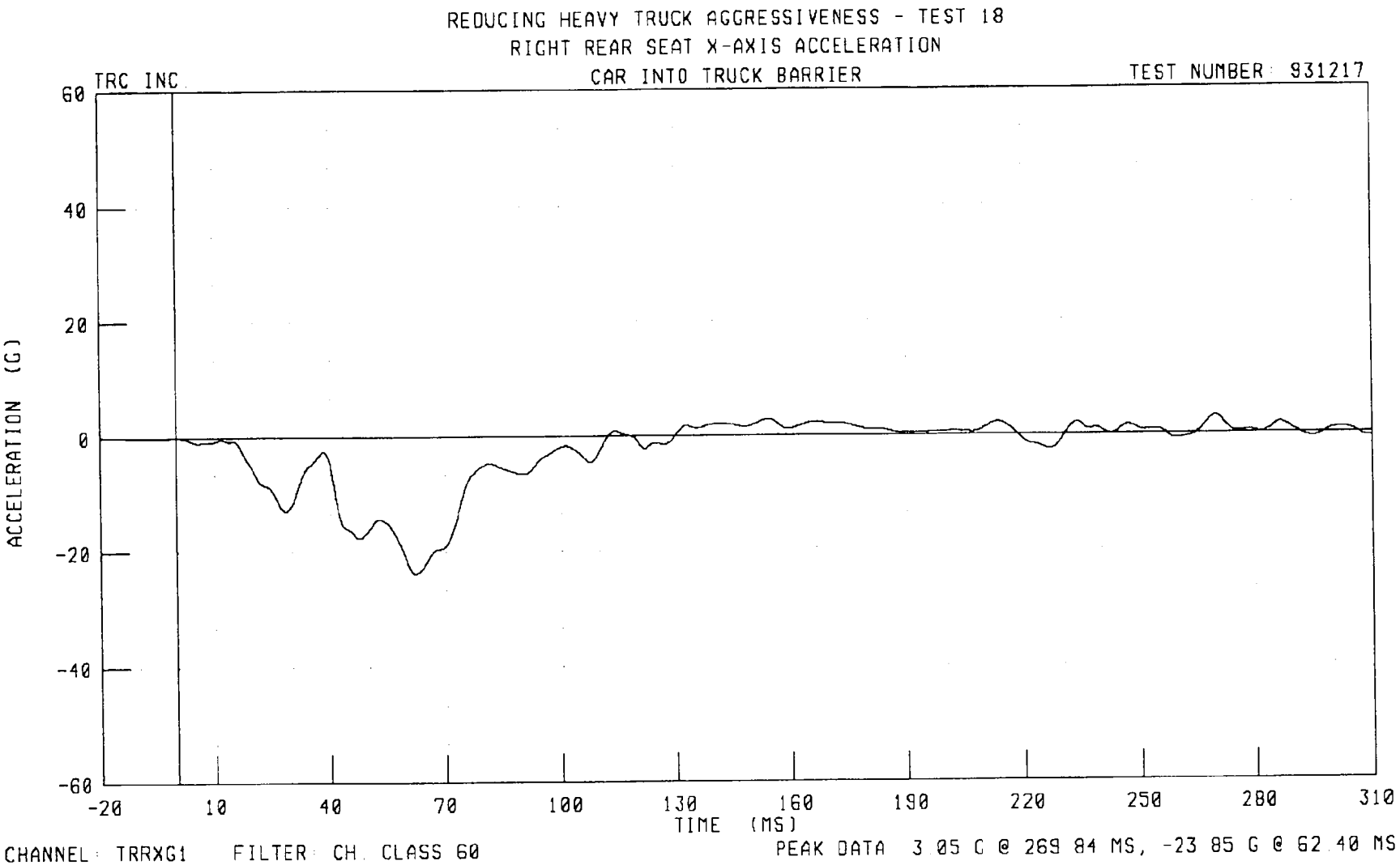
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18

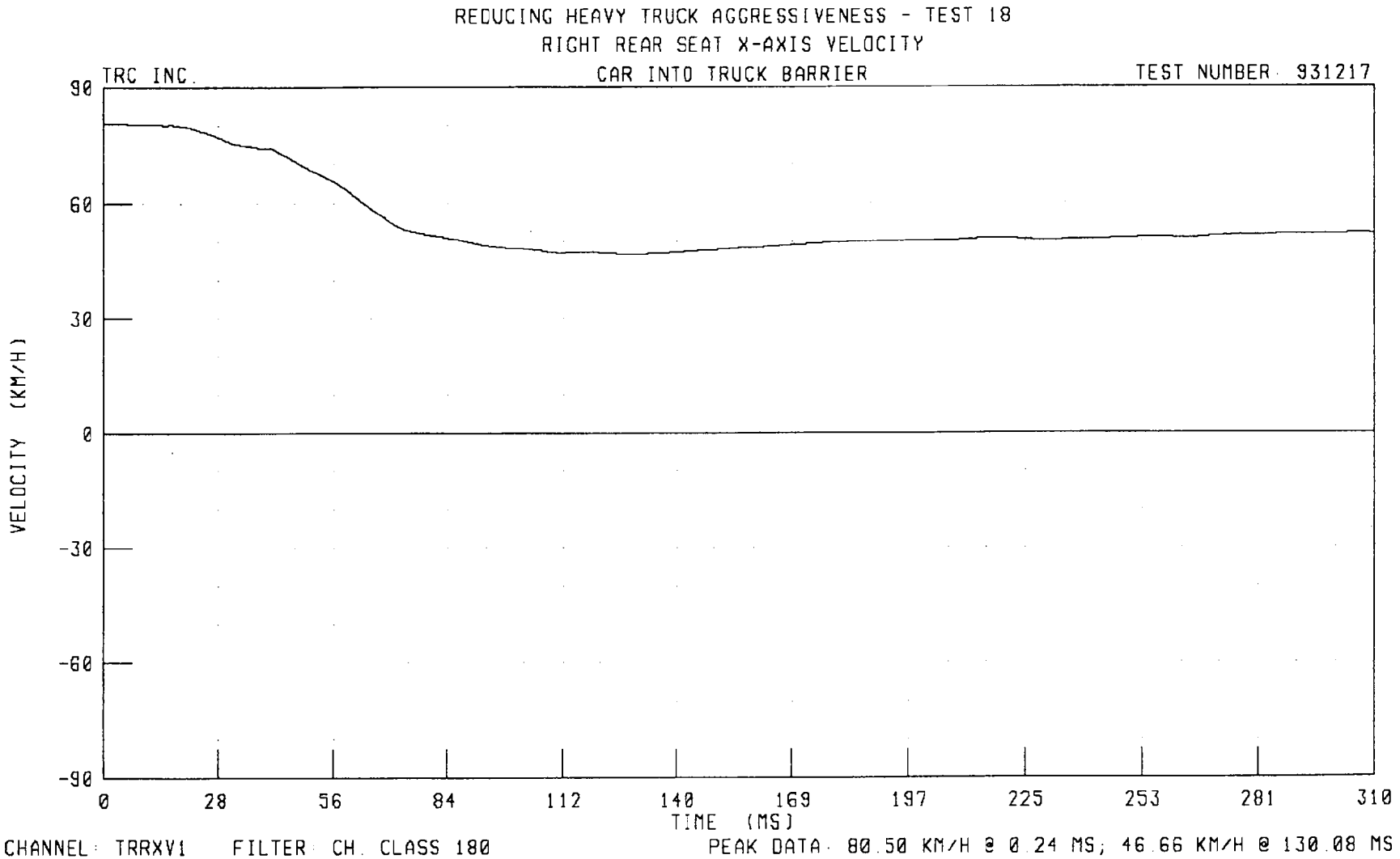
LEFT REAR SEAT X-AXIS VELOCITY

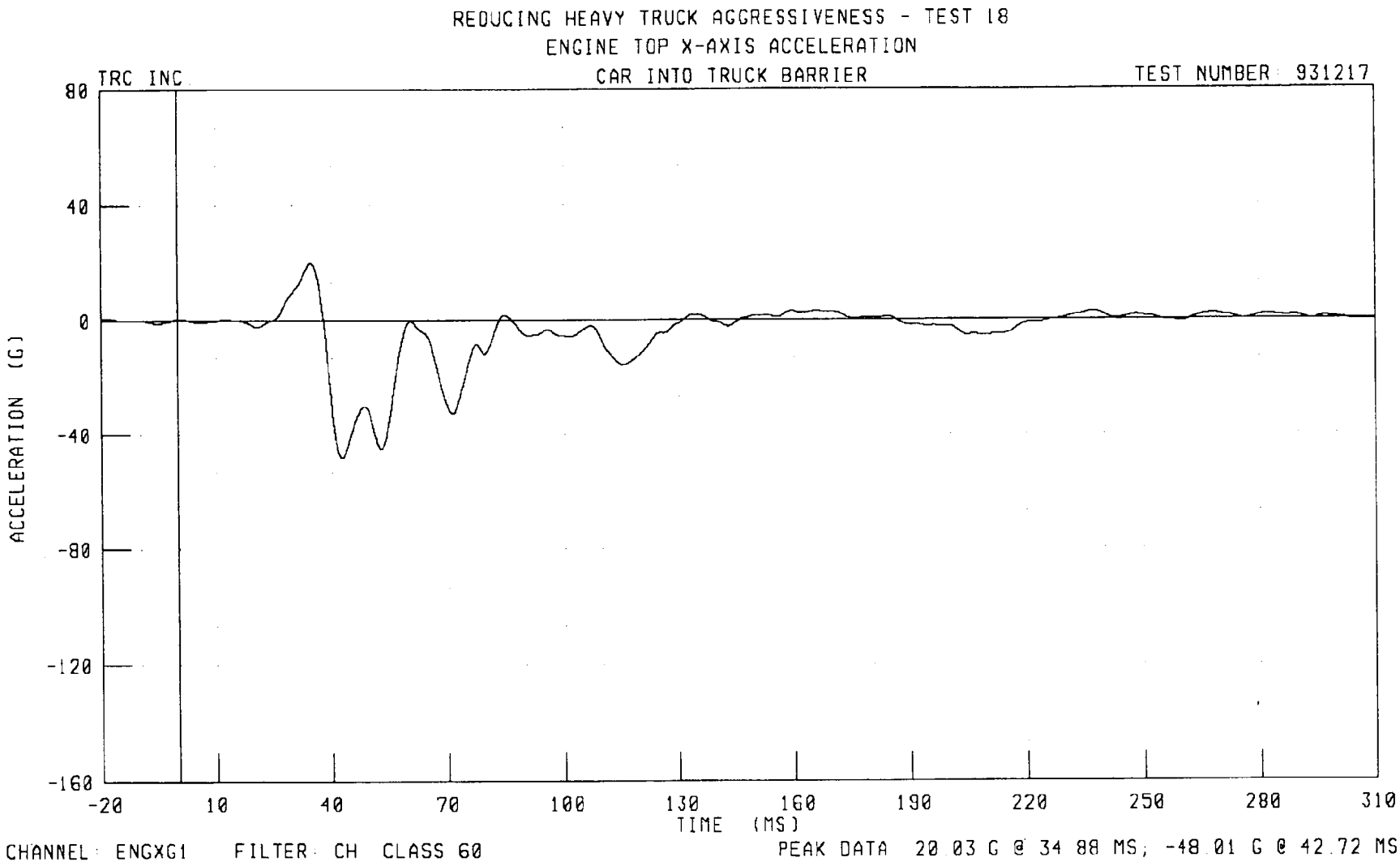
TRC INC. CAR INTO TRUCK BARRIER TEST NUMBER: 931217



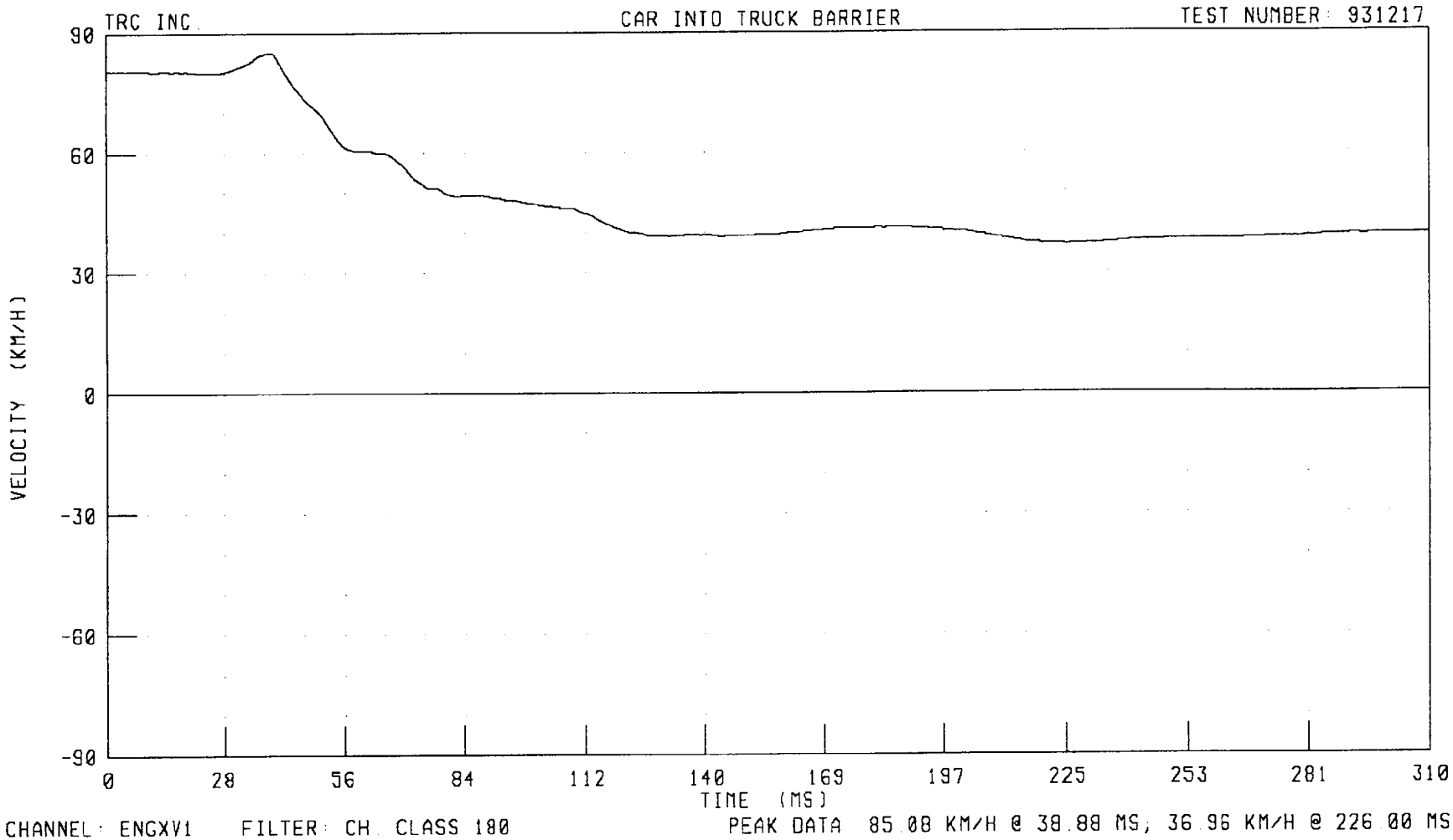
CHANNEL: TLRXV1 FILTER: CH. CLASS 180 PEAK DATA: 80.50 KM/H @ 0.56 MS, 59.87 KM/H @ 264.40 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
RIGHT REAR SEAT X-AXIS ACCELERATION
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER: 931217
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 3.05 G @ 269.84 MS, -23.85 G @ 62.40 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
RIGHT REAR SEAT X-AXIS VELOCITY
TRC INC.
CAR INTO TRUCK BARRIER
TEST NUMBER 931217
90
60
30
0
-30
-60
-90
VELOCITY (KM/H)
0
28
56
84
112
140
169
197
225
253
281
310
TIME (MS)
CHANNEL TRRXV1
FILTER CH. CLASS 180
PEAK DATA 80.50 KM/H @ 0.24 MS; 46.66 KM/H @ 130.08 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
ENGINE TOP X-AXIS ACCELERATION
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER: 931217
80
40
0
-40
-80
-120
-160
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: ENGXG1 FILTER: CH CLASS 60
PEAK DATA 20.03 G @ 34.88 MS; -48.01 G @ 42.72 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
ENGINE TOP X-AXIS VELOCITY
CAR INTO TRUCK BARRIER



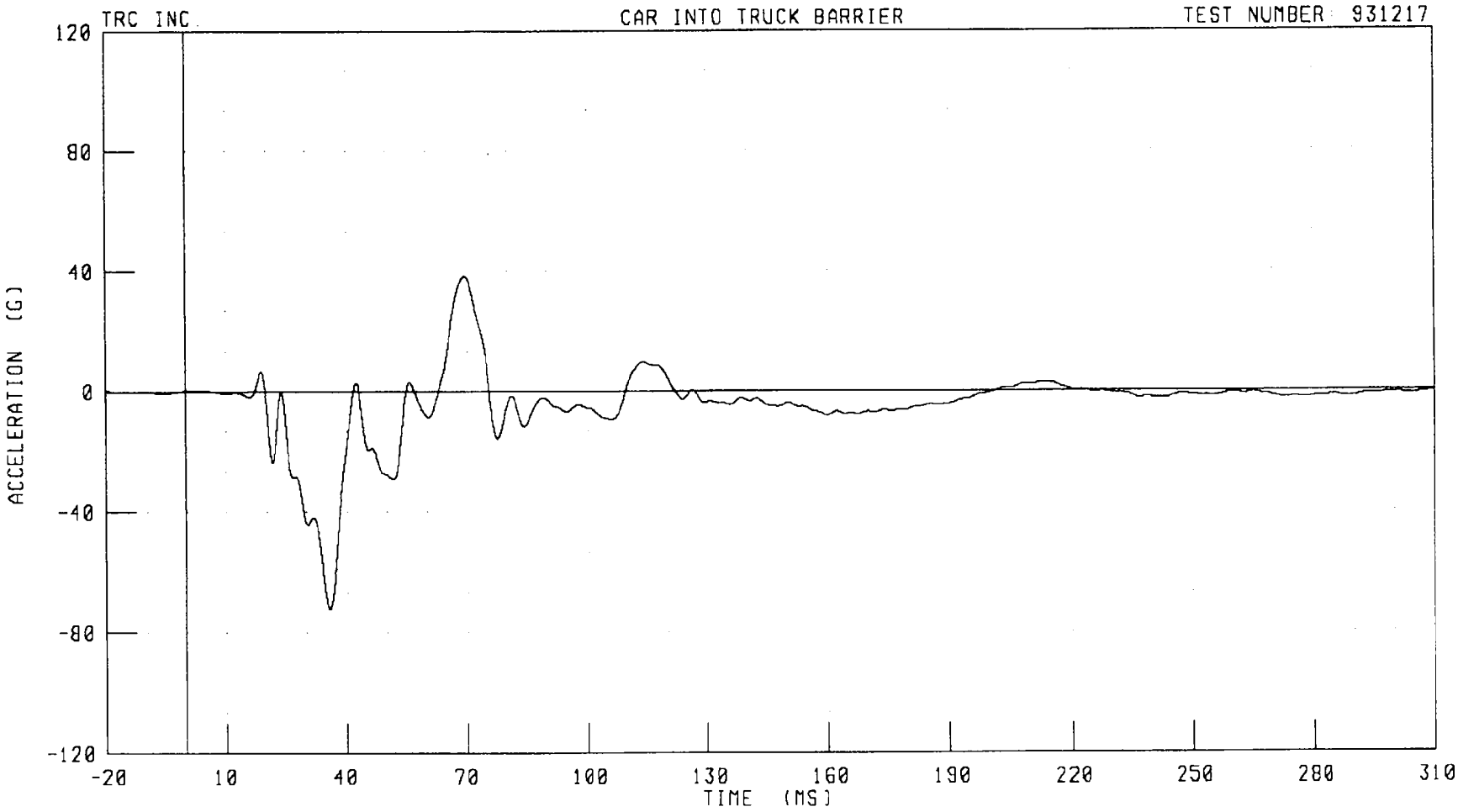
CHANNEL: ENGXV1 FILTER: CH. CLASS 180

PEAK DATA 85.08 KM/H @ 38.88 MS, 36.96 KM/H @ 226.00 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18

ENGINE BOTTOM X-AXIS ACCELERATION

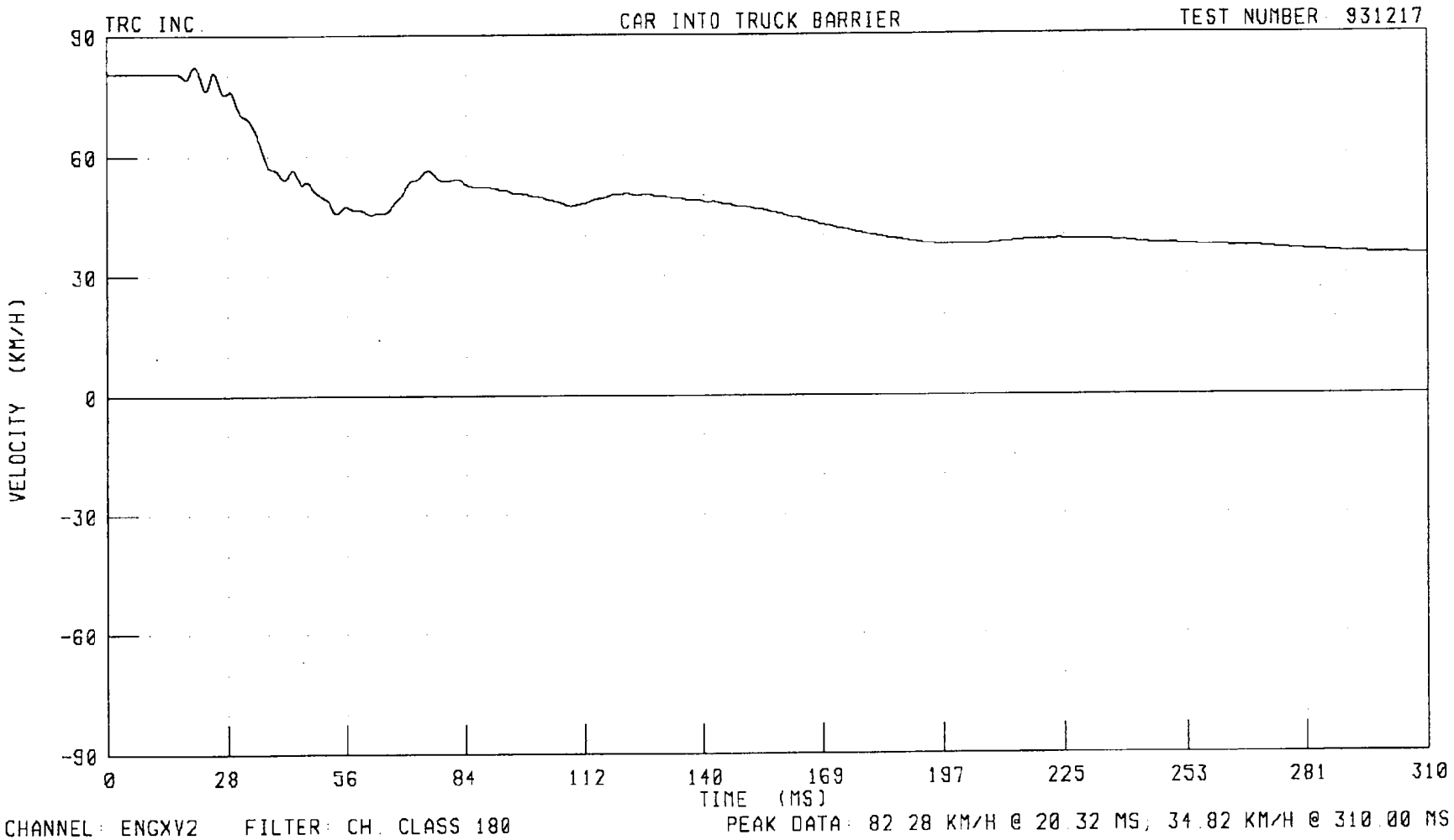
CAR INTO TRUCK BARRIER



CHANNEL ENGXG2 FILTER CH CLASS 60

PEAK DATA 38 17 G @ 69 60 MS, -72 23 G @ 35 84 MS

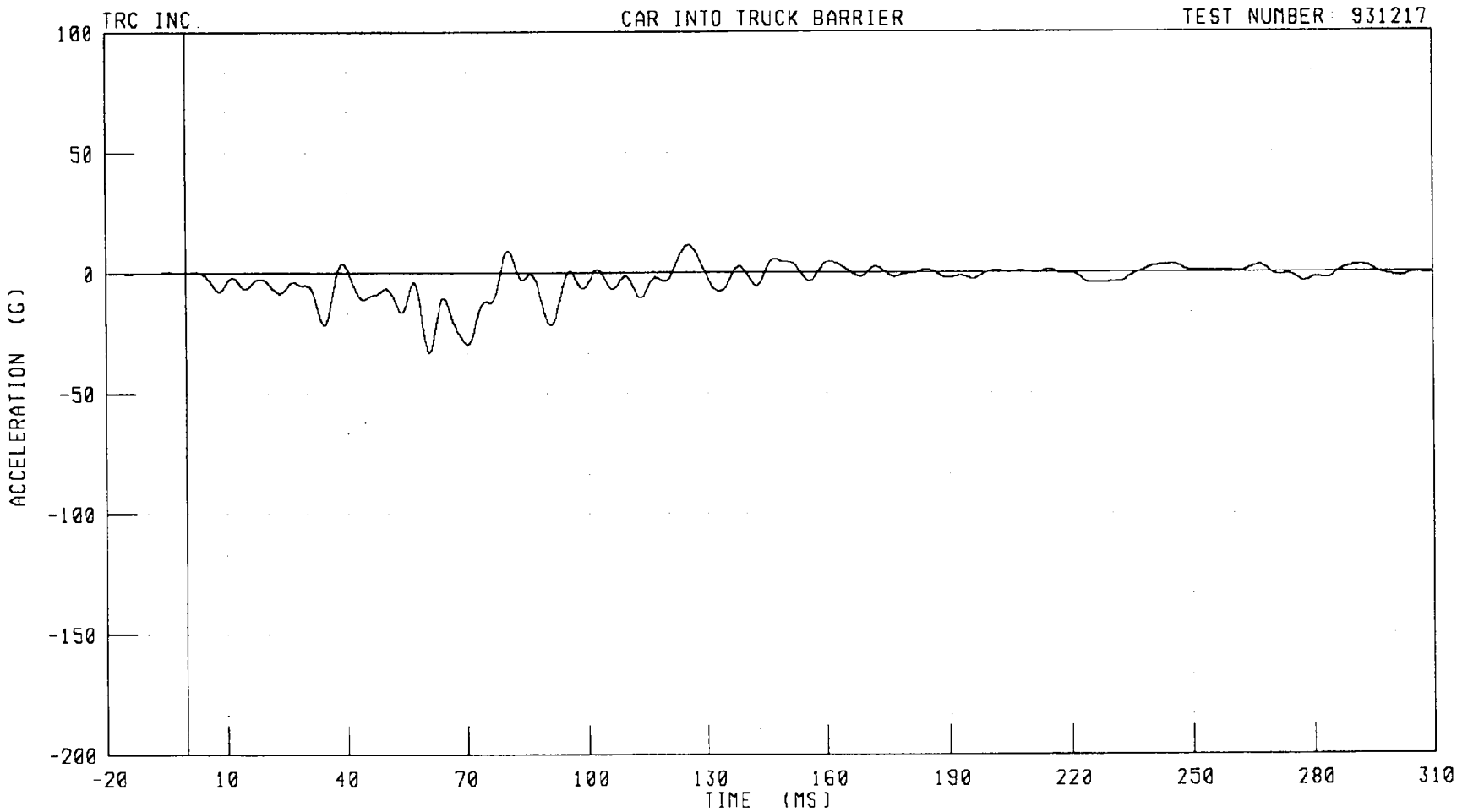
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
ENGINE BOTTOM X-AXIS VELOCITY
CAR INTO TRUCK BARRIER



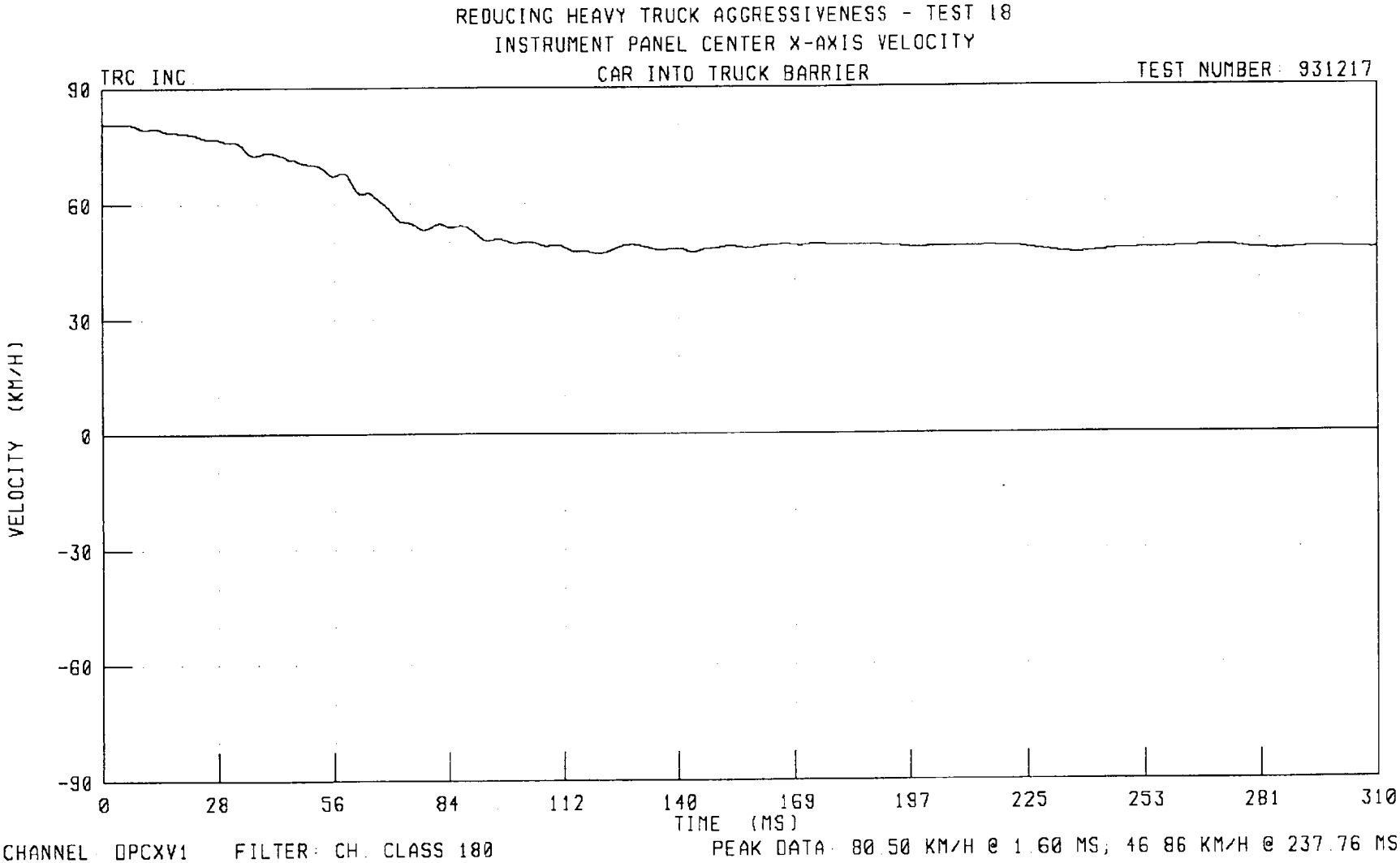
CHANNEL: ENGXV2 FILTER: CH. CLASS 180

PEAK DATA: 82.28 KM/H @ 20.32 MS; 34.82 KM/H @ 310.00 MS

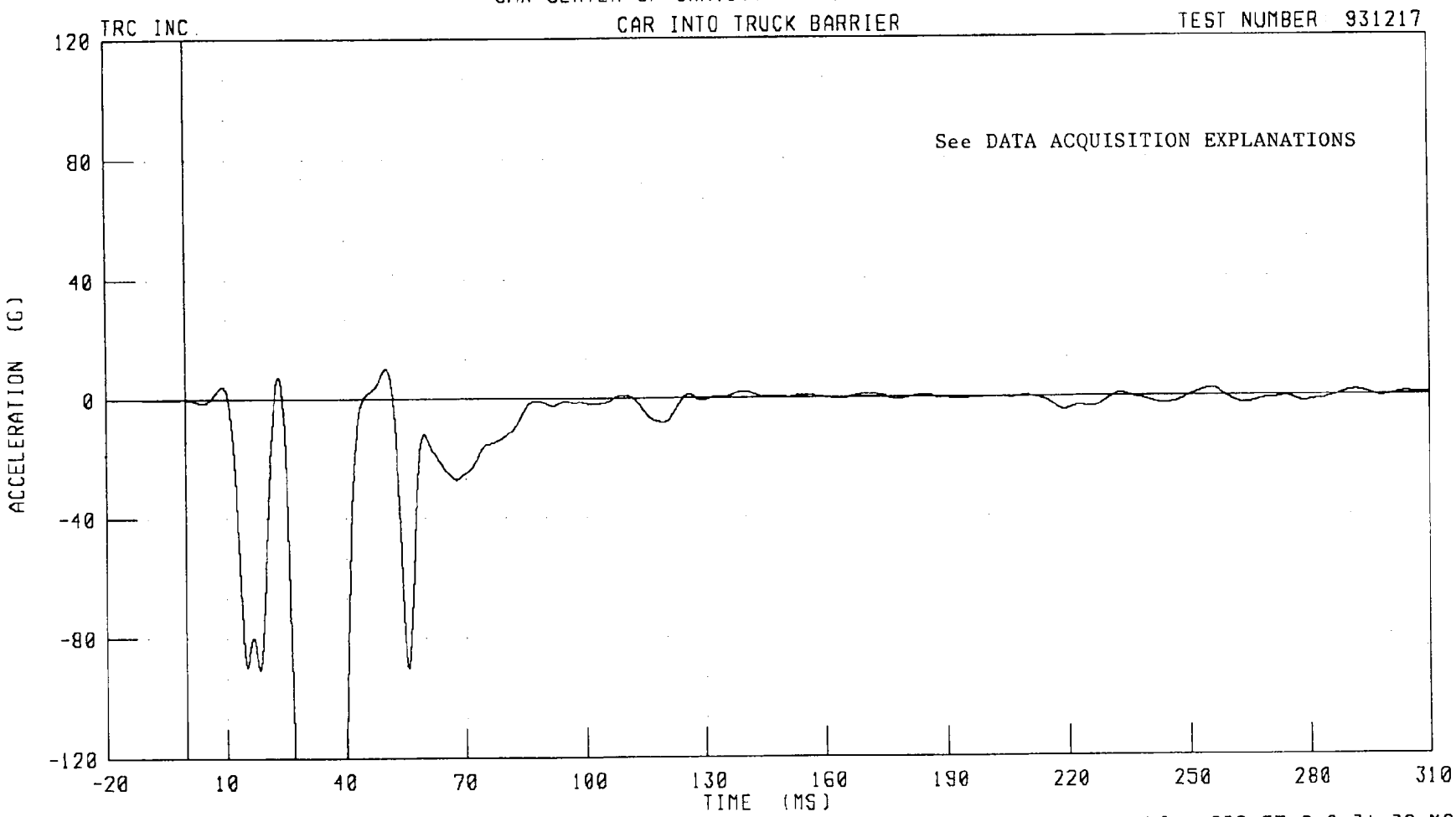
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
INSTRUMENT PANEL CENTER X-AXIS ACCELERATION
CAR INTO TRUCK BARRIER



CHANNEL: DPCXG1 FILTER: CH CLASS 60 PEAK DATA: 11.31 G @ 125.44 MS, -33.16 G @ 60.88 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
INSTRUMENT PANEL CENTER X-AXIS VELOCITY
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER: 931217
VELOCITY (KM/H)
90
60
30
0
-30
-60
-90
0
28
56
84
112
140
169
197
225
253
281
310
TIME (MS)
CHANNEL DPCXV1
FILTER: CH. CLASS 180
PEAK DATA: 80.50 KM/H @ 1.60 MS; 46.86 KM/H @ 237.76 MS

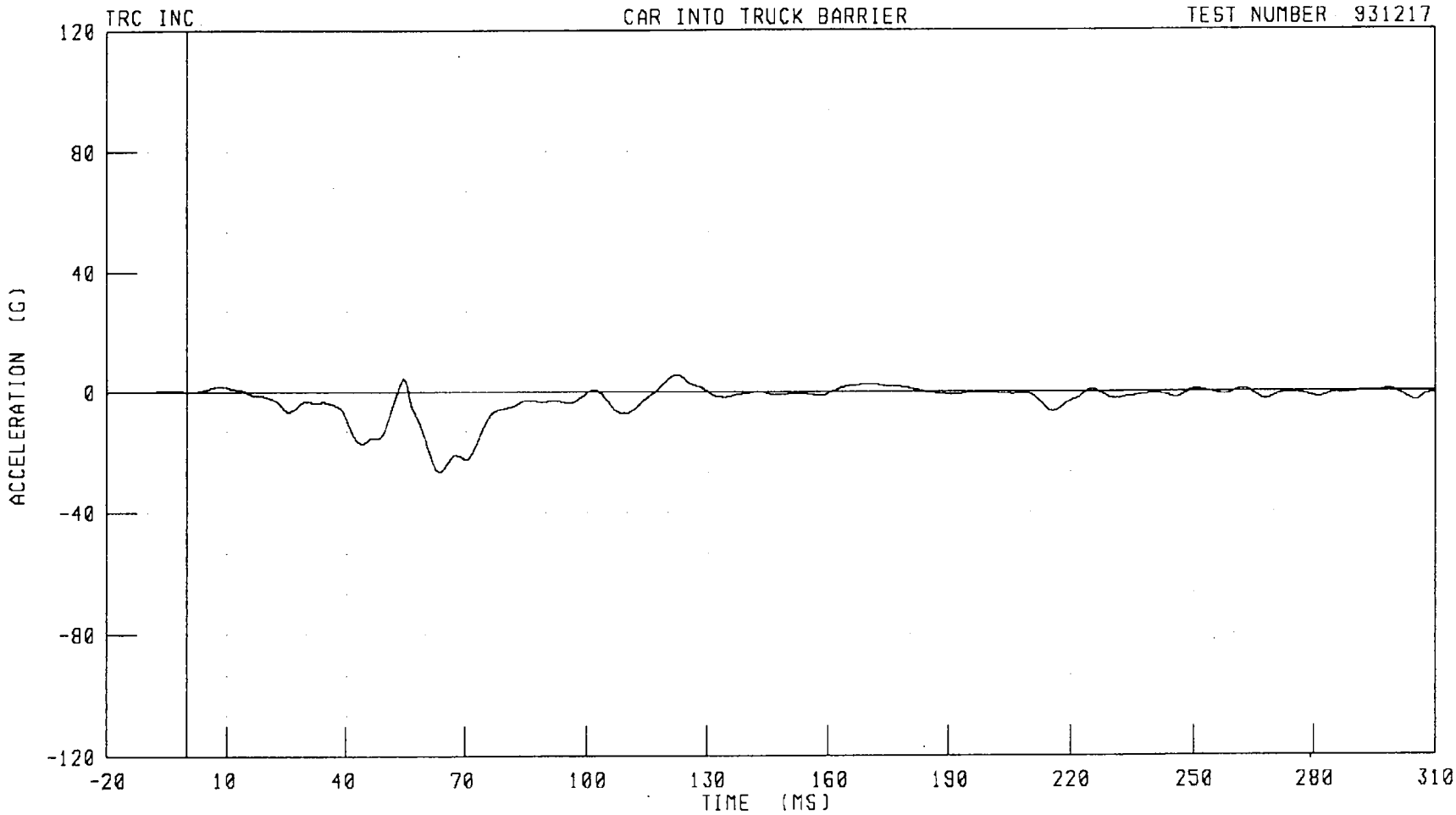
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
CAR CENTER OF GRAVITY X-AXIS ACCELERATION
CAR INTO TRUCK BARRIER



CHANNEL VCGXG1 FILTER CH CLASS 60

PEAK DATA 10 10 G @ 50 48 MS; -308 57 G @ 31 36 MS

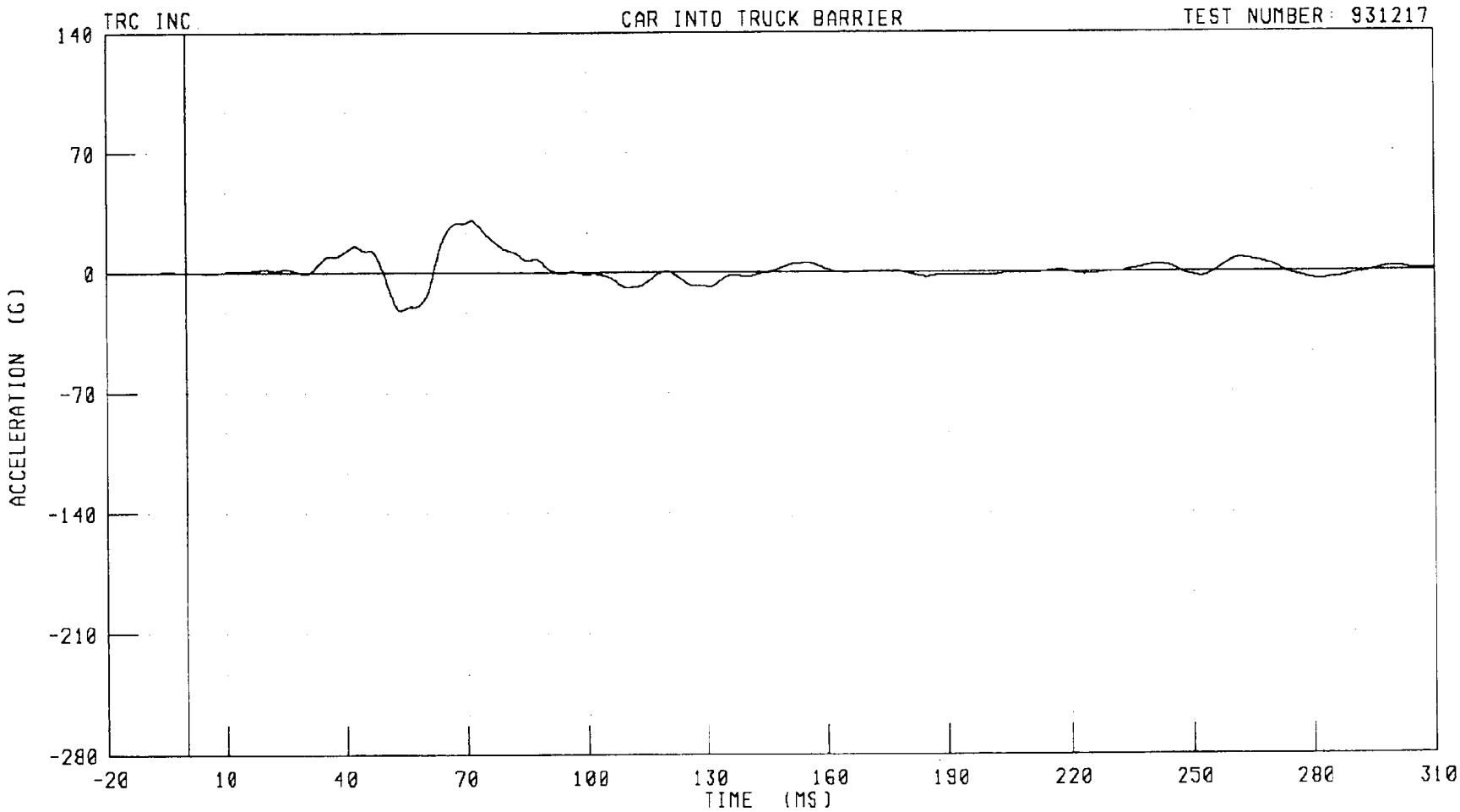
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
CAR CENTER OF GRAVITY Y-AXIS ACCELERATION
CAR INTO TRUCK BARRIER



CHANNEL VCGYG1 FILTER CH CLASS 60

PEAK DATA 5.56 G @ 122.40 MS; -26.38 G @ 63.60 MS

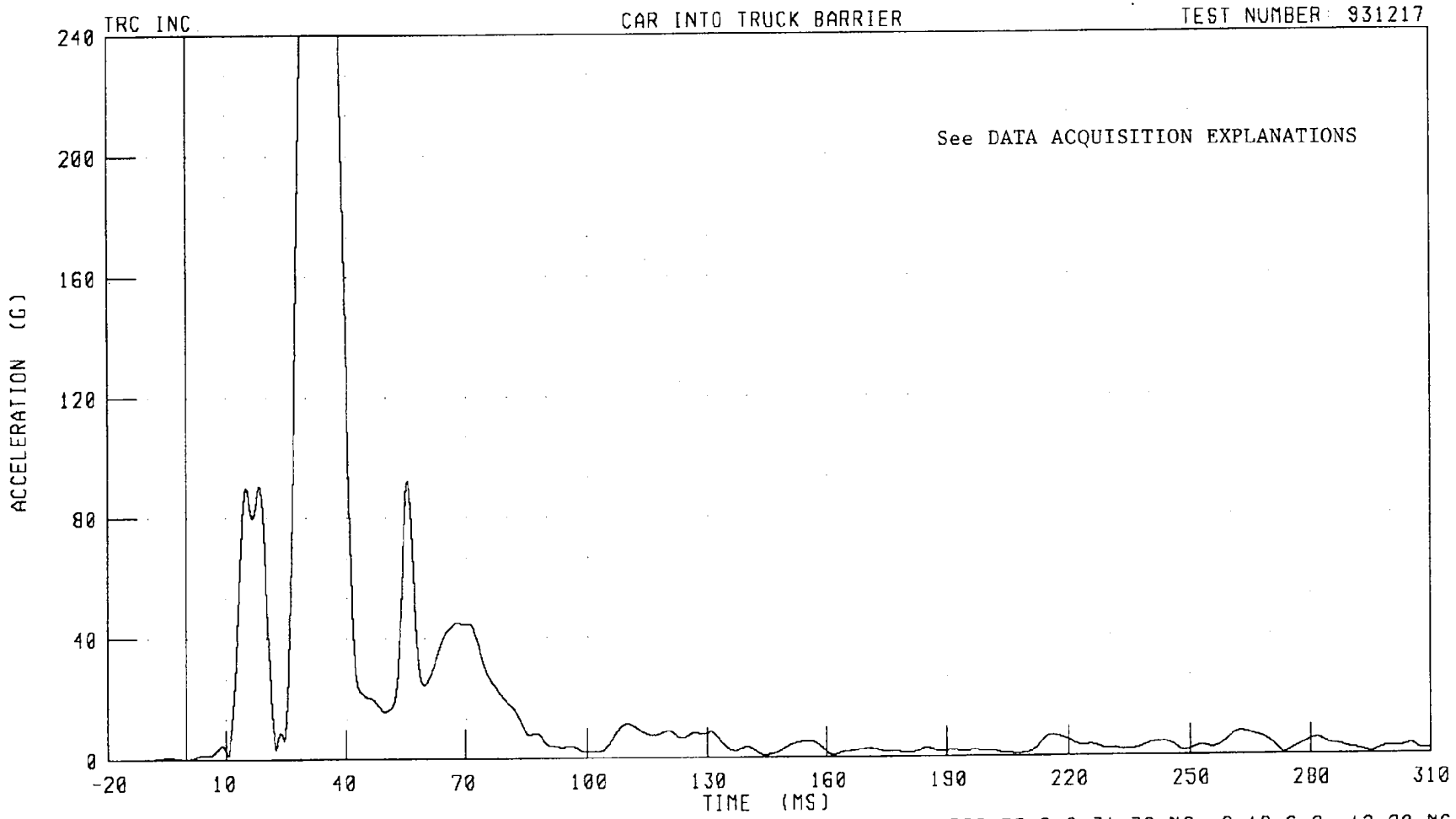
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
CAR CENTER OF GRAVITY Z-AXIS ACCELERATION
CAR INTO TRUCK BARRIER



CHANNEL VCGZG1 FILTER CH CLASS 60

PEAK DATA 30.54 G @ 71.36 MS, -21.88 G @ 53.76 MS

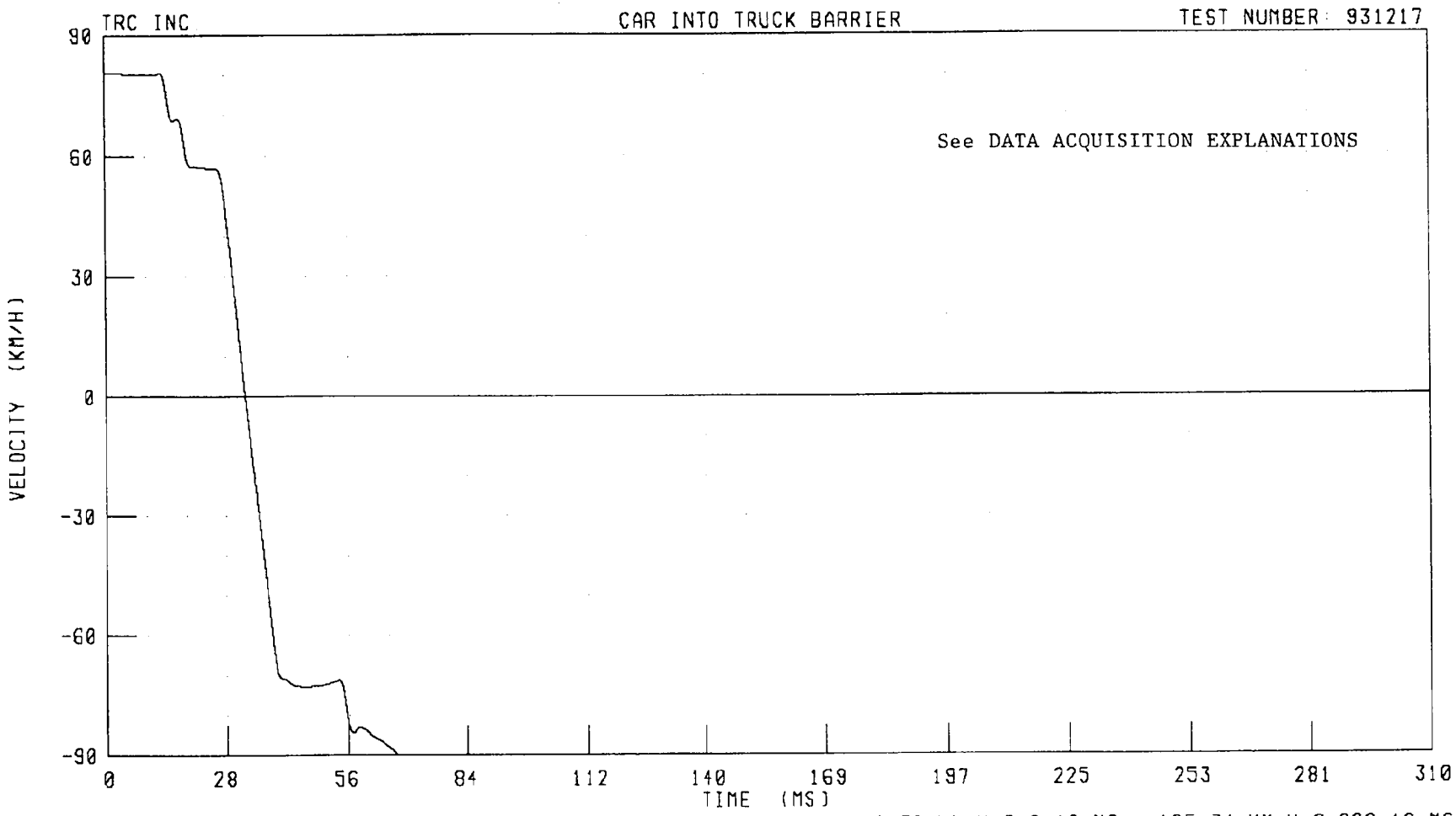
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
CAR CENTER OF GRAVITY RESULTANT ACCELERATION
CAR INTO TRUCK BARRIER



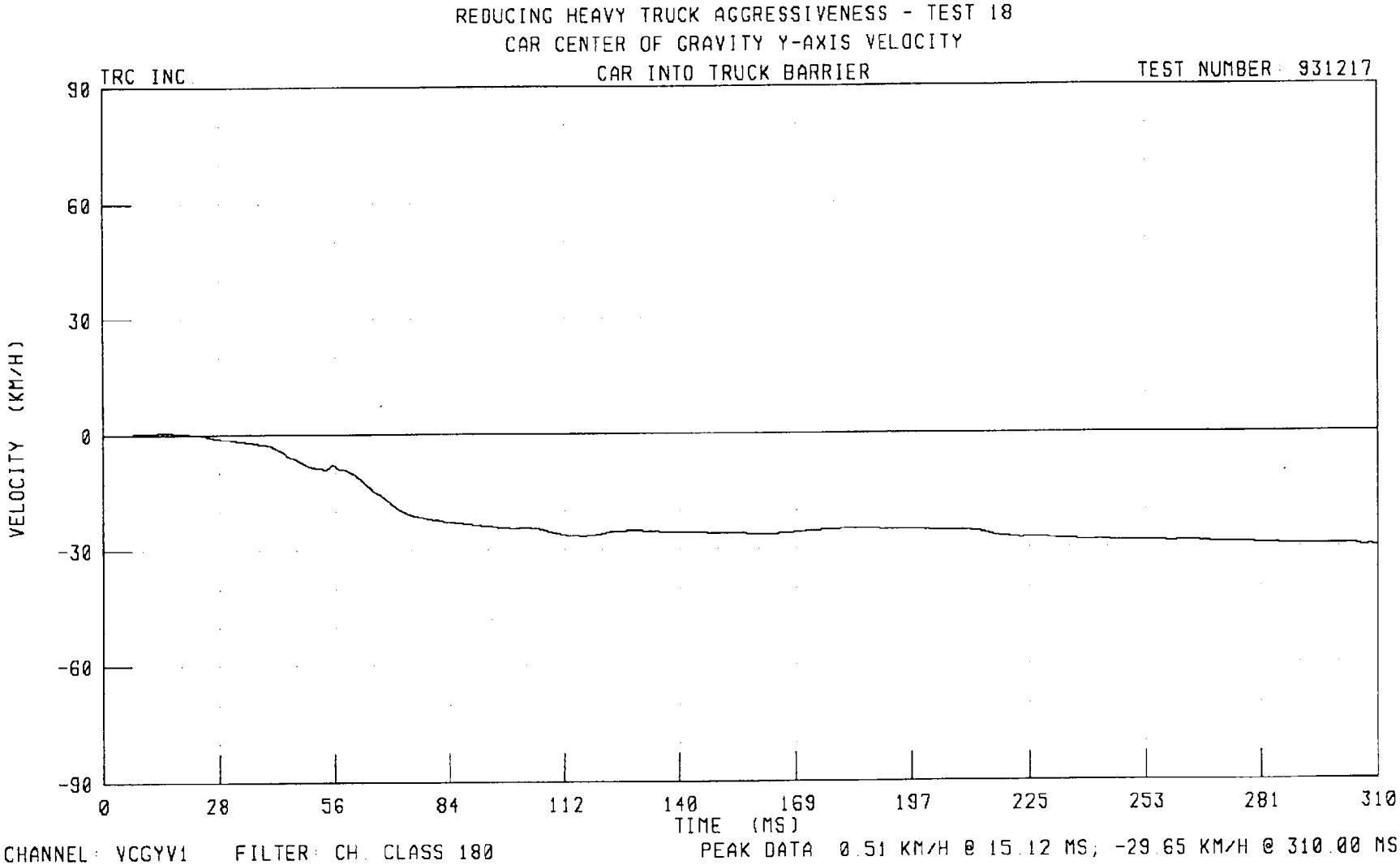
CHANNEL VCGRG1 FILTER CH CLASS 60

PEAK DATA 308 59 G @ 31 36 MS; 0 12 G @ -12 80 MS

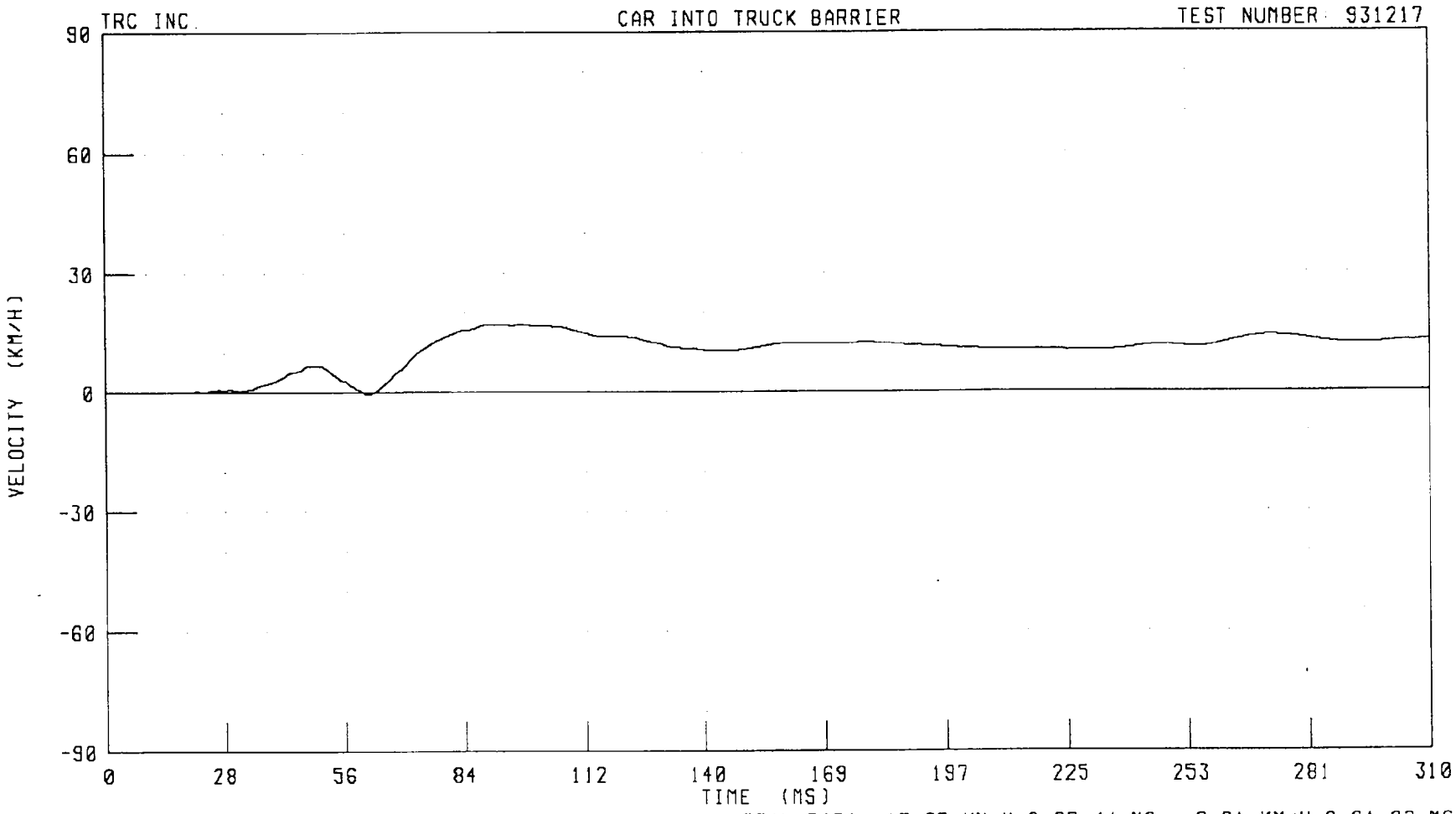
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
CAR CENTER OF GRAVITY X-AXIS VELOCITY
CAR INTO TRUCK BARRIER



CHANNEL: VCGXV1 FILTER: CH CLASS 180 PEAK DATA: 80.50 KM/H @ 0.16 MS, -105.34 KM/H @ 288.16 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
CAR CENTER OF GRAVITY Y-AXIS VELOCITY
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER: 931217
VELOCITY (KM/H)
90
60
30
0
-30
-60
-90
0
28
56
84
112
140
169
197
225
253
281
310
TIME (MS)
CHANNEL: VCGYV1
FILTER: CH. CLASS 180
PEAK DATA 0.51 KM/H @ 15.12 MS; -29.65 KM/H @ 310.00 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
CAR CENTER OF GRAVITY Z-AXIS VELOCITY
CAR INTO TRUCK BARRIER

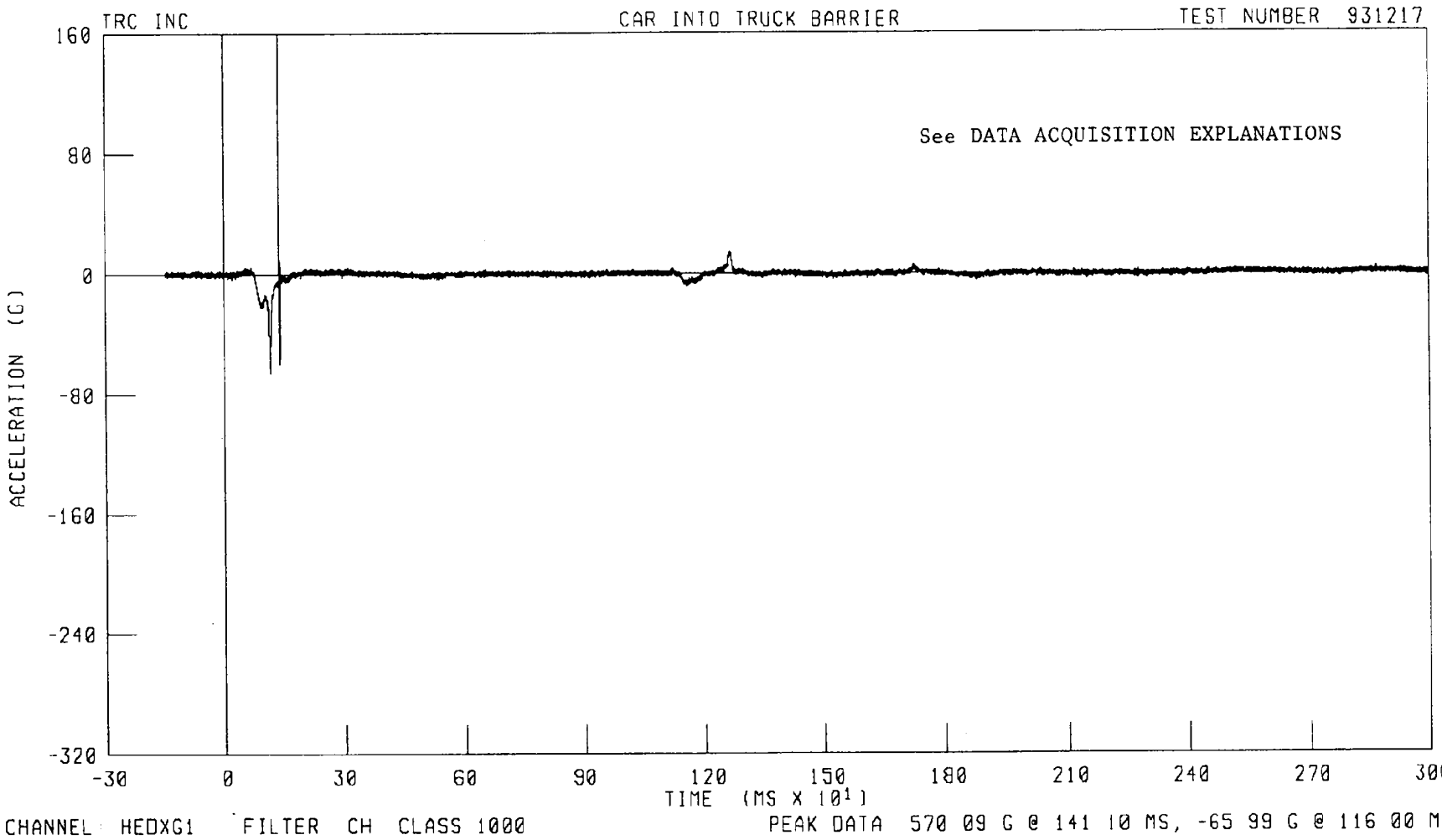


CHANNEL VCGZV1 FILTER CH CLASS 180

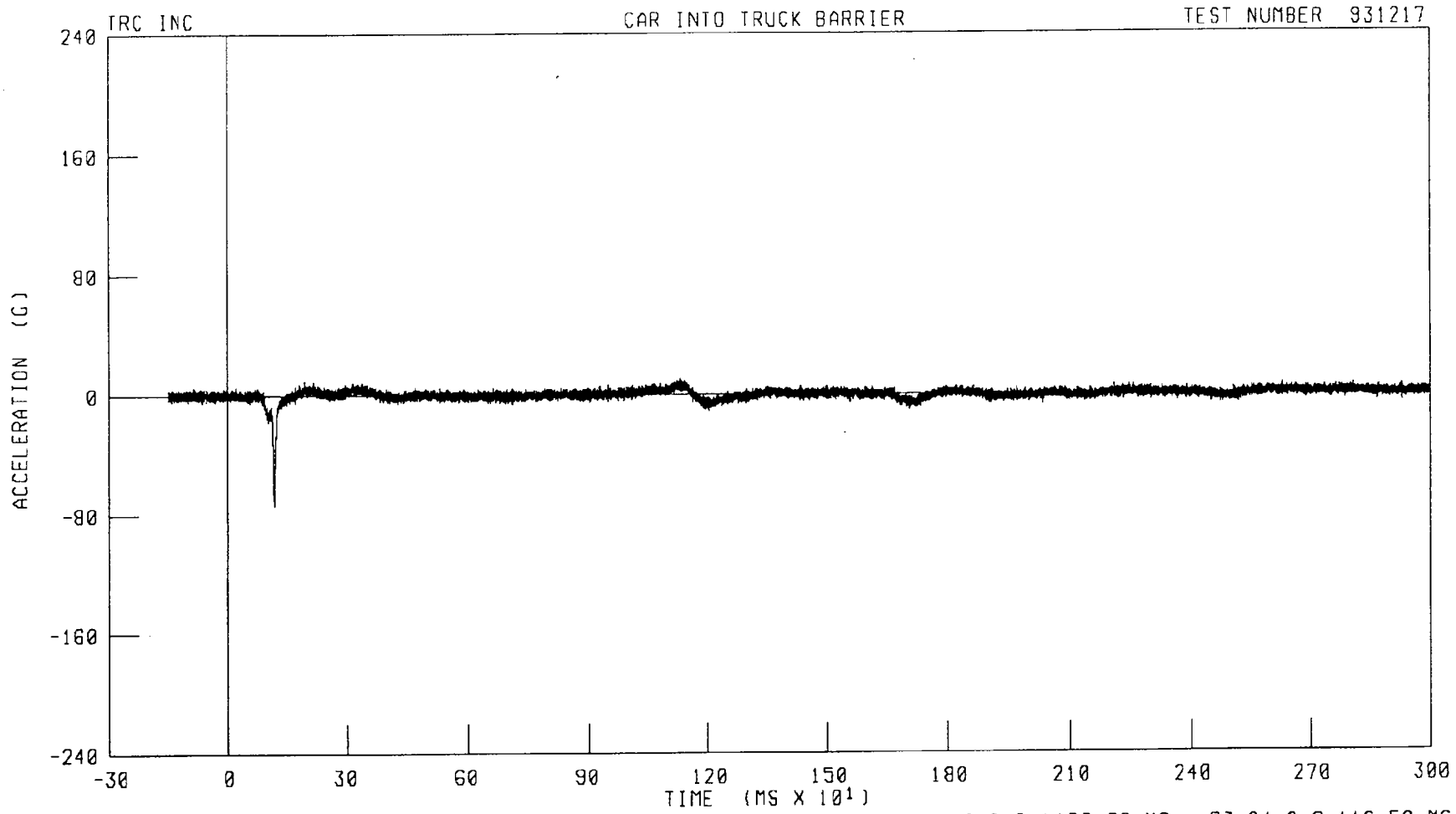
PEAK DATA 17 07 KM/H @ 97 44 MS, -0 61 KM/H @ 61 92 MS

EXTENDED TIME FRAME DATA PLOTS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER HEAD X-AXIS ACCELERATION
CAR INTO TRUCK BARRIER

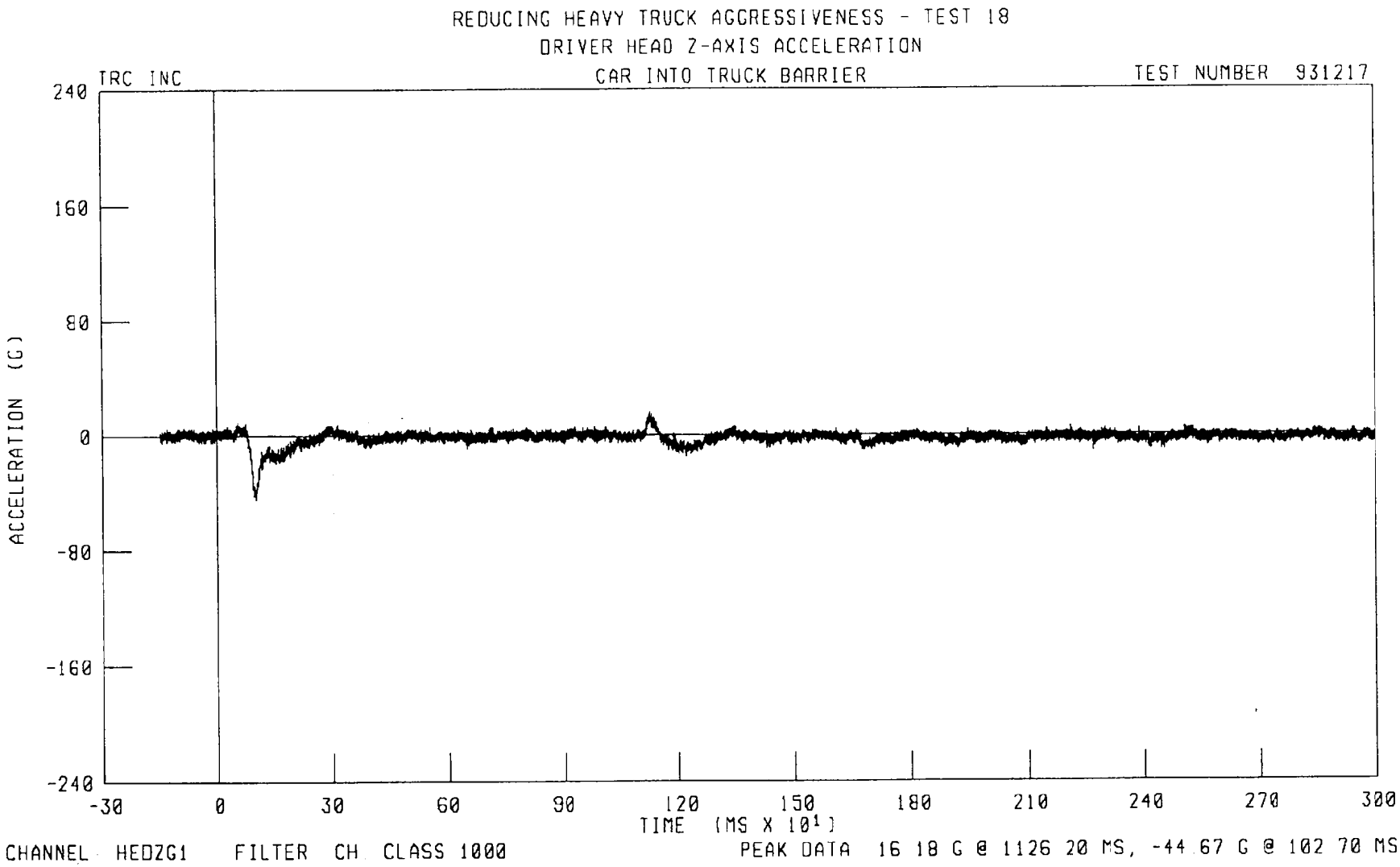


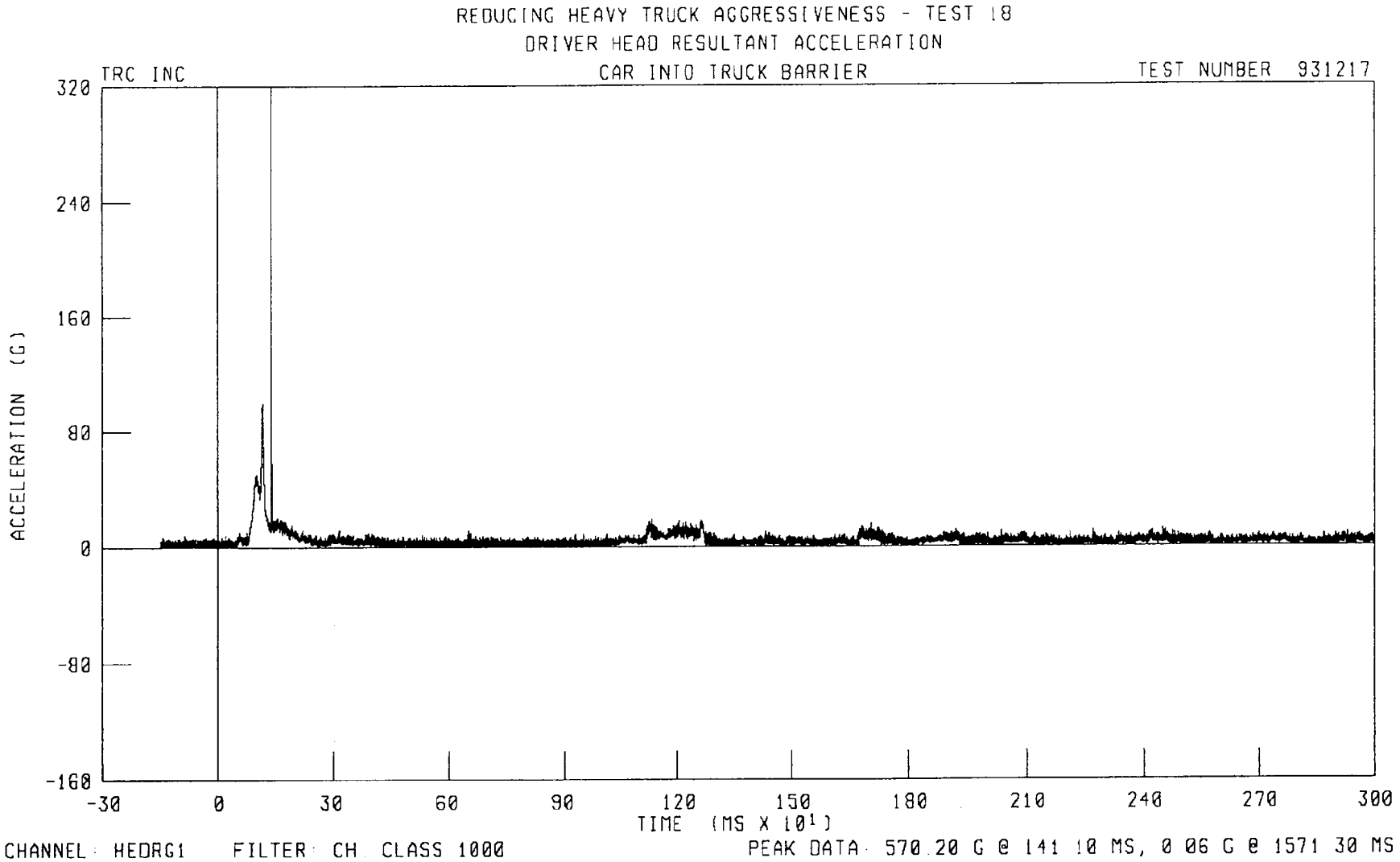
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER HEAD Y-AXIS ACCELERATION
CAR INTO TRUCK BARRIER

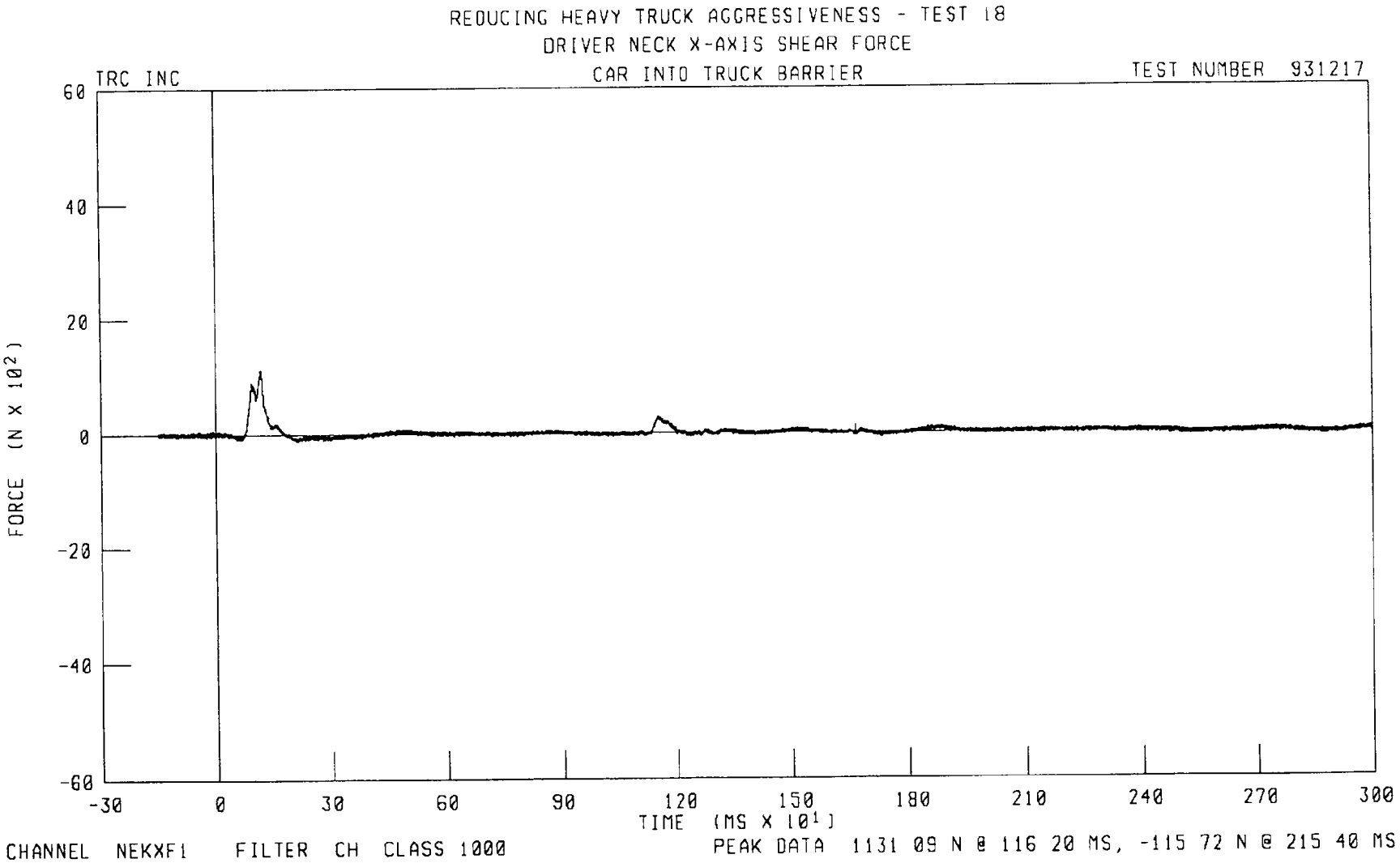


CHANNEL HEDYG1 FILTER CH CLASS 1000

PEAK DATA 11 06 G @ 1130 30 MS, -73 94 G @ 116 50 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER HEAD Z-AXIS ACCELERATION
TRC INC
CAR INTO TRUCK BARRIER
TEST NUMBER 931217
240
160
80
0
-80
-160
-240
ACCELERATION (G)
-30
0
30
60
90
120
150
180
210
240
270
300
TIME (MS X 10¹)
CHANNEL HEDZG1 FILTER CH CLASS 1000
PEAK DATA 16 18 G @ 1126 20 MS, -44 67 G @ 102 70 MS

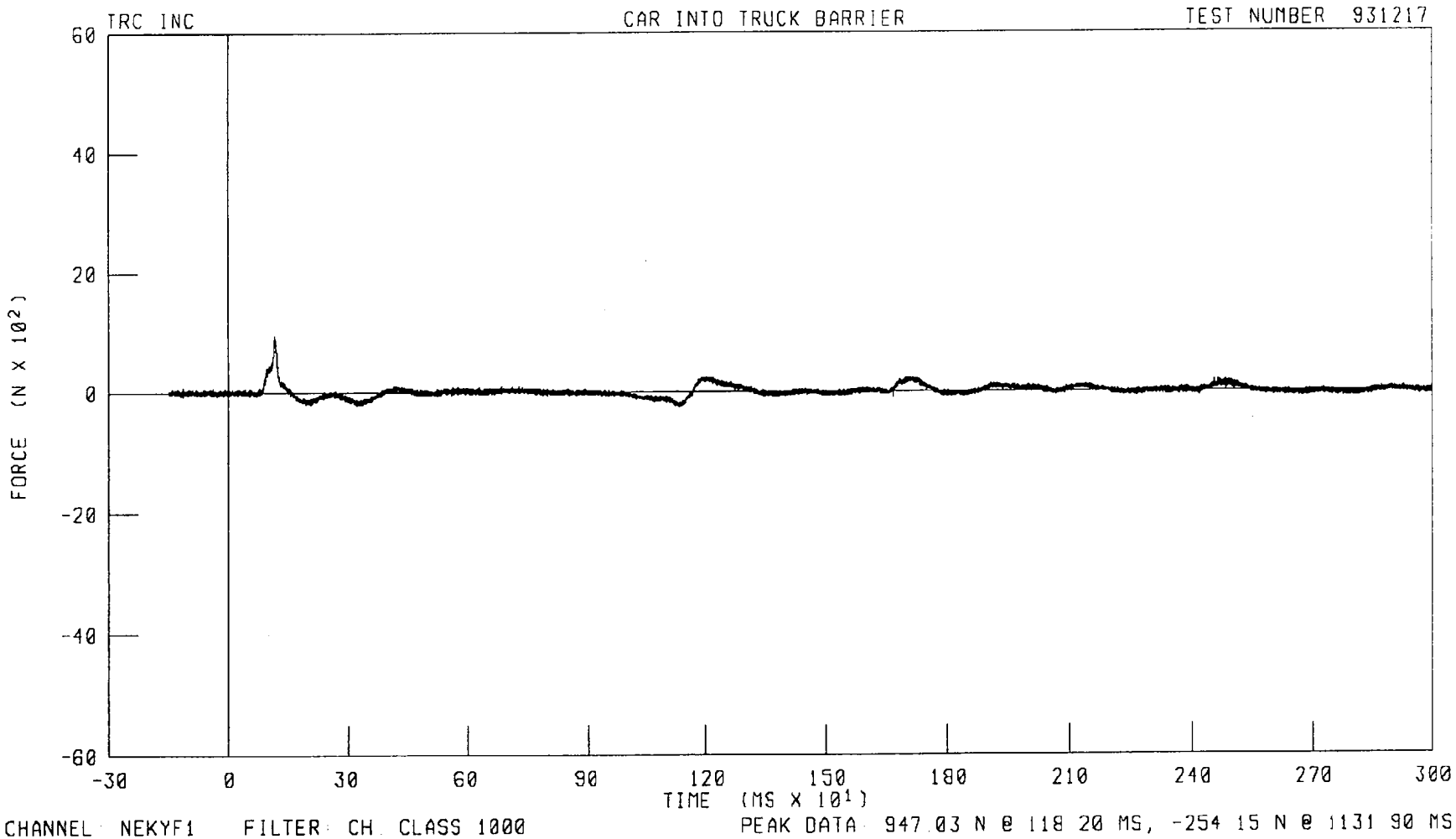

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER HEAD RESULTANT ACCELERATION
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
320
240
160
80
0
-80
-160
ACCELERATION (G)
-30
0
30
60
90
120
150
180
210
240
270
300
TIME (MS X 10¹)
CHANNEL HEDRG1 FILTER CH CLASS 1000
PEAK DATA 570.20 G @ 141.10 MS, 0.06 G @ 1571.30 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER NECK X-AXIS SHEAR FORCE
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
60
40
20
0
-20
-40
-60
FORCE (N X 10^2)
-30
0
30
60
90
120
150
180
210
240
270
300
TIME (MS X 10^1)
CHANNEL NEKXF1 FILTER CH CLASS 1000
PEAK DATA 1131 09 N @ 116 20 MS, -115 72 N @ 215 40 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18

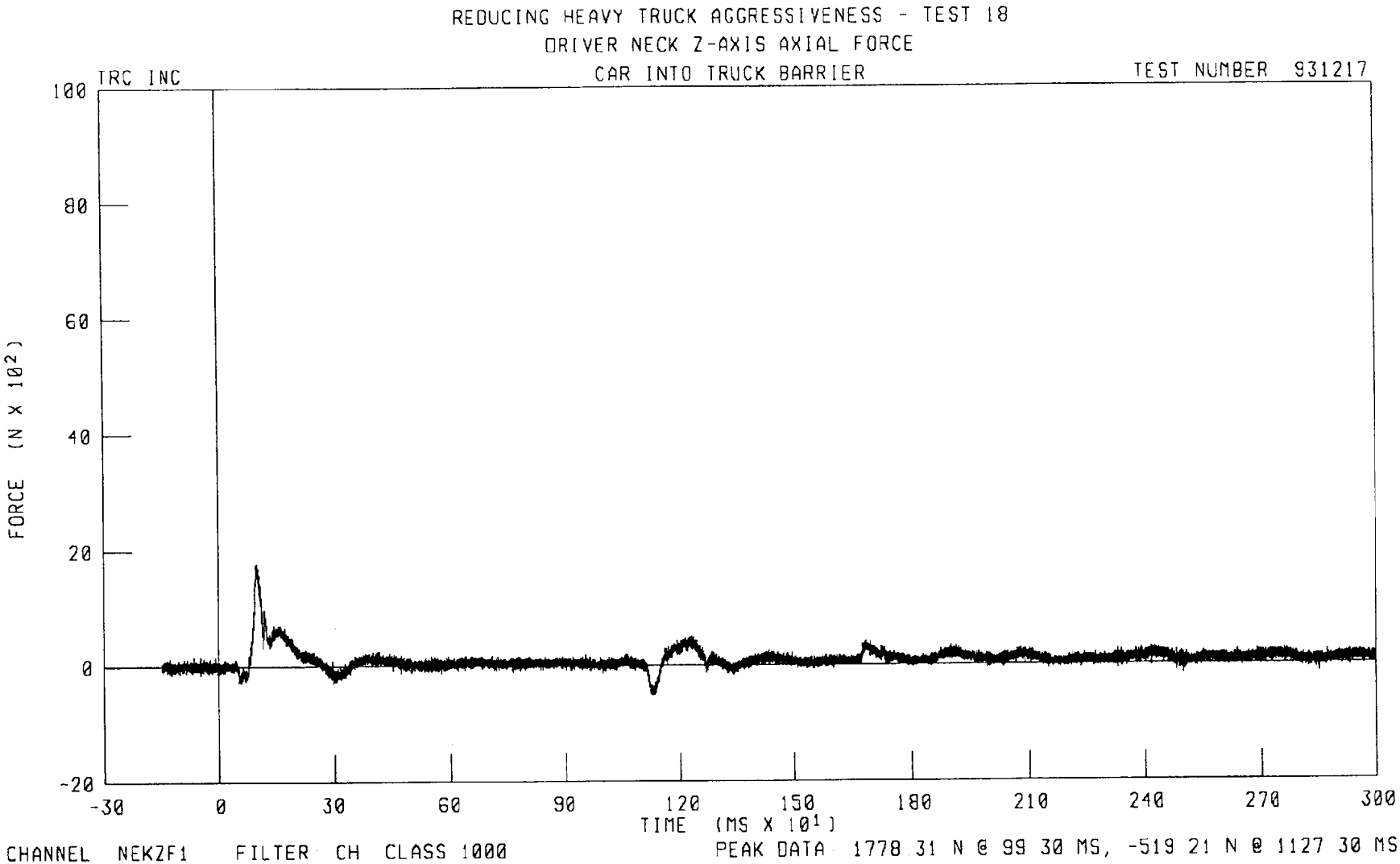
DRIVER NECK Y-AXIS SHEAR FORCE

CAR INTO TRUCK BARRIER

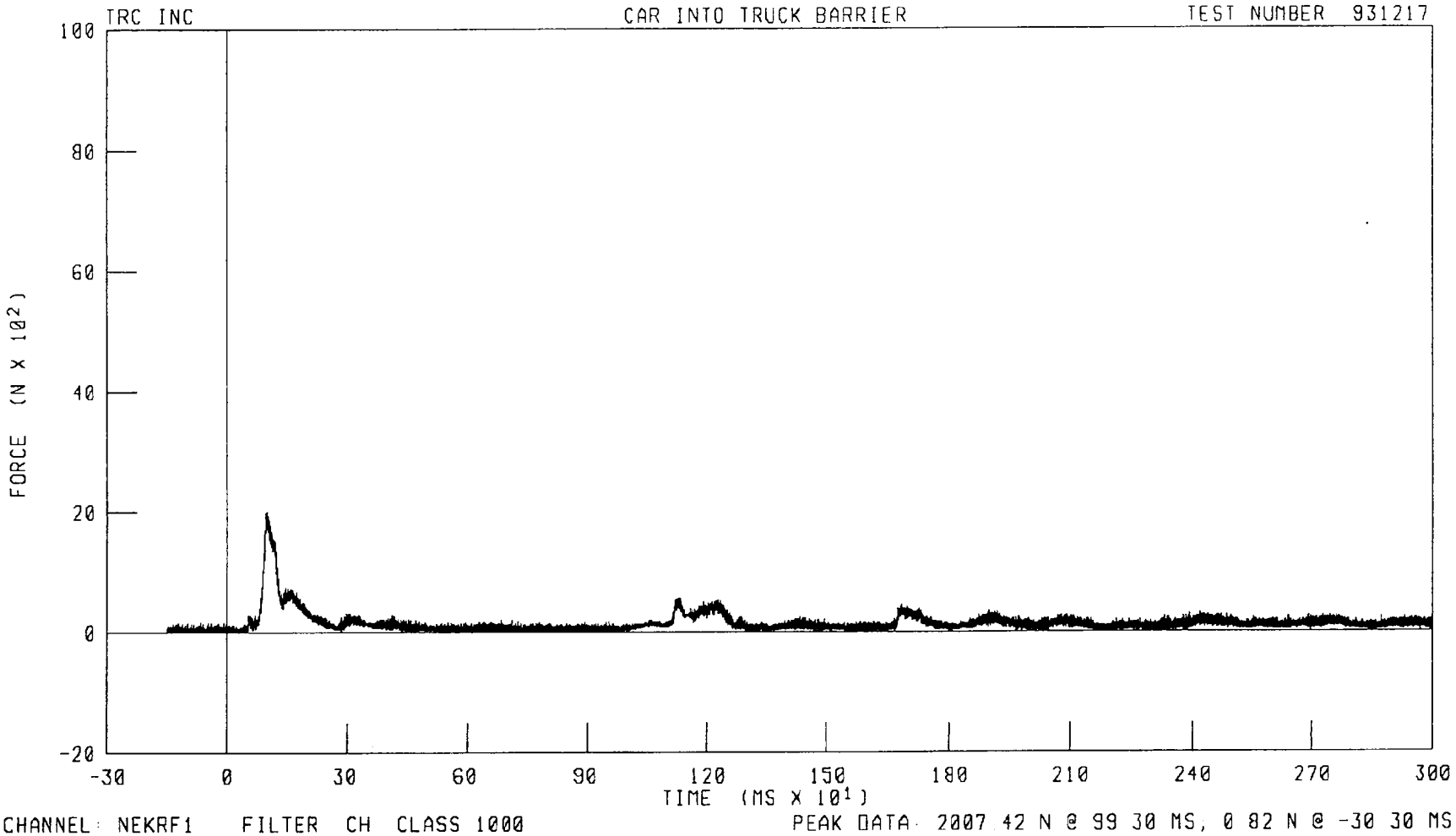


CHANNEL NEKYF1 FILTER CH CLASS 1000

PEAK DATA 947.03 N @ 118.20 MS, -254.15 N @ 1131.90 MS

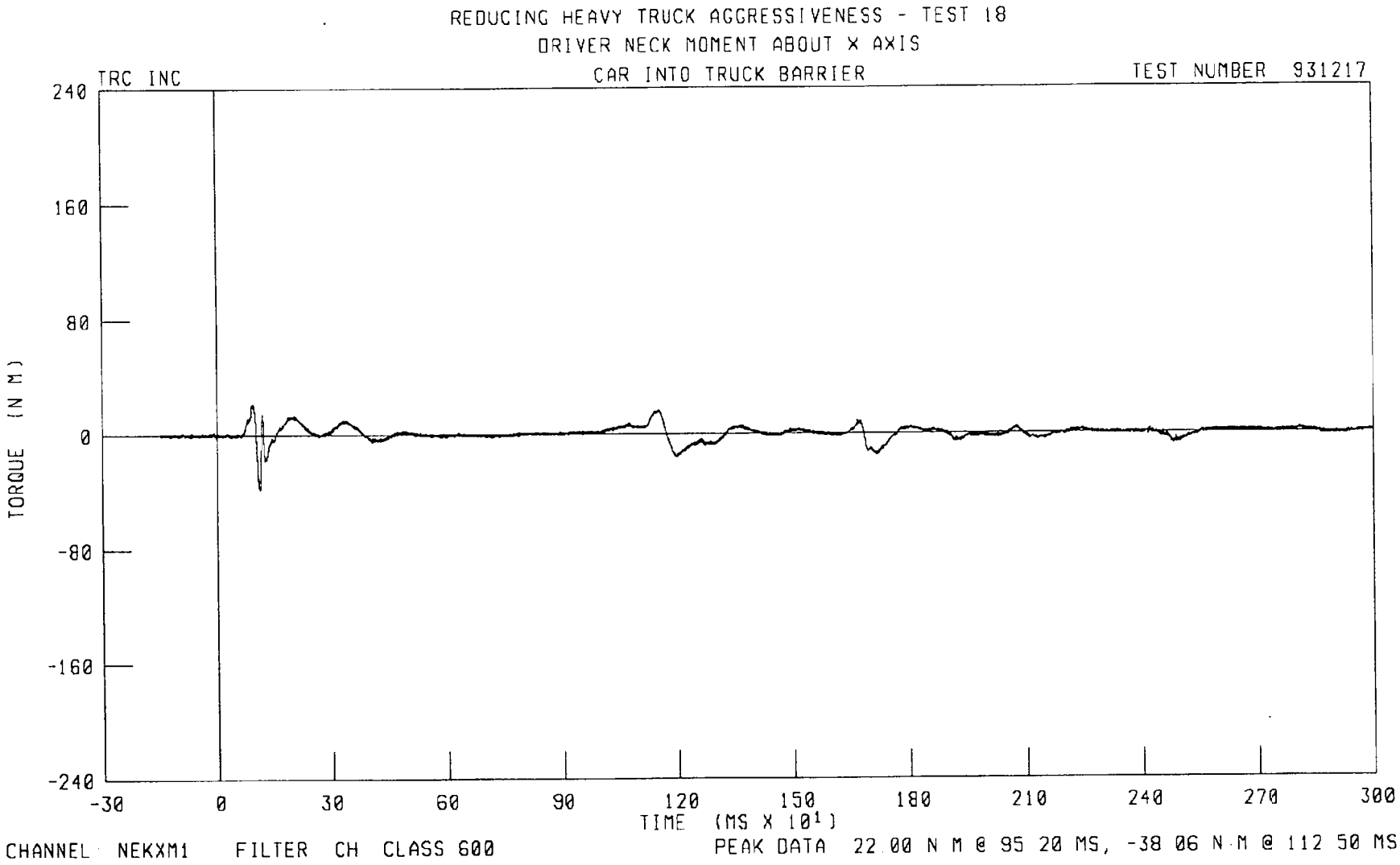

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER NECK Z-AXIS AXIAL FORCE
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
100
80
60
40
20
0
-20
FORCE (N X 10²)
-30
0
30
60
90
120
150
180
210
240
270
300
TIME (MS X 10¹)
CHANNEL NEKZF1 FILTER CH CLASS 1000
PEAK DATA 1778 31 N @ 99 30 MS, -519 21 N @ 1127 30 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER NECK RESULTANT FORCE
CAR INTO TRUCK BARRIER

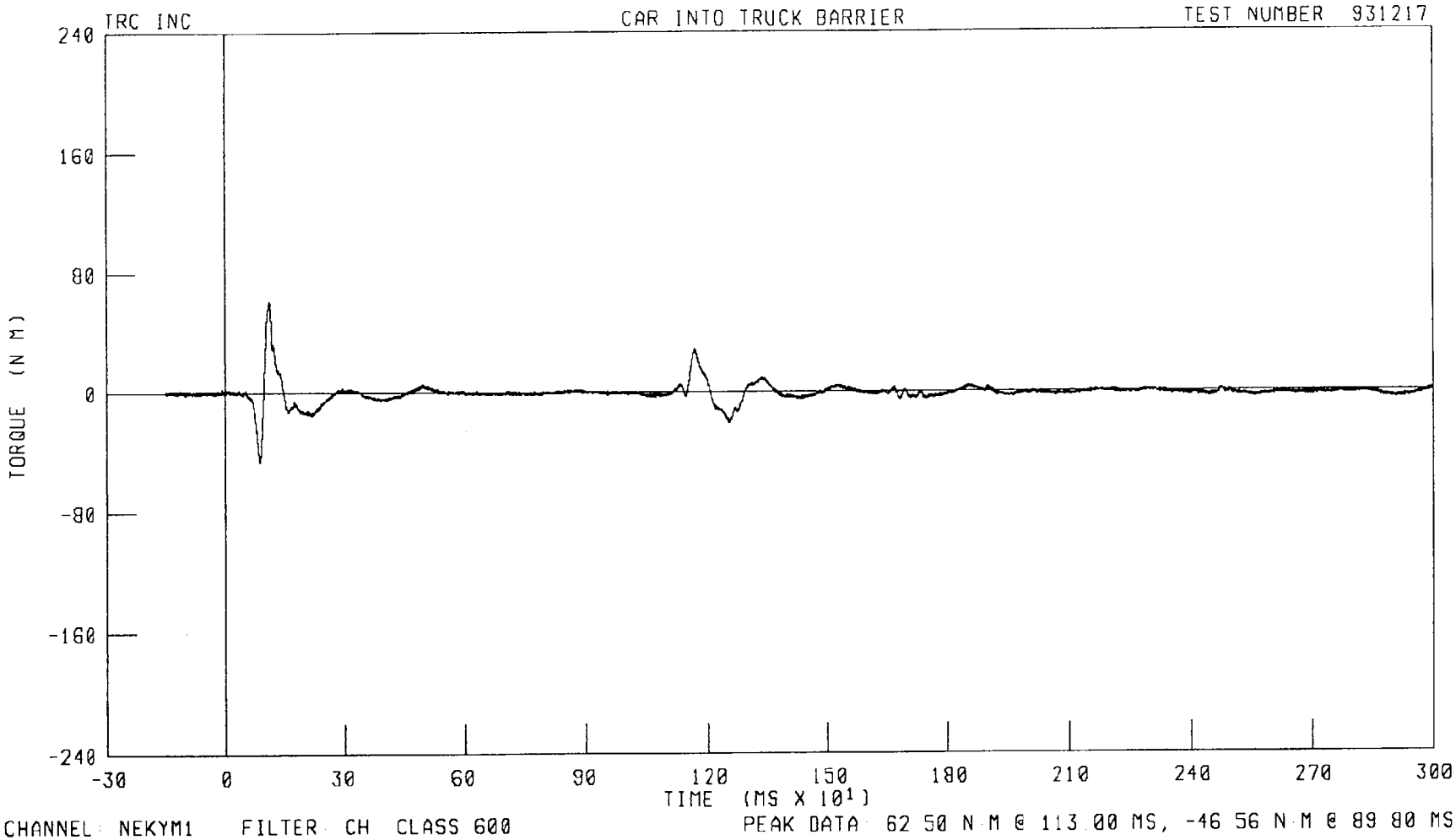


CHANNEL: NEKRF1 FILTER CH CLASS 1000

PEAK DATA: 2007.42 N @ 99.30 MS, 0.82 N @ -30.30 MS

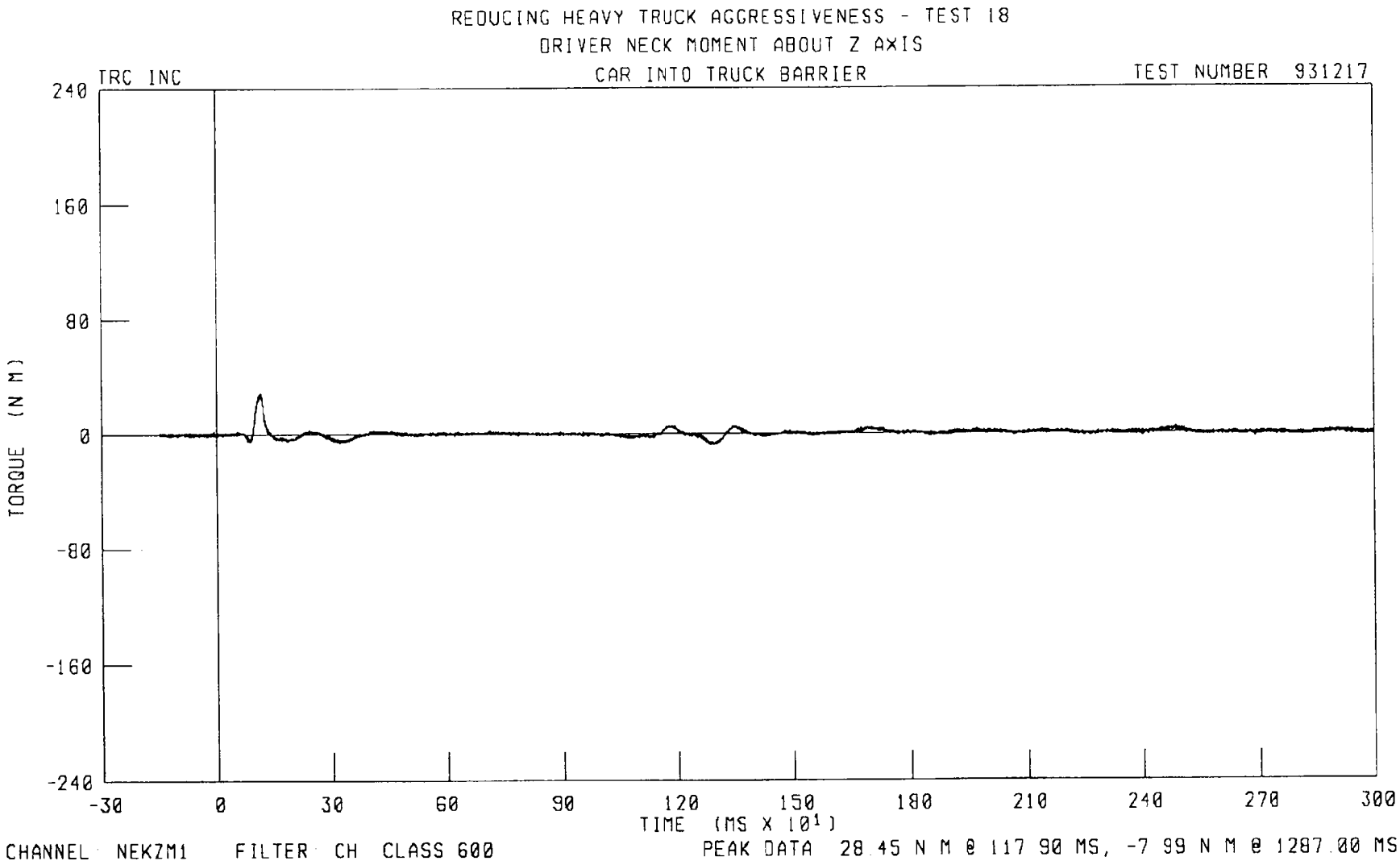

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER NECK MOMENT ABOUT X AXIS
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
240
160
80
0
-80
-160
-240
TORQUE (N M)
-30
0
30
60
90
120
150
180
210
240
270
300
TIME (MS X 10¹)
CHANNEL NEKXM1 FILTER CH CLASS 600
PEAK DATA 22.00 N M @ 95.20 MS, -38.06 N M @ 112.50 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER NECK MOMENT ABOUT Y AXIS
CAR INTO TRUCK BARRIER

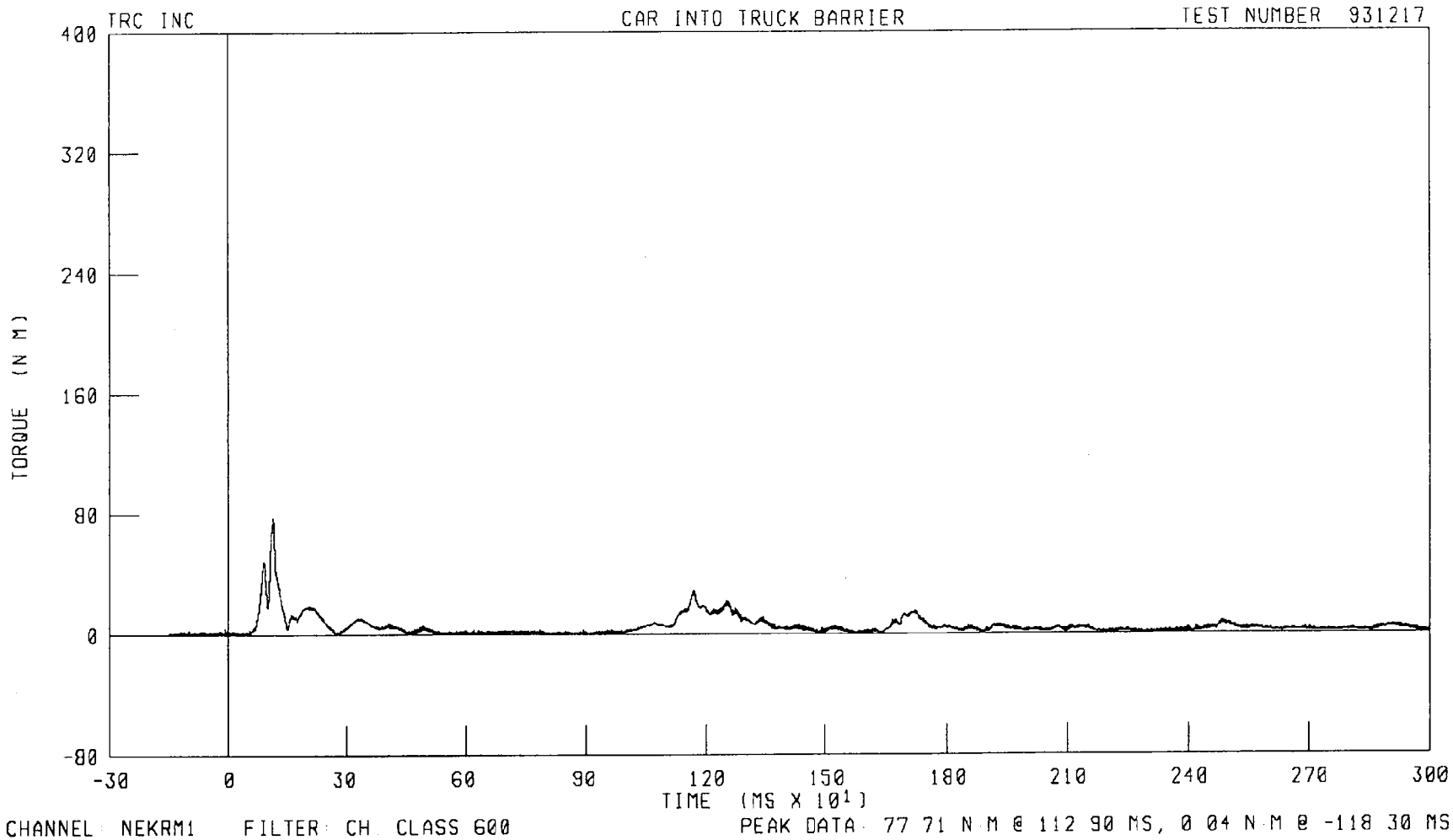


CHANNEL NEKYM1 FILTER CH CLASS 600

PEAK DATA 62 50 N M @ 113 00 MS, -46 56 N M @ 89 80 MS

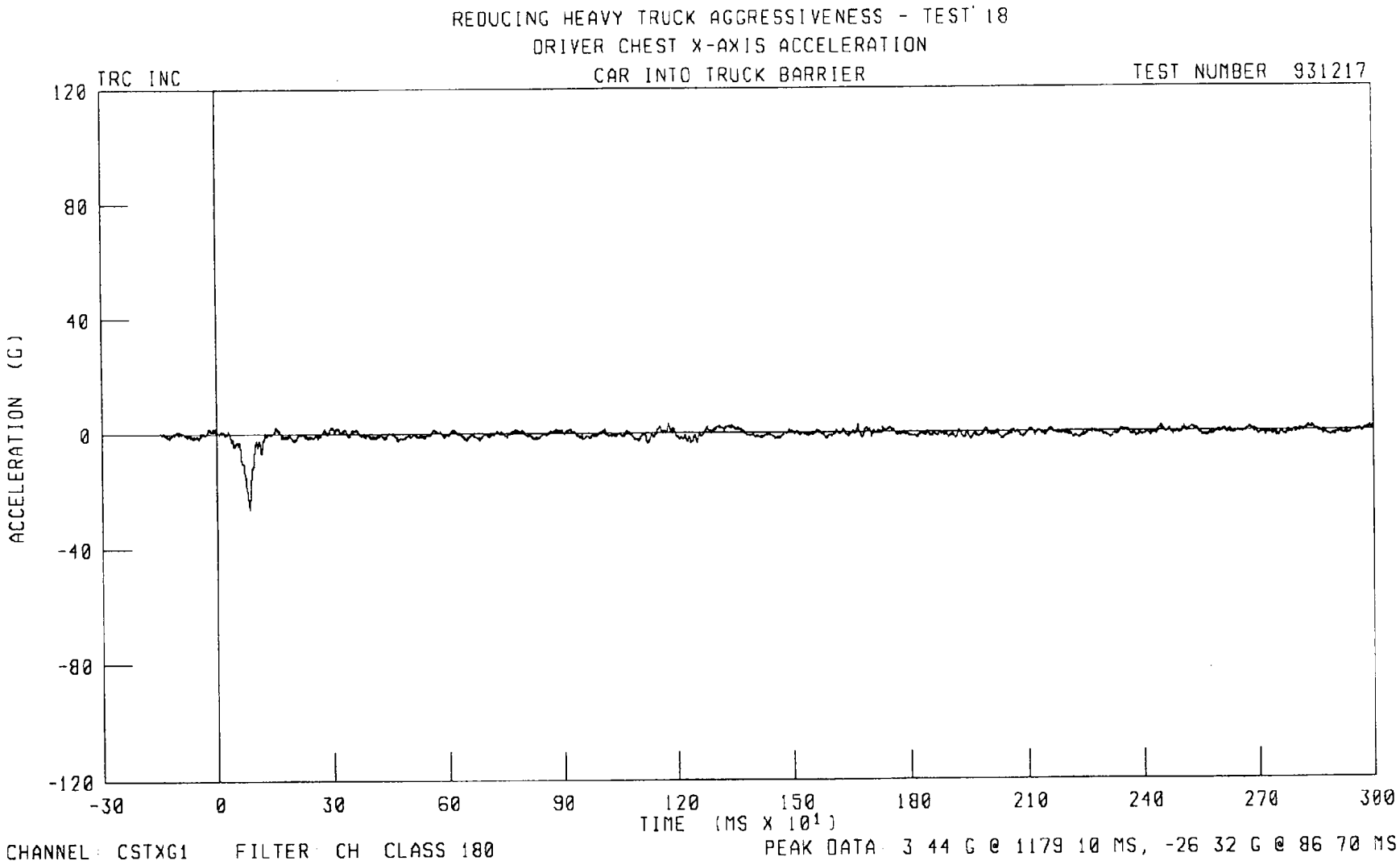

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER NECK MOMENT ABOUT Z AXIS
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
240
160
80
0
-80
-160
-240
TORQUE (N M)
-30
0
30
60
90
120
150
180
210
240
270
300
TIME (MS X 10¹)
CHANNEL NEKZM1 FILTER CH CLASS 600
PEAK DATA 28.45 N M @ 117.90 MS, -7.99 N M @ 1287.00 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER NECK MOMENT RESULTANT
CAR INTO TRUCK BARRIER

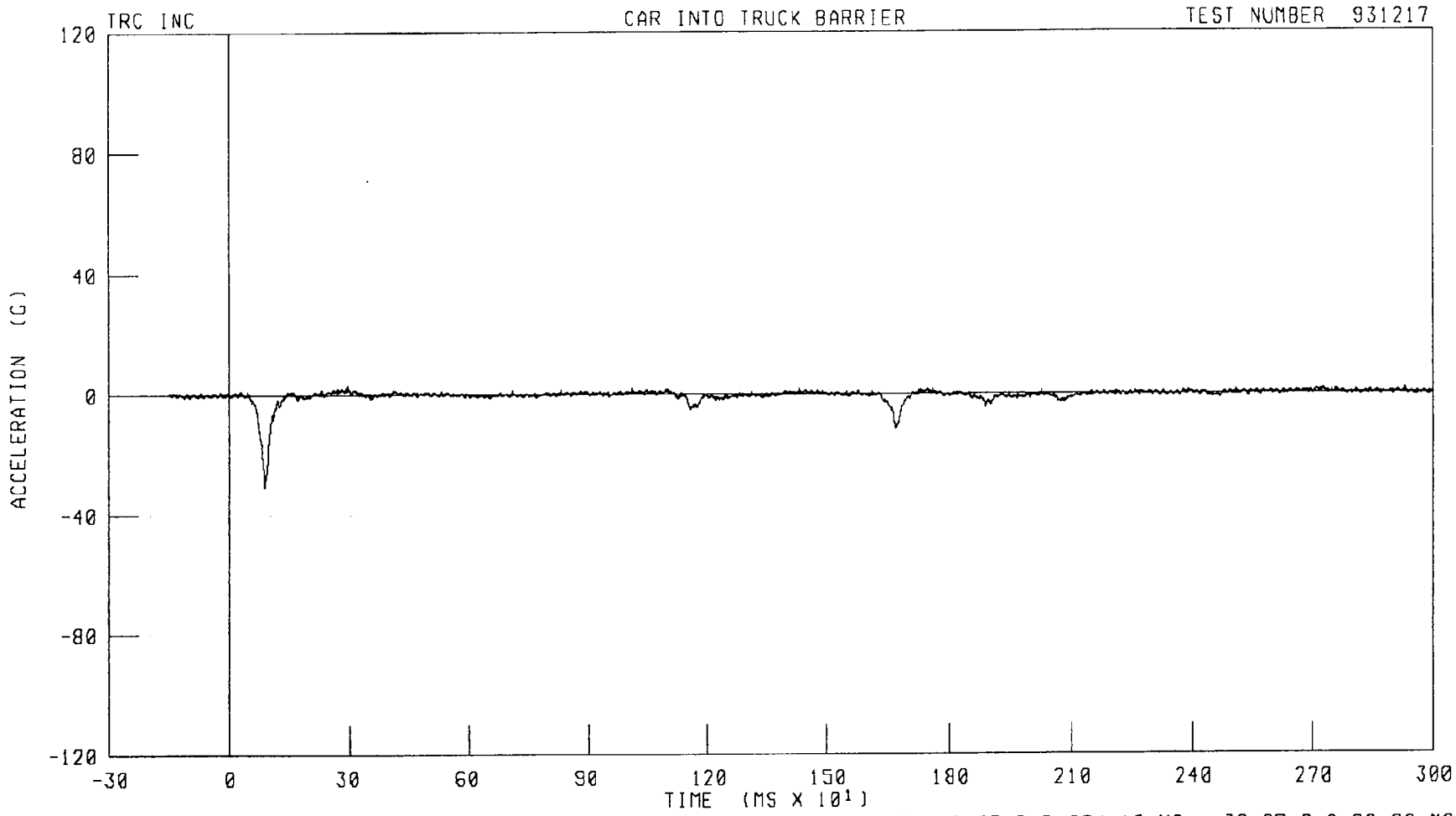


CHANNEL NEKRM1 FILTER CH CLASS 600

PEAK DATA 77 71 N M @ 112 90 MS, 0 04 N M @ -118 30 MS

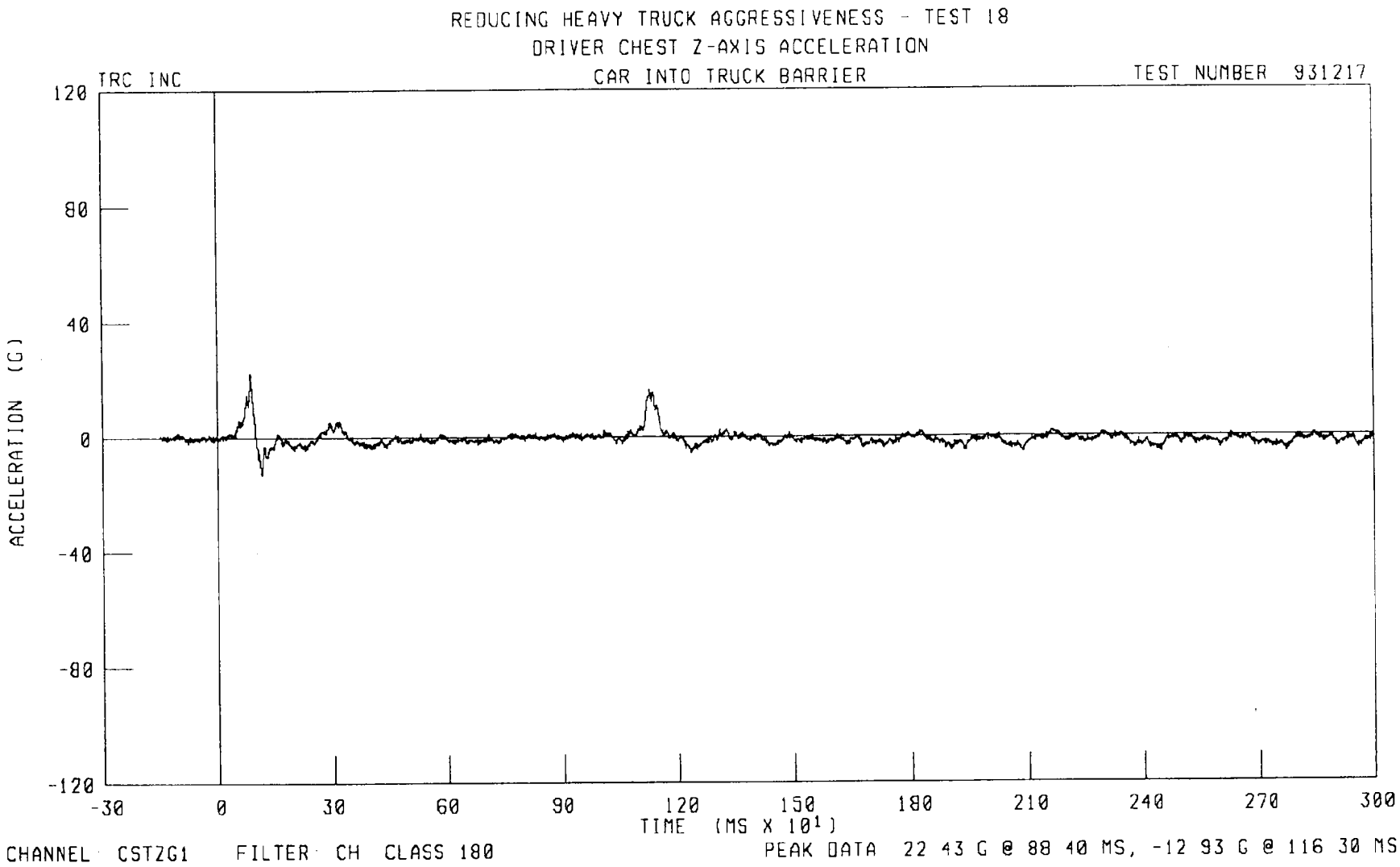

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER CHEST X-AXIS ACCELERATION
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
120
80
40
0
-40
-80
-120
ACCELERATION (G)
-30
0
30
60
90
120
150
180
210
240
270
300
TIME (MS X 10¹)
CHANNEL CSTXG1 FILTER CH CLASS 180
PEAK DATA 3 44 G @ 1179 10 MS, -26 32 G @ 86 70 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER CHEST Y-AXIS ACCELERATION
CAR INTO TRUCK BARRIER

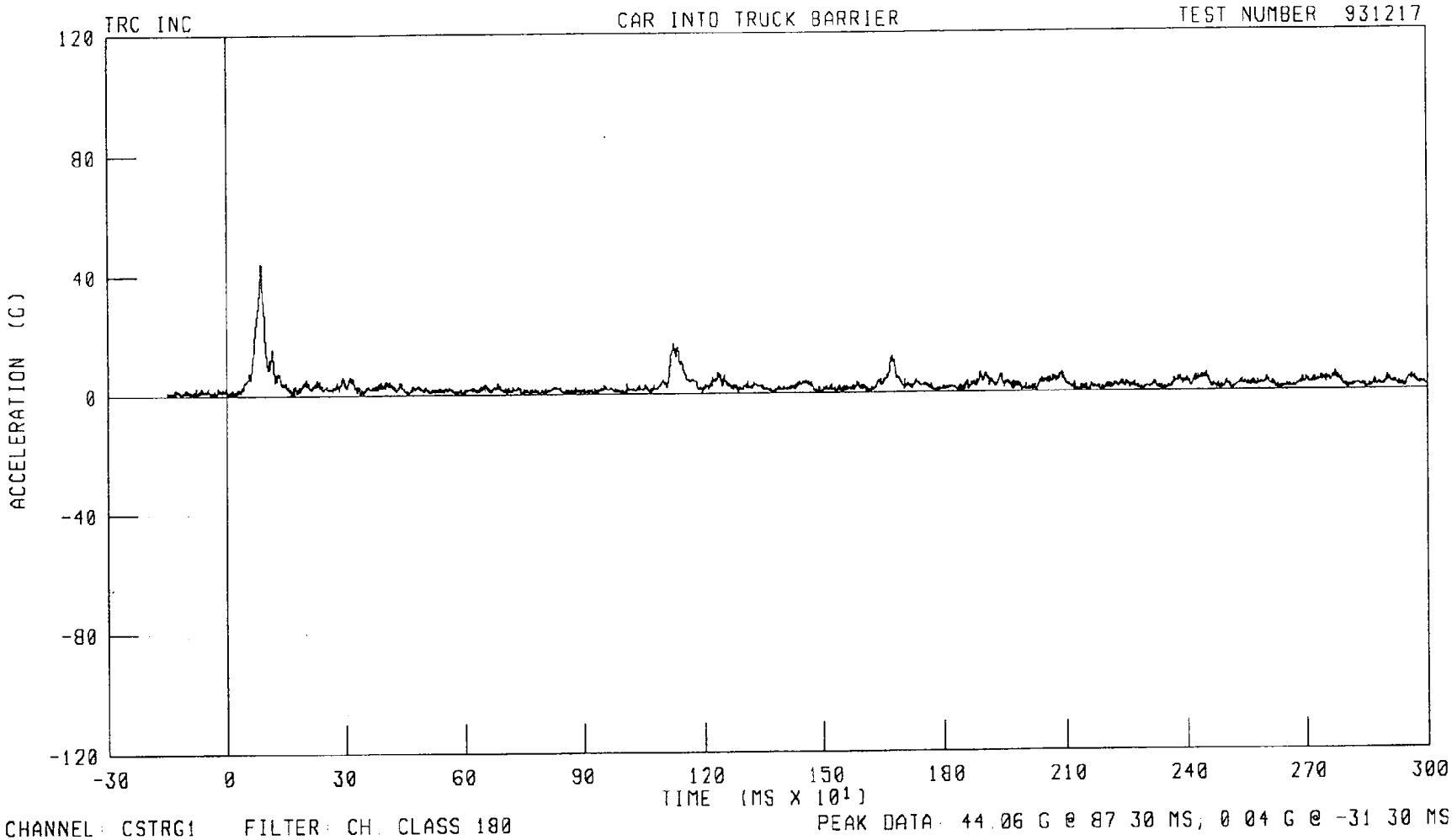


CHANNEL CSTYG1 FILTER CH CLASS 180

PEAK DATA 2 95 G @ 294 10 MS, -30 97 G @ 89 20 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER CHEST Z-AXIS ACCELERATION
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
120
80
40
0
-40
-80
-120
ACCELERATION (G)
-30
0
30
60
90
120
150
180
210
240
270
300
TIME (MS X 10¹)
CHANNEL CSTZG1 FILTER CH CLASS 180
PEAK DATA 22 43 G @ 88 40 MS, -12 93 G @ 116 30 MS

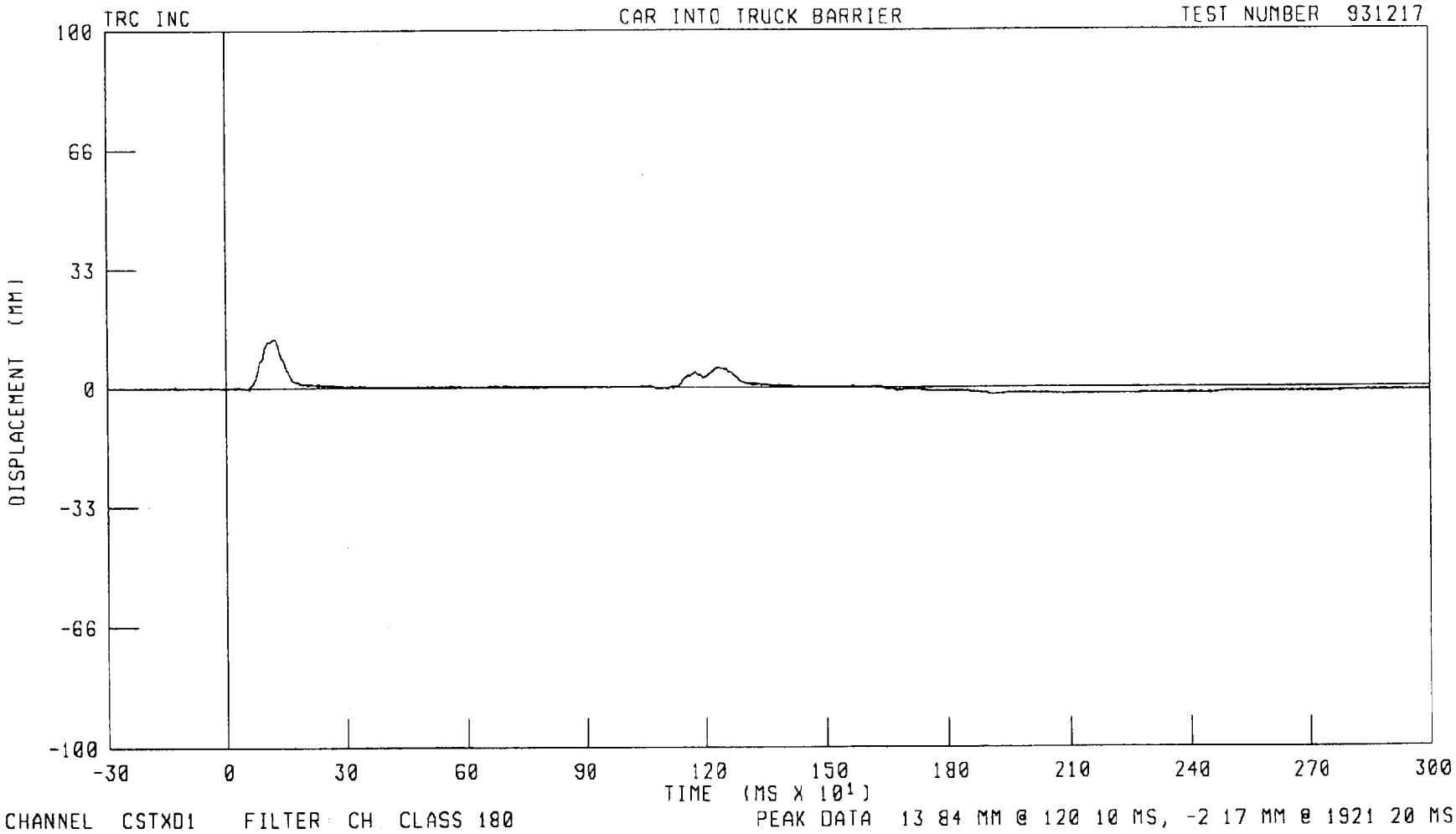
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER CHEST RESULTANT ACCELERATION
CAR INTO TRUCK BARRIER



CHANNEL CSTRG1 FILTER CH CLASS 180

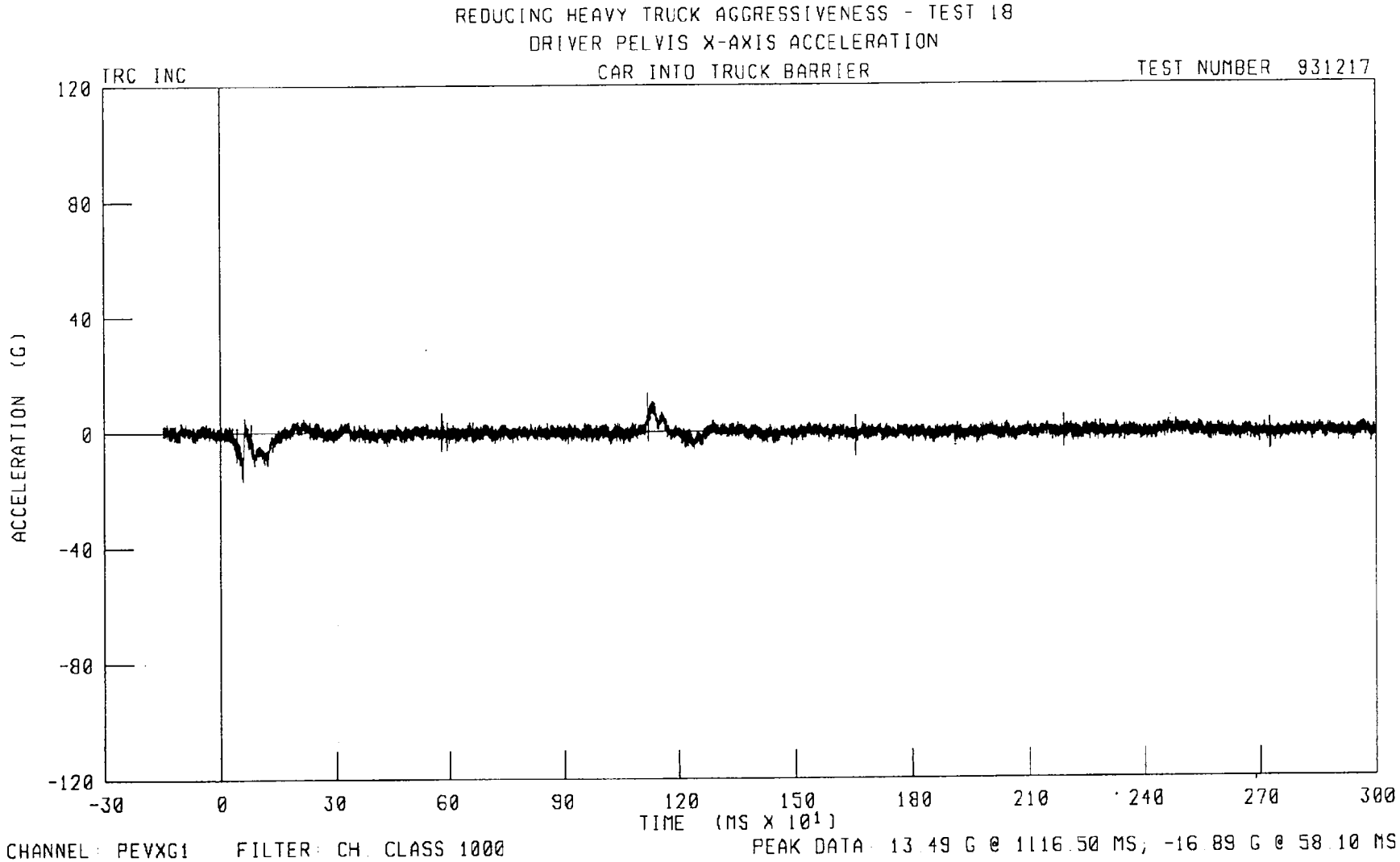
PEAK DATA 44.06 G @ 87 30 MS, 0 04 G @ -31 30 MS

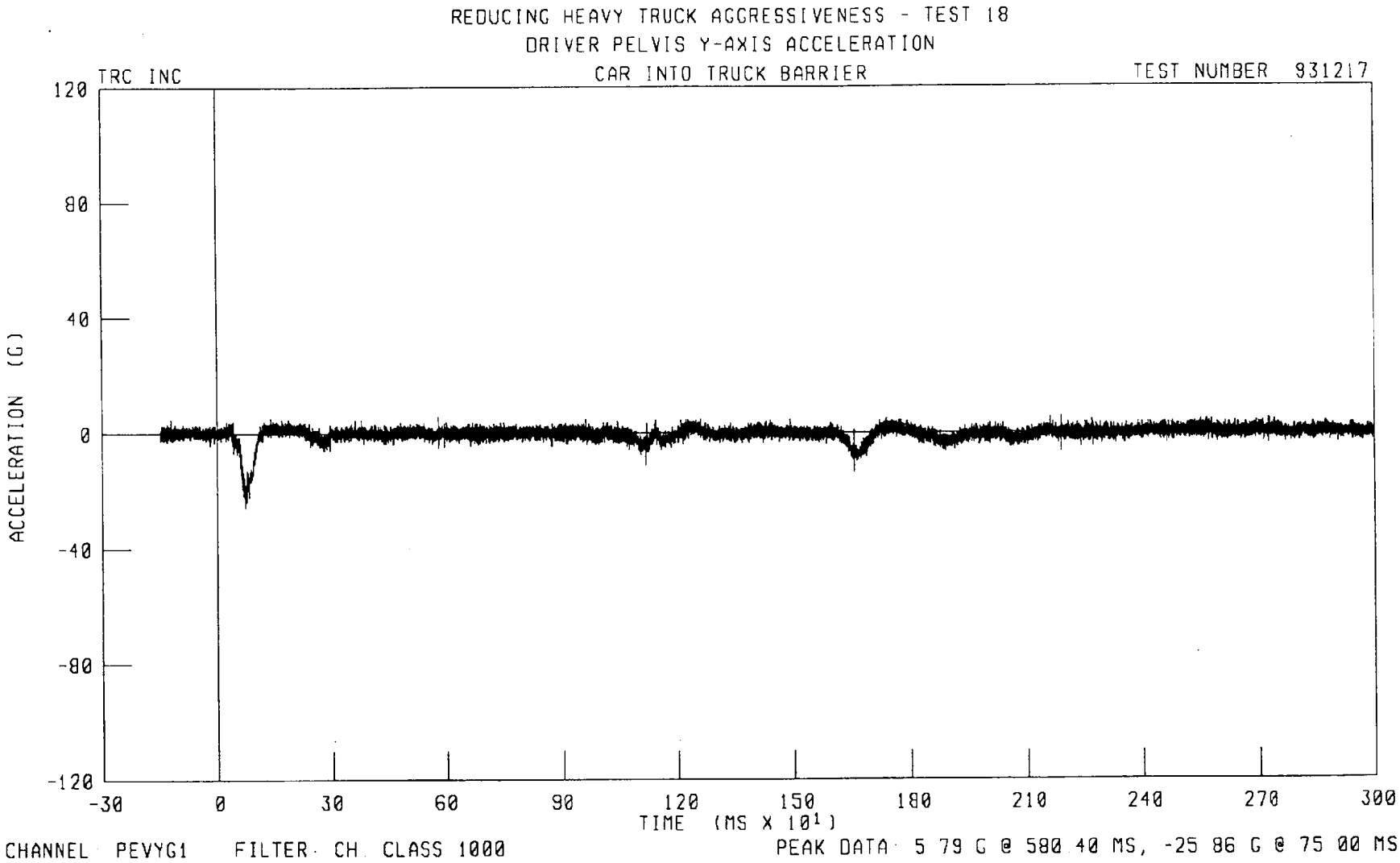
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER CHEST DEFLECTION
CAR INTO TRUCK BARRIER

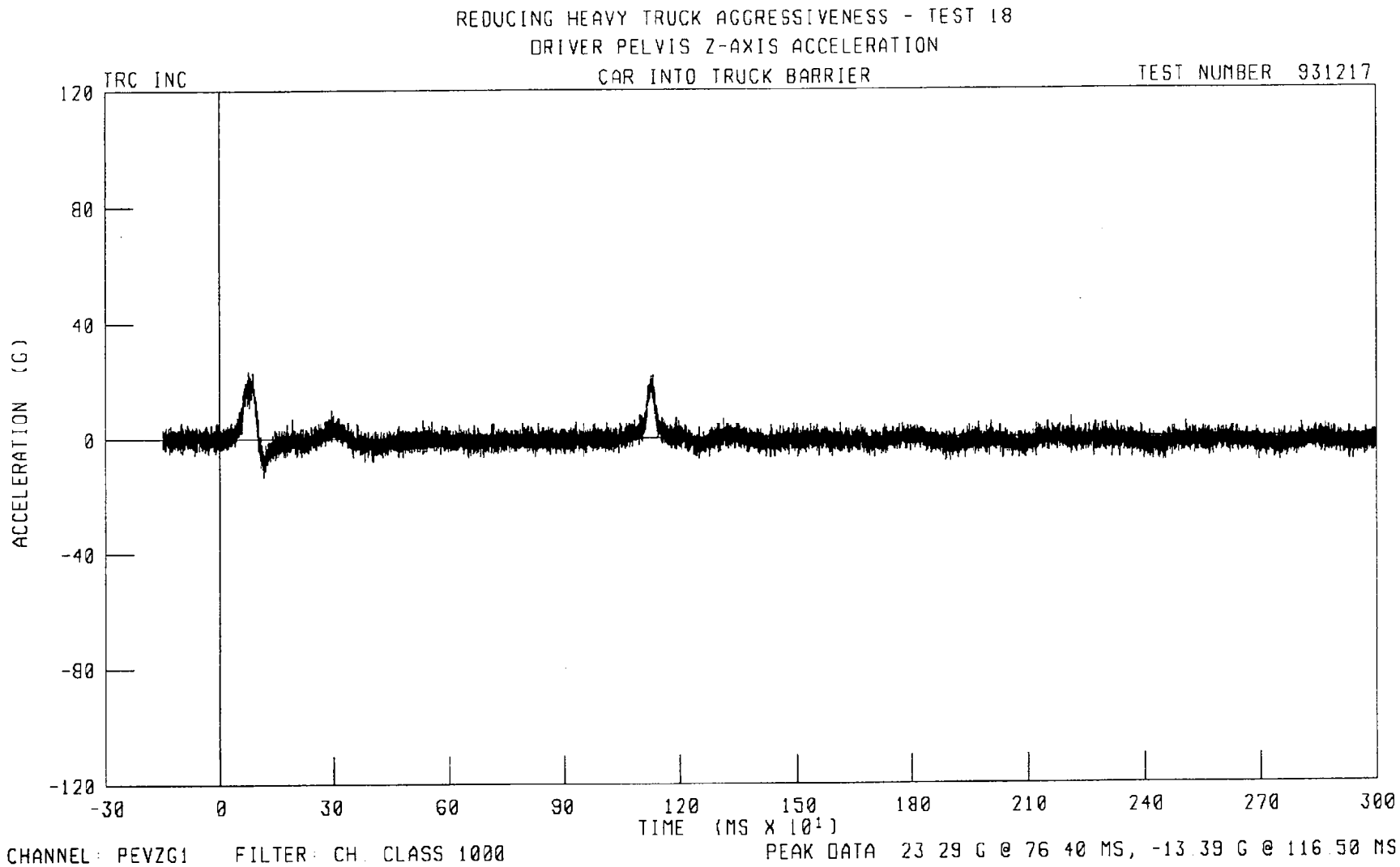


CHANNEL CSTXD1 FILTER CH CLASS 180

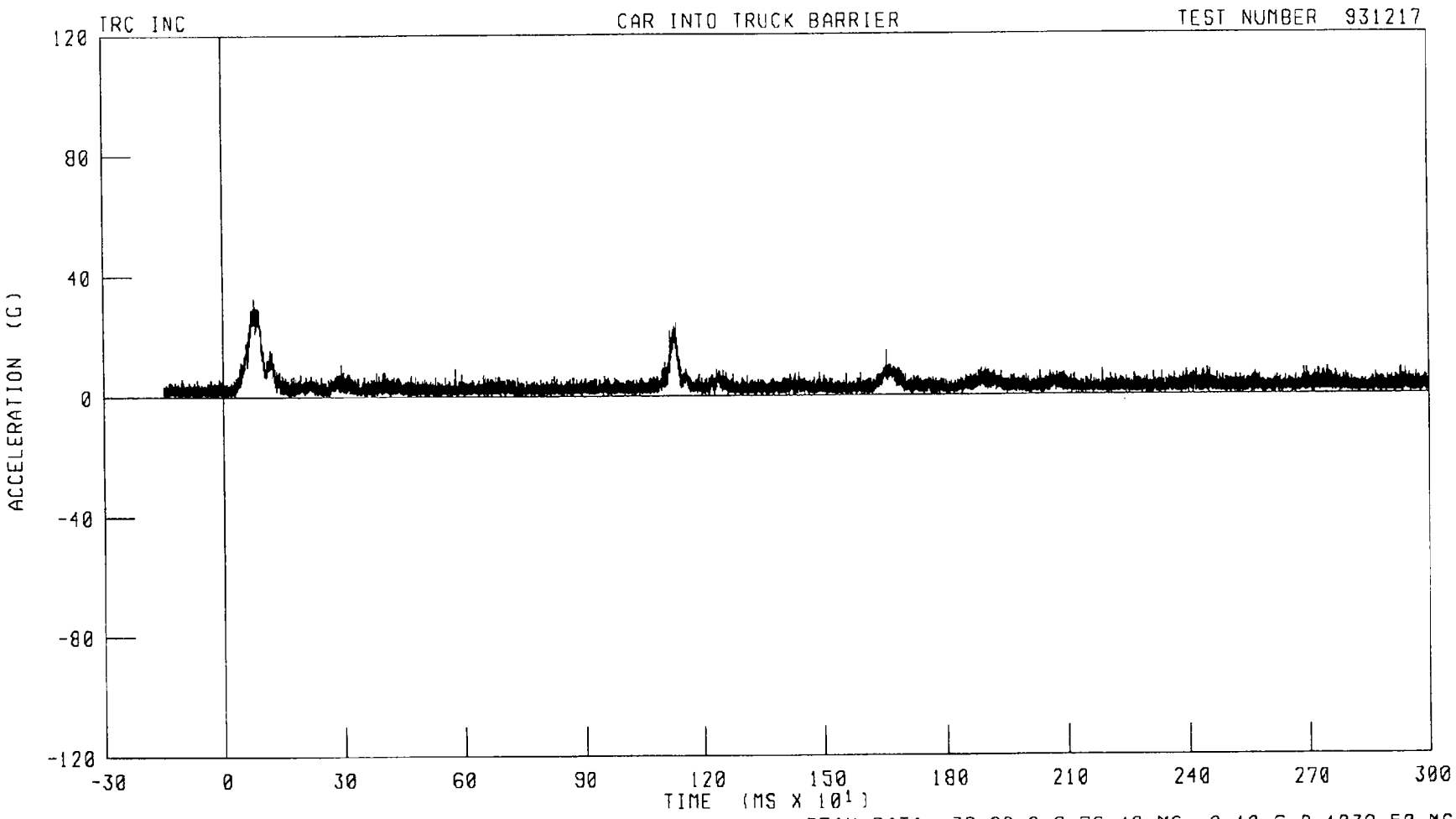
PEAK DATA 13 84 MM @ 120 10 MS, -2 17 MM @ 1921 20 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER PELVIS X-AXIS ACCELERATION
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
120
80
40
0
-40
-80
-120
ACCELERATION (G)
-30
0
30
60
90
120
150
180
210
240
270
300
TIME (MS X 10¹)
CHANNEL PEVXG1
FILTER CH CLASS 1000
PEAK DATA 13.49 G @ 1116.50 MS, -16.89 G @ 58.10 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER PELVIS Y-AXIS ACCELERATION
TRC INC
CAR INTO TRUCK BARRIER
TEST NUMBER 931217
120
80
40
0
-40
-80
-120
ACCELERATION (G)
-30
0
30
60
90
120
150
180
210
240
270
300
TIME (MS X 10¹)
CHANNEL PEVYG1 FILTER CH CLASS 1000
PEAK DATA 5 79 G @ 580 40 MS, -25 86 G @ 75 00 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER PELVIS Z-AXIS ACCELERATION
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
120
80
40
0
-40
-80
-120
ACCELERATION (G)
-30
0
30
60
90
120
150
180
210
240
270
300
TIME (MS X 10¹)
CHANNEL: PEVZG1 FILTER: CH CLASS 1000
PEAK DATA 23.29 G @ 76.40 MS, -13.39 G @ 116.50 MS

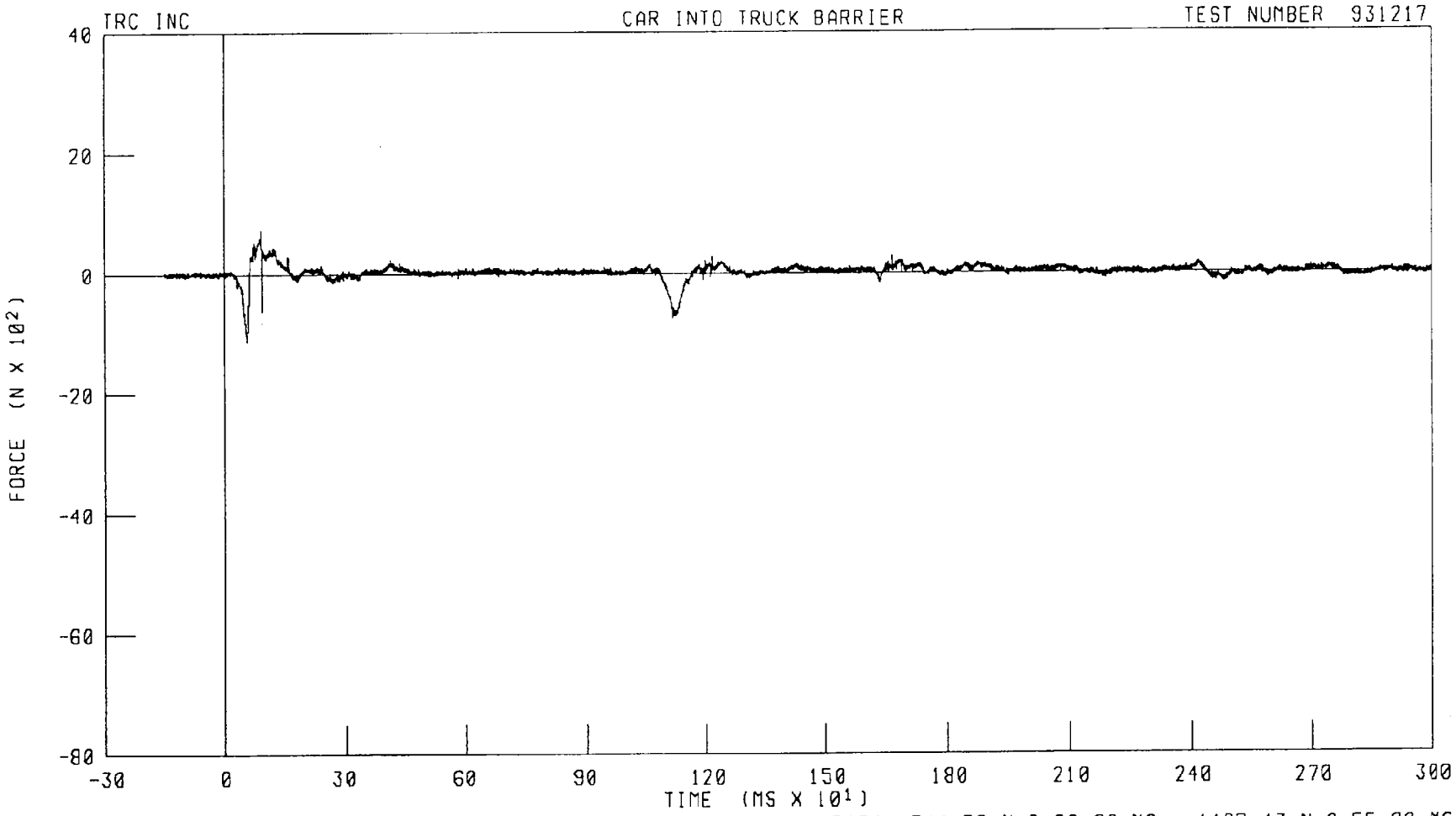
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER PELVIS RESULTANT ACCELERATION
CAR INTO TRUCK BARRIER



CHANNEL PEVRG1 FILTER CH CLASS 1000

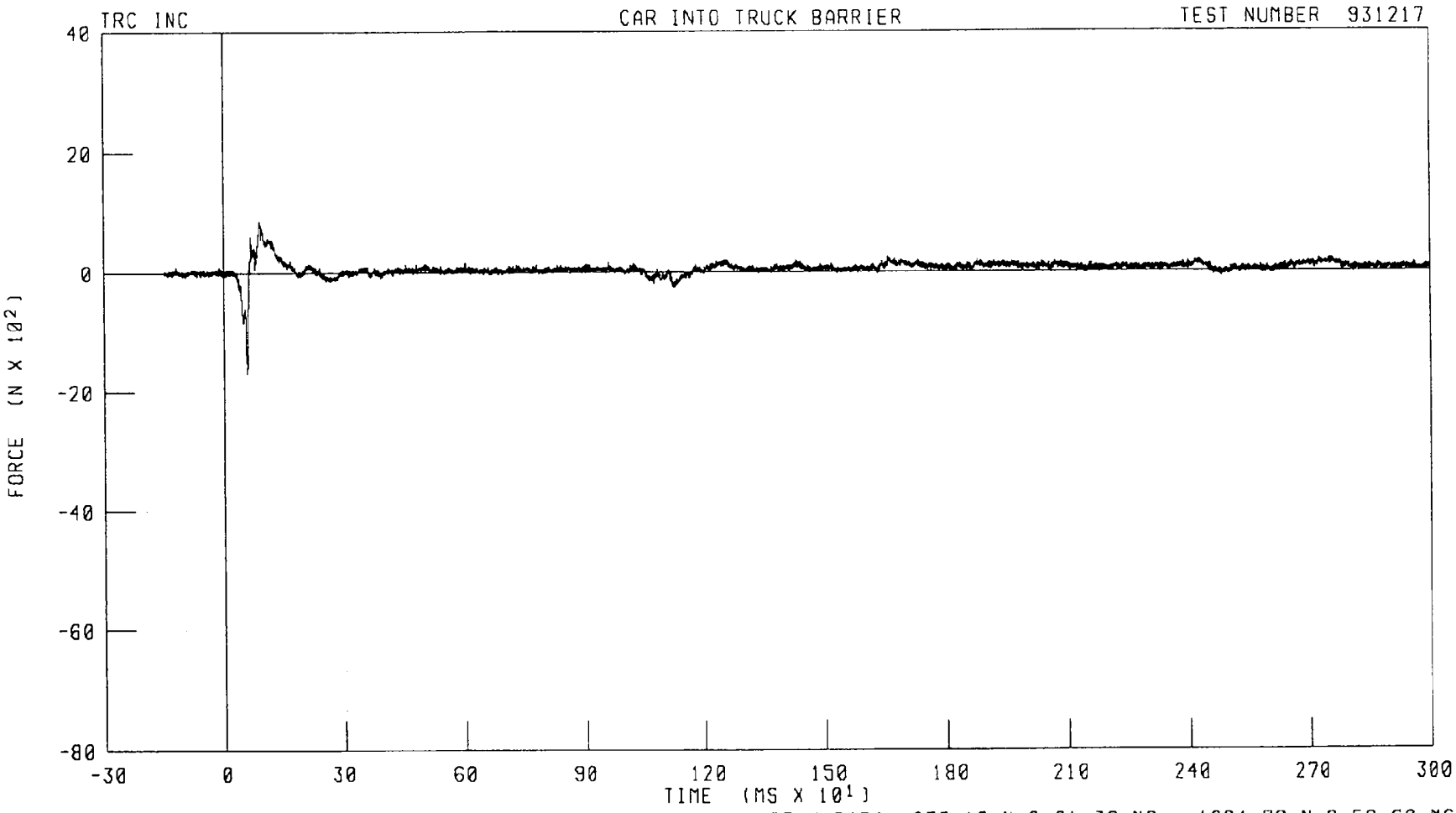
PEAK DATA 32 89 G @ 76 40 MS, 0 10 G @ 1038 50 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER LEFT FEMUR FORCE
CAR INTO TRUCK BARRIER



CHANNEL: LFMF1 FILTER: CH CLASS 600 PEAK DATA 744 76 N @ 92 60 MS; -1127 43 N @ 55 80 MS

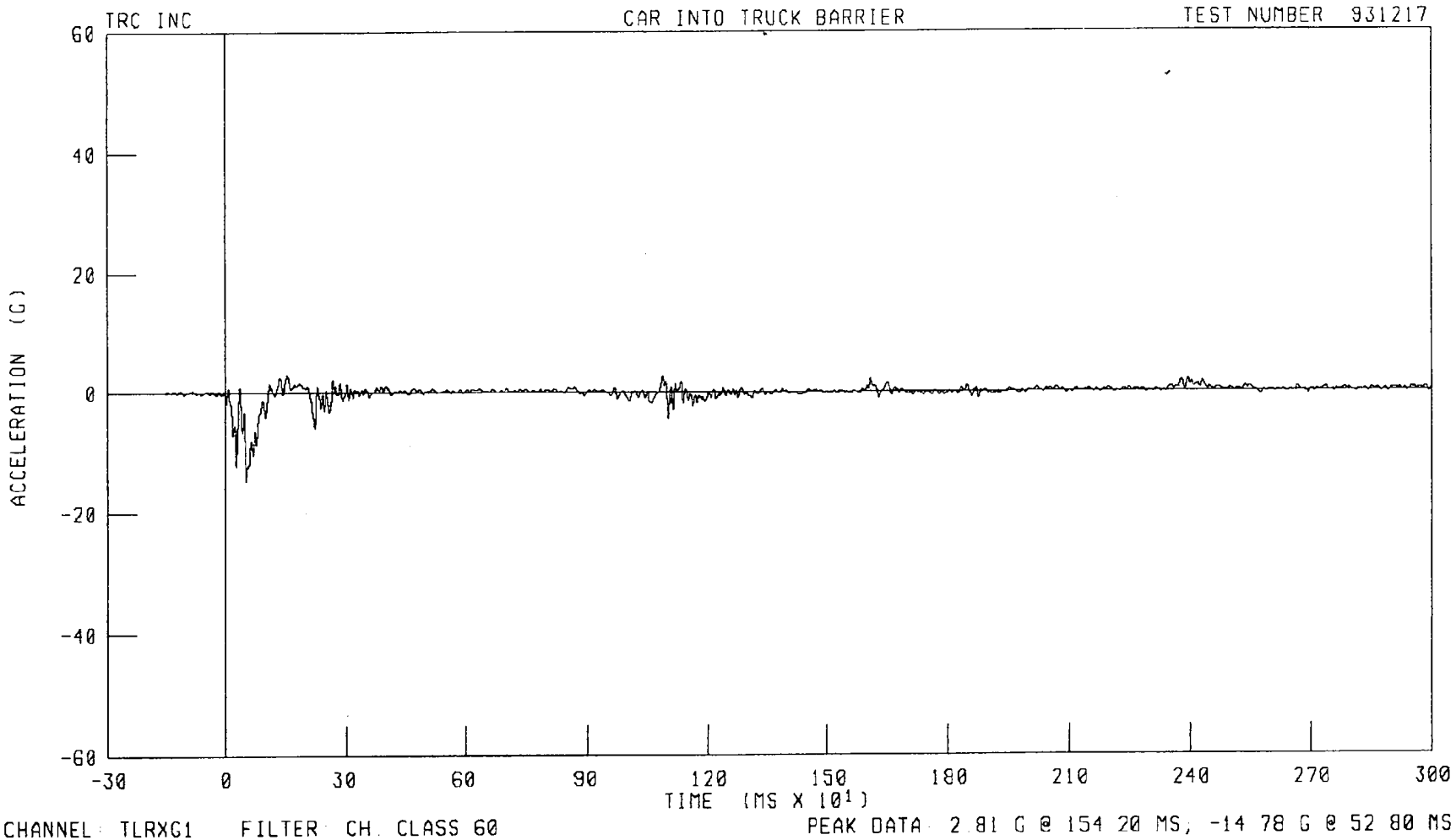
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
DRIVER RIGHT FEMUR FORCE
CAR INTO TRUCK BARRIER



CHANNEL RFMFI FILTER CH CLASS 600

PEAK DATA 858.12 N @ 91.30 MS, -1694.70 N @ 59.60 MS

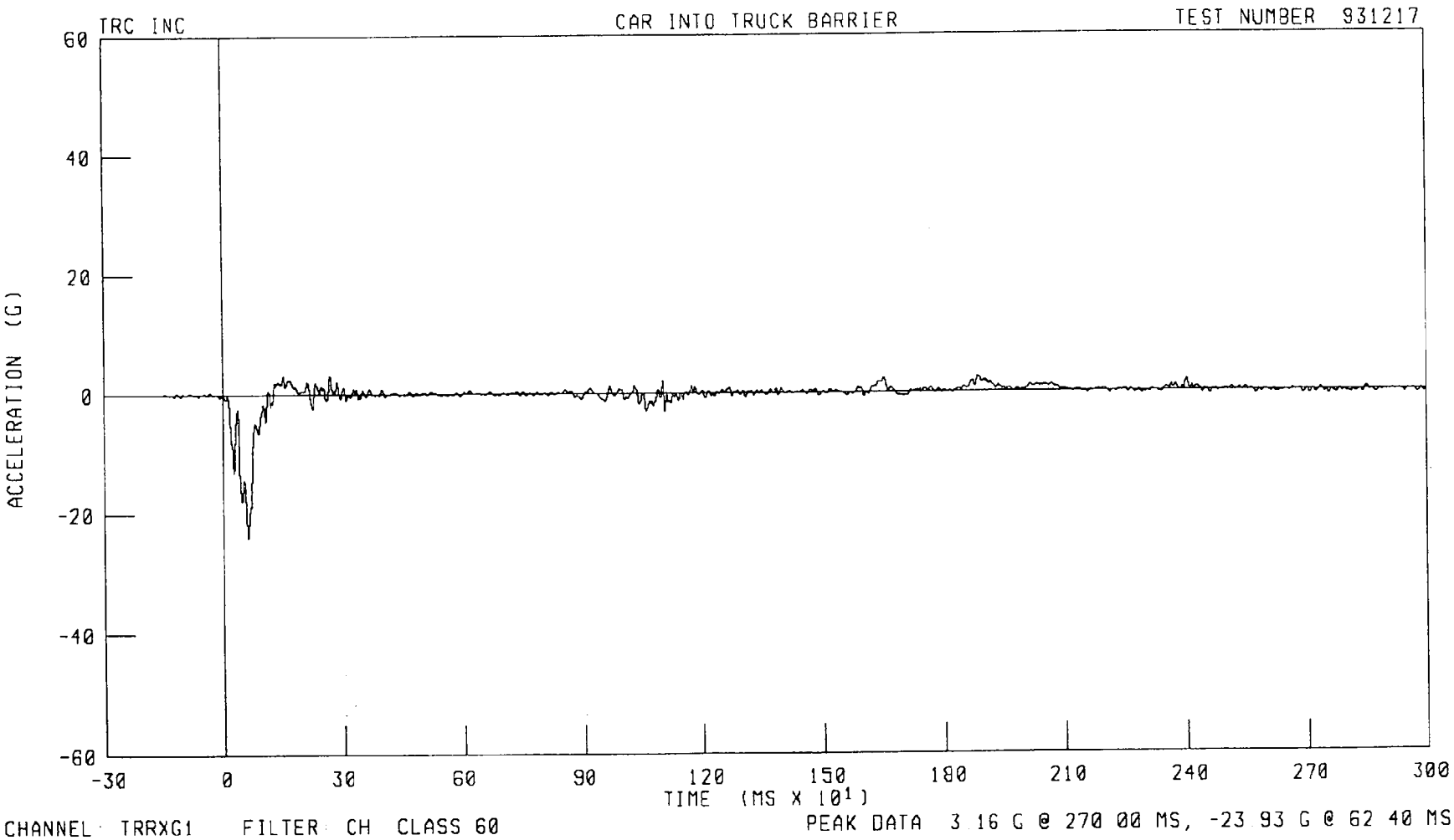
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
LEFT REAR SEAT X-AXIS ACCELERATION
CAR INTO TRUCK BARRIER



CHANNEL TLRXG1 FILTER CH CLASS 60

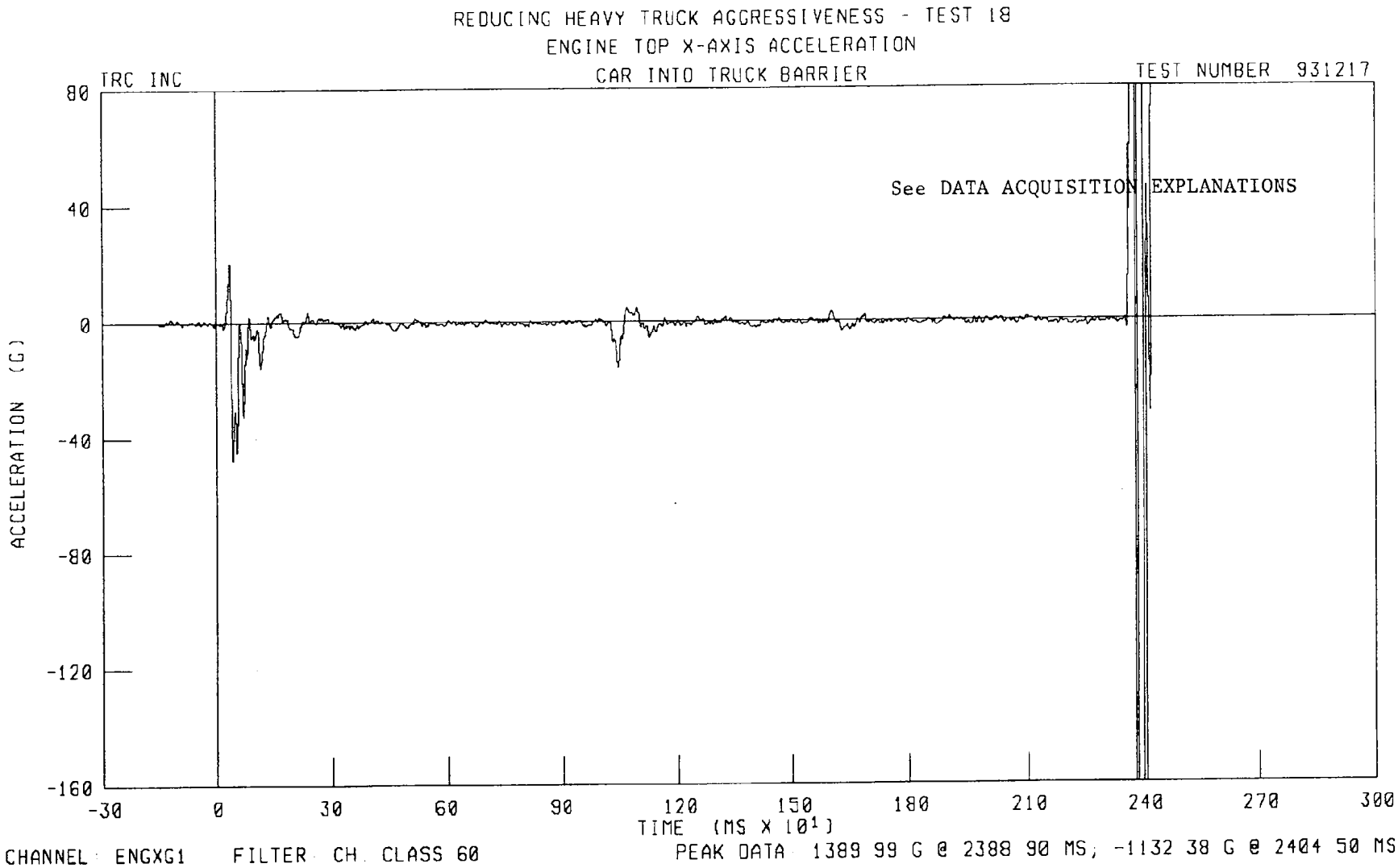
PEAK DATA 2 81 G @ 154 20 MS, -14 78 G @ 52 80 MS

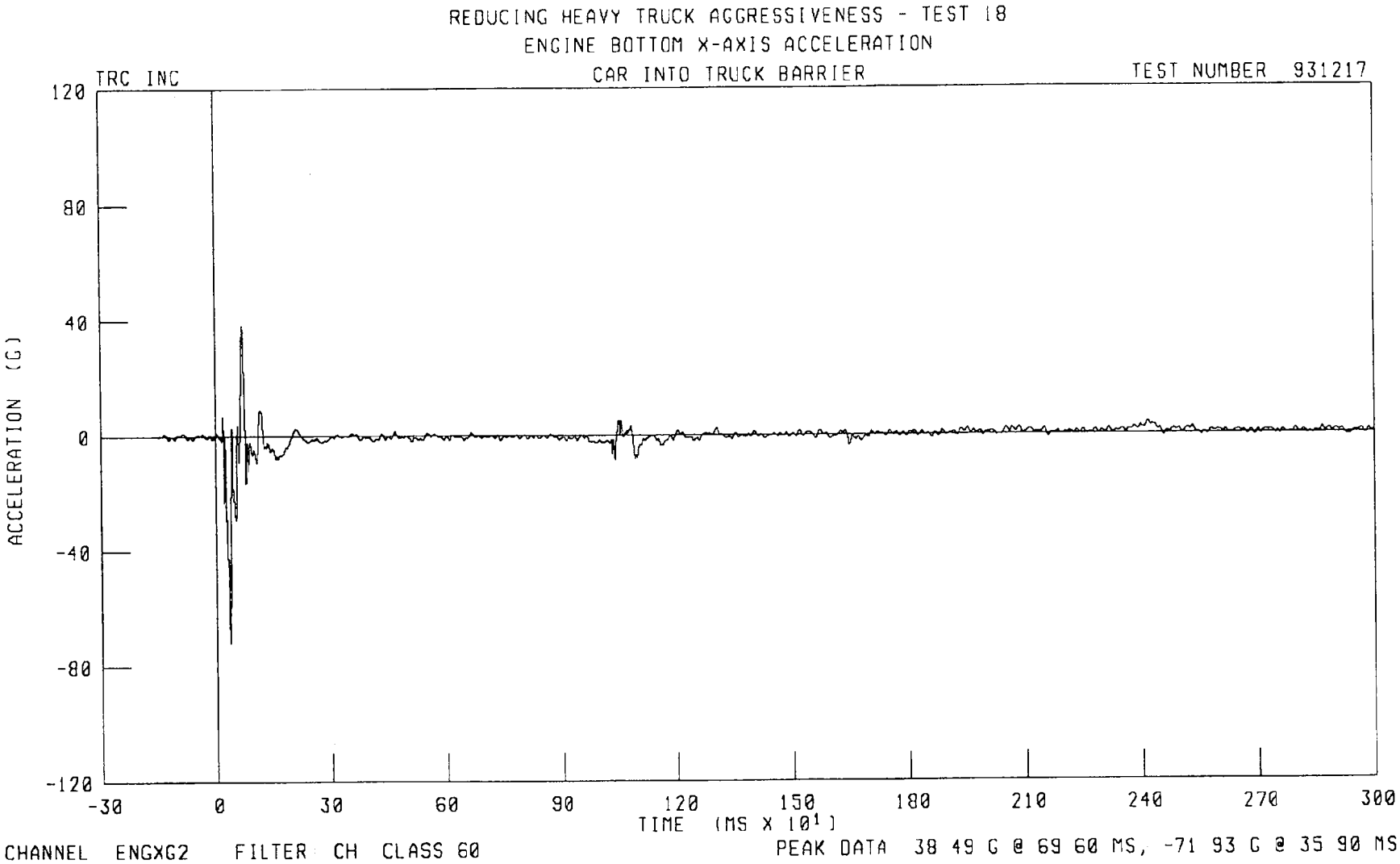
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
RIGHT REAR SEAT X-AXIS ACCELERATION
CAR INTO TRUCK BARRIER



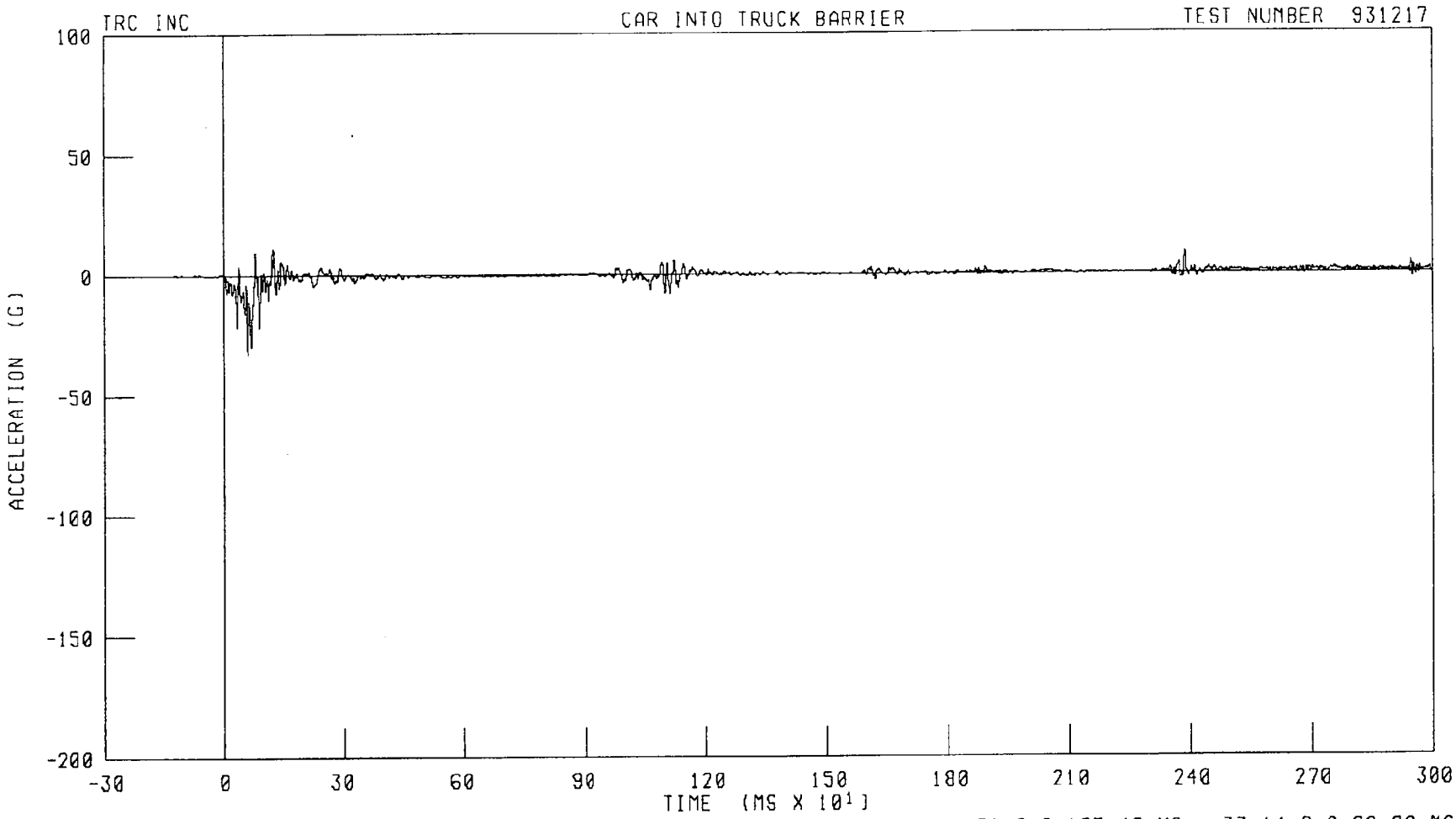
CHANNEL TRRXG1 FILTER CH CLASS 60

PEAK DATA 3.16 G @ 270.00 MS, -23.93 G @ 62.40 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
ENGINE TOP X-AXIS ACCELERATION
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
See DATA ACQUISITION EXPLANATIONS
ACCELERATION (G)
80
40
0
-40
-80
-120
-160
-30
0
30
60
90
120
150
180
210
240
270
300
TIME (MS X 10¹)
CHANNEL ENGXG1 FILTER CH CLASS 60
PEAK DATA 1389 99 G @ 2388 90 MS; -1132 38 G @ 2404 50 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
ENGINE BOTTOM X-AXIS ACCELERATION
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
120
80
40
0
-40
-80
-120
ACCELERATION (G)
-30
0
30
60
90
120
150
180
210
240
270
300
TIME (MS X 10¹)
CHANNEL ENGXG2 FILTER CH CLASS 60
PEAK DATA 38 49 G @ 69 60 MS, -71 93 G @ 35 90 MS

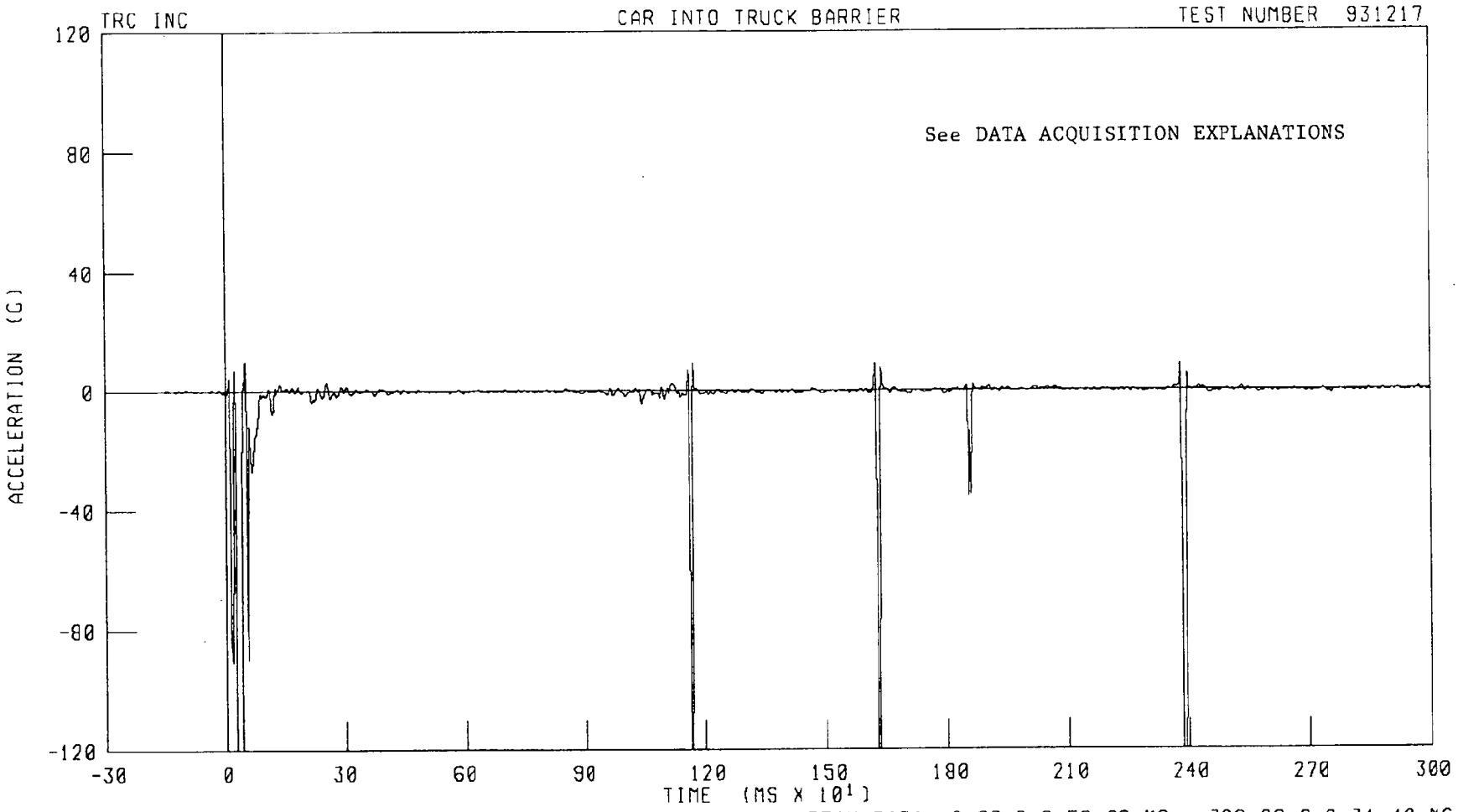
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
INSTRUMENT PANEL CENTER X-AXIS ACCELERATION
CAR INTO TRUCK BARRIER



CHANNEL DPCXG1 FILTER CH CLASS 60

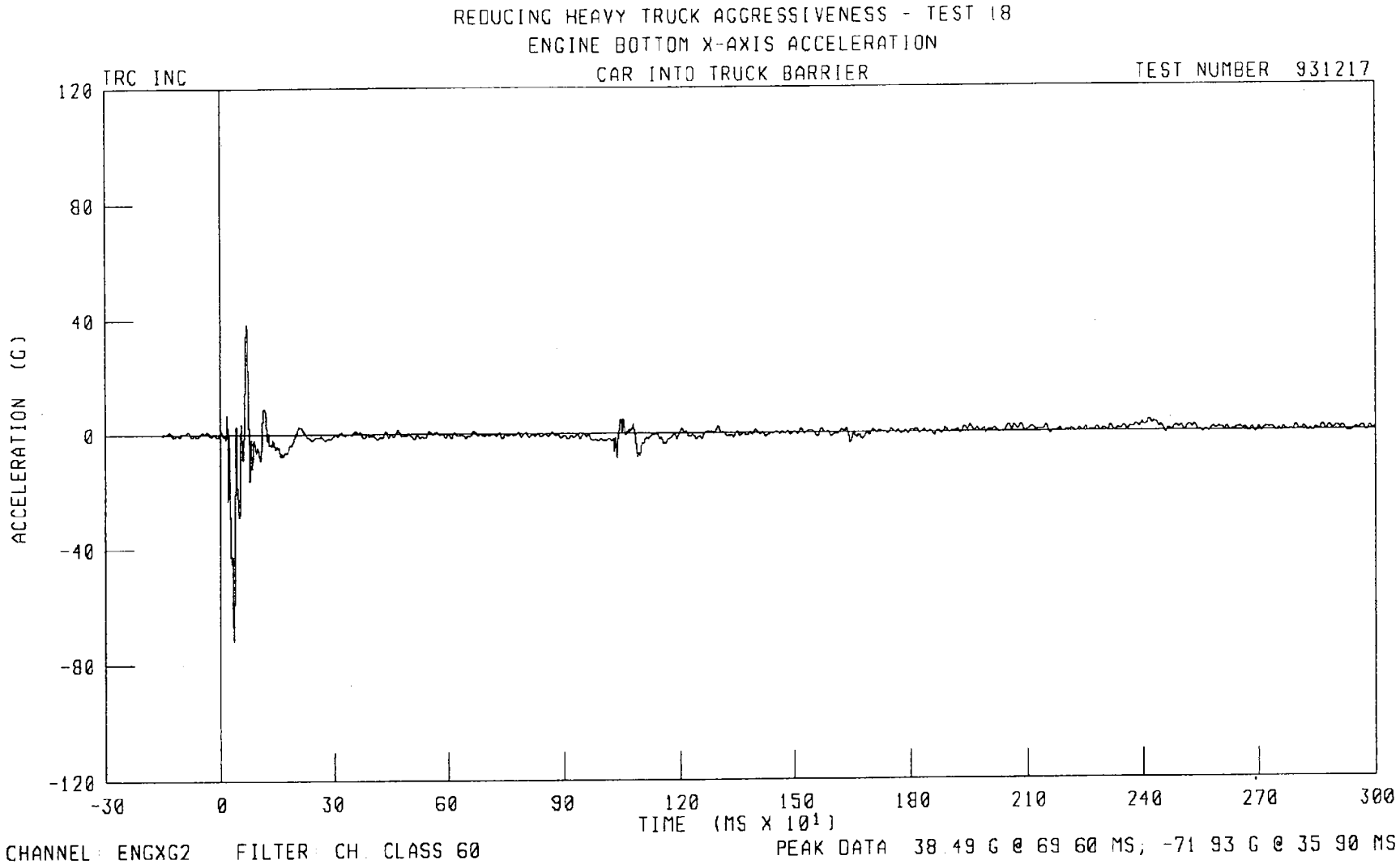
PEAK DATA 11 31 G @ 125 40 MS, -33 14 G @ 60 90 MS

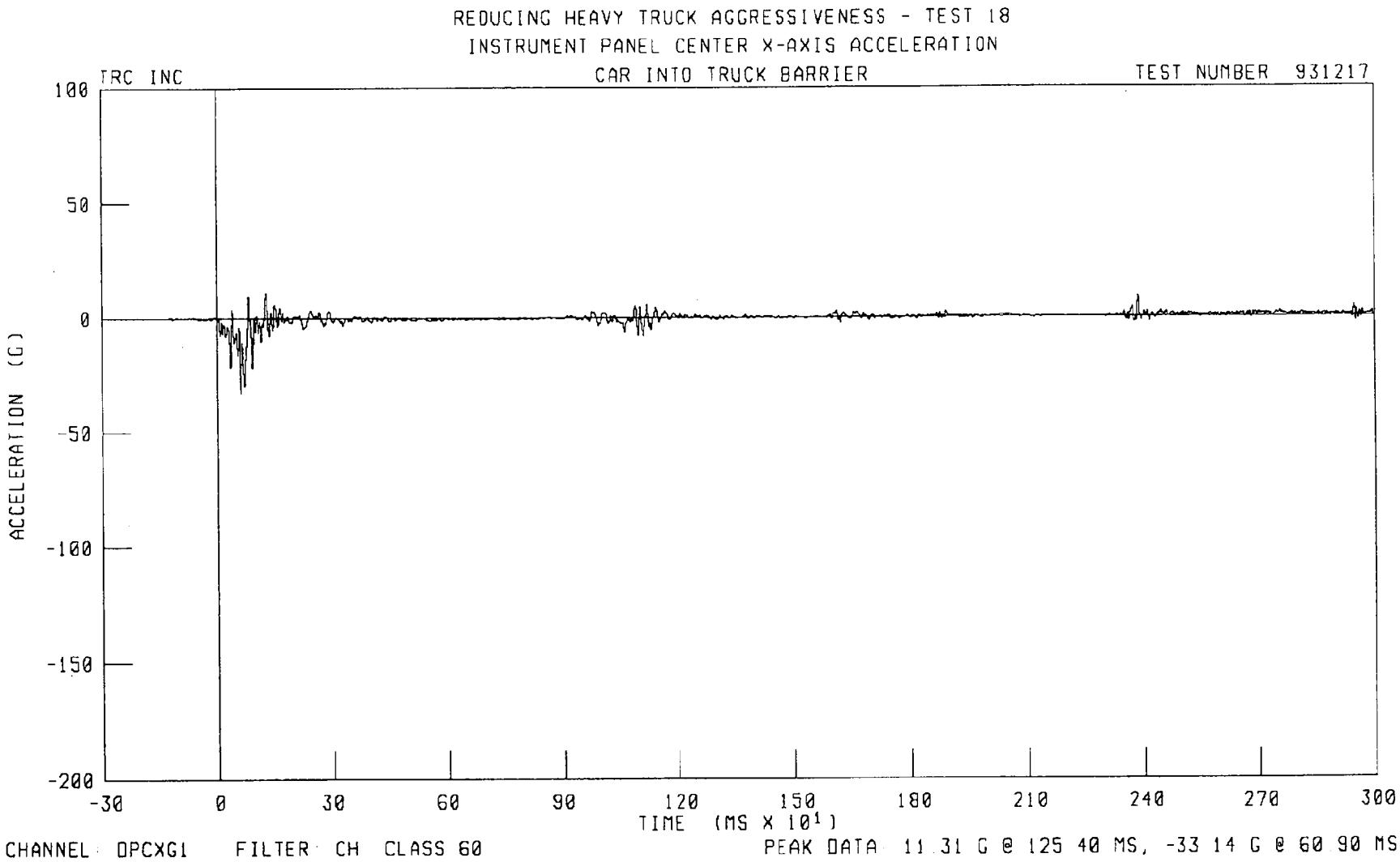
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
CAR CENTER OF GRAVITY X-AXIS ACCELERATION
CAR INTO TRUCK BARRIER



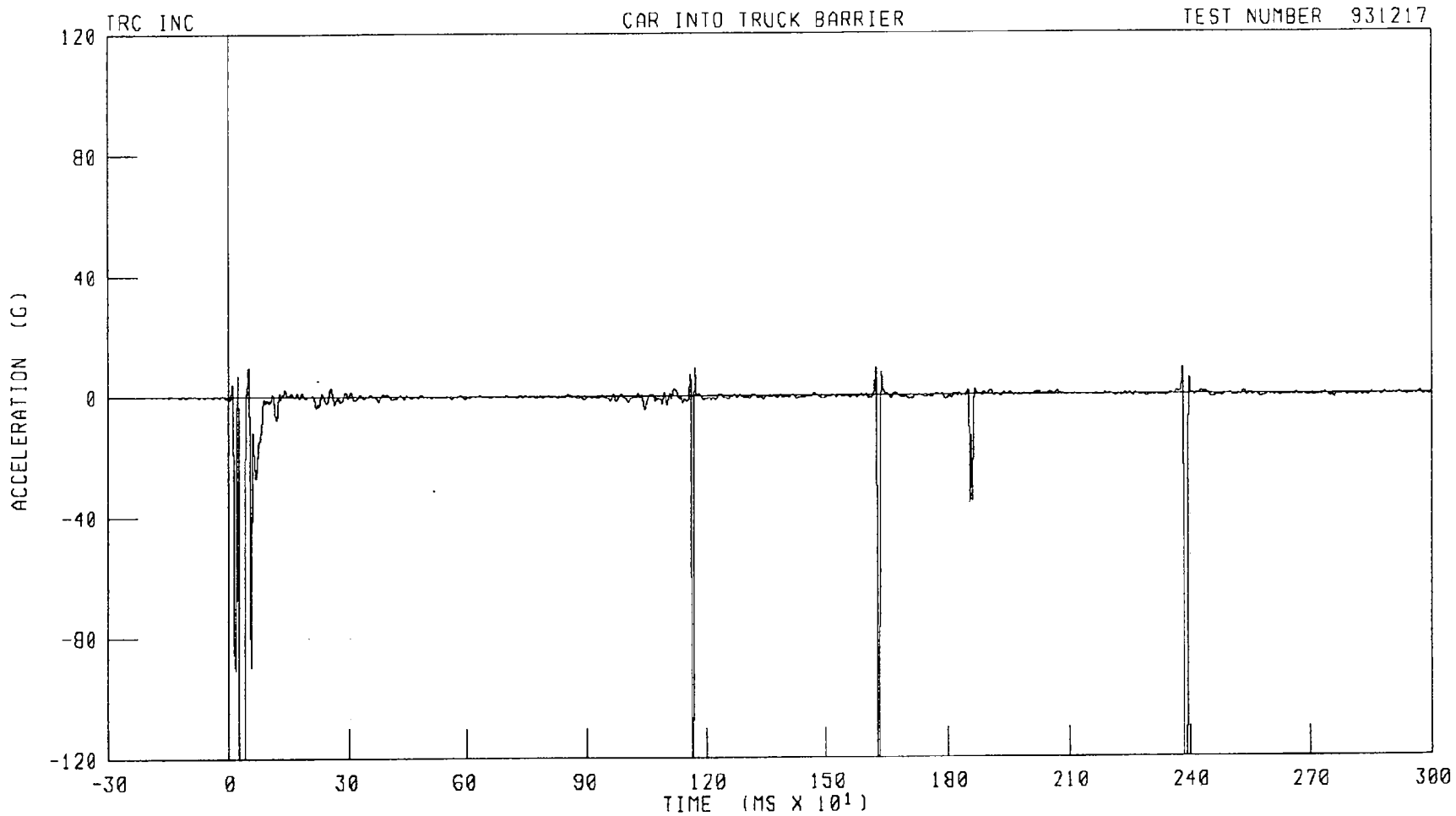
CHANNEL VCGXG1 FILTER CH CLASS 60

PEAK DATA 9 93 G @ 50 60 MS, -308 62 G @ 31 40 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
ENGINE BOTTOM X-AXIS ACCELERATION
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
120
80
40
0
-40
-80
-120
ACCELERATION (G)
-30
0
30
60
90
120
150
180
210
240
270
300
TIME (MS X 10¹)
CHANNEL ENGXG2 FILTER CH CLASS 60
PEAK DATA 38 49 G @ 69 60 MS; -71 93 G @ 35 90 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
INSTRUMENT PANEL CENTER X-AXIS ACCELERATION
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
ACCELERATION (G)
100
50
0
-50
-100
-150
-200
-30
0
30
60
90
120
150
180
210
240
270
300
TIME (MS X 10¹)
CHANNEL OPCXG1 FILTER CH CLASS 60
PEAK DATA 11.31 G @ 125.40 MS, -33.14 G @ 60.90 MS

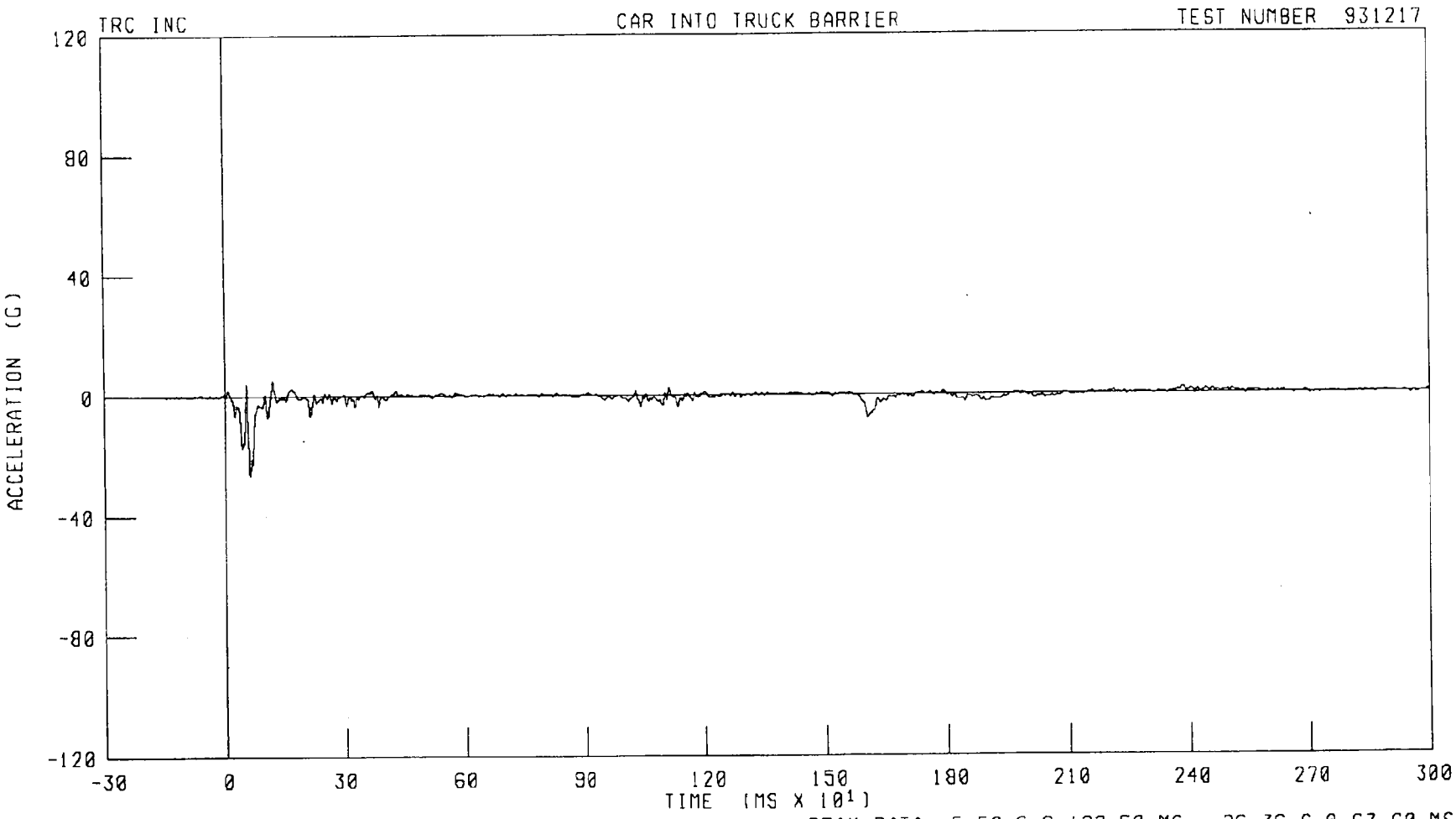
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
CAR CENTER OF GRAVITY X-AXIS ACCELERATION
CAR INTO TRUCK BARRIER



CHANNEL: VCGXG1 FILTER: CH CLASS 60

PEAK DATA 9 93 G @ 50 60 MS, -308 62 G @ 31 40 MS

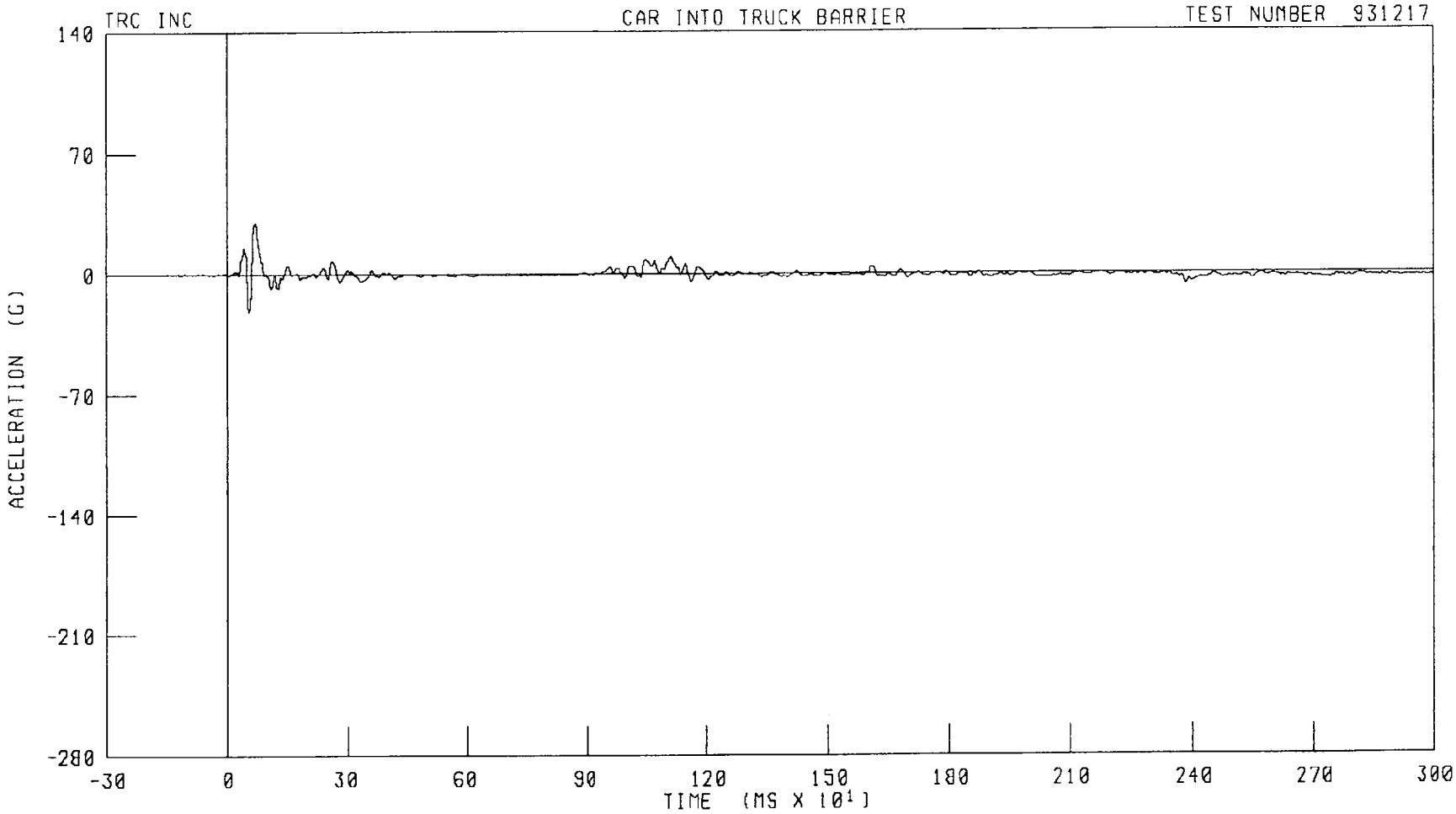
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
CAR CENTER OF GRAVITY Y-AXIS ACCELERATION
CAR INTO TRUCK BARRIER



CHANNEL: VCGYG1 FILTER CH CLASS 60

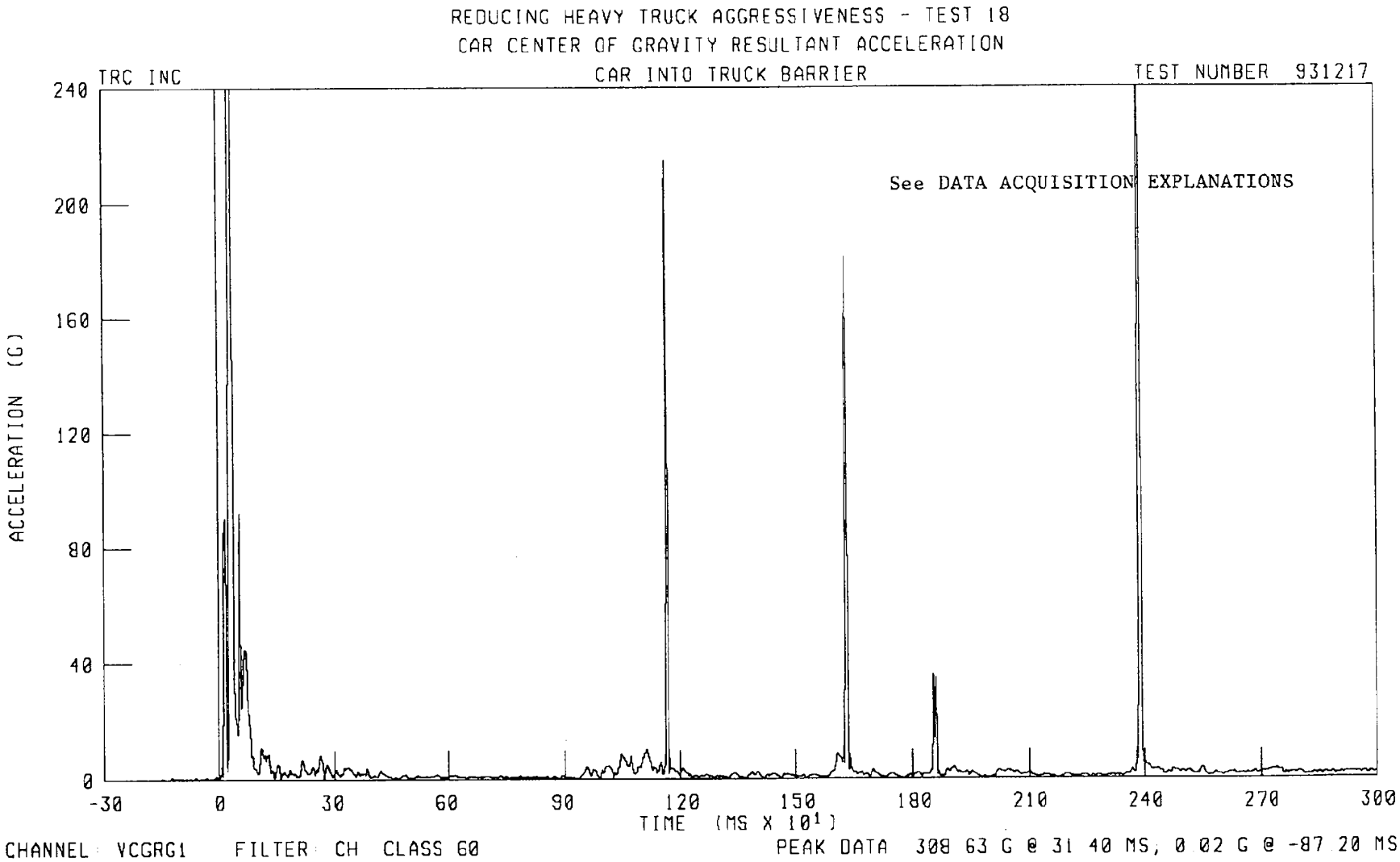
PEAK DATA 5 50 G @ 122 50 MS; -26 36 G @ 63 60 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
CAR CENTER OF GRAVITY Z-AXIS ACCELERATION
CAR INTO TRUCK BARRIER



CHANNEL VCGZG1 FILTER CH CLASS 60

PEAK DATA 30.47 G @ 71.40 MS, -22.04 G @ 53.90 MS

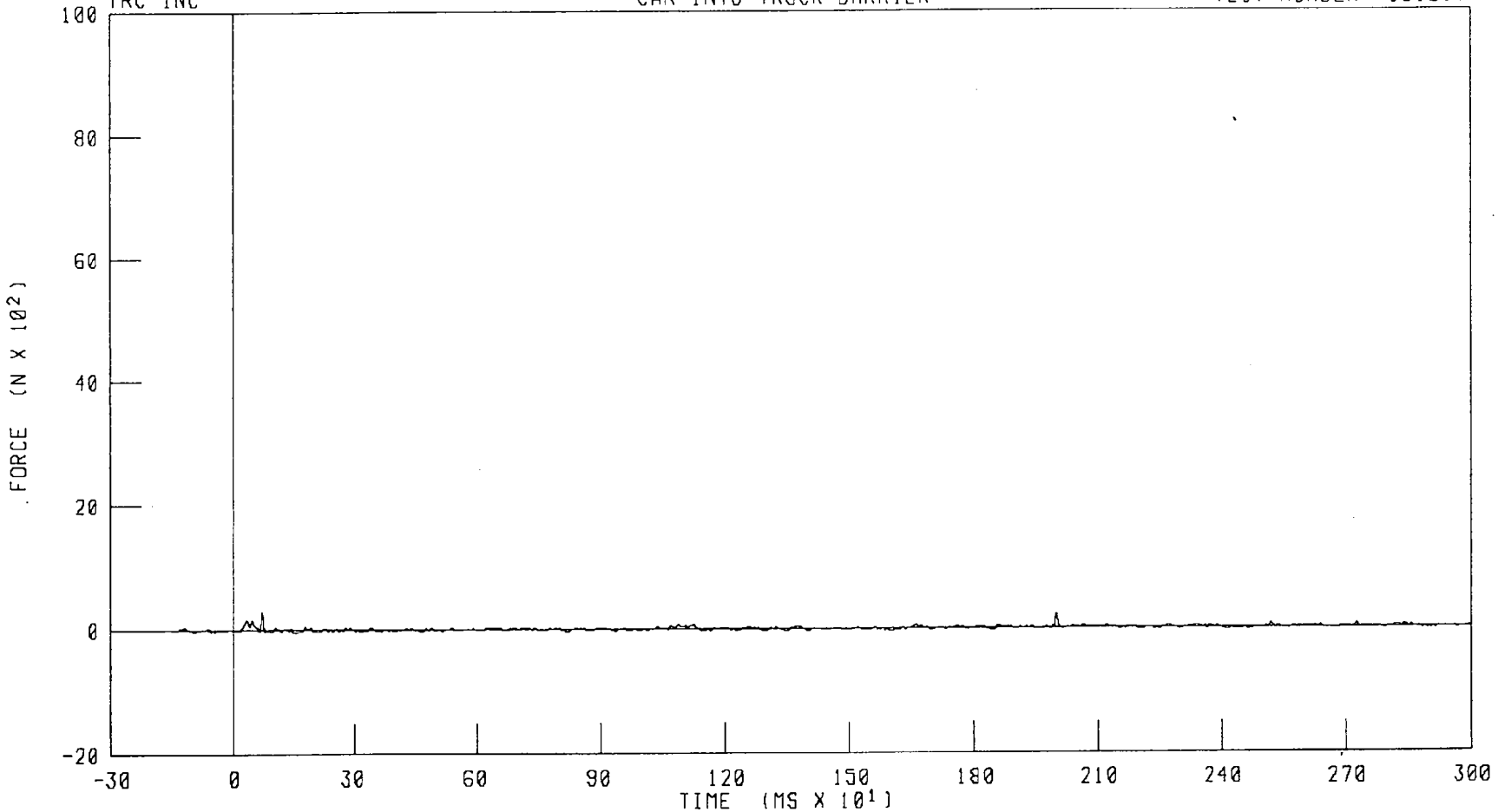

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18
CAR CENTER OF GRAVITY RESULTANT ACCELERATION
CAR INTO TRUCK BARRIER
TRC INC
TEST NUMBER 931217
See DATA ACQUISITION EXPLANATIONS
ACCELERATION (G)
240
200
160
120
80
40
0
-30
0
30
60
90
120
150
180
210
240
270
300
TIME (MS X 10¹)
CHANNEL VCGRG1 FILTER CH CLASS 60
PEAK DATA 308 63 G @ 31 40 MS, 0 02 G @ -87 20 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18

DRIVER LAP BELT OUTBOARD FORCE

CAR INTO TRUCK BARRIER

TRC INC TEST NUMBER 931217

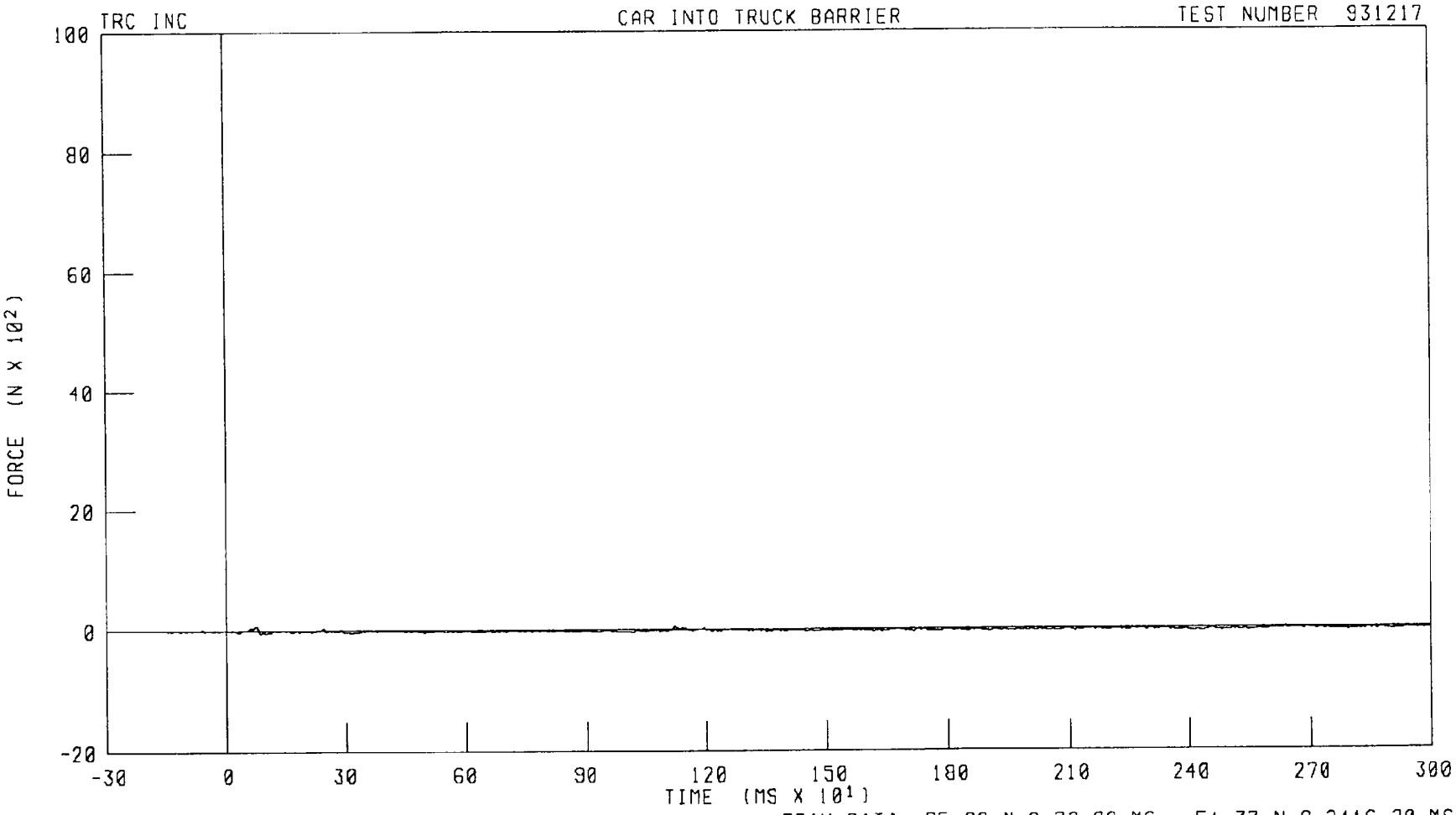


CHANNEL LBOF1 FILTER CH CLASS 60 PEAK DATA 300 95 N @ 71 20 MS, -42 23 N @ 152 90 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 18

DRIVER SHOULDER BELT FORCE

CAR INTO TRUCK BARRIER



CHANNEL SHBF1 FILTER CH CLASS 60

PEAK DATA 75 02 N @ 72 90 MS, -51 37 N @ 2416 20 MS

APPENDIX C

DUMMY CERTIFICATION INFORMATION

TRANSPORTATION RESEARCH CENTER INC.
HYBRID III EXTERNAL DIMENSIONS
048 HUMANOID

TRC INC. TEST NO: 48C10ED1 572E SN048 EXT.DIMENSION CAL10 14-DEC-93

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	986. MM
WAIST CIRCUMFERENCE	(Z)	836 - 866 MM	851. MM
CHEST DEPTH	(O)	213 - 229 MM	218. 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	155. 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	432. MM
KNEE PIVOT HEIGHT	(M)	485 - 500 MM	493. MM
FOOT LENGTH	(P)	252 - 267 MM	259. MM
FOOT BREADTH	(W)	91 - 107 MM	99. MM
SHOULDER PIVOT FROM BACKLINE	(E)	84 - 94 MM	91. MM
SHOULDER BREADTH	(V)	422 - 437 MM	427. MM
SHOULDER PIVOT HEIGHT	(B)	506 - 521 MM	511. MM
ELBOW REST HEIGHT	(J)	191 - 211 MM	201. MM
SHOULDER-ELBOW LENGTH	(I)	330 - 345 MM	343. MM
BACK OF ELBOW TO WRIST PIVOT	(G)	290 - 305 MM	295. MM

DUMMY MEETS SPECIFICATIONS
TECHNICIAN Pete Foust

RUN NUMBER: 121493.0900

TRANSPORTATION RESEARCH CENTER INC.

HEAD DROP TEST

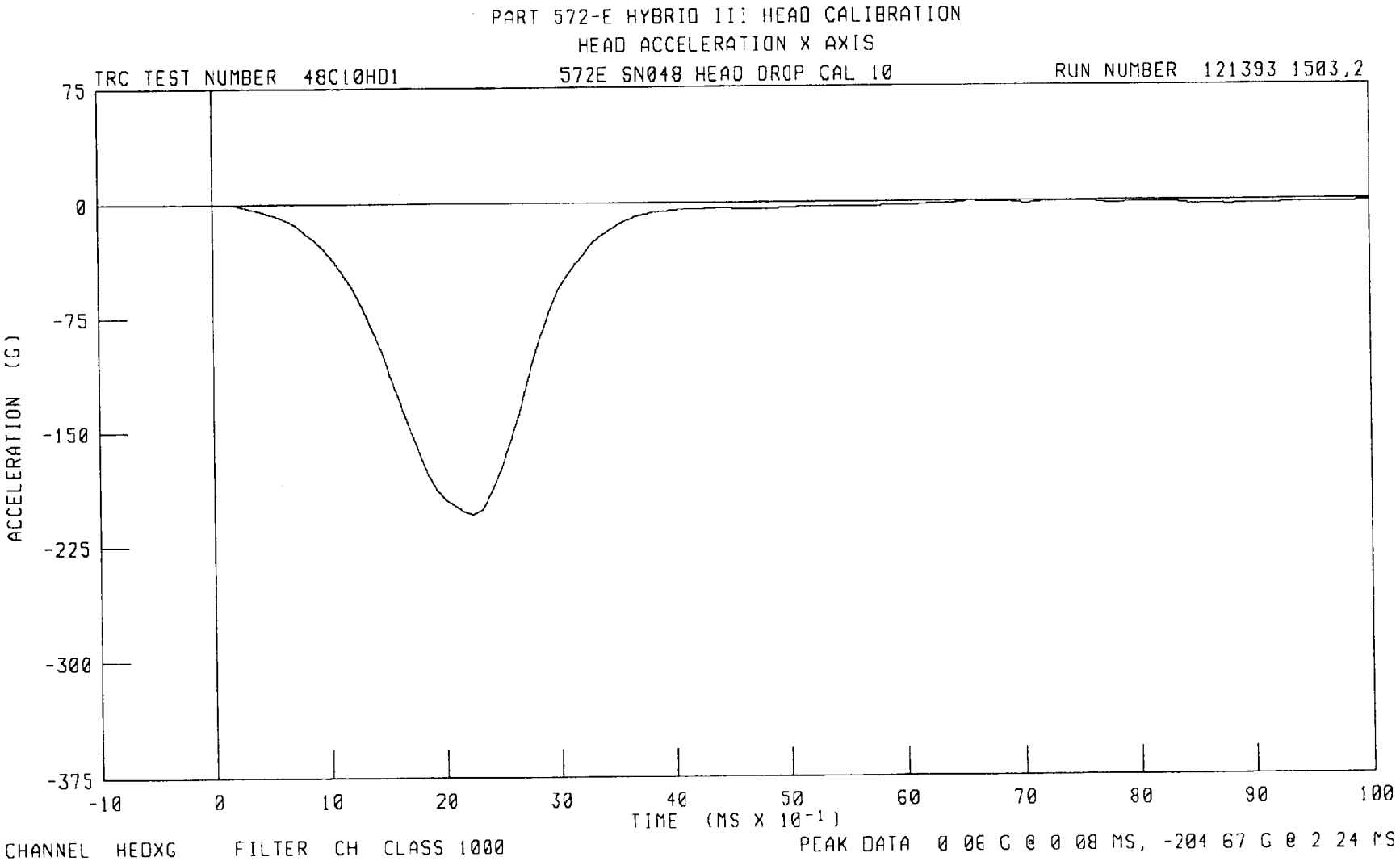
HYBRID III 13-DEC-93

TRC INC. TEST NO: 48C10HD1 572E SN048 HEAD DROP CAL 10

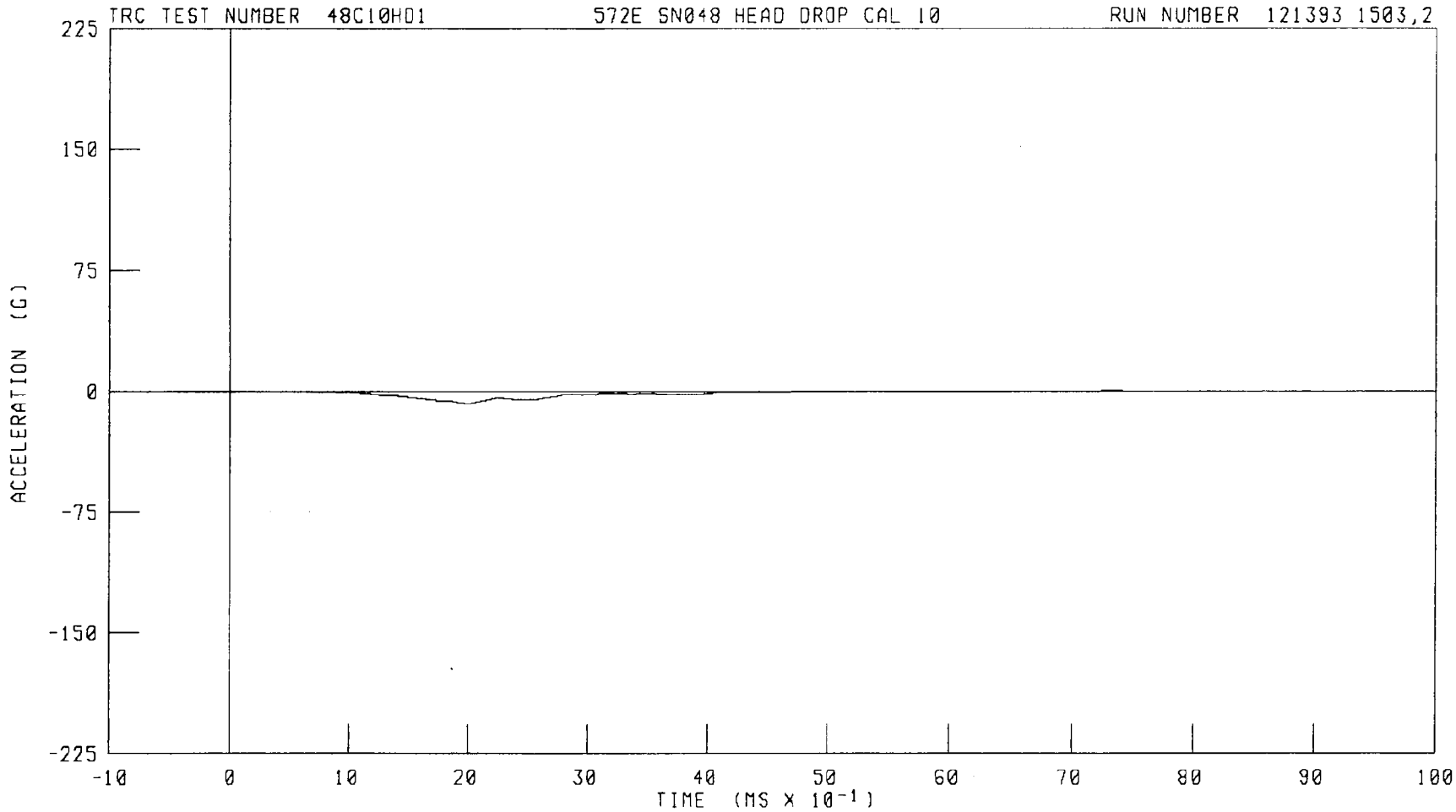
TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10 - 70 %	55.0 %
PEAK RESULTANT ACCELERATION	225 - 275 G	233.22 G
PEAK LATERAL ACCELERATION	15 G MAX	-7.30 G
IS ACCELERATION CURVE UNIMODAL?	YES	YES

TEST MEETS SPECIFICATIONS

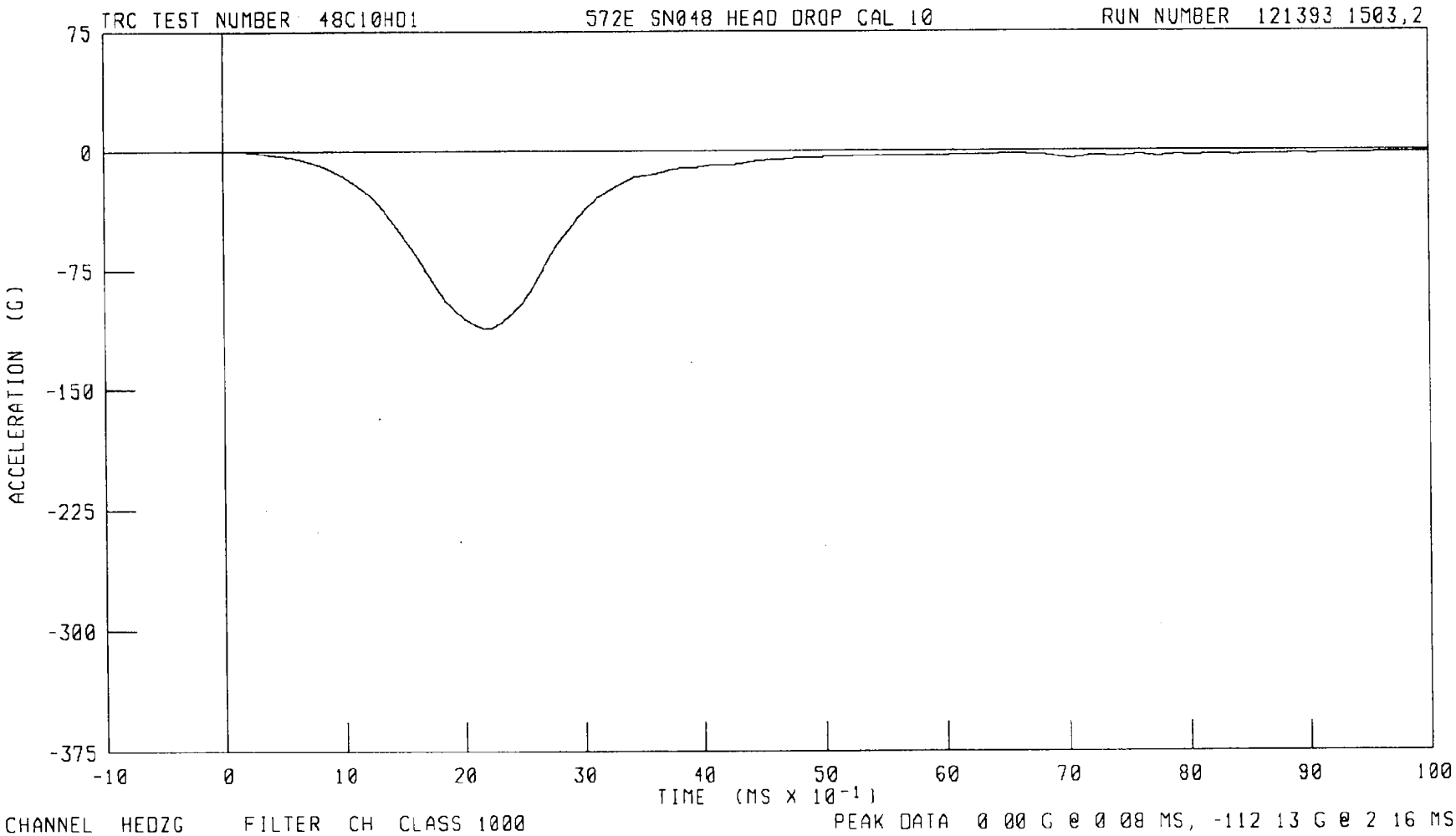
TECHNICIAN Pete Foss RUN NUMBER: 121393.1503;2


PART 572-E HYBRID III HEAD CALIBRATION
HEAD ACCELERATION X AXIS
TRC TEST NUMBER 48C10HD1
572E SN048 HEAD DROP CAL 10
RUN NUMBER 121393 1503,2
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 0E G @ 0 08 MS, -204 67 G @ 2 24 MS

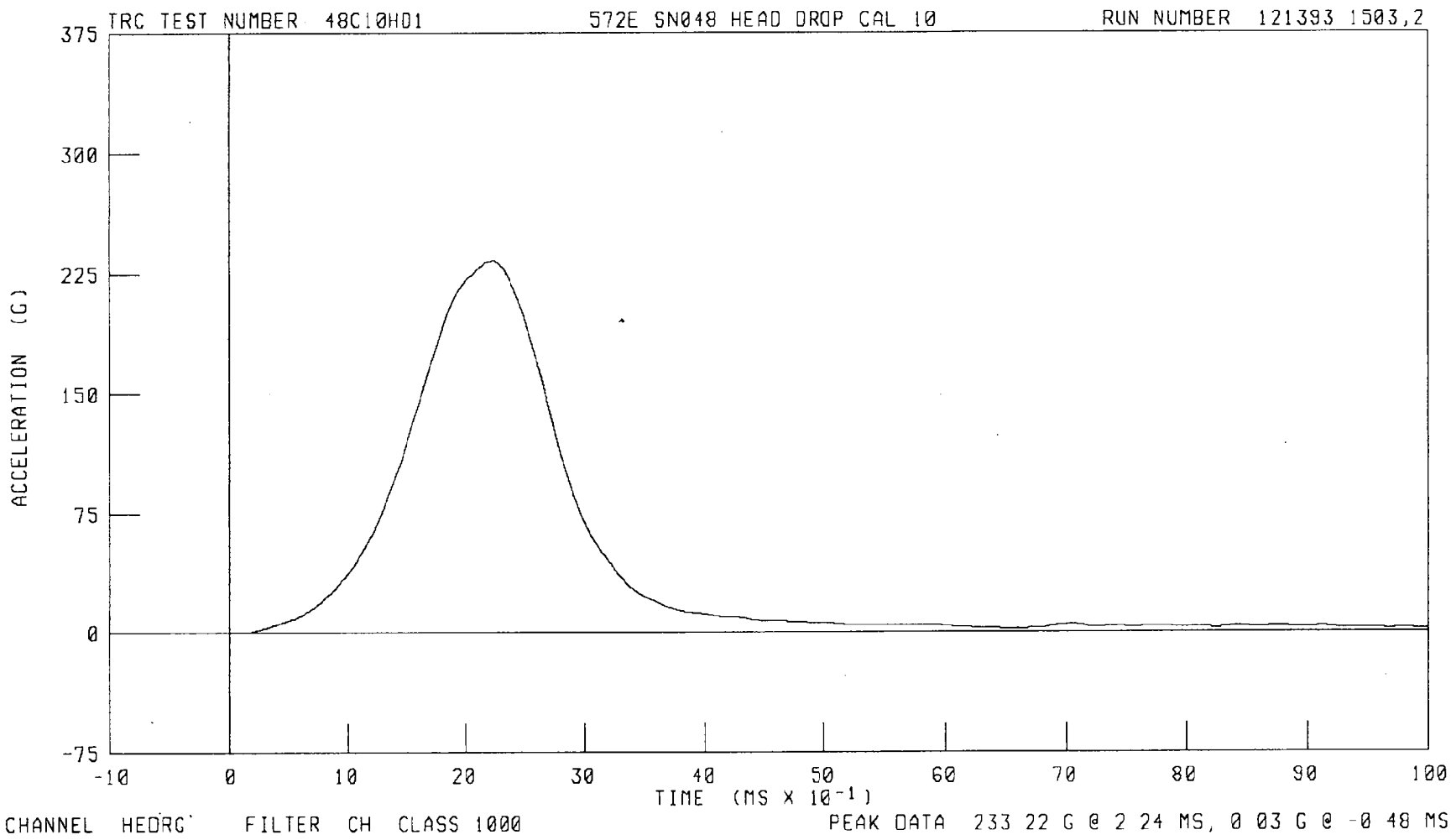
PART 572-E HYBRID III HEAD CALIBRATION
HEAD ACCELERATION Y AXIS



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



PART 572-E HYBRID III HEAD CALIBRATION
HEAD RESULTANT ACCELERATION



TRANSPORTATION RESEARCH CENTER INC.

NECK FLEXION TEST

HYBRID III 14-DEC-93

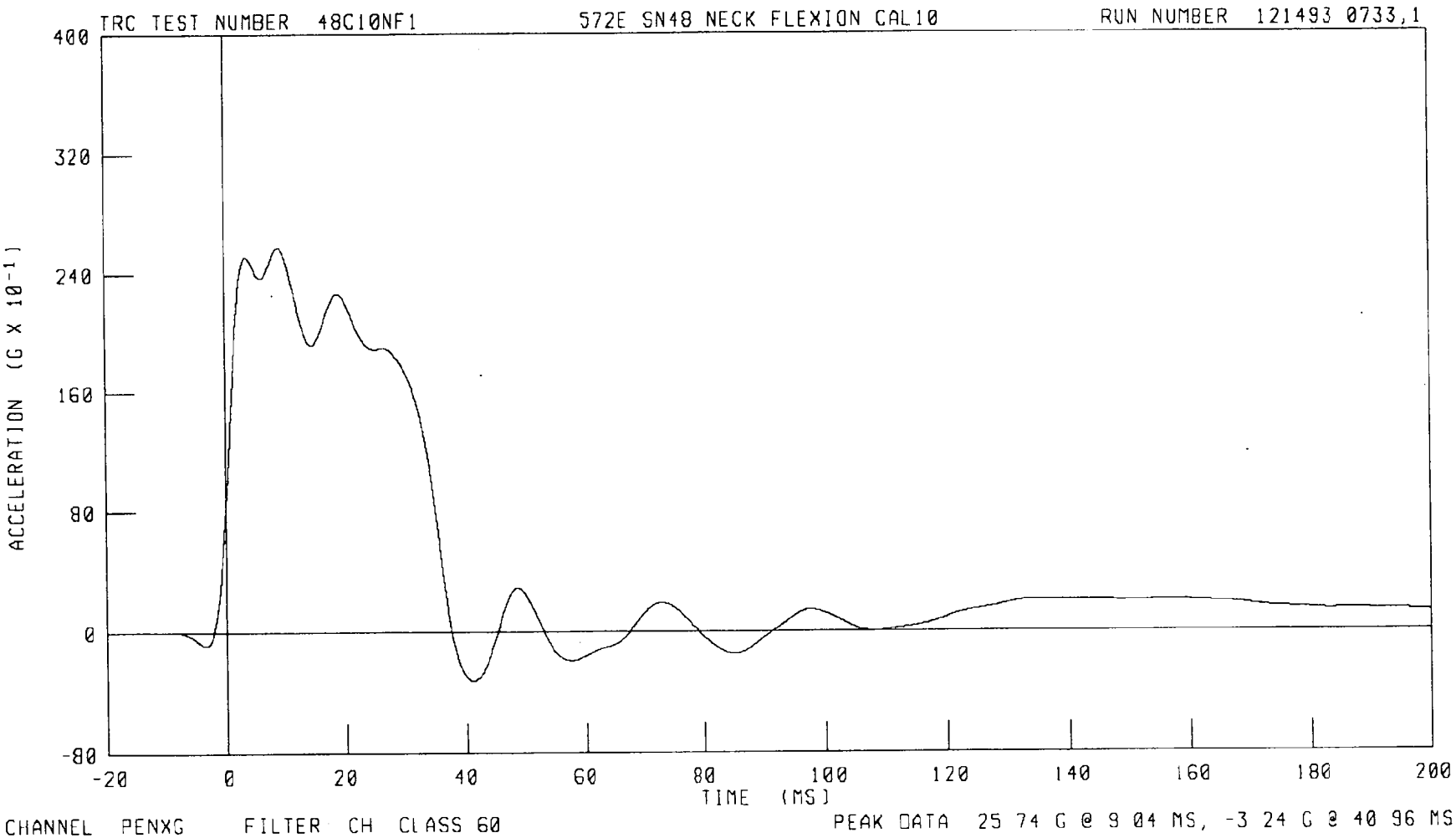
6 AXIS NECK TRANSDUCER
TRC INC. TEST NO: 48C10NF1 572E SN48 NECK FLEXION CAL10

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/S	7.01 M/S
PENDULUM DECELERATION	10 MS	22.50 - 27.50 G	25.25 G
	20 MS	17.60 - 22.60 G	22.09 G
	30 MS	12.50 - 18.50 G	17.35 G
MAX PENDULUM G		29 G MAX	25.73 G
MAX PENDULUM G ABOVE 30 MS		29 G MAX	17.29 G
DECELERATION-TIME CURVE DECAY TIME TO 5 G		34 - 42 MS	35.76 MS
D PLANE ROTATION	MAX	64 - 78 DEG.	73.83 DEG.
	TIME	57 - 64 MS	60.00 MS
MOMENT ABOUT OCCIPITAL CONDYLE	MAX	88.2 - 108.5 NM	92.75 NM
	TIME	47 - 58 MS	49.12 MS
ROTATION ANGLE-TIME CURVE DECAY TIME TO ZERO		113 - 128 MS	117.84 MS
POSITIVE MOMENT-TIME CURVE DECAY TIME TO ZERO		97 - 107 MS	97.84 MS

TEST MEETS SPECIFICATIONS

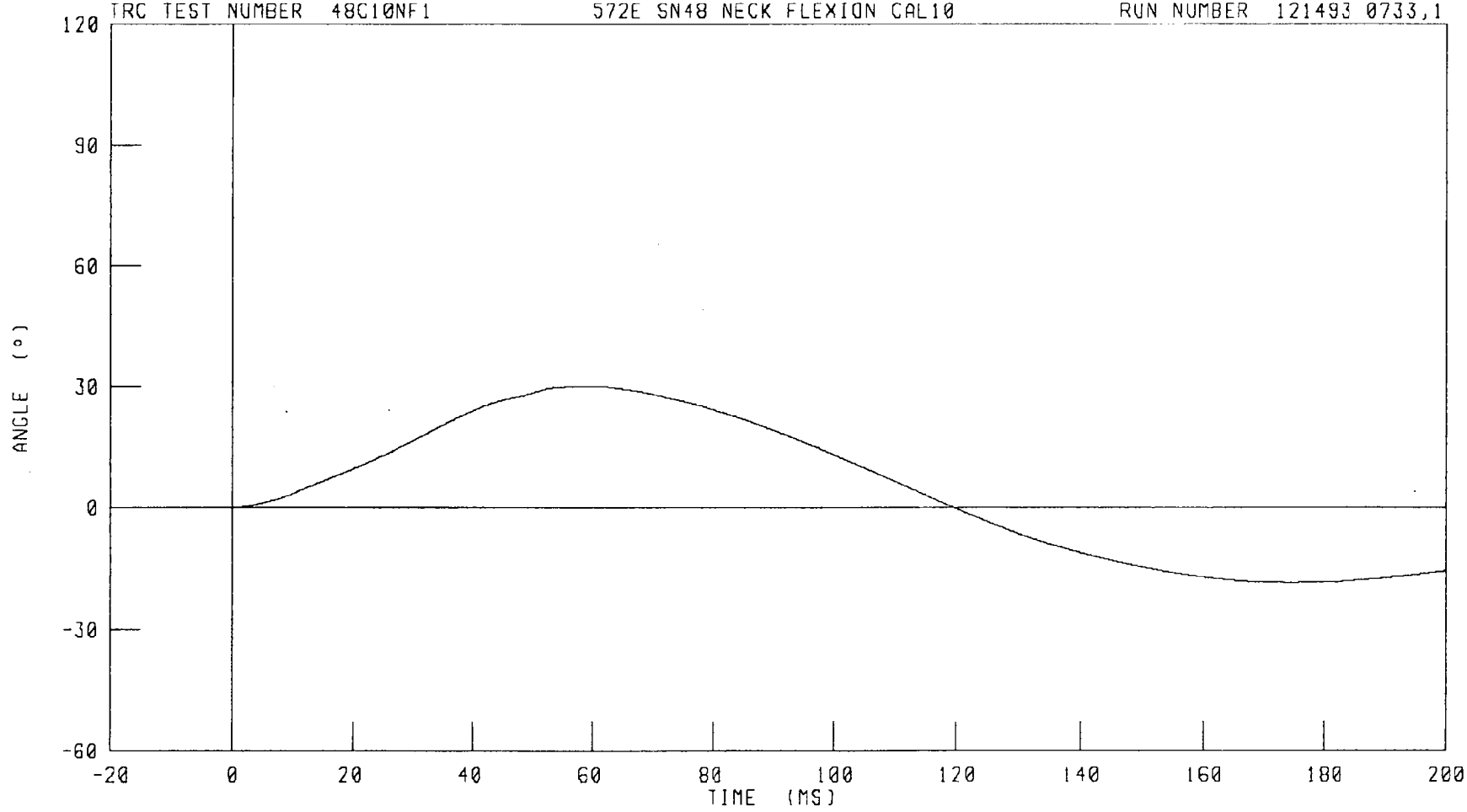
TECHNICIAN Pete Faust RUN NUMBER: 121493.0732;1

PART 572-E HYBRID III NECK FLEXION CALIBRATION
PENDULUM DECELERATION



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

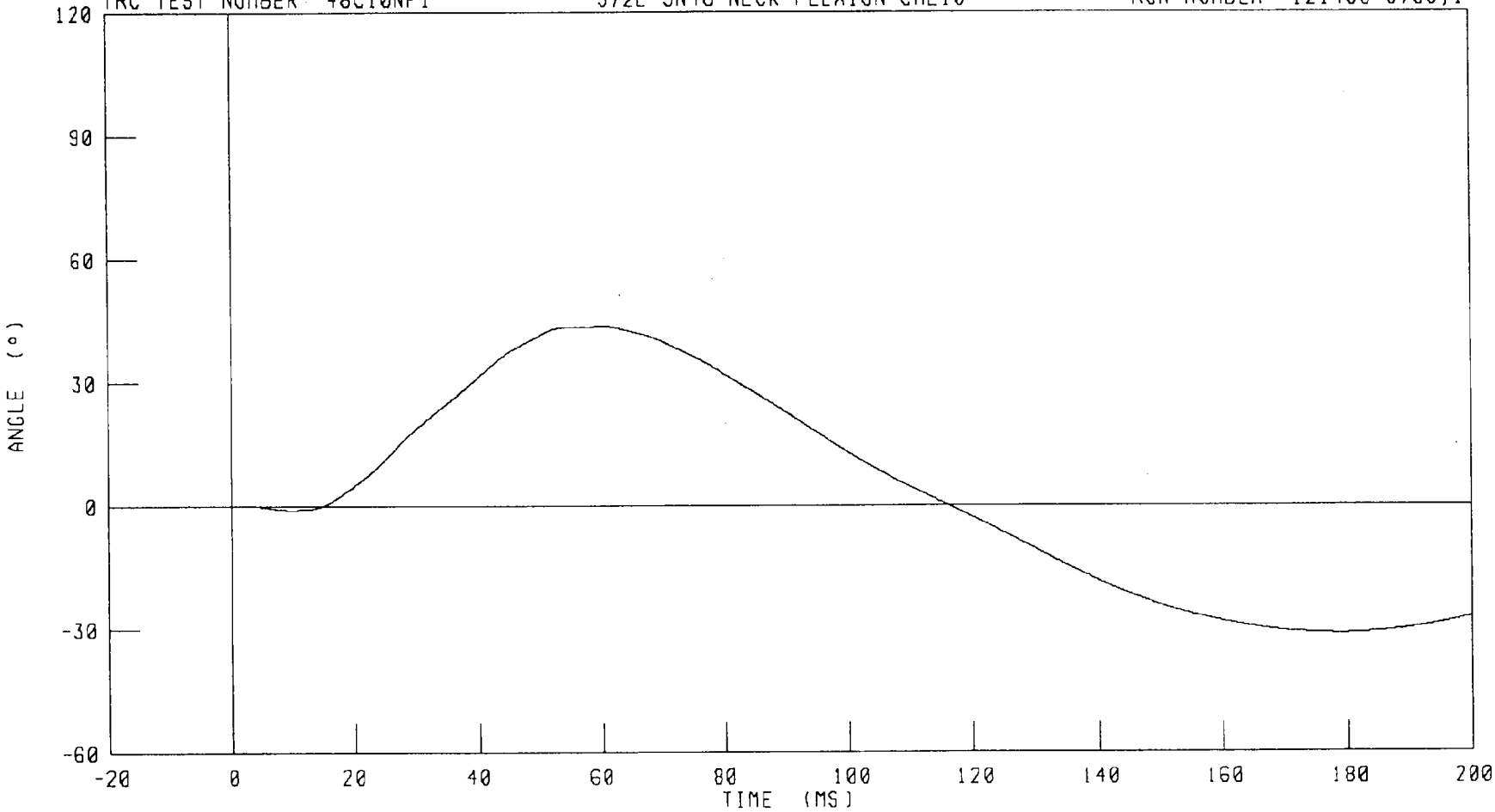
TRC TEST NUMBER 48C10NF1 572E SN48 NECK FLEXION CAL10 RUN NUMBER 121493 0733,1



CHANNEL BETA FILTER CH CLASS 60 PEAK DATA 30 12 ° @ 59 60 MS, -18 39 ° @ 174 56 MS

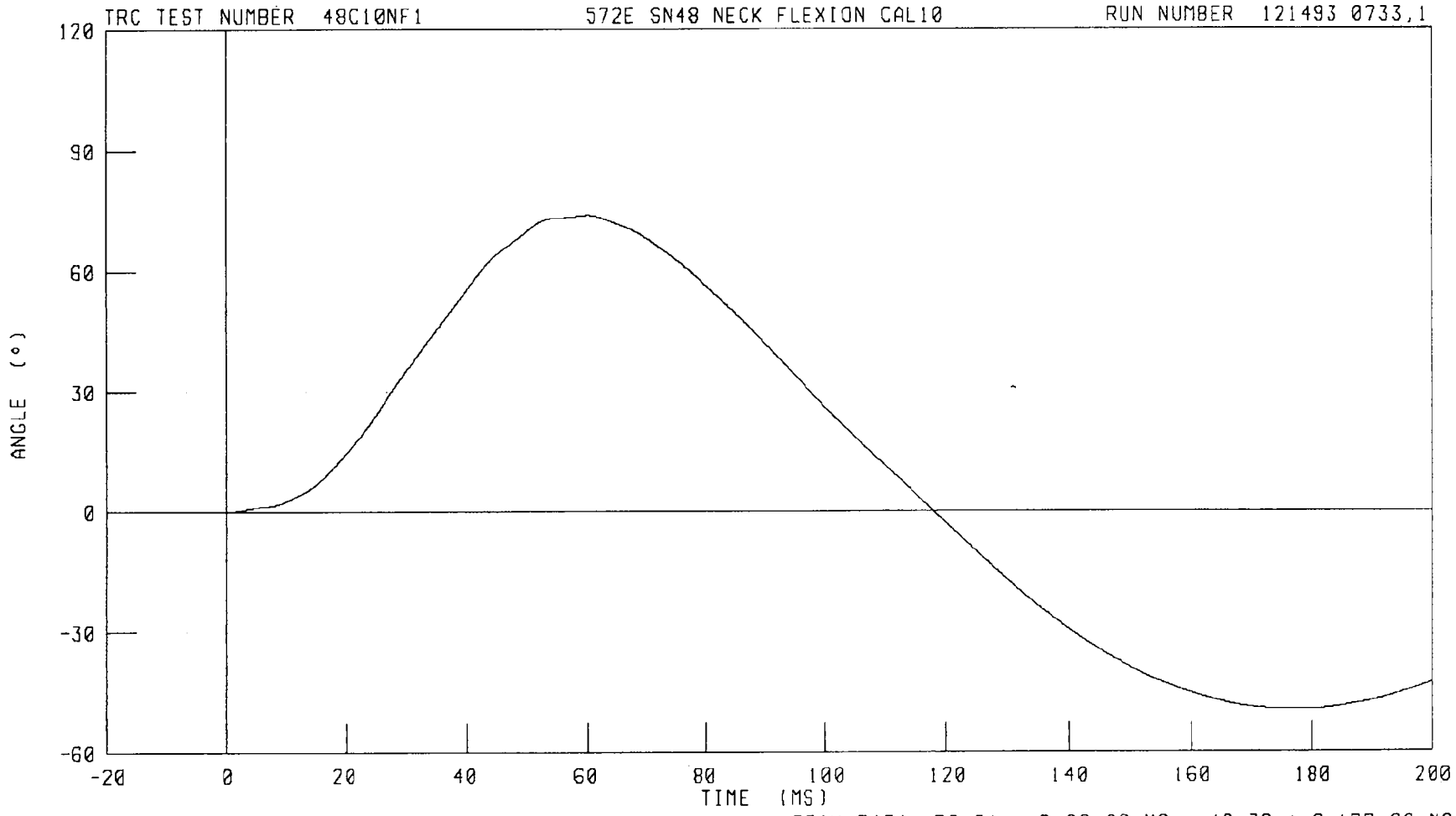
PART 572-E HYBRID III NECK FLEXION CALIBRATION
ROTATION ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER 48C10NF1 572E SN48 NECK FLEXION CAL10 RUN NUMBER 121493 0733,1



CHANNEL THETA FILTER CH CLASS 60 PEAK DATA 43 72 ° @ 60 08 MS, -31 10 ° @ 178 80 MS

PART 572-E HYBRID III NECK FLEXION CALIBRATION
TOTAL ROTATION



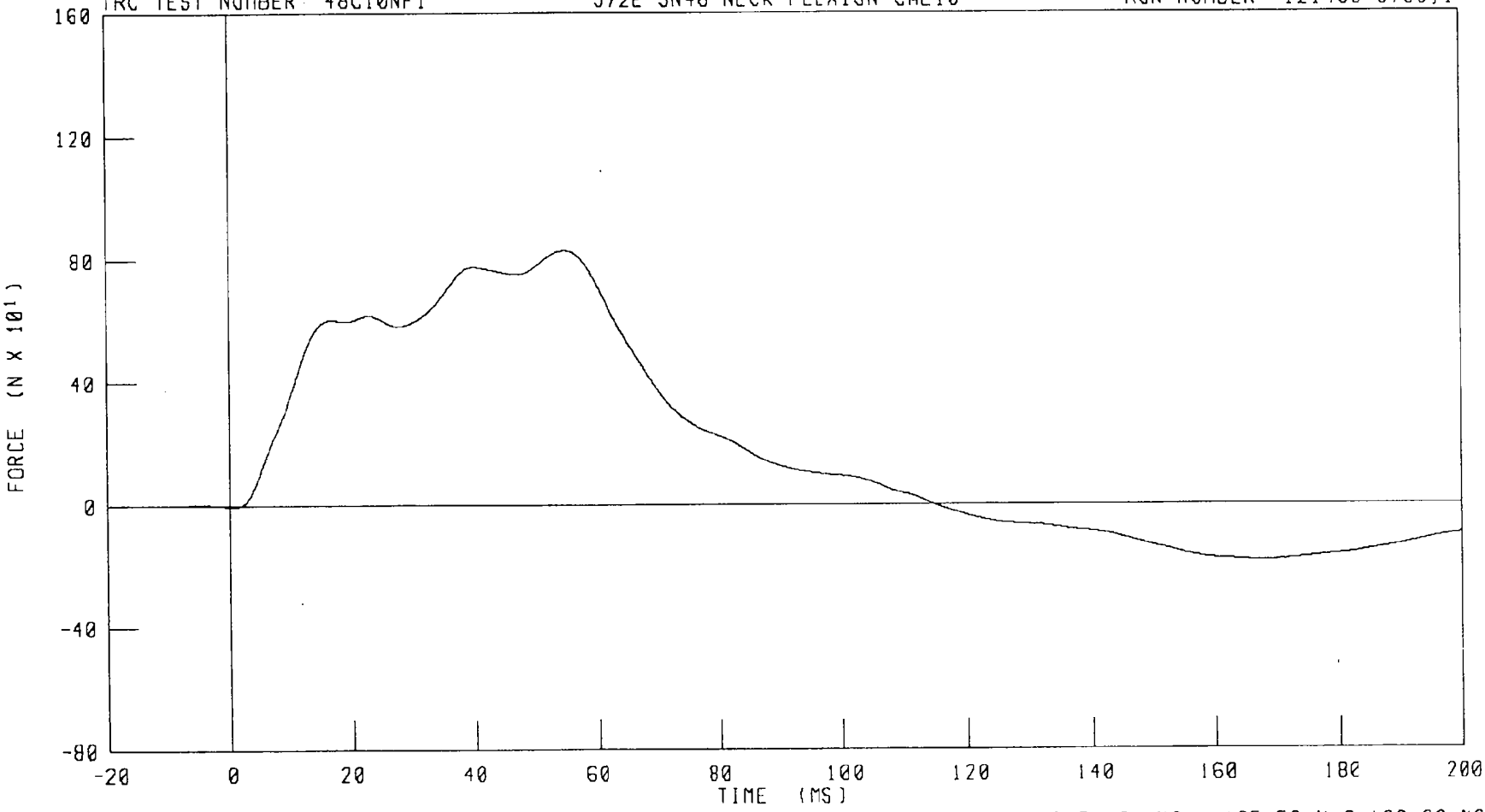
CHANNEL TOTAN FILTER CH CLASS 60

PEAK DATA 73 84 ° @ 60 00 MS, -49 36 ° @ 177 60 MS

PART 572-E HYBRID III NECK FLEXION CALIBRATION

NECK FORCE X AXIS

TRC TEST NUMBER 48C10NF1 572E SN48 NECK FLEXION CAL10 RUN NUMBER 121493 0733,1



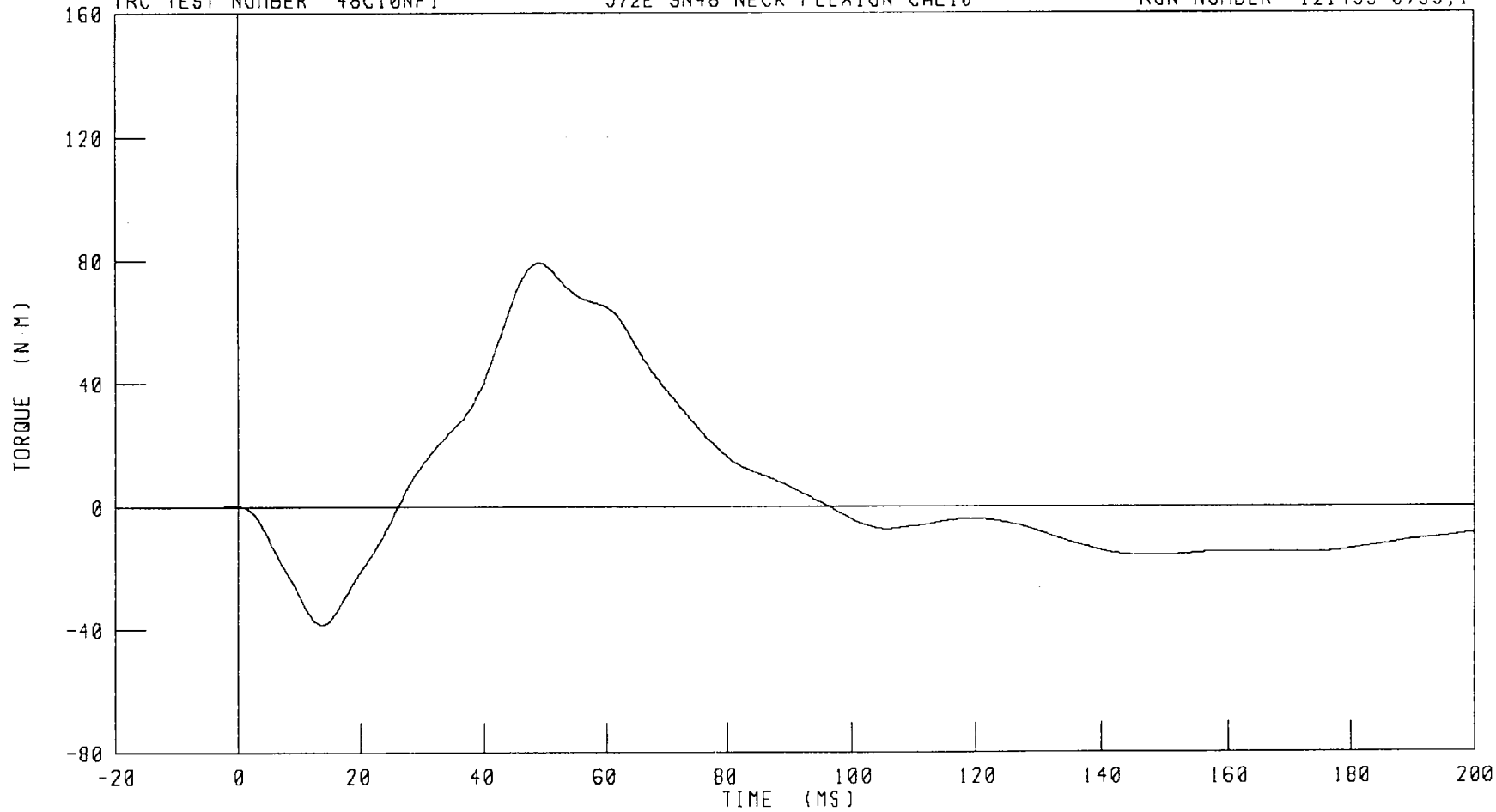
CHANNEL NEKXF FILTER CH CLASS 60

PEAK DATA 829 21 N @ 54 64 MS, -185 52 N @ 168 00 MS

PART 572-E HYBRID III NECK FLEXION CALIBRATION

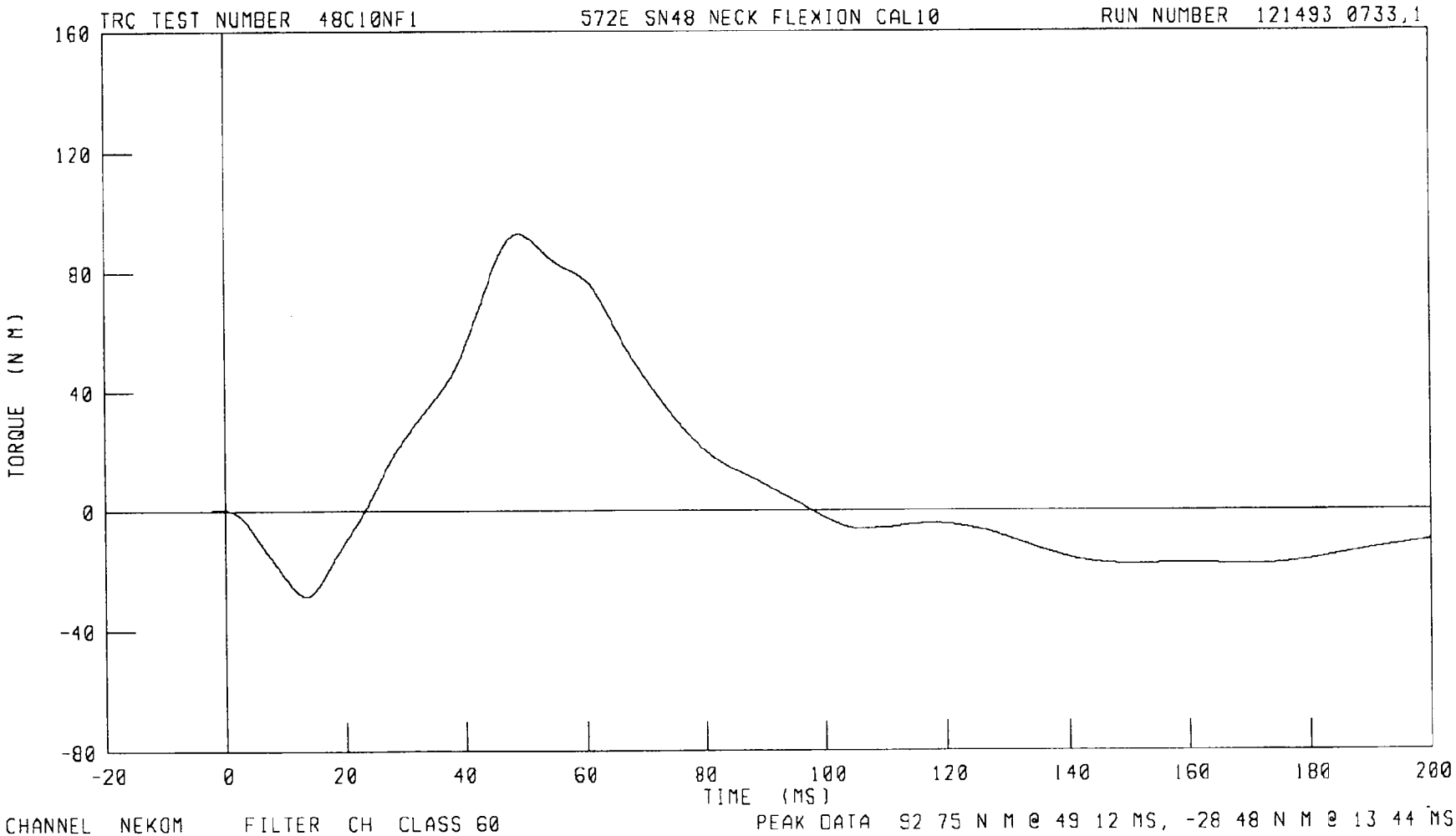
NECK MOMENT Y AXIS

TRC TEST NUMBER 48C10NF1 572E SN48 NECK FLEXION CAL10 RUN NUMBER 121493 0733,1



CHANNEL NEKYM FILTER CH CLASS 60 PEAK DATA 79 20 N M @ 48 96 MS, -38 32 N M @ 13 84 MS

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



TRANSPORTATION RESEARCH CENTER INC.

NECK EXTENSION TEST

HYBRID III 14-DEC-93

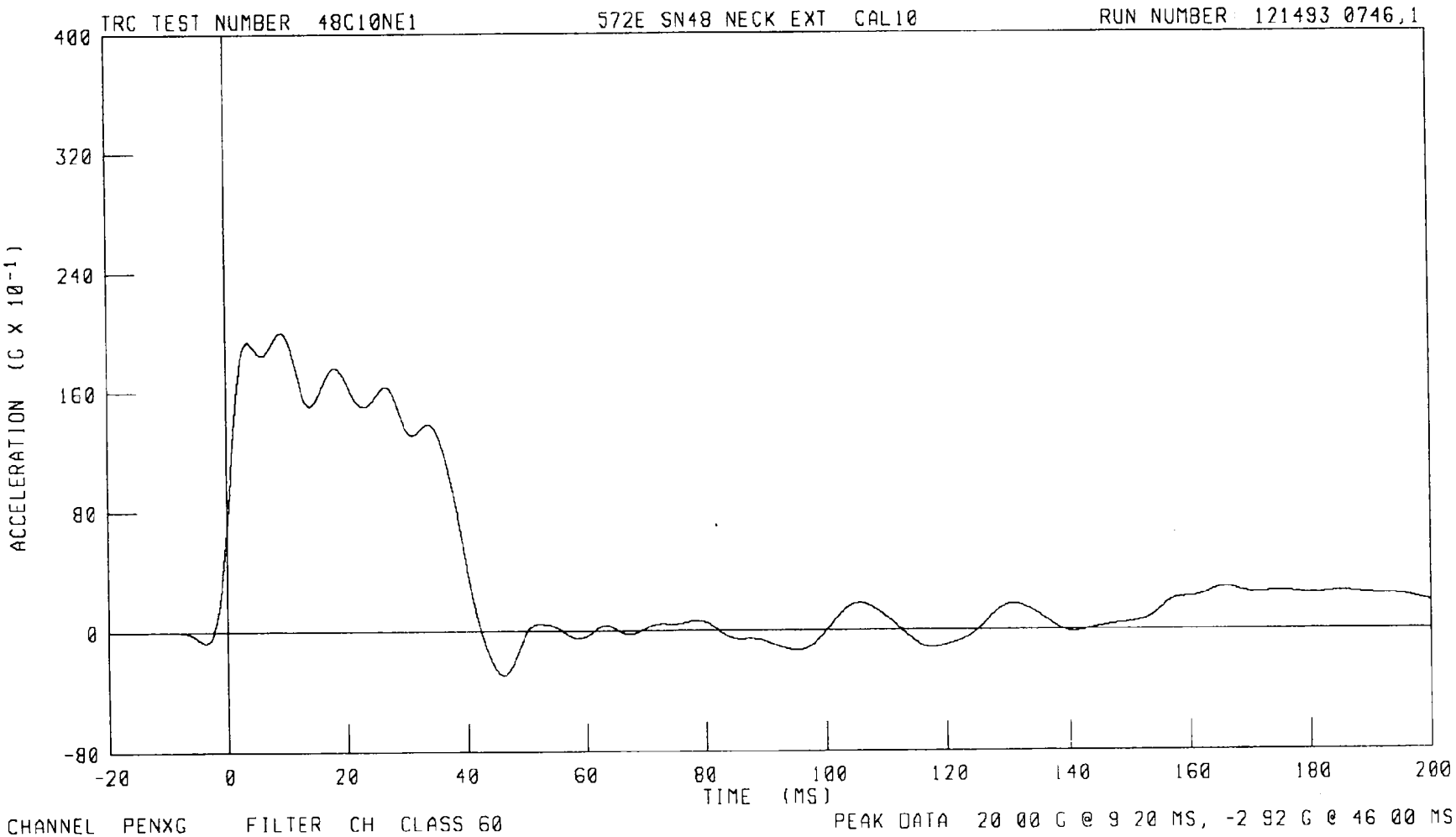
6 AXIS NECK TRANSDUCER
TRC INC. TEST NO: 48C10NE1 572E SN48 NECK EXT. CAL10

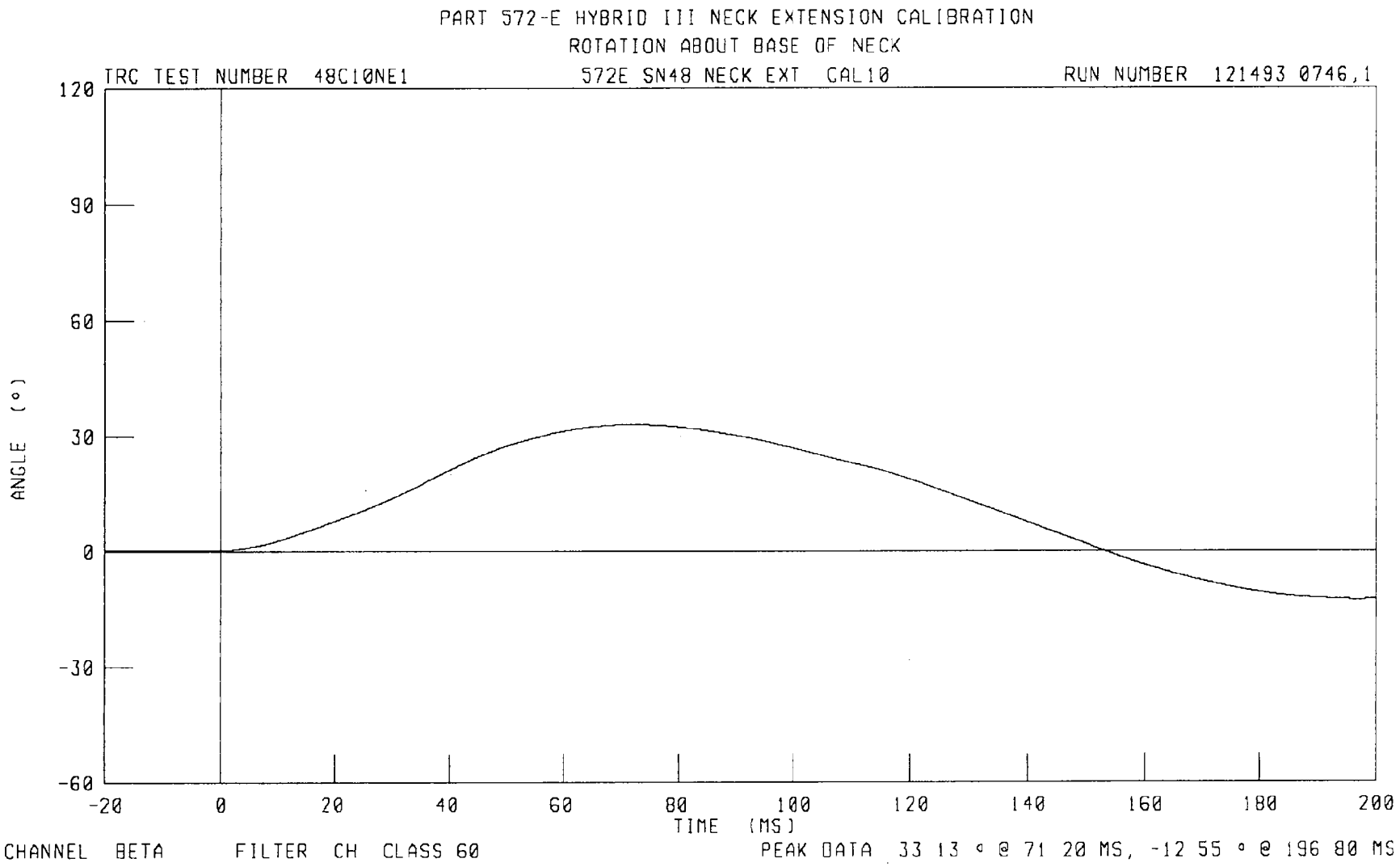
TEST PARAMETER		SPECIFICATION	TEST RESULTS
TEMPERATURE		20.6-22.2 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY		10 - 70 %	55.0 %
IMPACT VELOCITY		5.95 - 6.19 M/S	6.02 M/S
PENDULUM DECELERATION	10 MS	17.20 - 21.20 G	19.70 G
	20 MS	14.00 - 19.00 G	16.67 G
	30 MS	11.00 - 16.00 G	13.47 G
MAX PENDULUM G		22 G MAX	19.99 G
MAX PENDULUM G ABOVE 30 MS		22 G MAX	13.86 G
DECELERATION-TIME CURVE DECAY TIME TO 5 G		38 - 46 MS	39.60 MS
D PLANE ROTATION	MAX	81 - 106 DEG.	94.21 DEG.
	TIME	72 - 82 MS	72.08 MS
MOMENT ABOUT OCCIPITAL CONDYLE	MIN	-80.0/-52.9 NM	-72.17 NM
	TIME	65 - 79 MS	68.32 MS
ROTATION ANGLE-TIME CURVE DECAY TIME TO ZERO		147 - 174 MS	152.08 MS
NEGATIVE MOMENT-TIME CURVE DECAY TIME TO ZERO		120 - 148 MS	137.20 MS

TEST MEETS SPECIFICATIONS

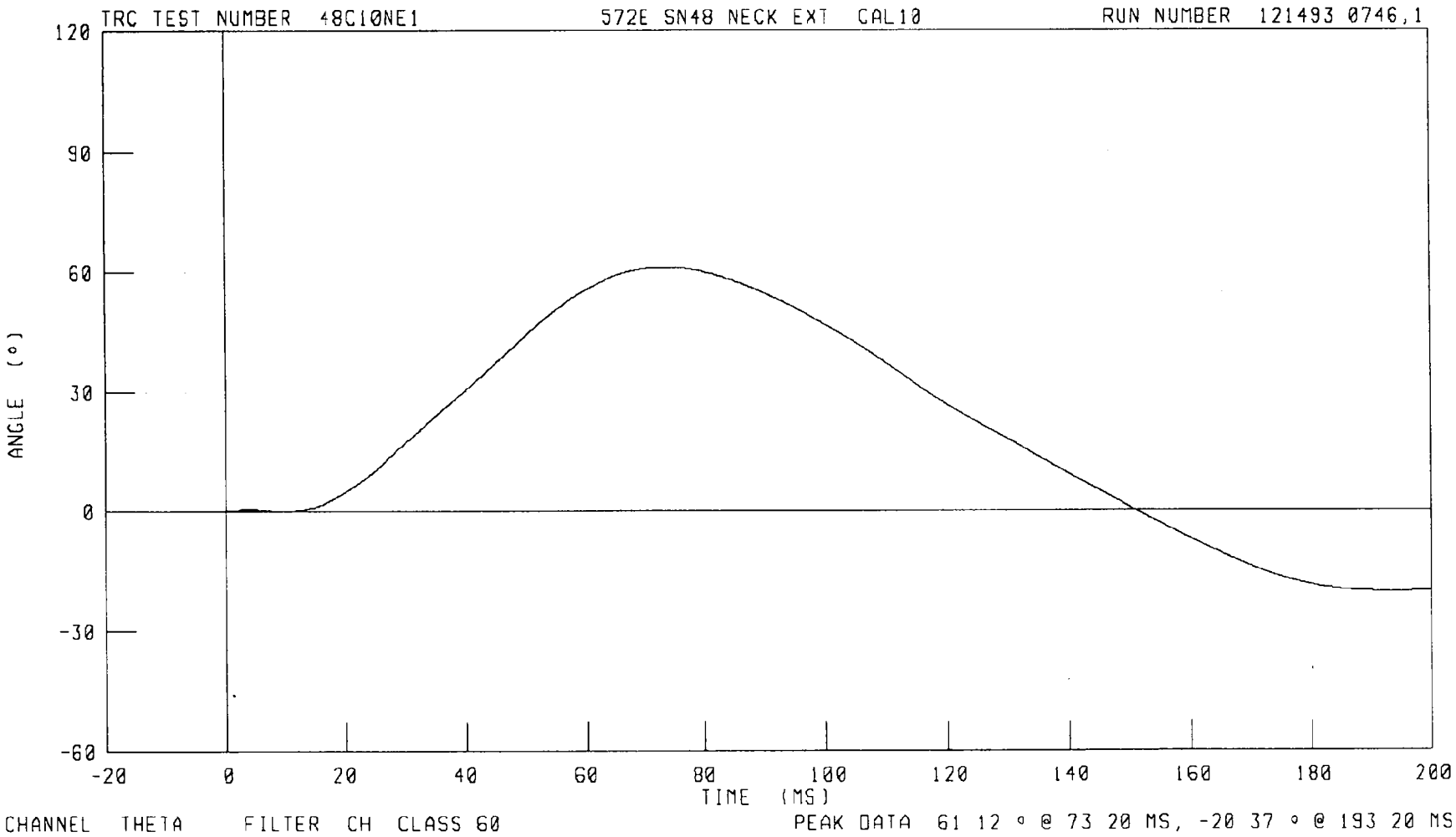
TECHNICIAN Pete Foust RUN NUMBER: 121493.0745;1

PART 572-E HYBRID III NECK EXTENSION CALIBRATION
PENDULUM DECELERATION



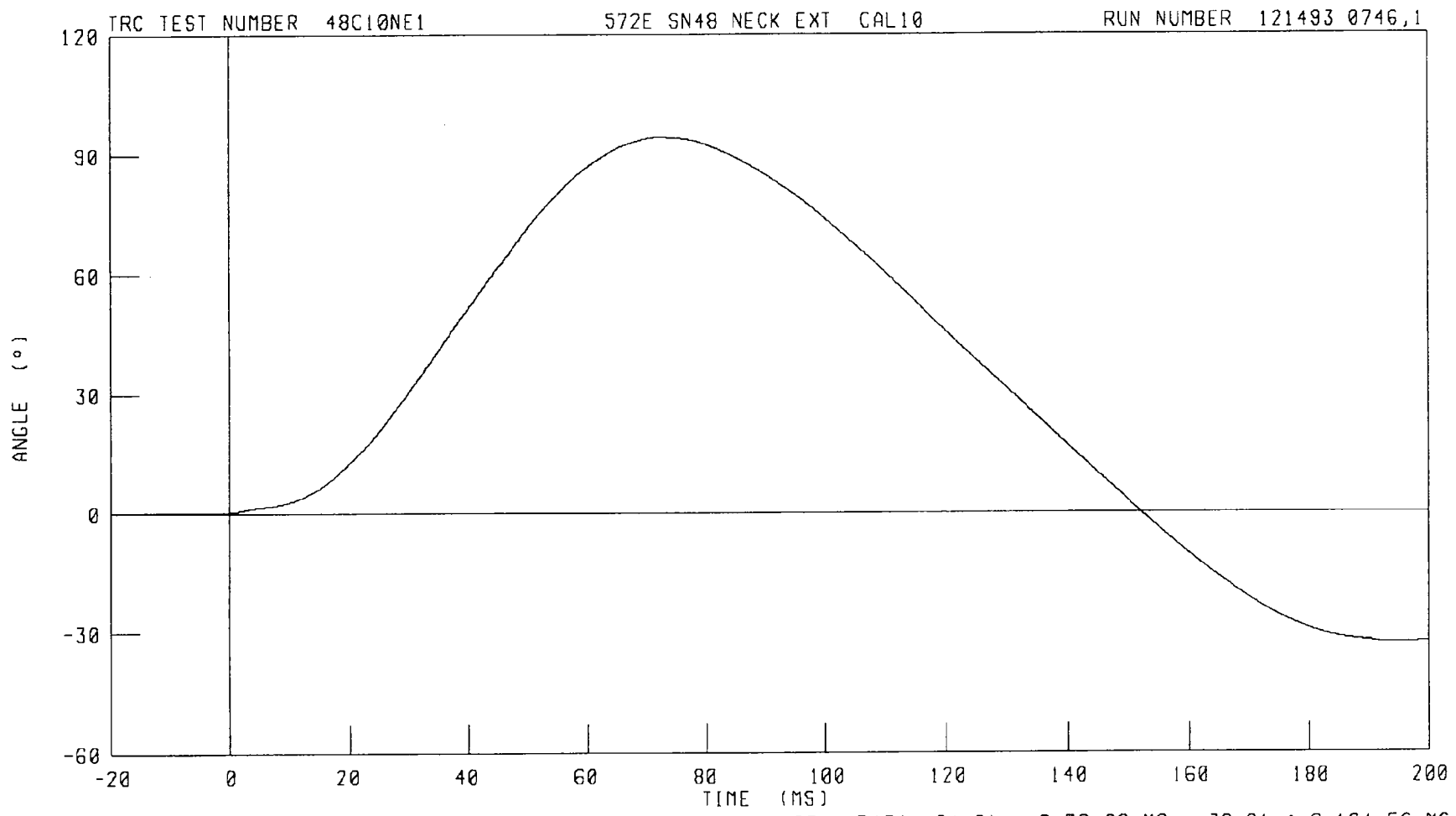

PART 572-E HYBRID III NECK EXTENSION CALIBRATION
ROTATION ABOUT BASE OF NECK
TRC TEST NUMBER 48C10NE1
572E SN48 NECK EXT CAL10
RUN NUMBER 121493 0746,1
120
90
60
30
0
-30
-60
ANGLE (°)
-20
0
20
40
60
80
100
120
140
160
180
200
TIME (MS)
CHANNEL BETA
FILTER CH CLASS 60
PEAK DATA 33 13 ° @ 71 20 MS, -12 55 ° @ 196 80 MS

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



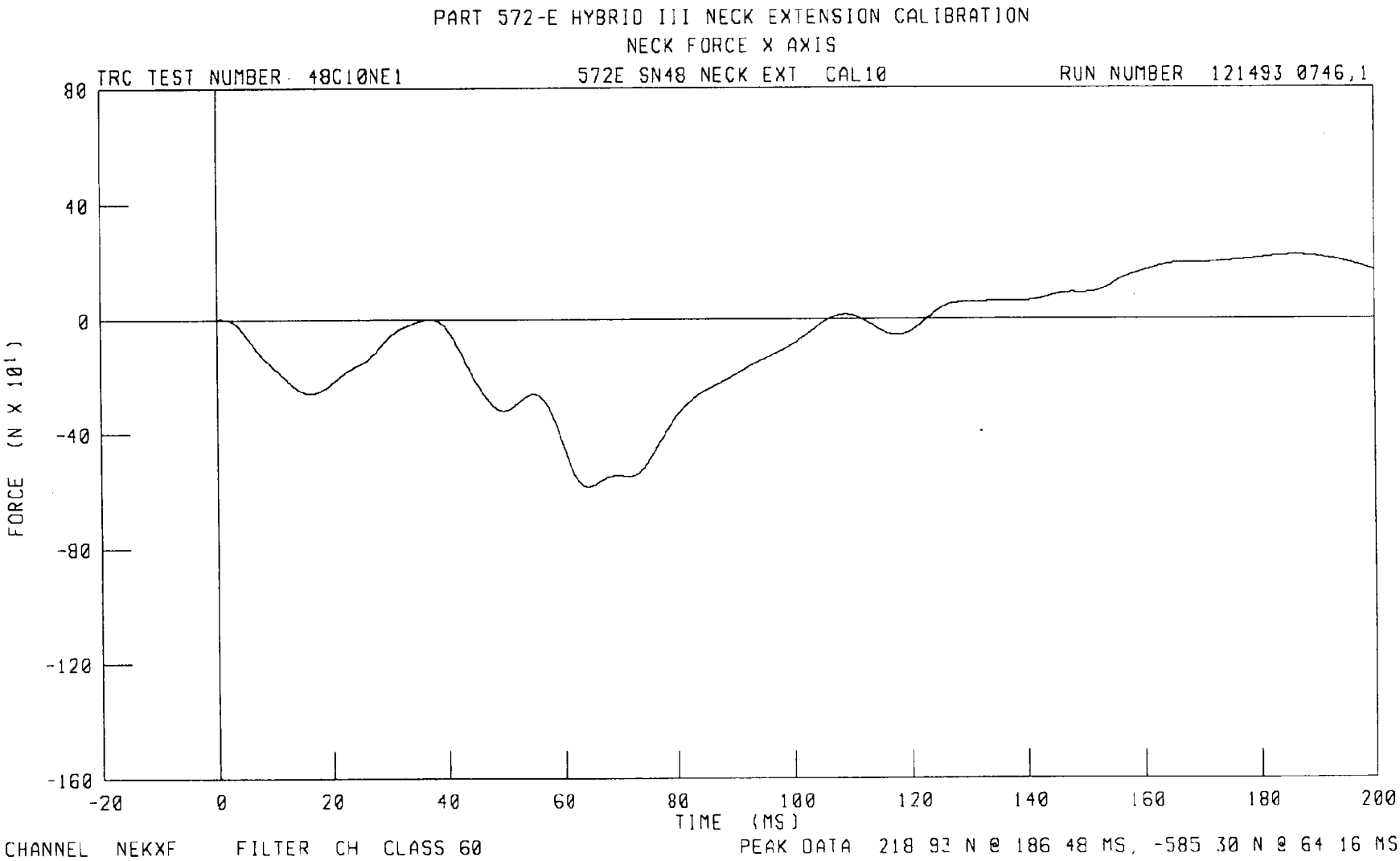
PART 572-E HYBRID III NECK EXTENSION CALIBRATION

TOTAL ROTATION

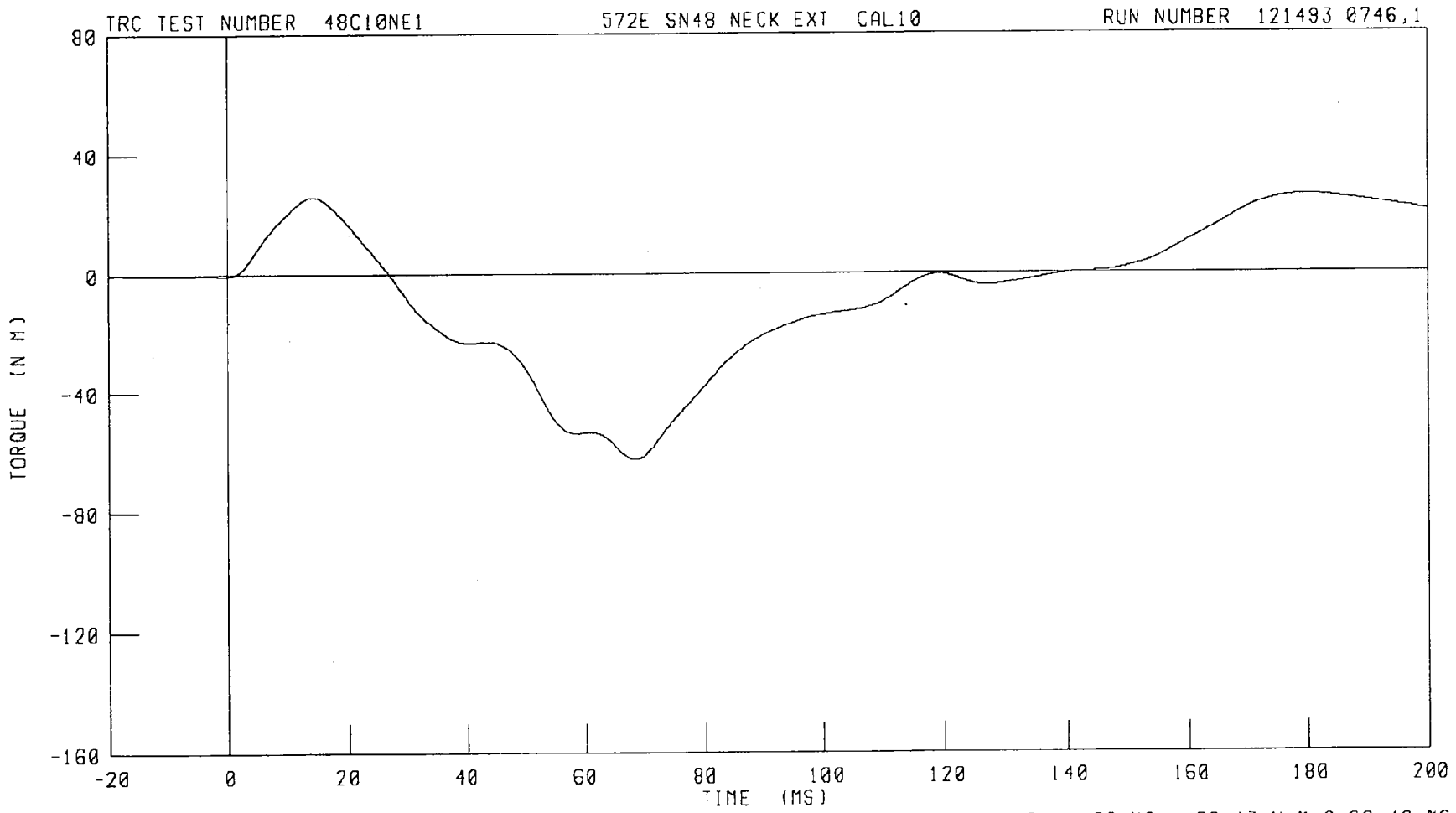


CHANNEL TOTAN FILTER CH CLASS 60

PEAK DATA 94 21 ° @ 72 08 MS, -32 81 ° @ 194 56 MS

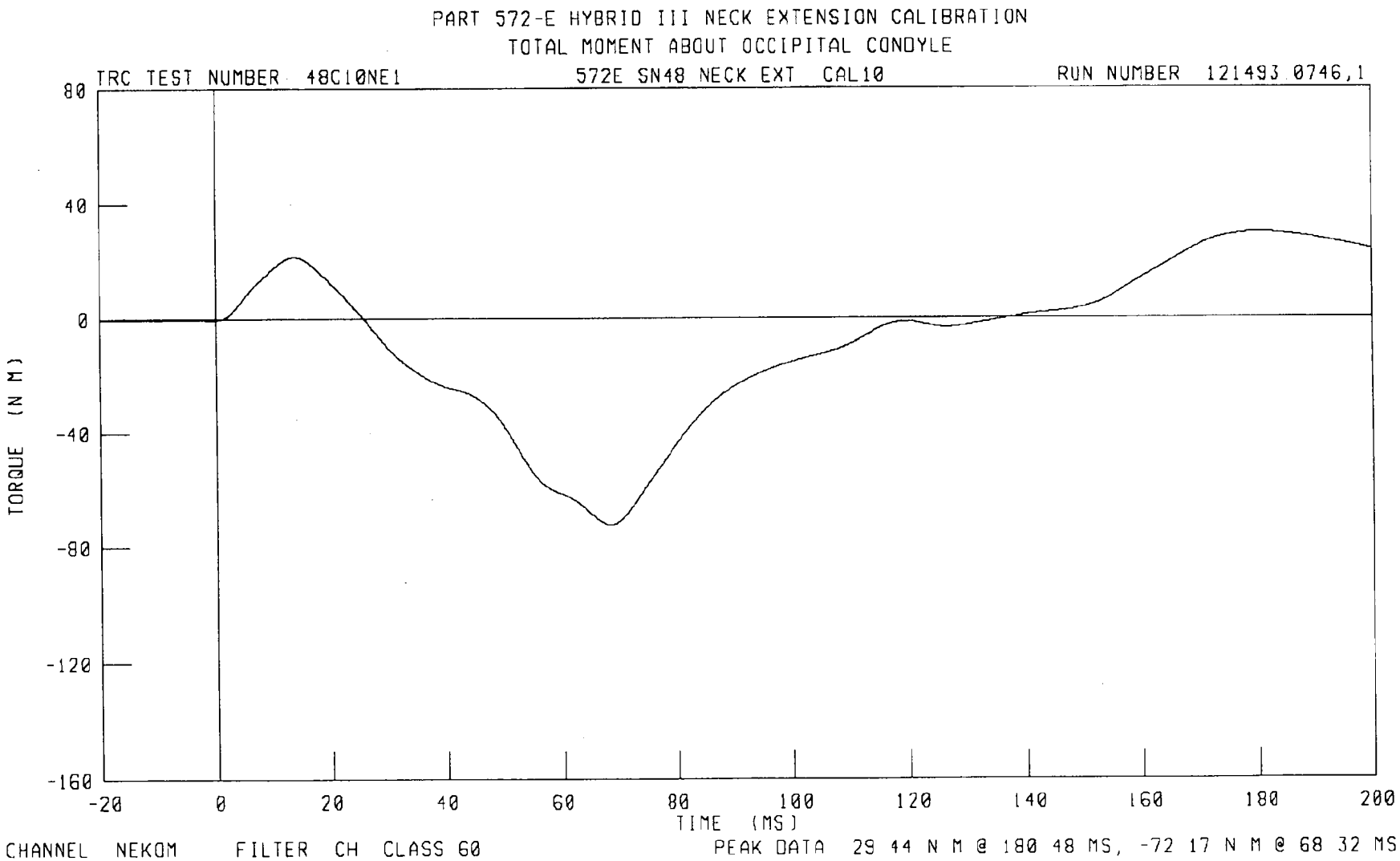

PART 572-E HYBRID III NECK EXTENSION CALIBRATION
NECK FORCE X AXIS
TRC TEST NUMBER 48C10NE1
572E SN48 NECK EXT CAL10
RUN NUMBER 121493 0746,1
80
40
0
-40
-80
-120
-160
FORCE (N X 10¹)
-20
0
20
40
60
80
100
120
140
160
180
200
TIME (MS)
CHANNEL NEKXF
FILTER CH CLASS 60
PEAK DATA 218 93 N @ 186 48 MS, -585 30 N @ 64 16 MS

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



CHANNEL NEKYM FILTER CH CLASS 60

PEAK DATA 25 87 N M @ 14 08 MS, -62 43 N M @ 68 40 MS


PART 572-E HYBRID III NECK EXTENSION CALIBRATION
TOTAL MOMENT ABOUT OCCIPITAL CONDYLE
TRC TEST NUMBER 48C10NE1
572E SN48 NECK EXT CAL10
RUN NUMBER 121493 0746,1
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 29 44 N M @ 180 48 MS, -72 17 N M @ 68 32 MS

TRANSPORTATION RESEARCH CENTER INC.

THORAX IMPACT TEST

HYBRID III 14-DEC-93

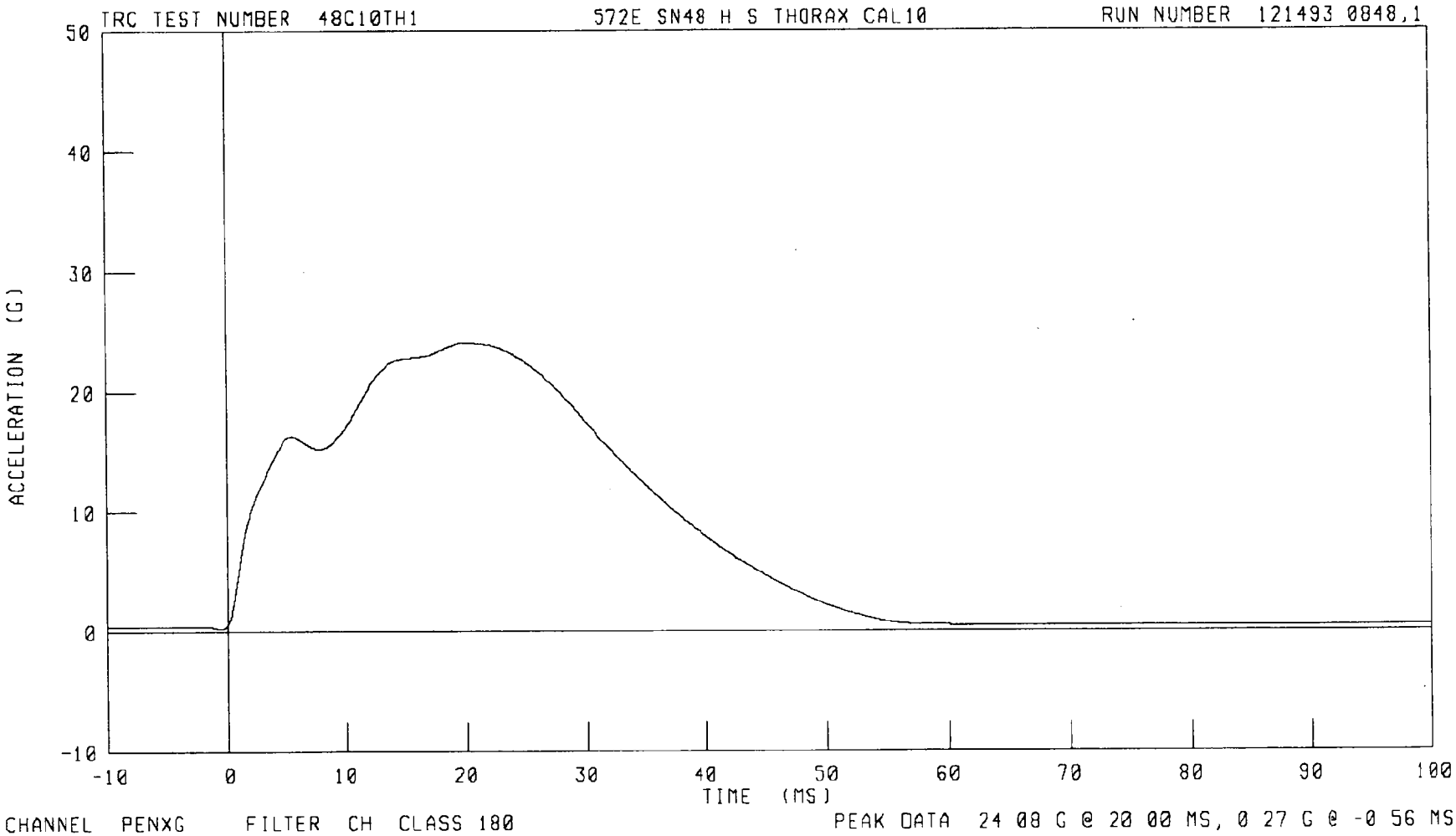
TRC INC. TEST NO: 48C10TH1 572E SN48 H.S.THORAX CAL10

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/S	6.68 M/S
MAXIMUM DEFLECTION	63.5 - 72.6 MM	70.7 MM
MAXIMUM RESISTIVE FORCE	5159 - 5894 N	5517. N
INTERNAL HYSTERESIS	69% - 85%	68.9%

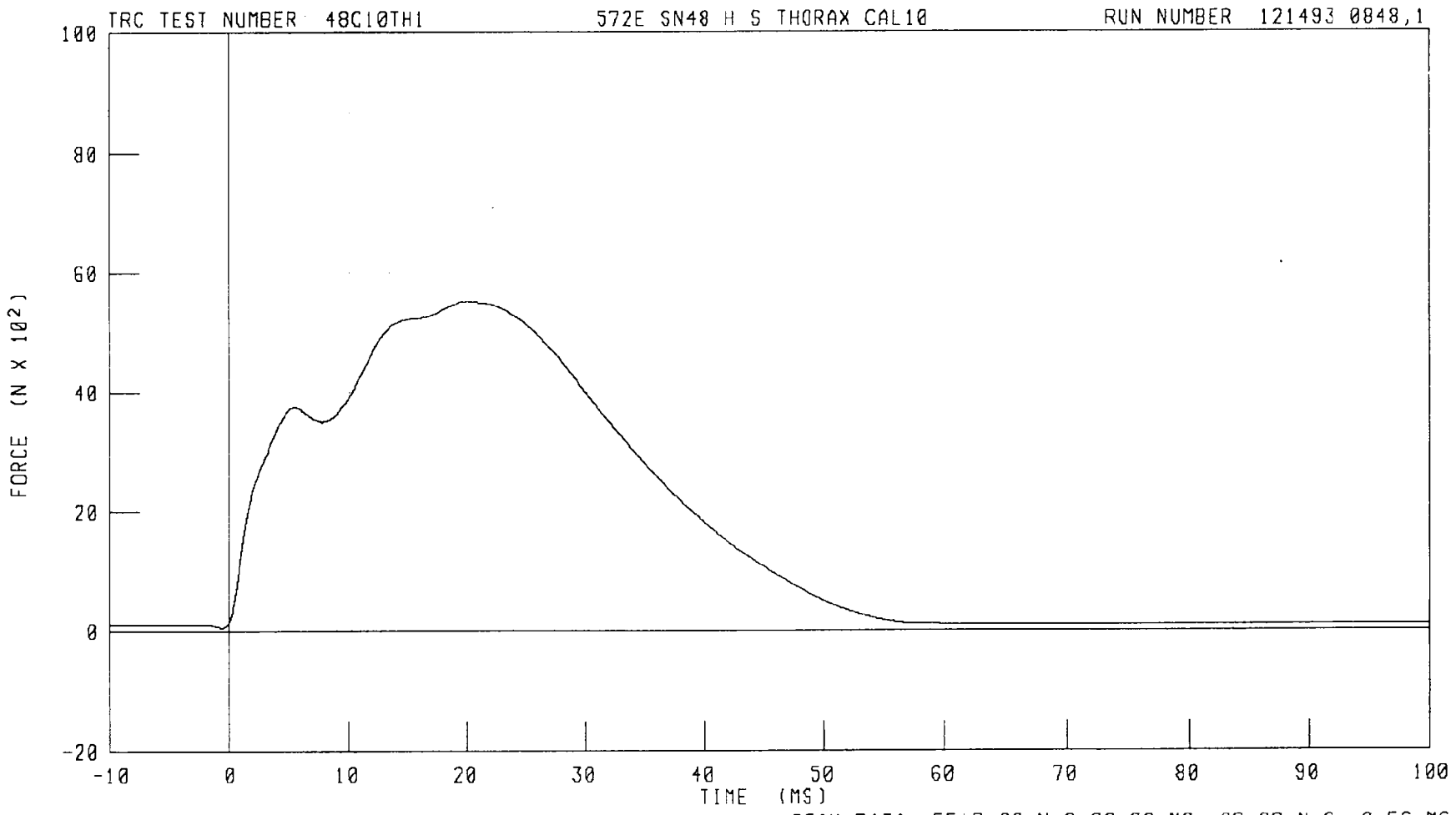
TEST MEETS SPECIFICATIONS

TECHNICIAN Pete Gast RUN NUMBER: 121493.0847;1

PART 572-E HYBRID III THORAX CALIBRATION
PENDULUM DECELERATION



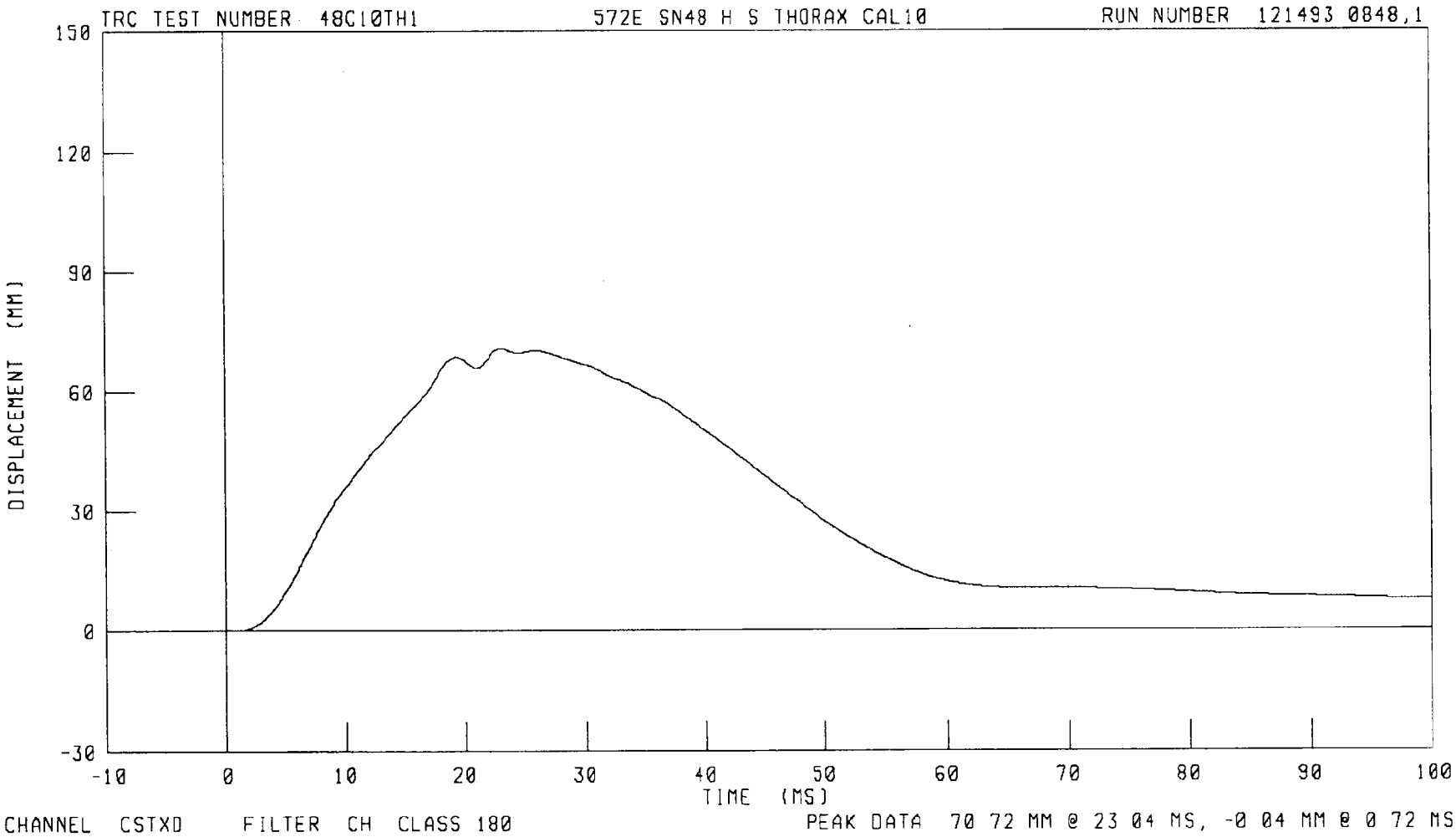
PART 572-E HYBRID III THORAX CALIBRATION
PENDULUM FORCE



CHANNEL PENXF FILTER CH CLASS 180

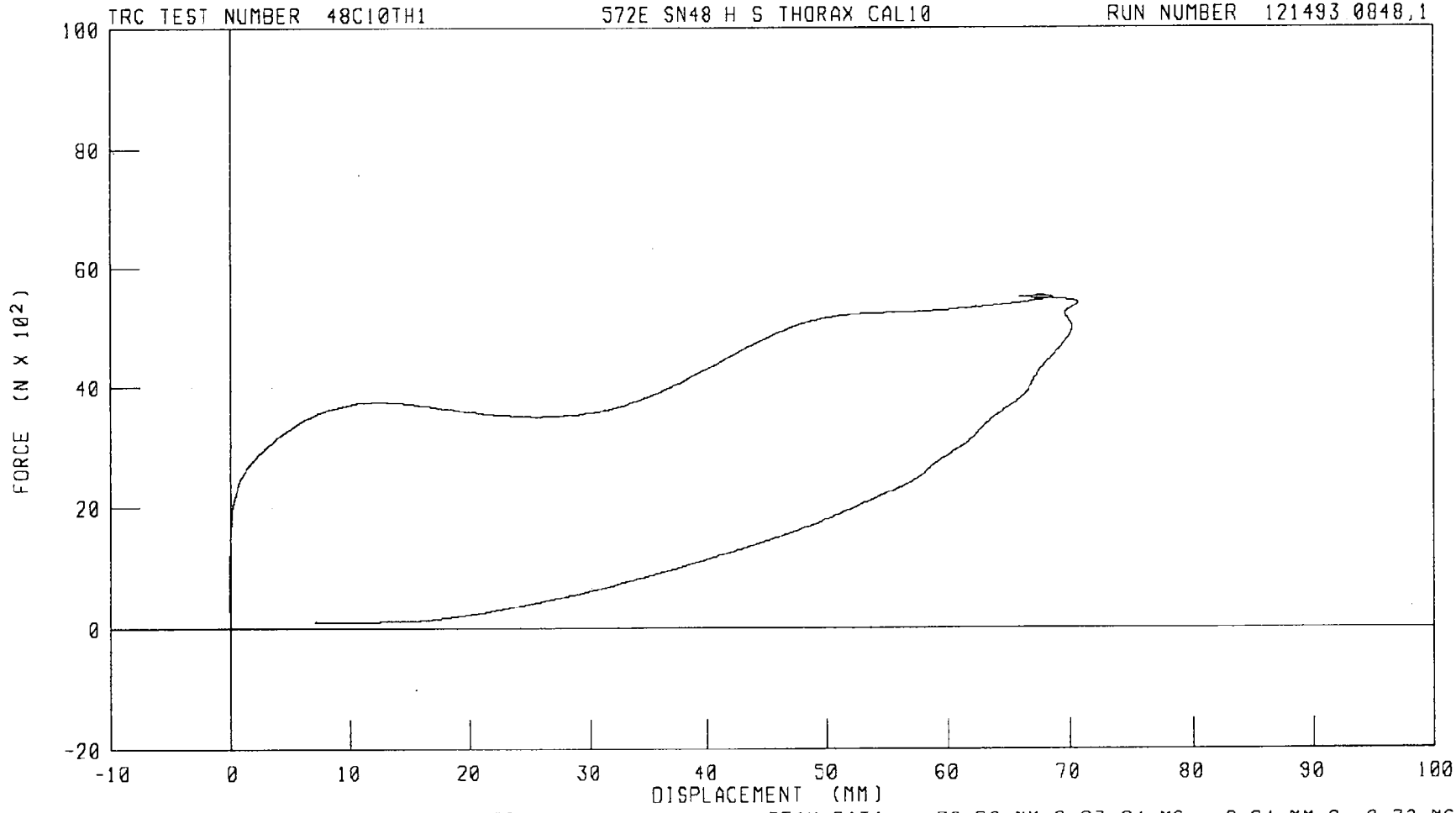
PEAK DATA 5517 22 N @ 20 00 MS, 60 98 N @ -0 56 MS

PART 572-E HYBRID III THORAX CALIBRATION
STERNUM DISPLACEMENT



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

TRC TEST NUMBER 48C10TH1 — 572E SN48 H S THORAX CAL10 — RUN NUMBER 121493 0848,1



CHANNEL CSTXD FILTER CH CLASS 180 PEAK DATA 70 72 MM @ 23 04 MS, -0 04 MM @ 0 72 MS
PENXF CH CLASS 180 5517 22 N @ 20 00 MS, 60 98 N @ -0 56 MS

TRANSPORTATION RESEARCH CENTER INC.

RIGHT KNEE IMPACT TEST

HYBRID III 13-DEC-93

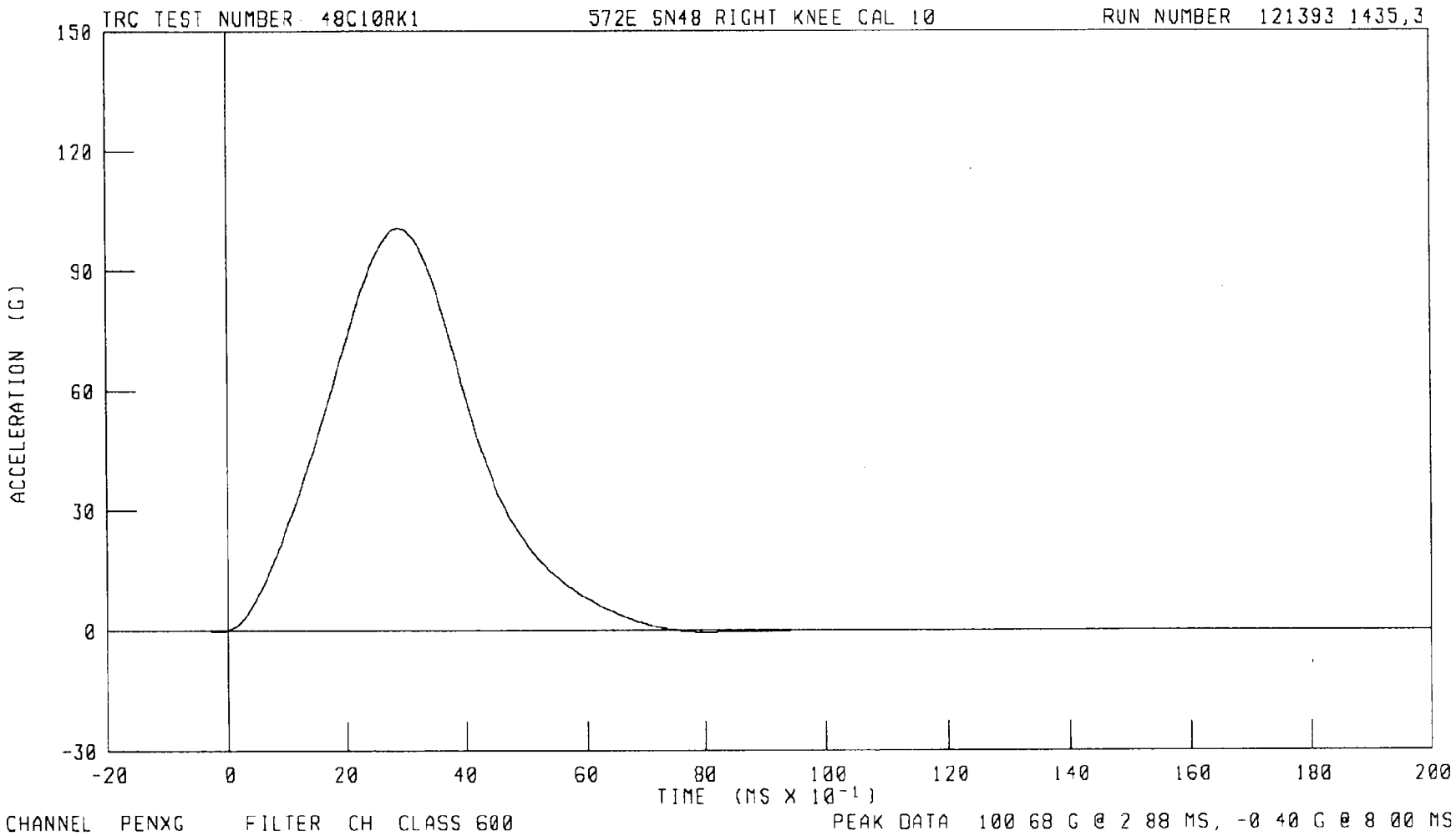
TRC INC. TEST NO: 48C10RK1 572E SN48 RIGHT KNEE CAL 10

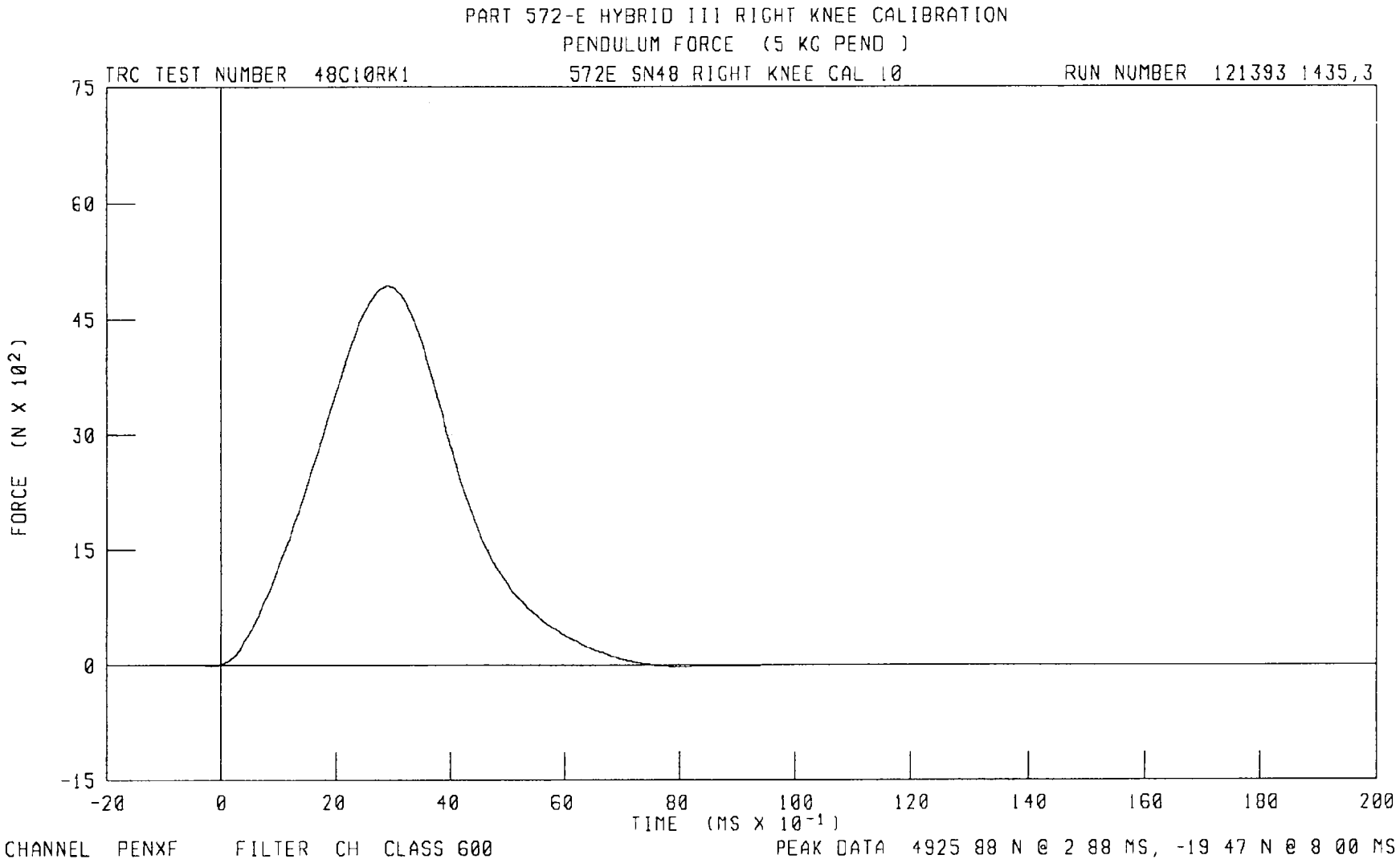
TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10 - 70 %	55.0 %
PROBE VELOCITY	2.07 - 2.13 M/S	2.09 M/S
PEAK KNEE IMPACT FORCE PROBE WEIGHT	4714 - 5783 N 5.0 KG	4925.8 N

TEST MEETS SPECIFICATIONS

TECHNICIAN Pete Fout RUN NUMBER: 121393.1435;3

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




PART 572-E HYBRID III RIGHT KNEE CALIBRATION
PENDULUM FORCE (5 KG PEND)
TRC TEST NUMBER 48C10RK1
572E SN48 RIGHT KNEE CAL 10
RUN NUMBER 121393 1435,3
75
60
45
30
15
0
-15
FORCE (N X 10²)
-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 4925 88 N @ 2 88 MS, -19 47 N @ 8 00 MS

TRANSPORTATION RESEARCH CENTER INC.

LEFT KNEE IMPACT TEST

HYBRID III 13-DEC-93

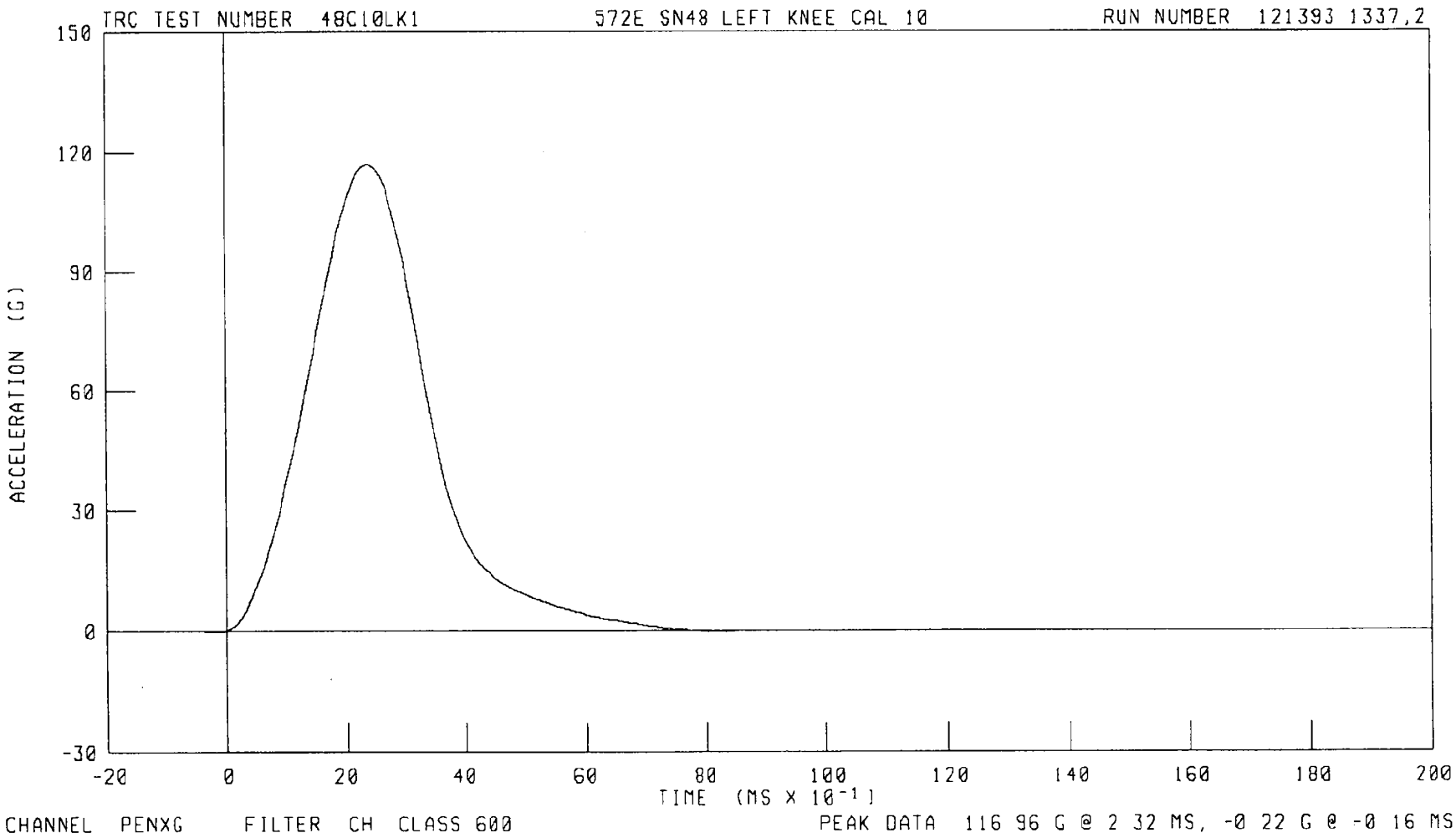
TRC INC. TEST NO: 48C10LK1 572E SN48 LEFT KNEE CAL 10

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10 - 70 %	55.0 %
PROBE VELOCITY	2.07 - 2.13 M/S	2.10 M/S
PEAK KNEE IMPACT FORCE PROBE WEIGHT	4714 - 5783 N 5.0 KG	5722.8 N

TEST MEETS SPECIFICATIONS

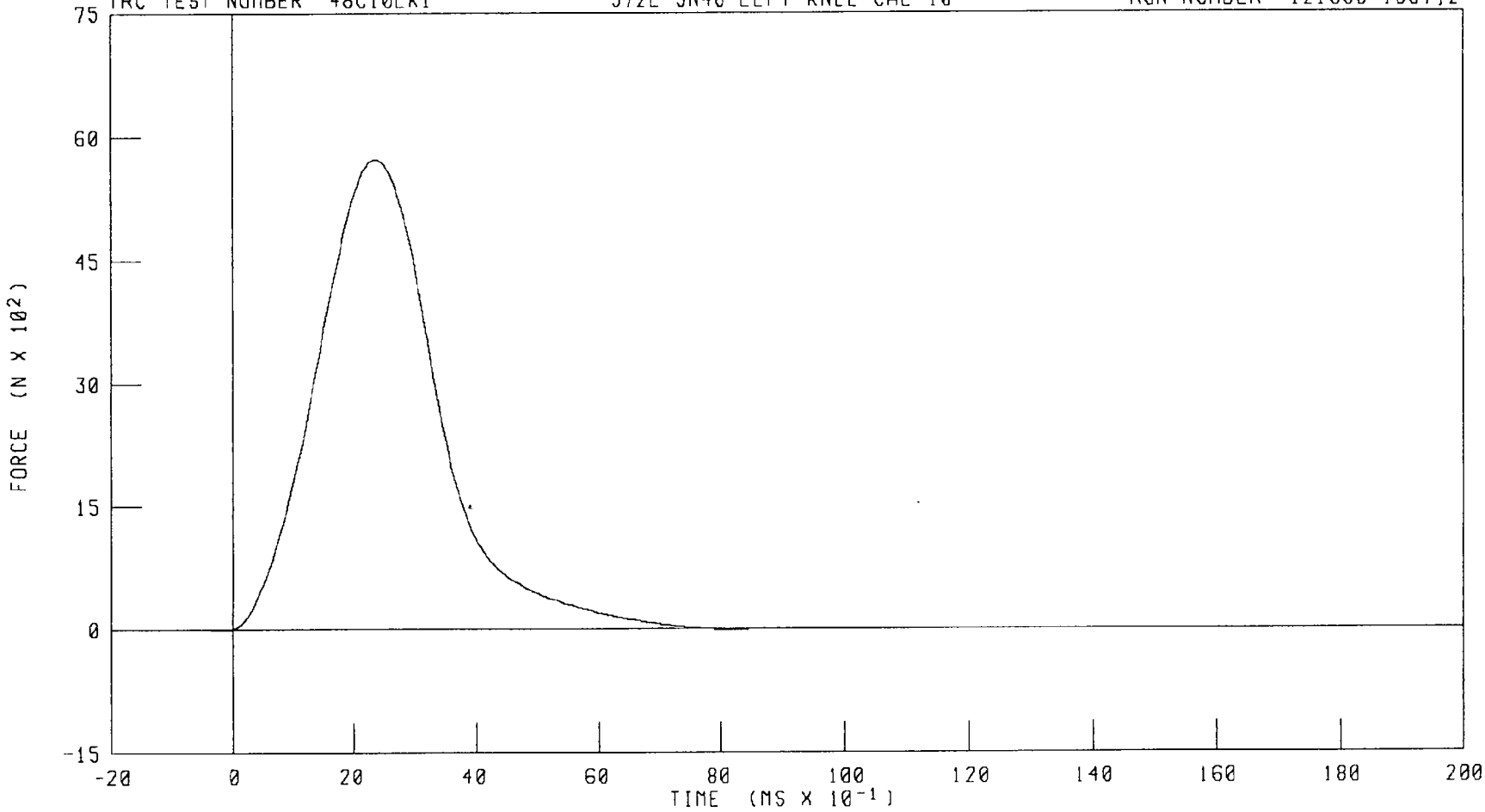
TECHNICIAN Pete Fox RUN NUMBER: 121393.1336;2

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



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

TRC TEST NUMBER 48C10LK1 572E SN48 LEFT KNEE CAL 10 RUN NUMBER 121393 1337,2



CHANNEL PENXF FILTER CH CLASS 600 PEAK DATA 5722 85 N @ 2 32 MS, -10 98 N @ -0 16 MS

APPENDIX D

MISCELLANEOUS TEST INFORMATION

DUMMY INSTRUMENTATION PLACEMENT

DUMMY MFR. & S/N: HUMANOID/048

SEATING POSITION: DRIVER

LOCATION	AXIS	MFR	MODEL	S/N	ORIENTATION (+ SENSING)
HEAD ACCELERATION	X	ENDEVCO	7264	EH78J	REAR
HEAD ACCELERATION	Y	ENDEVCO	7264	DH37J	LEFT
HEAD ACCELERATION	Z	ENDEVCO	7264	DD17J	UP
NECK FORCE	X	DENTON	1716	0106	*
NECK FORCE	Y	DENTON	1716	0106	*
NECK FORCE	Z	DENTON	1716	0106	*
NECK MOMENT	X	DENTON	1716	0106	*
NECK MOMENT	Y	DENTON	1716	0106	*
NECK MOMENT	Z	DENTON	1716	0106	*
CHEST ACCELERATION	X	ENDEVCO	7264	EH92J	FRONT
CHEST ACCELERATION	Y	ENDEVCO	7264	CC24H	LEFT
CHEST ACCELERATION	Z	ENDEVCO	7264	FG28J	UP
CHEST DEFLECTION	X	VERNITECH	81422A	9041	OUTWARD
PELVIS ACCELERATION	X	ENDEVCO	7264	BC75J	REAR
PELVIS ACCELERATION	Y	ENDEVCO	7264	FC43J	LEFT
PELVIS ACCELERATION	Z	ENDEVCO	7264	AP87	UP
LEFT FEMUR FORCE		GSE	2435	726	TENSION
RIGHT FEMUR FORCE		GSE	2430	756	TENSION

*See SIGN CONVENTION sheet for positive sensing orientation of neck load channels.

VEHICLE INSTRUMENTATION INFORMATION

TEST NO. 931217

NO.	LOCATION	AXIS	MFR	MODEL	S/N	ORIENTATION (+ SENSING)
1	LEFT REAR SEAT					
	CROSSMEMBER LONGITUDINAL	X	ENDEVCO	2264	AS95	REAR
2	RIGHT REAR SEAT					
	CROSSMEMBER LONGITUDINAL	X	ENDEVCO	2264	AT38	REAR
3	ENGINE TOP LONGITUDINAL	X	ENDEVCO	2264	BC41J	REAR
4	ENGINE BOTTOM LONGITUDINAL	X	ENDEVCO	2264	AU09	REAR
5	INSTRUMENT PANEL CENTER					
	LONGITUDINAL	X	ENDEVCO	2264	AZ67	FRONT
6	VEHICLE CENTER OF GRAVITY					
	LONGITUDINAL	X	ENDEVCO	2264	BP85J	REAR
	LATERAL	Y	ENDEVCO	2264	AY66	LEFT
	VERTICAL	Z	ENDEVCO	2264	BA46	UP
	LAP BELT OUTBOARD FORCE		LEBOW	3419	674	TENSION
	SHOULDER BELT OUTBOARD FORCE		LEBOW	3419	236	TENSION

SIGN CONVENTION
NHTSA DATA TAPE REFERENCE GUIDE

ACCELEROMETERS:

+X:	FORWARD
+Y:	LEFTWARD
+Z:	UPWARD

POTENTIOMETERS:

+CHEST LONGITUDINAL DEFLECTION:	OUTWARD
+CHEST LATERAL DEFLECTION:	LEFTWARD
+SEAT BELT DISPLACEMENT:	OUTWARD
+SEAT BELT EXTENSION:	ELONGATION
+KNEE SLIDER DISPLACEMENT:	DISTANCE BETWEEN FEMUR AND TIBIA INCREASED (IN RELATION TO A SEATED DUMMY)

LOAD CELLS:

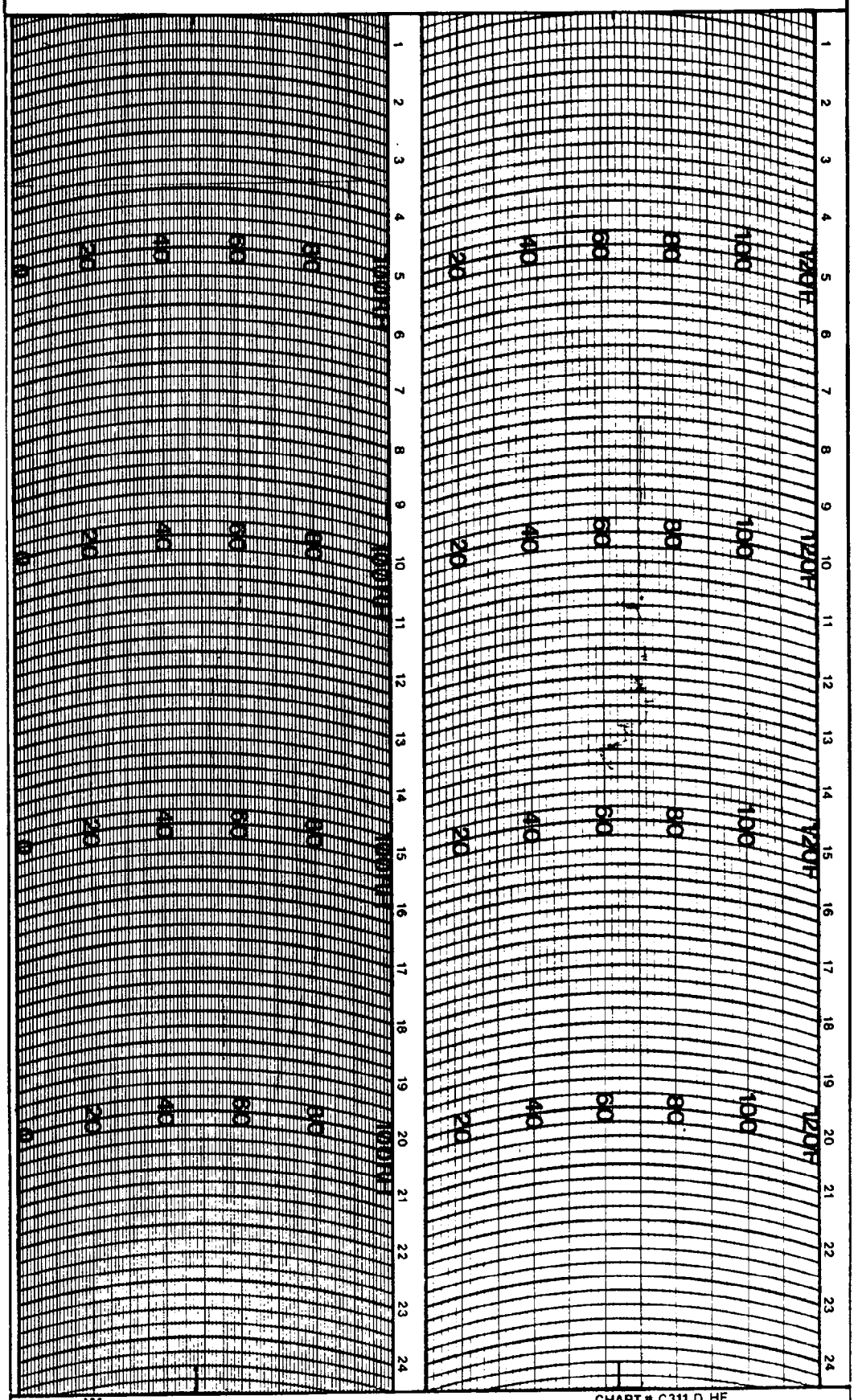
+FEMUR FORCE:	TENSION
+SEAT BELT FORCE:	TENSION
+BARRIER FORCE:	TENSION

NECK LOAD CELLS:

+X FORCE:	HEAD PUSHED FORWARD
+Y FORCE:	HEAD PUSHED LEFTWARD
+Z FORCE:	HEAD PULLED UPWARD (TENSION ON NECK)
+X MOMENT:	RIGHT EAR ROTATING TOWARD RIGHT SHOULDER
+Y MOMENT:	CHIN ROTATING TOWARD CHEST
+Z MOMENT:	CHIN ROTATING TOWARD LEFT SHOULDER

TIBIA LOAD CELLS:

+X FORCE:	TENSION
+Y FORCE:	TENSION
+Z FORCE:	TENSION
+X MOMENT:	BOTTOM OF TIBIA MOVING LEFTWARD
+Y MOMENT:	BOTTOM OF TIBIA MOVING REARWARD



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

HYGROTHERMOGRAPH
1 DAY

CHART # C311 D HF
PART # 699123

STATION _____ DATE ON _____ DATE OFF _____

OCCUPANT COMPARTMENT THERMOGRAPH