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U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

DOT HS 808 042

May 1993

Final Report

# Reducing Heavy Truck Aggressiveness

# Moving Heavy Truck into a 1988 Ford Taurus 4-Door Sedan at 80.5 KPH.

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Technical Report Documentation Page

| 1. Report No. | 2. Government Accession No. | 3. Recipient's Catalog No. |
|---|---|---|
| DOT HS 808 042 | | |

| 4. Title and Subtitle | 5. Report Date |
|---|---|
| REDUCING HEAVY TRUCK AGGRESSIVENESS<br>MOVING HEAVY TRUCK INTO A 1988 FORD TAURUS<br>4-DOOR SEDAN AT 80.5 KPH | APRIL - MAY 1993 |
| | 6. Performing Organization Code |
| 7. Author(s)<br>S. A. Johnston, Project Engineer, TRC | 8. Performing Organization Report No.<br>930426 |
| 9. Performing Organization Name and Address<br>National Highway Traffic Safety Admin.<br>Vehicle Research and Test Center<br>P. O. BOX 37<br>East Liberty, OH 43319 | 10. Work Unit No. (TRAIS) |
| | 11. Contract or Grant No.<br>DTNH22-88-C-07292 |
| 12. Sponsoring Agency Name and Address<br>U. S. Department of Transportation<br>National Highway Traffic Safety Administration<br>400 Seventh St., S.W.<br>Washington, DC 20590 | 13. Type of Report and Period Covered<br>FINAL REPORT<br>APRIL - MAY 1993 |
| | 14. Sponsoring agency Code<br>DOT/NHTSA/VRTC |

15. Supplemental Notes

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 1988 Ford Taurus 4-door sedan, VIN 1FABP5242JG257037, at Transportation Research Center Inc. on April 26, 1993. The test vehicle was impacted on the left front of the vehicle by the heavy truck. The struck vehicle contained ten (10) accelerometers and one (1) instrumented Hybrid III driver dummy.

| 17. Key Words | 18. Distribution Statement |
|---|---|
| Heavy Truck Aggressiveness<br>Occupant Response | Available from:<br>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 | | |

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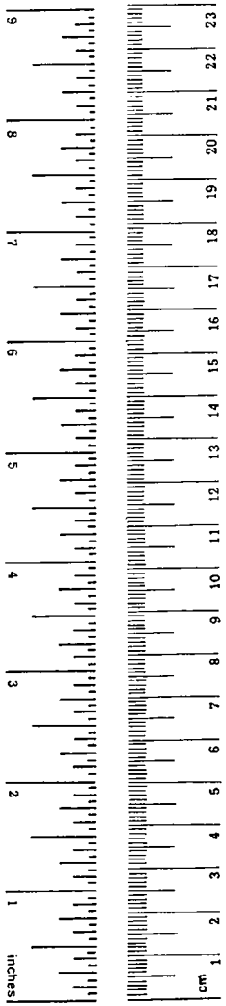
# METRIC CONVERSION FACTORS

## Approximate Conversions to Metric Measures

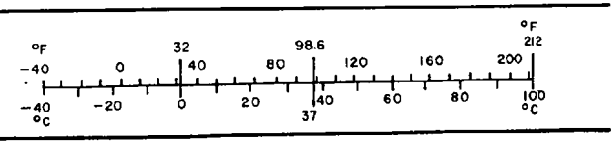
| Symbol | When You Know | Multiply by | To Find | Symbol |
|---|---|---|---|---|
| | **LENGTH** | | | |
| in | inches | *2.5 | centimeters | cm |
| ft | feet | 30 | centimeters | cm |
| yd | yards | 0.9 | meters | m |
| mi | miles | 1.6 | kilometers | km |
| | **AREA** | | | |
| $in^2$ | square inches | 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 April 26, 1993.

The stationary vehicle, a 1988 Ford Taurus 4-door sedan, was equipped with a 3.8-liter, 6-cylinder, transverse gasoline engine and a 3-speed automatic transmission. The test weight of the vehicle was 1581 kg. The vehicle was instrumented with eight (8) 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 stationary vehicle was impacted in the left front at 0 degrees by a moving heavy truck at 80.5 kph. The intended impact engagement was the left front of the car with the left front of the truck.

The moving heavy truck's test weight was 11,163 kg. The truck was equipped with a standard bumper extended 16 inches forward of the standard location. The truck was instrumented with two (2) longitudinal and lateral axis accelerometers and one (1) vertical axis accelerometer.

The dummy's head injury criterion, HIC, was 2,035. The dummy's chest deceleration with 3 milliseconds minimum duration was 46.4 g. The dummy's maximum left and right femur forces were 8110 N and 13,210 N, respectively.

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 8000 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 five (5) 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 EXPLANATION

The driver lap belt outboard force and shoulder belt force, LBOF1 and SHBF1, recorded an anomalous spike at 24 milliseconds.

The engine top X-axis accelerometer, ENGXG1, data was lost from 115 to 113 milliseconds and the data channel did not return to zero after the crash test as a result of the vehicle's crush pinching the data cable. This affected the engine top X-axis velocity calculation, ENGXV1.

The engine bottom X-axis accelerometer, ENGXG2, data was lost after 98 milliseconds as a result of the vehicle's crush cutting the data cable. This affected the engine bottom X-axis velocity calculation, ENGXV2.

The right brake caliper X-axis accelerometer, BCRXG1, data was lost after 59 milliseconds as a result of the vehicle's crush cutting the data cable. This affected the right brake caliper X-axis velocity calculation, BCRXV1.

The truck front frame crossmember X-axis and Z-axis acceleration, FFCXGA and FFCZGA, data channels did not return to zero after the crash test. This affected the truck frame crossmember resultant acceleration, FFCRGA, and X-axis and Z-axis velocity, FFCXVA, and FFCZVA, calculation.

TABLE 1 CRASH TEST SUMMARY

| | | |
|---|---|---|
| TEST TYPE: | Heavy Truck into Stationary Vehicle | |
| TEST DATE: 04/26/93 | TEST TIME: 1350 | AMBIENT TEMP. (°C): 4 |
| VEHICLE YEAR/MAKE/MODEL/BODY STYLE: | 1988/Ford/Taurus/4-door sedan | |
| VEHICLE TEST WEIGHT (KG): | 1581 | |
| IMPACT ANGLE (DEG)*: | 0 | |
| IMPACT VELOCITY (KPH)**: | PRIMARY = 80.5 | SECONDARY = 80.5 |
| MAXIMUM STATIC CRUSH (MM): | 199 | |
| DUMMY: | Driver #048 | |
| TYPE: | Part 572E | |
| LOCATION: | Left front | |
| RESTRAINT: | 3-point unibelt | |
| NUMBER OF DATA CHANNELS: | 35 | |
| NUMBER OF CAMERAS: | HIGH-SPEED 5 | REAL-TIME 1 |

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

## TABLE 2 TEST VEHICLE INFORMATION

VEHICLE MANUFACTURER: Ford Motor Company

MAKE/MODEL: Ford/Taurus VIN: 1FABP5242JG257037

BODY STYLE: 4-door sedan MODEL YEAR: 1988

COLOR: Brown

ENGINE DATA: TYPE: transverse CYLINDERS: 6 DISPLACEMENT: 3.8 liters

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

DATE VEHICLE RECEIVED: NA ODOMETER READING: 41,512

DEALER'S NAME AND ADDRESS: NA

ACCESSORIES:

| | | | |
|---|---|---|---|
| POWER STEERING | Yes | AUTOMATIC TRANSMISSION | Yes |
| POWER BRAKES | Yes | AUTOMATIC SPEED CONTROL | Yes |
| POWER SEATS | No | TILTING STEERING WHEEL | Yes |
| POWER WINDOWS | No | TELESCOPING STEERING WHEEL | No |
| TINTED GLASS | Yes | AIR CONDITIONING | Yes |
| RADIO | Yes | ANTI-SKID BRAKE | 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:

DATE OF MANUFACTURE: VIN:

GVWR: LBS

GAWR: FRONT: LBS., REAR: LBS.

*The vehicle did not contain a label stating certification data.

TABLE 2 TEST VEHICLE INFORMATION CONT'D

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

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

SPARE TIRE (MFR., LINE, SIZE): General, Temporary, T135/80R14

TYPE OF SEATS: FRONT: Split bench
REAR: Bench

TYPE OF FRONT SEAT BACKS: Manually adjustable

MAXIMUM WIDTH: 1792 MILLIMETERS

WHEELBASE: 2680 MILLIMETERS

LOCATION OF LABEL STATING TIRE & CAPACITY DATA:

The label was located on the passenger's side C-pillar.

TIRE & CAPACITY DATA FROM VEHICLE'S LABEL:

RECOMMENDED TIRE SIZE: P205/70R14

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

DESIGNATED SEATING CAPACITY: 2 FRONT 3 REAR 5 TOTAL

VEHICLE CAPACITY WEIGHT: 900 LBS.

TEST VEHICLE ATTITUDE (ALL MEASUREMENTS ARE IN MILLIMETERS):

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| DELIVERED ATTITUDE: | LF | 697; | RF | 700; | LR | 633; | RR | 639 |
| PRE-TEST ATTITUDE: | LF | 696; | RF | 699; | LR | 605; | RR | 610 |
| POST-TEST ATTITUDE: | LF | 592; | RF | 635; | LR | 556; | RR | 672 |

TABLE 2 TEST VEHICLE INFORMATION CONT'D

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

| | | | |
|---|---|---|---|
| RIGHT FRONT | 460 KG | RIGHT REAR | 260 KG |
| LEFT FRONT | 474 KG | LEFT REAR | 251 KG |
| TOTAL FRONT WEIGHT | 934 KG | (64.6% OF TOTAL VEHICLE WEIGHT) | |
| TOTAL REAR WEIGHT | 511 KG | (35.4% OF TOTAL VEHICLE WEIGHT) | |
| TOTAL DELIVERED WEIGHT | 1445 KG | | |
| TARGET TEST WEIGHT | 1581 KG * | | |

WEIGHT OF TEST VEHICLE:

| | | | |
|---|---|---|---|
| RIGHT FRONT | 458 KG | RIGHT REAR | 315 KG |
| LEFT FRONT | 493 KG | LEFT REAR | 315 KG |
| TOTAL FRONT WEIGHT | 951 KG | (60.2% OF TOTAL VEHICLE WEIGHT) | |
| TOTAL REAR WEIGHT | 630 KG | (39.8% OF TOTAL VEHICLE WEIGHT) | |
| TOTAL TEST WEIGHT | 1581 KG | | |

WEIGHT OF BALLAST SECURED IN VEHICLE CARGO AREA: None

COMPONENTS REMOVED TO MEET TARGET TEST WEIGHT: None

CG = 1067 MILLIMETERS REARWARD OF FRONT WHEEL CENTERLINE

*The target test weight was established during Test 920507.

## TABLE 3 TRUCK INFORMATION

**WEIGHT DISTRIBUTION**

**FRONT:** 3543 KG

**REAR:** 7620 KG

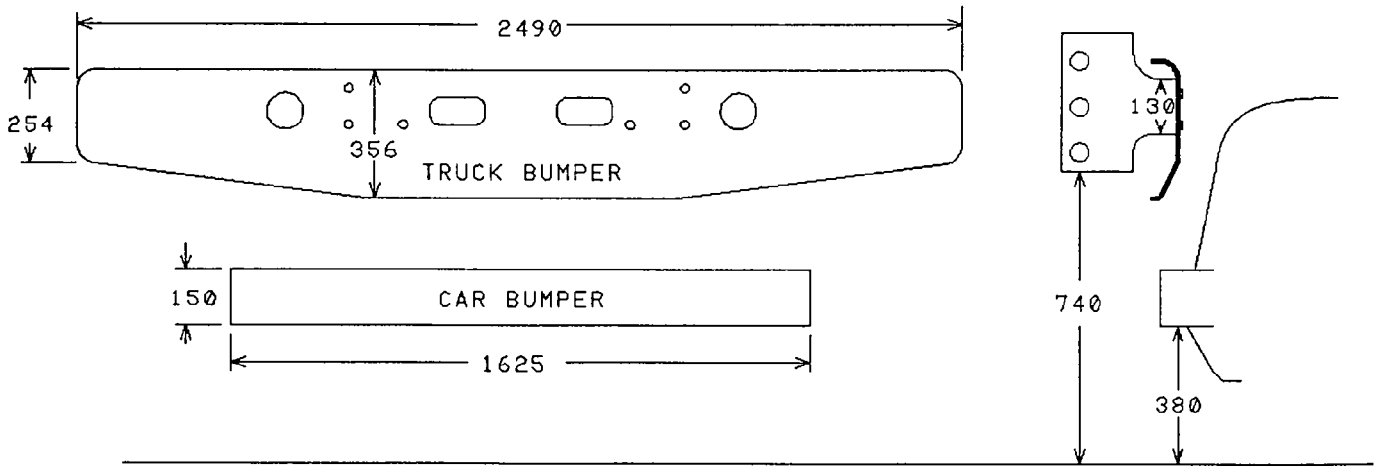
**AXLE SPACING**

**FRONT:** 3835 MM

**REAR:** 1308 MM

DISTANCE OF C.G. BEHIND FRONT AXLE: 3064 MM

BUMPER DESCRIPTION: Stock truck bumper extended forward 16 inches.
Truck damage:
The front axle was pushed rearward on the leaf spring.
The left bumper bracket cracked. The bumper face was badly deformed.




All dimensions are in millimeters.

## TABLE 4 POST-IMPACT DATA

TEST NUMBER: 930426

TEST DATE: 04/26/93 TEST TIME: 1350

TEST TYPE: Heavy Truck into Stationary Vehicle IMPACT ANGLE: 0

AMBIENT TEMPERATURE AT IMPACT AREA: 4° C

TEMPERATURE IN OCCUPANT COMPARTMENT: 4° 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

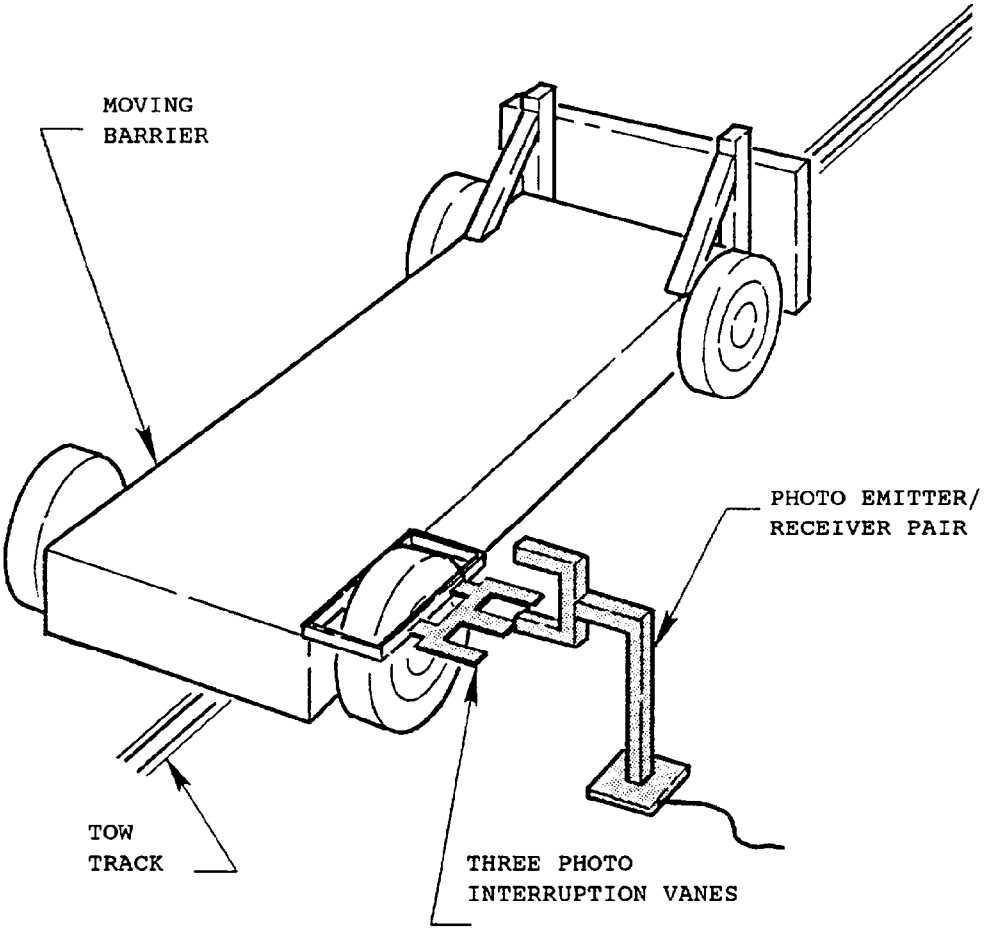
EXITING VELOCITY TRAP = 51 MM

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

| | | | | | | |
|---|---|---|---|---|---|---|
| OVERALL LENGTH OF TEST VEHICLE: | PRE-TEST: | L | 4539; | C | 4800; | R 4642 |
| | POST-TEST: | L | 4447; | C | 4665; | R 4652 |
| | TOTAL CRUSH: | L | 92; | C | 135; | R -10 |

AVERAGE CRUSH: 72

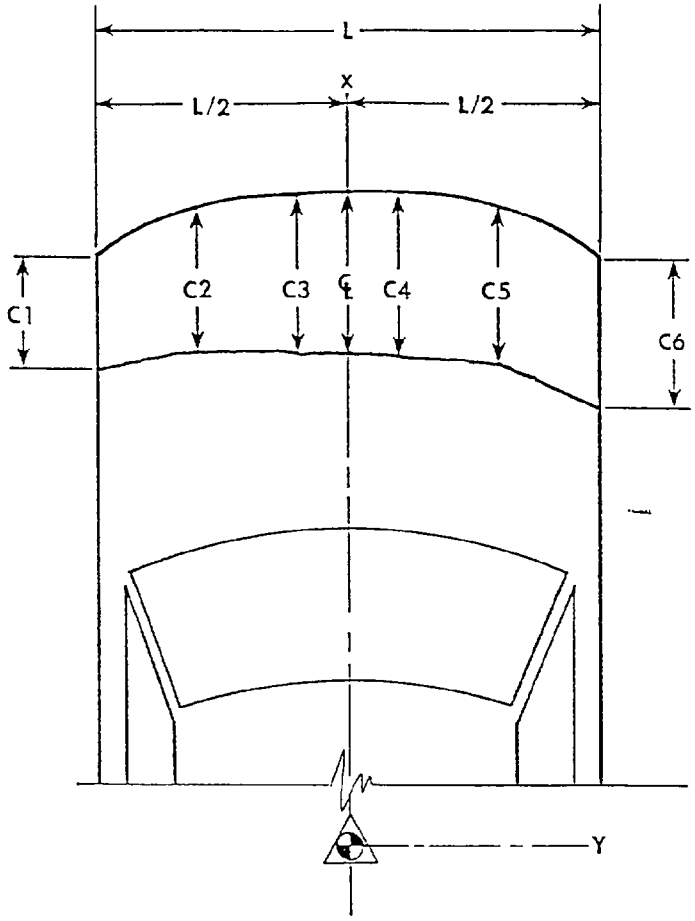
FIGURE 1 IMPACT VELOCITY MEASUREMENT SYSTEM




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

The vanes have 305-millimeter spacing.

FIGURE 2 VEHICLE CRUSH



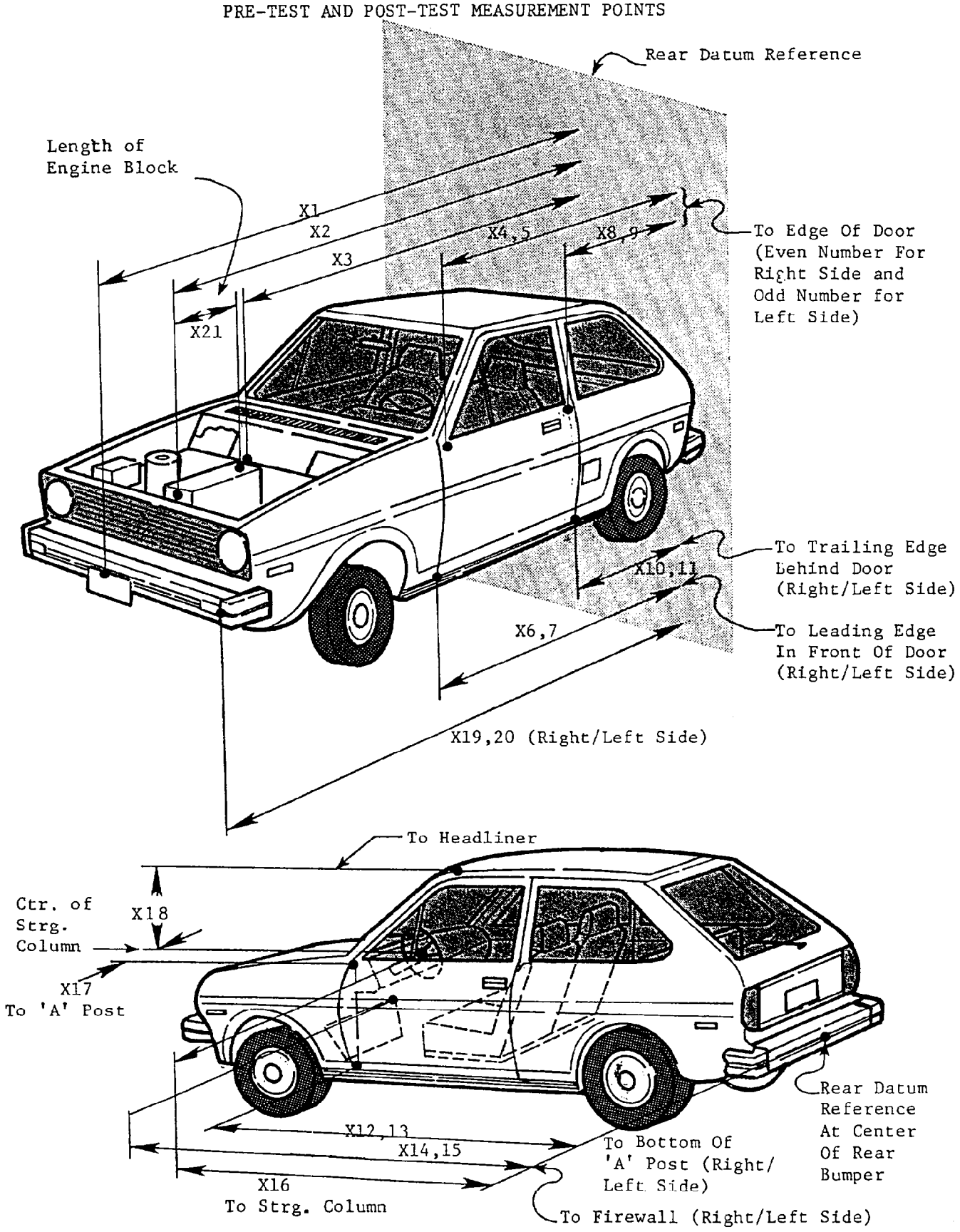

NOTES: L is pre-test length of contact surface.
C1 through C6 are spaced equally apart.
CL is vehicle centerline.
All measurements are in millimeters.

Vehicle Ford Taurus

| | PRE-TEST | POST-TEST | CRUSH |
|---|---|---|---|
| L | 1524 | | |
| C1 | 4539 | 4447 | 92 |
| C2 | 4744 | 4545 | 199 |
| C3 | 4800 | 4633 | 167 |
| C4 | 4800 | 4683 | 117 |
| C5 | 4735 | 4695 | 40 |
| C6 | 4642 | 4652 | -10 |
| CL | 4800 | 4665 | 135 |

FIGURE 3

PRE-TEST AND POST-TEST MEASUREMENT POINTS



## TABLE 5 IMPACTED VEHICLE MEASUREMENTS

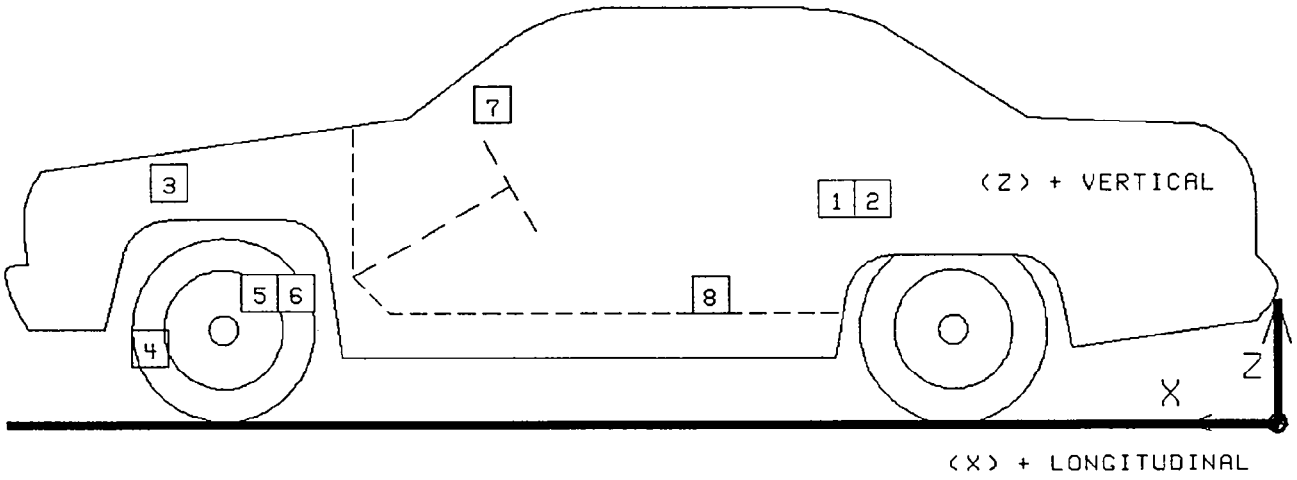
VEHICLE MAKE/MODEL: Ford/Taurus TEST NUMBER: 930426

ALL MEASUREMENTS ARE IN MILLIMETERS

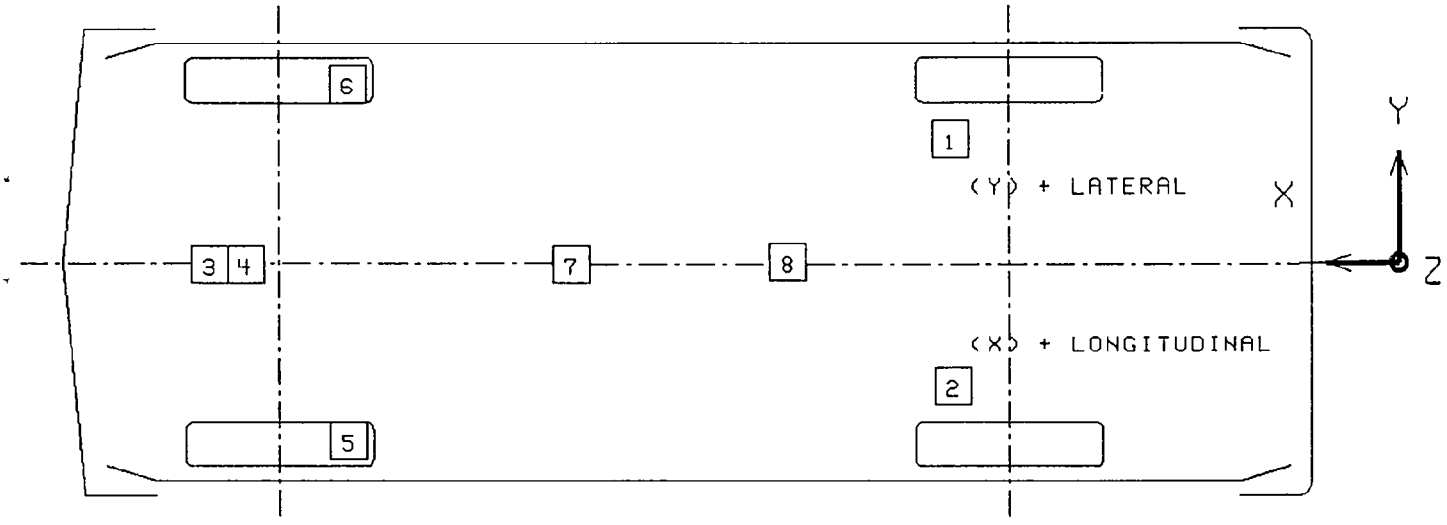
| NO. | TYPE OF MEASUREMENT | PRE-TEST | POST-TEST | DIFF. |
|---|---|---|---|---|
| X1 | TOTAL LENGTH OF VEHICLE AT CENTERLINE | 4800 | 4665 | 135 |
| X2 | REAR SURFACE OF VEHICLE TO FRONT OF ENGINE BLOCK | 4270 | 3990 | 280 |
| X3 | REAR SURFACE OF VEHICLE TO FIREWALL | 3590 | 3330 | 260 |
| X4 | REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF RIGHT DOOR | 3297 | 3318 | -21 |
| X5 | REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF LEFT DOOR | 3295 | 3278 | 17 |
| X6 | REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF RIGHT DOOR | 3238 | 3232 | 6 |
| X7 | REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF LEFT DOOR | 3244 | 3180 | 64 |
| X8 | REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF RIGHT DOOR | 2217 | 2239 | -22 |
| X9 | REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF LEFT DOOR | 2209 | 2216 | -7 |
| X10 | REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF RIGHT DOOR | 2210 | 2206 | 4 |
| X11 | REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF LEFT DOOR | 2202 | 2242 | -40 |
| X12 | REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON RIGHT SIDE | 3217 | 3225 | -8 |
| X13 | REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON LEFT SIDE | 3220 | 3116 | 104 |
| X14 | REAR SURFACE OF VEHICLE TO FIREWALL - RIGHT SIDE | 3552 | 3512 | 40 |
| X15 | REAR SURFACE OF VEHICLE TO FIREWALL - LEFT SIDE | 3554 | 3221 | 333 |
| X16 | REAR SURFACE OF VEHICLE TO STEERING WHEEL CENTER | 2795 | 2662 | 133 |
| X17 | CENTER OF STEERING COLUMN TO "A" POST | 295 | 247 | 48 |
| X18 | CENTER OF STEERING COLUMN TO HEADLINER | 416 | 722 | -306 |
| X19 | REAR SURFACE OF VEHICLE TO RIGHT SIDE OF FRONT BUMPER | 4642 | 4652 | -10 |
| X20 | REAR SURFACE OF VEHICLE TO LEFT SIDE OF FRONT BUMPER | 4539 | 4447 | 92 |
| X21 | LENGTH OF ENGINE BLOCK | 400 | 400 | 0 |

FIGURE 4

# VEHICLE ACCELEROMETER PLACEMENT




SIDE VIEW




BOTTOM VIEW

TABLE 6

VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

TEST NUMBER 930426

| 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 | 1722.0 | 736.0 | 365.0 | 1.3 | 337.6 | 31.5 | 37.0 |
| 2 | RIGHT REAR SEAT CROSSMEMBER LONGITUDINAL | 1725.0 | -736.0 | 372.0 | 1.1 | 338.8 | 30.4 | 54.4 |
| 3 | ENGINE TOP LONGITUDINAL | 4210.0 | 0.0 | 854.0 | 93.2 | 85.5 Y | --- | --- Y |
| 4 | ENGINE BOTTOM LONGITUDINAL | 4051.0 | -63.0 | 183.0 | --- | --- Y | --- | --- Y |
| 5 | RIGHT BRAKE CALIPER LONGITUDINAL | 3899.0 | -667.0 | 311.0 | --- | --- Y | --- | --- Y |
| 6 | LEFT BRAKE CALIPER LONGITUDINAL | 3893.0 | 667.0 | 310.0 | 27.0 | 107.4 | 82.6 | 37.3 |

TABLE 6

VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY CONTINUED

TEST NUMBER 930426

| No. | LOCATION | X* | Y* | Z* | POSITIVE DIRECTION MAX G | POSITIVE DIRECTION MSEC | NEGATIVE DIRECTION MAX G | NEGATIVE DIRECTION MSEC |
|---|---|---|---|---|---|---|---|---|
| 7 | INSTRUMENT PANEL CENTER | 3175.0 | -64.0 | 967.0 | | | | |
| | LONGITUDINAL | | | | 37.6 | 118.5 | 90.5 | 68.9 |
| 8 | CENTER OF GRAVITY | 2780.0 | 0.0 | 322.0 | | | | |
| | LONGITUDINAL | | | | 2.3 | 12.6 | 28.6 | 63.6 |
| | LATERAL | | | | 6.3 | 65.8 | 12.0 | 45.8 |
| | VERTICAL | | | | 33.8 | 64.9 | 30.1 | 37.4 |
| | RESULTANT | | | | 43.9 | 64.5 | | |

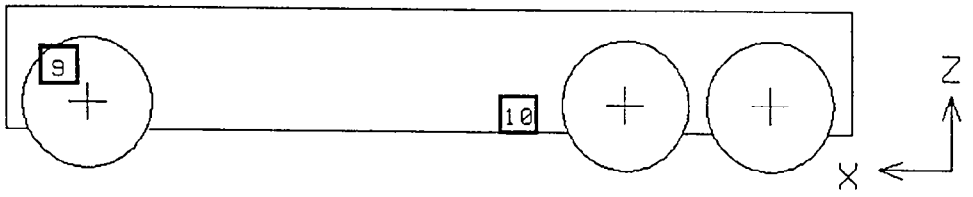
* ALL MEASUREMENTS OF ACCELEROMETER LOCATIONS ARE IN INCHES.

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

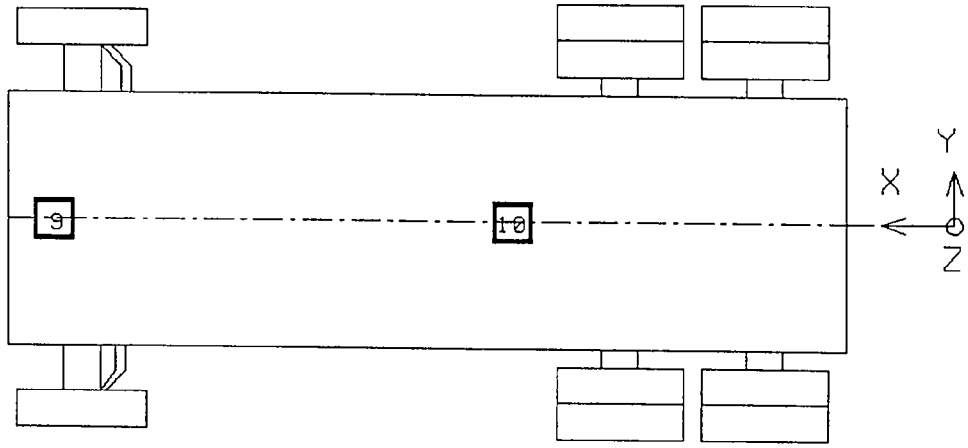
$^{\gamma}$See DATA ACQUISITION EXPLANATIONS

FIGURE 5

# HEAVY TRUCK ACCELEROMETER PLACEMENT




SIDE VIEW




BOTTOM VIEW

TABLE 7

HEAVY TRUCK ACCELEROMETER LOCATIONS AND DATA SUMMARY

TEST NUMBER 930426

| No. | LOCATION | X* | Y* | Z* | POSITIVE DIRECTION MAX G | POSITIVE DIRECTION MSEC | NEGATIVE DIRECTION MAX G | NEGATIVE DIRECTION MSEC |
|---|---|---|---|---|---|---|---|---|
| 9 | FRONT FRAME CROSSMEMBER | 6160 | 0 | 658 | | | | |
| | LONGITUDINAL | | | | 30.2 | 50.0 ϒ | 14.8 | 22.5 ϒ |
| | LATERAL | | | | 26.9 | 112.6 | 14.2 | 40.3 |
| | VERTICAL | | | | 24.8 | 25.3 ϒ | 66.0 | 93.3 ϒ |
| | RESULTANT | | | | 70.5 | 93.3 ϒ | | |
| 10 | CENTER OF GRAVITY | 2527 | 0 | 1050 | | | | |
| | LONGITUDINAL | | | | 11.7 | 29.3 | 16.6 | 24.8 |
| | LATERAL | | | | 17.5 | 36.3 | 2.2 | 20.3 |

* ALL MEASUREMENTS OF ACCELEROMETER LOCATIONS ARE IN MILLIMETERS.

REFERENCE: X: + FORWARD FROM TRAILING EDGE OF TRUCK
Y: + LEFT FROM TRUCK CENTERLINE
Z: + UP FROM GROUND LEVEL

ϒ See DATA ACQUISITION EXPLANATIONS

TABLE 8

DUMMY DATA SUMMARY

TEST NUMBER 930426

| | DRIVER DUMMY SN: 048 | | | |
|---|---|---|---|---|
| | POSITIVE DIRECTION | | NEGATIVE DIRECTION | |
| | MAX | MSEC | MAX | MSEC |
| HEAD ACCELERATION (g) | | | | |
| LONGITUDINAL | 13.2 | 187.3 | 189.6 | 111.3 |
| LATERAL | 7.9 | 10.1 | 50.9 | 111.6 |
| VERTICAL | 6.6 | 257.0 | 64.0 | 109.4 |
| RESULTANT | 194.6 | 111.5 | | |
| HIC | 2035 FROM 95.1 TO 120.8 | | | |
| NECK FORCE (N) | | | | |
| LONGITUDINAL | 1298.9 | 108.1 | 83.4 | 24.6 |
| LATERAL | 348.6 | 118.8 | 285.8 | 106.5 |
| VERTICAL | 4324.3 | 108.9 | 199.1 | 26.5 |
| RESULTANT | 4461.7 | 108.9 | | |
| NECK MOMENT (N-M) | | | | |
| ABOUT X | 12.2 | 90.8 | 26.7 | 106.6 |
| ABOUT Y | 44.8 | 116.3 | 47.2 | 99.0 |
| ABOUT Z | 15.3 | 110.0 | 10.4 | 152.0 |
| RESULTANT | 47.4 | 99.0 | | |

TABLE 8

DUMMY DATA SUMMARY CONTINUED

TEST NUMBER 930426

| | DRIVER DUMMY SN: 048 | | | |
|---|---|---|---|---|
| | POSITIVE DIRECTION | | NEGATIVE DIRECTION | |
| | MAX | MSEC | MAX | MSEC |
| CHEST ACCELERATION (g) | | | | |
| LONGITUDINAL | 2.2 | 8.1 | 51.2 | 92.9 |
| LATERAL | 8.3 | 72.5 | 16.0 | 108.5 |
| VERTICAL | 25.0 | 108.3 | 19.9 | 79.9 |
| RESULTANT | 52.1 | 79.9 | | |
| 3 MSEC | 46.4 | | | |
| CHEST DEFLECTION (mm) | | | | |
| LONGITUDINAL | 0.3 | 17.3 | 38.2 | 102.0 |
| PELVIS ACCELERATION (g) | | | | |
| LONGITUDINAL | 10.0 | 104.5 | 96.2 | 71.3 |
| LATERAL | 15.4 | 68.9 | 19.8 | 75.9 |
| VERTICAL | 26.5 | 76.8 | 7.3 | 161.4 |
| RESULTANT | 97.2 | 71.3 | | |
| FEMUR LOAD (N) | | | | |
| LEFT | 196.1 | 30.9 | 8110.3 | 75.9 |
| RIGHT | 1466.8 | 99.6 | 13209.5 | 71.0 |

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

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

## TABLE 9 POST-IMPACT DUMMY/VEHICLE DATA

VISIBLE DUMMY CONTACT POINTS:

| | DRIVER #048 | PASSENGER # NA |
|---|---|---|
| HEAD | Instrument panel | |
| CHEST | Steering wheel | |
| ABDOMEN | Steering wheel | |
| LEFT KNEE | Instrument panel | |
| RIGHT KNEE | Instrument panel | |

DOOR OPENING:

| | LEFT | RIGHT |
|---|---|---|
| FRONT | Tools required | Opened, with difficulty |
| REAR | Opened, with difficulty | Opened easily |

SEAT MOVEMENT:

| | SEAT BACK FAILURE | SEAT SHIFT |
|---|---|---|
| FRONT | None | None |
| REAR | NA | NA |

GLAZING DAMAGE:

The entire windshield was cracked on impact.

The driver's side door glass also cracked on impact.

OTHER NOTABLE IMPACT EFFECTS:

None

## DUMMY KINEMATIC SUMMARY

The dummy translated forward at impact. The dummy's hands and knees impacted the instrument panel. The dummy's chest and torso impacted the steering wheel. The dummy's head impacted the top surface of the instrument panel. The dummy came to rest against the steering wheel.

## FIGURE 6 DUMMY AND SEAT POSITIONING DATA

PRE-IMPACT DATA:

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

MODEL YEAR: 1988 COLOR: Brown

DATA FROM CERTIFICATION LABEL:

VEHICLE MANUFACTURER: _____

DATE OF MANUFACTURE: _____ VIN: _____

GVWR: _____ LBS.; GAWR: FRONT = _____ LBS.; REAR = _____ LBS.

POST-IMPACT DATA:

DATE OF TEST: 04/26/93 TIME: 1350 TEMPERATURE: 4° C

IMPACT VELOCITY: PRIMARY = 80.5 MPH SECONDARY = 80.5 MPH

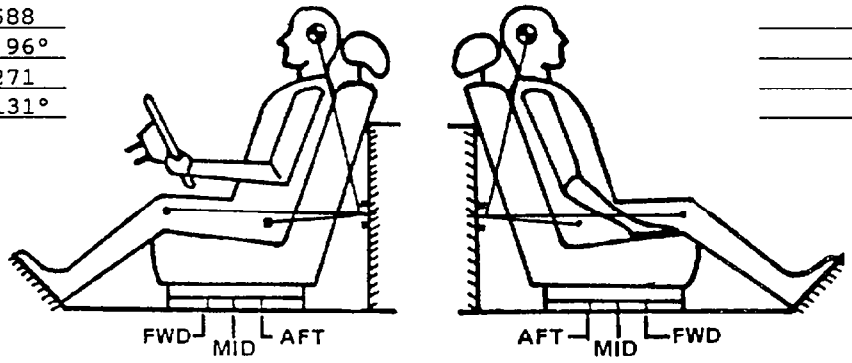
REQUIRED IMPACT VELOCITY RANGE: 79.7 TO 81.3 MPH

SEAT TYPE: Bucket ADJUSTER TYPE: Manual

FRONT SEAT BACK TYPE: Manually-adjustable

TECHNICIANS: R. Cribley, R. Summers, K. Watkins

| DRIVER DUMMY # 048 TYPE: HIII | | PASSENGER DUMMY # NA TYPE: | |
|---|---|---|---|
| HEAD | 471 | | HEAD |
| TARGET | 9° | | TARGET |
| KNEE | 588 | | KNEE |
| JOINT | 96° | | JOINT |
| APPROX- | 271 | | APPROX- |
| IMATE | 131° | | IMATE |
| "H" | | | "H" |
| POINT | | | POINT |




A = 1425

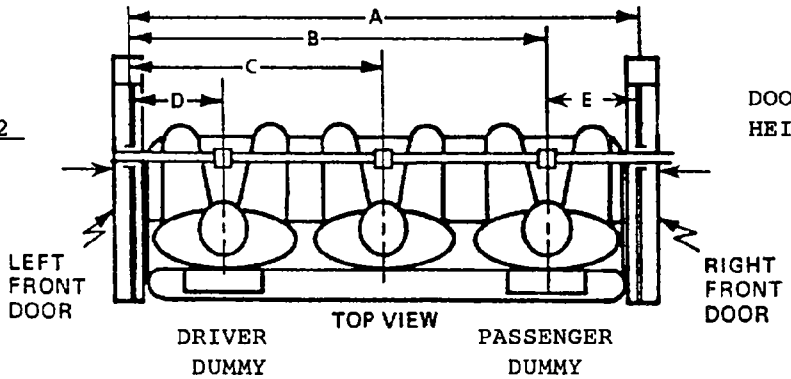
B = NA

C = NA

D = 336

E = NA

DOOR GLASS HEIGHT = 202




DOOR GLASS HEIGHT = 200

ALL ANGLES ARE RELATIVE TO VERTICAL PLANE THROUGH DOOR STRIKER.

ALL DISTANCE MEASUREMENTS ARE IN MILLIMETERS.

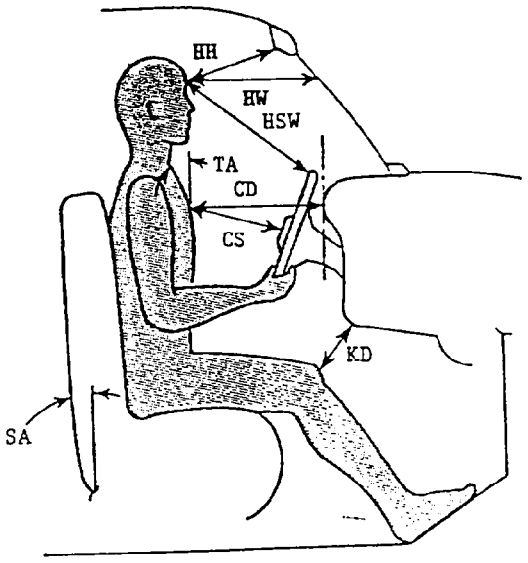
*The vehicle did not contain a certification label.

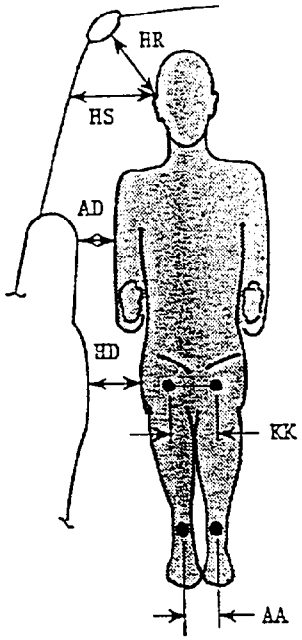
## FIGURE 7 DUMMY IN VEHICLE POSITIONING DATA

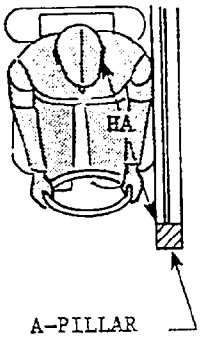
| | DRIVER | PASSENGER |
|---|---|---|
| | 048 | NA |
| HH | 360 | |
| HW | 592 | |
| CD | 556 | |
| CS | 340 | |
| KDL | 116 | |
| KDR | 114 | |
| TA | 18° | |
| SA | 23° | |
| HSW | 471 | |

| | DRIVER | PASSENGER |
|---|---|---|
| | 048 | NA |
| HR | 165 | |
| HS | 257 | |
| AD | 104 | |
| HD | 157 | |
| KK | 202 | |
| AA | 293 | |
| HA | 560 | |

KNEE OUTER BOLT HEAD TO
OUTER BOLT HEAD SPACING:
DRIVER = 280
PELVIS ANGLE:
DRIVER = 25°



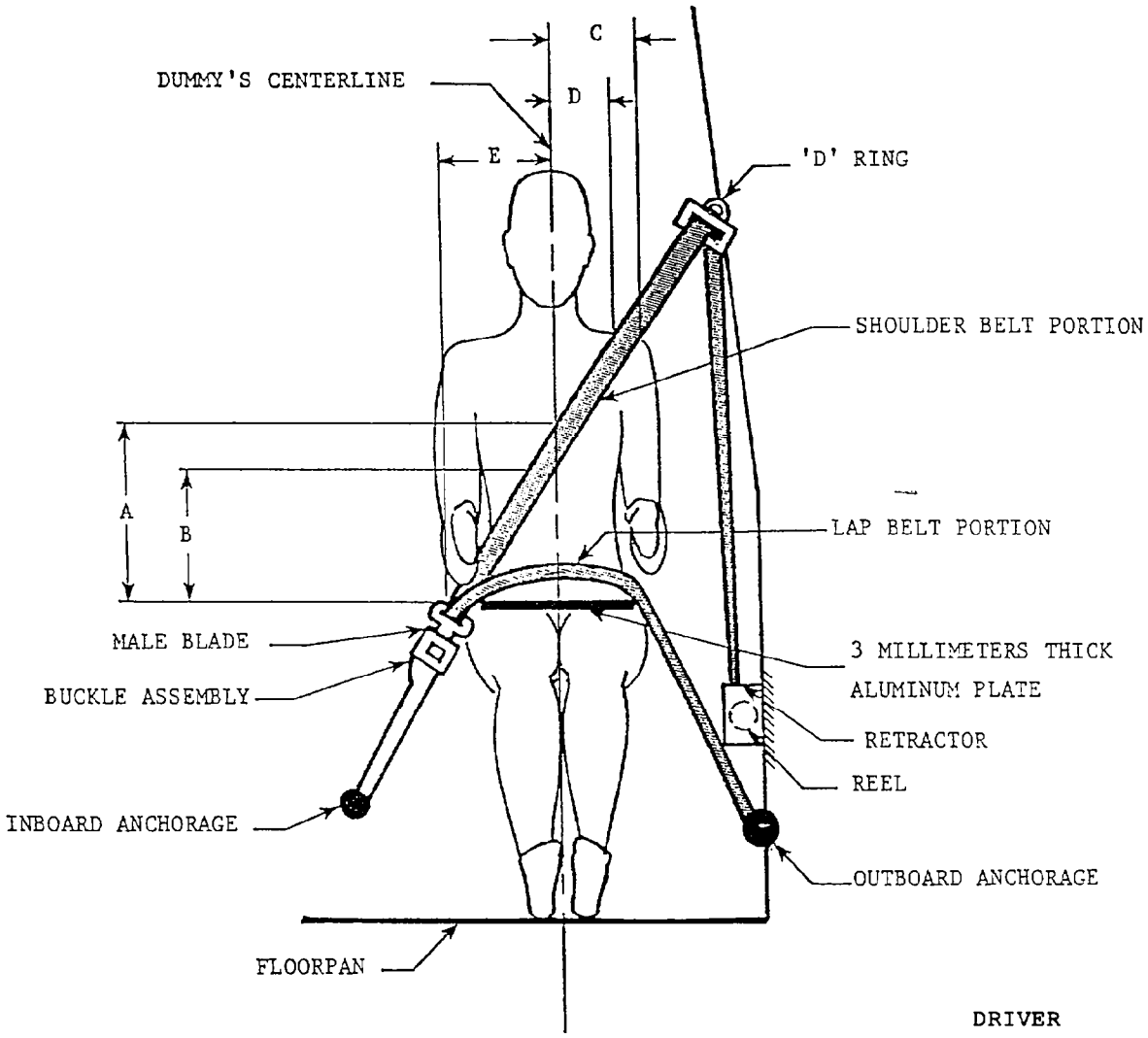




HH = HEAD TO WINDSHIELD HEADER
HW = HEAD TO WINDSHIELD
CD = CHEST TO DASH
CS = CHEST TO STEERING WHEEL
KD = KNEE TO DASH
TA = TORSO ANGLE
SA = SEAT BACK ANGLE
HSW= HEAD TO STEERING WHEEL

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.

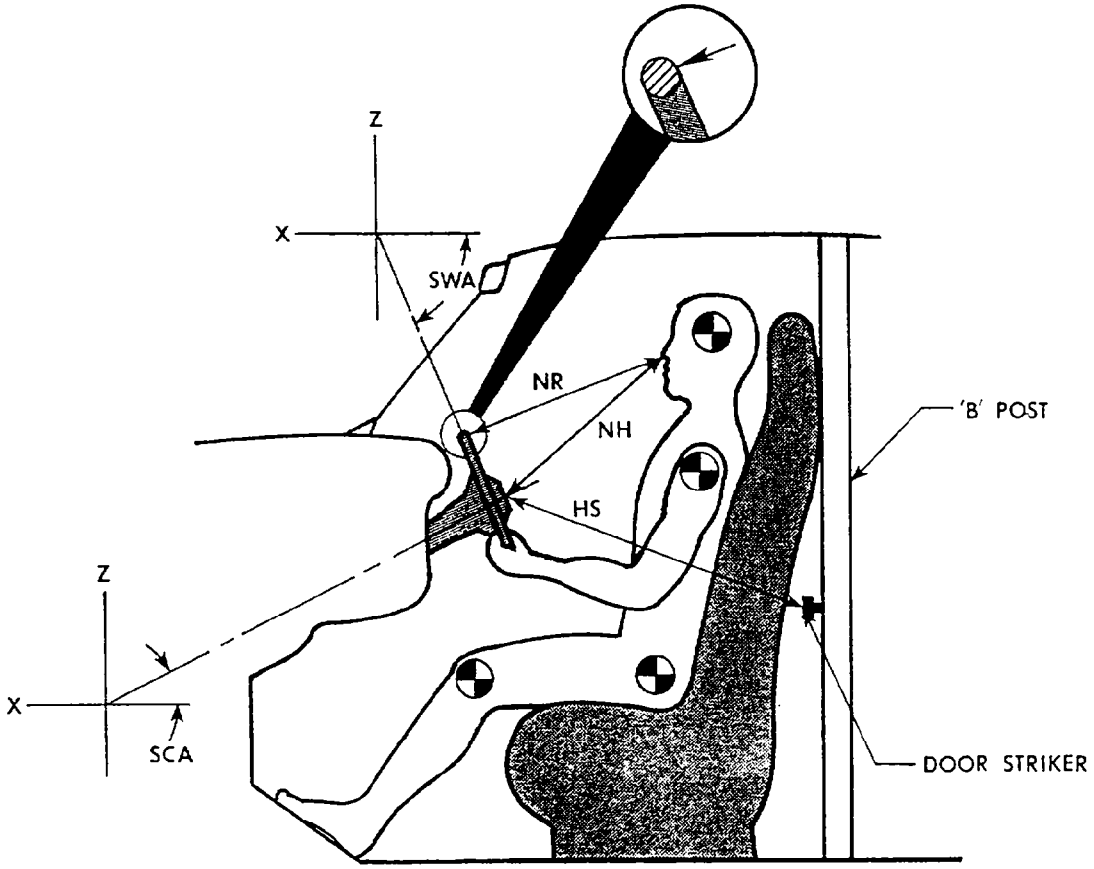
## FIGURE 8 SEAT BELT POSITIONING DATA




| | DRIVER DUMMY |
|---|---|
| A - TOP SURFACE OF ALUMINUM PLATE TO BELT UPPER EDGE | 355 |
| B - TOP SURFACE OF ALUMINUM PLATE TO BELT LOWER EDGE | 280 |
| C - DUMMY CENTERLINE TO OUTER EDGE OF BELT AT CHEST FLESH TOP | 83 |
| D - DUMMY CENTERLINE TO INNER EDGE OF BELT AT CHEST FLESH TOP | 23 |
| E - DUMMY CENTERLINE TO INTERSECTION OF UPPER TORSO BELT AND LAP BELT | 210 |

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 third of five positions.

| | MEASUREMENTS |
|---|---|
| NR - DISTANCE FROM TIP OF DUMMY'S NOSE TO TOP REAR SURFACE OF STEERING WHEEL RIM. | 423 |
| NH - DISTANCE FROM TIP OF DUMMY'S NOSE TO CENTER OF STEERING COLUMN HUB. | 425 |
| HS - DISTANCE FROM CENTER OF STEERING COLUMN HUB TO THE FORWARD SURFACE OF THE DOOR LOCK STRIKER PIN. | 597 |
| SCA - ANGLE OF STEERING COLUMN RELATIVE TO THE HORIZONTAL X AXIS | 23° |
| SWA - ANGLE OF STEERING WHEEL RELATIVE TO THE HORIZONTAL X AXIS | 67° |

ALL DISTANCE MEASUREMENTS ARE IN MILLIMETERS.

FIGURE 10

# CAMERA POSITIONS

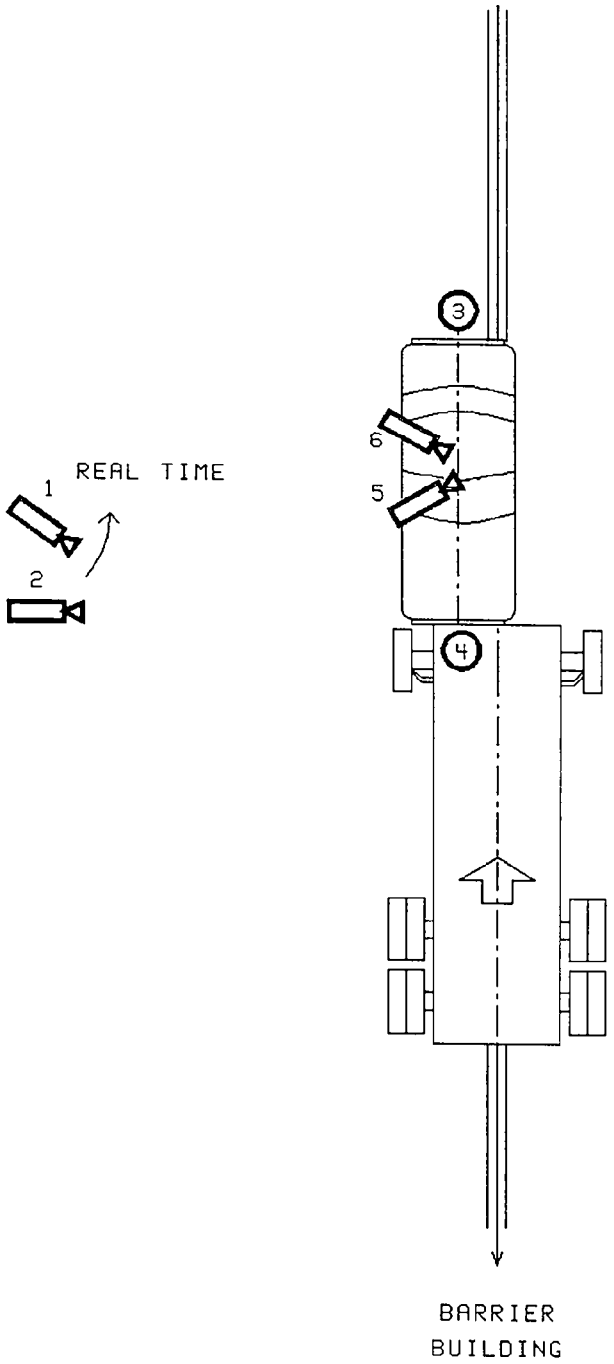


TABLE 10 MOTION PICTURE CAMERA INFORMATION

| CAMERA NO. | LOCATION | TYPE | LENS (mm) | SPEED (fps) | PURPOSE OF CAMERA DATA |
|---|---|---|---|---|---|
| 1 | Left panning | Bolex | 12-120 | 24 | Real-time documentation |
| 2 | Left wide | Photosonic | 13 | 563 | Vehicle dynamics |
| 3 | Overhead wide | Photosonic | 8 | 500 | Vehicle dynamics |
| 4 | Onboard truck | Photosonic | 8 | 500 | Dummy kinematics |
| 5 | Onboard car front | Photosonic | 8 | 955 | Dummy kinematics |
| 6 | Onboard car rear | Photosonic | 8 | 1002 | Dummy kinematics |

# APPENDIX A

PHOTOGRAPHS


Figure A-1. PRE-TEST FRONT VIEW

Figure A-2. PRE-TEST LEFT SIDE VIEW

Figure A-3. POST-TEST LEFT SIDE VIEW

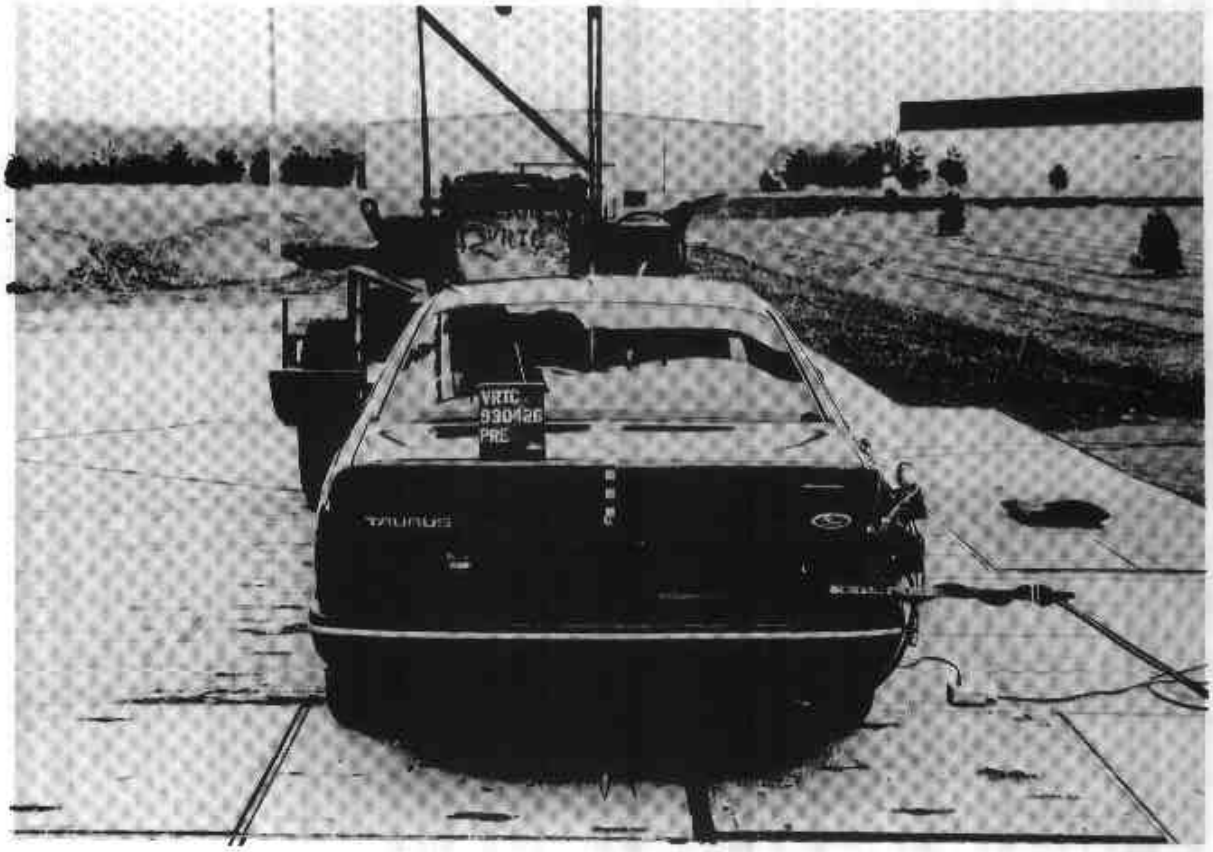



Figure A-4. PRE-TEST REAR VIEW

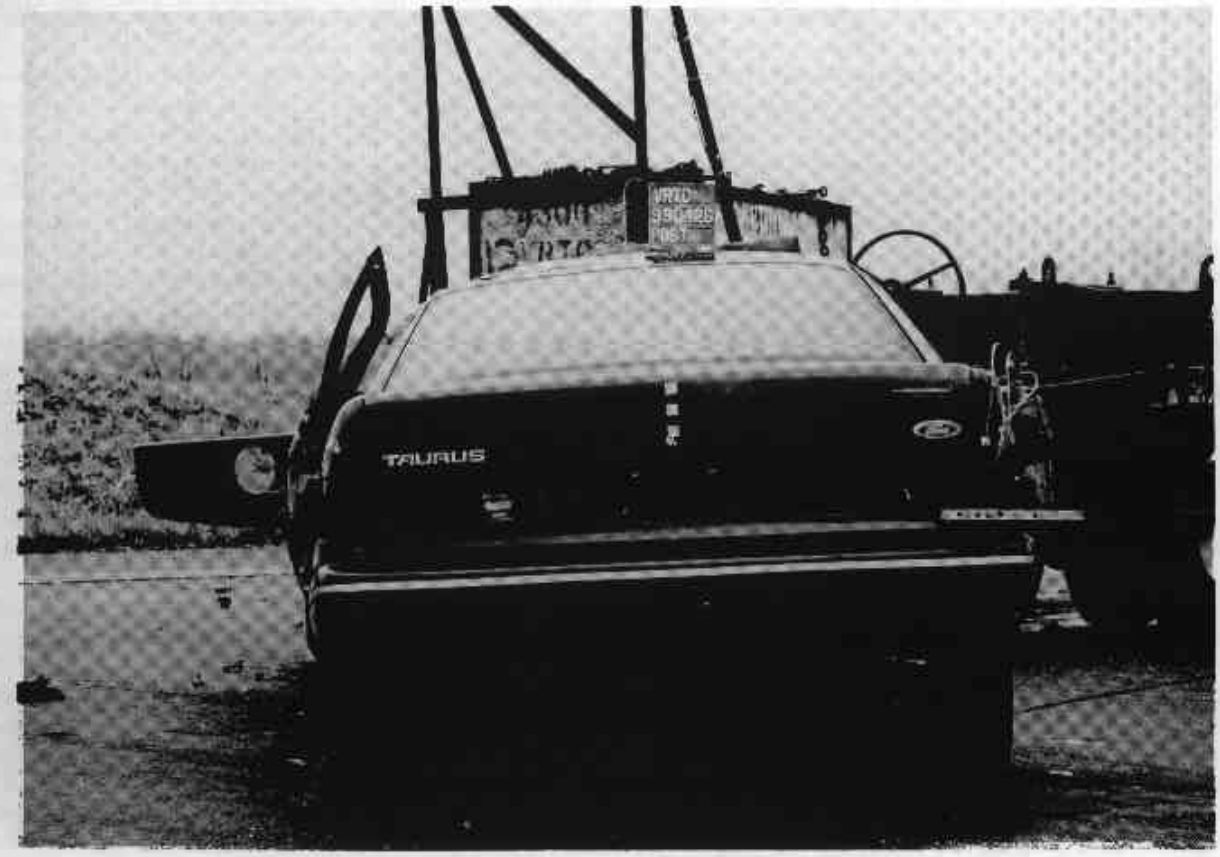



Figure A-5. POST-TEST REAR VIEW

Figure A-6. PRE-TEST RIGHT SIDE VIEW

Figure A-7. POST-TEST RIGHT SIDE VIEW

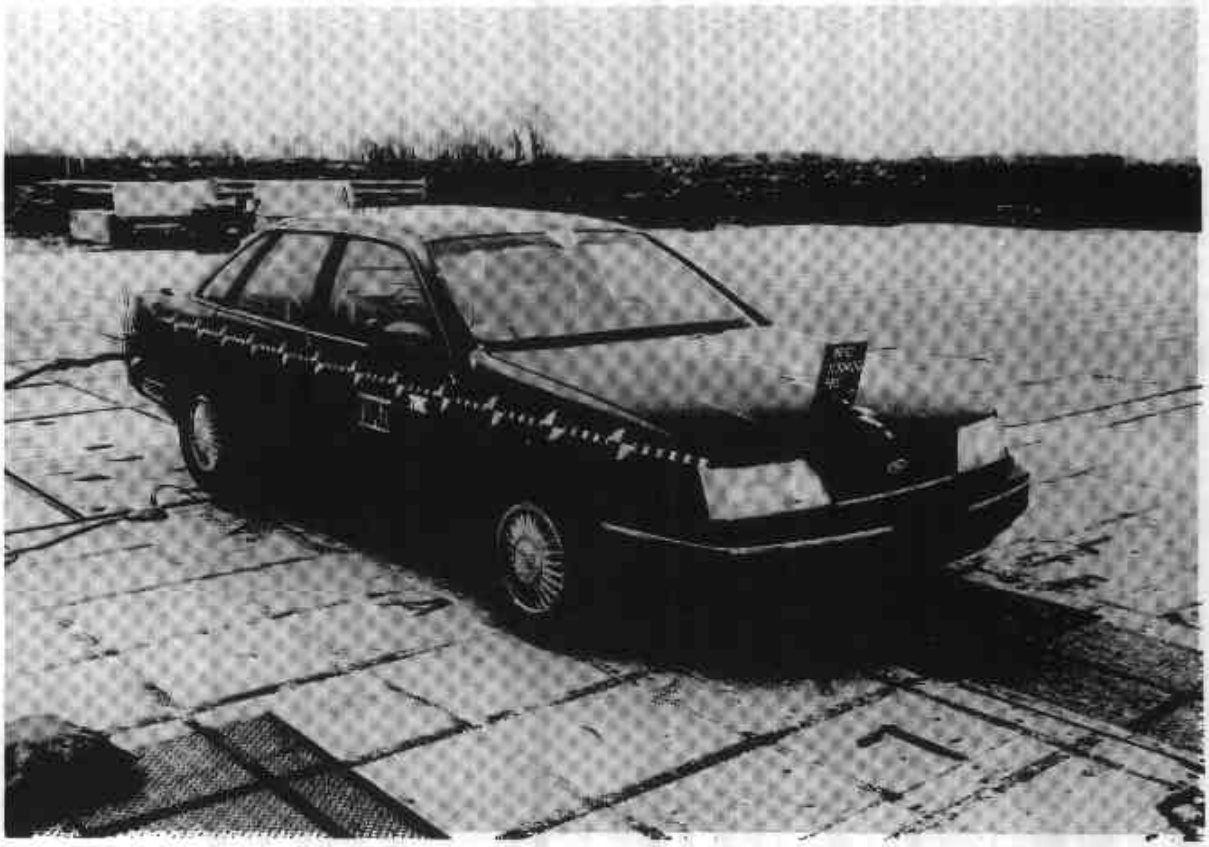


Figure A-8. PRE-TEST RIGHT FRONT THREE-QUARTER VIEW

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

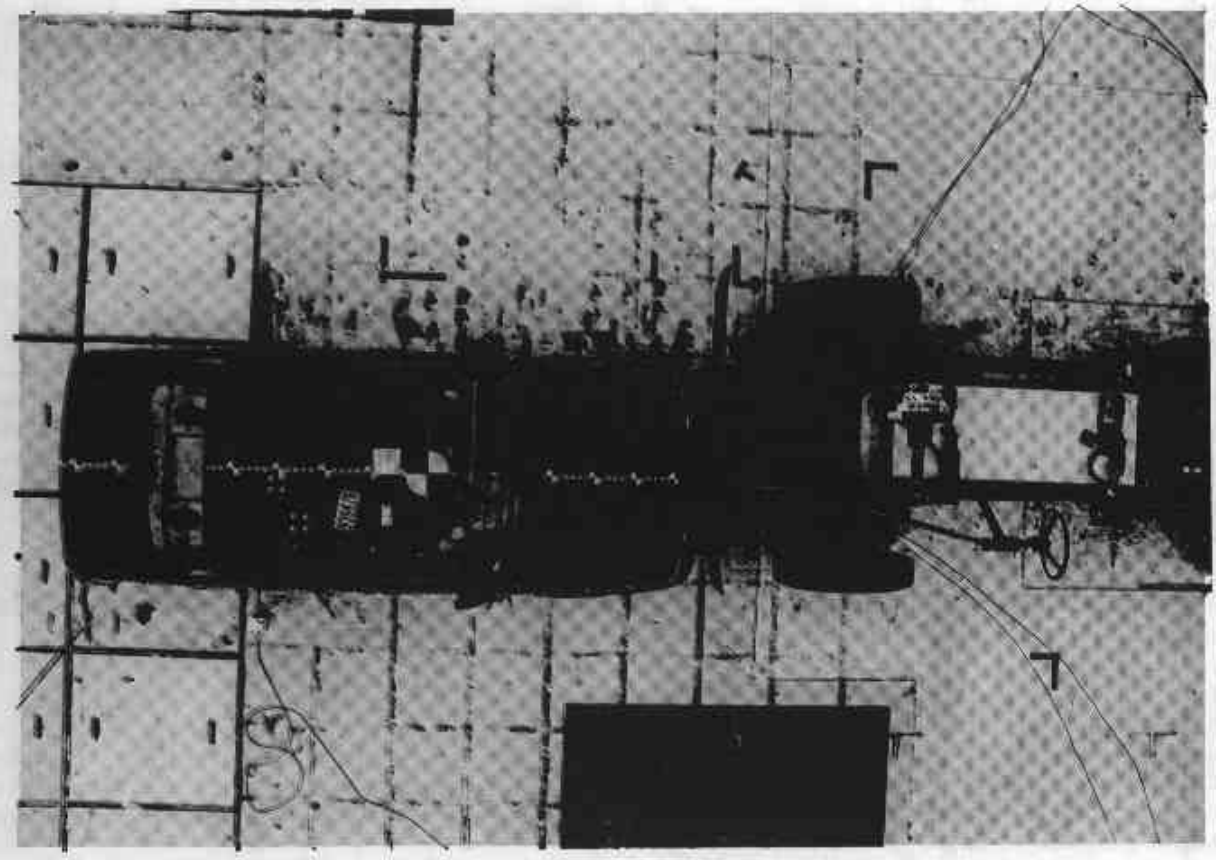


Figure A-10. PRE-TEST TRUCK OVERHEAD VIEW

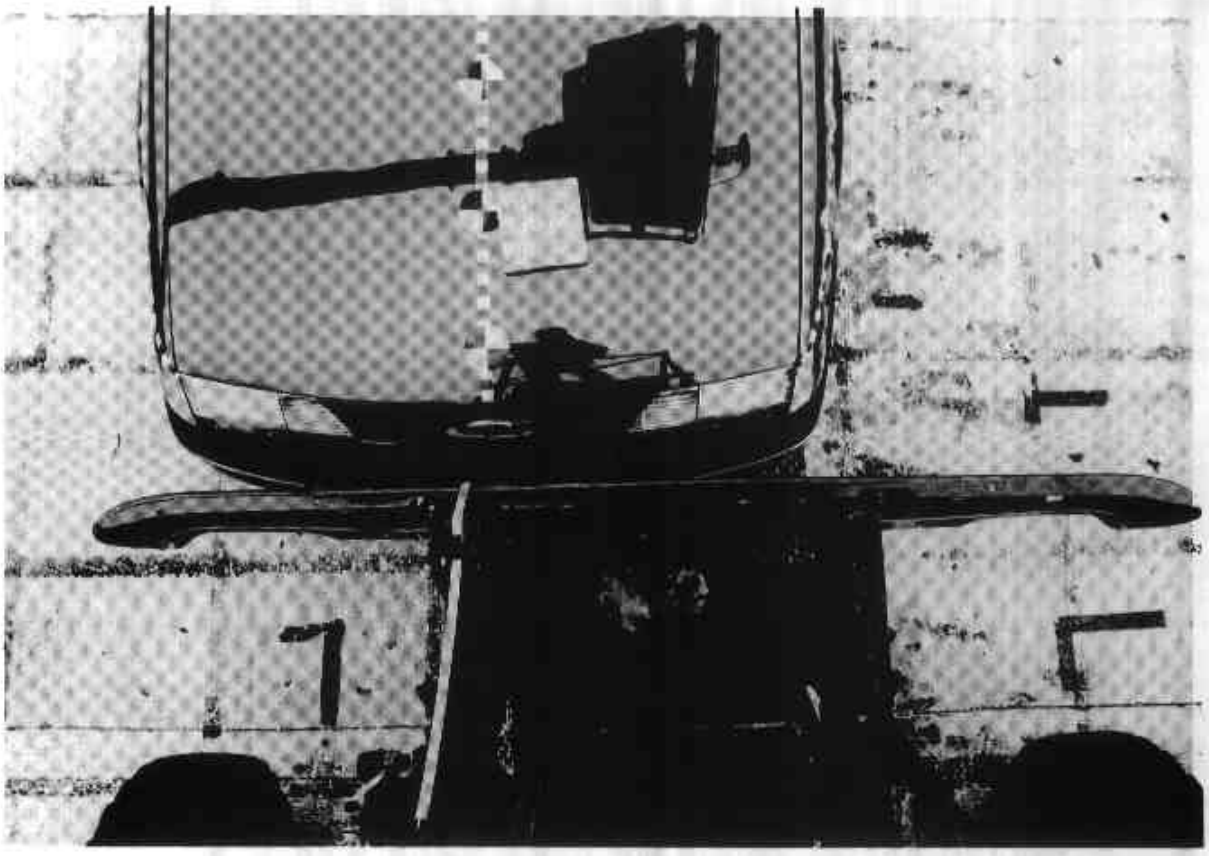


Figure A-11. PRE-TEST BUMPER ENGAGEMENT VIEW

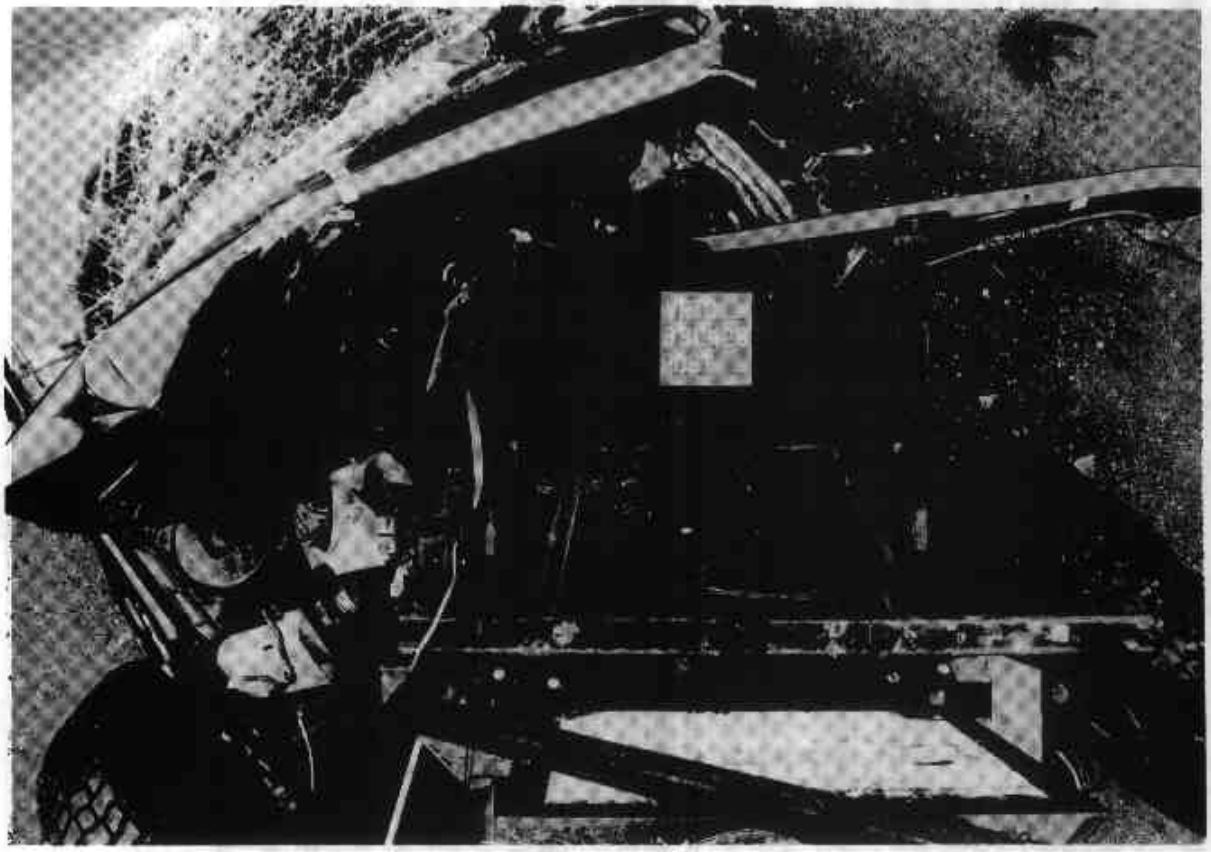


Figure A-12. POST-TEST BUMPER ENGAGEMENT VIEW

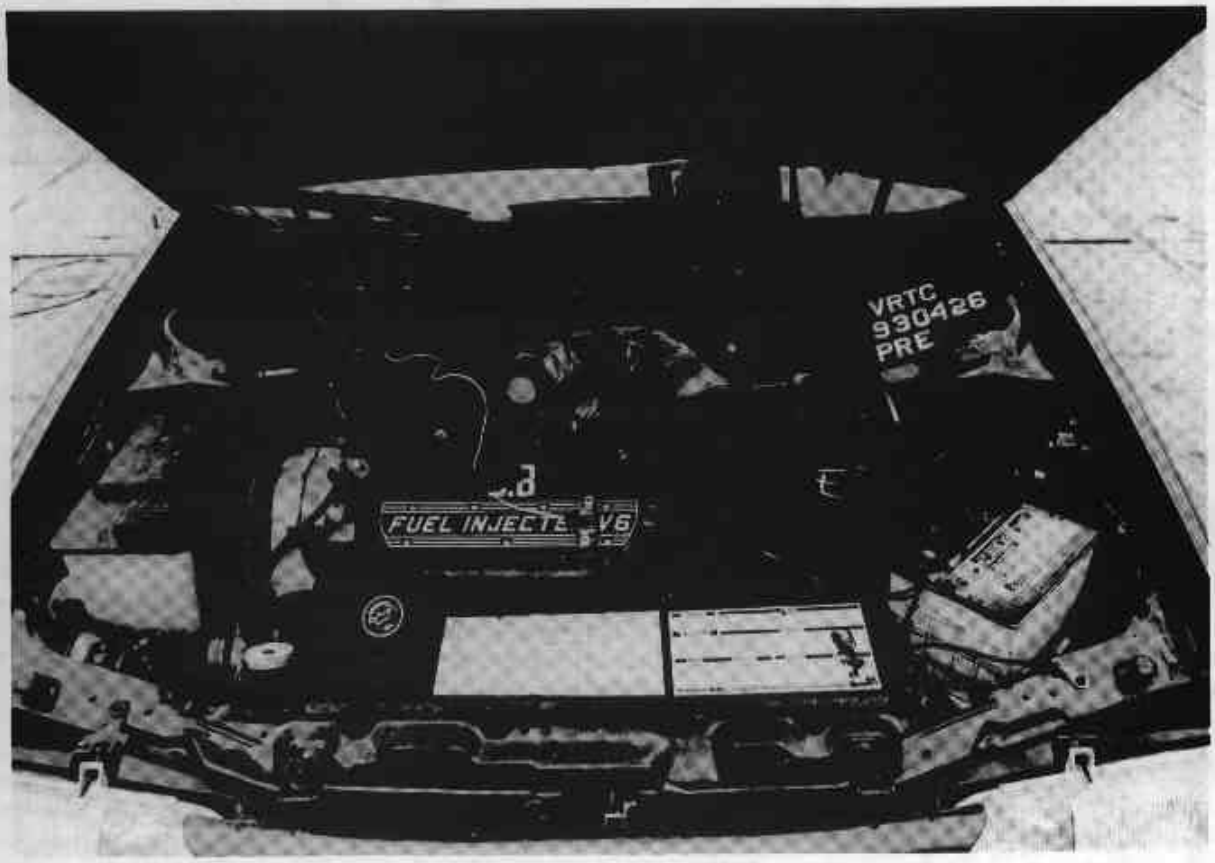



Figure A-13. PRE-TEST ENGINE COMPARTMENT VIEW

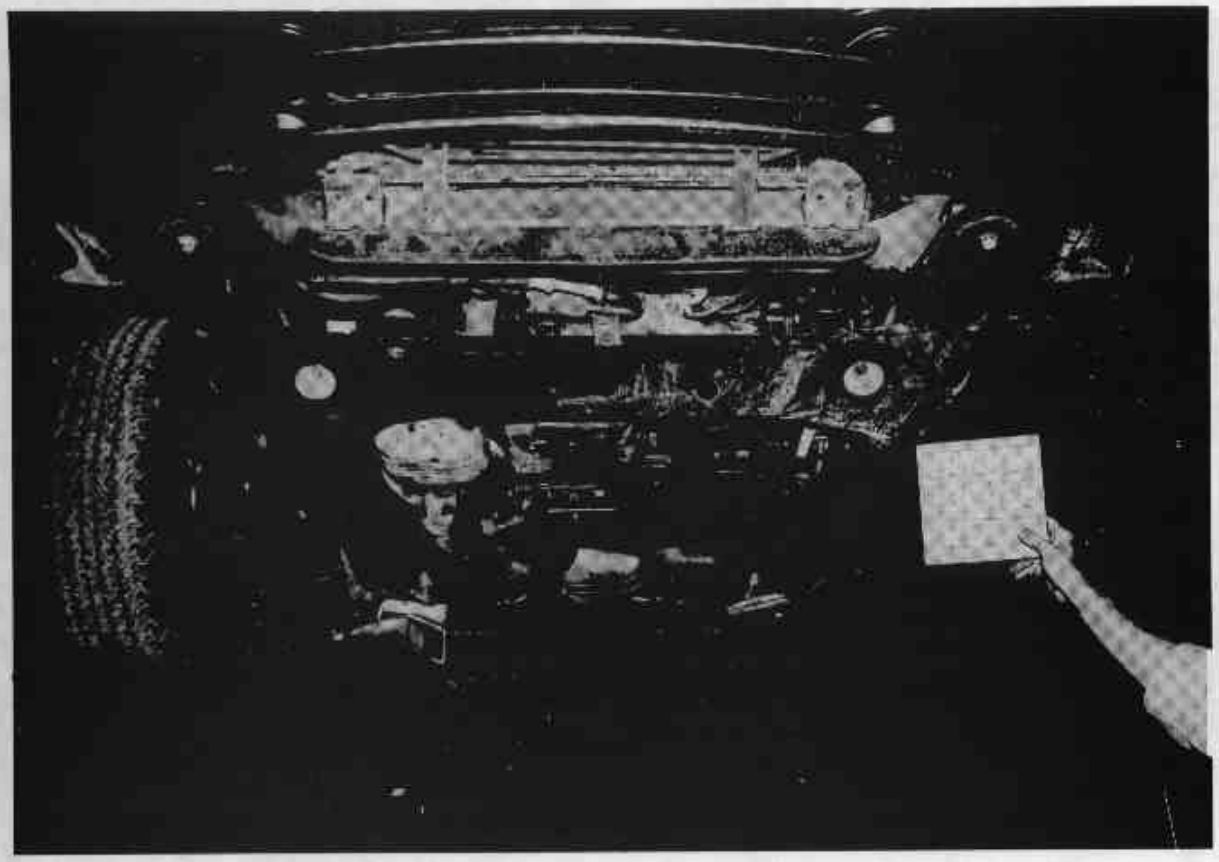


Figure A-14. PRE-TEST FRONT UNDERBODY VIEW

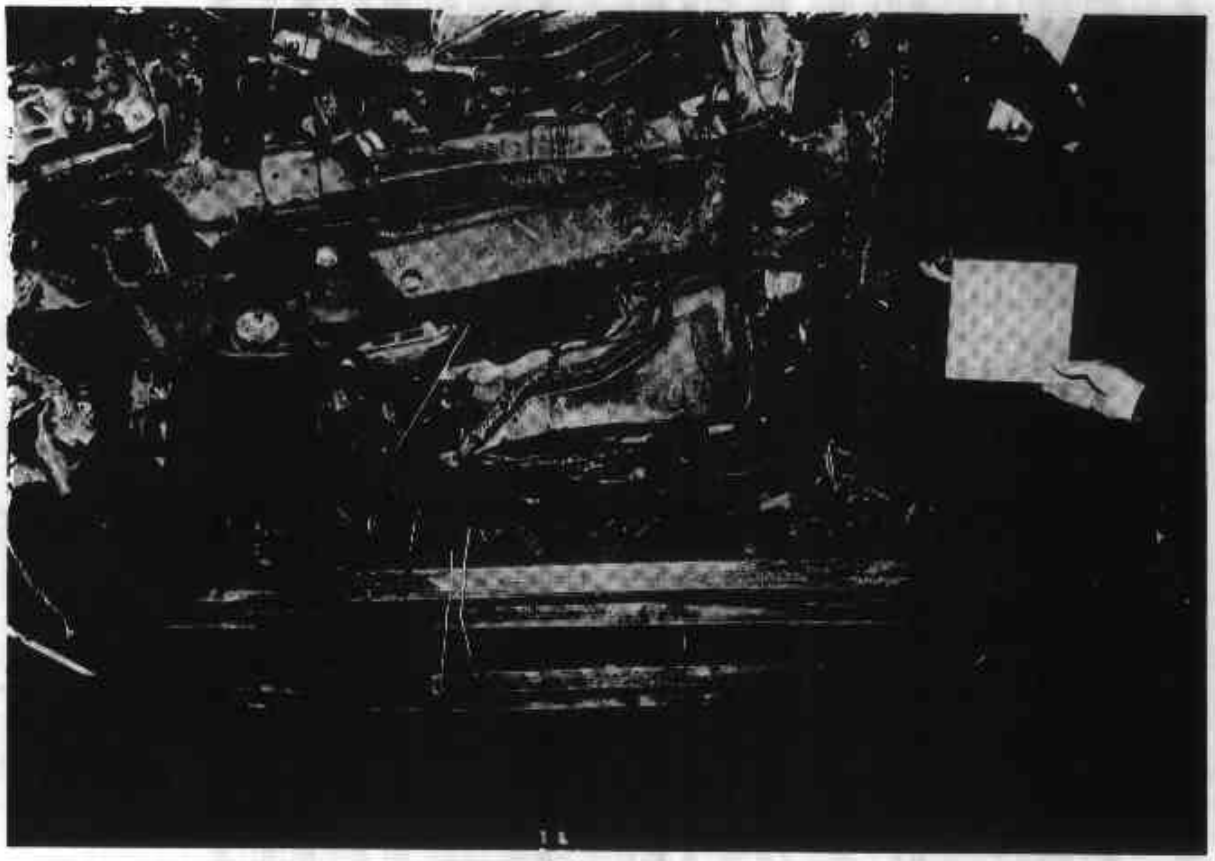


Figure A-15. POST-TEST FRONT UNDERBODY VIEW

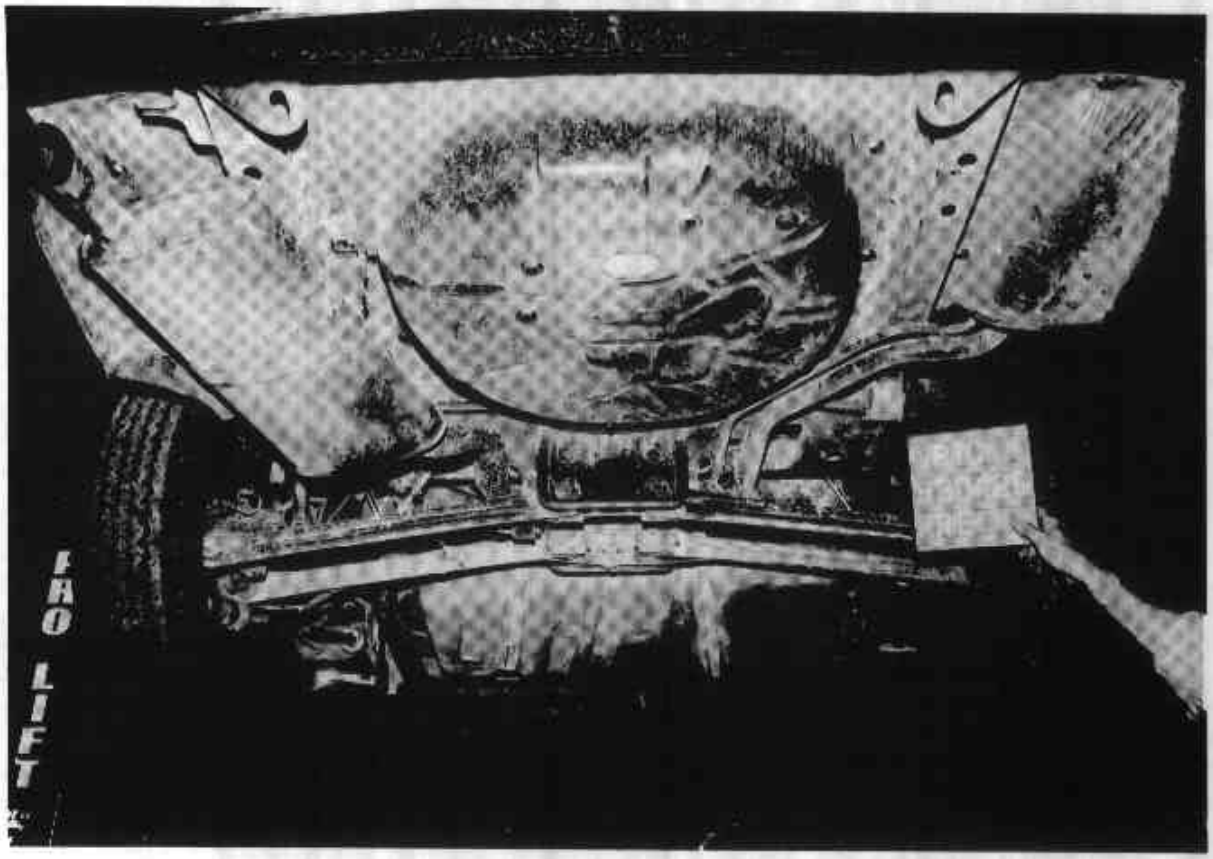



Figure A-16. PRE-TEST REAR UNDERBODY VIEW

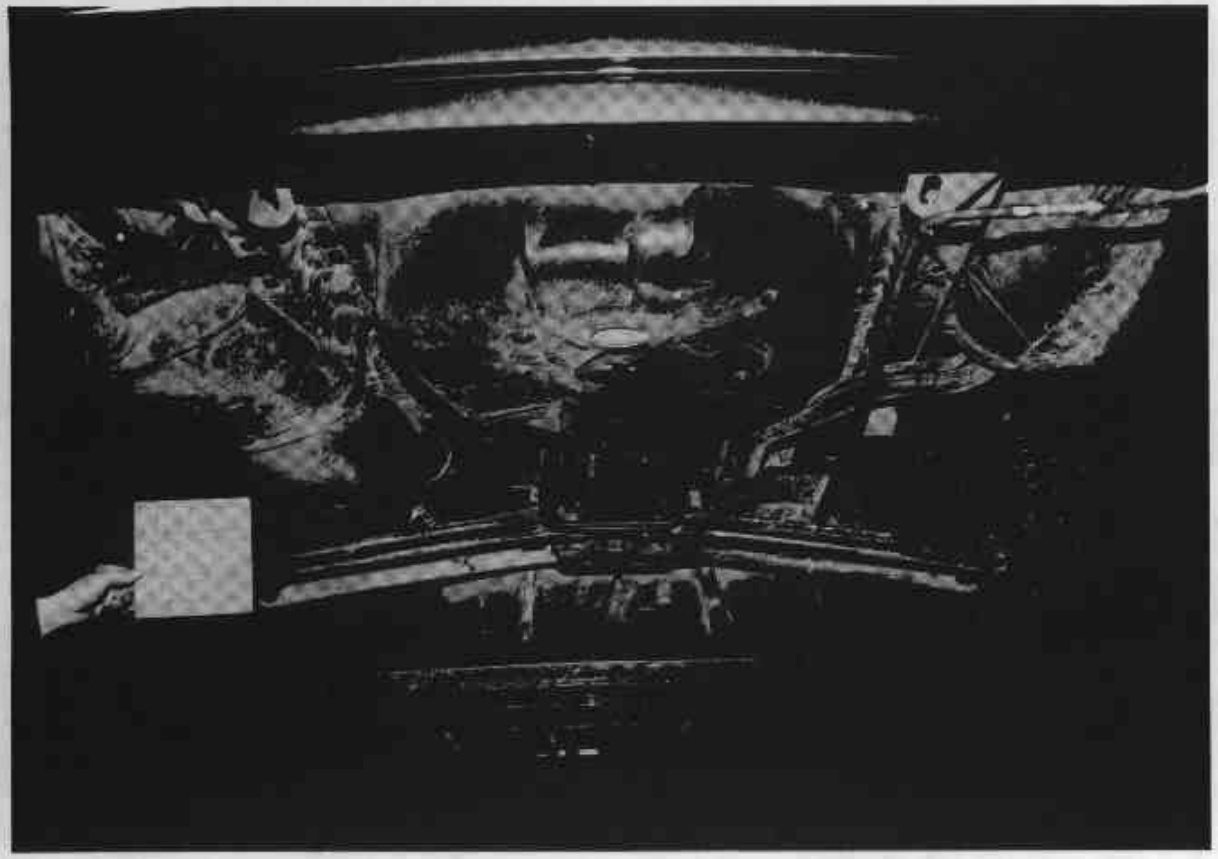


Figure A-17. POST-TEST REAR UNDERBODY VIEW

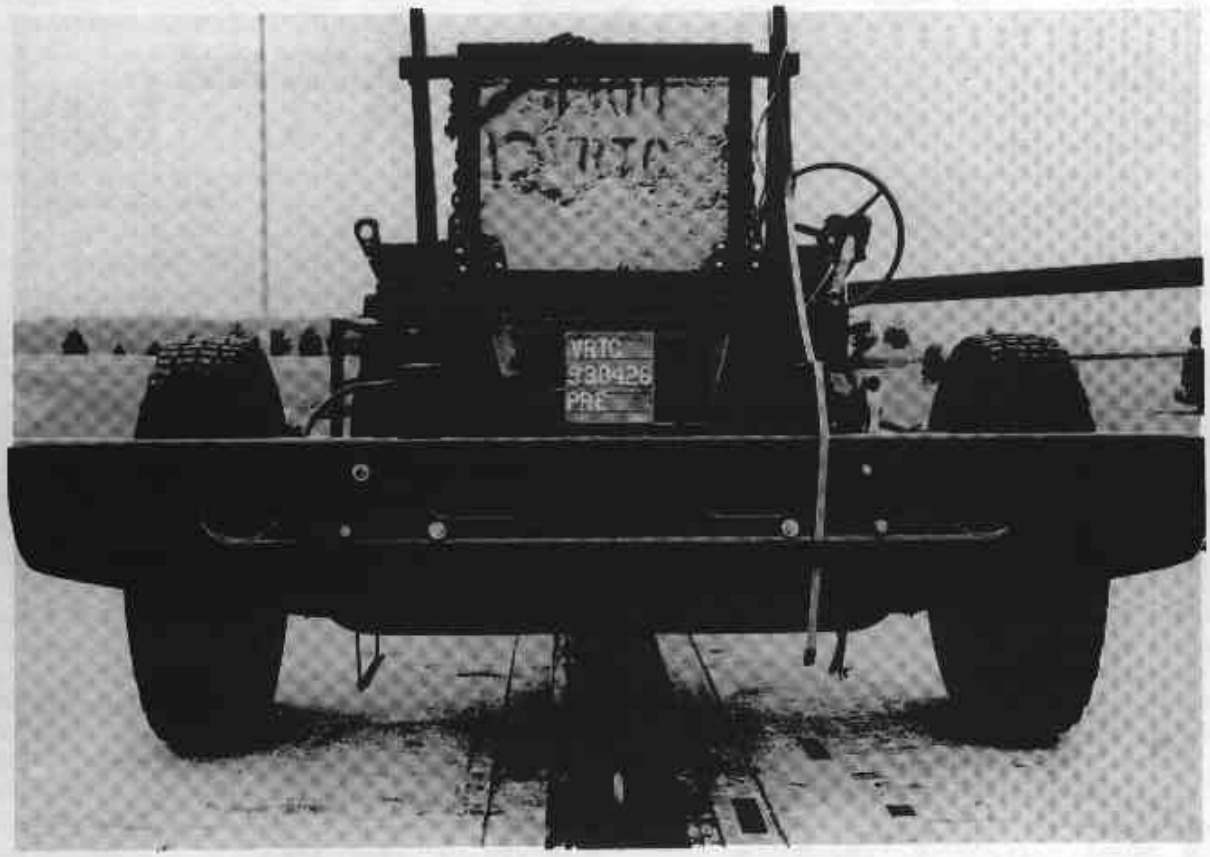



Figure A-18. PRE-TEST TRUCK FRONT VIEW

Figure A-19. POST-TEST TRUCK FRONT VIEW

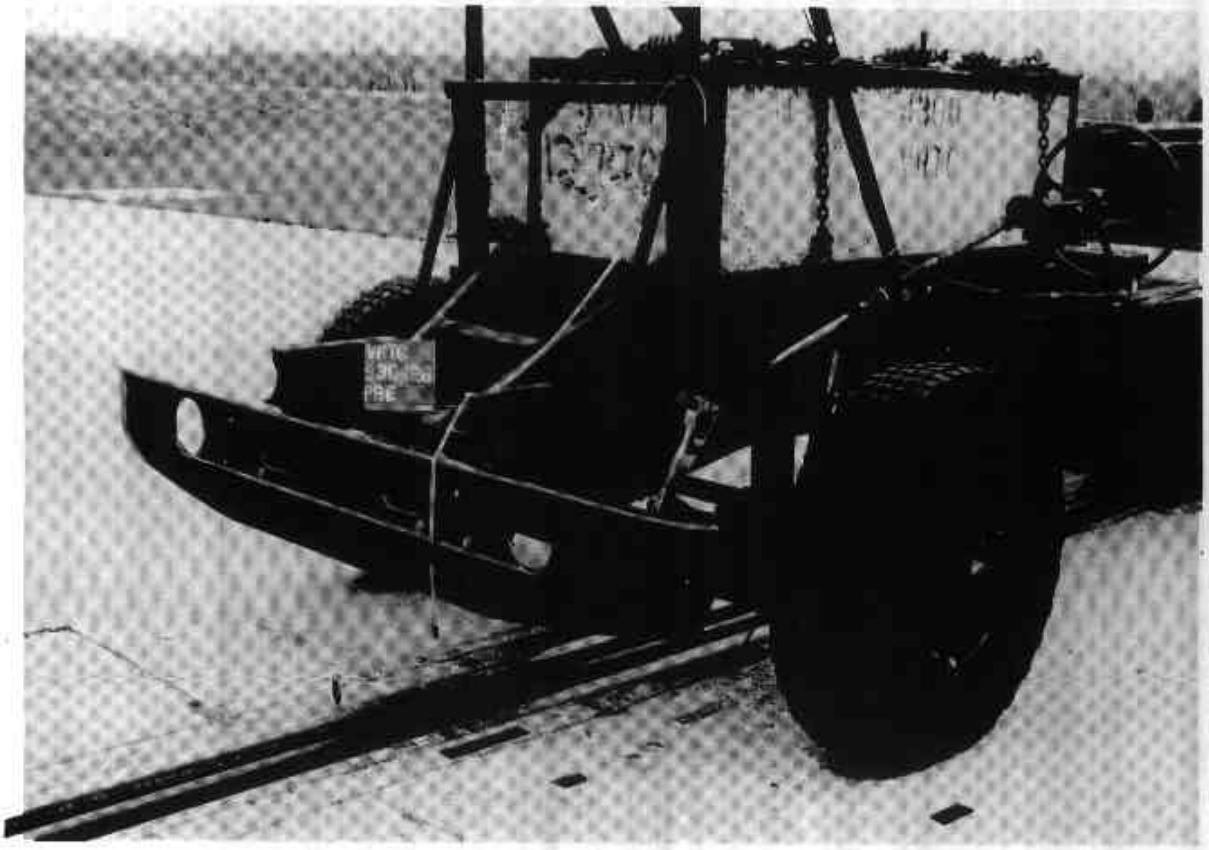


Figure A-20. PRE-TEST TRUCK CLOSE-UP - VIEW 1

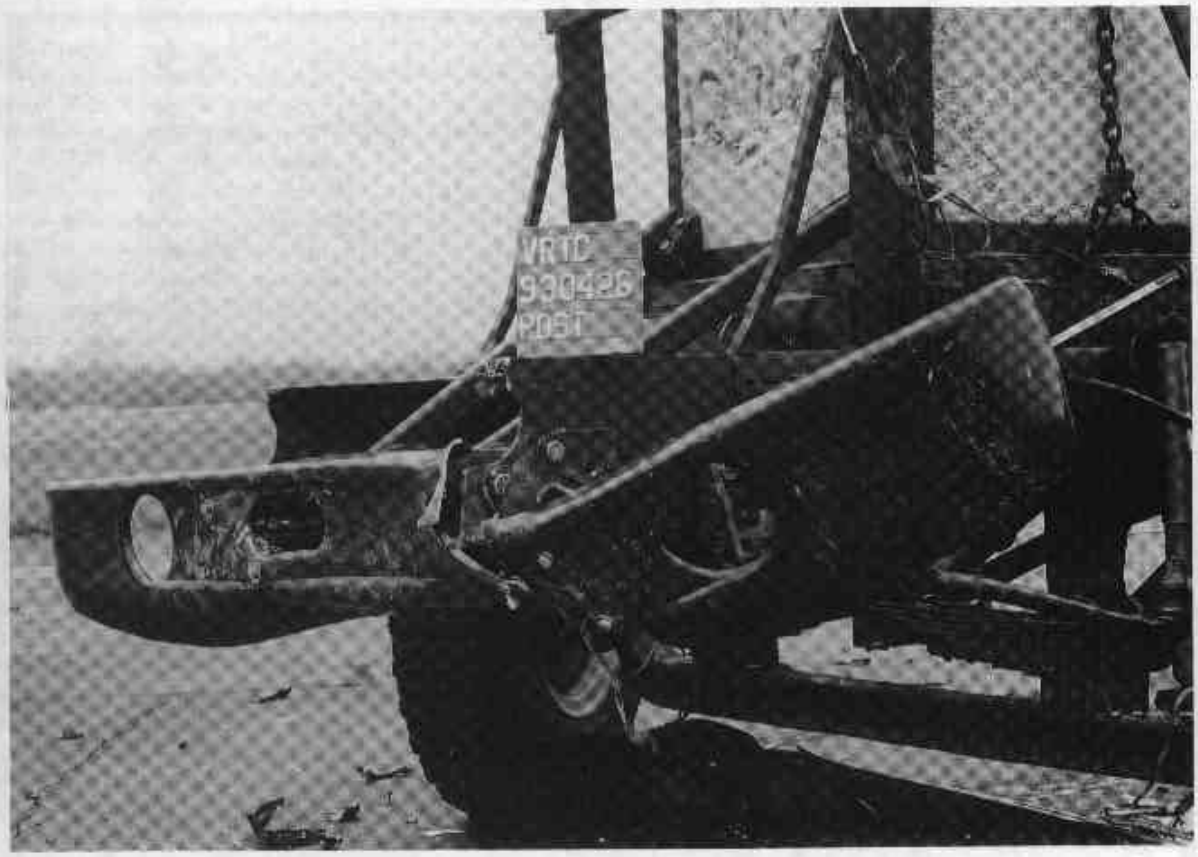



Figure A-21. POST-TEST TRUCK CLOSE-UP - VIEW 1


Figure A-22. PRE-TEST TRUCK CLOSE-UP - VIEW 2

Figure A-23. POST-TEST TRUCK CLOSE-UP - VIEW 2

Figure A-24. POST-TEST TRUCK DAMAGE CLOSE-UP - VIEW 1

Figure A-25. POST-TEST TRUCK DAMAGE CLOSE-UP - VIEW 2

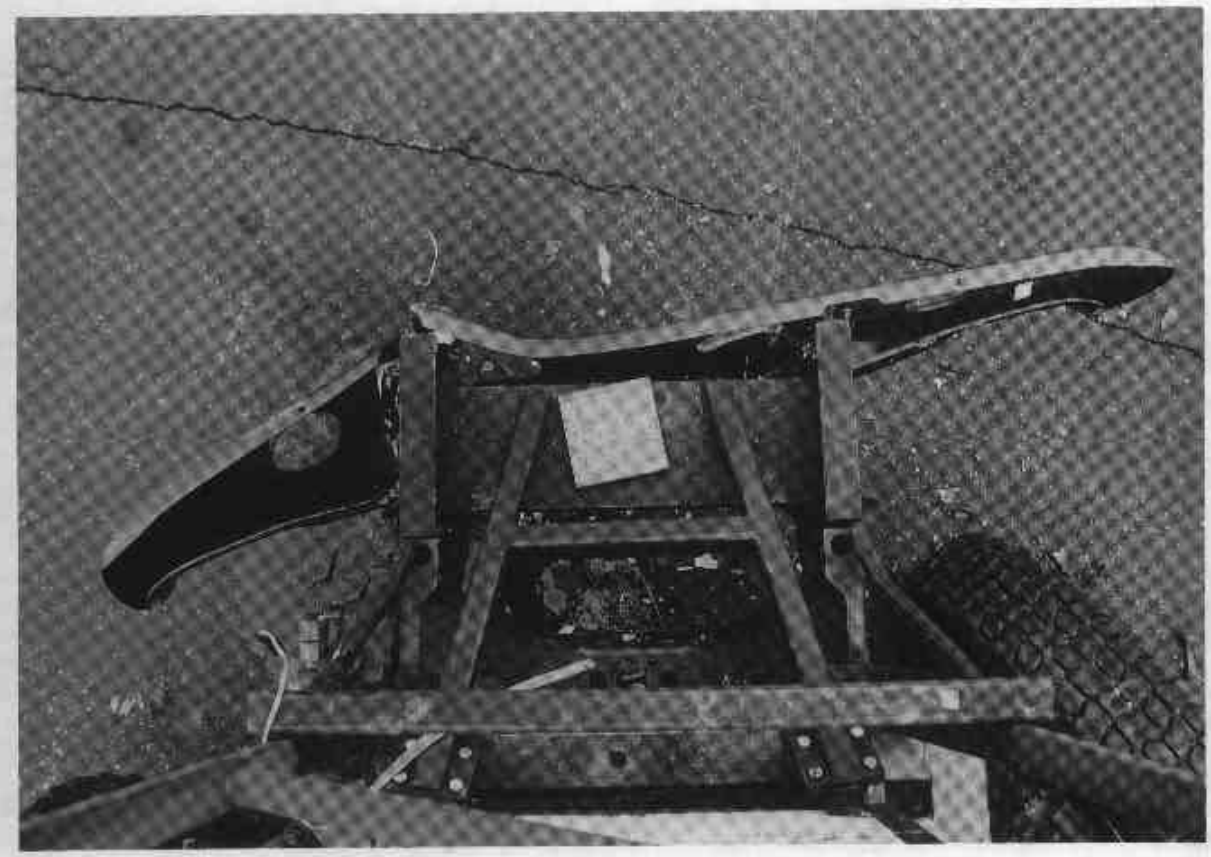


Figure A-26. POST-TEST TRUCK DAMAGE CLOSE-UP - VIEW 3

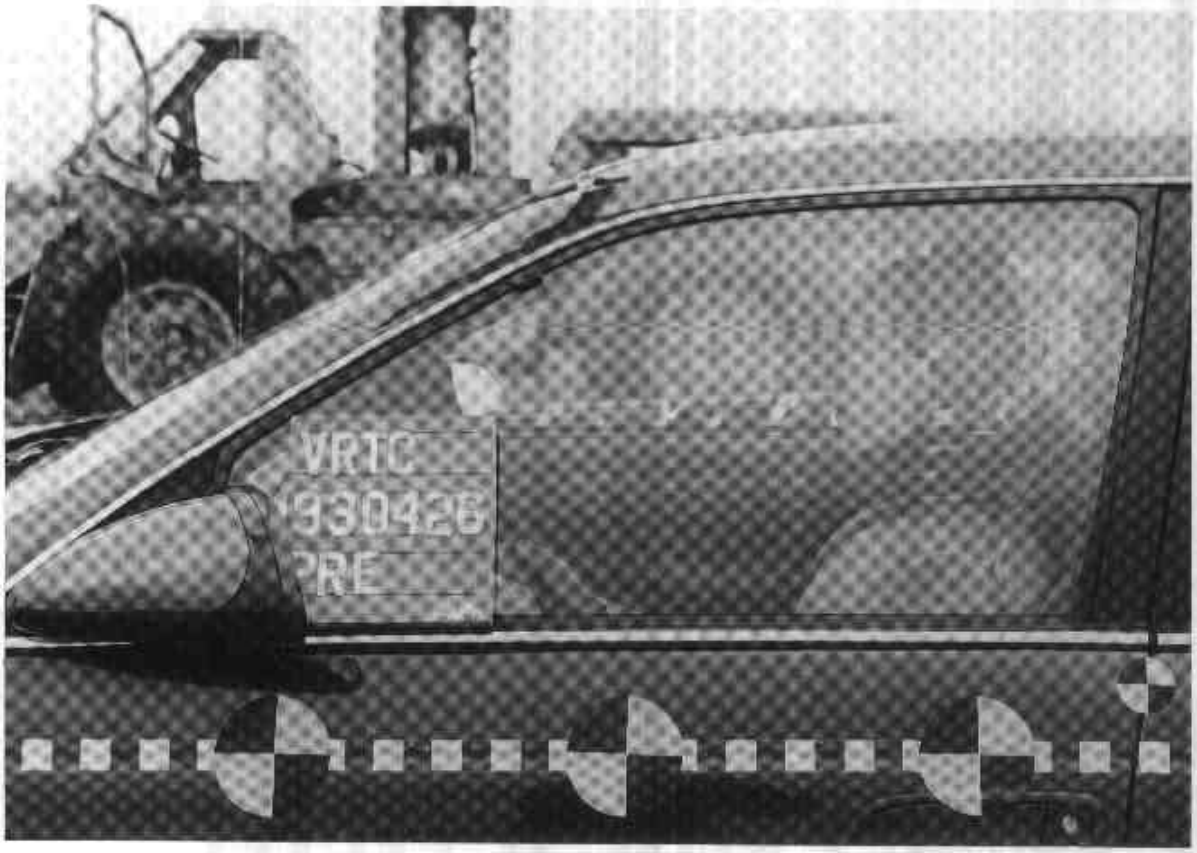



Figure A-27. PRE-TEST DUMMY VIEW

Figure A-28. POST-TEST DUMMY VIEW


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


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

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

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

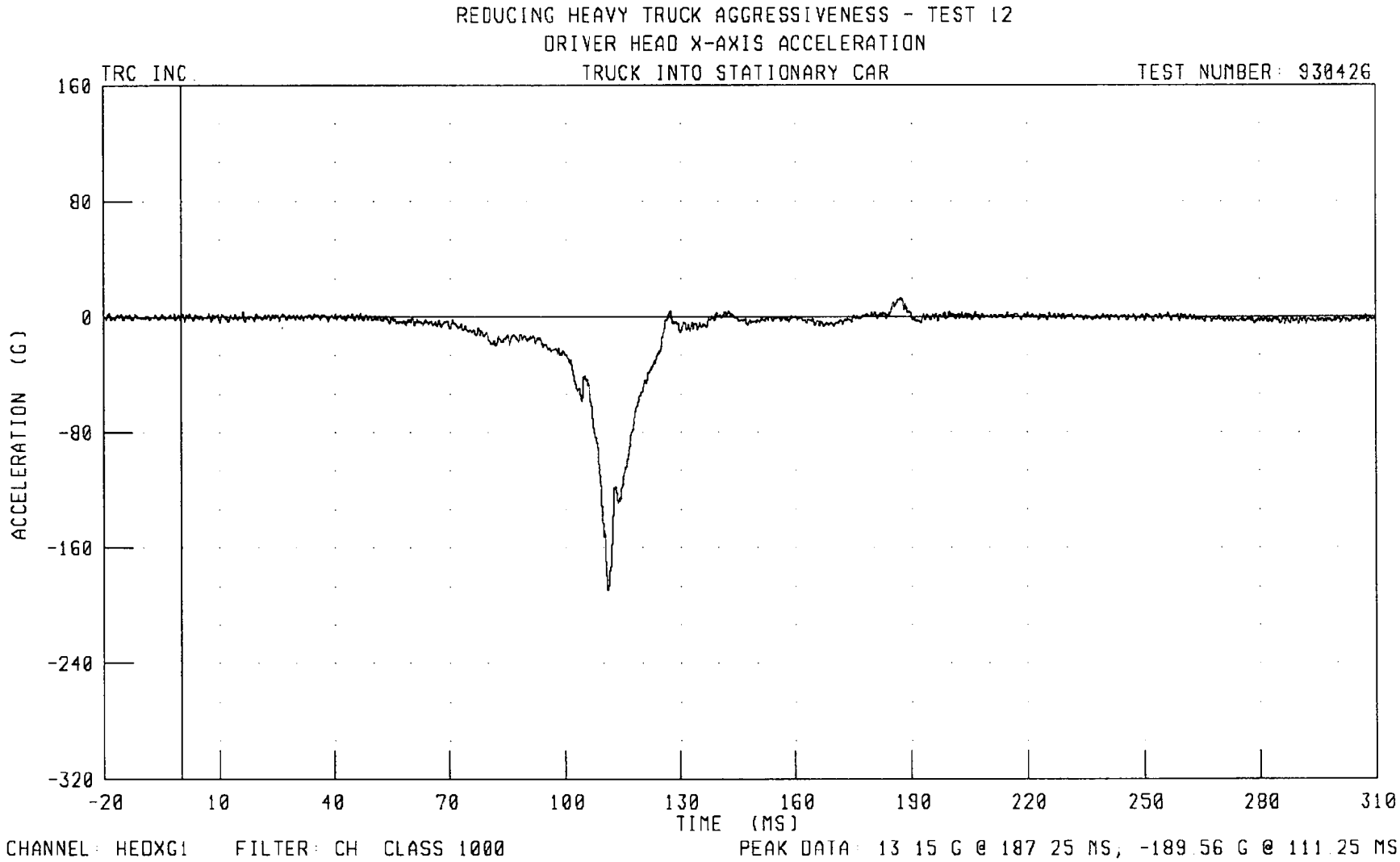

Figure A-33. POST-TEST DUMMY HEAD CONTACT - VIEW 1

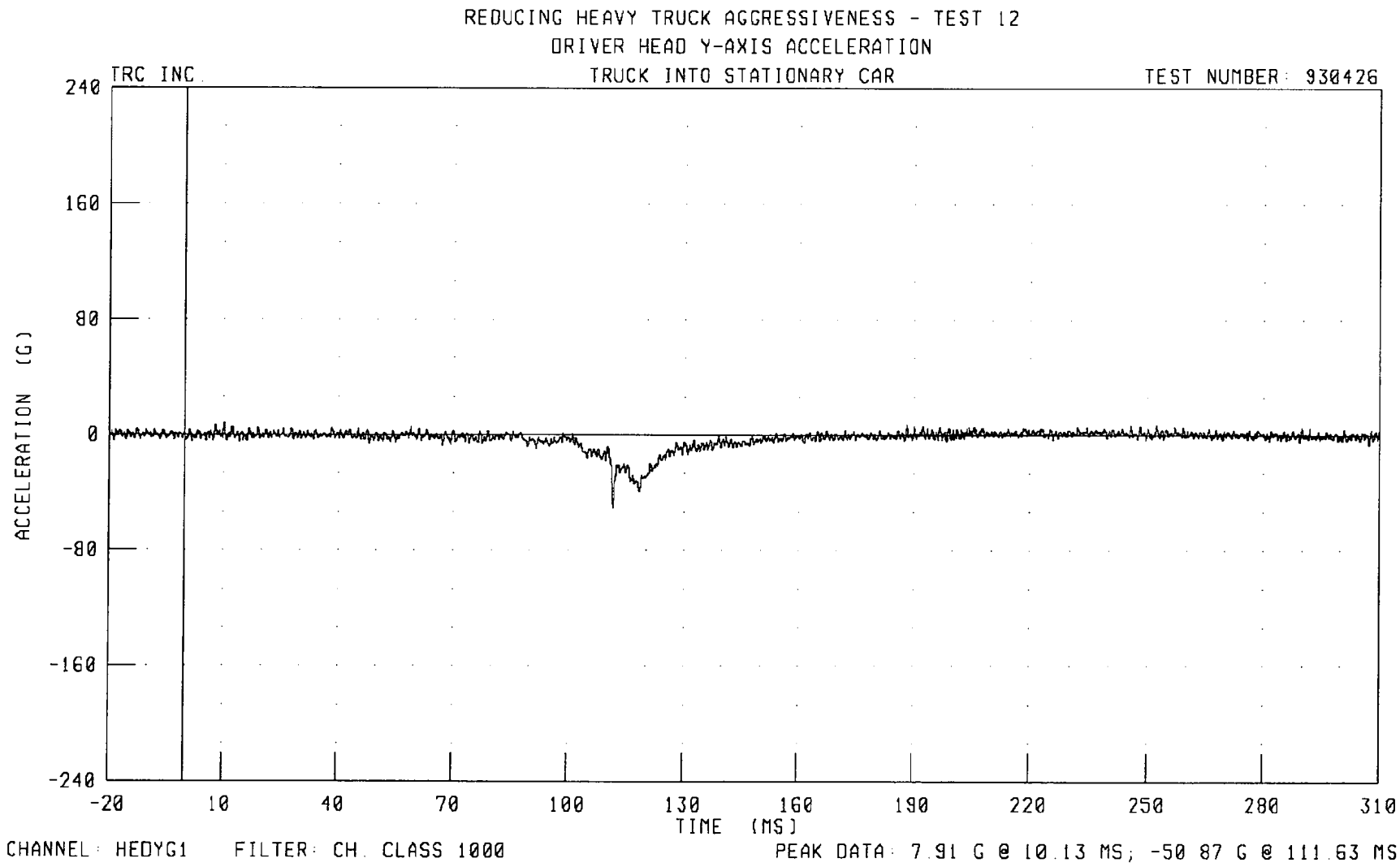

Figure A-34. POST-TEST DUMMY HEAD CONTACT - VIEW 2

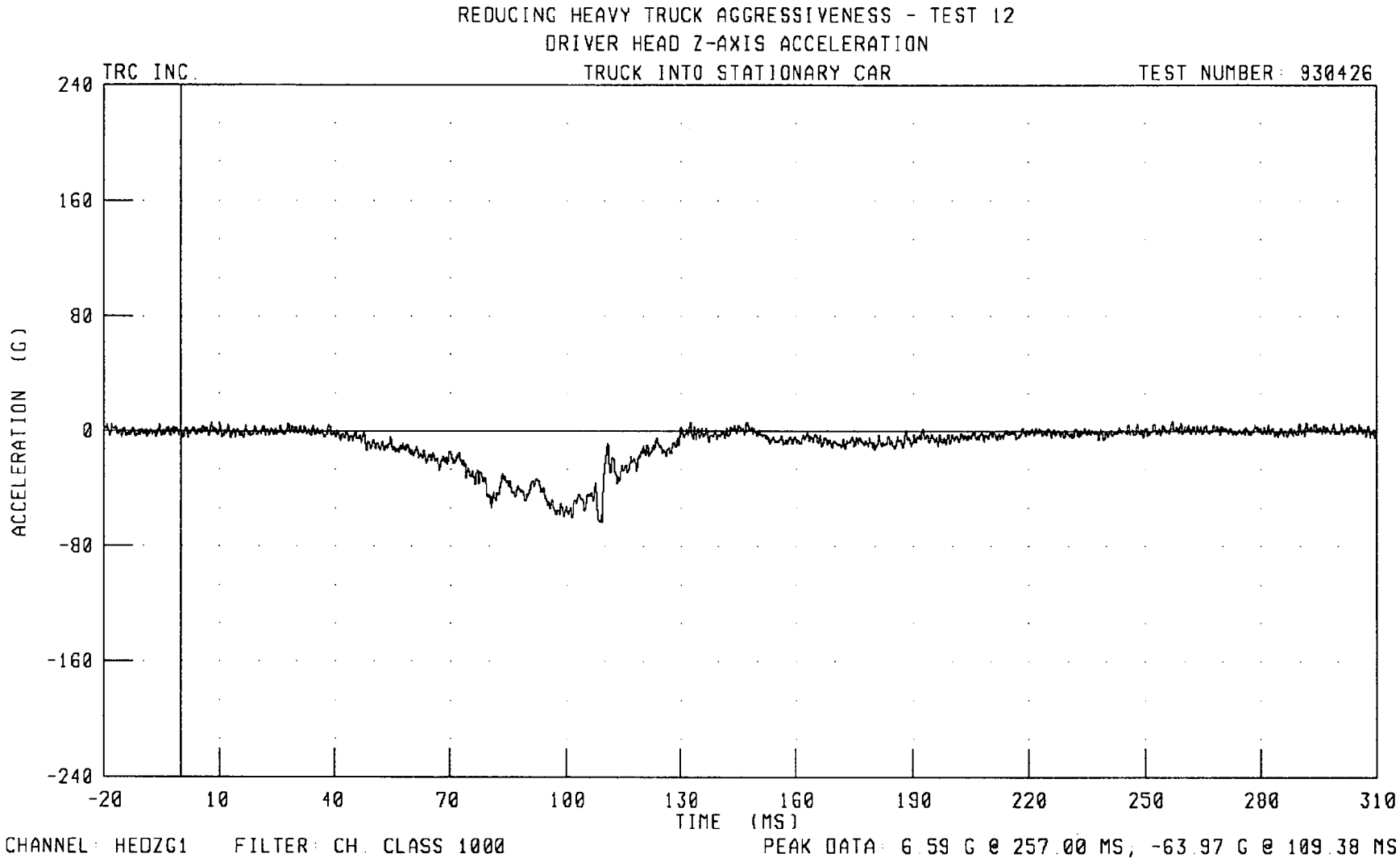

Figure A-35. POST-TEST DUMMY KNEE CONTACT VIEW

# APPENDIX B

## DATA PLOTS

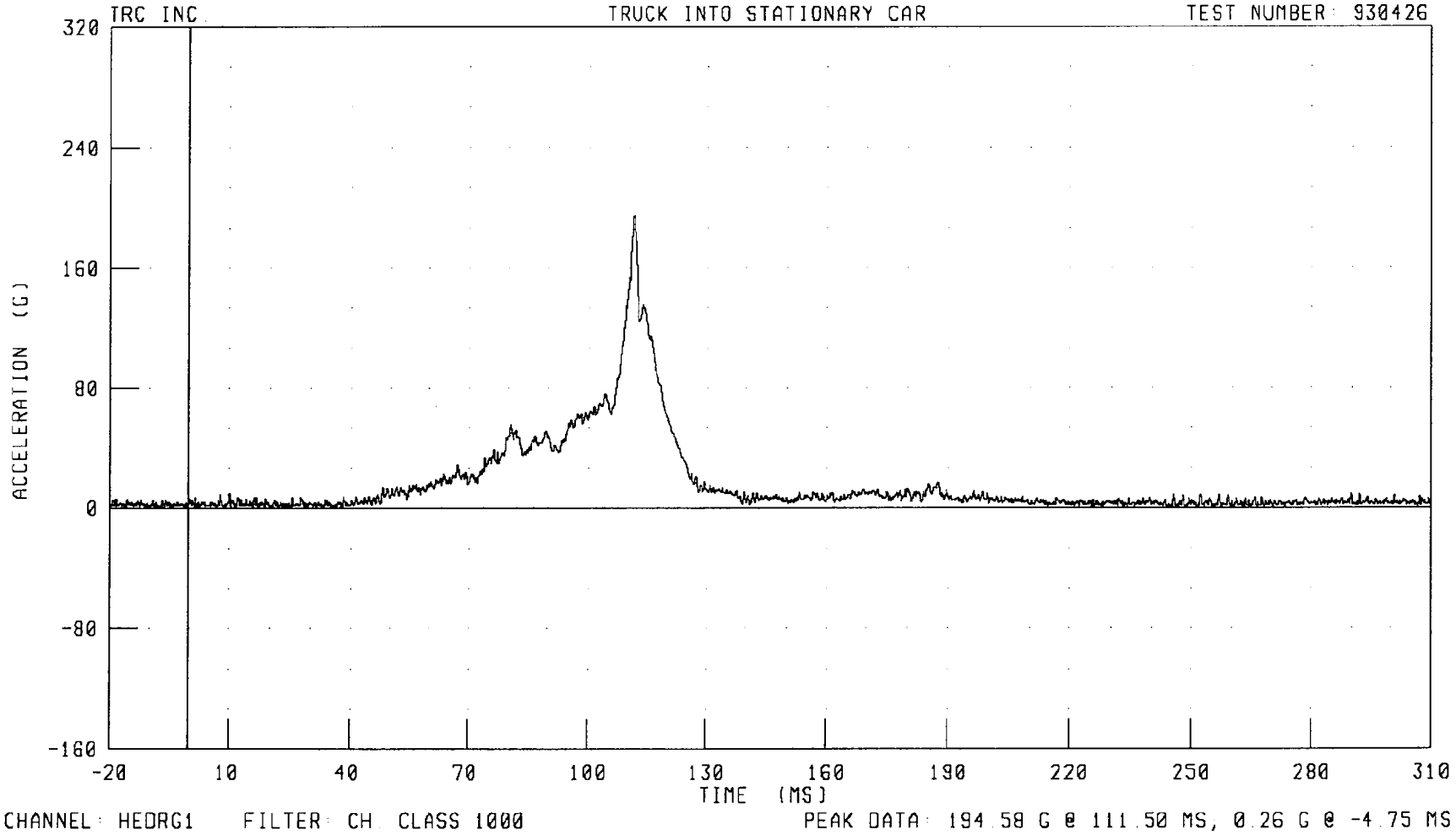

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER HEAD X-AXIS ACCELERATION
TRC INC
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
160
80
0
-80
-160
-240
-320
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: HEDXG1
FILTER: CH CLASS 1000
PEAK DATA: 13.15 G @ 187.25 MS, -189.56 G @ 111.25 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER HEAD Y-AXIS ACCELERATION
TRC INC
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
240
160
80
0
-80
-160
-240
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: HEDYG1
FILTER: CH. CLASS 1000
PEAK DATA: 7.91 G @ 10.13 MS; -50.87 G @ 111.63 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER HEAD Z-AXIS ACCELERATION
TRC INC.
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
240
160
80
0
-80
-160
-240
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: HEDZG1
FILTER: CH. CLASS 1000
PEAK DATA: 6.59 G @ 257.00 MS, -63.97 G @ 109.38 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12

DRIVER HEAD RESULTANT ACCELERATION



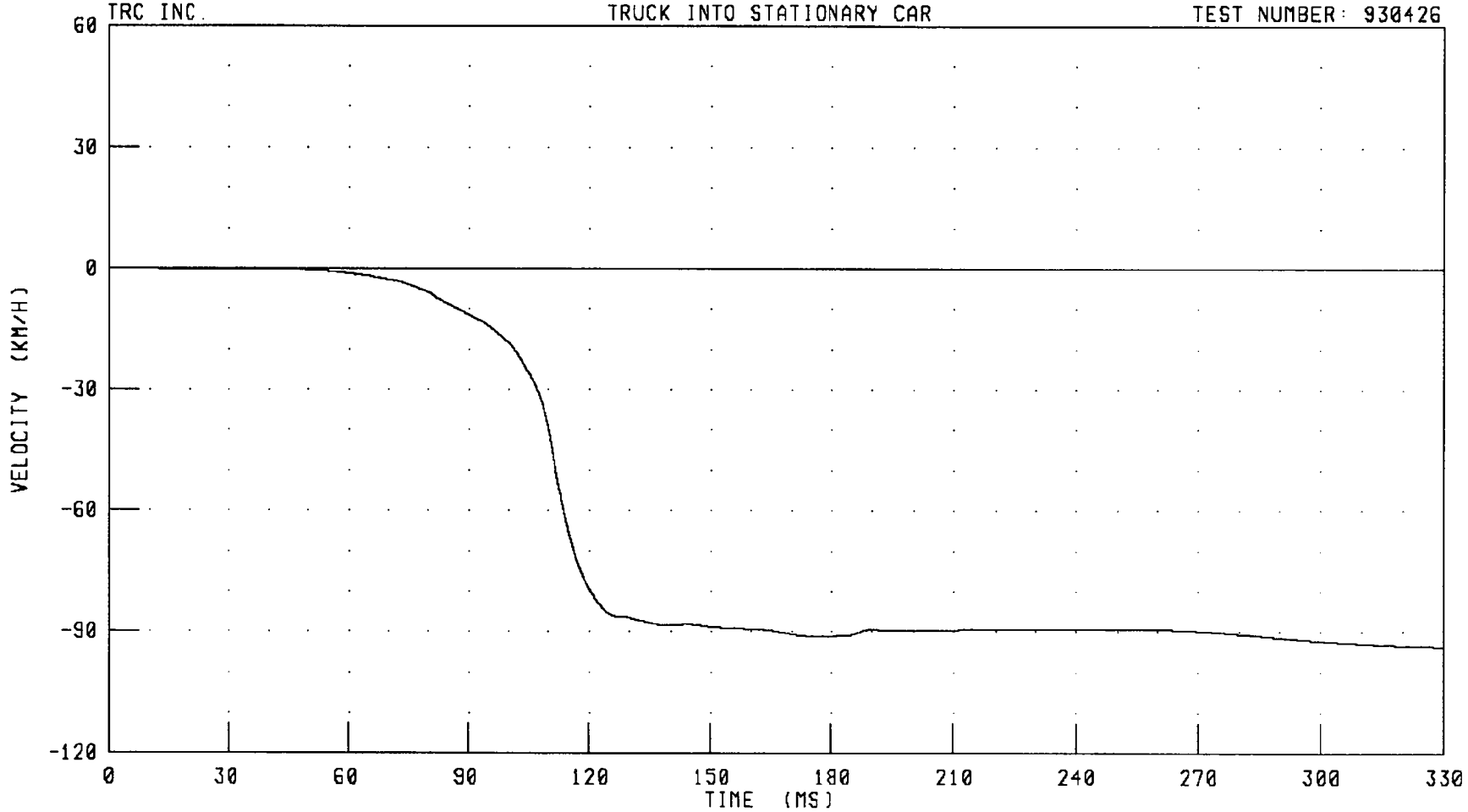

CHANNEL: HEDRG1 FILTER: CH CLASS 1000

PEAK DATA: 194.58 G @ 111.50 MS, 0.26 G @ -4.75 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12

DRIVER HEAD X-AXIS VELOCITY

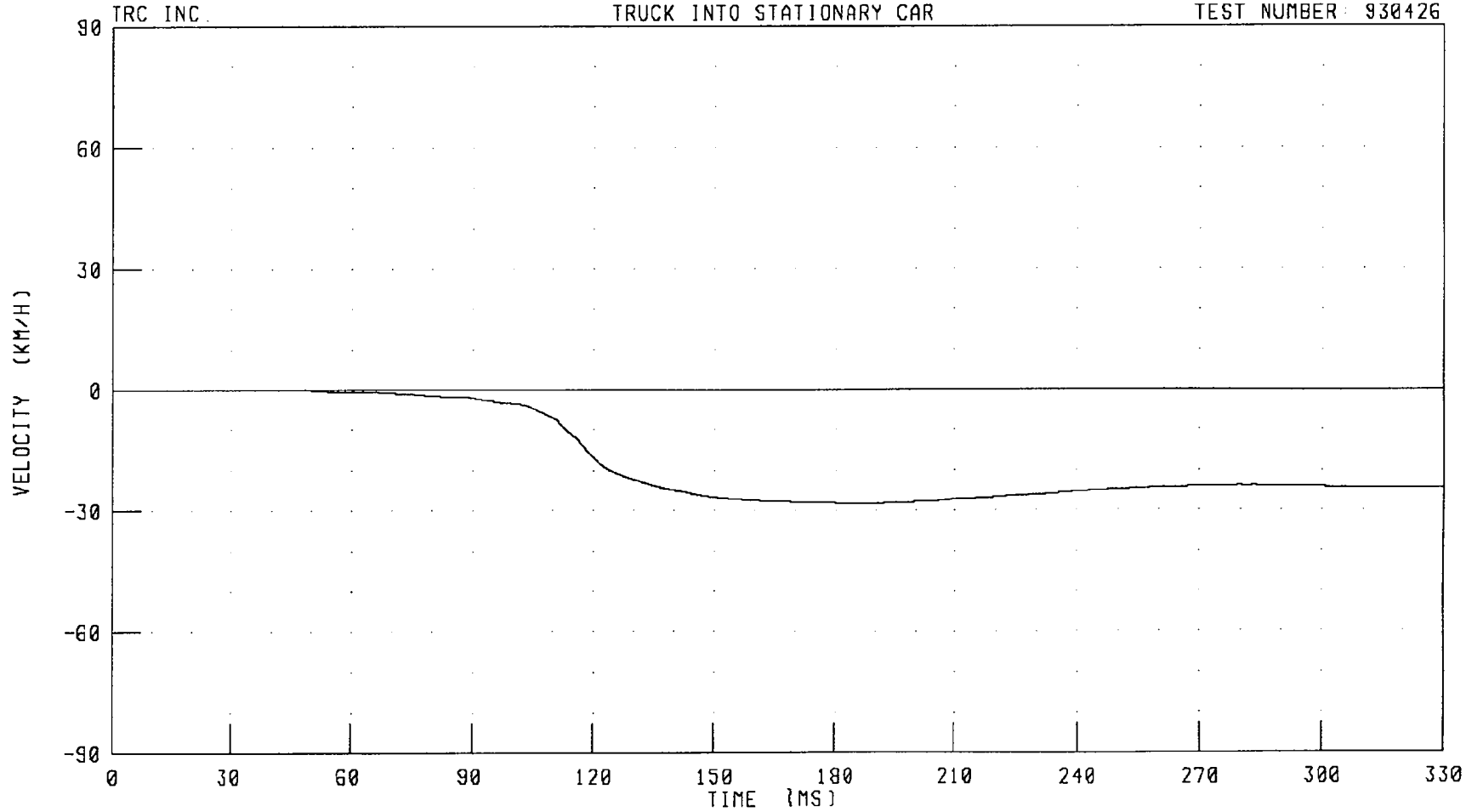
TRC INC. TRUCK INTO STATIONARY CAR TEST NUMBER: 930426



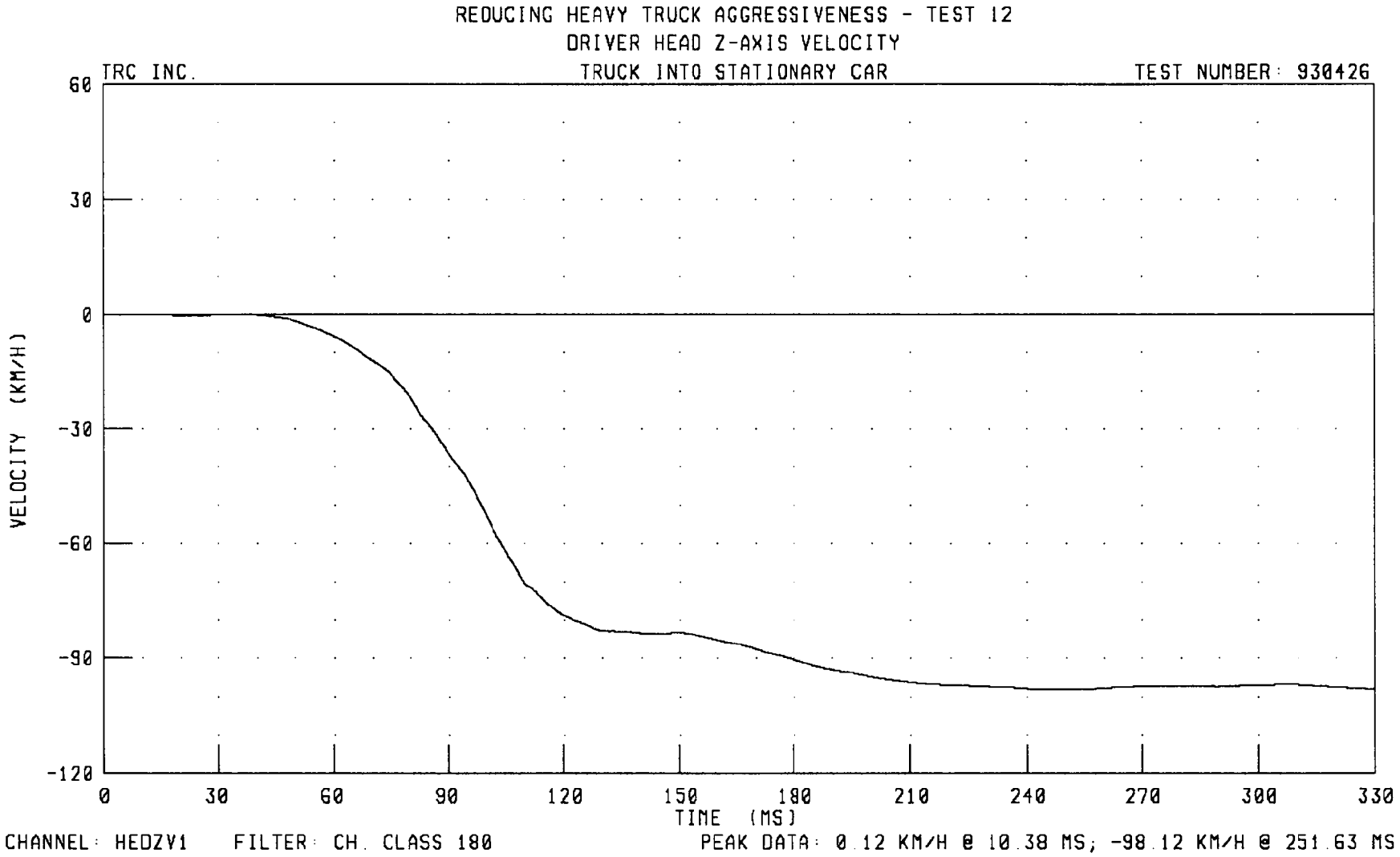

CHANNEL: HEDXV1 FILTER: CH. CLASS 180

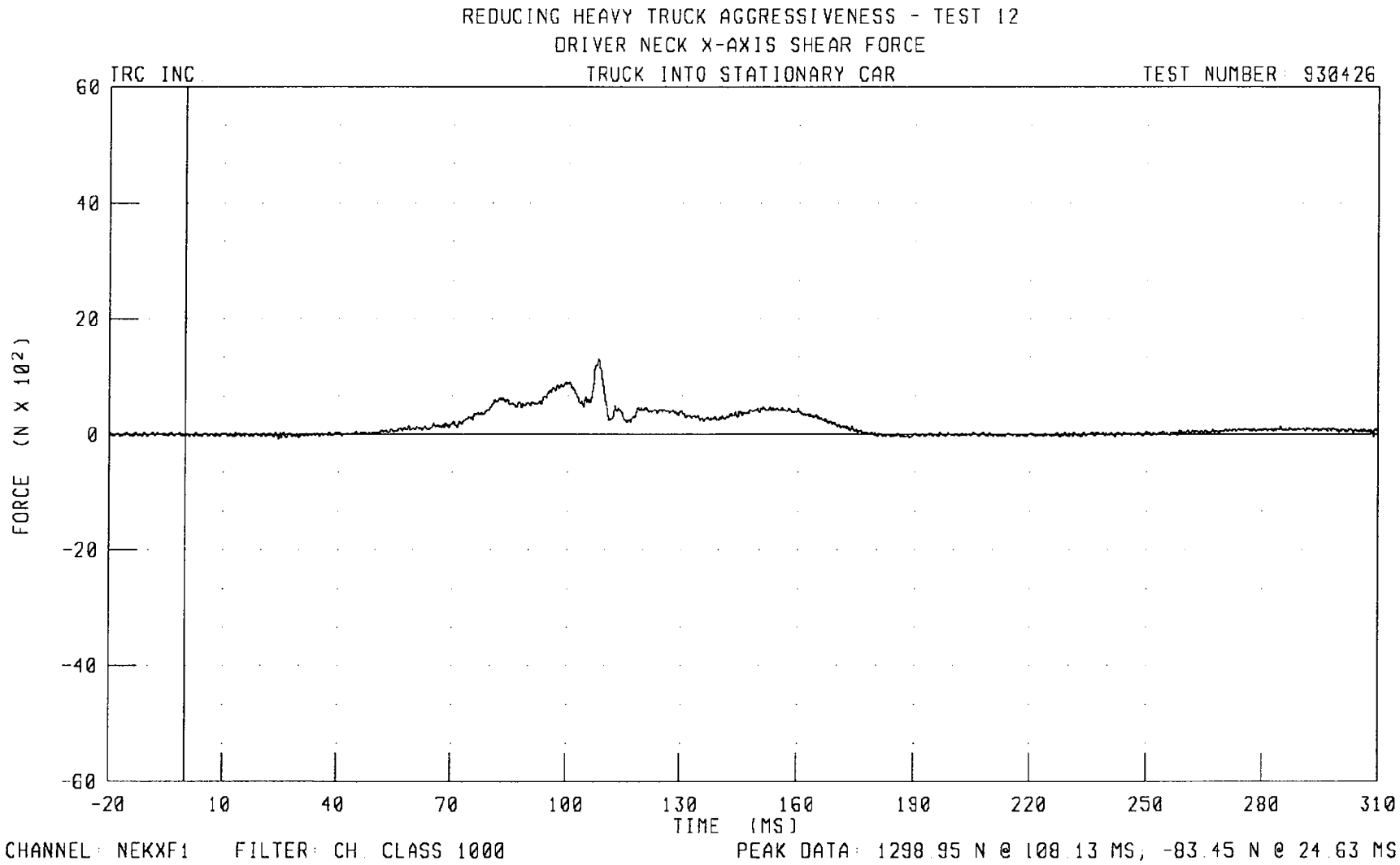
PEAK DATA: 0.00 KM/H @ 2.25 MS; -93.65 KM/H @ 330.00 MS

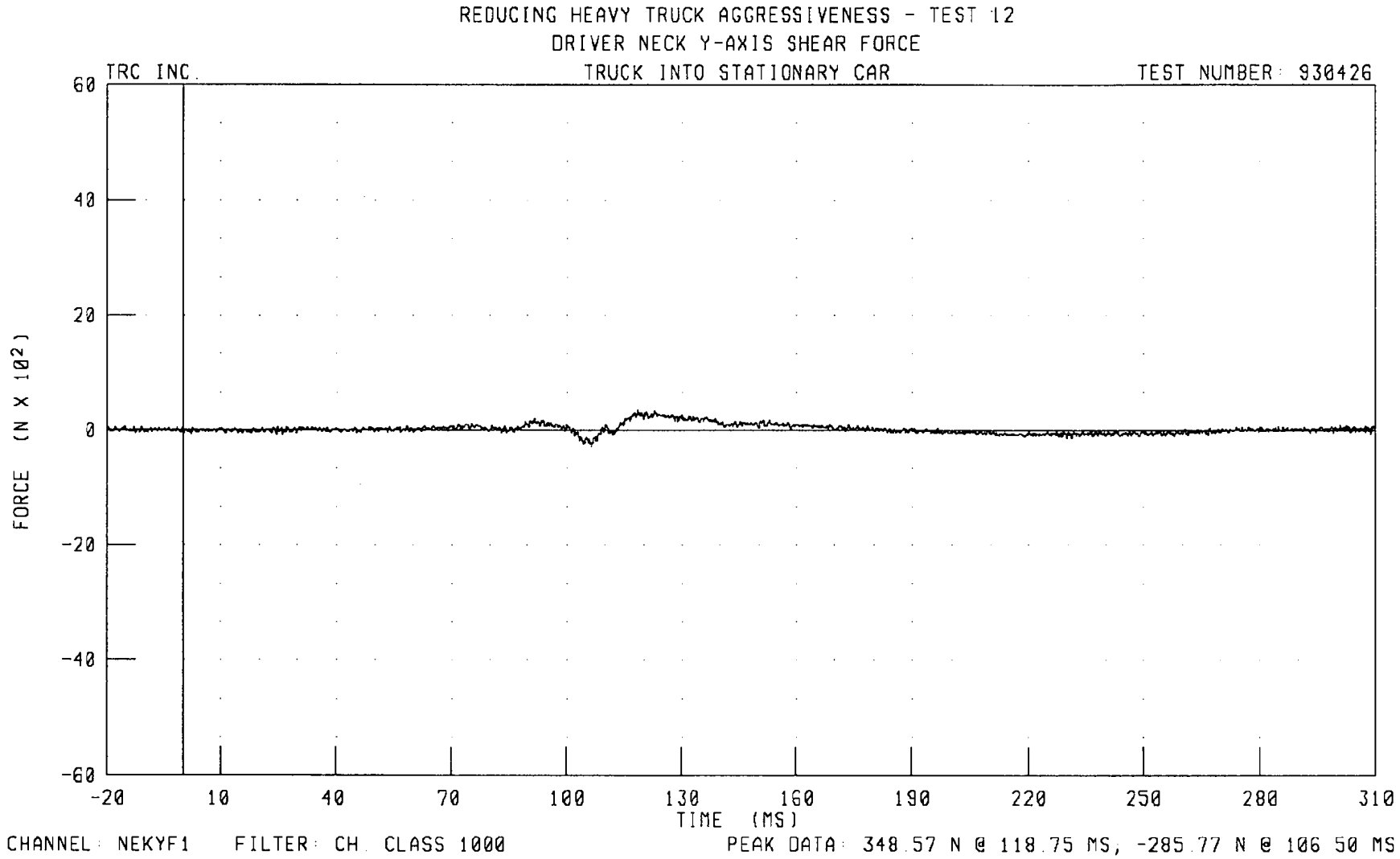
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER HEAD Y-AXIS VELOCITY
TRC INC. TRUCK INTO STATIONARY CAR TEST NUMBER: 930426

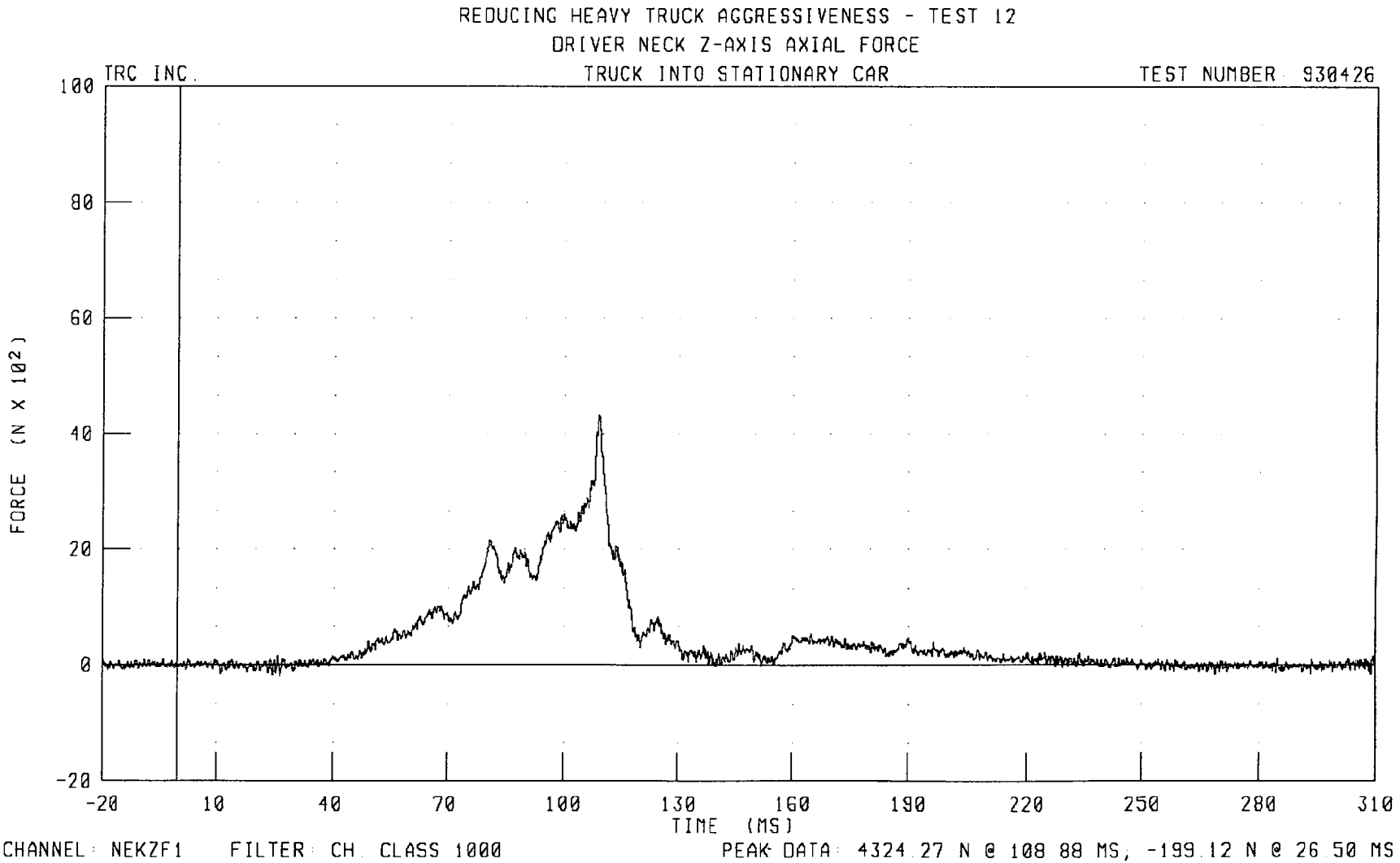



CHANNEL: HEDYV1 FILTER: CH. CLASS 180 PEAK DATA: 0.08 KM/H @ 43.50 MS; -28.20 KM/H @ 185.38 MS

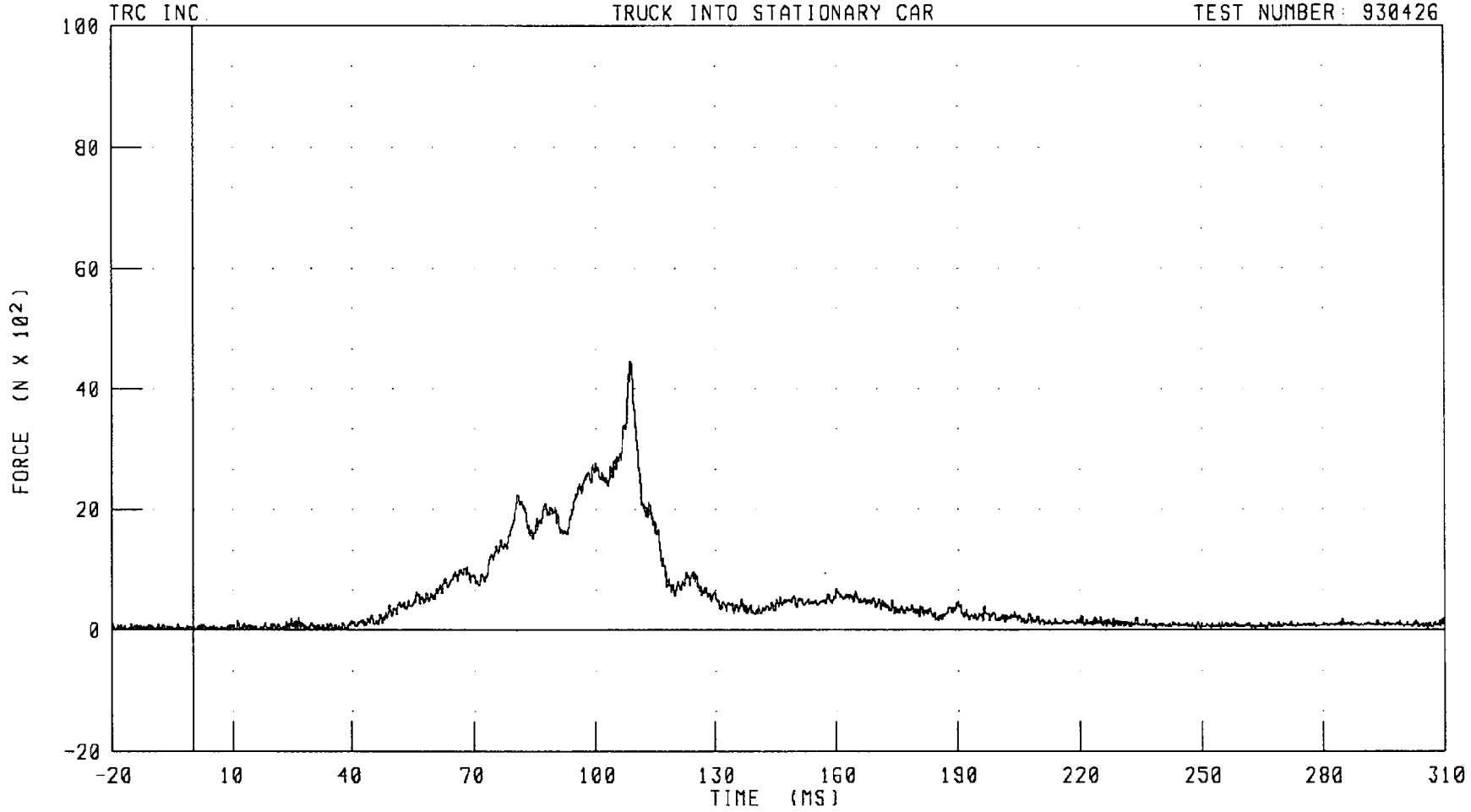

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER HEAD Z-AXIS VELOCITY
TRUCK INTO STATIONARY CAR
TRC INC.
TEST NUMBER: 930426
60
30
0
-30
-60
-90
-120
VELOCITY (KM/H)
0
30
60
90
120
150
180
210
240
270
300
330
TIME (MS)
CHANNEL: HEDZV1
FILTER: CH. CLASS 180
PEAK DATA: 0.12 KM/H @ 10.38 MS; -98.12 KM/H @ 251.63 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER NECK X-AXIS SHEAR FORCE
TRC INC
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
60
40
20
0
-20
-40
-60
FORCE (N X 10²)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: NEKXF1
FILTER: CH CLASS 1000
PEAK DATA: 1298.95 N @ 108.13 MS, -83.45 N @ 24.63 MS

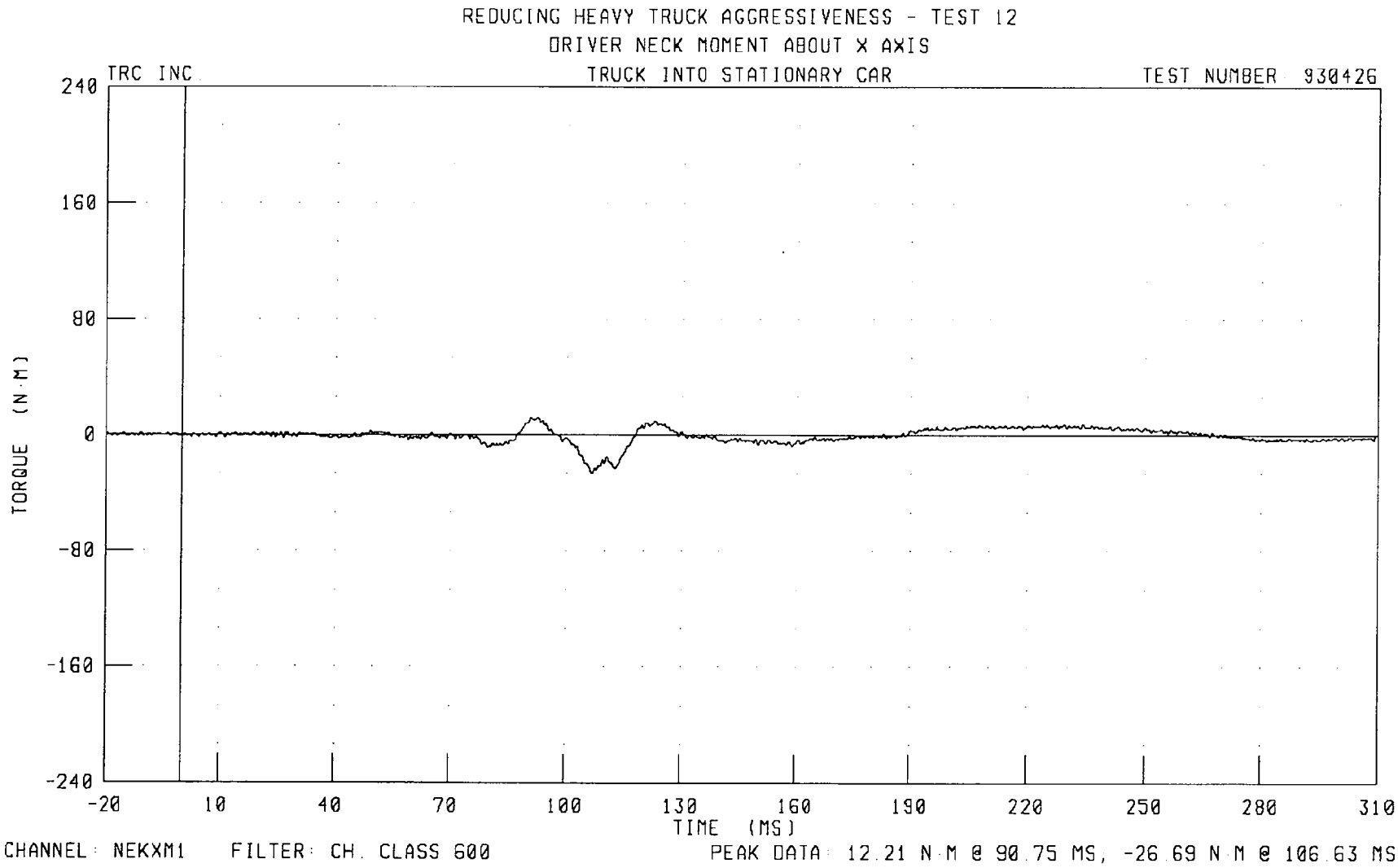

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER NECK Y-AXIS SHEAR FORCE
TRC INC.
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
60
40
20
0
-20
-40
-60
FORCE (N X 10²)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: NEKYF1
FILTER: CH CLASS 1000
PEAK DATA: 348.57 N @ 118.75 MS, -285.77 N @ 106.50 MS

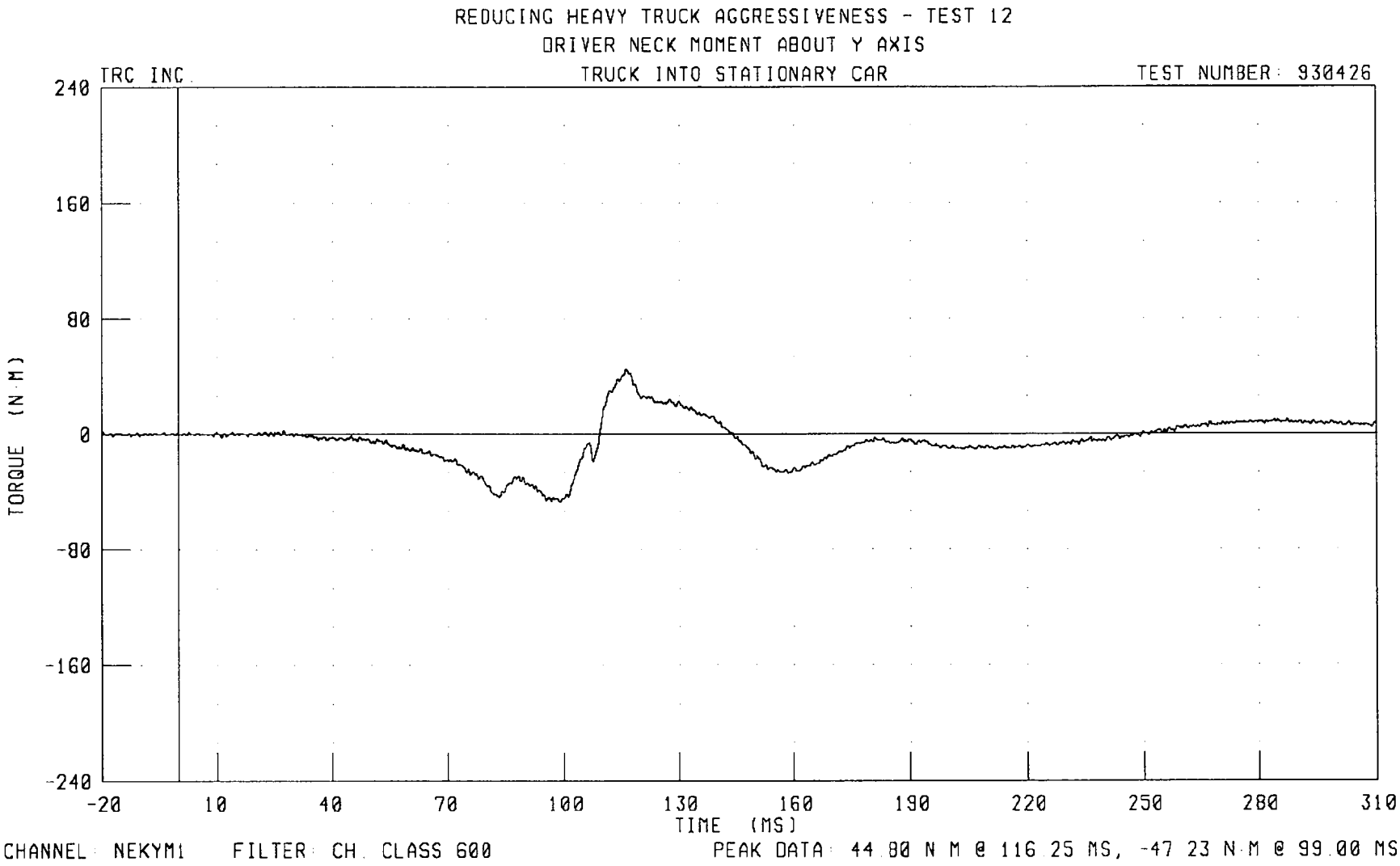

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER NECK Z-AXIS AXIAL FORCE
TRC INC.
TRUCK INTO STATIONARY CAR
TEST NUMBER 930426
100
80
60
40
20
0
-20
FORCE (N X 10²)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL NEKZF1
FILTER CH CLASS 1000
PEAK DATA 4324.27 N @ 108.88 MS, -199.12 N @ 26.50 MS

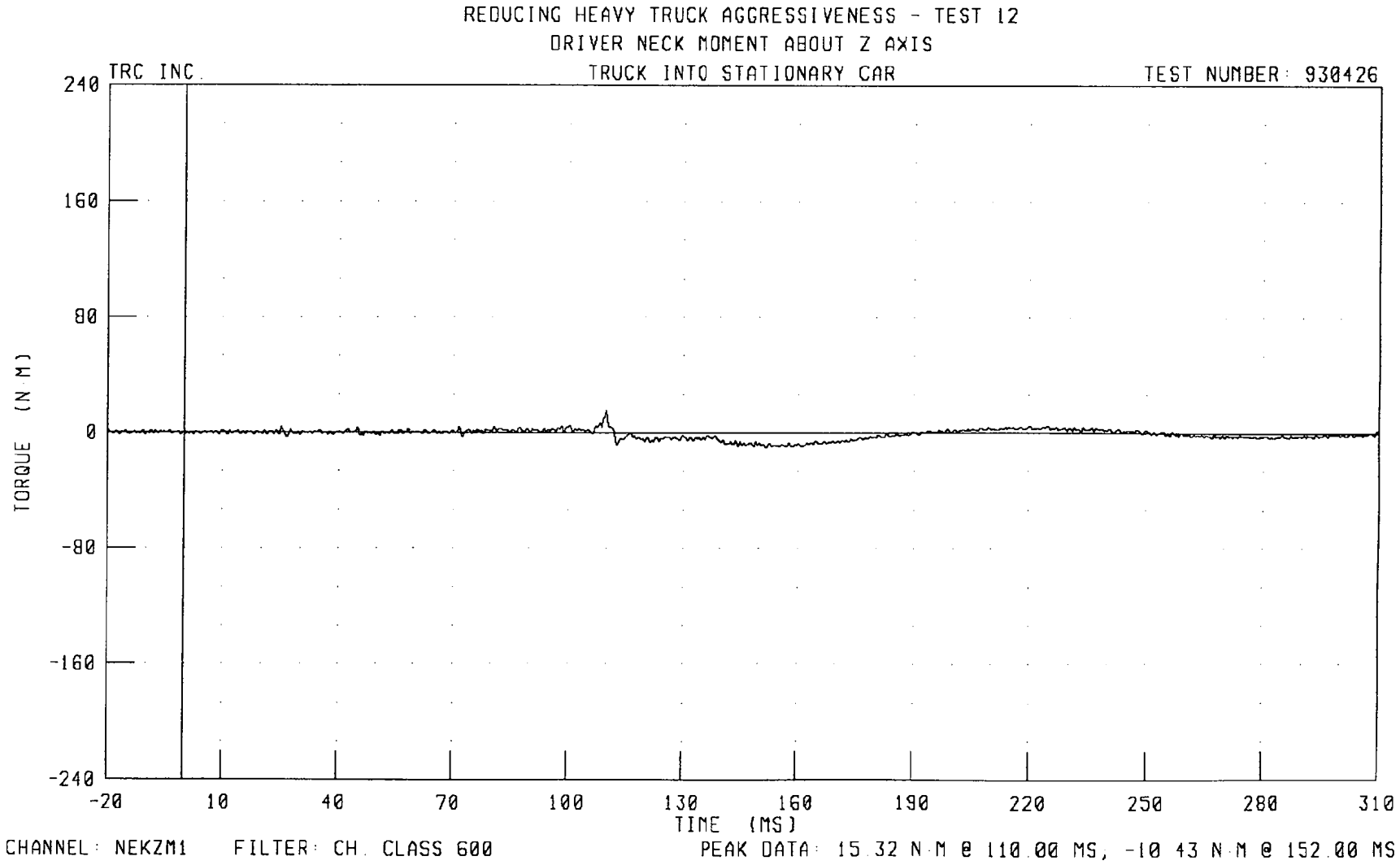
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER NECK RESULTANT FORCE
TRUC INC. TRUCK INTO STATIONARY CAR TEST NUMBER: 930426

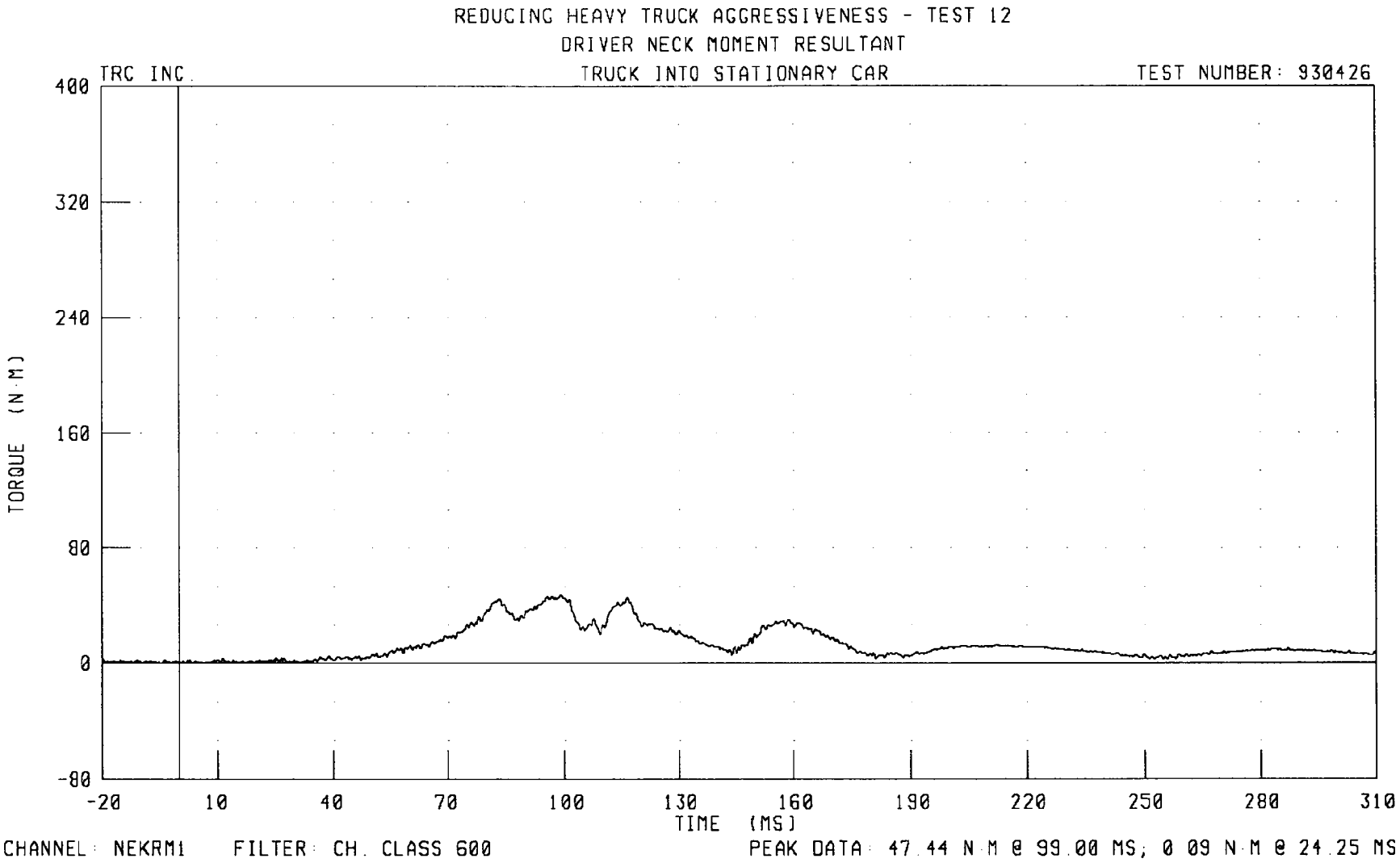


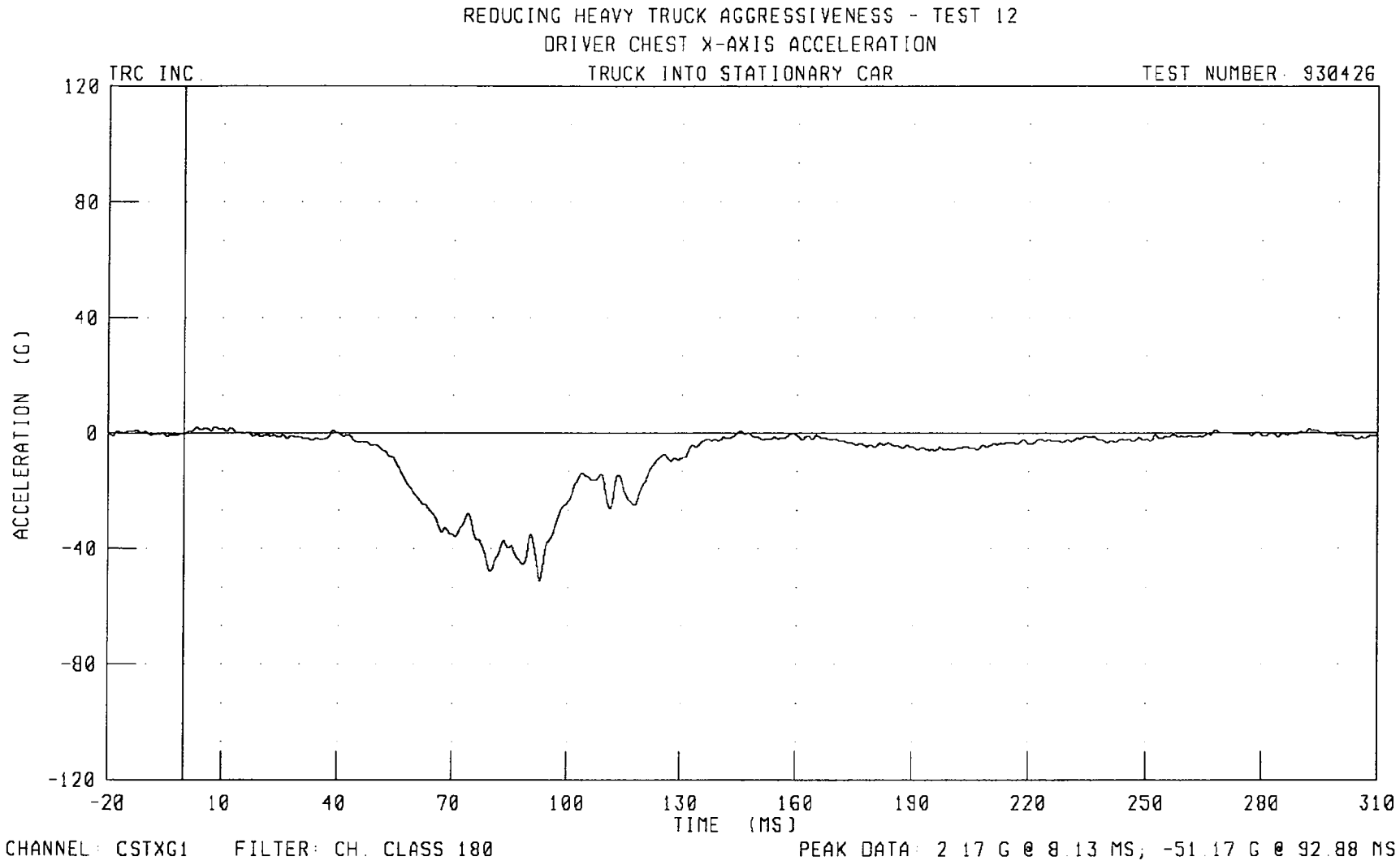

CHANNEL: NEKRF1 FILTER: CH. CLASS 1000 PEAK DATA: 4461.66 N @ 108.88 MS; 2.25 N @ 8.25 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER NECK MOMENT ABOUT X AXIS
TRC INC
TRUCK INTO STATIONARY CAR
TEST NUMBER 930426
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: NEKXM1
FILTER: CH. CLASS 600
PEAK DATA: 12.21 N-M @ 90.75 MS, -26.69 N-M @ 106.63 MS

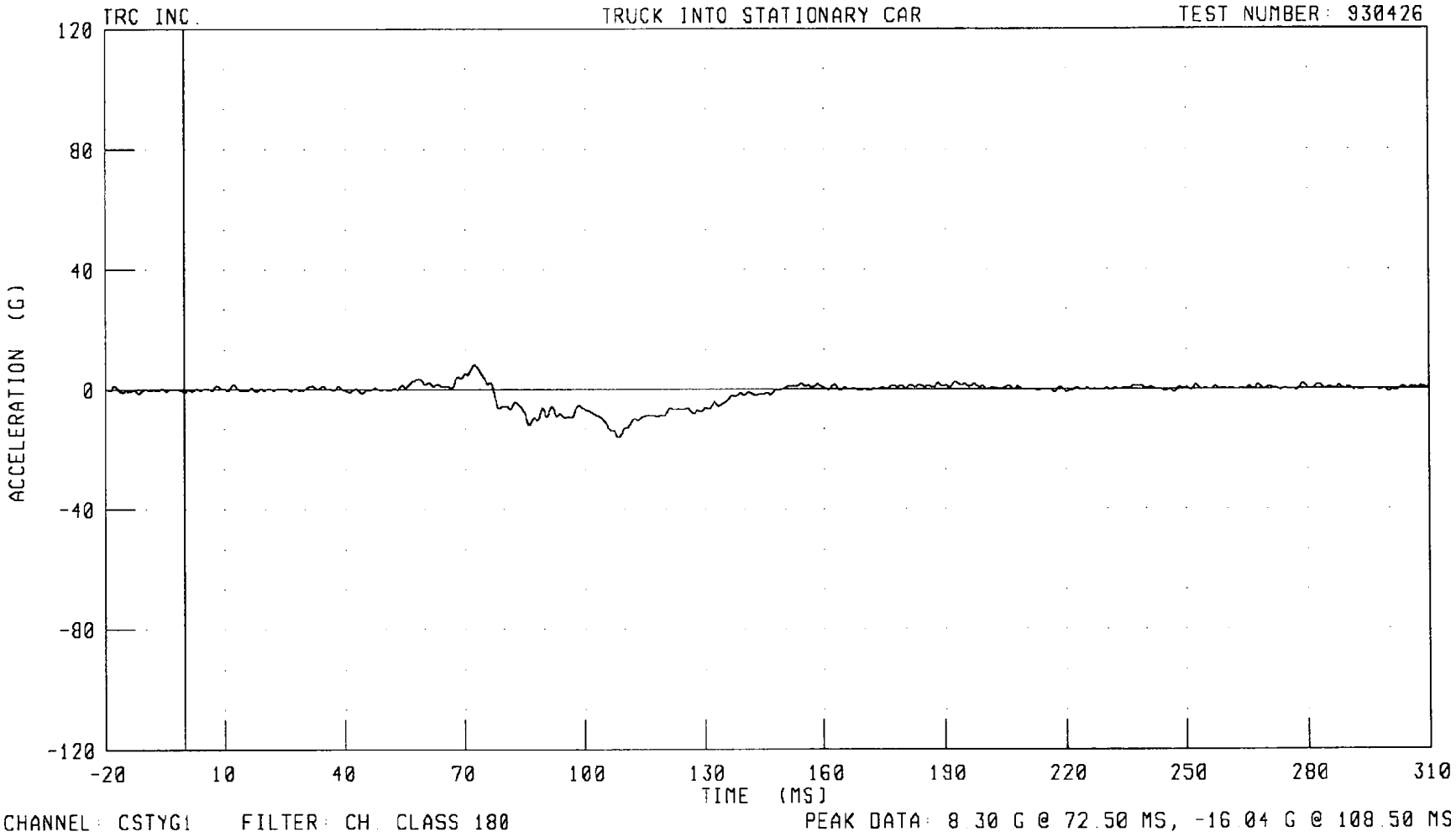

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER NECK MOMENT ABOUT Y AXIS
TRUCK INTO STATIONARY CAR
TRC INC.
TEST NUMBER: 930426
240
160
80
0
-80
-160
-240
TORQUE (N.M)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: NEKYM1
FILTER: CH. CLASS 600
PEAK DATA: 44.80 N.M @ 116.25 MS, -47.23 N.M @ 99.00 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER NECK MOMENT ABOUT Z AXIS
TRUCK INTO STATIONARY CAR
TRC INC.
TEST NUMBER: 930426
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: 15.32 N.M @ 110.00 MS, -10.43 N.M @ 152.00 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER NECK MOMENT RESULTANT
TRC INC.
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
400
320
240
160
80
0
-80
TORQUE (N-M)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: NEKRM1
FILTER: CH. CLASS 600
PEAK DATA: 47.44 N-M @ 99.00 MS; 0.09 N-M @ 24.25 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER CHEST X-AXIS ACCELERATION
TRC INC.
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
120
80
40
0
-40
-80
-120
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: CSTXG1
FILTER: CH. CLASS 180
PEAK DATA: 2.17 G @ 8.13 MS; -51.17 G @ 92.88 MS

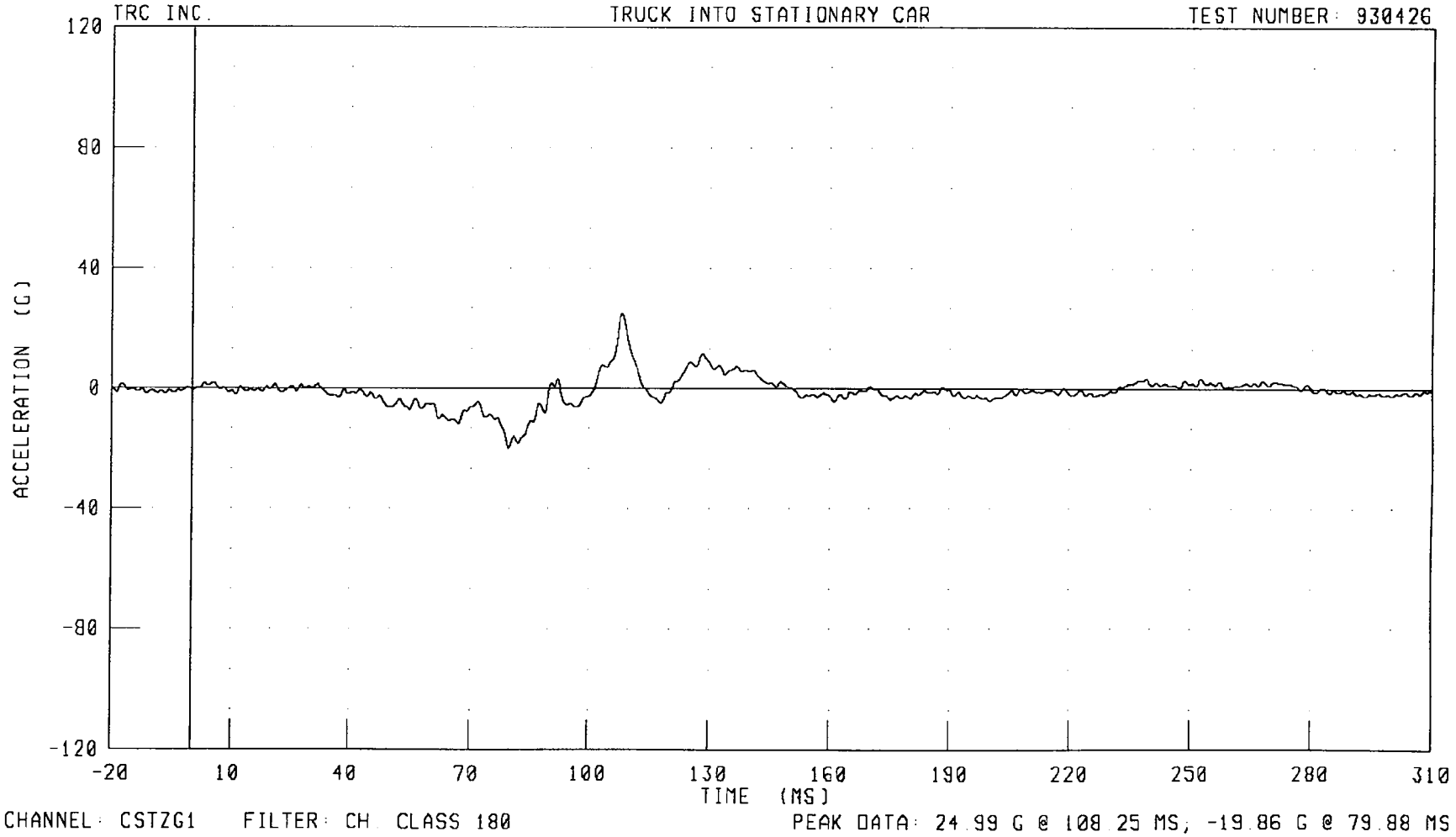
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER CHEST Y-AXIS ACCELERATION




CHANNEL: CSTYG1 FILTER: CH CLASS 180 PEAK DATA: 8.30 G @ 72.50 MS, -16.04 G @ 108.50 MS

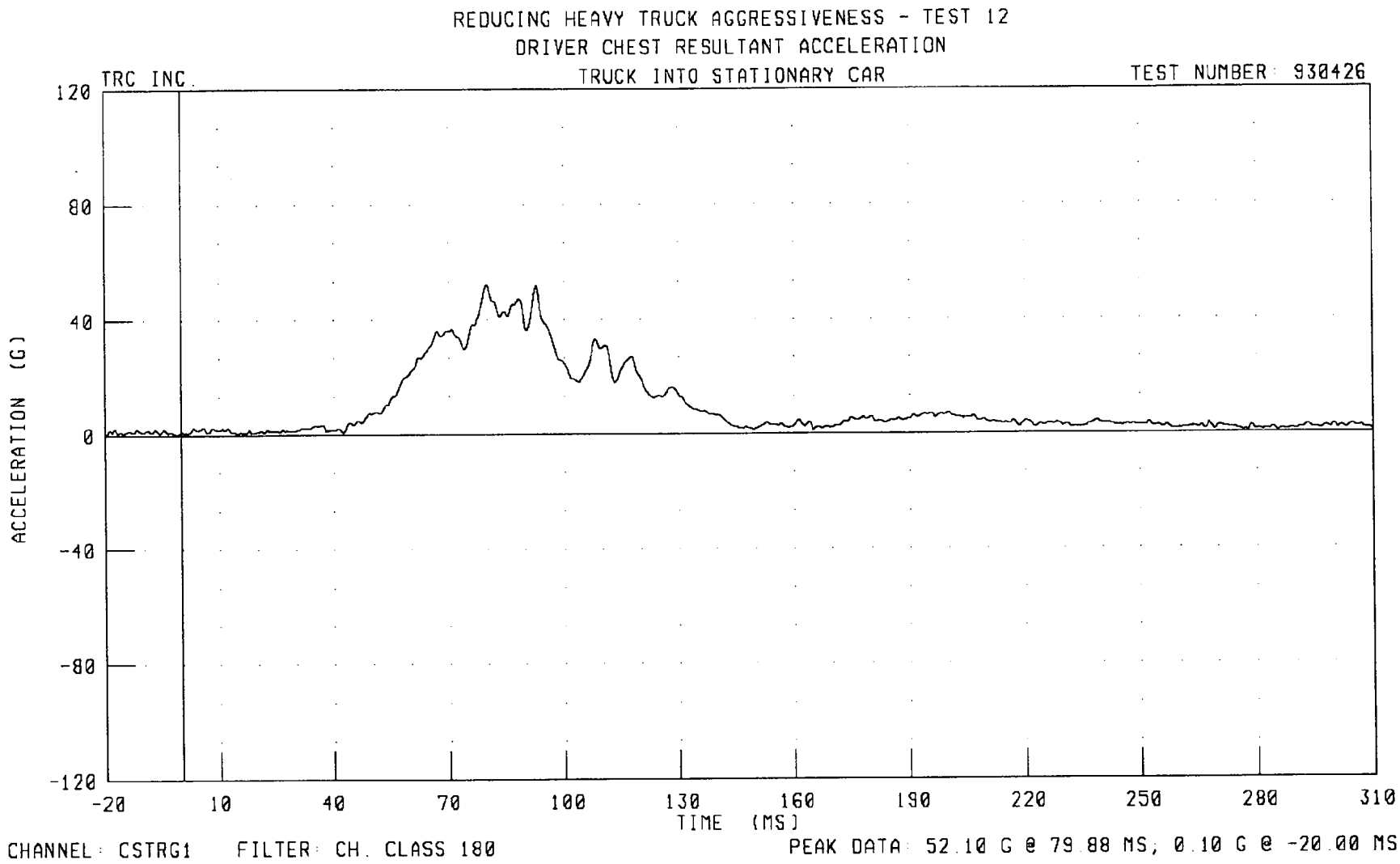
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12

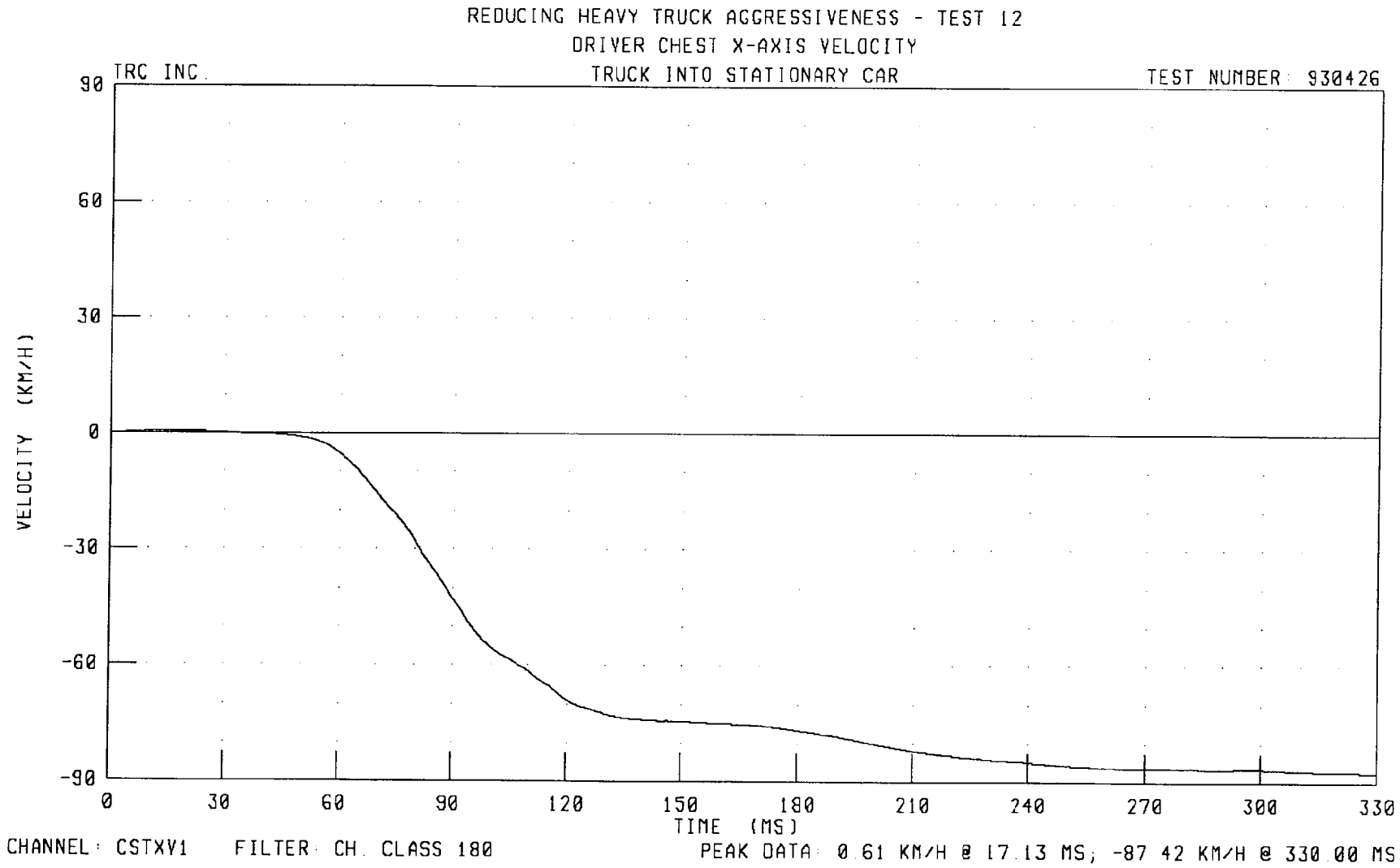
DRIVER CHEST Z-AXIS ACCELERATION




CHANNEL: CSTZG1 FILTER: CH CLASS 180

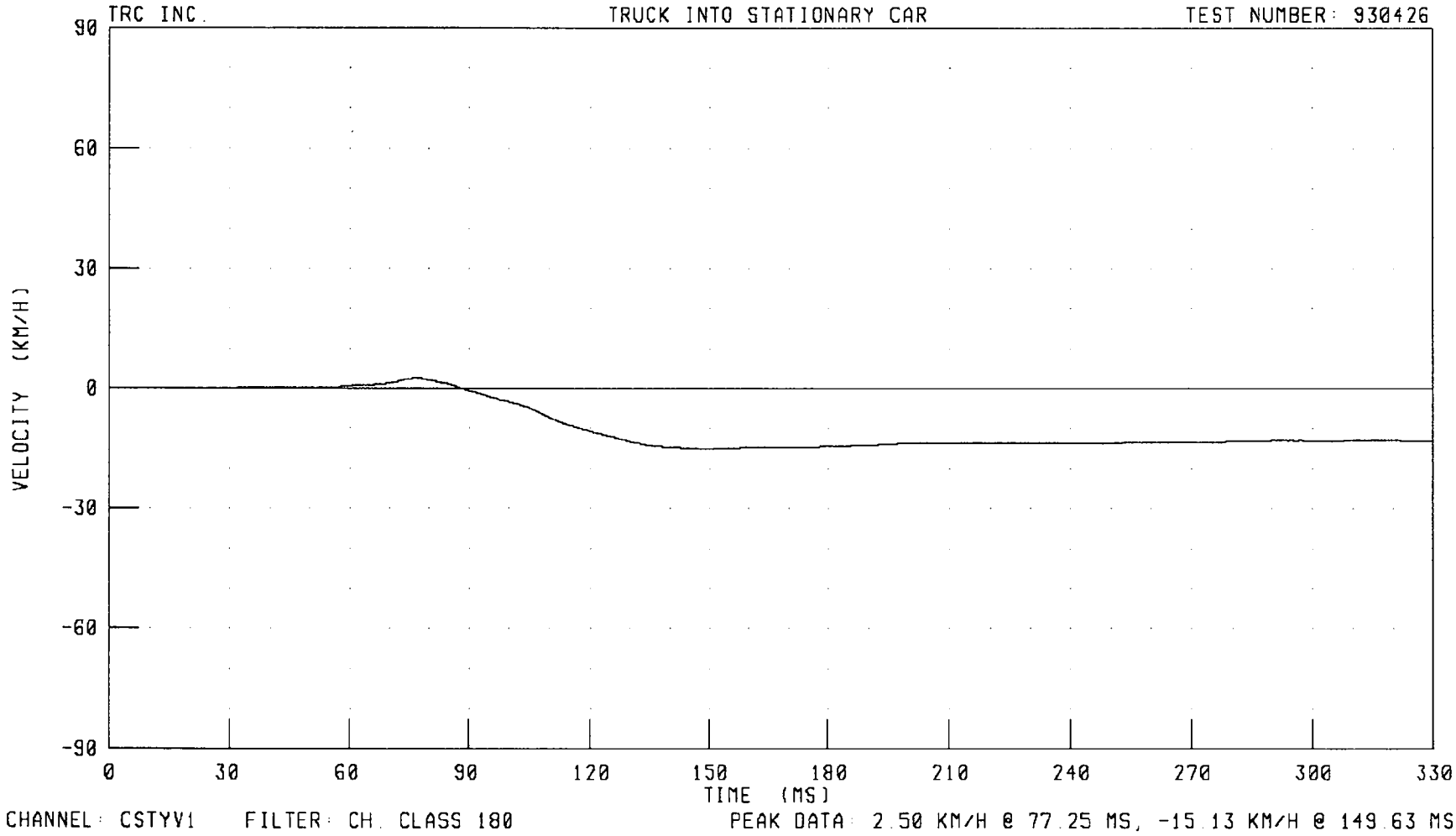
PEAK DATA: 24.99 G @ 108.25 MS; -19.86 G @ 79.88 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER CHEST RESULTANT ACCELERATION
TRUCK INTO STATIONARY CAR
TRC INC.
TEST NUMBER: 930426
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: 52.10 G @ 79.88 MS, 0.10 G @ -20.00 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER CHEST X-AXIS VELOCITY
TRUCK INTO STATIONARY CAR
TRC INC.
TEST NUMBER: 930426
VELOCITY (KM/H)
90
60
30
0
-30
-60
-90
0
30
60
90
120
150
180
210
240
270
300
330
TIME (MS)
CHANNEL: CSTXV1
FILTER: CH. CLASS 180
PEAK DATA: 0.61 KM/H @ 17.13 MS; -87.42 KM/H @ 330.00 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12

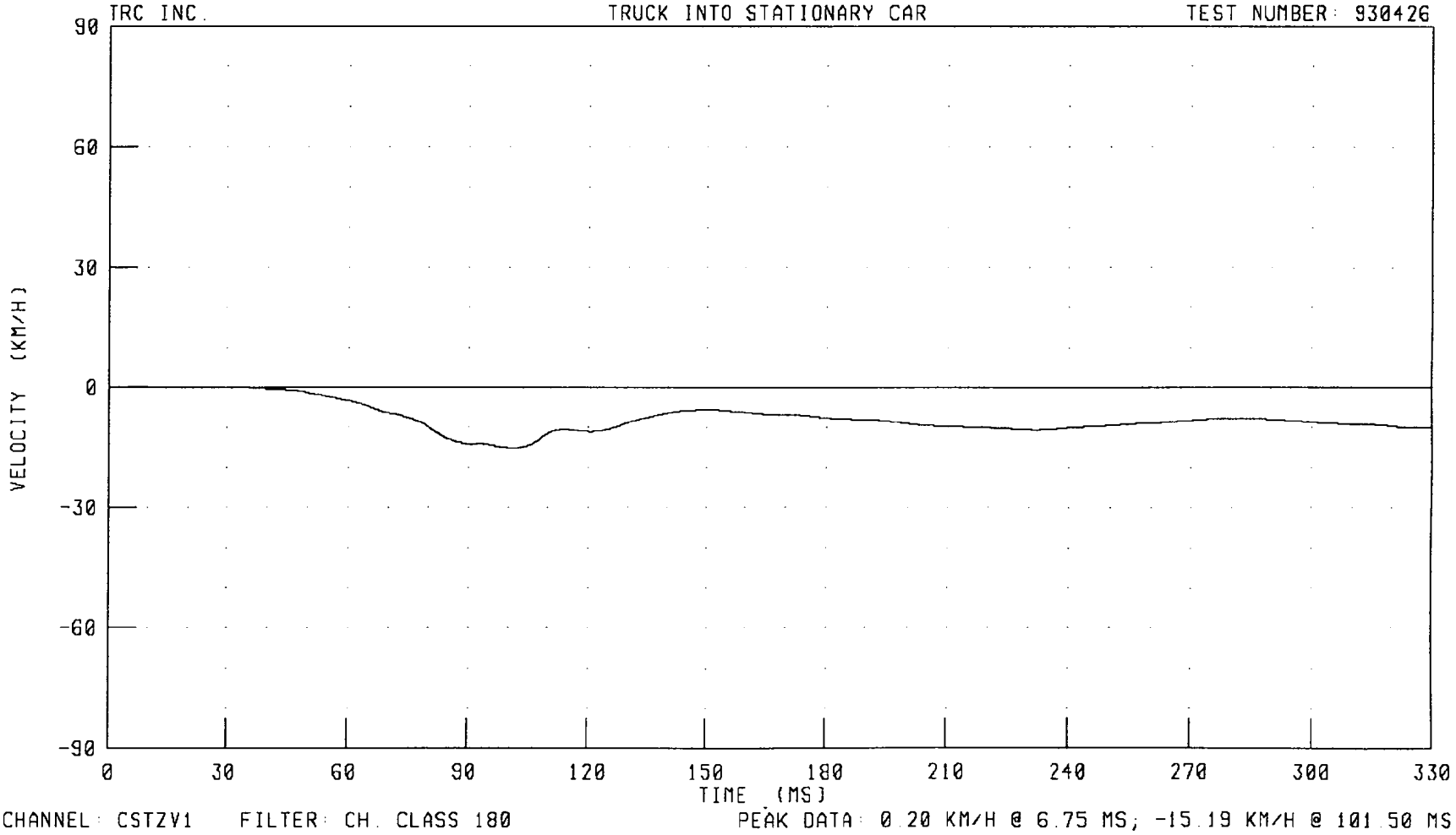
DRIVER CHEST Y-AXIS VELOCITY



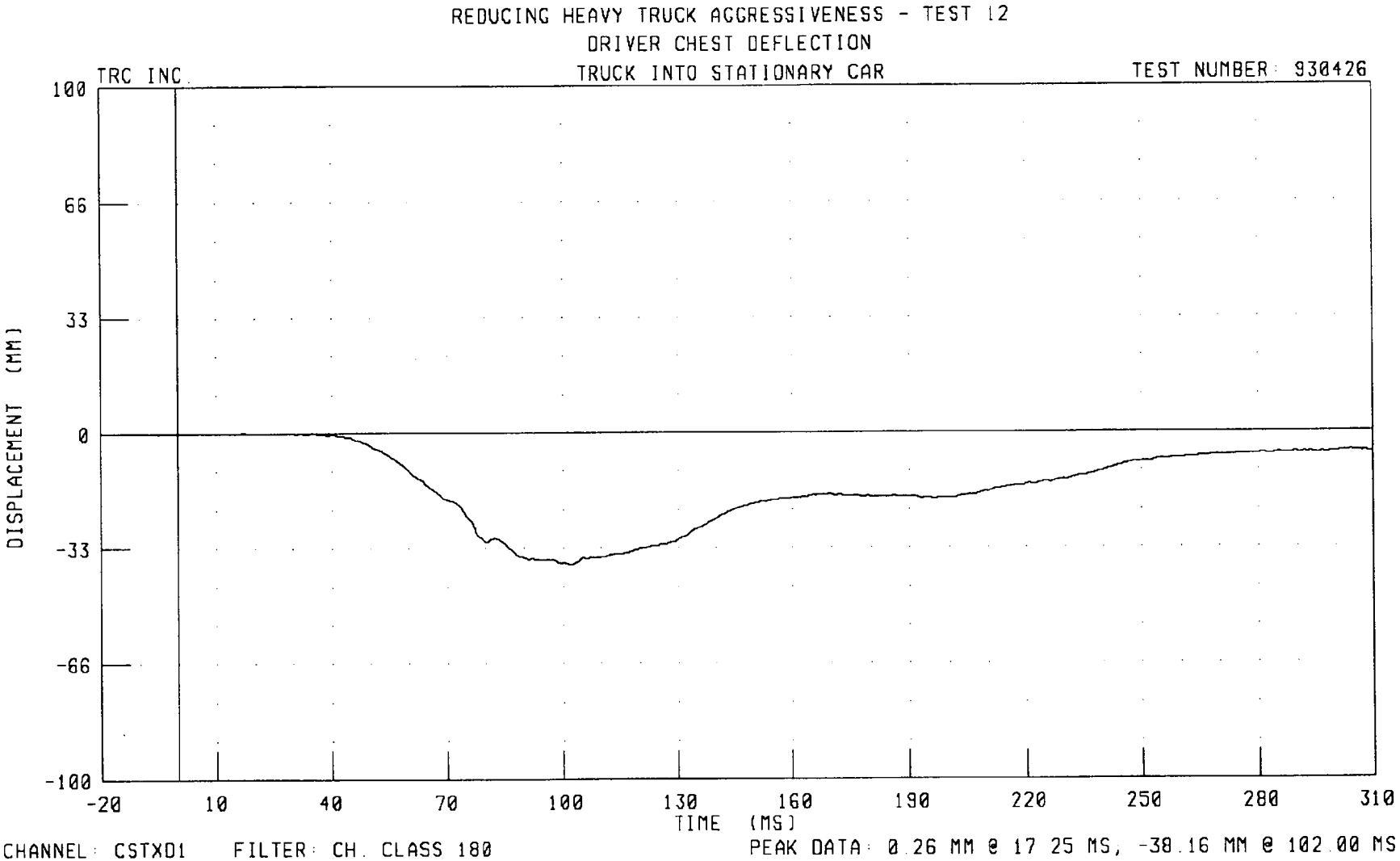

CHANNEL: CSTYV1 FILTER: CH. CLASS 180 PEAK DATA: 2.50 KM/H @ 77.25 MS, -15.13 KM/H @ 149.63 MS

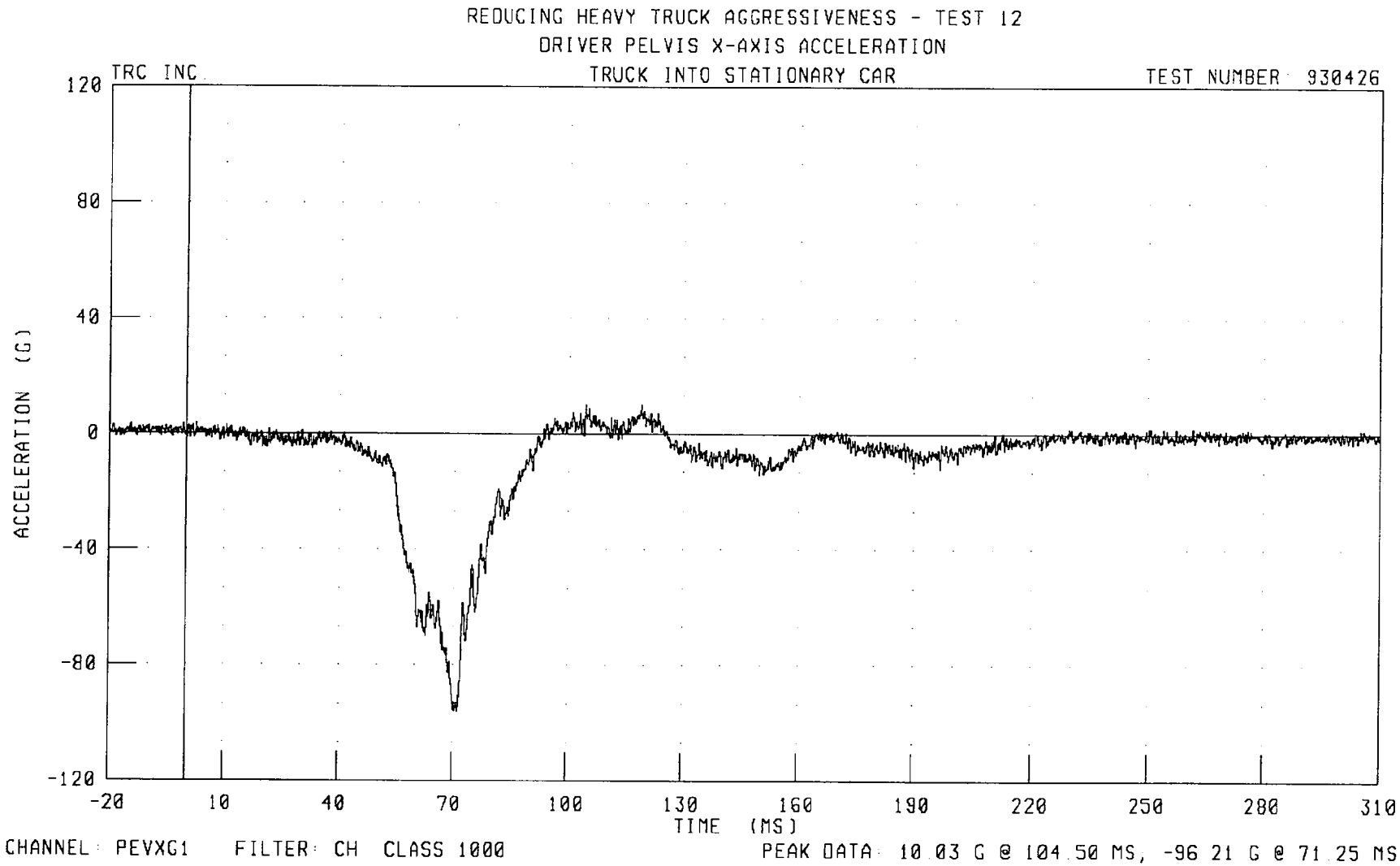
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12

DRIVER CHEST Z-AXIS VELOCITY

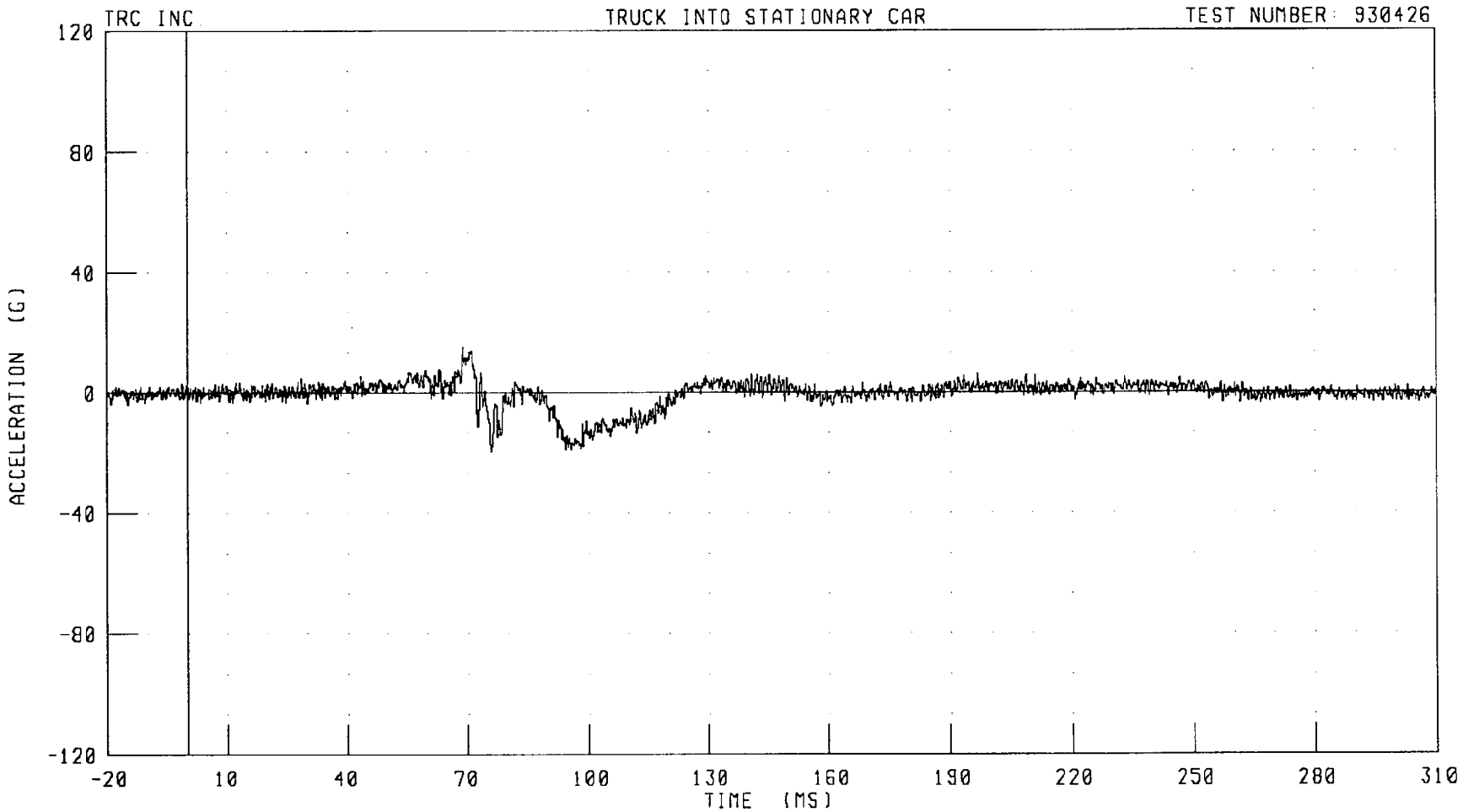



CHANNEL: CSTZV1 FILTER: CH. CLASS 180 PEAK DATA: 0.20 KM/H @ 6.75 MS; -15.19 KM/H @ 101.50 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER CHEST DEFLECTION
TRUCK INTO STATIONARY CAR
TRC INC.
TEST NUMBER: 930426
100
66
33
0
-33
-66
-100
DISPLACEMENT (MM)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: CSTXD1
FILTER: CH. CLASS 180
PEAK DATA: 0.26 MM @ 17.25 MS, -38.16 MM @ 102.00 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER PELVIS X-AXIS ACCELERATION
TRUCK INTO STATIONARY CAR
TRC INC
TEST NUMBER 930426
120
80
40
0
-40
-80
-120
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL PEVXG1 FILTER CH CLASS 1000
PEAK DATA 10.03 G @ 104.50 MS, -96.21 G @ 71.25 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER PELVIS Y-AXIS ACCELERATION

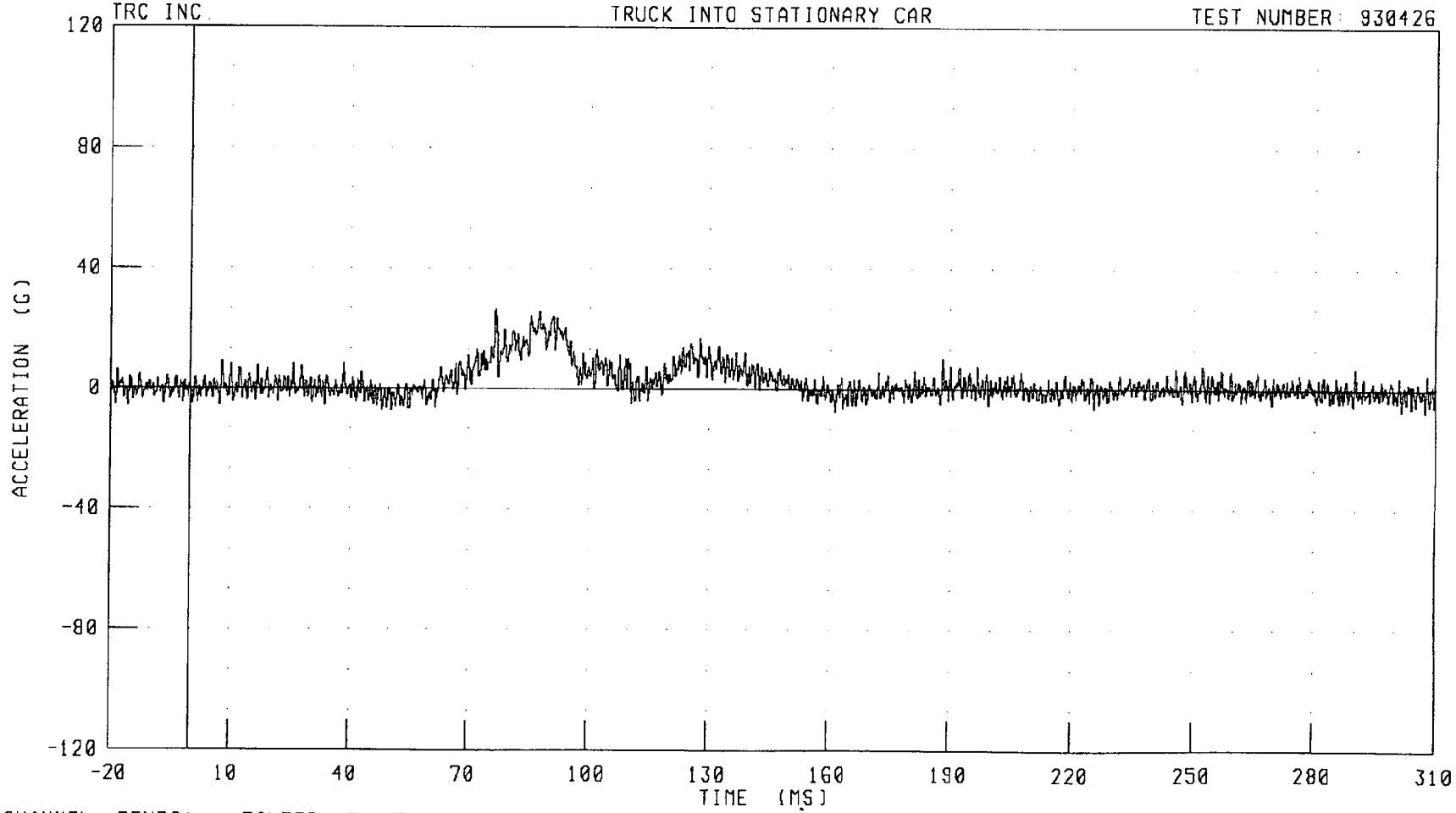



CHANNEL: PEVYG1 FILTER: CH. CLASS 1000 PEAK DATA: 15.35 G @ 68.88 MS, -19.77 G @ 75.88 MS

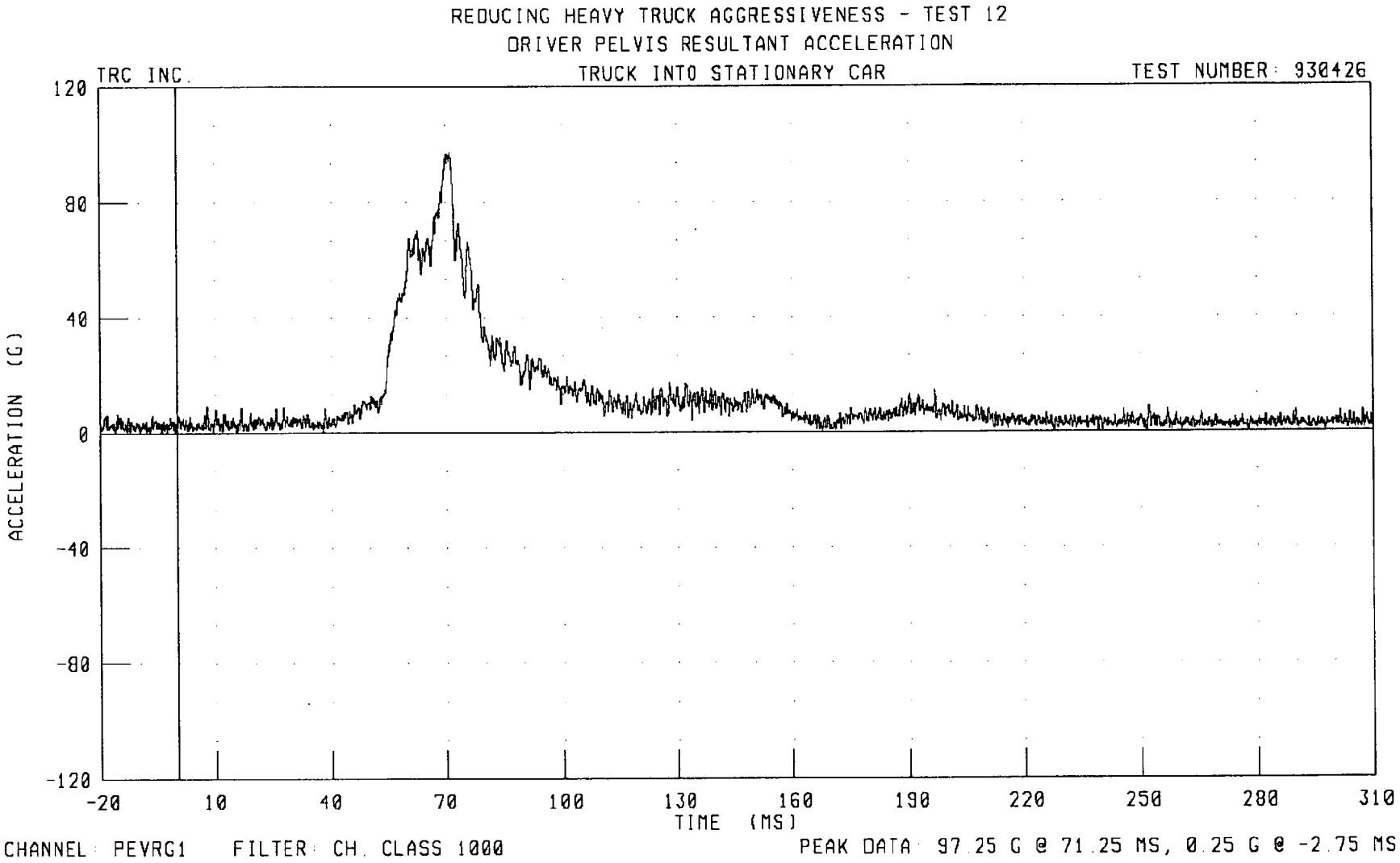
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12

DRIVER PELVIS Z-AXIS ACCELERATION

TRC INC. TRUCK INTO STATIONARY CAR TEST NUMBER: 930426



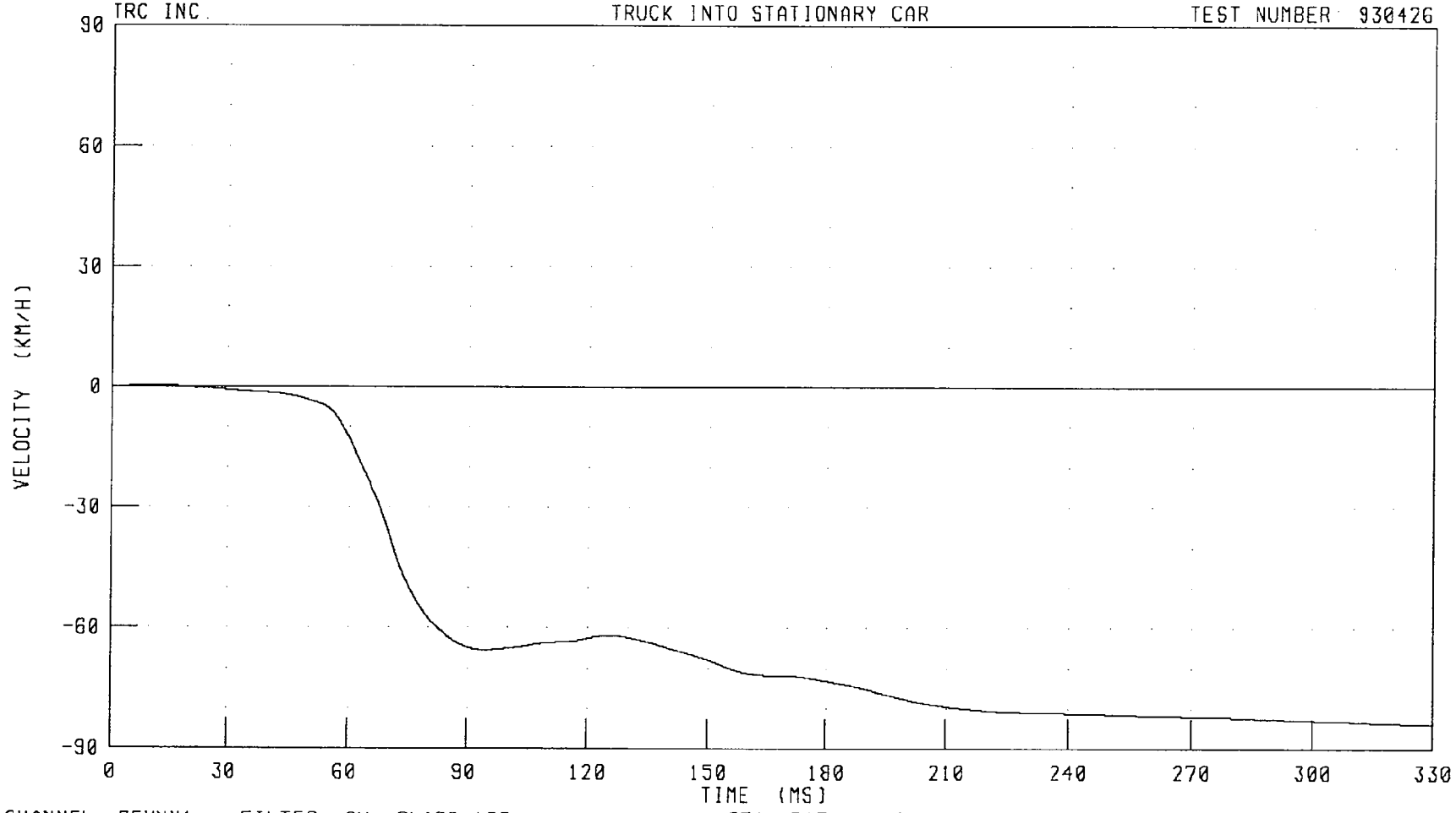

CHANNEL: PEVZG1 FILTER: CH CLASS 1000 PEAK DATA: 26.53 G @ 76.75 MS; -7.32 G @ 161.38 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER PELVIS RESULTANT ACCELERATION
TRUCK INTO STATIONARY CAR
TRC INC.
TEST NUMBER: 930426
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: 97.25 G @ 71.25 MS, 0.25 G @ -2.75 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12

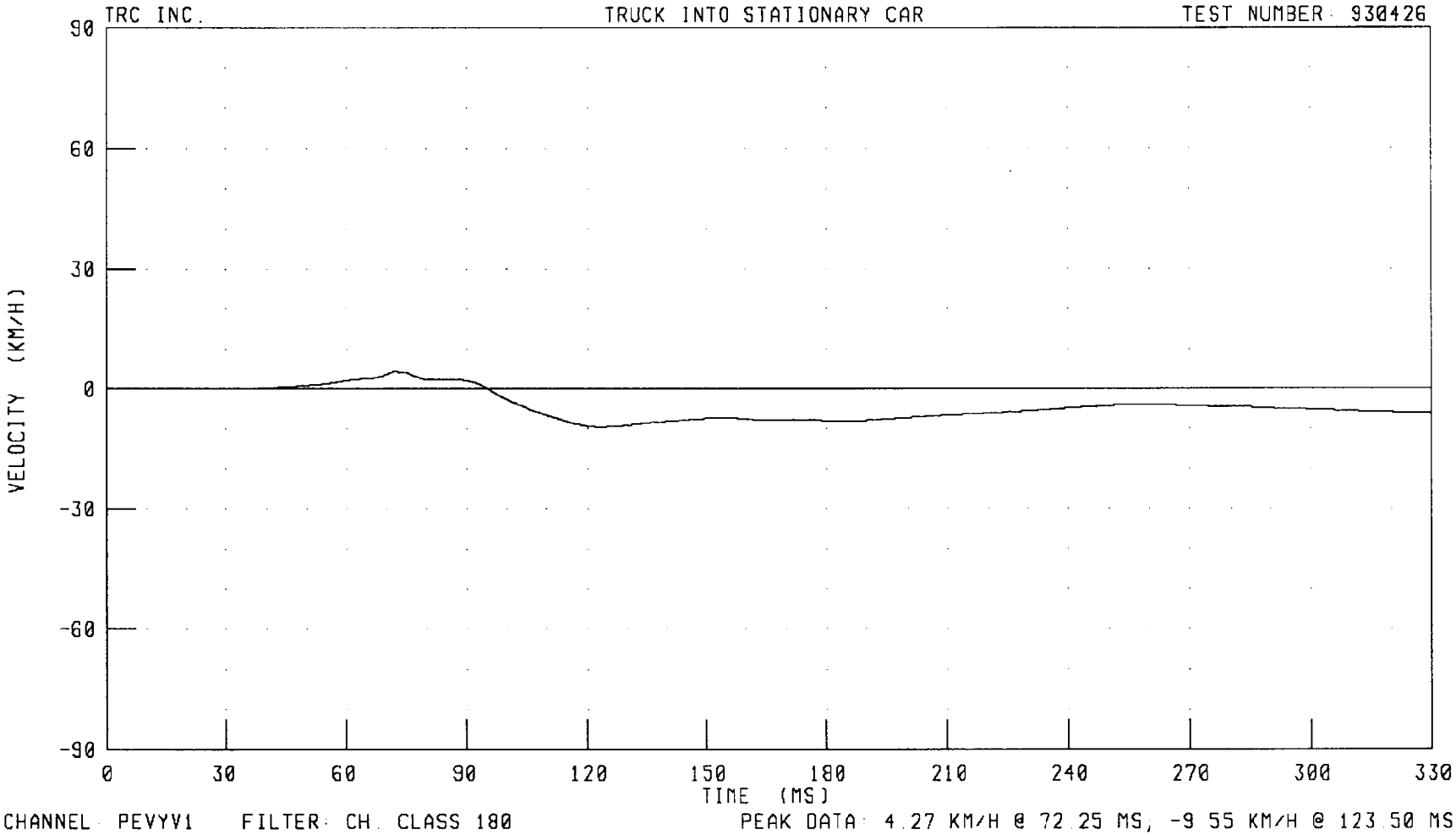
DRIVER PELVIS X-AXIS VELOCITY

TRC INC. TRUCK INTO STATIONARY CAR TEST NUMBER: 930426

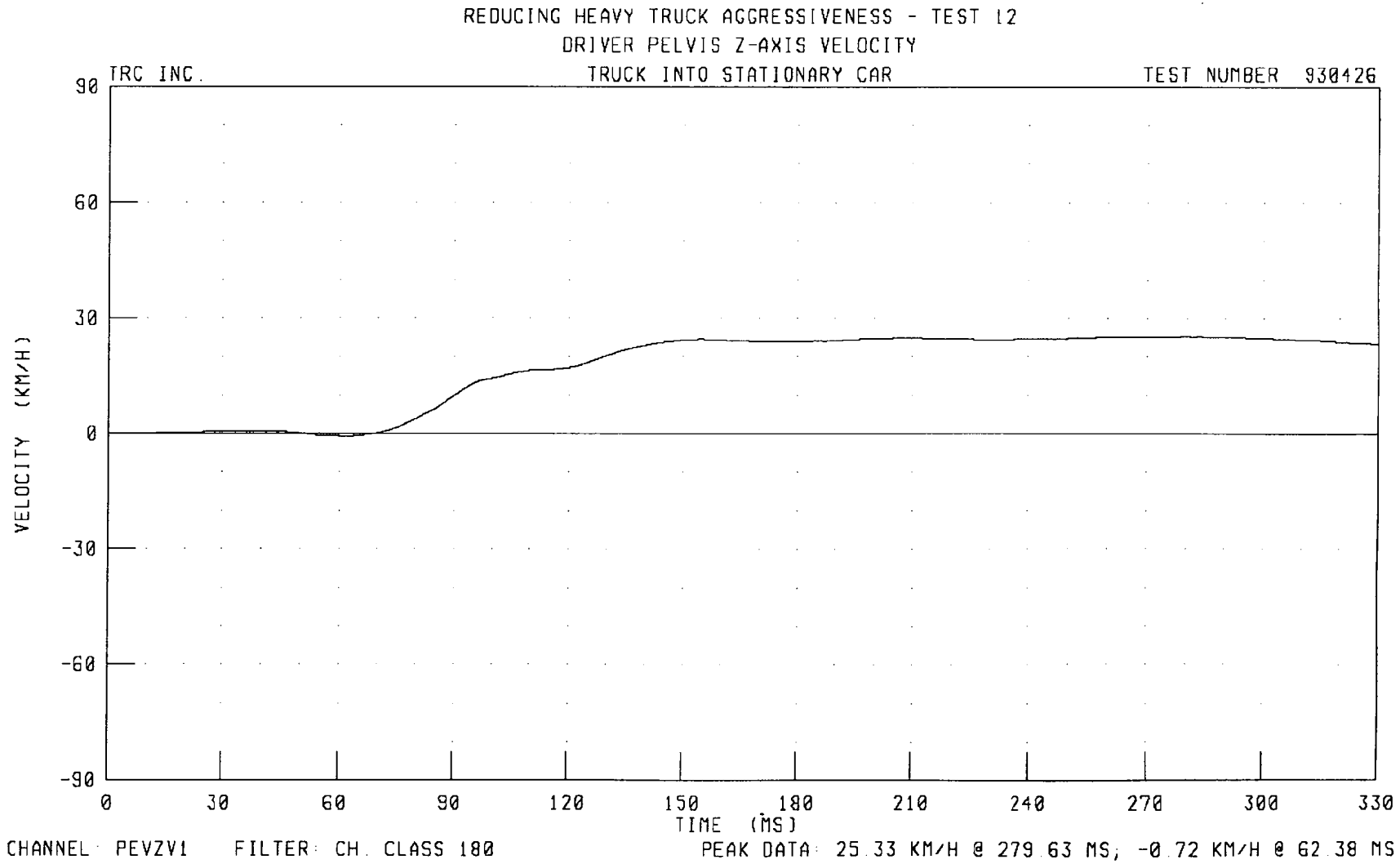


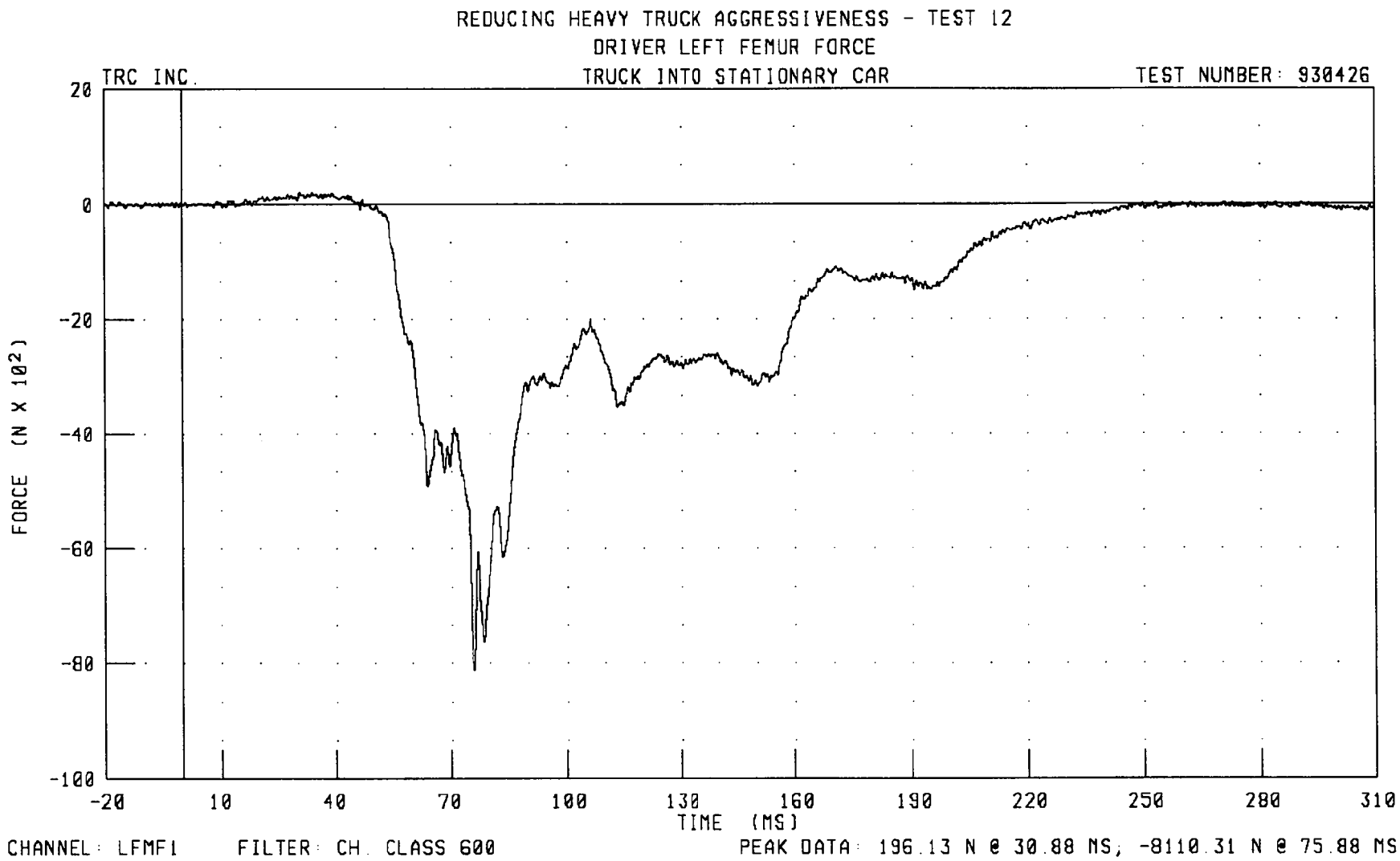

CHANNEL: PEVXV1 FILTER: CH. CLASS 180 PEAK DATA: 0.23 KM/H @ 12.00 MS, -83.76 KM/H @ 328.38 MS

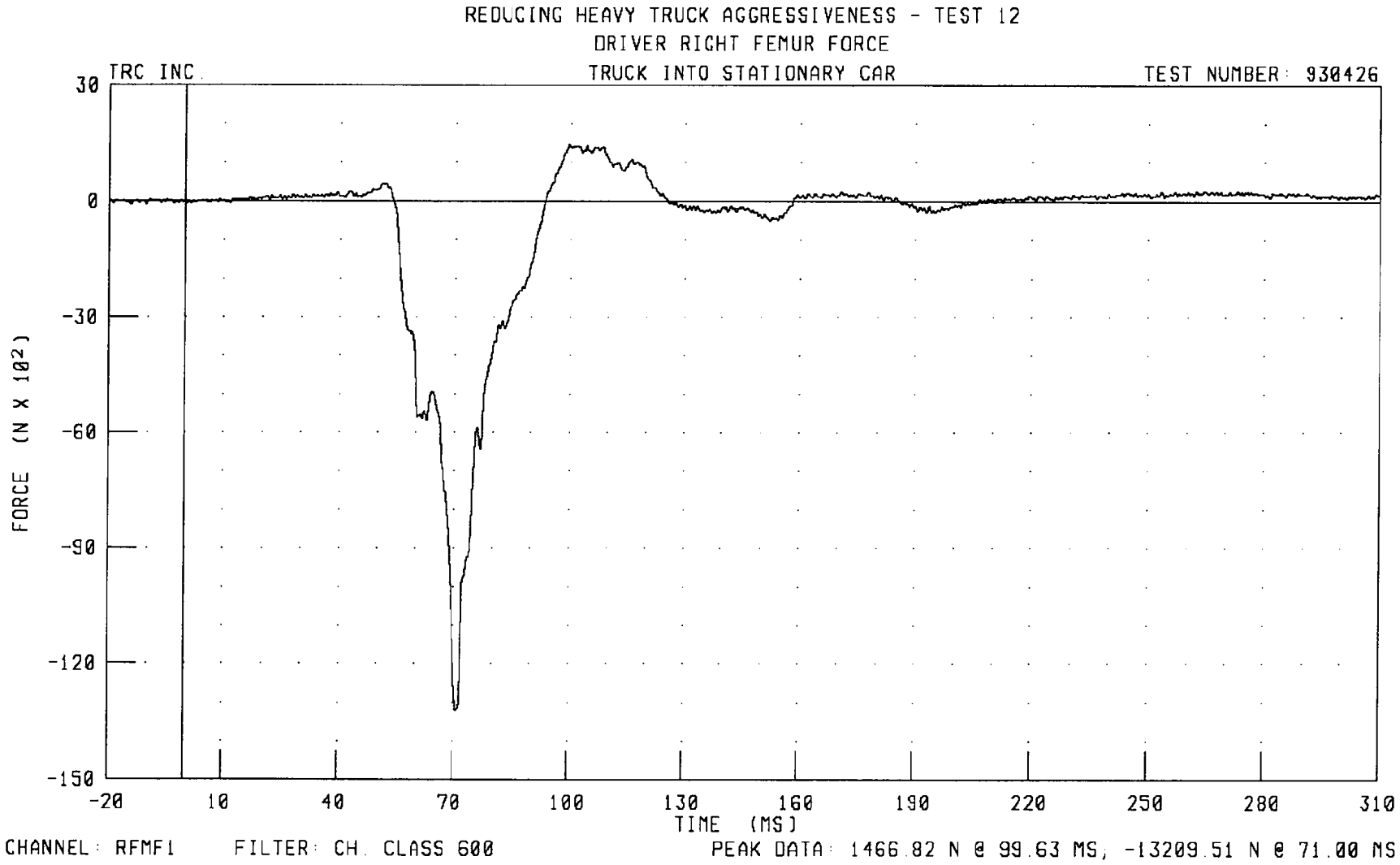
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER PELVIS Y-AXIS VELOCITY




CHANNEL: PEVYV1 FILTER: CH. CLASS 180 PEAK DATA: 4.27 KM/H @ 72.25 MS, -9.55 KM/H @ 123.50 MS

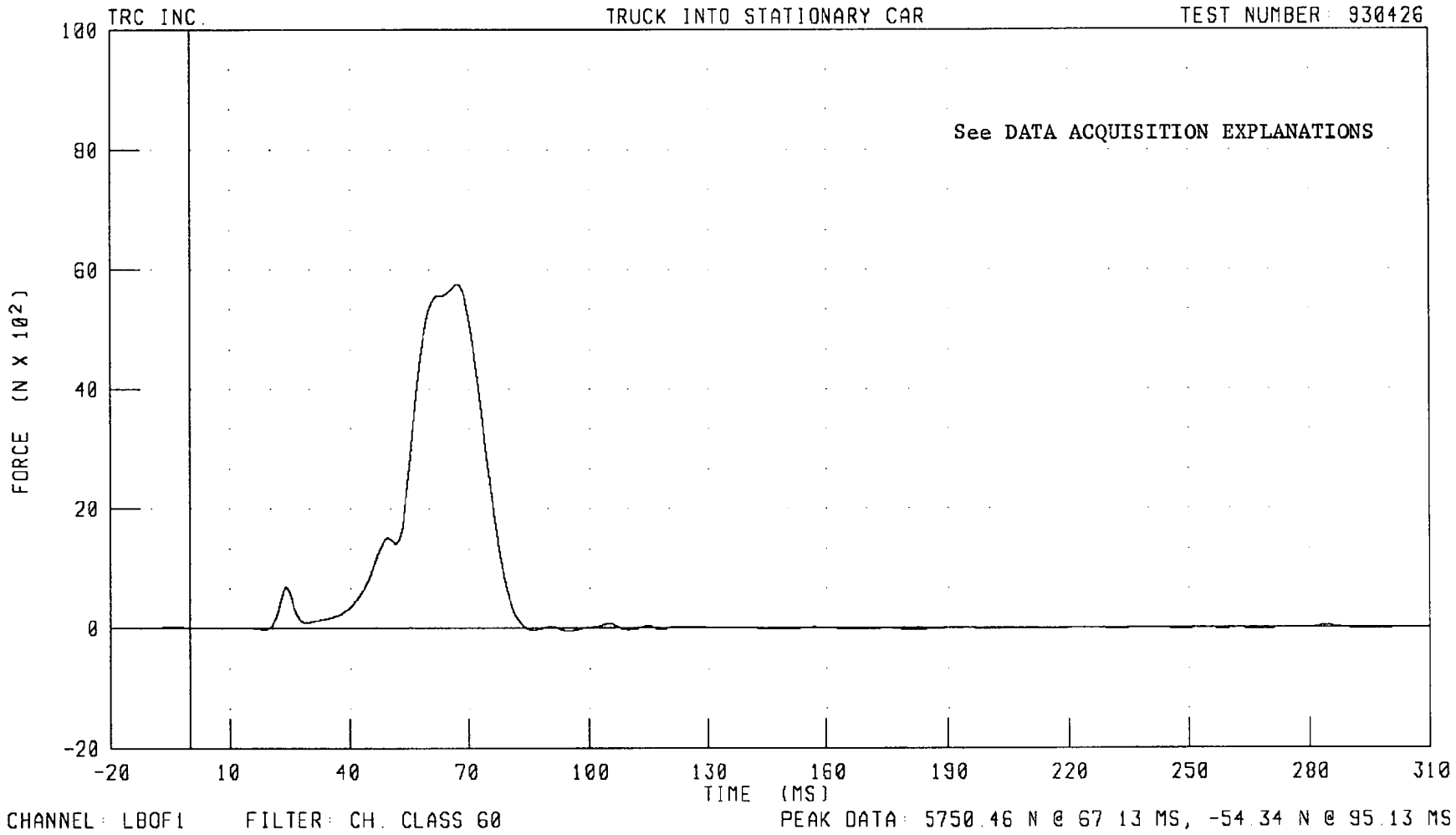

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER PELVIS Z-AXIS VELOCITY
TRC INC.
TRUCK INTO STATIONARY CAR
TEST NUMBER 930426
VELOCITY (KM/H)
90
60
30
0
-30
-60
-90
0
30
60
90
120
150
180
210
240
270
300
330
TIME (MS)
CHANNEL PEVZV1 FILTER CH CLASS 180
PEAK DATA 25.33 KM/H @ 279.63 MS; -0.72 KM/H @ 62.38 MS

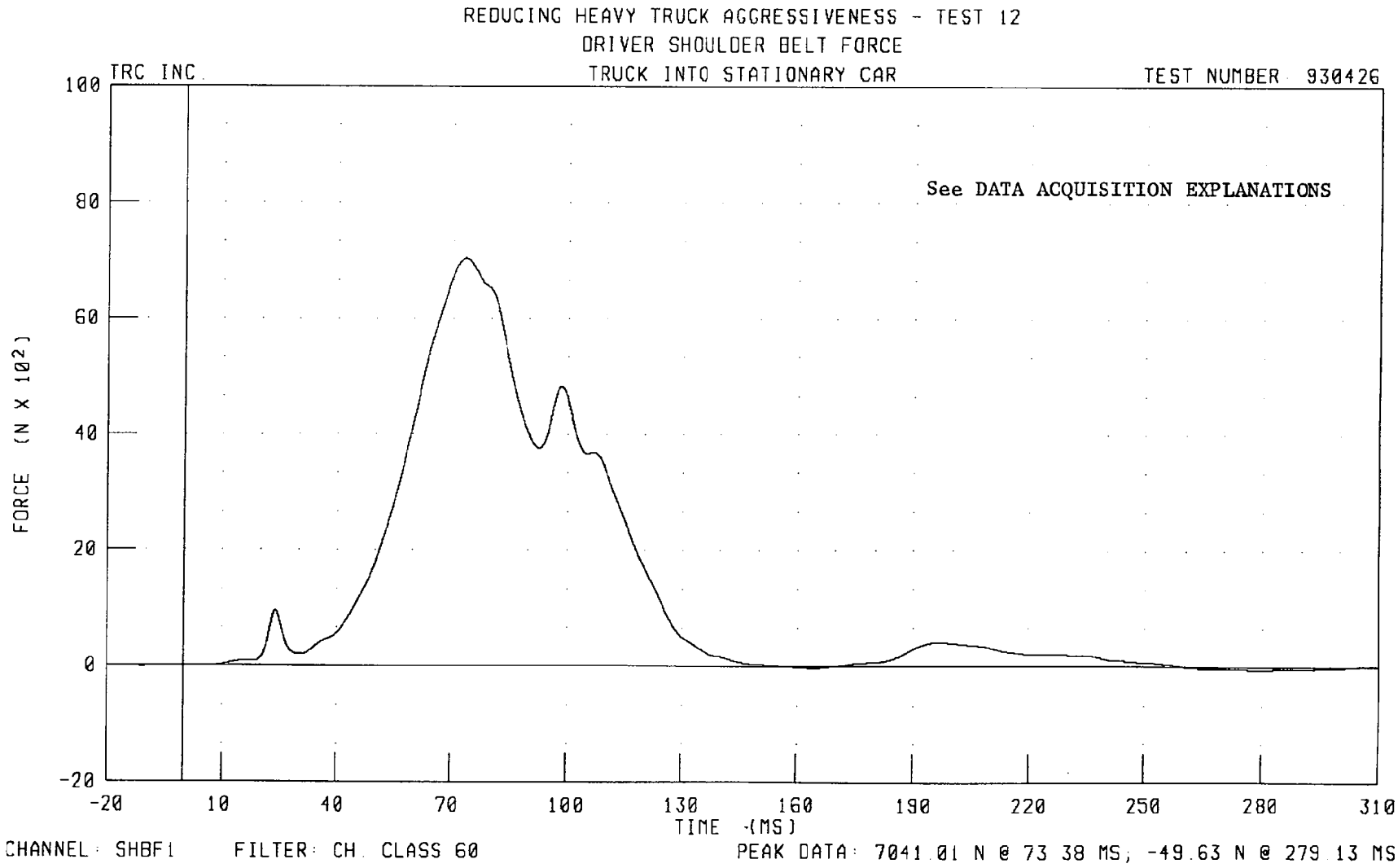

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER LEFT FEMUR FORCE
TRC INC.
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
20
0
-20
-40
-60
-80
-100
FORCE (N X 10²)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: LFMF1
FILTER: CH. CLASS 600
PEAK DATA: 196.13 N @ 30.88 MS; -8110.31 N @ 75.88 MS

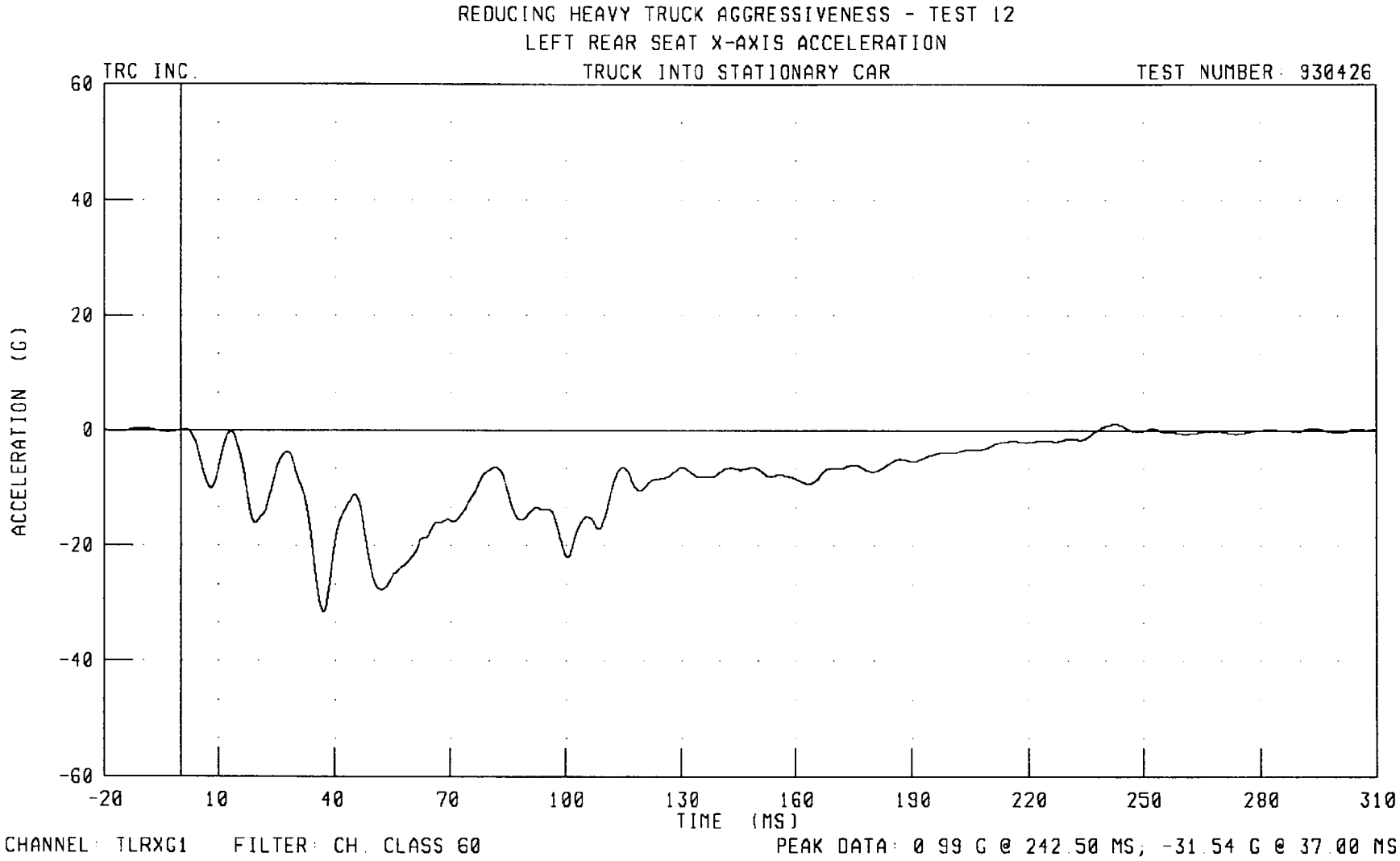

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER RIGHT FEMUR FORCE
TRUCK INTO STATIONARY CAR
TRC INC.
TEST NUMBER: 930426
30
0
-30
-60
-90
-120
-150
FORCE (N X 10²)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: RFMF1
FILTER: CH. CLASS 600
PEAK DATA: 1466.82 N @ 99.63 MS, -13209.51 N @ 71.00 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12

DRIVER LAP BELT OUTBOARD FORCE

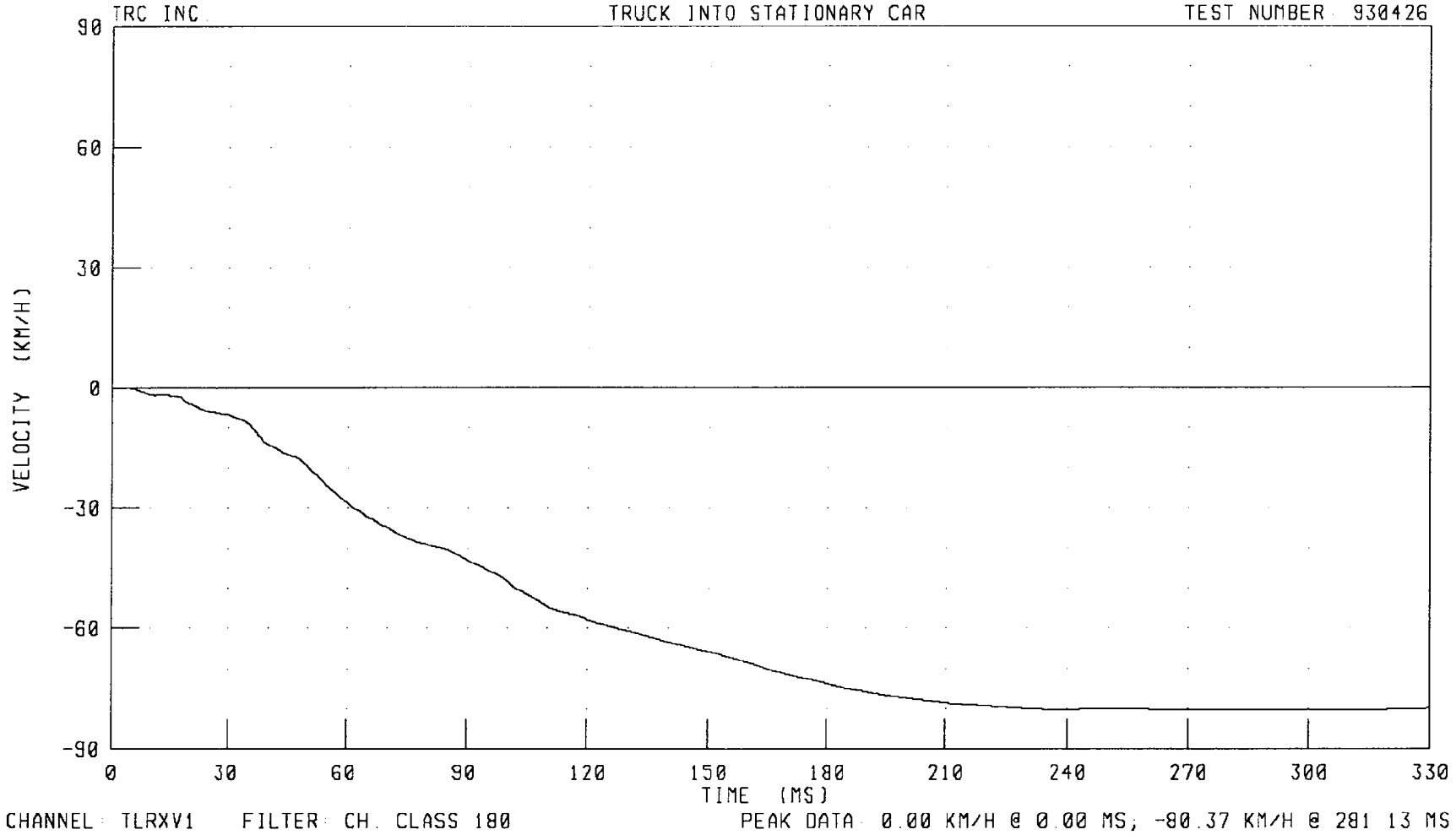



REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
DRIVER SHOULDER BELT FORCE
TRUCK INTO STATIONARY CAR
TRC INC
TEST NUMBER 930426
See DATA ACQUISITION EXPLANATIONS
FORCE (N X 10²)
100
80
60
40
20
0
-20
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: SHBF1
FILTER: CH CLASS 60
PEAK DATA: 7041.01 N @ 73.38 MS; -49.63 N @ 279.13 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
LEFT REAR SEAT X-AXIS ACCELERATION
TRC INC.
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
60
40
20
0
-20
-40
-60
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: TLRXG1
FILTER: CH. CLASS 60
PEAK DATA: 0.99 G @ 242.50 MS, -31.54 G @ 37.00 MS

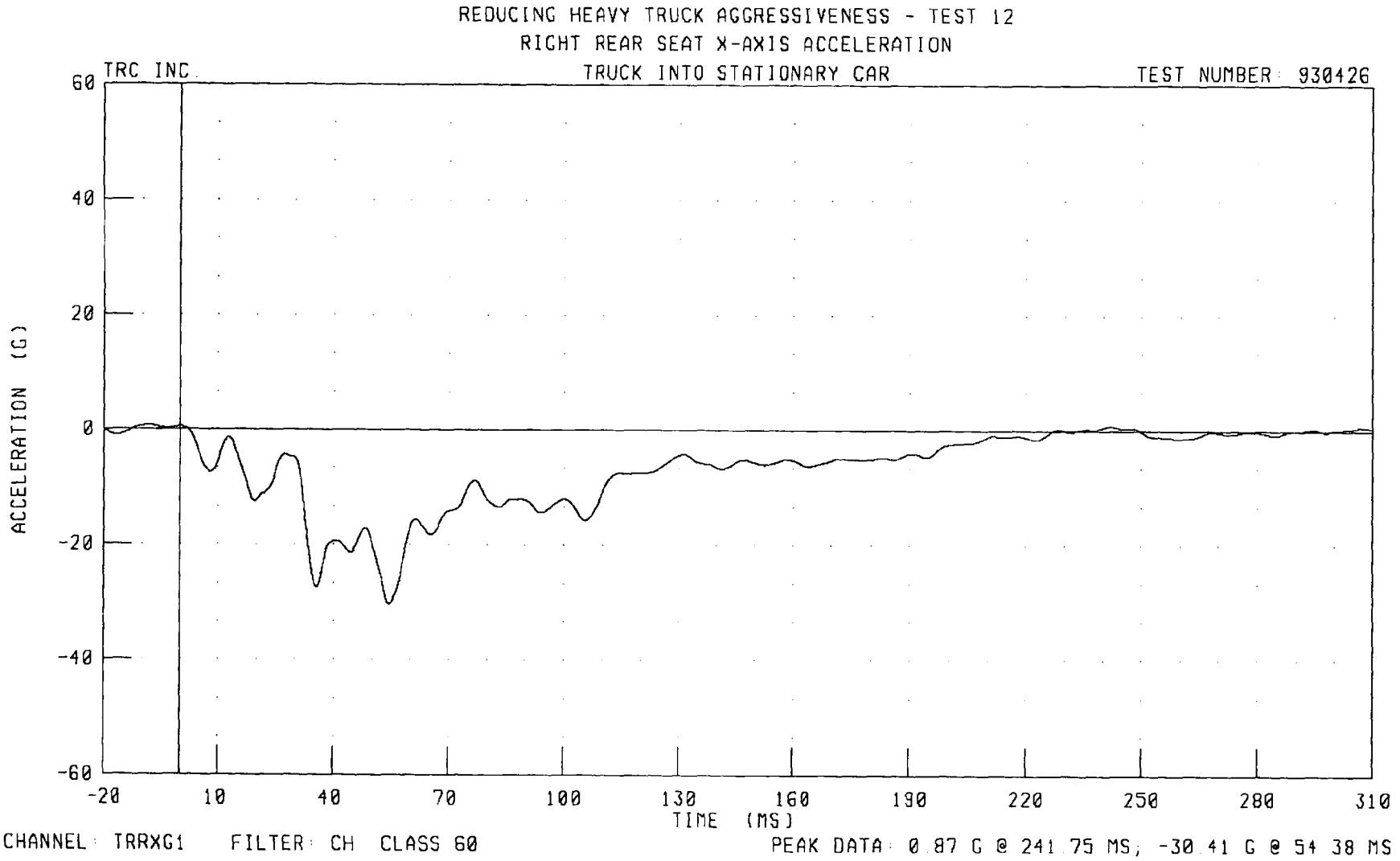
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12

LEFT REAR SEAT X-AXIS VELOCITY




CHANNEL TLRXV1 FILTER CH CLASS 180 PEAK DATA 0.00 KM/H @ 0.00 MS; -80.37 KM/H @ 281 13 MS

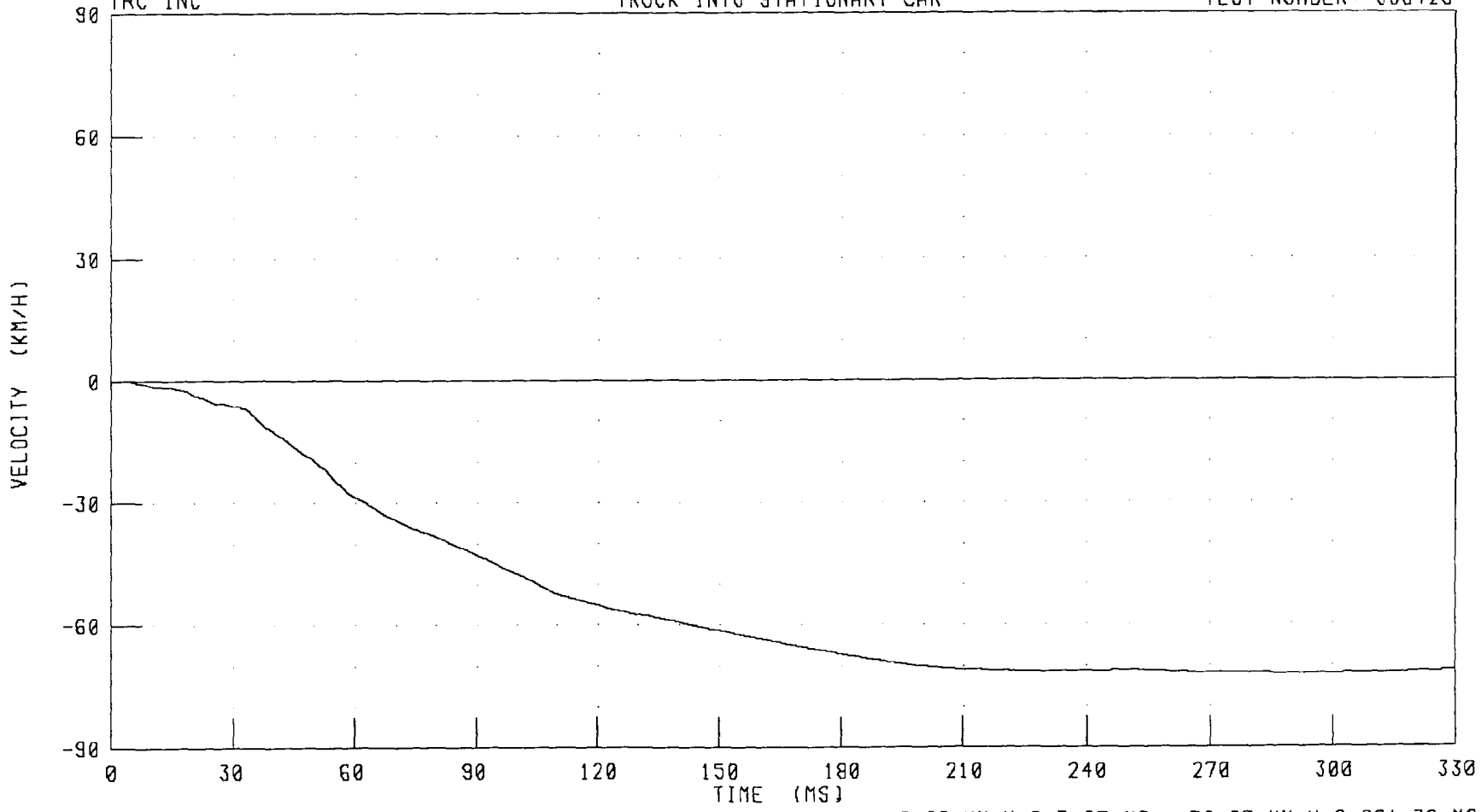
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12



REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12

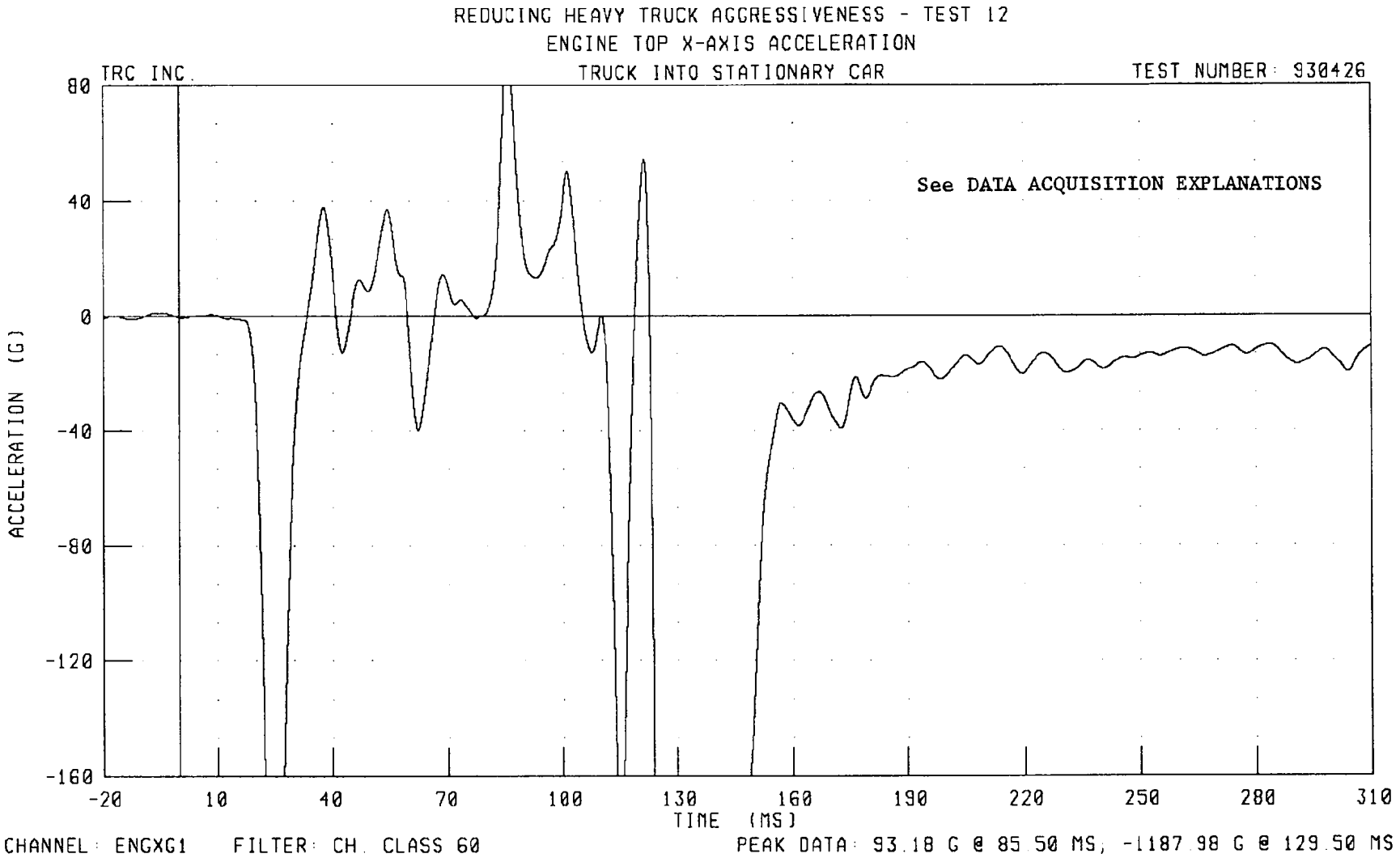
RIGHT REAR SEAT X-AXIS VELOCITY

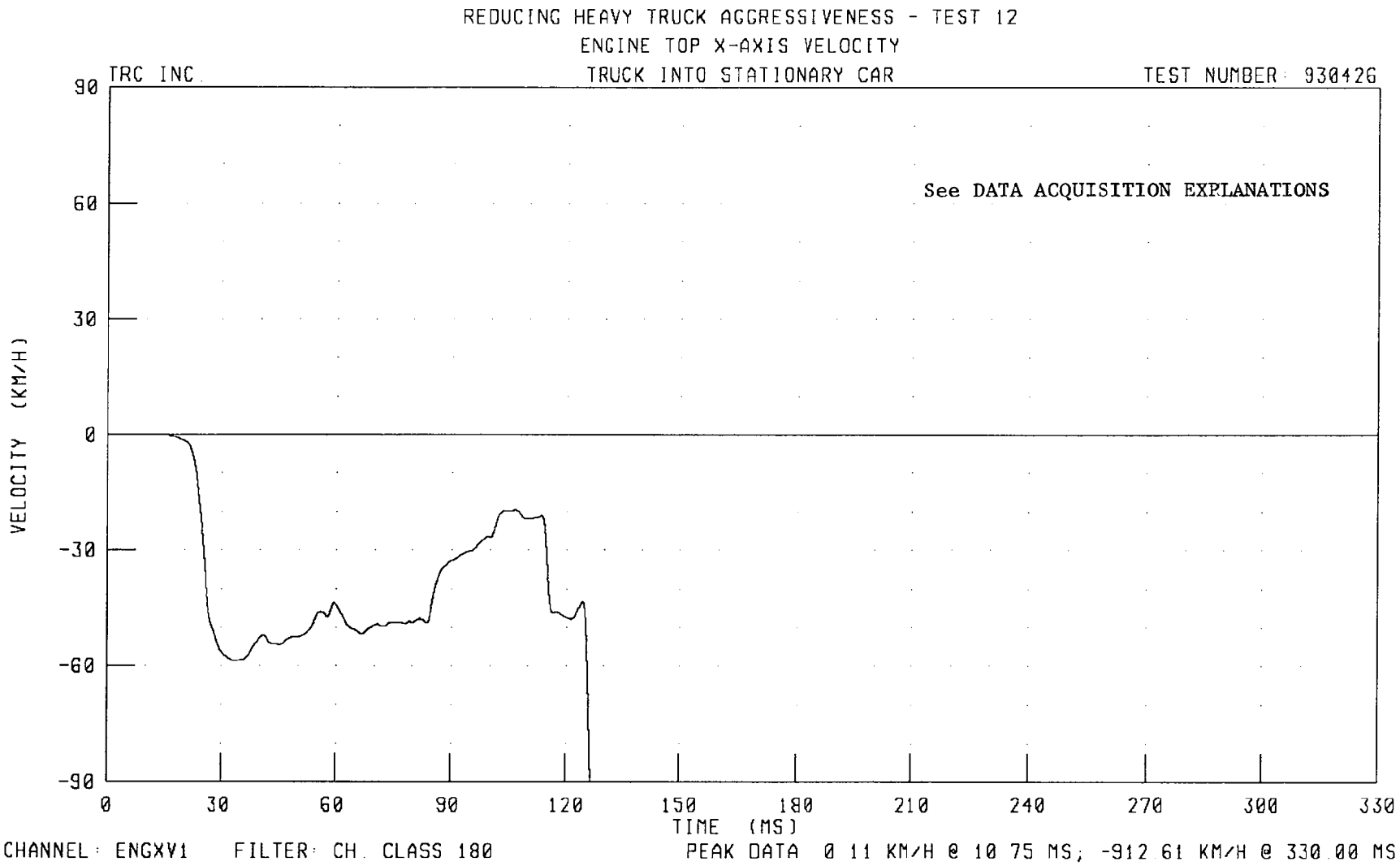
TRC INC — TRUCK INTO STATIONARY CAR — TEST NUMBER 930426



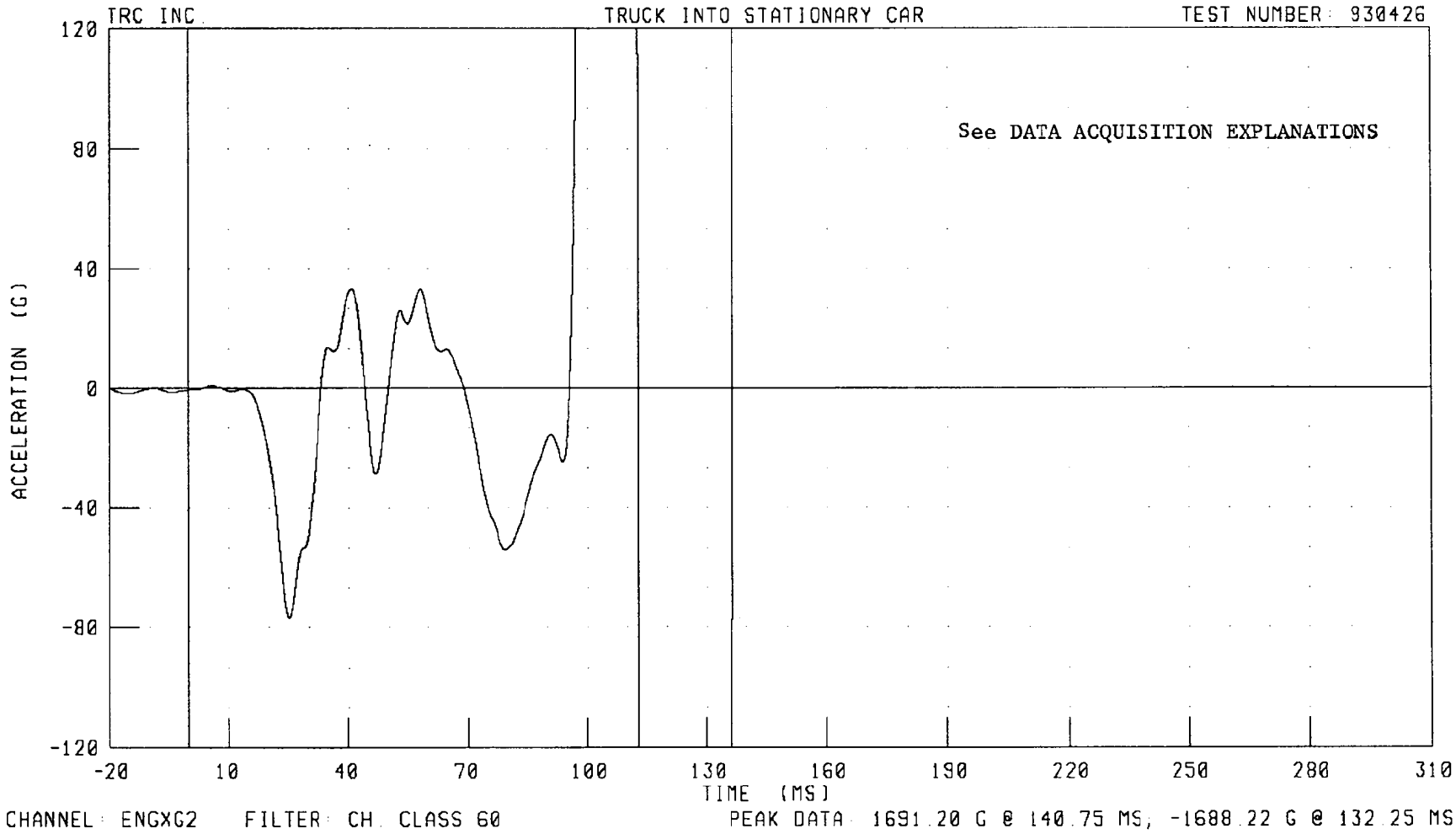

CHANNEL TRRXV1 FILTER CH CLASS 180

PEAK DATA 0.02 KM/H @ 3.25 MS; -72.07 KM/H @ 291.38 MS

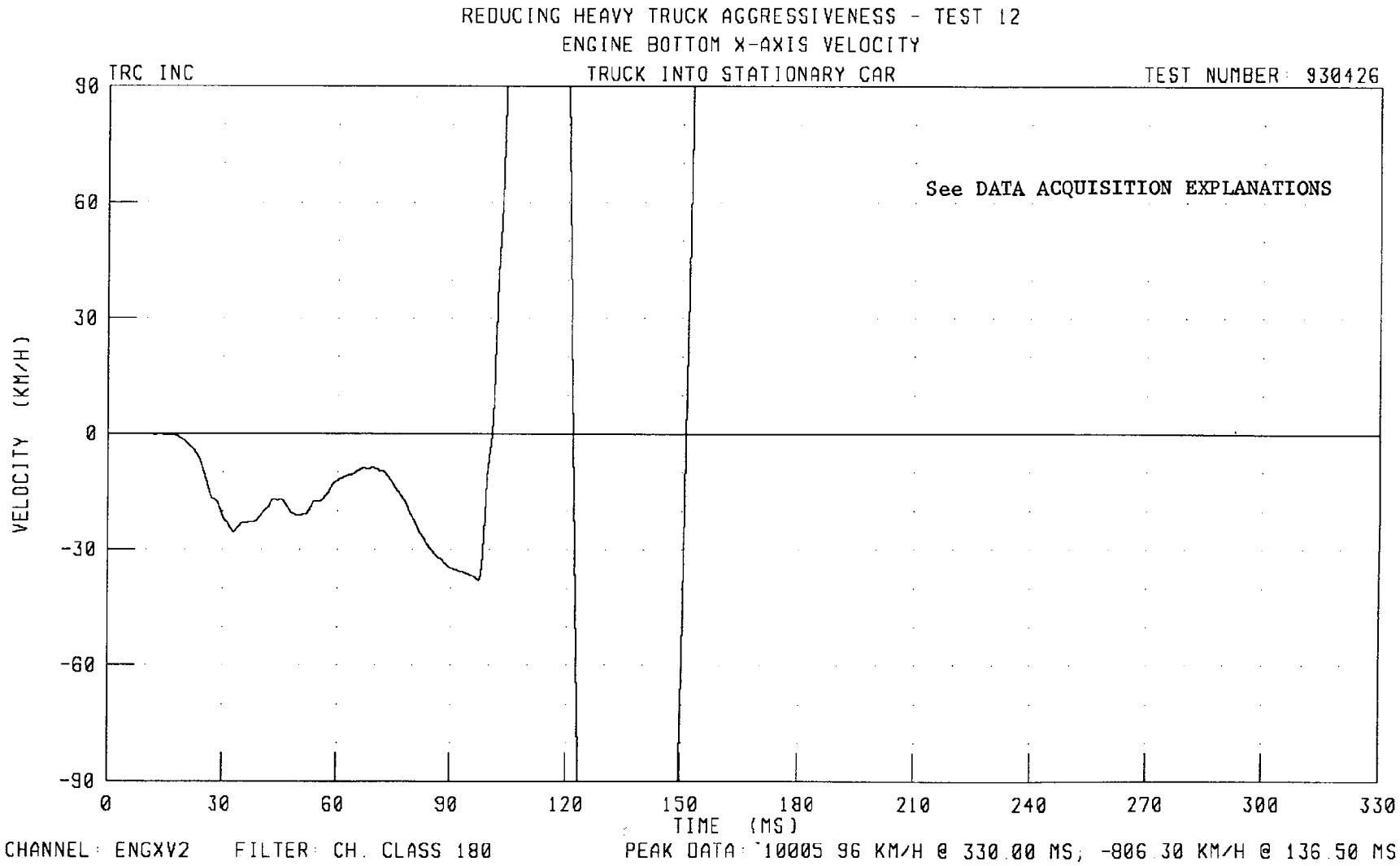

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
ENGINE TOP X-AXIS ACCELERATION
TRUCK INTO STATIONARY CAR
TRC INC.
TEST NUMBER: 930426
See DATA ACQUISITION EXPLANATIONS
ACCELERATION (G)
80
40
0
-40
-80
-120
-160
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: ENGXG1
FILTER: CH. CLASS 60
PEAK DATA: 93.18 G @ 85.50 MS, -1187.98 G @ 129.50 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
ENGINE TOP X-AXIS VELOCITY
TRC INC
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
See DATA ACQUISITION EXPLANATIONS
VELOCITY (KM/H)
90
60
30
0
-30
-60
-90
0
30
60
90
120
150
180
210
240
270
300
330
TIME (MS)
CHANNEL: ENGXV1
FILTER: CH CLASS 180
PEAK DATA 0 11 KM/H @ 10 75 MS; -912 61 KM/H @ 330 00 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
ENGINE BOTTOM X-AXIS ACCELERATION



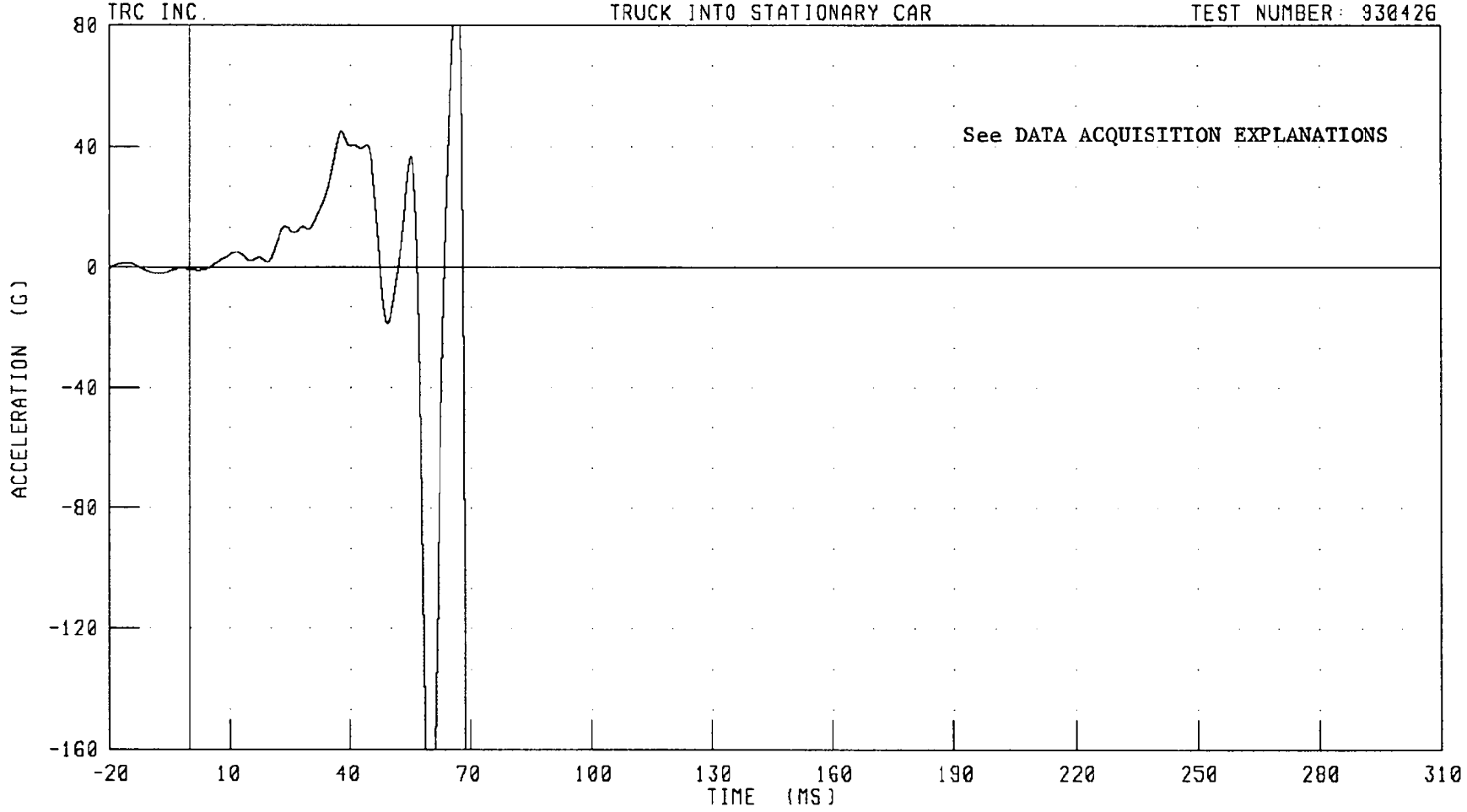

CHANNEL: ENGXC2 FILTER: CH CLASS 60 PEAK DATA: 1691.20 G @ 140.75 MS, -1688.22 G @ 132.25 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
ENGINE BOTTOM X-AXIS VELOCITY
TRC INC
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
See DATA ACQUISITION EXPLANATIONS
VELOCITY (KM/H)
90
60
30
0
-30
-60
-90
0
30
60
90
120
150
180
210
240
270
300
330
TIME (MS)
CHANNEL: ENGXV2
FILTER: CH. CLASS 180
PEAK DATA: 10005.96 KM/H @ 330.00 MS; -806.30 KM/H @ 136.50 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12

RIGHT BRAKE CALIPER X-AXIS ACCELERATION

TRC INC. TRUCK INTO STATIONARY CAR TEST NUMBER: 930426

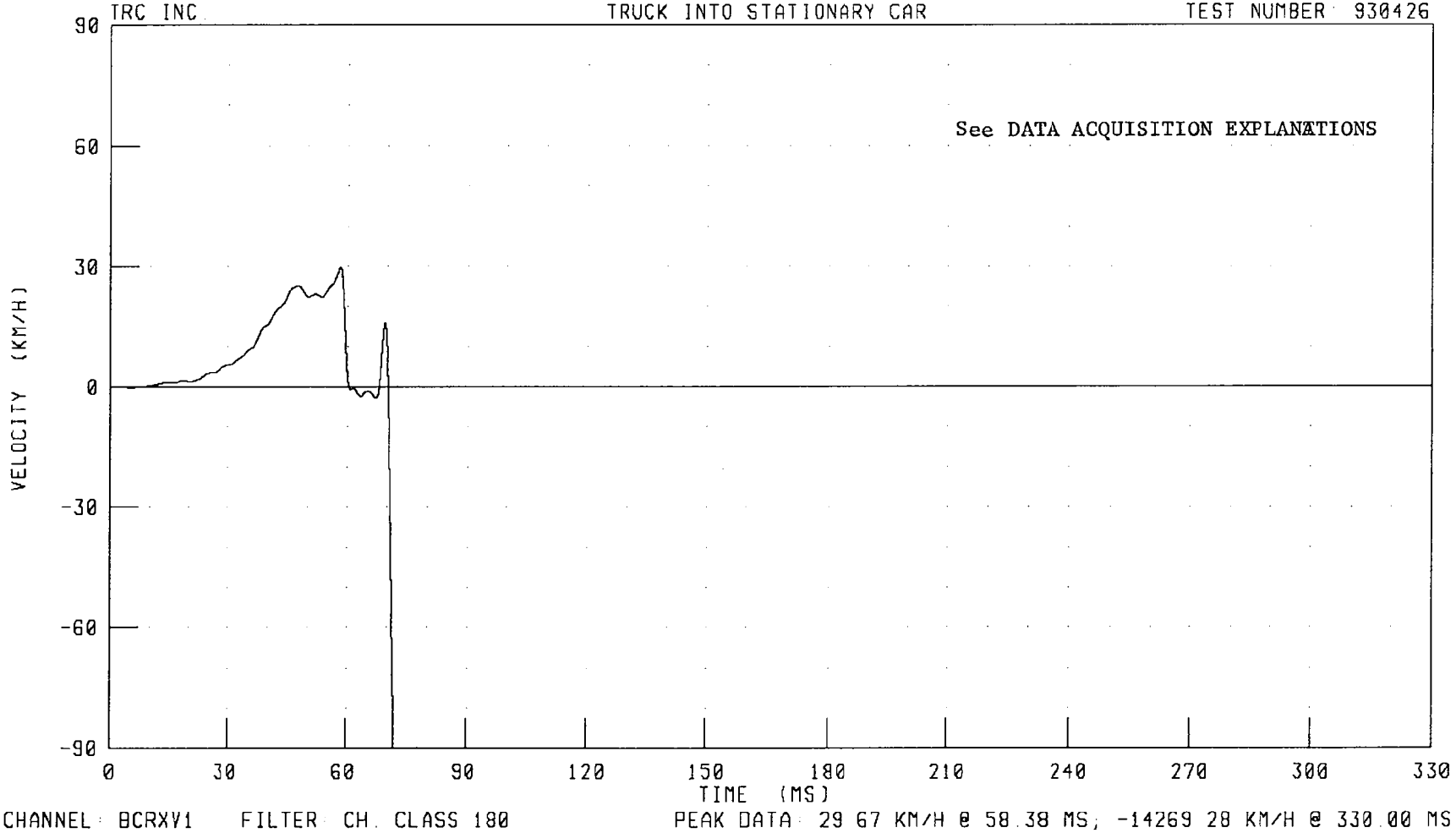



CHANNEL: BCRXG1 FILTER: CH. CLASS 60 PEAK DATA: 98.17 G @ 66.63 MS; -1579.63 G @ 80.75 MS

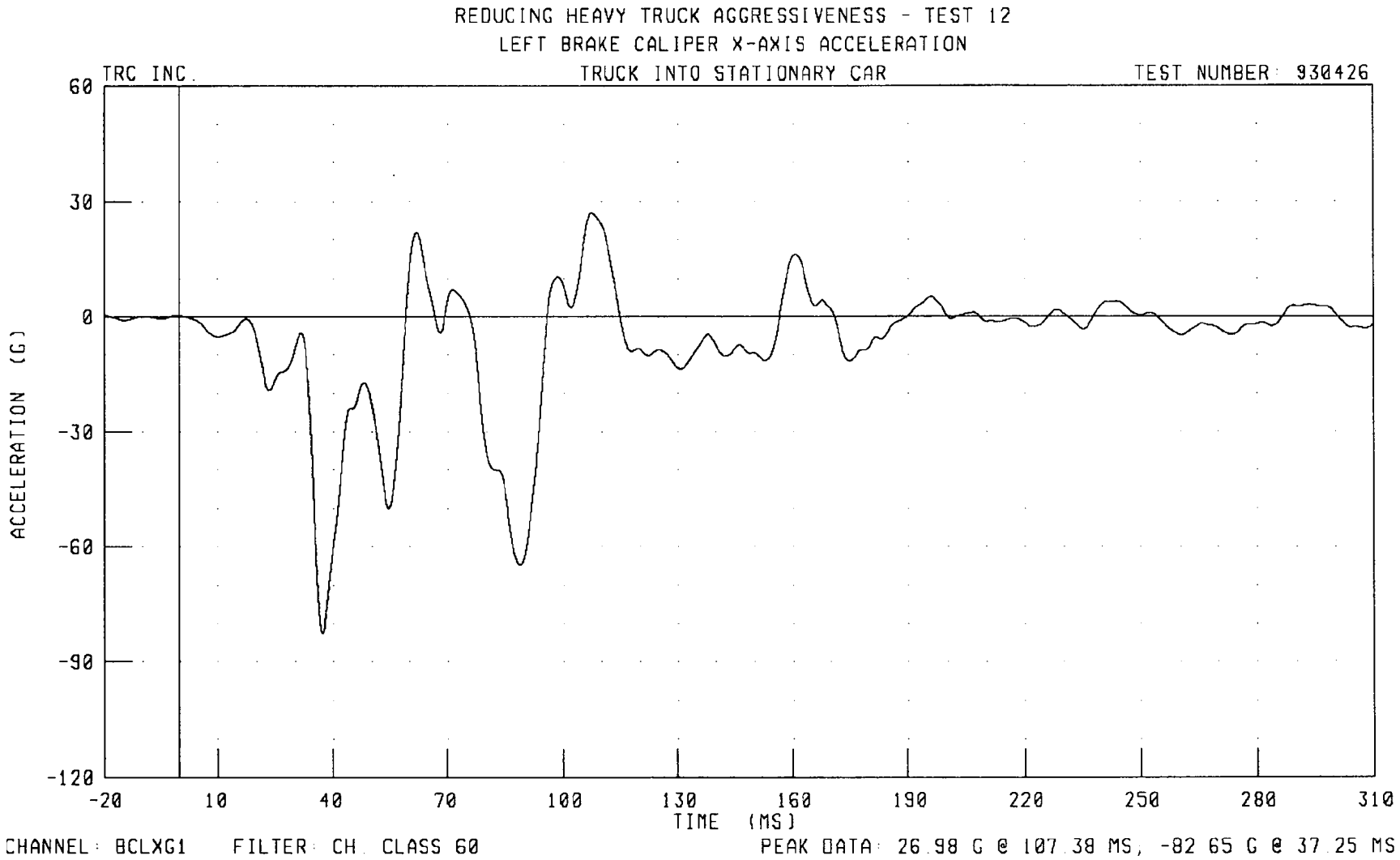
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12

RIGHT BRAKE CALIPER X-AXIS VELOCITY

TRC INC. TRUCK INTO STATIONARY CAR TEST NUMBER: 930426



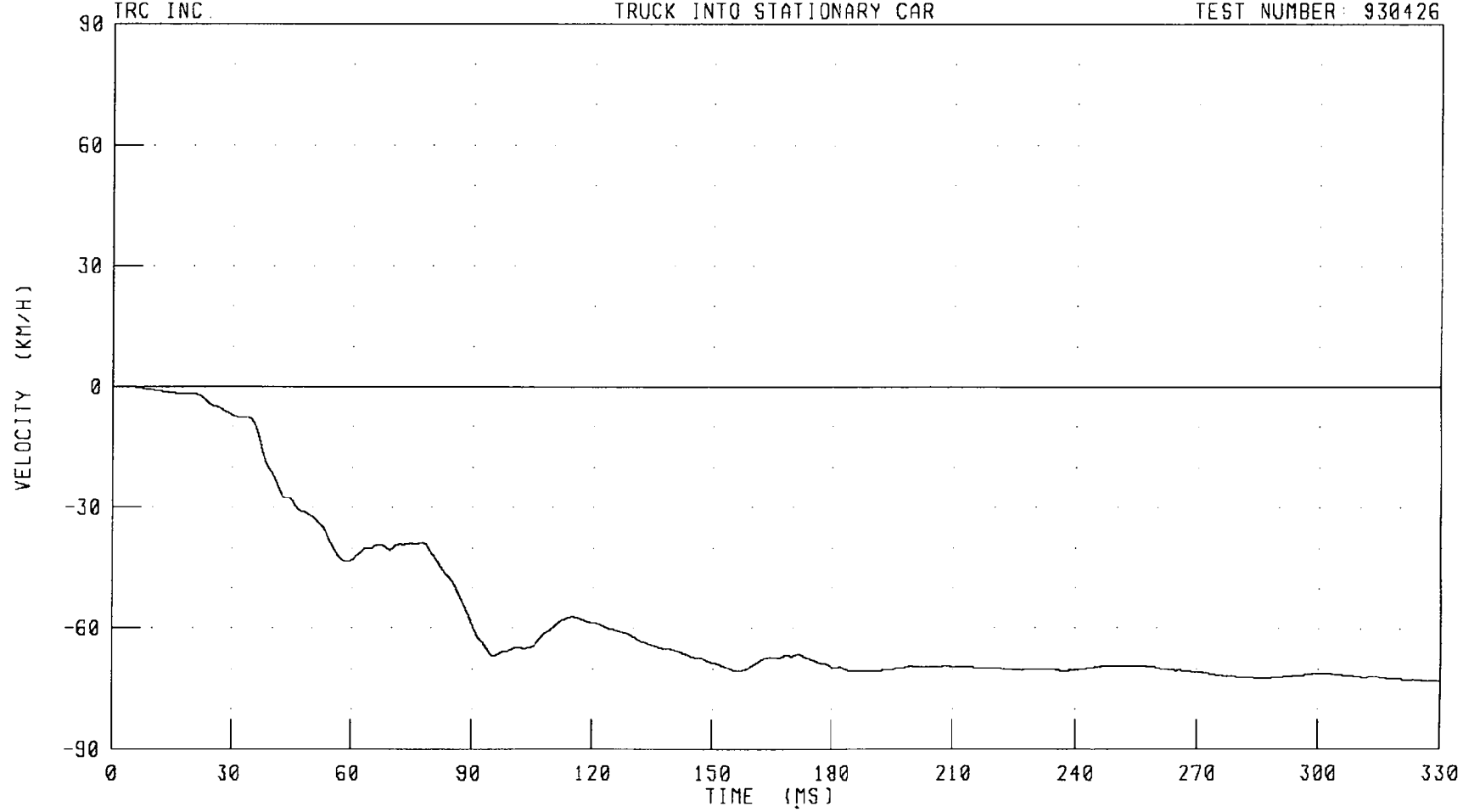

CHANNEL: BCRXV1 FILTER: CH. CLASS 180 PEAK DATA: 29.67 KM/H @ 58.38 MS; -14269.28 KM/H @ 330.00 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
LEFT BRAKE CALIPER X-AXIS ACCELERATION
TRC INC.
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
60
30
0
-30
-60
-90
-120
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: BCLXG1
FILTER: CH CLASS 60
PEAK DATA: 26.98 G @ 107.38 MS, -82.65 G @ 37.25 MS

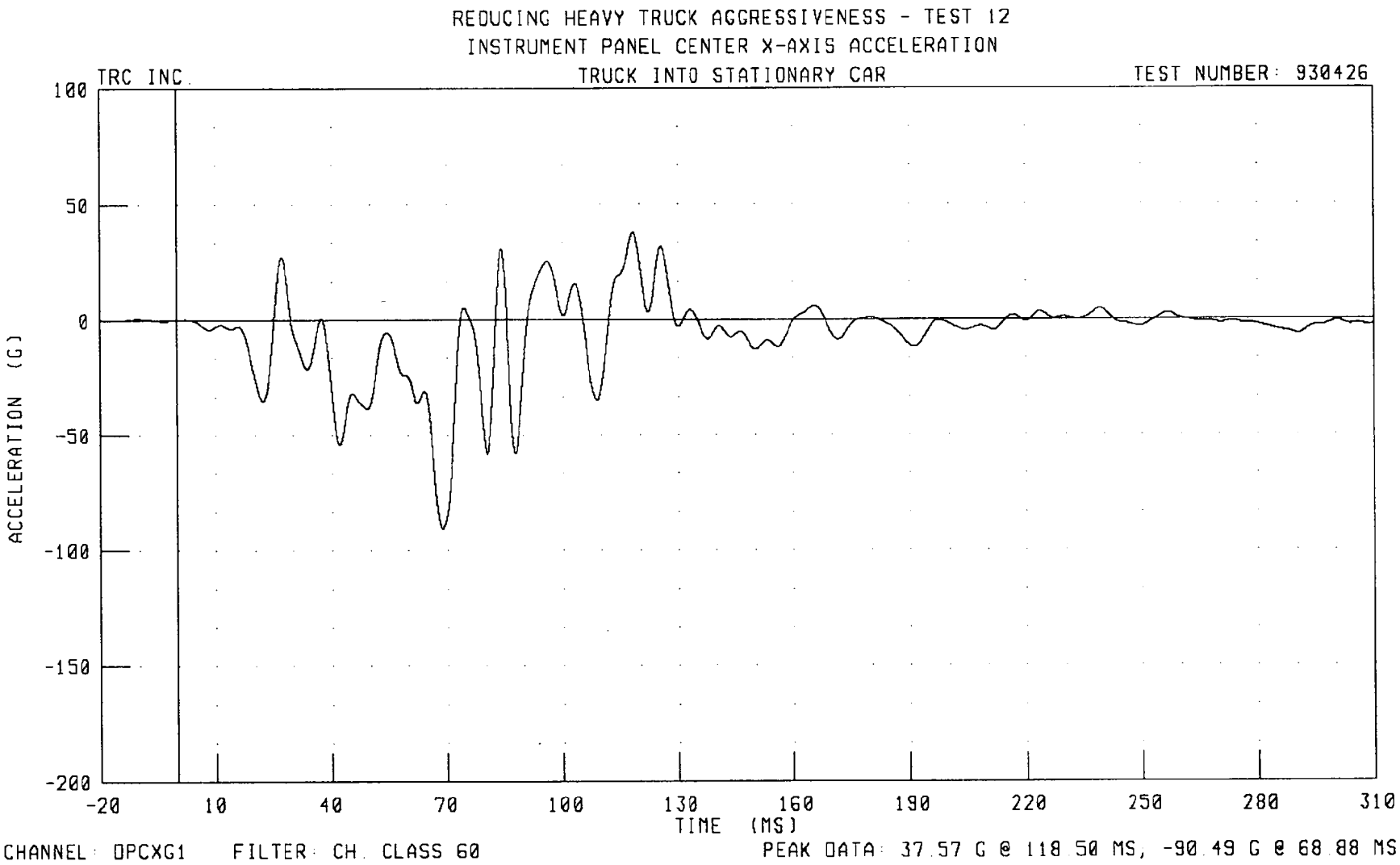
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12

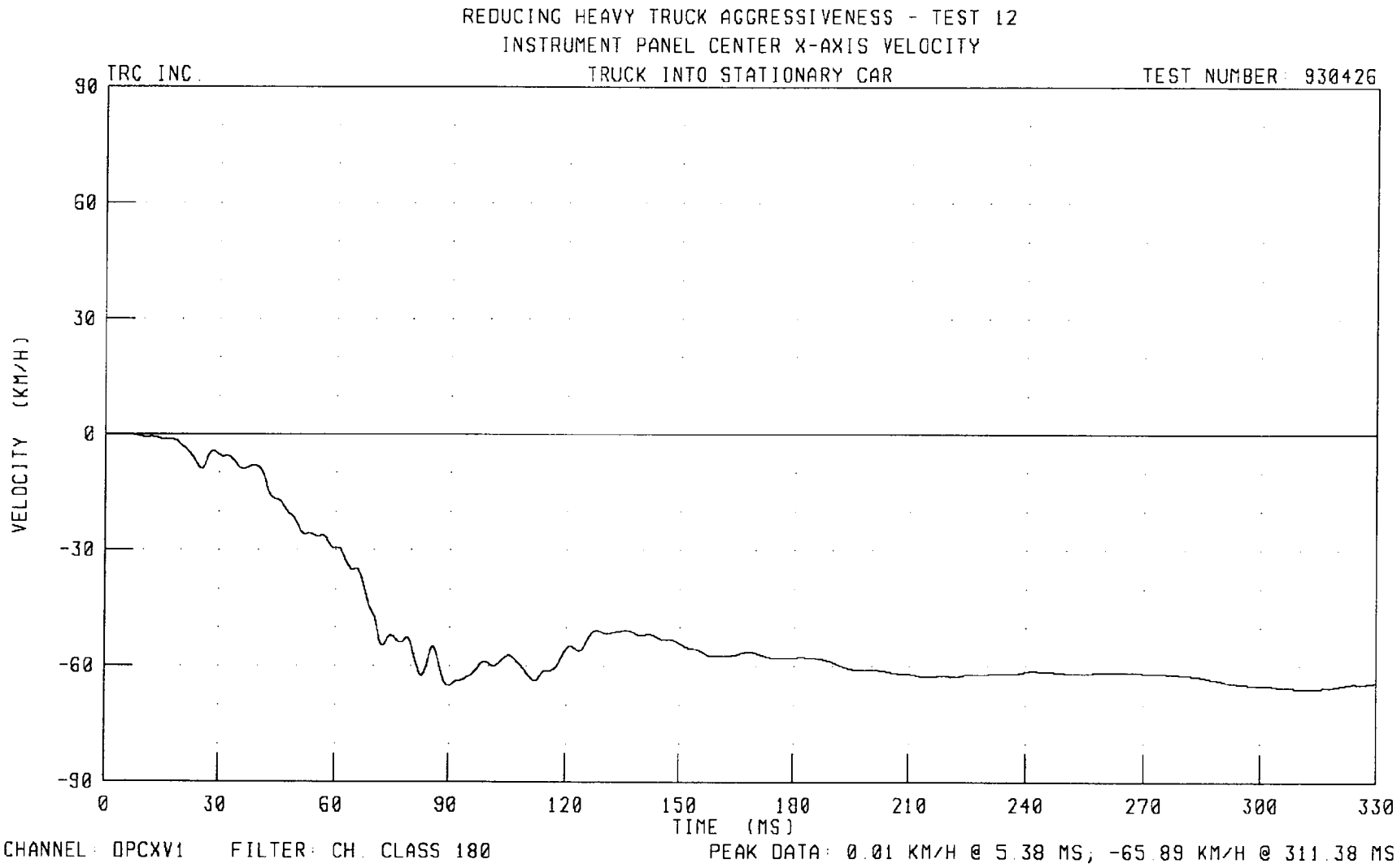
LEFT BRAKE CALIPER X-AXIS VELOCITY

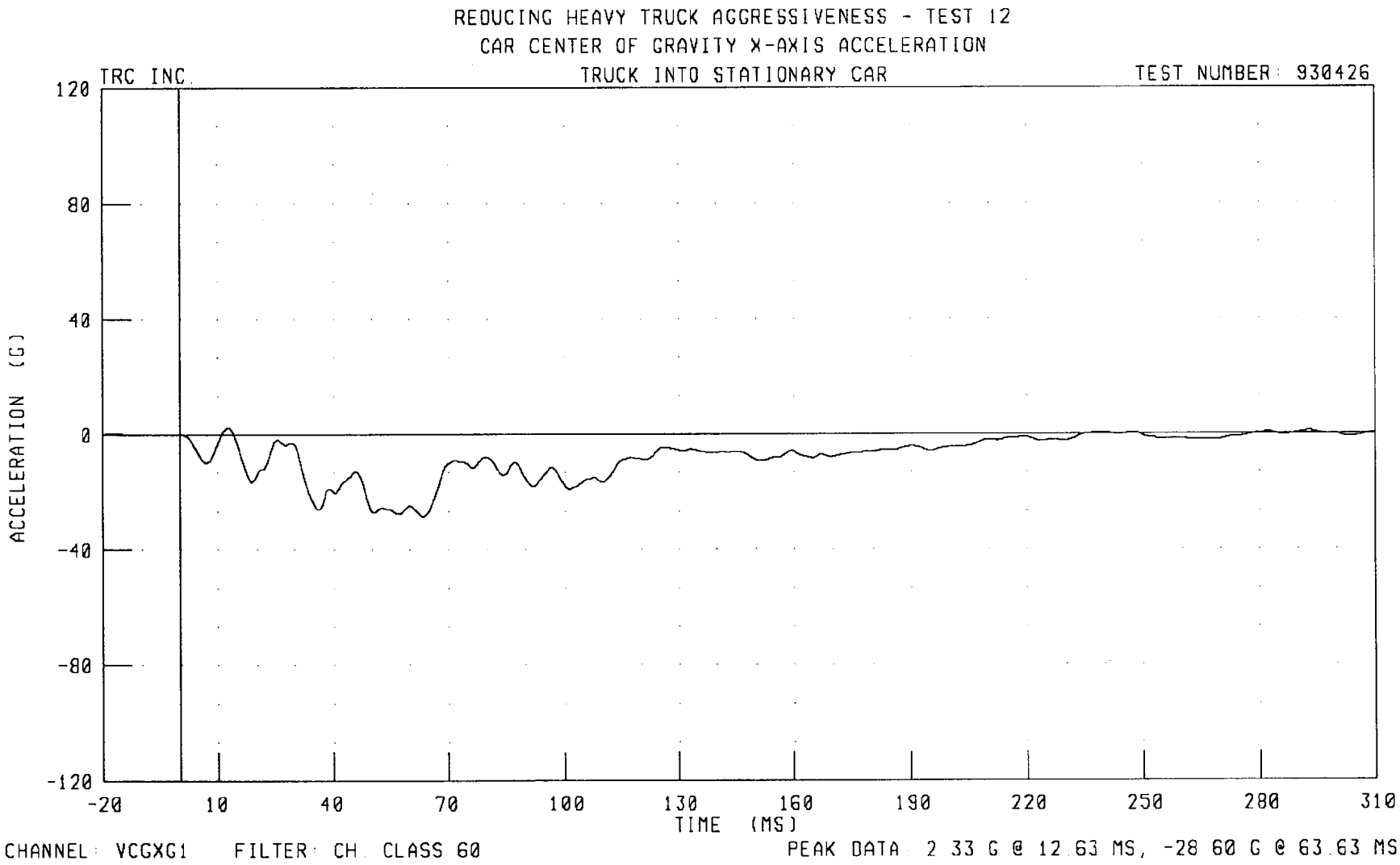
TRC INC TRUCK INTO STATIONARY CAR TEST NUMBER: 930426

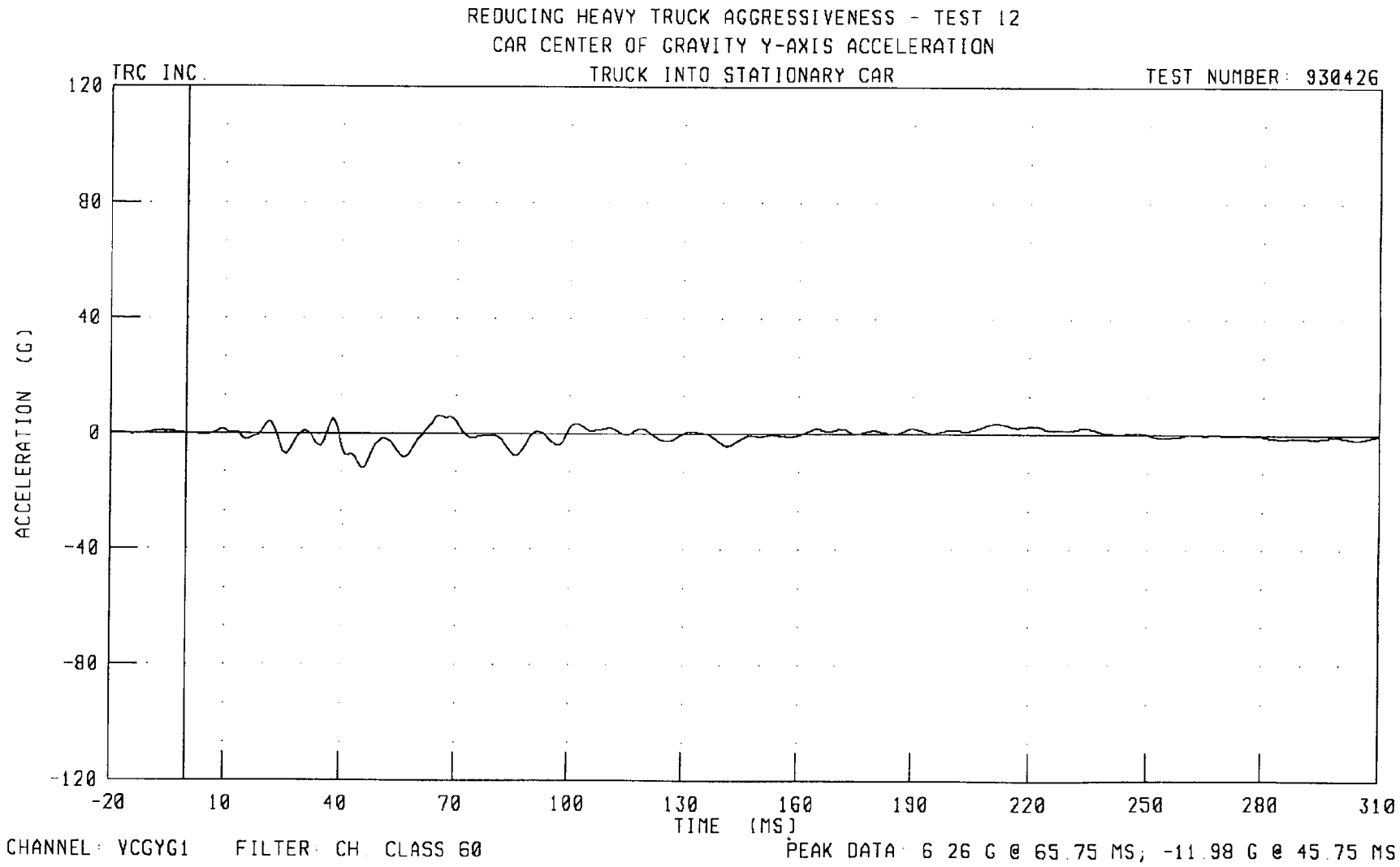


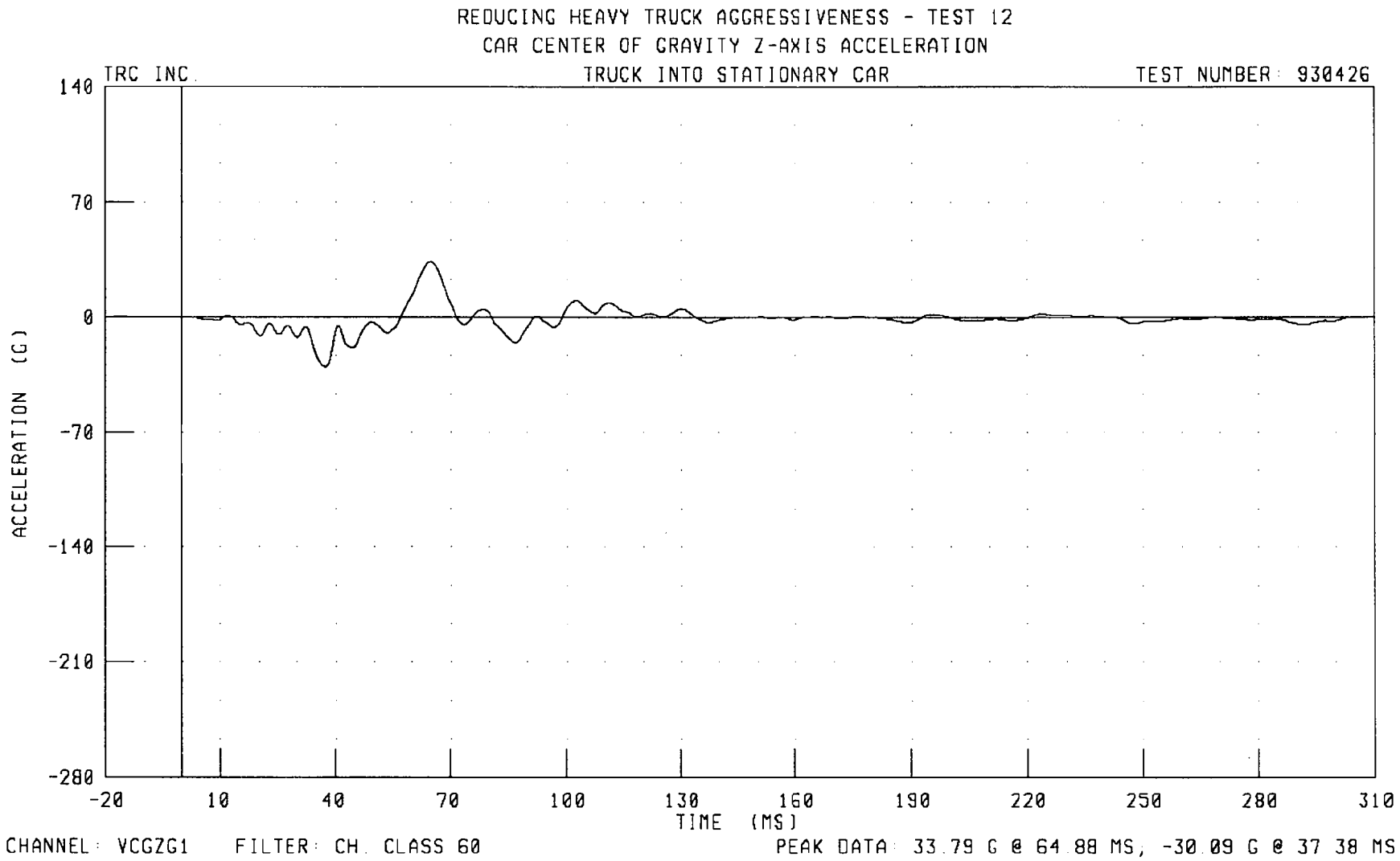

CHANNEL: BCLXV1 FILTER: CH CLASS 180 PEAK DATA: 0.00 KM/H @ 0.00 MS, -72.82 KM/H @ 328.50 MS

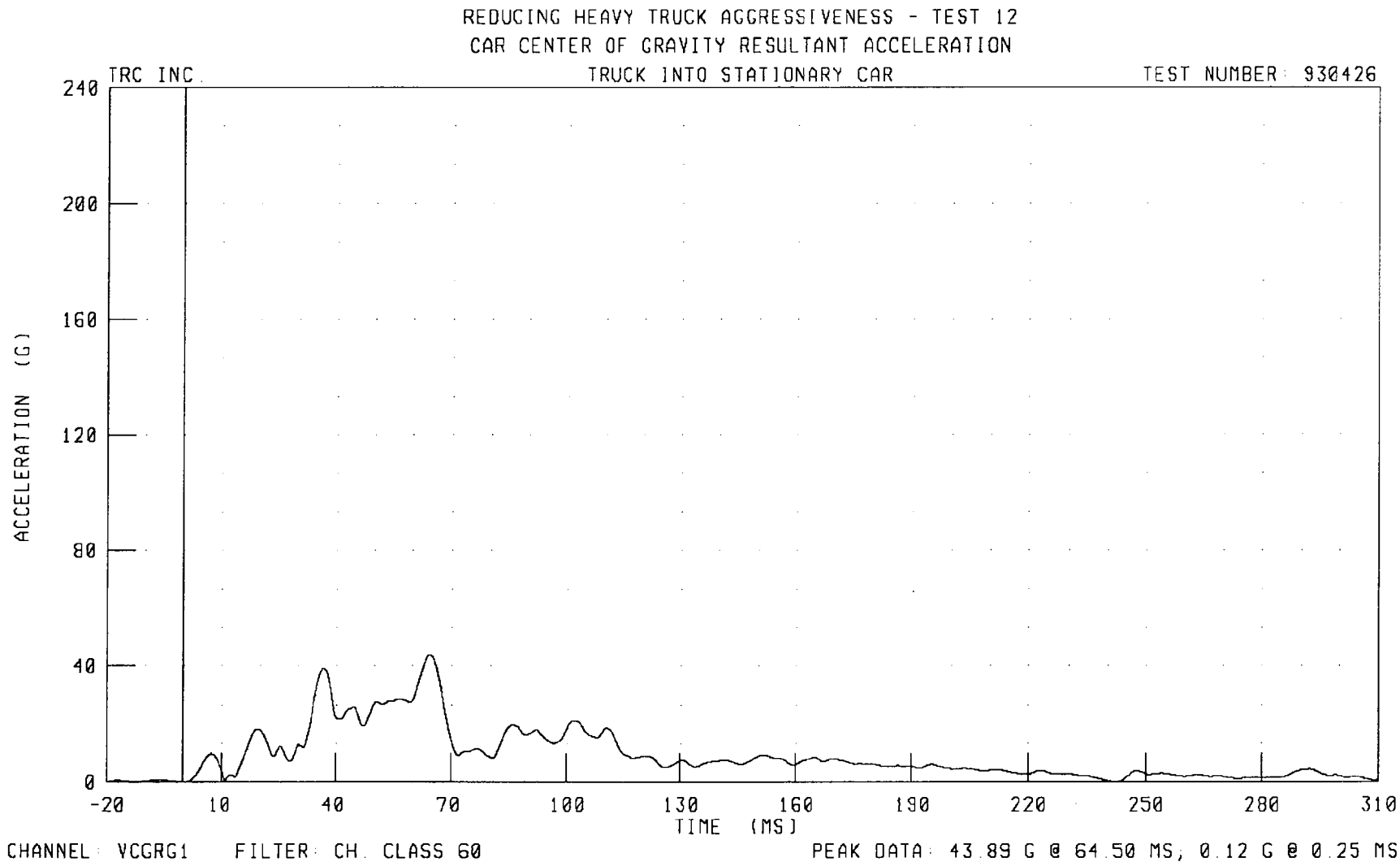

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
INSTRUMENT PANEL CENTER X-AXIS ACCELERATION
TRC INC.
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
100
50
0
-50
-100
-150
-200
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: DPCXG1
FILTER: CH. CLASS 60
PEAK DATA: 37.57 G @ 118.50 MS, -90.49 G @ 68.88 MS

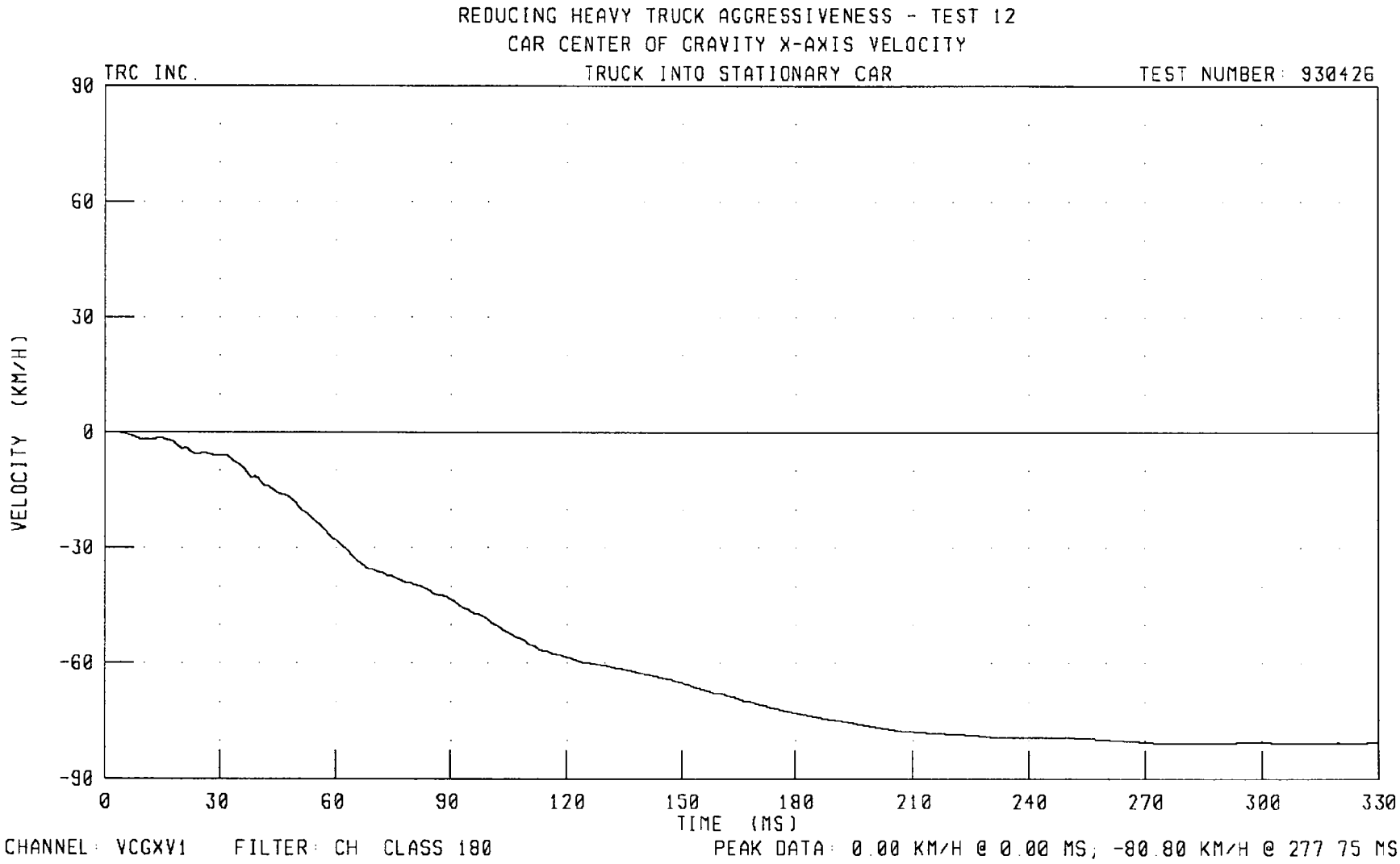

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
INSTRUMENT PANEL CENTER X-AXIS VELOCITY
TRC INC.
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
VELOCITY (KM/H)
90
60
30
0
-30
-60
-90
0
30
60
90
120
150
180
210
240
270
300
330
TIME (MS)
CHANNEL: DPCXV1
FILTER: CH. CLASS 180
PEAK DATA: 0.01 KM/H @ 5.38 MS; -65.89 KM/H @ 311.38 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
CAR CENTER OF GRAVITY X-AXIS ACCELERATION
TRC INC.
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
120
80
40
0
-40
-80
-120
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: VCGXG1
FILTER: CH CLASS 60
PEAK DATA 2 33 G @ 12 63 MS, -28 60 G @ 63 63 MS

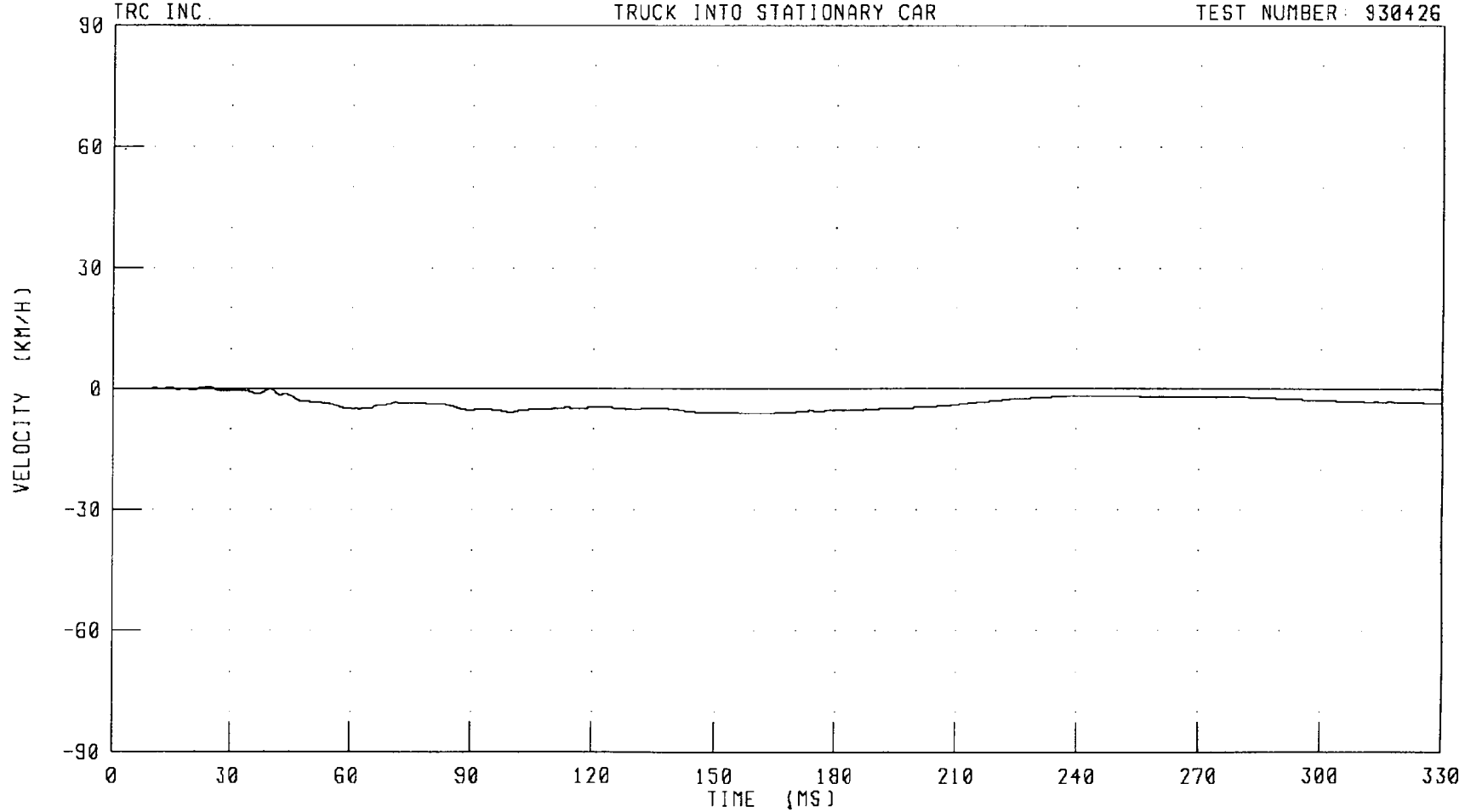

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
CAR CENTER OF GRAVITY Y-AXIS ACCELERATION
TRUCK INTO STATIONARY CAR
TRC INC.
TEST NUMBER: 930426
120
80
40
0
-40
-80
-120
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: VCGYG1
FILTER: CH CLASS 60
PEAK DATA: 6.26 G @ 65.75 MS; -11.98 G @ 45.75 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
CAR CENTER OF GRAVITY Z-AXIS ACCELERATION
TRC INC.
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
140
70
0
-70
-140
-210
-280
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: VCGZG1
FILTER: CH. CLASS 60
PEAK DATA: 33.79 G @ 64.88 MS, -30.09 G @ 37.38 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
CAR CENTER OF GRAVITY RESULTANT ACCELERATION
TRC INC
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
ACCELERATION (G)
240
200
160
120
80
40
0
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: VCGRG1 FILTER: CH. CLASS 60
PEAK DATA: 43.89 G @ 64.50 MS, 0.12 G @ 0.25 MS

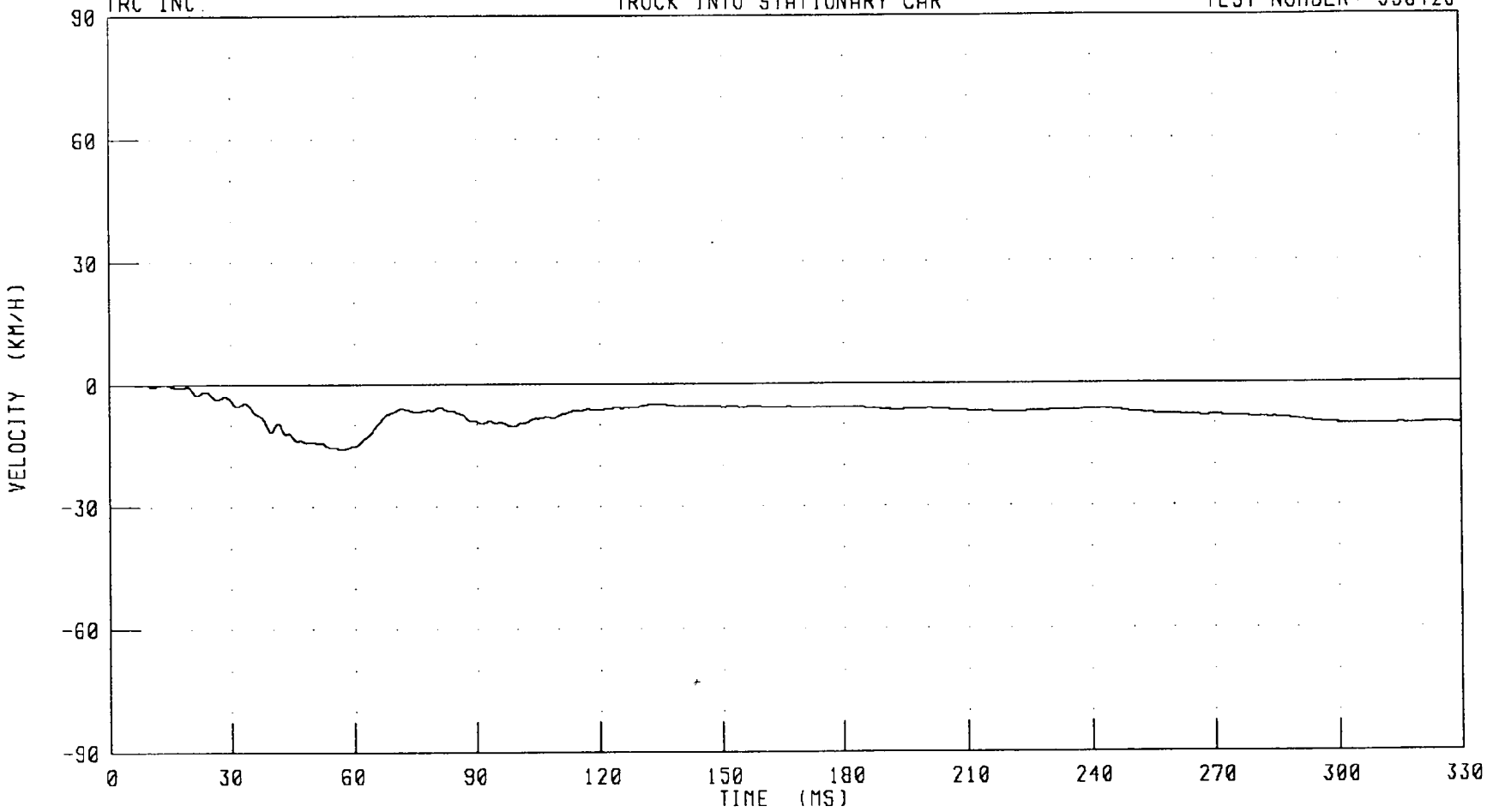

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
CAR CENTER OF GRAVITY X-AXIS VELOCITY
TRC INC.
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
90
60
30
0
-30
-60
-90
VELOCITY (KM/H)
0
30
60
90
120
150
180
210
240
270
300
330
TIME (MS)
CHANNEL: VCGXV1
FILTER: CH CLASS 180
PEAK DATA: 0.00 KM/H @ 0.00 MS; -80.80 KM/H @ 277.75 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
CAR CENTER OF GRAVITY Y-AXIS VELOCITY




CHANNEL: VCGYV1 FILTER: CH. CLASS 180 PEAK DATA: 0.53 KM/H @ 24.00 MS; -6.10 KM/H @ 161.13 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
CAR CENTER OF GRAVITY Z-AXIS VELOCITY
TRC INC. TRUCK INTO STATIONARY CAR TEST NUMBER: 930426

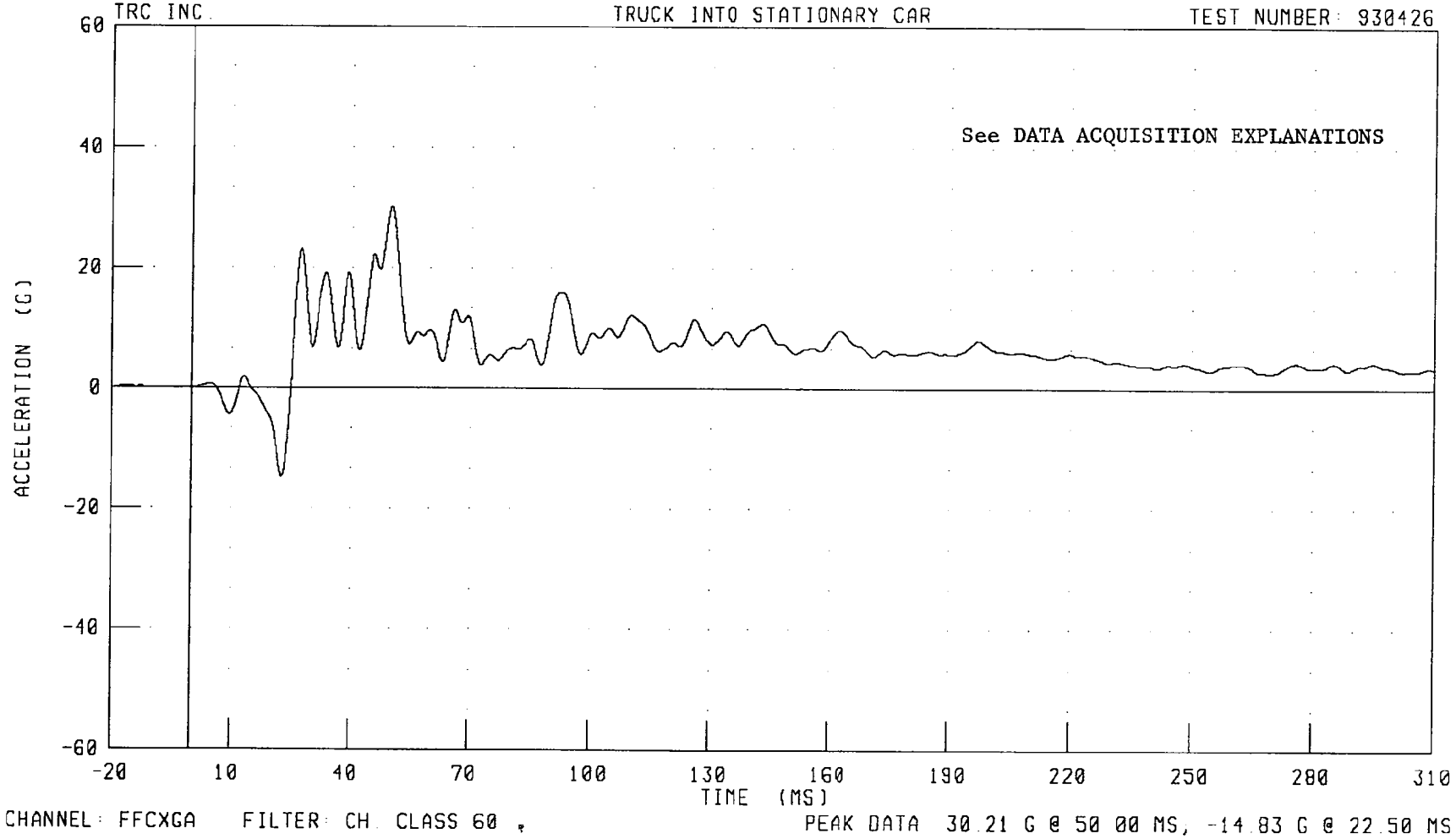



CHANNEL: VCGZV1 FILTER: CH. CLASS 180 PEAK DATA: 0.03 KM/H @ 4.75 MS, -16.09 KM/H @ 57.00 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12

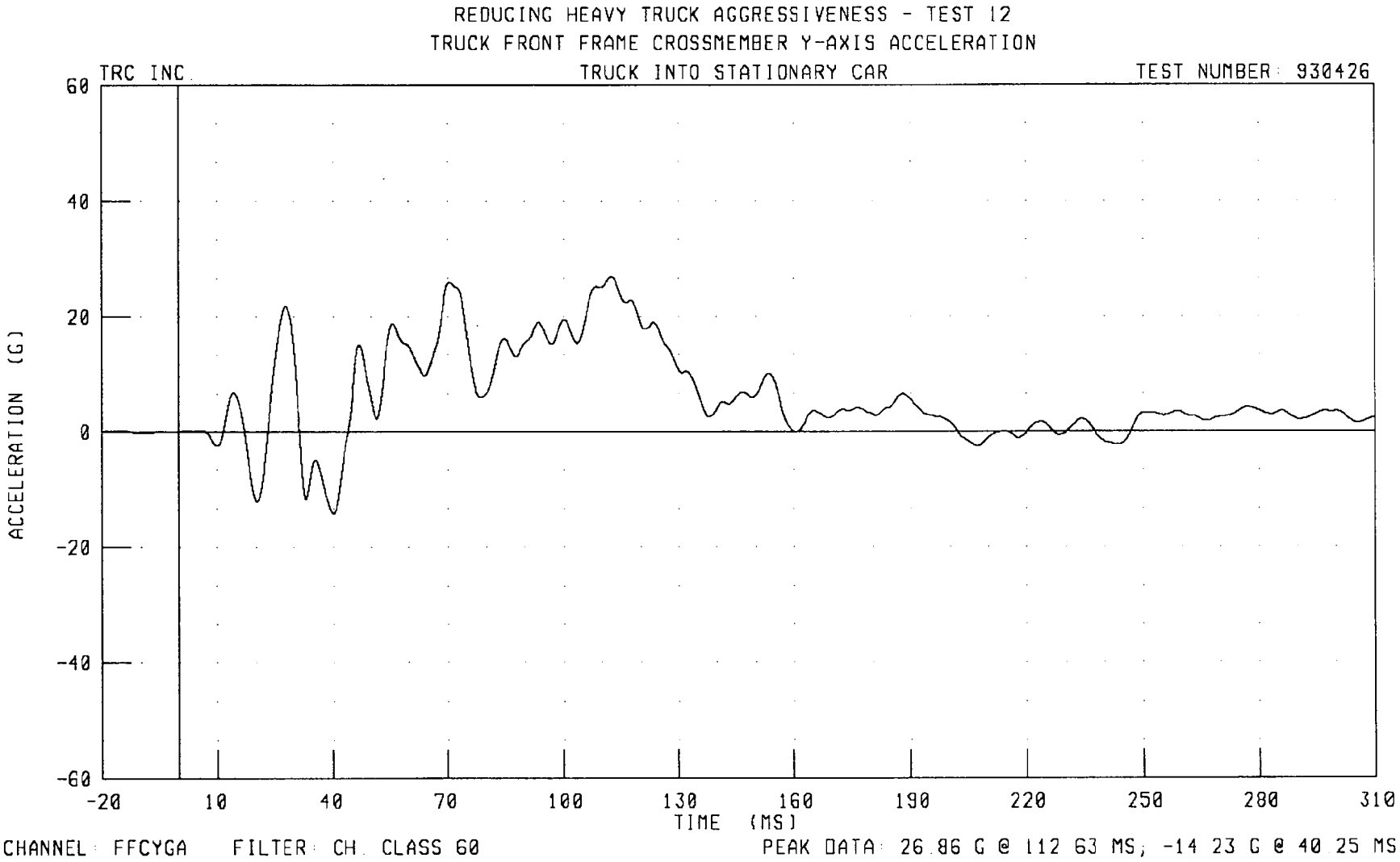
TRUCK FRONT FRAME CROSSMEMBER X-AXIS ACCELERATION

TRUCK INTO STATIONARY CAR

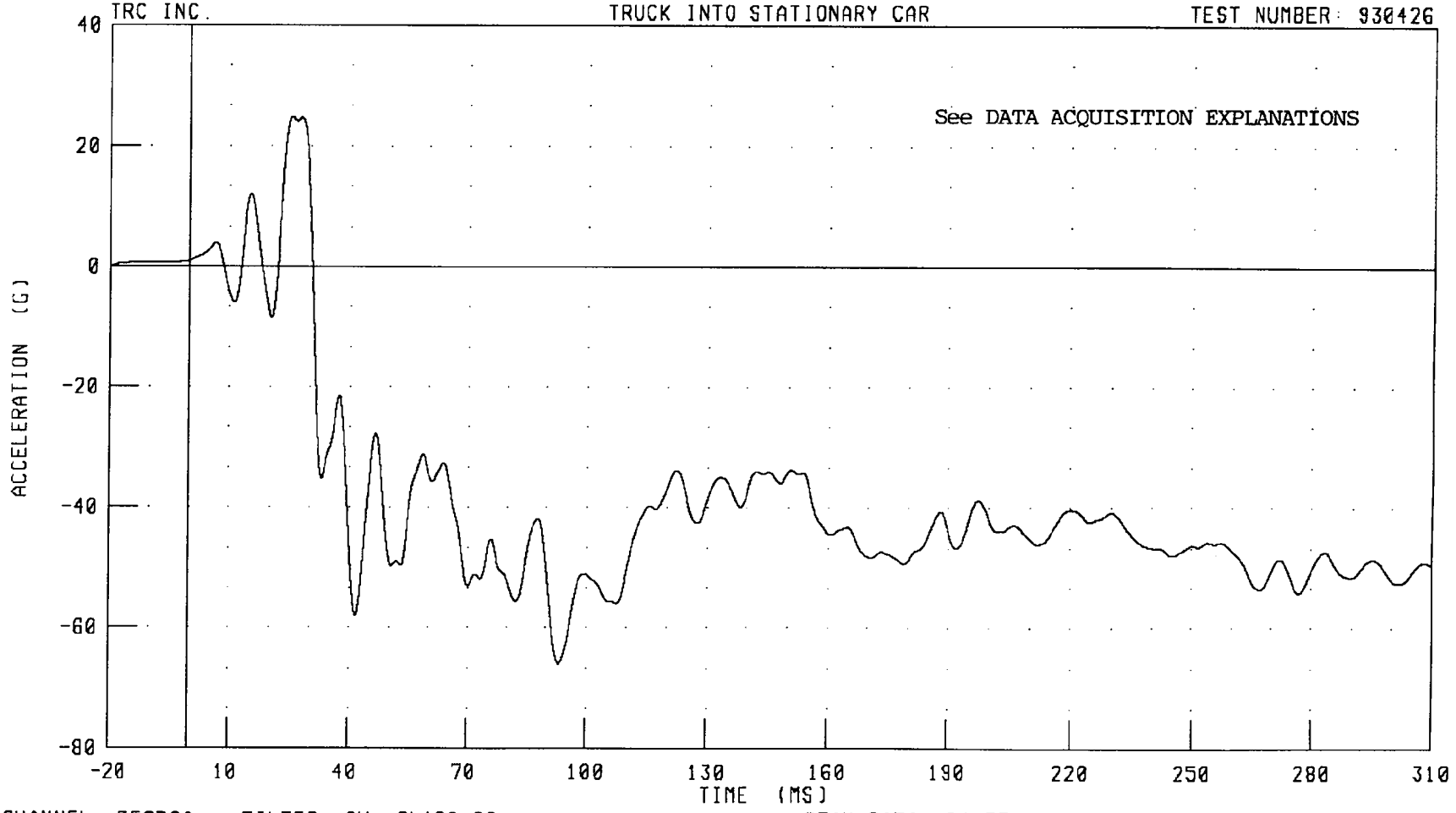



CHANNEL: FFCXGA FILTER: CH CLASS 60

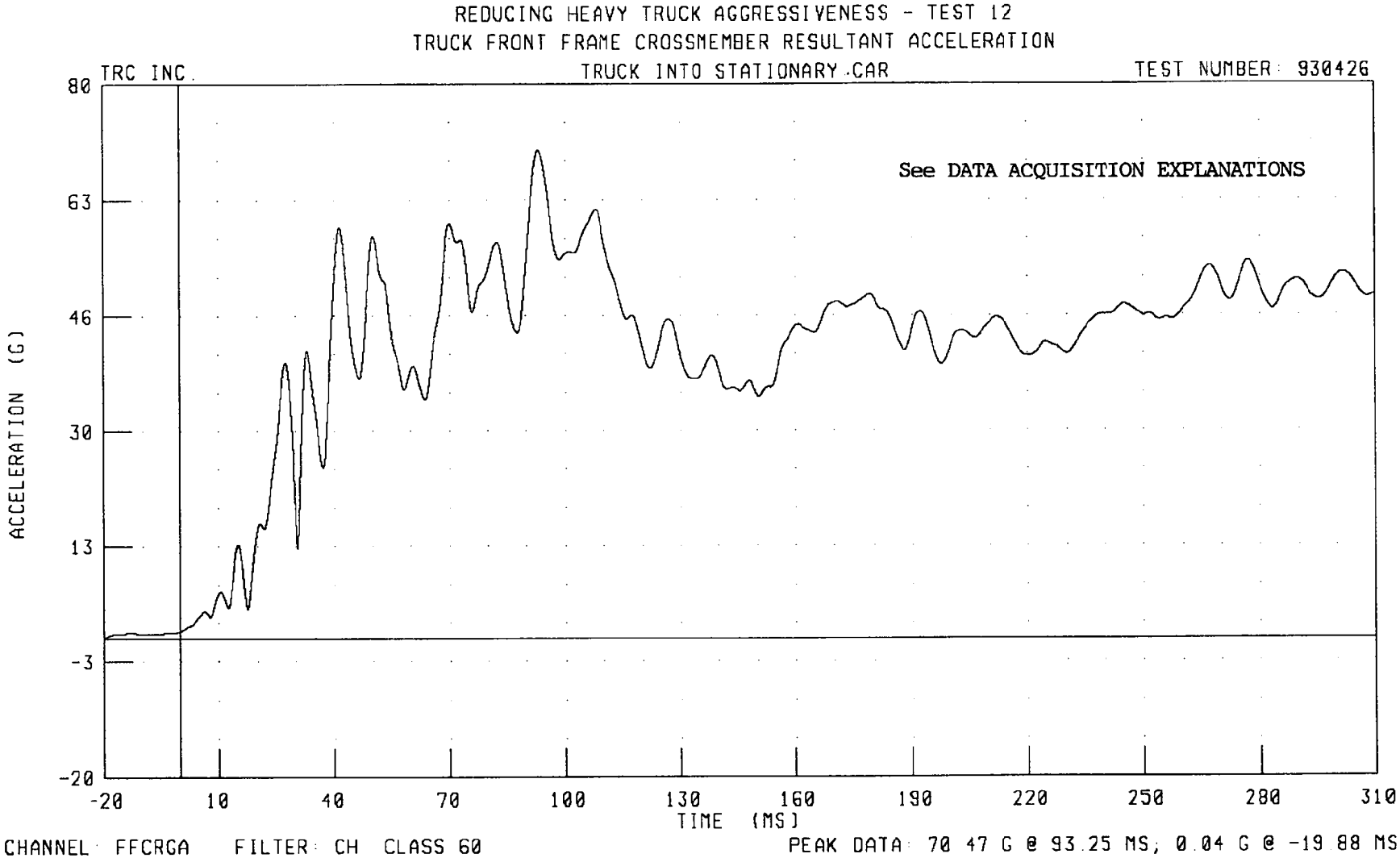
PEAK DATA 30.21 G @ 50.00 MS, -14.83 G @ 22.50 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
TRUCK FRONT FRAME CROSSMEMBER Y-AXIS ACCELERATION
TRC INC
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
60
40
20
0
-20
-40
-60
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: FFCYGA FILTER: CH CLASS 60
PEAK DATA: 26.86 G @ 112.63 MS; -14.23 G @ 40.25 MS

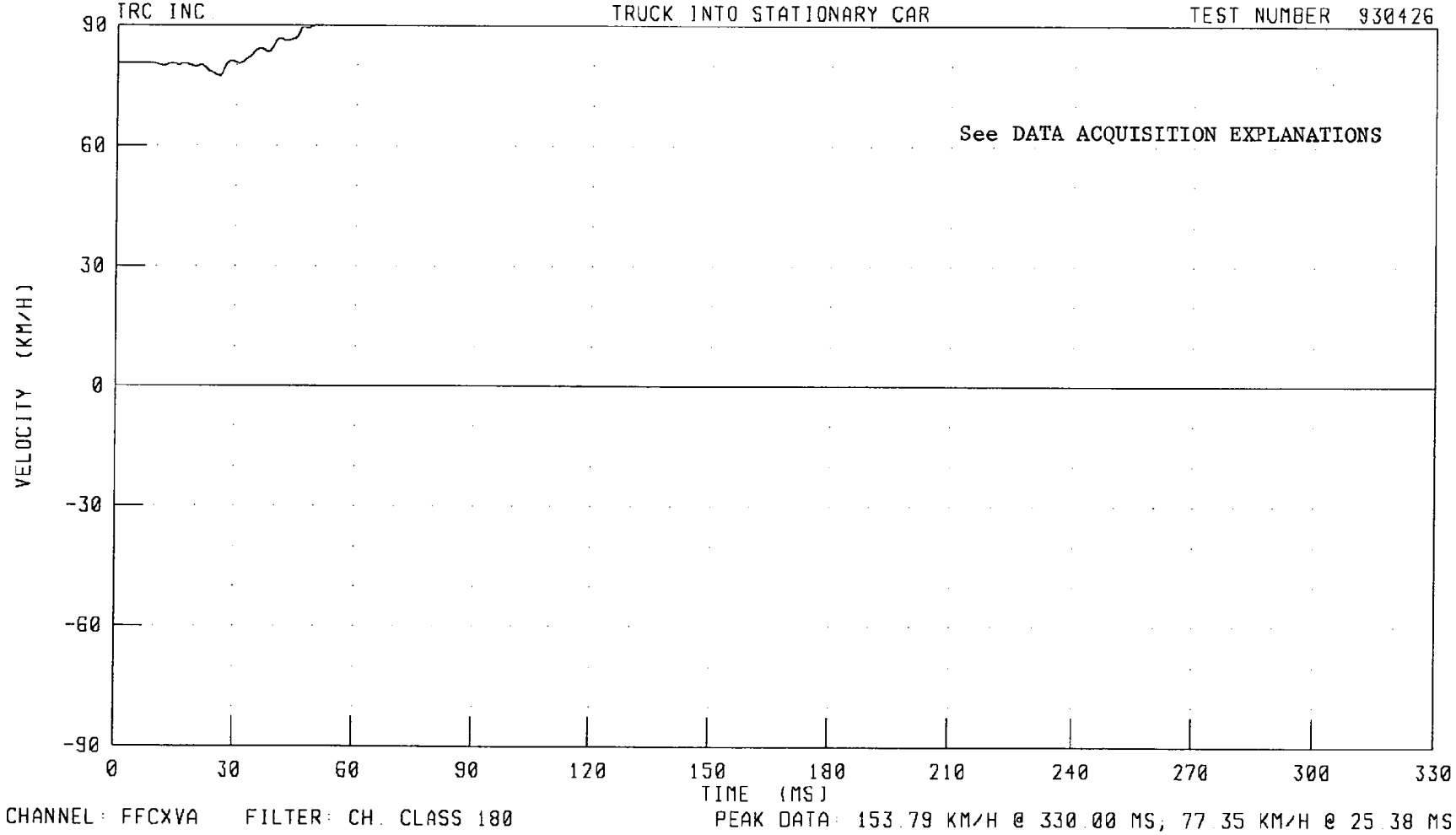
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
TRUCK FRONT FRAME CROSSMEMBER Z-AXIS ACCELERATION
TRUCK INTO STATIONARY CAR



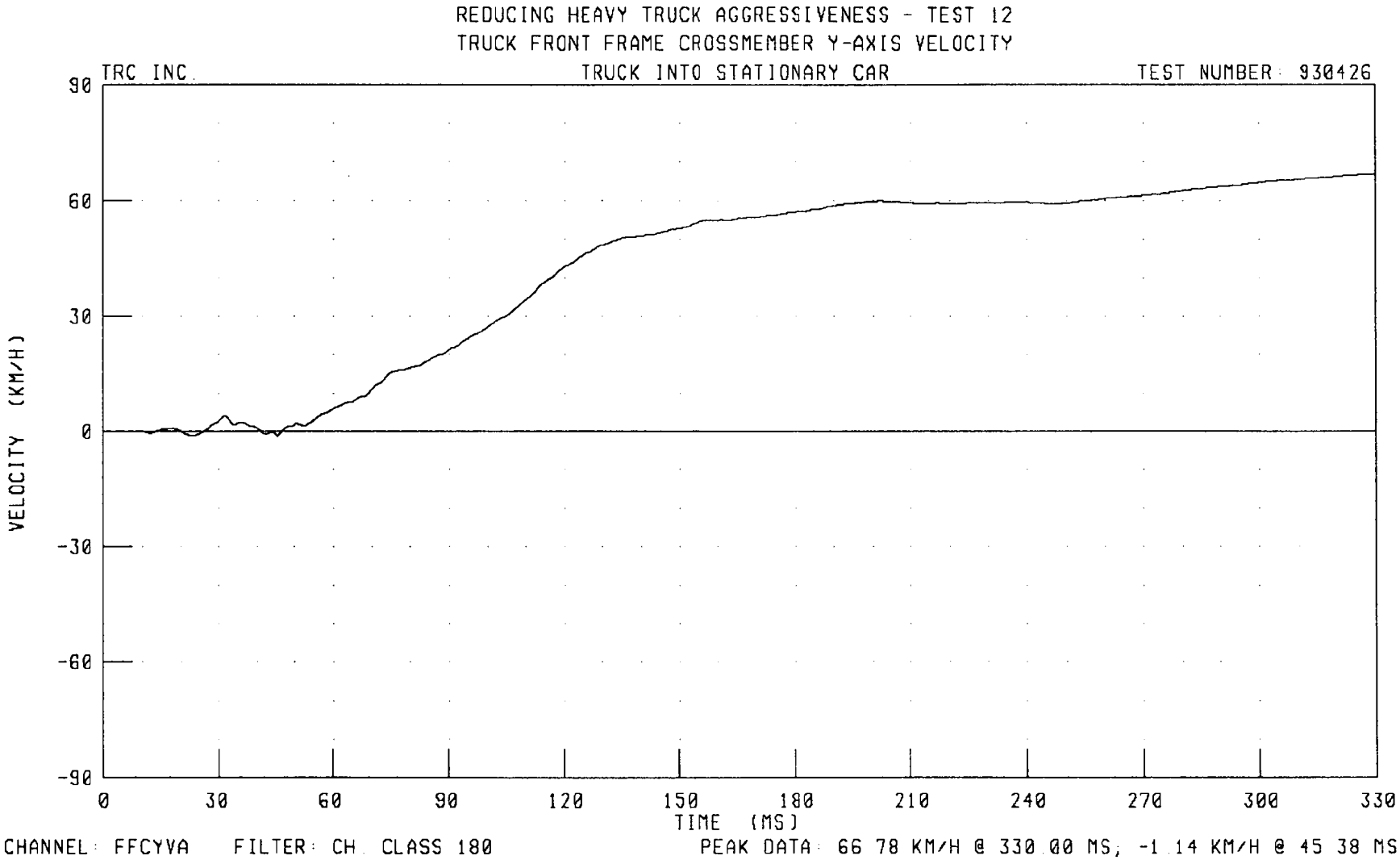

CHANNEL: FFCZGA FILTER: CH. CLASS 60 PEAK DATA: 24.77 G @ 25.25 MS; -66.01 G @ 93.25 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
TRUCK FRONT FRAME CROSSMEMBER RESULTANT ACCELERATION
TRUCK INTO STATIONARY CAR
TRC INC.
TEST NUMBER: 930426
See DATA ACQUISITION EXPLANATIONS
ACCELERATION (G)
80
63
46
30
13
-3
-20
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: FFCRGA FILTER: CH CLASS 60
PEAK DATA: 70.47 G @ 93.25 MS; 0.04 G @ -19.88 MS

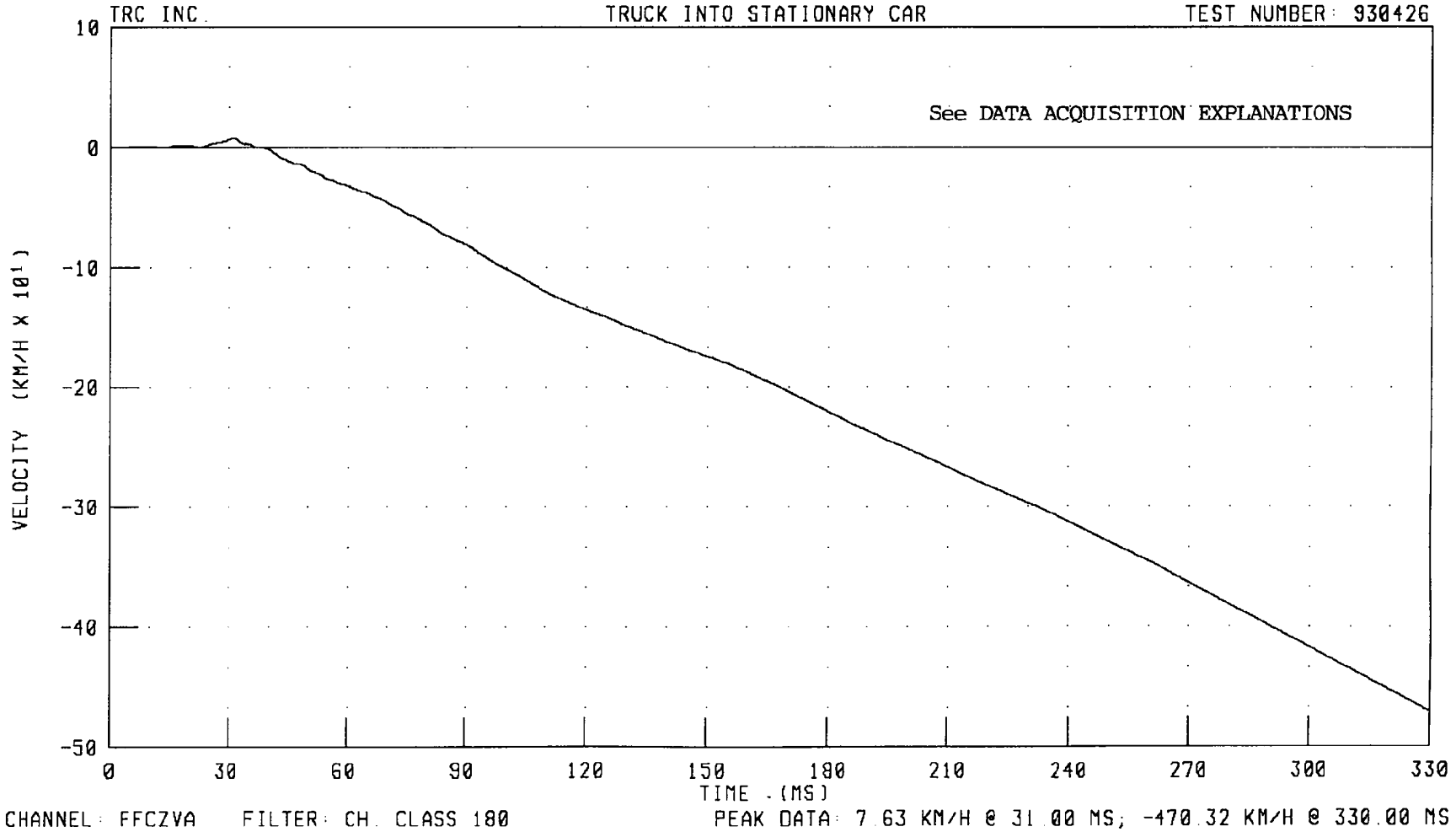
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
TRUCK FRONT FRAME CROSSMEMBER X-AXIS VELOCITY
TRUCK INTO STATIONARY CAR




CHANNEL: FFCXVA FILTER: CH. CLASS 180 PEAK DATA: 153.79 KM/H @ 330.00 MS; 77.35 KM/H @ 25.38 MS

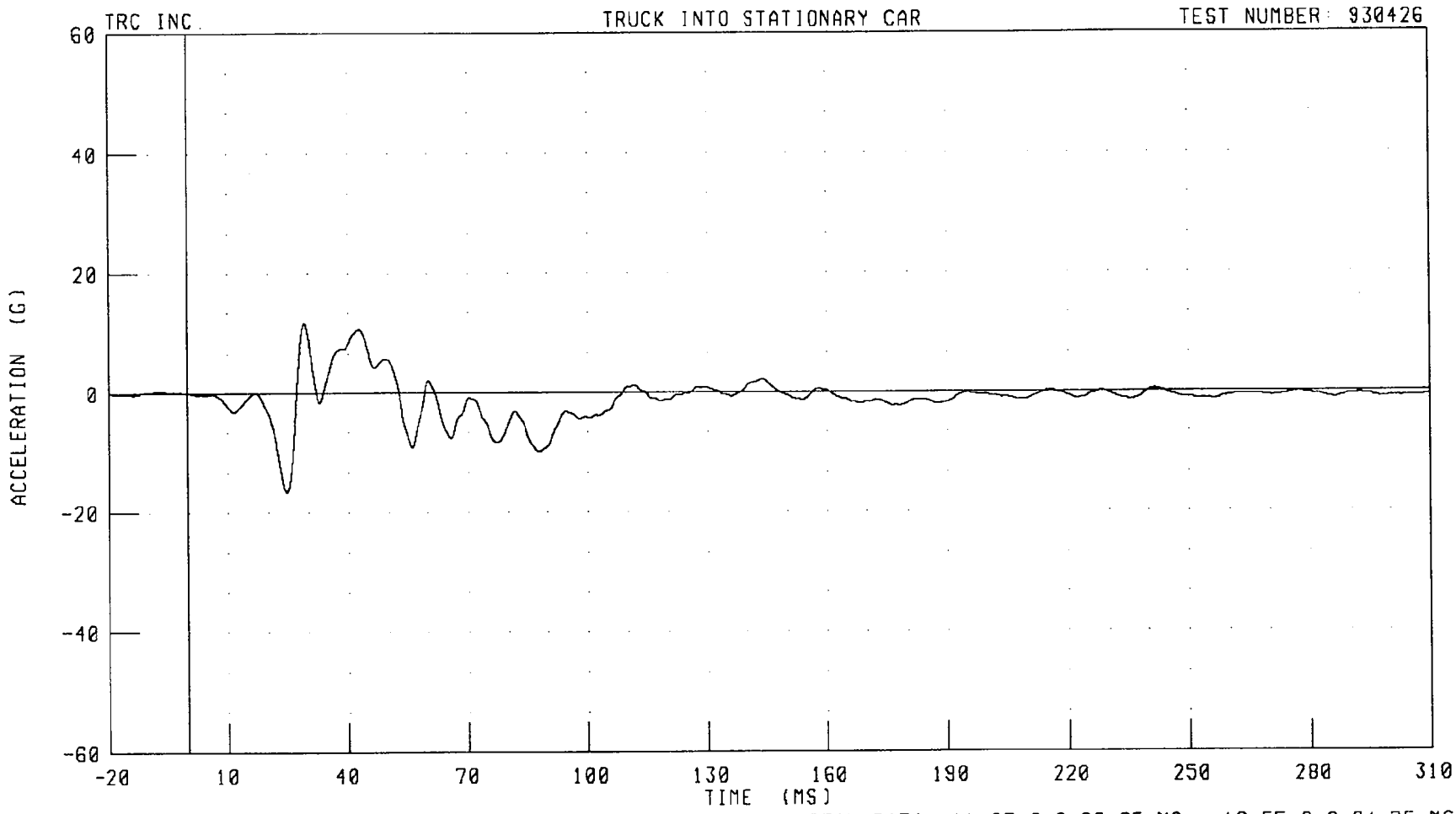

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
TRUCK FRONT FRAME CROSSMEMBER Y-AXIS VELOCITY
TRC INC.
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
VELOCITY (KM/H)
90
60
30
0
-30
-60
-90
0
30
60
90
120
150
180
210
240
270
300
330
TIME (MS)
CHANNEL: FFCYVA
FILTER: CH. CLASS 180
PEAK DATA: 66.78 KM/H @ 330.00 MS; -1.14 KM/H @ 45.38 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
TRUCK FRONT FRAME CROSSMEMBER Z-AXIS VELOCITY




CHANNEL: FFCZVA FILTER: CH. CLASS 180 PEAK DATA: 7.63 KM/H @ 31.00 MS; -470.32 KM/H @ 330.00 MS

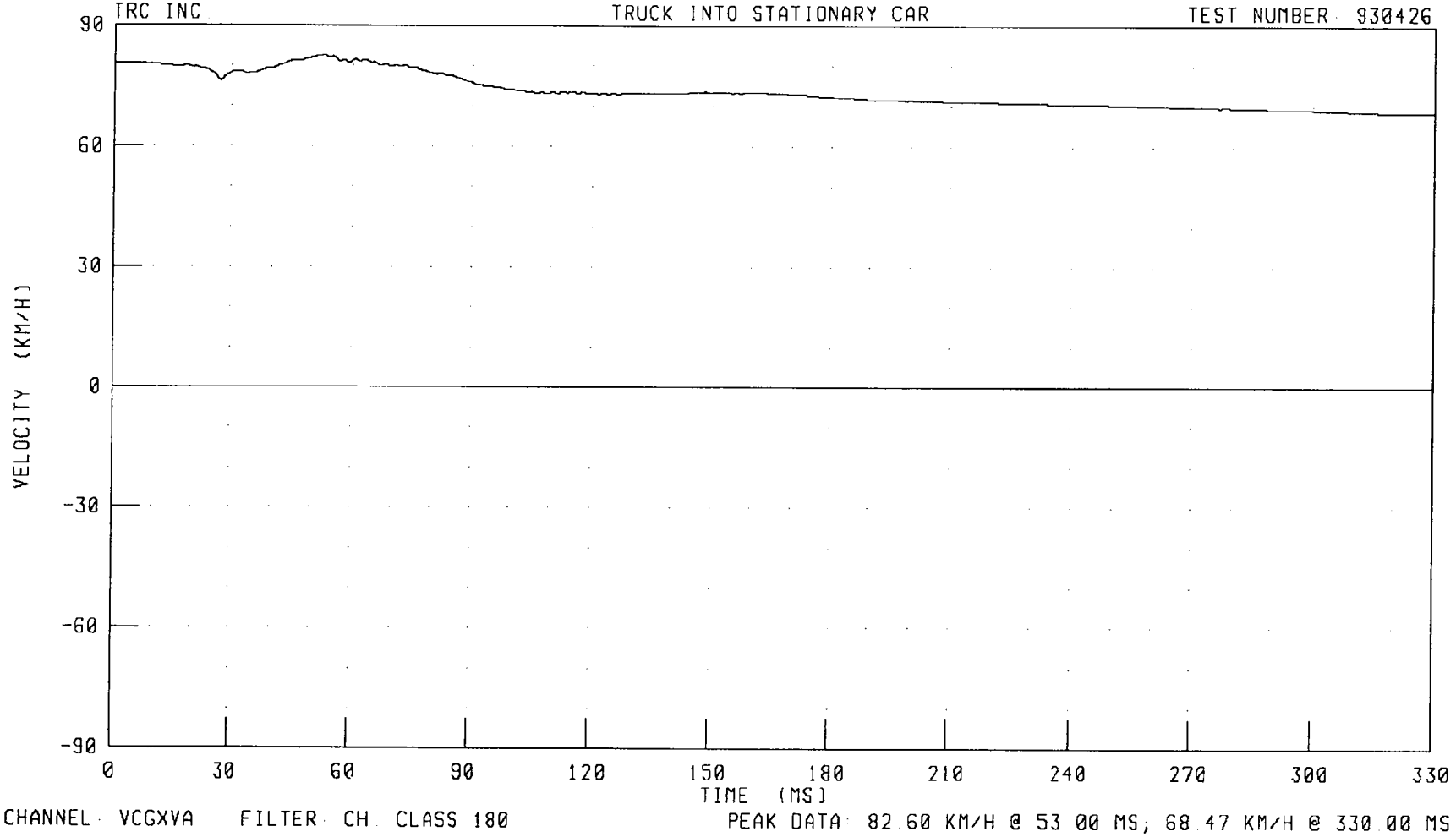
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
TRUCK CENTER OF GRAVITY X-AXIS ACCELERATION
TRUCK INTO STATIONARY CAR




CHANNEL: VCGXGA FILTER: CH. CLASS 60 PEAK DATA: 11.67 G @ 29.25 MS; -16.55 G @ 24.75 MS

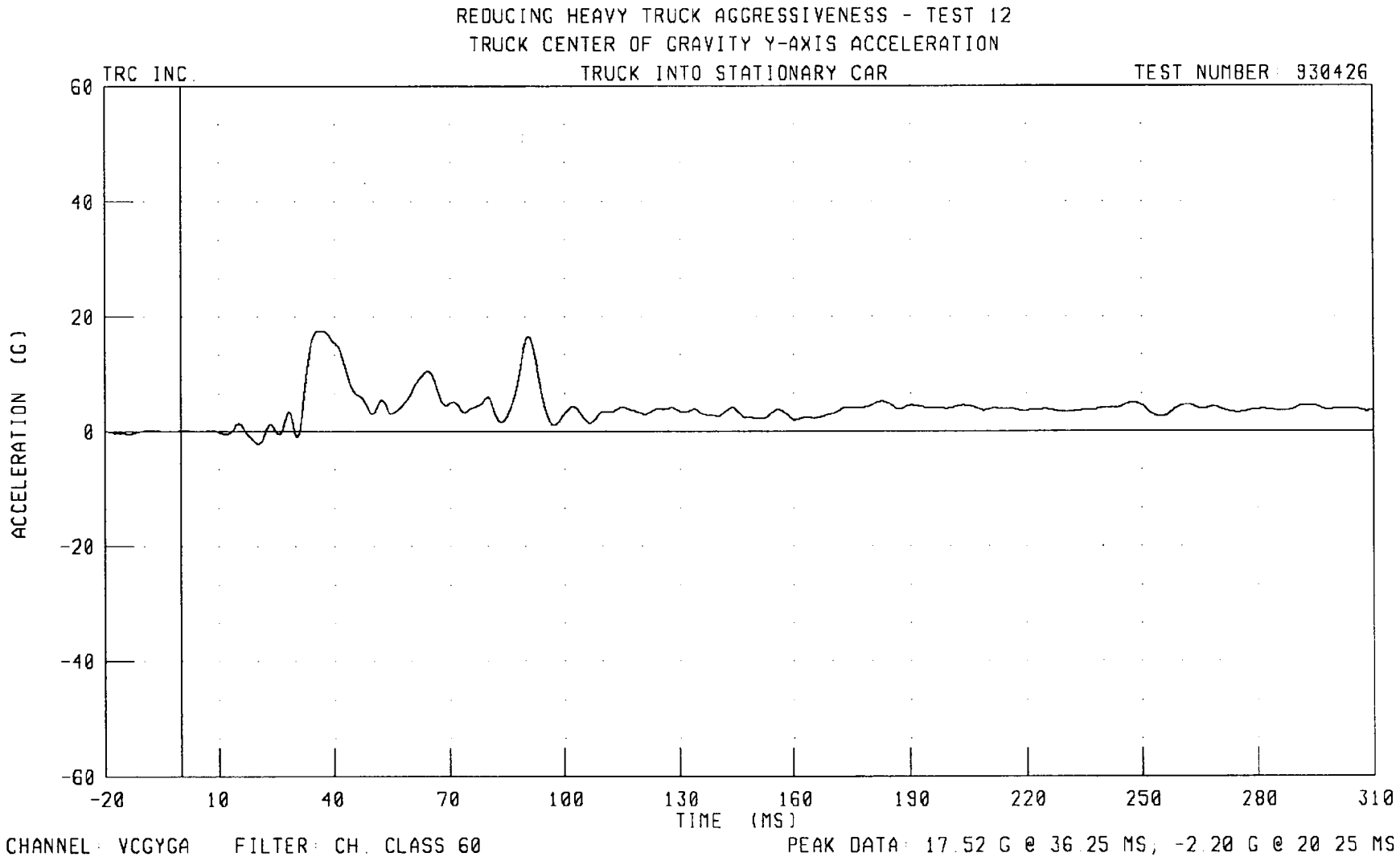
REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12

TRUCK CENTER OF GRAVITY X-AXIS VELOCITY

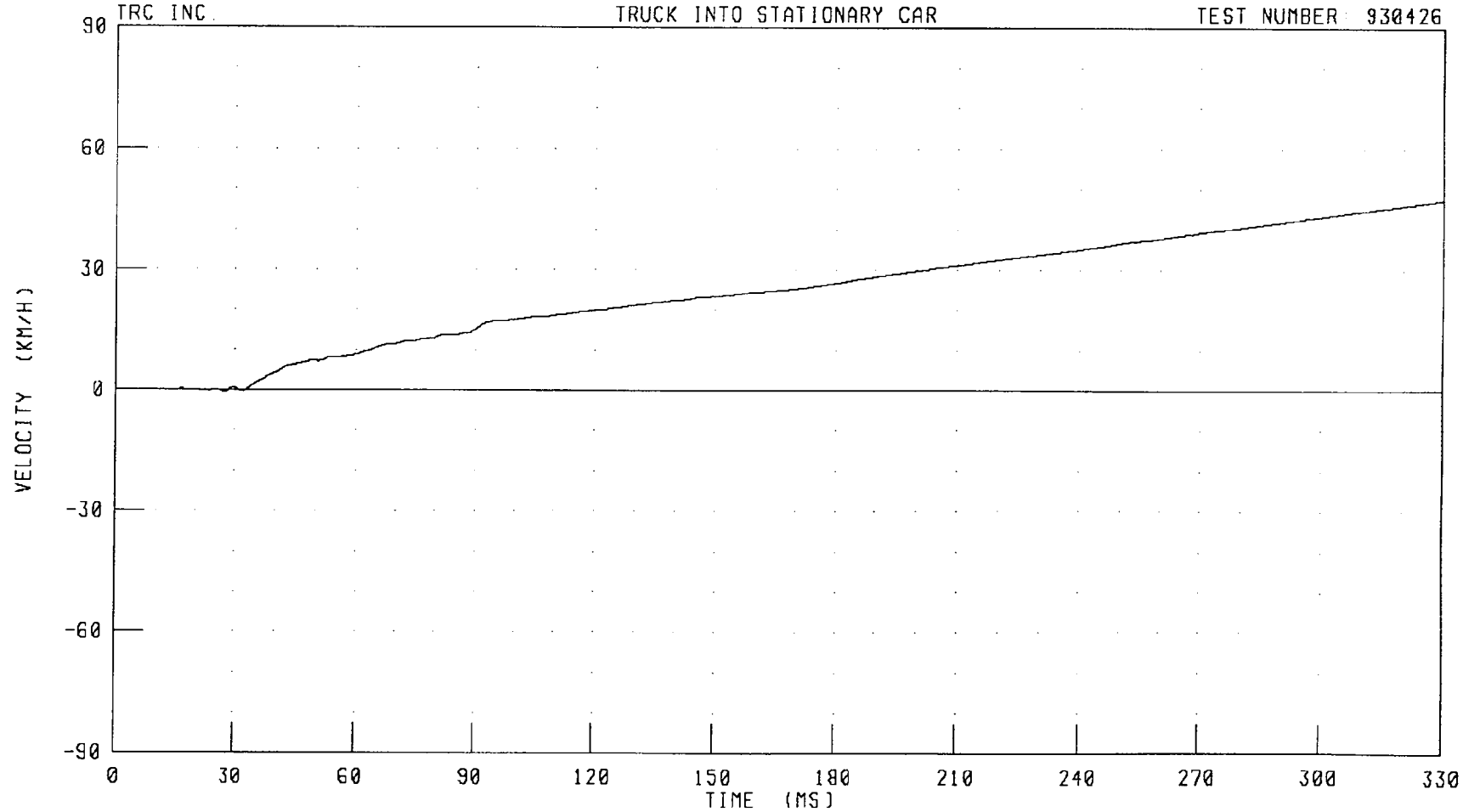



CHANNEL VCGXVA FILTER CH CLASS 180

PEAK DATA 82.60 KM/H @ 53.00 MS; 68.47 KM/H @ 330.00 MS


REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
TRUCK CENTER OF GRAVITY Y-AXIS ACCELERATION
TRC INC.
TRUCK INTO STATIONARY CAR
TEST NUMBER: 930426
60
40
20
0
-20
-40
-60
ACCELERATION (G)
-20
10
40
70
100
130
160
190
220
250
280
310
TIME (MS)
CHANNEL: VCGYGA
FILTER: CH. CLASS 60
PEAK DATA: 17.52 G @ 36.25 MS, -2.20 G @ 20.25 MS

REDUCING HEAVY TRUCK AGGRESSIVENESS - TEST 12
TRUCK CENTER OF GRAVITY Y-AXIS VELOCITY




CHANNEL VCGYVA FILTER CH CLASS 180

PEAK DATA 47.43 KM/H @ 330.00 MS; -0.41 KM/H @ 27.25 MS

# APPENDIX C

## DUMMY CERTIFICATION

TRANSPORTATION RESEARCH CENTER INC.
HYBRID III EXTERNAL DIMENSIONS
HUMANOID 48

24-MAR-93

TRC 48C7ED1 572E SN48 EXT. DIMENSION CAL 07

| 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 |

TEST MEETS SPECIFICATIONS

TECHNICIAN L. E. Le Van

TRANSPORTATION RESEARCH CENTER INC.

HEAD DROP TEST

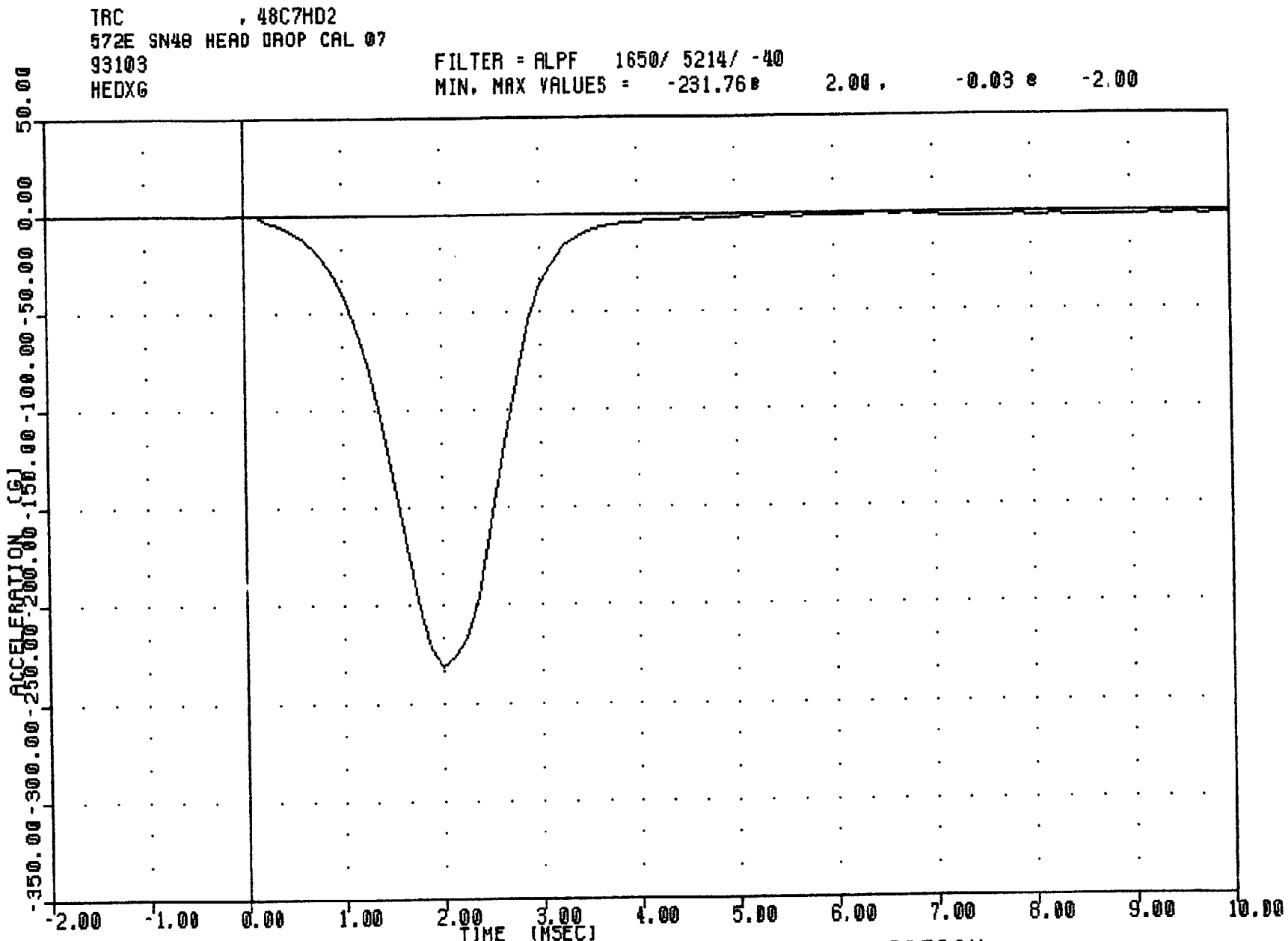
HYBRID III 13-APR-93

TRC 48C7HD2 572E SN48 HEAD DROP CAL 07

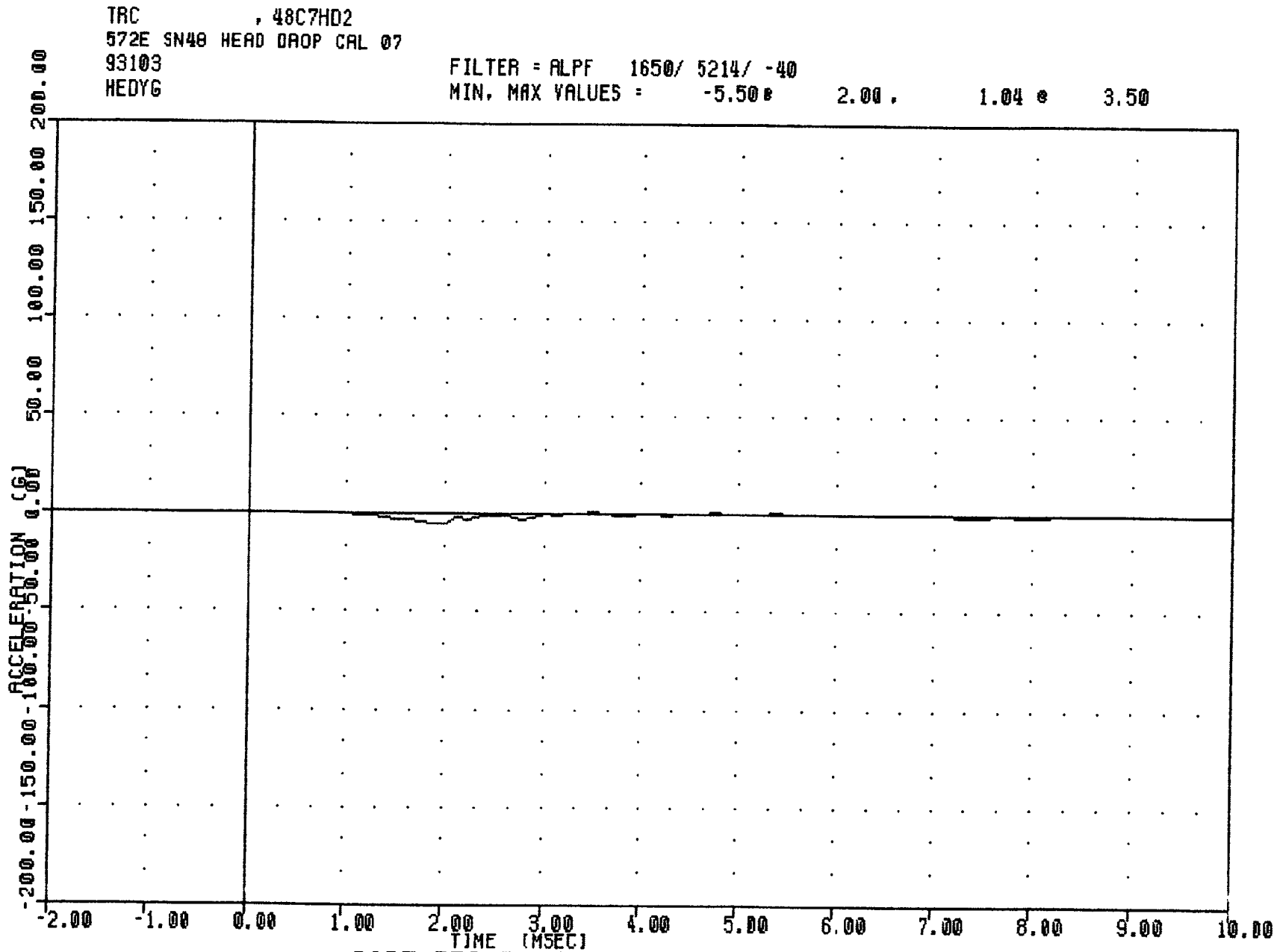
| TEST PARAMETER | SPECIFICATION | TEST RESULTS |
|---|---|---|
| TEMPERATURE | 18.9-25.6 DEG. C | 21.1 DEG. C |
| RELATIVE HUMIDITY | 10% - 70% | 48.0 % |
| PEAK RESULTANT ACCELERATION | 225 - 275 G | 260.59 G |
| PEAK LATERAL ACCELERATION | 15 G MAX | -5.49 G |
| IS ACCELERATION CURVE UNIMODAL? | YES | YES |

TEST MEETS SPECIFICATIONS

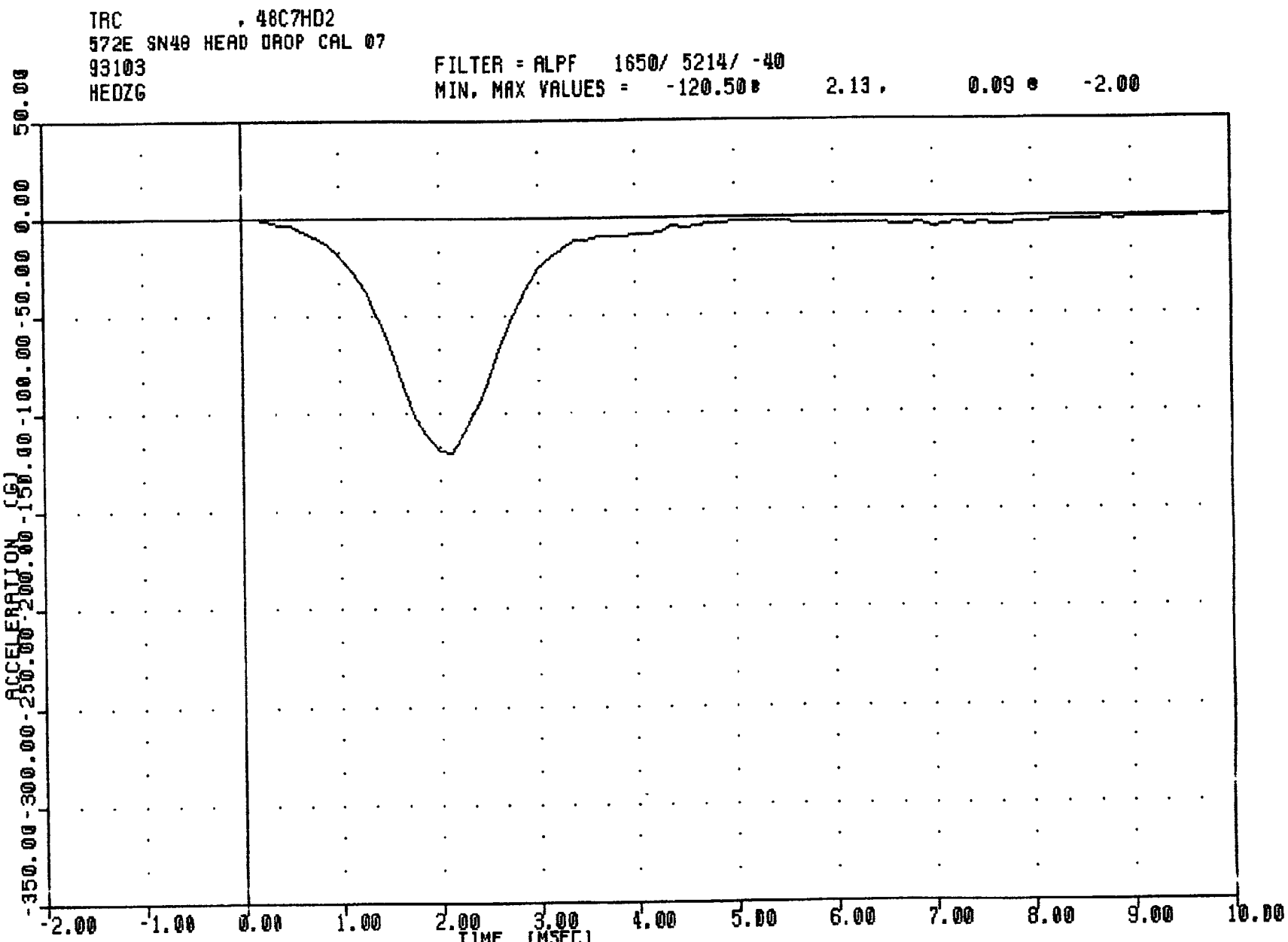
TECHNICIAN R. E. Tech



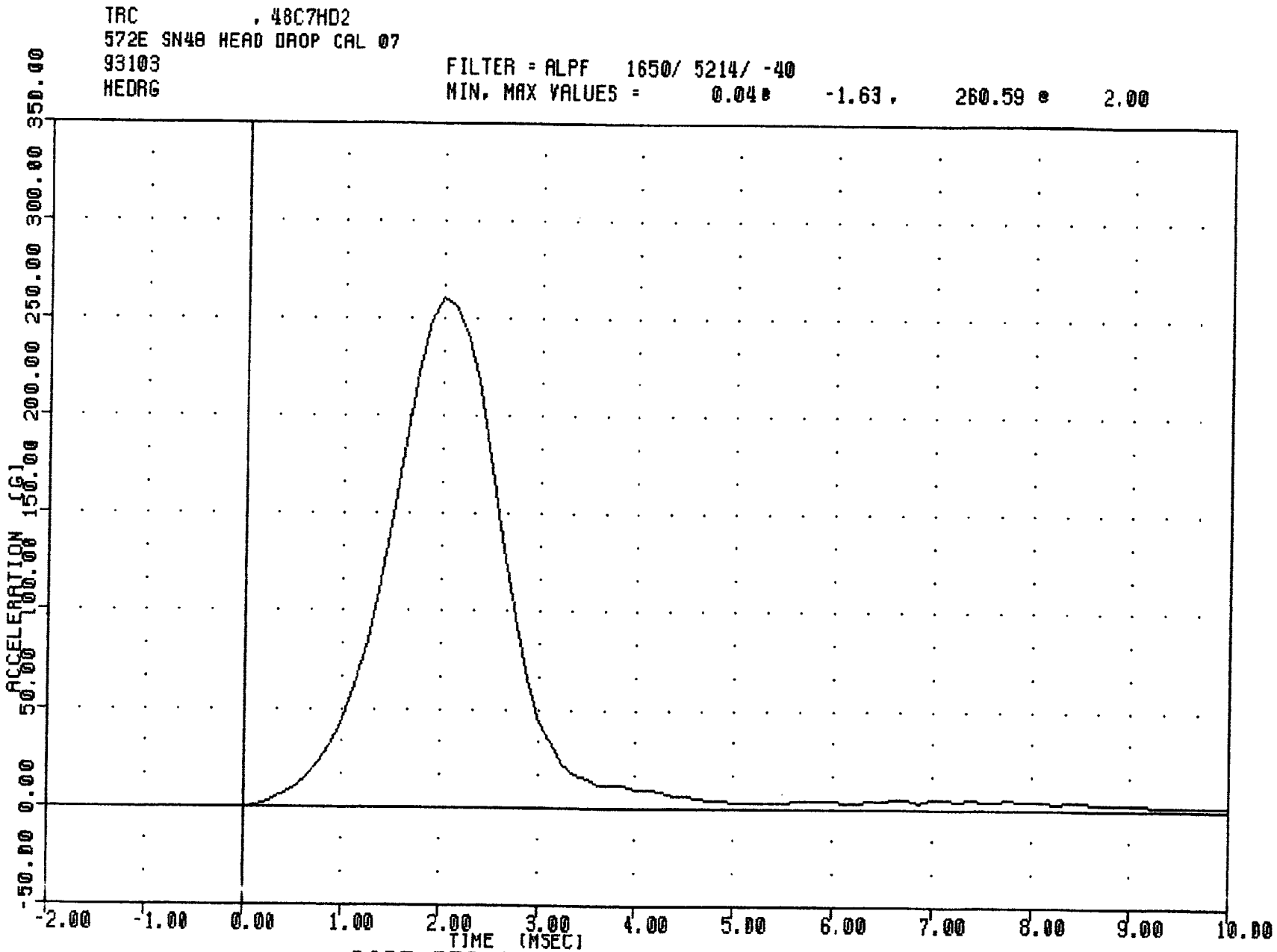

PART 572-E HYBRID III HEAD CALIBRATION
HEAD ACCELERATION X AXIS




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




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




PART 572-E HYBRID III HEAD CALIBRATION
HEAD RESULTANT ACCELERATION

TRANSPORTATION RESEARCH CENTER INC.

NECK FLEXION TEST

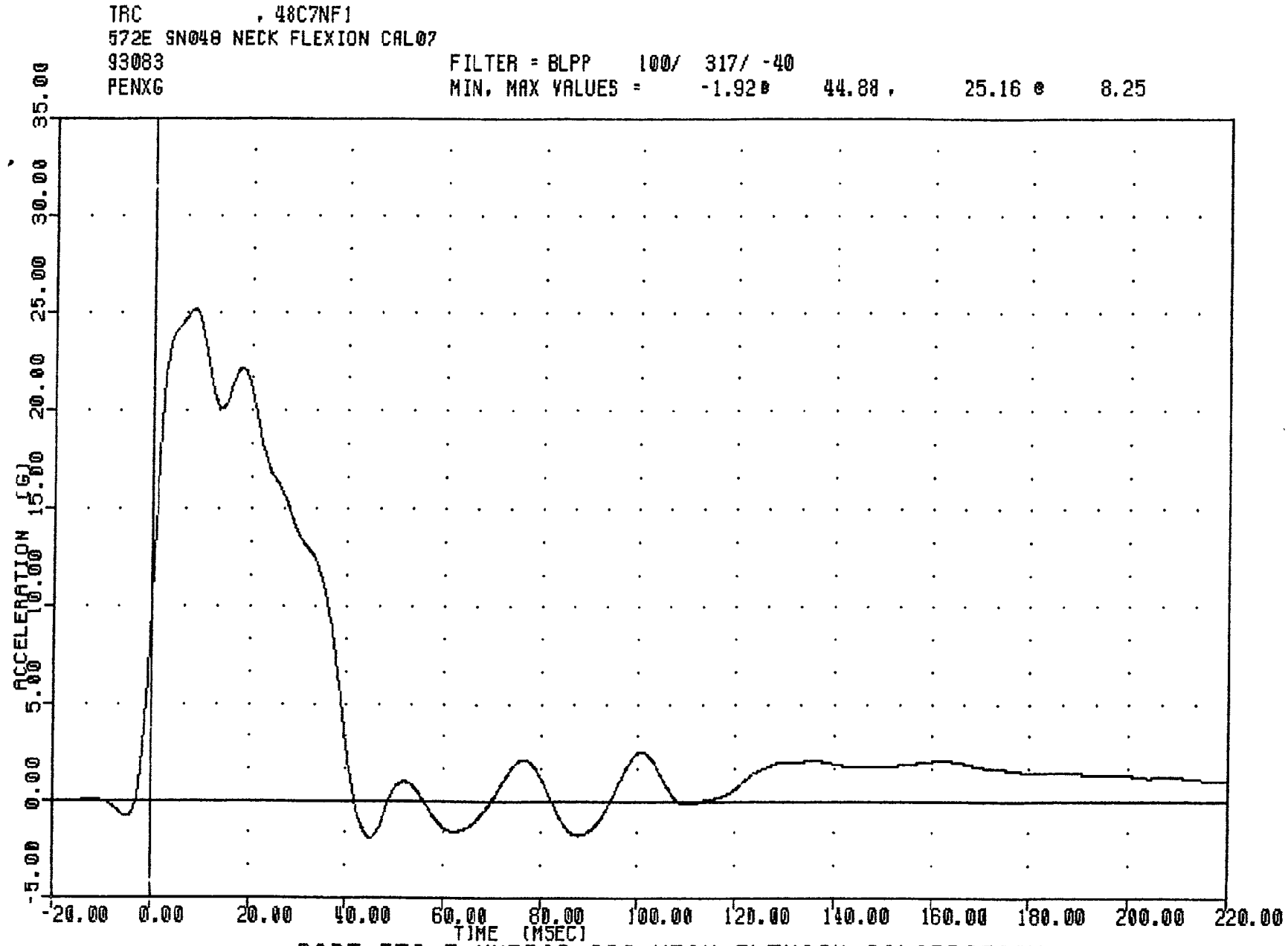
HYBRID III 24-MAR-93

6 AXIS NECK TRANSDUCER
TRC 48C7NF1 572E SN048 NECK FLEXION CAL07

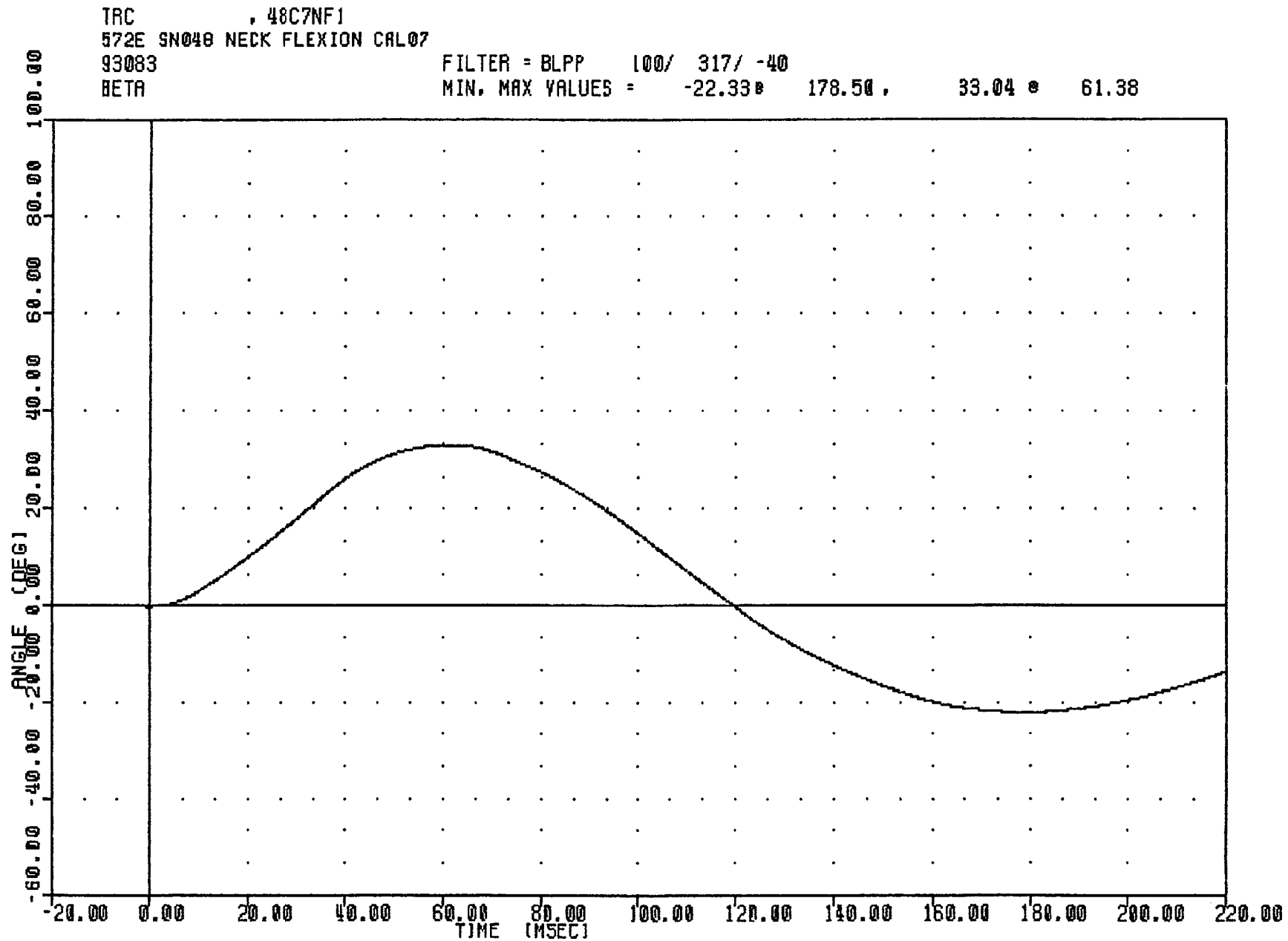
| TEST PARAMETER | | SPECIFICATION | TEST RESULTS |
|---|---|---|---|
| TEMPERATURE | | 20.6-22.2 DEG. C | 21.7 DEG. C |
| RELATIVE HUMIDITY | | 10% - 70% | 50.0 % |
| IMPACT VELOCITY | | 6.89 - 7.13 M/SEC | 7.10 M/SEC |
| PENDULUM DECELERATION | 10 MS | 22.50 - 27.50 G | 24.15 G |
| | 20 MS | 17.60 - 22.60 G | 21.11 G |
| | 30 MS | 12.50 - 18.50 G | 13.72 G |
| MAX PENDULUM G ABOVE 30 MS | | 29 G MAX | 13.66 G |
| DECELERATION-TIME CURVE DECAY TIME TO 5 G | | 34 - 42 MS | 38.75 MS |
| D PLANE ROTATION | MAX | 64 - 78 DEG. | 73.16 DEG. |
| | TIME | 57 - 64 MS | 59.88 MS |
| MOMENT ABOUT OCCIPITAL CONDYLE | MAX | 88.2 - 108.5 NM | 89.73 NM |
| | TIME | 47 - 58 MS | 52.13 MS |
| ROTATION ANGLE-TIME CURVE DECAY TIME TO ZERO | | 113 - 128 MS | 118.63 MS |
| POSITIVE MOMENT-TIME CURVE DECAY TIME TO ZERO | | 97 - 107 MS | 100.25 MS |

TEST MEETS SPECIFICATIONS

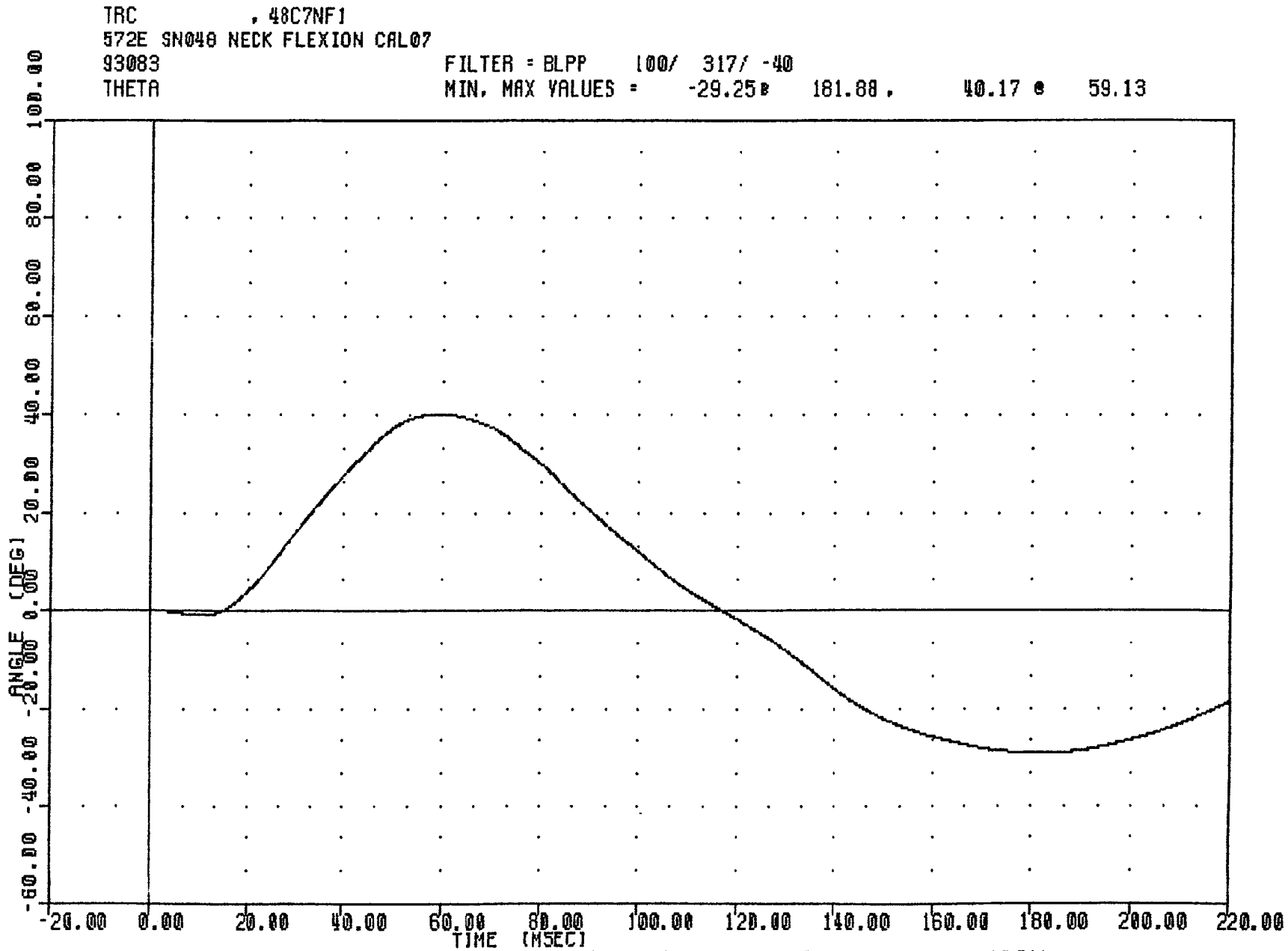
TECHNICIAN R. E. LeVan



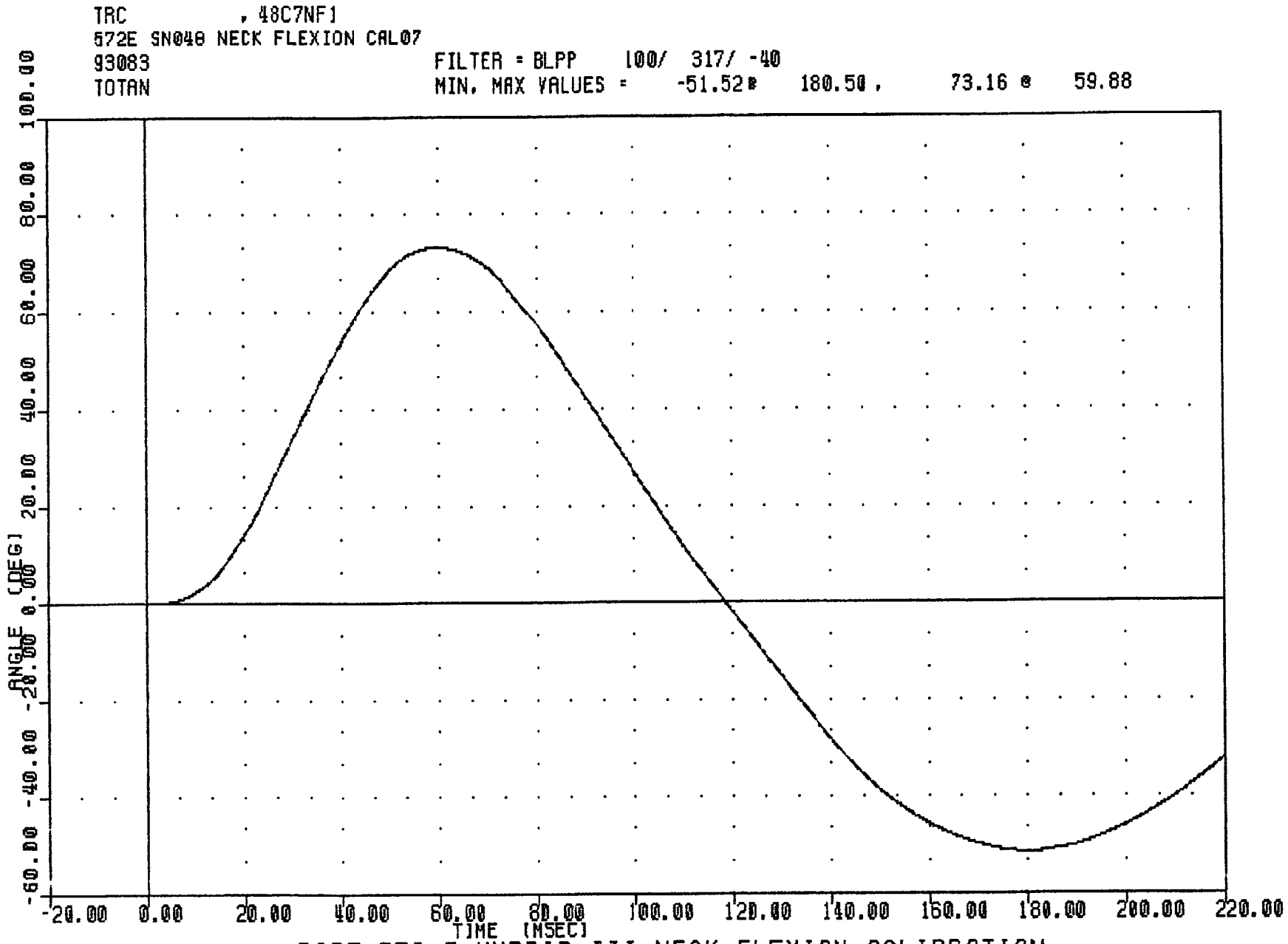

PART 572-E HYBRID III NECK FLEXION CALIBRATION
PENDULUM DECELERATION



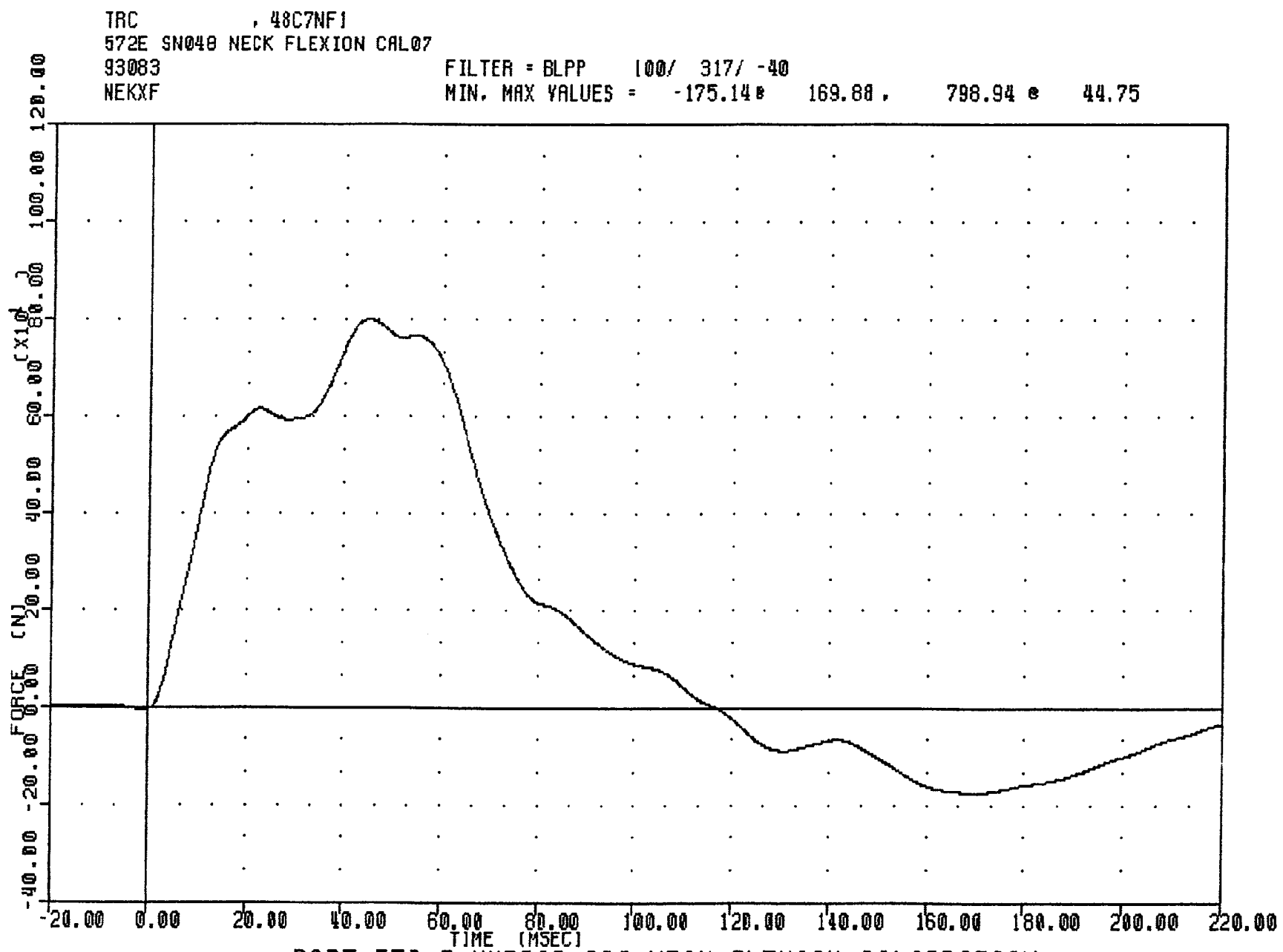

PART 572-E HYBRID III NECK FLEXION CALIBRATION
ROTATION ABOUT BASE OF NECK



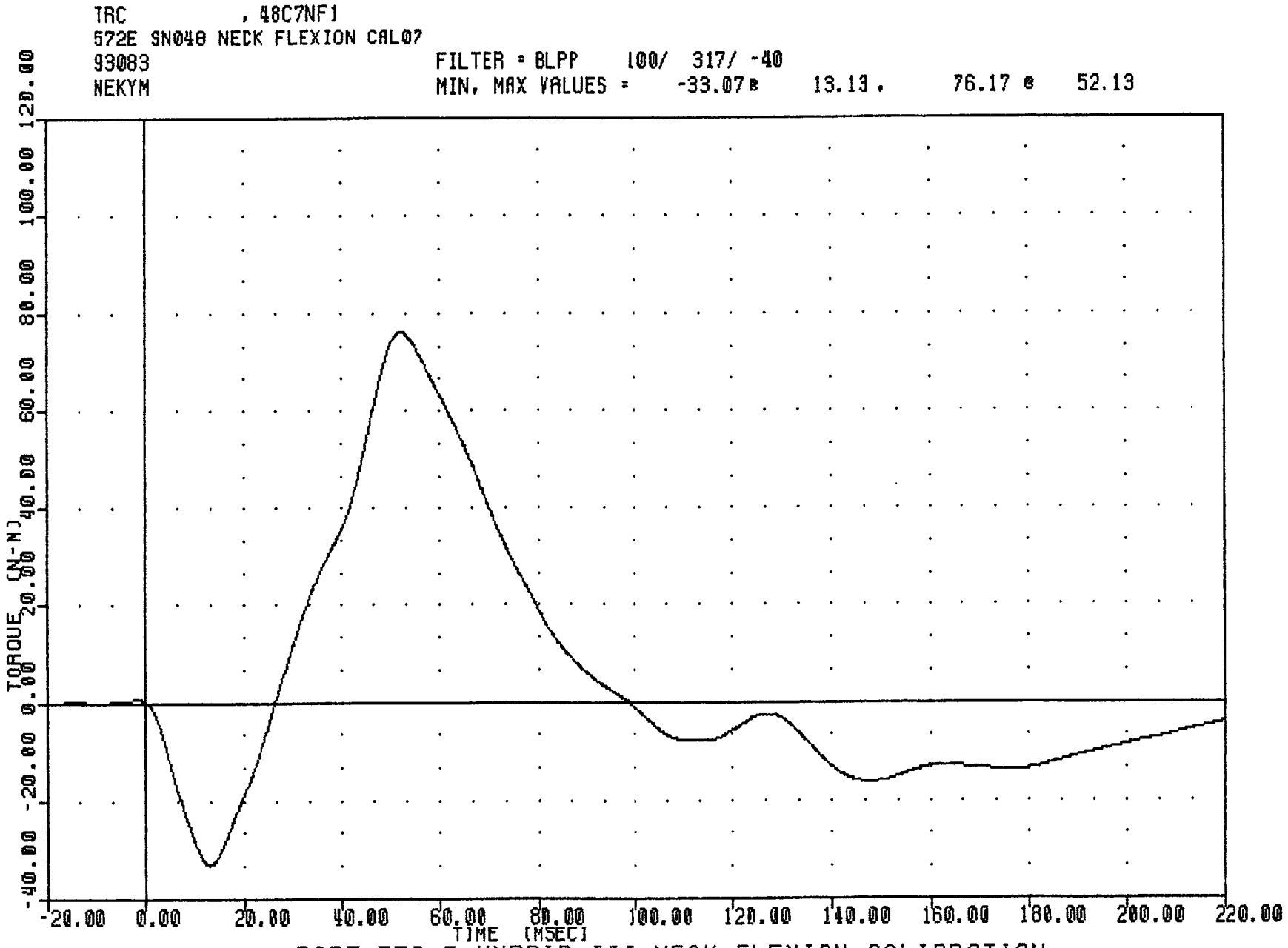

PART 572-E HYBRID III NECK FLEXION CALIBRATION
ROTATION ABOUT OCCIPITAL CONDYLE



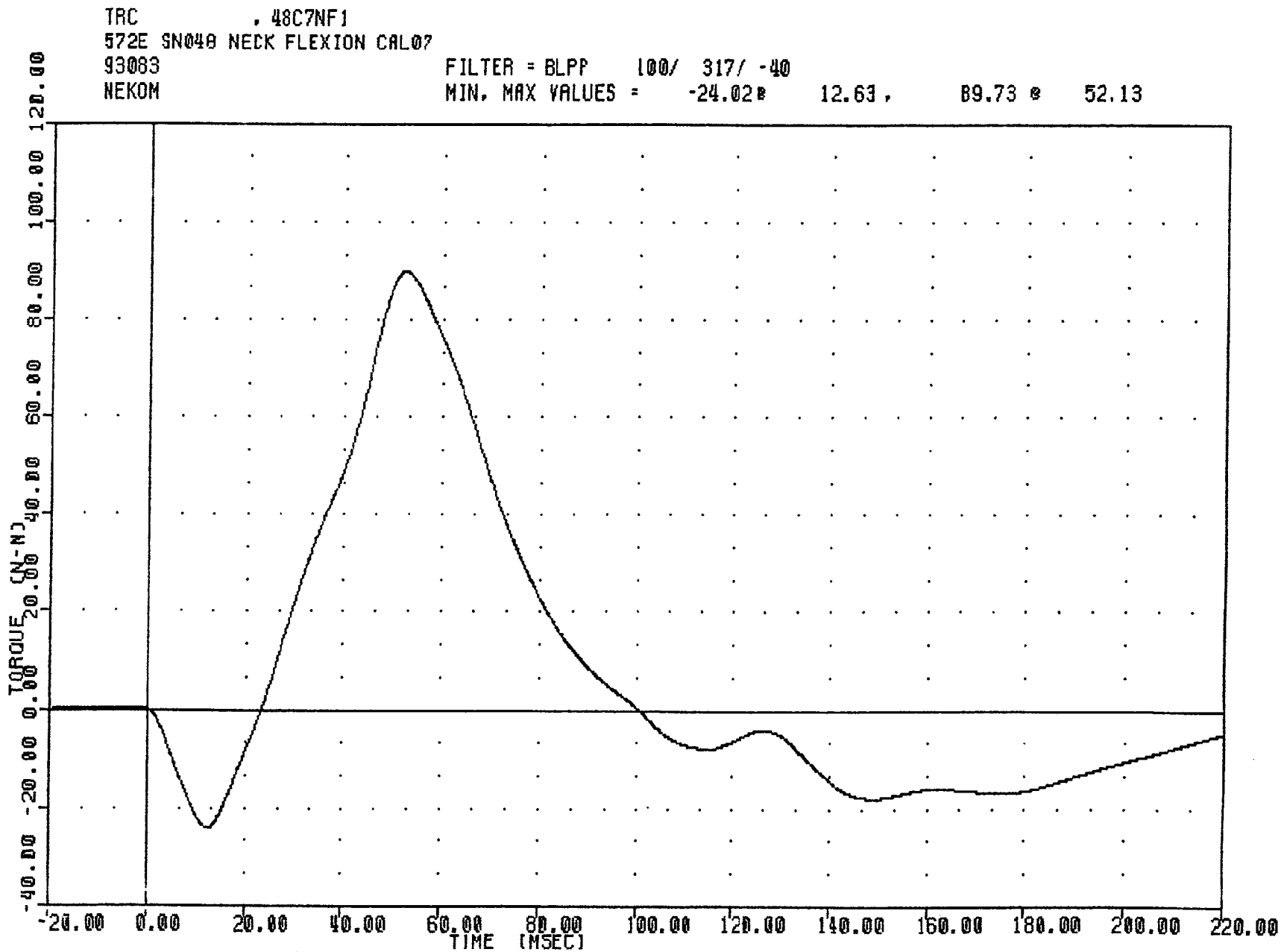

PART 572-E HYBRID III NECK FLEXION CALIBRATION
TOTAL ROTATION




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




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




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

TRANSPORTATION RESEARCH CENTER INC.

NECK EXTENSION TEST

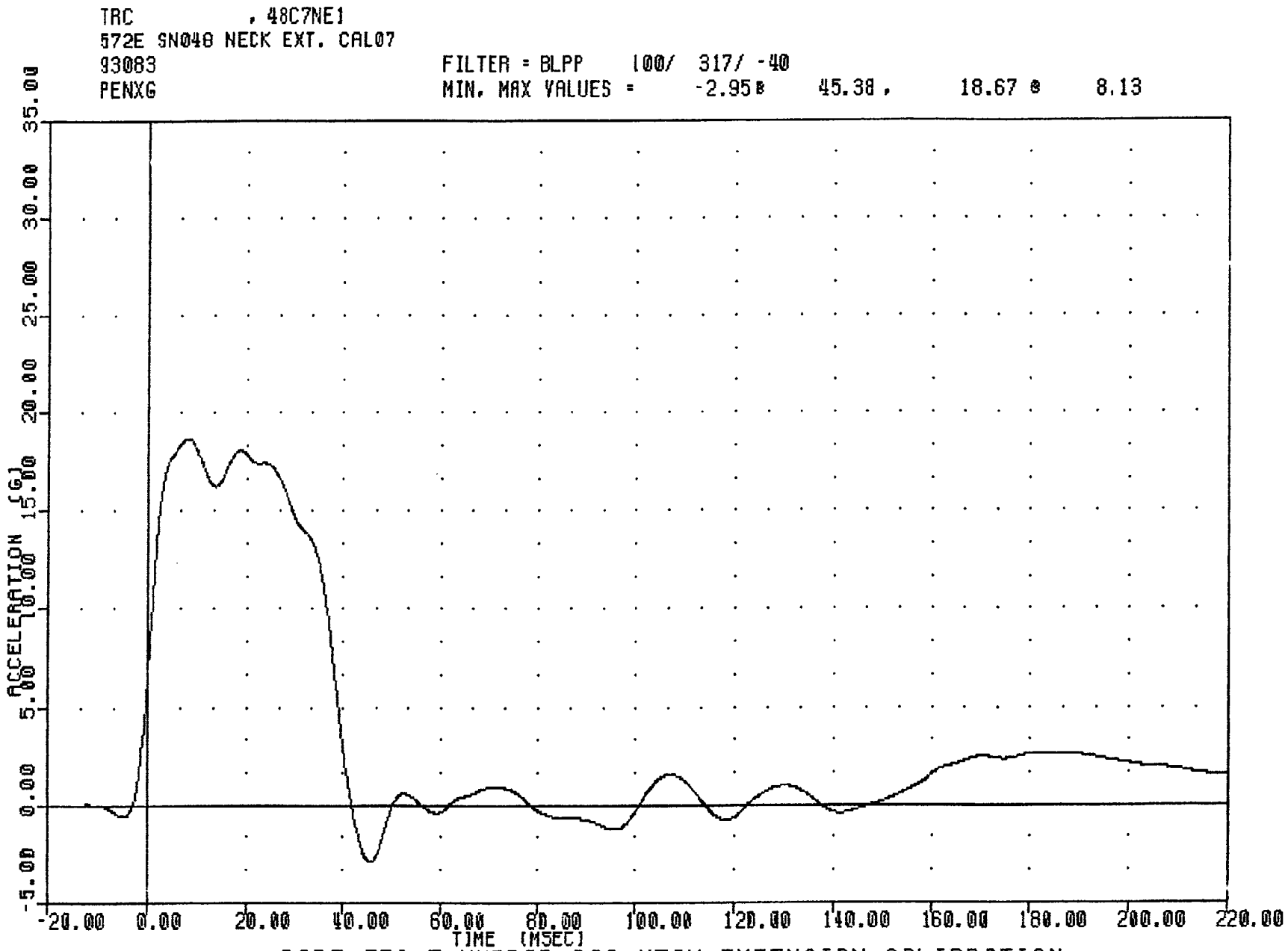
HYBRID III 24-MAR-93

6 AXIS NECK TRANSDUCER
TRC 48C7NE1 572E SN048 NECK EXT. CAL07

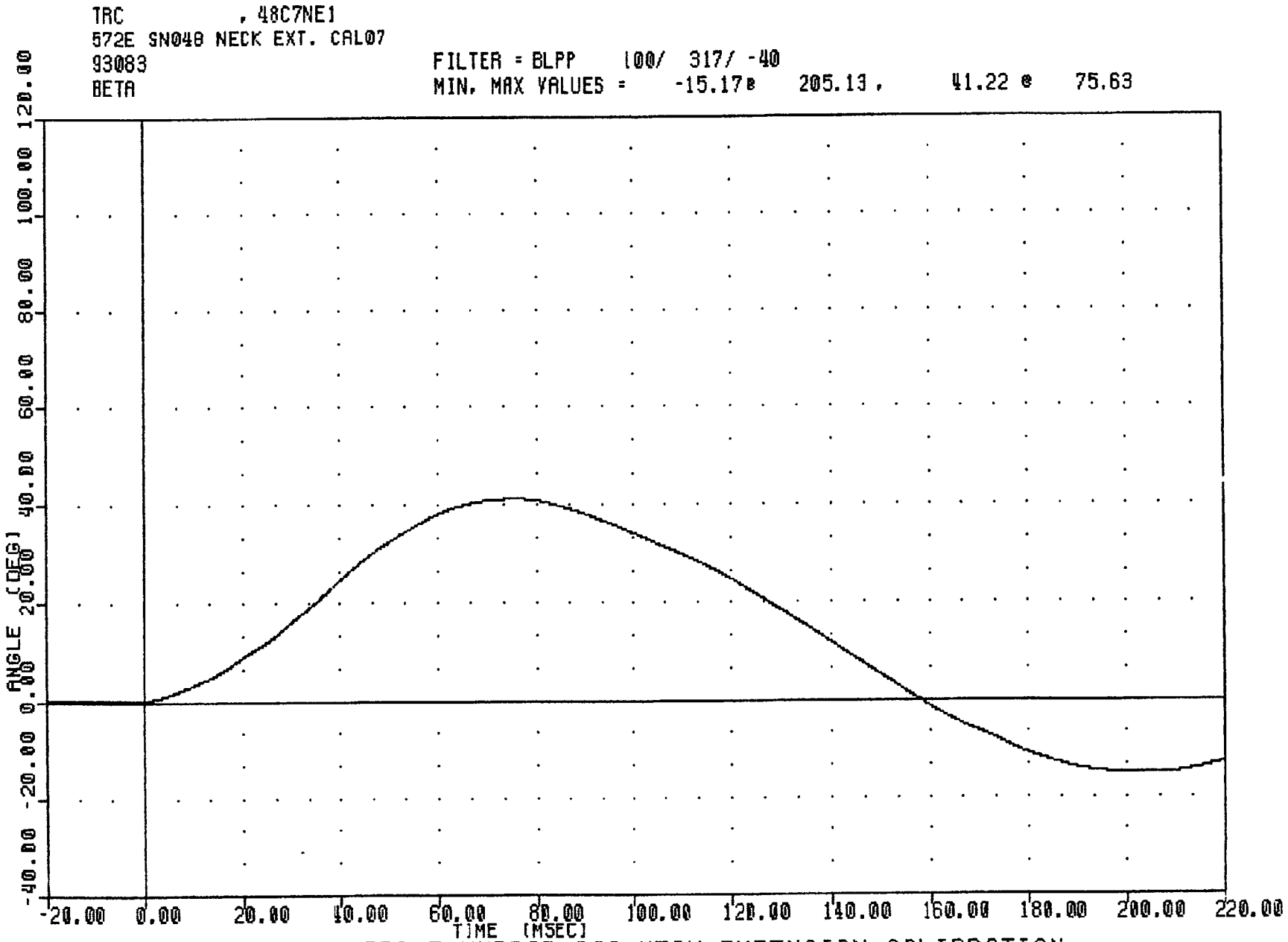
| TEST PARAMETER | | SPECIFICATION | TEST RESULTS |
|---|---|---|---|
| TEMPERATURE | | 20.6-22.2 DEG. C | 21.7 DEG. C |
| RELATIVE HUMIDITY | | 10% - 70% | 50.0 % |
| IMPACT VELOCITY | | 5.95 - 6.19 M/SEC | 6.05 M/SEC |
| PENDULUM DECELERATION | 10 MS | 17.20 - 21.20 G | 18.12 G |
| | 20 MS | 14.00 - 19.00 G | 17.84 G |
| | 30 MS | 11.00 - 16.00 G | 14.69 G |
| MAX PENDULUM G ABOVE 30 MS | | 22 G MAX | 14.62 G |
| DECELERATION-TIME CURVE DECAY TIME TO 5 G | | 38 - 46 MS | 38.88 MS |
| D PLANE ROTATION | MAX | 81 - 106 DEG. | 101.53 DEG. |
| | TIME | 72 - 82 MS | 75.88 MS |
| MOMENT ABOUT OCCIPITAL CONDYLE | MIN | -80.0/-52.9 NM | -71.07 NM |
| | TIME | 65 - 79 MS | 70.13 MS |
| ROTATION ANGLE-TIME CURVE DECAY TIME TO ZERO | | 147 - 174 MS | 157.88 MS |
| NEGATIVE MOMENT-TIME CURVE DECAY TIME TO ZERO | | 120 - 148 MS | 146.63 MS |

TEST MEETS SPECIFICATIONS

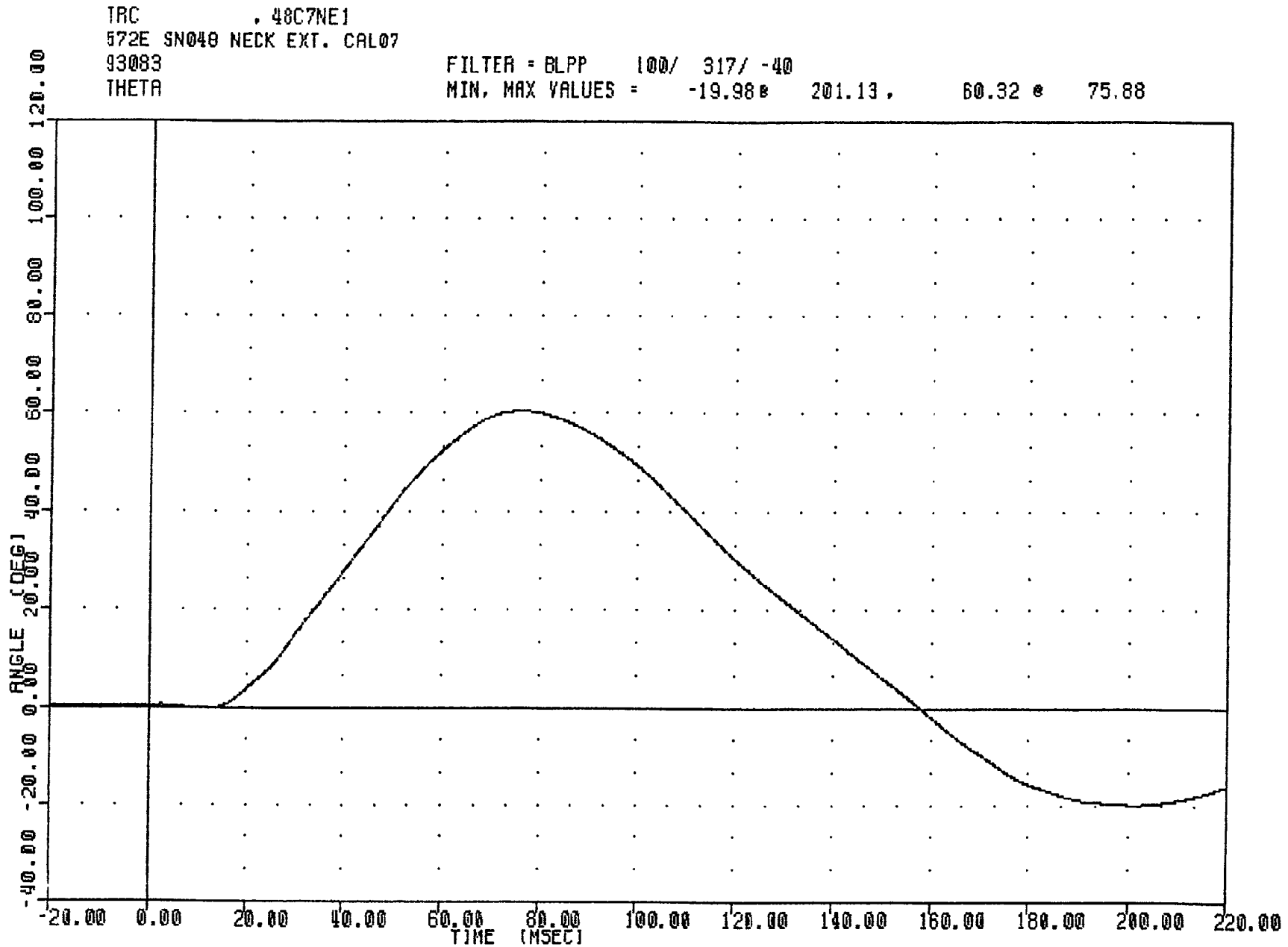
TECHNICIAN R. E. LeVan



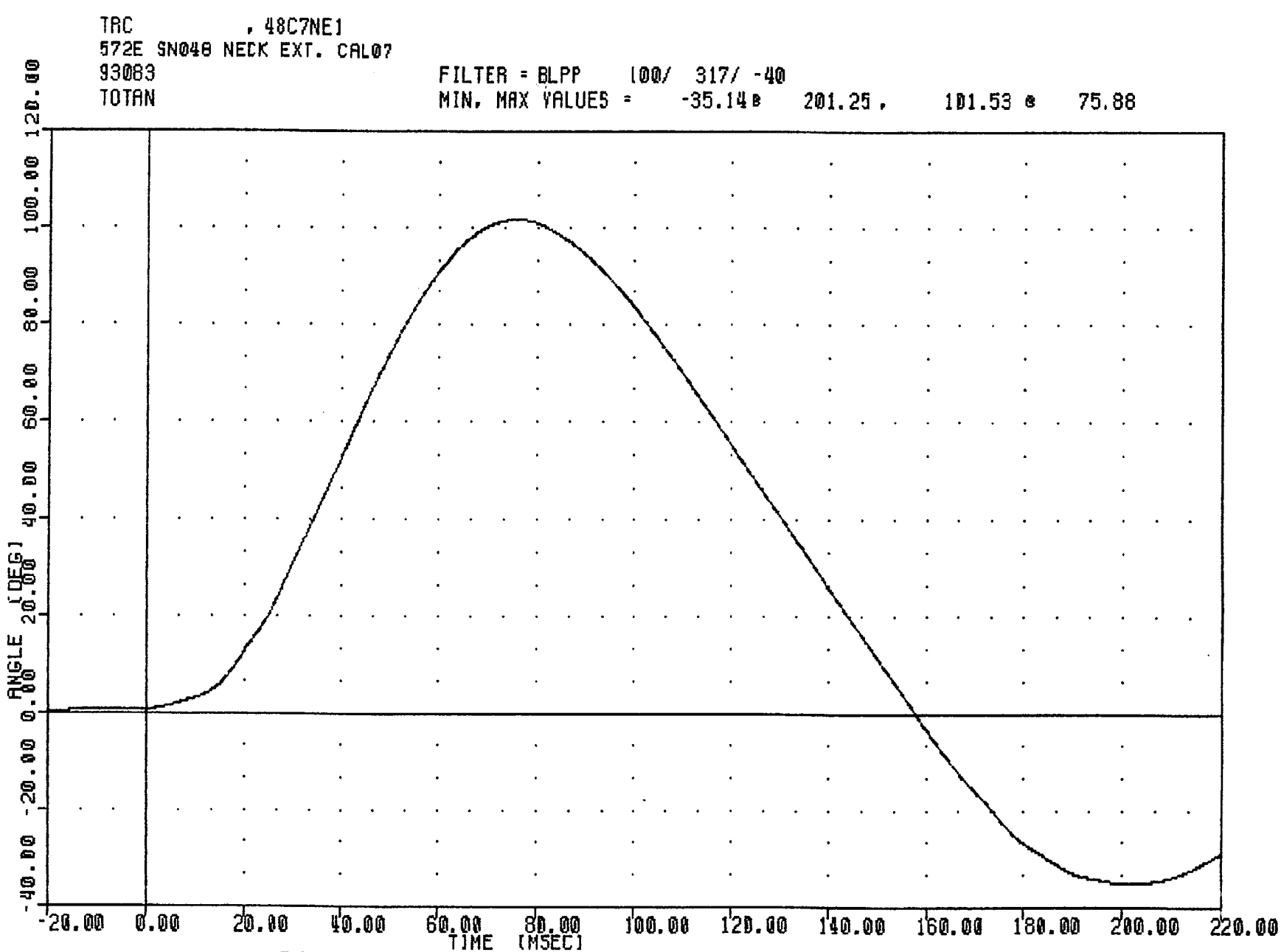

PART 572-E HYBRID III NECK EXTENSION CALIBRATION
PENDULUM DECELERATION



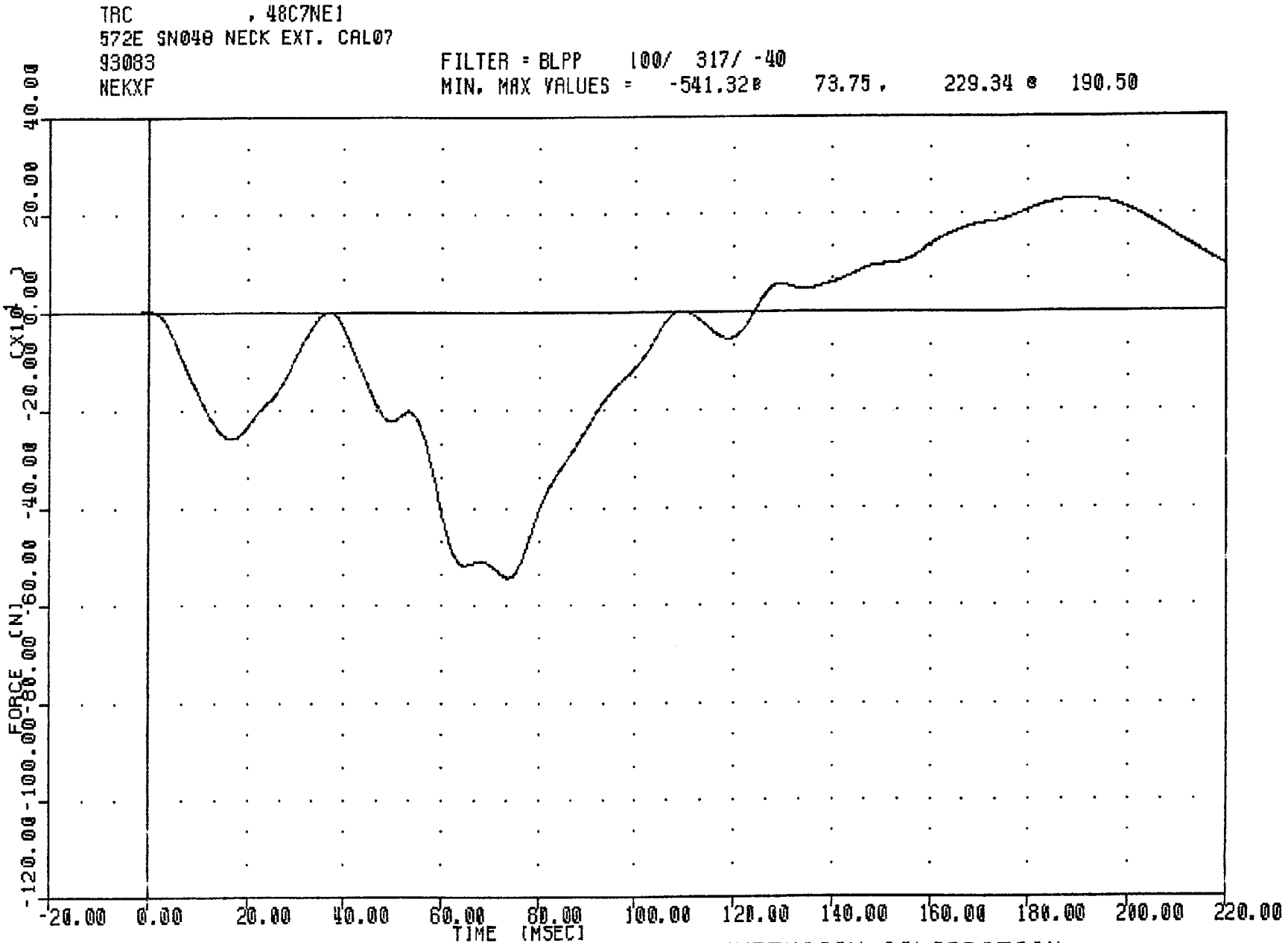

PART 572-E HYBRID III NECK EXTENSION CALIBRATION
ROTATION ABOUT BASE OF NECK



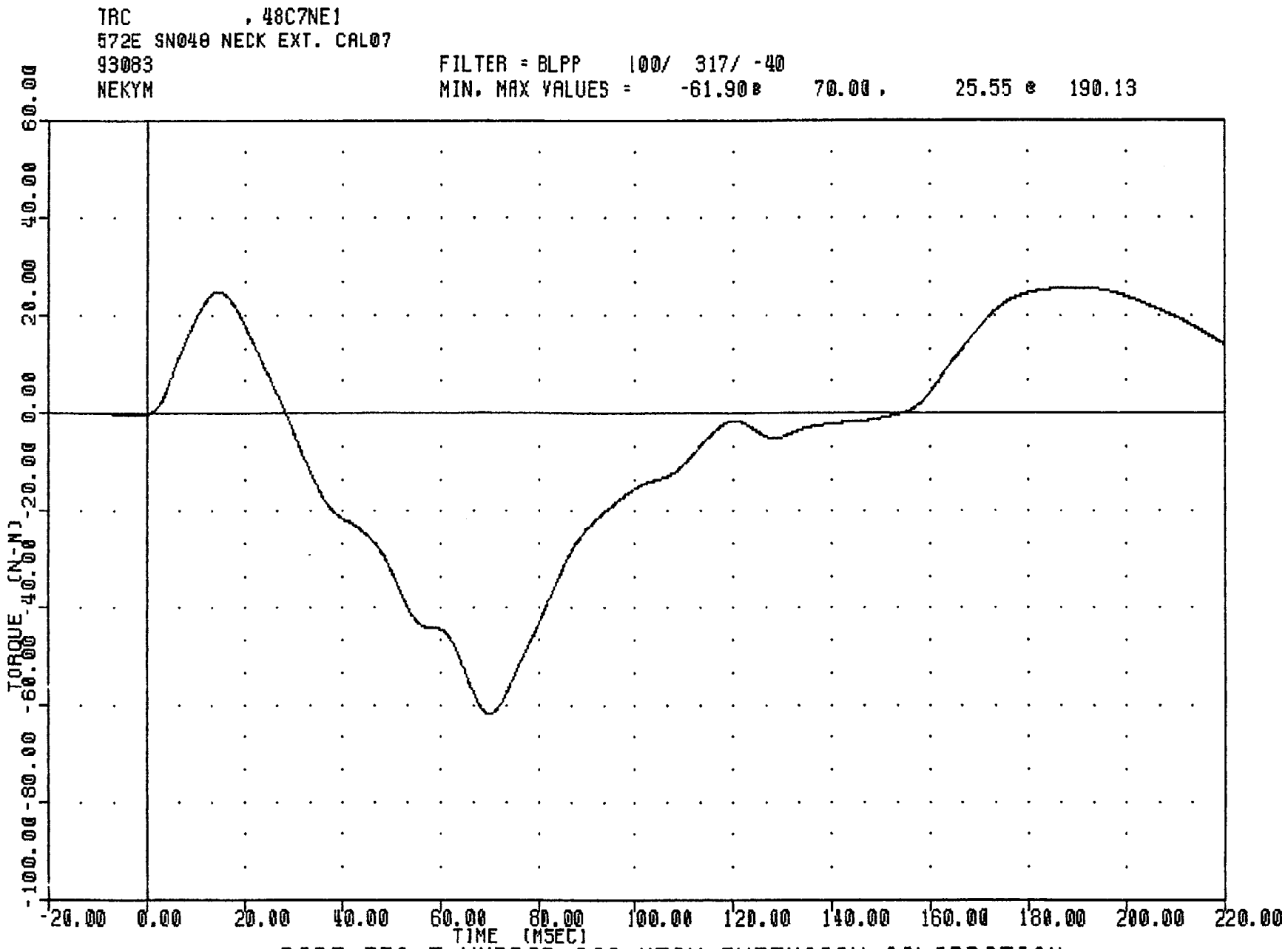

PART 572-E HYBRID III NECK EXTENSION CALIBRATION
ROTATION ABOUT OCCIPITAL CONDYLE



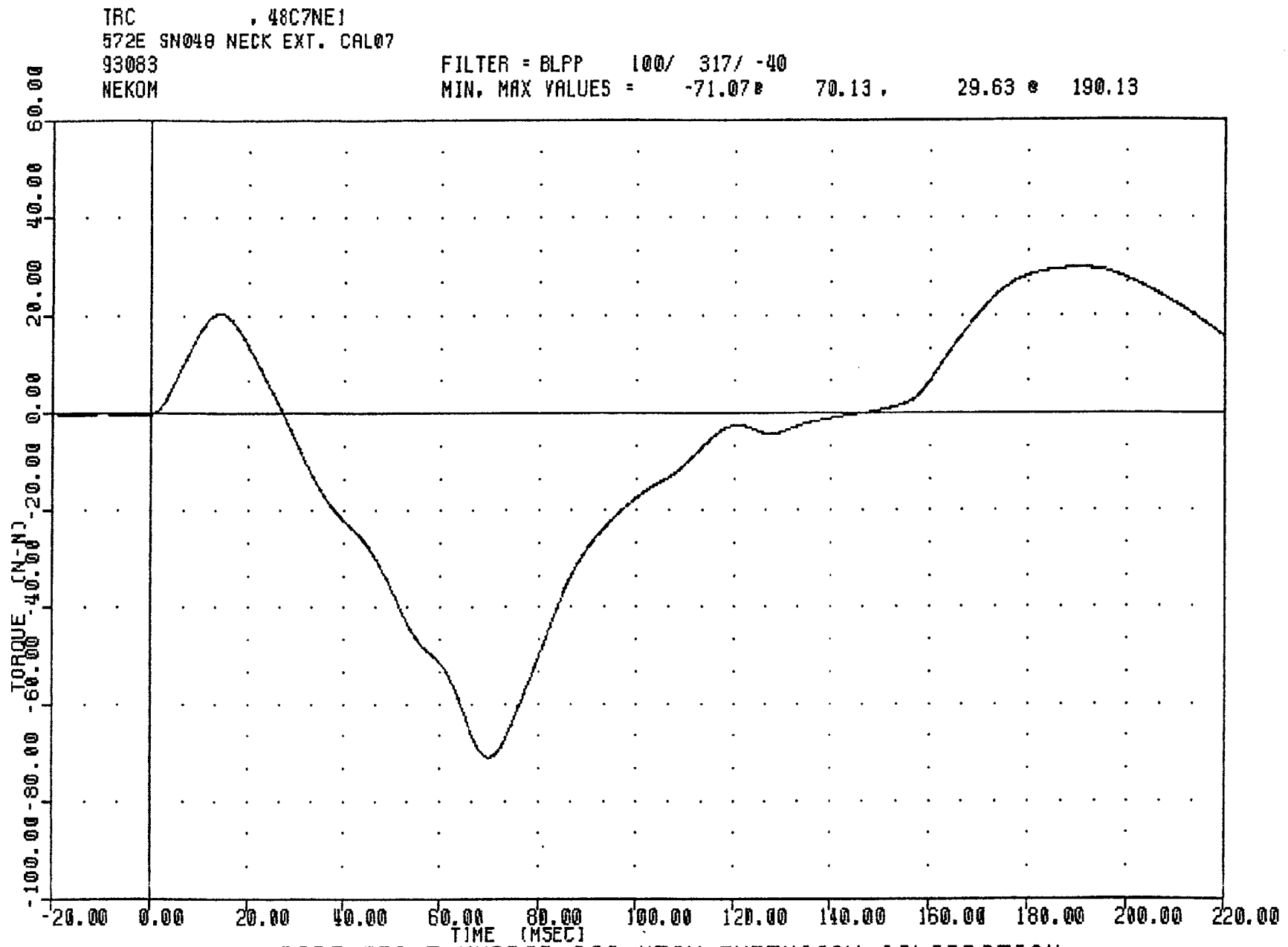

PART 572-E HYBRID III NECK EXTENSION CALIBRATION
TOTAL ROTATION




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




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

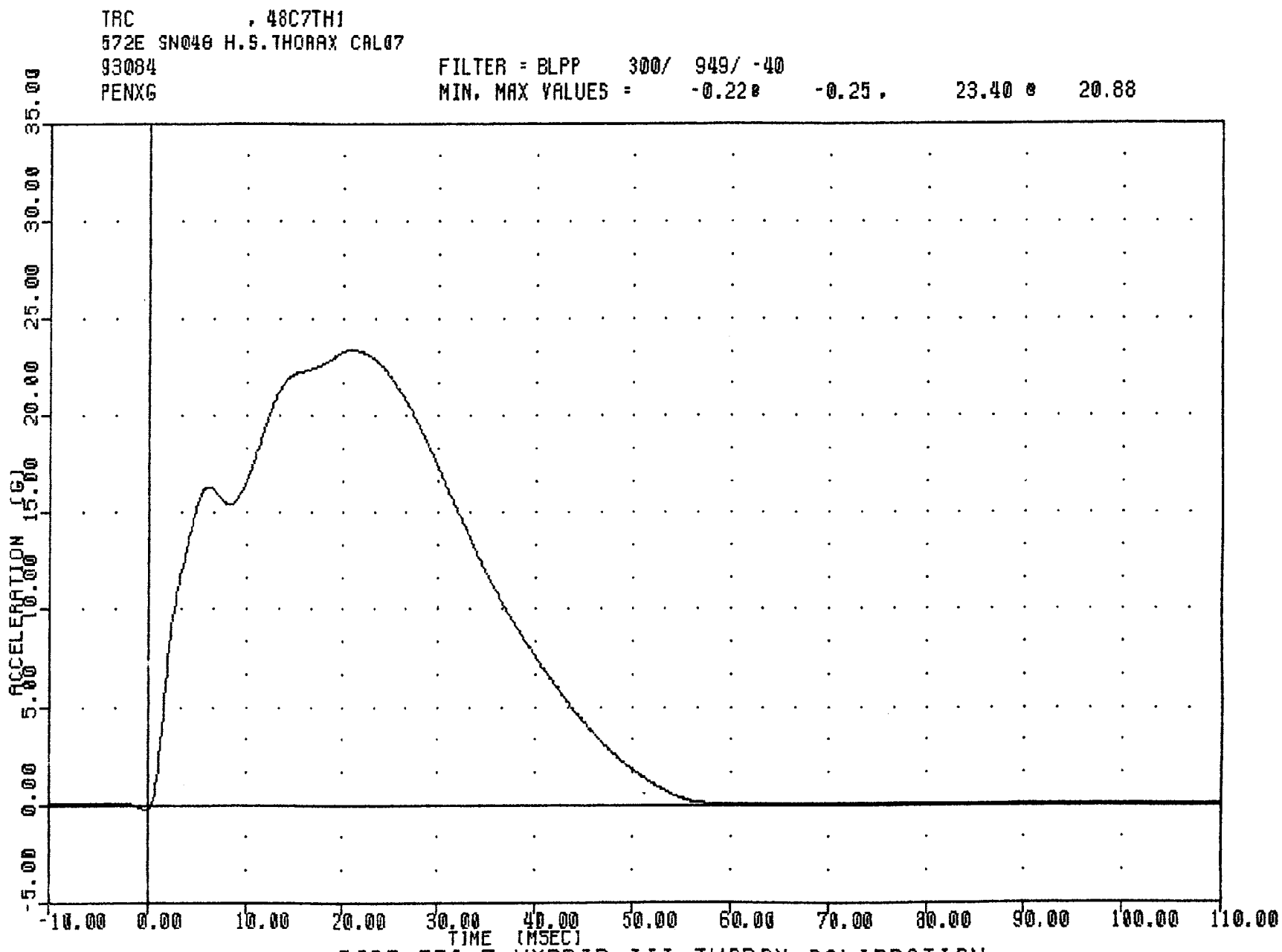
HYBRID III 25-MAR-93

TRC 48C7TH1 572E SN048 H. S. THORAX CAL07

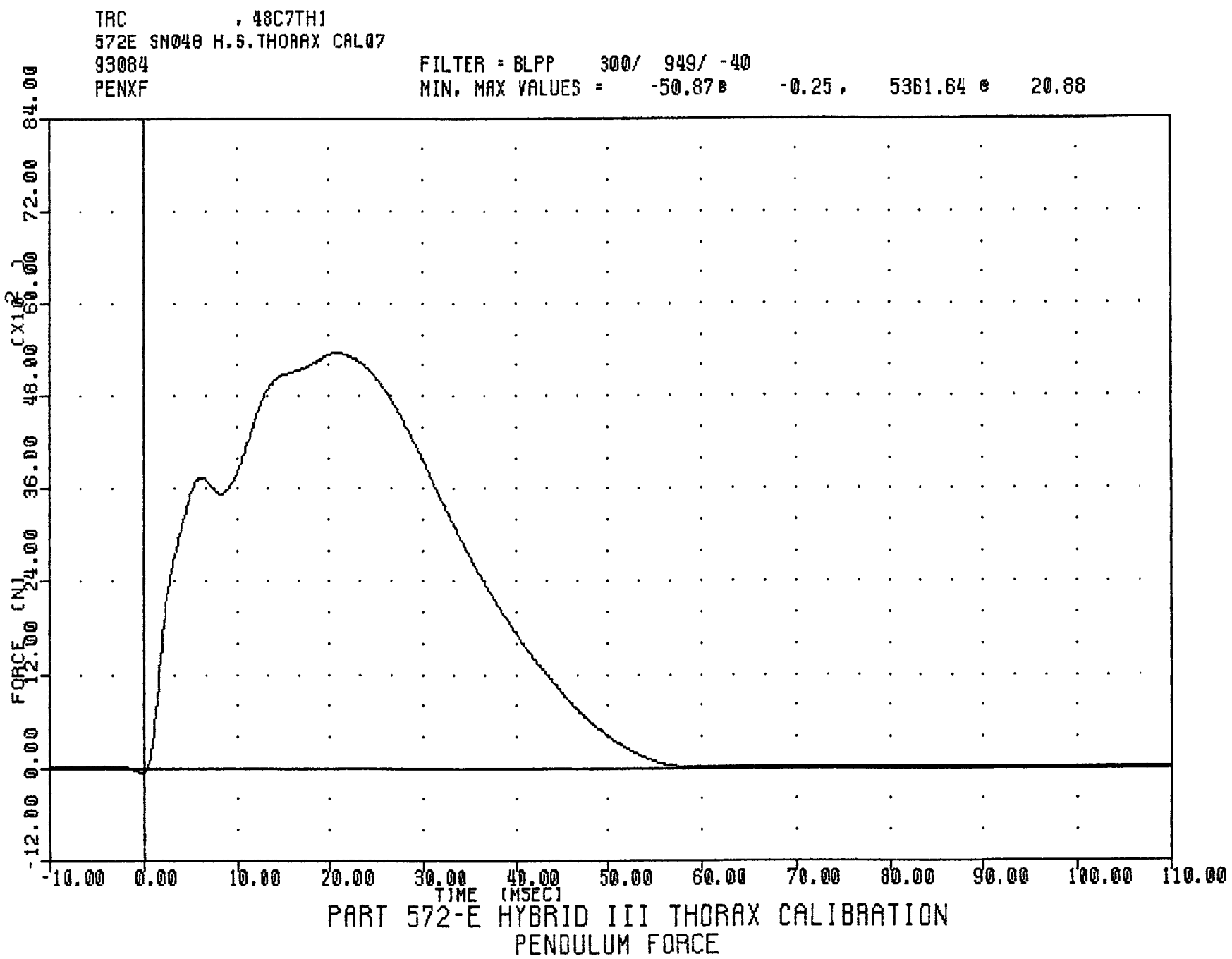
| TEST PARAMETER | HIGH SPEED TEST SPECIFICATION | TEST RESULTS |
|---|---|---|
| TEMPERATURE | 20.6-22.2 DEG. C | 21.1 DEG. C |
| RELATIVE HUMIDITY | 10% - 70% | 50.0 % |
| PENDULUM VELOCITY | 6.59 - 6.83 M/SEC | 6.68 M/SEC |
| MAXIMUM DEFLECTION | 63.5 - 72.6 MM | 69.2 MM |
| MAXIMUM RESISTIVE FORCE | 5159 - 5894 N | 5361. N |
| INTERNAL HYSTERESIS | 69% - 85% | 72.0% |

TEST MEETS SPECIFICATIONS

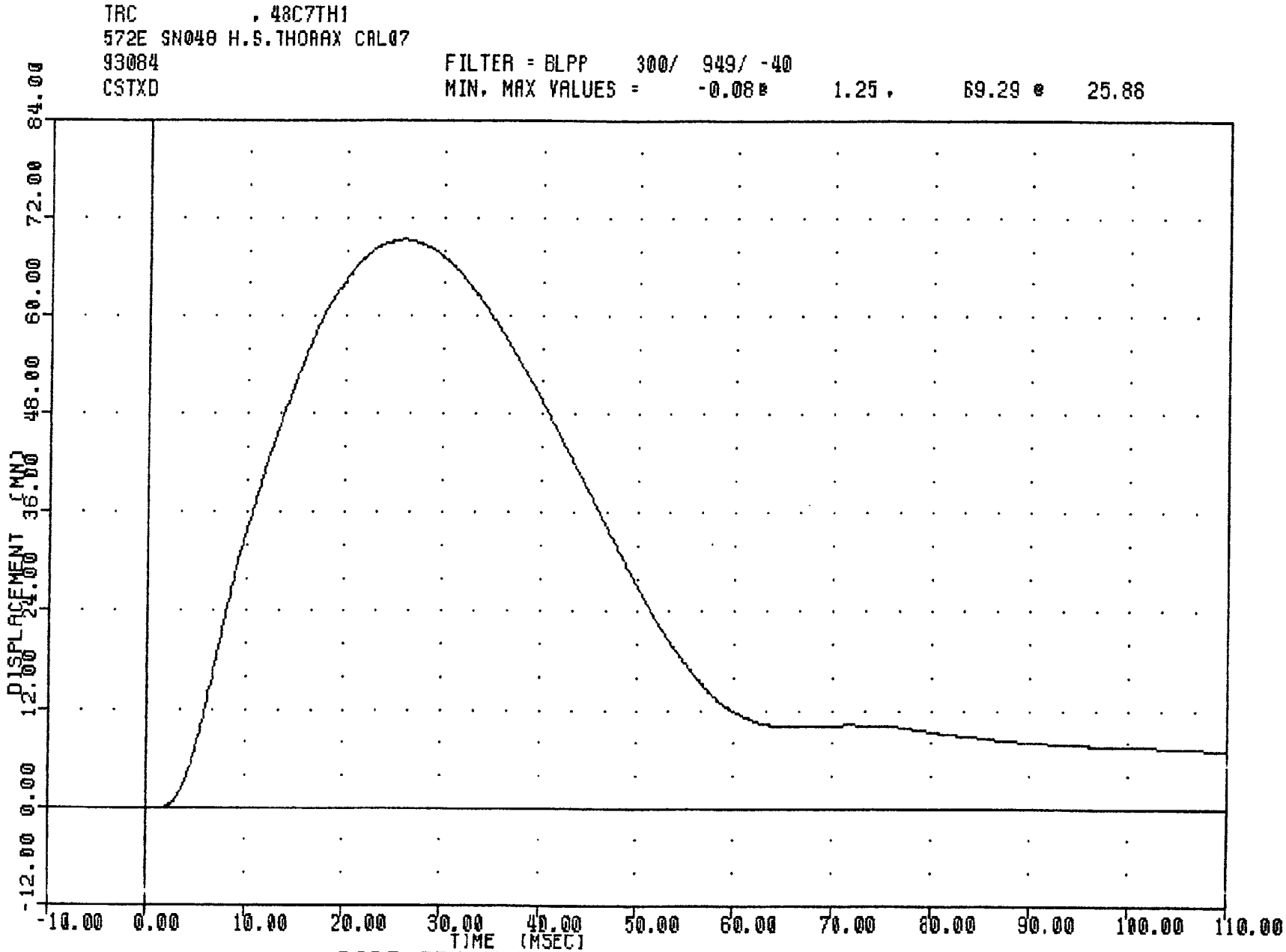
TECHNICIAN R. E. Le Van



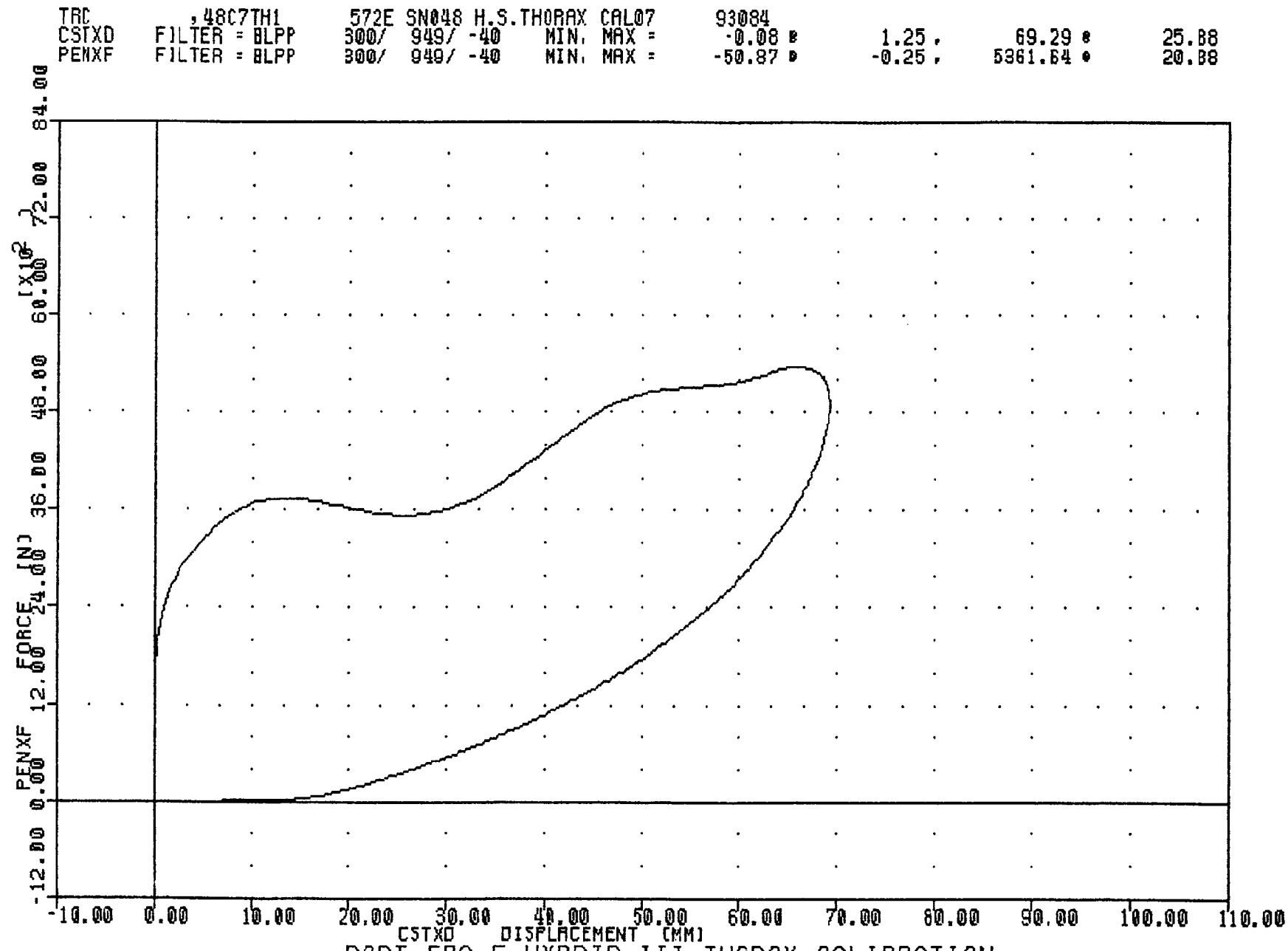

PART 572-E HYBRID III THORAX CALIBRATION
PENDULUM DECELERATION




PART 572-E HYBRID III THORAX CALIBRATION
PENDULUM FORCE




PART 572-E HYBRID III THORAX CALIBRATION
STERNUM DISPLACEMENT




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

TRANSPORTATION RESEARCH CENTER INC.

KNEE IMPACT TEST

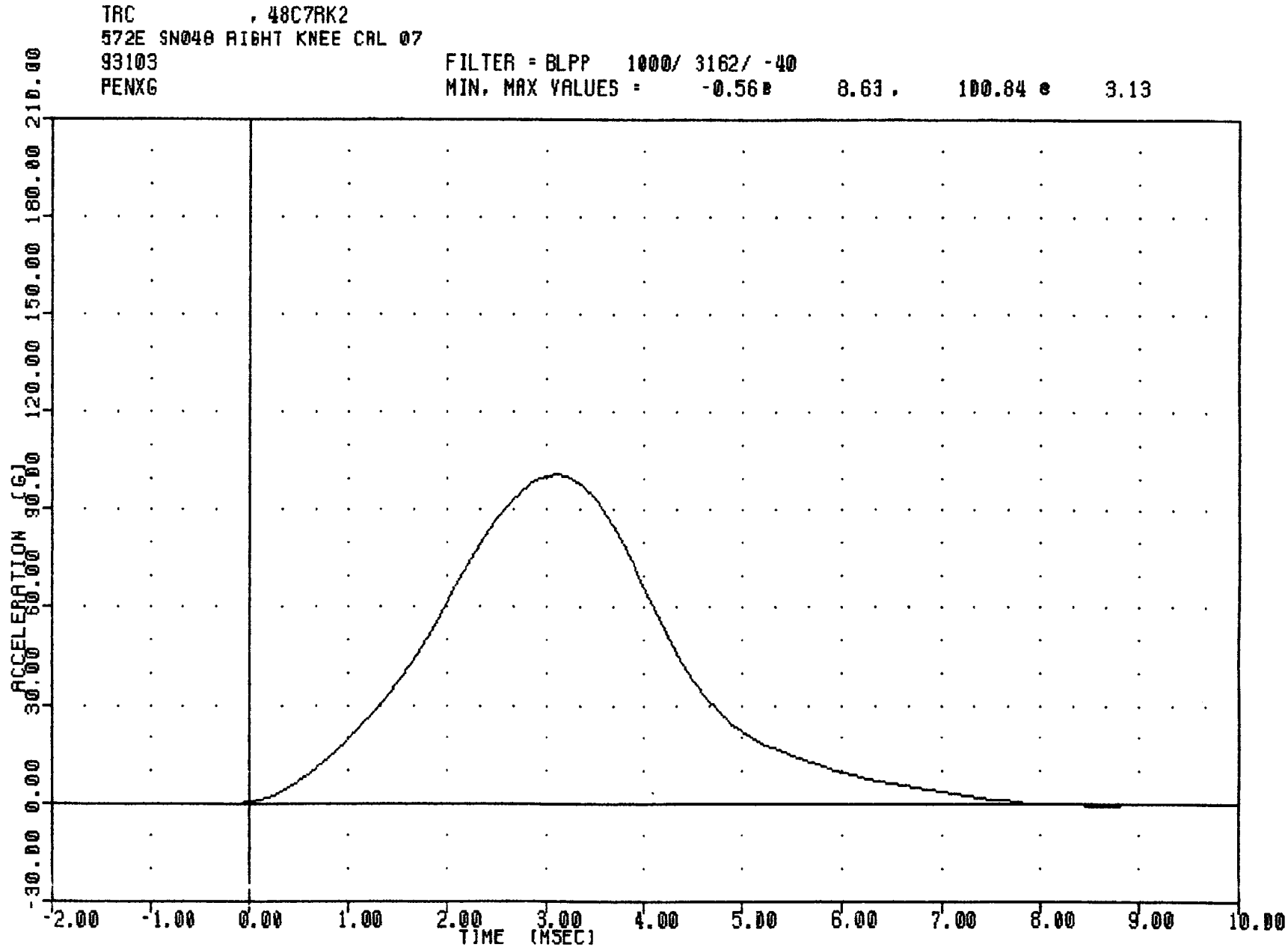
HYBRID III 13-APR-93

RIGHT KNEE
TRC 48C7RK2 572E SN048 RIGHT KNEE CAL 07

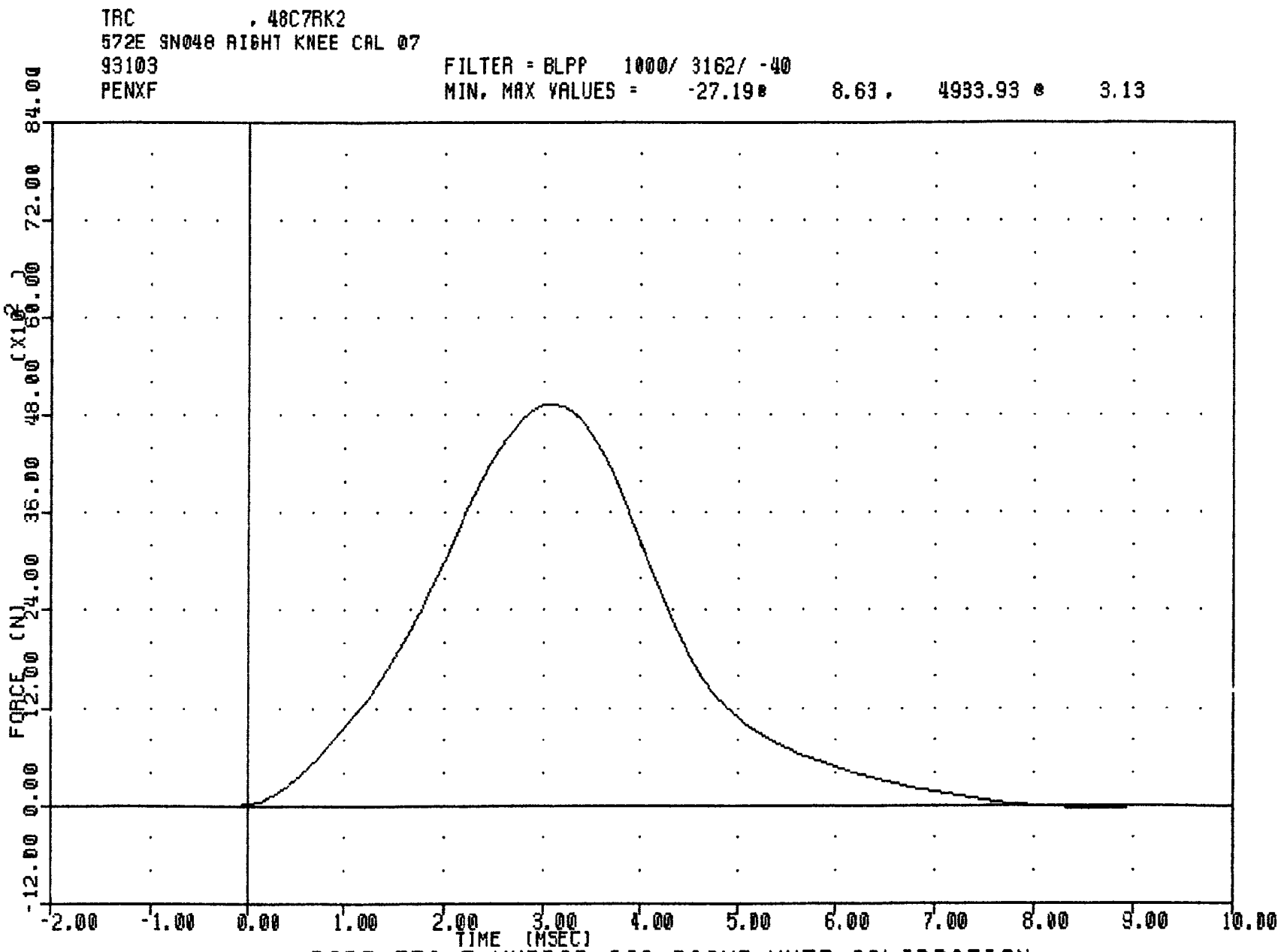
| TEST PARAMETER | SPECIFICATION | TEST RESULTS |
|---|---|---|
| TEMPERATURE | 18.9-25.6 DEG. C | 21.1 DEG. C |
| RELATIVE HUMIDITY | 10% - 70% | 48.0 % |
| PROBE VELOCITY | 2.07 - 2.13 M/SEC | 2.08 M/SEC |
| PEAK KNEE IMPACT FORCE<br>PROBE WEIGHT | 4714 - 5783 N<br>5.0 KG | 4933.9 N |

TEST MEETS SPECIFICATIONS

TECHNICIAN K. E. L.




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.)

TRANSPORTATION RESEARCH CENTER INC.

KNEE IMPACT TEST

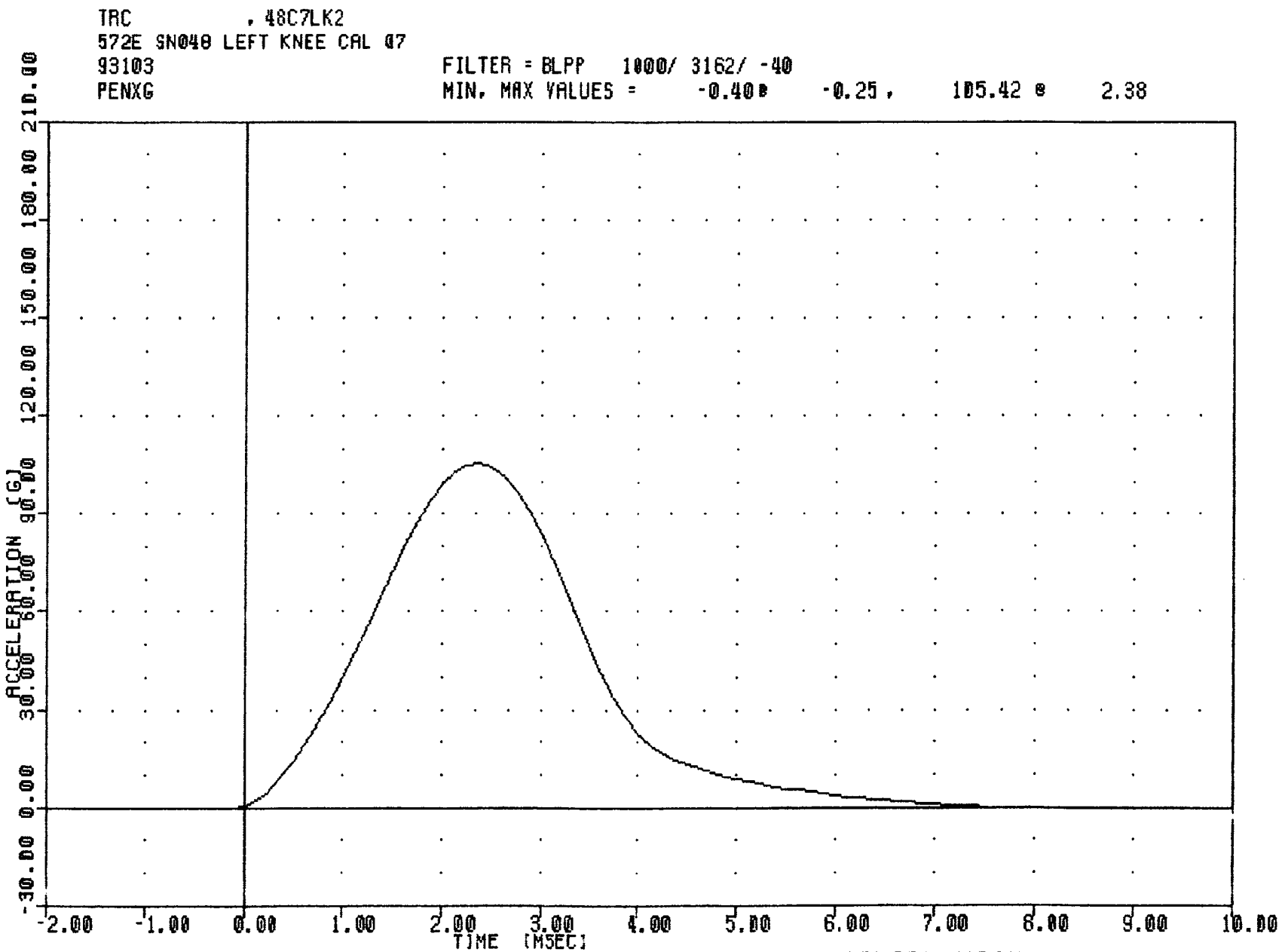
HYBRID III 13-APR-93

LEFT KNEE
TRC 48C7LK2 572E SN048 LEFT KNEE CAL 07

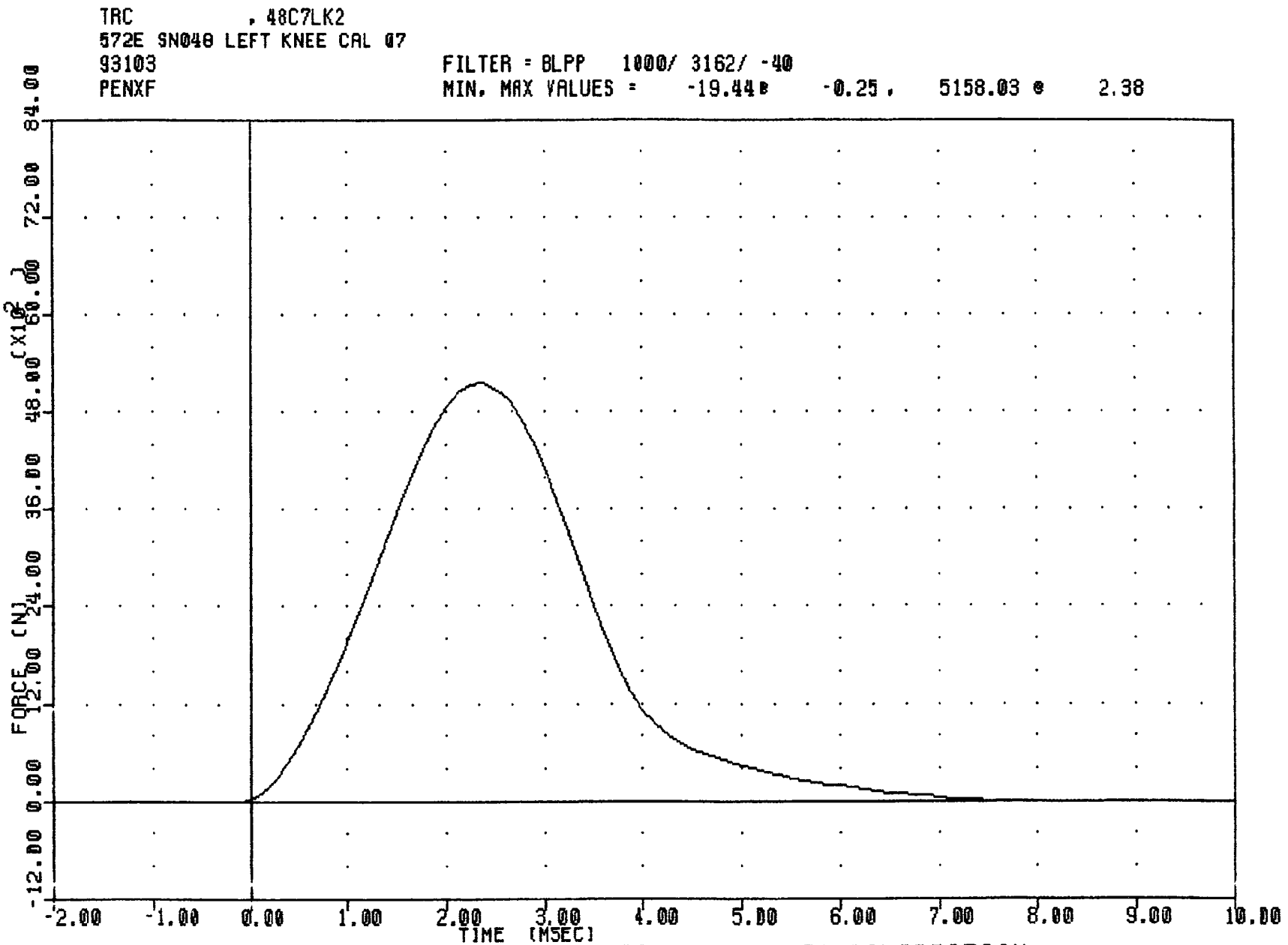
| TEST PARAMETER | SPECIFICATION | TEST RESULTS |
|---|---|---|
| TEMPERATURE | 18.9-25.6 DEG. C | 21.1 DEG. C |
| RELATIVE HUMIDITY | 10% - 70% | 48.0 % |
| PROBE VELOCITY | 2.07 - 2.13 M/SEC | 2.07 M/SEC |
| PEAK KNEE IMPACT FORCE<br>PROBE WEIGHT | 4714 - 5783 N<br>5.0 KG | 5158.0 N |

TEST MEETS SPECIFICATIONS

TECHNICIAN R. E. Le Va




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.)

# 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 | 014 | 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. 930426

| NO. | LOCATION | AXIS | MFR | MODEL | S/N | ORIENTATION (+ SENSING) |
|---|---|---|---|---|---|---|
| 1 | LEFT REAR SEAT | | | | | |
| | CROSSMEMBER LONGITUDINAL | X | ENDEVCO | 2264 | AS29 | REAR |
| 2 | RIGHT REAR SEAT | | | | | |
| | CROSSMEMBER LONGITUDINAL | X | ENDEVCO | 2264 | AR24 | REAR |
| 3 | ENGINE TOP LONGITUDINAL | X | ENDEVCO | 2264 | AS76 | REAR |
| 4 | ENGINE BOTTOM LONGITUDINAL | X | ENDEVCO | 2264 | BB67 | REAR |
| 5 | RIGHT BRAKE CALIPER | | | | | |
| | LONGITUDINAL | X | ENDEVCO | 2264 | AY59 | REAR |
| 6 | LEFT BRAKE CALIPER | | | | | |
| | LONGITUDINAL | X | ENDEVCO | 2264 | AZ31 | REAR |
| 7 | INSTRUMENT PANEL CENTER | | | | | |
| | LONGITUDINAL | X | ENDEVCO | 2264 | AS44 | REAR |
| | LAP BELT OUTBOARD FORCE | | LEBOW | 2264 | 610 | TENSION |
| | SHOULDER BELT OUTBOARD FORCE | | LEBOW | 2264 | 590 | TENSION |
| 8 | VEHICLE CENTER OF GRAVITY | | | | | |
| | LONGITUDINAL | X | ENDEVCO | 2264 | AY66 | REAR |
| | LATERAL | Y | ENDEVCO | 2264 | AS03 | RIGHT |
| | VERTICAL | Z | ENDEVCO | 2264 | AG24 | UP |

## HEAVY TRUCK ACCELEROMETER INFORMATION

TEST NO. 930426

| NO. | LOCATION | AXIS | MFR | MODEL | S/N | ORIENTATION (+ SENSING) |
|---|---|---|---|---|---|---|
| 9 | FRONT FRAME CROSSMEMBER | X | ENDEVCO | 7264 | CF11H | FRONT |
| | | Y | ENDEVCO | 7264 | CL73H | LEFT |
| | | Z | ENDEVCO | 7264 | CH97H | UP |
| 10 | TRUCK CENTER OF GRAVITY | X | ENDEVCO | 7264 | CJ04H | REAR |
| | | Y | ENDEVCO | 7264 | CJ37H | RIGHT |

## 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 |

*U.S. G.P.O.:1993-301-717:80384