V3417

REPORT NUMBER: 301-CAL-00-7

# SAFETY COMPLIANCE TESTING FOR FMVSS 301
# FUEL SYSTEM INTEGRITY

MAZDA MOTOR CORPORATION
2000 MAZDA PROTEGE
4-DOOR SEDAN

NHTSA NUMBER: CY5402

VERIDIAN TEST NUMBER: 8480-17

VERIDIAN ENGINEERING
P.O. BOX 400
BUFFALO, NEW YORK 14225

July 13, 2000

FINAL REPORT

PREPARED FOR:

U. S. Department of Transportation
National Highway Traffic Safety Administration
ENFORCEMENT
Office of Vehicle Safety Compliance
400 Seventh Street, S. W.
Room No. 6115 (NEF-30)
Washington, DC 20590

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Accepted By: _____

Acceptance Date: _____

## TECHNICAL REPORT STANDARD TITLE PAGE

| | | |
|---|---|---|
| 1. Report No.<br>301-CAL-00-7 | 2. Government Accession No. | 3. Recipient's Catalog No. |
| 4. Title and Subtitle<br>Final Report of FMVSS 301 Compliance Testing of a<br>2000 Mazda Protege 4-Door Sedan NHTSA No. CY5402 | | 5. Report Date<br>July 13, 2000<br>6. Performing Organization Code<br>CAL |
| 7. Author(s)<br>Lawrence Q. Valvo, Project Engineer<br>David J. Travale, Program Manager | | 8. Performing Organization Report No.<br>8480-17 |
| 9. Performing Organization Name and Address<br>Veridian Engineering<br>4455 Genesee Street<br>Buffalo, New York 14225 | | 10. Work Unit No.<br>11. Contract or Grant No.<br>DTNH22-95-D-11000 |
| 12. Sponsoring Agency Name and Address<br>U.S. Department of Transportation National Highway Traffic Safety Administration Office of Vehicle Safety Compliance (NEF-30)<br>400 Seventh St , S.W., Rm. 6115, Washington, D.C. 20590 | | 13. Type of Report and Period Covered<br>Final Test Report<br>July 2000<br>14. Sponsoring Agency Code<br>NEF-30 |
| 15. Supplementary Notes | | |
| 16. Abstract<br>Compliance tests were conducted on the subject 2000 Mazda Protege 4-Door Sedan in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-301-01 for the determination of FMVSS 301 compliance. Test failures identified were as follows:<br><br>The test vehicle appeared to comply with all requirements of FMVSS 301 "Fuel System Integrity." | | |
| 17. Key Words<br>Compliance Testing<br>Safety Engineering<br>FMVSS 301 | 18. Distribution Statement<br>Copies of this report are available from:<br>NHTSA Technical Reference Division<br>Room 5108 (NAD-52), 400 Seventh , S.W.,<br>Washington, D.C. 20590<br>Telephone No. (202) 366-4946 | |

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Section 1

# PURPOSE OF COMPLIANCE TEST

This 30 mph rear moving barrier impact test is part of the Federal Motor Vehicle Safety Standard (FMVSS) 301 Compliance Test Program conducted for the National Highway Traffic Safety Administration (NHTSA) by Veridian Engineering under Contract No. DTNH22-95-D-11000. The purpose of this test was to determine if the subject vehicle, a 2000 Mazda Protege 4-Door Sedan, meets the performance requirements of FMVSS No. 301, "Fuel System Integrity." This compliance test was conducted using the requirements found in the OVSC Laboratory Test Procedure No. TP-301-01, dated March 28, 1994.

Section 2

## COMPLIANCE TEST RESULTS SUMMARY

A 2895 pound 2000 Mazda Protege 4-Door Sedan was impacted from the rear by a 3961 pound moving barrier at a velocity of 29.0 mph. The test was performed by Veridian Engineering on July 13, 2000.

One instrumented Part 572 E and one non-instrumented Part 572 B, 50th percentile male Anthropomorphic Test Device (ATD) were placed in the driver and right-front passenger seating positions respectively. No additional ballast was required to achieve vehicle target test weight.

The crash event was recorded by one real-time and eight high-speed cameras. Camera locations and other pertinent camera information are found on pages 3-9 and 3-10 of this report. Pre- and post-test photographs of the vehicle can be found in Appendix A. Vehicle and ATD electronic data plots are presented in Appendix B.

The 13.2 gallon fuel tank was filled to 92.5 percent capacity with orange Stoddard fluid prior to the impact. After the impact, there was no fluid leakage for the first 30 minutes nor during any phase of the rollover test. Average vehicle longitudinal crush was 11.4 inches. The vehicle appeared to comply with all the requirements of FMVSS No. 301 "Fuel System Integrity." Section 3 presents the results of these tests.

Table 1

CRASH TEST SUMMARY

Vehicle NHTSA No.: CY5402 Test Mode: 30 mph Rear Barrier

Test Date: July 13, 2000 Time: 11:44 Temperature : 70 °F

Vehicle Make/Model/Body Style: 2000 Mazda Protege 4-Door Sedan

Vehicle Test Weight: 2895 lbs Impact Velocity: 29.0 mph

Static Crush: Left Side = 10.5 inches

Right Side = 11.0 inches

Centerline = 12.7 inches

Average Crush: 11.4 inches

TYPE OF FRONT OCCUPANT RESTRAINT SYSTEM INSTALLED IN TEST VEHICLE:

Driver's DSP: 3-Point Seatbelt, Airbag, Knee Bolster

Right Passenger's DSP: 3-Point Seatbelt, Airbag, Knee Bolster

VISIBLE DUMMY CONTACT POINTS:

Driver: Back of head to center of head restraint, back to center of seat back.

Passenger: Back of head to center of head restraint, back to center of seat back.

DOOR OPENING DATA: Closed / Operable - Left Front

Closed / Operable - Right Front

Stoddard Solvent Spillage from Vehicle's Fuel System: None

Remarks: The rear window shattered during the impact. The driver seat back reclined approximately 25 degrees during the impact. The seat back remained operable following the impact.

Table 2

GENERAL TEST AND VEHICLE PARAMETER DATA

TEST VEHICLE INFORMATION:

Year/Make/Model/Body Style: 2000 Mazda Protege 4-Door Sedan

NHTSA No.: CY5402 ; VIN: JM1BJ2221Y0218198 ; Color: Red

Engine Data: 4 cylinders; - CID; 1.6 Liters; - cc

Placement: - Longitudinal or In-Line; X Transverse or Lateral

Transmission Data: 5 speeds; X Manual; - Automatic; - Overdrive

Final Drive: - Rear Wheel Drive; X Front Wheel Drive; - Four Wheel Drive

Major Options: X A/C; X Pwr.Strg.; X Pwr. Brakes

- Pwr. Windows; - Pwr. Door Locks; X Tilt Wheel

Date Received: 10/99 ; Odometer Reading 83 miles

Selling Dealer: Not Available

& Address: -

DATA FROM TIRE VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured by: Mazda Motor Corporation

Date of Manufacture: 10/99

GVWR: 3472 lbs.; GAWR: 1830 lbs. FRONT; 1653 lbs. REAR

DATA FROM TIRE PLACARD:

Location of Placard on Vehicle: Driver door

Tire Pressure with Maximum Capacity Vehicle Load: 32 psi FRONT 32 psi REAR

Recommended Tire Size: 185/65R14

* Recommended Cold Tire Pressure: 32 psi FRONT; 32 psi REAR

Size of Tires on Test Vehicle: 185/65R14

Type of Spare Tire: Temporary

Vehicle Capacity Data:

Type of Front Seats: - Bench; X Bucket; - Split Bench

Number of Occupants: 2 Front; 3 Rear; 5 Total

Vehicle Capacity Weight (VCW) = 850 lbs.

No. of Occupants x 150 lbs. = 750 lbs.

Rated Cargo/Luggage Weight (RCLW) = 100 lbs.

*Tire pressure used for test

Table 2

GENERAL TEST AND VEHICLE PARAMETER DATA ( cont. )

WEIGHT OF TEST VEHICLE AS RECEIVED FROM DEALER (with maximum fluids)= UDW:

| | | | |
|---|---|---|---|
| Right Front = | 749.5 lbs. | Right Rear = | 488.5 lbs. |
| Left Front = | 738.5 lbs. | Left Rear = | 501.5 lbs. |
| TOTAL FRONT = | 1,488 lbs. | TOTAL REAR = | 990 lbs. |

TOTAL DELIVERED WEIGHT = 2,478 lbs.

% of Total Front of Vehicle Weight = 60 % of Total Rear Weight = 40 %

CALCULATION OF VEHICLE'S TARGET TEST WEIGHT:

| | | |
|---|---|---|
| Total Delivered Weight | = | 2,478 lbs. |
| Rated Cargo/Luggage Weight (RCLW) | = | 100 lbs. |
| Weight of 2 p.572 Dummies, 167 & 164 lbs | = | 331 lbs. |
| TARGET TEST WEIGHT | = | 2,909 lbs. |

WEIGHT OF TEST VEHICLE WITH TWO DUMMIES AND 86 POUNDS OF CARGO WEIGHT:

| | | | |
|---|---|---|---|
| Right Front = | 870 lbs. | Right Rear = | 558 lbs. |
| Left Front = | 882 lbs. | Left Rear = | 585 lbs. |
| TOTAL FRONT = | 1,752 lbs. | TOTAL REAR = | 1,143 lbs. |

TOTAL TEST WEIGHT = 2,895.0 lbs.

% of Total Front Weight = 60.5 % % of Total Rear Weight = 39.5 %

* Weight of Ballast Secured in Vehicle Trunk Area = 0 lbs.

Type of Ballast: None

Method of Securing Ballast: -

Vehicle Components Removed for Weight Reduction: None

VEHICLE ATTITUDE (all dimension in inches):

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| AS DELIVERED: | RF | 25.7 | LF | 25.9 | RR | 25.7 | LR | 25.9 |
| AS TESTED: | RF | 24.6 | LF | 24.6 | RR | 24.8 | LR | 24.8 |

Vehicle's Wheel Base: 102.9 in.

Location of Vehicle's C.G.: 40.6 inches rearward of front wheel center.

FUEL SYSTEM DATA:

Fuel System Capacity From Owner's Manual = 13.2 gallons

Usable Capacity Figure Furnished by COTR = 13.2 gallons

Test Volume Range (91 to 94% of Usable Capacity) = 12.0 to 12.4 gallons

ACTUAL TEST VOLUME= 12.2 gallons (with entire fuel system filled)

* Ballast weight includes the RCLW, the weight of drained vehicle fluids and the weight of any removed vehicle components less the weight of onboard instrumentation, cameras, and hardware.

Table 2

GENERAL TEST AND VEHICLE PARAMETER DATA ( cont. )

FUEL SYSTEM DATA (continued):

| | | |
|---|---|---|
| Test Fluid Type: | Stoddard Solution | |
| Test Fluid Specific Gravity: | 0.764 | |
| Test Fluid Kinematic Viscosity: | 0.96 | centistokes |
| Test Fluid Color: | Orange | ("red" is preferred) |
| Type of Vehicle Fuel Pump: | Electric | |

Electric Fuel Pump Operation with Ignition Switch ON and Engine OFF - Fucl pump operated.

Details of Fuel System: Fuel filler is located on the left rear quarter panel aft of the rear axle; Fuel tank is located on the vehicle underbody beneath the rear seat and forward of the rear axle; Fuel lines are routed along along the inboard side of the left frame rail.

Table 3

MOVING BARRIER PARAMETER DATA

WEIGHT OF MOVING BARRIER:

| | | | | | |
|---|---|---|---|---|---|
| Right Front = | 1113 | lbs. | Right Rear = | 868 | lbs. |
| Left Front = | 1102 | lbs. | Left Rear = | 878 | lbs. |
| TOTAL FRONT = | 2,215 | lbs. | TOTAL REAR = | 1,746 | lbs. |

TOTAL BARRIER WEIGHT = 3,961 lbs.

MOVING BARRIER DIMENSIONS:

Barrier Face Height: 60.0 in.

Barrier Face Width: 78.0 in.

Barrier Face Ground Clearance: 5.0 in.

Tread Width: 59.5 in.

Wheel Base: 120.0 in.

Location of C.G.:

X: 52.9 inches rearward of front wheel center.

Y: 0.0 inches from longitudinal-vertical plane of symmetry.

Z: 16.3 inches above ground.

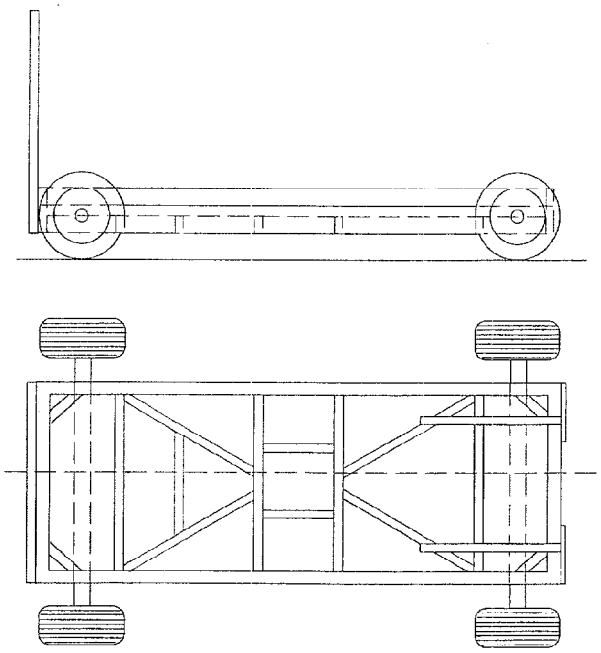


Table 4

## POST IMPACT DATA

TYPE OF TEST:

Type of Test: Rear Barrier Impact Angle: 0°

Test Date: July 13, 2000 Time: 11:44 Temperature: 70 °F

Vehicle NHTSA No.: CY5402

Required Impact Velocity Range: 28.9 to 29.9 mph

BARRIER IMPACT VELOCITY: (Speed traps within 5 feet of impact plane.)

Trap No. 1 = 29.0 mph; Trap No. 2 = 29.0 mph

Average Impact Speed = 29.0 mph

VEHICLE STATIC CRUSH: (For frontal and rear impacts only.)

Vehicle Length:

| | | | | | | |
|---|---|---|---|---|---|---|
| Pre-Test | Right = | 170.5 | ; C/L = | 174.6 | ;Left = | 170.5 |
| Post-Test | Right = | 159.5 | ; C/L = | 161.9 | ;Left = | 160.0 |
| Crush | Right = | 11.0 | ; C/L = | 12.7 | ;Left = | 10.5 |
| AVERAGE | = | 11.4 | inches | | | |

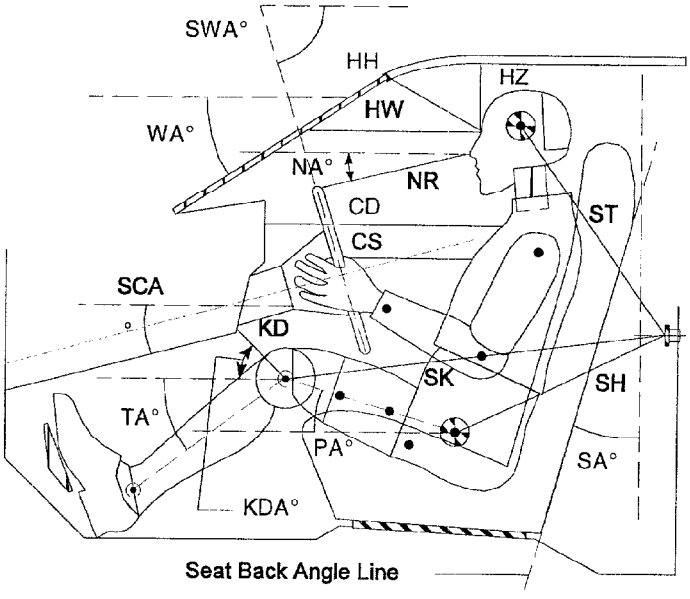
Section 3

# COMPLIANCE TEST DATA

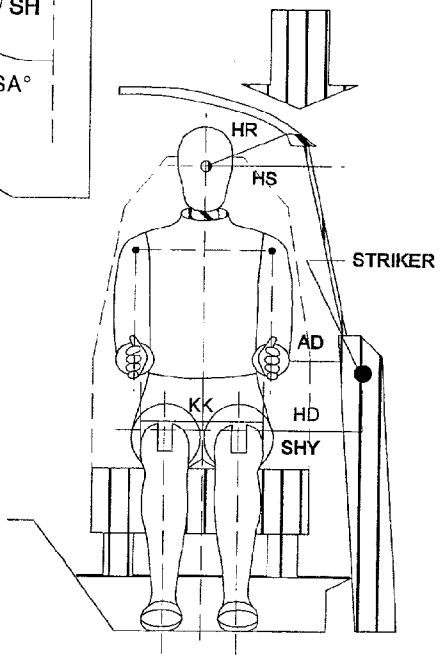
Figure 1

PART 572 DUMMY IN-VEHICLE POSITION
(FOR REAR IMPACTS ONLY)

## DUMMY MEASUREMENT FOR FRONT SEAT PASSENGERS




AD - Arm to Door
HD - H-Point to Door
HR - Head to Side Header
HS - Head to Side Window
KK - Knee to Knee
SHY- Striker to H-Point (Y Direction)




CD - Chest to Dash
CS - Steering Wheel to Chest
HH - Head to Header
HW - Head to Windshield
HZ - Head to Roof
KDA - Knee to Dash Angle
KDL - Left Knee to Dash
KDR - Right Knee to Dash
NA - Nose to Rim Angle
NR - Nose to Rim
PA - Pelvic Angle
RA - Rim to Abdomen
SA - Seat Back Angle
SCA - Steering Column Angle
SH - Striker to H-Point
SK - Striker to Knee
ST - Striker to Head
SWA - Steering Wheel Angle
TA - Tibial Angle
WA - Windshield Angle

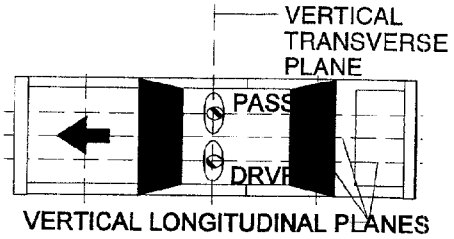


Table 5

FRONT SEAT OCCUPANT MEASUREMENTS
(FOR REAR IMPACT ONLY)

| | DRIVER (Serial #152) | | |
|---|---|---|---|
| WA° | 29 deg. | | |
| SWA° | 67 deg. | | |
| SCA° | 23 deg. | | |
| SA° | 14 deg. | | |
| HZ | 7.6 | | |
| HH | 11.3 | | |
| HW | 22.9 | | |
| HR | 8.4 | | |
| NR | 13.4 | Angle | 12 deg. |
| CD | 19.9 | | |
| CS | 10.3 | | |
| RA | 6.7 | | |
| KDL | 5.3 | Angle (KDA) | 25 deg. |
| KDR | 5.0 | | |
| PA° | 23 deg. | | |
| TA° | 46 deg. | | |
| KK | 13.2 | | |
| ST | 20.8 | Angle | 12 deg. |
| SK | 23.2 | Angle | 89 deg. |
| SH | 9.6 | Angle | 119 deg. |
| SHY | 9.4 | | |
| HS | 13.2 | | |
| HD | 5.7 | | |
| AD | 3.5 | | |

(Measurements in inches)

Table 6
FUEL SYSTEM INTEGRITY POST IMPACT TEST DATA

FMVSS NO. 301

TEST VEHICLE NHTSA NO.: CY5402 TEST DATE: July 13, 2000

Vehicle Mfgr./Make/Model: 2000 Mazda Protege 4-Door Sedan

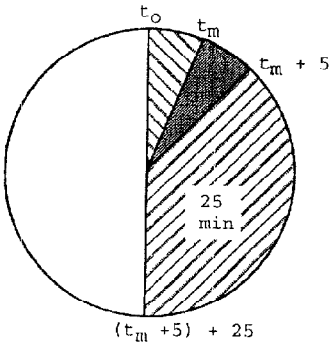
Test vehicle fuel tank filled to 91% to 94% of manufacturer's "usable" capacity and with electric fuel pump operating (if it will operate without engine operation). Part 572 test dummies located at each front designated seating position.

**********

TEST VEHICLE IMPACT TYPE:

- Frontal (30 mph)
- Oblique (30 mph) with - ° barrier face first contacting - (driver/passenger) side
- X Rear Moving Barrier (30 mph)
- Lateral Moving Barrier (20 mph)

FUEL SPILLAGE MEASUREMENT:




1. From impact until vehicle motion ceases
2. For five minute period after vehicle motion ceases
3. For next 25 minutes

| ACTUAL | MAX ALLOWED |
|---|---|
| 0 | 1 oz. |
| 0 | 5 oz. |
| 0 | 1 oz./1 min. |

SOLVENT SPILLAGE DETAILS:

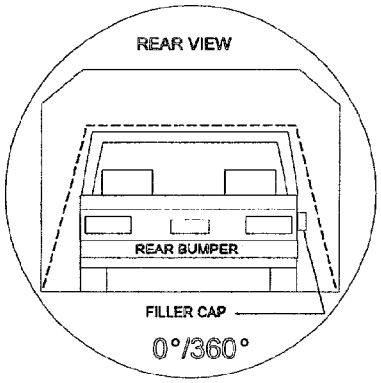
None

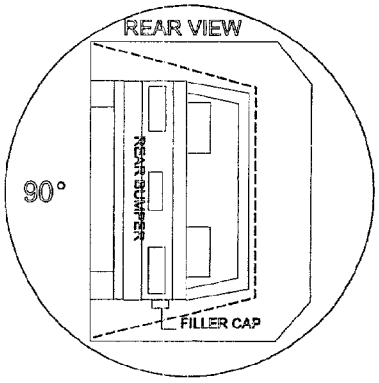
Table 7

FMVSS NO. 301 STATIC ROLLOVER DATA SHEET

TEST PHASE :
0-90 Deg.

Vehicle NHTSA ID No. :
CY5402




I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

| | | | | |
|---|---|---|---|---|
| Rollover Fixture 90° Rotation Time (Spec. Range = 1 to 3 minutes) | 1 | minutes | 16 | seconds |
| FMVSS 301 Position Hold Time + | 5 | minutes | 00 | seconds |
| TOTAL | 6 | minutes | 16 | seconds |
| Next whole minute interval | 7 | minutes | | |

II. FMVSS 301 REQUIREMENTS:

(1) Time Period

| First 5 minutes FROM onset of rotation | 6th min. | 7th min. | 8th min. if reqd. |
|---|---|---|---|

(2) Maximum Allowable Solvent Spillage

| 5 ounces | 1 ounce | 1 ounce | 1 ounce |
|---|---|---|---|

III. ACTUAL TEST VEHICLE SOLVENT SPILLAGE:

| 0 | 0 | 0 | N/A |
|---|---|---|---|

Note: Record spillage for whole minute intervals only as determined above.

IV. SOLVENT SPILLAGE LOCATION(S):

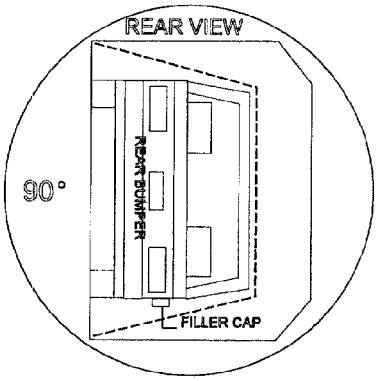
None

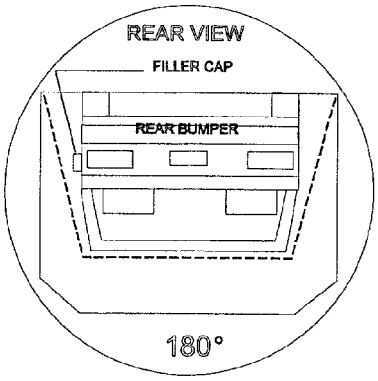
Table 7

FMVSS NO. 301 STATIC ROLLOVER DATA SHEET (cont.)

TEST PHASE :
90-180 Deg.

Vehicle NHTSA ID No. :
CY5402




I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

| | | | | | |
|---|---|---|---|---|---|
| Rollover Fixture 90° Rotation Time (Spec. Range = 1 to 3 minutes) | | 1 | minutes | 6 | seconds |
| FMVSS 301 Position Hold Time + | | 5 | minutes | 00 | seconds |
| | TOTAL | 6 | minutes | 6 | seconds |
| Next whole minute interval | | 7 | minutes | | |

II. FMVSS 301 REQUIREMENTS:

(1) Time Period

| First 5 minutes FROM onset of rotation | 6th min. | 7th min. | 8th min. if reqd. |
|---|---|---|---|

(2) Maximum Allowable Solvent Spillage

| 5 ounces | 1 ounce | 1 ounce | 1 ounce |
|---|---|---|---|

III. ACTUAL TEST VEHICLE SOLVENT SPILLAGE:

| 0 | 0 | 0 | N/A |
|---|---|---|---|

Note: Record spillage for whole minute intervals only as determined above.

IV. SOLVENT SPILLAGE LOCATION(S):

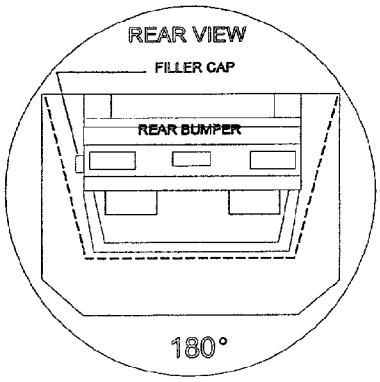
None

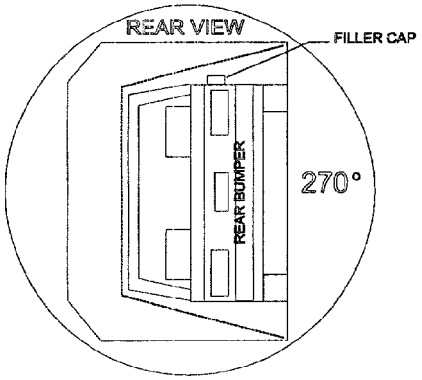
Table 7

FMVSS NO. 301 STATIC ROLLOVER DATA SHEET (cont.)

TEST PHASE :
180-270 Deg.

Vehicle NHTSA ID No. :
CY5402




I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

| | | | | | |
|---|---|---|---|---|---|
| Rollover Fixture 90° Rotation Time (Spec. Range = 1 to 3 minutes) | | 1 | minutes | 3 | seconds |
| FMVSS 301 Position Hold Time + | | 5 | minutes | 00 | seconds |
| | TOTAL | 6 | minutes | 3 | seconds |
| Next whole minute interval | | 7 | minutes | | |

II. FMVSS 301 REQUIREMENTS:

(1) Time Period

| First 5 minutes FROM onset of rotation | 6th min. | 7th min. | 8th min. if reqd. |
|---|---|---|---|

(2) Maximum Allowable Solvent Spillage

| 5 ounces | 1 ounce | 1 ounce | 1 ounce |
|---|---|---|---|

III. ACTUAL TEST VEHICLE SOLVENT SPILLAGE:

| 0 | 0 | 0 | N/A |
|---|---|---|---|

Note: Record spillage for whole minute intervals only as determined above.

IV. SOLVENT SPILLAGE LOCATION(S):

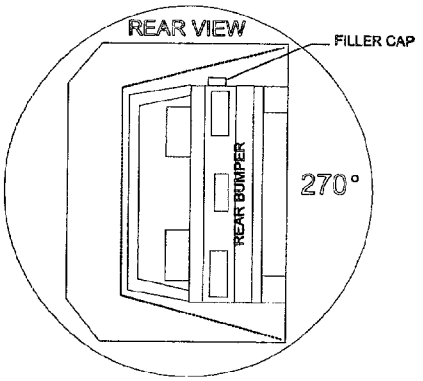
None

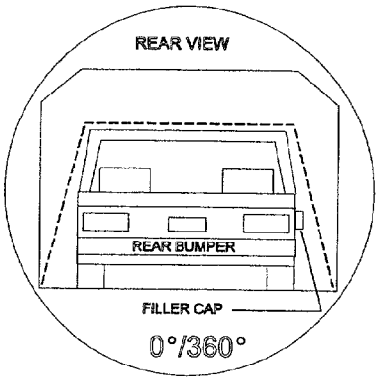
Table 7

FMVSS NO. 301 STATIC ROLLOVER DATA SHEET (cont.)

TEST PHASE :
270-360 Deg.

Vehicle NHTSA ID No. :
CY5402




I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

| | | | | |
|---|---|---|---|---|
| Rollover Fixture 90° Rotation Time (Spec. Range = 1 to 3 minutes) | | 1 | minutes | 6 seconds |
| FMVSS 301 Position Hold Time + | | 5 | minutes | 00 seconds |
| | TOTAL | 6 | minutes | 6 seconds |
| Next whole minute interval | | 7 | minutes | |

II. FMVSS 301 REQUIREMENTS:

(1) Time Period

| First 5 minutes FROM onset of rotation | 6th min. | 7th min. | 8th min. if reqd. |
|---|---|---|---|

(2) Maximum Allowable Solvent Spillage

| 5 ounces | 1 ounce | 1 ounce | 1 ounce |
|---|---|---|---|

III. ACTUAL TEST VEHICLE SOLVENT SPILLAGE:

| 0 | 0 | 0 | N/A |
|---|---|---|---|

Note: Record spillage for whole minute intervals only as determined above.

IV. SOLVENT SPILLAGE LOCATION(S):

None

Figure 2

**CAMERA POSITIONS FOR REAR IMPACTS**

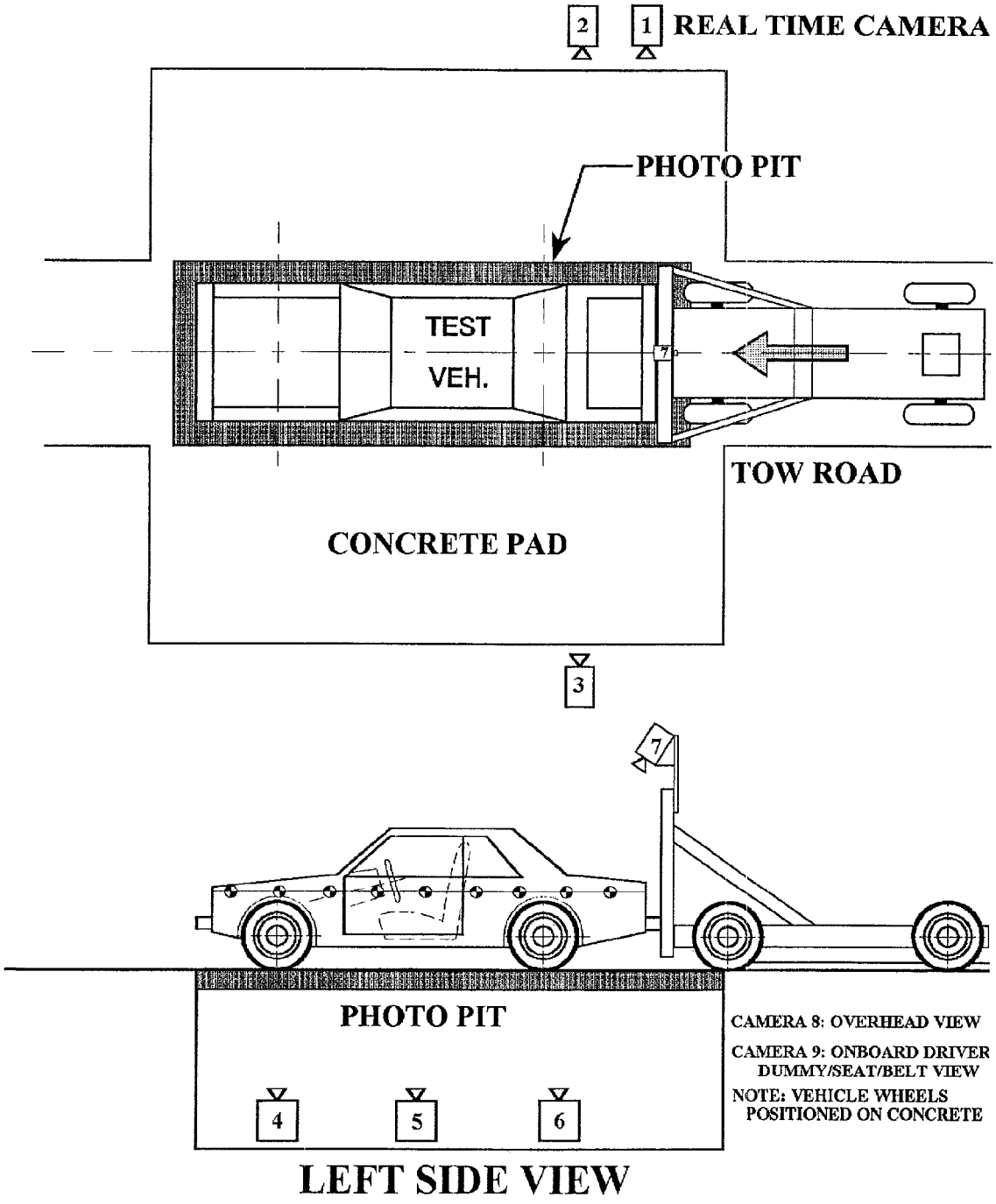


Table 8

HIGH-SPEED CAMERA LOCATIONS

NHTSA No. : CY5402 Vehicle : 2000 Mazda Protege 4-Door Sedan

| CAMERA NO. | VIEW | CAMERA POSITIONS (inches)* | | | ANGLE** (degrees) | LENS (mm) | SPEED (fps) |
|---|---|---|---|---|---|---|---|
| | | X | Y | Z | | | |
| 1 | Real-Time Camera | - | - | - | - | - | 24 |
| 2 | Right Side View | 516.0 | 68.7 | 43.2 | -1 | 25 | 990 |
| 3 | Left Side View | 504.9 | 97.0 | 48.4 | -1 | 25 | 1000 |
| 4 | Vehicle Front Underbody View | 0 | 139.5 | -77.0 | 90 | 13 | 1000 |
| 5 | Vehicle Mid-Section Underbody View | 0 | 82.0 | -77.0 | 90 | 13 | 1030 |
| 6 | Vehicle Rear Underbody View | 0 | 30.5 | -77.0 | 90 | 13 | 1000 |
| 7 | Moving Barrier View | 0 | 0 | 99.0 | -105 | 13 | 990 |
| 8 | Overhead Overall View | 10 | 120 | 386.0 | -90 | 13 | 1000 |
| 9 | Onboard Driver Dummy/Seat/Belt View | - | - | - | - | 8 | 750 |

* X = film plant to monorail centerline (+ to left of rail)
Y = film plane to impact location (+ ahead of impact location)
Z = film plane to ground (+ above ground)
** = referenced to horizontal plane

Appendix A

PHOTOGRAPHS

LIST OF PHOTOGRAPHS

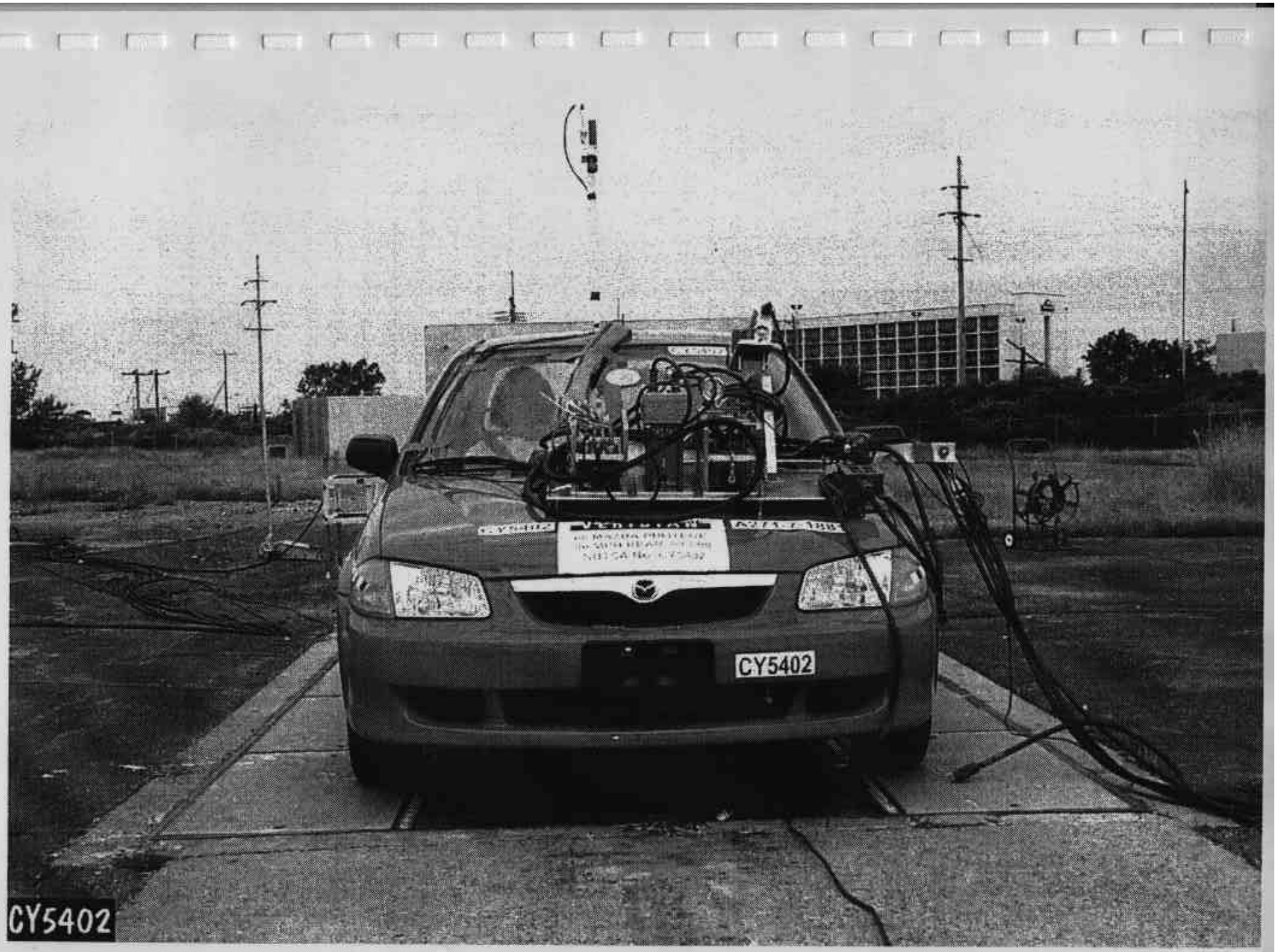



Figure A-1: PRE-TEST FRONT VIEW

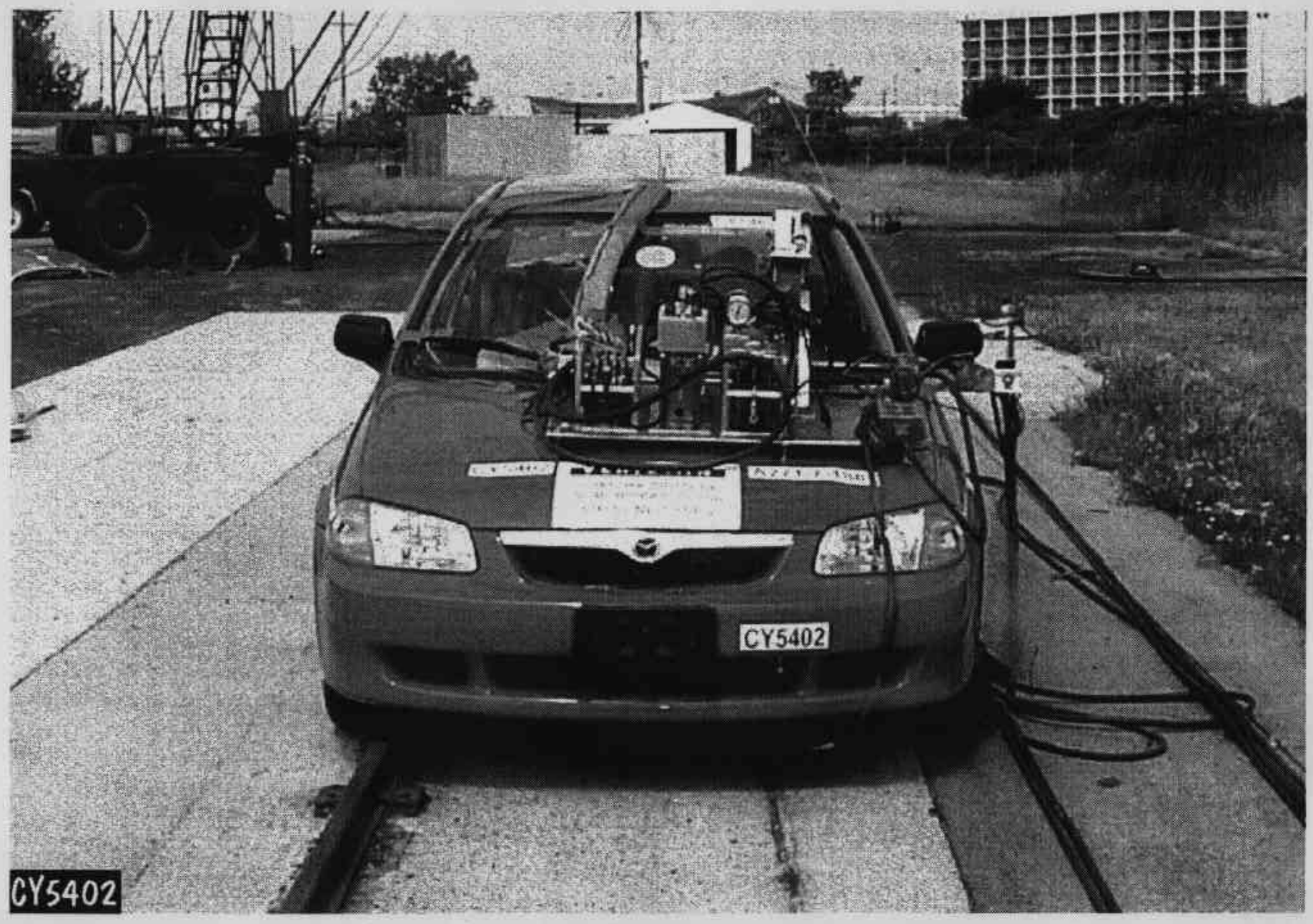



Figure A-2: POST-TEST FRONT VIEW


Figure A-3: PRE-TEST LEFT SIDE VIEW


Figure A-4: POST-TEST LEFT SIDE VIEW


Figure A-5: PRE-TEST RIGHT SIDE VIEW


Figure A-6: POST-TEST RIGHT SIDE VIEW


Figure A-7: PRE-TEST REAR VIEW


Figure A-8: POST-TEST REAR VIEW


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



8480-17


Figure A-10: POST-TEST LEFT FRONT THREE-QUARTER VIEW


Figure A-11: PRE-TEST RIGHT REAR THREE-QUARTER VIEW


Figure A-12: POST-TEST RIGHT REAR THREE-QUARTER VIEW

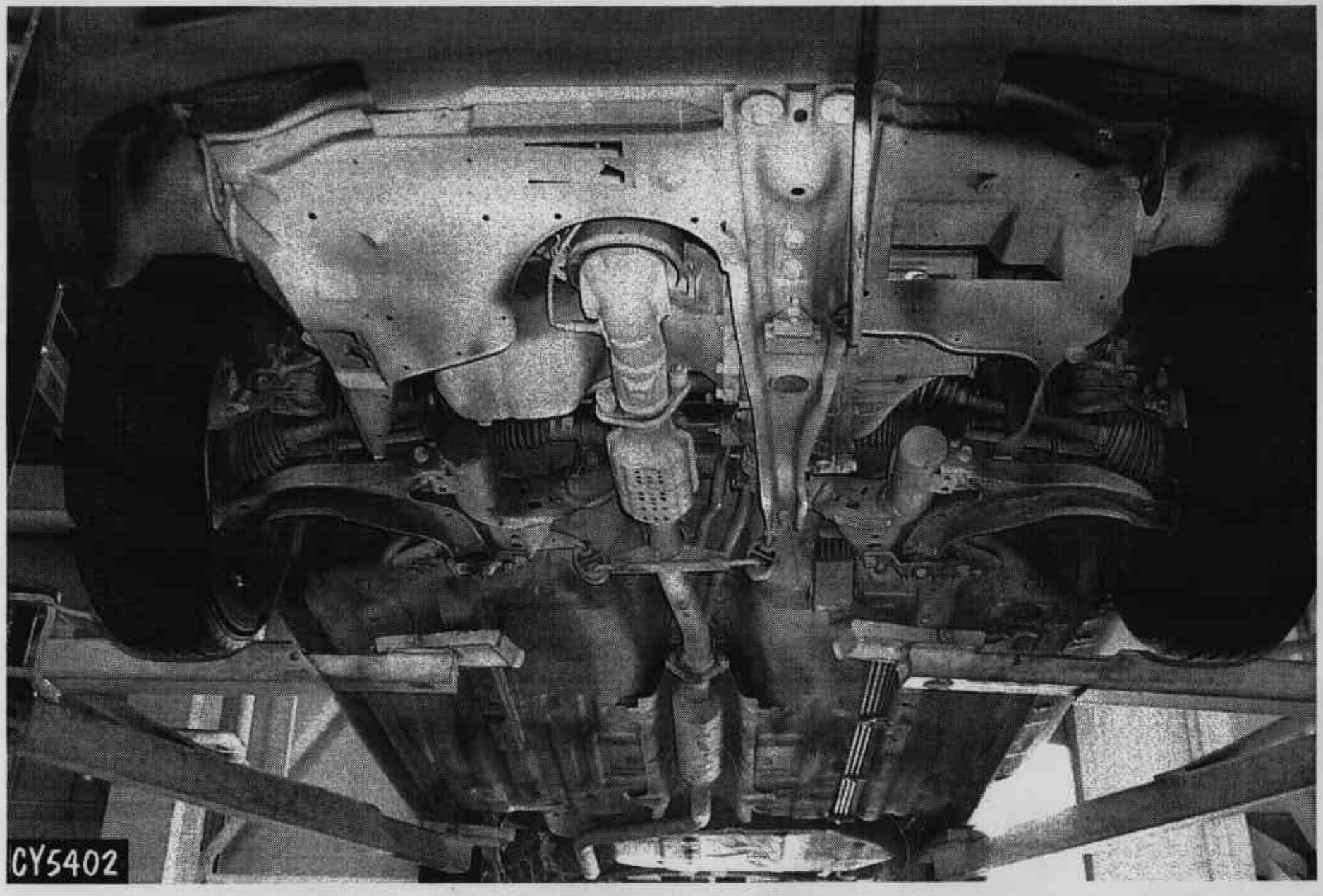



Figure A-13: PRE-TEST FRONT UNDERBODY VIEW


Figure A-14: POST-TEST FRONT UNDERBODY VIEW

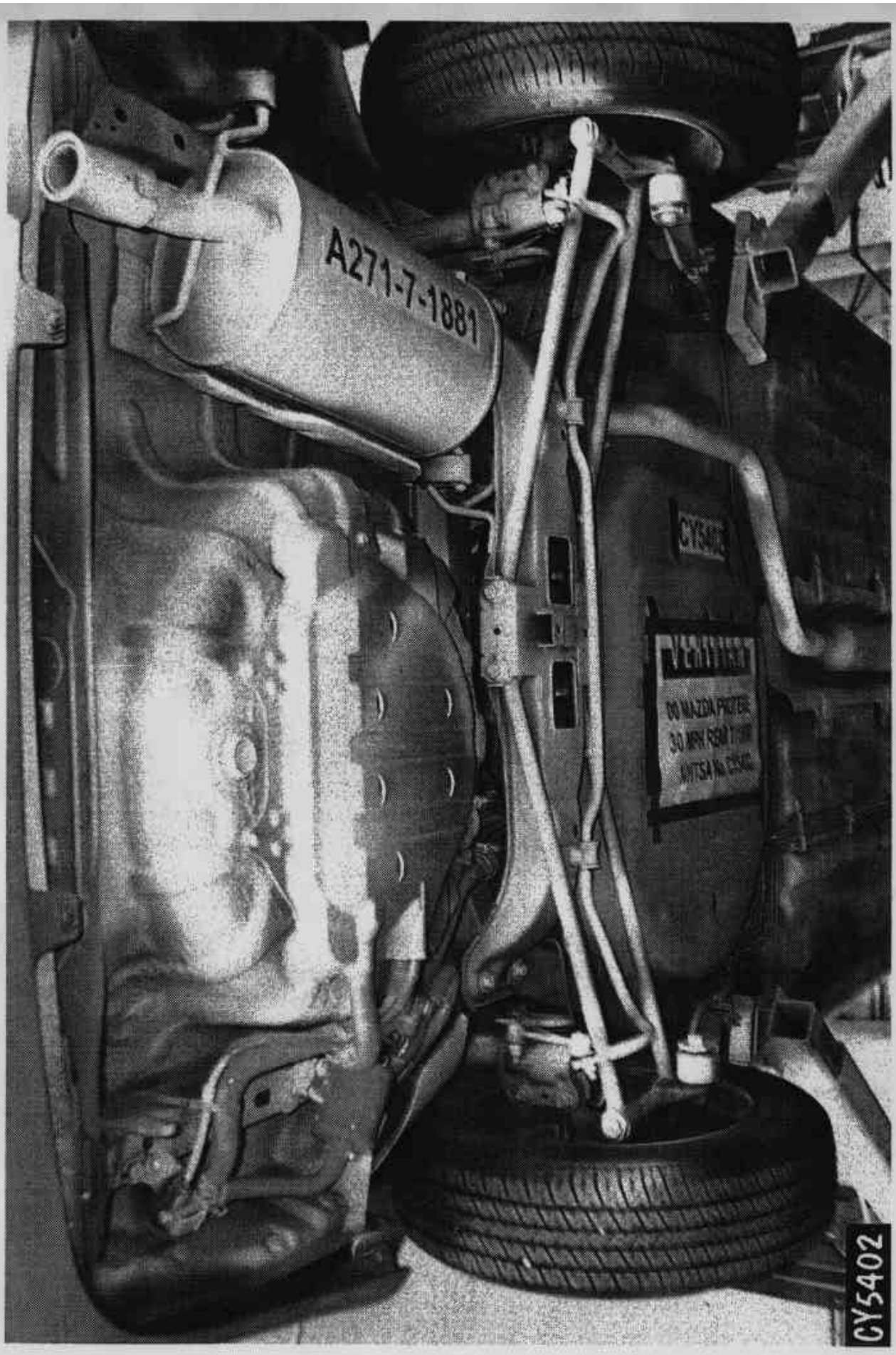



Figure A-15: PRE-TEST REAR UNDERBODY VIEW


Figure A-16: POST-TEST REAR UNDERBODY VIEW

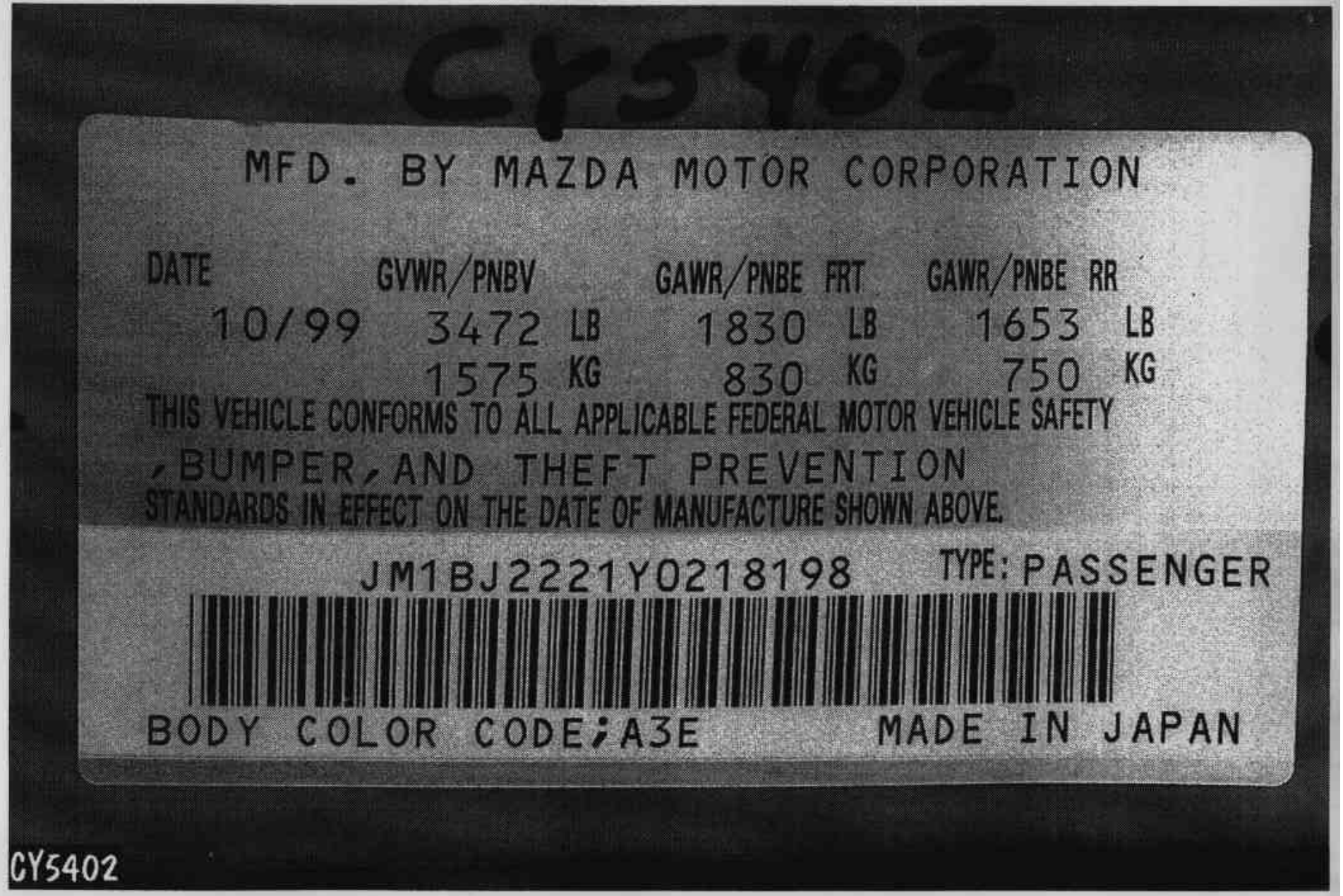



Figure A-17: CERTIFICATION PLACARD

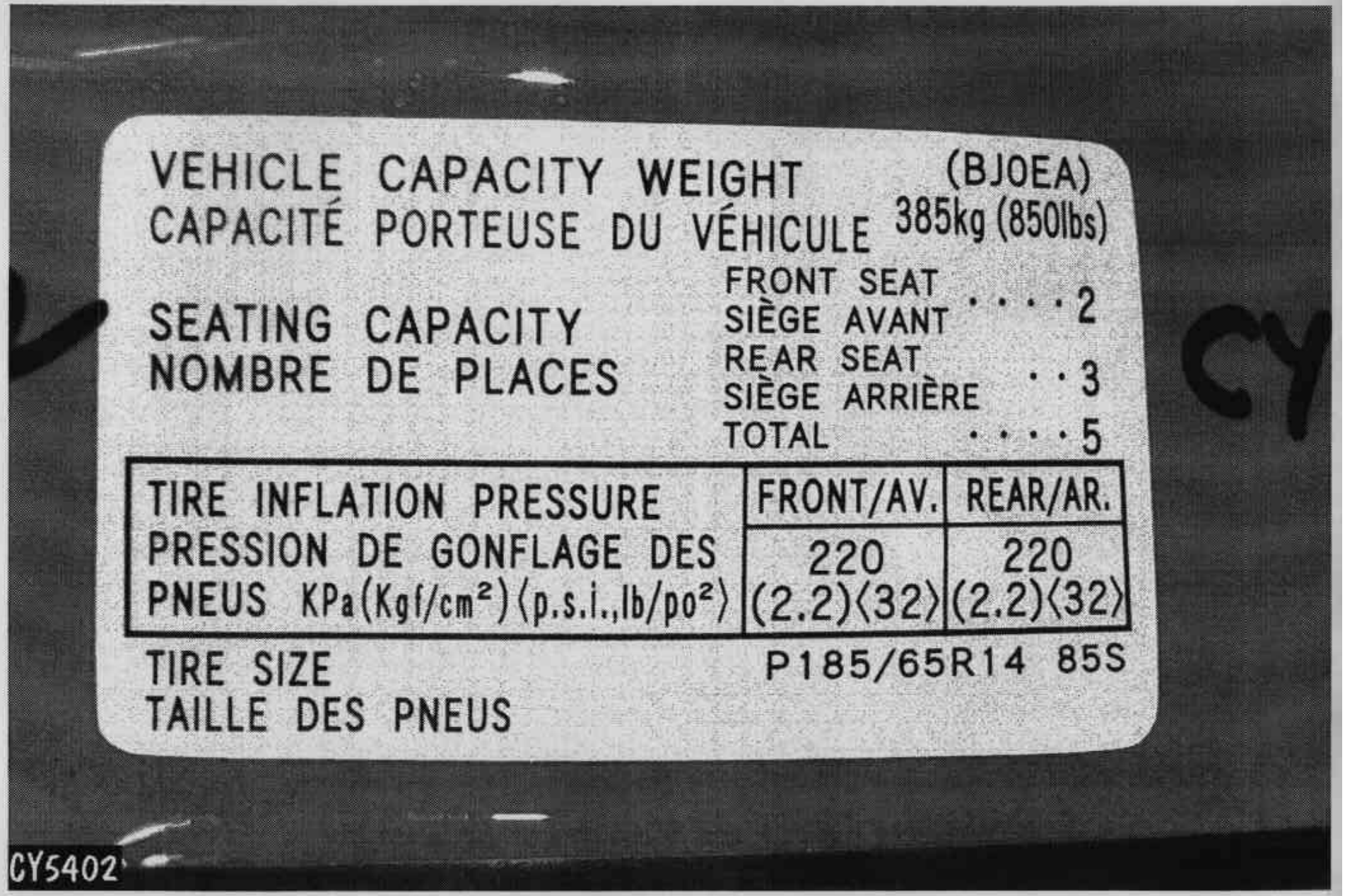



Figure A-18: TIRE PLACARD


Figure A-19: ROLLOVER 90°

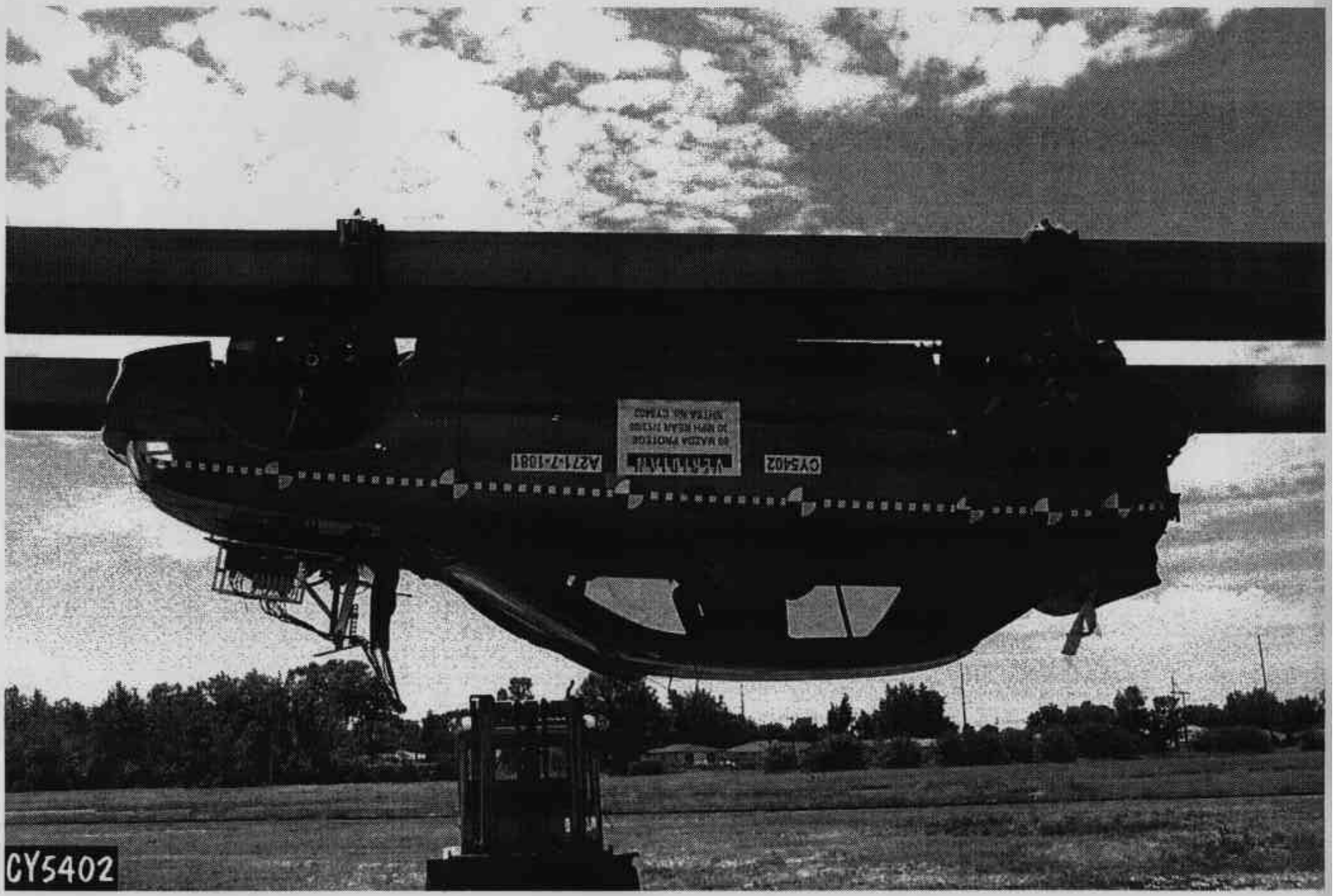



Figure A-20: ROLLOVER 180°

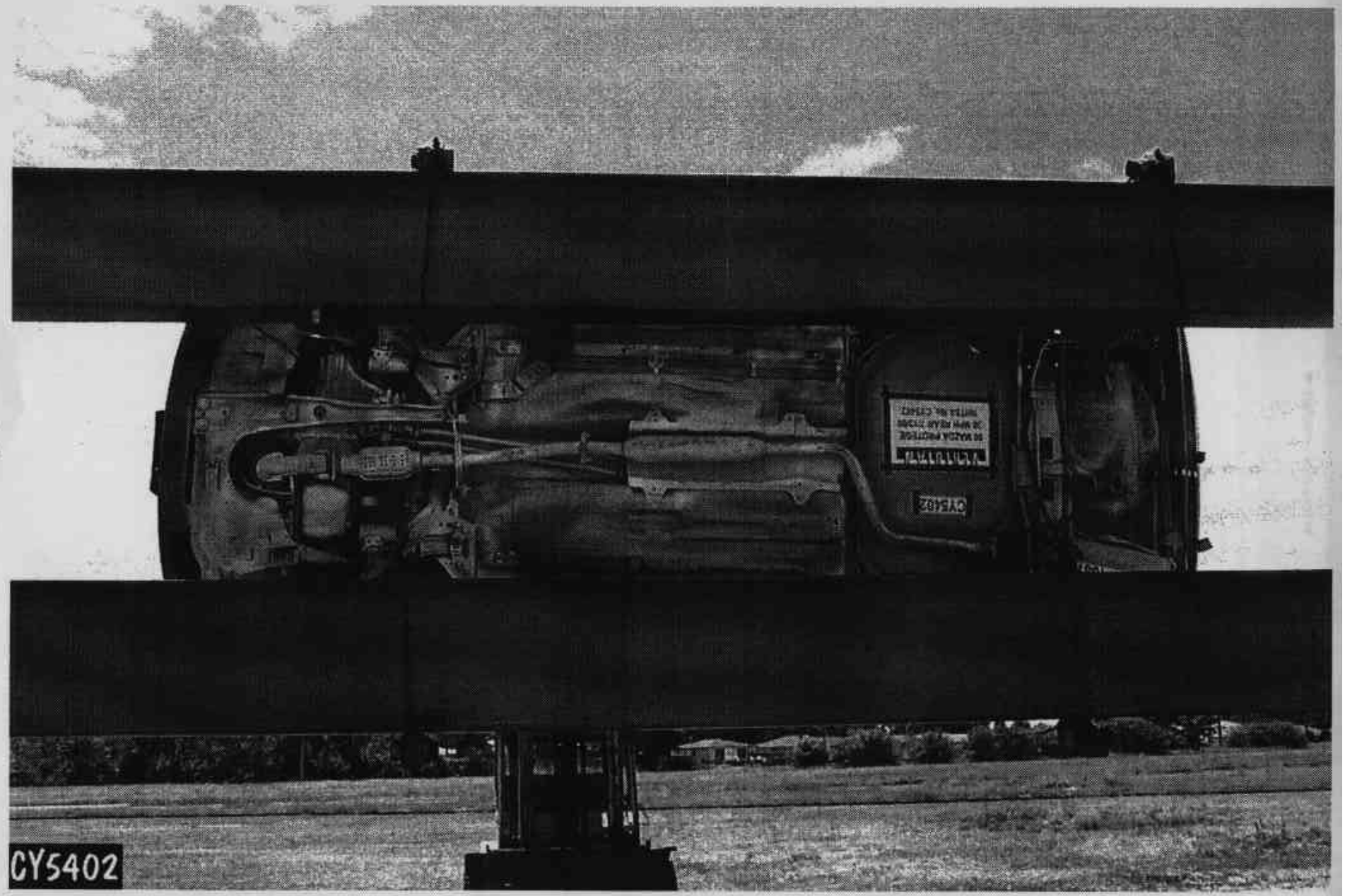



Figure A-21: ROLLOVER 270°

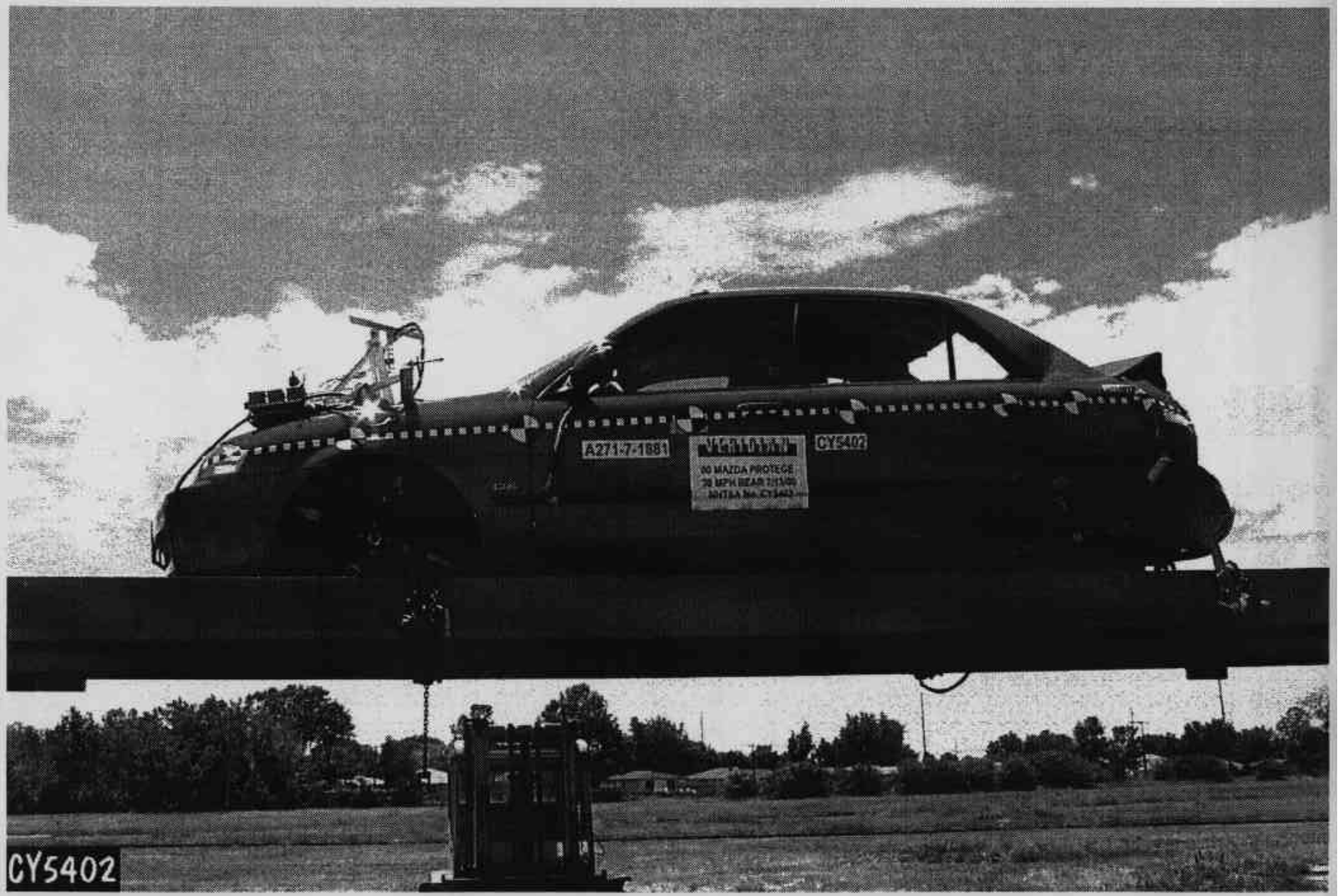



Figure A-22: ROLLOVER 360°

Appendix B

VEHICLE AND DUMMY RESPONSE DATA

(REAR IMPACT ONLY)

FACILITY: VERF DATE: July 13, 2000
TEST#: A271-7-1881
TITLE: NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege CY5402

| CHN | NAME | Unit | Max | msec | Min | msec | Filt | Comment |
|---|---|---|---|---|---|---|---|---|
| 26 | Acc #3 Upper Seatback X | g | 22.0 | 49.4 | -15.9 | 42.2 | CFC_60 | |
| 27 | Acc #4 Lower Seatback X | g | 21.3 | 8.2 | -4.1 | 19.1 | CFC_60 | |
| 31 | Acc #1 Left Rear Xmember X | g | 19.9 | 5.9 | -0.8 | 169.7 | CFC_60 | |
| 34 | Acc #2 Right Rear Xmember X | g | 21.9 | 5.6 | -0.9 | 147.9 | CFC_60 | |
| 37 | P1 Head x | g | 27.2 | 124.3 | -3.7 | 396.9 | CFC_1000 | |
| 38 | P1 Head y | g | 2.5 | 387.6 | -4.7 | 158.4 | CFC_1000 | |
| 39 | P1 Head z | g | 17.2 | 108.8 | -0.1 | -16.5 | CFC_1000 | |
| 40 | P1 Head Resultant | g | 28.7 | 123.1 | 0.0 | -32.3 | CFC_1000 | |
| 41 | P1 Upper Neck Fx | lbf | 34.6 | 393.4 | -53.2 | 125.3 | CFC_1000 | |
| 42 | P1 Upper Neck Fy | lbf | 24.9 | 142.0 | -20.9 | 388.9 | CFC_1000 | |
| 43 | P1 Upper Neck Fz | lbf | 0.6 | -26.7 | -239.9 | 108.8 | CFC_1000 | |
| 44 | P1 Upper Neck F Resultant | lbf | 240.8 | 108.8 | 0.0 | -18.5 | CFC_1000 | |
| 45 | P1 Upper Neck Mx | in-lb | 44.8 | 109.1 | -81.5 | 378.3 | CFC_600 | |
| 46 | P1 Upper Neck My | in-lb | 56.3 | 151.9 | -181.0 | 127.3 | CFC_600 | |
| 47 | P1 Upper Neck Mz | in-lb | 77.9 | 177.8 | -46.1 | 251.1 | CFC_600 | |
| 48 | P1 Upper Neck M Resultant | in-lb | 190.9 | 127.3 | 0.0 | -14.9 | CFC_600 | |
| 49 | P1 Chest x | g | 12.1 | 80.3 | -1.9 | 355.2 | CFC_180 | |
| 50 | P1 Chest y | g | 1.7 | 349.2 | -1.9 | 84.6 | CFC_180 | |
| 51 | P1 Chest z | g | 5.6 | 74.8 | -0.6 | 166.9 | CFC_180 | |
| 52 | P1 Chest Resultant | g | 13.0 | 79.0 | 0.0 | -29.2 | CFC_180 | |
| 53 | P1 Chest Compression | in | 0.0 | 203.0 | -0.0 | 104.8 | CFC_600 | |
| 54 | P1 Pelvic x | g | 17.5 | 74.6 | -1.9 | 142.3 | CFC_1000 | |
| 55 | P1 Pelvic y | g | 2.8 | 57.2 | -1.6 | 107.9 | CFC_1000 | |
| 56 | P1 Pelvic z | g | 9.0 | 59.8 | -1.8 | 176.2 | CFC_1000 | |
| 57 | P1 Pelvic Resultant | g | 19.1 | 67.1 | 0.0 | -27.4 | CFC_1000 | |
| 58 | P1 Lap Belt | lbf | 12.2 | 34.8 | -8.1 | 55.3 | CFC_60 | |
| 59 | P1 Belt Spoolout | in | 0.0 | 18.6 | -5.0 | 261.9 | CFC_180 | Transducer bottomed |

P1 HIC(36 ms): 107.5
t1: 103.8 msec
t2: 139.8 msec
Duration: 36.0 msec
Average Acceleration: 24.5 g
Input channels: P1 Head x (2) CFC_1000
P1 Head y (3) CFC_1000
P1 Head z (4) CFC_1000

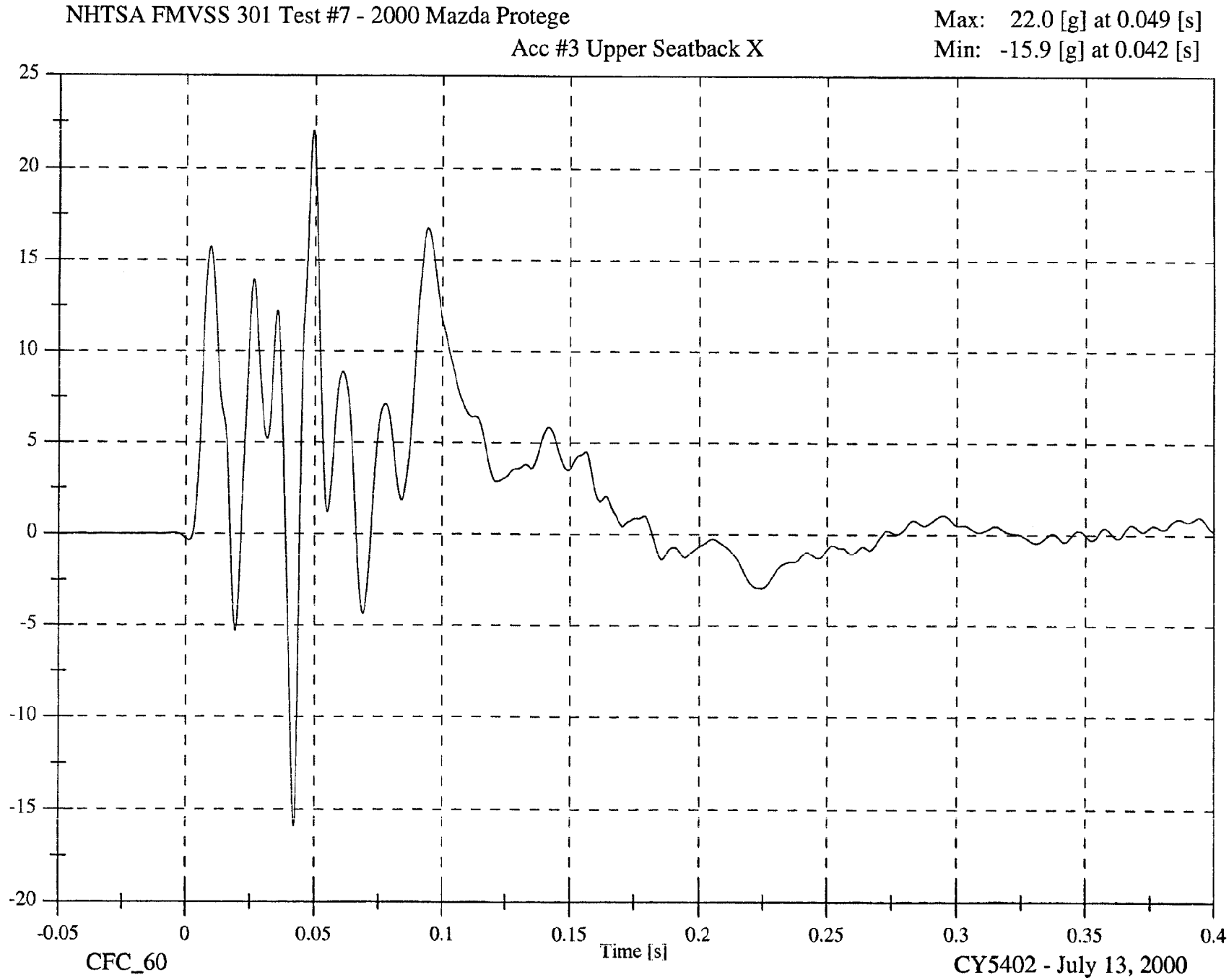
P1 CLIP(3 ms): 12.9 g
t1: 77.3 msec
t2: 80.3 msec
Duration: 3.0 msec
P1 CSI: 29.5
Input channels: P1 Chest x (11) CFC_180
P1 Chest y (12) CFC_180
P1 Chest z (13) CFC_180

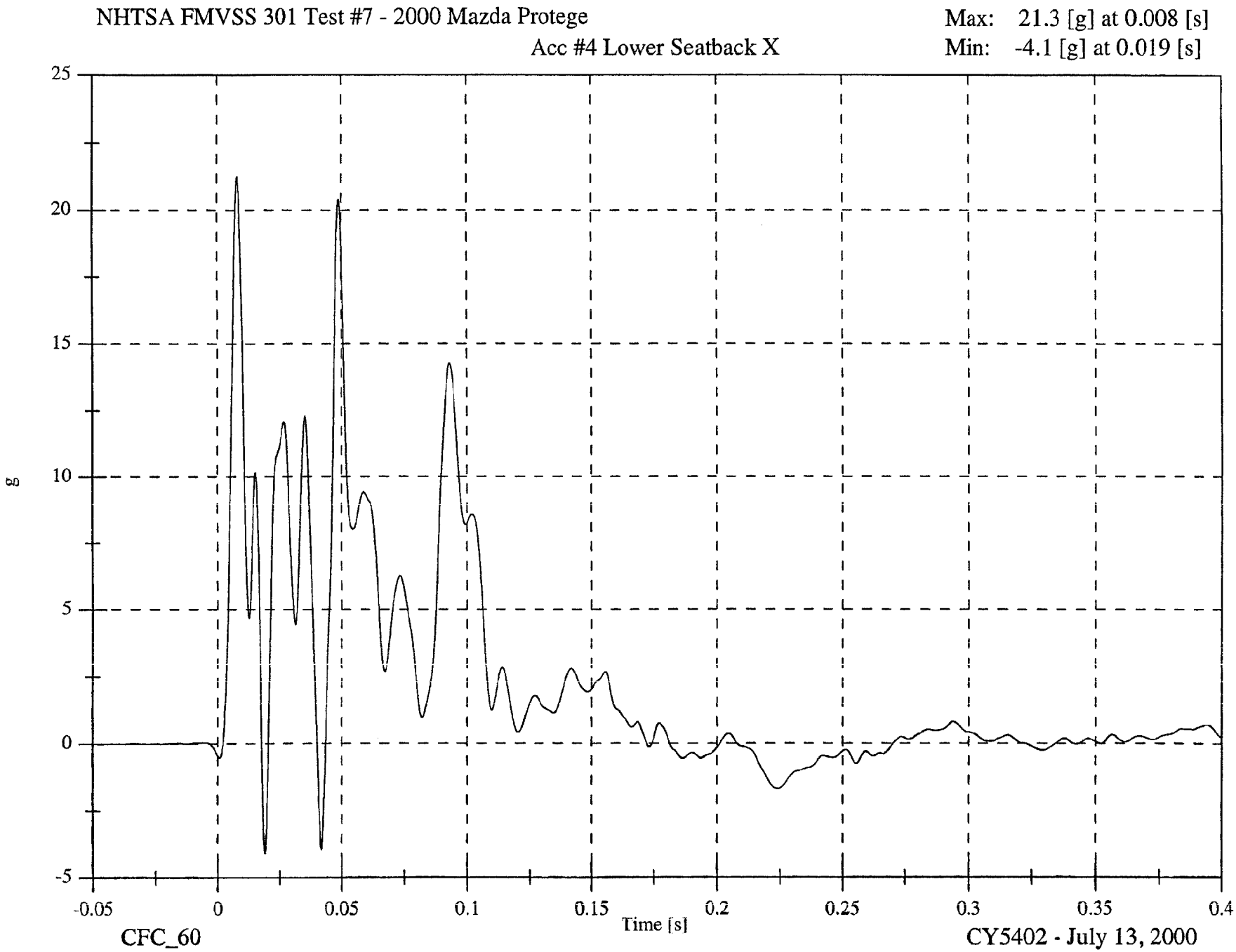
P1 CHEST DISP: Max: 0.0 in 203.0 msec
Min: -0.0 in 104.8 msec
Input channel: P1 Chest Compression (14) CFC_600

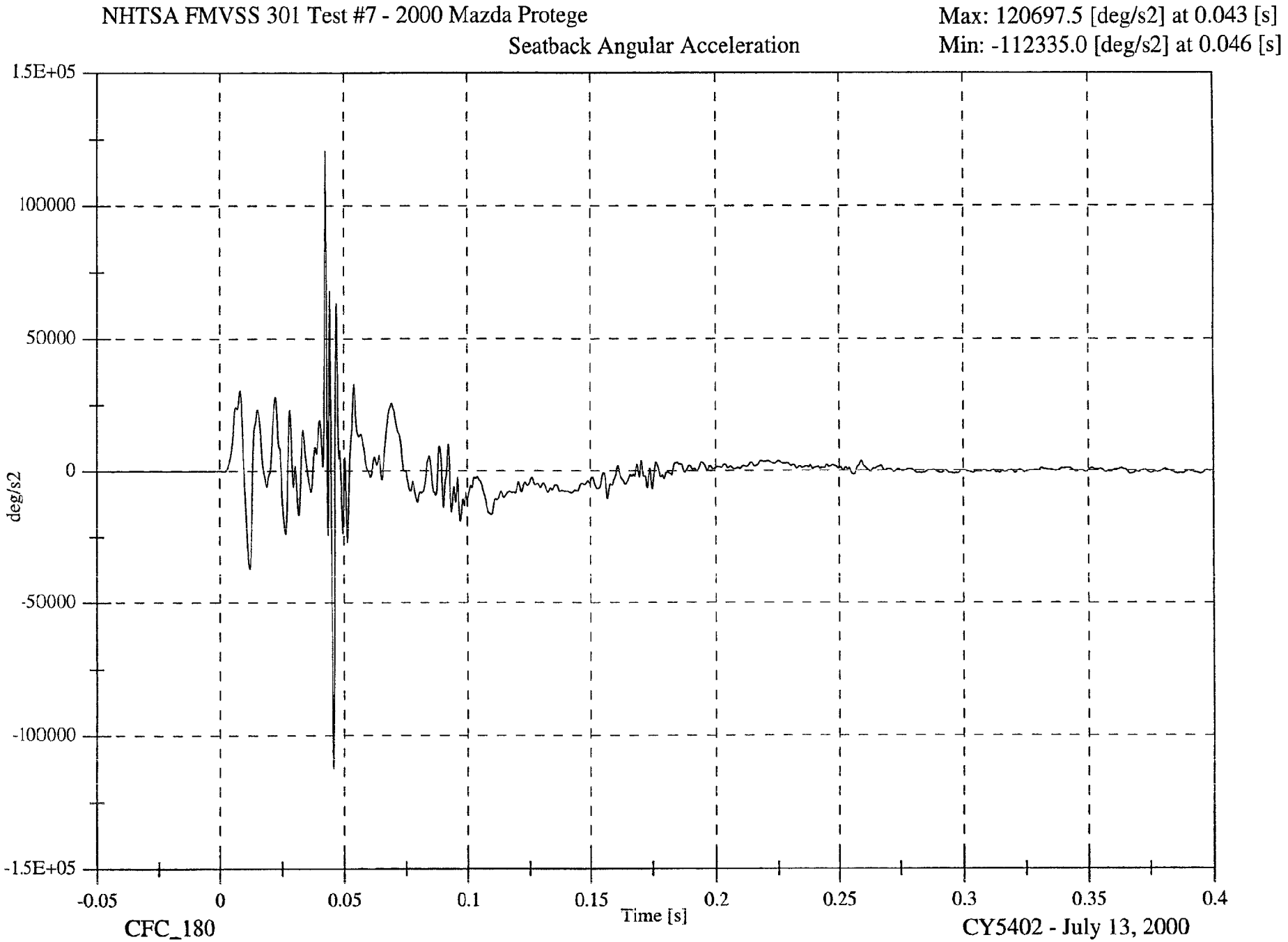
TEST NO. CY5402

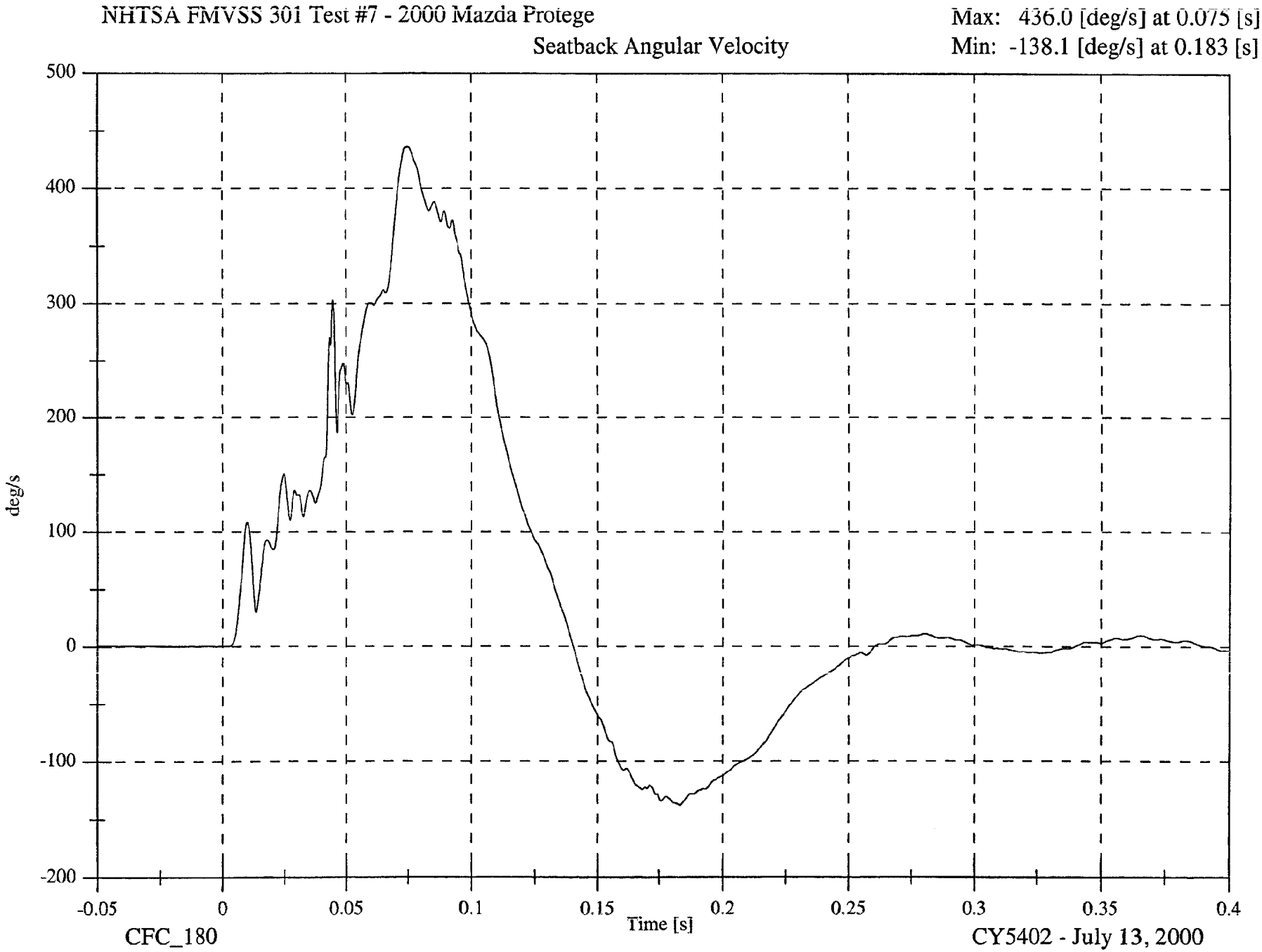
| VEHICLE | SAE FILTER CHANNEL CLASS |
| --- | --- |
| | 60 |

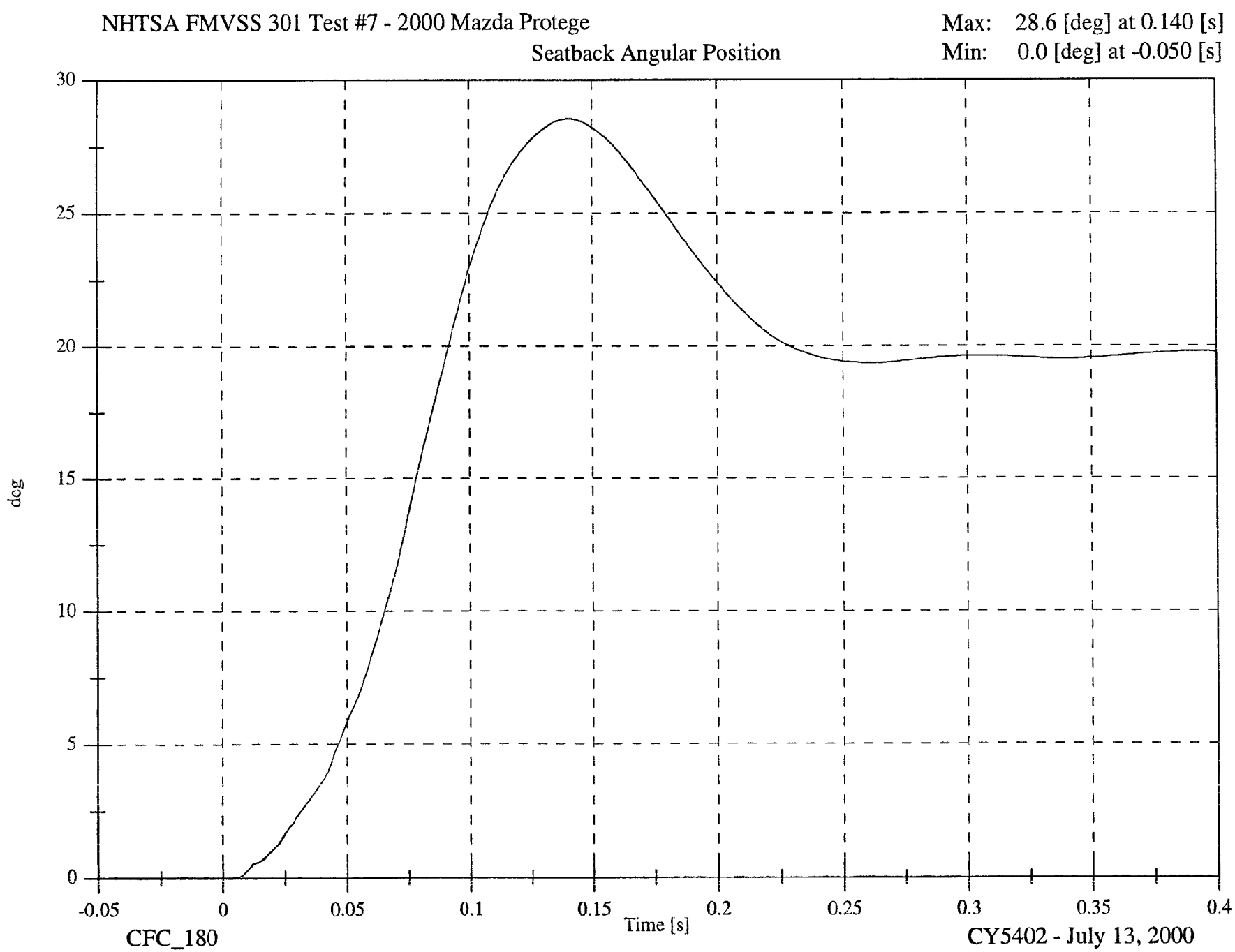
Note: Angular seatback position is measured in degrees of rotation from the initial (design) position.

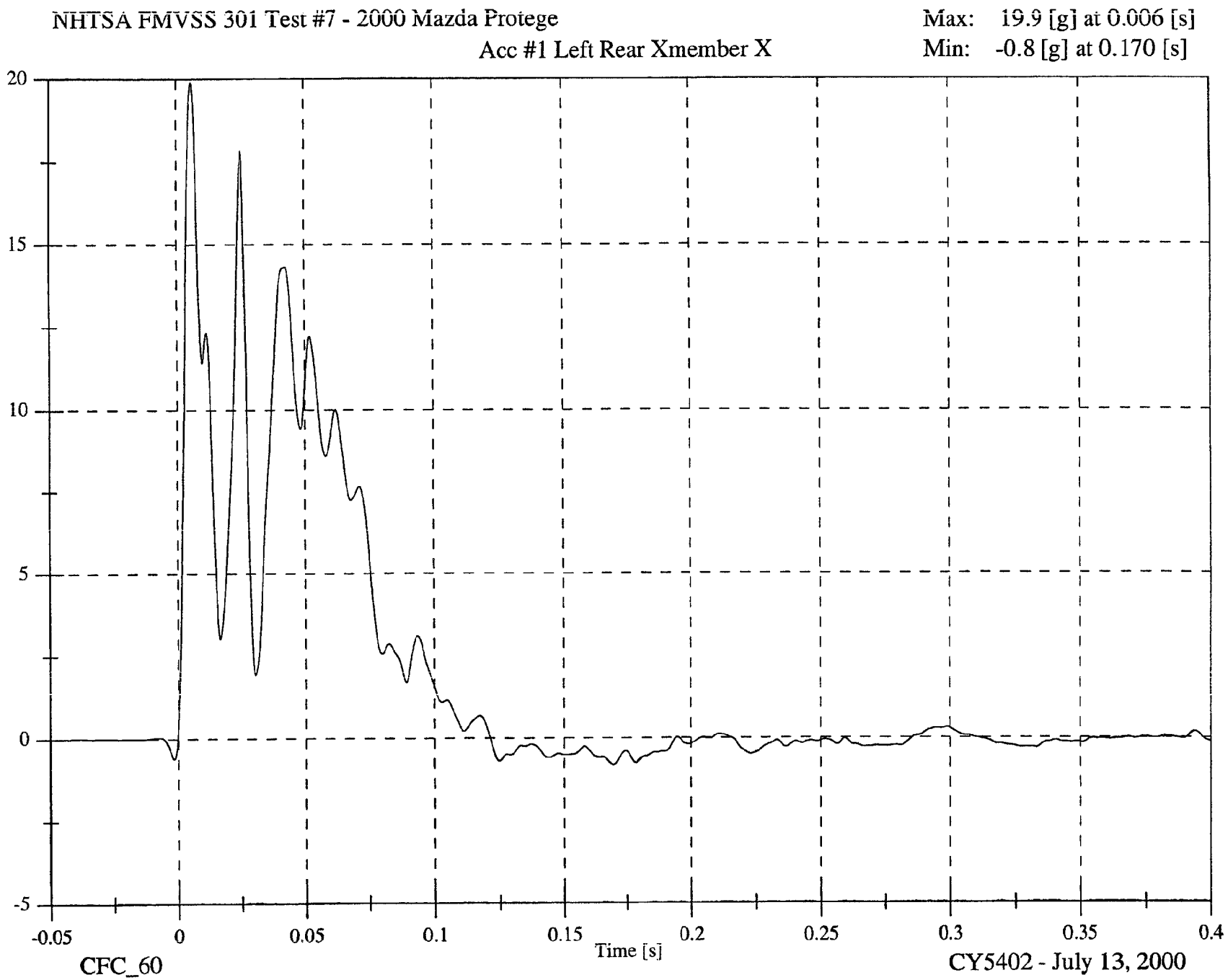

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
Acc #3 Upper Seatback X
Max: 22.0 [g] at 0.049 [s]
Min: -15.9 [g] at 0.042 [s]
25
20
15
10
5
0
-5
-10
-15
-20
g
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_60
CY5402 - July 13, 2000

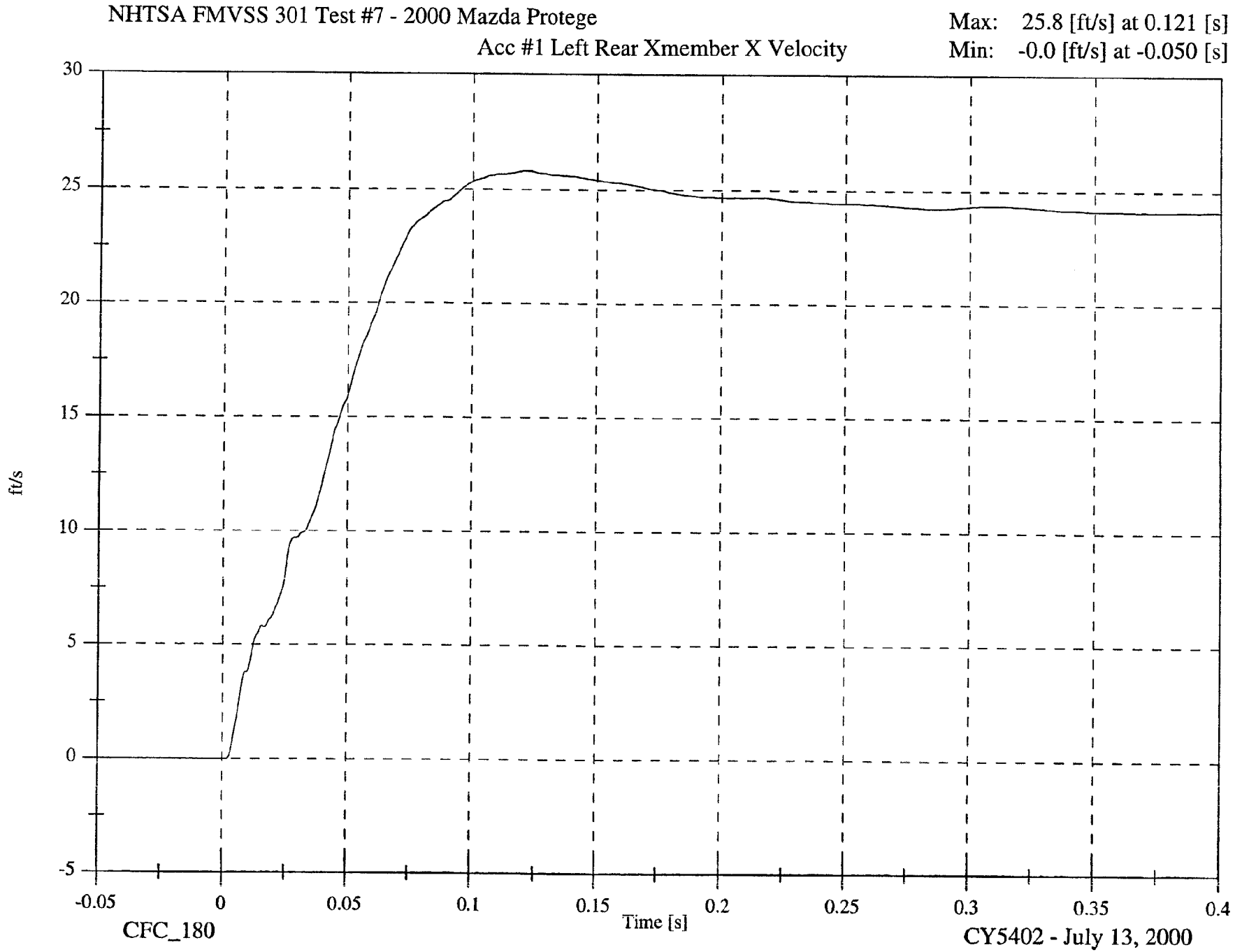

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
Acc #4 Lower Seatback X
Max: 21.3 [g] at 0.008 [s]
Min: -4.1 [g] at 0.019 [s]
25
20
15
10
5
0
-5
g
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_60
CY5402 - July 13, 2000


NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
Seatback Angular Acceleration
Max: 120697.5 [deg/s2] at 0.043 [s]
Min: -112335.0 [deg/s2] at 0.046 [s]
1.5E+05
100000
50000
0
-50000
-100000
-1.5E+05
deg/s2
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_180
CY5402 - July 13, 2000

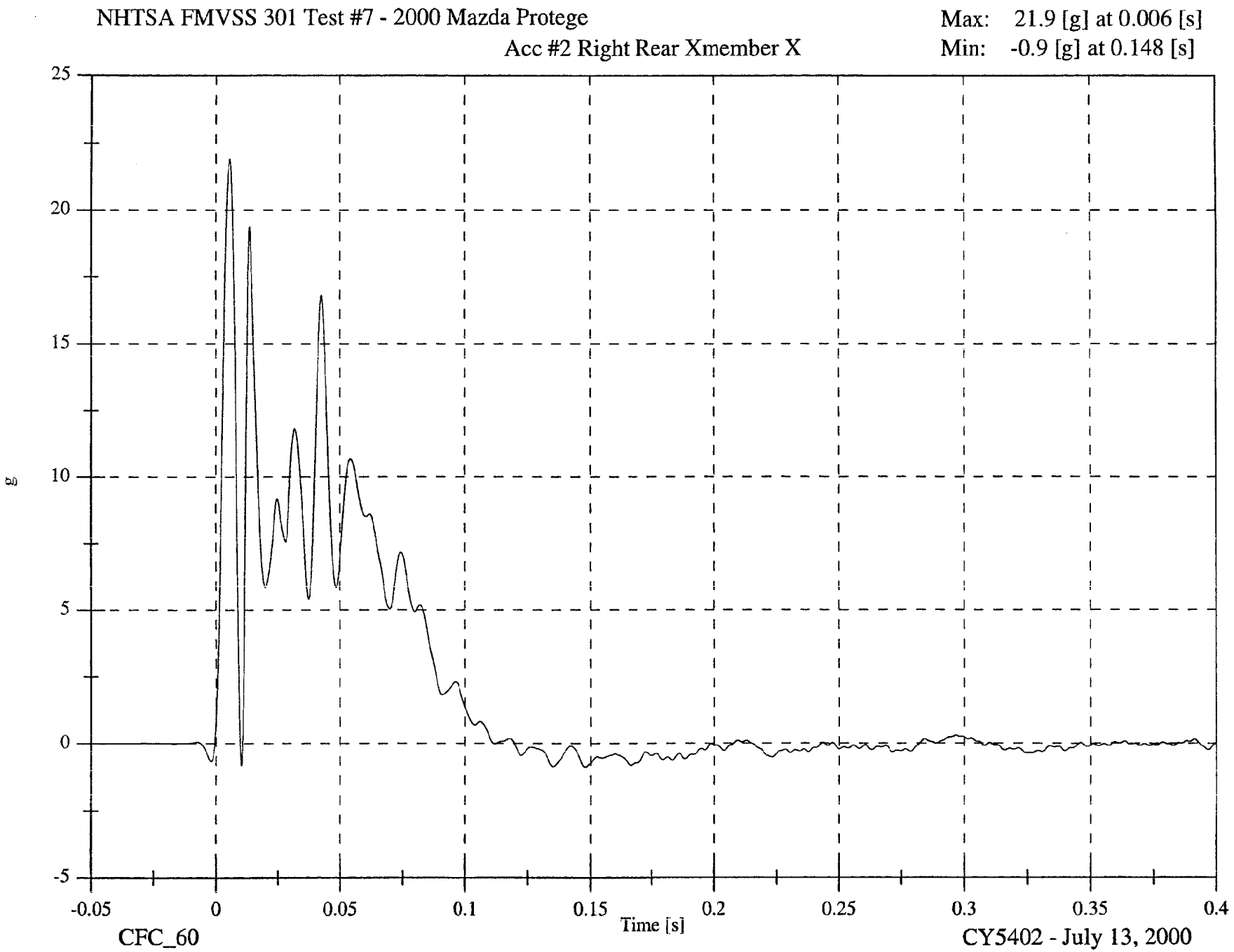

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
Seatback Angular Velocity
Max: 436.0 [deg/s] at 0.075 [s]
Min: -138.1 [deg/s] at 0.183 [s]
500
400
300
200
100
0
-100
-200
deg/s
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_180
CY5402 - July 13, 2000

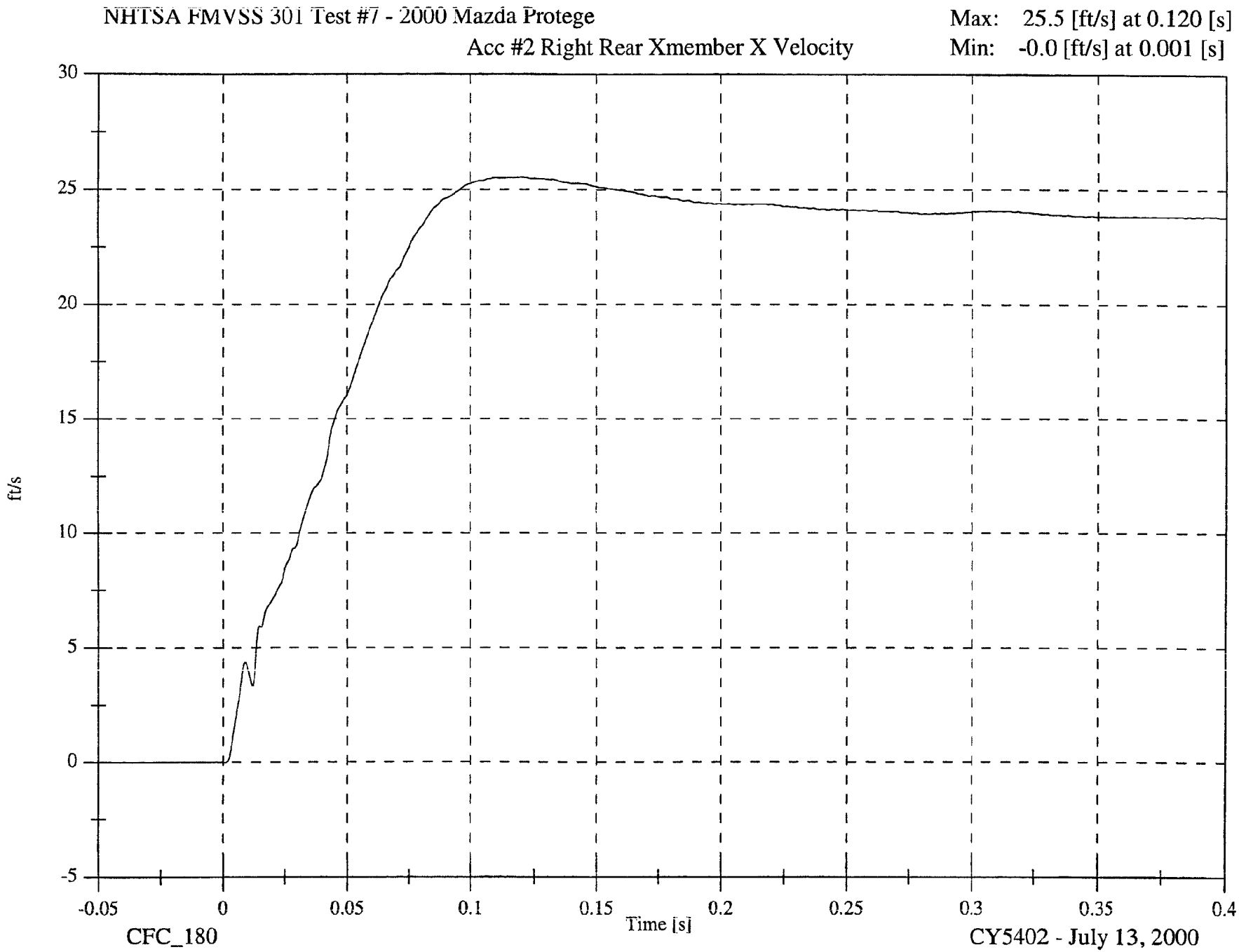

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
Seatback Angular Position
Max: 28.6 [deg] at 0.140 [s]
Min: 0.0 [deg] at -0.050 [s]
30
25
20
15
10
5
0
deg
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_180
CY5402 - July 13, 2000

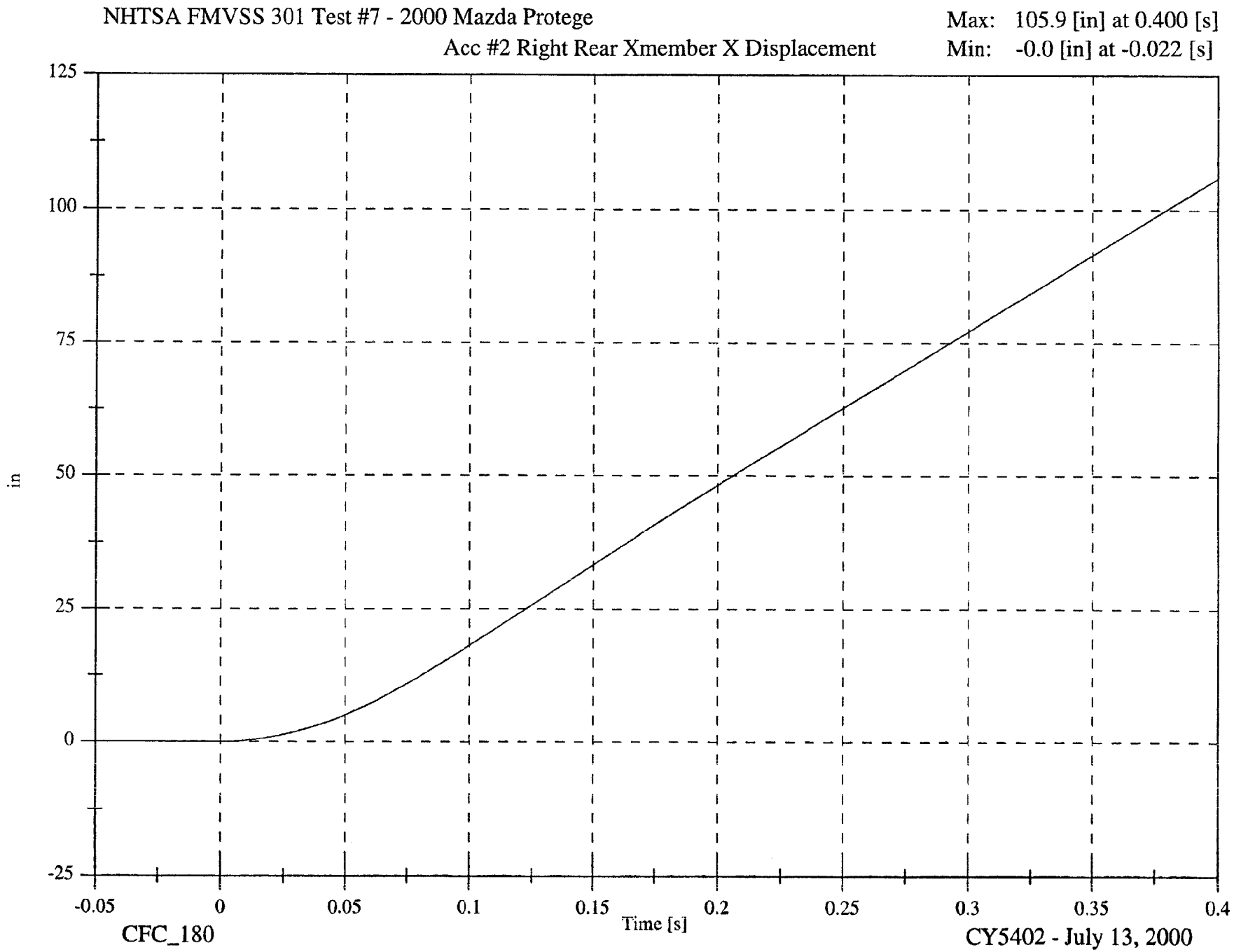

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
Acc #1 Left Rear Xmember X
Max: 19.9 [g] at 0.006 [s]
Min: -0.8 [g] at 0.170 [s]
20
15
10
5
0
-5
g
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_60
CY5402 - July 13, 2000


NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
Acc #1 Left Rear Xmember X Velocity
Max: 25.8 [ft/s] at 0.121 [s]
Min: -0.0 [ft/s] at -0.050 [s]
30
25
20
15
10
5
0
-5
ft/s
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_180
CY5402 - July 13, 2000


NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
Acc #1 Left Rear Xmember X Displacement
Max: 106.9 [in] at 0.400 [s]
Min: -0.0 [in] at -0.010 [s]
125
100
75
50
25
0
-25
in
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_180
CY5402 - July 13, 2000

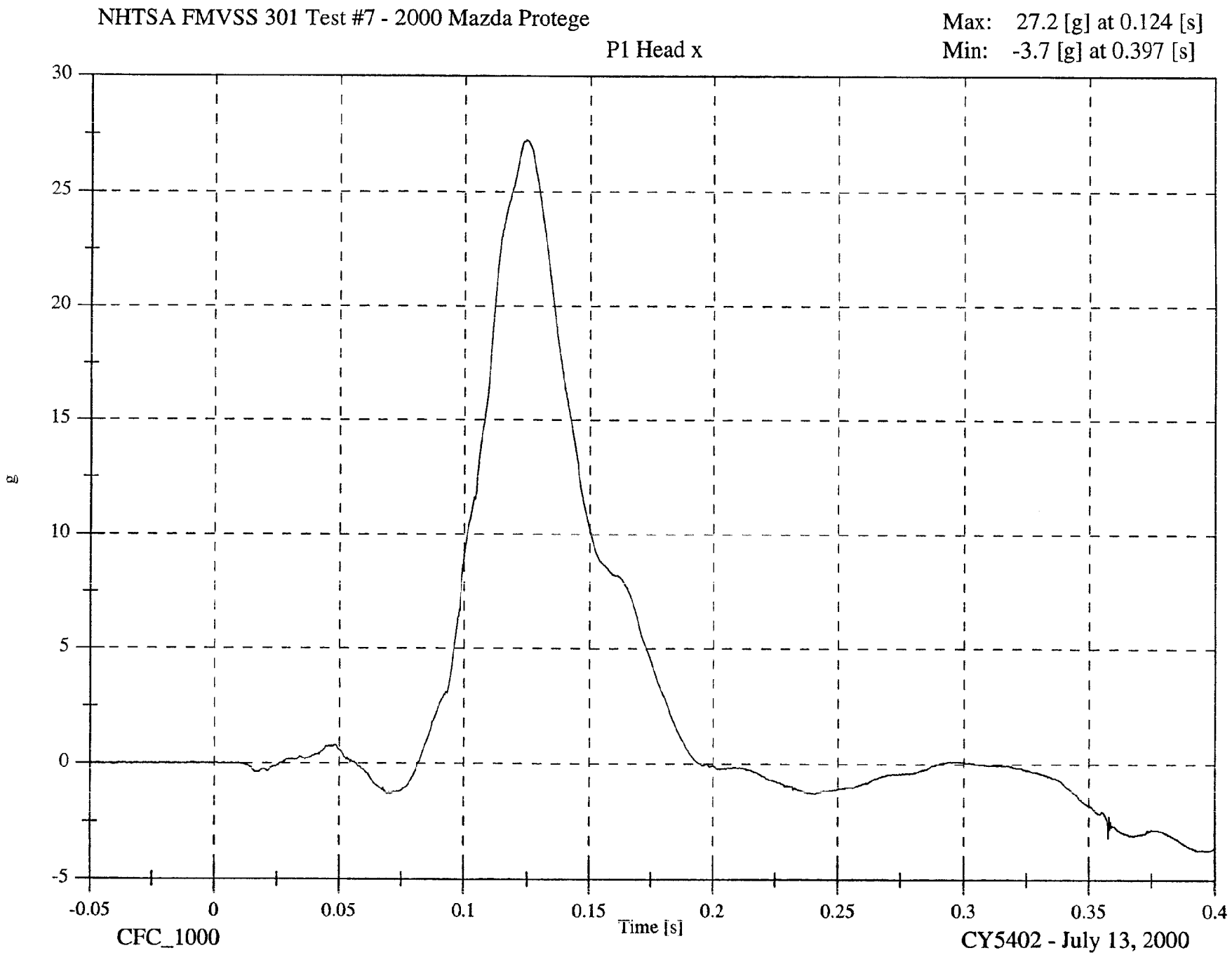

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
Acc #2 Right Rear Xmember X
Max: 21.9 [g] at 0.006 [s]
Min: -0.9 [g] at 0.148 [s]
25
20
15
10
5
0
-5
g
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_60
CY5402 - July 13, 2000

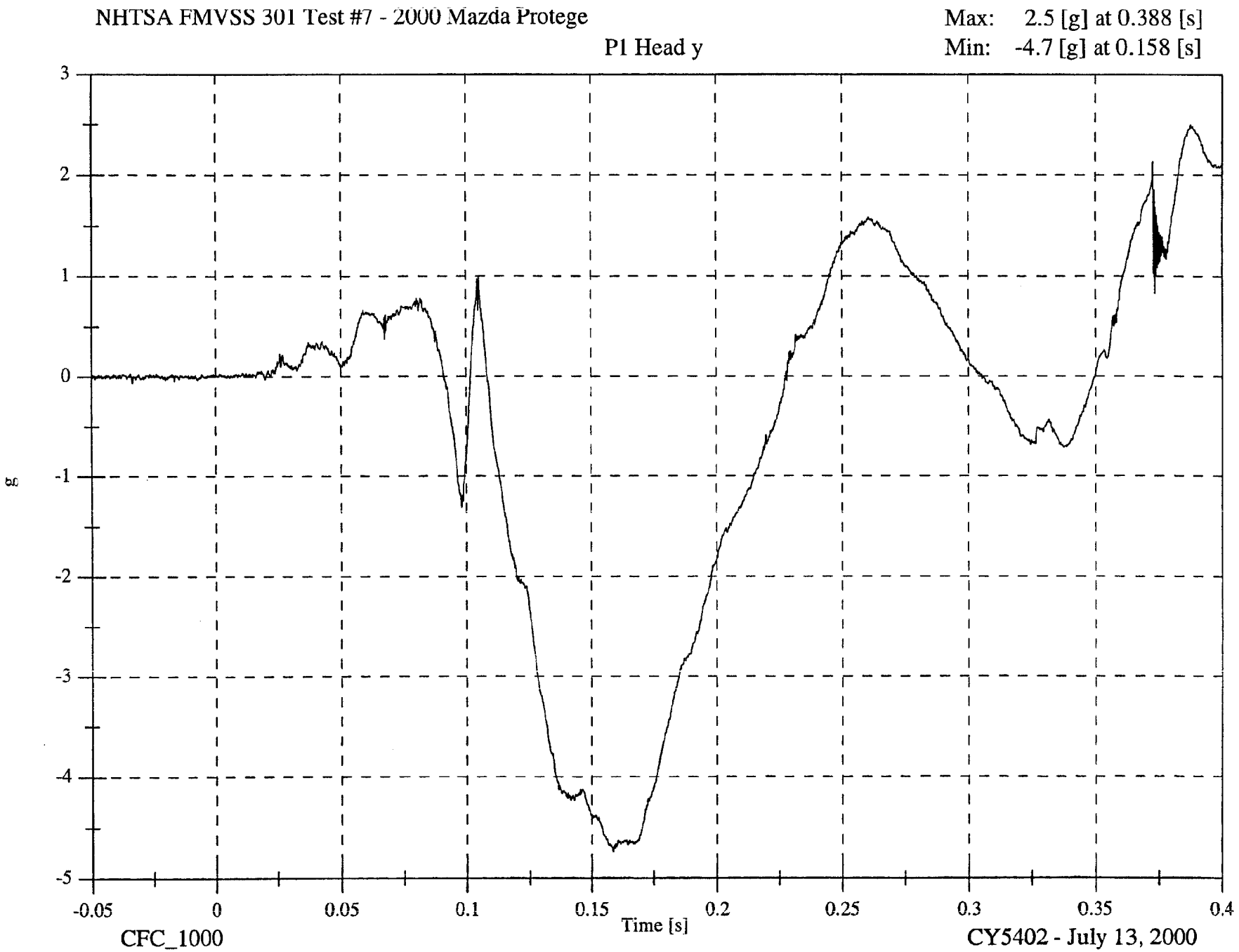

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
Acc #2 Right Rear Xmember X Velocity
Max: 25.5 [ft/s] at 0.120 [s]
Min: -0.0 [ft/s] at 0.001 [s]
30
25
20
15
10
5
0
-5
ft/s
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_180
CY5402 - July 13, 2000

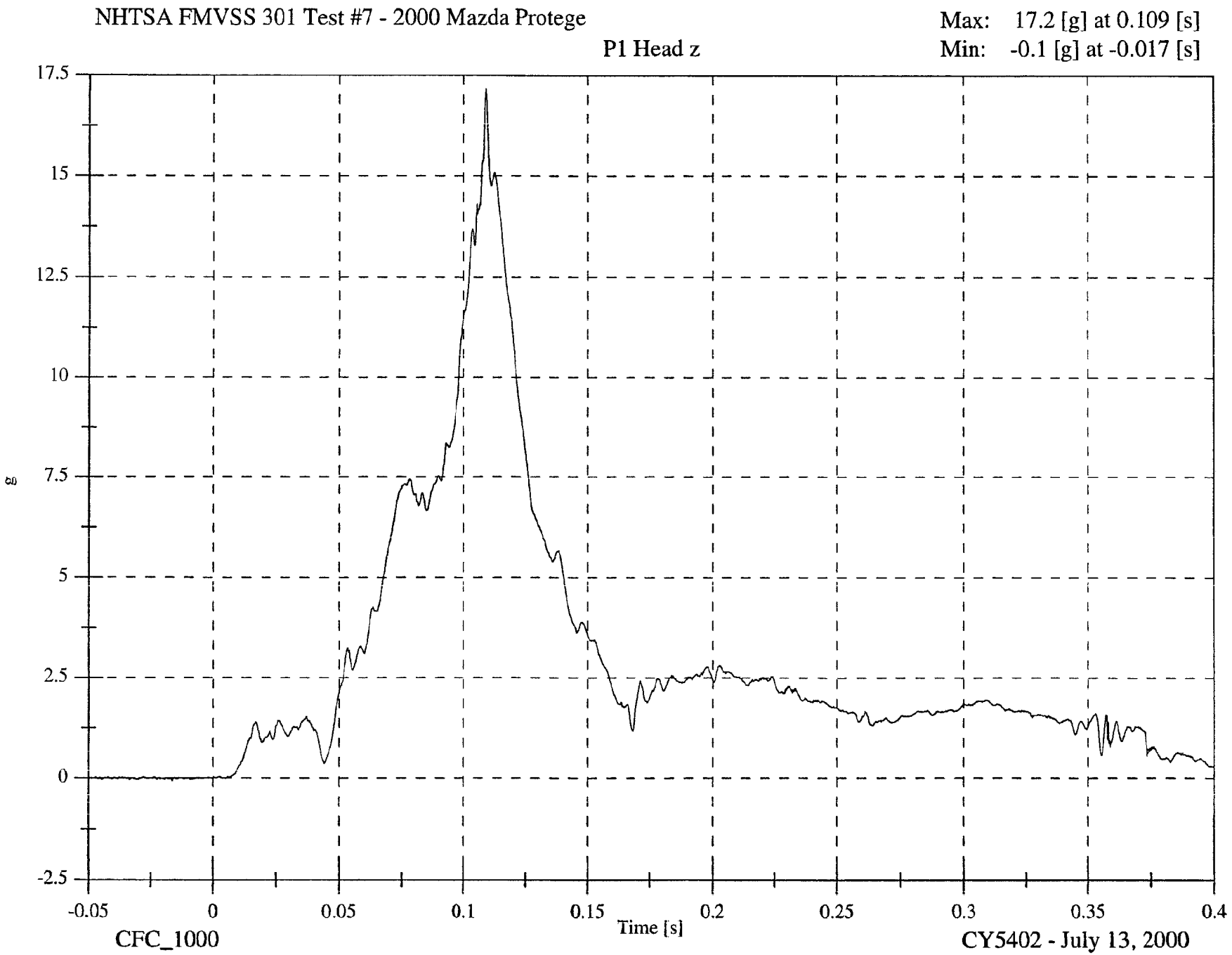

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
Acc #2 Right Rear Xmember X Displacement
Max: 105.9 [in] at 0.400 [s]
Min: -0.0 [in] at -0.022 [s]
125
100
75
50
25
0
-25
in
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_180
CY5402 - July 13, 2000

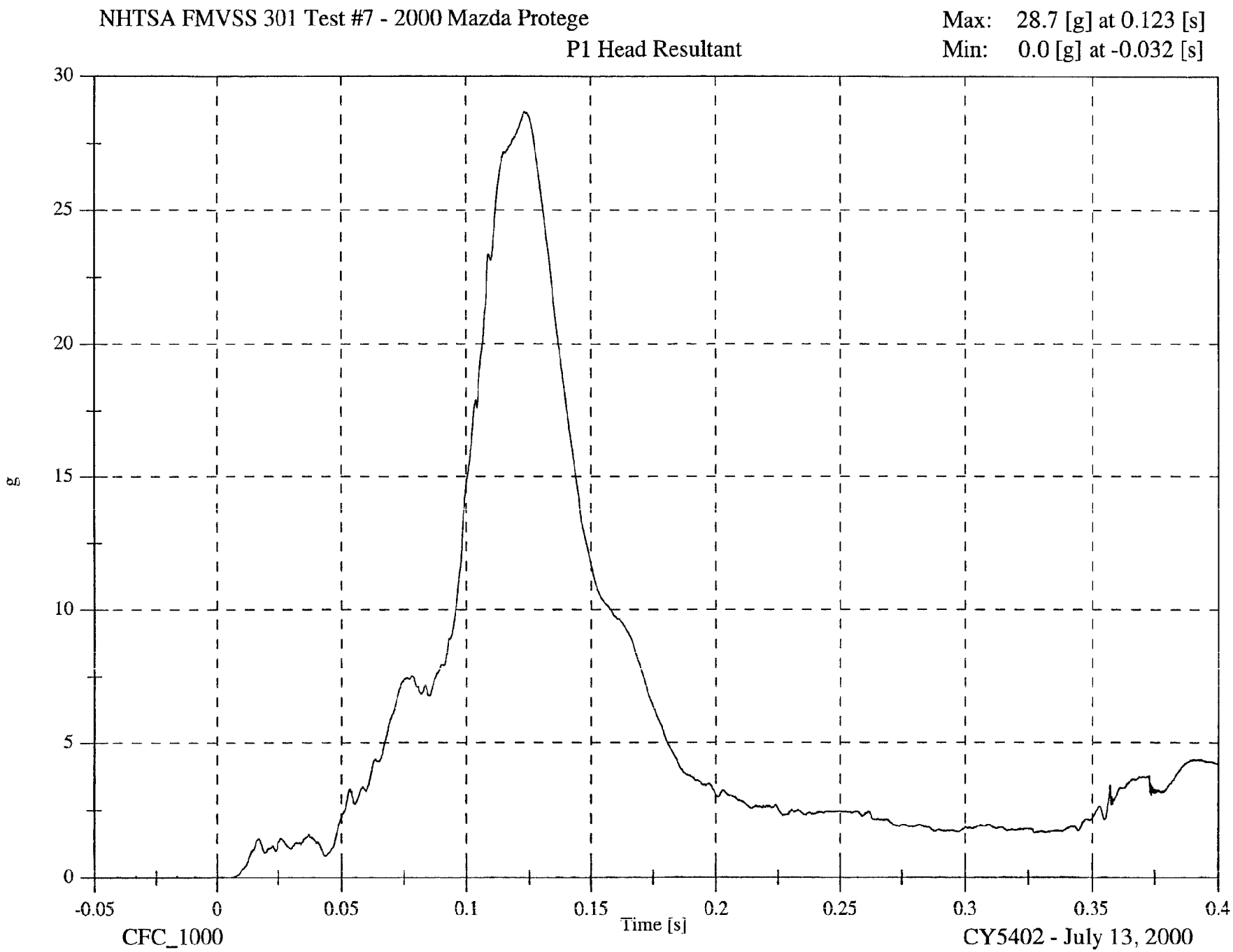
TEST NO. CY5402

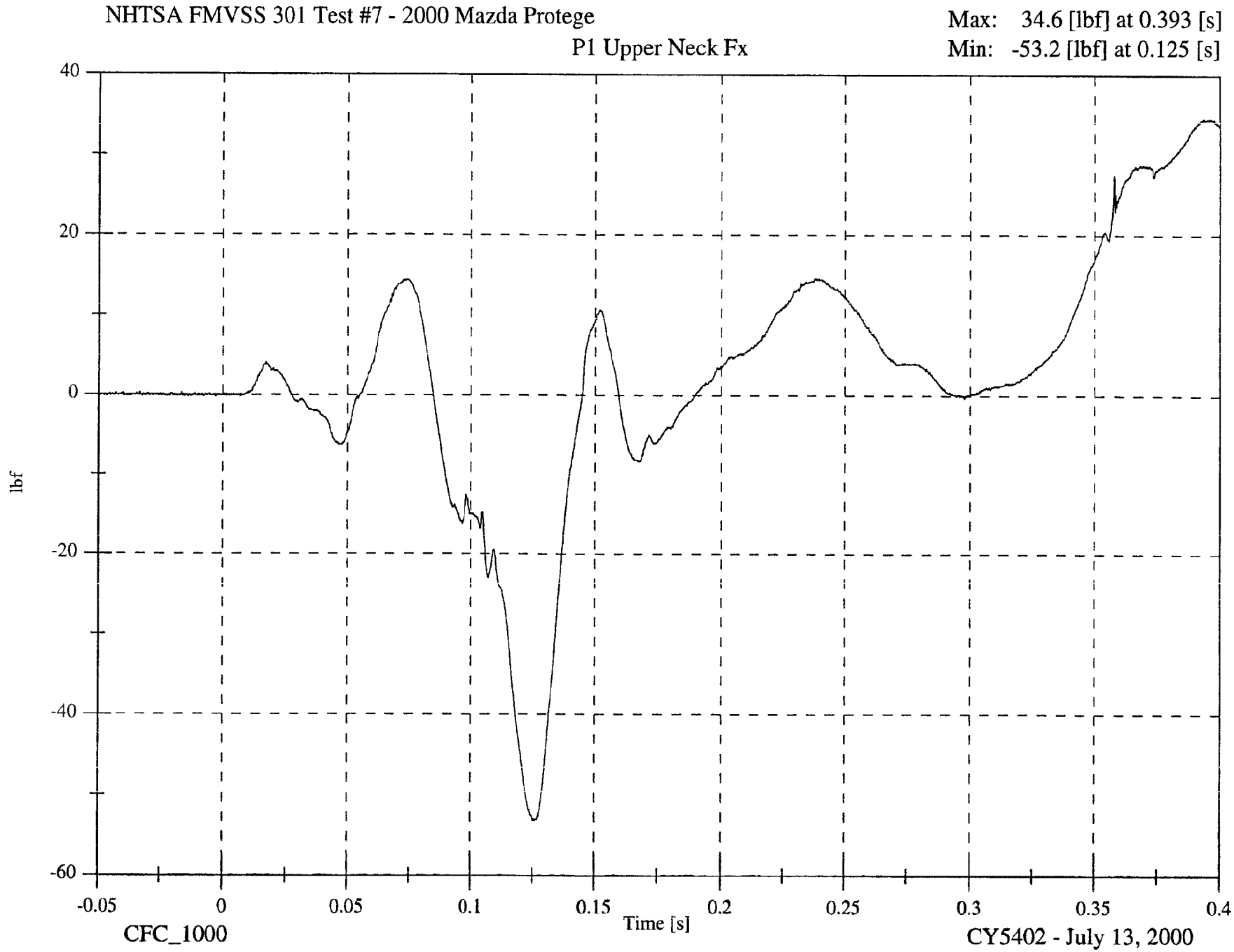
| DRIVER DUMMY (Pos. 1) | SAE FILTER CHANNEL CLASS |
|---|---|
| Head Accelerations | 1000 |
| Chest Accelerations | 180 |
| Pelvic Accelerations | 1000 |
| Upper Neck Forces | 1000 |
| Upper Neck Moments | 600 |
| Belt Forces | 60 |
| Belt Spoolout | 60 |

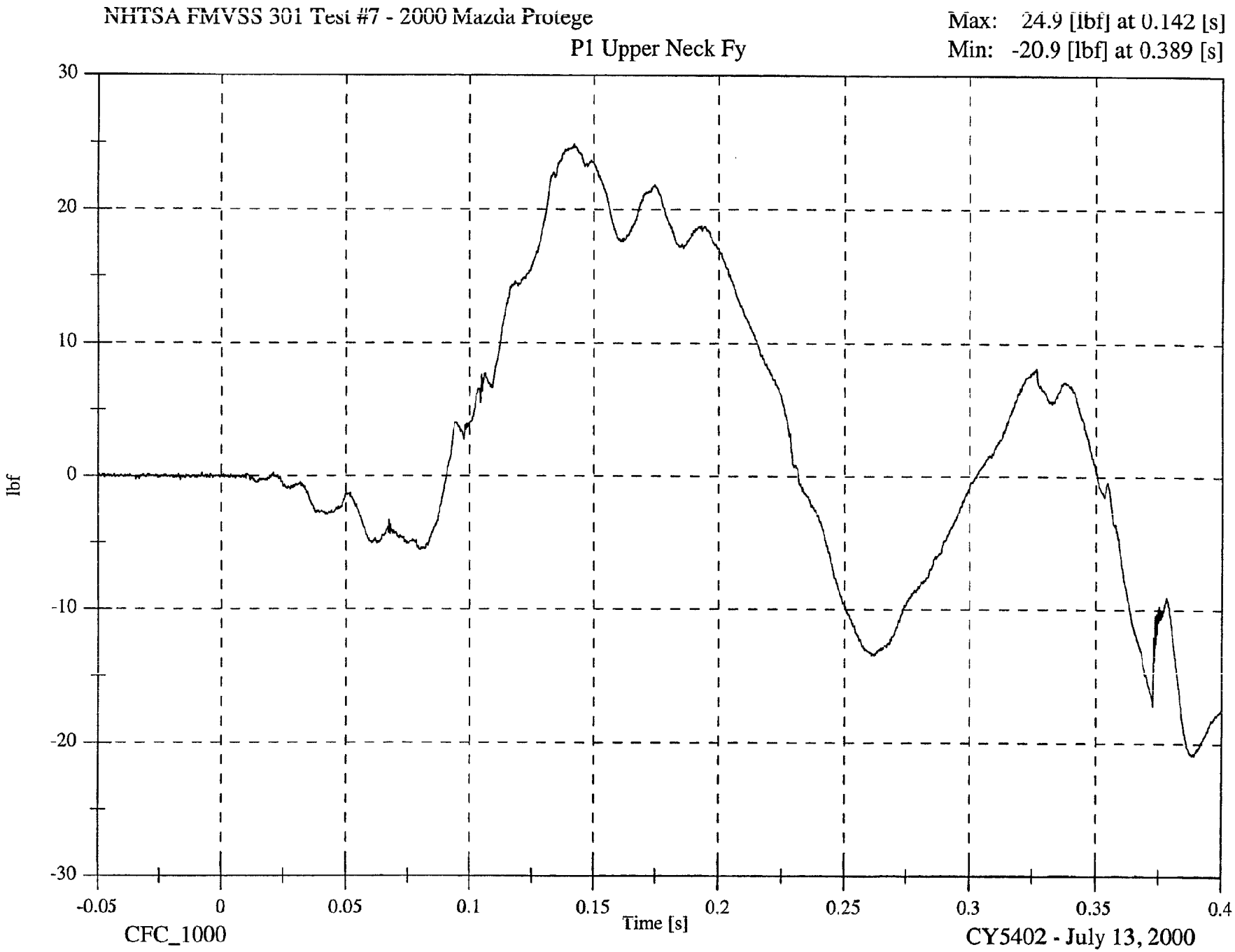

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Head x
Max: 27.2 [g] at 0.124 [s]
Min: -3.7 [g] at 0.397 [s]
30
25
20
15
10
5
0
-5
g
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_1000
CY5402 - July 13, 2000

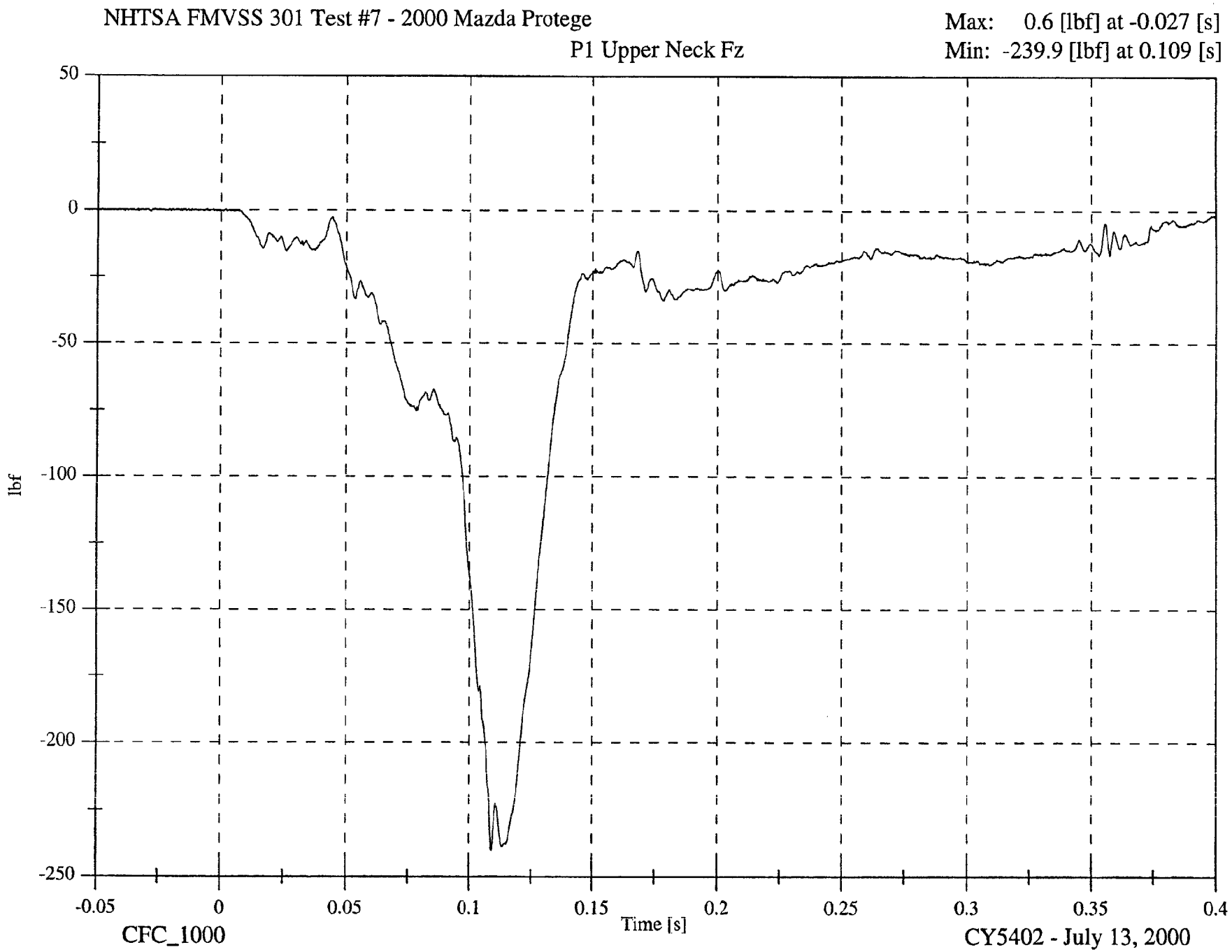

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Head y
Max: 2.5 [g] at 0.388 [s]
Min: -4.7 [g] at 0.158 [s]
g
Time [s]
CFC_1000
CY5402 - July 13, 2000

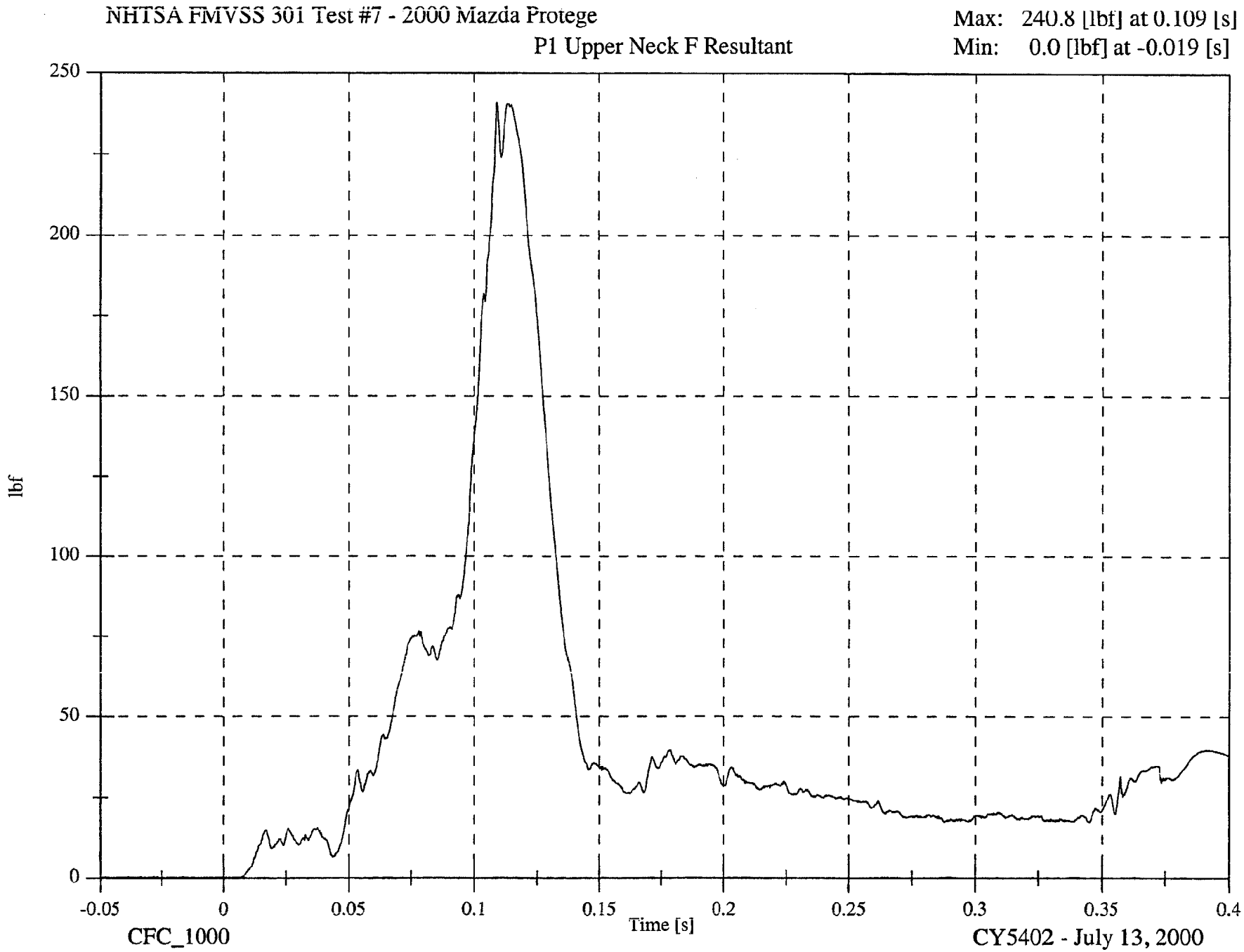

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Head z
Max: 17.2 [g] at 0.109 [s]
Min: -0.1 [g] at -0.017 [s]
17.5
15
12.5
10
7.5
5
2.5
0
-2.5
g
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_1000
CY5402 - July 13, 2000

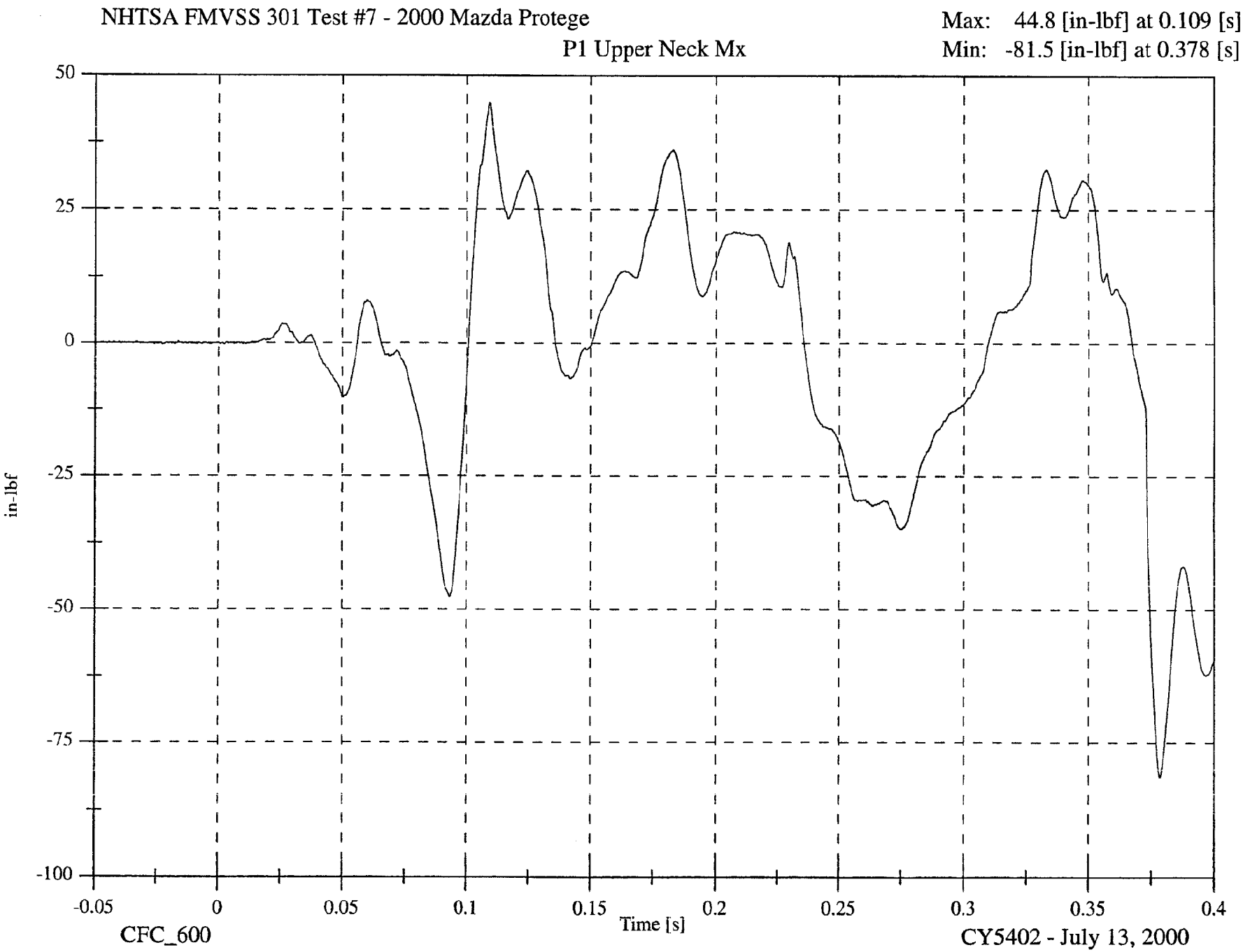

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Head Resultant
Max: 28.7 [g] at 0.123 [s]
Min: 0.0 [g] at -0.032 [s]
30
25
20
15
10
5
0
g
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_1000
CY5402 - July 13, 2000

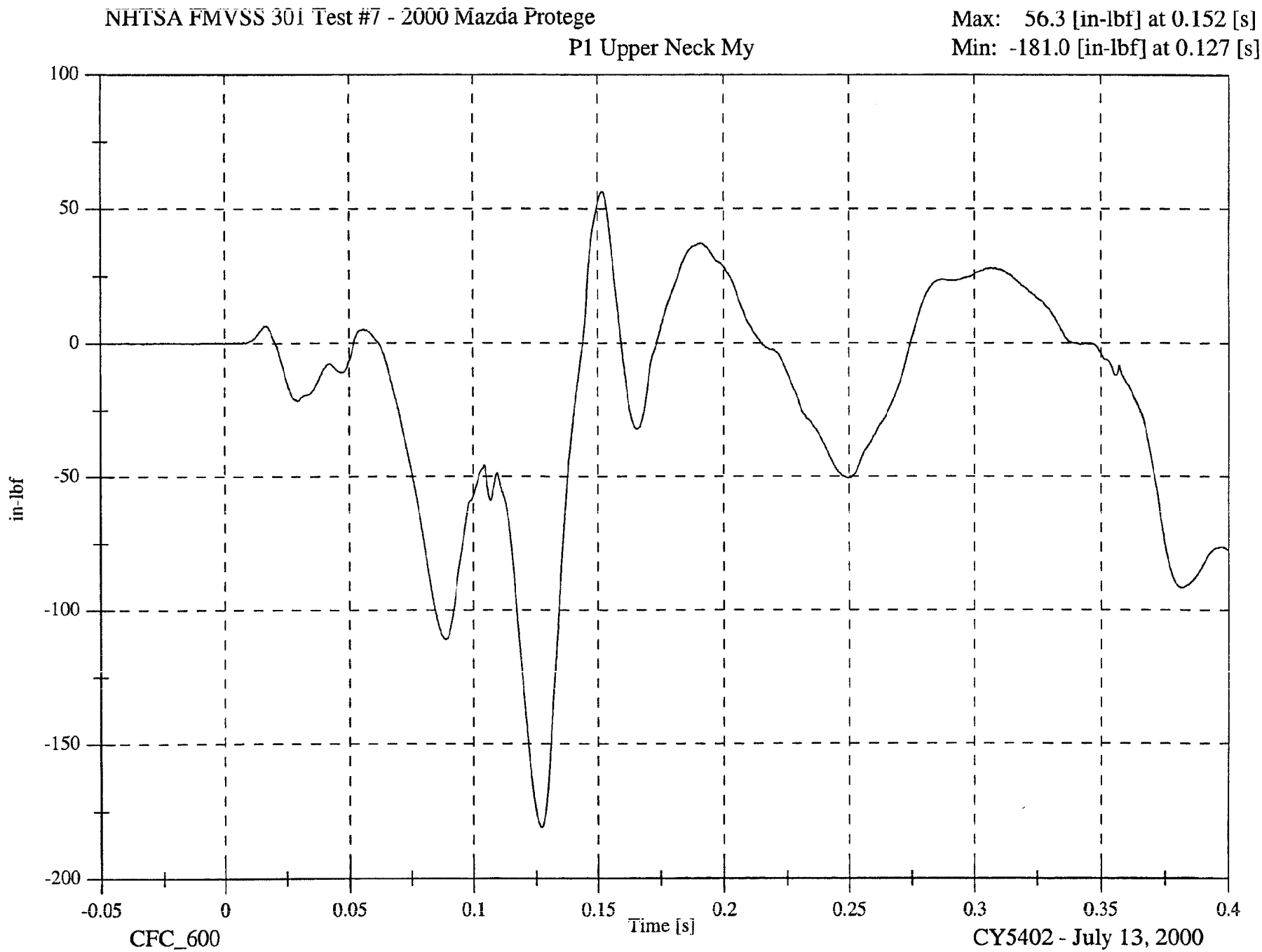

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Upper Neck Fx
Max: 34.6 [lbf] at 0.393 [s]
Min: -53.2 [lbf] at 0.125 [s]
40
20
0
-20
-40
-60
lbf
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_1000
CY5402 - July 13, 2000

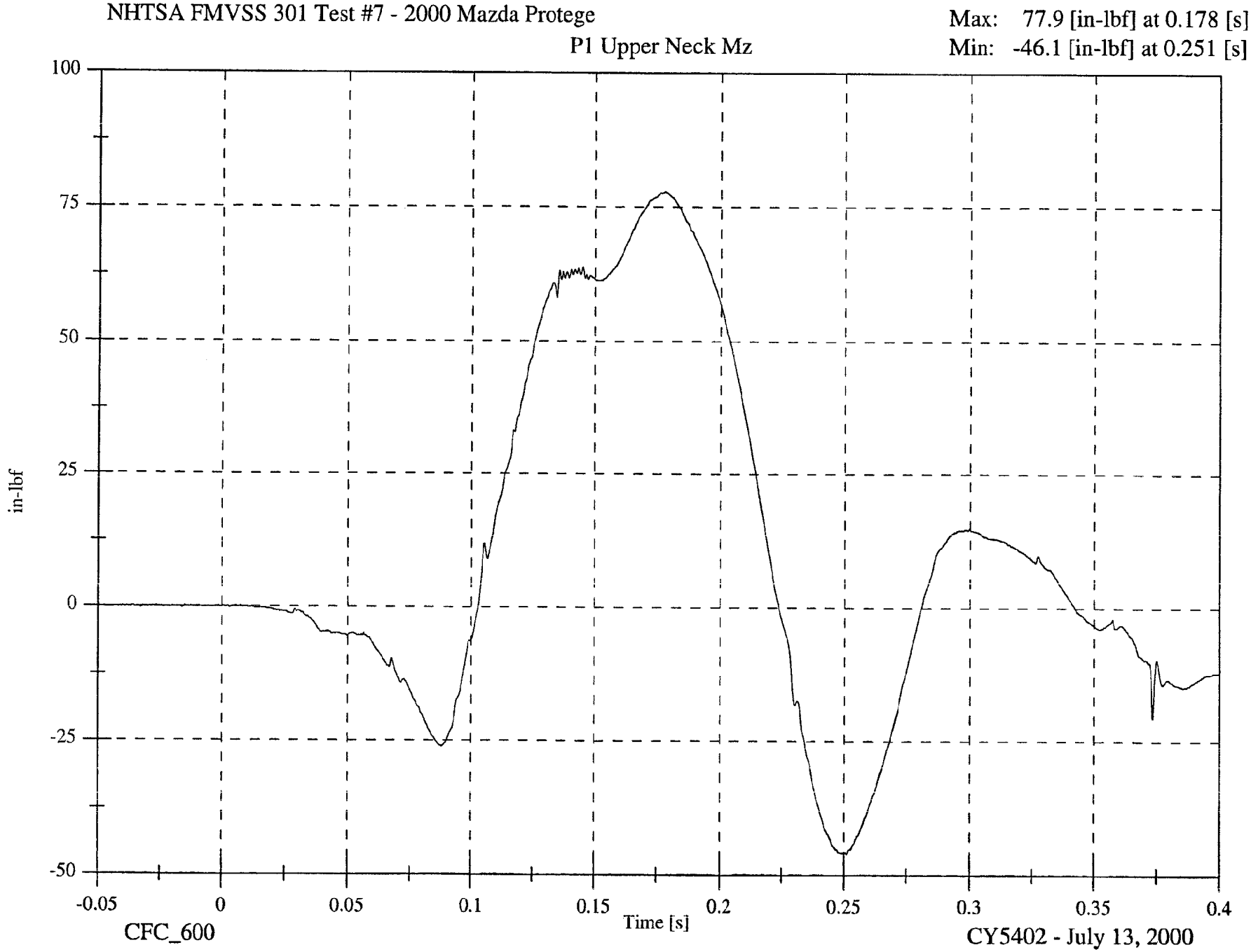

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Upper Neck Fy
Max: 24.9 [lbf] at 0.142 [s]
Min: -20.9 [lbf] at 0.389 [s]
30
20
10
0
-10
-20
-30
lbf
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_1000
CY5402 - July 13, 2000

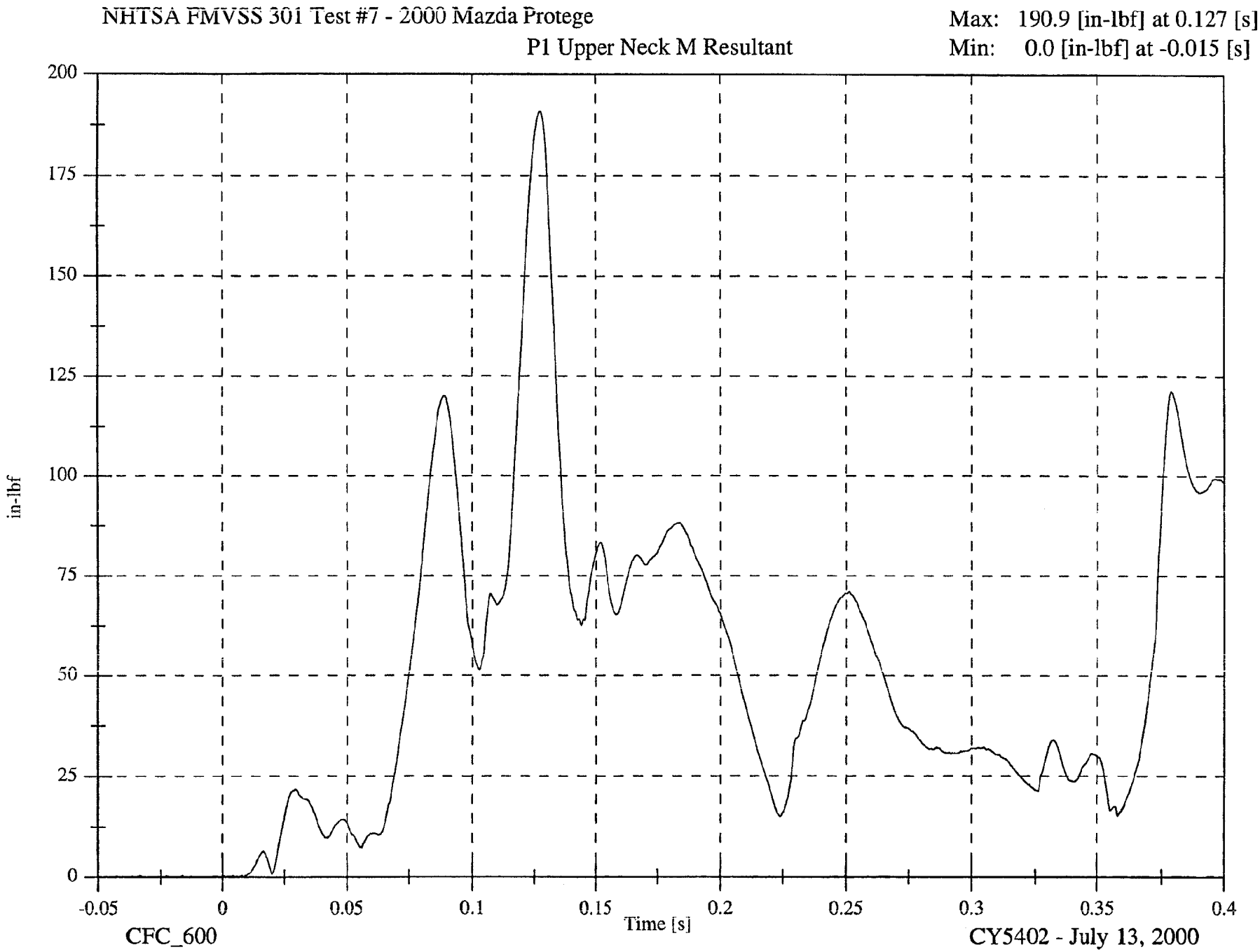

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Upper Neck Fz
Max: 0.6 [lbf] at -0.027 [s]
Min: -239.9 [lbf] at 0.109 [s]
50
0
-50
-100
-150
-200
-250
lbf
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_1000
CY5402 - July 13, 2000

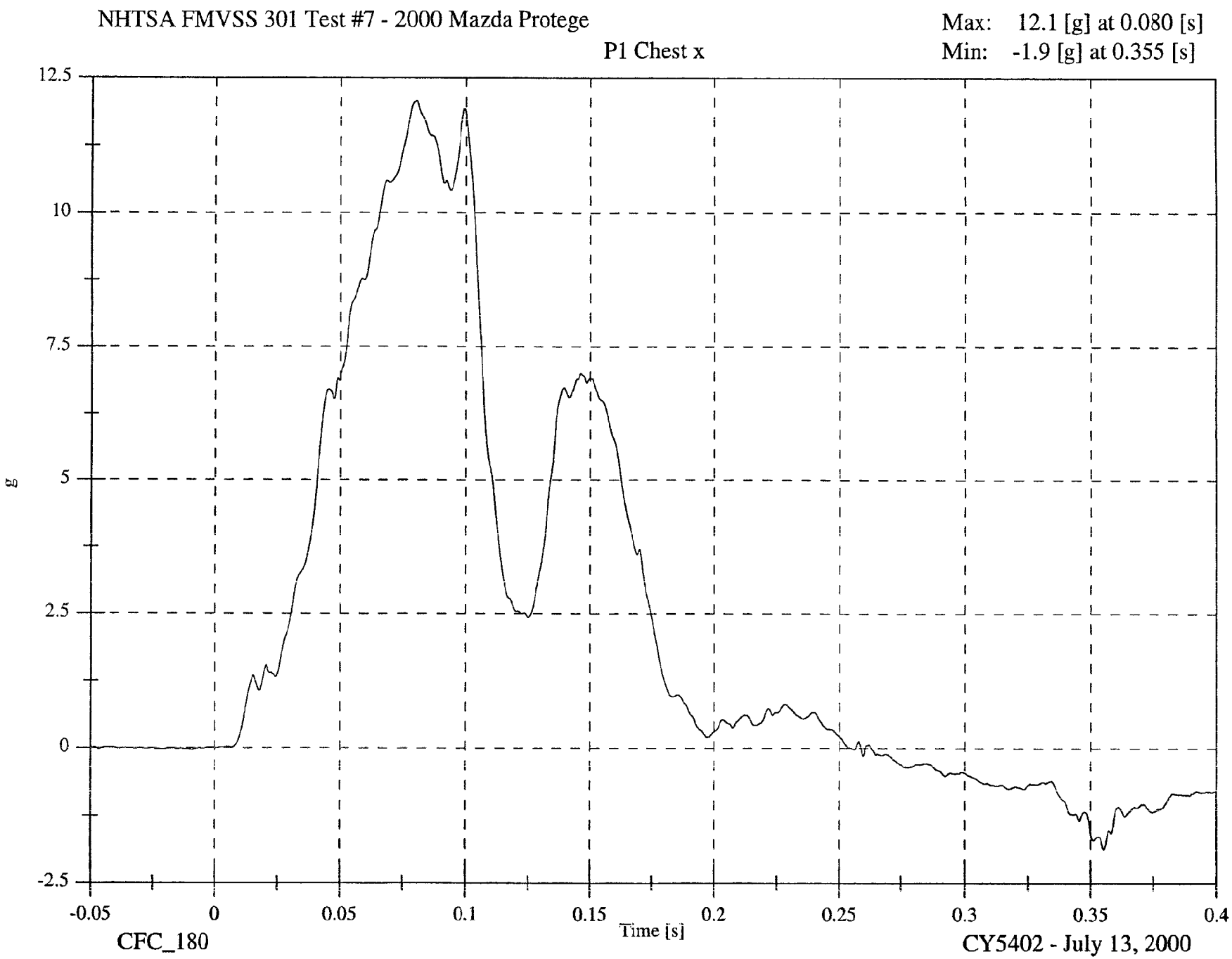

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Upper Neck F Resultant
Max: 240.8 [lbf] at 0.109 [s]
Min: 0.0 [lbf] at -0.019 [s]
250
200
150
100
50
0
lbf
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_1000
CY5402 - July 13, 2000

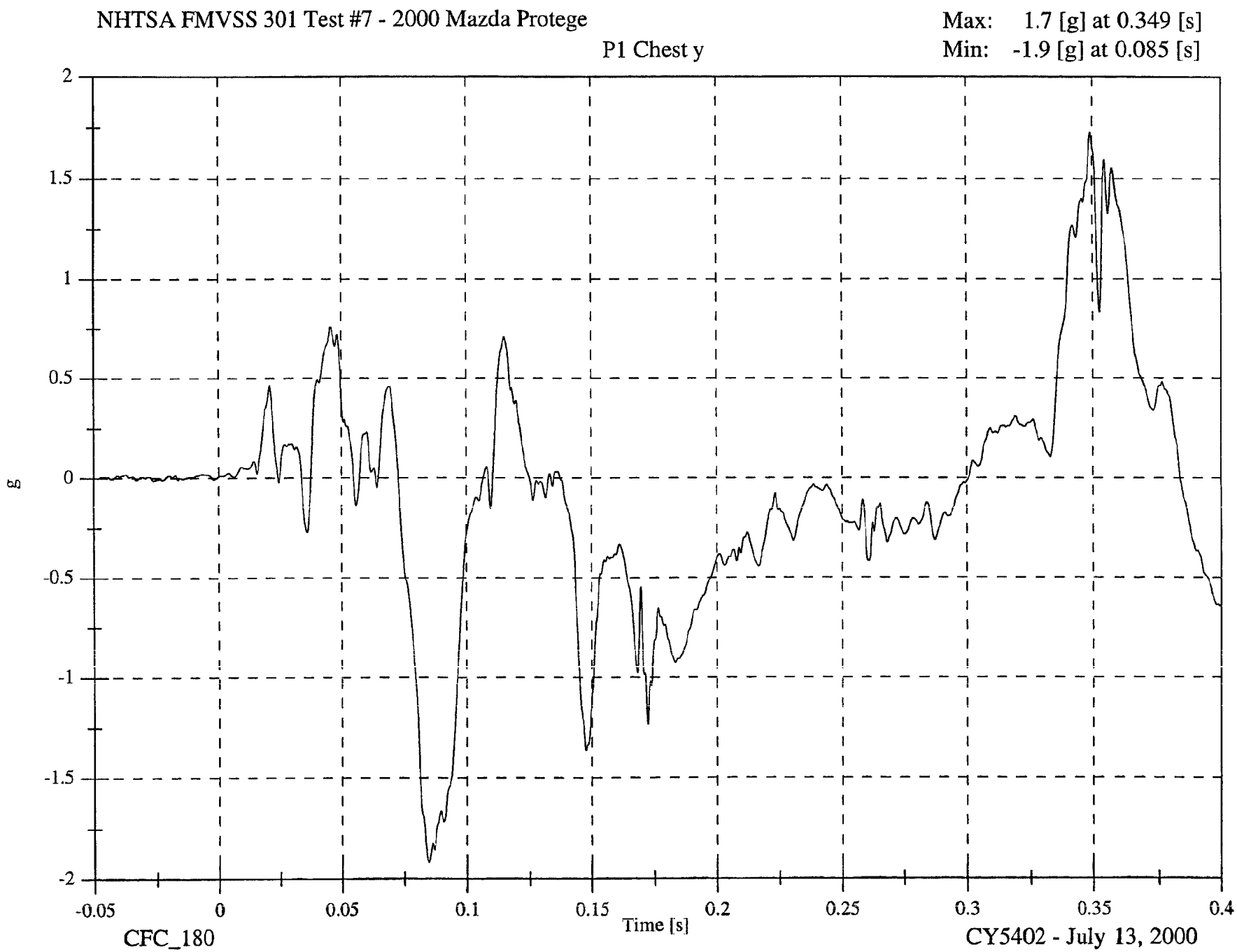

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Upper Neck Mx
Max: 44.8 [in-lbf] at 0.109 [s]
Min: -81.5 [in-lbf] at 0.378 [s]
50
25
0
-25
-50
-75
-100
in-lbf
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_600
CY5402 - July 13, 2000

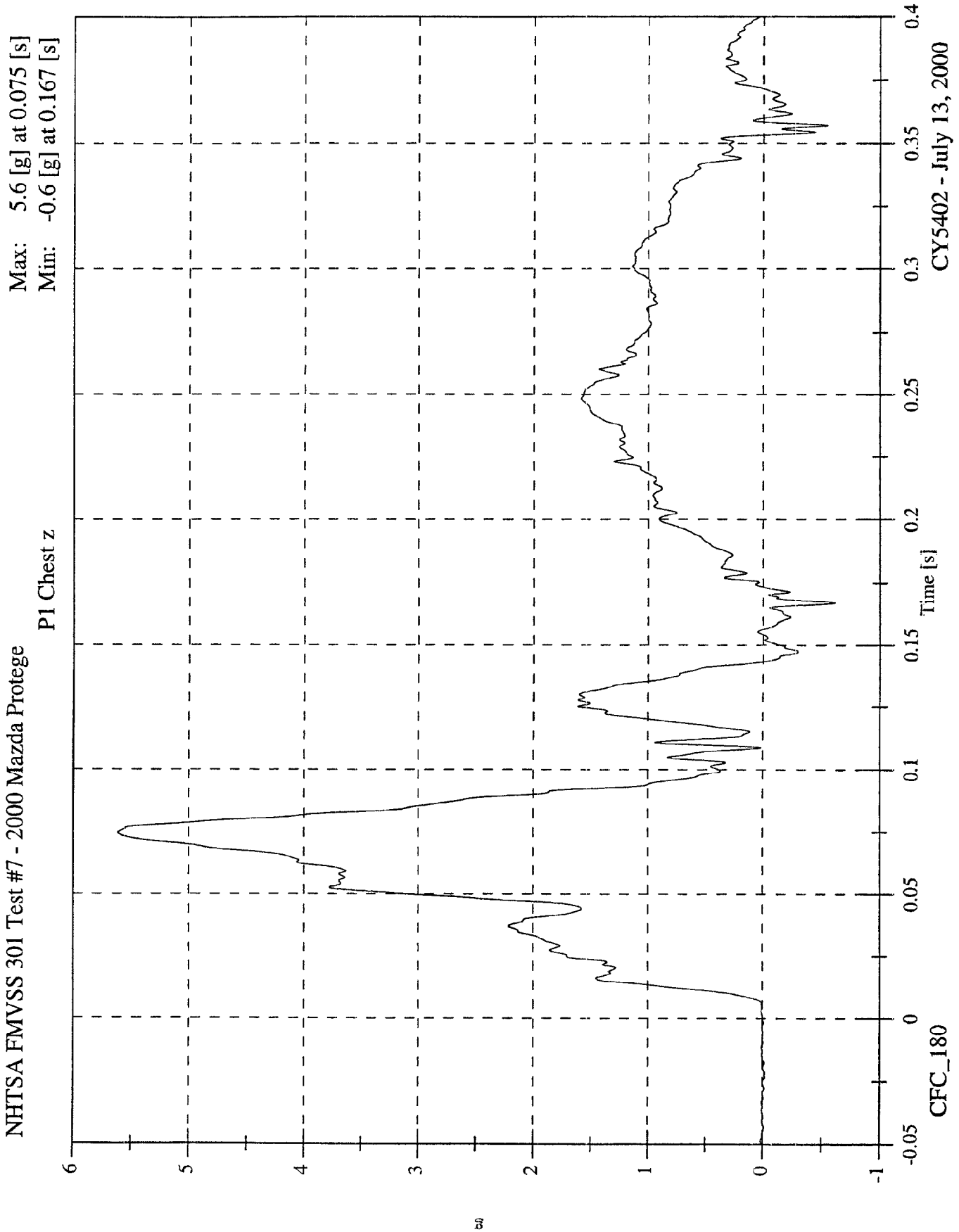

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Upper Neck My
Max: 56.3 [in-lbf] at 0.152 [s]
Min: -181.0 [in-lbf] at 0.127 [s]
100
50
0
-50
-100
-150
-200
in-lbf
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_600
CY5402 - July 13, 2000

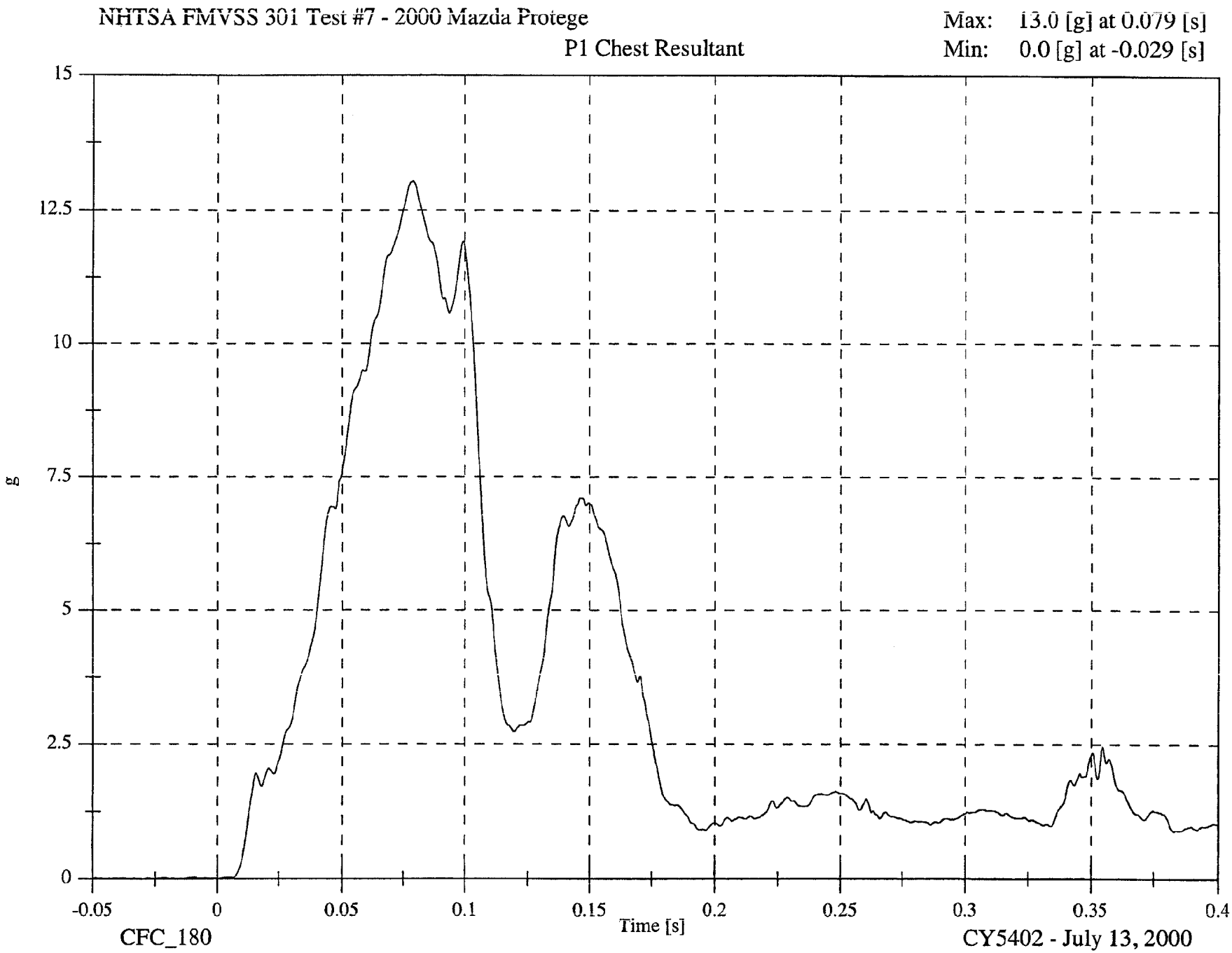

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Upper Neck Mz
Max: 77.9 [in-lbf] at 0.178 [s]
Min: -46.1 [in-lbf] at 0.251 [s]
100
75
50
25
0
-25
-50
in-lbf
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_600
CY5402 - July 13, 2000

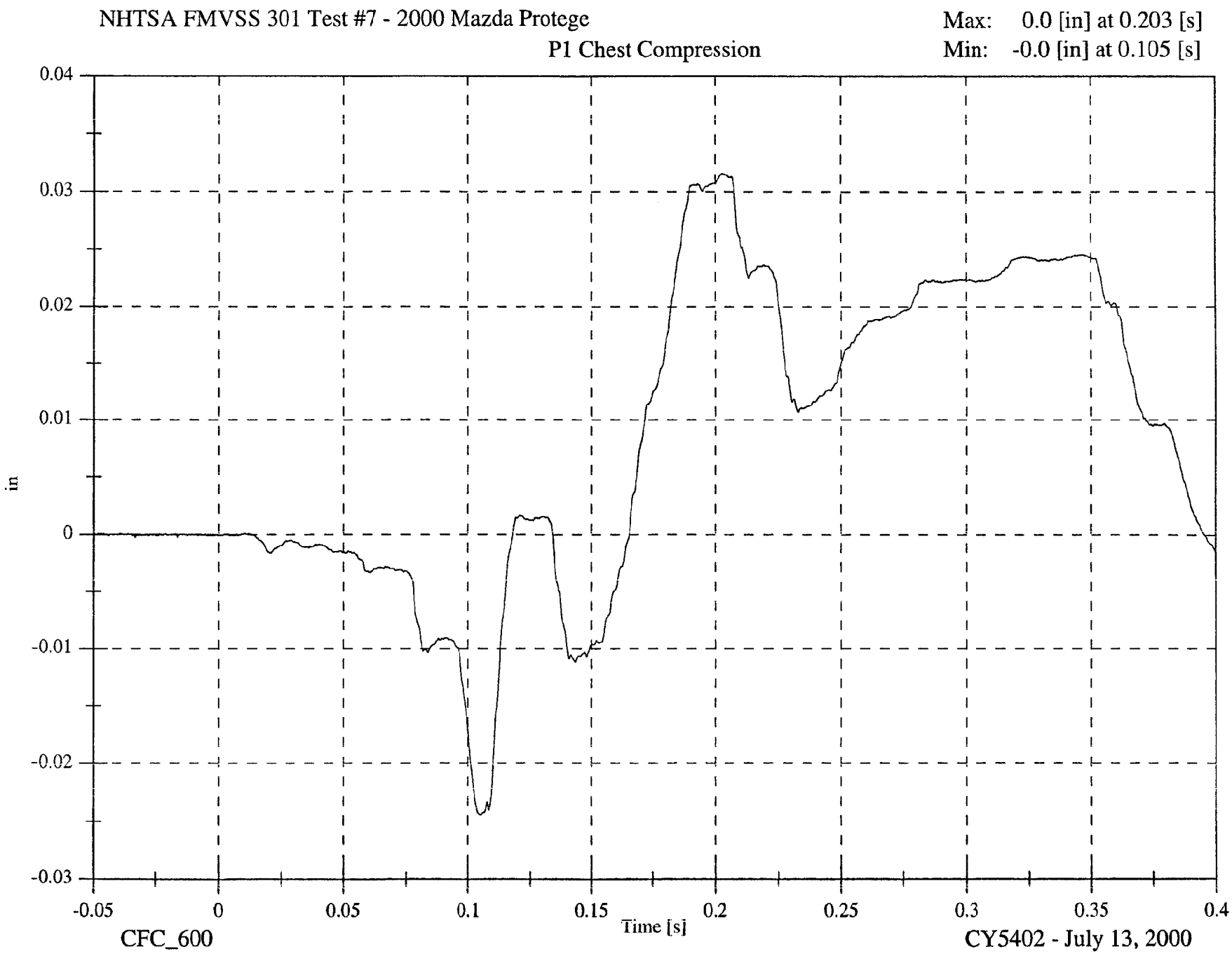

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Upper Neck M Resultant
Max: 190.9 [in-lbf] at 0.127 [s]
Min: 0.0 [in-lbf] at -0.015 [s]
in-lbf
200
175
150
125
100
75
50
25
0
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_600
CY5402 - July 13, 2000

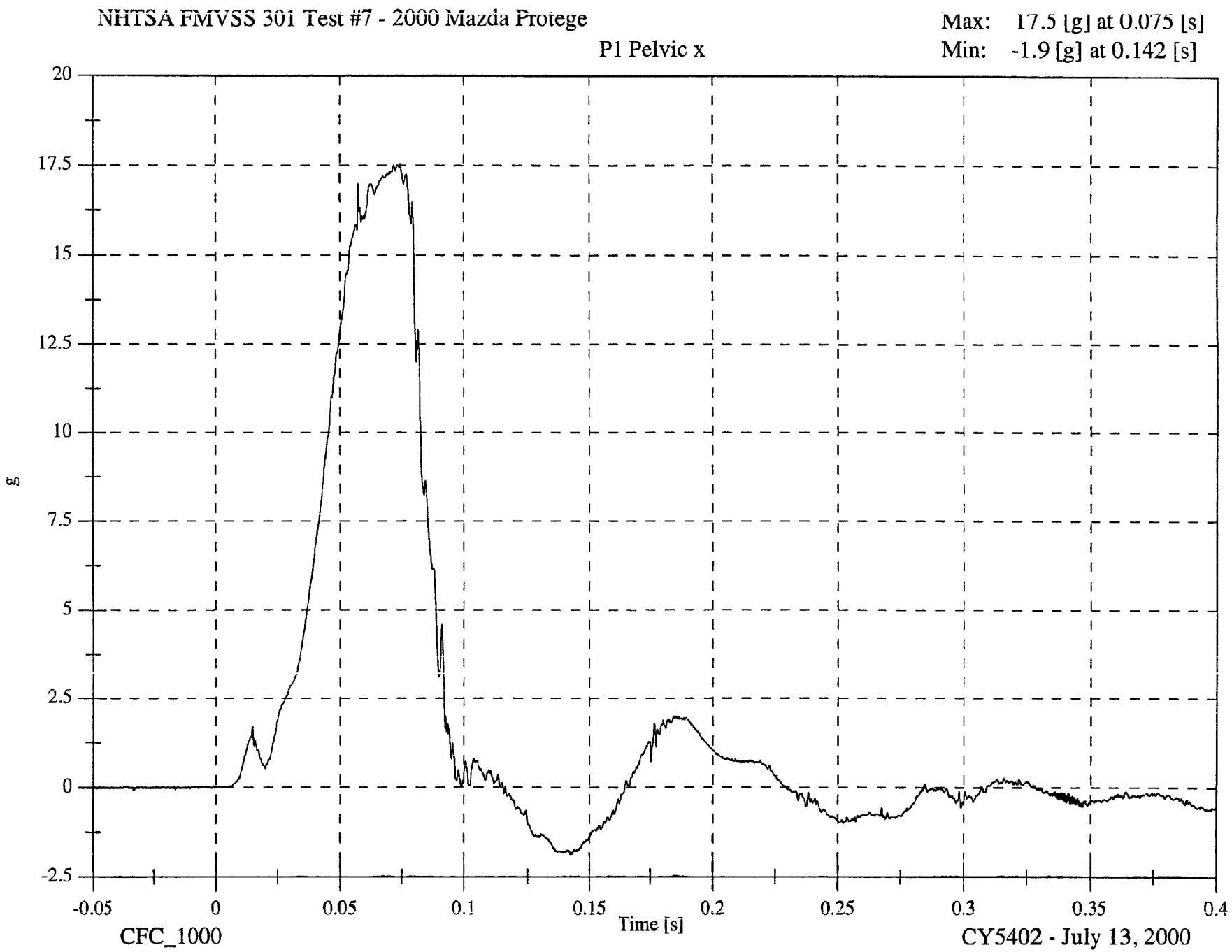

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Chest x
Max: 12.1 [g] at 0.080 [s]
Min: -1.9 [g] at 0.355 [s]
12.5
10
7.5
5
2.5
0
-2.5
g
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_180
CY5402 - July 13, 2000

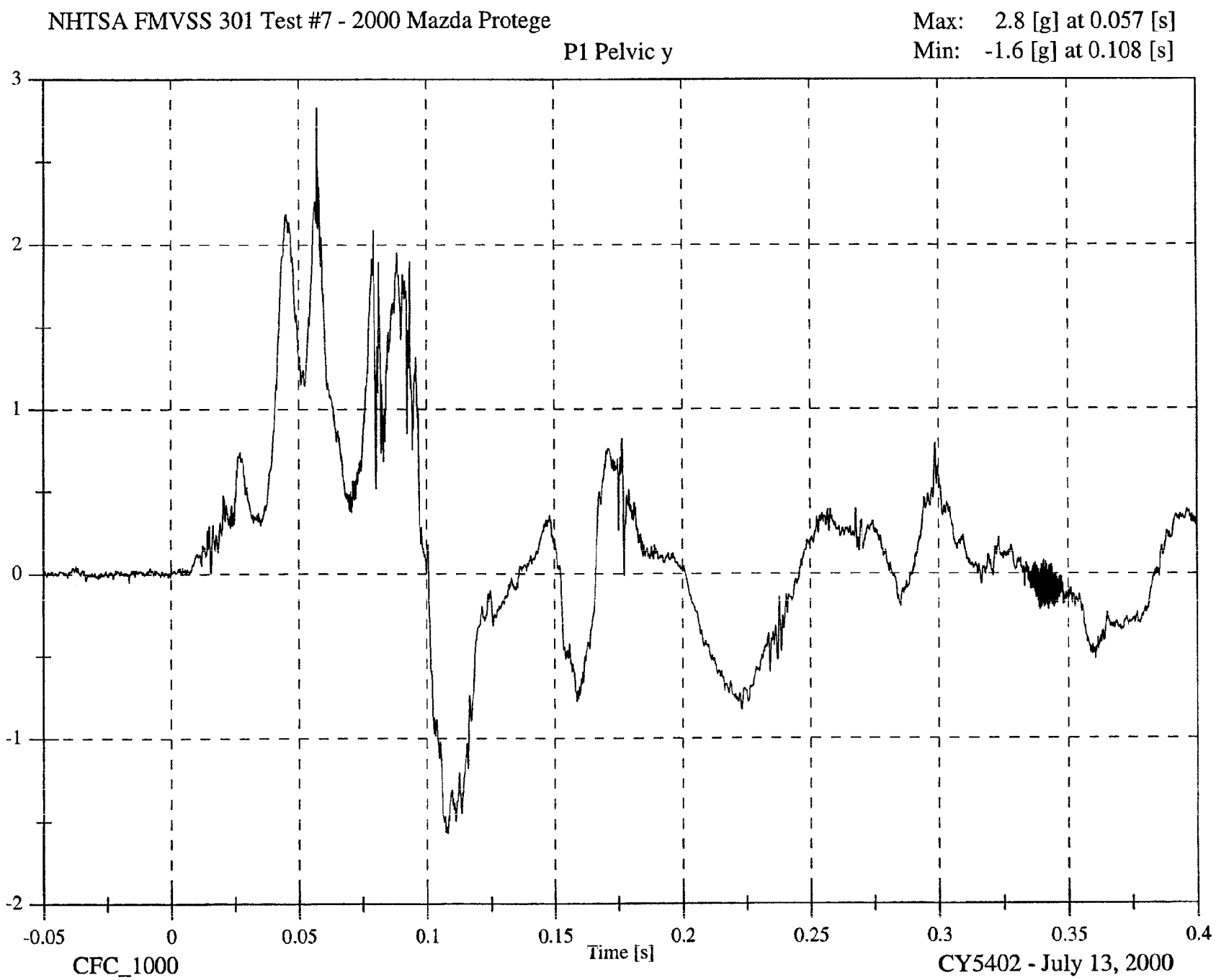

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Chest y
Max: 1.7 [g] at 0.349 [s]
Min: -1.9 [g] at 0.085 [s]
g
Time [s]
CFC_180
CY5402 - July 13, 2000

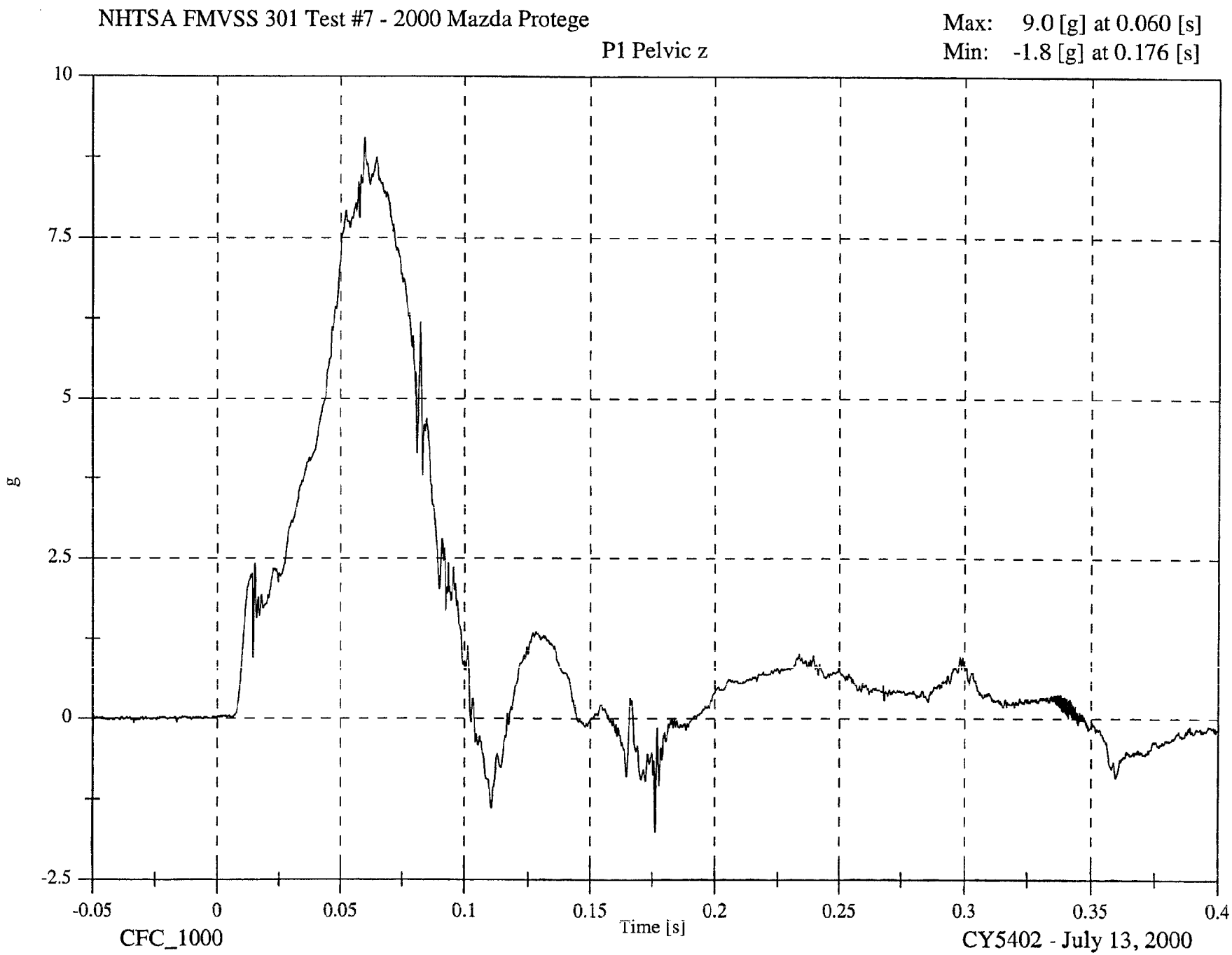

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Chest z
Max: 5.6 [g] at 0.075 [s]
Min: -0.6 [g] at 0.167 [s]
CFC_180
CY5402 - July 13, 2000
Time [s]
g
6
5
4
3
2
1
0
-1
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4

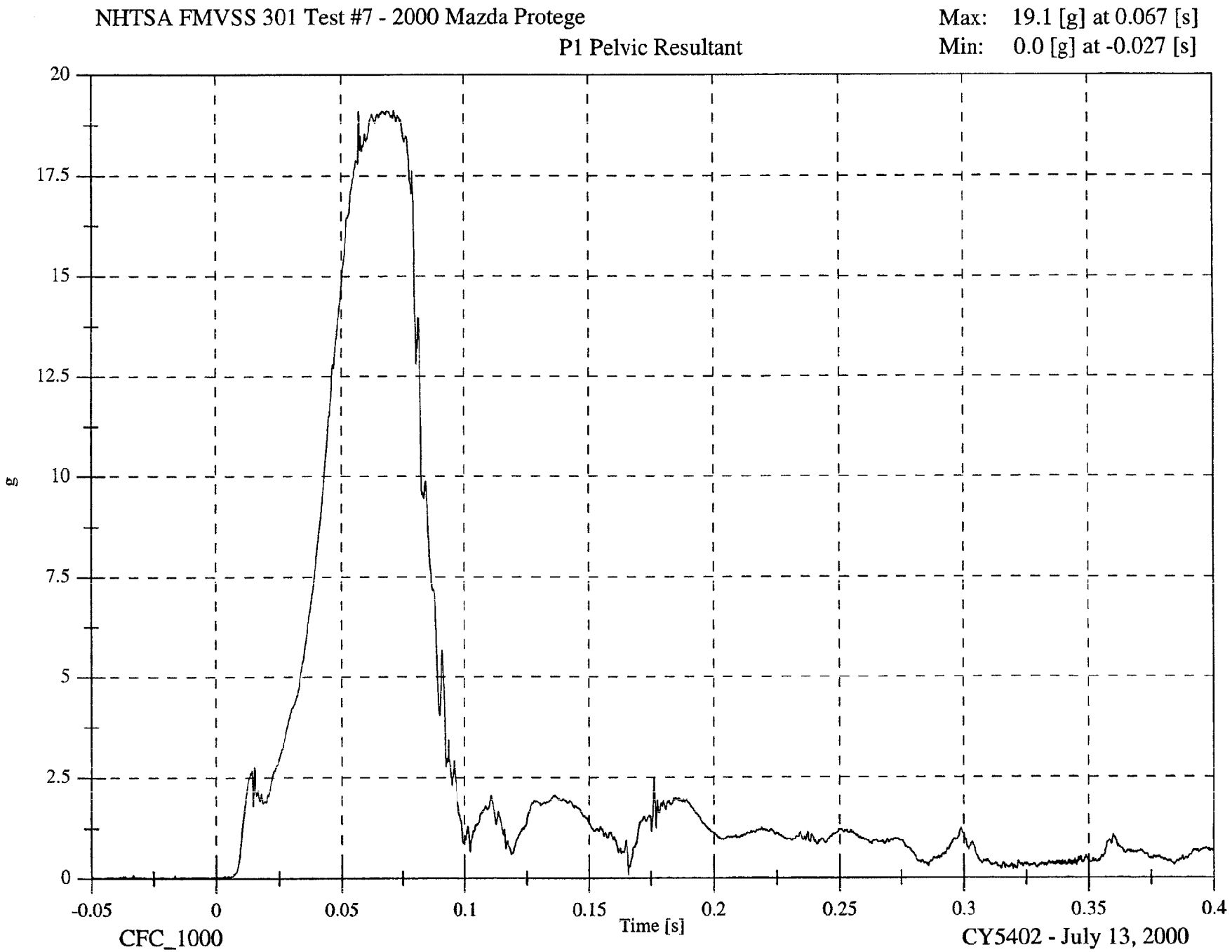

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Chest Resultant
Max: 13.0 [g] at 0.079 [s]
Min: 0.0 [g] at -0.029 [s]
15
12.5
10
7.5
5
2.5
0
g
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_180
CY5402 - July 13, 2000

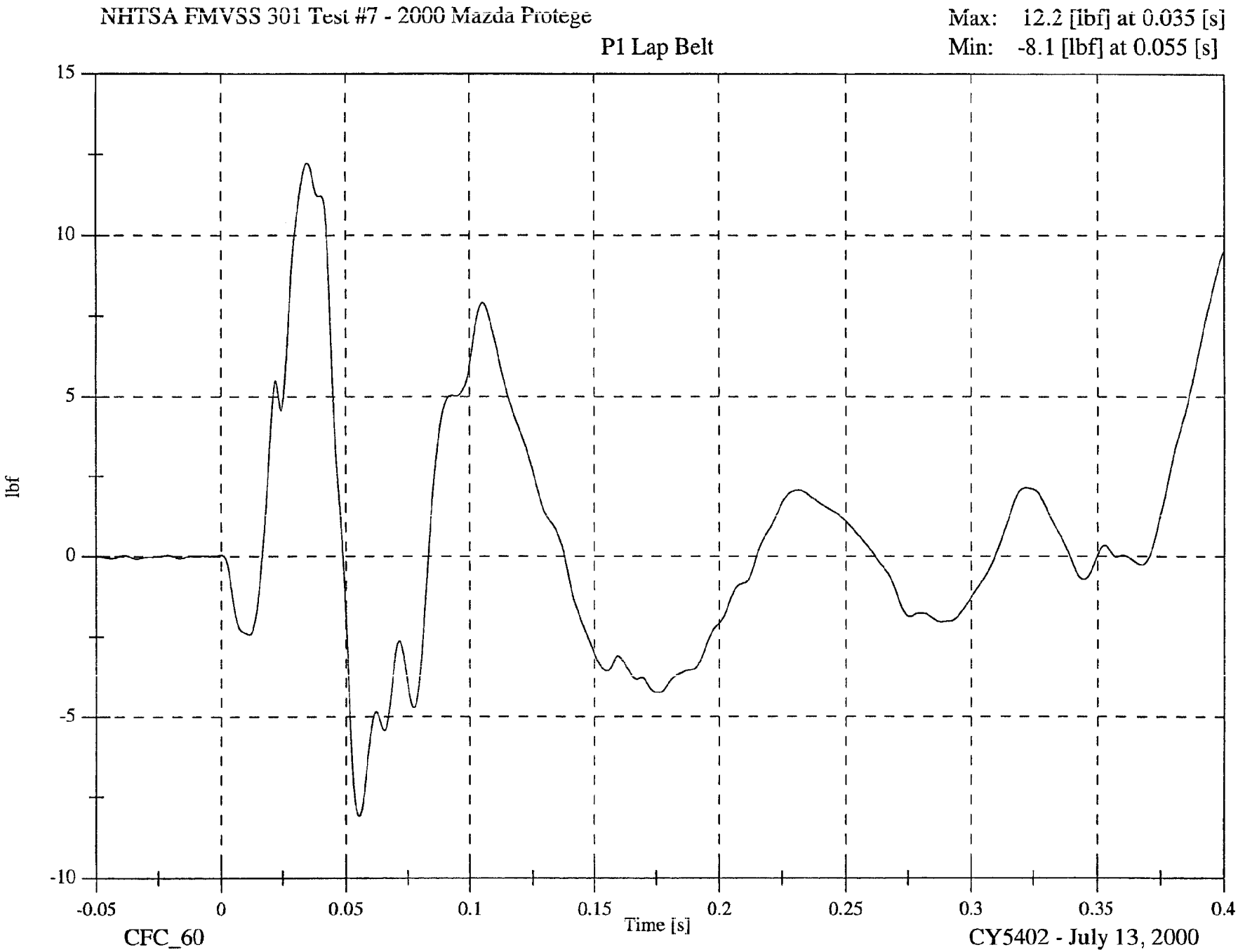

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Chest Compression
Max: 0.0 [in] at 0.203 [s]
Min: -0.0 [in] at 0.105 [s]
0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
in
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_600
CY5402 - July 13, 2000

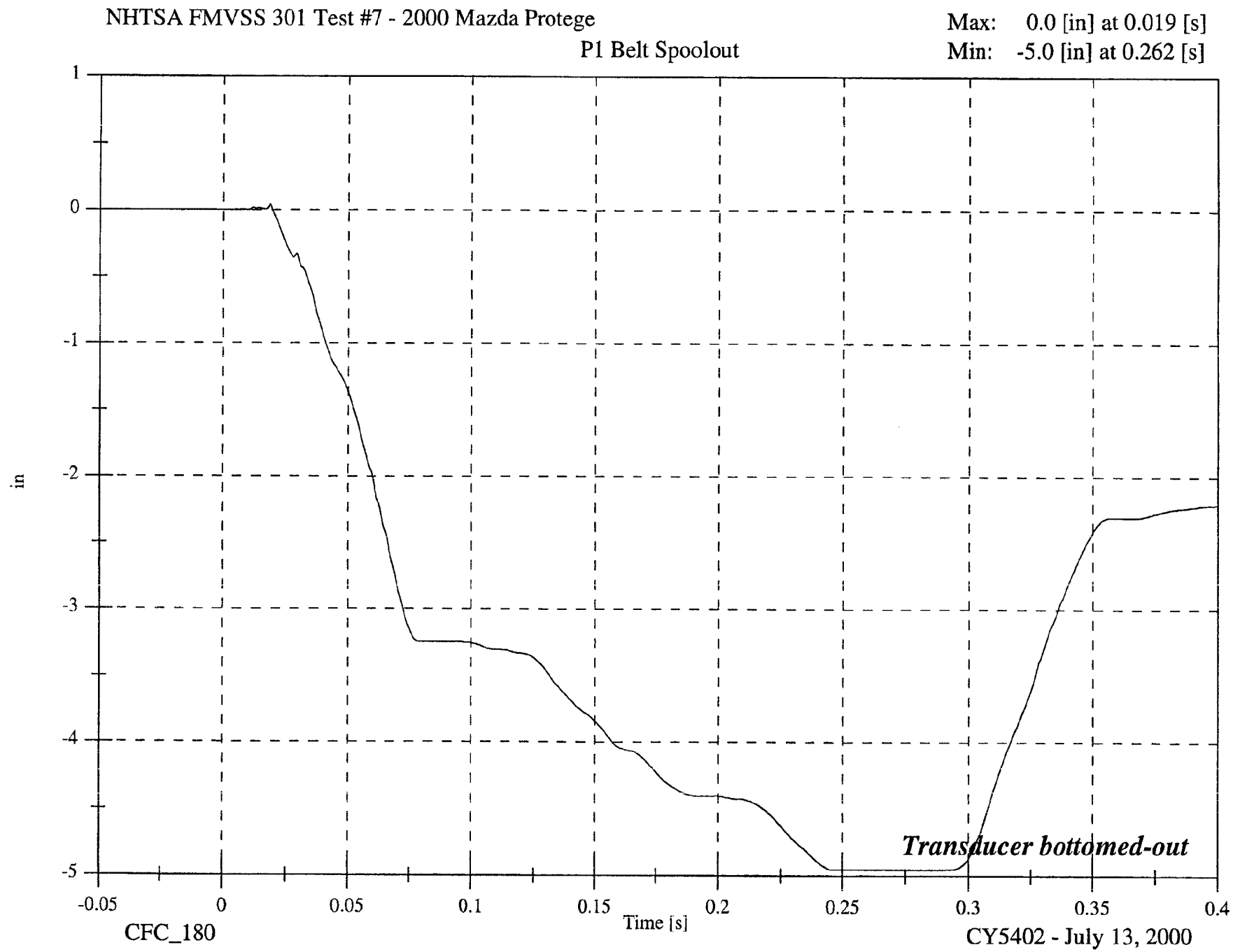

NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Pelvic x
Max: 17.5 [g] at 0.075 [s]
Min: -1.9 [g] at 0.142 [s]
20
17.5
15
12.5
10
7.5
5
2.5
0
-2.5
g
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_1000
CY5402 - July 13, 2000


NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Pelvic y
Max: 2.8 [g] at 0.057 [s]
Min: -1.6 [g] at 0.108 [s]
3
2
1
0
-1
-2
g
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_1000
CY5402 - July 13, 2000


NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Pelvic z
Max: 9.0 [g] at 0.060 [s]
Min: -1.8 [g] at 0.176 [s]
10
7.5
5
2.5
0
-2.5
g
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_1000
CY5402 - July 13, 2000


NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Pelvic Resultant
Max: 19.1 [g] at 0.067 [s]
Min: 0.0 [g] at -0.027 [s]
20
17.5
15
12.5
10
7.5
5
2.5
0
g
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_1000
CY5402 - July 13, 2000


NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Lap Belt
Max: 12.2 [ibf] at 0.035 [s]
Min: -8.1 [lbf] at 0.055 [s]
15
10
5
0
-5
-10
lbf
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
CFC_60
CY5402 - July 13, 2000


NHTSA FMVSS 301 Test #7 - 2000 Mazda Protege
P1 Belt Spoolout
Max: 0.0 [in] at 0.019 [s]
Min: -5.0 [in] at 0.262 [s]
1
0
-1
-2
-3
-4
-5
in
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Time [s]
Transducer bottomed-out
CFC_180
CY5402 - July 13, 2000