

REPORT NUMBER: 301-CAL-99-07

V3243

**SAFETY COMPLIANCE TESTING FOR FMVSS 301
FUEL SYSTEM INTEGRITY**

Hyundai Motor Company
1999 Hyundai Sonata
4 door sedan

NHTSA NUMBER: CX0510

VERIDIAN TEST NUMBER: 8480-7

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



June 8, 1999

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

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. 301-CAL-99-07	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Final Report of FMVSS 301 Compliance Testing of a 1999 Hyundai Sonata 4 door sedan NHTSA No. CX0510		5. Report Date June 8, 1999	6. Performing Organization Code CAL
		8. Performing Organization Report No. 8480-7	
7. Author(s) Patrick G. MacDiarmid, Jr., Project Engineer David J. Travale, Program Manager		10. Work Unit No.	
9. Performing Organization Name and Address Veridian Engineering 4455 Genesee Street Buffalo, New York 14225		11. Contract or Grant No. DTNH22-95-D-11000	
		13. Type of Report and Period Covered Final Test Report June 1999- July 1999	
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Office of Vehicle Safety Compliance (NEF-30) 400 Seventh St , S.W., Rm. 6115, Washington, D.C. 20590		14. Sponsoring Agency Code NEF-30	
		15. Supplementary Notes	
16. Abstract Compliance tests were conducted on the subject 1999 Hyundai Sonata 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: The test vehicle appeared to comply with all requirements of FMVSS 301 "Fuel System Integrity."			
17. Key Words Compliance Testing Safety Engineering FMVSS 301		18. Distribution Statement <u>Copies of this report are available from:</u> NHTSA Technical Reference Division Room 5108 (NAD-52), 400 Seventh , S.W., Washington, D.C. 20590 Telephone No. (202) 366-4946	
19. Security Classif. (of this report) UNCLASSIFIED	20. Security Classif. (of this page) UNCLASSIFIED	21. No. of Pages	22. Price

TABLE OF CONTENTS

<u>Section</u>		<u>Page No.</u>
1	PURPOSE OF COMPLIANCE TEST	1-1
2	SUMMARY OF COMPLIANCE TEST RESULTS	2-1
3	COMPLIANCE TEST DATA	3-1
4	NONCOMPLIANCE DATA	4-1
APPENDIX A	PHOTOGRAPHS	A-1
APPENDIX B	VEHICLE AND DUMMY RESPONSE DATA (REAR IMPACT ONLY)	B-1

LIST OF FIGURES

<u>Figure No.</u>		<u>Page No.</u>
1	PART 572 DUMMY IN-VEHICLE POSITION	3-2
2	CAMERA POSITION FOR REAR IMPACT	3-9

LIST OF TABLES

<u>Table No.</u>		<u>Page No.</u>
1	CRASH TEST SUMMARY	2-2
2	GENERAL TEST AND VEHICLE PARAMETER DATA	2-3
3	MOVING BARRIER PARAMETER DATA	2-6
4	POST-IMPACT DATA	2-7
5	FRONT SEAT OCCUPANT MEASUREMENTS	3-3
6	FMVSS NO. 301 - "FUEL SYSTEM INTEGRITY" POST-IMPACT TEST DATA	3-4
7	FMVSS NO. 301 - STATIC ROLLOVER DATA SHEET	3-5
8	HIGH-SPEED CAMERA LOCATIONS	3-10
9	TEST VEHICLE NONCOMPLIANCE NOTICE	4-2
10	LABORATORY NOTICE OF TEST FAILURE TO OVSC	4-3
11	ANTI-SIPHONING DEVICE FOR ALCOHOL FUEL VEHICLE	4-4

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 1999 Hyundai Sonata 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.

Table 1

CRASH TEST SUMMARY

Vehicle NHTSA No.: CX0510 Test Mode: 30 mph Rear Barrier
 Test Date: June 8, 1999 Time: 11:10 Temperature: 79 °F
 Vehicle Make/Model/Body Style: 1999 Hyundai Sonata 4 door sedan
 Vehicle Test Weight: 3517 lbs Impact Velocity: 29.5 mph
 Static Crush: Left Side = 18.8 inches
 Right Side = 19.7 inches
 Centerline = 22.0 inches
 Average Crush: 20.2 inches

TYPE OF FRONT OCCUPANT RESTRAINT SYSTEM INSTALLED IN TEST VEHICLE:

Driver's DSP: Air Bag with 3 point belt system
 Right Passenger's DSP: Air Bag with 3 point belt system

VISIBLE DUMMY CONTACT POINTS:

Driver: Rear of head with headrest.

 Passenger: Rear of head with headrest

DOOR OPENING DATA:

closed-operable - Left Front
closed-operable - Right Front

Stoddard Solvent Spillage from Vehicle's Fuel System: None

Remarks: Driver's seat reclined (approx 43 degrees) but was operable. Passenger seat track released and was
broken, seat back reclined (approx 17 degrees). Rear window shattered. Rear doors could not be opened
by hand. Air bags did not deploy.

Table 2

GENERAL TEST AND VEHICLE PARAMETER DATATEST VEHICLE INFORMATION:

Year/Make/Model/Body Style: 1999 Hyundai Sonata 4 door sedan

NHTSA No.: CX0510 ; VIN: KMHWF25S3XA035873 ; Color: light moss

Engine Data: 4 cylinders; CID; 2.4 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

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

Date Received: 2/11/99 ; Odometer Reading 116 miles

Selling Dealer: R.J.Ide Hyundai

& Address: 2425 Rochester Road, Canadagua, NY 14424

DATA FROM TIRE VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured by: Hyundai Motor Company

Date of Manufacture: 9/30/98

GVWR: 4090 lbs.; GAWR: 2271 lbs. FRONT; 1984 lbs. REAR

DATA FROM TIRE PLACARD:

Location of Placard on Vehicle: Left side front door

Tire Pressure with Maximum Capacity Vehicle Load: 30 psi FRONT 30 psi REAR

Recommended Tire Size: P195/70R14 90H

* Recommended Cold Tire Pressure: 30 psi FRONT; 30 psi REAR

Size of Tires on Test Vehicle: P195/70R14 90H

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) = 860 lbs.

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

Rated Cargo/Luggage Weight (RCLW) = 110

*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	=	<u>943</u>	lbs.	Right Rear	=	<u>593</u>	lbs.
Left Front	=	<u>957</u>	lbs.	Left Rear	=	<u>594</u>	lbs.
TOTAL FRONT	=	<u>1,900</u>	lbs.	TOTAL REAR	=	<u>1,187</u>	lbs.
TOTAL DELIVERED WEIGHT	=	<u>3,087</u>	lbs.				
% of Total Front of Vehicle Weight	=	<u>62</u>	%	% of Total Rear Weight	=	<u>38</u>	%

CALCULATION OF VEHICLE'S TARGET TEST WEIGHT:

Total Delivered Weight	=	<u>3,087</u>	lbs.
Rated Cargo/Luggage Weight (RCLW)	=	<u>110</u>	lbs.
Weight of 2 p.572 Dummies, 167 & 164 lbs	=	<u>331</u>	lbs.
TARGET TEST WEIGHT	=	<u>3,528</u>	lbs.

WEIGHT OF TEST VEHICLE WITH TWO DUMMIES AND 98 POUNDS OF CARGO WEIGHT:

Right Front	=	<u>1071</u>	lbs.	Right Rear	=	<u>683</u>	lbs.
Left Front	=	<u>1071</u>	lbs.	Left Rear	=	<u>691</u>	lbs.
TOTAL FRONT	=	<u>2,142</u>	lbs.	TOTAL REAR	=	<u>1,374</u>	lbs.
TOTAL TEST WEIGHT	=	<u>3,516.0</u>	lbs.				
% of Total Front Weight	=	<u>60.9</u>	%	% of Total Rear Weight	=	<u>39.1</u>	%

* Weight of Ballast Secured in Vehicle Trunk Area = 10 lbs.

Type of Ballast: lead shot

Method of Securing Ballast: location in vehicle and tape

Vehicle Components Removed for Weight Reduction: none

VEHICLE ATTITUDE (all dimension in inches):

AS DELIVERED:	RF	<u>26.6</u>	LF	<u>26.5</u>	RR	<u>26.8</u>	LR	<u>26.6</u>
AS TESTED:	RF	<u>25.8</u>	LF	<u>25.4</u>	RR	<u>26.1</u>	LR	<u>25.9</u>
Vehicle's Wheel Base:		<u>105.8</u>	in.					
Location of Vehicle's C.G.:		<u>41.3</u>	inches rearward of front wheel center.					

FUEL SYSTEM DATA:

Fuel System Capacity From Owner's Manual	=	<u>17.2</u>	gallons
Usable Capacity Figure Furnished by COTR	=	<u>17.17</u>	gallons
Test Volume Range (91 to 94% of Usable Capacity)	=	<u>15.7</u>	to <u>16.2</u> gallons
ACTUAL TEST VOLUME	=	<u>15.8</u>	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 - Fuel pump operated.	
Details of Fuel System:	Fuel filler in left rear quarter panel. Fuel lines run along left inside frame rail.
Fuel tank located in front of rear "axle" and just left of center laterally.	

Table 3

MOVING BARRIER PARAMETER DATA

WEIGHT OF MOVING BARRIER:

Right Front	=	<u>1113</u>	lbs.	Right Rear	=	<u>868</u>	lbs.
Left Front	=	<u>1102</u>	lbs.	Left Rear	=	<u>878</u>	lbs.
TOTAL FRONT	=	<u>2,215</u>	lbs.	TOTAL REAR	=	<u>1,746</u>	lbs.
TOTAL BARRIER WEIGHT	=	<u>3,961</u>	lbs.				

MOVING BARRIER DIMENSIONS:

Barrier Face Height:	<u>60.0</u>	in.
Barrier Face Width:	<u>78.0</u>	in.
Barrier Face		
Ground Clearance:	<u>5.0</u>	in.
Tread Width:	<u>59.5</u>	in.
Wheel Base:	<u>120.0</u>	in.
Location of C.G.:	X: <u>52.9</u> inches rearward of front wheel center.	
	Y: <u>0.0</u> inches from longitudinal-vertical plane of symmetry.	
	Z: <u>16.3</u> inches above ground.	

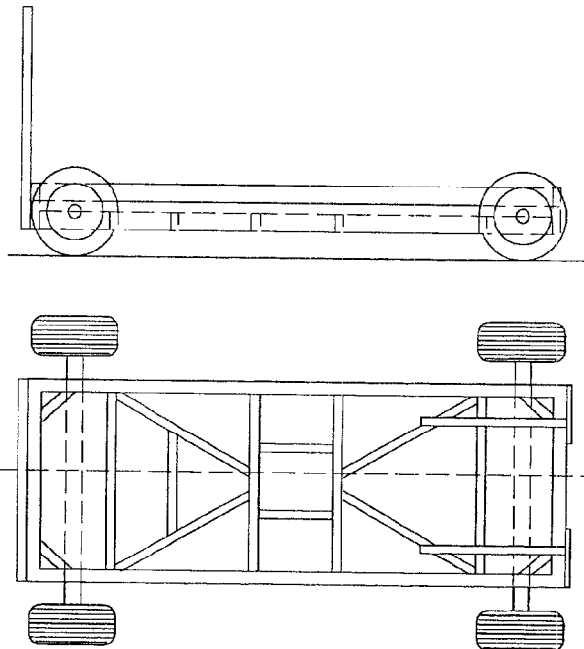


Table 4

POST IMPACT DATATYPE OF TEST:

Type of Test: Rear Barrier Impact Angle: 0°
 Test Date: June 8, 1999 Time: 11:10 Temperature: 79 °F
 Vehicle NHTSA No.: CX0510
 Required Impact Velocity Range: 28.9 to 29.9 mph

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

Trap No. 1 = 29.5 mph; Trap No. 2 = 29.5 mph
 Average Impact Speed = 0.0 mph

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

Vehicle Length:

Pre-Test	Right =	<u>186.3</u>	; C/L =	<u>189.5</u>	; Left =	<u>185.5</u>
Post-Test	Right =	<u>166.6</u>	; C/L =	<u>167.5</u>	; Left =	<u>166.7</u>
Crush	Right =	<u>19.7</u>	; C/L =	<u>22.0</u>	; Left =	<u>18.8</u>
AVERAGE	=	<u>20.2</u>	inches			

Section 3

COMPLIANCE TEST DATA

Figure 1

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

DUMMY MEASUREMENT FOR FRONT SEAT PASSENGERS

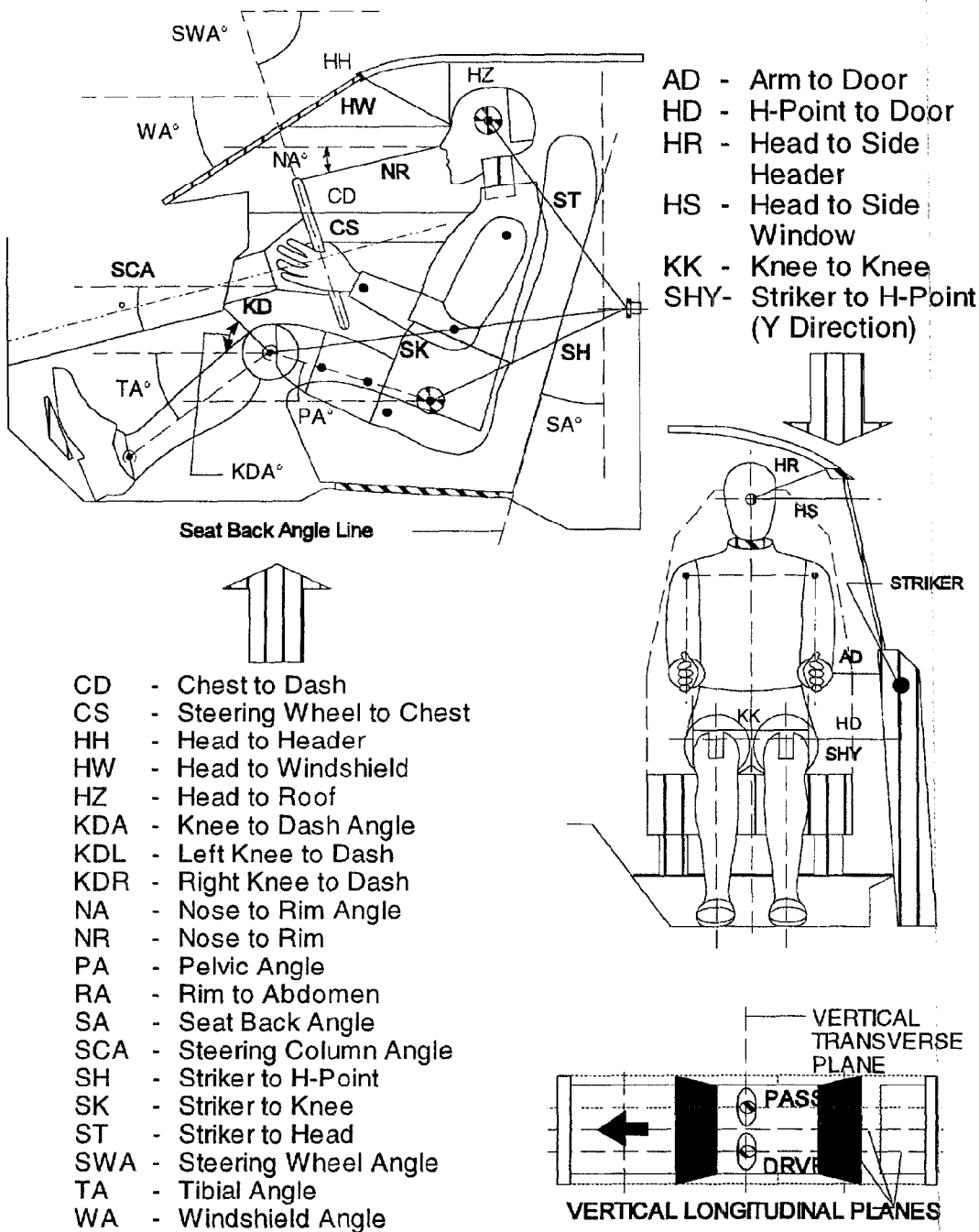


Table 5

FRONT SEAT OCCUPANT MEASUREMENTS
(FOR REAR IMPACT ONLY)

	DRIVER (Serial #152)		
WA°	29 deg.		
SWA°	66.5 deg.		
SCA°	23.5 deg.		
SA°	66.2 deg.		
HZ	7.0		
HH	12.3		
HW	22.0		
HR	8.5		
NR	15	Angle	12 deg.
CD	20.1		
CS	11.8		
RA	7.9		
KDL	6.5	Angle (KDA)	30 deg.
KDR	6.4		
PA°	21.5 deg.		
TA°	32 deg.		
KK	11.2		
ST	19.2	Angle	22 deg.
SK	24.3	Angle	102 deg.
SH	12.2	Angle	137 deg.
SHY	10.0		
HS	12.5		
HD	6.6		
AD	5.1		

Table 6
FUEL SYSTEM INTEGRITY POST IMPACT TEST DATA

FMVSS NO. 301

TEST VEHICLE NHTSA NO.: CX0510 TEST DATE: June 8, 1999

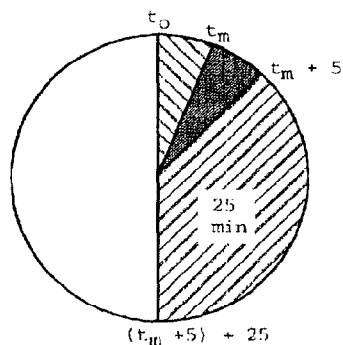
Vehicle Mfgr./Make/Model: 1999 Hyundai Sonata 4 door sedan

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:

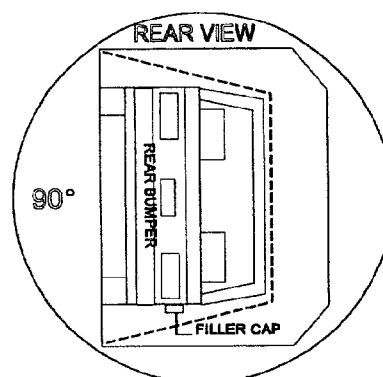
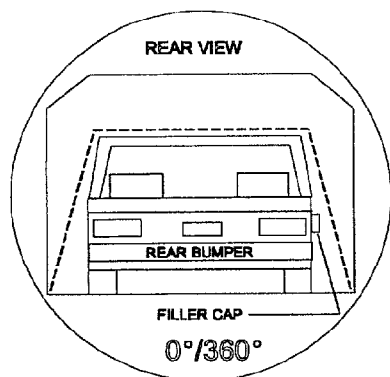
None

Table 7

FMVSS NO. 301 STATIC ROLLOVER DATA SHEET

TEST PHASE :
0-90 Deg.

Vehicle NHTSA ID No. :
CX0510

I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

Rollover Fixture 90° Rotation Time 1 minutes 05 seconds
 (Spec. Range = 1 to 3 minutes)

FMVSS 301 Position Hold Time + 5 minutes 00 seconds

TOTAL

6 minutes 5 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:

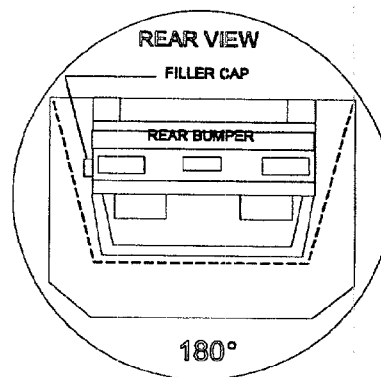
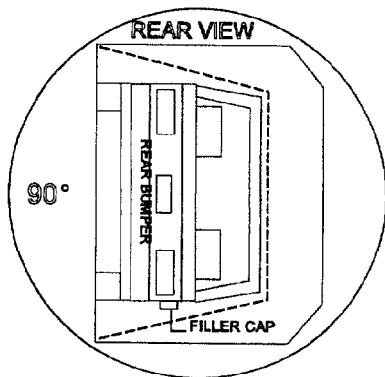
0	0	0	n/a
---	---	---	-----

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. :CX0510I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:Rollover Fixture 90° Rotation Time
(Spec. Range = 1 to 3 minutes)1 minutes 05 seconds

FMVSS 301 Position Hold Time +

5 minutes 00 seconds

TOTAL

6 minutes 5 seconds

Next whole minute interval

7 minutesII. 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):

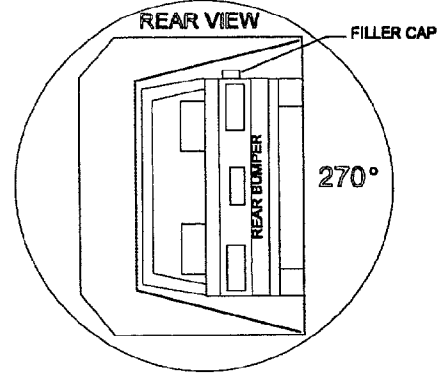
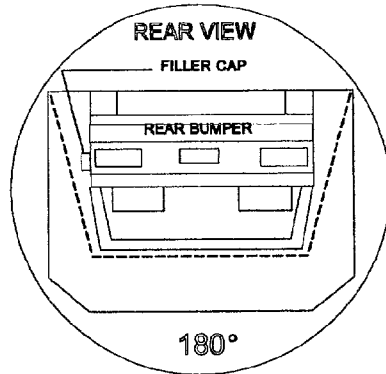
None

Table 7

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

TEST PHASE :
180-270 Deg.

Vehicle NHTSA ID No. :
CX0510

I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

Rollover Fixture 90° Rotation Time
 (Spec. Range = 1 to 3 minutes)

1 minutes 01 seconds

FMVSS 301 Position Hold Time +

5 minutes 00 seconds

TOTAL

6 minutes 1 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):

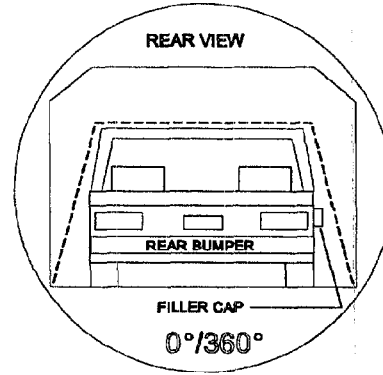
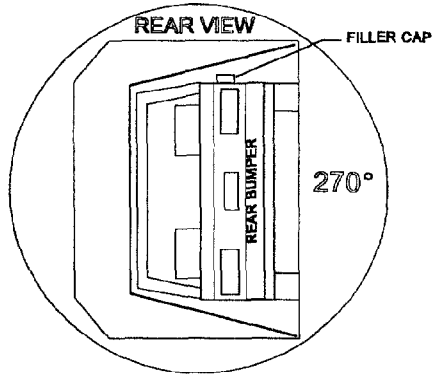
None

Table 7

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

TEST PHASE :
270-360 Deg.

Vehicle NHTSA ID No.:
CX0510

I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

Rollover Fixture 90° Rotation Time 1 minutes 06 seconds
 (Spec. Range = 1 to 3 minutes)

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

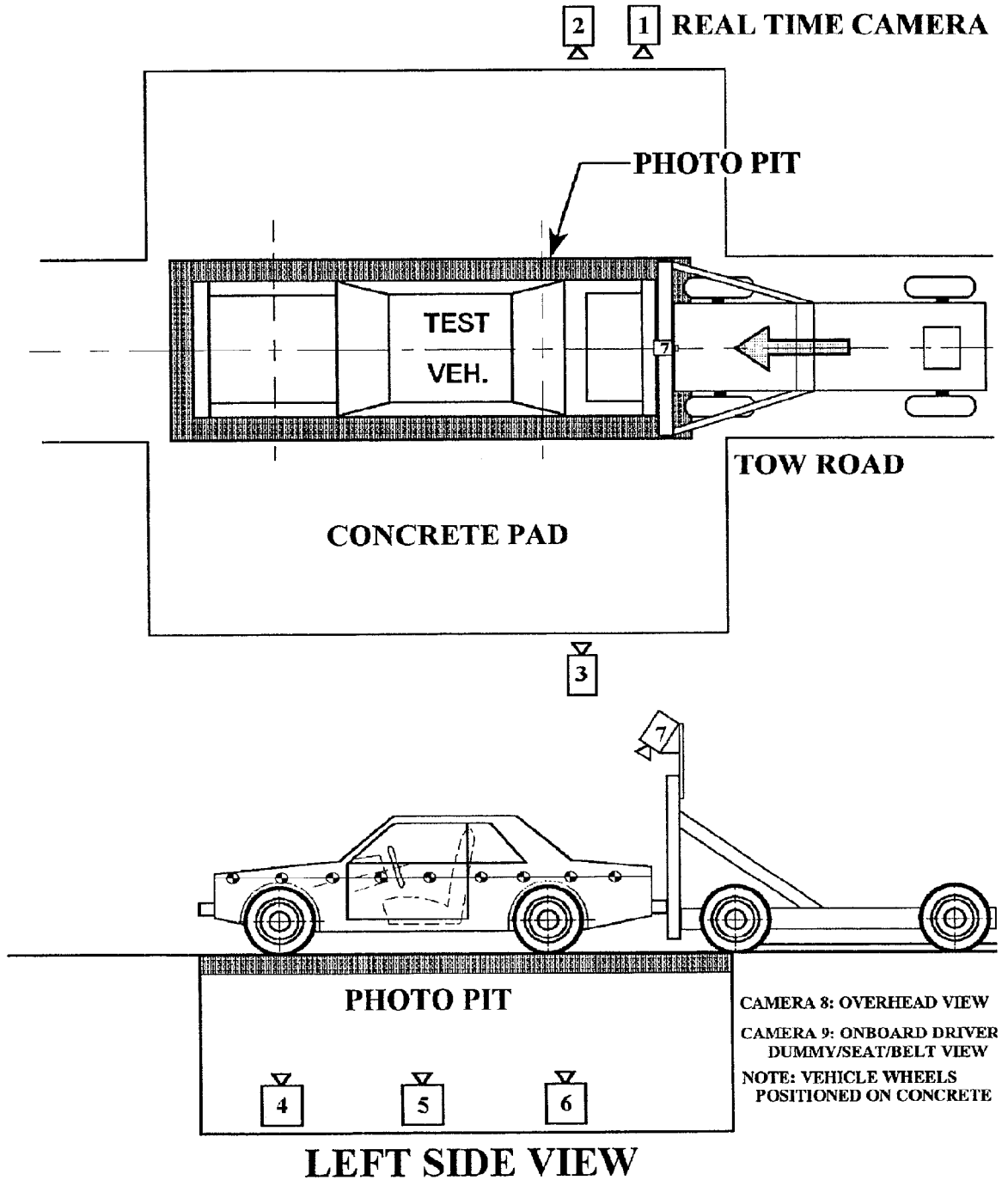


Table 8

HIGH-SPEED CAMERA LOCATIONSNHTSA No. : CX0510 Vehicle : 1999 Hyundai Sonata 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	-506	40	44	1	25	1000
3	Left Side View	504	67	50	0	25	1000
4	Vehicle Front Underbody View	0	36	-77	90	13	600
5	Vehicle Mid-Section Underbody View	0	79	-77	90	13	605
6	Vehicle Rear Underbody View	0	133	-77	90	13	610
7	Moving Barrier View	0	0	99	-105	13	1010
8	Overhead Overall View	-20	0	386	-90	13	1010
9	Onboard Driver Dummy/Seat/Belt View	-	-	-	-	13	715

* 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

Section 4

NONCOMPLIANCE DATA

Table 9

TEST VEHICLE NONCOMPLIANCE NOTICE

NHTSA Contract Lab: Veridian Engineering

Lab Project Manager & Telephone No.: David J. Travale (716) 632 - 7500

Date of Test: June 8, 1999 Vehicle NHTSA No.: CX0510

Vehicle Manufacturer: Hyundai Motor Company

Model Year: 1999 VIN: KMHWF25S3XA035873

Model: Sonata Body Style: 4 door sedan Build Date: 9/30/98

Dummy Stabilized Temperature at Time of Test: 70 °F (Spec. = 69 - 72 °F)

Impact Velocity: 29.5 mph; Time of Test: 11:10

Type of Automatic Restraint System:

Driver: Air Bag with 3 point belt system

Passenger: Air Bag with 3 point belt system

Failure Details:

None

Requirements:

Approximate date that final test report will be made available to CTM:

Date Mfg. Rep. Notified: Rep. Name:

Remarks:

Date of Proposed Joint Inspection of Test Vehicle:

NHTSA CMT: CIR No.: Date:

Table 10

LABORATORY NOTICE OF TEST FAILURE TO OVSC

FMVSS NO.: 301; Test Date: June 8, 1999

Laboratory: Veridian Engineering

Contract No.: DTNH22-95-D-11000; Delv. Order No.: _____

Laboratory Project Engineer's Name: _____

Test Vehicle Year/Make/Model/Body Style:

1999 Hyundai Sonata 4 door sedan

Vehicle NHTSA No.: CX0510; VIN: KMHWF25S3XA035873

Manufacturer: Hyundai Motor Company

Test Failure Description: None

FMVSS Requirement, Paragraph(s) _____:

Notification to NHTSA (COTR): _____

Date: _____; By: _____

Remarks:

Table 11

ANTI-SIPHONING DEVICE FOR ALCOHOL FUEL VEHICLES

Vehicle Model Year/Make/Model/Body: 1999 Hyundai Sonata 4 door sedan

Vehicle NHTSA No.: CX0510 VIN: KMHWF25S3XA035873

Vehicle Build Date: 9/30/98 Test Date: June 8, 1999

Test Laboratory: Veridian Engineering

Observers: _____

1. Provide a description of the anti-siphoning device if possible.

Not Applicable

2. Did the test hose pass through the anti-siphoning device opening?

Yes - _____ No - _____

3. The test hose length outside of the fuel filler neck at maximum insertion:

Length = _____ cm

4. The maximum inserted test hose length is (120.00 cm - measurement from item 3):

Length = _____ cm

5. Was there evidence that the test hose contacted the surface of the Stoddard fluid in the fuel tank of the test vehicle?

Yes - _____ (Fail) No - _____ (Pass)

6. Measure the length of the portion of the hose that was submerged in the Stoddard solvent:

Length = _____ cm

Appendix A
PHOTOGRAPHS

LIST OF PHOTOGRAPHS

<u>Figure</u>	<u>Photograph Title</u>	<u>Page No.</u>
A-1	PRE-TEST FRONT VIEW	A-3
A-2	POST-TEST FRONT VIEW	A-4
A-3	PRE-TEST LEFT SIDE VIEW	A-5
A-4	POST-TEST LEFT SIDE VIEW	A-6
A-5	PRE-TEST RIGHT SIDE VIEW	A-7
A-6	POST-TEST RIGHT SIDE VIEW	A-8
A-7	PRE-TEST REAR VIEW	A-9
A-8	POST-TEST REAR VIEW	A-10
A-9	PRE-TEST LEFT FRONT THREE-QUARTER VIEW	A-11
A-10	POST-TEST LEFT FRONT THREE-QUARTER VIEW	A-12
A-11	PRE-TEST RIGHT REAR THREE-QUARTER VIEW	A-13
A-12	POST-TEST RIGHT REAR THREE-QUARTER VIEW	A-14
A-13	PRE-TEST FRONT UNDERBODY VIEW	A-15
A-14	POST-TEST FRONT UNDERBODY VIEW	A-16
A-15	PRE-TEST REAR UNDERBODY VIEW	A-17
A-16	POST-TEST REAR UNDERBODY VIEW	A-18
A-17	CERTIFICATION PLACARD	A-19
A-18	TIRE PLACARD	A-20
A-19	ROLLOVER 90°	A-21
A-20	ROLLOVER 180°	A-22
A-21	ROLLOVER 270°	A-23
A-22	ROLLOVER 360°	A-24

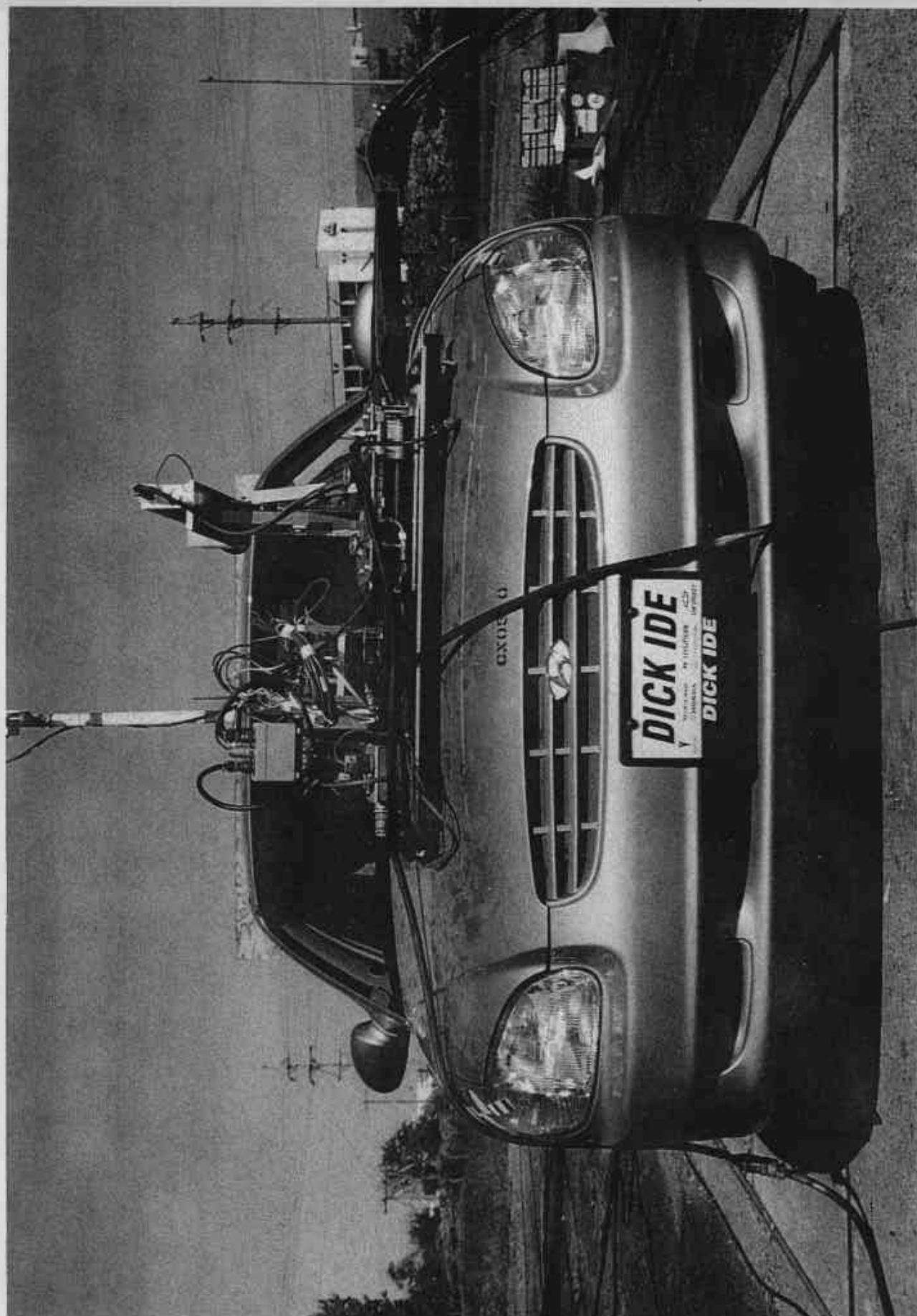


Figure A-1 PRE-TEST FRONT VIEW

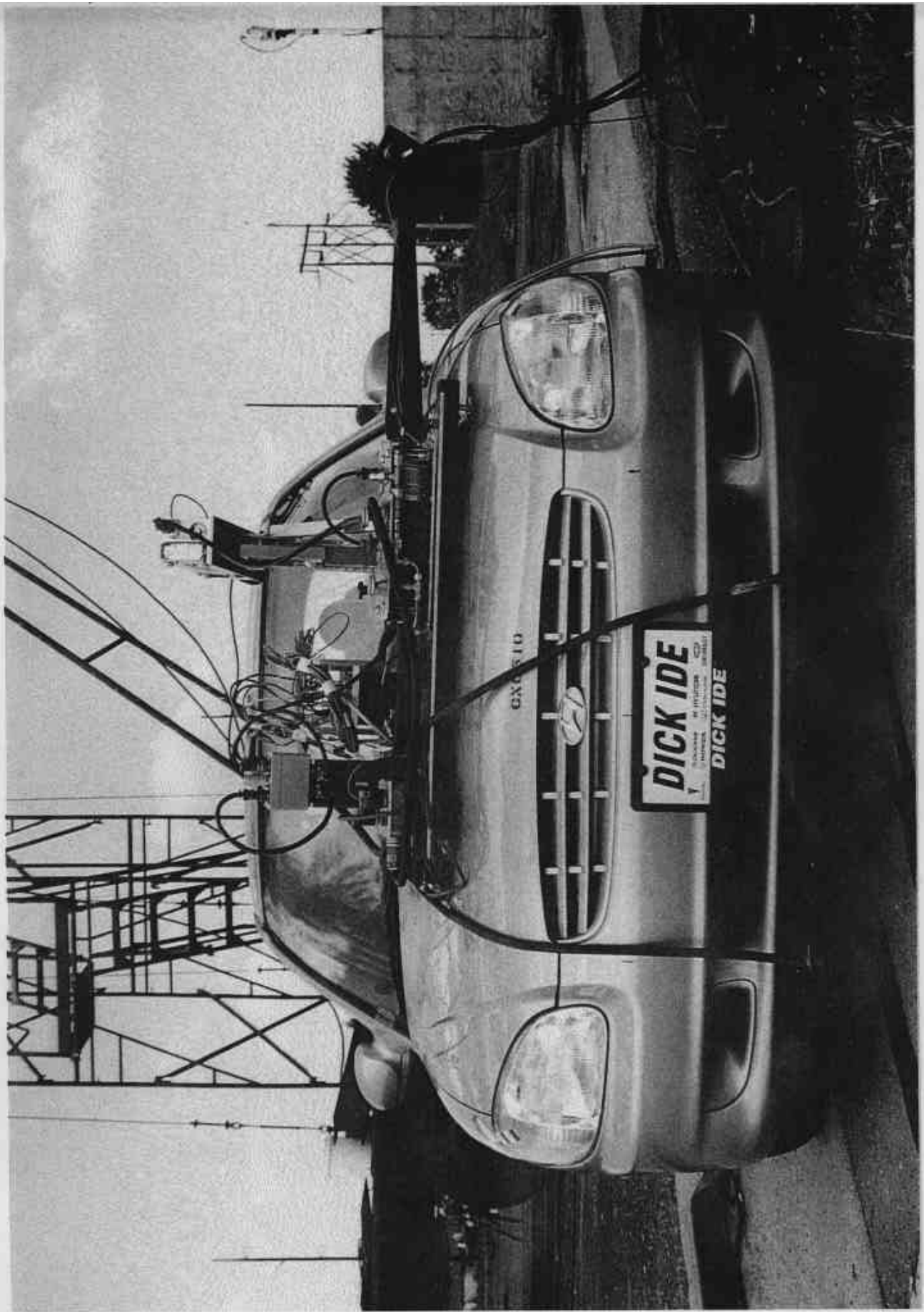


Figure A-2 POST-TEST FRONT VIEW

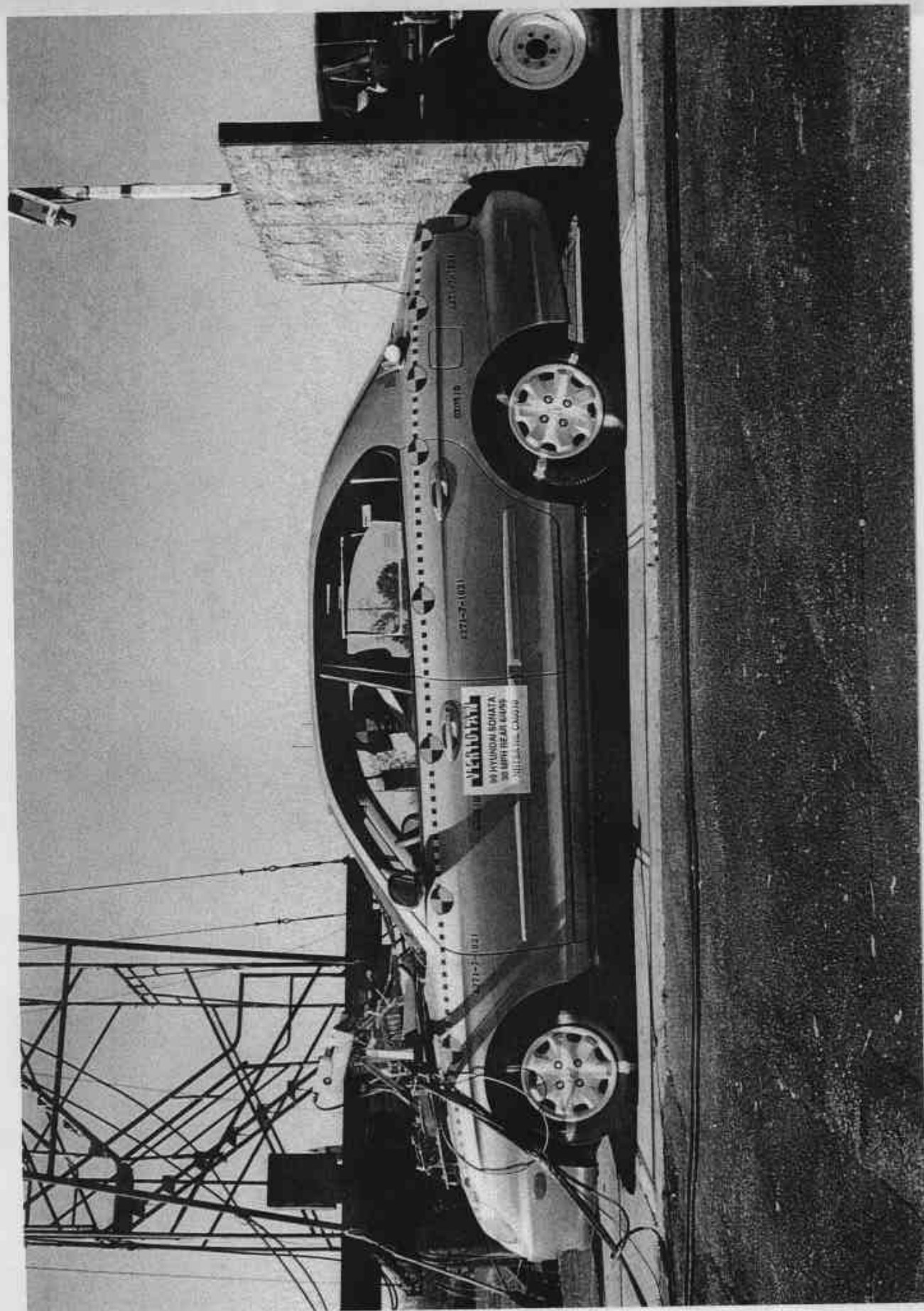


Figure A-3 PRE-TEST LEFT SIDE VIEW



Figure A-4 POST-TEST LEFT SIDE VIEW

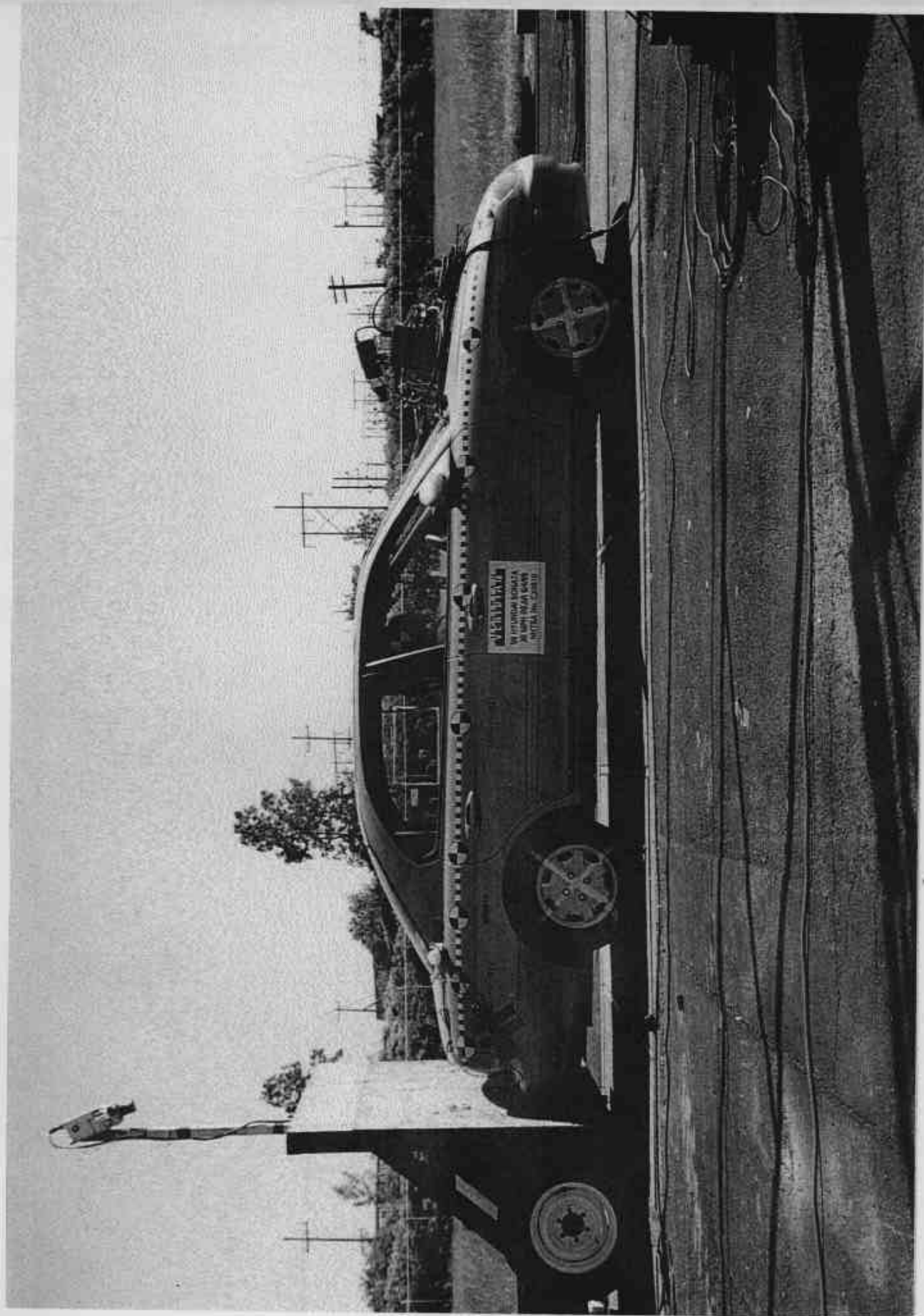


Figure A-5 PRE-TEST RIGHT SIDE VIEW

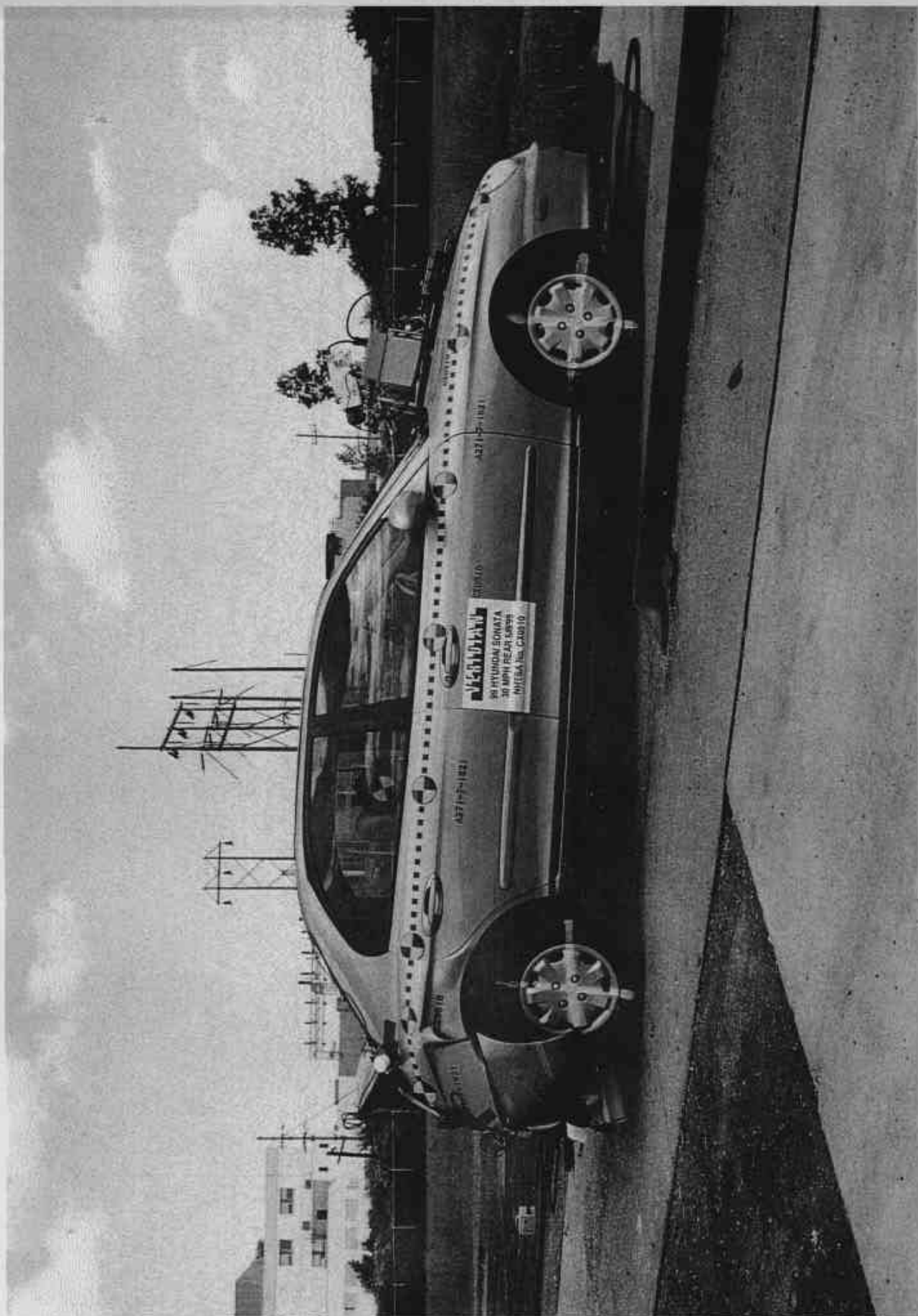


Figure A-6 POST-TEST RIGHT SIDE VIEW



Figure A-7 PRE-TEST REAR VIEW



Figure A-8 POST-TEST REAR VIEW

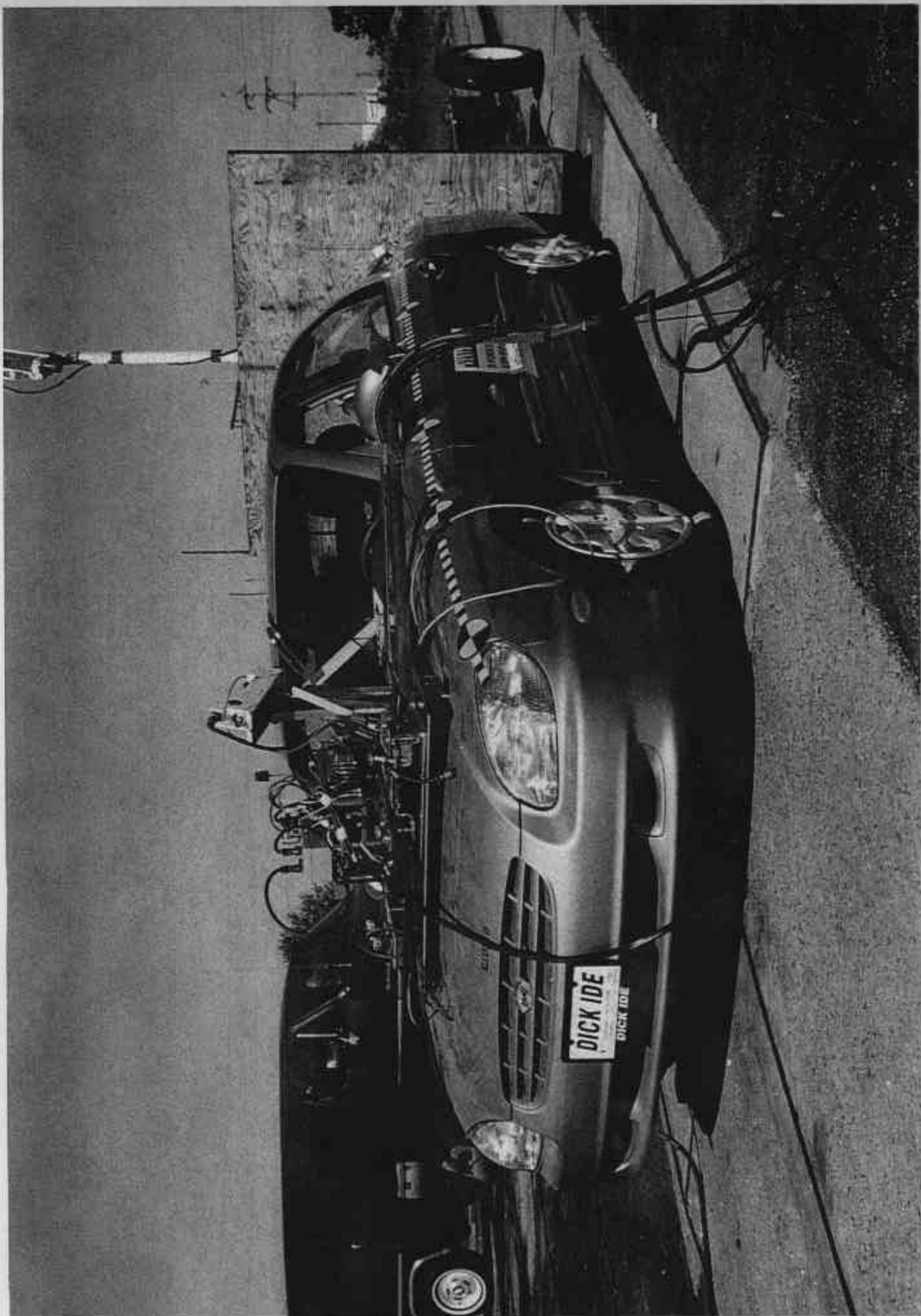


Figure A-9 PRE-TEST LEFT FRONT THREE-QUARTER VIEW



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



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

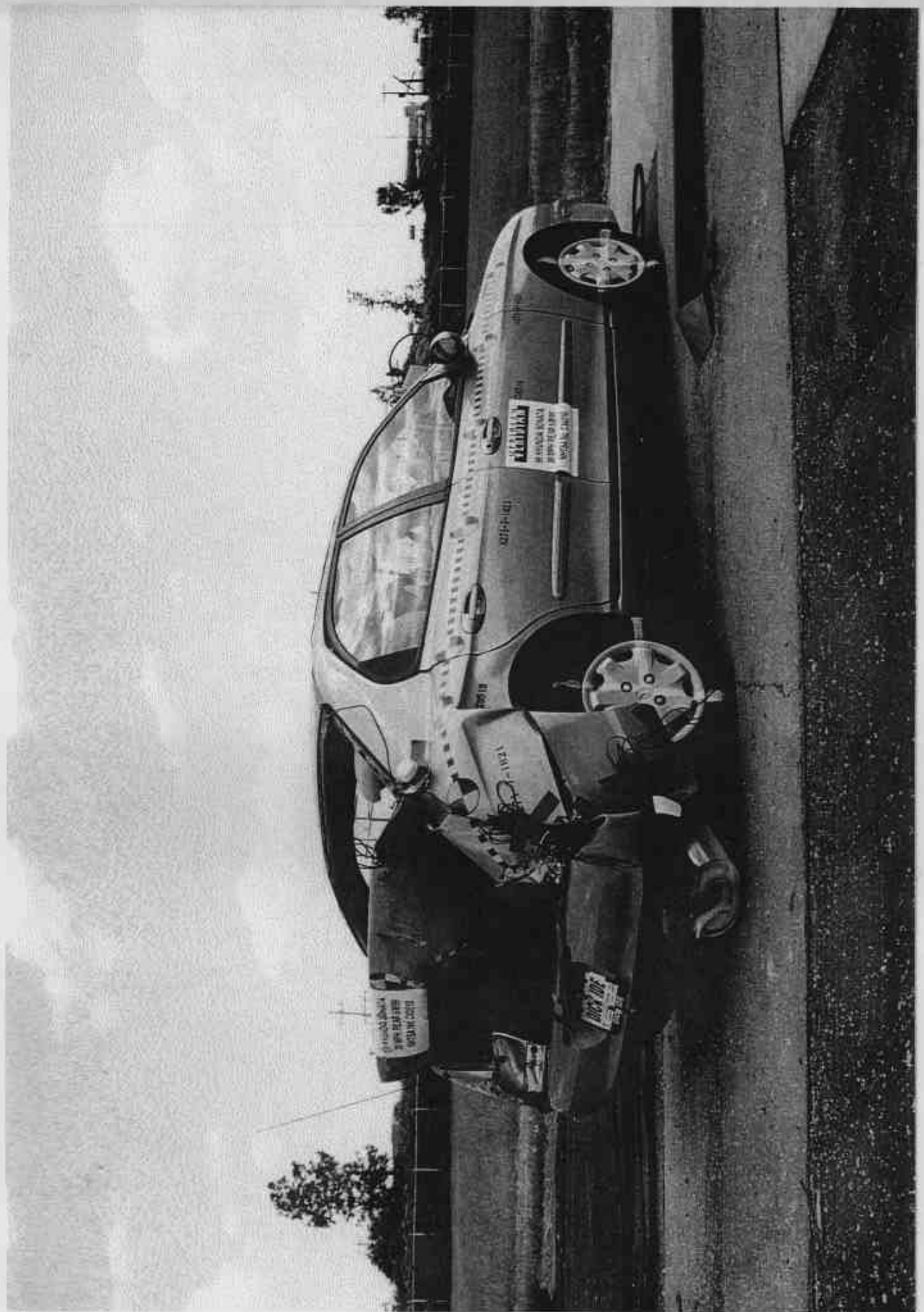


Figure A-12 POST-TEST RIGHT REAR THREE-QUARTER VIEW

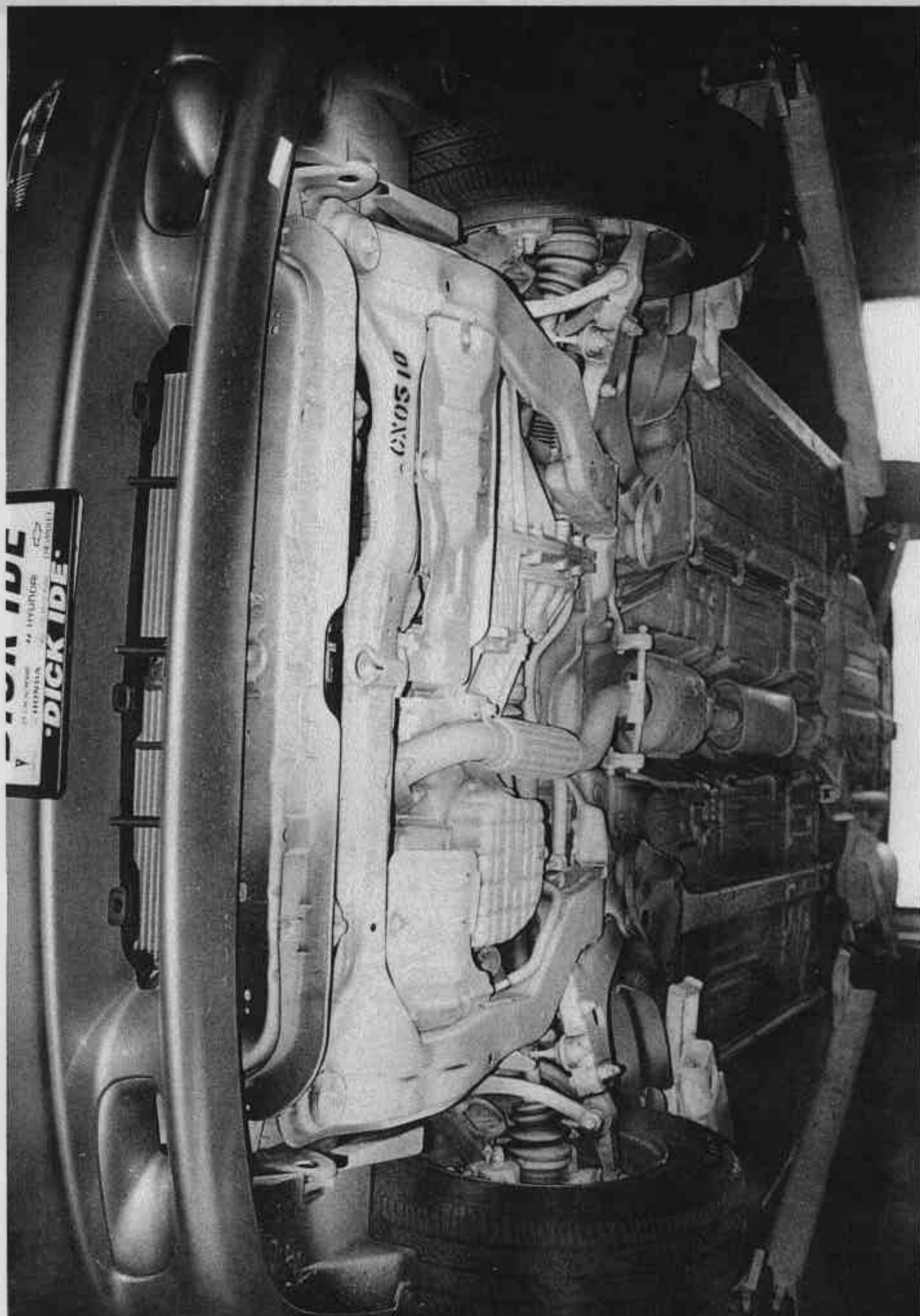


Figure A-13 PRE-TEST FRONT UNDERBODY VIEW

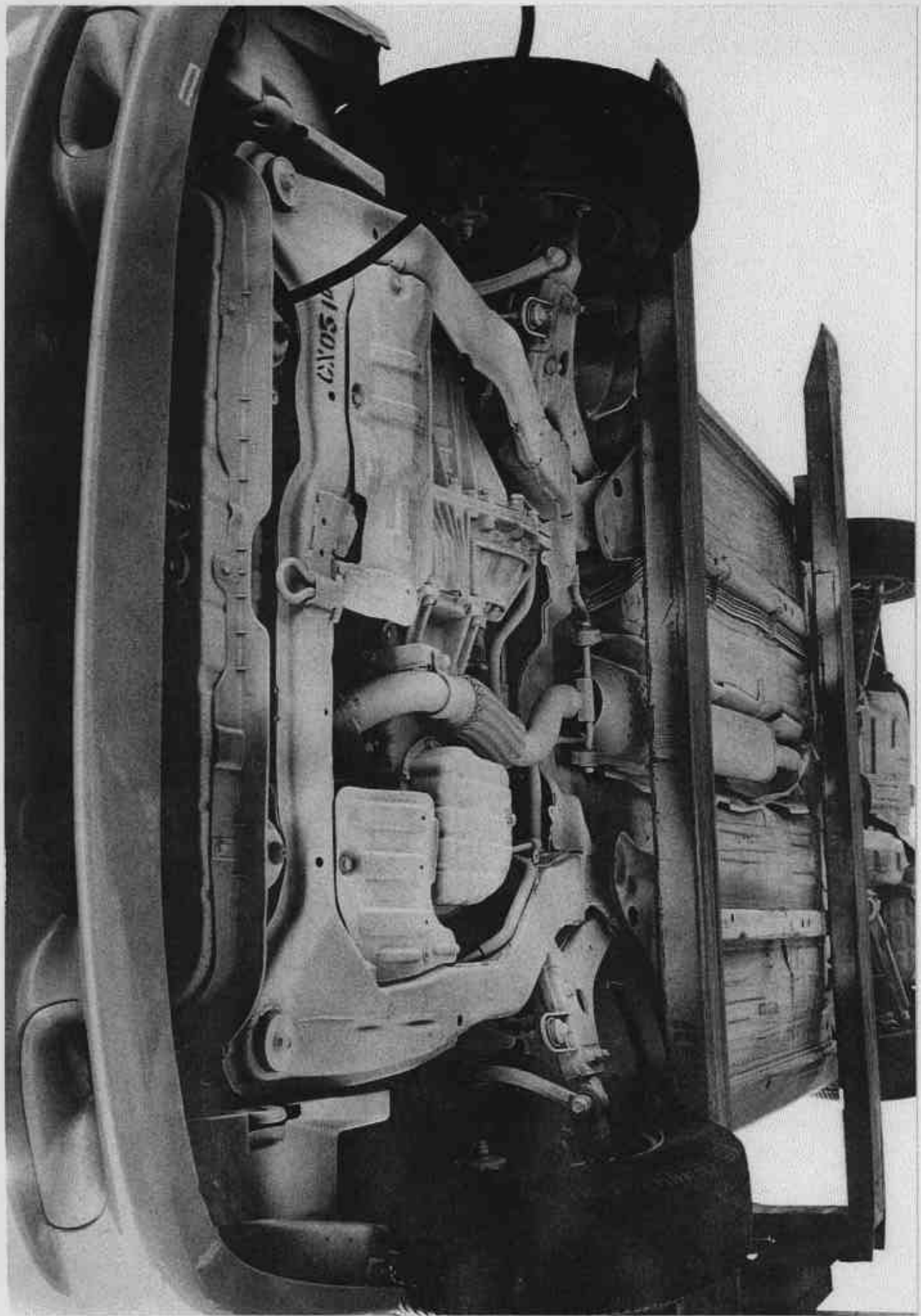


Figure A-14 POST-TEST FRONT UNDERBODY VIEW

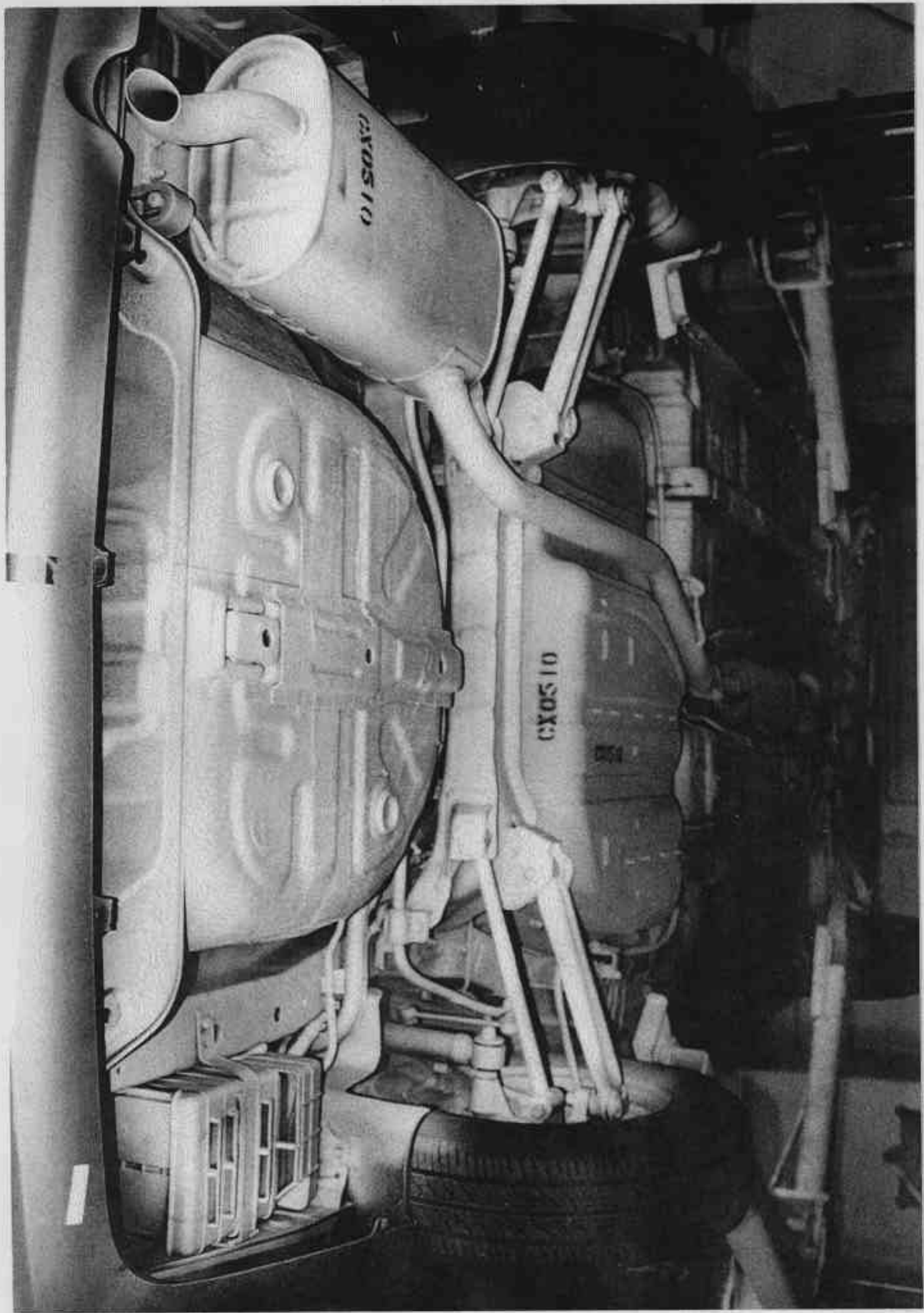


Figure A-15 PRE-TEST REAR UNDERBODY VIEW

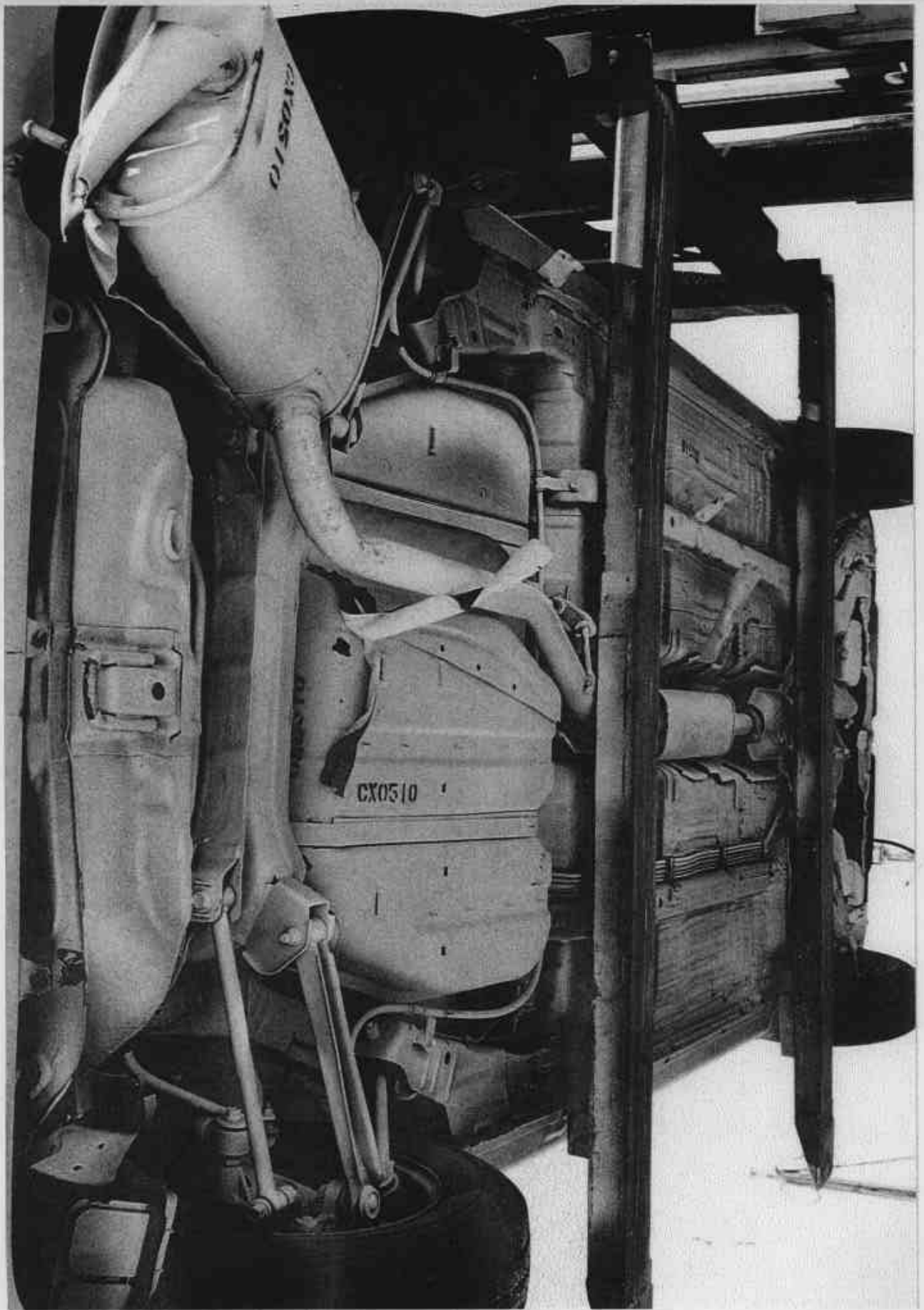


Figure A-16 POST-TEST REAR UNDERBODY VIEW

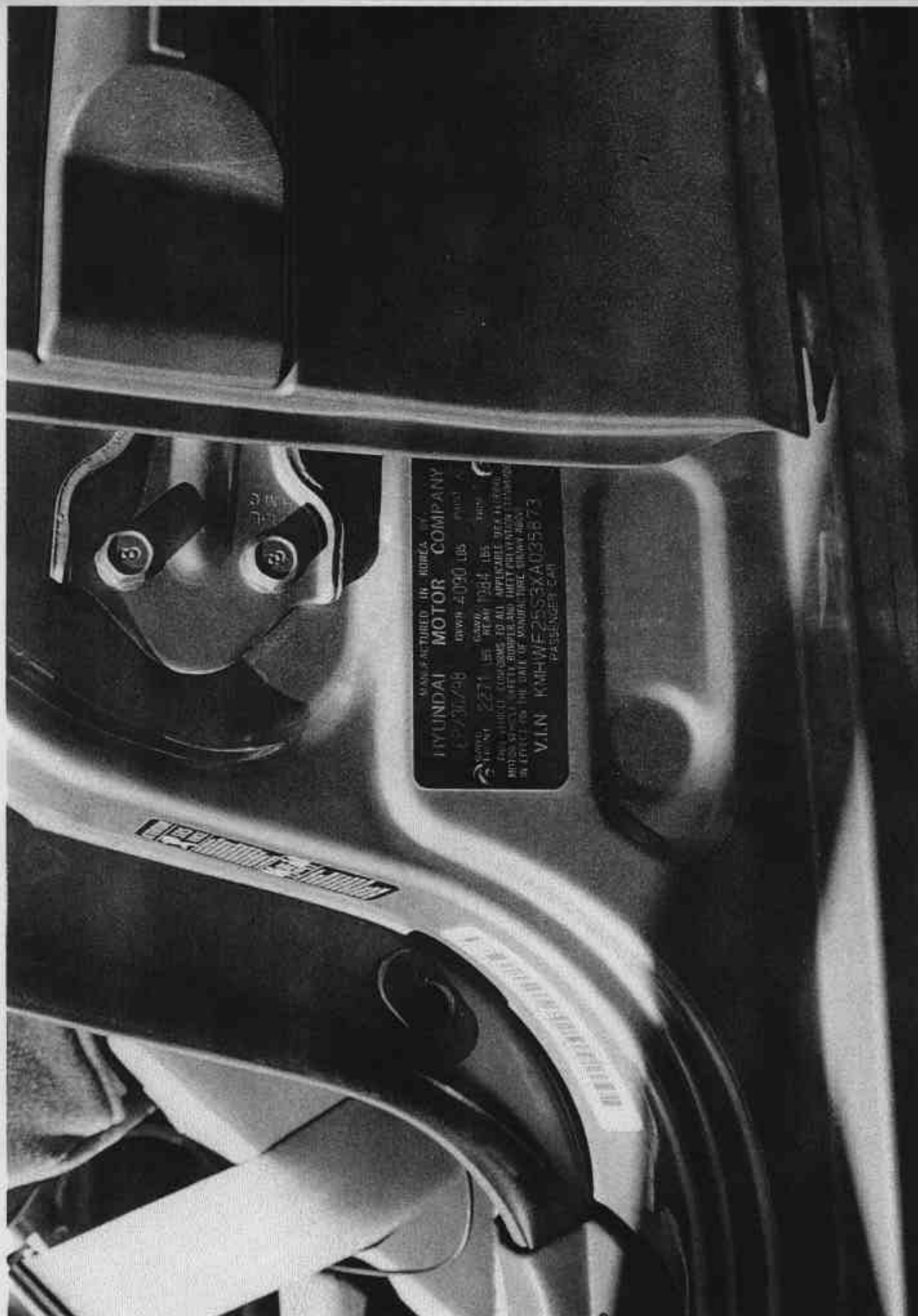
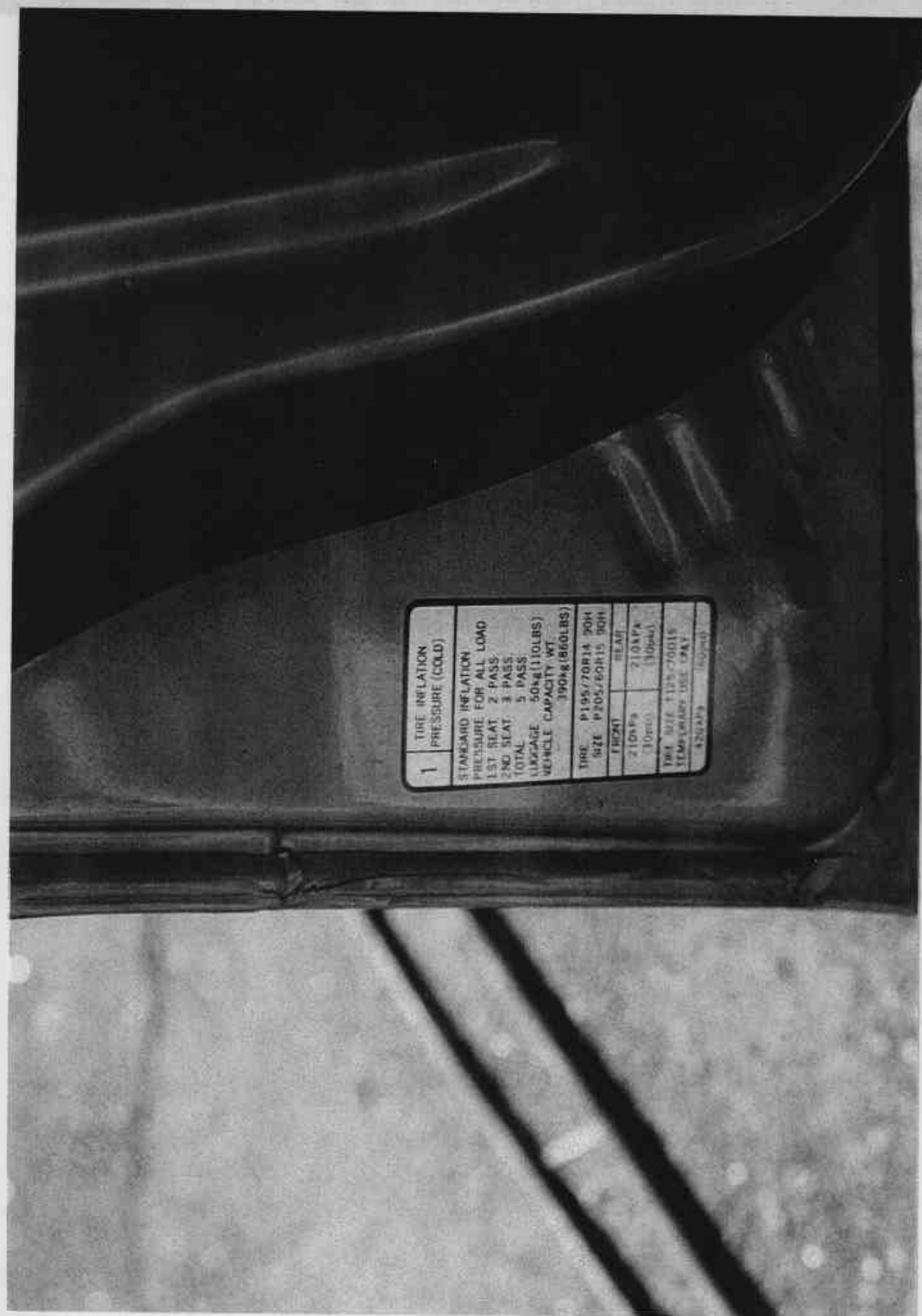


Figure A-17 CERTIFICATION PLACARD



1	TIRE INFLATION PRESSURE (COLD)
STANDARD INFLATION PRESSURE FOR ALL LOAD	
1ST SEAT	2-PASS
2ND SEAT	3-PASS
TOTAL	5-PASS
LIKAGE	50kg(110LBS)
VEHICLE CAPACITY WT	390kg(860LBS)
TIRE	P195/70R14 90H
SIZE	P205/60R15 90H
FRONT	REAR
210kPa (30psi)	210kPa (30psi)
TIRE SIZE 11.5-70015	
TEMPERATURE USE 194F	
420kPa	420kPa

Figure A-18 TIRE PLACARD



Figure A-20 ROLLOVER 180°

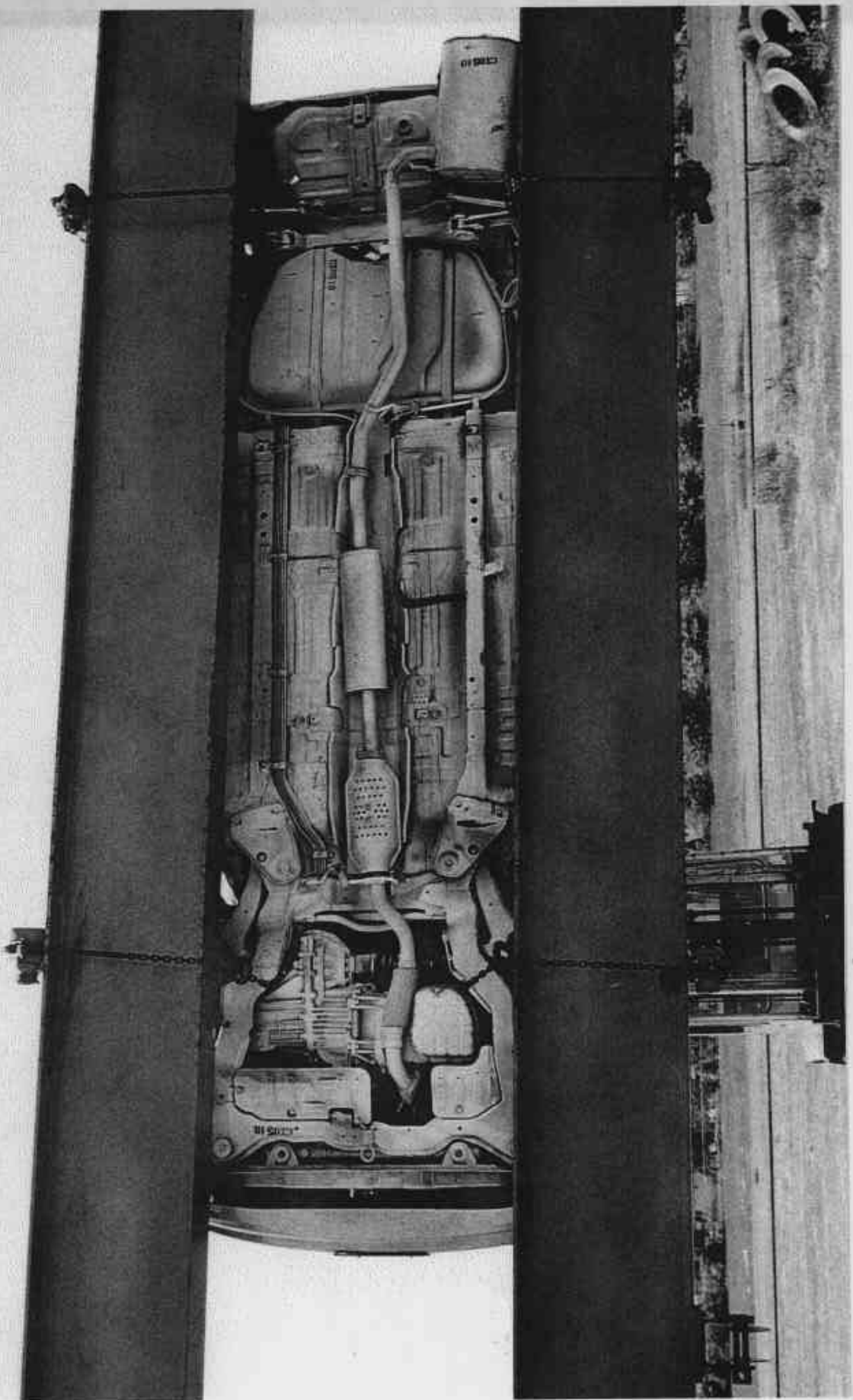


Figure A-21 ROLLOVER 270°



Figure A-22 ROLLOVER 360°

Appendix B

VEHICLE AND DUMMY RESPONSE DATA

(REAR IMPACT ONLY)

FACILITY: VERF

DATE: June 08, 1999

TEST#: A271-0070-1822

TITLE: 301 Test #7 1999 Hyundai Sonata CX0510

CHN	NAME	Unit	Max	msec	Min	msec	Filt
24	Acc #3(X) Upper Seat Back X	g	41.5	107.9	-29.6	101.3	60
25	Acc #4(X) Lower Seat Back X	g	25.6	112.6	-42.4	106.0	60
29	Acc #1(X) Left Rear Xmember	g	0.3	133.6	-0.2	59.0	60
32	Acc #2(X) Right Rear Xmember	g	16.9	8.3	-2.0	130.9	60
35	Driver Head X	g	13.7	105.5	-0.4	32.5	1000
36	Driver Head Y	g	2.0	94.6	-1.6	106.1	1000
37	Driver Head Z	g	13.0	101.5	-1.9	51.4	1000
38	Driver Head Resultant	g	18.4	105.4	0.0	-2.7	1000
39	Driver Upper Neck Fx	lbf	24.2	112.6	-5.2	58.0	1000
40	Driver Upper Neck Fy	lbf	14.5	206.3	-7.7	127.9	1000
41	Driver Upper Neck Fz	lbf	164.6	103.2	-21.2	50.9	1000
42	Driver Upper Neck F Resultant	lbf	164.8	103.2	0.0	-64.4	1000
43	Driver Upper Neck Mx	in-lb	38.5	100.2	-19.2	140.6	600
44	Driver Upper Neck My	in-lb	91.1	186.5	-67.1	100.4	600
45	Driver Upper Neck Mz	in-lb	25.5	102.9	-10.9	140.7	600
46	Driver Upper Neck M Resultant	in-lb	92.6	186.6	0.0	-99.6	600
47	Driver Chest X	g	15.1	83.2	0.0	493.8	180
48	Driver Chest Y	g	1.6	132.8	-0.9	89.9	180
49	Driver Chest Z	g	4.5	91.8	-0.9	225.5	180
50	Driver Chest Resultant	g	15.7	82.8	0.0	-56.9	180
51	Driver Chest Displacement	in	0.0	114.1	0.0	28.1	600
52	Driver Pelvic X	g	18.8	70.2	-4.6	131.7	1000
53	Driver Pelvic Y	g	2.8	87.7	-3.2	109.2	1000
54	Driver Pelvic Z	g	6.4	77.9	-1.3	104.5	1000
55	Driver Pelvic Resultant	g	19.8	74.1	0.0	-22.6	1000
56	Driver Belt Spoolout	in	3.9	86.3	0.0	-100.0	180

P1 HIC(36ms): 26.0

t1: 91.8 msec

t2: 127.8 msec

Duration: 36.0 msec

Average Acceleration: 13.9 g

Input channels: Driver Head X (2) CFC_1000

Driver Head Y (3) CFC_1000

Driver Head Z (4) CFC_1000

P1 CLIP(3ms): 15.6 g

t1: 81.3 msec

t2: 84.3 msec

Duration: 3.0 msec

P1 CSI: 28.7

Input channels: Driver Chest X (5) CFC_180

Driver Chest Y (6) CFC_180

Driver Chest Z (7) CFC_180

TEST NO. CX0510

VEHICLE

SAE FILTER CHANNEL CLASS

60

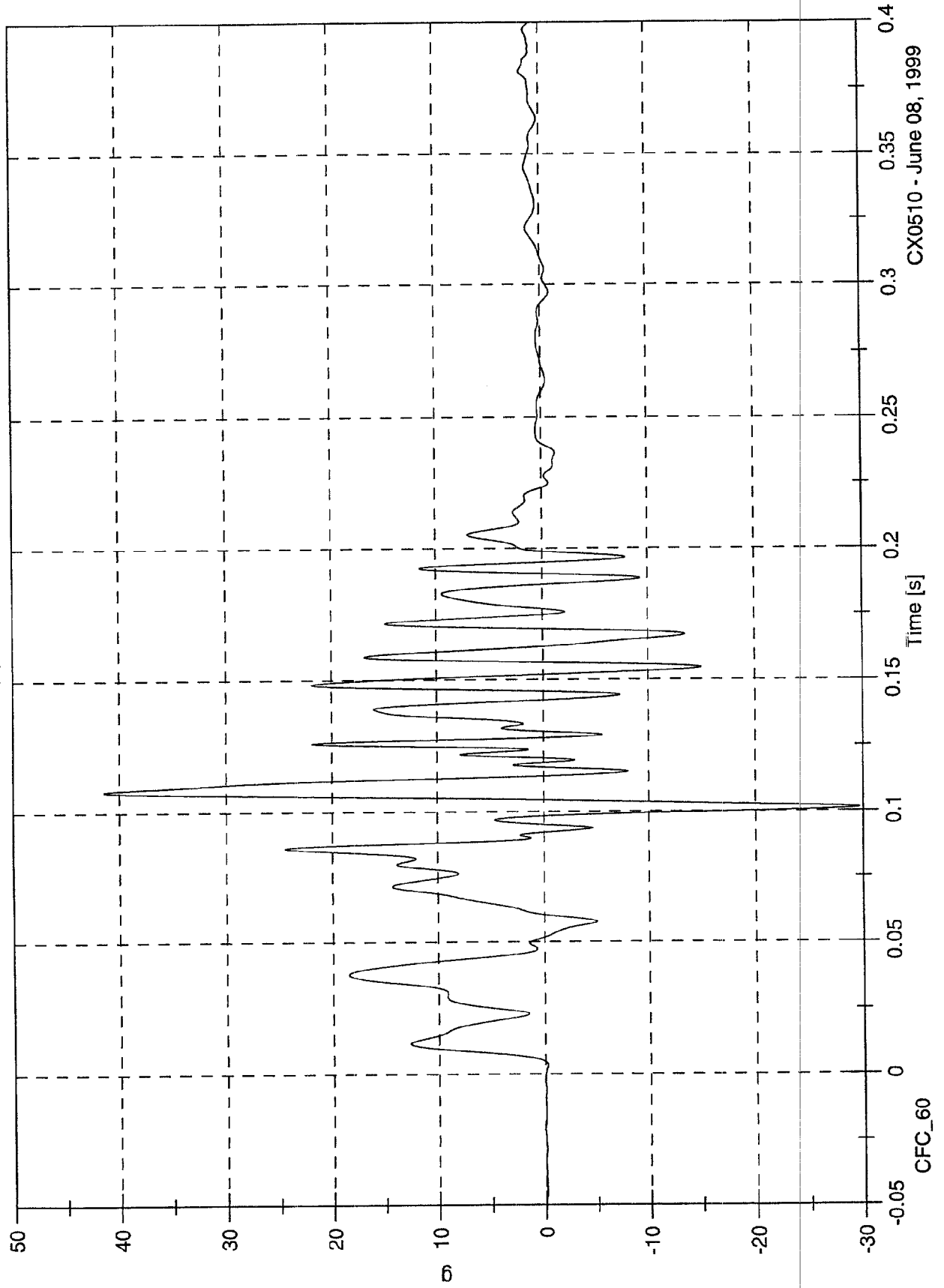
Note: Angular seatback position is measured in degrees of rotation from the initial (design) position.

301 Test #7 1999 Hyundai Sonata

Acc #3(X) Upper Seat Back X

Max: 41.5 [g] at 0.108 [s]

Min: -29.6 [g] at 0.101 [s]



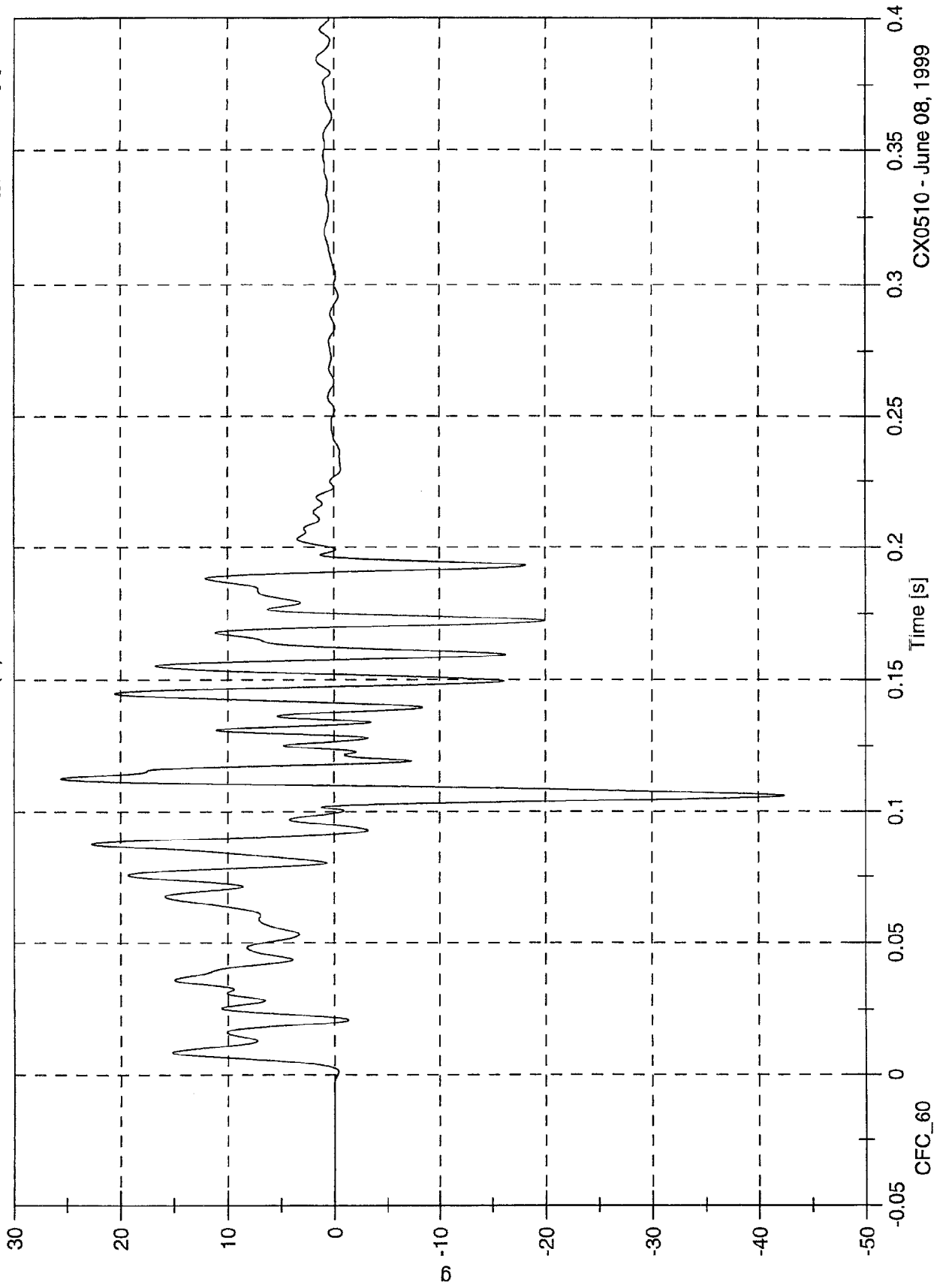
CX0510 - June 08, 1999

301 Test #7 1999 Hyundai Sonata

Max: 25.6 [g] at 0.113 [s]

Min: -42.4 [g] at 0.106 [s]

Acc #4(X) Lower Seat Back X

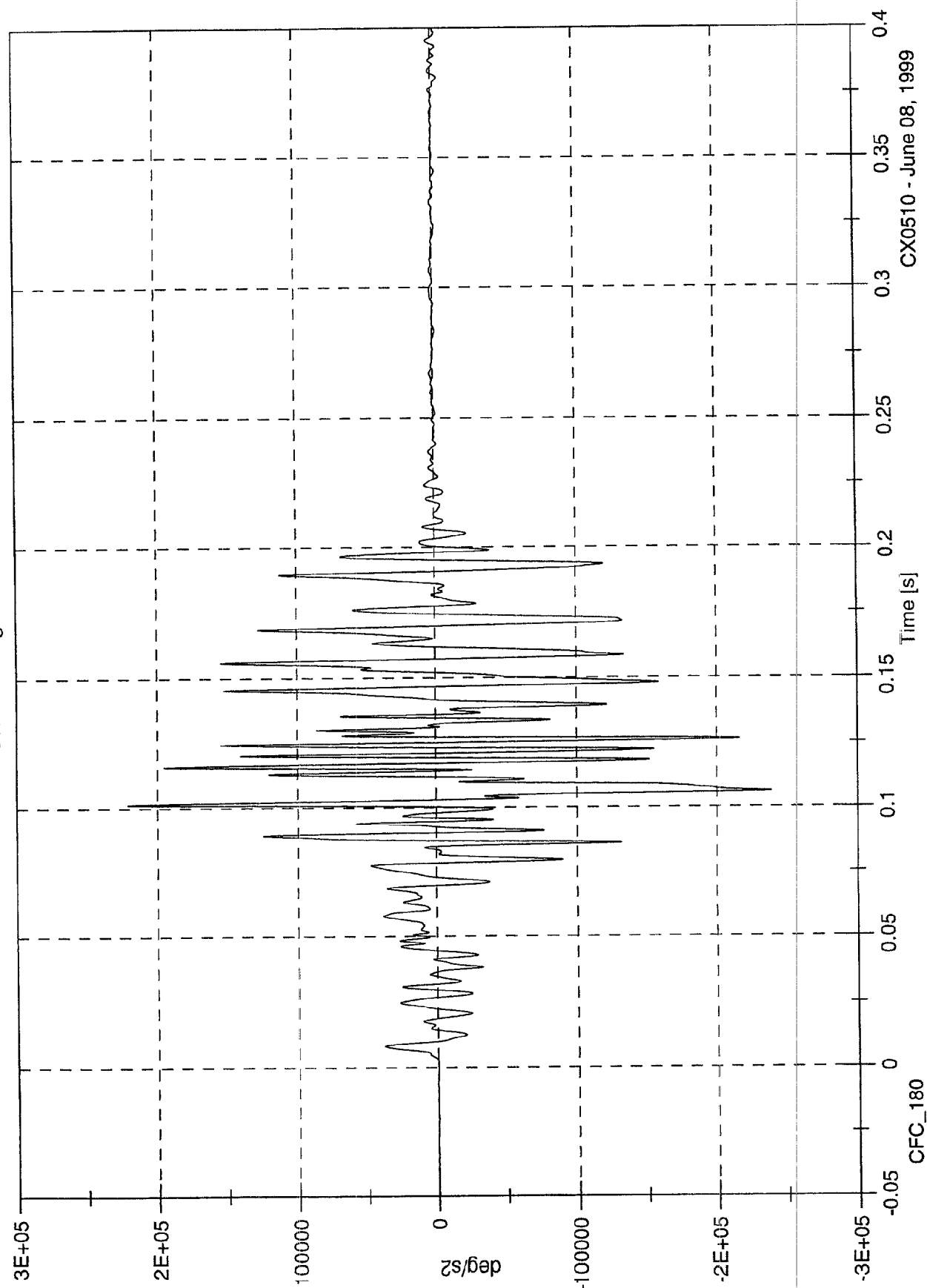


CX0510 - June 08, 1999

Max: 221087.7 [deg/s²] at 0.101 [s]
Min: -238925.0 [deg/s²] at 0.106 [s]

301 Test #7 1999 Hyundai Sonata

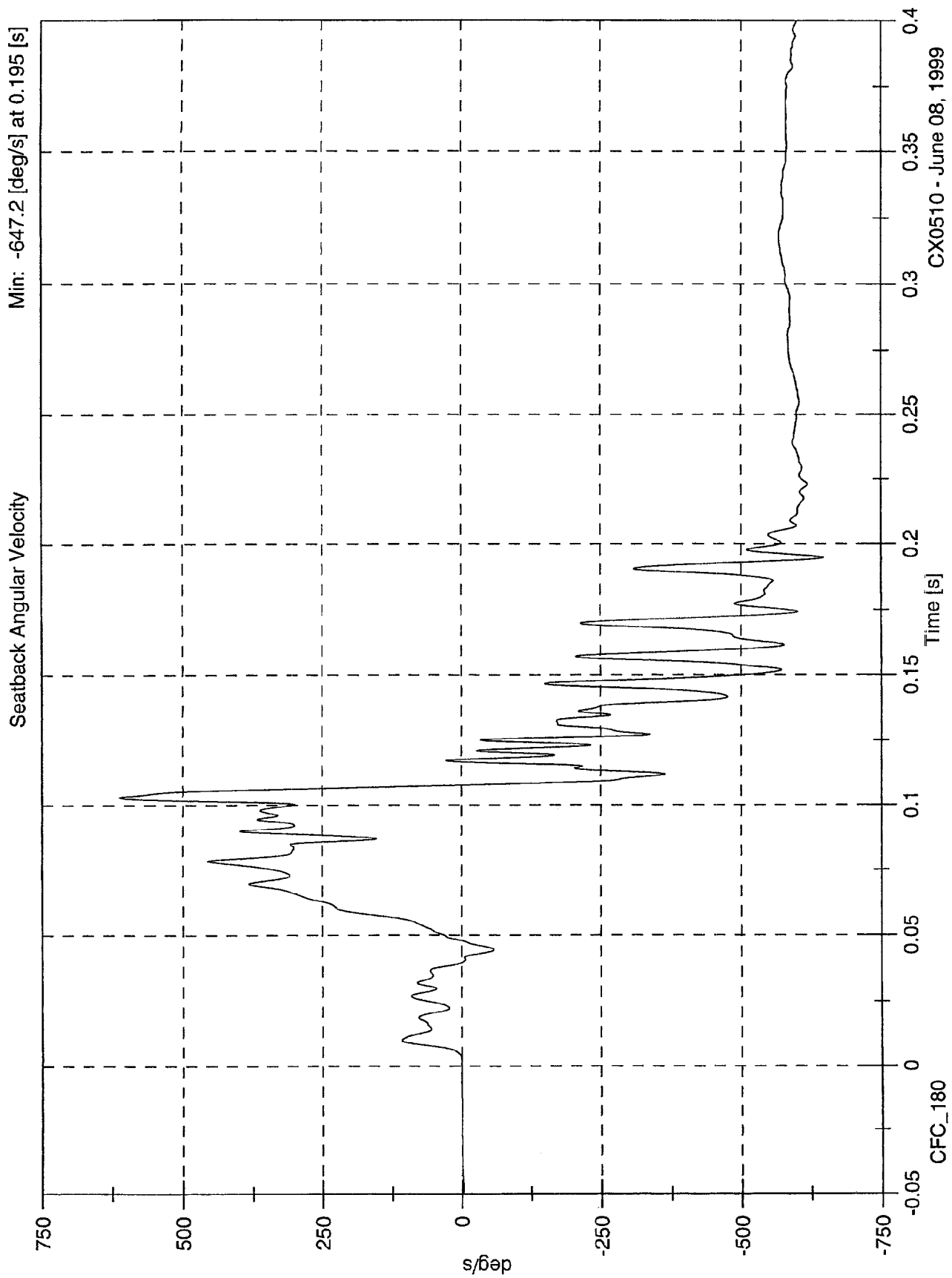
Seatback Angular Acceleration



CX0510 - June 08, 1999

301 Test #7 1999 Hyundai Sonata

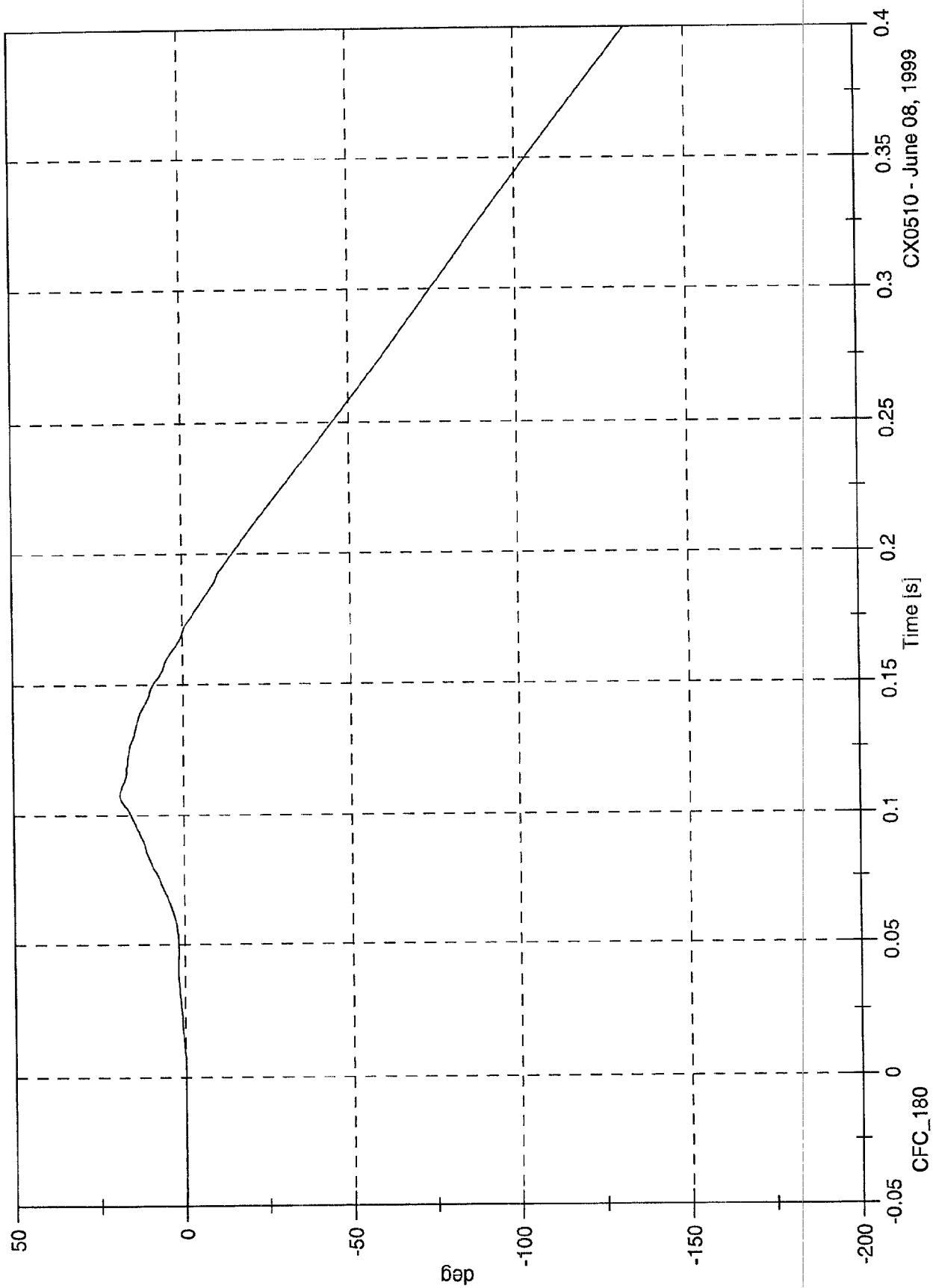
Max: 612.2 [deg/s] at 0.103 [s]
Min: -647.2 [deg/s] at 0.195 [s]



301 Test #7 1999 Hyundai Sonata

Max: 18.8 [deg] at 0.108 [s]
Min: -193.2 [deg] at 0.500 [s]

Seatback Angular Position

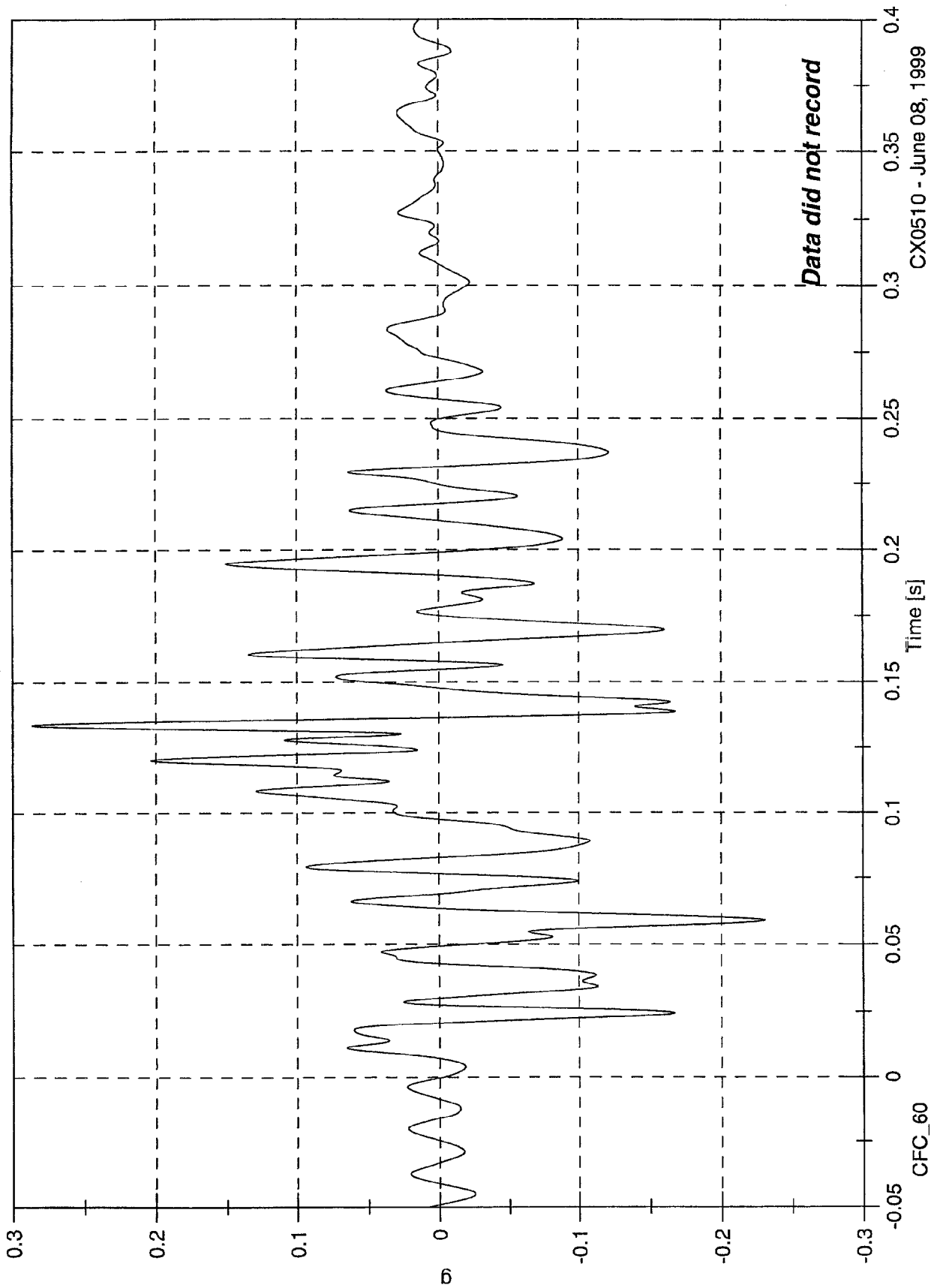


CX0510 - June 08, 1999

301 Test #7 1999 Hyundai Sonata

Max: 0.3 [g] at 0.134 [s]
Min: -0.2 [g] at 0.059 [s]

Acc #1(X) Left Rear Xmember

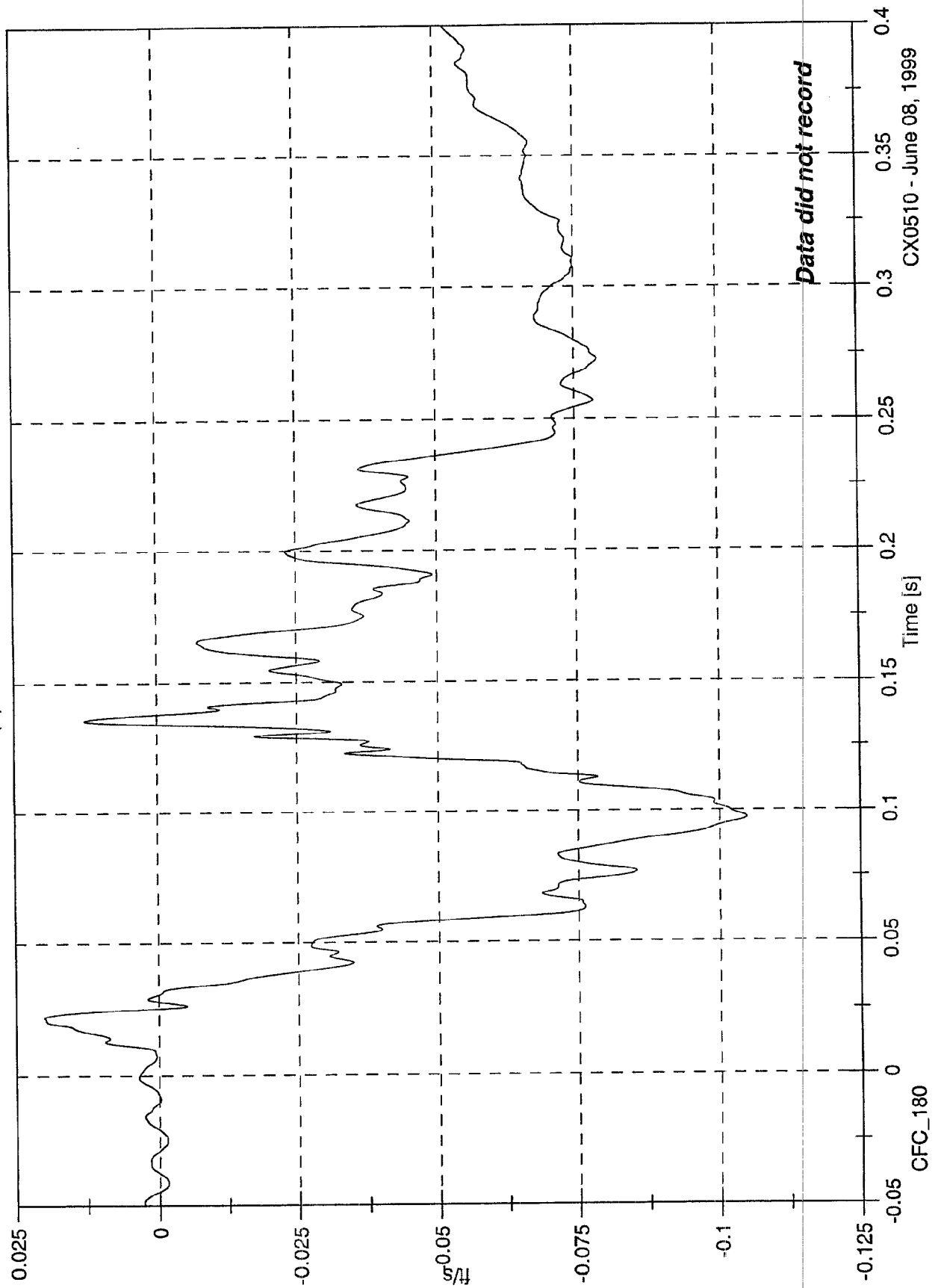


CX0510 - June 08, 1999

301 Test #7 1999 Hyundai Sonata

Max: 0.0 [ft/s] at 0.022 [s]
Min: -0.1 [ft/s] at 0.097 [s]

Acc #1(X) Left Rear Xmember Velocity

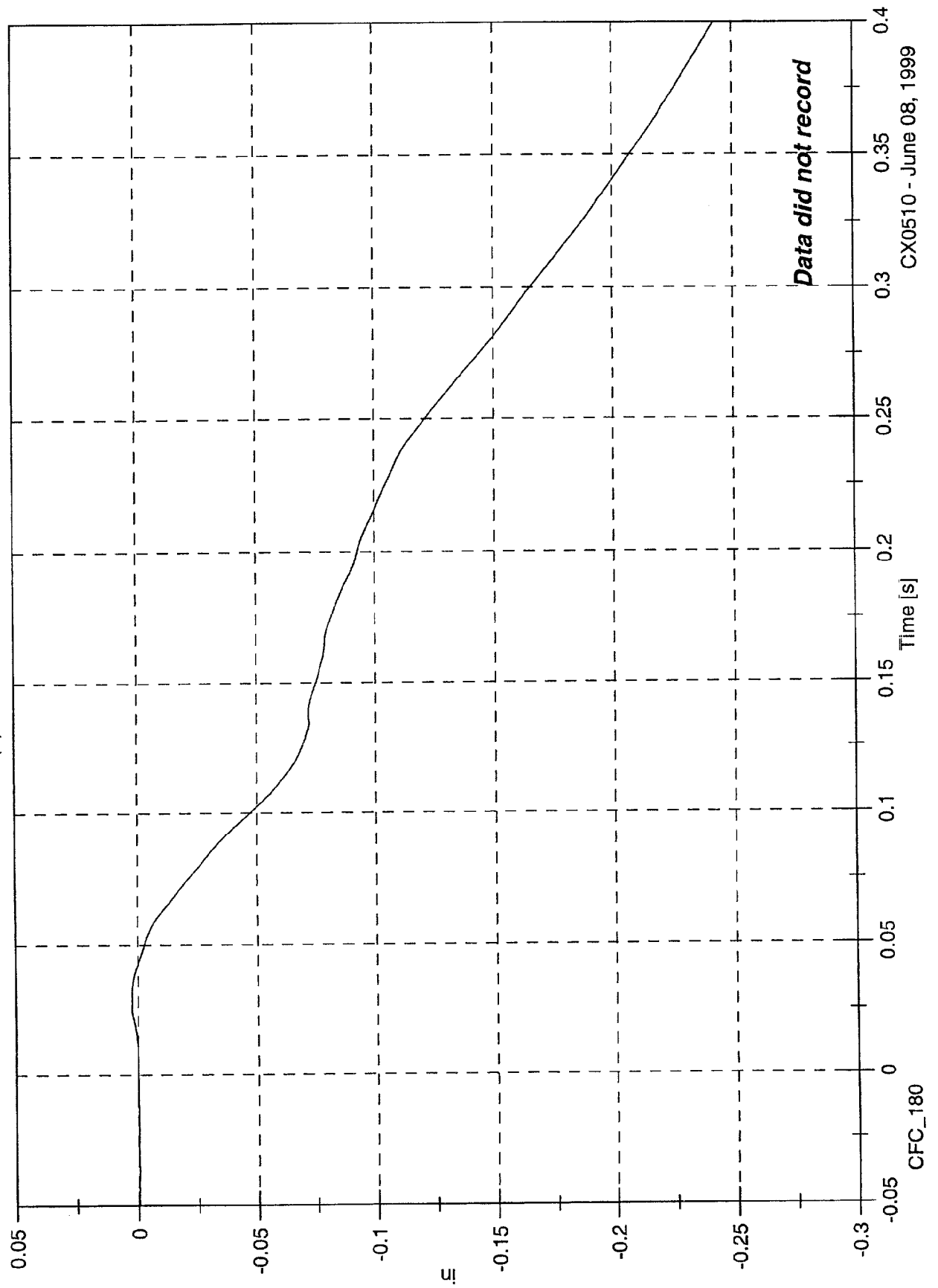


CX0510 - June 08, 1999

301 Test #7 1999 Hyundai Sonata

Max: 0.0 [in] at 0.025 [s]
Min: -0.3 [in] at 0.500 [s]

Acc #1(X) Left Rear Xmember Displacement

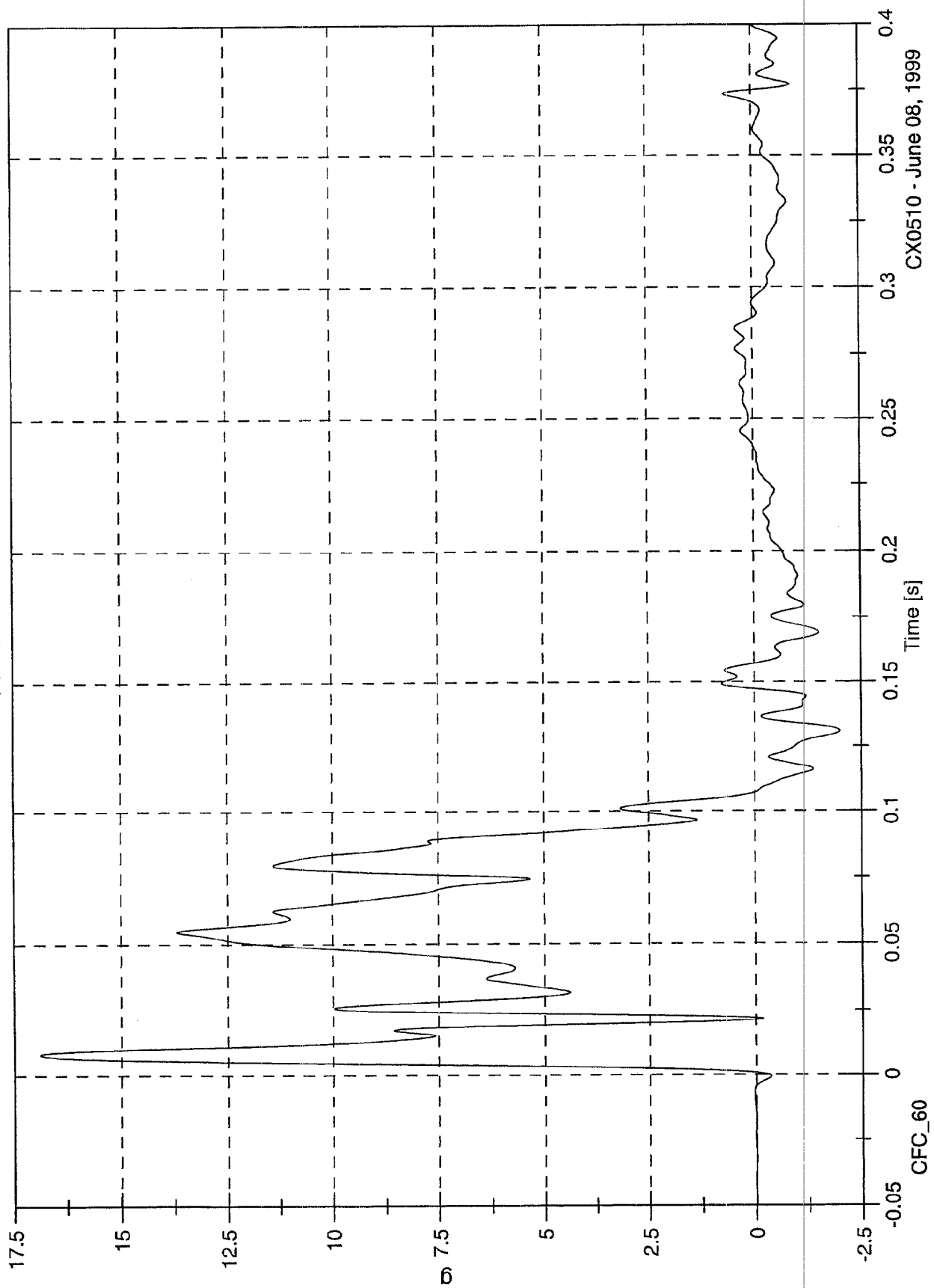


CX0510 - June 08, 1999

301 Test #7 1999 Hyundai Sonata

Max: 16.9 [g] at 0.008 [s]
Min: -2.0 [g] at 0.131 [s]

Acc #2(X) Right Rear Xmember

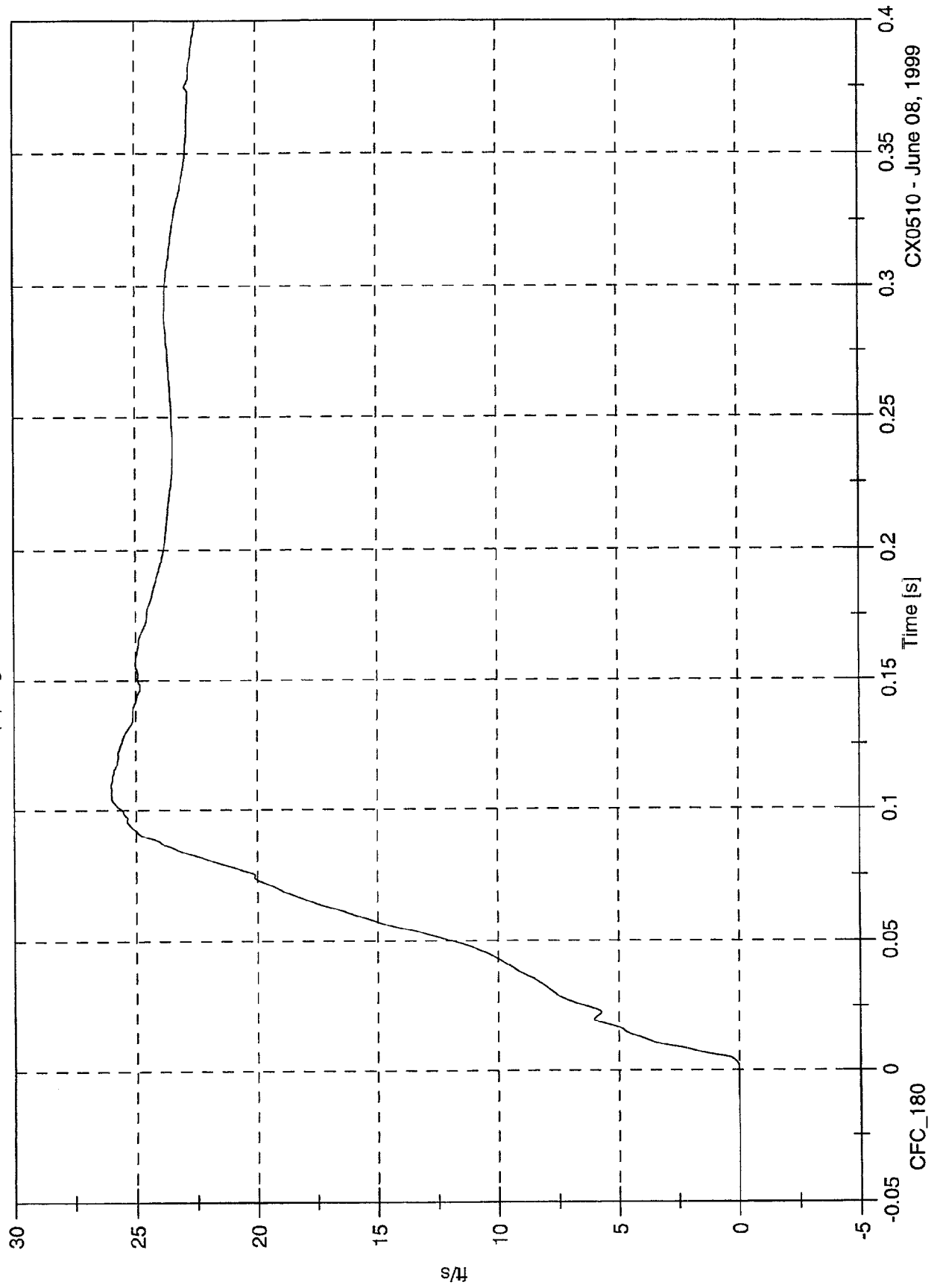


301 Test #7 1999 Hyundai Sonata

Max: 26.0 [ft/s] at 0.106 [s]

Min: -0.0 [ft/s] at -0.063 [s]

Acc #2(X) Right Rear Xmember Velocity



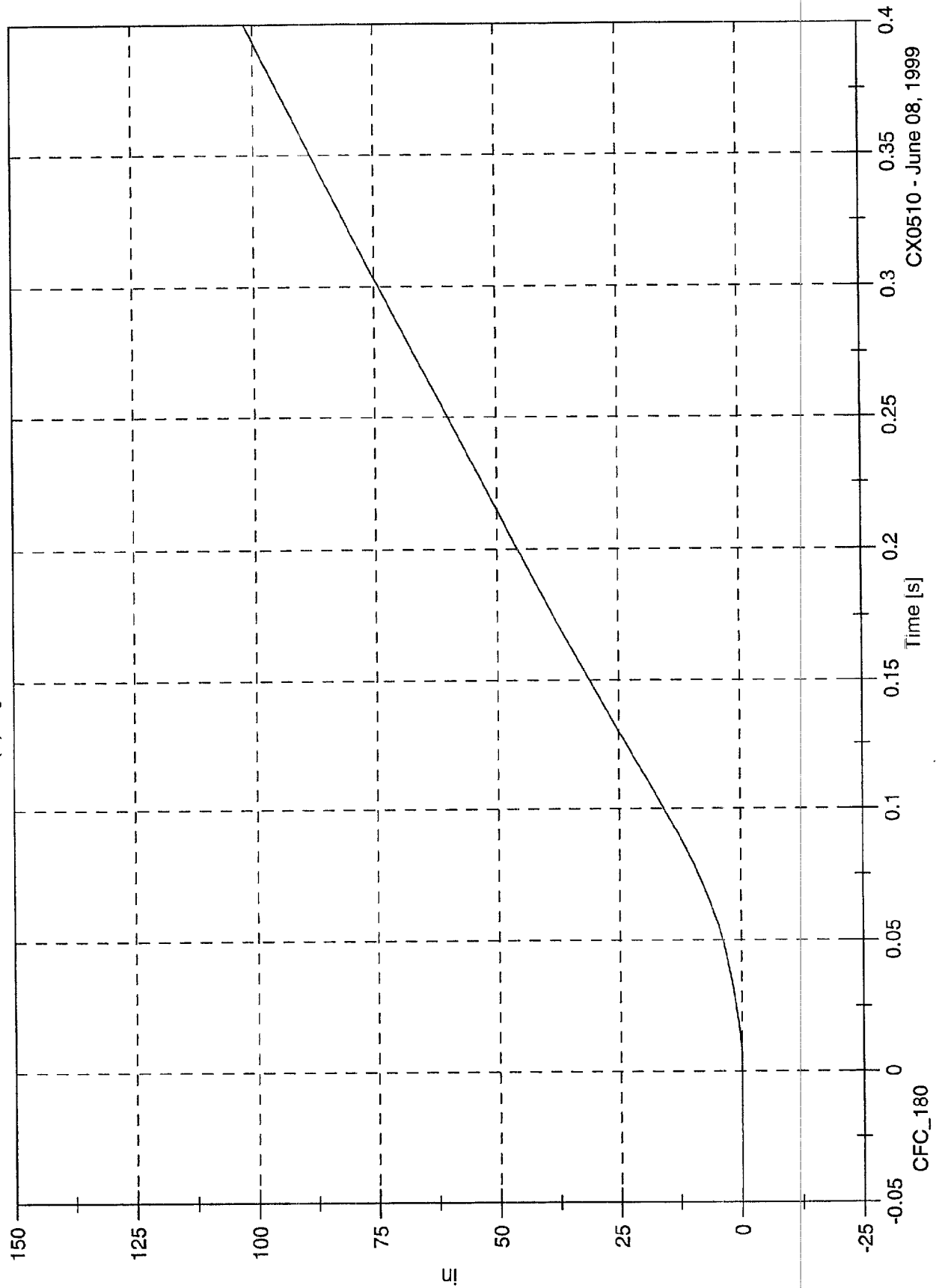
CX0510 - June 08, 1999

301 Test #7 1999 Hyundai Sonata

Max: 128.5 [in] at 0.500 [s]

Min: -0.0 [in] at -0.010 [s]

Acc #2(X) Right Rear Xmember Displacement



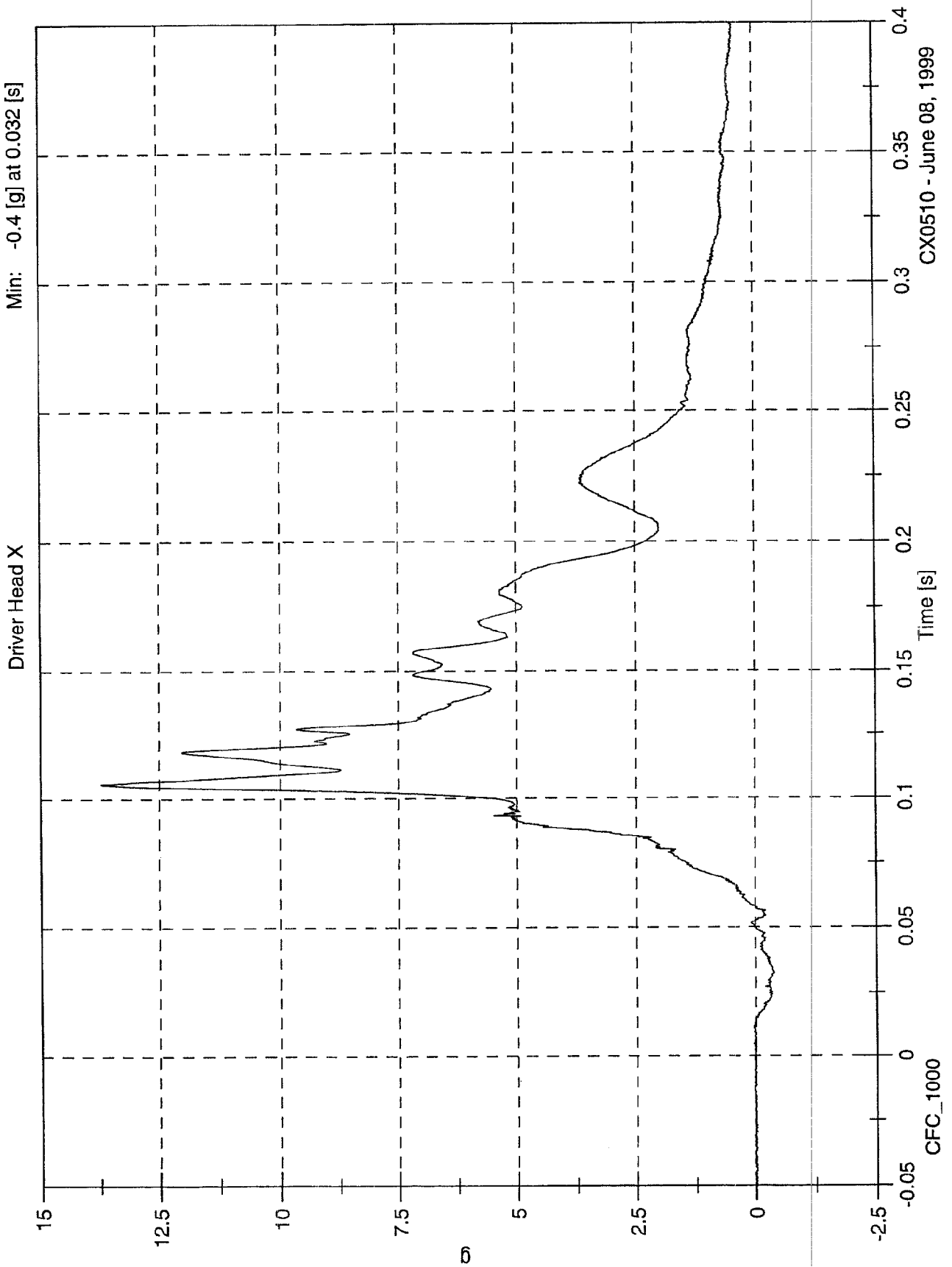
CX0510 - June 08, 1999

TEST NO. CX0510

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

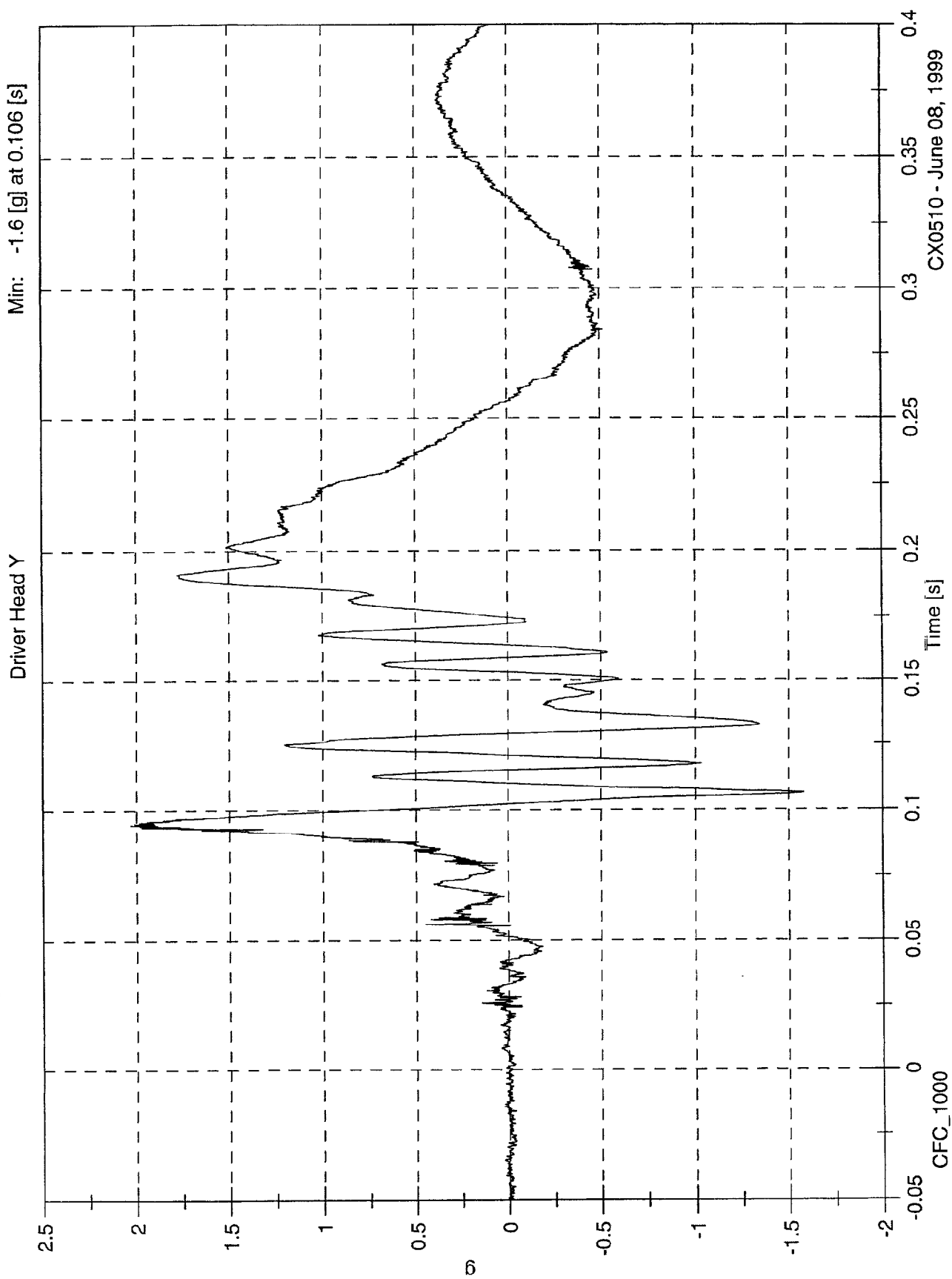
301 Test #7 1999 Hyundai Sonata

Max: 13.7 [g] at 0.105 [s]
Min: -0.4 [g] at 0.032 [s]



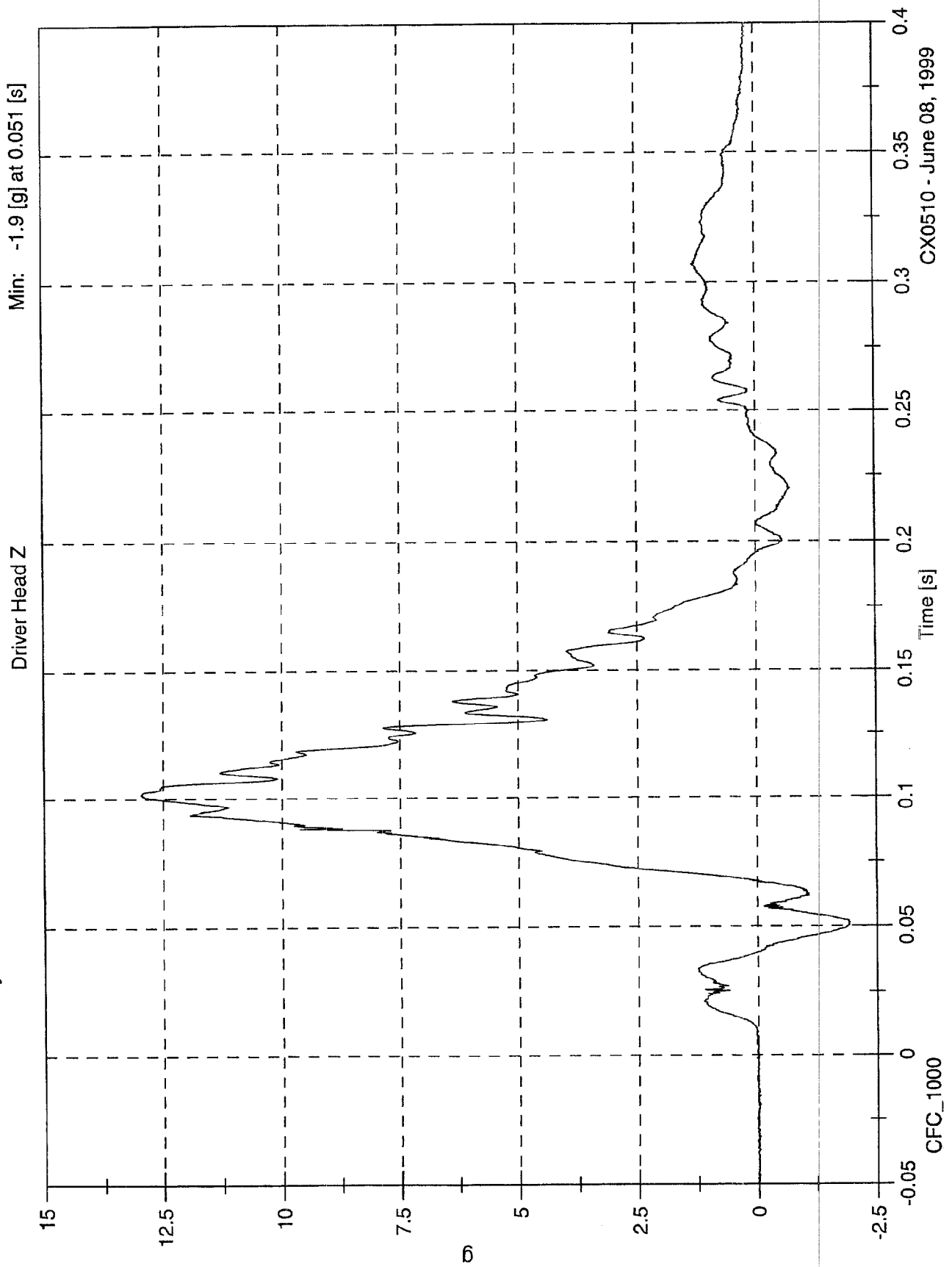
301 Test #7 1999 Hyundai Sonata

Max: 2.0 [g] at 0.095 [s]
Min: -1.6 [g] at 0.106 [s]



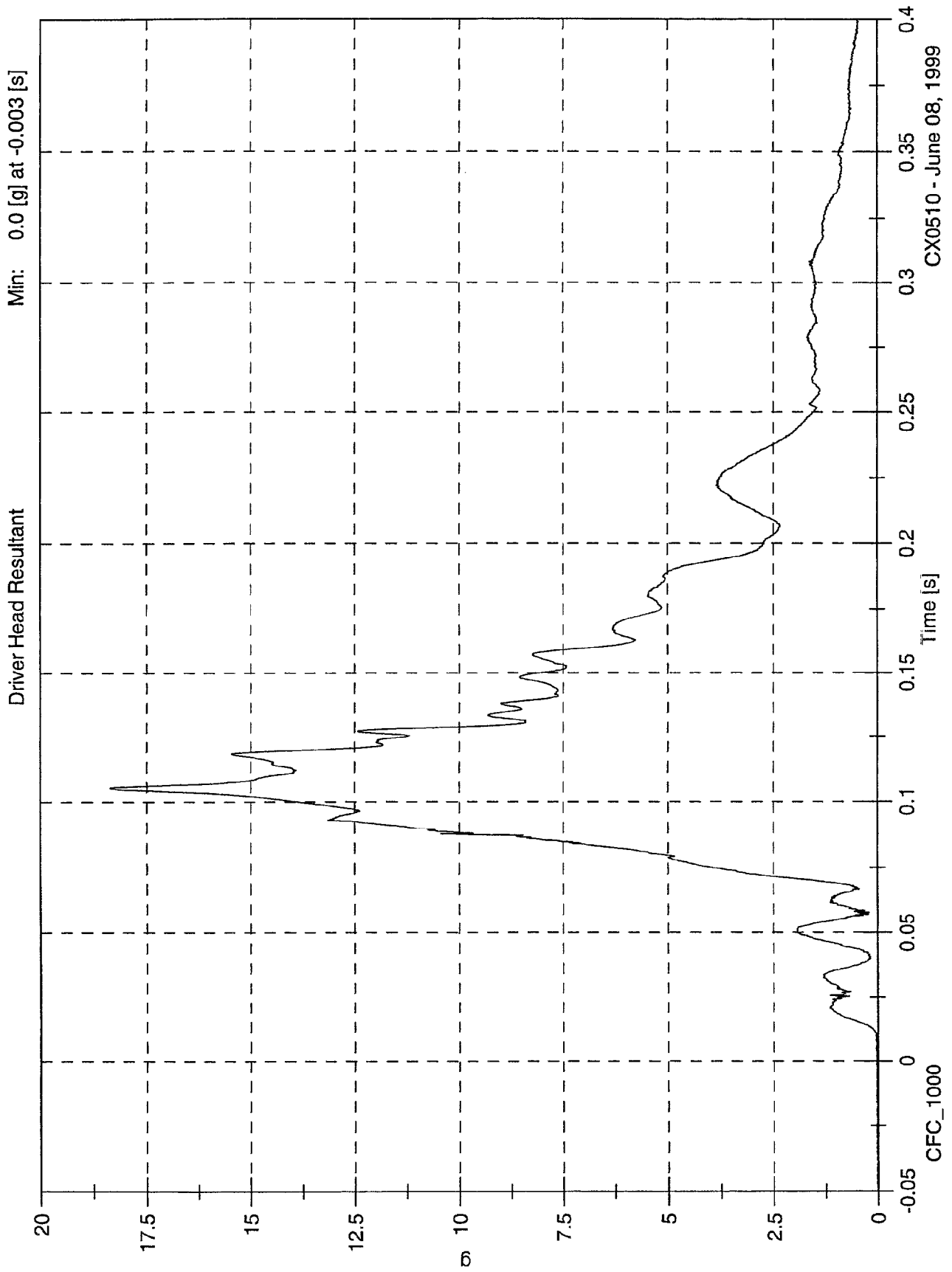
301 Test #7 1999 Hyundai Sonata

Max: 13.0 [g] at 0.102 [s]
Min: -1.9 [g] at 0.051 [s]



301 Test #7 1999 Hyundai Sonata

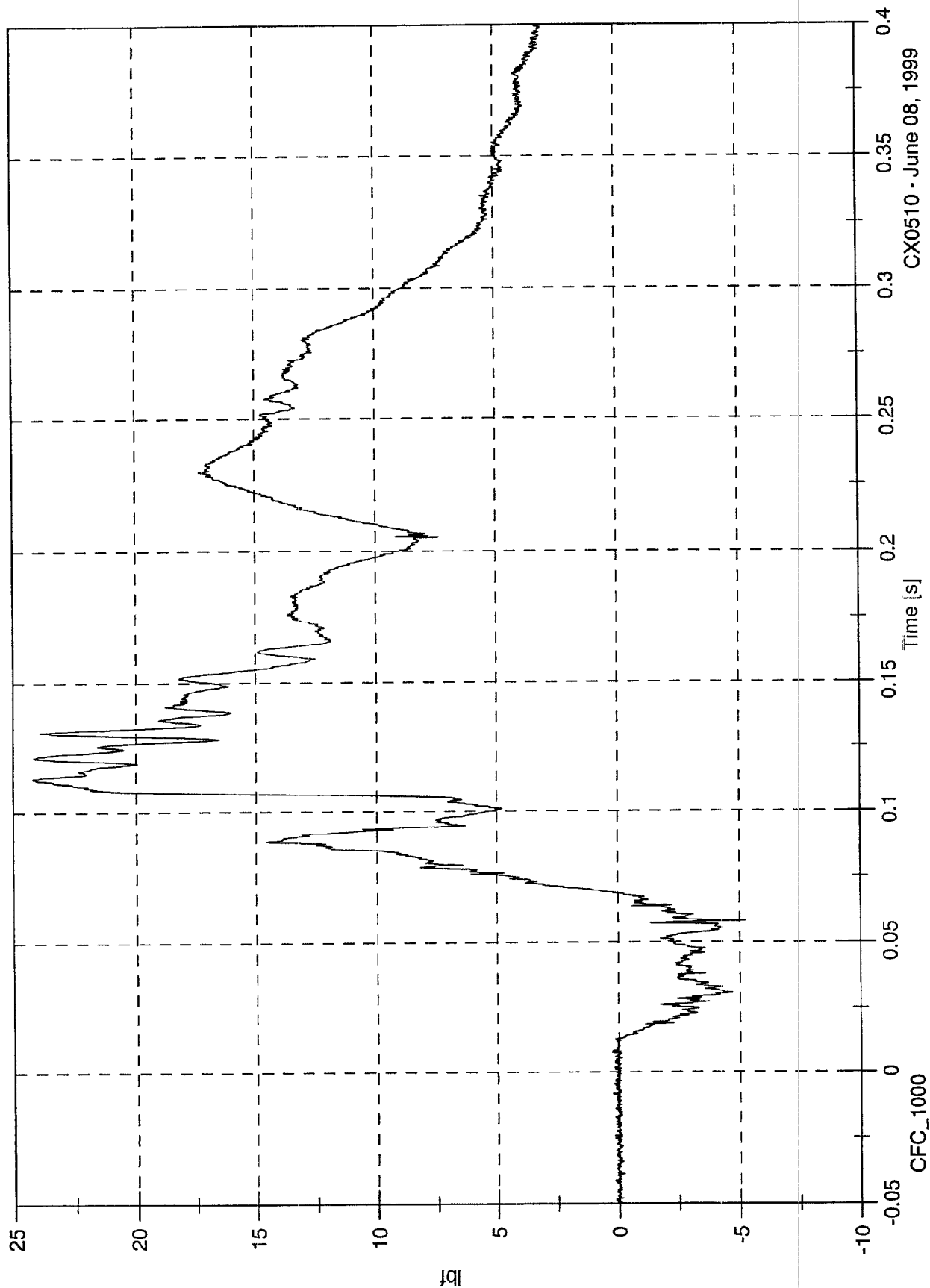
Max: 18.4 [g] at 0.105 [s]
Min: 0.0 [g] at -0.003 [s]



301 Test #7 1999 Hyundai Sonata

Max: 24.2 [lbf] at 0.113 [s]
Min: -5.2 [lbf] at 0.058 [s]

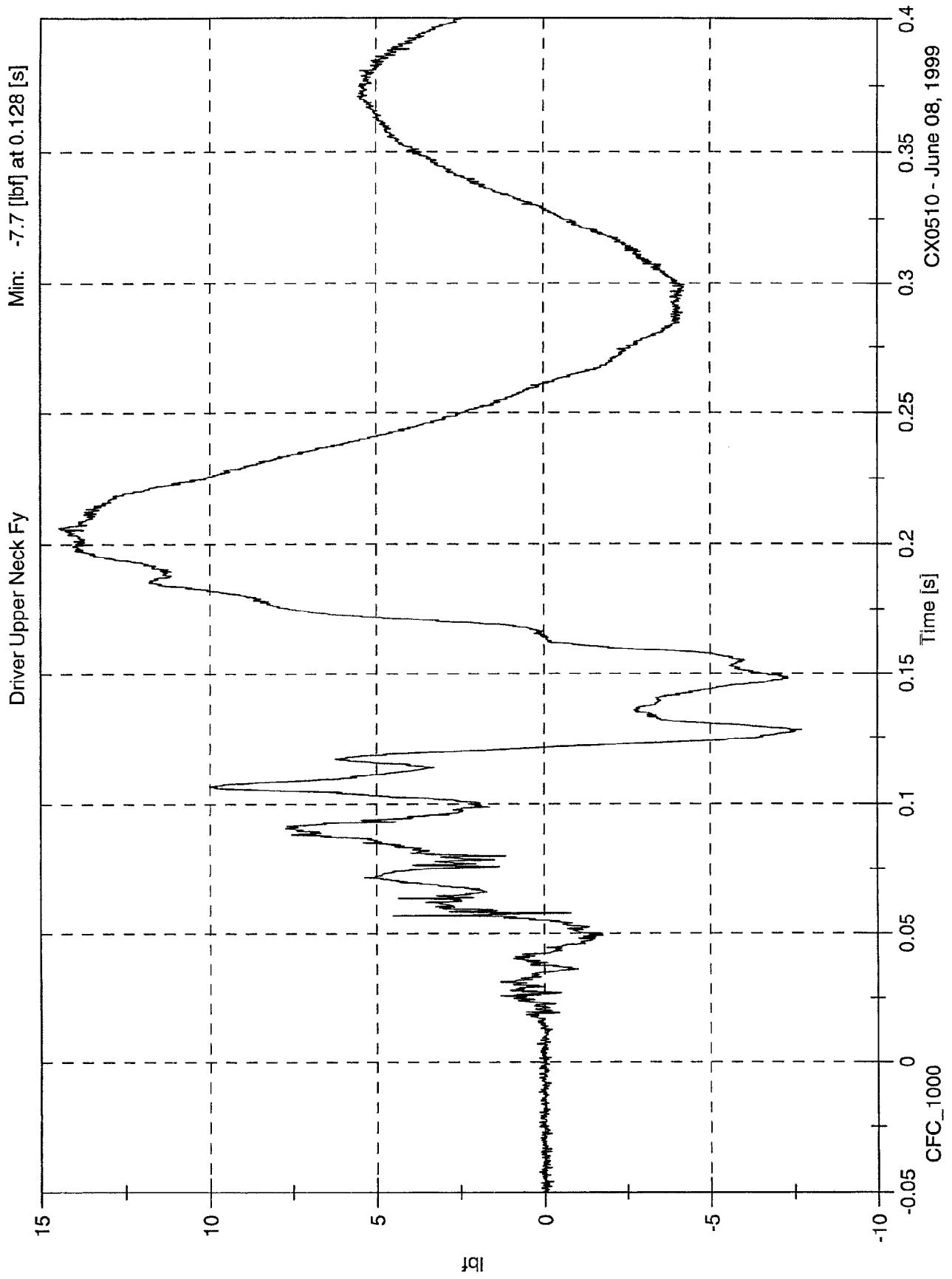
Driver Upper Neck Fx



CX0510 - June 08, 1999

301 Test #7 1999 Hyundai Sonata

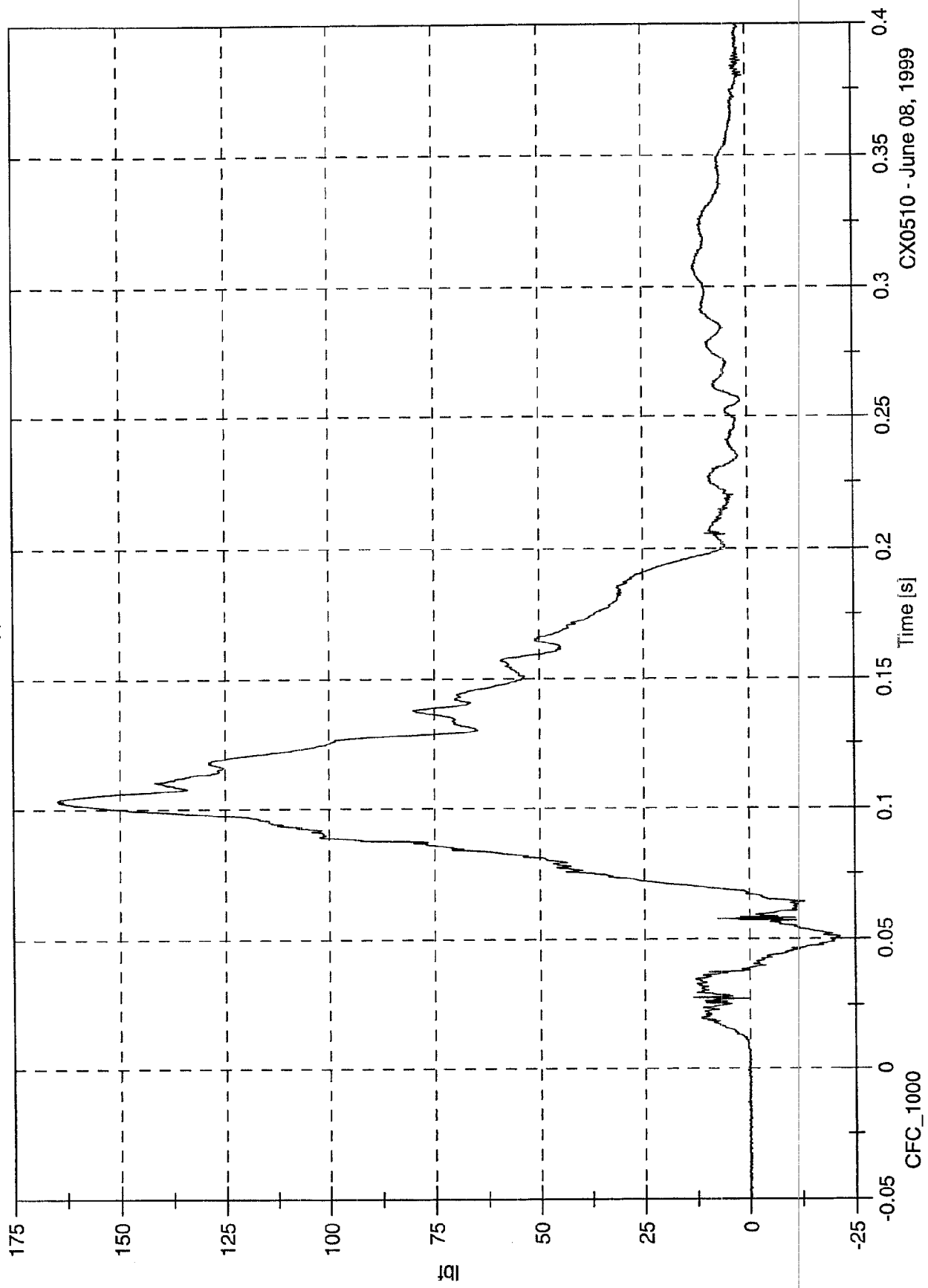
Max: 14.5 [lbf] at 0.206 [s]
Min: -7.7 [lbf] at 0.128 [s]



301 Test #7 1999 Hyundai Sonata

Max: 164.6 [lbf] at 0.103 [s]
Min: -21.2 [lbf] at 0.051 [s]

Driver Upper Neck Fz



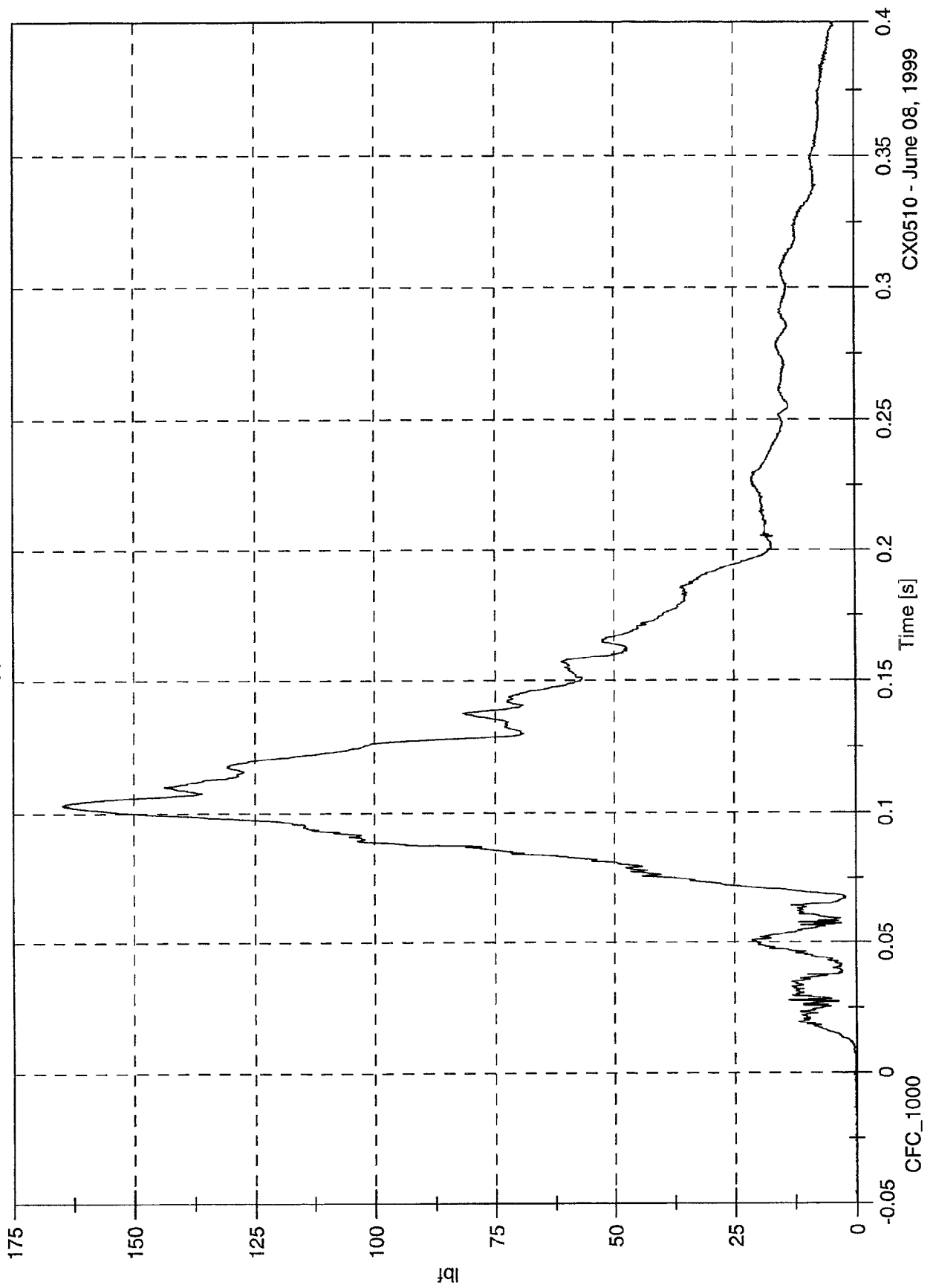
CX0510 - June 08, 1999

301 Test #7 1999 Hyundai Sonata

Max: 164.8 [lbf] at 0.103 [s]

Min: 0.0 [lbf] at -0.064 [s]

Driver Upper Neck F Resultant

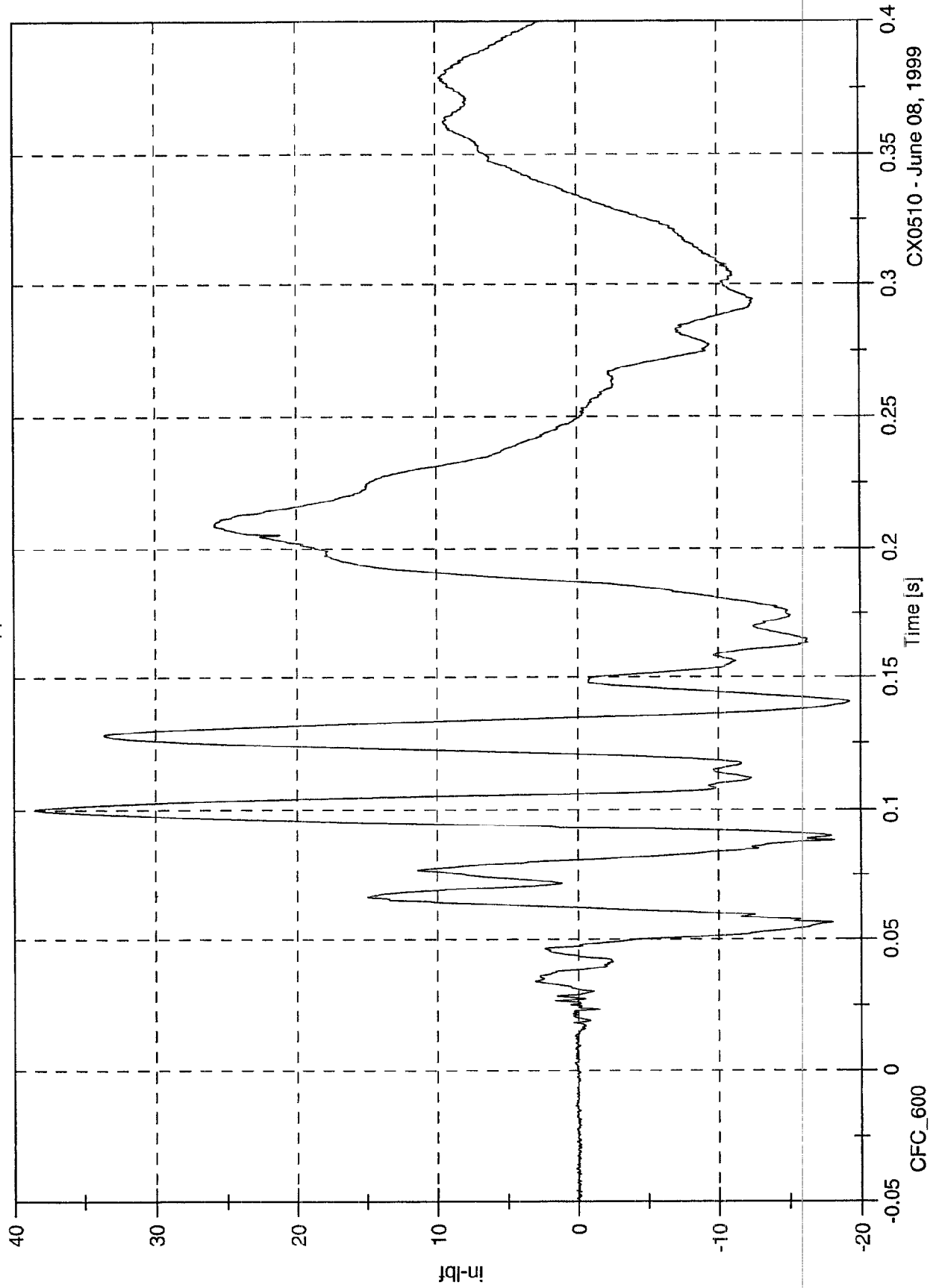


CX0510 - June 08, 1999

301 Test #7 1999 Hyundai Sonata

Driver Upper Neck Mx

Max: 38.5 [in-lbf] at 0.100 [s]
Min: -19.2 [in-lbf] at 0.141 [s]

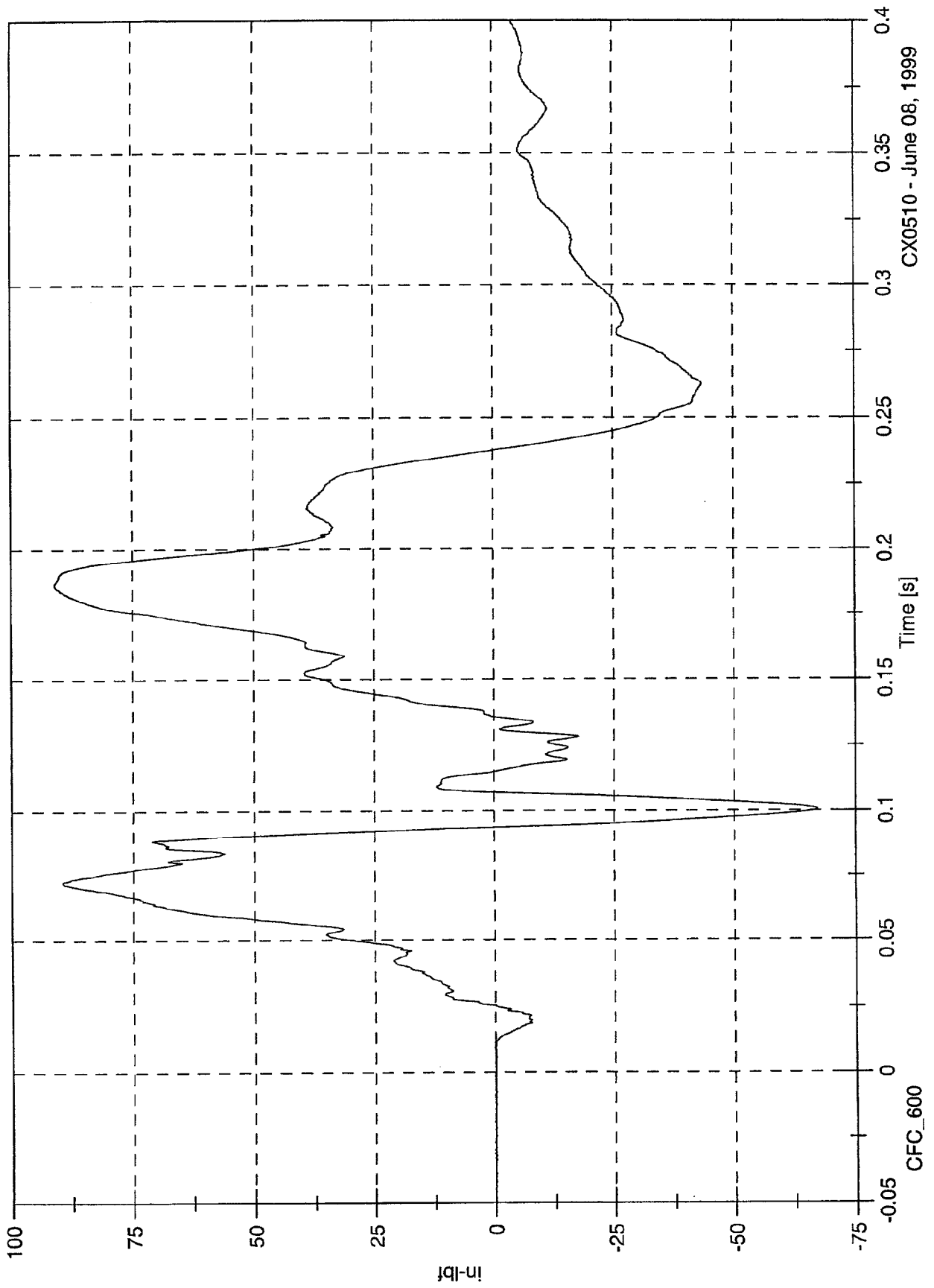


301 Test #7 1999 Hyundai Sonata

Max: 91.1 [in-lbf] at 0.187 [s]

Min: -67.1 [in-lbf] at 0.100 [s]

Driver Upper Neck My

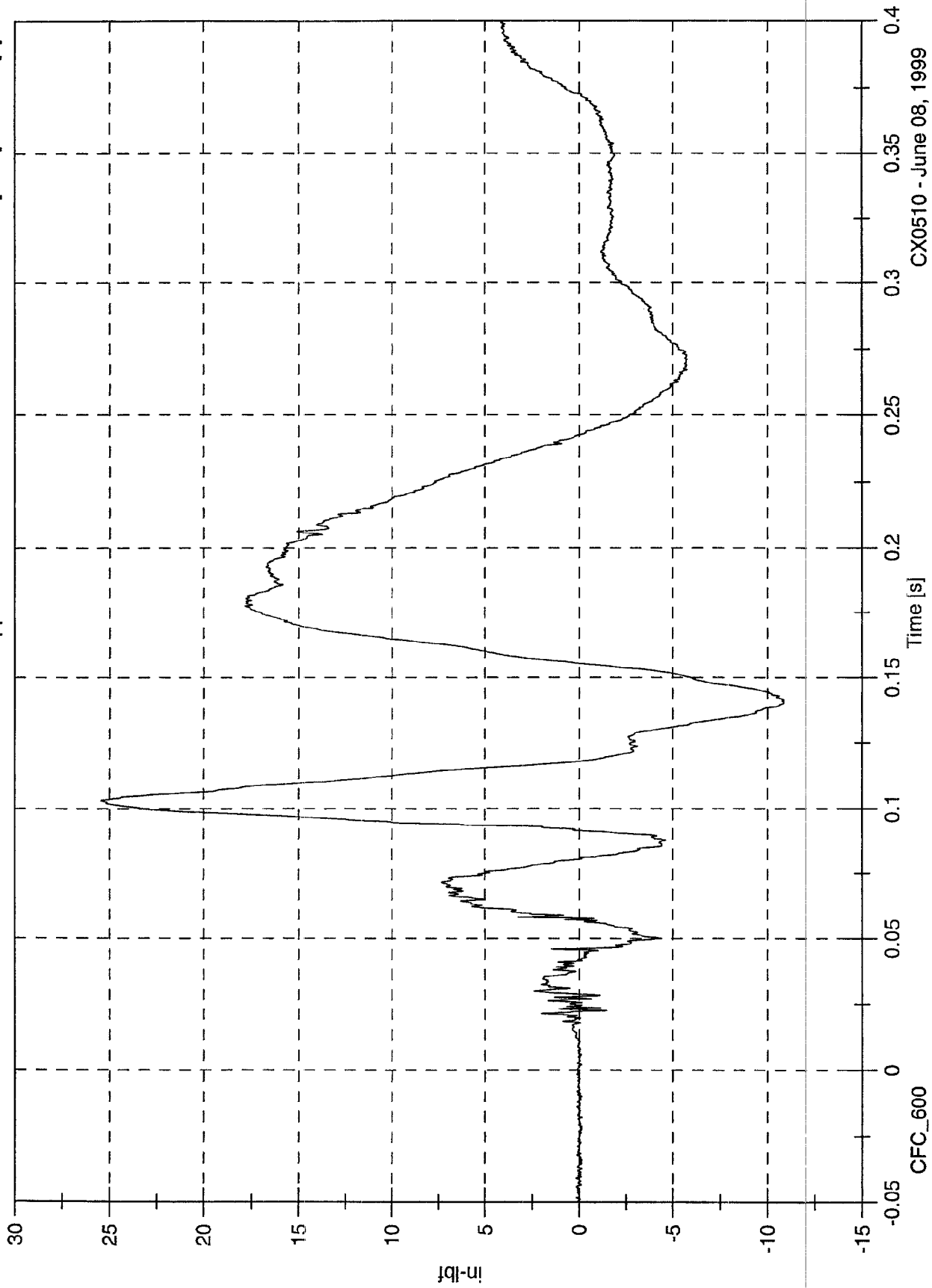


CX0510 - June 08, 1999

301 Test #7 1999 Hyundai Sonata

Max: 25.5 [in-lbf] at 0.103 [s]
Min: -10.9 [in-lbf] at 0.141 [s]

Driver Upper Neck Mz

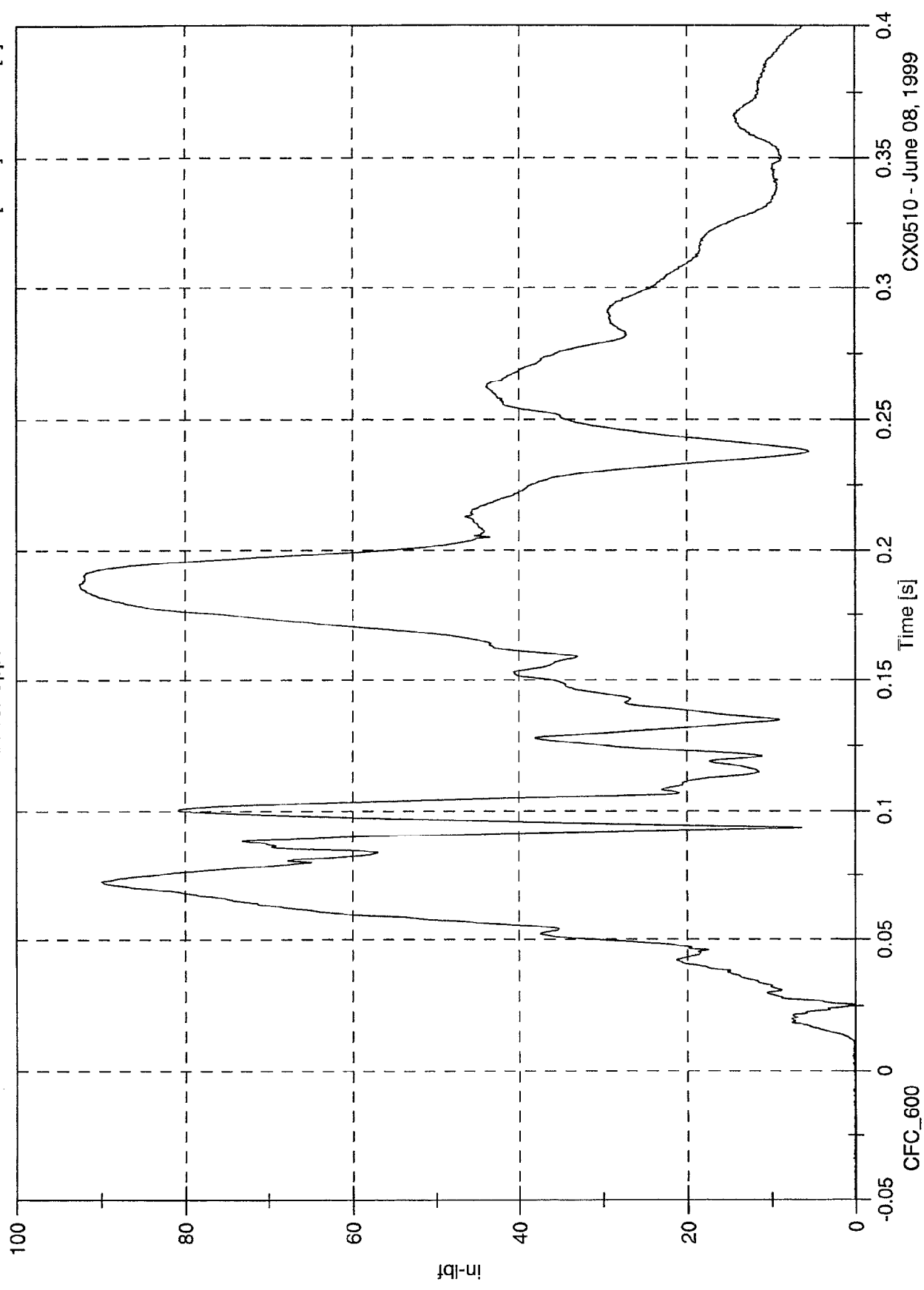


CX0510 - June 08, 1999

301 Test #7 1999 Hyundai Sonata

Max: 92.6 [in-lbf] at 0.187 [s]
Min: 0.0 [in-lbf] at -0.100 [s]

Driver Upper Neck M Resultant



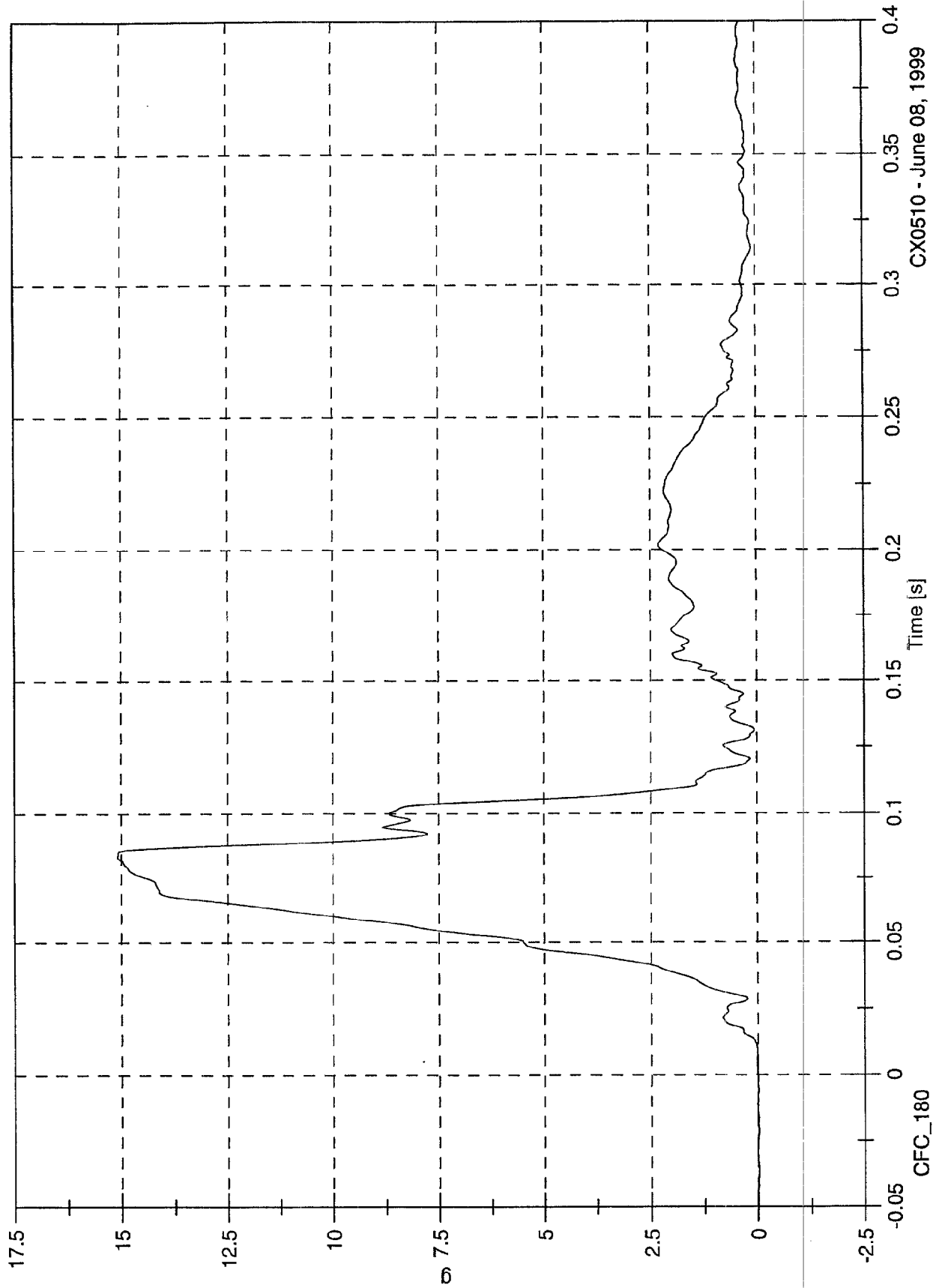
CX0510 - June 08, 1999

301 Test #7 1999 Hyundai Sonata

Driver Chest X

Max: 15.1 [g] at 0.083 [s]

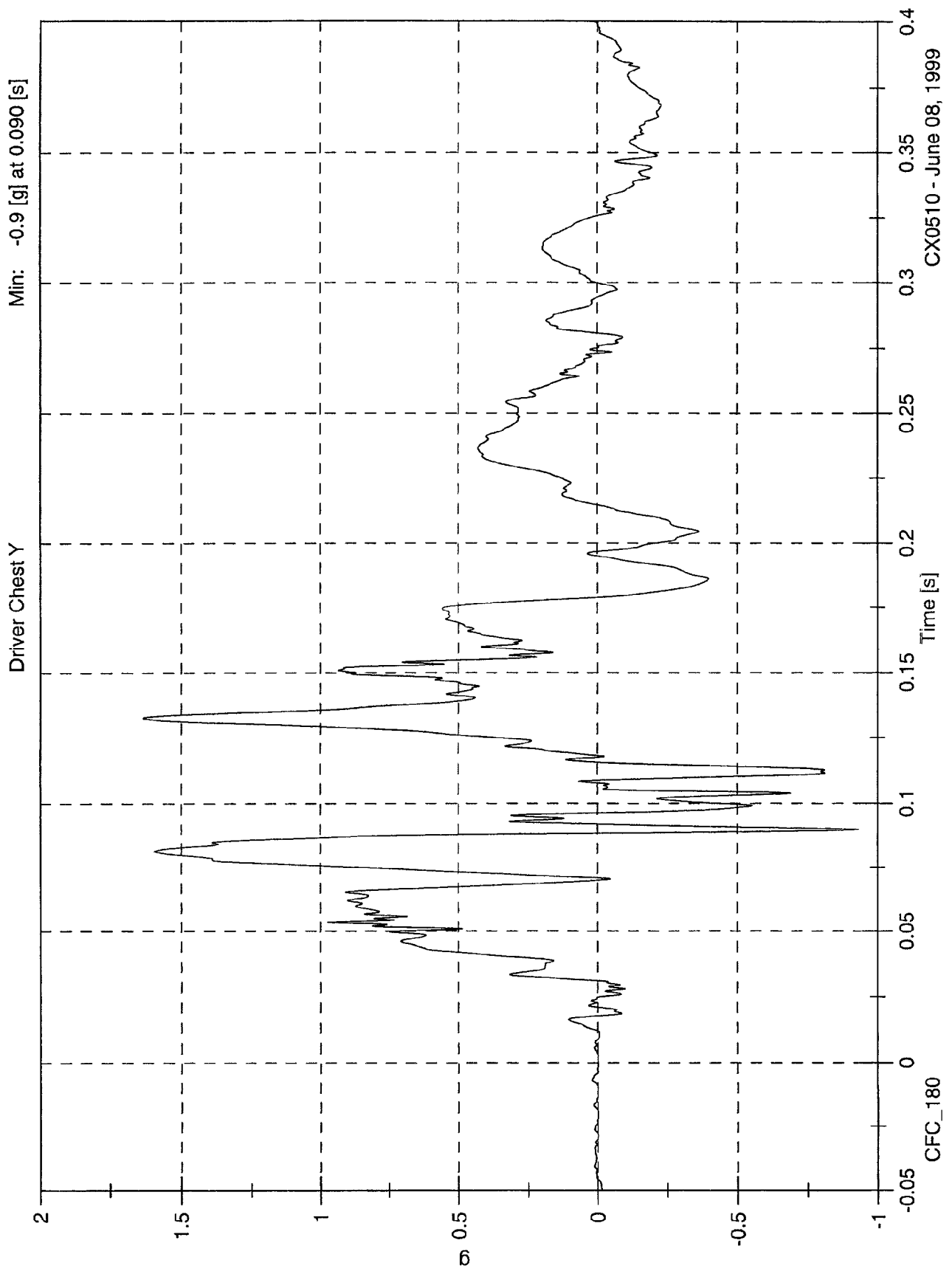
Min: -0.0 [g] at 0.494 [s]



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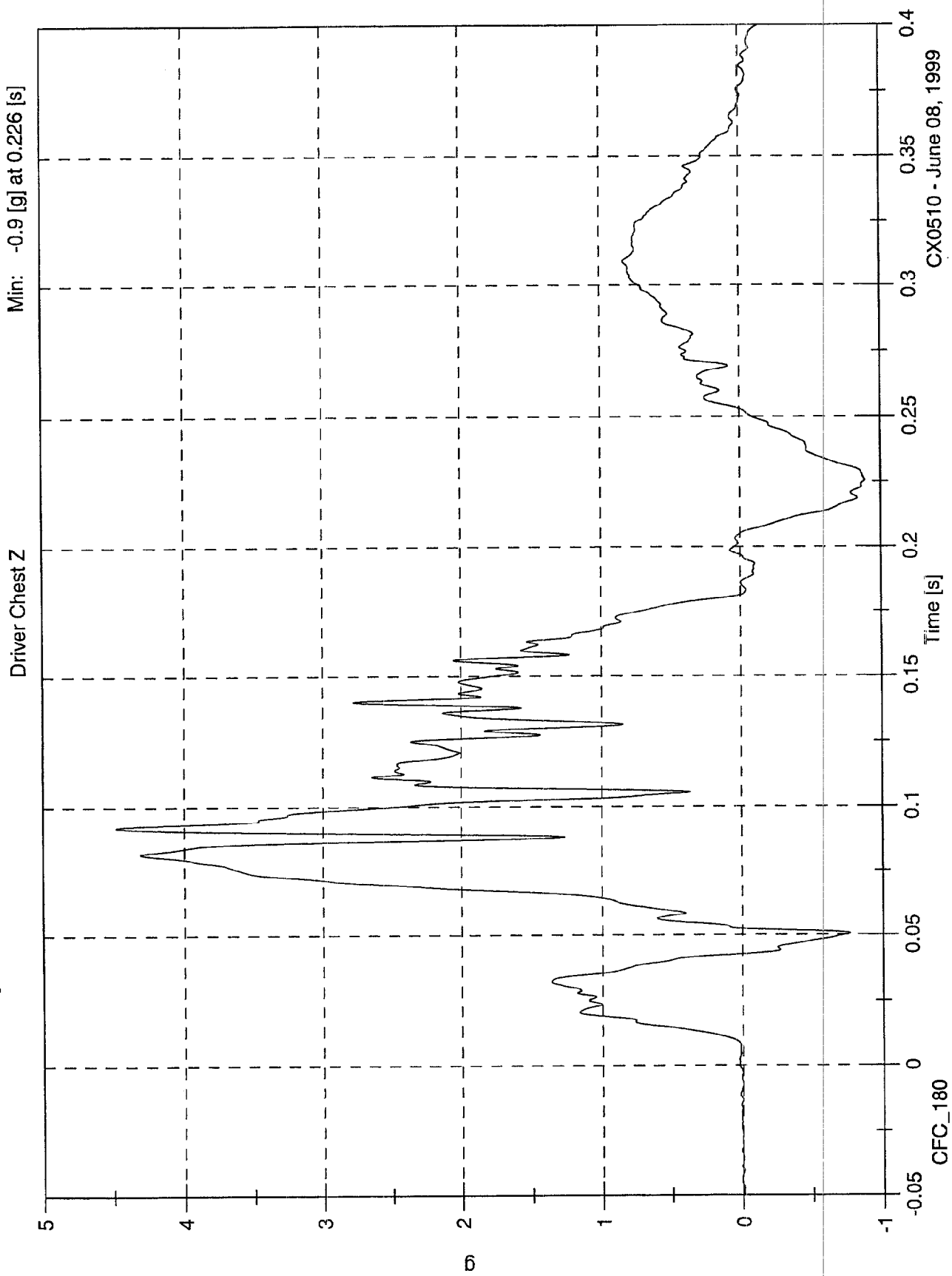
301 Test #7 1999 Hyundai Sonata

Max: 1.6 [g] at 0.133 [s]
Min: -0.9 [g] at 0.090 [s]



Max: 4.5 [g] at 0.092 [s]
Min: -0.9 [g] at 0.226 [s]

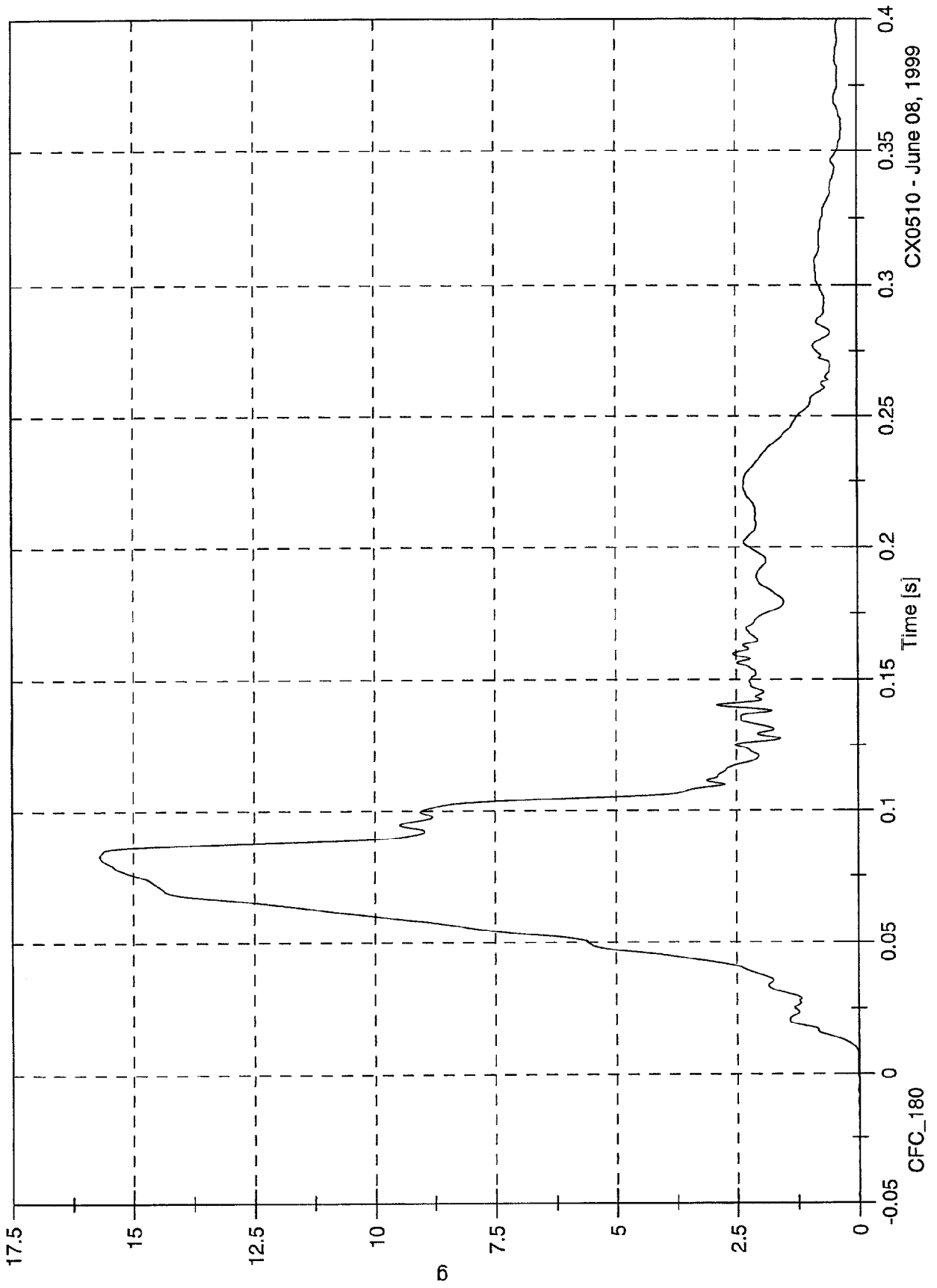
301 Test #7 1999 Hyundai Sonata



301 Test #7 1999 Hyundai Sonata

Max: 15.7 [g] at 0.083 [s]
Min: 0.0 [g] at -0.057 [s]

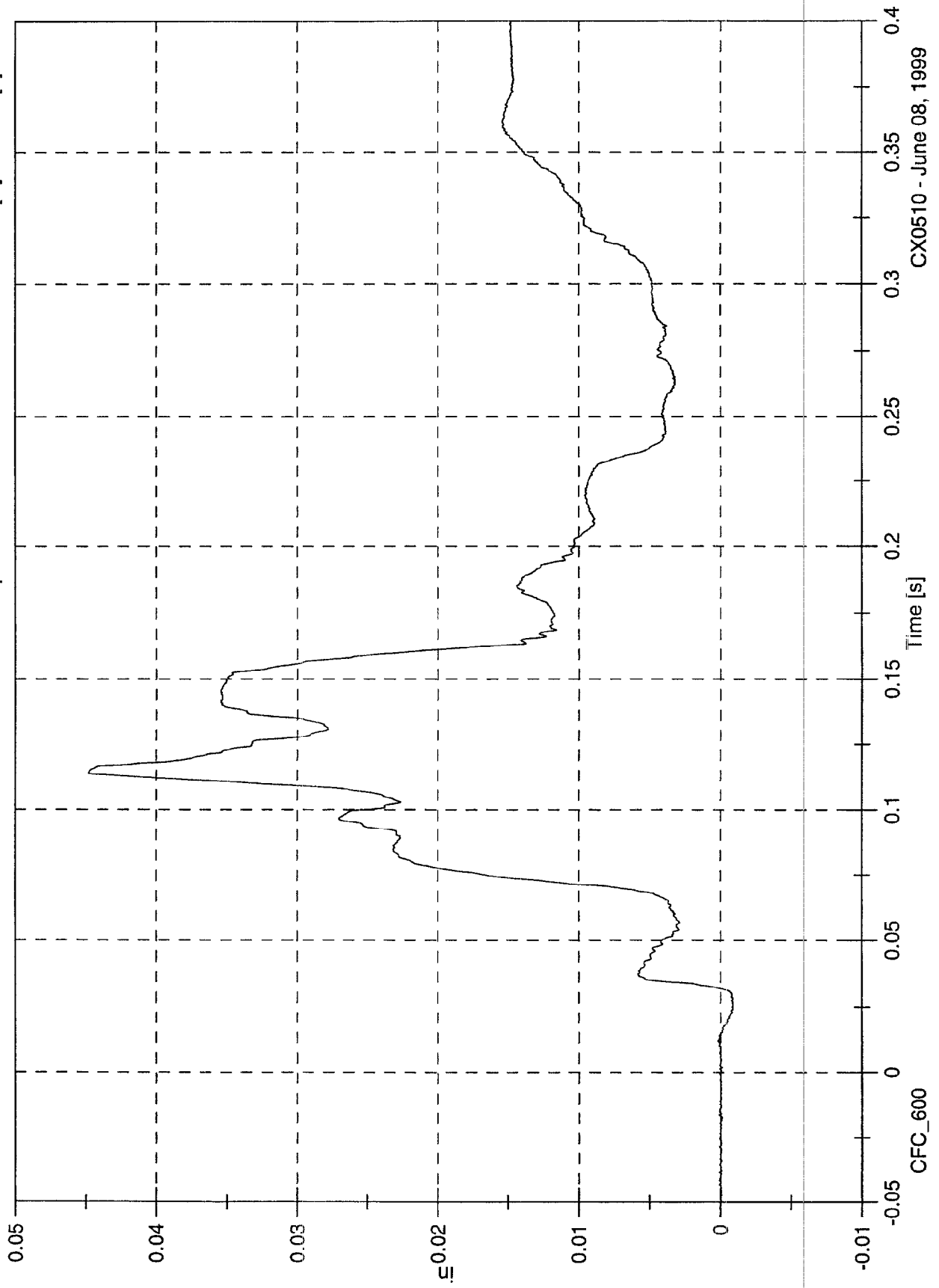
Driver Chest Resultant



301 Test #7 1999 Hyundai Sonata

Max: 0.0 [in] at 0.114 [s]
Min: -0.0 [in] at 0.028 [s]

Driver Chest Displacement



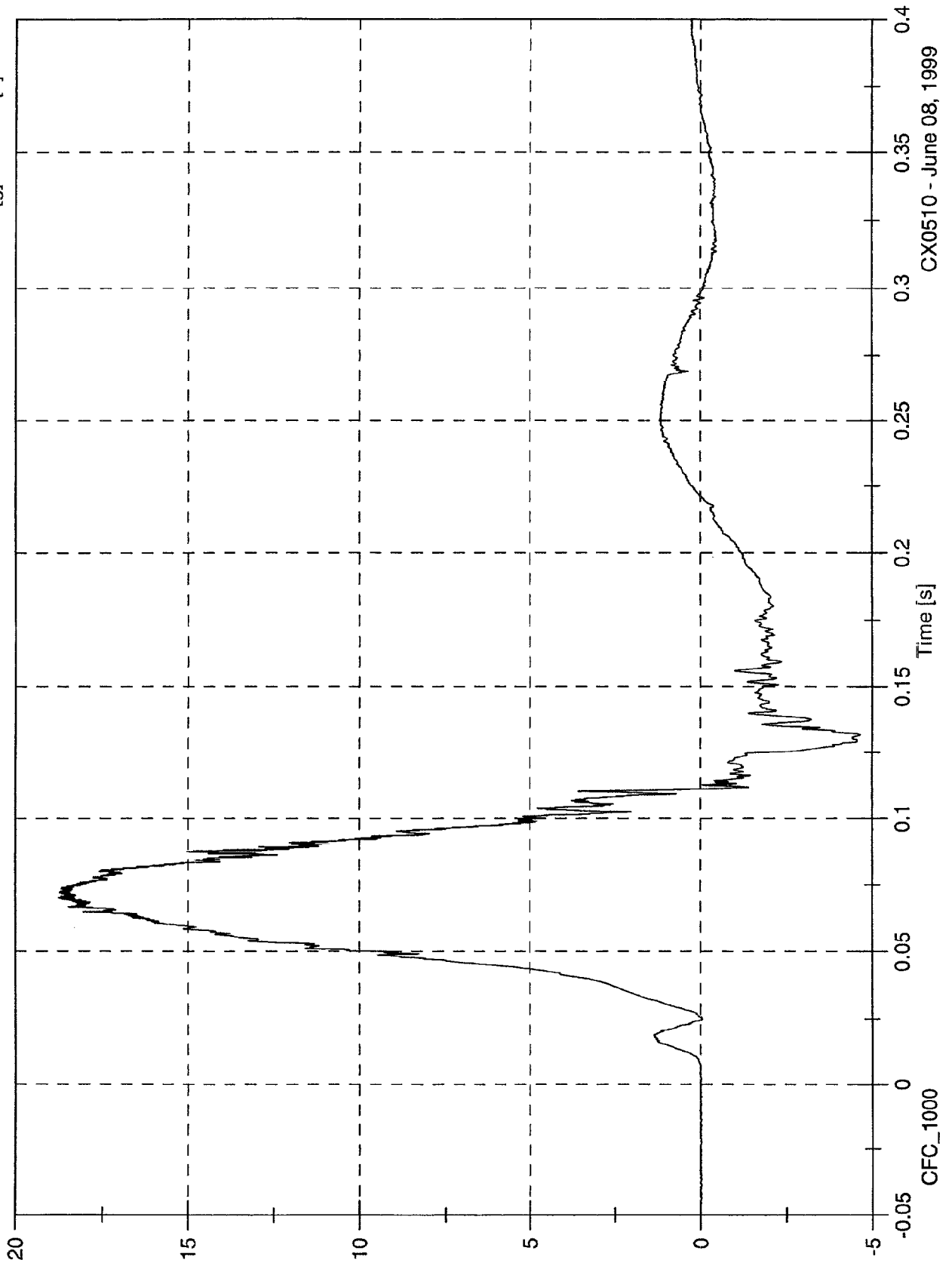
CX0510 - June 08, 1999

301 Test #7 1999 Hyundai Sonata

Max: 18.8 [g] at 0.070 [s]

Min: -4.6 [g] at 0.132 [s]

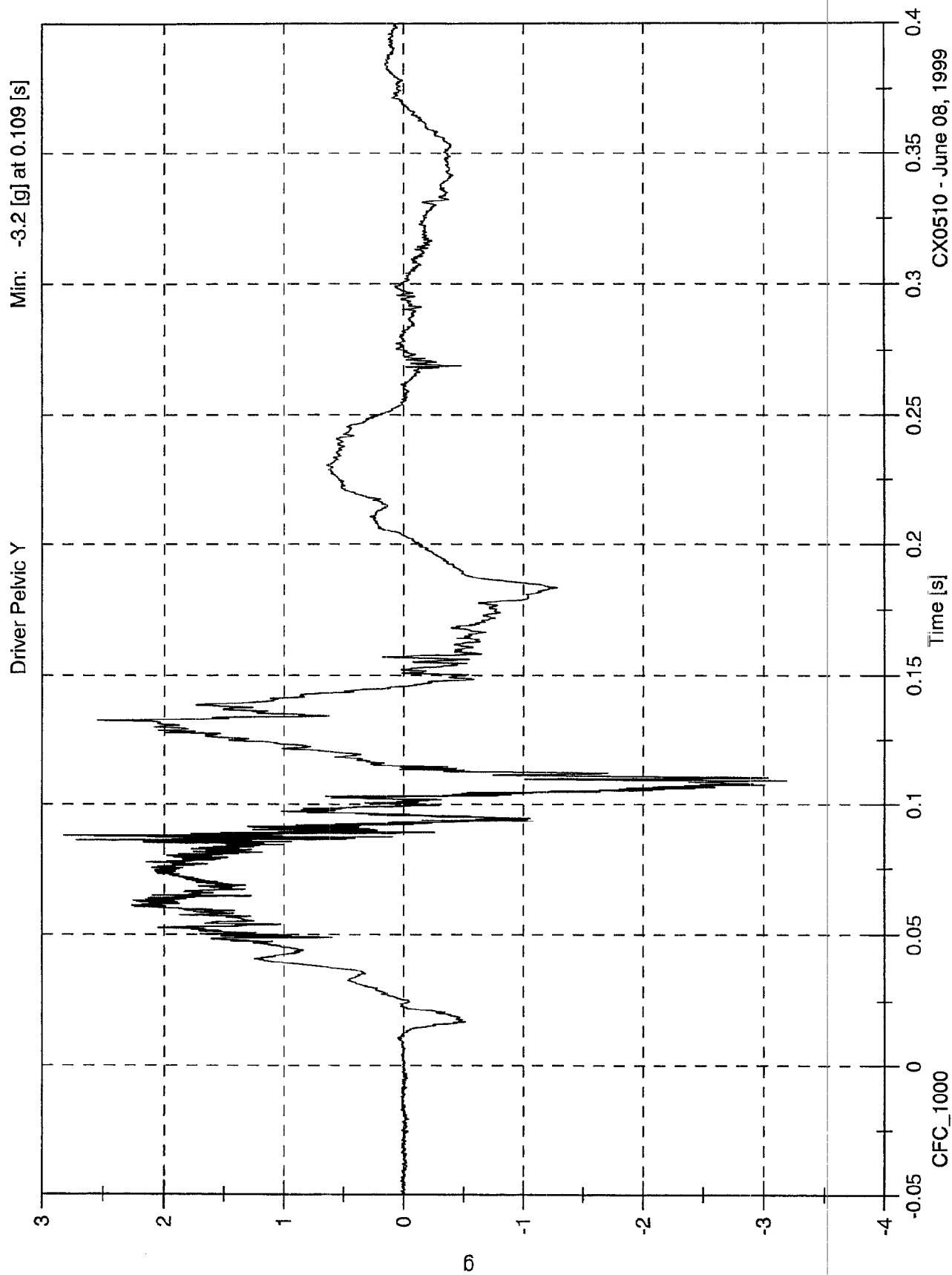
Driver Pelvic X



CX0510 - June 08, 1999

301 Test #7 1999 Hyundai Sonata

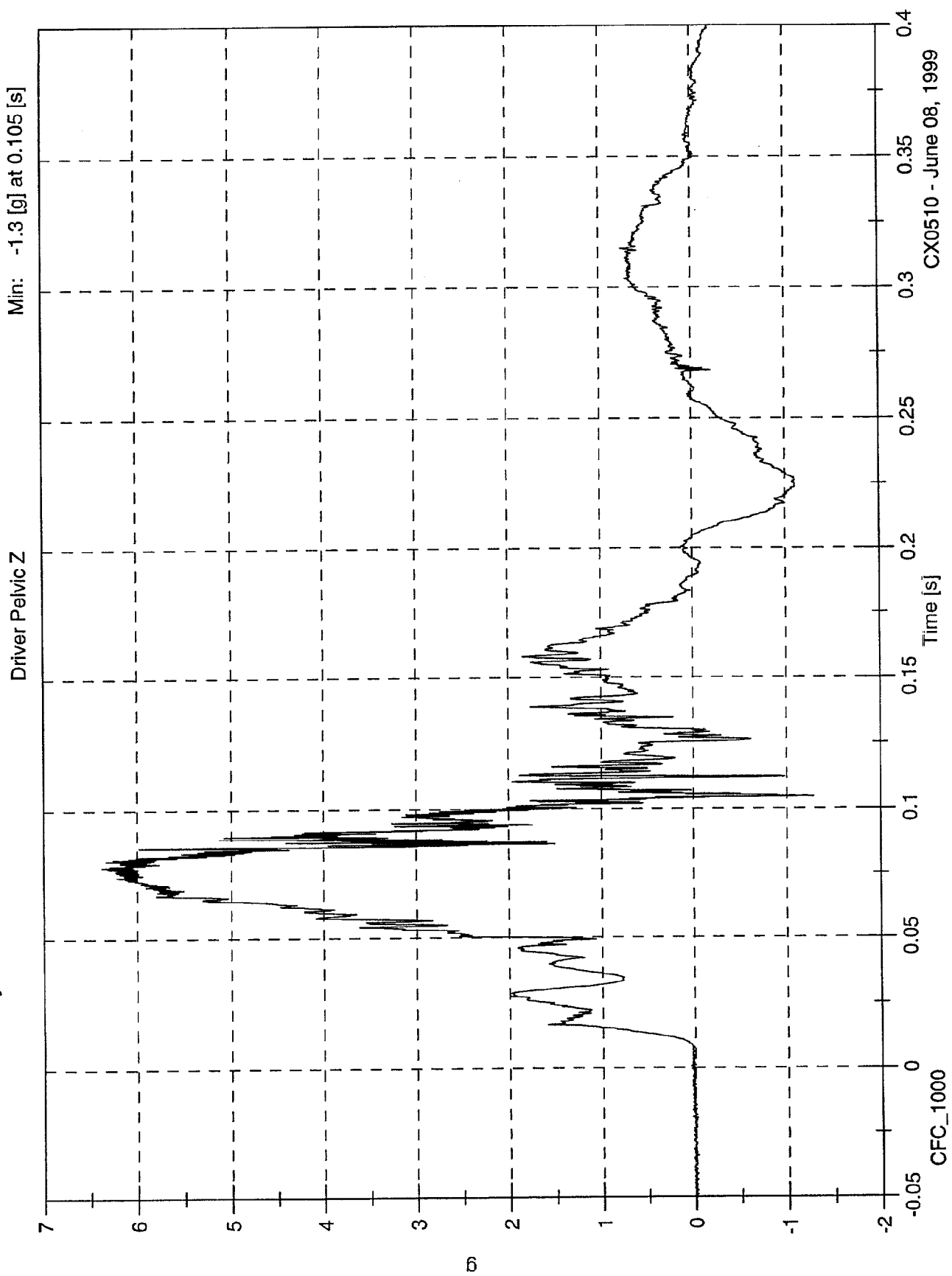
Max: 2.8 [g] at 0.088 [s]
Min: -3.2 [g] at 0.109 [s]



CX0510 - June 08, 1999

301 Test #7 1999 Hyundai Sonata

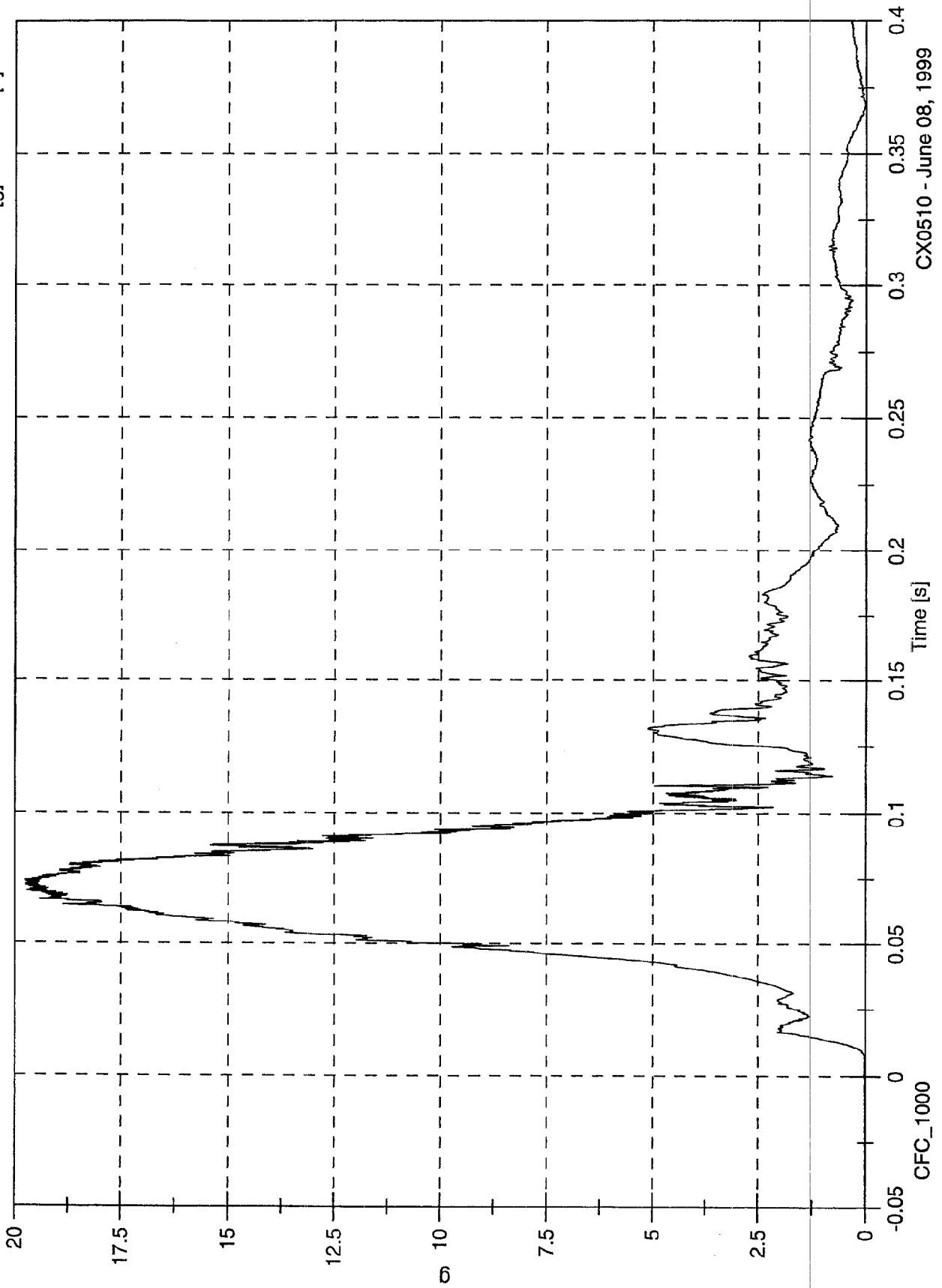
Max: 6.4 [g] at 0.078 [s]
Min: -1.3 [g] at 0.105 [s]



301 Test #7 1999 Hyundai Sonata

Max: 19.8 [g] at 0.074 [s]
Min: 0.0 [g] at -0.023 [s]

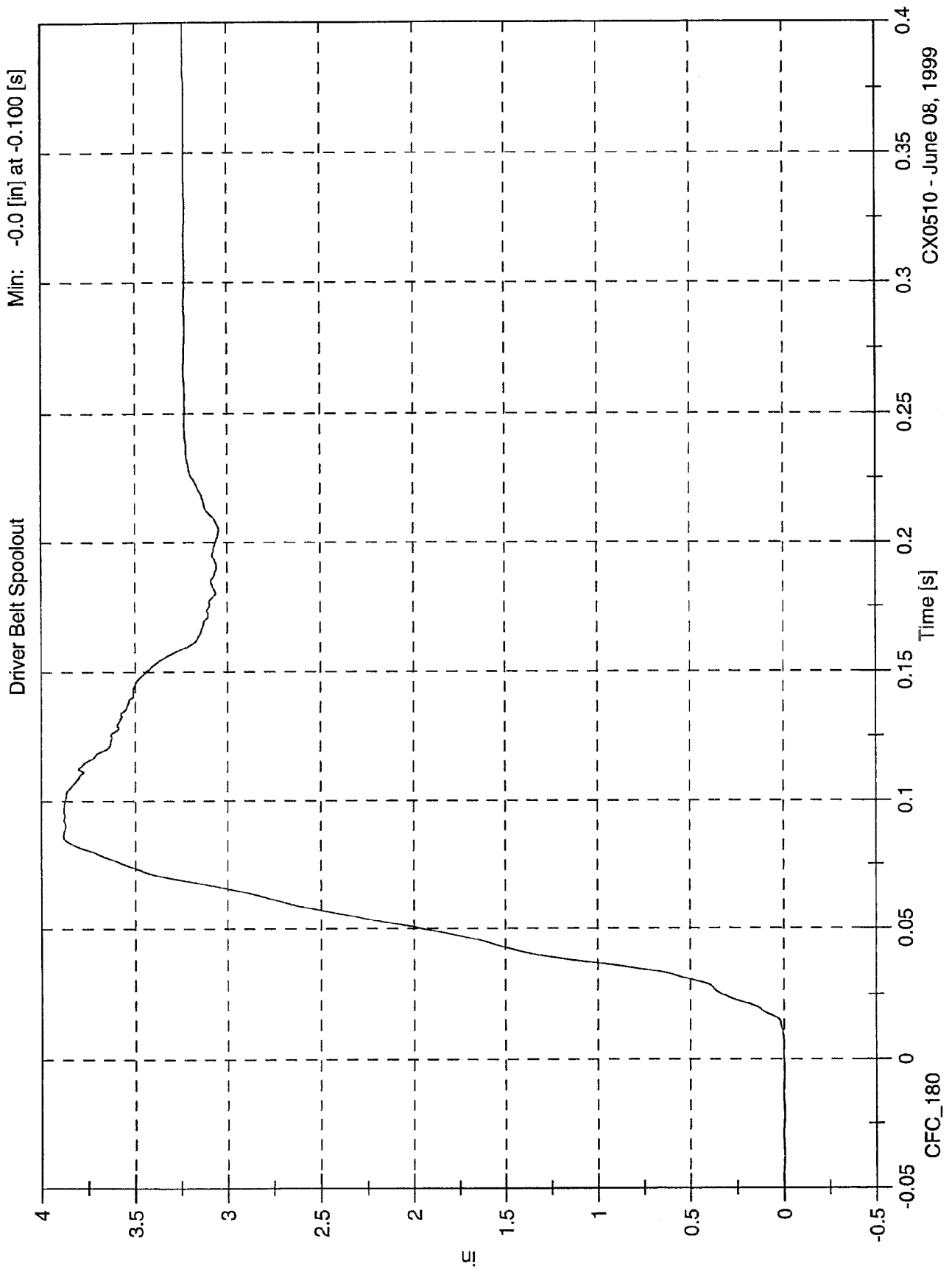
Driver Pelvic Resultant



CX0510 - June 08, 1999

301 Test #7 1999 Hyundai Sonata

Max: 3.9 [in] at 0.086 [s]
Min: -0.0 [in] at -0.100 [s]



CX0510 - June 08, 1999

PHOTOGRAPH NOT AVAILABLE