REPORT NUMBER: 214P-CAL-10-3

SAFETY COMPLIANCE TESTING FOR FMVSS 214
DYNAMIC SIDE IMPACT PROTECTION
RIGID POLE SIDE IMPACT

HYUNDAI MOTOR MANUFACTURING
2011 HYUNDAI SONATA GLS
4-DOOR SEDAN

NHTSA NUMBER: CB0500

PREPARED BY:
CALSPAN CORPORATION
P.O. BOX 400
BUFFALO, NEW YORK 14225

Test Date: March 25, 2010

FINAL REPORT

PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
1200 NEW JERSEY AVENUE, SE
NVS-220, WEST BUILDING 4TH FLOOR
WASHINGTON, DC 20590

This final test report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, in response to Contract Number DTNH22-07-D-00064.

This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturers' names or products are mentioned it is only because they are considered essential to the object of the publication and should not be construed as an endorsement. The United States Government does not endorse products or manufacturers.

Prepared by: _____ Date: June 4, 2010
Vincent M. Paolini, Project Engineer

Approved by: _____ Date: June 4, 2010
David J. Travale, Program Manager
Transportation Research Group

FINAL REPORT ACCEPTANCE BY OVSC:

Accepted by _____ Date: 6/9/2010

Technical Report Documentation Page

1. Report No. 214P-CAL-10-3	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Final Report of FMVSS 214P Compliance Side Impact Testing of a 2011 Hyundai Sonata GLS 4-Door Sedan NHTSA No.: CB0500		5. Report Date March 25, 2010 6. Performing Organization Code CAL
7. Author(s) Vincent M. Paolini, Project Engineer David J. Travale, Program Manager		8. Performing Organization Report No. tr2433
9. Performing Organization Name and Address Calspan Corporation Transportation Research Group P.O. Box 400 Buffalo, New York 14225		10. Work Unit No. 11. Contract or Grant No. DTNH22-07-D-00064
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Office of Vehicle Safety Compliance- Enforcement 1200 New Jersey Avenue, SE Room W43-503 Washington, DC 20590		13. Type of Report and Period Covered: Final Report April 2010 14. Sponsoring Agency Code NVS-220
15. Supplementary Notes		

16. Abstract

A 32 km/h (20 mph) 75° oblique impact compliance test was conducted on the subject 2011 Hyundai Sonata GLS 4-Door Sedan in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP- 214P-01 for the determination of FMVSS 214 Side Impact Protection compliance. The test was conducted by the Calspan Corporation Transportation Research Group in Buffalo, New York, on March 25, 2010.

The impact velocity was 31.2 km/h, and the ambient temperature at the struck side (driver side) of the test vehicle was 21.7°C. The test vehicle's maximum post test static crush was 308 mm at level 3. The test vehicle's occupant performance is as follows:

	DRIVER
HIC	353.5
Max. Rib Deflection (mm)	23.9
Sum of Abdomen Forces (N)	1304.9
Pubic Symphysis (N)	2181.5

The doors on the struck side of the vehicle did not separate from the body at the hinges or latches and the opposite doors did not open during the side impact event.

17. Key Words	18. Distribution Statement
Compliance Testing Side Impact Protection Pole Test ES-2re	Copies of this report are available from: National Highway Traffic Safety Admin. Technical Information Services Room E12-100 East Bldg. 1200 New Jersey Avenue, SE Washington, DC 20590 Phone : (202) 366-2588

19. Security Class. (of this report)	20. Security Class. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	221	

Form DOT F1700.7 (8-72)

TABLE OF CONTENTS

SECTION 1
PURPOSE AND TEST PROCEDURE

PURPOSE

This side impact test is part of the FY 2010 FMVSS 214 Side Impact Protection Compliance Test Program sponsored by the National Highway Traffic Safety Administration (NHTSA) under Contract No. DTNH22-07-D-00064. The purpose of this test was to evaluate side impact protection in a 2011 Hyundai Sonata GLS 4-Door Sedan. The side impact test was conducted in accordance with the Office of Vehicle Safety Compliance's Laboratory Test Procedure (TP-214P-01, dated January 2010).

SUMMARY

A rigid pole impact test was conducted on a 2011 Hyundai Sonata GLS 4-Door Sedan. The test was towed into a rigid pole at an angle of 75° and a velocity of 31.2 km/h. The test was conducted by the Calspan Corporation Transportation Sciences Group in Buffalo, New York on March 25, 2010. Pre-test and post-test photographs of the test vehicle and side impact dummy are included in Appendix A of this report.

One Part 572U dummy was placed in the left front outboard designated seating position according to instructions specified in TP-214P-01 dated January 2010. The side impact event was documented by 1 real-time and 9 high-speed cameras.

The ES2-re male dummy was instrumented with a tri-axial accelerometer pack located in the head, 3 rib displacement transducers located in the chest, 3 load cells located in the abdomen and a load cell in the pubic symphysis.

The summary of the test results follows:

Driver ES-2re Male Dummy		
HIC	353.5	
UPPER RIB DEFLECTION	19.4	mm
MIDDLE RIB DEFLECTION	16.5	mm
LOWER RIB DEFLECTION	23.9	mm
ABDOMEN (FRONT)	377.8	N
ABDOMEN (MID)	381.7	N
ABDOMEN (REAR)	567.8	N
SUM OF ABDOMEN FORCES	1304.9	N
PUBIC SYMPHYSIS	2181.5	N

SECTION 2

DATA SHEET NO. 1
TEST VEHICLE INFORMATION AND OPTIONS

Test Vehicle:	2011 Hyundai Sonata GLS	NHTSA No.	CB0500
Test Program:	FMVSS 214P Side Impact	Test Date:	March 25, 2010

Vehicle Information	
Make	Hyundai Motor Manufacturing
Model	Sonata GLS
Body Style	4-Door Sedan
VIN	5NPEB4AC4BH009273
Body Color	Silver
Engine Disp (liters)	2.4
# of Cylinders	4
Engine Placement	Lateral
Transmission Type	Automatic/Manual
Transmission Speeds	6
Overdrive	Yes
Final Drive	Front
Odometer Reading	44

Options	
ESC	Yes
All-Wheel Drive	No
Power Steering	Yes
Tilt Steering Wheel	Yes
Driver Side Curtain Airbag	Yes
Driver Side Torso Airbag	Yes
Driver Combo Bag	No
Driver Seat Belt Pretentioners	Yes
Driver Seat Belt Load Limiters	Yes
Driver Power Seats	No
Rear Pass. Curtain Airbag	Yes
Rear Pass. Side Torso Airbag	No
Rear Pass. Seat Belt Pretentioners	No
Rear Pass. Seat Belt Load Limiters	No
Rear Pass. Power Seats	No
Power Windows	Yes
Air Conditioning	Yes
AM/FM CD	Yes
Automatic Door Locks (ADL)	Yes
Does owner's manual provide instructions to disable ADLs?	Yes
Anti-Lock Brakes	Yes

DATA FROM CERTIFICATION LABEL

Manufactured By	Hyundai Motor Manufacturing	GVWR (kg)	1950
		GAWR Front (kg)	1100
Date of Manufacture	1/26/2010	GAWR Rear (kg)	960

VEHICLE CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench		
Number Of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				410.0
Cargo Wt. (RCLW) (kg)				69.8

DATA SHEET NO. 2
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle:	2011 Hyundai Sonata GLS	NHTSA No.	CB0500
Test Program:	FMVSS 214P Side Impact	Test Date:	March 25, 2010

TIRE PRESSURES

	Units	LF	RF	RR	LR
As Delivered	kpa	225	225	225	225
As Tested	kpa	225	225	225	225

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW) (Axle)			Fully Loaded (Axle)			As Tested (ATW) (Axle)		
		Front	Rear	Total	Front	Rear	Total	Front	Rear	Total
Left	kg	452.0	295.0		482.0	356.0		464.0	361.0	
Right	kg	446.0	276.0		453.0	327.0		460.0	323.5	
Ratio	%	61.1	38.9		57.8	42.2		57.4	42.6	
Totals	kg	898.0	571.0	1469.0	935.0	683.0	1618.0	924.0	684.5	1608.5

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1469.0
Weight of 1 P572U ATD (78.0 kg each)	kg	78.0
Rated Cargo/Luggage Weight (RCLW)	kg	69.8
Calculated Vehicle Target Weight (TVTW)	kg	1616.8

* Actual As Tested Weight (ATW) will be TVTW -4.5/-9.1 kg

Weight of Ballast (including instrumentation package and cameras): 61.5 kg

WEIGHT of BALLAST and VEHICLE COMPONENTS REMOVED TO MEET TVTW

Description of Component	Weight (kg)
Ballast (if any)	22.7

TEST VEHICLE ATTITUDES

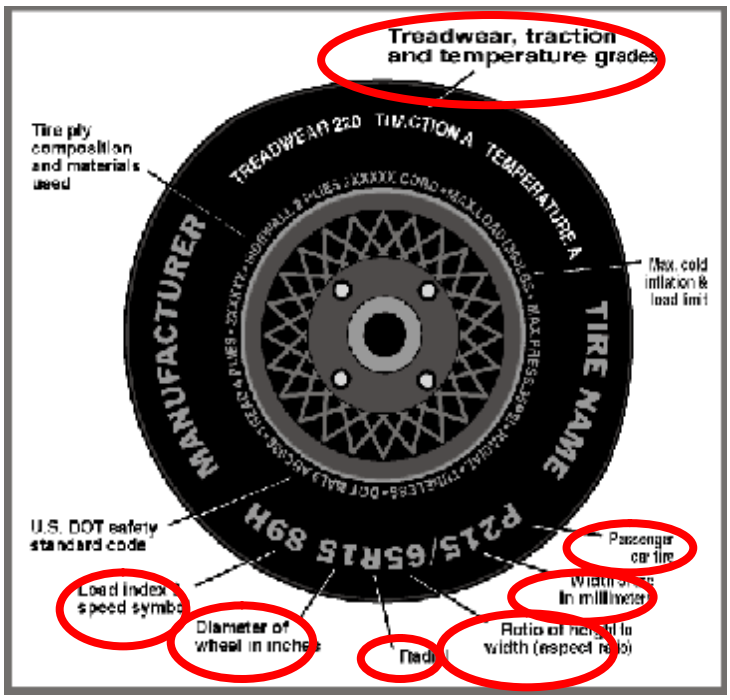
	Units	LF	RF	LR	RR
Fully Loaded	mm	699	707	699	688
As Tested	mm	705	708	702	686
DIFF Δ	mm	-6	-1	-3	2

CALCULATION OF THE VERTICAL IMPACT REFERENCE LINE

Measurement Description	Units	Value
Test Vehicle Wheel Base	mm	2784
Vertical Impact Reference Line Aft of Front Axle	mm	1422

DATA SHEET NO. 3
VEHICLE TIRE INFORMATION

Test Vehicle:	2011 Hyundai Sonata GLS	NHTSA No.	CB0500
Test Program:	FMVSS 214 Indicant Side Impact	Test Date:	March 25, 2010



DATA FROM TIRE PLACARD

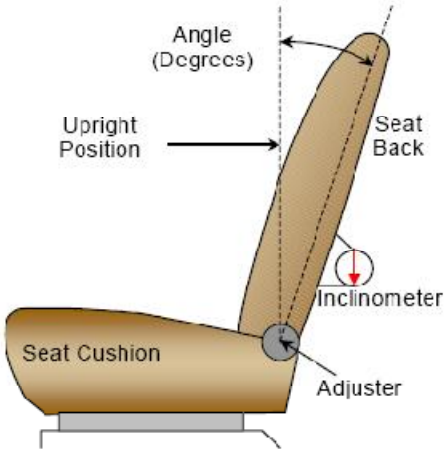
Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	300	300
Cold / Test Pressure (kPa)	225	225
Recommended Tire Size	P205/65R16	P205/65R16
Tire Size on Vehicle	P205/65R16	P205/65R16
Tire Manufacturer	Kumho	Kumho
Tire Name	Solus KH25	Solus KH25
Tire Type	Passenger	Passenger
Tire Width (mm)	205	205
Ratio of Height to Width (aspect ratio)	65	65
Radial	Yes	Yes
Wheel Diameter	16	16
Load Index & Speed Symbol	94H	94H
Treadwear	480	480
Traction Grade	A	A
Temperature Grade	A	A

DATA SHEET NO. 4
SEAT AND SEAT BELT ADJUSTMENT DATA

Test Vehicle:	2011 Hyundai Sonata GLS	NHTSA No.	CB0500
Test Program:	FMVSS 214 Indicant Side Impact	Test Date:	March 25, 2010

NORMAL DESIGN RIDING POSITION

An inclinometer was placed on the head restraint post and it measured a vertical angle of 9.4 degrees without the ATD in seat. The sill pitch angle was 0.6 degrees (pitched down)



FRONT SEAT ASSEMBLY

SEAT BACK ANGLES

	Degrees
Driver w/ Seated Dummy	9.4

SEAT FORE/AFT POSITIONS

The seat was placed in the mid-travel position while maintaining the seat cushion mid-angle position.

SEAT FORE/AFT POSITION

	Driver Seat
Total Fore/Aft Travel (mm)	240
Test Position (mm)	120
Test Detent (forward-most detent	12
Total Number of Detents (including	24

SEAT BELT UPPER ANCHORAGES

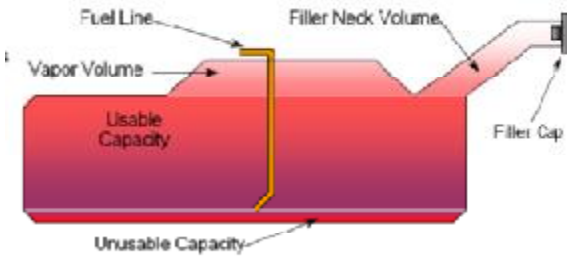
	Total # of Positions	Placed in Position #
Driver Seat	4	1 (uppermost)

DATA SHEET NO. 5
FUEL SYSTEMS AND STEERING WHEEL POSITION DATA

Test Vehicle:	2011 Hyundai Sonata GLS	NHTSA No.	CB0500
Test Program:	FMVSS 214 Indicant Side Impact	Test Date:	March 25, 2010

FUEL SYSTEM INFORMATION

The test vehicle is equipped with an electric fuel pump. The fuel pump operates continuously while the engine is running.



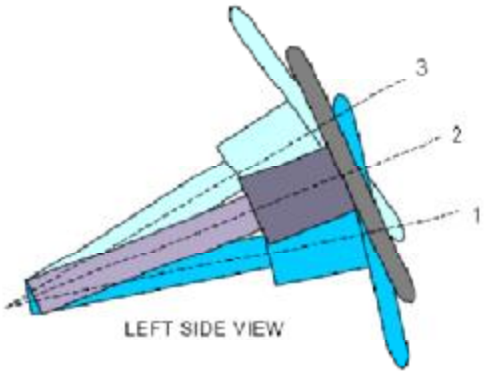
VEHICLE FUEL TANK ASSEMBLY

FUEL TANK CAPACITY

	Liters
Usable Capacity (Form 1)	70.0
Usable Capacity (Owner's Manual)	70.0
Usable Capacity of "Optional" Fuel Tank	--
Stoddard Used for Test (92%-94% of Fuel Tank Usable Capacity)	65.1

STEERING COLUMN ADJUSTMENT

A flat plate was placed on the top and bottom of steering wheel. The inclinometer was placed on the flat plate to measure the angle



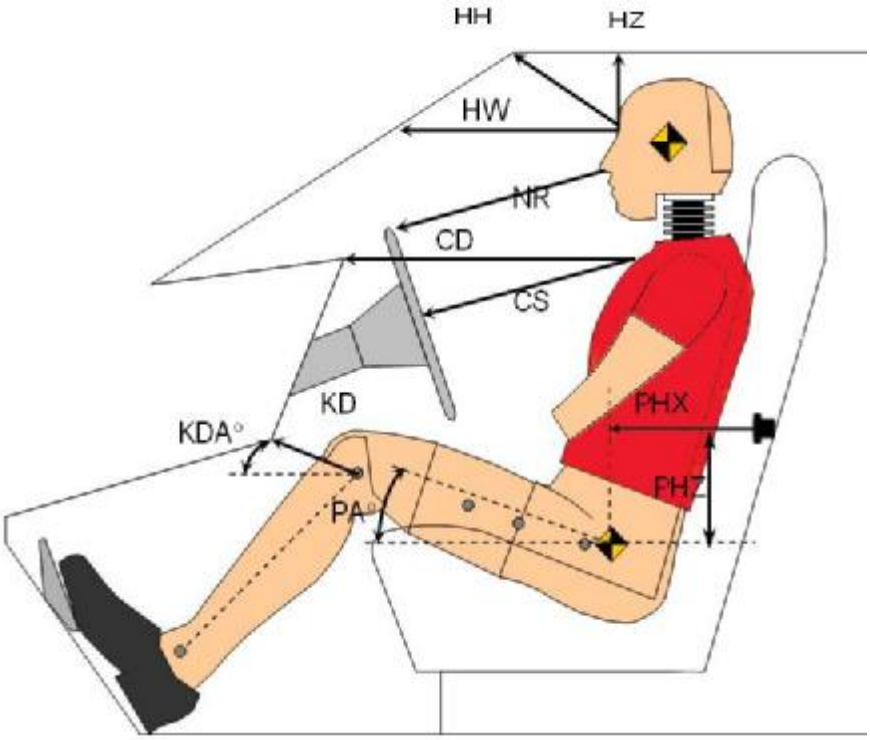
STEERING COLUMN ASSEMBLY

STEERING COLUMN POSITIONING

	Degrees	Fore/Aft Position (mm)
Lowermost - Position 1	22.6	NA
Geometric Center – Position 2	24.8	NA
Uppermost – Position 3	26.9	NA
Telescoping Steering Wheel Travel	NA	40
Test Position	24.8	20

DATA SHEET NO. 6
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

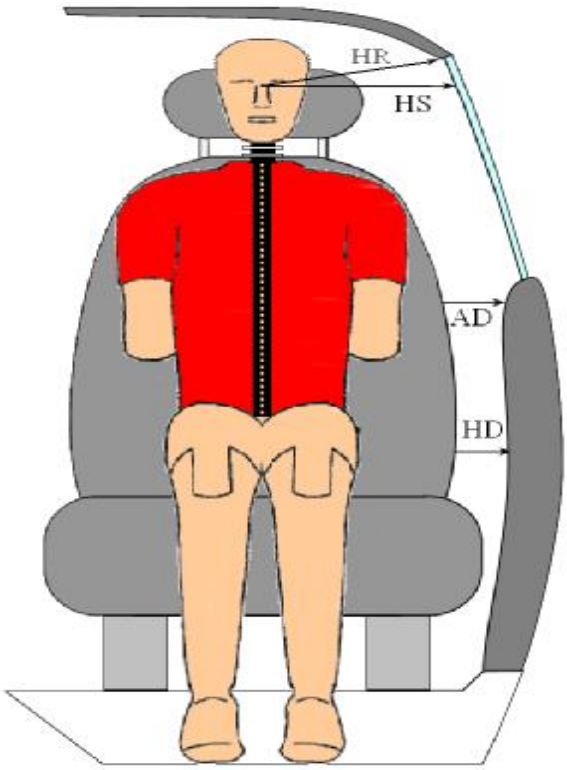
Test Vehicle:	2011 Hyundai Sonata GLS	NHTSA No.	CB0500
Test Program:	FMVSS 214 Indicant Side Impact	Test Date:	March 25, 2010



Frt. Occupant Code	Measurement Description	037 ES2-re	
		Length (mm)	Angle
HH	Header to Header	426	
HW	Header to Windshield	644	
HZ	Head to Roof	155	
NR	Nose to Rim/Seat Back	530	
CD	Chest to Dash/Seat Back	650	
CS	Chest to Steering Wheel	369	
KDL	Left Knee to Dash/Seat Back	200	30.0
KDR	Right Knee to Dash/Seat Back	155	25.0
PA	Pelvic Angle		24.0
PHX	H-Point to Striker (X-Axis)	223	
PHZ	H-Point to Striker (Z-Axis)	255	

DATA SHEET NO. 7
DUMMY LATERAL CLEARANCE DIMENSIONS

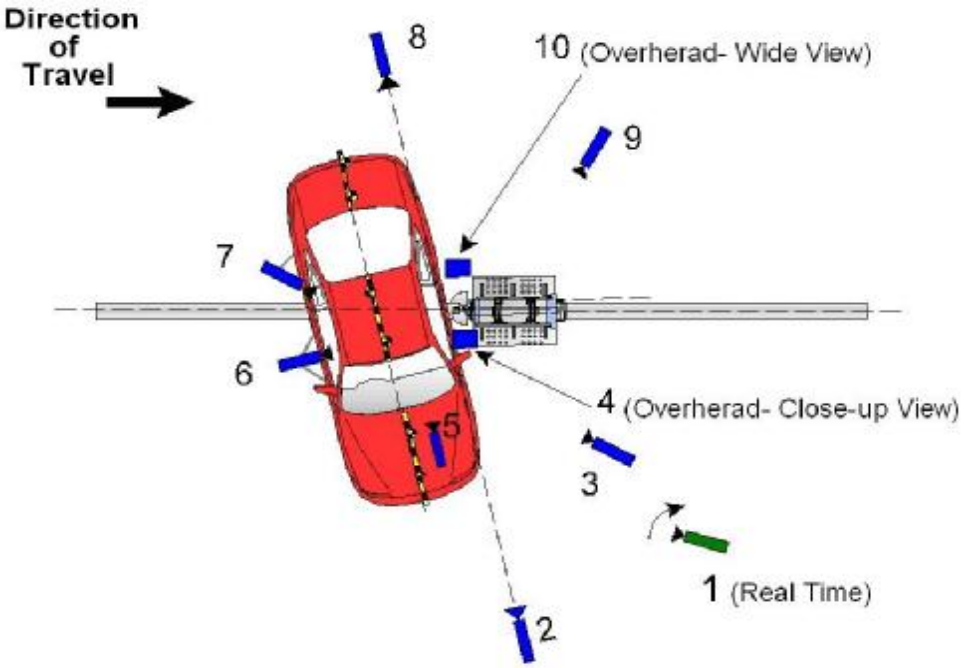
Test Vehicle:	2011 Hyundai Sonata GLS	NHTSA No.	CB0500
Test Program:	FMVSS 214 Indicant Side Impact	Test Date:	March 25, 2010



Code		Units	Front Occupant
HR	Head to Side Header	mm	185
HS	Head to Side Window	mm	335
AD	Arm to Door	mm	118
HD	H-point to Door	mm	155

DATA SHEET NO. 8
HIGH SPEED CAMERA LOCATIONS AND DATA

Test Vehicle:	2011 Hyundai Sonata GLS	NHTSA No.	CB0500
Test Program:	FMVSS 214P Side Impact	Test Date:	March 25, 2010

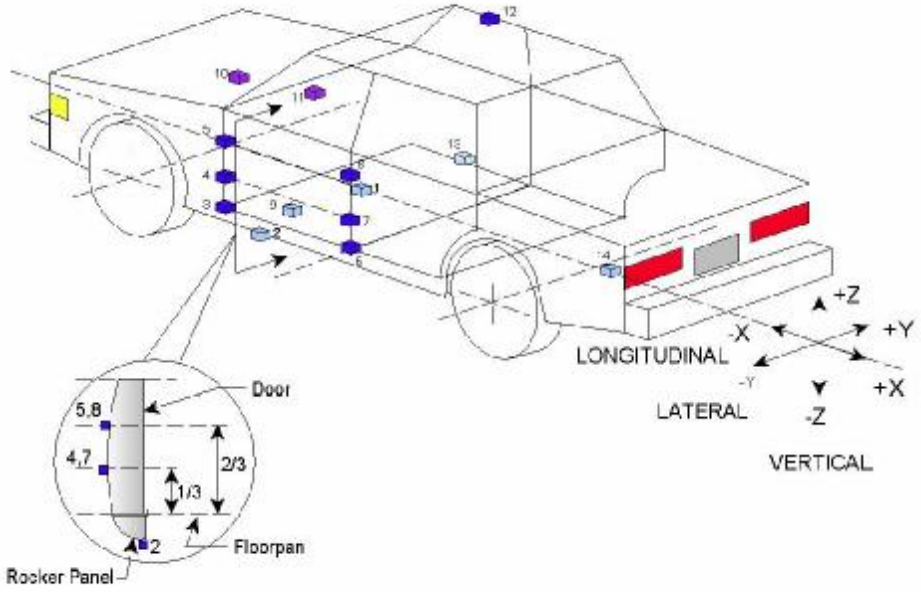


No.	CAMERA VIEW	Location			LENS (mm)	FILM SPEED (fps)
		X	Y	Z		
1	Real time (24 fps) film coverage	-	-	-	-	24
2	Front ground level - impact view	-1890	-4290	1035	28	1000
3	Impact side 45* - forward pole view	-1670	-1245	2270	24	1000
4	Overhead Close-up view of impact	-40	-210	4375	28	1000
5	Onboard – dummy front view				25	500
6	Onboard – dummy side view				12.5	500
7	Onboard – dummy rear view				12.5	500
8	Rear ground level – impact view	1560	6480	1020	24	1000
9	Impact side 45º - rearward pole view	-2950	2640	1510	24	1000
10	Overhead wide-view of impact	310	-160	4375	14	1000

Reference: Impact Point projected to Ground
+X = To Front, +Y = To Right, +Z = Down
*All measurements accurate to ± 6 mm.

DATA SHEET NO. 9
TEST VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle:	2011 Hyundai Sonata GLS	NHTSA No.	CB0500
Test Program:	FMVSS 214 Indicant Side Impact	Test Date:	March 25, 2010



Loc. No.	Accelerometer Location	Coordinates (mm)		
		X	Y	Z
1	Vehicle C.G.	2749	28	476
2	Left Floor Sill	3013	-695	326
3	Left A-Pillar Sill	3293	-678	305
4	Left A-Pillar Low	3310	-659	422
5	Left A-Pillar Mid	3294	-668	1020
6	Left B-Pillar Sill	2267	-696	374
7	Left B-Pillar Low	2264	-696	659
8	Left B-Pillar Mid	2200	-689	943
9	Left Seat Track	2358	-589	290
10	Engine Top	4093	84	804
11	Firewall	3722	-39	837
12	Right Roof	2292	607	1399
13	Right Floor Sill	2916	692	334
14	Rear Deck	1203	-1	509

X – Test Vehicle Rear Bumper (+ forward)
Y – Test Vehicle Centerline (+ to right)
Z – Ground Plane (+ down)

DATA SHEET NO. 10
TEST VEHICLE ACCELEROMETER DATA SUMMARY

Test Vehicle:	2011 Hyundai Sonata GLS	NHTSA No.	CB0500
Test Program:	FMVSS 214 Indicant Side Impact	Test Date:	March 25, 2010

Loc. No	Description	Peak Values (g's)			
		Max	Time (ms)	Min	Time (ms)
1	Vehicle CG (X)	15.5	27.7	-14.2	63.6
	Vehicle CG (Y)	38.6	31.6	-1.0	213.6
	Vehicle CG (Z)	27.2	30.7	-20.3	60.7
	Vehicle CG Resultant	47.2	31.0	0.0	0.0
2	Left Floor Sill (Y)	46.7	10.2	-7.5	23.2
3	Left A-Pillar Sill (Y)	41.2	19.6	-15.0	124.9
4	Left A-Pillar Low (Y)	39.0	19.8	-18.0	44.8
5	Left A-Pillar Mid (Y)	142.7	21.9	-96.9	28.9
6	Left B-Pillar Sill (Y)	57.4	10.8	-24.1	38.0
7	Left B-Pillar Low (Y)	206.4	17.2	-110.8	13.8
8	Left B-Pillar Mid (Y)	91.1	14.2	-37.7	17.3
9	Seat Track (Y)	74.7	25.0	-11.4	55.3
10	Engine Top (X)	9.2	103.5	-14.0	32.1
	Engine Top (Y)	10.2	57.0	-1.9	194.7
11	Firewall (Y)	11.3	46.4	-1.3	2.7
12	Right Roof (Y)	22.2	39.4	-1.1	209.3
13	Right Floor Sill (Y)	6.5	63.0	-2.3	173.1
14	Rear Deck (X)	4.7	109.1	-3.9	170.6
	Rear Deck (Y)	19.5	46.9	-1.3	170.1

DATA SHEET NO. 11
DUMMY INJURY RESPONSE DATA FOR ES-2re

Test Vehicle:	2011 Hyundai Sonata GLS	NHTSA No.	CB0500
Test Program:	FMVSS 214 Indicant Side Impact	Test Date:	March 25, 2010

DUMMY Serial # 037				
	Positive		**Negative**	
	MAX	**TIME (ms)**	**MAX**	**TIME (ms)**
HEAD ACCELERATION (g)				
Longitudinal (X)	10.5	16.5	-25.1	49.9
Lateral (Y)	55.8	55.6	-15.9	97.3
Vertical (Z)	26.9	29.3	-8.4	21.1
Resultant (R)	57.7	51.9	0.0	-58.9
HIC36 (t1, t2)	353.5		t1 = 42.3	t2 = 67.4
THORAX DEFLECTION (mm)				
Upper Rib	19.4	46.5	-2.7	76.1
Middle Rib	16.5	40.4	-4.6	70.1
Lower Rib	23.9	45.8	-3.4	69.7
ABDOMINAL FORCES (N)				
Front	377.8	40.3	-7.7	15.3
Middle	381.7	42.4	-24.0	17.0
Rear	567.8	41.4	-23.4	106.2
SUM	1304.9	41.4	-26.3	102.4
PELVIS FORCE (N)				
Pubic Symphysis (Y)	152.4	166.9	-2181.5	57.4

Reference:

Positive direction:

Longitudinal	(x) = forward
Lateral	(y) = to right
Vertical	(z) = down

DATA SHEET NO. 12
POST TEST OBSERVATIONS

Test Vehicle:	2011 Hyundai Sonata GLS	NHTSA No.	CB0500
Test Program:	FMVSS 214 Indicant Side Impact	Test Date:	March 25, 2010

TEST DUMMY INFORMATION AND CONTACT

Description	Front Occupant
Head Contact	Side of Head – Side curtain airbag
Upper Torso Contact	Side Torso airbag
Lower Torso Contact	Side Torso airbag
Left Knee Contact	No Contact
Right Knee Contact	No contact

POST TEST DOOR OPENING AND SEAT TRACK INFORMATION

Description	Front	Rear
Left Side Doors	Jammed Shut	Jammed Shut
Right Side Doors	Closed and operational	Closed and operational
Hatch and Other Doors	NA	Closed and operational
Seat Movement	None	None
Seat Back Failure	None	None

POST TEST STRUCTURAL OBSERVATIONS

Critical Areas of Performance	Observations and Conclusions
Pillar Performance	B-Pillar Intrusion caused by pole impact
Sill Separation	No separation
Windshield Damage	Severe cracking on left side of windshield
Window Damage	Left front window shattered
Other Notable Effects	None

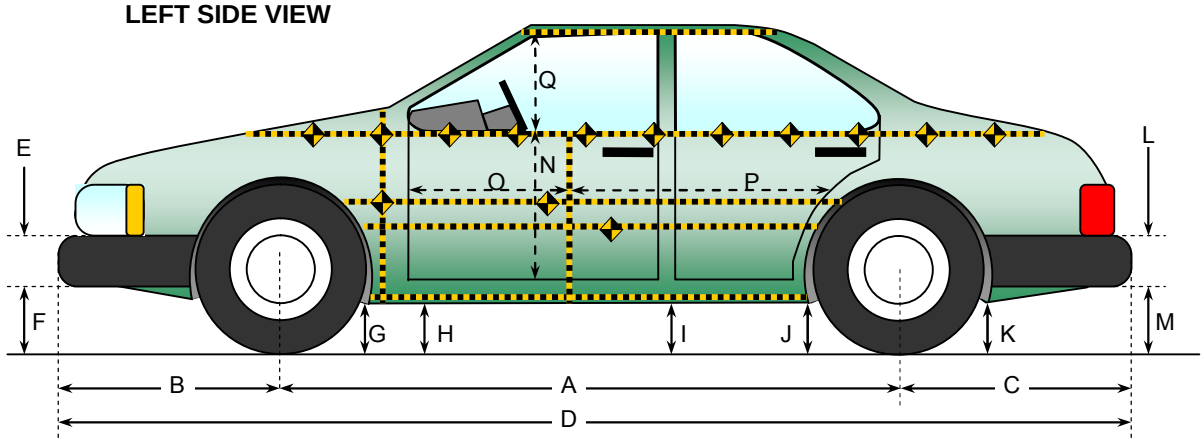
SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

Restraint Type	Front Occupant	
	Installed	Operated
Front Airbag	Yes	No
Side Torso Airbag	Yes	Yes
Head Airbag	No	NA
Curtain Airbag	Yes	Yes
Seat Belt Pretensioner	Yes	Yes
Seat Belt Load Limiter	Yes	Yes

DATA SHEET NO. 13
VEHICLE PRE-TEST AND POST-TEST MEASUREMENTS

Test Vehicle:	2011 Hyundai Sonata GLS	NHTSA No.	CB0500
Test Program:	FMVSS 214 Indicant Side Impact	Test Date:	March 25, 2010

LEFT SIDE VIEW

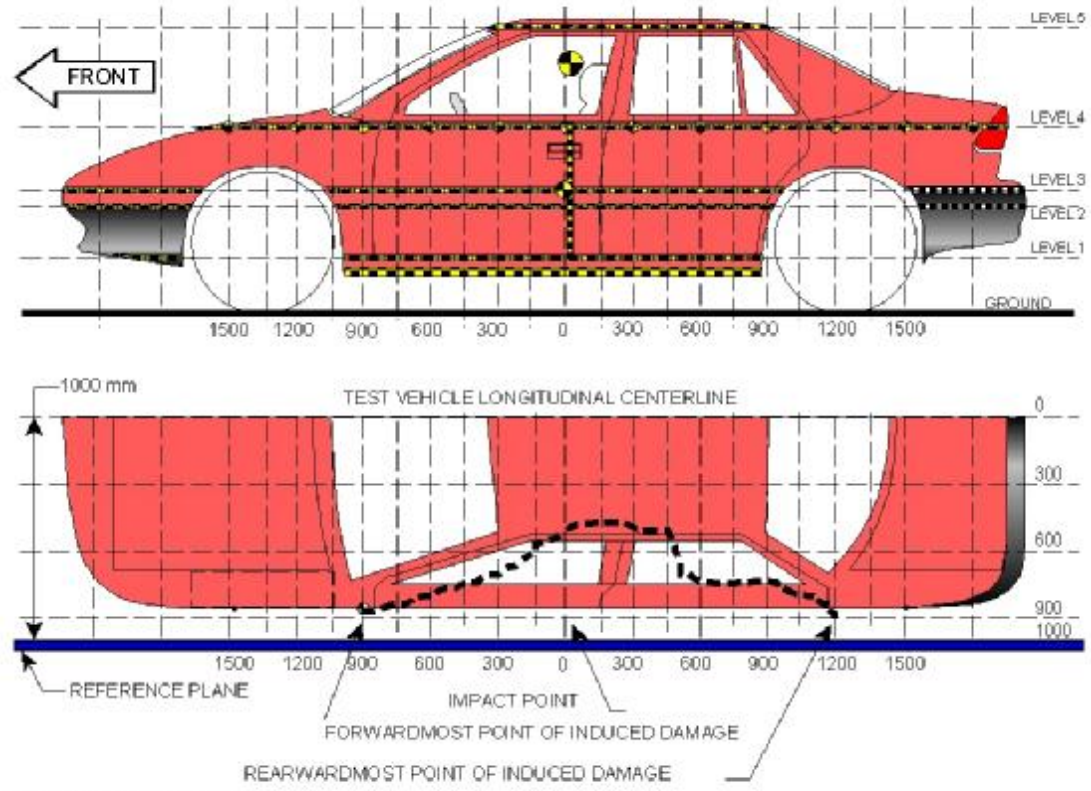


Code	Description	Pre-Test	Post-Test	Diff Δ
A	Wheelbase	2784	2755	29
B	Front Axle to FSOV	959	970	-11
C	Rear Axle to RSOV	1080	1075	5
D	Total Length at Centerline	4823	4800	23
E	Front Bumper Thickness	142	142	0
F	Front Bumper Bottom to Ground	369	424	-55
G	Sill Height at Front Wheel Well	157	171	-14
H	Sill Height at Front Door Leading Edge	159	173	-14
I	Sill Height at B Pillar	174	177	-3
J1	Sill Height at Rear Wheel Well	170	189	-19
J2	Pinch Weld Height at Rear Wheel Well	162	171	-9
K	Sill Height Aft of Rear Wheel Well	206	212	-6
L	Rear Bumper Thickness	270	270	0
M	Rear Bumper Bottom to Ground	347	311	36
N	Sill Height to Window Bottom Sill	734	735	-1
O	Front Door Leading Edge to Impact CL	916	904	12
P	Rear Door Trailing Edge to Impact CL	1090	1068	22
Q	Front Window Opening	403	374	29
R*	Right Side Length	4688	4688	0
S*	Left Side Length	4689	4642	47
T*	Vehicle Width at B Post	1817	1511	306

* - not shown in schematic above

DATA SHEET NO. 14
EXTERIOR CRUSH MEASUREMENTS

Test Vehicle:	2011 Hyundai Sonata GLS	NHTSA No.	CB0500
Test Program:	FMVSS 214 Indicant Side Impact	Test Date:	March 25, 2010



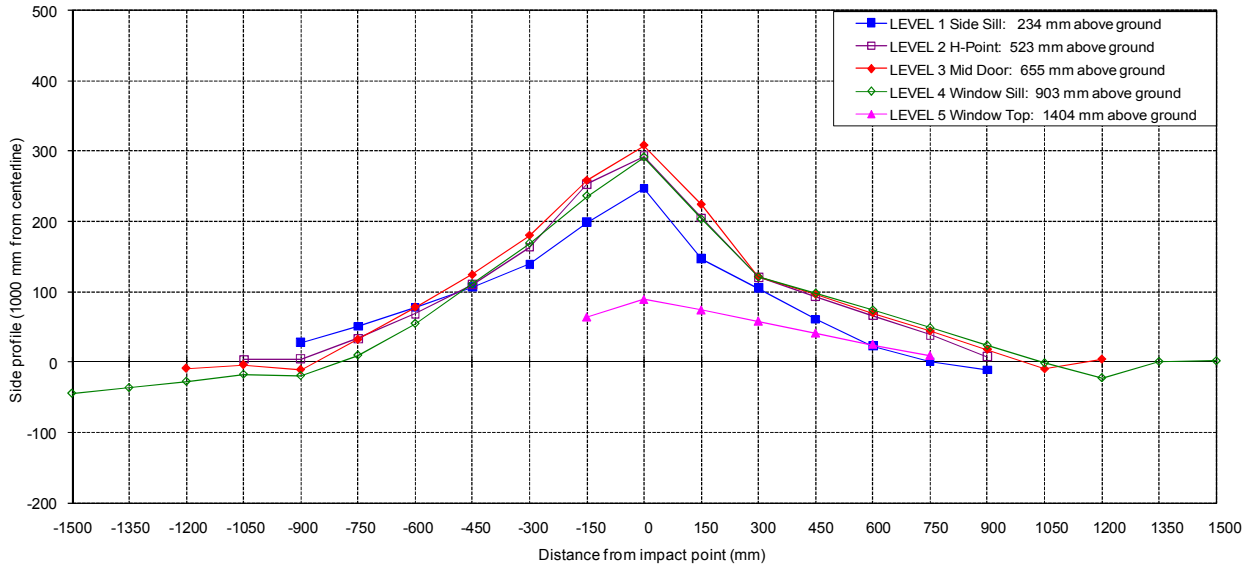
NOTE: All measurements are in millimeters (mm)

Maximum Exterior Crush Measurements

Level	Measurement Description	Maximum Exterior Static Crush	Distance from Impact	Height Above Ground
1	Sill Top	247	0	234
2	Occupant H-Point	293	0	523
3	Mid-Door	308	0	655
4	Window Sill	291	0	903
5	Window Top	89	0	1404

DATA SHEET NO. 15
VEHICLE EXTERIOR CRUSH PROFILES

Test Vehicle:	2011 Hyundai Sonata GLS	NHTSA No.	CB0500
Test Program:	FMVSS 214 Indicant Side Impact	Test Date:	March 25, 2010



	Pre-Test					Post-Test					Diff Δ				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
-1500	--	--	--	790	--	--	--	--	834	--	--	--	--	-44	--
-1350	--	--	--	812	--	--	--	--	848	--	--	--	--	-36	--
-1200	--	--	919	836	--	--	--	928	863	--	--	--	-9	-27	--
-1050	--	917	909	845	--	--	913	913	862	--	--	4	-4	-17	--
-900	883	907	908	851	--	855	902	919	870	--	28	5	-11	-19	--
-750	876	905	910	858	--	825	871	878	848	--	51	34	32	10	--
-600	875	905	912	864	--	797	836	834	809	--	78	69	78	55	--
-450	874	905	913	867	--	767	795	789	756	--	107	110	124	111	--
-300	874	905	914	871	--	735	742	734	702	--	139	163	180	169	--
-150	873	905	915	873	589	674	652	657	637	525	199	253	258	236	64
0	872	905	915	877	607	625	612	607	586	518	247	293	308	291	89
150	871	904	915	882	609	724	699	691	679	535	147	205	224	203	74
300	871	900	911	885	609	766	779	790	764	551	105	121	121	121	58
450	871	898	909	890	607	810	805	813	792	566	61	93	96	98	41
600	872	896	906	891	602	849	830	836	817	577	23	66	70	74	25
750	874	895	903	884	591	873	856	859	835	582	1	39	44	49	9
900	876	901	903	876	--	887	893	885	852	--	-11	8	18	24	--
1050	--	--	910	865	--	--	--	920	866	--	--	--	-10	-1	--
1200	--	--	916	861	--	--	--	912	883	--	--	--	4	-22	--
1350	--	--	--	852	--	--	--	--	851	--	--	--	--	1	--
1500	--	--	--	841	--	--	--	--	839	--	--	--	--	2	--

DATA SHEET NO. 16
SUMMARY OF FMVSS 301 FUEL SYSTEM DATA

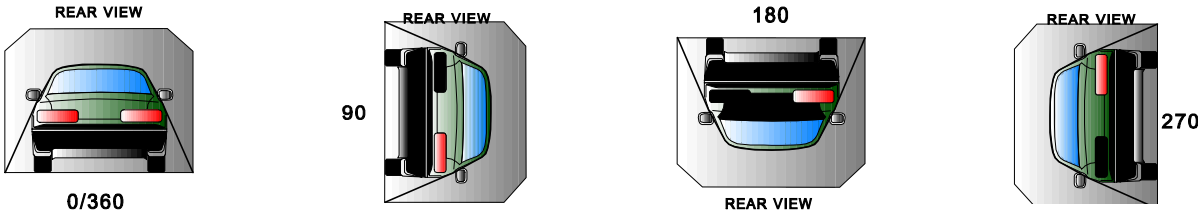
Test Vehicle:	2011 Hyundai Sonata GLS	NHTSA No.	CB0500
Test Program:	FMVSS 214 Indicant Side Impact	Test Date:	March 25, 2010

FUEL SYSTEM INTEGRITY POST IMPACT DATA

Time Interval	FMVSS 301 Maximum Allowable Spillage	Spillage (g)
Impact Until Motion Ceases	28 g	0
First Five Minutes Following Impact	142 g	0
Next 25 Minutes	28 g / 1 minute	0

Spillage Location(s)	None

STATIC ROLLOVER DATA

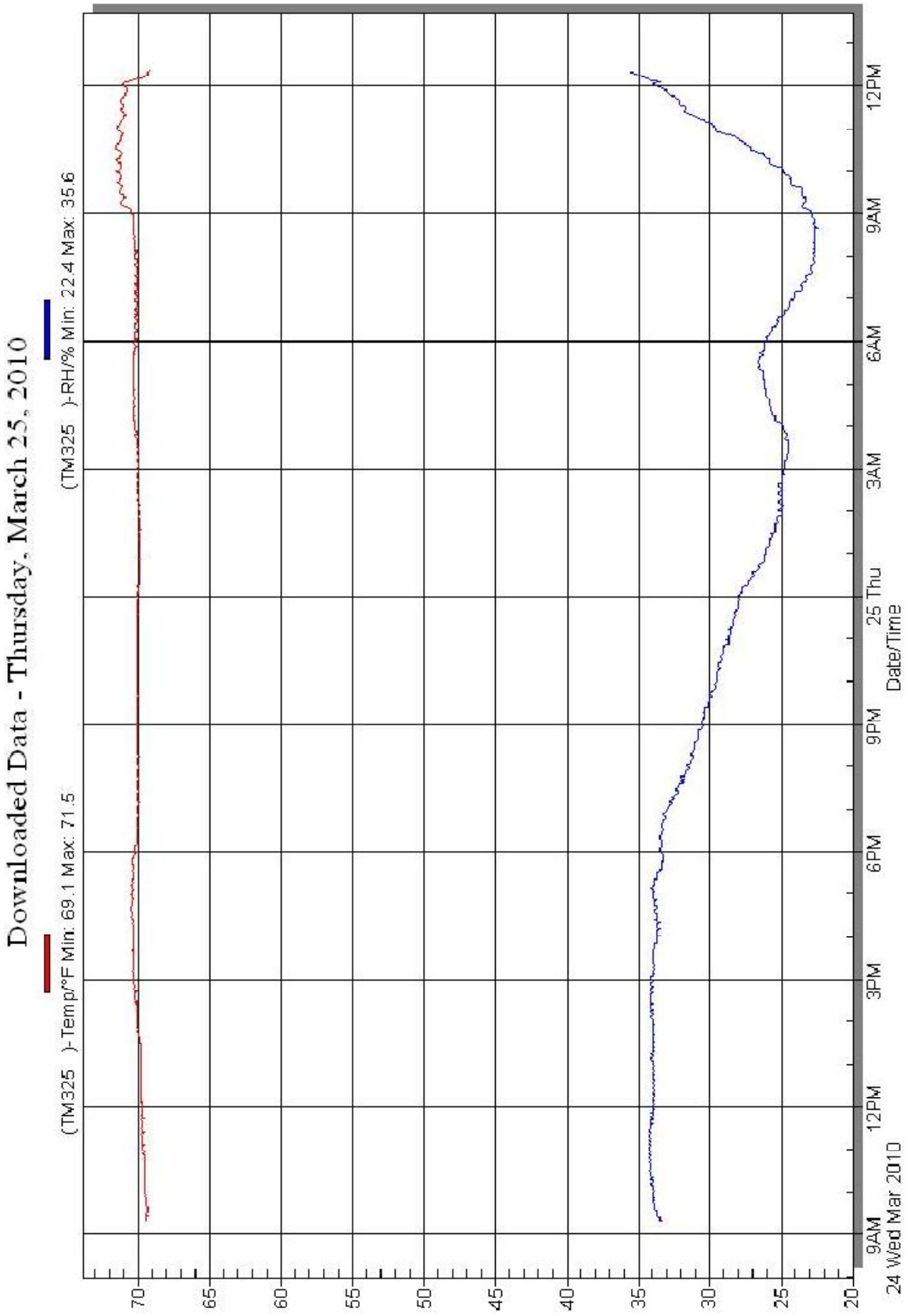


Rollover Stage	Rotation Time (spec. 1 -3 min)				FMVSS 301 Hold Time		Total Time				Next Whole Minute Interval	
0º - 90º	1	minutes	09	seconds	5	minutes	6	minutes	9	seconds	7	minutes
90º - 180º	1	minutes	02	seconds	5	minutes	6	minutes	2	seconds	7	minutes
180º-270º	1	minutes	05	seconds	5	minutes	6	minutes	5	seconds	7	minutes
270º-360º	1	minutes	11	seconds	5	minutes	6	minutes	11	seconds	7	minutes

Rollover Stage	Spillage (g)			
	First 5 min. from onset of rotation	6^{th} min.	7^{th} min.	8^{th} min. (if required)
0º - 90º	0	0	0	0
90º - 180º	0	0	0	0
180º-270º	0	0	0	0
270º-360º	0	0	0	0
FMVSS 301 Maximum Allowable (for each 90º stage)	142	28	28	28

Rollover Stage	Spillage Location(s)
0º - 90º	None
90º - 180º	None
180º-270º	None
270º-360º	None

DATA SHEET NO. 17
TEMPERATURE AND HUMIDITY TRACE



APPENDIX A

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

FIGURE A-1 : Pre-Test Front View of Test Vehicle

FIGURE A-2 : Post-Test Front View of Test Vehicle

FIGURE A-3 : Pre-Test Rear View of Test Vehicle

FIGURE A-4 : Post-Test Rear View of Test Vehicle

FIGURE A-5 : Pre-Test Impacted Side View of Test Vehicle

FIGURE A-6 : Post-Test Impacted Side View of Test Vehicle

FIGURE A-7 : Pre-Test Left ¾ Front View of Vehicle and Pole

FIGURE A-8 : Pre-Test Left ¾ Rear View of Vehicle and Pole

FIGURE A-9 : Pre-Test Overhead View of Aligned Vehicle and Pole

FIGURE A-10 : Post-Test Overhead View of Aligned Vehicle and Pole

FIGURE A-11 : Pre-Test Dummy Thru Opposite Window

FIGURE A-12 : Post-Test Dummy Thru Opposite Window

FIGURE A-13 : Pre-Test Close-up of Dummy w/Door Closed (Impact Side)

Photograph Not Available

FIGURE A-14 : Post-Test Dummy w/Door Closed (Impact Side)

FIGURE A-15 : Pre-Test Dummy Door Open

FIGURE A-16 : Pre-Test Dummy Shoulder and Door Top View

Photograph Not Available

FIGURE A-17 : Post-Test Dummy Shoulder and Door Top View

FIGURE A-18 : Pre-Test Interior of Front Door Closed (thru opposite door)

FIGURE A-19 : Post-Test Interior of Front Door Showing Dummy Impact Locations

FIGURE A-20 : Impact Event

FIGURE A-21 : Post-Test Impact Zone Close-up View

FIGURE A-22 : Post-Test ¾ Front View of Impact Zone

FIGURE A-23 : Post-Test ¾ Rear View of Impact Zone

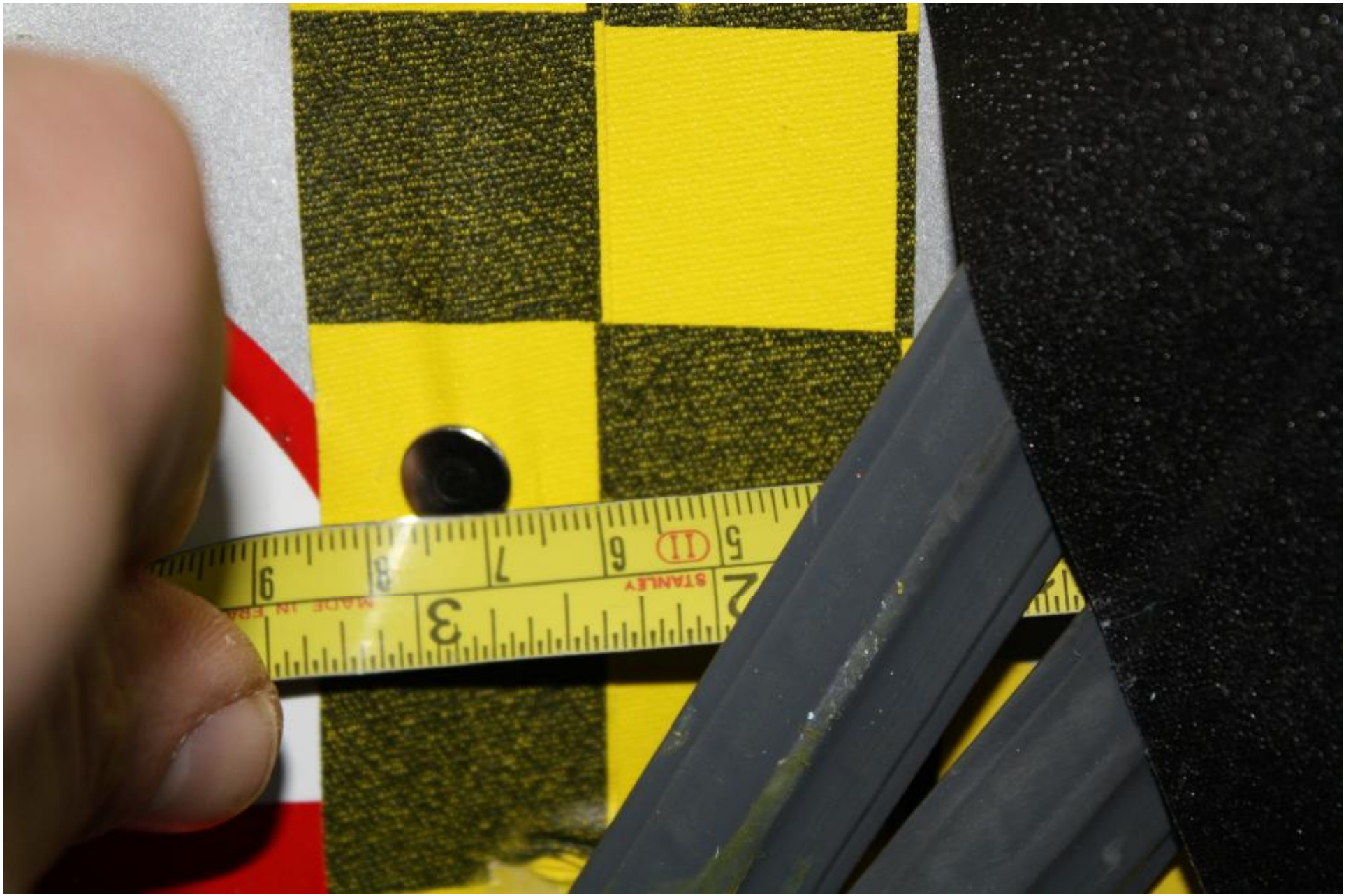


FIGURE A-24 : Post-Test Close-Up View of Impact Point Target

FIGURE A-25 : Close-up View of Vehicle's Certification Label

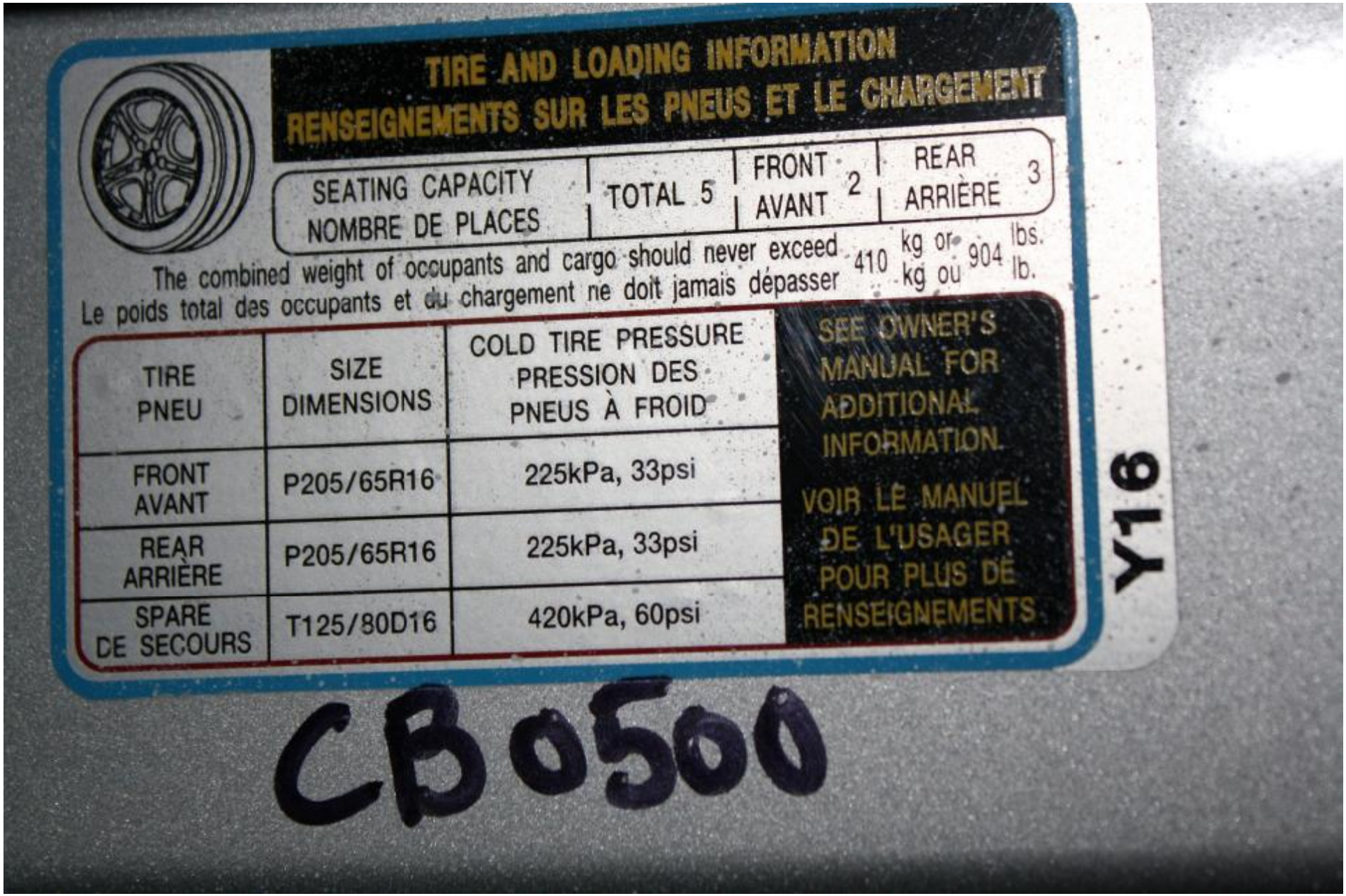


FIGURE A-26 : Close-up View of Vehicle's Tire Placard Label

FIGURE A-27 : Rollover 90 Degrees

FIGURE A-28 : Rollover 180 Degrees

FIGURE A-29 : Rollover 270 Degrees

FIGURE A-30 : Rollover 360 Degrees

APPENDIX B

DUMMY, VEHICLE AND MDB RESPONSE DATA

(SAE sign convention)

ES-2re DATA CHANNEL FILTER CLASS SUMMARY

Data Type	SAE Filter Class	Cut-off Frequency
Dummy Head Acceleration	1000	1650
Chest Deflection	180	300
Spine Acceleration	60	100
Abdomen Force	600	1000
Pubic Force	600	1000

DATA CHANNEL TITLE KEY

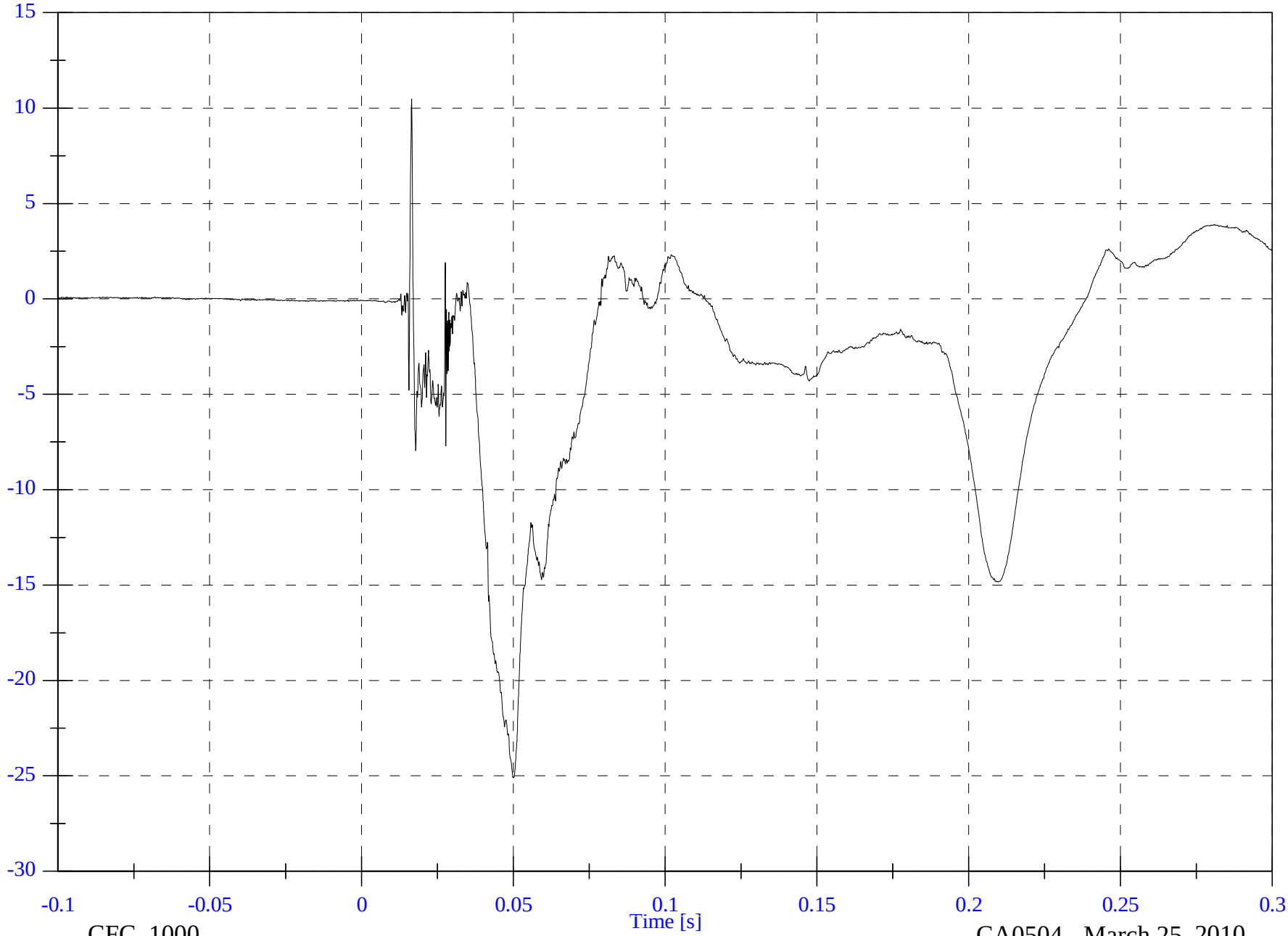
Prefix	Suffix
V1 = Vehicle 1 (Test Vehicle)	Ax = Acceleration, X-direction
	Ay = Acceleration, Y-direction
P1 = Left Front Seating Position (Driver)	Az = Acceleration, Z-direction
	Fx = Force, X-direction
A1-A18 = Accelerometer Location Number	Fy = Force, Y-direction
	Fz = Force, Z-direction
	Dx = Deflection, X-direction
	Dy = Deflection, Y-direction
	Dz = Deflection, Z-direction

TABLE OF DATA PLOTS for ES-2RE

FMVSS 214 Oblique Pole 2011 Hyundai Sonata

V1P1 Head x

Max: 10.5 [g] at 0.016 [s]
Min: -25.1 [g] at 0.050 [s]



B-4

tr2433

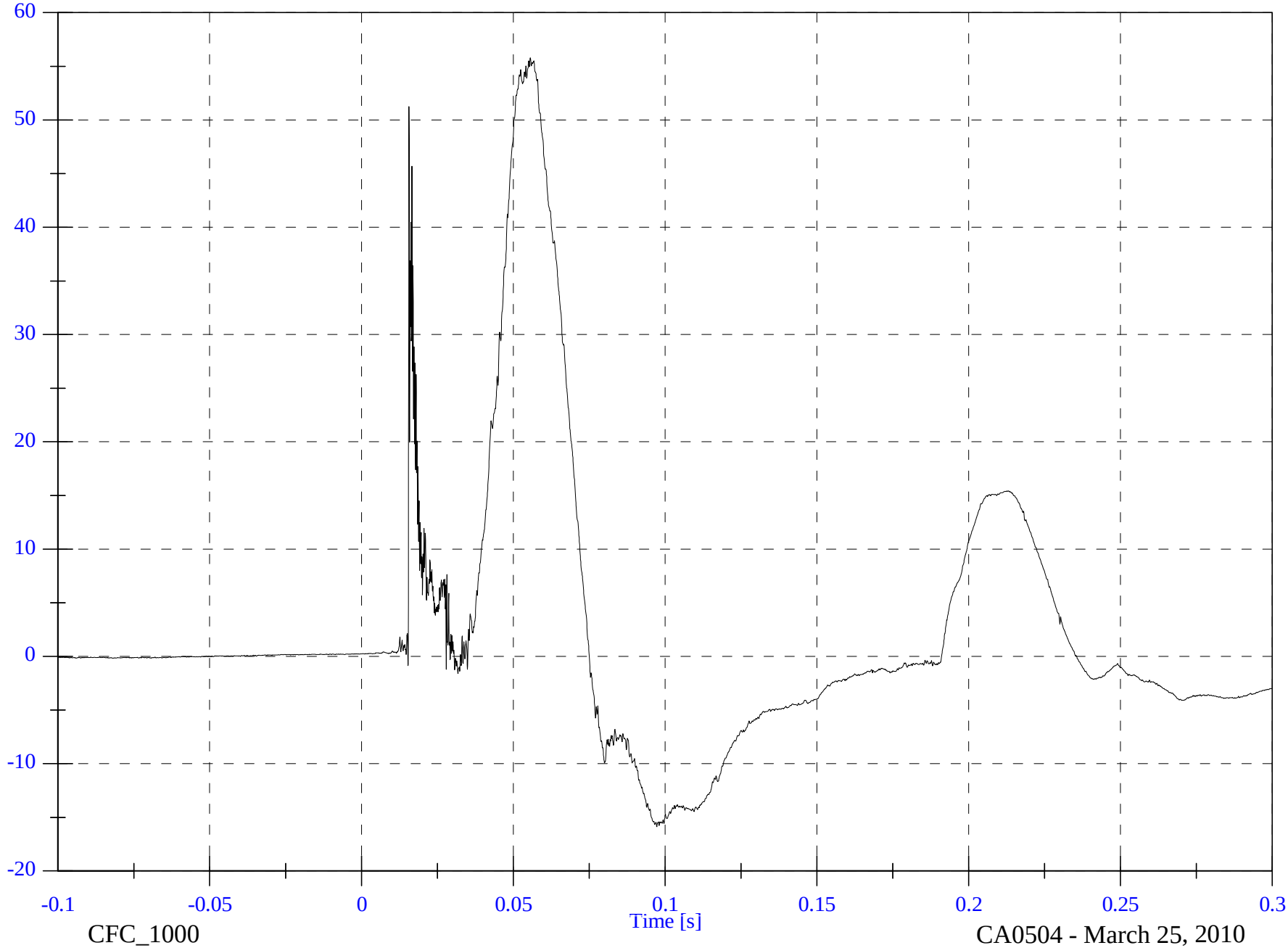
CFC_1000

CA0504 - March 25, 2010

FMVSS 214 Oblique Pole 2011 Hyundai Sonata

V1P1 Head y

Max: 55.8 [g] at 0.056 [s]
Min: -15.9 [g] at 0.097 [s]



B-5

tr2433

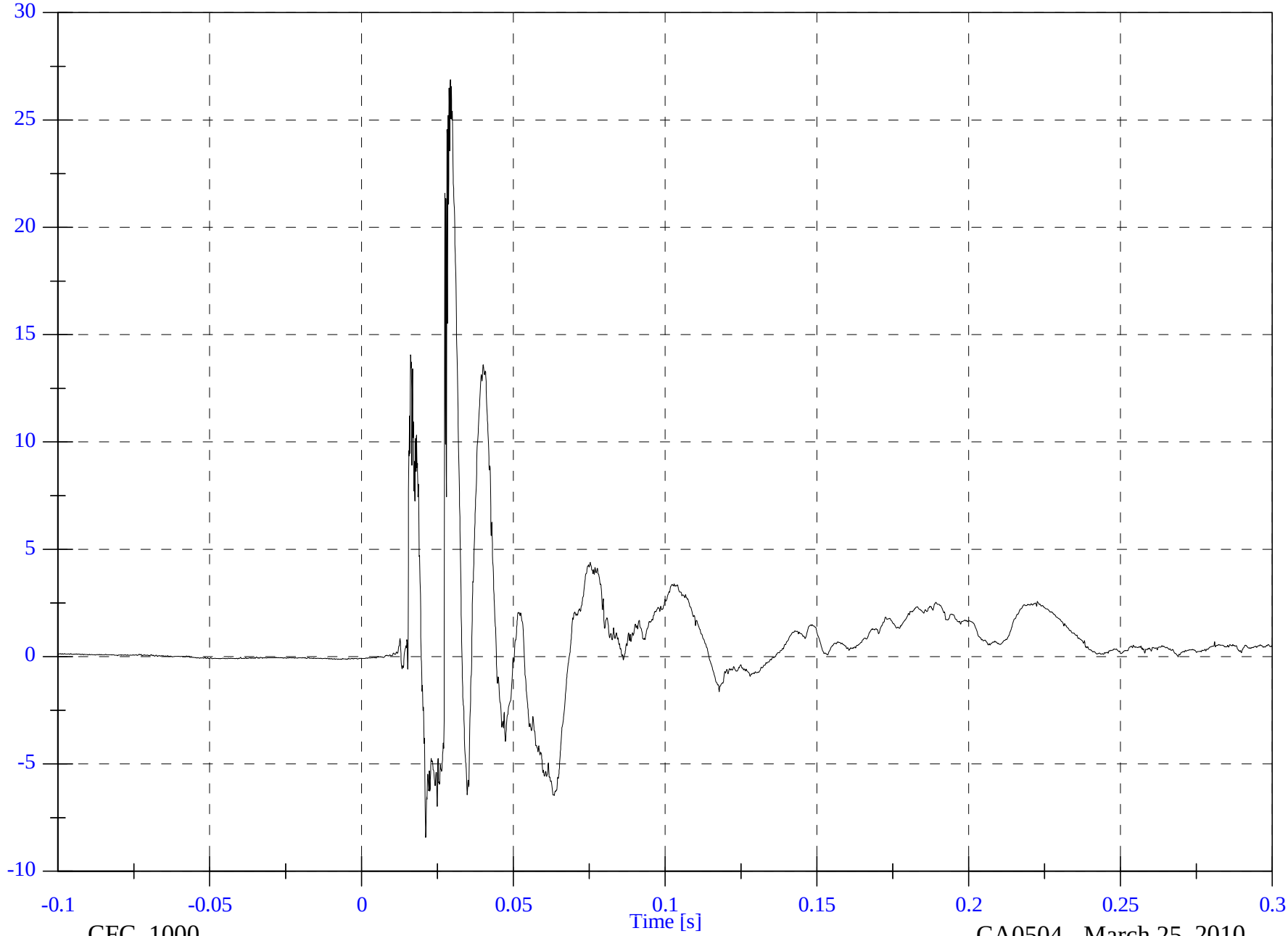
CFC_1000

CA0504 - March 25, 2010

FMVSS 214 Oblique Pole 2011 Hyundai Sonata

V1P1 Head z

Max: 26.9 [g] at 0.029 [s]
Min: -8.4 [g] at 0.021 [s]



B-6

tr2433

CFC_1000

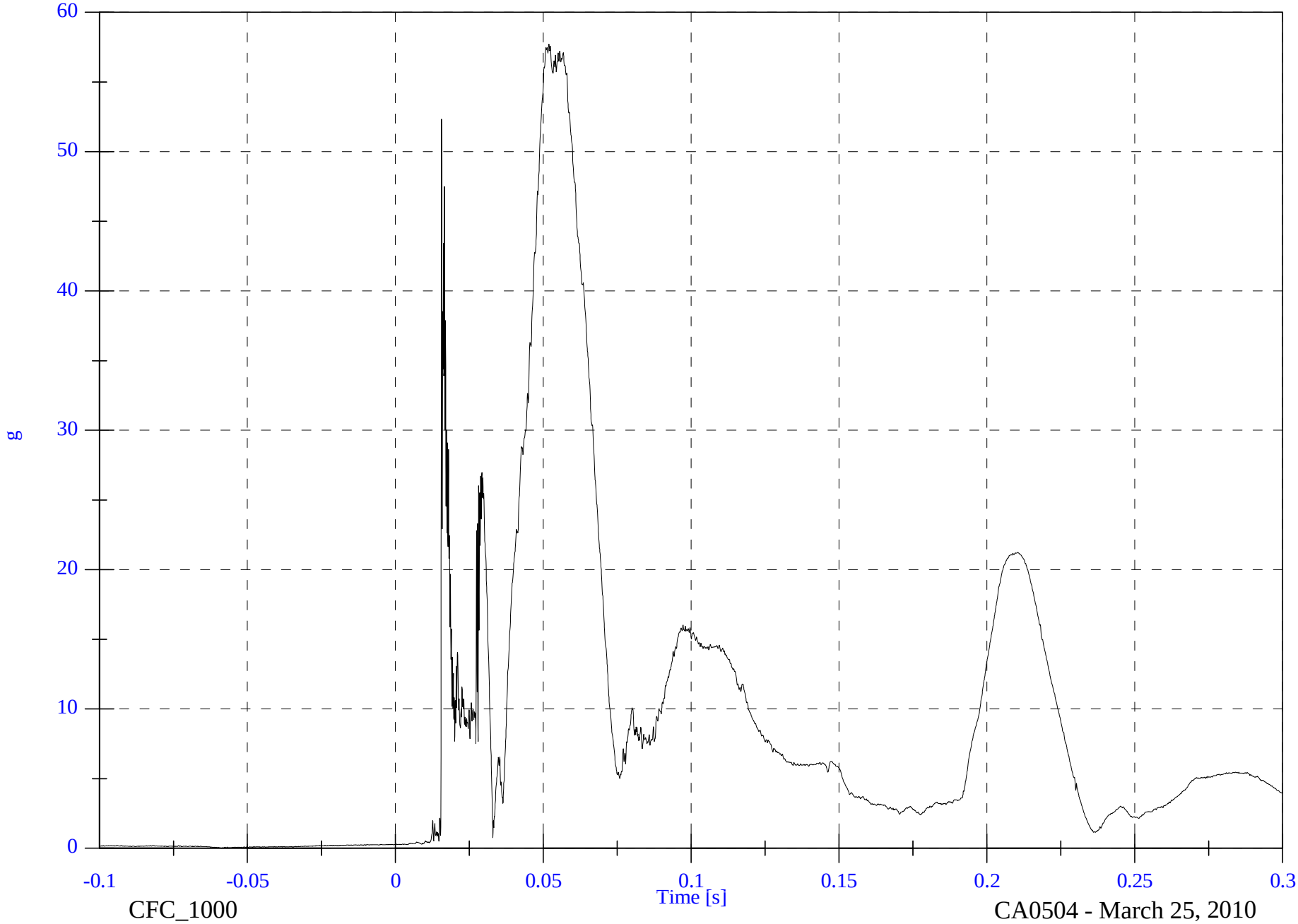
CA0504 - March 25, 2010

FMVSS 214 Oblique Pole 2011 Hyundai Sonata

V1P1 Head Resultant

Max: 57.7 [g] at 0.052 [s]

Min: 0.0 [g] at -0.059 [s]



B-7

tr2433

CFC_1000

CA0504 - March 25, 2010

FMVSS 214 Oblique Pole 2011 Hyundai Sonata

V1P1 Head x Velocity

Max: 8.1 [kph] at -0.045 [s]

Min: -29.5 [kph] at 0.239 [s]

CFC_180

CA0504 - March 25, 2010

B-8

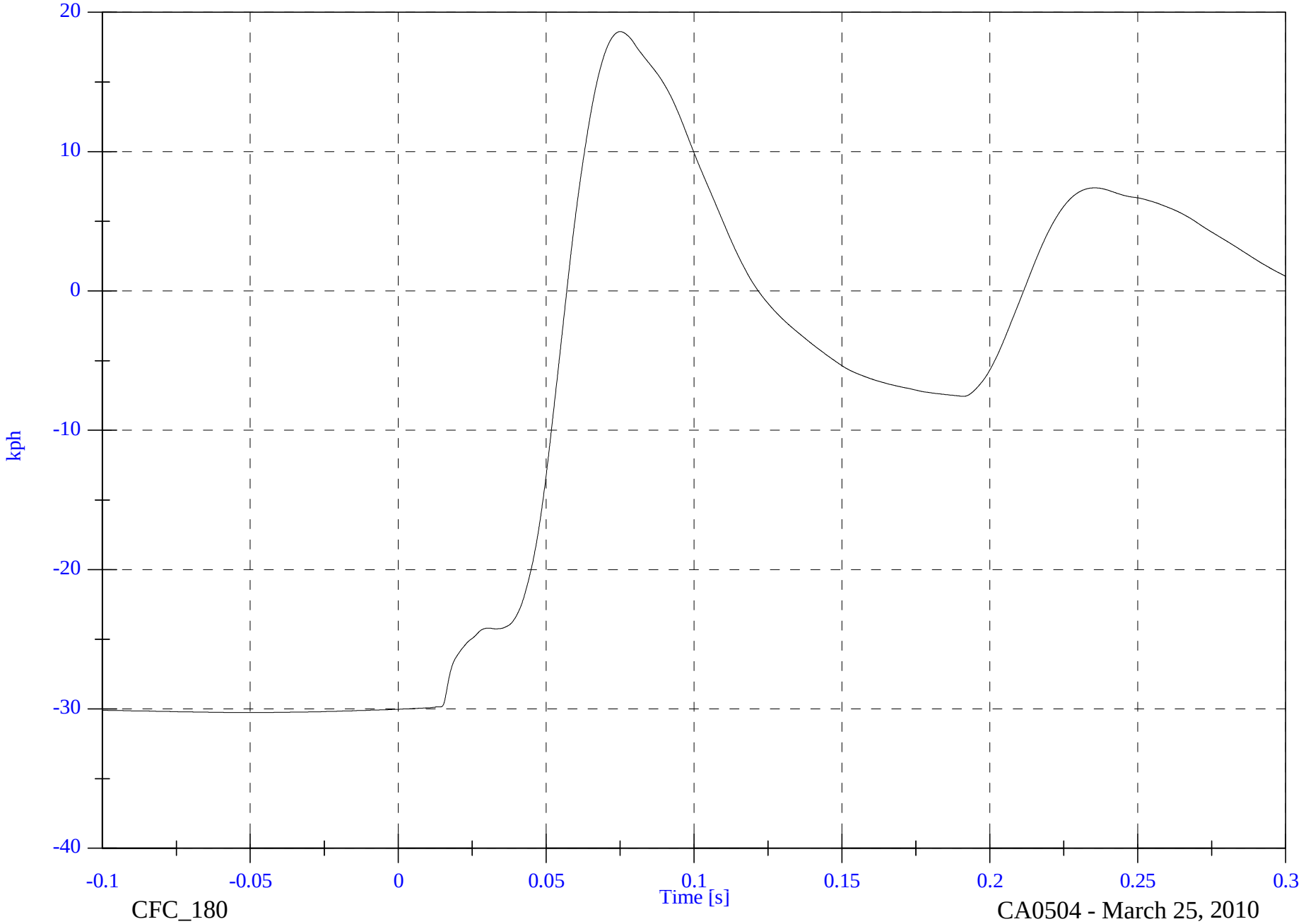
tr2433

FMVSS 214 Oblique Pole 2011 Hyundai Sonata

V1P1 Head y Velocity

Max: 18.6 [kph] at 0.075 [s]

Min: -30.3 [kph] at -0.049 [s]



CFC_180

CA0504 - March 25, 2010

B-9

tr2433

FMVSS 214 Oblique Pole 2011 Hyundai Sonata

V1P1 Head z Velocity

Max: 11.4 [kph] at 0.300 [s]

Min: -0.0 [kph] at 0.008 [s]

B-10

tr2433

CFC_180

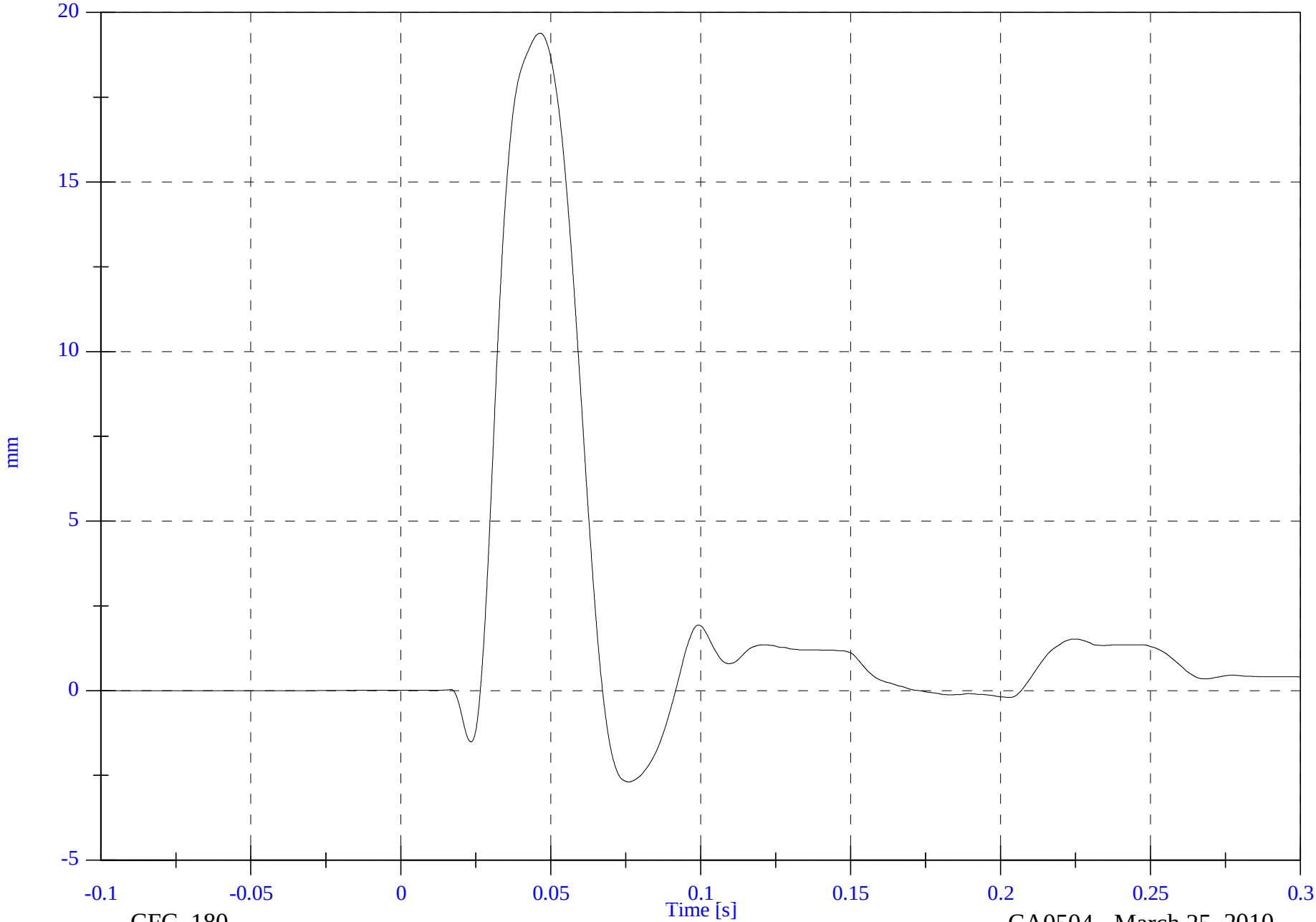
CA0504 - March 25, 2010

FMVSS 214 Oblique Pole 2011 Hyundai Sonata

V1P1 Upper Thorax Rib Dy

Max: 19.4 [mm] at 0.046 [s]

Min: -2.7 [mm] at 0.076 [s]



B-11

tr2433

CFC_180

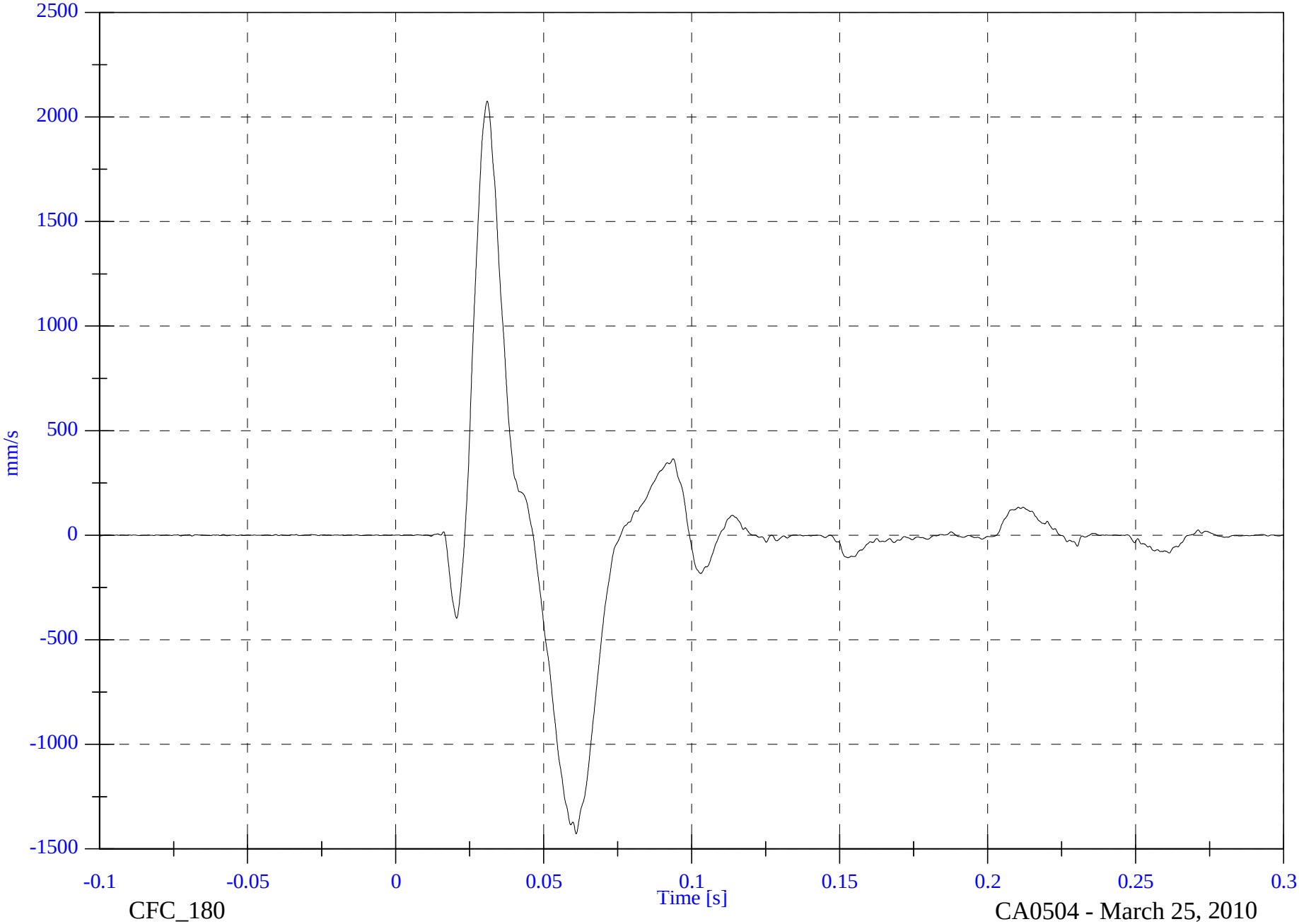
CA0504 - March 25, 2010

FMVSS 214 Oblique Pole 2011 Hyundai Sonata

V1P1 Upper Thorax Rib Dy Rate

Max: 2075.9 [mm/s] at 0.031 [s]

Min: -1428.0 [mm/s] at 0.061 [s]



B-12

tr2433

CFC_180

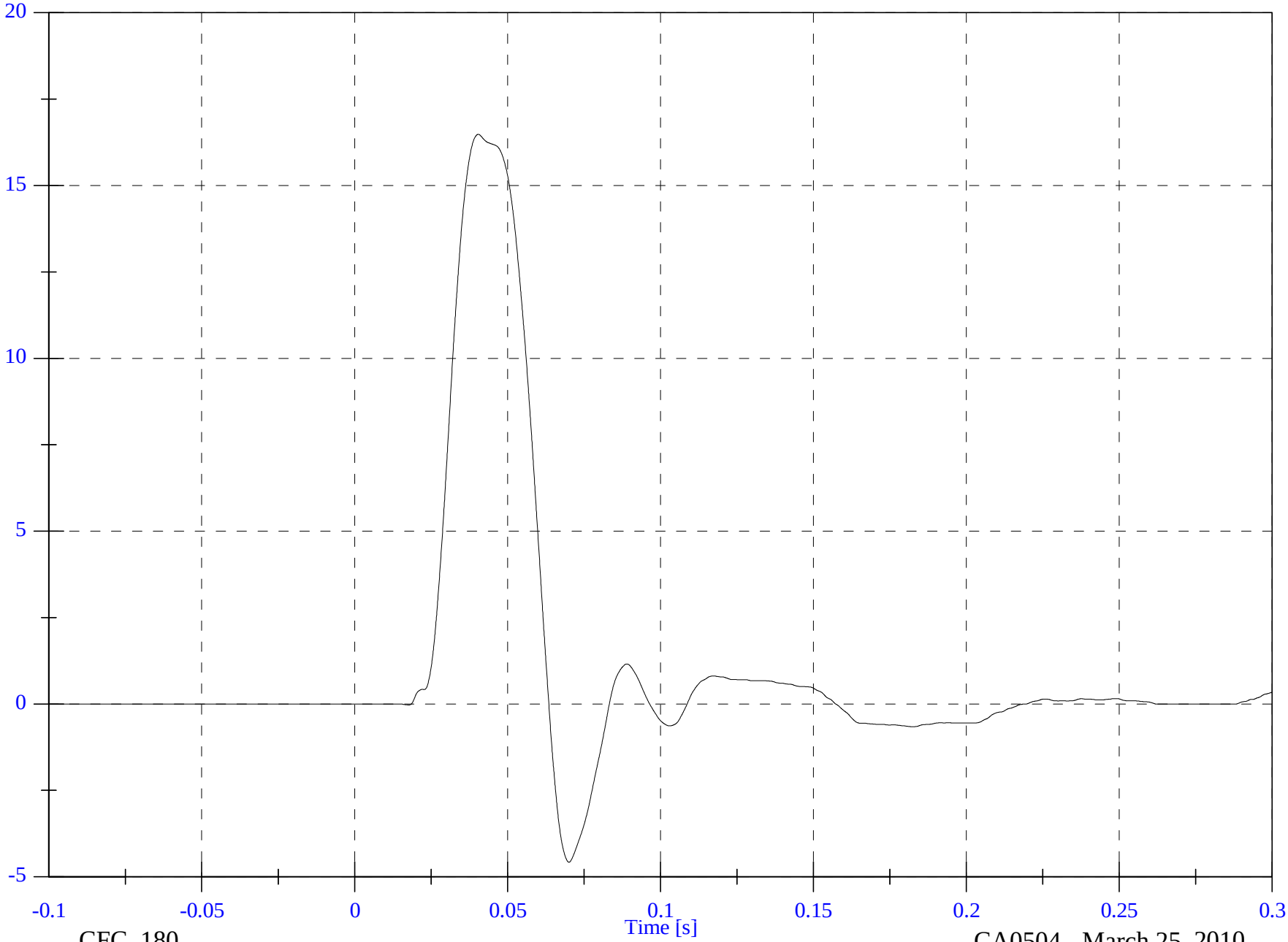
CA0504 - March 25, 2010

FMVSS 214 Oblique Pole 2011 Hyundai Sonata

V1P1 Middle Thorax Rib Dy

Max: 16.5 [mm] at 0.040 [s]

Min: -4.6 [mm] at 0.070 [s]



B-13

tr2433

CFC_180

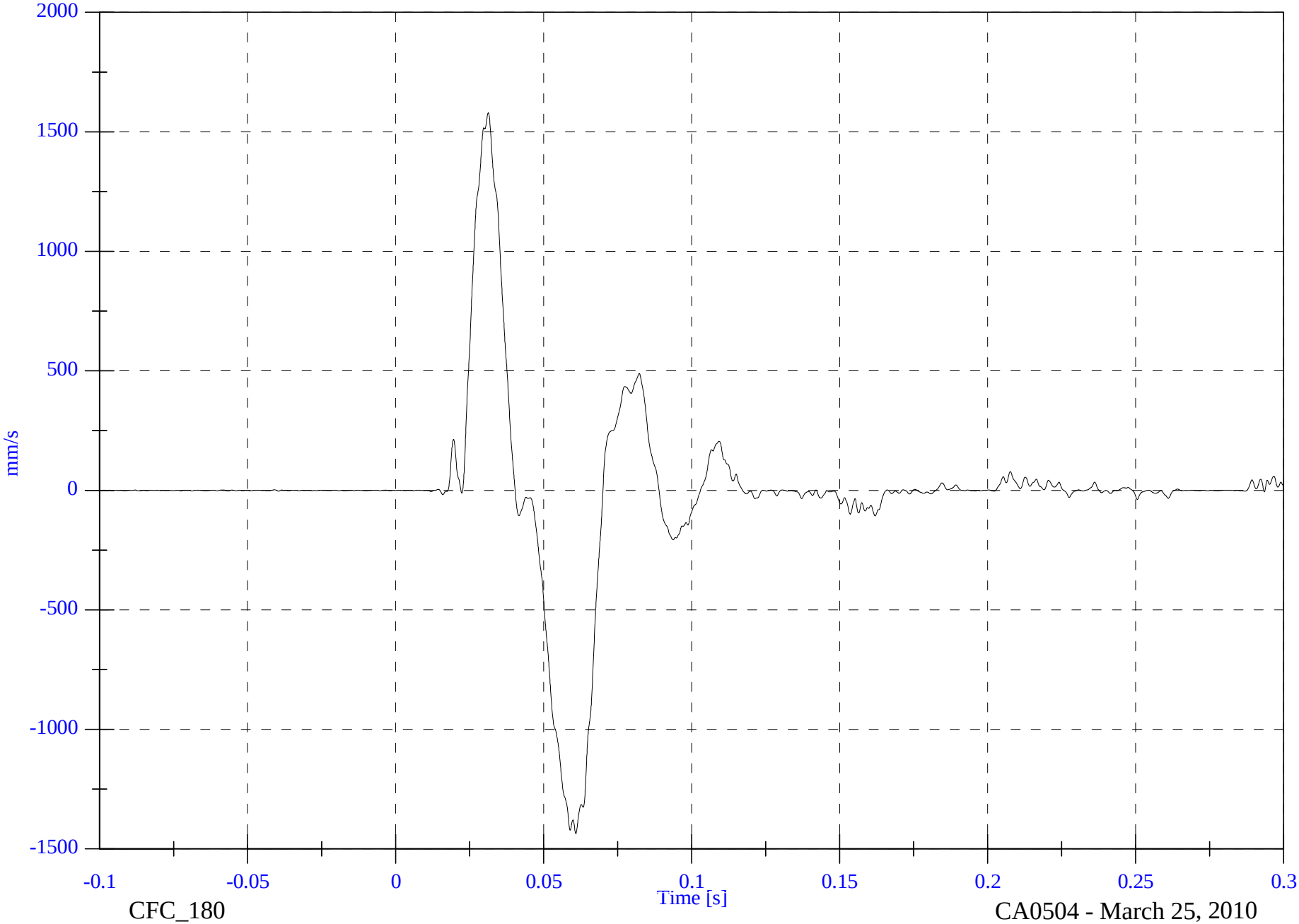
CA0504 - March 25, 2010

FMVSS 214 Oblique Pole 2011 Hyundai Sonata

V1P1 Middle Thorax Rib Dy Rate

Max: 1580.4 [mm/s] at 0.031 [s]

Min: -1436.1 [mm/s] at 0.061 [s]

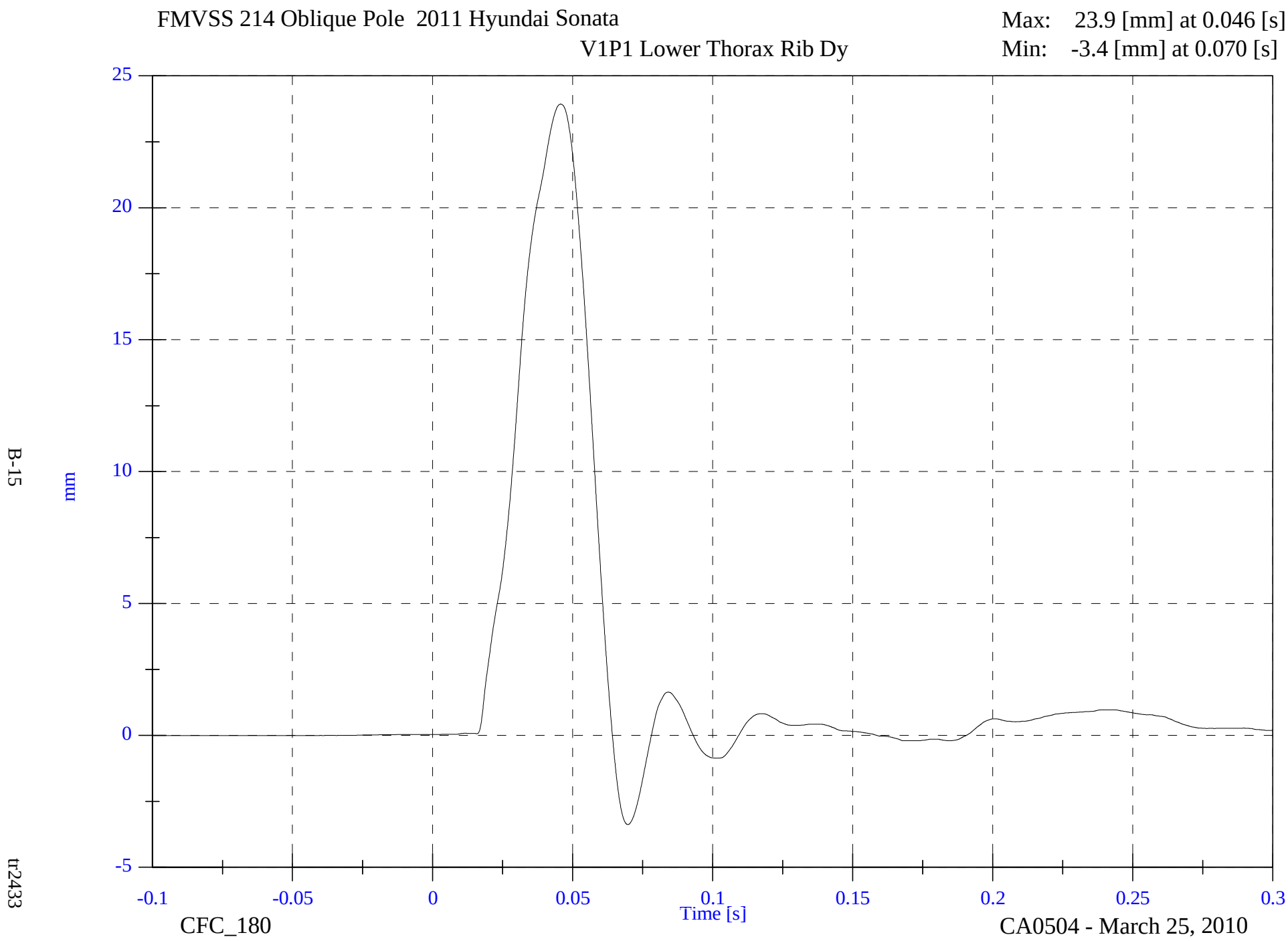


B-14

tr2433

CFC_180

CA0504 - March 25, 2010


FMVSS 214 Oblique Pole 2011 Hyundai Sonata
V1P1 Lower Thorax Rib Dy
Max: 23.9 [mm] at 0.046 [s]
Min: -3.4 [mm] at 0.070 [s]
25
20
15
10
5
0
-5
mm
-0.1
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
Time [s]
CFC_180
CA0504 - March 25, 2010

B-15

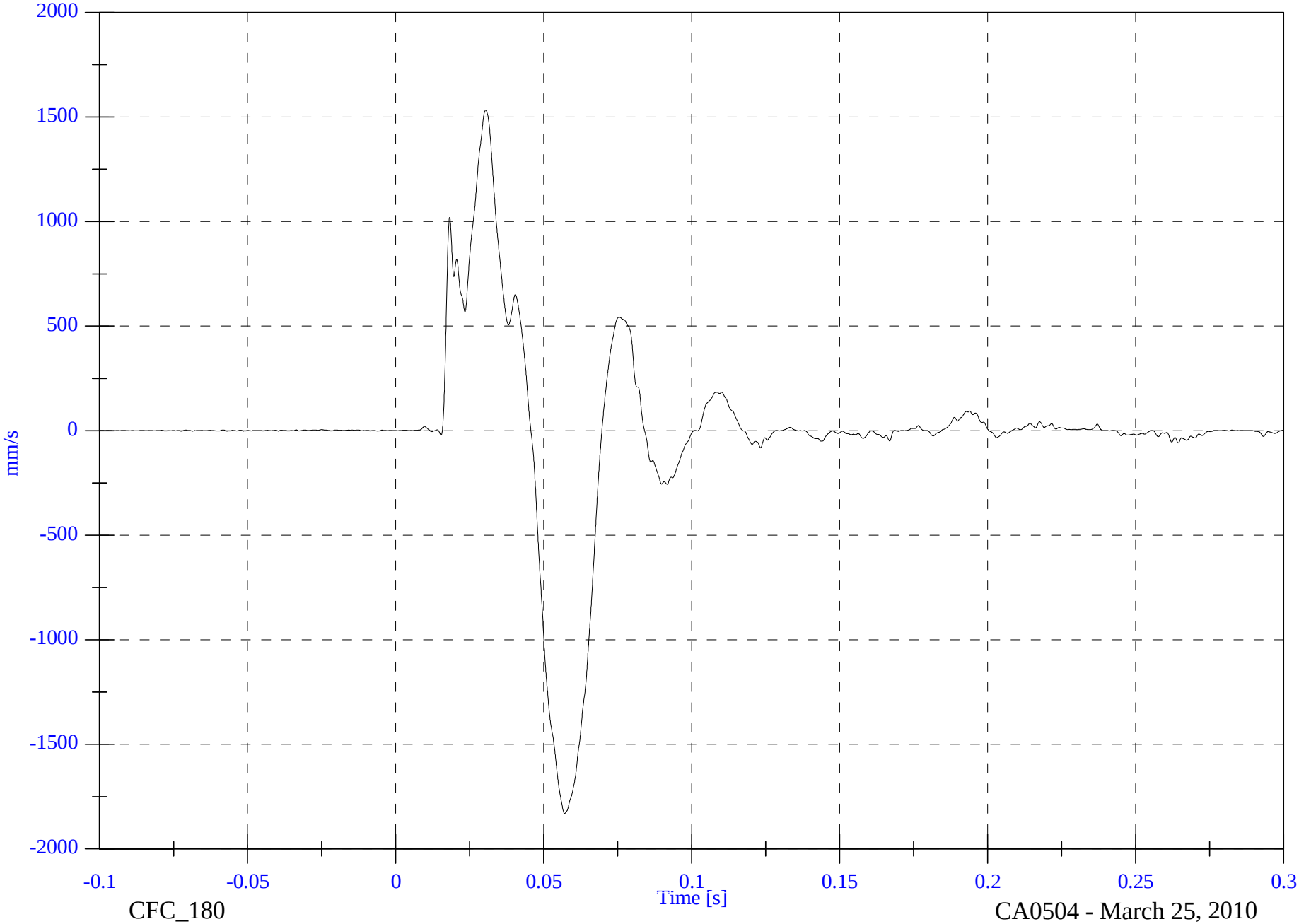
tr2433

FMVSS 214 Oblique Pole 2011 Hyundai Sonata

V1P1 Lower Thorax Rib Dy Rate

Max: 1533.4 [mm/s] at 0.030 [s]

Min: -1830.4 [mm/s] at 0.057 [s]



CFC_180

CA0504 - March 25, 2010

B-16

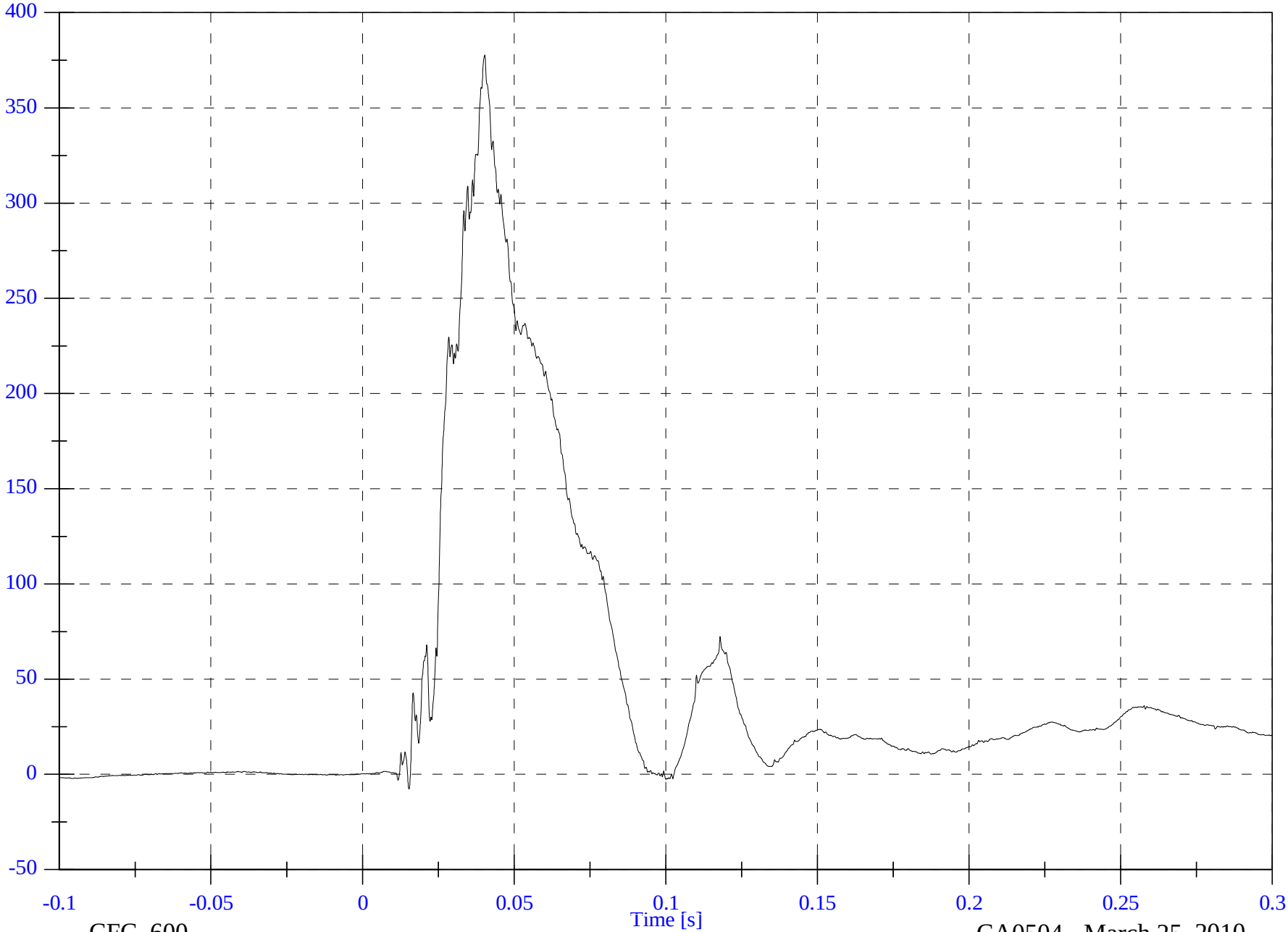
tr2433

FMVSS 214 Oblique Pole 2011 Hyundai Sonata

V1P1 Front Abdominal Fy

Max: 377.8 [N] at 0.040 [s]

Min: -7.7 [N] at 0.015 [s]



CFC_600

CA0504 - March 25, 2010

B-17

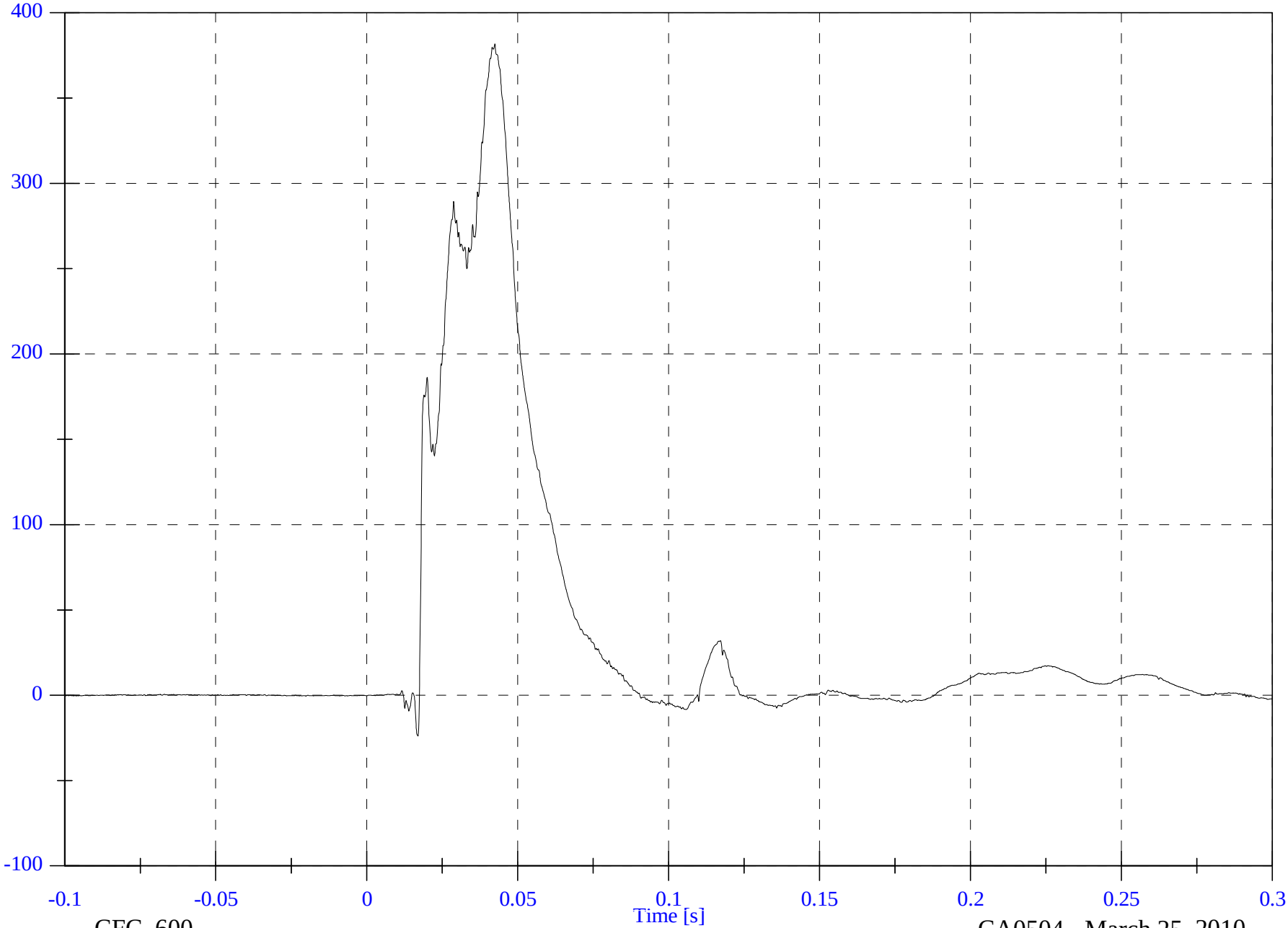
tr2433

FMVSS 214 Oblique Pole 2011 Hyundai Sonata

V1P1 Middle Abdominal Fy

Max: 381.7 [N] at 0.042 [s]

Min: -24.0 [N] at 0.017 [s]



B-18

tr2433

CFC_600

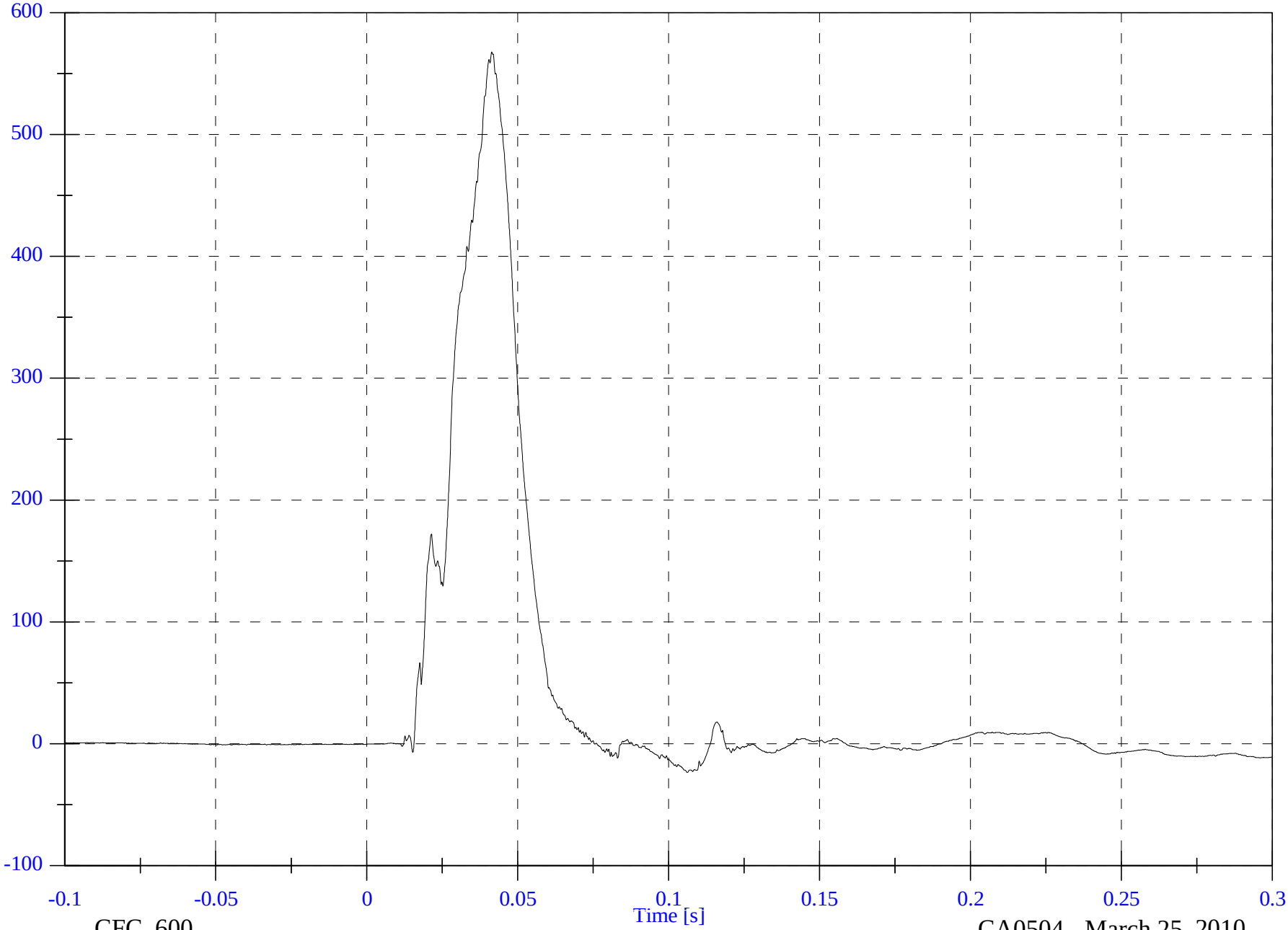
CA0504 - March 25, 2010

FMVSS 214 Oblique Pole 2011 Hyundai Sonata

V1P1 Rear Abdominal Fy

Max: 567.8 [N] at 0.041 [s]

Min: -23.4 [N] at 0.106 [s]



CFC_600

CA0504 - March 25, 2010

B-19

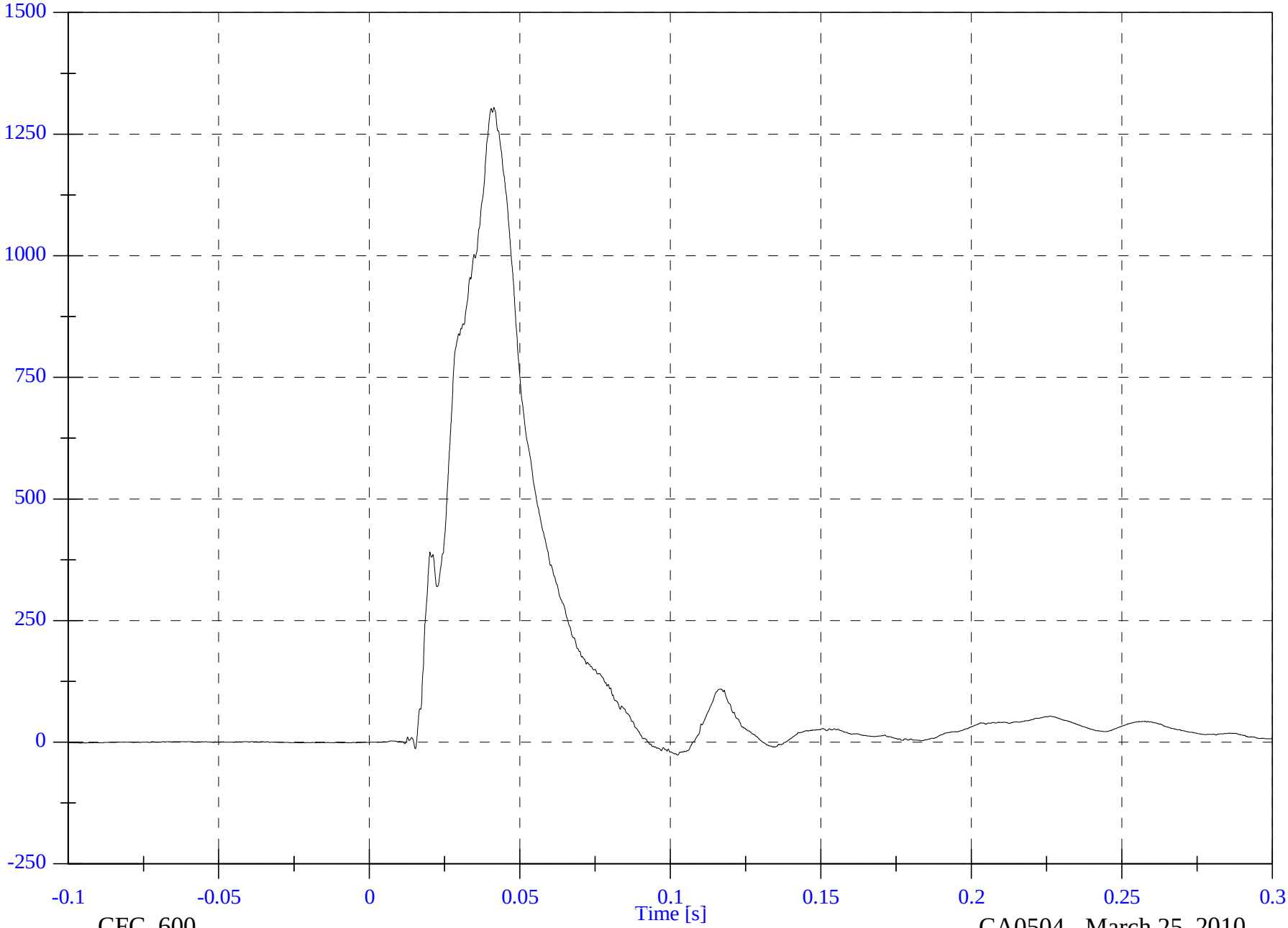
tr2433

FMVSS 214 Oblique Pole 2011 Hyundai Sonata

V1P1 Abdominal Summation

Max: 1304.9 [N] at 0.041 [s]

Min: -26.3 [N] at 0.102 [s]



B-20

tr2433

CFC_600

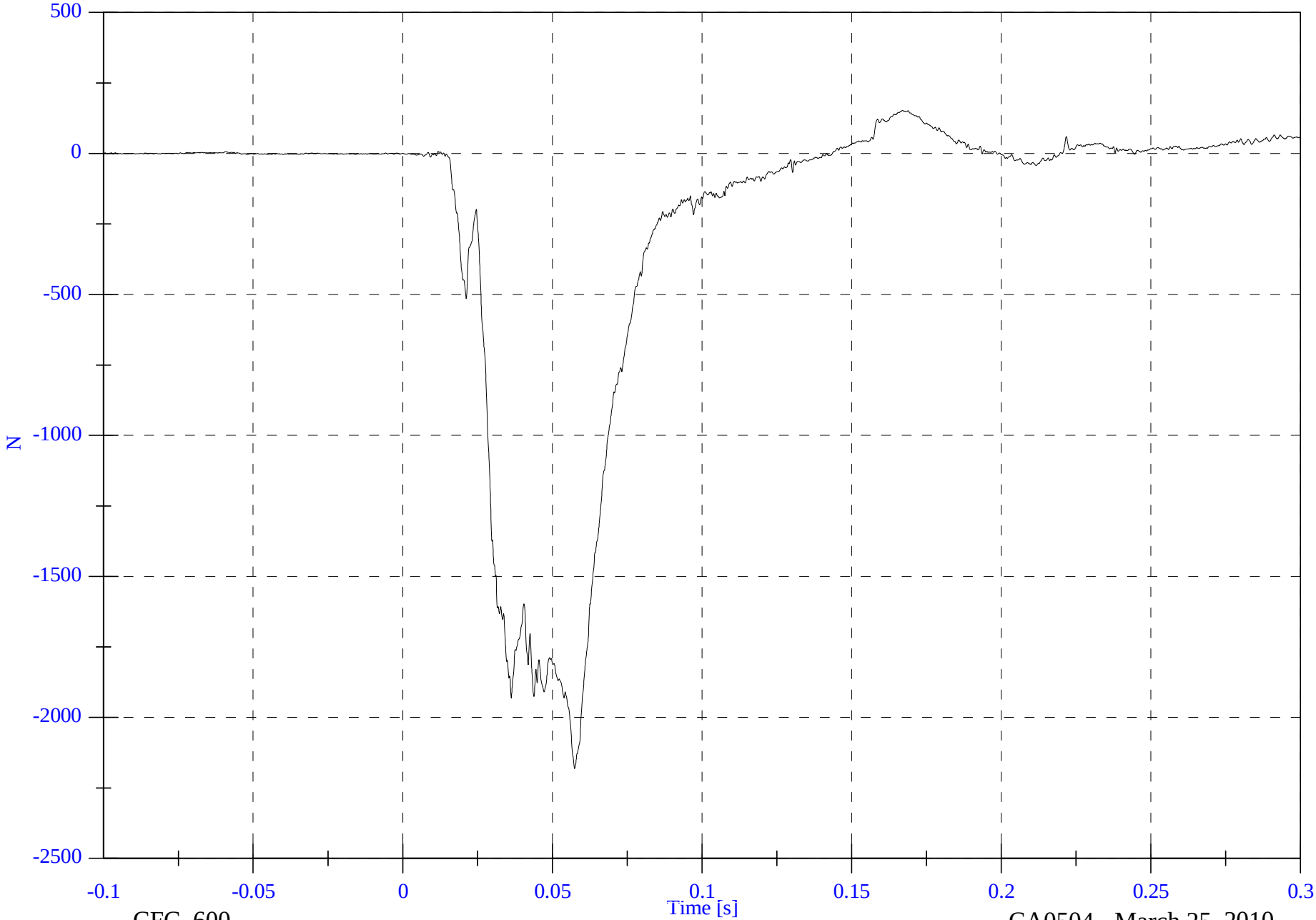
CA0504 - March 25, 2010

FMVSS 214 Oblique Pole 2011 Hyundai Sonata

V1P1 Pubic Symphysis Fy

Max: 152.4 [N] at 0.167 [s]

Min: -2181.5 [N] at 0.057 [s]



B-21

tr2433

CFC_600

CA0504 - March 25, 2010

APPENDIX C

VEHICLE ACCELEROMETER RESPONSE DATA

(SAE sign convention)

DATA CHANNEL TITLE KEY

Prefix	Suffix
V1 = Vehicle 1 (Test Vehicle)	Ax = Acceleration, X-direction
	Ay = Acceleration, Y-direction
P1 = Left Front Seating Position (Driver)	Az = Acceleration, Z-direction
	Fx = Force, X-direction
A1-A18 = Accelerometer Location Number	Fy = Force, Y-direction
	Fz = Force, Z-direction
	Dx = Deflection, X-direction
	Dy = Deflection, Y-direction
	Dz = Deflection, Z-direction

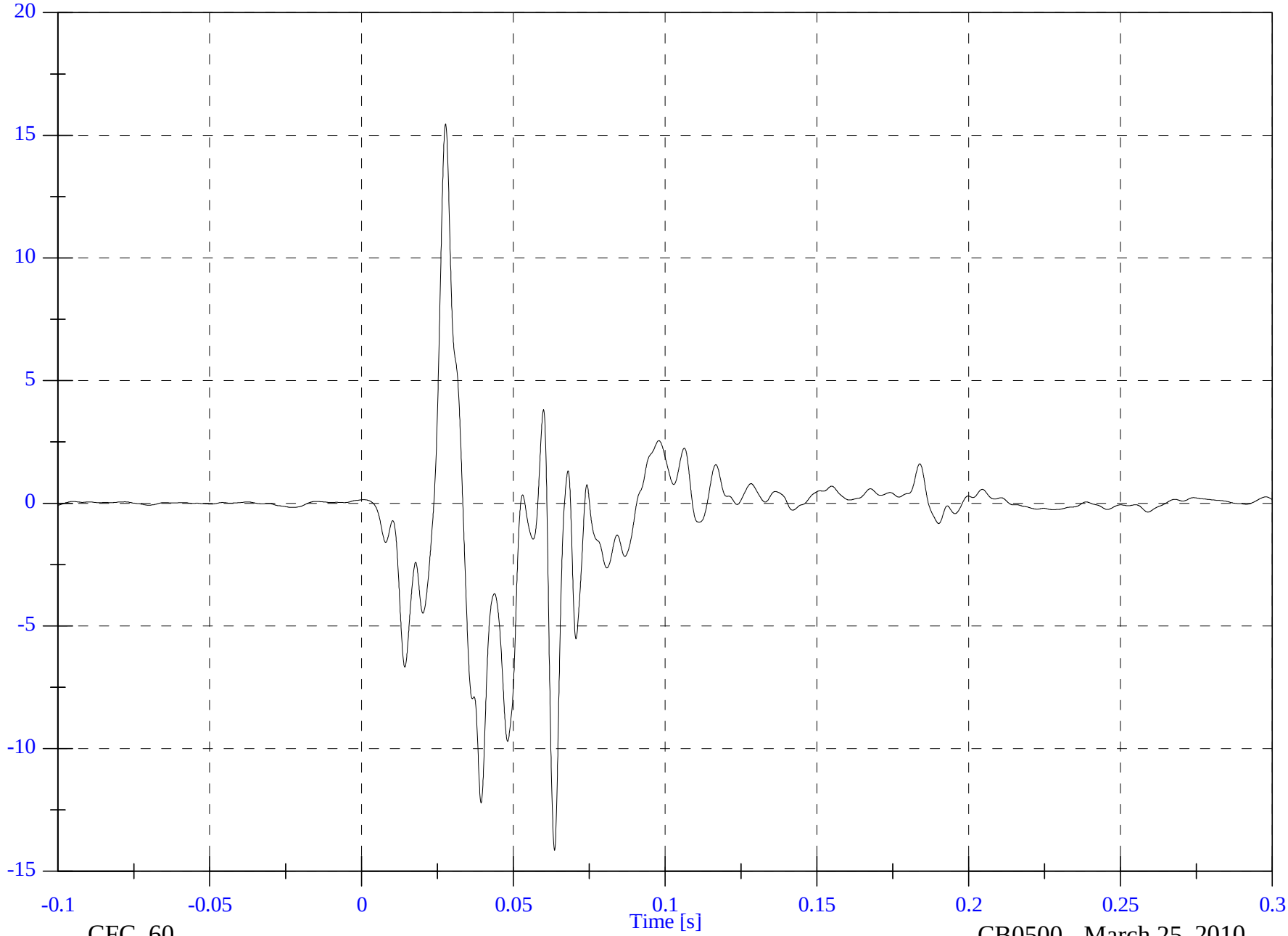
TABLE OF DATA PLOTS for VEHICLE

TABLE OF DATA PLOTS for VEHICLE

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Vehicle CG x

Max: 15.5 [g] at 0.028 [s]
Min: -14.2 [g] at 0.064 [s]



C-5

tr2433

CFC_60

CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Vehicle CG x Velocity

Max: 8.9 [kph] at 0.033 [s]

Min: 1.5 [kph] at 0.090 [s]

C-6

tr2433

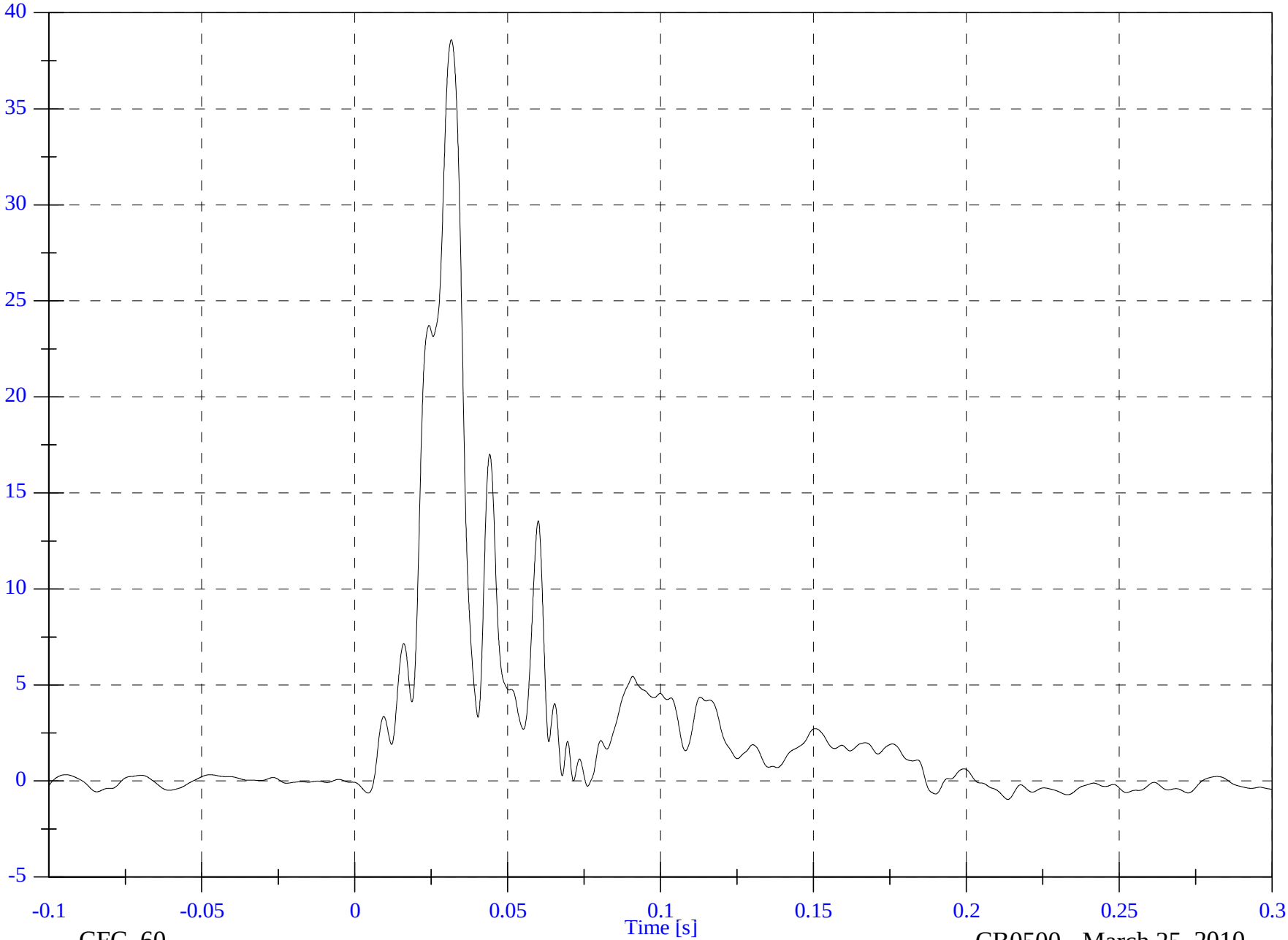
CFC_180

CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Vehicle CG y

Max: 38.6 [g] at 0.032 [s]
Min: -1.0 [g] at 0.214 [s]



C-7

tr2433

CFC_60

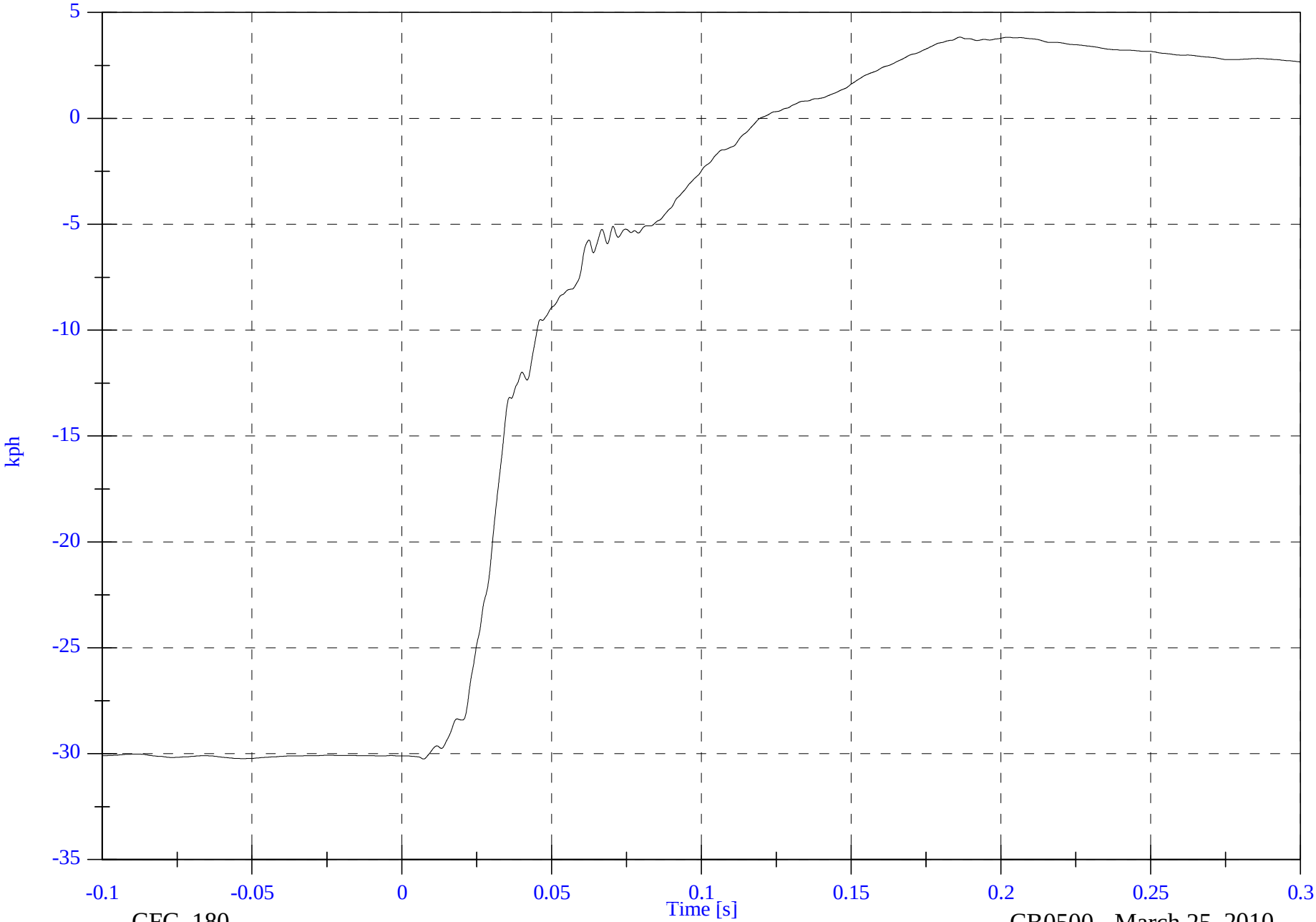
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Vehicle CG y Velocity

Max: 3.8 [kph] at 0.186 [s]

Min: -30.2 [kph] at 0.007 [s]



CFC_180

CB0500 - March 25, 2010

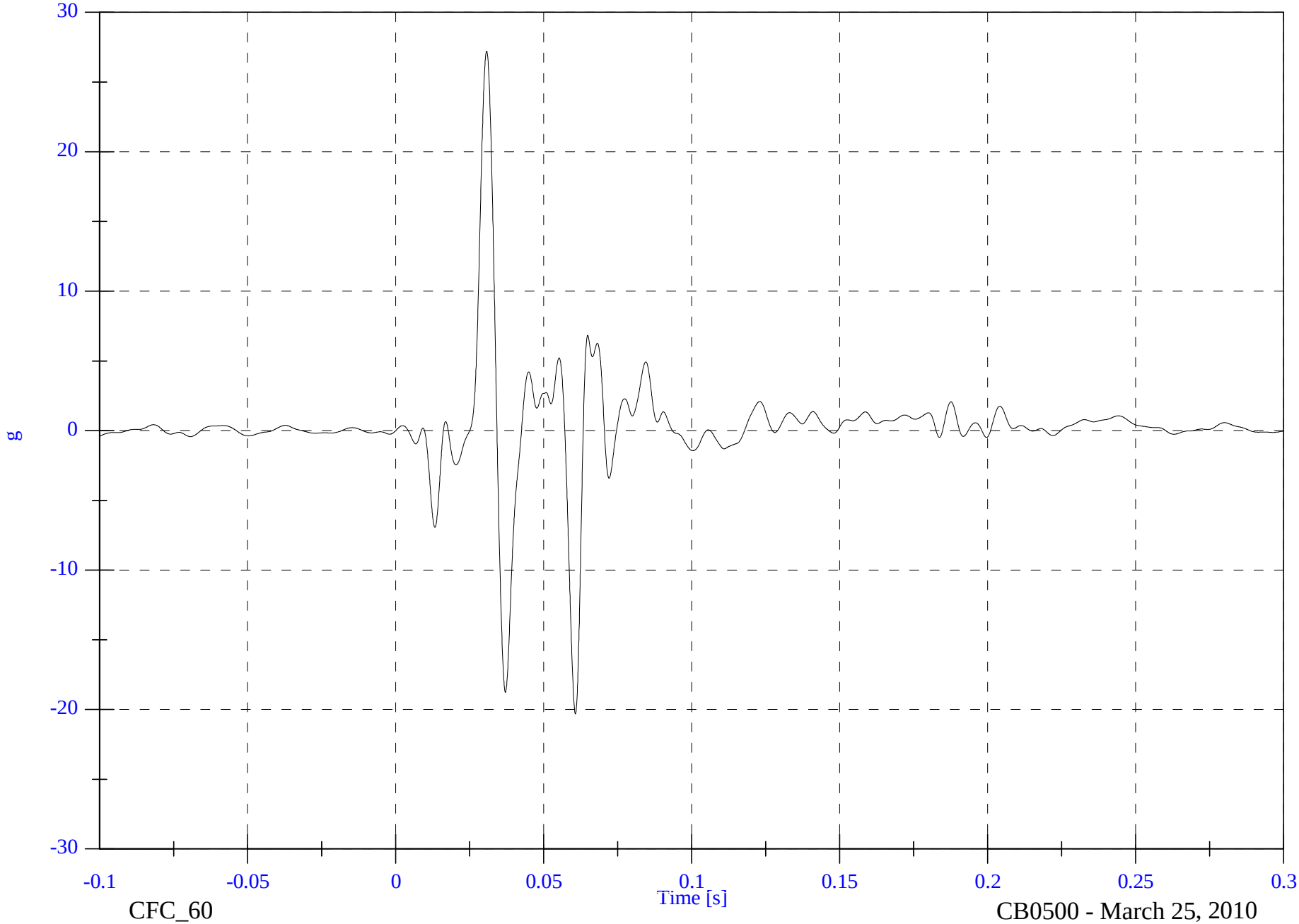
C-8

tr2433

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Vehicle CG z

Max: 27.2 [g] at 0.031 [s]
Min: -20.3 [g] at 0.061 [s]



C-9

tr2433

CFC_60

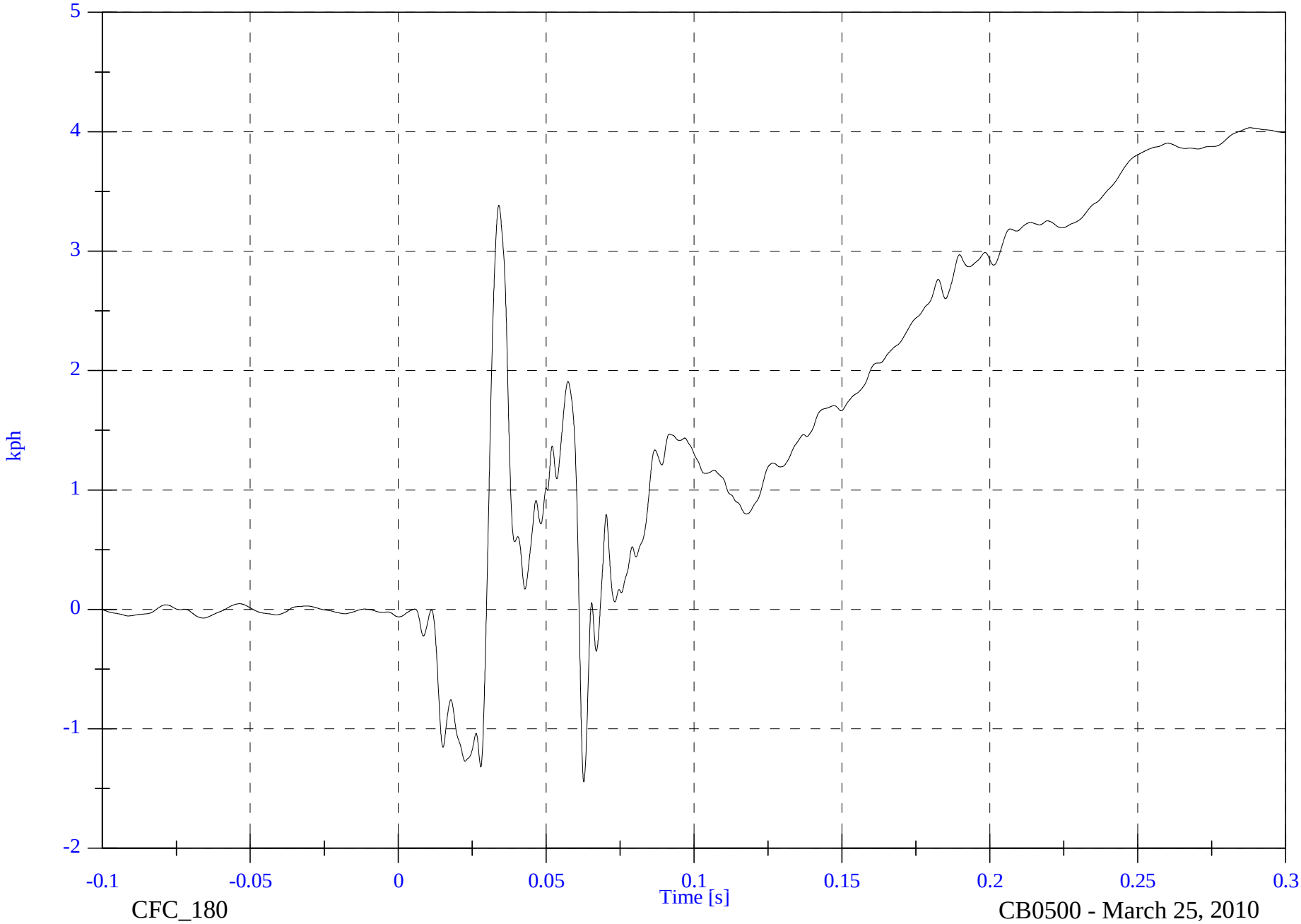
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Vehicle CG z Velocity

Max: 4.0 [kph] at 0.288 [s]

Min: -1.4 [kph] at 0.063 [s]



C-10

tr2433

CFC_180

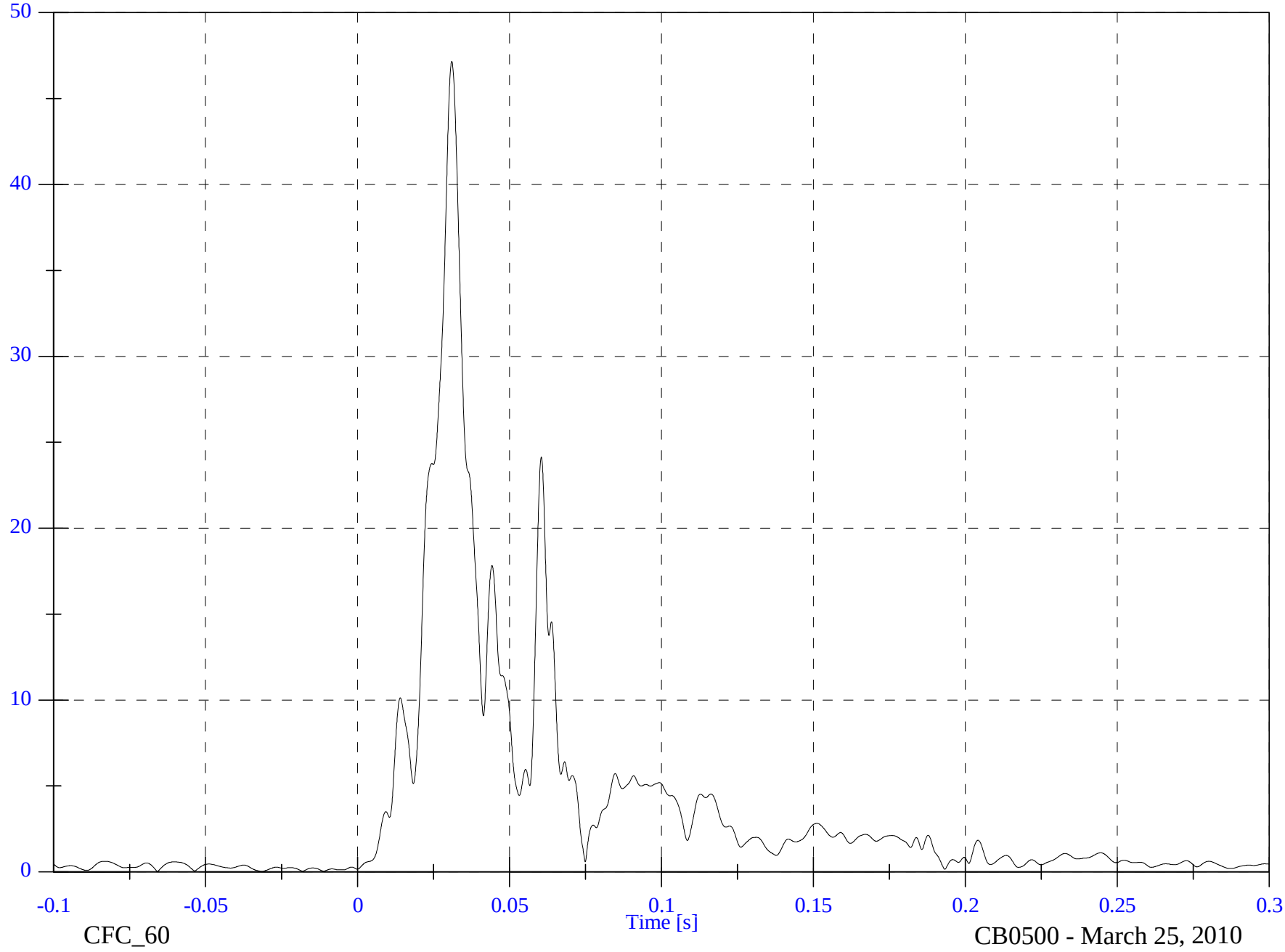
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Vehicle CG Resultant

Max: 47.2 [g] at 0.031 [s]

Min: 0.0 [g] at -0.066 [s]



C-11

tr2433

CFC_60

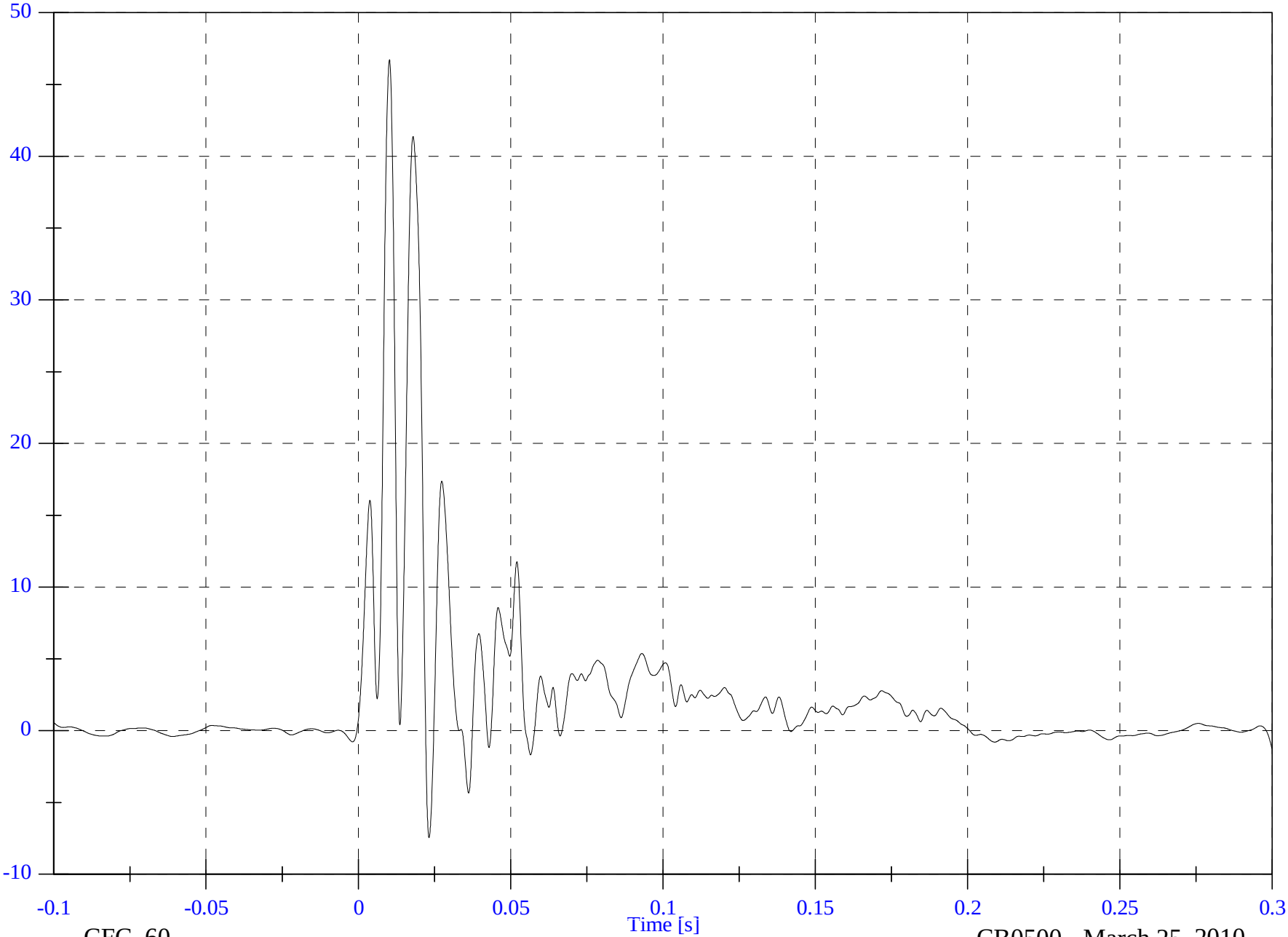
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left Front Sill y

Max: 46.7 [g] at 0.010 [s]

Min: -7.5 [g] at 0.023 [s]



C-12

tr2433

CFC_60

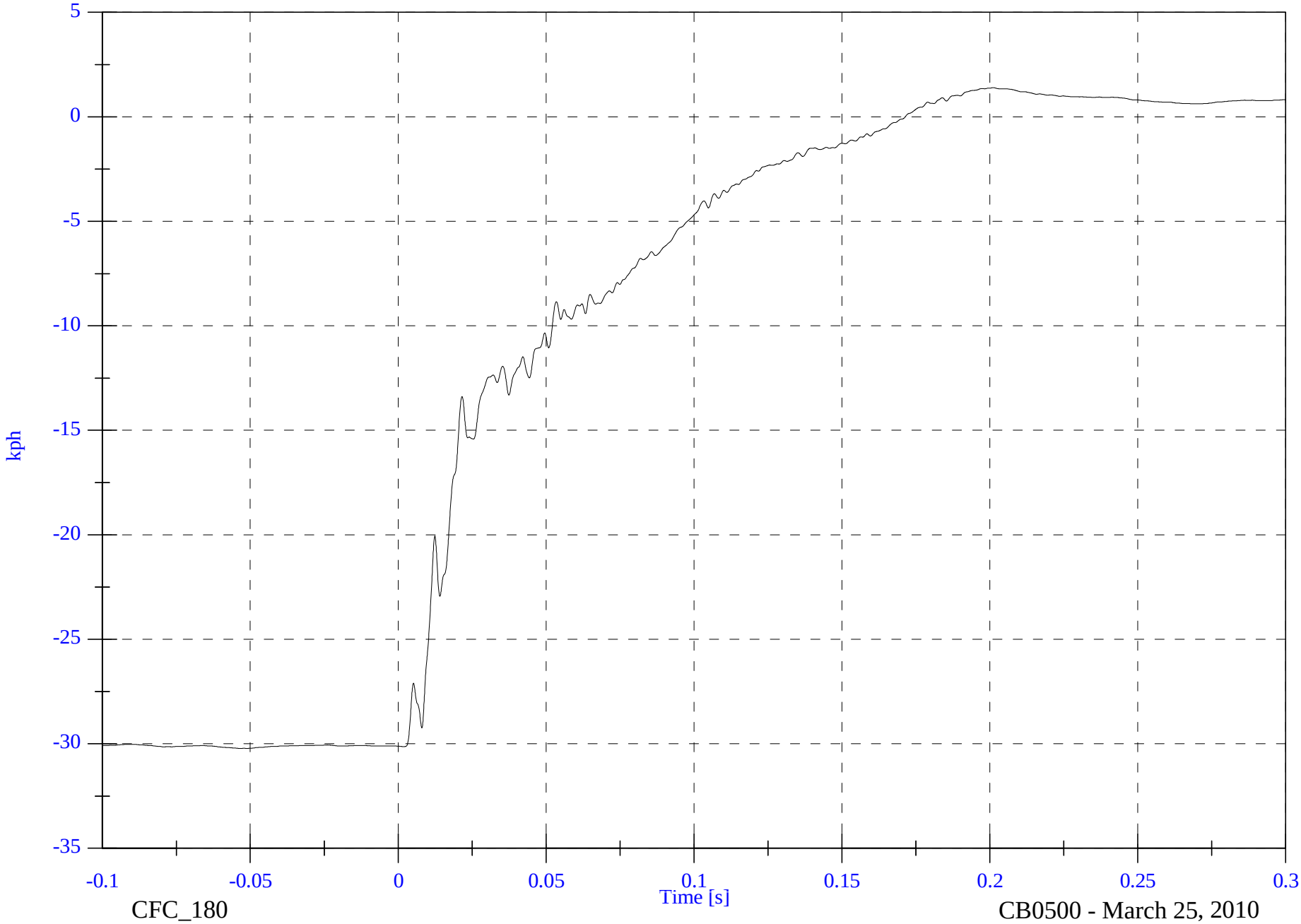
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left Front Sill y Velocity

Max: 1.4 [kph] at 0.201 [s]

Min: -30.2 [kph] at -0.053 [s]



C-13

tr2433

CFC_180

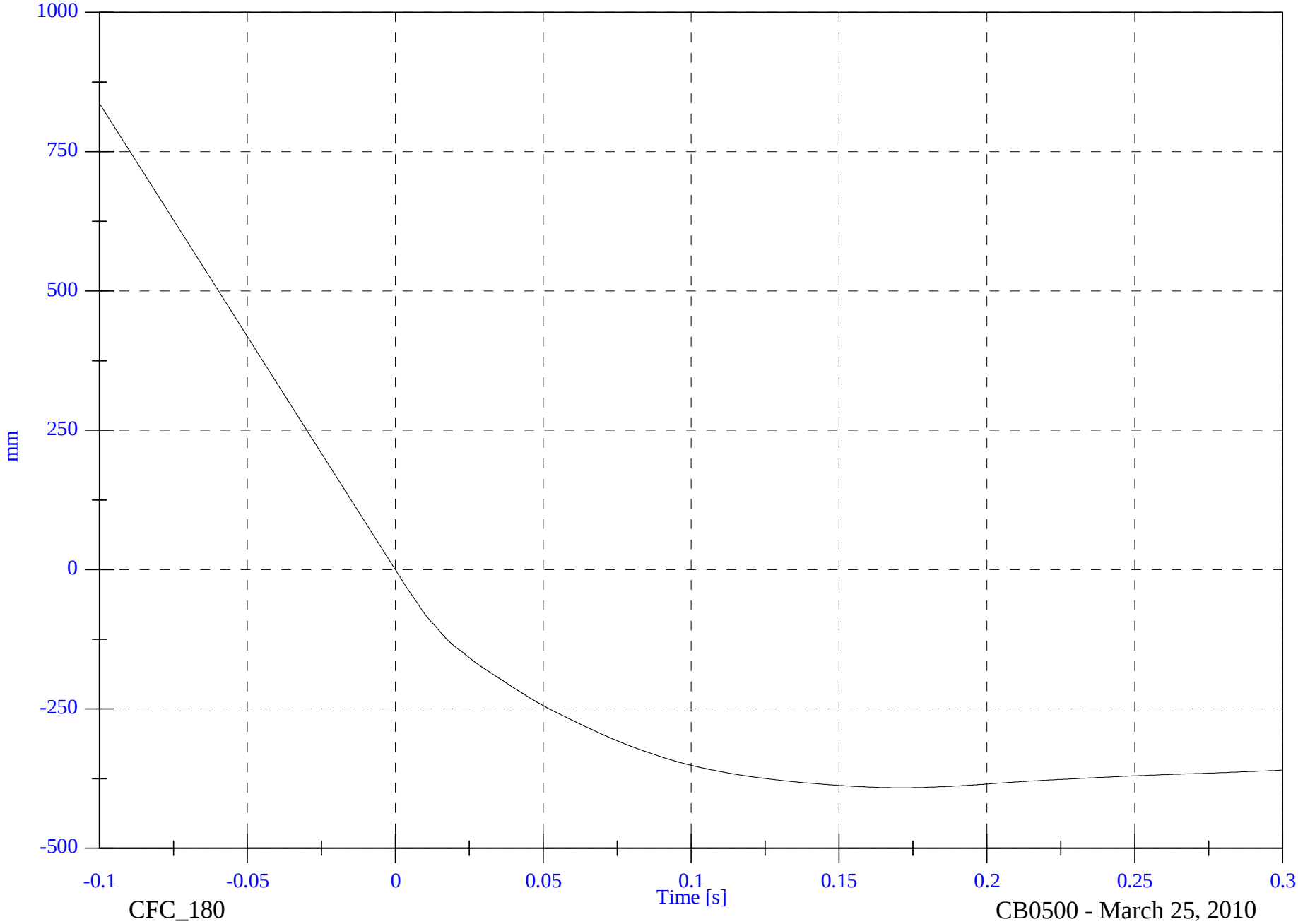
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left Front Sill y Displacement

Max: 836.0 [mm] at -0.100 [s]

Min: -391.5 [mm] at 0.171 [s]



CFC_180

CB0500 - March 25, 2010

C-14

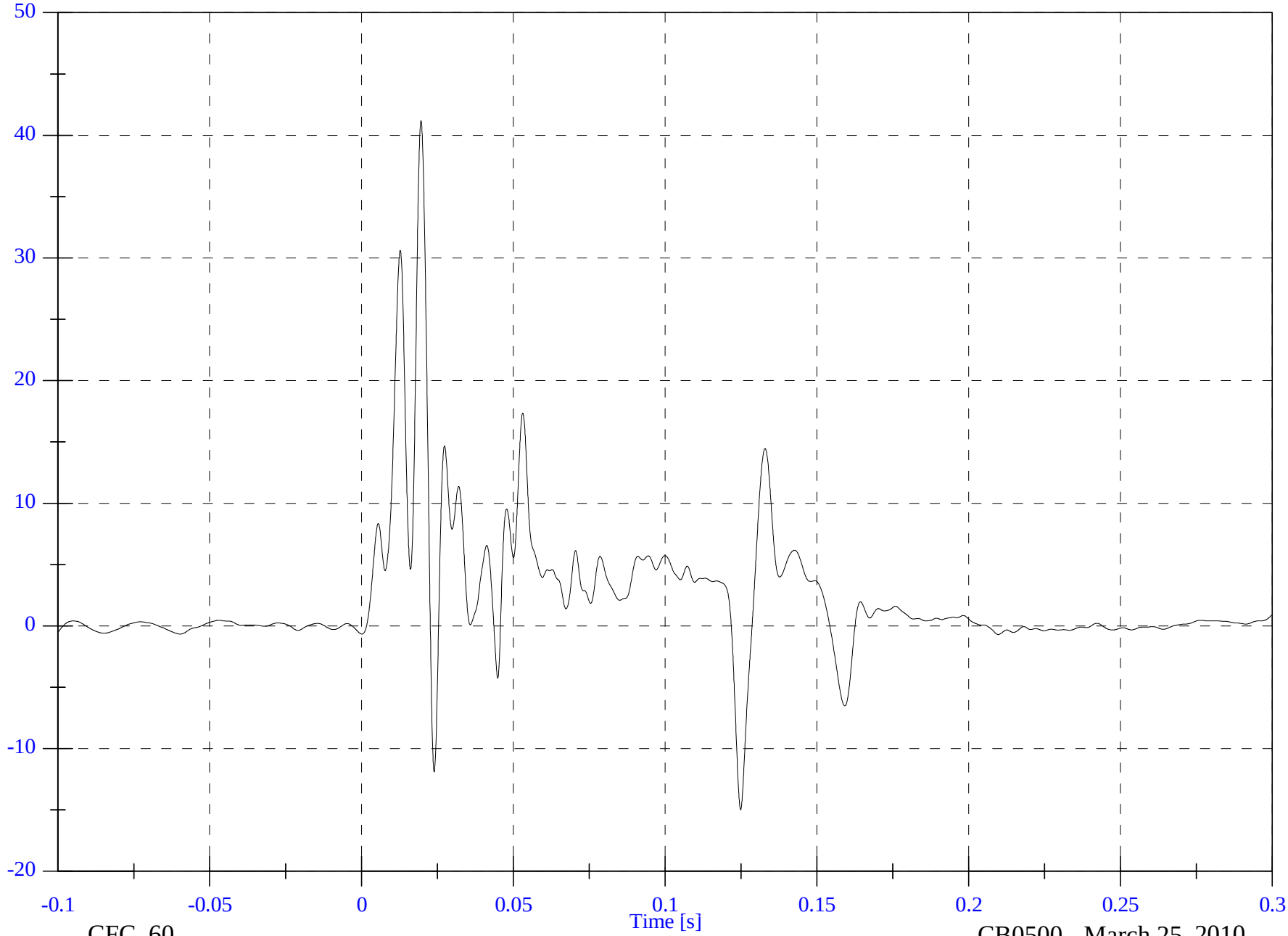
tr2433

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left Lower A-Pillar Sill

Max: 41.2 [g] at 0.020 [s]

Min: -15.0 [g] at 0.125 [s]



C-15

tr2433

CFC_60

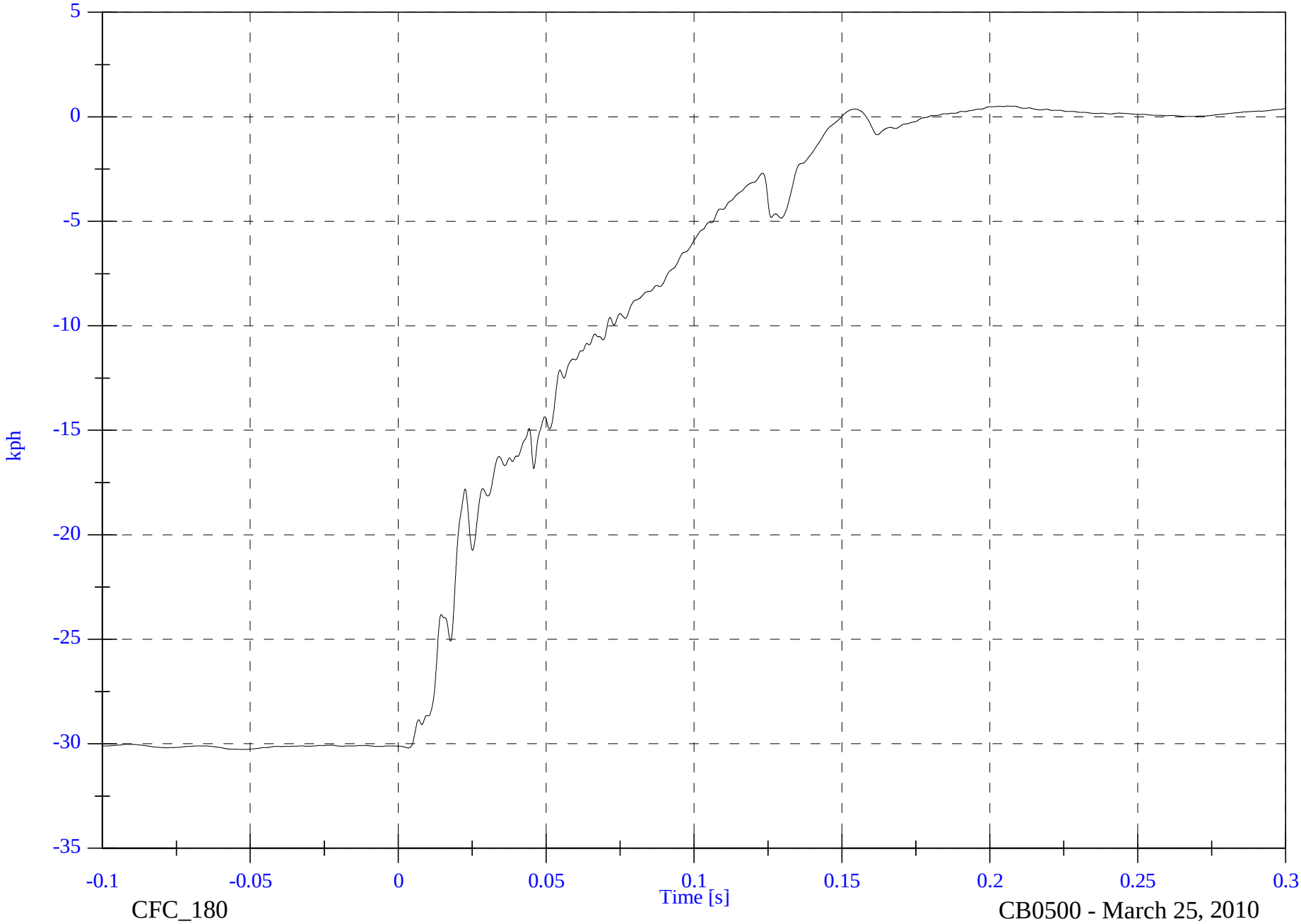
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left Lower A-Pillar Sill Velocity

Max: 0.5 [kph] at 0.206 [s]

Min: -30.3 [kph] at -0.053 [s]



C-16

tr2433

CFC_180

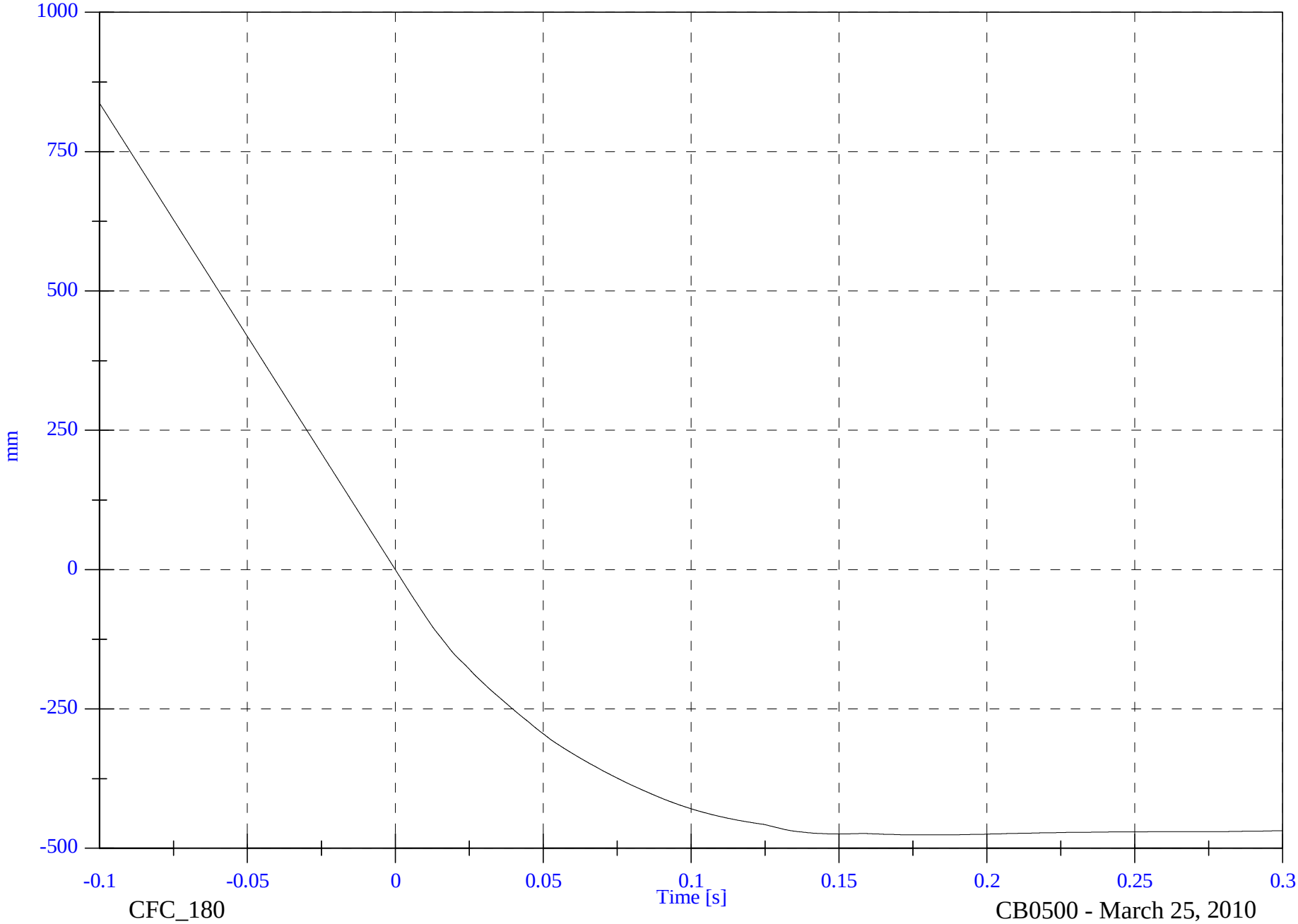
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left Lower A-Pillar Sill Displacement

Max: 836.6 [mm] at -0.100 [s]

Min: -476.0 [mm] at 0.179 [s]



CFC_180

CB0500 - March 25, 2010

C-17

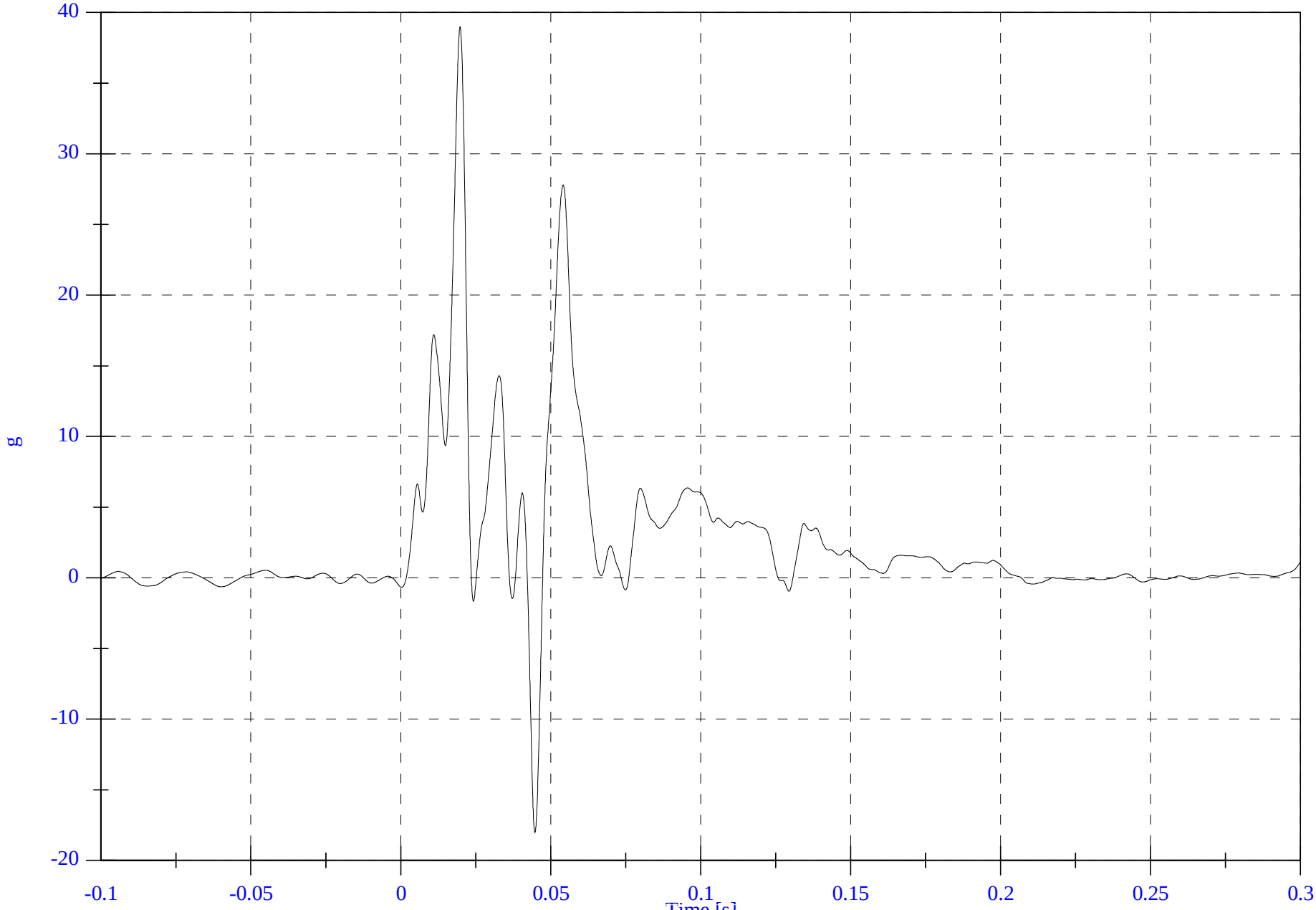
tr2433

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left A-Pillar Mid y

Max: 39.0 [g] at 0.020 [s]

Min: -18.0 [g] at 0.045 [s]



C-18

tr2433

CFC_60

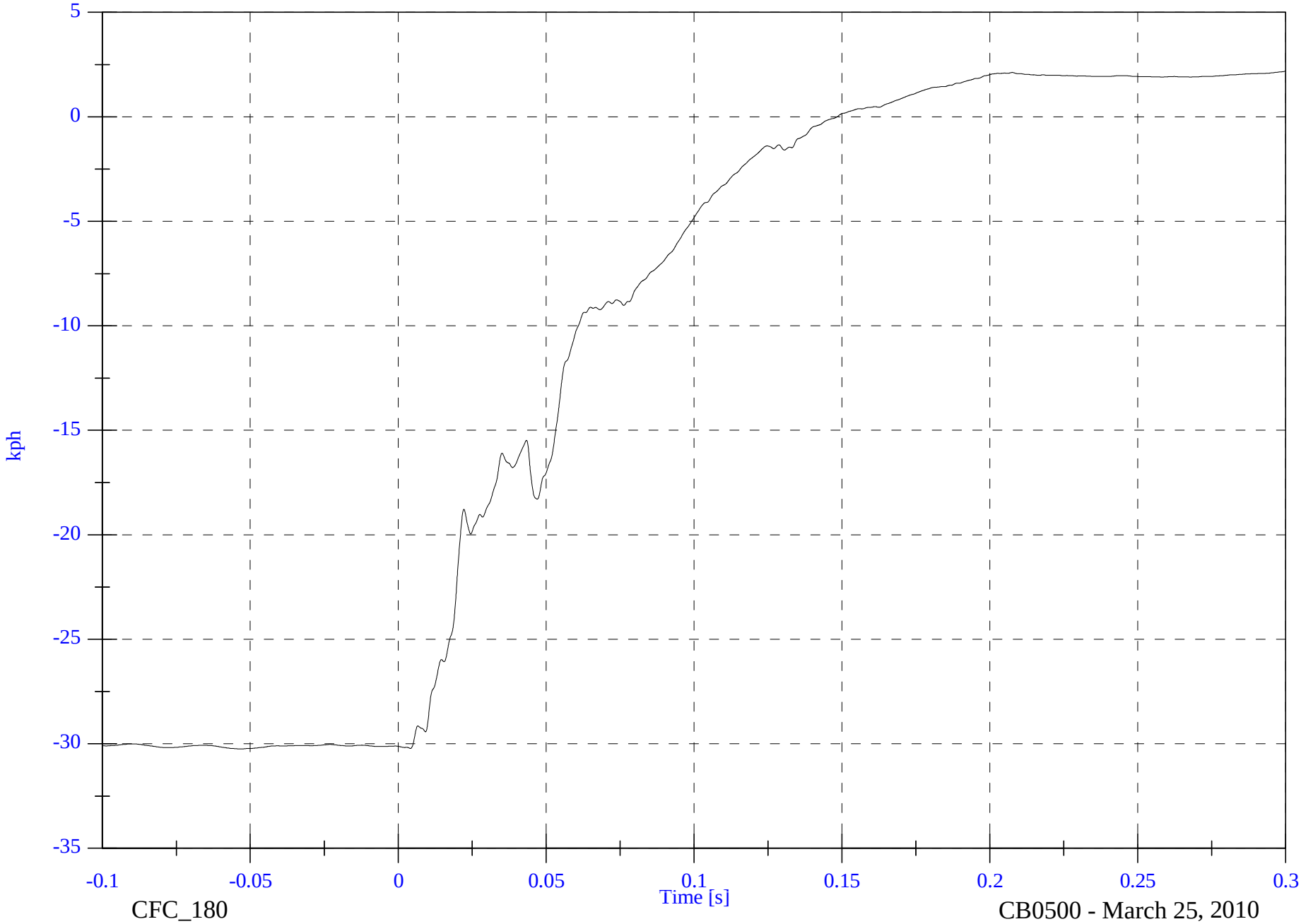
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left A-Pillar Mid y Velocity

Max: 2.2 [kph] at 0.300 [s]

Min: -30.2 [kph] at -0.053 [s]



CFC_180

CB0500 - March 25, 2010

C-19

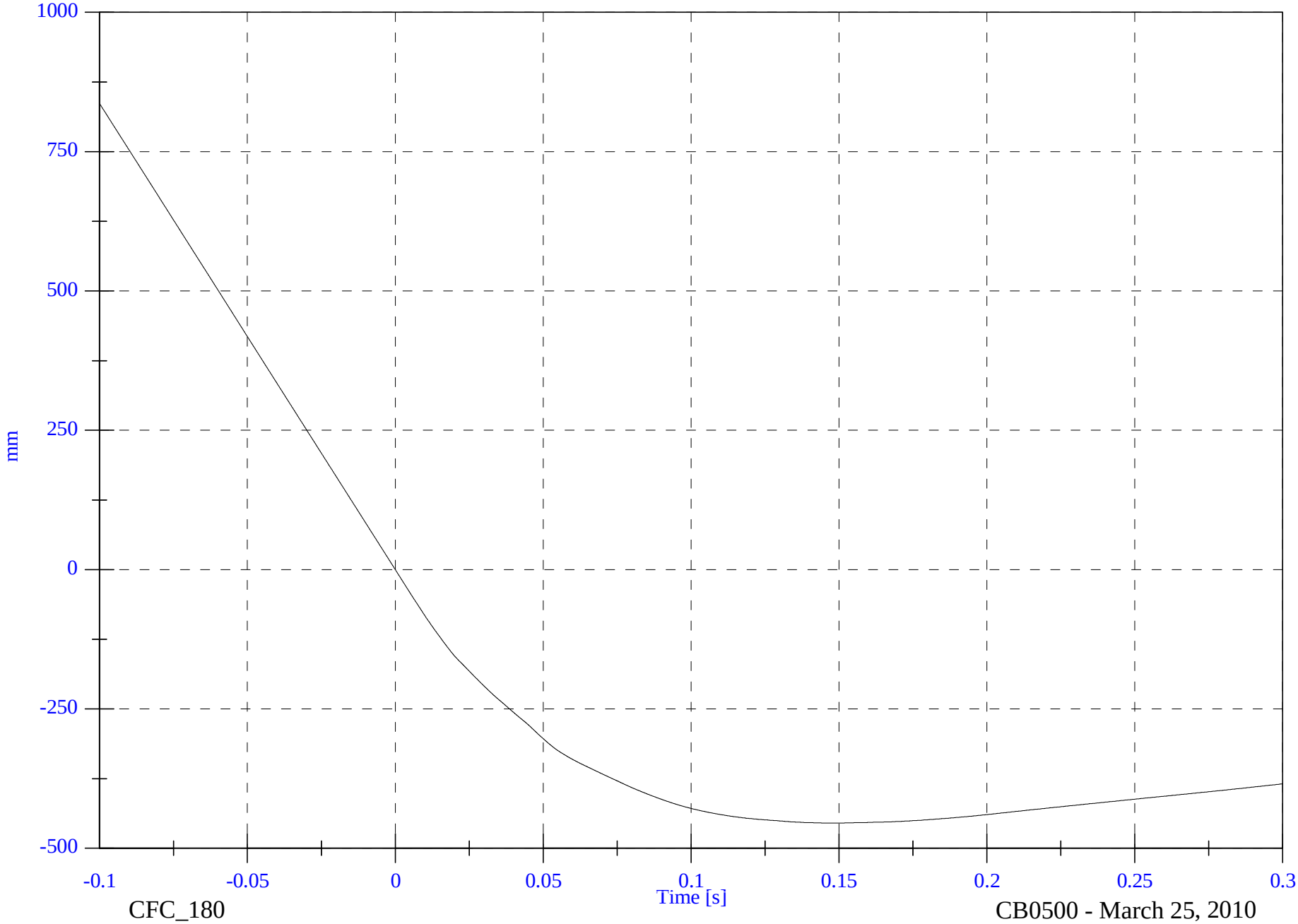
tr2433

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left A-Pillar Mid y Displacement

Max: 836.0 [mm] at -0.100 [s]

Min: -454.6 [mm] at 0.148 [s]



C-20

tr2433

CFC_180

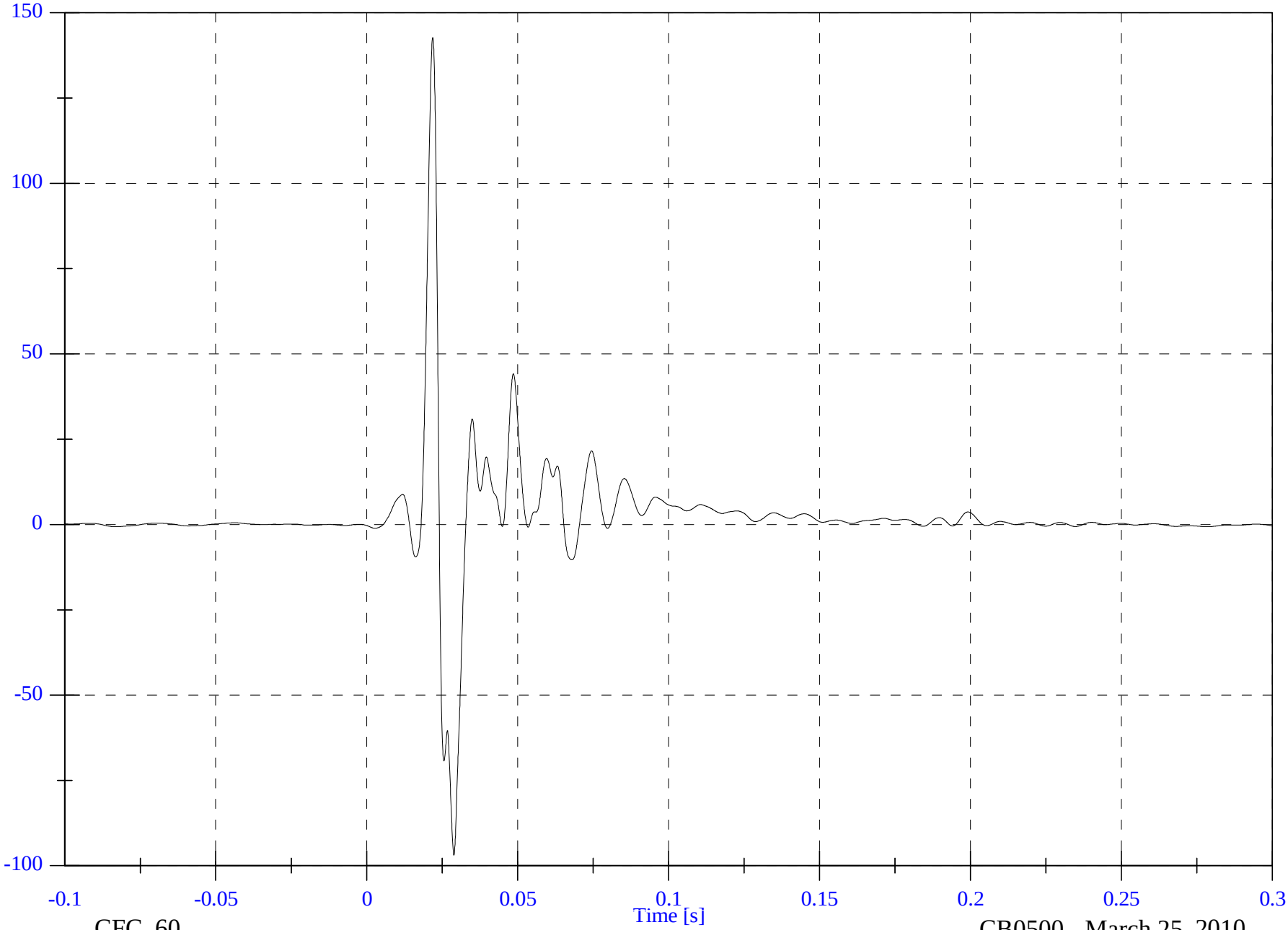
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left A-Pillar Top y

Max: 142.7 [g] at 0.022 [s]

Min: -96.9 [g] at 0.029 [s]



C-21

tr2433

CFC_60

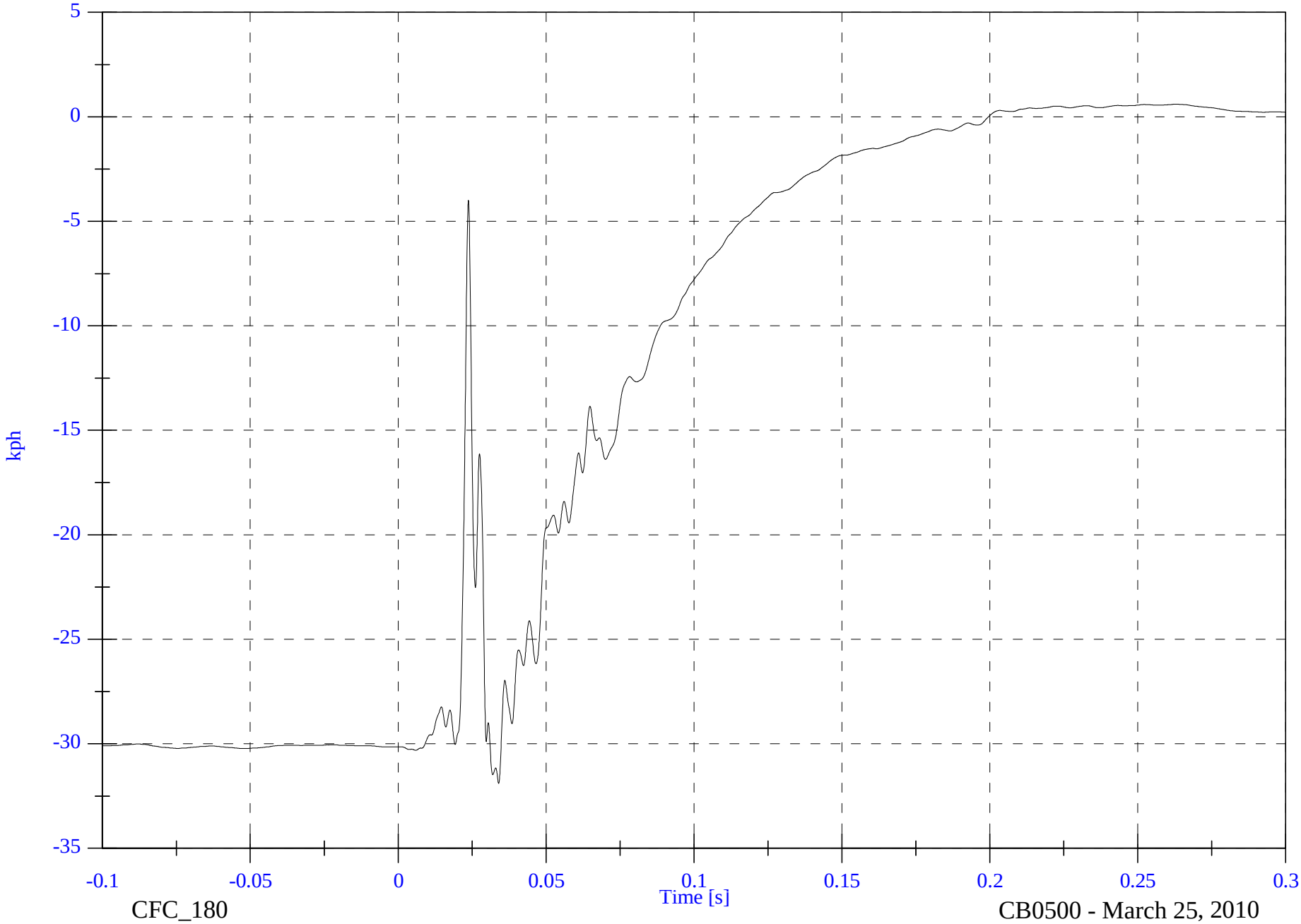
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left A-Pillar Top y Velocity

Max: 0.6 [kph] at 0.263 [s]

Min: -31.9 [kph] at 0.034 [s]



C-22

tr2433

CFC_180

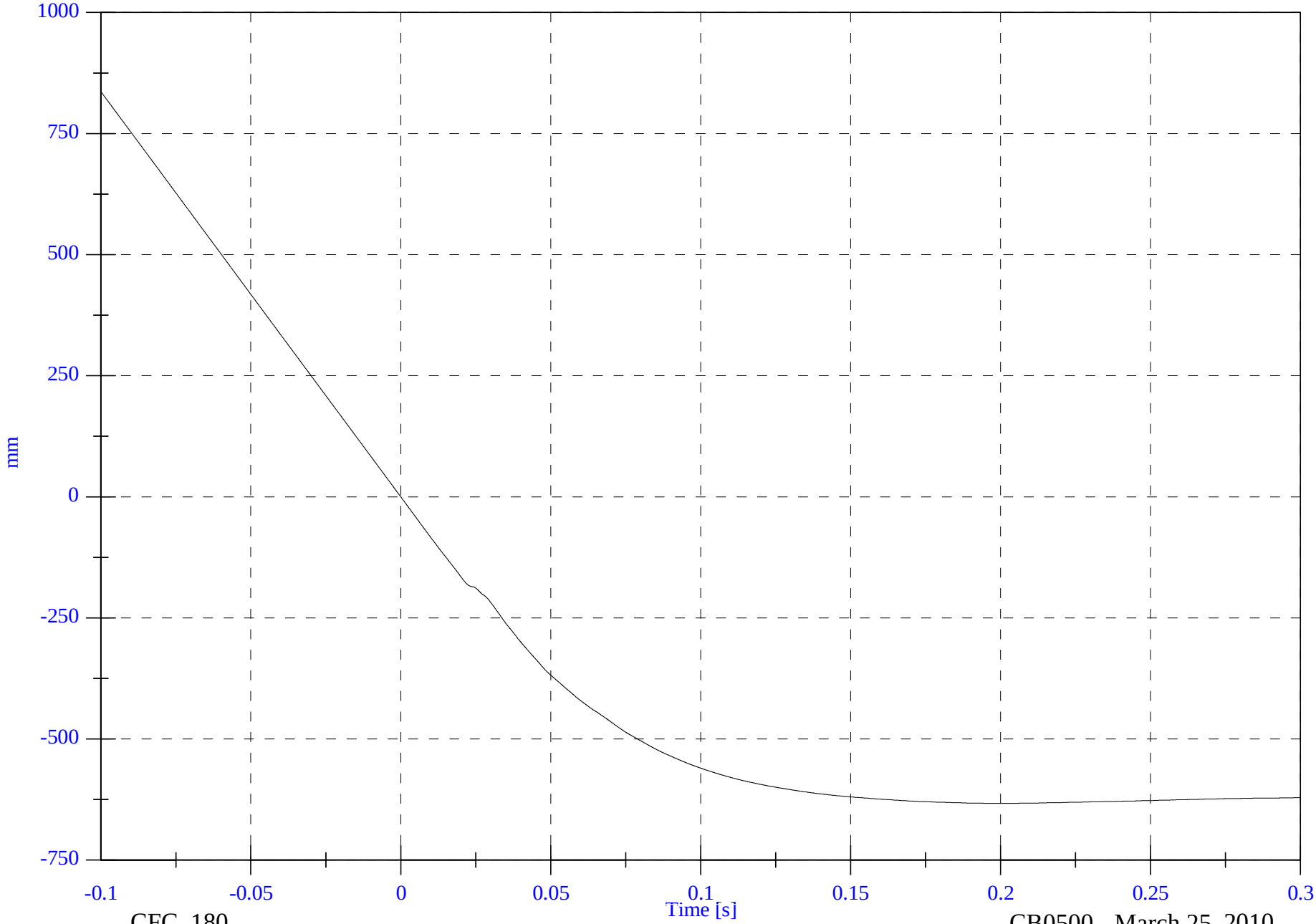
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left A-Pillar Top y Displacement

Max: 836.2 [mm] at -0.100 [s]

Min: -633.0 [mm] at 0.200 [s]



C-23

tr2433

CFC_180

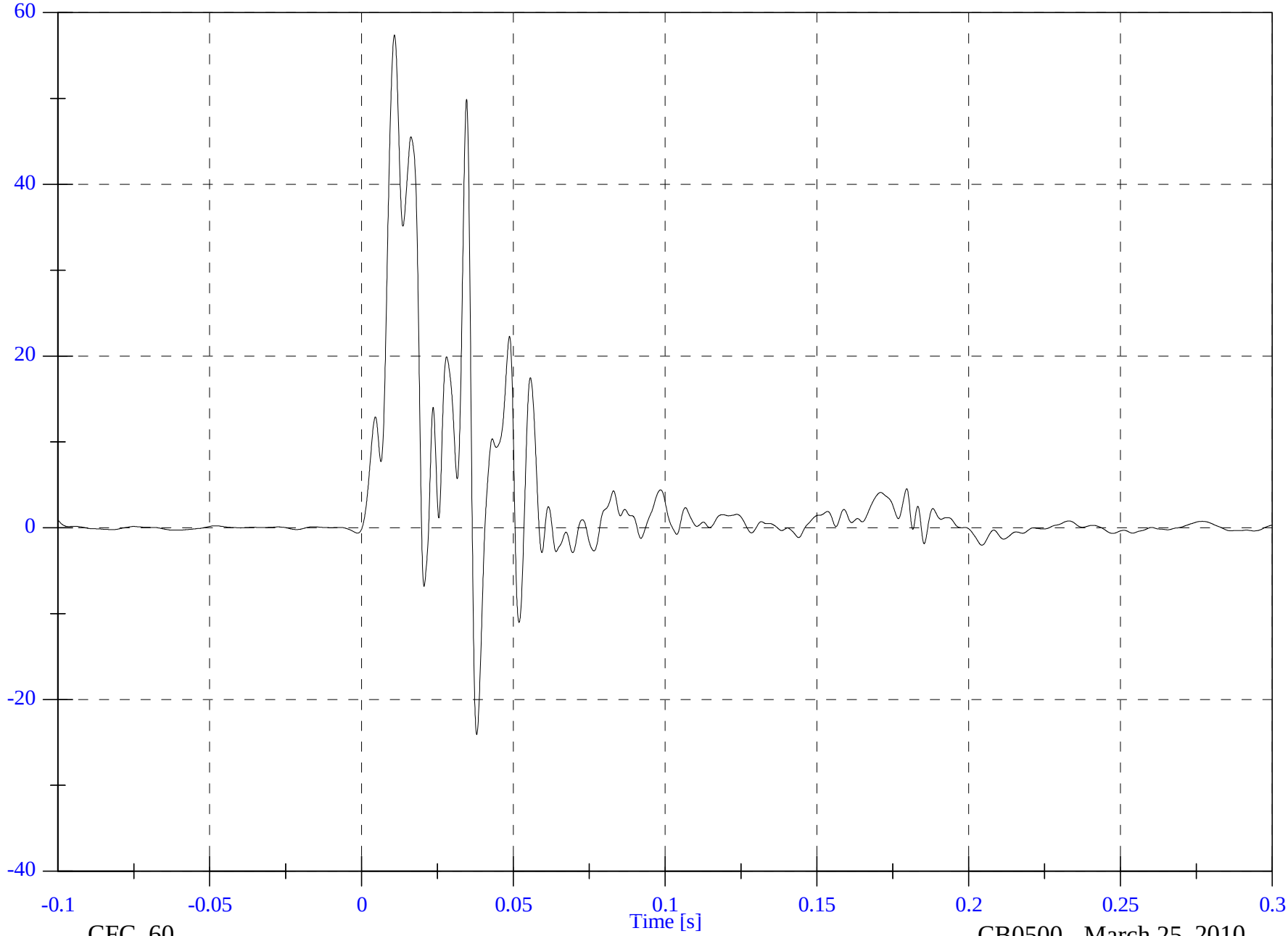
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left B-Pillar Sill y

Max: 57.4 [g] at 0.011 [s]

Min: -24.1 [g] at 0.038 [s]



C-24

tr2433

CFC_60

CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left B-Pillar Sill y Velocity

Max: 4.7 [kph] at 0.184 [s]

Min: -30.2 [kph] at -0.052 [s]

CFC_180

CB0500 - March 25, 2010

C-25

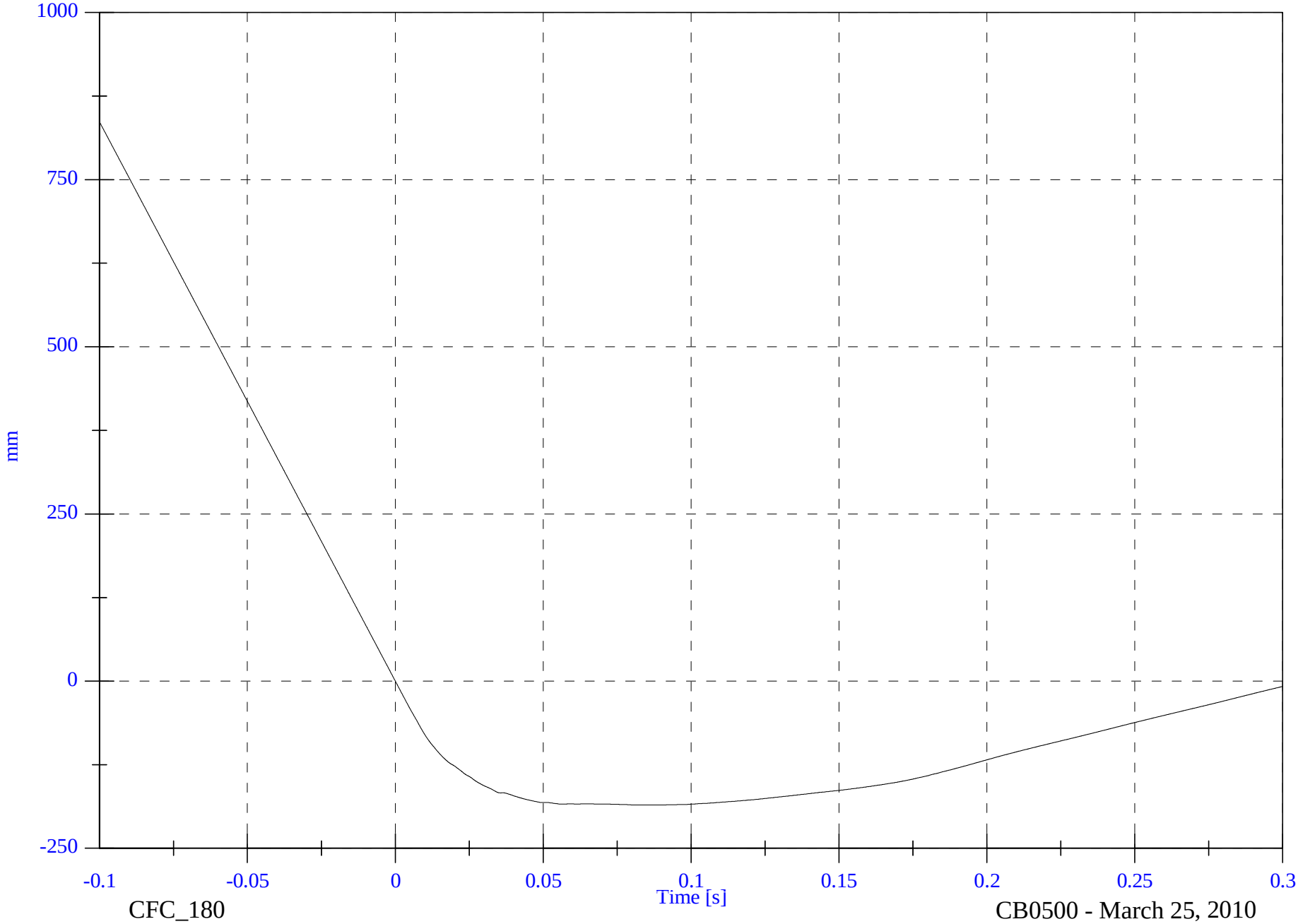
tr2433

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left B-Pillar Sill y Displacement

Max: 835.7 [mm] at -0.100 [s]

Min: -185.4 [mm] at 0.083 [s]



CFC_180

CB0500 - March 25, 2010

C-26

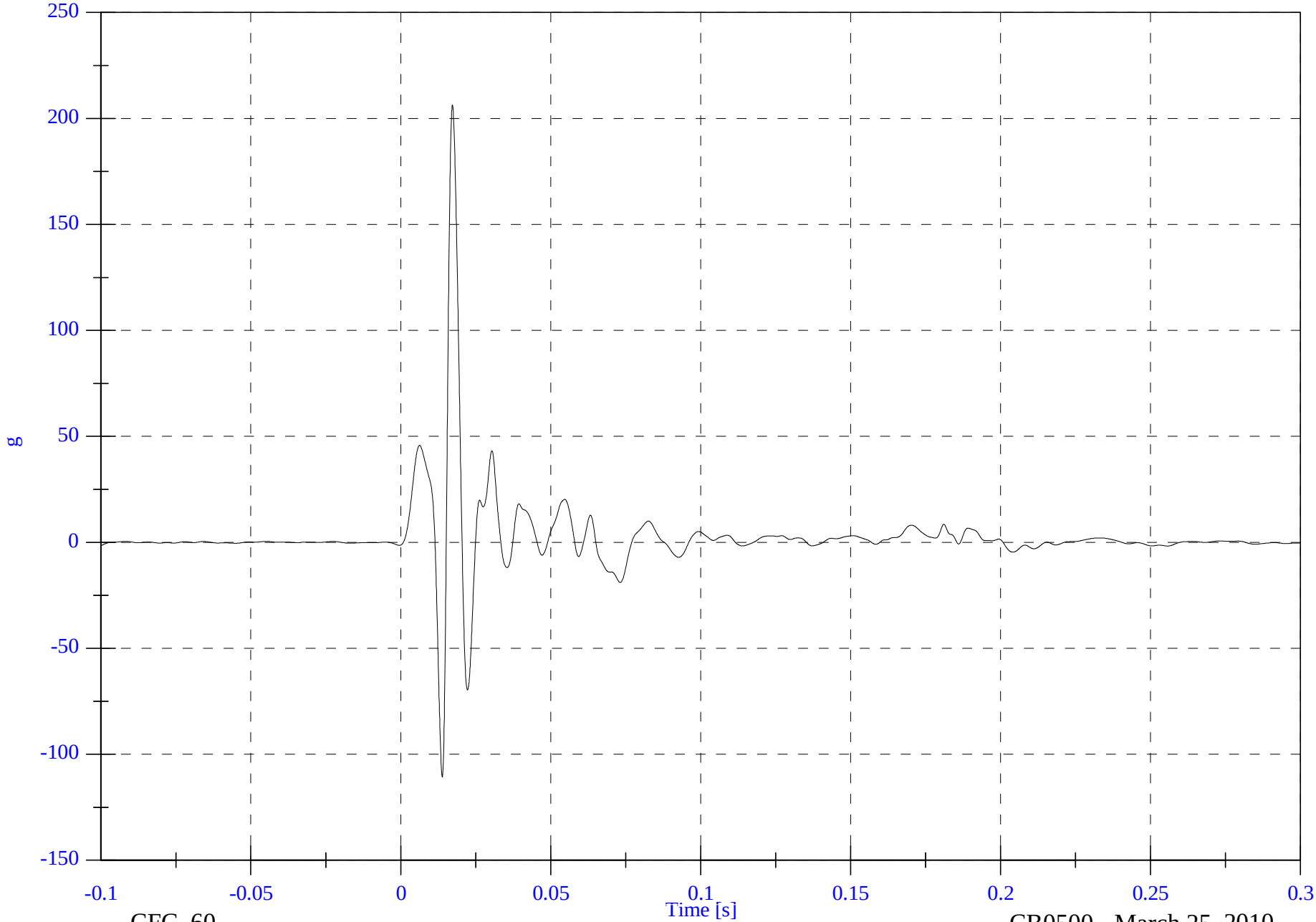
tr2433

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left B-Pillar Mid y

Max: 206.4 [g] at 0.017 [s]

Min: -110.8 [g] at 0.014 [s]



C-27

tr2433

CFC_60

CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left B-Pillar Mid y Velocity

Max: 5.1 [kph] at 0.201 [s]

Min: -42.5 [kph] at 0.015 [s]

CFC_180

CB0500 - March 25, 2010

C-28

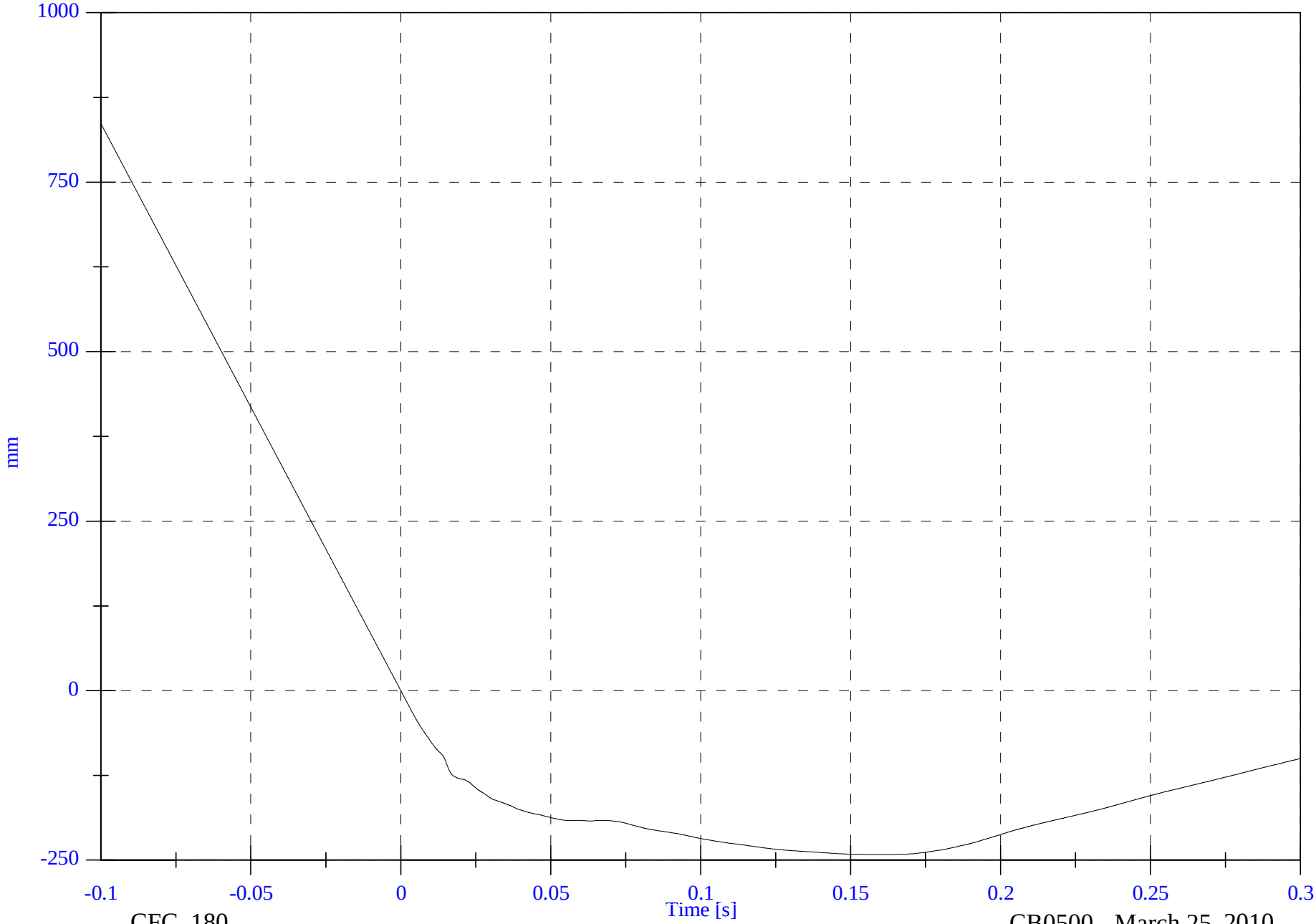
tr2433

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left B-Pillar Mid y Displacement

Max: 835.8 [mm] at -0.100 [s]

Min: -241.7 [mm] at 0.161 [s]



C-29

tr2433

CFC_180

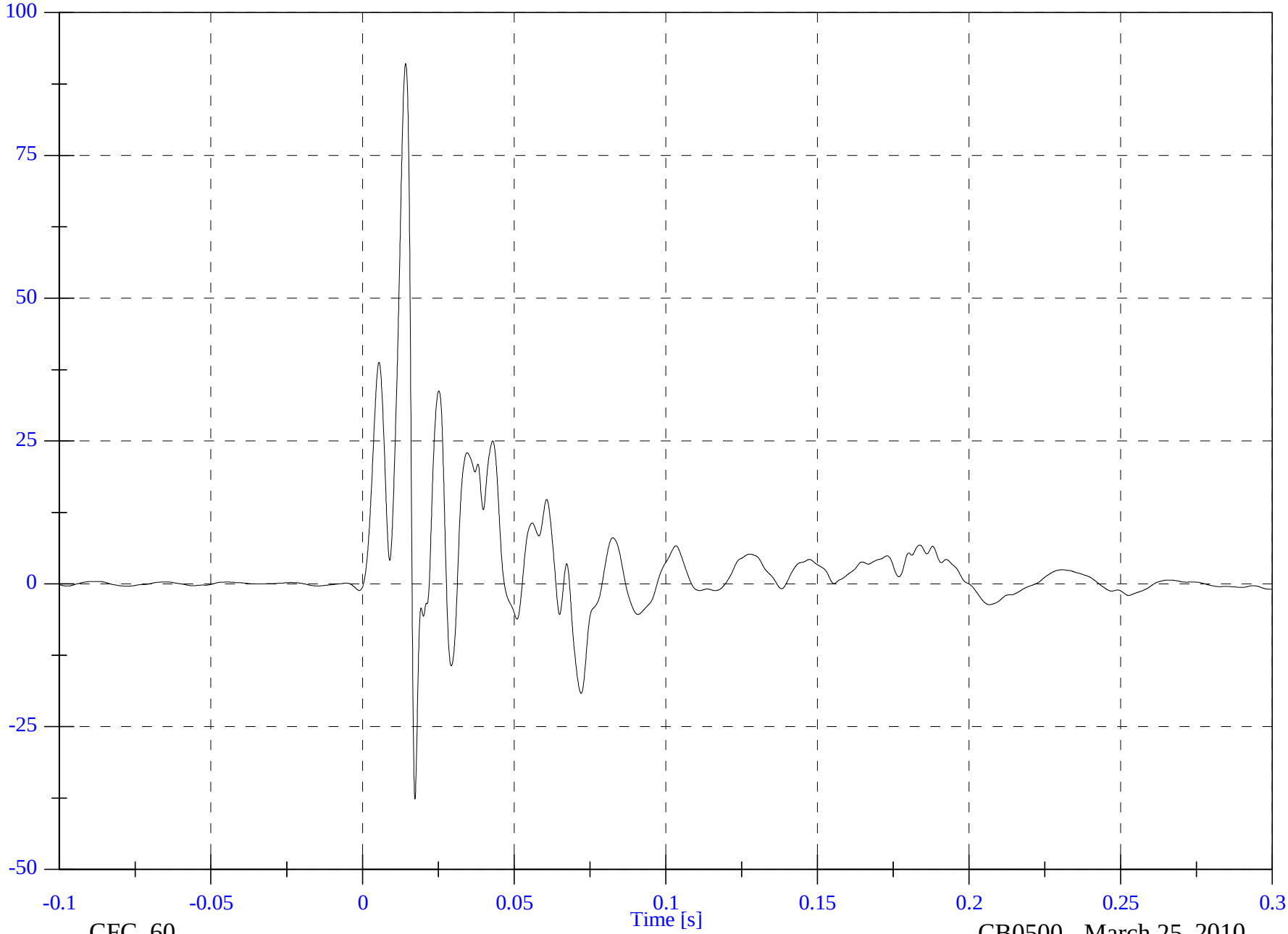
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left B-Pillar Top y

Max: 91.1 [g] at 0.014 [s]

Min: -37.7 [g] at 0.017 [s]



C-30

tr2433

CFC_60

CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left B-Pillar Top y Velocity

Max: 8.2 [kph] at 0.198 [s]

Min: -30.2 [kph] at -0.070 [s]

C-31

tr2433

CFC_180

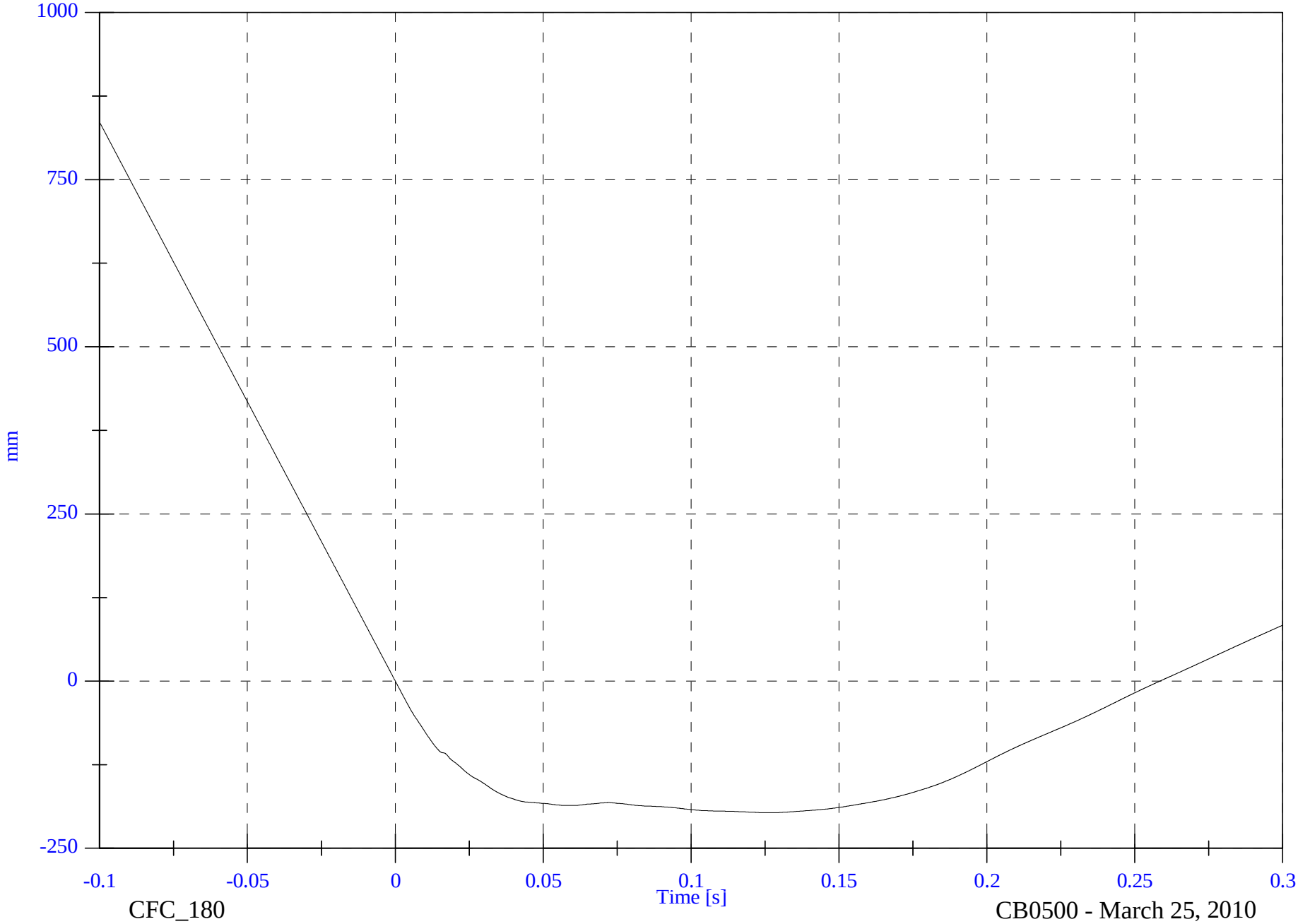
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Left B-Pillar Top y Displacement

Max: 835.5 [mm] at -0.100 [s]

Min: -196.8 [mm] at 0.127 [s]



C-32

tr2433

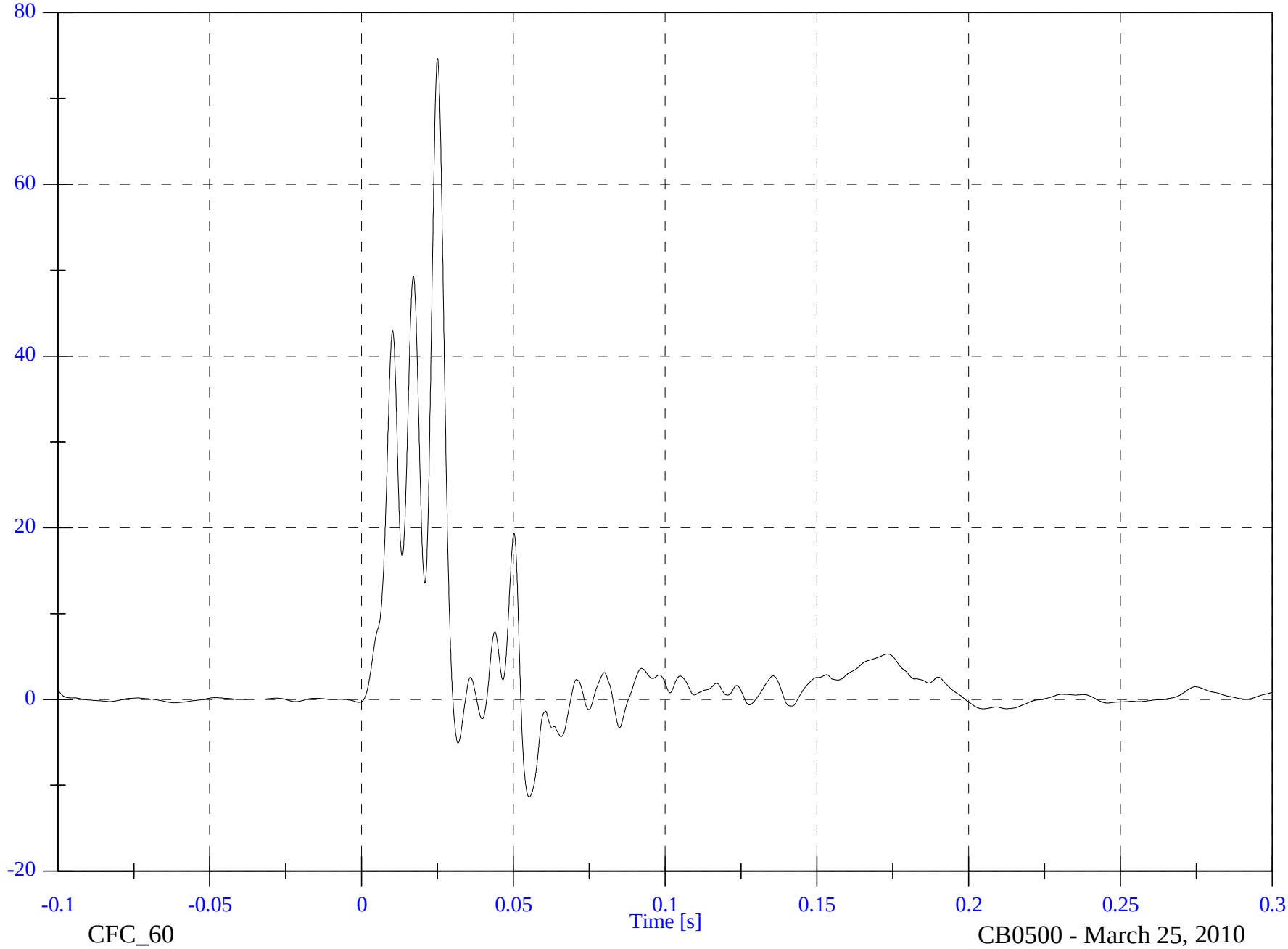
CFC_180

CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Seat Track y

Max: 74.7 [g] at 0.025 [s]
Min: -11.4 [g] at 0.055 [s]



C-33

tr2433

CFC_60

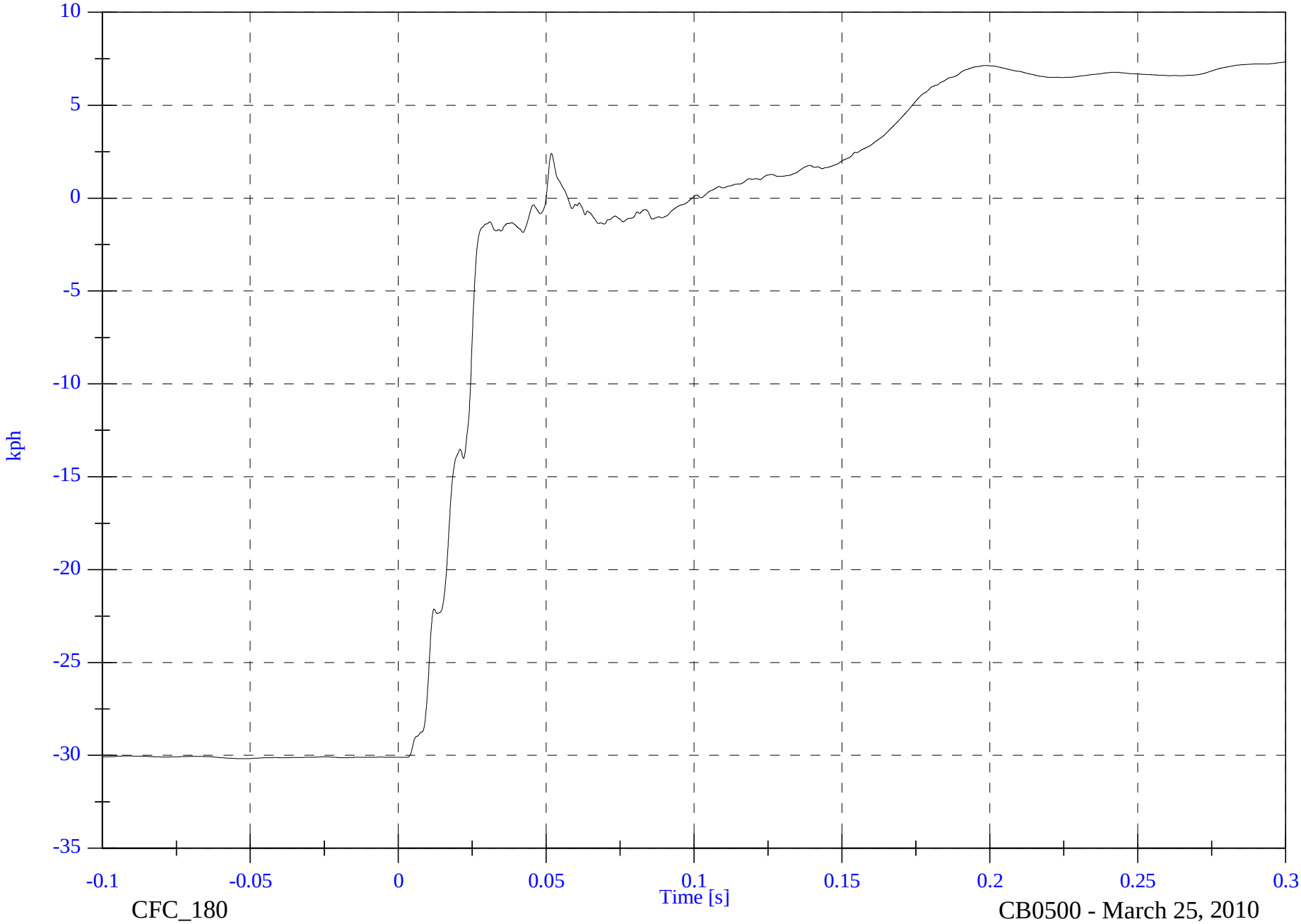
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Seat Track y Velocity

Max: 7.3 [kph] at 0.300 [s]

Min: -30.2 [kph] at -0.051 [s]



CFC_180

CB0500 - March 25, 2010

C-34

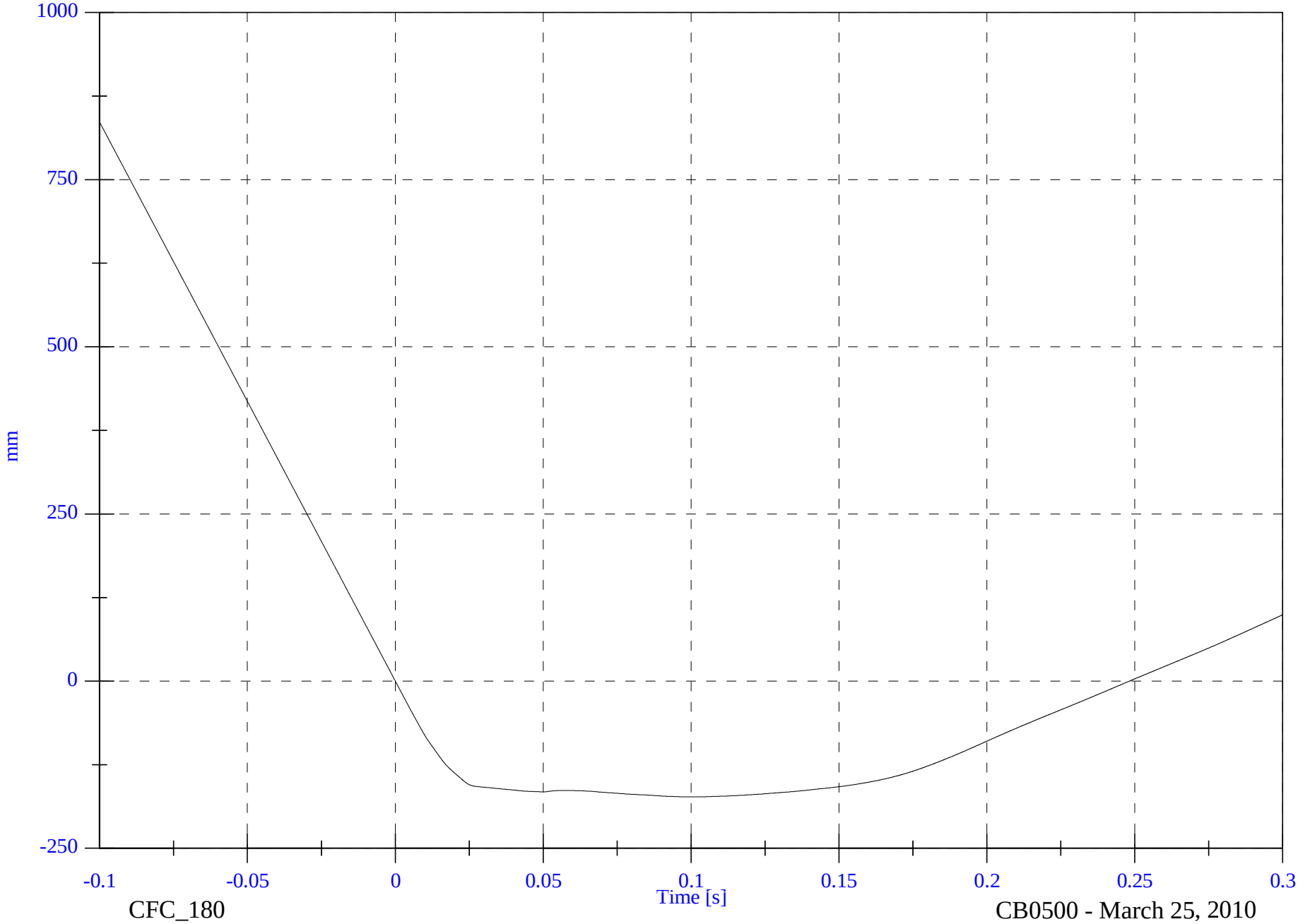
tr2433

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Seat Track y Displacement

Max: 835.6 [mm] at -0.100 [s]

Min: -173.1 [mm] at 0.099 [s]



CFC_180

CB0500 - March 25, 2010

C-35

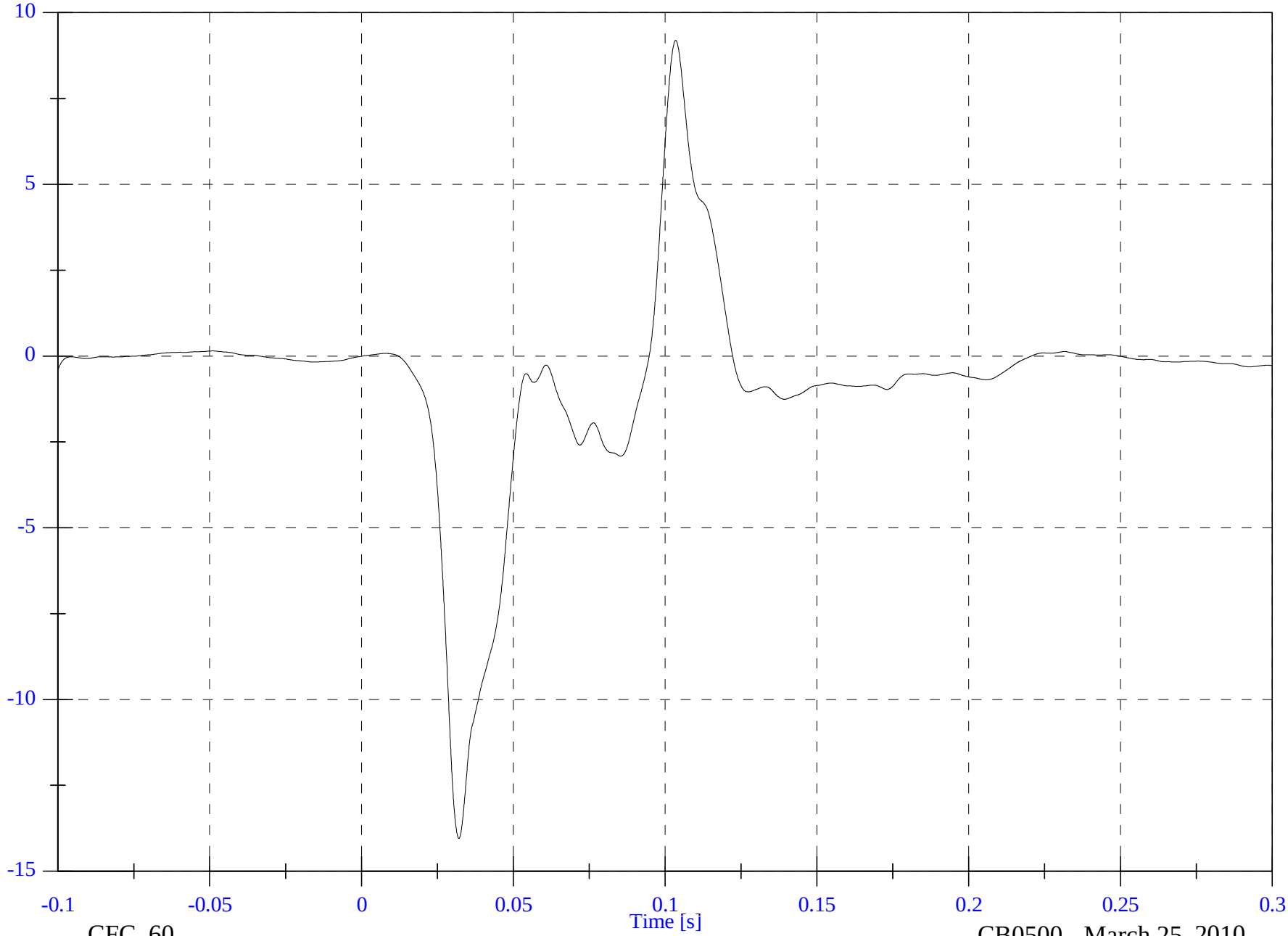
tr2433

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Engine Top x

Max: 9.2 [g] at 0.103 [s]

Min: -14.0 [g] at 0.032 [s]



C-36

tr2433

CFC_60

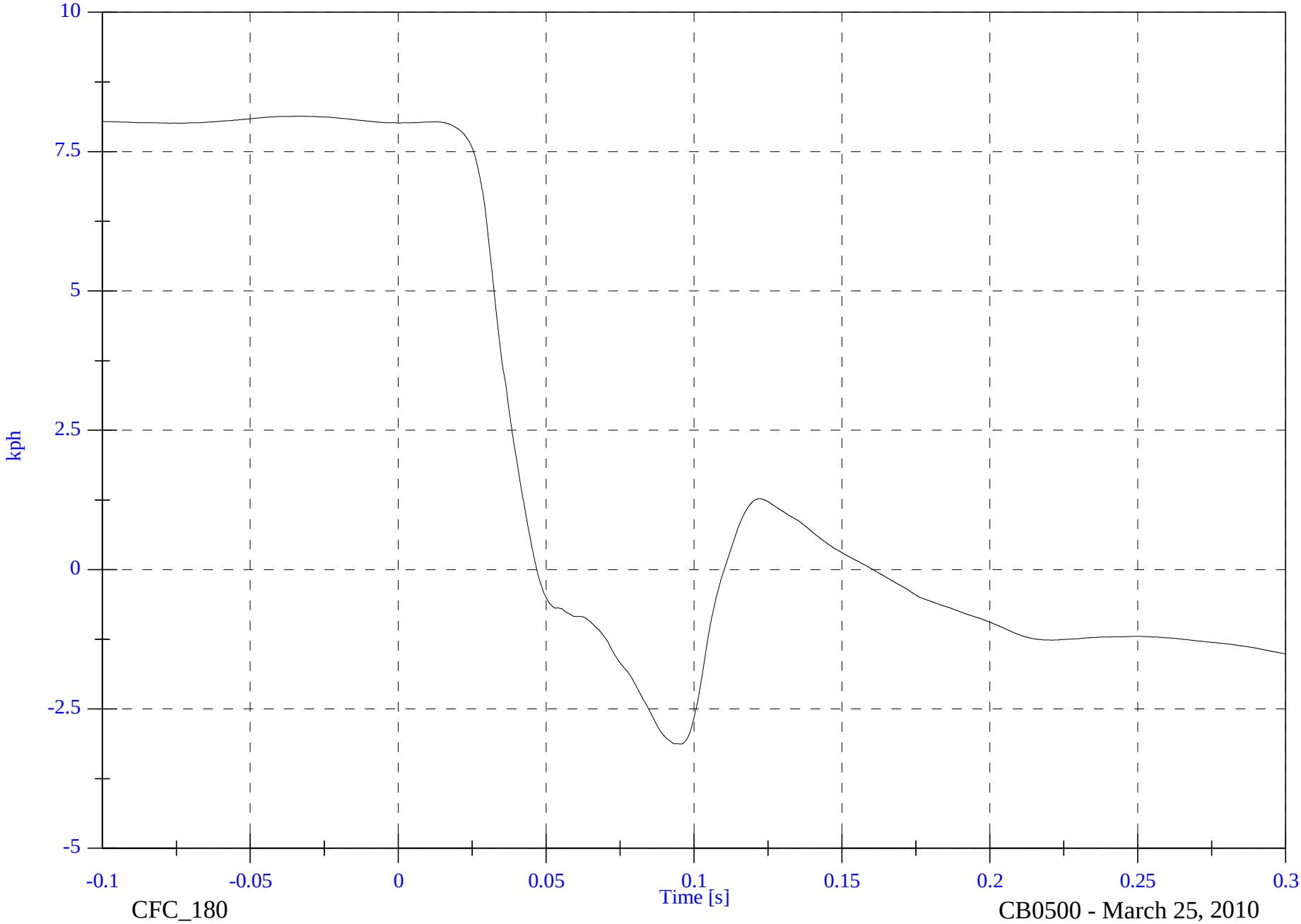
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Engine Top x Velocity

Max: 8.1 [kph] at -0.034 [s]

Min: -3.1 [kph] at 0.095 [s]



CFC_180

CB0500 - March 25, 2010

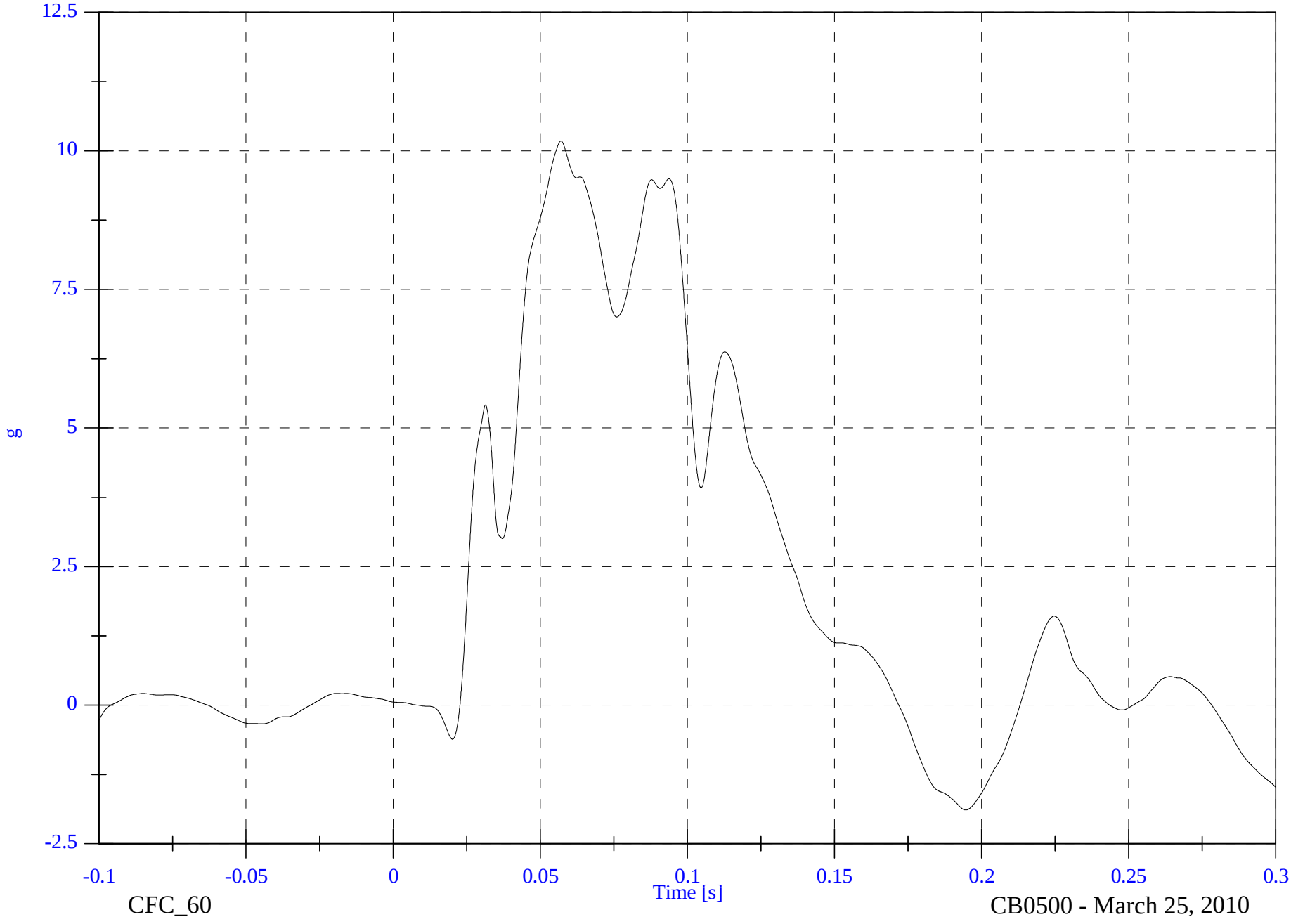
C-37

tr2433

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Engine Top y

Max: 10.2 [g] at 0.057 [s]
Min: -1.9 [g] at 0.195 [s]



C-38

tr2433

CFC_60

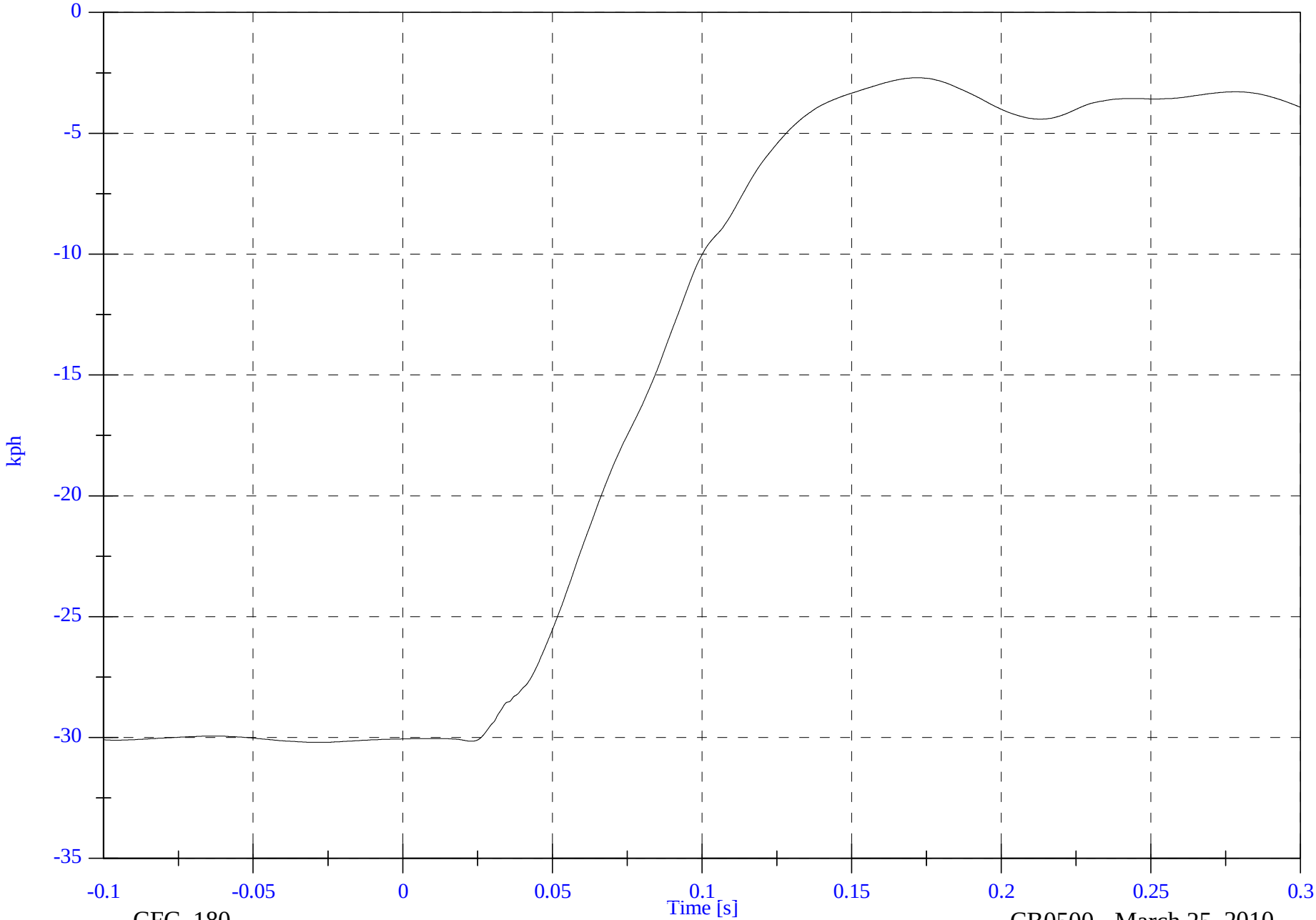
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Engine Top y Velocity

Max: -2.7 [kph] at 0.171 [s]

Min: -30.2 [kph] at -0.028 [s]



C-39

tr2433

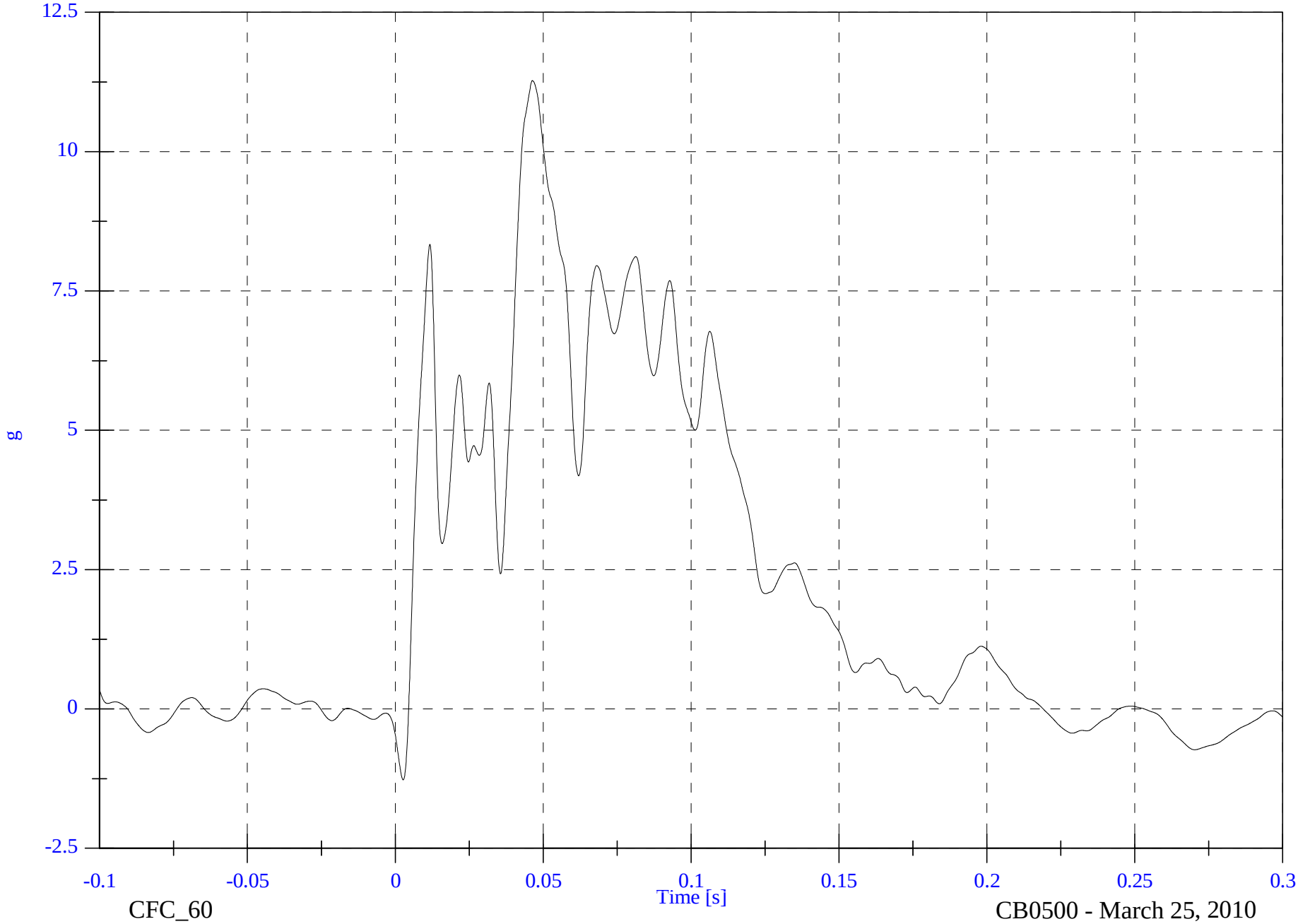
CFC_180

CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Firewall y

Max: 11.3 [g] at 0.046 [s]
Min: -1.3 [g] at 0.003 [s]



C-40

tr2433

CFC_60

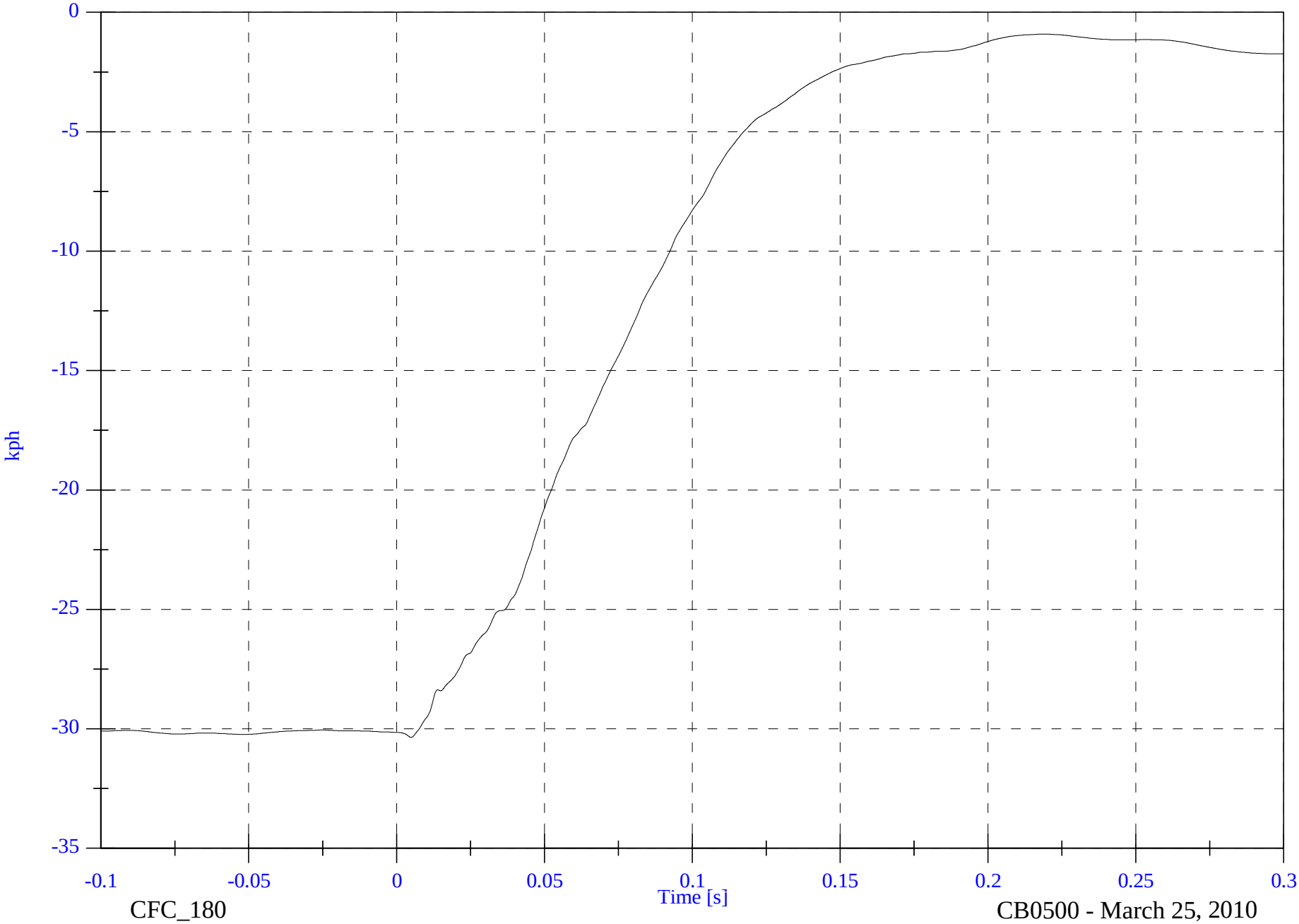
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Firewall y Velocity

Max: -0.9 [kph] at 0.219 [s]

Min: -30.4 [kph] at 0.005 [s]



C-41

tr2433

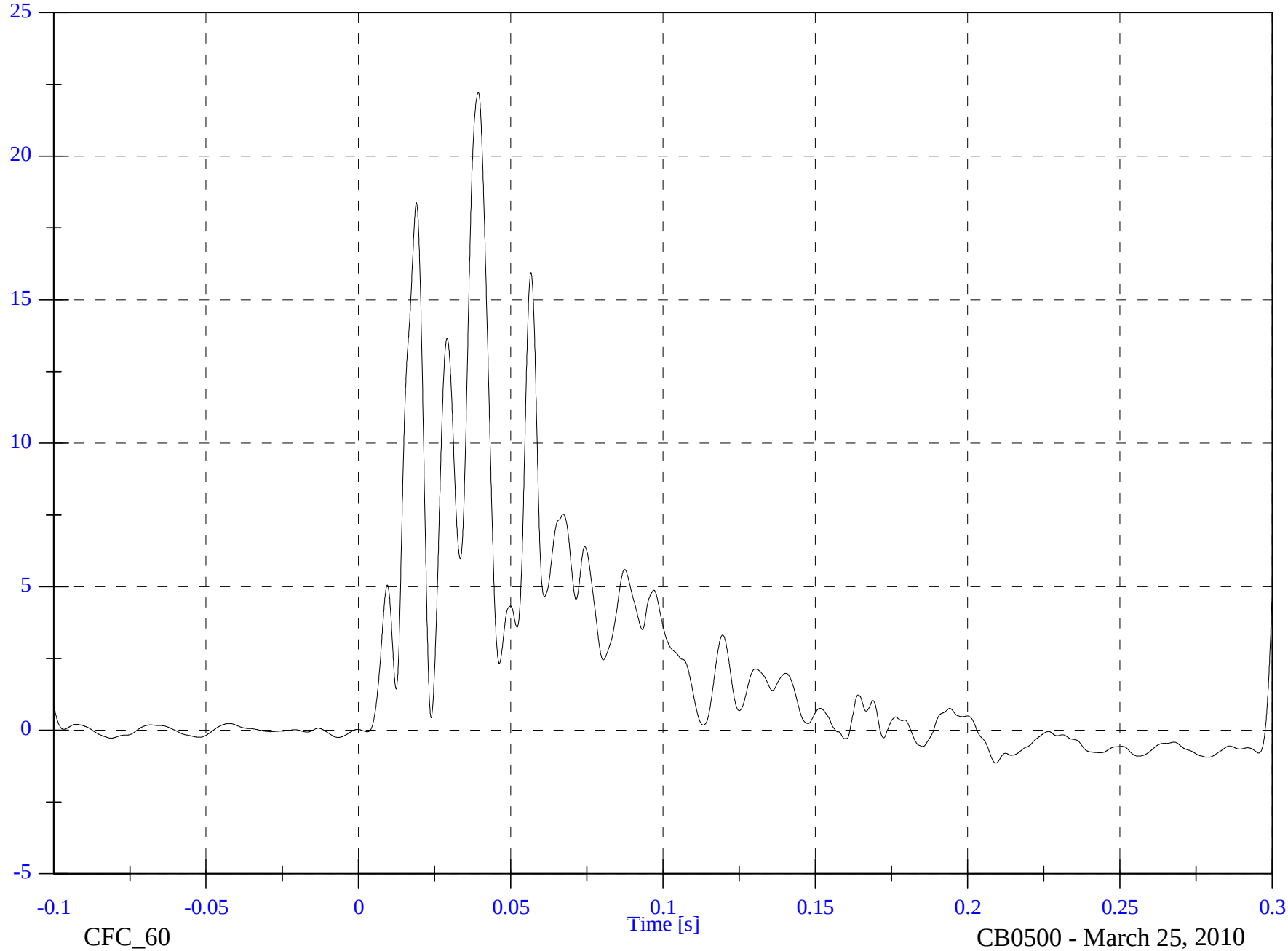
CFC_180

CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Roof Rail y

Max: 22.2 [g] at 0.039 [s]
Min: -1.1 [g] at 0.209 [s]



C-42

tr2433

CFC_60

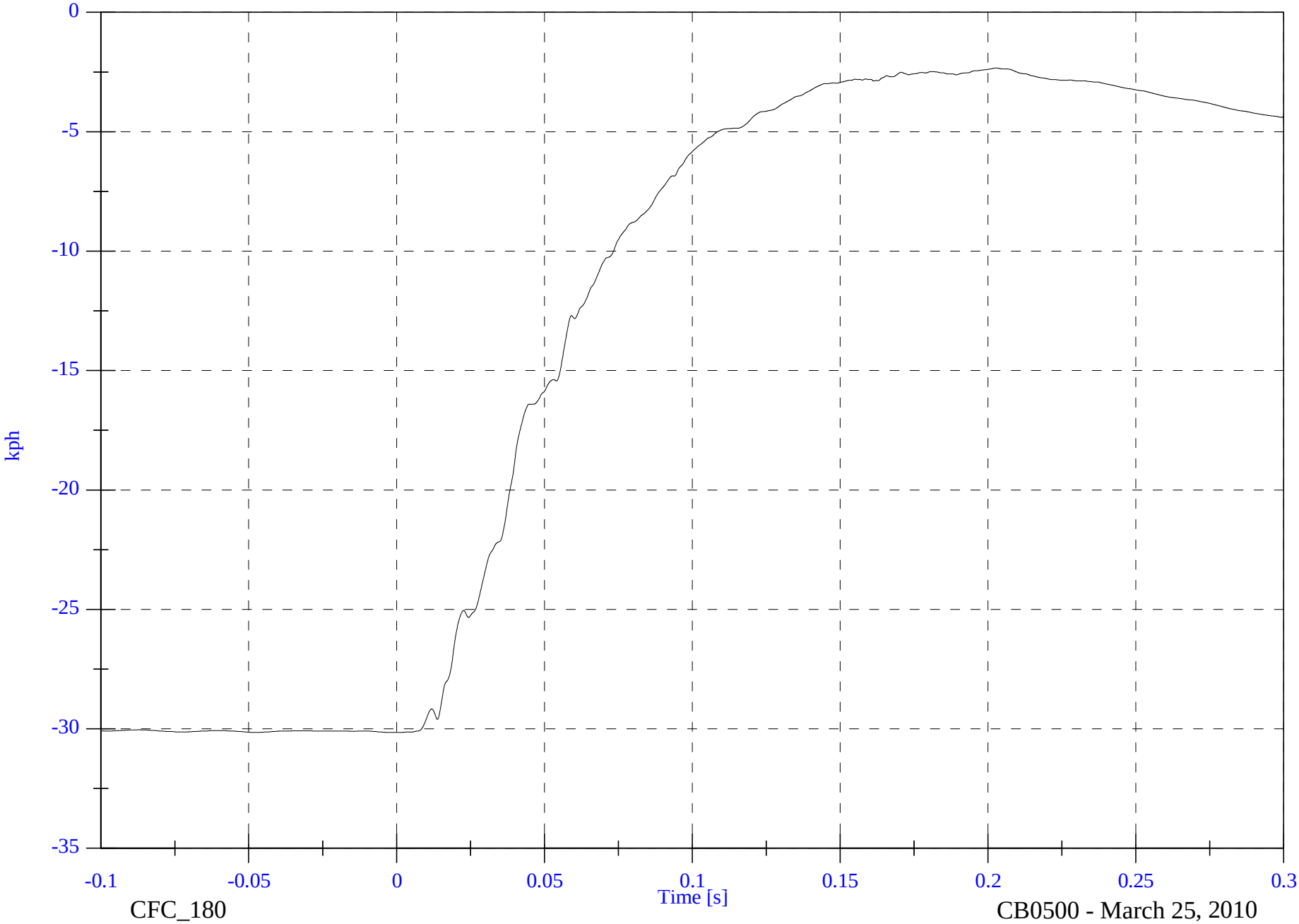
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Roof Rail y Velocity

Max: -2.3 [kph] at 0.203 [s]

Min: -30.1 [kph] at -0.002 [s]



C-43

tr2433

CFC_180

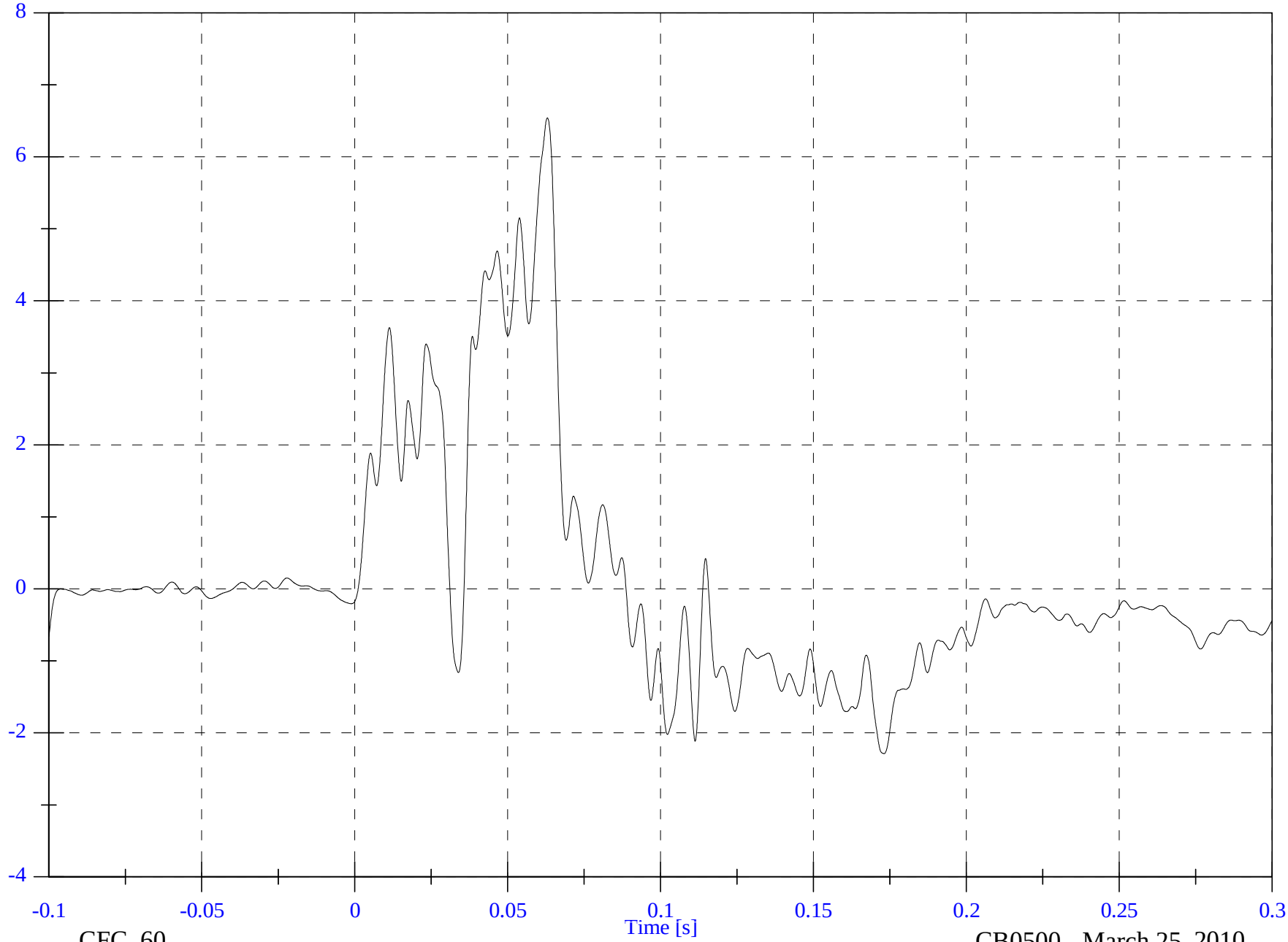
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Front Right Side Rail y

Max: 6.5 [g] at 0.063 [s]

Min: -2.3 [g] at 0.173 [s]



C-44

tr2433

CFC_60

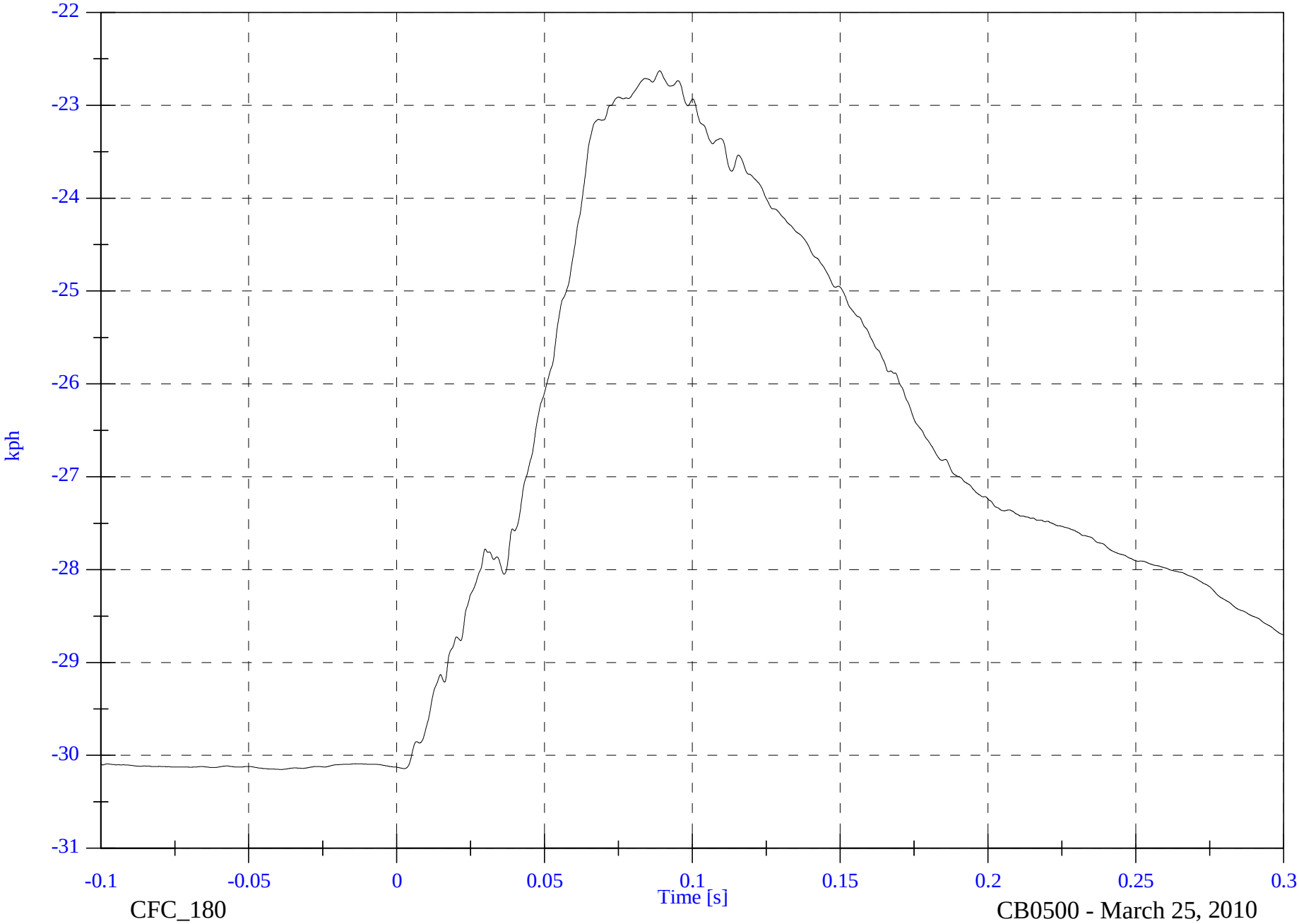
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Front Right Side Rail y Velocity

Max: -22.6 [kph] at 0.089 [s]

Min: -30.2 [kph] at -0.039 [s]



CFC_180

CB0500 - March 25, 2010

C-45

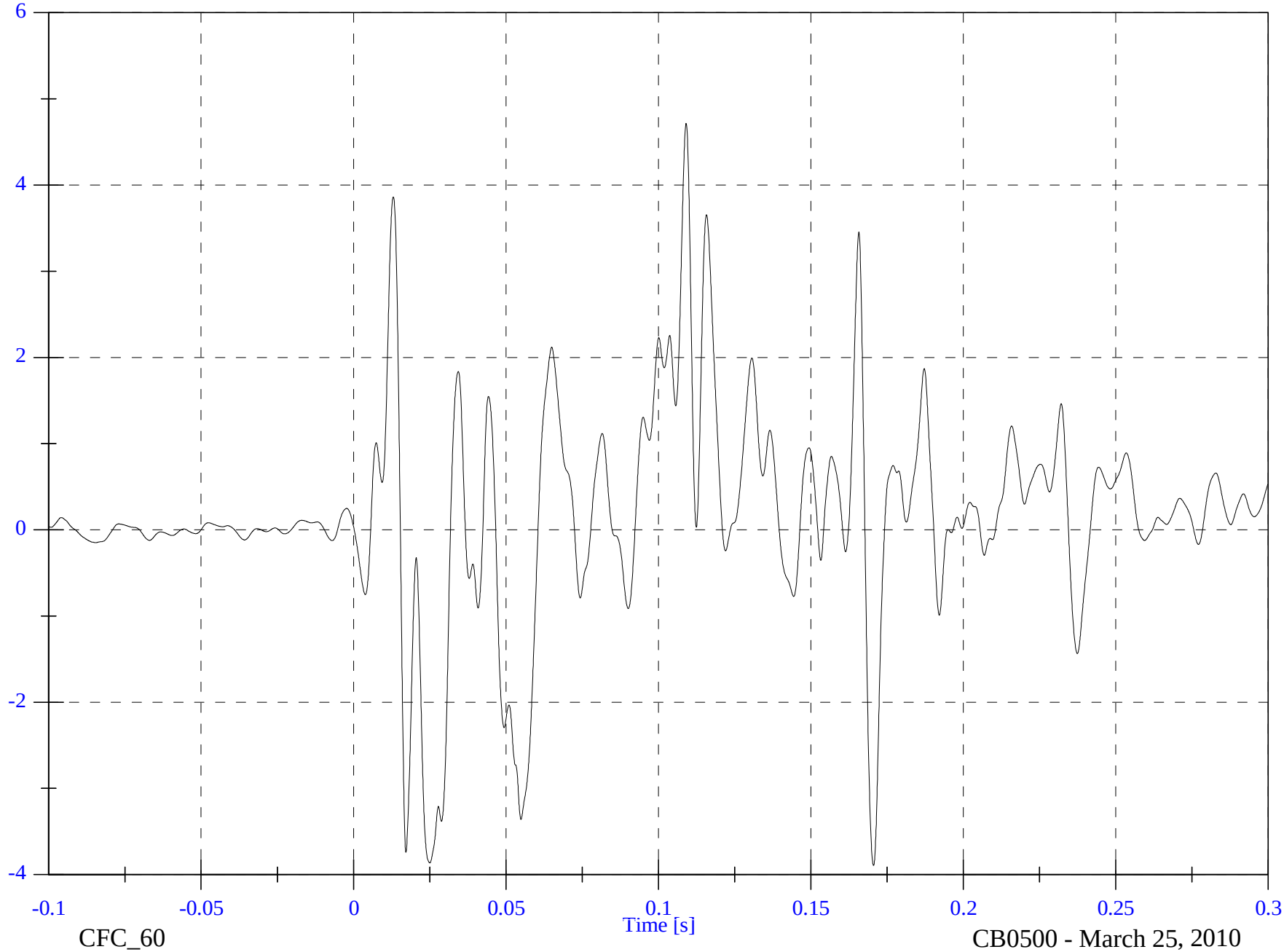
tr2433

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Rear Floorpan x

Max: 4.7 [g] at 0.109 [s]

Min: -3.9 [g] at 0.171 [s]



C-46

tr2433

CFC_60

CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Rear Floorpan x Velocity

Max: 10.5 [kph] at 0.300 [s]

Min: 6.2 [kph] at 0.061 [s]

C-47

tr2433

CFC_180

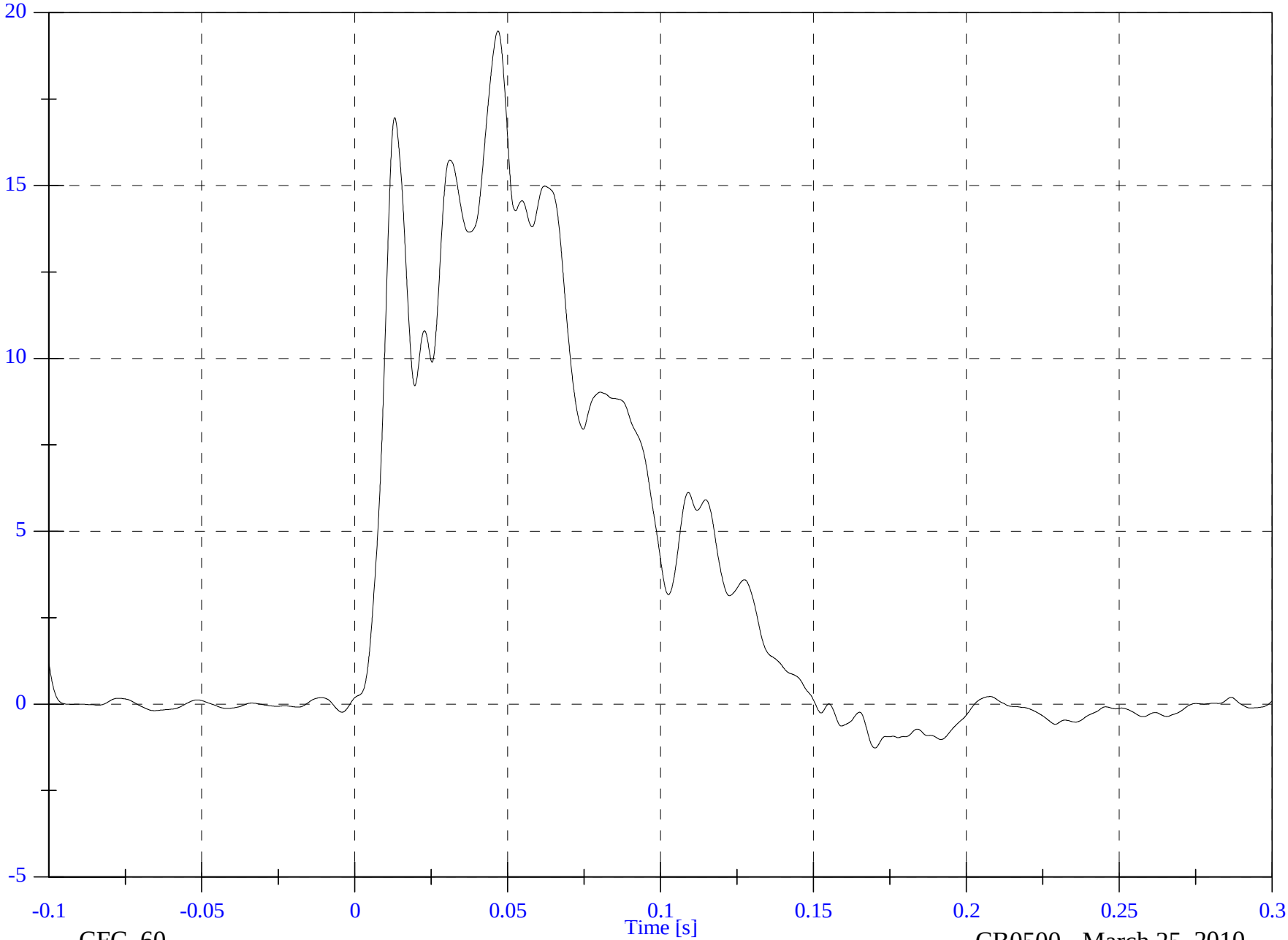
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Rear Floorpan y

Max: 19.5 [g] at 0.047 [s]

Min: -1.3 [g] at 0.170 [s]



C-48

tr2433

CFC_60

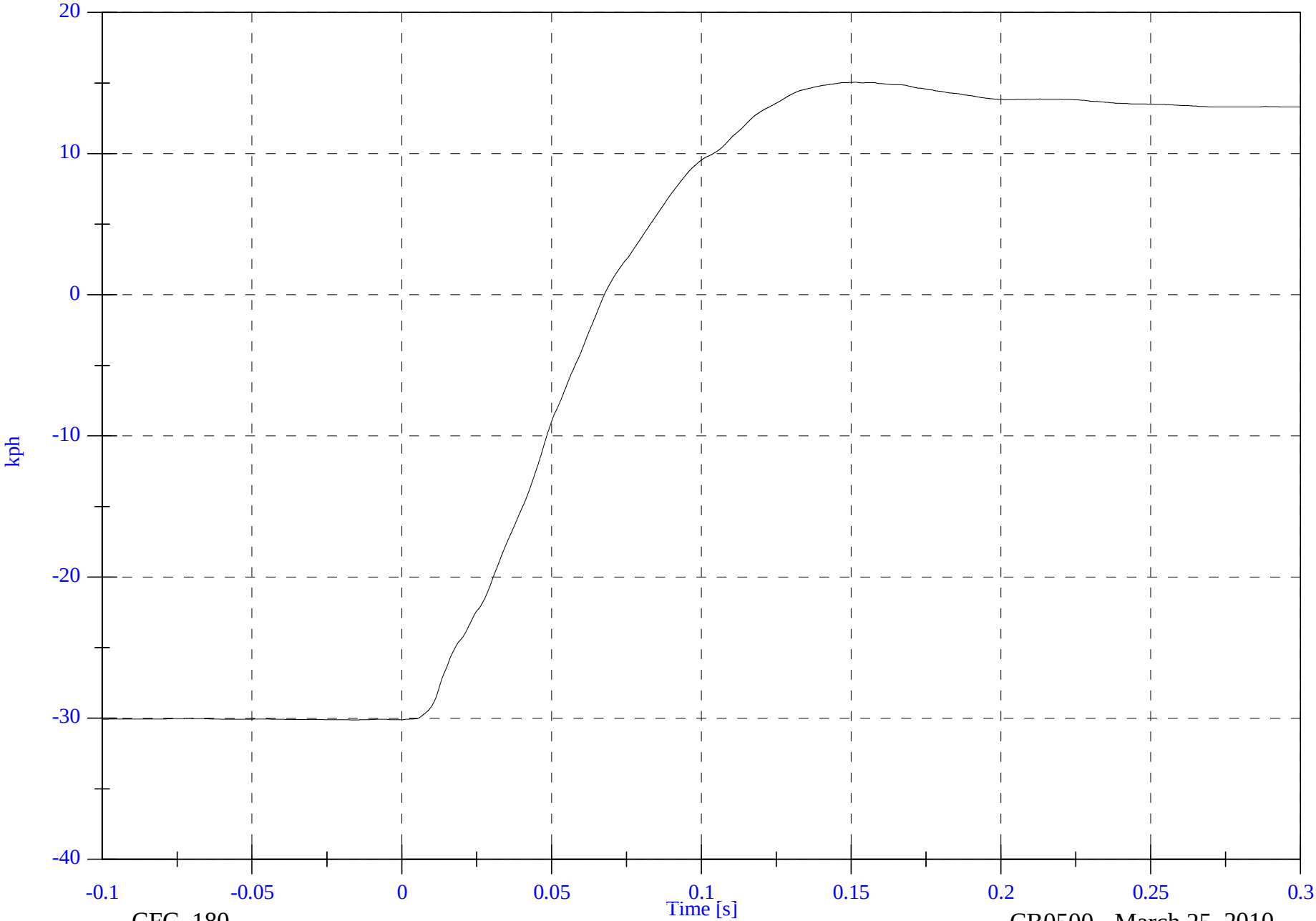
CB0500 - March 25, 2010

FMVSS214 Oblique Pole 2011 Hyundai Sonata

V1 Rear Floorpan y Velocity

Max: 15.1 [kph] at 0.151 [s]

Min: -30.1 [kph] at -0.016 [s]



C-49

tr2433

CFC_180

CB0500 - March 25, 2010

APPENDIX D

DUMMY ES2-re PERFORMANCE CALIBRATION TEST DATA

PRE-TEST

ES2-re S/N: 037

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Head Drop**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Head Drop**	Test Date:	**3/22/2010**
Test Number:	**1**	Test Time:	**9:36:01 AM**

Component Part Number	Component Serial Number
455-1007	

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**20.6**	deg C	P
Humidity	10	--	70	**28**	%RH	P
Resultant Acceleration	125	--	155	**149**	g	P
Oscillation	0.0	--	15.0	**3.4**	%	P
Fore-Aft Acceleration	-15.00	--	15.00	**7.28**	g	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

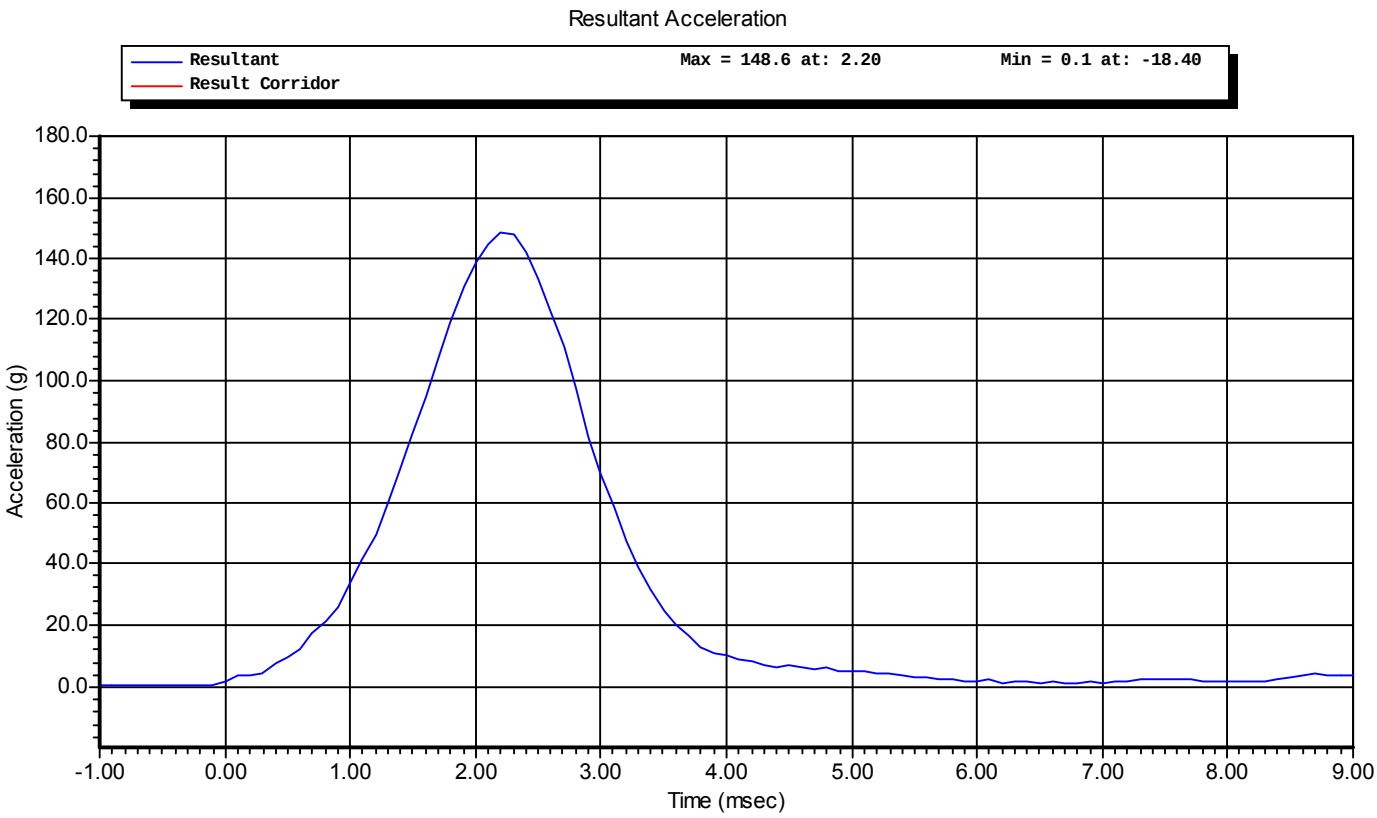
Manufacturer	Model	Serial Number	Calibration Date
Endevco	**7264-2000**	**AC-P18639**	**1/25/2010**
Endevco	**7264-2000**	**AC-P23128**	**1/25/2010**
Endevco	**7264-2000**	**AC-P16591**	**1/25/2010**

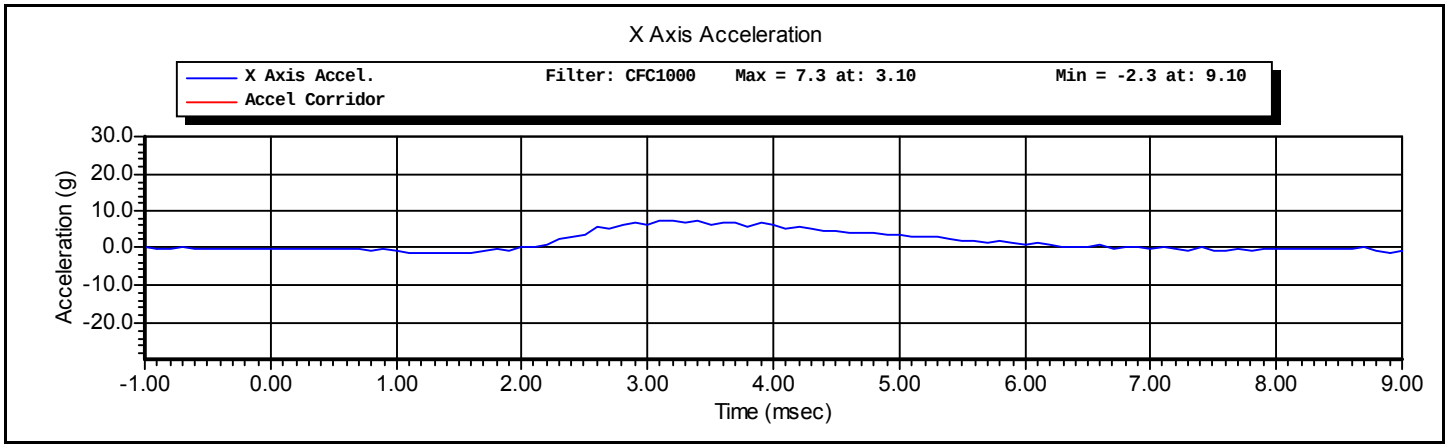
Test ID: **Head Drop** Test Time: **9:36:01 AM** Test Date: **3/22/2010**

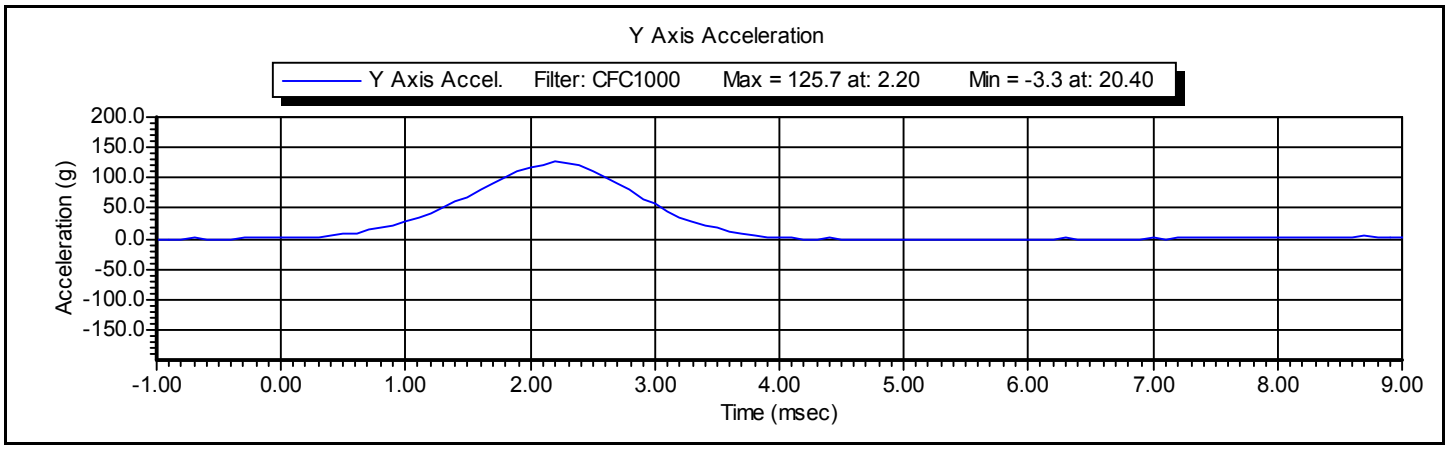
Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

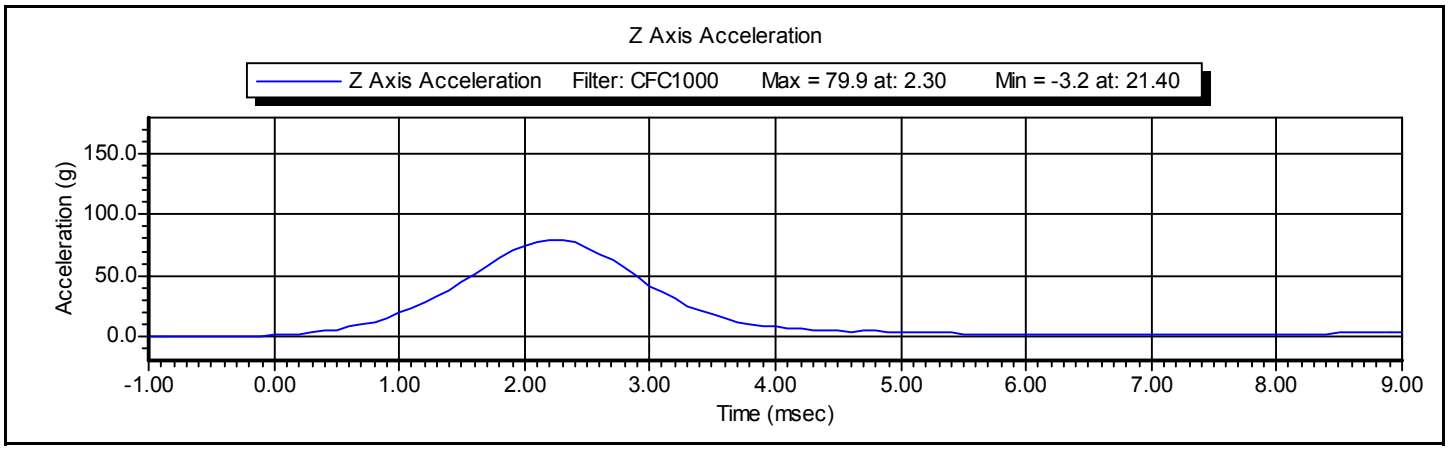
Test Name:	**Head Drop**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Head Drop**	Test Date:	**3/22/2010**
Test Number:	**1**	Test Time:	**9:36:01 AM**

Component Part Number	Component Serial Number
455-1007	









Test ID: **Head Drop** Test Time: **9:36:01 AM** Test Date: **3/22/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Neck Flexion**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Neck Flexion**	Test Date:	**3/22/2010**
Test Number:	**1**	Test Time:	**10:44:14 AM**

Component Part Number	Component Serial Number
455-2002	**19-020118A**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**20.6**	deg C	P
Humidity	10	--	70	**28**	%RH	P
Velocity	3.30	--	3.50	**3.39**	m/s	P
Maximum Neck Flexion Angle	49.0	--	59.0	**52.0**	degrees	P
Time At Maximum Neck Flexion	54.0	--	66.0	**57.5**	ms	P
Decay to Zero Degrees	53.0	--	88.0	**60.1**	ms	P
Velocity Corridor		--				P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

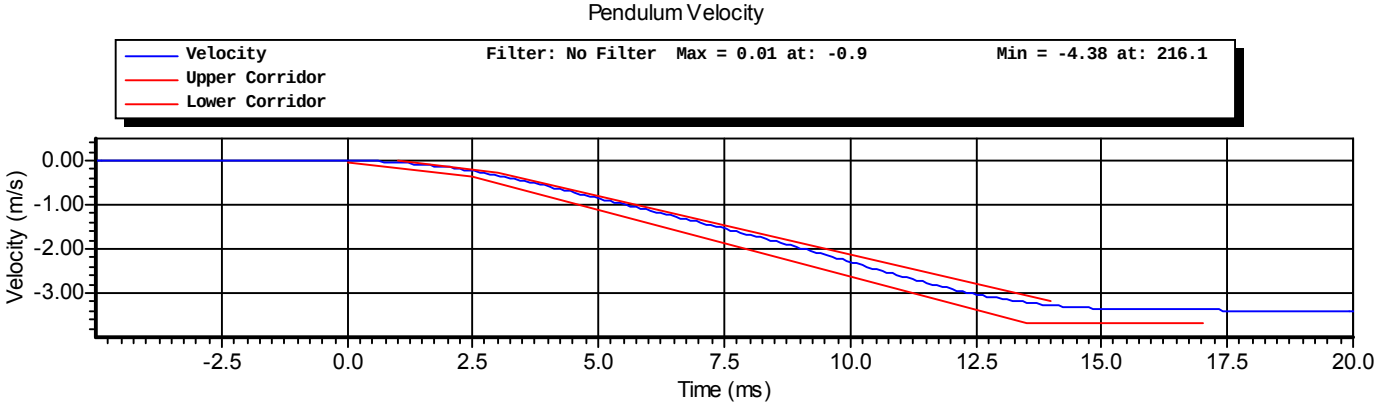
Manufacturer	Model	Serial Number	Calibration Date
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7231CT**	**AF5B3**	**2/24/2010**
DentonATD	**7000428**	**094**	**10/23/2009**
DentonATD	**7000428**	**095**	**10/23/2009**
DentonATD	**7000428**	**093**	**10/23/2009**

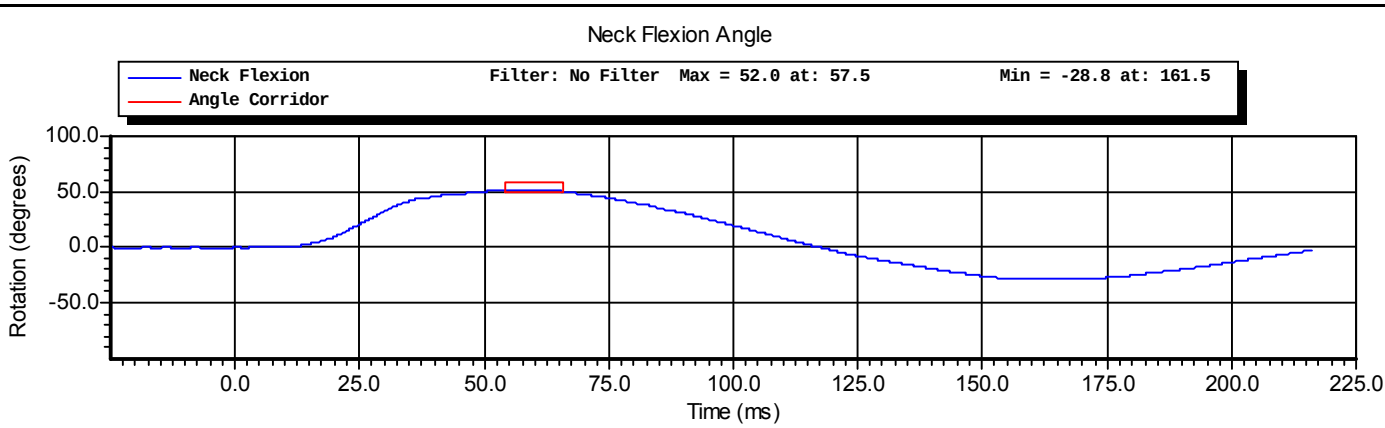
Test ID: **Neck Flexion** Test Time: **10:44:14 AM** Test Date: **3/22/2010**

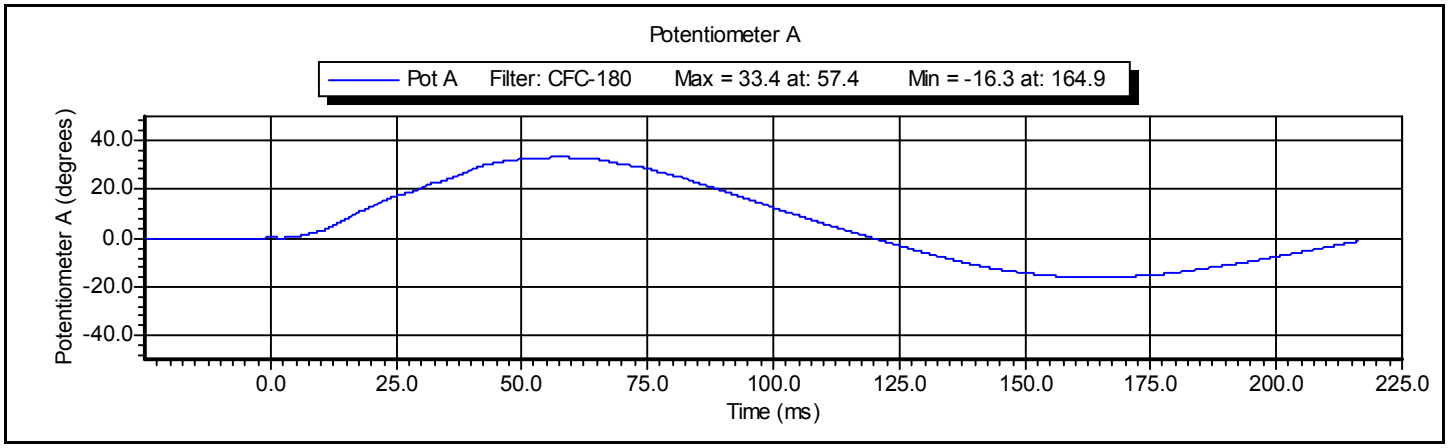
Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

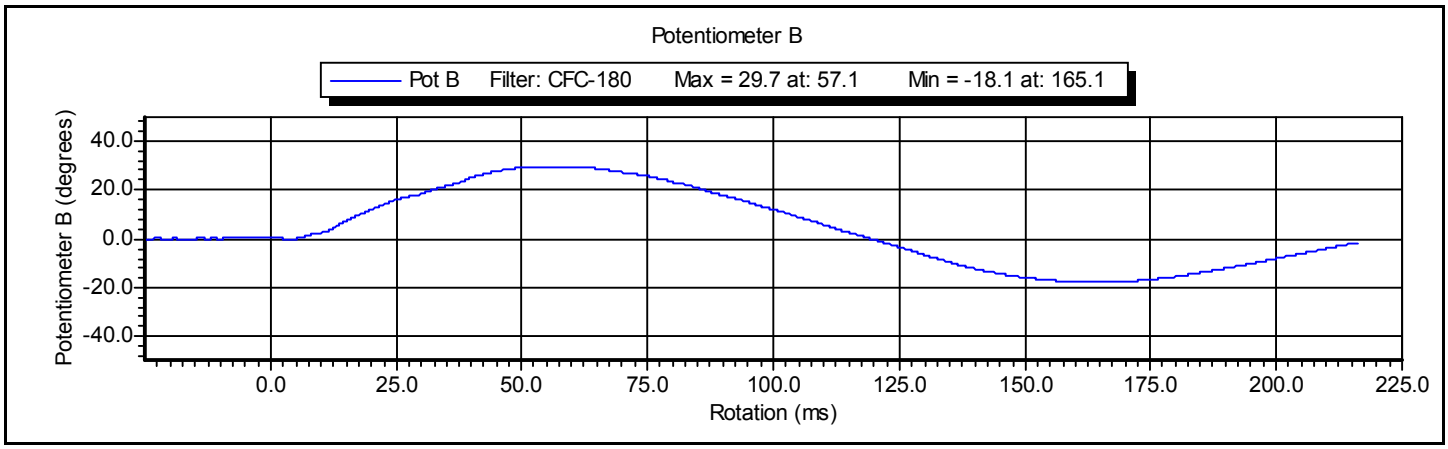
Test Name:	**Neck Flexion**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Neck Flexion**	Test Date:	**3/22/2010**
Test Number:	**1**	Test Time:	**10:44:14 AM**

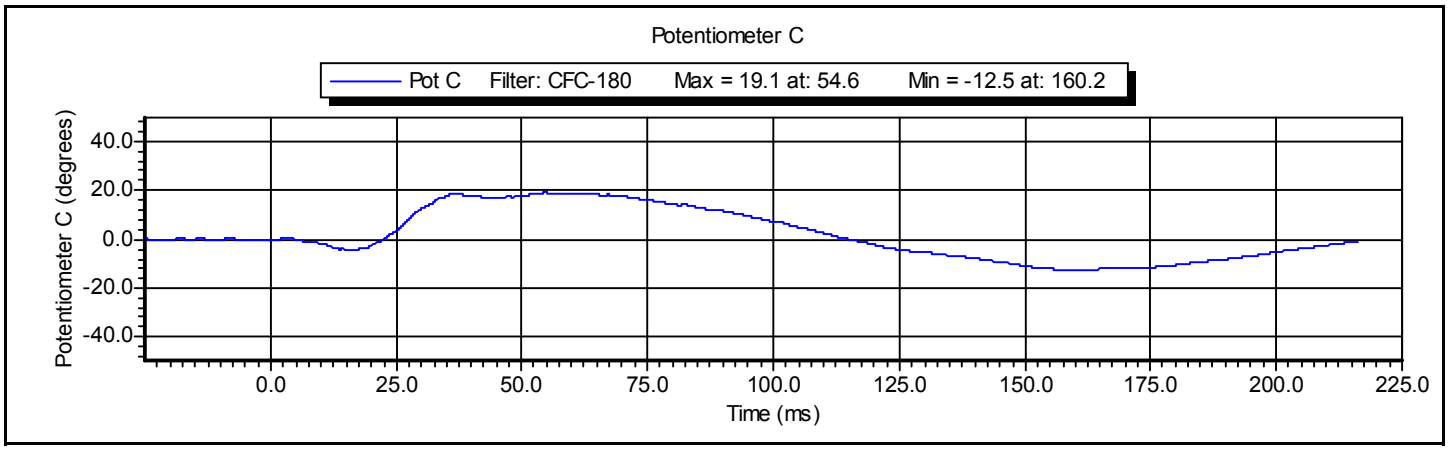
Component Part Number	Component Serial Number
455-2002	**19-020118A**











Test ID: **Neck Flexion** Test Time: **10:44:14 AM** Test Date: **3/22/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Shoulder Impact**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Shoulder Impact**	Test Date:	**3/18/2010**
Test Number:	**1**	Test Time:	**2:43:37 PM**

Component Part Number	Component Serial Number
960715-313	

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**21.1**	deg C	P
Humidity	10.0	--	70.0	**38.0**	%RH	P
Velocity	4.20	--	4.40	**4.28**	m/s	P
Pendulum Acceleration	-10.50	--	-7.50	**-7.91**	g	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

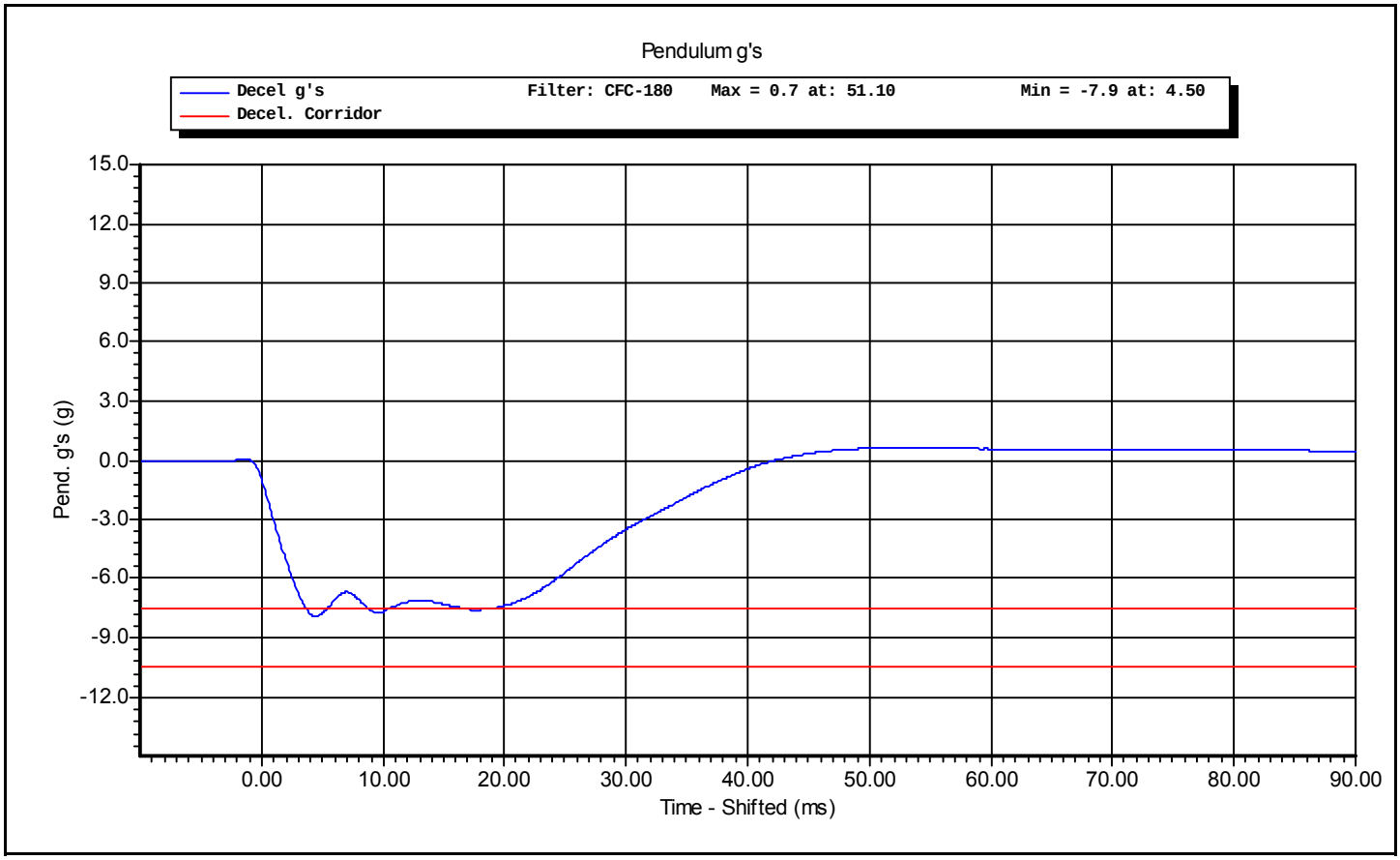
Manufacturer	Model	Serial Number	Calibration Date
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P16576**	**11/4/2009**

Test ID: **Shoulder Impact** Test Time: **2:43:37 PM** Test Date: **3/18/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

Test Name:	**Shoulder Impact**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Shoulder Impact**	Test Date:	**3/18/2010**
Test Number:	**1**	Test Time:	**2:43:37 PM**

Component Part Number	Component Serial Number
960715-313	



Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**3.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Lower Rib 3 m/s**	Test Date:	**3/19/2010**
Test Number:	**1**	Test Time:	**9:30:00 AM**

Component Part Number	Component Serial Number
455-3100	**1954-0126A**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**20.6**	deg C	P
Humidity	10.0	--	70.0	**27.0**	%RH	P
Velocity	2.90	--	3.10	**2.99**	m/s	P
Rib Displacement	-40.00	--	-36.00	**-38.84**	mm	P
Drop Height	454	--	464	**459**	mm	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

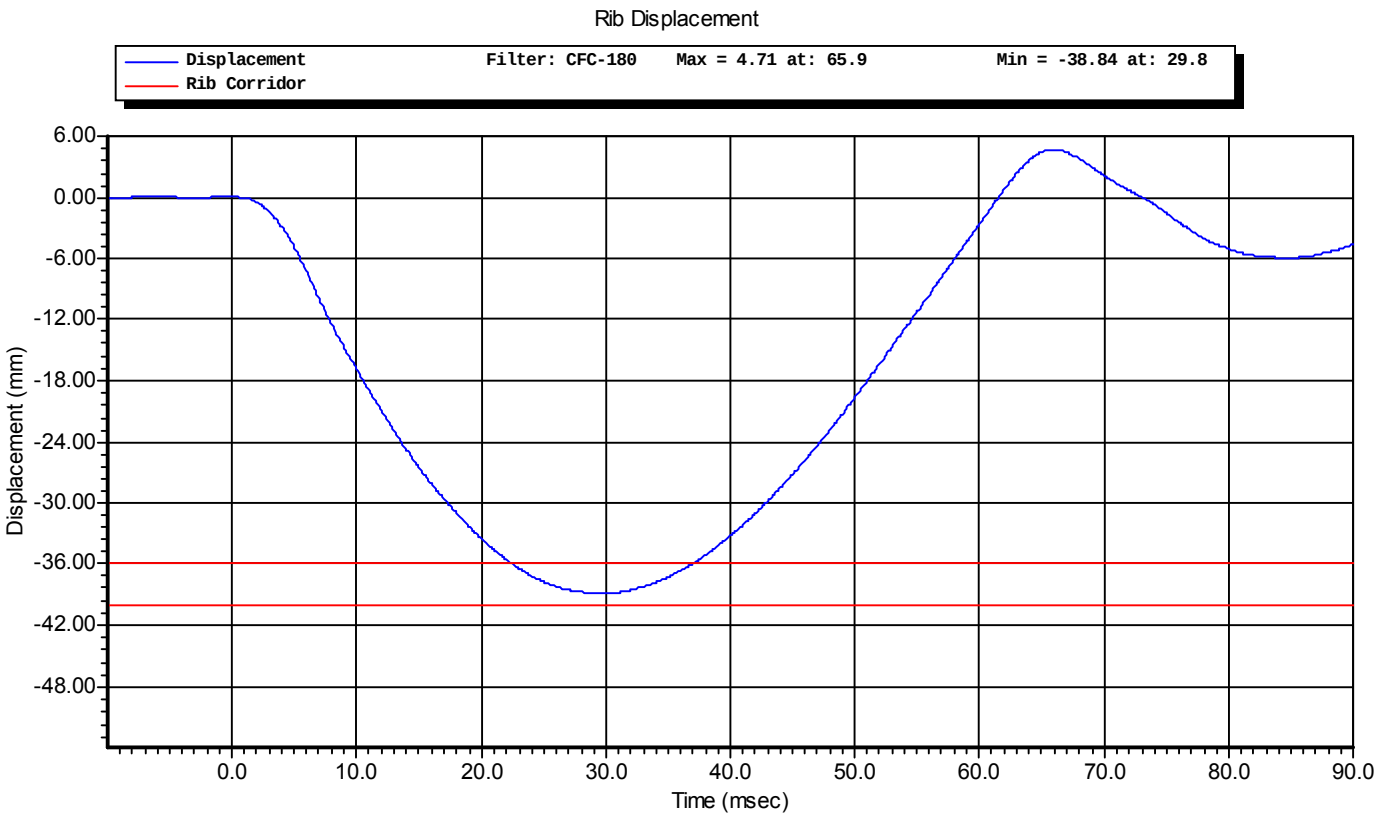
Manufacturer	Model	Serial Number	Calibration Date
Honeywell	**MLT-38000**	**DS-0552-3**	**1/11/2010**
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P23137**	**1/22/2010**

Test ID: **Lower Rib 3 m/s** Test Time: **9:30:00 AM** Test Date: **3/19/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**3.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Lower Rib 3 m/s**	Test Date:	**3/19/2010**
Test Number:	**1**	Test Time:	**9:30:00 AM**

Component Part Number	Component Serial Number
455-3100	**1954-0126A**



Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**4.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Lower Rib 4 m/s**	Test Date:	**3/19/2010**
Test Number:	**1**	Test Time:	**9:59:56 AM**

Component Part Number	Component Serial Number
455-3100	**1954-0126A**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**20.6**	deg C	P
Humidity	10.0	--	70.0	**28.0**	%RH	P
Velocity	3.90	--	4.10	**3.98**	m/s	P
Rib Displacement	-51.00	--	-46.00	**-46.79**	mm	P
Drop Height	807.0	--	823.0	**815.0**	mm	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

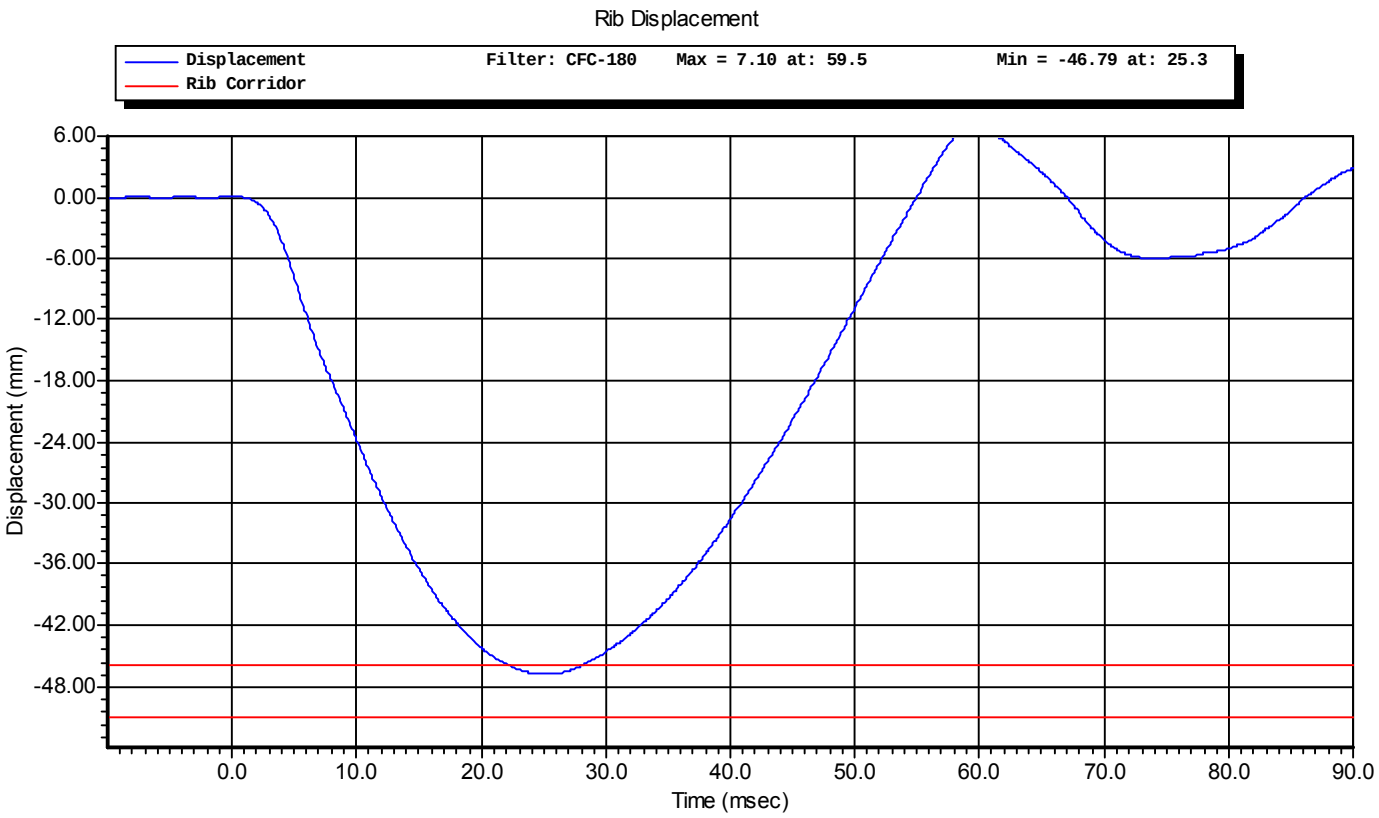
Manufacturer	Model	Serial Number	Calibration Date
Honeywell	**MLT-38000**	**DS-0552-3**	**1/11/2010**
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P23137**	**1/22/2010**

Test ID: **Lower Rib 4 m/s** Test Time: **9:59:56 AM** Test Date: **3/19/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**4.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Lower Rib 4 m/s**	Test Date:	**3/19/2010**
Test Number:	**1**	Test Time:	**9:59:56 AM**

Component Part Number	Component Serial Number
455-3100	**1954-0126A**



Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**3.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Middle Rib 3m/s**	Test Date:	**3/19/2010**
Test Number:	**1**	Test Time:	**10:05:55 AM**

Component Part Number	Component Serial Number
455-3100	**1954-0125A**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**20.6**	deg C	P
Humidity	10.0	--	70.0	**28.0**	%RH	P
Velocity	2.90	--	3.10	**2.98**	m/s	P
Rib Displacement	-40.00	--	-36.00	**-37.80**	mm	P
Drop Height	454	--	464	**459**	mm	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

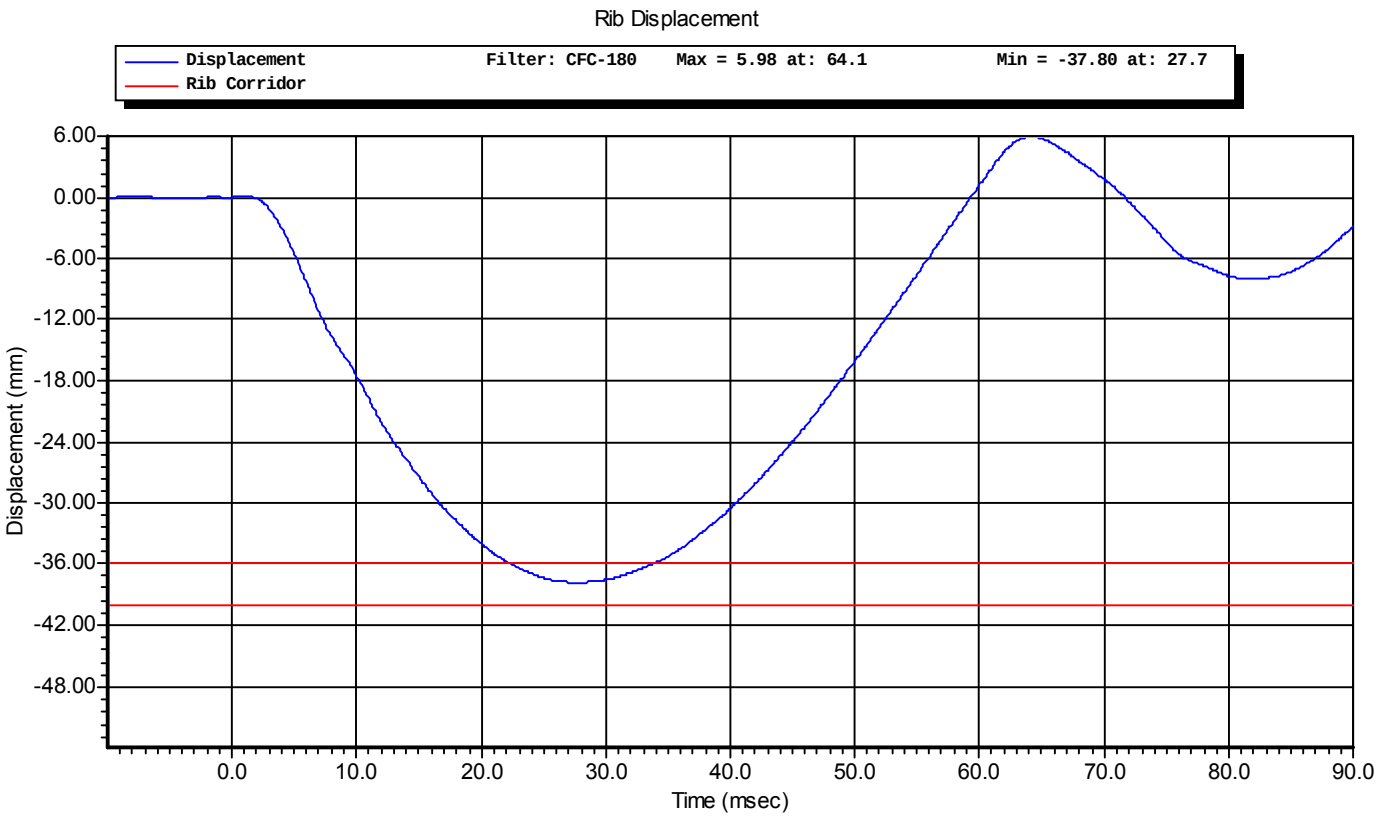
Manufacturer	Model	Serial Number	Calibration Date
Honeywell	**MLT-38000**	**DS-0807**	**1/11/2010**
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P23137**	**1/22/2010**

Test ID: **Middle Rib 3m/s** Test Time: **10:05:55 AM** Test Date: **3/19/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**3.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Middle Rib 3m/s**	Test Date:	**3/19/2010**
Test Number:	**1**	Test Time:	**10:05:55 AM**

Component Part Number	Component Serial Number
455-3100	**1954-0125A**



Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**4.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Middle Rib 4 m/s**	Test Date:	**3/19/2010**
Test Number:	**1**	Test Time:	**10:47:55 AM**

Component Part Number	Component Serial Number
455-3100	**1954-0125A**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**20.6**	deg C	P
Humidity	10.0	--	70.0	**28.0**	%RH	P
Velocity	3.90	--	4.10	**3.99**	m/s	P
Rib Displacement	-51.00	--	-46.00	**-47.28**	mm	P
Drop Height	807.0	--	823.0	**815.0**	mm	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

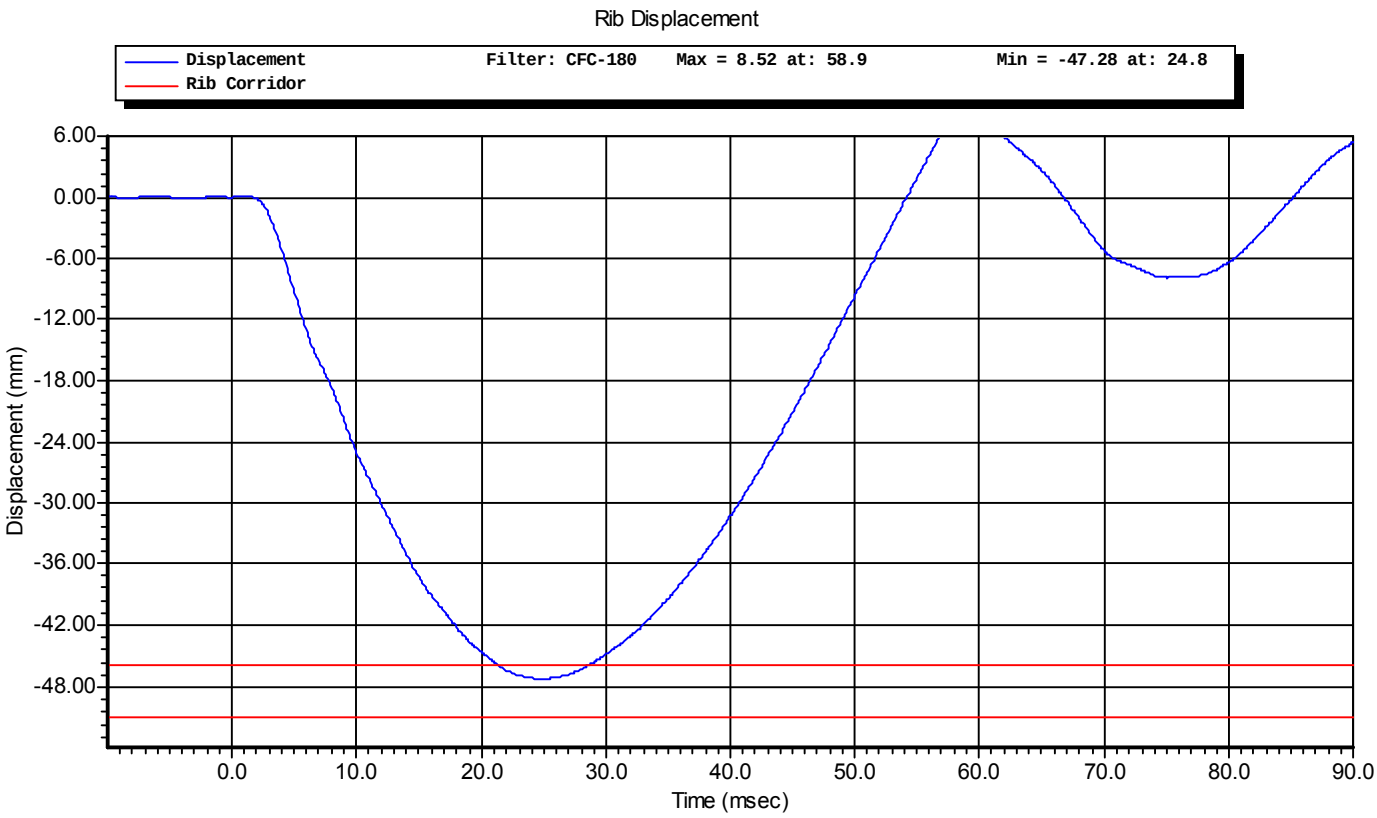
Manufacturer	Model	Serial Number	Calibration Date
Honeywell	**MLT-38000**	**DS-0807**	**1/11/2010**
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P23137**	**1/22/2010**

Test ID: **Middle Rib 4 m/s** Test Time: **10:47:55 AM** Test Date: **3/19/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**4.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Middle Rib 4 m/s**	Test Date:	**3/19/2010**
Test Number:	**1**	Test Time:	**10:47:55 AM**

Component Part Number	Component Serial Number
455-3100	**1954-0125A**



Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**3.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Upper Rib 3 m/s**	Test Date:	**3/19/2010**
Test Number:	**1**	Test Time:	**11:08:12 AM**

Component Part Number	Component Serial Number
455-3100	**1954-0124A**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**20.6**	deg C	P
Humidity	10.0	--	70.0	**28.0**	%RH	P
Velocity	2.90	--	3.10	**2.99**	m/s	P
Rib Displacement	-40.00	--	-36.00	**-38.60**	mm	P
Drop Height	454	--	464	**459**	mm	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

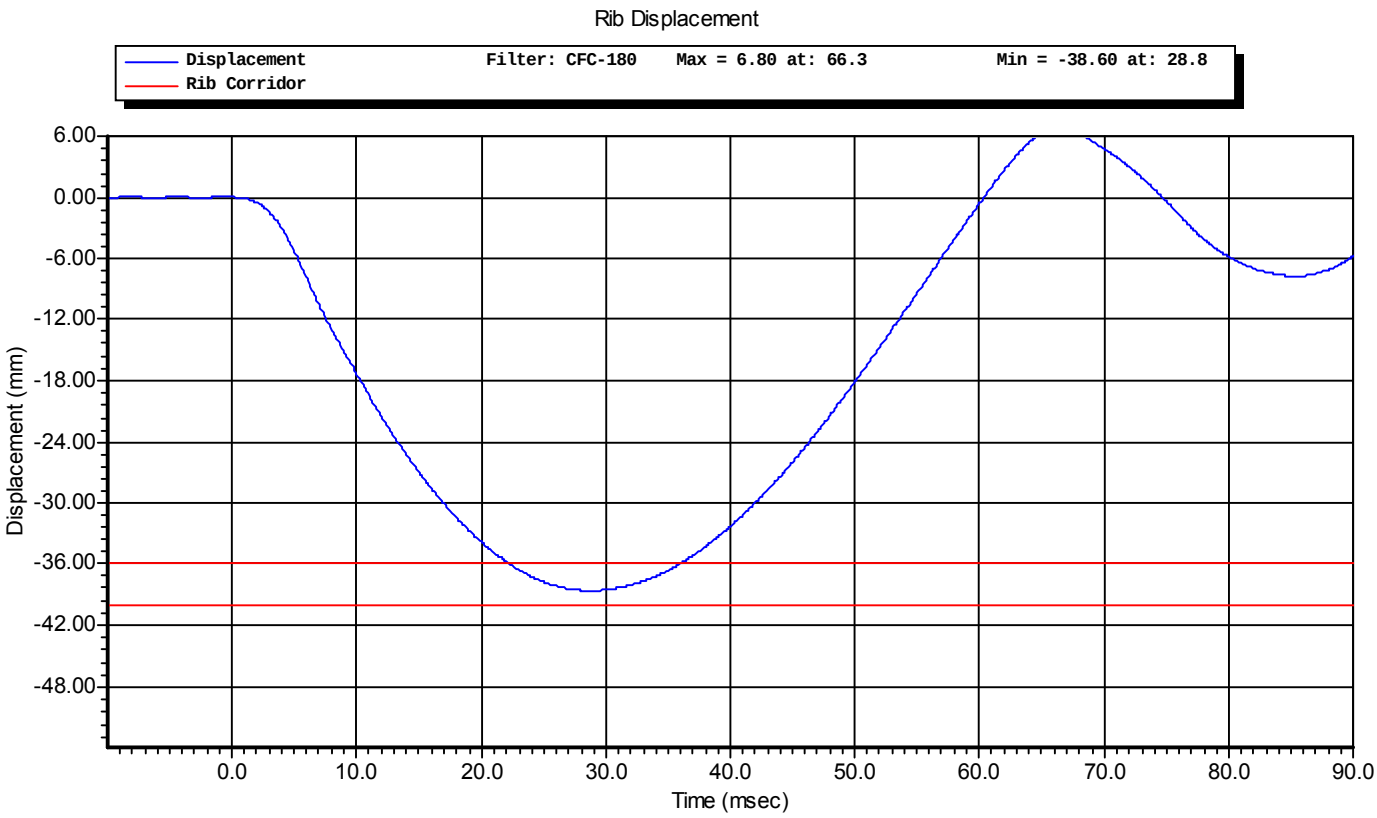
Manufacturer	Model	Serial Number	Calibration Date
Honeywell	**MLT-38000**	**DS-0552-01**	**1/11/2010**
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P23137**	**1/22/2010**

Test ID: **Upper Rib 3 m/s** Test Time: **11:08:12 AM** Test Date: **3/19/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**3.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Upper Rib 3 m/s**	Test Date:	**3/19/2010**
Test Number:	**1**	Test Time:	**11:08:12 AM**

Component Part Number	Component Serial Number
455-3100	**1954-0124A**



Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**4.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Upper Rib 4 m/s**	Test Date:	**3/19/2010**
Test Number:	**1**	Test Time:	**12:38:15 PM**

Component Part Number	Component Serial Number
455-3100	**1954-0124A**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**20.6**	deg C	P
Humidity	10.0	--	70.0	**28.0**	%RH	P
Velocity	3.90	--	4.10	**3.98**	m/s	P
Rib Displacement	-51.00	--	-46.00	**-49.09**	mm	P
Drop Height	807.0	--	823.0	**815.0**	mm	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

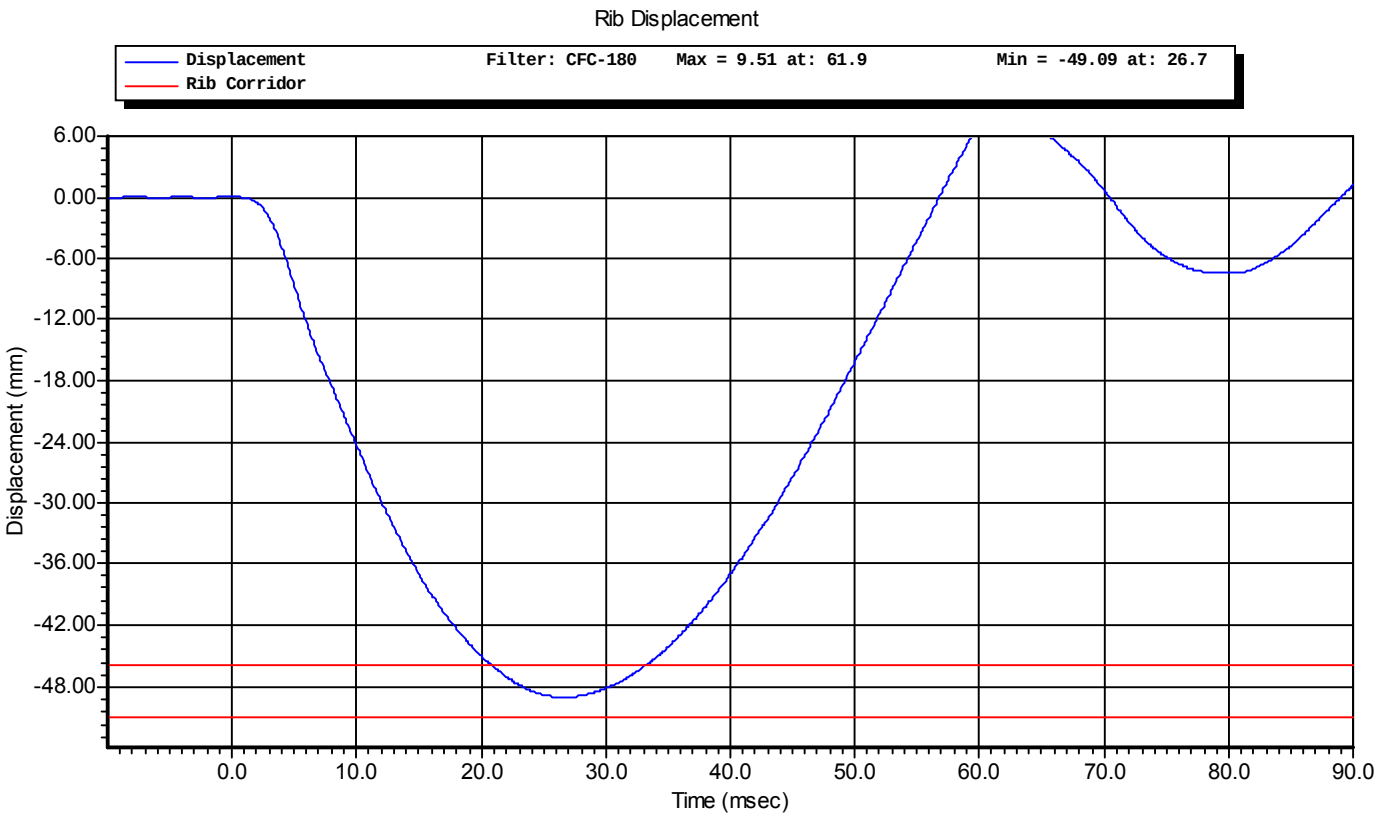
Manufacturer	Model	Serial Number	Calibration Date
Honeywell	**MLT-38000**	**DS-0552-01**	**1/11/2010**
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P23137**	**1/22/2010**

Test ID: **Upper Rib 4 m/s** Test Time: **12:38:15 PM** Test Date: **3/19/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**4.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Upper Rib 4 m/s**	Test Date:	**3/19/2010**
Test Number:	**1**	Test Time:	**12:38:15 PM**

Component Part Number	Component Serial Number
455-3100	**1954-0124A**



Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Thorax Impact**	Revision:	**8/15/2008**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Thorax Impact**	Test Date:	**3/19/2010**
Test Number:	**1**	Test Time:	**2:35:54 PM**

Component Part Number	Component Serial Number
Upper Rib - 175-4002	**1954-0124A**
Middle Rib - 175-4002	**1954-0125A**
Lower Rib - 175-4002	**1954-0126A**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**21.1**	deg C	P
Humidity	10.0	--	70.0	**30.0**	%RH	P
Velocity	5.40	--	5.60	**5.50**	m/s	P
Upper Rib Displacement	34.0	--	41.0	**36.1**	mm	P
Middle Rib Displacement	37.0	--	45.0	**41.1**	mm	P
Lower Rib Displacement	37.0	--	44.0	**42.2**	mm	P
Impactor Force	5100	--	6200	**5787**	N	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

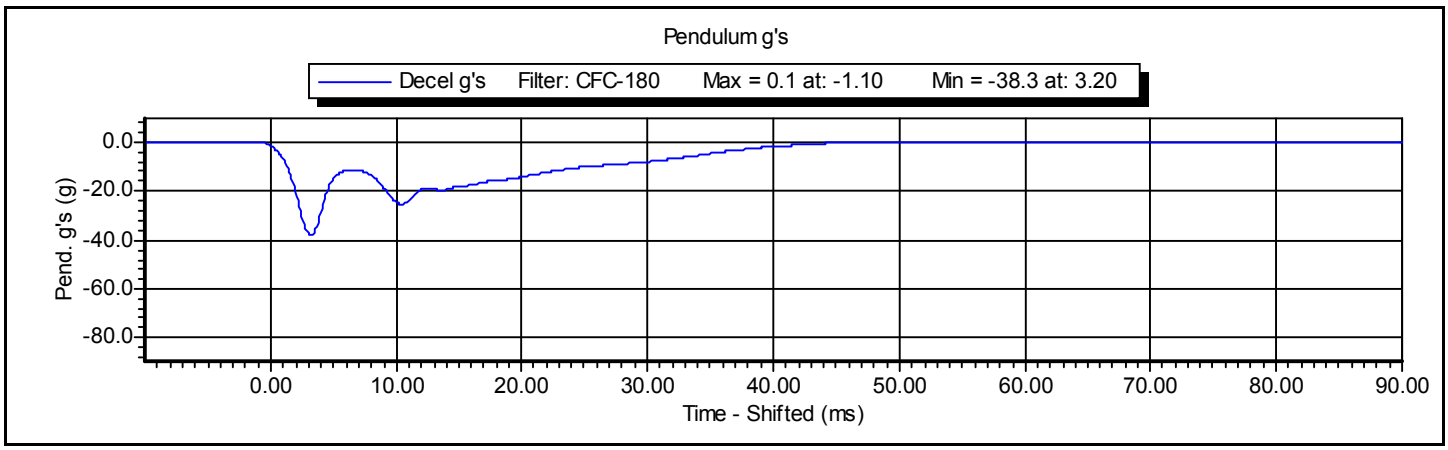
Manufacturer	Model	Serial Number	Calibration Date
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P16576**	**11/4/2009**
Honeywell	**MLT-38000**	**DS-0552-01**	**1/11/2010**
Honeywell	**MLT-38000**	**DS-0807**	**1/11/2010**
Honeywell	**MLT-38000**	**DS-0552-3**	**1/11/2010**

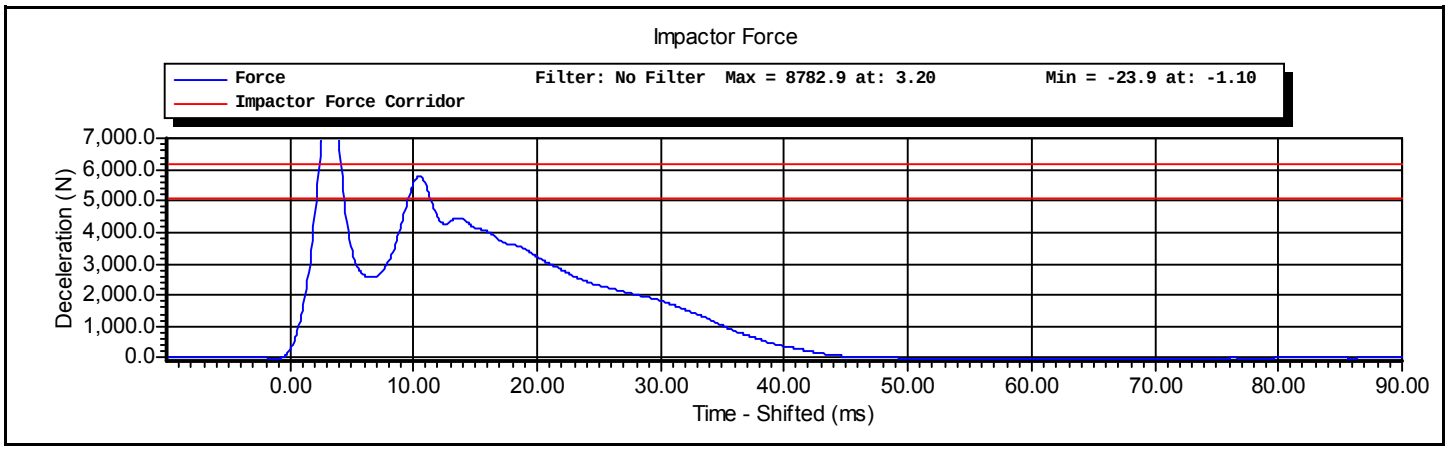
Test ID: **Thorax Impact** Test Time: **2:35:54 PM** Test Date: **3/19/2010**

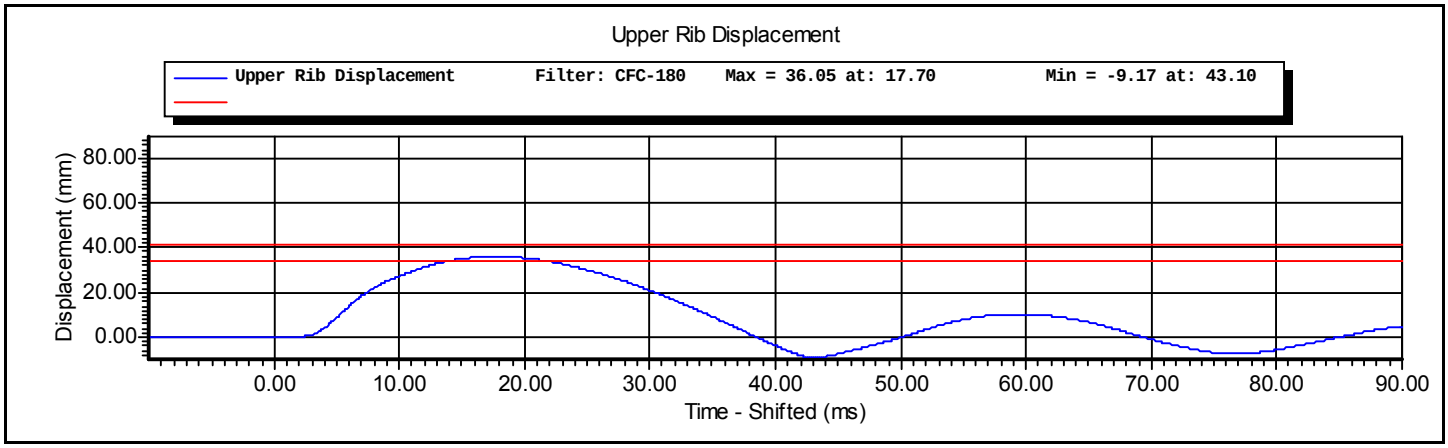
Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

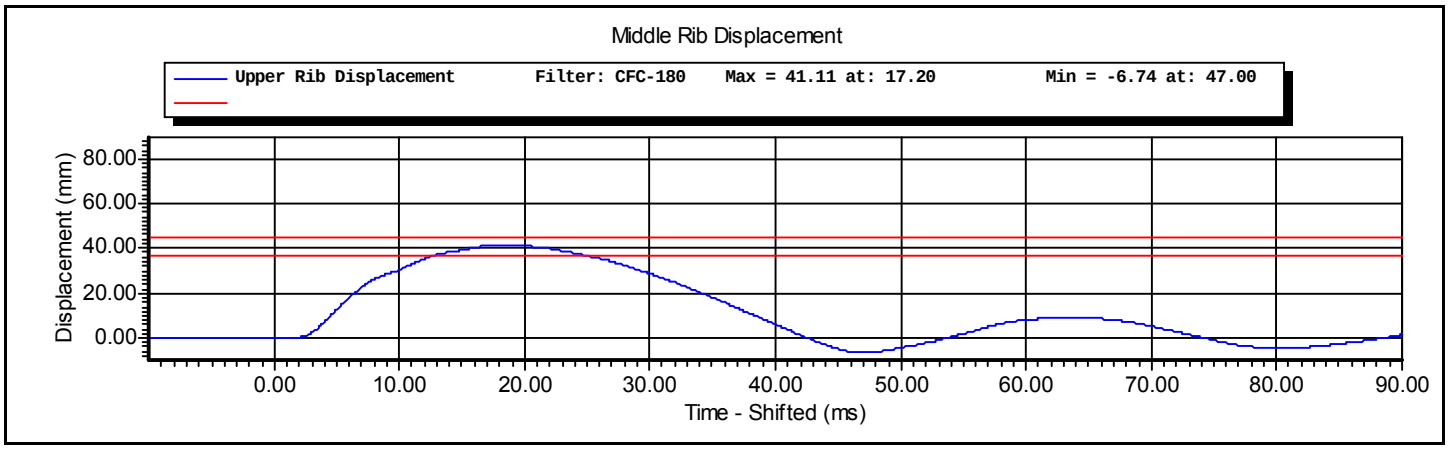
Test Name:	**Thorax Impact**	Revision:	**8/15/2008**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Thorax Impact**	Test Date:	**3/19/2010**
Test Number:	**1**	Test Time:	**2:35:54 PM**

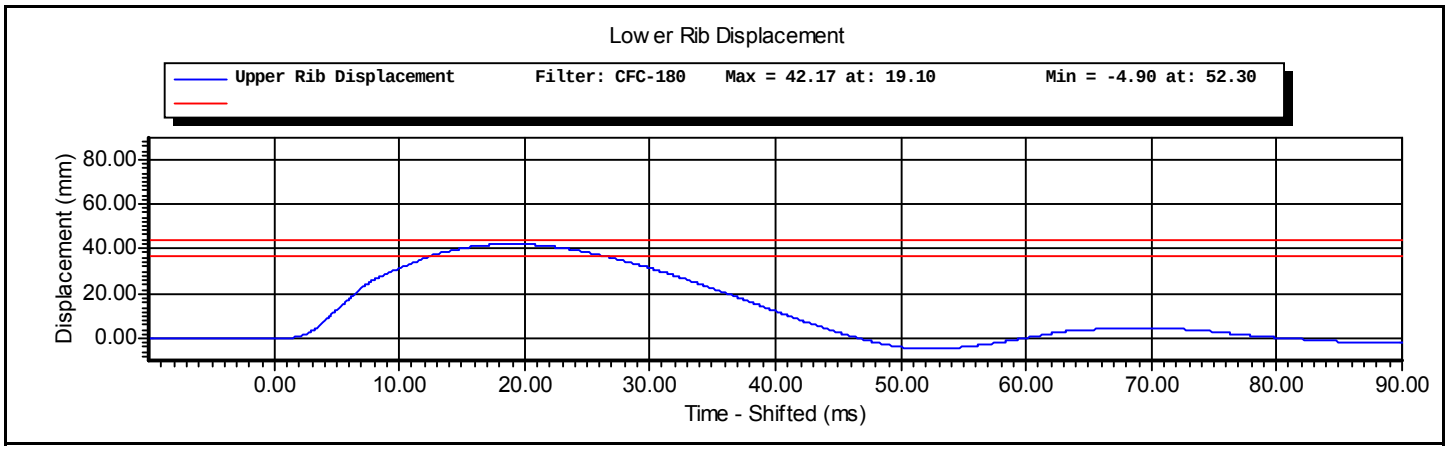
Component Part Number	Component Serial Number
Upper Rib - 175-4002	**1954-0124A**











Test ID: **Thorax Impact** Test Time: **2:35:54 PM** Test Date: **3/19/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Abdominal Impact**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Abdomen Test**	Test Date:	**3/18/2010**
Test Number:	**4**	Test Time:	**2:10:14 PM**

Component Part Number	Component Serial Number
455-4001	**19-179**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**21.1**	deg C	P
Humidity	10	--	70	**38**	%RH	P
Velocity	3.90	--	4.10	**3.95**	m/s	P
Peak Abdominal Force	-2.70	--	-2.20	**-2.57**	kN	P
Time At Peak Abdominal Force	10.0	--	12.3	**11.3**	ms	P
Maximum Pendulum Force	-4.80	--	-4.00	**-4.79**	kN	P
Time at Peak Pendumlum Force	10.6	--	13.0	**10.8**	ms	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

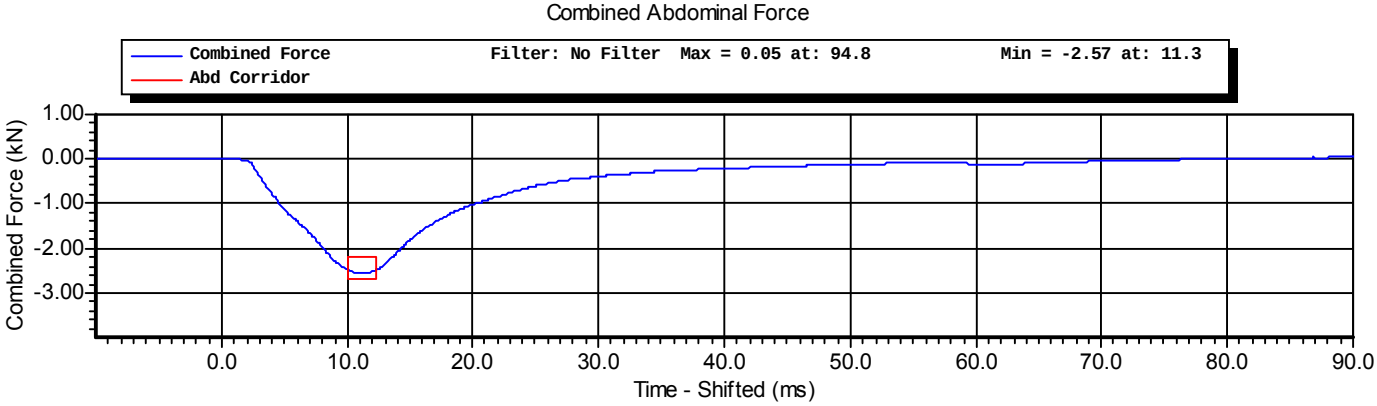
Manufacturer	Model	Serial Number	Calibration Date
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P16576**	**11/4/2009**
Denton	**2631**	**LC-1507Fy**	**1/7/2010**
Denton	**2631**	**LC-1508Fy**	**1/7/2010**
Denton	**2631**	**LC-1509Fy**	**1/7/2010**

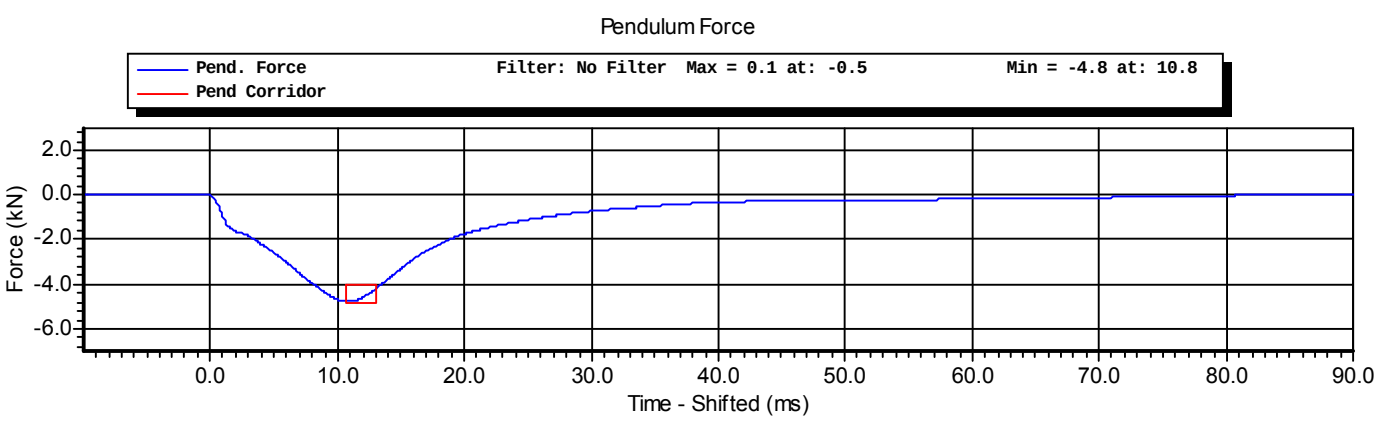
Test ID: **Abdomen Test** Test Time: **2:10:14 PM** Test Date: **3/18/2010**

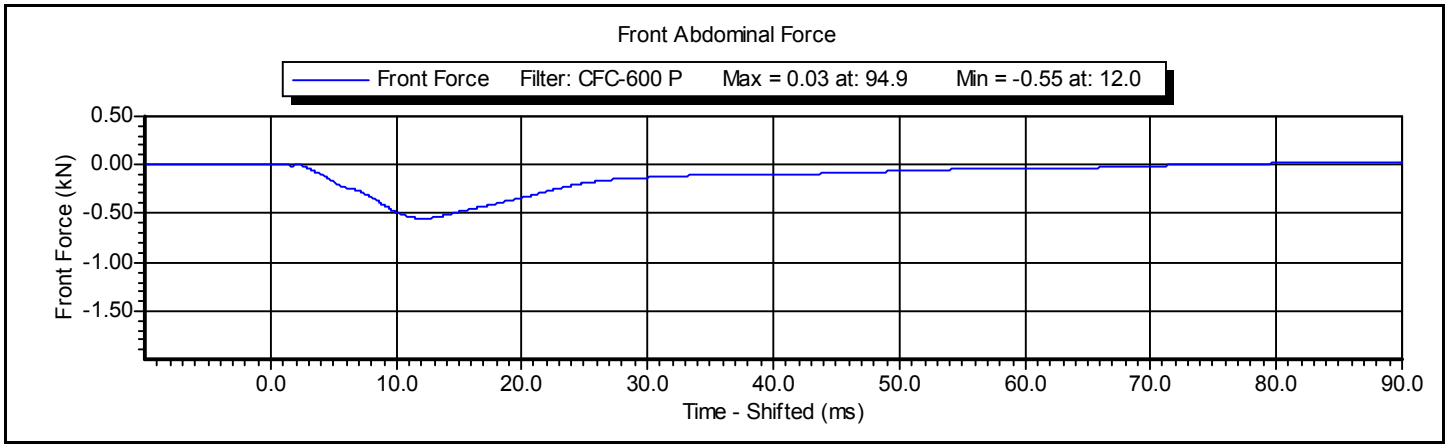
Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

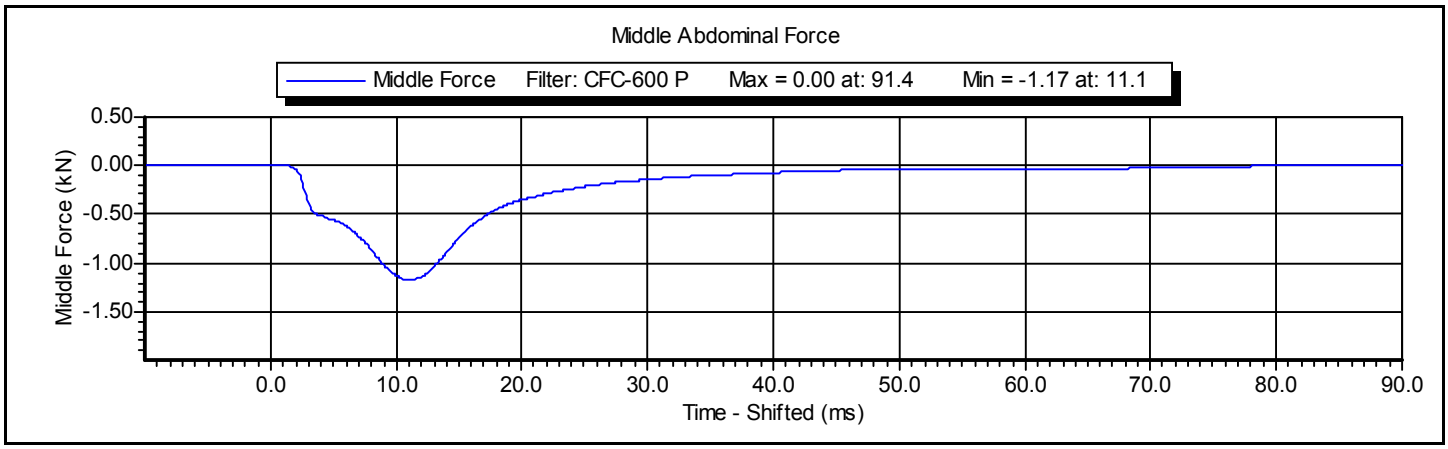
Test Name:	**Abdominal Impact**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Abdomen Test**	Test Date:	**3/18/2010**
Test Number:	**4**	Test Time:	**2:10:14 PM**

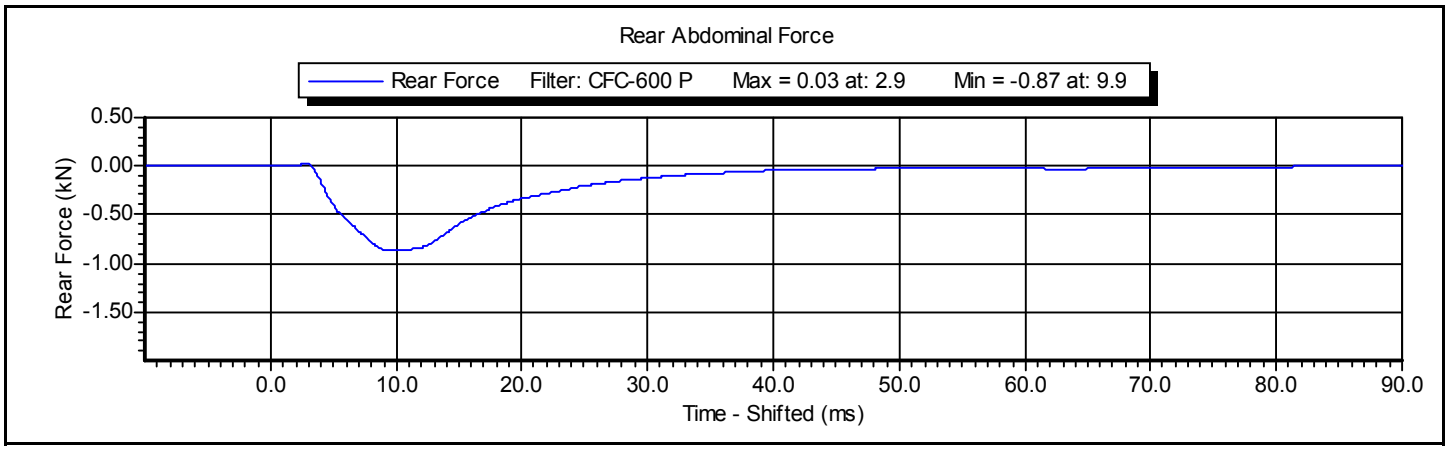
Component Part Number	Component Serial Number
455-4001	**19-179**











Test ID: **Abdomen Test** Test Time: **2:10:14 PM** Test Date: **3/18/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Lumbar Spine**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Lumbar Spine**	Test Date:	**3/24/2010**
Test Number:	**1**	Test Time:	**8:35:31 AM**

Component Part Number	Component Serial Number
175-5501	**15-0376**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**22.2**	deg C	P
Humidity	10	--	70	**25**	%RH	P
Velocity	5.95	--	6.15	**6.13**	m/s	P
Maximum Headform Flexion Angle	45.0	--	55.0	**47.5**	degrees	P
Time at Maximum Headform Flexion Angle	39.0	--	53.0	**43.5**	ms	P
Decay to Zero Degrees	37.0	--	57.0	**38.8**	ms	P
Velocity Corridor		--				P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

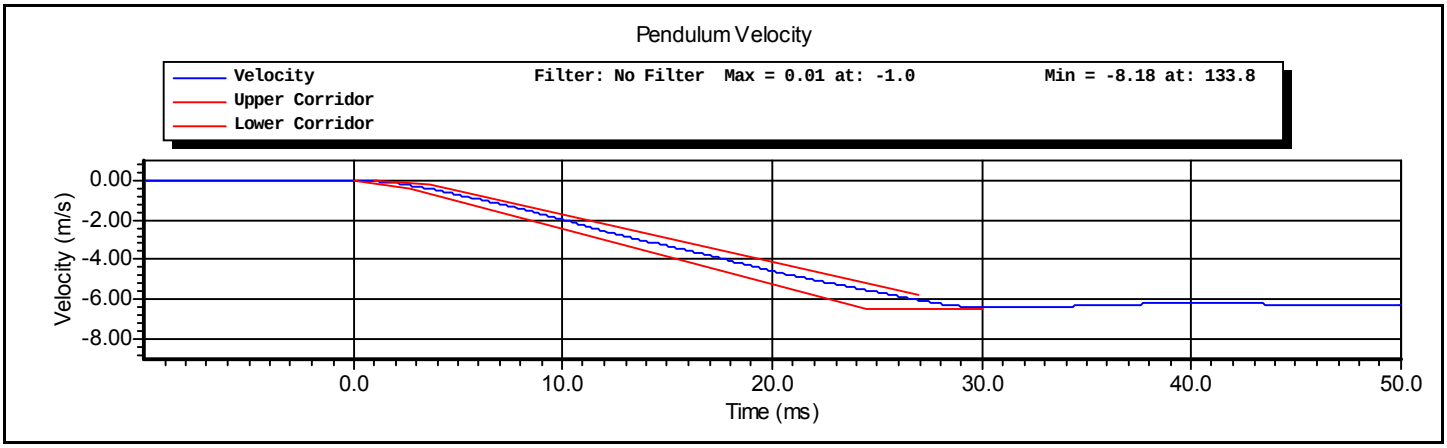
Manufacturer	Model	Serial Number	Calibration Date
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7231CT**	**AF5B3**	**2/24/2010**
DentonATD	**7000428**	**094**	**10/23/2009**
DentonATD	**7000428**	**095**	**10/23/2009**
DentonATD	**7000428**	**093**	**10/23/2009**

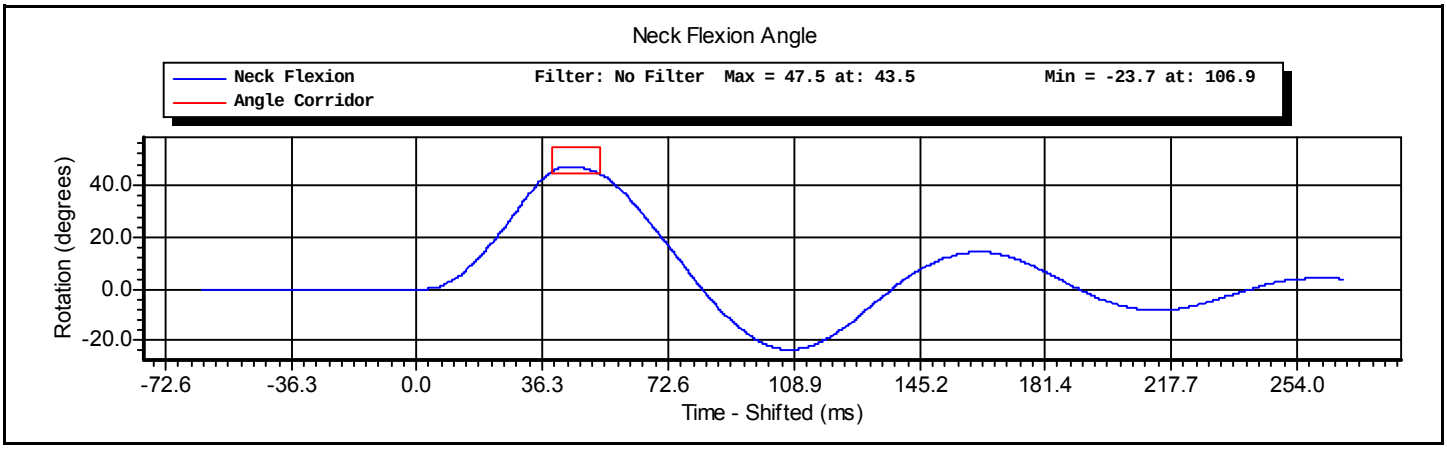
Test ID: **Lumbar Spine** Test Time: **8:35:31 AM** Test Date: **3/24/2010**

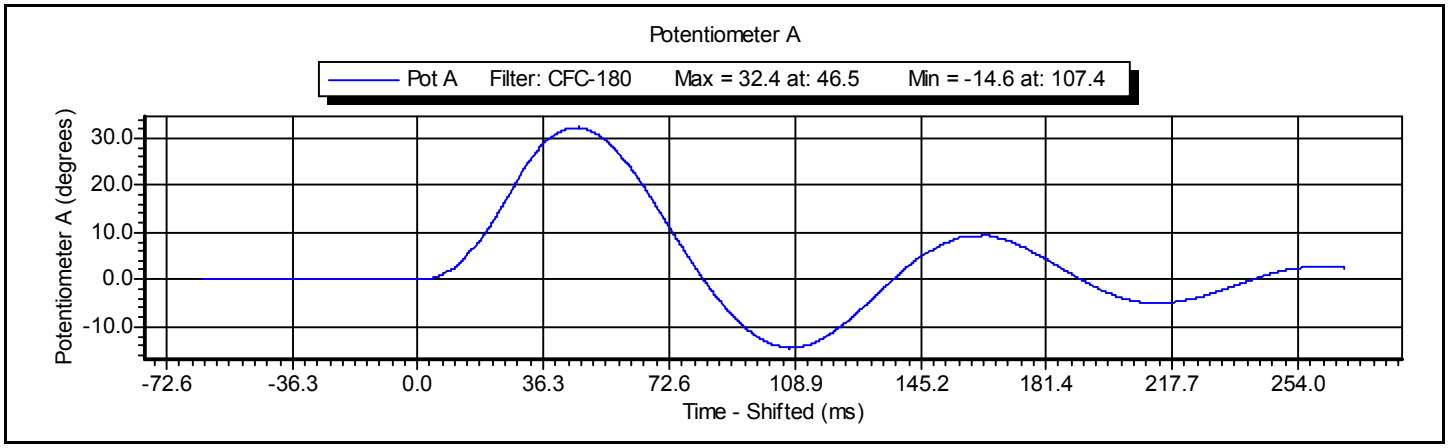
Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

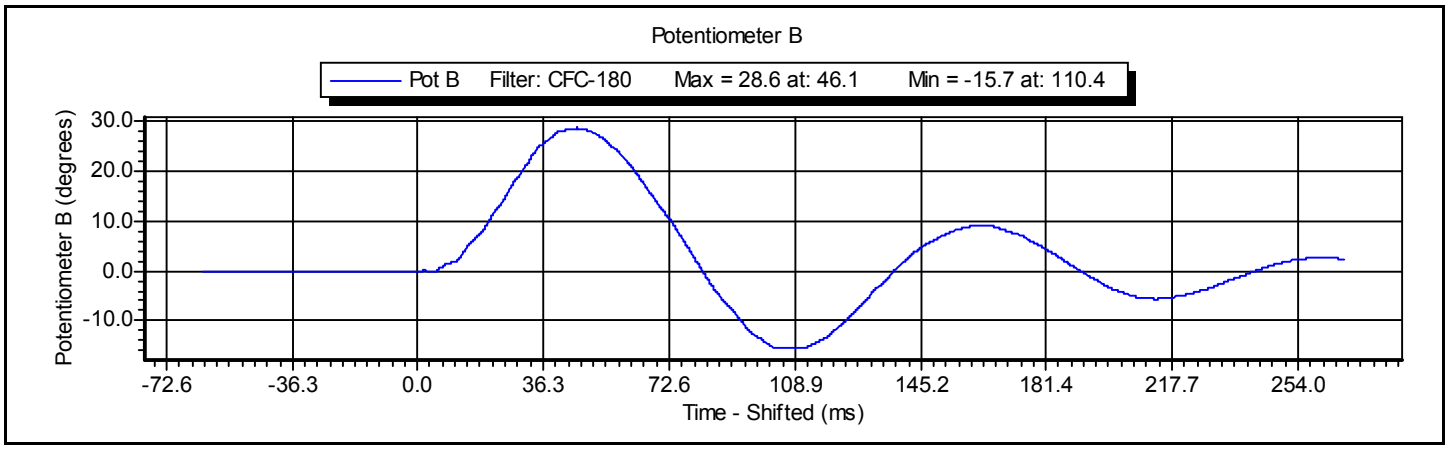
Test Name:	**Lumbar Spine**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Lumbar Spine**	Test Date:	**3/24/2010**
Test Number:	**1**	Test Time:	**8:35:31 AM**

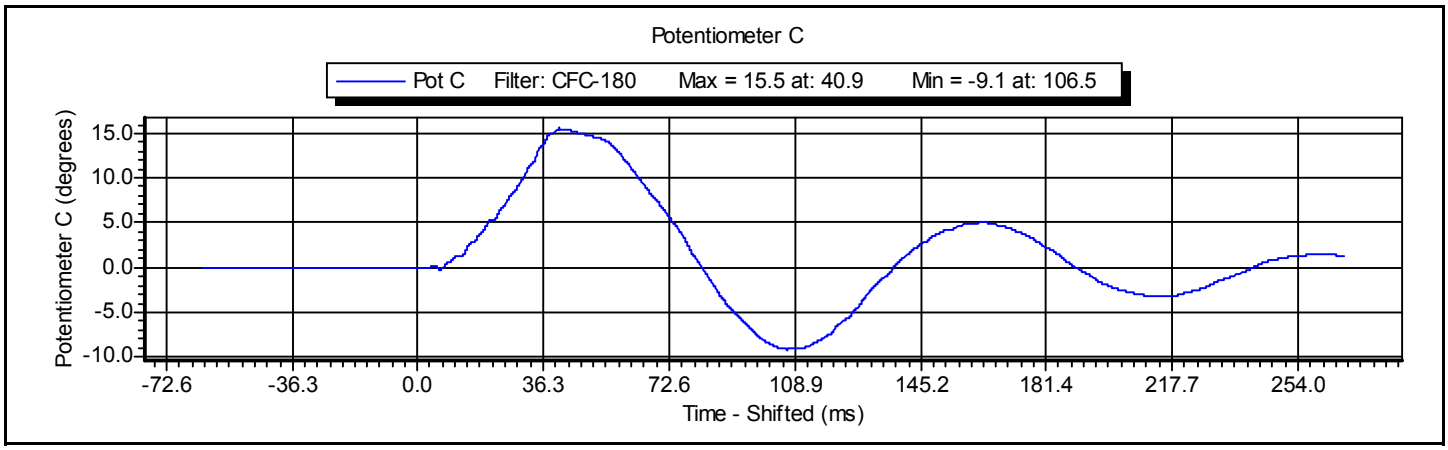
Component Part Number	Component Serial Number
175-5501	**15-0376**











Test ID: **Lumbar Spine** Test Time: **8:35:31 AM** Test Date: **3/24/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Pelvis Impact**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Pelvis Impact**	Test Date:	**3/18/2010**
Test Number:	**1**	Test Time:	**2:23:51 PM**

Component Part Number	Component Serial Number
455-4003	

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**21.1**	deg C	P
Humidity	10	--	70	**38**	%RH	P
Velocity	4.20	--	4.40	**4.29**	m/s	P
Peak Pendulum Force	-5.40	--	-4.70	**-5.05**	kN	P
Time at Peak Pendulum Force	11.80	--	16.10	**13.90**	ms	P
Peak Pubic Symphysis Force	-1.59	--	-1.23	**-1.46**	kN	P
Time at Peak Pubic Symphysis Force	12.20	--	17.00	**14.20**	ms	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

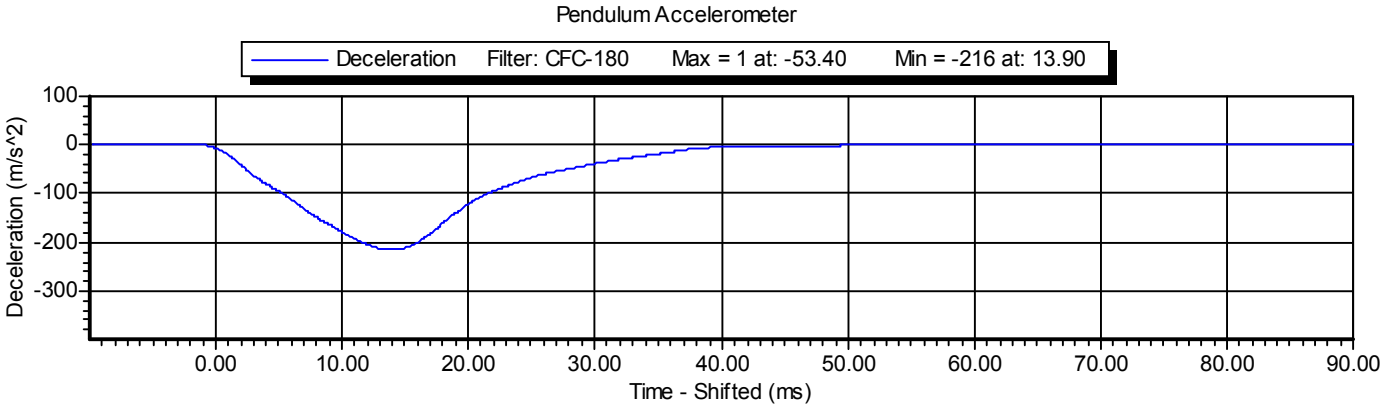
Manufacturer	Model	Serial Number	Calibration Date
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P16576**	**11/4/2009**
Denton	**3096**	**LC-458Fy**	**1/7/2010**

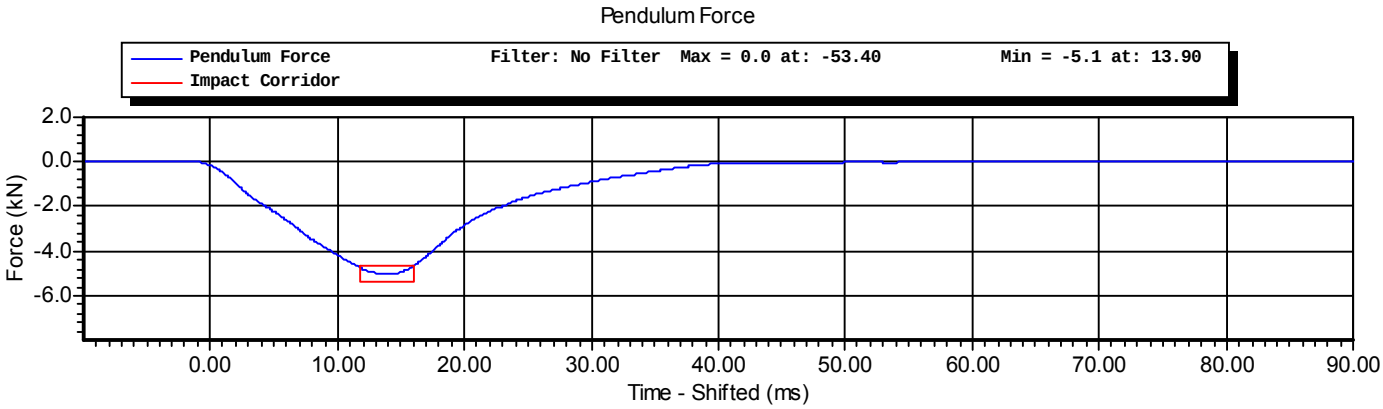
Test ID: **Pelvis Impact** Test Time: **2:23:51 PM** Test Date: **3/18/2010**

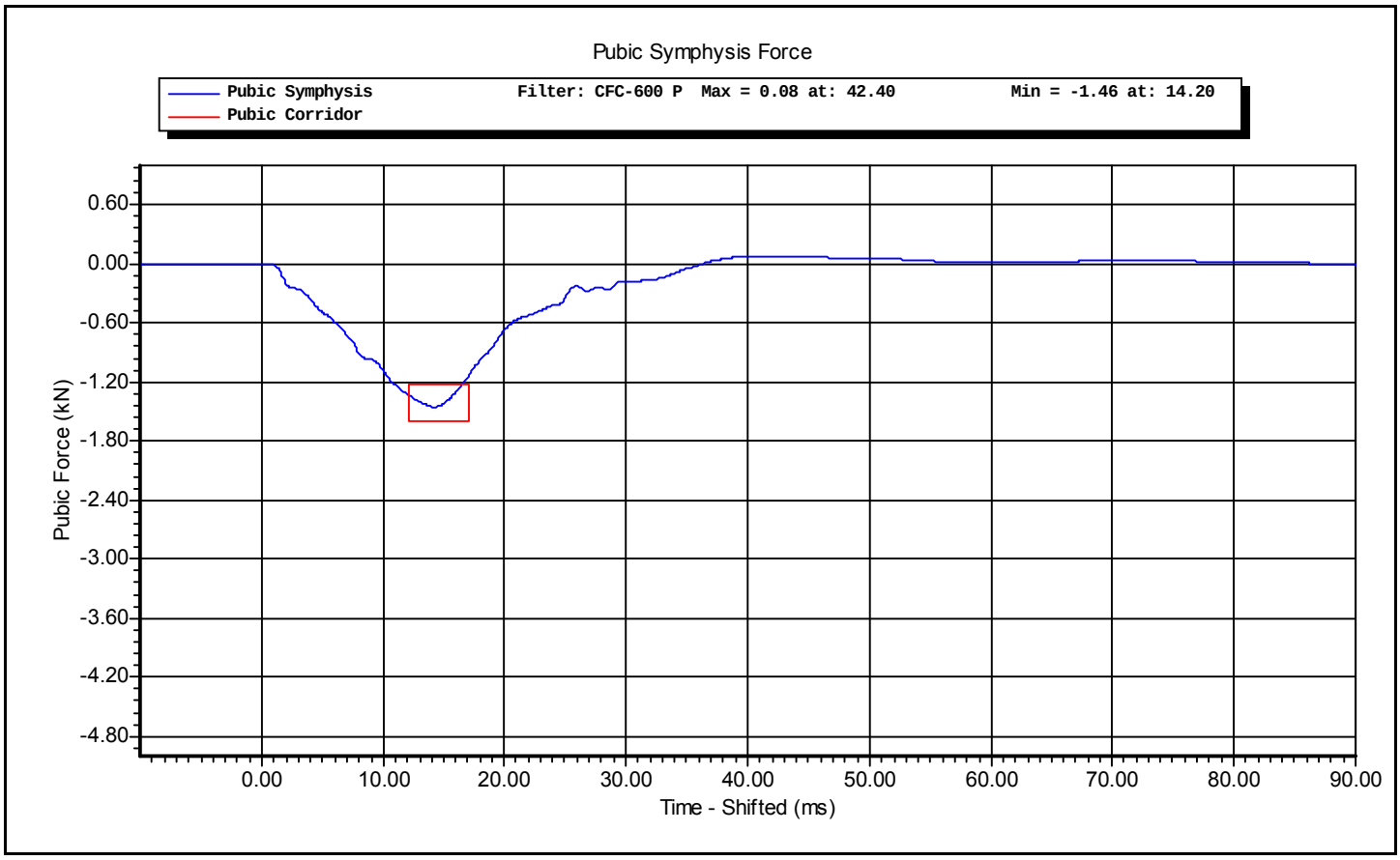
Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

Test Name:	**Pelvis Impact**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Pelvis Impact**	Test Date:	**3/18/2010**
Test Number:	**1**	Test Time:	**2:23:51 PM**

Component Part Number	Component Serial Number
455-4003	







Test ID: **Pelvis Impact** Test Time: **2:23:51 PM** Test Date: **3/18/2010**

POST-TEST

ES2-re S/N: 037

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Head Drop**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Head Drop**	Test Date:	**3/30/2010**
Test Number:	**3**	Test Time:	**4:04:37 PM**

Component Part Number	Component Serial Number
455-1007	

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**22.2**	deg C	P
Humidity	10	--	70	**35**	%RH	P
Resultant Acceleration	125	--	155	**145**	g	P
Oscillation	0.0	--	15.0	**5.3**	%	P
Fore-Aft Acceleration	-15.00	--	15.00	**5.93**	g	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

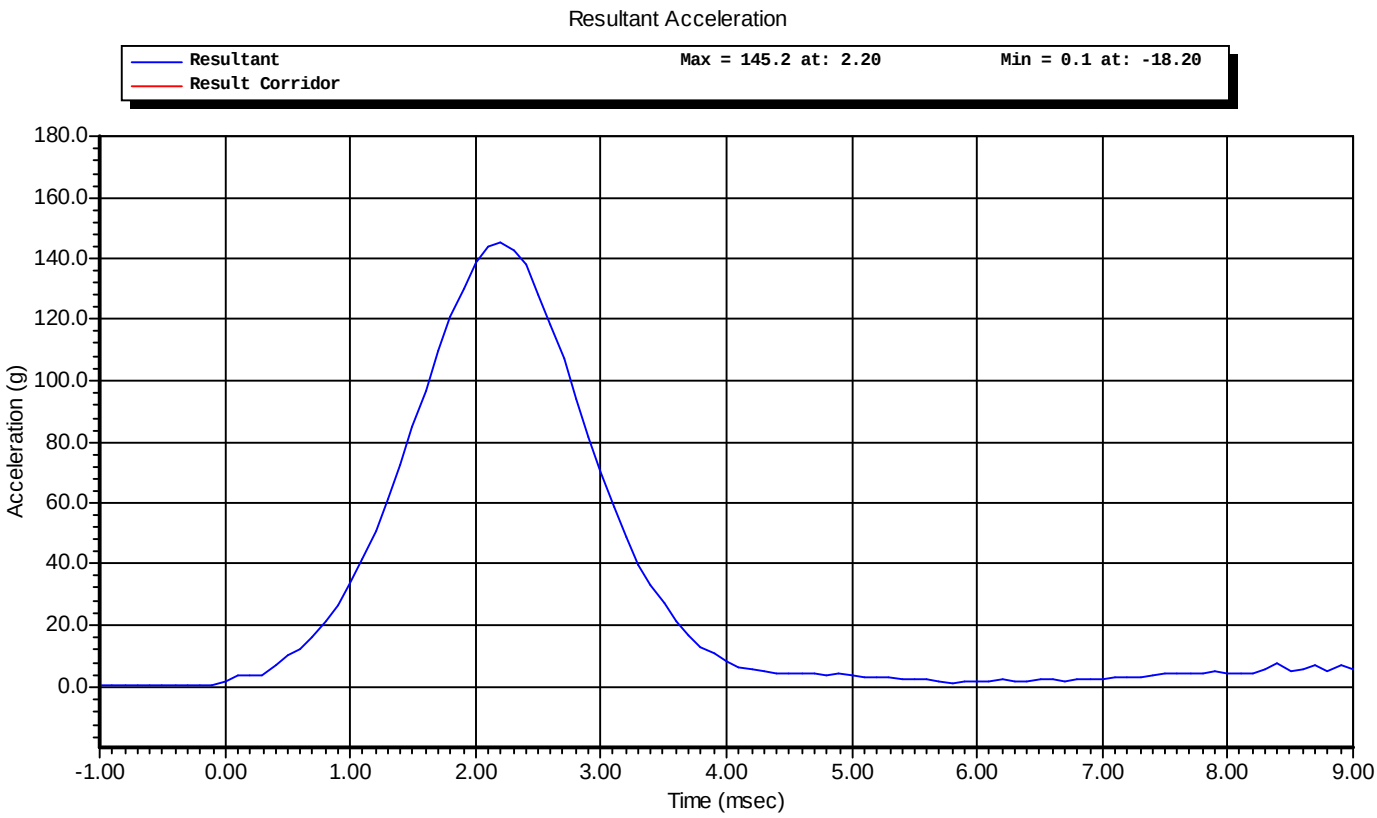
Manufacturer	Model	Serial Number	Calibration Date
Endevco	**7264-2000**	**AC-P18639**	**1/25/2010**
Endevco	**7264-2000**	**AC-P23128**	**1/25/2010**
Endevco	**7264-2000**	**AC-P16591**	**1/25/2010**

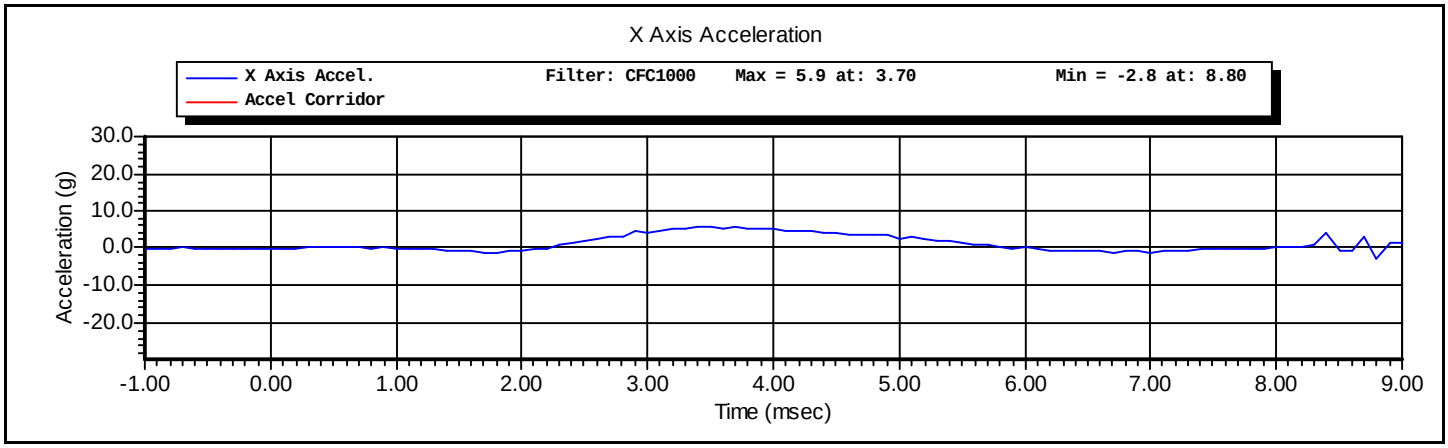
Test ID: **Head Drop** Test Time: **4:04:37 PM** Test Date: **3/30/2010**

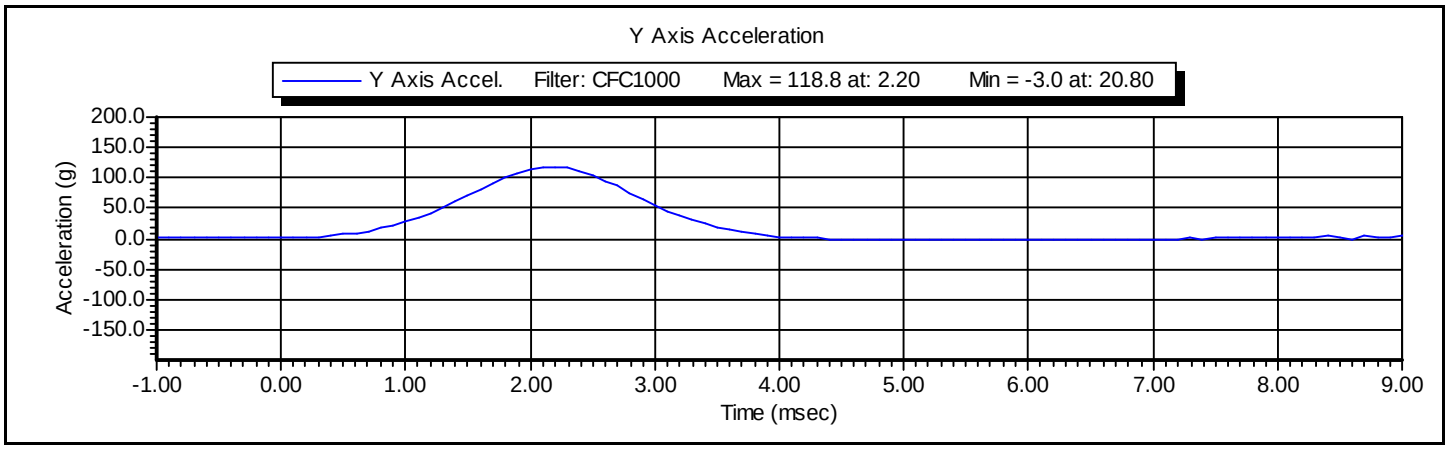
Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

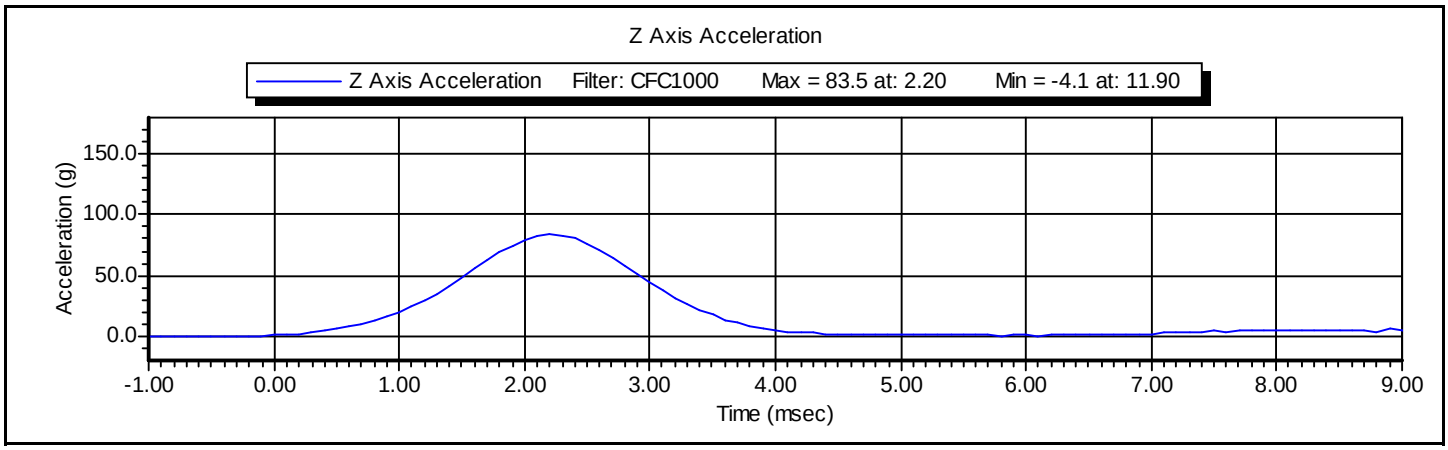
Test Name:	**Head Drop**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Head Drop**	Test Date:	**3/30/2010**
Test Number:	**3**	Test Time:	**4:04:37 PM**

Component Part Number	Component Serial Number
455-1007	









Test ID: **Head Drop** Test Time: **4:04:37 PM** Test Date: **3/30/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Neck Flexion**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Neck Flexion**	Test Date:	**3/29/2010**
Test Number:	**2**	Test Time:	**11:47:30 AM**

Component Part Number	Component Serial Number
455-2002	**19-020118A**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**22.2**	deg C	P
Humidity	10	--	70	**38**	%RH	P
Velocity	3.30	--	3.50	**3.42**	m/s	P
Maximum Neck Flexion Angle	49.0	--	59.0	**54.0**	degrees	P
Time At Maximum Neck Flexion	54.0	--	66.0	**55.8**	ms	P
Decay to Zero Degrees	53.0	--	88.0	**63.3**	ms	P
Velocity Corridor		--				P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

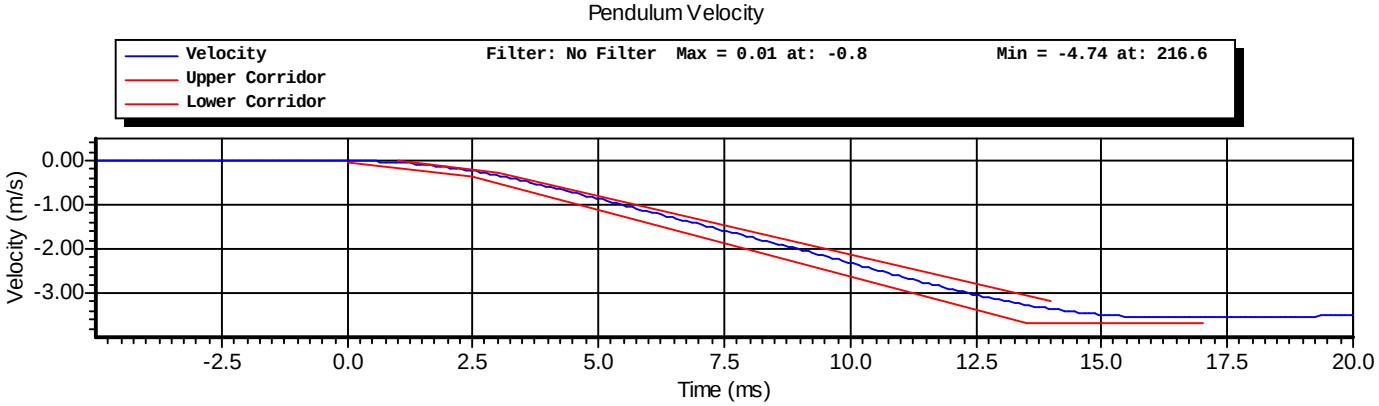
Manufacturer	Model	Serial Number	Calibration Date
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7231CT**	**AF5B3**	**2/24/2010**
DentonATD	**7000428**	**094**	**10/23/2009**
DentonATD	**7000428**	**095**	**10/23/2009**
DentonATD	**7000428**	**093**	**10/23/2009**

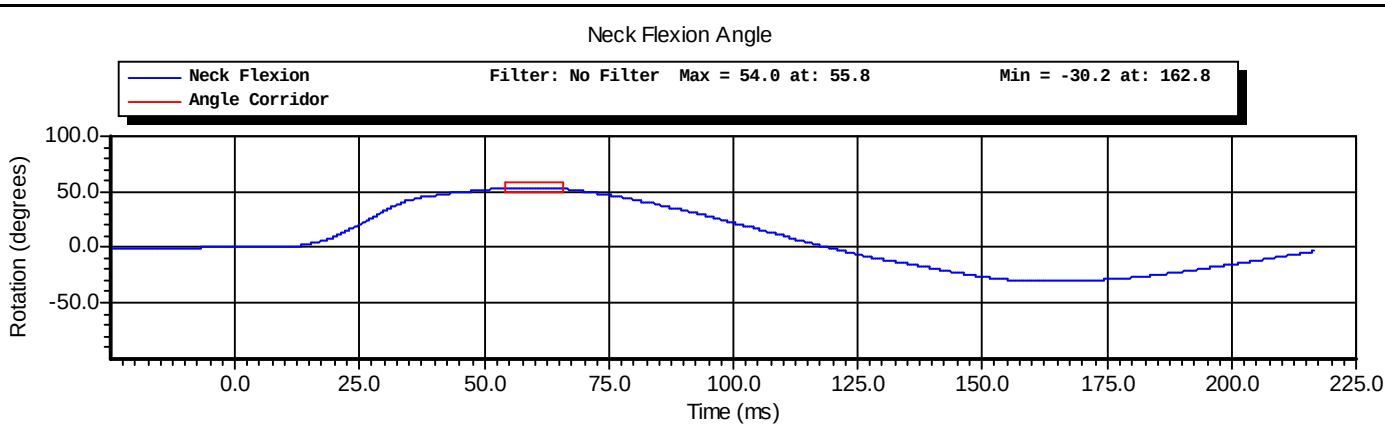
Test ID: **Neck Flexion** Test Time: **11:47:30 AM** Test Date: **3/29/2010**

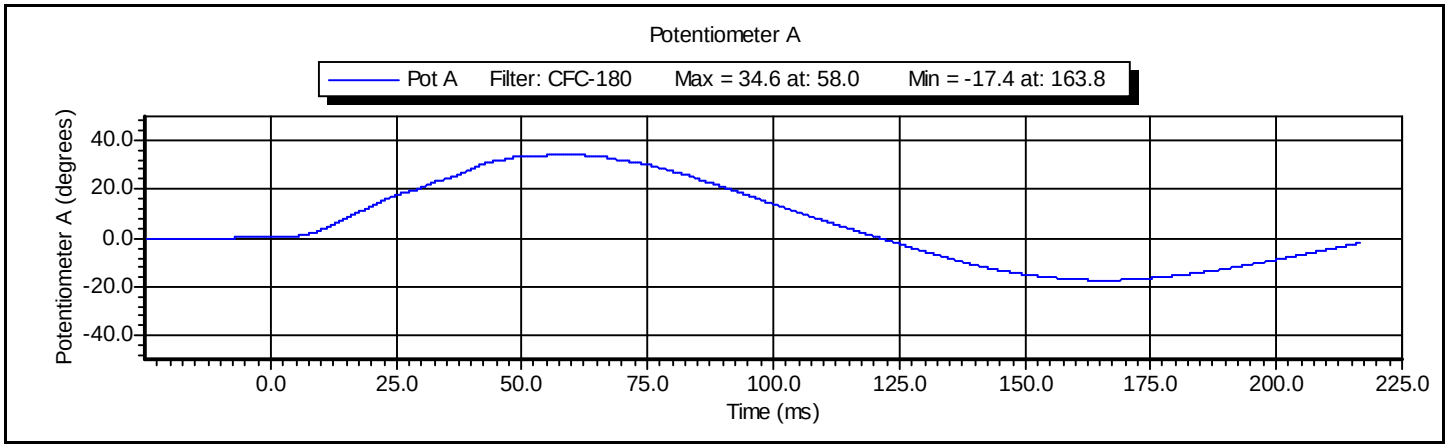
Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

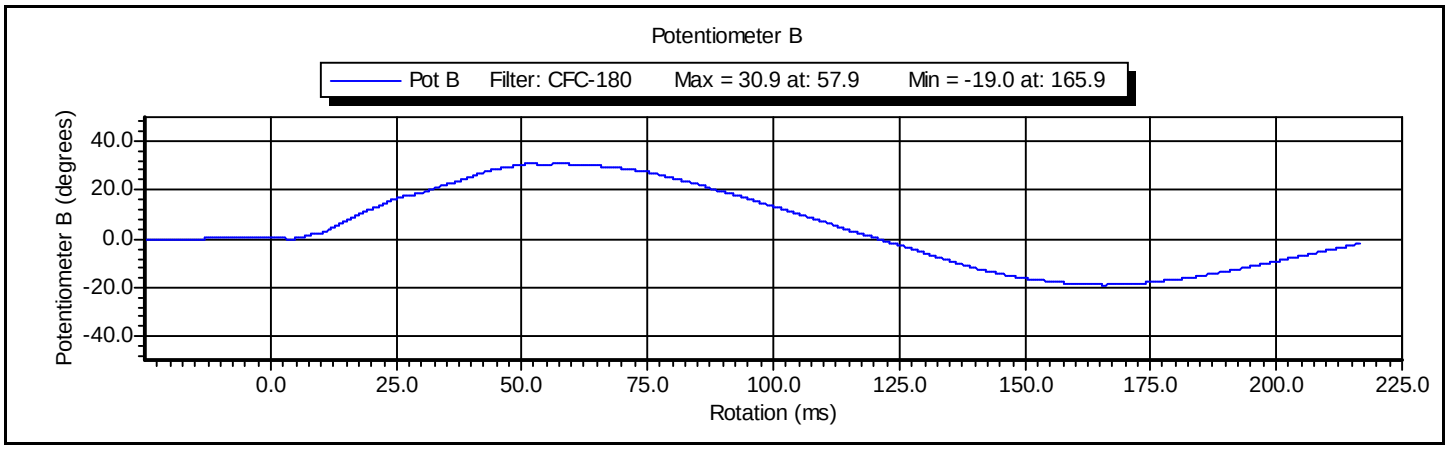
Test Name:	**Neck Flexion**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Neck Flexion**	Test Date:	**3/29/2010**
Test Number:	**2**	Test Time:	**11:47:30 AM**

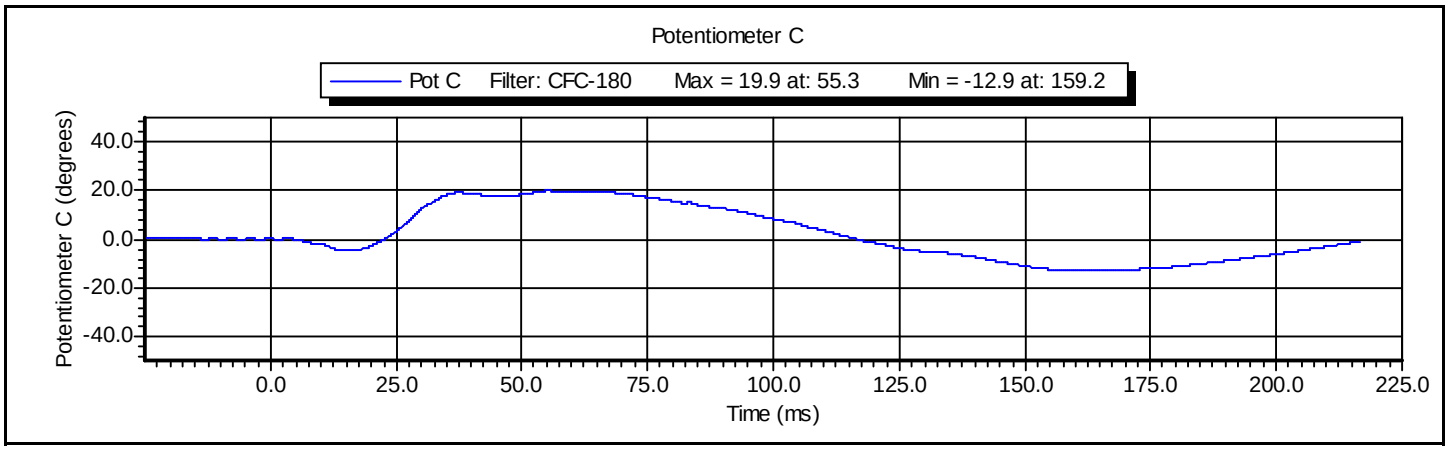
Component Part Number	Component Serial Number
455-2002	**19-020118A**











Test ID: **Neck Flexion** Test Time: **11:47:30 AM** Test Date: **3/29/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Shoulder Impact**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Shoulder Impact**	Test Date:	**3/26/2010**
Test Number:	**1**	Test Time:	**1:42:31 PM**

Component Part Number	Component Serial Number
960715-313	

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**21.7**	deg C	P
Humidity	10.0	--	70.0	**22.0**	%RH	P
Velocity	4.20	--	4.40	**4.29**	m/s	P
Pendulum Acceleration	-10.50	--	-7.50	**-8.04**	g	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

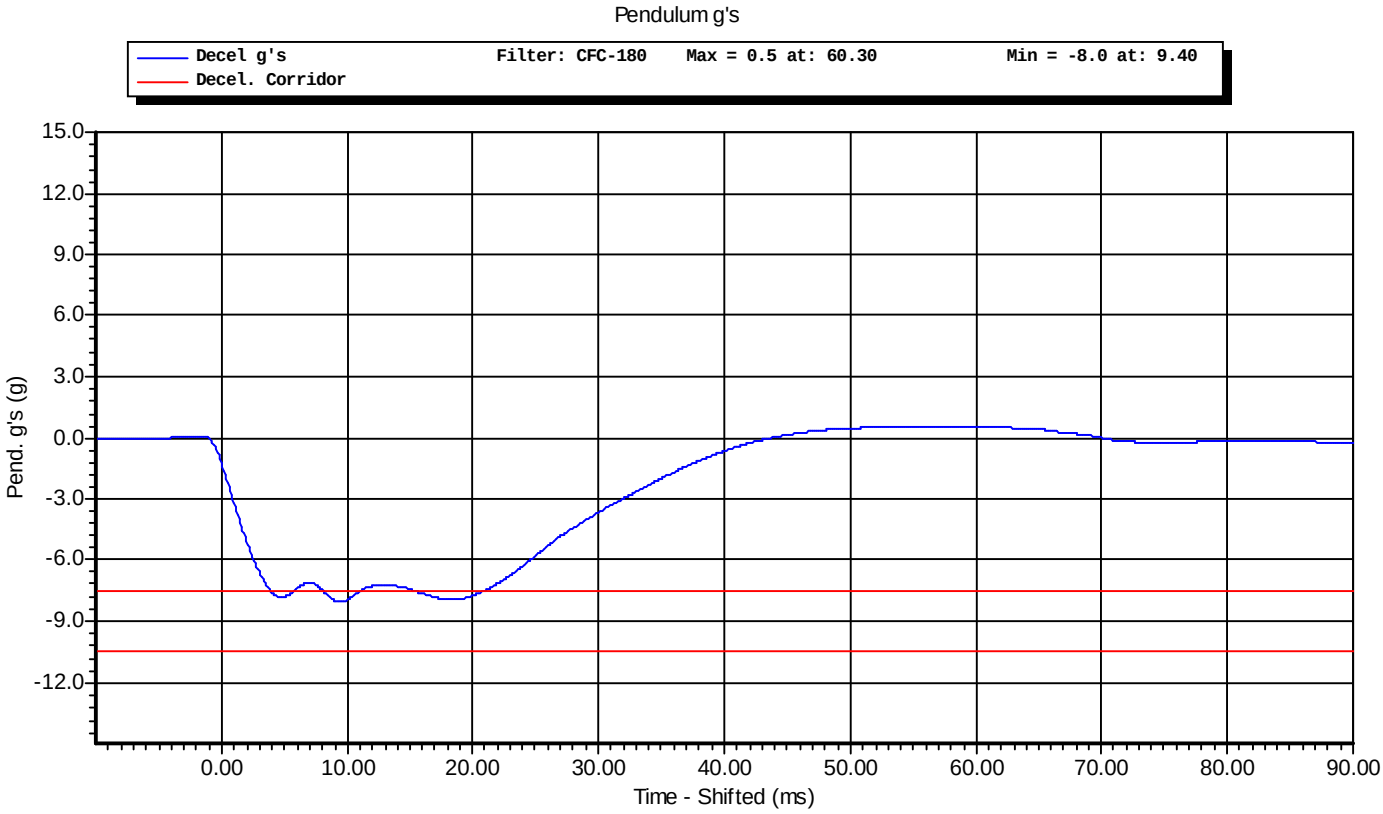
Manufacturer	Model	Serial Number	Calibration Date
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P16576**	**11/4/2009**

Test ID: **Shoulder Impact** Test Time: **1:42:31 PM** Test Date: **3/26/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

Test Name:	**Shoulder Impact**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Shoulder Impact**	Test Date:	**3/26/2010**
Test Number:	**1**	Test Time:	**1:42:31 PM**

Component Part Number	Component Serial Number
960715-313	



Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**3.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Lower Rib 3 m/s**	Test Date:	**3/26/2010**
Test Number:	**1**	Test Time:	**3:07:43 PM**

Component Part Number	Component Serial Number
455-3100	**1954-0126A**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**21.7**	deg C	P
Humidity	10.0	--	70.0	**26.0**	%RH	P
Velocity	2.90	--	3.10	**2.98**	m/s	P
Rib Displacement	-40.00	--	-36.00	**-38.21**	mm	P
Drop Height	454	--	464	**459**	mm	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

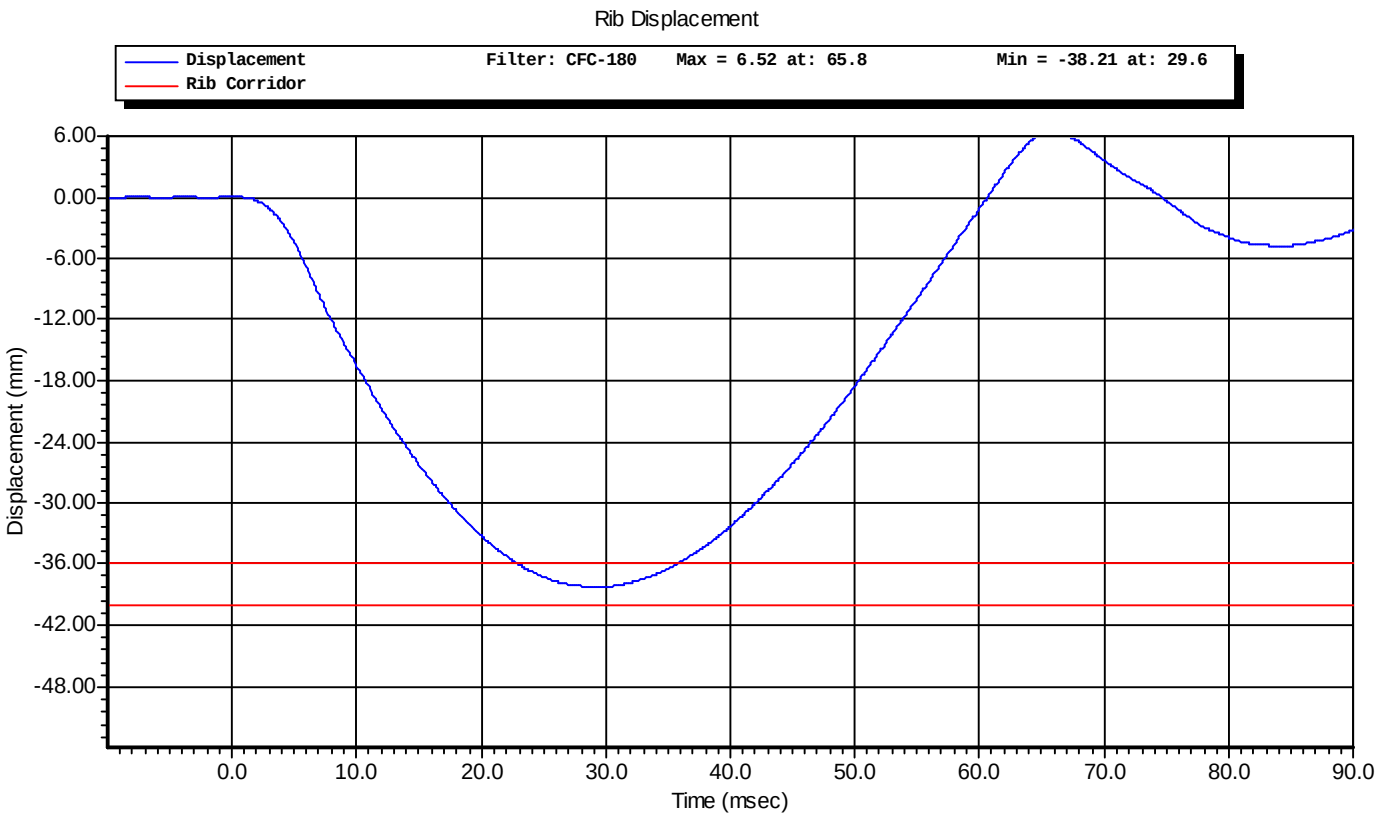
Manufacturer	Model	Serial Number	Calibration Date
Honeywell	**MLT-38000**	**DS-0552-3**	**1/11/2010**
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P23137**	**1/22/2010**

Test ID: **Lower Rib 3 m/s** Test Time: **3:07:43 PM** Test Date: **3/26/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**3.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Lower Rib 3 m/s**	Test Date:	**3/26/2010**
Test Number:	**1**	Test Time:	**3:07:43 PM**

Component Part Number	Component Serial Number
455-3100	**1954-0126A**



Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**4.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Lower Rib 4 m/s**	Test Date:	**3/26/2010**
Test Number:	**1**	Test Time:	**3:14:46 PM**

Component Part Number	Component Serial Number
455-3100	**1954-0126A**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**21.7**	deg C	P
Humidity	10.0	--	70.0	**26.0**	%RH	P
Velocity	3.90	--	4.10	**3.98**	m/s	P
Rib Displacement	-51.00	--	-46.00	**-47.29**	mm	P
Drop Height	807.0	--	823.0	**815.0**	mm	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

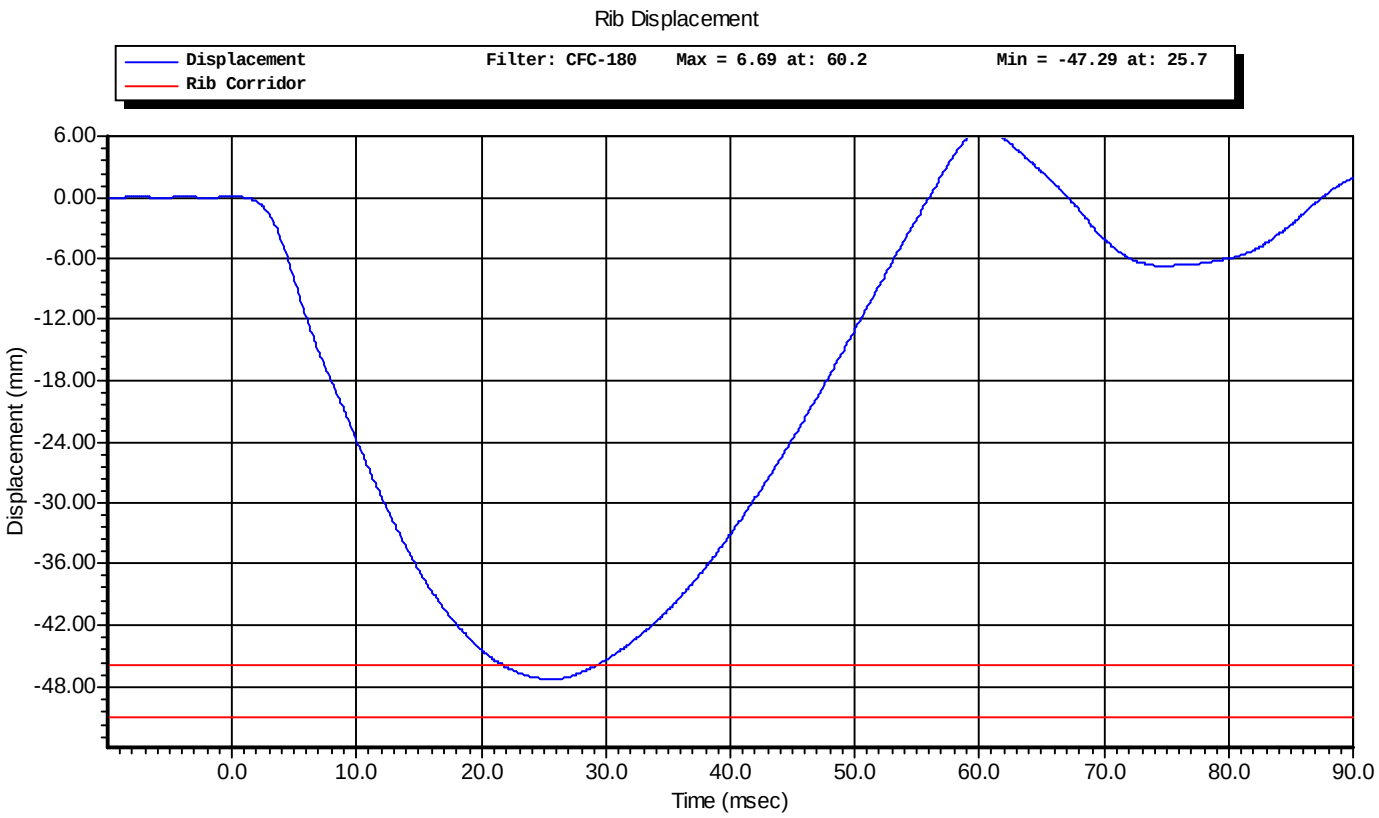
Manufacturer	Model	Serial Number	Calibration Date
Honeywell	**MLT-38000**	**DS-0552-3**	**1/11/2010**
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P23137**	**1/22/2010**

Test ID: **Lower Rib 4 m/s** Test Time: **3:14:46 PM** Test Date: **3/26/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**4.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Lower Rib 4 m/s**	Test Date:	**3/26/2010**
Test Number:	**1**	Test Time:	**3:14:46 PM**

Component Part Number	Component Serial Number
455-3100	**1954-0126A**



Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**3.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Middle Rib 3 m/s**	Test Date:	**3/26/2010**
Test Number:	**1**	Test Time:	**2:47:09 PM**

Component Part Number	Component Serial Number
455-3100	**1954-0125A**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**21.7**	deg C	P
Humidity	10.0	--	70.0	**26.0**	%RH	P
Velocity	2.90	--	3.10	**2.97**	m/s	P
Rib Displacement	-40.00	--	-36.00	**-37.75**	mm	P
Drop Height	454	--	464	**459**	mm	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

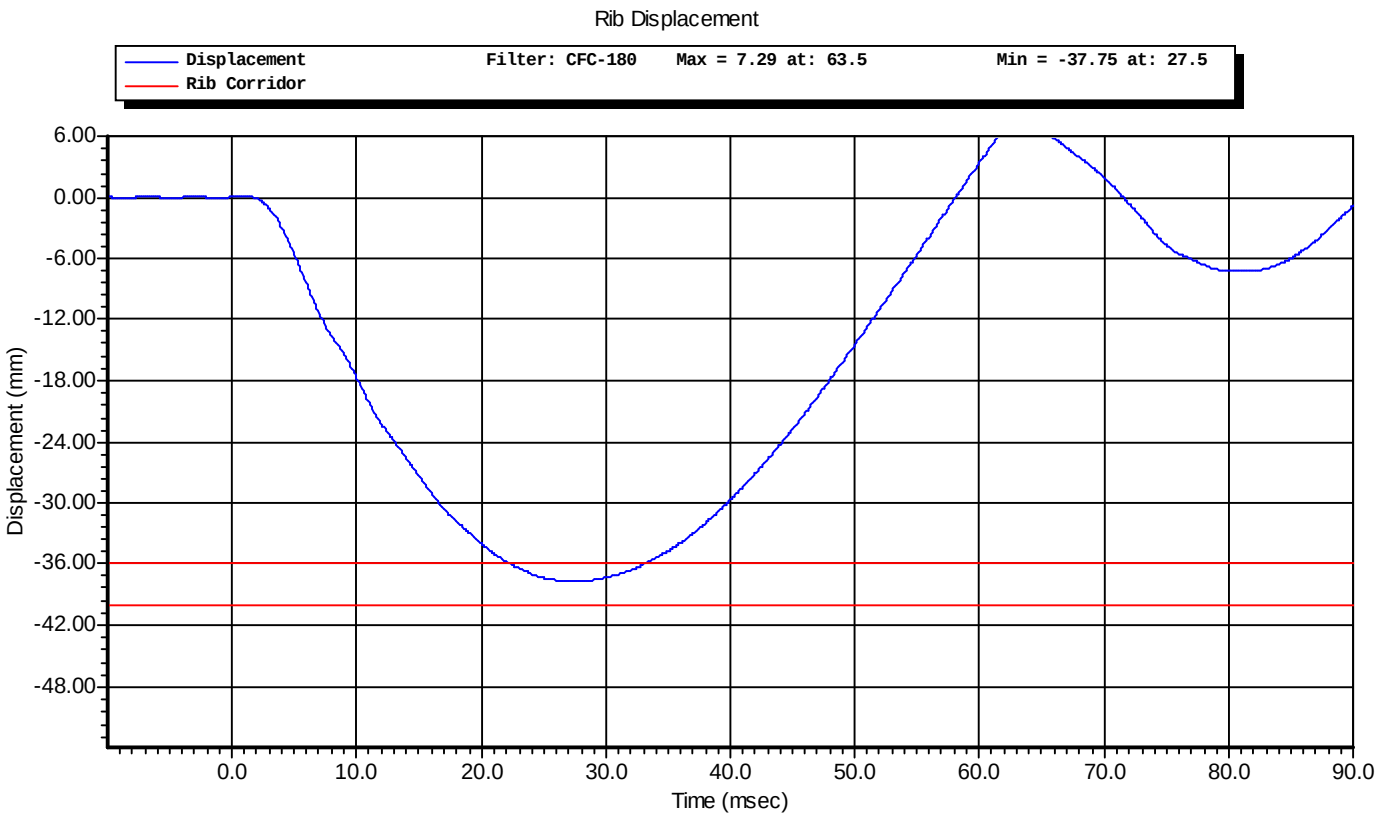
Manufacturer	Model	Serial Number	Calibration Date
Honeywell	**MLT-38000**	**DS-0807**	**1/11/2010**
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P23137**	**1/22/2010**

Test ID: **Middle Rib 3 m/s** Test Time: **2:47:09 PM** Test Date: **3/26/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**3.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Middle Rib 3 m/s**	Test Date:	**3/26/2010**
Test Number:	**1**	Test Time:	**2:47:09 PM**

Component Part Number	Component Serial Number
455-3100	**1954-0125A**



Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**4.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Middle Rib 4 m/s**	Test Date:	**3/26/2010**
Test Number:	**1**	Test Time:	**2:56:00 PM**

Component Part Number	Component Serial Number
455-3100	**1954-0125A**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**21.7**	deg C	P
Humidity	10.0	--	70.0	**26.0**	%RH	P
Velocity	3.90	--	4.10	**3.99**	m/s	P
Rib Displacement	-51.00	--	-46.00	**-47.45**	mm	P
Drop Height	807.0	--	823.0	**815.0**	mm	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

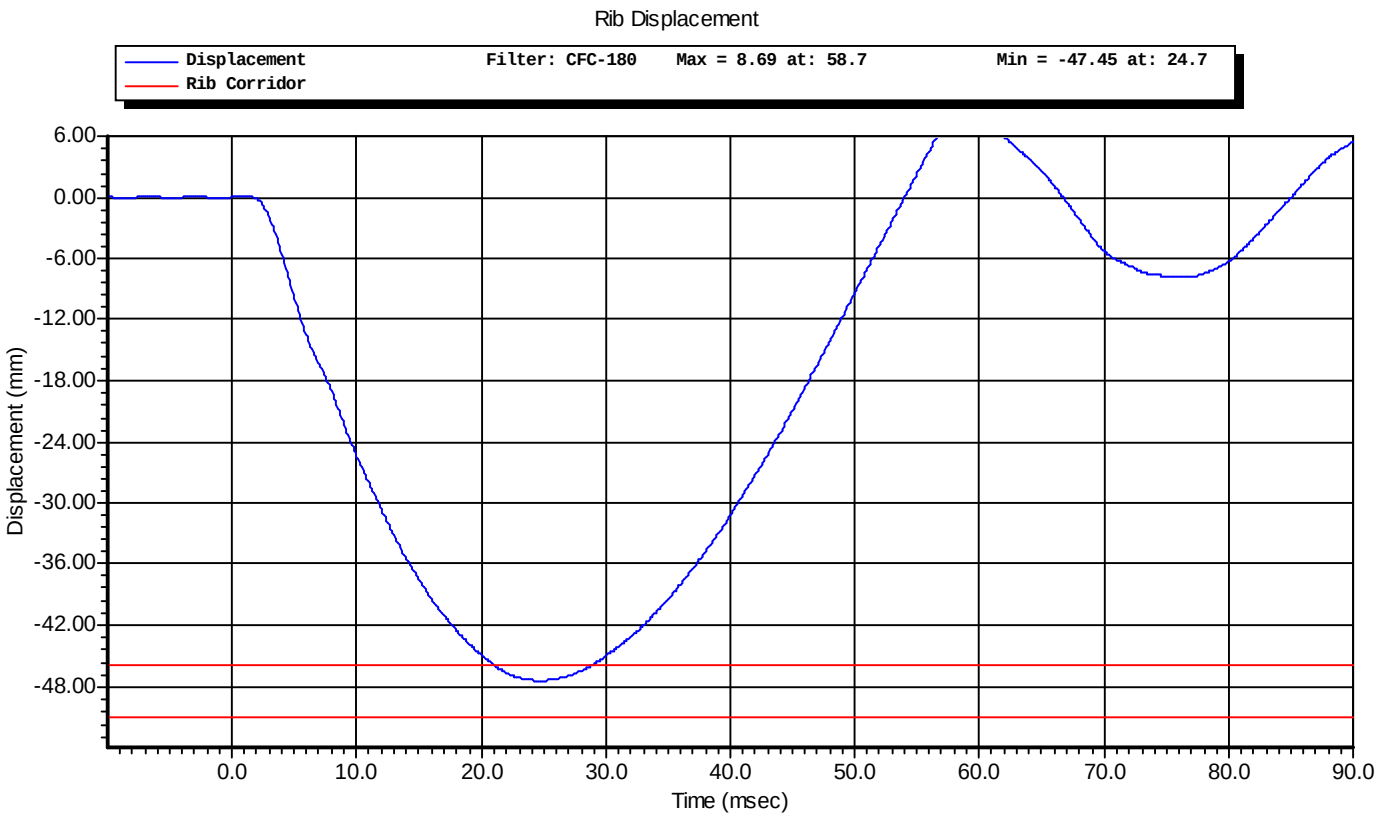
Manufacturer	Model	Serial Number	Calibration Date
Honeywell	**MLT-38000**	**DS-0807**	**1/11/2010**
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P23137**	**1/22/2010**

Test ID: **Middle Rib 4 m/s** Test Time: **2:56:00 PM** Test Date: **3/26/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**4.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Middle Rib 4 m/s**	Test Date:	**3/26/2010**
Test Number:	**1**	Test Time:	**2:56:00 PM**

Component Part Number	Component Serial Number
455-3100	**1954-0125A**



Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**3.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Upper Rib 3 m/s**	Test Date:	**3/26/2010**
Test Number:	**1**	Test Time:	**2:25:49 PM**

Component Part Number	Component Serial Number
455-3100	**1954-0124A**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**21.7**	deg C	P
Humidity	10.0	--	70.0	**26.0**	%RH	P
Velocity	2.90	--	3.10	**2.98**	m/s	P
Rib Displacement	-40.00	--	-36.00	**-38.65**	mm	P
Drop Height	454	--	464	**459**	mm	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

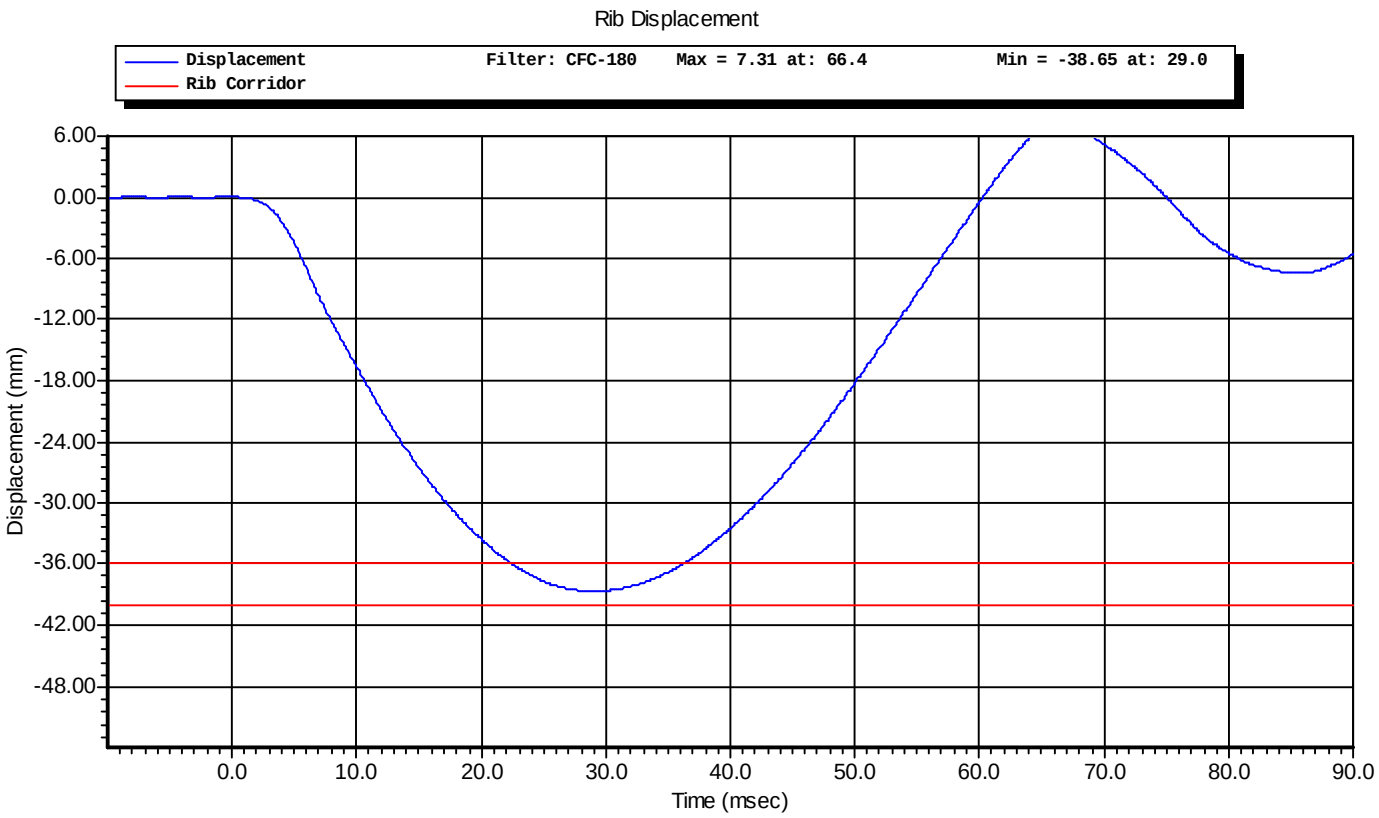
Manufacturer	Model	Serial Number	Calibration Date
Honeywell	**MLT-38000**	**DS-0552-01**	**1/11/2010**
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P23137**	**1/22/2010**

Test ID: **Upper Rib 3 m/s** Test Time: **2:25:49 PM** Test Date: **3/26/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**3.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Upper Rib 3 m/s**	Test Date:	**3/26/2010**
Test Number:	**1**	Test Time:	**2:25:49 PM**

Component Part Number	Component Serial Number
455-3100	**1954-0124A**



Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**4.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Upper Rib 4 m/s**	Test Date:	**3/26/2010**
Test Number:	**1**	Test Time:	**2:33:28 PM**

Component Part Number	Component Serial Number
455-3100	**1954-0124A**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**21.7**	deg C	P
Humidity	10.0	--	70.0	**26.0**	%RH	P
Velocity	3.90	--	4.10	**3.99**	m/s	P
Rib Displacement	-51.00	--	-46.00	**-49.29**	mm	P
Drop Height	807.0	--	823.0	**815.0**	mm	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

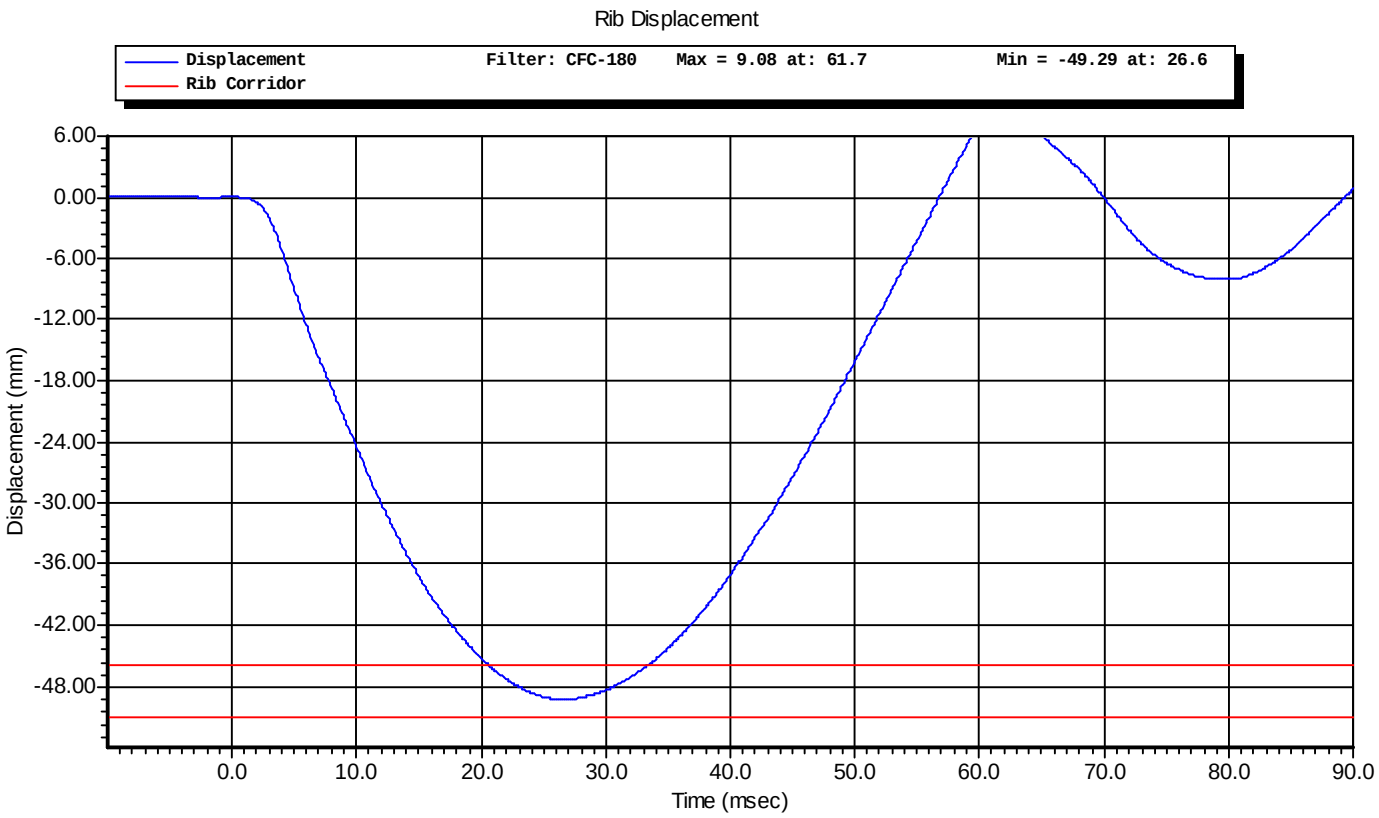
Manufacturer	Model	Serial Number	Calibration Date
Honeywell	**MLT-38000**	**DS-0552-01**	**1/11/2010**
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P23137**	**1/22/2010**

Test ID: **Upper Rib 4 m/s** Test Time: **2:33:28 PM** Test Date: **3/26/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

Test Name:	**Full Rib Module Impact**	Revision:	**12/14/2006**
Sub Test Name:	**4.0 Meters/Second**	Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Upper Rib 4 m/s**	Test Date:	**3/26/2010**
Test Number:	**1**	Test Time:	**2:33:28 PM**

Component Part Number	Component Serial Number
455-3100	**1954-0124A**



Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Thorax Impact**	Revision:	**8/15/2008**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Thorax Impact**	Test Date:	**3/26/2010**
Test Number:	**1**	Test Time:	**3:51:07 PM**

Component Part Number	Component Serial Number
Upper Rib - 175-4002	**1954-0124A**
Middle Rib - 175-4002	**1954-0125A**
Lower Rib - 175-4002	**1954-0126A**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**21.7**	deg C	P
Humidity	10.0	--	70.0	**27.0**	%RH	P
Velocity	5.40	--	5.60	**5.50**	m/s	P
Upper Rib Displacement	34.0	--	41.0	**36.6**	mm	P
Middle Rib Displacement	37.0	--	45.0	**41.1**	mm	P
Lower Rib Displacement	37.0	--	44.0	**42.3**	mm	P
Impactor Force	5100	--	6200	**5720**	N	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

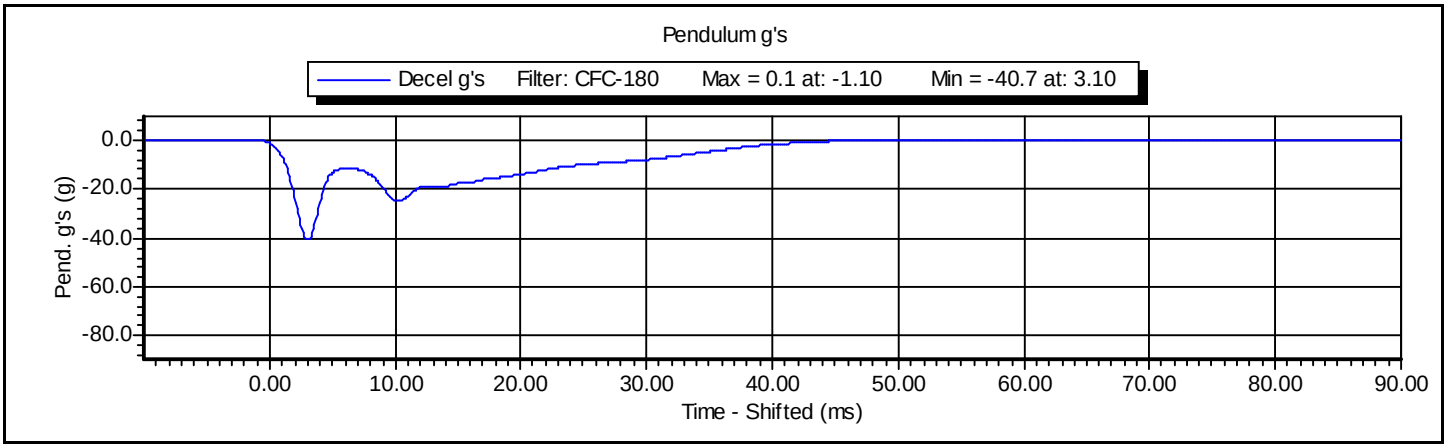
Manufacturer	Model	Serial Number	Calibration Date
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P16576**	**11/4/2009**
Honeywell	**MLT-38000**	**DS-0552-01**	**1/11/2010**
Honeywell	**MLT-38000**	**DS-0807**	**1/11/2010**
Honeywell	**MLT-38000**	**DS-0552-3**	**1/11/2010**

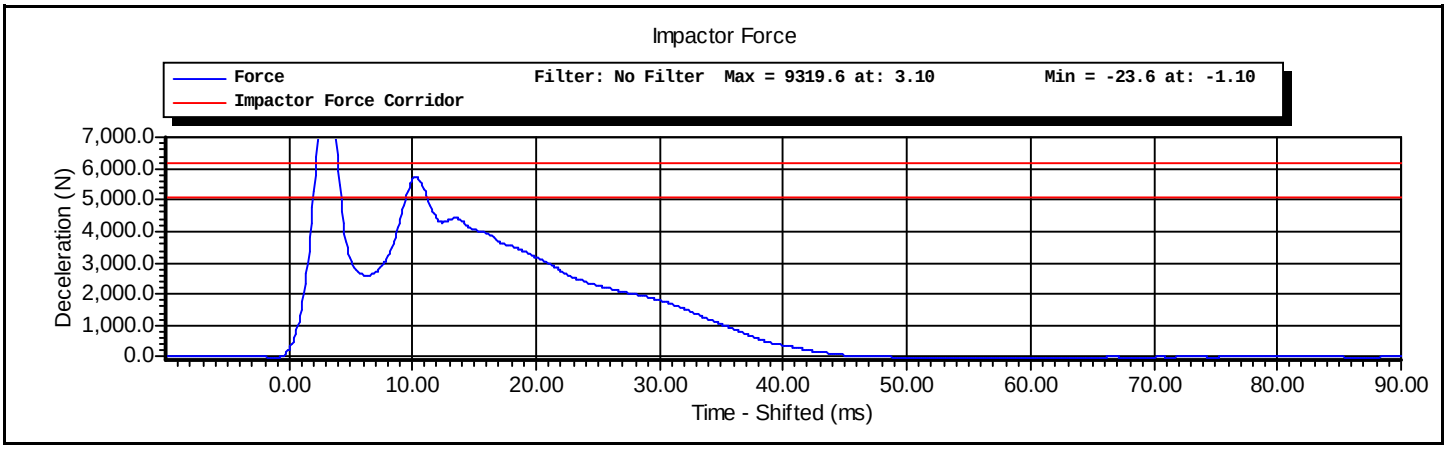
Test ID: **Thorax Impact** Test Time: **3:51:07 PM** Test Date: **3/26/2010**

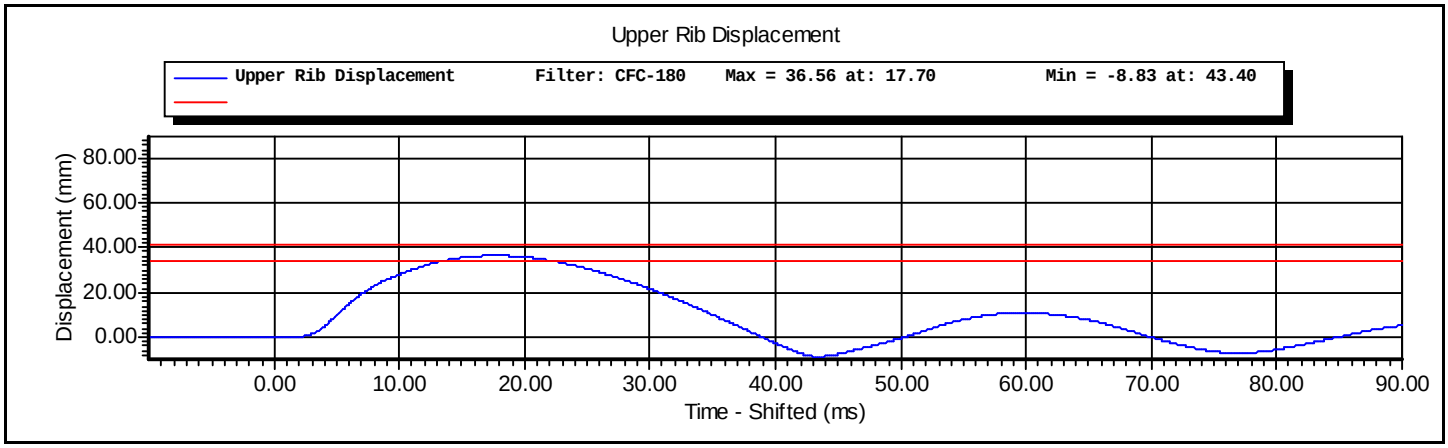
Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

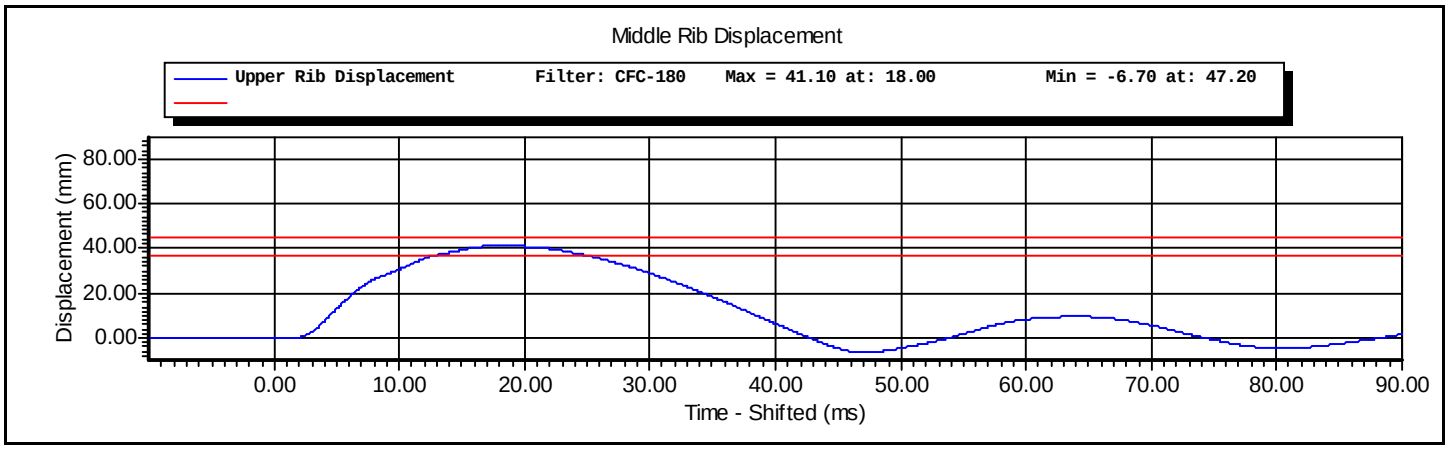
Test Name:	**Thorax Impact**	Revision:	**8/15/2008**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Thorax Impact**	Test Date:	**3/26/2010**
Test Number:	**1**	Test Time:	**3:51:07 PM**

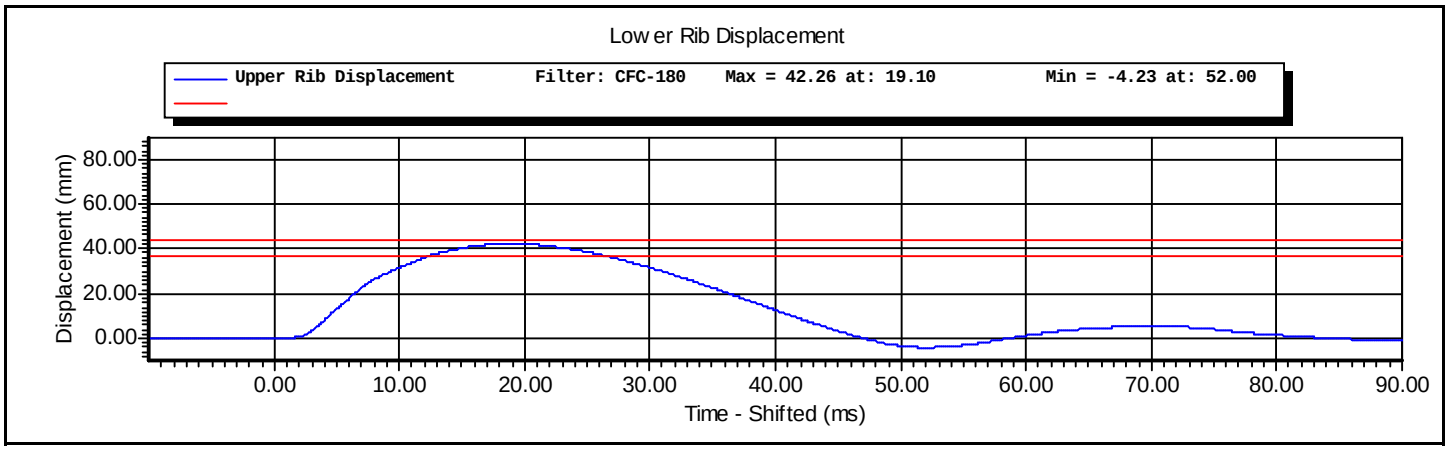
Component Part Number	Component Serial Number
Upper Rib - 175-4002	**1954-0124A**











Test ID: **Thorax Impact** Test Time: **3:51:07 PM** Test Date: **3/26/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Abdominal Impact**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Abdominal Test**	Test Date:	**3/26/2010**
Test Number:	**2**	Test Time:	**11:58:29 AM**

Component Part Number	Component Serial Number
455-4001	**19-179**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**21.7**	deg C	P
Humidity	10	--	70	**21**	%RH	P
Velocity	3.90	--	4.10	**3.92**	m/s	P
Peak Abdominal Force	-2.70	--	-2.20	**-2.49**	kN	P
Time At Peak Abdominal Force	10.0	--	12.3	**11.1**	ms	P
Maximum Pendulum Force	-4.80	--	-4.00	**-4.80**	kN	P
Time at Peak Pendumlum Force	10.6	--	13.0	**10.7**	ms	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

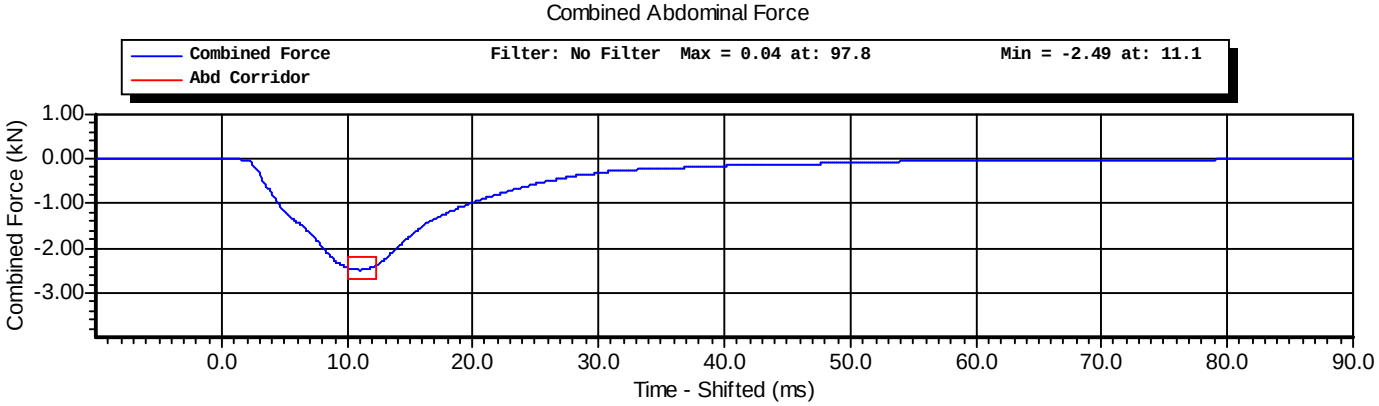
Manufacturer	Model	Serial Number	Calibration Date
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P16576**	**11/4/2009**
Denton	**2631**	**LC-1507Fy**	**1/7/2010**
Denton	**2631**	**LC-1508Fy**	**1/7/2010**
Denton	**2631**	**LC-1509Fy**	**1/7/2010**

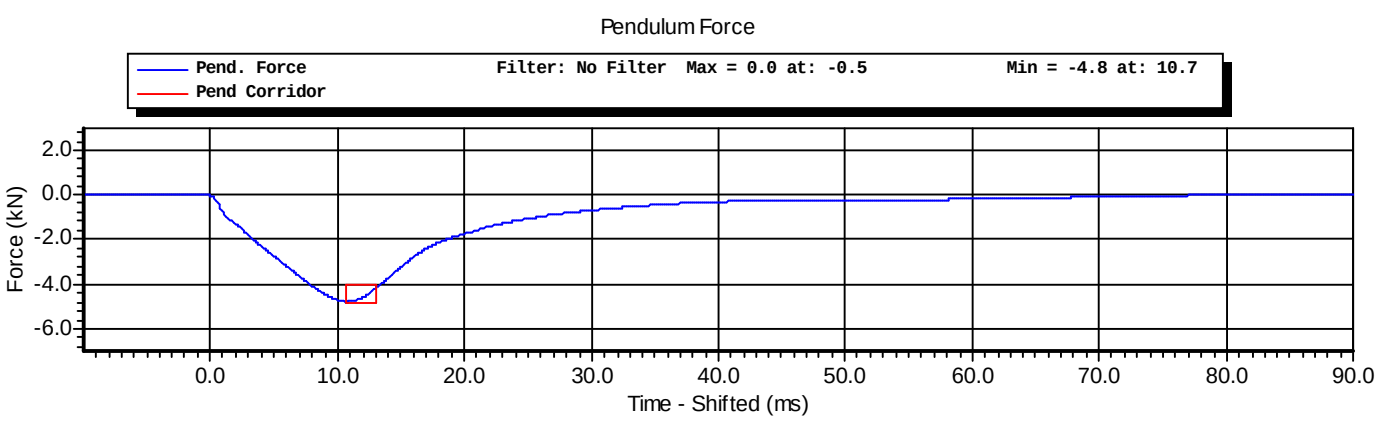
Test ID: **Abdominal Test** Test Time: **11:58:29 AM** Test Date: **3/26/2010**

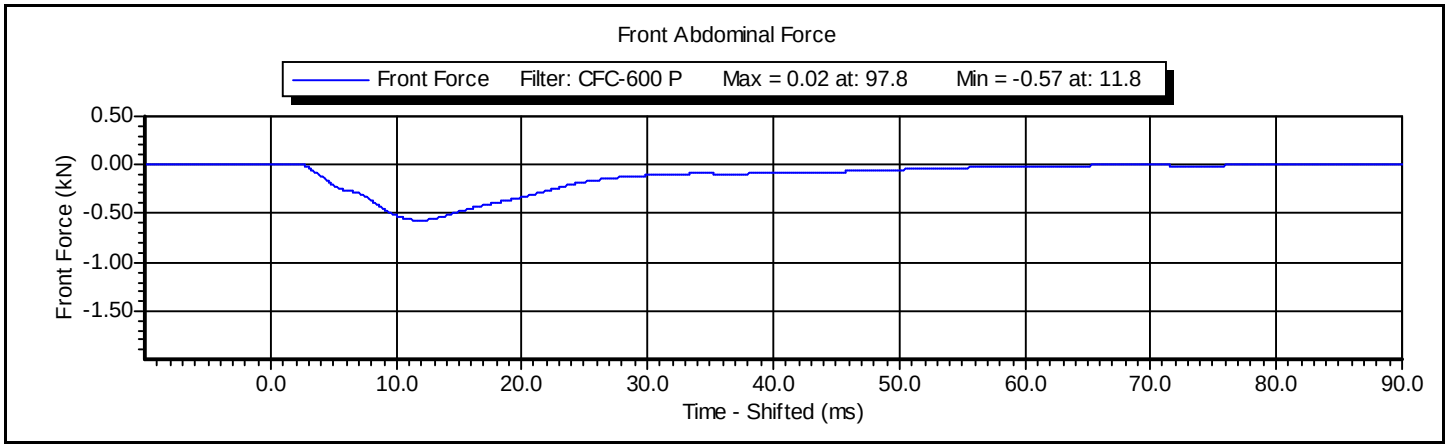
Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

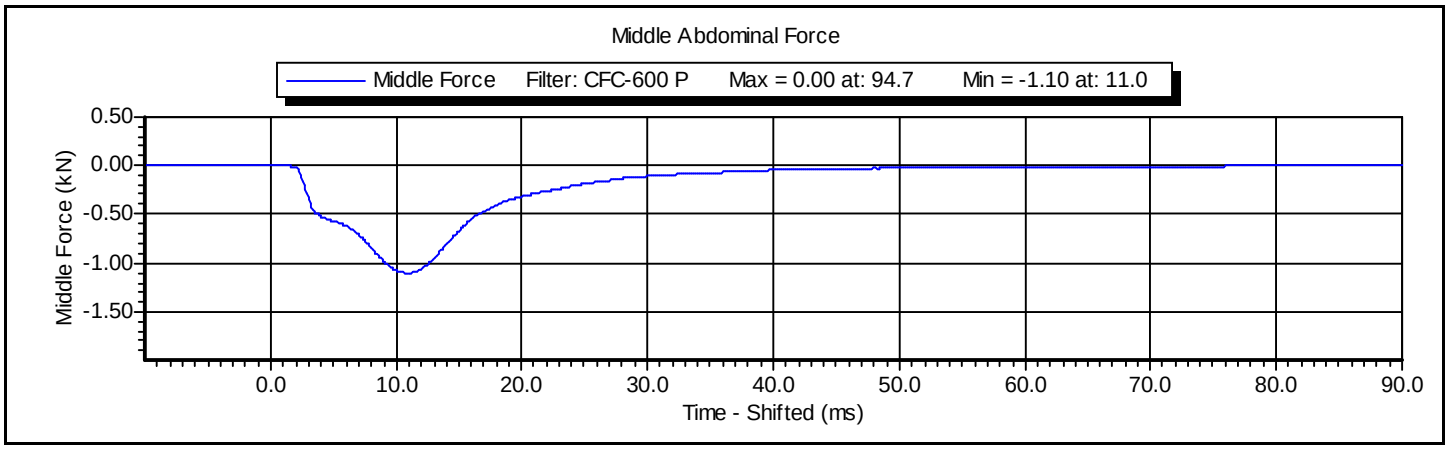
Test Name:	**Abdominal Impact**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Abdominal Test**	Test Date:	**3/26/2010**
Test Number:	**2**	Test Time:	**11:58:29 AM**

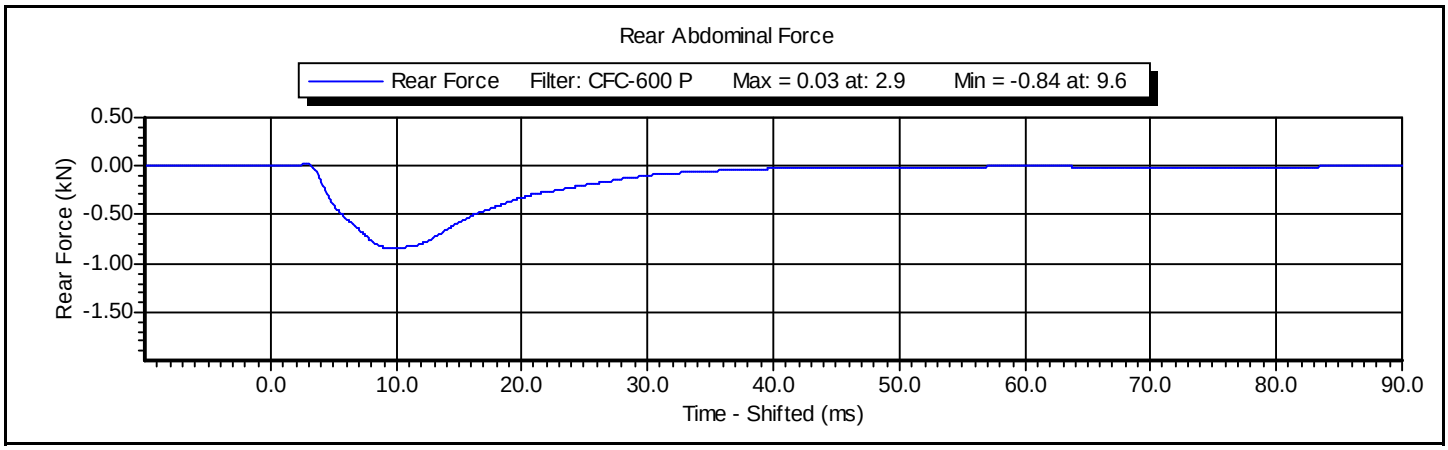
Component Part Number	Component Serial Number
455-4001	**19-179**











Test ID: **Abdominal Test** Test Time: **11:58:29 AM** Test Date: **3/26/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Lumbar Spine**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Lumbar Spine**	Test Date:	**3/30/2010**
Test Number:	**4**	Test Time:	**9:53:31 AM**

Component Part Number	Component Serial Number
175-5501	**15-0376**

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**21.7**	deg C	P
Humidity	10	--	70	**36**	%RH	P
Velocity	5.95	--	6.15	**6.05**	m/s	P
Maximum Headform Flexion Angle	45.0	--	55.0	**48.0**	degrees	P
Time at Maximum Headform Flexion Angle	39.0	--	53.0	**43.3**	ms	P
Decay to Zero Degrees	37.0	--	57.0	**38.1**	ms	P
Velocity Corridor		--				P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

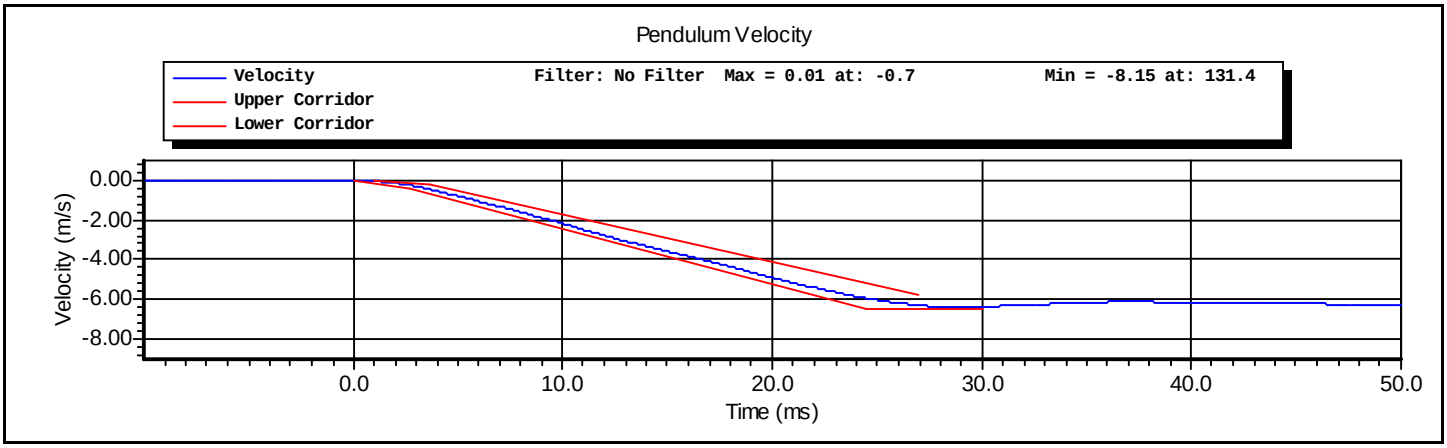
Manufacturer	Model	Serial Number	Calibration Date
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7231CT**	**AF5B3**	**2/24/2010**
DentonATD	**7000428**	**094**	**10/23/2009**
DentonATD	**7000428**	**095**	**10/23/2009**
DentonATD	**7000428**	**093**	**10/23/2009**

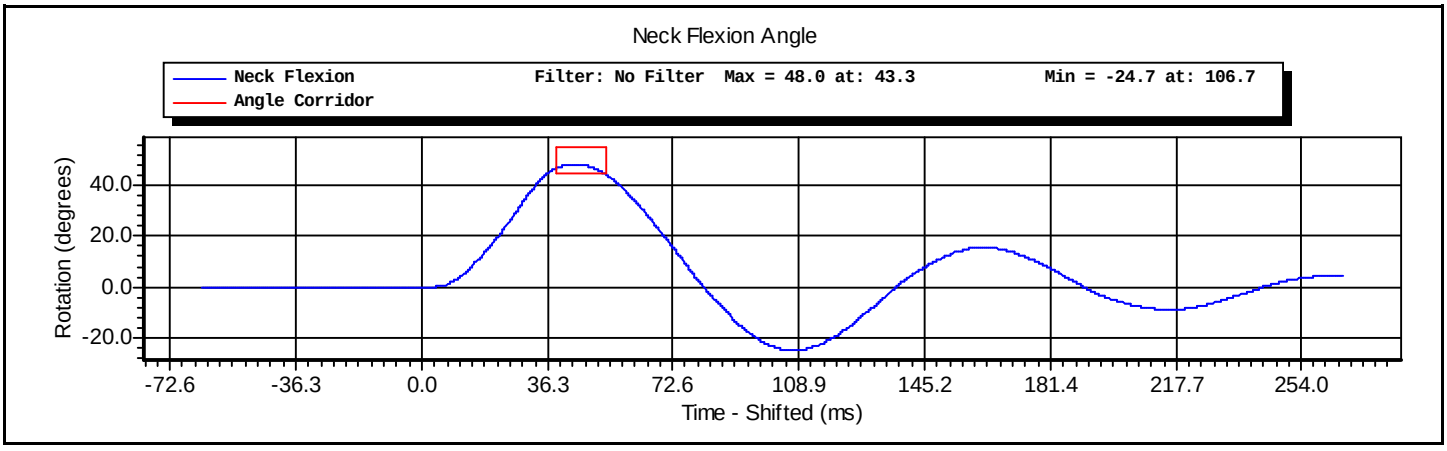
Test ID: **Lumbar Spine** Test Time: **9:53:31 AM** Test Date: **3/30/2010**

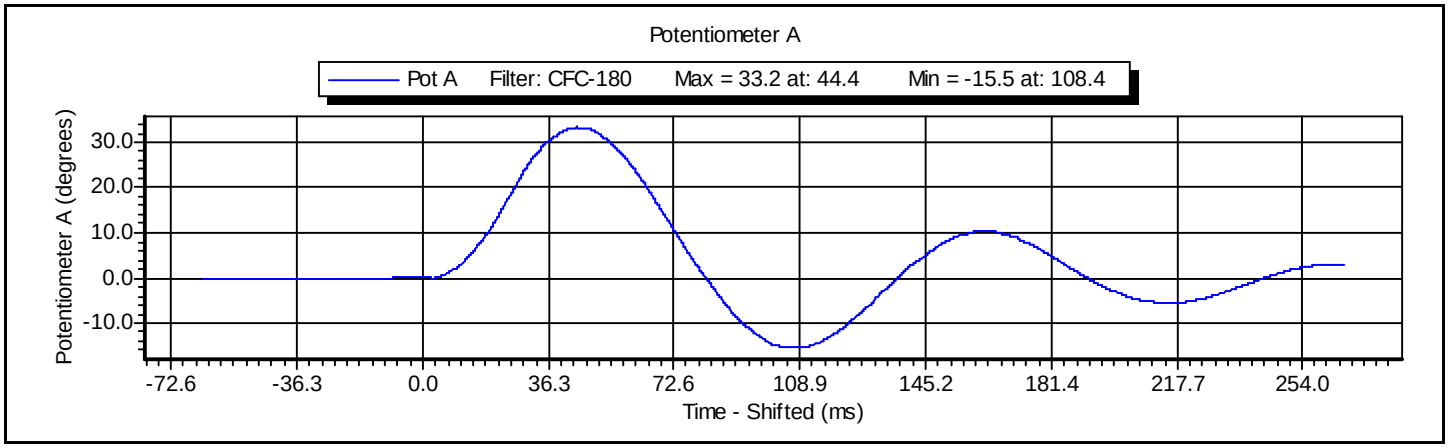
Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

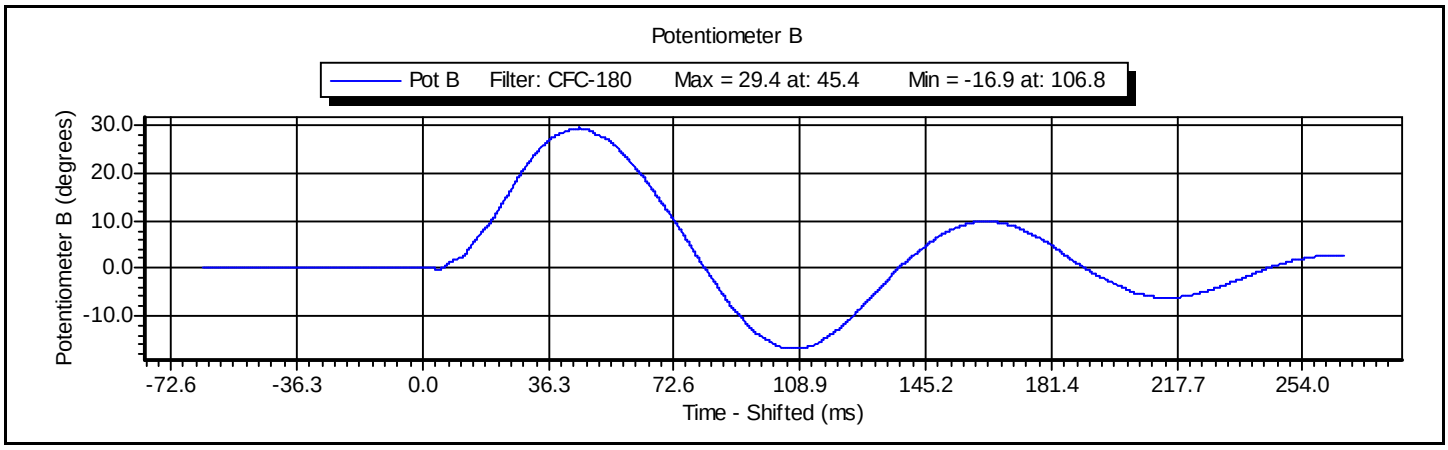
Test Name:	**Lumbar Spine**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Lumbar Spine**	Test Date:	**3/30/2010**
Test Number:	**4**	Test Time:	**9:53:31 AM**

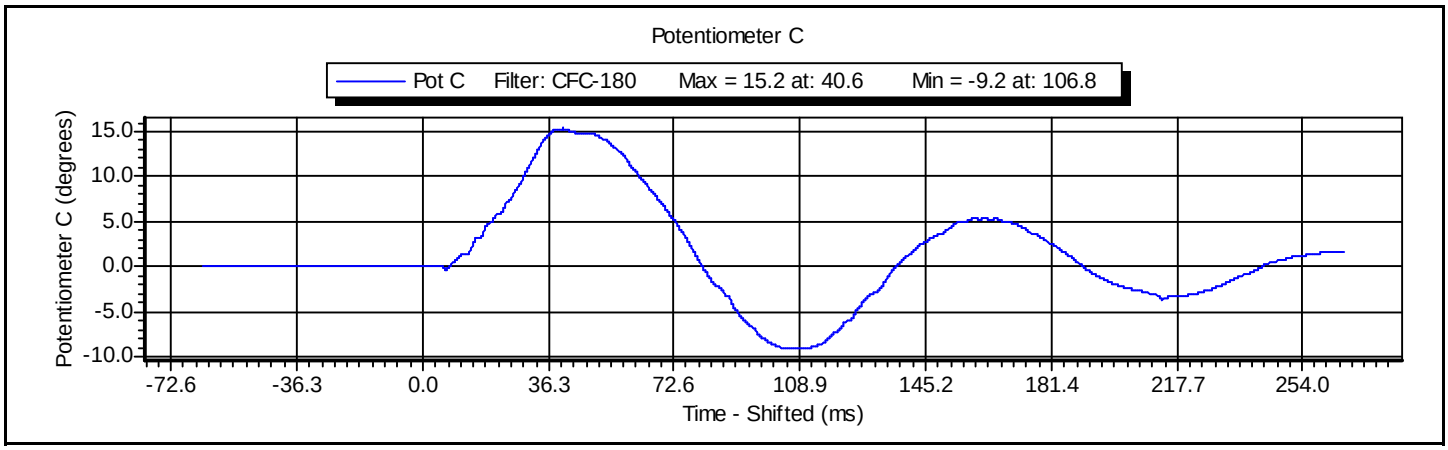
Component Part Number	Component Serial Number
175-5501	**15-0376**











Test ID: **Lumbar Spine** Test Time: **9:53:31 AM** Test Date: **3/30/2010**

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

Test Name:	**Pelvis Impact**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Pelvis Impact**	Test Date:	**3/26/2010**
Test Number:	**1**	Test Time:	**1:09:48 PM**

Component Part Number	Component Serial Number
455-4003	

Test Parameters	Test Specifications			Test Results		
Temperature	20.6	--	22.2	**21.7**	deg C	P
Humidity	10	--	70	**22**	%RH	P
Velocity	4.20	--	4.40	**4.29**	m/s	P
Peak Pendulum Force	-5.40	--	-4.70	**-5.27**	kN	P
Time at Peak Pendulum Force	11.80	--	16.10	**13.90**	ms	P
Peak Pubic Symphysis Force	-1.59	--	-1.23	**-1.59**	kN	P
Time at Peak Pubic Symphysis Force	12.20	--	17.00	**14.40**	ms	P

All test parameters are within specifications

Technician: **A. Rudniski** Signature: _____

Supervisor: **D. Travale** Signature: _____

Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

VERIFICATION REPORT

REFERENCE EQUIPMENT

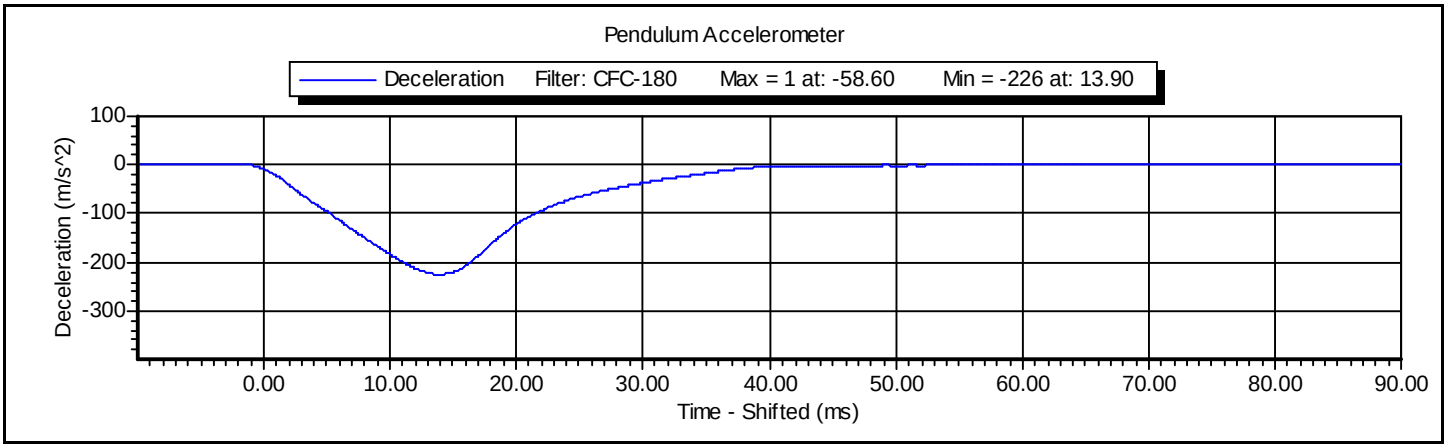
Manufacturer	Model	Serial Number	Calibration Date
DentonATD	**Velocity Trap**	**1**	**1/11/2010**
Endevco	**7264-2000**	**P16576**	**11/4/2009**
Denton	**3096**	**LC-458Fy**	**1/7/2010**

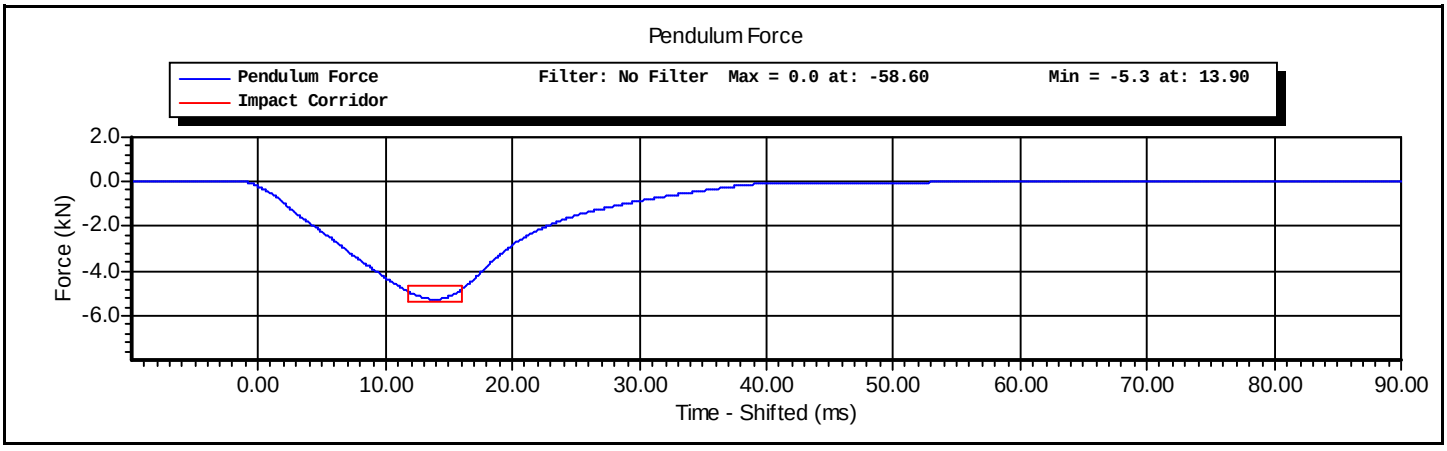
Test ID: **Pelvis Impact** Test Time: **1:09:48 PM** Test Date: **3/26/2010**

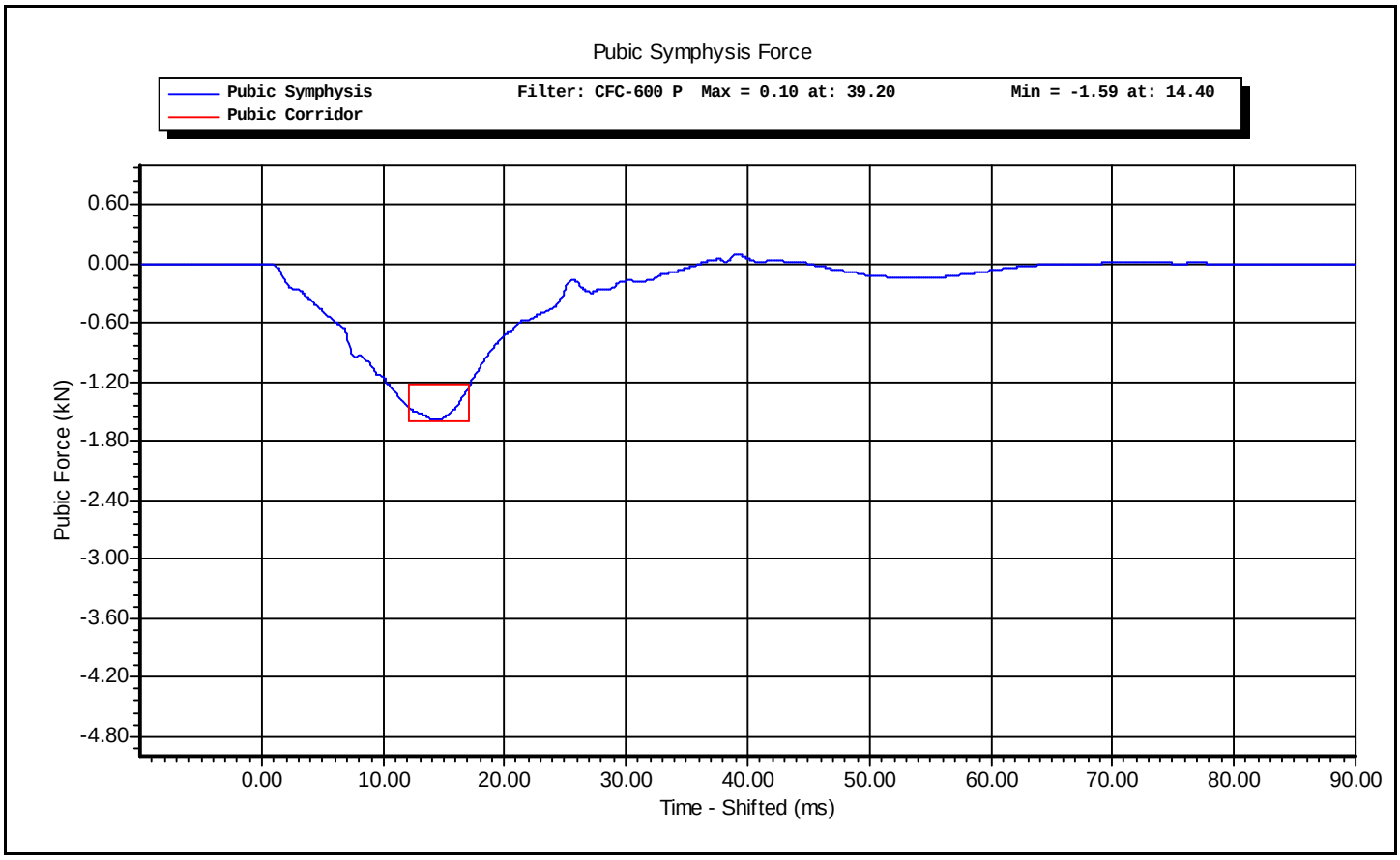
Calspan - Transportation Research Group
www.calspan.com
4455 Genesee Street, Buffalo, New York 14225 - Phone (716)632-7500

Test Name:	**Pelvis Impact**	Revision:	**12/14/2006**
Sub Test Name:		Spec Type:	**NHTSA**
ATD Type:	**ES-2re**		
ATD Serial Number:	**D037**		
Test ID:	**Pelvis Impact**	Test Date:	**3/26/2010**
Test Number:	**1**	Test Time:	**1:09:48 PM**

Component Part Number	Component Serial Number
455-4003	







Test ID: **Pelvis Impact** Test Time: **1:09:48 PM** Test Date: **3/26/2010**

APPENDIX E

TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

DUMMY INSTRUMENTATION

		FRONT ES2-re NO.: 037		
		SERIAL NUMBER	MANUFACTURER	CALIBRATION DATE
Head Accelerometers	X	AC-P18639	ENDEVCO	25-Jan-10
	Y	AC-P23128	ENDEVCO	25-Jan-10
	Y	AC-P16591	ENDEVCO	25-Jan-10
Head Accelerometers	X (Redundant)	AC-J45479	ENDEVCO	22-Jan-10
	Y (Redundant)	AC-P32453	ENDEVCO	25-Jan-10
	Z (Redundant)	AC-P22639	ENDEVCO	25-Jan-10
Thorax Potentiometers	Upper Rib (Y)	DS-0552-01	Honeywell	11-Jan-10
	Middle Rib (Y)	DS-0807	Honeywell	11-Jan-10
	Lower Rib (Y)	DS-0552-3	Honeywell	11-Jan-10
Abdomen Load Cells	Forward (Y)	LC-1507Fy	DENTON	07-Jan-10
	Middle (Y)	LC-1508Fy	DENTON	07-Jan-10
	Rear (Y)	LC-1509Fy	DENTON	07-Jan-10
Pubic Symphysis Load Cell (Y)		LC-458Fy	DENTON	07-Jan-10

REMARKS: None

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

VEHICLE AND MDB INSTRUMENTATION

VEHICLE INSTRUMENTATION	VEHICLE AND MDB INSTRUMENTS		
	SERIAL NUMBER	MANUFACTURER	CALIBRATION DATE
Vehicle CG (X)	AC-P26263	ENDEVCO	02-Feb-10
Vehicle CG (Y)	AC-P47300	ENDEVCO	02-Feb-10
Vehicle CG (Z)	AC-P32146	ENDEVCO	02-Feb-10
Left Floor Sill (Y)	AC-P16841	ENDEVCO	24-Feb-10
A-Pillar Left Sill (Y)	AC-APF89	ENDEVCO	04-Nov-09
Lower Left A-Pillar (Y)	AC-J38127	ENDEVCO	04-Nov-09
Middle Left A-Pillar (Y)	AC-P35793	ENDEVCO	24-Feb-10
B-Pillar Left Sill (Y)	AC-P23288	ENDEVCO	04-Nov-09
Lower Left B-Pillar (Y)	AC-P21516	ENDEVCO	04-Nov-09
Middle Left B-Pillar (Y)	AC-P23788	ENDEVCO	22-Jan-10
Driver Seat Track (Y)	AC-J32838	ENDEVCO	04-Nov-09
Engine Top (X)	AC-P35803	ENDEVCO	25-Oct-09
Engine Top (Y)	AC-P35811	ENDEVCO	25-Oct-09
Firewall Center (Y)	AC-P23926	ENDEVCO	25-Oct-09
Right Roof at Vertical Impact Reference (Y)	AC-P19217	ENDEVCO	22-Jan-10
Right Sill at at Vertical Impact Reference (Y)	AC-P26262	ENDEVCO	02-Feb-10
Rear Floorpan Behind Rear Axle at C/L (X)	AC-P23957	ENDEVCO	02-Feb-10
Rear Floorpan Behind Rear Axle at C/L (Y)	AC-P21373	ENDEVCO	02-Feb-10

REMARKS: None