REPORT NUMBER: 201-CAL-07-05

SAFETY COMPLIANCE TESTING FOR FMVSS 201 OCCUPANT PROTECTION IN INTERIOR IMPACT

GENERAL MOTORS DE MEXICO
2007 CHEVROLET HHR 4-DOOR

NHTSA NUMBER: C70107
CALSPAN TEST NUMBER: 8832-F201-05

CALSPAN
TRANSPORTATION SCIENCES CENTER
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Test Date: April 2, 2008

FINAL REPORT

PREPARED FOR:

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15. Supplementary Notes		

16. Abstract

Compliance tests were conducted on the subject vehicle, a 2007 Chevrolet HHR 4-door, in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure TP-201-02 for determination of FMVSS 201 compliance.

Test failures identified were as follows: The interior compartment door assembly (i.e., storage bin), located in the center of the instrument panel of the vehicle tested, did not remain closed, as required by S5.3 of FMVSS 201, when the instrument panel was tested in accordance with S5.1.

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SECTION 1

PURPOSE AND TEST PROCEDURE

This head impact compliance test is part of the FMVSS 201 Occupant Protection in Interior Impact Test Program sponsored by the National Highway Traffic Safety Administration (NHTSA) under Contract No. DTNH22-06-C-00031. The purpose of this impact compliance test was to determine whether the subject vehicle, a 2007 Chevrolet HHR 4-door, NHTSA No.C70107, meets the performance requirements of FMVSS 201, Occupant Protection in Interior Impact. The compliance test was conducted using the requirements found in the OVSC Laboratory Test Procedure No. TP-201-02 dated March 3, 1989.

SECTION 2

SUMMARY OF OCCUPANT PROTECTION IN INTERIOR IMPACTS

A 2007 Chevrolet HHR 4-door, NHTSA No. C70107, was impacted at various locations throughout its instrument cluster/dash panel and seat back area by a 6.8 kg (15 lb.), 165 mm (6.5 inch) diameter steel headform. A total of four (4) impacts were performed in this test series. The target area impacts were chosen by the NHTSA Contracting Officer's Technical Representative (COTR). The four (4) chosen impact points were:

Seat Back / Head Restraint Area

Instrument Panel Cluster Area

Airbag Cover / Dash Panel Area (2 impacts)

The selected impact areas on the test vehicle appeared to comply with the performance requirements of FMVSS 201.

The 165 mm (6.5 inch) diameter steel headform weighed 6.8 kg (15 lb.) and had an accelerometer mounted along the centerline of the head.

One (1) channel of data for each target impact test was recorded on a Keyser-Threde data acquisition system. Data plots can be found in Appendix C. Still photographs can be found in Appendix A.

To document each target area impact test, one 35mm camera picture was taken pre- and post-test at various locations to view the headform contact with the selected target areas. Real-time camera footage was taken during impacting the target locations with the head impact test device.

TEST VEHICLE RECEIVING INSPECTION DATA SHEET

VEHICLE YEAR/MAKE/MODEL/STYLE:	2007 Chevrolet HHR 4-door
NHTSA NO.:	C70107
VIN:	3GNDA13D97S617345
DATE OF MANUFACTURE:	03/07 (SEE CERTIFICATION LABEL)
COLOR:	RED
ODOMETER READING:	45 km
LABORATORY:	Calspan
TEST DATE:	April 3, 2008

NUMBER OF SEATING POSITIONS:
FRONT: 2 REAR: 3

INSTRUMENT PANEL:
NOTE UNUSUAL FEATURES: None

TYPE OF FRONT SEATS:
BENCH: - BUCKET: X SPLIT BACKS: -

TYPE OF HEAD RESTRAINTS:
FIXED: - ADJUSTABLE: X

VEHICLE EQUIPPED WITH ARMRESTS?
NO: - YES: X NUMBER: 4

LOCATION: Driver and Passenger side front and rear door panels

VEHICLE EQUIPPED WITH SUN VISORS?
NO: - YES: X

VEHICLE EQUIPPED WITH INTERIOR DOOR LATCHES?
NO: - YES: X NUMBER: 2

LOCATION: Glove Box and Instrument Panel Storage Bin

HEAD FORM IMPACT TEST RESULTS
INSTRUMENT PANEL

VEHICLE YEAR/MAKE/MODEL/STYLE:	2007 Chevrolet HHR 4-door
NHTSA NO.:	C70107
VIN:	3GNDA13D97S617345
DATE OF MANUFACTURE:	03/07 (SEE CERTIFICATION LABEL)
COLOR:	RED
ODOMETER READING:	45 km
LABORATORY:	Calspan
TEST DATE:	April 2, 2008

IMPACT LOCATION AND NUMBER				VELOCITY (kph)	PEAK ACCELERATION (3 ms Clip) Gs
Target	X (mm)	Y (mm)	ANGLE (degrees)		
Trim Above Radio Cluster	645	15	57	18.54	50.71
Left Side of Airbag Cover	678	216	65	18.45	57.24
Right Dash Below Airbag Cover	656	468	58	18.37	61.41

REFERENCE POINT:

Seating Reference Position (SGRP) on front passenger side is the reference point (x positive forward from SGRP and y positive to the right of the centerline of the vehicle).

REMARKS:

The interior compartment door assembly (i.e. storage bin), located in the center of the instrument panel of the vehicle tested, did not remain closed, as required by S5.3 of FMVSS 201, when the instrument panel was tested in accordance with S5.1.

HEAD FORM IMPACT TEST RESULTS
SEAT BACKS

VEHICLE YEAR/MAKE/MODEL/STYLE:	2007 Chevrolet HHR 4-door
NHTSA NO.:	C70107
VIN:	3GNDA13D97S617345
DATE OF MANUFACTURE:	03/07 (SEE CERTIFICATION LABEL)
COLOR:	RED
ODOMETER READING:	45 km
LABORATORY:	Calspan
TEST DATE:	April 2, 2008

IMPACT LOCATION AND NUMBER				VELOCITY (kph)	PEAK ACCELERATION (3 ms Clip) Gs
Target	X (mm)	Y (mm)	ANGLE (degrees)		
Passenger Side Front Seat Head Restraint	447	0	16	23.71	23.78

REFERENCE POINT:

SGRP on rear passenger side is the reference point (x positive forward from SGRP and y positive to the right of the SGRP).

SUNVISOR AND ARMREST EVALUATION

VEHICLE YEAR/MAKE/MODEL/STYLE:	2007 Chevrolet HHR 4-door
NHTSA NO.:	C70107
VIN:	3GNDA13D97S617345
DATE OF MANUFACTURE:	03/07 (SEE CERTIFICATION LABEL)
COLOR:	RED
ODOMETER READING:	45 km
LABORATORY:	Calspan
TEST DATE:	April 2, 2008

SUN VISOR INFORMATION:

1. Are sun visors constructed of or covered with energy absorbing material?

   YES (PASS): X NO (FAIL): -

2. Are any edges statically contactable by a spherical 6.5 inch (165 mm) diameter head form of radius less than 0.125 inch (3.175 mm)?

   YES (FAIL): - NO (PASS): X

ARMREST INFORMATION:

A. FIXED ARMREST

1. Is it constructed of energy absorbing material with the capability of laterally deflecting 2 inches (50.8 mm) without contacting any underlying rigid material?

   YES: N/A NO: N/A

2. Is it constructed of energy absorbing material that deflects or collapses within 1.25 inches (3.175 mm) of the rigid test panel surface without contacting underlying rigid material between 0.50 inches (12.7 mm) and 1.25 inches (3.175 mm) from the panel which has a vertical height of less than 1 inch (25.4 mm)?

   YES: N/A NO: N/A

3. Does it provide adequate pelvic area impact protection?

   YES: X NO: -

4. Does it meet at least one of the criteria No. 1 to 3?

   YES (PASS): X NO (FAIL): -

B. FOLDING ARMREST

Is it made of or covered with energy absorbing material? Or does it meet at least one of the criteria No. 1 to 3?

YES (PASS): X NO (FAIL): -

DOOR LATCH EVALUATION

VEHICLE YEAR/MAKE/MODEL/STYLE:	2007 Chevrolet HHR 4-door
NHTSA NO.:	C70107
VIN:	3GNDA13D97S617345
DATE OF MANUFACTURE:	03/07 (SEE CERTIFICATION LABEL)
COLOR:	RED
ODOMETER READING:	45 km
LABORATORY:	Calspan
TEST DATE:	April 2, 2008

LATCH ENGAGEMENT INTERFERENCE

DESCRIPTION OF LATCH LOCATION	NO LOAD	10G HORIZONTAL TRANSVERSE	10G VERTICAL	30G HORIZONTAL LONGITUDINAL
Glove Box	Pass	Pass	Pass	Pass
Storage Compartment	Pass	Pass	Pass	Pass

(APPENDIX B CONTAINS CALCULATION SHEETS WHICH ARE BASED ON MANUFACTURER'S DATA)

SUMMARY OF RESULTS

VEHICLE YEAR/MAKE/MODEL/STYLE:	2007 Chevrolet HHR 4-door
NHTSA NO.:	C70107
VIN:	3GNDA13D97S617345
DATE OF MANUFACTURE:	03/07 (SEE CERTIFICATION LABEL)
COLOR:	RED
ODOMETER READING:	45 km
LABORATORY:	Calspan
TEST DATE:	April 2, 2008

	NUMBER OF IMPACTS	PASS/FAIL
INSTRUMENT PANEL	3	PASS / FAILURE *
SEAT BACK	1	PASS
SUN VISORS	N/A	PASS
ARMRESTS	N/A	PASS
INTERIOR COMPARTMENT DOORS	N/A	PASS

REMARKS:

The interior compartment door assembly (i.e. storage bin), located in the center of the instrument panel of the vehicle tested, did not remain closed, as required by S5.3 of FMVSS 201, when the instrument panel was tested in accordance with S5.1.

The instrument panel cover surrounding the air ducts, A/C and heating controls and radio separated along the upper perimeter exposing the edges of the cabin environment.

APPENDIX A

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PHOTOGRAPHS

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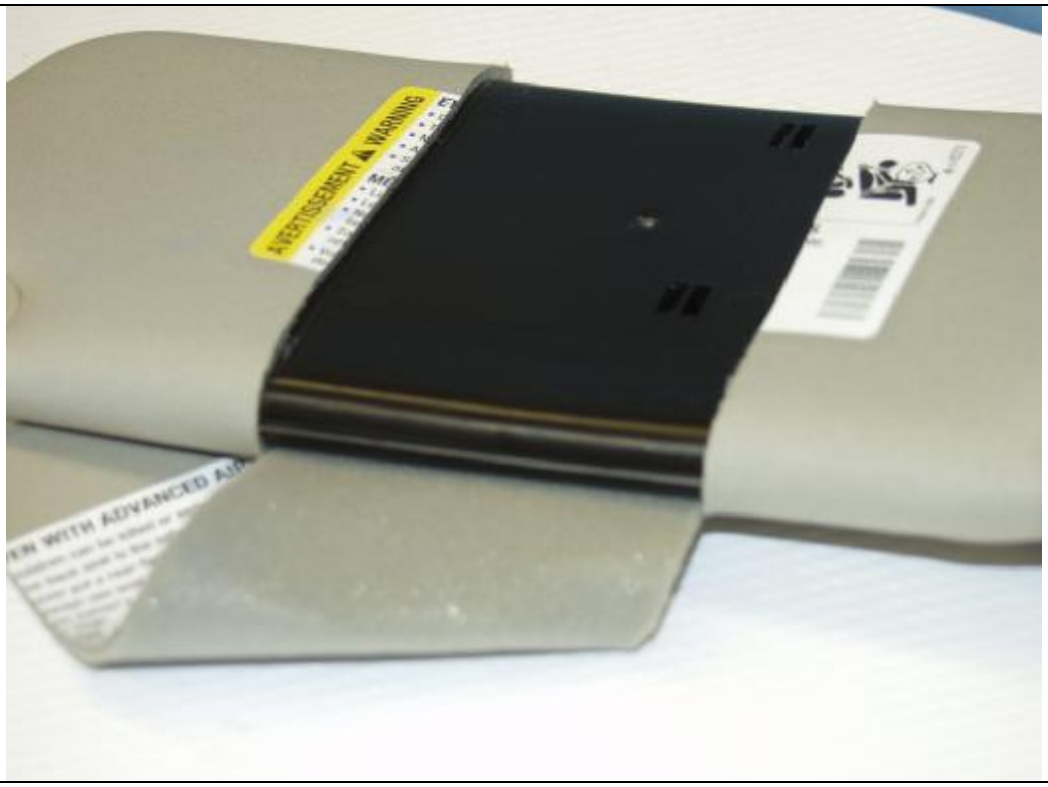


Figure A-10: SUN VISOR CONSTRUCTION

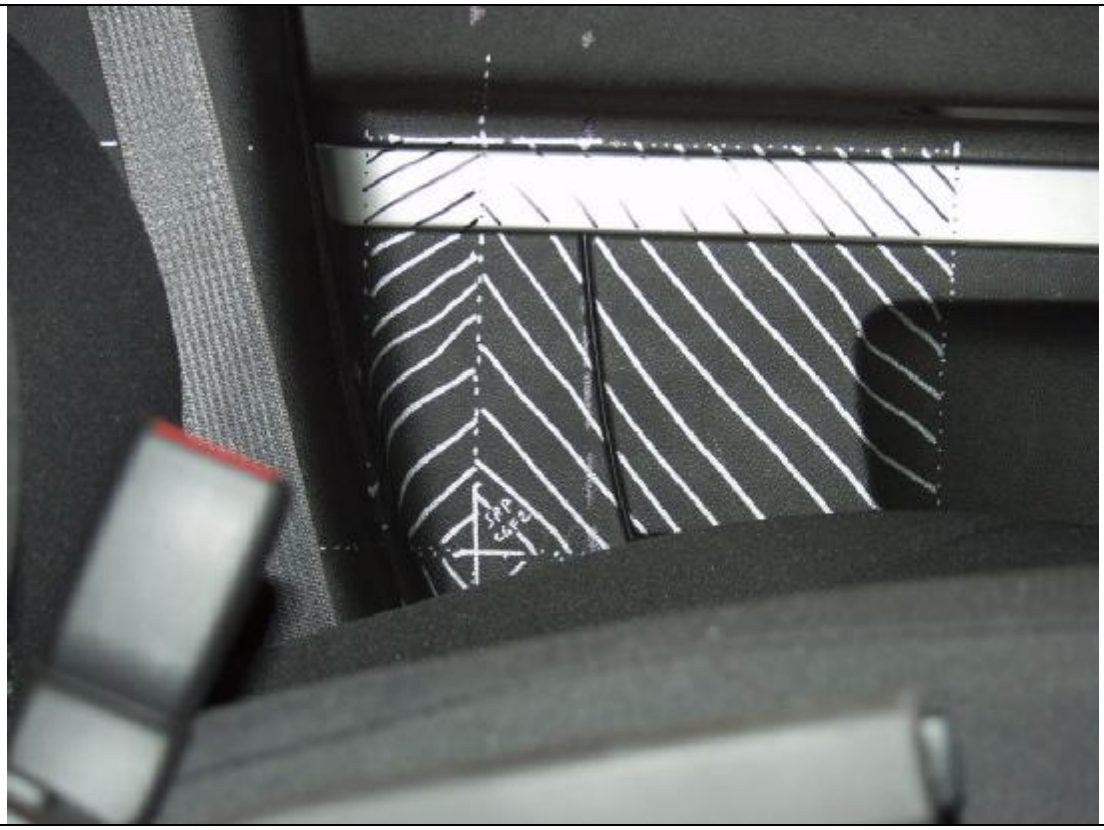
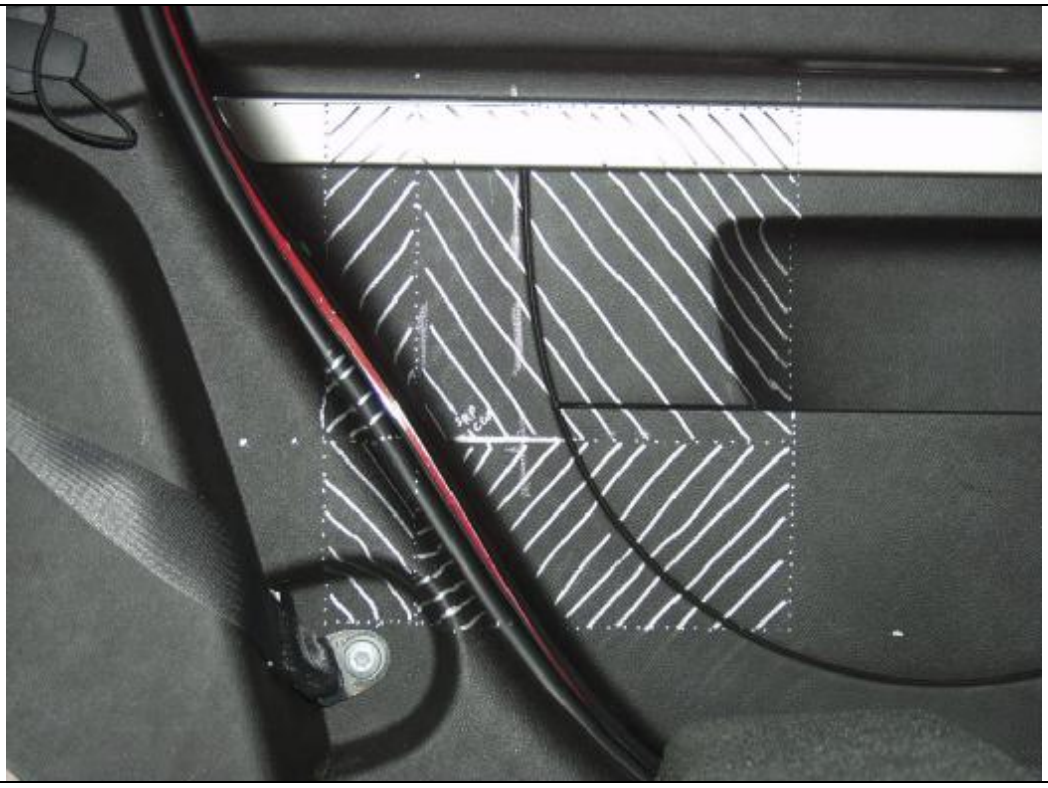


Figure A-11: ARMREST LEFT FRONT DOOR



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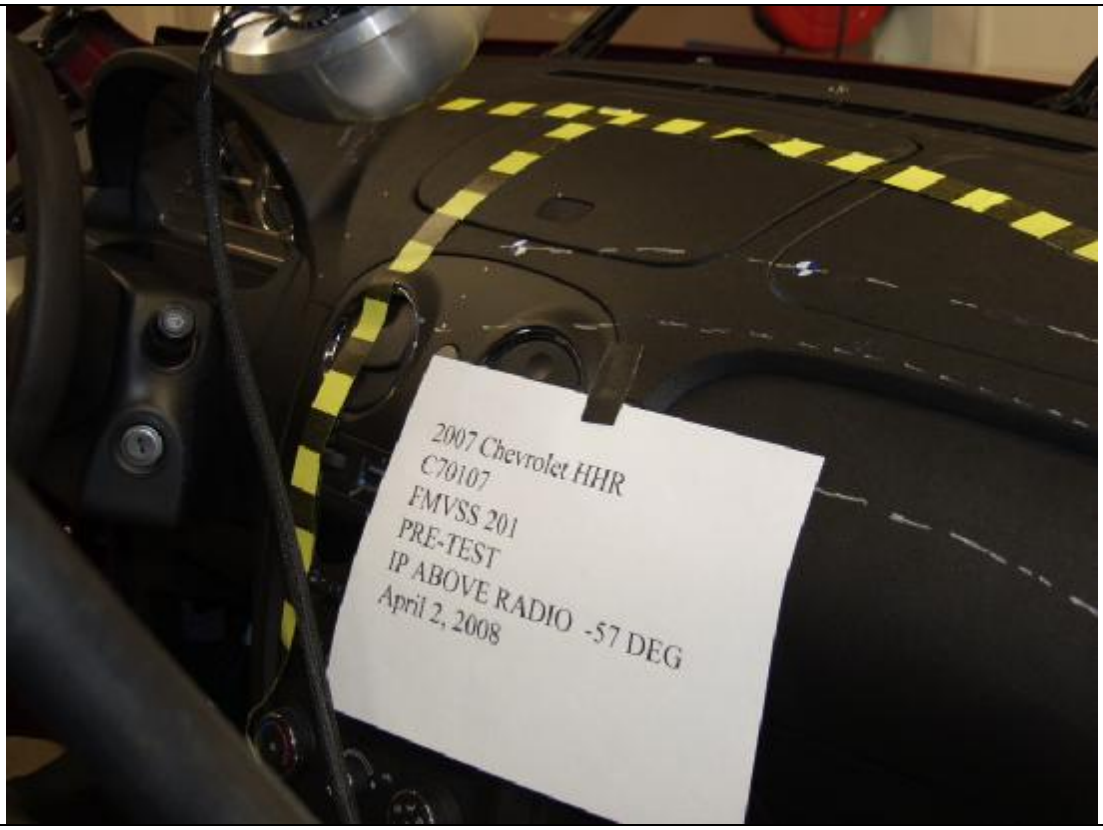


Figure A-15: INSTRUMENT PANEL LEFT SIDE AIRBAG COVER IMPACT PRE-TEST

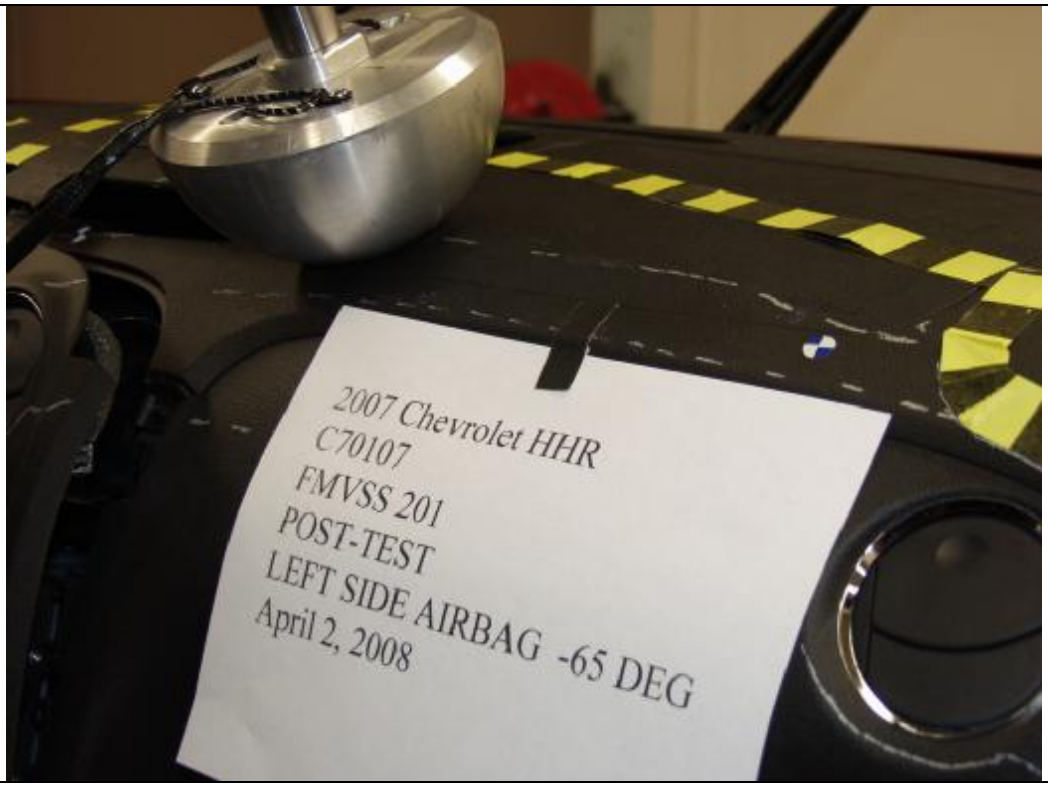


Figure A-16: INSTRUMENT PANEL LEFT SIDE AIRBAG COVER IMPACT POST-TEST

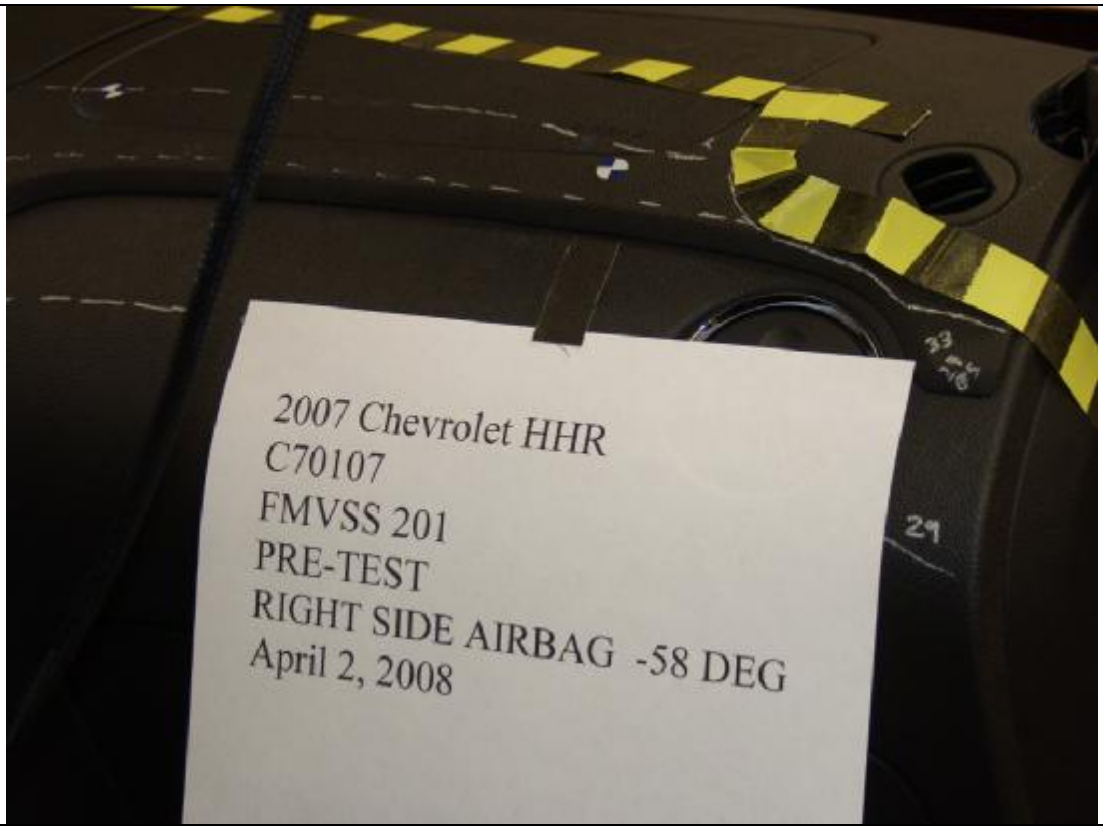


Figure A-17: INSTRUMENT PANEL RIGHT SIDE BELOW AIRBAG COVER IMPACT PRE-TEST

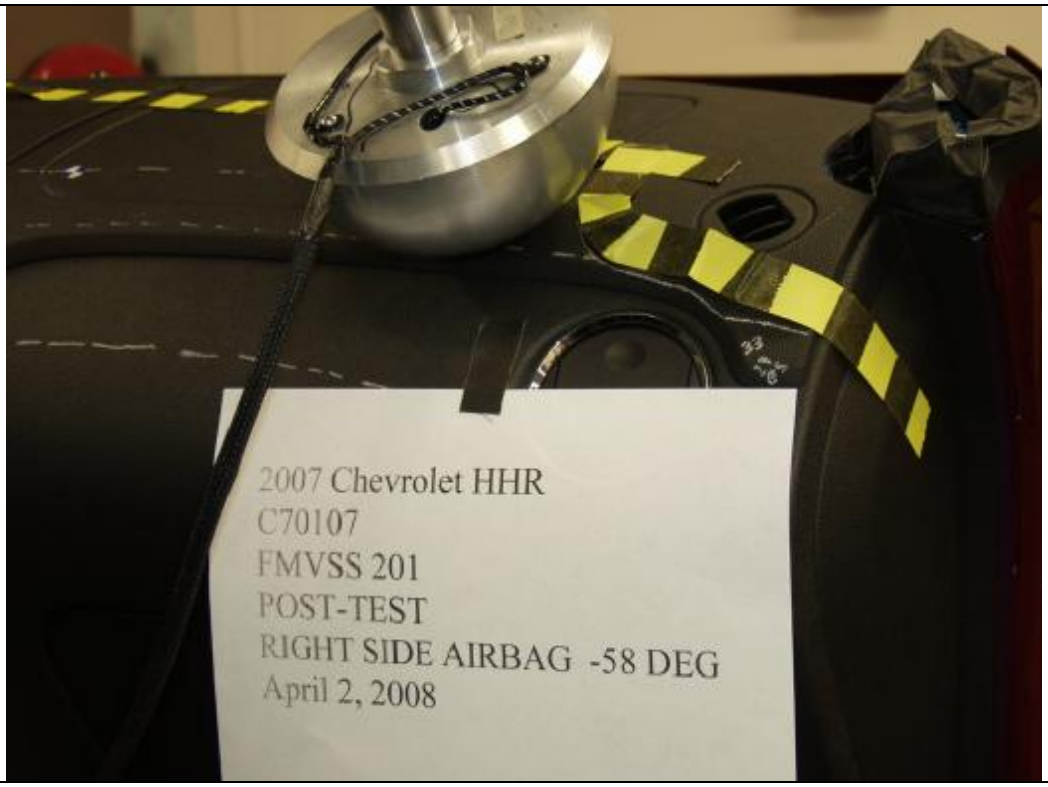


Figure A-18: INSTRUMENT PANEL RIGHT SIDE BELOW AIRBAG COVER IMPACT POST-TEST

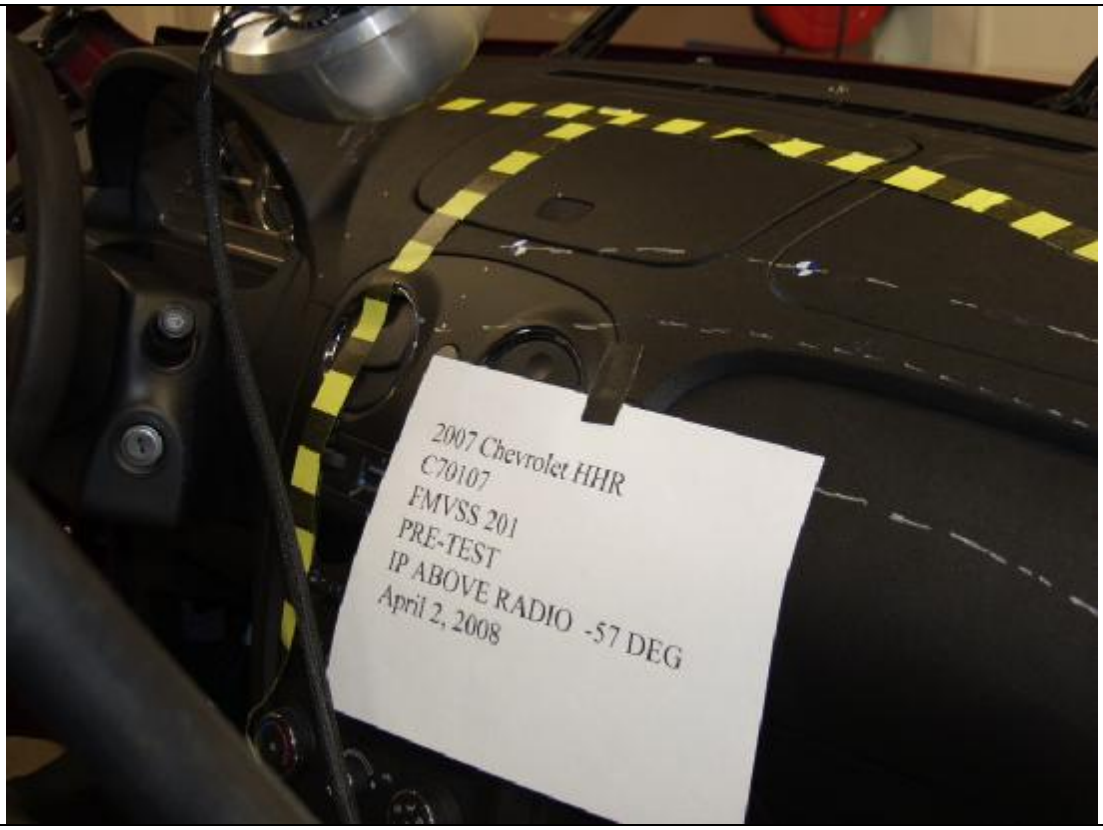


Figure A-19: INSTRUMENT PANEL RADIO CLUSTER IMPACT PRE-TEST

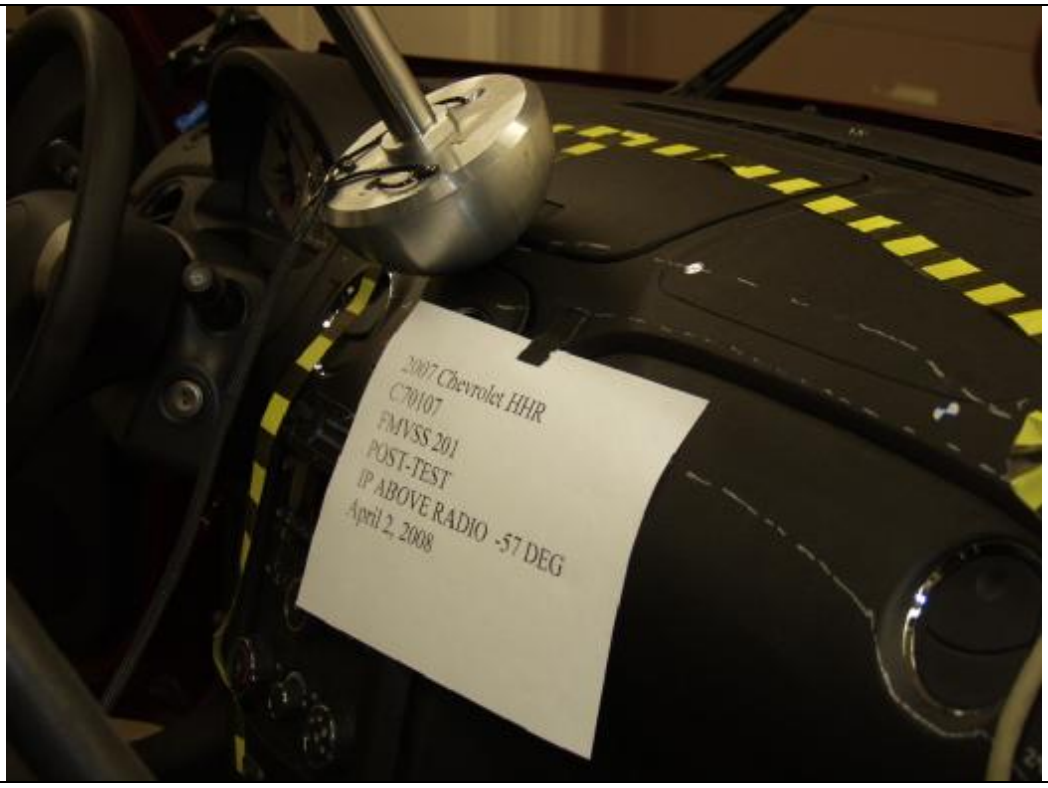


Figure A-20: INSTRUMENT PANEL RADIO CLUSTER IMPACT POST-TEST

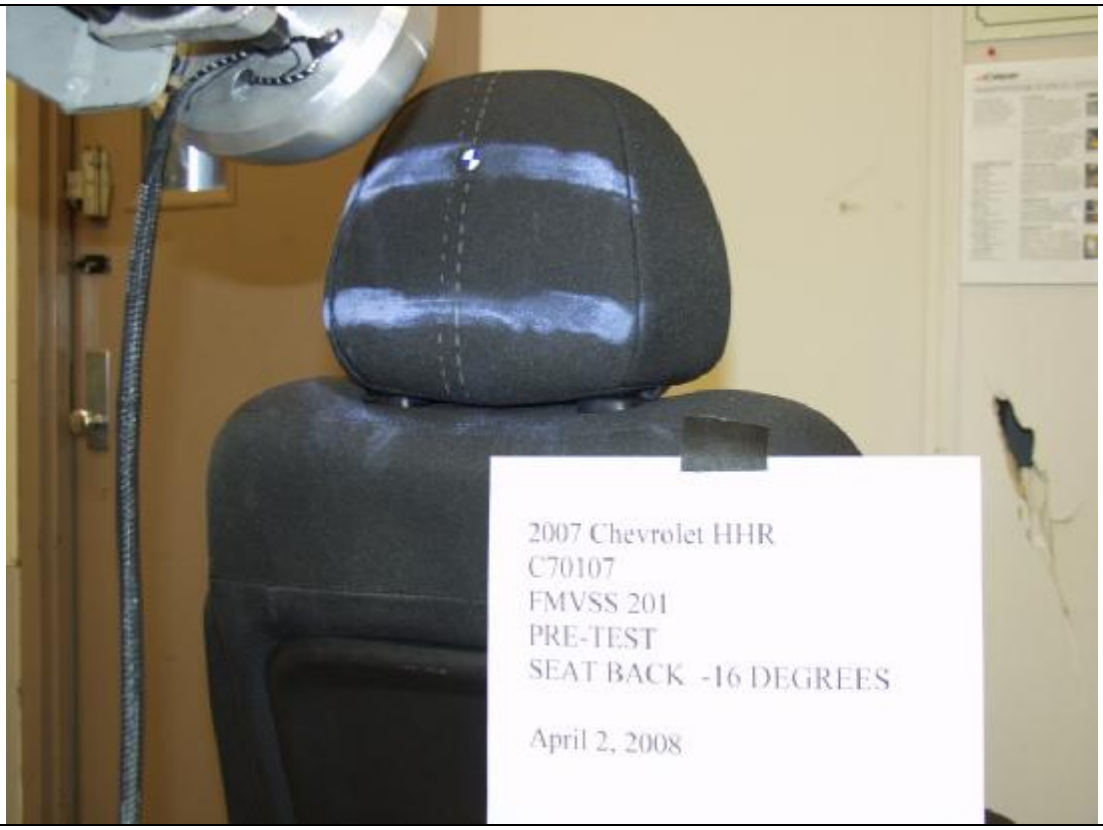


Figure A-21: HEAD RESTRAINT IMPACT AREA PRE-TEST

Figure A-22: HEAD RESTRAINT IMPACT AREA POST-TEST

APPENDIX B

INTERIOR COMPARTMENT DOOR CALCULATIONS

2007 Chevrolet HHR

FMVSS 201 S3.1

Instrument Panel Glove Box compartment

Latch Component Analysis

Manufacturer's latch component analysis

FORM – 201
Rev. 01/05/07

LATCH COMPONENT ANALYSIS INFORMATION

FMVSS No. 201

Latch component inertial analysis information for each interior compartment door assembly located in an instrument panel, console assembly, seat back, or side panel adjacent to a designated seating position in accordance with the procedure described in section 5 of SAE Recommended Practice J839b, "Passenger Car Side Door Latch Systems."

Such data shall include:

1. Geometric details of the latch/lock configuration.

2. Mass data for each element in the linkage.

3. Spring rates for each spring element in the configuration.

4. Any additional details unique to the design yet necessary to the calculations.

FMVSS 201 COMPLIANCE REPORT OF GM CORPORATE "STAND ALONE COMPONENT" LATCH ASSEMBLY GMT 001 PART # 25767142

OBJECTIVE:

To verify that the GM Corporate Glove Box Compartment Latch Assembly meets the FMVSS 201 inertia load requirements.

RESULTS:

30 G's in Rearward Longitudinal direction :
The latch assembly mechanism complies with FMVSS 201 requirements. Analysis indicates that a minimum total upward force of 4.81 N is acting to force the mechanism in closed position.

30 G's in Forward Longitudinal direction :
The latch assembly mechanism complies with FMVSS 201 requirements. Analysis indicates that a minimum total upward force of 5.71 N is acting to force the mechanism in closed position.

10 G's in Downward Vertical direction :
The latch assembly mechanism complies with FMVSS 201 requirements. Analysis indicates that a minimum total upward force of 4.72 N is acting to force the mechanism in closed position.

10 G's in Upward Vertical direction :
The latch assembly mechanism complies with FMVSS 201 requirements. Analysis indicates that the inertia and spring forces both are acting to force the mechanism in closed position.

10 G's in Transverse Horizontal direction :
Since the latch hinge axis lies in the transverse direction, transverse deceleration loading does not cause any additional opening moments on the latch mechanism assembly. The lateral acceleration forces are along the rotational axis of the handle. These loads have been set to zero in this analysis.

Conclusion:

Thus the Latch Complies with requirements S5.3.1 of FMVSS 201

REQUIRED DATA:

Mass of the Handle = 0.0168 Kg.
Mass of the Retainer = 0.0036 Kg.
Mass of the Retainer Spring = 0.00046 Kg.
Striker diameter – 4.00mm

Compression Spring:

Free Spring Length = 34.9 mm
Installed Spring Length = 32.5 mm
Compressed (Released) Spring Length 20.9 mm
Compression Spring Rate = 0.760 N/mm

Computation of Compression Spring Force:

Spring Force, $F_{installation}$ = (initial length - installed length) x spring constant
= (34.9 32.5)mm x (0.760 N/mm)
1.824 N
= Pre load on pawl.

Spring Force, $F_{release}$ = (installed length - released length) x spring constant
= (32.5 – 20.9) mm x (0.760 N/mm)
= 8.816 N
= Force to release.

Spring Force, $Fs = \frac{F_{installation} + F_{release}}{2} = \frac{10.61}{2}$ N =5.32N

SOLUTION METHOD:

The 30G and 10G acceleration forces were converted to static forces by applying respective accelerations to the center of gravity of the handle and retainer spring assembly. These forces are translated into moments about the handle hinge point and the net effective forces on the retainer-spring assembly are determined. The compressional retainer spring will be able to satisfy FMVSS 201 requirements i.e., to keep the latch closed in crash conditions.

COMPUTATION OF CENTER OF GRAVITY OF THE HANDLE:

Determination of the mass and center of gravity of the handle:
Density = 1.38 gm / c.c
Mass = Vol * Density = 0.0168 Kg.

The center of gravity location was determined from the UG model as:
Vertical offset, V = 8.0 mm
Horizontal offset, H = 2.8mm
Distance of the center of gravity to hinge point, D = 8.4mm
Distance: cg (Retainer + Spring)/Handle hinge point, H = 31.5 mm
in the installed Vehicle coordinate system.
Cg-Center of Gravity

CALCULATION OF THE EFFECT ON RETAINER DUE TO HANDLE INERTIA :

Let, F_H be the component of the inertia force normal to the handle surface.
So, effective moment about the handle hinge point:

$M_H = F_H \times d_{hcg} / \cos(90-70.9)^\circ$

where d_{hcg} is the distance of handle c.g from the handle hinge point = 8.0 mm
70.9° is the angle of handle acting force direction and the line between handle hinge point and cg.
Let F_R be the effective force on the retainer due to M_H.
F_c be the force exerted to keep the latch closed.
So, $F_R = F_c = M_H / d_{hl} = F_H \times (d_{hcg} / d_{hl})$
where d_{hl} = horizontal distance of the approximate center of gravity of the retainer-spring assembly from the handle hinge point = 31.5 mm.

CASE 1 (VERTICAL LOAD 10G) :

When the latch assembly is subjected to a 10G inertia load in the vertical directions, the downward/upward force balances are:

1. DOWNWARD

F_d (retainer + spring) = - [M (retainer + spring)] x [10G x cos31.4 + 1G x cos31.4] =
= -[(0.0036 + 0.00040)] x [9.81 x 10 x 0.85 + 1 x 9.81 x 0.85]
= - 0.37 N

Moment of Inertia of Handle = -[M(handle) x 10G x dhcg x cos(90-31.4) + M(handle) x 1G x cos58.6 x dhcg] x cos(90-70.9) =
= -[0.0168 x 10 x 9.81 x 8.0 x sin31.4 + 0.0168 x 1 x 9.81 x 0.52 x 8.0] / 0.94 =
= - 7.1 Nmm

F_h (handle inertia) = Moment of Inertia of Handle / dhl
= - 7.1 / 31.5
= - 0.23 N

Net effective force = 5.32– 0.23-- 0.37
= 4.72 (upwards)

So the Net Effective Force of 4.72 N acting upwards keeps the latch closed.

2. UPWARD

When the latch assembly is subjected to 10G inertia load in the vertical upward direction, **the inertia and spring forces both try to keep the latch closed.**

CASE 2 (TRANSVERSE LOAD 10G) :

When the latch assembly is subjected to 10G inertia load in the horizontal/transverse direction , the force is normal to the direction of retainer actuation and does not open or close the latch.

CASE 3 (LONGITUDINAL LOAD 30G) :

When the latch is subjected to 30G inertia load in the longitudinal direction, the force balances representing frontal and rear crashes are:

1. FORWARD

F_f (retainer + spring) = - M (retainer + spring) x [30G x cos(90-31.4) + 1G x cos31.4]
= (0.0036 + 0.0004) x [30 * 9.81 * sin31.4 + 9.81 x cos31.4]
= - 0.65 N

Moment of Inertia of Handle = M(handle) x [30G x dheg x sin(90-31.4) – 1G x 8.4 x Cos58.6] / cos(90-70.9) =
= 0.0168 x [30 x 9.81 x 8.4 x cos31.4 + 9.81 x 4.38]/ sin70.9 =
= 32.82 Nmm

F_h (handle inertia) = Moment of Inertia of Handle / dhl
= 32.82 / 31.5
= 1.04 N

Net effective force = 5.32 + 1.04 – 0.65 = 5.71 N

Net Effective Force of 5.71 N acting upwards keeps the latch assembly closed.

2. REARWARD

F_r (retainer + spring) = M (retainer + spring) x [30G x cos(90-31.4) – 1G x cos31.4] =
= [0.0036 + 0.0004] x [30 * 9.81 * sin31.4 – 9.81 x cos31.4] =
= 0.58 N

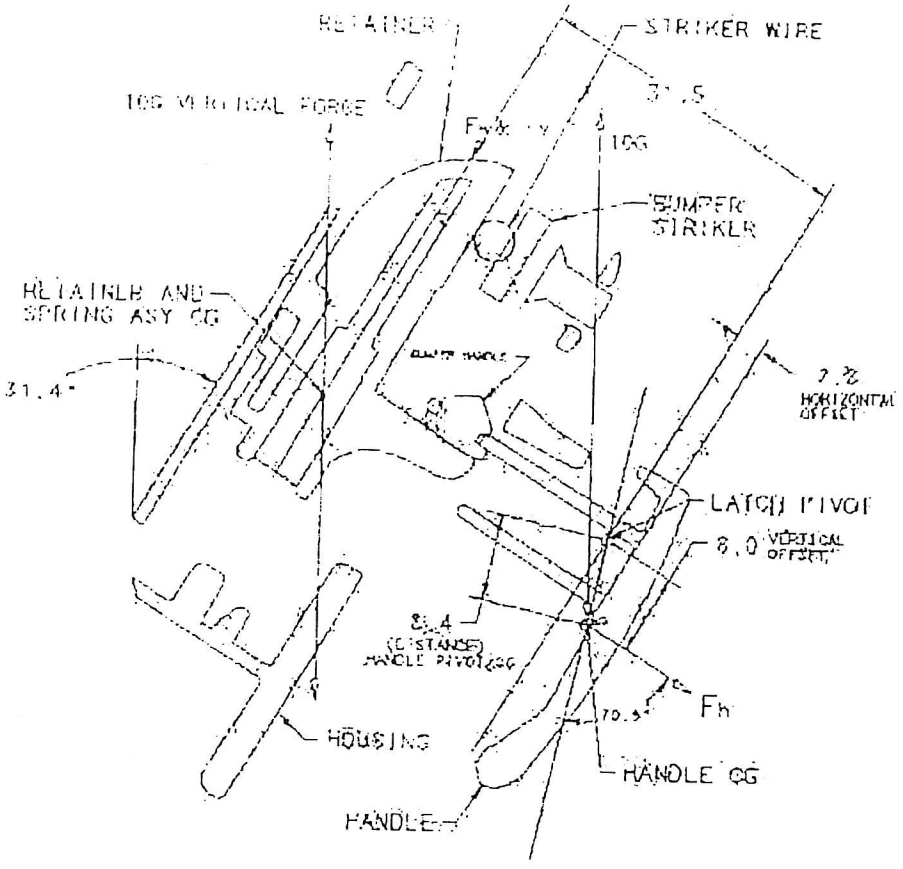
Moment of Inertia of Handle = -{M(handle) x [30G x dheg x cos31.4 + 1G x 8.4 x Cos58.6]} / cos(90-70.9) =
= -{ 0.0168 x [30 x 9.81 x 8.4 x cos31.4 + 9.81 x 4.38]/sin70.9

= - 34.18 Nmm

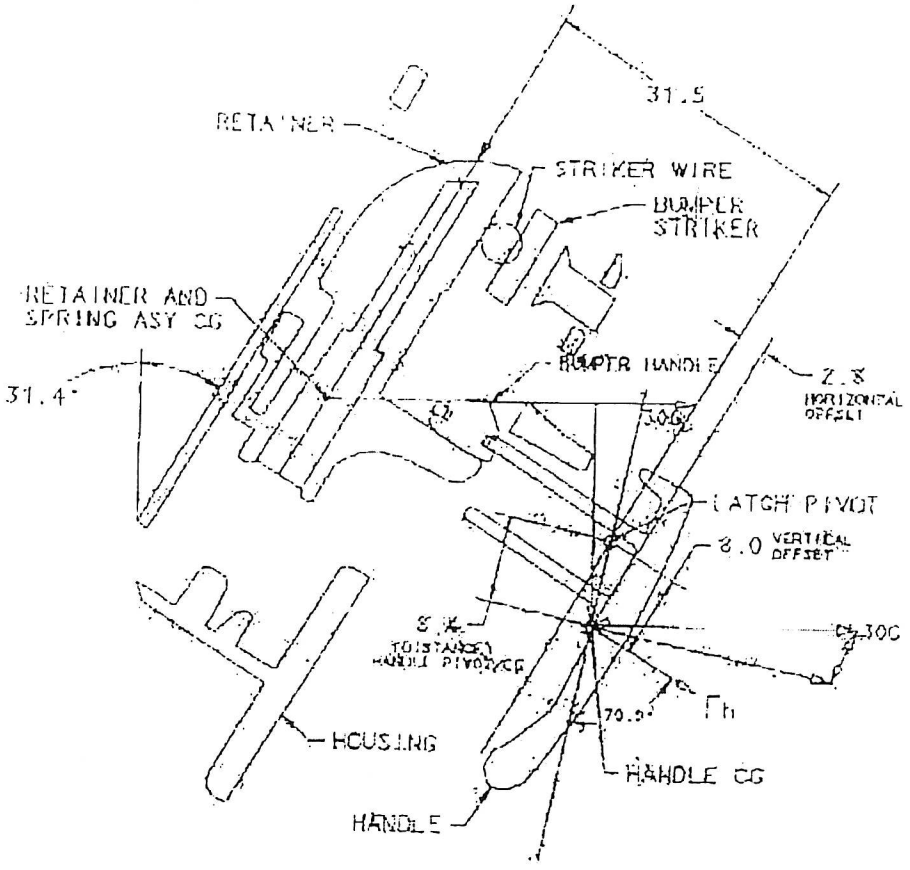
F_h (handle inertia) = Moment of Inertia of Handle / dhl
= - 34.18 / 31.5
= - 1.09 N

Net effective force = 5.32 – 1.09+ 0.58 = 4.81N

Net Effective Force of 4.81N acting upwards keeps the latch assembly closed.


RETAINER
STRIKER WIRE
100 VERTICAL FORCE
Fh
100
BUMPER STRIKER
RETAINER AND SPRING ASY CG
31.4°
7.2 HORIZONTAL OFFSET
LATCH PIVOT
8.0 VERTICAL OFFSET
8.4
Fh
70.5°
HOUSING
HANDLE CG
HANDLE

GMT001 SV


31.5
RETAINER
STRIKER WIRE
BUMPER STRIKER
RETAINER AND SPRING ASY CG
31.4
Z.8 HORIZONTAL OFFSET
LATCH PIVOT
8.0 VERTICAL OFFSET
30C
HOUSING
70.0
HANDLE CG
HANDLE

GMT001 SV

2007 Chevrolet HHR

FMVSS 201 S3.1

Instrument Panel Storage Bin

Latch Component Analysis

OBJECTIVE

To verify the GMT001 door bin assembly complies with FMVSS No. 201 set forth in paragraphs S3.3, S3.31 sections (a) & (c). Calculation procedures are followed as described in section 5 of SAE Recommended Practice J839b.

LATCH CHARACTERISTICS

Latch is design to pivot about an integrated arbor pin and a torsion spring is pre-loaded to maintain position. Said latch is not affected by traverse loads.

RESULTS

30 G's Forward and Rearward Longitudinal Direction
The latch / bin assembly mechanism complies with FMVSS 201 requirements. Analysis indicates force of 9.47N in upward and 4.49N downward.

Shear forces at the screws, latch paw pivot, and striker prove the latching system can withstand and the forces with a large safety factor.

10 G's Transverse Horizontal Direction
The latch / bin assembly mechanism complies with FMVSS 201 requirements. The latch is not affected

10G's Upward Vertical Direction (Worst Case Condition)
The latch assembly mechanism complies with FMVSS 201 requirements. In worst case condition analysis indicates a 26N force

Shear forces at the screws, latch paw pivot, and striker prove the latching system can withstand the forces with a large safety factor.

10G's Downward Vertical Direction
The latch assembly mechanism complies with FMVSS 201 requirements. Given worst case condition above analysis is redundant. Also, the two bumpers compressed at 3mm will have an upward opposing force of 35.84N

RESULTS FOR THE LATCH PAW INERTIA ANALYSIS

30 G's Forward and Rearward Longitudinal Direction
The Latch Paw mechanism complies with FMVSS 201 requirements. Analysis indicates a force 5.72N at 30G forward and 4.57N at 30G rearward force will keep the paw engaged to the striker. In both cases 5.72N and 4.57N is forcing the paw against the striker

10G Vertical Upward & 10G Vertical Downward

The latch assembly mechanism complies with FMVSS 201 requirements. Worst case condition analysis indicates a 26N force as indicated above when the latch paw was evaluated as part of latch system. Lateral forces have no affect on the paw.

CONCLUSION:

The latch assembly mechanism complies with all FMVSS 201 requirements by calculation and/or component specifications

Inertia Calculation – 30G Forward & Rearward Longitudinal Acceleration

GMT001 IP BIN

m	Mass Total		.384Kg
	Lid Inner& Outer =	.364Kg	
	House for Button & Latch =	.012Kg	
	Button =	.002Kg	
	Latch =	.004Kg	
	Screws =	.002Kg	

Fmg	Force of Gravity (m)(g)= (.384Kg)(9.81)	3.77N
Fd	Force of Deceleration (m)(g)(D)= (.384) (9.81) (30) =	113N
Dd	Radial Arm of Deceleration in Meters =	.00815M
Dr	Radial Arm of Latch pivot arbor in Meters =	.193M
Dmg	Radial Arm of Fmg =	.113M
Sfm	Spring Force Moment at hinge Mpt =	.480NM
Sfv	Spring Vector Force at Dr (.48 / .193)	2.49N
Bf	Bumper Force at Dr (3mm compression x2)	35.84N
Fr	Force at latch pivot point	

Sum of moments at hinge point Mo

$$= (Fr)(Dr) - ((Fmg)(Dmg) + (Fd)(Dd)) + Sfm = 0$$

Vector Force Conversion Analysis Forward 30G

$Fr = ((Fmg)(Dmg) + (Fd)(Dd))/Dr - Sfv$
$Fr = ((3.77)(.113) + (113)(.00815))/.193 - 2.49$
$Fr = (.426 + .921)/.193 + 2.49$
$Fr = 9.47N$ Upward

Vector Force Conversion Analysis Rearward 30G

$Fr = (.426 + .921)/.193 - 2.49$
$Fr = 4.49N$ Downward

Vertical 10G Upward Force (Worst case condition)

Force in Vertical
Moment = (m)(g)(10g)(Dmg)= (.384) (9.81) (10)(.133) = 5.01 N/M
Force at paw arbor = 5.01 / .193 = 26N

Since the weakest point of the latch will be the latch paw pivot arbor, and the two screws holding the latch assembly, both must withstand a 26N force and not fracture or shear.

Screw pull out strength

Attached here with please find the screw calculations showing one fastened screw for the latch assembly will withstand 939N. Said latch assembly is attached by two screws.

Striker Pin

The striker pin is a 3mm case hardened 1020 steel which will withstand a minimum 2000N force in shear

Latch paw pivot arbor shear strength

The shear modulus for Acetal material at 120 degrees F is 47 Mpa

F1 = Area x 2 (47Mpa)
F1 = 25,13 x 47Mpa
F1 = 1,1812 N

Vertical 10G Downward Force

In this case no shear forces are exhibited on the stricter, paw pivot, or attachment screws.

The two bumpers with 3mm compression with provide an opposing upward force of 35.84N

Inertia Calculation of the effect of the isolated Latch Paw about its pivot arbor

Mass of paw =	.004Kg
Ti = Torsion spring installed preload =	.051 Nm
Tr = Torsion spring release load =	.081 Nn
Vo = CG vertical offset to pivot =	.0065
Vh = CG horizontal offset to pivot =	.0027
Dr = Paw arbor pivot to striker	.0099M
Dd = CG of paw to paw pivot	.00532

Vector Force Conversion Analysis Forward 30G

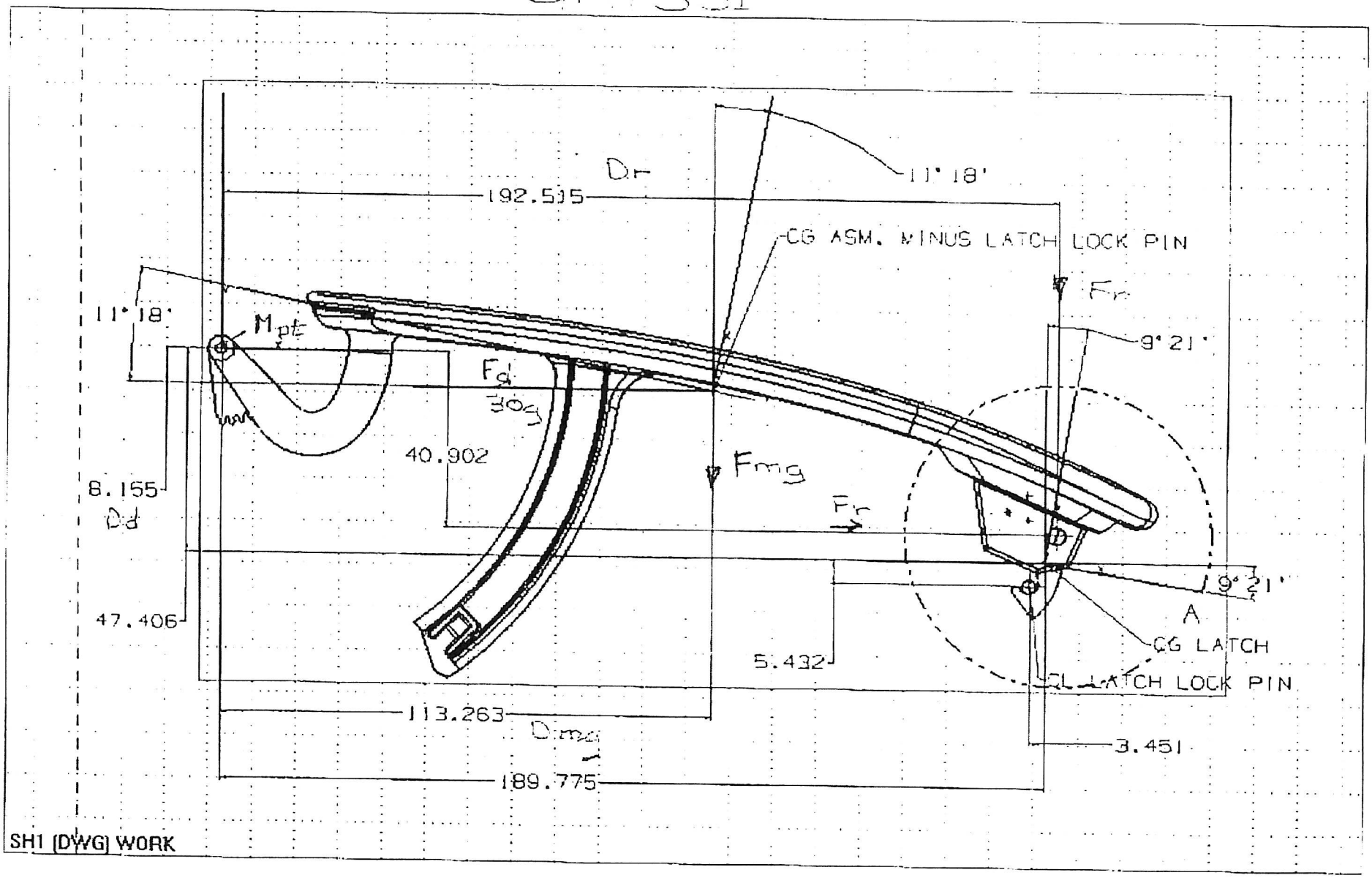
Mo = Moment about paw pivot + Spring force = 0
Mo = (.004)(30)(9.8)(.00532) + .051
Mo = .0057Nm +.051Nm
F1 = (.0057Nm +.051Nm) / .0099M
F1 = 5.72 N keeping the paw latched to the striker

Vector Force Conversion Analysis Rearward 30G

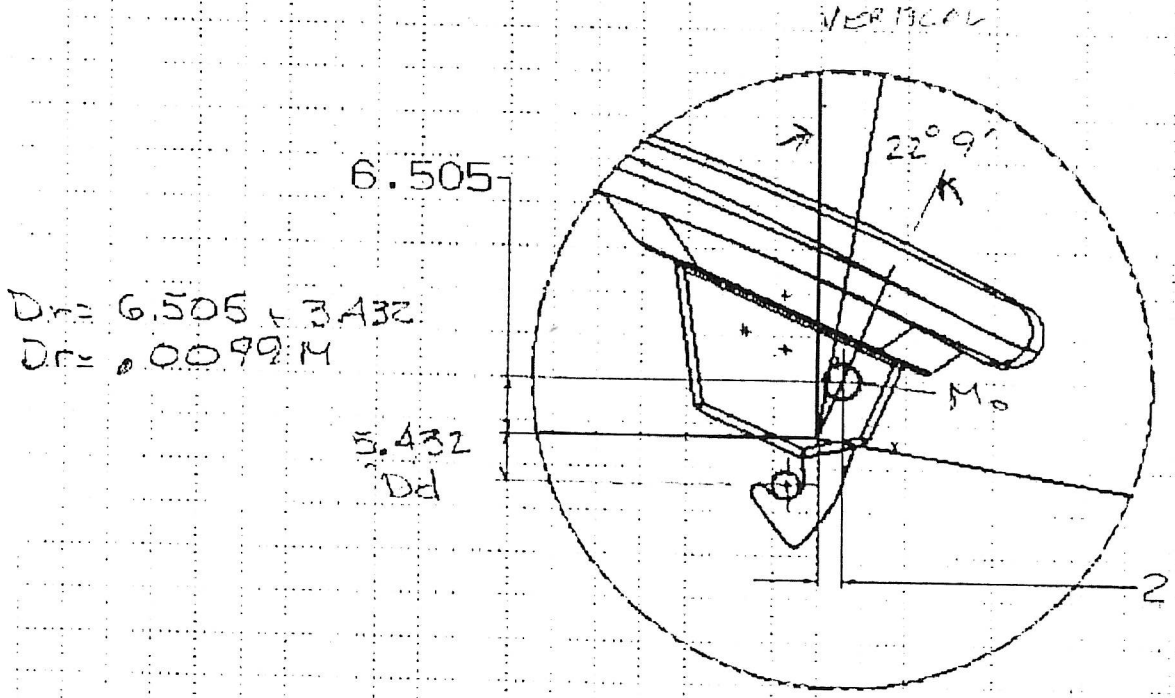
F1 = (-.0057Nm +.051Nm) / .0099M
F1 = 4.57N keeping the paw latched to the striker

Conclusion:
The paw will stay affixed to the striker in at 30G forward of rearward. Also, worst case condition on a 10G vertical load upward was evaluated as a lid assembly. A 10G lateral load has no effect

GM Top 1


Dr
11° 18'
192.515
CG ASM. MINUS LATCH LOCK PIN
Fr
11° 18'
Mpt
9° 21'
Fd
30g
40.902
Fmg
8.155
Dd
Fr
47.406
9° 21'
A
CG LATCH
5.432
CL LATCH LOCK PIN
113.263
Dmg
3.451
189.775
SH1 (DWG) WORK

GMT 001



Dr= 6.505 - 5.432
Dr= .0099 M

.0027
.0065
.0070
Dmg

DETAIL A
SCALE 4/1

SH1 [DWG] WORK...

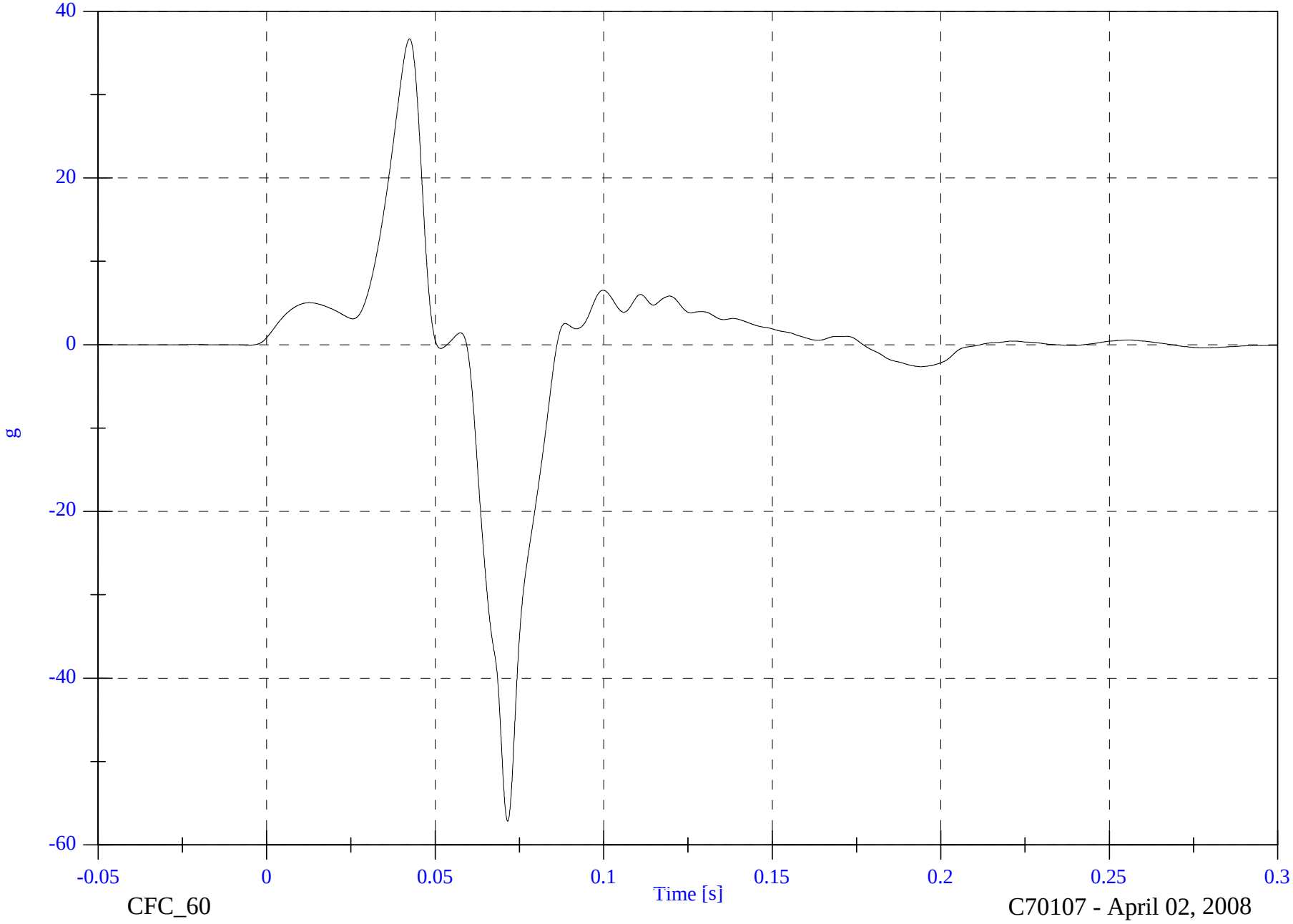
APPENDIX C

DATA PLOTS

C70107 INSTRUMENT PANEL ABOVE RADIO CLUSTER IMPACT PLOT #1 8832-FMH-05

FMVSS 201 Linear Impact - 2007 Chevrolet HHR - IP1 -57 Degrees
Impactor Headform Ax

Max: 36.7 [g] at 0.042 [s]
Min: -57.1 [g] at 0.071 [s]



CFC_60

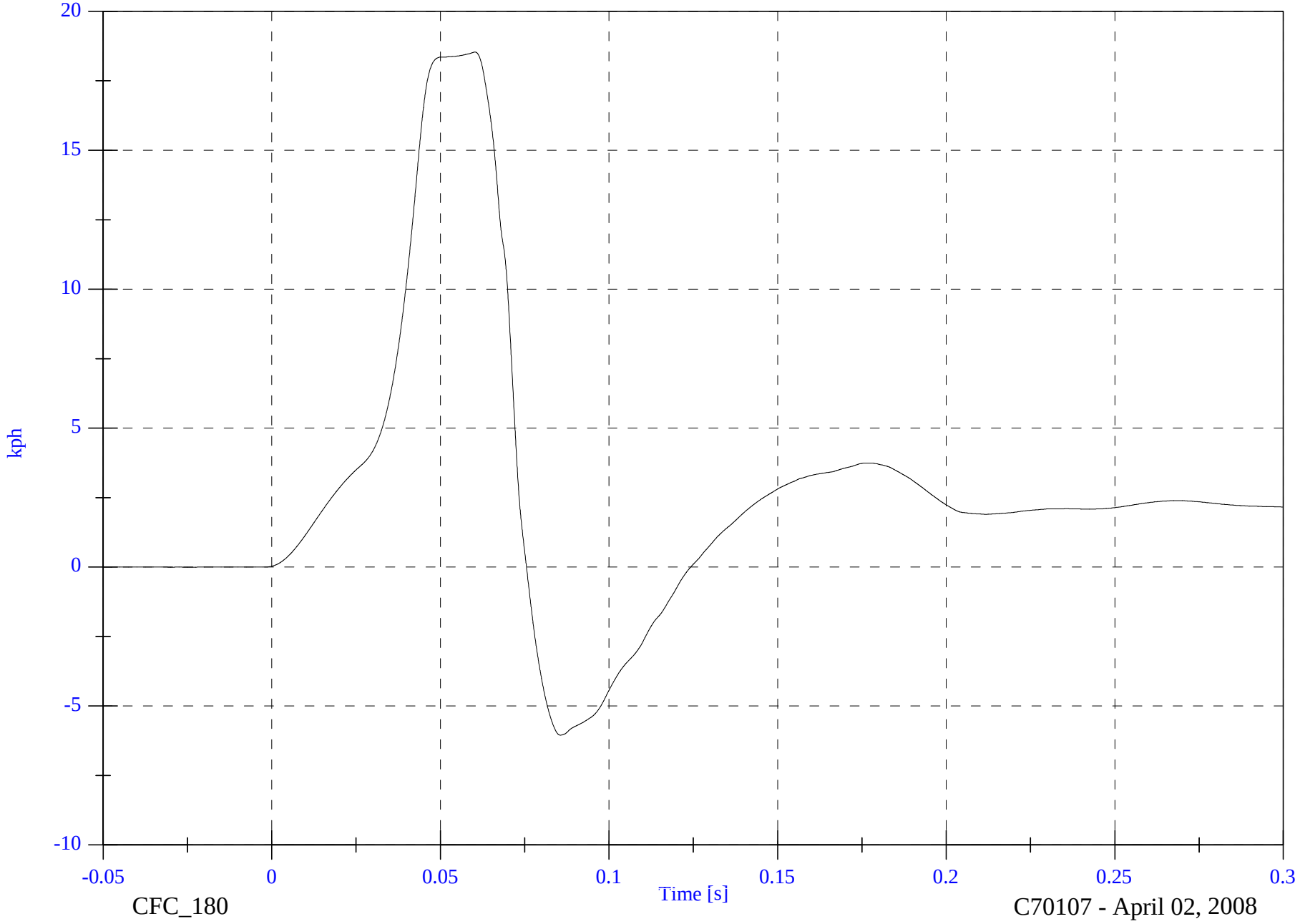
C70107 - April 02, 2008

FMVSS 201 Linear Impact - 2007 Chevrolet HHR - IP1 -57 Degrees

Impactor Headform Ax Velocity

Max: 18.5 [kph] at 0.060 [s]

Min: -6.0 [kph] at 0.086 [s]



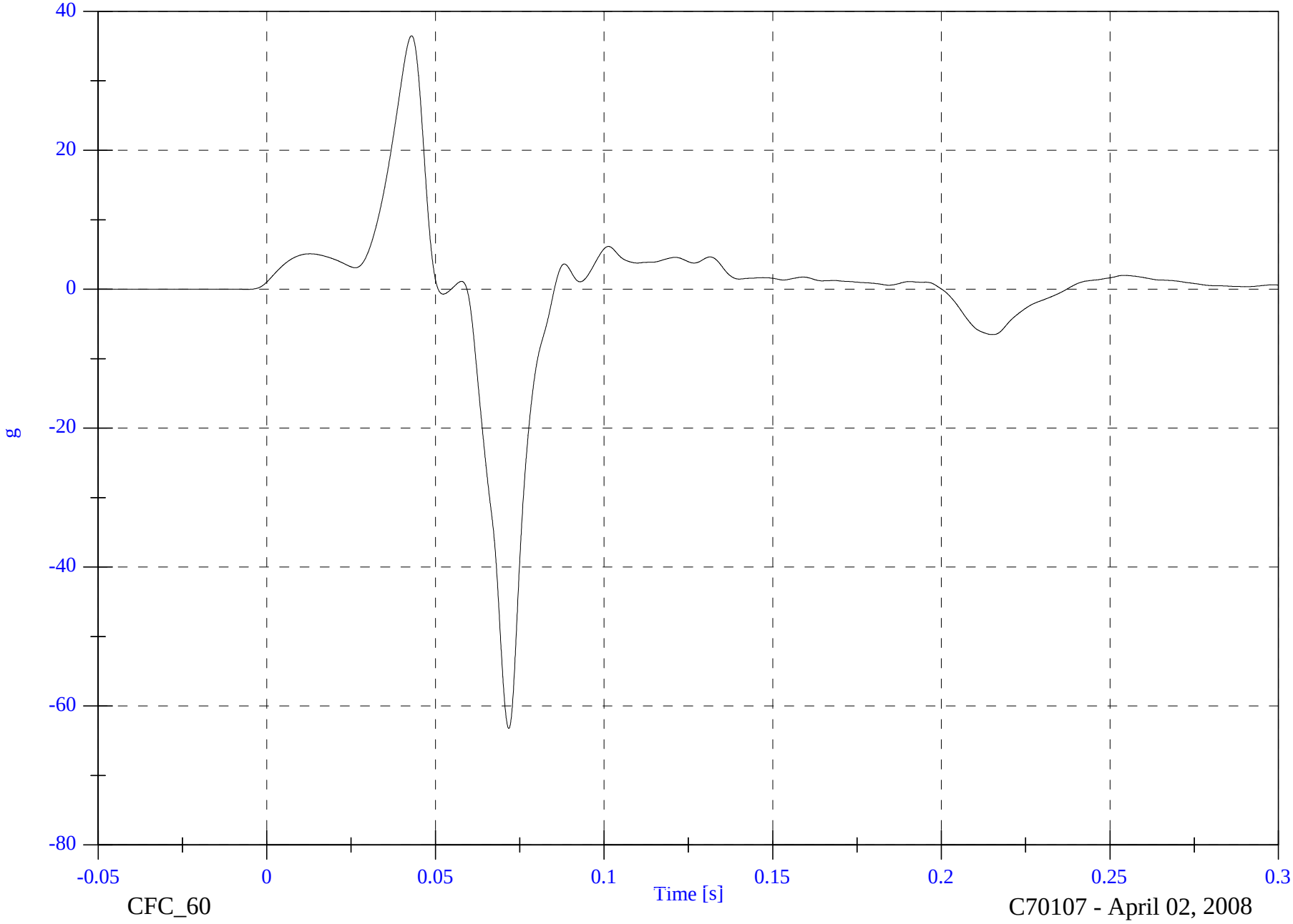
C70107 INSTRUMENT PANEL ABOVE RADIO CLUSTER IMPACT PLOT #2 8832-FMH-05

CFC_180

C70107 - April 02, 2008

FMVSS 201 Linear Impact - 2007 Chevrolet HHR - IP2 -65 Degrees
Impactor Headform Ax

Max: 36.5 [g] at 0.043 [s]
Min: -63.2 [g] at 0.072 [s]



C70107 LEFT SIDE DASH ON AIRBAG COVER IMPACT PLOT #1

8832-FMH-05

CFC_60

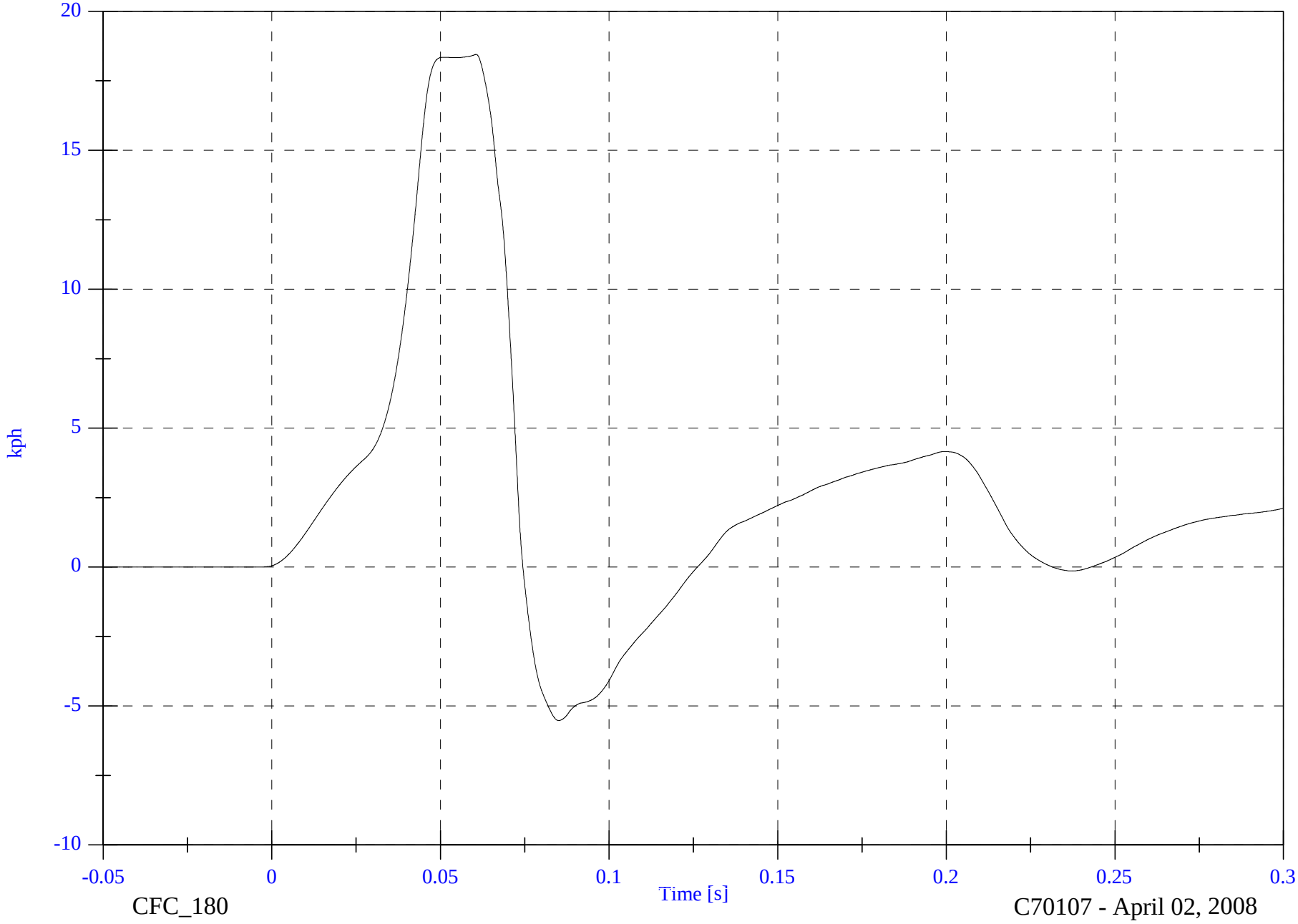
C70107 - April 02, 2008

FMVSS 201 Linear Impact - 2007 Chevrolet HHR - IP2 -65 Degrees

Impactor Headform Ax Velocity

Max: 18.4 [kph] at 0.061 [s]

Min: -5.5 [kph] at 0.085 [s]



C70107 LEFT SIDE DASH ON AIRBAG COVER IMPACT PLOT #2

8832-FMH-05

CFC_180

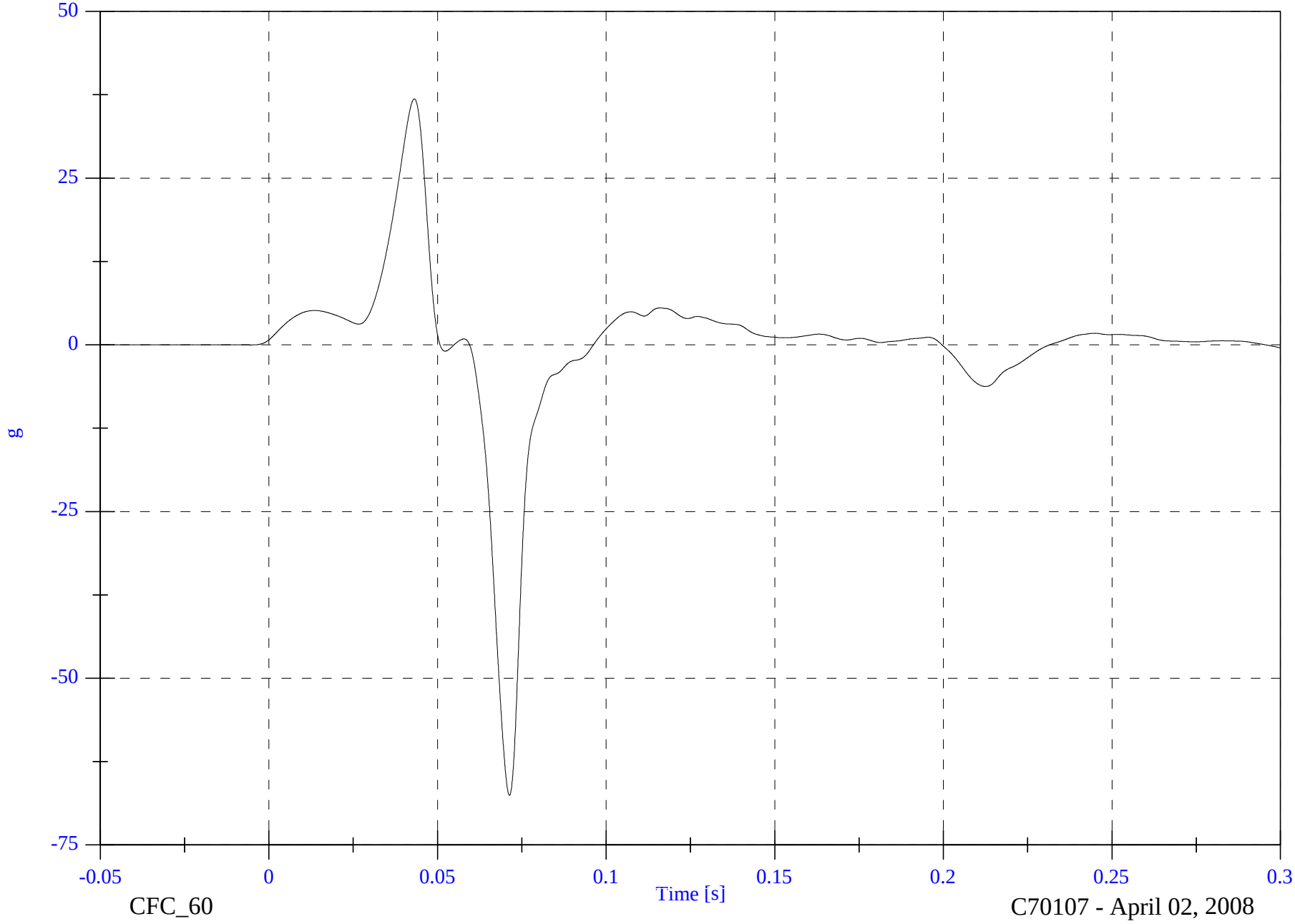
C70107 - April 02, 2008

FMVSS 201 Linear Impact - 2007 Chevrolet HHR - IP3 -58 Degrees

Impactor Headform Ax

Max: 36.9 [g] at 0.043 [s]

Min: -67.6 [g] at 0.071 [s]



C70107 RIGHT SIDE DASH BELOW AIRBAG IMPACT PLOT #1

8832-FMH-05

CFC_60

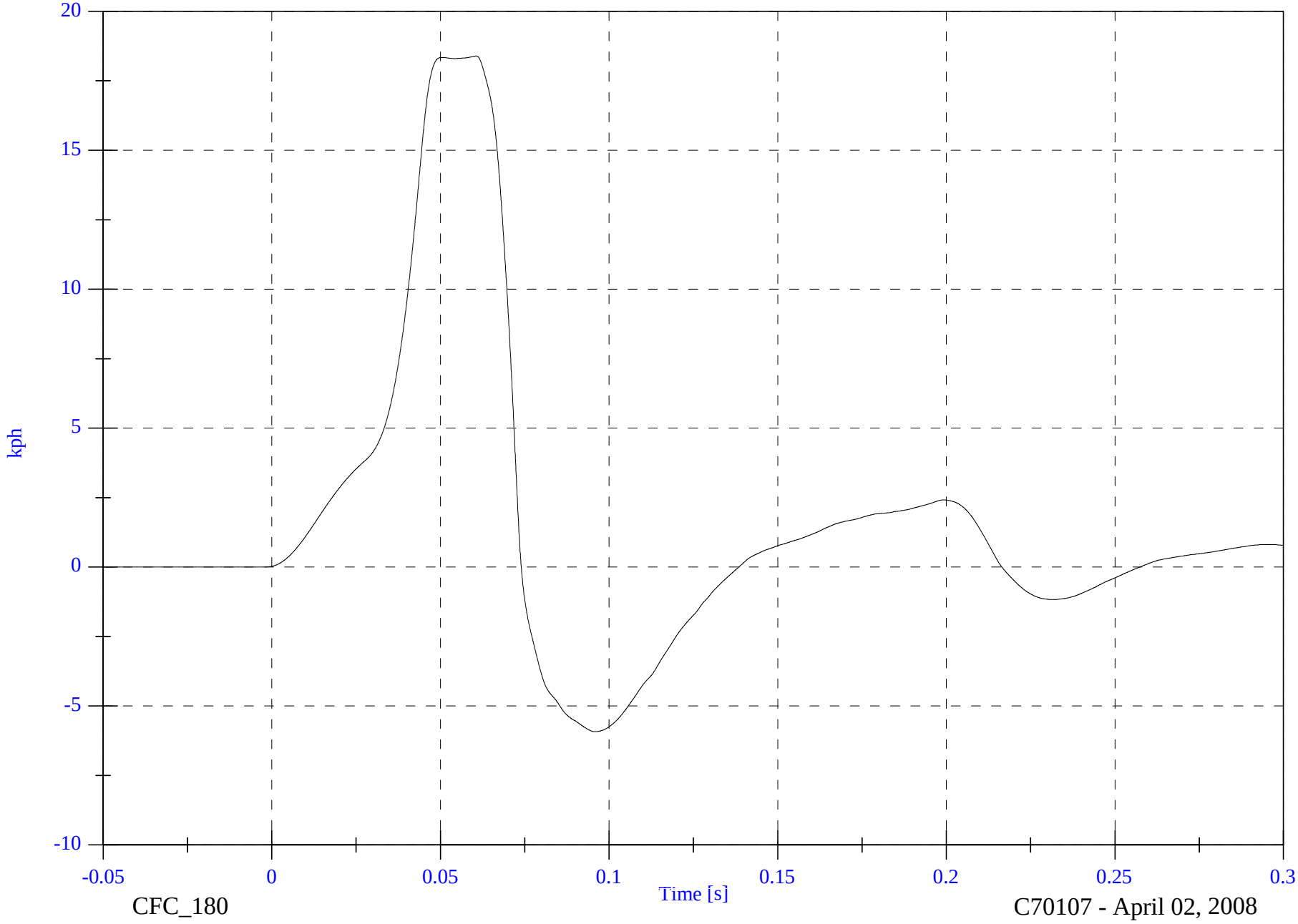
C70107 - April 02, 2008

FMVSS 201 Linear Impact - 2007 Chevrolet HHR - IP3 -58 Degrees

Impactor Headform Ax Velocity

Max: 18.4 [kph] at 0.061 [s]

Min: -5.9 [kph] at 0.096 [s]



C70107 RIGHT SIDE DASH BELOW AIRBAG IMPACT PLOT #2

8832-FMH-05

CFC_180

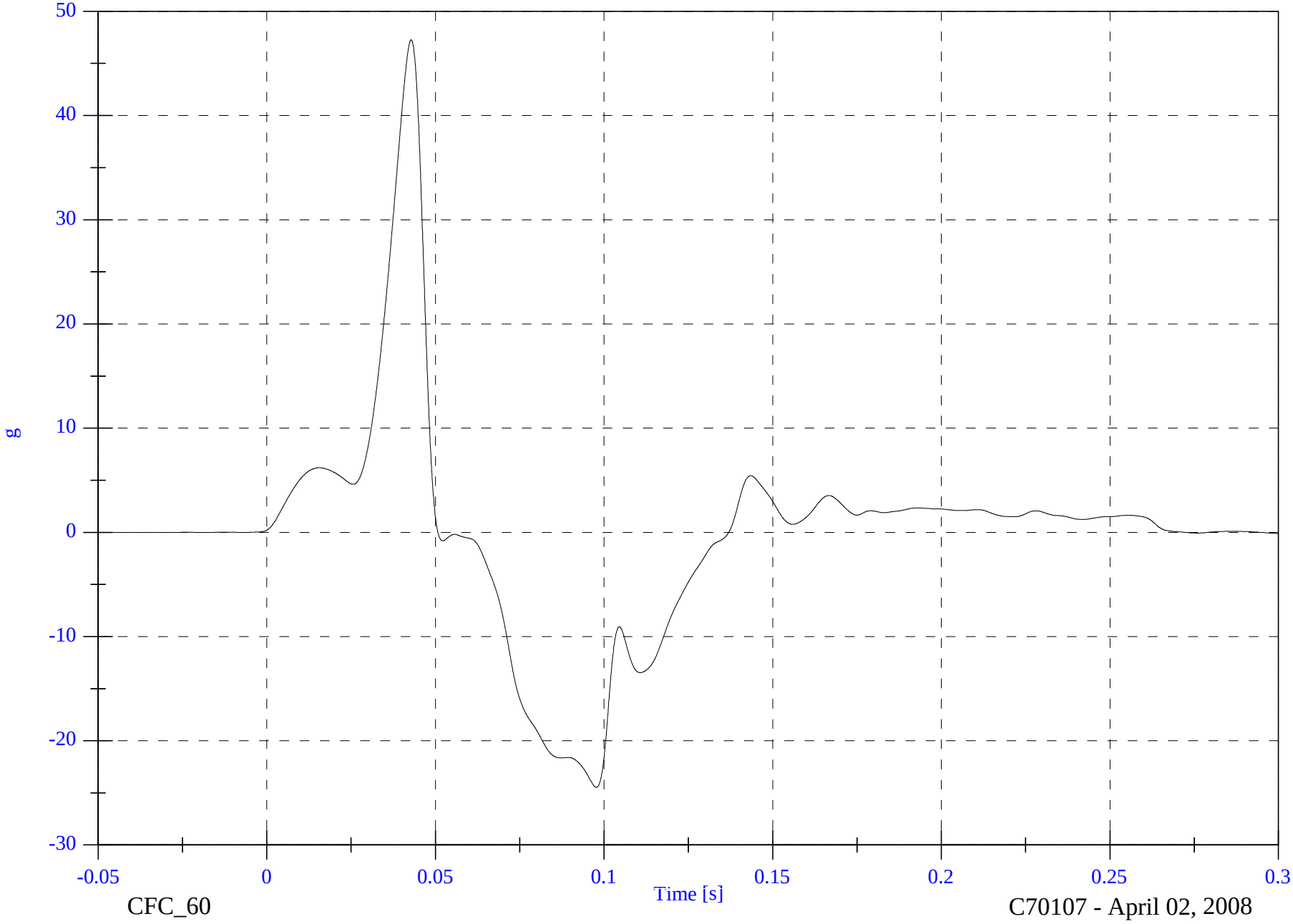
C70107 - April 02, 2008

FMVSS 201 Linear Impact - 2007 Chevrolet HHR - SB -16 Degrees

Impactor Headform Ax

Max: 47.3 [g] at 0.043 [s]

Min: -24.5 [g] at 0.098 [s]



C70107 SEAT BACK IMPACT PLOT #1

8832-FMH-05

CFC_60

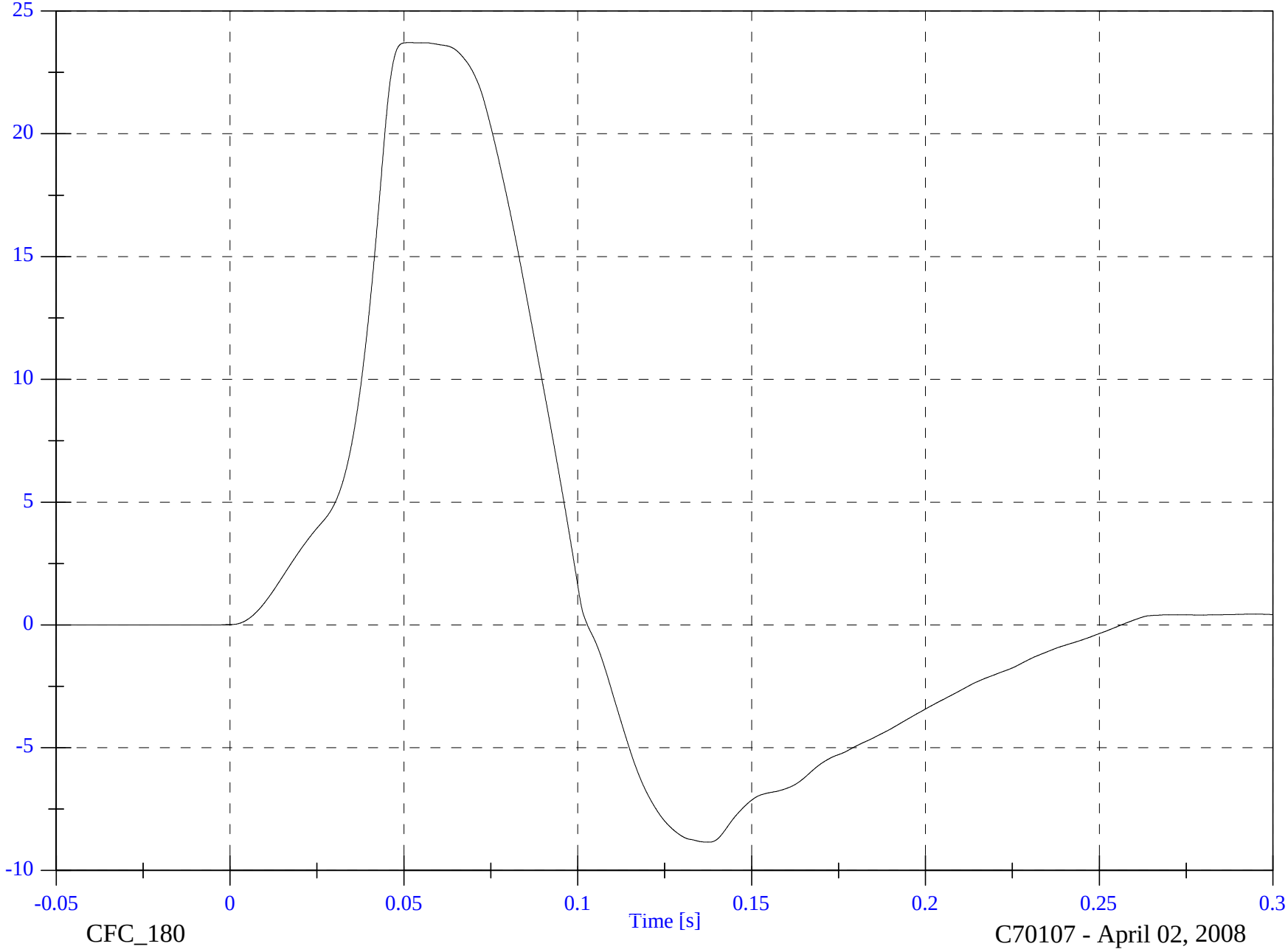
C70107 - April 02, 2008

FMVSS 201 Linear Impact - 2007 Chevrolet HHR - SB -16 Degrees

Impactor Headform Ax Velocity

Max: 23.7 [kph] at 0.051 [s]

Min: -8.8 [kph] at 0.138 [s]



C70107 SEAT BACK IMPACT PLOT #2

8832-FMH-05

CFC_180

C70107 - April 02, 2008