

**Vehicle Research and Test Center
1993 Cadillac DeVille into
Rear of a 1996 Jeep Grand Cherokee Limited
TRC Inc. Test Number: 131121**



**Prepared By:
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**Final Report
November 2013 – January 2014**

**Prepared For:
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Test Performed By: John Shultz, Supervisor

Report Approved January 23, 2014 by:

A handwritten signature in black ink, reading "Jeffery W. Sankey". The signature is written in a cursive style with a horizontal line underneath it.

Jeffery W. Sankey
Manager, Project Operations

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Section 1.0

Purpose and Test Procedure

Purpose

This vehicle-to-vehicle rear impact test was conducted for the National Highway Traffic Safety Administration (NHTSA) and Vehicle Research and Test Center (VRTC) by Transportation Research Center Inc. (TRC Inc.).

The test mode was defined as the bullet vehicle moving at 56.6 km/h to impact the target vehicle moving at 0 km/h at an impact angle of 180 degrees. The purpose of this test was to evaluate the aggressiveness of the bullet vehicle, a 1993 Cadillac DeVille, and the vehicle response of the target vehicle, a 1996 Jeep Grand Cherokee Limited, in this vehicle-to-vehicle rear impact mode.

Test Procedure

This test was conducted in accordance with VRTC instructions for a vehicle-to-vehicle rear impact test. Data was obtained relative to FMVSS 301, "Fuel System Integrity," performance.

The target vehicle, a 1996 Jeep Grand Cherokee Limited, was instrumented with six (6) accelerometers to measure longitudinal, lateral and vertical axis accelerations.

The bullet vehicle, a 1993 Cadillac DeVille, was instrumented with six (6) accelerometers to measure longitudinal, lateral and vertical axis accelerations. The vehicle's specified impact velocity range was 55.5 to 57.1 km/h.

The bullet vehicle impacted the rear of the target vehicle at an impact angle of 180 degrees. The intended impact point was the bullet vehicle's centerline aligned 381 millimeters left of the target vehicle's centerline.

One (1) Hybrid III 50th Male Ballast dummy was placed in the bullet vehicle's driver's seat. One (1) Hybrid III 50th Male Ballast dummy was placed in the target vehicle's driver's seat. Both dummies were restrained with seatbelts.

The twelve (12) data channels were digitally sampled and recorded at 12,500 samples per second and processed per SAE J211 March 1995.

The crash event was recorded by three (3) real-time panning motion picture cameras and nine (9) high-speed motion picture cameras.

The test summary data is presented in Section 2.0. The FMVSS 301 data is presented in Section 3.0. The camera and vehicle measurements are presented in Section 4.0. Appendix A contains the still photographic prints. Appendix B contains the vehicle data plots.

Section 2.0

Test Summary

Test Results Summary

This 56.6 km/h 180° vehicle-to-vehicle rear impact test was conducted by TRC Inc. on November 21, 2013.

The target test vehicle, a 1996 Jeep Grand Cherokee Limited, was equipped with a 5.2-liter 8 cylinder engine, 4 speed automatic transmission, power steering, power brakes, and front airbags. The target vehicle's test weight was 1934.0 kg.

The bullet test vehicle, a 1993 Cadillac DeVille, was equipped with a 4.9-liter 8 cylinder transverse engine, 4 speed automatic transmission, power steering, power brakes, and driver's front airbags. The bullet vehicle's test weight was 1771.2 kg. The bullet vehicle's impact speed was 56.6 km/h.

Data Acquisition Explanations

There are no anomalies to report.

Table 1 Crash Test Summary

Test mode:	Vehicle to Vehicle Rear Impact
Test date:	November 21, 2013
Test time:	11:51 AM
Ambient temperature:	6.1°C
Target vehicle year/make/ model/body style:	1996 Jeep/Grand Cherokee Limited/MPV
Target vehicle test weight:	1934.0 kg
Bullet vehicle year/make/ model/body style:	1993/Cadillac/DeVille/ Sedan
Bullet vehicle test weight:	1771.2 kg
Impact angle ¹ :	180°
Impact velocity ² :	Bullet vehicle = 56.6 km/h
Total number of data channels:	12
Number of cameras:	
High-speed:	9
Real-time:	3

¹ With respect to tow track centerline.

² Speed trap measurement ($\pm .08$ km/h accuracy)

Table 2 Target Vehicle General Test and Vehicle Parameter Data

Vehicle year/make/ model/body style:	1996 Jeep/Grand Cherokee Limited/MPV
VIN:	1J4GZ78Y4TC287427
Model year:	1996
Body style:	MPV
Color:	Dark Red
Engine data:	
Cylinders:	8
Displacement	5.2 liters
Type:	V
Placement:	Longitudinal
Transmission data:	<u>4</u> speed, <u> </u> manual, <u>X</u> automatic, <u>X</u> overdrive
Final drive:	<u> </u> FWD, <u> </u> RWD, <u>X</u> 4WD
Date vehicle received:	11/19/2013
Odometer reading:	250,524
Dealer's name	Customer Supplied

Accessories:

Power steering	Yes	Automatic transmission	Yes
Power brakes	Yes	Automatic speed control	Yes
Power seats	Yes	Tilting steering wheel	Yes
Power windows	Yes	Telescoping steering wheel	No
Tinted glass	Yes	Air conditioning	Yes
Radio	Yes	Anti-skid brake	No
Clock	Yes	Rear window defroster	Yes
Other	None	Power door locks	Yes

Certification data from vehicle's label¹:

Vehicle manufactured by:	N/A
Date of manufacture:	N/A
VIN:	N/A
GVWR:	N/A lbs. (N/A kg)
GAWR: Front:	N/A lbs. (N/A kg)
Rear:	N/A lbs. (N/A kg)

¹ The vehicle did not contain a certification label.

Table 2 Target Vehicle General Test and Vehicle Parameter Data, Continued

Tires on vehicle (mfr., line, size): Toyo, Tranpath, P225/70R16

Tire pressure with maximum capacity vehicle load:

Front: 44 psi (300 kPa)

Rear: 44 psi (300 kPa)

Spare tire (mfr., line, size): Goodyear, Invicta, P225/75R15

Type of seats:

Front Bucket

Rear Split Bench

Maximum width: 1795 mm

Wheelbase: 2690 mm

Location of "Recommended Tire Pressure" label:

Glove Box

Data from vehicle's "Recommended Tire Pressure" label:

Recommended tire size: P215/75R15

Recommended cold tire pressure: Front: 36 psi (248 kPa)
Rear: 36 psi (248 kPa)

Seating capacity: Front: 2
Mid: 0
Rear: 3
Total: 5

Vehicle capacity weight: 1150 lbs. (522 kg)

Rated cargo/luggage weight: N/A lbs. (N/A kg)

Test vehicle attitude:

Pre-test attitude: LF 790 mm; RF 767 mm; LR 812 mm; RR 817 mm

Post-test attitude: LF 762 mm; RF 807 mm; LR 745 mm; RR 759 mm

Table 2 Target Vehicle General Test and Vehicle Parameter Data Continued

Weight of test vehicle with required dummies and cargo weight:

Right front	535.4 kg	Right rear	397.0 kg
Left front	595.4 kg	Left rear	406.2 kg
Total front weight	1130.8 kg	(58.5% of total vehicle weight)	
Total rear weight	803.2 kg	(41.5% of total vehicle weight)	
Total test weight	1934.0 kg		

Weight of ballast secured in vehicle: 0 kg

Components removed to meet target test weight: None

Location of Vehicle's CG: 1117 mm rearward of front wheel centerline

Fuel System Data:

Usable fuel system capacity	N/A liters (from owner's manual)
Actual test volume:	68.5 liters

Table 3 Bullet Vehicle General Test and Vehicle Parameter Data

Vehicle year/make/ model/body style:	1993/Cadillac/DeVille/Sedan
VIN:	1G6CD53B7P4275317
Model year:	1993
Body style:	Sedan
Color:	Blue
Engine data:	
Cylinders:	8
Displacement	4.9 liters
Type:	V
Placement:	Transverse
Transmission data:	<u>4</u> speed, <u> </u> manual, <u>X</u> automatic, <u>X</u> overdrive
Final drive:	<u>X</u> FWD, <u> </u> RWD, <u> </u> 4WD
Date vehicle received:	11/19/2013
Odometer reading:	96,362
Dealer's name	Customer Supplied

Accessories:

Power steering	Yes	Automatic transmission	Yes
Power brakes	Yes	Automatic speed control	Yes
Power seats	Yes	Tilting steering wheel	Yes
Power windows	Yes	Telescoping steering wheel	No
Tinted glass	Yes	Air conditioning	Yes
Radio	Yes	Anti-skid brake	No
Clock	Yes	Rear window defroster	Yes
Other	None	Power door locks	Yes

Certification data from vehicle's label:

Vehicle manufactured by:	General Motors Corporation
Date of manufacture:	2/93
VIN:	1G6CD53B7P4275317
GVWR:	4707 lbs. (2135 kg)
GAWR: Front:	2632 lbs. (1194 kg)
Rear:	2075 lbs. (941 kg)

Table 3 Bullet Vehicle General Test and Vehicle Parameter Data, Continued

Tires on vehicle (mfr., line, size):

Left Front:	Bridgestone, Turanza, P205/70R15
Right Front:	Goodyear, Viva 2, P205/70R15
Left Rear:	Firestone, FR 710, P205/70R15
Right Rear:	Firestone, FR 710, P205/70R15

Tire pressure with maximum capacity vehicle load:

Front:	44 psi (300 kPa)
Rear:	44 psi (300 kPa)

Spare tire (mfr., line, size): Uniroyal, Temporary, T125/70D15

Type of seats:

Front	Split bench
Rear	Bench

Maximum width: 1865 mm

Wheelbase: 2885 mm

Location of "Recommended Tire Pressure" label:

Left Front Door

Data from vehicle's "Recommended Tire Pressure" label:

Recommended tire size: P205/70R15

Recommended cold tire pressure: Front: 30 psi (210 kPa)
Rear: 30 psi (210 kPa)

Seating capacity: Front: 3
Mid: 0
Rear: 3
Total: 6

Vehicle capacity weight: 1027 lbs. (466 kg)

Rated cargo/luggage weight: N/A lbs. (N/A kg)

Test vehicle attitude:

Pre-test attitude:	LF 670 mm;	RF 685 mm;	LR 667 mm;	RR 683 mm
Post-test attitude:	LF 664 mm;	RF 692 mm;	LR 647 mm;	RR 674 mm

Table 3 Bullet Vehicle General Test and Vehicle Parameter Data, Continued

Weight of test vehicle with required dummies and cargo weight:

Right front	524.6 kg	Right rear	342.6 kg
Left front	551.2 kg	Left rear	352.8 kg
Total front weight	1075.8 kg	(60.7% of total vehicle weight)	
Total rear weight	695.4 kg	(39.3% of total vehicle weight)	
Total test weight	1771.2 kg		

Weight of ballast secured in vehicle: 0 kg

Components removed to meet target test weight: None

Location of Vehicle's CG: 1133 mm rearward of front wheel centerline

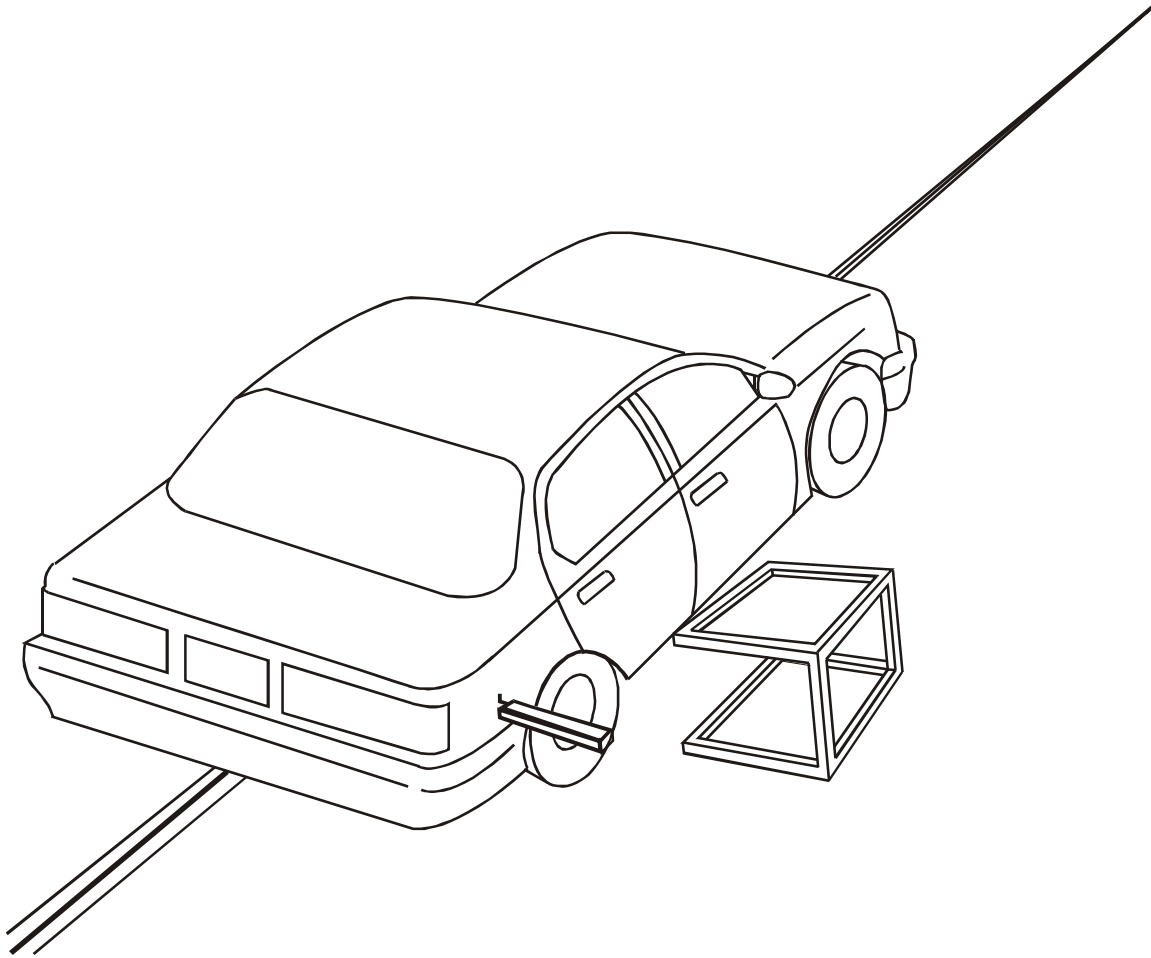
Fuel System Data:

Usable fuel system capacity	N/A liters (from owner's manual)
Actual test volume:	70.4 liters

Table 4 Post-Impact Data

Test number:	131121
Test date:	11/21/2013
Test time:	11:51 AM
Test type:	Vehicle to Vehicle Rear Impact
Impact angle:	180°
Ambient temperature at impact area:	6.1°C
Impact velocity:	
Target vehicle:	0 km/h
Bullet vehicle:	56.6 km/h
Required impact velocity range:	
Bullet vehicle:	55.5 to 57.1 km/h
Distance from each vehicle to intended impact point:	
Entering velocity trap:	660 mm
Exiting velocity trap:	50 mm, approximately

Figure 1 Impact Velocity Measurement System



The vane clears the final emitter/receiver pair approximately 50 millimeters before impact.

The emitter/receiver pairs have 610-millimeter spacing.

Table 5 Target Vehicle Accelerometer Data Summary

Accel. No.	Location		Positive Direction		Negative Direction	
			Max. (g)	Time (ms)	Max. (g)	Time (ms)
1	Vehicle Center of Gravity	X	12.42	75.28	-1.70	192.24
		Y	7.40	127.44	-10.48	73.04
		Z	3.76	50.32	-1.66	97.44
		R	15.35	73.92	0.01	-16.88
2	Vehicle Center of Gravity Redundant	X	12.63	75.04	-1.70	192.08
		Y	5.87	50.16	-2.11	72.16
		Z	7.47	127.52	-10.29	73.04
		R	15.61	73.84	0.00	-5.20

Reference: X: + Forward From Rear Bumper
 Y: + Rightward From Vehicle Centerline
 Z: + Downward From Ground Level

Table 6 Bullet Vehicle Accelerometer Data Summary

Accel. No.	Location		Positive Direction		Negative Direction	
			Max. (g)	Time (ms)	Max. (g)	Time (ms)
1	Vehicle Center of Gravity	X	0.72	3.2	-15.47	75.20
		Y	2.99	116.16	-3.26	61.76
		Z	14.89	64.00	-16.76	87.84
		R	21.83	87.76	0.04	-3.44
2	Vehicle Center of Gravity Redundant	X	0.63	3.12	-15.30	82.48
		Y	2.60	116.32	-3.29	61.60
		Z	12.29	62.80	-14.44	88.00
		R	19.96	87.84	0.06	290.24

Reference: X: + Forward From Rear Bumper
 Y: + Rightward From Vehicle Centerline
 Z: + Downward From Ground Level

Table 7 Target Vehicle Measurements

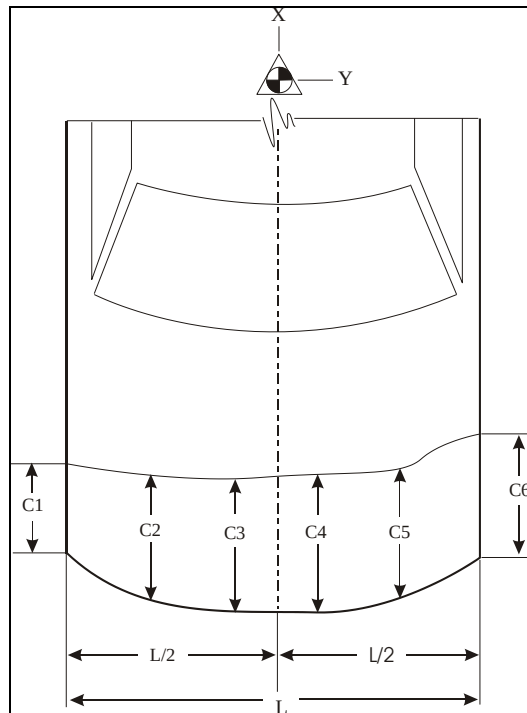
1996 Jeep Grand Cherokee Limited

Test Number: 131121

No.	Type of measurement	Pre-Test	Post-Test	Difference
X1	Total Length of Vehicle at Centerline	4454	4090	364
X2	Rear Surface of Vehicle to Front of Engine Block	479	490	-11
X3	Rear Surface of Vehicle to Firewall	1059	1068	-9
X4	Rear Surface of Vehicle to Upper Leading Edge of Right Door	1389	1405	-16
X5	Rear Surface of Vehicle to Upper Leading Edge of Left Door	1389	1395	-6
X6	Rear Surface of Vehicle to Lower Leading Edge of Right Door	1429	1441	-12
X7	Rear Surface of Vehicle to Lower Leading Edge of Left Door	1423	1418	5
X8	Rear Surface of Vehicle to Upper Trailing Edge of Right Door	2406	2420	-14
X9	Rear Surface of Vehicle to Upper Trailing Edge of Left Door	2407	2415	-8
X10	Rear Surface of Vehicle to Lower Trailing Edge of Right Door	2427	2425	2
X11	Rear Surface of Vehicle to Lower Trailing Edge of Left Door	2432	2422	10
X12	Rear Surface of Vehicle to Bottom of " A " Post on Right Side	1419	1435	-16
X13	Rear Surface of Vehicle to Bottom of " A " Post on Left Side	1415	1430	-15
X14	Rear Surface of Vehicle to Firewall-Right Side	1054	1065	-11
X15	Rear Surface of Vehicle to Firewall-Left Side	1089	1100	-11
X16	Rear Surface of Vehicle to Steering Wheel Center	1869	1880	-11
X17	Center of Steering Column to " A " Post	315	300	15
X18	Center of Steering Column to Headliner	415	420	-5
X19	Rear Surface of Vehicle to Right Side of Front Bumper	4409	4338	71
X20	Rear Surface of Vehicle to Left Side of Front Bumper	4412	4185	227
X21	Length of Engine Block	525	525	0

All measurements are in millimeters.

Figure 2 Target Vehicle Crush



Notes: L is pre-test length of contact surface.
C1 through C6 are spaced equally apart.
CL is vehicle centerline.

Vehicle: 1996 Jeep Grand Cherokee Limited

	Pre-test	Post-test	Crush
L	1524	N/A	N/A
C1	4412	4185	227
C2	4479	4162	317
C3	4454	4125	329
CL	4454	4090	364
C4	4454	4125	329
C5	4474	4147	327
C6	4409	4338	71

All measurements in millimeters.

Table 8 Bullet Vehicle Measurements

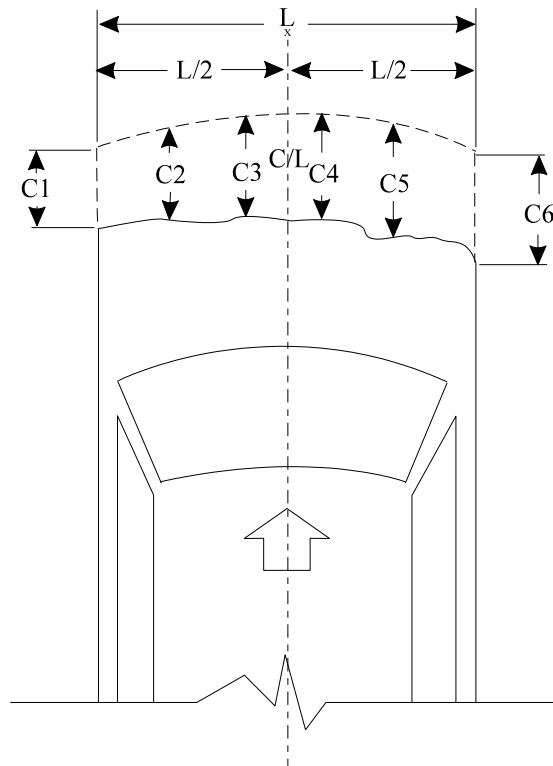
1993 Cadillac DeVille

Test Number: 131121

No.	Type of measurement	Pre-Test	Post-Test	Difference
X1	Total Length of Vehicle at Centerline	5204	5163	41
X2	Rear Surface of Vehicle to Front of Engine Block	4630	4508	122
X3	Rear Surface of Vehicle to Firewall	3885	3868	17
X4	Rear Surface of Vehicle to Upper Leading Edge of Right Door	3522	3124	398
X5	Rear Surface of Vehicle to Upper Leading Edge of Left Door	3516	3515	1
X6	Rear Surface of Vehicle to Lower Leading Edge of Right Door	3496	3500	-4
X7	Rear Surface of Vehicle to Lower Leading Edge of Left Door	3492	3502	-10
X8	Rear Surface of Vehicle to Upper Trailing Edge of Right Door	2509	2408	101
X9	Rear Surface of Vehicle to Upper Trailing Edge of Left Door	2500	2501	-1
X10	Rear Surface of Vehicle to Lower Trailing Edge of Right Door	2509	2510	-1
X11	Rear Surface of Vehicle to Lower Trailing Edge of Left Door	2506	2517	-11
X12	Rear Surface of Vehicle to Bottom of " A " Post on Right Side	3511	3490	21
X13	Rear Surface of Vehicle to Bottom of " A " Post on Left Side	3511	3492	19
X14	Rear Surface of Vehicle to Firewall-Right Side	3783	3782	1
X15	Rear Surface of Vehicle to Firewall-Left Side	3823	3825	-2
X16	Rear Surface of Vehicle to Steering Wheel Center	3048	3058	-10
X17	Center of Steering Column to " A " Post	347	330	17
X18	Center of Steering Column to Headliner	430	450	-20
X19	Rear Surface of Vehicle to Right Side of Front Bumper	5123	5123	0
X20	Rear Surface of Vehicle to Left Side of Front Bumper	5123	5135	-12
X21	Length of Engine Block	575	575	0
	Left Front Overhang	1101	1055	46
	Right Front Overhang	1104	1083	21
X26	Firewall to Engine or Transaxle	325	260	65
X27	Vertical Distance from Door Sill to Centerline of Steering Column	543	538	5
X28	Left Wheelbase	2885	2889	-4
X28	Right Wheelbase	2882	2865	17
X29	Maximum Width	1865	1865	0
X30	Rear Surface of Vehicle to Engine Bottom Target	4340	4313	27
X31	Rear Surface of Vehicle to Occupant Compartment Bottom Targets	2820	2817	3
X32	Rear Surface of Vehicle to Front Bumper Bottom Target	5129	5073	56
X33	Rear Surface of Vehicle to Frame Crossmember Bottom Target	4490	4478	12
RD	Rear Surface of Vehicle to Right Side of Dash Panel	3346	3335	11
CD	Rear Surface of Vehicle to Center of Dash Panel	3344	3347	-3
LD	Rear Surface of Vehicle to Left Side of Dash Panel	3342	3340	2

All measurements are in millimeters.

Figure 3 Bullet Vehicle Crush



Notes: L is pre-test length of contact surface.
 $C1$ through $C6$ are spaced equally apart.
 CL is vehicle centerline.

Vehicle: 1993 Cadillac DeVille

	Pre-test	Post-test	Crush
L	1524	N/A	N/A
$C1$	5123	5135	-12
$C2$	5137	5100	37
$C3$	5210	5175	35
CL	5204	5163	41
$C4$	5210	5175	35
$C5$	5138	5135	3
$C6$	5123	5123	0

All measurements are in millimeters.

Section 3.0

FMVSS 301 Data

Table 9 Target Vehicle Fuel System Data

Vehicle year/make/ model/body style:	1996/Jeep/Grand Cherokee Limited/MPV
Actual test volume:	68.5 liters
Test fluid type:	Stoddard
Specific gravity:	0.764
Kinematic viscosity:	0.99 centistoke
Test fluid color:	Purple
Type of fuel pump:	Electric
Did electric fuel pump operate with ignition switch "on" and the engine not operating.	Yes
Details of fuel system:	The fuel tank is located behind the rear axle. The fuel filler neck enters the top left side of the tank. The fuel filler cap is located on the left rear quarter panel. The fuel lines run along the inside of the left frame rail.

Table 10 Target Vehicle FMVSS 301 Post-Impact Test Data

Test date: 11/21/2013

Vehicle year/make/
model/body style: 1996/Jeep/Grand Cherokee Limited/MPV

Test requirements:

Test vehicle fuel tank filled was filled with 68.5 liters of Stoddard and had an electric fuel pump operating (if it will operate without engine operation). Part 572 test dummies located at each front designated seating position.

Test vehicle impact type:

- ☐ Frontal (30 mph)
- ☐ Oblique (30 mph) with ☐ barrier face first contacting (driver's/passenger's) side
- ☒ Rear vehicle to vehicle impact
- ☐ Lateral moving barrier (20 mph)

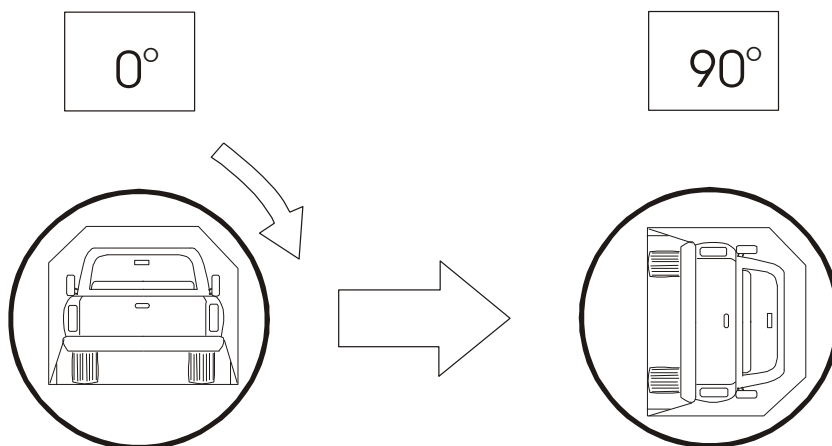
Fuel system fluid spillage measurements:

	<u>Test Results</u>	<u>Maximum Allowable</u>
1. From impact until vehicle motion ceases	None	28 g
2. 5-minute period after vehicle motion ceases	None	142 g
3. Next 25 minutes after 5-minute period	None	28 g/minute

Fuel system fluid spillage location(s): None

Figure 4 Target Vehicle FMVSS 301 Static Rollover Test Data

Test phase



Static rollover machine rotation time information: (specified range is 1-3 minutes)

Time required for machine to rotate 90° = 2 minutes, 0 seconds

FMVSS 301 position hold time = 5 minutes, 0 seconds

Total = 7 minutes, 0 seconds

Next whole minute interval = 7 minutes

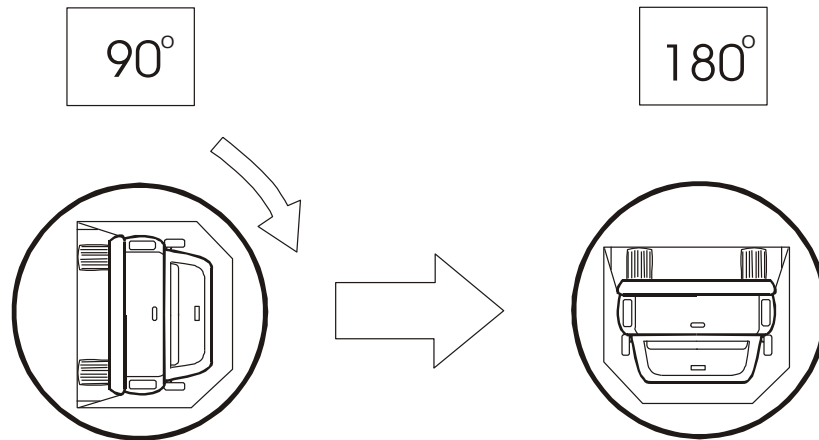
Fuel system fluid spillage measurements:

0° to 90° rotation (fuel filler cap down)		Test Results	Maximum Allowable
1.	First five minutes from onset of rotation	0g	142 g
2.	Sixth minute from onset of rotation	0g	28 g
3.	Seventh minute from onset of rotation	0g	28 g

Fuel system fluid spillage location(s): None

Figure 4 Target Vehicle FMVSS 301 Static Rollover Test Data, Continued

Test phase



Static rollover machine rotation time information: (specified range is 1-3 minutes)

Time required for machine to rotate 90° = 2 minutes, 0 seconds
FMVSS 301 position hold time = 5 minutes, 0 seconds
Total = 7 minutes, 0 seconds
Next whole minute interval = 14 minutes

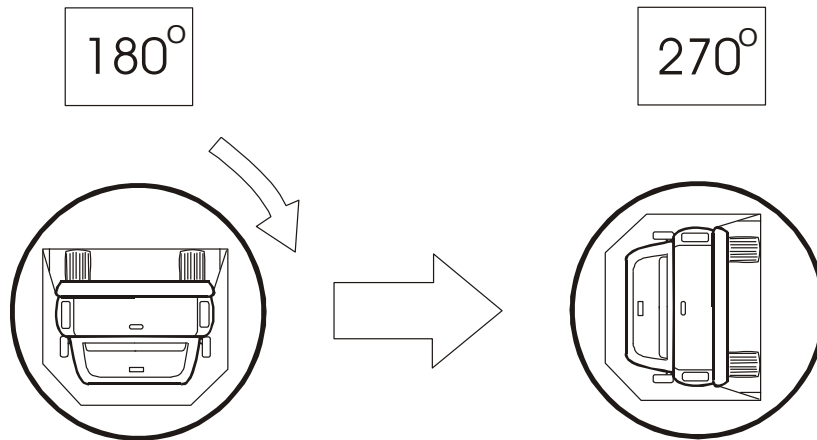
Fuel system fluid spillage measurements:

	Test Results	Maximum Allowable
<u>90° to 180° rotation</u>		
1. First five minutes from onset of rotation	0g	142 g
2. Sixth minute from onset of rotation	0g	28 g
3. Seventh minute from onset of rotation	0g	28 g

Fuel system fluid spillage location(s): None

Figure 4 Target Vehicle FMVSS 301 Static Rollover Test Data, Continued

Test phase



Static rollover machine rotation time information: (specified range is 1-3 minutes)

Time required for machine to rotate 90° = 2 minutes, 0 seconds
FMVSS 301 position hold time = 5 minutes, 0 seconds
Total = 7 minutes, 0 seconds
Next whole minute interval = 21 minutes

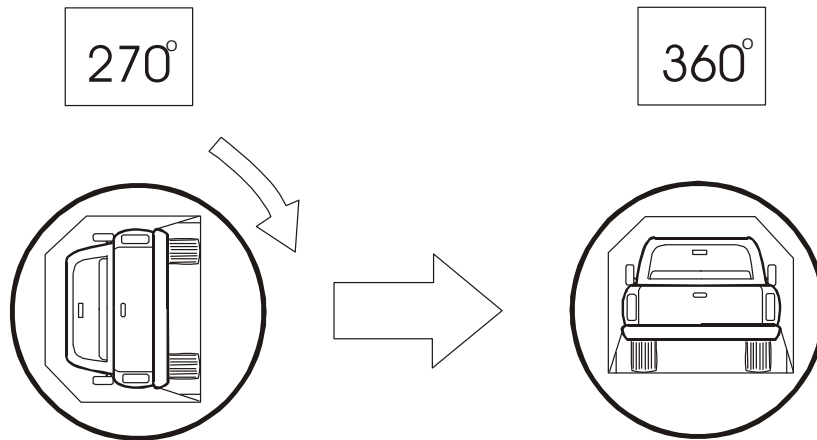
Fuel system fluid spillage measurements:

	Test Results	Maximum Allowable
<u>180 to 270° rotation</u>		
1. First five minutes from onset of rotation	0g	142 g
2. Sixth minute from onset of rotation	0g	28 g
3. Seventh minute from onset of rotation	0g	28 g

Fuel system fluid spillage location(s): None

Figure 4 Target Vehicle FMVSS 301 Static Rollover Test Data, Continued

Test phase



Static rollover machine rotation time information: (specified range is 1-3 minutes)

Time required for machine to rotate 90° = 2 minutes, 0 seconds
FMVSS 301 position hold time = 5 minutes, 0 seconds
Total = 7 minutes, 0 seconds
Next whole minute interval = 28 minutes

Fuel system fluid spillage measurements:

	Test Results	Maximum Allowable
<u>270° to 360° rotation</u>		
1. First five minutes from onset of rotation	0g	142 g
2. Sixth minute from onset of rotation	0g	28 g
3. Seventh minute from onset of rotation	0g	28 g

Fuel system fluid spillage location(s): None

Section 4.0

Camera Information

Figure 5 Camera Positions

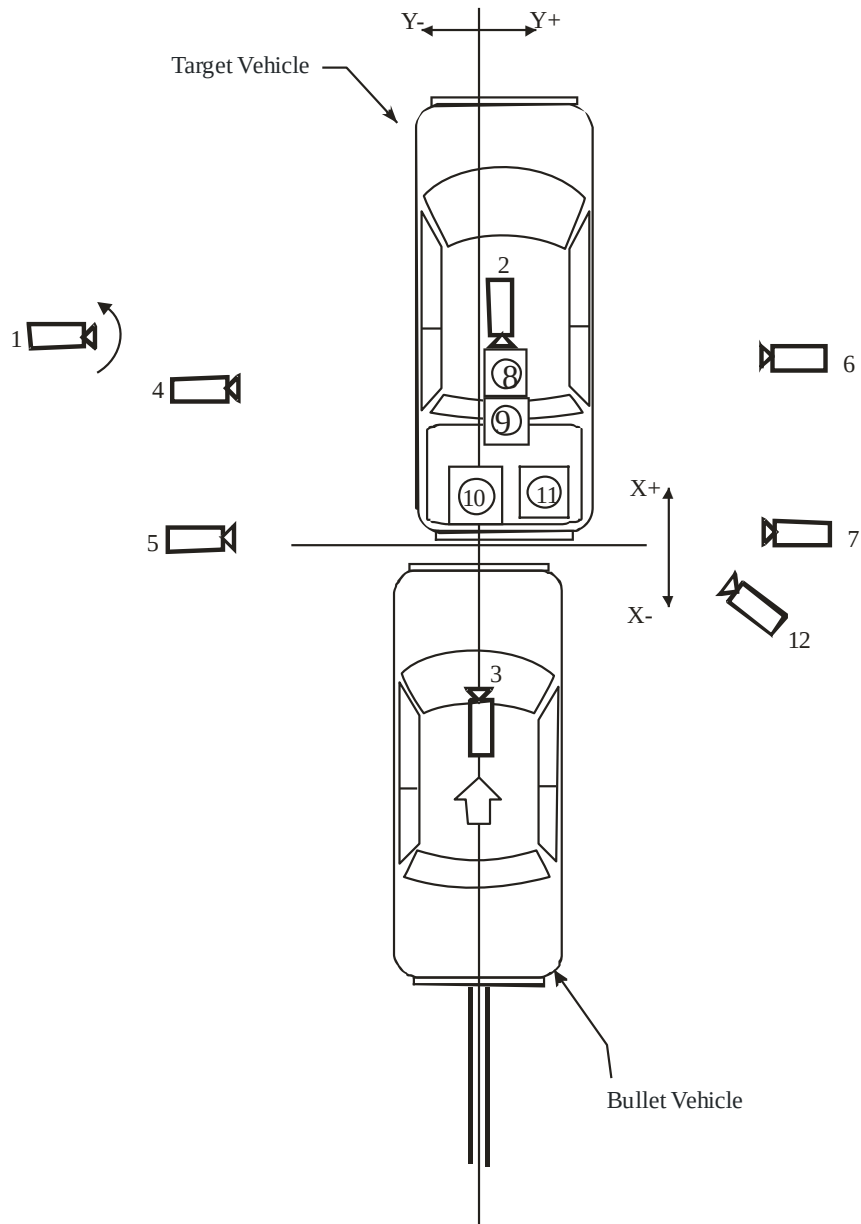


Table 11 Camera Information

Camera Number	Location	Location, mm			Angle (deg.)	Lens (mm)	Speed (fps)
		X	Y	Z			
1	Realtime Panning	N/A	N/A	N/A	N/A	Zoom	30
2	Realtime onboard target vehicle	N/A	N/A	N/A	N/A	Zoom	30
3	Realtime onboard bullet vehicle	N/A	N/A	N/A	N/A	Zoom	30
4	Left side target vehicle	1300	-7468	-1303	-1.7°	8.5	1000
5	Left side impact	355	-6553	-993	-1.7°	25	1000
6	Right side target vehicle	1080	7214	-1097	-1.1°	8.5	1000
7	Right side impact	300	9398	-1183	-2.5°	25	1000
8	Overhead	305	605	-5761	N/A	8.5	1000
9	Pit wide	640	0	2879	83°	12.5	1000
10	Pit medium	430	40	2876	85.6°	16	1000
11	Pit tight	180	-140	2717	87.1°	25	1000
12	Right ground level tight impact	-1829	3261	-110	5.9°	25	1000

+X: Forward (referenced to Target) from impact point
 +Y: Rightward (referenced to Target) from impact point
 +Z: Downward from ground level

Appendix A

Photographs



Figure A-1 Pre-Test Target Vehicle Frontal View



Figure A-2 Post-Test Target Vehicle Frontal View



Figure A-3 Pre-Test Target Vehicle Left Front 3/4 View



Figure A-4 Post-Test Target Vehicle Left Front 3/4 View



Figure A-5 Pre-Test Target Vehicle Left Side View



Figure A-6 Post-Test Target Vehicle Left Side View



Figure A-7 Pre-Test Target Vehicle Rear View



Figure A-8 Post-Test Target Vehicle Rear View



Figure A-9 Pre-Test Target Vehicle Right Rear 3/4 View



Figure A-10 Post-Test Target Vehicle Right Rear 3/4 View



Figure A-11 Pre-Test Target Vehicle Right Side View



Figure A-12 Post-Test Target Vehicle Right Side View

Photo Not Available

Figure A-13 Pre-Test Target Vehicle Front Underbody View



Figure A-14 Post-Test Target Vehicle Front Underbody View

Photo Not Available

Figure A-15 Pre-Test Target Vehicle Rear Underbody View

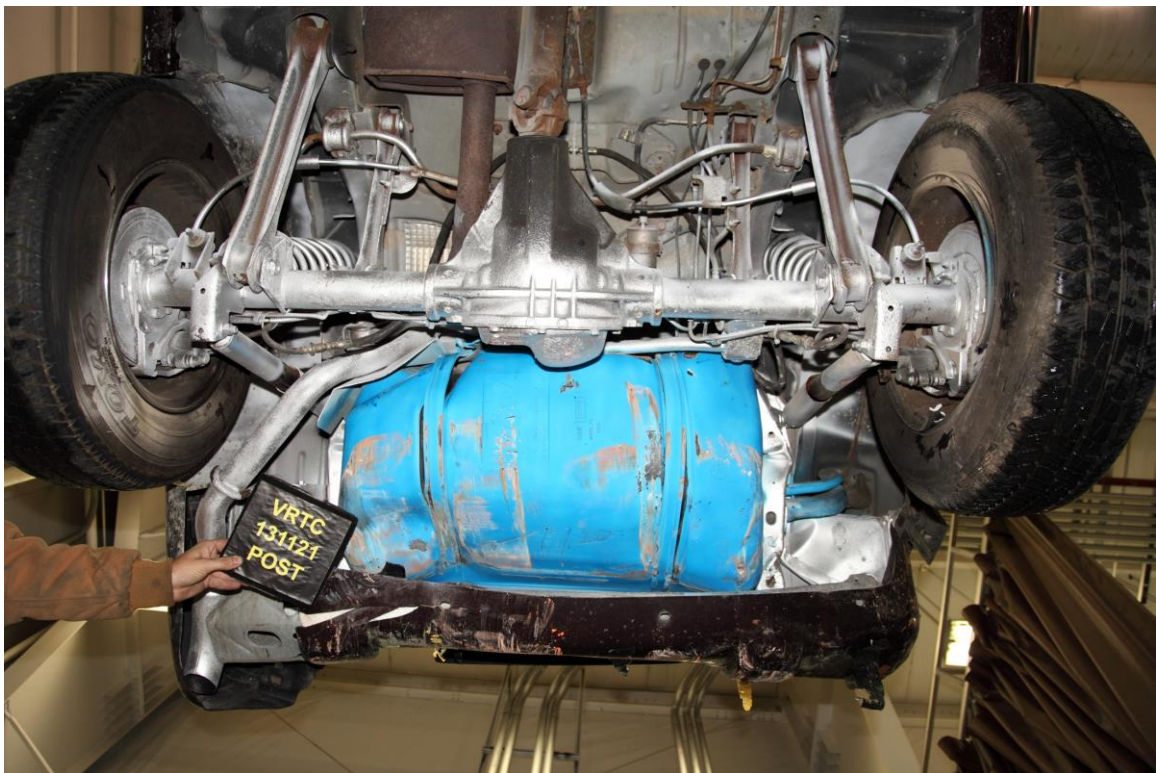


Figure A-16 Post-Test Target Vehicle Rear Underbody View



Figure A-17 Pre-Test Target Vehicle Overhead View

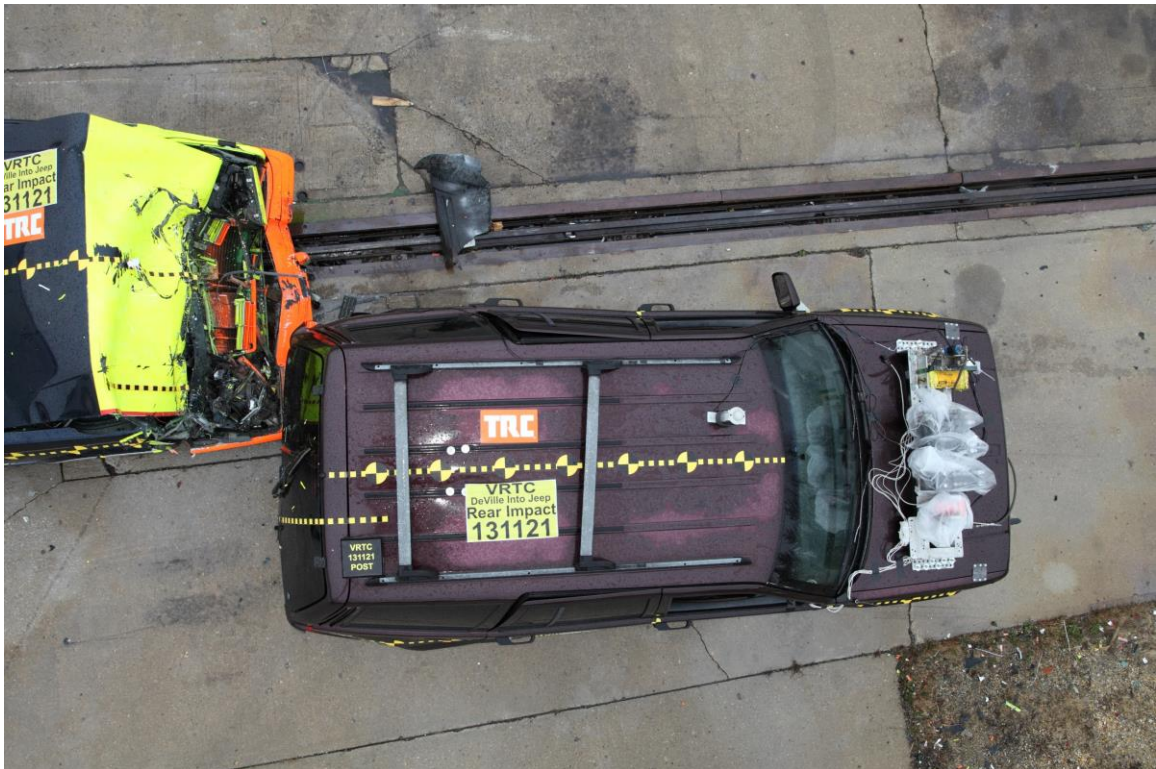


Figure A-18 Post-Test Target Vehicle Overhead View



Figure A-19 Pre-Test Target Vehicle Fuel Tank Close-up View

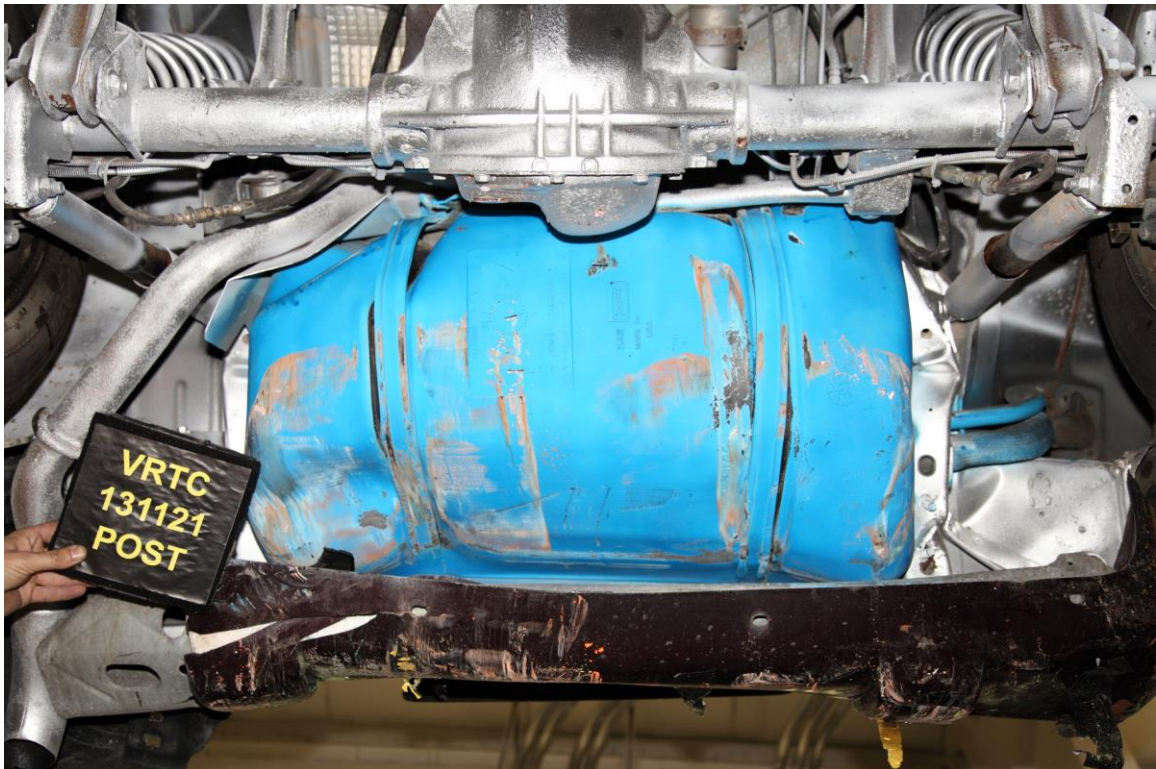


Figure A-20 Post-Test Target Vehicle Fuel Tank Close-up View

Photo Not Available

Figure A-21 Pre-Test Target Vehicle Fuel Line Close-up View

Photo Not Available

Figure A-22 Pre-Test Target Vehicle Fuel Filler Close-up View



Figure A-23 Post-Test Target Vehicle Fuel Filler Close-up – View 1



Figure A-24 Post-Test Target Vehicle Fuel Filler Close-up – View 2



Figure A-25 Pre-Test Target Vehicle Fuel Cap View



Figure A-26 Post-Test Target Vehicle Fuel Cap View



Figure A-27 Close-Up View of Target Vehicle Tire Information

Intentionally Left Blank



Figure A-28 Pre-Test Bullet Vehicle Frontal View



Figure A-29 Post-Test Bullet Vehicle Frontal View



Figure A-30 Pre-Test Bullet Vehicle Left Front 3/4 View



Figure A-31 Post-Test Bullet Vehicle Left Front 3/4 View



Figure A-32 Pre-Test Bullet Vehicle Left Side View



Figure A-33 Post-Test Bullet Vehicle Left Side View



Figure A-34 Pre-Test Bullet Vehicle Rear View



Figure A-35 Post-Test Bullet Vehicle Rear View



Figure A-36 Pre-Test Bullet Vehicle Right Rear 3/4 View



Figure A-37 Post-Test Bullet Vehicle Right Rear 3/4 View



Figure A-38 Pre-Test Bullet Vehicle Right Side View



Figure A-39 Post-Test Bullet Vehicle Right Side View

Photo Not Available

Figure A-40 Pre-Test Bullet Vehicle Front Underbody View



Figure A-41 Post-Test Bullet Vehicle Front Underbody View

Photo Not Available

Figure A-42 Pre-Test Bullet Vehicle Rear Underbody View

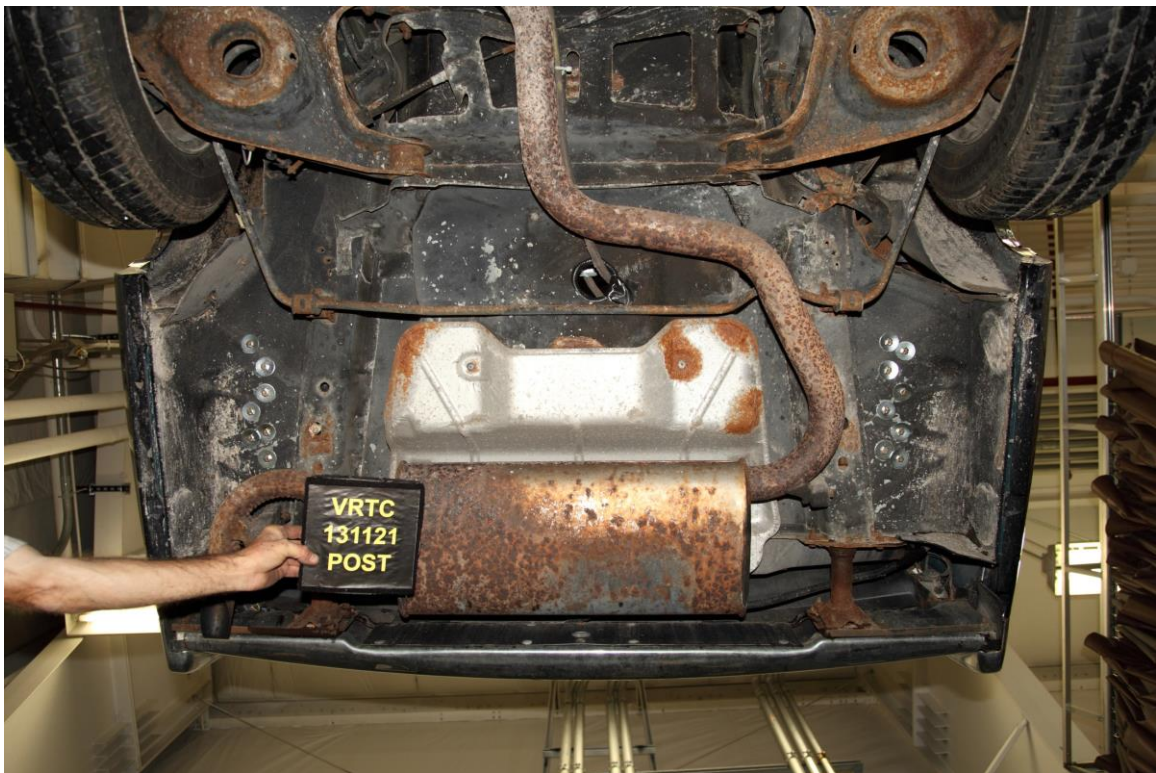


Figure A-43 Post-Test Bullet Vehicle Rear Underbody View

Photo Not Available

Figure A-44 Pre-Test Bullet Vehicle Fuel Tank View



Figure A-45 Post-Test Bullet Vehicle Fuel Tank View

Photo Not Available

Figure A-46 Pre-Test Bullet Vehicle Fuel Line Close-up View



Figure A-47 Post-Test Bullet Vehicle Fuel Line Close-up View

Photo Not Available

Figure A-48 Pre-Test Bullet Vehicle Fuel Filler Close-up View



Figure A-49 Post-Test Bullet Vehicle Fuel Filler Close-up View

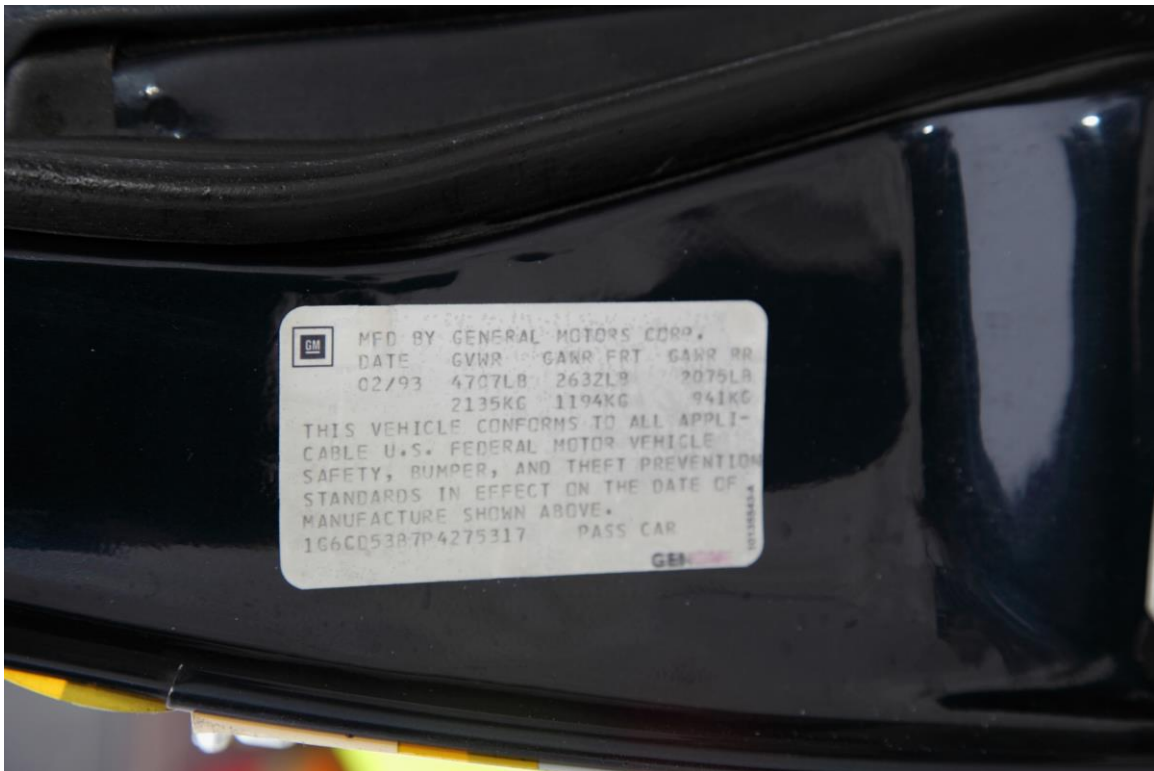


Figure A-50 Close-Up View of Bullet Vehicle Certification Label

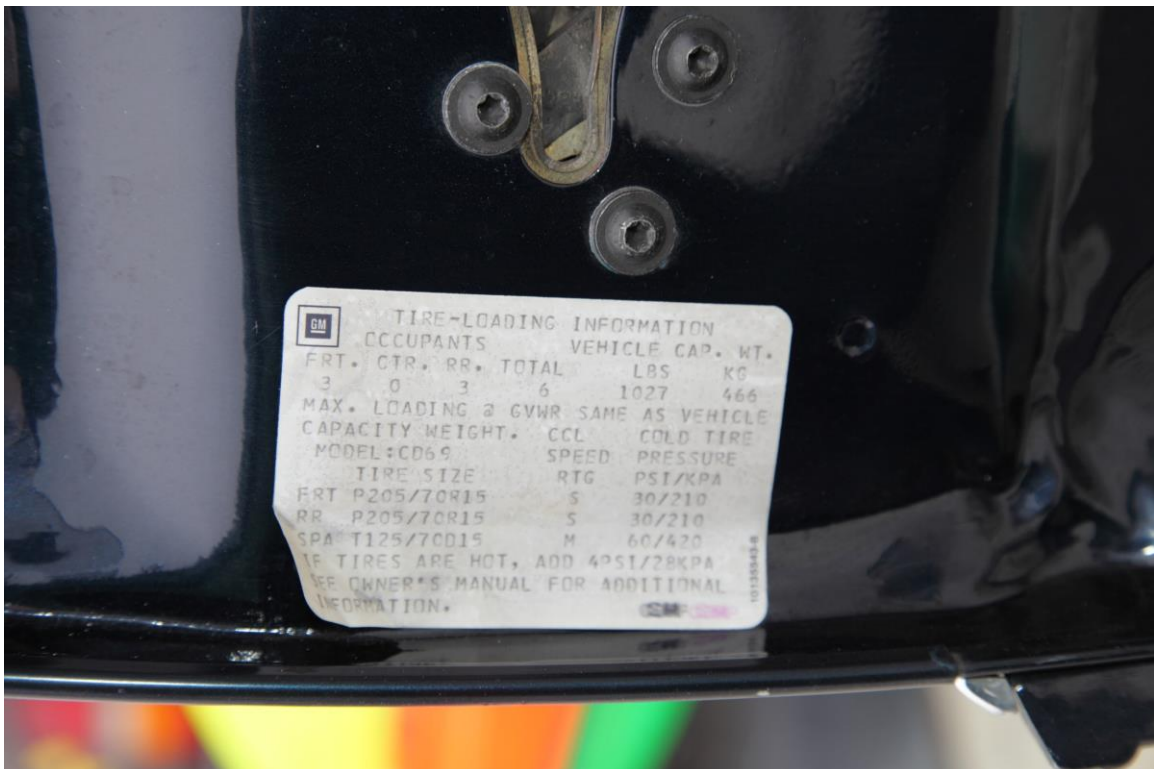


Figure A-51 Close-Up View of Bullet Vehicle Tire Information Placard or Label



Figure A-52 Pre-Test Bullet and Target Vehicles Overall Left Side View



Figure A-53 Post-Test Bullet and Target Vehicles Overall Left Side View



Figure A-54 Pre-Test Bullet and Target Vehicles Overall Right Side View



Figure A-55 Post-Test Bullet and Target Vehicles Overall Right Side View



Figure A-56 Pre-Test Bullet and Target Vehicles Overhead View



Figure A-57 Post-Test Bullet and Target Vehicles Overhead View

Photo Not Available

Figure A-58 Pre-Test Impact Alignment – Bullet and Target Vehicles Pit View

Intentionally Left Blank



Figure A-59 Target Vehicle at 90° on Static Rollover Device



Figure A-60 Target Vehicle at 180° on Static Rollover Device



Figure A-61 Target Vehicle at 270° on Static Rollover Device

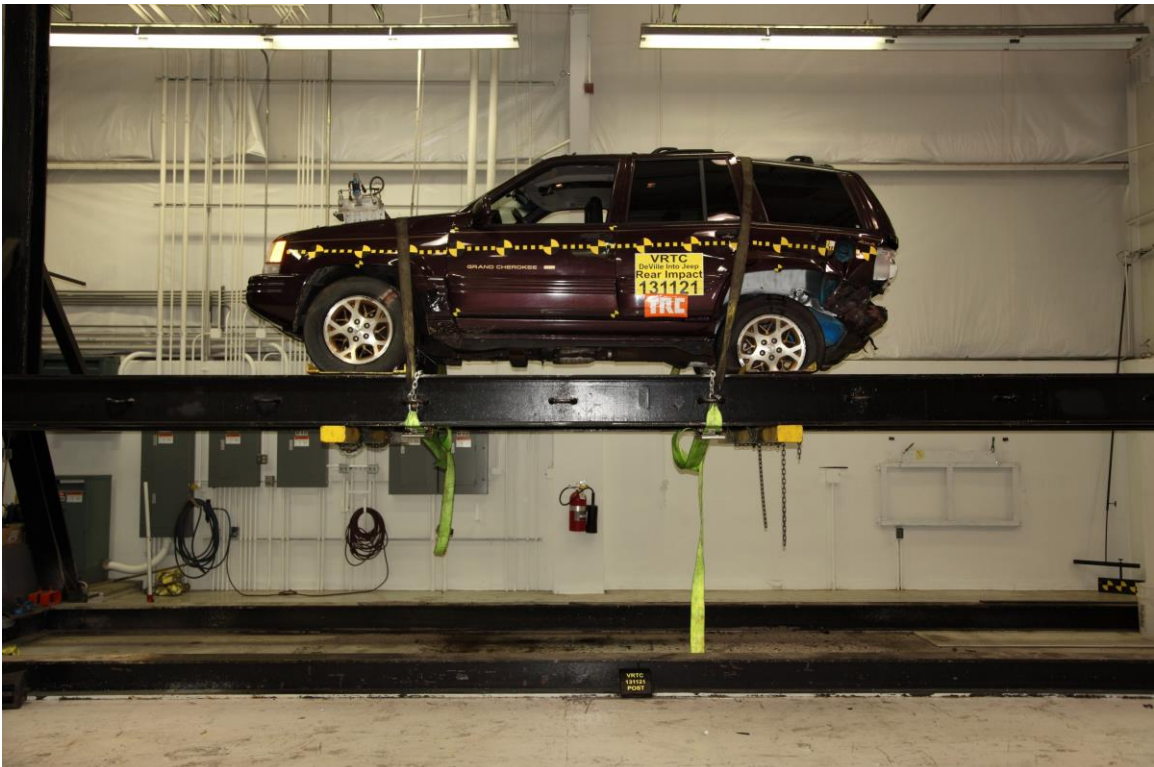


Figure A-62 Target Vehicle at 360° on Static Rollover Device

Appendix B

Data Plots



1993 Cadillac Deville Into Rear of 1996 Jeep GC-ZJ

Bullet Bullet Vehicle CG X

Date: 11/21/2013

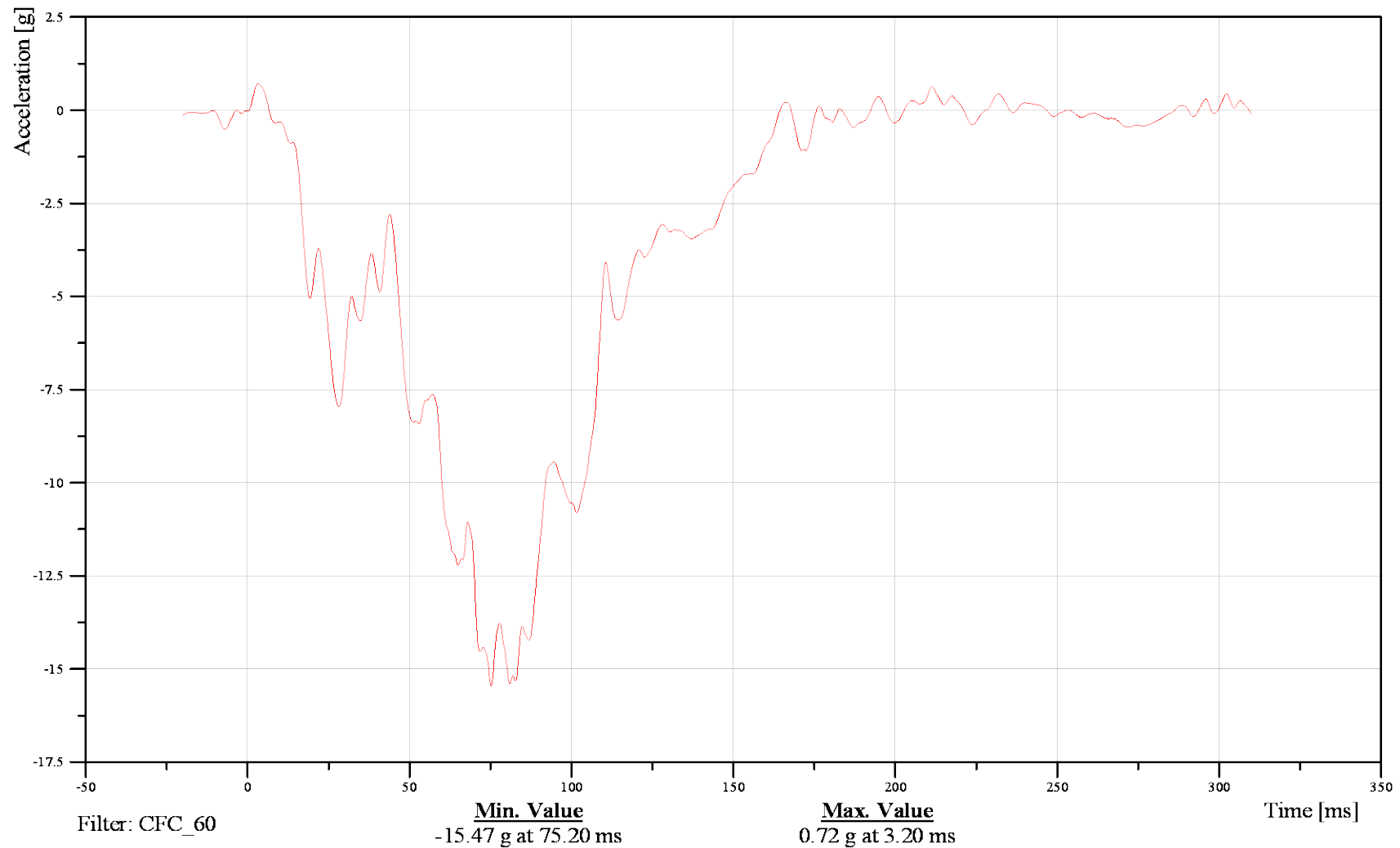
Time: 12:04

Customer: VRTC

10VEHCCG0000ACXD

TRC Inc. Test Lab: CTF

Test Number: 131121





1993 Cadillac Deville Into Rear of 1996 Jeep GC-ZJ

Bullet Bullet Vehicle CG Y

Date: 11/21/2013

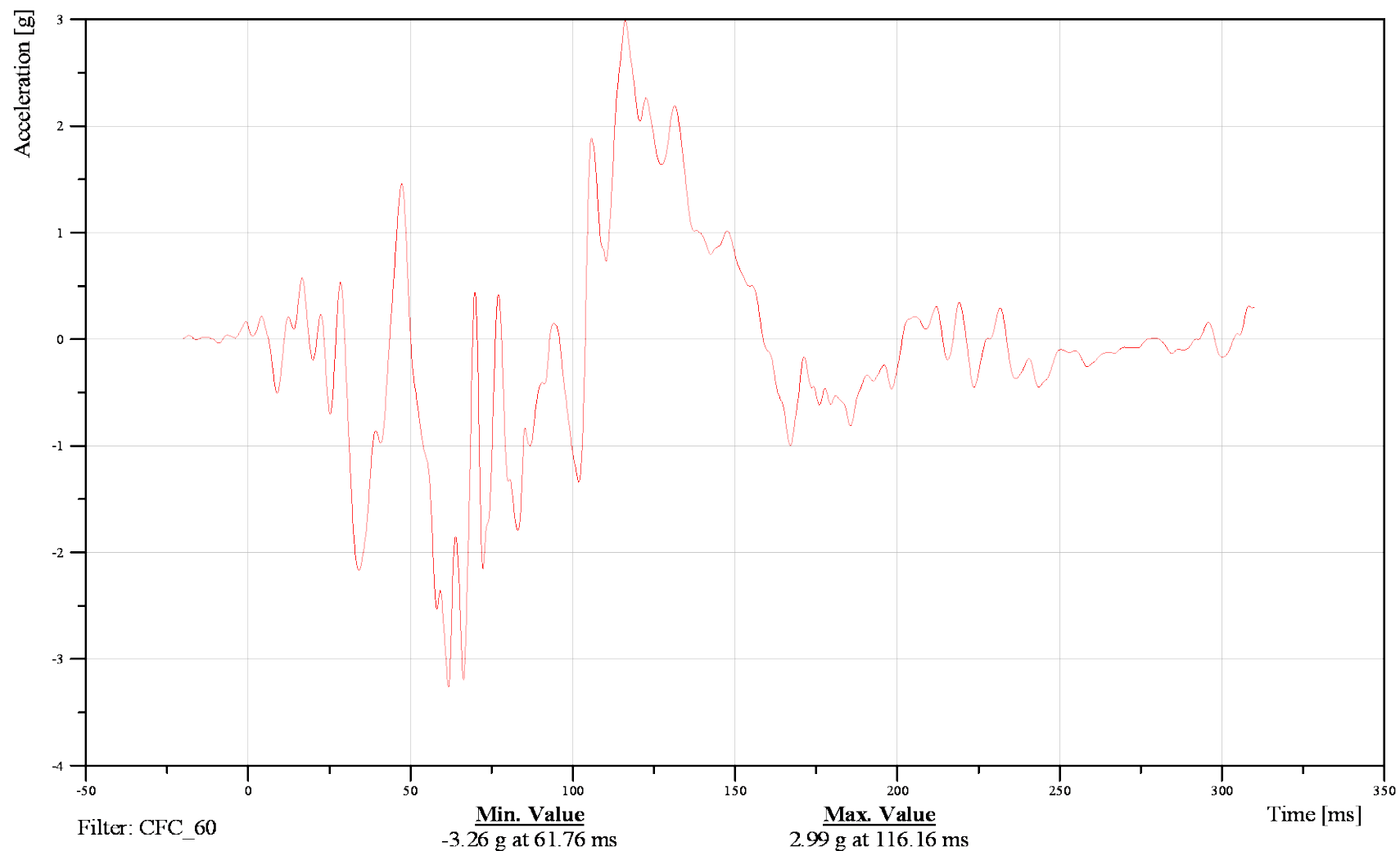
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Customer: VRTC

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TRC Inc. Test Lab: CTF

Test Number: 131121





1993 Cadillac Deville Into Rear of 1996 Jeep GC-ZJ

Bullet Bullet Vehicle CG Z

Date: 11/21/2013

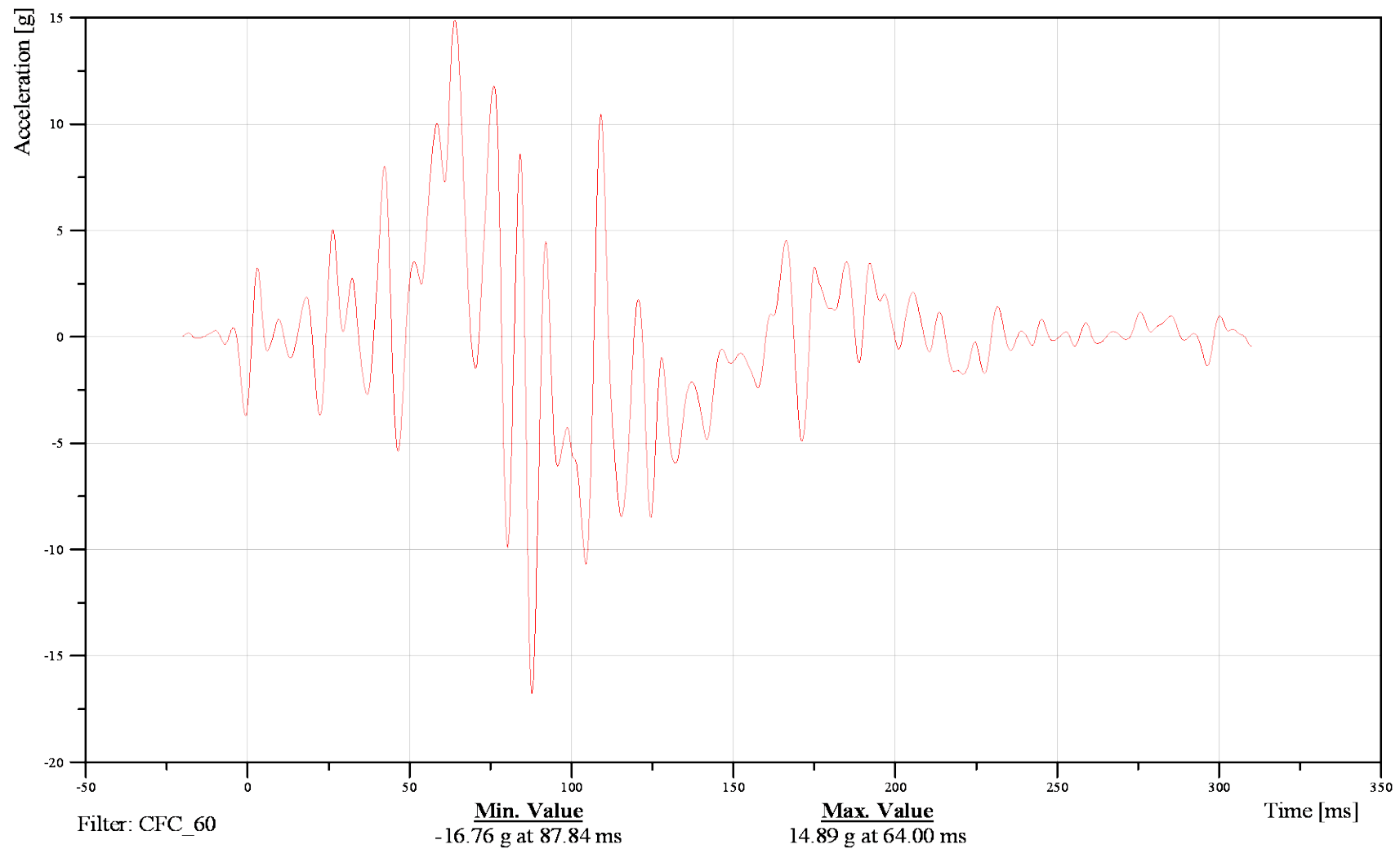
Time: 12:04

Customer: VRTC

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TRC Inc. Test Lab: CTF

Test Number: 131121





1993 Cadillac Deville Into Rear of 1996 Jeep GC-ZJ

Bullet Vehicle CG Acceleration Resultant

Date: 11/21/2013

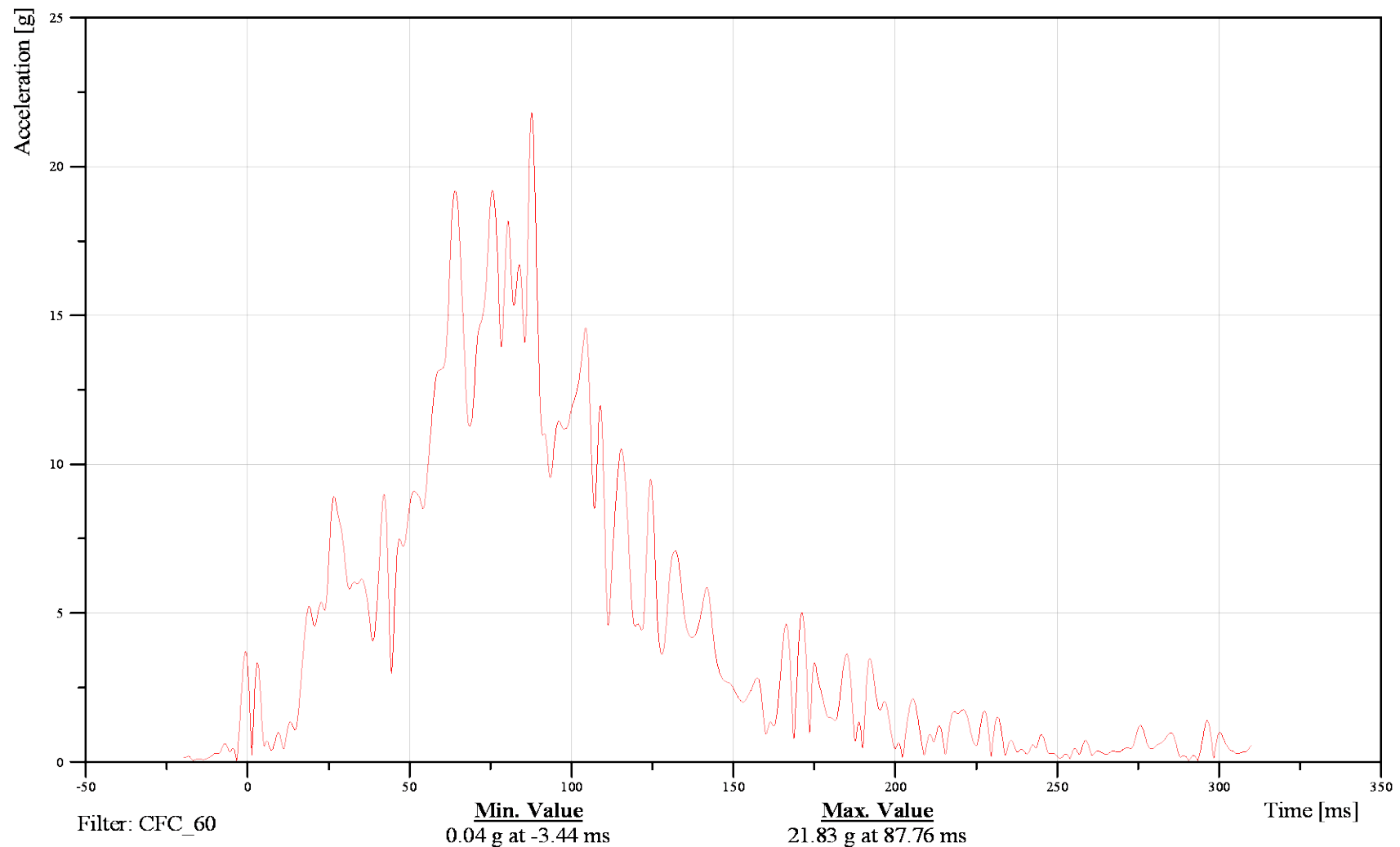
Time: 12:04

Customer: VRTC

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TRC Inc. Test Lab: CTF

Test Number: 131121





1993 Cadillac Deville Into Rear of 1996 Jeep GC-ZJ

Bullet Vehicle CG Redundant X

Date: 11/21/2013

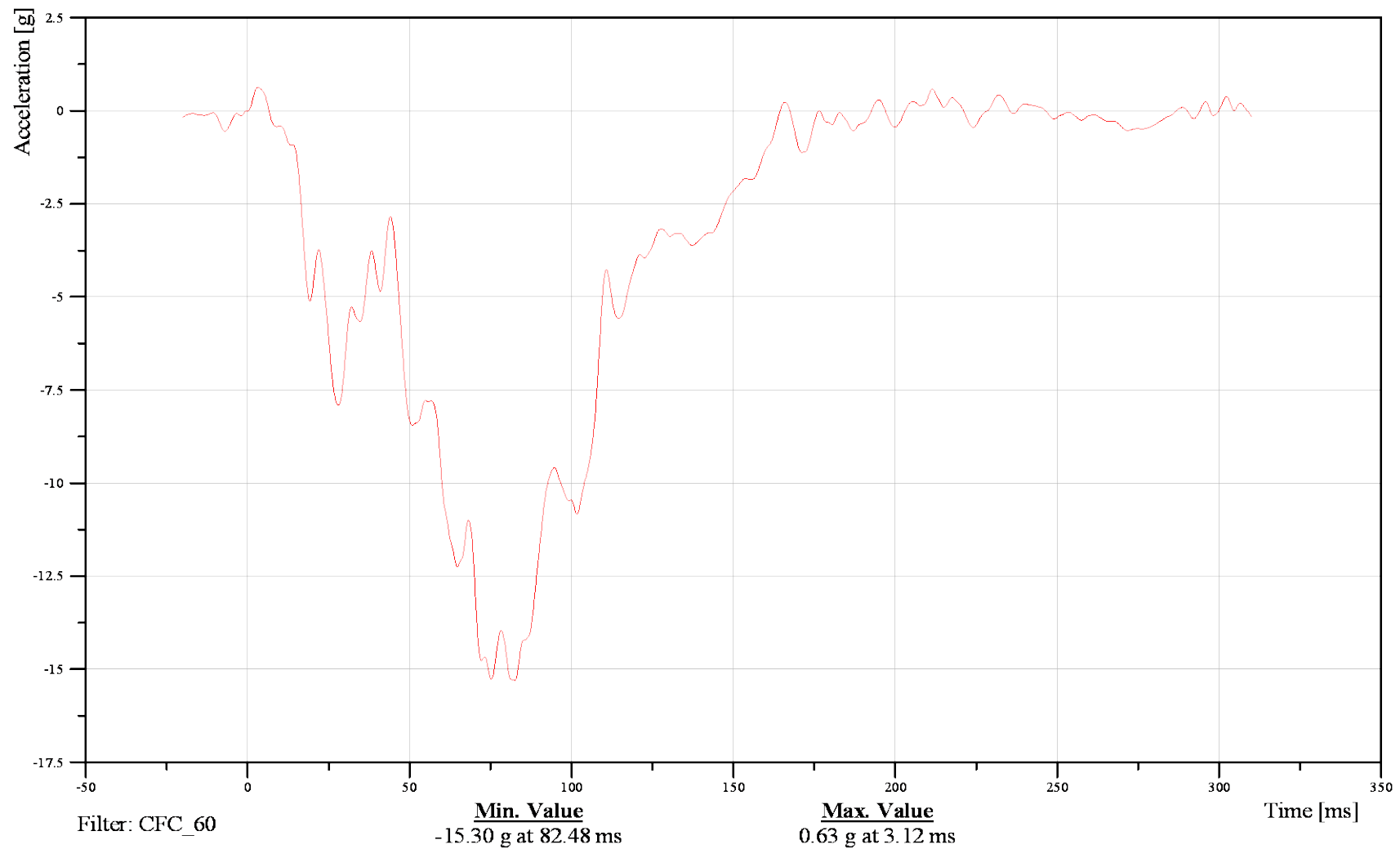
Time: 12:04

Customer: VRTC

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TRC Inc. Test Lab: CTF

Test Number: 131121





1993 Cadillac Deville Into Rear of 1996 Jeep GC-ZJ

Bullet Vehicle CG Redundant Y

Date: 11/21/2013

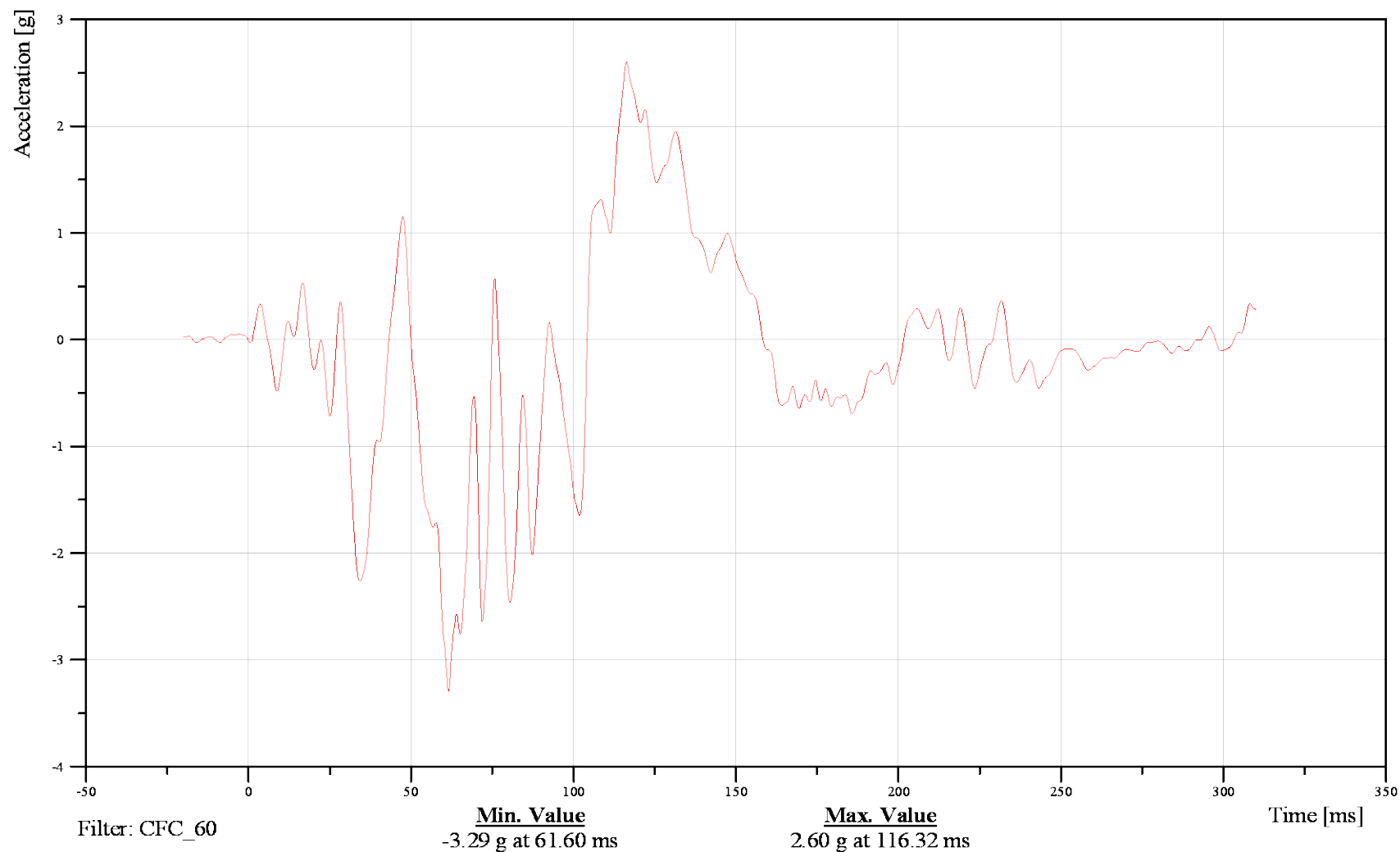
Time: 12:04

Customer: VRTC

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TRC Inc. Test Lab: CTF

Test Number: 131121





1993 Cadillac Deville Into Rear of 1996 Jeep GC-ZJ

Bullet Vehicle CG Redundant Z

Date: 11/21/2013

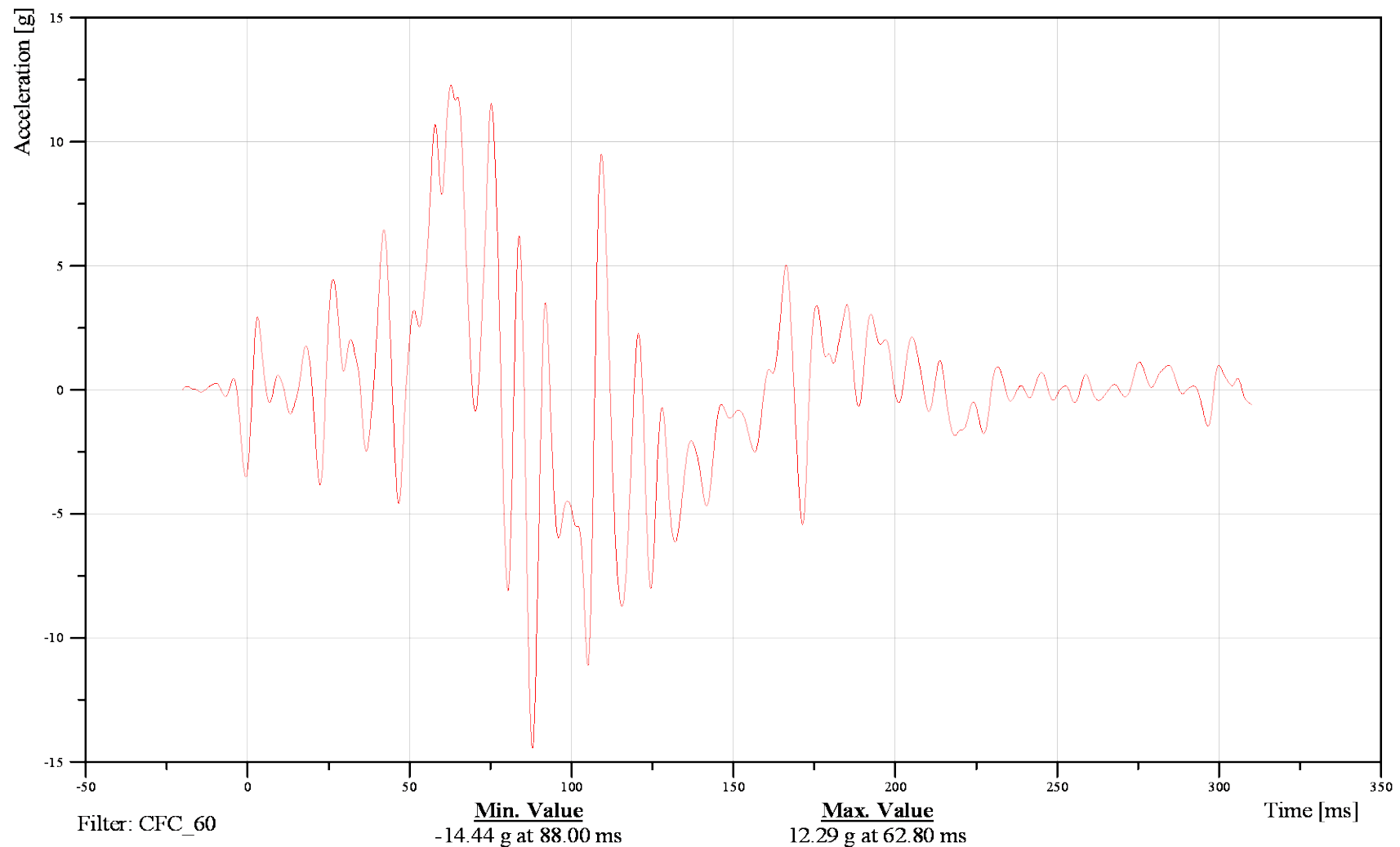
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Customer: VRTC

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TRC Inc. Test Lab: CTF

Test Number: 131121





1993 Cadillac Deville Into Rear of 1996 Jeep GC-ZJ

Bullet Vehicle CG Redundant Acceleration Resultant

Date: 11/21/2013

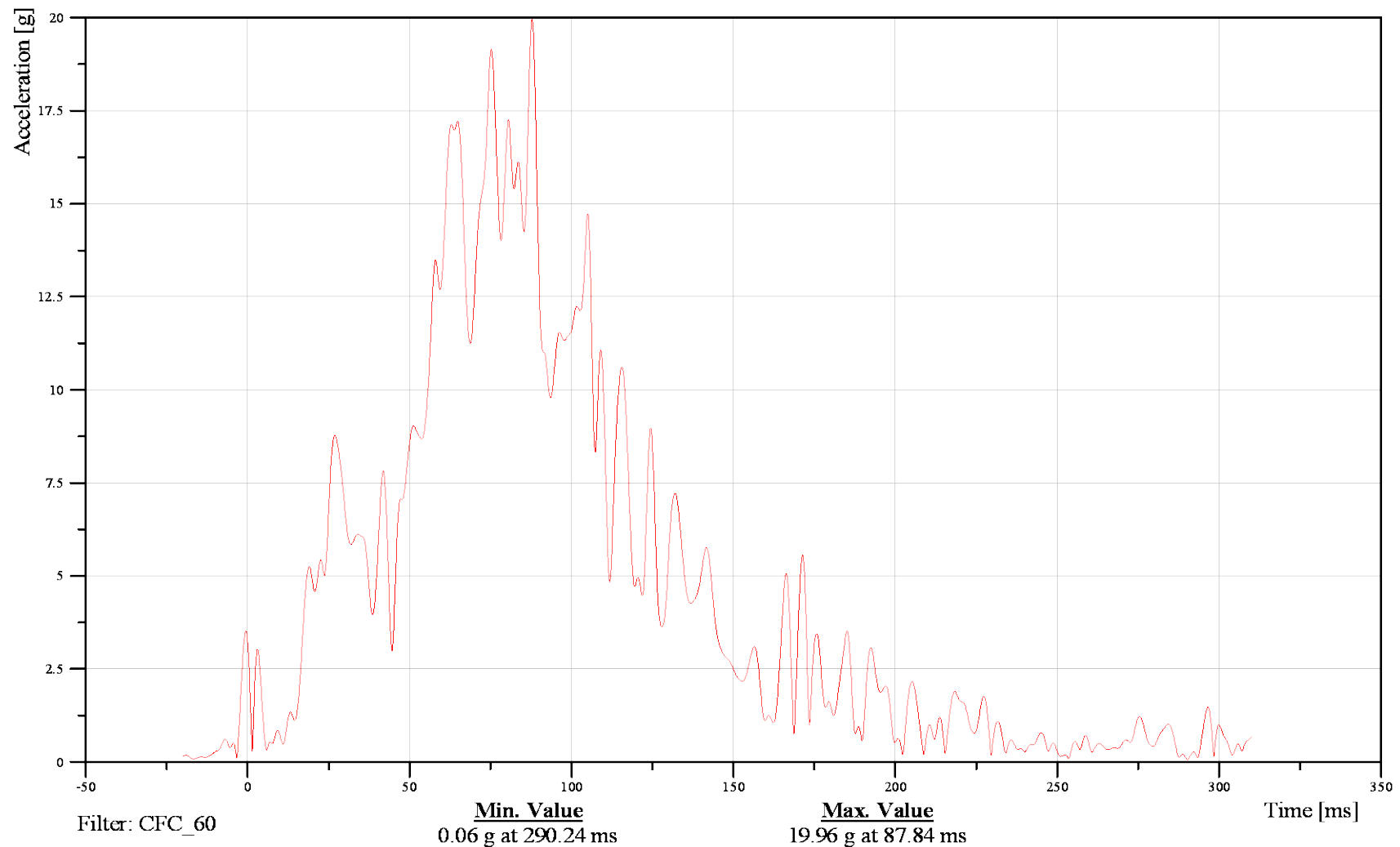
Time: 12:04

Customer: VRTC

10VEHCCGRD00ACRD

TRC Inc. Test Lab: CTF

Test Number: 131121





1993 Cadillac Deville Into Rear of 1996 Jeep GC-ZJ

Target Target Vehicle CG X

Date: 11/21/2013

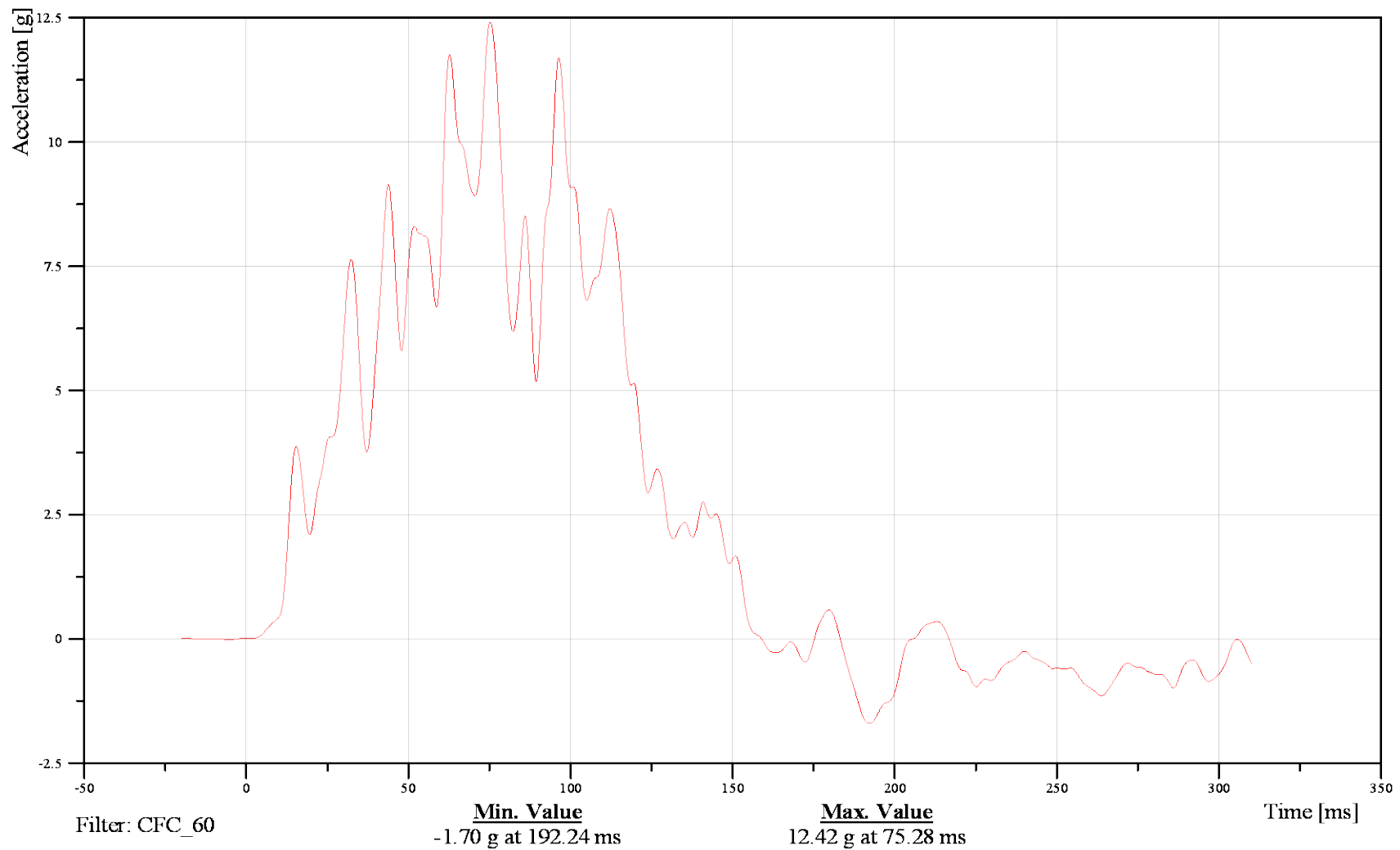
Time: 12:04

Customer: VRTC

20VEHCCG0000ACXD

TRC Inc. Test Lab: CTF

Test Number: 131121





1993 Cadillac Deville Into Rear of 1996 Jeep GC-ZJ

Date: 11/21/2013

Time: 12:04

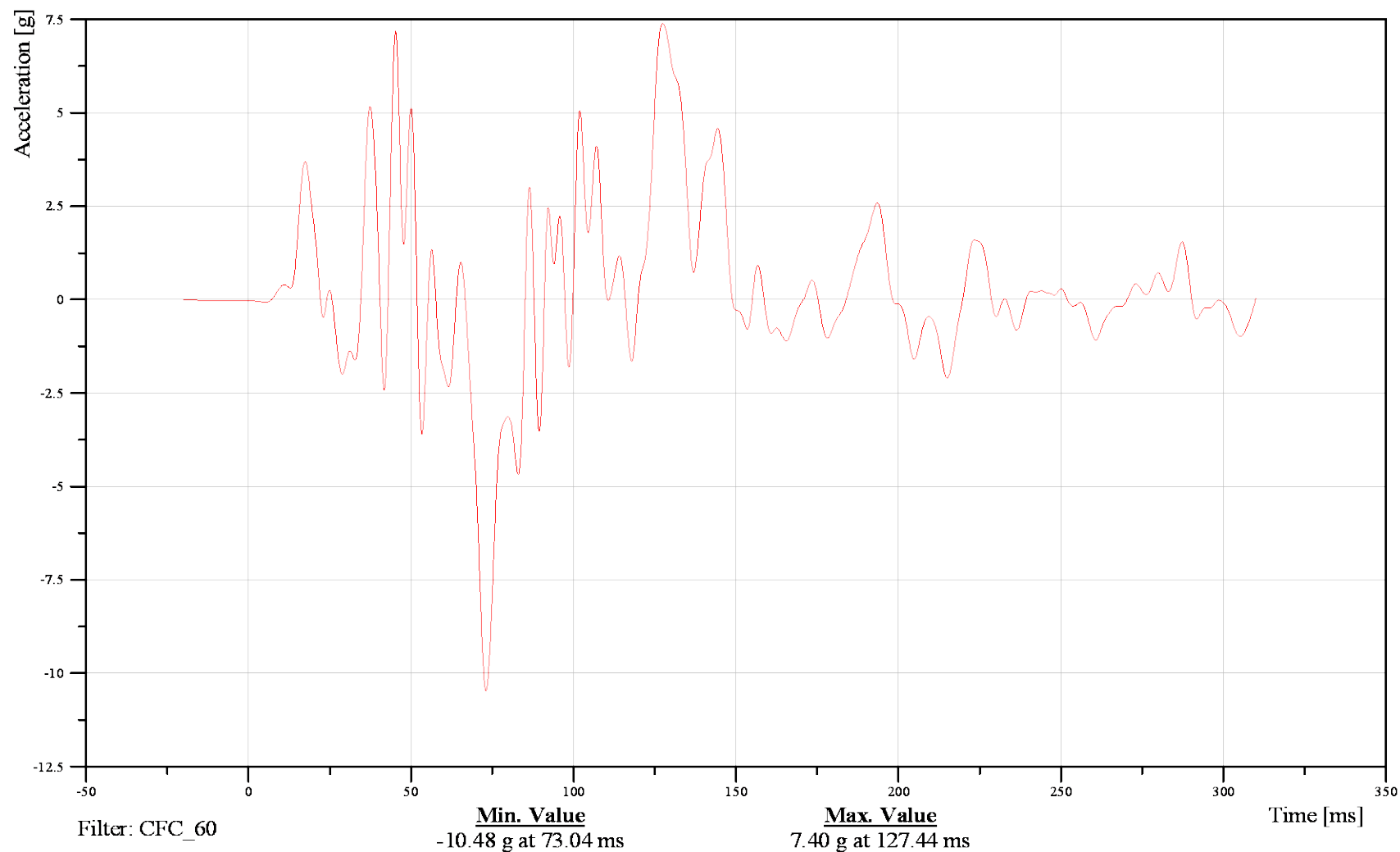
Target Target Vehicle CG Y

Customer: VRTC

20VEHCCG0000ACYD

TRC Inc. Test Lab: CTF

Test Number: 131121





1993 Cadillac Deville Into Rear of 1996 Jeep GC-ZJ

Date: 11/21/2013

Target Target Vehicle CG Z

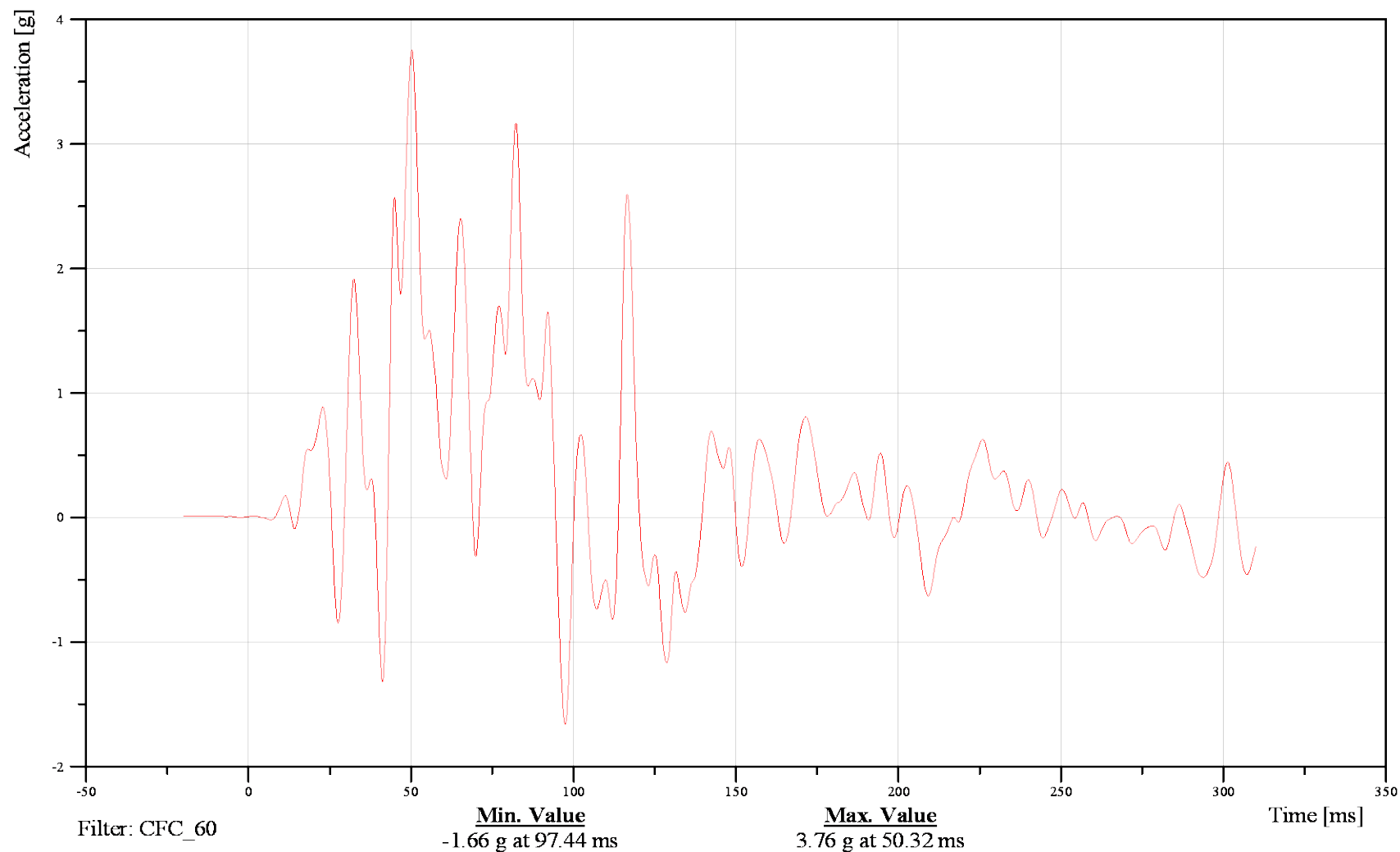
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Customer: VRTC

20VEHCCG0000ACZD

TRC Inc. Test Lab: CTF

Test Number: 131121





1993 Cadillac Deville Into Rear of 1996 Jeep GC-ZJ

Date: 11/21/2013

Time: 12:04

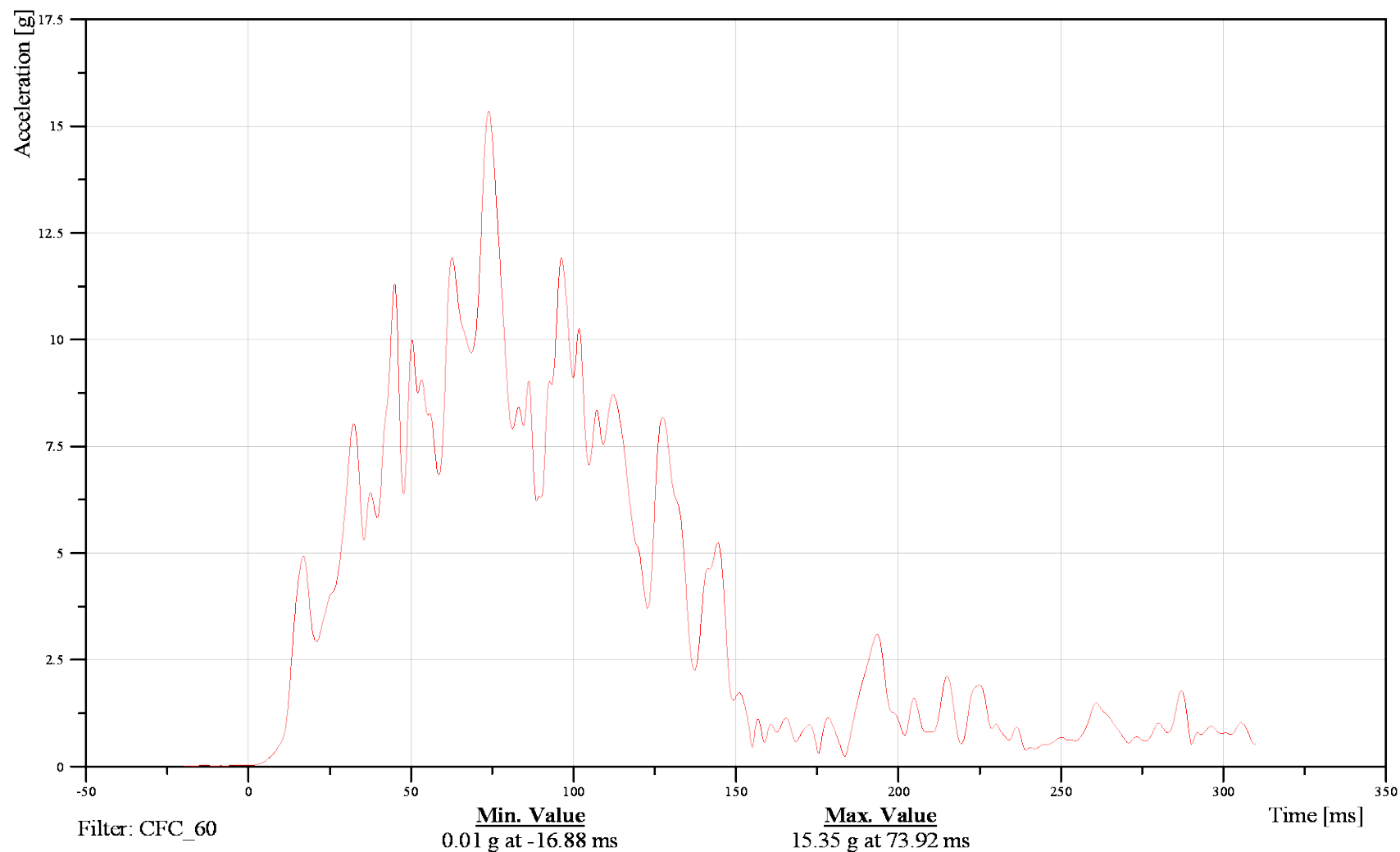
Target Vehicle CG Acceleration Resultant

Customer: VRTC

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TRC Inc. Test Lab: CTF

Test Number: 131121





1993 Cadillac Deville Into Rear of 1996 Jeep GC-ZJ

Target Vehicle CG Redundant X

Date: 11/21/2013

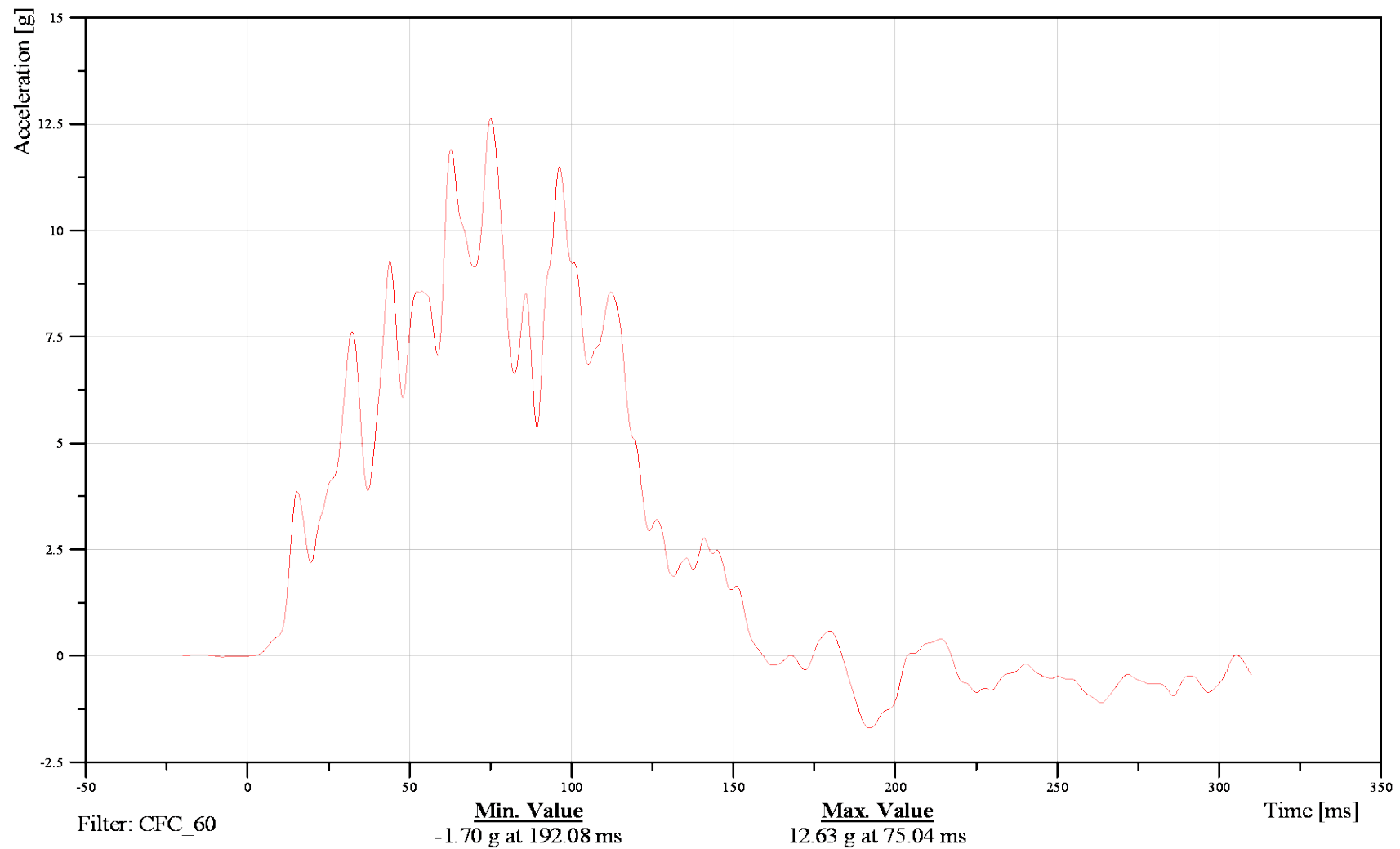
Time: 12:04

Customer: VRTC

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TRC Inc. Test Lab: CTF

Test Number: 131121





1993 Cadillac Deville Into Rear of 1996 Jeep GC-ZJ

Target Vehicle CG Redundant Y

Date: 11/21/2013

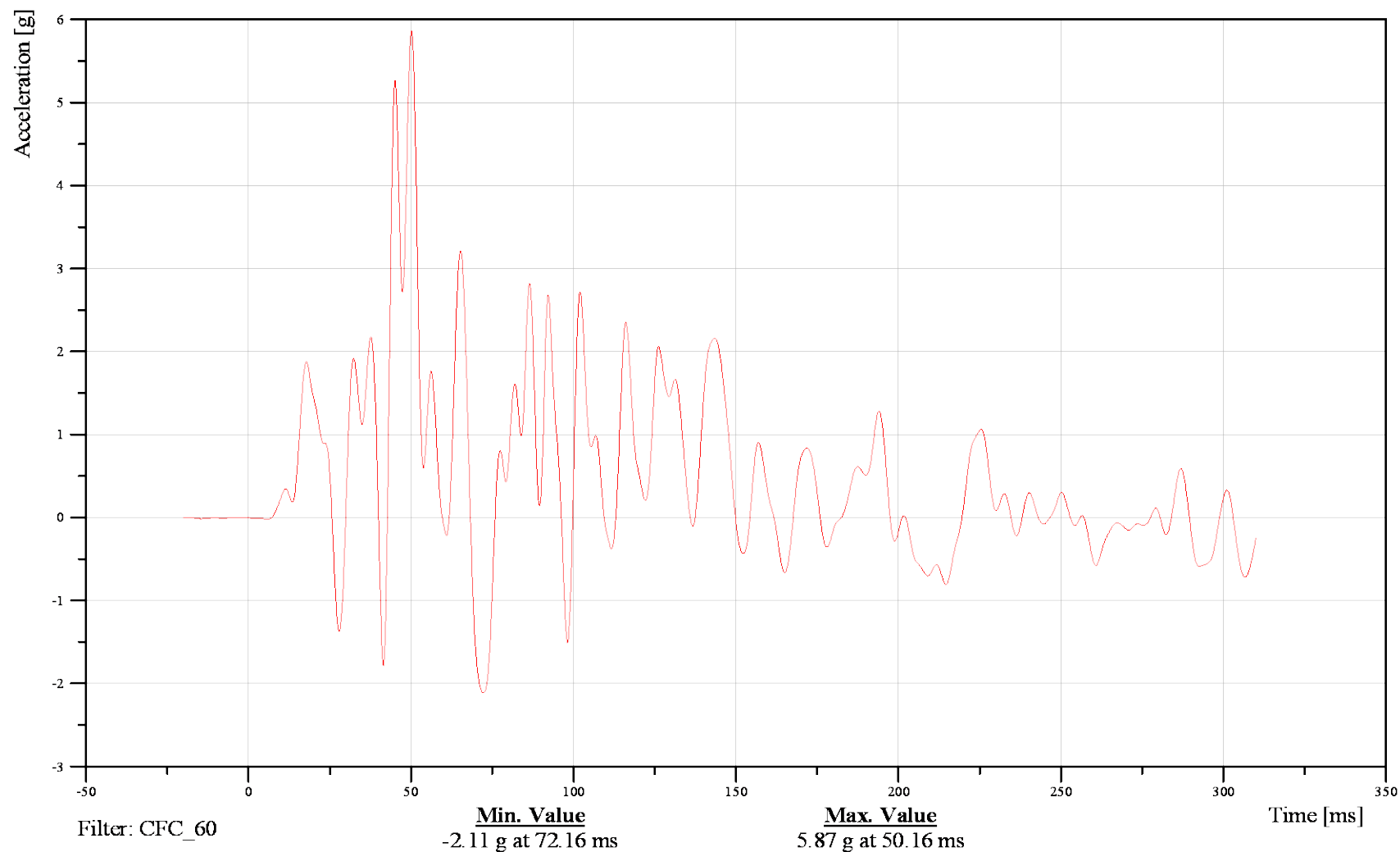
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Customer: VRTC

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TRC Inc. Test Lab: CTF

Test Number: 131121





1993 Cadillac Deville Into Rear of 1996 Jeep GC-ZJ

Target Vehicle CG Redundant Z

Date: 11/21/2013

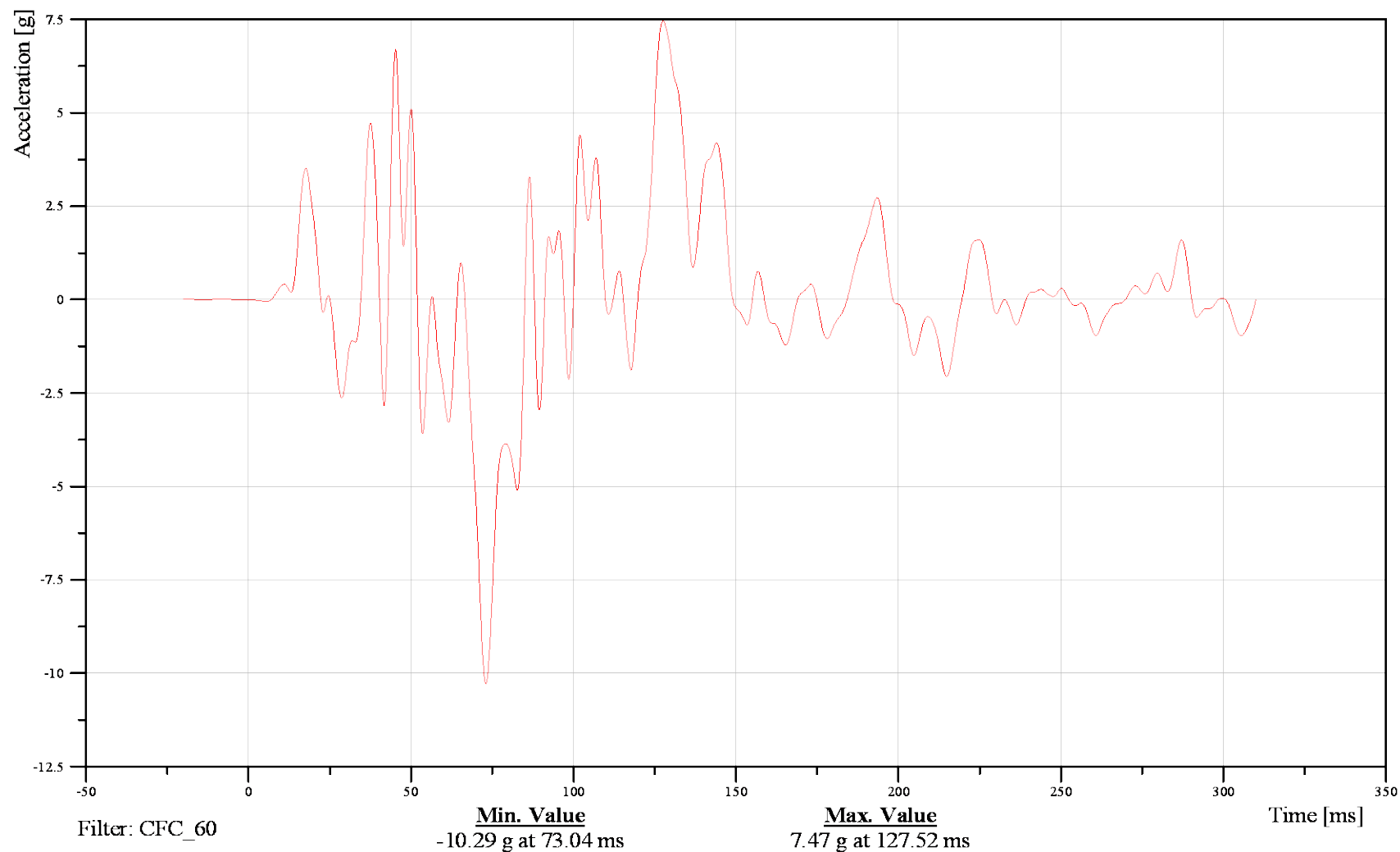
Time: 12:04

Customer: VRTC

20VEHCCGRD00ACZD

TRC Inc. Test Lab: CTF

Test Number: 131121





1993 Cadillac Deville Into Rear of 1996 Jeep GC-ZJ

Date: 11/21/2013

Time: 12:04

Target Vehicle CG Redundant Acceleration Resultant

Customer: VRTC

20VEHCCGRD00ACRD

TRC Inc. Test Lab: CTF

Test Number: 131121

