

Performance of Selected Event Data Recorders

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September 2001

Contents

1.0 Introduction.....	1
2.0 Test setup	1
3.0 Results	3
3.1 Performance of IWI EDRs.....	5
3.1.1 Compared to NHTSA accelerometers on the plate.....	5
3.2 Performance of DriveCam EDRs	7
3.2.1 Compared to NHTSA accelerometers on the plate.....	7
3.3 Performance of Ford OEM RCM data.....	10
3.4 Comparison of velocities from EDR data.....	10
3.5 Comparison of all EDR's.....	12
4.0 Conclusions.....	15
Appendix A Output from MACBOX.....	16

List of Figures

Figure 1 Test Setup	1
Figure 2 Plate with EDR's.....	2

1.0 Introduction

This report describes the findings of a study to compare the performance of selected Event Data Recorders (EDR's) in recording the crash environment for severe impact conditions.

The Agency initiated research in evaluating the performance of EDR's in summer 2000. Manufacturers of EDR's, in production or prototype, were invited to participate in the study. Three manufacturers responded and their products are included in this report. They are: Independent Witness Incorporated (IWI) (<http://www.iwiwitness.com/>), DriveCam (<http://www.drivecam.com/>) and Georgia Institute of Technology (G. Tech).

As of writing of this report, the data from G.Tech. EDR's (called Mobile Acceleration Crash Box or MACBOX) was not available as the development of the device was still in progress. Subsequently, some information was made available to the agency in February 2002. The output of the MACBOX, based on that information, is included in Appendix A.

2.0 Test setup

The EDR's were attached to the bed of a 2001 Ford F-150 pickup which was crashed into a flat fixed rigid barrier at 30 mph (48 kph). The EDR's were mounted on an aluminum plate which was attached to the bed of the truck. Self tapping screws were used to attach the EDR's to the plate and the plate to the truck.

A picture of the setup is shown in Figure 1.

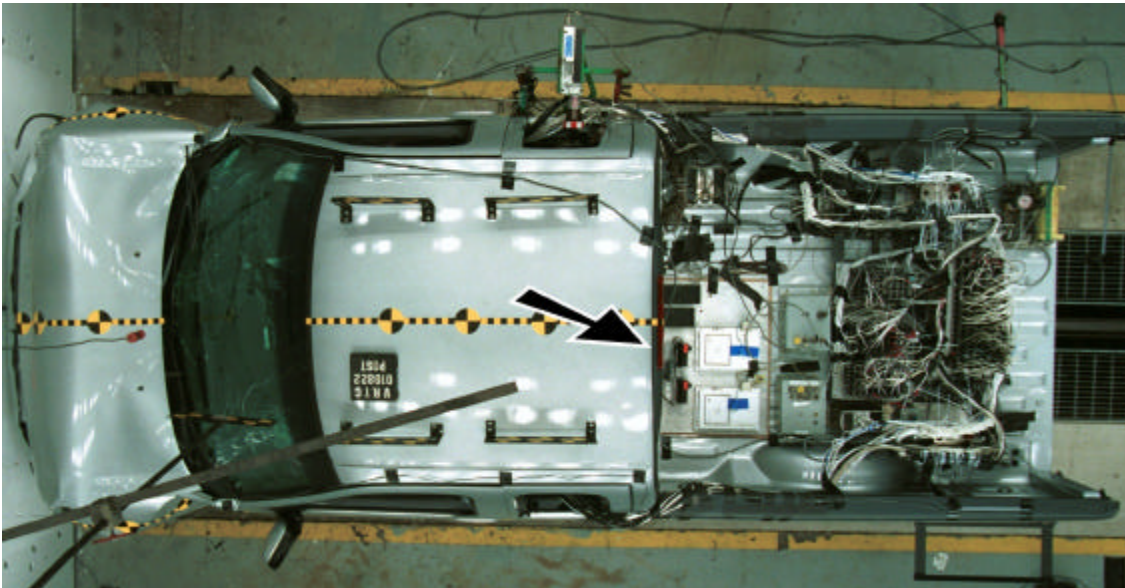


Figure 1 Test Setup

The plate with the EDR's is marked with the arrow. The detailed view of the plate is shown in Figure 2.

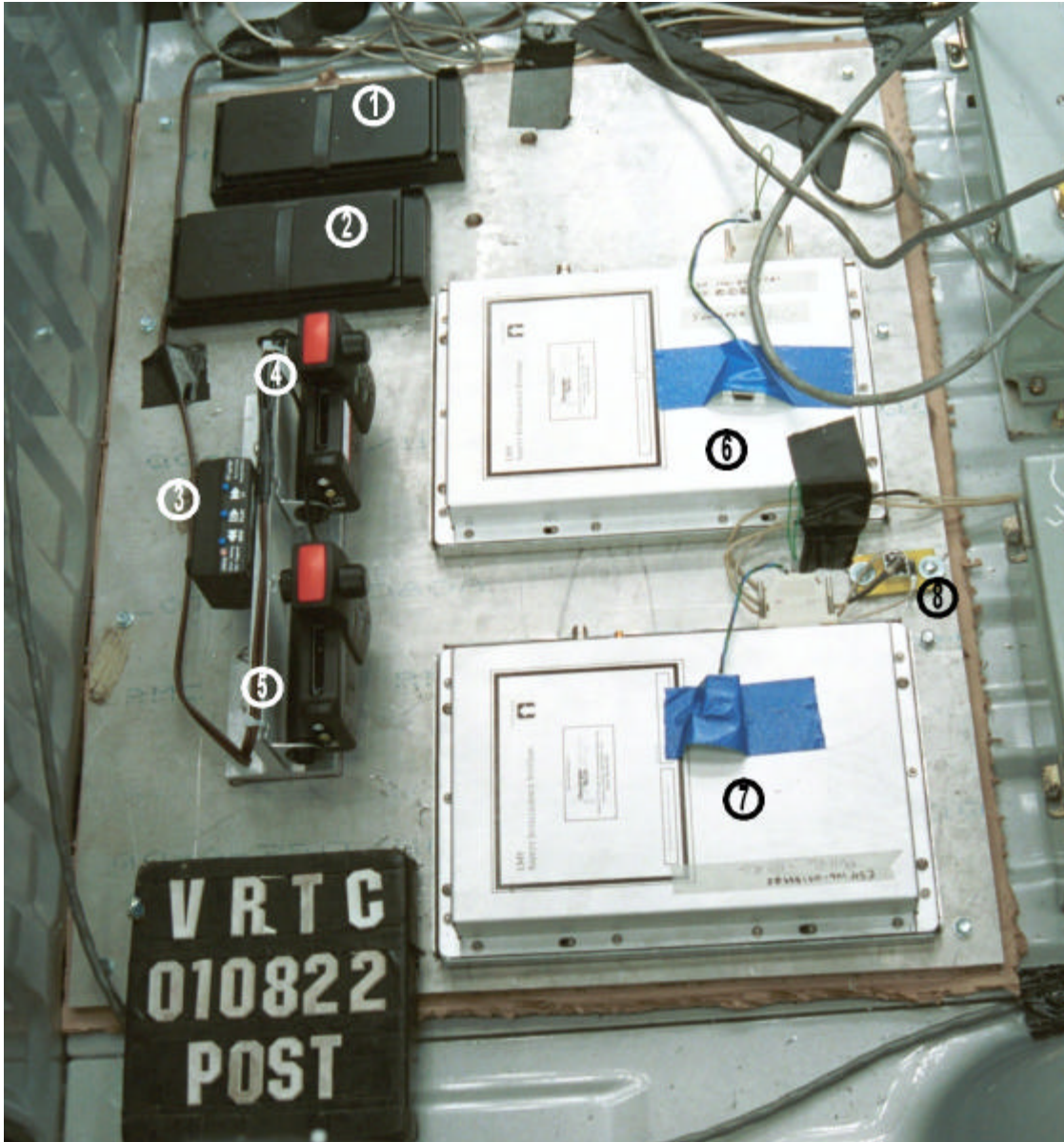


Figure 2 Plate with EDR's

The EDR's identified in Figure 2 are

- 1 and 2) IWI
- 3, 4 and 5) DriveCam
- 6 and 7) G.Tech.MACBOX
- 8) Three Endevco 7460 accelerometers (baseline)

The data from the NHTSA accelerometers and IWI data were filtered to SAE J211 Class 60 (cutoff frequency of 100 Hz).

The two units from IWI were "B6 Witness Unit". There were six DriveCam units installed. The plate had DriveCam-1, DriveCam-II ver 1.1, and DriveCam-II ver 1.5 (under development) units. Similar units were attached to the windshield (near the rear-view mirror). The two units provided by Ga. Tech. are MACBOX (Phase 1 box), owned by Safety Intelligence System Corporation "SIS".

Additionally, crash pulse and delta-V data from the EDR used by Ford in the F-150 OEM Restraint Control Module (RCM) was extracted by Ford and is reproduced in the report. This RCM was located on the vehicle centerline, behind the dashboard, approximately vertically under the radio.

This report does not describe the details of the algorithms used by the EDR's, their internal structures or data gathering capabilities. The scope of this report is limited to comparing the output of the crash pulse from the EDR's to the output from reference accelerometers.

The crash test was conducted on August 22, 2001 at Transportation Research Center, Inc., by the Vehicle Research and Test Center, East Liberty, Ohio.

3.0 Results

This study examined the capabilities of the selected EDR's in recording the crash deceleration pulse, even though DriveCam and G.Tech EDR's were capable of collecting more than the crash deceleration pulse. For example, the DriveCam system recorded video and sound and the G.Tech systems recorded GPS location during the crash event. The G.Tech system is expected to record other aspects of the crash environment, although the units tested recorded just the crash pulse and GPS data.

As mentioned earlier in the report, the data from MACBOX EDR's were not made available to the Agency in any usable form in time for this report. Some information was provided subsequently, which allowed the data from one of the MACBOX'es (box #2, with manual trigger) to be extracted. That data is presented in Appendix A. The data from MACBOX #1, which used automatic trigger to detect the crash event, was not considered to be representative of the crash event. Both MACBOX units were still under development at the time of the crash test.

The DriveCam, IWI and Ford used automatic detection of the crash event. Hence, the first data collected was 5-6 millisecond after the start of the impact, after a certain threshold value of deceleration was recorded. The Ford RCM also uses a threshold for triggering the event, but compensates for the time delay by shifting time zero by 5-6 ms. The data collection was initiated manually on the MACBOX #2 unit. The start of the event was then assigned by inspecting the recorded data during post-processing

The DriveCam units used in the crash test recorded accelerations in longitudinal and lateral directions only. The units attached to the windshield had an earlier version of the controlling software and had a lower sampling rate than the units attached to the plate in

the bed of the truck. The sampling rate of all DriveCam units tested was considered to be too low to allow accurate calculations of delta-V.

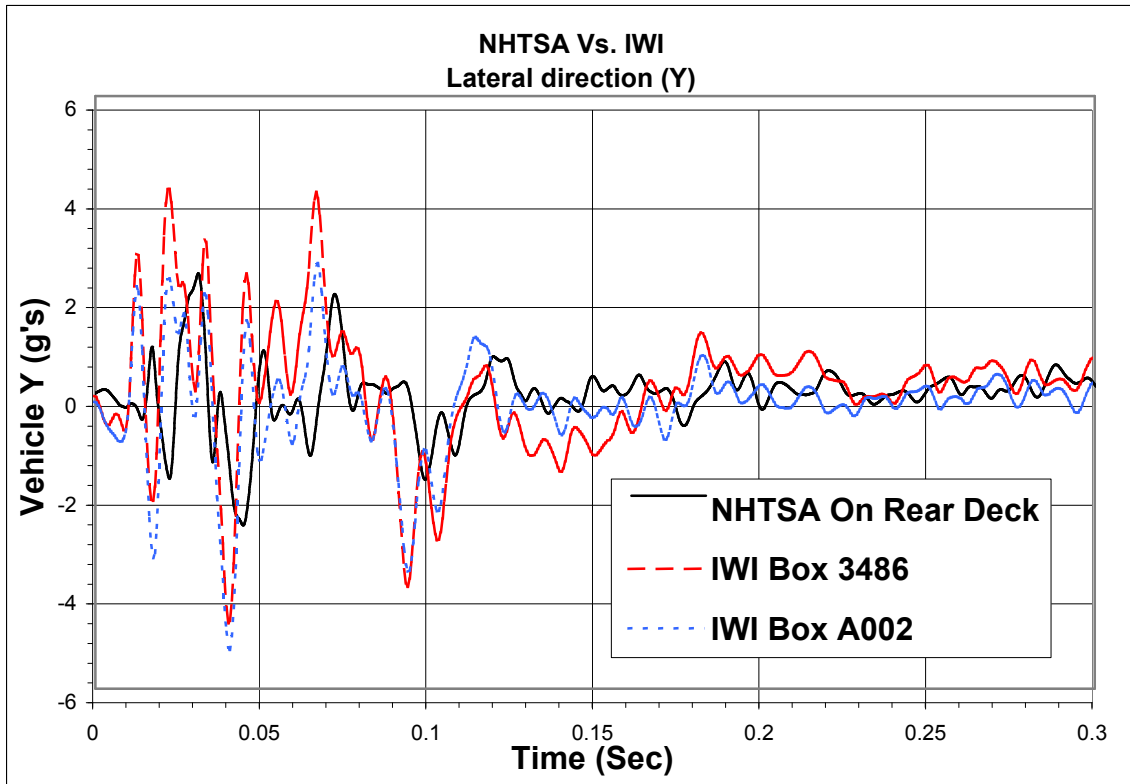
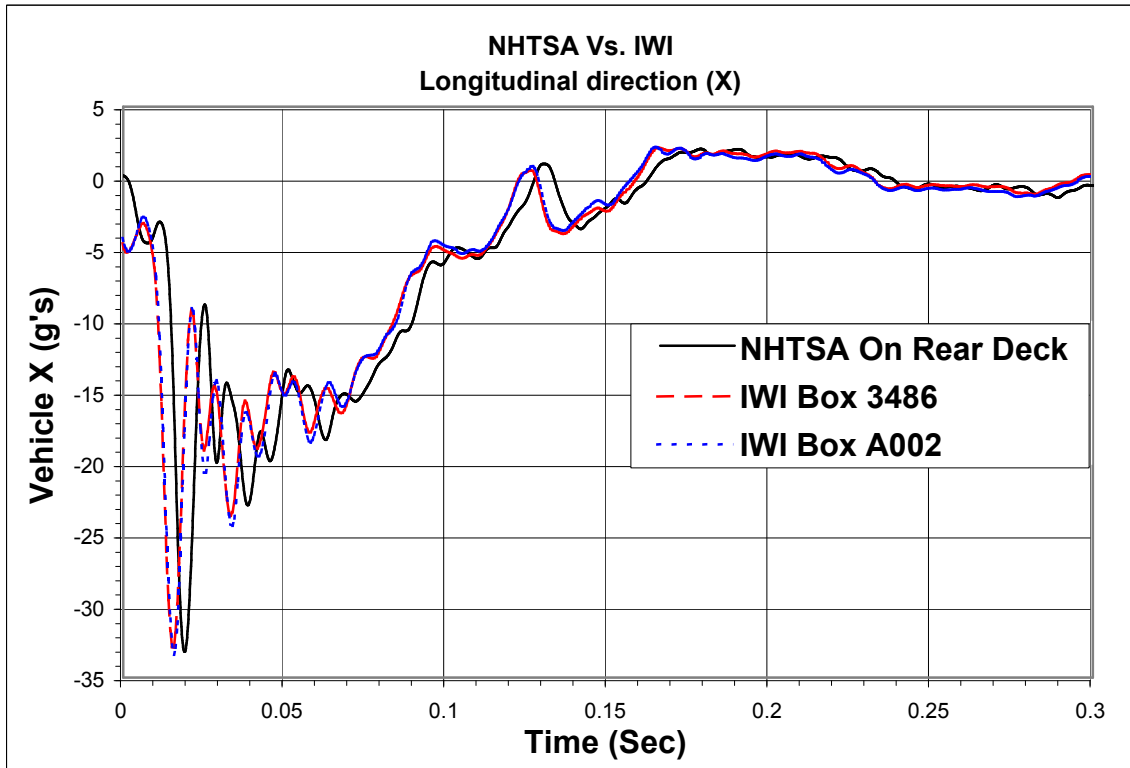
The output of the EDR's shown in Figure 2 were compared to reference accelerometers on the plate. The output of the DriveCam units attached to the windshield and the Ford RCM was compared to reference accelerometers in the passenger cabin, on the center tunnel near the vehicle center of gravity. This was done to compare the output of the EDR's to the suitable crash environment, which is different at different locations in the vehicle.

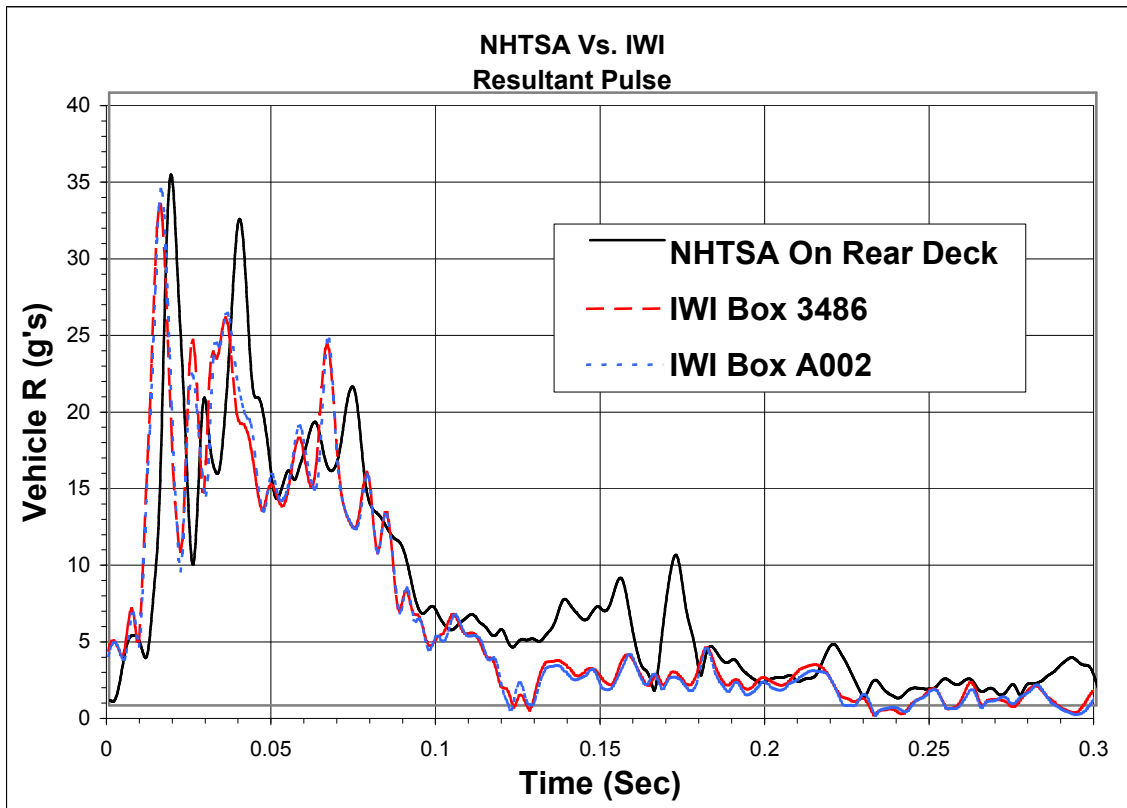
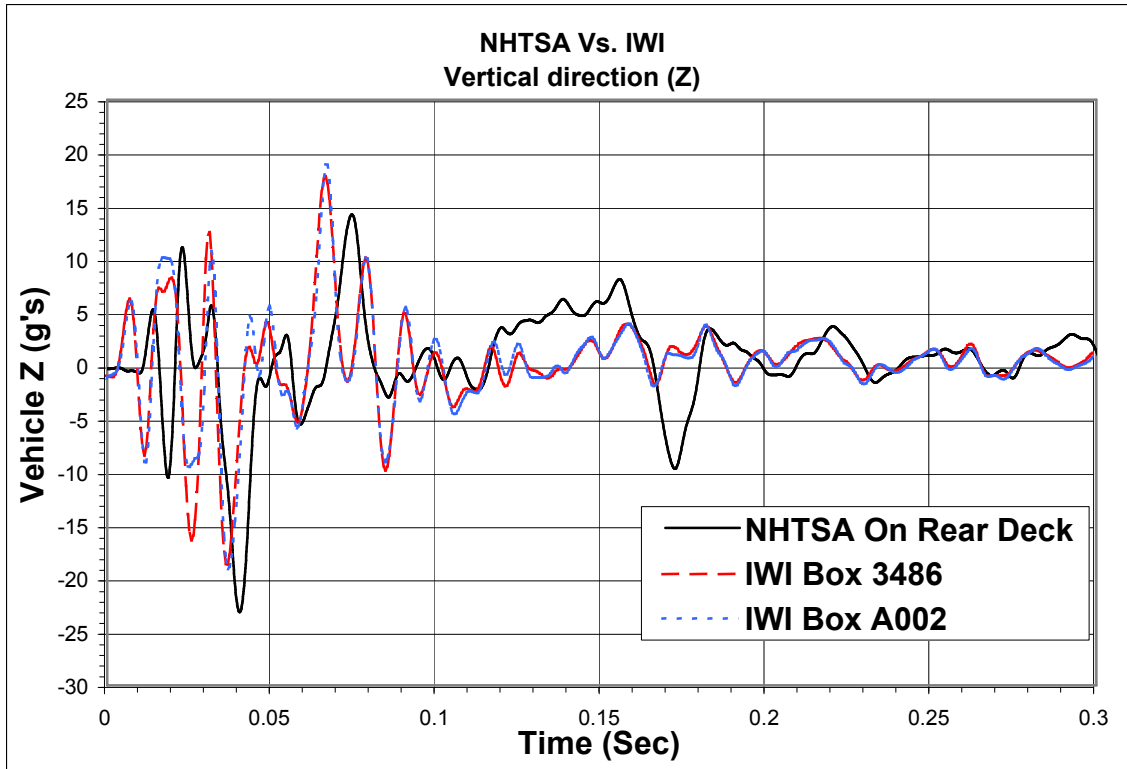
The following graphs show the results from the EDR's as compared to the reference accelerometers. In these graphs, the positive directions of the X, Y, Z axes are as follows:

- X - Forward, rear to front of the vehicle
- Y - Right, driver to passenger sides of the vehicle
- Z - Down, roof to floor of the vehicle.

3.1 Performance of IWI EDRs

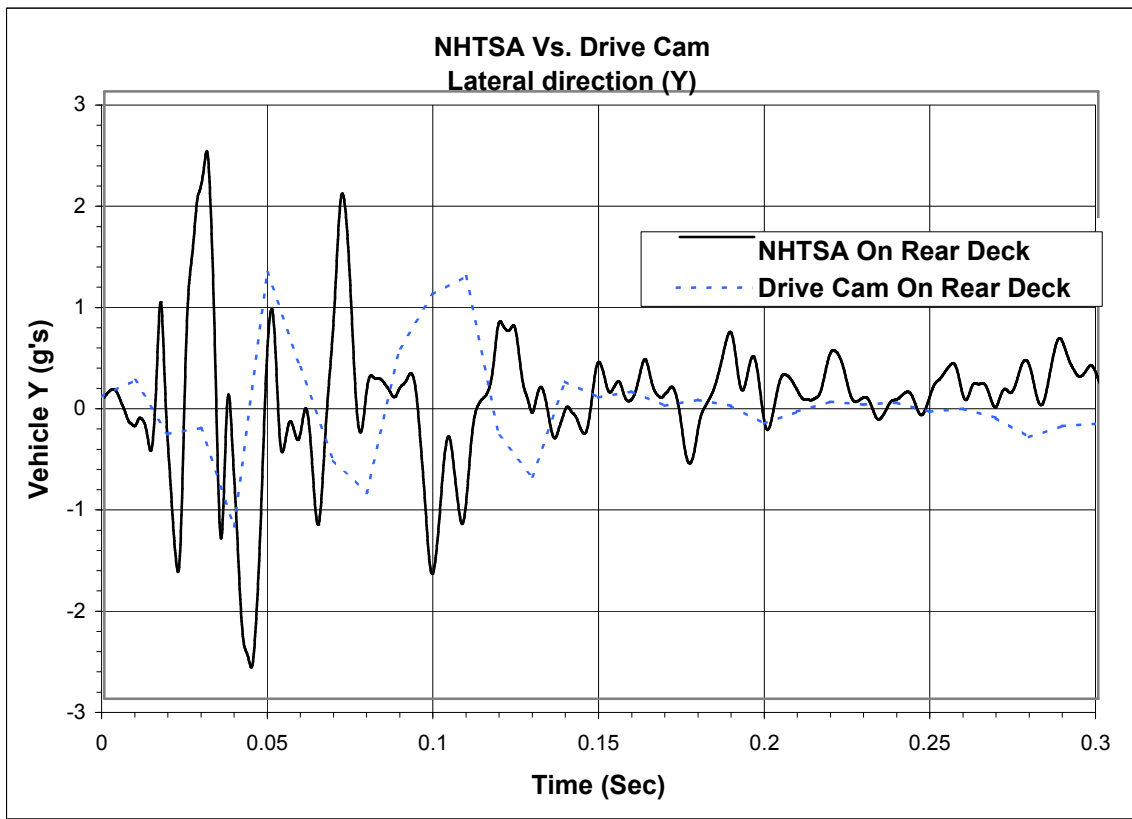
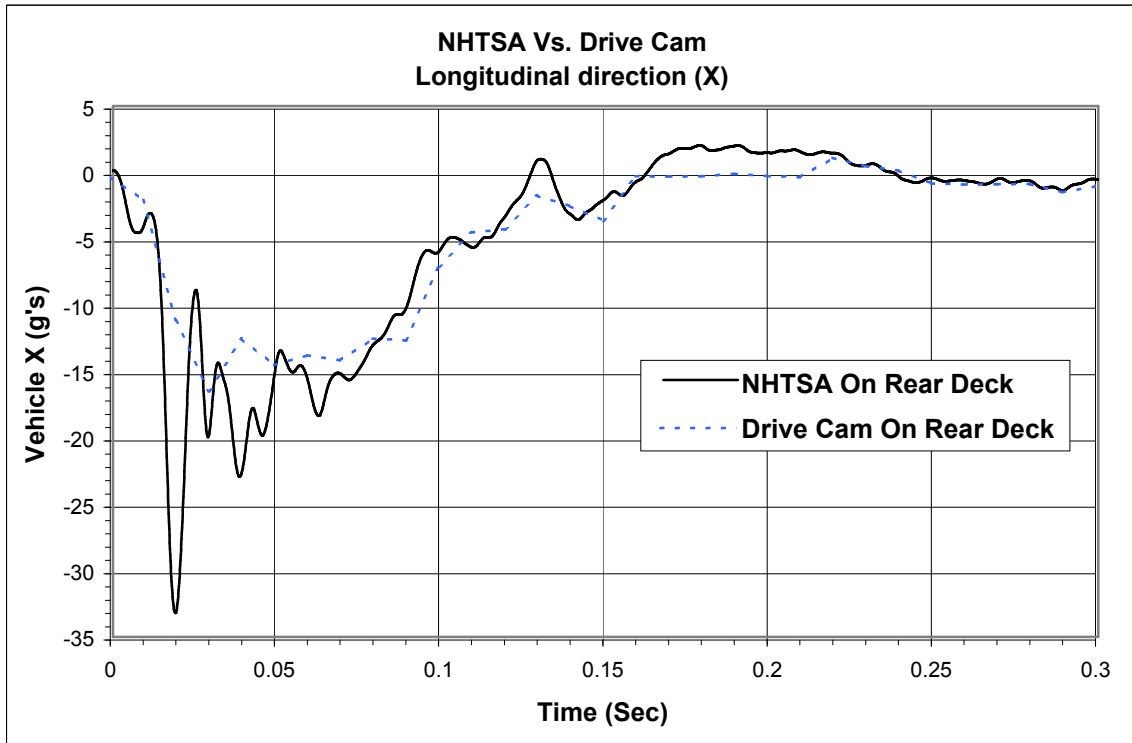
3.1.1 Compared to NHTSA accelerometers on the plate

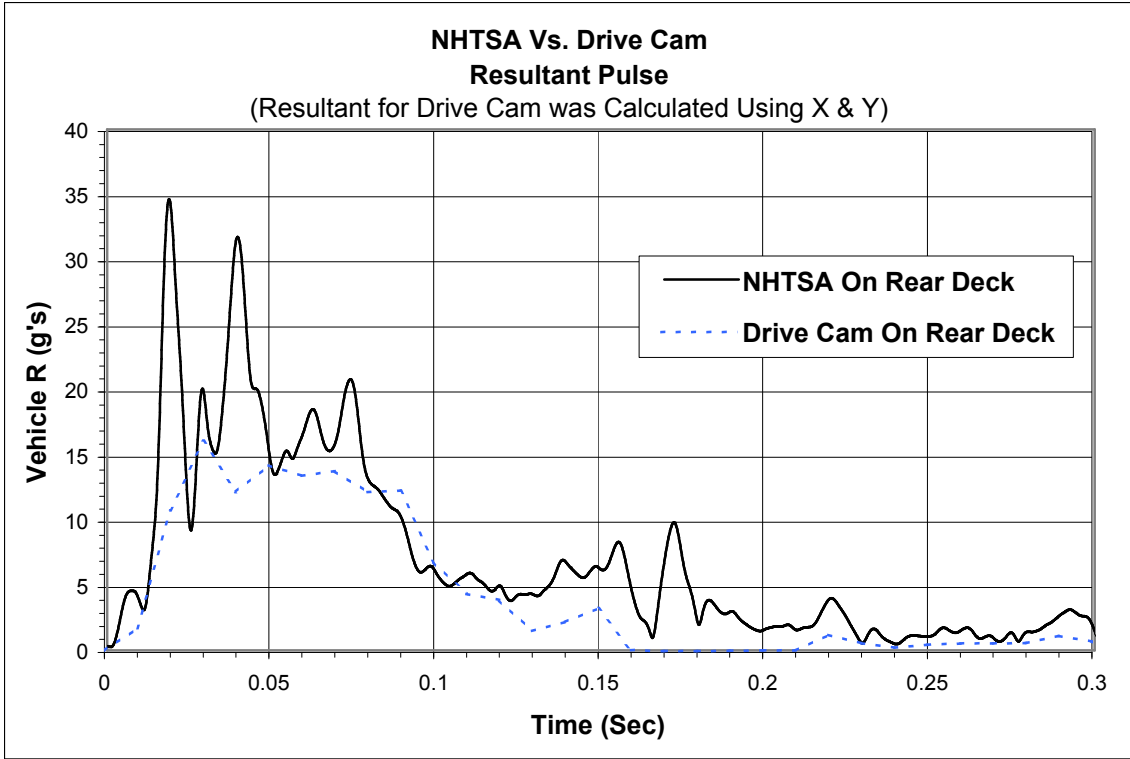




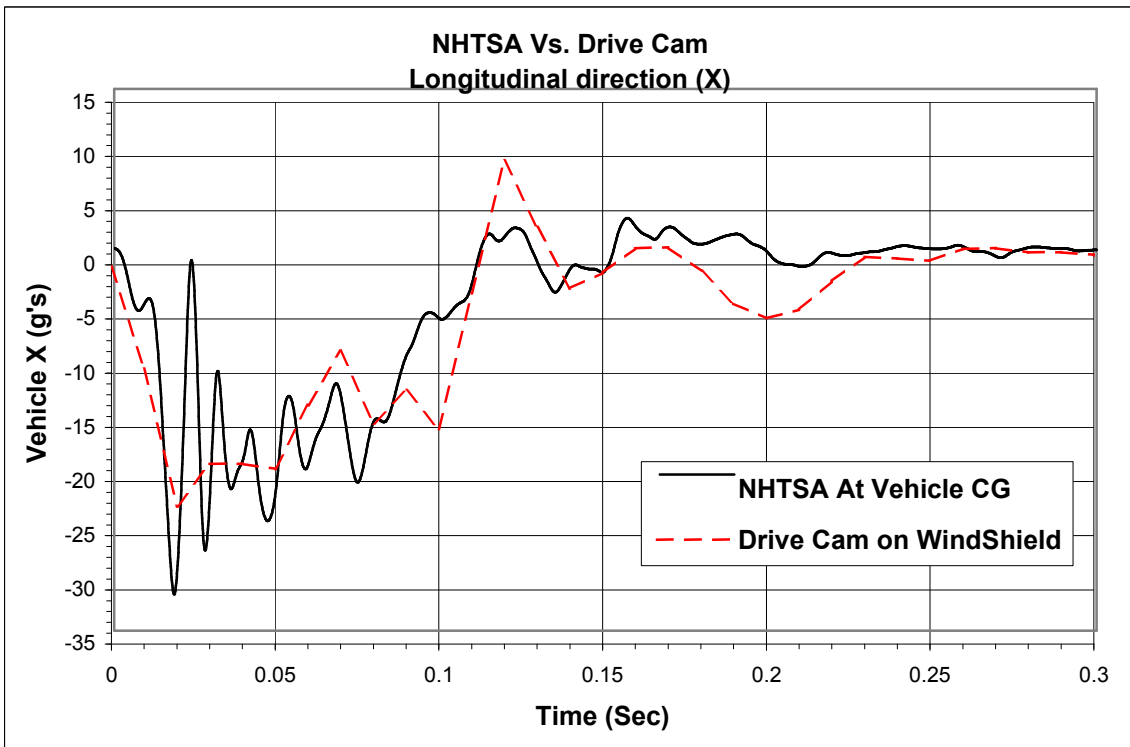
3.2 Performance of DriveCam EDRs

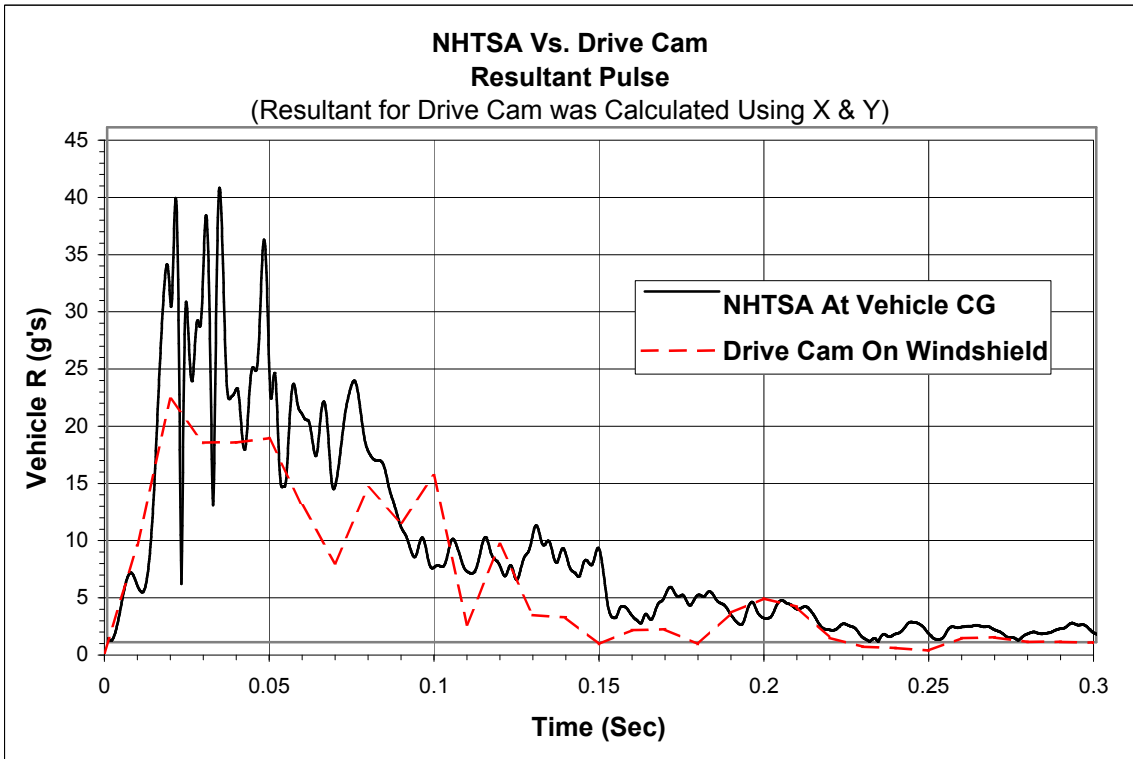
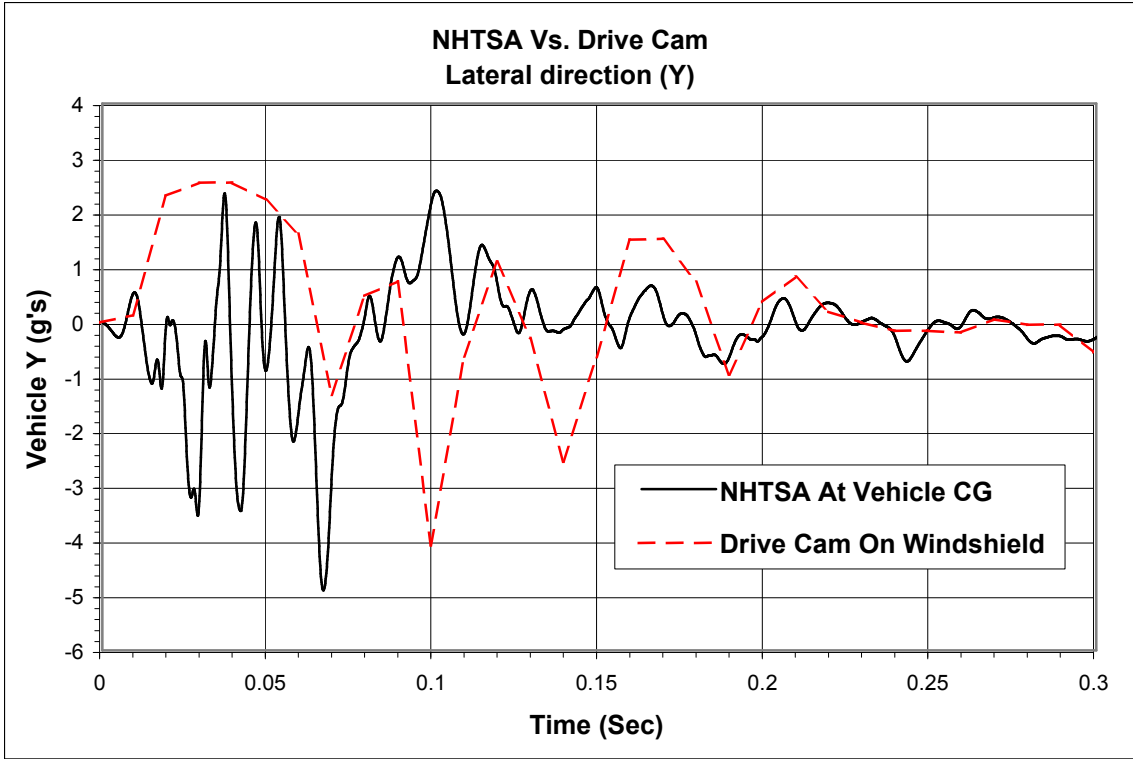
3.2.1 Compared to NHTSA accelerometers on the plate





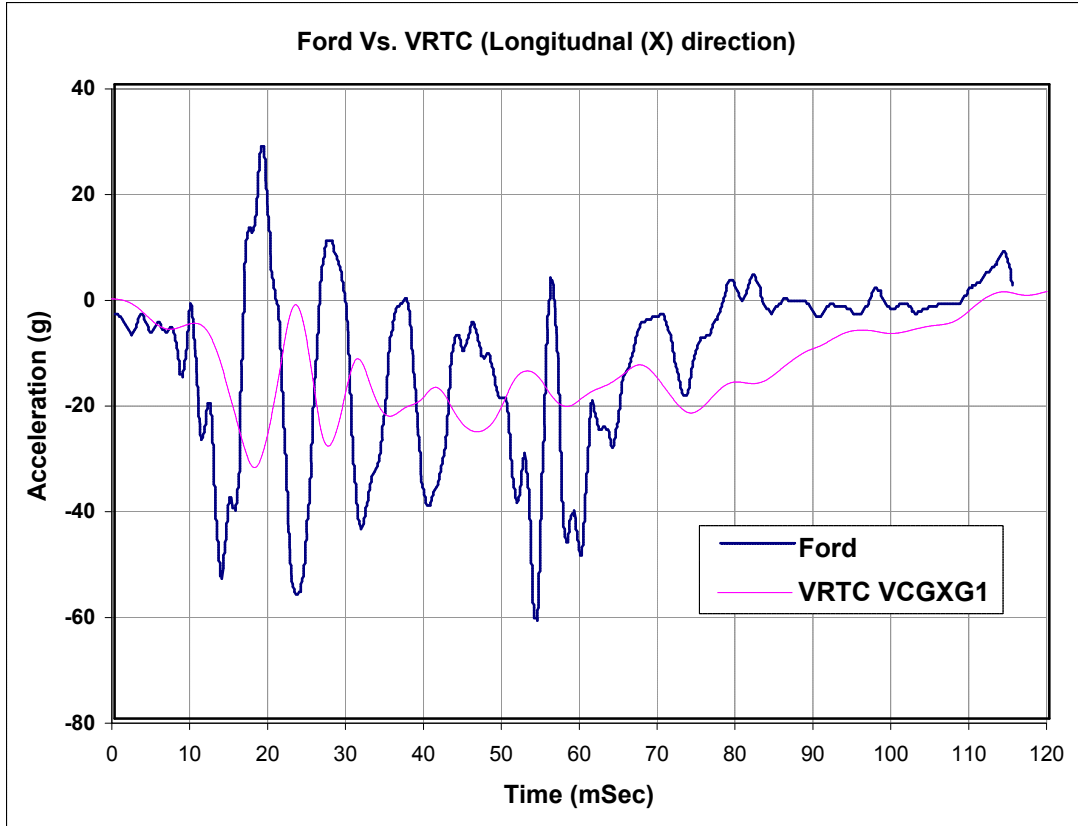
3.2.2 Compared to NHTSA accelerometers at the vehicle CG





3.3 Performance of Ford OEM RCM data.

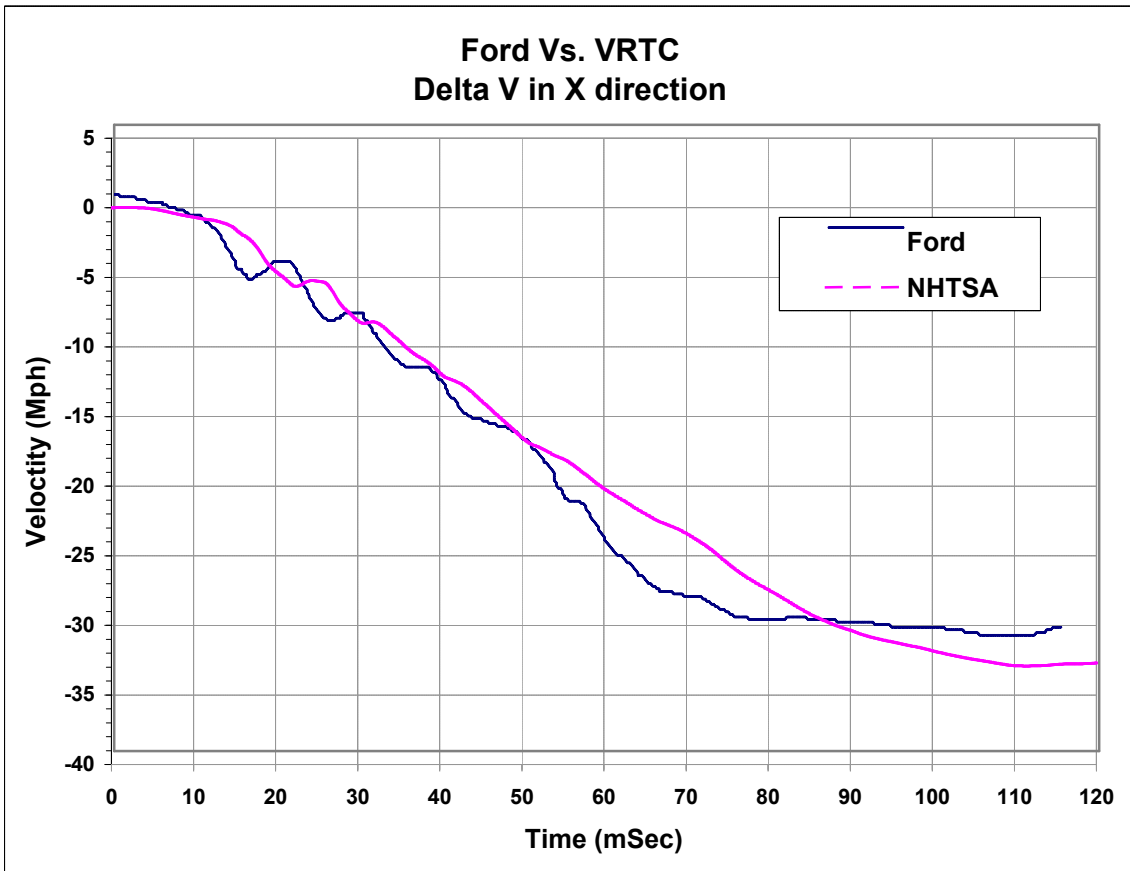
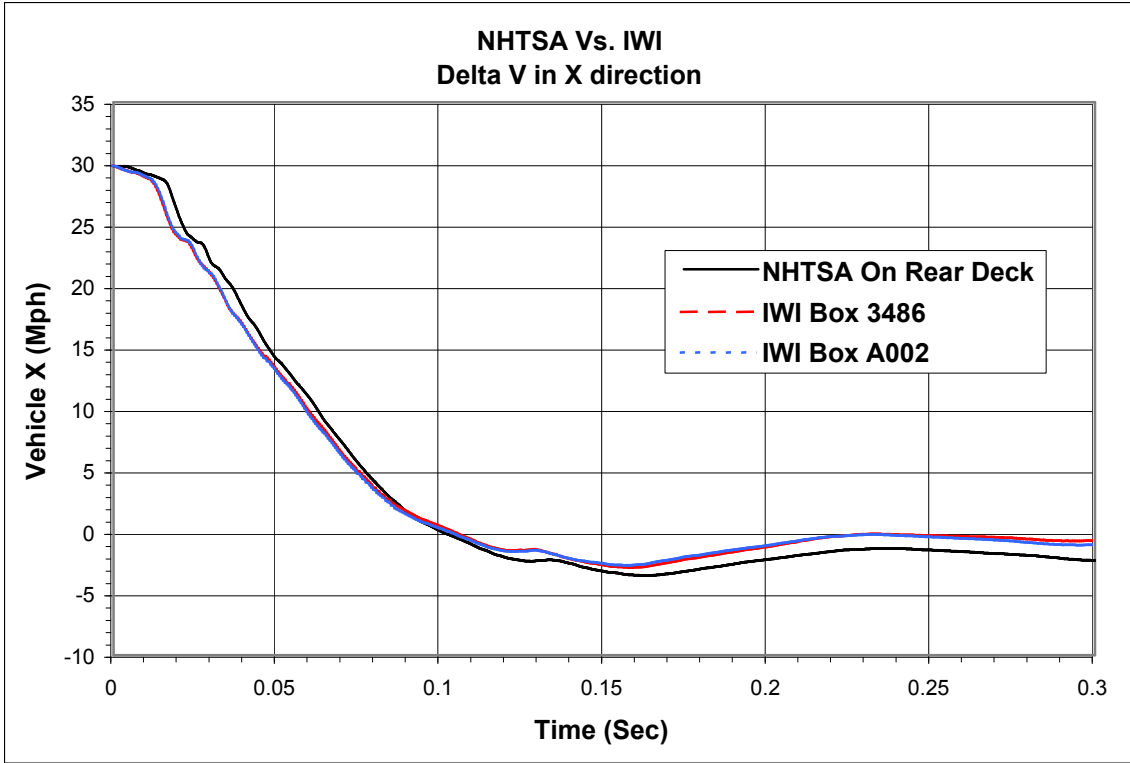
The crash pulse from the Ford RCM was extracted and compared to the NHTSA accelerometers at the vehicle CG.



3.4 Comparison of velocities from EDR data.

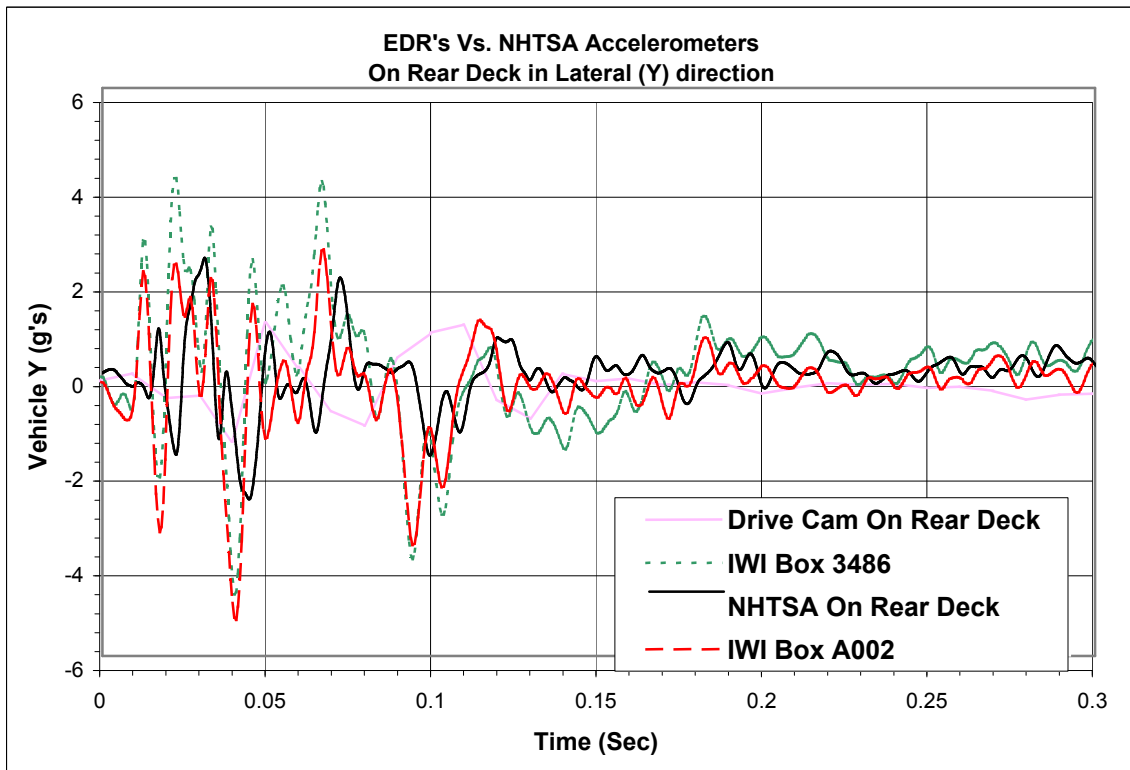
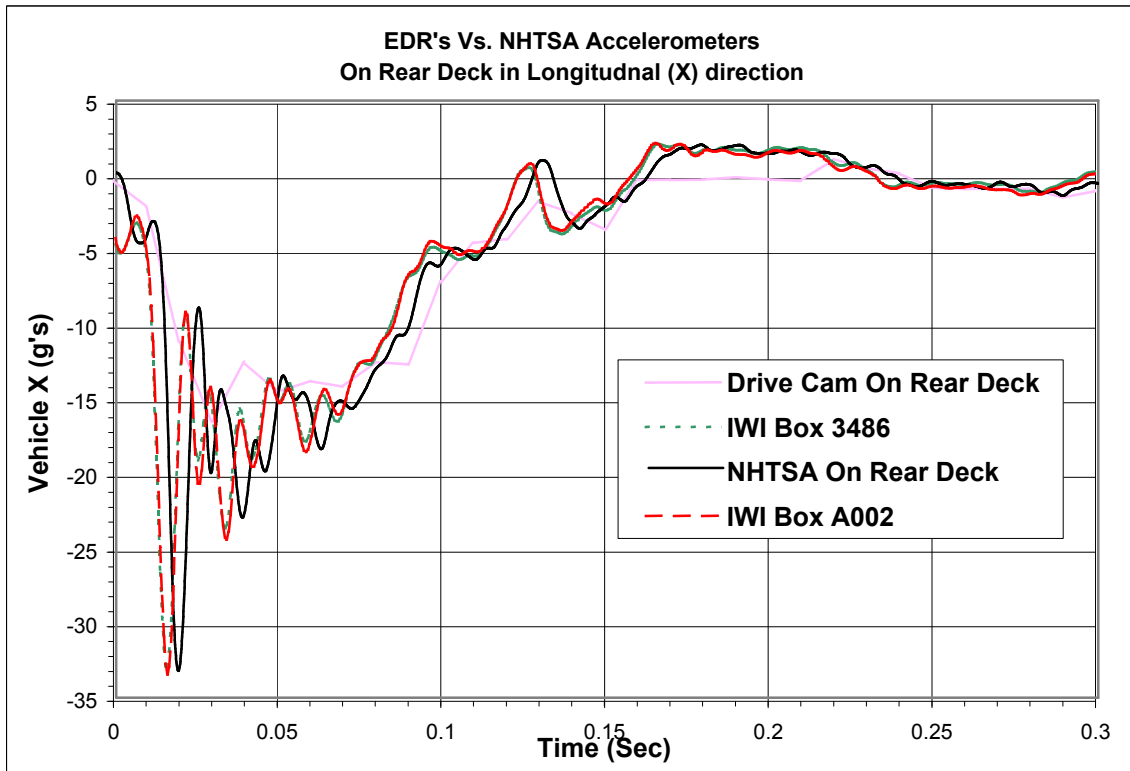
Data from the IWI EDR was integrated to get the velocity-time history and compared to similar curves from the reference accelerometers on the plate. Similarly, the delta-V data was extracted from the Ford EDR and compared to the delta-V from reference accelerometers at the vehicle CG.

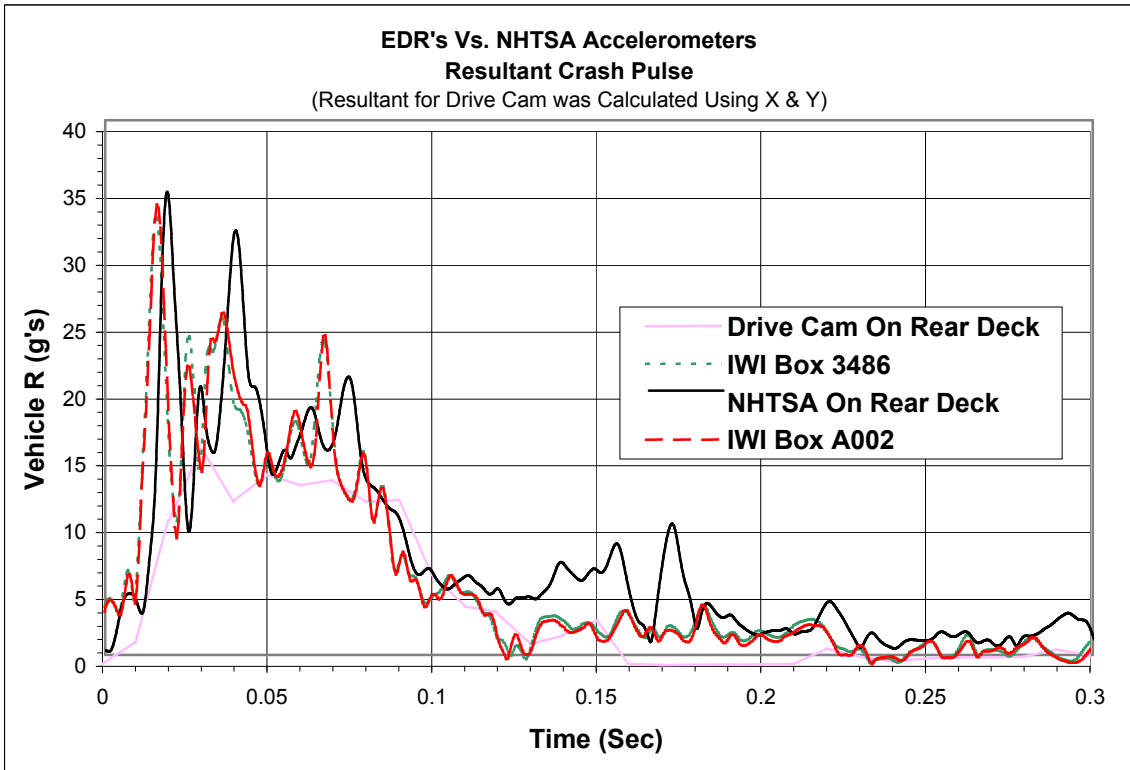
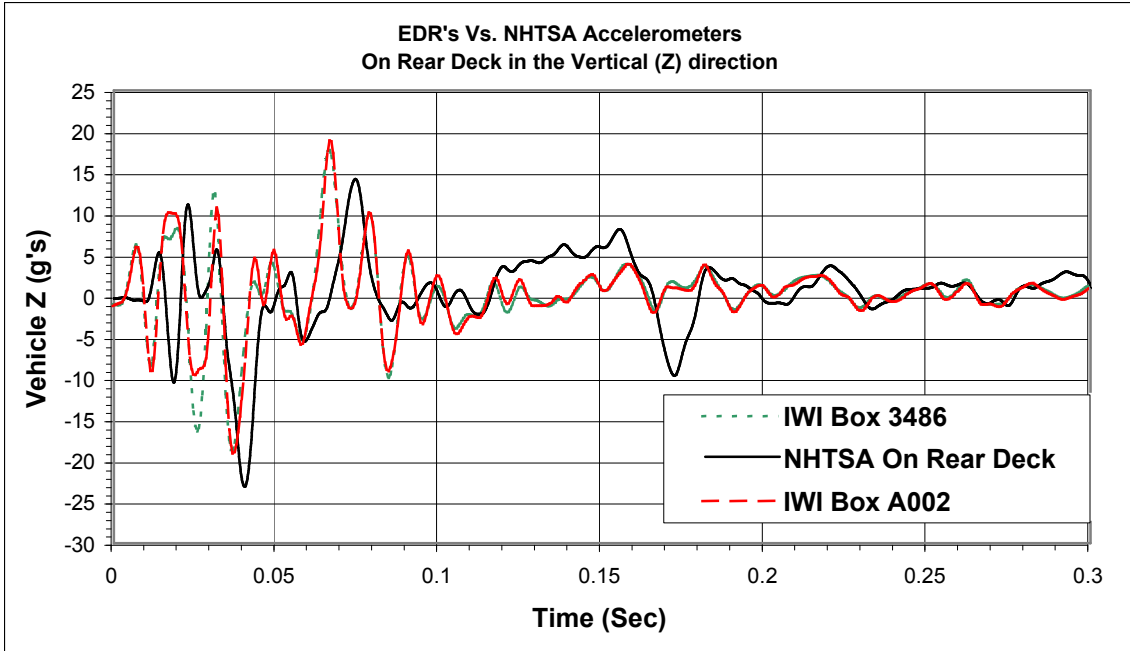
As previously mentioned, the sampling rate of the devices from DriveCam units tested was considered to be too low for getting accurate velocity profiles and was not included in this comparison.



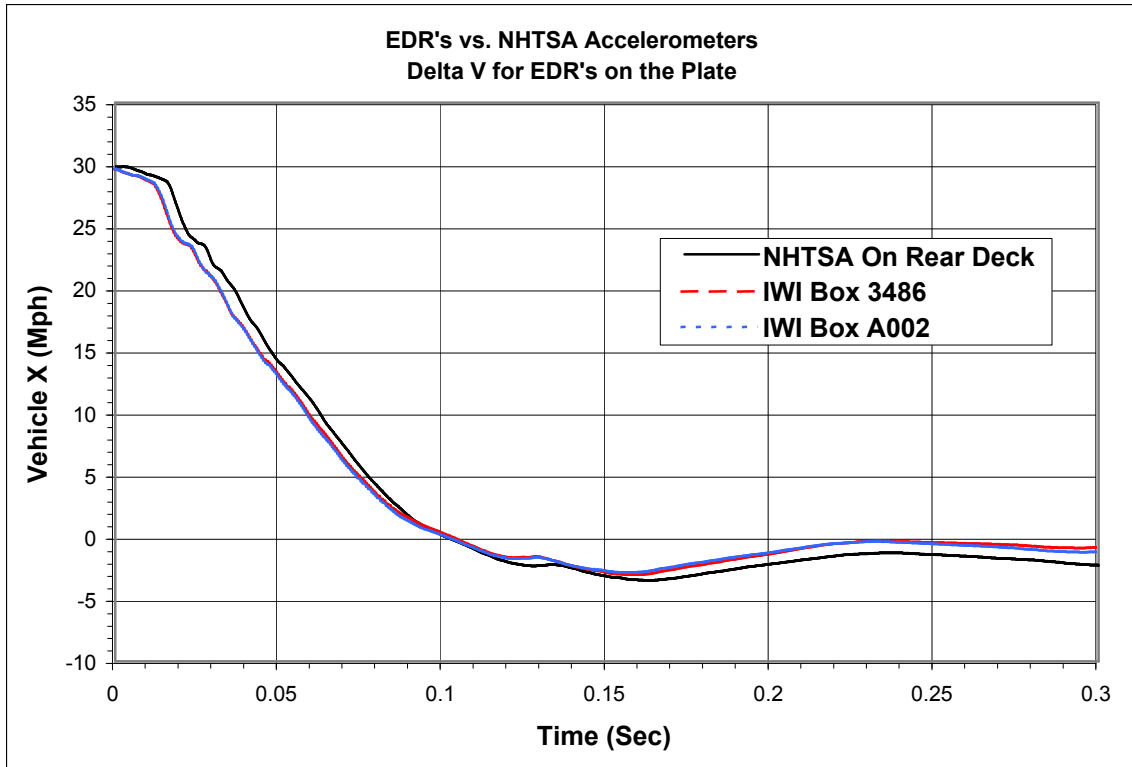
3.5 Comparison of all EDR's

A comparison of the output from the EDR's and accelerometers on the plate in the rear of the truck is presented in the following plots.

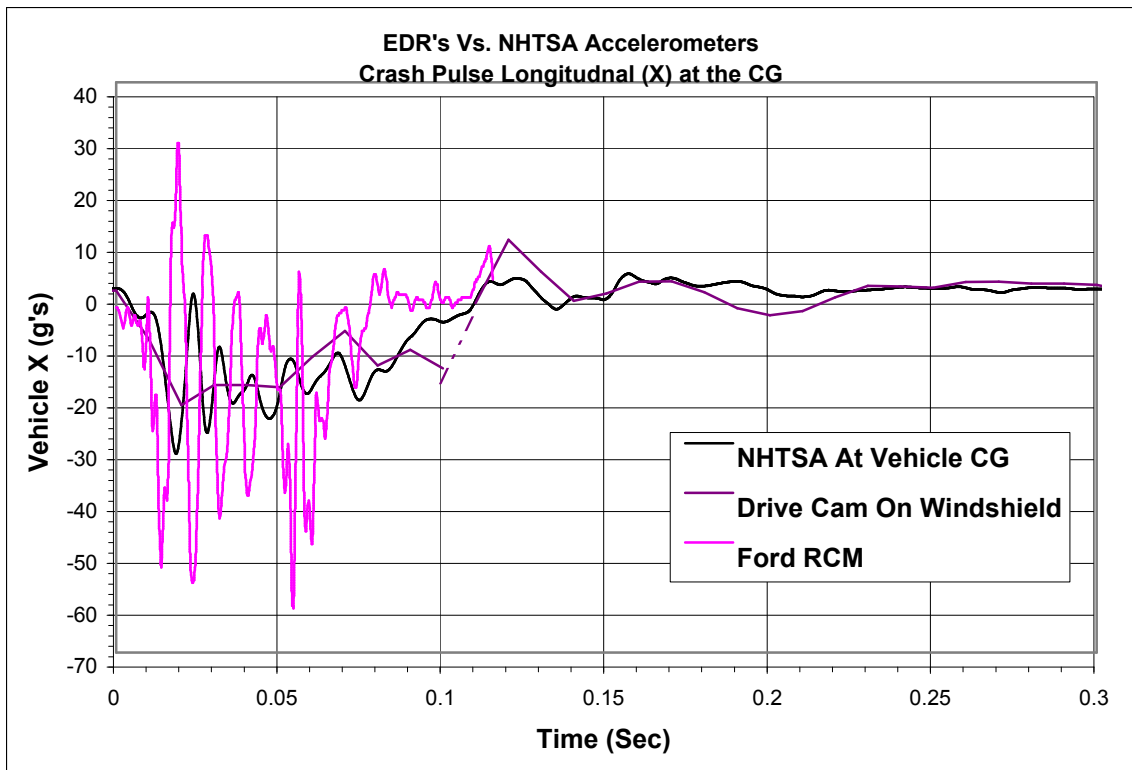




The delta-V from the EDR's on the plate is compared to those from accelerometers in the following plot. Selecting a cutoff time of 160 ms, the delta V values for NHTSA was 33.27 mph, and those from the IWI EDR's were 32.69 mph and 32.50 mph respectively. Again, the sampling rate of the DriveCam unit was considered to be too low to be able to produce comparable delta-V estimates.



A comparison of the output from the accelerometers at the vehicle CG., DriveCam unit on the windshield, and Ford RCM module are shown for the longitudinal direction in the following plot.



4.0 Conclusions

Amongst the EDR's tested, the IWI B6 Witness units were the closest to the reference accelerometers. Both the IWI units produced virtually identical acceleration readings, and were very close to the NHTSA accelerometers except for the event trigger. The IWI boxes use a certain threshold (approx 5 g) to trigger data capture for the event, and hence, lag the reference accelerometers by a few milliseconds. The time zero for the reference accelerometers is determined by a contact switch attached to the rigid barrier. The peak values and the shape of the crash pulse recorded by the IWI EDR's were similar to those from the reference accelerometers.

The DriveCam-II ver 1.5 (pre release) had lower sampling rate than the IWI EDR's. The G.Tech MACBOX devices were not developed enough to be evaluated in this study.

Appendix A Output from MACBOX

As of writing of this report, the data from G.Tech. EDR's (called Mobile Acceleration Crash Box or MACBOX) was not available as the development of the device was still in progress. Subsequently, some information was made available to the agency in February 2002. The output of the MACBOX, based on that information, is included in the plots below.

The data from MACBOX #1, which used automatic trigger to detect the crash event, was not considered to be representative of the crash event. Data from MACBOX #2, which was triggered manually to initiate data collection, was extracted and is shown here. The initial condition (time zero) for the data stream was determined by examining the data during post-processing.

An examination of results show that the product needs more development, especially in scaling, zero offsets and possibly polarity of the lateral and vertical (Y and Z) sensors.

