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A Compendium of Passenger Vehicle Event Data Recorder Literature and Analysis of Validation Studies

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Abstract

This paper presents a comprehensive literature review of original equipment event data recorders (EDR) installed in passenger vehicles, as well as a summary of results from the instrumented validation studies. The authors compiled 187 peer-reviewed studies, textbooks, legal opinions, governmental rulemaking policies, industry publications and presentations pertaining to event data recorders. Of the 187 total references, there were 64 that contained testing data. The authors conducted a validation analysis using data from 27 papers that presented both the EDR and corresponding independent instrumentation values for:

- Vehicle velocity change (ΔV)
- Pre-Crash vehicle speed

The combined results from these studies highlight unique observations of EDR system testing and demonstrate the observed performance of original equipment event data recorders in passenger vehicles.

Review and analysis of the current body of work indicates that original equipment event data recorders accurately measure and record the vehicle wheel (or transmission output) speed and integrated accelerations of the module. Reported values of vehicle velocity change (ΔV) and Pre-Crash vehicle speed tend to be less than the actual values. Numerous factors may contribute to the underreporting of this data. For Pre-Crash vehicle speed, the predominant factors include longitudinal wheel slip and sideslip. For ΔV, factors include off-axis accelerations and hardware or recording limitations. Analysts should consider event recorder data within the context of an accident reconstruction and account for factors that cause discrepancies between the reported and actual values.

Introduction

In 2000, the commercially available Crash Data Retrieval (CDR) system was released [1]. This tool allowed technicians to image and preserve post-crash data from select 1994 model year and newer General Motors vehicles. In model year 1999, select GM vehicles began to report Pre-Crash data. In 2003, the CDR system announced support of select Ford vehicles for 2001 model year and newer vehicles. In August of 2006, the National Highway Traffic Safety Administration (NHTSA) issued rule 49 of the Code of Federal Regulations (CFR) Part 563, pertaining to the standardization of data and data retrieval methods for vehicles with a gross vehicle weight rating (GVWR) of 8,500 pounds or less that were already voluntarily recording time-series event data [2]. This prompted additional automobile manufacturers to partner with the CDR system.

Beginning in 2007, a new release of the CDR system supported select 2005 model year and newer Chrysler vehicles. Numerous other automobile manufacturers followed suit.

Figure 1 contains a timeline of EDR coverage using commercially available tools by model year and major automaker.

(For a complete list of coverage by the CDR system at the time of publication, please refer to: http://crashdatagroup.com/software/CDR_v16.4_Vehicle_Coverage_List_R1_0_0.pdf)

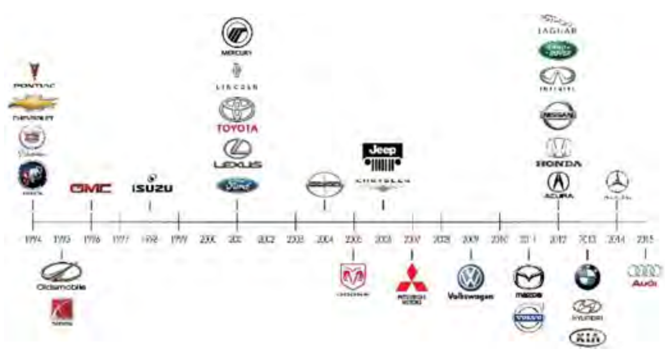

Figure 1. Timeline of EDR Coverage, Using Commercially Available Retrieval Tools, by Model Year and Manufacturer

Hyundai and Kia use a tool manufactured by Global Information Technologies (GIT) for retrieving event data and have been the subject of published literature. Jaguar, Land Rover and Mitsubishi also sell tools to retrieval EDR data, but the authors of this study are not aware of any publications pertaining to data obtained by these tools. Other vehicle manufacturers (such as Nissan, Toyota and Subaru) had EDRs supported by proprietary retrieval tools. In the case of Nissan and Toyota, these tools predated their support by the CDR system.

Body of Literature

The first paper to address EDR accuracy was a study of General Motors vehicles by Chidester in 1999 [3]. In this study, Chidester and GM personnel evaluated the system design and reported an accuracy of ± 4% for Pre-Crash vehicle speed and ±10% for longitudinal speed change. It should be noted that the Chidester publication did not include any instrumented test data. The Chidester paper was written prior to model year 1999 production, which was the first model year to include Pre-Crash speed. Subsequent to the Chidester study, many studies have been published pertaining to various vehicle makes and models under a variety of impact modes and operational conditions.

The authors of this study conducted a literature review and identified 187 peer-reviewed studies, textbooks, legal opinions, governmental rulemaking policies, industry publications and presentations pertaining to original equipment EDRs. A complete listing of the 187 references is contained in chronological order in Appendix A. The authors of the reviewed references represent various organizations from the automotive safety and accident reconstruction communities, listed below:

- Governmental Agencies
    - U.S. Department of Transportation: National Highway Traffic Safety Administration (NHTSA)
    - National Transportation Safety Board (NTSB)
    - National Aeronautics and Space Administration's (NASA) Jet Propulsion Laboratory (JPL)
    - U.S. Department of Transportation: Federal Motor Carrier Safety Administration
    - Transport Canada
    - National Research Institute of Police Science (Japan)
    - National Agency for Automotive Safety and Victim's Aid (Japan)
    - Swedish National Road and Transport Research
- Universities/Institutions of Higher Education
    - University of Western Ontario (Canada)
    - University of Saskatchewan (Canada)
    - Sandhills Community College (North Carolina, U.S.A.)
    - Warsaw University of Technology (Poland)
    - Rowan University (New Jersey, U.S.A.)
    - George Mason Law School (Virginia, U.S.A.)
    - Hongik University (Seoul, South Korea)
    - Monash University (Melbourne, Australia)
    - Wake Forest University (North Carolina, U.S.A.)
    - Virginia Polytechnic and State University (Virginia, U.S.A.)
    - Northwestern University - Center for Public Safety (Illinois, U.S.A.)
    - University of Notre Dame (Indiana, U.S.A.)
    - University of Tulsa (Oklahoma, U.S.A.)
    - George Mason University - Center for Collision Safety and Analysis (Virginia, U.S.A.)
- Law Enforcement Agencies
    - Scottsdale Police Department (Arizona, U.S.A.)
    - Kent County Sheriff Department (Michigan, U.S.A.)
    - Ontario Provincial Police (Ontario, Canada)
    - Criminal Investigation Laboratory of Gifu Prefecture Police Head Quarters (Japan)
    - Essex District Attorney's Office (Massachusetts, U.S.A.)
    - Michigan State Police (U.S.A.)
    - Ohio State Police (U.S.A.)
    - Orange County District Attorney's Office (California, U.S.A.)
- Institute of Police Technology and Management
- Institute of Electrical and Electronics Engineers
- Automobile Manufacturers
- Automotive Component Vendors
- Private Industry

Data Selection

The authors of this study parsed the total body of literature into the following five categories:

A. Informational: pertaining to the development of the technology and general guidelines for using event data.

B. Epidemiological and Automotive Safety: research using EDR data as an independent variable.

C. Legal: court rulings, rulemaking and evidentiary issues.

D. Validation studies: research reporting EDR data with matching independent instrumented data.

E. Other studies containing data: research reporting data that did not meet the specified validation requirement, which is discussed below.

Figure 2 contains a graph depicting the breakdown of the references by category.

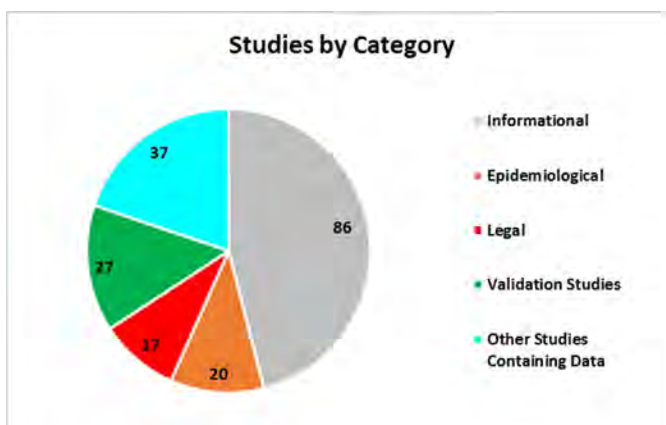

Figure 2. Studies by Category

The authors began the EDR data analysis by identifying the papers in which testing was conducted. Of the original 187 references listed in Appendix A, the 64 references that reported testing are listed in Appendix B. Of the 64 papers with testing, 27 contained paired data points from EDR and independent instrumentation suitable to validate the accuracy of ΔV and Pre-Crash vehicle speed. Appendix C contains a lookup table sorted by make, model and model year that identifies papers in which testing was completed.

In order to be included in the validation analysis, the paper had to report:

1. The make, model and model year of the test vehicle.
2. The EDR reported value(s) for the quantity being tested.
3. The corresponding value(s) being tested from independent instrumentation.

A total of 27 papers were identified that met these inclusion requirements. Of these 27 papers, there were nine that contained Pre-Crash data, nine that contained ΔV data and nine that contained both data types.

Analysis: Pre-Crash Data (Vehicle Speed)

EDR reported vehicle speed is typically measured by sensors monitoring the output of the transmission or an average of the speed of the drive wheels. These sensors can accurately report wheel speed but, due to certain factors, the wheel speed may not represent the true over-the-ground speed of the vehicle. These factors may include longitudinal wheel slip due to acceleration or braking, wheel sideslip due to rotation of the vehicle about the vertical axis, significant changes in the tire's rolling radius as compared to the vehicle's original equipment, and changes to final drive ratio compared to the vehicle's original equipment. These known anomalies are often discussed in the 'Data Limitations' section of the report generated by the CDR system and are studied in some of the literature reviewed in this paper.

Figure 3 is a plot of the difference between EDR measured Pre-Crash speed and independently measured Pre-Crash speed for all studies. The speed difference reported in this paper is reported as an absolute difference as opposed to percentage. While some data may have a slight dependency on speed, the authors have chosen to analyze the data independent of speed. Positive values on the vertical axis represent EDR reported speeds higher than the independent measurement, and negative values represent the EDR reporting a lower speed. The horizontal axis of this plot represents vehicle speed as measured by the independent instrumentation. Due to the density of the plotted data, the charts have been included as full page charts in Appendix D. A table containing all data points sorted chronologically by study is also included in Appendix E.

In Figure 3, three data points fell well below the rest of the population (speed differences of -12 at 35 mph, -7.8 at 34.8 mph and -7 at 50 mph). Two of these data points (-12 at 35 mph and -7 at 50 mph) were presented in studies examining the effects of initial brake engagement at the onset of hard braking [4, 5]. As expected, the high level of wheel slip during braking underreported the true over-the-ground speed of the vehicle. The other data point (-7.8 at 35 mph) was the NHTSA's New Car Assessment Program (NCAP) frontal barrier impact test #5310, involving a 2005 Buick Rendezvous equipped with an all-wheel drive *Hydra-Matic* 4T65-E 4-speed automatic transmission [6]. In this impact test, the Buick was towed on its wheels into a rigid frontal barrier. The owner's manual for the 2005 Buick Rendezvous states that the vehicle should not be towed with any of its wheels on the ground and that towing will cause damage to the drivetrain components. [7]. One hypothesis to explain the discrepancy in the EDR reported vehicle speed compared to the instrumented speed is that, while the vehicle was being towed into the barrier during testing, the drivetrain was damaged. This condition is unique to this particular vehicle and test setup and not likely to represent a real-world driving situation. However, this hypothesis has not been tested and is beyond the scope of this paper.

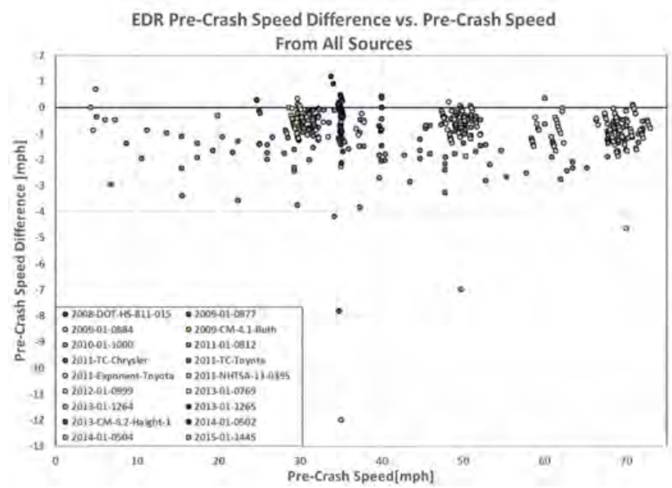

Figure 3. EDR Reported Speed Difference versus Vehicle Speed: All Studies

Figure 4 presents the same Pre-Crash speed data as Figure 3, but the data has been sorted by vehicle operational condition. As seen in Figure 4, steady state driving (green circles) is associated with minor speed differences and a tendency to underreport vehicle speed. However, active braking, mostly with Anti-Lock Braking Systems (ABS), is associated with greater underreporting and more variance in reported vehicle speed. Although data was very limited, braking without ABS was associated with even greater underreporting of vehicle speed. Similar observations were made by several authors of studies that included braking, citing wheel slip as the reason for the discrepancy in the data.

Figure 5 contains a plot of EDR speed difference versus vehicle speed for steady state operation only. As seen in Figure 5, the variability in speed difference is low for steady state driving conditions. Figure 6 contains a histogram that represents the speed difference distribution and a cumulative percentage plot for steady state driving. As seen in Figure 6, the data is not normally distributed. The data demonstrates positive kurtosis, with the peak and majority of data near the center of the distribution in the 0 mph speed difference bin, shown in black. The data also demonstrates a negative skew, as the majority of the EDR data underreported the measured vehicle speed during steady state driving. This pattern of low variability and slight underreporting is a common characteristic of the analyzed EDR data.

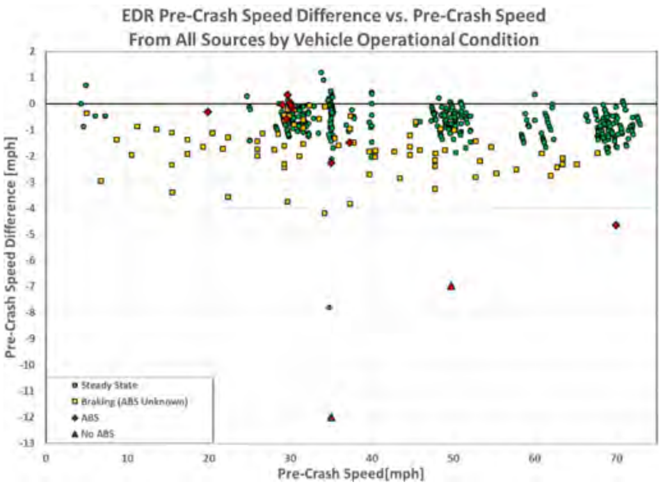

Figure 4. EDR Reported Speed Difference versus Vehicle Speed: Sorted by Vehicle Operational Condition

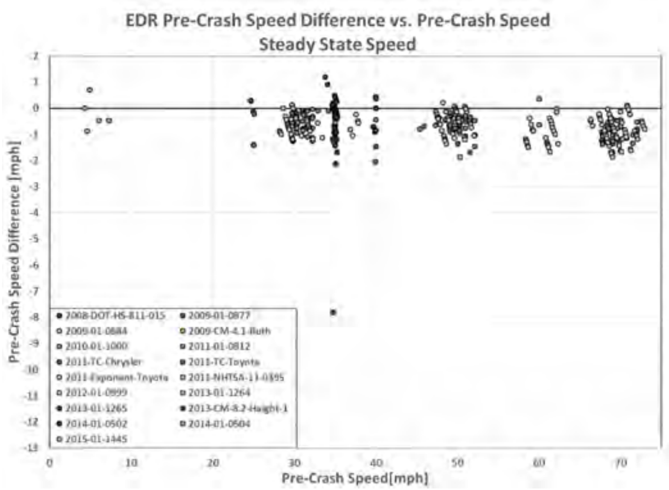

Figure 5. EDR Reported Speed Difference versus Vehicle Speed: Steady State Operation Only

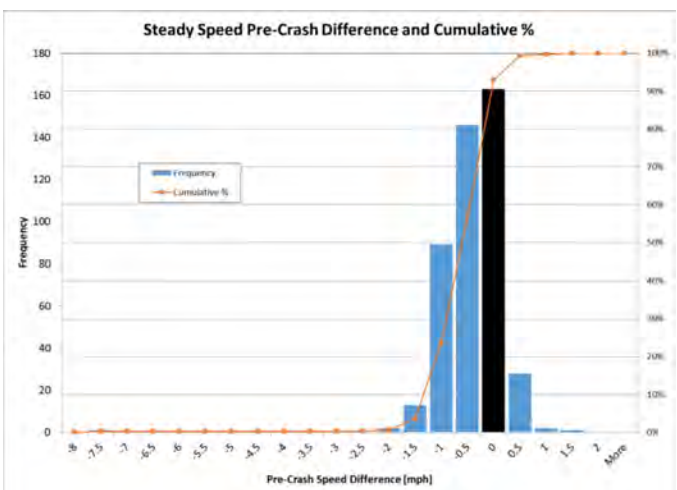

Figure 6. Frequency Distribution and Cumulative Percent of Speed Difference: Steady State Operation Only

Figures 7 and 8 contain graphics related to EDR speed difference versus vehicle speed during braking. As seen in Figures 7 and 8, the underreporting and variability of the EDR reported Pre-Crash speeds are much more pronounced during braking when the effects of wheel slip are present. In studies that examined the effects of braking, the speed difference was largest at the onset of heavy braking and tended to lessen as ABS systems modulated the brakes [4].

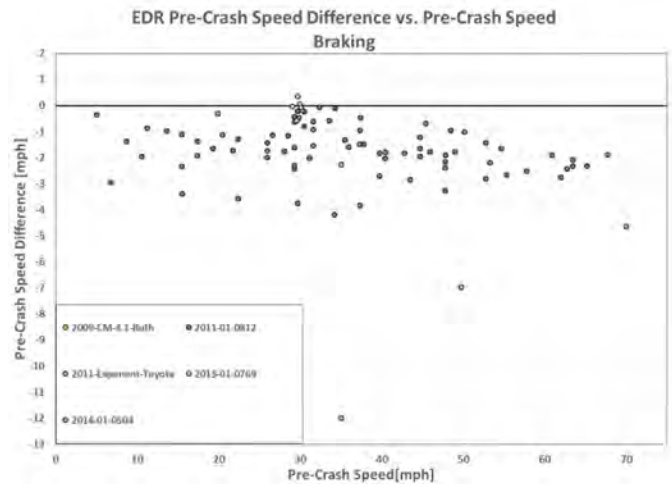

Figure 7. EDR Reported Speed Difference versus Vehicle Speed: Braking Only

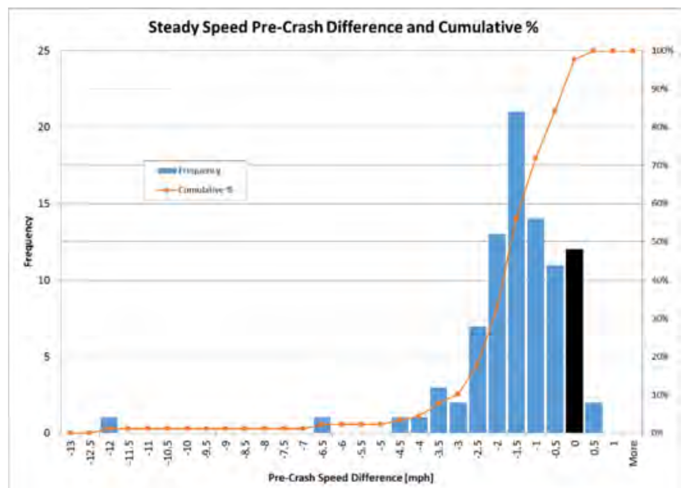

Figure 8. Frequency Distribution and Cumulative Percent of Speed Difference: Braking Only

Other Pre-Crash Studies Not Analyzed

Several additional studies presented EDR reported Pre-Crash speed results that were not conducive to statistical analysis. Although the test methods and techniques were adequate, the data in these papers was presented in graphical form and, due to the density of information, the authors of this study chose not to risk introducing errors while converting the data plotted graphically to discrete data points. In 2003, Lawrence examined the accuracy of steady state Pre-Crash speed from three 2002 model year GM vehicles [8]. In 2012, Brown presented data from a 2010 Toyota Camry during acceleration and braking [9]. Reust [10, 11, 12] and Ruth [13] evaluated the various vehicles during acceleration, coasting, braking and yaw maneuvers. In the 2006 study [10], Reust examined the effects of changing the rolling radius of a tire by testing a vehicle equipped with a "space saver" spare tire. In 2010, Ruth examined the accuracy of EDR Pre-Crash data during rotation on low friction surfaces [14]. Results reported in these studies are generally consistent with the validation analysis presented here.

Analysis: Crash Data (Vehicle Velocity Change, ΔV)

Figure 9 contains a composite plot of data from 401 tests from 18 studies that met the validation analysis requirements. The plot shows the difference between the EDR reported ΔV values and the independently measured values for all tests and impact modes. The plots follow SAE J1733 sign convention (frontal and right side impacts: negative, rear and left side impacts: positive).

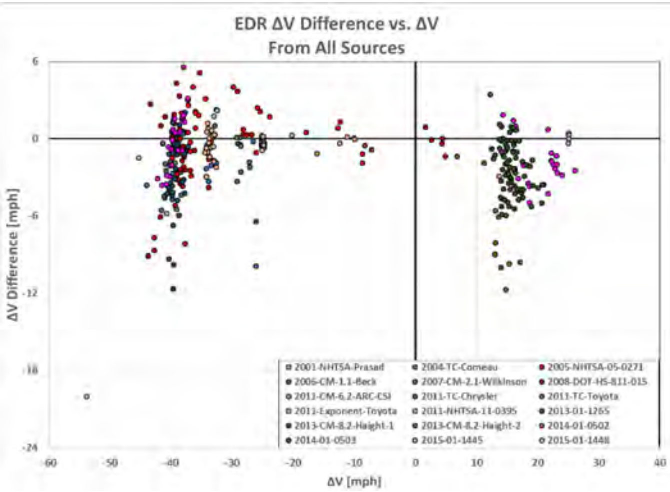

Figure 9. EDR ΔV Difference versus ΔV: Full Overlap, Frontal Rigid Barrier Tests

Much of the data presented in Figure 9 was from the NHTSA New Car Assessment Program (NCAP) 35 mph frontal barrier crash tests, side moving barrier tests and lateral pole tests. These tests are run under controlled conditions in a laboratory setting, using new vehicles at specific impact speeds.

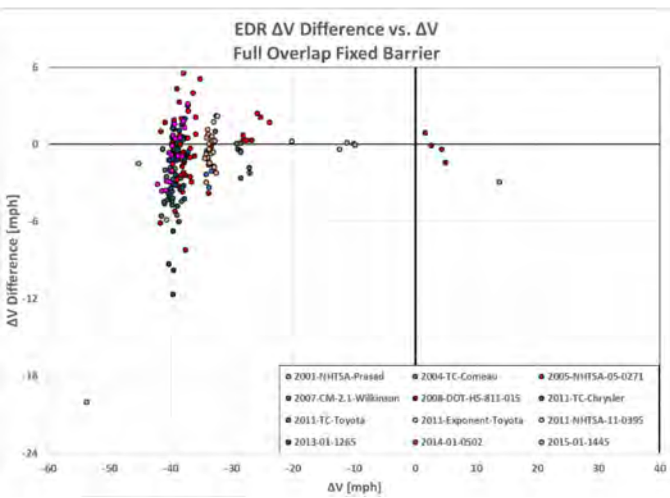

Figure 10. EDR ΔV Difference versus ΔV: Full Overlap, Frontal Rigid Barrier Tests

Figures 10, 12, 14 and 16 depict the difference between the EDR reported ΔV values for specific impact modes against the independently measured values, plotted on the vertical axis. Positive values represent the EDR overreporting the ΔV, while negative values represent the EDR underreporting. The horizontal axis of this plot represents total ΔV, as measured by the independent instrumentation. Figures 11, 13 and 15 present histograms of the ΔV difference distribution and cumulative percentage for specific impact modes. Due to the limited number of published test data for pole impacts, a histogram for that impact mode was not plotted.

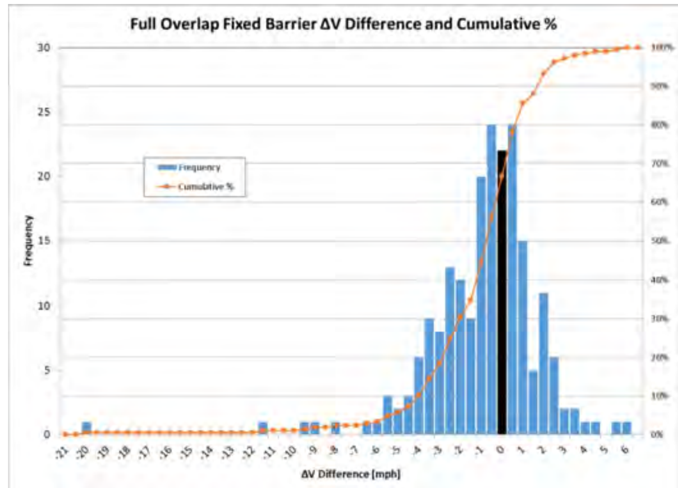

Figure 11. Frequency Distribution and Cumulative Percent ΔV Difference: Full Overlap, Frontal Rigid Barrier Tests

Kia & Hyundai Vehicles Using the GIT Tool

The largest overreported ΔV difference seen in Figures 9, 10 and 11 was from a 2012 Hyundai Accent [15]. Kia and Hyundai use a proprietary retrieval tool manufactured by Global Information Technologies (GIT), released in 2013, to image event data from vehicles built after September 2012 (model year 2013 and newer vehicles) in compliance with the CFR 563 ruling. In 2014, Ruth presented impact tests for some Kia and Hyundai vehicles during a "phase in" period during the 2010 to 2012 model years. These vehicles were tested in various impact modes, including frontal barrier tests, side impact tests, side pole tests and moving deformable barrier tests. In this study, Ruth identified tests in which the data from the GIT during the model year 2010 to 2012 "phase in" period was easily discernable as being inaccurate.

In 2015, Vandiver also reported anomalous data elements from the testing of a 2012 Kia Soul [16].

Data points associated with the "phase in" period for Kia and Hyundai have been plotted in magenta in Figures 9, 10, 12, 14 and 16. The authors of this paper suggest that data imaged by the GIT tool from vehicles built before September 2012 should be considered independently.

In 2013 and 2014, Haight, Gyorke and Haight wrote several articles in Collision Magazine, which were also re-released as a special edition of Collision Magazine, pertaining to Hyundai and Kia vehicles, and the data obtained using the GIT tool [17, 18, 19, 20, 21, 22]. In these articles, a description of the GIT tool is presented [18], as well as crash testing. These crash tests include IIHS small overlap frontal crash tests, IIHS moderate overlap crash tests and the IIHS side impact crash test for 2012-2014 model year Hyundai and Kia vehicles [19]. Case studies from real world crashes are also presented [20]. These crash tests present a combination of "reasonably accurate" data elements and several anomalous data parameters.

Studies: Evaluation of Event Data Recorders in Full Systems Crash Tests (Niehoff, 2005) & Preliminary Evaluation of Advanced Air Bag Field Performance Using Event Data Recorders (Gabler, 2008)

Many of the tests shown in Figures 9, 10 and 11, in which the reported EDR ΔV was higher than the ΔV reported from the laboratory instrumentation were from NHTSA publications [23, 24]. In both studies, the authors acknowledged that an EDR that was capable of recording only 100 to 150 ms of crash pulse data may not capture the entire duration of the actual crash. Gabler stated: "EDRs that do not record the entire event will underestimate the delta V not because of sensor inaccuracy, but because of recording capacity." In an attempt to reconcile this known limitation of the EDR, both studies presented ΔV comparisons between the EDR and the laboratory instrumentation restricted to the 100 ms interval and not the entire crash pulse.

The study authored by Niehoff, et al., presented crash test data from tests conducted by the NHTSA and IIHS [23]. The authors of this literature review discovered inconsistencies with the way the data is presented in this study. The first reported value comes from Test Number 3851. In this test a 2002 Chevrolet Avalanche was subjected to a frontal rigid barrier impact. According to the data presented the EDR reported a ΔV at 100 ms of 35.9 mph while the instrumentation reported a ΔV at 100 ms of 36.9 mph. Based on the tabular data, the reader would conclude that the EDR underreports the crash test ΔV by 1 mph at 100 ms. However, the graphics in the paper show the opposite. It appears that data presented in the contained tables have been transposed.

Data points associated with these references have been plotted in shades of red in Figures 9, 10, 12, 14 and 16.

Direct Contact Damage to the Module and Acceleration Clipping

The largest EDR reported ΔV difference depicted in Figures 9, 10 and 11 comes from one of the tests reported by Exponent Failure Analysis Associates in 2011 [25]. In this test, a 2007 Lexus ES-350 impacted a full overlap fixed barrier at a speed of approximately 50 mph. The EDR underreported the actual ΔV experienced by the vehicle by approximately 20 mph.

In this 2011 study, Exponent presented a study prepared for Toyota Motor Manufacturing, in which high severity (ΔV ~ 40 mph) frontal rigid barrier tests resulted in the fracture of the mounting flanges of the electronic control module. This fracture of the mounting flange of the module was the result of deformation of the floor pan underneath the module after the test vehicle experienced significant crush in the area of the module during the impact. As a result of the damage to the module mounting flange, the module was not fully fixed to the vehicle chassis which affected the measured accelerations by the module and ΔV reported by the EDR. Figure 17 contains a photograph from the Exponent study that depicts the fractured mounting flange of the module. Exponent observed that its laboratory instrumentation at the CG of the vehicle recorded accelerations in excess of 50 G's, which is the limit of the accelerometers within the module. Exponent suggested that it is probable that the accelerations recorded by the module were truncated or "clipped" at the hardware level. The ΔV discrepancy in this study was attributed to both the module being in the deformed region of the vehicle and accelerometer clipping.

Figure 17. Fractured Mounting Flange to Module (Courtesy of Exponent 2011, Figure 23)

Analysts of high-severity collisions should be aware of the effects of accelerometer clipping and the potential that the recording module may be located within the crush zone.

Small or Partial Overlap Testing

Figures 12 and 13 contain data from small or partial overlap tests. As seen in the plots in Figures 12 and 13, there is wide variability in the EDR-reported ΔV in these impact modes. Haight presented a study analyzing the results from the Insurance Institute for Highway Safety (IIHS) Small Overlap series of crash tests [26]. In this study, Haight reported discrepancy between the ΔV recorded by the EDR and the ΔV measured at the center of gravity (CG) of the vehicle, characterized by the author as a larger than normal or significant discrepancy. Haight attributed this discrepancy to rotational effects of the vehicle in this impact mode and the location of the EDR accelerometer relative to the laboratory accelerometer located at the CG of the vehicle. Haight presented a method to reconcile the EDR ΔV data to the vehicle CG accelerometer data using video analysis.

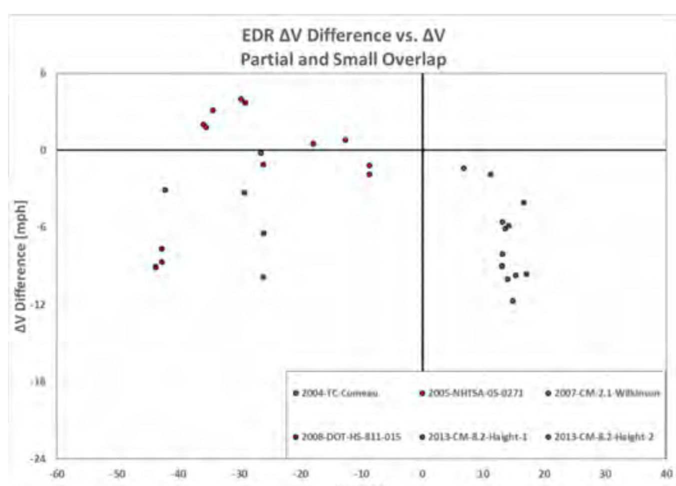

Figure 12. EDR ΔV Difference versus ΔV: Partial or Small Overlap Frontal Barrier Tests

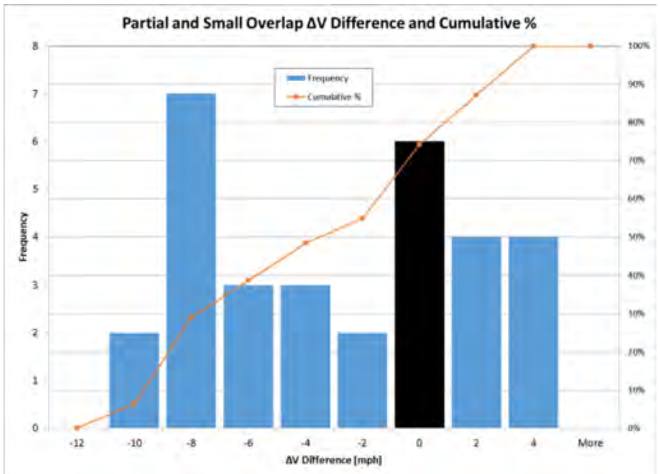

Figure 13. Frequency Distribution and Cumulative Percent ΔV Difference: Partial or Small Overlap Frontal Barrier Tests

Side Impact Testing

Figures 14 and 15 contain data from side impact testing by deformable moving barriers. As seen in the plots in Figures 14 and 15, the data is almost exclusively from driver side impacts and is concentrated around the speed of the NHTSA test from which nearly all of the data comes. This data, while more consistent, still shows a fair amount of underreporting and some variability which is likely, in part, attributed to the rotation effects previously described in the small overlap testing section by Haight [26].

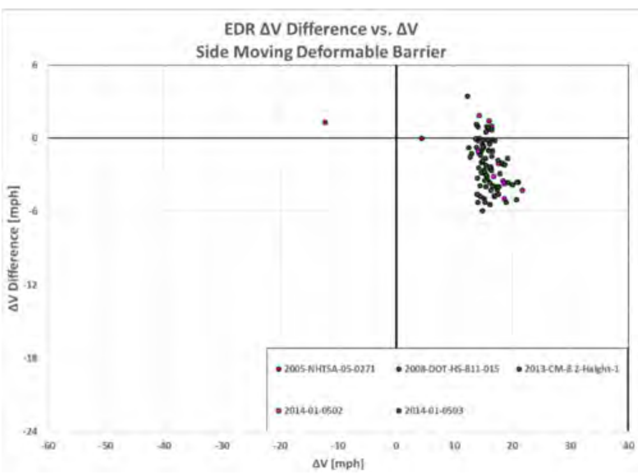

Figure 14. EDR ΔV Difference versus ΔV: Side Moving Deformable Barrier Impact Tests

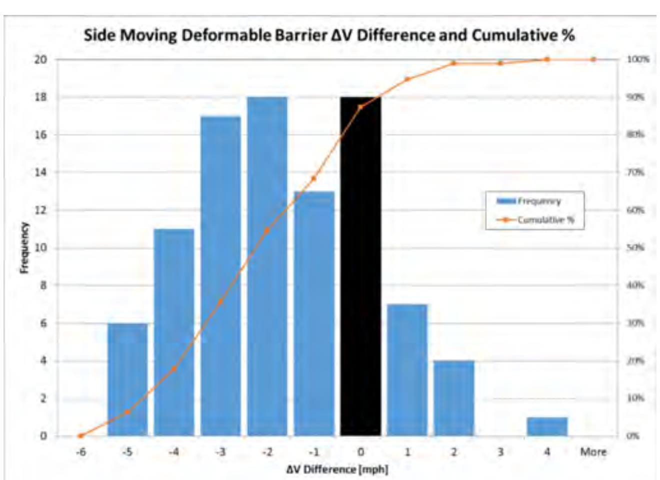

Figure 15. Frequency Distribution and Cumulative Percent ΔV Difference: Side Moving Deformable Barrier Impact Tests

Side Pole Impact Testing

Figure 16 contains the available data from pole impact testing. The data seen in Figure 16 comes from one NHTSA test of a Chevrolet Malibu and a number of Kia and Hyundai tests described previously. Despite the limited number of data points, there seems to be good agreement with the other presented analyses.

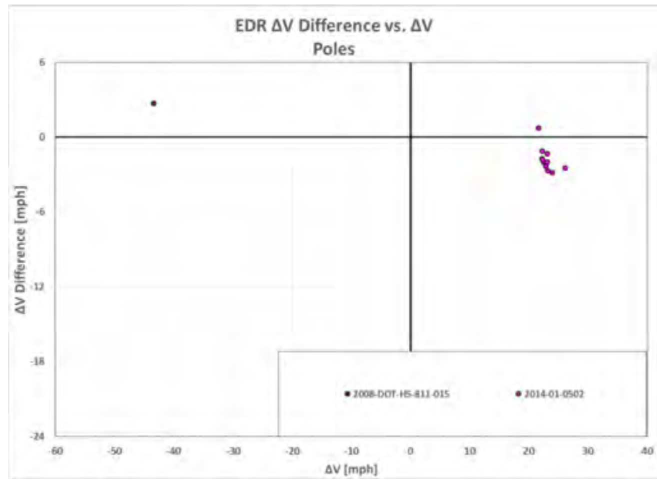

Figure 16. EDR ΔV Difference versus ΔV: Side Pole Impact Tests

Impact and Velocity Change (ΔV) Testing

Several EDR publications that focused on unique impact modalities or presented analytical difficulties were separated from the validation analysis. These publications are discussed separately below.

Automobile versus Pedestrian Testing

Fugger, et al., presented a study in which four General Motors vehicles impacted an anthropometric pedestrian dummy at speeds ranging from 5.2 to 39 mph across 37 crash tests [27]. Of the 37 tests, 16 tests resulted in event data being recorded and were subsequently analyzed. The authors presented numerical integration techniques to calculate ΔV from the accelerometer data. There is a low correlation between EDR reported ΔV and the ΔV from the presented methods.

Automobile versus Motorcycle Testing

In 2006, Beck performed collinear automobile to motorcycle impact testing [28]. Three tests were performed in which a 2002 Chevrolet Cavalier was driven, braked and impacted a stationary, upright 1989 Kawasaki EX500 and 160 lb. dummy. The weight ratio between the Chevrolet and Kawasaki was approximately 4.6:1. In the first test, the Chevrolet was driven and braked to an impact speed of approximately 12 mph. No event was recorded by the EDR in this impact. A second test was conducted at an impact speed of 27 mph and a non-deployment event was recovered by the EDR. In a third test, the speed of the Chevrolet at impact was approximately 37 mph and resulted in the recovery of a deployment event. Comparing the ΔV from the EDR to independent instrumentation, Beck found that the EDR underreported the actual ΔV by 0.53 mph (~6%) and 0.86 mph (~12%) for the second and third test.

Low Speed Vehicle-to-Vehicle and Vehicle-to-Barrier Testing

Several studies presented impact data in staged low speed collisions. In 2001, Correia [29] conducted 12 low speed vehicle-to-vehicle impact tests using a 2000 Chevrolet Malibu and a 1997 Chevrolet Cavalier at speeds from 2.6 to 8.4 km/h (1.6 to 5.2 mph). Many of those impacts did not record an event, however three tests resulted in the EDR underreporting the ΔV by 1.3 to 2.2 km/h (0.8 to 1.4 mph). However, since these were run at low speeds, the percent difference was as high as 44%. Correia suggested that the speed difference was the result of the EDR capturing only a portion of the crash pulse.

Lawrence [30] and Wilkinson [31] conducted hundreds of staged low speed vehicle-to-vehicle collisions and linear sled tests using late 1990s and early 2000s model year GM vehicles. They found that the GM EDRs underreported ΔV in all tests they performed.

Wilkinson [32] also tested a 2003 Ford Crown Victoria and a 2003 Ford Windstar in low speed collisions up to 13.5 km/h (8.4 mph). The study found that the Ford EDR had speed differences ranging from an overestimate of speed change by 0.3 km/h (0.2 mph) to an underestimate of speed change by 1.8 km/h (1.1 mph). The data from Wilkinson's testing was reevaluated by Lawrence in 2005 [33] using revised EDR software and found differences in the way the data was reported. The revised software reported ΔV differences ranging from +0.4 km/h to -1.3 km/h (+0.2 to -0.8 mph).

In 2013, Wilkinson [34] conducted low speed in-vehicle crash tests and linear sled tests using select 2005 to 2008 model year Toyota modules. Wilkinson reported that the speed change underestimates from the Toyota EDRs ranged from 1.3 to 2.6 km/h (0.8 to 1.6 mph) and the speed change overestimates ranged from 0.6 to 2.2 km/h (0.4 to 1.4 mph).

Vehicle to Heavy Truck Rear Underride Guard Testing

In 2004, Commeau [35] presented a variety of crash testing performed by Transport Canada, which included full frontal crashes of 1998 Chevrolet Cavaliers into fixed underride guard structures at speeds of 48 and 65 km/h (29.8 and 40.4 mph). The GM EDR in those tests underreported the speed change experienced by the Cavalier by 3.1 km/h (1.9 mph) and 5.8 km/h (3.6 mph), respectively.

Crash Simulation Sled System Testing

In 2015, Carr [36] presented a study in which EDRs and sensor arrays were removed from vehicles and mounted onto a HYGE™ crash simulation sled at various orientations, representing different impact modes. The modules tested were modules found in a 2012 Chevrolet Malibu 1LT, a 2012 Dodge Durango SXT and a 2012 Ram 1500 ST pickup. Carr concluded that:

The maximum percentage delta-V error magnitude observed was less than the 10 percent limit required by 49 CFR Part 563, and the average error magnitude for each EDR ranged from 0.3% to 4.3%. The maximum resultant delta-V error magnitude was less than 3%, and the maximum apparent PDOF angle error magnitude was 2.0 degrees.

Studies of Event Data Recorders on Vehicles in Japanese NCAP Crash Tests

The studies authored by Ishikawa, Takubo, et al., present crash test data from J-NCAP tests and more complex staged collisions from 2006 to 2009 [37, 38, 39]. As it pertains to Pre-Crash speed, Ishikawa concluded that Pre-Crash velocities recorded by the EDR were highly accurate and reliable when cars proceeded without braking prior to the collision. Ishikawa also concluded that the accuracy and reliability of the maximum ΔV recorded by the EDR decreased under highly complex or severe crash conditions, especially in pole impact tests. These conclusions were repeated by Takubo in 2009. In one pole test reported by Ishikawa, the EDR in the vehicle coded as P-1 underreported the ΔV in a frontal pole impact by 7.3 m/s (16.3 mph) or 29.4%. Ishikawa also reported multiple rear-end style impacts where the ΔV recorded by the EDR overestimated the calculated ΔV by as much as 1.2 m/s (2.7 mph) or 21.1% of the test ΔV and underreported by as much as 0.9 m/s (2.0 mph) or 21.5% of the test ΔV.

The way in which the data was presented did not allow the authors of this study to examine whether specific vehicle characteristics and/or test conditions contributed to the high discrepancy in EDR reported ΔV.

In these studies, the vehicles involved were coded PC-1 through PC-8, and Mv-1 through Mv-6. In his 2009 paper, Takubo states that "A Toyota Corolla E140 was used for most of the tests," and that "Cars in the front-most position (R-1): Toyota Progress (G10) with front, side, and curtain airbags…." The Toyota Progress was a vehicle only sold in the Japanese market, and Takubo did not state in this paper whether the Corollas or any other Toyota vehicles were the same or similar to those sold in the North American market. In his 2011 paper, Takubo presented data from additional J-NCAP tests, and states that "In the first paper, results of J-NCAP crash tests for **seven** models and three crash tests reconstructing typical real-world accidents were reported" (emphasis added). The 2009 paper only reports two different models. It's unclear what additional models were tested to bring the total to seven. In the 2011 paper, Takubo states that "All vehicle models are Toyota." While Takubo gives indications as to what models or platforms were tested, he does not indicate whether this data set is valid for North American market vehicles, and at least one vehicle (Toyota Progress) is only sold in the Japanese market. The authors attempted to contact Dr. Takubo to obtain additional information about the vehicles that were tested but, as of the writing of this paper, have been unsuccessful in doing so.

Discussion

Much of the Pre-Crash speed and ΔV differences shown in the validation analyses are caused by known limitations of EDR systems.

Pre-Crash speed data reported by EDR contains differences due to rounding, truncation, unit conversion and/or reporting of significant figure discrepancies. These differences are not errors but inherent properties of the system and this may account for much of the differences seen in the Pre-Crash data. Wheel slip during braking and acceleration as discussed previously account for differences in reported speed. In a similar way, changes in tire size or drivetrain ratio can change EDR-reported values when a vehicle has been modified from its original design.

The technical body of literature describes numerous factors that may affect the EDR-reported speed change (ΔV). Many EDRs are configured to only record data for a predetermined length of time. For impacts in which the crash pulse exceeds the maximum recording time of the EDR, only a portion of the crash will be captured. EDRs calculate ΔV by integrating accelerometer data after being triggered at a pre-defined threshold, which is on the order of 2 G's [3, 40]. Any acceleration of the vehicle prior to the threshold trigger will not be included in the ΔV calculation and result in an underestimate of ΔV. Similarly, if the EDR records data beyond the duration of the crash pulse, the resulting integrated speed change (ΔV) will include accelerations from the vehicle interacting with the ground (tire forces) that may overreport the actual ΔV. Accelerometers commonly used in airbag control modules have a maximum of 40 to 50 G's [41, 42]. If the peak accelerations experienced by the vehicle in a crash exceed the maximum capability of the vehicle's accelerometer, that acceleration will be "clipped" and result in an underestimate of ΔV. The location of the module relative to the vehicle center of mass and direct damage to the module or mounting have also been shown to affect the reporting of ΔV values. The EDRs in some vehicles have been found to contain a constant accelerometer offset [29, 41, 42]. In the case of positive accelerometer offset, the ΔV will be underreported in frontal crashes and overreported in rear crashes.

Understanding the operation and limitations of the EDR and the unique conditions of an accident will inform the proper usage of EDR data for accident reconstruction.

Summary

A comprehensive review of original equipment event data recorder literature and statistical analysis of included data showed that both Pre-Crash speed and ΔV data display a negatively skewed distribution, as the majority of the EDR data underreported the values measured by independent instrumentation. The analysis presented here supports the notion that original equipment EDRs tend to be accurate, and tend to underreport Pre-Crash speed and ΔV values.

The accuracy of any specific EDR reported value depends on a number of factors, including but not limited to, the collision type, the vehicle dynamics prior to and during the crash, and wheel slip. Each crash should be independently analyzed by considering physical evidence and unique crash conditions. EDRs provide valid and useful data that can be used as a supplement to a thorough accident reconstruction.

This paper should serve as a guide to the accuracy of original equipment event data recorders and as a reference for the accuracy of specific vehicle makes, models and testing during various vehicle operational conditions and impact modes. Analysis of a particular crash should be conducted with consideration of instrumented testing specific to the involved vehicles.

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Refer to Appendix A for the complete list of references that were reviewed and cited, sorted chronologically by year published.

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APPENDIX

APPENDIX A - BIBLIOGRAPHY (ALL STUDIES)

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APPENDIX C - PAPERS BY MAKE, YEAR AND MODEL

Make	Model	Model Year	Citation
Buick			
	Encore		
		2013	2013-CM-8.2-Haight-2
	LaCrosse		
		2005	2008-DOT-HS-811-015
		2010	2014-01-0503
		2011	2014-01-0503
	Lucerne		
		2006	2008-DOT-HS-811-015
		2011	2014-01-0503
	Rendezvous		
		2002	2007-CM-2.1-Wilkinson
			2005-NHTSA-05-0271
		2005	2008-DOT-HS-811-015
Cadillac			
	CTS		
		2003	2005-NHTSA-05-0271
		2012	2013-01-1265
			2014-01-0503
	Deville		
		2002	2007-CM-2.1-Wilkinson
			2005-NHTSA-05-0271
	DTS		
		2006	2008-DOT-HS-811-015
	Seville		
		2000	2007-CM-2.1-Wilkinson
			2005-NHTSA-05-0271
	SRX		
		2004	2007-CM-2.1-Wilkinson
			2005-NHTSA-05-0271
		2010	2014-01-0503
		2012	2013-01-1265
			2014-01-0503
Chevrolet			
	Avalanche		
		2002	2007-CM-2.1-Wilkinson
			2005-NHTSA-05-0271
		2003	2007-CM-2.1-Wilkinson
			2005-NHTSA-05-0271
		2004	2008-DOT-HS-811-015
	Camaro		
		2010	2014-01-0503
		2012	2013-01-1265
			2014-01-0503
	Cavalier		
		1998	2004-TC-Comeau
		1999	2004-TC-Comeau
		2001	2004-01-1195
		2002	2006-CM-1.1-Beck
		2003	2005-01-1190
			2007-CM-2.1-Wilkinson
			2005-NHTSA-05-0271
		2004	2005-01-1190
	Cobalt		
		2005	2008-DOT-HS-811-015
	Colorado		
		2004	2007-CM-2.1-Wilkinson
			2005-NHTSA-05-0271
		2005	2008-DOT-HS-811-015
		2006	2008-DOT-HS-811-015
	Cruze		
		2011	2014-01-0503
		2013	2013-CM-8.2-Haight-2
	Equinox		
		2005	2007-CM-2.1-Wilkinson
			2005-NHTSA-05-0271
		2010	2014-01-0503
	Express		
		2005	2008-DOT-HS-811-015
	HHR		
		2006	2008-DOT-HS-811-015
	Impala		
		2001	2004-TC-Comeau
		2002	2004-TC-Comeau
		2003	2005-01-1190
		2004	2005-01-1190
		2006	2008-DOT-HS-811-015
		2012	2013-01-1265
			2014-01-0503
	Malibu		
		2004	2008-DOT-HS-811-015
			2005-NHTSA-05-0271
		2008	2011-NHTSA-11-0395
		2011	2014-01-0503
		2012	2015-01-1448
	Monte Carlo		
		2006	2008-DOT-HS-811-015
	Silverado		
		2001	2005-NHTSA-05-0271
		2003	2007-CM-2.1-Wilkinson
			2005-NHTSA-05-0271
		2005	2008-DOT-HS-811-015
		2007	2008-DOT-HS-811-015
		2012	2013-01-1265

	Sonic		
		2012	2013-01-1265
			2014-01-0503
	Suburban		
		2003	2007-CM-2.1-Wilkinson
			2005-NHTSA-05-0271
		2012	2013-01-1265
			2014-01-0503
	Tahoe		
		2003	2007-CM-2.1-Wilkinson
			2005-NHTSA-05-0271
	Trailblazer		
		2002	2004-TC-Comeau
			2007-CM-2.1-Wilkinson
			2005-NHTSA-05-0271
		2004	2005-01-1190
	Traverse		
		2011	2014-01-0503
	Uplander		
		2005	2008-DOT-HS-811-015
	Volt		
		2011	2014-01-0503
Chrysler			
	200		
		2012	2013-01-1265
			2014-01-0503
	300		
		2012	2013-01-1265
			2014-01-0503
	Aspen		
		2009	2011-TC-Chrysler
			2011-NHTSA-11-0395
	Town & Country		
		2012	2013-01-1265
Dodge			
	Avenger		
		2008	2011-TC-Chrysler
			2011-NHTSA-11-0395
		2010	2014-01-0503
		2012	2013-01-1265
			2014-01-0503
			2013-CM-8.2-Haight-2
	Caliber		
		2011	2014-01-0503
	Charger		
		2012	2013-01-1265
			2014-01-0503
	Dakota		
		2008	2009-01-0877
	Dart		
		2013	2013-CM-8.2-Haight-2
	Durango		
		2012	2013-01-1265
			2014-01-0503
			2015-01-1448
	Grand Caravan		
		2008	2010-01-1002
	Journey		
		2009	2011-TC-Chrysler
			2011-NHTSA-11-0395
		2012	2013-01-1265
			2014-01-0503
	Ram		
		2009	2011-TC-Chrysler
			2011-NHTSA-11-0395
		2012	2015-01-1448
		#N/A	2015-01-1448
Fiat			
	500		
		2012	2013-01-1265
			2014-01-0503
Ford			
	500		
		2005	2008-DOT-HS-811-015
		2007	2008-01-0162
	Crown Victoria		
		2005	2008-01-0162
		#N/A	2011-CM-6.2-ARC-CSI
	Econoline		
		2005	2008-DOT-HS-811-015
	Edge		
		2008	2009-01-0884
			2011-NHTSA-11-0395
		2011	2014-01-0503
	Escape		
		2011	2014-01-0503
	Expedition		
		2012	2013-01-1265
			2014-01-0503
	Explorer		
		2012	2013-01-1265
			2014-01-0503
	F-150		
		2001	2001-NHTSA-Prasad
		2004	2005-NHTSA-05-0271
		2006	2013-01-0769
		2009	2011-NHTSA-11-0395
		2011	2014-01-0503
		2012	2013-01-1265
	F-250		
		2012	2013-01-1265
			2014-01-0503

	Flex		
		2010	2011-01-0812
		2013	2014-01-0504
	Focus		
		2008	2009-01-0884
			2010-01-1000
			2011-NHTSA-11-0395
		2012	2013-01-1265
			2014-01-0503
		2013	2013-CM-8.2-Haight-2
	Freestyle		
		2005	2008-DOT-HS-811-015
	Fusion		
		2010	2014-01-0503
		2011	2014-01-0503
	Mustang		
		2010	2014-01-0503
		2012	2013-01-1265
			2014-01-0503
	Ranger		
		2011	2014-01-0503
	Taurus		
		2005	2005-NHTSA-05-0271
		2010	2014-01-0503
GMC			
	Envoy		
		2004	2007-CM-2.1-Wilkinson
			2005-NHTSA-05-0271
		2006	2011-01-0809
Honda			
	Accord		
		2013	2013-CM-8.2-Haight-2
	Civic		
		2012	2013-01-1264
			2013-01-1265
			2014-01-0503
		2013	2013-CM-8.2-Haight-2
	CR-V		
		2012	2013-01-1264
			2013-01-1265
			2014-01-0503
	CR-Z		
		2012	2013-01-1265
	Fit		
		2012	2013-01-1265
			2014-01-0503
Hummer			
	H3		
		2006	2008-DOT-HS-811-015
Hyundai			
	Accent		
		2012	2013-CM-8.2-Haight-1
			2014-01-0502
		2013	2013-CM-8.2-Haight-1
	Elantra		
		2012	2014-01-0502
		2013	2013-CM-8.2-Haight-1
	Genesis		
		2010	2014-01-0502
	Santa Fe		
		2010	2014-01-0502
		2012	2014-01-0502
	Sonata		
		2011	2014-01-0502
	Tucson		
		2012	2014-01-0502
		2013	2013-CM-8.2-Haight-1
			2013-CM-8.2-Haight-2
Jeep			
	Commander		
		2008	2009-01-0877
			2009-CM-4.1-Ruth
	Compass		
		2007	2011-TC-Chrysler
			2011-NHTSA-11-0395
	Grand Cherokee		
		2011	2014-01-0503
	Liberty		
		2012	2013-01-1265
			2014-01-0503
Kia			
	Forte		
		2010	2014-01-0502
		2011	2014-01-0502
		2014	2013-CM-8.2-Haight-1
			2013-CM-8.2-Haight-2
	Optima		
		2011	2014-01-0502
	Rio		
		2012	2013-CM-8.2-Haight-1
			2014-01-0502
		2013	2013-CM-8.2-Haight-1
	Sorento		
		2011	2014-01-0502
		2012	2014-01-0502
	Soul		
		2010	2014-01-0502
		2011	2014-01-0502
		2012	2014-01-0502
			2015-01-1445
		2013	2013-CM-8.2-Haight-1
			2013-CM-8.2-Haight-2

	Sportage		
		2012	2014-01-0502
Lexus			
	ES-350		
		2007	2011-Exponent-Toyota
		2012	2013-01-1265
			2014-01-0503
	RX-350		
		2011	2014-01-0503
Lincoln			
	Town Car		
		2003	2005-NHTSA-05-0271
		2007	2008-01-0162
Mazda			
	Mazda3		
		2012	2014-01-0503
	Mazda6		
		2012	2013-01-1265
			2014-01-0503
Mitsubishi			
	Lancer		
		2009	2013-01-1263
Oldsmobile			
	Alero		
		2001	2004-01-1195
Pontiac			
	G6		
		2005	2008-DOT-HS-811-015
		2006	2008-DOT-HS-811-015
	G8		
		2009	2011-NHTSA-11-0395
	Grand Prix		
		2004	2007-CM-2.1-Wilkinson
			2005-NHTSA-05-0271
		2006	2008-DOT-HS-811-015
	Montana		
		2005	2008-DOT-HS-811-015
	Soltice		
		2007	2008-DOT-HS-811-015
	Wave		
		2009	2011-NHTSA-11-0395
Ram			
	1500		
		2011	2014-01-0503
		2012	2013-01-1265
	2500		
		2012	2013-01-1265
			2014-01-0503
Saturn			
	Aura		
		2007	2008-DOT-HS-811-015
	Ion		
		2003	2007-CM-2.1-Wilkinson
			2005-NHTSA-05-0271
		2004	2007-CM-2.1-Wilkinson
			2005-NHTSA-05-0271
		2005	2008-DOT-HS-811-015
	SC2		
		2002	2004-01-1195
	Vue		
		2002	2007-CM-2.1-Wilkinson
			2005-NHTSA-05-0271
		2008	2011-NHTSA-11-0395
Scion			
	iQ		
		2012	2013-01-1265
			2014-01-0503
	tC		
		2005	2008-DOT-HS-811-015
		2011	2014-01-0503
Toyota			
	4Runner		
		2004	2008-DOT-HS-811-015
		2010	2014-01-0503
		2012	2013-01-1265
			2014-01-0503
	Camry		
		2002	2011-Exponent-Toyota
		2003	2011-Exponent-Toyota
		2004	2008-DOT-HS-811-015
			2005-NHTSA-05-0271
		2005	2008-DOT-HS-811-015
			2011-Exponent-Toyota
			2011-TC-Toyota
			2011-NHTSA-11-0395
		2010	2012-01-0999
		2011	2012-01-0999
			2014-01-0503
		2012	2013-01-1265
			2014-01-0503
			2013-CM-8.2-Haight-2
	Corolla		
		2005	2008-DOT-HS-811-015
			2013-01-1268
		2006	2013-01-1268
		2007	2011-Exponent-Toyota
		2009	2011-TC-Toyota
			2011-NHTSA-11-0395
		2010	2011-TC-Toyota
			2011-NHTSA-11-0395
		2011	2014-01-0503
		2012	2014-01-0503

Highlander		
	2011	2014-01-0503
Matrix		
	2005	2008-DOT-HS-811-015
	2009	2011-TC-Toyota
		2011-NHTSA-11-0395
Prius		
	2004	2008-DOT-HS-811-015
RAV4		
	2004	2008-DOT-HS-811-015
	2007	2011-Exponent-Toyota
	2011	2014-01-0503
	2012	2013-01-1265
		2014-01-0503
Sienna		
	2004	2008-DOT-HS-811-015
		2005-NHTSA-05-0271
	2005	2008-DOT-HS-811-015
	2011	2014-01-0503
	2012	2013-01-1265
Solara		
	2004	2005-NHTSA-05-0271
Tacoma		
	2005	2008-DOT-HS-811-015
	2011	2014-01-0503
	2012	2013-01-1265
Tundra		
	2005	2008-DOT-HS-811-015
	2007	2011-Exponent-Toyota
	2011	2014-01-0503
	2012	2013-01-1265
Tundra		
	2012	2014-01-0503
Venza		
	2009	2011-TC-Toyota
		2011-NHTSA-11-0395
	2011	2014-01-0503
Yaris		
	2012	2013-01-1265
		2014-01-0503
Volvo		
S60		
	2012	2013-01-1265
XC60		
	2013	2013-CM-8.2-Haight-2

APPENDIX D - INSTRUMENTED TESTING DATA PLOTS

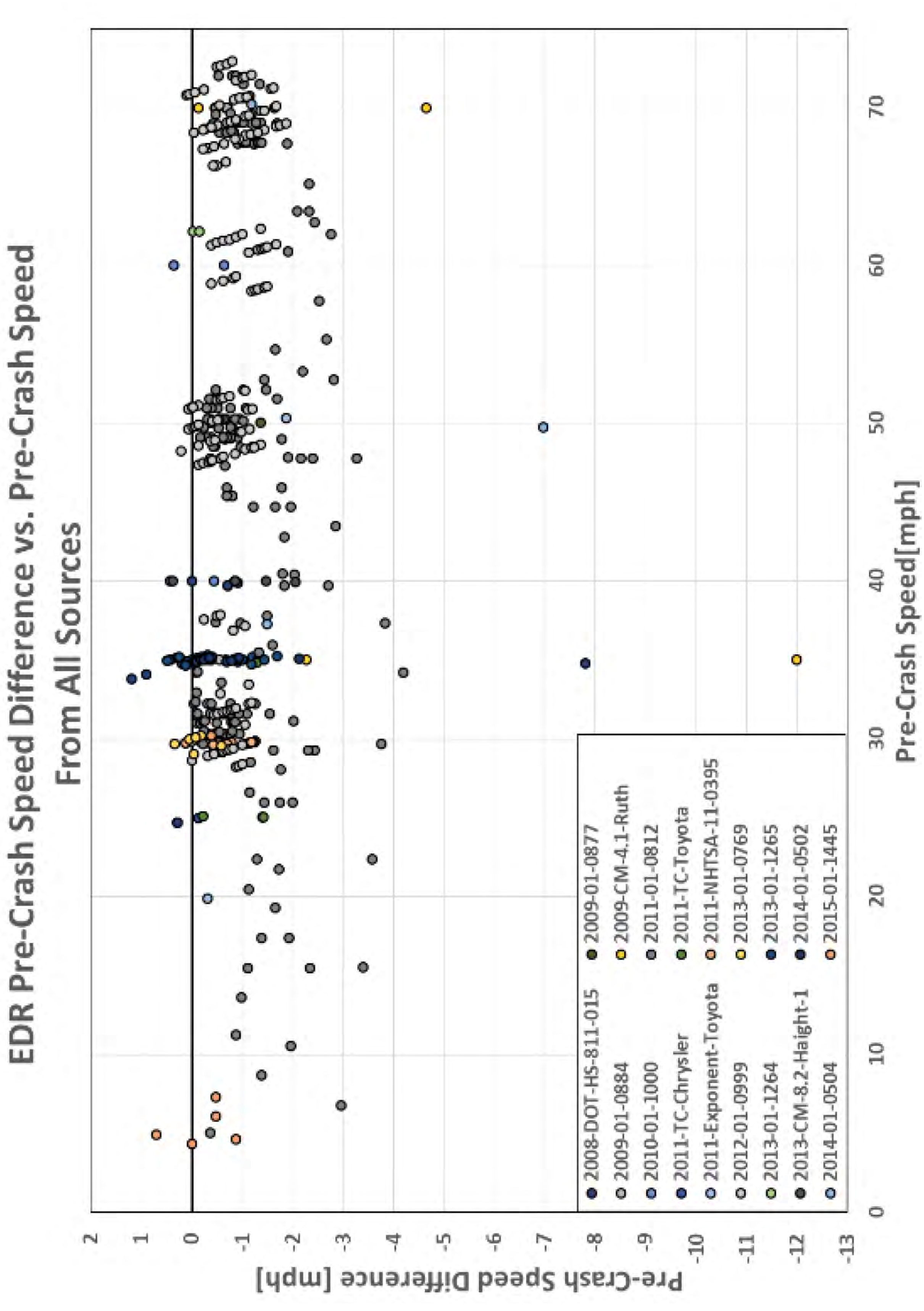

Figure 3. EDR Reported Speed Difference versus Vehicle Speed: All Studies

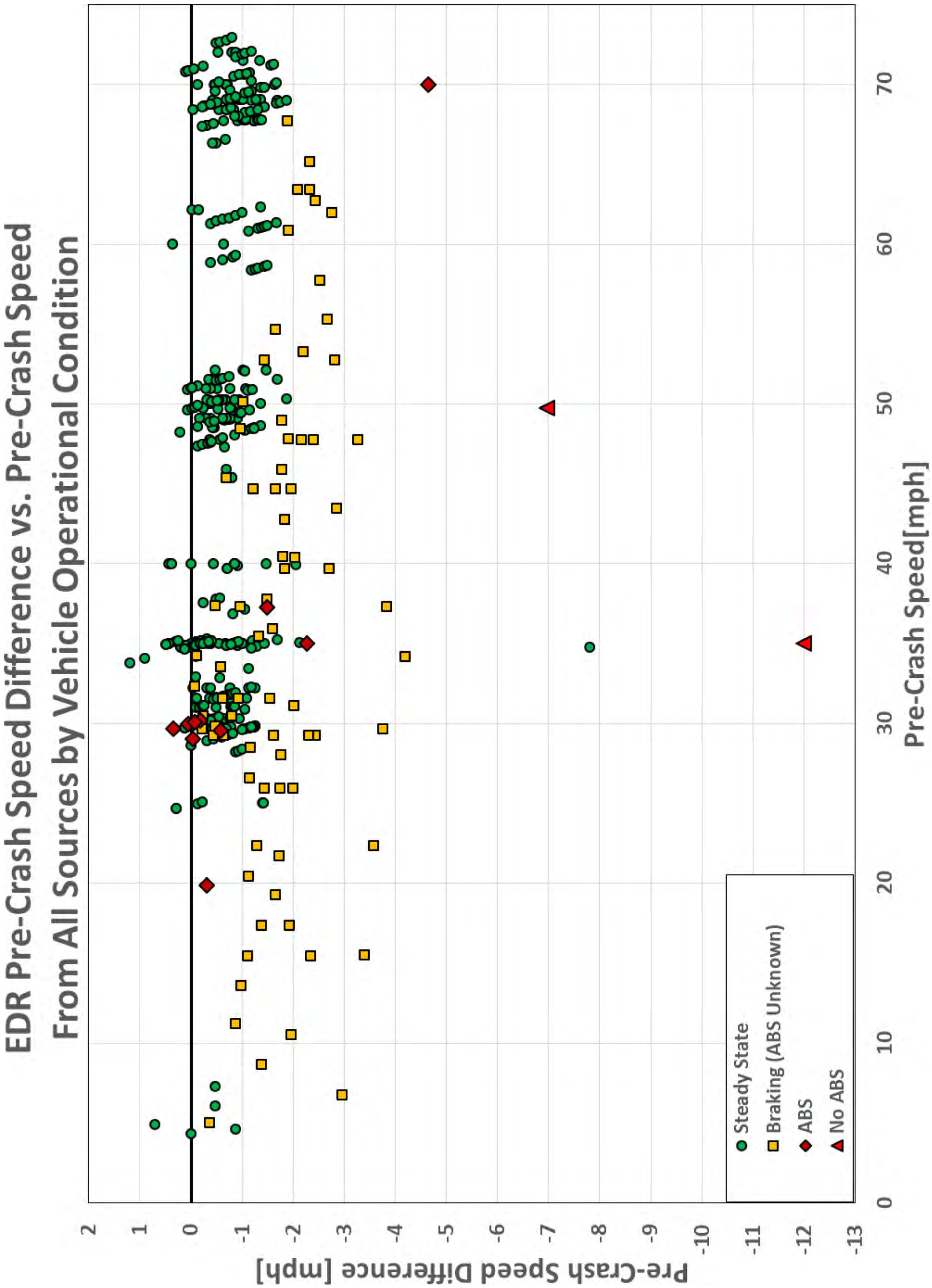

Figure 4. EDR Reported Speed Difference versus Vehicle Speed: Sorted by Vehicle Operational Condition

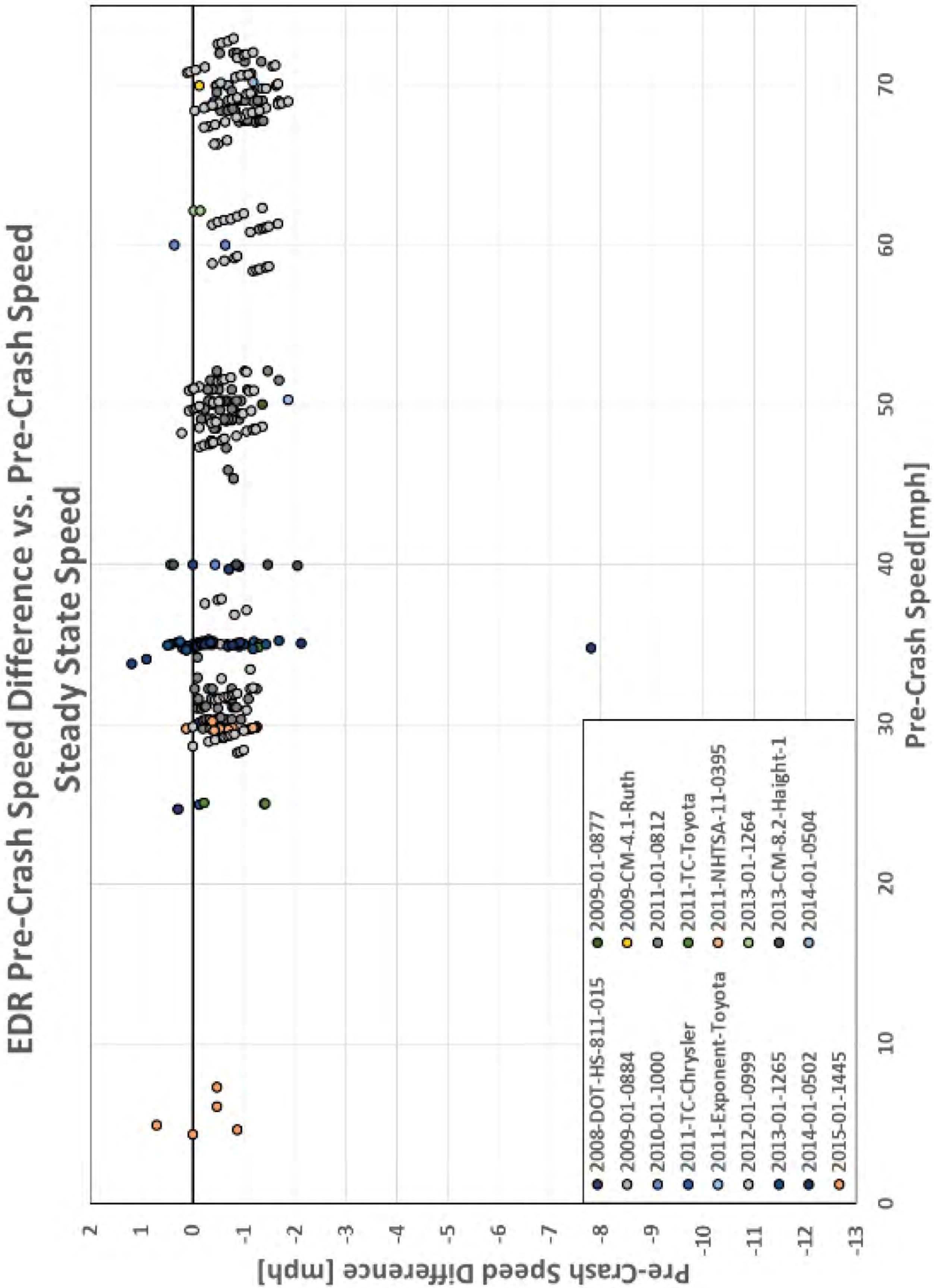

Figure 5. EDR Reported Speed Difference versus Vehicle Speed: Steady State Operation

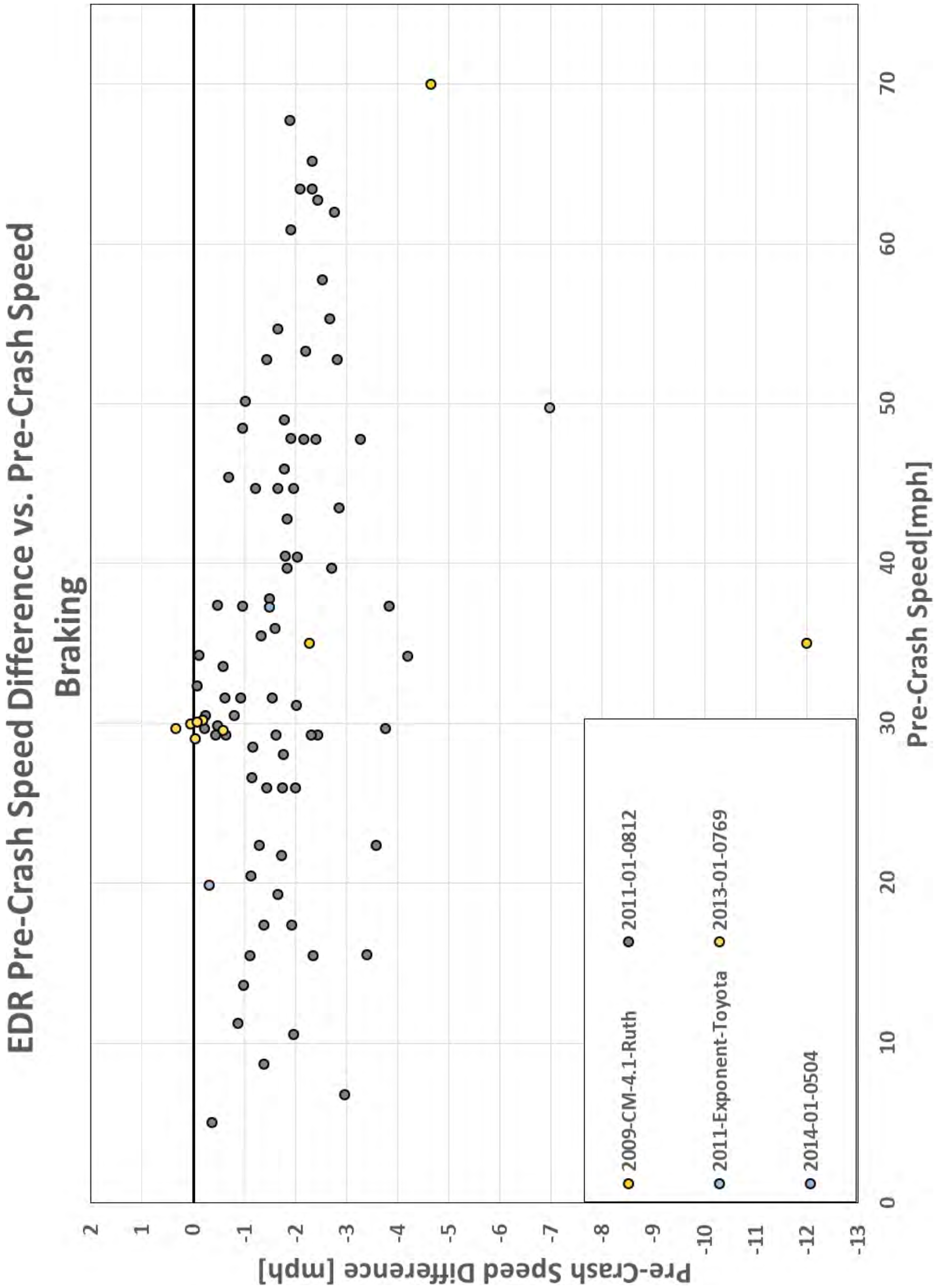

Figure 7. EDR Reported Speed Difference versus Vehicle Speed: Braking

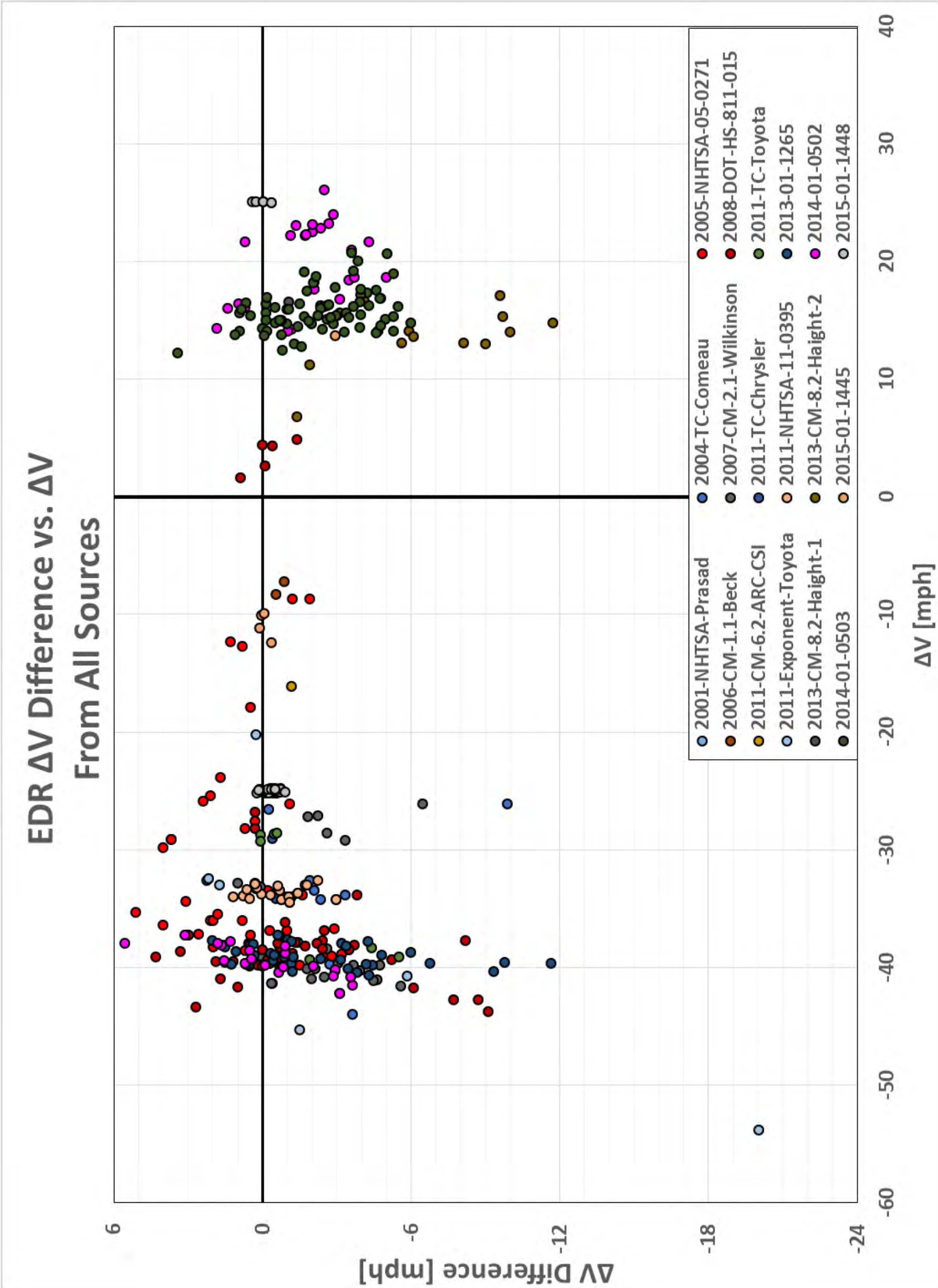

Figure 9. EDR ΔV Difference versus ΔV: Full Overlap, Frontal Rigid Barrier Tests

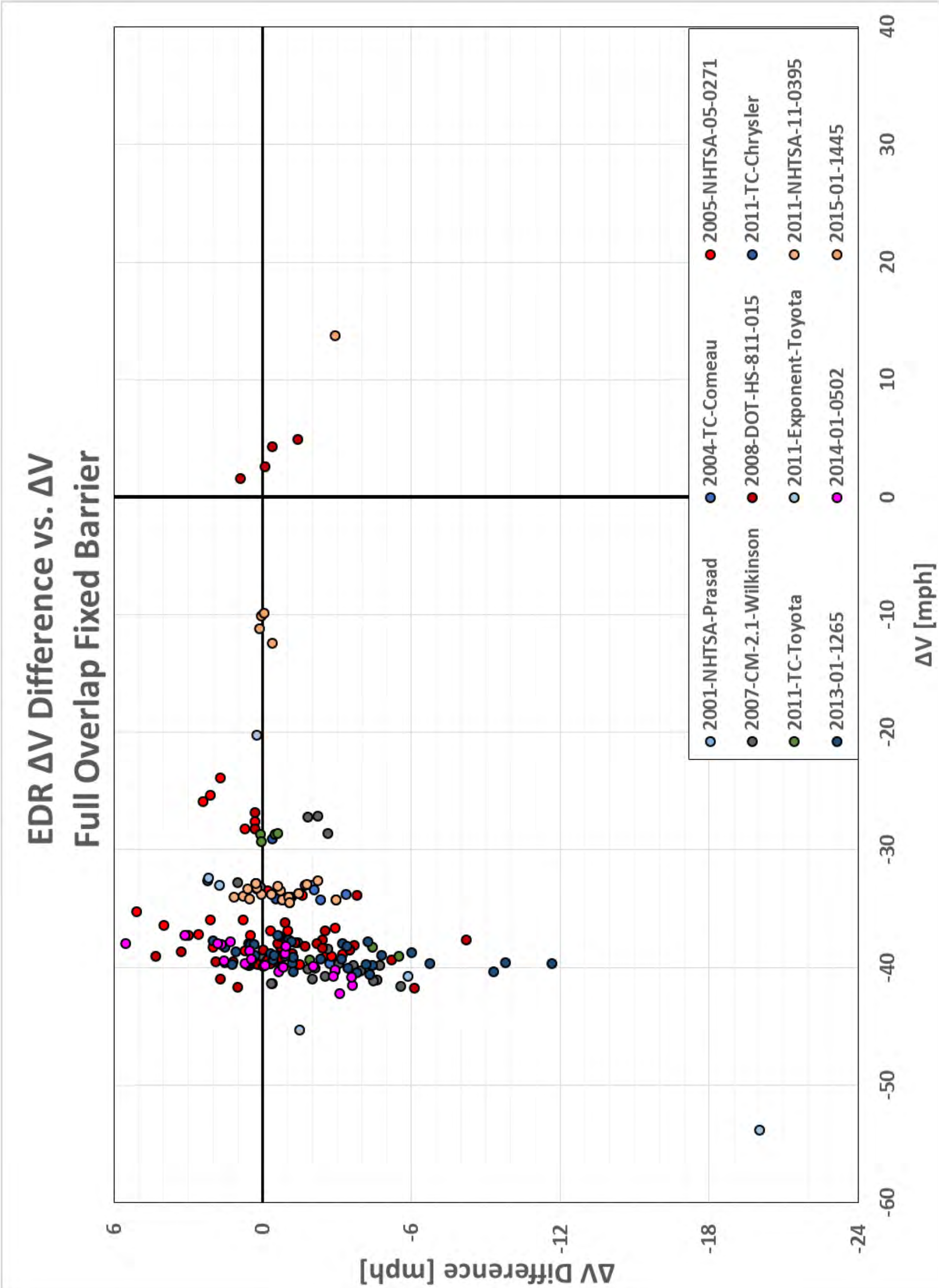

Figure 10. EDR ΔV Difference versus ΔV: Full Overlap, Frontal Rigid Barrier Tests

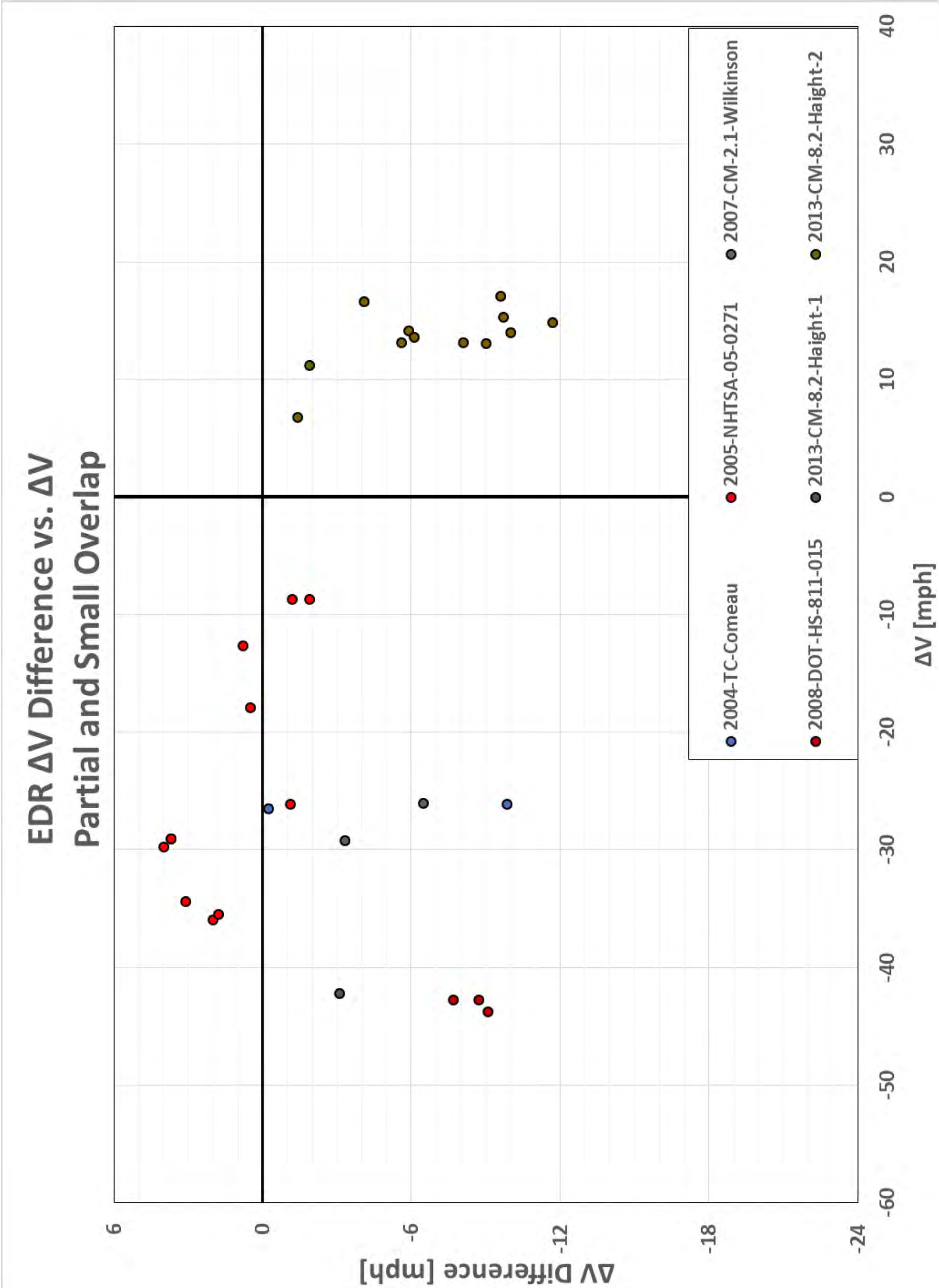

Figure 12. EDR ΔV Difference versus ΔV: Partial and Small Overlap Tests

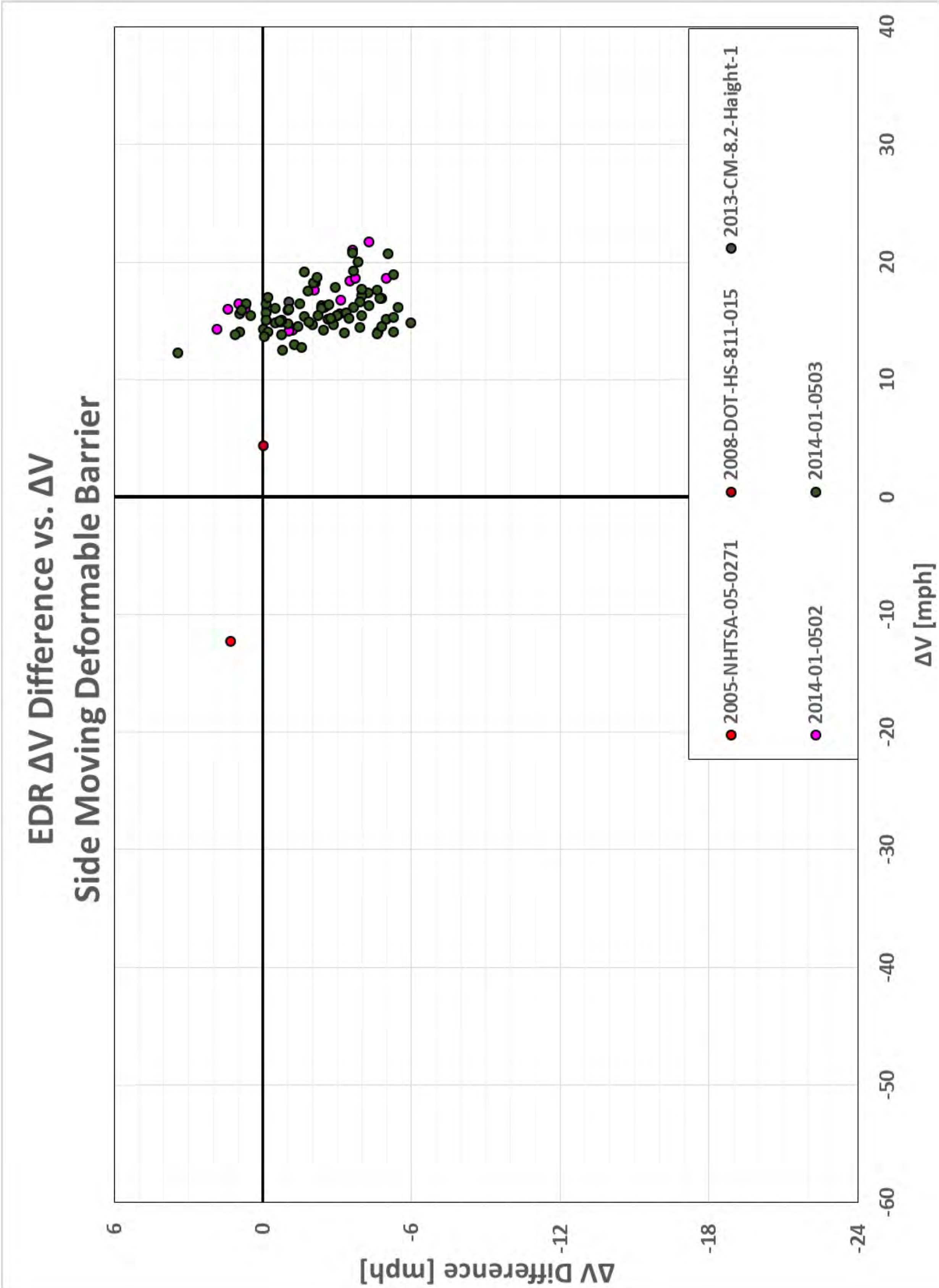

Figure 14. EDR ΔV Difference versus ΔV: Side Moving Deformable Barrier Impact Tests

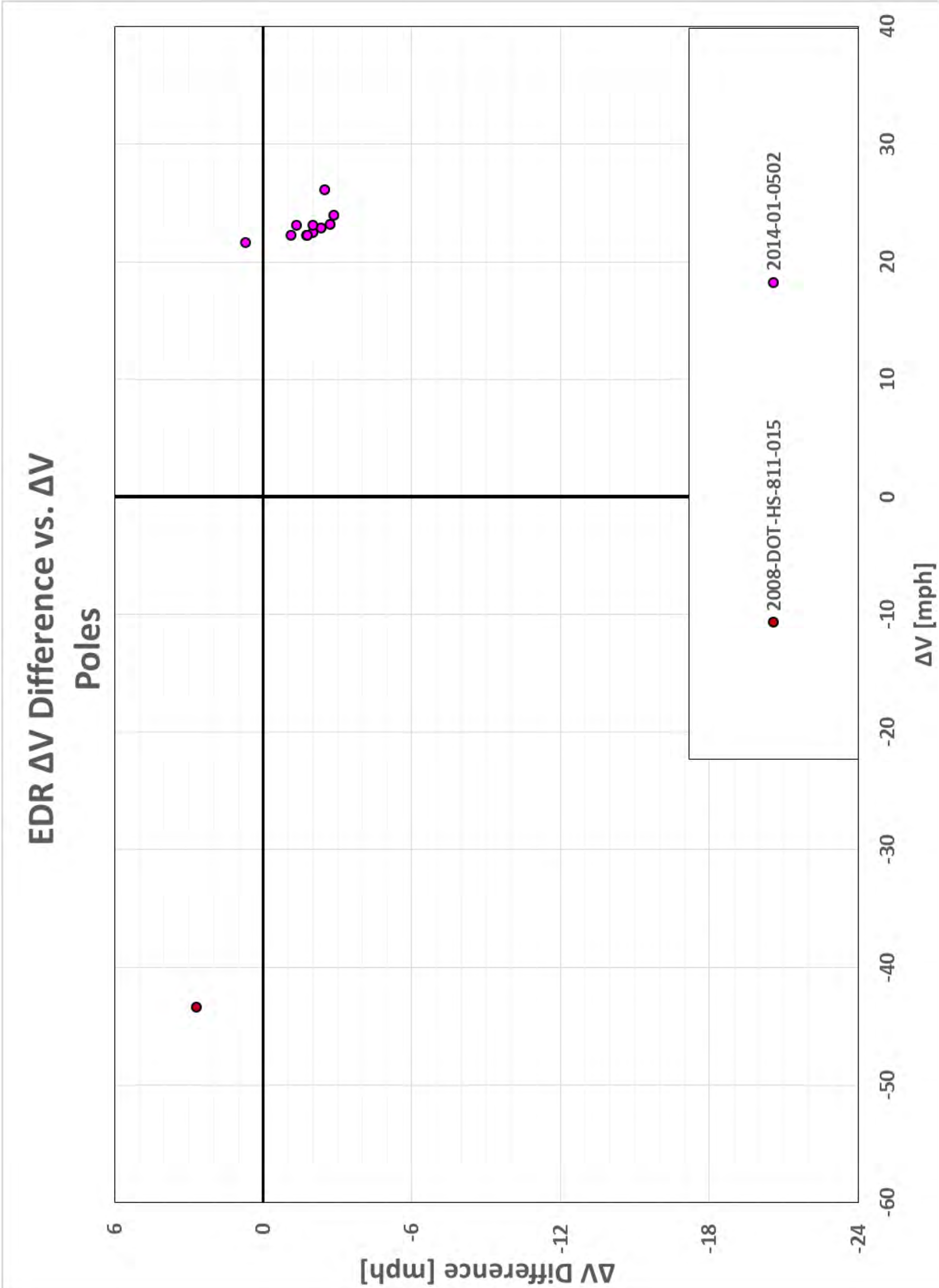

Figure 16. EDR ΔV Difference versus ΔV: Side Pole Impact Tests

Appendix E - Instrumented Testing Raw Data

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	∆V [mph]	∆V Difference [mph]
2001-NHTSA-Prasad	2001	Ford	F-150	-	-	-33.0	-2.0
2004-01-1195	2002	Saturn	SC2	11.3	0.0	-	-
2004-01-1195	2002	Saturn	SC2	13.6	-0.9	-	-
2004-01-1195	2002	Saturn	SC2	17.4	-0.6	-	-
2004-01-1195	2001	Oldsmobile	Alero	12.6	0.0	-	-
2004-01-1195	2001	Oldsmobile	Alero	21.8	-0.8	-	-
2004-01-1195	2001	Oldsmobile	Alero	23.8	1.3	-	-
2004-01-1195	2001	Oldsmobile	Alero	29.8	1.7	-	-
2004-01-1195	2001	Chevrolet	Cavalier	-	-	-0.6	-0.2
2004-01-1195	2001	Chevrolet	Cavalier	-	-	-0.6	-0.4
2004-01-1195	2001	Chevrolet	Cavalier	-	-	-0.8	1.1
2004-01-1195	2001	Chevrolet	Cavalier	-	-	-1.3	1.0
2004-01-1195	2001	Chevrolet	Cavalier	-	-	-1.2	1.5
2004-01-1195	2002	Saturn	SC2	11.0	-	-0.9	0.4
2004-01-1195	2002	Saturn	SC2	12.9	-	-0.7	1.5
2004-01-1195	2002	Saturn	SC2	16.6	-	-1.0	1.5
2004-01-1195	2001	Oldsmobile	Alero	12.0	-	-0.3	0.8
2004-01-1195	2001	Oldsmobile	Alero	20.8	-	-0.5	0.6
2004-01-1195	2001	Oldsmobile	Alero	20.7	-	-0.7	-0.4
2004-01-1195	2001	Oldsmobile	Alero	27.3	-	-1.2	1.5
2004-TC-Comeau	1998	Chevrolet	Cavalier	30.4	-	-32.6	-1.9
2004-TC-Comeau	1998	Chevrolet	Cavalier	40.1	-	-44.0	-3.6
2004-TC-Comeau	1998	Chevrolet	Cavalier	25.0	-	-26.6	-0.2
2004-TC-Comeau	2002	Chevrolet	Impala	24.8	-	-26.1	-9.9
2004-TC-Comeau	1999	Chevrolet	Cavalier	29.3	-	-33.4	-2.1
2004-TC-Comeau	2001	Chevrolet	Impala	29.6	-	-33.8	-3.3
2004-TC-Comeau	2002	Chevrolet	Trailblazer	29.8	-	-34.2	-2.3
2004-TC-Comeau	2002	Chevrolet	Trailblazer	34.8	-	-39.7	-2.7
2005-01-1190	2004	Chevrolet	Cavalier	-	-	-	-0.7
2005-01-1190	2004	Chevrolet	Cavalier	-	-	-	-0.7
2005-01-1190	2004	Chevrolet	Cavalier	-	-	-	-1.0
2005-01-1190	2003	Chevrolet	Cavalier	-	-	-	-1.2
2005-01-1190	2003	Chevrolet	Cavalier	-	-	-	-1.7
2005-01-1190	2004	Chevrolet	Impala	-	-	-	-1.8
2005-01-1190	2004	Chevrolet	Impala	-	-	-	-1.3
2005-01-1190	2004	Chevrolet	Impala	-	-	-	-1.8
2005-01-1190	2003	Chevrolet	Impala	-	-	-	-1.5
2005-01-1190	2004	Chevrolet	Trailblazer	-	-	-	-1.1

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	∆V [mph]	∆V Difference [mph]
2005-01-1190	2004	Chevrolet	Trailblazer	-	-	-	-1.6
2005-01-1190	2004	Chevrolet	Trailblazer	-	-	-	-1.2
2005-NHTSA-05-0271	2002	Chevrolet	Avalanche	35.1	-	-36.9	-1.0
2005-NHTSA-05-0271	2002	Buick	Rendezvous	35.1	-	-41.4	-0.4
2005-NHTSA-05-0271	2002	Saturn	Vue	35.0	-	-38.3	2.0
2005-NHTSA-05-0271	2002	Cadillac	Deville	35.3	-	-37.2	2.6
2005-NHTSA-05-0271	2002	Chevrolet	Trailblazer	35.1	-	-36.0	2.1
2005-NHTSA-05-0271	2003	Chevrolet	Suburban	24.8	-	-12.7	0.8
2005-NHTSA-05-0271	2003	Chevrolet	Cavalier	34.7	-	-36.4	4.0
2005-NHTSA-05-0271	2003	Chevrolet	Silverado	24.3	-	-23.9	1.7
2005-NHTSA-05-0271	2003	Chevrolet	Tahoe	24.3	-	-25.4	2.1
2005-NHTSA-05-0271	2003	Chevrolet	Avalanche	35.1	-	-36.9	-0.3
2005-NHTSA-05-0271	2003	Chevrolet	Silverado	34.7	-	-36.0	0.8
2005-NHTSA-05-0271	2003	Saturn	Ion	34.8	-	-38.6	0.7
2005-NHTSA-05-0271	2003	Chevrolet	Suburban	35.0	-	-37.5	-0.7
2005-NHTSA-05-0271	2002	Saturn	Vue	29.7	-	-33.5	-0.2
2005-NHTSA-05-0271	2002	Saturn	Vue	29.7	-	-33.9	-1.6
2005-NHTSA-05-0271	2004	Pontiac	Grand Prix	34.7	-	-37.3	0.5
2005-NHTSA-05-0271	2004	Toyota	Sienna	35.1	-	-39.8	-1.5
2005-NHTSA-05-0271	2004	Toyota	Solara	34.7	-	-38.9	-2.6
2005-NHTSA-05-0271	2004	Ford	F-150	35.0	-	-38.1	1.6
2005-NHTSA-05-0271	2004	Cadillac	SRX	35.1	-	-39.1	-2.8
2005-NHTSA-05-0271	2004	GMC	Envoy	35.0	-	-36.7	-2.9
2005-NHTSA-05-0271	2004	Chevrolet	Colorado	35.2	-	-38.9	-3.2
2005-NHTSA-05-0271	2000	Cadillac	Seville	70.4	-	-17.9	0.5
2005-NHTSA-05-0271	2004	Saturn	Ion	24.8	-	-25.9	2.4
2005-NHTSA-05-0271	2005	Chevrolet	Equinox	35.0	-	-35.3	5.1
2005-NHTSA-05-0271	2005	Ford	Taurus	25.0	-	-28.2	0.7
2005-NHTSA-05-0271	2004	Toyota	Camry	24.6	-	-27.6	0.3
2005-NHTSA-05-0271	2001	Chevrolet	Silverado	40.0	-	-26.1	-1.1
2005-NHTSA-05-0271	2002	Chevrolet	Trailblazer	40.0	-	-29.1	3.7
2005-NHTSA-05-0271	2003	Cadillac	CTS	40.0	-	-29.1	3.7
2005-NHTSA-05-0271	2003	Cadillac	CTS	40.0	-	-29.8	4.0
2005-NHTSA-05-0271	2004	Cadillac	SRX	40.0	-	-34.4	3.1
2005-NHTSA-05-0271	2003	Lincoln	Towncar	40.0	-	-19.4	-
2005-NHTSA-05-0271	2003	Lincoln	Towncar	40.0	-	-19.3	-
2005-NHTSA-05-0271	2004	Chevrolet	Malibu	40.0	-	-36.0	2.0
2005-NHTSA-05-0271	2004	Chevrolet	Malibu	40.0	-	-8.7	-1.2
2005-NHTSA-05-0271	2004	Chevrolet	Malibu	31.0	-	-12.3	1.3
2005-NHTSA-05-0271	2004	Chevrolet	Malibu	40.0	-	-35.5	1.8

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	ΔV [mph]	ΔV Difference [mph]
2005-NHTSA-05-0271	2004	Chevrolet	Malibu	40.0	-	-8.7	-1.9
2006-CM-1.1-Beck	2002	Chevrolet	Cavalier	27.2	-	-7.2	-0.9
2006-CM-1.1-Beck	2002	Chevrolet	Cavalier	37.1	-	-8.3	-0.5
2007-CM-2.1-Wilkinson	2002	Buick	Rendezvous	35.1	-	-41.4	-0.3
2007-CM-2.1-Wilkinson	2002	Cadillac	Deville	35.4	-	-40.3	-2.9
2007-CM-2.1-Wilkinson	2002	Chevrolet	Trailblazer	35.1	-	-38.5	-2.6
2007-CM-2.1-Wilkinson	2003	Chevrolet	Cavalier	34.7	-	-41.1	-4.6
2007-CM-2.1-Wilkinson	2003	Chevrolet	Silverado	24.3	-	-27.1	-2.2
2007-CM-2.1-Wilkinson	2003	Chevrolet	Tahoe	24.3	-	-27.2	-1.8
2007-CM-2.1-Wilkinson	2003	Chevrolet	Avalanche	35.1	-	-39.7	-3.1
2007-CM-2.1-Wilkinson	2003	Chevrolet	Silverado	34.7	-	-41.6	-5.6
2007-CM-2.1-Wilkinson	2003	Saturn	Ion	34.8	-	-40.1	-2.1
2007-CM-2.1-Wilkinson	2003	Chevrolet	Tahoe	35.0	-	-40.3	-3.9
2007-CM-2.1-Wilkinson	2003	Chevrolet	Suburban	35.0	-	-41.0	-2.0
2007-CM-2.1-Wilkinson	2002	Saturn	Vue	29.7	-	-33.2	0.1
2007-CM-2.1-Wilkinson	2002	Saturn	Vue	29.7	-	-32.8	1.0
2007-CM-2.1-Wilkinson	2004	Pontiac	Grand Prix	34.7	-	-40.1	-1.8
2007-CM-2.1-Wilkinson	2004	Cadillac	SRX	35.1	-	-39.8	-3.7
2007-CM-2.1-Wilkinson	2004	GMC	Envoy	35.0	-	-37.9	-1.4
2007-CM-2.1-Wilkinson	2004	Chevrolet	Colorado	35.2	-	-39.8	-4.7
2007-CM-2.1-Wilkinson	2004	Saturn	Ion	24.8	-	-28.6	-2.6
2007-CM-2.1-Wilkinson	2005	Chevrolet	Equinox	35.0	-	-41.1	-4.5
2007-CM-2.1-Wilkinson	2002	Chevrolet	Avalanche	35.1	-	-39.0	0.0
2007-CM-2.1-Wilkinson	2002	Saturn	Vue	35.0	-	-40.8	-2.5
2007-CM-2.1-Wilkinson	2003	Chevrolet	Suburban	24.8	-	-29.2	-3.3
2007-CM-2.1-Wilkinson	2000	Cadillac	Seville	34.7	-	-26.1	-6.5
2008-01-0162	2005	Ford	Crown Victoria	-	-0.2	-	-
2008-01-0162	2007	Lincoln	Towncar	-	0.6	-	-
2008-01-0162	2007	Ford	500	-	-0.4	-	-
2008-DOT-HS-811-015	2005	Buick	Rendezvous	34.8	-7.8	-39.0	-0.8
2008-DOT-HS-811-015	2005	Chevrolet	Colorado	35.2	-1.2	-37.9	-1.3
2008-DOT-HS-811-015	2005	Chevrolet	Express	34.9	-0.9	-37.7	-2.4
2008-DOT-HS-811-015	2005	Pontiac	Montana	34.8	0.2	-39.4	-5.2
2008-DOT-HS-811-015	2005	Saturn	Ion	-	-	4.4	0.0
2008-DOT-HS-811-015	2005	Chevrolet	Silverado	34.9	0.1	-41.8	-6.1
2008-DOT-HS-811-015	2005	Chevrolet	Uplander	34.9	0.1	-37.8	-0.9
2008-DOT-HS-811-015	2006	Chevrolet	Colorado	34.9	-0.9	-38.1	-3.7
2008-DOT-HS-811-015	2006	Chevrolet	Colorado	35.1	-0.1	-38.0	-2.2
2008-DOT-HS-811-015	2006	Pontiac	Grand Prix	35.1	-0.1	-39.5	-0.4
2008-DOT-HS-811-015	2006	Buick	Lucerne	35.1	-0.1	-39.4	-0.2

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	ΔV [mph]	ΔV Difference [mph]
2008-DOT-HS-811-015	2006	Chevrolet	HHR	34.9	0.1	-39.5	1.2
2008-DOT-HS-811-015	2006	Chevrolet	Impala	35.1	-0.1	-39.9	-0.7
2008-DOT-HS-811-015	2005	Pontiac	G6	35.3	-0.3	-39.5	1.9
2008-DOT-HS-811-015	2004	Chevrolet	Avalanche	35.0	0.0	-38.5	-3.5
2008-DOT-HS-811-015	2004	Chevrolet	Avalanche	30.1	-0.1	-33.9	-3.8
2008-DOT-HS-811-015	2006	Buick	Lucerne	24.7	0.3	-26.8	0.3
2008-DOT-HS-811-015	2006	Chevrolet	Monte Carlo	35.0	-1.0	-39.2	-0.7
2008-DOT-HS-811-015	2006	Cadillac	DTS	35.2	-0.2	-39.4	-0.2
2008-DOT-HS-811-015	2006	Hummer	H3	35.0	-1.0	-38.8	-1.2
2008-DOT-HS-811-015	2006	Pontiac	G6	24.7	0.3	-28.2	0.3
2008-DOT-HS-811-015	2007	Chevrolet	Silverado	35.1	-0.1	-38.5	-3.5
2008-DOT-HS-811-015	2007	Saturn	Aura	35.1	-0.1	-41.7	1.0
2008-DOT-HS-811-015	2007	Pontiac	Solstice	35.0	-1.0	-41.0	1.7
2008-DOT-HS-811-015	2007	Chevrolet	Silverado	34.8	0.2	-39.7	0.3
2008-DOT-HS-811-015	2005	Chevrolet	Cobalt	34.9	0.1	-39.8	0.2
2008-DOT-HS-811-015	2004	Chevrolet	Malibu	39.7	-0.7	-43.4	2.7
2008-DOT-HS-811-015	2005	Saturn	Ion	40.0	0.0	-42.8	-7.7
2008-DOT-HS-811-015	2005	Chevrolet	Colorado	39.7	-0.7	-43.8	-9.1
2008-DOT-HS-811-015	2005	Buick	LaCrosse	39.9	-0.9	-42.8	-8.7
2008-DOT-HS-811-015	2005	Ford	500	35.2	-0.2	-39.7	-0.3
2008-DOT-HS-811-015	2005	Ford	Freestyle	34.1	0.9	-39.9	0.0
2008-DOT-HS-811-015	2005	Ford	Econoline	34.9	0.1	-39.7	-0.3
2008-DOT-HS-811-015	2004	Toyota	Camry	-	-	1.6	0.9
2008-DOT-HS-811-015	2005	Toyota	Camry	-	-	-36.2	-0.9
2008-DOT-HS-811-015	2005	Toyota	Corolla	-	-	-38.3	-0.7
2008-DOT-HS-811-015	2005	Toyota	Corolla	-	-	4.3	-0.4
2008-DOT-HS-811-015	2005	Toyota	Matrix	-	-	-38.0	-0.6
2008-DOT-HS-811-015	2005	Toyota	Matrix	-	-	4.9	-1.4
2008-DOT-HS-811-015	2004	Toyota	RAV4	-	-	-37.3	3.0
2008-DOT-HS-811-015	2005	Toyota	Sienna	33.8	1.2	-38.2	-1.7
2008-DOT-HS-811-015	2004	Toyota	Sienna	-	-	2.6	-0.1
2008-DOT-HS-811-015	2005	Toyota	Tacoma	-	-	-36.9	-2.5
2008-DOT-HS-811-015	2004	Toyota	4Runner	-	-	-38.5	0.0
2008-DOT-HS-811-015	2004	Toyota	Prius	-	-	-38.7	3.3
2008-DOT-HS-811-015	2005	Toyota	Tundra	-	-	-38.4	-2.4
2008-DOT-HS-811-015	2005	Toyota	Tundra	-	-	-37.7	-8.2
2008-DOT-HS-811-015	2005	Scion	tC	-	-	-39.1	4.3
2009-01-0877	2008	Jeep	Commander	35.0	-0.7	-	-
2009-01-0877	2008	Jeep	Commander	70.0	-0.7	-	-
2009-01-0877	2008	Dodge	Dakota	35.0	-1.3	-	-

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	∆V [mph]	∆V Difference [mph]
2009-01-0877	2008	Dodge	Dakota	50.0	-1.4	-	-
2009-01-0877	2008	Dodge	Dakota	70.0	-1.6	-	-
2009-01-0883	#N/A	#N/A	#N/A	34.2	-0.7	-38.0	-1.1
2009-01-0883	#N/A	#N/A	#N/A	34.2	0.7	-38.3	-4.0
2009-01-0883	#N/A	#N/A	#N/A	34.2	-0.7	-36.7	-3.4
2009-01-0883	#N/A	#N/A	#N/A	34.2	-0.7	-40.0	-3.8
2009-01-0883	#N/A	#N/A	#N/A	34.2	-0.7	-42.1	-4.7
2009-01-0883	#N/A	#N/A	#N/A	34.2	-0.7	-47.9	-15.0
2009-01-0883	#N/A	#N/A	#N/A	34.2	-0.9	-40.5	-6.5
2009-01-0883	#N/A	#N/A	#N/A	40.0	-1.6	-42.5	0.2
2009-01-0883	#N/A	#N/A	#N/A	39.8	0.0	-49.4	-6.5
2009-01-0883	#N/A	#N/A	#N/A	39.8	-1.3	-48.5	-7.4
2009-01-0883	#N/A	#N/A	#N/A	39.8	-1.3	-45.2	-3.4
2009-01-0883	#N/A	#N/A	#N/A	39.8	-1.3	-43.4	-1.6
2009-01-0883	#N/A	#N/A	#N/A	40.0	-0.2	-50.1	-8.7
2009-01-0883	#N/A	#N/A	#N/A	39.6	-1.3	-42.1	-2.9
2009-01-0883	#N/A	#N/A	#N/A	40.0	-0.2	-38.9	6.3
2009-01-0883	#N/A	#N/A	#N/A	34.4	0.4	-18.6	-0.7
2009-01-0883	#N/A	#N/A	#N/A	34.4	0.4	-19.7	-2.0
2009-01-0883	#N/A	#N/A	#N/A	0.0	0.0	8.5	0.9
2009-01-0883	#N/A	#N/A	#N/A	0.0	0.0	14.3	1.1
2009-01-0883	#N/A	#N/A	#N/A	19.0	5.8	-12.8	0.9
2009-01-0883	#N/A	#N/A	#N/A	1.3	2.5	16.8	-1.3
2009-01-0883	#N/A	#N/A	#N/A	48.1	0.4	-39.6	-2.0
2009-01-0883	#N/A	#N/A	#N/A	-	-	-19.9	-2.5
2009-01-0883	#N/A	#N/A	#N/A	-	-	-20.4	-4.3
2009-01-0884	2008	Ford	Focus	35.0	-0.4	-	-
2009-01-0884	2008	Ford	Focus	50.0	-0.5	-	-
2009-01-0884	2008	Ford	Focus	70.0	-0.7	-	-
2009-01-0884	2008	Ford	Focus	35.0	-0.4	-	-
2009-01-0884	2008	Ford	Focus	50.0	-0.5	-	-
2009-01-0884	2008	Ford	Focus	70.0	-0.7	-	-
2009-01-0884	2008	Ford	Edge	35.0	-0.5	-	-
2009-01-0884	2008	Ford	Edge	50.0	-0.3	-	-
2009-01-0884	2008	Ford	Edge	70.0	-0.5	-	-
2009-01-0884	2008	Ford	Edge	35.0	-0.3	-	-
2009-01-0884	2008	Ford	Edge	50.0	-0.4	-	-
2009-01-0884	2008	Ford	Edge	70.0	-0.5	-	-
2009-CM-4.1-Ruth	2008	Jeep	Commander	35.0	-0.2	-	-
2009-CM-4.1-Ruth	2008	Jeep	Commander	70.0	-0.1	-	-

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	ΔV [mph]	ΔV Difference [mph]
2009-CM-4.1-Ruth	2008	Jeep	Commander	35.0	-12.0	-	-
2009-CM-4.1-Ruth	2008	Jeep	Commander	35.0	-2.3	-	-
2009-CM-4.1-Ruth	2008	Jeep	Commander	70.0	-4.7	-	-
2010-01-1000	2008	Ford	Focus	40.0	0.4	-	-
2010-01-1000	2008	Ford	Focus	40.0	-0.4	-	-
2010-01-1000	2008	Ford	Focus	60.0	0.4	-	-
2010-01-1000	2008	Ford	Focus	60.0	-0.6	-	-
2010-01-1002	2008	Dodge	Grand Caravan	-	-1.7	-	-
2010-01-1002	2008	Dodge	Grand Caravan	-	0.6	-	-
2010-01-1002	2008	Dodge	Grand Caravan	-	-2.5	-	-
2010-01-1002	2008	Dodge	Grand Caravan	-	1.5	-	-
2010-01-1002	2008	Dodge	Grand Caravan	-	-1.5	-	-
2010-01-1002	2008	Dodge	Grand Caravan	-	0.4	-	-
2011-01-0809	2006	GMC	Envoy	-	-1.3	-	-
2011-01-0809	2006	GMC	Envoy	-	-1.1	-	-
2011-01-0809	2006	GMC	Envoy	-	-2.0	-	-
2011-01-0809	2006	GMC	Envoy	-	-1.5	-	-
2011-01-0810	#N/A	Toyota	#N/A	34.2	-0.7	-38.5	-1.6
2011-01-0810	#N/A	Toyota	#N/A	34.2	0.7	-38.3	-4.0
2011-01-0810	#N/A	Toyota	#N/A	34.2	-0.7	-38.3	-4.9
2011-01-0810	#N/A	Toyota	#N/A	34.2	-0.7	-40.0	-3.8
2011-01-0810	#N/A	Toyota	#N/A	34.2	-0.7	-39.4	-2.0
2011-01-0810	#N/A	Toyota	#N/A	34.2	-0.7	-39.8	-3.4
2011-01-0810	#N/A	Toyota	#N/A	34.2	-0.7	-38.0	-0.4
2011-01-0810	#N/A	Toyota	#N/A	34.2	-0.7	-38.9	-4.5
2011-01-0810	#N/A	Toyota	#N/A	34.2	-0.7	-38.3	-5.4
2011-01-0810	#N/A	Toyota	#N/A	34.2	-0.9	-39.1	-5.1
2011-01-0810	#N/A	Toyota	#N/A	34.2	-0.7	-38.3	-4.3
2011-01-0810	#N/A	Toyota	#N/A	34.2	-2.0	-38.0	-5.6
2011-01-0810	#N/A	Toyota	#N/A	34.2	-0.7	-37.1	-4.3
2011-01-0810	#N/A	Toyota	#N/A	34.2	-0.7	-37.8	0.0
2011-01-0810	#N/A	Toyota	#N/A	40.0	-1.6	-43.2	-0.4
2011-01-0810	#N/A	Toyota	#N/A	39.8	0.0	-43.4	-0.4
2011-01-0810	#N/A	Toyota	#N/A	39.8	-1.3	-44.7	-3.6
2011-01-0810	#N/A	Toyota	#N/A	39.8	-1.3	-45.2	-3.4
2011-01-0810	#N/A	Toyota	#N/A	39.8	-1.3	-43.4	-1.6
2011-01-0810	#N/A	Toyota	#N/A	40.0	-1.6	-43.6	-1.1
2011-01-0810	#N/A	Toyota	#N/A	39.8	0.0	-43.8	-4.0
2011-01-0810	#N/A	Toyota	#N/A	39.8	0.0	-38.7	-1.1
2011-01-0810	#N/A	Toyota	#N/A	40.0	-0.2	-46.5	-5.1

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	ΔV [mph]	ΔV Difference [mph]
2011-01-0810	#N/A	Toyota	#N/A	39.6	-1.3	-44.5	-5.4
2011-01-0810	#N/A	Toyota	#N/A	39.6	-1.1	-45.9	-4.3
2011-01-0810	#N/A	Toyota	#N/A	39.8	-1.3	-45.9	-6.9
2011-01-0810	#N/A	Toyota	#N/A	39.8	0.0	-44.3	-1.8
2011-01-0810	#N/A	Toyota	#N/A	39.8	0.0	-45.2	0.7
2011-01-0810	#N/A	Toyota	#N/A	40.0	-0.2	-38.9	6.3
2011-01-0810	#N/A	Toyota	#N/A	19.9	0.0	-16.3	-0.7
2011-01-0810	#N/A	Toyota	#N/A	50.1	0.9	-55.9	-16.8
2011-01-0810	#N/A	Toyota	#N/A	49.7	0.0	-50.3	-3.6
2011-01-0810	#N/A	Toyota	#N/A	49.9	-	-17.9	-0.2
2011-01-0810	#N/A	Toyota	#N/A	34.2	0.7	-28.2	-2.0
2011-01-0810	#N/A	Toyota	#N/A	34.4	0.4	-18.6	-0.7
2011-01-0810	#N/A	Toyota	#N/A	34.4	0.4	-19.7	-2.0
2011-01-0810	#N/A	Toyota	#N/A	34.4	-	-10.1	-
2011-01-0810	#N/A	Toyota	#N/A	34.4	0.4	-8.5	-0.7
2011-01-0810	#N/A	Toyota	#N/A	34.2	0.7	36.2	-0.7
2011-01-0810	#N/A	Toyota	#N/A	34.2	0.7	35.6	-0.7
2011-01-0810	#N/A	Toyota	#N/A	34.2	0.7	27.7	-3.1
2011-01-0810	#N/A	Toyota	#N/A	17.0	0.4	21.7	-2.0
2011-01-0810	#N/A	Toyota	#N/A	0.0	0.0	12.8	-0.9
2011-01-0810	#N/A	Toyota	#N/A	22.4	4.9	11.2	0.7
2011-01-0810	#N/A	Toyota	#N/A	0.0	0.0	8.5	0.9
2011-01-0810	#N/A	Toyota	#N/A	0.0	0.0	14.8	0.7
2011-01-0810	#N/A	Toyota	#N/A	19.0	5.8	-12.8	0.9
2011-01-0810	#N/A	Toyota	#N/A	1.3	2.5	16.8	-1.3
2011-01-0810	#N/A	Toyota	#N/A	48.1	0.4	-39.6	-2.0
2011-01-0810	#N/A	Toyota	#N/A	0.0	0.0	4.3	0.0
2011-01-0810	#N/A	Toyota	#N/A	0.0	0.0	14.1	0.9
2011-01-0810	#N/A	Toyota	#N/A	9.2	0.7	9.4	-2.2
2011-01-0810	#N/A	Toyota	#N/A	0.0	0.0	-18.6	1.8
2011-01-0810	#N/A	Toyota	#N/A	49.2	0.4	-37.6	-1.8
2011-01-0812	2010	Ford	Flex	29.1	-0.6	-	-
2011-01-0812	2010	Ford	Flex	29.2	-0.5	-	-
2011-01-0812	2010	Ford	Flex	29.2	-0.5	-	-
2011-01-0812	2010	Ford	Flex	29.7	-0.2	-	-
2011-01-0812	2010	Ford	Flex	29.7	-0.4	-	-
2011-01-0812	2010	Ford	Flex	29.7	-0.5	-	-
2011-01-0812	2010	Ford	Flex	29.7	-0.5	-	-
2011-01-0812	2010	Ford	Flex	29.7	-0.6	-	-
2011-01-0812	2010	Ford	Flex	29.7	-0.6	-	-

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	∆V [mph]	∆V Difference [mph]
2011-01-0812	2010	Ford	Flex	29.7	-0.7	-	-
2011-01-0812	2010	Ford	Flex	29.7	-0.7	-	-
2011-01-0812	2010	Ford	Flex	29.7	-0.8	-	-
2011-01-0812	2010	Ford	Flex	29.8	-0.6	-	-
2011-01-0812	2010	Ford	Flex	30.2	-0.5	-	-
2011-01-0812	2010	Ford	Flex	30.3	-0.2	-	-
2011-01-0812	2010	Ford	Flex	30.3	-0.3	-	-
2011-01-0812	2010	Ford	Flex	30.3	-0.3	-	-
2011-01-0812	2010	Ford	Flex	30.3	-0.5	-	-
2011-01-0812	2010	Ford	Flex	30.3	-0.6	-	-
2011-01-0812	2010	Ford	Flex	30.3	-0.8	-	-
2011-01-0812	2010	Ford	Flex	30.3	-0.9	-	-
2011-01-0812	2010	Ford	Flex	30.4	-0.5	-	-
2011-01-0812	2010	Ford	Flex	30.4	-0.5	-	-
2011-01-0812	2010	Ford	Flex	31.0	-0.1	-	-
2011-01-0812	2010	Ford	Flex	31.0	-0.2	-	-
2011-01-0812	2010	Ford	Flex	31.0	-0.5	-	-
2011-01-0812	2010	Ford	Flex	31.1	-0.8	-	-
2011-01-0812	2010	Ford	Flex	31.1	-0.8	-	-
2011-01-0812	2010	Ford	Flex	31.1	-0.8	-	-
2011-01-0812	2010	Ford	Flex	31.1	-0.8	-	-
2011-01-0812	2010	Ford	Flex	31.1	-0.2	-	-
2011-01-0812	2010	Ford	Flex	31.1	-0.2	-	-
2011-01-0812	2010	Ford	Flex	31.1	-0.3	-	-
2011-01-0812	2010	Ford	Flex	31.6	-0.1	-	-
2011-01-0812	2010	Ford	Flex	31.6	-0.4	-	-
2011-01-0812	2010	Ford	Flex	31.6	-0.7	-	-
2011-01-0812	2010	Ford	Flex	31.6	-0.8	-	-
2011-01-0812	2010	Ford	Flex	31.6	-1.1	-	-
2011-01-0812	2010	Ford	Flex	31.7	-0.5	-	-
2011-01-0812	2010	Ford	Flex	32.2	0.0	-	-
2011-01-0812	2010	Ford	Flex	32.2	-0.3	-	-
2011-01-0812	2010	Ford	Flex	32.2	-0.4	-	-
2011-01-0812	2010	Ford	Flex	32.2	-0.8	-	-
2011-01-0812	2010	Ford	Flex	32.2	-1.3	-	-
2011-01-0812	2010	Ford	Flex	32.9	-0.1	-	-
2011-01-0812	2010	Ford	Flex	34.2	-0.1	-	-
2011-01-0812	2010	Ford	Flex	45.4	-0.8	-	-
2011-01-0812	2010	Ford	Flex	45.4	-0.8	-	-
2011-01-0812	2010	Ford	Flex	45.9	-0.7	-	-

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	∆V [mph]	∆V Difference [mph]
2011-01-0812	2010	Ford	Flex	47.3	-0.6	-	-
2011-01-0812	2010	Ford	Flex	47.8	-0.4	-	-
2011-01-0812	2010	Ford	Flex	48.5	-0.5	-	-
2011-01-0812	2010	Ford	Flex	48.5	-0.4	-	-
2011-01-0812	2010	Ford	Flex	49.0	-0.7	-	-
2011-01-0812	2010	Ford	Flex	49.1	-0.8	-	-
2011-01-0812	2010	Ford	Flex	49.1	-0.7	-	-
2011-01-0812	2010	Ford	Flex	49.1	-0.7	-	-
2011-01-0812	2010	Ford	Flex	49.1	-0.7	-	-
2011-01-0812	2010	Ford	Flex	49.1	-0.6	-	-
2011-01-0812	2010	Ford	Flex	49.1	-0.9	-	-
2011-01-0812	2010	Ford	Flex	49.1	-0.8	-	-
2011-01-0812	2010	Ford	Flex	49.1	-0.7	-	-
2011-01-0812	2010	Ford	Flex	49.1	-0.6	-	-
2011-01-0812	2010	Ford	Flex	49.1	-0.4	-	-
2011-01-0812	2010	Ford	Flex	49.1	-0.3	-	-
2011-01-0812	2010	Ford	Flex	49.1	-0.2	-	-
2011-01-0812	2010	Ford	Flex	49.6	-0.8	-	-
2011-01-0812	2010	Ford	Flex	49.7	-0.5	-	-
2011-01-0812	2010	Ford	Flex	49.7	-0.8	-	-
2011-01-0812	2010	Ford	Flex	49.7	-0.2	-	-
2011-01-0812	2010	Ford	Flex	50.2	-0.4	-	-
2011-01-0812	2010	Ford	Flex	50.3	-0.9	-	-
2011-01-0812	2010	Ford	Flex	50.3	-0.9	-	-
2011-01-0812	2010	Ford	Flex	50.3	-0.7	-	-
2011-01-0812	2010	Ford	Flex	50.3	-0.6	-	-
2011-01-0812	2010	Ford	Flex	50.3	-0.5	-	-
2011-01-0812	2010	Ford	Flex	50.3	-0.3	-	-
2011-01-0812	2010	Ford	Flex	50.3	-0.3	-	-
2011-01-0812	2010	Ford	Flex	51.0	-1.1	-	-
2011-01-0812	2010	Ford	Flex	51.0	-0.8	-	-
2011-01-0812	2010	Ford	Flex	51.0	-0.5	-	-
2011-01-0812	2010	Ford	Flex	51.0	-0.4	-	-
2011-01-0812	2010	Ford	Flex	51.0	-0.3	-	-
2011-01-0812	2010	Ford	Flex	51.5	-1.7	-	-
2011-01-0812	2010	Ford	Flex	51.5	-0.5	-	-
2011-01-0812	2010	Ford	Flex	51.5	-0.4	-	-
2011-01-0812	2010	Ford	Flex	51.5	-0.3	-	-
2011-01-0812	2010	Ford	Flex	52.1	-1.0	-	-
2011-01-0812	2010	Ford	Flex	52.1	-0.5	-	-

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	ΔV [mph]	ΔV Difference [mph]
2011-01-0812	2010	Ford	Flex	52.1	-1.5	-	-
2011-01-0812	2010	Ford	Flex	67.7	-0.9	-	-
2011-01-0812	2010	Ford	Flex	67.7	-1.2	-	-
2011-01-0812	2010	Ford	Flex	67.7	-1.2	-	-
2011-01-0812	2010	Ford	Flex	67.7	-1.2	-	-
2011-01-0812	2010	Ford	Flex	67.8	-1.0	-	-
2011-01-0812	2010	Ford	Flex	67.8	-1.1	-	-
2011-01-0812	2010	Ford	Flex	67.8	-1.1	-	-
2011-01-0812	2010	Ford	Flex	67.8	-1.3	-	-
2011-01-0812	2010	Ford	Flex	67.8	-1.3	-	-
2011-01-0812	2010	Ford	Flex	67.8	-1.3	-	-
2011-01-0812	2010	Ford	Flex	67.8	-1.4	-	-
2011-01-0812	2010	Ford	Flex	67.8	-1.1	-	-
2011-01-0812	2010	Ford	Flex	68.4	-0.5	-	-
2011-01-0812	2010	Ford	Flex	68.4	-0.7	-	-
2011-01-0812	2010	Ford	Flex	68.4	-0.7	-	-
2011-01-0812	2010	Ford	Flex	68.4	-0.8	-	-
2011-01-0812	2010	Ford	Flex	68.5	-0.8	-	-
2011-01-0812	2010	Ford	Flex	69.0	-0.4	-	-
2011-01-0812	2010	Ford	Flex	69.0	-1.2	-	-
2011-01-0812	2010	Ford	Flex	69.0	-1.7	-	-
2011-01-0812	2010	Ford	Flex	69.0	-1.7	-	-
2011-01-0812	2010	Ford	Flex	69.1	-0.8	-	-
2011-01-0812	2010	Ford	Flex	69.1	-0.9	-	-
2011-01-0812	2010	Ford	Flex	69.1	-1.0	-	-
2011-01-0812	2010	Ford	Flex	69.1	-1.0	-	-
2011-01-0812	2010	Ford	Flex	69.1	-1.0	-	-
2011-01-0812	2010	Ford	Flex	69.1	-1.4	-	-
2011-01-0812	2010	Ford	Flex	69.1	-1.3	-	-
2011-01-0812	2010	Ford	Flex	69.1	-0.8	-	-
2011-01-0812	2010	Ford	Flex	69.6	-0.5	-	-
2011-01-0812	2010	Ford	Flex	69.6	-1.2	-	-
2011-01-0812	2010	Ford	Flex	69.6	-0.8	-	-
2011-01-0812	2010	Ford	Flex	70.7	-1.1	-	-
2011-01-0812	2010	Ford	Flex	71.5	-1.0	-	-
2011-01-0812	2010	Ford	Flex	71.5	-1.3	-	-
2011-01-0812	2010	Ford	Flex	72.0	-0.5	-	-
2011-01-0812	2010	Ford	Flex	72.0	-0.8	-	-
2011-01-0812	2010	Ford	Flex	72.0	-0.9	-	-
2011-01-0812	2010	Ford	Flex	5.0	-0.4	-	-

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	ΔV [mph]	ΔV Difference [mph]
2011-01-0812	2010	Ford	Flex	6.7	-3.0	-	-
2011-01-0812	2010	Ford	Flex	8.7	-1.4	-	-
2011-01-0812	2010	Ford	Flex	10.5	-2.0	-	-
2011-01-0812	2010	Ford	Flex	11.2	-0.9	-	-
2011-01-0812	2010	Ford	Flex	13.6	-1.0	-	-
2011-01-0812	2010	Ford	Flex	15.5	-1.1	-	-
2011-01-0812	2010	Ford	Flex	15.5	-2.3	-	-
2011-01-0812	2010	Ford	Flex	15.5	-3.4	-	-
2011-01-0812	2010	Ford	Flex	17.4	-1.9	-	-
2011-01-0812	2010	Ford	Flex	17.4	-1.4	-	-
2011-01-0812	2010	Ford	Flex	19.3	-1.6	-	-
2011-01-0812	2010	Ford	Flex	20.5	-1.1	-	-
2011-01-0812	2010	Ford	Flex	21.7	-1.7	-	-
2011-01-0812	2010	Ford	Flex	22.4	-1.3	-	-
2011-01-0812	2010	Ford	Flex	22.4	-3.6	-	-
2011-01-0812	2010	Ford	Flex	26.0	-2.0	-	-
2011-01-0812	2010	Ford	Flex	26.0	-1.7	-	-
2011-01-0812	2010	Ford	Flex	26.0	-1.4	-	-
2011-01-0812	2010	Ford	Flex	26.6	-1.1	-	-
2011-01-0812	2010	Ford	Flex	28.0	-1.8	-	-
2011-01-0812	2010	Ford	Flex	28.5	-1.2	-	-
2011-01-0812	2010	Ford	Flex	29.2	-2.4	-	-
2011-01-0812	2010	Ford	Flex	29.2	-2.3	-	-
2011-01-0812	2010	Ford	Flex	29.2	-0.6	-	-
2011-01-0812	2010	Ford	Flex	29.2	-0.4	-	-
2011-01-0812	2010	Ford	Flex	29.2	-1.6	-	-
2011-01-0812	2010	Ford	Flex	29.7	-3.7	-	-
2011-01-0812	2010	Ford	Flex	29.7	-0.2	-	-
2011-01-0812	2010	Ford	Flex	29.8	-0.5	-	-
2011-01-0812	2010	Ford	Flex	30.5	-0.2	-	-
2011-01-0812	2010	Ford	Flex	30.5	-0.8	-	-
2011-01-0812	2010	Ford	Flex	31.1	-2.0	-	-
2011-01-0812	2010	Ford	Flex	31.6	-0.6	-	-
2011-01-0812	2010	Ford	Flex	31.6	-0.9	-	-
2011-01-0812	2010	Ford	Flex	31.6	-1.5	-	-
2011-01-0812	2010	Ford	Flex	32.3	-0.1	-	-
2011-01-0812	2010	Ford	Flex	33.5	-0.6	-	-
2011-01-0812	2010	Ford	Flex	34.2	-4.2	-	-
2011-01-0812	2010	Ford	Flex	34.2	-0.1	-	-
2011-01-0812	2010	Ford	Flex	35.5	-1.3	-	-

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	∆V [mph]	∆V Difference [mph]
2011-01-0812	2010	Ford	Flex	35.9	-1.6	-	-
2011-01-0812	2010	Ford	Flex	37.3	-3.8	-	-
2011-01-0812	2010	Ford	Flex	37.3	-1.0	-	-
2011-01-0812	2010	Ford	Flex	37.4	-0.5	-	-
2011-01-0812	2010	Ford	Flex	37.8	-1.5	-	-
2011-01-0812	2010	Ford	Flex	39.7	-2.7	-	-
2011-01-0812	2010	Ford	Flex	39.7	-1.8	-	-
2011-01-0812	2010	Ford	Flex	40.4	-2.0	-	-
2011-01-0812	2010	Ford	Flex	40.5	-1.8	-	-
2011-01-0812	2010	Ford	Flex	42.8	-1.8	-	-
2011-01-0812	2010	Ford	Flex	43.5	-2.8	-	-
2011-01-0812	2010	Ford	Flex	44.7	-1.2	-	-
2011-01-0812	2010	Ford	Flex	44.7	-1.6	-	-
2011-01-0812	2010	Ford	Flex	44.7	-2.0	-	-
2011-01-0812	2010	Ford	Flex	45.4	-0.7	-	-
2011-01-0812	2010	Ford	Flex	45.9	-1.8	-	-
2011-01-0812	2010	Ford	Flex	47.8	-2.2	-	-
2011-01-0812	2010	Ford	Flex	47.8	-2.4	-	-
2011-01-0812	2010	Ford	Flex	47.8	-3.3	-	-
2011-01-0812	2010	Ford	Flex	47.8	-1.9	-	-
2011-01-0812	2010	Ford	Flex	48.5	-1.0	-	-
2011-01-0812	2010	Ford	Flex	49.0	-1.8	-	-
2011-01-0812	2010	Ford	Flex	50.1	-1.0	-	-
2011-01-0812	2010	Ford	Flex	52.8	-1.4	-	-
2011-01-0812	2010	Ford	Flex	52.8	-2.8	-	-
2011-01-0812	2010	Ford	Flex	53.3	-2.2	-	-
2011-01-0812	2010	Ford	Flex	54.7	-1.6	-	-
2011-01-0812	2010	Ford	Flex	55.3	-2.7	-	-
2011-01-0812	2010	Ford	Flex	57.8	-2.5	-	-
2011-01-0812	2010	Ford	Flex	60.8	-1.9	-	-
2011-01-0812	2010	Ford	Flex	62.0	-2.8	-	-
2011-01-0812	2010	Ford	Flex	62.7	-2.4	-	-
2011-01-0812	2010	Ford	Flex	63.4	-2.1	-	-
2011-01-0812	2010	Ford	Flex	63.4	-2.3	-	-
2011-01-0812	2010	Ford	Flex	65.1	-2.3	-	-
2011-01-0812	2010	Ford	Flex	67.7	-1.9	-	-
2011-CM-6.2-ARC-CSI	#N/A	Ford	Crown Victoria	28.0	-	-16.2	-1.2
2011-TC-Chrysler	2009	Dodge	Journey	25.0	-0.1	-29.1	-0.4
2011-TC-Chrysler	2009	Dodge	Journey	29.8	-1.2	-33.9	-0.8
2011-TC-Chrysler	2007	Jeep	Compass	29.7	-0.5	-34.0	-1.2

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	ΔV [mph]	ΔV Difference [mph]
2011-TC-Chrysler	2007	Jeep	Compass	34.9	-0.7	-39.6	1.5
2011-TC-Chrysler	2008	Dodge	Avenger	29.7	0.1	-32.6	2.2
2011-TC-Chrysler	2009	Chrysler	Aspen	29.6	-0.4	-33.4	-0.6
2011-TC-Chrysler	2009	Dodge	Ram	29.6	-0.4	-34.2	-0.5
2011-TC-Toyota	2005	Toyota	Camry	25.1	-	-28.7	0.1
2011-TC-Toyota	2005	Toyota	Camry	29.8	-	-34.3	-1.1
2011-TC-Toyota	2005	Toyota	Camry	34.8	-	-39.1	-5.5
2011-TC-Toyota	2009	Toyota	Corolla	25.1	-0.2	-28.7	-0.5
2011-TC-Toyota	2010	Toyota	Corolla	25.0	-1.4	-29.3	0.1
2011-TC-Toyota	2009	Toyota	Corolla	29.7	-1.1	-34.3	-3.0
2011-TC-Toyota	2010	Toyota	Corolla	29.8	-1.2	-34.3	-0.8
2011-TC-Toyota	2009	Toyota	Corolla	34.8	-1.3	-39.4	-1.9
2011-TC-Toyota	2009	Toyota	Matrix	25.0	-1.4	-28.6	-0.6
2011-TC-Toyota	2009	Toyota	Matrix	29.6	-1.1	-34.1	-1.1
2011-TC-Toyota	2009	Toyota	Matrix	29.8	-1.2	-34.5	-1.1
2011-TC-Toyota	2009	Toyota	Matrix	29.8	-1.2	-33.7	-1.4
2011-TC-Toyota	2009	Toyota	Matrix	34.7	0.1	-38.3	-4.4
2011-TC-Toyota	2009	Toyota	Venza	29.8	-1.2	-32.9	0.3
2011-Exponent-Toyota	2007	Toyota	RAV4	19.9	-0.3	-20.3	0.2
2011-Exponent-Toyota	2007	Toyota	Tundra	30.2	-0.4	-33.3	0.2
2011-Exponent-Toyota	2007	Toyota	Corolla	40.6	-	-45.4	-1.5
2011-Exponent-Toyota	2005	Toyota	Camry	29.5	-	-33.0	1.7
2011-Exponent-Toyota	2007	Lexus	ES-350	50.3	-1.9	-53.9	-20.0
2011-Exponent-Toyota	2002	Toyota	Camry	29.7	-	-32.4	2.2
2011-Exponent-Toyota	2003	Toyota	Camry	40.1	-	-40.8	-5.8
2011-NHTSA-11-0395	2008	Chevrolet	Malibu	29.7	-0.7	-33.8	0.1
2011-NHTSA-11-0395	2009	Pontiac	G8	29.5	-0.5	-32.9	0.3
2011-NHTSA-11-0395	2009	Pontiac	Wave	29.6	-0.6	-33.8	-0.3
2011-NHTSA-11-0395	2009	Pontiac	Wave	29.8	-0.8	-33.5	-0.7
2011-NHTSA-11-0395	2008	Saturn	Vue	29.7	-0.7	-33.3	0.2
2011-NHTSA-11-0395	2008	Ford	Edge	29.8	-0.5	-33.0	-1.7
2011-NHTSA-11-0395	2008	Ford	Focus	29.6	-0.5	-33.1	-0.6
2011-NHTSA-11-0395	2009	Ford	F-150	29.7	-1.1	-33.0	-1.8
2011-NHTSA-11-0395	2005	Toyota	Camry	29.8	-	-34.3	-1.1
2011-NHTSA-11-0395	2009	Toyota	Corolla	29.7	-1.1	-34.3	-3.0
2011-NHTSA-11-0395	2010	Toyota	Corolla	29.8	-1.2	-34.3	-0.8
2011-NHTSA-11-0395	2009	Toyota	Matrix	29.6	-1.1	-34.1	-1.1
2011-NHTSA-11-0395	2009	Toyota	Matrix	29.8	-1.2	-34.5	-1.1
2011-NHTSA-11-0395	2009	Toyota	Matrix	29.8	-1.2	-33.7	-1.4
2011-NHTSA-11-0395	2009	Toyota	Venza	29.8	-1.2	-32.9	0.3

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	∆V [mph]	∆V Difference [mph]
2011-NHTSA-11-0395	2009	Dodge	Journey	29.8	-1.2	-33.9	0.8
2011-NHTSA-11-0395	2007	Jeep	Compass	29.7	-0.5	-34.0	1.2
2011-NHTSA-11-0395	2008	Dodge	Avenger	29.7	0.1	-32.6	-2.2
2011-NHTSA-11-0395	2009	Chrysler	Aspen	29.6	-0.4	-33.4	0.6
2011-NHTSA-11-0395	2009	Dodge	Ram	29.6	-0.4	-34.2	0.5
2012-01-0999	2010	Toyota	Camry	28.2	-0.9	-	-
2012-01-0999	2010	Toyota	Camry	28.3	-0.9	-	-
2012-01-0999	2010	Toyota	Camry	28.4	-1.0	-	-
2012-01-0999	2010	Toyota	Camry	28.6	0.0	-	-
2012-01-0999	2010	Toyota	Camry	28.9	-0.3	-	-
2012-01-0999	2010	Toyota	Camry	29.0	-0.4	-	-
2012-01-0999	2010	Toyota	Camry	29.2	-0.6	-	-
2012-01-0999	2010	Toyota	Camry	29.2	-0.7	-	-
2012-01-0999	2010	Toyota	Camry	29.3	-0.7	-	-
2012-01-0999	2010	Toyota	Camry	29.4	-0.8	-	-
2012-01-0999	2010	Toyota	Camry	29.6	-1.0	-	-
2012-01-0999	2010	Toyota	Camry	29.9	0.0	-	-
2012-01-0999	2010	Toyota	Camry	30.9	-1.1	-	-
2012-01-0999	2010	Toyota	Camry	31.5	-0.4	-	-
2012-01-0999	2010	Toyota	Camry	31.6	-0.5	-	-
2012-01-0999	2010	Toyota	Camry	31.7	-0.6	-	-
2012-01-0999	2010	Toyota	Camry	31.7	-0.7	-	-
2012-01-0999	2010	Toyota	Camry	31.8	-0.8	-	-
2012-01-0999	2010	Toyota	Camry	31.9	-0.8	-	-
2012-01-0999	2010	Toyota	Camry	31.9	-0.9	-	-
2012-01-0999	2010	Toyota	Camry	32.2	-1.1	-	-
2012-01-0999	2010	Toyota	Camry	32.3	-1.2	-	-
2012-01-0999	2010	Toyota	Camry	32.9	-0.6	-	-
2012-01-0999	2010	Toyota	Camry	33.5	-1.1	-	-
2012-01-0999	2010	Toyota	Camry	36.9	-0.8	-	-
2012-01-0999	2010	Toyota	Camry	37.2	-1.1	-	-
2012-01-0999	2010	Toyota	Camry	37.6	-0.2	-	-
2012-01-0999	2010	Toyota	Camry	37.8	-0.5	-	-
2012-01-0999	2010	Toyota	Camry	37.9	-0.6	-	-
2012-01-0999	2010	Toyota	Camry	47.4	-0.1	-	-
2012-01-0999	2010	Toyota	Camry	47.8	-0.6	-	-
2012-01-0999	2010	Toyota	Camry	48.3	-1.1	-	-
2012-01-0999	2010	Toyota	Camry	48.5	-1.2	-	-
2012-01-0999	2010	Toyota	Camry	48.5	-1.2	-	-
2012-01-0999	2010	Toyota	Camry	48.6	-0.1	-	-

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	ΔV [mph]	ΔV Difference [mph]
2012-01-0999	2010	Toyota	Camry	48.6	-1.4	-	-
2012-01-0999	2010	Toyota	Camry	50.9	-1.1	-	-
2012-01-0999	2010	Toyota	Camry	50.9	-1.2	-	-
2012-01-0999	2010	Toyota	Camry	51.1	-0.1	-	-
2012-01-0999	2010	Toyota	Camry	51.5	-0.5	-	-
2012-01-0999	2010	Toyota	Camry	51.5	-0.6	-	-
2012-01-0999	2010	Toyota	Camry	51.6	-0.6	-	-
2012-01-0999	2010	Toyota	Camry	51.7	-0.7	-	-
2012-01-0999	2010	Toyota	Camry	52.1	-1.1	-	-
2012-01-0999	2010	Toyota	Camry	58.4	-1.2	-	-
2012-01-0999	2010	Toyota	Camry	58.4	-1.2	-	-
2012-01-0999	2010	Toyota	Camry	58.5	-1.3	-	-
2012-01-0999	2010	Toyota	Camry	58.6	-1.4	-	-
2012-01-0999	2010	Toyota	Camry	58.7	-1.5	-	-
2012-01-0999	2010	Toyota	Camry	58.8	-0.4	-	-
2012-01-0999	2010	Toyota	Camry	59.0	-0.6	-	-
2012-01-0999	2010	Toyota	Camry	59.2	-0.8	-	-
2012-01-0999	2010	Toyota	Camry	59.3	-0.9	-	-
2012-01-0999	2010	Toyota	Camry	60.8	-1.1	-	-
2012-01-0999	2010	Toyota	Camry	61.0	-1.3	-	-
2012-01-0999	2010	Toyota	Camry	61.0	-1.4	-	-
2012-01-0999	2010	Toyota	Camry	61.1	-1.4	-	-
2012-01-0999	2010	Toyota	Camry	61.2	-1.5	-	-
2012-01-0999	2010	Toyota	Camry	61.3	-0.4	-	-
2012-01-0999	2010	Toyota	Camry	61.3	-1.7	-	-
2012-01-0999	2010	Toyota	Camry	61.4	-0.5	-	-
2012-01-0999	2010	Toyota	Camry	61.6	-0.6	-	-
2012-01-0999	2010	Toyota	Camry	61.6	-0.7	-	-
2012-01-0999	2010	Toyota	Camry	61.8	-0.9	-	-
2012-01-0999	2010	Toyota	Camry	62.0	-1.0	-	-
2012-01-0999	2010	Toyota	Camry	62.3	-1.4	-	-
2012-01-0999	2010	Toyota	Camry	67.4	-0.3	-	-
2012-01-0999	2010	Toyota	Camry	67.4	-0.3	-	-
2012-01-0999	2010	Toyota	Camry	68.2	-1.1	-	-
2012-01-0999	2010	Toyota	Camry	68.6	-1.4	-	-
2012-01-0999	2010	Toyota	Camry	68.6	-0.2	-	-
2012-01-0999	2010	Toyota	Camry	68.6	-0.2	-	-
2012-01-0999	2010	Toyota	Camry	68.7	-0.4	-	-
2012-01-0999	2010	Toyota	Camry	68.7	-0.4	-	-
2012-01-0999	2010	Toyota	Camry	68.8	-0.4	-	-

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	ΔV [mph]	ΔV Difference [mph]
2012-01-0999	2010	Toyota	Camry	68.8	-0.4	-	-
2012-01-0999	2010	Toyota	Camry	68.8	-1.7	-	-
2012-01-0999	2010	Toyota	Camry	68.9	-1.7	-	-
2012-01-0999	2010	Toyota	Camry	68.9	-0.5	-	-
2012-01-0999	2010	Toyota	Camry	68.9	-0.5	-	-
2012-01-0999	2010	Toyota	Camry	69.0	-1.9	-	-
2012-01-0999	2010	Toyota	Camry	69.0	-0.7	-	-
2012-01-0999	2010	Toyota	Camry	69.1	-0.8	-	-
2012-01-0999	2010	Toyota	Camry	69.2	-0.9	-	-
2012-01-0999	2010	Toyota	Camry	69.5	-1.1	-	-
2012-01-0999	2010	Toyota	Camry	69.5	-1.1	-	-
2012-01-0999	2010	Toyota	Camry	69.8	-1.4	-	-
2012-01-0999	2010	Toyota	Camry	69.8	-1.4	-	-
2012-01-0999	2010	Toyota	Camry	70.1	-1.7	-	-
2012-01-0999	2010	Toyota	Camry	71.2	-1.6	-	-
2012-01-0999	2010	Toyota	Camry	71.3	-1.6	-	-
2012-01-0999	2010	Toyota	Camry	71.7	-0.9	-	-
2012-01-0999	2010	Toyota	Camry	71.9	-1.0	-	-
2012-01-0999	2010	Toyota	Camry	72.0	-1.1	-	-
2012-01-0999	2010	Toyota	Camry	72.1	-1.2	-	-
2012-01-0999	2010	Toyota	Camry	72.6	-0.5	-	-
2012-01-0999	2010	Toyota	Camry	72.7	-0.6	-	-
2012-01-0999	2010	Toyota	Camry	72.8	-0.7	-	-
2012-01-0999	2010	Toyota	Camry	72.9	-0.8	-	-
2012-01-0999	2011	Toyota	Camry	47.5	-0.2	-	-
2012-01-0999	2011	Toyota	Camry	47.6	-0.3	-	-
2012-01-0999	2011	Toyota	Camry	47.6	-0.4	-	-
2012-01-0999	2011	Toyota	Camry	47.6	-0.4	-	-
2012-01-0999	2011	Toyota	Camry	47.9	-0.6	-	-
2012-01-0999	2011	Toyota	Camry	48.1	-0.8	-	-
2012-01-0999	2011	Toyota	Camry	48.3	0.2	-	-
2012-01-0999	2011	Toyota	Camry	48.5	-1.2	-	-
2012-01-0999	2011	Toyota	Camry	48.9	-0.4	-	-
2012-01-0999	2011	Toyota	Camry	48.9	-0.5	-	-
2012-01-0999	2011	Toyota	Camry	49.4	-0.9	-	-
2012-01-0999	2011	Toyota	Camry	49.5	-1.0	-	-
2012-01-0999	2011	Toyota	Camry	49.6	0.1	-	-
2012-01-0999	2011	Toyota	Camry	49.6	-1.1	-	-
2012-01-0999	2011	Toyota	Camry	49.7	0.0	-	-
2012-01-0999	2011	Toyota	Camry	49.8	-0.1	-	-

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	ΔV [mph]	ΔV Difference [mph]
2012-01-0999	2011	Toyota	Camry	49.8	-0.1	-	-
2012-01-0999	2011	Toyota	Camry	49.9	-0.1	-	-
2012-01-0999	2011	Toyota	Camry	50.2	-0.4	-	-
2012-01-0999	2011	Toyota	Camry	50.2	-0.5	-	-
2012-01-0999	2011	Toyota	Camry	50.9	0.1	-	-
2012-01-0999	2011	Toyota	Camry	51.0	0.0	-	-
2012-01-0999	2011	Toyota	Camry	51.0	0.0	-	-
2012-01-0999	2011	Toyota	Camry	66.3	-0.5	-	-
2012-01-0999	2011	Toyota	Camry	66.3	-0.4	-	-
2012-01-0999	2011	Toyota	Camry	66.6	-0.7	-	-
2012-01-0999	2011	Toyota	Camry	67.4	-0.2	-	-
2012-01-0999	2011	Toyota	Camry	67.6	-0.4	-	-
2012-01-0999	2011	Toyota	Camry	67.7	-0.6	-	-
2012-01-0999	2011	Toyota	Camry	68.0	-0.9	-	-
2012-01-0999	2011	Toyota	Camry	68.0	-0.9	-	-
2012-01-0999	2011	Toyota	Camry	68.3	-1.2	-	-
2012-01-0999	2011	Toyota	Camry	68.4	-1.3	-	-
2012-01-0999	2011	Toyota	Camry	68.4	0.0	-	-
2012-01-0999	2011	Toyota	Camry	68.6	-0.2	-	-
2012-01-0999	2011	Toyota	Camry	68.7	-0.4	-	-
2012-01-0999	2011	Toyota	Camry	70.2	-0.5	-	-
2012-01-0999	2011	Toyota	Camry	70.5	-0.8	-	-
2012-01-0999	2011	Toyota	Camry	70.6	-1.0	-	-
2012-01-0999	2011	Toyota	Camry	70.6	-0.9	-	-
2012-01-0999	2011	Toyota	Camry	70.7	-1.1	-	-
2012-01-0999	2011	Toyota	Camry	70.8	0.1	-	-
2012-01-0999	2011	Toyota	Camry	70.9	0.0	-	-
2012-01-0999	2011	Toyota	Camry	71.0	-0.1	-	-
2012-01-0999	2011	Toyota	Camry	71.1	-0.2	-	-
2013-01-0769	2006	Ford	F-150	30.2	-0.2	-	-
2013-01-0769	2006	Ford	F-150	30.0	0.1	-	-
2013-01-0769	2006	Ford	F-150	29.6	-0.6	-	-
2013-01-0769	2006	Ford	F-150	29.0	0.0	-	-
2013-01-0769	2006	Ford	F-150	29.7	0.4	-	-
2013-01-0769	2006	Ford	F-150	30.1	-0.1	-	-
2013-01-1263	2009	Mitsubishi	Lancer	-	5.8	-	-
2013-01-1263	2009	Mitsubishi	Lancer	-	4.4	-	-
2013-01-1263	2009	Mitsubishi	Lancer	-	4.8	-	-
2013-01-1263	2009	Mitsubishi	Lancer	-	4.4	-	-
2013-01-1263	2009	Mitsubishi	Lancer	-	4.0	-	-

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	∆V [mph]	∆V Difference [mph]
2013-01-1264	2012	Honda	CR-V	62.1	0.0	-	-
2013-01-1264	2012	Honda	Civic	62.1	-0.1	-	-
2013-01-1265	2012	Chrysler	Town & Country	35.0	-0.2	-38.2	-
2013-01-1265	2012	Dodge	Avenger	35.2	-0.4	-38.0	0.6
2013-01-1265	2012	Dodge	Journey	35.1	0.3	-37.3	-0.7
2013-01-1265	2012	Ford	Mustang	35.0	-0.2	-39.4	-0.4
2013-01-1265	2012	Ford	Focus	35.0	-0.1	-39.3	0.4
2013-01-1265	2012	Chrysler	200	35.2	-0.4	-39.9	-0.8
2013-01-1265	2012	Chevrolet	Impala	34.9	-0.1	-39.8	-4.4
2013-01-1265	2012	Chevrolet	Camaro	34.9	0.5	-37.8	-4.3
2013-01-1265	2012	Ford	Explorer	35.0	-0.2	-39.3	-2.3
2013-01-1265	2012	Toyota	Tacoma	35.2	-0.4	-39.8	-4.2
2013-01-1265	2012	Fiat	500	34.8	0.0	-39.0	-4.8
2013-01-1265	2012	Chevrolet	Suburban	35.0	-0.2	-37.7	2.0
2013-01-1265	2012	Toyota	Camry	35.0	-1.4	-38.0	-3.2
2013-01-1265	2012	Cadillac	CTS	34.9	-0.1	-39.7	-1.2
2013-01-1265	2012	Dodge	Durango	35.0	0.4	-39.9	0.5
2013-01-1265	2012	Ram	1500	34.9	-0.1	-37.3	-0.6
2013-01-1265	2012	Cadillac	SRX	35.0	0.4	-40.1	-3.4
2013-01-1265	2012	Chevrolet	Sonic	34.9	0.5	-38.2	-3.4
2013-01-1265	2012	Mazda	Mazda6	35.0	-0.9	-40.4	-9.3
2013-01-1265	2012	Jeep	Liberty	35.2	-0.4	-38.8	-0.3
2013-01-1265	2012	Volvo	S60	35.1	-0.3	-39.1	-1.2
2013-01-1265	2012	Honda	Fit	35.1	-0.3	-38.7	1.1
2013-01-1265	2012	Chevrolet	Silverado	34.9	-0.1	-38.0	0.5
2013-01-1265	2012	Toyota	Tundra	34.9	-0.1	-39.1	-0.9
2013-01-1265	2012	Chrysler	300	34.9	-0.1	-39.8	1.2
2013-01-1265	2012	Ram	1500	35.1	-0.3	-37.7	-1.0
2013-01-1265	2012	Toyota	Yaris	34.9	-0.1	-40.7	-4.3
2013-01-1265	2012	Dodge	Charger	35.0	-0.2	-39.8	0.6
2013-01-1265	2012	Toyota	Sienna	34.9	-0.1	-39.7	-11.6
2013-01-1265	2012	Lexus	ES-350	34.7	-1.2	-39.3	-3.2
2013-01-1265	2012	Honda	Civic	35.0	-0.2	-38.3	1.5
2013-01-1265	2012	Honda	CR-Z	35.0	-0.2	-39.6	-9.8
2013-01-1265	2012	Ford	F-250	35.0	-0.2	-39.8	0.7
2013-01-1265	2012	Ford	Expedition	35.0	-0.9	-39.0	-0.5
2013-01-1265	2012	Ford	F-150	35.2	-0.4	-39.0	0.3
2013-01-1265	2012	Honda	Civic	35.2	0.2	-40.4	-1.2
2013-01-1265	2012	Scion	iQ	35.0	-0.2	-40.5	-3.8
2013-01-1265	2012	Honda	CR-V	35.0	-0.2	-39.7	-6.7

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	∆V [mph]	∆V Difference [mph]
2013-01-1265	2012	Toyota	RAV4	35.2	-1.7	-38.7	-6.0
2013-01-1265	2012	Ram	2500	34.7	0.1	-37.8	-1.2
2013-01-1265	2012	Toyota	4Runner	35.0	-0.2	-38.0	0.4
2013-01-1268	2005	Toyota	Corolla	-	-	-	-1.6
2013-01-1268	2006	Toyota	Corolla	-	-	-	1.4
2013-CM-8.2-Haight-1	2012	Hyundai	Accent	40.0	-0.9	-42.3	-3.1
2013-CM-8.2-Haight-1	2012	Kia	Rio	40.0	0.4	-	-
2013-CM-8.2-Haight-1	2013	Hyundai	Accent	40.0	-0.9	-	-
2013-CM-8.2-Haight-1	2013	Hyundai	Elantra	40.0	-0.9	-	-
2013-CM-8.2-Haight-1	2013	Hyundai	Tucson	40.0	-0.9	-	-
2013-CM-8.2-Haight-1	2013	Kia	Rio	-	-	-	-
2013-CM-8.2-Haight-1	2013	Kia	Rio	31.1	-	16.6	-1.1
2013-CM-8.2-Haight-1	2013	Kia	Soul	40.0	-2.1	-	-
2013-CM-8.2-Haight-1	2014	Kia	Forte	40.0	-1.5	-	-
2013-Col-8.2-Haight-2	2012	Dodge	Avenger	40.0	-	-	-0.5
2013-Col-8.2-Haight-2	2012	Toyota	Camry	40.0	-	-	1.2
2013-Col-8.2-Haight-2	2013	Buick	Encore	40.0	-	-	1.1
2013-Col-8.2-Haight-2	2013	Chevrolet	Cruze	40.0	-	-	-0.6
2013-Col-8.2-Haight-2	2013	Dodge	Dart	40.0	-	-	0.2
2013-Col-8.2-Haight-2	2013	Ford	Focus	40.0	-	-	6.6
2013-Col-8.2-Haight-2	2013	Honda	Accord	40.0	-	-	1.0
2013-Col-8.2-Haight-2	2013	Honda	Civic	40.0	-	-	1.6
2013-Col-8.2-Haight-2	2013	Hyundai	Tucson	40.0	-	-	2.5
2013-Col-8.2-Haight-2	2013	Kia	Soul	40.0	-	-	3.6
2013-Col-8.2-Haight-2	2013	Volvo	XC60	40.0	-	-	-0.1
2013-Col-8.2-Haight-2	2014	Kia	Forte	40.0	-	-	4.7
2013-Col-8.2-Haight-2	2012	Dodge	Avenger	-	-	14.1	-5.9
2013-Col-8.2-Haight-2	2012	Toyota	Camry	-	-	6.8	-1.4
2013-Col-8.2-Haight-2	2013	Buick	Encore	-	-	15.3	-9.7
2013-Col-8.2-Haight-2	2013	Chevrolet	Cruze	-	-	11.2	-1.9
2013-Col-8.2-Haight-2	2013	Dodge	Dart	-	-	13.6	-6.1
2013-Col-8.2-Haight-2	2013	Ford	Focus	-	-	17.1	-9.6
2013-Col-8.2-Haight-2	2013	Honda	Accord	-	-	13.0	-9.0
2013-Col-8.2-Haight-2	2013	Honda	Civic	-	-	14.0	-10.0
2013-Col-8.2-Haight-2	2013	Hyundai	Tucson	-	-	14.8	-11.7
2013-Col-8.2-Haight-2	2013	Kia	Soul	-	-	13.1	-5.6
2013-Col-8.2-Haight-2	2013	Volvo	XC60	-	-	16.6	-4.1
2013-Col-8.2-Haight-2	2014	Kia	Forte	-	-	13.1	-8.1
2014-01-0502	2010	Kia	Forte	34.9	-0.1	-42.3	-3.1
2014-01-0502	2010	Kia	Forte	35.0	-0.8	-40.2	-2.9

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	∆V [mph]	∆V Difference [mph]
2014-01-0502	2010	Kia	Forte	35.0	-0.2	-39.7	0.7
2014-01-0502	2010	Hyundai	Genesis	35.1	-0.9	-38.6	0.5
2014-01-0502	2010	Hyundai	Genesis	35.1	-0.3	-37.8	1.3
2014-01-0502	2010	Hyundai	Genesis	35.2	-0.4	-37.3	3.1
2014-01-0502	2010	Kia	Soul	35.2	-0.4	-39.8	-
2014-01-0502	2011	Kia	Forte	35.0	-0.2	-39.5	1.5
2014-01-0502	2011	Kia	Optima	35.1	-0.3	-39.9	-0.1
2014-01-0502	2011	Hyundai	Sonata	35.0	-0.2	-38.8	-0.9
2014-01-0502	2011	Hyundai	Sonata	35.0	-0.2	-38.1	1.7
2014-01-0502	2011	Hyundai	Sonata	35.1	-0.3	-39.3	0.4
2014-01-0502	2011	Kia	Sorento	35.0	-0.8	-38.2	-0.9
2014-01-0502	2011	Kia	Soul	35.0	-0.2	-40.0	-
2014-01-0502	2012	Hyundai	Accent	34.9	-0.7	-38.0	5.5
2014-01-0502	2012	Hyundai	Elantra	35.1	-0.9	-40.4	-0.6
2014-01-0502	2012	Hyundai	Elantra	34.9	-0.7	-38.0	1.8
2014-01-0502	2012	Hyundai	Santa Fe	35.1	-0.9	-40.0	-0.8
2014-01-0502	2012	Kia	Sorento	35.0	-	-41.5	-3.6
2014-01-0502	2012	Kia	Soul	35.1	-2.1	-40.8	-2.9
2014-01-0502	2012	Kia	Sportage	35.0	-0.8	-40.8	-3.6
2014-01-0502	2012	Hyundai	Tucson	35.1	-0.3	-39.9	-2.0
2014-01-0502	2010	Hyundai	Genesis	-	-	18.3	-2.1
2014-01-0502	2010	Hyundai	Genesis	-	-	14.3	1.9
2014-01-0502	2010	Kia	Soul	-	-	16.2	-
2014-01-0502	2010	Kia	Forte	-	-	21.7	-4.3
2014-01-0502	2010	Kia	Forte	-	-	16.1	0.7
2014-01-0502	2010	Kia	Forte	-	-	16.4	1.0
2014-01-0502	2010	Hyundai	Santa Fe	-	-	14.2	-1.2
2014-01-0502	2011	Hyundai	Sonata	-	-	15.2	-2.8
2014-01-0502	2011	Kia	Sorento	-	-	15.4	-3.0
2014-01-0502	2011	Kia	Soul	-	-	20.3	-
2014-01-0502	2011	Kia	Forte	-	-	16.0	1.4
2014-01-0502	2011	Kia	Optima	-	-	16.3	-2.6
2014-01-0502	2012	Hyundai	Tucson	-	-	18.6	-5.0
2014-01-0502	2012	Hyundai	Accent	-	-	18.4	-3.5
2014-01-0502	2012	Hyundai	Elantra	-	-	18.6	-3.7
2014-01-0502	2012	Hyundai	Santa Fe	-	-	14.1	-1.0
2014-01-0502	2012	Kia	Sportage	-	-	16.8	-3.1
2014-01-0502	2012	Kia	Soul	-	-	21.0	-3.6
2014-01-0502	2012	Kia	Rio	-	-	17.6	-2.1
2014-01-0502	2010	Hyundai	Genesis	-	-	-	-

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	ΔV [mph]	ΔV Difference [mph]
2014-01-0502	2011	Hyundai	Sonata	-	-	22.5	-2.0
2014-01-0502	2011	Kia	Sorento	-	-	22.8	-2.3
2014-01-0502	2011	Kia	Soul	-	-	22.1	-
2014-01-0502	2011	Kia	Forte	-	-	26.1	-2.5
2014-01-0502	2011	Kia	Optima	-	-	23.1	-2.0
2014-01-0502	2012	Kia	Sorento	-	-	22.3	-1.1
2014-01-0502	2012	Hyundai	Tucson	-	-	24.0	-2.8
2014-01-0502	2012	Hyundai	Accent	-	-	22.2	-1.7
2014-01-0502	2012	Hyundai	Elantra	-	-	22.3	-1.8
2014-01-0502	2012	Hyundai	Santa Fe	-	-	21.7	0.7
2014-01-0502	2012	Kia	Sportage	-	-	23.1	-1.3
2014-01-0502	2012	Kia	Rio	-	-	23.2	-2.7
2014-01-0503	2010	Ford	Mustang	-	-	16.5	0.7
2014-01-0503	2010	Ford	Mustang	-	-	15.6	0.9
2014-01-0503	2010	Ford	Mustang	-	-	15.4	0.5
2014-01-0503	2010	Ford	Mustang	-	-	16.4	-0.1
2014-01-0503	2010	Ford	Fusion	-	-	17.3	-4.2
2014-01-0503	2010	Chevrolet	Camaro	-	-	15.7	-0.1
2014-01-0503	2010	Chevrolet	Equinox	-	-	14.9	-0.6
2014-01-0503	2010	Buick	Lacrosse	-	-	14.8	-0.5
2014-01-0503	2010	Ford	Taurus	-	-	14.9	-0.7
2014-01-0503	2010	Dodge	Avenger	-	-	15.6	-3.1
2014-01-0503	2010	Cadillac	SRX	-	-	14.5	-1.4
2014-01-0503	2010	Toyota	4Runner	-	-	15.1	-5.0
2014-01-0503	2011	Toyota	Sienna	-	-	14.4	-3.9
2014-01-0503	2011	Toyota	Camry	-	-	16.9	-4.8
2014-01-0503	2011	Chevrolet	Traverse	-	-	14.2	-2.4
2014-01-0503	2011	Chevrolet	Malibu	-	-	16.1	-0.5
2014-01-0503	2011	Jeep	Grand Cherokee	-	-	14.3	0.0
2014-01-0503	2011	Buick	Lucerne	-	-	14.0	0.9
2014-01-0503	2011	Toyota	Tacoma	-	-	16.2	-5.5
2014-01-0503	2011	Ram	1500	-	-	14.8	-6.0
2014-01-0503	2011	Ford	Escape	-	-	14.7	-2.0
2014-01-0503	2011	Ram	1500	-	-	15.3	-5.3
2014-01-0503	2011	Ford	Fusion	-	-	16.3	-2.4
2014-01-0503	2011	Toyota	Rav4	-	-	16.3	-4.3
2014-01-0503	2011	Lexus	RX-350	-	-	14.0	-3.3
2014-01-0503	2011	Ford	Edge	-	-	15.1	-2.6
2014-01-0503	2011	Chevrolet	Cruze	-	-	16.4	-1.5
2014-01-0503	2011	Toyota	Venza	-	-	16.9	-4.7

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	ΔV [mph]	ΔV Difference [mph]
2014-01-0503	2011	Toyota	Highlander	-	-	15.5	-4.0
2014-01-0503	2011	Dodge	Caliber	-	-	17.1	-4.0
2014-01-0503	2011	Toyota	Camry	-	-	16.6	-3.9
2014-01-0503	2011	Ford	Ranger	-	-	17.6	-4.6
2014-01-0503	2011	Toyota	Tundra	-	-	14.0	-4.7
2014-01-0503	2011	Ford	F-150	-	-	14.0	-0.2
2014-01-0503	2011	Toyota	Corolla	-	-	17.5	-1.8
2014-01-0503	2011	Ford	F-150	-	-	14.7	-1.0
2014-01-0503	2011	Buick	Lucerne	-	-	12.2	3.4
2014-01-0503	2011	Scion	tC	-	-	15.7	-3.4
2014-01-0503	2011	Buick	Lacrosse	-	-	15.3	-1.7
2014-01-0503	2011	Chevrolet	Volt	-	-	13.8	1.1
2014-01-0503	2012	Mazda	Mazda3	-	-	14.7	-2.9
2014-01-0503	2012	Ford	Mustang	-	-	14.9	-1.9
2014-01-0503	2012	Dodge	Avenger	-	-	16.2	-2.5
2014-01-0503	2012	Ford	Focus	-	-	20.0	-3.9
2014-01-0503	2012	Dodge	Journey	-	-	16.0	-2.4
2014-01-0503	2012	Chrysler	200	-	-	15.4	-3.0
2014-01-0503	2012	Chevrolet	Impala	-	-	15.0	-0.1
2014-01-0503	2012	Ford	Explorer	-	-	15.9	-1.0
2014-01-0503	2012	Chevrolet	Camaro	-	-	13.9	-4.6
2014-01-0503	2012	Fiat	500	-	-	19.2	-3.7
2014-01-0503	2012	Chevrolet	Suburban	-	-	19.1	-1.7
2014-01-0503	2012	Toyota	Camry	-	-	18.2	-2.1
2014-01-0503	2012	Cadillac	CTS	-	-	13.7	-0.1
2014-01-0503	2012	Dodge	Durango	-	-	13.0	-1.3
2014-01-0503	2012	Cadillac	SRX	-	-	12.5	-0.8
2014-01-0503	2012	Mazda	Mazda6	-	-	15.0	-0.7
2014-01-0503	2012	Ford	Expedition	-	-	15.9	0.9
2014-01-0503	2012	Chevrolet	Sonic	-	-	12.7	-1.6
2014-01-0503	2012	Jeep	Liberty	-	-	15.4	-2.2
2014-01-0503	2012	Honda	Fit	-	-	13.8	-0.7
2014-01-0503	2012	Toyota	Tundra	-	-	17.8	-2.9
2014-01-0503	2012	Chrysler	300	-	-	16.0	-1.1
2014-01-0503	2012	Toyota	Yaris	-	-	19.0	-5.3
2014-01-0503	2012	Dodge	Charger	-	-	17.6	-4.0
2014-01-0503	2012	Lexus	ES-350	-	-	15.0	-0.7
2014-01-0503	2012	Honda	Civic	-	-	17.0	-0.2
2014-01-0503	2012	Ford	F-250	-	-	16.3	-2.7
2014-01-0503	2012	Honda	Civic	-	-	15.2	-2.7

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	ΔV [mph]	ΔV Difference [mph]
2014-01-0503	2012	Scion	iQ	-	-	14.0	-5.3
2014-01-0503	2012	Toyota	Rav4	-	-	20.7	-5.0
2014-01-0503	2012	Ram	2500	-	-	15.2	-3.5
2014-01-0503	2012	Toyota	Corolla	-	-	20.8	-3.6
2014-01-0503	2012	Honda	CR-V	-	-	16.2	-3.7
2014-01-0503	2012	Toyota	4Runner	-	-	18.7	-2.2
2014-01-0503	2012	Fiat	500	-	-	14.5	-4.8
2014-01-0504	2013	Ford	Flex	70.2	-1.2	-	-
2014-01-0504	2013	Ford	Flex	49.7	-7.0	-	-
2014-01-0504	2013	Ford	Flex	37.3	-1.5	-	-
2015-01-1445	2012	Kia	Soul	1.3	-	-2.7	-
2015-01-1445	2012	Kia	Soul	4.9	0.7	-11.2	0.1
2015-01-1445	2012	Kia	Soul	4.3	0.0	-10.1	0.1
2015-01-1445	2012	Kia	Soul	6.1	-0.5	-12.4	-0.4
2015-01-1445	2012	Kia	Soul	4.6	-0.9	-9.9	-0.1
2015-01-1445	2012	Kia	Soul	4.7	-	9.8	-
2015-01-1445	2012	Kia	Soul	7.3	-0.5	13.7	-2.9
2015-01-1445	2012	Kia	Soul	30.2	-0.4	-	-
2015-01-1448	2012	Dodge	Durango	-	-	25.1	0.4
2015-01-1448	2012	Dodge	Durango	-	-	25.1	0.3
2015-01-1448	2012	Dodge	Durango	-	-	-25.2	0.2
2015-01-1448	2012	Dodge	Durango	-	-	-25.2	-0.4
2015-01-1448	2012	Dodge	Durango	-	-	-25.1	-0.2
2015-01-1448	2012	Dodge	Durango	-	-	-25.2	-0.6
2015-01-1448	2012	Dodge	Durango	-	-	-25.2	-0.6
2015-01-1448	2012	Dodge	Durango	-	-	-25.2	-0.1
2015-01-1448	2012	Dodge	Durango	-	-	-25.2	-0.3
2015-01-1448	2012	Dodge	Durango	-	-	-25.1	0.0
2015-01-1448	2012	Dodge	Durango	-	-	-25.0	0.0
2015-01-1448	2012	Dodge	Durango	-	-	-24.9	0.1
2015-01-1448	2012	Dodge	Durango	-	-	-25.0	-0.5
2015-01-1448	2012	Chevrolet	Malibu	-	-	25.1	0.0
2015-01-1448	2012	Chevrolet	Malibu	-	-	25.0	-0.4
2015-01-1448	2012	Chevrolet	Malibu	-	-	-24.8	-0.3
2015-01-1448	2012	Chevrolet	Malibu	-	-	-24.9	-0.6
2015-01-1448	2012	Chevrolet	Malibu	-	-	-24.8	-0.4
2015-01-1448	2012	Chevrolet	Malibu	-	-	-24.9	-0.6
2015-01-1448	2012	Chevrolet	Malibu	-	-	-24.9	-0.5
2015-01-1448	2012	Chevrolet	Malibu	-	-	-24.9	-0.2
2015-01-1448	2012	Chevrolet	Malibu	-	-	-25.0	0.1

Paper	Year	Make	Model	Pre-Crash Speed [mph]	Pre-Crash Speed Difference [mph]	ΔV [mph]	ΔV Difference [mph]
2015-01-1448	2012	Chevrolet	Malibu	-	-	-25.1	-0.6
2015-01-1448	2012	Chevrolet	Malibu	-	-	-24.9	-0.4
2015-01-1448	2012	Chevrolet	Malibu	-	-	-25.1	-0.6
2015-01-1448	2012	Chevrolet	Malibu	-	-	-24.9	-0.3
2015-01-1448	2012	Dodge	Ram	-	-	25.1	0.0
2015-01-1448	2012	Dodge	Ram	-	-	25.0	-0.4
2015-01-1448	2012	Dodge	Ram	-	-	-24.8	-0.5
2015-01-1448	2012	Dodge	Ram	-	-	-24.9	-0.6
2015-01-1448	2012	Dodge	Ram	-	-	-24.8	-0.7
2015-01-1448	2012	Dodge	Ram	-	-	-24.9	-0.5
2015-01-1448	2012	Dodge	Ram	-	-	-24.9	-0.7
2015-01-1448	2012	Dodge	Ram	-	-	-24.9	0.1
2015-01-1448	2012	Dodge	Ram	-	-	-25.0	0.2
2015-01-1448	2012	Dodge	Ram	-	-	-25.1	-0.7
2015-01-1448	2012	Dodge	Ram	-	-	-24.9	-0.7
2015-01-1448	2012	Dodge	Ram	-	-	-25.1	-0.9
2015-01-1448	#N/A	Dodge	Ram	-	-	-24.9	-0.5

The Engineering Meetings Board has approved this paper for publication. It has successfully completed SAE's peer review process under the supervision of the session organizer. The process requires a minimum of three (3) reviews by industry experts.

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