INDIANA UNIVERSITY
TRANSPORTATION RESEARCH CENTER
School of Public and Environmental Affairs
222 West Second Street
Bloomington, Indiana 47403-1501
(812) 855-3908 Fax: (812) 855-3537

ON-SITE CHILD SAFETY SEAT INVESTIGATION

CASE NUMBER - IN-03-001
LOCATION - Maryland
VEHICLE - 1994 ACURA INTEGRA LS
CRASH DATE - November 2002

Submitted:

October 10, 2003
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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

Technical Report Documentation Page

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16. *Abstract* This report covers an on-site child safety seat investigation involving a 1994 Acura Integra LS (case vehicle) and a 2001 Chevrolet C-2500 pickup truck (other vehicle). This crash is of special interest because the case vehicle's back left passenger (2-year-old male) was restrained in a forward-facing child safety seat (convertible seat with 5-point harness) and did not sustain any injury in a crash of moderate severity. The child seat was secured by the available manual lap-and-shoulder safety belt system. The case vehicle had been traveling north in the northbound left turn lane of a five-lane undivided roadway, approaching a three-leg intersection, and was starting to make a left turn to travel west. The Chevrolet was traveling south in the outside southbound lane of the same roadway and intended to continue straight ahead. The case vehicle driver did not attempt any avoidance maneuvers. The crash occurred within the intersection. The front of the other vehicle impacted the right side of the case vehicle. Both vehicles rotated a few degrees clockwise and come to rest a short distance southwest of the point of impact. The case vehicle was towed due to disabling damage and the other vehicle was driven away. The case vehicle's driver (37-year-old male) and back right passenger (5-year-old male) were both restrained by their available manual lap-and-shoulder safety belt system. The two child passengers were transported via ambulance to a hospital, where both were determined not to have any injuries and were released with no treatment. The driver accompanied his passengers to the hospital but was not seen as a patient. None of the case vehicle occupants sustained any injury.			
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TABLE OF CONTENTS

IN-03-001

BACKGROUND

IN-03-001

This on-site investigation was brought to the NHTSA's attention on December 16, 2002 by NASS/GES sampling activities. This crash involved a 1994 Acura Integra LS (case vehicle) and a 2001 Chevrolet 2500 pick-up truck (other vehicle). The crash occurred in November 2002 at 8:11 a.m., in Maryland, and was investigated by the applicable county police department. This crash is of special interest because the case vehicle's back left passenger (2-year-old male, black, non-Hispanic) was sitting in a forward-facing child safety seat (convertible seat with 5-point harness) and did not sustain any injury in a crash of moderate severity. This contractor inspected the scene and case vehicle and interviewed the case vehicle driver on 14-15 January, 2003. The other vehicle could not be located and was not inspected. This report is based on the police crash report, the interview with the case vehicle driver, scene and vehicle inspections, medical records, occupant kinematic principles and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle had been traveling north in the northbound left turn lane of a five-lane undivided state roadway, approaching a three-leg intersection, and was starting to make a left turn to travel west. The Chevrolet was traveling south in the outside southbound lane of the same roadway and intended to continue straight ahead. The case vehicle driver did not attempt any avoidance maneuvers. The crash occurred within the intersection.

The front of the other vehicle impacted the right side of the case vehicle. The case vehicle was redirected toward the southwest, rotated a few degrees clockwise and come to rest a short distance southwest of the point of impact heading a few degrees west of due north. The other vehicle rotated a few degrees clockwise and came to rest a short distance westward of the point of impact heading a few degrees west of due south.

The case vehicle was a 1994 Acura Integra LS front wheel drive, two-door, four-passenger hatchback coupe (VIN: JH4DC4455RS------). Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **02-RPEW-3 (70)**. The WinSMASH reconstruction program, missing vehicle algorithm based on the case vehicle's crush profile, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 40 km.p.h. [24.9 m.p.h.], -13.7 km.p.h. [-8.5 m.p.h.], and -37.6 km.p.h. [-23.4 m.p.h.]. The crash severity for the case vehicle was moderate (24 to 40 km.p.h. [15 to 25 m.p.h.]). The case vehicle was towed due to damage.

The Chevrolet contacted the case vehicle's right door, sill, and the side panel rearward of the B-pillar. The right door window glazing was shattered, the right side of the windshield was cracked and there was no other glazing damage. Maximum crush was measured as 44 centimeters [17.3 inches] slightly forward of the center of the right door. The wheelbase on the case vehicle's left side was lengthened 2 centimeters [0.8 inches] while the right side was shortened 1 centimeter [0.4 inch]. The case vehicle's right door, sill, B-pillar and the side panel rearward of the B-pillar were crushed inward. There was slight buckling on the right side of the roof. None of the wheels or tires were damaged in the crash.

The case vehicle's driver air bag was located in the steering wheel hub and the front right passenger air bag was located on the top of the instrument panel. Neither air bag deployed.

Inspection of the case vehicle's interior revealed lateral intrusion of the right door panel (37 centimeters [14.6 inches]), the right B-pillar (13 centimeters [5.1 inches]), and the side panel rearward of the B-pillar, which measured 20 centimeters [7.9 inches] immediately rearward of the B-pillar and tapered off to 0 at the C-pillar. There was a possible occupant contact to the right side panel, rearward of the B-pillar. The safety belt webbing at the driver's and back right seat positions showed evidence of use, but no evidence of loading from this side impact. The safety belt at the back left seat is discussed further, below.

The case vehicle's back left passenger was seated in a forward facing convertible child safety seat (CSS). The CSS was identified as a Cosco "Alpha Omega" model #02 531 BNG, dated 12-08-00. The CSS label indicated that the seat was appropriate for children between 13.6 - 36.3 kilograms [30 - 80 pounds] in the forward-facing configuration. The seat was equipped with a five-point harness, with padded shoulder straps and a harness retainer clip. The shoulder harnesses were threaded into the lower slots. The CSS was secured by the vehicle's three-point continuous loop safety belt, which had a sliding latch plate and an emergency locking retractor. There was evidence of loading on the safety belt, consisting of depressions in the webbing where the belt engaged the CSS frame. There were no loading marks on the CSS. The CSS did not have an integral tether and no aftermarket tether was added. The CSS had been removed from the case vehicle, but, based on the interview with the driver and the available evidence, it appears that the child seat was installed and secured with the vehicle's safety belt routed through the CSS frame.

The case vehicle's back left passenger (2-year-old male, black, non-Hispanic, 102 centimeters and 18 kilograms [40 inches, 40 pounds]) was restrained by the CSS five-point harness. His feet were hanging off the front of the CSS and may have been touching the vehicle's seat cushion. The case vehicle's driver was executing a left turn at low speed and made no known pre-crash avoidance maneuvers. The child and the CSS probably shifted slightly to the right as a result of the steering maneuver. The case vehicle's impact with the Chevrolet caused the back left passenger to move rightward and forward, toward the 70 degree direction of force.

The back left passenger was transported by ambulance to a hospital as a precaution. The hospital records indicate that the child was determined to have no injuries and was released with no treatment. The driver (father) also reported that the child did not sustain any injuries.

The case vehicle's driver (37-year-old male, black, non-Hispanic; 188 centimeters and 100 kilograms [74 inches, 220 pounds]) was restrained by the available manual, three-point, lap-and-shoulder safety belt system. He was leaning forward to assess traffic and his back was not against the seat back. His left foot was on the floor, his right foot was on the foot controls, and both hands were on the steering wheel. His seat track was located in its rearmost position. The driver's seat back was fully reclined at time of inspection, but the driver stated it was upright at the time of the crash. The tilt steering wheel was located in its down-most position.

The driver accompanied his passengers to a hospital by ambulance but was not seen as a patient. The driver reported a feeling of soreness in the right rib cage and no other injury.

The case vehicle's back right passenger (5-year-old male, black, non-Hispanic; 127 centimeters and 32 kilograms [50 inches and 71 pounds]) was restrained by his available, active, three-point, lap-and-shoulder safety belt system. He was sitting in an upright posture, with his back against the seat back, his feet on the floor and holding a book in his hands. His seat back and seat track were non-adjustable.

The back right passenger was transported by ambulance to a hospital as a precaution. The hospital records indicate that the child was determined to have no injuries and was released with no treatment. The driver (father) reported that the child felt soreness in his right ankle and had a slight headache and no other injuries.

The other vehicle was a 2001 Chevrolet C-2500 rear wheel drive, two-door pickup truck (VIN: 1GCHC29U01E------). The Chevrolet could not be located for inspection and, with no available photographs, the CDC for the Chevrolet cannot be estimated. The WinSMASH reconstruction program, missing vehicle algorithm based on the crush profile of the case vehicle, was used on the Chevrolet's most severe impact. The preliminary Total, Longitudinal and Lateral Delta V's are, respectively: 21.0 km.p.h. [13.0 m.p.h.], -19.7 km.p.h. [-12.2 m.p.h.] and +7.2 km.p.h. [+4.5 m.p.h.]. The Chevrolet was equipped with frontal air bags that did not deploy. The Chevrolet was driven away from the scene. According to the police crash report, the driver and the one passenger in the Chevrolet were not injured.

CRASH CIRCUMSTANCES

The case vehicle had been traveling north in the northbound left turn lane of a five-lane undivided state roadway, approaching an uncontrolled three-leg intersection, and was starting to make a left turn to travel west. The Chevrolet was traveling south in the outside southbound lane of the same roadway and intended to continue straight ahead. It was daylight with fog, there were no viewing obstructions and the asphalt road surface was worn but dry and free of defects. The speed limit was 56 km.p.h. [35 m.p.h.]. There were two northbound and two southbound through lanes, with a left turn lane for northbound traffic on the south leg of the intersection (**Figure 1**). The case vehicle driver did not attempt any avoidance maneuvers. The crash occurred within the intersection.

Figure 1: Case vehicle's northbound approach toward left turn (case photo #02)

The front of the other vehicle impacted the right side of the case vehicle. The case vehicle was redirected toward the southwest, rotated a few degrees clockwise and come to rest a short distance southwest of the point of impact, heading a few degrees west of due north. The other vehicle rotated a few degrees clockwise and came to rest a short distance westward of the point of impact, heading a few degrees west of due south (**Figure 2**).

Figure 2: Case vehicle's path toward impact in the mouth of the intersection (case photo #03)

CASE VEHICLE

The case vehicle was a 1994 Acura Integra LS front wheel drive, two-door, four-passenger hatchback coupe (VIN: JH4DC4455RS------), equipped with a 4 cylinder 1.8 liter gasoline engine and an automatic transmission with a console mounted selector lever. Anti-lock brakes are an option for this model but it is unknown if this vehicle was so equipped. The odometer reading showed 269,701 kilometers [167,589 miles]. The wheelbase was 257 centimeters [101.2 inches]. The case vehicle was towed due to disabling damage.

CASE VEHICLE DAMAGE

The Chevrolet contacted the case vehicle's right door, sill, and the side panel rearward of the front door (**Figures 3** and **4**). The right front door window glazing was shattered, the right side of the windshield was cracked and there was no other glazing damage. Direct damage began 31 centimeters [12.2 inches] forward of the right rear axle and extended 167 centimeters [65.7 inches] along the right side of the vehicle. Maximum crush was measured as 44 centimeters [17.3 inches] slightly forward of the center of the right door. The wheelbase on the case vehicle's left side was lengthened 2 centimeters [0.8 inches] while the right side was shortened 1 centimeter [0.4 inch]. The case vehicle's right door, sill, B-pillar and the side panel rearward of the door were

Figure 3: Acura's right rear (case photo #21)

Figure 4: Acura's right center/front (case photo #24)

crushed inward. There was slight buckling on the right side of the roof. None of the wheels or tires were damaged in the crash.

Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **02-RPEW-3 (70)**. The WinSMASH reconstruction program, missing vehicle algorithm based on the case vehicle's crush profile, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 40 km.p.h. [24.9 m.p.h.], -13.7 km.p.h. [-8.5 m.p.h.], and -37.6 km.p.h. [-23.4 m.p.h.]. The crash severity for the case vehicle was moderate (24 to 40 km.p.h. [15 to 25 m.p.h.]).

The case vehicle's driver air bag was located in the steering wheel hub and the front right passenger air bag was located on the top of the instrument panel. Neither air bag deployed.

Inspection of the case vehicle's interior revealed lateral intrusion of the right door panel (37 centimeters [14.6 inches]), the right B-pillar (13 centimeters [5.1 inches]), and the side panel rearward of the B-pillar, which measured 20 centimeters [7.9 inches] immediately rearward of the B-pillar and tapered off to 0 at the C-pillar. There was a possible occupant contact to the right side panel, rearward of the B-pillar. The safety belt webbing at the driver's and back right seat positions showed evidence of use, but no evidence of loading from this side impact. The safety belt system at the back left position (**Figure 5**) showed loading marks (stretching/indentations) consistent with its having been used to secure the child safety seat (**Figure 6**).

Figure 5: Back left seat where CSS was positioned (case photo #45)

Figure 6: Safety belt that was used with the CSS, showing loading marks (case photo #47)

CHILD SAFETY SEAT

The case vehicle's back left passenger was seated in a forward facing convertible child safety seat (CSS). The CSS was identified as a Cosco "Alpha Omega" model #02 531 BNG, dated 12-08-00 (**Figures 7, 8** and **9**). The CSS label indicated that the seat was appropriate for children between 13.6 - 36.3 kilograms [30 - 80 pounds] in the forward-facing configuration. The seat was equipped with a five-point harness, with padded

shoulder straps and a harness retainer clip. The shoulder harnesses were threaded into the lower slots. The CSS was secured by the vehicle's three-point continuous loop safety belt, which had a sliding latch plate and an emergency locking retractor. There was evidence of loading on the safety belt, consisting of depressions in the webbing where the belt engaged the CSS frame (**Figure 6**). There were no loading marks on the CSS. The CSS did not have an integral tether and no aftermarket tether was added. The CSS had been removed from the case vehicle at the time of inspection, but, based on the interview with the driver and the available evidence, it appears that the child seat was installed and secured with the vehicle's safety belt routed through the CSS frame.

Figure 7: CSS that was in the case vehicle's back left seat area (case photo #53)

Figure 8: Back of CSS; note, no tether present (case photo #55)

BACK LEFT PASSENGER KINEMATICS

The case vehicle's back left passenger (2-year-old male, black, non-Hispanic; 102 centimeters and 18 kilograms [40 inches, 40 pounds]) was restrained by the CSS five-point harness. His feet were hanging off the front of the CSS and may have been touching the vehicle's seat cushion. The case vehicle's driver was executing a left turn at low speed and made no known pre-crash avoidance maneuvers. The child and the CSS probably shifted slightly to the right as a result of the steering maneuver. The case vehicle's impact with the Chevrolet caused the back left passenger to move rightward and forward, toward the 70 degree direction of force. He probably loaded against the harness straps and the right side of the CSS shell, but was held essentially in place by the CSS harness. He probably rebounded slightly rearward as the case vehicle came to rest.

BACK LEFT PASSENGER INJURIES

The back left passenger was transported by ambulance to a hospital as a precaution. The

hospital records indicate that the child was determined to have no injuries and was released with no treatment. The driver (father) reported that the child did not sustain any injuries.

Figure 9: Left side of CSS; seat was secured by vehicle's lap-and-shoulder belt in manufacturer's designated slot (arrow) (case photo #56)

CASE VEHICLE DRIVER KINEMATICS

The case vehicle's driver (37-year-old male, black, non-Hispanic; 188 centimeters and 100 kilograms [74 inches, 220 pounds]) was restrained by the available manual, three-point, lap-and-shoulder safety belt system. He was leaning forward to assess traffic and his back was not against the seat back. His left foot was on the floor, his right foot was on the foot controls, and both hands were on the steering wheel. His seat track was located in its rearmost position. The driver's seat back was fully reclined at time of inspection, but the driver stated it was upright at the time of the crash. The tilt steering wheel was located in its down-most position. The impact with the Chevrolet caused him to move forward and rightward, toward the 70 degree direction of force. The right side of his chest and abdomen probably loaded against the safety belt webbing, but he was held essentially in place. He probably rebounded slightly rearward as the case vehicle came to rest.

DRIVER'S INJURIES

The driver accompanied his passengers by ambulance to a hospital but was not seen as a patient. The driver reported soreness in the right rib cage as the only injury he sustained.

CASE VEHICLE BACK RIGHT PASSENGER KINEMATICS

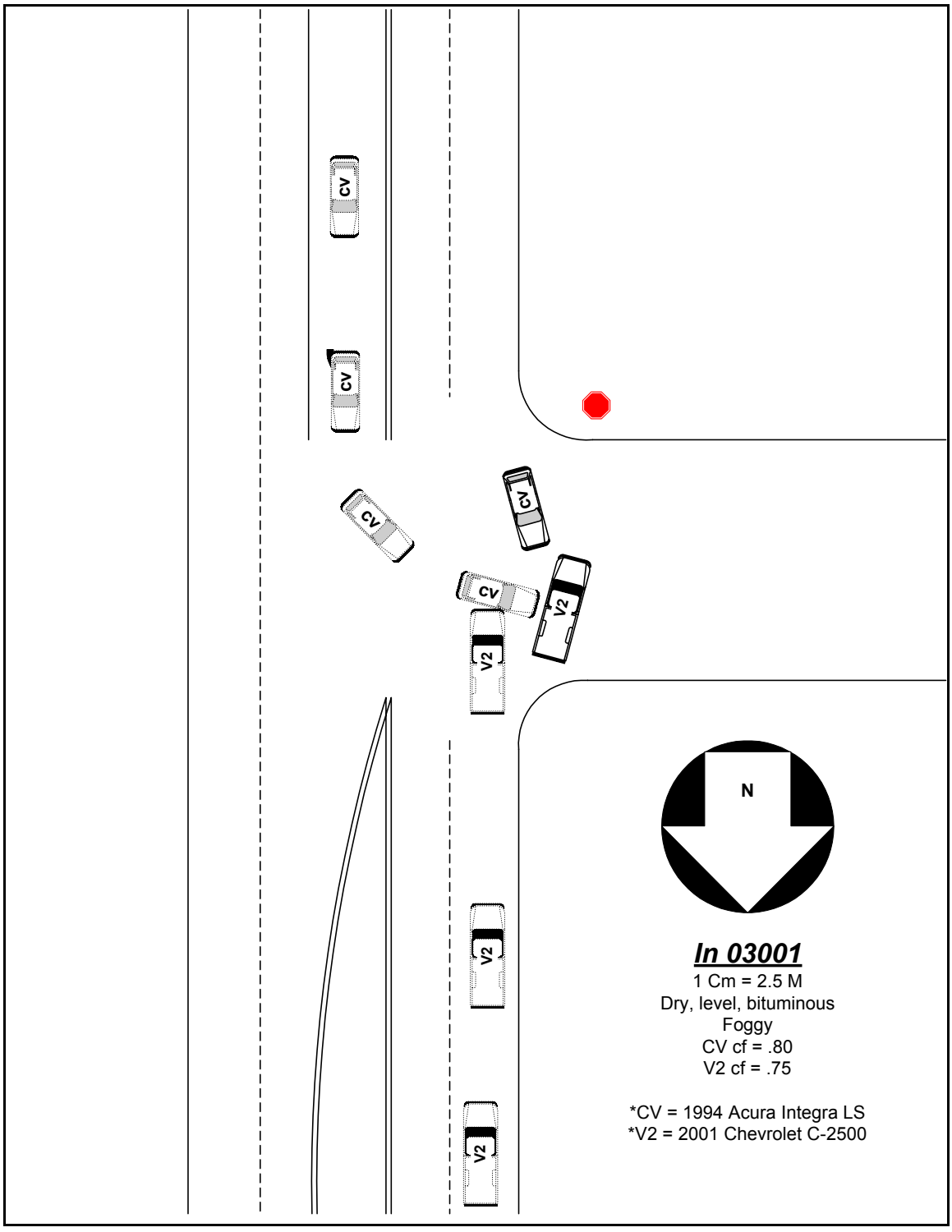
The case vehicle's back right passenger (5-year-old male, black, non-Hispanic; 127 centimeters and 32 kilograms [50 inches and 71 pounds]) was restrained by his available, active, three-point, lap-and-shoulder safety belt system. He was sitting in an upright posture, with his back against the seat back, his feet on the floor and holding a book in his hands. His seat back and seat track were non-adjustable. The impact with the Chevrolet caused him to move forward and rightward, toward the 70 degree direction of force. The right side of his chest and abdomen probably loaded against the safety belt webbing and the case vehicle's right side interior surface. There was intrusion by right side components, but this occupant was seated rearward of the heaviest intrusions. His right foot/ankle may have contacted the side panel rearward of the B-pillar. He probably rebounded slightly rearward as the case vehicle came to rest.

The back right passenger was transported by ambulance to a hospital as a precaution. The hospital records indicate that the child was determined to have no injuries and was released with no treatment. The driver (father) reported that the child felt soreness in his right ankle and had a slight headache and no other injuries.

OTHER VEHICLE

The other vehicle was a 2001 Chevrolet C-2500 rear wheel drive, two-door pickup truck (VIN: 1GCHC29U01E------). The Chevrolet could not be located for inspection and, with no available photographs, the CDC for the Chevrolet cannot be estimated. The WinSMASH reconstruction program, missing vehicle algorithm based on the case vehicle's crush profile, was used on the Chevrolet's most severe impact. The Total, Longitudinal and Lateral Delta V's are, respectively: 21.0 km.p.h. [13.0 m.p.h.], -19.7 km.p.h. [-12.2 m.p.h.] and +7.2 km.p.h. [+4.5 m.p.h.]. The Chevrolet was equipped with frontal air bags that, according to the police crash report, did not deploy. The Chevrolet was driven away from the scene.

According to the police crash report, the driver and the one passenger in the Chevrolet were not injured.


CV
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N
In 03001
1 Cm = 2.5 M
Dry, level, bituminous
Foggy
CV cf = .80
V2 cf = .75
*CV = 1994 Acura Integra LS
*V2 = 2001 Chevrolet C-2500