

CRASH DATA RESEARCH CENTER

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**CALSPAN ON-SITE CERTIFIED ADVANCED 208-COMPLIANT
VEHICLE CRASH INVESTIGATION**

SCI CASE NO: CA05-019

**VEHICLE: 2005 FORD FOCUS
LOCATION: KENTUCKY
CRASH DATE: JANUARY 2005**

Contract No. DTNH22-01-C-17002

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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 are 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.

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SCI CASE NO: CA05-019**

**VEHICLE: 2005 FORD FOCUS
LOCATION: KENTUCKY
CRASH DATE: JANUARY, 2005**

BACKGROUND

This investigation focused on the performance of the Certified Advanced 208-Compliant (CAC) safety system in a 2005 Ford Focus, **Figure 1**. This advanced occupant protection system was comprised of dual-stage frontal air bags, driver seat track position sensor, front safety belt buckle switch sensors, front seat belt pretensioners, and a front right occupant detection sensor. The CAC system was certified by the manufacturer to have met the requirements of the advanced Federal Motor Vehicle Safety Standard (FMVSS) 208. The vehicle's Restraint Control Module (RCM) tailored the deployment of the front seat belt pretensioners and frontal air bags based on the



Figure 1: 2005 Ford Focus.

crash severity and inputs from these sensors. The RCM had the capabilities of recording event data related to the crash. The Ford Focus was involved in a two-vehicle opposite direction crash with a 1993 Pontiac Grand Prix. At the time of the crash, the Ford Focus was occupied by a 63 year old restrained male driver, a 35 year old unrestrained female front right passenger, an 11 year old restrained female left rear passenger, and a 9 year old restrained male right rear passenger. The driver of the Ford was executing a left turn and failed to yield the right of way to the Pontiac. The force of the frontal impact resulted in the deployment of the frontal air bags in the Ford. The driver and rear passengers of the Ford were transported to a local hospital, treated and released with minor injuries. The front right passenger was not injured. The Pontiac was driven by a 21 year old restrained female. This occupant sustained a police reported non-incapacitating neck injury. She was transported to a local hospital, treated and released.

This crash was identified from a list of claims provided by an insurance company to the Crash Investigation Division (CID) of the National Highway Traffic Safety Administration (NHTSA). The list identified Certified Advanced 208-Compliant vehicles that had been involved in traffic crashes. The CID analyzed the list based on vehicle location and crash configuration and then forwarded a list of selected crashes to the Calspan Special Crash Investigations (SCI) team for follow-up investigation. The vehicles in this crash were located and cooperation was established with the local insurance adjusters and salvage yard. An on-site investigation was assigned to the Calspan SCI team on March 17, 2005 and the on-site portion of the investigation took place March 22, 2005. During the SCI inspection the RCM in the Ford was removed. The module was then forwarded to Ford Motor Company by the NHTSA for data retrieval and analysis. The data retrieval to be performed by Ford had not been completed at the time of this written report.

SUMMARY

Vehicle Data: 2005 Ford Focus

The 2005 Ford Focus ZX4 was identified by the Vehicle Identification Number (VIN): 1FAFP34NX5W (production sequence deleted). The four-door, five passenger sedan was equipped with the SE level trim package to include: cloth upholstered seats, air conditioning, power mirrors, power windows, power door locks, and remote key-less entry. The power train consisted of a 2.0 liter/I4 engine linked to a four-speed automatic transmission. The service brakes were a four-wheel disc system with ABS. The vehicle was manufactured in June 2004. The digital odometer could not be read due to crash related damage to the electrical system. The manual restraint systems consisted of three-point lap and shoulder belts in the five seat positions. The manual restraints in the front row were equipped with retractor pretensioners. The rear bench seat was equipped with Lower Anchors and Tethers for CHildren (LATCH) in all positions. The frontal air bag system consisted of advanced dual-stage driver and front right passenger air bags certified to the advanced FMVSS 208 occupant protection standard. The vehicle was not equipped with an inflatable side impact protection system. The Focus was equipped with Goodyear Eagle RSA P195/60R15 tires on OEM steel rims with plastic wheel covers. The recommended tire pressure was 221 kPa (32 PSI) front and rear. The specific measured tire data was as follows:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	228 kPa (33 PSI)	8 mm (10/32)	No	None
LR	200 kPa (29 PSI)	9 mm (11/32)	No	None
RF	193 kPa (28 PSI)	8 mm (10/32)	No	None
RR	207 kPa (30 PSI)	9 mm (11/32)	No	None

Vehicle Data: 1993 Pontiac Grand Prix

The 1993 Pontiac Grand Prix was identified by the Vehicle Identification Number (VIN): 1G2WH54T7PF (production sequence deleted). The four-door sedan was equipped with front bucket seats and a three passenger rear bench seat. The vehicle's date of manufacture was unknown; the left front door was jammed shut by the force of the crash. The power train consisted of 3.1 liter/V6 engine linked to a three-speed automatic transmission. The service brakes were a front disc/rear drum system with ABS. The manual restraint system consisted of door-mounted lap and shoulder belts in the front row. The rear bench seat was equipped with lap and shoulder belts in the outboard positions and a center lap belt. The Pontiac was not equipped with a front or side air bag system. The odometer read 342,380 km (212,751 miles) at the time of the inspection. The Pontiac was equipped with Big Legacy Tour Plus P205/70R15 tires at the left front and right front wheel positions. The left rear and right rear tires were Super Guard 60 P205/75R15. All four tires were mounted on OEM alloy rims. The recommended tire pressure was 207 kPa (30 PSI) front and rear. The specific measured tire data was as follows:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	186 kPa (27 PSI)	3 mm (4/32)	No	None
LR	159 kPa (23 PSI)	4 mm (5/32)	No	None
RF	165 kPa (24 PSI)	4 mm (5/32)	No	None
RR	228 kPa (33 PSI)	6 mm (7/32)	No	None

CRASH SITE

This two vehicle crash occurred during the nighttime hours in January, 2005. At the time of the crash, it was dark without overhead street lighting. The weather was cloudy and the asphalt road surface was wet. This opposite direction crash occurred on a five lane north/south road in a commercial setting. The 18 m (60 ft) wide straight and level road was configured with two lanes in each respective direction and a center turn lane. The travel lanes were bordered by 3 m (6 ft) wide shoulders and delineated by white edge lines. A service station/convenience store was located on the east side of the road. There were two entrance/exit driveways that led into the parking area surrounding the fuel island. The crash occurred in the outboard northbound lane at the mouth of the north-most entrance to the service station. The speed limit in the area of the crash was 89 km/h (55 mph). **Figure 2** is a southbound trajectory view of the Ford. The point of impact and final rest locations of the vehicles were not documented by the police investigation. There was no documented physical evidence at the scene that supported pre-crash maneuvers by either vehicle.



Figure 2: Southbound trajectory view of the Ford.

CRASH SEQUENCE

Pre-Crash

The 2005 Ford Focus was southbound in the center turn lane of the road intending to turn left into a service station. The vehicle was driven by a 63 year old restrained male. Additionally, the Ford was occupied by a 35 year old unrestrained female front right passenger, an 11 year old restrained female left rear passenger, and a 9 year old restrained male right rear passenger. The 1993 Pontiac Grand Prix was northbound in the outboard (right) lane of the road. The Pontiac was driven by a restrained 21 year old female. For unknown reasons, the driver of the Ford failed to yield the right-of-way and initiated a left turn directly across the path of the Pontiac. It was the Ford driver’s intention to enter the parking lot of the service station. A schematic of the crash is attached to the end of this report as **Figure 10**.

Crash

The crash occurred with the front plane of the Pontiac impacting the front plane of the Ford in an angled head-on impact configuration. The directions of force were in 12/1 o'clock sectors for the Pontiac and Ford, respectively. The force of the impact resulted in the deployment of the advanced frontal air bags in the Ford. The angular impact configuration resulted in a counterclockwise rotation of the Focus as it separated from the impact. The Ford came to rest straddling the northbound traffic lanes facing east. The precise final rest location of the Ford was unknown. The northbound momentum of the Pontiac caused the vehicle to drive through the impact. The vehicle came to a controlled rest facing north on the east road shoulder approximately 24 m (80 ft) north of the impact. The Damage Algorithm of the WINSMASH model was used to calculate the severity (delta V) of the impact. The total delta V of the Ford was 24 km/h (14.9 mph). The longitudinal and lateral components of delta V were -21 km/h (-13.0 mph) and -12 km/h (-7.5 mph), respectively. The total delta V of the Pontiac was 22 km/h (13.7 mph). The longitudinal and lateral components were -22 km/h (-13.7 mph) and 0, respectively.

Post-Crash

The police and ambulance personnel responded to the crash. The 63 year old driver of the Ford remained seated in the vehicle due to a perceived injury and was removed onto a backboard by the EMS. He was transported to a local hospital with a complaint of neck and chest pain. The 35 year female front right passenger exited the vehicle under her own power and was not injured. The 11 year old female and 9 year old male rear seat passengers were transported to a local hospital, treated and released. The 21 year old female driver of the Pontiac was transported to a local hospital with a reported non-incapacitating neck injury. Both vehicles sustained disabling damage in the crash and were deemed total losses by their respective insurance companies.

2005 FORD FOCUS

Exterior Damage

The exterior damage to the Ford Focus consisted of direct contact damage to the vehicle's front plane that extended across its entire 127 cm (50 in) front end width, **Figure 3**. The left corner of the Pontiac contacted the center aspect of the bumper deforming the bumper reinforcement rearward into a "V" pattern. The reinforcement bar crushed rearward into the air conditioner condenser and radiator. The bumper fascia fractured and separated across the width of the bumper reinforcement. The impact force deformed the left front fender rearward and outboard. There was direct contact to the leading edge of the hood that extended 8 cm (3 in) rearward. The residual crush profile measured along the bumper reinforcement was as follows:



Figure 3: Front view of the Ford.

C1 = 1 cm (0.4 in), C2 = 15 cm (5.9 in), C3 = 31 cm (12.2 in), C4 = 31 cm (12.2 in), C5 = 16 cm (6.3 in), C6 = 1 cm (0.4 in). The maximum crush was located 3 cm (1.2 in) right of the vehicle's

centerline and measured 36 cm (14.2 in). The left wheelbase dimension was reduced 3 cm (1.1 in). The right wheelbase was reduced 2 cm (0.6 in). All the doors remained closed throughout the crash and were operational during the post-crash inspection. The right aspect of the windshield was fractured by the deploying front right passenger air bag. The Collision Deformation Classification (CDC) of the front impact was 01-FDEW2.

1993 PONTIAC GRAND PRIX

Exterior Damage

Figure 4 is a front view of the damaged Pontiac. The vehicle sustained direct contact and induced damage that extended across the entire 147 cm (58 in) front end width. The direct contact damage at the bumper elevation began 37 cm (14.5 in) right of center and extended 110 cm (43.5 in) to the left front corner. The bumper fascia was fractured at its centerline and had separated at the left side. The leading edge of the hood sustained direct contact damage that began at its centerline and extended to its left corner. The damage profile was biased to the left indicative of the angular impact configuration.



Figure 4: Front view of the Pontiac.

The residual crush profile measured along the bumper reinforcement was as follows: C1 = 12 cm (4.7 in), C2 = 28 cm (11.0.in), C3 = 24 cm (9.4 in), C4 = 16 cm (6.3 in), C5 = 5 cm (2.0 in), C6 = 0 cm (0 in). The left wheelbase dimension was reduced 2 cm (0.7 in). The right wheelbase was unchanged. The left front fender crushed rearward and jammed the left front door closed. All the other doors remained closed during the impact and were operational post-crash. The windshield was intact and there was no damage to the side windows. The CDC of the front impact was 12-FDEW1.

2005 FORD FOCUS

Interior Damage

Figure 5 is a view of the front interior of the Ford Focus. The interior damage to the Ford was limited to the deployment of the vehicle's safety systems. The occupant compartment remained intact and there was no reduction in occupant space. There were no identified occupant contacts to the hard structures of the interior.



Figure 5: Front interior view.

The cloth upholstered manual driver seat was adjusted to a rear track position that measured 6 cm (2.5 in) forward of full rear. The total seat track travel measured 24 cm (9.5 in). The seat back was reclined 17 degrees aft of vertical. The

anti-submarine angle measured in the center of the seat cushion was 15 degrees. The horizontal distance from the seat back to the center hub of the steering wheel measured 63 cm (24.8 in). This distance was measured 43 cm (17 in) above the seat bight.

The four spoke tilt steering wheel was adjusted to the center position. There was no deformation of the steering wheel rim. There was no displacement of the steering column's shear capsules.

The front right seat was adjusted to a rear track position that measured 3 cm (1.2 in) forward of full rear. The total seat track travel measured 24 cm (9.5 in). The seat back was reclined 20 degrees. The anti-submarine angle of the seat cushion measured 15 degrees. The horizontal distance from the seat back to the rearmost edge of front right passenger air bag module measured 101 cm (39.8 in). This distance was measured 38 cm (15 in) above the seat bight. The front right passenger air bag module was recessed 18 cm (7 in) forward of the rearward protrusion of the instrument panel.

Manual Restraint Systems

The manual restraint systems in the Ford Focus consisted of three-point lap and shoulder belts in all five seat positions. The driver's restraint, **Figure 6**, consisted of continuous loop webbing, sliding latch plate, adjustable D-ring and a dual mode Emergency Locking Retractor (ELR) located in the base of the B-pillar. The retractor was equipped with a pretensioner that fired as a result of the impact. The webbing was locked in the worn position. The extended length of the webbing measured 177 cm (69.8 in). Examination of the webbing revealed it was creased and abraded in the area of the buckled latch plate. The creased webbing section measured 6 cm (2.3 in) in length and began 96 cm (37.8 in) above the outboard floor anchor. Examination of the latch plate revealed a corresponding minor abrasion to the friction surface of the hardware. There was minor evidence of historical use. The adjustable D-ring was in the full down position. The D-ring's friction surface did not reveal any evidence of loading. The evidence observed during the SCI inspection indicated the driver was restrained at the time of the crash.



Figure 6: Driver's position and the manual restraint.

The front right passenger restraint consisted of continuous loop webbing, a sliding latch plate, adjustable D-ring and a switchable Automatic Locking Retractor/Emergency Locking Retractor (ALR/ELR) attached to the base of the right B-pillar. The ALR/ELR retractor was equipped with a pretensioner. The pretensioner did not fire in the crash. The webbing was stowed in the retractor upon initial observation and the webbing extended and properly respooled onto the retractor. There was no crash related evidence of use on the webbing. The D-ring was in the full up position. Examination of the friction surface was unremarkable. There was no historical use marks on the latch plate and the friction surface of the hardware was not abraded. The evidence identified during the course of the inspection indicated the front right passenger was

unrestrained. The lack of manual restraint use by the front right passenger was consistent with the fact that the retractor pretensioner did not fire.

The left rear manual restraint consisted of continuous loop webbing, a sliding latch plate and a switchable ALR/ELR attached to the left C-pillar. The webbing extended through a guide in the C-pillar trim. Upon initial inspection, the webbing was extended from the retractor and the latch plate was inserted into the buckle. Examination of the restraint revealed the webbing was gathered and trapped in the latch plate, **Figure 7**. The latch plate was located 89 cm (35 in) from the anchor and could not be moved along the webbing. The gathered condition of the webbing was an indicator that the restraint was in use at the time of the crash. As the occupant



Figure 7: Left rear restraint webbing gathered in the latch plate.

loaded the webbing during the ride down of the crash, the webbing gathered in the corner of the latch plate hardware and became trapped. The latch plate revealed minor evidence of historical use.

The right rear manual restraint consisted of continuous loop webbing, a sliding latch plate and a switchable ALR/ELR attached to the right C-pillar. This webbing was stowed within the retractor upon initial inspection. The retractor was operational. Extension and examination of the webbing revealed a loading crease located 97 cm (38.2 in) from the anchor. Examination of the friction surface of the latch plate revealed a corresponding abrasion to the hardware. During the examination of the right rear manual restraint indicators consistent with its use at the time of the crash were observed.

Certified Advanced 208-Compliant Air Bag System

The Certified Advanced 208-Compliant (CAC) frontal air bag system consisted of advanced dual stage/dual threshold air bags for the driver and front right passenger, driver seat track position sensor, front safety belt buckle switches, front safety belt pretensioners and a front right occupant detection sensor. The frontal air bag system was certified by the manufacturer to have met the requirements of the advanced Federal Motor Vehicle Safety Standard 208. The CAC system was controlled and monitored by a Restraints Control Module (RCM) located under the center console immediately rearward of the transmission selector. Additionally, a front crash sensor located within the engine compartment was used to aid in crash detection and assess crash severity. The RCM commanded the deployment of the CAC system based on the severity of the crash and the inputs from the sensors.

The RCM was also equipped with Event Data Recorder (EDR) capabilities. Permission was obtained from the vehicle's insurance company and the RCM was removed from the vehicle at the request of the NHTSA. The module was then forwarded to the NHTSA. NHTSA subsequently forwarded the module to the Ford Motor Company for analysis and data download.

Ford had not completed the request to download the data at the time of this written report; therefore the data is not available.

The driver and front right passenger air bags deployed as a result of the frontal crash, **Figures 8 and 9**. The driver air bag deployed from an H-configuration module that was located in the center hub of the steering wheel rim. The width of the asymmetrical upper and lower flaps measured 18 cm (7 in), The height of the upper and lower flaps measured 5 cm (2 in) and 8 cm (3.2 in), respectively. The flaps opened at the designed tear seams during the deployment sequence and were free from occupant contact. The deployed driver air bag measured 56 cm (22 in) in diameter. The bag was not internally tethered. A series of broken red stitching was observed across the face of the bag. This stitching was probably used to package the bag and also to control the path of the air bag during deployment. The air bag was vented by semi-circular “fish gill” vents located in the 10 and 2 o’clock sectors. The diameter and height of each vent measured 3 cm (1 in) and 1 cm (0.5 in), respectively. There was no residual evidence of occupant contact to the face of the bag. The following manufacture’s nomenclature identified the driver air bag:

*604257700AC170ARS DAB
FRXR69L5AGT*

The front right passenger air bag was a top mount design located in the right aspect of the instrument panel. The module was a rectangular design. The cover flap measured 42 cm x 20 cm (16.5 in x 8 in), width by height. The flap was constructed of sheet vinyl and had a sheet metal backer that deformed forming a hinge during the deployment sequence. The cover flap contacted and fractured the windshield during its rotation at deployment. The deflated passenger air bag measured 43 cm x 57 cm (17 in x 22.5 in). The excursion of the face of the bag measured 43 cm (17 in) from the edge of the module. The air bag was vented by two 3 cm (1 in) diameter ports on the bag’s side panels. It was tethered by a single 9 cm (3.5 in) wide internal strap. The tether strap was sewn to face of the bag and reinforced by a 25 cm x 14 cm (10 in x 5.5 in) elliptical stitch pattern. The elliptical stitch pattern was positioned 5cm (2 in) off-center to the left. There was no residual evidence of occupant contact to the air bag.



Figure 8: Deployed driver air bag.



Figure 9: Deployed front passenger air bag.

DRIVER DEMOGRAPHICS

Age/Sex:	63 year old / Male
Height:	Not Available
Weight:	Not Available
Seat Track Position:	Rear track, 5 cm (2.5 in) forward of full rear
Manual Restraint Use:	Three-point lap and shoulder belt
Usage Source:	SCI vehicle inspection
Medical Treatment:	Transported to a local hospital, Treated and released

DRIVER INJURY

<i>Injury</i>	<i>Injury Severity (AIS 98 Update)</i>	<i>Injury Source</i>
Chest contusion, unspecified location	Minor (490402.1,9)	Seat belt loading
Neck strain	Minor (640278.1,6)	Non-contact, inertial flexion over the seat belt
Lumbar strain	Minor (640678.1,8)	Non-contact, inertial flexion over the seat belt

Note: the above injuries were identified in the treating hospital's emergency room records.

DRIVER KINEMATICS

The 63 year old driver was restrained at the time of the crash and seated in a rear track position. Upon impact, the seat belt's retractor locked, the retractor pretensioner fired and the driver air bag deployed. The fired pretensioner removed the slack from the belt system and tightened the webbing about the driver. The driver responded to the 1 o'clock direction of the impact force by initiating a forward trajectory. The driver loaded the seat belt system and began to ride down the force of the impact. The loading of the belt system was evidenced by the creased webbing at the latch plate. The driver's seat belt loading resulted in an unspecified chest contusion. As the driver flexed forward over the locked belt system, he strained his neck and the lumbar region of his back. The driver's face and chest contacted the deployed driver air bag during the later stage of the event without injury. The driver then rebounded back into his seat and came to rest.

FRONT RIGHT OCCUPANT DEMOGRAPHICS

Age/Sex:	35 year old / Female
Height:	Not Available
Weight:	Not Available
Seat Track Position:	Rear track, 3 cm (1.2 in) forward of full rear
Manual Restraint Use:	None
Usage Source:	SCI vehicle inspection
Medical Treatment:	None, not injured

FRONT RIGHT OCCUPANT INJURY

The front right occupant was not injured in the crash.

FRONT RIGHT OCCUPANT KINEMATICS

The 35 year old female was seated in a rear track position in a presumed upright posture. She was not restrained by the vehicle’s three-point lap and shoulder belt. Upon impact, the front right passenger air bag deployed. The occupant’s initial rear seat position pre-positioned her away from the inflating air bag and the hard structures of the forward interior. The occupant initiated a forward trajectory in response to the 1 o’clock direction of the impact. She contacted the deployed air bag with her face and chest and rode down the force of the crash. The occupant was not injured by the contact to the inflated air bag. The occupant then rebounded back into her seat during the later stages of the event and came to rest.

LEFT REAR OCCUPANT DEMOGRAPHICS

Age/Sex:	11 year old / Female
Height:	Not Available
Weight:	Not Available
Seat Track Position:	Non-adjustable rear bench
Manual Restraint Use:	Three-point lap and shoulder belt
Usage Source:	SCI vehicle inspection
Medical Treatment:	Transported to a local hospital, Treated and released

LEFT REAR OCCUPANT INJURY

<i>Injury</i>	<i>Injury Severity (AIS 98 Update)</i>	<i>Injury Source</i>
Right facial cheek contusion	Minor (290402.1,1)	Occupant to occupant contact, possible
Abrasion right hip	Minor (890202.1,1)	Seat belt loading
Contusion right hip	Minor (890402.1,1)	Seat belt loading

Note: the above injuries were identified in the treating hospital’s emergency room records.

LEFT REAR OCCUPANT KINEMATICS

The 11 year old female was restrained by the vehicle’s three-point lap and shoulder belt in the left rear seat position. Upon impact, the force of the crash locked the seat belt retractor. The occupant responded to the 1 o’clock direction of the impact by initiating a forward trajectory. The occupant contacted and loaded the locked belt system with her chest and pelvis. The seat belt loading was evidenced by the webbing that gathered and became trapped in the latch plate. The occupant’s loading of the seat belt resulted in the abrasion and contusion of the right hip. The Ford rotated counterclockwise as it separated from the impact with the Pontiac. The occupant reacted to this dynamic motion by exhibiting a rightward trajectory (with respect to the vehicle). This kinematic pattern possibly resulted in occupant-to-occupant contact. This interaction was the possible source of the identified right cheek abrasion/contusion. The occupant then rebounded back into the seat and came to rest.

RIGHT REAR OCCUPANT DEMOGRAPHICS

Age/Sex:	9 year old / Male
Height:	Not Available
Weight:	Not Available
Seat Track Position:	Non-adjustable rear bench
Manual Restraint Use:	Three-point lap and shoulder belt
Usage Source:	SCI vehicle inspection
Medical Treatment:	Transported to a local hospital, Treated and released

RIGHT REAR OCCUPANT INJURY

<i>Injury</i>	<i>Injury Severity (AIS 98 Update)</i>	<i>Injury Source</i>
Right facial cheek abrasion	Minor (290202.1,1)	Right rear door panel, possible
Right facial cheek contusion	Minor (290402.1,1)	Right rear door panel, possible
Unknown head contusion	Minor (190402.1,9)	Unknown

Note: the above injuries were identified in the treating hospital's emergency room records.

RIGHT REAR OCCUPANT KINEMATICS

The 9 year old male was restrained by the vehicle's three-point lap and shoulder belt in the left rear position. Upon impact, the seat belt retractor locked. The occupant responded to the 1 o'clock direction of the impact by initiating a forward trajectory. The occupant loaded the locked belt system with his chest and pelvis. The seat belt loading was evidenced by the creased webbing at the latch plate and abrasion to the hardware. As the Ford separated from the initial impact it began to rotate counterclockwise. The occupant reacted to this dynamic motion by exhibiting a rightward trajectory (with respect to the vehicle). As a result, the occupant contacted the right door panel with the right side of her head. This kinematic pattern possibly resulted in the right cheek abrasion. There was no identified contact evidence in the vehicle to support this injury. The occupant then rebounded back into the seat and came to rest.

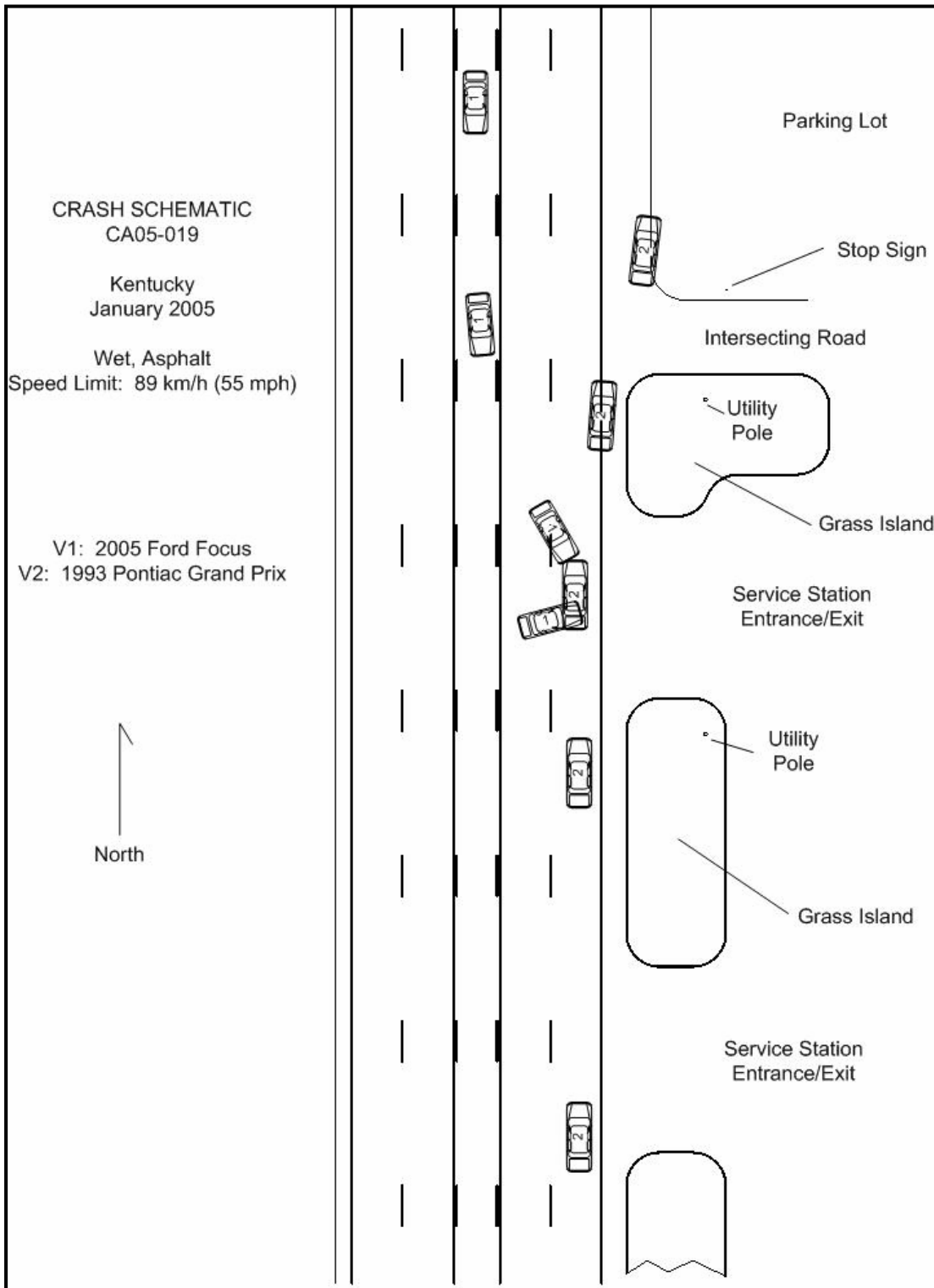


Figure 10: Crash Schematic.