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ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE INVESTIGATION

CASE NUMBER - IN-04-014
LOCATION - Texas
VEHICLE - 2004 FORD TAURUS
CRASH DATE - April 2004

Submitted:

March 17, 2005
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Contract Number: DTNH22-01-C-07002

Prepared for:

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National Highway Traffic Safety Administration
National Center for Statistics and Analysis
Washington, D.C. 20590-0003

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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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15. *Supplementary Notes* On-site air bag investigation involving a 2004 Ford Taurus SE four-door sedan with manual safety belts and dual front advanced air bag system.			
16. *Abstract* This report covers an on-site investigation of an air bag deployment crash that involved a 2004 Ford Taurus SE (case vehicle), which ran-off-road into a median and impacted a crash attenuator. This crash is of special interest because the case vehicle was equipped with multiple Advanced Occupant Protection System (AOPS) features, including advanced air bags, the driver's air bag deployed as a result of the crash, and the restrained driver (26-year-old, male) sustained only minor injuries. In addition, the manufacturer of the case vehicle has certified that it meets the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The case vehicle was traveling east in a left curve in the inside lane of a five lane divided Interstate highway. The case vehicle's driver was talking on his cellular telephone and departed the right side of the roadway, entered the median, and the front of the case vehicle impacted a crash attenuator causing the case vehicle's driver air bag to deploy. The case vehicle's driver stated he took no actions to avoid the crash. The police crash report indicated the driver was under the influence of drugs. The driver was seated with his seat back upright, his seat track located between its middle and forward position and the steering wheel located in its center position. He was restrained by his available, active, three-point, lap-and-shoulder safety belt system, and the buckle-mounted pretensioner activated as a result of the crash. The driver was not transported from the scene, but sought treatment later at a local hospital emergency room. The driver sustained, according to his interview, a bruise to his nose from his air bag and an 8 to 10 centimeter (3 to 4 inches) bruise on his left shoulder from his shoulder belt. The driver also complained of pain to his chest and lower back. The driver lost five work days as a result of the crash.			
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BACKGROUND

IN-04-014

This investigation was brought to NHTSA's attention on May 12, 2004 by NASS CDS/ GES sampling activities. This was a single vehicle crash involving a 2004 Ford Taurus SE (case vehicle) that ran-off-road and impacted a crash attenuator constructed of six, thick-walled rubber barrels held together by steel cables. The crash occurred in April, 2004, at 11:12 a.m., in Texas and was investigated by the applicable city police department. This crash is of special interest because the case vehicle was equipped with multiple Advanced Occupant Protection System (AOPS) features, including advanced air bags, the driver's air bag deployed as a result of the crash, and the driver [26-year-old, White (non-Hispanic) male] sustained only minor injuries. In addition, the manufacturer of the case vehicle has certified that it meets the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. This contractor inspected the case vehicle on May 25, 2004, inspected the scene on May 26, 2004 and interviewed the case vehicle's driver on June 27, 2004. This summary is based on the police crash report, scene and vehicle inspections, an interview with the case vehicle driver, occupant kinematic principles and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling east in a left curve in the inside lane and the driver was intending to continue eastbound. The driver was talking on his cellular telephone. The case vehicle departed the right side of the roadway entered the median and the front of the vehicle impacted a crash attenuator causing the driver's air bag to deploy. The driver stated he took no actions to avoid the crash. The police crash report indicated the driver was under the influence of drugs.

The case vehicle sustained 22 centimeters (8.7 inches) of residual maximum crush to the front bumper occurring at C_3. The CDC for the case vehicle's front impact with the crash attenuator was determined to be: **12-FDEW-1** (**0**-degrees). In addition, the right headlamp, fender and right front wheel engaged a cable that was part of the crash attenuator. The CDC for this damage was determined to be: **12-FREE-6** (**0** degrees).

The crash was out of scope for the WinSMASH reconstruction program due to the movement of the crash attenuator. However, the WinSMASH program was used to determine a Barrier Equivalent Speed (BES) for the case vehicle based on the front bumper crush. The calculated BES was 22.2 km.p.h. (13.8 m.p.h.). The calculated BES appears low based on the overall damage to the case vehicle. This contractor estimates the crash severity to be moderate [24 to 40 km.p.h. (15 to 25 m.p.h)]. The case vehicle was towed due to damage.

Immediately prior to the crash, the case vehicle's driver [26-year-old, White (non-Hispanic) male, 168 centimeters and 66 kilograms (66 inches and 145 pounds)] was talking on his cellular telephone. He was restrained by his three-point, lap-and-shoulder belt, and was seated upright with his back against the seat, left foot on the floor, right foot on the accelerator, left hand on the steering wheel and his right hand holding the cellular telephone. His seat track was located between its forward and middle positions. The seat back was upright and the tilt steering wheel was located in its center position.

The case vehicle's impact with the crash attenuator caused the driver to move forward along a path opposite the case vehicle's 0 degree direction of principal force. The driver loaded his seat belt and his face and chest contacted his deployed air bag. The driver rebounded back into his seat and remained in his seat as the case vehicle came to rest against the crash attenuator. The driver exited his vehicle without assistance. The case vehicle's driver was not transported from the crash scene to a medical facility. He stated that he sought medical treatment following the crash at the emergency room of a local hospital. He sustained only minor injuries.

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the case vehicle was traveling was a one-way, five-lane, divided, interstate highway traversing in an easterly direction. The section of the trafficway where the crash occurred was within an interchange area. The trafficway was divided by a 5 meters (16.4 feet) wide grass median. The crash attenuator was located near the north edge of the median at the end of a concrete median barrier on the approach to a bridge overpass (**Figure 1**). The crash attenuator consisted of six, thick-walled rubber barrels. The first five barrels were each 90 centimeters (35.4 inches) in diameter. The last barrel was 70 centimeters (27.6 inches) in diameter. The barrels were connected by a dual steel cable, slip-joint system and mounted on a steel frame. The entire assembly was anchored to a concrete slab 6.2 meters in length and 1.3 meters in width. There were two through lanes on the south side of the median and three through lanes on the north side of the median. The through lanes on both sides of the median were adjacent to entrance ramps. The case vehicle's roadway contained three travel lanes, each nominally 3.7 meters (12 feet) wide with a 3 meters (9.8 feet) wide bituminous shoulder adjacent to the median. The roadway was curved slightly to the left with a 0.6% negative grade. The travel lanes were traveled polished concrete with an estimated coefficient of friction of 0.65 when dry. The case vehicle's approach to the crash location was uncontrolled and the speed limit was 88 km.p.h. (55 m.p.h.). There was no regulatory speed limit sign posted near the crash site for the case vehicle's roadway. The roadway pavement markings consisted of single broken white lane lines with white outside edge lines. At the time of the crash the light condition was daylight, the atmospheric condition was cloudy, and the roadway pavement was dry. Traffic density was moderate and the site of the crash was in an industrial/commercial urban area. See the **Crash Diagram** at the end of this report.

Figure 1: Overview of the trafficway and travel direction of the case vehicle to impact with the crash attenuator, indicated by arrow (case photo #01)

Pre-Crash: The case vehicle was on the north side of the median traveling east in the inside lane in a left curve at a driver estimated speed of about 88 km.p.h. (55 mph), and the driver was intending to continue eastbound. The case vehicle's driver was talking on his cellular telephone and departed the right side of the roadway and entered the median (**Figure 2** below). The driver

stated he took no actions to avoid the crash. The police crash report indicated the driver was under the influence of drugs and that a blood test was given; however, the drug test results were indicated as unknown on the police crash report. This contractor was unable to confirm the driver's police reported drug use. The crash occurred on the right side of the roadway within the median

Figure 2: Approach of case vehicle to impact with the crash attenuator (case photo #04)

Figure 3: Damage to front of case vehicle from impact with crash attenuator; bumper cover, grille and left headlamp/turn lamp assembly were missing (case photo #10)

Crash: The front of the case vehicle (**Figure 3**) impacted the crash attenuator (**Figure 4**) causing the case vehicle's driver supplemental restraint (air bag) to deploy. The case vehicle's front right air bag did not deploy because that position had an occupant sensor and there was no front right occupant in the vehicle. The weight sensor in the front right seat properly determined the absence of a passenger and suppressed deployment of the front right air bag.

Figure 4: The crash attenuator impacted by the case vehicle, arrow shows plastic deposit from case vehicle's right headlamp, each stripe on rod is 5 cm (2 in) (case photo #06)

Post-Crash: As a result of the impact, the case vehicle rotated clockwise a few degrees. The case vehicle came to rest on the shoulder facing southeast (**Figure 5** below) with the front of the case vehicle in contact with the crash attenuator.

CASE VEHICLE

The 2004 Ford Taurus SE was a front wheel drive, four-door sedan (VIN: 1FAFP53U54A------) equipped with dual stage driver and front right passenger air bags, driver seat position sensor, driver and front right passenger seat belt usage sensors, and driver and front right safety belt buckle-mounted pretensioners and energy management retractors. Side impact air bags were an option for the case vehicle, but it was not so equipped. Four-wheel anti-lock brakes and traction control were also an option, but it is not known if the case vehicle was

equipped with these options. Lastly, the front right seat was equipped with a passenger weight sensor.

Figure 5: View west back to case vehicle's approach from the area of final rest (case photo #09)

The various sensors in the case vehicle's advanced occupant restraint system analyze a combination of factors including the predicted crash severity and driver and front right passenger seat belt usage to determine the front air bag inflation level appropriate for the severity of the crash. For the front right seat position, an occupant weight sensor determines first, if a passenger is on the seat and, second if the weight on the seat is at or below a set value (the specific weight value is not known for the case vehicle). If no front right passenger is seated or the weight on the seat is below the set value, then the sensor will suppress deployment of the front right passenger air bag.

CASE VEHICLE DAMAGE

Exterior Damage: The case vehicle's front bumper cover, grille and left headlamp/turn lamp assembly were not present at the vehicle inspection (**Figure 6**). However, based on the 90 centimeter (35.4 inches) diameter of the crash attenuator's barrel and the damage to the case vehicle's bumper bar, hood, right fender and right front wheel, it appears that the case vehicle sustained direct contact across the majority of the front end, beginning at the right bumper corner. It appears the direct contact may not have involved the left bumper corner and left headlamp/turn lamp assembly. Additionally, the contact with the crash attenuator's cable assembly produced direct damage to the right headlamp/ turn lamp assembly, right fender and right front wheel (**Figures 7** and **8** below).

Figure 6: Left front view of front damage to case vehicle from crash attenuator impact, front bumper cover, grille and left headlamp/turn lamp assembly were missing (case photo #12)

Figure 7: Damage to the right headlamp/turn lamp assembly, right fender and right front wheel from impact with the crash attenuator's cable assembly (case photo #19)

Figure 8: Close view of damage to case vehicle's right front wheel from crash attenuator's cable assembly (case photo #20)

The crush measurements were taken at the front bumper bar (**Figure 9**). The residual maximum crush was measured as 22 centimeters (8.7 inches) occurring at C_3. The table below shows the case vehicle's crush profile

Units	Event	Direct Damage		Field L	C_1	C_2	C_3	C_4	C_5	C_6	Direct	Field L
		Width CDC	Max Crush								±D	±D
cm	1	110	22	117	0	6	22	21	14	5	19	0
in		43.3	8.7	46.1	0.0	2.4	8.7	8.3	5.5	2.0	7.5	0.0

The case vehicle's wheelbase was reduced 3 centimeters (1.2 inches) on the left side and 8 centimeters (3.1 inches) on the right side. Induced damage involved the hood, right fender, and both right side doors were displaced slightly in there door frames.

The case vehicle's recommended tire size was: P215/60R16 and the vehicle was equipped with tires of this size. The case vehicle's tire data are shown in the table below. The source of a puncture to the right rear tire could not be determined. It may have occurred during the towing and storage of the case vehicle following the crash.

Figure 9: Top view of crush to front of case vehicle (case photo #22)

Tire	*Measured Pressure*		*Recommend Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kpa	psi	kpa	psi	milli-meters	32nd of an inch			
LF	221	32	207	30	9	11	None	No	No
RF	0	0	207	30	9	11	Cut in sidewall	No	Flat
LR	221	32	207	30	9	11	None	No	No
RR	0	0	207	30	9	11	Sidewall punctured	No	Flat

Vehicle Interior: Inspection of the case vehicle's interior revealed no evidence of occupant contact marks to the left instrument panel or other interior surfaces. However, there was a small yellow stain on the air bag due to contact by the driver's face. There was no evidence of compression of the energy absorbing steering column, and no deformation of the steering wheel rim was observed.

Damage Classification: The front bumper fascia, grille and left headlight/turn lamp assembly were not present at the inspection of the case vehicle. However, based on the damage to the bumper bar and hood, the CDC for the case vehicle's front impact with the crash attenuator was determined to be: **12-FDEW-1** (**0**-degrees). In addition, the right headlamp/turn lamp assembly, right fender and right front wheel engaged a cable that was part of the crash attenuator. The cable produced unique scrape marks on the headlamp and fender, and broke a section out of the right front wheel (**Figure 8** above). A second CDC was assigned to capture this damage. The CDC was determined to be: **12-FREE-6** (**0** degrees).

The crash was out-of-scope for the WinSMASH reconstruction program due to the movement of the crash attenuator. However, the WinSMASH program was used to determine a Barrier Equivalent Speed (BES) for the case vehicle based on the front bumper crush. The calculated BES was 22.2 km.p.h. (13.8 m.p.h.). The calculated BES appears low based on the overall damage to the case vehicle. This contractor estimates the crash severity to be moderate [24 to 40 km.p.h. (15 to 25 m.p.h)]. The case vehicle was towed due to damage.

Figure 10: Overview of the steering wheel and air bag module flaps (case photo #27)

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with certified advanced 208-compliant frontal air bags at the driver and front right passenger positions. The driver's air bag deployed as a result of the case vehicle's impact with the crash attenuator.

The case vehicle's driver air bag was located in the steering wheel hub. The air bag module cover flaps (**Figure 10** above) consisted of a rectangular upper flap 21.5 centimeters (8.5 inches) in width and 6 centimeters (2.4 inches) in height, and a slightly semi-circular lower flap 21.5 centimeters (8.5 inches) in width and 10 centimeters (4 inches) in height. Each of the flaps was made of thick vinyl. An inspection of the air bag module cover flaps and the air bag fabric revealed that the cover flaps opened at the designated tear points. There was no evidence of damage during the deployment to the air bag or the module cover flaps. The deployed driver's air bag (**Figure 11**) was round with a diameter of about 61 centimeters (24 inches). The air bag was designed with a single cone-shaped tether, 17 centimeters (6.7 inches) in diameter in the center of the air bag. It was sewn to the air bag with a double stitched seam about one centimeter (0.4 inch) wide. The driver's air bag had two vent ports (**Figure 12**), approximately 2.5 centimeters (1 inch) in diameter, located at the 11 and 1 o'clock positions. An inspection of the air bag fabric revealed a small yellow stain at the center left portion of the air bag (**Figure 13**) indicating contact by the driver's face. In addition, an area of very light blue or purple scuffing was observed at the top portion of the air bag immediately above the yellow stain. The origin of this scuff is not known.

Figure 11: Overview of the driver's air bag, yellow tape shows location of yellow stain (case photo #28)

Figure 12: Driver's air bag vent ports, indicated by arrows (case photo #31)

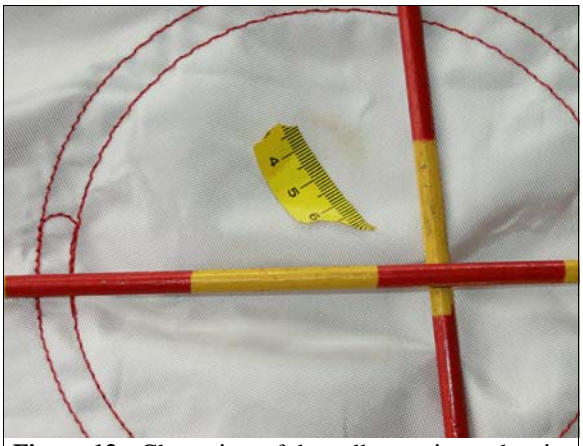


Figure 13: Close view of the yellow stain on the air bag to the right of the yellow tape (case photo #29)

The front right passenger air bag was located on the top of the instrument panel (**Figure 14** below). The deployment of the front right air bag was properly suppressed by the case vehicle's advanced occupant protection system because there was no front right passenger in the case vehicle at the time of the crash.

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash the case vehicle's driver [26-year-old, White (non-Hispanic) male, 168 centimeters and 66 kilograms (66 inches and 145 pounds)] was talking on his cellular telephone. He was seated upright with his

back against the seat, left foot on the floor, right foot on the accelerator, left hand on the steering wheel and his right hand holding the cellular telephone. His seat track was located between its forward and middle positions. The seat back was upright and the tilt steering wheel was located in its center position.

Based on this contractor's vehicle inspection and driver interview data, the driver was restrained by his available, active, three-point, lap-and-shoulder, safety belt system. The safety belt system was equipped with a buckle-mounted pretensioner (**Figure 15**), which had activated and compressed the buckle stalk cover (**Figure 16**). The pretensioner piston was observed to be flush with the end of the pretensioner barrel, a movement of about 5 centimeters (2 inches). Inspection of the seat belt assembly also revealed faint striations on the D-ring, but no load marks on the seat belt webbing or latch plate were observed.

The driver stated in his interview that he made no pre-crash avoidance actions, and no related skid marks were found during this contractor's scene inspection. The driver also indicated he remained in his upright driving position at the time of the impact. The case vehicle's impact with the crash attenuator caused the driver to move forward along a path opposite the case vehicle's 0 degree direction of principal force as the case vehicle decelerated. The driver loaded his seat belt and his face and chest contacted his deployed air bag. The driver rebounded back into his seat and remained in his seat as the case vehicle came to rest against the crash attenuator. The driver exited his vehicle without assistance.

Figure 14: Overview of the front right instrument panel, front right air bag located in top of instrument panel (case photo #40)

Figure 15: Close view of the driver's seat belt pretensioner assembly (case photo #38)

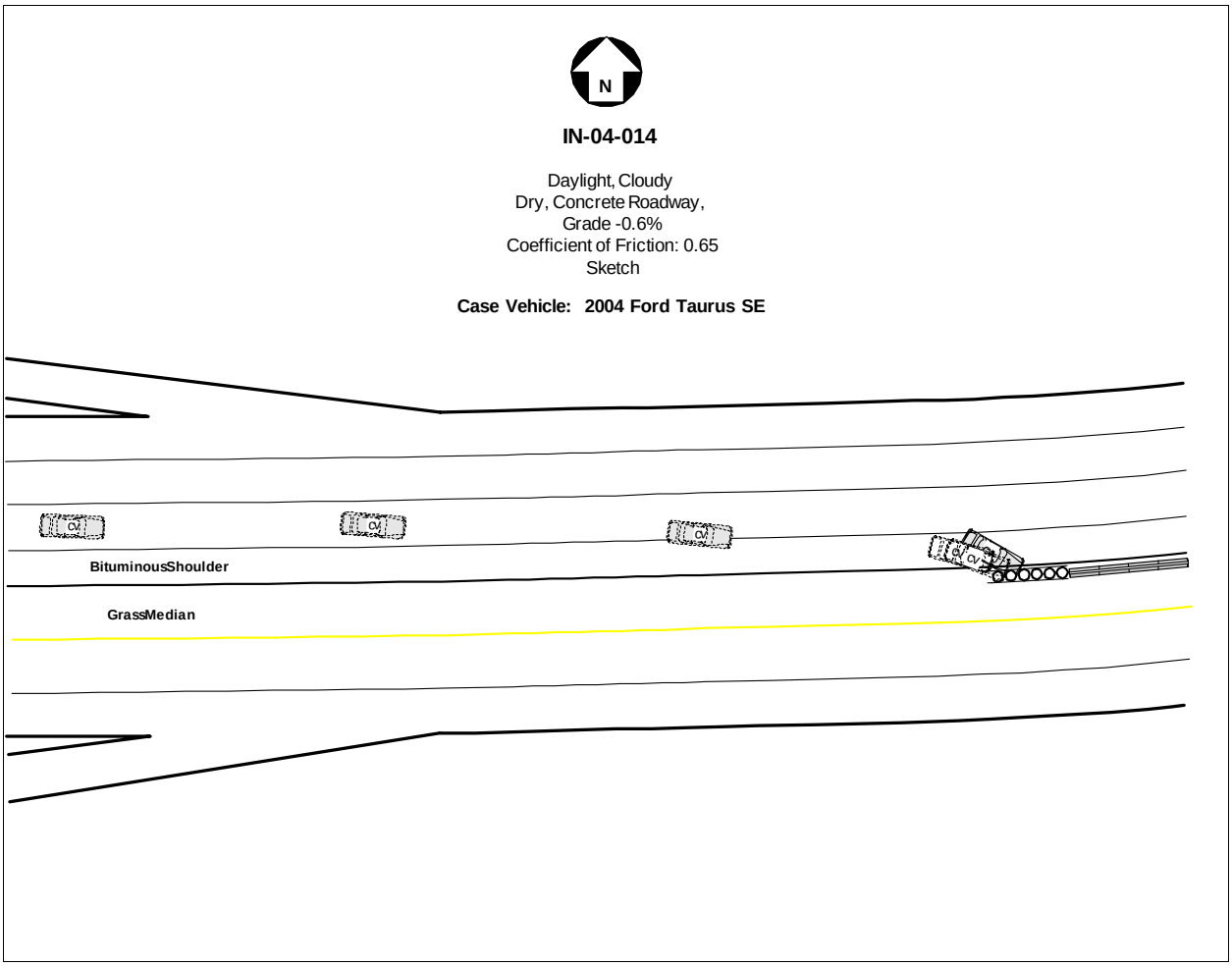
Figure 16: The driver's seat belt buckle showing compression of the buckle stalk due to the actuation of the pretensioner (case photo #37)

CASE VEHICLE DRIVER INJURIES

The case vehicle's driver was not transported from the crash scene to a medical facility. He stated that he sought medical treatment following the crash at the emergency room of a local hospital. The driver sustained, according

to his interview, a bruised nose, an 8 to 10 centimeters (3 to 4 inches) bruise on his left shoulder and pain to his chest and lower back.. The driver's bruised nose resulted from contact with his deployed air bag. The bruise to his left shoulder was due to loading his shoulder belt. The pain to his chest and lower back were likely due to crash forces and loading his seat belt during the crash. The driver did not receive any follow-up treatment for his injuries and lost five work days as a result of the crash. The table below shows the driver's injuries and injury mechanisms.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion {bruise} nose, not further specified	minor 290402.1,4	Air bag, driver's	Certain	Interviewee (driver)
2	Contusion {bruise}, 7.6 to 10.2 cm (3 to 4 in), on left shoulder	minor 790402.1,2	Torso portion of safety belt system	Certain	Interviewee (driver)


N
IN-04-014
Daylight, Cloudy
Dry, Concrete Roadway,
Grade -0.6%
Coefficient of Friction: 0.65
Sketch
Case Vehicle: 2004 Ford Taurus SE
CV
CV
CV
CV
BituminousShoulder
GrassMedian