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ON-SITE HEAVY TRUCK UNDERRIDE INVESTIGATION

CASE NUMBER - IN10015
LOCATION - OHIO
VEHICLE - 2008 WABASH NATIONAL SEMI-TRAILER
CRASH DATE - March 2010

Submitted:

June 4, 2010

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Prepared for:

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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 heavy truck underride investigation involving a 2002 Freightliner CST120 6x4 truck tractor pulling a 2008 Wabash National Semi-Trailer and a 2005 Ford Taurus SE.			
16. *Abstract* This on-site investigation focused on a 2008 Wabash National semi-trailer and its rear impact guard. The semi-trailer was being pulled by a 2002 Freightliner CTS120 6x4 truck tractor. The driver of the Freightliner was traveling east on an interstate highway. The vehicle was struck by a bird and the driver pulled the vehicle to the right into an entrance ramp merge lane and stopped. He activated the vehicle's emergency flashers and exited the vehicle to check for damage. A 2005 Ford Taurus was traveling east in the entrance ramp negotiating a right curve and approaching the back of the semi-trailer. The front plane of the Ford impacted the impact guard (event 1) and underrode the back of the semi-trailer. Witnesses estimated the travel speed of the Ford at between 80 and 97 km/h (50 and 60 mph). No brake lights were seen on the Ford prior to the crash. The crash separated the impact guard from the semi-trailer. A fire ignited in the Ford's engine compartment (event 2) and consumed the front and passenger compartment of the Ford. The driver of the Ford sustained fatal injuries.			
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TABLE OF CONTENTS IN10015

Page No.

This on-site investigation focused on a 2008 Wabash National semi-trailer and its rear impact guard (**Figure 1**). This crash was brought to our attention by the National Highway Traffic Safety Administration (NHTSA) on March 23, 2009. The investigation was assigned on April 20, 2009. The crash involved a 2005 Ford Taurus SE and the Wabash semi-trailer, which was pulled by a 2002 Freightliner CST120 6x4 truck-tractor. The crash occurred in March, 2010, at 1418 hours, in Ohio and was investigated by the Ohio State Highway Patrol. The inspection of the Wabash semi-trailer, Ford, and the crash scene were conducted on April 21-22, 2010. This report is based on the police crash report, crash scene and vehicle inspections, and evaluation of the evidence.

Figure 1: The damaged 2008 Wabash National semi-trailer and its damaged rear impact guard

CRASH CIRCUMSTANCES

Crash Environment: This crash occurred on a 5-lane divided, interstate highway during daylight hours and cloudy weather conditions. The interstate traversed in an east-west direction. The crash occurred on the eastbound side of the interstate on a overpass bridge and within an entrance ramp merge lane. The east roadway had two through lanes and the entrance ramp merge lane. Each lane was 3.7 m (12.1 ft) in width. The entrance ramp merge lane was divided from the through lanes by a gore that was 2.7 m (9 ft) in width in the area where the crash occurred. The outside bituminous shoulder was 2.1 m (7.2 ft) in width and was bordered by a concrete bridge rail. The roadway pavement markings consisted of solid white edge and gore lines and broken white lane lines. The roadway surface on the approach to the crash was level, dry bituminous which changed to level, dry concrete at the crash site. The Crash Diagram is on page 7 of this report.

Pre-Crash: The driver of the Freightliner was traveling east in the first lane from the right approaching the interchange area when a bird impacted the front of the vehicle. The driver pulled the vehicle to the right into the entrance ramp merge lane and stopped (**Figure 2**). He activated the vehicle's emergency flashers and exited the vehicle to check for damage. The Ford's driver was traveling east in the entrance ramp merge lane negotiating a right curve and approaching the back of the semi-trailer (**Figure 3**). Witnesses estimated the travel speed of the

Figure 2: Area where the Freightliner was stopped

Ford at between 80 and 97 km/h (50 and 60 mph). No brake lights were seen on the Ford prior to the crash.

Crash: The front plane of the Ford (**Figure 4**) impacted the impact guard (event 1) and underrode the back of the semi-trailer (**Figure 5**). A fire ignited in the Ford's engine compartment (event 2). The impact guard engagement on the Ford began at the front left bumper corner. The direct contact on the impact guard began at the left corner and extended approximately 160 cm (62.9 in) to the right. The crash separated the impact guard from the semi-trailer. The Ford penetrated under the semi-trailer and contacted the mud flap bracket, air reservoir tank, slack adjusters, and back axle (**Figure 6**). The tandem wheels on the semi-trailer were adjusted forward. The distances from the back of the semi-trailer to the back tires and back axle were 222 cm (87 in) and 271 cm (106.7 in), respectively. The A-pillars and roof of the Ford engaged the back of the semi-trailer, and the roof was crushed rearward 77 cm (30.3 in). Both vehicles came to final rest in the entrance ramp merge lane heading east.

Figure 3: Approach of the Ford entering the entrance ramp lane; arrow shows area of impact

Figure 4: Damage on the Ford from underriding the semi-trailer and from the fire

Figure 5: The back of the semi-trailer and damaged impact guard

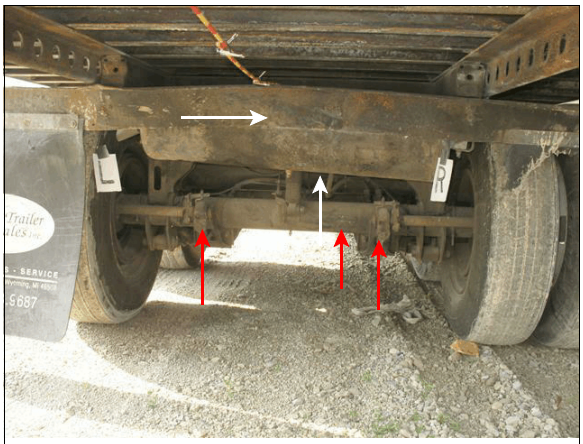


Figure 6: The Ford contacted the mud flap bracket, air reservoir tank, slack adjusters, and the axle

Post-Crash: The police were notified of the crash at 1422 hours and arrived at the crash scene at 1429 hours. The driver of the Freightliner attempted to put out the fire with an extinguisher from his vehicle but was unsuccessful. The fire was subsequently extinguished by a local fire

department. The driver of the Ford was deceased at the crash scene. The Ford and the semi-trailer were towed due to damage.

CASE VEHICLE

The 2002 Freightliner CST 120 was a 6x4 truck-tractor (VIN:1FUJBBCG12L------) equipped with a 12.7-liter, I6 diesel engine. The truck-tractor was pulling a 2008 Wabash National dual-axle, 16 m (53 ft) van-type semi-trailer (VIN 1JJV532W38L------).

SEMI-TRAILER AND DAMAGED REAR IMPACT GUARD DOCUMENTATION

One identification placard was found on the impact guard but the fire had rendered it unreadable. The impact guard's right vertical support broke at the weld on the horizontal member of the impact guard (**Figures 7** and **8**). The left vertical support broke at the frame rail on the semi-trailer (**Figures 9** and **10**). The schematic on the following page presents the post-crash measurements of the semi-trailer and impact guard.

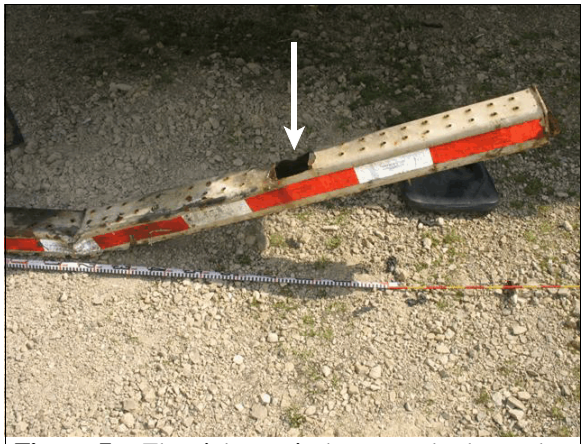


Figure 7: The right vertical support broke at the weld on the impact guard

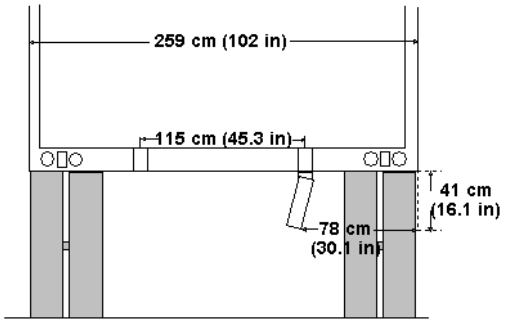
Figure 8: Right side view of the right vertical support for the impact guard on the semi-trailer

Figure 9: The broken left vertical support on the impact guard

Figure 10: The broken impact guard vertical support bracket on the left frame rail of the semi-trailer

Post-Crash Measurements of Semi-Trailer and Impact Guard

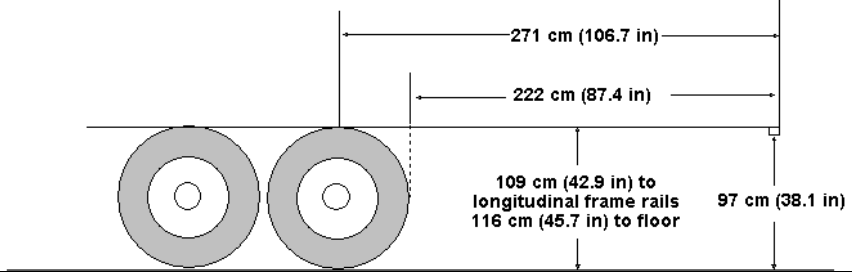
Back View of Semi-Trailer



Back View of Damaged Rear Impact Guard

Length of horizontal member as measured along damage contour was 246.4 cm (97 in)

Side View of Back Portion of Semi-Trailer



The 2005 Ford Taurus was a front wheel drive, 4-door sedan (VIN: 1FAFP53285A-------) equipped with a 3.0-liter, V6 engine, 4-speed automatic transmission, and dual stage driver and front passenger frontal air bags. The manufacturer has certified that the vehicle is compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208.

Exterior Damage: The Ford sustained damage on the front plane that extended to the A-pillars and roof. The direct damage involved the front bumper, grille, both headlamp/turn signal assemblies, hood, windshield, both A-pillars, roof and both B-pillars. The direct damage began at the front left bumper corner and extended 124 cm (48.8 in) across the bumper. The A-pillars and roof engaged the back of the semi-trailer and the roof was crushed rearward 77 cm (30.3 in, **Figure 11**). The B-pillars also engaged the back of the semi-trailer and the left B-pillar was crushed rearward 33 cm (13 in), while the right B-pillar was crushed 30 cm (11.8 in). A front crush profile was taken at the bumper level and the maximum residual crush was 56 cm (22 in) occurring at C_2 (**Figure 12**). The table below presents the front 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	124	56	124	43	56	49	38	29	15	0	0
in		48.8	22.0	48.8	16.9	22.0	19.3	15.0	11.4	5.9	0.0	0.0

A fire ignited in the engine compartment of the Ford. The front of the vehicle and the passenger compartment sustained major fire damage.

Damage Classification: The CDC for the front impact with the semi-trailer was 12FDAA9 (0 degrees). A Delta V could not be calculated for the Ford since an impact with a heavy truck is out of scope for the WinSMASH program. However, WinSMASH was used to calculate a Barrier Equivalent Speed (BES) based on the front crush on the Ford. The calculated BES was 51.2 km/h (31.8 mph).

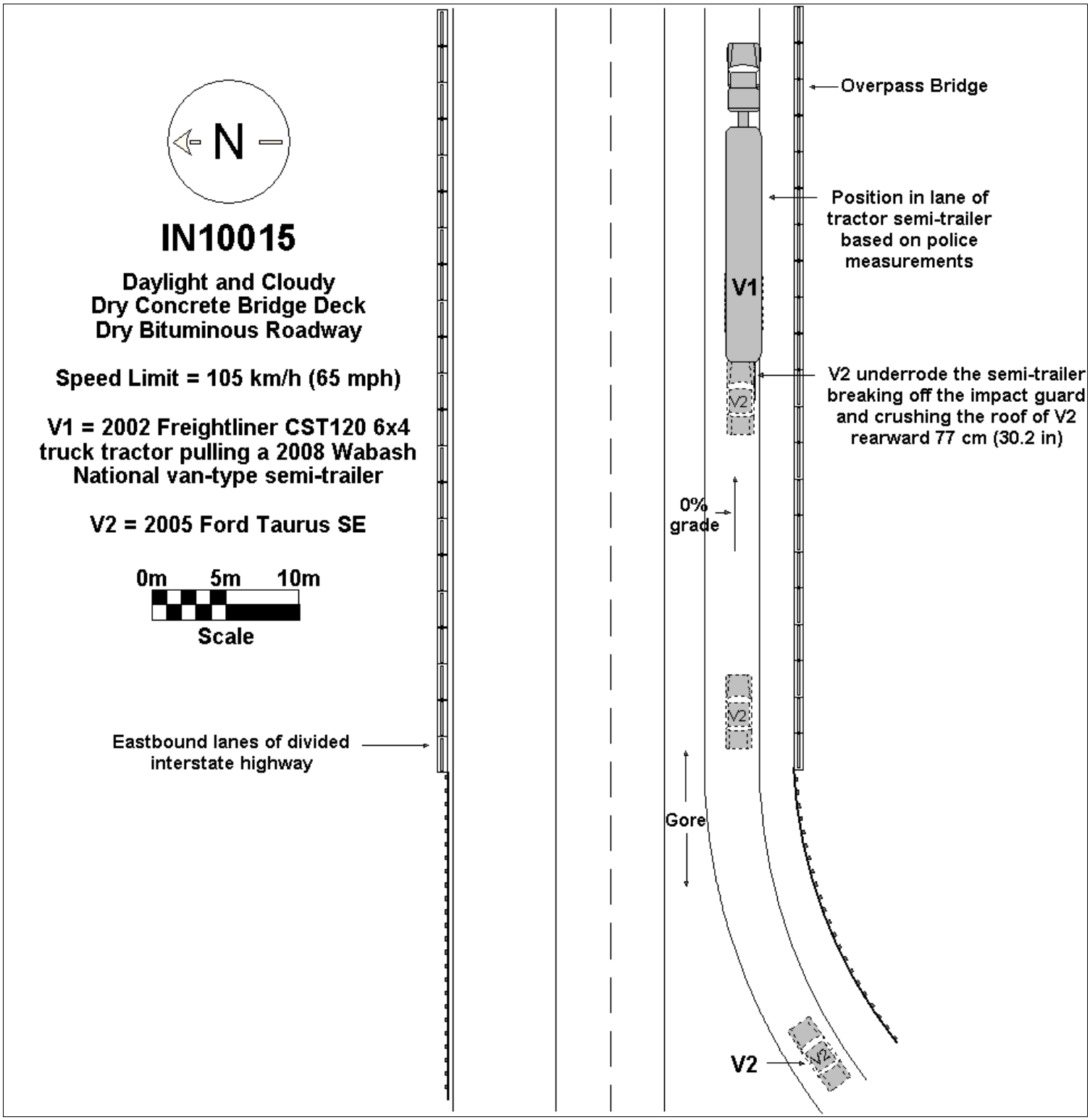
Figure 11: Left side view of the roof and A-pillar crush on the Ford

Figure 12: Top view of the crush on the Ford

The vehicle manufacturer's recommended tire size was P215/60R16. The Ford was equipped with the recommended size tires. The vehicle's tire data are presented in the table below.

Tire	*Measured Pressure*		*Vehicle Manufacturer's Recommended Cold Tire Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kPa	psi	kPa	psi	milli-meters	32nd of an inch			
LF	276	40	207	30	2	2	None	No	No
LR	255	37	207	30	2	2	None	No	No
RR	255	37	207	30	0	0	None	No	No
RF	Flat	Flat	207	30	1	1	Charred by fire	No	Yes

Other Vehicle's Driver: The driver of the Ford (39-year-old, male) was restrained by the lap-and-shoulder safety belt. He sustained fatal injuries and was pronounced deceased at the scene.


N
IN10015
Daylight and Cloudy
Dry Concrete Bridge Deck
Dry Bituminous Roadway
Speed Limit = 105 km/h (65 mph)
V1 = 2002 Freightliner CST120 6x4 truck tractor pulling a 2008 Wabash National van-type semi-trailer
V2 = 2005 Ford Taurus SE
0m 5m 10m
Scale
Eastbound lanes of divided interstate highway
Overpass Bridge
Position in lane of tractor semi-trailer based on police measurements
V1
V2 underrode the semi-trailer breaking off the impact guard and crushing the roof of V2 rearward 77 cm (30.2 in)
V2
0% grade
V2
Gore
V2
V2