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ON-SITE AIR BAG NON-DEPLOYMENT INVESTIGATION

CASE NUMBER - IN97-052
LOCATION - TEXAS
VEHICLE - 1995 CHEVROLET C-1500 PICKUP
CRASH DATE - June, 1997

Submitted:

December 30, 2002

Contract Number: DTNH22-94-D-17058

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 non-deployment investigation involving a 1995 Chevrolet C-1500, extended cab, pickup truck, with manual safety belts and driver's air bag, and a 1992 Chevrolet C-1500, regular cab pickup truck			
16. *Abstract* This report covers an on-site investigation of a crash involving a 1995 Chevrolet C-1500, 4x2, extended cab, regular bed, pick-up truck (case vehicle) and a 1992 Chevrolet C-1500, 4x2, conventional cab, regular bed, pick-up truck (other vehicle). This crash is of special interest because the case vehicle's, improperly restrained, driver (25-year-old male) sustained minor injuries when the driver air bag did not deploy as a result of a frontal collision. The case vehicle was traveling northwest in a heavy rain storm in the inside center through lane of the northwestbound roadway which was part of an eight-lane, divided, state highway (i.e., both the northwest and southeastbound roadways had four through lanes at this location). The 1992 pickup had been traveling northwest in the inside center lane of the same northwestbound roadway. A noncontact vehicle in the outside center lane changed lanes to the left directly in front of the 1992 pickup. The driver of the 1992 pickup took evasive action and successfully evaded the noncontact vehicle but, as a result, rotated approximately 210 degrees counterclockwise and was heading in a southerly direction, traveling backwards, in the inside center lane of the northwestbound roadway when the crash occurred. The front of the case vehicle impacted the right front of the 1992 pickup. This impact failed to deploy the case vehicle's driver (only) supplemental restraint (air bag). As a result of the initial impact, the 1992 pickup was spun counterclockwise while the case vehicle continued essentially northwestward. The left side of the case vehicle was side slapped by the right side of the 1992 pickup. The case vehicle's driver was seated with his seat track located in its rearmost position, and the tilt steering wheel was located in its down-most position. He was improperly restrained (i.e., wearing his shoulder belt behind his back) by his available, active, three-point, lap-and-shoulder, safety belt system and sustained, according to his interview, minor contusions to his head and right knee, and strains to his cervical and thoracic regions. The front right passenger (23-year-old female) was seated with her seat track located in its rearmost position and was restrained by her available, active, three-point, lap-and-shoulder, safety belt system. She sustained, according to her interview minor contusions to her chest and bilateral knees and strains to her whole back (i.e., thoracic and lumbar).			
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BACKGROUND

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This on-site investigation was brought to NHTSA's attention on December 3, 1997 by an attorney representing the driver of the case vehicle in this crash. This crash involved a 1995 Chevrolet C-1500 pick-up truck (case vehicle) and a 1992 Chevrolet C-1500 pickup truck (other vehicle). The crash occurred in June, 1997, at 11:30 a.m., in Texas and was investigated by the applicable city police department. This crash is of special interest because the case vehicle's, improperly restrained, driver [25-year-old, White (non-Hispanic) male] sustained minor injuries when the driver air bag did not deploy as a result of a frontal collision. This contractor inspected the scene and vehicles on 11-12 December, 1997. This contractor interviewed the case vehicle's front right passenger on September 25, 1998 and the driver on November 10, 1998. This summary is based on the Police Crash Report; interviews with the case vehicle's driver, front right passenger, and the driver's attorney; scene and vehicle inspections; occupant kinematic principles; and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling northwest in a heavy rain storm in the inside center through lane (third from the east shoulder) of the northwestbound roadway which was part of an eight-lane, divided, state highway and intended to continue traveling northwestward (i.e., both the northwest and southeastbound roadways had four through lanes at this location). The 1992 pickup had been traveling northwest in the inside center lane of the same northwestbound roadway of the same eight-lane divided, state highway and intended to continue traveling northwestward. A noncontact vehicle in the outside center lane of the same northwestbound roadway was traveling erratically and changed lanes to the left directly in front of the 1992 pickup. The driver of the 1992 pickup took evasive action (braked and most likely steered) and successfully evaded the noncontact vehicle but, as a result, rotated approximately 210 degrees counterclockwise and was heading in a southerly direction, traveling backwards, in the inside center lane of the northwestbound roadway. The case vehicle's driver indicated that he had no time to evade the 1992 pickup, but his right foot may have been moving between the accelerator and brake pedals just prior to the crash. The crash occurred in the inside center lane of the northwestbound roadway; see **POLICE CRASH SCHEMATIC** below.

The front of the case vehicle impacted the right front of the 1992 pickup. This impact failed to deploy the case vehicle's driver (only) supplemental restraint (air bag). As a result of the initial impact, the 1992 pickup was spun counterclockwise while the case vehicle continued essentially northwestward. The left side of the case vehicle's truck bed, just behind the extended cab, was impacted by the right side of the 1992 pickup. The case vehicle came to rest heading northwestward in the inside center northwestbound lane. The 1992 pickup also came to rest heading northwestward straddling the inside northwestbound through lane and the southwest shoulder of the northwestbound roadway.

The 1995 Chevrolet C-1500 was a rear wheel drive, two-door, extended cab, standard bed, pick-up truck (VIN: 2GCEC19K5S1------). The case vehicle was equipped with four-wheel anti-lock brakes. Based on the vehicle inspection, the CDC for the case vehicle's initial impact was estimated as: **12-FDEW-1 (350)**. The CDC had to be estimated because the case vehicle's

bumper was not available for inspection. The CDC for the side slap impact was determined to be: **09-LBEN-2**. The WinSMASH reconstruction program, missing vehicle algorithm, was used on the case vehicle's highest severity impact. The preliminary Total, Longitudinal, and Lateral Delta Vs are, respectively: 18.0 km.p.h. (11.2 m.p.h.), -17.7 km.p.h. (-11.0 m.p.h.), and +3.1 km.p.h. (+1.9 m.p.h.). This reconstruction is considered suspect, and the results appear to be high. This contractor's explanation for why the case vehicle's air bag did not deployed is twofold. First, this contractor determined that not all of the observed and measured damage occurred in this crash. Second, the 1992 pickup had most likely not yet come to rest (i.e., was still rotating counterclockwise and moving backwards) prior to the case vehicle striking it. The case vehicle was towed due to damage.

The case vehicle's initial contact with the 1992 pickup appears to have involved the majority of the front end. Direct damage began 42 centimeters (16.5 inches) inward from the outside edge of the right fender and extended, a measured distance of 138 centimeters (54.3 inches), above the bumper along the front of the hood. Maximum crush was measured as 21 centimeters (8.3 inches) at C_1. For the side slap impact, direct damage began 75 centimeters (29.5 inches) forward of the right rear axle and extended rearward, a measured distance of 21 centimeters (8.3 inches), above the sill along the side of the truck bed. The case vehicle's wheelbase was neither shortened nor extended on either side. The case vehicle's front bumper, bumper fascia, grille, hood, left headlight and turn signal assemblies, and radiator were directly damaged and crushed rearward. None of the case vehicle's tires were physically restricted or deflated. The right headlight and turn signal assemblies sustained induced damage as well as both the right and left fenders.

The case vehicle's driver air bag was located in the steering wheel hub. The driver air bag did not deploy as a result of this crash. The case vehicle was not equipped with a front right passenger air bag.

The inspection of the case vehicle's interior revealed a scuff on the left "A"-pillar and a small spider web crack on the windshield's glazing near the left "A"-pillar. In addition, the air vent underneath the steering column within the driver's knee bolster was depressed inward and cracked, most likely from contact by the driver's right knee. Furthermore, there was evidence of occupant contact in the front right seating area. Specifically, the air vent on the right instrument panel was depressed inward and the hinge on the glove box door was broken.

The 1992 Chevrolet C1500 is a rear wheel drive, two-door, regular cab, standard bed, pickup truck (VIN: 1GCDC14Z5NZ------). The 1992 pickup was equipped with two-wheel, anti-lock brakes. Based on the available photograph, the CDC for the 1992 pickup is estimated as: **01-RFEW-2 (20)**. The 1992 pickup was towed due to damage.

Immediately prior to the crash the case vehicle's driver [183 centimeters and 122 kilograms (72 inches, 270 pounds)] was seated in a slightly reclined posture with his back against the seat back, his left foot on the floor, his right foot most likely on or moving toward the brake, and both hands on the steering wheel. His seat track was located in its rearmost position with the seat back sightly reclined, and the tilt steering wheel was located in its down-most position.

The case vehicle's driver was improperly restrained (i.e., wearing his shoulder belt behind his back) by his available, active, three-point, lap-and-shoulder, safety belt system. An inspection of the case vehicle's driver seat belt system showed evidence of loading, but only to the lap belt portion.

The case vehicle's driver most likely decelerated the vehicle by moving his right foot from the accelerator pedal toward the brake pedal, intending to brake the vehicle and avoid the crash. As a result, and independent of the improper use of his available safety belts, his pre-impact body position did not change just prior to impact. The case vehicle's primary impact with the 1992 pickup enabled the case vehicle's driver to continue forward and slightly leftward toward the case vehicle's 350 degree Direction of Principal Force as the case vehicle decelerated. The driver loaded the lap portion of his safety belt while his torso, simultaneously, jackknifed over it. The side slap impact would have caused the driver to move slightly toward the 270 degree Direction of Principal Force but, for the most part, had little affect upon the driver's movement. However, the driver's left upper hand/wrist may have impacted the windshield's glazing and/or left "A"-pillar as a result of slipping off the steering wheel either during the initial or the side slap impacts. After loading the steering column and/or striking the windshield the driver rebounded back into his seat back as the vehicle came to rest. At final rest, the case vehicle's driver was back in his seat close to his original seating position.

The driver was transported by ambulance to the hospital. He sustained minor injuries and was treated and released. Based upon his interview, the injuries sustained by the case vehicle's driver included: contusions to the top of his head and right knee, and strains to his cervical and thoracic regions.

The case vehicle's front right passenger [23-year-old, White (unknown ethnicity) female; 173 centimeters and 91 kilograms (68 inches, 200 pounds)] was seated upright with her back against the seat back, her feet on the floor, her left hand on her lap, and her right holding onto the door handle. Her seat track was located in its rearmost position, and the seat back was upright.

The case vehicle's front right passenger was restrained by her available, active, three-point, lap-and-shoulder, safety belt system. An inspection of the front right passenger's seat belt restraint showed evidence of loading but, once again, only to the lap belt portion.

The front right passenger accompanied the case vehicle's driver (i.e., husband) to the hospital but was not treated; however, she subsequently sought treatment later. She sustained minor injuries and was released. Based upon her interview, the injuries sustained by the front right passenger included: strains to her whole back (i.e., thoracic and lumbar), bilateral knee contusions, and a seat belt contusion across her chest.

CRASH CIRCUMSTANCES

The case vehicle was traveling northwest in a heavy rain storm in the inside center through lane (third from the east shoulder) of the northwestbound roadway which was part of an eight-lane, divided, state highway (**Figure 1** below) and intended to continue traveling northwestward (i.e.,

both the northwest and southeastbound roadways had four through lanes at this location). The 1992 pickup had been traveling northwest in the inside center lane of the same northwestbound roadway of the same eight-lane divided, state highway and intended to continue traveling northwestward. A noncontact vehicle in the outside center lane of the same northwestbound roadway was traveling erratically and changed lanes to the left directly in front of the 1992 pickup. The driver of the 1992 pickup took evasive action (braked and most likely steered) and successfully evaded the noncontact vehicle but, as a result, hydroplaned on the roadway's wet surface and rotated approximately 210 degrees counterclockwise. The 1992 pickup ended up heading in a southerly direction, most likely traveling backwards, in the inside center lane of the northwestbound roadway. The case vehicle's driver indicated that he had no time to evade the 1992 pickup, but his right foot may have been moving between the accelerator and brake pedals just prior to the crash. The crash occurred in the inside center lane of the northwestbound roadway.

Figure 1: Case vehicle's northwestward travel path in inside center (3rd) lane of northwestbound roadway (case photo #01)

The state highway was straight and level (**Figure 1**) with a heading of 321 degrees at the area of impact. The pavement was concrete, but sharp, and the width of each of the four travel lanes was measured at 3.7 meters (12 feet). The shoulders were improved (i.e., concrete) and the northwestbound roadway had 3.7 meter (12 foot) wide shoulders on both the northeast and southwest sides of the roadway. The northwest and southeastbound roadways were divided by a median with concrete barriers. Pavement markings consisted of single broken white lane lines with intermittent raised pavement markers separating each lane. In addition the roadway was bordered by a solid white edge line on the outside lane and a solid yellow "no passing" line along the inside lane at the median. The estimated coefficient of friction was 0.70, when dry. There were guide signs and regulatory signs posted along the side of the roadway. The legal posted speed limit was 89 km.p.h. (55 m.p.h.). At the time of the crash the light condition was daylight, the atmospheric condition was overcast but without precipitation, and the road pavement was extremely wet from a torrential rain storm that had just hit the area moments prior to the crash. Traffic density was moderate, and the site of the crash was urban commercial.

Figure 2: Case vehicle's frontal deformation with contour gauge present; Note: vertical rod approximates location where 1992 pickup's right front corner penetrated case vehicle's hood (case photo #03)

The front (**Figure 2** and **Figure 3** below) of the case vehicle impacted the right front (**Figure 4** below) of the 1992 pickup as it spun counterclockwise in the inside center lane of the

northwestbound roadway. This impact failed to deploy the case vehicle's driver (only) supplemental restraint (air bag). As a result of the initial impact, the 1992 pickup was spun counterclockwise while the case vehicle continued essentially northwestward. The left side of the case vehicle's truck bed, just behind the extended cab (**Figure 5**), was impacted by the right rear corner of the 1992 pickup. The case vehicle came to rest heading northwestward in the inside center northwestbound lane. The 1992 pickup also came to rest heading northwestward straddling the inside northwestbound through lane and the southwest (median) shoulder of the northwestbound roadway.

Figure 3: Case vehicle's frontal deformation viewed from left of front with contour gauge present (case photo #06)

Figure 4: Insurance photo of damage to 1992 Chevrolet pickup's right fender and right front wheel assembly (case photo #25)

CASE VEHICLE

The 1995 Chevrolet C-1500 was a rear wheel drive, five-passenger, 4x2, two-door, extended cab, standard bed [2 meter(6.5 feet)], ½ ton, pick-up truck (VIN: 2GCEC19K5S1------) equipped with a 5.7L, V-8 engine and a four-speed automatic transmission with overdrive. Braking was achieved by a power-assisted, front disc and rear drum, four-wheel, anti-lock system. The case vehicle's wheelbase was 359 centimeters (141.5 inches), and the odometer reading at inspection was 65,302 kilometers (40,577 miles).

Figure 5: Side slap damage on left side of case vehicle's pickup bed (case photo #07)

Inspection of the vehicle's interior revealed adjustable front bucket seats with adjustable head restraints; a non-adjustable back bench seat with adjustable head restraints for the back outboard seating positions; continuous loop, three-point, lap-and-shoulder, safety belt systems at the front and back outboard positions; and a two-point, lap belt system at the back center position. The front seat belt systems were **not** equipped with manually operated height adjusters for the "D"-

rings. The vehicle was equipped with a knee bolster for the driver's position only. The air vent on the driver's knee bolster was pushed inwards by the driver's right knee. Automatic restraint was provided by a Supplemental Restraint System (SRS) that consisted of a frontal air bag for the driver (only) position. The frontal air bag did not deployed as a result of the case vehicle's frontal impact with the 1992 pickup (**Figure 6**).

Figure 6: Case vehicle's driver seating area showing non-deployed driver air bag (case photo #13)

The inspection of the case vehicle's interior revealed a scuff on the left "A"-pillar and a small spider web crack on the windshield's glazing near the left "A"-pillar. As mentioned above, the air vent underneath the steering column within the driver's knee bolster was depressed inward and cracked, most likely from contact by the driver's right knee (**Figure 7**). Furthermore, there was evidence of occupant contact in the front right seating area. Specifically, the air vent on the right instrument panel was depressed inward and the hinge on the glove box door was knocked off its hinges by the front right passenger's right knee after it came open during the collision (**Figure 8**). Finally, the energy absorbing steering column showed no evidence of compression.

Figure 7: Close-up of case vehicle's driver knee bolster area showing air vent pushed in from occupant contact (case photo #15)

Figure 8: Evidence of occupant contact to case vehicle's glove box door and right instrument panel area (case photo #18)

CASE VEHICLE DAMAGE

The case vehicle's initial contact with the 1992 pickup appears to have involved the majority of the front end. The field "L" and induced damage extended across the entire front end of the case vehicle, a distance of 166 centimeters (65.4 inches). Direct damage began 42 centimeters (16.5 inches) inward from the outside edge of the right fender and extended, a measured distance of 138 centimeters (54.3 inches), above the bumper along the front of the hood (**Figures 2** and **3** above) Maximum crush was measured as 21 centimeters (8.3 inches) at C_1. The 1992 pickup's impact with the case vehicle's front resulted in the front bumper being torn off its two frame

mounts (**Figure 9**). The residual crush to the two frame rails, which supported the two front bumper mounts, were measured at 13 centimeters (5.1 inches) on the left and 8 centimeters (3.1 inches) on the right. This contractor used these two points on the front to determine the case vehicle's crush profile. The resulting residual six "C"-measurements were as follows: 15 centimeters (5.9 inches) at C_1, 13.5 centimeters (5.3 inches) at C_2, 12 centimeters (4.7 inches) at C_3, 10 centimeters (3.9 inches) at C_4, 8 centimeters (3.1 inches) at C_5, and 6.5 centimeters (2.6 inches) at C_6. These "C"- measurements were used in the reconstruction program to determine the case vehicle's Delta V. For the side slap impact, direct damage began 75 centimeters (29.5 inches) forward of the right rear axle and extended rearward, a measured distance of 21 centimeters (8.3 inches), above the sill along the side of the truck bed. The case vehicle's wheelbase was neither shortened nor extended on either side. The case vehicle's front bumper, bumper fascia, grille, and left headlight assembly were torn off. The case vehicle's hood and radiator were directly damaged and crushed rearward. None of the case vehicle's tires were physically restricted or deflated from the front end damage. The right headlight and turn signal assemblies sustained induced damage as well as both the right and left fenders. There was no evidence of intrusion to the case vehicle's interior.

Figure 9: Overhead view of case vehicle's frontal damage with contour gauge present; Note: front bumper torn away during initial impact with other vehicle (case photo #11)

Based on the vehicle inspection, the CDC for the case vehicle's initial impact was estimated as: **12-FDEW-1 (350)**. The CDC had to be estimated because the case vehicle's bumper was not available for inspection. The CDC for the side slap impact was determined to be: **09-LBEN-2** [maximum crush was 5 centimeters (2.0 inches)]. The WinSMASH reconstruction program, missing vehicle algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 18.0 km.p.h. (11.2 m.p.h.), -17.7 km.p.h. (-11.0 m.p.h.), and +3.1 km.p.h. (+1.9 m.p.h.). This reconstruction is considered suspect, and the results appear to be high. This contractor's explanation for why the case vehicle's air bag did not deployed is twofold. First, this contractor determined that not all of the observed and measured damage occurred in this crash. Second, the 1992 pickup had most likely not yet come to rest (i.e., was still rotating counterclockwise and moving backwards) prior to the case vehicle striking it. The case vehicle was towed due to damage.

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with a Supplemental Restraint System (SRS) that contained a frontal air bag at the driver (only) position. The driver air bag did not deploy as a result of the frontal impact with the 1992 pickup. The case vehicle's driver air bag was located in the steering wheel hub. The case vehicle was not equipped with a front right passenger air bag. There was no visible evidence of direct contact from the driver to the steering wheel hub, spokes, and/or rim (**Figure 10** below).

This contractor's best explanation for why the case vehicle's air bag did not deployed is twofold. First, this contractor determined that not all of the observed and measured damage occurred in this crash. Second, the 1992 pickup had most likely not yet come to rest (i.e., was still rotating counterclockwise and moving backwards) prior to the case vehicle striking it.

Figure 10: Case vehicle's non-deployed driver air bag; Note: evidence of driver contact (yellow tape) on left side of windshield's glazing and left "A"-pillar (case photo #22)

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash the case vehicle's driver [183 centimeters and 122 kilograms (72 inches, 270 pounds)] was seated in a reclined posture with his back against the seat back, his left foot on the floor, his right foot most likely on or moving toward the brake, and both hands on the steering wheel, bracing for the impending crash. His seat track was located in its rearmost position with the seat back sightly reclined, and the tilt steering wheel was located in its down-most position.

The case vehicle's driver was improperly restrained (i.e., wearing his shoulder belt behind his back) by his available, active, three-point, lap-and-shoulder, safety belt system. An inspection of the case vehicle's driver seat belt system showed evidence of loading, but only to the lap belt portion (**Figure 11**).

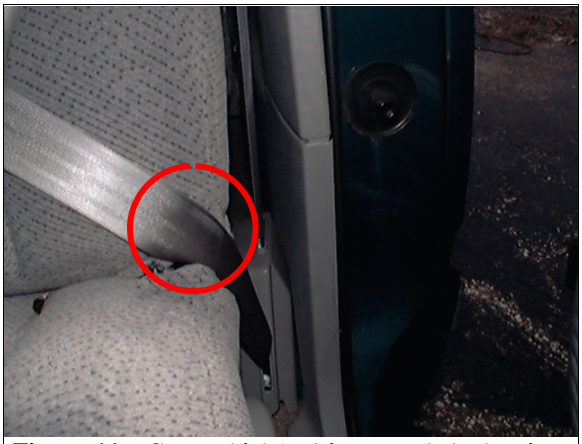


Figure 11: Case vehicle's driver seat belt showing heat abrasion (highlighted) on lap belt portion of webbing (case photo #19)

The case vehicle's driver most likely decelerated the vehicle by moving his right foot from the accelerator pedal toward the brake pedal, intending to brake the vehicle and avoid the crash. As a result, and independent of the improper use of his available safety belts, his pre-impact body position did not change just prior to impact. The case vehicle's primary impact with the 1992 pickup enabled the case vehicle's driver to continue forward and slightly leftward toward the case vehicle's 350 degree Direction of Principal Force as the case vehicle decelerated. The driver loaded the lap portion of his safety belt while his torso, simultaneously, jackknifed over it. The

Figure 12: Close-up of scuff on case vehicle's left "A"-pillar and spider web crack on left wind-shield's glazing (case photo #17)

side slap impact would have caused the driver to move slightly toward the 270 degree Direction of Principal Force but, for the most part, had little affect upon the driver's movement. However, the driver's left upper hand/wrist may have impacted the windshield's glazing and/or left "A"-pillar as a result of slipping off the steering wheel either during the initial or the side slap impacts (**Figure 10** above and **Figure 12** above). After contacting the steering column and/or striking the windshield the driver rebounded back into his seat back as the vehicle came to rest. At final rest, the case vehicle's driver was back in his seat close to his original seating position.

CASE VEHICLE DRIVER INJURIES

The driver was transported by ambulance to the hospital. He sustained minor injuries and was treated and released. Based upon his interview, the injuries sustained by the case vehicle's driver included: contusions to the top of his head and right knee, and strains to his cervical and thoracic regions.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion {knot} on top left of head	190402.1 minor	Steering wheel spokes and/or rim	Probable	Interviewee (same person)
2	Strain cervical spine {neck}, not further specified	640278.1 minor	Steering wheel spokes and/or rim	Possible	Interviewee (same person)
3	Strain thoracic spine {upper back} not further specified	640478.1 minor	Steering wheel spokes and/or rim	Possible	Interviewee (same person)
4	Contusion {bruised} right knee	890402.1 minor	Knee bolster, driver's	Probable	Interviewee (same person)

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

The case vehicle's front right passenger [23-year-old, White (unknown ethnicity) female; 173 centimeters and 91 kilograms (68 inches, 200 pounds)] was seated upright with her back against the seat back, her feet on the floor, her left hand on her lap, and her right holding onto the door handle. Her seat track was located in its rearmost position, and the seat back was upright.

The case vehicle's front right passenger was restrained by her available, active, three-point, lap-and-shoulder, safety belt system. An inspection of the front right passenger's seat belt restraint showed evidence of loading but, once again, only to the lap belt portion (**Figure 13** below).

The case vehicle's driver most likely decelerated the vehicle by moving his right foot from the accelerator pedal toward the brake pedal, intending to brake the vehicle and avoid the crash. As a result, and independent of the use of her available safety belts, the front right passenger's pre-impact body position did not change just prior to impact. The case vehicle's primary impact

with the 1992 pickup enabled the case vehicle's front right passenger to continue forward and slightly leftward toward the case vehicle's 350 degree Direction of Principal Force as the case vehicle decelerated. The front right passenger loaded her safety belts, limiting her forward motion but contusing her chest and/or right shoulder, while her knees contacted the glove box door and the right lower instrument panel causing contusions. The side slap impact would have caused the front right passenger to move toward the 270 degree Direction of Principal Force, and most likely resulted in the inertial motion that strained her back. The front right passenger most likely rebounded back into her seat back as the vehicle came to rest. At final rest, the case vehicle's front right passenger was back in her seat most likely close to her original seating position.

Figure 13: Overhead view of case vehicle's front right passenger safety belt showing heat abrasion (highlighted) on lap belt portion of webbing (case photo #21)

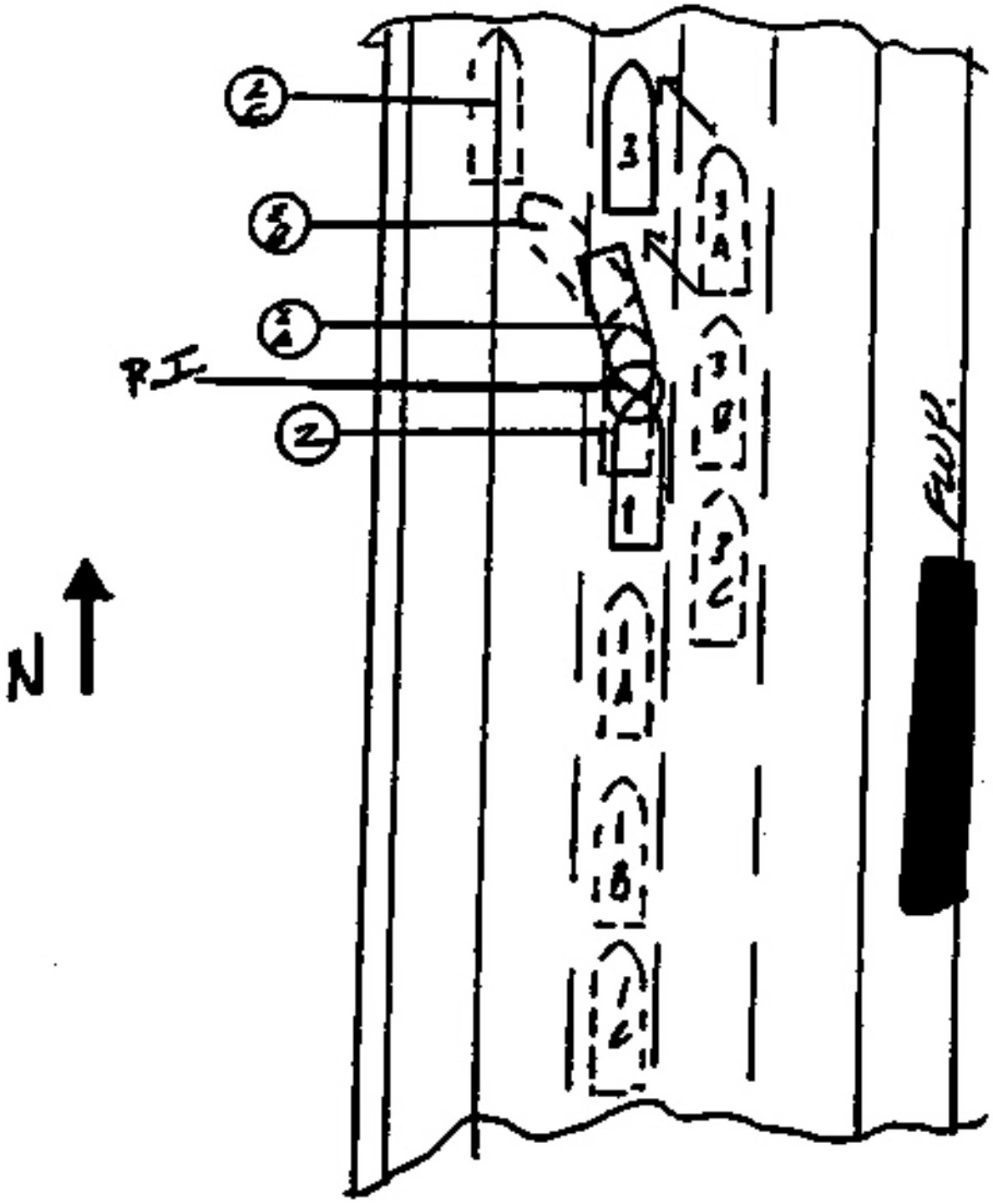
CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The front right passenger accompanied the case vehicle's driver (i.e., husband) to the hospital but was not treated; however, she subsequently sought treatment later. She sustained minor injuries and was released. Based upon her interview, the injuries sustained by the front right passenger included: strains to her whole back (i.e., thoracic and lumbar), bilateral knee contusions, and a seat belt contusion across her chest.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1 2	Contusion {bruise} chest, not further specified Contusion {bruise} right shoulder, not further specified	490402.1 790402.1 minor	Torso belt portion of safety belt system	Probable	Interviewee (same person)
3	Strain thoracic spine {whole back}, not further specified	640478.1 minor	Other noncontact injury source: inertial motion	Possible	Interviewee (same person)
4	Strain lumbar spine {whole back}, not further specified	640678.1 minor	Lap belt portion of safety belt system	Probable	Interviewee (same person)
5	Contusion {bruise} left knee, not further specified	890402.1 minor	Glove box door	Certain	Interviewee (same person)
6	Contusion {bruise} right knee, not further specified	890402.1 minor	Right instrument panel and below	Probable	Interviewee (same person)

The 1992 Chevrolet C1500 was a rear wheel drive, 4x2, three-passenger (standard), two-door, regular cab, standard bed, pickup truck (VIN: 1GCDC14Z5NZ------) equipped with a 4.3L, V-6 engine and either a five-speed manual (standard) or four-speed automatic (optional) transmission. The vehicle was not equipped with a Supplemental Restraint System (air bag) for either front seating position. Braking was achieved by a power-assisted, front disc and rear drum, two-wheel, anti-lock system. The case vehicle's wheelbase was 298 centimeters (117.5 inches), and the odometer reading is unknown because the vehicle was not inspected. Based on the available photograph, the CDC for the 1992 pickup is estimated as: **01-RFEW-2 (20)**.

The WinSMASH reconstruction program, missing vehicle algorithm, was used on the 1992 pickup's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 21.0 km.p.h. (13.0 m.p.h.), -19.8 km.p.h. (-12.3 m.p.h.), and -7.2 km.p.h. (-4.5 m.p.h.). Clearly, the damage shown in the available photograph (**Figure 4** above) does not support the severity of this reconstruction, making this reconstruction suspect and the results high. The 1992 pickup was towed due to damage.



Sketch from Police Crash Report: Note: movement of the case vehicle is labeled 1C, 1B, 1A, and 1, respectively. Movement of the other vehicle is labeled 2, 2A, 2B, and 2C. Movement of the noncontact vehicle is labeled 3C, 3B, 3A, and 3. In this sketch, the initial impact occurred at positions 1 and 2A. Finally, the north arrow is not correct. The heading angle for the roadway was approximately 320 degrees.