Remote, Redesigned Air Bag Special Study

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Dynamic Science, Inc., Case Number (1998-082-802E)

1998 Toyota Tercel

Washington

July/1998

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16. Abstract

This remote investigation was focused on the redesigned air bag system deployment of a 1998 Toyota Tercel two-door coupe. This was a two vehicle crash that occurred during a weekend, Saturday night in July, 1998. The weather was clear and the bituminous roadway surface was dry. This crash occurred within an urban four-leg intersection. The roadway was lighted by overhead luminaires that were operating at the time of the crash. The north and southbound legs are comprised of an undivided four- lane roadway (two northbound lanes and two southbound lanes). The east and westbound travel lanes consist of an undivided, two-lane roadway. Each leg of the intersection is controlled by an overhead traffic signal and the posted speed limit is 56 km/h (35 mph). Vehicle 1, a 1998 Toyota Tercel, two-door coupe was driven by a 19-year-old female (165 cm/ 65 in., 59 kg/ 130 lbs.) who was wearing the available three-point manual lap and shoulder belt in a normal and correct fashion. Driver 1 was traveling southbound in lane 2 approaching the intersection with the intention of turning left. Driver 1 stopped at the intersection and initiated a left turn sequence when the overhead traffic signal turned to the green signal phase. Vehicle 2, a 1989 Honda Accord four-door sedan was being driven by a 23 year-old-male who reportedly was restrained by the available two-point motorized shoulder belt and manual lap belt. The front, right seated position was occupied by a fully restrained 19 year-old-male. There was a vehicle (non-contacted) adjacent to Vehicle 2, traveling northbound in lane 2 without the headlights on. This vehicle apparently partially obstructed the view of both Vehicle 1 and Vehicle 2. As Vehicle 1 turned left, the front left bumper corner of Vehicle 2 (12FLEE2) impacted the frontal plane of Vehicle 1 (01FDEW2) in an obtuse angle front to front impact configuration. The calculated total delta V was 32.2km/h (20 mph) for Vehicle 1 with a longitudinal delta V of -24.7 km/h (-15.3 mph) which proved to be of sufficient force to deploy the redesigned frontal air bags. Vehicle 2 (1989 Honda Accord) underwent a calculated delta V of 24.5 km/h (15.2 mph).Vehicle 1 rotated approximately 192 degrees in a counterclockwise direction coming to rest north of the northwest intersection quadrant and facing west. Vehicle 2 was slightly deflected to the right and came to rest adjacent to the northeast intersection quadrant and facing north. The driver of the case vehicle was transported to a Medical Center where she was treated for a concussion in which she was reported to be lethargic and sleepy (AIS-2). Driver 1 was reported to have numerous facial contusions (AIS-1). She also sustained a right forearm contusion and abrasion (AIS-1). All of her injuries were attributed to the driver's air bag. The occupants of Vehicle 2 reportedly were uninjured.

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Summary

This remote investigation was focused on the redesigned air bag system deployment of a 1998 Toyota Tercel two-door coupe. This was a two vehicle crash that occurred during a weekend, Saturday night in July, 1998. The weather was clear and the bituminous roadway surface was dry. This crash occurred within an urban four-leg intersection. The roadway was lighted by overhead luminaires that were operating at the time of the crash. The north and southbound legs are comprised of an undivided four-lane roadway (two northbound and two southbound lanes). The east and westbound travel lanes consist of an undivided, two-lane roadway. Each leg of the intersection is controlled by an overhead traffic signal and the posted speed limit is 56 km/h (35 mph).

Figure 1. Vehicle 1 (frontal damage)

Vehicle 1, a 1998 Toyota Tercel, two-door coupe was driven by a 19-year-old female (165 cm/65 in., 59 kg/130 lbs.) who was wearing the available three-point manual lap and shoulder belt in a normal and correct fashion. Driver 1 was traveling southbound in lane 2 approaching the intersection with the intention of turning left. Driver 1 stopped at the intersection and initiated a left turn sequence when the overhead traffic signal turned to the green signal phase.

Figure 2. Vehicle 2 (frontal damage)

Vehicle 2, a 1989 Honda Accord four-door sedan was being driven by a 23 year-old-male who reportedly was restrained by the available two-point motorized shoulder belt and manual lap belt. The front, right seated position was occupied by a fully restrained 19 year-old-male. There was a vehicle (non-contacted) adjacent to Vehicle 2, traveling northbound in lane 2 without the headlights on. This vehicle apparently partially obstructed the view of both Vehicle 1 and Vehicle 2.

As Vehicle 1 turned left, the front left bumper corner of Vehicle 2 (12FLEE2) impacted the frontal plane of Vehicle 1 (01FDEW2) in an obtuse angle front to front impact configuration. The calculated delta V was 32.2 km/h (20 mph) for Vehicle 1 with a longitudinal delta V of -24.7 km/h (-15.3 mph) which proved to be of sufficient force to deploy the redesigned frontal air bags. Vehicle 2, 1989 Honda Accord, underwent a calculated delta V of 24.5 km/h (15.2 mph)[1].

[1] Calculated using WinSmash 1.2.1 Damage Only Routine

Vehicle 1 rotated approximately 192 degrees in a counterclockwise direction coming to rest north of the northwest intersection quadrant and facing west. Vehicle 2 was slightly deflected to the right and came to rest adjacent to the northeast intersection quadrant and facing north. The driver of the case vehicle was transported to a Medical Center where she was treated for a concussion in which she was reported to be lethargic and sleepy (AIS-2). Driver 1 was reported to have numerous facial contusions (AIS-1). She also sustained a right forearm contusion and abrasion (AIS-1). All of her injuries were attributed to the driver's air bag. The occupants of Vehicle 2 reportedly were uninjured.

Table 1. Delta V

	Case Vehicle		Other Vehicle	
	km/h	mph	km/h	mph
Total	32.2	20	24.5	15.2
Longitudinal	-24.7	-15.3	-24.1	-15
Lateral	-20.7	-12.9	4.3	2.7

Exterior of Case Vehicle

Table 2. Vehicle Information

Model year, make and model	1998 Toyota Tercel
VIN	JT2AC52LXW0
CDC	81FDEW2 Incremented 80 for shift to the left

Table 3. Crush Measurements

Plane of Impact	Field L cm/in.	C1 cm/in.	C2 cm/in.	C3 cm/in.	C4 cm/in.	C5 cm/in.	C6 cm/in.
Front Bumper	147	34	32	34	20	7	0
	57.9	13.4	12.6	13.4	7.9	2.8	0

Figure 3. Exterior damage to Vehicle 1 (1998 Toyota Tercel)

Interior of Case Vehicle

Figure 4. Front, left view showing interior of case vehicle

Figure 5. Front, right view showing case vehicle interior

The interior of the Toyota Tercel was void of interior damage due to occupant contacts. The laminated windshield, side window glazing and backlight were undamaged. The occupant compartment maintained its integrity and there were no intruding components due to the frontal impact. There was a large scuff mark documented to the driver's air bag which was located right of the air bag center point.

This vehicle is equipped with front bucket seats which are equipped with folding back(s). The driver's seat was adjusted at its rear most track position. The front seats are equipped with integral head restraints which were not damaged during the impact.

Case Vehicle Occupant Protection Systems

The 1998 Toyota Tercel was equipped with redesigned air bag systems which consisted of a single centrally located (console/transmission tunnel) sensor assembly[2]. An air bag warning lamp is located in the front, left mid-instrument panel area. There is an air bag module located in the front left (steering wheel hub) and front right instrument panel (top mount) which house the air bags and inflator units. The front seats are equipped with active three-point lap and shoulder restraints with adjustable height anchorage adjustments.

Figure 6. View showing deployed driver's air bag

Figure 7. View showing deployed passenger (front, right) air bag

[2] Refer to the attached SRS Wire Harness and Connector Mapping Views

The front, left driver's air bag was housed in the steering wheel hub and was concealed by symmetrical double horizontal module cover flaps. The circular air bag was tethered and equipped with two exhaust vent port holes. The lower instrument panel is equipped with a rigid plastic knee bolster. A large scuff mark was documented to the upper right quadrant (right of center) of the air bag fabric. This was documented as a facial make-up transfer and lip stick smudge mark.

The front, right air bag was located on the instrument panel, top surface plane. The module cover flap is rectangular in design with asymmetric halves. There was no residual damage to the air bag and the module cover flaps opened at their designed tear points.

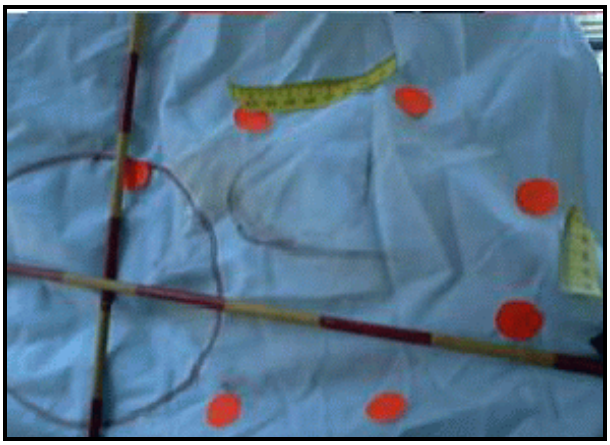


Figure 8. Close-up view showing facial cosmetic transfers and lip stick smudge mark

Case Vehicle Occupant Demographics

	Occupant 1	
Age/Sex:	19/Female	
Seated Position:	Front Left	
Seat Type:	Bucket with folding back(s)	
Height (cm/in:):	165	64.96
Weight (kg/lbs).:	59	130.1
Pre-existing Medical Condition:	None Reported	
Body Posture:	Unknown	
Hand Position:	At least one hand on the steering wheel rim-unknown position	
Foot Position:	Right foot on accelerator pedal and left foot on floor panel	
Restraint Usage:	Active, three-point lap and shoulder belt	
Air bag:	Driver air bag deployed as a result of the frontal impact.	

Occupant Injuries

Table 4. Injuries

Injury	Injury Severity (AIS)	Injury Mechanism
Concussion / head injury / lethargic and sleepy upon examination	2	Air bag
Numerous facial contusions	1	Air bag
Right forearm contusion	1	Air bag
Right forearm abrasion	1	Air bag

Occupant Kinematics

The 19 year-old-female of the Toyota Tercel two-door coupe was fully restrained and situated in the front left seated position. Her exact posture was unknown, however, she presumably was upright and facing forward.

She responded to the 40 degree principle direction of force by moving forward and to her right. She loaded the lap belt webbing which prohibited her lower torso from extended forward motion. Apparently, her lower extremities did not make contact with the knee bolster. The applied shoulder belt webbing held her upper torso from continued forward motion as her head and face pitched downward and to the right making significant contact with the air bag. This documented head impact resulted in a concussion in which she was reported to be lethargic and sleepy upon hospital examination (AIS-2). She also sustained numerous facial contusions, a right forearm contusion and abrasion (AIS-1) from contact with the deploying air bag.

The case vehicle initiated a rapid counterclockwise rotation (post-impact) and her upper torso pitched to the right as the deployed air bag deflated. She rebounded back into the seatback support as the case vehicle came to its final rest position.

Immediately following the crash, she unbuckled the lap and shoulder restraint and exited the vehicle unassisted. Driver 1 walked to the side of the road and sat down waiting for the police and EMT's to arrive. Apparently, she was alert and oriented at the crash location, however, she developed head injury symptoms (sleepy and lethargic) when examined at the Medical Center.

Figure 9. Deployed driver's air bag

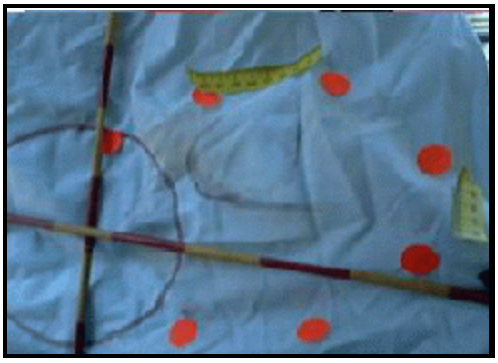


Figure 10. Close up view of large black scuff mark (facial cosmetic transfers)

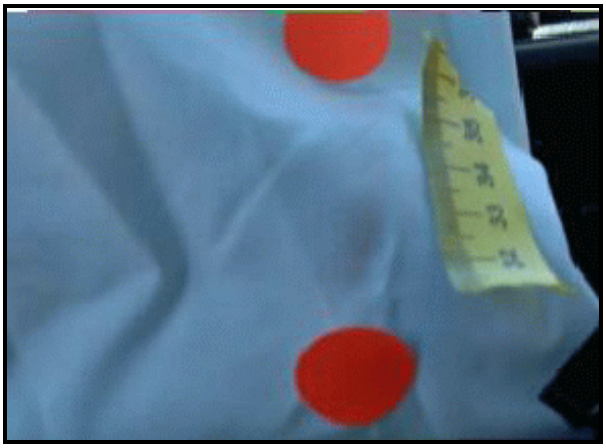
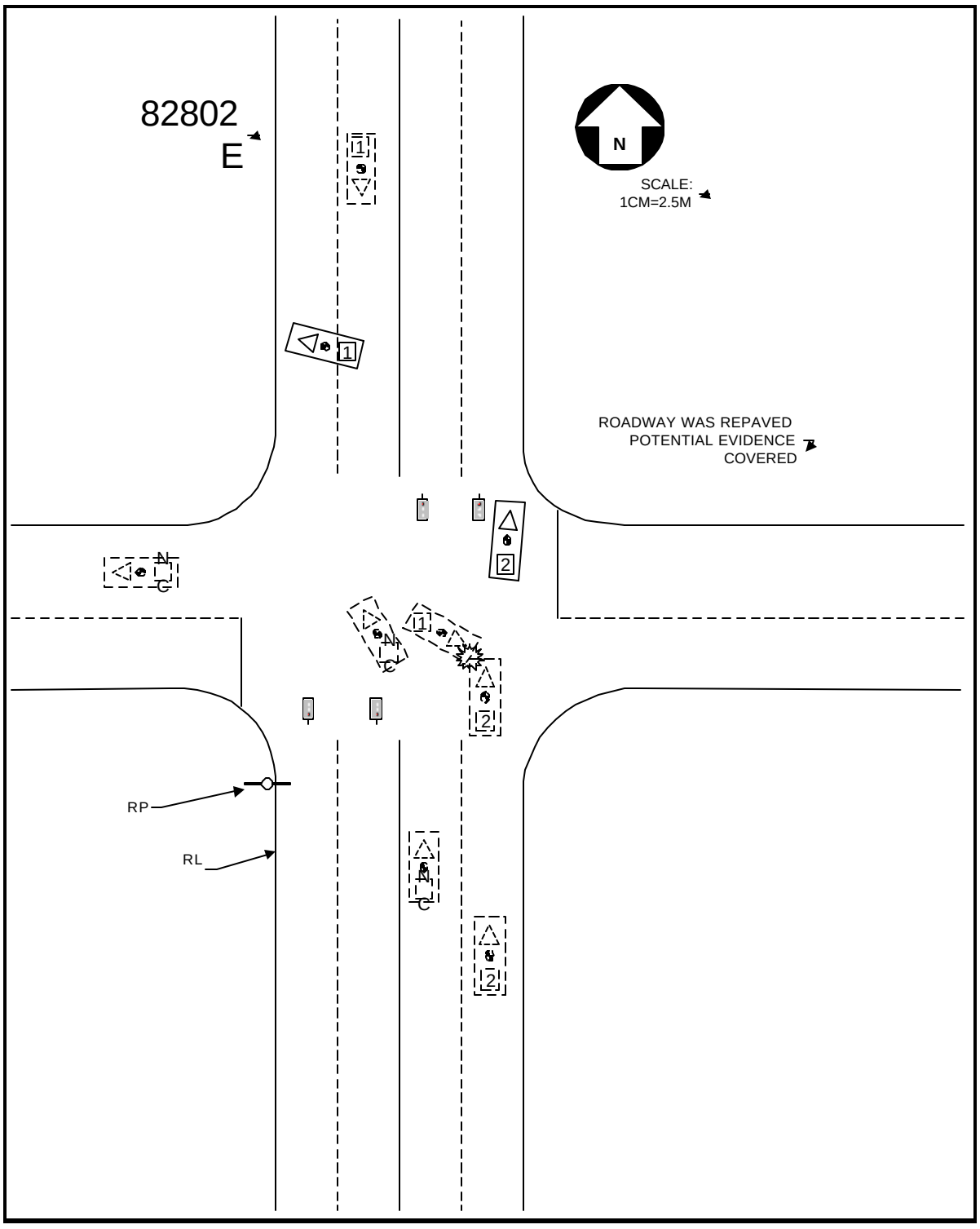
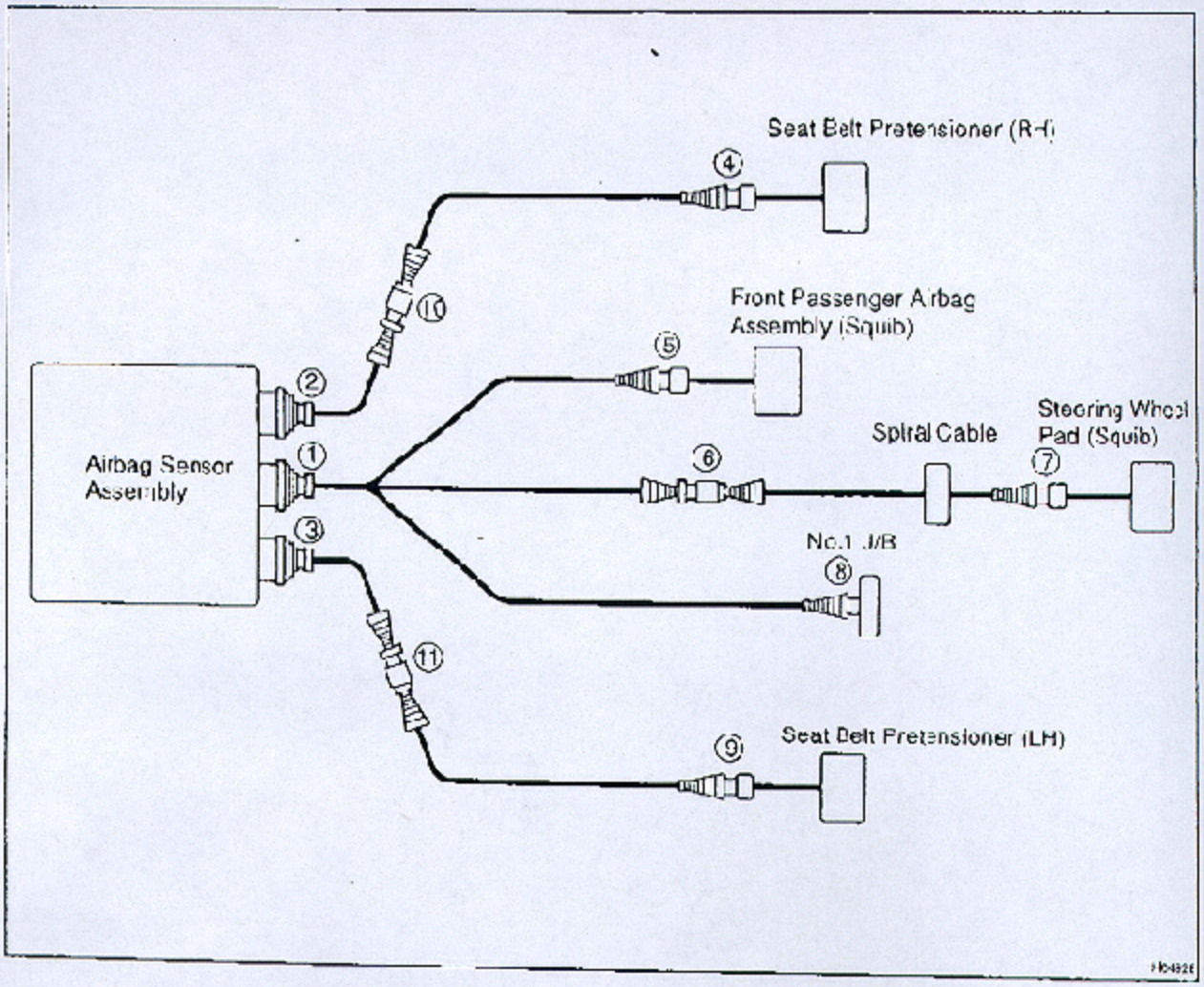


Figure 11. Close up view of lip stick transfer

Scene Diagram



7. SRS CONNECTORS



No.	Item	Application
(1)	Terminal Twin–Lock Mechanism	Connectors 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
(2)	Airbag Activation Prevention Mechanism	Connectors 1, 2, 3, 4, 5, 6, 7, 8, 10, 11
(3)	Electrical Connection Check Mechanism	Connectors 1, 2, 3
(4)	Connector Twin–Lock Mechanism	Connectors 6, 7

RS

(a) All connectors in the SRS are colored in yellow to distinguish them from other connectors. Connectors having special functions and specifically designed for SRS are used in the locations shown above to ensure high reliability. These connectors use durable gold–plated terminals.

WIRE HARNESS AND CONNECTOR LOCATION