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# Report of Fatal Crash

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16. Abstract

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## Fatal Crash

In the fall of 2007 an adult male driving a 2007 Toyota Tundra was fatally injured in a single vehicle crash. The driver of the vehicle had reportedly been awake for upwards of twenty hours and had a reported blood alcohol concentration of .08. For unknown reasons the vehicle departed the right side of the road impacted a wooden fence, an electrical / cable box and a large tree. There were no reported witnesses to the crash.

Questions were raised as to the reason for the road departure and any applicability of reported occurrences of unintended acceleration. In May of 2010 NHTSA became aware of the incident and assigned a Special Crash Investigation (SCI) team to look into the incident. Due to the length of time that had lapsed since the crash, the 2007 Toyota Tundra was not available for inspection. However, it was reported the decedent's family had taken possession of the vehicles' air bag control module shortly after the 2007 crash.

Once the Toyota software was available to image event data recorders (EDR) the family requested Toyota to image the module and use the data to clarify issues in the case. Due to legal issues involved, the family had an outside consultant utilize Toyota engineers to image the data on the EDR. The data was imaged using the Toyota's prototype read out tool (ROT) with the first release of the software. Anomalous Post-Crash data was reported in the output file which was inconsistent with reported scene facts. NHTSA received a congressional request to image the data contained within the EDR and provide the results to the Senator. While legal issues were being settled, Toyota released updated versions of the ROT software. The file previously imaged by Toyota was opened with the updated software yielding different results. The imaged file was provided to SCI by the outside consultant hired by the family.

Questions arose as to the validity and accuracy of the updated results. NHTSA crash investigators reviewed the EDR results and attempted to piece together the crash reconstruction based on all available information (e.g., police information, scene evidence, vehicle damage, EDR data, etc.). Although NHTSA Investigators never had possession of the EDR module, the data file was provided to them and could be opened in subsequent versions of the software without having to physically connect the EDR module to the software tool. With the updated software (version 1.3.1.2) the subject vehicle (2007 Toyota Tundra) EDR data provided the following Pre-Crash data:

Table 1: Subject Vehicle Pre-Crash EDR Data

| Time Interval | -5 sec | -4 sec | -3 sec | -2 sec | -1 sec | AE |
|---|---|---|---|---|---|---|
| Speed (mph) | 74.6 | 74.6 | 74.6 | 74.6 | 75.8 | 74.6 |
| Brake | OFF | OFF | OFF | OFF | OFF | OFF |
| Accelerator (V) | 1.48(OFF) | 1.48(OFF) | 1.48(OFF) | 1.48(OFF) | 1.52(MID) | 1.37(OFF) |
| Engine (rpm) | 2,000 | 2,000 | 2,000 | 2,000 | 2,400 | 2,000 |

The Pre-Crash speed data reported in the EDR (approximately 75 mph) was consistent with police observations and crush damage pattern to the vehicle. As indicated in Table 2, the early version of the ROT software indicated the velocity changes from this impact in the 177 mph range, although the speed was still in the 75 mph range. Questions arose as to the accuracy of the Post-Crash data contained in the EDR. As explained by Toyota to the family, there was a translation error in the early version of the software which resulted in anomalous Post-Crash data being reported by the EDR.

Table 2: Subject Vehicle Post Crash EDR Data as imaged with ROT version 1.2

| Time Interval(ms) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vehicle Change(mph) | 0.3 | 0.5 | 0.5 | 0.5 | 44 | 44 | 88 | 88 | 89 | 89 | 133 | 133 | 177 | 177 | 177 |

The updated software (Version 1.3.1.2) was subsequently used to report the data and the Post-Crash Data was reported as indicated in Table 3.

Table 3: Post Crash Data as imaged with ROT version 1.3.1.2

| Time Interval(ms) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vehicle Change(mph) | 0.3 | 0.5 | 0.5 | 0.5 | 0.3 | 0.3 | 0.2 | 0.3 | 1 | 1.4 | 1.2 | 1.2 | 1 | 1 | 1 |

The Pre-Crash data remained the same in this version of the software; however the Post-Crash data indicated a maximum velocity change of 1.4 mph at 100 ms post crash. The data also appeared to be inconsistent based on the crash circumstances (i.e. a 75 mph precrash travel speed versus a tree should yield a higher velocity change). Particular scrutiny was affixed to the Post-Crash data in light of the severe impact and fatal consequences.

It should be noted that there are two other banks of data stored in this EDR. The data in those events are termed “next most recent” and “past max DeltaV” data”. The Pre-Crash data in these banks was indicated as:

Table 4: Pre-Crash Data Stored in Subject Vehicle’s Two Other EDR Banks

| Time Interval | -5 sec | -4 sec | -3 sec | -2 sec | -1 sec | AE |
|---|---|---|---|---|---|---|
| Speed (mph) | 78.3 | 78.3 | 78.3 | 78.3 | 78.3 | 78.3 |
| Brake | ON | ON | ON | ON | ON | ON |
| Accelerator(V) | -0.04(FALSE) | -0.04(FALSE) | -0.04(FALSE) | -0.04(FALSE) | -0.04(FALSE) | -0.04(FALSE) |
| Engine (rpm) | 6,000 | 6,000 | 6,000 | 6,000 | 6,000 | 6,000 |

As can be seen, all of the data is exactly the same for all samples of time which was confirmed by Toyota to be default data stored in the EDR. The Post-Crash data for the “next most recent” and “past max DeltaV”” was indicated as:

Table 5: Post-Crash Data Stored in Subject Vehicles Two Other EDR Banks

| Time Interval(ms) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vehicle Change | -0.2 | -0.3 | -0.5 | -0.7 | -0.9 | -1 | -1.2 | -1.4 | -1.5 | -1.7 | -1.9 | -2.1 | -2.2 | -2.4 | -2.6 |

This data potentially could have been related to other events in the crash, however it was ruled out based on facts associated with the crash. Specifically, the other events reported occurring in the crash included impacts with fence posts and a small electrical / cable box. It was unlikely that these events produced the exact same Post-Crash data.

As part of the entire understanding of this crash, NHTSA Crash Investigators searched various salvage lots for similar vintage Toyota Tundra's and documented the vehicle damage along with imaging the EDR when possible. Crash Investigators were able to locate several Tundra vehicles involved in crashes and noted a similar pattern with the EDR files. Namely, the air bag was deployed and both the Pre-Crash and Post-Crash data stored in the next most recent" and "past max DeltaV"data (Bank 1 and Bank 2) from all the modules was exactly the same. Refer to Table 4 for Pre-Crash data and Table 5 for Post-Crash data.

As noted above, the exact same data (for Bank 1 and Bank 2) was stored on the Toyota Tundra modules imaged. It appears that data is stored in these data banks are the factory default data. The data in these files appears to be locked when there is a deployment file stored in Bank 0 (i.e., the deployment event).

An interesting pattern emerged while inspecting the 2007 – 2009 Toyota Tundra in various salvage facilities and viewing crash pictures of several other Tundra models across the country. As indicated earlier in Table 3, the subject vehicle Post-Crash data had a maximum velocity change of 1.4 mph. Two other Tundra models had deployment files recorded (Bank 0) with very low velocity changes. Specifically, the front air bags deployed in one Tundra at a velocity change under 0.5 mph and the other Tundra in the range of 0.3 – 1.2 mph. The subject vehicle's front air bag deployed at a velocity change between 1.0 and 1.2 mph. All of these ranges seem extraordinarily low to have an air bag deploy. Other

Tundra vehicles were reviewed via on-line images and there appeared to be a pattern of the front air bags deploying in relatively minor crash events.

The air bag deployment timing is of particular interest because as noted by Toyota, once the air bag deploys, the data banks are locked and no other data is written to the EDR. As evidenced by the exemplar Tundra's, there was one event noted in the crash, the air bag was deployed and the remaining data banks had default data stored. In the exemplar crashes reviewed where EDR data was obtained, it appeared consistent that the air bag deployed very early in the crash sequence (low delta V) thus locking the EDR and preventing the recording of any further data.

As detailed earlier, the subject vehicle departed the road and struck several wooden fence posts and a small electrical /cable box prior to the severe impact with the tree. The Post-Crash data retrieved from the subject vehicle indicated that the front air bag deployed at 126 msec into the crash with a velocity change between 1.0 and 1.2 mph. This is consistent with the reported facts of departing the road at about 75 mph and striking a wooden fence post. A velocity change for this type of event could be expected in the 1-2 mph range. As detailed in the subject vehicle EDR, the air bag deployed 126 msec into the event, and all subsequent data was locked out of recording by the EDR due to the deployment event.

Crash reconstruction and occupant kinematic principles are consistent with the subject vehicle air bag deploying prior to the significant impact with the tree. The Pre-Crash and Post-Crash data stored in the subject vehicle's EDR appears consistent with the crash circumstances. The front air bag deployed early in the crash event with the impact with the wooden fence post(s) thus locking the EDR data, and the impact with the tree was apparently not captured by the EDR.

Based on crash circumstances, EDR data, and police and reconstruction data, there did not appear to be evidence of an unintended acceleration event. There was no further speculation as to the reason for the road departure, other than the police reported information of the driver potentially falling asleep.