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Post-Collision Vehicle Fire Incident

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Post-collision vehicle fire losses are resulting in enormous lawsuits in the United States and this type of litigation is sure to make its way to Canada. In the majority of these cases, the occupants of the vehicles survive the accident, but the resultant fire causes considerable trauma, injury, or death. Public fears of vehicles erupting in flames or exploding can sometimes lead to reluctance in aiding the trapped occupants of collision-damaged vehicles. Post-collision vehicle fires account for less than 3% of all fatal accidents on the road but a very high percentage of these fires result in significant injury or death.

Vehicle safety has become one of the main considerations when the public purchases a vehicle. Vehicle safety systems include airbags, seatbelt pretensioners, passenger compartment rigidity and vehicle crush zones, to name a few. As the safety of vehicles increases, the chances of surviving a collision increase. However, high speed collisions still result in significant vehicle damage and surviving occupants have great difficulty exiting the vehicle.

A SAE (Society of Automobile Engineers) technical paper on post-collision vehicle fires concluded that 88% of vehicle accidents studied occurred outside of urban areas where the average speed of vehicles was higher. Damages usually resulted in extensive deformation of the vehicle's critical areas, such as the fuel system, main

power supply and distribution and fluid/lubrication reservoir areas of the vehicle. In 70% of the cases studied, the vehicle speed at impact was approximately 80 km/h. The pre-collision speed of the vehicle would have been even higher, since braking would have reduced the speed of the vehicle prior to impact. Of the accidents analyzed, only 55% occurred during daylight hours and 30% involved wet road conditions. Trees were involved in 25% of the impacts

The analysis of a post-collision vehicle fire begins with a thorough technical assessment and accident reconstruction. Crash data modules that survive the fire can provide valuable information about the collision. This information must be properly interpreted and scientifically evaluated. Some of the crash data modules can be downloaded by commercially available systems. These include GM, Ford, and Isuzu vehicles. Toyota and Chrysler plan to include their vehicles in the near future. Other vehicles require proprietory systems that may or may not include crash data and are only available through the manufacturer. The crash data module provides a variety of information, including vehicle speed, engine speed, throttle position, brake status, state of the driver's seatbelt, and much more.

The collision scene must be fully documented so that all the site evidence is included in an engineering assessment. A Total Station can be used to map the road, incident scene and its evidence, including skid marks, gouges, crash measurements, and other stationary objects. Other sources of information include surveys, satellite imagery, General Motors On-Star, and site photographs.

The analysis of a damaged and burnt vehicle can be difficult and requires specialized expertise. Companies that specialize in this type of investigation normally acquire an exemplar vehicle for comparative purposes and future testing. The vehicle crush must be accurately measured in order to determine the Delta-V at impact. An exemplar vehicle can assist in determining the crush of the vehicle, but is also useful in acquiring knowledge about location of fuel lines, battery cables, electrical components, and fluid/lubrication reservoirs. A thorough and comprehensive examination of the fire damaged vehicle will be required in order to determine the cause of fire.

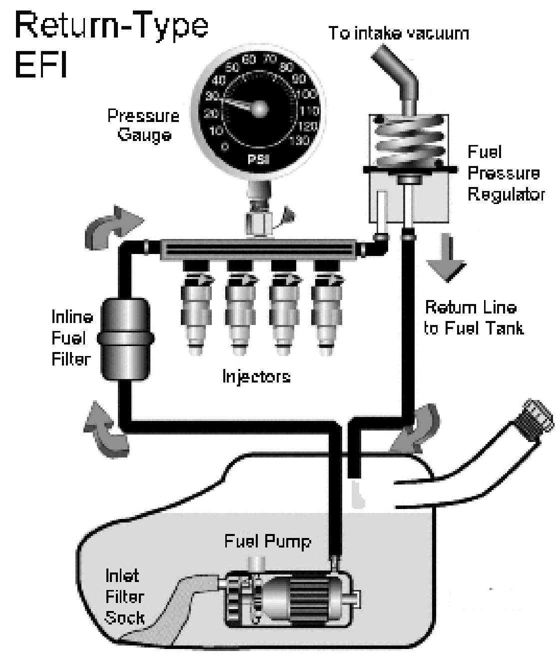
All of the collected site data and vehicle crush data are used to reconstruct the vehicle collision. Accident reconstruction software such as PC Crash can be used to not only predict the speed and direction of the involved vehicles prior to impact, but can also predict the angle of impact and the post-impact trajectory of the vehicles to their final resting positions. Vehicle accident reconstruction software can also predict the Delta-V at impact using measured values of crush or photogrammetry. Many of these programs also produce animations that can assist in visualizing the accident (see Rochon Report – Accident Reconstruction, Volume II Issue I, July 2007).

The investigation of a vehicle fire begins with establishing the origin of the fire. The National Fire Protection Association 921, "Guide to Fire and Explosion Investigations" contains a "Vehicle Fire" section that should be referenced by fire investigators. Other reference materials include the Ignition Handbook, and peer reviewed technical papers that deal with various issues, such as the hot surface ignition temperatures of various fluids. The basic methodology for investigating a fire endorsed by NFPA 921 is the scientific method. This is a systematic approach that is used to uncover factual data and test hypotheses. The origin of the fire can either be established by a thorough and comprehensive scientific evaluation or by a single irrefutable account of the area or origin by a dependable eyewitness.

Once the area of fire origin has been determined, the fire investigator must consider all of the possible causes for the fire. Common ignition scenarios for post-collision vehicle fires involve the following:

1. The fugitive release of fuel and/or fuel spillage;
2. The ignition of spilled fluids/lubricants;
3. The hot surface ignition of spilled fluids/lubricants;
4. An electrical ignition source;
5. A mechanical ignition source; and,
6. Ignition from another involved vehicle.

The fire investigator must consider the physical properties of all the flammable and combustible liquids within a vehicle as well as the flammability of the materials and upholstery that are used in the construction of the vehicle. Although the interior materials of vehicles are required to meet flammability standards within the passenger compartment of vehicles, special expertise is required to interpret the real-life implications of these standards. In addition, when considering ignitable hot fluids on a hot surface, consideration must be given to shielding and the location of the hot surfaces with respect to the location of the fugitive hot fluids.



A fuel spill can occur from a fuel tank filler neck that becomes compromised by the collision forces and/or deformation or crush of the vehicle. Fuel spillage can also occur from defective component parts or improper assembly of component parts. Rollovers present a unique challenge and can result in a fuel leakage. When crush or deformation compromise the fuel system, there is an urgent requirement to shut off the fuel pump. Normally this is accomplished by an oil pressure switch, a camshaft rotation relay or an inertia switch. Fuel line siphoning poses a unique hazard since it results in the continuous flow of fuel from a compromised fuel line and is unaided by mechanical or electric pumps. Fuel feed lines of a vehicle are the most susceptible to fuel line siphoning. Fuel line siphoning occurs when there is an absence of an anti-siphoning device and/or the fuel line is compromised below the level of the fuel inside the fuel tank. The fire investigator must also consider the residual pressure of fuel remaining within the fuel lines of the closed fuel system. The average amount of fuel that can be released from a closed fuel line system under pressure is in the range of 4 to 5 ounces, which is sufficient to initiate a fire in a vehicle.

Electrical sources are an important consideration in the ignition of vehicle fires. Batteries within vehicles provide a competent source of ignition even after the ignition switch has been turned off. Crush and deformation of the vehicle can compromise insulation, resulting in electrical arcing activity. Some manufacturers have recognized this hazard and utilize a pyrotechnic charge on the positive cable of the battery to blow the cable off the battery upon activation of an inertia switch. Special expertise is required to examine the electrical system of a vehicle after a fire and determine whether the electrical system was responsible for the initiation of the fire.

Newer vehicles present new challenges for investigation of post collision vehicle fires. Hybrid vehicles that utilize electromotive force from stored battery power can increase the risk of electrically initiated fires. Manufacturers are also using electrical systems with higher voltages between 24 volts DC and 120 volts AC/DC. More sophisticated vehicles utilize engine management systems which incorporate triac(s) (bi-directional electronic switches) that can react more quickly than conventional fuses and breakers. Diagnostic systems can be used to determine whether fuel leaks occurred prior to the fire and whether electrical systems became grounded during the collision. When the engine management system data has been downloaded, assessment of the data can provide valuable information with respect to damage to the various systems caused by crush or deformation of the vehicle prior to the vehicle fire.

Post collision vehicle fire investigations require specialized knowledge and expertise. In many cases, engine management systems and crash data modules can assist the fire investigator in determining the cause of the fire. The litigation that ensues as a result of the injury or death in a post-collision vehicle fire is costly and requires a comprehensive and thorough accident reconstruction and vehicle fire investigation. Ultimately, this information can be utilized to make vehicles safer in the future.

If you survive a vehicle collision, you should not be significantly injured or killed by an ensuing fire.

Vincent Rochon is the President of Rochon Engineering Incorporated, a multi-disciplinary forensic engineering firm. He has extensive experience in the investigation of fires and is a Certified Fire and Explosion Investigator and a Certified Vehicle Fire Investigator. The Professional Engineers at Rochon Engineering Incorporated have expertise in both accident reconstructions and vehicle fire investigation. Visit us at www.rochons.ca.