



Investigation of a vehicle fire caused by manufacturing defect

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ABSTRACT

An unreported cause of vehicle fire has been identified using a series of scientific approaches including fracture analysis. A fracture was found adjacent to the welding joint of right catalytic converter and exhaust manifold, which was the probable point of origin, of the burned vehicle. Using fracture analysis, it was verified that the fracture initiate due to the welding crack and formed far before the fire. Thus, it was confirmed that the hot air ejected from right catalytic converter via the fracture ignite the pipeline and/or fuel nearby, initiate the vehicle fire.

In 2012, 172,500 highway vehicle fires were reported which comprised 13% of all fire in United States. These highway vehicle fires resulted in 300 civilian fire deaths, 800 civilian fire injuries and an estimated \$1.1 billion in direct property loss [1]. The high percentage and enormous loss demonstrates the importance to improve the vehicle fire investigation. A Variety of fire cause such as arson, electrical arc, electrical abnormally heating, frictional heating, combustibles on hot surfaces, etc. has been reported [2,3]. In present fire case, an unreported cause of vehicle fire has been identified. By employing a series of scientific approaches, the authors concluded that the fire was caused by manufacturing defect of the exhaust manifold of the burned vehicle.

1. Fire scene investigation

A Sport Utility Vehicle caught fire at idle speed at a toll gate after a 60 Kilometers driving on a highway in Inner Mongolia, P. R. China. The fire destroyed the vehicle and the toll gate and resulted in \$0.5 million in direct property loss as shown in Fig. 1. The witnesses declared that the fire was firstly found around right front tire. The first picture taken by witness after the fire shown in Fig. 2 confirmed the statement. A careful fire scene inspection has been conducted and the area around the right three-way catalytic converter as shown in Fig. 3, was determined to be the area of origin, which coincide with declarations of witnesses.

The possible fire cause then be analyzed as following:

Arson was excluded. Firstly, the fire was witnessed during driving on a highway daytime. Secondly, the fire can not be observed before the vehicle stopped.

After careful scene inspection and paper review, it was confirmed that no electrical devices or wire were placed at the area of origin. Therefore, electrical arc and/or electrical heating was excluded.

Brake heating was also excluded. Firstly, when the fire was observed and the picture shown in Fig. 2 was taken, the right front size was not ignited. Secondly, the tire was not the in the area of origin.

According to our investigation, no grass and the like was found in the highway, and the vehicle had been washed on day before. Moreover, the grass and the like was not easy to be get and stay on the exhaust pipe for the structure of the vehicle. Consequently, it was not possible that grass and the like was ignited by hot surfaces of the vehicle.

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Fig. 1. A survey of the fire.



Fig. 2. First picture taken after the fire indicating the fire origin.



Fig. 3. Area of origin of fire exhibits significantly more damage and color change compared with the others.

During the fire scene inspection, a fracture as shown in Fig. 4, was found on exhaust manifold adjacent to welding joint in the area. The size of the crack is 6.5 cm long and 0.28 cm wide. It was possible that the hot air ejected from right catalytic converter via the fracture ignite the pipeline and/or fuel nearby, initiate the vehicle fire. The possibility was discussed throughout the rest of this article.

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