

## **Executive Summary**

At 21:28 on November 30, 2023, a passenger car using an Advanced Driver Assistance System (ADAS) collided with a truck-mounted attenuator (TMA) which performed mobile work and stopped in the inner lane of Daya Section at 176.4K northbound of National Highway No. 1. This occurrence caused damage to the front of the passenger car and the rear of TMA. There were no casualties in this occurrence.

In accordance with the Transportation Occurrence Investigation Act, the Taiwan Transportation Safety Board (TTSB) is an independent transportation occurrence investigation agency, and responsible for conducting the investigation. The investigation team also included members from the Freeway Bureau, Ministry of Transportation and Communications (MOTC), the Vehicle Safety Certification Center (VSCC), and Volkswagen Group Taiwan Co., Ltd.

The draft for this investigation report was completed in August 2024. It was revised after preliminary review at the 67th Board Meeting of the TTSB on September 13, 2024, according to procedures, and then sent to relevant agencies (institutions) for their opinions. The investigation report was published after review and approval by the 69th Board Meeting on November 8, 2024.

After comprehensive investigation and analysis of the factual data, a total of 11 findings and 2 safety recommendations were obtained.

### **I. Investigation Findings**

#### **Findings Related to Probable Causes**

1. The main reasons for vehicles colliding with truck-mounted attenuators on national highways are the driver zoning out, feeling sleepy, or being distracted, regardless of whether they are equipped with Advanced Driver Assistance Systems.

2. None of the Advanced Driver Assistance Systems (ADAS) currently provided by various brands have reached the level of autonomous driving that drivers can fully rely on, and their detection and response still have limitations under certain circumstances. Therefore, drivers can only use the systems to assist them with driving. Among the occurrences involving vehicles that collided with truck-mounted attenuator (TMA) while their ADAS function was turned on, some drivers did not fully understand the limitations and relied too much on the system, causing them to be distracted or zone out. As a result, they did not notice the situation in front of them in time for an appropriate response. This is the main reason that caused vehicles to collide with TMA.

### **Findings Related to Risks**

1. Interview records show that most car manufacturers do not provide detailed explanations of the limitations and notices of the Advanced Driver Assistance Systems (ADAS) when selling or delivering vehicles. If the salesperson fails to carefully explain the usage scenarios and inform consumers of limitations, it may cause drivers to misuse the ADAS due to incorrect understanding.
2. Regardless of whether the attenuator of truck-mounted attenuator (TMA) is deployed, it is a vehicle type mentioned in the limitations of the Advanced Driver Assistance Systems (ADAS). Moreover, TMA is usually moving slowly or stopped in the inner lane, which may cause them to be unrecognizable by ADAS, causing vehicles to directly collide with TMA.

3. Occurrence vehicle A was driving in the inner lane when it passed construction warning vehicle 3. There was a container truck moving in the outer lane in front to the right, which may have blocked the warning lights and LED signage panel of construction warning vehicle 3. There were 2 lanes between occurrence vehicle A and construction warning vehicle 3, so it is indeed possible that the driver in occurrence vehicle A could not recognize the message that the inner lane was closed when driving at speeds exceeding 90 km/h.

### **Other Findings**

1. The driver of occurrence vehicle A holds a driver's license for private passenger cars issued by the Ministry of Transportation and Communications, and does not have any record of traffic violations. There is no evidence that the driver was under the influence of alcohol or drugs while driving. It was sunny and the driver had good visibility at the time of the occurrence. The tire tread and brake disc test results of occurrence vehicle A were normal. The vehicle was found to be in compliance with regulations after inspection and there were no relevant records of abnormalities.
2. The investigation team reviewed 73 collisions caused by turning on the Advanced Driver Assistance Systems (ADAS). The ADAS of all vehicles corresponded to SAE J3016 autonomous driving level 1 or level 2. According to the description of SAE J3016, the driver must pay attention to road conditions at all times, and immediately intervene to control the vehicle and turn off the ADAS. The drivers are fully responsible for driving their vehicles.

3. Most of the new cars currently on the market are equipped with advanced emergency braking (AEB) systems, and may have all passed the testing requirements of United Nations Economic Commission for Europe Regulation No. 152 (UNECE R152). However, the domestic vehicle safety type approval does not require vehicles to pass the UNECE R152 testing standards (i.e., it has not formulated testing standards corresponding to the UNECE R152), so car manufacturers are still responsible for verifying whether the AEB of the vehicles they sell can operate normally.
4. The cushion and energy-absorbing design of truck-mounted attenuator can effectively reduce the impact force of collisions. In addition to protecting the passengers of the vehicle causing the accident, it can also protect construction vehicles and workers, thereby reducing the safety risk of drivers and the construction team.
5. At the time of the occurrence, traffic control facilities were deployed for mobile work carried out along the inner lane. The deployment method was in compliance with the "Traffic Control Rules for Construction."
6. When mobile work is carried out along the inner lane in the United States, multiple construction warning vehicles are deployed on the inner shoulder to effectively provide a warning effect. Ireland deploys multiple construction warning vehicles on the outer shoulder to make up for the limitation that construction warning vehicles cannot be deployed on the inner shoulder, further improving the warning effect. In comparison, the inner shoulder of national highways in Taiwan is only one meter wide and not enough to park construction warning vehicles. Only one construction warning vehicle is deployed on the

outer shoulder, which has a relatively low warning effect. Therefore, the deployment of traffic control facilities and construction warnings in Taiwan should be more comprehensive to facilitate the safety of drivers on the road.

## **II. Safety Recommendations**

### **To the Ministry of Transportation and Communications**

1. Refer to the levels of autonomous driving of SAE J3016 and testing standards established by the United Nations Economic Commission for Europe, and complete Taiwan's testing standards for ADAS and autonomous driving systems as soon as possible to ensure the safety and reliability of autonomous driving related technologies.

### **To the Freeway Bureau, MOTC**

1. Strengthen the deployment method of traffic control facilities for mobile work carried out along the inner lane, so that drivers driving in the inner lane can easily recognize the warning messages on the traffic control facilities, thereby lowering the risk of collision with truck-mounted attenuators.