PLASFUELSYS POSITION PAPER ON IMPACT TESTING OF PHEV TANKS

1. The origin

The drop test was created by an HDPE material supplier to validate raw material impact properties during the early development of plastic fuel tanks, which technology was not at the time the established one versus steel. In the early seventies, VW adopted the drop test to validate the HDPE material performance in a given tank design with a specific focus on pinch line (seam) behavior. The goal was never to correlate tank impact performance with vehicle crash (which is never performed at -40°C) but to have a periodic production robustness control. Also, this test was never intended to be conducted on tanks with mounted components (internal or external, either welded, rivet snapped or attached).

Many OEMs that initially introduced the drop test for product validation replaced it with a sled test to have higher repeatability of test conditions especially in the impact direction. The sled test offers the possibility to replicate the energy the car underbody is actually transferring to the fuel system and to design representative vehicle structures to impact the tank.

This kind of impact testing has never been introduced for steel tank validation.

2. Today

Sled/drop tests are conducted at -40°C, with simple impact directions (X, Y, Z) and at high energy levels up to 4000J. These tests conditions are not representative of vehicle crash conditions. In a crash situation, the tank will be submitted to high deceleration but may not see any direct impact depending on vehicle structure and environment. If an impact does occur to the tank during vehicle crash then:

- It will occur at a lower energy than in sled/drop test as the car body is absorbing impact energy. The impact energy on the tank is vehicle specific and can be derived from actual vehicle crash testing or crash simulations.

- The specific components potentially impacting the tank are dependent of the vehicle architecture.

For plug-in hybrid electric vehicles (PHEV), the fuel tank is required to withstand higher working pressure than for conventional vehicles: typically up to 35kPa. Without any reinforcing elements, a fuel tank submitted to such a pressure level would have a deformation exceeding customer requirements. To limit the deformation and to ensure fuel tank durability, pressurized fuel tanks require reinforcing devices, such as for example internal pillars between the top and bottom.

Plastic reinforced tanks are capable of withstanding the required higher internal pressure but also provide PHEV's with significant weight savings compared to steel tanks. It should also be noted as well that that there is a general trend of fuel tank downsizing for PHEV's, which on one side is limiting the energy absorption capabilities while allowing to better protect the tank from impacts.

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Therefore, the combination of increased tank rigidity and higher volumetric energy limits the capability of passing not only the drop test but also a 4000J sled test. Most importantly, neither test correlates to an actual crash situation.

3. Recommendation

In order to maximize the benefits of the new tank technologies, for the abovementioned reasons, **PlasFuelSys recommends to limit the drop test or the 4000J sled test to qualify the blowmolded tankshell without components and reinforcements** for product validation and production control integrity (especially pinch line quality).

On the other hand, **PlasFuelSys supports performing sled testing on a tank with components** in representative vehicle crash test conditions (realistic impact energy derived from simulated or actual crash test).

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About PlasFuelSys:

PlasFuelSys is the representative organisation of plastic fuel systems providers for the automotive sector in Europe. Its mission is to represent and promote the interest of the Automotive Plastic Fuel Tanks and Systems Industry providing a common voice to the market and its institutions, keeping its members regularly updated on EU legislation which could affect their industry. The Plastic Fuel Tanks and Systems industry employs more than 10,000 workers in Europe and sees an annual production of more than 16 million units. PlasFuelSys is a *European Plastics Converters* sector group.

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