Electrostatic Solutions Technical Brief No. 8

Avoiding electrostatic shocks at car park ticket barriers

Vehicles rolling on a road surface generate electrostatic charge that can build up to a high voltage on the vehicle. At the same time charge tends to dissipate to ground through the vehicle tyres and ground surface. Charge generation halts when the vehicle comes to a standstill, and usually the accumulated charge drains ("decays") away before it can cause shocks or other nuisance to the vehicle users.

If the floor electrical resistance is too high, the charge and voltage can remain for many seconds or minutes. The charge and voltage "decay time" will depend on many factors, including the resistance to-ground (R_g) of the floor surface. High R_g leads to a long charge decay time and high voltage build up.

In the extreme, a person may reach out from the vehicle window while high voltage remains on the vehicle. They may experience a shock as they touch an earthed metal surface such as a ticket machine, as the accumulated charge is released as an electrostatic discharge (ESD) through their body to earth.

If we wish the charge on the vehicle to be dissipated within about one second, a resistance from the vehicle to ground less than about 10^9 Ω would be required. This includes the resistance of the vehicle tyres as well as the R_g of the floor. While we have no control over the car tyres, it is wise to maintain the characteristic R_g of the floor material to less than 10^9 Ω.

Under dry conditions electrostatic charging of vehicles can be greater as the resistance-to-ground and surface resistance of the floor, charge and voltage decay times are increased. The result is an increase in shocks experienced by drivers as they lean from their cars to operate the ticket machines.

The vehicle voltage can vary with vehicle tyre characteristics and other factors such as the speed of approach to the barrier. A high speed is likely to lead to a high charge level and greater likelihood of shocks. A long ramp with highly insulating floor approaching the entrance barrier gives ample opportunity for a vehicle to reach a high voltage. The worst case occurs when there is no queue and a driver immediately stops at the barrier to take a ticket – the vehicle has no opportunity to stand and reduce its charge.

We can prevent voltage build-up on vehicles by providing an adequate charge dissipation path from the vehicle to ground, by using a sufficiently low resistance earthed floor material. If this is achieved, no shocks will be evident. Untreated concrete is nearly ideal in this respect, usually giving R_g around 10^6 Ω. This is unlikely to give vehicle charging even under dry conditions.

Facility design to avoid voltage build-up on the vehicle

The facility designer should aim to keep the resistance-to-ground of the floor surface near the barriers to less than 10^9 Ω, measured using a suitable test method such as IEC61340-2-3. Bare concrete typically has R_g around 10^6 Ω but some coatings such as asphalt and epoxies can have values several orders of magnitude higher, up to 10^{12} Ω or more.

The key areas that must have low R_g are the areas that the vehicle tyres will contact as they approach the barriers and where they halt as the ticket machine is operated (Figure 1). There are various ways that this could be achieved, depending on convenience and the construction of floor in the area. The size and position of such conductive areas on the floor is not critical – however, as a minimum two conveniently placed strips as indicated are recommended, arranged so that for the majority of vehicles arriving, all four tyres are on the conductive area when the vehicle is at rest in a typical position next to the ticket machine. Any charge accumulated on the car will then start to drain away as soon as a wheel makes contact with the conductive areas, and by the time the car comes to rest, it should have lost the majority of its charge.

It is left for the facility designer to find the most suitable and durable method of implementing these conductive floor areas. In practice it may be more convenient to provide a single larger grounded conductive floor area covering the region where the car halts near the barrier.

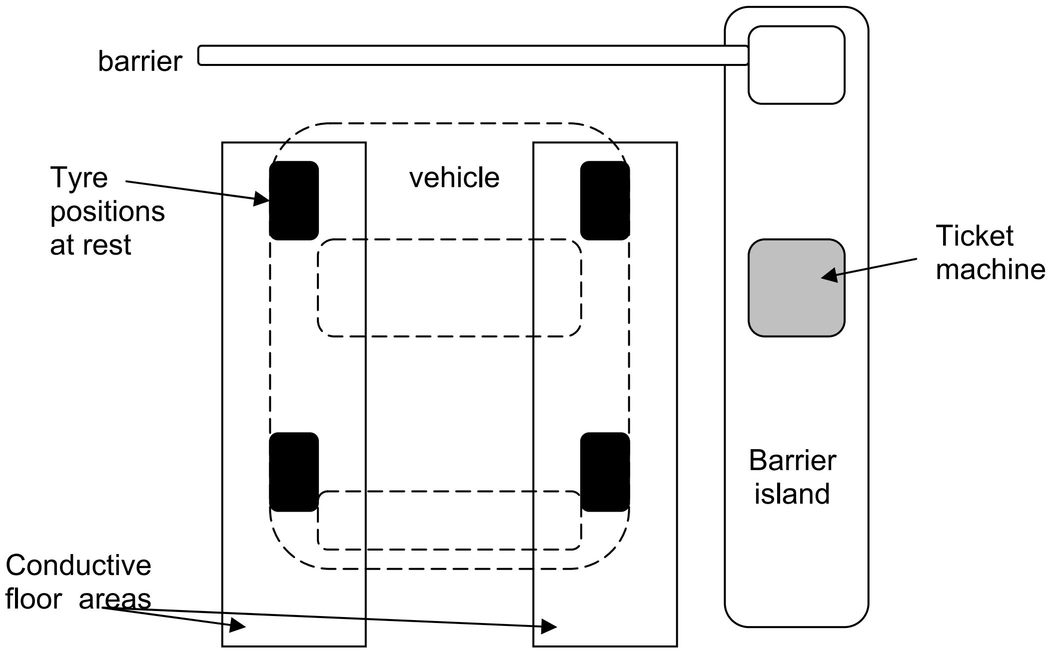

Figure 1. Suggested position of earthed conductive floor areas

References

Smallwood JM. *Report on the Risk of Static Ignition During Vehicle Refuelling: A Study of the Available Relevant Research*. Electrostatic Solutions Ltd. Report UKPIA2000-01-31 commissioned by UK Petroleum Industry Association, The Society of Motor Manufacturers and Traders Ltd. and the Institute of Petroleum. June 2000.

Electrostatic Solutions Ltd http://www.electrostatics.net

Telephone: +44 (0)23 8090 5600 **Email:** jeremys@electrostatics.net

13 Redhill Crescent, Bassett, Southampton, Hampshire, SO16 7BQ, U.K.