

Numerous common reasons for the ignition of buses or coaches have been identified, including but not limited to, e.g.: heat, vibration, material fatigue or malfunction, inadequate maintenance, and faulty electrical system design.

Most bus and coach fires start in the engine compartment or surrounding areas. In addition, fires can start in the electrical system in the bus and the wheel houses. In order to fully understand the risks associated with any given vehicle design it is important to consider both fire hazards, electrical hazards and EMC/EMI performance.

SP performs risk assessments of complete vehicles in order to determine and identify potential risks associated with the vehicle that could cause fires.

**SP Electronics** has been working with electrical safety and EMC evaluation since 1990. SP has long experience of evaluating different types of industrial products and vehicles according to European and international IEC/ISO safety standards. SP also performs fire investigations specifically related to situations where the fire may have been initiated by the electrical system. Further, we are involved in defining and investigating the electrical safety of new types of vehicles with electric or hybrid motor drives. SP takes an active part in international standardization in the automotive field, e.g., SP has been active within the standardization of vehicle cables in ISO TC 22 SC3 WG4 USAG Automotive Electrical Cables for more than twenty years. SP has a significant amount of experience in testing of cables, harness products and automotive hoses, as well as other vehicle components. SP's well-equipped laboratories offer a broad range of opportunities for the testing of durability, mechanical, thermal and chemical properties.

**SP Fire Technology** is a world leader in the evaluation of fire safety in a broad range of applications. Isolated events seldom lead to a fire, rather a fire is the result of a combination of several events. The design of a vehicle means taking a wealth of product development requirements, functions and properties into account. Therefore, the final product is often a compromise between conflicting needs. There are often numerous combinations of components or designs that can lead to a hazard, be that a fire or other event, which are not always fully understood or treated. It is not only the design of the new product that determines whether the fire risk, for example, is high.



### Fire in buses

Weak points in designs and legislation of fire safety of buses have been identified and a programme for resolution or mitigation of weak points has been defined by work at SP. As a consequence SP is now involved in the Working Party on General Safety Provisions (GRSG) focussed on bus safety at the United Nations in Geneva (UN ECE). Most focus so far has been on revising ECE Regulation No. 118 where the fire performance requirements on interior materials are prescribed. SP, together with authorities having jurisdiction and industry in Sweden, Norway, Germany and France, are also looking at requirements for detection and fire fighting equipment in buses within the framework of the GRSG.

### Fire Risk Assessment

In the context of vehicle safety, Fire Risk Assessment entails consideration of both the hazard (i.e., the potential for a fire to occur) and the risk (i.e., hazard related to statistical occurrence) of a fire. Issues that should be considered include ignition risks, fire performance of materials and heat transport in and around the hot spots in the vehicle.

### Electrical Risk Assessment

In the context of vehicle safety Electrical Risk Assessment entails consideration of the vehicle electronic architectures. An Electrical Risk Assessment should be performed with respect to international standards (ISO and IEC) and regulations (UN/ECE), as well as relevant requirements based on our experience of risk evaluation and mitigation. It is not self-evident that compliance with international regulations will ensure fire safety; in fact our experience shows that using additional requirements provides added value in terms of risk mitigation. Incident reports and physical examination of parts and vehicles from incidents also give valuable information as input to an assessment

### EMC/EMI Performance

In the context of vehicle safety EMC/EMI performance concentrates on an assessment of the vehicle electronic architectures immunity to high electromagnetic fields. Modern vehicles where important functionality is using information transferred over data-buses are particularly vulnerable to fields generated by external telecommunication transmitters, radar stations, but also cell phones etc. carried by passengers or drivers. An EMC/EMI Performance assessment considers the complexity level of this architecture compared to the level of EMC immunity specified by legal regulations and manufacturer specific specifications.

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