

Uniform standards for LiDAR in rain, fog and dirt

DIN SAE SPEC 91571 creates the first reproducible test basis for adverse conditions

Aachen, March 2026

Automated driving functions are only as reliable as their sensor technology. In addition to radar and camera systems, LiDAR sensors can be used. LiDAR (Light Detection and Ranging) systems use laser pulses to generate high-resolution three-dimensional images of the vehicle's surroundings. They measure distances, detect objects and provide so-called point clouds, which can be used for functions such as lane guidance, obstacle detection and automated driving manoeuvres.

In practice, however, these systems do not operate under laboratory conditions. Rain, fog, dust or dirt on the sensor cover can significantly affect signal quality. At the same time, there have been no uniformly harmonised test procedures to date for objectively and comparably evaluating the performance of different LiDAR systems under such adverse conditions. Manufacturers, suppliers and testing organisations sometimes used their own methods, which limited the comparability of the results.

Development of a standardised test methodology

Against this backdrop, the industry consortium **LPAC (LiDAR Performance in Adverse Conditions)** was launched in October 2023 under the leadership of fka GmbH. The aim was to develop a reproducible and manufacturer-independent test methodology for evaluating the performance of LiDAR sensors under non-ideal environmental conditions.

Twelve companies from the automotive industry joined the consortium, including OEMs, Tier 1 suppliers, LiDAR manufacturers, component suppliers and testing organisations.

'Higher automation levels must work reliably even when conditions are far from ideal' explains **Prof. Dr.-Ing. Adrian Zlocki**, Head of Automated Driving at fka GmbH. 'With DIN SAE SPEC 91571, we are creating the first reproducible and manufacturer-independent basis for objectively evaluating the performance of LiDAR sensors under realistic environmental conditions. This not only increases the comparability between systems, but also strengthens trust, transparency and safety in the development of automated vehicles in the long term.'

The method development focused on three key influencing factors:

1. **Weather conditions** such as rain or fog
2. **Contamination** of the sensor surface by dust, dirt or road spray
3. **Interference** from other LiDAR systems or optical sensors

Additionally, a methodology for evaluation of sensor cleaning performance using sensor data was defined.

The test methodology, the necessary test tools and defined scenarios were developed and validated as part of the project. Eight different LiDAR sensors were tested on a test track in Aachen – with wavelengths of 905 nm and 1550 nm and different measuring principles such as **time-of-flight (ToF)**, which measures the time differences between laser pulses, and **Frequency Modulated Continuous Wave (FMCW)**, which additionally determines speed information via frequency shifts.

Temporary rain, fog and spray chambers were used under realistic conditions. In addition, systematic interference tests were carried out with several LiDAR systems operating simultaneously.

Publication of DIN SAE SPEC 91571

Based on the results of the LPAC consortium, **DIN SAE SPEC 91571** was published in March 2026 by the **German Institute for Standardisation (DIN)** and the **Society of Automotive Engineers (SAE)**.

The specification defines a uniform evaluation methodology for LiDAR sensors – regardless of sensor design, technical configuration or measurement principle. It enables structured performance evaluation at both the point cloud and object levels under defined adverse conditions.

This new framework particularly benefits:

- Vehicle manufacturers
- Sensor and component suppliers
- Development and research institutions
- Hardware and software developers
- Testing organisations and test site operators
- Manufacturers of ADAS and automated driving functions



'The challenge was to map environmental influences such as precipitation, aerosols, pollution and optical interference not only qualitatively, but also in a way that is reproducible in terms of measurement technology,' explains **Amogh Sakpal**, project manager of the LPAC consortium at fka GmbH. "With DIN SAE SPEC 91571, we define clearly structured test procedures, evaluation metrics at point cloud and object level, and standardised boundary conditions. This makes it possible to compare the performance of different LiDAR technologies – regardless of wavelength or measurement principle – under identical conditions. This is an essential prerequisite for reliable development decisions and the industrial scaling of automated driving functions."

The DIN SAE SPEC 91571 is now available [here](#).

Members of the LPAC consortium

fka GmbH, CHASM Advanced Materials, Daikin Chemical Europe, DEKRA Automobil, Honda R&D Europe, Kautex Textron, MicroVision, Scantinel Photonics, TORC Robotics, Valeo, Volvo Cars

About fka

For over 40 years, fka has been internationally renowned as an innovative development service provider for the mobility industry. Driving the world forward by developing ideas and creating innovations is the mission statement that the 170-strong team at fka has taken up as its banner.

Our passion for efficient, safe and fascinating mobility inspires the entire team. As one of the first companies on the Aachen campus, the spin-off from the Institute for Automotive Engineering at RWTH Aachen University demonstrated its foresight early on. Interdisciplinary expertise in all aspects of mobility and technological visions, combined with the advantages of an inspiring, creative location, are the driving force behind fka. Ideas, innovations and unique methodological expertise are shaped into well-founded and proven solutions that give fka's customers the necessary edge in a wide range of issues.

A complete range of services, from consulting and design to simulation and construction, right through to prototype construction and experimental testing, forms the basis for this.



With the motto 'creating ideas & driving innovations', the team already has the mobility of the future firmly in its sights.

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