



WHITE PAPER

General Safety Regulations for Assisted Driving

Legal Consulting. Systems Engineering. Verification and Validation.

EXECUTIVE SUMMARY

Advanced Driver-Assistance Systems (ADAS) have become key technologies shaping the future of mobility and the automotive industry. Attributed to their widely recognized benefits such as active safety improvements, driver workload reduction and traffic pressure alleviation, ADAS features are increasingly being welcomed to the market. More importantly, safety-related ADAS features have been mandated in the EU, and regulatory agencies in other markets have announced their forced implementation. As of 2022, new safety technologies such as Lane Keeping Assist, Advanced Emergency Braking and Blind Spot Indication System will become mandatory in European passenger cars, trucks and buses to avoid potential collisions and protect vulnerable road users like pedestrians and cyclists.

The increased demand is leading to significantly higher validation efforts by OEMs. To support this, AVL offers engineering services for all phases of the development, assisted by innovative tools and methods in order to reduce time and cost effort.

A good understanding of the legislation is key to derive the requirements correctly. AVL supports customers with highly competent legislation consultancy. We are also participating in a multiple ADAS standardization consortiums in order to be prepared for future standards.

Our independence from the supplier industry, combined with an extensive understanding of available assistance systems, enable us to assist our customers with model-based systems engineering (MBSE) and define the best ADAS specifications in terms of performance and legal requirements.

Our engineering services are supported by advanced methods and tools throughout the complete development, particularly in the area of calibration, verification and validation leading to reduced testing effort which consequently save cost and time. Testing can be offered in various environments, from Model-in-the-Loop (MiL)/ Software-in-the-Loop (SiL), Driver-in-the-Loop (DiL) and Vehicle-in-the-Loop (ViL), to proving ground and real-world public road testing. Several combinations can be realized thanks to the advanced Verification and Validation (V&V) Toolchain and co-simulation platform. Innovative digital twin approaches combine virtual and real-world environments with the aim of providing the leanest solution for our customers.

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INTRODUCTION AND INDUSTRY DEMAND

The General Safety Regulation (GSR) enforces a minimum set of active safety features in all new vehicles sold in Europe. The validation program must cover the legal requirements for vehicle models including all variants and customized vehicle equipment such as different tire sets, payloads or ride heights. Thus, in contrast to the standardized NCAP, multiple repetition loops of the entire validation program with different vehicle parameter variations must be executed. A balanced share between proving ground tests and virtual simulations provides an effective optimization of time and cost effort.

The validation and testing makes up the largest part of the GSR development effort. However, prior to the testing phase, system design needs to take place supported by flexible and agile systems engineering processes. Our MBSE approach, together with a highly integrated virtual development toolchain, allows for early cross checks against GSR requirements already in the design phase.

The new regulation defines only a basic level of active safety features, which must primarily operate under good weather and light conditions. Dependent on a car maker's strategy, these ADAS safety features should be further validated in terms of robust performance under real-world conditions such as changing weather, traffic density and daylight.

The car industry demands a strong ADAS validation partner with a broad understanding of the new GSR who takes over full responsibility for either legislative GSR validation test packages or complete test packages – all in combination with OEM-specific robustness and standardized NCAP validation procedures.



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REGULATORY ROADMAP FOR ADAS FEATURES

- „if fitted“ requirements
- mandatory for new type approvals (2022) and all new registrations (2024)
- only in case of automated vehicles

Regulatory Roadmap for ADAS features **M1-N3**

M1 N1			M2 N2 M3 N3		
LDWS			2013	LDWS	
			2014		
ACSF / CSF / ESF			2016	AEB V2V	ACSF / CSF / ESF
			2018	BSIS	
AEB V2V			2020		AEB V2V
CS/CSMS	SW Update/SW UMP		2021	CS/CSMS	SW Update/SW UMP
MOIS					
EDR	ELKS	AEB V2V, V2P	2022	LDWS	BSIS
Reverse Detection	DAMS	Driver Repl. System		Speed Limiter	Platooning (if fitted)
Vehicle Surrounding Info	Emergency Stop Signal	Alcohol Interlock		Driver Repl. System	Vehicle Surrounding Info
CS/CSMS	ISA	DDAW		Alcohol Interlock	CS/CSMS
				DDAW	Reverse Detection
AEB V2B			2024	ADDW	
ADDW					
			2026	EDR	Heavy-duty Direct Vision

Legend: ACSF (Automatically Commanded Steering Function), ADDW (Advanced Driver Distraction Warning), AEB (Advanced Emergency Braking System), BSIS (Blind Spot Information System), CS (Cyber Security), CSF (Corrective Steering Function), CSMS (Cyber Security Management System), DAMS (Driver Availability Monitoring System), DDAM (Driver Drowsiness and Attention Warning), EDR (Event Data Recorder), ELKS (Emergency Lane Keeping Systems), ESF (Emergency Steering Function, ISA (Intelligent Speed Assist), LDWS (Lane Departure Warning System), V2B (Vehicle to Bicyclist), V2P (Vehicle to Pedestrian), V2V (Vehicle to Vehicle)

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ADAS REGULATIONS AND RELATED AVL SERVICES

Introduction to the new regulations and legal consultancy

The new GSR introduces fresh legal obligations for the development of ADAS that affect all on-road vehicle manufacturers and suppliers.

The regulation was adopted on November 27th, 2019, and put into force in January 2020 across Europe. It is the European Union’s way of beginning a new era of vehicle safety that focuses on the safety of both the vehicle occupants and vulnerable road users (pedestrians and cyclists). Its scope covers light, medium and heavy-duty vehicles and trailers, i.e. N1-N3 and M1 to M3 vehicles.

The new GSR has a strong focus on ADAS features and advancing its implementation with the aim to increase road safety and reduce both serious injuries and fatalities on the road.

Its general application will start in July 2022 for new type approval, and in July of 2024 for all new registrations.

Furthermore, it allows the combination of virtual and real-world testing which enables new efficient approaches for validation.

AVL Legal Services:

For AVL, achieving GSR-compliance means closely monitoring legal discussions, early reviewing of drafts and anticipating future legislation, as well as providing legal intelligence to our customers through tailor-made support. With our consultancy services, customers can define the best strategy for their product portfolio whilst fulfilling GSR homologation requirements and optimizing its implementation.

Legislation Services



Continuous monitoring and legal expertise



Legislation Consulting



Tailored support for your projects



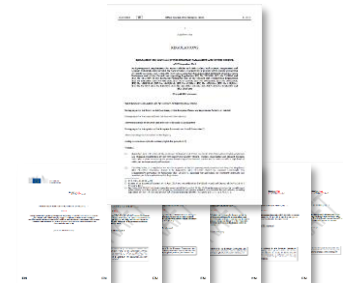
Studies and newsletters



Regulatory forecasts and trends analyses



Homologation support



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SYSTEMS ENGINEERING

Flexible system development with best traceability

The GSR dictates the implementation of several safety features within a short timeframe. An agile development process is key to enabling quick development loops to find the best system architecture that meets legal and customer-specific requirements.

AVL is experienced in working within the customers' specific processes. Additionally, we have developed our own agile development process following established automotive methods. This allows full traceability during the complete development cycle. Following this process, we can track the system requirements and potential updates based on the results from the verification tests. This makes us quick, agile and flexible while selecting the best system whilst securing quality.

Depending on the customer requirements we offer several project types – we can perform the complete project or execute certain parts of it. Regardless of the project type, system and component supplier engagement and management are key for selecting the best system (performance, price, quality, flexibility). Being an independent engineering company, we can perfectly act as partner interlinking supplier(s) and customers.

Our MBSE approach, with its various proven tools and highly efficient process methods, is key to master the speed and complexity needed to support customer timelines, and still considering the complete problem. Our “systems thinking” mindset supports OEMs in bringing their products faster to the market while also reducing cost.

GSR-related use cases and system requirements can be provided off-the-shelf and will be enhanced frequently with latest legal drafts.

AVL Engineering Services



- System design
- Requirement development and management
- Safety Engineering (HARA, TARA, SOTIF)
- ISO 26262 and SOTIF (ISO/PAS 21448)
- Vehicle safety concepts
- System simulation and analysis
- Process management
- Function-based release
- Configuration and change management
- Definition of verification and validation
- Test planning and management
- Test specification

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GSR TESTING APPROACH

Efficient Proving Ground Testing

The implementation of GSR-related Active Safety Features, relevant for homologation, leads to higher development efforts by OEMs, associated with larger scope for Verification & Validation (V&V). This in turn pushes the demands for methods and tools to improve efficiency in ADAS V&V.

The GSR defines test scenarios with a wide operating area like speeds, distances, loading conditions, etc. Therefore, AVL has developed a methodology to create test plans based on physical models of the dedicated vehicle ensuring the best trade-off between amount of test cases and quality / robustness.

We have the full GSR test catalogue with the related system requirements available in a digitalized format including the following items:

- Digital twin of the AVL ZalaZONE proving ground with GSR testing scenarios in Open.Drive and Open.Scenario format to ensure efficient test planning and simulation activities
- A smart driver guidance instructs the drivers to set corresponding test conditions, and directly analyzes test execution tolerances which leads to less repetition loops and faster progress
- Maximum traceability in the development process can be achieved thanks to the immediate analysis of the acceptance criteria which are confirming the system requirement IDs

The proving ground AVL ZalaZONE is equipped with the largest smart city in Europe, a highway and rural road section and an area dedicated to testing of active safety features. Hence, it offers capabilities for testing legislative, NCAP and functional requirements, executing ADAS reliability and robustness tests as well as AD development testing.



Active safety testing at proving ground



AVL ZalaZONE proving ground



Smart Mobile Solutions for driver guidance

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GSR TESTING APPROACH

Scenario-based ADAS/AD V&V Toolchain

Developing and testing the wide range of GSR features to meet series demands and regional specifics is increasingly expensive. The more variants that are available and at a higher automation level, the more effort and investments are required for safety testing and validation. To cope with the high complexity, high volume and high cost, new and efficient testing and validation methods and tools are needed. An important part of the solution is data-driven development and scenario-based testing, together with the shift into virtualization and simulation as well as overall development process optimization.

The AVL SCENIUS™ suite is a holistic solution for scenario-based ADAS/AD verification and validation. It supports the complete process from scenario design and management, to test case generation, test allocation and result reporting. Open interfaces and a modular design, allow a seamless integration into different development and test environments. Advanced reporting dashboards deliver deep insights into results.

The Scenario Designer is a tool for easy design, edit, parametrization and verification of ASAM Open.Scenario, and it is mostly used by the requirement engineer. On the one hand, the Scenario Data Manager gives the test planning engineer an efficient and workflow-optimized management of scenarios and all components required for test case execution. On the other hand, the Test Case Generator provides the test-planning engineer and execution-engineer test order and result management, and applies different advanced methods for test planning.

The AVL DRIVINGCUBE™ combines both, simulation and ready-to-drive vehicles on a chassis dynamometer and powertrain testbed. It paves a new way to speed up the validation and approval process of ADAS/AD systems. Its holistic sensor simulation and full range steering ability bring the proving ground to the testbed. Using fully automated, scenario-based testing increases the test coverage whilst reducing effort.



AVL SCENIUS™ - Scenario Designer



AVL SCENIUS™ - Dashboard



AVL DRIVINGCUBE™

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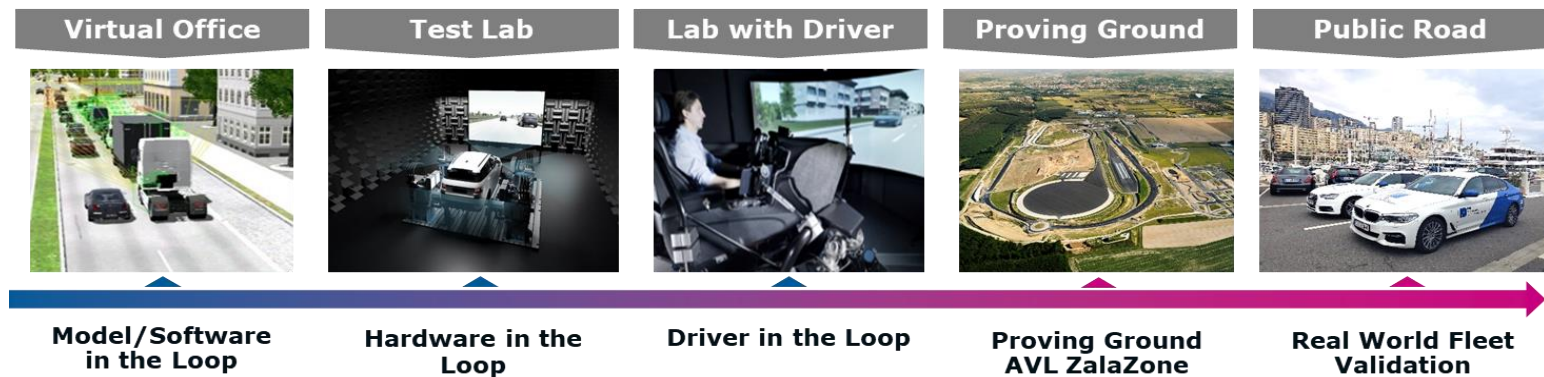
GSR TESTING APPROACH

Best combination of development environments

The digital twin approach is the basis for combining simulation and real vehicle testing. It enables the use of further test environments (HiL, DiL, ViL, etc.) to reduce test effort and time while keeping complexity of the testing environment manageable.

As an intermediate step towards real-world public road testing, additional approaches have been developed for testing of feature such as DDAW (Driver Drowsiness and Attention Warning) and ISA (Intelligent Speed Assist) in HiL/DiL/ViL environments, and have been widely considered as being effective.

AVL provides services for test preparation, test execution and test evaluation/reporting in several different development environments and secures outstanding correlation between virtual and real tests in order to meet demands from homologation authorities.



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Beyond legal requirements: End user satisfaction

Usually, ADAS test programs are extended to public roads in order to validate robustness and reliability in various environments of daily usage. Beyond legislative requirements, the ADAS performance needs to be validated further according to the driver's expectation and highest end user satisfaction, respectively.

Therefore, AVL supports global fleet testing campaigns on public roads including a full range of services from route planning, global test execution, data collection, analysis and assessment of ADAS performance.

The AVL approach with Over-the-Air (OTA) transfer of collected data including, selected metadata from the fleet vehicles to a backend software, enables a new way of monitoring and interactively optimizing the fleet testing progress. The targeted coverage rate and maneuver diversity can be reliably achieved by continuously adjusting route segments of the fleet vehicles. At the backend platform, driving maneuvers are automatically analyzed and assessed in terms of KPI performance targets.

To further enhance efficiency, the test drivers in the vehicles are supported by a voice-controlled test guidance app. It assists the drivers in guiding through pre-defined maneuvers and can provide suggestions for maneuvers from the test catalogue where test parameters would just fit. The test progress for all maneuvers are synchronized over the entire test fleet in order to improve the test output in terms of highest coverage and maneuver diversity.



Driver guidance for proving ground and public road testing without co-drivers.

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Accelerating the development of safe and robust GSR features

AVL's ADAS expertise involves optimal application of proprietary methodologies for an efficient execution across all development phases - from analysis of the legislative requirements via systems engineering, to verification and validation of GSR features, ensuring best preparation work for successfully vehicle type approval.

Legal Consulting

- Continuous monitoring provides our customers with highest legal expertise of existing and planned regulations
- Tailored support beyond GSR like NCAP, ALKS, AD, NHTSA etc. allows our customers to select the best development approaches



Systems Engineering

- Early investigation of system requirements corresponding to GSR will safeguard successful homologation of the vehicle
- Available machine-readable test plans lead to shorter validation time
- Processes compliant to automotive standards ensure highest development efficiency



Verification & Validation

- Ready-to-use test catalogue for immediate execution of validation lead to fast and reliable results
- Several testing environments provide highest flexibility to include other validation programs like NCAP, ALKS, customer satisfaction, robustness, safety, etc.
- Proven methodologies for highest testing efficiency and quality assured results



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