



UNECE

Inland Transport Committee

World Forum for Harmonization of Vehicle Regulations

Framework document on automated/autonomous vehicles¹

¹ This document has been prepared by the representatives of China, European Union, Japan and the United States of America. It has been adopted by the World Forum for Harmonization of Vehicle Regulations (WP.29) at its 178th session, see ECE/TRANS/WP.29/1147, para. 27 and then revised. It has been endorsed by the Inland Transport Committee of UNECE at its February 2020 session. The Annex has since been updated in November 2021, see ECE/TRANS/WP.29/2021/151 and ECE/TRANS/WP.29/1161, para. 28.

Purpose

This Framework document's primary purpose is to provide guidance to World Forum for Harmonization of Vehicle Regulations (WP.29) subsidiary Working Parties (GRs) by identifying key principles for the safety and security of automated/autonomous vehicles of levels 3 and higher².

The framework document also defines the work priorities for WP.29 and indicates the deliverables, timelines and working arrangements for those certain work products related to those priorities.

Working Principles

Technical provisions and/or guidance and resolutions for automated/autonomous vehicles shall be conducted within the contexts of both the 1958 Agreement and 1998 Agreement.

Technical provisions, guidance resolutions and evaluation criteria for automated vehicles will to the extent possible, be performance based, technology neutral, and based on state-of-the-art technology while avoiding restricting future innovation.

Existing standards/guidelines of the contracting parties and in standardization bodies shall be reviewed as well as previous work and reference documents agreed in UNECE.

This document shall be approved and managed by WP.29 as specific work items are expected to be prepared in multiple GRs with extensive cross-coordination between them. The implementation of each work item shall be monitored at each WP.29 session under a dedicated agenda item. Furthermore, this document shall be reviewed once a year and be updated, if necessary.

Safety Vision

WP.29 recognizes that for automated/autonomous vehicles to fulfil their potential in particular to improve road transport, then they must be placed on the market in a way that reassures road users of their safety. If automated/autonomous vehicles confuse users, disrupt road traffic, or otherwise perform poorly then they will fail. WP.29 seeks to avoid this outcome by creating the framework to helping to deliver safe and secure road vehicles in a consistent manner, and to promote collaboration and communication amongst those involved in their development and oversight.

The level of safety to be ensured by automated/autonomous vehicles implies that “an automated/autonomous vehicle shall not cause any non-tolerable risk”, meaning that automated/autonomous vehicle systems, under their automated mode (Operational Design Domain (ODD) or Operational Domain (OD)), shall not cause any traffic accidents resulting in injury or death that are reasonably foreseeable and preventable. Based on this principle, this framework sets out a series of vehicle safety topics to be taken into account to ensure safety.

² See Automated Driving definitions referenced in WP.29 ECE/TRANS/WP.29/1140, adopted in March 2018

Key issues and principles to be considered by WP29 subsidiary bodies as a priority

The following list of issues and principles will guide discussions and activities on automated/autonomous vehicles within WP.29 and each of its relevant subsidiary Working Parties. The aim is to capture the shared interests and concerns of regulatory authorities, provide the general parameters for work, and to provide common definitions and guidance.

The following is a list of common principles with brief descriptions and explanation. It is expected these would form the basis for further development.

- a) System Safety: When in the automated mode, the automated/autonomous vehicle should be free of unreasonable safety risks to the driver and other road users and ensure compliance with road traffic regulations;
- b) Failsafe Response: The automated/autonomous vehicles should be able to detect its failures or when the conditions for the [ODD/OD] are not met anymore. In such a case the vehicle should be able to transition automatically (minimum risk manoeuvre) to a minimal risk condition;
- c) Human Machine Interface (HMI) /Operator information: Automated/ autonomous vehicle should include driver engagement monitoring in cases where drivers could be involved (e.g. take over requests) in the driving task to assess driver awareness and readiness to perform the full driving task. The vehicle should request the driver to hand over the driving tasks in case that the driver needs to regain a proper control of the vehicle. In addition, automated vehicle should allow interaction with other road users (e.g. by means of external HMI on operational status of the vehicle, etc.);
- d) Object Event Detection and Response (OEDR): The automated/autonomous vehicles shall be able to detect and respond to object/events that may be reasonably expected in the [ODD/OD];
- e) Operational Design Domain (ODD/OD)] (automated mode): For the assessment of the vehicle safety, the vehicle manufacturers should document the OD available on their vehicles and the functionality of the vehicle within the prescribed OD. The OD should describe the specific conditions under which the automated vehicle is intended to drive in the automated mode. The OD should include the following information at a minimum: roadway types; geographic area; speed range; environmental conditions (weather as well as day/night time); and other domain constraints;
- f) Validation for System Safety: Vehicle manufacturers should demonstrate a robust design and validation process based on a systems-engineering approach with the goal of designing automated driving systems free of unreasonable safety risks and ensuring compliance with road traffic regulations and the principles listed in this document. Design and validation methods should include a hazard analysis and safety risk assessment for Automated Driving System (ADS), for the OEDR, but also for the overall vehicle design into which it is being integrated and when applicable, for the broader transportation ecosystem. Design and validation methods should demonstrate the behavioural competencies an Automated/autonomous vehicle would be expected to perform during a normal operation, the performance during crash avoidance situations and the performance of fall back strategies. Test approaches may include a combination of simulation, test track and on road testing;

g) Cybersecurity: The automated/autonomous vehicle should be protected against cyber-attacks in accordance with established best practices for cyber vehicle physical systems. Vehicles manufacturers shall demonstrate how they incorporated vehicle cybersecurity considerations into ADSs, including all actions, changes, design choices, analyses and associated testing, and ensure that data is traceable within a robust document version control environment;

h) Software Updates: Vehicle manufacturers should ensure system updates occur as needed in a safe and secured way and provide for after-market repairs and modifications as needed;

i) Event data recorder (EDR) and Data Storage System for Automated Driving vehicles (DSSAD): The automated/autonomous vehicles should have the function that collects and records the necessary data related to the system status, occurrence of malfunctions, degradations or failures in a way that can be used to establish the cause of any crash and to identify the status of the automated/autonomous driving system and the status of the driver. The identification of differences between EDR and DSSAD to be determined.

Additional issues not listed in the currently agreed WP29 priorities

j) Vehicle maintenance and inspection: Vehicle safety of in-use vehicles should be ensured through measures such as related to maintenance and the inspection of automated vehicles etc. Additionally, vehicle manufacturers are encouraged to have documentation available that facilitates the maintenance and repair of ADSs after a crash. Such documentation would likely identify the equipment and the processes necessary to ensure safe operation of the automated/autonomous vehicle after repair;

k) Consumer Education and Training: Vehicle manufacturers should develop, document and maintain employee, dealer, distributor, and consumer education and training programs to address the anticipated differences in the use and operation of automated vehicles from those of conventional vehicles;

l) Crashworthiness and Compatibility: Given that a mix of automated/autonomous vehicles and conventional vehicles will be operating on public roadways, automated/autonomous vehicle occupants should be protected against crashes with other vehicles;

m) Post-crash AV behaviour: Automated/autonomous vehicles should be able to return to a safe state immediately after being involved in a crash. Things such as shutting off the fuel pump, removing motive power, moving the vehicle to a safe position off the roadway, disengaging electrical power, and other relevant actions should be considered. A communication with an operations center, collision notification center, or vehicle communications technology should be used.

The following annex contains the full consolidated list of safety aspects in the guidelines of Contracting Parties.

Annex

Table 1

Detailed WP.29 work priorities related to automated/autonomous vehicles

Title	Description of work / ECE/TRANS/WP.29/2019/2	Corresponding principles/elements	Allocation to	Main targets	Activities		Deliverable/ Deadline for submission to WP29
					Current activities	Future Activities	
Functional Requirements for automated/autonomous vehicles)	This work item should cover the functional requirements for the combination of the different functions for driving: longitudinal control (acceleration, braking and road speed), lateral control (lane discipline), environment monitoring (headway, side, rear), minimum risk manoeuvre, transition demand, HMI (internal and external) and driver monitoring. This work item should also cover the requirements for Functional Safety	a. System safety b. Failsafe Response c. HMI /Operator information d. OEDR (Functional Requirements) e. Operational Design Domain	GRVA/ FRAV informal group	Automated / Autonomous vehicles	Identification and definition of high-level performance requirements for ADS		March 2021
					High-level definition of safety of ADS and mandatory manufacturer description of ADS		March 2021
						Draft initial WP.29 guidelines for ADS safety requirements based on "current activities" including the requirements on motorway use case.	GRVA of September 2021 for delivery to WP.29 of November 2021 (information) / March 2022 (endorsement)
						Proposal for WP.29 guidelines on ADS safety requirements	GRVA of February 2022 for delivery to WP.29 of March 2022 (information)/ June 2022 (endorsement)

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