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Consideration of proposals for new UN Regulations submitted by the Working Parties subsidiary to the World Forum, if any:
Proposal for a new UN Regulation on ADS

Proposal for a new United Nations Regulation on uniform provisions concerning the approval of motor vehicles with regard to their Automated Driving Systems

Submitted by the Working Party on Automated/Autonomous and Connected Vehicles (GRVA)*

The text reproduced below was adopted by the Working Party on Automated/Autonomous and Connected Vehicles (GRVA) at its twenty-fourth session (ECE/TRANS/WP.29/GRVA/24, paragraph 60) and requested by the World Forum for Harmonization of Vehicle Regulations (WP.29) at its 198th session (ECE/TRANS/WP.29/1190, para. 13). It is based on ECE/TRANS/WP.29/GRVA/2026/3 (as amended by informal document WP.29-198-09) and submitted pursuant to ECE/TRANS/WP.29/2019/34/Rev.2 as amended by ECE/TRANS/WP.29/2021/151, ECE/TRANS/WP.29/2023/43, and ECE/TRANS/WP.29/2024/33 (Framework Document on Automated Vehicles), ECE/TRANS/WP.29/2024/39 (Guidelines and recommendations for Automated Driving System safety requirements, assessments and test methods to inform regulatory development), and informal document WP.29-191-30/Rev.1 as adopted during the 191st WP.29 session (Regulatory approach for Automated Driving Systems). It also includes the amendments drafted by GRVA during the consultations held in Canada, as part of the twenty-fifth GRVA session. It is submitted to the World Forum for Harmonization of Vehicle Regulations (WP.29) and to the Administrative Committee (AC.1) for consideration at their June 2026 sessions.

* In accordance with the programme of work of the Inland Transport Committee for 2026 as outlined in proposed programme budget for 2026 (A/80/6 (Sect. 20), table 20.7), the World Forum will develop, harmonize and update UN Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

UN Regulation No. [xxx]

Uniform provisions concerning the approval of motor vehicles with regard to their Automated Driving Systems

Contents

Introduction

1. This Regulation establishes uniform provisions and a harmonized methodology for validating the safety of vehicles with regard to their Automated Driving Systems (ADS) to enable the safe introduction of this technology in the market. As a general concept, this Regulation requires the ADS to deliver a level of safety in mixed traffic at least equivalent to that of a competent and careful human driver.

2. Due to the diversity of ADS vehicle configurations and the characteristics and constraints of their Operational Design Domains (ODD), this Regulation does not include detailed prescriptive requirements and specific test procedures. Instead, this Regulation covers manufacturer requirements and processes to ensure safety management capability over the lifecycle of the ADS. This is alongside high-level outcome-focused requirements for the ADS and a safety-case approach where manufacturers are required to demonstrate through a structured body of claims, arguments and evidence that the ADS meets the requirements of the Regulation and is free from unreasonable risk. While Safety Management Systems (SMS) and safety cases are well established in the aerospace and nuclear industries, this is a first application for regulations administered by the World Forum for Harmonization of Vehicle Regulations (WP.29) with both the UN Regulation and UN Global Technical Regulation for ADS in a combined approach.

3. This Regulation includes requirements for ADS performance of the Dynamic Driving Task (DDT), interactions between the ADS and its users, and provisions relevant to safe use such as data storage systems, cyber security and software update management. Requirements for in-service monitoring and reporting (ISMR) cover the manufacturer monitoring the performance of the ADS and reporting to the respective authorities on significant incidents that occur.

4. The Regulation further establishes obligations on manufacturers to implement and maintain an SMS addressing the entire lifecycle of the ADS, to substantiate a comprehensive safety case and to demonstrate the credibility of the testing environments and methods used.

5. This Regulation also details procedures to assess the documentation and evidence provided by the manufacturer. This covers the audit of the SMS, the assessment of the safety case and test environment, and assessor confirmatory testing to confirm the accuracy of the evidence provided by the manufacturer in the safety case.

6. The requirements in this Regulation are written with the expectation that ADS software does not include the use of online in-vehicle learning that self modifies system behaviour.

7. The content of this Regulation is based on current evidence and research available to WP.29. As both the technology and regulatory approaches develop, updates may be required to maintain a contemporary regulatory framework for ADS.

8. To support consistent interpretation, application and assessment of these provisions, an accompanying interpretation/guidance document has been prepared, which manufacturers, technical services and relevant authorities should pay due regard to.

1. Scope

1.1. This Regulation applies to the type-approval of vehicles of Categories M, N, L_6 and L_7 with regard to their Automated Driving Systems.

1.2. This Regulation does not apply to any ADS feature that has been approved as an Automated Lane-Keeping System (ALKS) pursuant to UN Regulation No. 157 except for the provisions under paragraph 7.3.2.17.

2. Definitions

2.1. "*Automated Driving System (ADS)"* means the vehicle hardware and software that are collectively capable of performing the entire Dynamic Driving Task (DDT) on a sustained basis. [1]

2.2. *"ADS vehicle"* means a vehicle equipped with an ADS.

2.3. *"Dynamic Driving Task (DDT)"* means the real-time operational and tactical functions required to operate the vehicle.

2.3.1. When the ADS feature is active, the DDT is always performed in its entirety by the ADS which means the whole of the tactical and operational functions necessary to operate the vehicle (i.e., the ADS performs "the entire DDT" as stated in the definition of an "Automated Driving System" under paragraph 2.1.). These functions can be grouped into three interdependent categories: sensing and perception, planning and decision, and control.

2.3.2. Sensing and perception include:

(a) Monitoring the driving environment via object and event detection, recognition, and classification,

(b) Perceiving other vehicles and road users, the roadway and its fixtures, objects in the vehicle's driving environment and relevant environmental conditions,

(c) Sensing the ODD boundaries, if any, of the ADS feature, and

(d) Positional awareness.

2.3.3. Planning and decision include:

(a) Predicting actions of other road users,

(b) Response preparation, and

(c) Manoeuvre planning.

2.3.4. Control includes:

(a) Object and event response execution,

(b) Lateral vehicle motion control,

(c) Longitudinal vehicle motion control, and

(d) Enhancing conspicuity via lighting and signalling.

2.3.5. The DDT excludes strategic functions.

2.4. *"Real time"* means the actual time during which a process or event occurs.

2.5. *"(ADS) function"* means an ADS hardware and software capability designed to perform a specific portion of the DDT.

2.5.1. *"Operational function"* means a capability to control the real-time motion of the vehicle.[2]

[1] This definition is based on SAE J3016 and ISO/PAS 22736 (Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles). These standards define levels of driving automation based on the functionality of the driving automation system feature as determined by an allocation of roles in DDT and DDT fallback performance between that feature and the (human) user (if any). The term "Automated Driving System" is used specifically to describe a Level 3, 4, or 5 driving automation system.

[2] Operational functions involve executing micro-changes in steering, braking, and accelerating to maintain lane position or proper vehicle separation and immediate responsive actions to avoid crashes in critical driving situations.

2.5.2. *"Tactical function"* means a capability to perceive the vehicle environment and control real-time planning, decision, and execution of manoeuvres, including conspicuity of the vehicle and its motion.[3]

2.5.3. *"Strategic function"* means a capability to issue commands, instructions, or guidance for execution by an ADS.[4]

2.6. *"(ADS) feature"* means an application of an ADS designed specifically for use within an Operational Design Domain (ODD).

2.6.1. *"ADS feature of type 1 (ADSF-1)"* means an ADS feature which includes an ADS fallback response requiring a fallback user.

2.6.2. *"ADS feature of type 2 (ADSF-2)"* means an ADS feature which does not include an ADS fallback response requiring a fallback user.

2.7. *"(ADS feature) active"* means the operational state in which an ADS feature is performing the DDT.

2.8. *"(ADS feature) activation"* means the act of changing the operational state of an ADS feature, from available to active.

2.9. *"(ADS feature) available"* means the operational state of an ADS feature pursuant to the ADS verification that the ODD conditions of the feature have been met at a time prior to activation of the feature when it is not performing any part of the DDT.

2.10. *"(ADS feature) deactivation"* means the change of the operational state of the ADS feature from the state in which it is performing all of the DDT to the state in which it is performing none of the DDT.

2.11. *"Data Storage System for Automated Driving (DSSAD)"* means the capability to record and store data concerning the safety performance of a vehicle's ADS.

2.11.1. *"(DSSAD) triggering event"* means a time-stamped data element that triggers the recording and storing of time-series data elements.

2.11.2. *"Emergency manoeuvre"* means a manoeuvre performed by the system in case of an event in which the vehicle is at imminent collision risk and has the purpose of avoiding or mitigating a collision.

2.11.3. *"Imminent collision risk"* means a situation or an event that leads to a collision of the vehicle with another road user or an obstacle that cannot be avoided by a braking demand lower than 5 m/s^2.

2.11.4. *"Detected object"* means a static or dynamic object (e.g., animal or other road user) detected by the ADS and recognised as relevant for the purpose of performing the DDT.

2.12. *"Operational Design Domain (ODD)"* means the operating conditions under which an ADS feature is specifically designed to function.

2.12.1. *"ODD exit"* means:

(a) the presence of one or more ODD conditions outside the limits defined for use of the ADS feature, and/or

(b) the absence of one or more conditions required to fulfil the ODD conditions of the ADS feature.

2.13. "*Occurrence"* means a safety-relevant event involving an ADS vehicle.[5]

[3] Examples include deciding whether to overtake a vehicle or change lanes, signalling intended manoeuvres, deciding when to initiate the manoeuvre, choosing the proper speed, and executing the manoeuvre.

[4] Examples include setting the starting point, destination, route, and way points to be used by an ADS during a trip.

[5] The occurrences to be reported are listed in Annex 3.

2.13.1. *"Critical Occurrence"* means an occurrence during which at least one of the following criteria is fulfilled:

(a) At least one person suffers an injury that requires medical attention or dies as a result of being in the vehicle or being involved in the event,

(b) The ADS vehicle, other vehicles, or stationary objects sustain physical damage that exceeds a certain threshold, or

(c) Any vehicle involved in the event experiences a deployment of any non-reversible occupant restraint system, vulnerable road user secondary safety system, or the delta-V thresholds to be met, whichever occurs first.

2.13.2. *"Significant Occurrence"* means occurrences that are not "Critical Occurrences" but are required to be reported on a short-term basis due to their relevance to safety.

2.13.3. *"Vulnerable road user secondary safety system"* means a deployable vehicle system outside the occupant compartment designed to mitigate injury consequences to vulnerable road users during a collision.

2.14. *"(ADS) user"* means a human user of an ADS vehicle.

2.14.1. *"Occupant"* means an ADS user located inside an ADS vehicle.

2.14.2. *"Driver"* means an ADS user who performs in real time part or all of the DDT for a particular ADS vehicle.

2.14.3. *"Fallback user"* means an occupant designated to perform the DDT pursuant to an ADS fallback response.

2.14.4. *"(ADS vehicle) Passenger"* means an occupant who is not a driver or fallback user.

2.15. *"ADS fallback response"* means a system-initiated deactivation procedure or an ADS-controlled procedure to place the vehicle in a mitigated risk condition (MRC).

2.16. *"System-initiated deactivation of the ADS"* means a procedure by which the ADS initiates the transfer of performance of the DDT from an ADSF-1 to a fallback user.

2.17. *"User-initiated deactivation of the ADS"* means a procedure by which the user initiates the transfer of performance of the DDT from an ADS feature to the user.

2.18. *"Suppressed"*, in relation to manual controls, means a condition, in which a control function is limited or has limited effect until a threshold is exceeded.

2.19. *"Remote termination"* means the act of remotely disabling one or more ADS features of one or more vehicles.

2.20. *"Mitigated Risk Condition (MRC)"* means a stable and stopped state of the vehicle that reduces the risk of a crash.

2.21. *"Other road user (ORU)"* means any entity making use of publicly accessible road infrastructure.

2.21.1. *"Road-safety agent"* means a human engaged in directing traffic, enforcing traffic laws, and/or responding to traffic incidents.

2.21.2. *"Priority vehicle"* means a vehicle subject to exemptions, authorisations, and/or right-of-way under traffic laws while performing a specified function.

2.22. *"Behavioural competency"* means an expected and verifiable capability of an ADS feature to operate a vehicle within the ODD of the feature.

2.23. *"Failure"* means the termination of an intended behaviour of a system or component due to fault manifestation.

2.24. *"Fault"* means an abnormal condition that can cause a system or component to fail.

2.25. *"Functional safety"* means the absence of unreasonable risks under the occurrence of hazards caused by a malfunctioning behaviour of electric/electronic systems (safety hazards resulting from system faults).

2.26. *"Safety of the intended functionality (SOTIF)"* means the absence of unreasonable risk due to hazards resulting from functional insufficiencies of the intended functionality or reasonably foreseeable misuse.

2.27. *"Safety Management System (SMS)"* means a systematic approach to managing safety that encompasses and integrates organisational, human, and technical factors:

(a) Human component ensuring the ADS lifecycle is monitored by personnel with appropriate skills, training, and understanding to identify risks and appropriate mitigation measures while accounting for the possibility of human errors.

(b) Organisational component procedures and methods that help to manage the identified risks, understand their relationships and interactions with other risks and mitigation measures, and help to ensure that there are no unforeseen consequences, and

(c) Technical component using appropriate tools and equipment.

2.28. *"Test method"* means a structured approach to consistently derive knowledge about the performance of an ADS by means of executing tests.

2.29. *"Virtual testing"* means a type of testing that uses a simulation toolchain(s) to generate evidence for the manufacturer's safety case.

2.29.1. *"Simulation"* means the imitation of the operation of a real-world process or system over time, utilising a software implementation for some (or all) of the models, tools, or test environment.

2.29.2. *"Simulation toolchain"* means a simulation tool or a combination of simulation tools that are used to generate evidence for the manufacturer's safety case.

2.29.3. *"Model"* means a description or representation of a system, entity, phenomenon, or process.

2.29.4. *"(Model) parameter"* means a numerical value inferred from real-world data and used to represent a system characteristic.

2.29.5. *"Stochastic model"* means a model involving or containing a random variable or variables pertaining to chance or probability.

2.29.6. *"Validation (of a simulation model)"* means the process of determining the degree to which a simulation model is an accurate representation of the real world from the perspective of its intended uses.

2.29.7. *"Verification (of a simulation model)"* means the process of determining the extent to which a simulation model or a virtual testing tool is compliant with its requirements and specifications as detailed in its conceptual models, mathematical models, or other constructs.

2.29.8. *"Sensor Stimulation"* means a technique whereby artificially generated signals are provided to trigger the element under testing in order to produce the result required for evaluation of the element.

2.30. *"Test track"* means a facility, including a proving ground or roadway, closed to public traffic and designed to enable physical assessment of an ADS and/or ADS vehicle performance, e.g., via sensor stimulation and/or the use of dummy devices.

2.31. *"Safety case"* means structured documentation that provides a compelling, comprehensible, and valid case that the ADS meets the relevant ADS

requirements of this Regulation and is free from unreasonable risks to the ADS vehicle user(s) and other road users.

2.31.1. *"Argument"* means a written explanation within a safety case that captures the logical connections between a claim and the evidence for achievement of that claim.

2.31.2. *"Claim"* means a verifiable statement within a safety case.

2.31.3. *"Evidence"* means material pertinent to demonstrating the validity of a claim, such as physical test results, simulation results, analyses with supporting data, etc.

2.32. *"Safety concept"* means a description of the measures designed into the ADS so that it operates in such a way that it is free of unreasonable safety risks to the ADS vehicle user(s) and other road users in every operating condition relevant to the ODD.

2.33. *"(Driving) situation"* means the conditions surrounding a vehicle (including other road users).

2.33.1. *"Nominal situation"* means a driving situation that is neither a critical nor a failure situation.

2.33.2. *"Critical situation"* means a driving situation that requires prompt action by the ADS to avoid or mitigate the risk of a crash that could result in adverse consequences on human health or property damage.

2.33.3. *"Failure situation"* means a driving situation where a failure compromises the capability of the ADS to perform the entire DDT.

2.34. *"Traffic scenario"* means a representation of a sequence of driving situations that can occur during a given trip.

2.34.1. *"Nominal scenario"* means a traffic scenario representing one or more nominal driving situations.

2.34.2. *"Critical scenario"* means a traffic scenario representing one or more critical situations.

2.34.3. *"Failure scenario"* means a traffic scenario representing one or more failure situations.

2.34.4. *"Functional scenario"* means a basic traffic scenario describing a situation and its corresponding elements at the highest level of abstraction in natural, non-technical language.[6]

2.34.5. *"Abstract scenario"* means a formalized, declarative description of a scenario derived from a functional scenario.[7] The specification on the abstract level enables highlighting of the relevant aspects of the scenario while focusing on efficient description of relations (cause-effect).

2.34.6. *"Logical scenario"* means a traffic scenario elaborated at a lower level of abstraction to include value ranges or probability distributions for each element of the corresponding functional scenario.[8]

2.34.7. *"Concrete scenario"* means a traffic scenario at a level of abstraction in which specific values have been selected for each element from the continuous ranges as may be defined in the corresponding logical scenario.

[6] For example, a description of the ego vehicle's actions, the interactions of the ego vehicle with other road users and objects, and other elements that compose the scenario such as environmental conditions.

[7] Declarative descriptions can include structured natural language, programming language or other forms of languages that meet the required criteria (formalized and declarative).

[8] For example, elaborating the lane element to cover possible lane widths.

2.35. *"Safety-relevant object"* means an object that, if collided with, is likely to cause non-trivial damage to the vehicle or that is likely to pose a safety risk to other road users, vehicle occupants, or infrastructure.

2.36. *"Vehicle Type with regard to its Automated Driving System (ADS)"* means a category of vehicles which do not differ in such essential aspects as:

(a) The system characteristics and design of the ADS,

(b) Vehicle features that significantly influence the performance of the ADS, and

(c) The manufacturer's designation of the vehicle type.

2.37. For the definitions with regard to Software Identification Number, refer to the Consolidated Resolution on the Construction of Vehicles (R.E.3), Annex 7, paragraph 2.

3. Application for Approval

3.1. Prior to application for approval, and as early as reasonably practicable, the manufacturer or their duly accredited representative shall provide the following information to the approval authorities[9] of all the Contracting Parties in whose territory features of the ADS can be active ('receiving approval authorities').[10]

(a) A single point of contact for the receiving approval authorities to request information from the manufacturer,

(b) The expected granting approval authority and the designated technical service being used by the manufacturer, if already selected, and

(c) Brief details of the ADS, its feature(s) and ODD; this information shall be treated as confidential by the receiving approval authority.

3.1.1. In the case that the territory of an additional Contracting Party is added as part of an application for extension of a type approval, the requirements of paragraph 3.1. shall apply *mutatis mutandis* with respect to that Contracting Party and its approval authority.

3.2. The application for approval of a vehicle type with regard to its ADS shall be submitted by the manufacturer or by their duly accredited representative. It shall be accompanied by the documents mentioned below in triplicate:

3.2.1. A certificate of compliance for the SMS in accordance with this Regulation.

3.2.2. A description of the vehicle type with regard to the items mentioned in paragraph 2.36, together with a documentation package as required in Appendix 1 of Annex 1 which gives access to the basic design of the ADS and the means by which it is linked to other vehicle systems or by which it directly controls output variables. The numbers and/or symbols identifying the vehicle type shall be specified.

3.2.3. In the case of ADS with features that can be active in the territory of Contracting Parties other than the Contracting Party issuing the approval, the

[9] Using the email address(es) provided on the online platform ("/343 Application") provided by UNECE and dedicated to the exchange of such information: https://www.unece.org/trans/main/wp29/datasharing.html or, if unavailable/discontinued, in the latest revision of document ECE/TRANS/WP.29/343 ('/343 document'). Contracting Parties without an approval authority shall publish the relevant contact details on the online platform ("/343 Application") or in the /343 Document in lieu of the details of an approval authority for this UN Regulation along with a note stating that this is not an approval authority.

[10] These provisions shall be kept under periodic review by GRVA for amendment as necessary to support effective implementation of this UN Regulation.

manufacturer shall provide to the granting approval authority the following information for each territory:

(a) Summary of how freedom from unreasonable risk has been defined, including details of specificities for the respective territory (if any),

(b) Summary of how the safety level of a competent and careful human driver has been determined, including details of specificities for the respective territory (if any),

(c) Summary of how applicable traffic rules have been identified, interpreted, and assessed,

(d) Summary of specific testing carried out regarding the territory,

(e) A single point of contact for the receiving approval authorities to request information from the manufacturer, and

(f) Details of the authorities identified for fulfilling the obligation to provide post-deployment notifications and reports to the 'relevant authority'.

3.2.4. In the case of ADS vehicles that are subject to the requirements of UN Regulation No. 79, an analysis showing that the safety concept of the ADS steering equipment is compatible with the safety concept of the ADS.

3.3. In cases where information is shown to be covered by intellectual property rights or to constitute specific know-how of the manufacturer or of their suppliers, the manufacturer or their suppliers shall make available sufficient information to enable the checks referred to in this Regulation to be made properly. Such information shall be treated on a confidential basis.

4. Approval

4.1. Approval authorities shall grant, as appropriate, type approval with regard to Automated Driving Systems, only to such vehicle types that satisfy the requirements of this Regulation.

4.1.1. The approval authority or its designated technical service shall verify in accordance with paragraph 8 that the manufacturer has taken the necessary measures relevant for the vehicle type in respect of:

(a) The test environments according to paragraph 7.2,

(b) The safety case according to paragraph 7.3,

(c) Post-deployment safety according to paragraph 7.4,

(d) Other manufacturer requirements according to paragraph 7.5.

4.1.1.1. In the case of ADS vehicles that are subject to the requirements of UN Regulation No. 79, the approval authority or its designated technical service shall verify the compatibility between the safety concept of the ADS steering equipment and the safety concept of the ADS.

4.1.2. The approval authority or its designated technical service shall verify by confirmatory testing of a vehicle of the vehicle type, according to paragraph 8.3.3, that the manufacturer has implemented the measures they have documented.

4.1.2.1. Confirmatory Testing shall at least include track and real-world testing.

4.1.2.2. Track testing may be omitted from confirmatory testing if the approval authority or its designated technical service deems the evidence collected by real-world testing sufficient to verify that the manufacturer has implemented the measures they have documented.

4.1.3. The approval authority or its designated technical service shall verify that the Certificate of Compliance for SMS submitted by the manufacturer is valid and is applicable to the vehicle type.

4.1.4. The approval authority shall refuse to grant the type approval where the manufacturer has not fulfilled one or more of the requirements of this Regulation.

4.1.5. The approval authority shall also refuse to grant the type approval where the approval authority or its designated technical service has not received sufficient information from the manufacturer to assess the Automated Driving System of the vehicle type.

4.2. Notice of approval or of extension or refusal of approval of a vehicle type pursuant to this Regulation shall be communicated to the Parties to the 1958 Agreement that apply this Regulation by means of a form conforming to the model in Annex 1 to this Regulation.

4.3. Approval authorities shall not grant any type approval without verifying that the manufacturer has put in place satisfactory arrangements and procedures to properly manage all aspects required by this Regulation.

4.4. The approval authority and its designated technical service(s) shall ensure, in addition to the criteria laid down in Schedule 2 of the 1958 Agreement, that they have:

(a) Competent personnel with appropriate skills and specific knowledge of:

(i) Functional safety (e.g., ISO 26262),

(ii) Safety of the intended functionality (e.g., ISO 21448),

(iii) Modelling & simulation,

(iv) Safety management systems,

(v) Automated driving systems,

(vi) Human factors.

These personnel shall also be able to make the necessary link with cyber security.

(b) Implemented procedures for the uniform evaluation according to this Regulation.

4.5. Approvals covering ADS features that can be active in the territory of a Contracting Party other than the Contracting Party issuing the approval.[11]

4.5.1. Before granting an approval according to this UN Regulation, the granting approval authority shall inform the approval authorities[12] of the respective Contracting Parties in whose territory any feature of the Automated Driving System can be active. The following information shall be provided by the granting approval authority to each receiving approval authority as soon as the granting approval authority has all necessary information from the manufacturer but at the latest within 30 days prior to granting the approval:

(a) The information described in paragraphs 3.2.3.(a) to (f) above.

(b) Details of requirements where a significant interpretation has been made (if any).

[11] These provisions shall be kept under periodic review by GRVA for amendment as necessary to support effective implementation of this UN Regulation.

[12] Using the email address(es) provided on the online platform (“/343 Application”) provided by UNECE and dedicated to the exchange of such information: https://www.unece.org/trans/main/wp29/datasharing.html. Contracting Parties without an approval authority shall publish the relevant contact details on the online platform (“/343 Application”) in lieu of the details of an approval authority for this UN Regulation, along with a note stating that this is not an approval authority.

This information shall be considered as confidential by the receiving approval authority.

4.5.2. Following a review of the documentation described in paragraph 4.5.1, the receiving approval authority may provide comments to the granting approval authority on the interpretation or application of this UN Regulation with respect to their territory. Comments shall be provided within 30 days of receipt of the documentation described in paragraph 4.5.1. In case of dispute, a detailed justification shall be provided by the receiving approval authority making the comments to the granting approval authority.

4.5.2.1. Having taken account of any comments, the granting approval authority shall grant the approval with the respective Contracting Party or Parties included in the list in Appendix 2 to Annex 1.

4.5.2.2. If it is not possible for the granting approval authority to take into account the comments received or in case of any dispute between Contracting Parties this shall be settled in accordance with Article 10 and Schedule 6 of the 1958 Agreement.

4.5.2.3. The granting approval authority remains responsible for all decisions regarding the granting of an approval under this Regulation.

4.5.3. In the case that the territory of an additional Contracting Party is added as part of the extension of a type approval, the requirements of paragraphs 4.5.1. and 4.5.2. shall apply *mutatis mutandis* with respect to that Contracting Party and its approval authority.

4.5.4. In the case of modifications to a vehicle type resulting in extension of an approval that covers territory of other Contracting Parties, the granting approval authority shall consider whether these changes affect the validity of the information previously reviewed by receiving approval authorities. If so, the approval authorities of the relevant Contracting Parties shall be consulted in accordance with paragraph 4.5.1 and 4.5.2.

4.5.5. Each approval authority shall, within 14 days after granting or extending a type approval pursuant to this Regulation, upload the type approval together with the supplementing documentation (including all related test reports) in English language to the secure internet database "DETA", established by the United Nations Economic Commission for Europe.

4.6. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation, an international approval mark consisting of:

4.6.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval[13], and

4.6.2. The number of this Regulation, followed by the letter "R", a dash and the approval number, to the right of the circle prescribed in paragraph 4.6.1. above.

4.7. If the vehicle conforms to a vehicle type approved under one or more other Regulations annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.6.1. above need not be repeated; in such a case, the Regulation and approval numbers and the additional symbols shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.6.1. above.

4.8. The approval mark shall be clearly legible and be indelible.

4.9. The approval mark shall be placed close to or on the vehicle or bodywork data plate affixed by the manufacturer.

4.10. Annex 2 to this Regulation gives examples of arrangements of approval marks.

[13] The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev.8

5. General requirements

5.1. As a general concept, the safety level of ADS shall be at least to the level of a competent and careful human driver.

5.2. The ADS shall be free from unreasonable risk.

5.3. The requirements of this Regulation are without prejudice to applicable laws governing:

(a) Access to data,

(b) Availability of data,

(c) Data privacy,

(d) Data protection, and

(e) Provision of data to other authorities.

6. ADS requirements

6.1. Performance of the DDT

6.1.1. The ADS shall be capable of performing the entire DDT within the ODD of its feature(s).

6.1.2. ADS Performance of the DDT in Nominal Situations

6.1.2.1. The driving behaviour of the ADS shall not cause a collision. [14]

6.1.2.2. The ADS shall adapt its driving behaviour in line with safety risks: this shall at least include:

(a) Anticipating the risks in the driving environment to reduce the likelihood of encountering a critical situation,

(b) Adapting its speed in line with safety risks, and

(c) Maintaining appropriate distances from other road users by controlling the longitudinal and lateral motion of the vehicle.

6.1.2.3. The ADS shall avoid unreasonable disruption to the flow of traffic in line with safety risks.

6.1.2.4. The ADS shall detect and respond to objects and events relevant to its performance of the DDT.

6.1.2.5. The ADS shall detect and respond to priority vehicles in accordance with the applicable traffic law(s).

6.1.2.6. The ADS shall comply with traffic rules in accordance with application of relevant law within the area of operation.

6.1.2.7. The ADS shall interact safely with other road users.

6.1.2.8. The ADS shall avoid collisions with safety-relevant objects.

6.1.2.9. The ADS shall signal its operational status if required by applicable laws.

6.1.2.10. Pursuant to a passenger request under para. 6.2.3.1., the ADS shall bring the vehicle to a safe stop.

6.1.2.11. The ADS shall have strategies in place to appropriately detect and respond to instructions from road safety agents.

6.1.3. ADS Performance of the DDT in Critical Situations

[14] It is acknowledged that establishing causation can be complex, and not always possible. However, where it is established that the behaviour of an ADS caused a collision, this is a non-compliance with this requirement.

6.1.3.1. The requirements for DDT performance under nominal situations shall continue to apply during critical situations as far as is reasonably practicable under the specific circumstances with the aim of minimising overall safety risks.

6.1.3.2. When a collision cannot be avoided, the ADS shall aim to mitigate its severity.

6.1.3.3. In the event of a collision involving the ADS vehicle, if required to stop by applicable law, the ADS shall fall back to an MRC or bring the vehicle to a standstill as appropriate. During this process, the user may initiate deactivation of the ADS if the design of the ADS allows.

6.1.3.3.1. The ADS shall not resume travel unless:

(a) The safe operational state of the ADS vehicle has been verified, and

(b) It is permissible under the applicable laws.

6.1.3.3.2. Notwithstanding para. 6.1.3.3.1.(a), if the collision occurred while an ADSF-2 was active, when directed by a road safety agent, the ADS shall move the vehicle unless the ADS determines that the manoeuvre poses an unreasonable safety risk or is not technically possible due to damage. Alternatively, the safety case shall describe how the road safety agent's instructions will be complied with in such circumstances.

6.1.4. ADS Performance of the DDT in Failure Situations

6.1.4.1. The requirements for DDT performance in nominal situations shall continue to apply during failure situations as far as is reasonably practicable under the specific circumstances with the aim of minimising overall safety risks.

6.1.4.2. The ADS shall detect faults, malfunctions, and abnormalities that compromise its capability to perform the DDT within the ODD.

6.1.4.3. In response to a fault, the ADS shall either:

(a) Execute a fallback response and prohibit activation of the impacted feature(s) if the fault prevents the ADS from performing the DDT in accordance with the requirements under paragraph 6.1., or

(b) Adapt its performance of the DDT in accordance with the severity of the fault provided the resulting performance complies with the requirements under paragraph 6.1.

6.1.4.4. The ADS shall be capable of remote termination.

6.1.4.4.1. The procedure for remote termination of an ADS performing the DDT shall include the capability to perform an ADS fallback response.

6.1.4.4.2. The remote termination of an ADS or ADS feature(s) shall render it unable to be activated until such time as the remote termination is rescinded.

6.1.5. ADS Performance of the DDT at ODD Boundaries

6.1.5.1. The ADS shall recognise the conditions and boundaries of the ODD of its feature(s).

6.1.5.2. The ADS shall be able to determine when the conditions are met for activation of each feature.

6.1.5.3. The ADS shall prevent activation of a feature unless the ODD conditions of the feature are met.

6.1.5.4. The ADS shall execute a fallback response when one or more ODD conditions of the feature in use are no longer met.

6.1.5.4.1. In response to an ODD exit, ADSF-2 shall aim to bring the ADS vehicle to a stop in a safe location that complies with traffic rules (e.g., a parking space).

6.1.5.5. The ADS shall be able to anticipate and safely respond to foreseeable exits from the ODD of each feature.

6.1.6. Fallbacks to a Mitigated Risk Condition

6.1.6.1. For ADSF-2, the ADS fallback response shall be to place the vehicle in an MRC. The ADS feature may permit a user-initiated deactivation to interrupt the fallback to an MRC.

6.1.6.2. For ADSF-1, if it has not been possible to complete a system-initiated deactivation procedure, the ADS shall execute a fallback to an MRC. During the fallback to MRC, the user may initiate the deactivation of the ADS.

6.1.6.3. Upon completion of an ADS fallback to an MRC, a user may be permitted to assume control of the vehicle.

6.2. Interactions between the ADS and its User(s)

6.2.1. General requirements

6.2.1.1. Safety-relevant information and signals shall be:

(a) Noticeable by the target user(s) under all operating conditions,

(b) Comprehensible and unambiguous, and

(c) Multi-modal (e.g., optical, auditory, haptic) if needed.

6.2.1.2. The ADS shall signal initiation of a fallback to an MRC to the ADS user(s).

6.2.1.3. The ADS shall permit a user to override ADS operation of doors in the event of an emergency.

6.2.2. ADS features that permit a user to take over the performance of the DDT.

6.2.2.1. General requirements

6.2.2.1.1. The ADS feature shall be designed to prevent misuse and errors in operation by the user.

6.2.2.1.2. While an ADS feature is active:

(a) The controls related to manual performance of the DDT shall be disabled, suppressed, or, by other means, made unavailable in a manner that prevents unsafe interference with the ADS performance of the DDT:

(i) In the case these controls are suppressed, the ADS shall have strategies in place to prevent ambiguous states of control or unintentional effect on the DDT.

(ii) When a user overcomes a suppression threshold, a user-initiated deactivation procedure shall commence and must follow the requirements of 6.2.2.3. Overcoming the suppression threshold shall not be the primary means to request a user-initiated deactivation,

(b) Devices for indirect vision, tell-tales, indicators, and non-ADS-related warnings may be disabled, suppressed, or, by other means, made unavailable, and

(c) In the case of an ADSF-2, direct view to the outside environment may be reduced or compromised. Direct view shall be restored immediately upon the passenger requesting deactivation.

6.2.2.1.3. The vehicle controls dedicated to the ADS shall be clearly identified and distinguishable to accommodate only the appropriate interactions.

6.2.2.1.4. While an ADS feature is active, it shall inform the user of:

(a) ADS status information,

(b) The role of the fallback user in the case of an ADSF-1, and

(c) Adapted performance of the DDT consequent to some failure of the ADS.

6.2.2.1.5. The ADS shall indicate the availability of a feature for activation.

6.2.2.1.6. While active, an ADSF-1 shall:

(a) Continuously assess whether the fallback user is available to assume the role of driver. A fallback user is considered available when

(i) The user is at least awake, and

(ii) Correctly seated in such a way as to enable the fallback user to take control of the DDT at the end of the deactivation procedure.

(b) Provide effective procedures for re-engaging the fallback user who has been detected to be not available.

(c) Trigger a fallback to an MRC where it has not been possible, feasible, and/or safe to re-engage the fallback user.

(d) Ensure the system-initiated deactivation procedure includes sufficient time for the fallback user to perceive the need to take over and to safely re-engage with the driving task.

6.2.2.2. ADS feature activation

6.2.2.2.1. The ADS shall ensure a safe ADS feature activation.

6.2.2.2.2. The ADS shall provide immediate feedback to indicate success or failure when the ADS user attempts to activate an ADS feature.

6.2.2.2.3. The feature activation procedure (e.g., sequence of actions and states) shall take into account relevant recommendations or standards.

6.2.2.2.4. Upon activation of an ADSF-1, the ADS shall immediately and explicitly inform the fallback user of the consequent expectations on them to be ready to respond to a request to resume the DDT.

6.2.2.2.5. The ADS shall obtain the passenger's consent to perform the role of fallback user each time before executing a transition from an ADSF-2 to an ADSF-1.

6.2.2.3. ADS feature deactivation to manual driving

6.2.2.3.1. The ADS shall follow a safe ADS feature deactivation procedure.

6.2.2.3.2. A suggestion from an ADSF-2 that a user might optionally take control shall be considered a user-initiated deactivation if the user accepts the suggestion.

6.2.2.3.3. Following the user requesting deactivation of the ADS feature, the ADS shall follow a deactivation procedure to safely transfer control of the DDT to the user.

6.2.2.3.4. The ADS shall respond when the user requests to initiate a system deactivation procedure. The ADS shall only initiate the system deactivation procedure if the ADS verifies that the user is in position to assume the role of the driver.

6.2.2.3.5. ADS feature deactivation may be delayed if it is assessed by the ADS that the situation is unsuitable or unsafe for the subsequent mode of vehicle operation. In this case, the user shall be informed of this circumstance.

6.2.2.3.6. The ADS feature shall remain active until the system deactivation procedure has been completed or the ADS vehicle reaches a mitigated risk condition.

6.2.2.3.7. The deactivation procedure (e.g., sequence of actions and states) shall take into account relevant recommendations or standards.

6.2.2.3.8. The ADS shall assess if the fallback user or the passenger assuming the role of the driver is suitably engaged to resume the DDT before completion of the deactivation procedure.

6.2.2.3.8.1. A user is considered suitably engaged to resume the DDT when they are at least:

(a) In contact with the steering control and,

(b) Their gaze has been primarily directed to the driving task relevant area long enough to be able to resume the DDT safely.

6.2.2.3.8.2. If gaze monitoring is momentarily unavailable, other user-engagement monitoring measures may be used. Such measures shall be described in the safety concept.

6.2.2.3.9. The ADS shall provide a specific indication of the completion of the deactivation of the ADS.

6.2.2.3.10. At the completion of the deactivation procedure, control shall be returned to the driver without any sustained lateral or longitudinal control assistance active. However, any sustained lateral assistance system that is permitted or required to be automatically enabled at the initiation of the power train may be set to the same state as it was prior to ADS activation.

6.2.2.3.11. During the deactivation procedure, controls related to manual performance of the DDT, direct view to the outside environment, devices for indirect vision, indicators, warnings, and tell-tales shall be set to an appropriate state for manual driving.

6.2.2.3.12. If applicable, ADS features operating control of closures shall no longer influence closures or the controls associated with closures.

6.2.3. ADS features that do not permit a user to take over the performance of the DDT.

6.2.3.1. The ADS shall provide the passenger(s) with means to request to stop the vehicle.

6.2.3.2. The ADS vehicle shall provide safety-related information to the passengers.

6.2.3.3. If safety risks to passengers arise while an ADS feature is active (e.g., safety belts not fastened, passengers not seated), the ADS shall respond according to the strategies described in paragraph 7.3.2.10.

6.2.3.4. Controls provided for manual driving (e.g., steering, service brake, parking brake, accelerator, lighting) shall be designed to prevent any effect on the DDT while the ADS is performing the DDT, or reasonable safeguards shall be put in place to prevent access to controls.

6.2.4. Information provision to users who can perform the role of the driver

6.2.4.1. Means shall be provided that facilitate user understanding of the functionality and operation of the system.

6.2.4.1.1. A description of the ADS features and their capabilities and limitations shall be provided.

6.2.4.1.2. Instructions for the activation and deactivation of the ADS feature(s) shall be provided, with clear explanations of the distinctions between user-initiated deactivation and system-initiated deactivation where applicable.

6.2.4.1.3. A description of the transitions of user roles and the procedure for those transitions, for example, reversion to manual driving following deactivation of the ADS feature shall be provided.

6.2.4.1.4. Any expectations on the fallback user to be ready to resume the DDT upon request shall be explained.

6.2.4.1.5. A general overview of non-driving-related activities (NDRA) allowed when an ADS feature is active shall be provided.

6.2.4.1.6. Information related to the signals used by the ADS feature(s) shall be provided, including:

(a) Visual tell-tales, icons,

(b) Acoustic signals, and

(c) Haptic signals.

6.2.4.1.7. Information on possible changes in the performance of the DDT by the ADS features following a failure of the ADS shall be provided.

6.2.4.1.8. Information on how the ADS feature responds to inputs by the user into controls provided for manual driving (e.g., steering, service brake, parking brake, accelerator, lighting), if they are available, shall be provided.

6.2.4.1.9. Information on any additional safety precautions in using an ADS feature to be taken by the user shall be provided, such as that owners, operators or drivers should check the condition of tyres and lights.

6.3. Other ADS Requirements

6.3.1. Data Storage Systems for Automated Driving

6.3.1.1. The ADS vehicle shall be equipped with a DSSAD capable of monitoring the safety performance of the ADS in accordance with the provisions of this Regulation.

6.3.2. The ADS shall be protected from cyber threats.

6.3.2.1. This requirement shall be demonstrated by compliance with the requirements of UN Regulation No. 155 according to its original version or later series of amendments.

6.3.3. If the ADS software can be updated, the ADS shall support safe and secure software updates.

6.3.3.1. The requirement under paragraph 6.3.3. above shall be demonstrated by compliance with the requirements of UN Regulation No. 156 according to its 01 or later series of amendments.

6.3.4. The ADS shall be designed to protect against unauthorized access to and modification of the ADS features and functions. The measures ensuring protection from unauthorized access shall be provided in alignment with engineering best practices.

6.3.5. The ADS shall provide an interface for the purposes of maintenance and repair by authorized persons.

6.3.5.1. For vehicles without manual driving controls, suitable means shall be made available, where necessary (e.g., special controls, test modes, ADS functions) to enable the performance of the physical checks required for mandated inspections of other vehicle systems in the jurisdiction of operation (e.g., Periodical Technical Inspection, safety standards inspection, etc.).

6.3.6. The ADS shall receive all signals transmitted to it by other systems of the ADS vehicle and appropriately manage them. A list of these signals and how they are managed shall be included in the manufacturer’s safety case.

6.3.7. While an ADSF-2 is active, the ADS shall manage relevant non-DDT-related tasks (which would otherwise be performed by a driver) in accordance with the manufacturer’s safety case. Alternatively, where the ADS does not perform such necessary tasks, the safety case shall describe how these tasks are performed.

6.3.8. The performance of the ADS shall not be adversely affected by magnetic or electrical fields.

6.3.8.1. The requirement under paragraph 6.3.8. above shall be demonstrated by fulfilling the technical requirements of the 07 or later series of amendments to UN Regulation No. 10.

6.3.9. If an ADS feature can be activated while the ADS vehicle is operating as a vehicle combination, the ADS shall also meet the requirements of this Regulation with respect to that vehicle combination while that ADS feature is active.

7. Manufacturer requirements

7.1. Safety Management Systems (SMS)

7.1.1. The manufacturer shall establish, implement, and document a Safety Management System (SMS).

7.1.2. Safety policy

7.1.2.1. The safety policy shall outline the aims and objectives that the manufacturer uses to achieve the desired safety outcomes.

7.1.2.2. The manufacturer shall provide evidence that its safety policy implements the following aspects:

(a) Safety policies and principles (e.g., ISO 21434, para. 5.4.1 and ISO 9001 Automotive 5.2.),

(b) Organization safety objectives and the process for creating safety performance indicators used in the safety case,

(c) Appropriate structure for the SMS taking into account Regulation, standards, best practice guidance, and the use-case of the ADS and its features and mapping its organization structure, processes, and work products onto the SMS,

(d) Safety culture (e.g., ISO 26262-2, para. 5.4.2),

(e) Safety governance, including management commitment (e.g., ISO 21434, para. 5.4.1 and ISO 9001 Automotive 5.1), clear lines of accountability and roles and responsibilities (e.g., ISO 26262-2, para. 6.4.2, this relates to the organizational and project-dependent activities), and

(f) Quality Management System (e.g., IATF 16949 or ISO 9001) to support safety engineering, including change management, configuration management, requirement management, tool management, etc.

7.1.3. Risk management

7.1.3.1. The SMS shall include a management process to identify, assess, and mitigate organisational, human, and technical risks.

7.1.3.1.1. The SMS shall show the link between the overall risk management process, the mitigations, and the resulting operational risks.

7.1.3.2. The manufacturer shall document its risk-management processes and activities with consideration of relevant standards and best practices, including:

(a) Risk identification (e.g., ISO 31000 para. 6.2),

(b) Risk analysis (e.g., ISO 31000 para. 6.3),

(c) Risk evaluation (e.g., ISO 31000 para. 6.4),

(d) Risk treatment (e.g., ISO 31000 para. 6.5),

(e) Processes for keeping the risk assessments up to date, and

(f) Review of safety performance of the organisation and effectiveness of safety risk controls.

7.1.4. Safety assurance

7.1.4.1. The manufacturer shall demonstrate that periodic independent internal audits and external audits are carried out to ensure that the processes established for the Safety Management System are implemented consistently.

7.1.4.2. The manufacturer shall put in place suitable arrangements (e.g., contractual arrangements, clear interfaces, quality management system) with any organisation involved in the development, manufacturing, or in-use

deployment of its ADS and its features (e.g., contracted suppliers, service providers, or manufacturers' sub-organisations).

7.1.4.2.1. The manufacturer shall document its processes and activities, including the following aspects:

(a) Organisational policy for supply chains,

(b) Incorporation of risks originating from supply chains,

(c) Evaluation of supplier SMS capability and corresponding audits,

(d) Processes to establish contracts, agreements for ensuring safety across the phases of development, production, and post-deployment,

(e) Processes for distributed safety activities, and

(f) The manufacturer shall have processes for providing safety-relevant information to relevant parties as needed, enabling them to meet their legal obligations.

7.1.4.3. SMS documentation shall be regularly updated in line with any relevant changes to the SMS processes. Gap analysis shall be used when auditing and updating the SMS, examining the current safety culture before formulating new and more appropriate SMS processes to ensure issues are adequately resolved.

7.1.4.4. The manufacturer shall have processes for:

(a) Assuring that all practices and activities documented as part of the SMS are followed,

(b) Assuring that an independent check of compliance with the applicable requirements is performed (i.e., not from person creating the compliance data), and

(c) Assuring the continued evaluation of the Safety Management System so that it remains effective.

7.1.4.5. The manufacturer shall define appropriate Key Performance Indicators (KPI) to measure the effectiveness of the Safety Management System throughout the ADS lifecycle (development, production, operation and decommissioning).

7.1.5. Safety promotion

7.1.5.1. The SMS shall be subject to a process of continual improvement (e.g. "Plan, Do, Check, Act" as described in ISO 9001). Any changes to SMS documentation should be communicated as required to the approval authority.

7.1.5.2. The manufacturer shall institute and maintain:

(a) Effective communications within the organization on safety issues (e.g., ISO 26262-2, para. 5.4.2.3),

(b) Information sharing outside of the organization (e.g., ISO 21434, para. 5.4.5 and ISO 9001, but from a safety perspective),

(c) SMS training plans.

7.1.6. Management of design and development

7.1.6.1. The SMS shall include evidence of the deployment of the safety policy in the Design and Development phase, including the following:

(a) Roles and responsibilities of the people involved during the design and development phase,

(b) Qualifications and experience of persons responsible for making decisions that affect safety, and

(c) Coordination of roles, responsibilities and information transfer between design and production activities.

7.1.6.2. The manufacturer shall implement its processes and activities to ensure the robustness of the design and development phase, including the following aspects:

(a) A general description of how the organization performs all the design and development activities,

(b) Vehicle/system design and development, integration, and implementation and safety case processes and activities, including at least to the following:

(i) Requirements management (e.g., requirement capture and validation),

(ii) Suitability of the physical testing environment,

(iii) Credibility of virtual tool chain,

(iv) Tool management,

(v) System integration,

(vi) Software development assurance,

(vii) Hardware development assurance,

(viii) Management of functional safety (e.g., ISO 26262) and SOTIF (e.g., ISO 21448), including the ongoing evaluation and update of risk assessments and interactions,

These processes shall include elements like e.g Failure Mode and Effect Analysis (FMEA), Fault Tree Analysis (FTA), System-Theoretic Process Analysis (STPA) or any similar process appropriate to system functional safety and SOTIF.

(ix) Management of human factors, including human-centred design processes for safety-relevant interactions (e.g., ISO 9241-210).

(c) Change management, including but not limited to:

(i) Major design decisions,

(ii) ADS design modifications,

(iii) Changes in key personnel responsible for making decisions that affect safety, and

(iv) Tools and thresholds adopted for ADS safety verification.

7.1.6.3. The manufacturer shall include effective communication channels between the departments and third-party organizations responsible for functional safety, SOTIF, cybersecurity, and any other relevant disciplines related to the achievement of vehicle safety.

7.1.6.4. The SMS shall include a process for creating safety performance indicators used in the safety case.

7.1.7. Management of production

7.1.7.1. The manufacturer shall establish and document the production process in the SMS. This documentation shall cover at least the following aspects:

(a) Quality Management System (e.g., IATF 16949 or ISO 9001), and

(b) A description of the way in which the manufacturer performs all the production functions, including management of working conditions, working environment, equipment and tools.

7.1.7.2. The manufacturer shall establish and document their distributed production processes and activities in the SMS. The processes and activities shall include:

(a) Liaison between the manufacturer and all other organisations (e.g., suppliers, partners, or subcontractors) involved in the supply chain, and

(b) Criteria for the acceptability of "subsystem/components" manufactured by other partners or subcontractors. (i.e., deployment of production assurance requirements to the supply chain).

7.1.8. Management of post-deployment safety

7.1.8.1. The manufacturer shall establish processes to demonstrate its capabilities to manage safety during the post-deployment phase, including carrying out ISMR and taking remedial actions when necessary.

7.1.8.2. The processes for ISMR shall demonstrate the capabilities:

(a) To monitor ADS operations,

(b) To confirm the compliance with the defined safety case and compliance with the performance requirements,

(c) To identify safety risks related to ADS performance that need to be addressed in the frame of the SMS activities, including instances of non-compliance with ADS safety requirements,

(d) To manage potential safety-relevant gaps during the in-service operation and to provide the information that allows the ADS to be updated according to the appropriate manufacturer processes,

(e) To support the development of new or revise existing scenarios,

(f) To perform event investigation,

(g) To report occurrences to the relevant authority when they occur, and

(h) To share learnings derived from occurrence analysis which have triggered SMS processes for the continuous improvement of the ADS vehicle safety.

7.1.8.3. The process for ISMR shall demonstrate the capabilities for handling the reports received from other sources, including distinguishing false reports from actual events and conducting thorough investigations when necessary.

7.1.8.4. The manufacturer shall demonstrate the capabilities to monitor the performance of all its in-service ADS vehicles.

7.1.8.5. The manufacturer shall demonstrate the capabilities to collect and analyse vehicle data and data from other sources to achieve the ISMR objectives.

7.1.8.5.1. The manufacturer shall have:

(a) A data-acquisition strategy,

(b) A data-retention strategy, and

(c) Data access, security, and protection policies.

7.1.8.5.2. The data acquisition strategy shall ensure a representative collection of data to monitor the ADS in service performance.

7.1.8.5.3. The data retention strategy shall ensure that:

(a) Data related to a detected safety issue is retained until any necessary corrective action and review processes are complete, and

(b) A subset of the collected data is retained to enable longer-term trend analysis.

7.1.8.5.4. The data access, security and protection policies shall ensure that information access is allowed only to authorised persons and contains safeguards to ensure the security and protection of the data in accordance with the data-protection laws of the relevant jurisdiction.

7.1.8.5.5. The manufacturer shall achieve the following objectives from the monitoring activity:

(a) Verify the safety performance (i.e., Safety Performance Indicators) and confirm the in-service safety level of the system (i.e., metrics and thresholds),

(b) Identify areas of operational risk,

(c) Identify when the ADS prevents incidents/accidents (e.g., MRC fallbacks, collision avoidance, emergency manoeuvres),

(d) Characterise and analyse occurrences,

(e) Discover trends that suggest the emergence of unacceptable risks,

(f) Ensure that remedial actions are put in place when an unacceptable risk is discovered or predicted by trends,

(g) Confirm the effectiveness of any remedial action, and

(h) Enable the development of new or the revision of existing scenarios derived from ISMR activities.

7.1.8.5.6. The manufacturer shall perform a data analysis with sufficient frequency so that remedial action can be taken promptly and in line with reporting requirements listed under paragraph 7.4.

7.1.8.5.7. The analysis techniques shall include at least the following:

(a) Routine measurements: a selection of parameters shall be collected to characterise the performance of ADS and to allow a comparative analysis. These measurements shall aim at identifying and monitoring emerging trends and tendencies before the trigger levels associated with exceedances are reached.

(b) Exceedance detection: a set of safety performance indicators shall be selected to cover the main areas of interest for the ADS operation with the aim of searching for deviations from safety performance and limits. They shall be continuously reviewed to reflect the current operations.

(c) Occurrence analysis: It shall be possible to characterise and investigate all the occurrences listed in Annex 3 using the recorded data.

(d) Statistics: Data series shall be collected to support the analysis process with additional information. These data shall provide information to generate rates and trends.

7.1.8.6. The manufacturer shall have mechanisms in place for receiving and analysing safety-relevant feedback and reports from other sources to extract safety-relevant information and to review the safety monitoring data.

7.1.8.6.1. The other sources shall include at least:

(a) ADS-related vehicle maintenance and inspection feedback,

(b) Law enforcement and other road-safety authorities,

(c) Service operators, customers, public and dealer feedback.

7.1.8.7. The manufacturer shall evaluate the results from the monitoring activity to assess:

(a) In-service safety performance,

(b) The adequacy of the metrics and thresholds, and

(c) The outcome of remedial actions.

7.1.8.8. The manufacturer shall have a process for the decommissioning of the ADS or ADS features.

7.2. Test environments

7.2.1. Virtual testing

7.2.1.1. The manufacturer shall describe the intended use(s) of virtual testing and its role in the overall testing strategy.

7.2.1.2. The manufacturer shall demonstrate that each simulation toolchain is suitable to use for virtual testing by showing that they fulfil the requirements laid down in the present section.

7.2.1.2.1. In performing this assessment, the manufacturer shall take into account the results of the simulation toolchain criticality analysis as described under paragraph 7.2.1.9. below to produce evidence to support the safety case and for the assessment of ADS compliance with functional/user requirements.

7.2.1.3. Data management

7.2.1.3.1. The manufacturer shall manage the relevant data used to verify, validate, and update the simulation toolchain(s) until the ADS has been decommissioned. The manufacturer shall consider the completeness, accuracy, and consistency of this data.

7.2.1.3.2. The manufacturer shall maintain a record of the data used in the validation of the toolchain(s).

7.2.1.3.3. The manufacturer shall describe the measures taken to ensure the quality and integrity of data or tools integrated into the simulation toolchain(s) from organisations that are not under the control of the manufacturer.

7.2.1.3.4. Management of input data and simulation toolchain(s) parameters

7.2.1.3.4.1. The manufacturer shall document the input data used to verify and validate the simulation toolchain(s).

7.2.1.3.4.2. The documentation shall note important quality characteristics of the input data.

7.2.1.3.4.3. The documentation shall show that the input data covers the intended ADS functionalities that the virtual testing aims to assess.

7.2.1.3.4.4. The documentation shall describe the calibration procedures used to fit parameters associated with the simulation toolchain(s).

7.2.1.3.4.5. The documentation shall explain the reasons for any changes to the data or parameters that occur when a new version of a simulation toolchain(s) is released.

7.2.1.3.5. The manufacturer shall quantify the uncertainty in the simulation toolchain(s) and its outputs that occur because of the quality of the data (e.g., data coverage, signal-to-noise ratio, and sensors' uncertainty/bias/sampling rate).

7.2.1.3.6. Management of output data

7.2.1.3.6.1. The manufacturer shall record the output data from the simulation toolchain(s) used for its validation.

7.2.1.3.6.2. Each output record shall be traceable to the input data that produced the output.

7.2.1.3.6.3. The manufacturer shall conduct statistical analysis of the output data and note any important quality characteristics deduced from this analysis.

7.2.1.3.6.4. The manufacturer shall show that the quality of the output data is sufficient to:

(a) Validate the simulation toolchain(s) and its components,

(b) Allow consistency/sanity check of the simulation toolchain(s) and its components, and

(c) Produce evidence to support the ADS safety case.

7.2.1.3.6.5. If stochastic models exist in the simulation toolchain(s), with regard to the data generated by these models, the manufacturer shall:

(a) Characterise the variance in the output of the simulation toolchain(s), and

(b) Ensure the possibility of a deterministic re-execution of the simulation toolchain(s).

Where determinism cannot be guaranteed, the manufacturer shall provide evidence that its impact on the credibility of the simulation toolchain is acceptable.

7.2.1.4. Competency of personnel

7.2.1.4.1. The manufacturer shall document and provide the rationale for their confidence in the competency of:

(a) The personnel who developed the simulation toolchain(s) and its components,

(b) The personnel who assessed the simulation toolchain(s) and its components, and

(c) The personnel who used the simulation toolchain(s) to perform the testing with the purpose of validating the system.

7.2.1.4.2. The manufacturer shall have processes and procedures that identify and maintain the skills, knowledge, and experience needed to develop, assess, and use the simulation toolchain(s). The following processes shall be established, maintained, and documented:

(a) Process to identify and evaluate the necessary competencies that are required to perform the modelling and simulation activities identified by the manufacturer, and

(b) Process for training personnel to be competent to perform the modelling and simulation activities.

7.2.1.4.3. The manufacturer shall maintain records of the personnel involved in the development, assessment, and use of the simulation toolchain(s) showing they have received the necessary training and have been deemed competent to perform the requested modelling and simulation activities.

7.2.1.4.4. The manufacturer shall set up suitable arrangements with third-party organisations linked to the simulation toolchain(s), to ensure that the competency of the third-party personnel is adequate to perform the tasks assigned to those personnel.

7.2.1.4.5. The arrangements with third-party organisations shall be aligned with the SMS provisions reported in 7.1.4.2. and 7.1.6.3.

7.2.1.5. Release management

7.2.1.5.1. The manufacturer shall manage and support the simulation toolchain(s) used for virtual testing throughout the lifecycle of the simulation toolchain(s).

7.2.1.5.1.1. This management and support shall also continue until the end of the post-deployment phase of the ADS.

7.2.1.5.2. The manufacturer shall manage and document the simulation toolchain(s) release management process, including:

(a) A description of the modifications associated with each toolchain(s) release,

(b) A record of any associated software (e.g., specific software product, designations and version) and hardware arrangements (e.g., XiL configuration), and

(c) A record of the internal review activities that supported the toolchain(s) acceptance and release.

7.2.1.6. Description of the simulation toolchain

7.2.1.6.1. The manufacturer shall describe the simulation toolchain(s) and identify its scope of applicability, its limitations, assumptions, and the sources of uncertainty that can affect results.

7.2.1.6.2. The manufacturer shall provide a description of the simulation toolchain(s) and its components.

7.2.1.6.3. The manufacturer shall provide a description of the approach adopted in the simulation toolchain(s) validation.

7.2.1.6.4. The manufacturer shall provide a description of the acceptance tests and criteria that will be used to determine that the simulation toolchain(s) can be used to produce the evidence needed to support the ADS safety case.

7.2.1.7. Simulation toolchain assumptions, known limitations, and uncertainty quantification

7.2.1.7.1. The manufacturer shall describe the modelling assumptions and considerations that guided the design of the toolchain(s).

7.2.1.7.2. The manufacturer shall provide information on:

(a) Assumptions made during the development of each simulation toolchain and its components, and the limitations that these assumptions impose on its scope and applicability, and

(b) The rationale for choices made about the level of fidelity of each simulation toolchain and its components.

7.2.1.7.3. The manufacturer shall provide justification that the tolerances associated with the simulation toolchain(s) are appropriate and meet the acceptance tests and criteria.

7.2.1.7.4. The manufacturer shall provide details of the sources of uncertainty in each simulation toolchain and its components and the assessment of their impact on the results.

7.2.1.8. Simulation toolchain scope

7.2.1.8.1. The manufacturer shall document the scope of each simulation toolchain and identify its limitations.

7.2.1.8.1.1. The scope shall refer to the ODD and identify any limitations about its applicability to the ODD.

7.2.1.8.2. The manufacturer shall demonstrate how each simulation toolchain imitates the relevant physical phenomena and meets the necessary level of accuracy.

7.2.1.8.3. The manufacturer shall provide sufficient evidence to justify the claim that the simulation toolchain(s) can be used within the defined scope.

7.2.1.8.4. The manufacturer shall provide a list of tests used for validation and the corresponding parameters and any known limitations.

7.2.1.9. Simulation toolchain Criticality Analysis

7.2.1.9.1. The manufacturer shall review the error estimates of the simulation toolchain(s) to assess their criticality and the effect these would have on the manufacturer's claims about their safety case.

7.2.1.10. Simulation toolchain verification

7.2.1.10.1. The manufacturer shall demonstrate that the simulation toolchain(s) will not exhibit unrealistic behaviour for valid inputs which have not been explicitly tested.

7.2.1.11. Simulation toolchain code verification

7.2.1.11.1. The manufacturer shall document the execution of proper code verification techniques used in evaluating each simulation toolchain and its components (e.g., static/dynamic code verification, convergence analysis and comparison with exact solutions if applicable).

7.2.1.11.2. The manufacturer shall provide evidence that the input parameter space was sufficiently explored to identify if there are any parameter combinations for which the simulation toolchain shows unstable or unrealistic behaviour.

7.2.1.11.3. The manufacturer shall undertake sanity and consistency checking procedures and provide information on the results to show that the simulation toolchain(s) is robust.

7.2.1.12. Simulation toolchain calculation verification

7.2.1.12.1. The manufacturer shall document numerical error estimates (e.g., discretization error, rounding error, iterative procedures, and convergence).

7.2.1.12.2. The manufacturer shall review the analysis and demonstrate that the numerical errors are understood and sufficiently bounded to allow the simulation toolchain(s) to be used for virtual testing.

7.2.1.13. Simulation toolchain sensitivity analysis

7.2.1.13.1. The manufacturer shall provide documentation demonstrating that the input data and parameters that most critically influence the toolchain outputs have been identified by means of appropriate sensitivity analysis techniques.

7.2.1.13.2. The manufacturer shall demonstrate that robust calibration procedures have been adopted for assigning appropriate value(s) to all the simulation parameters while ensuring that special attention is taken for the most critical parameters.

7.2.1.13.3. The manufacturer shall demonstrate that sensitivity analysis has been used to identify the critical input data and parameters that need particular attention in order to characterize the uncertainty of the overall simulation toolchain outputs.

7.2.1.14. Simulation toolchain validation

7.2.1.14.1. The manufacturer shall perform a validation analysis based on quantitative metrics to determine the degree to which each simulation toolchain is an accurate representation of the real-world system.

7.2.1.14.2. The manufacturer shall provide evidence that each simulation toolchain's results are consistent and correlate with the results of physical tests.

7.2.1.14.3. The validation shall be performed on a sufficiently representative set of tests in order to substantiate the claims that the simulation toolchain(s) is suitable and can be used within its scope.

7.2.1.14.4. The manufacturer shall define the measures of performance (metrics) that will be used when comparing the results of physical tests and the output of the simulation toolchain(s).

7.2.1.14.5. The manufacturer shall use appropriate statistical techniques when comparing the results of physical tests and the corresponding output of the simulation toolchain and its components.

7.2.1.14.6. The manufacturer shall specify acceptance tests and criteria during the development of each simulation toolchain and its components and demonstrate that they have been achieved.

7.2.1.14.7. The manufacturer shall define the methodology and tests used for each simulation toolchain validation.

7.2.1.14.7.1. It should be clear whether the full ODD is within scope of the toolchain(s) or only part of it.

7.2.1.14.7.2. The validation strategy may consist of one or more of the following:

(a) Subsystem model validation (e.g., environment models, sensor models, and vehicle models),

(b) Vehicle system model validation (vehicle dynamics model together with the environment model),

(c) Sensor system validation (sensor model together with the environment model), and

(d) Integrated system validation (sensor model together with the environment model with influences from vehicle model).

7.2.1.14.8. The manufacturer shall demonstrate that the accuracy criteria defined during each simulation toolchain development have been met.

7.2.1.14.9. The manufacturer shall provide evidence that the processes related to the validation activity have been followed.

7.2.1.14.10. The manufacturer shall document their uncertainty characterization analysis and provide information about how the simulation toolchain(s) should be used and any safety margins that should be applied when it is used for virtual testing.

7.2.1.14.11. The manufacturer shall demonstrate that it has techniques to estimate each simulation toolchain's critical inputs and that they have been applied and the results documented.

7.2.1.14.12. The manufacturer shall demonstrate that they have characterised the critical parameters used in each simulation toolchain and its components, and where appropriate, have identified these as distributions with confidence intervals.

7.2.1.14.13. The manufacturer shall demonstrate that they have achieved a proper characterization of the uncertainty of the results of each simulation toolchain and its components, because of any assumptions therein.

7.2.1.14.14. The manufacturer shall demonstrate that they have differentiated between the aleatory and epistemic uncertainties associated with each simulation toolchain.[15]

7.2.2. Track testing

7.2.2.1. The manufacturer shall demonstrate that the track testing environment and capabilities are suitable to conduct testing and gather evidence to support the safety case. In particular, the manufacturer shall demonstrate that:

(a) The track testing conducted includes static and dynamic elements representative of the ODD and of the expected operating conditions, and

(b) The equipment used during track testing undergoes periodic inspection, maintenance, and calibrations to ensure that the measurements are characterized by sufficient accuracy and precision.

7.2.3. Real-world testing

7.2.3.1. The manufacturer shall demonstrate that the real-world testing facilities (public roads), environment, and capabilities are suitable to conduct testing and gather evidence to support the safety case. In particular the manufacturer shall demonstrate that:

(a) The selected test routes hold a sufficient probability for the ADS to encounter situations that involve a large number of other road users, unlikely road infrastructure, or abnormal geographic/environmental conditions, and

(b) The equipment used during real-world testing undergoes periodic inspection, maintenance, and calibrations to ensure that the measurements are characterized by sufficient accuracy and precision.

7.3. Safety case for an ADS

7.3.1. System Description

7.3.1.1. The manufacturer shall provide a system description.

[15] "Aleatory Uncertainty" means the portion of uncertainty deriving from a random process that cannot be reduced, while "Epistemic Uncertainty" means the portion of uncertainty deriving from a lack of knowledge about a process that can be reduced via observations.

7.3.1.2. The system description shall describe the type(s) of use(s) for which the ADS is intended, such as personal car ownership, urban taxi fleet, goods transportation, highway use, etc.

7.3.1.2.1. This shall include a description of each ADS feature configuration, including ADS functions applicable to that specific feature and the intended uses and limitations on the use of the feature, which gives a simple explanation of its operational characteristics.

7.3.1.3. The system description shall describe how the Operational Design Domain has been defined for each ADS feature and explain the boundaries of each of the conditions in which the feature is designed to operate. This shall include at least the following:

(a) Geographic limitations,

(b) Roadway characteristics (e.g., road type, road conditions, speed limit),

(c) Environmental conditions (e.g., weather, illumination), and

(d) Dynamic elements (e.g., kinds of other road users).

7.3.1.4. The system description shall include outlines of the following elements of the ADS and their relationships to other vehicle systems:

(a) Hardware components and their functions, and

(b) Software components and their functions.

7.3.1.4.1. The outlines shall include block diagrams and/or schematics.

7.3.1.4.1.1. The hardware components outline shall include a schematic of the ADS illustrating the equipment distribution.

7.3.1.4.1.2. The outlines shall integrate the hardware identification markings of the ADS components in their diagrams and/or schematics, and a table shall be provided to link the hardware identification to the software identification.

7.3.1.4.1.3. A single hardware identification marking shall be used for functions that are combined within a single component (e.g., control unit or single computer) but are shown in multiple blocks in a block diagram.

7.3.1.4.2. The outlines shall include the components/functions of the ADS and other vehicle systems that are relevant to meeting the requirements of this Regulation.

7.3.1.4.2.1. The outlines shall show interconnections between the components/functions of the ADS and those components/functions and other systems via:

(a) A circuit diagram for the electrical transmission links,

(b) A piping diagram for pneumatic and/or hydraulic transmission equipment, and

(c) A simplified diagrammatic layout for mechanical linkages.

7.3.1.4.2.2. There shall be a clear correspondence between transmission links in the hardware and software components outline, schematics, and/or diagrams and the signals carried between components and systems of the corresponding functions outline, schematics, and/or diagrams.

7.3.1.4.2.3. Priorities of signals on multiplexed data paths shall be stated wherever priority can be an issue affecting performance or safety.

7.3.1.4.3. The outlines shall include how the following functions and aspects are addressed:

(a) Sensing and perception of events and objects,

(b) Decision-making and planning,

(c) Remote supervision and remote monitoring by a remote supervision centre (if applicable),

(d) Information display/user interface,

(e) The data storage system (e.g., Data Storage System for Automated Driving), and

(f) Redundancies of relevant components and/or connections.

7.3.1.4.4. The hardware components outline shall provide information regarding the installation options that will be employed for the individual components that comprise the sensing system.

7.3.1.4.4.1. These options shall include, but are not limited to, the location of the component in/on the vehicle, the material(s) surrounding the component, the dimensioning and geometry of the material surrounding the component, and the surface finish of the materials surrounding the component, once installed in the vehicle.

7.3.1.4.4.2. The information shall also include installation specifications that are critical to the ADS's performance, such as tolerances on installation angle.

7.3.1.4.4.3. Any changes to the individual components of the sensing system, or the installation options, shall be updated in the documentation.

7.3.1.5. A list of all inputs relevant to/for the ADS, including those from sensors, shall be provided and the working range of these defined, along with a description of how each variable is linked to the control functions of the ADS and potential impacts on system behaviour. This shall include the nominal range, and coverage area of each sensor.

7.3.1.6. A list of all of the ADS outputs shall be provided and an explanation given, in each case, of whether the output directly controls the vehicle or is processed via another vehicle system. The range of control exercised on each variable shall be defined as well as the nominal capabilities of control actuators.

7.3.1.7. The system description shall describe how the ADS detects and responds to approaching and crossing of ODD boundaries.

7.3.1.8. The system description shall document:

(a) The conditions that must be present to permit activation of the feature,

(b) The conditions that trigger a fallback response,

(c) The conditions that must be present to permit deactivation of the feature, and

(d) The conditions that might prompt the user to voluntarily take back control, if applicable.

7.3.1.9. The system description shall indicate the categories of other road users with whom the ADS is designed to interact (e.g., pedestrians, cyclists, etc) and describe the nature of their interactions with the ADS.

7.3.1.10. The system description shall identify the ADS users with whom the ADS is designed to interact and describe the nature of their interactions with the ADS.

7.3.1.11. If the ADS can request a remote intervention, the system description shall describe the nature and process for such interaction.

7.3.1.12. The system description shall describe the methods of activating, overriding, or deactivating the ADS feature by any or all of: the ADS user (where relevant), remote intervention (where relevant), passengers (where relevant) or other road users (where relevant).

7.3.1.13. Data Storage Systems for Automated Driving

7.3.1.13.1. In accordance with Annex 8, the manufacturer shall describe the DSSAD installed on the ADS vehicle, including:

(a) Capability to record time-stamped data,

(b) Capability to record time-series data,

(c) List of recordable data elements,

(d) Means for enabling access to stored data, and

(e) Means for protecting data against unauthorized access and manipulation.

7.3.1.13.2. The manufacturer shall justify the use of data elements provided by an alternative format listed in Annex 8.

7.3.1.14. The system description shall describe the range of end states constituting a mitigated risk condition that can be achieved by the ADS feature, including:

(a) The conditions that might trigger an attempt to reach a mitigated risk condition,

(b) The processes by which the ADS feature attempts to reach a mitigated risk condition, and

(c) The evaluation of risk related to mitigated risk condition end states.

7.3.1.15. The system description shall include the following information:

(a) A list of the potential faults identifiable by the diagnostic system(s) of the ADS feature, and

(b) A list of vehicle system(s) and/or component(s) other than the ADS whose failure would preclude the ADS from performing the DDT.

7.3.1.16. The system description shall describe how the ADS feature responds to failure situations, including at least one or more following means (as applicable):

(a) Fallback (or fail-safe) operation using a partial system.

(b) Redundancy using separate systems.

(c) Diversity of systems performing the same function.

(d) Removal of some or all automated driving function(s).

7.3.1.16.1. If a partial performance mode of operation is used under certain fault conditions (e.g., in case of severe failures), the system description shall describe:

(a) Conditions for activation of that mode (e.g., type of failure),

(b) Resulting ADS feature behaviour and capabilities (e.g., achievement of a mitigated risk condition immediately), and

(c) Warning strategy to the user/remote supervision centre (if applicable).

7.3.1.16.2. If a second (backup) or a diverse means to realize the performance of the dynamic driving task is used, the system description shall describe:

(a) The principles of the change-over mechanism,

(b) The logic and level of redundancy and any built-in checking features, and

(c) The resulting limits of effectiveness.

7.3.1.16.3. If the chosen response to a system failure entails the removal of an ADS function, the system description shall describe how it is done in compliance with the relevant provisions of this Regulation. It shall also describe how all the corresponding output control signals associated with this function are inhibited.

7.3.1.17. The system description shall describe how user gaze is monitored, how the ADS determines that gaze is directed to a driving task-relevant area, and what parameters are used by the ADS for gaze duration in those areas for the purposes of 6.2.2.3.8.1.(b).

7.3.2. Safety concept

7.3.2.1. The manufacturer shall document its safety concept which shall include the risks identified according to the SMS processes relevant to the ADS under paragraph 7.1.3. and shall include how those risks have been reduced, mitigated or accepted.

7.3.2.1.1. The safety concept shall demonstrate the manufacturer's use of processes with top-down (from possible hazard to design) and bottom-up approaches (from design to possible hazards) in its identification of hazards.

7.3.2.2. The safety concept shall describe how the ADS features detect, identify, and respond to hazards, including the following:

(a) Detection and identification of hazards,

(b) Design provisions for SOTIF and functional safety (e.g., redundancies),

(c) An analysis that shows how the ADS will behave (e.g., control strategies) to mitigate or avoid hazards that can have a bearing on the safety of the ADS user(s) and other road users, and

(d) An analysis that shows how unknown hazardous scenarios and situations will be managed.

7.3.2.3. The safety concept shall describe the process the ADS uses to determine if a collision with an object would cause non-trivial damage.

7.3.2.4. The safety concept shall describe the ADS's strategy for determining if the ADS vehicle has collided with a safety-relevant object.

7.3.2.5. The safety concept shall describe how the ADS determines the presence/absence of the conditions stated under paragraph 7.3.1.3., and any linked/dependent conditions (e.g., reduced speed in icy weather).

7.3.2.6. The safety concept shall describe the conditions that the automated driving system is reasonably likely to encounter on its trip(s), including, but not limited to, environmental and geographical conditions, and/or the presence or absence of certain traffic or roadway characteristics, and explain how those expected conditions compare to the ODD of the ADS as described pursuant to paragraph 7.3.1.3.

7.3.2.7. The safety concept shall describe measures or strategies, where applicable, implemented to:

(a) Prevent or mitigate abuse, misuse, and errors by occupants that could affect safe performance of the DDT (e.g., occupants attempting to access driving controls),

(b) Prevent, mitigate, or deter harm to occupants caused by external sources (e.g., unauthorised persons attempting to access a vehicle with occupants), and

(c) Prevent, mitigate, or deter abuse and misuse of the vehicle or its systems from external sources. (e.g., objects placed on vehicles during operation, attempts to damage a vehicle).

7.3.2.8. The safety concept shall describe strategies to limit sudden ODD exits and frequent activation and deactivation situations.

7.3.2.9. The safety concept shall include a list of safety risks to passengers (e.g., safety belts not fastened, passengers not seated) and a description of how they are managed for all passengers while an ADS feature is active.

7.3.2.10. The safety concept shall describe the strategies in place to avoid operating the vehicle when the general working condition of the vehicle is not satisfactory (e.g., condition of tyres, brakes, lighting, status of external loads, steering). These strategies may include technological solutions, physical inspections or other relevant solutions.

7.3.2.11. Data Storage System for Automated Driving

7.3.2.11.1. The manufacturer shall provide evidence demonstrating the following:

(a) Recording of the data elements listed under 7.3.1.13.1.(c) and

(b) Storage of recorded data in accordance with Annex 8.

7.3.2.12. The safety concept shall describe the approach used by the manufacturer to derive behavioural competencies and scenarios that are ODD-relevant.

7.3.2.12.1. The manufacturer may refer to the methodology outlined in Annex 7 as a suitable approach to derive behavioural competencies and scenarios that are ODD-relevant or alternative methods, providing they are equally comprehensive.

7.3.2.13. The safety concept shall describe the scenario identification and generation approach and how that approach addresses the following:

(a) Coverage of the appropriate nominal, critical and failure situations,

(b) Use of data driven, knowledge driven and stochastic approaches to systematically identify hazardous events and other occurrences,

(c) Inclusion of elements (especially dynamic elements) that are representative of existing traffic conditions in the expected operating conditions, and

(d) Incorporate the identified characteristics and behaviours of all the relevant scenario elements.

7.3.2.14. The safety concept shall describe the manufacturer's approach to scenario selection to cover the reasonably foreseeable situations and conditions that the ADS will encounter including how the following aspects are covered:

(a) The selection of sufficient scenarios in which the ADS needs to initiate a fallback response (e.g., approaching the ODD boundaries),

(b) Reasonably foreseeable situations that are not deemed to be preventable by the ADS (e.g. related to unsafe behaviour by other road users or by infrastructural failures), and

(c) The use of appropriate techniques to explore the parameter space when choosing concrete scenarios.

7.3.2.15. The safety concept shall describe how the manufacturer has determined the suitability of processes, resources, and competent personnel in place to:

(a) Design and undertake the testing that produces the evidence supporting the ADS safety case,

(b) Select scenarios that combine static and dynamic elements of a test track for correctly reproducing the situations selected for track testing,

(c) Identify test routes that capture predictable aspects of the ODD (e.g., road types and geometries), elements found in the related nominal situations (e.g., other road users, signs, and signals), and typical dynamic conditions (e.g., high/low traffic densities).

(d) Ensure that the test routes enable verification of nominal requirements for the safety of user interactions, including prior to, at the time of, and after entering and exiting the ODD of an ADS feature,

(e) Assess the behavioural competencies demonstrated by the ADS for each scenario against the DDT performance requirements under paragraph 6.1., and

(f) Assess the capability of the ADS to ensure the safety of users and the safe use of the ADS.

7.3.2.16. The safety concept shall include the following information:

(a) Verification and validation plans including metrics and targets:

(i) An explanation of how scenarios and situations are selected as part of verification and validation to provide reasonable coverage of the ODD and its boundaries,

(ii) Methodology, metrics, and targets used to determine reasonable ODD coverage,

(iii) Any analysis comparing the performance of an ADS feature to that of a manually driven vehicle of comparable category (e.g., Category M_1) in situations within the ODD of the feature, and

(iv) Identification of any metrics or targets resulting from the analysis in (iii).

(b) Scoring/evaluation methodology to obtain metrics,

(c) Justification of the chosen acceptance criteria for metrics,

(d) Verification and validation results, including evidence that the targets have been met (i.e., metrics meet acceptance criteria), and

(e) The strategy applied for preventing activation of the ADS or ADS feature(s) after it has been decommissioned.

7.3.2.17. In the case of vehicles equipped with an ALKS that has been approved to UN Regulation No. 157, the safety concept shall demonstrate the safe and proper integration of the ALKS with the ADS and any interaction of the ALKS with other ADS features.

7.3.3. Claims, arguments, and evidence

7.3.3.1. The safety case shall include a series of claims for each of which there must be at least one supporting argument.

7.3.3.1.1. Each argument shall be supported by at least one piece of evidence.

7.3.3.1.2. Each claim, argument, and piece of evidence shall be uniquely labelled but may be used more than once (i.e., a piece of evidence may support more than one argument).

7.3.3.2. The claims, arguments, and evidence shall be understandable, logical, correct, and robust and shall demonstrate that:

(a) The ADS is free of unreasonable risk to ADS user(s) and other road users and

(b) The ADS meets applicable requirements of this Regulation in each of following areas:

(i) Performance of the DDT (paragraph 6.1.)

(ii) User interactions (paragraph 6.2), except for the user information requirements under paragraph 6.2.4., and

(iii) Other requirements (paragraph 6.3.).

7.3.3.3. The following summary information shall be provided with regards to the claims, arguments and evidence:

(a) A summary identifying the relationships between claims and their supporting argument and evidence, and

(b) A summary identifying each regulatory requirement noted above and the claims that demonstrate the requirement is met.

7.3.3.4. The claims, arguments, and evidence shall describe how the SMS processes (section 7.1) have been applied to manage ADS safety throughout the lifecycle of the system.

7.3.3.5. Relevant assumptions made in relation to claims, arguments, and evidence shall be stated.

7.3.3.6. The claims, arguments, and evidence shall demonstrate that the approach to testing is suitable for the demonstration of the safety case and the compliance with performance/functional requirements.

7.3.3.7. Each requirement defined under paragraphs 7.3.3.2, 7.3.3.4, 7.3.3.6, and as may be defined by the manufacturer shall have at least a claim.

7.3.3.7.1. Multiple sub-claims for a claim may be created, where a broader claim may not be sufficient or where additional justification is warranted as long as said sub-claims are sequenced logically and their relationships are included in the summary documents.

7.3.3.8. Each argument supporting a claim shall provide contextual information and supporting information that explains how a claim is met based on an appropriate set of evidence.

7.3.3.9. Evidence supporting argumentation shall consist of test results or analysis (e.g., system layout and schematics, photographs, required documentation, etc.) as appropriate.

7.3.3.9.1. The virtual, track, and real-world test environments used to generate evidence shall satisfy the requirements under paragraphs 7.2.1., 7.2.2., and 7.2.3. respectively.

7.3.3.9.2. Testing results may be provided individually or on aggregate and shall include appropriate acceptance criteria.

7.3.3.9.3. Each test shall include enough information or be recorded in such a way that it may be reproduced upon request (e.g., same software/hardware versions, same tool versions, same scenario, same parameters, etc.).

7.3.3.9.3.1. The manufacturer shall facilitate access and execution of the necessary tools and analysis software upon request by the authority for the purpose of reproducing this evidence as part of the approval process or during compliance verification.

7.3.4. Manufacturer’s review of its safety case

7.3.4.1. As part of the manufacturer’s demonstration of compliance with the specifications of paragraph 7.1.4., the manufacturer shall review its safety case prior to approval and is encouraged to do so during the development process.

7.3.4.2. The reviewer(s) shall be independent, meaning that they are free from conditions that would threaten their ability to review the safety case without bias.

7.3.4.3. The reviewer(s) may be internal or external to the manufacturer.

7.3.4.4. The review shall be documented, available for inspection, and include:

(a) Qualifications of the reviewer/ review team,

(b) Date/period of review, version of the safety case, tools and ADS reviewed,

(c) Methods used to review the safety case,

(d) Listing of any evidence repeated/reproduced, and

(e) Identified gaps, questions or areas of lower confidence or unknowns.

7.3.4.5. Following each review, and after a time of the manufacturer’s choice but before assessment of compliance, the manufacturer shall include in their review documentation the steps taken to remediate or improve upon any findings (e.g., release notes).

7.4. Post-deployment safety

7.4.1. The manufacturer shall provide reports on the in-service safety performance of its ADS vehicles to enable:

(a) Monitoring implementation of the SMS processes required under paragraphs 7.1.4. and 7.1.8.,

(b) Monitoring of ADS performance for consistency with the claims evidenced in the safety case of the ADS under paragraph 7.3.3., and

(c) Identification of safety concerns in need of remedy.

7.4.2. The reporting by the manufacturer shall be based upon information known to the manufacturer.

7.4.3. The manufacturer shall provide initial notifications, short-term reports, and periodic reports to the relevant authority.

7.4.4. The manufacturer shall provide the supporting data underpinning the report by means of an agreed data exchange mechanism upon request by the relevant authority.

7.4.5. The manufacturer shall provide the relevant authority with a description of the data processing (for example: filtering and conditioning) procedure and agree on the steps undertaken to deliver the data supporting the report.

7.4.6. The manufacturer shall report occurrences when at least one of the following is fulfilled:

(a) An ADS feature was active when the ADS vehicle was involved in the occurrence, or

(b) An ADS feature was active up to 30 seconds prior to the ADS vehicle experiencing the occurrence.

7.4.7. Initial notifications

7.4.7.1. The manufacturer shall notify the relevant authority of a critical occurrence without unreasonable delay in accordance with the applicable laws after becoming aware of it.

7.4.7.2. The initial notification may be limited to high-level data (e.g., location, time, type of accident).

7.4.8. Short-term reporting

7.4.8.1. The manufacturer shall provide short-term reports for the significant and critical occurrences listed in Annex 3 of this Regulation.

7.4.8.2. The manufacturer shall issue each short-term report within 30 days from its knowledge of the occurrence.

7.4.8.3. The manufacturer shall report the occurrences in accordance with the template provided in Annex 4 of this Regulation.

7.4.9. Periodic reporting

7.4.9.1. The manufacturer shall provide periodic reports for the occurrences listed in Annex 3.

7.4.9.2. The periodic report shall provide evidence of the in-service ADS safety performance. In particular, it shall demonstrate that:

(a) The ADS fulfils the performance requirements as evaluated in the test methods and/or declared in the safety case,

(b) No inconsistencies have been detected compared to the ADS safety performance declared prior to market introduction, and

(c) Any newly discovered significant ADS safety performance issues that pose an unreasonable risk to safety have been adequately addressed and how this was achieved, including how they were addressed.

7.4.9.3. The manufacturer shall submit periodic reporting regularly, at least every year, in the form of aggregated data (e.g., per hour of operation and distance driven) for ADS-vehicle type and related to ADS operation.

7.4.9.4. The manufacturer shall provide the periodic report in accordance with the template provided in Annex 5.

7.5. Other manufacturer requirements

7.5.1. The manufacturer shall make available the extent, timing, and frequency of maintenance operations necessary for safe ADS performance to the vehicle owner or operator.

8. Compliance assessments

8.1. Audit of the Safety Management System

8.1.1. The approval authority or its designated technical service shall audit the documentation of the manufacturer's safety management system to verify compliance with the requirements under paragraph 7.1.

8.1.2. The approval authority or its designated technical service shall verify the evidence on the robustness of the manufacturer's processes to manage safety risks and to ensure safety throughout the ADS lifecycle (development, production, deployment, and post-deployment).

8.1.3. The approval authority or its designated technical service shall evaluate the robustness of the manufacturer's processes to monitor the safety management system activities (KPIs) and to take appropriate (corrective or preventive) action to address any issue.

8.1.4. The audit of the safety management system shall be conducted by auditors meeting the requirements under paragraph 4.4, as applicable.

8.1.5. Audit of the safety policy

8.1.5.1. The approval authority or its designated technical service shall verify that the safety policy covers following aspects:

(a) Definition of the principles and objectives upon which the SMS is built, operated, and maintained,

(b) General recognition of the inherent risks of ADS-related activities throughout their life cycle, including the risks of the parties involved,

(c) Organisational structure and the safety governance elements and their appropriateness for the needs of the organisation,

(d) Evidence of the commitment to safety, and

(e) Description of the means/approaches to engage people within the organisation in the culture of safety.

8.1.6. Audit of the risk management

8.1.6.1. The approval authority or its designated technical service shall verify that the risk-management processes cover following aspects:

(a) Reactive and proactive practices for risk management are in place,

(b) The risk management activity is not limited to the ADS itself but includes risk arising from organisation/people which can affect the SMS effectiveness or the safety of the ADS,

(c) The risk management activity includes risks from third parties, and

(d) The risk management activity covers and is performed over the entire lifecycle.

8.1.7. Audit of the safety assurance

8.1.7.1. The approval authority or its designated technical service shall verify that the safety-assurance processes cover the following aspects:

(a) Periodic independent internal audits and external audits,

(b) Processes for the management of the supply chain and any other involved organisation(s) that could affect the safety of the ADS,

(c) Change management processes are in place,

(d) Processes for corrective actions to maintain an acceptable level of safety are in place,

(e) The corrective action applies to the ADS as well as SMS,

(f) Monitoring practices to measure overall safety performance are in place,

(g) The monitoring practices apply to the ADS as well as to the SMS, and

(h) Independent functions for carrying out the compliance assessment and audit are in place.

8.1.8. Audit of safety promotion

8.1.8.1. The approval authority or its designated technical service shall verify that the safety-promotion processes cover the following aspects:

(a) There is an appropriate level of competence of the personnel to perform their duties,

(b) The competence is promoted through training,

(c) Means for internal and external safety communications are in place, and

(d) Process for continuous improvement.

8.1.9. Audit of design and development processes

8.1.9.1. The approval authority or its designated technical service shall verify that the design and development process cover the following aspects:

(a) Management of the design and development phase, and

(b) Evidence of the embodiment of the safety policy, risk management, safety assurance and safety promotion aspects in the design and development.

8.1.10. Audit of production processes

8.1.10.1. The approval authority or its designated technical service shall verify that the production processes cover the following aspects:

(a) Management of the production phase, and

(b) Evidence of the embodiment of the safety policy, risk management, safety assurance and safety promotion aspects in the production.

8.1.11. Audit post-deployment processes

8.1.11.1. The approval authority or its designated technical service shall verify that the post-deployment safety processes cover the following aspects:

(a) Management of the post-deployment phase, and

(b) Evidence of the embodiment of the safety policy, risk management, safety assurance and safety promotion aspects in the post-deployment phase.

8.1.11.2. Audit of In-Service Monitoring and Reporting (ISMR)

8.1.11.2.1. The approval authority or its designated technical service shall verify the suitability of the manufacturer’s ISMR practices for the ADS.

8.1.11.2.2. The documentation review shall provide evidence that:

(a) The processes for ISMR are suitable for the ADS,

(b) The tools used for ISMR are suitable for the ADS, and

(c) The personnel for ISMR have an adequate level of competence.

8.1.11.2.3. The approval authority or its designated technical service shall verify the manufacturer's capability to monitor the ADS in accordance with the requirements under paragraphs 7.1.8.1. through 7.1.8.7.

8.1.11.2.4. The approval authority or its designated technical service shall evaluate the manufacturer's methods:

(a) To verify the safety performance of the ADS during the operation, and

(b) To ensure the effectiveness of their safety risk controls.

8.1.11.2.5. The approval authority or its designated technical service shall verify and evaluate that the manufacturer has a mechanism in place:

(a) To collect data from the vehicle and to receive data from other sources, and

(b) To utilize all relevant data feeding sources in order to assess the ADS safety risks, evaluate its safety performance, and, in time, take appropriate actions and check their effectiveness.

8.1.11.2.6. The documentation review shall provide evidence that, at least:

(a) Responsibilities and timelines are defined to ensure that the monitoring is applied and effective,

(b) Methods for data collection and analysis are adequate to ensure monitoring objectives are fulfilled,

(c) ADS safety performance will be verified in reference to the safety performance indicators and safety performance targets as indicated in the safety case,

(d) The risks are managed and controlled based on the information coming from the monitoring activities,

(e) The monitoring takes into account feedback and information received from sources other than the ADS vehicle data, and

(f) The effectiveness of the monitoring activity will be regularly reviewed.

8.1.11.2.7. The approval authority or its designated technical service shall verify the manufacturer's capability to report the occurrences listed in Annex 3.

8.1.11.2.8. The approval authority or its designated technical service shall evaluate the manufacturer's approach/methods for reporting the occurrences experienced by the ADS during the operation and for assessing the cause of such events.

8.1.11.2.9. The approval authority or its designated technical service shall verify that the manufacturer utilizes the reporting templates provided in Annex 4 and Annex 5.

8.1.11.2.10. The approval authority or its designated technical service shall evaluate the adequacy of the information that the manufacturer intends to use for the characterisation of the occurrences (e.g., data elements and metrics).

8.2. Assessment of the test environments

8.2.1. Virtual testing environments

8.2.1.1. The approval authority or its designated technical service shall verify that each simulation toolchain used by the manufacturer is suitable for conducting virtual testing in compliance with requirements listed under paragraph 7.2.1.

8.2.1.2. The approval authority or its designated technical service shall review the documentation provided by the manufacturer to determine whether the simulation toolchain(s) is suitable to undertake virtual testing.

8.2.1.2.1. The approval authority or its designated technical service shall review the documentation and evidence supporting the manufacturer's claims about the simulation toolchain(s) capability and its scope.

8.2.1.2.2. The approval authority or its designated technical service may require the manufacturer to demonstrate the execution of the simulation toolchain(s) and the generation of results to verify that the evidence complies with the provisions under paragraph 7.2.1 of the Regulation and to understand the use of the simulation toolchain(s).

8.2.1.2.3. The approval authority or its designated technical service shall audit the information provided by the manufacturer and may require additional testing to verify its claims. The results of the audit and of any additional tests shall be reviewed and any concerns or discrepancies shall be documented and reviewed with the manufacturer.

8.2.1.2.3.1. If the approval authority or its designated technical service is unable to confirm that there is an appropriate level of consistency between the information provided by the results and those of the manufacturer or raises other concerns and the manufacturer cannot provide a reasonable explanation for the discrepancies, then the manufacturer shall undertake a review to identify the reasons for those discrepancies.

8.2.1.2.3.2. After the discrepancies under paragraph 8.2.1.2.3.1. above have been identified and resolved, the manufacturer shall explain its findings and impact. The manufacturer shall add this new information and associated updates to the material being assessed. Updated material shall be assessed by the approval authority or its designated technical service.

8.2.1.2.4. The assessment shall determine and document if the simulation toolchains are suitable for virtual testing.

8.2.2. Track testing

8.2.2.1. The approval authority or its designated technical service shall verify compliance of the track testing facilities, environment, and capabilities used to generate the evidence to support the safety case with the provisions under paragraph 7.2.2.

8.2.2.2. The approval authority or its designated technical service may require the manufacturer to demonstrate the execution of its track tests to verify that the evidence complies with the provisions under paragraph 7.2.2.

8.2.3. Real-world testing

8.2.3.1. The real-world testing facilities, environment, and capabilities used to generate the evidence to support the safety case claims shall be assessed for compliance with the provisions under paragraph 7.2.3.

8.2.3.2. The approval authority or its designated technical service may require the manufacturer to demonstrate the execution of its real-world tests to verify that the evidence complies with the provisions under paragraph 7.2.3.

8.3. Assessment of the safety case

8.3.1. Assessment of the safety-case content

8.3.1.1. The approval authority or its designated technical service shall assess the safety case to determine its completeness and robustness. The team responsible for the assessment shall meet the requirements in paragraph 4.4. as applicable.

8.3.1.2. The approval authority or its designated technical service may require the manufacturer to provide supporting documentation and assist in reproducing evidence or may subject the ADS to confirmatory tests.

8.3.1.3. The approval authority or its designated technical service shall review the manufacturer’s safety case for completeness to ensure that at least the following criteria have been met:

(a) The manufacturer’s safety concept is consistent and complete,

(b) Each requirement of this Regulation has been addressed by one or more claims in accordance with paragraph 7.3.3.7.,

(c) The cumulation of claims would yield a system absent of unreasonable risk pursuant to paragraphs 7.3.2.1, 7.3.2.16. and 7.3.3.2.,

(d) Each claim is supported by one or more arguments in accordance with paragraph 7.3.3.1.,

(e) Each argument is supported by a non-zero set of evidence in accordance with paragraph 7.3.3.1.1.,

(f) The manufacturer has documented metrics and acceptance criteria related to their claims in accordance with paragraph 7.3.2.16., and

(g) Unique labelling of claims, arguments and evidence in accordance with paragraph 7.3.3.1.2., and backward and forward traceability from requirements to evidence in accordance with paragraph 7.3.3.3.

8.3.1.4. The approval authority or its designated technical service shall review the manufacturer's safety case for robustness to verify that at least the following criteria have been met:

(a) All identified risks in the safety concept have been reduced, mitigated or accepted and the aggregate residual risk (quantitative or qualitative) is below the unreasonable risk threshold,

(b) The integrity level used for development, verification, and validation of the ADS and its features is appropriate to reduce the risk below the unreasonable risk threshold,

(c) The tools by which testing evidence is obtained achieve an acceptable level of credibility and demonstrate stability of performance when subjected to variations in accordance with paragraph 8.2.,

(d) Testing evidence was obtained from an adequately explained combination of virtual, track and real-world testing and shows consistency of results between those test methods.

(e) The manufacturer has taken steps to limit the potential for unintended functions in the ADS or for unintended functions to be induced in interfacing systems,

(f) Testing evidence provided can be repeated and reproduced with consistency of safety objectives in accordance with paragraph 8.3.2.,

(g) The testing evidence demonstrated by the manufacturer provides reasonable coverage of foreseeable operating conditions and events in the intended area of operation in alignment with the approaches described in paragraphs 7.3.2.13. and 7.3.2.14., including conditions consistent with the ODD of the ADS and conditions that may involve ODD exit, and

(h) The manufacturer has conducted one or more self-assessments and has taken steps to remediate any findings in accordance with paragraph 7.3.4.

8.3.1.5. The approval authority or its designated technical service shall prepare a report of its assessment in such a manner that allows traceability (e.g., versions of documents are coded and listed in the records). The report shall include any identified discrepancies/gaps, and remediations undertaken by the manufacturer.

8.3.1.6. Assessment of the DSSAD

8.3.1.6.1. The documentation provided under paragraph 7.3.1.13. shall be verified for consistency with the provisions of Annex 8.

8.3.2. Assessment of safety-case testing activities

8.3.2.1. General provisions

8.3.2.1.1. The approval authority or its designated technical services shall verify that the approach to testing adopted by the manufacturer is suitable for the

demonstration of the safety case and the compliance with performance/functional requirements.

8.3.2.1.2. The approval authority or its designated technical service shall verify that the combined coverage of the testing results from all pillars (virtual, track, real world) is sufficient to support the ADS safety case claims.

8.3.2.2. Assessment of the scenarios and their management

8.3.2.2.1. The approval authority or its designated technical service shall verify that the manufacturer has used suitable and documented processes to derive behavioural competencies and scenarios that are relevant to both the ODD and to the ADS safety case. [16]

8.3.2.2.2. The approval authority or its designated technical service shall verify that the manufacturer's approach and processes to identify and generate scenarios is appropriate. In particular, the resulting scenarios shall:

(a) Cover the appropriate nominal, critical, and failure situations,

(b) Use data-driven, knowledge-driven, and stochastic approaches to systematically identify hazardous events and other occurrences,

(c) Include elements (especially dynamic elements) that are representative of existing traffic conditions in the expected operating conditions, and

(d) Incorporate the identified characteristics and behaviours of all the relevant scenario elements.

8.3.2.2.3. The approval authority or its designated technical service shall verify that the set of scenarios and situations resulting from the manufacturer's scenario generation and identification process is suitable for demonstrating the ADS safety case. This includes covering reasonably foreseeable situations and conditions that the ADS will encounter during its real-world operations. In particular, the approval authority or its designated technical service shall verify that the set of scenarios and situations selected as evidence to support the ADS safety case includes:

(a) Scenarios and situations in which the ADS needs to initiate a fallback response (e.g., approaching the ODD boundaries), and

(b) Reasonably foreseeable situations that are not deemed to be preventable by the ADS (e.g., related to unsafe behaviour by other road users or by infrastructural failures).

8.3.2.2.4. The approval authority or its designated technical service shall verify that the manufacturer has adopted appropriate techniques to explore the parameter space when choosing concrete scenarios.

8.3.2.3. Assessment of the processes in place for testing

8.3.2.3.1. The approval authority or its designated technical service shall verify that the manufacturer has suitable processes, resources and competent personnel who can design the testing that produces the evidence supporting the ADS safety case.

8.3.2.3.1.1. The approval authority or its designated technical service shall verify that the manufacturer has suitable processes in place to select and combine static and dynamic elements of a test track for correctly reproducing the conditions of the scenarios selected to track testing.

8.3.2.3.1.2. The approval authority or its designated technical service shall verify that the manufacturer has suitable processes in place to identify test routes that capture predictable aspects of the ODD (e.g., road types and geometries), elements found in the related nominal situations (e.g., other road users, signs, and signals), and typical dynamic conditions (e.g., high/low traffic densities). The

[16] The methodology in Annex 7 is one suitable process against which to review the process adopted by the manufacturer.

test routes shall also enable verification of requirements for the safety of user interactions, including prior to, at the time of, and after entering and exiting the ODD of an ADS feature.

8.3.2.3.2. The approval authority or its designated technical service shall verify that the manufacturer has suitable processes, resources and competent personnel to undertake the testing that produces the evidence supporting the ADS safety case.

8.3.2.3.2.1. The approval authority or its designated technical service shall verify that the manufacturer has suitable processes, resources and competent personnel to assess the behavioural competencies demonstrated by the ADS for each scenario and situation against the requirements for performance of the DDT.

8.3.2.3.2.2. The approval authority or its designated technical service shall verify that the manufacturer has suitable processes, resources and competent personnel who can assess the capability of the ADS to ensure the safety of users and the safe use of the ADS.

8.3.2.3.3. The approval authority or its designated technical service shall verify that the manufacturer has not optimised the ADS for a set of known test cases.

8.3.2.4. Assessment of testing evidence

8.3.2.4.1. The approval authority or its designated technical service shall review the evidence produced by the manufacturer in demonstrating the ADS safety case using the different test methods:

(a) Virtual testing.

(b) Track testing.

(c) Real-world testing.

8.3.2.4.1.1. The approval authority or its designated technical service shall review the evidence produced by the manufacturer in demonstrating the capability of the ADS to perform the DDT.

8.3.2.4.1.2. The approval authority or its designated technical service shall review the evidence produced by the manufacturer to demonstrate the capability of the ADS to interact with users in compliance with the requirements under paragraph 6.2.

8.3.2.4.1.3. The approval authority or its designated technical service shall verify that the procedures and data collection associated with testing are in line with established scientific and engineering practice.

8.3.2.4.1.4. For the specific case of ADS interaction testing, the approval authority or its designated technical service shall:

(a) Verify that the people involved are representative of the expected general population of ADS users and other road users where applicable, and

(b) Verify that the results achieved can be considered statistically significant.

8.3.2.4.1.5. The approval authority or its designated technical service shall verify the suitability of the set of tests carried out as evidence to support the safety case, in particular in terms of coverage, consistency, and relevance.

8.3.2.4.1.6. The approval authority or its designated technical service shall verify that the results of the tests are able to demonstrate the behavioural competencies of the ADS when performing the DDT. In particular the approval authority or its designated technical service shall verify that the test results confirm the claims and arguments in the ADS safety case:

(a) In nominal, critical and failure situations,

(b) While approaching and crossing the ODD boundaries, and

(c) In the case that collisions with other road users are not deemed to be preventable.

8.3.2.4.1.7. The approval authority or its designated technical service shall verify that the manufacturer has suitable processes in place to identify the set of scenarios to be tested using the different testing methods.

8.3.2.4.1.8. The approval authority or its designated technical service shall verify that the manufacturer has suitable processes in place to verify the consistency of the test results across the different testing methods adopted.

8.3.2.4.2. Assessment of virtual testing evidence

8.3.2.4.2.1. The approval authority or its designated technical service shall verify that the manufacturer's virtual testing has been carried out incorporating proper consideration of the assumptions, accuracy and uncertainty in the simulation toolchain(s) in line with the requirements under paragraph 7.2.1. The reviewer shall verify that the use of the results from the virtual testing reflects these considerations.

8.3.2.4.2.2. The approval authority or its designated technical service shall verify that any virtual test using a simulation toolchain containing stochastic elements has taken account of the possible uncertainty in the results.

8.3.2.4.2.3. If the manufacturer uses virtual testing to demonstrate scenario coverage the approval authority or its designated technical service shall verify that they have included critical scenarios and low probability events. The critical scenarios shall include unavoidable collision scenarios.

8.3.2.4.3. Assessment of track testing evidence

8.3.2.4.3.1. The approval authority or its designated technical service shall review the evidence from track testing that is provided by the manufacturer to support the safety case of the ADS.

8.3.2.4.3.2. The approval authority or its designated technical service shall verify that at least part of the scenario tested via track testing includes critical scenarios replicating conditions that could result in a collision.

8.3.2.4.4. Assessment of real-world testing evidence

8.3.2.4.4.1. The approval authority or its designated technical service shall review the evidence from real-world testing that is provided by the manufacturer to support the ADS safety case.

8.3.2.4.4.2. The approval authority or its designated technical service shall verify that the evidence collected via real-world testing by the manufacturer covers a wide variety of situations and conditions that the ADS may encounter during its real-world operations.

8.3.2.4.4.3. To the extent that an ADS encounters critical or failure situations during a real-world test drive, the response of the ADS, including any discrepancies with the nominal performance requirements, shall be considered by the approval authority or its designated technical service in conjunction with the outcomes of track and virtual testing.

8.3.3. Confirmatory testing

8.3.3.1. Confirmatory testing conducted or required by the approval authority or its designated technical service shall use one or more test methods and pre-defined and repeatable test protocols to confirm that the evidence provided by the manufacturer accurately represents the ADS performance. The confirmatory tests shall cover a range of driving conditions representative of the ODD, including at least and as appropriate:

(a) Failure situations,

(b) Behaviours in the presence of vulnerable road users,

(c) Situations with a large number of other road users, traffic disturbance, unlikely road infrastructure, uncommon road conditions, and/or atypical environmental conditions,

(d) User interactions,

(e) Compliance with traffic rules,

(f) Collision avoidance and mitigation,

(g) ODD boundaries and fallbacks to MRC, and

(h) Conditions that trigger DSSAD and ISMR functions.

8.3.3.1.1. The approval authority or its designated technical service shall ensure that the physical testing (proving ground and/or public road) facilities and environment and the virtual testing environment as applicable are suitable to conduct the testing and confirm the evidence provided by the manufacturer to support the safety case in accordance with the requirements under paragraph 7.2.

8.3.3.1.2. The approval authority or its designated technical service shall compare the information generated by the confirmatory testing with the evidence produced by the manufacturer to check that there is an appropriate level of consistency between them.

8.3.3.1.2.1. The approval authority or its designated technical service's confirmatory testing strategy may identify a test case that is within the ODD but not easily compared to an existing result provided by the manufacturer. This case should still be considered and the results compared with the expected behaviour of the ADS. The expected behaviour should be determined in discussion with the manufacturer.

8.3.3.1.2.2. If the approval authority or its designated technical service is unable to confirm that there is an appropriate level of consistency between the results, the manufacturer shall review the alleged discrepancies and take appropriate action to resolve them.

8.3.3.2. Virtual testing

8.3.3.2.1. The provisions included in the following paragraphs up to and including 8.3.3.2.4. shall apply in the case that confirmatory virtual testing is conducted or required.

8.3.3.2.2. The approval authority or its designated technical service shall demonstrate that the simulation toolchain used for virtual testing complies with the requirements under paragraph 7.2.1.

8.3.3.2.3. The approval authority or its designated technical service shall document its choices for the scenarios selected.

8.3.3.2.4. The approval authority or its designated technical service may require the manufacturer to make available the virtual testing environment it has used to produce evidence in its safety case to carry out confirmatory virtual testing.

8.3.3.3. Track testing

8.3.3.3.1. Paragraphs 8.3.3.3.2. through 8.3.3.3.9. apply in the case that confirmatory track testing is conducted or required.

8.3.3.3.2. The approval authority or its designated technical service shall explain and document its choices for the scenarios used to test the ADS.

8.3.3.3.3. Any track testing shall be conducted on a testing ground that is part of, or suitably represents, the ODD of the ADS and complies with the requirements under paragraph 7.2.2.

8.3.3.3.3.1. The approval authority or its designated technical service may request to use the testing ground used by the manufacturer to carry out confirmatory track testing.

8.3.3.3.4. Track testing may be conducted to verify that ADS responds safely to situations:

(a) Occurring within the ODD,

(b) Occurring while crossing the ODD boundaries, and

(c) Concerning its activation outside of the ODD.

8.3.3.3.5. The approval authority or its designated technical service shall consider how to manage real-world variations. Variations may include, but are not limited to, changes in lighting conditions, weather, road surface conditions, and surrounding traffic behaviour. The approval authority or its designated technical service shall confirm that the ADS maintains safe performance within its ODD and verify that the ADS responds to approaching and crossing of ODD boundaries in line with the safety case.

8.3.3.3.6. The approval authority or its designated technical service shall ensure an appropriate protocol is used for recording the track testing. It will contain at least minimum requirements on test-relevant data collection and analysis, e.g., how the data is recorded, how measurements are derived from the recorded data, and how the measurements are analysed.

8.3.3.3.7. The approval authority or its designated technical service shall ensure that the track testing carried out is recorded with sufficient details to allow the tests to be reproduced to a sufficient level of accuracy. The information recorded shall include at least the test equipment, the test set-up, and the test environment, as well as any variations and adjustments.

8.3.3.3.8. The approval authority or its designated technical service shall select scenarios where the behaviour or position of other road users requires the ADS to react to their movement or presence.

8.3.3.3.9. The approval authority or its designated technical service shall use track testing to also confirm that user(s)-related aspects are in line with the ADS safety case.

8.3.3.4. Real world testing

8.3.3.4.1. The approval authority or its designated technical service shall ensure that real-world testing is conducted safely and therefore can end a test at any point if it becomes unsafe.

8.3.3.4.2. The approval authority or its designated technical service shall ensure that real world testing only be conducted if an appropriate level of safety for the other road users and for users in the vehicle can be demonstrated.

8.3.3.4.3. The approval authority or its designated technical service shall demonstrate that real-world testing confirms the claimed ADS performance in real traffic conditions.

8.3.3.4.4. The approval authority or its designated technical service shall demonstrate that real-world testing confirms the claimed ADS performance when approaching and crossing ODD boundaries, where appropriate.

8.3.3.4.5. The approval authority or its designated technical service shall demonstrate that real-world testing confirms the claimed ADS performance relating to issues that may not be well captured by track tests and simulation, such as perception quality limitation (e.g., due to light and environmental conditions, etc.).

8.3.3.4.6. The approval authority or its designated technical service shall demonstrate that real-world testing confirms the claimed ADS performance for aspects relating to human factors, such as user-initiated deactivation, system-initiated deactivation (not leading to a mitigated risk condition), audibility of messages in real-world conditions, if applicable to the ADS.

8.3.3.4.7. The approval authority or its designated technical service shall demonstrate that real-world testing confirms the claimed ADS performance related to the interaction with ADS users and other road users under these conditions.

8.3.3.4.8. The approval authority or its designated technical service shall review the environment and conditions of the selected test routes to ensure they reflect the environment and conditions of the ODD of the ADS feature(s).

8.3.3.4.9. The approval authority or its designated technical service shall ensure that the selection of test routes utilises appropriate strategies to enhance the probability

of ADS encountering situations that involve a large number of other road users, unlikely road infrastructure, or abnormal geographic/environmental conditions, by examining when and where specific elements (e.g., high- or low-density traffic) typically occur. It is understood that it may not be possible to encounter all traffic situations during a real-world test.

8.3.3.4.10. The approval authority or its designated technical service shall ensure that an appropriate protocol is followed when undertaking real-world testing. It should contain minimum requirements that standardise how the test-relevant data are to be collected and analysed (e.g., how the data is recorded, how measurements are derived from the recorded data, and how the measurements are analysed).

8.3.3.4.11. The approval authority or its designated technical service shall ensure that real-world testing confirms the claimed ADS performance both within its ODD and outside its ODD (e.g., to determine the ADS's appropriate recognition and response when not in its ODD) on public roads.

8.3.3.4.12. The approval authority or its designated technical service shall review any failure to meet the requirements of this Regulation identified during real-world testing and assess it both directly and by evaluating it against any other relevant and available evidence (e.g., data gathered during other testing or supplied by the manufacturer).

8.3.3.4.13. In case of track testing according to paragraph 8.3.3.3., the approval authority or its designated technical service shall compare the information generated during real-world testing with the information from track testing to ensure there is an appropriate level of correlation of the results, including the performance of the ADS.

8.3.3.4.13.1. If there is insufficient consistency between the results, then the manufacturer should be informed and should review the alleged discrepancies and take appropriate action to resolve them.

8.3.3.4.14. Test coverage and termination criteria

8.3.3.4.14.1. The real-world test drive shall cover the functions required to perform the entire DDT in the ODD pursuant to the outcomes of the safety case analysis.

8.3.3.4.14.2. The test should be terminated only when all relevant parts of paragraph 8.3.3.4.14.1, excluding safety-critical and failure-related scenarios, have been monitored and assessed.

8.3.3.5. For all vehicles, equipment and parts with which the approval tests are performed, the manufacturer shall provide the necessary information (e.g., software versions and system parameters) to allow the designated technical service to uniquely identify the configuration of all hardware and software that have an influence on performance with regard to this Regulation; this information shall be appended to the test report.

8.4. Post-deployment safety assessment

8.4.1. The approval authority or its designated technical service shall receive information provided by the manufacturer and assess that it is in accordance with the manufacturer’s SMS.

8.4.2. The approval authority or its designated technical service shall review the information provided by the manufacturer on the ADS operations (e.g., notifications, short-term and periodic reports):

(a) To receive confirmatory evidence on the safety case and on the Safety Management System,

(b) To receive information on the ADS safety level and assess whether the ADS continues to be safe when operated on the road,

(c) If applicable, to verify that this information is used to develop new scenarios or variants of existing scenarios used to generate evidence that supported the ADS safety case, and

(d) To assess the effectiveness of the remedial actions.

8.4.3. The approval authority or its designated technical service shall review the manufacturer's data processing (for example: filtering and conditioning) procedure during occurrence investigation and agree on the steps undertaken to deliver the data supporting the report.

8.4.4. The approval authority or its designated technical service shall ensure the confidentiality of sensitive and business confidential reported information in the short-term template.

8.4.5. The approval authority or its designated technical service, where necessary, may verify the information provided and, if needed, the approval authority or its designated technical service may require further investigations and evidence, including test, before closing the occurrence.

9. Modifications and extension of approval of the vehicle type

9.1. Every modification of the vehicle type as defined in paragraph 2.36. of this Regulation shall be notified to the approval authority that approved that vehicle type. The approval authority may then either:

(a) Consider that the modifications made do not have an adverse effect on the conditions of the granting of the approval and grant an extension of approval,

(b) Consider that the modifications made affect the conditions of the granting of the approval and require further assessment of the safety case, tests or additional checks before granting an extension of approval,

(c) Decide, in consultation with the manufacturer, that a new type approval is to be granted, or

(d) Apply the procedure contained in paragraph 9.1.1. (Revision) and, if applicable, the procedure contained in paragraph 9.1.2. (Extension).

9.1.1. Revision

When particulars recorded in the information documents of Annex 1 - Appendix 1 have changed and the approval authority considers that the modifications made are unlikely to have appreciable adverse effect, and that in any case the vehicle still meets the requirements, the modification shall be designated a "revision".

In such a case, the approval authority shall issue the revised pages of the information documents of Annex 1 - Appendix 1 as necessary, marking each revised page to show clearly the nature of the modification and the date of reissue. A consolidated, updated version of the information documents of Annex 1 - Appendix 1, accompanied by a detailed description of the modification, shall be deemed to meet this requirement.

9.1.2. Extension

The modification shall be designated an "extension" if, in addition to the change of the particulars recorded in the information folder:

(a) Further inspections or tests are required; or

(b) Any information on the communication document (with the exception of its attachments) has changed; or

(c) Approval to a later series of amendments is requested after its entry into force.

9.2. Notice of confirmation, extension, or refusal of approval shall be communicated by the procedure specified in paragraph 4.2. above, to the Contracting Parties to the Agreement applying this Regulation. In addition, the

index to the information documents and to the test reports, attached to the communication document of Annex 1, shall be amended accordingly to show the date of the most recent revision or extension.

9.3. The approval authority issuing the extension of approval shall assign a series number to each communication form drawn up for such an extension.

9.4. The manufacturer may apply for a new approval for the purpose of differentiating software versions intended to be used on vehicles already registered in the market from the software versions intended to be used on new vehicles. This may cover the situations where type approval Regulations are updated, or hardware changes are made to vehicles in series production. In agreement with the approval authority or its designated technical service, duplication of tests for these approvals shall be avoided where possible.

10. Conformity of Production

Procedures for the conformity of production shall conform to the general provisions defined in Article 2 and Schedule 1 to the Agreement (E/ECE/TRANS/505/Rev.3) and meet the following requirements:

10.1. Every vehicle approved pursuant to this UN Regulation shall be so manufactured as to conform to the type approved.

10.2. The approval authority that has granted the approval may at any time verify the conformity of control methods applicable to each production unit. The normal frequency of such inspections shall be once every two years.

11. Penalties

11.1. The approval granted in respect of a vehicle type pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 10. on conformity of production are not complied with.

11.2. The approval granted in respect of a vehicle type pursuant to this UN Regulation may be withdrawn if the post-deployment safety requirements laid down in paragraph 7.4 are not complied with.

11.3. If a Contracting Party withdraws an approval it had previously granted, it shall forthwith so notify the other Contracting Parties applying this UN Regulation by sending them a communication form conforming to the model in Annex 1.

12. Production definitively discontinued

12.1. If the holder of the approval completely ceases to manufacture a type of vehicle approved in accordance with this UN Regulation, the holder shall so inform the approval authority that granted the approval, which in turn shall forthwith inform the other Contracting Parties to the Agreement applying this Regulation by means of a communication form conforming to the model in Annex 1.

12.2. The production is not considered definitely discontinued if the manufacturer intends to obtain further approvals for software updates for vehicles already registered in the market.

13. Names and addresses of Technical Services responsible for conducting approval tests and of Type Approval Authorities

13.1. The Contracting Parties to the Agreement applying this Regulation shall communicate to the Secretariat of the United Nations the names and addresses

of the technical services responsible for conducting approval tests and of the approval authorities that grant approval and to which forms certifying approval or refusal, or extension or withdrawal of approval, issued in the other countries, are to be sent.

14. Certificate of compliance for a Safety Management System (SMS)

14.1. Each Contracting Party issuing type approvals pursuant to this Regulation shall appoint an approval authority to carry out the assessment of the manufacturer and to issue a Certificate of Compliance for the SMS.

14.2. An application for a Certificate of Compliance for SMS shall be submitted by the manufacturer or by their duly accredited representative.

14.3. It shall be accompanied by the undermentioned documents in triplicate, and by the following in particular:

14.3.1. Documents describing the Safety Management System.

14.3.2. A signed declaration using the model as defined in Appendix 1 to Annex 9.

14.3.3. In the context of the assessment, the manufacturer shall declare using the model as defined in Appendix 1 to Annex 9 and demonstrate to the satisfaction of the approval authority or its designated technical service that they have the necessary processes to comply with all the requirements for the SMS according to this Regulation.

14.4. When this assessment has been satisfactorily completed and in receipt of a signed declaration from the manufacturer according to the model as defined in Appendix 1 to Annex 9, a certificate named “Certificate of Compliance for a Safety Management System” shall be granted to the manufacturer.

14.5. The approval authority shall use the model set out in Annex 9 to this Regulation for the Certificate of Compliance for SMS.

14.6. The initial Certificate of Compliance for SMS issued by the approval authority will have a validity up to a maximum of three years. The approval authority shall perform a re-assessment within one year after granting the first ADS approval under this certificate of compliance.

14.7. The approval authority that has granted the Certificate of Compliance for SMS may at any time verify that the requirements for it continue to be met. The approval authority shall withdraw the Certificate of Compliance for SMS if the requirements laid down in this Regulation are no longer met.

14.8. The manufacturer shall inform the approval authority or its designated technical service of any change that will affect the relevance or validity of the Certificate of Compliance for SMS. After consultation with the manufacturer, the approval authority or its designated technical service shall decide whether a new assessment is necessary.

14.9. In due time, permitting the approval authority to complete its assessment before the end of the period of validity of the Certificate of Compliance for SMS, the manufacturer shall apply for a new (or for the extension of the existing) Certificate of Compliance for SMS.

14.10. The approval authority shall, subject to a positive outcome of the assessment, issue a new Certificate of Compliance or an extension of the existing Certificate of Compliance with a validity for a further period of maximum three years. The approval authority shall verify that the SMS continues to comply with the requirements of this Regulation. The approval authority shall issue a new certificate (or extend the existing certificate) in cases where changes have been brought to the attention of the approval authority or its

designated technical service and assessment of the changes result in a positive judgement.

14.11. The expiry or withdrawal of the manufacturer's Certificate of Compliance for SMS shall be considered, with regard to the vehicle types to which the SMS concerned was relevant, as modification of approval, as referred to in this Regulation, which may include the withdrawal of the approval if the conditions for granting the approval are no longer met.

Annex 1

Communication

(Maximum format: A4 (210 x 297 mm)) issued by: Name of administration:
.....
.....
.....

Concerning:[2] Approval granted
Approval extended
Approval withdrawn with effect from dd/mm/yyyy
Approval refused
Production definitively discontinued
of a vehicle type with regard to ADS pursuant to UN Regulation No. [185]

Approval No.: .....
Extension No.: .....
Revision No.:.....
Reason for extension or revision: .....

1. Trade name or mark of vehicle: .....

2. Vehicle type: .....

3. Manufacturer's name and address: .....

4. If applicable, name and address of manufacturer's representative:.....

5. General construction characteristics of the vehicle:.....

5.1. Photographs and/or drawings of a representative vehicle .....

6. Description and/or drawing of the ADS including:

6.1. ADS intended uses:.....

6.2 List of all ADS Features: .....

6.3. Overview of the ADS elements: .....

6.4. Installation of the ADS sensing system: .....

7. ADS feature(s) and overview (for each feature):

Item	*Description*	*Feature 1*	*...*	*Feature n*
7.1.	ADS feature type (i.e., ADSF-1 or ADSF-2)			
7.2.	ADS feature(s) performance and limitations, including a brief description of the ODD			
7.3.	Specified maximum speed of the ADS features declared by the manufacturer			

7.4. Overview of the interactions between the ADS and its user(s) and/or drawing of the ADS Human-Machine Interface (HMI) including:

Item	*Description*	*Feature 1*	*...*	*Feature n*
7.4.1.	Means to activate, deactivate the ADS feature and to take over the performance of the DDT from the system (if applicable)			

[1] Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in the Regulation).
[2] Strike out what does not apply.

7.4.2.	Methods to detect user availability (if applicable)			
7.4.3.	Methods to determine user engagement (if applicable)			

7.5. Written description and/or drawing of the information given to the user, including:

Item	*Description*	*Feature 1*	*...*	*Feature n*
7.5.1.	System status			
7.5.2.	The role of the fallback user (if applicable)			
7.5.3	Adapted performance in case of failure			
7.5.4	ADS feature deactivation to manual driving (if applicable)			
7.5.5	Fallback to a Mitigated Risk Condition			

8. Data Storage System for Automated Driving (DSSAD):

8.1. Details of how to access data from the DSSAD: .....

9. Cyber Security and Software updates:

9.1. Cyber Security Type Approval Number (if applicable):.....

9.2. Software Update Type approval number (if applicable): .....

10. Safety case:

10.1. Manufacturers document reference for the Safety Case (including version number) ...

10.2. Information Document: see Annex 1-Appendix 1 .....

11. Technical Service responsible for conducting approval tests: .....

11.1. Date of report issued by that service:.....

11.2. (Reference) Number of the report issued by that service:.....

12. Approval granted/extended/revised/refused/withdrawn

13. Position of approval mark on vehicle: .....

14. Place:.....

15. Date: .....

16. Signature: .....

17. Annexed to this communication is a list of documents in the approval file deposited at the administration services having delivered the approval and which can be obtained upon request.

Additional information regarding software identification and software updates (where applicable):

18. $R_{[185]}$SWIN:.....

18.1. Is the $R_{[185]}$SWIN held on the vehicle[2]: Yes/No

18.2. Information on how to read the $R_{[185]}$SWIN or software version(s) in case the $R_{[185]}$SWIN is not held on the vehicle:.....

18.3. If applicable, list the relevant parameters that will allow the identification of those vehicles that can be updated with the software represented by the $R_{[185]}$SWIN under the item above:.....

19. Description of the means to enable periodic road worthiness tests, if applicable: .....

Annex 1 - Appendix 1

Information document

The following information shall be supplied in triplicate and include a list of contents. Any drawings or pictures shall be supplied in appropriate scale and in sufficient detail on size A4 or on a folder of A4 format. Photographs, if any, shall show sufficient detail.

Information document

Information document No … relating to the type-approval of a type of a Vehicle with regard to the Automated Driving System (ADS) pursuant to UN Regulation No. [185].

0.	General information
0.1.	Trade name or mark of vehicle:
0.2.	Vehicle type:
0.2.1.	Commercial name(s) (if available):
0.2.2.	Means of identification of type, if marked on the vehicle:[1]
0.2.3.	Location of that marking:
0.2.4	Category of vehicle:[2]
0.3.	Manufacturer's name and address:
0.3.1.	Name(s) and address(es) of assembly plant(s):
0.4.	If applicable, name and address of the manufacturer's representative:
0.5.	General construction characteristics of the vehicle:
0.5.1.	Photographs and/or drawings of a representative vehicle:
1.	Automated Driving System (ADS)
1.1.	ADS description and drawings (in accordance with paragraph 7.3.1.)
1.1.1.	ADS intended uses (in accordance with paragraph 7.3.1.2.)
1.2.	List and description of the ADS feature(s)
1.2.1.	Operational Design Domain, boundary conditions, and expected operating conditions (in accordance with paragraph 7.3.1.3.)
1.2.2.	System outline (in accordance with paragraph 7.3.1.4.)
1.2.2.1.	Main ADS functions (functional architecture)
1.2.2.1.1.	Vehicle’s internal functions (e.g., sensing and perception, decision-making and planning, information display/user interface)
1.2.2.1.2.	Vehicle’s external functions (e.g., backend, off-board infrastructure needed)
1.2.2.2.	Overview of the major elements of the ADS
1.2.2.2.1.	Control units
1.2.2.2.2.	Sensors and installation of the sensors on the vehicle
1.2.2.2.3.	Actuators
1.2.2.2.4.	Maps and positioning
1.2.2.2.5.	Other hardware
1.2.2.3.	ADS diagrams and schematics
1.2.2.3.1.	Schematic system layout (e.g. block diagram)
1.2.2.3.2.	List and schematic overview of interconnections
1.3.	ADS feature information (in accordance with paragraphs 6.1., 6.2., 7.3.1.5. to 7.3.1.12, 7.3.1.15, and 7.3.1.16.)

[1] If the means of identification of type contains characters which are not relevant to describing the vehicle (i.e., types covered by the type-approval certificate), such characters shall be represented in the documentation by the symbol '?' (e.g., ABC??123??).

[2] As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3.), document ECE/TRANS/WP.29/78/Rev.8, para. 2. https://unece.org/transport/vehicle-regulations/wp29/resolutions.

Item	*Description*	*Feature 1*	*...*	*Feature n*
1.3.1.	ADS Feature type (i.e., ADSF-1 or ADSF-2)			
1.3.2.	ADS feature performance and limitations, including description of the ODD			
1.3.3.	Specified maximum speed of the ADS features declared by the manufacturer			
1.3.4.	Input and output relevant to ADS and their ranges			
1.3.5.	Description of the ADS performance of the DDT (nominal, critical, failure scenarios, at ODD boundaries, fallback strategies)			
1.3.6.	Description of interactions between the ADS and its user(s):			
1.3.6.1.	Human-machine interaction concept with occupants, other road users and remote interactions including information provided to the users			
1.3.6.2.	Description of the means to activate and deactivate the feature and to take over the performance of the DDT system (if applicable)			
1.3.6.3.	Description of the ADS feature deactivation to manual driving (if applicable)			
1.3.6.4.	Methods to detect user availability (if applicable)			
1.3.6.5.	Methods to determine user engagement (if applicable)			
1.3.6.6.	Conditions for triggering a request to the occupant(s) or for remote intervention			
1.3.6.7.	Written description or drawing of the information given to the user, including:			
1.3.6.7.1.	System status			
1.3.6.7.2.	The role of the fallback user (if applicable)			
1.3.6.7.3.	Adapted performance in case of failure			
1.3.6.7.4.	ADS feature deactivation to manual driving (if applicable)			
1.3.6.7.5.	Fallback to a Mitigated Risk Condition			

1.4. Safety case (in accordance with paragraphs 7.1.4. to 7.1.8., 7.2., 7.3.2., and 7.4.) [3]

1.4.1. Manufacturer Statement that the vehicle is free from unreasonable risks

1.4.1.1. Manufacturer's declaration:
The manufacturer..... affirms that the ADS is free of unreasonable safety risks to the occupants and other road users.

1.4.2. General description of failure-handling main principles and fallback strategy, including fallbacks to a Mitigated Risk Condition.

1.4.3. Description of the strategy to determine that the ADS feature is within its ODD, to remain within its ODD in case of operational disturbances (e.g. expected conditions exceed ODD ranges), to limit sudden ODD exits and frequent activation/deactivation situations.

[3] The manufacturer may provide a document reference and high-level description for sensitive or business confidential information.

1.4.4. Description of the strategy to prevent or mitigate abuse/misuse and errors by occupants, and to prevent, mitigate or deter harm to occupants caused by external sources and abuse/misuse of the vehicle or its systems from external sources.

1.4.5. Description of the strategy to manage the risk for passengers and to avoid operating the vehicle when the general working conditions are not satisfactory

1.4.6. Description of the strategy to determine collision with safety-relevant object and to assess the damage (i.e. trivial or non-trivial damage).

1.4.7. Verification and validation by the manufacturer for the compliance to the DDT performance requirements, the interactions between the ADS and its user(s), the other ADS requirements and the conclusion that the system is designed in such a way that it is free from unreasonable risks for the occupants and other road users and reasonable coverage of the ODD and its boundaries is achieved .

1.4.8. Description of the adopted approach to derive behavioural competencies and scenarios that are ODD-relevant.

1.4.8.1. Description of the approach for selection of nominal, critical and failure scenarios.

1.4.9. Description of the used methods and tools (software, laboratory, others) and summary of the credibility assessment.

1.4.9.1. Description of the results.

1.4.9.2. Uncertainty of the results.

1.4.9.3. Interpretation of the results.

1.4.10. DSSAD and ISMR (as applicable)

1.4.10.1. Type of data stored.

1.4.10.2. Storage location(s).

1.4.10.3. Recorded occurrences and data elements.

1.4.10.4. Means to ensure data security, integrity, and protection.

1.4.10.5. Means to access the data.

1.4.11. Cyber security and software update.

1.4.11.1. Cyber Security type-approval number (If applicable).

1.4.11.2. Number of the certificate of compliance for cyber-security management system (If applicable).

1.4.11.3. Software update type-approval number (If applicable).

1.4.11.4. Number of the certificate of compliance for software-update management system (If applicable).

1.4.11.5. Software Identification of the ADS.

1.4.11.5.1. Information on how to read the $R_{[185]}$SWIN or software version(s) in case the $R_{[185]}$SWIN is not held on the vehicle.

1.4.11.5.2. If applicable, list the relevant parameters that will allow the identification of those vehicles that can be updated with the software represented by the $R_{[185]}$SWIN.

1.5. Operational information (in accordance with paragraphs 6.2.4. and 7.5.): Information to user(s), maintenance information, instructions in case of failures and ADS requests, operational measures (e.g., when intervention is needed) (to be annexed to the information document)

1.6. Description of the means to enable periodic roadworthiness tests, if applicable (in accordance with paragraph 6.3.5.1.)

Annex 1- Appendix 2

Addendum to Communication No …
concerning the type approval of a vehicle type with regard to ADS pursuant to UN Regulation No. [185]

Additional information:
Contracting Parties where the vehicle manufacturer has declared that the ADS has been assessed to comply with this Regulation, including local traffic rules:

Country	*Assessed*	*Comments on any restrictions*
E 1 Germany	Yes/No (as apply)	
E 2 France		
E 3 Italy		
E 4 Netherlands		
E 5 Sweden		
E 6 Belgium		
E 7 Hungary		
E 8 Czech Republic		
E 9 Spain		
E 10 Serbia		
E 11 United Kingdom		
E 12 Austria		
E 13 Luxembourg		
E 14 Switzerland		
E 16 Norway		
E 17 Finland		
E 18 Denmark		
E 19 Romania		
E 20 Poland		
E 21 Portugal		
E 22 Russian Federation		
E 23 Greece		
E 24 Ireland		
E 25 Croatia		
E 26 Slovenia		
E 27 Slovakia		

Country	*Assessed*	*Comments on any restrictions*
E 28 Belarus		
E 29 Estonia		
E 30 Republic of Moldova		
E 31 Bosnia and Herzegovina		
E 32 Latvia		
E 34 Bulgaria		
E 35 Kazakhstan		
E 36 Lithuania		
E 37 Turkey		
E 39 Azerbaijan		
E 40 North Macedonia		
E 41 Andorra		
E 43 Japan		
E 44 Uzbekistan		
E 45 Australia		
E 46 Ukraine		
E 47 South Africa		
E 48 New Zealand		
E 49 Cyprus		
E 50 Malta		
E 51 Republic of Korea		
E 52 Malaysia		
E 53 Thailand		
E 54 Albania		
E 55 Armenia		
E 56 Montenegro		
E 57 San Marino		
E 58 Tunisia		
E 60 Georgia		
E 62 Egypt		
E 63 Nigeria		
E 64 Pakistan		
E 65 Uganda		
E 66 Philippines		

Country	*Assessed*	*Comments on any restrictions*
E 67 Viet Nam		
E 68 Kyrgyzstan		
E 70 Cambodia*		

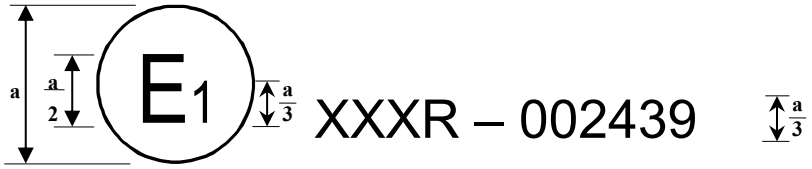
* The list of Contracting Parties applying UN Regulation No. [ADS] is available online: https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XI-B-16&chapter=11

Annex 2

Arrangements of approval marks

Model A

(See paragraph 4.6. of this Regulation)

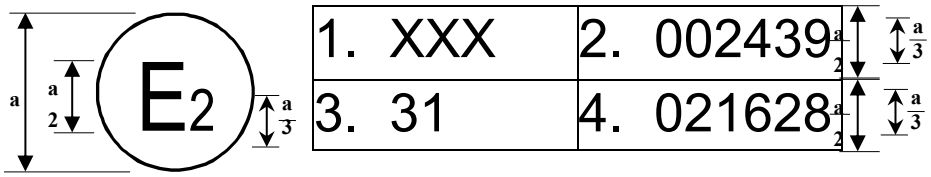


a = 8 mm (minimum)

The above approval mark affixed to a vehicle shows that the vehicle type concerned has, with regard to its ADS, been approved in Germany (E1) pursuant to UN Regulation No. [185] under approval No. 002439. The approval number indicates that the approval was granted in accordance with the requirements of UN Regulation No. [185] in its original version.

Model B

(See paragraph 4.7. of this Regulation)



The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in France (E2) pursuant to UN Regulation Nos. [185] and 31. The first two digits of the approval numbers indicate that these approvals were granted in accordance with the requirements of UN Regulation No. [185] in its original version and UN Regulation No. 31 as amended by the 02 series of amendments.

Annex 3

List of Reportable Occurrences by Reporting Type

The following table lists the occurrences to be reported by the manufacturer in accordance with paragraphs 7.4.8.1., 7.4.9.1., and 8.1.11.2.7. of this Regulation. The table indicates the reporting type(s) that apply to each occurrence.

Occurrences	*Reporting Type*		
	Notification	*Short-term*	*Periodic*
1. **Critical occurrences**[1]	X	X	X
2. **Significant occurrences**			
ADS operation outside its ODD		X	X
ADS failure to achieve a mitigated risk condition when necessary		X	X
Failure to meet the ADS requirements under paragraph 6 of this Regulation		X	X
Performance issues constituting an unreasonable risk to safety		X	X
3. **Other occurrences**[2]			
Uncompleted system-initiated deactivation processes to manual driving			X
Communication issues affecting the safety of the ADS			X
Cybersecurity issues affecting the safety of the ADS			X
System failures that compromise the capability of the ADS to perform the entire DDT			X
Maintenance or repair issues affecting the ADS's intended functionality [3]			X
Unauthorized modifications to ADS that could affect the intended functionality			X
Manoeuvres performed to reach MRC			X
Emergency Manoeuvres			X
Active ADS feature required remote interaction to navigate a driving situation [4]			X
Fallback user unavailability [5]			X
Prevention of takeover under unsafe conditions[6]			X

[1] If such an occurrence also belongs to one of the remaining sub-categories listed in the occurrence table, the following provisions apply:
- Short-term report: there is no need to double-report such occurrence also as part of one of the remaining categories listed in the table.
- Periodic reporting: the occurrence should be double reported both as part of critical occurrence and as occurrence belonging to one of the remaining categories listed in the table. However, the report shall specifically note this aspect.

[2] The Occurrences of this category could be also reported as critical or significant occurrences. In this case, the periodic report shall specifically note this aspect.

[3] This occurrence captures systematic problems due to a maintenance/repair/service action discovered during the ADS operations.

[4] This occurrence captures events in which the ADS will require a support for “tactical functions” to cope with very specific situations, while the ADS continues to perform the entire dynamic driving task.

[5] At aggregate level, this information can provide useful information on the validity of the HMI concept and on the need to provide more effective procedures for keeping the fallback user available.

[6] It is acknowledged that there is no obligation to implement such design solution. However, such information can provide useful information to evaluate the safety benefit of implementing such solution.

Annex 4

In-Service Reporting Template: Short-term Reporting

1.1. The following template aims at ensuring that a consistent and comprehensive set of information is delivered to the relevant authority to foster an effective implementation of the short-term reporting ISMR requirements.

1.2. The manufacturer may use the short-term template to also report for other occurrences which are not mandated in Annex 3.

1.3. Depending on the nature of the significant occurrence, non-applicable fields shall be marked N/A.

1.4. The authority may request further information where a field has been marked N/A.

Entry name	*Mandatory (Y/N)*	*Field to be filled*	*Type/size*
WHAT			
Headline	Y		Text
OCCURRENCE CLASSIFICATION			
Occurrence class[1]	Y		Text
Occurrence type[2]	Y		Text
OCCURRENCE DETAILS			
Last active/active ADS feature at the time of the occurrence	Y		Text
ODD conditions relevant to the occurrence analysis	Y		Text
Maximum ADS-determined/estimated vehicle speed during the 10 seconds prior to the collision	Y		Number – (km/h)
Maximum ADS vehicle longitudinal deceleration during the 10 seconds after the collision	Y		Number – (m/s^2)
Availability of EDR data	Y		Y/N
Availability of DSSAD data	Y		Y/N
Additional supporting data available[3]	Y		Y/N
Occurrence reported to the law enforcement known to the manufacturer	N		Y/N
Police report available	N		Y/N

[1] Class can be: critical occurrence/significant occurrence/other occurrence.

[2] Reference: Table in Annex 3.

[3] Data can include ADS vehicle data (speeds…), ADS vehicle collected media (cameras…) or third-party sources.

Entry name	*Mandatory (Y/N)*	*Field to be filled*	*Type/size*
VEHICLE DETAILS			
Vehicle Identification Number	Y		Text (17)
Vehicle approval number	Y		Text
Vehicle category	Y		Text
Mileage	N		Number
ADS identifier	Y		Text
ADS licensing authorities	N		Text
Operator (if any/available)	N		Text
Other ADS features	N		Text
WHEN			
UTC date	Y		(YYYY/MM/DD)
UTC time	Y		(HH:mm)
Local date	Y		(YYYY/MM/DD)
Local time	Y		(HH:mm)
WHERE			
Country	Y		Text
State/Province	N		Text
City	N		Text
Location	Y		Text (longitude, latitude)
Roadway type	Y		Text
Roadway surface	Y		Text
Roadway description	Y		Text

Entry name	*Mandatory (Y/N)*	*Field to be filled*				*Type/size*
KNOWN OR ALLEGED DAMAGE						
Description of Damage to the ADS vehicle	N					Text
ADS vehicle damage area(s)	N	Front left	Front centre	Front right	Top	
		Rear left	Rear centre	Rear right	Bottom	
		Right side	Left side	Unknown		
ADS vehicle occupant restraint systems deployed	N					Y/N
ADS vehicle towed	N					Y/N
Any ADS feature no longer able to operate	N					Y/N
Other vehicles damaged	N					Y/N
KNOWN OR ALLEGED INFRASTRUCTURE DAMAGE						
Infrastructure type	N					Text
Detailed description	N					Text
KNOWN OR ALLEGED INJURY[4]						
Injury type	N					(Fatal/non-fatal)
Fatalities: ADS vehicle user(s)	N					Number
Fatalities: Other road user(s)	N					Number
Injuries: ADS user(s)	N					(Number and text)
Injuries: Other road user(s)	N					(Number and text)
DESCRIPTION OF THE OCCURRENCE						
Detailed description[5]	Y					Text
Post-occurrence behaviour	Y					Text

[4] Supporting information can be derived from CADaS taxonomy (https://road-safety.transport.ec.europa.eu/system/files/2021-07/cadas_glossary_v_3_7.pdf) or from Abbreviated Injury Scale (https://www.aaam.org/abbreviated-injury-scale-ais/)

[5] If the ADS did not deviate from its intended functionality or violate safety requirements, the field can provide supporting justification. Otherwise, the root cause analysis will identify and explain the issue.

Entry name	*Mandatory (Y/N)*	*Field to be filled*	*Type/size*
ANALYSIS			
Root cause analysis	Y		Text
Corrective action needed	Y		Y/N
Corrective action implemented	Y		Y/N
If implemented, description of corrective action	Y		Text
New or variant of an existing scenario encountered	Y		Y/N
Speed limit at location	Y		Number
ADS user(s) available at occurrence, in case of ADSF-1 (Y/N)	N		Y/N
Attempted (successful/completed) user-initiated deactivation of the ADS feature within 30 seconds prior to the occurrence, if applicable (Y/N)	N		Y/N
REPORT MANAGEMENT			
Reporting entity	Y		Text
Report ID	Y		Text
Report version	Y		Number
Report status (e.g., initial notification, in progress, closed)	Y		Text
Report date	Y		(YYYY/MM/DD)
Parties informed	Y		Text

Annex 5

In-Service Reporting Template: Periodic Reporting

1.1. The periodic template provides a list of information with its corresponding reporting specifications that should be made available to the authority on a yearly basis.

1.2. The following template aims at ensuring that a consistent and comprehensive set of information is delivered to the relevant authority to foster an effective application of the periodic reporting scheme. Further granularity of the information can be considered depending on the ADS use cases.

1.3. Where an ADS has more than one feature, the periodic report shall clearly differentiate each feature.

Entry name	*Mandatory (Y/N)*	*Field to be filled*	*Type/size*
ADS IDENTIFICATION			
Manufacturer	Y		Text
Vehicle/system approval number	Y		Text
ADS licensing authority(ies) (if applicable)	N		Text
ADS software version/identifier(s)	Y		Text
Applicable SMS	Y		Text
Vehicles equipped with ADS	Y		Number
ADS OPERATION INFORMATION (segmented by ADS feature)			
ADS-equipped vehicles per feature			Number
Cumulative distance travelled by an active ADS feature, optionally segmented by:	Y		Number
Country/province of operation	N		Text
Times of the day	N		Text
Weather conditions	N		Text
Road conditions[1]	N		Text
Cumulative time travelled by an active ADS feature, optionally segmented by:	Y		Number
Country/province of operation	N		Text
Times of the day	N		Text
Weather conditions	N		Text
Road conditions	N		Text
Average ADS time engagement	Y		Number

[1] Those refer to the state of the road at the time of operation, such as: dry, wet, icy, snowy, or muddy.

Entry name	*Mandatory (Y/N)*	*Field to be filled*	*Type/size*
OCCURRENCES ASSESSMENT (segmented by ADS feature)			
Occurrences covered under the short-term reporting provisions			
Critical occurrences known to the manufacturer	Y		Number
ADS operation outside its ODD	Y		Number
ADS failure to achieve an MRC when necessary	Y		Number
Failure to meet the ADS requirements under paragraph 6 of this Regulation	Y		Number
Performance issues constituting an unreasonable risk to safety	Y		Number
Occurrences covered under the periodic reporting provisions			
Uncompleted system-initiated deactivation process to manual driving	Y		Number
Occurrences safety review	Y		Text
Communication issues affecting the safety of the ADS	Y		Number
Occurrences safety review	Y		Text
Cybersecurity issues affecting the safety of the ADS	Y		Number
Occurrences safety review	Y		Text
System failures that compromise the capability of the ADS to perform the entire DDT	Y		Number
Occurrences safety review	Y		Text
Unauthorized modifications to the ADS that could affect the intended functionality	Y		Number
Occurrences safety review	Y		Text
Manoeuvres performed to reach MRC	Y		Number
Occurrences safety review	Y		Text
Emergency manoeuvres	Y		Number
Occurrences safety review	Y		Text
ADS feature required remote interaction	Y		Number
Occurrences safety review	Y		Text
Fallback user unavailability (where applicable)	Y		Number
Occurrences safety review	Y		Text
Prevention of takeover under unsafe conditions (where applicable)	Y		Number
Occurrences safety review	Y		Text

Entry name	*Mandatory (Y/N)*	*Field to be filled*	*Type/size*
OCCURRENCES SAFETY OUTCOME (segmented by ADS feature)			
Fatalities	Y		Number
ADS vehicle users	Y		Number
Other road users	Y		Number
Injuries	Y		Number/Text
ADS vehicle users	Y		Number/Text
Other road users	Y		Number/Text
Detected collisions	Y		Number
Collision review	Y		Text
OCCURRENCES AGGREGATE DESCRIPTION (segmented by ADS feature)			
Collision with[2]:	Y		-
Passenger car	N		Number
Van	N		Number
Truck	N		Number
Bus	N		Number
Other vehicle	N		Number
Motorcycle	N		Number
Cyclist	N		Number
Pedestrian	N		Number
Other VRU	N		Number
Animal	N		Number
Fixed object	N		Number
Unknown	N		Number
ADS vehicle damage level			
ADS vehicle no longer able to operate	Y		Number
ADS vehicle needing repairs	Y		Number
Unknown	Y		Number
ADS vehicle damaged area			
Front	Y		Number
Front left	Y		Number
Front right	Y		Number
Rear	Y		Number
Rear left	Y		Number
Rear right	Y		Number
Top	Y		Number
Bottom	Y		Number
Unknown	Y		Number

[2] The following list is provided as an example. Manufacturers may use different categories as long as "vehicle" and "vulnerable road-users" are reported separately.

ADS MONITORING ASSESSMENT (segmented by ADS feature)			
ADS Safety Monitoring manufacturer outcome, including:			Text
SPIs monitoring analysis	Y		Text
Identified operational risks	Y		Text
Identified corrective actions	Y		Text
Implemented corrective actions	Y		Text
REPORT MANAGEMENT			
Reporting entity	Y		Text
Report ID	Y		Text
Report version	Y		Number
Report status (e.g., initial notification, in progress, closed)	Y		Text
Report date	Y		(YYYY/MM/DD)
Parties informed	Y		Text

Annex 6

Threshold Definitions

1. General

1.1. This annex defines thresholds for the reporting of critical occurrences as defined under paragraph 2.13.1.

1.2. The timing for the notification of such occurrences starts from the manufacturer's knowledge that the occurrence exceeded the threshold for critical occurrence.

1.3. The manufacturer shall exert all reasonable efforts to gather the relevant evidence supporting the critical occurrence identification without delays or limitations.

2. Injury level threshold

2.1. The injury level threshold for a critical occurrence aims at promoting the reporting of collisions resulting in a fatality or any person requiring medical attention due to the injury, regardless of whether the person killed or injured was an occupant of the subject vehicle.

2.2. The threshold is triggered by the attendance in the area of the collision of an ambulance.

2.3. The manufacturer shall classify the occurrence as critical if they reasonably believe that there may be an injury requiring medical attention to any person even if an ambulance has not been detected.

2.4. The manufacturer is expected to fulfil these criteria through one of the following approaches:

(a) ADS strategies in place to appropriately detect such situations provided that the ADS vehicle is still capable of performing audio/visual sensing capabilities, following the collision or via remote visual check (if applicable),

(b) Processes to receive and analyse information from other sources, or

(c) Combination of (a) and (b).

3. Physical damage threshold

3.1. The physical damage triggering condition for critical occurrence aims at promoting the reporting of collisions that, despite not causing any significant injury or fatality to people, are deemed critical because of the extent of the damages produced on vehicles or stationary objects.

3.2. The concept of "physical damage" is here intended as:

(a) Tow-away, e.g., damage that restricts/prevents regular operation of a vehicle involved in the collision as part of the reported occurrence, or

(b) Importance-based, e.g., a damage that affects the safe state of the ADS, critical road infrastructure asset and other vehicles/road users.

3.3. The manufacturer is expected to fulfil this criterion through one of the following approaches:

(a) ADS strategies in place to appropriately detect such situations provided that the ADS vehicle is still capable of performing audio/visual sensing capabilities, following the collision or via remote visual check (if applicable),

(b) Processes to receive and analyse information from other sources, or

(c) Combination of (a) and (b).

3.4. Tow-away damage threshold

3.4.1. The tow-away threshold is triggered when the damage occurred to a vehicle involved in the collision is such that the same can no longer be operated either manually or in automated mode requiring specialized equipment for traffic restoration.

3.5. Importance-based damage threshold

3.5.1. Importance-based damage thresholds consider the type of the item which was damaged to take into account its relevance and health status.

3.5.2. The importance-based threshold shall be deemed exceeded when one of the following conditions occurs:

(a) Collision with priority vehicles,

(b) Collision rendering traffic lights and/or other safety-relevant road signage no longer operational/visible,

(c) Collision affecting infrastructure communication/connectivity support system,

(d) Collision damaging or rendering a roadway segment impassable,

(e) Collision producing fire, or

(f) Any other collision which requires the attendance of road safety agent.

4. Restraint system and Delta-V threshold

4.1. The restraint system triggering condition and Delta-V threshold aims at promoting the reporting of occurrences in case one of the following applies:

(a) The deployment of any non-reversible deployable occupant restraint systems,

(b) The deployment of vulnerable road user secondary safety system, such as airbags, pretensioners, and active bonnet systems, or

(c) The applicable Delta-V thresholds to be met according to the EDR system fitted on the vehicle.

Annex 7

ODD-based Behavioural Competencies and Scenario Identification Approach

1. Introduction

This annex provides an overview on an approach that may be used to derive verifiable performance criteria for the approval or, as relevant, for self-certification of ADS, based on the manufacturer's description of the Operational Design Domain (ODD) of the ADS. Such criteria would be developed by identifying behavioural competencies that embody and correspond to specific ADS safety requirements and relevant scenarios and situations that may be used to validate the ADS's competencies.

The suggested approach includes a description of how such competencies can be classified into nominal, critical and failure and mapped to the relevant scenarios, selected either from existing databases or identified through the application of different approaches.

Different approaches may exist to perform such an activity; therefore, the approach herein presented should be considered as a recommended guideline for both manufacturers and authorities.

1.1. Operational Design Domain

The external conditions constituting the ODD in which the ADS was designed to operate will help determine which ADS competencies are required. For example, if an ADS has an ODD which comprises of roads with non-signalised junctions, one of the required behavioural competencies for the ADS in that ODD could potentially be "unprotected left or right turn". However, the same behaviour competency may not be required if the ODD of an ADS is limited to motorways or highways.

1.2. Behavioural competencies

Behavioural competencies track the three broad categories of driving situations that may be encountered in the performance of the DDT: nominal, critical, and failure.

Critical situations are those requiring a prompt action of the ADS to avoid or mitigate the risk of a collision, that could result in adverse consequences on human health or property damage. For example, those in which the behaviour of one or more road users (e.g., violating traffic regulations) and/or a sudden and not reasonably foreseeable change of the operating conditions of the given ODD (e.g., sudden storm, damaged road infrastructure) requires the ADS to take prompt action.

Failure situations involve those in which the ADS or another vehicle system experiences a failure that compromises the ADS's ability to perform the DDT, such as sensor or computer failure or a failed propulsion system.

Nominal situations are those that are neither critical nor failure situations, such as those in which the behaviour of other road users and the operating conditions of the given ODD are reasonably foreseeable (e.g., other traffic participants operating in line with traffic regulations) and no failures occur that are relevant to the ADS's performance of the DDT.

2. Approach Description

The ODD-based behavioural competencies and scenario identification approach is based on the interaction of the following elements:

(a) Behavioural competencies and scenario generation

(b) Competencies and scenario mapping

(c) Assumptions

(d) Performance and acceptance criteria evaluation

Figure 1 describes the overall approach. Once acceptance criteria are defined based on the overall requirements, different approaches (described below) are used to generate nominal, critical and failure scenarios tests. Testing is performed using various test methods, and the outcome is evaluated to see if there is sufficient evidence to support the safety case claims and the acceptance criteria. The following section describes the different stages and steps.

2.1. Behavioural Competencies Identification

The approach suggests a series of analytical frameworks that could help to derive measurable criteria appropriate for the specific application. These frameworks are divided into:

(a) ODD Analysis

(b) Driving interactions analysis

(c) OEDR analysis.

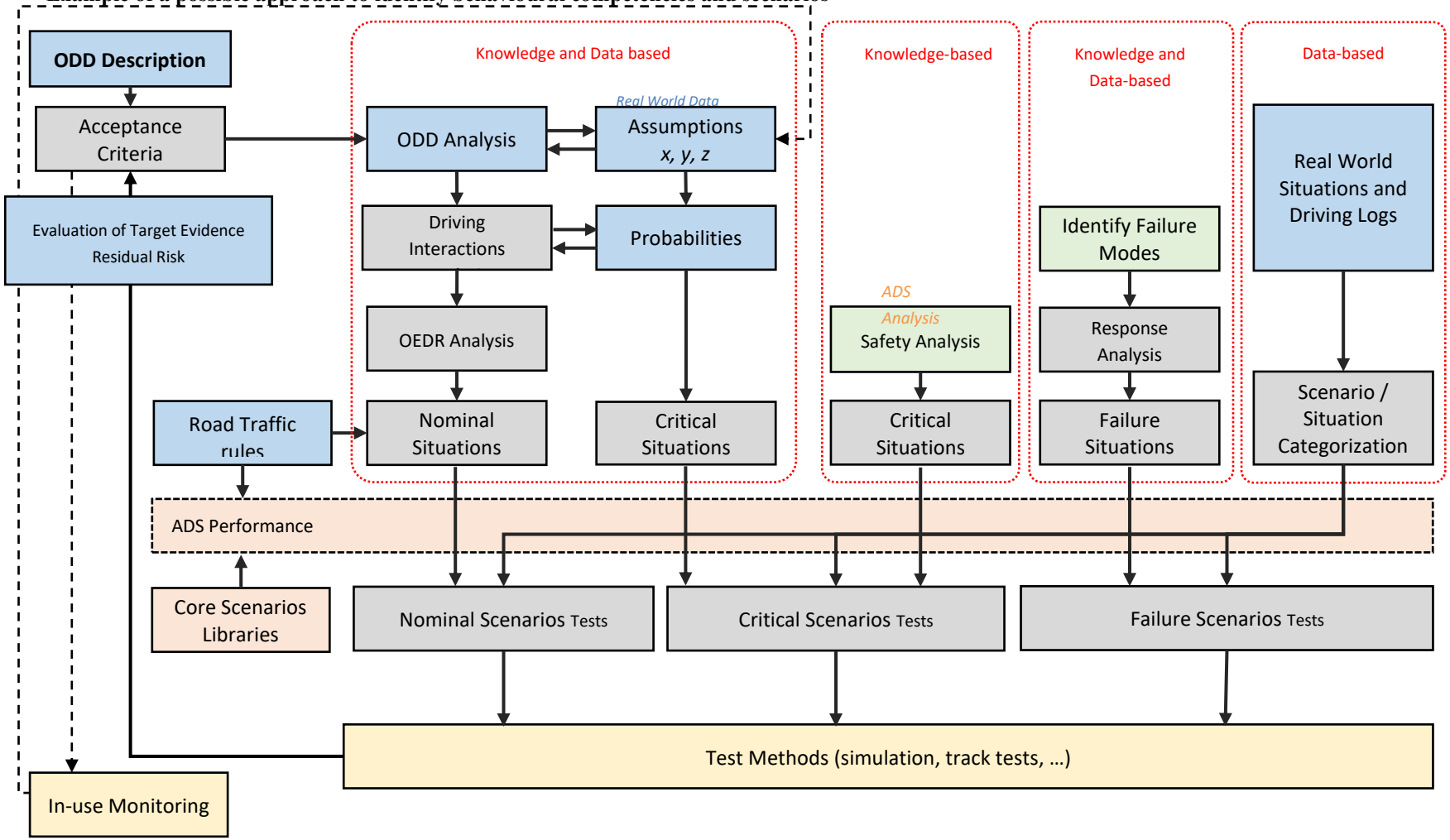
2.1.1. ODD analysis

This analysis represents the first step with the aim to identify the characteristics of the ODD. An ODD description can consist of stationary physical elements (e.g., physical infrastructure), environmental conditions, dynamic elements (e.g., reasonably expected traffic level and composition, vulnerable road users) and operational constraints to the specific ADS application. The output consists of a list of elements to be considered in the subsequent analysis.

2.1.2. Driving interactions analysis

In the driving interactions analysis, the behaviours of other road users that are reasonably expected and the presence of roadway characteristics in the ODD are explored in more detail by mapping actors with appropriate properties and defining interactions between the objects.

Figure 1
Example of a possible approach to identify behavioural competencies and scenarios



An example of this analysis is given in Table 1, where static and dynamic behaviours of other objects (including other road users) that the ADS is reasonably expected to encounter within the ODD are described. In the case of vehicles, this includes behaviours such as “acceleration”, “deceleration”, “cut-in”; for pedestrians, examples of dynamic behaviours include “crossing road”, “walking on sidewalk”, etc.

The behaviour of other road users and the condition of physical objects within the ODD may fall at any point along a continuum of likelihood. For example, deceleration by other vehicles may range from what is expected and reasonable in the traffic circumstances, to unreasonable but somewhat likely rapid deceleration, to extremely unlikely (e.g., a sudden cut-in combined with full braking on a clear high-speed road). The analysis of the ODD and reasonably expected driving situations within the ODD should make distinctions that include an estimate of the likelihood of situations to ensure that the ADS’s performance is evaluated based on response to reasonably likely occurrences involving nominal, critical and failure situations but not on the expectation that the ADS will avoid or mitigate the most extremely unlikely occurrences.

2.1.3. Object and Event Detection and Response (OEDR) Analysis: Behavioural competencies identification

Once the objects and their reasonably expected behaviours have been identified, it is possible to map the appropriate ADS response, which can be expressed as a behavioural competency. The detailed response is derived from more general and applicable safety requirements. The acceptable ADS response will vary depending on whether the driving situation involves nominal, critical, or failure characteristics.

The outcome of the analysis is a set of behavioural competencies that can be applied to the events characterizing the ODD. Table 2 provides a qualitative example of a matching event and response.

The combination of objects, events, and their potential interaction, as a function of the ODD, constitute the set of potential situations pertinent to the ADS under analysis.

2.2. Scenario Identification

To ensure that the behavioural competencies identified in the previous paragraphs are ready to be assessed, ODD-relevant scenarios must be identified.

Scenarios can be described at different abstraction levels (i.e., functional, abstract, logical, and concrete) by focusing the scenario description on specific aspects, while leaving other details for further processing.

Sampling techniques can be used when selecting parameters to be used in creating logical and concrete scenarios for the ADS validation for a particular ADS and its ODD to avoid the ADS being optimized for a set of known test cases.

Table 1
Examples of static and dynamic objects and their properties

Objects	*Examples of events and interactions*
Vehicles (e.g. cars, light trucks, heavy trucks, buses, motorcycles)	Lead vehicle decelerating Lead vehicle stopped Lead vehicle accelerating Changing lanes Cutting in Turning Encroaching opposite vehicle Encroaching adjacent vehicle Entering roadway Cutting out
Pedestrians	Crossing road: inside crosswalk, Crossing road: outside crosswalk Walking on sidewalk/shoulder
Cyclists	Riding in lane Riding in adjacent lane Riding in dedicated lane Riding on sidewalk/shoulder Crossing road: inside/outside crosswalk
Animals	Static in lane Moving into/out of lane Static/moving in adjacent lane Static/moving on shoulder
Debris	Static in lane
Other dynamic objects (e.g., shopping cart)	Static in lane Moving into/out of lane
Traffic signs	Stop Yield Speed limit Crosswalk Railroad crossing School zone
Vehicle signals	Direction indicators

Table 2
Examples of elementary behavioural competencies for given events

Event	*Response*
Lead vehicle decelerating	Follow vehicle, decelerate, stop
Lead vehicle stopped	Decelerate, stop
Lead vehicle accelerating	Accelerate, follow vehicle
Lead vehicle turning	Decelerate, stop
Vehicle changing lanes	Yield, decelerate, follow vehicle
Vehicle cutting in	Yield, decelerate, stop, follow vehicle
Opposite vehicle encroaching	Decelerate, stop, shift within lane, shift outside lane
Adjacent vehicle encroaching	Yield, decelerate, stop
Lead vehicle cutting out	Accelerate, decelerate, stop
Pedestrian crossing road	Yield, decelerate, stop
Cyclist riding in lane	Yield, follow
Cyclist crossing road	Yield, decelerate, stop

This approach suggests complementary methodologies to derive reasonably expectable scenarios, which might occur for a given ODD:

(a) Knowledge-based methods,

(b) Data-based methods, and

(c) Goal-based methods.

A knowledge-driven scenario generation approach utilizes domain specific (or expert) knowledge to identify nominal, critical and failure events systematically and create scenarios. Examples of knowledge-driven scenarios generation approaches include:

(a) Experience acquired during ADS development,

(b) Synthetically generated scenarios from key parameter variations,

(c) Engineered scenarios based on functional safety requirements and safety of intended functionality,

(d) Composing complex scenarios from basic scenarios,

(e) Random variations of scenario parameters, both for the ADS and ORUs.

A data-driven approach utilizes the available data to identify and classify occurring scenarios. Data-driven scenarios generation approaches include:

(a) Analysing human driver behaviour, including evaluating naturalistic driving data,

(b) Collision data from accident databases, insurance records, and law enforcement authorities.

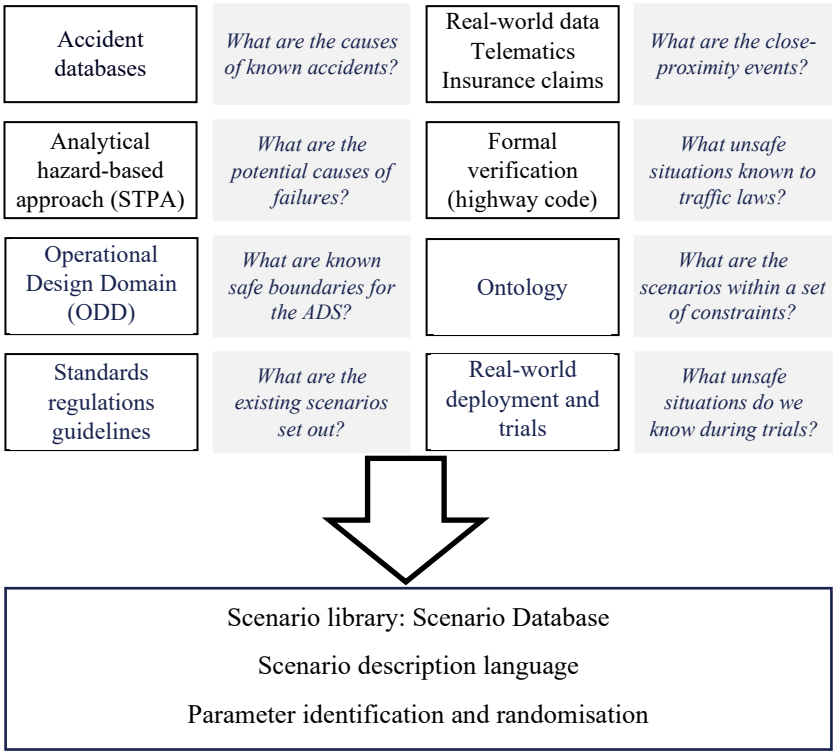
(c) Traffic patterns relevant for the ODD from real-world driving logs;

(d) Situations recorded using instrumented vehicles, the ADS vehicle's sensors, infrastructure or drones.

(e) In-Service Monitoring and Reporting findings.

Figure 2 illustrates various data-based and knowledge-based scenario generation methods.

Figure 2
Examples of data-based and knowledge-based generation methods



While many of the knowledge-based methods are looking at existing data and knowledge, a different method is goal based.

Training ADS systems requires large volumes of data from driving logs and recordings. The same data resources can be used to test the behavioural competencies. The challenge is to map these into the scenario categories, in order to ensure that this testing and its results are counted correctly toward the acceptance criteria evaluation.

One method to categorise these logs and recordings is to match them to existing abstract scenario libraries, and classify them to nominal, critical and failure scenarios. With categorization and classification, the evaluation of these scenarios, and counting their contribution to the evidence and the success criteria, can take place.

The scenario-generation method should include adequate coverage of relevant nominal, failure, and critical scenarios and situations to effectively validate the ADS. “Coverage” refers to the degree to which scenarios sufficiently incorporates driving situations in order to validate the relevant requirements of this Regulation. Sufficient coverage is essential to the overall effectiveness and credibility of these methodologies as a validation approach. Sufficient coverage should be with respect to the ADS feature or ODD. Coverage can be measured across different domains, and metrics can be used to determine sufficiency. Coverage can be measured both on the test scenarios serving as input to the test, as well as on the behavioural competencies and KPIs demonstrated during testing.

2.3. Behavioural competencies and scenarios mapping

Once relevant scenarios and behavioural competencies have been identified, it is necessary to link them. The classification in the three broad categories of driving situations an ADS might encounter such as nominal, critical and failure, serves the purpose.

2.3.1. Nominal Situations Competencies

In these situations, ADS competencies can often be derived by applying traffic laws of the country where the ADS is intended to operate, as well as by applying general safe driving principles for situations not addressed adequately by current traffic laws for human drivers. Examples of such competencies may include adherence to legal requirements to maintain a safe distance from vehicles ahead, provide pedestrians the right of way, obey traffic signs and signals, etc. Of course, some nominal competencies (e.g., safe merging, safely proceeding around road hazards) may not be explicitly articulated or mandated by traffic laws. In some instances, traffic laws may provide wide discretion for the driver to determine the safest response to a particular situation (for example, how to respond to adverse weather conditions). As such not all traffic laws are stated with sufficient specificity to provide a clear basis for defining a competency.

Therefore, an example approach to codify rules of the road to provide additional specificity is introduced in paragraph 2.5.2. below. Additionally, application of models involving safe driving behaviour may be needed in addition to reference to codified rules of the road in developing behavioural competencies for nominal driving situations.

Table 3 provides an example of competencies and scenario mapping for nominal situations.

2.3.2. Critical Situations Competencies

The development of these competencies requires analysis of (1) what constitutes such unreasonable behaviours by ORUs and/or a sudden change of the operating conditions that are not reasonably foreseeable and (2) what constitutes an appropriate ADS response to avoid or mitigate the imminent crash. Additionally, it is also important to identify the occurrence of unplanned emergent behaviour in critical situations.

Analysis of the first type can be based on a variety of methodologies, including reference to existing standards (which offer guidance on what behaviours by other road users are reasonably foreseeable) and other models of reasonable driving behaviour. Analysis of the second factor may be based on various models of acceptable human driving behaviour in crash imminent situations.

Hazard identification methods (e.g., Systems Theoretic Process Analysis) that analyse the system design for functional and operational insufficiencies can help identify the occurrence of emergent behaviours that could lead to critical situations.

Development of behavioural competencies for critical driving situations faces several challenges. No general consensus exists on the appropriate models for the behaviour of ORUs or appropriate responses by the ADS to unreasonable ORU behaviours that make a crash imminent.

Table 4 provides an example of competencies and scenario mapping for critical situations.

Table 3
Example of competencies and scenario mapping in nominal situations

ODD Element	Driving Behaviour	Traffic Rule	ADS Requirements	Behavioural Competency	Test Scenario
Bicycle	Riding in lane		The ADS shall adapt its driving behaviour in line with safety risks	The ADS ensures relative velocity during passing manoeuvre does not exceed e.g. 30 km/h	The ADS travels between e.g.30–50 km/h on the centre line of its lane A cyclist travels in the same direction as the ADS between e.g. 10–20 km/h, e.g. 0.2–1 m away from the lane edge
		Drivers will need to use a minimum passing distance for bicycles of 1.5m in urban areas, and 2m out of town	The ADS shall comply with traffic rules in accordance with application of relevant law within the area of operation.	The ADS shifts in lane to pass by cyclist with 1.5.m lateral distance	
			The ADS shall avoid unreasonable disruption to the flow of traffic in line with safety risks.	The ADS crosses the centre lane marking to ensure the safe passing distance is not violated	
			The ADS shall interact safely with other road users	The ADS activates the turn signal if the centre lane marking is crossed	

Table 4
Example of competencies and scenario mapping in critical situations

Losses	Hazards	Unsafe Control Action	Loss scenario	Causal factors	Behavioural Competency	Test Scenario
Collision with object outside the vehicle	ADS does not maintain a safe distance from the lead motor vehicle	Braking demand is not provided	Object in vehicle trajectory is not detected	Undetected/misclassified object; Obscured object; Incorrect sensor fusion result	The ADS is following behind a lead vehicle, with the headway set by the ADS. The lead vehicle decelerates at the max assumed rate depending on the weather conditions	Lead vehicle decelerated to turn (right/left) or travel straight on a (mini /large) roundabout
			Object is not considered to be in the vehicle trajectory	Localisation issues leading to incorrect positioning of ego vehicle or object		Lead vehicle decelerated while shifting lane to avoid a static object/other road user.

Critical situation behavioural competencies should provide evidence that an ADS needs to be responsive to actions by other road users, which may make a crash unavoidable. Therefore, critical scenarios should not be limited to those that are deemed preventable by the ADS. Unsafe behaviours of other road users (e.g., vehicle travelling in the wrong direction, sudden unsignalled lane changes, and exceeding the speed limit) — if reasonably foreseeable within the appropriate ODD — should be included as part of validation testing.

2.3.3. Failure Situations Competencies

The ADS safety requirements include management of various failure modes. As noted above, failure situations scenarios involve those in which the ADS or another vehicle system experiences a fault or failure that compromises the ADS's ability to perform the DDT, such as sensor or computer failure or a failed propulsion system.

In developing the behavioural competencies appropriate for failure situations, the objective is to describe the ability of the ADS to detect and respond safely to specific types of faults and failures. Depending upon the nature and extent of the fault or failure, the responses can include identifying a minor fault for immediate repair after trip completion, responding to a significant fault with restrictions (such as limp-home mode) for the remainder of the trip, or responding to major failures by achieving a mitigated risk condition. Communication of the fault or failure condition to vehicle users may also be a desirable ADS behavioural competency.

Table 5 provides an example of competencies and scenario mapping for failure situations.

2.4. Assumptions

Concrete performance requirements depend on the specific situation that the ADS encounters, on a reference behaviour that is deemed appropriate for a human driver or a technical system, and on assumptions (e.g., cut-in speed values, reaction times, …) about the behaviour of the vehicle and other road users. Assumptions concerning the actions of other road users may need to account for cultural differences in driving styles in different geolocations, making it impracticable to harmonise these assumptions across different domains. Therefore, evidence should be provided to support the assumptions made. Existing standards provide sets of assumptions to be considered by ADS safety-related models for an initial set of driving situations. Additionally, several other tools including data collection campaigns performed during the development phase, real-world accident analysis and realistic driving behaviour evaluations, constraint randomisation, Bayesian optimisation besides others can be used to inform values for such assumptions.

2.5. Performance Evaluation

As previously highlighted, nominal situations are considered reasonably foreseeable for a given ODD and therefore it is expected that the ADS would be capable of handling them without any resulting collision.

Table 5
Example of competencies and scenario mapping in failure situation

Failure Type	Failure Mode	Potential Cause	Behavioural Competency	ADS Requirements	Test Scenario	Pass/Fail Criteria
Perception	Fail to identify ODD boundary	Failure to detect ODD attribute e.g. heavy rain/fog	Safely stop in lane of travel	The ADS shall recognise the conditions and boundaries of the ODD of its feature(s)	The ADS operates beyond the predicted ODD	The ADS detects the ODD conditions are not met and initiates a fallback to a mitigated risk condition
				In response to a fault, the ADS shall either execute a fallback response and prohibit activation of the impacted feature(s) if the fault prevents the ADS from performing the DDT in accordance with the requirements of paragraph 6.1. of this Regulation, or adapt its performance of the DDT in accordance with the severity of the fault provided the resulting performance complies with the requirements of paragraph 6.1.		The fallback to an MRC should not cause the vehicle to decelerate greater than 4 m/s^2

On the other hand, in failure situations, the aim is to assess the ADS ability to recognise faults/failures in the system and safely react to such cases.

For the purpose of defining performance criteria in critical situations, those situations where others are at fault, behaving unforeseeably, and the collision might potentially not be prevented have to be analysed further. In these situations, different considerations can be made.

2.5.1. Evaluation of target evidence and residual risk

As testing by the manufacturer is an ongoing process, the outcome of the testing is constantly evaluated. The goal of the evaluation is to assess if sufficient evidence to support the claims of the safety case is achieved, and if an assessment of an acceptable residual risk can be developed. This evaluation is a major input to the decision on whether the acceptance criteria have been met or if more scenarios and tests are required. If more is required, then additional effort is invested (by using all method shown above) to increasing the ODD and scenario coverage until the goals of the acceptance criteria are met.

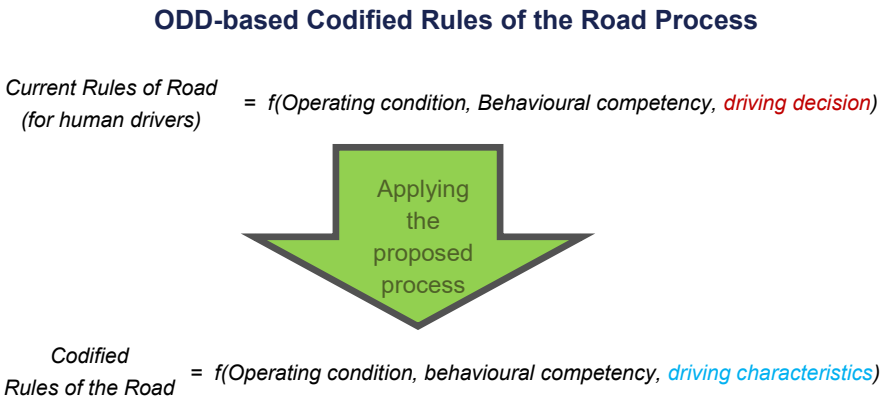
Another way to look at it is represented by the goal-based methods. As the acceptance criteria are defined, they are actually setting the goals that should be demonstrated by testing and coverage and used as evidence for safety claims. Starting from these goals, and looking at the existing status of the evidence, gaps in testing and coverage can be identified, and mapped back to missing scenarios that should be used for testing.

2.5.2. Application of Rules of Road

An approach to define an acceptance criterion related to nominal driving situations is to evaluate the ADS performance against the rules of the road. Furthermore, ADS safety requirements state that, “The ADS shall comply with traffic rules in accordance with application of relevant law within the area of operation.”

One possible approach is the codification of the “rules of the road”. Figure 3 illustrates the use of rules of the road as pass/fail criteria for individual scenarios. The following approach for codification of Rules of the Road can be used to link individual rules with corresponding scenarios using ODD and behaviour labels.

Figure 3. Rules of the road to define pass/fail criteria



Current rules of the road (for human drivers) have three components:

Operating conditions include both ODD aspects and vehicle states (e.g., system failures, hardware failures etc.). Every set of traffic laws or behaviour rules (for human drivers) defined in any country are based on an understanding of the expected behaviours of human drivers. As a result, they do not explicitly

define all aspects of the expected driving behaviour but can be argued to include “implicit assumptions” based on this understanding.

Following the process, a “codified” rule of the road for an automated driving system will also have three components:

Codified rule = Operating condition + behavioural competency + driving decisions

The process of codification helps identify where “implicit assumptions” about driving behaviour are present in the rules for human drivers. The codified rules of the road help to turn “undefined” attributes in the rules of the road (for human drivers) to “defined” attributes in the codified “rules of the road”.

Annex 8

Data Storage Systems for Automated Driving (DSSAD)

1. Purpose

1.1. This annex provides DSSAD specifications in accordance with paragraphs 6.3.1.1., 7.3.1.13., 8.3.1.6., and 8.3.3.1. The manufacturer shall address these specifications in its description of the DSSAD installed on the ADS in accordance with paragraph 7.3.1.13.

2. Data storage and security

2.1. The DSSAD shall be capable of recording and storing time-stamped and time-series data elements as defined in paragraph 5 of this annex.

2.2. The DSSAD shall be protected against both unauthorized access and manipulation.

2.3. Data elements under paragraph 5 of this annex that may be stored off-board the vehicle shall remain stored on the vehicle until the data has been successfully uploaded to an off-board storage facility.

3. Data format

3.1. Each data element listed in paragraph 5 of this annex shall be available in accordance with paragraph 4 of this annex. The output shall be provided in an open standard format (e.g. JSON, CSV, XML), with the exception of 'sensor data', and the data shall be in a readable form, aside from 'sensor data' and 'visual images'.[1]

3.2. Information required to interpret the output to correlate it with respect to the data elements required in paragraph 5 of this annex shall be provided by the manufacturer to an authorized entity on request and subject to applicable national law(s).

3.3. Time-stamp data format

3.3.1. Time stamp data shall be recorded in a clearly identifiable way with the following data:

(a) The time stamped data element, as listed under paragraph 5.2.1. of this annex.

(b) The additional information noted in the table under paragraph 5.2.1. for each time stamped data element as appropriate.

(c) Date (Resolution: yyyy/mm/dd)

(d) Time stamp

(i) Resolution: hh/mm/ss timezone (e.g., 12:59:59 UTC)

(ii) Accuracy: +/- 1.0 second

[1] Readable means that the data is of numerical values and natural language which can be understood to represent a specific data point with a value associated with it (e.g. <<speed>>35<<speed/>>, not hexadecimal or binary).

(e) Location: global longitude + latitude; shall be recorded in decimal degrees and to at least five (5) decimal places but shall be unrounded.

3.3.2. A single timestamp may be allowed for multiple elements recorded simultaneously within the time resolution of the specific data elements. If more than one element is recorded with the same timestamp, the information from the individual elements shall indicate the chronological order.

4. Data Accessibility

4.1. The DSSAD data (whether stored on or off board the vehicle) shall be readily available and retrievable through an electronic communication interface that complies with a publicly available interface standard. It is recommended to use an internationally recognized standard.[2]

4.2. Instructions for retrieving the DSSAD data via the electronic communication interface shall be maintained by the manufacturer.[2]

4.3. The stored DSSAD data shall be retrievable even when the main onboard vehicle power supply is not available.

4.4. The DSSAD data shall be retrievable even after an impact to the vehicle of a severity level set by relevant regulations.

4.5. If the DSSAD data is intended to be stored on board the vehicle, then the following applies.

4.5.1. The data elements concerning the activation and deactivation of the feature in paragraph 5.2.1. of this annex shall be available via the vehicle's information display/user interface where controls related to manual performance of the DDT are provided.

4.5.2. Upon request of an authorized entity, the manufacturer shall make available to them the manufacturer-specific tools, software, web service interfaces, and/or support to retrieve the DSSAD data.

4.6. If the DSSAD data is intended to be stored off-board the vehicle, then the following applies.

4.6.1. An authorized entity shall not have to install any manufacturer-specific systems or software to retrieve the DSSAD data.

5. Data elements

5.1. The DSSAD shall record and store the data elements listed under paragraph 5.2. and 5.3. of this annex. This requirement shall be without prejudice to applicable laws governing access to data, availability, privacy, and data protection.

5.2. Time-stamp data elements

5.2.1. The following table details the data elements of time-stamp data to be recorded, along with any additional information.

Event	*Additional Information*
Activation of the feature	ADS feature is activated by the: (a) system, or (b) user
The following data elements shall be recorded if they occur while an ADS feature is active.	

[2] Contracting parties may further define technical specifications for data accessibility and/or availability of instructions under national law.

Deactivation of the feature	(a) Initiated by the system, or (b) Initiated by a user
ODD exit	
Start of ADS fallback to user, if applicable	ADS fallback to user initiated due to: (a) Foreseen condition (b) Unforeseen condition (c) Failure (d) Input to the driving controls, or (e) ODD exit.
Start of ADS fallback to an MRC	Fallback to an MRC initiated due to: (a) ODD exit (b) ADS failure (c) Collision detected (d) Detection that fallback user is not available when they have no longer met the conditions of paragraph 6.2.2.1.6 of this Regulation (if applicable), or (e) Failure of the fallback user to take control following a system-initiated deactivation of the ADS.
User input to the driving controls, if applicable	Application of: (a) brake control, (b) acceleration control, (c) steering control, or (d) direction indicator.
Application of the passenger stop request as designated in paragraph 6.2.3.1. of this Regulation	
Prevention of user takeover, if applicable	Prevention of user takeover (if applicable) due to: (a) Unintentional user input, (b) Current situation unsuitable, (c) Current situation unsafe, or (d) User not suitably engaged.
Detection that fallback-user is not available when they have no longer met the conditions of paragraph 6.2.2.1.6. of this Regulation, if applicable	
Start of Emergency Manoeuvre	
End of Emergency Manoeuvre	
Event Data Recorder (EDR) trigger input [3]	
Detected collision	
MRC achieved	Indication of end states per paragraph 7.3.1.14 of this Regulation
Detected failure that compromises the ADS	Nature of failure in accordance with para. 7.3.1.15.

[3] Excluding any last stop trigger.

capability to perform the DDT	
Remote intervention in a tactical function, if applicable.	

5.3. Time series data elements

5.3.1. The data elements [in paragraph 5.3.2.] shall be recorded if the following thresholds are reached or conditions occur:

(a) Detected collision

(b) EDR trigger input (excluding last stop trigger)

The DSSAD shall record each data element with a range, resolution, frequency, and accuracy such that the data elements provide sufficient detail, even after any data compression is applied, to evaluate the actions of the ADS vehicle and provide sufficient information to enable understanding of the actual context of the situation for any of the above triggering events. These parameters shall be included in the description of each data element under paragraph 7.3.1.13.1.(c). of this Regulation.

5.3.1.1. If there is no system or sensor designed to provide the data element to be recorded and stored under paragraph 5.3. of this annex, alternative data may be utilized if the data provides equivalent information to the specified data element.

5.3.1.2. Notwithstanding the recording interval specified in paragraph 5.3.2., the DSSAD may stop recording the data required to be recorded following the triggering event after the ADS vehicle achieves an MRC or comes to a standstill as described in paragraph 6.1.3.3. of this Regulation.

5.3.2. The following table details the data elements of time-series data to be recorded during a triggering event.[

Data element	*Condition for requirement*	*Recording interval/time (relative to triggering event)*
Visual images[4]	Mandatory	-7 to +7 seconds
Detected object distance, longitudinal	Mandatory, if available	-7 to 0 seconds
Detected object distance, lateral	Mandatory, if available	-7 to 0 seconds
Detected object relative velocity, longitudinal	Mandatory, if available	-7 to 0 seconds
Detected object relative velocity, lateral	Mandatory, if available	-7 to 0 seconds
Detected object classification	Mandatory, if available	-7 to 0 seconds
Sensor data[5]	Mandatory if 'Detected object elements' are not available	-7 to 0 seconds

[4] This data element is generally represented by a camera image; however, this image may be a construct of other sensor data if camera images are unavailable.

[5] For example, camera, radar, LiDAR used by the ADS for decision making. This shall be documented in the information package provided to the Authorised Entity. This shall include a "Visual Representation" submitted to the Authorised Entity at the time of providing the DSSAD data.

ADS-requested accel demand	Mandatory	-7 to +7 seconds
ADS-requested service braking demand	Mandatory	-7 to +7 seconds
ADS-requested parking brake demand	Mandatory	-7 to +7 seconds
ADS-requested steering demand	Mandatory	-7 to +7 seconds
Vehicle acceleration, longitudinal	Mandatory	-7 to +7 seconds
Vehicle acceleration, lateral	Mandatory	-7 to +7 seconds
ADS-determined vehicle speed	Mandatory	-7 to +7 seconds

]

5.4 Power and communication failure

If a fault (e.g. due to damage or power loss) results in the absence of a signal needed to generate a DSSAD data element, this Regulation does not require the ADS to have the capability to restore the signal. However, if such a fault occurs prior to a triggering event, the failure of the source of the signal (e.g., system or sensor) shall be recorded by the DSSAD (in accordance with paragraph 5.3.1.) If the fault occurs after the triggering event (i.e., during recording), the failure of the source shall not affect the data recorded by the DSSAD prior to the occurrence of the fault.

Data need not be recorded when the power or the communication is lost to the device hosting the DSSAD or systems providing data.

Annex 9

Model of Certificate of Compliance for SMS

Certificate of compliance for safety management system

With UN Regulation No. [This Regulation]
Certificate Number [Reference number]
[……. Approval Authority]
Certifies that

Manufacturer: .....
Address of the manufacturer: .....
Complies with the provisions of paragraph 7.1. of Regulation No. [ADS]
Verifications have been performed on: .....
by (name and address of the Approval Authority): .....
Number of report:.....

The certificate is valid until: […..*Date*]
Done at: [……*Place*]
On: […….*Date*]
[…….*Signature*]

Annex 9—Appendix

Model of declaration of compliance for Safety Management System

Manufacturer's declaration of compliance with the requirements for safety management System.

Manufacturer Name: .....

Manufacturer Address:.....

(Manufacturer Name) attests that the necessary processes to comply with the requirements for the Safety Management System laid down in paragraph 7.1. of UN Regulation No. [ADS] are installed and will be maintained.

Done at: .....(place)

Date: .....

Name of the signatory: .....

Function of the signatory: .....

....

..... (Stamp and signature of the manufacturer's representative)

.