

Guidelines and Recommendations concerning Safety Requirements for Automated Driving Systems

1. Purpose of this document
 - 1.1. FRAV has established this document to facilitate and record its work in progress. Contents of this document may change in accordance with FRAV decisions.
 - 1.2. This document may inform interested parties on the status of work within FRAV.
 - 1.3. This document does not constitute a formal or informal proposal. FRAV will issue such proposals in one or more separate documents as determined and approved by the group.
2. Definitions
 - 2.1. “*Automated Driving System (ADS)*” means the hardware and software that are collectively capable of performing the entire DDT on a sustained basis [within the ODD of its features: open issue for further consideration].¹
 - 2.2. “*(ADS) feature*” means an application of ADS hardware and software designed specifically for use within an ODD.²
 - 2.3. “*(ADS) function*” means an application of ADS hardware and software designed to perform a specific portion of the DDT.³
 - 2.4. “*ADS vehicle*” means a vehicle equipped with an ADS.⁴
 - 2.5. “*Driver*” means a **qualified** human being engaged in dynamic control of the vehicle.⁵ [open issue: ADS determination of “qualified” (as opposed to traffic laws on driver qualifications/obligations)]
 - ~~2.5.1. A driver should possess the necessary qualifications and be physically and mentally fit to engage in the dynamic control of a vehicle.⁶~~
 - 2.6. “*Dynamic control*” means the real-time execution of operational and tactical functions required to operate a vehicle based on perception, information processing, and decision making.⁷ [open issue: understanding difference between “dynamic

¹ Based on FRAV-09-05.

² Ibid.

³ Ibid.

⁴ Ibid.

⁵ Based on FRAV-16-12 (A driver is a human being who is engaged in real-time in the dynamic control of a vehicle.)

⁶ Ibid. Para. 4.2. would provide ADS requirements related to [ADS determination of] user fulfilment of safety-relevant roles and responsibilities.

⁷ Based on FRAV-09-05, Based on FRAV-14-07/Rev.1, FRAV-16-12 per WP.1/2021/2 (“Dynamic control” refers to carrying out the real-time operational and tactical functions required to move the vehicle. This includes controlling the vehicle’s lateral and longitudinal motion, monitoring the road environment, responding to events in the road traffic environment, and planning and signaling for manoeuvres) and Michon, J.A., 1979 (update

control” and “DDT”—dynamic control used in relation to human perception, operation, control aspects]

2.7. “*Dynamic Driving Task (DDT)*” means the real-time operational and tactical functions required to operate the vehicle.⁸

2.7.1. The DDT excludes strategic functions such as trip scheduling and selection of destinations and waypoints.

2.7.2. ~~DDT operational and tactical functions~~ The operational and tactical functions of the DDT can be logically grouped under three general categories:

2.7.2.1. Sensing and perception, including:

2.7.2.1.1. Monitoring the driving environment via object and event detection, recognition, and classification.

2.7.2.1.2. Perceiving other vehicles and road users, the roadway and its fixtures, objects in the vehicle’s path, and relevant environmental conditions. [Open issue: clarify “other vehicles and road users” because ORU defined to differentiate objects that can reciprocally interact with ADS (e.g., humans, drivers)] [Open issue: further work on defining objects with consideration of animals, pedestrians/humans, or other categories that may be safety-relevant][open issue: clarify between vehicle environment and specific issue of in the vehicle path]

2.7.2.1.3. Sensing the ODD boundaries, if any, of the ADS feature.

2.7.2.1.4. Positional awareness.

2.7.2.2. Planning and decision, including

2.7.2.2.1. Prediction of actions of other road users.

2.7.2.2.2. Response preparation.

2.7.2.2.3. Maneuver planning.

2.7.2.3. Control, including

2.7.2.3.1. Object and event response execution.

2008). “Dealing with Danger”, Summary Report of the Workshop on Physiological and Psychological Factors in Performance under Hazardous Conditions with Special Reference to Road Traffic Accidents, Gieten, Netherlands, May 23-25, 1978.

⁸ Based on FRAV-14-07/Rev.1. This document defines DDT and DDT functions specifically “in the context of an ADS-equipped vehicle”. Therefore, the DDT definition specifically refers to “ADS functions” and “ADS vehicle”.

- 2.7.2.3.2. Lateral vehicle motion control.
 - 2.7.2.3.3. Longitudinal vehicle motion control.
 - 2.7.2.3.4. Enhancing conspicuity via lighting, signaling and/or gesturing, etc. [open issue: how does “gesturing” relate to ADS operation? General intent that includes what a driver or ADS may do.]
- 2.8. “*ADS fallback response*” means an ADS-initiated transition of control or an ADS-controlled procedure to place the vehicle in a minimal risk condition.⁹
- 2.9. “*Fallback user*” means a user designated to assume the role of driver upon completion of a transition of control.¹⁰ [open issue: further consideration of “fallback-ready user” as possible term per SAE/ISO taxonomy.]
- 2.10. “*Minimal Risk Condition (MRC)*” means a stable and stopped state of the vehicle that reduces the risk of a crash.¹¹ [open issue: further consideration of “MRC” as defined in SAE/ISO taxonomy]
- 2.11. “*Operational Design Domain (ODD)*” means the operating conditions under which an ADS feature is specifically designed to function.¹² [open issue: include illustrative items of ODD elements per SAE/ISO taxonomy?]
- 2.12. “*Operational functions*” refer to basic capabilities such as the capacity to control lateral and longitudinal motion of the vehicle.¹³ [open issue: room to clarify based on literature]
- 2.13. “*Other road user (ORU)*” means any entity using a roadway and capable of safety-relevant interaction with an ADS vehicle.

⁹ Based on SAE J3016 (2021): “[DDT] Fallback: The response by the user to either perform the DDT or achieve a minimal risk condition (1) after occurrence of a DDT performance-relevant system failure(s), or (2) upon operational design domain (ODD) exit, or the response by an ADS to achieve minimal risk condition, given the same circumstances.” The FRAV mandate is limited to ADS requirements; therefore, the definition is modified to specifically address ADS fallbacks. The reasons for the fallback are omitted because the fallback triggers are addressed by the ADS safety requirements.

¹⁰ Based on SAE J3016 “fallback-ready user” (The user of a vehicle equipped with an engaged Level 3 ADS feature who is properly qualified and able to operate the vehicle and is receptive to ADS-issued requests to intervene and to evident DDT performance-relevant system failures in the vehicle compelling him or her to perform the DDT fallback.). In terms of WP.29 vehicle regulations, the FRAV anticipates requirements to meet the safety need for the driver to be qualified, able, and receptive. See para. 3.2.4.

¹¹ Based on SAE J3016 (2021): “A stable, stopped condition to which a user or an ADS may bring a vehicle after performing the DDT fallback in order to reduce the risk of a crash when a given trip cannot or should not be continued.” The revised wording focuses on what an MRC is without additional references to how or why the vehicle has been placed in the MRC. Current discussions on ADS management of safety-critical situations suggest that the safety requirements would stipulate conditions under which the ADS should place the vehicle in an MRC. User decisions to place the vehicle in an MRC manually fall outside the scope of ADS requirements.

¹² Based on FRAV-09-05.

¹³ Michon, J.A., 1985. “A Critical View of Driver Behavior Models: What Do We Know, What Should We Do?” In L. Evans & R. C. Schwing (Eds.). Human behavior and traffic safety (pp. 485-520). New York: Plenum Press, 1985.

- 2.14. “*Priority vehicle*” means a vehicle subject to exemptions, authorizations, and/or right-of-way under traffic laws while performing a specified function.
- 2.15. “*Real time*” means the actual time during which a process or event occurs.¹⁴
- 2.16. “*Road-safety agent*” means a human being engaged in directing traffic, enforcing traffic laws, maintaining/constructing roadways, and/or responding to traffic incidents.
- 2.17. “*Tactical functions*” refer to the real-time planning, decision, and execution of maneuvers.¹⁵
- 2.18. “*Transition of control (TOC)*” means a procedure by which the ADS engages the fallback user in dynamic control of the vehicle such that the fallback user assumes the role of driver upon completion.¹⁶ [relevant to requirements on ADS verification of driver control: TOC procedure under section 4.2.]
- 2.19. “*(ADS) User*” means a human being engaged in the use of an ADS vehicle where dynamic control of the vehicle is entirely maintained on a sustained basis by the ADS performance of the DDT.¹⁷
3. Guidelines for ADS descriptions
- 3.1. General considerations
- 3.1.1. ADS may be designed for specific purposes and to operate under prescribed conditions.¹⁸
- 3.1.2. The conditions under which an ADS is designed to operate are known collectively as the Operational Design Domain (ODD).
- 3.1.2.1. **The ODD conditions include, but are not limited to, environmental, geographical, and time-of-day restrictions, and/or the requisite presence or absence of certain traffic or roadway characteristics.**
- 3.1.3. ADS may **or may not** be designed to **transfer control to** a qualified driver in the vehicle. The roles and responsibilities of an ADS user differ depending upon the ADS configuration, intended uses, and limitations on its use.¹⁹
- 3.1.4. ADS safety requirements need to address the diversity of configurations, intended uses, and limitations on use while addressing usage specifications of individual ADS.

¹⁴ Proposed to ensure uniform interpretation of the term “real time”.

¹⁵ Op. cit. Michon, J.A., 1985.

¹⁶ Based on FRAV-16-12.

¹⁷ Based on FRAV-16-12.

¹⁸ GRVA-09-28

¹⁹ Ibid.

- 3.1.5. Therefore, FRAV intends to provide guidelines for the manufacturer's description of an ADS, including measurable/verifiable ODD specifications, to enable the application of safety requirements to the ADS under assessment.
- 3.2. The manufacturer shall describe the ADS configuration and the intended uses and limitations on the use of its feature(s).
 - 3.2.1. The manufacturer shall list the potential faults covered by the diagnostic system(s) of the ADS.²⁰
- 3.3. The manufacturer shall establish the ODD conditions and boundaries of each ADS feature in measurable and/or verifiable terms.²¹ [open issue: This section will be expanded/refined to address documentation on ODD elements]
 - 3.3.1. The ODD conditions addressed by the manufacturer shall, at a minimum, include:²²
 - 3.3.1.1. Precipitation (rain, snow).
 - 3.3.1.2. Time of day (light intensity, including the case of the use of lighting devices).
 - 3.3.1.3. Visibility.
 - 3.3.1.4. Road and lane markings.
 - 3.3.1.5. Road surface adhesion**
 - 3.3.1.6. Country of operation.²³
 - 3.3.1.7. V2x dependencies, if any.²⁴
- 3.4. The manufacturer shall establish terms for the correct use of the ADS.²⁵

²⁰ Based on FRAV-18-06 (“The ADS should perform self-diagnosis of faults in accordance with the OEMs prescribed list”). The proposal presupposes that the OEM provides the prescribed list, suggesting an element for inclusion in the manufacturer description of the ADS.

²¹ Based on FRAV-18-06 (“The ODD conditions and boundaries (measurable limits) should be established by the manufacturer.”). Because Section 3 will provide guidelines for declaring the ODD conditions and boundaries of each ADS feature, it is proposed to place this requirement in this section.

²² Based on FRAV-18-06 (“The ODD conditions to be recognized by the ADS should include: Precipitation (rain, snow), Time of day (light intensity, including the case of the use of lighting devices), Visibility, Road and lane markings”). Per the requirement that the ADS shall recognize its ODD conditions (4.1.2. below), it seems appropriate to cross-reference this performance requirement with the manufacturer's establishment of the conditions relevant to the ADS under assessment pursuant to the Section 3 guidelines.

²³ Based on FRAV-18-06 (“The ADS should comply with traffic rules [in the country of operation / within the ODD]”). FRAV agreed that the country or countries of operation would be included in the ADS description to enable application of requirements specific to such jurisdictions (e.g., traffic laws, languages, special vehicle markings).

²⁴ Based on FRAV-17-09 (“The ADS should establish a stable connection and response correctly if the vehicle has V2X options.”).

²⁵ Based on FRAV-18-06 (“The ADS manufacturer should provide tools for the authorized user to learn about system functionality and operation.”) Input on requirements for ADS interactions with ADS users relate to the

- 3.4.1. The **manufacturer** shall provide written information on the intended uses and limitations on the use of the ADS feature(s).²⁶
- 3.4.2. The manufacturer shall describe means made available to the public to promote a correct understanding of the intended uses and limitations on the use of the ADS.²⁷
- 3.4.3. The manufacturer shall provide the following information for ADS designed to interact with a fallback user.²⁸
 - 3.4.3.1. The manufacturer shall provide written information on the roles and responsibilities of the fallback user, including ~~on activities other than driving non-driving-related activities.~~²⁹ [open issue: permissible driver activities other than driving subject to national law (WP.1), not under manufacturer authority—relates to configuration such as designed for fallback user subject to national laws on non-driving activities]
 - 3.4.3.2. The manufacturer shall provide written instructions for the activation and deactivation of the ADS.³⁰
 - 3.4.3.3. The manufacturer shall provide written information on ADS responses to fallback user interventions in the dynamic control of the vehicle.³¹
 - 3.4.3.4. The manufacturer shall provide written descriptions of the transfer of control procedures, including ADS notifications and fallback user responses.³²

ADS configuration, intended uses, and limitations on use that would be established by the manufacturer. Per para. 3.1.3 on the diversity of possible user roles and responsibilities depending upon the ADS configuration, the manufacturer would need to provide information on correct use. This information would enable the application of requirements for user notifications and other ADS responses to incorrect use.

²⁶ Based on FRAV-18-06 (“ADS manufacturer should provide documented information on ADS (features) capabilities and limitations (the information should also refer to specific scenarios)”).

²⁷ Based on FRAV-18-06 (“ADS manufacturer should describe the possible educational approach: Theoretical and practical training, How it aligns with common HMI and interaction”). Statement provided to facilitate FRAV discussions on the role of public and consumer education (if any) in the establishment of ADS safety requirements.

²⁸ Based on FRAV-18-06 (“ADS manufacturer should provide documented information on allowed transition of roles and procedure for the transition (activation/deactivation, ToC, Override)”). The proposed requirements would only concern ADS designed for use with a fallback user, so this paragraph clarifies the scope.

²⁹ Based on FRAV-18-06 (“ADS manufacturer should provide documented information on roles and responsibility of Driver/user and ADS when ADS (feature) is on/off” and “ADS manufacturer should provide a list of NDRA allowed when an ADS feature is active”).

³⁰ Op. cit. FRAV-18-06 (“ADS manufacturer should provide documented information on allowed transition of roles and procedure for the transition (activation/deactivation, ToC, Override)”).

³¹ Ibid.

³² Ibid.

3.4.3.5. The manufacturer shall provide information detailing the human-machine interactions, including HMI indicators, telltales, and signals. [open issue: further consideration to clarify to whom the information is provided.]—check UN R121 terminology

4. ADS safety recommendations

4.1. ADS performance of the DDT³³

- 4.1.1. The ADS shall be capable of performing the entire Dynamic Driving Task (DDT) within the ODD of its feature(s).³⁴
- 4.1.2. The ADS shall recognize the conditions and boundaries of the ODD of its feature(s) pursuant to the manufacturer’s declaration under **paragraph 3.3**.³⁵
- 4.1.3. The ADS shall detect and respond to objects and events relevant to the DDT.³⁶
- 4.1.4. The ADS shall comply with safety-relevant traffic laws according to the ODD of the feature in use.³⁷
- 4.1.5. The ADS shall interact safely with other road users.³⁸

4.2. ADS interactions with ADS vehicle users

- 4.2.1. User interaction with and the interface of ADS (features) shall have a high-level commonality of design.
- 4.2.2. The ADS HMI shall provide clear and unambiguous information to the user.

³³ Based on FRAV-05-02 (“ADS should drive safely”).

³⁴ Based on FRAV-18-06 (“The ADS should be capable of performing the entire Dynamic Driving Task (DDT)”; “The capability of the ADS to perform the entire DDT should be determined in the context of the ODD of the ADS”). Per GRVA-07-54, an ADS integrates functions that enable performance of the DDT within the ODD of its feature(s). A feature may use all or some of the ADS functions and features may share ADS functions.

³⁵ Based on FRAV-18-06 (“The ADS should recognize the ODD conditions and boundaries of the ODD of its feature(s)”). The manufacturer establishes the conditions for the individual ADS and its features in accordance with the guidelines under Section 3.

³⁶ Based on FRAV-18-06 (“The ADS should detect and respond to objects and events relevant for the DDT”). Under its ORU workstream, FRAV is developing a properties-based approach to defining OEDR requirements.

³⁷ Based on FRAV-18-06 (“The ADS should comply with traffic rules [in the country of operation / within the ODD]”). Per the FRAV discussions, “country of operation” has been placed under the ADS description/ODD guidelines. Regarding discussions on the proposal “ADS should comply with the traffic laws in nominal conditions, except when in specific circumstances or when necessary to enhance the safety of the vehicle’s occupants and/or other road users”, FRAV recognizes that traffic laws aim to prioritize road safety such that the laws may permit prioritization of individual provisions over others and/or deviations from strict adherence in the interests of safety. FRAV is discussing possibilities to reflect this “safety vs. strict compliance” balance.

³⁸ Based on FRAV-18-06 (“The ADS should interact safely with other road users”).

- 4.2.3. The ADS shall be designed to prevent misuse and errors in operation. [open issue: clarification of addressable misuse and user errors]
- 4.2.4. The ADS shall be designed to **ensure** a safe ADS feature activation.
- 4.2.5. An ADS which permits a transition of control shall be designed to **ensure** safe transitions of control. [open issue: transitions to be subject to elaboration of detailed provisions on safe transitions, including verification of driver control—see table in detailed provisions]
- 4.2.6. **An ADS which permits user takeovers of control** shall be designed to **ensure** safe user-initiated takeovers.
- 4.2.7. The use of the ADS shall be supported by documentation and tools to facilitate the **authorized** user in understanding the functionality and operation of the system. [open issue: clarify targeted user for this requirement]
- 4.3. ADS management of safety-critical situations³⁹
 - 4.3.1. The ADS shall execute a fallback response in the event of a failure in the ADS and/or other vehicle system that prevents the ADS from performing the DDT.⁴⁰
 - 4.3.2. The ADS shall signal its intention to place the vehicle in an MRC.⁴¹
 - 4.3.3. Pursuant to a traffic accident, the ADS shall stop the vehicle. [open issue: text should be improved for clarity.]
- 4.4. ADS management of system failures⁴²
 - 4.4.1. The ADS shall detect and respond to system malfunctions and abnormalities relevant to its performance of the DDT.⁴³
 - 4.4.2. The ADS shall be **designed to protect against** ~~protected from~~ unauthorized access.
 - 4.4.3. The ADS shall signal [faults/failures] compromising its capability to perform the entire DDT relevant to the ODD of its feature(s).
 - 4.4.4. The ADS shall **be designed to protect against** ~~prohibit~~ unauthorized modifications to safety-critical hardware and software ~~in accordance with best engineering practices~~. [open issue: consider “tampering”, “inadvertent”, “unintentional”]

³⁹ Based on FRAV-05-02 (“ADS should manage safety-critical situations”).

⁴⁰ Based on FRAV-18-06 (“The ADS should execute a safe fallback response in the event of a failure of the ADS and/or other vehicle system that prevents the ADS from performing the DDT”).

⁴¹ Based on FRAV-18-06 (“The ADS should signal its intention to place the vehicle in an MRC to: ADS user or vehicle occupants, Other road users (e.g., by hazard lights)”).

⁴² Based on FRAV-05-02 (“ADS should safely manage failure modes”).

⁴³ Based on FRAV-18-06 (“The ADS should detect system malfunctions/abnormalities and evaluate system’s ability to fulfill the entire DDT”).

- 4.4.5. The ADS may continue to operate in the presence of [faults/failures] that do not prevent that ADS from fulfilling the **applicable** safety recommendations **applicable to the ADS**.⁴⁴ [open issue: consider relation with 4.4.1.: permission versus requirements, examples of “insignificant” faults/failures—what failures not safety?]
- 4.4.6. The ADS shall signal [faults/failures] compromising its ability to execute the DDT.⁴⁵
- 4.5. ADS maintenance of a safe operational state. [open issue: pending further discussion—some experts suggested that topic may be addressable by other entities.]
 - 4.5.1. The ADS should signal required system maintenance to the user.
 - 4.5.2. The ADS should be accessible for the purposes of maintenance and repair to authorized persons.
 - 4.5.3. ADS safety should be ensured in the event of discontinued production/support/maintenance.
- 4.6. The following table provides additional information on the elaboration of ADS safety requirements for use under the New Assessment/Test Method (NATM).
 - 4.6.1. The table is structured in accordance with five core safety aspects:
 - 4.6.1.1. The ADS should drive safely.
 - 4.6.1.2. The ADS should interact safely with the ADS vehicle user(s).
 - 4.6.1.3. The ADS should manage safety-critical traffic situations.
 - 4.6.1.4. The ADS should safely manage failure modes.
 - 4.6.1.5. The ADS should maintain a safe operational state.
 - 4.6.2. The left column (“safety requirements”) reproduces ADS safety recommendations presented above (paras. 4.1-4.5. inclusive).
 - 4.6.2.1. These recommendations have been generally accepted by FRAV as a basis for further elaboration of safety requirements.
 - 4.6.3. The right column (“detailed provisions”) provides additional information concerning the elaboration of the safety recommendations in the left column.
 - 4.6.3.1. ADS safety requirements shall be verifiable and/or measurable under the NATM tools and methods.

⁴⁴ Based on FRAV-18-06 (“Provided a failure does not significantly compromise ADS performance, the ADS should respond safely to the presence of a [faults/failure] in the system.” and “The limited operation of the ADS should comply to the normally applicable safety requirements”).

⁴⁵ Based on FRAV-18-06 (“The ADS should signal [faults/failures] affecting the ability to execute the DDT”).

- 4.6.3.2. The right column highlights aspects that may be suitable for the development of such measurable/verifiable criteria for assessing ADS fulfilment of the safety requirements. **These items are all under discussion and not yet agreed by FRAV.**
- 4.6.3.3. The elaboration of these safety requirements involves collaboration with the Validation Methods for Automated Driving informal working group.
 - 4.6.3.3.1. Consideration of traffic scenarios that define conditions the ADS may encounter, including nominal performance of the DDT, ADS responses to safety-critical traffic situations, and ADS responses to system failures.
 - 4.6.3.3.2. Consideration of the assessment methods to be used in evaluating ADS performance against the safety requirements such as virtual testing, track tests, and under real-world driving on public roads.
 - 4.6.3.3.3. Consideration of the procedures for determining ADS configurations, intended uses, and limitations on use to ensure assessments appropriate across the diversity of ADS.
 - 4.6.3.3.4. Consideration of procedures for monitoring the performance of ADS in the field, including attention to data collection and analysis to provide appropriate reporting on performance metrics.
- 4.6.3.4. Based on the above, FRAV anticipates the development of measurable/verifiable criteria for application of the safety requirements to the NATM methods and tools.

Table 1. ADS Safety **Recommendations** and Development of Detailed Provisions

	Safety Recommendations	Detailed Provisions (under discussion)
The ADS should drive safely.		
1.	The ADS shall be capable of performing the entire Dynamic Driving Task (DDT) within the ODD of its feature(s).	<ul style="list-style-type: none"> • The capability of the ADS to perform the entire DDT should be determined in the context of the ODD of the ADS • As part of the DDT, the ADS should be able to: <ul style="list-style-type: none"> ○ Operate at safe speeds. ○ Maintain appropriate distances from [other road users] by controlling the longitudinal and lateral motion of the vehicle. ○ Adapt its behaviour to the surrounding traffic conditions (e.g., by avoiding disruption to the flow of traffic). ○ Adapt its behaviour in line with safety risks (e.g., by giving all road users and passengers the highest priority).
2.	The ADS shall recognize the conditions and boundaries of the ODD of its feature(s) pursuant to the manufacturer’s declaration.	<ul style="list-style-type: none"> • The ADS should be able to determine when the conditions are met for activation. • The ADS should detect and respond when one or more ODD conditions are not or no longer fulfilled. • The ADS should be able to anticipate planned exits of the ODD • The ODD conditions and boundaries (measurable limits) should be established by the manufacturer. • The ODD conditions to be recognized by the ADS should include: <ul style="list-style-type: none"> ○ Precipitation (rain, snow) ○ Time of day (light intensity, including the case of the use of lighting devices) ○ Visibility ○ Road and lane markings

3.	The ADS shall detect and respond to objects and events relevant to its performance of the DDT.	<ul style="list-style-type: none"> • [Objects and events might include, but are not limited, to: <ul style="list-style-type: none"> ○ Vehicles, motorcycles, bicycles, pedestrians, obstacles ○ Road accidents ○ Road safety agents / enforcement agents ○ Emergency vehicles] • The ADS shall detect objects in and around its path of travel that exceed a minimum size. • The ADS shall recognize objects as static or mobile. • The ADS shall recognize markings and signals used to indicate priority vehicles within the ODD of its feature(s). • The ADS shall classify priority vehicles within the ODD of its feature(s) in accordance with the relevant traffic law(s). • The ADS shall yield the right of way to priority vehicles in service in accordance with the relevant traffic law(s).
4.	The ADS shall comply with safety-relevant traffic laws according to the ODD of the feature in use.	<ul style="list-style-type: none"> • ADS should comply with the traffic laws in nominal conditions, except when in specific circumstances or when necessary to enhance the safety of the vehicle's occupants and/or other road users.
5.	The ADS shall interact safely with other road users.	<ul style="list-style-type: none"> • The ADS shall avoid collisions with safety-relevant objects where possible. • The ADS shall signal intended changes of direction. • The ADS shall signal its operational status (active/inactive) as needed.

The ADS should interact safely with the ADS vehicle user(s).		
6.	User interaction with and the interface of ADS (features) shall have a high-level commonality of design.	<ul style="list-style-type: none"> • The ADS should be designed to foster a level of trust that is aligned with its capabilities and limitations to ensure proper use of the system. • The operation of the interaction shall have in common: <ul style="list-style-type: none"> ○ [use of common sequence of states in the transition/activation/overriding/...] • The interaction should be simplified: <ul style="list-style-type: none"> ○ [Limit the number of roles] ○ [Limit the number of potential transitions] ○ [Limit the number of settings] ○ [Limit the number of different interaction modes]
7.	The ADS HMI shall provide clear and unambiguous information to the user.	<ul style="list-style-type: none"> • The vehicle shall indicate its ADS capabilities in terms of their automated [features] and their ODD. • The ADS shall inform the user on the current conditions: <ul style="list-style-type: none"> ○ ADS status information ○ The availability of ADS features ○ User Role ○ Responsibility ○ Permitted NDRA ○ Potential roles to activate ○ “Standard” information: <ul style="list-style-type: none"> ▪ Vehicle speed, range and Time to Fuel ○ ADS failure information • The ADS shall inform the user on the upcoming conditions: <ul style="list-style-type: none"> ○ ODD boundaries ○ Upcoming actions or change in roles ○ Oncoming decisions/manoeuvres ○ Estimated time until take over in normal conditions ○ Transition related communication. • The ADS shall ensure that safety related information is prioritized and presented in a clear and unambiguous manner.
8.	The ADS shall be designed to prevent misuse and errors in operation.	<ul style="list-style-type: none"> • The ADS shall be designed to prevent inadvertent activation or deactivation. • The controls dedicated to the ADS shall be clearly distinguishable from other controls. • The ADS shall provide feedback when the user attempts to enable unavailable functions.

<p>9.</p>	<p>The ADS shall be designed to assure a safe ADS feature activation.</p>	<ul style="list-style-type: none"> • The ADS shall inform the user that preconditions for activation are met. • The activation should follow a common sequence of actions and states: <ul style="list-style-type: none"> ○ Common sequence to be a pass/fail criterion. • The ADS shall provide confirmation that the system is activated.
<p>10.</p>	<p>An ADS which permits a transition of control shall be designed to assure safe transitions of control.</p>	<ul style="list-style-type: none"> • The interaction shall follow a common sequence of actions and states in the Transition of control (change of user roles): <ul style="list-style-type: none"> ○ Common sequence to be a pass/fail criterion. <div data-bbox="711 630 1315 976" data-label="Diagram"> </div> <p style="text-align: center;">Figure 2 – System-initiated transition from automated to manual driving</p> <ul style="list-style-type: none"> • Transition of control shall return to a common default user role (to prevent mode confusion and other risks): <ul style="list-style-type: none"> ○ This shall normally be fully engaged driving (conventional driver). ○ Common default user to be a pass/fail criterion. • The ADS shall continuously verify whether the user is available for the transition of control and warn the user if not available when required. • The ADS shall verify that the driver is in stable control of the vehicle to complete the transfer of control to the user. • During transition, the ADS shall remain active until the transition of control has been completed or the ADS reaches a minimal risk condition.

<p>11.</p>	<p>[The ADS shall be designed to assure a safe user-initiated takeover.]</p>	<ul style="list-style-type: none"> • Under safe conditions the user is allowed to initiate a takeover of the ADS. • The deactivation should follow a common sequence. <ul style="list-style-type: none"> ○ Common sequence to be a pass/fail criterion. • The ADS should prevent and warn a user for a user-initiated takeover that would likely lead to an unsafe situation. • The ADS should provide a clear feedback of the successful user initiated takeover. <ul style="list-style-type: none"> ○ The clear feedback should be a pass/fail criterion. • The user-initiated takeover should return to a common default user role (to prevent mode confusion and other risks) <ul style="list-style-type: none"> ○ This should normally be fully engaged driving (conventional driver). ○ Common default user role to be a pass/fail criterion.
<p>12.</p>	<p>[The use of the ADS shall be supported by documentation and tools to facilitate the authorized user in understanding the functionality and operation of the system.]</p>	<p>Documentation:</p> <ul style="list-style-type: none"> • The following information should be documented: • description of the possible educational approach: • Theoretical and practical training • How it aligns with common HMI and interaction • Operational Description of ADS (features) capabilities and limitations (the information should also refer to specific scenarios) • Description on roles and responsibility of driver/user and ADS when ADS (feature) is on/off • description of allowed transition of roles and procedure for the transition (activation/deactivation, ToC, Override) • general overview list of NDRA allowed when an ADS feature is active. <p>Tools:</p> <ul style="list-style-type: none"> • The ADS supports the user in correct operation (coaching). • The ADS gives prompt feedback on erroneous operation.

The ADS should manage safety-critical situations.		
13.	The ADS shall execute a fallback response in the event of a failure in the ADS and/or other vehicle system that prevents the ADS from performing the DDT.	<ul style="list-style-type: none"> • In the absence of a fallback-ready user, the ADS should fall back directly to a Minimal Risk Condition (MRC) • If the ADS is designed to request and enable intervention by a human driver, the ADS should execute an MRM in the event of a failure in the transition of control to the user <ul style="list-style-type: none"> ○ [Upon completion of an MRM, a user may be permitted to assume control of the vehicle] ○ [The user should be permitted to override the ADS to assume full control over the vehicle]
14.	The ADS shall signal its intention to place the vehicle in an MRC.	<ul style="list-style-type: none"> • The ADS should signal its intention to place the vehicle in an MRC to: <ul style="list-style-type: none"> ○ ADS user or vehicle occupants ○ Other road users (e.g., by hazard lights)
15.	Pursuant to a traffic accident, the ADS shall stop the vehicle.	<ul style="list-style-type: none"> • ADS reactivation should not be possible until the safe operational state of the ADS has been verified.
The ADS should safely manage failure modes.		
16.	The ADS shall detect and respond to system malfunctions and abnormalities relevant to its performance of the DDT.	<ul style="list-style-type: none"> • The ADS should perform self-diagnosis of faults in accordance with the OEMs prescribed list • The ADS should detect system malfunctions/abnormalities and evaluate system's ability to fulfill the entire DDT
17.	The ADS shall be protected from unauthorized access.	<ul style="list-style-type: none"> • The measures ensuring protection from an authorized access should be provided in alignment with engineering best practices.
18.	The ADS shall signal [faults/failures] compromising its capability to perform the entire DDT relevant to the ODD of its feature(s).	
19.	The ADS shall prohibit unauthorized modifications to safety-critical hardware and software in accordance with best engineering practices.	
20.	The ADS may continue to operate in the presence of [faults/failures] that do not prevent that ADS from fulfilling the applicable safety recommendations.	<ul style="list-style-type: none"> • The limited operation of the ADS should comply to the normally applicable safety requirements. • [For situations where the ADS is not able to perform the DDT safely, the ADS should have the function to prevent activation. If the ADS has OTA functionality, this function may be activated remotely if the authorities or the vehicle manufacturer determine that the ADS is unsafe.]

21.	The ADS shall signal [faults/failures] compromising its ability to execute the DDT.	<ul style="list-style-type: none"> The ADS should signal [faults/failures] affecting the ability to execute the DDT.
The ADS should maintain a safe operational state.		
22.	[The ADS should signal required system maintenance to the user.]	
23.	[The ADS should be accessible for the purposes of maintenance and repair to authorized persons.]	
24.	ADS safety should be ensured in the event of discontinued production/support/maintenance.	