Contents

5.11. Recommendations on safe use of the ADS by ADS users

5.11.1. Scope and purpose.

5.11.1.1. This section provides recommendations on the interaction processes between the user and the ADS vehicle to obtain a safe use of an ADS vehicle.

5.11.1.2. These recommendations do not apply to ADS vehicles designed without accommodations for a user.

5.11.1.3. User is short for ADS user

5.11.2. ADS vehicles with accommodations for a user

5.11.2.1. The ADS shall signal the presence of a fault that prevents the ADS from performing the DDT functions required by its feature(s) pursuant to para. 4.9.

5.11.2.2. The ADS shall signal its intention to place the vehicle in an MRC to the ADS user(s).

5.11.2.3. The ADS may control the operation of closures, if available, as relevant to occupant safety, or to restrict or enable access to compartments. Controls related to closures may be disabled by the ADS.

5.11.2.4. The ADS HMI shall provide information and signals clearly noticeable under all operating conditions, multimodal if needed, simple and unambiguously.

5.11.3. ADS vehicles that permit manual driving

5.11.3.1. General recommendations

5.11.3.1.1. The ADS users are: driver, fall-back user, passenger in the driving seat, passenger

5.11.3.1.2. The vehicle controls may be disabled, suppressed, de-activated, inhibited or by other means made unavailable, as needed to limit errors in operation, misuse and reduce ambiguous states of vehicle control.

5.11.3.1.3. The vehicle shall indicate its ADS capabilities in terms of their automated [features] and their ODD.

5.11.3.1.4. The ADS shall be designed to prevent misuse and errors in operation by the user.
(a) The vehicle controls dedicated to the ADS shall be clearly distinguishable from other controls to accommodate only the appropriate interactions.
(b) The ADS HMI need to take into account potential impairments of users (such as colour blindness, impaired hearing) which do not require specific hardware adaptations of the vehicle.

5.11.3.1.5. While an ADS feature is active it shall inform the user in the driving seat on:
(a) ADS status information.
(b) The availability of automated features (ADS).
(c) Responsibilities for the user.
(d) Permitted NDRA (or not-permitted NDRA).
(e) “Standard” information that support situation awareness.
(f) Any failure of the ADS.
(g) Upcoming actions or change in roles.
(h) Estimated time until transition of control in nominal conditions (when applicable).

5.11.3.1.6. While the ADS is not active it shall inform the driver:
(a) ADS status information.
(b) The availability of automated features (ADS).
(c) Any failure of the ADS.

5.11.3.1.7. The ADS shall have a Driver Monitoring System to support correct engagement of the [fallback] user.

5.11.3.1.8. Any form of deactivation shall return control of the DDT to the driver without any continuous control assistance (temporarily intervening safety systems such as ESC shall remain activated).

5.11.3.1.9. For the ADS users the ADS shall be supported by documentation and tools to facilitate user understanding of the functionality and operation of the system covering at least:
(a) An operational description of the ADS feature capabilities and limitations (the information should also refer to specific scenarios and/or ODD).
(b) A description of the roles and responsibility of driver/user and ADS when an ADS (feature) is on/off.
(c) A description on the permitted transitions of roles and the procedure for those transitions.
(d) A general overview of NDRA allowed when an ADS feature is active.

5.11.3.1.10. The ADS manufacturer / vehicle manufacturer (as appropriate) shall provide documentation available for audit on:
(a) The details of their user-centred design process
(b) Its intended educational approach for theoretical and practical training

5.11.3.2. Recommendations on the ADS feature activation when in motion

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

(a) The ADS shall provide prompt feedback when the user attempts to enable unavailable features.
(b) The ADS shall inform the user that preconditions for feature activation are met.
(c) The activation shall follow a common sequence of actions and states (ISO/TR 21959-1:2020(E)).
(d) The ADS feature shall provide confirmation that the system is activated.
(e) An ADS feature activation resulting in a change of user role shall inform the user about this change in roles and corresponding responsibilities.

5.11.3.3. Recommendations on the ADS feature deactivation while in motion

5.11.3.3.1. The ADS shall be designed to ensure a safe user-initiated takeover process.
(a) The ADS shall allow the user to initiate a take-over process
(b) The ADS shall momentarily delay deactivation of driving control when immediate human resumption of control could compromise safety
(c) The take-over process shall follow a common sequence of actions and states (ISO/TR 21959-1:2020(E))
(d) The ADS shall verify that the user is in stable control of the vehicle to complete the user-initiated takeover of control process.
(e) The ADS shall provide specific feedback of the completion of the deactivation of the ADS.
(f) If applicable upon ADS deactivation, the vehicle controls, indicators, warnings and tell-tales shall be restored to an activated state.
(g) If applicable ADS features operating control of closures, shall no longer influence closures or the controls associated with closures.

(h) If applicable, controls associated with the operation of the ADS feature shall no longer influence the ADS feature.

5.11.3.3.2. The ADS shall ensure a safe transition of control.

(a) A transition of control in nominal situations should be indicated in timely manner to support that the fallback user may re-engage to the driving task as appropriate.
(b) The Transition of control process shall follow a common sequence of actions and states. (ISO/TR 21959-1:2020(E))
(c) The ADS shall
a. continuously verify whether the fallback user is available for the Transition of Control and
b. adapt the Transition of Control process, including the time budget where feasible, to the state of the fallback user and/or to the ADS. (and suggest a minimum time budget)
c. provide a warning when the user is not available when required.
(d) The ADS shall verify that the fallback user is in stable control of the vehicle to complete the Transition of Control process.
(e) During transition, the ADS shall remain active until the Transition of control has been completed or the ADS reaches a minimal risk condition.
(f) The ADS shall provide specific feedback of the completion of the transition of control.
(g) If applicable upon ADS deactivation, the vehicle controls, indicators, warnings and tell-tales shall be restored to an activated state.
(h) If applicable ADS features operating control of closures, shall no longer influence closures or the controls associated with closures.
(i) If applicable, controls associated with the operation of the ADS feature shall no longer influence the ADS feature.

5.11.4. ADS system designs that prohibit a user to perform the DDT (e.g. shuttle, robotaxi, bus)

5.11.4.1. General Recommendations

5.11.4.1.1. The user in the vehicle is a passenger.

5.11.4.1.2. The ADS shall provide users with means to request to stop the fully automated vehicle.

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

5.11.4.1.4. The ADS shall verify that it is safe for the users to start driving

5.11.5. Remote operation of ADS vehicles

To be determined.

explanatory text. To be ignored for the moment.

This section provides safety-related recommendations to support user interactions with automated driving systems (ADS). It is noted that the recommendations vary depending on user role, system design and tasks to be performed by the user during the use of the vehicle with ADS.
"Human-Machine Interaction and Operator Information" were identified as key areas to address within Functional Requirements for Automated Vehicles (FRAV).
The recommendations in this document focus mainly on safe interaction needs for three specific roles the human being may be required to perform when utilising an ADS: 1) passengers (in the driver seat), 2) fallback user, and 3) driver, also noting that these roles may change depending on the ADS design while using ADS
This document also provides general recommendations relevant to the safe design of controls, displays, information, and warnings for ADS activation, deactivation, and usage.
These recommendations are informed by prior UNECE regulations that support safe user interactions with advanced driver assistance systems (ADAS).
Human interaction with automation has had a troubled history so, in order not to repeat the mistakes of technology-driven automation, it is necessary to develop recommendations based on human factors, which is an established multidisciplinary science that applies knowledge of human abilities and limitations to the design and evaluation of technology for improved safety and usability.
To avoid hazardous automation mode confusion due to a lack of clarity about human and ADS responsibilities, or varying capabilities and ODD between ADS, it is essential to provide users with the appropriate information, in a suitable format, related to their current role and status of the ADS.
While these recommendations are focused on human-centred design to achieve minimum levels of safety, it is recognized that following them will also help to improve ADS usability and user experience.
Given the challenges of developing a common set of safety recommendations for diverse ADS capabilities, vehicle types, and user roles, this document endeavours to prioritise minimum safety needs for higher-risk applications (i.e., ADS vehicles that can also be driven manually).
The recommendations in this document are designed to establish a minimum that manufacturers are expected to consider in order to avoid compromising safety.
It should also be noted that it is a novel challenge for a regulatory body to develop safety recommendations for vehicle systems that perform the entire driving task rather than a more traditional focus on limited functions for specific vehicle classes where a driver is always available to intervene.
ADS present further challenges to regulators because they require new regulatory concepts, tools, and methodologies to assess and monitor the admitted vehicles in addition to those historically used for previous vehicle technologies and systems.
Accordingly, while the recommendations herein are attempting to be objectively verifiable, further work may be needed to refine the requirements into more readily verifiable specifications for ADS as understanding and experience increase.
While this document recognizes the importance of innovation to the development of ADS by providing flexible recommendations to accommodate progress, there are some limits because innovation can never be prioritised over safety.
Where manufacturers do not follow specific recommendations herein, they will be expected to provide evidence that such designs will not compromise safety.
These recommendations provide direction for potential future regulations and support the industry by explaining the expected outcome, while allowing for flexibility in design.

A **high-level commonality in the interaction processes and interface** between the vehicle and a user for all brands and models will help drivers to develop and apply a mental model[1] of how their responsibilities relate to the level of automation and of how to interact with the systems. It will also help to reduce the risk of user confusion (e.g., mode confusion) when changing between vehicles with ADS from different manufacturers. Such commonality cannot be defined now, but it is vital to establish it as a goal of future design.

[1] A mental model is an explanation of someone's thought process about how something works in the real world.