**Draft UN Regulation**

**Uniform provisions concerning the approval of motor vehicles with regard to their [Advanced Driver Assistance Systems] ([ADAS])**

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| **Legend:**  Initial text, not agreed after the end of the actual TF on ADAS session;  New text submitted to the actual TF on ADAS session;  Agreed text.  Additional amendments to the already agreed text or amendments to new text proposals | **Note:**  UN Regulation No. 157 (ALKS) was used as the base text.  This document is the next version of ADAS-06-03. |

| **Draft regulatory text** | **Comments, Remarks, Justification** |
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| **Uniform provisions concerning the approval of motor vehicles with regard to their Advanced Driver Assistance Systems ([ADAS])** |  |
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| **Introduction** |  |
|  | Advanced Driver Assistance Systems ([ADAS])addressed in this UN Regulation can be defined as electronically controlled vehicle systems aimed at assisting a human driver in performing the dynamic driving task (DDT) through information support (e.g., warnings in safety-critical situations) and assisting in executing the lateral and/or longitudinal control of the vehicle temporarily or on a sustained basis, but which require the human driver to permanently monitor the environment and vehicle/system performance.  Thus, [ADAS] may not be capable to support in performing the entire DDT as they are limited in Object and Event Detection and Response (OEDR) and Operational Design Domain (ODD), and may not be capable to recognize certain environmental conditions. [ADAS] is intended to assist the human driver, who remains responsible for the entire DDT as well as OEDR. [ADAS] provide assistance at the tactical and operational driving levels.  From SAE J3016 (2021): Level 1 (*driver* assistance) and Level 2 (partial automation) *features* are capable of performing only part of the *DDT*, and thus require a *driver* to perform the remainder of the *DDT*, as well as to supervise the *feature’s* performance while engaged. As such, these *features*, when engaged, support—but do not replace—a *driver* in performing the *DDT*.  Implementation of [ADAS] requires appropriate understanding by the human driver of the performance capabilities of the [ADAS] in the vehicle. The appropriate information provision and interaction with the driver is required to ensure that the human driver is fully engaged in the DDT, and to avoid potential human driver’s misinterpretation, overestimation, or difficulty with [ADAS]/vehicle control.  Comment AVERE: Ideally focus on outlining testing requirements and related scoring evaluating behaviour, comfort, smoothness, etc. Priority topics could include sensor performance, sensor blindness, comfort, safety, predictable/humanlike behaviour. |
| **1. Scope** |  |
| 1.1. This UN Regulation applies to the type approval of vehicles of Categories [M and N[[1]](#footnote-1)]with regards to their [Advanced Driver Assistance Systems] ([ADAS]) capable of assisting the human driver in controlling the longitudinal and lateral motion of the vehicle on a sustained basis.  1.2. This UN Regulation applies only to [ADAS] meeting the general operational principles set out in paragraph 5.1.1.  1.3. This UN Regulation does not apply to [ADAS]:  1.3.1. which are already subject to other UN Regulations;  1.3.2. which provide information support only;  1.3.3. which provide momentary intervention during potentially hazardous situations (e.g., Advanced Emergency Braking System - AEBS).  1.4. This UN Regulation does not apply to Automated Driving Systems (ADS) capable of performing the entire dynamic driving task (DDT) and which thus replacing the human driver. |  |
| **2. Definitions**  For the purposes of this Regulation: |  |
| 2.1. *[“Advanced Driver Assistance Systems] ([ADAS”]) / [“Dynamic Control Assistance Systems (DCAS)] / [“Continuous Driving Assistance Systems (CDAS)”]* – hardware and software collectively capable of assisting a human driver in performing the dynamic driving task (DDT) by influencing the lateral and/or longitudinal control of the vehicle [temporarily or] on a sustained basis, [but which require the human driver to permanently monitor the environment and vehicle/system performance].  2.2. *Dynamic Driving Task (DDT)”* – in the context of an [ADAS]-equipped vehicle, means all of the real-time operational and tactical functions required to operate the vehicle and performed by a human driver. DDT functions can logically be grouped into three general categories: sensing and perception; planning and decision; control. The sensing and perception category includes: monitoring the driving environment via object and event detection, recognition, and classification, which includes: perceiving other vehicles and road users, the roadway and its fixtures, objects in the vehicle’s path, and relevant environmental conditions; positional awareness. The planning and decision category includes: prediction of actions of other road users; response preparation; manoeuvre planning. The control category includes: object and event response execution; lateral vehicle motion control; longitudinal vehicle motion control; enhancing conspicuity via lighting, signalling and/or gesturing, etc. *(FRAV-14-07-Rev.1)*  2.3. [*“Driver”* – an in-vehicle positioned human being who performs in real-time all of the DDT by manually exercising braking, accelerating, steering, and transmission gear selection input devices to operate a particular vehicle from the designated seating position that makes in-vehicle input devices (steering wheel, brake and accelerator pedals, gear shift) accessible to a driver.]  *Submitted by AAPC*  2.3. [*“Driver”* – means a human being engaged in dynamic control of the vehicle]  2.4. *“Dynamic Control”* – [means performance of real-time operational and tactical functions required to navigate a vehicle through prevailing traffic conditions]  2.4. *“[Road] Safety”* is a state of the vehicle, which can reduce and maintain the risk of personal injury or property loss at an acceptable level or below through the continuous hazard identification and risk management process.  2.5. *“Object and Event Detection and Response (OEDR)”* – the subtasks of the DDT that include monitoring the driving environment (detecting, recognizing, and classifying objects and events and preparing to respond as needed) and executing an appropriate response to such objects and events.  2.6. *“Use case”* – a specific application of [ADAS] designated to assist a driver in executing the specific portion of the DDT.  2.7. “*Operational design domain (ODD)”* – Operating conditions under which [ADAS] or the specific use case of [ADAS] is specifically designed to function, including, but not limited to, environmental, geographical, and time-of-day restrictions, and/or the requisite presence or absence of certain traffic or roadway characteristics.  2.8 *“Driver engagement”* – The driver’s involvement in the execution of the DDT and the driver’s availability to intervene immediately, as needed.  2.9. *"Lane Change Procedure"* – The sequence of operations aimed at performing a lane change of a vehicle. The sequence starts from the activation of the direction indicator lamps and ends when the direction indicator lamps are deactivated. It comprises the following operations:  (a) Activation of the direction indicator lamps;  (b) Lateral movement of the vehicle towards the lane boundary;  (c) Lane Change Manoeuvre;  (d) Resumption of the lane keeping function;  (e) Deactivation of direction indicator lamps.  2.10. "Lane Change Manoeuvre" – The part of the Lane Change Procedure which:  (a) Starts when the outside edge of the tyre tread of the vehicle front wheel closest to the lane markings touches the inside edge of the lane marking to which the vehicle is being manoeuvred;  (b) Ends when the rear wheels of the vehicle have fully crossed the lane marking. | 6th Session: Preference for ‘Dynamic Control Assistance Systems (DCAS)’. Japan maintained preference for ‘Continuous Driving Assistance Systems (CDAS)’.  The definition of [ADAS] shall correspond to the text agreed at the 4th ADAS TF session.  Note: the terms “temporarily” and “sustained” can be derived from SAE J3016 (2021), term 3.28, as below:  3.28 SUSTAINED [OPERATION OF A VEHICLE]: Performance of part or all of the DDT both between and across external events, including responding to external events and continuing performance of part or all of the DDT in the absence of external events.  NOTE 1: External events are situations in the driving environment that necessitate a response by a driver or driving automation system (e.g., other vehicles, lane markings, traffic signs).  NOTE 2: Sustained performance of part or all of the DDT by a driving automation system changes the user’s role. (See scope for discussion of roles.) By contrast, an automated intervention that is not sustained according to this definition does not qualify as driving automation. Hence, systems that provide momentary intervention in lateral and/or longitudinal vehicle motion control but do not perform any part of the DDT on a sustained basis (e.g., anti-lock brake systems, electronic stability control, automatic emergency braking) are not classifiable (other than at Level 0) under the taxonomy.  NOTE 3: Conventional cruise control does not provide sustained operation because it does not respond to external events. It is therefore also not classifiable (other than at Level 0) under the taxonomy.  OICA-CLEPA: There may not be a need to define the driver, similar to R79. Definitions should be checked to be aligned to one another. I.e. ‘engaged’ in dynamic control, while dynamic control is defined as ‘performance of real-time operational and tactical functions’. Suggest simplification  OICA-CLEPA (2.4): Define ‘dynamic control’ to confirm continuous rather than temporary functions.  AAPC: Agree. Need to define dynamic control and ‘DCAS’. |
| **3. Application for approval** | From UN R157 |
| 3.1. The application for approval of a vehicle type with regard to the [ADAS] shall be submitted by the vehicle manufacturer or by the manufacturer’s authorized representative.  3.2. It shall be accompanied by the documents mentioned below in triplicate:  3.2.1. A description of the vehicle type with regard to the items mentioned in paragraph 2.1.1., together with a documentation package as required in Annex 1 which gives access to the basic design of the [ADAS] 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.  3.3. A vehicle representative of the vehicle type to be approved shall be submitted to the Technical Service conducting the approval tests. |  |
| **4. Approval** | From UN R157 |
| 4.1. If the vehicle type submitted for approval pursuant to this Regulation meets the requirements of paragraph 5 to 9 below, approval of that vehicle shall be granted.  4.2. An approval number shall be assigned to each type approved; its first two digits (at present 00 corresponding to the 00 series of amendments, its original version) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party shall not assign the same number to another vehicle type.  4.3. Notice of approval or of refusal or withdrawal of approval pursuant to this Regulation shall be communicated to the Parties to the Agreement which apply this Regulation by means of a form conforming to the model in Annex 1 and documentation supplied by the applicant being in a format not exceeding A4 (210 x 297 mm), or folded to that format, and on an appropriate scale or electronic format.  4.4. 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 conforming to the model described in Annex 2, consisting of:  4.4.1. A circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval;[[2]](#footnote-2)  4.4.2. 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 4.4.1. above.  4.5. 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 4.4.1. 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 4.4.1. above.  4.6. The approval mark shall be clearly legible and be indelible.  4.7. The approval mark shall be placed close to or on the vehicle data plate. |  |
| **5. Specifications** |  |
| **5.1. [ADAS] Functionality** |  |
| The fulfilment of the provisions of this paragraph ~~5.~~ [and its subparagraphs] shall be demonstrated by the manufacturer to the technical service during the inspection of the safety approach as part of the assessment to Annex [X] ~~3~~. | Co-Chair: This statement cannot be extended to all paragraph 5, as we will have the provisions subject to tests, etc.  OICA-CLEPA: All provisions are subject to audit irrespective of whether requirements would be subject to tests or not.  Chair: Confirmed this interpretation |
| 5.1.1. General operational principles of [ADAS]  The following principles set the framework for [ADAS] operation. Deviation from these principles shall mean that the considered electronically controlled vehicle system is not [ADAS] and such system shall not be approved pursuant to this UN Regulation.  5.1.1.1. [ADAS] shall be designed in such a way that it ensures the driver to remain engaged with the driving task and that the driver can always override [ADAS].  5.1.1.2. [ADAS] shall require the human driver to permanently monitor [ADAS] performance.  5.1.1.3. [ADAS] shall be designed according to the following principles:   1. The human driver permanently monitors the driving environment and responds if necessary; 2. The human driver remains fully engaged with the dynamic driving task, at least mentally, although he/she may be temporarily disengaged from some physical aspects of driving; 3. The human driver immediately intervenes and overrides [ADAS] when required by [ADAS], or other vehicle systems, or the environment; 4. The human driver determines when activation or deactivation of [ADAS] is appropriate and can deactivate [ADAS] immediately when needed; 5. The human driver shall not perform non-driving related tasks beyond those permitted during normal driving and remains responsible for the correct execution of the integral dynamic driving task. 6. The system shall propose the driver to refresh driver education when abnormal use in conflict with a-e is detected by system. | System operational frameworks associated with the [ADAS] definition. Include description of [ADAS] functionality.  OICA-CLEPA comment: 5.1.1 provision may be not be required (general principle of regulatory compliance). Move to the introduction/scope?  Co-Chair: These principles are here as the manufacturers should declare in the documentation that a vehicle complies with those principles.  Japan: Reflect documentation requirements further down in the document.  NL (5.1.1.1): The intention of this requirement is to assure pro-active driver engagement |
| 5.1.1.4. The main purpose of the [ADAS] is to improve road safety and/or driving efficiency without compromising road safety. Road safety shall not only focus on whether the vehicle can adopt corresponding measures to minimize the risk of the vehicle, but also whether the corresponding measures of the vehicle will cause other traffic participants in danger.  5.1.1.5. The application of [ADAS] shall ensure that the vehicle can assist the driver in performing the DDT without causing excessive impact or even collisions on other traffic participants.  5.1.1.6. The design of [ADAS] shall be such that driving manoeuvres assisted by the system will not pose an undue risk to the safety of the vehicle occupants and other road users. | OICA-CLEPA: Suggest to move 5.1.1.4 to introduction, because it is not really a requirement. Not a safety requirement.   5.1.1.7 - It is not Safety requirement. How often a system disengages depends on many external conditions. We have not even regulated this aspect for ALKS, so why introduce it here? Provisions introducing expectations of other traffic provisions are not appropriate.  Japan: ADAS should not negatively affect traffic flow, which may be of particular importance for ADAS.  Check/align with the items elaborated by FRAV IWG.  Co-Chair: not yet addressed. |
| **5.1.2. Assistance to a driver in executing the DDT.**  The manufacturer shall describe in details [in the documentation] the role of each [use case]/[functionality]/[systems and subsystems] of [ADAS] in executing the DDT functions by the driver and the assistance provided. | FRAV-14-07-Rev.1 – Description of DDT elements (to review)  Co-Chair: added to the definition.  AAPC: There should not be a section for DDT in an ADAS regulation.  OICA-CLEPA; Support AAPC concern. Replace DDT with Control Assistance or Vehicle Dynamic Behavior?  Co-Chair: Vehicle Dynamic Behavior listed in 5.4.3.  Co-Chair: This section is for a manufacturer to describe the assistance of [ADAS] in executing the DDT. Based on ADAS-05-03. |
| **5.1.3. Specific provisions to OEDR** |  |
| 5.1.3.1 [ADAS] shall be able to assess its surroundings as required by the [ODD]/[system boundaries] for each [system]/[function].  5.1.3.2 If [ADAS] is used in environments where vulnerable road users (such as pedestrians and cyclists) are present, [ADAS] shall be able to adequately detect such vulnerable road users. | NL: We should be careful not to end-up with systems where the driver would only require to supervise the system and just monitor the environment, while the DDT is effectively performed by the system, i.e. the system behaving as an ADS-like system.  FIA (5.1.3.2): The System should be able to detect VRUs in any environment, even if the road is not dedicated to be used by VRUs in normal circumstances (eg highways). This could occur eg after an accident. |
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| **5.1.4. [System boundaries] / ODD**  The manufacturer shall establish and describe in details [in the documentation] [to the Technical Service] the ODD for each use case of [ADAS] and indicate which ODD conditions and boundaries (measurable limits) can be recognized automatically by [ADAS] and by which means. The manufacturer shall describe the performance of [ADAS] when the vehicle is about to leave the ODD and outside ODD. As a minimum, ODD conditions include:   1. Road: type (highway, rural, etc.), surface (type, adhesion), geometry, lane characteristics, availability of lane markings, edge of road, road crossings; 2. Road facilities (traffic control facilities, special facilities (road construction markings, etc.), other facilities; 3. Other road users, which [ADAS] is capable to recognize; | OICA-CLEPA: Experience of system boundaries could be relevant as a strategy to keep the driver in the loop. Should take care in defining such requirements.  The Operational Design Domain is equivalent to the activation condition of the system. For this we recommend considering ODD according to the following table:   |  |  |  | | --- | --- | --- | | ODD | Road | Road type | | Road surface | | Road geometry | | Lane characteristics | | Edge of road | | Road crossing | | Road facilities | Traffic control facilities | | Special facilities | | Temporary facilities | | Fixed facilities | | Target object | Vehicle | | Non-Motor Vehicle | | Pedestrian | | Animal | | Others | | Weather related environmental conditions | Weather | | Illumination | | Temperature | | Digital information | High precision map | | Communication type | | Positioning type |   OICA-CLEPA: The above table is not adequate for ADAS. Not all environmental elements as listed could be detected or are appropriate. Should be included in detailed description of system.  Chair: Can be deleted if it is ensured relevant information is required to be provided by manufacturer by a provision elsewhere.  Other road users as defined by FRAV IWG.  FIA (5.1.5): List in the column “comments” should be clarified that the category ‘Target object – vehicles’ also have to include Powered Two Wheelers and any kind of heavy vehicle.  ITU: Should ensure consideration of interface in HMI, and any confusion about what is handled or not handled.  Secretary: Clarify that these provisions are relevant with respect to the documentation to be provided to the Technical service. Requirements regarding driver information are handled below. |
| **5.1.5. [ADAS] modes of operation**  5.1.5.1. [ADAS] in operable condition shall have the following modes: “Off”, “Standby” and “Active”. The relationship between modes is shown on the drawing below.  5.1.5.1.1. When [ADAS] is in "Off” mode (or switched off), [ADAS] shall not assist the driver in executing DDT.  5.1.5.1.2. When [ADAS] is in "Standby" mode, [ADAS] is switched on, but its operating conditions are not all met. [ADAS] shall not assist the driver in executing DDT.  5.1.5.1.3. When [ADAS] is in "Active" mode, [ADAS] is switched on, and its operating conditions are met. [ADAS] shall assist the driver in executing DDT.  5.1.5.2. The manufacturer shall specify [in the documentation] [ADAS] operating conditions enabling [ADAS] to be in "Active" mode. | In addition to the failure state, the system state can be mainly divided into the four categories-on/off/active/standby, and the transition conditions and modes among them are as follows:   1. The system starts automatically after the vehicle is powered on or the driver starts on his own initiative; 2. The driver can actively switch on/off the system, and when the system is actively switch off a prompt message will be sent; 3. When the system meets the activation condition, it switches from the standby state to the activation state. The activation condition can be understood as that the system is in its ODD; 4. When the activation condition is not satisfied, the system exits from the activation state to the standby state; 5. The system does not execute DDT when the system is in standby or off state.   UN R 79, paras. 2.4.13. – 2.4.15., 5.6.2.1.2., 5.6.2.2.2., 5.6.4.2.4. modified. |
| **5.1.6. [ADAS] interactions with other vehicle systems** | OICA-CLEPA: Section may be used in case that pre-conditions would be defined in system operation. Maintain as placeholder. |
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| **5.2. [ADAS] interaction with the human driver** | HMI moved to functional requirements. |
| The fulfilment of the provisions of this paragraph shall be demonstrated by the manufacturer to the technical service during the inspection of the safety approach as part of the assessment to Annex [X]. |  |
| **5.2.1. Measures addressing the human driver’s awareness of [ADAS] capabilities and performance** |  |
| **5.2.1.1. Estimation of change of the human driver’s behaviour due to [ADAS] operation**  **[**The manufacturer shall [take into account] how [ADAS] change the driver’s workload. The manufacturer shall estimate possible driver’s expectations, misinterpretations, overreliance, difficulties with vehicle control when [ADAS] assists the driver in executing DDT. The manufacturer shall explain measures addressing full driver’s engagement in vehicle control.] | This section should predict the change of the human driver’s workload and address ensuring that the driver is fully engaged in performing DDT, possible human driver’s expectations, misinterpretations, overestimations, difficulties with [ADAS]/vehicle control.  Chair (5.2.1.1): Introduced to ensure a preliminary assessment is made of changes in driver behaviour when using the system. Manufacturer to explain how the system assist the driver and does not mislead, ensuring appropriate use.  OICA-CLEPA: Not sufficiently covered elsewhere? Unclear how ‘estimations’ would be made. May be sufficient to base the provisions of the CEL annex and to expand when it comes to avoiding driver abuse of the system. Suggest removal. |
| **5.2.1.2. Human driver education and marketing of [ADAS]**  5.2.1.2.1. Manufacturer must provide the driver with clear and accessible information or training about how the particular ADAS has to be operated by the driver. The information must contain information on the driver’s responsibility, the limitations of the ADAS and demonstrate how different warning signals are to be interpreted.  5.2.1.2.1. **[**The manufacturer shall develop and present at the time of type-approval the educational course for drivers and ensure (e.g., by the means of registration) that the consumers will take this educational course either via the dealers’ network or via publicly available manufacturer’s Internet resource. The educational course shall consist of printed guidelines for the desirable driver’s behaviour and at least a 30-minute video with voice and/or printed comments containing educational examples of good and poor driving practices involving [ADAS] subject to type approval. At least, the educational course shall include:   1. Explanation of DDT, The driver’s responsibility; 2. The role of each use case of [ADAS] in executing the DDT functions by the driver and the assistance provided; 3. [ADAS] OEDR capabilities and limitations; 4. [ADAS] ODD; 5. [ADAS] modes of operation and switching between modes; 6. [Measures ensuring the human driver’s [ADAS] mode awareness]; 7. Driver Engagement Detection; 8. Possibility of [ADAS] overriding; 9. Human-machine interface (HMI):    * 1. [ADAS] activation and deactivation;      2. [ADAS] status indication;      3. [ADAS] messages to the human driver and their interpretation;      4. Vehicle behaviour when reaching [ADAS] ODD;      5. Vehicle behaviour when exceeding [ADAS] ODD;      6. Information on [ADAS] failures; 10. Good driving examples (video); 11. Poor driving examples (video).]   5.2.1.2.2.a [If [ADAS] is item for marketing the vehicle, the manufacturer must not use illustrations or special product naming that give the customer an impression that the system has other or more advanced capabilities than stated in the driver education.]  5.2.1.2.2.b [The naming of the system shall not mislead the customer that the system has other or more advanced capabilities than stated in the driver education.] | Description of the driver information, engagement and possibly educational approach.  Norway*:* The education could be a video or practical training. We believe that a higher awareness and knowledge of how the ADAS works will contribute to higher mentally engagements and reduce risk of missuses ref. 5.1.1.5.  Experience so far has shown that many users have too high expectations about ADAS (ODD) and do not read the comprehensive and complex user manual. This is also related the gap between how the vehicle is marketed and the manufacturer’s statements of WARNINGS and LIMITATIONS in the user manual. Wrong naming of ADAS increase the risk of mode confusion (ADAS versus ADS)  NL: it is useful to introduce such a chapter. There will be a challenge how to address the transfer of driver information when the vehicle ownership changes  NL: this section could also provide information how the control is shared between the human (driving subtask performed by human) and the system (driving subtask performed by ADAS)  6th Session: Legality to be checked.  AAPC: Provisions may not be appropriate within the context of the WP.29 scope of activities. Supportive of general intent but specific provisions require review.  OICA-CLEPA: Concerned with these provisions. Provide evidence of driver confusion. May not fit in WP.29 scope. Manufacturer cannot be held accountable for the forced education of the driver in order to use the system. Supports appropriate marketing, but this would fall outside of the scope of type-approval. The issue could be addressed through appropriate definitions.  AVERE: Statements regarding driver overreliance and misunderstanding should be balanced with recognition of safety benefit of ADAS. Agree with OICA-CLEPA/AAPC. |
| **5.2.2. Measures ensuring the human driver’s [ADAS] mode awareness** | Alliance for Automotive Innovation: Level 2 Driver Monitoring Principles (<https://www.autosinnovate.org/about/advocacy/L2%20Driver%20Monitoring%20Principles.pdf>)  6th Session: Sufficiently covered by the section on HMI in 5.6? |
| **5.3. Functional requirements** | NL: Might be worth discussing whether e.g. ASIL levels for Functional Safety could also be introduced? |
| **5.3.1. OEDR sensor requirements** | General plus function-specific requirements, if appropriate. |
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| **5.3.2. Driver Engagement Detection**  5.3.2.1. General  5.3.2.1.1. [ADAS] shall implement strategies to evaluate the driver's engagement. [ADAS] implemented for different use cases shall ensure that the driver remains sufficiently engaged with the DDT during [ADAS] operation according to the specific use case.  5.3.2.1.2. [ADAS] shall be equipped with the means to appropriately detect driver engagement in conditions depending on [ADAS] capability, driving and environmental conditions.  5.3.2.1.3. [ADAS] shall alert the driver with increasing levels of visual and audible or haptic warnings in order to request appropriate driver engagement. [ADAS] shall terminate warnings only if [ADAS] detects that the driver has appropriately re-engaged based on the [ADAS] design.  5.3.2.1.4. [ADAS] shall de-activate following a lack of driver input or engagement in accordance to the system’s driver engagement design.  *Submitted by OICA-CLEPA*  5.3.2.1. General provisions  5.3.2.1.1. The system shall be equipped with the means to appropriately detect driver engagement depending on system capability, driving and environmental conditions.  The system’s driver engagement monitoring strategy shall be demonstrated by the manufacturer to the technical service during the inspection of the safety approach as part of the assessment to Annex X and according to the relevant tests of Annex Y  5.3.2.1.2. The system shall alert the driver with visual, audible or haptic warnings in order to request appropriate driver engagement. In case the driver is unresponsive the alert shall be escalated.  The warnings shall remain active as long as the driver remains inappropriately disengaged from the driving task or until the system is deactivated.  5.3.2.1.3. The system shall deactivate in accordance to the system’s driver engagement monitoring strategy and the provisions of par. 5.4.2.2., 5.4.2.3. and 5.4.2.4. as applicable, if the driver remains unresponsive.  After automatic deactivation due to insufficient driver engagement the system shall clearly inform the driver about this status by an emergency signal which shall be different from the other warning signals for a sufficient duration or until the driver is again engaged according to the system’s driver engagement monitoring strategy.  5.3.2.2. Hands-on driving  5.3.2.2.1. The system shall provide a means of detecting that the driver is holding the steering control.  The system shall provide an appropriate optical Hands-On-Warning (e.g. a pictorial information showing hands on the steering control) to the driver once he is assessed to not hold the steering control as required by the system’s driver engagement monitoring strategy.  The warning shall be escalated and be accompanied by an audible signal and the system shall be finally automatically deactivated if the driver remains disengaged according to the system’s driver engagement monitoring strategy.  5.3.2.3. Hands-off driving  5.3.2.3.1. Notwithstanding the requirements of paragraph 5.4.2.2. the hands-On-Warning may be suppressed to allow for hands off driving as long as all of the following conditions are met  5.3.2.3. *Placeholder*  5.3.2.4. Additional measures under special conditions  5.3.2.4.1. If any of the criteria below are applicable to [ADAS]:  *(Comment industry: equivalent to “high performing, high level of support”)*   1. [ADAS] itself initiates driving maneuvers (e.g. lane changes); 2. [ADAS] exceeds a maximum lateral acceleration of 3,3 m/s2; 3. …,   the following provisions shall apply to ~~the~~ ~~system~~ [ADAS] when it is operated in a state where any of the above criteria could apply:  5.3.2.4.1.1. [ADAS] shall implement at least two strategies to ensure the driver remains sufficiently engaged (e.g., hands-on wheel monitoring and a required minimum steering input by the driver);  5.3.2.4.1.2. [ADAS] shall demonstrate sufficiently robust environmental perception capabilities according to paragraphs xxx;  5.3.2.4.1.3. [ADAS] shall increase the frequency of checks to ensure sufficient driver engagement in challenging driver situations. The manufacturer shall describe the relevant control strategy in the documentation.  5.3.2.4.1. For highly dynamic driving manoeuvres (e.g. significant lateral accelerations) or manoeuvres automatically initiated by the system (e.g. automatic lane changes) the following provisions shall apply additionally to those of paragraph 5.4.2.2:   * the system shall ensure the driver is holding the steering control * the system shall monitor at least two criteria to ensure the driver remains sufficiently engaged according to paragraph 5.4.2.4.1. * The system shall demonstrate sufficient environmental perception capabilities according to paragraphs xxx   5.3.2.4.2. The driver shall be deemed to be sufficiently engaged if at least two engagement criteria (e.g. steering input, gaze direction, absence of input to driver-exclusive vehicle controls) have individually determined that the driver is engaged with the driving task in the last [30] seconds.  As soon as the driver is deemed to be not sufficiently engaged, or fewer than two availability criteria can be monitored, the system shall give a warning to the driver and if no appropriate response to that warning is detected, revert back to basic support. | The system shall implement strategies to evaluate the driver's involvement in the dynamic driving task and his availability to intervene immediately, as needed.  The Driver Engagement definition added.  Maybe this should be moved partly to the HMI section.  NL: Just ‘detecting’ driver engagement is too shallow, ADAS shall implement strategies to assure the driver engagement in a proactive manner. Such will probably have to include a combination of several measures.  FIA (5.4.2.1): Data protection has to be guaranteed, no storage or transmission of personal data without the consent of the driver!  NL: Hand-off driving is a clear example of a system that can easily lead to ‘mode confusion’ and should not be allowed  OICA-CLEPA: Hands-off would not be applicable for more complex systems. Alternative monitoring options may allow for various strategies to improve driver comfort. Category 2B in ECE/TRANS/WP.29/1140 reflects these systems.  Co-Chair: Industry should respond to issue of maintaining the driver in the loop during short/long periods during hands-off. Is both being asked for? How would a driver practically be kept in the loop?  UK: As one gets closer to automation, the more the driver would be inclined to be distracted. Concern of mode confusion is often mentioned. Intent is not to restrict capability, but to ensure appropriate driver engagement as systems become more capable.  AAPC: If a system requires a driver to be attentive and to supervise the system, it’s ADAS. If it does not, it’s ADS. Under this regulation, the intent is to ensure that the driver appropriately treats the system as an ADAS even though capability may be extended.  Chair: May need better clarification to better refer to the deactivation of control.  UK: Agreed that inspiration from ALKS should be taken, however may need to go beyond as drivers would be required to immediately intervene at any point. Careful consideration of the approach taken required to ensure driver actions do not lead to the assumption of continued automated control.  OICA-CLEPA: Driver does not need to ‘take back control’ because he was never out of it. These provisions aim to take steps in order to alleviate some of these concerns. |
| **5.3.3. Vehicle dynamic behaviour**  *Submitted by OICA-CLEPA*  5.3.3.1. Dynamic behavior of the vehicle when executed by [ADAS] shall be controllable for the driver.  5.3.3.2. Dynamic behavior of the vehicle when executed by [ADAS] shall be predictable and shall not lead to uncontrollable situations for other road users. | Dynamic behavior of the vehicle when executed by the system shall be controllable for the driver.  Dynamic behavior of the vehicle when executed by the system shall be predictable and shall not lead to uncontrollable situations for other road users.  Dynamic behavior of the vehicle when executed by the system shall appropriately account for changing environmental and traffic conditions. |
| **5.3.4. Function-specific requirements** |  |
| **5.3.4.1. Lane keeping**  *Submitted by OICA-CLEPA*  5.3.4.1.1. The activated [ADAS] shall keep the vehicle in lane when operated within the system boundaries.  5.3.4.1.2. The activated [ADAS] shall keep the vehicle in a stable position within its lane. | An activated system shall keep the vehicle in lane when operated within the system boundaries.  An activated system shall keep the vehicle in a stable position within its lane. |
| **5.3.4.2. Lane changing**  *Submitted by OICA-CLEPA*  5.3.4.2.1. A lane change procedure can be initiated by the driver or [ADAS].  5.3.4.2.1.1. Initiation of a lane change procedure by [ADAS] shall only be permitted in situations where it is justified per the traffic environment and the general safety principles.  5.3.4.2.2. A lane change procedure shall be indicated to other road users.  5.3.4.2.3. A lane change procedure shall be completed without undue delay.  5.3.4.2.4. After the initiation of the lane change procedure the ~~LCM~~ lane change maneuver shall commence in accordance with traffic rules in the country of operation (i.e., with regard to minimum indication time before a lane change maneuver is started).  5.3.4.2.5. A lane change maneuver shall be predictable and manageable to other road users (i.e., shall not force other vehicles to unmanageably decelerate). | A lane change procedure can be initiated by the driver or the system.  Initiation of a lane change procedure by the system shall only be permitted in situations where it is justified per the traffic environment and the general safety principles.  A lane change procedure must be indicated to other road users.  A lane change procedure must be completed without undue delay.  After the initiation of the LCP the LCM shall commence in accordance with traffic rules in the country of operation (i.e., with regard to minimum indication time before a LCM is started).  A lane change maneuver shall not force another vehicle to unmanageably decelerate / be predictable and manageable to other road users. |
| **5.3.4.3. Other transitions between lane-keeping phases**  *Submitted by OICA-CLEPA*  5.3.4.3.1. The provisions of this paragraph apply for manoeuvres that:   1. lead the vehicle to follow a trajectory when there is no dedicated lane (e.g., while turning at an intersection); 2. lead to an interaction with other road users while following a dedicated lane (e.g., when driving through a roundabout); 3. lead the vehicle to leave its lane of travel when this manoeuvre is not a lane change (e.g., in order to drive around a parked vehicle on the side of the road).   5.3.4.3.2. If [ADAS] is designed to following a trajectory on the basis of other sources of information than lane markings (e.g., when turning at an intersection), [ADAS] shall be equipped with adequate measures to robustly determine the appropriate trajectory.  5.3.4.3.3. [ADAS] shall indicate driving manoeuvres (e.g. turn) to other road users.  5.3.4.3.4. Crossing into another lane is permissible when:   1. forming an access corridor for emergency and enforcement vehicles; 2. driving around a stationary obstacle in the lane; 3. passing a slower moving vehicle or road user on the side of the lane with sufficient lateral distance.   5.3.4.3.5. Crossing into another lane shall only be permissible if [ADAS] is able to determine the position and movement of other road users. | If following a trajectory on the basis of other sources of information than lane markings (e.g. when turning at an intersection), the system shall be equipped with adequate measures to robustly determine the appropriate trajectory.  The system shall indicate driving manoeuvres (e.g. turn) to other road users.  Crossing into another lane is permissible when …  Crossing into another lane shall only be permissible if the system is able to determine the position and movement of other road users. |
| **5.3.4.4. Risk Mitigation Function** |  |
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| **5.3.4.5. Low-speed manoeuvring** |  |
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| **5.4. [ADAS] overriding by the human driver**  *Submitted by OICA-CLEPA*  5.5.1. It shall be possible for the driver to intervene at any time. |  |
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| **5.5. Human-machine interface (HMI)** |  |
| **5.5.1. [ADAS] activation and deactivation**  *Submitted by OICA-CLEPA*  5.5.1.1. [ADAS] shall be off at the initiation of each new ignition cycle, regardless of what mode the driver had previously selected.  5.5.1.2. [ADAS] shall become active only upon a deliberate action of the driver.  5.5.1.3. It shall be possible to deactivate ~~the~~ ~~system~~ [ADAS] with a deliberate action of the driver.  *Alternative:*  *Submitted by the Co-Chair:*  5.5.1.1. [ADAS] shall automatically switch to "Standby" mode immediately after the vehicle is powered on.  5.5.1.2. [ADAS] shall automatically switch from "Standby" mode to "Active" mode, if [ADAS] operating conditions allow so. [ADAS] shall automatically switch from "Active" mode to "Standby" mode, if [ADAS] operating conditions do not allow to be in “Active” mode, or if [ADAS] operating target had been reached.  5.5.1.3. The vehicle shall be equipped with a means for the driver to switch [ADAS] to “Off” mode at any time by a single action of the driver. Following this action, [ADAS] shall only return to “Standby” mode again as a result of a deliberate action by the driver.  5.5.1.4. The provisions of paragraph 5.6.1.3. shall not apply to [ADAS] designated for emergency operation in the event, when the driver becomes unresponsive. | System shall be off at the initiation of each new ignition cycle by default, unless specifically selected as a mode by the driver.  By default, the system will require an activation of the system by a deliberate action of the driver, unless specifically selected as a mode by the driver.  FIA (5.6.1.1): Text conflicts with 5.1.6. The system starts automatically after the vehicle is powered on.  It shall be possible to deactivate the system with a deliberate action of the driver.  OICA-CLEPA: 5.6.1.1 may depend on the scope, could not be applicable to e.g. RMF. Needs further review as we go along.  NL: ADAS ADS features should be designed according to harmonized / common HMI principles to support smooth switching from one vehicle to another.  NL: The information presented to the driver / user should be organized according to saliency principles, shall prevent from unintended/inadvertent activation or activation outside the ODD and provide information on the system capabilities/ODD.  OICA-CLEPA/AVERE (on 5.6 overall): May be more valuable to consider a more general thinking of what should be indicated to the driver in view of the flux of different signals and warning requirements in other regulations. |
| **5.5.2. [ADAS] status indication**  5.5.2.1. When [ADAS] is in "Standby" mode or "Active" mode, an optical signal shall be provided to the driver.  [5.5.2.2. [ADAS] shall inform the driver clearly about any system initiated driving manoeuvres (e.g., system-initiated lane change).] | Relevant system states when the system is activated shall be indicated to the driver.  The status indication shall be suitable to ensure mode awareness.  6th Session: Do we need 5.6.2.2.? |
| **5.5**.**3. [ADAS] messages/signals to the human driver**  5.5.3.1. [ADAS] messages/signals shall inform/warn the driver only about:   1. [ADAS] status: either “Off” or “Standby”/”Active”; 2. [ADAS] request of the driver’s engagement to vehicle control; 3. [ADAS] had reached or exceeded its [ODD]/[system] boundaries; 4. [ADAS] failures.   5.5.3.2. [ADAS] messages/signals shall be clear, timely and noticeable and shall not lead to confusion. In the case of multiple messages, they shall be prioritized. Voice or textual messages shall not be used.  5.5.3.3. The manufacturer shall list and explain all [ADAS] messages/signals in the type-approval documentation and in the vehicle operation manual.  [5.5.3.4. To avoid driver informational overload and keep the driver promptly engaged to vehicle control, the manufacturer shall apply measures restricting communications between the vehicle and the driver, specifically by reducing the number of voice or textual messages and avoiding video effects attracting the driver’s attention.] | * Message classification   + Fault indication   + Information prompt   + Status prompt * Warning messages * Measures to avoid driver informational overload   AVERE (5.6.3.4): Need to take extreme caution with this provision. Driver information provision should be balanced against concerns of driver information overload. User interface can play an important role in ensuring that the driver is appropriately aware of the factors influencing ADAS intent. |
| **5.5.4. [ADAS] fallback special cases**  *Submitted by OICA-CLEPA / Co-Chair* |  |
| **5.5.4.1. [System behaviour when r~~R~~eaching the [ADAS] boundaries] [ADAS] behaviour when reaching the ODD boundaries**  [ADAS], which had detected ODD boundaries, shall inform the driver by the means of the blinking status signal. [ADAS] shall retain in “Standby” mode and shall not automatically switch to "Active" mode until returning to ODD conditions. |  |
| **5.5.4.2. [System behaviour when e~~E~~xceeding the [ADAS] boundaries] [ADAS] behaviour when exceeding the ODD boundaries**  [ADAS], which had detected occasional or sudden exit the ODD boundaries, shall inform the driver by the means of the blinking status signal. [ADAS], which was in “Standby” mode, shall retain in that mode. ADAS], which was in “Active” mode, shall immediately terminate its control assistance and return to “Standby” mode, unless [ADAS] operating algorithm is capable of completing the current [ADAS] operating target. In the latter case [ADAS] shall return to “Standby” mode after completing the current [ADAS] operating target. |  |
| **5.5.4.3. [ADAS] failures**  5.6.4.3.1. [ADAS] must be designed to detect sensor malfunctions or degradations which may affect the safe performance of [ADAS]. A failure of the [ADAS] perception system shall be indicated by a fault signal (optical/audible) to the driver. Following an indication of the fault signal to the driver, [ADAS] shall immediately terminate its control assistance and turn to “Off” mode, unless [ADAS] operating algorithm is capable of completing the current [ADAS] operating target. In the latter case [ADAS] shall turn to “Off” mode after completing the current [ADAS] operating target.  5.5.4.3.2. A failure of the [ADAS] decision-making system shall result in an immediate fault signal (optical/audible) to the driver and abort of control assistance. [ADAS] shall turn to “Off” mode.  5.5.4.3.3. A failure of the [ADAS] execution system ~~should~~ shall result in an immediate fault signal (optical/audible) to the driver and abort of control assistance, unless [ADAS] operating algorithm is capable of completing the current [ADAS] operating target. In the latter case [ADAS] shall turn to “Off” mode after completing the current [ADAS] operating target. | Timing question: on the ODD boundary or before the ODD boundary?  In fact, there are still doubts about whether the fallback of the [ADAS] system occurs near the boundary of the ODD or on the boundary of the ODD. For the fallback that occurs on the ODD boundary, we think this can effectively remind the driver that the current external environment has affected the driving, and remind the driver that the system cannot perform the driving task normally in the current state; For the fallback that occurs within the ODD boundary, it can leave more reaction time for the driver to ensure the safety of driving, but it is difficult to confirm whether the current status prompt is reasonable from the test method. At the same time, we believe that the fallback cannot be issued later than the ODD boundary.   |  |  |  | | --- | --- | --- | | Number | Faulty subsystem | System response | | 1 | Perception system | The system control should first send out the fault signal and then exit smoothly instead of ending suddenly. | | 2 | Decision system | The system control should be stopped and a fault signal should be issued. | | 3 | Execution system | The system control should be stopped. If the system can still complete the current dynamic driving task or exit smoothly, the corresponding operation can be performed before the system control is completely stopped. |   OICA-CLEPA: Is it necessary to set the requirements considering Perception, Decision and Execution individually? Is it really wise from a driver perspective that the system behaves differently in these scenarios?  FIA: Agree to the basic idea, but how should control be given ‘gradually’ to the driver if the system fails. This then gives a minimum risk of incorrect maneuvers on the part of the system: it must be defined. We need to decide what a failure is, i.e. out of calibration including the non-monitored parts that are allowed. |
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| **6. Modification of vehicle type and extension of approval** |  |
| 6.1. Every modification to an existing vehicle type shall be notified to the Type Approval Authority which approved the vehicle type.  The Authority shall then either:  (a) Decide, in consultation with the manufacturer, that a new type-approval is to be granted; or  (b) Apply the procedure contained in paragraph 6.1.1. (Revision) and, if applicable, the procedure contained in paragraph 6.1.2. (Extension).  6.1.1. Revision  When particulars recorded in the information documents have changed and the Type Approval Authority considers that the modifications made are unlikely to have appreciable adverse effects and that in any case the foot controls still meet the requirements, the modification shall be designated a "revision".  In such a case, the Type Approval Authority shall issue the revised pages of the information documents as necessary, marking each revised page to show clearly the nature of the modification and the date of re-issue.  A consolidated, updated version of the information documents, accompanied by a detailed description of the modification, shall be deemed to meet this requirement.  6.1.2. Extension  The modification shall be designated an "extension" if, in addition to the change of the particulars recorded in the information documents,  (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.  6.2. Confirmation or refusal of approval, specifying the alteration, shall be communicated by the procedure specified in paragraph 4.3. 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.  6.3. The competent authority issuing the extension of approval shall assign a serial number to each communication form drawn up for such an extension. |  |
| **7. Conformity of production** |  |
| 7.1. Procedures concerning conformity of production shall comply with those set out in the 1958 Agreement, Schedule 1 (E/ECE/TRANS/505/Rev.3) and meet the following requirements:  7.2. A vehicle approved pursuant to this Regulation shall be so manufactured as to conform to the type approved by meeting the requirements of this regulation;  7.3. The Type Approval Authority which has granted 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. |  |
| **8. Penalties for non-conformity of production** |  |
| 8.1. The approval granted in respect of a vehicle type pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 8, above are not complied with.  8.2. If a Contracting Party withdraws an approval, it had previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation by sending them a communication form conforming to the model in Annex 1 to this Regulation. |  |
| **9. Production definitively discontinued** |  |
| 9.1. If the holder of the approval completely ceases to manufacture a type of vehicle approved in accordance with this Regulation, he shall so inform the Type Approval Authority which 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 to this Regulation.  9.2. The production is not considered definitely discontinued if the vehicle manufacturer intends to obtain further approvals for software updates for vehicles already registered in the market. |  |
| **10. Names and addresses of technical series responsible for conducting approval tests and of Type Approval Authorities** |  |
| The Contracting Parties to the Agreement applying this Regulation shall communicate to the United Nations Secretariat[[3]](#footnote-3) the names and addresses of the Technical Services responsible for conducting approval tests and of the Type Approval Authorities which grant approval and to which forms certifying approval or extension or refusal or withdrawal of approval are to be sent. |  |

| **Draft regulatory text** | **Comments, Remarks, Justification** |
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| **Annex 1** |  |
| **Communication**  (Maximum format: A4 (210 x 297 mm)  [[4]](#footnote-4)    issued by: Name of administration:  ......................................  ......................................  ......................................  **4**    Concerning:[[5]](#footnote-5) Approval granted  Approval extended  Approval refused  Approval withdrawn  Production definitively discontinued  of a vehicle type with regard to steering equipment pursuant to UN Regulation No. XXX  Approval 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 [ADAS]: see Addendum 1. |  |
| 7. Cyber Security and Software updates  7.1. Cyber Security Type Approval Number (if applicable):  7.2. Software Update Type approval number (if applicable):  8. Special requirements to be applied to the safety aspects of electronic control systems (Annex 4)  8.1. Manufacturers document reference for Annex 4 (including version number):  8.2. Information document form (Appendix to Annex 4)  9. Technical Service responsible for conducting approval tests  9.1. Date of report issued by that service  9.2. (Reference) Number of the report issued by that service  10. Approval granted/extended/revised/refused/withdrawn2  11. Position of approval mark on vehicle  12. Place  13. Date  14. Signature  15. 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  16. R15XSWIN:  16.1. Information on how to read the R15XSWIN or software version(s) in case the R15XSWIN is not held on the vehicle:  16.2. If applicable, list the relevant parameters that will allow the identification of those vehicles that can be updated with the software represented by the R15XSWIN under item 19.1.: |  |
| **Appendix 1** | (Taken from UN R 157 (ALKS) and adapted for [VCAS]) – *Submitted by OICA-CLEPA* |
| Addendum 1 to Type approval Communication No …  concerning the type approval of a vehicle type with regard to [ADAS] pursuant to Regulation No. xxx  Information document form for [ADAS]  **1. System description [ADAS]**  1.1. Dynamic Driving Task (DDT)  1.1.1. Longitudinal control provided by the system  1.1.2. Lateral control provided by the system  1.1.3. Object and Event Detection and Response (OEDR) by the system  1.2. Operating Scenarios  1.3. [System boundaries] [ODD]  1.4. [ADAS] states, modes, transitions and actions  1.5. [ADAS] interactions with other vehicle systems  1.6. [ADAS] interaction with the human driver  1.6.1. Measures addressing the human driver’s awareness of ~~[VCAS]~~ [ADAS] capabilities and performance  1.6.2. Estimation of change of the human driver’s behaviour due to ~~[VCAS]~~ [ADAS] operation  1.6.2. Human driver education  1.6.3. Measures ensuring the human driver’s ~~[VCAS]~~ [ADAS] mode awareness  **2. Description of the functions of [ADAS] including control strategies**  2.1. Main [ADAS] Functions (functional architecture, environmental perception).  2.1.1. Vehicle-internal  2.1.2. Vehicle-external (e.g. backend)  **3. Overview major components (units) of ~~"The System"~~ [ADAS]**  3.1. Control Units  3.2. Sensors  3.3. Maps/Positioning  **4. [ADAS] layout and schematics**  4.1. Schematic system layout including sensors for the environmental perception (e.g., block diagram)  4.2. List and schematic overview of interconnections (e.g., block diagram)  **5. Specifications**  5.1. Means to check the correct operational status of [ADAS]  5.2. Means implemented to protect against simple unauthorized activation/operation and interventions into [ADAS]  **6. Safety Concept**  6.1. Safe Operation – Vehicle Manufacturer Statement  6.2. Outline software architecture (e.g. block diagram)  6.3. Means by which the realization of [ADAS] logic is determined  6.4. General description of failure handling main principles  6.5. Driver, vehicle occupants and other road users’ interaction including warning signals to be given to driver.  6.6. Validation by the manufacturer for the performance requirements specified elsewhere in the regulation including the OEDR, the HMI the conclusion that that the system is designed in such a way that it is free from unreasonable risks for the driver, vehicle occupants and other road users.  **7. Information provisions to users**  7.1. Model of the information provided to users (including expected driver’s tasks within the ODD and when going out of the ODD.  7.2. Extract of the relevant part of the owner`s manual |  |

| **Draft regulatory text** | **Comments, Remarks, Justification** |
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| **Annex 2** |  |
| **Arrangements of approval marks**  **Model A**  (See paragraph 4.4. of this Regulation)    **XXXR - 002439**  a = 8 mm min  The above approval mark affixed to a vehicle shows that the vehicle type concerned has, with regard to [ADAS], been approved in the Netherlands (E 4) pursuant to UN Regulation No. XXX under approval No. 002439. The approval number indicates that the approval was granted in accordance with the requirements of UN Regulation No. XXX in its original version.  **Model B**  (See paragraph 4.5. of this Regulation)     |  |  | | --- | --- | | **XXX** | **002439** | | **31** | **021628** |   a = 8 mm min  The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the Netherlands (E 4) pursuant to Regulations Nos. XXX and 31.[[6]](#footnote-6) The approval numbers indicate that, at the dates when the respective approvals were given, UN Regulation No. XXX was in its original version and UN Regulation No. 31 included the 02 series of amendments. |  |

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| **Annex 3** – *Submitted by OICA-CLEPA* | Co-Chair: Consider combining with Annex 4. Industry to review whether both annexes cannot be merged. |
| **Special requirements to be applied to the safety aspects of electronic control systems ~~and audit~~**  1. General  This annex defines the special requirements for documentation, fault strategy and verification with respect to the safety aspects of Complex Electronic Vehicle Control Systems (paragraph 2.4. below) as far as this Regulation is concerned.  This annex shall also apply to safety related functions identified in this Regulation which are controlled by electronic system(s) (paragraph 2.3.) as far as this Regulation is concerned.  This annex does not specify the performance criteria for “The System” but covers the methodology applied to the design process and the information which shall be disclosed to the Technical Service, for type approval purposes.  This information shall show that “The System” respects, under non-fault and fault conditions, all the appropriate performance requirements specified elsewhere in this Regulation and that it is designed to operate in such a way that it does not induce safety critical risks.  2. Definitions  For the purposes of this annex,  2.1. *The System*” means an electronic control system or complex electronic control system that provides or forms part of the control transmission of a function to which this Regulation applies. This also includes any other system covered in the scope of this Regulation, as well as transmission links to or from other systems that are outside the scope of this Regulation, that acts on a function to which this Regulation applies.”  2.2. “*Safety Concept*” is a description of the measures designed into the system, for example within the electronic units, so as to address system integrity and thereby ensure safe operation under fault and non-fault conditions, including in the event of an electrical failure. The possibility of a fall-back to partial operation or even to a back-up system for vital vehicle functions may be a part of the safety concept.  2.3. “*Electronic Control System*” means a combination of units, designed to co-operate in the production of the stated vehicle control function by electronic data processing. Such systems, often controlled by software, are built from discrete functional components such as sensors, electronic control units and actuators and connected by transmission links. They may include mechanical, electro-pneumatic or electro-hydraulic elements.  2.4. “*Complex Electronic Vehicle Control Systems*” are those electronic control systems in which a function controlled by an electronic system or the driver may be over-ridden by a higher-level electronic control system/function. A function which is over-ridden become~~s~~ part of the complex system, as well as any overriding system/function within the scope of this Regulation. The transmission links to and from overriding systems/function outside of the scope of this Regulation shall also be included.  2.5. “Higher-Level Electronic Control” systems/functions are those which employ additional processing and/or sensing provisions to modify vehicle behaviour by commanding variations in the function(s) of the vehicle control system. This allows complex systems to automatically change their objectives with a priority which depends on the sensed circumstances.  2.6. “*Units*” are the smallest divisions of system components which will be considered in this annex, since these combinations of components will be treated as single entities for purposes of identification, analysis or replacement.  2.7. “*Transmission links*” are the means used for inter-connecting distributed units for the purpose of conveying signals, operating data or an energy supply. This equipment is generally electrical but may, in some part, be mechanical, pneumatic or hydraulic.  2.8. “*Range of control*” refers to an output variable and defines the range over which the system is likely to exercise control.  2.9. “*Boundary of functional operation*” defines the boundaries of the external physical limits within which the system is able to maintain control.  2.10. “*Safety Related Function*” means a function of “The System” that is capable of changing the dynamic behaviour of the vehicle. “The System” may be capable of performing more than one safety related function.  3. Documentation  3.1. Requirements  The manufacturer shall provide a documentation package which gives access to the basic design of “The System” and the means by which it is linked to other vehicle systems or by which it directly controls output variables. The function(s) of “The System” and the safety concept, as laid down by the manufacturer, shall be explained. Documentation shall be brief, yet provide evidence that the design and development has had the benefit of expertise from all the system fields which are involved. For periodic technical inspections, the documentation shall describe how the current operational status of “The System” can be checked.  The Technical Service shall assess the documentation package to show that “The System”:  (a) Is designed to operate, under non-fault and fault conditions, in such a way that it does not induce safety critical risks;  (b) Respects, under non-fault and fault conditions, all the appropriate performance requirements specified elsewhere in this Regulation; and,  (c) Was developed according to the development process/method declared by the manufacturer.  3.1.1. Documentation shall be made available in two parts:  (a) The formal documentation package for the approval, containing the material listed in paragraph 3. (with the exception of that of paragraph 3.4.4.) which shall be supplied to the Technical Service at the time of submission of the type approval application. This documentation package shall be used by the Technical Service as the basic reference for the verification process set out in paragraph 4. of this annex. The Technical Service shall ensure that this documentation package remains available for a period determined in agreement with the Approval Authority. This period shall be at least 10 years counted from the time when production of the vehicle is definitely discontinued.  (b) Additional material and analysis data of paragraph 3.4.4. which shall be retained by the manufacturer, but made open for inspection at the time of type approval. The manufacturer shall ensure that this material and analysis data remains available for a period of 10 years counted from the time when production of the vehicle is definitely discontinued.”  3.2. Description of the functions of “The System”  A description shall be provided which gives a simple explanation of all the control functions of “The System” and the methods employed to achieve the objectives, including a statement of the mechanism(s) by which control is exercised.  Any described function that can be over-ridden shall be identified and a further description of the changed rationale of the function’s operation provided.  3.2.1. A list of all input and sensed variables shall be provided and the working range of these defined.  3.2.2. A list of all output variables which are controlled by “The System” shall be provided and an indication given, in each case, of whether the control is direct or via another vehicle system. The range of control (paragraph 2.7.) exercised on each such variable shall be defined.  3.2.3. Limits defining the boundaries of functional operation (paragraph 2.8.) shall be stated where appropriate to system performance.  3.3. System layout and schematics  3.3.1. Inventory of components.  A list shall be provided, collating all the units of “The System” and mentioning the other vehicle systems which are needed to achieve the control function in question.  An outline schematic showing these units in combination, shall be provided with both the equipment distribution and the interconnections made clear.  3.3.2. Functions of the units  The function of each unit of “The System” shall be outlined and the signals linking it with other units or with other vehicle systems shall be shown. This may be provided by a labelled block diagram or other schematic, or by a description aided by such a diagram.  3.3.3. Interconnections  Interconnections within “The System” shall be shown by a circuit diagram for the electric transmission links, by a piping diagram for pneumatic or hydraulic transmission equipment and by a simplified diagrammatic layout for mechanical linkages. The transmission links both to and from other systems shall also be shown.  3.3.4. Signal flow, operating data and priorities  There shall be a clear correspondence between these transmission links and the signals and/or operating data carried between Units. Priorities of signals and/or operating data on multiplexed data paths shall be stated wherever priority may be an issue affecting performance or safety as far as this Regulation is concerned.  3.3.5. Identification of units  Each unit shall be clearly and unambiguously identifiable (e.g., by marking for hardware and marking or software output for software content) to provide corresponding hardware and documentation association.  Where functions are combined within a single unit or indeed within a single computer, but shown in multiple blocks in the block diagram for clarity and ease of explanation, only a single hardware identification marking shall be used. The manufacturer shall, by the use of this identification, affirm that the equipment supplied conforms to the corresponding document.  3.3.5.1. The identification defines the hardware and software version and, where the latter changes such as to alter the function of the Unit as far as this Regulation is concerned, this identification shall also be changed.  3.4. Safety concept of the manufacturer  3.4.1. The Manufacturer shall provide a statement which affirms that the strategy chosen to achieve “The System” objectives will not, under non-fault conditions, prejudice the safe operation of the vehicle.  3.4.2. In respect of software employed in “The System”, the outline architecture shall be explained and the design methods and tools used shall be identified. The manufacturer shall show evidence of the means by which they determined the realization of the system logic, during the design and development process.  3.4.3. The Manufacturer shall provide the Technical Service with an explanation of the design provisions built into “The System” so as to generate safe operation under fault conditions. Possible design provisions for failure in “The System” are for example:  (a) Fall-back to operation using a partial system.  (b) Change-over to a separate back-up system.  (c) Removal of the high-level function.  In case of a failure, the driver shall be warned for example by warning signal or message display. When the system is not deactivated by the driver, e.g., by turning the ignition (run) switch to “off”, or by switching off that particular function if a special switch is provided for that purpose, the warning shall be present as long as the fault condition persists.  3.4.3.1. If the chosen provision selects a partial performance mode of operation under certain fault conditions, then these conditions shall be stated and the resulting limits of effectiveness defined.  3.4.3.2. If the chosen provision selects a second (back-up) means to realise the vehicle control system objective, the principles of the change-over mechanism, the logic and level of redundancy and any built-in back-up checking features shall be explained and the resulting limits of back-up effectiveness defined.  3.4.3.3. If the chosen provision selects the removal of the Higher-Level Function, all the corresponding output control signals associated with this function shall be inhibited, and in such a manner as to limit the transition disturbance.  3.4.4. The documentation shall be supported, by an analysis which shows, in overall terms, how the system will behave on the occurrence of any individual hazard or fault which will have a bearing on vehicle control performance or safety.  The chosen analytical approach(es) shall be established and maintained by the Manufacturer and shall be made open for inspection by the Technical Service at the time of the type approval.  The Technical Service shall perform an assessment of the application of the analytical approach(es). The audit shall include:  (a) Inspection of the safety approach at the concept (vehicle) level with confirmation that it includes consideration of interactions with other vehicle systems. This approach shall be based on a Hazard / Risk analysis appropriate to system safety.  (b) Inspection of the safety approach at the system level. This approach shall be based on a Failure Mode and Effect Analysis (FMEA), a Fault Tree Analysis (FTA) or any similar process appropriate to system safety.  (c) Inspection of the validation plans and results. This validation shall use, for example, Hardware in the Loop (HIL) testing, vehicle on–road operational testing, or any means appropriate for validation.  The assessment shall consist of checks of hazards and faults chosen by the Technical Service to establish that the manufacturer’s explanation of the safety concept is understandable, logical and that the validation plans are suitable and have been completed.  The Technical Service may perform or may require to perform tests as specified in paragraph 4. to verify the safety concept.  3.4.4.1. This documentation shall itemize the parameters being monitored and shall set out, for each fault condition of the type defined in paragraph 3.4.4. of this annex, the warning signal to be given to the driver and/or to service/technical inspection personnel.  3.4.4.2. This documentation shall describe the measures in place to ensure the “The System” does not prejudice the safe operation of the vehicle when the performance of “The System” is affected by environmental conditions e.g. climatic, temperature, dust ingress, water ingress, ice packing.  4. Verification and test  4.1. The functional operation of “The System”, as laid out in the documents required in paragraph 3., shall be tested as follows:  4.1.1. Verification of the function of “The System”  The Technical Service shall verify “The System” under non-fault conditions by testing a number of selected functions from those declared by the manufacturer in paragraph 3.2. above.  For complex electronic systems, these tests shall include scenarios whereby a declared function is overridden.  4.1.2. Verification of the safety concept of paragraph 3.4.  The reaction of “The System” shall be checked under the influence of a failure in any individual unit by applying corresponding output signals to electrical units or mechanical elements in order to simulate the effects of internal faults within the unit. The Technical Service shall conduct this check for at least one individual unit, but shall not check the reaction of “The System” to multiple simultaneous failures of individual units.  The Technical Service shall verify that these tests include aspects that may have an impact on vehicle controllability and user information (HMI aspects).”  4.1.2.1. The verification results shall correspond with the documented summary of the failure analysis, to a level of overall effect such that the safety concept and execution are confirmed as being adequate.  5. Reporting by Technical Service  Reporting of the assessment by the Technical Service shall be performed in such a manner that allows traceability, e.g. versions of documents inspected are coded and listed in the records of the Technical Service.  An example of a possible layout for the assessment form from the Technical Service to the Type Approval Authority is given in Appendix 1 to this Annex. | Based on Annex 6 to UN R 79. May need amendments.  FIA: The whole provision concerning periodical technical inspections is far from enough and advantages vehicle manufacturers. In this formulation, PTI is completely laid into the hands of OEMS who can define what they want.  We need exact and OEM-independent definitions of how the system functionality can be checked with acceptable effort – free right to access, repair and maintenance.  FIA: At least 18 years, life-time support is necessary even for the last buyer of the vehicle model. Or even better until the last vehicle is demolished. Putting a maximum age on a vehicle is not sustainable and stimulates waste.  FIA: Ibidem  FIA: What is meant with non-fault conditions? Is this a way to exclude some legal responsibilities? Legal implications should be checked.  FIA: What is meant with non-fault conditions? Is this a way to exclude some legal responsibilities? Legal implications should be checked. |
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| **Draft regulatory text** | **Comments, Remarks, Justification** |
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| **Appendix ~~1~~**  Model assessment form for electronic systems  Test report No:  1. Identification   * 1. Vehicle make:   2. Type:   3. Means of identification of type if marked on the vehicle:   4. Location of that marking:   5. Manufacturer’s name and address:   6. If applicable, name and address of manufacturer’s representative:   7. Manufacturer’s formal documentation package:   Documentation reference No:  Date of original issue:  Date of latest update:   1. Test vehicle(s)/system(s) description    1. General description:    2. Description of all the control functions of "The System", and methods of operation:    3. Description of the components and diagrams of the interconnections within "The System": 2. Manufacturer’s safety concept    1. Description of signal flow and operating data and their priorities:    2. Manufacturer’s declaration:  *The manufacturer(s)* ............................................................. *affirm(s) that the strategy chosen to achieve "The System", objectives will not, under non-fault conditions, prejudice the safe operation of the vehicle.*    3. Software outline architecture and the design methods and tools used:    4. Explanation of design provisions built into "The System" under fault conditions:    5. Documented analyses of the behaviour of "The System» under individual hazard or fault conditions:    6. Description of the measures in place for environmental conditions:    7. Provisions for the periodic technical inspection of "The System":    8. Results of "The System" verification test, as per para. 4.1.1. of Annex 3 to UN Regulation No. [1XX]:    9. Results of safety concept verification test, as per para. 4.1.2. Annex 3 to UN Regulation No. [1XX]:    10. Date of test:    11. This test has been carried out and the results reported in accordance with ... to UN Regulation No. [1XX] as last amended by the .... series of amendments.  Technical Service[[7]](#footnote-7) carrying out the test Signed: ....................................... Date: ........................................    12. Type Approval Authority1 Signed: ....................................... Date: ........................................   Comments: |  |

| **Draft regulatory text** | **Comments, Remarks, Justification** |
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| **Annex 4** – | Based on Annex 4 to UN R 157. May need amendments. |
| **Special requirements to be applied to the audit** | Chair: To review in view of Annex 3. Merge? |
| **1. General**  1.1. “The requirements of this Annex are intended to ensure that an acceptable thorough consideration of functional and operational safety for [ADAS] has been performed by the manufacturer during the design and development processes and will continue to be done throughout the vehicle type lifecycle (design, development, production, field operation, decommissioning). This validation should be confirmed by in use monitoring.  The requirements cover the documentation which shall be disclosed by the manufacturer to the type-approval authority or the Technical Service acting on its behalf (hereafter referred to as type-approval authority), for type approval purposes and verification to be carried out by the type-approval authority.  This documentation shall demonstrate that [ADAS] meets the performance requirements specified in paragraph 5. of this UN Regulation, that it as that [ADAS] is designed and developed to operate in such a way that it is free of unreasonable safety risks to the driver, passengers, and other road users.  The type approval authority granting the approval shall verify through targeted spot checks and tests that the argumentation provided by the documentation is strong enough and that the design and processes described in documentation are actually implemented by the manufacturer.  While based on the provided documentation, evidence and process audits/product assessments carried out to the satisfaction of the type approval authority concerning this Regulation, the residual level of risk of the assessed [ADAS] is deemed to be acceptable for the entry into service of the vehicle type, the overall vehicle safety during [ADAS] lifetime in accordance with the requirements of this regulation remains the responsibility of the manufacturer requesting the type-approval.  1.2. The manufacturer shall be required to demonstrate that:   1. Robust processes are in place to ensure safety throughout the vehicle lifecycle (development phase, production, but also operation on the road and decommissioning). It shall include taking the right measures to monitor the vehicle in the field and to take the right action when necessary; 2. Hazard and risks relevant for the system have been identified and a consistent safety-by-design concept has been put in place to mitigate these risks; and 3. The risk assessment and the safety- by-design concept have been validated by the manufacturer through testing showing before the vehicle is placed on the market that the vehicle meets the safety requirements and in particular is free of unreasonable safety risks to the broader transport ecosystem in particular the driver, passengers and other road users.   **2. Definitions**  For the purposes of this annex,  2.1. "The system" means [ADAS]. This also includes any transmission links to or from other systems that are outside the scope of this Regulation but affect [ADAS] performance.  2.2. "Safety Concept" is a description of the measures designed into the system, for example within the electronic units, so that the vehicle operates in such a way that it is free of unreasonable safety risks to the driver, passengers and other road users under faults and non-fault conditions. The possibility of a fallback to partial operation or even to a back-up system for vital vehicle functions shall be a part of the safety concept.  2.3. "Electronic control system" means a combination of units, designed to co-operate in the production of the stated [ADAS] functions by electronic data processing. Such systems, commonly controlled by software, are built from discrete functional components such as sensors, electronic control units and actuators and connected by transmission links. They may include mechanical, electro-pneumatic or electro-hydraulic elements.  2.4. "Higher-Level Electronic Control" systems are those which employ processing and/or sensing provisions to assist the human driver in realization of the dynamic driving task.  2.5. "Units" are the smallest divisions of system components which will be considered in this annex, since these combinations of components will be treated as single entities for purposes of identification, analysis or replacement.  2.6. "Transmission links" are the means used for inter-connecting distributed units for the purpose of conveying signals, operating data or an energy supply. This equipment is generally electrical but may, in some part, be mechanical, pneumatic or hydraulic.  2.7. "Range of control" refers to an output variable and defines the range over which the system is likely to exercise control.  2.8. "Boundary of functional operation" defines the boundaries of the external physical limits within which the system is able to perform the dynamic driving tasks (i.e. including the transition demands and minimum risk manoeuvres).  2.9. "Operational Design Domain (ODD)" of the system defines the specific operating conditions (e.g., environmental, geographic, time-of-day, traffic, infrastructure, speed range, weather and other conditions) within the boundaries fixed by this regulation under which the system is designed to operate.  2.10. "Control strategy" means a strategy to ensure robust and safe operation of the function(s) of "the system" in response to a specific set of ambient and/or operating conditions (such as road surface condition, traffic intensity and other road users, adverse weather conditions, etc.). This may include the automatic deactivation of a function or temporary performance restrictions (e.g. a reduction in the maximum operating speed, etc.).  2.11. "Functional safety": absence of unreasonable risks under the occurrence of hazards caused by a malfunctioning behaviour of electric/electronic systems (safety hazards resulting from system faults).  2.12. "Fault": abnormal condition that can cause an element (system, component, software) or an item (system or combination of systems that implement a function of a vehicles) to fail.  2.13. "Failure" means the termination of an intended behaviour of an element or an item.  2.14. "Operational safety" means the absence of unreasonable risk under the occurrence of hazards resulting from functional insufficiencies of the intended functionality (e.g. false/missed detection), operational disturbances (e.g. environmental conditions like fog, rain, shadows, sunlight, infrastructure) or by reasonably foreseeable misuse/errors by the driver, passengers and other road users (safety hazards — without system faults).  2.15. "Unreasonable risk" means the overall level of risk for the driver, vehicle occupants and other road users which is increased compared to a competently and carefully driven manual vehicle.  **3. Documentation**  **3.1. Requirements**  The manufacturer shall provide a documentation package which gives access to the basic design of "The System" and the means by which it is linked to other vehicle systems or by which it directly controls output variables.  The function(s) of "The System", including the control strategies, and the safety concept, as laid down by the manufacturer, shall be explained.  Documentation shall be brief, yet provide evidence that the design and development has had the benefit of expertise from all the system fields which are involved.  For periodic technical inspections, the documentation shall describe how the current operational status of "The System" can be checked.  Information about how the software version(s) and the failure warning signal status can be readable in a standardized way via the use of an electronic communication interface, at least be the standard interface (OBD port).  The Type-approval authority shall assess the documentation package to show that "The System":   1. Is designed and was developed to operate in such a way that it is free from unreasonable risks for the driver, passengers and other road users within the declared ODD and boundaries; 2. Respects, under the performance requirements specified elsewhere in this UN Regulation; 3. Was developed according to the development process/method declared by the manufacturer and that this includes at least the steps listed in paragraph 3.4.4.   3.1.1. Documentation shall be made available in three parts:   1. Application for type approval: The information document which is submitted to the type approval authority at the time of type approval application shall contain brief information on the items listed in the Appendix to Annex 1. It will become part of the approval. 2. The formal documentation package for the approval, containing the material listed in this paragraph 3. (with the exception of that of paragraph 3.4.4.) which shall be supplied to the Type Approval Authority for the purpose of conducting the product assessment / process audit. This documentation package shall be used by the Type Approval Authority as the basic reference for the verification process set out in paragraph 4. of this Annex. The Type Approval Authority shall ensure that this documentation package remains available for a period determined of at least 10 years counted from the time when production of the vehicle type is definitely discontinued. 3. Additional confidential material and analysis data (intellectual property) of paragraph 3.4.4. which shall be retained by the manufacturer, but made open for inspection (e.g. on-site in the engineering facilities of the manufacturer) at the time of the product assessment / process audit. The manufacturer shall ensure that this material and analysis data remains available for a period of 10 years counted from the time when production of the vehicle type is definitely discontinued.   3.2. Description of the functions of "The System" including control strategies  A description shall be provided which gives a simple explanation of all the functions including control strategies of "The System" and the methods employed to assist the human driver in performing the dynamic driving task within the ODD and the boundaries under which [ADAS] is designed to operate, including a statement of the mechanism(s) by which control is exercised. The manufacturer shall describe the interactions expected between the system and the driver and other road users as well as Human-Machine-Interface (HMI).  If [ADAS] has multiple functionalities, any single function for which the hardware and software are present in the vehicle at the time of production, shall be declared and are subject to the requirements of this annex, prior to their use in the vehicle. The manufacturer shall also document the data processing in case of continuous learning algorithms are implemented.  3.2.1. A list of all input and sensed variables shall be provided and the working range of these defined, along with a description of how each variable affects system behaviour.  3.2.2. A list of all output variables which are controlled by "The System" shall be provided and an explanation given, in each case, of whether the control is direct or via another vehicle system. The range of control (paragraph 2.7.) exercised on each such variable shall be defined.  3.2.3. Limits defining the boundaries of functional operation including ODD-limits shall be stated where appropriate.  3.2.4. Interaction concept with the driver when ODD limits are reached shall be explained.  3.2.5. Information shall be provided about the means to activate, override or deactivate the system including the strategy how the system is protected against unintentional deactivation. This shall also include information about how the system detects that the driver is engaged in vehicle control along with specification and documented evidence of the used parameter to identify driver attentiveness as well as the influence on the steering thresholds.  3.3. System layout and schematics  3.3.1. Inventory of components.  A list shall be provided, collating all the units of "The System" and mentioning the other vehicle systems which are needed to achieve the control function in question.  An outline schematic showing these units in combination, shall be provided with both the equipment distribution and the interconnections made clear.  This outline shall include:  (a) Perception and objects detection including mapping and positioning  (b) Characterization of Decision-making  (c) Remote supervision and remote monitoring by a remote supervision centre (if applicable).  3.3.2. Functions of the units  The function of each unit of "The System" shall be outlined and the signals linking it with other units or with other vehicle systems shall be shown. This may be provided by a labelled block diagram or other schematic, or by a description aided by such a diagram.  3.3.3. Interconnections within "The System" shall be shown by a circuit diagram for the electric transmission links, by a piping diagram for pneumatic or hydraulic transmission equipment and by a simplified diagrammatic layout for mechanical linkages. The transmission links both to and from other systems shall also be shown.  3.3.4. There shall be a clear correspondence between transmission links and the signals carried between Units. Priorities of signals on multiplexed data paths shall be stated wherever priority may be an issue affecting performance or safety.  3.3.5. Identification of units  Each unit shall be clearly and unambiguously identifiable (e.g. by marking for hardware, and by marking or software output for software content) to provide corresponding hardware and documentation association. Where software version can be changed without requiring replacement of the marking or component, the software identification must be by software output only.  Where functions are combined within a single unit or indeed within a single computer, but shown in multiple blocks in the block diagram for clarity and ease of explanation, only a single hardware identification marking shall be used. The manufacturer shall, by the use of this identification, affirm that the equipment supplied conforms to the corresponding document.  3.3.5.1. The identification defines the hardware and software version and, where the latter changes such as to alter the function of the unit as far as this Regulation is concerned, this identification shall also be changed.  3.3.6. Installation of sensing system components  The manufacturer shall provide information regarding the installation options that will be employed for the individual components that comprise the sensing system. 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. The information shall also include installation specifications that are critical to the system’s performance, e.g. tolerances on installation angle.  Changes to the individual components of the sensing system, or the installation options, shall be notified to the Type Approval Authority and be subject to further assessment.  3.4. Safety concept of the manufacturer  3.4.1. The manufacturer shall provide a statement which affirms that the "The System" is free from unreasonable risks for the driver, passengers and other road users.  3.4.2. In respect of software employed in "The System", the outline architecture shall be explained and the design methods and tools used shall be identified (see 3.5.1). The manufacturer shall show evidence of the means by which they determined the realization of the system logic, during the design and development process.  3.4.3. The manufacturer shall provide the Type Approval Authority with an explanation of the design provisions built into "The System" so as to ensure functional and operational safety. Possible design provisions in "The System" are for example:  (a) Fall-back to operation using a partial system.  (b) Redundancy with a separate system.  3.4.3.1. If the chosen provision selects a partial performance mode of operation under certain fault conditions (e.g. in case of severe failures), then these conditions shall be stated (e.g. type of severe failure) and the resulting limits of effectiveness defined as well as the warning strategy to the driver.  3.4.3.2. If the chosen provision selects a second (back-up) means, the principles of the change-over mechanism, the logic and level of redundancy and any built in back-up checking features shall be explained and the resulting limits of back-up effectiveness defined.  3.4.4. The documentation shall be supported, by an analysis which shows, in overall terms, how the system will behave to mitigate or avoid hazards which can have a bearing on the safety of the driver, passengers and other road users.  The chosen analytical approach(es) shall be established and maintained by the manufacturer and shall be made open for inspection by the Type Approval Authority at the time of the type approval.  The Type Approval Authority shall perform an assessment of the application of the analytical approach(es):  (a) Inspection of the safety approach at the concept (vehicle) level.  This approach shall be based on a Hazard / Risk analysis appropriate to system safety.  (b) Inspection of the safety approach at the system level including a top down (from possible hazard to design) and bottom-up approach (from design to possible hazards). The safety approach may be based on a Failure Mode and Effect Analysis (FMEA), a Fault Tree Analysis (FTA) and a System-Theoretic Process Analysis (STPA) or any similar process appropriate to system functional and operational safety.  (c) Inspection of the validation/verification plans and results including appropriate acceptance criteria. This shall include validation testing appropriate for validation, for example, Hardware in the Loop (HIL) testing, vehicle on-road operational testing, testing with real end users, or any other testing appropriate for validation/verification. Results of validation and verification may be assessed by analysing coverage of the different tests and setting coverage minimal thresholds for various metrics.  The inspection shall confirm that at least each of the following items is covered where applicable under (a)-(c):  (i) Issues linked to interactions with other vehicle systems (e.g. braking, steering);  (ii) Failures of the system and system risk mitigation reactions;  (iii) Situations within the ODD when a system may create unreasonable safety risks for the driver, passengers and other road users due to operational disturbances (e.g. lack of or wrong comprehension of the vehicle environment, lack of understanding of the reaction from the driver, passenger or other road users, inadequate control, challenging scenarios);  (iv) Identification of the relevant scenarios within the boundary conditions and management method used to select scenarios and validation tool chosen.  (v) Decision making processes resulting in providing the assistance to the driver in performing the dynamic driving tasks, for the interaction with other road users and in compliance with traffic rules;  (vi) Reasonably foreseeable misuse by the driver (e.g. driver engagement recognition system and an explanation on how the availability criteria were established), mistakes or misunderstanding by the driver (e.g. unintentional override) and intentional tampering of the system.  (viii) Cyber-attacks having an impact on the safety of the vehicle (can be done through the analysis done under the UN Regulation No. 155 on Cyber Security and Cyber Security Management System).  The assessment by the Approval Authority shall consist of spot checks of selected hazards (or cyber threats) to establish that argumentation supporting the safety concept is understandable and logical and implemented in the different functions of the systems. The assessment shall also check that validation plans are robust enough to demonstrate safety (e.g., reasonable coverage of chosen scenarios testing by the validation tool chosen) and have been completed.  It shall demonstrate that the vehicle is free from unreasonable risks for the driver; vehicle occupants and other road users in the operational design domain, i.e. through:  (a) an overall validation target (i.e., validation acceptance criteria) supported by validation results, demonstrating that the entry into service of [ADAS] will overall not increase the level of risk for the driver, vehicle occupants, and other road users compared to conventional vehicles without driver assistance systems; and  (b) A scenario-specific approach showing that the system will overall not increase the level of risk for the driver, passengers and other road users compared to conventional vehicles without driver assistance systems for each of the safety relevant scenarios.  The Type Approval Authority shall perform or shall require performing tests as specified in paragraph 4. to verify the safety concept.  3.4.4.1. This documentation shall itemize the parameters being monitored and shall set out, for each failure condition of the type defined in paragraph 3.4.4. of this annex, the warning signal to be given to the driver and/or to service/technical inspection personnel.  3.4.4.2. This documentation shall also describe the measures in place to ensure the "The System" is free from unreasonable risks for the driver, vehicle occupants, and other road users when the performance of "The System" is affected by environmental conditions e.g., climatic, temperature, dust ingress, water ingress, ice packing.  3.5. Hazard analysis related to [ADAS] application  3.5.1. The manufacturer shall demonstrate:  3.5.1.1. The implementation of the robust processes to ensure the operational and functional safety of [ADAS] during the vehicle lifecycle (development phase, production, but also operation on the road and decommissioning) including those to take the right measures to monitor vehicles in the field and to take the right action when necessary;  3.5.1.2. Hazards and risks relevant for [ADAS] have been identified and a consistent safety-by-design concept has been put in place to mitigate these hazards and risks, in particular:  a. Possible hazardous situations and sources of hazards at:  i. [ADAS] normal operation;  ii. Reaching and exceeding [ADAS] ODD;  iii. [ADAS] failures;  b. Reasonably foreseeable [ADAS] misuse and countermeasures to avoid such a misuse;  3.5.1.3. The risk assessment and the safety-by-design concept have been validated by the manufacturer through testing showing before the vehicle is placed on the market that the vehicle meets the safety requirements and in particular is free of unreasonable safety risks to the broader transport ecosystem, in particular the driver, passengers and other road users. Further the validation shall be confirmed by in use monitoring at the time of Conformity of Production (CoP) verification by the Type Approval Authority.  3.~~5~~6. Safety management system (Process Audit)  3. ~~5~~6.1. In respect of software and hardware employed in "The System", the manufacturer shall demonstrate to the type approval authority in terms of a safety management system that effective processes, methodologies and tools are in place, up to date and being followed within the organization to manage the safety and continued compliance throughout the product lifecycle (design, development, production, operation including respect of traffic rules, and decommissioning).  3. ~~5~~6.2. The design and development process shall be established including safety management system, requirements management, requirements’ implementation, testing, failure tracking, remedy and release  3. ~~5~~6.3. The manufacturer shall institute and maintain effective communication channels between manufacturer departments responsible for functional/operational safety, cybersecurity and any other relevant disciplines related to the achievement of vehicle safety.  3. ~~5~~6.4. The manufacturer shall have processes to monitor safety-relevant incidents/crashes/collisions caused by the engaged [ADAS] and a process to manage potential safety-relevant gaps post-registration (closed loop of field monitoring) and to update the vehicles. They shall report critical incidents (e.g., collision with another road users and potential safety-relevant gaps) to the Type Approval Authorities when critical incidents.  3. ~~5~~6.5. The manufacturer shall demonstrate that periodic independent internal process audits are carried out to ensure that the processes established in accordance with paragraphs 3.5.1 to 3.5.4. are implemented consistently.  3. ~~5~~6.6. Manufacturers shall put in place suitable arrangements (e.g., contractual arrangements, clear interfaces, quality management system) with suppliers to ensure that the supplier safety management system comply with the requirements of paragraphs 3.5.1. (except for vehicle related aspects like "operation" and "decommissioning"), 3.5.2, 3.5.3 and 3.5.5.  4. Verification and tests  4.0. Taking into account the results of the analysis of the manufacturer’s documentation package referred to in paragraph 3., the Type Approval Authority shall request the tests to be performed or witnessed by the Technical Service to check specific points arisen from the audit evaluation.  4.1. The functional operation of "The System", as laid out in the documents required in paragraph 3., shall be tested as follows:  4.1.1. Verification of the function of "The System"  The Type approval Authority shall verify "The System" under non-failure conditions by testing on a track a number of selected functions from those described by the manufacturer in paragraph 3.2. above, and by checking the overall behaviour of the system in real driving conditions including the compliance with traffic rules.  These tests shall include scenarios whereby the system is overridden by the driver.  These tests can be based on scenarios listed in Annex 5 to this UN Regulation and/or on additional scenarios not covered by Annex 5.  4.1.1.1. The verification results shall correspond with the description, including the control strategies, provided by the manufacturer in paragraph 3.2. and shall comply with the requirements of this regulation.  4.1.2. Verification of the safety concept of paragraph 3.4.  The reaction of "The System" shall be checked under the influence of a faults in any individual unit by applying corresponding output signals to electrical units or mechanical elements in order to simulate the effects of internal failure within the unit. The Type Approval Authority shall conduct this check for at least one individual unit, but shall not check the reaction of "The System" to multiple simultaneous failures of individual units.  The Type Approval Authority shall verify that these tests include aspects that may have an impact on vehicle controllability and user information (HMI aspects).  4.1.2.1. The Type Approval Authority shall also check a number of scenarios that are critical for the Object and Event Detection and Response (OEDR) and characterization of the decision-making and HMI functions of the system (e.g. object difficult to detect, when the system reaches the ODD boundaries, traffic disturbance scenarios) as defined in the regulation.  4.1.2.2. The verification results shall correspond with the documented summary of the hazard analysis, to a level of overall effect such that the safety concept and execution are confirmed as being adequate and in compliance with the requirements of this regulation.  4.2. Simulation tool and mathematical models for verification of the safety concept may be used in accordance with Schedule 8 of Revision 3 of the 1958 Agreement, in particular for scenarios that are difficult on a test track or in real driving conditions. Manufacturers shall demonstrate the scope of the simulation tool, its validity for the scenario concerned as well as the validation performed for the simulation tool chain (correlation of the outcome with physical tests). Simulation shall not substitute physical tests in Annex 5 to this UN Regulation.  5. Reporting  Reporting of the assessment shall be performed in such a manner that allows traceability, e.g., versions of documents inspected are coded and listed in the records of the Technical Service.  An example of a possible layout for the assessment form from the Technical Service to the Type Approval Authority is given in Appendix 1 to this Annex. The listed items in this Appendix are outlined as minimum set of items which need to be covered.  6. Competence of the auditors/assessors  The assessments under this Annex shall only be conducted by auditors/assessors with the technical and administrative knowledge necessary for such purposes. They shall in particular be competent as auditor/assessor for ISO 26262-2018 (Functional Safety - Road Vehicles), and ISO/PAS 21448 (Safety of the Intended Functionality of road vehicles); and shall be able to make the necessary link with cybersecurity aspects in accordance with UN Regulation No. 155 and ISO/SAE 21434). This competence should be demonstrated by appropriate qualifications or other equivalent training records. | Secretary: TF on ADAS to review appropriate location/integration into CEL Annex. |
| Appendix 1  Model assessment form for [ADAS]  Test report No:  **1. Identification**  1.1. Make:  1.2. Vehicle Type:  1.3. Means of system identification on the vehicle:  1.4. Location of that marking:  1.5. Manufacturer’s name and address:  1.6. If applicable, name and address of manufacturer’s representative:  1.7. Manufacturer’s formal documentation package:  Documentation reference No:  Date of original issue:  Date of latest update:  **2. Test vehicle(s)/system(s) description**  2.1. General description:  2.2. Description of all the control functions of "The System", and methods of operation:  2.3. Description of the components and diagrams of the interconnections within "The System":  2.4. Description of all the control functions of "The System", and methods of operation:  2.5. Description of the components and diagrams of the interconnections within "The System":  **3. Manufacturer’s safety concept**  3.1. Description of signal flow and operating data and their priorities:  3.2. Manufacturer’s declaration:   *The manufacturer(s)* ............................................................. *affirm(s) that the "The System"* is free from unreasonable risks for the driver, vehicle occupants and other road users*.*  3.3. Software outline architecture and the design methods and tools used:  3.4. Explanation of the safety concept of "The System":  3.5. Documented analyses of the behaviour of "The System" under individual hazard or fault conditions:  3.6. Description of the measures in place for environmental conditions:  3.7. Provisions for the periodic technical inspection of "The System":  3.8. Results of "The System" verification test, as per para. 4.1.1. of Annex 4 to UN Regulation No. [1XX]:  3.9. Results of safety concept verification test, as per para. 4.1.2. of Annex 4 to UN Regulation No. [1XX]:  3.10. Date of test(s):  3.11. This test(s) has been carried out and the results reported in accordance with … to UN Regulation No. [1XX] as last amended by the ... series of amendments.  Technical Service carrying out the test Signed: ....................................... Date: ........................................  3.12. Comments: |  |
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| **Draft regulatory text** | **Comments, Remarks, Justification** |
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| **Annex 5** |  |
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| **Draft regulatory text** | **Comments, Remarks, Justification** |
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| **Annex 6** |  |
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1. As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3.), document ECE/TRANS/WP.29/78/Rev.6, para. 2 - [www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html](http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html) [↑](#footnote-ref-1)
2. 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), documentECE/TRANS/WP.29/78/Rev. 6 - [www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html](http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html) [↑](#footnote-ref-2)
3. Through 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 [↑](#footnote-ref-3)
4. Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in UN Regulation No. [15X]). [↑](#footnote-ref-4)
5. Strike out what does not apply. [↑](#footnote-ref-5)
6. The second number is given merely as an example. [↑](#footnote-ref-6)
7. To be signed by different persons even when the Technical Service and Type Approval Authority are the same or alternatively, a separate Type Approval Authority authorization is issued with the report. [↑](#footnote-ref-7)