UN Regulation No. xxx

**Legend:**

Initial text, not agreed after the end of the previous 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

*Ongoing points of discussion*

Uniform provisions concerning the approval of vehicles with regard to Dynamic Control Assistance Systems

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Introduction

*Point of discussion: Review for consistency. Longitudinal-only systems and systems are not in the scope of 1.1. Does the regulation also apply to level 1 systems? Tactical and operational driving levels to be defined.*

Dynamic Control Assistance Systems (DCAS) addressed in this UN Regulation can be defined as electronically controlled vehicle systems aimed at assisting a human driver in performing dynamic control through information support (e.g., warnings in safety-critical situations) and assistance 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, DCAS may not be capable to support in performing the complete dynamic control as they are limited in Object and Event Detection and Response (OEDR) and system boundaries, and may not be capable to recognize certain environmental conditions. DCAS is intended to assist the human driver, who remains responsible for the entire dynamic control as well as OEDR. DCAS 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 dynamic control, and thus require a driver to perform the remainder of dynamic control, 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 dynamic control.

Implementation of DCAS requires appropriate understanding by the human driver of the performance capabilities of the DCAS in the vehicle. The appropriate information provision and interaction with the driver is required to ensure that the human driver is fully engaged in dynamic control, and to avoid potential human driver’s misinterpretation, overestimation, or difficulty with DCAS/vehicle control.

1. Scope

*Point of discussion: Decide on vehicle categories.*

*~~Should work be focused on functions of specific ODDs?~~*

* 1. This UN Regulation applies to the type approval of vehicles of Categories [M~~,~~ and N[[1]](#footnote-2) **~~and O~~**]with regards to their Dynamic Control Assistance Systems (DCAS).

2. Definitions

*Point of discussion: Review for consistency.*

*Ensure careful consideration of the use of ‘control’ throughout the regulation as to not imply the responsibility over the vehicle.*

For the purposes of this Regulation:

2.1. *“Driver Control Assistance Systems (DCAS)”* – hardware and software collectively capable of assisting a driver in controlling the longitudinal and lateral motion of the vehicle on a sustained basis, and which requires the human driver to be permanently engaged and to monitor the environment, and vehicle/system performance.

2.2. *“Driver”* – means a human being **responsible** in any aspect of performing dynamic control of a vehicle **irrespective of whether assistance is provided by DCAS.**

2.3. ***“Dynamic Control”* – means to carrying out all the real-time operational and tactical functions required to move the vehicle. This includes controlling the vehicle’s lateral and longitudinal motion, monitoring the road environment, responding to events in the road traffic environment, and planning and signalling for manoeuvres. For the purpose of this Regulation, only a driver is in charge and responsible for vehicle dynamic control; DCAS provides assistance for the driver to carry out operational functions.**

~~[Road] Safety Definition deleted…~~

2.4. *“Object and Event Detection and Response (OEDR)”* – ~~the~~ subtasks of the ~~DDT~~ **dynamic control** 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 **[performed either by the driver or DCAS].**

2.5. “*System Boundaries*” – are those limits or conditions **[established by a manufacturer]** up to or within which DCAS or a subfunction of DCAS is designed to function. These may include, but are not limited to, environmental, geographical, and time-of-day restrictions, and/or the requisite presence or absence of certain traffic or roadway characteristics.

2.6. *“Driver engagement”* - [Placeholder]

*Point of discussion:*

* *Maintain as placeholder for the time being until approach is defined. AAPC suggested including ‘driver perception, information processing and decision making in operating the vehicle’ based on J.A. Michon’s research..*

2.7 *“Operational functions”* – means the basic capabilities required to operate a vehicle [such as controlling the vehicle’s lateral and longitudinal motion**] [by actuating vehicle controls].**

2.8 *“Tactical functions*” – means the real-time planning **and** determination~~, and execution~~ of maneuvers.

*Point of discussion:*

* *Sweden: Is this appropriate to define for DCAS?*
* *AAPC: Definition is needed due to reference in ‘dynamic control’, irrespective of responsibility for respective function*

2.9 *"Lane Change Procedure"* – means 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" – means 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.

**2.10 *“DCAS Basic Support”* – [Placeholder]**

**2.11 *“Nominal dynamic drivin manoeuvre”* – [Placeholder]**

**2.12 “*Highly dynamic driving manoeuvre*” – [Placeholder]**

3. Application for approval

3.1. The application for approval of a vehicle type with regard to the DCAS 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 DCAS 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

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-3)

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

*Point of discussion: Ensure consistency with documentation requirements. Check/align with FRAV IWG items*

*Is DCAS differentiated from ADS based on driver engagement or based on a functional difference?*

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] (in particular for conditions not tested under Annex [Y]) and according to the relevant tests in Annex [Y].

**5.1. General Requirements**

5.1.1. General operational principles

The manufacturer shall demonstrate to the satisfaction of the Technical Service that the system is designed to fulfil the following principles:

5.1.1.1. DCAS shall be designed in such a way that it ensures the driver remains engaged with the driving task.

5.1.1.2. DCAS shall be designed to enable override by the driver at any time.

5.1.1.3. DCAS shall be designed according to the following principles:

1. The system **is** designed to prevent misuse by the driver (e.g. performing non-driving related tasks beyond those permitted during normal driving);
2. The manufacturer has implemented strategies to disable activation of the system for the duration of the start/run cycle when the driver is detected to repeatedly demonstrate prolonged insufficient engagement with the driving task while the system is active;
3. **The manufacturer has implemented strategies to encourage driver understanding of the system’s functional capabilities and limitations and his continued role in the driving task.**

5.1.2. General provisions to OEDR

5.1.2.1. DCAS shall be able to assess its surroundings (e.g., road markings, other road users) as required to implement the assistance to the driver described in paragraph 5.3.3, within the system boundaries described in paragraph 5.1.3.

*Germany: More important than object/other road user detection requirements, are requirements outlining expected response*

5.1.2.2. DCAS shall be able to adequately detect vulnerable road users (such as pedestrians and cyclists) **and all** **other road users relevant for the system’s intended capability**. The manufacturer shall describe in detail [in the documentation] **the system boundaries for this detection capability and reference other relevant equipped vehicle systems approved under other regulations.** ~~, where DCAS is capable of vulnerable road user detection~~.

5.1.2.3. The manufacturer shall describe in detail [in the documentation] OEDR of each [use case]/[functionality]~~/[systems and subsystems]~~ of DCAS.

5.1.2.4. The application of DCAS shall not negatively affect traffic flow **and shall not cause neighbouring vehicles to slow down or change their direction of motion unless required to perform a normal manoeuvre or to ensure safety. The manufacturer’s control strategy shall ensure that the vehicle does not create unreasonable risks**.

*Points of discussion: FIA: Are self-diagnostics requirements needed in this section?*

5.1.3. System boundaries

5.1.3.1. The manufacturer shall establish and describe in detail [in the documentation] [to the Technical Service] the boundary conditions for each function of the system and indicate which of these can be recognized automatically by DCAS and by which means. The manufacturer shall describe the behaviour of the system when the vehicle is reaching these boundaries and the effect on the performance when operated outside these boundary conditions. As a minimum, the conditions to be described include:

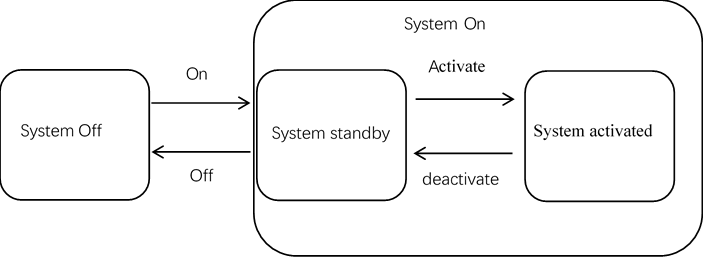
1. Road: type (highway, rural, etc.), surface (type, adhesion), geometry, lane characteristics, availability of lane markings, edge of road, road crossings;
2. Road facilities (traffic control facilities, special facilities (road construction markings, etc.), other facilities;
3. **Geographical boundaries (e.g. digital maps), if applicable;**
4. **Environmental conditions (inclement weather, temperature);**
5. Other road users, which DCAS is capable of recognizing;

**5.1.3.2.** **The manufacturer shall establish and describe in detail [in the documentation] [to the Technical Service] estimated DCAS behavior or relevant deactivation strategies when the system crosses described system boundaries. It is recognized that this description may be limitative and that described performance may not be consistent.**

**5.1.3.3.** **If the system succesfully detected an approaching system boundary, it shall visually notify the driver in accordance to the strategies described by the manufacturer as outlined in 5.3.2. and according to the requirements defined in 5.4.**

5.1.4. DCAS modes of operation

*Point of discussion: Section still needs updating to ensure consistent wording and appropriate representation of ‘four states’. Needs clarification regarding applicability to ‘holistic’ systems or subsystems.*

5.1.4.1. DCAS in operable condition shall have the following modes: “Off”, “On”, “Standby” and “Active”. The relationship between modes is shown on the drawing below.

5.1.4.1.1. When DCAS is in "Off” mode (or switched off), DCAS shall not assist the driver in executing dynamic control.

5.1.4.1.2. When DCAS is in "On” mode (or switched on and either in “Standby” or “Active”, if applicable), DCAS shall only assist the driver in executing dynamic control if the operating conditions are all met.

5.1.4.1.3. When DCAS is in "Standby" mode, DCAS is switched on, but its operating conditions are not all met. DCAS shall not assist the driver in executing dynamic control.

5.1.4.1.4. When DCAS is in "Active" mode, DCAS is switched on, and its operating conditions are met. DCAS shall assist the driver in executing dynamic control.

5.1.4.2. The manufacturer shall specify [in the documentation] DCAS operating conditions enabling DCAS to be in "Active" mode.

5.1.5. DCAS interaction with other vehicle systems

5.1.5.1. While the system is active, its operation shall not unreasonably deactivate or suppress the functionality of activated assistance systems (e.g. AEBS).

**5.1.6. Modes of Operation in terms of dynamic control assistance**

**5.1.6.1 “DCAS Basic Support*”* – [Placeholder]**

**5.1.6.2 *“*Nominal dynamic driving manoeuvre*”* – [Placeholder]**

**5.1.6.3 “Highly dynamic driving manoeuvres” – [Placeholder]**

**5.2. System interaction with the driver**

[5.2.1. Measures addressing the human driver’s awareness of [DCAS] capabilities and performance]

[5.2.1.1. Estimation of change of the human driver’s behaviour due to [DCAS] operation]

[The manufacturer shall [take into account] [explain [in the documentation]] how [DCAS] change the driver’s workload. The **Technical Service** shall estimate possible driver’s expectations, misinterpretations, overreliance, difficulties with vehicle control when [DCAS] assists the driver in executing DDT. The manufacturer shall explain measures addressing full driver’s engagement in vehicle control.]

5.2.2. Information material for driver [education]/[instruction] with regard to DCAS

*Point of discussion:*

*- Section is intended to touch on the need for the driver to be educated about the system, and the manufacturer to make relevant information available to facilitate such education.*

*- Add a requirement on the manufacturer to provide information regarding the naming and information provided on the system, which shall not mislead the consumer? Needs input.*

*- FIA: Instruction manuals do not describe which systems are and are not available in the vehicle. Recommend more detailed description for each model.*

*- Align on the use of instruction versus education, whether it is appropriate to address marketing in the type-approval framework.*

5.2.2.1. **In addition to the user manual t**he manufacturer shall provide the driver with clear and easily accessible information (e.g. documentation, video) about how the particular DCAS has to be operated by the driver. The information must contain information on the driver’s responsibility, the limitations of the DCAS and demonstrate how different warning signals are to be interpreted, to cover at least the following aspects:

1. Explanation of the safety benefit of DCAS, if applicable;
2. **Reminder of the driver’s responsibility when using DCAS**
3. ~~Explanation on how the vehicle control is shared between the human (driving the~~ **~~dynamic control~~** ~~subtask performed by a human) and the system (driving subtask~~ **~~dynamic control~~** ~~performed by DCAS);~~
4. **Explanation on how and to which extent of the vehicle dynamic control DCAS (DCAS subsystems) does (do) assist the driver;**
5. ~~The role of each use case of DCAS in executing the DDT functions by the driver~~ **~~dynamic control~~** ~~and the assistance provided;~~
6. DCAS OEDR capabilities and limitations;
7. DCAS System Boundaries;
8. DCAS modes of operation and switching between modes;
9. [Measures ensuring the human driver’s DCAS mode awareness];
10. Driver Engagement Detection;
11. Possibility of DCAS overriding;
12. Human-machine interface (HMI):
    * 1. DCAS activation and deactivation;
      2. DCAS status indication;
      3. DCAS messages to the human driver and their interpretation;
      4. Vehicle behaviour when reaching DCAS system boundaries;
      5. Vehicle behaviour when exceeding DCAS system boundaries;
      6. Information on DCAS failures;

**5.2.2.2. The manufacturer shall outline a system information strategy to the Technical Service which aims to encourage the driver to review DCAS operation information as described in 5.2.2.1. Such a strategy may include a regular notification to the driver at the start of a drive cycle that such information is available, but can be turned off by the driver.**

*Point of discussion (regarding marketing of systems):*

- Germany: Sympathy with respect to concern of manufacturers, but invites industry justification for the removal of the section.

- *Compromise may be to require the manufacturer to inform approval authority of the intended marketing of the system. However, marketing may not always be defined at type-approval and this may stray into competences of other authorities.*

*[5.2.3.1 [If DCAS 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 information materials.]*

*5.2.3.1.1 [The naming of the system shall not mislead the customer that the system has other or more advanced capabilities than stated in the information materials.]]*

**5.3. Functional requirements**

5.3.1 **General Requirements** ~~DCAS overriding by the driver~~

5.3.1.1. It shall be possible for the driver to intervene at any time.

**5.3.1.2. It shall be possible for the driver to perform minor longitundinal or steering corrections (e.g. to avoid a pothole) while the system is ‘On’, provided this does not result in driver confusion about the system’s mode of operation and does not negatively impact safety per system design.**

**5.3.1.2. When the system can no longer meet the requirements as defined in 5.3, it shall not be possible to activate the system.**

5.3.2. OEDR requirements

5.3.2.1 The system shall be able to detect the driving environment, other road users and traffic dynamics according to the support functions provided to the driver as described in paragraphs 5.1.2. and 5.1.3.

5.3.2.2. OEDR requirements for lane keeping

5.3.2.2.1. The system shall at least detect the border of the lane (e.g. lane markings, road edge **and other lane markers**) [where the function operates, within the system boundaries of paragraph 5.1.3.]. The system may also secure the detection of the lane with other means**,** ~~like~~ e.g.~~,~~ an assessment of **surrounding** traffic flow ~~around~~, map data.

5.3.2.3. OEDR requirements for lane changing

5.3.2.3.1. The system shall be able to appropriately respond to vehicles and other road users

• ahead within its own and the left and right adjacent lane of travel and

• driving beside [in the adjacent left or right lane of travel]

• driving behind or approaching in the left and right adjacent lane of travel

when operated within its system boundaries.

5.3.2.4. OEDR requirements for transitions between phases of lane keeping

The system shall be able to appropriately respond to vehicles, road users and a blocked path ahead which are already within or may enter the planned trajectory and the corresponding driving environment in order to ensure a safe operation.

5.3.3. Assurance of Driver Engagement / **Driver Engagement Management System**

*Point of discussion: Review use of ‘Use Case’ in context of broader text*

*Germany: The vehicle has to be equipped with safety features to master each situation itself, or ensure that the driver is in the loop at all times and does not lose awareness. This has to be evidenced without doubt during approval.*

5.3.3.1. General

5.3.3.1.1. **The system shall be equipped with means to appropriately detect and evaluate the driver’s 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.**

~~DCAS shall implement strategies to evaluate the driver's engagement. DCAS implemented for different use cases shall ensure that the driver remains [sufficiently] engaged during DCAS operation according to the specific use case.~~

*Point of discussion: Germany: Driver engagement should ideally be distinguished for daydreaming. Industry to propose solution to ensure the driver is visually actively engaged with the DDT with respect to situation awareness. What if engagement of the driver is not possible? Hands-on may not be sufficient.*

*Sweden: Include the need of provisions to enforce the driver in taking an active part in the driver task*

5.3.3.1.2. **The system shall use visual or audible information to encourage the driver to appropriately perform the driving task while assisted by the system during a given manoeuvre. (e.g. system recommends to check side-view mirrors when a lane change is performed)**

~~DCAS shall be equipped with the means to appropriately detect driver engagement in conditions depending on DCAS capability, driving and environmental conditions.~~

5.3.3.1.3. **The system** ~~DCAS~~ shall alert the driver with ~~increasing levels of~~ visual and 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.** ~~The system DCAS shall terminate warnings only if the system DCAS detects that the driver has appropriately re-engaged based on the the system’s DCAS design.~~

**The system’s** ~~DCAS~~ warning escalation strategy shall account for **and prioritize** warning strategies of simultaneously activated emergency assistance systems (e.g. AEBS).

5.3.3.1.4. **The system** ~~DCAS~~ shall de-activate **in a controlled manner** following a lack of driver input or engagement in accordance to the system’s driver engagement **monitoring strategy** ~~design~~ **and the provisions of par. 5.3.3.2., 5.3.3.3. and 5.3.3.4. as applicable**.

**Upon 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.**

**If the vehicle or system is equipped with an emergency assistance system, (such as a Risk Mitigation Function) that would be able to safely navigate the vehicle to achieve a minimum risk condition, which may be regulated by an equivalent regulation, the system will activate said system if the appropriate conditions are met. The manufacturer will declare the design of the system, or relevant approval attained under another regulation, to the Technical Service.**

*Point of discussion: Germany: If the situation is critical, the driver is disengaged and we require the system to deactivate, should additional support (limited in time) be provided by the system to compensate for the driver’s disengagement?*

Alternative submitted by OICA-CLEPA

~~5.3.3.1. General provisions~~

*~~Point of discussion: NL/FIA: Only detection of driver engagement is too shallow. Strategies that proactively assure driver engagement are needed.~~*

~~5.3.3.1.1. 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~~

**~~5.3.3.1.2 The system shall use visual or audible information to encourage the driver to appropriately perform the driving task while assisted by the system during a given manoeuvre. (e.g. system recommends to check side-view mirrors when a lane change is performed)~~**

~~5.3.3.1.3. 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.~~

~~The system’s warning escalation strategy shall account for warning strategies of simultaneously activated emergency assistance systems (e.g. AEBS).~~

~~5.3.3.1.4. The system shall deactivate~~ **~~in a controlled manner~~** ~~in accordance to the system’s driver engagement monitoring strategy and the provisions of par. 5.3.2.2., 5.3.2.3. and 5.3.2.4. as applicable, if the driver remains unresponsive.~~

~~After~~ **~~Upon~~** ~~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.~~

*~~Point of discussion: Should a definition for RMF or link to ECE R79 be introduced? Is there alternatively a more general description for RMF-type systems possible?~~*

*~~Following the warning when disengagement is detected and no driver input has been detected, what should happen then? Should DCAS bring the vehicle to a stop?~~*

~~[Alternatively, a Risk Mitigation Function may start an intervention.]~~

5.3.3.2. ~~Basic~~ Driver engagement monitoring **for nominal dynamic driving manoeuvres**

5.3.3.2.1. 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.

5.3.3.2.1. The hands-On-Warning may be suppressed to allow for hands off driving as long as all of the following conditions are met

5.3.3.3. *Placeholder*

5.3.3.4. ~~Extended~~  Driver engagement monitoring **for highly dynamic and system-initiated driving manoeuvres**

*~~Point of discussion: Germany: Are self-initiated manoeuvres while the driver is engaged acceptable in this regulation? Should driver confirmation be required? If so, is this compatible with the outlined use-cases?~~*

5.3.3.4.1. 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 xxx:

• the system shall ensure the driver is holding the steering control

• the system shall monitor at least two criteria (e.g. steer control, camera monitoring, etc.) to ensure the driver remains sufficiently engaged according to paragraph 5.3.3.4.**2**.

• The system shall demonstrate sufficient environmental perception capabilities according to paragraphs xxx

5.3.3.4.2. The driver shall be deemed to be sufficiently engaged if hands-on-wheel confirmation and at least one engagement criteria (e.g. steering input, gaze direction, ~~absence~~ presence 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.

**5.3.3.4.3. For systems that monitor driver gaze direction or eye movements, a driver shall be considered to be disengaged if he is not appropriately directionally monitoring his environment for more than [3] seconds. The strategies to ensure appropriate detection based on system design shall be declared by the manufacturer to the Technical Service. (e.g. looking away)**

**5.3.3.4.4. If equipped to perform highly dynamic manoeuvres, the system shall not initiate such manoeuvers unless the driver is deemed to be sufficiently engaged as defined in 5.3.3.4.1, 5.3.3.4.2. The system shall additionally provide a visual and haptic or audible warning to the driver that system performance has been limited until the driver is appropriately engaged.**

*Point of discussion: Germany: Is it sufficient to fulfil R157 requirements? The system should be able to distinguish daydreaming. 30 seconds is a long time for highly dynamic manoeuvres without any driver engagement but full driver responsibility. Driver should be continuously engaged in the driving task, looking away for more than 3 seconds is already classified as a distraction.*

**5.3.3.5. System interaction with the driver**

**The manufacturer shall declare to the Technical Service additional strategies intended to encourage appropriate driver engagement for the system’s operational environment and design. Such strategies may include:**

* **Human-Machine Interface elements intended to improve driver awareness and response (e.g. information related to system intent, environmental elements)**
* **Driver involvement in system tactical decision-making (e.g. choice of actions or path)**
* **Obligations on the driver to confirm a maneuver or a series of maneuvers (e.g. use of the indicator stalk or button)**
* **Use of other sensors and systems to infer or encourage appropriate driver engagement**
* **Other relevant strategies**

5.3.3.6. The manufacturer shall demonstrate to the technical service the strategies implemented in the system to comply with par. **5.3.3.2,** 5.3.3.4.2, **5.3.3.4.3 and 5.3.3.5**. Alternatively, and in agreement with the Technical Service, conformity may be met through compliance with an equivalent regulation.

5.3.4. Vehicle dynamic behaviour / **System Dynamic** **Control Assistance**

*Point of discussion:*

*- ITU: There should be careful consideration of what the interface in the HMI is going to be, and any confusion about what will be handled by the system or not.*

*- OICA-CLEPA proposed structure similar to 5.3.4 which facilitates the addition of provisions for function-specific situation, as required.*

5.3.4.1. Dynamic **control assistance provided by the system** ~~behavio~~**~~u~~**~~r of the vehicle when executed by DCAS~~ shall be controllable ~~for~~ **by** the driver **so that he can safely resume unassisted control of the system when turned off**.

5.3.4.2. Dynamic **control assistance** ~~behavio~~**~~u~~**~~r of the vehicle when~~ executed by ~~DCAS~~ **the system** shall be predictable and shall not lead to uncontrollable situations for other road users.

5.3.4.2.1. When changing lanes

5.3.4.2.1.x. During the lane change manoeuvre, the system shall aim to avoid inducing a longitudinal deceleration **higher than 3.0 m/s²** for a vehicle **in the target lane** approaching from the rear, **unless exceptionally required due to traffic conditions**.

5.3.4.2.1.x. During a lane change manoeuvre, the system shall aim to avoid a lateral acceleration of more than 1 m/s2 in addition to the lateral acceleration generated by the lane curvature.

5.3.4.2.2. When decelerating

5.3.4.2.2.1. **The system shall not slow down with a deceleration demand not greater than** 4m/s², unless required by the surrounding traffic (e.g. a decelerating lead vehicle).

5.3.4.3 The manufacturer shall describe in details [in the documentation] **the dynamic control assistance that is provided for each** [use case]/[functionality] of DCAS.

*Point of discussion: Review use of ‘use cases’ in this subsection which does not play a role in performing the DDT.*

5.3.5. Function-specific requirements

5.3.5.1. Lane keeping

5.3.5.1.1. The activated system shall keep the vehicle in lane when operated within the system boundaries.

5.3.5.1.2. The activated system shall keep the vehicle in a stable position within its lane.

5.3.5.2. Lane changing

5.3.5.2.1. A lane change procedure can be initiated by the driver or the system **so long as the driver is given sufficient notice and is appropriately engaged**.

5.3.5.2.1.1. 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 **according to the manufacturer’s safety concept**.

*Point of discussion: Germany: Where is the border between pass/fail for TA?*

xxx. The system shall only be permitted to change lanes, if the vehicle is equipped with detection capabilities to the front, side and rear to assess the criticality of that lane change.

xxx. Lane change procedures shall only be performed in an uncritical way.

5.3.5.2.2. A lane change procedure shall be indicated to the driver and other road users.

5.3.5.2.3. A lane change procedure shall be completed without undue delay.

5.3.5.2.4. After the initiation of the lane change procedure the 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).

xxx. [[DCAS] shall not perform a lane change towards a lane intended for traffic moving in the opposite direction.]

[xxx. A lane change performed by the system shall not cause a collision with another vehicle or road user in the predicted path of the vehicle during a lane change.]

5.3.5.2.5. A lane change maneuver shall be predictable and manageable to other road users (i.e., shall not force other vehicles to ~~unmanageably~~ **unreasonably** decelerate).

xxx A lane change manoeuvre shall only be started if a vehicle in the target lane is not forced to ~~unmanageably~~ **unreasonably** decelerate due to the lane change of the vehicle.

xxx A lane change manoeuvre shall only be started if there is sufficient space to a vehicle following behind or approaching from the rear in the adjacent lane.

xxx In case the DCAS decelerates the vehicle during a lane change procedure, this deceleration shall be factored in when assessing the distance to a vehicle approaching from the rear, and the deceleration shall be manageable for the vehicle approaching from the rear.

xxx [~~Where there is not sufficient headway time for the vehicle behind at the end of the lane change procedure, DCAS shall not increase the rate of deceleration for a certain period of time after the completion of the lane change procedure except for the purpose of avoiding or mitigating the risk of an imminent collision.]~~

5.3.5.3. Other transitions between lane-keeping phases

5.3.5.3.1. The provisions of this paragraph apply for manoeuvres that:

a. lead the vehicle to follow a trajectory when there is no dedicated lane (e.g., while turning at an intersection);

b. lead to an interaction with other road users while following a dedicated lane (e.g., when driving through a roundabout);

c. 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).

d. lead the vehicle to transition between lanes with different directions of travel (e.g. U-turn)

e. lead the vehicle to depart or arrive at a parked position

5.3.5.3.2. If DCAS is designed to 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 in accordance with traffic rules and in respect of other road users.

5.3.5.3.3. DCAS shall indicate driving manoeuvres controlled by the system (e.g. turn) to other road users as required by traffic rules.

5.3.5.3.4. Crossing into another lane is permissible when:

a. forming an access corridor for emergency and enforcement vehicles;

b. driving around a stationary obstacle in the lane;

c. passing a slower moving vehicle or road user in or near to the lane with sufficient lateral distance.

d. the maneuver is required in order to follow a set destination in the vehicle’s navigation system, if applicable in the system’s design

e. the maneuver is instructed by legitimate external sources (e.g. static and dynamic road signs, road works, emergency or enforcement instruction, etc.), if applicable in the system’s design

5.3.5.3.5. Crossing into another lane shall only be permissible if DCAS is able to determine the position and movement of other road users to the rear, side and/or front where relevant to the specific manoeuvre**, and that there is adequate distance to them to perform the manoeuvre**.

5.3.5.4 Risk Mitigation Function

5.3.5.5 Low-speed maneuvering

**5.3.5.6 System safety response in critical situations**

**[Placeholder to address RMF/emergency response systems. See 5.3.3.1.4 in driver engagement]**

**5.4. Human-machine interface (HMI)**

5.4.1. General HMI principles

5.4.1.1. The information presented to the driver~~/user~~ shall be organized according to saliency principles.

5.4.1.2. The HMI shall prevent unintended/inadvertent activation or activation outside the System Boundaries.

5.4.2. DCAS activation and deactivation

5.4.2.1. DCAS shall be off at the initiation of each new start/run cycle, regardless of what mode the driver had previously selected**, unless specifically configured by the driver**.

*~~Point of discussion: FIA: The driver should be able to decide the status of systems after a new ignition cycle.~~*

5.4.2.2. DCAS shall switch to “On” only upon a deliberate action of the driver.

*Point of discussion: Check for consistency of states usage throughout the regulation, and if ‘active’ or ‘On’ aligns with outlined states above.*

*UK: It should be clear whether an action by the driver turns the system ‘on’, or moves the system from ‘standby’ to ‘active’ state.*

5.4.2.3. It shall be possible to ~~deactivate~~ **turn off** DCAS with a deliberate action of the driver.

5.4.3. DCAS status indication

5.4.3.1. When **the system** ~~DCAS~~ is ~~in either~~ “On”, **a** ~~or alternatively~~ "Standby" or "Active" mode, ~~a~~ visual signal shall be provided to the driver.

5.4.4. DCAS messages/signals to the human driver

5.4.4.1. **The system’s** ~~DCAS~~ messages/signals shall inform/warn the driver about:

a. DCAS status: ~~either~~ “Off”, ~~either “On”~~ or “Standby”~~/~~ **or** ”Active”;

**b. DCAS request of the driver’s engagement to vehicle control;**

c. DCAS request ~~of the~~ **for the** driver~~’s~~ ~~engagement~~ to **resume unassisted control**  ~~take control~~ **of the** vehicle ~~control~~;

d. DCAS has detected to have **approached (if possible),** reached or exceeded its system boundaries;

e. DCAS failures.

5.4.4.2. **The system** ~~DCAS~~ messages/signals shall be clear, timely and noticeable and shall not lead to confusion. In the case of multiple messages, they shall be prioritized. Messages/signals from emergency assistance systems shall be considered as highest priority.

5.4.4.X. **The system** ~~DCAS~~ shall not warn the driver, if **the system** ~~DCAS~~ is capable ~~to manage~~ **of managing** the current traffic situation safely.

5.4.4.4. The manufacturer shall list and explain all DCAS messages/signals in the type-approval documentation and in the vehicle operation manual.

5.4.5. Measures ensuring the human driver’s DCAS mode awareness

**The system shall visually and either haptically or audibly inform the driver of any instance where the DCAS mode of operation is changed between the states as outlined in 5.1.4.**

**Any visual signal used to indicate the current mode shall be clearly distinguishable from signals used to present other mode states, and shall not lead to confusion as described in 5.4.4.2.**

*Point of discussion: Is this sufficiently covered above? Alternatively, cfr. Alliance for Automotive Innovation: Level 2 Driver Monitoring Principles (https://www.autosinnovate.org/about/advocacy/L2%20Driver%20Monitoring%20Principles.pdf)*

5.4.6. DCAS fallback special cases

5.4.6.1. System behaviour when system boundaries have been detected to be reached

Upon detection that its boundary conditions are **exceeded** ~~met~~, the activated system shall switch to “standby” [or “off”] mode.

Termination of assistance shall be such that sudden loss of ~~steering~~ **any** **dynamic control** support is avoided.

The system shall only change from “standby” mode to “active” mode when all operating conditions are met again.

Termination of assistance shall be indicated to the driver by at least an optical signal (i.e. the change from the “active” status indication to the “standby” status indication).

5.4.7. DCAS failures

~~Proposal from OICA-CLEPA~~

5.4.7.1. The activated system shall respond to detected failures**, sensor malfunctions or degradation** affecting the operation of the system appropriately.

Upon detection of a failure**, malfunction or degradation of sensor performance** affecting the safe operation of the system, the system shall immediately terminate its control assistance in a safe manner in accordance with the safety concept and turn to “Off” mode, and provide at least an optical failure warning signal to the driver [for an appropriate period / [x] s]. **The system will gradually reduce its control assistance if it is capable and safe to do so, and inform the driver according to 5.4.7.2.**

~~Proposal from Chair~~

~~5.4.7.1. DCAS shall be designed to detect sensor malfunctions or degradations which may affect the safe performance of DCAS.~~

~~5.4.7.2. A failure of DCAS shall be indicated by an optical fault signal to the driver. Following the indication of the fault signal to the driver, DCAS shall immediately terminate its control assistance and turn to “Off” mode, unless DCAS operating algorithm is capable of completing the current DCAS operating target. In the latter case DCAS shall turn to “Off” mode after completing the current DCAS operating target.~~

~~Additional (from Annex 3, 3.4.3.):~~

5.4.7.2. If **the system** ~~DCAS function~~ allows a partial performance mode of operation under certain fault conditions (e.g., in case of severe failures), then these conditions shall be indicated to the driver by the means of a separate warning signal(s)/message(s).

Such conditions shall be explained in the vehicle operation manual:

5.4.7.2.1. If a partial performance mode of operation under certain fault conditions (e.g. in case of severe failures) is possible, then these conditions (e.g. type of severe failure) and the resulting limits of effectiveness shall be stated.

5.4.7.2.2. If a second (back-up) means is possible, 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.

5.4.7.3. In case of a failure, the warning shall be present as long as the fault condition persists, unless the system is ~~not deactivated~~ **turned off** by the driver, e.g., by turning the ignition (run) switch to “off”, or by switching off that particular function if a ~~special~~ **specific** is provided for that purpose. **This warning shall be present any time the driver attempts to turn the system “on” until the fault has been resolved.**

Point of discussion:

ITU – Should reporting requirements on the manufacturer be introduced?

FIA – Lifetime support requirements?

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 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

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| **Annex 1** |
| **Communication**  (Maximum format: A4 (210 x 297 mm)  [[3]](#footnote-4)    issued by: Name of administration:  ......................................  ......................................  ......................................  **4**    Concerning:[[4]](#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 DCAS: 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.: |

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| **Appendix 1** |
| Addendum 1 to Type approval Communication No …  concerning the type approval of a vehicle type with regard to DCAS pursuant to Regulation No. xxx  Information document form for DCAS  **1. System description DCAS**  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  1.4. DCAS states, modes, transitions and actions  1.5. DCAS interactions with other vehicle systems  1.6. DCAS interaction with the human driver  1.6.1. Measures addressing the human driver’s awareness of DCAS capabilities and performance  1.6.2. Estimation of change of the human driver’s behaviour due to DCAS operation  1.6.2. Human driver education  1.6.3. Measures ensuring the human driver’s DCAS mode awareness  **2. Description of the functions of DCAS including control strategies**  2.1. Main DCAS Functions (functional architecture, environmental perception).  2.1.1. Vehicle-internal  2.1.2. Vehicle-external (e.g. backend)  **3. Overview major components (units) of DCAS**  3.1. Control Units  3.2. Sensors  3.3. Maps/Positioning  **4. DCAS 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 DCAS  5.2. Means implemented to protect against simple unauthorized activation/operation and interventions into DCAS  **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 DCAS 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 and 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 system boundaries and when going out of the system boundaries.  7.2. Extract of the relevant part of the owner`s manual |

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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 DCAS, 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.[[5]](#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** – |
| **Special requirements to be applied to the audit**  *Point of discussion: Maintain R157 or R79 CEL ANNEX? Consider NATM.* |
| **1. General**  1.1. “The requirements of this Annex are intended to ensure that an acceptable thorough consideration of functional and operational safety for DCAS 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 DCAS meets the performance requirements specified in paragraph 5. of this UN Regulation, that it as that DCAS 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 DCAS is deemed to be acceptable for the entry into service of the vehicle type, the overall vehicle safety during DCAS 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 DCAS. This also includes any transmission links to or from other systems that are outside the scope of this Regulation but affect DCAS 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 DCAS 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. "System boundaries" 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.  *Point of discussion: Ensure consistency with the text.*  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 system 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 system boundaries under which DCAS 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 DCAS 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 system boundaries of functional operation including limits shall be stated where appropriate.  3.2.4. Interaction concept with the driver when system boundary 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 system boundaries 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 DCAS 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 DCAS 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 DCAS 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 DCAS 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. DCAS normal operation;  ii. Reaching and exceeding DCAS system boundaries;  iii. DCAS failures;  b. Reasonably foreseeable DCAS 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.  3.6. Safety management system (Process Audit)  3.6.1. 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).  3.6.2. The design and development process shall be established including safety management system, requirements management, requirements’ implementation, testing, failure tracking, remedy and release  3.6.3. 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.  3.6.4. The manufacturer shall have processes to monitor safety-relevant incidents/crashes/collisions caused by the engaged DCAS 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.  *Point of discussion: Any EDR provisions should be checked with the EDR/DSSAD IWG.*  3.6.5. 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.  3.6.6. 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.  *Point of discussion: Compliance with traffic rules is only requested in the context of lane change capabilities?*  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 system 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. |

Appendix 1

Model assessment form for DCAS

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:

**Annex 5**

**Annex 6**

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-2)
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-3)
3. Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in UN Regulation No. [15X]). [↑](#footnote-ref-4)
4. Strike out what does not apply. [↑](#footnote-ref-5)
5. The second number is given merely as an example. [↑](#footnote-ref-6)