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## Economic Commission for Europe

### Inland Transport Committee

### World Forum for Harmonization of Vehicle Regulations

#### 198th session

Geneva, 10–13 March 2026

Item 4.13.4 of the provisional agenda

#### 1958 Agreement:

**Consideration of proposals for new UN Regulations submitted  
by the Working Parties subsidiary to the World Forum, if any**

## **Proposal for a new UN Regulation No. [182] on Driver Drowsiness and Attention Warning system**

### **Submitted by the Working Party on General Safety Provisions \***

The text reproduced below was adopted by the Working Party on General Safety Provisions (GRSG) at its 130<sup>th</sup> session (ECE/TRANS/WP.29/GRSG/109, para. 44). It is based on GRSG-130-37. It is submitted to the World Forum for Harmonization of Vehicle Regulations (WP.29) and to the Administrative Committee (AC.1) for consideration at their March 2026 sessions.

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



**Regulation No. [182]\*****Uniform provisions concerning the approval of a vehicle type  
with regard to a Driver Drowsiness and Attention Warning  
(DDAW) system****Contents**

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\* The Regulation number will be known when this UN Regulation enters into force. [182] will be replaced by the Regulation number once determined.

## 0. Introduction

- 0.1. This UN Regulation in its original form (00 series of amendments) is closely aligned with the EU Commission Delegated Regulation (EU) 2021/1341 for driver drowsiness and attention warning systems, with some differences including for clarity and/or editorial corrections when relevant. In addition to (EU) 2021/1341 for baseline content, it was also necessary to interpret and integrate various material from the document titled "Answers to the questions raised by Stakeholders on the application of the rules on Driver Drowsiness and Attention Warning systems set out in the Delegated Regulation (EU) 2021/1341" along with the supporting document referenced in this FAQ document and titled "DDAW warning classification table.xlsx".
- 0.2. Fatigue has been long considered one of the most significant road safety problems across the world. Fatigue negatively affects a driver's physical, cognitive, psychomotor and sensory processing capabilities, which can cause the driver to have difficulty maintaining a constant speed and/or lane position, slower reaction times, lapses in attention, altered decision-making, and to fall asleep (including both micro-sleeps and falling into deeper sleep).
- 0.3. The severity of fatigue related crashes is particularly high, as drivers that are drowsy or asleep are much less likely to react effectively to reduce the severity of an impending impact (e.g. braking, steering to avoid serious impact, etc.). Additionally, high speeds are a contributing factor in these crashes, as fatigue typically occurs in long distance drives at constant speed.
- 0.4. A Driver Drowsiness and Attention Warning (DDAW) system can be used to monitor the driver's physical state through direct and/or indirect means (e.g. by analysis and recognition of driving or steering patterns, or using driver monitoring cameras). The system will be able to provide a warning if the driver is identified as drowsy.
- 0.5. Constantly changing driving and steering patterns when driving within urban areas significantly increase the difficulty in reliable assessment of drowsy driving. In addition, as it is known that longer distance driving at constant speed (e.g. typical highway driving) presents an increased risk of drowsiness through task monotony, it is most important to account for these conditions in specifying a DDAW system for a vehicle. Therefore, motor vehicles with a maximum design speed of 70km/h or below should be exempt from having to be equipped with a DDAW system.
- 0.6. There are some subgroups of vehicles where the benefit of a DDAW system may be more limited because they are primarily used in other conditions than highway conditions (e.g. category G vehicles, construction vehicles, etc.). In some cases (e.g. vehicles of category G, construction vehicles mainly used in off-road areas and gravel tracks, military vehicles) the operating environment and/or manner in which the vehicles are used may lead to a high number of false positives for assessment of drowsiness. Regardless from the benefit, there may also be some vehicle types for which the installation of a DDAW system would be technically difficult or not feasible (e.g. special purpose vehicles).
- 0.7. Paragraph 1.2. states that this Regulation is without prejudice to requirements of national or regional laws related to privacy, data protection and personal data processing. This means that any Contracting Party applying this regulation may prescribe any additional such requirements through its laws. Technical Services and Approval Authorities will not assess compliance with any such regional or national laws as part of an application for type approval of a vehicle type with regard to its DDAW system. This is a matter for the relevant regional and/or national authorities, as well as vehicle manufacturers.

For example, a DDAW system may use data from cameras and/or other sensors which monitor the vehicle occupants. Contracting Parties may choose to specify requirements in regional or national law to prevent this data from being used to confirm the unique identification of any natural person.

This could be achieved through more general privacy laws, and/or specific technical requirements, including for example to keep any data within a closed-loop system for no longer than is needed for the system to perform its safety function, and to prevent unauthorised access. Contracting Parties should also consider the possibility that biometric personal data, and/or the storage of historical data of a particular driver, could be used to improve the performance of the DDAW system. Such systems could for example seek permission from a driver and this request may be accompanied by explanatory information of the system changes that will be implemented and the reasons for those changes.

0.8. [Reserved].

## **1. Scope**

- 1.1. This Regulation applies to vehicles of category M and N<sup>1</sup>, with a maximum design speed above 70 km/h.
- 1.2. This Regulation is without prejudice to requirements of national or regional laws related to privacy, data protection and personal data processing.
- 1.3. This Regulation does not apply to vehicles of category X and Y.<sup>1</sup>

## **2. Definitions**

For the purposes of this Regulation:

- 2.1. "*Approval of a vehicle type*" means the full procedure whereby a Contracting Party to the Agreement certifies that a vehicle type meets the technical requirements of this Regulation.
- 2.2. "*Biometric personal data*" means data resulting from specific technical processing relating to the physical, physiological or behavioural characteristics of a natural person, which allow or confirm the unique identification of that natural person, such as facial images or fingerprint data.
- 2.3. "*Direct means*" is a method for observing the driver directly to assess drowsiness.
- 2.4. "*Driver Drowsiness and Attention Warning (DDAW) system*" means a system that assesses the driver's reduced alertness and warns the driver via the vehicle's Human-Machine Interface when they are assessed to be drowsy.
- 2.5. "*Drowsiness threshold*" is a quantification of the level of driver drowsiness, at or before which the DDAW system shall provide a drowsiness warning to the driver.
- 2.6. "*Drowsy driver*" means a driver whose reduced alertness level is such that a warning shall be provided by the vehicle's DDAW system in accordance with this Regulation. A driver can be assessed to be drowsy by a DDAW system using direct means and/or indirect means.
- 2.7. "*Human-Machine Interface (HMI)*" means the user interface of the vehicle that allows the human to engage and interact with the software components of the vehicle, including for observation of their status.

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<sup>1</sup> As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3) (document TRANS/WP.29/78/Rev.8, para.2)-<https://unece.org/transport/vehicle-regulations/wp29/resolutions>

- 2.8. *"Indirect means"* is a method of observing the vehicle behaviour and/or vehicle parameters to assess drowsiness.

Examples of vehicle parameters used for inclusion in primary metrics and/or secondary metrics in a DDAW system using indirect means may include but are not limited to the following:

- (a) Steering wheel reversal rate;
- (b) Yaw rate;
- (c) Standard deviation of lane position (where lane position refers to position of the vehicle relative to the lateral lane markings).

- 2.9. *"Karolinska Sleepiness Scale (KSS)"* means the subjective self-report scale that is used to measure the level of drowsiness being experienced by the driver over a regular time interval of between 5 minutes and 15 minutes (as shown in the table below).

Rating	Verbal Description
1	Extremely alert
2	Very alert
3	Alert
4	Rather alert
5	Neither alert nor sleepy
6	Some signs of sleepiness
7	Sleepy, no effort to keep awake
8	Sleepy, some effort to keep awake
9	Very sleepy, great effort to keep awake, fighting sleep

- 2.10. *"Primary metrics"* are the main parameters used by the DDAW system for assessment of drowsiness.

- 2.11. *"Secondary metrics"* are additional and optional parameters that may increase robustness of the DDAW system.

- 2.12. *"System learning phase"* is the time period required, following a system start-up phase, for self-calibration of the DDAW system parameters such that the DDAW system will meet prescribed performance levels under normal operating conditions.

- 2.13. *"System start-up phase"* is the time period required for the DDAW system to become fully activated and begin assessing the driver's alertness, immediately following the application of system activation and the system activation conditions being met.

- 2.14. *"Trigger behaviour"* means the specific output of the DDAW system computing the primary metrics and (if applicable) secondary metrics, for which a drowsiness warning is provided to the driver, intended to indicate they are a drowsy driver. The variable(s) monitored to determine the metrics may be related but are not limited to either:

- (a) vehicle behaviour (the way the vehicle is being driven);
- (b) driver action (movements or gestures of the driver);
- (c) driver appearance (how the driver looks, or the change in this);

- (d) driver physiological state; or
  - (e) any combination of the above.
- 2.15. *"Vehicle type with regard to its DDAW system"* means a category of vehicles which do not differ in such essential respects such as:
  - (a) the manufacturer's trade name or mark;
  - (b) the type and design of the DDAW system, including but not limited to:
    - (i) the method(s) used in assessment of a drowsy driver;
    - (ii) the functionality and minimum performance of the sensor(s) used in the DDAW system;
    - (iii) the warning system methods, strategy and characteristics; and
  - (c) the vehicle features and systems which significantly influence the functioning or performance of the DDAW system.

### **3. Application for approval**

- 3.1. The application for approval of a vehicle type with regard to its DDAW system shall be submitted by the vehicle manufacturer or by its authorized representative.
- 3.2. The application for approval of a vehicle type with regard to its DDAW system shall be accompanied by the following:
  - (a) the numbers and/or symbols identifying the vehicle type;
  - (b) a description of the vehicle type, including in particular with regard to the items mentioned in paragraph 2.15.;
  - (c) a documentation package detailing how the DDAW system functions, in accordance with Annex 3; and
  - (d) a documentation package validating the effectiveness of the DDAW system, in accordance with Annex 4.
- 3.3. A vehicle which is representative of the vehicle type to be approved shall be submitted to the Technical Service responsible for assessing the technical documentation submitted by the manufacturer and conducting the verification tests.

### **4. Approval**

- 4.1. If the vehicle type submitted for approval pursuant to this Regulation meets the technical requirements of paragraph 5. below, approval of that vehicle type shall be granted.
  - 4.1.1. The conformity of the vehicle type to the technical requirements in paragraph 5. below, shall be demonstrated by the manufacturer through the submission of documentation packages in accordance with Annex 3 and Annex 4.
  - 4.1.2. The Technical Service shall verify the vehicle type submitted for approval pursuant to this Regulation meets the technical requirements of paragraph 5. below, through an assessment of the documentation packages (including the relevant test report(s)) submitted as part of the application for approval, according to the process set out in Annex 5.

- 4.2. An approval number shall be assigned to each approved type in accordance with Schedule 4 of the Agreement (E/ECE/TRANS/505/Rev.3). The same Contracting Party shall not assign the same number to the same vehicle type equipped with another type of DDAW system, or to another vehicle type.
- 4.3. Notice of approval, extension, refusal or withdrawal of approval pursuant to this Regulation shall be communicated to the Contracting Parties to the Agreement applying this Regulation by means of a form conforming to the model in Annex 1.
- 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:
- (a) a circle surrounding - the letter "E" followed by the distinguishing number of the country which has granted approval;<sup>2</sup> and
  - (b) the number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the circle prescribed in this paragraph.
- 4.4.1. 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. need not be repeated; in this case the Regulation and approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.
- 4.5. The approval mark shall be clearly legible and shall be indelible.
- 4.6. The approval mark shall be placed close to or on the vehicle data plate.

## 5. Technical requirements

- 5.1. Applicability
- 5.1.1. Any vehicle fitted with a DDAW system meeting the definition in paragraph 2.4. above, shall meet the requirements set out in paragraphs 5.2. to 5.7. below.
- 5.2. General technical requirements
- 5.2.1. A DDAW system shall monitor a driver's level of drowsiness and alert the driver through the vehicle HMI.
- 5.2.2. The DDAW system shall be designed to avoid or minimize the system error rate (false positive) under real driving conditions.
- 5.2.3. The DDAW system and any other system which warns the driver when they are distracted, shall be designed to avoid overlap and not prompt the driver separately and concurrently, or in a confusing manner, where one action triggers both systems.
- 5.2.4. The effectiveness of the DDAW system shall not be adversely affected by magnetic or electrical fields. This shall be demonstrated by fulfilling the technical requirements and respecting the transitional provisions of the 06 or later series of amendments to UN Regulation No. 10.

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<sup>2</sup> The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev.8 - <https://unece.org/transport/vehicle-regulations/wp29/resolutions>

- 5.3. DDAW system control
  - 5.3.1. It shall not be possible for the driver to manually deactivate the DDAW system.
    - 5.3.1.1. It may however be possible for the driver to manually deactivate the DDAW system HMI warnings.
      - 5.3.1.2. Following manual deactivation of the DDAW system HMI warnings, it shall be possible for the driver to re-activate the system HMI warnings by taking no more than the same number of actions as were required to deactivate it.
  - 5.3.2. Where pre-defined by the manufacturer, the DDAW system may be automatically deactivated in the following situations:
    - (a) When another system takes over the entire dynamic driving task on a sustained basis;
    - (b) When a driver-operated vehicle system, assisting a human driver in controlling the longitudinal and lateral motion on a sustained basis, is active and contains a driver monitoring system that will comprehensively assess the driver's reduced alertness and warn the driver via the vehicle's HMI when they are assessed to be drowsy.
  - 5.3.2.1. The DDAW system shall be automatically reactivated as soon as the conditions that led to its automatic deactivation are no longer present.
  - 5.3.2.2. In the context of paragraph 5.3.2.(a), the dynamic driving task shall include all real time operational functions and tactical functions required to operate the vehicle, excluding strategic functions such as trip scheduling, and selection of destinations and waypoints, and including the following subtasks:
    - (a) Lateral vehicle motion control via steering (operational);
    - (b) Longitudinal vehicle motion control via acceleration and deceleration (operational);
    - (c) Monitoring the driving environment via object and event detection, recognition, classification, and response preparation (operational and tactical);
    - (d) Object and event response execution (operational and tactical);
    - (e) Manoeuvre planning (tactical);
    - (f) Enhancing conspicuity via lighting, sounding the horn, signalling or gesturing (tactical).
  - 5.3.3. The emission of drowsiness warnings by the DDAW system may be automatically suppressed under conditions in which other driving assistance system are warning about an imminent danger or a critical situation.
    - 5.3.3.1. The drowsiness warning function shall be automatically reinstated as soon as the conditions that led to its suppression are no longer present.
  - 5.3.4. The DDAW system, including HMI warnings, shall be automatically reinstated to normal operation mode at each initiation of the powertrain.<sup>3,4</sup> The vehicle manufacturer can choose to make such automatic reinstatement to be dependent upon one of the following conditions:
    - 5.3.4.1. the driver's door having been opened;
    - 5.3.4.2. the vehicle being switched off for a maximum period of 15 minutes.

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<sup>3</sup> A new engine start (or run cycle) which is performed automatically, for example by the operation of a stop/start system, is not considered as an initiation of the powertrain.

<sup>4</sup> As defined in Mutual Resolution No. 2 (M.R.2) of the 1958 and the 1998 Agreements - Containing Vehicle Propulsion System Definitions, see document ECE/TRANS/WP.29/1121.



- 5.3.5. The DDAW system shall be automatically activated above the vehicle speed of 70 km/h.
- 5.3.6. Once activated, the DDAW system shall operate normally within the vehicle speed range of 65 km/h to 130 km/h or the vehicle's maximum speed, whichever is lower.
- 5.3.6.1. The DDAW system shall not be automatically deactivated at a vehicle speed of above 130 km/h, although the system's behaviour can be adapted to the degraded situation.
- 5.3.7. There shall be less than 5 minutes required for a system start-up phase immediately following the vehicle meeting the activation criteria set out in paragraph 5.3.5.
- 5.3.8. The system learning phase shall begin once the system start-up phase is completed and all conditions for the normal operation of the DDAW system referred to in paragraphs 5.3. and 5.4. are met.
- 5.3.8.1. If a warning is provided during the system learning phase, the system learning phase is considered over.
- 5.4. Environmental conditions
- 5.4.1. The DDAW system shall operate effectively during the day and night.
- 5.4.2. The DDAW system shall operate in absence of weather conditions limiting the system's operation. The manufacturer is required to document the system limitations caused by weather conditions, including the technical challenge and the strategy for the system's behaviour in these given weather conditions, in accordance with Annex 4, paragraph 2.1.2.
- 5.4.3. At a minimum, the DDAW system shall work effectively on a multi-lane divided road, with or without a central divide, when lane markings are visible on both sides of the lane.
- 5.5. Monitoring driver drowsiness
- 5.5.1. The DDAW system shall assess driver drowsiness by direct means and/or indirect means.
- 5.5.1.1. In the case of indirect means, vehicle behaviour used as indicators to assess a drowsy driver may include but are not limited to the following:
  - (a) A reduction in the number of micro-corrections within driver steering, paired with an increase in the number of large and fast corrections;
  - (b) An increase in the variability of a vehicle's lateral lane position.
- 5.5.2. The DDAW system shall provide a warning to the driver at a level of drowsiness which is equivalent to or above 8 on the reference sleepiness scale defined in paragraph 2.9. of this Regulation (the Karolinska Sleepiness Scale, hereinafter referred to as the "KSS").
- 5.5.2.1. The DDAW system may provide a warning to the driver at a level of drowsiness which is equivalent to level 7 on the KSS.
- 5.5.2.2. In addition, the manufacturer may implement an information strategy on the HMI prior to the warning.
- 5.5.2.3. The manufacturer shall carry out validation testing in accordance with Annex 4 – Appendix 1.

- 5.6. Human-machine interface requirements
  - 5.6.1. Warning nature
    - 5.6.1.1. Visual and acoustic or any other warning (including haptic) used by the DDAW system to alert the driver shall be presented as soon as possible after occurrence of the trigger behaviour and may cascade and intensify until acknowledgement thereof by the driver.

Can be accepted as acknowledgement by the driver: an improvement of the driving behaviour based on the input(s) used for the DDAW system (strategy to be described in the documentation provided by the manufacturer).
  - 5.6.2. Visual warning
    - 5.6.2.1. The visual warning shall be located so as to be readily visible and recognisable in daylight and at night-time by the driver and distinguishable from other alerts.
    - 5.6.2.2. The visual warning shall be a steady or flashing indication (e.g. tell-tale, pop-up message).
    - 5.6.2.3. Any new symbols developed for the purpose of a DDAW system visual warning are recommended to be constructed using similar elements to and keeping coherence with ISO 2575:2010+A7:2017 K.21 and/or ISO 2575:2010+A7:2017 K.24.
    - 5.6.2.4. The contrast of the symbol with the background in sunlight, twilight and night conditions are recommended to be in accordance with ISO 15008:2017.
    - 5.6.2.5. The following visual alert and background colour combinations should not be used: red/green; yellow/blue; yellow/red; red/violet.
  - 5.6.3. Acoustic warning
    - 5.6.3.1. The acoustic warning shall be easily recognised by the driver.
    - 5.6.3.2. A majority of the acoustic warning shall fall within the frequency range of 200–8,000 Hz and amplitude range of 50–90 dB. The vehicle manufacturer may adjust the amplitude depending on the surrounding noise level.
    - 5.6.3.3. If speech alerts are utilized, the vocabulary used shall be consistent with any text used as part of the visual alert.
    - 5.6.3.4. The audible portion of the alert shall last for at least the duration that allows the driver to understand it.
  - 5.6.4. Haptic warning
    - 5.6.4.1. The haptic warning shall be noticeable by the driver and be provided directly or indirectly through any interface expected to attract the attention of the driver.
- 5.7. DDAW system failure warning
  - 5.7.1. Permanent failures
    - 5.7.1.1. There shall not be an appreciable time interval between each DDAW system self-check, and subsequently there shall not be a delay in displaying the failure warning signal in the case of an electrically detectable failure.
    - 5.7.1.2. A constant visual failure warning signal (e.g. warning reflecting the relevant Diagnostic Trouble Codes for the system, tell-tale, pop-up message) shall be provided when there is a permanent failure detected in the DDAW system as a result of which the system does not meet the requirements of this Regulation.
    - 5.7.1.3. Upon detection of a non-electrical failure condition (e.g. sensor obscuration, excluding temporary obscuration such as caused by sun glare), the failure warning signal as laid down in paragraph 5.7.1.2. shall be displayed.

- 5.7.2. Temporary failures
- 5.7.2.1. Upon detection of a temporary non-electrical failure condition, the failure warning signal as laid down in paragraph 5.7.1.2. may be displayed, and a different temporary visual failure warning signal may also be used as complementary information.
- 5.7.3. Failures that activate the warning signal mentioned in paragraph 5.7.1.2., but which are not detected under static conditions (during which the vehicle is stationary), shall be retained upon detection and continue to be displayed from each initiation of the powertrain<sup>3,4</sup>, for as long as the failure or defect persists.

## **6. Modification of the vehicle type and extension of approval**

- 6.1. Every modification of a vehicle type, with regard to this Regulation, shall be notified to the Type Approval Authority which approved the vehicle type. The Type Approval Authority shall then either:

- (a) Consider that the modifications made do not have an adverse effect on the conditions of the granting of the approval and grant an extension of approval;
- (b) Consider that the modifications made affect the conditions of the granting of the approval and require further tests or additional checks before granting an extension of approval;
- (c) Decide, in consultation with the manufacturer, that a new type-approval is to be granted; or
- (d) Apply the procedure contained in paragraph 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, 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 alterations, shall be communicated by the procedure specified in paragraph 4.3. above to the Contracting Parties to the Agreement applying this UN 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.

6.2.1. In the case of an extension, the approval authority shall assign a serial number to each extension, to be known as the extension number.

## **7. Conformity of production**

7.1. Procedures for the conformity of production shall conform to the general provisions defined in Article 2 and Schedule 1 to the Agreement (E/ECE/TRANS/505/Rev.3) and meet the following requirements:

7.1.1. A vehicle approved pursuant to this Regulation shall be so manufactured as to conform to the type approved by meeting the requirements of paragraph 5. above; and

7.1.2. The approval authority which has granted the approval may at any time verify the conformity of control methods applicable to each production unit. The normal frequency of such inspections is once every two years, while the minimum frequency shall be once every three 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 7.1.1. above is not complied with, or if the vehicle or vehicles selected have failed to pass the checks prescribed in paragraph 7.1.2. above.

8.2. If a Contracting Party to the Agreement applying this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation by means of 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, it shall so inform the authority which granted the approval, which in turn shall forthwith notify the other Contracting Parties to the Agreement applying this Regulation by means of a communication for conforming to the model set out in Annex 1 to this Regulation.

## **10. Names and addresses of the Technical Services responsible for conducting approval tests, and of the Type Approval Authorities**

10.1. 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 approval or extension, or refusal or withdrawal of approval are to be sent.

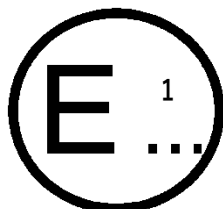
## Annex 1

### Communication

(maximum format: A4 (210 x 297 mm))

issued by: Name of administration:

.....  
.....  
.....



Concerning: <sup>2</sup> Approval granted

Approval extended

Approval refused

Approval withdrawn

Production definitively discontinued

of a vehicle type with regard to the DDAW system performance pursuant to UN Regulation No. 1XX

Approval No. ....

1. Trade name or mark of the vehicle: .....
2. Vehicle type: .....
3. Means of identification of type, if marked on the vehicle/component/separate technical unit<sup>2</sup>: .....
4. Location of that marking: .....
5. Category of vehicle: .....
6. Name and address of manufacturer: .....
7. If applicable, name and address of manufacturer's representative: .....
8. Brief description of vehicle: .....
9. Technical Service performing the assessments and verifications:.....
10. Date of report issued by that Technical Service: .....
11. Number of the report issued by that Technical Service:.....
12. Approval granted/refused/extended/withdrawn: <sup>2</sup> .....
13. Position of approval mark on the vehicle: .....
14. Place: .....
15. Date: .....
16. Signature: .....
17. Any remarks: .....

<sup>1</sup> Distinguishing number of the country which has granted/ extended/refused/withdrawn approval (see approval provisions in the Regulation).

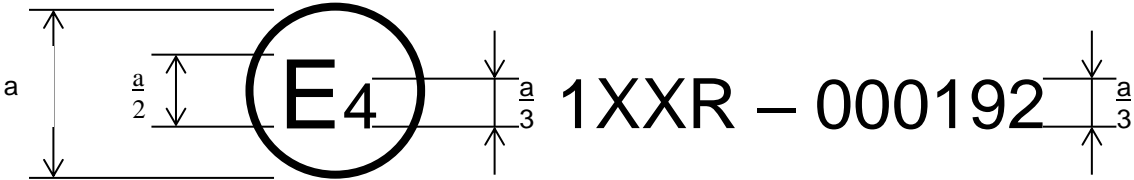
<sup>2</sup> Delete what does not apply.

18. The list of documents deposited with the Approval Authority which has granted approval is annexed to this communication and may be obtained on request.

Annex 2

Arrangement of the approval mark

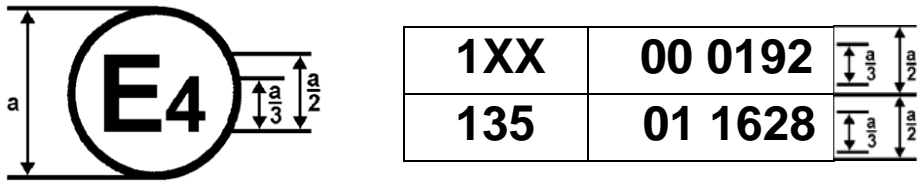
Model A  
(See paragraph 4.4. of this Regulation)



a = 8 mm min.

The above approval mark affixed to a vehicle shows that the vehicle type concerned has, with regard to its DDAW system, been approved in the Netherlands (E 4) pursuant to UN Regulation No. 1XX under approval No. 000192. The first two digits (00) of the approval number indicate that the approval was granted in accordance with the requirements of UN Regulation No. 1XX in its original form.

Model B  
(See paragraph 4.4.1. of this Regulation)



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 UN Regulations Nos. 1XX and 135.<sup>1</sup> The first two digits of the approval numbers indicate that, at the dates when the respective approvals were granted, UN Regulation No. 1XX incorporated the 00 series of amendments and UN Regulation No. 135 incorporated the 01 series of amendments.

<sup>1</sup> The latter number is given only as an example

## Annex 3

### **Documentation package on the Driver Drowsiness and Attention Warning system functionality**

1. The documentation package provided by the manufacturer to both the Approval Authority and the Technical Service, to detail how the DDAW system functions, shall include:
  - (a) a list of all the system inputs containing the primary metrics;
  - (b) a description of how the metrics function and monitor the driver and/or driving behaviour;
  - (c) a description of the trigger behaviour being monitored by the system;
  - (d) evidence on the relationship between a drowsy driver and the chosen trigger behaviour;
  - (e) the system's drowsiness threshold;
  - (f) the vehicle speed at which the system is activated;
  - (g) an explanation of the system's activation, reactivation and deactivation functions;
  - (h) a document detailing the functionality of the system's HMI; and
  - (i) a document providing at least one test protocol to be tested by the Technical Service, for which the DDAW system shall deliver a warning when performed.
- 1.1. The document detailing the functionality of the system's HMI shall include evidence of compliance with the DDAW system HMI requirements set out in paragraph 5.6. of this Regulation, and justifications where the manufacturer has chosen not to follow the recommendations listed in paragraphs 5.6.2.3., 5.6.2.4. and/or 5.6.2.5. of this Regulation.
- 1.2. The list of system inputs shall only be provided to the Approval Authority and the Technical Service for the purpose of verifying the DDAW system for the type-approval.
2. The manufacturer shall also provide the Technical Service with a list of all the system inputs containing both the primary metrics and secondary metrics.
- 2.1. The list of secondary metrics will not be passed on from the Technical Service to the Approval Authority.
3. Provisions for the Periodic Technical Inspection of the system
- 3.1. For periodic technical inspections, the documentation shall describe how the correct operational status of the system can be confirmed (e.g. bulb check).



## Annex 4

### Documentation package on the effectiveness of the Driver Drowsiness and Attention Warning system

1. The manufacturer shall carry out validation testing in accordance with Appendix 1 of this Annex, to ensure that the DDAW system is able to monitor driver drowsiness in a manner which is accurate, robust and scientifically valid.
2. The documentation package provided by the manufacturer to both the Approval Authority and the Technical Service, as evidence on the effectiveness of the DDAW system, including to document the validation testing, shall include:
  - (a) the information on the number and demographics of the test participants assessed;
  - (b) the description of the test conditions assessed;
  - (c) evidence that the system works effectively in weather conditions not limiting the system's operation;
  - (d) a description of full test methodology used to assess the effectiveness of the system and the rationale behind, including any alternative or complementary measurements, and/or alternative drowsiness threshold (referred to in paragraphs 6.2., 6.3., and 7. respectively of Appendix 1 to this Annex);
  - (e) a description of the statistical analysis technique used;
  - (f) an analysis and description of the results, including demonstration that the performance levels meet the required minimum acceptance criteria referred to in paragraph 9 of Appendix 1 to this Annex;
  - (g) evidence that the system alerts a driver at the time of, or before reaching the KSS level set out in paragraph 5.5.2. of this Regulation; and
  - (h) the data of each participant for statistical anomaly assessment.
- 2.1.1. The information on demographics of the test participants referred to in paragraph 2. (a) of this annex shall include:
  - (a) inclusionary or exclusionary criteria that were used when selecting participants; and
  - (b) a statement on the adequacy of the participants in respect of the targeted demography for the vehicle set out in paragraph 4.3. of Appendix 1 to this Annex.
- 2.1.2. The evidence referred to in paragraph 2. (c) of this annex shall indicate the known or logical limitations due to weather conditions, the technical challenge, and the strategy for the system's behaviour in these given weather conditions (e.g. strong rain, snow, high temperature, etc.).
- 2.1.3. The information on full test methodology referred to in paragraph 2. (d) of this annex shall include:
  - (a) evidence that the complementary measurement(s) or the combination of the primary (KSS or alternative measure) and complementary measurement(s) are a valid and accurate means to assess driver drowsiness;
  - (b) information on how the data of the primary and complementary measurements were analysed and collated to assess the effectiveness of the DDAW system; and

- (c) evidence that the drowsiness threshold being used in the validation testing is equivalent to a KSS level referred to in paragraph 5.5.2. of this Regulation.
- 2.1.4. If a statistical analysis technique that differs from that set out in paragraph 9.1. of Appendix 1 of this Annex is used (refer paragraph 2. (e) above), evidence on the statistical analysis method and level of significance used shall be provided.
- 2.1.5. If the validation was performed on another vehicle type, the documentation shall contain information linking the validation process to the type-approval requirements for the motor vehicle concerned.
  - 2.1.5.1. For example, the manufacturer may provide documents demonstrating the technical similarities or the adaptation required to enable the DDAW system to the vehicle presented for type-approval. The participants shall also be similar (target demography, involvement of professional driver) to those required for the assessment of the vehicle presented for type-approval.
- 2.1.6. If the validation was performed as part of a research to establish compliance with the technical requirements for the DDAW system, the documentation shall contain information linking the validation testing to the respective type-approval requirements for the motor vehicle concerned.
  - 2.1.6.1. For example, the manufacturer may provide an additional link between what is enabled in the version of the DDAW system installed in the motor vehicle concerned, and a recalculation of the equivalent sensitivity values from the data produced during the research phase.

## Annex 4 – Appendix 1

### Test procedures for the validation of Driver Drowsiness and Attention Warning systems

1. Purpose
  - 1.1. Validation testing to ensure that DDAW systems are able to monitor driver drowsiness in a manner which is accurate, robust and scientifically valid.
2. Definitions
 

For the purposes of this Annex:

  - 2.1. "*Concordance rate*" is a score calculated from the rating of a sleep expert on facial training video.
3. Testing requirements
  - 3.1. Validation testing shall take place using human participants. Alternatively, the data used for the validation shall derive from behaviour data collected using human participants.
  - 3.2. Any validation testing that includes a human participant operating a motor vehicle in a real-world, non-simulated road environment, shall have a safety backup.
    - 3.2.1. The safety backup shall intervene if the driver becomes drowsy, so that he or she can no longer safely control the motor vehicle.
    - 3.2.2. If the safety backup intervenes, the participant shall not be permitted to drive any further as part of the testing.
    - 3.2.3. If the safety backup is a backup driver, an appropriate safety strategy (for example: double pedals) shall be required.
    - 3.2.4. Once the safety backup intervenes, the safety strategy prepared for this test shall apply (for example, another non-drowsy driver takes primary control of the vehicle and the drowsy driver shall not be allowed to continue to drive).
  - 3.3. If validation testing is performed in a simulator, the manufacturer shall document its limitations in comparison to real-world open-road testing of the DDAW system. Such documentation will include comparison of the primary input data used for the DDAW system, from the simulator and the vehicle in real-world conditions, together with an analysis of the validity of the simulated test results.
4. Testing sample
  - 4.1. Each test participant shall generate at least 1 true positive or 1 false negative event as referred to in paragraphs 6.1.4. to 6.1.7. of this Appendix. The total number, obtained by the sum of true positive events and false negative events, shall be equal to, or higher than 10. The minimum sample size shall be 10 participants. More than one test may be run for each participant in order to acquire more data for a given participant.
    - 4.1.1. The sensitivity per participant shall be calculated first for each participant, then the average sensitivity and its standard deviation shall be calculated from the values of sensitivity per participant.
    - 4.1.2. Results may be provided for a subgroup of participants from a larger test, to include only participants fitting the description above.
  - 4.2. All the results from participants fitting the requirements of paragraph 4.1. above shall be accounted for the validation. Excluding results from participants with at least 1 true positive or 1 false negative is not allowed.

- 4.3. The participants shall correspond to the targeted demography for the vehicle (for example, participants with a valid licence to drive the vehicle on which the DDAW system is installed).
- 4.4. None of the 10 participants of the minimum sample size shall be involved in the development of the DDAW system. One of the acceptance criteria, of paragraph 9. below, shall be met with and without results from the additional participants involved in the DDAW system development.
- 5. Environmental conditions
  - 5.1. At a minimum, the system shall be tested in both the day and night conditions listed below in paragraphs 5.1.3. and 5.1.4., and record at least a true positive event in each condition (overall, not for each participant tested in the condition).
    - 5.1.1. It is not necessary for all participants to test both conditions.
    - 5.1.2. Systems not affected by light do not need to meet the minimum number of true positive events in each condition.
    - 5.1.3. For non-simulated road environment testing:
      - (a) Day: testing shall start after sunrise and before sunset;
      - (b) Night: testing shall start after sunset and before sunrise.
    - 5.1.4. For simulated road environment testing:
      - (a) Day: conditions diffuse with ambient light (ISO 15008:2017);
      - (b) Night: condition of low ambient illumination under which the adaptation level of the driver is mainly influenced by the portion of the road ahead covered by the vehicle's own headlights and surrounding street lights, and display and instrument brightness (ISO 15008:2017).
- 6. Measuring drowsiness
  - 6.1. Application of the Karolinska Sleepiness Scale
    - 6.1.1. The participant's level of drowsiness shall be measured using the KSS.
      - 6.1.1.1. Participants shall be trained on the KSS before they apply it as part of the DDAW system validation testing.
        - 6.1.1.1.1. The training process shall be the same for all participants.
        - 6.1.1.1.2. The training process shall be clearly documented in the evidence dossier supplied to the Technical Service in accordance with Annex 4 of this Regulation.
      - 6.1.1.2. The standardised wording in the paragraph 2.9. of this Regulation shall be used and all levels of the KSS shall be labelled.
    - 6.1.2. Measurements shall be obtained during the testing at regular intervals of between approximately 5 minutes and 15 minutes, where each measurement obtained shall be assumed to cover the previous interval.
      - 6.1.2.1. The recommended intervals do not apply before the participant first provides a self-assessment rating at level 6 or above on the KSS.
    - 6.1.3. During the validation tests, it is recommended to mute the warnings from the DDAW system to prevent changes of the status of the participant before the next self-assessment. The time at which the warning from the DDAW system is provided (muted or not) shall be recorded to clearly establish if it is a true positive event.
    - 6.1.4. Any warning from the DDAW system shall be treated as a true positive event if the participant's previous or next rating is at a KSS of level 7 or above. Paragraphs 6.1.6. and 6.1.7. provide further clarification on generation of true positive events.

- 6.1.4.1. Once a true positive event has occurred, all the data points after this event shall be considered irrelevant for this specific test. If the participant restarted the test after a rest, it shall be considered a different dataset (with the same participant).
- 6.1.4.2. Where a warning is provided by the DDAW system and neither the previous or next rating of the participant is at a KSS of level 7 or above, this shall be treated as a false positive event, and testing may continue.
- 6.1.4.3. Where no warning is provided by the DDAW system and neither the previous or next rating of the participant is at a KSS of level 7 or above, this shall be treated as a true negative event, and testing may continue.
- 6.1.4.4. Where the participant's previous and next rating are at a KSS of level 7 or below, no warning from the DDAW system shall also be treated as a true negative event, and testing may continue; that is, a KSS of level 7 may result in a true positive or a true negative event depending on warning status.
- 6.1.4.5. Where only one of these participant's previous or next ratings is at a KSS level of 7 or below, paragraph 6.1.7. provides further clarification on generation of true negative events.
- 6.1.5. Once a false negative event has occurred, the testing shall continue where this is supported by the applicable safety strategy, and the measurements obtained after that event included in the test run for the participant, subject to the other provisions of this Appendix.
- 6.1.5.1. A false negative event shall be recorded after a participant rating changes from a KSS of level 7 or below, to a KSS of level 8 or above, and where the provisions of paragraph 6.1.7. set that a false negative event has occurred;
  - 6.1.5.1.1. a false negative event shall only be recorded once after such a transition in participant KSS level as described by paragraph 6.1.5.1. - successive false negative events shall not be recorded after only one such transition; and
  - 6.1.5.1.2. to record an additional false negative event will require the participant rating to fall below a KSS of level 8 again, and then increase to a KSS of level 8 or above again, subject to the other provisions of paragraph 6.1.7. that set a false negative event has occurred.
- 6.1.6. If a participant rating is at or below a KSS of level 7, and the subsequent rating is at a KSS of level 7 (e.g. a sequence of ratings can be 6-7 or 7-7), a warning from the DDAW system in the testing interval immediately prior to or following the second rating in this sequence shall be treated as a true positive and end the specific test as in paragraph 6.1.4.1.
- 6.1.7. If a participant rating is below the drowsiness threshold referred to in paragraph 5.5.2. of this Regulation, and the subsequent rating is above or equal to the drowsiness threshold (e.g. a sequence of ratings can be 6-8, 7-8 or 7-9), either:
  - 6.1.7.1. the DDAW system provides a warning in the testing interval immediately prior to the second rating in this sequence and it shall be treated as a true positive and end the specific test as in paragraph 6.1.4.1.; or
  - 6.1.7.2. the DDAW system does not provide a warning in the testing interval immediately prior to the second rating in this sequence, and this shall be treated as either;
    - (a) a false negative where the testing does not continue; or
    - (b) a true negative where the testing continues for an extra testing interval, after which the participant provides a self-assessment above or equal to the drowsiness threshold again (e.g. sequence of ratings can be 6-8-8, 7-8-9 or 7-9-8), and where;
      - (i) the DDAW system does not provide a warning during this extra testing interval, this data point shall be treated as a false negative; or

- (ii) the DDAW system provides a warning during this extra testing interval, this data point shall be treated as a true positive<sup>1</sup>; or
- 6.1.7.3. the DDAW system does not provide a warning in the testing interval immediately prior to the second rating in this sequence, and this shall be treated as a true negative where the testing continues for an extra testing interval, after which the participant provides a self-assessment at the KSS level 7 (e.g. sequence of ratings can be 6-8-7, 7-8-7 or 7-9-7), and where;
  - (a) the DDAW system does not provide a warning during this extra testing interval, this data point shall be treated as true negative and marked as an outlier - outliers shall be documented in the documentation package, whereby the treatment of the surrounding data points and classification of any subsequent system warnings shall be explained by the manufacturer; or
  - (b) the DDAW system provides a warning during this extra testing interval, this data point shall be treated as a true positive<sup>1</sup>; or
- 6.1.7.4. the DDAW system does not provide a warning in the testing interval immediately prior to the second rating in this sequence, and this shall be treated as a true negative where the testing continues for an extra testing interval, after which the participant provides a self-assessment below the KSS level 7 (e.g. sequence of ratings can be 6-8-6, 7-8-6 or 7-9-6), and where;
  - (a) the DDAW system does not provide a warning during this extra testing interval, the data points from this specific test shall be excluded from the overall testing data results as the drowsiness ratings of the participant are likely unreadable – it is recommended to provide an additional training session to the participant after such a result (note that this is without prejudice to other situations which can be excluded); or
  - (b) the DDAW system provides a warning during this extra testing interval, this data point shall be treated as a true positive<sup>1</sup>.
- 6.1.7.5. Further to the system warning classification described by paragraph 6.1.7.3. (a), but where the specific provisions of paragraph 6.1.7.3. do not apply;
  - any sequence of ratings where the participant rating is above or equal to the drowsiness threshold referred to in paragraph 5.5.2. of this Regulation, and then falls to the KSS level 7 at the subsequent measurement (e.g. sequence of ratings can be 8-7 or 9-7), and where the DDAW system does not provide a warning during the testing interval between these two ratings, this data point shall be treated as true negative and marked as an outlier. Outliers shall be documented in the documentation package, whereby the treatment of the surrounding data points and classification of any subsequent system warnings shall be explained by the manufacturer.
- 6.1.7.6. Further to the system warning classification described by paragraph 6.1.7.4. (a), but where the specific provisions of paragraph 6.1.7.4. do not apply;

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<sup>1</sup> The specific test ends as soon as this warning is given, with the next rating irrelevant, as per paragraph 6.1.4.1.

- any sequence of ratings where the participant rating is above or equal to the drowsiness threshold referred to in paragraph 5.5.2. of this Regulation, and then falls to below the KSS level 7 at the subsequent measurement (e.g. sequence of ratings can be 8-6 or 9-6), and where the DDAW system does not provide a warning during the testing interval between these two ratings, the data points from this specific test shall be excluded from the overall testing data results as the drowsiness ratings of the participant are likely unreadable. It is recommended to provide an additional training session to the participant after such a result.

Table 1 provides an illustration of the DDAW system warning classifications that correspond to testing using application of the KSS and the requirements of paragraphs 6.1.4. to 6.1.7. under particular test cases.

Table 1

Driver Drowsiness and Attention Warning system warning classifications for particular test cases under application of the Karolinska Sleepiness Scale

Test Case	Karolinska Sleepiness Scale measurements at Tn, Tn+1, Tn+2 **										
	Tn	Test interval between Tn and Tn+1				Tn+1	Test interval between Tn+1 and Tn+2				Tn+2
		Warning given		No Warning			Warning given		No Warning		
		Warning Classification*	Appendix 1 reference para	Warning Classification*	Appendix 1 reference para		Warning Classification*	Appendix 1 reference para	Warning Classification*	Appendix 1 reference para	
1	<7	FP	6.1.4.2.	TN	6.1.4.3.	<7	FP	6.1.4.2.	TN	6.1.4.3.	<7
2	<7	FP	6.1.4.2.	TN	6.1.4.3.	<7	TP	6.1.4., 6.1.6.	TN	6.1.4.4.	7
3	<7	FP	6.1.4.2.	TN	6.1.4.3.	<7	TP	6.1.4., 6.1.7.1. <sup>c</sup>	TN <sup>b</sup>	6.1.7.	>=8
4	<7	TP	6.1.4., 6.1.6.	TN	6.1.4.4.	7	TP	6.1.4.	TN	6.1.4.4.	<7
5	<7	TP	6.1.4., 6.1.6.	TN	6.1.4.4.	7	TP	6.1.4., 6.1.6.	TN	6.1.4.4.	7
6	<7	TP	6.1.4., 6.1.6.	TN	6.1.4.4.	7	TP	6.1.4., 6.1.7.1. <sup>c</sup>	TN <sup>b</sup>	6.1.7.	>=8
7	<7	TP	6.1.4., 6.1.7.1.	TN <sup>a</sup>	6.1.7.4.	>=8	TP	6.1.7.4. (b)	exclude all	6.1.7.4. (a)	<7
8	<7	TP	6.1.4., 6.1.7.1.	TN <sup>a</sup>	6.1.7.3.	>=8	TP	6.1.7.3. (b)	TN outlier	6.1.7.3. (a)	7
9	<7	TP	6.1.4., 6.1.7.1.	TN <sup>a</sup>	6.1.7.2. (b)	>=8	TP	6.1.7.2. (b) (ii)	FN	6.1.7.2. (b) (i)	>=8
10	7	TP	6.1.4.	TN	6.1.4.4.	<7	FP	6.1.4.2.	TN	6.1.4.3.	<7
11	7	TP	6.1.4.	TN	6.1.4.4.	<7	TP	6.1.4., 6.1.6.	TN	6.1.4.4.	7
12	7	TP	6.1.4.	TN	6.1.4.4.	<7	TP	6.1.4., 6.1.7.1. <sup>c</sup>	TN <sup>b</sup>	6.1.7.	>=8
13	7	TP	6.1.4., 6.1.6.	TN	6.1.4.4.	7	TP	6.1.4.	TN	6.1.4.4.	<7
14	7	TP	6.1.4., 6.1.6.	TN	6.1.4.4.	7	TP	6.1.4., 6.1.6.	TN	6.1.4.4.	7
15	7	TP	6.1.4., 6.1.6.	TN	6.1.4.4.	7	TP	6.1.4., 6.1.7.1. <sup>c</sup>	TN <sup>b</sup>	6.1.7.	>=8
16	7	TP	6.1.4., 6.1.7.1.	TN <sup>a</sup>	6.1.7.4.	>=8	TP	6.1.7.4. (b)	exclude all	6.1.7.4. (a)	<7
17	7	TP	6.1.4., 6.1.7.1.	TN <sup>a</sup>	6.1.7.3.	>=8	TP	6.1.7.3. (b)	TN outlier	6.1.7.3. (a)	7
18	7	TP	6.1.4., 6.1.7.1.	TN <sup>a</sup>	6.1.7.2. (b)	>=8	TP	6.1.7.2. (b) (ii)	FN	6.1.7.2. (b) (i)	>=8
19	>=8	TP	6.1.7.4. (b) <sup>d</sup>	exclude all	6.1.7.4. (a) <sup>d</sup>	<7	N/A <sub>2</sub>	see note N/A <sub>2</sub>	N/A <sub>2</sub>	see note N/A <sub>2</sub>	<7
20	>=8	TP	6.1.7.4. (b) <sup>d</sup>	exclude all	6.1.7.4. (a) <sup>d</sup>	<7	N/A <sub>2</sub>	see note N/A <sub>2</sub>	N/A <sub>2</sub>	see note N/A <sub>2</sub>	7
21	>=8	TP	6.1.7.4. (b) <sup>d</sup>	exclude all	6.1.7.4. (a) <sup>d</sup>	<7	N/A <sub>2</sub>	see note N/A <sub>2</sub>	N/A <sub>2</sub>	see note N/A <sub>2</sub>	>=8
22	>=8	TP	6.1.7.3. (b) <sup>d</sup>	TN outlier	6.1.7.3. (a) <sup>d</sup>	7	N/A <sub>1</sub>	see note N/A <sub>1</sub>	N/A <sub>1</sub>	see note N/A <sub>1</sub>	<7
23	>=8	TP	6.1.7.3. (b) <sup>d</sup>	TN outlier	6.1.7.3. (a) <sup>d</sup>	7	N/A <sub>1</sub>	see note N/A <sub>1</sub>	N/A <sub>1</sub>	see note N/A <sub>1</sub>	7
24	>=8	TP	6.1.7.3. (b) <sup>d</sup>	TN outlier	6.1.7.3. (a) <sup>d</sup>	7	N/A <sub>1</sub>	see note N/A <sub>1</sub>	N/A <sub>1</sub>	see note N/A <sub>1</sub>	>=8
25	>=8	TP	6.1.7.2. (b) (ii) <sup>d</sup>	FN	6.1.7.2. (b) (i) <sup>d,e</sup>	>=8	TP	6.1.4. <sup>d,e</sup>	exclude all	6.1.7.6. <sup>d,e</sup>	<7
26	>=8	TP	6.1.7.2. (b) (ii) <sup>d</sup>	FN	6.1.7.2. (b) (i) <sup>d,e</sup>	>=8	TP	6.1.4. <sup>d,e</sup>	TN outlier	6.1.7.5. <sup>d,e</sup>	7
27	>=8	TP	6.1.7.2. (b) (ii) <sup>d</sup>	FN	6.1.7.2. (b) (i) <sup>d,e</sup>	>=8	TP	6.1.4. <sup>d,e</sup>	N/A <sub>3</sub>	6.1.5.1. <sup>d,e</sup>	>=8



**Explanatory notes for Table 1:**

**T<sub>n</sub>** is the point in time at the end of the testing interval for which the participant first provides a KSS rating of level 6 or above (refer to paragraph 6.1.2.1. of this Appendix). Where warnings have been given from the DDAW system within a sequence of participant ratings that are not described by the test cases of Table 1, these system warnings shall be classified in accordance with the requirements of paragraph 6.1.4. For example;

where a sequence of ratings is 4-5-5, and the DDAW system provides a warning in the testing interval immediately prior to the second rating in this sequence, this shall be treated as a false positive event (FP) as per paragraph 6.1.4.2.

**T<sub>n+1</sub>** is the point in time at the end of the testing interval immediately following T<sub>n</sub>.

**T<sub>n+2</sub>** is the point in time at the end of the testing interval immediately following T<sub>n+1</sub>.

<sup>a</sup> On the basis that the testing continues for an extra testing interval, otherwise the classification is false negative (FN).

<sup>b</sup> On the basis that the testing continues for an extra testing interval and T<sub>n+1</sub> becomes T<sub>n</sub>, T<sub>n+2</sub> becomes T<sub>n+1</sub>, and new data is assigned to T<sub>n+2</sub>, otherwise the classification is false negative (FN).

<sup>c</sup> For a situation where T<sub>n+1</sub> is considered as T<sub>n</sub>, and T<sub>n+2</sub> is considered as T<sub>n+1</sub>, because both T<sub>n</sub> and T<sub>n+1</sub> have a rating  $\leq 7$  and a true positive (TP) event did not occur in the testing interval between, so testing continued.

<sup>d</sup> For where it is assumed that prior to **T<sub>n</sub>** as defined above, the participant has provided a self-assessment at a KSS level below 6 at the previous measurement, and as such the rating has moved from below the drowsiness threshold referred to in paragraph 5.5.2. of this Regulation to above or equal to the drowsiness threshold (e.g. 5-8).

<sup>e</sup> For where the previous test case was either case 9 or case 18, and a false negative (FN) was recorded in the second testing interval, so T<sub>n+1</sub> becomes T<sub>n</sub>, T<sub>n+2</sub> becomes T<sub>n+1</sub>, and new data assigned is to T<sub>n+2</sub> as testing continues.

**N/A<sub>1</sub>** The classification is subject to the treatment of the data points surrounding a true negative outlier, as applied and explained by the manufacturer in accordance with provisions of paragraph 6.1.7.3. (a).

**N/A<sub>2</sub>** A classification does not apply as the data points from the specific test run will be discarded in accordance with provisions of paragraph 6.1.7.4. (a), as the drowsiness ratings of the participant are likely unreadable.

**N/A<sub>3</sub>** A classification does not apply due to the provisions of paragraph 6.1.5.1.

\* TP, FN, FP and TN events are also described at paragraph 9.1. of this Appendix.

\*\* Where testing is valid to continue after T<sub>n+2</sub>, data for T<sub>n</sub> can be disregarded so T<sub>n+1</sub> becomes T<sub>n</sub>, T<sub>n+2</sub> becomes T<sub>n+1</sub>, with new data assigned to T<sub>n+2</sub>.

## 6.2. Alternative measurement(s)

6.2.1. Manufacturers may use an alternative measurement(s) to the KSS described in paragraph 6.1. above, to validate a DDAW system under the following conditions:

- (a) if the alternative measurements are obtained using a method which directly monitors the participants' state, such as Electroencephalogram or PERCLOS (percentage of eyelid closure); or
- (b) if the alternative measurements are obtained using a method fitting that which is described in paragraph 6.1. above, except for the drowsiness scale used; or
- (c) if the measurement is performed by sleep video analysis performed by at least 3 assessors (sleep experts), who do not interact with the participant and each other before the rating process is finalised. The measurement time interval for this method shall not exceed 5 minutes.

6.2.2. Where alternative measurements to the KSS are used to determine the participant's level of drowsiness, the manufacturer shall provide evidence that the chosen measurement is a valid and accurate means to assess driver drowsiness, and that the drowsiness threshold used in the validation testing is equivalent to a KSS level referred to in paragraph 5.5.2. in this Regulation.

6.2.2.1. For the sleep video analysis, expected evidence concerns the quality of the video used, the visibility of the setup for the participant, the correspondence between the rating scale and the KSS, the training of the assessors (in addition a minimal performance level of 'concordance rate' superior or equal to 0.70 is required), information of independence of the assessors to the DDAW system development, and description on how the final rating is calculated based on the input from the sleep experts.

$$\text{Concordance rate} = \sum_{i=1}^n [1 - (|A_i - B_i|)/D]/n$$

A: 'True' Drowsiness rating of the training video;

B: Evaluated drowsiness level by the sleep expert;

D: Maximum of drowsiness level occurring during the training video;

n: number of data points to rate during the training video

6.2.3. If the alternative measurements are obtained using a time interval in accordance with that specified in paragraph 6.1.2. above, paragraph 6.1.7. shall apply, where the drowsiness levels shall be expressed as KSS equivalent values, including as required by paragraph 7.

6.2.3.1. If the time interval is shorter than 5 minutes, the interpretation of paragraph 6.1.7. shall not apply. Instead:

6.2.3.1.1. a false negative event occurs only if the DDAW system does not provide a warning during the 10 minutes following the last rating below the drowsiness threshold (refer to paragraph 7); and

6.2.3.1.2. if during 5 minutes or more the ratings are above the drowsiness threshold, and then followed by a rating below the drowsiness threshold, this data point (below the drowsiness threshold) shall be treated as an outlier - all outliers shall be documented in the documentation package.

6.2.4. If the time intervals are longer than 15 minutes, the Technical Service may consider raising the requirements set by the below paragraphs 9.1. (a), and 9.1. (b) by the amount set out in paragraph 9.1. (c) to better allow for a correct assessment of the driver's drowsiness.

6.3. Complementary measurement(s)

6.3.1. Manufacturers may use complementary measurement(s) to the KSS or the alternative measurement(s) to validate a DDAW system, which shall be duly documented in the documentation package under Annex 4.

6.3.1.1. Where sleep expert video analysis is used as a complementary measurement, at a minimum two raters and an inter-rater reliability test shall be conducted, and the results shall be included in the documentation package. The facial cues and body movements/behaviours for each level of drowsiness on the KSS shall be demonstrated (usually it is a confidential document).

7. Equivalence between alternative drowsiness measurements and the KSS

7.1. If alternative measurements to the KSS are used to validate a DDAW system, the manufacturer shall state the threshold being used and provide evidence detailing the equivalency between the threshold and a KSS level of 8.

- 7.1.1. If the alternative measurement uses a scale which has fewer descriptive levels than the KSS, the equivalence between the alternative scale and the KSS shall refer to the lowest corresponding level when compared to the KSS.
- 7.1.1.1. The only exception is for the level of the alternative scale that includes the equivalency to a KSS level of 8, in which case it shall refer to the highest corresponding level when compared to the KSS. For example:
- (a) if the alternative scale level "4" corresponds to a range between "6 and 7" on the KSS, a "4" on the alternative scale shall be considered a "6" on the KSS;
  - (b) if an alternative scale level "A" corresponds to a range between "6.5 and 8.5" on the KSS, an "A" on the alternative scale shall be considered an "8" on the KSS.
- 7.2. If a complementary measurement is used in addition to the KSS or to an alternative measurement to validate a DDAW system, the manufacturer shall state the threshold being used and provide evidence detailing the equivalency between the threshold and a KSS level of 8.
8. Test results
- 8.1. Test data shall only be discarded by the manufacturer before any statistical analysis is conducted in any of the following cases:
- (a) there is an error in carrying out the testing procedure;
  - (b) the participant's KSS ratings are deemed unreliable;
  - (c) insufficient data is collected for a participant (e.g. length of trial was too short or participant did not generate at least 1 true positive event or 1 false negative event).
- 8.2. The manufacturer shall document any errors that occur during testing as part of the evidence in the documentation package, separate from the test results, along with the erroneous data and, if applicable, the reason for excluding a participant's data from the statistical analysis.
9. Acceptance criteria
- 9.1. A DDAW system shall be deemed effective by the Technical Services if the following requirements (a) or (b) is satisfied as modified, if necessary, by the requirements (c) for tests using interval time above 15 minutes and (d) for tests performed in a non-simulated (open road) environment:
- (a) The average sensitivity is above 40 per cent (Sensitivity calculated from the average of the sensitivity of all participants);
  - (b) The lower bound from the 90 per cent confidence interval of the sensitivity results shall be above 20 per cent. It means that 95 per cent of the participants statistically have more than 20 per cent average sensitivity, this is verified by satisfying the equation:
 
$$Average(Sensitivity) - 1.645 \times \frac{Standard\ Deviation(Sensitivity)}{\sqrt{Number\ of\ participants}} \geq 20\%$$
  - (c) The requirement listed in subparagraph (a) is increased by 5 per cent and the requirement listed in subparagraph (b) is increased by 2.5 per cent if the testing method does not use an interval time equal to or shorter than the 15 minutes possible in paragraph 6.2.3. above (upper bound possible between the recommended interval and the alternative interval for measurements).
  - (d) The requirement listed in subparagraph (a) is lowered by 5 per cent and the requirement listed in subparagraph (b) is lowered by 2.5 per cent if the testing method is performed on an open road.

For example, the average sensitivity required for an open road test using an interval time equal to or shorter than 15 minutes will be > 35 per cent and the average sensitivity required for a simulation test with interval time of more than 15 minutes will be > 45 per cent.

#### Performance metric calculation

The performance metrics shall be calculated as:

Sensitivity value of a participant:

$$Sensitivity = \frac{n(TP)}{n(TP) + n(FN)} \times 100 \%$$

Average sensitivity for all participants:

$$Average(Sensitivity) = \frac{\sum Sensitivity}{Number\ of\ participants}$$

Standard Deviation (Sensitivity):

$$Standard\ Deviation(Sensitivity) = \sqrt{\frac{\sum (Sensitivity - Average(Sensitivity))^2}{Number\ of\ participants}}$$

Where:

n(TP) is the total number of events in which the system and driver both correctly identify as drowsy – (TP is ‘true positive’);

n(FN) is the total number of events in which the system predicts that the driver is not drowsy, but when the driver is in fact drowsy – (FN is ‘false negative’);

n(FP) is the total number of events in which the system predicts that the driver is drowsy, but the driver is not drowsy – (FP is ‘false positive’);

n(TN) is the total number of events in which the system and driver both correctly identify as not being drowsy – (TN is ‘true negative’);

$\sum$  is the sum over all the participants.

Note: The distribution of the results is approximated by a Gaussian distribution.

- 9.2. If the DDAW system requires a learning phase, the acceptance criteria listed in paragraph 9.1. above shall exclude false negative events obtained during the system learning phase or for 30 minutes after the conditions for activation of the DDAW system are fulfilled, whichever is shorter.

## Annex 5

### **Assessment by the Technical Service of the Driver Drowsiness and Attention Warning system documentation packages and test report**

1. The Technical Service shall check that the manufacturer has proved that the DDAW system meets the technical requirements specified in paragraph 5. of this Regulation by using the validation criteria specified in Annex 4 – Appendix 1. At least the following actions are expected:
  - (a) check that the reported performance levels meet the required minimum thresholds referred to paragraph 5.5.2. of this Regulation;
  - (b) review the test report to verify whether the underlying methodology presented in the test report meets the requirements set out in Annex 4 – Appendix 1;
  - (c) perform an assessment of the test report from the validation testing carried out by the manufacturer.
- 1.1. The assessment of the test report shall verify whether the underlying evidence from the tests performed correspond with the reported test results to a level of overall effect such that the performance declaration is confirmed as being adequate. This includes assessing the participant data for statistical anomalies such as the number of outliers.
- 1.2. The Technical Service may use means at its discretion for the assessment of the test report. Such means may include a review of the full raw data sets from a selection of test drives chosen by the Technical Service (including any data that was excluded from the analysis) and re-running parts of the validation testing based on collected data (may only be possible for limited validation methods, such as sleep video analysis).
2. The Technical Service shall assess the capability of the test protocol proposed by the manufacturer to detect a drowsy driving event, including by considering the information on system functionality submitted by the manufacturer as part of the documentation package in accordance with Annex 3. The Technical Service shall also perform the test based on the proposed protocol.
- 2.1. The test shall be deemed to be passed as soon as the DDAW system provides a warning for a drowsy driver.
- 2.2. If the test fails to provide a warning for a drowsy driver, the Technical Service may repeat it up to two times.
- 2.3. The root cause of any failed test run shall be analysed by the Technical Service and the analysis shall be annexed to the test report. If the root cause cannot be linked to a deviation in the test setup, the Technical Service may test any variation of a parameter within that parameter's range, as defined in the test protocol provided by the manufacturer.
- 2.4. A reference to the code of the respective test protocol, which has been run by the Technical Service, shall be included in the "Remarks" section of the Type-Approval Certificate in order to allow competent authorities to request the test protocol from the Technical Service that carried out the test (for example, when performing market surveillance activities).