Australian Government

Department of Infrastructure, Transport, Regional Development, Communications and the Arts

Document DDADWS-09-XX
Submitted by Australia

Opportunities for improvement in the 01 series regulation on Driver Drowsiness and Attention Warning system

IWG DDADWS Meeting 9
13-15 October 2025

Purpose and approach to presentation

- Initial starting list of areas for improvement in the 00 series of new UN regulation on vehicle DDAW system.
- A starting point, not exhaustive or limiting.
- Technical requirements that are deemed to be in need of improvement will be shown for review.
- Questions to be posed for open discussion by IWG members to confirm issues and consider potential amendments.

Broad overview of topics to be covered

- Activation, learning and deactivation
- System metrics and performance limitations
- System architecture
- System warning requirements and acknowledgement by the driver
- Drowsiness threshold and validation testing

Note: Some other valid topics have been raised through other workshop presentations and so are not directly included in this particular discussion.

Activation, learning and deactivation

Manual deactivation of DDAW system

- Relevant text from 00 series regulation

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.

Activation, learning and deactivation

Manual deactivation of DDAW system (cont'd)

- Questions / considerations for 01 series

Para 5.3.1. (aligned with the EU reg) was included for 00 series, in part due to concerns over a manufacturer possibly allowing a driver to fully deactivate a DDAW system that benefits from continual learning, and so is slow to 're-activate'. However, improvements are possible, such as;

1) Making a distinction between systems using indirect means and direct means with respect to the ability to manually deactivate the DDAW system?
2) For a system using indirect means, disallow manual deactivation only if the system requires a learning phase > [X] minutes?
3) Always allow manual deactivation of a system using direct means on the basis that vehicle occupants may have privacy concerns?
4) Should it be mandatory to have separate controls for deactivation of the DDAW system warnings and the ADDW system warnings, as they monitor for very different driver states?

Activation, learning and deactivation

Automatic reinstatement of DDAW system

- Relevant text from 00 series regulation

5.3.4.	The DDAW system, including HMI warnings, shall be automatically reinstated to normal operation mode at each initiation of the powertrain.[3,4] 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.

Activation, learning and deactivation

Automatic reinstatement of DDAW system (cont'd)

- Questions / considerations for 01 series

5.3.4. The DDAW system, including HMI warnings, shall be automatically reinstated to normal operation mode at each initiation of the powertrain. The vehicle manufacturer can choose to make such automatic reinstatement to be dependent upon one of the following conditions **having been met, whichever occurs first**:

The above proposal of text within para 5.3.4. of "…having been met, whichever occurs first…" was not adopted for the 00 series of the regulation. The justification for the proposal included that:

1) where a manufacturer **only considers the inactive powertrain period** this could lead to not having the DDAW system reinstated upon recommencement of driving after e.g.:
    a. a new driver entering the vehicle within the XX minute period;
    b. a driver making brief fuel / toilet stops and continuing to drive for a very long time in total.

Activation, learning and deactivation

Automatic reinstatement of DDAW system (cont'd)

- Questions / considerations for 01 series

2) where a manufacturer **only considers the driver's door status** this could lead to not having the DDAW system reinstated upon recommencement of driving after e.g.:

   a. the same driver spending a considerable amount of time in a 'parked' state with the vehicle systems switched off (e.g. working on laptop, talking on phone, eating, attempting to sleep);

   b. the same driver staying in the vehicle and having a passenger exit to attend to fuel stops.

Sample extract from Euro NCAP Safe Driving Driver Engagement protocol version 1 March 2025

To be eligible for scoring points in Driver Monitoring, the following conditions shall be met:

- The DSM system shall be default ON at the start of every journey and deactivation of the system shall not be possible with a momentary single push on a button.

Activation, learning and deactivation

Automatic reinstatement of DDAW system (cont'd)

- Questions / considerations for 01 series

3) Based on the concerns raised over the 00 series requirements for automatic reinstatement, the Euro NCAP extract, and our objectives on achieving improved road safety benefits:

   a. Should the additional conditions should remain available for triggering automatic reinstatement of the DDAW system, but as previously proposed as "…having been met, whichever occurs first…" to avoid some of the scenarios raised?

   b. In addition to an automatic reinstatement strategy potentially modified as per a. above, should we require systems using direct means to trigger reinstatement whenever the driver has been changed, i.e. not dependent upon a new initiation of the powertrain?

   c. Should the additional conditions (driver's door, time switched off) be removed entirely such that automatic reinstatement always occurs at each initiation of the powertrain?

Activation, learning and deactivation

Vehicle speed range in which the DDAW system must be active

- Relevant text from 00 series regulation

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.

Sample extract from Euro NCAP Safe Driving Driver Engagement protocol version 1 March 2025

1.1 General Requirements

For the distraction, microsleep, sleep and unresponsive driver states, the vehicle shall warn and/or intervene at forward speed of at least 20 km/h or for Lane Support at the

1.3.2 Drowsiness

Systems capable of detecting a driver reaching a KSS level >7 at the latest, or an equivalent metric appropriate to assess risky levels of drowsiness are eligible to score points. The system shall be functional from 50 km/h.

Activation, learning and deactivation

Vehicle speed range in which the DDAW system must be active (cont'd)

- Questions / considerations for 01 series

1) Even though there is increased risk of driver fatigue at constant speed such as typical highway conditions, should the 01 series of the regulation still consider that:
    a. for at least systems using direct means, the lower limit of the speed range could be reduced to e.g. 30-40 km/h, from which the DDAW system must warn drivers at KSS of level 8 or more, and upon detection of microsleep?
    b. if a. was adopted, any warnings at KSS level of less than 8 could be suppressed until the 'normal' operational speed (e.g. 50 km/h) – would this be appropriate?

Note: amendment a. could provide a considerable road safety benefit to in scenarios where drowsiness conceivably occurs frequently; e.g. a tired shift worker returning home in an urban area.

Activation, learning and deactivation

Interruptions and reset of the learning phase

- Relevant text from 00 series regulation

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.
5.3.8.	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.
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.

Activation, learning and deactivation

Interruptions and reset of the learning phase (cont'd)

Sample extract from Euro NCAP Safe Driving Driver Engagement protocol version 1 March 2025*

1.1 General Requirements

lowest operational speed. For the impairment driver states, when the vehicle is moving forward at a speed of at least 50 km/h and for detection of these impairment states, a learning period at a speed of at least 50 km/h of up to 10 minutes is permitted from the start of every journey.

Note: The above extract is not being suggested as good drafting or a good benchmark, but is included for reference as per other extracts from the protocol.

* The '**safervans**' protocol (version 1 May 2025) sets speeds of 65 km/h in the equivalent paragraph for the drowsiness state, however it is unclear if this is an error as the system is also required to be functional from 50 km/h for detection of the drowsiness state.

Activation, learning and deactivation

Interruptions and reset of the learning phase (cont'd)

- Questions / considerations for 01 series

A new para 5.3.6.2. was proposed for 00 series as a logical complement to the paragraph 5.3.6.1. covering speed beyond the nominal speed range, and to address some concerns regarding the learning phase time limit and the possibility of reset triggers causing the actual learning time to become excessive.

5.3.6.2. Once activated, the DDAW system shall not be automatically deactivated at a vehicle speed of below 65 km/h such that a system learning phase allowed by paragraph 5.3.8. that is incomplete is reset or paused. Interruptions to this learning phase are however acceptable where the period of this reduced speed is excessive in the context of the system design and monitoring limitations, as documented by the manufacturer in accordance with Annex 3 para 1.3.

1.3. The information provided in accordance with para 1 (f) shall include the strategy and limitations for completion of the system learning phase following deviations from the activation speed, including periods where the vehicle speed falls below the lower limit of the normal operational speed range.

Activation, learning and deactivation

Interruptions and reset of the learning phase (cont'd)

- Questions / considerations for 01 series

1) What are the views of the IWG on the importance of setting requirements to ensure that any allowed system learning phase does not become excessive through continual pause and/or reset?
    a. It would be useful to consider information on e.g. the system designs that do / don't require a learning phase, the benefits of the learning phase, the typical duration of learning phases.
2) What are the views of the IWG on the proposed text (not adopted for the 00 series) shown on the preceding slide for para 5.3.6.2?
3) What are the views of the IWG on the proposed text (not adopted for the 00 series) shown on the preceding slide for Annex 3 para 1.3?

Activation, learning and deactivation

Driving conditions under which the DDAW system must operate effectively

- Relevant text from 00 series regulation

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.

Activation, learning and deactivation

Driving conditions under which the DDAW system must operate effectively (cont'd)

- Questions / considerations for 01 series

1) Should we be more prescriptive in the 01 series of the regulation as to the range of conditions where it is not acceptable that the DDAW system effectiveness is degraded, including:
   a. weather conditions that can be shown to occur at a significant frequency?
   b. road conditions that are of significance regarding;
      i. proportion of national road network they represent?
      ii. road type highly correlated with crashes caused by driver drowsiness? (see next slide on this)

Activation, learning and deactivation

Driving conditions under which the DDAW system must operate effectively (cont'd)

- Questions / considerations for 01 series

Further to question 1. b) ii on the previous slide:

This may mean that systems using indirect means must be capable of detecting road edges in the absence of lane markings, on the basis that the metrics used to assess for reduced alertness of the driver includes data relating to the position of the vehicle relative to the lane markings, and noting:

- Lane markings are often absent in rural areas.
- According to the University of Adelaide's Centre for Automotive Safety Research's in-depth crash investigation database, of the 260 crashes that were investigated since 2014 on South Australian rural high-speed roads, there was a dashed centreline for 25% of the head-on crashes and no edgeline for 31% of the run off road crashes.

Activation, learning and deactivation

Driving conditions under which the DDAW system must operate effectively (cont'd)

- Questions / considerations for 01 series

Examples of conditions which could be added as 'normal operating conditions', in this case adapted from EU/UN regulation on ELKS (and proposed amendments for 01 series of the UN regulation), most of which would only be relevant for DDAW systems using indirect means:

- solid line and dashed lane markings in line with one of those described in Annex 3 (Visible lane marking identification) to UN Regulation No 130 in its 01 series of amendments;
- with the markings being in good condition and of a material conforming to the standard for visible markings of that contracting party;
- in all illumination conditions without blinding of the sensors (e.g. direct blinding sunlight) and with activated passing-beam (dipped-beam) headlamps if necessary;

Activation, learning and deactivation

Driving conditions under which the DDAW system must operate effectively (cont'd)

- Questions / considerations for 01 series

Cont'd from previous slide

Examples of conditions which could be added as 'normal operating conditions', in this case adapted from EU/UN regulation on ELKS (and proposed amendments for 01 series of the UN regulation), most of which would only be relevant for DDAW systems using indirect means:

- in absence of weather conditions affecting the visibility of lane markings or the road edge (e.g. no fog);
- for road edges (where lane markings are not present), the road edge shall consist of grass and/or gravel or any other substitute agreed between the manufacturer and the Technical Service, for example, soil.

System metrics and performance limitations

Metrics used by the DDAW system

- Relevant text from 00 series regulation

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.

System metrics and performance limitations

Metrics used by the DDAW system (cont'd)

- Questions / considerations for 01 series

Should it be mandatory for the DDAW system to include particular data for calculation of metrics, even if these are only secondary metrics, to increase reliability of the system under varied conditions? For example, data that can be positively correlated with development of fatigue, such as:

1) trip duration with same driver?
2) total driving time in last X hours?
3) driving time at 'constant speed'?
4) traffic density?
5) time of day?
6) weather conditions?

System metrics and performance limitations

Limitations of systems using indirect means, and performance of alternate DDAW system

- Relevant text from 00 series regulation

5.5.	Monitoring driver drowsiness
5.5.1.	The DDAW system shall assess driver drowsiness by direct means and/or indirect means.
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 robust 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.

System metrics and performance limitations

Limitations of systems using indirect means, and performance of alternate DDAW system (cont'd)

- Questions / considerations for 01 series

For the situation of para 5.3.2. (b), where a DCAS is active; as UN R171 does not currently include drowsiness monitoring as part of the Driver State Monitoring requirements, this would prevent a DDAW system from being automatically deactivated. However, a DDAW system using **indirect means** cannot effectively assess driver drowsiness in a situation where the driver is not nominally required to steer, brake, accelerate the vehicle. Does this result in the need for either (or all):

1) UN R171 to be updated accordingly? or
2) provisions in the 01 series of the DDAW system regulation that disallow use of indirect means in a vehicle that includes a DCAS? or
3) a DCAS can only be activated in a vehicle with a DDAW system using indirect means if e.g.;
    a. the last assessed alertness level was > X?
    b. the DCAS will only remain active for a maximum of Y minutes?

System metrics and performance limitations

Limitations of systems using indirect means, and performance of alternate DDAW system (cont'd)

- Questions / considerations for 01 series

The text shown below from para 5.3.2. (b);

"….a robust 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."

was a compromise for the 00 series of the regulation. An amendment proposed at Mtg 8 was:

"….an appropriate driver monitoring system that will include assessment of the driver's reduced alertness and warn the driver via the vehicle's HMI when they are assessed to be drowsy, **and is performing at least at an equivalent level as to this Regulation**."

1) Although this text requires refinement, the intended improvement was to be more prescriptive in terms of the performance level that must be achieved by the alternate driver monitoring system. What is considered to be a suitable approach to drafting relevant requirements?

System architecture

'Backup' DDAW system functionality through indirect means

- Relevant text from 00 series regulation

5.5. Monitoring driver drowsiness

5.5.1. The DDAW system shall assess driver drowsiness by direct means and/or indirect means.

- Questions / considerations for 01 series

1) Is there a safety case and technological justification for requiring that every DDAW system using direct means also have a 'backup' system using indirect means, for use in situations such as when the direct means may not properly function due to the driver wearing tinted glasses or a hat, or where the driver may deactivate the direct means for privacy reasons?
   a. Can it be considered that the vehicle sensors required to implement an indirect system are likely to be fitted to most vehicles regardless of their potential use for this purpose?
2) How might performance requirements differ for such a backup system?

System architecture

‘Backup’ DDAW system functionality through indirect means (cont’d)

Sample extract from Euro NCAP Safe Driving Driver Engagement protocol version 1 March 2025

1.1.1 Noise Variables

A robust DSM system is expected to cover a wide variety of drivers, occlusions and driver behaviours to provide the highest societal safety benefit. To receive points in the DSM assessment, the whole range of each driver, occlusion and behaviour listed below shall be covered.

System architecture

‘Backup’ DDAW system functionality through indirect means (cont’d)

Sample extract from Euro NCAP Safe Driving Driver Engagement protocol version 1 March 2025*

1.1.1.2 Occlusion

Noise Variables	Ranges / Elements	Performance Requirement
Lighting	Daytime (100,000 lux) – night-time (1 lux)	Functional
Eyewear	Clear sunglasses with >70% transmittance * including those with thick rims.	Functional
	Sunglasses with a <15% transmittance*	Inform if not functional
Facial hair	Short facial hair (<20mm in length)	Functional
	Long facial hair (>150mm in length)	Functional
Hand on wheel	One hand on wheel at 12 o’clock position	Inform if not functional
Facial occlusion	Face-mask (Protective equipment guarding the airways)	Functional
	Hats	Inform if not functional
	Long head hair fringe obscuring eyes	Inform if not functional
Eyelash makeup	Thick eyelash makeup	Inform if not functional

** Referred to light in the wavelength operated by the camera (Transmittance of sunglasses shall correlate to the light used by the sensor).*

*Inform if not functional for ‘safervans’

*Inform if not functional for ‘safervans’

System warning requirements and acknowledgement by the driver

Suppression of warnings from the DDAW system on a priority basis

- Relevant text from 00 series regulation

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.

- Questions / considerations for 01 series

5.3.3. was a compromise for the 00 series of the regulation. An amendment proposed at Mtg 8 was:

"… or a critical situation, as long as those warnings are at least as intrusive as described for the DDAW system in accordance with paragraph 5.6."

1) Although this text requires refinement, the intended improvement was to be more prescriptive in terms of the performance level from other system warning(s) to allow suppression of the DDAW system warning. What is considered to be a suitable approach to drafting relevant requirements?

System warning requirements and acknowledgement by the driver

Drowsiness warnings from system

- Relevant text from 00 series regulation

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).

System warning requirements and acknowledgement by the driver

Drowsiness warnings from system (cont'd)

Sample extract from Euro NCAP Safe Driving Driver Engagement protocol version 1 March 2025

1.4.2 Non-Transient state warning requirements

A visual and (haptic and/or audible) warning shall be issued immediately after driver is classified as impaired, sleeping or unresponsive.

Microsleep and sleep warnings shall be distinct and deliver a higher perceived level of urgency than the distraction and impairment warnings.

Alternatively, prompting rest areas in the navigation system are allowed as a warning for impaired states.

Not included in the 'safervans' protocol

Note: it is not clear if the rest area prompts alone are accepted in the protocol as a warning for drowsiness (form of impairment), however it is suggested this is better reserved for early drowsiness warnings at lower KKS before warning escalation at increased drowsiness where required.

System warning requirements and acknowledgement by the driver

Drowsiness warnings from system (cont'd)

- Questions / considerations for 01 series

Concerns with 00 series para 5.6.1.1. warning nature requirements for discussion by the IWG include:

1) **Warning type**; it is not clear (despite follow-on paragraphs dedicated to warning types) that any particular type of warning is mandatory. For example, a manufacturer may choose to only implement a visual warning as a means of alerting the driver, which is far from ideal and may be completely ineffective under many circumstances of driver drowsiness.
2) **Warning format**; if both a visual and acoustic warning are implemented, the visual warning does not need to include an informational element to readily explain to the driver what the accompanying acoustic warning is indicating (e.g. a short text message about drowsiness).

System warning requirements and acknowledgement by the driver

Drowsiness warnings from system (cont'd)

- Questions / considerations for 01 series

Concerns with 00 series para 5.6.1.1. warning nature requirements for discussion by the IWG include:

3) **Haptic warning**; this was included (optional type) with very basic requirements as a minor improvement over the EU regulation. However, as this warning type is widely considered very effective, the requirements for the 01 series should be more prescriptive to ensure both a minimum level of performance as well as some degree of consistency in implementation.

System warning requirements and acknowledgement by the driver

Drowsiness warnings from system (cont'd)

- Questions / considerations for 01 series

Concerns with 00 series para 5.6.1.1. warning nature requirements for discussion by the IWG include:

4) Acknowledgement by the driver;

a. it would ideally be clarified better as to what action constitutes 'acknowledgement', and what the DDAW system shall do following this action.

b. there is a fundamental difference between the warning persisting for as long as the system continues to detect drowsiness, and the system being muted due to an action taken by the driver (e.g. press button on dashboard / screen or steering column stalk) that is considered to be 'acknowledgement' of the warning.

c. the driver could still be very drowsy at the time they provide 'acknowledgement', so in such a case, is it justified to mute the warning, and for how long?

System warning requirements and acknowledgement by the driver

Drowsiness warnings from system (cont'd)

- Questions / considerations for 01 series

Concerns with 00 series para 5.6.1.1. warning nature requirements for discussion by the IWG include:

5) Acknowledgement by the driver - Interaction with testing procedure;

a. 'acknowledgement' is also important in the context of the testing procedure, whereby the Annex 4 - Appendix 1 para 6.1.4.1 requirements in 00 series set that a test run shall end once a true positive warning is given.

b. if an 'acknowledgement' results in an extended period of e.g. muted warnings or a DDAW system 'sleep mode', this combined with the validation procedure misses the opportunity to ensure (through testing) that the system continues to accurately detect drowsiness under conditions where the driver and/or vehicle behaviour may change in that time.

System warning requirements and acknowledgement by the driver

Drowsiness warnings from system (cont'd)

- Questions / considerations for 01 series

Concerns with 00 series para 5.6.1.1. warning nature requirements for discussion by the IWG include:

6) Acknowledgement by the driver – assessment of requirement;

a. if the requirements of para 5.6.1.1. set that an 'acknowledgement' of the warning by the driver is mandatory in order to stop the warning, how is such acknowledgement assessed by a Technical Service or Type Approval Authority?

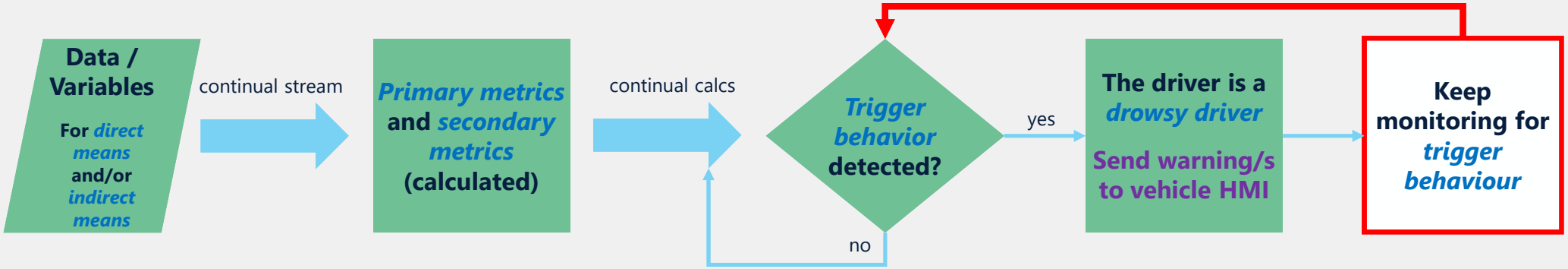
Sample extract from Euro NCAP Safe Driving Driver Engagement protocol version 1 March 2025

1.1 General Requirements

The DSM system shall continuously monitor the driver state. For the system to start measuring the driver state, a total of 1 minute of driving at forward speed of at least 10 km/h is allowed.

Continuous monitoring not set by 00 series

Simplified schematic – link between definitions and terms – basic processing steps by the DDAW system:



Definition of "trigger behavior" lists typical data source categories monitored by the DDAW system. The monitoring takes place for systems using direct and/or indirect means.

New definitions of "primary metrics" and "secondary metrics", linking these to detection of drowsiness. The definition of "trigger behavior" makes reference to these metrics.

The updated definition of "trigger behavior" makes reference to the metrics, the data monitored to determine those metrics, and the link to new definition of "drowsy driver".

The new definition of "drowsy driver" makes reference to a level of drowsiness that requires DDAW system warning in accordance with the regulation*.

*note an important distinction from definition of "drowsiness threshold"; a DDAW system that meets the regulation may be designed such that a "drowsy driver" includes KSS levels of 7 to 9, otherwise levels 8 to 9, whereas the system threshold can only be either KSS level of 7 or 8.

System warning requirements and acknowledgement by the driver

System failure warnings

- Relevant text from 00 series regulation

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.

System warning requirements and acknowledgement by the driver

System failure warnings (cont'd)

- Questions / considerations for 01 series

A new para 5.7.2.2. was proposed for the 00 series to take a similar approach as with the ADDW and provide information to the driver when the performance of the DDAW system is temporarily degraded.

5.7.2.2. Information shall be provided to the driver concerning the current limitation of the DDAW system and/or typical limitations of the DDAW system. The limitations concerned include the ones causing the DDAW system to temporarily function inadequately because insufficient driver facial features are detectable (where applicable) due to excessive driver-, vehicle-, environment-related or other elements that affect the performance of the DDAW system. The vehicle manufacturer may use an active approach via an additional visual warning and/or a passive approach via written information.

1) Should this system capability also be included as a requirement for the 01 series of the regulation?

Drowsiness threshold and validation testing

Drowsiness threshold for system warnings

- Relevant text from 00 series regulation

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.

Drowsiness threshold and validation testing

Drowsiness threshold for system warnings (cont'd)

- Questions / considerations for 01 series

Some feedback within the IWG has been received suggesting that:

- Using KSS level 7 as the threshold for warning trigger is a problem, as it misses early hypovigilance (fatigue-related inattention) which occurs and become problematic before physical drowsiness is felt.
- Hypovigilance affects a critical process (signal detection, sustained attention, reaction times etc.), is highly prevalent (fatigue always start by hypovigilance), so is the stronger contributor of fatigue to crash risk, over and above drowsiness.
- Consequently, a KSS level 6 as the threshold would be safer with an effective warning strategy (e.g., a multistage warning strategy with less annoying signals that escalate).
- The system should warn a driver of the early signs of fatigue (hypovigilance) to recommend a break giving them time to plan. In this way the process becomes proactive, not only reactive, and it does not omit to include a very significant portion of the general fatigue risk.

Drowsiness threshold and validation testing

Drowsiness threshold for system warnings (cont'd)

- Questions / considerations for 01 series

The previous feedback is counter to alternate feedback received, which promotes an increase in the drowsiness threshold to a KSS level of 8 only (i.e., removal of the optional threshold of KSS level of 7).

We will need to compare the relative merits of (at a broad level):

- earlier system intervention but with less 'aggressive' warnings that escalate with increase in driver drowsiness level, where each new warning is more likely to be expected; against
- later system intervention that would have a more aggressive or faster escalating warning strategy, with these warnings occurring at a point in time where the driver is more likely to initially relate to the warning through the way they are feeling (i.e. due to their higher KSS level).

Drowsiness threshold and validation testing

Concealment of warnings during validation testing

- Relevant text from 00 series regulation

Annex 4 – Appendix 1, para 6.1.3.

During the validation tests, ~~it is recommended to mute~~ the warnings from the DDAW system **shall be concealed** to prevent changes of the status of the participant before the next self-assessment. The time at which the warning from the DDAW ~~is provided (muted or not)~~**occurs** shall be recorded to clearly establish if it is a true positive event.

- Questions / considerations for 01 series

As shown in amendments to para 6.1.3. above, it is proposed that concealing the warnings should not be recommended but rather mandated. This is considered to not only lead to more a consistently applied testing methodology, but a more robust standard of testing.

Drowsiness threshold and validation testing

False negative events

- Relevant text from 00 series regulation (Annex 4 – Appendix 1)

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.

Drowsiness threshold and validation testing

False negative events (cont'd)

- Questions / considerations for 01 series

The below new paragraph 6.1.5.3. was proposed for 00 series (with consequential para numbering edits).

6.1.5.3. After a transition in participant KSS level as described by paragraph 6.1.5.1. which results in the recording of a false negative event, successive false negative events shall be recorded every [X minutes] where;

6.1.5.3.1. the participant rating does not fall back below a KSS level of 8 and then increase to a KSS of level 8 or above again; and

6.1.5.3.2. no warning is given by the DDAW system.

This proposes that successive false negative events may be recorded following the first event recorded in accordance with para 6.1.5.1, and where a repeat transition in participant KSS level does **not** occur, subject to a time lapse of [X] minutes.

Drowsiness threshold and validation testing

False negative events (cont'd)

- Questions / considerations for 01 series
- The 00 series requirements essentially do not impose any time-based penalty when calculating the sensitivity of the system, and yet validation testing requires regular measurements at relatively short time intervals (nominally 5 minutes).
- Receiving a true positive after driving drowsy for e.g. 3 hours, currently assists with compliance of the system to requirements (participant sensitivity of 50% via 1FN, 1TP), but may rightly lead to criticism.
- The DDAW system should not be assessed to only detect what a driver may self-report as a particular **change** in drowsiness level, but rather it is meant to detect drowsiness of a particular level, regardless of whether that is a change from e.g. 5 minutes ago.
- It is the drowsiness of the driver at any point in time that presents the road safety issue, not just the time around a specified drowsiness level change. Ideally the system shall be evaluated accordingly.

Drowsiness threshold and validation testing

Calculation of participant sensitivity value

- Relevant text from 00 series regulation (Annex 4 – Appendix 1)

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.

Drowsiness threshold and validation testing

Calculation of participant sensitivity value (cont'd)

- Relevant text from 00 series regulation (Annex 4 – Appendix 1)

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);

Performance metric calculation

The performance metrics shall be calculated as:

Sensitivity value of a participant:

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

Drowsiness threshold and validation testing

Calculation of participant sensitivity value (cont'd)

- Questions / considerations for 01 series

1) Should the text clarify that the "Sensitivity value of a participant" is;

   a. the total for a given participant across all separate tests they were involved in for the particular validation testing, and even if e.g. those tests were conducted on separate days?

   b. how that average is to be calculated, on the basis that combining all TP and FN from separate test runs into the one overall calculation can lead to different results to a calculation of the sensitivity value separately for each test run and then calculating an average, for that participant?

   This would help ensure a more robust testing procedure and consistent application of the requirements amongst manufacturers.

Drowsiness threshold and validation testing

Assignment of participant drowsiness ratings to testing intervals

- Relevant text from 00 series regulation (Annex 4 – Appendix 1)

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.
6.1.4.	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.

Drowsiness threshold and validation testing

Assignment of participant drowsiness ratings to testing intervals (cont'd)

- Questions / considerations for 01 series

1) Is para 6.1.4. in conflict with para 6.1.2, which states "…each measurement obtained shall be assumed to cover the previous interval", in conjunction with the requirements of para 5.5.2 that set a drowsiness warning threshold at KSS of level 8, but also allow warnings to be given at KSS of level 7?
    a. For example, the participant declares a rating of 7, the next time interval begins, the DDAW system provides a warning near the end of that interval, after which the participant declares a rating of 6.
2) Should para 6.1.2 be updated to more fully reflect para 6.1.4 and the general testing procedure?

thank you

Department of Infrastructure, Transport,
Regional Development, Communications and the Arts