EURO NCAP

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Driver Monitoring Test Procedure

Safe Driving

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PREFACE

DISCLAIMER: Euro NCAP has taken all reasonable care to ensure that the information published in this protocol is accurate and reflects the technical decisions taken by the organisation. In the unlikely event that this protocol contains a typographical error or any other inaccuracy, Euro NCAP reserves the right to make corrections and determine the assessment and subsequent result of the affected requirement(s).

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INTRODUCTION

The assessment of Driver Monitoring systems is detailed in the Euro NCAP Driver Engagement protocol. This assessment is based on information provided to Euro NCAP by the Vehicle Manufacturer along with spot testing that is conducted by the Euro NCAP laboratories.

Euro NCAP requires the Vehicle Manufacturer to provide a dossier that contains sufficient technical detail of all Driver Monitoring assessment areas. This Technical Bulletin specifies the complementary spot testing for Driver Monitoring testing. The dossier shall be provided to the Euro NCAP Secretariat at least 2 months before any testing begins.

1 MEASURING EQUIPMENT

Sample and record all video data at a frequency of at least 25Hz.

1.1 Measurements and Variables

T	Time
T_0	Start of test (T_{away} – 4.0s or T_{close} – 4.0s)
T_{away}	Time of first eye movement looking away from forward road view ahead or looking away from gaze location
T_{gaze}	Time of glance first landing on gaze location
T_{road}	Time of glance first landing on forward road view ahead
T_{close}	Time of first continuous eyes closed (no eye visible)
T_{warn}	Time of first instance of audio/visual warning
T_{FCW}	Time where FCW activates with attentive driver
T_{FCW_inatt}	Time where FCW activates with inattentive driver
T_{LDW}	Time where LDW activates with attentive driver
T_{LDW_inatt}	Time where LDW activates with inattentive driver

1.2 Measuring Equipment

Equip the VUT with data measurement and acquisition equipment to sample and record data with an accuracy of at least:

- VUT speed to 0.1km/h
- Driver gaze location
- In-vehicle warning(s)

2 TEST CONDITIONS

2.1 Test Track

Conduct tests on a uniform, solid-paved surface.

The presence of lane markings is allowed for DSM testing. The lane for the VUT and GVT will have a width of 3.5 to 3.7m. The lane markings on these lanes need to conform to one of the lane markings as defined in UNECE Regulation 130.

2.2 Weather Conditions

For DSM testing, no precipitation shall be falling and horizontal visibility at ground level shall be greater than 1km. Wind speeds shall be below 10m/s to minimise GVT disturbance in tests where applicable.

Natural ambient illumination shall be homogenous with no strong shadows cast across the test area other than those caused by the VUT or GVT. Ensure testing is not performed driving towards, or away from the sun when there is direct sunlight.

2.3 Vehicle Preparation

Fit the on-board test equipment and instrumentation in the vehicle to observe the driver application of the test scenario and the relative timing of the DSM response. Also fit any associated cables, cabling boxes and power sources.

3 TEST PROCEDURE

3.1 VUT Pre-test Conditioning

A new car is used as delivered to the test laboratory.

If requested by the Vehicle Manufacturer, drive a maximum of 100km on a mixture of urban and rural roads with other traffic and roadside furniture to ‘calibrate’ the sensor system for the collision avoidance technology (FCW and LDW). Avoid harsh acceleration and braking.

Where assessing FCW and/or LDW optimisation, perform a maximum of ten runs at the lowest speed the systems are supposed to work, to ensure proper functioning of the systems ahead of investigating timing optimisation with driver inattention.

3.2 Test Conduct

3.2.1 VUT

Before initiating testing, drive the vehicle for at least 1 minute fully attentive at a speed of ≥10km/h to allow the DSM time to identify the driver and enable the system. In case a fault is reported, make adjustments and repeat the process to enable the system.

Check that the system is default ON at the start of every journey and that deactivation of the system should not be possible with a momentary single push of a button. The test driver should record the actions required to deactivate the DSM system.

For vehicles with an automatic transmission select D. For vehicles with a manual transmission select the highest gear where the RPM will be at least 1500 at the test speed. If fitted, a speed limiting device or cruise control may be used to maintain the VUT speed (not ACC and Lane Centering), unless the Vehicle Manufacturer shows that there are interferences of these devices with DSM system in the VUT.

3.2.2 Driver attributes

The test driver shall have attributes in the required range of the variables specified in the Euro NCAP Driver Engagement protocol.

Adjust seating position and driving controls to a comfortable position for the driver to safely drive the vehicle and allow the DSM a clear view of the driver’s face.

3.2.3 Driver states

Throughout the different driver state tests, the driver should maintain consistent body posture (not relaxing or elevating).

Head turning (for owl movements) or eye-gazing (for lizard movements) shall be directed toward the gaze location at a natural rate of movement.

3.2.3.1 Movement types

3.2.3.1.1 Lizard

A small rotation of the head is allowed for lizard movements toward gaze locations far from the forward road view (e.g., passenger face).

3.2.3.1.2 Body lean rear passenger

Movement should be carried out as if shifting visual attention away from the road and forward-facing position to view over their shoulder to focus on opposite side rear head restraint.

Keeping both hands on the steering wheel, the driver should rotate upper body posture with head turning in owl-like movement to view opposite side rear head restraint at a natural rate of movement. Maintain gaze at the location for up to a maximum of 5 seconds. Return gaze directly to the forward road view after the warning is issued.

3.2.3.1.3 Body lean passenger footwell

Movement should be carried out as if shifting visual attention away from the road and forward-facing position to reach down to the passenger footwell.

Keeping their driver-side hand on the steering wheel, the driver should lean upper body posture with head turning in owl-like movement and reach down towards the centre of the passenger footwell with their passenger side arm at a natural rate of movement. Maintain gaze at the location for up to a maximum of 5 seconds. Return gaze directly to the forward road view after the warning is issued.

4 TEST SCENARIOS

The transient and non-transient driver states are described in the Euro NCAP Driver Engagement protocol.

4.1 Warning tests

For tests intended to assess warning timing, drive the test vehicle in a straight line at a speed in the range of 20 to 80km/h. Between T_0 and $T_{away,}$ the driver shall be fully attentive with eyes on the forward road view. The test ends when the warning is issued.

4.1.1 Transient states

4.1.1.1 Long distraction

Maintain gaze at the location for up to a maximum of 5 seconds. Return gaze directly to the forward road view after the warning is issued.

Driver shall perform all movement types claimed to function in each long distraction scenario, randomly selecting half of the gaze locations for spot testing. For each distraction scenario and movement type, use dissimilar gaze locations where possible to broaden the assessment.

4.1.1.2 Short distraction and phone use

Movement sequence shall be conducted according to the VATS strategy implemented by the Vehicle Manufacturer, as described in the Driver Monitoring dossier.

Driver shall perform all movement types claimed to function in each short distraction and phone use scenarios, spot testing half of the gaze locations. For each distraction scenario and movement type, use dissimilar gaze locations where possible to broaden the assessment.

4.1.2 Non-transient states

4.1.2.1 Drowsiness and Non-fatigue related impairment

For the drowsiness scenario the Vehicle Manufacturer shall supply a dossier detailing the detection strategy and how their vehicle responds. Euro NCAP reserve the right to practically investigate the DSM system performance to verify the information in the dossier.

4.1.2.2 Microsleep

Close eyes with a neutral head position for a maximum of 4 seconds. Return gaze directly to the forward road view after the warning is issued.

Alternatively, a driver microsleep test method as illustrated by the Vehicle Manufacturer in the dossier, and considered acceptable and practicable by Euro NCAP.

4.1.2.3 Sleep

Close eyes with an initial neutral head position, for a maximum of 7 seconds. Return gaze directly to the forward road view after the warning is issued.

Alternatively, a driver sleep test method as illustrated by the Vehicle Manufacturer in the dossier, and considered acceptable and practicable by Euro NCAP.

4.1.2.4 Unresponsive Driver

4.1.2.4.1 Sleep Option

Close eyes with an initial neutral head position for a minimum of 13 seconds to trigger the EF distinct warning, followed by EF intervention, and maintain closed eyes until the EF intervention is finalized.

Alternatively, using an alternative sleep-like unresponsive driver test method as illustrated by the Vehicle Manufacturer in the dossier, and considered acceptable and practicable by Euro NCAP.

4.1.2.4.2 Distraction Option

Maintain gaze at the driver lap gaze location for up to a minimum of 14 seconds to trigger the EF distinct warning, followed by EF intervention, and maintain the gaze fixation until the EF intervention is finalized.

Alternatively, using an alternative distraction-like unresponsive driver test method as illustrated by the Vehicle Manufacturer in the dossier, and considered acceptable and practicable by Euro NCAP.

4.2 Intervention tests

To check sensitivity change, the following spot checks shall be conducted:

- One spot check for Forward Support Sensitivity (in a randomly elected scenario amongst CCRs, CMRs and CCRm scenarios of Crash Avoidance Frontal Collisions, within the ‘Standard Range not adjacent to Extended Ranges’ speeds and impact locations) in a randomly selected Transient driver state (where performance is claimed).
- One spot check for Lane Support Sensitivity (in a randomly selected LKA Dashed Line case) in a randomly selected Transient driver state (where performance is claimed).
- One spot check for Forward Support Sensitivity or Lane Support Sensitivity in a randomly selected Non-Transient driver state (where performance is claimed, except impairment unless realizable).
- One spot check for Unresponsive Driver (where performance is claimed)

All random selections shall be done by the Euro NCAP Secretariat and for Transient driver states, where possible, shall combine dissimilar driver states and/or movements/gaze locations to broaden the assessment. Random selection for Lane Support Sensitivity shall be according to Table 1.

The driver’s state under test shall be realized (e.g., driver’s gaze at the gaze location) 1 +0.5 s before the activation timing of the system under test (e.g., FCW, AEB, LDW) in its distracted/impaired setting. The activation timing shall be provided by the Vehicle Manufacturer or investigated by the Test Laboratory prior to the test. For Lane Support Sensitivity, the Vehicle Manufacturer may specify a specific activation timing and/or triggering condition.

	Fixed parameter			Variable parameter (randomly selected where performance is claimed)					
	Lane Marking	V_{Long}	V_{Lat}*	Departure Direction	Distraction Type	Glance Target Type	Movement Type	Glance Location	Expected Behavior
Baseline	Dashed	70 km/h	0.3 m/s	Driver	None	None	None	Forward road view	Suppression/ Warning only/ …
				Passenger	None	None	None	Forward road view	According LDC protocol 5.2.1.3 Driver State Link
Transient	Dashed	70 km/h	0.3 m/s	Driver	Long Distraction	Driving / Non-driving task	Owl / Lizard / Body lean	Glovebox	Steering Intervention
				Passenger	Long Distraction	Driving / Non-driving task	Owl / Lizard / Body lean	In-vehicle infotainment system	
				Driver	VATS	Driving / Non-driving task	Owl / Lizard	Toggle forward road view ↔ passenger footwell	
				Passenger	VATS	Driving / Non-driving task	Owl / Lizard	Toggle forward road view ↔ instrument cluster	
				Driver	Basic Phone Usage	-	Owl / Lizard	Toggle forward road view ↔ driver knee outboard	
				Passenger	Basic Phone Usage	-	Owl / Lizard	Toggle forward road view ↔ driver lap	
				Driver	Advanced Phone Usage	-	Lizard	Toggle forward road view ↔ phone mounted on dashboard outboard	
				Passenger	Advanced Phone Usage	-	Lizard	Toggle forward road view ↔ phone held in view of instrument cluster	
Non-Transient	Dashed	70 km/h	0.3 m/s	Driver	Non-fatigue Related	Euro NCAP Secretariat to provide specific instructions if verification is requested			Steering Intervention
				Passenger	Drowsiness				
				Driver	Microsleep				
				Passenger	Sleep				

Table 1 Lane Support Sensitivity - Spot Check selection cases

4.3 Occlusions

4.3.1 Long distraction

Occlusions for owl and lizard only. Using 3 test cases which were previously assessed as functional, the driver should repeat the testing with a different occlusion for each case.

4.3.2 Short Distraction

Using 3 test cases which were previously assessed as functional, the driver should repeat the testing with a different occlusion accessory for each case as referenced in APPENDIX A

4.3.3 Phone Use

Using 3 test cases which were previously assessed as functional, the driver should repeat the testing with a randomly selected, different occlusion accessory for each case.

4.3.4 Fatigue

Driver performs microsleep and sleep, resulting in 2 tests (Drowsy may be tested provided it can be reproduced by a non-fatigued test operator).

Using the test cases which were previously assessed as functional, the driver should repeat the testing with a different occlusion accessory for each case.

4.3.5 Unresponsive Driver

Driver performs 1 unresponsive driver test. If the test case proves functional, the driver should repeat the testing with a different occlusion accessory.

4.4Not functional system test

The driver should obstruct the view of an instrument cluster mounted DSM system from identifying the driver by placing their hand and gripping the upper portion of the steering wheel and hold the position for at least 10 seconds.

For DSM systems mounted in other locations e.g., rearview mirror, A-Pillar, this test is not necessary unless the Vehicle Manufacturer claimed a non-functional system under any other occlusion type, in which case such occlusion type should be checked as stated above.

4.4.1 On-road evaluation

Throughout the on-road evaluation on public roads, the test driver shall manually annotate the instances where a non-relevant vehicle warning and/or intervention is issued, e.g., a distraction

alert that is issued when the test driver is gazing on-road, a drowsiness alert that is issued when the self-perceived level of alertness is high, etc.

With the collected evidence, the Euro NCAP Secretariat reserves the right to liaise with the Vehicle Manufacturer in case the driver acceptance of the DSM system during normal driving on public roads is deemed unacceptable.

APPENDIX A OCCLUSION ACCESSORIES

Cap – baseball cap with large, curved peak at the front, designed to provide shade over the user's eyes.

Hat – brimless cap that fits the head closely that does not cover any predominant facial feature.

Sunglasses – Shaded wayfarer style glasses with a <15% transmittance (or EN1836 category 3)

Facemask – Type 2R Certified EN14683 facemask, generally manufactured with blue cloth. To be worn covering the chin, mouth the nose, not obscuring the eyes.