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 Crash Avoidance protocols.

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.

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.

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, directly followed with a head nodding forwards movement (replicating an asleep driver) 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, directly followed with a head nodding forwards movement (replicating an asleep driver) for a maximum of 7 seconds to initiate the EF.

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 maximum of 5 seconds to initiate the EF.

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.

4.1.3 Intervention tests

For systems with a Driver State Link where intervention performance in Forward Support and/or Lane Support is claimed, the test laboratory shall conduct all the Verification Tests of the Euro NCAP Crash Avoidance protocol in Transient and/or Non-transient driver states that can be reproduced by a test driver.

The Verification Tests shall be conducted in a randomly selected driver state (where performance is claimed), to confirm system performance. The driver state random selection will be done by the Euro NCAP Secretariat, combining where possible dissimilar driver states and/or movements/gaze locations to broaden the assessment.

The driver's state under test shall be realized (e.g., driver's gaze at the gaze location) 1s before the activation timing of the system under test (e.g., FCW, AEB, LDW). The activation timing is to be provided by the Vehicle Manufacturer or investigated by the Test Laboratory prior to the test.

4.1.4 Degraded 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.

4.1.5 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.