

This assessment document has been annotated to outline where ATHENA fits right in.



**EUROPEAN NEW CAR ASSESSMENT PROGRAMME
(Euro NCAP)**



**TEST AND ASSESSMENT PROTOCOL –
CHILD PRESENCE DETECTION**

Version 1.0
May 2021

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Preface

DISCLAIMER: Euro NCAP has taken all reasonable care to ensure that the information published in this document 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).

EUROPEAN NEW CAR ASSESSMENT PROGRAMME (Euro NCAP)

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1. Introduction

1.1 Background

Leaving a child unattended in a parked car, even for a few minutes, can lead to heat-stroke and death, especially if the car is exposed to the sun. A child's inability to exit the vehicle on their own, combined with a low tolerance for high temperatures, requires that children never be left unattended in a car. Temperatures can reach a critical level in just 15 minutes and leaving windows ajar does little to reduce the threat (ADAC 2017¹).

Child deaths from vehicle-related heat-stroke occur less frequently than those resulting from crashes, but the nature of these entirely avoidable deaths deserves special attention as the technology already exists to address the issue of child hyperthermia in vehicles.

Technological solutions for Child Presence Detection (CPD) are available that can detect a child's presence in the vehicle and alert the vehicle user or third-party services. Euro NCAP will reward vehicles that offer such solutions as standard from 2023.

1.2 Scope

To avoid heatstroke-related injury and death, some countries have made it illegal to leave a child alone in a car, even for a minute. Following this principle, CPD technology must address situations where the child is left behind, regardless of whether it was intentional or unintentional and in hot weather or not.

Young children up to the age of 4 years old are particularly at risk. However, there are reported cases of older children getting into unlocked vehicles on their own and not able to get out. As these cases occur less frequently, this scenario will be addressed in a review of the protocol in 2023 with inclusion into the CPD assessment in 2025.

The protocol details how CPD systems will be evaluated by Euro NCAP. The system requirements and scoring are detailed in the Euro NCAP Child Occupant Protection Assessment Protocol.

¹ <https://presse.adac.de/meldungen/adac-ev/technik/hitze-im-auto.html>

2. Definitions

Throughout this protocol the following terms are used:

2.1 Sensing

2.1.1 Direct sensing

The ability to detect the absolute presence of a human inside the vehicle by means of tracking heartbeat, respiration, movement, or any other sign of life. Direct sensing may or may not allow categorisation and localisation of the subject(s).

2.1.2 Indirect sensing

The ability to derive the potential presence of a subject or object inside the car based on logic using information such as door opening, pressure or capacitive sensing etc. Indirect sensing does not distinguish between live persons or objects.

2.2 Journey

The start of a journey is defined as engine running or forward movement for all types of vehicle (ICE, hybrid and fully electric). A journey is deemed to have finished 15 minutes after engine or ignition off.

2.3 Warnings

2.3.1 Initial warning

The first exterior audio-visual signal from a vehicle that informs the driver/carer directly that a child may be in the vehicle. This is the first opportunity for a driver/carer to be warned that a child has been locked in a vehicle. The initial warning can be addressed with both direct and indirect sensing.

2.3.2 Escalation warning

More persistent and repetitive than initial warnings, providing additional warning signals to the driver/carer and the surrounding environment that a child may be in the vehicle.

2.4 Intervention

An action by which a system mitigates the threat to any child that has been locked in a vehicle, either knowingly or unknowingly. It is considered a last resort when warnings have been ignored and the internal vehicle temperature may be critical.

3. General Requirements

3. General Requirements

3.1 Any CPD system eligible for scoring must be able to detect or assess the presence of child trapped in a vehicle occupant compartment by providing warnings for as long as necessary (Section 4) and, where possible, intervene (Section 5) to mitigate the risk of hyperthermia. *This is precisely the function of the Athena safety system. Its sensors are able to detect life anywhere in the vehicle.*

3.2 The system must address children of ages up to and including six years old. The following potential situations shall be considered: • Children left behind in a vehicle unintentionally (Scenario 1), 2023. • Children left behind in a vehicle intentionally (Scenario 2), 2023. • Children three to six years of age that have entered an unlocked vehicle and become trapped inside the vehicle without the knowledge of the caregiver (Scenario 3), for assessments from 1st Jan 2025.

The Athena system is minimally operational but always on. It detects a door open/close and moves to vigilance mode (detection and alarm preparation). A solo child entering an unlocked vehicle would start the system by opening and closing the door. When the system detected no driver presence, it would begin flashing lights and making audible beeps. A caregiver would become aware of the situation at that point, but, if not, the escalation to calling pre-programmed numbers and providing details and location would provide fool-proof protection.

3.3 The system must take all likely child positions inside the vehicle compartment into account, such as seating positions, all seat rows as well as optional and removable seats. *Athena sensors work regardless of where children may be located. They do not depend upon pressure sensing – they rely on respiration and motion.*

3.3.1 With the implementation of Scenario 3 in 2025, the coverage area for this scenario will be extended to include the driver's seat as well as other areas where a child may hide within the cabin. The luggage area, accessible from the occupant compartment behind the rearmost seatback, boot or rear door will be excluded. The Scenario 3 extended coverage area does not apply to Scenario 1 & 2 assessments.

Subsequent versions of Athena, including those that are designed for OEM vehicles, will be capable of meeting the above requirements.

3.4 The functionality of each system and their compliance with warning/intervention requirements is assessed in accordance with the procedures laid out in Section 7.

Athena is believed to conform with Section 7.

3.5 Any CPD system must be fitted as standard equipment to the vehicle as defined in the VSSTR Protocol.

Athena currently is designed to address after-market vehicles of 2013 to 2023 model years. The design is consistent across all models and it is installed in essentially the same way in all models, making it a de facto standard. Its technology would enable OEM vehicles to employ these standards, as well.

3.5.1 Vehicles offering optional seats and/or rows will have those positions assessed.

Athena sensing is not seat-specific (e.g. pressure sensing). It is respiration and motion specific. Breathing produces CO₂ and chest movement, both of which are sensed. Moving around inside the vehicle is also sensed.

3.5.2 For vehicles without rear seat rows, such as two seaters and pick-ups, only the one seat row is to be covered and an adjusted vehicle-based assessment will be applied as defined in the COP Assessment Protocol.

Athena, again, is not seat-specific, so its use in any vehicle, even those without rear seats, remains consistent.

3.5.3 Systems that are not integrated into the vehicle, such as those incorporated into CRS, will not be rewarded by Euro NCAP.

At present, the after-market of vehicles of model year 2013-2023 number in the millions, worldwide. These would go unaddressed without a solution such as the Athena safety system.

3.6 System deactivation

3.6.1 Temporary deactivation of the CPD system by the driver for a single journey is permitted.

If a driver has a child in the car, or is driving alone, there would be no deactivation in countries/states that require that no child ever be left, alone, inside a vehicle. Optionally, in countries/states where it would be permitted, the Athena system could be programmed to allow a short, deactivation grace period.

3.6.1.1 Deactivation must be more complicated than a short push of a button to avoid deactivating the system inadvertently.

With Athena, the grace-period initiation would not be easily accessed precluding inadvertent deactivation.

3.6.1.2 It is not permitted to deactivate individual parts of the system, e.g. escalation warning only.

Athena's deactivation mode is a grace-period timeout that does not deactivate any warning indications nor warning escalation. It simply delays onset of light flashing and beeping during the grace period. Again, this capability would not be available in countries/states that have laws about leaving a child, alone, in a vehicle under any circumstances.

3.6.1.3 The system must automatically re-arm at the commencement of the subsequent journey. Version 1.0 4 May 2021

The Athena safety system, once in vigilance mode, due to detection of door open/close sequence would only revert to vigilance mode if driver is detected in the vehicle. Should the system ultimately escalate to full level 1 and 2 status, it would continue light flashing/beeping until rescue. It detects rescue by absence of lifeform sensory input. At that point, it reverts to vigilance mode; and with no changes for some predetermined period of time, it goes to quiescent mode to preserve battery life.

3.6.2 Long term deactivation of a CPD system with indirect sensing shall only be performed by a dealer.

Athena uses direct sensing, so no dealer deactivation is required or performed.

3.6.2.1 An option to reactivate the system by the driver may be offered, but it must not be possible to reactivate the system inadvertently.

Activation and deactivation is not under driver control, so this does not apply to the Athena safety system.

3.6.2.2 Over the air (OTA) deactivation by the dealer is permitted providing it is in response to a specific customer request for the system to be disabled.

In its after-market implementation, the Athena system cannot be deactivated OTA.

3.6.2.3 For vehicles equipped with direct sensing systems, long term deactivation is not permitted.

Deactivation is not subject to driver control.

3.6.3 If a system has been deactivated either temporarily or long term, the inactive status of the CPD system must be indicated by a dedicated tell-tale² that is clearly visible to the driver.

Any status change, battery deficiency, or subsystem inconsistency is detected routinely by Athena and reported via application and by intermittent system-status signal inside of vehicle.

3.6.3.1 With long term deactivation, the tell-tale is required for a duration of no less than 60 seconds from either the start of the journey or from when the system is deactivated if done during the journey. The tell-tale is also required for a duration of no less than 5 seconds after turning the ignition off.

N/A. Athena does not allow long-term deactivation and reactivation.

3.6.3.2 With temporary deactivation, a tell-tale duration of no less than 10 seconds is required. The tell-tale is also required for a duration of no less than 5 seconds after turning the ignition off. ² When an ISO standard has been developed defining a CPD tell-tale, this will be adopted by Euro NCAP no more than two years following ISO TS publication and become mandatory for any rewards. Version 1.0 5 May 2021

Same as above.

4. Warning Requirements

4.1 Initial warning (after locking)

4.1.1 Where the system has either assumed or detected that a child is locked inside a vehicle, an initial warning outside the vehicle is required at the moment the vehicle is locked. Where the system can positively confirm that either an adult (small female and larger) is present or no child is in the vehicle, an initial warning is not required.

Within a short duration (less than 10 seconds) for the system to detect door close/driver absence/lifeform presence, Athena will begin first-level alarm of flashing lights and beeps.

4.1.1.1 The time between locking and the initial warning must be as short as possible. However, a delay of no more than 10 seconds is permissible to allow the system to assess occupancy.

Where sensing is based on CO2 and motion detection, there is some latency once driver and child have exited for the system to determine that no alarm condition exists. That latency is less than 10 seconds. Within that period if driver exit and lifeform remains, the first-level alarm is initiated and a timeout timer is activated whose timeout initiates a second-level alert.

4.1.1.2 Status notifications inside the vehicle, pre-empting the initial warning at or shortly following ignition off, are permitted but not required to avoid unnecessary notifications and the risk of carers routinely ignoring them.

Within 10 seconds of driver exit, if a child remains in the vehicle, lights will flash and beeps will sound. As soon as the driver returns, opens the door, and removes the child, within 10 seconds, first-level alert stops and system reverts to vigilance mode.

4.1.1.3 Where a child has gained access to the vehicle (Scenario 3, 2025) and no doors have been locked, a delay of no more than 10 minutes from door closure is permitted to the initial warning. Door closure means the child locks are either operational (preventing the door being opened from the inside) or not operational and applies to the door in both the primary and secondary latch positions.

It Athena is awakened by door open/close, and detects presence of a child and no driver, it will begin its escalated alert process.

4.1.2 The initial warning must consist of both visual and audible components from the vehicle, for example flashing exterior lights and horn/siren activation, etc.

Initial alert is lights flashing and loud beeping sounds.

4.1.2.1 The CPD warning must be distinctive and differ from that used to signal normal locking or other similar daily functions, e.g. unique use of flashing or vibration pattern and audible signal.

The Athena first-level alert is programmable to produce a unique and distinctive flashing and sound.

4.1.2.2 The warning may be a simple beep and flash of lights but must continue for at least 3 seconds or until cancelled.

Athena is fully compatible.

4.1.2.3 Signal gaps are permissible proving the start of the signal is positive (i.e. audible and visual).

Once the first-level alert is activated, it proceeds without gaps. When Athena reverts to vigilance mode, the first-level alert stops.

4.1.3 The initial warning may be delayed (e.g. at a fuel station) by the driver pushing a specific button or activating a temporary system delay in the system menu. The delay to the initial warning must not exceed 10 minutes and the initial warning must be triggered.

Leaving a door partially open can provide a temporary system delay.

4.1.4 The initial warning may be cancelled by acknowledging the warning. Examples of cancellation include those detailed below but other methods of intentional signal acknowledgement will be accepted.

Initial warning in default configuration happens when driver opens door and removes child, and system detects no lifeform present in vehicle.

4.1.4.1 For indirect sensing, unlocking the vehicle and opening a door.

N/A

4.1.4.2 For direct sensing, unlocking the vehicle and/or opening a door.

Athena changes from quiescent mode to vigilance mode upon door open and close. If it detects no driver or lifeform, it remains in vigilance mode for a predetermined period of time and reverts to quiescent mode.

4.1.4.3 Cancelling via a mobile phone that is directly connected to the vehicle by means of Bluetooth, UWB or Wifi (mobile phone signal is not a permissible method).

Athena's communication in level-two alert is via cellular message/voice and links to GPS location. The phone cannot be used to cancel its vigilance or alert condition.

4.1.5 Cancellation may affect all aspects of the initial warning but must not affect the timing of escalation warning or intervention (where fitted) if a child remains in the vehicle. Version 1.0 6 May 2021

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4.1.6 An initial warning that tracks the presence of a mobile phone directly connected to the vehicle, e.g. via Bluetooth, must meet the signal requirements above. It must also warn either using the vehicle or mobile phone if the connection with the phone has been lost. For example, if the phone is out of range of the vehicle.

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4.1.2.3 Signal gaps are permissible proving the start of the signal is positive (i.e. audible and visual).

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4.1.4.3 Cancelling via a mobile phone that is directly connected to the vehicle by means of Bluetooth, UWB or Wifi (mobile phone signal is not a permissible method).

Athena's communication in level-two alert is via cellular message/voice and links to GPS location. The phone cannot be used to cancel its vigilance or alert condition.

4.1.5 Cancellation may affect all aspects of the initial warning but must not affect the timing of escalation warning or intervention (where fitted) if a child remains in the vehicle. Version 1.0 6 May 2021

N/A

4.1.6 An initial warning that tracks the presence of a mobile phone directly connected to the vehicle, e.g. via Bluetooth, must meet the signal requirements above. It must also warn either using the vehicle or mobile phone if the connection with the phone has been lost. For example, if the phone is out of range of the vehicle.

N/A

5. Intervention

- 5.1 A reward is given to vehicles that will initiate an intervention if there is a child in the vehicle, all doors are closed and initial/escalation warnings have either ended or been cancelled. Intervention is defined in Section 2.4. Examples of intervention include, but are not limited to, those detailed below.
- 5.2 Rewards for intervention are only available to vehicles equipped with direct sensing with both initial and escalation warnings that meet the respective requirements in Sections 4.1 and 4.2 and has demonstrated that a child is detected in all of the configurations detailed in Section 7.2.
- 5.3 Intervention will be rewarded providing the following requirements are met:
- 5.3.1 The intervention must actively reduce the threat of hyperthermia to any children in the vehicle by either:
- Instigating rescue of the child. For example, with the use of a mobile application*, eCall Advanced, contact with a third-party service (TPS) or other means of direct contact with other carers located elsewhere (not a driver or passenger on the same journey).

Athena will ultimately escalate to calling a pre-programmed set of phone numbers including a first-responder number. Upon pickup, Athena sends text/audio message detailing situation and providing a link to vehicle's location.

-
- Or,
- Allowing access to the child, for example unlocking the doors or,
- Reducing the interior temperature (excluding lowering windows).

Athena for after-market installations is capable of monitoring temperature and turning on A/C while awaiting rescue.

* Where the warning is transmitted with the use of a mobile device, for example via an application, the OEM must provide the necessary application to be used with the vehicle/CPD system. Supporting instructions and any other information must also be provided in the vehicle handbook. Euro NCAP does not require the OEM to oblige the customer to install/use this app or to accept the connection of the mobile phone with the car/OEM-offered services.

Currently, Athena is an after-market safety system solution. Its technology can be licensed and applied in OEM implementations.

- 5.3.2 It must occur within either:
- 10 minutes of the vehicle being locked or,
 - 5 minutes after the first escalation was triggered (including initial warning delay) or,
 - The internal vehicle temperature or temperature gradient becomes critical, a duration and time of 'critical temperature' have not yet been defined.

Athena is fully compatible with these conditions.

- 5.4 In addition to the intervention(s) detailed in 5.3, supplementary warnings, in addition to those used as escalations to contact the child carer(s) on the same

journey (passenger and/or driver), must also be provided within the timings detailed in Section 5.3.2. For example, with the use of a mobile application* (see above) or other means of direct contact.

Note: The TPS eCall shall be free of charge and available at least for the first six years.

Athena's escalated response includes calling numbers that have been preprogrammed into the device, including for first-responder emergency numbers. Athena's installation includes cellular connectivity. It is a flat, monthly charge. Thus, calls, such as eCall are free of charge and covered under the installation and support provisions.

6. Scoring

6.1 Scoring (2023-2024)

Sensing	Warnings and intervention	Points	
		All seats (excluding driver)	Without front passenger seat(s)
Direct and/or indirect sensing	Initial warning	1	0.5
Direct sensing only	Initial and escalation warnings	3	1.5
	Initial, escalation and Intervention	4	2

6.2 Scoring (2025 and later)

From 2025 onwards, no points will be awarded to either vehicles with indirect sensing or where a vehicle is equipped with an initial warning only.

Sensing	Warnings and intervention	Points	
		All seats	Without front row
Direct sensing only Coverage of Scenario 1, 2 & 3	Initial and escalation warnings	3	1.5
	Initial, escalation and Intervention	4	2

Sensing	Warnings and intervention	Points	
		All seats (excluding driver)	Without front passenger seat(s)
Direct sensing only Coverage of Scenario 1, 2	Initial and escalation warnings	2	1
	Initial, escalation and Intervention	3	1.5

7. Indirect Sensing System Test Procedure

N/A – Athena is a direct-sensing safety system.

7.1 System information

Prior to testing, the vehicle manufacturer shall provide the following general system information:

- Sensor type and principle, e.g. door switch and opening logic etc.
- Sensor location and CPD system architecture
- Detection: e.g weight etc.
- Intended coverage areas, e.g all optional seats including 3rd row
- Deactivation: temporary/long term (where applicable, not mandatory)
- Intended use cases covered by the system (detailed below)

7.2 Tests

Vehicle assessments will be carried out by the vehicle inspectors and assessed using a number of ‘use cases’ representing typical journey conditions. The use cases are detailed below and represent typical situations that might occur when a child is taken on a journey. Only systems that trigger a correct response in all defined use cases below are eligible for scoring.

Each use case is detailed with the use of certain subsequent steps (actions) to be carried out in a specific order. The assessment will be carried out by following the individual actions in the order detailed for each use case.

The numerical part of each action details the type of action to be performed, such as opening/closing doors and locking the vehicle. The alphabetic part of each step provides specific details of what action to perform where multiple possibilities exist. The key to each of the individual actions is in Section 10.

- 1) Preparation
- 2) Simulated entry – adult and/or child
- 3) Driving
- 4) Stopping
- 5) Simulated exit
- 6) Activation – at end of journey
- 7) Warning – required or not

- 7.2.1 This simulates two separate journeys, one is starting with a locked and the other an unlocked vehicle. In both cases, the driver forgets to remove the child at the end of the journey and locks the vehicle. A CPD initial warning is required. These are two independent use cases that should be assessed separately.

Actions

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Locked 1A→ 2B→ 3C→ 4B→ 5A→ 6A→ 7A→ End

Unlocked 1B→ 2B→ 3C→ 4B→ 5A→ 6A→ 7A→ End

- 7.2.2 This simulates a journey, starting with a locked vehicle, where a child remains in the vehicle at the end of the journey but only the driver door is opened and closed. No other doors are opened and, where fitted, the CPD initial warning is delayed by the driver for example refuelling. A CPD warning is required within 10 minutes of delay activation.

Actions

1A→ 2B→ 3C→ 4B→ 5A→ 6C→ 7B→ 10mins (max) → 7A End

If a system does not offer the possibility to delay the CPD signal, this assessment can be ignored.

- 7.2.3 This simulates a journey, starting with a locked vehicle, where a child is installed in the vehicle and only the driver door is opened and closed during a journey. No other doors are opened and, where fitted, the CPD signal is delayed by the driver for refuelling. The driver then continues the journey (within 10 mins) and then forgets to remove the child at the end of the journey (only). A CPD initial warning is required upon door locking at the end of the journey. This is one single use case for one journey.

Actions

1A→ 2B→ 3C→ 4B→ 5A→ 6C→ 7B→

<10min Journey recommences

1A→ 2A→ 3C→ 4B→ 5A→ 6A→ 7A End

If a system does not offer the possibility to delay the CPD signal, this assessment can be ignored.

- 7.2.4 This simulates a journey, starting with a locked vehicle, where a child is installed in the vehicle but only the driver door is opened and closed. No other doors are opened and, where fitted, the CPD initial warning is delayed by the driver for refuelling. A warning is expected within 10 minutes of delay activation. The same journey recommences (within 15min of door locking), the driver forgets the child at the end of the journey, no other doors have been opened, a CPD warning is required. This is one single use case in one journey.

Actions

1A→ 2B→ 3C→ 4B→ 5A→ 6C→ 7B→ 10mins→

7A Journey recommences

1A→ 2A→ 3C→ 4B→ 5A→ 6A→ 7A End

If a system does not offer the possibility to delay the CPD signal, this assessment can be ignored.

- 7.2.5 This simulates a journey, starting with a locked vehicle with no rear doors, where the driver forgets to remove the child at the end of the journey and locks the vehicle. A CPD warning is expected if the actions required to access the rear seat and child (e.g. move driver's seat) are not repeated before door locking.

Actions

1A→ 2B*→ 3C→ 4B→ 5A→ 6A→ 7A End

*2B shall include the necessary actions to access the rear seats.

- 7.2.6 This simulates a journey, starting with a locked vehicle, where there are two children installed in the vehicle. One child exits the vehicle mid-journey and the journey continues. At the end of the journey the driver exits the vehicle and forgets the one remaining child. A CPD warning is required.

Actions

1A→ 2B→ 3C→ 4C→ 2E→ 3E→ 4B→ 5A→ 6A→ 7A End

- 7.2.7 This simulates a journey, starting with a locked vehicle, where there is no child in the vehicle at the start of the journey. A child then enters the vehicle mid-journey and the journey continues. At the end of the journey the driver exits the vehicle and forgets the child. A CPD warning is required.

Actions

1A→ 2A→ 3C→ 4C→ 2D→ 3E→ 4B→ 5A→ 6A→ 7A End

- 7.2.8 This simulates a journey, starting with a locked vehicle, where a child is installed in the vehicle. The journey ends and the driver exits the vehicle. The rear door adjacent to the child is opened and closed without the child being removed from the vehicle, which is then locked. This is the intentionally left case and a CPD warning is required. This scenario (2) is monitored for 2023/2024 and the outcome will not be included in the system assessment. However, the datasheet and website publication will detail if this scenario is covered by the system or not.

Where a vehicle is equipped with an indirect sensing system that does not give a warning in this use case, the vehicle handbook must inform the user that no CPD warning is provided if the rear doors are opened before locking.

Actions

1A→ 2B→ 3C→ 4B→ 5B→ 6A→ 7A End

7.2.9 Avoid false positives

Systems will be checked for false positives in the two scenarios detailed below. However, although compliance with the case below is strongly recommended, the outcome will not be included in the system assessment.

This simulates a journey, starting with a locked vehicle, where the driver removes the child at the end of the journey. No children are in the vehicle when locked, in this case a warning is NOT required.

Actions

1A→ 2B→ 3C→ 4B→ 5D→ 6A→ 7B End

This simulates a journey, starting with a locked vehicle, where the driver opens the door and places/hangs an object in the rear before the journey. At the end of the journey, the door remains unopened at the time of locking, in this case a warning is NOT required.

Actions

1A→ 2C→ 3C→ 4B→ 5A→ 6A→ 7B End

7.3 CRS to be installed

If the CPD system requires a CRS to be present, then the following CRS must be used for each of the use cases detailed above.

- 1) New-born infant (4kg) in a Maxi Cosi Cabriofix, belted installation rearward facing.
- 2) New-born infant (4kg) in a Maxi Cosi 2way Pearl with 2wayFix base, rearward facing. Installation of child only, CRS (base and shell) already installed in vehicle.
- 3) P3/Q3 in Britax Roemer King II LS, belted installation, forward facing.
- 4) Q6 on a Concord Vario XT-5, belted installation, forward facing.

8. Direct Sensing System Evaluation

8.1 The evaluation of direct sensing systems will be based on information provided by the vehicle manufacturer. A dossier is required detailing how the system establishes the presence of a child and the sequence, including timing, of subsequent warnings and intervention(s). The information required is detailed in the following sections. Euro NCAP reserves the right to check any and/or all of the CPD requirements during the vehicle assessment.

8.2 In order for any points to be awarded, the dossier must contain the information detailed in the following sections and system must react correctly to all of the scenarios outlined in this section.

8.3 Test tool validation must be approved by Euro NCAP in advance of dossier delivery and vehicle assessment. Where a technology is presented to Euro NCAP that is not adequately evaluated with the test procedure, the OEM must contact the Euro NCAP Secretariat and a way to proceed will be developed.

8.4 Dossier contents

It is the OEM's responsibility to provide all of the necessary information required to demonstrate the performance of the system in accordance with the Euro NCAP assessments. The following must be included as a minimum:

8.4.1 General system information:

- Sensor type and principle: wi-fi, RF, camera etc.
Uses camera, CO2 and motion detection
- Sensor location and CPD system architecture
Sensors are located in a device installed above and mid-way between all seats and vehicle sides. It covers the entire vehicle and does not depend upon visuals.
- Detection: movement, respiration etc.
Movement and respiration are detected and using AI technology can determine the presence of a human being in a vehicle
- Coverage areas, including footwell and all optional seats, e.g. 3rd row
Athena can cover virtually all areas including trunk (boot).
- Deactivation: temporary/long term (where applicable)
Where permitted by law, temporary deactivation is available.
- CPD mobile device applications necessary for warnings (where applicable)
Unobtrusive wiring to vehicle lights/sounders are the default; an accessory sounder and light subsystem is available as an optional implementation.

8.4.2 Sensing data:

- Respiration monitoring output
CO2 monitoring and baselining used for detection of presence and absence.
- Movement monitoring output, other as applicable
Mmwave sensing is used to detect motion such as moving on floor or seat, and inhalation and exhalation.
- Triggering thresholds and any grey zone information
Latencies associated with detecting changes in CO2 are accounted for when determining presence or absence.

- Influence from any external interference e.g. sunlight, electromagnetic or radio waves

Athena's enclosure minimizes the influence of electromagnetic-wave impingement.

8.4.3 Demonstration of system compliance:

- Sensing and decision time to warning activation
With Athena, it is demonstrably 10 seconds or less.
- Scenarios detailed in the COP Assessment Protocol Section 2.5.7, 2.5.8 and Section 2.5.9.

- Warning signal demonstration
Demonstrable first-level and second-level responses are inherent in product testing and Q/A.
- Intervention demonstration (where applicable, not mandatory)
Second-level (escalated) response, including phone calls, are demonstrable.

8.4.4 Validation of test tool (where applicable)

- See Section 8.7 for further information

8.5 Evaluation scenarios

Direct sensing systems must be able to react correctly to all possible use cases. The necessary required child occupant details are below.

The assessments may be performed either in-door (parking garage) or outside. However, elements that are necessary to the function of the system should be present, such as phone signals and temperature where applicable.

8.5.1 Scenarios 1 & 2 (forgotten and intentionally left behind)

8.5.1.1 New-born infant in a rearward-facing CRS:

- Sleeping under blanket/sun shield
Athena is operative to detect the child in this scenario.

8.5.1.2 One-year old infant/child in a rearward-facing CRS:

- Sleeping under blanket without limb movement
- Awake under blanket with limb movement

Athena is operative to detect the child in this scenario.

8.5.1.3 Three-years old child in forward-facing CRS:

- Sleeping under blanket without limb movement
- Awake under blanket with limb movement

Athena is operative to detect the child in this scenario.

8.5.1.4 Six-years old on booster cushion installed with three-point belt

- Sleeping without limb movement
- Awake with limb movement

Athena is operative to detect the child in this scenario.

8.5.2 Blanket and sun-shade

For the sleeping situations the blanket shall be placed over the child from the shoulders down to cover the feet with arms beneath. For the awake situations, the blanket shall be placed over the child from the chest down to cover the feet with the arms above the material. The blanket to be used shall be no less than 70cm x 90cm, 300GSM in weight and made from Cotton or Polyester.

A sun-shade shall also be used with rearwards facing CRS that attaches from the carry handle to the seat shell around the head. Alternatively, a shade may be improvised from a cotton cloth placed around the shell of the CRS and covering the opening.

8.5.3 Scenario 3 (child enters unlocked vehicle), 2025

The conditions for evaluating Scenario 3 are detailed below.

8.5.3.1 Parked vehicle with unlocked doors

8.5.3.2 A door (any door) is opened, test subject enters vehicle and door is closed (not locked) but with child lock activated

This scenario would trigger Athena's transition from quiescent to vigilance mode starting the detections, timing and escalated response.

8.5.3.3 Sensor is triggered (directly, or maybe only after a certain delay time) to check if a living being is in the vehicle (footwell included)

The scenario of 8.5.3.2 would initiate sensing, detecting, initial warning and escalated response sequence.

8.5.3.4 Where presence is confirmed, the initial warning must be triggered in accordance with Section 4.1.1.3.

Within 10 seconds or the scenario of 8.5.3.2 a first-level warning is initiated and conditional timing may trigger escalated response.

8.6 Specific system requirements

Systems may use a range of parameters either individually or in combination to establish occupancy and/or categorisation. Systems that detect occupant respiration or movement, the individual parameters to be proven by the OEM are as follows:

Respiration

The following respiration rates shall be used for sleeping children:

- New-born infant 30bpm
- One year old 22bpm
- Three year old child 20bpm
- Six year old 18bpm

Respiration rate can be used to further support detection and CO2 increase above baseline is a de facto indicator of a living being in the vehicle.

Movement and motion

Presence of childlike manikin, sizes and cases requiring random movement.

The following movement is accepted for children in a CRS:

- Head: Pitch, roll, yaw
- Upper and lower limbs: Waving, kicking, playing on a mobile phone...

All such movements are detected by Athena and would be used, alone, or in conjunction with CO2 increases to begin response sequence.

Day and night

Systems that rely on optical sensing methods, such as cameras, demonstrations will be required to show that occupants can be detected in a range of lighting conditions, for example day and night-time.

The camera used in Athena for detecting driver presence or exit is capable of detection under day or night conditions.

8.7 Test tool validation

The OEM and/or system supplier is required to provide information detailing the validation of any test tools used. Where tools are used in place of human subjects,

validation data is required to demonstrate that the test tool can be used as a suitable human surrogate.

A direct comparison between the output recorded with humans and the test tool(s) is required in a vehicle environment. The test scenarios described above shall be replicated along with details of the 'worst case' conditions/subject for the sensing technology. A range of human subjects is required from new-born to 6YO, along with age, weight and stature must also be provided to demonstrate the worst -case human for the detection system is covered by the test tool. Depending on what parameter is being evaluated, it may be necessary to seat the children, or position the respective test tool(s), in an appropriate CRS.




Where human subjects are used either in the development of test tools or validation of a CPD system, all relevant ethical and privacy guidelines must be followed.

9. Evaluation Criteria

9.1 The criteria against which a system will be assessed are detailed in the Child Occupant Protection Assessment protocol. A summary of the items is detailed below.

- Time between locking to start of initial warning audio-visual signal (must be positive)
- Composition of initial warning
- Duration of initial warning
- Cancellation only occurs under prescribed conditions
- Delay to initial warning, fuel station scenario
- Warning when mobile connection is lost
- Deactivation temporary (where fitted) and long term (where fitted)
- Time until escalation warning
- Max permissible time from locking to escalation warning 15mins
- Composition of escalation warning
- Cancellation of escalation
- Escalation warning recommences
- Composition of intervention
- Time until intervention

10. Key to Use Cases

CPD simplified test matrix (indirect sensing)							
			A	B	C	D	E
1	Prepare		Unlock car	Start with unlocked car, left for [30] minutes			
2	Simulate entry		Open driver's door	Open any door (for at least 7 sec, no more than 12 sec) adjacent to where a child can be placed*	Open any door (for at least 7 sec, no more than 12 sec) adjacent to where a child can be placed*	Open any door (for at least 7 sec, no more than 12 sec) adjacent to where a child can be placed*	Open any door (for at least 7 sec, no more than 12 sec) adjacent to where a child can be placed*
			Close driver's door	Place object/CRS on seat**	Close door	Place object/CRS on seat**	Close door
				Close door	Open driver's door	Close door	
				Open driver's door	Close driver's door		
			Close driver's door				
3	Journey (in motion)		No action	Ignition on	Ignition on	Ignition on	Simulate driving
					Simulate driving	Simulate driving	
						Simulate second entry or exit***	
4	Stopping		No action	Ignition off	Vehicle stops, ignition on		
5	Simulate exit		Driver door opens	Driver door opens	Door adjacent to seating position where child can be retrieved is opened	Driver door opens	Door adjacent to seating position where child can be retrieved is opened
			Driver door closes	Driver door closes	Simulate further driving/Stopping/Exit	Driver door closes	Retrieve item/child
				Door adjacent to seating position where child can be retrieved is opened		Door adjacent to seating position where child can be retrieved is opened	Simulate further driving/Stopping/Exit
				Door closed		Retrieve child/item	
					Door closed		
6	Activation		Doors locked	No further actions performed.	Doors locked, delay active		
7	Initial warning		Warning expected	Warning not expected			
Key:			Highlighted actions can be performed out of order		*for 3 door car, driver's door included		
					**for 3 door car, perform action to access rear seats		
					***7 seaters, access through boot lid		