



TF-ADAS Workshop on Hands-free **Hands-free level 2 in DCAS**

26 July-2023

OICA/CLEPA

L2-Hands-free Driving - Introduction and Market Demand



System Introduction in different markets*:

US:	2018	Great Britain:	2023
Canada:	2018	Germany:	2023
China:	2018		
Japan:	2019		

(*usage depends on local traffic regulations)

Type of systems introduced:

Highway lanekeeping:	2018>
Highway lanekeeping and lanechange:	2022>

- Customers are widely using L2 Hands-free driving systems in major markets since 2018
- Hands-free: Driver is free choice to put hands either on or off the steering control, during hands-free operation
- Growing number of manufacturers are offering these systems and functionality is expanding
- ISO PAS 11585 (Conditional Hands Free Driving Systems) describes State of the Art, ready in August 2023
- Example Cadillac: “Over 34 million hands-free miles driven with Super Cruise” since market introduction*
- Example Ford: “System has enabled already 64 million hands-free miles (102 million km) driven in US and Canada” **

* <https://www.cadillac.com/world-of-cadillac/innovation/super-cruise> (status Nov 2022)

** [Ford Brings Hands-Free Driving Technology to Motorways in Great Britain | Ford of Europe | Ford Media Center](#) (status Apr 2023)

Level 2 Hands-free - Background

- **2018: The informal group ACSF (16th session) ...**
 - started to develop provisions for Automated Lane Keeping Systems, **ALKS (ECE-R157)**
 - invited industry to start directly with GRVA the discussion on what needs to be changed /added to **ECE-R79** to allow for **Hands-Off/ Eyes On** Lane Keeping Systems under a **SAE Level 1-2** assumption.
- **2020: GRVA-07-23: OICA/CLEPA submitted a proposal to amend R79 ACSF B1** to allow Hands-Off in specific conditions.
- **2021: GRVA** established a **TF-ADAS** to develop a new UN-R with the focus on systems of Level 2 (DCAS)
- **2021-Sept: TF-ADAS-07: OICA/CLEPA** announced an independent research project on level 2 Hands-Off in order to ...
 - answer the concerns and questions raised at GRVA and at TF-ADAS
 - enable a fact-based discussion in the TF-ADAS
- **2023-Jan-19: GRVA-TF-ADAS -17:** Presentation of the study results & recommendations
- **2023-July 26: OICA/CLEPA proposal for hands-free provisions in DCAS regulation (driver disengagement monitoring section)**

Level 2 Hands-Free – FKA/TUM study results (ADAS-17-05)

- Study performed by Aachen University (FKA) and Munich (TUM), with scientific advisory board members from Sweden (Chalmers), Japan (AIST) and US (Virginia Tech). Within investigated scope are state-of-the-art hands-free lanekeeping systems for highways.
- The study addressed the 5 main concerns that were raised in GRVA through a deep analysis of existing literature, customer surveys, simulator and on-road evaluations, field operational tests, based on state of the art systems

Motivation for the project

Potential Challenges and Questions (CQs)

Technische Universität München **TUM** **ika** RWTH AACHEN UNIVERSITY **fka**

Challenges and questions potentially related to a hands-free use of L2 functions (focus on interaction behavior):






- **CQ1: Hands-off = mind-off?**
 - There are concerns that a lack of driver involvement in the driving task (exacerbated by the lack of contact with the steering wheel during use of L2H-off functions) will reduce the driver's attention to the driving task.
- **CQ2: Prolonged transition times**
 - There are concerns that hands-on (reaction) times (returning hands to the steering wheel) as well as longer reaction times in general lead to an increased risk of accidents.
- **CQ3: Foreseeable misuse**
 - There are concerns that the use of L2H-off functions will lead to foreseeable misuse or to disuse, particularly with respect to an increased initiation of non-driving related tasks.
- **CQ4: Mode confusion**
 - There are concerns that with the introduction of L2H-off functions drivers are no longer aware of their tasks and roles as drivers and have a lesser understanding of ODD and system functioning, which also makes it difficult to anticipate functional limitations.
- **CQ5: Safety level**
 - There is uncertainty as to what level of safety can be achieved by introducing L2H-off functions.

Image source: FlatIcon.com

CREATING IDEAS & DRIVING INNOVATIONS 2023/01/19 L2H-off Overview Slide No. 3 23j0001.pptx © fka GmbH

Project Overview L2H-off

Summary: CQ Assessment

Technische Universität München **TUM** **ika** RWTH AACHEN UNIVERSITY **fka**

Challenges and questions potentially related to a hands-free use of L2 functions:






- **CQ1: Hands-off = mind-off?**
 - Hands-off does not decrease the (visual) involvement in the driving task when monitoring the driver's visual attention.
- **CQ2: Prolonged transition times**
 - The physical disadvantage of hands-free driving can be compensated by supporting a sufficient involvement in the driving task.
- **CQ3: Foreseeable misuse**
 - The potential for misuse is closely related to the DMS design and does not increase by hands-free monitoring alone.
- **CQ4: Mode confusion**
 - Hands-free monitoring does not increase mode confusion in comparison to L2H-on functions when providing prior information on driver role and system functioning.
 - Misconceptions of HMI signals can prevent successful driver interventions.
- **CQ5: Safety level**
 - A similar interaction quality with L2H-off and L2H-on functions was found in terms of criticality metrics and perceived safety.

Image source: FlatIcon.com

CREATING IDEAS & DRIVING INNOVATIONS 2023/01/19 L2H-off Overview Slide No. 86 23j0001.pptx © fka GmbH

FKA/TUM addressed the main concerns related to hands-free operation

Level 2 Hands-Free – FKA/TUM study results (ADAS-17-05) + Final Report

- Numerous questions were received on the research and answers were provided by FKA/TUM Universities, either during the live Q&A of TF-ADAS-17 meeting or afterwards with document ADAS-19-06
- The final detailed report (417 pages) has been released end of April
<https://www.vda.de/de/aktuelles/publikationen/publication/level-2-hands-o---recommendations-and-guidance>
- Final report includes guidelines & recommendations for regulating L2 hands-free systems.
These are based on discussions with project external scientists from the U.S., Japan, Sweden, and Germany and expert from the automotive industry.

Questions to FKA/TUM study were collected and answered

Level 2 Hands-Free – Development of the Proposal for DCAS

Base

FKA/TUM study
Guidelines for hands-free L2

ISO PAS 11585*
(presented today)

Manufacturers market &
research experience

Process

- Align with general DCAS
- Add guidelines applicable to all DCAS to general part
- Adapt wording for regulation

Result

Integrated and aligned proposal for driver disengagement monitoring
hands-on and hands-free

**1st step = hands-free
on divided highways****

Target = Informal document for GRVA Sept 23, to include hands-free provisions into the DCAS Regulation from the beginning

*ISO PAS 11585: Road vehicles --Partial driving automation — Technical characteristics of conditional hands-free driving systems

** Industry sees the limitation of such technology to highway driving as initial step.

Once enough evidence is gathered, a discussion on the application to other road types should be started.

Driver disengagement (Paragraph 5.5.4.2.)

- Supports the driver to remain engaged, provides warnings incl. escalation in case of disengagement
- Includes measures if no response to warnings (RMF) and for repeated disengagements
- Compliance demonstrated in audit (Annex 3) and tests (Annex 4)

Overview of 3 proposed driver disengagement monitoring approaches for different DCAS modes: (5.5.4.2.1):

1) Pure Motoric disengagement monitoring (i.e. Hands-on)

- For DCAS similar or close to R79 (having no feature from section 6)
- Hands-on warning cascade in line with R79
- Driver unavailability response as final escalation

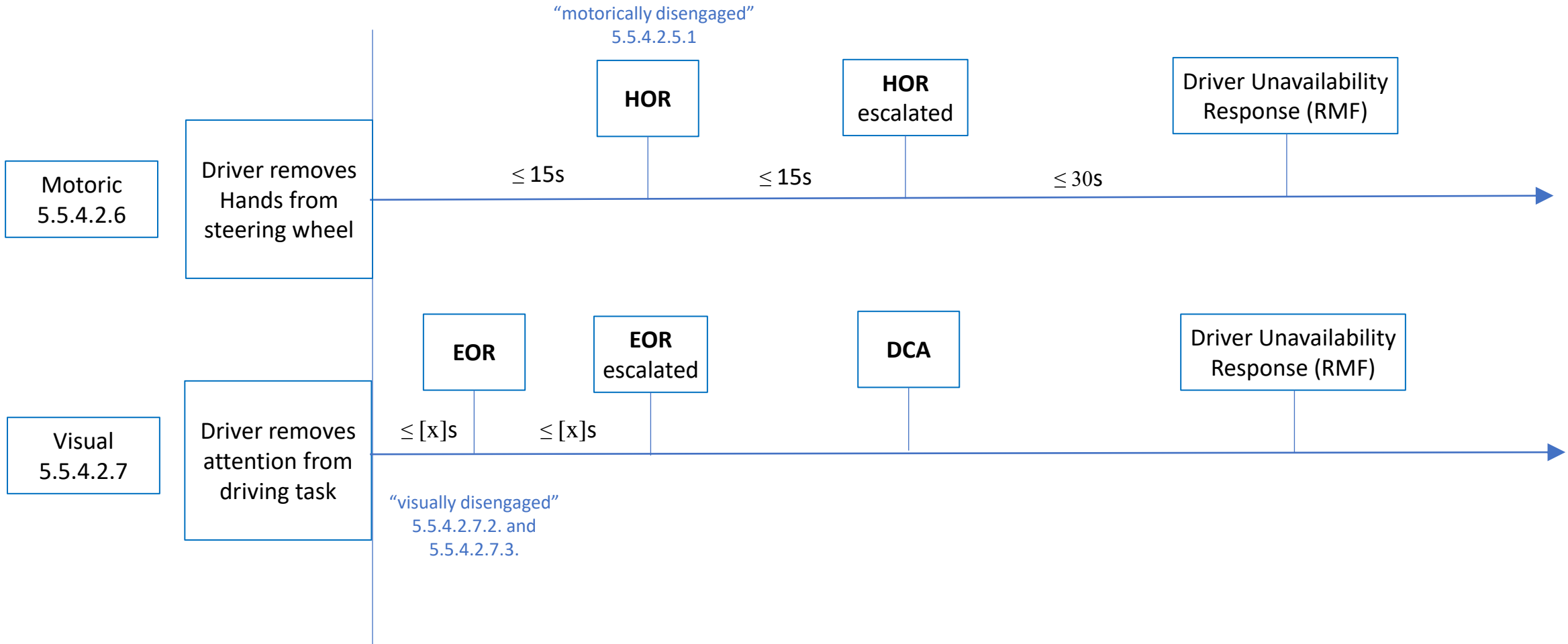
2) Pure Visual disengagement monitoring (i.e. Hands-free systems)

- Limited in ODD and functionality in a first step (no VRU, separation from oncoming traffic)
- Requirements & warning cascade in line with FKA-TUM guidelines based on their hands-free research project

3) Combined motoric disengagement AND general attentiveness monitoring

- For most DCAS, not part of 1) or 2)
- General attentiveness confirmed by at least one of the following:
 - Eye gaze/head position towards driving task / not distracted (e.g. National/regional requirements)
 - Appropriate input to vehicle controls (e.g. Shared haptic control etc)
 - Alternative criteria to be approved by Technical Service (for technology neutrality)

Visualisation of the Driver Disengagement Warning Cascades (5.5.4.2.6 – 5.5.4.2.9)



HOR = Hands On Request = 5.5.4.2.3.1.

EOR = Eyes On Request = 5.5.4.2.3.2.

DCA = Direct Control Alert = 5.5.4.2.3.3