



Federal Ministry
of Transport and
Digital Infrastructure

Challenges and opportunities related to the technology and functionality for automated vehicles

Oliver Klöckner

Automated Vehicles
(Technology and Application)
20th September 2016
Palais des Nations, Geneva



Federal Ministry
of Transport and
Digital Infrastructure

Technical requirements for steering systems

UNECE R-79

Regulation No. 79

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF
VEHICLES WITH REGARD TO STEERING EQUIPMENT



UNITED NATIONS



Federal Ministry
of Transport and
Digital Infrastructure

ADASS

ADASS = Advanced Driver Assistance Steering System

- A system, additional to the main steering system
- provides assistance to the driver in steering the vehicle
- the **driver remains at all times in primary control of the vehicle**
- 2 different categories of ADASS: **ACSF** and **CSF**



Federal Ministry
of Transport and
Digital Infrastructure

ACSF

ACSF = Automatically Commanded Steering Function

- A function within a complex electronic control system
- Continuous control function (no time limit for the intervention)
- System assists the driver in
 - following a particular path,
 - low speed manoeuvring, or
 - parking operations
- control action shall be automatically disabled if the vehicle speed exceeds the set limit of 10 km/h (speed limitation)



Federal Ministry
of Transport and
Digital Infrastructure

ACSF

Examples of Application

Automatically
Commanded
Steering
Function
(ACSF)



Park Assist



Remote Controlled Parking



CSF = Corrective Steering Function

- A function within a complex electronic control system
- Discontinuous control function
(limited duration of the interventions)
- Corrective steering interventions in order
 - to maintain the basic desired path of the vehicle, or
 - to influence the vehicle's dynamic behaviour
- No speed limitation for CSF



Federal Ministry
of Transport and
Digital Infrastructure

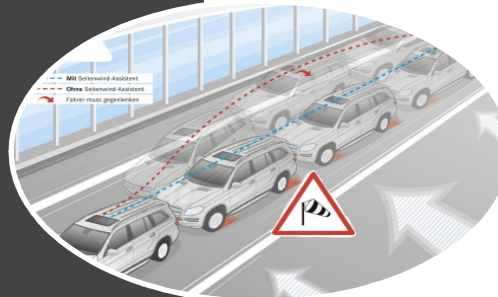
CSF

Examples of Application

Corrective
Steering
Function
(CSF)



Lane Keeping Assist



Sidewind Assist



Federal Ministry
of Transport and
Digital Infrastructure

Mission of the GRRF Informal Working Group on ACSF



Terms of Reference

- The informal group shall review the requirements and limitations associated with Automatically Commanded Steering Function technology (ACSF) as defined in Regulation No. 79.
- It shall prepare a draft regulatory proposal regarding advances in control system technology and the transport opportunities provided by the Vienna and Geneva Conventions.



Terms of Reference

The informal group shall address the following issues:

- Review the current speed limitation (10 km/h) with the purpose of permitting ACSF functionality during interurban journeys.
- Define HMI requirements for communicating between ACSF-system and the driver (e.g. system status, malfunction, transition)
- Define requirements to enable the evaluation of ACSF during periodic technical inspection.



Terms of Reference

- The group will focus on systems for vehicles of categories N and M
- The group should take full account of existing data and research in developing its regulatory proposals. It should consider pre-existing standards (e.g. ISO, SAE and JSAE) and Regulations from other territories for ACSF developing its proposals.



Federal Ministry
of Transport and
Digital Infrastructure

Guidance to GRs concerning Automated Driving Technology



Guidance to GRs

- At the 164th session of WP.29 GRRF sought guidance on how to proceed with the development of technical regulations aimed at permitting the advancement of automated driving
- WP.29 tasked the ITS/AD Informal Group with developing guidance for the GRs
- As a result the ITS/AD Informal Group presented a guidance paper
- GRRF continued its work on the basis of the understanding reached with the ITS/AD Informal Group



Guidance to GRRF

Automated assistance systems shall be designed so that:

- they provide a means to keep the driver engaged to ensure that he/she constantly supervise the dynamic driving task executed by an automation system or a function of that system
- they deactivate immediately with request for immediate control by the driver
- the driver's intention at any time shall be reliably reflected



Guidance to GRRF

Constraints:

- The system shall be designed to ensure the attentiveness of the driver during periods of use of the automated function
- The driver can be hands-on or hands-off, but monitoring the dynamic driving task and the driving environment at all times, ready to take control when required
- This should be ensured via a combination of in-use requirements and design requirements which should monitor the driver activity and define a minimum level of performance and functionality



Guidance to GRRF

Possible suggestions to be considered by GRRF (IWG ACSF):

- How to ensure a safe transition from the system to the driver
- How to prevent adverse effects on other vehicles and other traffic
- A limited use in specific road environment depending on the system
- Not to inhibit current development of such systems



Federal Ministry
of Transport and
Digital Infrastructure

Status of the IWG ACSF



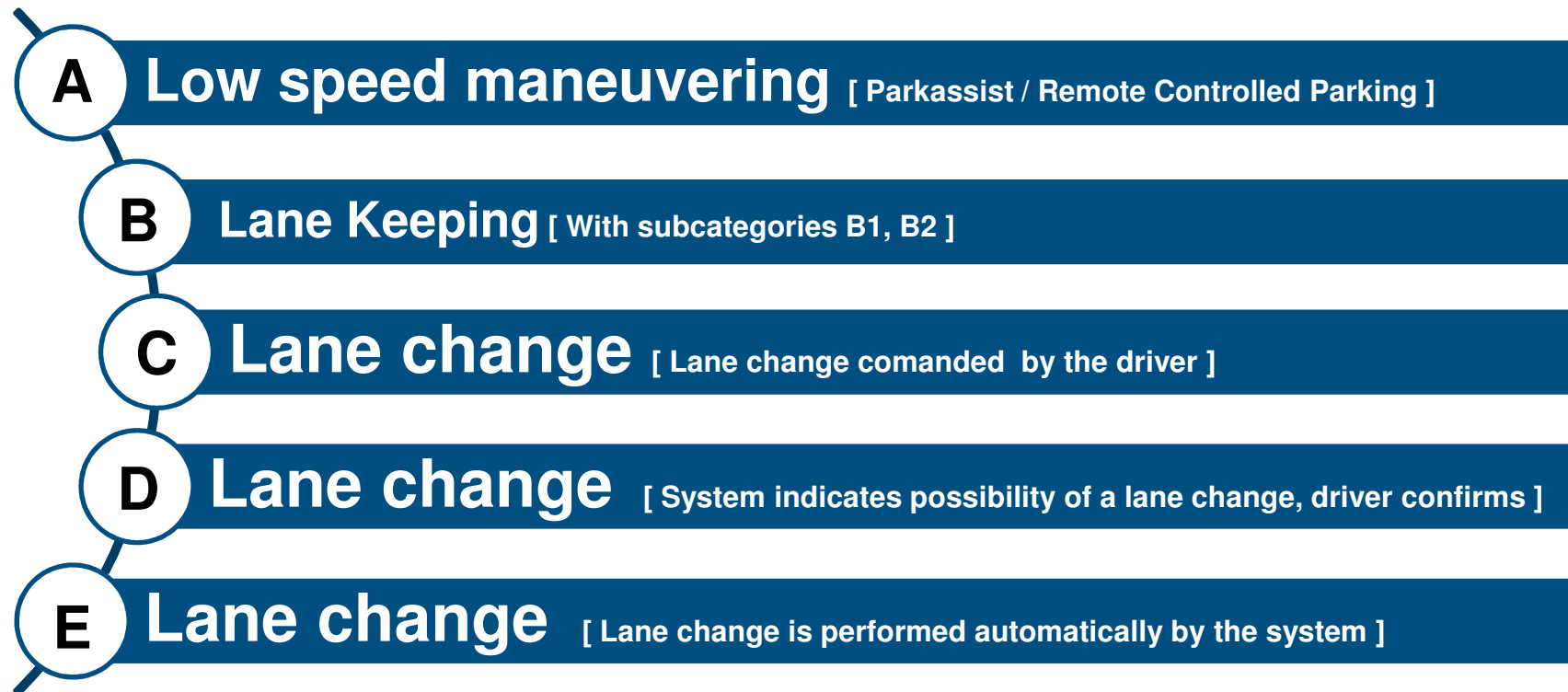
Content of the new provisions for ACSF

- 5 new Categories of ACSF
- Minimum Sensor Performance (Radar, Lidar, Camera etc.)
- Longitudinal control and protective deceleration
- Minimal Risk Manoeuvre
- Driver availability recognition system
- Human Machine Interaction (HMI)
- Transition from manual steering to automatic steering and vice versa
- Data Storage system
- Periodic Technical Inspection (PTI)
- Test requirements for ACSF



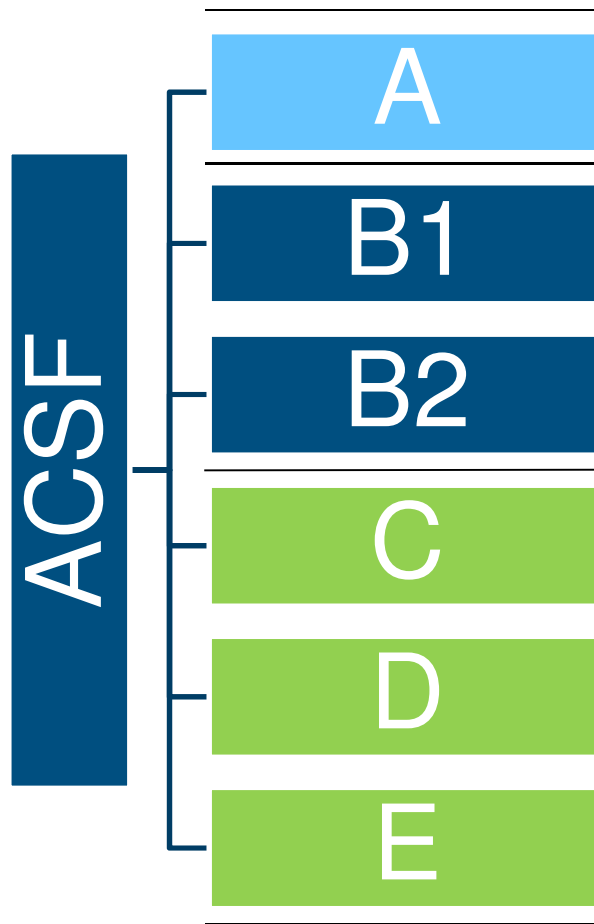
5 new categories of ACSF

ACSF Category





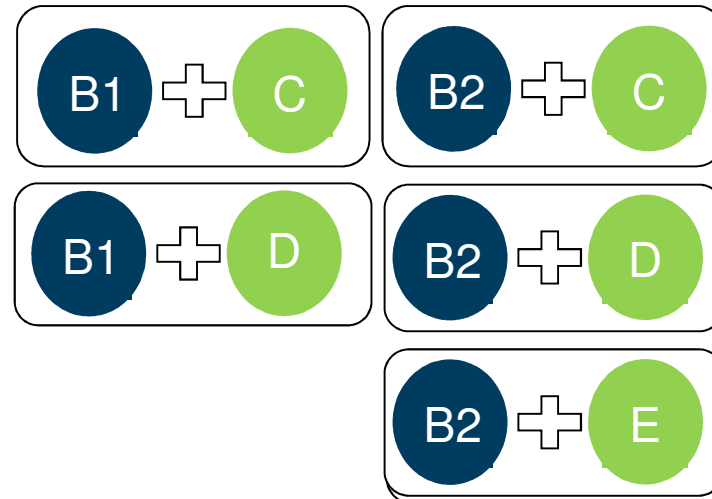
ACSF Categories and permitted combinations



Stand alone Categories



Permitted Combinations





Permissible field of application

	Beyond Highway*	Highway*
A	yes	[yes]
B1	yes	yes
B2	no	yes
C	no	yes
D	no	yes
E	no	yes

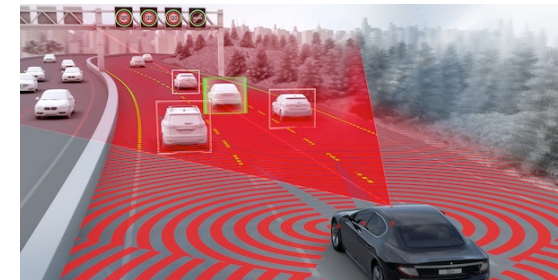
⇒ Any combination out of the categories B2, C, D and E can be only used on Highways*

* road section which is not dedicated to pedestrians or bicyclists and which has a [physical or constructional] separation of traffic moving in opposite directions

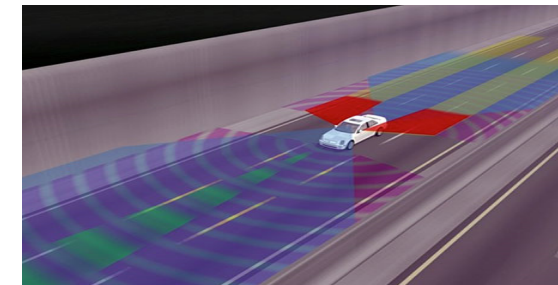


Requirements for Minimum Sensor Performance

- Vehicles equipped with the highest category of ACSF (Cat. B2, E) must be equipped with means (e.g. Radar, Lidar, Camera etc.) to monitor a minimum range to the front, the side and behind the vehicle with the purpose to avoid or to mitigate collisions
- New Provisions include detailed requirements of the sensor performance related to the respective speed



Source: ZF TRW



Source: gpsworld.com



Longitudinal control and protective deceleration

- Collisions with other road users, road furniture or other objects while using ACSF shall be prevented
- The system shall ensure correct safety distances to other road users (like Adaptive Cruise Control)
- Automatic Emergency Braking in case of sudden unexpected events if the time for safe transition to the driver is too short



Source: EURO NCAP



Human Machine Interaction (HMI)

- Information about the current system status and driving mode must be clearly indicated to the driver
- Every change of the system status and driving mode must be clearly indicated to the driver
- Clear warning strategy
 - Visual warning
 - Acoustic warning
 - Haptic warning



Source: HAVEit



Transition from manual steering to automatic steering and vice versa

- Activation of the ACSF only by deliberate action of the driver
- It must be possible at any time for the driver to override the ACSF
- System will initiate a transition demand to the driver, e.g.
 - In case the system boundaries are reached
 - In case of a sudden unexpected event
 - If seat belt is unfastened or driver left the driver`s seat
 - If the driver seems to be not available (not active)
- After the transition demand the vehicle shall follow the initial path for at least 4 s.
- If no reaction by the driver to the transition demand, a Minimal Risk Manoeuvre shall be carried out

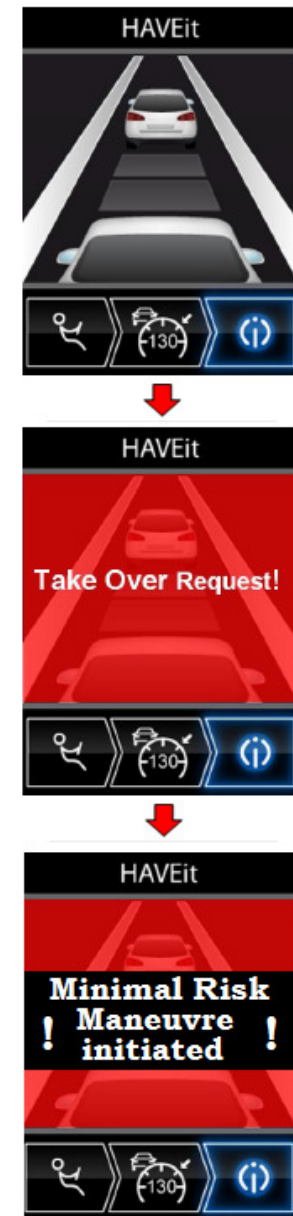


Minimal Risk Manoeuvre

ACSF must comprise a **Minimal Risk Manoeuvre** (Emergency strategy to reach a status with as less risk possible in the given traffic situation, if the driver is not able to take over steering in time)

Example of a MRM process:

- Failure warning
- Transition demand (Take Over Request)
- Driver does not respond
- Keeping the initial path for a certain time
- Cancel motor power and decelerate smoothly
- Slowing down to standstill
- Switching hazard lights on



Source: HAVEit



Driver availability recognition system

A) System shall ensure that the driver is present in the seat:

- When the driver is not present in the driver seat the system shall provide a distinctive warning until the driver is detected to be back in the driver seat or until a transition demand is initiated.
- When the driver is not back in the driver seat during the distinctive acoustic warning with a max. duration of [15 s] a transition demand shall be initiated



Driver availability recognition system

B) System shall ensure that the driver is available to takeover steering

- The system shall check if the driver is available to take over the steering by permanently evaluating driver's activity
- When the driver does not show any activity for a time span of maximum [180] s, the system shall provide a distinctive acoustic warning until appropriate actions of the driver are detected (e.g. the driver resumes manual control) or until a transition demand is initiated
- When the system does not detect appropriate actions from the driver during the distinctive acoustic warning with a max. duration of [15 s] a transition demand shall be initiated



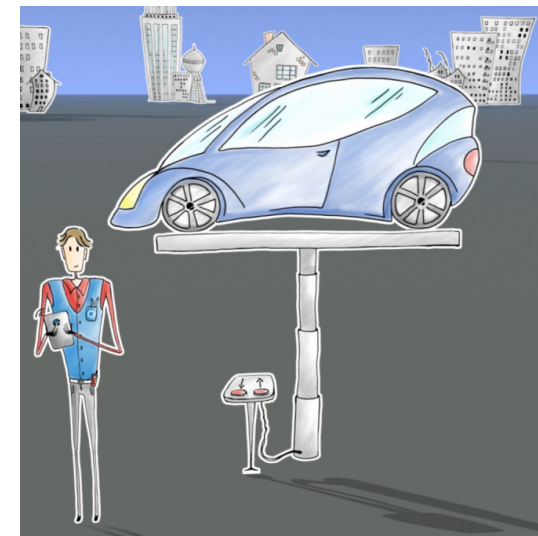
Data storage system

- A data storage system shall be installed into vehicles, which are equipped with ACSF (Cat. E, B2)
- In case of an accident the recorded data could be used to check
 - who was steering (ACSF system or the driver)
 - did the ACSF system worked properly according to the requirements
- Content of data to be recorded (accident time, accident location, system failures, drivers operation, etc.) and further requirements are still under discussion



Periodic Technical Inspection (PTI)

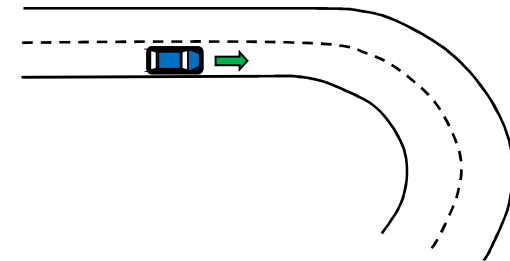
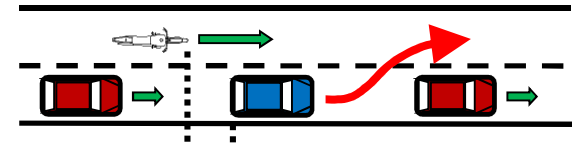
- It shall be possible that the correct operational status of the ACSF systems can be verified in a simple way during the periodic technical inspection
- It shall be possible to check, if the correct software version is installed
- Necessary special information must be made available freely by the manufacturer





Test requirements for ACSF (Category E)

- Function Tests
 - Lane Keeping
 - Abort of Lane change
 - Lane Change
- Transition Tests
 - Max. lateral acceleration
 - Missing Lane Marking
 - Driver not available
 - Sensor Failure
 - Overriding the Minimal Risk Manoeuvre
- Emergency Tests
 - Braking behind moving target
 - Braking behind stationary target



Source: EURO NCAP



Federal Ministry
of Transport and
Digital Infrastructure

Timeline



Timeline

Feb. 2015	Proposal to establish an Informal Working Group for ACSF in the 79 th session of GRRF
Mar. 2015	WP29 endorsed the creation of the Informal Working Group in the 165 th session
Apr. 2015 – Sept. 2016	8 meetings of the Informal Working Group ACSF
Sept. 2016	IWG ACSF will present first drafts of amendments to R-79 in the 82 nd session of GRRF for less complex ACSF categories
Sept. 2017	Final Draft proposal to amend UNECE R-79 shall be presented in the 84 th session of GRRF

Thank you for your attention!

Federal Ministry of Transport
and Digital Infrastructure

Robert-Schuman-Platz 1
D-53175 Bonn

www.bmvi.de