

Safety Concept for Cooperative HAD Vehicles

LEVELS OF AUTOMATION

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/Deceleration	Monitoring of Driving Environment	Fallback Performance of Dynamic Driving Task	System Capability (Driving Modes)
Human driver monitors the driving environment						
0	No Automation	the full-time performance by the <i>human driver</i> of all aspects of the <i>dynamic driving task</i> , even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	Driver Assistance	the <i>driving mode</i> -specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	Human driver and system	Human driver	Human driver	Some driving modes
2	Partial Automation	the <i>driving mode</i> -specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	System	Human driver	Human driver	Some driving modes
Automated driving system ("system") monitors the driving environment						
3	Conditional Automation	the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> with the expectation that the <i>human driver</i> will respond appropriately to a <i>request to intervene</i>	System	System	Human driver	Some driving modes
4	High Automation	the <i>driving mode</i> -specific performance by an automated driving system of all aspects of the <i>dynamic driving task</i> , even if a <i>human driver</i> does not respond appropriately to a <i>request to intervene</i>	System	System	System	Some driving modes
5	Full Automation	the full-time performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> under all roadway and environmental conditions that can be managed by a <i>human driver</i>	System	System	System	All driving modes

TESTING OF LEVEL 3 SYSTEMS

Specification of Cooperative HAD Function	SAE Level	Effort
Objectives for Cooperative HAD Function	Level 3	<ul style="list-style-type: none"> - Highly Available Components - Series-grade Development Process - Series-grade Validation and Testing
Cooperative HAD Function under Test	Level 2	Arrangements for Safe Testing

ARRANGEMENTS FOR SAFE TESTING

Safety Requirements for Cooperative HAD		Opel	Audi	BMW	Bosch	Teves	Iff
Guidelines for Test Vehicles							
Test on public roads with safety driver		✓	✓	✓	✓	✓	✓
Operator for supervising the closed-loop-test		✓	✓	✓	✓	✓	✓
Emergency button to interrupt the actuator commands		✓	✓	✓	✓	✓	✓
Deactivation of the driving function ...							
	... by break pedal	✓	✓	✓	✓	✓	✓
	... by activation-button	✓	✓	✓	✓	✓	✓
	... by emergency-button	✓	✓	✓	✓	✓	✓
	... by steering-wheel-torque > x Nm		✓	✓	✓	✓	✓
	... by acceleration pedal		✓		✓		
Activation of the driving function ...							
	... by explicit activation through the safety driver	✓	✓	✓	✓	✓	✓
	... after system deactivation by explicit activation through the safety driver	✓	✓	✓	✓	✓	✓
System Monitoring							
Actuator commands							
	Steering torque or similar commands	✓	✓	✓	✓	✓	✓
	Engine torque or similar commands	✓	✓	✓	✓	✓	✓
	Deceleration or similar commands	✓	✓	✓	✓	✓	✓
Driver Safety							
All mounted airbags are active. Only in reasonable cases they are removed, such as behind monitors.		✓	✓	✓	✓	✓	✓
Additional parts, such as monitors or buttons, are safely installed.		✓	✓	✓	✓	✓	✓

