

Characteristics of an Effective Simulator

under consideration of Directive 2003/59/EC

Note:

In the categories "Visual System", "Motion System", "Acoustic System", "Driver's Workplace", "Vehicle (Calculation) Model", "Database and Surrounding/Autonomous Traffic" and "Evaluation and Administrator Functions", the minimum respective compliance level is 40 percent. Across all categories, the total minimum compliance with the criteria required to be awarded the Quality Seal is 60 percent.

M.1 Visual System	
Criteria	Explanations / Examples
M.1.1 Horizontal field of vision of at least 180 degrees.	Insight for instance into cross-traffic and intersections is possible.
M.1.2 Vertical field of vision in the driving direction corresponds to the real vehicle.	The visual impression is not restricted by simulator components.
M.1.3 No visible flickering or jerking of the images.	The flicker frequency is at least 50 Hz; the system is not jerky because of limits and/or a shortage of system resources.
M.1.4 No annoying transitions between the image sections in the horizontal field of vision.	
M.1.5 Rear view mirror views are available where needed.	Outside mirrors and if applicable also an additional inside mirror are simulated.
M.1.6. The clarity of pixeling is also designed depending on the viewing distance.	There are no or only minimal visible differences in the resolution between the front view and the rearview mirror view.
Total points - Visual System	

M.2 Motion System	
Criteria	Explanations / Examples
M.2.1 The acceleration and brake reactions are realistically designed.	In case of harsh acceleration or braking, a pitching motion (± 10 degrees) can be felt.
M.2.2 Abrupt manoeuvres or changing road conditions lead to a position instability of the passenger compartment.	Position instabilities are apparent due to movement of the seat, steering wheel tremors etc.
M.2.3 The motion system depicts various load states and axle loads.	For example, the bouncing of a road tanker (due to surging movements) during emergency braking is simulated.
M.2.4 The intervention of driver assistance systems is noticeable.	The intervention of, for instance, the ESP, a lane keeping assist or lane departure warning system can be perceived by a visual warning or markers, steering wheel tremors or vibration of the seat.

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M.2 Motion System	
Criteria	Explanations / Examples
M.2.5 The image and/or visual system and the movements of the simulator are synchronised.	Simulator sickness can largely be avoided as a result.
Total points - Motion System	

M.3 Acoustic System	
Criteria	Explanations / Examples
M.3.1 Driving and motor sounds change with RPM and load.	
M.3.2 Rolling sounds change with the vehicle type and speed.	
M.3.3 Wind sounds change with the speed.	
M.3.4 Single events can be depicted acoustically.	Single events are, for instance, aquaplaning, regular ABS braking, emergency braking without ABS, collision, driving over an obstacle.
M.3.5 Ambient noise corresponds to the direction of origin.	Directional hearing is possible; oncoming traffic, for instance, is perceived as such.
M.3.6 Acoustic warnings can be differentiated according to whether they originate from the vehicle itself or the street environment.	Vehicle warnings can be acoustically differentiated, for instance, from driving over a rumble strip or sliding off onto the shoulder.
Total points - Acoustic System	

M.4 Driver's Workplace	
Criteria	Explanations / Examples
M.4.1 Impression inside the vehicle cab is the same as in series production cabs.	The control elements correspond to those in series production vehicles or are realistically designed.
M.4.2 Full cockpit instrumentation is the same as in a series production cab.	All instruments work, i.e. none of the instrument components installed in a real vehicle are deactivated: speedometer, tachometer, temperature and fuel gauge are functional just like the fan, the defrost setting of which can cause stress.
M.4.3 The depiction of driver assistance and vehicle control systems corresponds to those available in real vehicles.	

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M.4 Driver's Workplace	
Criteria	Explanations / Examples
M.4.4. Tasks in parallel to the driving tasks can be depicted by the technology used.	The radio, traffic announcements, navigation system announcements and displays, telephone or radio communication etc. can be depicted and/or incorporated. Distractions from the vehicle's own infotainment system or mobile devices such as a smart phone dummy can be integrated as well.
Total points - Driver's Cab	

M.5 Vehicle (Calculation) Model	
Criteria	Explanations / Examples
M.5.1 The response times of the simulator correspond to those of a real vehicle.	Acceleration, braking and steering movements by the simulator are implemented in "real time".
M.5.2 The acceleration and brake performance as well as the gear ratio of the simulator correspond to those of a real vehicle.	
M.5.3. The force-distance characteristics of the simulator correspond to those of a real vehicle.	The accelerator, brake, clutch, steering, transmission and other control switches or levers can be operated with the same force required as in the real vehicle.
M.5.4 Malfunctioning of the driving dynamics and the limits of driving physics can be experienced.	Malfunctioning of driving dynamics: for instance failure of driver assist systems, tyre blowouts, tyre fires on single axles, power steering failure. Limits of driving physics: for instance understeering or oversteering, intervention of dynamic control systems (ABS, ESP), skidding.
M.5.5 The grip level can be changed.	Wet conditions, snow, ice, one-sided slippery pavement etc. can be simulated.
M.5.6 Load states and axle loads (load distribution) can be changed.	
M.5.7 Different vehicle types in a class can be represented in the simulator.	A lorry simulator can depict, for example, a tractor, a lorry with trailer, an articulated lorry or a road tanker. An emergency vehicle simulator can simulate a fire-fighting vehicle, an aerial ladder platform ("ladder truck") or an equipment vehicle.
M.5.8 Visibility ranges and weather conditions are adaptable to training needs.	Darkness, fog, side wind, rain, snow etc. can be simulated.
Total points - Vehicle (Calculation) Model	

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M.6 Database and Surrounding/Autonomous Traffic	
Criteria	Explanations / Examples
M.6.1 The traffic environment is realistically designed; ideally it can be adapted and/or edited for the target group and/or the driving task.	Residential areas, commercial districts, street furniture, green areas, bus lanes, tram rails etc. are realistically depicted.
M.6.2 The street design and signage correspond to the Road Traffic Regulations (StVO) and the guidelines for road design (RAS).	There are no "fantasy signs" or apparently incorrect signage in the simulation, such as deviating from the right-before-left-principle in a zone with a speed limit of 30 km/h.
M.6.3 Different road categories can be depicted.	City streets, country roads, motorways etc. can be simulated.
M.6.4 Slopes and inclines can be depicted.	
M.6.5 The density of the surrounding motorised traffic can be changed.	The vehicle density is variable from "very light traffic" to "stop & go and/or congestion".
M.6.6 The density of the surrounding non-motorised traffic can be changed.	The number of pedestrians and/or cyclists visible in the simulation is variable – from none to groups or throngs.
M.6.7 Single events and local disruptions can be depicted and flexibly controlled.	The following can be simulated for example: switchable traffic lights, switchable railroad crossings, trams entering traffic, incorrect behaviour by surrounding pedestrians, cyclists and motorised traffic participants, breakdowns, aquaplaning, wild animal crossing, road work, stranded vehicle, suddenly braking vehicle, stopping without using indicator, vehicle entering traffic from the hard shoulder, vehicle running a red light, emergency vehicle with siren crossing the intersection on a red light.
M.6.8 Aggressive, normal and defensive behaviour can be separately designed and assigned to specific traffic participants or groups of traffic participants.	
M.6.9a The driver's own decision behaviour determines the movement and/or driving behaviour of the other traffic participants, i.e. motorised and non-motorised road users.	Depending on the speed of the approaching emergency vehicle, a pedestrian for instance decides to cross the crosswalk, to stop halfway and to go back, or to let the vehicle pass before crossing the crosswalk. Whether or not an emergency vehicle corridor is formed, depends on how clear the driving behaviour of the emergency vehicle is.
M.6.9.b (NEW) The movement and driving behaviour of the other traffic participants, i.e. motorised and non-motorised road users, is variable even in identical traffic situations.	When approaching a vehicle with a poorly secured load, it must not loose part of the load every time; when passing a cyclist, the rider must not swerve into the lane every time etc.

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M.6 Database and Surrounding/Autonomous Traffic	
Criteria	Explanations / Examples
M.6.10 Collisions are recognised and cause the simulation to be terminated.	"Fun fair" rides with multiple collisions with vehicles or pedestrians are not possible, nor is ploughing through the countryside and swerving around trees.
M.6.11 Event control is dependent on the vehicle speed.	When obstacles are incorporated in the simulation, they approach depending on the driving speed – one cannot "drive away" from the obstacles nor avoid them by driving extremely slowly (and the obstacle appears far ahead of the vehicle).
Total points - Database and Surrounding/Autonomous Traffic	

M.7 Evaluation and Administrator Functions	
Criteria	Explanations / Examples
M.7.1 Observers generally have the opportunity to monitor the run.	Ideally, monitoring by observers is possible using separate screens, so the driver does not have to be observed directly.
M.7.2 During monitoring, observers can see accelerator and brake activation, readiness to brake, gear selection, retarder use etc., which is feasible also via control lamps only when necessary.	Monitoring may also be possible via control lamps only.
M.7.3 Observers can see the distance behaviour while monitoring the run.	For example, a graphical visualisation of distance behaviour exists.
M7.4 There is a replay mode for follow-up discussions.	The replay mode depicts the view into the driving direction and the vehicle instruments.
M.7.5 The replay mode supports additional perspectives.	The run can also be followed, for instance, from the perspective of other road users or a bird's eye view.
M.7.6 Runs that have been completed or parts thereof can be entirely repeated.	The run itself as well as the replay mode can be repeated; images from the run can be frozen ("freeze frame").
M.7.7 An individual evaluation of the run according to additional parameters is possible.	For example, distances to other traffic participants, the duration of readiness to brake, speed and fuel consumption gradients, a list of traffic violations or transverse and longitudinal acceleration can be depicted.
M.7.8 Problem and participant-specific traffic scenarios can be constructed for the simulator runs; ideally, the creation of scenarios is quick and flexible.	Practice runs on the motorway or country road are available for inexperienced drivers in order to exercise for instance staying in the lane; special thoroughfare scenarios can be provided in case of side swiping or manoeuvring damages etc.

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M.7 Evaluation and Administrator Functions	
Criteria	Explanations / Examples
M.7.9 The training content of the simulator runs can be adapted to the personal learning capability of the participant.	Even right before starting the run, the difficulty of the run can be adjusted to the individual capabilities of the participant.
M.7.10 Simulator runs can be stopped at any time to ask the participants for their self-assessments.	Participant self-assessments for instance regarding the expected stopping distance, the size of the minimum turning curve etc.
M.7.11 There are means for communication between the trainer, driver, passengers, control centre etc.	Communication with the trainer or others may be face-to-face or via loudspeakers.
M.7.12 The administrator can actively intervene in traffic events using an "admin vehicle".	
M.7.13 An eye tracking system is installed.	The fixation points of the driver can be depicted.
M.7.14 Additional physiological measurements can be recorded, ideally with corresponding visualisation.	Measuring the heart rate, blood pressure, skin resistance etc. is possible.
Total points - Evaluation and Administrator Functions	