Annex 1

Requirements to be met by motor vehicles with autonomous driving functions

Part 1

Functional requirements to be met by vehicles with autonomous driving functions

Vehicles with autonomous driving functions must meet the functional requirements described in the following. The required functions may be demonstrated by the manufacturer or the vehicle keeper or both during a possible 'test phase', in which the motor vehicle with autonomous driving functions is operated without passengers in the defined operational area.

1. Dynamic driving task

The motor vehicle must be able to perform the driving task safely in all situations within the approved defined operational area by choosing the appropriate driving path and speed independently and adapting them continuously. This includes aligning the trajectory with the changing environment of the motor vehicle with autonomous driving functions and ensuring compliance with legal requirements. The safety of all road users, all uninvolved third parties and all vehicle occupants must be the top priority when performing the driving task. The motor vehicle with autonomous driving functions must react appropriately to unexpected events, even if these occur suddenly.

Motor vehicles with autonomous driving functions, which are used to carry vehicle occupants or occupants that are either standing or not wearing safety belts, may not accelerate more than 2.4 metres per second squared in the horizontal plane in regular operations. It may be necessary to exceed this limit depending on verifiable factors impacting the endangerment of vehicle occupants and other road users as well as uninvolved third parties. This may be the case, for instance, if only persons wearing a seat belt, but no standing passengers are in the vehicle.

Motor vehicles with activated autonomous driving functions must meet at least the requirements described in nos. 1.1 to 1.4 below to perform the driving task.

1.1 General avoidance of collisions

Collisions with other road users or uninvolved third parties must be avoided as long as this is possible by means of

1. emergency braking interventions or
2. evasive manoeuvres that do not endanger other surrounding road users, uninvolved third parties or occupants of the vehicle with autonomous driving functions.

If the avoidance of a collision, which serves to avert endangerment of the lives of the occupants of the vehicle with autonomous driving functions, may only be achieved by endangering the lives of other surrounding road users or of uninvolved third parties (unavoidable alternative endangerment of human life), the protection of other surrounding road users and uninvolved third parties may not be subordinated to the protection of the occupants of the motor vehicle with autonomous driving functions.

1.2 Interaction with other road users

a) Road users driving in front of the autonomous vehicle on the carriageway are detected. An appropriate safe distance from the vehicle in front is maintained at all times in all speed ranges and in all possible driving situations. Section 4 of the German Road Traffic Regulations governs the safe distance to be maintained.

b) Lane changes from an adjacent lane to the own lane or from the own lane to an adjacent lane by vehicles driving in front or behind are detected and taken into account appropriately for the driving task.

c) Situations that require a lane change (such as vehicles stopping or driving slowly on the carriageway, the end of a lane) are detected and suitable lane change manoeuvres are conducted safely.

d) Emergency vehicles are recognized and suitable driving manoeuvres are conducted safely.

1.3 Planning of driving paths and speeds

Speed adaptations do not result in any avoidable impairment of occupants, other road users or uninvolved third parties. The following requirements apply:

a) Speed limits and changes to the speed limit are detected and the speed is adapted accordingly.

b) Special speed requirements are detected and complied with by adapting the speed curve and trajectory (e.g. outside schools or near road works, at bus stops, level crossings, in tight curves or on slopes, in bottlenecks where the own lane has to be used also by oncoming traffic).

c) Signals and instructions of police officers in accordance with section 36 of the German Road Traffic Regulations, traffic light signals in accordance with section 37 of the German Road Traffic Regulations as well as other signs in accordance with sections 39 to 42 of the German Road Traffic Regulations as well as traffic installations in accordance with section 43 of the German Road Traffic Regulations are detected and taken into account in the speed curve and trajectory.

d) Situations where others must be given the right of way (e.g. at pedestrian crossings, at junctions or three-way junctions) are detected and are handled without endangering or obstructing road users who have right of way. A calculated time to collision of more than three seconds is to be observed in relation to the road

user with the right of way. Any deviations from these values must be justified sufficiently and documented on the basis of systematic state-of-the-art safety assessments. The state-of-the-art requirement is deemed to have been satisfied if the requirements of ISO 26262:2018-12 Road vehicles - Functional safety[1] are met.

e) Structural road design features which impact the law governing road user behaviour (e.g. cycle tracks segregated up to 5 metres from the edge of a road with right of way in accordance with section 9 (3) of the Road Traffic Regulations or lowered kerbs in accordance with section 10 of the Road Traffic Regulations) are detected and taken into account in the speed curve and trajectory.

f) Road works, temporarily changed lane routings or road markings are detected and taken into account in the speed curve and trajectory.

g) Deficiencies in the accessories, in particular in the traffic installations (e.g. worn, damaged, missing or defective temporary or permanent road markings and traffic signs, ghost markings) and the road furniture, in particular those set forth in letters a to f above are detected and taken into account in the speed curve and trajectory. This applies especially after storm and other weather events.

1.4 Reaction to environmental conditions

Weather, environmental and road infrastructure conditions (such as rain, line-of-sight obstruction due to smoke, pot-holes) are taken into account in the speed curve and trajectory. The driving path and the speed – up to and including standstill of the vehicle – are to be chosen in such a way that the requirements set out in nos. 1.1 to 1.3 are also met under changed weather conditions.

2. Minimal risk condition

For motor vehicles with autonomous driving functions and without conventional devices for performing the driving task, the following applies:

The motor vehicle may only exit the minimal risk condition on the initiative of the technical oversight.

3. Emergency driving function

The motor vehicle with autonomous driving functions must be equipped with an emergency driving function. If the motor vehicle has to transition to the minimal risk condition due to a defect in the motor vehicle, this must be done by means of the emergency driving function. In the emergency driving function, motor vehicles must have activated hazard warning lights and may not move faster than walking pace. This speed limit does not apply to the transition of autonomous driving from the normal driving operation to the emergency driving function, if braking is necessary.

4. Manual driving

When the vehicle is driven manually, a driver performs the driving task. The motor vehicle with autonomous driving functions must be equipped with devices that enable the driver to take over the driving task.

If the vehicle control is limited to speeds not exceeding walking pace in manual driving mode, the driver does not have to be in the motor vehicle with autonomous driving functions. In this case, control may be performed via a remote control that is located within close range of the motor vehicle. The maximum distance that can be covered via remote control is 6 metres, measured in a straight line. The manufacturer is to put in place suitable technical means to ensure compliance with the maximum distance.

If the motor vehicle with autonomous driving functions is to be operated at speeds exceeding walking pace when driven manually, it has to be equipped with a driver seat. The seat is to be designed in compliance with the current regulations.

5. Continuous self-monitoring

The technical equipment necessary to perform the driving task must be monitored by the motor vehicle with autonomous driving functions independently and continuously to ensure its functionality. This monitoring is to be designed to ensure that an impairment of the technical equipment required to safely use public roads triggers a transition to the minimal risk condition.

5.1 For motor vehicles with autonomous driving functions and without conventional devices to dynamically perform the driving task, the following applies:

a) Non-personal technical data is collected and saved in the motor vehicle for continuous monitoring of the technical equipment.

b) An impairment of the technical equipment is to be reported immediately to the technical oversight.

5.2 For motor vehicles with autonomous driving functions and with conventional devices to perform the driving task, the following applies:

It must not be possible to reactivate the autonomous driving function as long as the technical equipment remains impaired.

6. Transmission of data to the motor vehicle

The motor vehicle must to be able to reliably receive and use data and information from external technical units (such

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as backends or servers of a provider, external sensors, smartphones) that are necessary to perform the driving task independently in the autonomous driving mode. Data from external entities may be used in the motor vehicle to perform the autonomous driving functions. For instance, in certain use cases, data and information may be transmitted from an external technical unit to the motor vehicle and from the motor vehicle to a technical unit via a wide area network connection (WAN connection). The transmission of such data must comply, in particular, with the requirements of Articles 24, 25 and 32 of Regulation (EU) 2016/679 and be protected to a state-of-the-art security standard. The security plan must address the risks identified in a threat analysis with effective measures and include a data protection impact assessment in accordance with Article 35 of Regulation (EU) 2016/679. A centralized secure electronic control unit (SECU) should be used for data transmission. The SECU serves as an information gateway in the motor vehicle. The SECU communicates internally with the communication buses of the motor vehicle and the physical on-board diagnostics II connection (OPBD II) or to a proprietary interface of the manufacturer. Information technology security requirements used for data transmission are described in Part 5. The integrity, authenticity and availability of the data transmission must be ensured.

Motor vehicles with autonomous driving functions may/are permitted to communicate with other vehicles or with infrastructure components. On the basis of the data protection impact assessment in accordance with Article 35 of Regulation (EU) 2016/679, this communication must comply in particular with the requirements for information technology in accordance with Part 5 and therefore with the requirements set out in Articles 24, 25 and 32 of Regulation (EU) 2016/679. During operation in an optional test phase, communication between the motor vehicle with autonomous driving functions and other vehicles and infrastructure components are to be tested and adapted if necessary.

7. Functional safety and safety of the intended functionality

7.1 Operating manual

The purpose of the operating manual is to ensure safe operation of the motor vehicle and enable the technical oversight to react correctly to faults by providing detailed requirements.

7.2 Safety concept

The safety of the driving function is to be assessed in the safety concept. By means of a systematic approach, the hazard scenarios and incidents relevant for the operational design domain (ODD) must be identified and assessed in a risk analysis.

To prevent hazards or mitigate the risks to an acceptable level, based on the detected risks, a system behaviour must be defined for the corresponding scenarios and incidents or system upgrades must be implemented.

The system has to be state of the art. The state-of-the-art requirement is deemed to have been satisfied when the requirements of ISO/PAS 21448:2019-01 Road vehicles - Safety of the intended functionality[2] are met. The sufficient completeness of the scenarios is documented on the basis of validation drives or other data recordings made during vehicle operation by means of statistical analyses.

7.2.1 Hazard analysis

The hazard analysis names and orders safety critical aspects of the autonomous driving function. The analysis must show how the technical equipment used to implement the autonomous driving function reacts in case of faults in possible operational situations and what influence these reactions have on the safety and controllability of the motor vehicle. In any case, the hazard analysis includes the safety of the vehicle occupants and other road users. Identifying the situations that are most difficult to handle for the technical equipment is also part of the hazard analysis.

The methods used to draw up the risk analysis must be scientific and technological state-of-the-art. With regard to the risk analysis methods, this is assumed to be given if a hazard analysis and risk assessment in accordance with ISO 26262-3:2018-12 Road Vehicles - Functional safety - Part 3: Concept phase or ‘hazard identification and risk evaluation’ in accordance with ISO/PAS 21448:2019-01 is conducted.[3]

7.2.2 Safety measures

The safety concept of the manufacturer in accordance with no. 7.2 must show how the technical equipment detects hazards to a state-of-the-art level and mitigates or avoids them with suitable measures. Possible safety measures include the following in particular

a) technical measures regarding the electric and electronic infrastructure, activation of fallback levels or external measures (such as resorting to emergency driving mode, activation of an emergency system, override function, transition to minimal risk condition),

b) organizational measures (such as limiting the suitable operational area, specific instructions to the driver for the manual driving mode, limiting the permitted number of passengers, adapting the carriageway or the signage) and

c) technical measures that ensure that the autonomous functions of a vehicle can be shut down safely and visibly in case of an accident, so that autonomous vehicle activities are blocked and only manual control via vehicle equipment is possible. The necessary measures to shut down autonomous driving functions are to be continuously provided to emergency services in a suitable form.

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[3] Regarding the scientific and technological state-of-the-art. reference is alternatively made to the ‘hazard identification and risk evaluation’ in accordance with ISO/PAS 21448:2019-01. As soon as these are available in German language, there will be a corresponding note in the Transport Gazette.

The methods used to develop measures to mitigate or avoid hazards must be state of the art.

The state-of-the-art requirement is deemed to have been satisfied if the requirements of Road vehicles - Functional safety - Part 4: Product development at the system level or ISO/PAS 21448:2019-01[4] are met.

7.3 Periodical technical inspection of vehicles

The feasibility of the periodical technical inspection is to be ensured with a suitable functional and constructional design of the motor vehicle (such as driving manually, accessibility of brakes). In particular, it must be possible to drive onto brake testers, light adjustment stations, car lifts or pits and to conduct all mandatory tests.

8. Sensor system

To technically implement the autonomous driving function, a sensor system must be used, which detects the objects, data or persons around the motor vehicle required to safely perform the driving task and, which, with regard to processing personal data, complies with the provisions of Regulation (EU) 2016/679, the Federal Data Protection Act and specific data protection-related legal provisions. To satisfy the purpose mentioned in sentence 1 and in compliance with the above-mentioned requirements, the sensor system can be supported by external systems. If weather, environmental and infrastructure conditions affect the performance of the sensors, the technical equipment of the motor vehicle initiates measures to compensate the risks resulting from the reduced performance of the sensors.

The sensors are to be incorporated into the safety concept of the motor vehicle with autonomous driving functions in accordance with no. 7.2 and into the permanent system monitoring structure in accordance with no. 5.

9. Aging and wear and tear of the system

The motor vehicle must meet the functional requirements also in case of aging and wear and tear of the relevant system components. If signs of aging impact the performance, for instance of the sensors, the technical equipment of the motor vehicle with autonomous driving functions compensates the risks resulting from the reduced performance of the sensors.

Part 2

Test and validation methods for vehicles with autonomous driving functions

In the following, test and validation methods are defined, with which compliance with the technical requirements to be met by the autonomous driving function may be verified by the authorities responsible for granting an operating permit. As part of this, compliance of all requirements may be verified by carrying out tests.

10. Assessment and test scenarios

For the tests to obtain an operating permit as well as for verification of compliance with the requirements related to this operating permit, tests may be conducted as needed. The test scenarios must be designed to sufficiently cover all scenarios, test parameters and environmental influences. This coverage is to be justified to the Federal Motor Transport Authority or to the agencies commissioned by the Federal Motor Transport Authority in accordance with section 3 (7). This justification must include a validation or suitable evidence on the basis of empirical collection of non-personal data. The test scenarios must be suitable to prove that the degree of safety of a motor vehicle with autonomous driving functions is higher than the degree of safety of vehicles driven by persons.

The test scenarios must be suitable to prove that the technical equipment for environment perception is sufficiently robust to handle errors in input/sensor data and unfavourable environmental conditions.

10.1 Artificial errors and limits of the operational area

The following is permitted to test the requirements:

a) faults may be induced artificially in the technical equipment;

b) the motor vehicle may be brought into environments that deviate from the designated operational area.

10.2 Test scenarios, deviations and pass criteria

Within the scope of the assessment, the Federal Motor Transport Authority selects test scenarios in accordance with the designated operational area. They are selected on the basis of the manufacturer's catalogue of test scenarios as described in section 3 (2). To verify compliance with the requirements to be met by the motor vehicle, driving tests under real world road traffic must be carried out as part of the operating permit issuance process. The assessment is complemented by simulations and driving manoeuvres conducted on a test range.

Depending on the test scenarios specified by the responsible authority as part of the operating permit issuance process, the pass criteria are defined on the basis of the following values. Manufacturers who deviate from these values must justify and document this sufficiently. Justification and documentation must be state of the art. The state-of-the-art requirement is deemed to have been satisfied if the requirements of ISO 26262:2018-12 Road vehicles - Functional safety[5] are met.

10.2.1 Pass criteria of UN Regulation No 152

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[5] Published by: Beuth Verlag GmbH, Burggrafenstraße 6, 10787 Berlin, securely deposited in the archives of the German Patent and Trademark Office in Munich.

Compliance with the requirements under no. 1.1 to be met by the motor vehicle with autonomous driving functions to avoid collisions is to be ensured by deriving pass criteria from the requirements as per UN Regulation No 152 - Uniform provisions concerning the approval of motor vehicles with regard to the Advanced Emergency Braking System (AEBS) for M1 and N1 vehicles (Official journal L 360 of 30 October 2020, p. 66).

Here, the following amendments to the text of UN Regulation No 152 are always applicable:

a) No. 5.1.4 warnings to the driver, is not to be applied.

b) Nos. 5.2.1.2 and 5.2.2.2, a deviation from the required braking demand of at least 5 metres per second squared is required when considering the vehicle properties in autonomous operation as well as the ambient conditions. For instance, for vehicles that are intended to transport standing passengers in the autonomous operation mode, the braking demand required to protect the vehicle occupants may be lower.

c) No. 5.2.1.4 (a) to (e) (restrictions of the requirements) are not applicable. New restrictions that result from the definition of the ODD are conceivable (e.g. the restriction “in daylight” results from “no automated driving at night”).

d) No. 5.2.2.4 (a) is applicable with the following amendment: ‘with crossing pedestrians with a lateral speed component of not more than 7 km/h, with crossing cyclists with a lateral speed component of not more than 25 km/h’. Letters (b) to (e) is not applicable.

e) Nos. 5.2.1.4 and 5.2.2.4, the tables are to be applied on the basis of the speed limits of the automated driving function in such a way that a relative collision speed of ‘0’ (no collision) is demanded throughout the entire speed range.

f) The numbers governing over-riding and deactivating the emergency braking system are not to be applied.

10.2.2 Lane departure

The motor vehicle with autonomous driving functions may leave its own lane only in the following cases: During the ‘lane change’ manoeuvre, for low-speed manoeuvring (for instance when parking, at narrow junctions), to swerve to avoid obstacles or oncoming vehicles, to avoid collisions and to give way to emergency vehicles.

10.2.3 Safety distance

Lead vehicles in the same lane are detected. An appropriate safety distance must be maintained at all times in all speed ranges and in all possible driving situations.

10.2.4 Lane changes of other vehicles

Lane changes made by lead or trailing vehicles from an adjacent lane to the ego lane or from the ego lane to an adjacent lane are detected and taken into account appropriately for the driving task.

10.2.5 Avoiding collisions with vehicles travelling in the same direction

Collisions with road users travelling in the same direction and intruding into the ego lane must be avoided within the conditions specified by the following inequation. The inequation only applies to road users cutting in in front of the motor vehicle with autonomous driving functions and only if the road users moving into the lane were visible for at least 0.72 seconds before intruding:

$$TTC_{Spurwechsel} \geq \frac{v_{rel}}{2\alpha} + \frac{1}{2}\tau + \tau_{Reaktion}$$

In the following, the parameters of the preceding inequation are specified:

$TTC_{lane\ change}$	Time to Collision (TTC) at the time of intrusion into the lane of the motor vehicle with autonomous driving functions in seconds. Intrusion is defined as crossing the outer edge of the lane by more than 30 centimetres.	
V_{rel}	Relative speed in metres per second [m/s]. Positive when the motor vehicle with autonomous driving functions approaches a road user cutting in and travelling at lower speed.	

T	Time in seconds that elapses until the deceleration a in metres per second squared is reached	Typical values are 0.5 seconds until reaching 10 seconds squared. These values are to be scaled accordingly for lower possible decelerations of the motor vehicle with autonomous driving functions. Therefore, for 6 seconds squared, it is assumed that this deceleration is achieved in 0.3 seconds, and for 2.4 seconds squared in 0.12 seconds.
$T_{reaction}$	Time in seconds required to initiate a brake reaction.	0.1 seconds
a	Deceleration in metres per second squared	2.4 seconds squared for motor vehicles with autonomous driving functions that are designed to transport vehicle occupants standing or not wearing safety belts; 6 seconds squared for other motor vehicles with autonomous driving functions

This means a required collision avoidance in case of intrusion of another road user into the ego lane above the following TTC values (shown for speeds in 10 km/h speed steps by way of example). These requirements are to be met regardless of environmental conditions and is, in general, to be considered when pass criteria are derived.

v_{rel} [kilometres per hour]	$TTC_{lane\ change}$ [second] for motor vehicles with autonomous driving functions with standing vehicle occupants	$TTC_{lane\ change}$ [second] for other motor vehicles with autonomous driving functions
10	0.74	0.48
20	1.32	0.71
30	1.9	0.94
40	2.47	1.18
50	3.05	1.41
60	3.63	1.64

If a road user changing lanes with a lower time to collision (TTC) performs a cut-in manoeuvre into the lane of the motor vehicle with autonomous driving functions, it is not to be expected that a collision can still be avoided. If a collision cannot be avoided, the consequences of a collision are to be minimized by braking and therefore reducing the speed as much as possible while weighing the risk for the occupants of the motor vehicle with autonomous driving functions resulting from braking and the collision. The control strategy of the systems may only change between collision avoidance and collision mitigation as long as braking is preferred to an unsuccessful evasive manoeuvre. Evasive manoeuvres may only be conducted in compliance with the requirements in no. 1.1.

10.2.6 Lane change manoeuvres

The pass criteria for lane change manoeuvres are set out in UN Regulation No 79 - Uniform provisions concerning the approval of vehicles with regard to steering equipment (OJ L318 of 14 December 2018, p.1). Requirements of this regulation concerning functions related to the driver are not applicable. The driving manoeuvres are to be planned in such a way that no other road users are endangered.

The pass criteria for safe lane changes and for how to avoid endangering other road users are based on the requirements in nos. 5.6.4.7 and 5.6.4.8 of UN Regulation No 79, whereas (v_{app}) the corresponding speed limit specified in the ODD may be applied concerning the speed of the approaching vehicle.

10.2.7 Turning left/right and crossing

The following pass criteria are to be considered for the interaction with other road users while turning left/right and crossing, (see Figure 1):

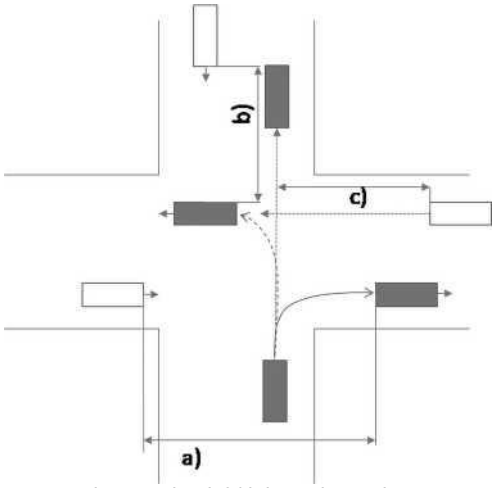


Figure 1: Visualization of the distances when turning left/right and crossing. Case a: Distance to be kept from following traffic when turning left/right. Case b: Additional distance to be kept from oncoming traffic when turning left/right through oncoming traffic. Case c: Distance to be kept when crossing through crossing traffic with right of way

Pass criteria for safe left/right turning and crossing are to be derived from the requirements set out in nos. 5.6.4.7 and 5.6.4.8 of UN Regulation No 79. The speed limit applicable in the driving situation may be applied for the speed of the approaching vehicle (v_{app}). The requirements for the geometrical relationships to the surrounding traffic is to be transferred accordingly from the lane change to the turning left/right manoeuvre (a in Figure 1).

For turn left/right manoeuvres across the opposite carriageway, the following applies with regard to taking account of the oncoming traffic: In addition to keeping the distance to the following traffic on the target road, it is to be ensured that the TTC of the oncoming traffic with right of way to the calculated point of collision (intersection point of driving paths) never falls below 3 seconds (b in Figure 1).

The same applies to crossing involving traffic with right of way (c in Figure 1): The TTC of the traffic with right of way to the fictitious point of collision (intercept of driving paths) must be more than 3 seconds.

11. Testing

During testing, not only real vehicles but also state of the art test tools may be used as replacements for real vehicles and other road users (such as 'soft targets', pedestrian dummies and/or mobile platforms). Regarding the properties relevant to evaluating the performance of the sensor system, the test tools must be equivalent to real vehicles and other road users. Tests may only be conducted in a way that does not endanger persons involved in the test. The corresponding occupational health and safety requirements are to be considered.

Whether requirements are met may also be verified with a suitable simulation. For this purpose, the simulation tools must be validated. The validation of the simulation tools must be conducted by comparing them to a representative selection of real tests; there may be no significant difference between the parameters derived from the simulation and from the driving test. The performance of the sensor system concerning object detection and classification depending on different distances and environmental conditions, must be determined in real tests for the simulation. Every simulation series is to be supplemented with real tests, if considered necessary by the technical service.

Every requirement described in this Ordinance, which is relevant for the autonomous driving mode in the designated operational area in accordance with the operating permit applied for, and every dangerous scenario identified in accordance with no. 7.2 is to be tested at least by means of simulation. For this purpose, the motor vehicle to be tested is to be put into the corresponding situation when driving autonomously by choosing the appropriate traffic environment. At least the reaction of the motor vehicle with autonomous driving functions to the scenarios identified as dangerous in no. 7.2 is to be tested. For this test, at least three sets of parameters are to be chosen.

12. Requirements to be met by the test range and the environmental conditions

For tests conducted in the context of issuing an approval in accordance with section 3, the defined operational area designated for approval itself may be used as long as it is possible to conduct tests there without endangering other road users and uninvolved third parties. Tests are to be conducted under different environmental conditions.

Part 3

Digital data storage

13. General requirements to be met by the digital data storage

The motor vehicle with autonomous driving functions must have an integrated data storage system, which complies with Articles 24, 25 and 32 of Regulation (EU) 2016/679, is event-based and records, stores and uses data of the motor vehicle with autonomous driving functions during its operation in accordance with sections 9 (5) and 15 solely for the purpose of improving road safety. The data to be recorded is governed in section 1g (1) of the Road Traffic Act in conjunction with Annex 2 to this Ordinance.

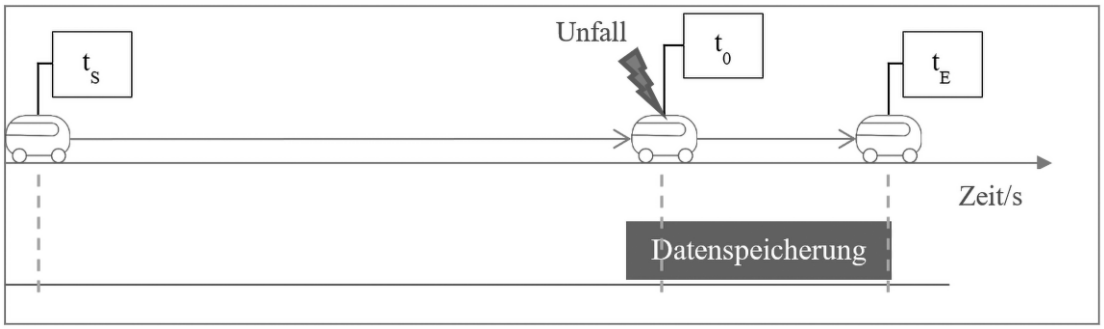
The data storage is to be designed in accordance with the data protection requirements of section 1g of the Road Traffic Act and of this Ordinance as well as the requirements under Articles 24, 25 and 32 of Regulation (EU) 2016/679 on corresponding data security provisions based on state-of-the-art technology. An access control system as well as cryptographic data protection practices are to be provided in accordance with the relevant Technical Guidelines of the Federal Office for Information Security. The Federal Office for Information Security is to be involved in developing the specific wording of the requirements. Essential data storage requirements are presented in the following:

13.1 Events to be stored

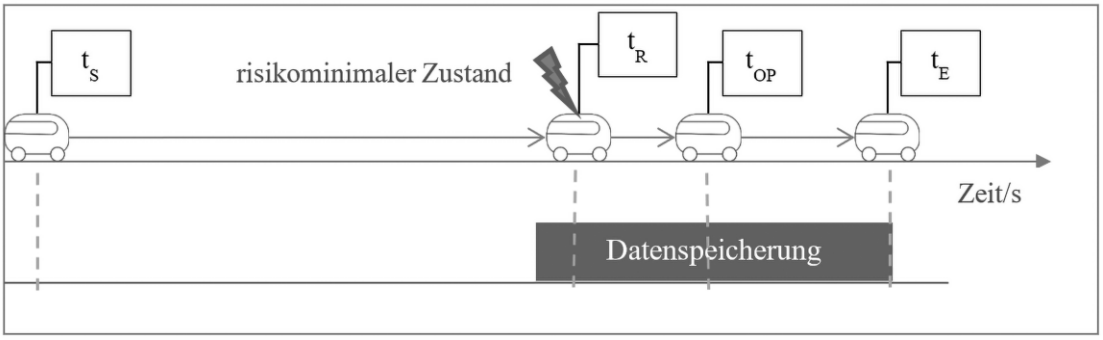
The following presents the different data recording cases.

Case 1 - Autonomous driving in the defined operational area

Case 2: Autonomous driving in the determined operational area with an event (such as an accident)



Case 3: Autonomous driving in the defined operational area with an event and subsequent transition of the motor vehicle to the minimal risk condition



Key:

Point in time	Description
t_S	Start of the drive (motor vehicle started)
t_E	End of the drive
t_0	Accident
t_{0P}	Request or input of technical oversight
t_R	Triggering of the minimal risk condition

13.2 Technical requirements for storing, retrieving and transferring data

The data storage system may not be volatile. The stored data must be retained when disconnected from the power supply.

Additional technical requirements for data storage device:

a) The data stored in the motor vehicle with autonomous driving functions is accessed via the standardized 16-pin on-board diagnostics interface (16-pin OBD interface) via a communication module in accordance with ISO 22900-1:2008-03[6] Road vehicles - Modular vehicle communication interface (MVCI) - Part 1: Hardware design requirements using the manufacturer's proprietary software or via the proprietary interface. In addition, in certain situations or after certain events, the data must be sent directly via wide area network connection (WAN connection) to the responsible government agency.

b) The Federal Motor Transport Authority and the responsible authority may only access and download the stored data via the standardized 16-pin interface or via the proprietary interface where this is necessary for the discharge of functions under this Ordinance.

c) For repairs, access to the data storage device in the motor vehicle with autonomous driving functions is via the standardized 16-pin OBD interface by means of a communication module in accordance with ISO 22900 using the manufacturer's proprietary software or via the proprietary interface only.

d) The data storage and data transmission to the Federal Motor Transport Authority and the responsible authority must meet the information technology security requirements (Part 5). In particular, data must be protected in accordance with the state of the art while observing the requirements of Articles 24, 25 and 32 of Regulation 2016/679 against manipulation and misuse.

Part 4
Requirements to be met by human-machine interfaces

14. Interaction

Only in exceptional situations do motor vehicles with autonomous driving functions that are operated autonomously within a defined operational area require interaction with the technical oversight.

In particular, the human-machine interface is to be designed to take account of the following two exceptions.

14.1 The technical oversight accepts a driving manoeuvre for the motor vehicle with autonomous driving functions

The technical equipment places the motor vehicle in the minimal risk condition, as the drive cannot be continued due to a traffic situation. The minimal risk condition is exited with support from the technical oversight. Here, the following is to be observed:

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a) The autonomous driving function may first propose possible driving manoeuvres to the technical oversight to continue the journey and deliver sufficient data to assess the situation.
b) If the technical oversight specifies a driving manoeuvre, this must be validated by the autonomous driving function.

Notwithstanding letters a and b, the driving manoeuvre may not be carried out if this would endanger road users or uninvolved third parties. The autonomous driving function remains responsible for the safe performance or non-performance of these driving manoeuvres, with the system assessing the current local traffic situation

14.2 Manual takeover of the driving task outside the defined operational area

If the autonomous drive reaches the boundaries of the defined operational area, the motor vehicle must be placed in the minimal risk condition by the autonomous function. If the drive is continued outside the defined operational area by a driver, the driver is to be prompted to become active by means of a suitable interaction concept. If the stoppage of the motor vehicle with autonomous driving functions would impede the surrounding traffic or third parties, the prompt is to be combined with a notice to that effect. The intensity of the prompt is to be increased continuously. The prompt may be implemented by means of sound signals with increasing volume or vibration signals with increasing intensity.

Part 5
Information technology security requirements

15. Information technology security

The requirements to be met by the manufacturer regarding information technology security requirements are set out in the requirements of the UN Regulation No 155 – Uniform provisions concerning the approval of vehicles with regards to cybersecurity and cybersecurity management system (OJ l 83 of 9 March 2021, p. 30) as amended, with the following provisos: The requirements of nos. 1, 3, 4, 5.3.1 to 5.3.5 do not apply. The security concept must comply with the requirements set out in Articles 24, 25 and 32 of Regulation (EU) 2016/679 and with the data protection impact assessment in accordance with Article 35 of Regulation (EU) 2016/679.

16. Security of radiocommunications

The connections are to be designed to ensure that protection against unauthorized access to the connections implements with the requirements set out 5 are to be secured and encrypted in accordance with the state-of-the-art practices using open and established standards (such as TLS 1.3 as in the Technical Guideline TR-02102-2 Cryptographic Mechanisms: Recommendations and Key Lengths, issued by the Federal Office for Information Security in January 2020 and published on the Federal Office for Information Security website[7]).

[7] Can be obtained from Bundesamt für Sicherheit in der Informationstechnik, Postfach 200363, 53133 Bonn; securely deposited in their archives, when this Ordinance enters into force, also available at: https://www.bsi.bund.de/SharedDocs/Downloads/DE/BSI/Publikationen/TechnischeRichtlinien/TR02102/BSI-TR-02102-2.pdf;jsessionid=55C61697617F17382A64C6612D32125B.internet082?__blob=publicationFile&v=1

Annex 2

Data storage

During operation, on occasions listed under section 1g (2) of the Road Traffic Act, the following data are to be recorded in the motor vehicle with autonomous driving functions.

	Data	Sample file format
1.	Vehicle identification number	Alphanumeric characters [A-Z; 0-9] Example: AAAAAA654398GFRDE
2.	Position data	Latitude and longitude [±ddd.ddddd, indicated in ± degrees (°) and decimal degrees, 5 decimal places] Altitude in metres Output in the global positioning system, exchange format as a sequence of points, in which changes to the direction of movement occur; indication of the (map) reference system.
3.	Frequency and time of use and activation/deactivation of the autonomous function	Date (year:month:day), time (hour:minute:second), example: 2019-07-16, 05:25:12
4.	Frequency and timing of alternative driving manoeuvres accepted	Frequency, individual times (hour:minute:second)
5.	System monitoring data (start/end) including software version	Alphanumeric characters [A-Z; 0-9] including explanation Example: P0601 internal control module memory check sum error
6.	Environmental and weather conditions	Temperature/°C, brightness/light intensity/lux, setting of windscreen wiper on/off
7.	Connectivity	Connectivity parameters such as latency and available bandwidth
8.	Name of the activated/deactivated passive and active security systems, status, triggering entity (system or external)	Name of the system, status, entity Example: Emergency braking system, active, system functionality
9.	Vehicle acceleration in the longitudinal and lateral direction	Numeric values in metres per second squared
10.	Speed	Numeric value in metres per second squared
11.	Status of the lighting equipment	Example: Directional indicator on/off Daytime running light on/off
12.	Voltage supply of the autonomous motor vehicle	Numeric value in volt
13.	External commands and information sent to the motor vehicle	Sent format of the commands as well as metadata on information: File size, file format, source, destination, transfer time

Annex 3

Documentation obligations of the manufacturer

1. Functional description

The objective of the functional description is to explain the fundamental technology underlying the motor vehicle's functions and the conditions necessary to safely operate it as well as the implementation of the data protection and data security requirements. The taxonomy of the functional description has to be state-of-the-art. This is deemed to have been satisfied if the requirements of ISO 26262-3:2018-12 Road vehicles - Functional safety - Part 3: Concept phase[8] are met. The functional description must address the following topics:

1.1 Operational area of the motor vehicle with autonomous driving functions (such as carriage of passengers in traffic between defined stations),

1.2 Technical description (block diagrams, interfaces with other vehicle systems),

1.3 Description of required functions of the motor vehicle and the systems statuses (such as drive with activated autonomous function, other driving modes, minimal risk condition).

1.4 Environmental conditions required for trouble-free operation (such as visibility, weather conditions, carriageway conditions),

1.5 Normative and procedural requirements for the operation (such as occupational safety and health, internal acceptance processes, digital role and rights system),

1.6 System of interaction with other road users (such as reaction to ambiguous behaviour, warning signals, hand signals),

1.7 Requirements to be met by transport infrastructure to ensure trouble-free operation (such as radio signals of signs and traffic lights) and

1.8 Implementing and ensuring the data protection and data security requirements.

2. Operating manual

In order to ensure the safe operation of the motor vehicle with autonomous driving functions, the operating manual must explain in detail operation, maintenance, overall inspection, diagnostics of the motor vehicle and the parameters serving data protection and data security. The operating manual should at least comprise the following aspects:

2.1 A roles, rights and responsibilities system for the activities necessary for operation;

2.2 Definition of required capabilities required to perform the activities necessary for operation;

2.3 Scope, process, times and intervals of maintenance measures;

2.4 Safety instructions related to observing limit values of technical functions;

2.5 Troubleshooting and safety measures to be taken during operation in case of errors;

2.6 Documents for maintenance and repair measures including the necessary templates;

2.7 Presentation of functionalities for data protection and data security.

3. Safety concept

The documentation of the safety concept in accordance with Annex 1 no. 7.2 is also intended to make sure that the functional safety can be verified.

4. Information technology security

The documentation must ensure that information technology security can be verified and must contain a detailed description of how data protection and data security requirements are ensured, in particular with regard to compliance with the requirements set out in Articles 24, 25 and 32 of Regulation (EU) 2016/679.

[8] Published by: Beuth Verlag GmbH, Burggrafenstraße 6, 10787 Berlin, securely deposited in the archives of the German Patent and Trademark Office in Munich.

Article 2

Amendment of the schedule of fees for measures relating to road traffic

The schedule of fees for measures relating to road traffic of 25 January 2011 (Federal Law Gazette I, p. 98), last amended by Article 6 of the Ordinance of 18 March 2022 (Federal Law Gazette I, p. 498), is amended as follows:

1. Section 2 (1) is amended as follows:
   a) In no. 11, the full stop is replaced by a comma.
   b) The following nos. 12 and 13 are inserted:
      „12. Costs for an officially approved expert for motor vehicle traffic, a technical service designated for testing whole vehicles of the relevant vehicle categories or of another entity commissioned by the Federal Motor Transport Authority for the assessment of suitability of a motor vehicle with automated or autonomous driving functions including the evaluation of the information security of vehicles and vehicle parts,
      13. The costs for an expert report commissioned by the responsible authority in accordance with section 9 (3) sentence 1 of the Autonomous Vehicles Approval and Operation Ordinance.“
2. The Annex is amended as follows:
   a) After fee number 111.2.1, the following fee numbers 111.3 to 111.7 are inserted.

Fees Number	Subject	Fee euros
‘111.3	for the operating permit for motor vehicles with autonomous driving functions	8,925.00 to 89,240.00
111.4	for the approval for trialling purposes for motor vehicles with autonomous driving functions	8,925.00 to 89,240.00
111.5	for the approval of the subsequent activation of an autonomous driving function in motor vehicles already registered based on staff requirements and operating expenditure per hour and person	49.00 to 129.00
111.6	for the approval of the subsequent activation of an automated driving function in motor vehicles already registered based on staff requirements and operating expenditure per hour and person	49.00 to 129.00
111.7	for the approval for trialling purposes for automated driving functions based on staff requirements and operating expenditure per hour and person	49.00 to 129.00”.

b) After fee number 112.3, the following fee numbers 112.4 to 112.8 are inserted:

Fees Number	Subject	Fee euros
„112.4	for the operating permit for motor vehicles with autonomous driving functions	4,462.50 to 44,620.00
112.5	for the approval for trialling purposes for motor vehicles with autonomous driving functions	4,462.50 to 44,620.00
112.6	for the approval of the subsequent activation of an autonomous driving function in motor vehicles already registered based on staff requirements and operating expenditure per hour and person	49.00 to 129.00
112.7	for the approval of the subsequent activation of an automated driving function in motor vehicles already registered based on staff requirements and operating expenditure per hour and person	49.00 to 129.00
112.8	for the approval for trialling purposes for automated driving functions based on staff requirements and operating expenditure per hour and person	49.00 to 129.00”.

c) After fee number 400, the following sub-section H is inserted:

Fee number Number	„ Subject '	Fee euros

“H. Autonomous Vehicles Approval and Operation Ordinance (AFGBV)

400a	Approval of the defined operational area for motor vehicles with autonomous driving function	
Fees Number	Subject	Fee euros
400a.1	Assessment of an application for approval of a determined operational area for the operation of motor vehicle with autonomous driving functions in accordance with section 8 of the Autonomous Vehicles Approval and Operation Ordinance, including the inspection of the operational area, fact-finding measures, coordination with third parties to be involved, assessment of the underlying operating permit of the motor vehicle with autonomous driving functions as well as the decision on the application regarding its issuance, amendment, rejection or cancellation, including entry	790.60 to 79,060.00
400a.2	Evaluation and assessment of supplements for a defined operational area for already approved determined operational areas as well as re-testing whether the requirements for an approval of an approved determined operational area are met, based on staff requirements and operating expenditure per hour an person	49.00 to 129.00”.

Article 3
Amendment of the Vehicle Registration and Licensing Regulations (Fahrzeug-Zulassungsverordnung)

The Vehicle Registration and Licensing Regulations of 3 February 2011 (Federal Law Gazette I, p. 139), last amended by Article 9 of the Act of 12 July 2021 (Federal Law Gazette. I p. 3091), are amended as follows:

1. The following subsection 1a is inserted after section 3 (1):
   “(1a) The approval of vehicles with autonomous driving functions or of vehicles for trialling of automated or autonomous driving functions is, in addition, governed by the provisions of the Autonomous Vehicles Approval and Operation Ordinance of 24 June 2022 (Federal Law Gazette I p. 986) as amended.“
2. Section 6 (7) is amended as follows:
   a) In no. 7 (k), the word ‘und’ (and) at the end is deleted.
   b) In no. 7 (l), the full stop at the end is replaced by a semicolon.
   c) The following no. 8 is inserted:
      “8.For vehicles with autonomous or automated driving functions:
      a) the number, the issuing authority and the date of the operating permit,
      b) the number, the issuing authority and the date of the approval for trialling purposes,
      c) the number, the issuing authority and the date of the approval of the operational area,
      d) Information on equipment with autonomous or automated driving and additional functions.“

Article 4
Entry into force

This Ordinance enters into force on the day following its promulgation.

The Bundesrat has given its consent.

Berlin, 24 June 2022

Federal Minister
for Digital and Transport
Volker Wissing