a. Compliance costs of the Federal Government

The KBA incurs annual compliance costs totaling 892,395 Euro for personnel costs (2x upper service A14, 4x senior service A12). The Federal Office for Information Security needs two upper service posts (A14) for the evaluation of security concepts and the validation of the implementation of the concepts. This results in an annual compliance cost of 330,272 Euro (direct personnel costs: 208,123 Euro; direct material costs: 49,700 Euro plus overhead surcharge of 28.1 per cent).

Regarding the scope of the reviews: The draft law explicitly provides for a direct intervention of the Technical Supervision (e.g., via an external access from a control center) in the self-driving vehicle control. Without adequate measures to ensure IT security, there would be considerable potential for damage in the entire field of self-driving. The envisaged measures must therefore be evaluated in the light of current knowledge, see Annex I, Appendix 5 and Annex IV, Clause 4 to this Ordinance, and the measures aimed at an IT security concept must be reviewed in the scope of subsequent market surveillance, see Sec. 5 AFGBV. This requires the involvement of the BSI on a permanent basis to ensure an IT security concept. The BSI provides corresponding consulting and support services to the Approval Authority (KBA) concerning the above-mentioned clauses.

The evaluation of security concepts for self-driving, the associated consulting services for the Approval Authority and the validation of the implementation of the concepts in motor vehicles require in-depth specialist knowledge in the areas of networked vehicle architectures and a high degree of familiarity with the current findings in the area of IT security in connection with automated driving functions. For this specialized task profile, the BSI must build up the corresponding expertise to the extent of two posts with the rating A14. Technological development in the above-mentioned areas must be continuously monitored and expertise thus maintained at a high level.

aa) Issuance of approvals

According to Sec. 2, the operation of motor vehicles with a self-driving function for traffic on public roads requires an operating permit from the KBA for a motor vehicle with a self-driving function. To this end, the corresponding expertise must be built up and maintained at the KBA. The requirement profile of the personnel necessary for this is different from what is sufficient today in the type-approval procedure. Accordingly, new personnel to be recruited must have strong prior knowledge in the field of self-driving, software analysis as well as data security.

Pursuant to Sec. 16, the KBA issues test permits. The test permit is issued for an individual vehicle. The necessary preconditions include requirements for the vehicle as well as for the expertise of the applicant and the persons involved in the development and testing. Furthermore, a development concept is mentioned as the basis for the test permits to be granted, whereby not only such functions of automation are included, but all technologies to be tested contained in the vehicle. In particular with regard to the evaluation of the development concept as well as the wide field of further technologies to be tested, reference is made to the above-mentioned necessity for the development of expertise.

It is estimated that a need for two upper service engineers (A14) is required for the evaluation of the extensive concepts and new technologies as well as in the further development of provisions based on the findings made during the evaluations, and a need for four senior service engineers (A12) is required for the review of the further approval requirements. The need for higher service engineers is required due to the involvement with new technologies and the necessary self-organization of the respective individual projects for approval. Engineers in the senior service are also required for the operational implementation of the tests.

The scope of testing per approval is estimated at approx. 300 hours upper service and approx. 600 hours senior service. In addition, the scope of a possible cooperation in the further development of the corresponding provisions in the field of self-driving should be considered.

The expense for issuing an operating permit for motor vehicles with self-driving functions and for issuing test certificates are considered equivalent for this calculation due to the still undefined requirements in each case.

bb) Market surveillance

Within the scope of market surveillance, corresponding self-driving systems will have to be reviewed regularly.

The associated compliance costs arising from required field investigations are to be covered by fee income. The field investigations, which are generally carried out by the KBA in a random sampling procedure on their own test stands or with their own measuring instruments, serve to ensure that, in particular within the scope of the first-time registration of a vehicle for operation on public roads, only vehicles that conform to the approval and legal requirements are registered. Within the scope of registration according to FZV, the type data is also available to all vehicle manufacturers, which the manufacturers can use to independently fill in the vehicle data in the registration certificate part II (ZB II). In order to ensure the accuracy of this data, the task of the field investigations now incumbent on the KBA has the objective of monitoring whether the vehicle types in the field or on the market for which the manufacturer completes the ZB II are actually in conformity with the approval or the law and thus to monitor the approval and legal conformity of the ZB II and its preparation. These and other tasks required within the scope of market surveillance should, due to their fundamental nature for all vehicles on the market, be dealt with in a separate draft regulation, with corresponding consideration in the ZB II fee.

b. Compliance costs for the federal states (including municipalities)

An annual personnel expenditure of approx. 395,300 Euro is generated at the competent federal state authorities for the obligations related to the approval of operational design domains as well as the registration for motor vehicles with self-driving functions. The information is based on several interviews conducted with authorities from different federal states. The compliance costs presented include expenses that can currently be estimated by those surveyed. It was not possible to quantify the compliance costs for individual obligations. It can be assumed that there will be a one-off compliance cost, but this could not be quantified ex-ante.

For the calculation, the wage costs according to the current 2017 wage cost tables for measuring compliance costs and bureaucratic costs of the Federal Statistical Office were used for ex-ante measurements. For federal obligations, the values for the federal government (basic service 27.80 Euro / intermediate service 31.70 Euro / senior service 43.40 Euro / upper service 65.40 Euro) were used as a basis for the calculation. The obligations of the federal states, including the municipalities, were calculated on the basis of the wage costs for public administration in general (basic service 27.00 Euro / intermediate service 32.20 Euro / senior service 42.40 Euro / upper service 61.90 Euro).

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| --- | --- |
| 292,000 Euro | Determination of the operational design domain by approval pursuant to Sec. 7 paragraph 2 AFGBV |
| + 73000 Euro | Approval of the defined operational design domain pursuant to Sec. 9 paragraph 1 AFGBV |
| + 20,000 Euro | Notifications of subsequent changes and replacement of persons pursuant to Sec. 9 paragraph 6 AFGBV |
| + 7,000 Euro | Revocation of an approval pursuant to Sec. 10 AFGBV |
| + 1,300 Euro | Entry of the defined operational design domain pursuant to Sec. 11 paragraph 3 AFGBV or the test permit pursuant to Sec. 16 paragraph 7 AFGBV in the registration certificate Part I  |
| + 2,000 Euro | Review of the evidence of compliance with the technical and organizational requirements pursuant to Sec. 8 paragraph 2 AFGBV |

= 395,300 Euro

Determination of the operational design domain by approval pursuant to Sec. 7 paragraph 2 AFGBV:

According to the federal state authorities surveyed, site inspections or route inspections may be necessary for the definition of an operational design domain in order to be able to carry out a review of the given infrastructure. The definition of the operational design domain can be route-specific or more general, excluding individual road types (such as motorways). In order to be able to define an operational design domain for a motor vehicle with self-driving function, it must be further checked whether the technical requirements of the vehicle and the self-driving functions meet the conditions of the infrastructure at hand so that safe traffic operation is guaranteed.

For this purpose, the applicant must submit all required documents. The time values used as a basis for review and defining the operational design domain were estimated on the basis of empirical values with exemptions for automated traffic granted to date by the upper federal state authorities. The estimates of the average processing time vary greatly, as there may be cases in which only the framework conditions are examined and in others extensive hearings with several authorities etc. still have to be carried out. In total, personnel costs of around 292,000 Euro are incurred by the upper federal state authority for the determination of the operational range.

Approval of the defined operational design domain pursuant to Sec. 9 paragraph 1 AFGBV:

The defined operational design domain shall be approved by the competent authority under state law if the preconditions pursuant to Sec. 9 paragraph 1 AFGBV are met. The estimation of the processing time for the granting of an approval for the defined operational design domain is based on empirical values of the current exemptions for automated traffic. This results in personnel costs of around 73,000 Euro. It was not possible to quantify ex-ante whether and what effort could arise here for the municipalities and, if applicable, other authorities to be involved in the consultation process.

Notifications of subsequent changes / replacement of persons pursuant to Sec. 9 paragraph 6 AFGBV:

Subsequent changes in technical preconditions or replacement of personnel shall be notified without delay to the competent authority under state law. From the point of view of the federal state authorities surveyed, a review can only result in an additional file note or a new approval process. Due to this, there were major differences in the estimation of the additional expense per report. An average of the time values named by the federal state authorities surveyed was used as a basis. With regard to frequency, potential owners surveyed assume, based on current knowledge, that technical changes subject to notification occur at least once a year due to ongoing technical development. Based on empirical values regarding staff turnover, it can also be assumed that every two years the corresponding report will be supplemented by a report on personnel changes. Thus, an annual reporting of subsequent changes is taken as a basis. Notification of subsequent changes pursuant to Sec. 9 paragraph 6 AFGBV may result in the need to issue only a file note or a new approval, so there was a wide spread in the estimation of minutes per case. The federal state authorities therefore incur personnel costs of around 20,000 Euro for subsequent changes.

Revocation of an approval pursuant to Sec. 10 AFGBV:

The federal state authorities surveyed see the additional expense to be determined for the revocation of an approval as strongly dependent on the respective facts, as these can in part generate very different efforts for the presentation of evidence. An average of the estimated time values was therefore taken as a basis. In terms of frequency, the federal state authorities surveyed assume that revocation will be required in 5 per cent of the defined operational design domains approved each year. This means that the revocation of an approval incurs personnel costs of around 7,000 Euro.

Entry of the defined operational design domain pursuant to Sec. 11 paragraph 3 AFGBV or the test permit pursuant to Sec. 16 paragraph 7 AFGBV in the registration certificate Part I:

The registration of the self-driving function shall be limited to the specified operational design domain or for testing. Specified operational design domains or a reference to the test permits shall be entered in the Part I registration certificate. According to the federal state authorities surveyed and the registration offices, the entry of the registration restriction in the registration certificate is made analogously to the current procedure by means of a note in line 22 of the registration certificate Part I. Overall, a minor additional expense of 1,300 Euro in personnel costs is assumed.

Review on the evidence of compliance with the technical and organizational requirements pursuant to Sec. 8 paragraph 2 AFGBV:

The owner shall employ reliable and competent persons for the implementation of and compliance with the technical and organizational requirements and shall provide evidence thereof. In order to assess their reliability, the owner must, for example, provide evidence of appropriate qualifications for the persons deployed, a certificate of good conduct for submission to an authority and an extract from the Register of Driver Fitness. Within the scope of the review of the application for a defined operational design domain, a review of the relevant evidence is required, which is estimated separately at this point. The federal state authorities incur additional personnel costs of approximately 2,000 Euro for the review of the evidence submitted.

**VIII. Further costs**

For the application for an operating permit for a motor vehicle with self-driving function at the KBA, further costs in the form of fees are incurred by the manufacturers. Based on the above assumption of five applications for operating permits per year, the newly introduced fee number 111.3 for the granting of an operating permit to operate for motor vehicles with self-driving functions will result in additional annual costs for manufacturers amounting to 446,200 Euro:

5 operating permits \* 89,240 Euro = 446,200 Euro

Based on the above-mentioned assumption of five applications for test permits per year, the newly introduced fee number 111.4 for the granting of a test permit for motor vehicles for commercial owners will result in an annual compliance cost of 446,200 Euro:

5 test permits \* 89,240 Euro = 446,200 Euro

To apply for a defined operational design domain, an approval must be obtained from the competent authority under state law. For this, "further costs" in the form of fees could be incurred by the respective applicants. However, these could not be quantified because the regulations or the amount of the fees were not yet available at the time of the survey.

No effects on the price level, in particular on the consumer price level, are to be expected from this ordinance.

**IX. Gender policy issues**

The regulations do not have any impact on gender equality. The ordinance does not provide a basis for hidden disadvantages, participation deficits or the consolidation of traditional roles.

**X. Sustainability**

The management rules and indicators of the national sustainability strategy were examined. The ordinance on the traffic of motor vehicles with self-driving functions in specified operational design domains promotes the use of driverless vehicle systems. The further development and use of assistance, automated and self-driving systems is expected to increase road safety and efficiency while at the same time reducing mobility-related environmental impacts (especially emissions and land consumption). In addition, this will improve the mobility of society and strengthen Germany as a location for business and innovation.

**XI. Evaluation**

This legal ordinance issued on the basis of the... Act on the Amendment of Road Traffic Provisions (Autonomous Driving Act) is also an anticipation of future forms of mobility that will only be introduced into regular operation. In view of further developments in this field and the updating of international provisions, the regulations created by the Amendment Act are to be evaluated at the end of year 2023. For details, please refer to the justification to Sec. 1l of the German Road Traffic Law.

**B. On the individual provisions:**

**I. Re Article 1**

**Ordinance on the Approval and Operation of Motor Vehicles with Self-Driving Functions in Specified Operational Design Domains (Autonomous Vehicles Approval and Operation Ordinance - AFGBV)**

**Section 1**

The provision serves to define the scope of this Ordinance. By linking to Sections 1d to 1i of the German Road Traffic Law (StVG) in paragraph 1, these provisions, in particular the definitions, are incorporated into the text of the ordinance and declared applicable, so that in particular no new definitions are required in the text of the ordinance.

Paragraph 2 clarifies that this ordinance determines the procedural regulations for the granting of an operating permit for motor vehicles with self-driving function, for the determination of an operational design domain, as well as for the registration of motor vehicles with self-driving function to be allowed in road traffic. A further regulatory component of this Ordinance in the first procedural stage is in particular the technical requirements catalog attached in Annex I to this Ordinance, on the basis of which the assessment of motor vehicles with self-driving functions is carried out.

Finally, paragraph 3 extends the scope of the Ordinance to the requirements and obligations for the manufacturer, the owner and the Technical Supervision of motor vehicles with a self-driving function in specified operational design domains.

Paragraph 4 excludes motor vehicles of the Federal Armed Forces, the Federal Police and the Civil Defense from the scope of the Ordinance, provided that they are intended for the performance of sovereign tasks and are used with due regard for public safety and order. Motor vehicles of the Federal Armed Forces, the Federal Police and the Civil Defense also use self-driving functions. However, they are subject to special operating conditions in their range of applications and have special equipment. Therefore, a deviation and subsequently an analogous application of the provisions are necessary for the fulfillment of sovereign assignments.

**Section 2**

Section 2 regulates the procedure for granting an operating permit for motor vehicles with self-driving functions. Sec. 2 clarifies that this operating permit is the basic requirement for the operation of motor vehicles with self-driving functions in public spaces. It conditions all further procedural stages. Exceptions to this are not envisaged, without prejudice to the existing regulations relating to the testing of corresponding vehicles, and are therefore inadmissible. This abolishes the previous practice of a singular exemption of the respective federal state for a corresponding vehicle in order to meet the requirements of simplification and comparability as well as the increased demand for the use of such vehicles in regular operation. The reference to Sec. 20 paragraph 1, 3 and 3a of the Road Traffic Licensing Regulations makes it possible to issue a general operating permit for mass produced motor vehicles with self-driving functions, so that it is not necessary to apply for a type-approval for identical vehicles in each case. Furthermore, the Federal Motor Transport Authority is authorized to issue operating permits for the subsequent activation of self-driving functions.

**Section 3**

The procedure for granting an operating permit for motor vehicles with a self-driving function is initiated with the submission of a corresponding application by the manufacturer of that motor vehicle, as Sec. 3 paragraph 1 clarifies. The Federal Motor Transport Authority is intended to be the central authority in this procedure. This regulation serves to simplify administration and to ensure a uniform standard throughout Germany for the assessment of motor vehicles with self-driving functions.

Paragraph 2 sets out the necessary content of an application. For this purpose, the manufacturer shall make a binding declaration that the motor vehicle with self-driving function fulfills the technical preconditions set out in Annex I to this Ordinance and that the manufacturer guarantees that the requirements necessary for granting on operating permit for a motor vehicle with self-driving function are met. This declaration shall guarantee the legality of the installed technical equipment and parts which, for example, represent an effective solution to previous specifications through further development, but are not yet standardized and normed in this respect.

On the basis of this declaration, it will be checked whether the motor vehicles with self-driving function meet the requirements of the established regulations of the United Nations Economic Commission for Europe (UNECE). As such regulations are currently being developed for automated and self-driving vehicles at the UNECE, they cannot yet be comprehensively reviewed. In part, these gaps are filled by the new requirements at national level by means of this legal ordinance. In order not to slow down the driving force of automated, self-driving and networked driving, the manufacturer's declaration should suffice for a transitional period, insofar as certain technical requirements are not yet verifiable.

In addition, however, the Federal Motor Transport Authority is to be at liberty to demand further information from the manufacturer that is necessary for the approval procedure, as paragraph 2, sentence 2 clarifies.

Within the scope of the validation of the motor vehicle, the Federal Motor Transport Authority may also commission an officially recognized motor vehicle traffic expert or a comparable body, as stipulated in paragraph 3.

**Section 4**

The provision determines the preconditions under which the requested operating permit for motor vehicles with self-driving function is issued. First of all, it is necessary that all information according to Sec. 3 paragraph 2 is available. The validation of the motor vehicle with self-driving function by the Federal Motor Transport Authority must be concluded with the result that the motor vehicle complies with the preconditions specified in Annex I to this Ordinance. The operating permit includes the determination of the basic technical performance of the motor vehicle. Based on this determination, it should be possible to assess in the next procedural stage when approving the defined operational design domain whether the motor vehicle with self-driving function can meet the vehicle technology requirements set by the respective operational design domain. This does not define specific operational design domains in advance.

In order to also enable the operating permit of subsequently activated automated or self-driving functions, the Federal Motor Transport Authority is authorized to issue corresponding technical requirements for these with the involvement of the competent federal state authorities in accordance with this Ordinance.

**Section 5**

Pursuant to this Provision, the Federal Motor Transport Authority shall carry out the tasks of market surveillance with regard to the vehicles and vehicle parts to be approved and authorized pursuant to this Ordinance. In order to ensure that the approved vehicles and vehicle parts are adequately monitored for conformity even after they have been manufactured on the market, the Federal Motor Transport Authority is assigned the corresponding verification and market surveillance tasks and powers. In addition, it is regulated that the Federal Motor Transport Authority shall involve the Federal Office for Information Security in the evaluation of the information technology security of vehicles and vehicle parts. Involvement of the BSI is necessary to ensure that appropriate measures to guarantee IT security are incorporated into the technical requirements. Otherwise, there would be a considerable potential for damage in the entire field of self-driving.

**Section 6**

The provision determines under which preconditions the operating permit granted according to Sec. 4 is to be revoked. Due to the strict preconditions for the technical equipment of motor vehicles with self-driving functions and the special safety relevance associated with this, the revocation is intended as a bound decision if one of these alternative preconditions is met. The Federal Motor Transport Authority has no discretionary powers in this respect. Irrespective of the aforementioned grounds for revocation, withdrawal and revocation continue to be possible on the basis of Sections 48 and 49 of the Administrative Procedure Act (VwVfG), which is clarified by paragraph 2.

Paragraph 4 grants a flow of information between the Federal Motor Transport Authority and the federal states in the event of revocation of the operating permit. This is essential, as both parties are involved in the placing on the market or registration of the motor vehicle with self-driving function and should inform each other of any changes.

**Section 7**

Section 3 regulates the procedure for the approval of a defined operational design domain. Sec. 7 clarifies that motor vehicles with self-driving functions may only be operated in specified operational design domains. In this context, the designation of an operational design domain shall require the approval of the competent authority in accordance with the provisions of this Ordinance. The number of possible defined operational design domains is explicitly not limited. In principle, therefore, motor vehicles with self-driving functions can be used in several defined operational design domains, provided that the respective preconditions are met. Likewise, several vehicles can also be used in the same operational design domain. In order to simplify the procedure, for identically constructed motor vehicles with self-driving functions, the approval of the defined operational design domain may be granted for several identically constructed vehicles pursuant to Sec. 2 sentence 3, provided that a corresponding operating permit for motor vehicles with self-driving functions is available.

The definition of certain operational design domains is intended to enable the operation of self-driving vehicles for certain operational scenarios in order to take into account the different mobility needs of local authorities, such as the transport of passengers and/or goods on the last mile or demand-oriented services in off-peak times. At the same time, the definition of operational design domains also means a restriction. Motor vehicles with self-driving functions may not be in the self-driving mode outside an approved, defined operational design domain. This will create controllable framework conditions for the use of self-driving vehicles, which is essential as a contribution to higher road safety and greater acceptance among the population.

**Section 8**

The procedure for the approval of the defined operational design domain is initiated with the submission of a corresponding application, as Sec. 8 paragraph 1 clarifies. The applicant at this procedural stage is the future owner. The competent authority at this procedural stage shall be determined in accordance with the respective state law. Since regional and local conditions play an essential role in the determination of operational design domains, it is not appropriate at this procedural stage to determine a central Approval Authority throughout Germany. Regional and local conditions in the definition of operational design domains for motor vehicles with self-driving functions are more effectively identified and taken into account by competent authorities of the federal states.

Paragraph 1 specifies the enumerative list of necessary documents to be attached to the application. These must be cumulative and do not allow for deviations.

First and foremost is the concrete description of the defined operational design domain for the operation of the motor vehicle with self-driving function. It is up to the applicant here to outline as precisely as possible how the operational design domain determined by him in this respect is defined. The applicant must therefore state, among other things, whether he wishes to operate the motor vehicle with self-driving function for the purpose of passenger transport and/or the transport of goods. Furthermore, any special features with regard to the infrastructure relevant for the operation of the motor vehicle with self-driving function shall be presented.

Furthermore, the applicant must make declarations that the deactivation of the motor vehicle with self-driving function within the meaning of Sec. 1e paragraph 2 sentence 1 number 4 StVG and the enabling of driving maneuvers within the meaning of Sec. 1e paragraph 3 StVG are guaranteed in this defined operational design domain and that the personnel and material preconditions according to Sections 13 and 14 are met. Since the operating permit for motor vehicles with self-driving function is a mandatory precondition for the corresponding motor vehicle to be operated on public roads at all, this operating permit must be submitted to the competent authority with the application for approval of the defined operational design domain in accordance with paragraph 2 number 1. Further documents to be submitted are a certificate of good conduct from the owner and the technical supervisor for submission to an authority and an extract from the driving license register as well as an extract from the Register of Driver Fitness for the Technical Supervision. These documents serve to validation the reliability of the persons concerned against the background of the high requirements to be placed on the safe operation of a motor vehicle with a self-driving function, in particular for commercial goods or passenger transport, in view of the novelty of the technologies. Furthermore, the authority should be at liberty to request further information from the applicant, as paragraph 3 makes clear.

**Section 9**

The provision determines the preconditions under which the requested approval of the operational design domain is granted. Accordingly, pursuant to paragraph 1 sentence 1, the defined operational design domain must be suitable for the operation of a motor vehicle with a self-driving function and the personnel and material preconditions pursuant to Sections 13 and 14 must be met.

In this respect, the competent authority shall also verify the existence of the preconditions of Sections 13 and 14. The basis for this is the declaration of the owner pursuant to Sec. 8 paragraph 1 numbers 2 and 3 and the certificates of good conduct for submission to an authority and extracts from the driver license register on the persons named in Sections 13 and 14.

The preconditions for the suitability of a designated operational design domain are described in paragraph 2 and thus specify the scope of testing of the competent authority. Here, it must be checked on the basis of the operating permit granted pursuant to Sec. 4 whether the corresponding findings regarding the performance of the motor vehicle with self-driving function meet the requirements of the specified operational design domain. A site visit will usually be required for the assessment of the infrastructures. It should be emphasized that a motor vehicle with a self-driving function should in principle be able to operate on the existing infrastructure without the need for infrastructure-related adaptations by the respective construction authorities. In particular, the vehicles should be able to detect traffic signs, lane markings, road routes, light signals, level crossings, etc. independently and react accordingly due to the technical requirements according to Annex I of this Ordinance. Furthermore, the operation of the motor vehicle with self-driving function in this operational design domain must not impair the safety and ease of road traffic. In particular, the vehicle itself must not cause an obstruction to traffic. For example, if the technical equipment of the vehicle allows self-driving operation only up to a maximum speed of 30 km/h, it would be detrimental to the safety and ease of traffic to allow the vehicle to drive on a road where the maximum permitted speed is 70 km/h. In addition, other public interests must not stand in the way of an approval. This applies not least to aspects of environmental law (for example immission control). The approval of defined operational design domains will affect the interests and concerns of local communities due to various local reference points. The respective local authorities are likely to be concerned, on the one hand, about being informed that motor vehicles with self-driving functions are to be operated on their roads in the future and, on the other hand, about being able to exercise a say in this. Therefore, paragraph 4 stipulates that the decision on the approval of a designated operational design domain shall be taken in agreement with the respective local authority concerned. The same applies if an operational design domain extends across a federal state border, so that authorities of two federal states may have to decide.

Paragraph 3 sentence 1 provides that it may also commission an officially recognized expert for motor vehicle traffic or a comparable body with the validation. According to sentence 2, the obligation to submit a corresponding expert opinion may also be imposed on the applicant. In this way, the administrative procedure can be simplified and accelerated.

Paragraph 5 gives the competent authority the possibility to attach ancillary provisions to the approval at any time. Here it will also be decisive as to what extent the performance of the motor vehicle with self-driving function is established by the operating permit. In particular, it may be necessary to keep the motor vehicle initially without passengers, goods or other loads for a period determined according to the circumstances, in order to have the vehicle familiarize itself with any special features of the road infrastructure. In order to ensure effective control of the motor vehicle with self-driving function, data processing is then carried out pursuant to Sec. 15.

Paragraph 6 ensures that even during operation the owner complies with his obligations or, in the event of infringements, the competent authority under state law can take the necessary measures. This makes a significant contribution to road safety. Finally, the fact that the persons involved may change is taken into account, although the requirements for them remain the same.

Paragraph 7 ensures the flow of information between the Federal Motor Transport Authority and the federal states as required by Sec. 5 paragraph 4.

**Section 10**

The provision determines the preconditions under which the approval of the defined operational design domain granted according to Sec. 9 is to be revoked.

The enumerated grounds for revocation have a particular safety-relevant, which is why revocation is justified as a bound decision if one of these alternative preconditions is met.

According to paragraph 2, however, withdrawal and revocation shall continue to be possible on the basis of Sections 48 and 49 VwVfG irrespective of the aforementioned grounds for revocation.

Paragraph 3 grants - corresponding to the regulation under Sec. 6 paragraph 4 - a flow of information between the federal states and the Federal Motor Transport Authority if there is a revocation of the approval of the defined operational design domain.

**Section 11**

Section 4 deals with the third procedural stage, the registration of motor vehicles with self-driving functions to road traffic pursuant to Sec. 1 paragraph 1 StVG. Section 11 declares the Ordinance on the Registration of Vehicles for Road Traffic (FZV) applicable with certain stipulations. In order to avoid further administrative effort, it is intended to fall back on the existing regulations in this respect, since motor vehicles with self-driving functions - apart from the previous procedural stages - do not have to be assessed differently from conventional vehicles in this procedural stage.

Accordingly, the registration pursuant to Sec. 3 paragraph 1 sentence 2 FZV requires a valid operating permit for a motor vehicle with self-driving function according to Sec. 4, a valid approval of a defined operational design domain pursuant to Sec. 9 and the existence of a motor vehicle liability insurance in accordance with the compulsory insurance law. This information must be submitted with the application pursuant to Sec. 6 FZV. Without these preconditions, motor vehicles with self-driving functions may not be admitted to road traffic.

**Section 12**

Section 5 regulates the requirements and duties of care for the manufacturer, the owner and the Technical Supervision of motor vehicles with self-driving functions in defined operational design domains, as well as specifications for data processing.

Section 12 states that the manufacturer of a motor vehicle with a self-driving function shall provide the owner with the repair and maintenance information for that motor vehicle. This information is essential for the owner to comply with his obligations pursuant to Sec. 13.

**Section 13**

The provision serves to substantiate the obligations of the owner pursuant to Sec. 1f paragraph 1 of the StVG. In order to fulfill these obligations during the operation of the motor vehicle with self-driving function, paragraph 1 provides for a catalog of corresponding obligations to act. These are obligations in connection with the technical maintenance of the motor vehicle with self-driving function, which are in connection with the requirements of Annex II to this Ordinance. The owner shall carry out inspections on the vehicle at regular intervals to ensure road safety, environmental compatibility and compliance with the applicable provisions. An interval of 90 days is a compromise between the high requirements on the road safety of these systems and the organizational and economically justifiable effort.

Paragraph 2 clarifies that the owner is obliged to appoint the Technical Supervision within the meaning of Sec. 1d paragraph 3 StVG. In principle, however, it is not excluded that the owner - provided that he is a natural person - can take over the tasks of the Technical Supervision himself. In addition, by providing the necessary material preconditions, he must ensure that the person performing the Technical Supervision can fulfill their obligations. This includes, in particular, the provision and establishment of appropriate premises, for example in the form of a control center. What is needed are devices such as monitors to establish visual contact with the surroundings of the motor vehicle with self-driving function, communication systems to be able to establish contact with passengers and other road users, devices that unambiguously signal to the Technical Supervision when he or she must approve driving maneuvers suggested by the vehicle or set the vehicle to the minimum risk state, and corresponding input devices with which these actions can be implemented.

Paragraph 3 imposes further organizational obligations on the owner. In addition to the appointment of the Technical Supervision, he shall appoint further qualified and reliable personnel who can take over the technical and organizational tasks in accordance with the specifications according to paragraph 1. The professional qualifications of these persons are specified in Annex II, point 2, and must be demonstrated by the owner. The validation of the reliability of these persons serves to monitor the owner's duty of care. Especially against the background of ensuring the high safety of motor vehicles with self-driving functions, it is indispensable to define not only the technical and organizational requirements for the owner but also their monitoring. Within the scope of the permit of the defined operational design domain, the owner must therefore provide evidence that he has appointed the aforementioned personnel and has checked their reliability by submitting certificates of good conduct, extracts from the Register of Driver Fitness.

Paragraph 4 modifies the period for the general inspection pursuant to Sec. 29 of the Road Traffic Licensing Regulations and sets an interval of 6 months.

**Section 14**

The provision stipulates that the Technical Supervision - like the other personnel employed by the owner pursuant to Sec. 13 paragraph 3 - must be reliable and professionally suitable. For this purpose, the owner shall provide the evidence referred to in point 1 of Annex II. In addition, they must be the holder of a driver's license, which is dependent on the type of vehicle. For instance, when transporting not more than 16 persons by the motor vehicle with self-driving function, the Technical Supervision requires a driving license of class D1, whereas when transporting goods with a total permissible mass of more than 3500 kg but not more than 7500 kg, they require a driving license of class C1. Even if the Technical Supervision does not drive the vehicle, it is essential to be qualified in handling appropriate motor vehicles of this type in order to monitor the obligations of the Technical Supervision.

If the function of the Technical Supervision is carried out by the owner himself, he must fulfill these preconditions personally.

**Section 15**

In addition to the stipulations on data processing according to Sec. 1g of the German Road Traffic Law, Sec. 15 regulates by reference to Annex III how data storage is to be carried out. In this respect, the Annex determines the exact times of data storage, the parameters of the data categories and the data formats.

**Section 16**

Up to now, the testing of automated and self-driving motor vehicles has been approved by the competent federal state authorities like any other testing content pursuant to Sec. 19 paragraph 6 in conjunction with Sec. 70 paragraph 1 numbers 1 and 2 of the StVZO. The intention of the new provision is to regulate permits specifically and only for motor vehicles with automated and self-driving functions in a uniform manner throughout Germany in order to bring about legal certainty for manufacturers and their agents and thus to sufficiently take into account the special features of these novel technologies. The basic stipulations are regulated by Sec. 1h of the German Road Traffic Law. Sec. 16 specifies the requirements for approval by the Federal Motor Transport Authority.

Paragraph 2 describes the regular time limit of corresponding test permits. The testing shall be limited for an appropriate period of time and should not normally exceed four years. The approval shall be extended for a further two years in each case if the original approval conditions continue to apply and the progress of the testing to date does not constitute an obstacle to an extension. The expiry of the period of validity is suspended by the filing of an action or an objection against the approval.

The chosen framework of four years offers the Federal Motor Transport Authority sufficient leeway to do justice to the particular circumstances of each individual case. At the same time, it increases planning and investment security for innovators and stakeholders involved. Otherwise, the concern would be that overly unspecific regulations that leave any design to the discretion of the Approval Authority could lead to high levels of uncertainty among users (and those involved in approval) and a reluctance to use test provisions.

In addition, the explicit time limit ensures that these are indeed experimental and test provisions, i.e., regulations that serve to gain experience. Thus, the (constitutional) legal requirements for trial clauses require that the temporary nature of the regulation be preserved.

In addition, the special features of testing must also be taken into account, which can lead to further problems for those testing if the time limits are too rigid. Therefore, it is possible to obtain an extension of the test permit for a further two years, provided that the original approval conditions continue to apply and the progress of the testing to date does not constitute an obstacle to an extension. A reliable extension option also improves the cost-effectiveness of the investments as well as their planning capability.

Experience with other trial clauses also shows that the suspensive effect of third-party objections in practice often significantly impedes the testing or even renders the approval obsolete if this is not explicitly regulated within the scope of the trial provision because, for example, the remaining trial period is no longer sufficient after the objection has been resolved.

In this context, it is appropriate to set higher requirements for the Technical Supervision and monitoring of the test vehicles. Instead of a mere deactivation option, an override should also be possible. However, this must not be done remotely, but only on site. The Federal Motor Transport Authority has the necessary preconditions to approve manufacturers' concepts for testing. Such an approval should then, for reasons of practicability, cover all the technologies to be tested in the vehicle, not just those relating to automation.

**Section 17**

The provision determines facts for administrative offenses in the sense of Sec. 24 StVG. This is to ensure, in the interests of road traffic and ease of movement, that the provisions of this Ordinance are complied with and that motor vehicles with self-driving functions are operated within the appropriate controlled framework and that their functions are not misused.

**Annexes I to IV**

The annexes serve to specify the technical and organizational requirements for motor vehicles with self-driving functions and their operation. Furthermore, requirements for persons involved are specified. The requirements are based on the current state-of-the-art and the associated current state of knowledge. The constant development of the technology of automated and self-driving systems makes it necessary to update these annexes in the future.

**II. Re Article 2**

**Amendment of the Fee Regulations for Road Traffic Measures (GebOSt)**

**Re Point 1:**

The amendment of Article 2 with regard to the newly included expenses results from the complex approval procedure for automated and self-driving functions. In this procedure, Sec. 1i paragraph 3 StVG, for example, provides for the participation of the Federal Office for Information Security (BSI) on questions of IT security in the implementation and further development and the evaluation of technical requirements.

This Ordinance (Article 1: Autonomous Vehicle Approval and Operation Ordinance - AFGBV) explicitly provides for the support of the KBA by the BSI in the evaluation of the information technology security of vehicles and vehicle parts within the scope of granting operating permit (Sec. 5 paragraph 3).

Within the scope of the approval procedure at the KBA, it is also stipulated that the KBA may commission an officially recognized motor vehicle traffic expert or another body for the assessment of the motor vehicle with a self-driving function (Sec. 3 paragraph 3).

The expenses associated with the approval procedure, which are due because of involving the KBA as the competent authority for the granting of permits (cf. Sec. 1e paragraph 3 StVG: Operation of motor vehicles with self-driving functions) and for the approvals (cf. Sec. 1h paragraph 2 Sentence 1 StVG: Subsequent activation of automated and self-driving functions; cf. Sec. 1i paragraph 2 Sentence 1 StVG: Testing of automated and self-driving functions) must be consistently imposed on the fee debtor within the scope of his application procedure.

The new number 12 in Sec. 2 of the GebOSt implements this and allows the competent authority to charge the fee debtor not only the fee numbers anchored in the Annex (to Sec. 1) for the approval procedures for automated or self-driving functions but also the expenses incurred in the process.

The expenses in the new number 12 can also be applied to the performance of tasks by the KBA within the scope of market surveillance (cf. Sec. 5 paragraph 1).

With the insertion of the provision on expenses in number 12 in the text of the GebOSt, its application extends to the entire Annex (to Sec. 1).

**Re Point 2**

**Letter a.**

For fee numbers 111.3 and 111.4:

The amount of the fees is measured against the requirements of the ordinance, in this case the explicit mention of observing the cost recovery principle when setting the amount of the fees. It is assumed that the following administrative expenses will be incurred. Here, based on the expert estimate, which was determined in interviews with potential owners and current test field operators, it is assumed that 10 permits per year (5 operating permits and 5 test permits) will be required. This figure is assumed for the calculations for material and personnel expenses, taking into account overhead costs.

For the calculation of the fees, the personnel and material cost rates for economic efficiency studies and cost calculations (status: 06.18.2020) are taken as a basis. These take into account the material and personnel costs as well as the overhead portion. The following fee calculation is made on this basis.

In order to cope with the upcoming approval processes, the expertise of personnel with the corresponding university education is necessary, who have an in-depth insight into the complex of topics of self-driving as well as cyber security. In the KBA, grades A 12 and A 14 possess this required expertise. This grade is based on the following KBA personnel cost rates:

A14: 165,136 Euro / year / person

A12: 140,531 Euro / year / person

The granting of an approval includes the following activities:

- Basic development / policy work,

- Initial assessment of the manufacturer,

- Designation of technical service,

- Issuance of operating and test permits,

- Monitoring in operation.

An essential part of this is the granting of operating and test permits. This takes into account the following activities, among others:

- Coordination of the individual projects and those involved in the process,

- Specification / development of test scenarios and evidence to be provided regarding the degree of automation, software updates and cyber security,

- Review of application documents,

- Review of approval documents (e.g., manual and security concept),

- Supervision / performance of reviews at the test location,

- Review of all relevant legal acts (e.g., standard provisions that are relevant for the regulations on autonomous and automated procedures, in particular the law on self-driving and the AFGBV),

- Issuance of permits.

The KBA assumes that an applicant will contact the KBA at an early stage, that reviews will take place both in the operational design domain and at the applicant's premises, and that document and concept checks will be carried out at the KBA. The reviews within the scope of the granting of the operating permit will have to be carried out to a large extent on site in intended or representative operational design domains of the vehicle as well as on test tracks of the applicant. An iterative development and approval process in the presence of the applicant, its developers and experts from appropriate technical services or authorities (e.g., BSI) is to be assumed. In order to review the safe functionality of the vehicle in practical operation, the presence of the KBA is considered to be indispensable. An exclusively document-related review is not considered sufficient. It is assumed that the process flows shown in the approval procedure require a considerable amount of time and involve not inconsiderable human resources.

In the overall view, the effort per approval is assumed to be approx. 300 hours of the expertise in the higher service and approx. 600 hours of the expertise in the senior service. This results in an effort of 3,000 hours in the higher service and 6,000 hours in the senior service for the ten assumed approval procedures.

It is assumed that 1,500 hours are worked per full-time staff position per year. This means that two posts in the higher service and four posts in the senior service are required to cover the administrative workload for the approval procedures to be carried out in the year.

This results in the following calculation based on the estimated compliance costs:

(2 \* A14 + 4 \* A12)

= ((2 \* 165,136 Euro) + (4 \* 140,531 Euro))

= (330,272 Euro + 562,123 Euro)

= 892,396.00 Euro

Thus, a total expenditure of 892,396 Euro is incurred for the ten accepted approval procedures.

Accordingly, the expenses per approval case amount to 89,239.60 Euro. This can be seen in the calculation below.

(2 \* A14 + 4 \* A12) / 10

= ((2 \* 165,136 Euro) + (4 \* 140,531 Euro)) / 10

= (330,272 Euro + 562,123 Euro) / 10

= 89,239, 60 Euro

Taking into account the requirement of a cost-covering fee calculation as well as the estimates of the number of approvals in connection with the personnel to be provided by the KBA, the result is a fee of at least 89,240 Euro rounded up for a new approval. The amount of the fee applies to the granting of an operating permit for motor vehicles with self-driving functions and equally to the granting of test permits for motor vehicles with self-driving functions. This can be justified by the fact that the expense for both procedures is comparable. This is because the examination framework in the administrative procedure is congruent. In each case, these are complex review procedures for self-driving functions. Both application situations therefore cause the same amount of expense for the KBA.

For fee numbers 111.5 to 111.7

In addition to the granting of operating permits for motor vehicles with self-driving functions as well as corresponding test permits for these vehicles, permits for the subsequent activation of automated or self-driving functions in already registered vehicles are possible. Furthermore, test permits are also possible for automated self-driving functions. Compared to the granting of corresponding permits for a complete vehicle, this approval only covers individual functions in the vehicle. The scope of the necessary reviews and thus the granting of an approval is estimated to be less than for a complete vehicle. As there is no estimate of the number of approvals and empirical values for the time required for approval, and as there is expected to be a significant difference between the individual applications in terms of the complexity of the functions to be checked, a fee based on time and effort is considered to be appropriate. The fee framework is set per hour per person per case and, at 49.00 Euro to 129.00 Euro, covers all expected personnel costs in the approval procedure. In this way, material costs plus overhead costs are recorded in addition to pure personnel costs. This allows for the necessary flexibility in calculating the actual expense with the granting of an approval.

**Re Letter b.**

For fee numbers 112.4 and 112.5

These fee numbers are necessary in order to charge the administrative expenses incurred for supplements to permits already granted to the person requesting the supplement to an approval. Experience has shown that the issues to be examined for supplements are less extensive than for a new approval. Experience from many years of approval practice shows that the effort is usually halved. Therefore, only half of the fee rate of fee numbers 111.3 and 111.4 is applied accordingly. The fee for a supplement is thus set at 44,620 Euro.

For fee numbers 112.6 to 112.8

Supplements for the granting of a permit for the subsequent activation of an automated or self-driving function in already registered motor vehicles as well as supplements for the granting of a test permit for self-driving functions are also provided for here as a fee according to effort for the reasons already given for the justification of fee numbers 111.5 to 111.7.

**III. Re Article 3**

Regulation of the entry into force.

Annex I - Requirements for vehicles with self-driving function

Unless otherwise provided for below, the stipulations of Ordinance (EU) 2018/858[[1]](#footnote-1) and the German Road Traffic Law shall apply mutatis mutandis insofar as these stipulations do not require the presence of a driver.

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Appendix 1: Functional requirements for vehicles with self-driving function

Vehicles with self-driving functions must fulfill the functional requirements outlined below. The self-driving function must be tested for safety. The safety must be proven to the Federal Motor Transport Authority. Appendix 2 to this Annex shall be applied for the evidence to the Federal Motor Transport Authority. Beyond this evidence, the required functions must be demonstrated by the manufacturer and/or owner in an optional, so-called test phase of the vehicle with self-driving function without passengers in the specified operational design domain.

# Dynamic driving task

The vehicle must be able to perform the driving task independently and dynamically in the approved, specified operational design domains in all situations safely by appropriate choice of trajectory (driving path) and speed. This includes the alignment of the driving process with the dynamic surroundings of the vehicle with self-driving function and conformity with legal requirements. The safety of all road users and all passengers must be given the highest priority in the performance of the driving task. The vehicle with self-driving function must react appropriately to unexpected events, even if they occur suddenly.

Vehicles with a self-driving function intended to carry standing or unbelted passengers shall not exceed a combined (resultant) horizontal acceleration of 2,4 meters per second squared in normal operation. Depending on verifiable factors influencing the risk to occupants and external road users, it may be necessary to exceed this limit. This may be the case, for example, if there are only belted occupants inside the vehicle, but not standing occupants.

The vehicle with the self-driving function engaged shall, in order to fulfill the driving task, at least comply with the requirements set out in the following Clauses 1.1 to 1.4:

## Avoiding collision with other road users

In principle, collisions can occur with other road users who can approach the vehicle with self-driving function from all directions. A classification of the critical situation according to the main direction ("crossing", "in the same direction" or "from the opposite direction"), according to the type of road user (vehicles, pedestrians, cyclists, animals) and according to the type of object in the trajectory (can be crossed, cannot be crossed) allows the derivation of requirements.

The following requirements must be met:

a. To avoid the collision:

aa. Vehicles, pedestrians, cyclists, animals and obstacles (also suddenly appearing) in the surroundings are detected. A suitable reaction or maneuver is initiated on the basis of their behavior or on the basis of a prognosis of their behavior and, in the case of vehicles and animals, after a risk assessment. Personal injuries are to be avoided if possible or, if avoidance is not possible, minimized.

bb. Oncoming vehicles are detected and taken into account accordingly during the driving task. This includes vehicles approaching in the lane of the vehicle with self-driving function and a corresponding evasive or braking reaction.

cc. With regard to driving vehicles, it can be assumed that these vehicles decelerate at a maximum rate of 10 meters per second squared.

b. Collisions with animals must be avoided if the maneuver necessary to avoid them would not cause danger to other road users, uninvolved third parties or the occupants of the self-driving vehicle, or if the collision itself would cause danger to the occupants of the vehicle.

d. Collisions with objects that cannot be driven over must only be avoided if the maneuver necessary to avoid them does not create a hazard for other road users or the occupants of the self-driving vehicle or if the collision itself would create a hazard for the vehicle occupants (example: large pieces of cargo).

e. Collisions with cross traffic that does not have the right of way must only be avoided if this is physically possible and with the state-of-the-art due to the visibility conditions, the relative speed and the associated early detection of the other road user. If a collision cannot be avoided, the consequences shall be minimized by braking and by reducing the speed as much as possible as a result. Letter a, double letter aa shall apply accordingly.

## Interaction with other road users

1. Vehicles ahead in the lane are detected. An appropriate safety distance is maintained at all times in every speed range and in every possible driving situation (especially driving straight ahead, turning, and changing lanes). The safety distance to be maintained is derived from Sec. 4 of the Road Traffic Regulations (StVO).
2. The lane change of preceding or following vehicles from an adjacent lane into the own driving lane or out of it into an adjacent lane is recognized and taken into account accordingly in the driving task.
3. Situations that require a lane change (examples: stopped or slow vehicles in the lane, end of a driving lane) are recognized and the lane change is carried out safely, taking into account the traffic and observing the applicable traffic regulations (use of direction indicators, side distance).
4. Emergency vehicles are recognized and suitable maneuvers are initiated in compliance with the applicable traffic regulations.

## Planning the trajectories and speeds

1. Speed limits and changes to the speed limit are detected and the speed is adjusted accordingly. When making speed adjustments, occupants, surrounding traffic and third parties are taken into account in such a way that they are not impaired in any way.
2. Special speed requirements (e.g., school and construction site areas, bus stops, level crossings, narrow curve radii or gradients, narrow places where the own driving lane must be shared by oncoming traffic) are recognized and followed in the speed and driving process.
3. Traffic facilities (e.g., traffic lights, signs, crossings) are recognized and obeyed when it comes to speed and the driving process.
4. Situations in which the right of way must be yielded to others, such as at zebra crossings, intersections or junctions, are recognized and managed without endangering or obstructing those who have the right of way. A time to collision of more than three seconds shall be observed with respect to the person having the right of way. If the manufacturer deviates from these values, they must sufficiently justify and document this on the basis of systematic safety assessments according to generally recognized rules of technology. As an example, ISO 26262:2018 Road vehicles - Functional safety[[2]](#footnote-2).
5. Access restrictions and crossings are detected and an appropriate reaction to comply with compliant behavior is initiated.
6. Construction site areas temporarily changed lane routes or lane markings are recognized and followed during the driving process.

## Reaction to environmental conditions

Weather, environmental and road infrastructure conditions are taken into account in the speed and driving process (examples: rain, obstruction of view due to smoke). The trajectory and speed shall be selected - up to the standstill of the vehicle - in such a way that the requirements set out in Sections 1.1. to 1.3. are also met in the event of changed environmental conditions.

# Minimal risk condition

The vehicle with self-driving function shall be able to detect system limits and failure of systems or functions relevant to the driving task at any time. If the vehicle detects that the corresponding system limits have been reached or that a corresponding failure has occurred, it must be able to reach the risk-minimum state independently. The hazard warning lights must be activated automatically by the vehicle. The vehicle with self-driving function brings itself to a standstill in the safest possible place within the scope of the maneuver to establish the minimum risk condition.

For vehicles without conventional devices for performing the driving task:

The vehicle can only leave the minimum risk condition at the instigation of the Technical Supervision. The Technical Supervision shall conduct an analysis of the triggering and need for the risk-minimum condition before initiating its termination. If the minimum risk condition was triggered by a defect on the vehicle, the driving task must be taken over manually by the Technical Supervision after reaching the minimum risk condition until the triggering defect has been permanently eliminated. Manual driving is regulated in Clause 4 of this Appendix.

# Emergency driving function

The vehicle with self-driving function must be equipped with an emergency driving function. If the vehicle must return to the minimum risk state in the event of a vehicle defect, this must be done with the emergency driving function. Driving with the emergency driving function may only be carried out at walking speed and with the hazard warning lights activated. The transition of the self-driving function from normal driving to driving with the emergency driving function is exempt from this speed limit if braking is required.

# Manual drive mode

In manual driving mode, a person driving the vehicle performs the driving task. The vehicle with self-driving function shall be equipped with devices that enable a person driving the vehicle to perform the driving task.

If the control in manual driving mode is limited to speeds no higher than walking speed, it is not necessary for the person driving the vehicle to be inside the vehicle with self-driving function. The control can be carried out via a remote control located in the vicinity of the vehicle. The maximum distance over which control via remote control is possible must not exceed 6 meters, measured in a direct, straight line.

If the vehicle is to be driven in manual mode at speeds higher than walking speed, a seat shall be provided for the person driving the vehicle. This shall be designed in accordance with the applicable provisions.

# Permanent system monitoring

All systems necessary for the performance of the driving task must be permanently monitored by the vehicle itself that they are working correctly. The system monitoring shall be carried out in such a way that any impairment of systems necessary for the safe participation of the vehicle with self-driving function in road traffic leads to the risk-minimizing state.

For vehicles without conventional devices for performing the dynamic driving task:

* Storage of permanent system monitoring data shall be provided by the manufacturer. The owner shall provide this data at the request of the Federal Motor Transport Authority for a validation of the operating permit or to the authority responsible under state law for the permit of the defined operational design domains, insofar as this is necessary for the fulfillment of the tasks of the Federal Motor Transport Authority and the authority responsible under state law in each case.
* The Technical Supervision must be notified immediately of any impairment of functionality. The Technical Supervision shall make an evaluation of the impact on the safe operation of the vehicle with self-driving function.

For vehicles equipped with conventional devices for performing the driving task:

* The self-driving function shall be designed by the manufacturer in such a way that the self-driving function cannot be reactivated as long as there is an impairment of the functionality.

# Data transmission

The data and information from external technical units (for example, backends/server of a provider, external sensors, smartphone) required for self-driving mode must be able to be safely received and used by the vehicle. Data from external units can be used by algorithms in the vehicle to implement with self-driving functions to address specific actuators. For example, data and information can be transmitted from an external technical unit to the vehicle and from the vehicle to a technical unit via a wide area network (WAN) connection in certain cases of usage. The transfer of such data must in particular comply with the requirements of Ordinance (EU) 2016/679 in the version of 05.04.2016 (in short: Data Protection Regulation), Articles 24, 25 and 32 and be secured in accordance with the current state-of-the-art. The safeguarding concept 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 the General Data Protection Regulation. A central secure electronic control unit (SECU) should be used for data transmission. The SECU serves as an information gateway in the vehicle. The SECU communicates internally to the vehicle's communication buses and to the physical On-Board Diagnostics II (OBD II) port or to a manufacturer's proprietary interface. Requirements for security in the field of information technology for data transmission can be found in Appendix 5 to Annex I. In particular, the integrity, authenticity and availability of the data transmission must be ensured.

Communication of the vehicle with self-driving function with other vehicles (V2V) or with infrastructure components (V2I) is permitted. It must, on the basis of a data protection impact assessment pursuant to Article 35 of the General Data Protection Regulation, comply in particular with the information technology requirements set out in Appendix 5 to this Annex and thus with the requirements of Articles 24, 25 and 32 of the General Data Protection Regulation. During operation in an optional test phase, the communication of the vehicle with self-driving function with other vehicles and infrastructure components shall be tested and adjusted wherever necessary.

# Functional security and functional safety

## User manual

The manufacturer shall prepare a User Manual based on the functional description of the vehicle with self-driving function. The purpose of the User Manual is to ensure the safe operation of the vehicle by means of detailed specifications and to enable the Technical Supervision to react correctly if any faults occur. The User Manual must be submitted to the Federal Motor Transport Authority at the time of application in order to obtain operating permit and must be checked by the Federal Motor Transport Authority. The User Manual must also be made available to the owner.

## Safety concept

The manufacturer must draw up a safety concept. In this safety concept, the safety of the function shall be evaluated. Using a systematic approach, the hazardous scenarios and events relevant to the Operational Design Domain ODD must be identified and evaluated in a risk analysis. Based on identified risks, a system behavior or system improvements must be defined and implemented for the corresponding scenarios and events, which make it possible to prevent hazards or reduce their risk to an acceptable level. A state-of-the-art system can be found, for example, in ISO(/PAS) 21448 Road vehicles - Safety of the intended function. The sufficient completeness of the ODD-specific scenarios must be proven by static analyses on the basis of validation runs or other data recordings during the driving operation.

### Hazard analysis

As a basis for the safety concept, a hazard analysis must be carried out by the manufacturer. The analysis identifies and classifies safety-critical parts of the self-driving function. The analysis must show how the overall system for the technical realization of the self-driving function reacts in possible operating situations if a fault occurs and what influence these reactions have on the safety and controllability of the vehicle. In any case, the hazard analysis includes the safety of passengers and other road users.

Possible methods for preparing the analysis are the hazard and risk analysis according to ISO 26262-3:2018 Road vehicles - Functional safety - Part 3: Concept phase and a "Hazard Identification and Risk Evaluation" according to ISO(/PAS) 21448 to identify the basic hazards. Based on the system design, fundamental analyses such as Failure Mode and Effect Analysis (FMEA) or Fault Tree Analysis (FTA) should also be carried out according to the state-of-the-art, which systematically consider the risk posed by concrete failure cases.

### Safety measures

The manufacturer's safety concept according to 7.2. shall demonstrate at system level the detection and minimization or avoidance of possible hazards identified in the hazard analysis according to the state-of-the-art by appropriate measures. Possible safety measures by the manufacturer are in particular

* technical measures in the electrical and electronic infrastructure, activation of fallback levels or external measures (examples: Recourse to emergency driving mode, activation of a back-up system, override function, transfer to the minimum risk state);
* organizational measures (examples: Delimitations of the suitable operational design domains, specific instructions to the responsible persons for manual driving, delimitation of the permitted passenger circle, adaptation of the roadway or signage).

Methods as described in ISO 26262-4:2018 Road vehicles - Functional safety - Part 4: System level product development or ISO(/PAS) 21448 shall be used to develop measures to minimize or circumvent hazards.

## Periodic technical vehicle inspection

The manufacturer shall ensure the feasibility of the periodic technical vehicle inspection by appropriate functional and design measures (examples: manual driving, accessibility of brakes). In particular, it must be possible to drive onto brake test stands, light stands, lifting platforms or pits and to carry out all prescribed reviews.

# Sensor system

For the technical realization of the self-driving function, sensor systems must be used that detects all objects, data or persons in the surroundings of the vehicle that are necessary for the safe fulfillment of the driving task and, with regard to the processing of personal data, complies with the requirements of the Basic Data Protection Regulation of the Federal Data Protection Act and special legal data protection provisions. In order to fulfill the purpose stated in sentence 1 and in compliance with the aforementioned specifications, the sensor system may be supported by external systems. If weather, environmental and infrastructure conditions affect the performance of the sensor system, the vehicle with self-driving function initiates measures to compensate for the risks resulting from the reduced performance of the sensor system.

The sensor system shall be integrated into the safety concept of the vehicle with self-driving function according to Clause 7.2. and into the permanent system monitoring according to Clause 5 of this Appendix.

# Aging and wear of the system

The vehicle must meet the functional requirements even when taking into account the aging and wear of the relevant system components. This consideration must be proven to the Federal Motor Transport Authority within the scope of the application for the granting of the operating permit. If aging phenomena affect the performance of the sensor system, measures are initiated by the vehicle with self-driving function to compensate for the risks resulting from the reduced performance of the sensor system.

Appendix 2: Test and validation methods for vehicles with self-driving function

The following defines test and validation methods that can be used to verify compliance with the requirements for self-driving function required in Annex I Appendix 1.

In doing so, each requirement from Annex I Appendix 1 can be reviewed for compliance by means of tests without exception.

# Pass criteria

The pass criteria are based on the requirements in Annex I, Appendix 1. The requirements are defined there in such a way that pass criteria can be derived not only for a specific given set of test parameters, but for all safety-relevant parameter combinations that can occur in the operating conditions covered by the operating permit and the specified operational design domain (examples: Speed range, longitudinal and lateral acceleration range, radii of curvature, brightness, and number of driving lanes).

For a safety evidence, a completeness of the relevant scenarios and test cases according to the requirements of Annex I Appendix 1 shall be taken into account.

Through validation or other empirical data collection, appropriate evidence must be established that the completeness of the scenarios considered and the variation of the resulting test cases and their parameters provide a level of safety of the self-driving vehicle that is higher than the level of safety for vehicles driven by people.

## Review and test cases

Within the scope of the operating permit reviews and within the scope of the verification of compliance with the requirements associated with the permit, validations may be designed as necessary and the number of validations may be extended as necessary as long as they remain within the limits of the specified operational design domains for the vehicle being tested. In doing so, the vehicle manufacturer must define the test cases and justify to the technical service as to why the selected test cases provide sufficient test coverage for all scenarios, test parameters and environmental influences. Sufficient robustness of the perceptual systems for the self-driving function against input/sensor data disturbance and adverse environmental conditions must be demonstrated.

## Artificial errors and limits of the operational design domain

In order to test the requirements relating to the failure of functions, the self-test of the system and the initiation and execution of a maneuver to achieve a risk-minimized state, faults may be artificially induced and the vehicle in self-driving mode may be artificially placed in situations and subjected to environmental conditions where it reaches the limits of the specified operational design domains.

## Test scenarios, deviations and pass criteria

Depending on the intended operational design domain (corresponding to an "Operational Design Domain" or ODD), test scenarios are to be selected accordingly within the scope of the type testing. The selection is made on the basis of a scenario catalog drawn up by the manufacturer in consultation with the Technical Service. Type testing can be carried out on the basis of simulations, execution of driving maneuvers on the test site and driving tests in real road traffic.

Depending on the test scenarios defined in the intended operational design domain within the scope of the type testing, the pass criteria are defined by the following values. If the manufacturer deviates from these values, they shall adequately justify and document this on the basis of safety assessments according to ISO 26262:2018 Road vehicles - Functional safety[[3]](#footnote-3).

### Pass criteria from UN Regulation No. 152

The fulfillment of the requirements for the vehicle self-driving functions with regard to the avoidance of collisions with vehicles in longitudinal and lateral traffic, with stopping vehicles and with cyclists and pedestrians shall be ensured by deriving the pass criteria from the requirements of UN Regulation No 152, published as document ECE/TRANS/WP.29/2019/61e, taking into account the following amendments:

* Paragraph 5.1.4. the warning to the driver, shall not apply.
* Paragraphs 5.2.1.2. and 5.2.2.2. the minimum deceleration requirement of 5.0 meters per second squared shall be deviated from taking into account the characteristics of the vehicle in self-driving mode as well as the environmental conditions. For example, vehicles intended to transport standing passengers during self-driving mode may require a lower minimum deceleration to protect the vehicle occupants.
* Paragraph 5.2.1.4, the indents (limitations of requirements) are not applicable. New restrictions resulting from the definition of the ODD are conceivable (example: no self-driving at night  restriction "during daylight").
* Paragraph 5.2.2.4, the indent "with crossing pedestrians with a lateral speed component of not more than 5 km/h" should be amended to read "with crossing pedestrians with a lateral speed component of not more than 7 km/h and with crossing bicyclists with a lateral speed component of not more than 25 km/h". All other indents are not applicable.
* Paragraph 5.2.1.4. and paragraph 5.2.2.4., the tables shall be applied on the basis of the speed limits of the self-driving function such that a relative collision speed of '0' (no collision) is required over the entire speed range.
* The paragraphs regarding override and emergency braking system shut-down do not apply.

### Leaving the driving lane

The vehicle with self-driving function may only leave its own driving lane in the following cases: during the maneuver "lane change", for maneuvering in the low speed range (e.g., parking, narrow intersections), for avoiding obstacles and oncoming vehicles, and for collision avoidance (see section "Planning trajectories and speeds"). Appendix I, number 1.1 letter a double letter aa shall apply mutatis mutandis.

### Safety distance

Vehicles ahead in the lane are detected. Maintain an appropriate safe distance at all times in every speed range and in every possible driving situation (especially when driving straight ahead, when turning, and when changing lanes).

### Changing lanes of other vehicles

The lane change of preceding or following vehicles from an adjacent lane into the own driving lane or out of it into an adjacent lane is recognized and taken into account accordingly in the driving task.

### Collision avoidance with vehicles driving in the same direction

Collisions with vehicles driving in the same direction, intruding in their own driving lane and cyclists shall be avoided within the conditions determined by the following equation. (Equation is only valid for road users turning in front of the vehicle with self-driving function, and only if the turning road users were visible at least 0.72 seconds before the turning):

$$TTC\_{Spurwechsel}\geq \frac{v\_{rel}}{2a}+\frac{1}{2}τ+τ\_{Reaktion}$$

The parameters of the above equation are specified below:

|  |  |  |
| --- | --- | --- |
| $$TTC\_{Spurwechsel}$$ | Time to collision (TTC) at the time of intruding in the driving lane of the vehicle with self-driving function in seconds. Intrusion is defined as exceeding the outer edge of the driving lane by more than 30 centimeters. |  |
| $$v\_{rel}$$ | Relative speed in meters per second [m/s]. Positive for the approach of the vehicle with self-driving function to a slow moving vehicle. |  |
| $$τ$$ | Time in seconds that elapses until the deceleration *a* is reached in meters per second squared. | Typical values are 0.5 seconds to reach 10 seconds squared. For lower possible decelerations of the vehicle, scale the values accordingly. For 6 second squared, it is therefore assumed that this delay is reached in 0.3 seconds, 2.4 second squared in 0.12 seconds. |
| $$τ\_{Reaktion}$$ | Time in seconds required to initiate a braking reaction. | 0.1 seconds |
| $$a$$ | Delay in meters per second squared | 2.4 seconds squared for vehicles designed to carry standing or unbelted passengers[[4]](#footnote-4),6 seconds squared for other vehicles. |

This results in a required collision avoidance with a vehicle intrusion its own lane above the following TTC values (shown as an example for speeds in 10 kilometer per hour increments). These requirements are to be met regardless of environmental conditions and should be taken into account when deriving pass criteria.

|  |  |  |
| --- | --- | --- |
| $v\_{rel}$ [kilometers per hour] | *TTClane change*[second] for vehicles with standing passengers | *TTClane change*[second] for other vehicles |
| 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 |

Should a lane changer intrude into the lane of the vehicle with self-driving function with less time to impact (TTC), collision avoidance can no longer be assumed. If a collision cannot be avoided, the consequences shall be minimized by braking and thus reducing speed as much as possible, weighing the danger to the occupants of the vehicle with self-driving function due to the braking and the collision. The guidance strategy of the system may change between collision avoidance and collision mitigation only to the extent that braking is prioritized over an avoidance maneuver that is no longer successful.

### Lane change maneuver

The passing criteria for lane change maneuvers shall be based on the requirements of United Nations Economic Commission for Europe (UNECE) Regulation No 79 - Uniform provisions concerning the permit of vehicles with regard to the steering equipment [2018/1947], 03 series of amendments (in short: UN Regulation No. 79) for Automatically Commanded Steering Function Systems (AC SF)of category C steering systems according to Sec. 5.6.4.6. Requirements of UN Regulation No. 79 on functions relating to the person driving shall not apply. Maneuvers shall be planned in such a way that there is no danger to other road users.

The passing criteria with regard to safe lane changes and how to avoid endangering other road users during lane changes are based on the requirements of UN Regulation No 79, 03 series of amendments for ACSF systems of category C Sec. 5.6.4.7. and Sec. 5.6.4.8. whereby the speed of the approaching vehicle (*vapp*) may be based on the respective speed limit prevailing in the ODD.

### Turning and crossing

With regard to interaction with other road users when turning and crossing, the following passing criteria must be taken into account (see Figure 1):



**Figure1: Visualization of the distances when turning and crossing. Case a): Distance to be maintained from following traffic when turning. Case b): Additional distance to be maintained from oncoming traffic when turning by oncoming traffic. Case c): Distance to be maintained from crossing traffic with right of way when crossing.**

The passing criteria for not obstructing or endangering other road users on the target roads when turning are based on the requirements of UN Regulation No 79, 03 series of amendments for ACSF systems of category C Sec. 5.6.4.7. and Sec. 5.6.4.8. For the approach speed vapp the respective speed limit prevailing in the ODD may be applied and whereby the requirements and the geometric relations for the following traffic after the turn are to be transferred accordingly from the lane change to the turn maneuver (Case a in Figure 1).

For turning across the oncoming lane, it applies to the consideration of oncoming traffic that - in addition to the distance to the following traffic on the target road - it must be ensured that the TTC of the oncoming traffic with right of way to the fictitious collision point (intersection of the trajectories) never falls below 3 seconds. (Case b in Figure 1)

The same applies when crossing with priority traffic (Case c in Figure 1): The TTC of the priority traffic to the fictitious collision point (intersection of the trajectories) must be more than 3 seconds.

1. Full title: Ordinance (EU) 2018/858 of the European Parliament and of the Council of 30 May 2018 on the permit and market surveillance of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles, amending Ordinances (EC) No 715/2007 and (EC) No 595/2009 and repealing Directive 2007/46/EC [↑](#footnote-ref-1)
2. Where reference is made in this Ordinance to DIN or ISO standards, these have been published by Beuth Verlag GmbH, Burggrafenstraße 6, 10787 Berlin. They are archived at the German Patent and Trade Mark Office in Munich. [↑](#footnote-ref-2)
3. Where reference is made in this Ordinance to DIN or ISO standards, these have been published by Beuth Verlag GmbH, Burggrafenstraße 6, 10787 Berlin. They are archived at the German Patent and Trade Mark Office in Munich. [↑](#footnote-ref-3)
4. http://www.ureko.de/downloads/veroeffentlichungen/152.pdf [↑](#footnote-ref-4)