4 March 2021

Agreement

Concerning the Adoption of Harmonized Technical United Nations Regulations for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these United Nations Regulations*

(Revision 3, including the amendments which entered into force on 14 September 2017)

Addendum 154 – UN Regulation No. 155

Date of entry into force as an annex to the 1958 Agreement: 22 January 2021

Uniform provisions concerning the approval of vehicles with regards to cyber security and cyber security management system

This document is meant purely as documentation tool. The authentic and legal binding text is: ECE/TRANS/WP.29/2020/79 (as amended by ECE/TRANS/WP.29/2020/94 and ECE/TRANS/WP.29/2020/97).

UNITED NATIONS

* Former titles of the Agreement:
Agreement concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts, done at Geneva on 20 March 1958 (original version);
Agreement concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions, done at Geneva on 5 October 1995 (Revision 2).

UN Regulation No. 155

Uniform provisions concerning the approval of vehicles with regards to cyber security and cyber security management system

Contents

1. Scope

1.1. This Regulation applies to vehicles, with regard to cyber security, of the Categories M and N.

This Regulation also applies to vehicles of Category O if fitted with at least one electronic control unit.

1.2. This Regulation also applies to vehicles of the Categories L_6 and L_7 if equipped with automated driving functionalities from level 3 onwards, as defined in the reference document with definitions of Automated Driving under WP.29 and the General Principles for developing a UN Regulation on automated vehicles (ECE/TRANS/WP.29/1140).

1.3. This Regulation is without prejudice to other UN Regulations, regional or national legislations governing the access by authorized parties to the vehicle, its data, functions and resources, and conditions of such access. It is also without prejudice to the application of national and regional legislation on privacy and the protection of natural persons with regard to the processing of their personal data.

1.4. This Regulation is without prejudice to other UN Regulations, national or regional legislation governing the development and installation/system integration of replacement parts and components, physical and digital, with regards to cybersecurity.

2. Definitions

For the purpose of this Regulation the following definitions shall apply:

2.1. "*Vehicle type*" means vehicles which do not differ in at least the following essential respects:

(a) The manufacturer's designation of the vehicle type;

(b) Essential aspects of the electric/electronic architecture and external interfaces with respect to cyber security.

2.2. "*Cyber security*" means the condition in which road vehicles and their functions are protected from cyber threats to electrical or electronic components.

2.3. "*Cyber Security Management System (CSMS)*" means a systematic risk-based approach defining organisational processes, responsibilities and governance to treat risk associated with cyber threats to vehicles and protect them from cyber-attacks.

2.4. "*System*" means a set of components and/or sub-systems that implements a function or functions.

2.5. "*Development phase*" means the period before a vehicle type is type approved.

2.6. "*Production phase*" refers to the duration of production of a vehicle type.

2.7. "*Post-production phase*" refers to the period in which a vehicle type is no longer produced until the end-of-life of all vehicles under the vehicle type. Vehicles incorporating a specific vehicle type will be operational during this phase but will no longer be produced. The phase ends when there are no longer any operational vehicles of a specific vehicle type.

2.8. "*Mitigation*" means a measure that is reducing risk.

2.9. "*Risk*" means the potential that a given threat will exploit vulnerabilities of a vehicle and thereby cause harm to the organization or to an individual.

2.10. "*Risk Assessment*" means the overall process of finding, recognizing and describing risks (risk identification), to comprehend the nature of risk and to

determine the level of risk (risk analysis), and of comparing the results of risk analysis with risk criteria to determine whether the risk and/or its magnitude is acceptable or tolerable (risk evaluation).

2.11. "*Risk Management*" means coordinated activities to direct and control an organization with regard to risk.

2.12. "*Threat*" means a potential cause of an unwanted incident, which may result in harm to a system, organization or individual.

2.13. "*Vulnerability*" means a weakness of an asset or mitigation that can be exploited by one or more threats.

3. Application for approval

3.1. The application for approval of a vehicle type with regard to cyber security shall be submitted by the vehicle manufacturer or by their duly accredited representative.

3.2. It shall be accompanied by the undermentioned documents in triplicate, and by the following particulars:

3.2.1. A description of the vehicle type with regard to the items specified in Annex 1 to this Regulation.

3.2.2. In cases where information is shown to be covered by intellectual property rights or to constitute specific know-how of the manufacturer or of their suppliers, the manufacturer or their suppliers shall make available sufficient information to enable the checks referred to in this Regulation to be made properly. Such information shall be treated on a confidential basis.

3.2.3. The Certificate of Compliance for CSMS according to paragraph 6 of this Regulation.

3.3. Documentation shall be made available in two parts:

(a) The formal documentation package for the approval, containing the material specified in Annex 1 which shall be supplied to the Approval Authority or its Technical Service at the time of submission of the type approval application. This documentation package shall be used by the Approval Authority or its Technical Service as the basic reference for the approval process. The Approval Authority or its Technical Service shall ensure that this documentation package remains available for at least 10 years counted from the time when production of the vehicle type is definitively discontinued.

(b) Additional material relevant to the requirements of this regulation may be retained by the manufacturer, but made open for inspection at the time of type approval. The manufacturer shall ensure that any material made open for inspection at the time of type approval remains available for at least a period of 10 years counted from the time when production of the vehicle type is definitively discontinued.

4. Marking

4.1. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation an international approval mark consisting of:

4.1.1. A circle surrounding the Letter "E" followed by the distinguishing number of the country which has granted approval.

4.1.2. The number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the circle described in paragraph 4.1.1. above.

4.2. If the vehicle conforms to a vehicle type approved under one or more other Regulations annexed to the Agreement in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.1.1. above need not be repeated; in this case the Regulation and approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.1.1. above.

4.3. The approval mark shall be clearly legible and shall be indelible.

4.4. The approval mark shall be placed on or close to the vehicle data plate affixed by the Manufacturer.

4.5. Annex 3 to this Regulation gives examples of the arrangements of the approval mark.

5. Approval

5.1. Approval Authorities shall grant, as appropriate, type approval with regard to cyber security, only to such vehicle types that satisfy the requirements of this Regulation.

5.1.1. The Approval Authority or the Technical Service shall verify by means of document checks that the vehicle manufacturer has taken the necessary measures relevant for the vehicle type to:

(a) Collect and verify the information required under this Regulation through the supply chain so as to demonstrate that supplier-related risks are identified and are managed;

(b) Document risks assessment (conducted during development phase or retrospectively), test results and mitigations applied to the vehicle type, including design information supporting the risk assessment;

(c) Implement appropriate cyber security measures in the design of the vehicle type;

(d) Detect and respond to possible cyber security attacks;

(e) Log data to support the detection of cyber-attacks and provide data forensic capability to enable analysis of attempted or successful cyber-attacks.

5.1.2. The Approval Authority or the Technical Service shall verify by testing of a vehicle of the vehicle type that the vehicle manufacturer has implemented the cyber security measures they have documented. Tests shall be performed by the Approval Authority or the Technical Service itself or in collaboration with the vehicle manufacturer by sampling. Sampling shall be focused but not limited to risks that are assessed as high during the risk assessment.

5.1.3. The Approval Authority or Technical Service shall refuse to grant the type approval with regard to cyber security where the vehicle manufacturer has not fulfilled one or more of the requirements referred to in paragraph 7.3., notably:

(a) The vehicle manufacturer did not perform the exhaustive risk assessment referred to in paragraph 7.3.3.; including where the manufacturer did not consider all the risks related to threats referred to in Annex 5, Part A;

(b) The vehicle manufacturer did not protect the vehicle type against risks identified in the vehicle manufacturer's risk assessment or proportionate mitigations were not implemented as required by paragraph 7.;

(c) The vehicle manufacturer did not put in place appropriate and proportionate measures to secure dedicated environments on the vehicle type (if provided) for the storage and execution of aftermarket software, services, applications or data;

(d) The vehicle manufacturer did not perform, prior to the approval, appropriate and sufficient testing to verify the effectiveness of the security measures implemented.

5.1.4 The assessing Approval Authority shall also refuse to grant the type approval with regard to cyber security where the Approval Authority or Technical Service has not received sufficient information from the vehicle manufacturer to assess the cyber security of the vehicle type.

5.2. Notice of approval or of extension or refusal of approval of a vehicle type pursuant to this Regulation shall be communicated to the Parties to the 1958 Agreement which apply this Regulation, by means of a form conforming to the model in Annex 2 to this Regulation.

5.3. Approval Authorities shall not grant any type approval without verifying that the manufacturer has put in place satisfactory arrangements and procedures to manage properly the cyber security aspects as covered by this Regulation.

5.3.1. The Approval Authority and its Technical Services shall ensure, in addition to the criteria laid down in Schedule 2 of the 1958 Agreement that they have:

(a) Competent personnel with appropriate cyber security skills and specific automotive risk assessments knowledge;[1]

(b) Implemented procedures for the uniform evaluation according to this Regulation.

5.3.2. Each Contracting Party applying this Regulation shall notify and inform by its Approval Authority other Approval Authorities of the Contracting Parties applying this UN Regulation about the method and criteria taken as a basis by the notifying Authority to assess the appropriateness of the measures taken in accordance with this regulation and in particular with paragraphs 5.1., 7.2. and 7.3.

This information shall be shared (a) only before granting an approval according to this Regulation for the first time and (b) each time the method or criteria for assessment is updated.

This information is intended to be shared for the purposes of collection and analysis of the best practices and in view of ensuring the convergent application of this Regulation by all Approval Authorities applying this Regulation.

5.3.3. The information referred to in paragraph 5.3.2 shall be uploaded in English language to the secure internet database "DETA",[2] established by the United Nations Economic Commission for Europe, in due time and no later than 14 days before an approval is granted for the first time under the methods and criteria of assessment concerned. The information shall be sufficient to understand what minimum performance levels the Approval Authority adopted for each specific requirement referred to in paragraph 5.3.2 as well as the processes and measures it applies to verify that these minimum performance levels are met. [3]

[1] E.g. ISO 26262-2018, ISO/PAS 21448, ISO/SAE 21434

[2] https://www.unece.org/trans/main/wp29/datasharing.html

[3] Guidance for the detailed information (e.g. method, criteria, performance level) to be uploaded and the format shall be given in the interpretation document which is under preparation by the Task Force on Cyber Security and Over-the-Air issues for the seventh session of GRVA.

5.3.4. Approval Authorities receiving the information referred to in paragraph 5.3.2 may submit comments to the notifying Approval Authority by uploading them to DETA within 14 days after the day of notification.

5.3.5. If it is not possible for the granting Approval Authority to take into account the comments received in accordance with paragraph 5.3.4., the Approval Authorities having sent comments and the granting Approval Authority shall seek further clarification in accordance with Schedule 6 to the 1958 Agreement. The relevant subsidiary Working Party[4] of the World Forum for Harmonization of Vehicle Regulations (WP.29) for this Regulation shall agree on a common interpretation of methods and criteria of assessment.[5] That common interpretation shall be implemented and all Approval Authorities shall issue type approvals under this Regulation accordingly.

5.3.6. Each Approval Authority granting a type approval pursuant to this Regulation shall notify other Approval Authorities of the approval granted. The type approval together with the supplementing documentation shall be uploaded in English language by the Approval Authority within 14 days after the day of granting the approval to DETA.[6]

5.3.7. The Contracting Parties may study the approvals granted based on the information uploaded according to paragraph 5.3.6. In case of any diverging views between Contracting Parties this shall be settled in accordance with Article 10 and Schedule 6 of the 1958 Agreement. The Contracting Parties shall also inform the relevant subsidiary Working Party of the World Forum for Harmonization of Vehicle Regulations (WP.29) of the diverging interpretations within the meaning of Schedule 6 to the 1958 Agreement. The relevant Working Party shall support the settlement of the diverging views and may consult with WP.29 on this if needed.

5.4. For the purpose of paragraph 7.2. of this Regulation, the manufacturer shall ensure that the cyber security aspects covered by this Regulation are implemented.

6. Certificate of Compliance for Cyber Security Management System

6.1. Contracting Parties shall appoint an Approval Authority to carry out the assessment of the manufacturer and to issue a Certificate of Compliance for CSMS.

6.2. An application for a Certificate of Compliance for Cyber Security Management System shall be submitted by the vehicle manufacturer or by their duly accredited representative.

6.3. It shall be accompanied by the undermentioned documents in triplicate, and by the following particular:

6.3.1. Documents describing the Cyber Security Management System.

6.3.2. A signed declaration using the model as defined in Appendix 1 to Annex 1.

6.4. In the context of the assessment, the manufacturer shall declare using the model as defined in Appendix 1 to Annex 1 and demonstrate to the satisfaction of the Approval Authority or its Technical Service that they have the necessary processes to comply with all the requirements for cyber security according to this Regulation.

[4] The Working Party on Automated/Autonomous and Connected Vehicles (GRVA)

[5] This interpretation shall be reflected in the interpretation document referred to in the footnote to paragraph 5.3.3.

[6] Further information on the minimum requirements for the documentation package will be developed by GRVA during its seven session.

6.5. When this assessment has been satisfactorily completed and in receipt of a signed declaration from the manufacturer according to the model as defined in Appendix 1 to Annex 1, a certificate named Certificate of Compliance for CSMS as described in Annex 4 to this Regulation (hereinafter the Certificate of Compliance for CSMS) shall be granted to the manufacturer.

6.6. The Approval Authority or its Technical Service shall use the model set out in Annex 4 to this Regulation for the Certificate of Compliance for CSMS.

6.7. The Certificate of Compliance for CSMS shall remain valid for a maximum of three years from the date of deliverance of the certificate unless it is withdrawn.

6.8. The Approval Authority which has granted the Certificate of Compliance for CSMS may at any time verify that the requirements for it continue to be met. The Approval Authority shall withdraw the Certificate of Compliance for CSMS if the requirements laid down in this Regulation are no longer met.

6.9. The manufacturer shall inform the Approval Authority or its Technical Service of any change that will affect the relevance of the Certificate of Compliance for CSMS. After consultation with the manufacturer, the Approval Authority or its Technical Service shall decide whether new checks are necessary.

6.10. In due time, permitting the Approval Authority to complete its assessment before the end of the period of validity of the Certificate of Compliance for CSMS, the manufacturer shall apply for a new or for the extension of the existing Certificate of Compliance for CSMS. The Approval Authority shall, subject to a positive assessment, issue a new Certificate of Compliance for CSMS or extend its validity for a further period of three years. The Approval Authority shall verify that the CSMS continue to comply with the requirements of this Regulation. The Approval Authority shall issue a new certificate in cases where changes have been brought to the attention of the Approval Authority or its Technical Service and the changes have been positively re-assessed.

6.11. The expiry or withdrawal of the manufacturer's Certificate of Compliance for CSMS shall be considered, with regard to the vehicle types to which the CSMS concerned was relevant, as modification of approval, as referred to in paragraph 8, which may include the withdrawal of the approval if the conditions for granting the approval are not met anymore.

7. Specifications

7.1. General specifications

7.1.1. The requirements of this Regulation shall not restrict provisions or requirements of other UN Regulations.

7.2. Requirements for the Cyber Security Management System

7.2.1. For the assessment the Approval Authority or its Technical Service shall verify that the vehicle manufacturer has a Cyber Security Management System in place and shall verify its compliance with this Regulation.

7.2.2. The Cyber Security Management System shall cover the following aspects:

7.2.2.1. The vehicle manufacturer shall demonstrate to an Approval Authority or Technical Service that their Cyber Security Management System applies to the following phases:

(a) Development phase;

(b) Production phase;

(c) Post-production phase.

7.2.2.2. The vehicle manufacturer shall demonstrate that the processes used within their Cyber Security Management System ensure security is adequately considered, including risks and mitigations listed in Annex 5. This shall include:

(a) The processes used within the manufacturer's organization to manage cyber security;

(b) The processes used for the identification of risks to vehicle types. Within these processes, the threats in Annex 5, Part A, and other relevant threats shall be considered;

(c) The processes used for the assessment, categorization and treatment of the risks identified;

(d) The processes in place to verify that the risks identified are appropriately managed;

(e) The processes used for testing the cyber security of a vehicle type;

(f) The processes used for ensuring that the risk assessment is kept current;

(g) The processes used to monitor for, detect and respond to cyber-attacks, cyber threats and vulnerabilities on vehicle types and the processes used to assess whether the cyber security measures implemented are still effective in the light of new cyber threats and vulnerabilities that have been identified.

(h) The processes used to provide relevant data to support analysis of attempted or successful cyber-attacks.

7.2.2.3. The vehicle manufacturer shall demonstrate that the processes used within their Cyber Security Management System will ensure that, based on categorization referred to in paragraph 7.2.2.2 (c) and 7.2.2.2 (g), cyber threats and vulnerabilities which require a response from the vehicle manufacturer shall be mitigated within a reasonable timeframe.

7.2.2.4. The vehicle manufacturer shall demonstrate that the processes used within their Cyber Security Management System will ensure that the monitoring referred to in paragraph 7.2.2.2 (g) shall be continual. This shall:

(a) Include vehicles after first registration in the monitoring;

(b) Include the capability to analyse and detect cyber threats, vulnerabilities and cyber-attacks from vehicle data and vehicle logs. This capability shall respect paragraph 1.3. and the privacy rights of car owners or drivers, particularly with respect to consent.

7.2.2.5. The vehicle manufacturer shall be required to demonstrate how their Cyber Security Management System will manage dependencies that may exist with contracted suppliers, service providers or manufacturer's sub-organizations in regards of the requirements of paragraph 7.2.2.2.

7.3. Requirements for vehicle types

7.3.1. The manufacturer shall have a valid Certificate of Compliance for the Cyber Security Management System relevant to the vehicle type being approved.

However, for type approvals prior to 1 July 2024, if the vehicle manufacturer can demonstrate that the vehicle type could not be developed in compliance with the CSMS, then the vehicle manufacturer shall demonstrate that cyber security was adequately considered during the development phase of the vehicle type concerned.

7.3.2. The vehicle manufacturer shall identify and manage, for the vehicle type being approved, supplier-related risks.

7.3.3. The vehicle manufacturer shall identify the critical elements of the vehicle type and perform an exhaustive risk assessment for the vehicle type and shall treat/manage the identified risks appropriately. The risk assessment shall consider the individual elements of the vehicle type and their interactions. The risk assessment shall further consider interactions with any external systems. While assessing the risks, the vehicle manufacturer shall consider the risks related to all the threats referred to in Annex 5, Part A, as well as any other relevant risk.

7.3.4. The vehicle manufacturer shall protect the vehicle type against risks identified in the vehicle manufacturer's risk assessment. Proportionate mitigations shall be implemented to protect the vehicle type. The mitigations implemented shall include all mitigations referred to in Annex 5, Part B and C which are relevant for the risks identified. However, if a mitigation referred to in Annex 5, Part B or C, is not relevant or not sufficient for the risk identified, the vehicle manufacturer shall ensure that another appropriate mitigation is implemented.

In particular, for type approvals prior to 1 July 2024, the vehicle manufacturer shall ensure that another appropriate mitigation is implemented if a mitigation measure referred to in Annex 5, Part B or C is technically not feasible. The respective assessment of the technical feasibility shall be provided by the manufacturer to the approval authority.

7.3.5. The vehicle manufacturer shall put in place appropriate and proportionate measures to secure dedicated environments on the vehicle type (if provided) for the storage and execution of aftermarket software, services, applications or data.

7.3.6. The vehicle manufacturer shall perform, prior to type approval, appropriate and sufficient testing to verify the effectiveness of the security measures implemented.

7.3.7. The vehicle manufacturer shall implement measures for the vehicle type to:

(a) Detect and prevent cyber-attacks against vehicles of the vehicle type;

(b) Support the monitoring capability of the vehicle manufacturer with regards to detecting threats, vulnerabilities and cyber-attacks relevant to the vehicle type;

(c) Provide data forensic capability to enable analysis of attempted or successful cyber-attacks.

7.3.8. Cryptographic modules used for the purpose of this Regulation shall be in line with consensus standards. If the cryptographic modules used are not in line with consensus standards, then the vehicle manufacturer shall justify their use.

7.4. Reporting provisions

7.4.1. The vehicle manufacturer shall report at least once a year, or more frequently if relevant, to the Approval Authority or the Technical Service the outcome of their monitoring activities, as defined in paragraph 7.2.2.2.(g)), this shall include relevant information on new cyber-attacks. The vehicle manufacturer shall also report and confirm to the Approval Authority or the Technical Service that the cyber security mitigations implemented for their vehicle types are still effective and any additional actions taken.

7.4.2 The Approval Authority or the Technical Service shall verify the provided information and, if necessary, require the vehicle manufacturer to remedy any detected ineffectiveness.

If the reporting or response is not sufficient the Approval Authority may decide to withdraw the CSMS in compliance with paragraph 6.8.

8. Modification and extension of the vehicle type

8.1. Every modification of the vehicle type which affects its technical performance with respect to cybersecurity and/or documentation required in this Regulation shall be notified to the approval authority which approved the vehicle type. The Approval Authority may then either:

8.1.1. Consider that the modifications made still comply with the requirements and documentation of existing type approval; or

8.1.2. Proceed to necessary complementary assessment pursuant to paragraph 5, and require, where relevant, a further test report from the Technical Service responsible for conducting the tests.

8.1.3. Confirmation or extension or refusal of approval, specifying the alterations, shall be communicated by means of a communication form conforming to the model in Annex 2 to this Regulation. The Approval Authority issuing the extension of approval shall assign a series number for such an extension and inform there of the other Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in Annex 2 to this Regulation.

9. Conformity of production

9.1. The Conformity of Production Procedures shall comply with those set out in the 1958 Agreement, Schedule 1 (E/ECE/TRANS/505/Rev.3) with the following requirements:

9.1.1. The holder of the approval shall ensure that results of the conformity of production tests are recorded and that the annexed documents remain available for a period determined in agreement with the Approval Authority or its Technical Service. This period shall not exceed 10 years counted from the time when production is definitively discontinued;

9.1.2. The Approval Authority which has granted type approval may at any time verify the conformity control methods applied in each production facility. The normal frequency of these verifications shall be once every three years.

10. Penalties for non-conformity of production

10.1. The approval granted in respect of a vehicle type pursuant to this Regulation may be withdrawn if the requirements laid down in this Regulation are not complied with or if sample vehicles fail to comply with the requirements of this Regulation.

10.2. If an Approval Authority withdraws an approval it has previously granted, it shall forthwith so notify the Contracting Parties applying this Regulation, by means of a communication form conforming to the model in Annex 2 to this Regulation.

11. Production definitively discontinued

11.1. If the holder of the approval completely ceases to manufacture a type of vehicle approved in accordance with this Regulation, he shall so inform the authority which granted the approval. Upon receiving the relevant communication that authority shall inform thereof the other Contracting Parties to the Agreement applying this Regulation by means of a copy of the approval form bearing at the end, in large letters, the signed and dated annotation "PRODUCTION DISCONTINUED".

12. Names and addresses of Technical Services responsible for conducting approval test, and of Type Approval Authorities

12.1. The Contracting Parties to the Agreement which apply this Regulation shall communicate to the United Nations Secretariat the names and addresses of the Technical Services responsible for conducting approval tests and of the Type Approval Authorities which grant approval and to which forms certifying approval or extension or refusal or withdrawal of approval, issued in other countries, are to be sent.

Annex 1

Information document

The following information, if applicable, shall be supplied in triplicate and include a list of contents. Any drawings shall be supplied in appropriate scale and in sufficient detail on size A4 or on a folder of A4 format. Photographs, if any, shall show sufficient detail.

1. Make (trade name of manufacturer): .....

2. Type and general commercial description(s): .....

3. Means of identification of type, if marked on the vehicle: .....

4. Location of that marking: .....

5. Category(ies) of vehicle: .....

6. Name and address of manufacturer/ manufacturer's representative: .....

7. Name(s) and Address(es) of assembly plant(s): .....

8. Photograph(s) and/or drawing(s) of a representative vehicle: .....

9. Cyber Security

9.1. General construction characteristics of the vehicle type, including:

(a) The vehicle systems which are relevant to the cyber security of the vehicle type;

(b) The components of those systems that are relevant to cyber security;

(c) The interactions of those systems with other systems within the vehicle type and external interfaces.

9.2. Schematic representation of the vehicle type

9.3. The number of the Certificate of Compliance for CSMS: .....

9.4. Documents for the vehicle type to be approved describing the outcome of its risk assessment and the identified risks: .....

9.5 Documents for the vehicle type to be approved describing the mitigations that have been implemented on the systems listed, or to the vehicle type, and how they address the stated risks: .....

9.6. Documents for the vehicle type to be approved describing protection of dedicated environments for aftermarket software, services, applications or data: .....

9.7. Documents for the vehicle type to be approved describing what tests have been used to verify the cyber security of the vehicle type and its systems and the outcome of those tests: .....

9.8. Description of the consideration of the supply chain with respect to cyber security: ...

Annex 1 - Appendix 1

Model of Manufacturer's Declaration of Compliance for CSMS

Manufacturer's declaration of compliance with the requirements for the Cyber Security Management System

Manufacturer Name: .....

Manufacturer Address: .....

……..(*Manufacturer Name*) attests that the necessary processes to comply with the requirements for the Cyber Security Management System laid down in paragraph 7.2 of UN Regulation 155 are installed and will be maintained.

Done at: …… (*place*)

Date: .....

Name of the signatory: .....

Function of the signatory: .....

.....

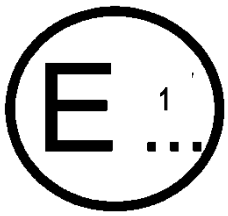
(*Stamp and signature of the manufacturer's representative*)

Annex 2

Communication

(Maximum format: A4 (210 x 297 mm))

issued by: Name of administration:
.....
.....
.....



Concerning:[8] Approval granted
Approval extended
Approval withdrawn with effect from dd/mm/yyyy
Approval refused
Production definitively discontinued

of a vehicle type, pursuant to UN Regulation No. 155

Approval No.: .....

Extension No.: .....

Reason for extension: .....

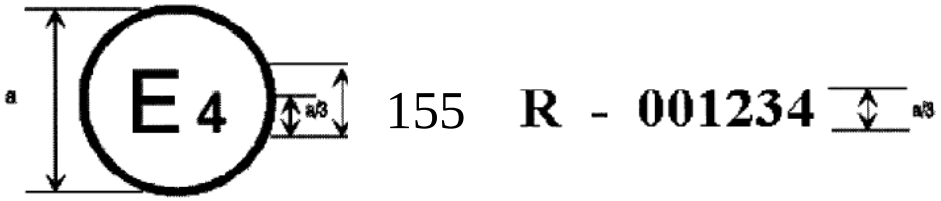
1. Make (trade name of manufacturer): .....
2. Type and general commercial description(s) .....
3. Means of identification of type, if marked on the vehicle: .....
3.1. Location of that marking: .....
4. Category(ies) of vehicle:.....
5. Name and address of manufacturer / manufacturer's representative: .....
6. Name(s) and Address(es) of the production plant(s) .....
7. Number of the certificate of compliance for cyber security management system: .....
8. Technical Service responsible for carrying out the tests: .....
9. Date of test report: .....
10. Number of test report: .....
11. Remarks: (if any). .....
12. Place:.....
13. Date: .....
14. Signature: .....
15. The index to the information package lodged with the Approval Authority, which may be obtained on request is attached:

[7] Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in the Regulation).
[8] Strike out what does not apply.

Annex 3

Arrangement of approval mark

Model A
(See paragraph 4.2 of this Regulation)



a = 8 mm min.

The above approval mark affixed to a vehicle shows that the road vehicle type concerned has been approved in the Netherlands (E 4), pursuant to Regulation No. 155, and under the approval number 001234. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of this Regulation in its original form (00).

Annex 4

Model of Certificate of Compliance for CSMS

Certificate of compliance for cyber security management system

With UN Regulation No. [*This Regulation*]

Certificate Number [*Reference number*]

[……. *Approval Authority*]

Certifies that

Manufacturer: .....

Address of the manufacturer: .....

complies with the provisions of paragraph 7.2 of Regulation No. 155

Checks have been performed on:.....

by (name and address of the Approval Authority or Technical Service): .....

Number of report:.....

The certificate is valid until […..*Date*]

Done at [……*Place*]

On […….*Date*]

[…….*Signature*]

Attachments: description of the Cyber Security Management System by the manufacturer.

Annex 5

List of threats and corresponding mitigations

1. This annex consists of three parts. Part A of this annex describes the baseline for threats, vulnerabilities and attack methods. Part B of this annex describes mitigations to the threats which are intended for vehicle types. Part C describes mitigations to the threats which are intended for areas outside of vehicles, e.g. on IT backends.

2. Part A, Part B, and Part C shall be considered for risk assessment and mitigations to be implemented by vehicle manufacturers.

3. The high-level vulnerability and its corresponding examples have been indexed in Part A. The same indexing has been referenced in the tables in Parts B and C to link each of the attack/vulnerability with a list of corresponding mitigation measures.

4. The threat analysis shall also consider possible attack impacts. These may help ascertain the severity of a risk and identify additional risks. Possible attack impacts may include:

   (a) Safe operation of vehicle affected;

   (b) Vehicle functions stop working;

   (c) Software modified, performance altered;

   (d) Software altered but no operational effects;

   (e) Data integrity breach;

   (f) Data confidentiality breach;

   (g) Loss of data availability;

   (h) Other, including criminality.

Part A. Vulnerability or attack method related to the threats

1. High level descriptions of threats and relating vulnerability or attack method are listed in Table A1.

Table A1
List of vulnerability or attack method related to the threats

High level and sub-level descriptions of vulnerability/ threat			*Example of vulnerability or attack method*	
4.3.1 Threats regarding back-end servers related to vehicles in the field	1	Back-end servers used as a means to attack a vehicle or extract data	1.1	Abuse of privileges by staff (**insider attack**)
			1.2	**Unauthorized internet access** to the server (enabled for example by backdoors, unpatched system software vulnerabilities, SQL attacks or other means)
			1.3	**Unauthorized physical access** to the server (conducted by for example USB sticks or other media connecting to the server)
	2	Services from back-end server being disrupted, affecting the operation of a vehicle	2.1	**Attack on back-end server stops it functioning**, for example it prevents it from interacting with vehicles and providing services they rely on
	3	Vehicle related data held on back-end servers being lost or compromised ("data breach")	3.1	Abuse of privileges by staff (**insider attack)**
			3.2	**Loss of information in the cloud**. Sensitive data may be lost due to attacks or accidents when data is stored by third-party cloud service providers
			3.3	**Unauthorized internet access to the server** (enabled for example by backdoors, unpatched system software vulnerabilities, SQL attacks or other means)
			3.4	**Unauthorized physical access to the server** (conducted for example by USB sticks or other media connecting to the server)
			3.5	**Information breach** by unintended sharing of data (e.g. admin errors)
4.3.2 Threats to vehicles regarding their communication channels	4	Spoofing of messages or data received by the vehicle	4.1	**Spoofing of messages** by impersonation (e.g. 802.11p V2X during platooning, GNSS messages, etc.)
			4.2	**Sybil attack** (in order to spoof other vehicles as if there are many vehicles on the road)
	5	Communication channels used to conduct unauthorized manipulation, deletion or other amendments to vehicle held code/data	5.1	Communications channels permit **code injection**, for example tampered software binary might be injected into the communication stream
			5.2	Communications channels permit **manipulate** of vehicle held data/code
			5.3	Communications channels permit **overwrite** of vehicle held data/code
			5.4	Communications channels permit **erasure** of vehicle held data/code
			5.5	Communications channels permit introduction of data/code to the vehicle (write data code)
	6	Communication channels permit untrusted/unreliable messages to be accepted or are	6.1	Accepting information from an **unreliable or untrusted source**
			6.2	**Man in the middle** attack/ session hijacking

High level and sub-level descriptions of vulnerability/ threat			*Example of vulnerability or attack method*	
		vulnerable to session hijacking/replay attacks	6.3	**Replay attack**, for example an attack against a communication gateway allows the attacker to downgrade software of an ECU or firmware of the gateway
	7	Information can be readily disclosed. For example, through eavesdropping on communications or through allowing unauthorized access to sensitive files or folders	7.1	**Interception of information** / interfering radiations / monitoring communications
			7.2	Gaining **unauthorized access** to files or data
	8	Denial of service attacks via communication channels to disrupt vehicle functions	8.1	**Sending** a large number of garbage **data** to vehicle information system, **so that it is unable to provide services** in the normal manner
			8.2	**Black hole attack**, in order to disrupt communication between vehicles the attacker is able to block messages between the vehicles
	9	An unprivileged user is able to gain privileged access to vehicle systems	9.1	An unprivileged user is able to **gain privileged access**, for example root access
	10	Viruses embedded in communication media are able to infect vehicle systems	10.1	**Virus** embedded in communication media infects vehicle systems
	11	Messages received by the vehicle (for example X2V or diagnostic messages), or transmitted within it, contain malicious content	11.1	Malicious **internal** (e.g. CAN) **messages**
			11.2	Malicious **V2X messages,** e.g. infrastructure to vehicle or vehicle-vehicle messages (e.g. CAM, DENM)
			11.3	Malicious diagnostic messages
			11.4	Malicious **proprietary messages** (e.g. those normally sent from OEM or component/system/function supplier)
4.3.3. Threats to vehicles regarding their update procedures	12	Misuse or compromise of update procedures	12.1	Compromise of **over the air software update procedures**. This includes fabricating the system update program or firmware
			12.2	Compromise of **local/physical software update procedures**. This includes fabricating the system update program or firmware
			12.3	The **software** is **manipulated before the update process** (and is therefore corrupted), although the update process is intact
			12.4	**Compromise** of cryptographic keys of the software provider **to allow invalid update**
	13	It is possible to deny legitimate updates	13.1	Denial of Service attack against update server or network to **prevent rollout of critical software updates** and/or unlock of customer specific features
4.3.4 Threats to vehicles regarding unintended human actions facilitating a cyber attack	15	Legitimate actors are able to take actions that would unwittingly facilitate a cyber-attack	15.1	Innocent victim (e.g. owner, operator or maintenance engineer) being **tricked into taking an action** to unintentionally load malware or enable an attack
			15.2	**Defined security procedures** are not followed

High level and sub-level descriptions of vulnerability/ threat			*Example of vulnerability or attack method*	
4.3.5 Threats to vehicles regarding their external connectivity and connections	16	Manipulation of the connectivity of vehicle functions enables a cyber-attack, this can include telematics; systems that permit remote operations; and systems using short range wireless communications	16.1	Manipulation of **functions designed to remotely operate systems**, such as remote key, immobilizer, and charging pile
			16.2	**Manipulation of vehicle telematics** (e.g. manipulate temperature measurement of sensitive goods, remotely unlock cargo doors)
			16.3	Interference with **short range wireless systems** or sensors
	17	Hosted 3rd party software, e.g. entertainment applications, used as a means to attack vehicle systems	17.1	**Corrupted applications**, or those with poor software security, used as a method to attack vehicle systems
	18	Devices connected to external interfaces e.g. USB ports, OBD port, used as a means to attack vehicle systems	18.1	**External interfaces** such as USB or other ports used as a point of attack, for example through code injection
			18.2	Media infected with a **virus** connected to a vehicle system
			18.3	**Diagnostic access (e.g. dongles in OBD port)** used to facilitate an attack, e.g. manipulate vehicle parameters (directly or indirectly)
4.3.6 Threats to vehicle data/code	19	Extraction of vehicle data/code	19.1	Extraction of copyright or proprietary software from vehicle systems (product **piracy**)
			19.2	Unauthorized access to the **owner's privacy information** such as personal identity, payment account information, address book information, location information, vehicle's electronic ID, etc.
			19.3	Extraction of cryptographic keys
	20	Manipulation of vehicle data/code	20.1	Illegal/unauthorized changes to **vehicle's electronic ID**
			20.2	**Identity fraud.** For example, if a user wants to display another identity when communicating with toll systems, manufacturer backend
			20.3	Action to **circumvent monitoring systems** (e.g. hacking/ tampering/ blocking of messages such as ODR Tracker data, or number of runs)
			20.4	Data manipulation to **falsify vehicle's driving data** (e.g. mileage, driving speed, driving directions, etc.)
			20.5	Unauthorized changes to **system diagnostic data**
	21	Erasure of data/code	21.1	Unauthorized deletion/manipulation of **system event logs**
	22	Introduction of malware	22.2	Introduce **malicious software** or malicious software activity
	23	Introduction of new software or overwrite existing software	23.1	**Fabrication of software** of the vehicle control system or information system

High level and sub-level descriptions of vulnerability/ threat			*Example of vulnerability or attack method*	
	24	Disruption of systems or operations	24.1	**Denial of service**, for example this may be triggered on the internal network by flooding a CAN bus, or by provoking faults on an ECU via a high rate of messaging
	25	Manipulation of vehicle parameters	25.1	Unauthorized access of **falsify the configuration parameters** of vehicle's key functions, such as brake data, airbag deployed threshold, etc.
			25.2	Unauthorized access of **falsify the charging parameters**, such as charging voltage, charging power, battery temperature, etc.
4.3.7 Potential vulnerabilities that could be exploited if not sufficiently protected or hardened	26	Cryptographic technologies can be compromised or are insufficiently applied	26.1	Combination of short **encryption keys** and long period of validity enables attacker to break encryption
			26.2	Insufficient use of cryptographic algorithms to protect sensitive systems
			26.3	Using already or soon to be deprecated **cryptographic algorithms**
	27	Parts or supplies could be compromised to permit vehicles to be attacked	27.1	**Hardware or software, engineered to enable an attack** or fails to meet design criteria to stop an attack
	28	Software or hardware development permits vulnerabilities	28.1	**Software bugs**. The presence of software bugs can be a basis for potential exploitable vulnerabilities. This is particularly true if software has not been tested to verify that known bad code/bugs is not present and reduce the risk of unknown bad code/bugs being present
			28.2	**Using remainders** from development (e.g. debug ports, JTAG ports, microprocessors, development certificates, developer passwords, …) can permit access to ECUs or permit attackers to gain higher privileges
	29	Network design introduces vulnerabilities	29.1	**Superfluous internet ports left open**, providing access to network systems
			29.2	Circumvent **network separation** to gain control. Specific example is the use of unprotected gateways, or access points (such as truck-trailer gateways), to circumvent protections and gain access to other network segments to perform malicious acts, such as sending arbitrary CAN bus messages
	31	Unintended transfer of data can occur	31.1	Information breach. Personal data may be leaked when the **car changes user** (e.g. is sold or is used as hire vehicle with new hirers)
	32	Physical manipulation of systems can enable an attack	32.1	**Manipulation of electronic hardware**, e.g. unauthorized electronic hardware added to a vehicle to enable "man-in-the-middle" attack **Replacement of authorized electronic hardware** (e.g., sensors) with unauthorized electronic hardware **Manipulation of the information** collected by a sensor (for example, using a magnet to tamper with the Hall effect sensor connected to the gearbox)

Part B. Mitigations to the threats intended for vehicles

1. Mitigations for "Vehicle communication channels"

Mitigations to the threats which are related to "Vehicle communication channels" are listed in Table B1.

Table B1
Mitigation to the threats which are related to "Vehicle communication channels"

Table A1 reference	*Threats to "Vehicle communication channels"*	*Ref*	*Mitigation*
4.1	Spoofing of messages (e.g. 802.11p V2X during platooning, GNSS messages, etc.) by impersonation	M10	The vehicle shall verify the authenticity and integrity of messages it receives
4.2	Sybil attack (in order to spoof other vehicles as if there are many vehicles on the road)	M11	Security controls shall be implemented for storing cryptographic keys (e.g., use of Hardware Security Modules)
5.1	Communication channels permit code injection into vehicle held data/code, for example tampered software binary might be injected into the communication stream	M10 M6	The vehicle shall verify the authenticity and integrity of messages it receives Systems shall implement security by design to minimize risks
5.2	Communication channels permit manipulation of vehicle held data/code	M7	Access control techniques and designs shall be applied to protect system data/code
5.3	Communication channels permit overwrite of vehicle held data/code		
5.4 21.1	Communication channels permit erasure of vehicle held data/code		
5.5	Communication channels permit introduction of data/code to vehicle systems (write data code)		
6.1	Accepting information from an unreliable or untrusted source	M10	The vehicle shall verify the authenticity and integrity of messages it receives
6.2	Man in the middle attack / session hijacking	M10	The vehicle shall verify the authenticity and integrity of messages it receives
6.3	Replay attack, for example an attack against a communication gateway allows the attacker to downgrade software of an ECU or firmware of the gateway		
7.1	Interception of information / interfering radiations / monitoring communications	M12	Confidential data transmitted to or from the vehicle shall be protected
7.2	Gaining unauthorized access to files or data	M8	Through system design and access control it should not be possible for unauthorized personnel to access personal or system critical data. Example of Security Controls can be found in OWASP
8.1	Sending a large number of garbage data to vehicle information system, so that it is unable to provide services in the normal manner	M13	Measures to detect and recover from a denial of service attack shall be employed

Table A1 reference	*Threats to "Vehicle communication channels"*	*Ref*	*Mitigation*
8.2	Black hole attack, disruption of communication between vehicles by blocking the transfer of messages to other vehicles	M13	Measures to detect and recover from a denial of service attack shall be employed
9.1	An unprivileged user is able to gain privileged access, for example root access	M9	Measures to prevent and detect unauthorized access shall be employed
10.1	Virus embedded in communication media infects vehicle systems	M14	Measures to protect systems against embedded viruses/malware should be considered
11.1	Malicious internal (e.g. CAN) messages	M15	Measures to detect malicious internal messages or activity should be considered
11.2	Malicious V2X messages, e.g. infrastructure to vehicle or vehicle-vehicle messages (e.g. CAM, DENM)	M10	The vehicle shall verify the authenticity and integrity of messages it receives
11.3	Malicious diagnostic messages		
11.4	Malicious proprietary messages (e.g. those normally sent from OEM or component/system/function supplier)		

2. Mitigations for "Update process"

Mitigations to the threats which are related to "Update process" are listed in Table B2.

Table B2
Mitigations to the threats which are related to "Update process"

Table A1 reference	*Threats to "Update process"*	*Ref*	*Mitigation*
12.1	Compromise of over the air software update procedures. This includes fabricating the system update program or firmware	M16	Secure software update procedures shall be employed
12.2	Compromise of local/physical software update procedures. This includes fabricating the system update program or firmware		
12.3	The software is manipulated before the update process (and is therefore corrupted), although the update process is intact		
12.4	Compromise of cryptographic keys of the software provider to allow invalid update	M11	Security controls shall be implemented for storing cryptographic keys
13.1	Denial of Service attack against update server or network to prevent rollout of critical software updates and/or unlock of customer specific features	M3	Security Controls shall be applied to back-end systems. Where back-end servers are critical to the provision of services there are recovery measures in case of system outage. Example Security Controls can be found in OWASP

3. Mitigations for "Unintended human actions facilitating a cyber attack"

Mitigations to the threats which are related to "Unintended human actions facilitating a cyber attack" are listed in Table B3.

Table B3
Mitigations to the threats which are related to "Unintended human actions facilitating a cyber attack"

Table A1 reference	*Threats relating to "Unintended human actions"*	*Ref*	*Mitigation*
15.1	Innocent victim (e.g. owner, operator or maintenance engineer) is tricked into taking an action to unintentionally load malware or enable an attack	M18	Measures shall be implemented for defining and controlling user roles and access privileges, based on the principle of least access privilege
15.2	Defined security procedures are not followed	M19	Organizations shall ensure security procedures are defined and followed including logging of actions and access related to the management of the security functions

4. Mitigations for "External connectivity and connections"

Mitigations to the threats which are related to "external connectivity and connections" are listed in Table B4.

Table B4
Mitigation to the threats which are related to "external connectivity and connections"

Table A1 reference	*Threats to "External connectivity and connections"*	*Ref*	*Mitigation*
16.1	Manipulation of functions designed to remotely operate vehicle systems, such as remote key, immobiliser, and charging pile	M20	Security controls shall be applied to systems that have remote access
16.2	Manipulation of vehicle telematics (e.g. manipulate temperature measurement of sensitive goods, remotely unlock cargo doors)		
16.3	Interference with short range wireless systems or sensors		
17.1	Corrupted applications, or those with poor software security, used as a method to attack vehicle systems	M21	Software shall be security assessed, authenticated and integrity protected. Security controls shall be applied to minimise the risk from third party software that is intended or foreseeable to be hosted on the vehicle
18.1	External interfaces such as USB or other ports used as a point of attack, for example through code injection	M22	Security controls shall be applied to external interfaces
18.2	Media infected with viruses connected to the vehicle		
18.3	Diagnostic access (e.g. dongles in OBD port) used to facilitate an attack, e.g. manipulate vehicle parameters (directly or indirectly)	M22	Security controls shall be applied to external interfaces

5. Mitigations for "Potential targets of, or motivations for, an attack "

Mitigations to the threats which are related to "Potential targets of, or motivations for, an attack " are listed in Table B5.

Table B5
Mitigations to the threats which are related to "Potential targets of, or motivations for, an attack"

Table A1 reference	*Threats to "Potential targets of, or motivations for, an attack"*	*Ref*	*Mitigation*
19.1	Extraction of copyright or proprietary software from vehicle systems (product piracy / stolen software)	M7	Access control techniques and designs shall be applied to protect system data/code. Example Security Controls can be found in OWASP
19.2	Unauthorized access to the owner's privacy information such as personal identity, payment account information, address book information, location information, vehicle's electronic ID, etc.	M8	Through system design and access control it should not be possible for unauthorized personnel to access personal or system critical data. Examples of Security Controls can be found in OWASP
19.3	Extraction of cryptographic keys	M11	Security controls shall be implemented for storing cryptographic keys e.g. Security Modules
20.1	Illegal/unauthorised changes to vehicle's electronic ID	M7	Access control techniques and designs shall be applied to protect system data/code. Example Security Controls can be found in OWASP
20.2	Identity fraud. For example, if a user wants to display another identity when communicating with toll systems, manufacturer backend		
20.3	Action to circumvent monitoring systems (e.g. hacking/ tampering/ blocking of messages such as ODR Tracker data, or number of runs)	M7	Access control techniques and designs shall be applied to protect system data/code. Example Security Controls can be found in OWASP. Data manipulation attacks on sensors or transmitted data could be mitigated by correlating the data from different sources of information
20.4	Data manipulation to falsify vehicle's driving data (e.g. mileage, driving speed, driving directions, etc.)		
20.5	Unauthorised changes to system diagnostic data		
21.1	Unauthorized deletion/manipulation of system event logs	M7	Access control techniques and designs shall be applied to protect system data/code. Example Security Controls can be found in OWASP.
22.2	Introduce malicious software or malicious software activity	M7	Access control techniques and designs shall be applied to protect system data/code. Example Security Controls can be found in OWASP.
23.1	Fabrication of software of the vehicle control system or information system		
24.1	Denial of service, for example this may be triggered on the internal network by flooding a CAN bus, or by provoking faults on an ECU via a high rate of messaging	M13	Measures to detect and recover from a denial of service attack shall be employed
25.1	Unauthorized access to falsify configuration parameters of vehicle's key functions, such as brake data, airbag deployed threshold, etc.	M7	Access control techniques and designs shall be applied to protect system data/code. Example Security Controls can be found in OWASP
25.2	Unauthorized access to falsify charging parameters, such as charging voltage, charging power, battery temperature, etc.		

6. Mitigations for "Potential vulnerabilities that could be exploited if not sufficiently protected or hardened"

Mitigations to the threats which are related to "Potential vulnerabilities that could be exploited if not sufficiently protected or hardened" are listed in Table B6.

Table B6
Mitigations to the threats which are related to "Potential vulnerabilities that could be exploited if not sufficiently protected or hardened"

Table A1 reference	*Threats to "Potential vulnerabilities that could be exploited if not sufficiently protected or hardened"*	*Ref*	*Mitigation*
26.1	Combination of short encryption keys and long period of validity enables attacker to break encryption	M23	Cybersecurity best practices for software and hardware development shall be followed
26.2	Insufficient use of cryptographic algorithms to protect sensitive systems		
26.3	Using deprecated cryptographic algorithms		
27.1	Hardware or software, engineered to enable an attack or fail to meet design criteria to stop an attack	M23	Cybersecurity best practices for software and hardware development shall be followed
28.1	The presence of software bugs can be a basis for potential exploitable vulnerabilities. This is particularly true if software has not been tested to verify that known bad code/bugs is not present and reduce the risk of unknown bad code/bugs being present	M23	Cybersecurity best practices for software and hardware development shall be followed. Cybersecurity testing with adequate coverage
28.2	Using remainders from development (e.g. debug ports, JTAG ports, microprocessors, development certificates, developer passwords, …) can permit an attacker to access ECUs or gain higher privileges		
29.1	Superfluous internet ports left open, providing access to network systems		
29.2	Circumvent network separation to gain control. Specific example is the use of unprotected gateways, or access points (such as truck-trailer gateways), to circumvent protections and gain access to other network segments to perform malicious acts, such as sending arbitrary CAN bus messages	M23	Cybersecurity best practices for software and hardware development shall be followed. Cybersecurity best practices for system design and system integration shall be followed

7. Mitigations for "Data loss / data breach from vehicle"

Mitigations to the threats which are related to "Data loss / data breach from vehicle" are listed in Table B7.

Table B7
Mitigations to the threats which are related to "Data loss / data breach from vehicle"

Table A1 reference	*Threats of "Data loss / data breach from vehicle"*	*Ref*	*Mitigation*
31.1	Information breach. Personal data may be breached when the car changes user (e.g. is sold or is used as hire vehicle with new hirers)	M24	Best practices for the protection of data integrity and confidentiality shall be followed for storing personal data.

8. Mitigations for "Physical manipulation of systems to enable an attack"

Mitigation to the threats which are related to "Physical manipulation of systems to enable an attack" are listed in Table B8.

Table B8
Mitigations to the threats which are related to "Physical manipulation of systems to enable an attack"

Table A1 reference	*Threats to "Physical manipulation of systems to enable an attack"*	*Ref*	*Mitigation*
32.1	Manipulation of OEM hardware, e.g. unauthorised hardware added to a vehicle to enable "man-in-the-middle" attack	M9	Measures to prevent and detect unauthorized access shall be employed

Part C. Mitigations to the threats outside of vehicles

1. Mitigations for "Back-end servers"

Mitigations to the threats which are related to "Back-end servers" are listed in Table C1.

Table C1
Mitigations to the threats which are related to "Back-end servers"

Table A1 reference	*Threats to "Back-end servers"*	*Ref*	*Mitigation*
1.1 & 3.1	Abuse of privileges by staff (insider attack)	M1	Security Controls are applied to back-end systems to minimise the risk of insider attack
1.2 & 3.3	Unauthorised internet access to the server (enabled for example by backdoors, unpatched system software vulnerabilities, SQL attacks or other means)	M2	Security Controls are applied to back-end systems to minimise unauthorised access. Example Security Controls can be found in OWASP
1.3 & 3.4	Unauthorised physical access to the server (conducted by for example USB sticks or other media connecting to the server)	M8	Through system design and access control it should not be possible for unauthorised personnel to access personal or system critical data
2.1	Attack on back-end server stops it functioning, for example it prevents it from interacting with vehicles and providing services they rely on	M3	Security Controls are applied to back-end systems. Where back-end servers are critical to the provision of services there are recovery measures in case of system outage. Example Security Controls can be found in OWASP
3.2	Loss of information in the cloud. Sensitive data may be lost due to attacks or accidents when data is stored by third-party cloud service providers	M4	Security Controls are applied to minimise risks associated with cloud computing. Example Security Controls can be found in OWASP and NCSC cloud computing guidance
3.5	Information breach by unintended sharing of data (e.g. admin errors, storing data in servers in garages)	M5	Security Controls are applied to back-end systems to prevent data breaches. Example Security Controls can be found in OWASP

2. Mitigations for "Unintended human actions"
Mitigations to the threats which are related to "Unintended human actions" are listed in Table C2.

Table C2
Mitigations to the threats which are related to "Unintended human actions"

Table A1 reference	*Threats relating to "Unintended human actions"*	*Ref*	*Mitigation*
15.1	Innocent victim (e.g. owner, operator or maintenance engineer) is tricked into taking an action to unintentionally load malware or enable an attack	M18	Measures shall be implemented for defining and controlling user roles and access privileges, based on the principle of least access privilege
15.2	Defined security procedures are not followed	M19	Organizations shall ensure security procedures are defined and followed including logging of actions and access related to the management of the security functions

3. Mitigations for "Physical loss of data"
Mitigations to the threats which are related to "Physical loss of data" are listed in Table C3.

Table C3
Mitigations to the threats which are related to "Physical loss of data loss"

Table A1 reference	*Threats of "Physical loss of data"*	*Ref*	*Mitigation*
30.1	Damage caused by a third party. Sensitive data may be lost or compromised due to physical damages in cases of traffic accident or theft	M24	Best practices for the protection of data integrity and confidentiality shall be followed for storing personal data. Example Security Controls can be found in ISO/SC27/WG5
30.2	Loss from DRM (digital right management) conflicts. User data may be deleted due to DRM issues		
30.3	The (integrity of) sensitive data may be lost due to IT components wear and tear, causing potential cascading issues (in case of key alteration, for example)		