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Regulation No. 107

(M_2 and M_3 vehicles)

Frontal collision of buses

Proposal for a new regulation for vehicles of category M_3 with regard to the protection of the driver and crew member(s) seated alongside the driver in the case of a frontal collision

Submitted by the expert from Germany

The text reproduced below has been prepared by the expert from Germany in order to improve the safety of the driver and the crew of coaches in the case of a frontal collision.

A. PROPOSAL

Regulation No. XXX

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF VEHICLES OF CATEGORY M3 WITH REGARD TO THE PROTECTION OF THE DRIVER AND THE CREW MEMBER(S) SEATED ALONGSIDE THE DRIVER IN THE CASE OF A FRONTAL COLLISION

CONTENTS

1. SCOPE

This Regulation applies to:

1.1. non-low floor vehicles of category M_3 Class II with a maximum mass exceeding 7.5 tonnes,

1.2. vehicles of category M_3 Class III with a maximum mass exceeding 7.5 tonnes.

2. TERMS AND DEFINITIONS

For the purpose of this Regulation:

2.1. "Approval of a vehicle" means the approval of a vehicle type pursuant to the requirements of this Regulation, with regard to the protection of the driver and a member(s) of the crew seated alongside the driver in the case of a frontal collision.

2.2. "Vehicle type" means a category of power-driven vehicles which do not differ in such essential respects as the dimensions, shapes and materials of the components of the front bodywork.

2.3. "Low floor vehicle" is a vehicle in which at least 35 per cent of the area available for standing passengers (or in its forward section in the case of articulated vehicles, or in its lower deck in the case of double-decker vehicles) forms an area without steps and includes access to at least one service door.

2.4. "Transverse plane" means a vertical plane perpendicular to the median longitudinal plane of the vehicle.

2.5. "Longitudinal plane" means a plane parallel to the median longitudinal plane of the vehicle.

2.6. "Front bodywork" means the structure in the front part of the body.

2.7. "Superstructure" means the load-bearing components of the bodywork as defined by the manufacturer, containing those coherent parts and elements which contribute to the strength and energy absorbing capability of the front bodywork.

2.8. "Residual space" means a space to be preserved for the driver and a member(s) of the crew seated alongside the driver to provide better survival possibility in case of a frontal impact.

2.9. Units of measurement

Dimensions and linear distances	metres (m) or millimetres (mm)
Mass or load	kilograms (kg)
Force (and weight)	Newtons (N)
Moment	Newton-metres (Nm)
Energy	Joules (J)
Gravitational constant	9.81 (m/s2)

3. APPLICATION FOR APPROVAL

3.1. The application for approval of a vehicle type with regard to the protection of the driver and a member(s) of the crew in the case of a frontal collision shall be submitted by the vehicle manufacturer or by his duly accredited representative.

3.2. It shall be accompanied by three copies of drawings showing the front of the vehicle and sufficiently detailed drawings relating to the structure of the front of the vehicle.

4. APPROVAL

4.1. If the vehicle type or group of vehicle types submitted for approval to this Regulation meets the requirements of paragraph 5. below, approval of that vehicle type shall be granted.

4.2. An approval number shall be assigned to each vehicle type approved. Its first two digits (at present 00, corresponding to the Regulation in its original form) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party shall not assign the same number to another vehicle type.

4.3. Notice of approval or of refusal or extension of approval of a vehicle type pursuant to this Regulation shall be communicated to the Parties to the Agreement which apply this Regulation, by means of a communication form (see Annex 1) and of drawings and diagrams supplied by the applicant for approval, in a format agreed between the manufacturer and the technical service. Paper documentation shall be foldable to A4 (210 mm x 297 mm) format.

4.4. 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:

4.4.1. a circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval.1/

4.4.2. the number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the circle prescribed in paragraph 4.4.1.

4.4.3. If a type conforms to a 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 4.4.1. need not be repeated; in such a case, the Regulation 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. 4. 1.

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

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

4.4.6. Annex 2 to this Regulation gives an example of the approval mark.

5. REQUIREMENTS

5.1. The front bodywork of the vehicle shall be so designed as to eliminate to the greatest possible extent the risk of injury to the driver and a member(s) of the crew seated alongside the driver in the event of a frontal collision.

1/ 1 for Germany, 2 for France, 3 for Italy, 4 for the Netherlands, 5 for Sweden, 6 for Belgium, 7 for Hungary, 8 for the Czech Republic, 9 for Spain, 10 for Serbia, 11 for the United Kingdom, 12 for Austria, 13 for Luxembourg, 14 for Switzerland, 15 (vacant), 16 for Norway, 17 for Finland, 18 for Denmark, 19 for Romania, 20 for Poland, 21 for Portugal, 22 for the Russian Federation, 23 for Greece, 24 For Ireland, 25 for Croatia, 26 for Slovenia, 27 for Slovakia, 28 for Belarus, 29 for Estonia, 30 (vacant), 31 for Bosnia and Herzegovina, 32 for Latvia, 33 vacant, 34 for Bulgaria, 35 (vacant), 36 for Lithuania, 37 for Turkey, 38 (vacant), 39 for Azerbaijan, 40 for the former Yugoslav Republic of Macedonia, 41 (vacant), 42 for the European Community (Approvals are granted by its Member States using their respective ECE symbol), 43 for Japan, 44 (vacant), 45 for Australia, 46 for Ukraine, 47 for South Africa, 48 for New Zealand, 49 for Cyprus, 50 for Malta, 51 for the Republic of Korea, 52 for Malaysia, 53 for Thailand and 56 for Montenegro. Subsequent numbers shall be assigned to other countries in the chronological order in which they ratify or accede to the 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, and the numbers thus assigned shall be communicated by the Secretary-General of the United Nations to the Contracting Parties to the Agreement.

5.2. It shall be subjected to the test specified in Annex 3 to this Regulation.

5.3. Residual space required after the test.

5.3.1. After undergoing the test referred to in paragraph 5.2, above, the vehicle or front bodywork shall exhibit a residual space allowing accommodation of the manikin defined in annex 3, appendix 3 in the normal driving position on the seat, when the latter is in its median position, without contact between the manikin and non-resilient parts. To facilitate installation, the manikin(s) may be put on the seat(s) before performing the frontal impact or may be inserted after the impact in dismantled form and assembled in the vehicle. For this purpose, the seat shall be adjusted to its most rearward position and the manikin completely assembled and so placed that its H point coincides with the R point. The seat shall then be moved forward to its median position for the assessment of the survival space.

5.3.2. The space so defined shall be verified for the driver's seat and any crew member's seat alongside the driver.

5.4. Other conditions

5.4.1. The test may be carried out without doors installed.

5.4.2. If doors are installed they shall not be required to open after testing.

5.4.3. Interior panels in front of the driver and any member of the crew shall be fitted if, after the test, they are likely to intrude into the residual space.

5.5. A test need not be carried out if the manufacturer can prove by simulation(s)/ calculation(s) according to Annex 5 that the structure of the front bodywork of the vehicle will not undergo deformation dangerous to the driver and any member of the crew (penetration into the residual space) if subjected to the conditions of the test.

6. MODIFICATION OF THE TYPE AND EXTENSION OF APPROVAL

6.1. Every modification of the approved vehicle with regard to this Regulation shall be notified to the administrative department which approved the vehicle type. The department may then either:

6.1.1. consider that the modifications made are unlikely to have an appreciable adverse effect and that in any case the modified vehicle type still complies with the requirements, or

6.1.2. require a further test report from the technical service responsible for conducting the tests.

6.2. Confirmation or refusal of approval, specifying the alterations shall be communicated by the procedure specified in paragraph 4.3. above to the Contracting Parties to the Agreement applying this Regulation.

6.3. The competent authority issuing the extension of approval shall assign a serial number to each communication form drawn up for such an extension and inform thereof the other Contracting Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in Annex 1 to this Regulation.

7. CONFORMITY OF PRODUCTION

The conformity of production procedures shall comply with those set out in the Agreement, Appendix 2 (E/ECE/324-E/ECE/TRANS/505/Rev.2).

7.1. Vehicles approved under this Regulation shall be so manufactured as to conform to the type approved by meeting the requirements of the relevant part(s) of this Regulation.

7.2. The authority that 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 one every two years.

8. PENALTIES FOR NON-CONFORMITY OF PRODUCTION

8.1. The approval granted in respect of a vehicle type pursuant to this Regulation may be withdrawn if the requirements set forth above are not met.

8.2. If a Contracting Party to the Agreement applying this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation by means of a communication form conforming to the model in Annex 1 to this Regulation.

9. PRODUCTION DEFINITELY DISCONTINUED

If the holder of the approval completely ceases to manufacture a vehicle type 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 Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in Annex 1 to this Regulation.

10. TRANSITIONAL PROVISIONS

10.1. As from the official date of entry into force of this Regulation, no Contracting Party applying this Regulation shall refuse to grant approval under this Regulation.

10.2. No Contracting Party applying this Regulation shall refuse national type approval of a vehicle type approved under this Regulation.

10.3. Starting [36] months after the entry into force of this Regulation, Contracting Parties applying this Regulation may refuse national type approval of a new vehicle type which does not meet the requirements of this Regulation.

10.4. Starting [60] months after the entry into force of this Regulation, Contracting Parties applying this Regulation may refuse first national registration (first entry into service) of a vehicle which does not meet the requirements of this Regulation.

11. NAMES AND ADDRESSES OF TECHNICAL SERVICES RESPONSIBLE FOR CONDUCTING APPROVAL TESTS AND OF ADMINISTRATIVE DEPARTMENTS

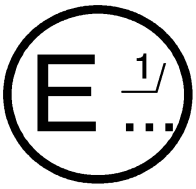
The Parties to the 1958 Agreement applying this Regulation shall communicate to the United Nations Secretariat the names and addresses of the technical services responsible for conducting approval tests and of the administrative departments which grant approval and to which forms certifying approval or extension or refusal or withdrawal of approval, issued in other countries, are to be sent.

Annex 1

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

COMMUNICATION

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



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

concerning: 2/ APPROVAL GRANTED
APPROVAL EXTENDED
APPROVAL REFUSED
APPROVAL WITHDRAWN
PRODUCTION DEFINITELY DISCONTINUED

of a vehicle type pursuant to Regulation No. XXX

Approval No.: ..... Extension No.: .....

Reason for extension: .....

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

2. Type: .....

3. Means of identification of type, if marked on the vehicle/component/separate technical unit 3/ .....

3.1. Location of that marking: .....

4. Category of vehicle 4/: .....

5. Name and address of manufacturer: .....

6. Location of the ECE approval mark: .....

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

8. Additional information (where applicable)

9. Technical service responsible for carrying out the tests: .....

10. Date of test report: .....

11. Number of test report: .....

12. Remarks (if any): .....

13. Place: .....

14. Date: .....

15. Signature: .....

16. The index to the information package lodged with the approval authority, which may be obtained on request, is attached.

_____

1/ Distinguishing number of the country which has granted/extended approval (see approval provisions in the Regulation).

2/ Strike out what does not apply (there are cases where nothing needs to be deleted, when more than one entry is applicable).

3/ If the means of identification of type contains characters not relevant to describe the vehicle, component or separate technical unit types covered in this information document, such characters shall be represented in the documentation by the symbol "?" (e.g. ABC??123??).

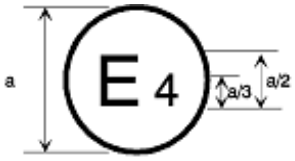
4/ As defined in Annex 7 to the Consolidated Resolution on the Construction of Vehicles (R.E.3) (document TRANS/WP.29/78/Rev.1/Amend.2, as amended).

Annex 2

ARRANGEMENTS OF APPROVAL MARKS

Example 1

(See paragraph 4.4. of this Regulation)



XXXR - 001234

a = 8 mm min

The above approval mark affixed to a vehicle shows that the type concerned was approved in the Netherlands (E4) pursuant to paragraph 4.4 of Regulation No. XXX under approval No. 001234. The first two digits (00) of the approval number indicate that the approval was granted in accordance with the requirements of Regulation No. XXX in its original form.

Annex 3

TEST PROCEDURE

1. TEST METHOD

The complete vehicle or alternatively the front bodywork shall be tested using an appropriate test method, such as a swing-bob, mobile barrier, etc., incorporating the specifications of the impact plate prescribed in appendix 1 to this annex, of the manufacturer's choice.

2. ANCHORAGE OF THE VEHICLE OR FRONT BODYWORK

For the test, the structure shall, at the manufacturer's choice, be fixed rigidly to the ground or to a separate frame rigidly fixed to the ground. The structure or frame shall be secured in the manner prescribed in Appendix 2 to this Annex.

3. TEST CONDITIONS

3.1. The impact plate shall have the characteristics set out in Appendix 1 to this Annex.

3.2. At the time of the impact, the vertical transversal plane of the vehicle or front bodywork shall be parallel to the vertical transversal plane of the impact plate.

3.3. The impact plate shall be so positioned that in the vertical position:

3.3.1. its striking face is in contact with the foremost part of the vehicle or front bodywork;

3.3.2. its centre of gravity is 50 mm ± 50 mm below the R point of the driver's seat; and

3.3.3. its centre of gravity is in the median longitudinal plane of the vehicle.

3.4. The impact plate shall strike the vehicle or front bodywork at the front in the direction towards the rear of the vehicle or front bodywork. The direction of impact shall be horizontal and shall be parallel to the median longitudinal plane of the vehicle.

4. IMPACT ENERGY

4.1. The impact energy shall be at least 44 000 J.

5. PREPARATION OF THE TEST VEHICLE

5.1. The structure to be tested shall be representative of the series production.

5.2 The vehicle or front bodywork to be tested need not be in a fully finished, "ready for operation" condition. Generally, any alteration from the fully finished condition is acceptable if the basic features and behaviour of the superstructure are not influenced by it. The test vehicle or front bodywork shall be the same as its fully finished version in respect of all of those elements which, according to the manufacturer, contribute to the strength.

5.3. If the test is performed including the doors, the doors shall be in their closed position (operational mode) but not locked.

5.4. A supporting frame may be used to fix the vehicle or front bodywork structure to the ground. The supporting frame shall not strengthen the front bodywork.

Annex 3 - Appendix 1

IMPACT PLATE CHARACTERISTICS

1. Characteristics of the impact plate.

The impact plate shall be made of steel.

2. Its mass shall be 1500 ± 250 kg and shall be evenly distributed.

3. Its striking surface, rectangular and flat, shall be 2500 mm wide and 800 mm high. Its edges shall be rounded to a radius of curvature of not less than 1.5 mm.

Annex 3 - Appendix 2

INSTRUCTIONS FOR SECURING VEHICLES TO THE TEST BED

1. ANCHORING CHAINS OR ROPES

Each anchoring chain or rope shall be of steel and shall be capable of withstanding a tractive load of at least 10 tonnes.

2. VERTICAL BLOCKING OF THE CHASSIS FRAME

Vertical movement of the vehicle or front bodywork shall be limited at the manufacturer's choice by chains, ropes and blocks.

3. LONGITUDINAL ATTACHMENT

Rearward movement of the vehicle or front bodywork shall be limited by chains or ropes. The chains or ropes may cross one another.

4. LATERAL ATTACHMENT

Lateral movement shall be limited by chains or ropes.

5. TENSIONING OF CHAINS OR ROPES AND REAR ATTACHMENT

The chains or ropes shall be placed under a load so that all slack is taken up.

6. EQUIVALENT MOUNTING

At the request of the manufacturer the test may be carried out with the vehicle or front bodywork mounted on a supporting frame.

Annex 3 - Appendix 3

MANIKIN TO BE USED TO VERIFY THE RESIDUAL SPACE

A manikin corresponding to the size and the movability of the Hybrid III 1/ dummy shall be used to examine the residual space for the driver and for each member of the crew seated alongside the driver.

1/ The technical specifications and detailed drawings of Hybrid III, corresponding to the principal dimensions of the fiftieth percentile male of the United States of America, and the specifications for its adjustment for this test are deposited with the Secretary-General of the United Nations and may be consulted on request at the secretariat of the Economic Commission for Europe, Palais des Nations, Geneva, Switzerland.

Annex 4

PROCEDURE FOR DETERMINING THE "H" POINT AND THE ACTUAL TORSO ANGLE FOR SEATING POSITIONS IN MOTOR VEHICLES

Note by the secretariat. Annex standard. It will be reproduced only in the consolidated text of the Regulation.

Annex 5

COMPUTER SIMULATION OF THE FRONT IMPACT TEST ON A VEHICLE OR FRONT BODYWORK AS AN EQUIVALENT APPROVAL METHOD

1. ADDITIONAL DATA AND INFORMATION

The superstructure of the vehicle or relevant front bodywork may be shown to meet the requirements specified in paragraph 5. of this Regulation by a computer simulation method approved by the technical service. If the manufacturer chooses this approval method, the following information shall be supplied to the technical service in addition to the data, and drawings listed in paragraph 3.2. of this Regulation.

1.1. A description of the applied simulation method which has been utilised, and an identification of the analysis software, including its producer, its commercial name and the version used.

1.2. The material models and the input data utilised.

2. THE MATHEMATICAL MODEL

The model shall be capable of describing the real physical behaviour of the front impact process, in accordance with Annex 3. The mathematical model shall be constructed, and assumptions prescribed, in such a way that the calculation gives conservative results. The model shall be built up with the following considerations:

2.1. The technical service may require tests to be carried out on the vehicle structure or front bodywork structure to prove the validity of the mathematical model and to verify the assumptions made in the model.

3. REQUIREMENTS FOR THE ALGORITHM AND SIMULATION PROGRAM AND FOR COMPUTING EQUIPMENT

3.1. The simulation program shall start, at the latest, at the point of first contact with the impact plate.

3.2. The initial conditions at the point of first contact with the front impact plate shall be defined.

3.3. The simulation program shall run, at least, until the maximum deformation is reached.

3.4. The simulation program shall produce a stable solution, in which the result is widely independent of the incremental time (displacement, force) step.

3.5. The simulation program shall be able to calculate the energy components for the energy balance at every incremental time (displacement, force) step.

3.6. Non-physical energy components introduced by the process of mathematical modelling (for example, "hourglass" and internal damping) shall not exceed 5 per cent of the total energy at any time.

3.7. All physical contacts between parts of the vehicle or front bodywork, which may have a noticeable influence on the results, shall be taken into account in the mathematical model.

4. EVALUATION OF THE SIMULATION

4.1. When the stated requirements for the simulation program are met, the simulation of the changes in geometry of the interior structure and comparison with the geometrical shape of the residual space can be evaluated as defined in paragraph 5. of this Regulation.

4.2. If the residual space is not infringed at the end of the simulated test, the approval shall be granted. The end of the simulated test is defined as the moment when the elastic springback is completely finished.

4.3. If the residual space is infringed at the end of the simulated test, the approval shall be refused.

5. DOCUMENTATION

5.1. The report on the simulation shall contain the following information:

5.1.1. All the data and information stated in paragraph 1. of this annex;

5.1.2. A drawing showing the mathematical model of the superstructure of the vehicle or front bodywork;

5.1.3. Plots or data which show in an appropriate way that the requirements specified in paragraph 5. of this Regulation are met. This requirement can be satisfied by the provision of a plot of the distance between the inside contour of the deformed structure and certain endangered points of the manikin, against time respectively displacement of the impact plate;

5.1.4. A statement of whether, or not, the requirements specified in paragraph 5. of this Regulation have been met;

5.1.5. All the data and information necessary for the identification of the vehicle type, the superstructure of the vehicle or relevant front bodywork, the mathematical model of the superstructure, and the calculation itself.

B. JUSTIFICATION

This proposal for a draft regulation aims to address the safety of the driver and the crew member(s) seated alongside the driver in the case of a frontal collision of a vehicle of category M_3. The importance of this subject has been brought to the attention of GRSG at its eighty-fifth session by the representatives of Spain and Hungary. Recent research and data presented by Spain at the nineteenth session of GRSG showed the need to address the issue of injuries and fatalities due to frontal collisions of certain vehicles of category M_3. It has been mentioned that improved protection of the driver could contribute to a higher level of safety of the passengers due to better controlled evacuation of the vehicle under the guidance of the driver and/or crew. The justifications put forward by the Spanish delegate in informal document No. GRSG-90-30 led to the start of some regulatory work in Germany.

The scope of the proposed new regulation addresses non-low floor vehicles of category M_3 Class II and vehicles of category M_3 Class III. These classes cover the typical coaches and interurban vehicles which should be the focus of a first step.

The available studies could not prove that actual frontal impacts on the road concentrate on a typical kind of accident. This is the reason why Germany finds it appropriate to vary the height of the impact according to the height of the driver's R-point to make sure that the test configuration focuses on the driver's area.

In alignment with UNECE Regulation No. 66, offering an alternative to the cost intensive full-scale test, the proposed draft regulation contains requirements for a computer simulation adapted to the constraints of a frontal impact testing.

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