

Draft modification of  
**REGULATION NO. 66**

Uniform provisions concerning the approval of large passenger vehicles with regard to the strength of their superstructure in case of rollover accident

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**Annexes**

- Annex 1. Communication form
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- Annex[ X<sub>3</sub> ] Rollover test on complete vehicle
- Annex[ X<sub>4</sub> ] Body section rollover test
- [ Annex[ X<sub>5</sub> ] Pendulum test on body sections ]
- Annex[ X<sub>6</sub> ] Computer simulation of rollover test on complete vehicle
- Annex[ X<sub>7</sub> ] Calculation method based on quasi/static tests.

**1. SCOPE**

This Regulation applies to single-deck rigid or articulated vehicles designed and constructed for the carriage of more than 22, whether seated or standing, in addition to the driver and crew.

## DEFINITIONS

- 2.1. Vehicle means a vehicle designed and equipped for transportation of passengers
- 2.2. Vehicle type unchanged
- 2.3. Approval of a vehicle unchanged text of original para.2.1.
- 2.4. Articulated vehicle means a vehicle ... (Take the definition from Reg.36.)
- 2.5. Superstructure unchanged text of original para. 2.7.
- 2.6. Passenger compartment unchanged text of original para 2.3.
- 2.7. Driver's compartment unchanged text of original para 2.4
- 2.8. Unladen kerb mass ( $M_k$ ) (kg) means the mass of the vehicle in running order, unoccupied and unladen but with the addition of 75 kg for the mass of the driver, the mass of fuel corresponding to 90% of the capacity of the fuel tank specified by the manufacturer, and the masses of coolant, lubricant, tools and spare wheel, if any.
- 2.9. Residual space means a space to be preserved in the passenger's and driver's compartment providing better survival possibility for passengers, driver and crew in case of rollover accident.
- 2.10. Rollover test on complete vehicle means a realistic rollover situation which is defined as basic test with full scale vehicle to prove the required strength of the superstructure
- 2.11. Tilting bench means a technical device, an arrangements of tilting platform, ditch and concrete ground surface together, the help of which a rollover test on complete vehicle can be performed.
- 2.12. Tilting platform means a rigid plane which can be rotated around a horizontal axis in order to tilt a vehicle either to determine its CG's height or to perform a rollover test on complete vehicle.
- 2.13. Energy balance means controlling the principle of energy conservation during the standard rollover test as a process. The total potential energy of the vehicle - trough kinetic energy - is transformed into different kind of mechanical works.
- 2.14. Plastic zone means a special, geometrically limited part of the superstructure in which, as the result of dynamic, impact forces:
  - large scale plastic deformations are concentrated
  - essential distortion of the original shape (cross section, length, or other geometry) occurs
  - in consequence of local buckling the loss of stability ensues
  - due to the deformation work a certain amount of kinetic energy is absorbed.
- 2.15. Plastic hinge means a simple plastic zone formed on rod-like element like single tube, window column, etc.
- 2.16. Reference energy ( $E_R$ ) means the potential energy of the vehicle to be tested, when staying in the starting, unstable position of the rollover process

To be continued, it is not finished yet!

## 3. APPLICATION FOR APPROVAL

3.1. Unchanged

3.2. Unchanged

3.2.1. The main general parameters of the vehicle, especially:

- 3.2.1.1. general layout drawings of the vehicle and its interior arrangement with the main dimensions
- 3.2.1.2. the unladen kerb mass of the vehicle (kg) and the axle loads (kg) coming from it.

- 3.2.1.3. the exact position of the unladen vehicle's centre of gravity (CG) together with the measuring report. To determine the CG's position the measuring and calculation methods described in Annex [X<sub>1</sub>] shall be used.
  - 3.2.1.4. the value of reference energy (E<sub>R</sub>) which is the product of the unladen kerb mass (M<sub>K</sub>), the gravity constant (g) and the height of CG (h<sub>0</sub>) in the vehicle unstable position when starting the rollover test (See Fig.1.)
  - 3.2.2. Detailed description of the superstructure of the vehicle type, including its main dimensions, construction and constituent materials, especially:
    - 3.2.2.1. drawing about the manufacturer's model of the load bearing and energy absorbing frame structure of the vehicle type against dynamic loads in case of rollover test
    - 3.2.2.2. description and drawings of those parts and constructional arrangements of the vehicle type which have significant influence on the strength of the superstructure or on the residual space, see Annex [X<sub>2</sub>]
  - 3.2.3. Detailed and exact drawing about the survival space. The manufacturer can provide a survival space independently from seating arrangement as a worst case, if:
    - 3.2.3.1. the supporting and reinforcing effect of installed seats are not considered
    - 3.2.3.2. the mass of possible maximum number of seats is considered
    - 3.2.3.3. the residual space is determined according to all possible seating arrangement.
  - 3.2.4. Further detailed documentation, parameters, data depending on the approval test method chosen by the manufacturer, given accordingly in Annex [X<sub>3</sub>], Annex [X<sub>4</sub>], [Annex [X<sub>5</sub>]], Annex [X<sub>6</sub>] and Annex [X<sub>7</sub>]
  - 3.2.5. In case of an articulated vehicle all of these information shall be given separately for the two rigid parts of the vehicle type, except para 3.2.1.1. which is related to the complete vehicle.
- 3.3. On request of the Technical Service a complete vehicle shall be presented to check the mass, axle loads, position of CG and all other data and information which are relevant in respect of the strength of superstructure.
- 3.4. According to the approval test method chosen by the manufacturer, test pieces, units, specimens shall be submitted to the Technical Service on its request.. The arrangement and number of these test pieces should be checked up with the Technical Service. In case of units, specimens which were already tested earlier, the test results, test reports shall be submitted.

#### 4. APPROVAL

The sub para.-s under this heading should be harmonised with the newer version of Reg.36, or Reg.52.

#### 5. GENERAL SPECIFICATIONS AND REQUIREMENTS

##### 5.1. Requirements.

The superstructure of the vehicle shall have the sufficient strength to ensure that the residual space during and after the rollover test on complete vehicle is unharmed. That means:

- 5.1.1. No displaced part of the vehicle shall intrude into the residual space, which were out of it before the test (e.g. pillars, safety rings, luggage racks, etc.) All the structural parts, which are originally in the residual space (e.g. vertical handholds, partitions, kitchenettes, toilets, etc.) shall be ignored, when evaluating the harm of the residual space.

5.1.2. No part of the residual space shall project outside the contour of the deformed structure. The contour of the deformed structure should be determined step by step, between every two window and/or door pillars. In one segment, between two deformed pillars the contour is a theoretical surface, determined by straight lines running through the inside contour points of the two neighbouring deformed pillars having the same height above the floor level before the rollover test. (See Figure 2)

## 5.2. Residual space.

The residual space means the volume within the passenger and driver's compartment determined by one-one vertical transverse plane on both sides of the vehicle defined in Figure 1(a), when this planes are moved along longitudinal straight lines (see Figure 1(b) ) with the following instructions:

- 5.2.1. The straight lines are determined by theoretical  $S_R$  points on both sides of the vehicle. Behind the rearmost and in front of the foremost seat's theoretical  $S_R$  points the straight lines are horizontal
- 5.2.2. The position of the theoretical  $S_R$  points are located on each seat-back centre line of the outer seats, 500 mm above the floor under the seats, 150 mm from the inside surface of the side wall. This dimensions shall be applied in the case of rearwards facing and inward facing seats, too.
- 5.2.3. The rearmost vertical border plane of the residual space is 200 mm behind the theoretical  $S_R$  point of the rearmost outer seat
- 5.2.4. the foremost vertical border plane of the residual space is 600 mm in front of the theoretical  $S_R$  point of the foremost passenger seat or the driver's seat in its foremost position if it is adjustable, or the crew seat if it is located.
- 5.2.5. the residual space is continuous between its rearmost and foremost border plane.
- 5.2.6. if the two sides of the vehicle are not identical (symmetric) related to the seat floor arrangement and the height of the theoretical  $S_R$  points, the step between the two heights of the residual space shall be in the longitudinal vertical centre plane of the vehicle (See Figure 1( c ) )
- 5.2.7. If the rearmost and foremost seats on the two sides of the vehicle are not in the two sides of the vehicle are not in the same longitudinal positions, the length of the residual space on the two sides can be different.

## 5.3. Specification of rollover test on complete vehicle

The rollover test is a lateral tilting test, shown on Figure 3. and specified as follows:

- 5.3.1. The full scale vehicle is standing (no speed) when tilting slowly until its unstable position
- 5.3.2. The rollover test starts in the unstable position of the vehicle with zero angular velocity and the axis of rotation is running through the wheel-ground connecting points. In this moment the tested vehicle is characterised by the reference energy  $E_R$  (see Fig.3. and para 3.2.1.4)
- 5.3.3. the vehicle tips over into a ditch, having a horizontal, dry concrete ground surface with a nominal depth of 800 mm
- 5.3.4. the detailed technical specification of the rollover test on complete vehicle as an approval test is given in [X<sub>3</sub>]

## 5.4. Specifications of equivalent approval tests

Instead of the rollover test on complete vehicle, at the discretion of the manufacturer, one of the following equivalent approval test methods can be chosen:

- 5.4.1. rollover test on body sections being representative of the complete vehicle, in accordance with the specifications of Annex [X<sub>4</sub>]

[5.4.2. pendulum test on body sections being representative of the complete vehicle, in accordance with the specifications of Annex [X<sub>5</sub>] ]

5.4.3.computer simulation of the standard rollover test in accordance with the specifications of Annex [X<sub>6</sub>]

5.4.4.calculation method based on the results of quasi-static tests in accordance with the specifications of Annex [X<sub>7</sub>]

5.4.5. Basic principle is that the equivalent approval test methods must be carried out in such a way that they represent the rollover test specified in the Appendix of Annex [X<sub>3</sub>] If the equivalent approval test method chosen by the manufacturer cannot take account of the special feature, construction of the vehicle (e.g. air-conditioning installation on the roof, changing height of the waist rail, changing roof height, etc.) the vehicle may be required by the Technical Service to undergo the rollover test specified in Annex [X<sub>3</sub>]

### 5.5. Test of articulated buses

In the case of an articulated vehicle, each rigid section of the vehicle shall comply with the general requirement specified in para 5.1. and shall be tested and approved accordingly. If one of the rigid section of an articulated vehicle has only one axle, the standard test shall be carried out on such a way that

5.5.1.an artificial support shall be applied at the articulated hinge structure of the section which holds it in its original position on the tilting platform, when this is in the horizontal position

5.5.2.the artificial support has to provide such an axis of rotation for the rigid section, which is running through the wheel-ground connecting point being parallel to the vertical, longitudinal symmetry plane of the rigid section.

### 5.6.Direction of rollover test

The rollover test shall be carried out on that side of the vehicle which is more dangerous with respect to the residual space. The decision is made by the competent Technical Service on the basis of the manufacturer proposal, considering at least the followings

5.6.1.the lateral eccentricity of CG which can result bigger potential energy in the unstable, starting position of the vehicle

5.6.2.the asymmetry of the residual space according to para 5.2.6.

5.6.3.the different, asymmetrical constructional feature of the two sides of the vehicle, which side is stronger (weaker), better supported by partitions, inner boxes (e.g. wardrobe, toilet, kitchenette, etc.)

## 6. **MODIFICATION AND EXTENSION OF APPROVAL OF A VEHICLE TYPE**

### 6.1. Unchanged

6.1.1. Unchanged

6.1.2. Unchanged

6.1.3. (New paragraph) The consideration should be based on two aspects:

6.1.3.1.(New paragraph) constructional aspect means whether is there any change in the load bearing and energy absorbing frame structure (dimensions, material, constructional details, technology, etc.) and if there is, is it considerable or not.

6.1.3.2. (New paragraph) energy aspect means whether the reference energy (E<sub>R</sub>) is changed or not. If the modified vehicle type has the same or smaller reference energy than the approved one, no further test is needed from the energy aspect.

### 6.2. Unchanged

6.3. Unchanged

**7. CONFORMITY OF PRODUCTION**

Use the up to date version, e.g. from Reg.36.

**8. PENALTIES FOR NON-CONFORMITY OF PRODUCTION**

Use the up to date version, e.g. from Reg.36.

**9. PRODUCTION DEFINITELY DISCONTINUED**

Use the up to date version, e.g. from Reg.36.

**10. TRANSITIONAL PROVISIONS**

To be agreed in GRSG

**11. NAMES AND ADDRESSES OF TECHNICAL SERVICES..**

Use the up to date version, e.g. from Reg.36.

**Supplement to the existing Annex 1.**

5. (Modified text) Brief summary description of the superstructure in respect of para, 3.2.2. and Annex [X<sub>2</sub>]
6. (New paragraph) Exact drawing about the residual space used in the approval procedure.....
7. - 8. Renumber original para. 6. - 7.
9. (New paragraph) The value of reference energy (kJ) according to para. 3.2.1.4.
- 10.- 11. Renumber original para. 8-9.
12. (New paragraph) Direction of the rollover test used or supposed during the approval procedure  
.....
13. - 14. - 15. - 16. - 17.- 18 Renumber original para 10. - 11. - 12. - 13. - 14. -15.
19. (Modified text of original para. 16.) List of documents, containing data specified in para. 3.2. and in the appropriate Annex which specifies the used approval test method. The listed documents are deposited by the competent authority and are available on request ...

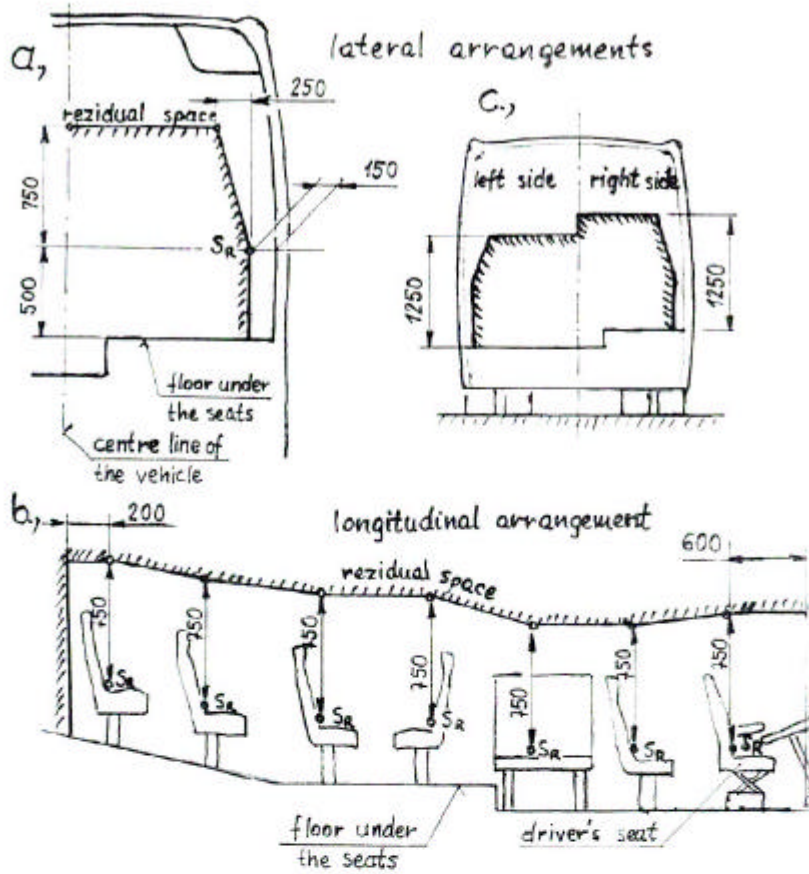


Figure 1. The residual space

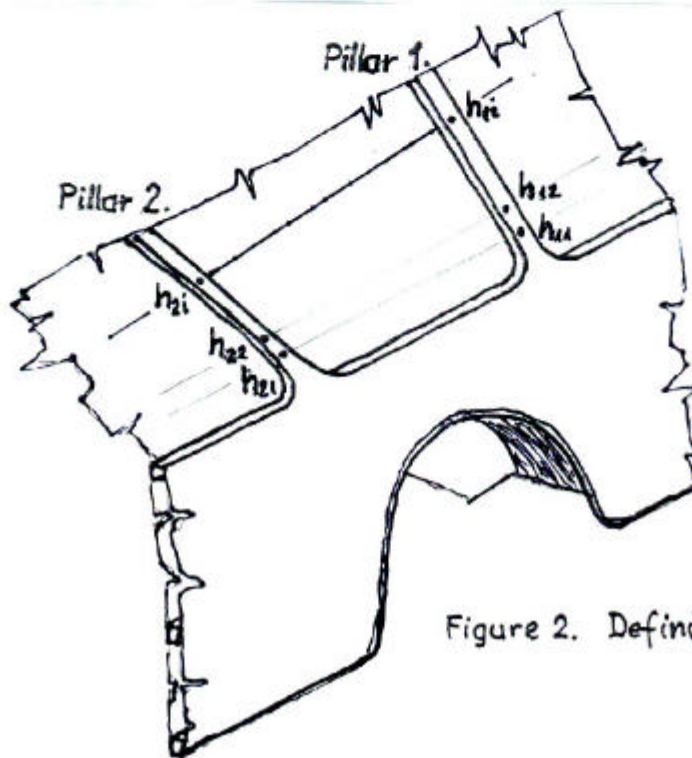


Figure 2. Definition of contour

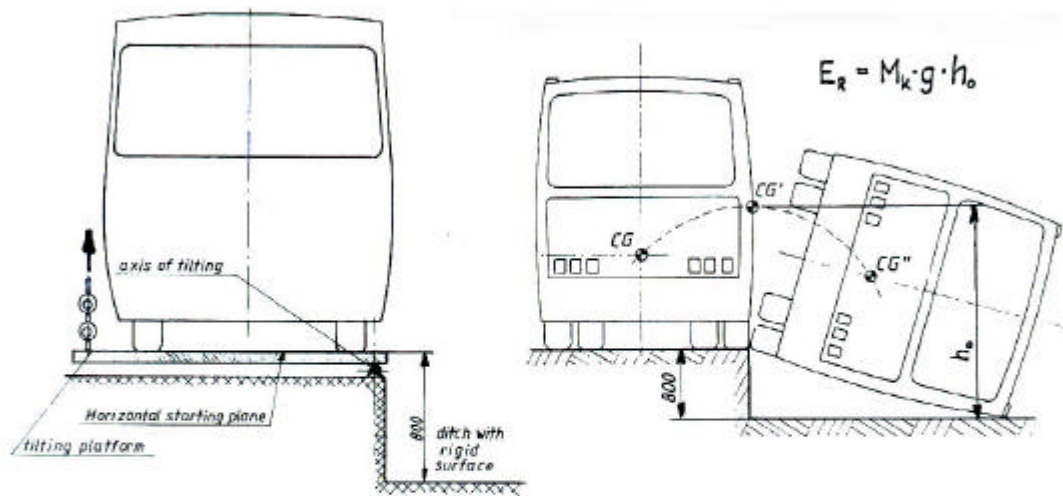


Figure 3. Rollover test with complete vehicle