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## ANNEX

### PART II

#### CHAPTER III

##### **Lower legform to frontal protection system**

1. Test purpose
  - 1.1. To test compliance with the requirements laid down in paragraph 3.1.1 of Annex I to Directive 2005/66/EC.
2. Test points
  - 2.1. A minimum of three lower legform to frontal protection system tests must be carried out on test points between the upper and lower frontal protection system reference lines (see Figures 1 and 2). The test points must be at positions judged by the test authority to be the most likely to cause injury. Tests must be carried out to different types of structure where they vary throughout the area to be assessed. The points tested by the test authorities shall be indicated in the test report.
3. Test apparatus
  - 3.1. The lower legform impactor must consist of two foam covered rigid segments, representing femur (upper leg) and tibia (lower leg), joined by a deformable, simulated knee joint. The overall length of the impactor must be  $926 \pm 5$  mm and comply with the requirements laid down in Section 5 of this Chapter and with Figure 6. Brackets, pulleys, etc., attached to the impactor for the purpose of launching it, may extend the dimensions shown in Figure 6.
  - 3.2. Transducers must be fitted to measure knee-bending angle and knee-shearing displacement. One uni-axial accelerometer must be fitted to the non-impacted side of the tibia, close to the knee joint, with its sensitive axis in the impact direction.
  - 3.3. The instrumentation response value CFC, as defined in ISO 6487: 2000, must be 180 for all transducers. The CAC response values, as defined in ISO 6487: 2000, must be  $50^\circ$  for the knee-bending angle, 10 mm for the shearing displacement and 500 g for the acceleration.
  - 3.4. The impactor must meet the performance requirements specified in Section 2 of Appendix I, and must be fitted with deformable knee elements from the same batch as those used in the certification tests. The impactor must also be fitted with foam cut from one of up to four consecutive sheets of Confor™ foam flesh material, or equivalent, produced from the same batch of manufacture (cut from one block or bun of foam), provided that foam from one of these sheets was used in the dynamic certification test and the individual weights of these sheets are within  $\pm 2\%$  of the weight of the sheet used in the certification test. The certified impactor may be used for a maximum of 20 impacts before re-certification. With each test new plastically deformable knee elements should be used. The impactor must also be re-certified if more than one year has elapsed since the previous certification or if any impactor transducer output, in any impact, has exceeded the specified CAC.
  - 3.5. The impactor must be mounted, propelled and released as specified in Chapter II.

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4. Test procedure
  - 4.1. The stabilised temperature of the test apparatus and the vehicle or separate technical unit must be  $20^{\circ} \pm 4^{\circ}\text{C}$ .
  - 4.2. Tests must be made to the frontal protection system at points selected under paragraph 2.1.
  - 4.3. The direction of impact must be in the horizontal plane and parallel to the longitudinal vertical plane of the frontal protection system as mounted on the vehicle or mounting frame. The tolerance for the direction of the velocity vector in the horizontal plane and in the longitudinal plane must be  $\pm 2^{\circ}$  at the time of first contact.
  - 4.4. The axis of the impactor must be perpendicular to the horizontal plane with a tolerance of  $\pm 2^{\circ}$  in the lateral and longitudinal plane. The horizontal, longitudinal and lateral planes are orthogonal to each other (see Figure 8).
  - 4.5. The bottom of the impactor must be 25 mm above ground reference level at the time of first contact with the frontal protection system (see Figure 7), with a  $\pm 5$  mm tolerance. When setting the height of the propulsion system, an allowance must be made for the influence of gravity during the period of free flight of the impactor.
  - 4.6. At the time of first contact the impactor must have the intended orientation about its vertical axis, for the correct operation of its knee joint, with a tolerance of  $\pm 5^{\circ}$ .
  - 4.7. At the time of the first contact the centre line of the impactor must be within  $\pm 10$  mm tolerance to the selected impact position.
  - 4.8. During contact between the impactor and the frontal protection system, the impactor must not contact the ground or any object which is not part of the frontal protection system or the vehicle.
  - 4.9. The impact velocity of the impactor when striking the frontal protection system must be  $11,1 \pm 0,2$  m/s. The effect of gravity must be taken into account when the impact velocity is obtained from measurements taken before the time of first contact.
5. Lower legform impactor
  - 5.1. The diameter of the femur and tibia must be  $70 \pm 1$  mm and both must be covered by foam 'flesh' and skin. The foam flesh must be 25 mm thick Confor™ foam type CF-45, or equivalent. The skin must be made of neoprene foam, faced with 0,5 mm thick nylon cloth both sides, with an overall thickness of 6 mm.
    - 5.1.1. The length of the femur and tibia must be 432 mm and 494 mm from the centre of the knee respectively.
  - 5.2. The total mass of the femur and tibia must be  $8,6 \pm 0,1$  kg and  $4,8 \pm 0,1$  kg respectively, and the total mass of the impactor must be  $13,4 \pm 0,2$  kg.
  - 5.3. The centre of gravity of the femur and tibia must be  $217 \pm 10$  mm and  $233 \pm 10$  mm from the centre of the knee respectively.
  - 5.4. The moment of inertia of the femur and tibia, about a horizontal axis through the respective centre of gravity and perpendicular to the direction of impact, must be  $0,127 \pm 0,010$  kgm<sup>2</sup> and  $0,120 \pm 0,010$  kgm<sup>2</sup> respectively.

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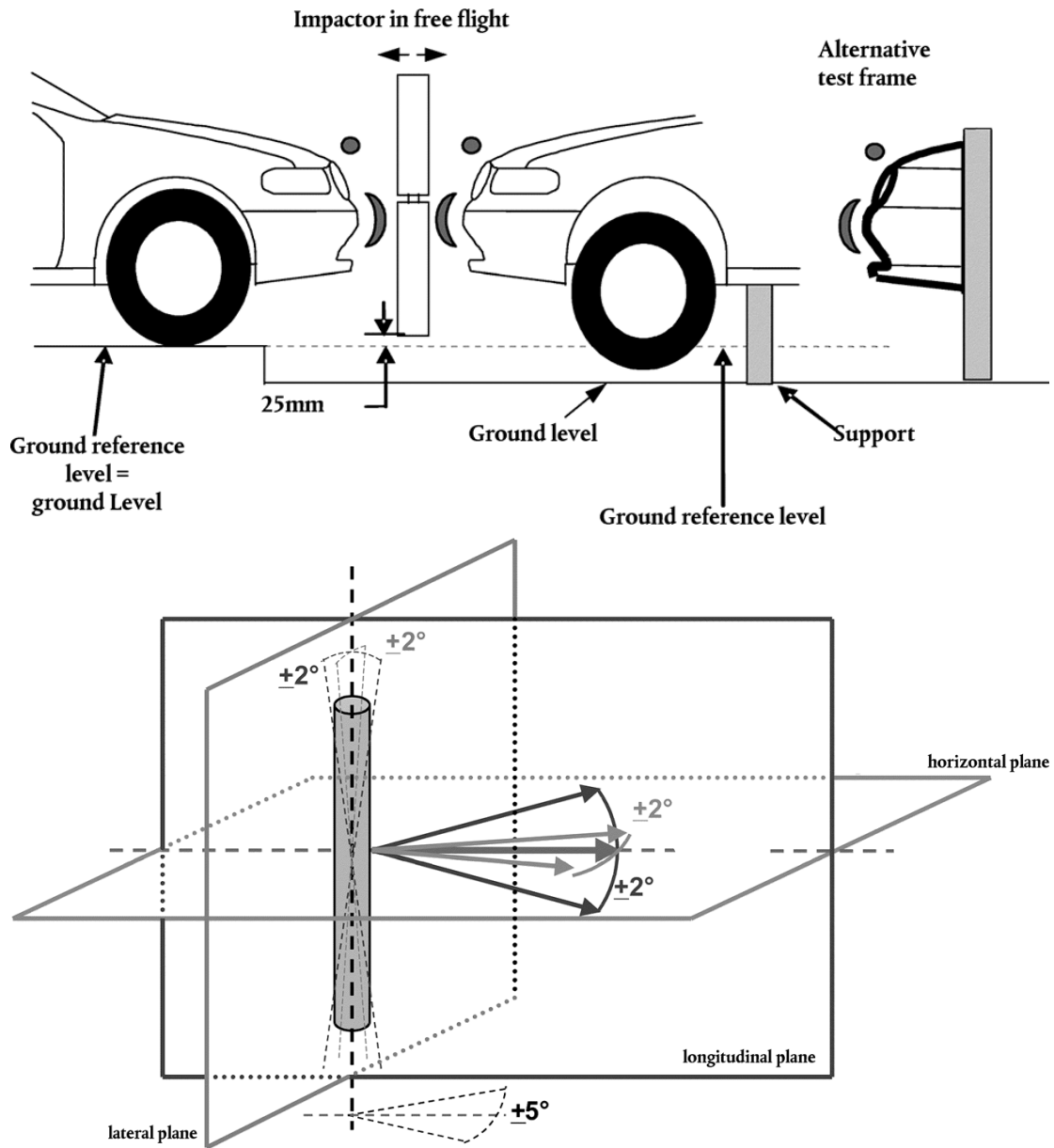
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- 5.5. A uni-axial accelerometer must be mounted on the non-impacted side of the tibia,  $66 \pm 5$  mm below the knee joint centre, with its sensitive axis in the direction of impact.
- 5.6. The impactor must be instrumented to measure the bending angle and the shearing displacement between femur and tibia.
- 5.7. A damper must be fitted to the shear displacement system and may be mounted at any point on the rear face of the impactor or internally. The damper properties must be such that the impactor meets both the static and dynamic shear displacement requirements and prevents excessive vibrations of the shear displacement system.



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