**Proposals from Mr Césari for amendments to the preamble as agreed in the action items INF GR / PS / 139**

**Action 1 of PS / 139**

Insert in
IV. Discussion of issues addressed by the gtr
(g) Test procedure
(i) Head protection

"The decisions concerning head impact angles fro child and adult tests (respectively 50° and 65° to the horizontal) were based on 2 reports used as working documents. They are:

- Glaeser K.P. (1991) "Development of a Head Impact Test Procedure for Pedestrian Protection" BASt Report under contract N° ETD/89/7750/M1/28 to the E.C.
- Janssen E.G., Nieboer J.J. (1990) "Protection of vulnerable road users in the event of a collision with a passenger car, part1 – computer simulations". TNO Report N° 75405002/1.

I will try to provide a copy of these reports.
The EEVC values are a compromise between PMHS tests and simulation results.
The PMHS tests gave a peak of the distribution at 60° and all the results were between 50° and 80°. Simulations gave a result around 67° for adults, with few influence of vehicle shape.
EEVC choose a value of 65° close to the simulation and to the average of PMHS results.
For children, EEVC considered simulations of small female (close in anthropometry to a 12 years old child) and of a6 years old child. Results of small female simulations were very close to adult ones, and 6 Y. O. child simulations suggested a value around 50°. EEVC picked a value of 50°, considering that a 6year old child is more relevant than a12 Y. O. for child pedestrian protection."

**Action 3 of PS / 139**

Insert in
IV. Discussion of issues addressed by the gtr
(e) Performance requirement
(ii) Lower leg protection

"Knee injuries are typical leg injuries in car to pedestrian collisions.
Most frequent knee injuries are knee ligaments elongations/ruptures and/or knee articulation surfaces crush (tibia plateau and/or femur condyle).

The most common mechanism related to pedestrian knee injury is a lateral bending between the thigh and the leg, sometimes associated with shearing motion (horizontal displacement between the tibia top and the femur lower extremity in the direction of impact).

Several experimental research works were conducted in Europe, Japan and the USA using PMHS components during the last decade; some of these works include numerical simulations in order to better understand what happens inside the knee joint during the loading process.

These studies propose a bending limit in the range of 15 to 21°, for knee protection; it seems advisable to consider a value close to the upper limit (21°) of this range and not the average, for the following reasons: the absence of muscle tone in PMHS tests dropping the knee stiffness, and the high rigidity of the impactor bones which transfers to the knee joint a part of the impact energy normally absorbed by human long bones deformations.

There are less research works dealing with knee shearing limits and it is acknowledged that it is almost impossible to precisely determine knee shearing motion during PMHS tests, as the values are low (a few millimeters), and the knee is covered with flesh and skin. The value of 6 mm as proposed seems to correspond to the (limited) knowledge available concerning knee shearing biomechanics, even if some other biomechanical researches have proposed higher values.

Results of a series of pedestrian PMHS tests performed with modern cars suggests an average value of 222g for tibia injury tests, and of 202 g for non tibia injury tests. A value of 200 g's would correspond to a 50% injury risk, and to protect a higher proportion of the population at risk, a lower value of tibia acceleration has to be selected."

**Action 4 of PS / 139**

Insert in
IV. Discussion of issues addressed by the gtr
(e) Performance requirement
(iii) Upper leg protection

"For high bumper, the car impact occurs above the knee, and then, the thigh is directly impacted by the car front.

Biomechanical research works conclude in a upper leg tolerance in bending in the range of 4 to 7 kN peak force, and 300 to 600 Nm bending moment; these values are based on PMHS test results, for a three-point bending in the middle of the femur. The absence of muscle tone in the PMHS tests and the difference in the impact point between the PMHS test and the car impact would support a higher tolerance, especially for the peak force value. The limits proposed for the upper leg impactor in high bumper tests seems then acceptable."

**Action 6 of PS / 139**

Insert in
IV. Discussion of issues addressed by the gtr
(e) Performance requirement
(i) Head protection

"It is proposed to consider a HIC value calculated with 15 ms, and not 36 ms, which is generally used for car occupant.

The main reason is that head impact to external car structure is very short, only a few milliseconds of contact. Then, using either 15 ms or 36 ms pulse window provides the same HIC value; moreover, taking a short time duration avoids the risk of considering a second impact after rebound, which may be processed if a longer duration is considered and may then give a wrong HIC value."

**Action 9 of PS / 139**

Insert in
IV. Discussion of issues addressed by the gtr
(f) Test conditions
(i) Head protection

"Adult headform characteristics have been analyzed by EEVC with doc EEVC/WG17/268. This document proposes to keep a value of adult head moment of inertia of:
0.0110 $kgm^2$, allowing a variation of +/- 0.001 $kgm^2$. (adult headform MoI comprised between 0.0100 and 0.0120 $kgm^2$). This has been agreed by EEVC WG17. "