

United States' Analysis of the Need to Raise the Head Restraint Height to 850 mm

The Netherlands presented data showing that the average height of the US population and the Netherlands population has increased in recent years and so the head restraint height of 800 mm estimated to be adequate for the 95th percentile male may not be sufficient anymore. Therefore, they feel that the 800 mm head restraint height needs to be increased to 850 mm.

The 750 mm and 800 mm head restraint height for the 50th and 95th percentile male used in FMVSS 202 was obtained from some military anthropometry data. The assumption made was that an adequate head restraint must be at least as high as the head center of gravity.

An analysis was conducted with the classic UMTRI data (Anthropometry of Motor Vehicle Occupants, Volume 1, 1983, University of Michigan Transportation Research Institute). The UMTRI data provides the vertical height of the head cg relative to the H-point for an occupant in a vehicle seat. The torso angle was approximately 26 degrees. The origin and coordinates are as shown in Figure 1.

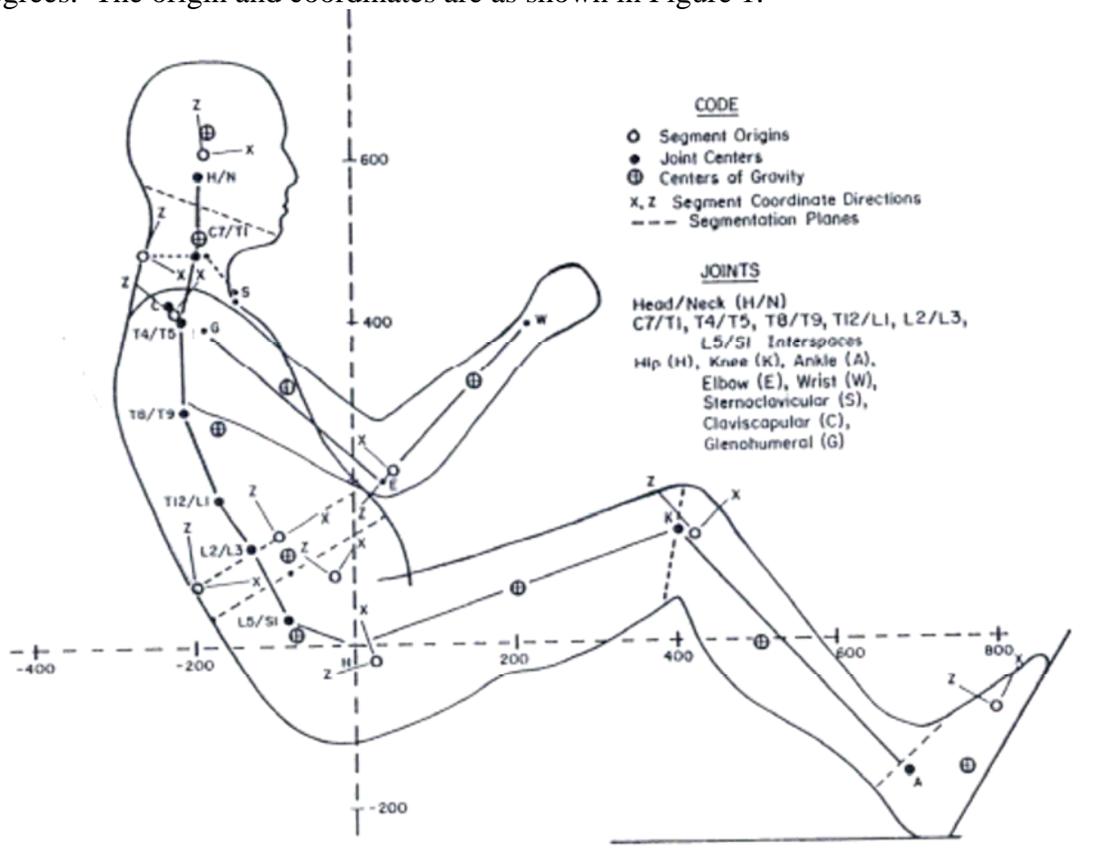


Figure 1. Anthropometry specifications for the 50th percentile male in vehicle seat.

Table 1 presents the stature, erect sitting height, vertical height of head cg from the h-point in a vehicle seat for the UMTRI data. The height of head cg from h-point along the torso line with a 27 degree torso angle with vertical is also presented. In the UMTRI

study, the subjects were sitting in an idealized seat of approximately 24 degrees resulting in a torso angle of approximately 25-27 degrees. Therefore, a 27 degree torso angle was used to compute the head cg to H-point distance along the torso line (= vertical height of head cg above h-point / cosine(torso angle)).

During rear impact the torso ramps up along the seatback resulting in the head cg moving upward. Kroonenberg et al. estimated the increase in head height to be approximately 15 mm. The required height of the head restraint (measured along the torso line above the H-point per NHTSA procedure) was adjusted to take into consideration the upward ramping of the torso during rear impact (15 mm height was added to the vertical height of the head cg from the h-point). A head restraint is assumed to be adequate if it is at least as high as the head center of gravity from the h-point (as measured per the NHTSA procedure)

The required height of a head restraint is equal to (vertical height of head cg above h-point+15 mm)/cosine(torso angle)

The erect sitting height from the 2000 CEESAR and the 2004 Netherlands data for the 50th and 95th percentile male were used to extrapolate the head cg height along the torso line for the sitting height of the 50th and 95th percentile from the UMTRI data to the 2000 CEESAR and 2004 Netherlands data and are presented in Table 1. The height of a head restraint (measured according to NHTSA procedure) that would be adequate after taking into account 15 mm of ramping upward of the head cg is also presented. In all these cases, a head restraint is considered adequate if it is as high as the head center of gravity during rear impact.

Table 1.
Anthropometry data

Anthropometry data	UMTRI data		Ceasar data		Netherlands data	
	50M	95M	50M	95M	50M	95M
erect height	175.1	186.4	177.7	191.3	181.8	197.1
erect sitting height	91.1	97.1	92.8	99.4	95	101.6
vertical height of head CG from H point mm	646	678	655	690	667	702
height of head CG from H point along torso line of 27 deg	725	761	735	768	742	781
Required head restraint height (per NHTSA procedure) after accounting for 15 mm ramping up of the head	742	778	752	792	765	805

According to the CEASAR data, the head restraint height (measured by the NHTSA procedure) that is at a vertical height of the head CG is 752 mm for a 50th percentile male and 792 mm for a 95th percentile male. The head restraint height that is at the head cg level using the Netherlands data is 765 mm for a 50th percentile male and 805 mm for a 95th percentile male. Therefore the current requirement of 800 mm head restraint height along the torso line is sufficient for a 95th percentile male from the Netherlands.