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**Date**

14 June 2010

**Our reference**

SB5-2010-00348

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**Project number**

032.31886

**Your reference**

ing. J.Th.M. Ammerlaan

**Subject**

Head and neck positions for the Dutch population in a driving position.

Dear Mr Ammerlaan,

Referring to the RDW order number 45/19210 and the TNO reference number SB5-2010-00207, we are glad to provide you with our results. In addition to providing a table detailing these results this letter describes the agreed work approach we utilised.

**Work approach:**

Three different human head and neck positions were measured using DELMIA software (version 5.19, Dassault Systèmes). The back of the head (BH), Centre Of Gravity (COG) of the head and the position between the Cervical 7 spine (C7) and the thoracic 1 spine (T1) were measured. The male manikins were created using the Dutch anthropometric CAESAR 2004 database. The positions were determined for the 1<sup>st</sup>, 5<sup>th</sup>, 10<sup>th</sup>, 20<sup>th</sup>, 25<sup>th</sup>, 30<sup>th</sup>, 40<sup>th</sup>, 50<sup>th</sup>, 60<sup>th</sup>, 70<sup>th</sup>, 75<sup>th</sup>, 80<sup>th</sup>, 90<sup>th</sup>, 95<sup>th</sup> and 99<sup>th</sup> percentile.

All the manikins were created and positioned as follows:

1. The model was positioned on to the H-point (HRP) used as referential origin;
2. Adjusting body length percentile;
3. Adjusting bodyweight percentile;
4. Adjusting sitting height percentile (Figure 1);
5. Adjusting distance from Menton to top of head percentile (Figure 2) (to adjust face length);
6. Adjusting backseat angle to 25 degrees (reference to vertical axis);
7. Slumped position on base of the UMTRI model;
8. Adjusting line of sight to 5-10 degree (reference to horizontal axis). Resulting in the body position as shown in Figure 3.

Back of the Head is a static anthropometrical point, which corresponds with the landmarks used in DELMIA. COG of the head is calculated starting from the top of the head in accordance with formula A (see RDW document number HR-3-6). The positions of COG, BH and C7-T1 are clarified in Figure 4.

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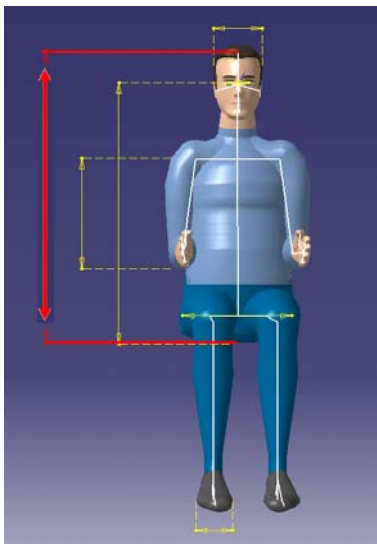


Figure 1 Sitting height.

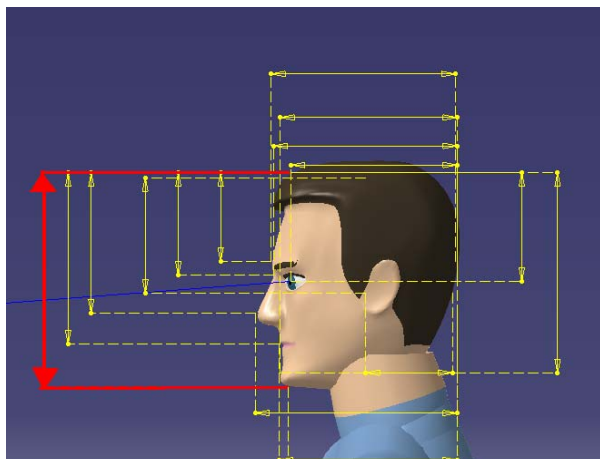


Figure 2 Menton to top of head.

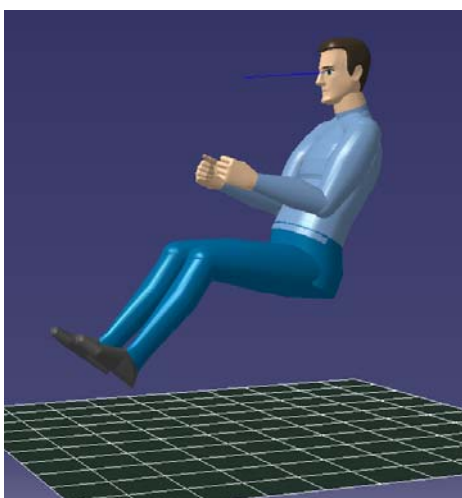


Figure 3 Resulting body position.

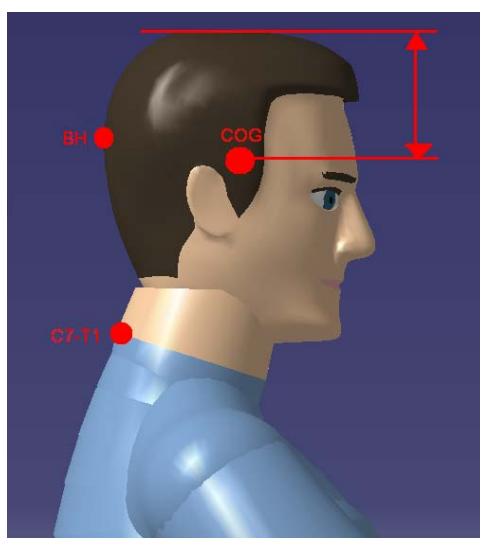


Figure 4 Projection BH /COG /C7 T1.

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**Results:**

Results of all the measurements data are shown in Table 1. It is elementary to use the data with a certain error margin. The error margin indicates that persons do not assume the same seated position on repeated occasions and consequently there is always slight differences in measurement results e.g. different joint angles. The excepted error margin was considered as +/- 7mm (Oudenhuijzen et al., 2010: On the creation of 3D libraries for F-16 pilots in their crew station: Method development, library creation and validation, TNO Report 2010 P001).

Table 1 Measured coordinates in millimetre, with H-point as origin.

	Back Head			Center Of Gravity			C7/TH1 (spine)		
	X	Y	Z	X	Y	Z	X	Y	Z
	(mm)		(mm)	(mm)		(mm)	(mm)		(mm)
p1	-227*	0	623*	-128*	0	575*	-226*	0	507*
p5	-248*	0	640*	-137*	0	605*	-238*	0	528*
p10	-261*	0	665*	-153*	0	633*	-247*	0	556*
p20	-262*	0	675*	-156*	0	642*	-249*	0	561*
p25	-267*	0	681*	-157*	0	647*	-253*	0	567*
p30	-269*	0	690*	-159*	0	656*	-254*	0	574*
p40	-273*	0	707*	-164*	0	673*	-259*	0	590*
p50	-278*	0	719*	-167*	0	684*	-263*	0	604*
p60	-283*	0	725*	-180*	0	696*	-267*	0	615*
p70	-277*	0	752*	-158*	0	709*	-271*	0	627*
p75	-288*	0	752*	-176*	0	716*	-273*	0	633*
p80	-289*	0	760*	-176*	0	679*	-277*	0	633*
p90	-297*	0	782*	-185*	0	746*	-284*	0	656*
p95	-302*	0	801*	-189*	0	763*	-290*	0	670*
p99	-316*	0	841*	-199*	0	802*	-303*	0	710*

\* +/- 7 mm error margin (to compensate for positioning fluctuation).

We are confident that these results fulfil your expectations and that the data will be implemented in your work, resulting in an optimal and safe traffic environment for all people.

With kind regards,

S.H.H. Grassère BSc and A.J.K. Oudenhuijzen MSc  
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