RDW

Informal document **GRSP-51-24**
(51st GRSP, 21–25 May 2012,
agenda item 3)

Actual needed height of head restraints

Follow up of discussions during

IWG on gtr No.7 in London, March 2012

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Contents

- Terms of reference of the informal group on Head Restraints phase 2, part (b): the actual height
- History
- Anthropometry:
  - sitting height dummies versus erect sitting height of males in USA and NL
  - measurement of erect sitting height
  - erect sitting height, data from UK and Germany
- Head restraint height based on automotive posture
- Calculation of needed head restraint height
- Needed head restraint height

Terms of reference of the informal group on Head Restraints phase 2

Text from doc. GTR7-01-08 (ECE/TRANS/WP.29/2009/130**):**

“ III. SUBJECTS FOR REVIEW AND TASKS TO BE UNDERTAKEN

6. With regard to head restraint height, the informal group should decide:

(a) How to define the effective height;

(b) The height requirements **”**

History

- the study UMTRI-83-53-1, Dec. 1983 delivered anthropometric specifications for a small female, a mid-sized male and a large male,
- these data were used for the constitution of an adult-dummy family,

- the mid-sized male in automotive posture is also used by ICBC to create the HRMD. (hereby a reproduction of Figure 5-1 showing some specifications)

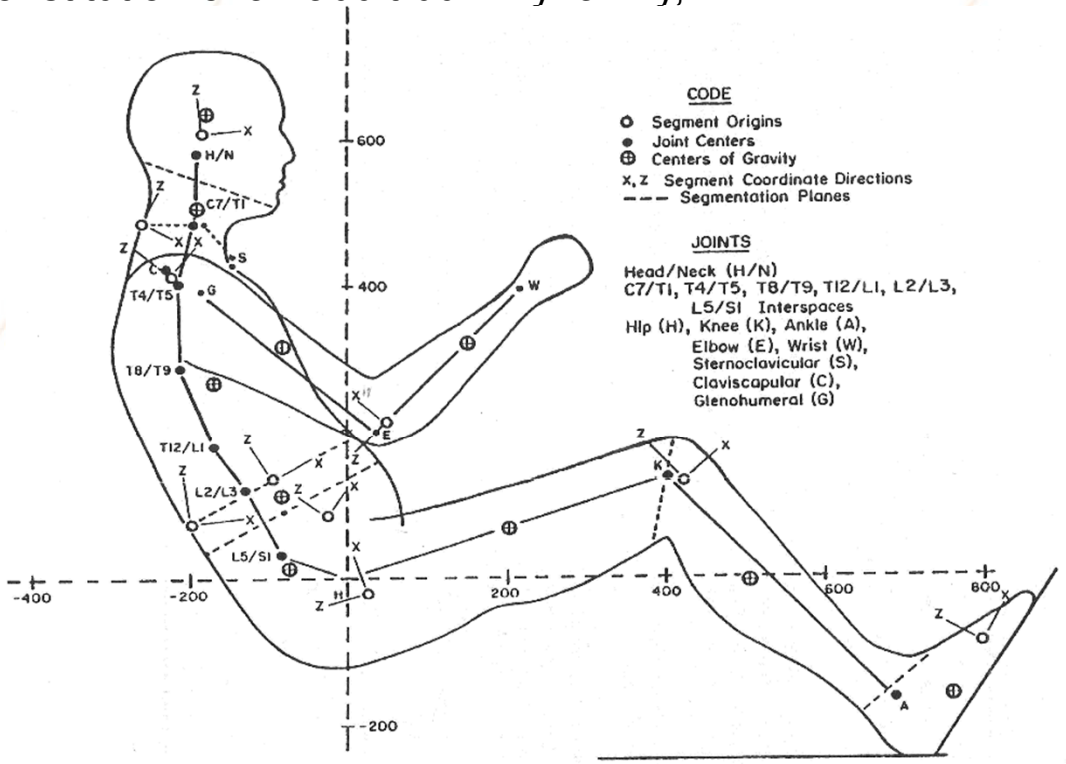


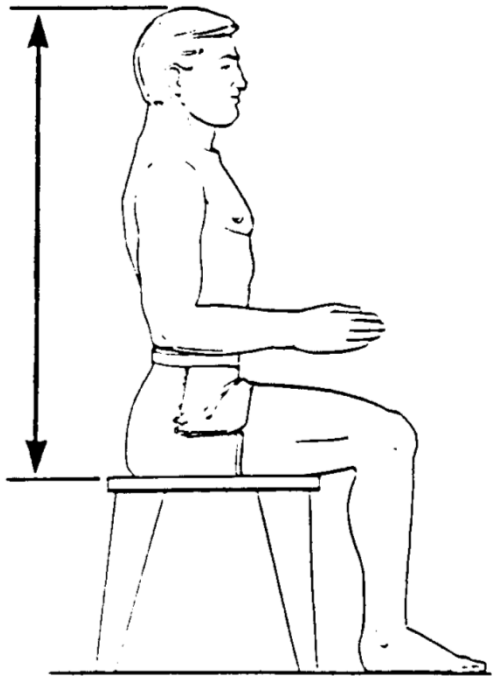
FIGURE 5-1. Anthropometric specifications for mid-sized male dummy.

Anthropometry / dummies versus males from USA and NL

	UMTRI-83-53-1 Dec.'83		Hybrid III	BIORID	Caesar data USA male population 2000		Caesar data NL male population updated to 2004	
	http://deepblue.lib.umich.edu/		www.humanetics atd.com	www.humanetics atd.com			HR-3-6	
.. th % ile male	Standing height	Erect sitting height	Sitting height	Sitting height	Standing height	Erect sitting height	Standing height	Erect sitting height
1						829		860
5						862		882
10						876		896
20						894		912
25						901		916
30						906		924
40						917		940
50	1751	911	884	884	1777	928	1818	949
60						937		960
70						949		971
75						954		976
80						960		982
90						977		1001
95			935		1913	994	1971	1016
99						1022		1052

All measurements in mm , Caesar data concern the male population of age 20 - 60 years.

Anthropometry / measurement of erect sitting height



An objective method, used in Anthropometry worldwide, measures the erect seating height with the subject sitting up straight

(this method includes also the straightening of the spine that occurs at the moment the occupant sustains a rear impact).

Anthropometry / data from UK

(earlier presented in HR-6-11)

Anthropometric Data 1 - UK

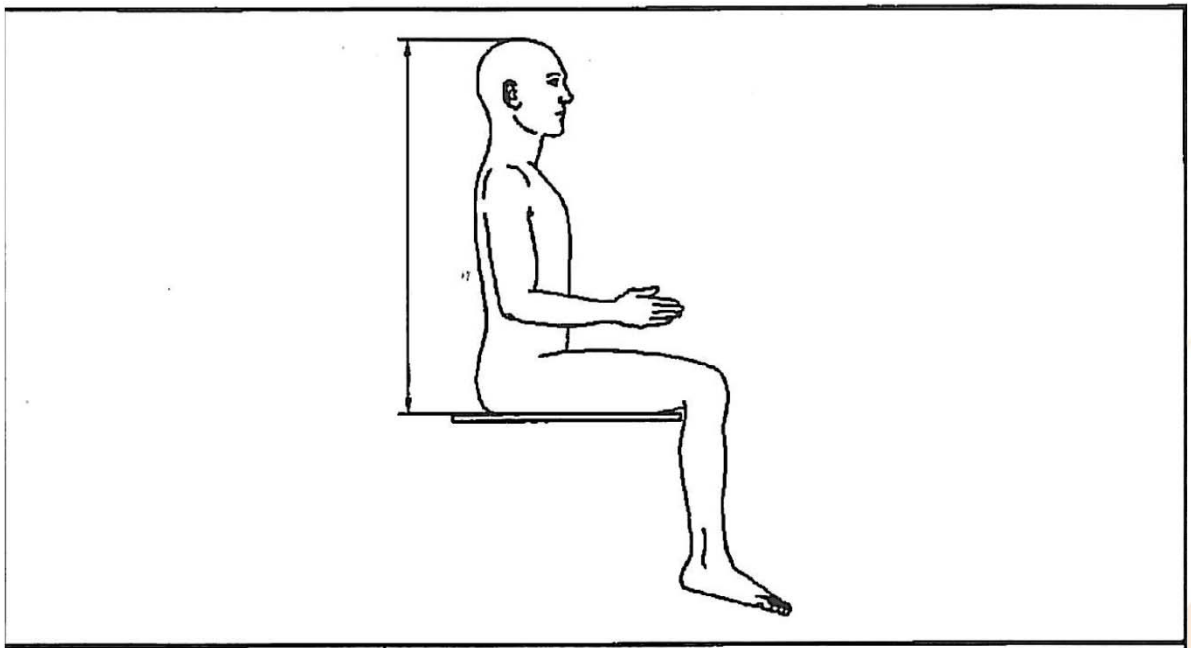
Male			
	5th%ile	50th%ile	95th%ile
Stature	1641.0	1755.1	1869.2
Erect Sitting Height	860.4	920.2	980.0
Head Circumference	547.3	575.0	602.7
Face Length	105.9	118.8	131.7

1 ADULTDATA - The handbook of adult anthropometric and strength measurements. Department of Trade and Industry, London. ISBN 0 9522571 3 0. May 1998.

Anthropometry / data from Germany I

(abstract from DIN 33402-2: 2005, tabelle 22)

Tabelle 22 — Körpersitzhöhe (Stammlänge)



Altersgruppen	Körpersitzhöhe (Stammlänge) mm					
	Männer			Frauen		
	Perzentil					
Jahre	5	50	95	5	50	95
18–65	**855**	**910**	**965**	**810**	**860**	**910**
18–25	875	935	985	830	880	930
26–40	865	920	975	820	870	915
41–60	845	900	960	805	855	905
61–65	830	885	945	790	840	900

Anthropometry / data from Germany II

(presented in March 2007 in EEVC SC)

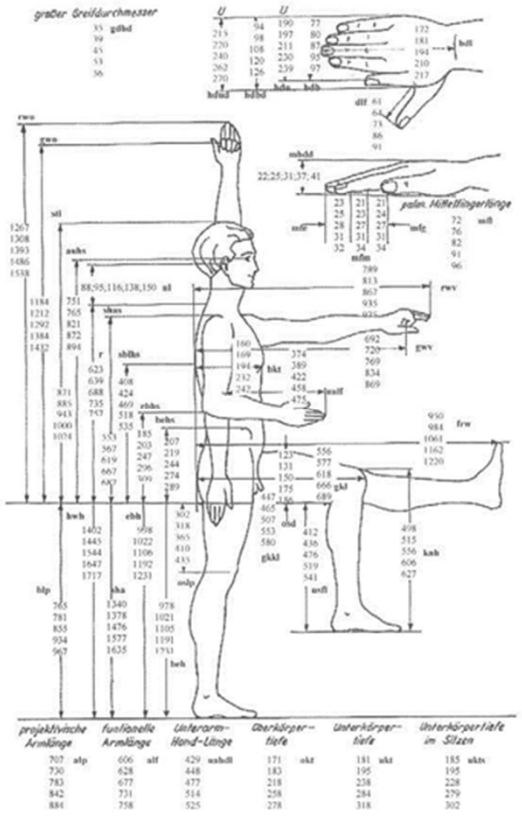


Abb. 5: Lage der untersuchten Messstrecken am Körper und ihre Perzentilwerte 1,5,50,95,99 (von oben nach unten in mm und kg) für junge Männer

39

Free from internet anthropometric data from source:

"Brandenburgische Umwelt Berichte (BUB) 10S.23-53 (2001), Körpermasse

Young adult males
Erect Sitting Height
5th%ile 885 mm
50th%ile 943 mm
95th%ile 1000 mm

Head restraint height based on automotive posture

- In the world of anthropometry the erect sitting height is used.
- On the other hand, in the automotive world the use of automotive posture is very common.
- In the following we will make use of automotive posture.
- Accompanying remarks:
  - when using automotive posture, for the proper design of head restraints one should take account of spine straightening,
  - besides spine straightening one has to take account of ramping up too!

X- and Z-coordinate of back-of-head of people nowadays

• The TNO study presented in Berlin (GTR7-04-03) made use of the posture from UMTRI-83-53-1 (= the study used to create the HRMD) and combined this with the recent anthropometric database of CAESAR **(C**ivilian **A**merican and **E**uropean **S**urface **A**nthropometry **R**esource)**.**

• This study delivered a.o. the X- and Z-coordinate of the back-of-head of the 2004 NL large male (in **automotive** posture with a seat back angle of 25 degrees).

• Compared with the HRMD installed on the 3-D H-machine this leads to the following:

	HRMD installed on 3-D H-point machine	Large male (= Caesar 2004 NL)
Z-coordinate back-of head w.r.t. H-point	669	763
X-coordinate back-of head w.r.t. H-point	263	302

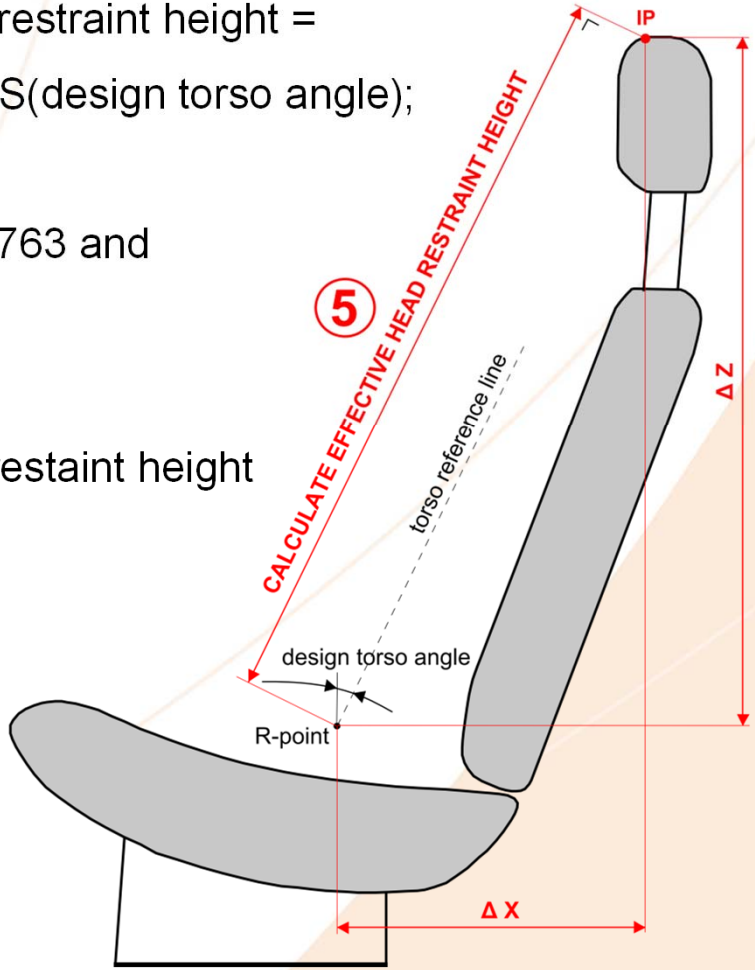
• These new found coordinates can be used to calculate the actual needed head restraint height

Calculation of needed head restraint height I

- Available are the X- and Z-coordinate of the back-of-head of the large male being 302 respectively 763 mm;
- It is assumed that there will be no spine straightening and no ramping up of the body, so the head would travel horizontally rearward;
- It is assumed that the distance (backset) from the head to the contact point on the head restraint is 30 mm;
- So the X- and Z-coordinate of the point of the head restraint that is supposed to catch the head will be 332 respectively 763 mm;

Calculation of needed head restraint height II

- The formula for calculating effective head restraint height =
  Δ X * SIN(design torso angle) + Δ Z * COS(design torso angle);
- Used values will be Δ X = 332 mm, Δ Z = 763 and
  a design torso angle of 25 degree;
- The outcome for the actual needed head restaint height
  is **831 mm**.



Needed head restraint height

Remarks:

•On one hand it is assumed that there will be no spine straightening and no ramping up of the body, but from research concerning automotive seats (e.g. SAE paper 983158 Human Head-Neck Responses During Low-speed Rear Impact from Kroonenberg, A. van den, Philippens, M., Cappon, H., Wismans, J., Hell, W., Langwieder, K.) an upward movement of the head of 35 mm is reported.

•On the other hand the population in the Netherlands and Scandinavia seems to be taller than e.g. in the UK.

•However the EEVC WG20 report “UK Cost-Benefit Analysis: Enhanced Geometric Requirement for Vehicle Head Restraints”, reported that a head restraint height of **840** mm and a backset of 40 mm would deliver the greatest benefit after subtracting the associated cost!

NL conclusions on needed head restraint height

•In the Informal Group of GRSP on Head Restraints (phase 1) The Netherlands has proposed a head restraint height that would at least reach to 850 mm based on the principle of erect sitting height;

•In the Informal Group of GRSP on gtr No.7 Head Restraints (phase2) the item of head restraint height has been further explored and for the above mentioned height, values of 830 and 840 mm seem better to serve more Parties.

•The Netherlands concludes now that the head restaint height should at least reach to the values mentioned under the second bullet.

Thank you for your attention