CHSIR Anthropometric Database, CHSIR Truncated Anthropometric Database, and Boundary Manikins

The NASA crew anthropometric dimensions that the Commercial Transportation System (CTS) must accommodate are listed in CCT-REQ-1130 Draft 3.0, with the specific critical anthropometric dimensions for use in vehicle design (and suit design in the event that a pressure suit is part of the commercial partner's design solution) in Appendix D: Crew Physical Dimension and Mass Design Data (Table D-1) (also reference Commercial Human System Integration Requirements (CHSIR) – JSC 6599, section 4.0)

Guidance on the evaluation of CTS design using anthropometric data, as well as background information on how the data was generated, can be found in the Commercial Human System Integration Process Document (CHSIP) – JSC 65995, section 4.5, Design For Crewmember Physical Characteristics and Capabilities.

The following three files are provided to Commercial Partners to assist in anthropometric evaluation of the CTS design:

1) **The CHSIR Anthropometric database (modified ANSUR database)**

The electronic file provided is the Army ANSUR database filtered based on age, weight, and other factors to approximate the potential astronaut population.

2) **CHSIR Truncated Anthropometric database**
This database takes the CHSIR Anthropometric database and truncates it to exclude any subjects that fall outside the 1st to 99th percentile in any of the vehicle and suit design critical dimensions. The electronic file provided is the data set from which the critical dimensions in CCT-REQ-1130 were sourced (also reference Commercial Human System Integration Requirements (CHSIR) – JSC 6599, section 4.0 Physical Characteristics and Capabilities, CH4001). The goal is for the partner to meet this modified database 100%.

3) **Boundary Manikin data**

The electronic file provided is data that could be used to create representative manikins, or models, for analysis. This data is sourced from the CHSIR anthropometric database, and presented in millimeters.

Limitations/Caveats associated with the data provided:

The CHSIR Anthropometric and CHSIR Truncated Anthropometric databases contain only unsuited data.

Boundary manikins are for static, unsuited (minimally clothed), and standard postural conditions.

The boundary manikins represented here do not capture the overall shape of the actual person. While the linear measurements can be used to create a figure, the shape features of the digital human may require more information than what is presented in the anthropometric measurements from the database for that particular individual.

To reflect suit conditions (if appropriate), specific suit anthropometry is needed. If suited data is not available, appropriate suit factors may be needed to update the manikin information to estimate suited conditions. Similarly, these manikins do not represent pressurization condition, which may have grossly different anthropometry or suit factors than the unpressurized suited or unsuited data.

The boundary manikins represent standing erect and seated on a standard stool with 90 degrees of seat back and seat pan subtended angle.

This boundary manikin anthropometry data was developed in the NASA JSC Anthropometry and Biomechanics Facility (ABF). For more information on how the data was developed please contact your partner's Human Health & Performance Integrator, and you will be put in touch with the NASA Anthropometry subject matter expert.

The anthropometry shown in the excel file contains data from 24 female and 25 male individual subjects, representing the dimensions such as height, weight, circumference, length, etc. This data could be used to create representative manikins for analysis.

Each subject has a subject number (Column A entitled "'SUBJNO' ") which allows for locating the rest of their anthropometry in the CHSIR anthropometry "parent" database, as needed. If the manikin designer needs additional individual specific anthropometric dimensions other than the ones identified in the boundary manikin anthropometry file, please use the CHSIR anthropometric database and the manikin identification number to cull additional anthro data for that specific manikin.

Background on the use of Boundary Manikins

For evaluation purposes, it is necessary to make sure that the entire user population is accommodated (CHSIR Truncated Anthropometric Database). Unfortunately, it is not always possible to have the time to do the simulation of entire population. Also, it may be necessary to do a quick analysis early on before investing time and effort to devote to the simulation of entire population, hence the reason to use boundary manikins.

Boundary manikins are derived from performing Principle Component Analysis (PCA) by focusing on a select set of anthropometric measurements that were deemed important for a specific purpose. The CHSIR Truncated Anthropometric database was used as the basis for the PCA analysis. This database has many anthropometric measurements of individual subjects. For NASA vehicle, suit, and seat and other hardware design purposes, certain critical design measurements were selected and documented (refer to the CHSIR Truncated Anthropometric database and critical dimension in CCT-REQ-1130 Appendix D as mentioned above) after consulting with designers and engineers.

Using these critical measurements, PCA (a multivariate analysis method) was performed to select the worst cases or boundary cases (i.e. folks with long legs and short torso, short arm with long torso, wide shoulder vs. narrow shoulder, Etc). The boundary cases are referred to as boundary manikins.

It may be possible to use these boundary manikins during non standard static postural conditions provided the following is accounted for.   Currently, these manikins represent standing erect and seated in a standard stool with 90 degrees of seat back and seat pan subtended angle. If the subtended angle is changed, for instance, to 70 degrees, then new measurements along with standard measurements could be taken from a small sample of unsuited subjects and the resulting delta factor could be applied across the standard anthropometric measurements for these boundary manikins, as well as to the truncated database.

If there are any questions regarding these files and how to use them, please contact your partner's Human Health & Performance Integrator, and you will be put in touch with the NASA Anthropometry subject matter expert.