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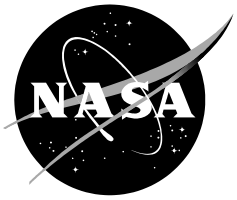

Exploration Extravehicular Mobility Unit Demo Rendering Configuration Control Computer-Aided Design Model User's Guide

National Aeronautics and
Space Administration

Johnson Space Center
Houston, Texas 77058

September 2019

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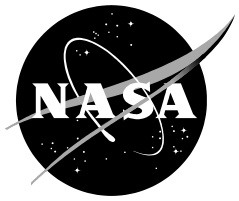

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This report is also available in electronic form at http://www.sti.nasa.gov/ and http://ntrs.nasa.

The Exploration Extravehicular Mobility Unit (EMU) (xEMU) Computer-Aided Design (CAD) models are configuration controlled. This is a managed copy of the development xEMU system prior to Preliminary Design Review (PDR). Please do not transfer this model to others or modify it. The model may be obtained by emailing lee.coggins@nasa.gov . Please include your organization/company and designated point of contact (email and phone) along with your request. This will ensure that you are working with the most up-to-date copy while tracking those who have it. The model is not meant to be used as a volumetric simulator for any engineering work, but rather to allow for a good visual rendering of the suit.

The flight xEMU Demonstration (Demo) unit is planned for the International Space Station (ISS) in the 2023 and beyond timeframe. The Demonstration xEMU is a hybrid of the Planetary and Microgravity xEMU. Whereas the hard upper torso and shoulders assembly and life support system are exploration class (i.e., Gateway and Lunar/Mars Surface), the Lower Torso Assembly (LTA), arms, and gloves are that of the EMU in use on ISS today. Views of the configuration control CAD model of the xEMU Demo are provided in Figure 1, for reference.

Figure 1. CAD model of the xEMU.

The full xEMU with the Planetary LTA is the configuration intended for microgravity use on Gateway and surface use on the Moon and later on Mars. Modifications to this demonstration configuration for the xEMU include boots compatible with walking on a surface as opposed to using the boots as a microgravity restraint, aka Articulating Portable Foot Restraints. The Exploration LTA and arms are still in development; therefore, the CAD being provided at this point is for the xEMU Demo configuration.

The xEMU Demo is a rear entry suit in which the Portable Life Support System (PLSS) rotates away from the Pressure Garment, thereby allowing the crew member to enter and exit the suit. The rear entry suit is ingressed thru a suit hatch, as shown in Figure 2. The don/doff envelope is dimensioned, as also shown in Figure 2. Note: The images in this figure are not representative of the Demo suit features; specifically, the green plate indicates a suit port, which is not a requirement for the Demo suit. Regardless, the approximate dimensions are still applicable, per EVA-EXP-0031, EVA Office Extravehicular Activity (EVA) Airlocks and Alternative Ingress/Egress Methods Document.

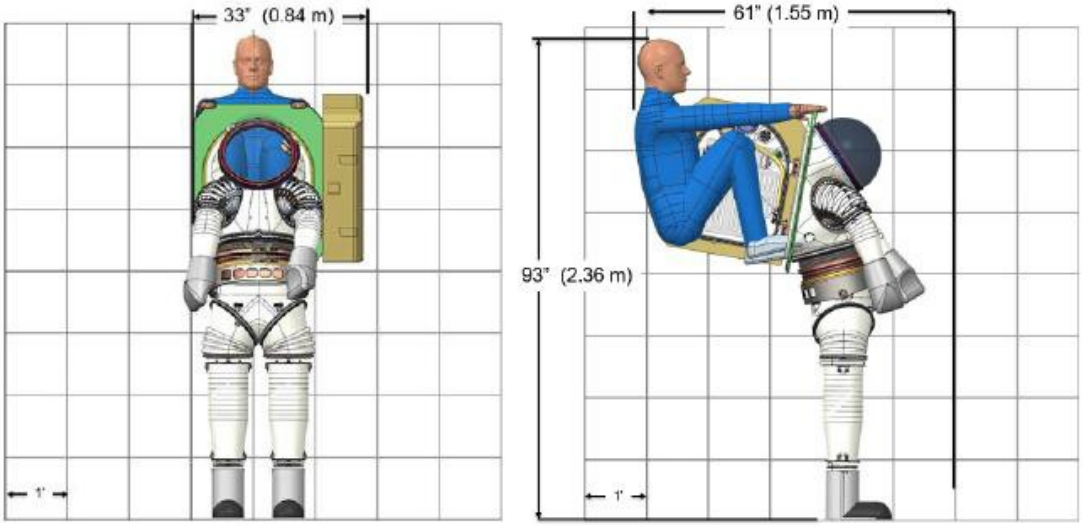

Figure 2. xEMU don/doff volume estimate.

The work envelope for early CAD visualization purposes can be considered equal to the existing EMU requirement. Design and early testing of the xEMU engineering units indicates that it will be able to exceed the EMU work envelopes shown. However, these data are preliminary only, and are not sufficient to update the requirements. Please use the envelopes shown as they are within both EMU and xEMU work envelopes. One- and two-handed work envelopes are illustrated in Figure 3.

Additionally, the approximate distance from the xEMU Demo work envelope to an ISS-style worksite interface used to secure an Articulating Portable Foot Restraint (APFR) is shown in Figure 4. An additional requirements box is able to locate APFR ingress/egress handrails and local restraints to be used while reacting loads during EVA.

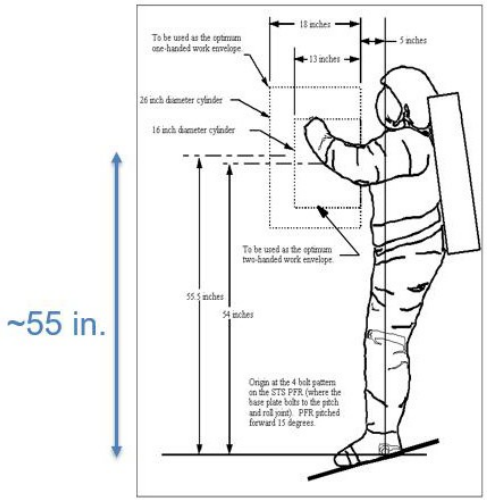

Figure 3. Optimum EVA work envelope.

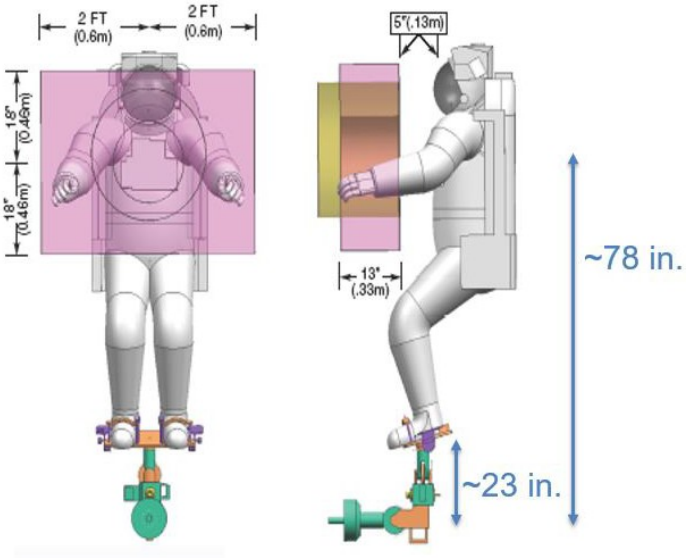

Figure 4. Crew aids for stability, foot restraint ingress, egress and local force reaction.

The volume required for the suit, either for translation purposes or working volume, is shown in Figure 5. A 43-inch cylinder may be shown around the suit to analyze the amount of room required for 5th% - 95th % EVA crew. It is recommended to use the 43-inch diameter work and translation envelope for reference and show the xEMU Demo within it for clarity, per EVA-EXP-0035, EVA Office Exploration EVA System Compatibility.

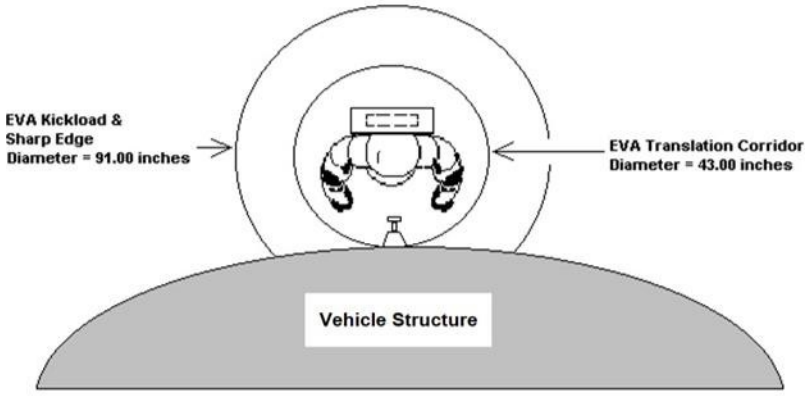

Figure 5. Translation and work volume.

The Demo model is intended primarily for visualization and reference use only. It should not be used to program reach and range parameters, as it is for static use only. It is approximately a 50th% in arm span, and 5th% height -- a smaller model. Do not rely on the physical volume of the Demo CAD model alone. Later CAD configuration updates corresponding to the xEMU version will include the 99% range size.

The models are available in two file formats: .fbx or .obj/.mtl files. These were chosen as being the most current and acceptable formats that many CAD applications can read. The .png files provide the texture maps and color data for the model and need to accompany the fbx or obj/mtl files.