



## Occupant Geometry

### 1 Introduction

**Note:** Nothing in this standard supercedes applicable laws and regulations.

**Note:** In the event of conflict between the English and domestic language, the English language shall take precedence.

**1.1 Purpose.** This specification covers the GM Vehicle Configuration Engineering Tool (VCET) or Vehicle Configuration Engineering (VCE) Occupant, which is part of the Product Design Library (PDL) associated with Unigraphics (UGNX). The UGNX operator creates Occupant Geometry (OG) used in the design and checking of a vehicle interior. The OG includes elements for establishing the H-Point and Seating Reference Point (SgRP), the Eyellipse (as described in SAE J941), and the Head Position Contour (as described in SAE J1052). Although many terms and dimensions use human body parts in their name, they should not be construed as measures that indicate occupant accommodation, capabilities, or comfort.

**Note:** References to SAE Standards throughout this document may appear with the number only, as in SAE J826.

**1.2 Applicability.** This GMW applies to all vehicles: car, Crossover Utility Vehicles (CUV), Sport Utility Vehicles (SUV) and trucks.

### 2 References

**Note:** Only the latest approved standards are applicable unless otherwise specified.

#### 2.1 External Standards/Specifications.

|          |           |           |
|----------|-----------|-----------|
| SAE J826 | SAE J1052 | SAE J1517 |
| SAE J941 | SAE J1100 | SAE J4004 |

#### 2.2 GM Standards/Specifications.

GMW3059

### 3 Requirements

**3.1 Process for Applying SAE Standards:** SAE J826, SAE J941, SAE J1052, and SAE J4004. All vehicle programs completing production runs prior to the 2018 Model Year will be evaluated and publish dimensions using the 1997 SAE J941 and SAE J1052 standards, referencing the H-Point based on either the November 2008 SAE J826 (Oscar) or August 2008 SAE J4004 (Homer).

The 1997 SAE standards for eyellipse and head contour are the ones used in Vehicle Configuration, and are consistent with the original plastic templates defined and developed in the 1960's at GM. The newer versions are based on a different population and anthropometric data. If the newer data was used, the historical knowledge would be lost and the understanding of the occupant package.

**Note:** SAE J826 modified with regard to the required interface with accelerator pedal. Refer to paragraphs 3.6.1.1 thru 3.6.1.4.

**3.2 Process for Applying SAE Recommended Practice SAE J1100.** User and system applied occupant dimensions based on SAE J1100 are exported into Microsoft Excel for further processing.

**3.3 Occupant Geometry (OG) Description.** The OG is constructed to represent in profile an adult male wearing a flat-bottomed shoe and corresponds to the side view profile from SAE J826. There is an optional provision to show the "arched" Bottom of Shoe of the Three Dimensional H-Point Machine. Individual torso, thigh, lower leg

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and foot segments are represented. The 95<sup>th</sup> percentile leg lengths are used in present design practices and are required for reporting dimensional information.

**3.4 Usage** The OG has two basic usages. In establishing the design criteria during initial packaging, the OG is used to describe the passenger compartment space and seating attitude during the conception, engineering and development stages of a vehicle. The second usage of the OG is to display and describe the passenger compartment space and seating attitude for reporting purposes and for comparison with data obtained from checks made with the Three Dimensional H-Point Machine.

**3.5 Positioning Procedure.** This standard describes the positioning of the OG in the front, second and third seat compartment space on a vehicle General Arrangement (GA) or Seating Arrangement (SA) drawing.

### **3.6 Driver Position.**

**3.6.1** Rules that apply when establishing the Driver Position.

**3.6.1.1** Accelerator Pedal profile should contact but must not pass through (or break) the Driver shoe plane. For carryover (C/O) programs or component sets, the curved Bottom of Shoe from SAE J826 can be used in place of the plane if:

- It was previously used in the occupant setup. or
- The driver shoe plane would cause unnecessary revalidation.

**3.6.1.2** Seating Reference Point (SgRP) must be on the SAE Seating Curve defined in SAE J4004, or the SAE 95<sup>th</sup> percentile curve defined in SAE J1517.

**3.6.1.3** For new programs, compress the base content floor covering stack-up (but do not include floor mats, even if standard equipment) 5 mm for the Accelerator Heel Point (AHP). C/O programs can maintain current compression if it differs from 5 mm and would cause unnecessary revalidation.

**3.6.1.4** The driver ankle angle will be set to 87 degrees to achieve maximum reportable legroom and most forward (packaging efficient) SgRP location for any given pedal configuration. See Figure A1 for packaging guidelines for the shoe.

**Note:** Any deviation from these rules by the production design must be corrected or if minimal (within 1 mm of the requirement) either noted and accepted by Vehicle Architecture or accompanied by a statement from the Vehicle Chief Engineer that will be used when/if inquiries come from other manufacturers, consumers, marketing representatives or government agencies.

**3.6.2** If the Accelerator Pedal position does not exist, select a SgRP and use the capability of the VCET to follow paragraphs 3.6.1.2, 3.6.1.3, and 3.6.1.4, to find the AHP. This will also determine the seat height and legroom. Once the shoe plane is established, any accelerator pedal designed for the program must follow paragraph 3.6.1.1.

**3.6.3** If the Accelerator Pedal position does exist, 3.6.1.1 shall be followed in accordance with the VCET OG capability to follow paragraphs 3.6.1.2, 3.6.1.3, and 3.6.1.4 to identify the curve on which the SgRP must fall. Once a specific SgRP on that curve is selected, the AHP, seat height and legroom will be known.

See Figure A2 for OG positioning variants.

**3.7** Successive row (2nd row, 3rd row or greater) seating position.

**3.7.1** Rules that apply when establishing the Occupant Geometry for Designated Seating Positions behind the driver:

**3.7.1.1** Preceding row positioned at its Seating Reference Point (SgRP) and design attitude.

**3.7.1.2** For new programs, compress the base content floor covering (e.g., carpet and acoustic) 5 mm for the Floor Reference Point (FRP). C/O programs can maintain current compression if it differs from 5 mm and would cause unnecessary revalidation.

**3.7.1.3** Ankle angle (A46-x) shall be limited to a minimum value of 87 degrees and a maximum of 130 degrees.

**3.7.1.4** Upper and forward surfaces of the shoe and lower leg are limits used to determine the OG position.

**3.7.1.5** All interior components of the fully trimmed base contented vehicle at Start of Regular Production (SORP) to be represented and used as potential limits to the OG. Data and position to be estimated for components in development or not fully released for production.

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**Note:** Any deviation from these rules by the production design must be corrected or if minimal (within 1 mm of the requirement) either noted and accepted by Vehicle Architecture or accompanied by a statement from the Vehicle Chief Engineer that will be used when/if inquiries come from other manufacturers, consumers, marketing representatives or government agencies.

**3.7.2** Position the H-Point of the OG on the specified SgRP in the GA.

**3.7.3** Set the specified torso angle.

**3.7.4** Maintaining the OG torso, place the Bottom of Shoe (BOS) on the compressed floor-covering surface with the rear of the shoe moved as far rearward as possible. The shoe can be placed on the Y plane centerline of the occupant, or up to 127 mm on either side of the Y plane centerline of the floor pan section. Shoe locations inboard of the occupant centerline are compatible with shoe locations determined from the existing H-point machine installation and field measurement procedures (audit or benchmarking).

**3.7.5** Move the shoe forward along the compressed floor covering surface until the occupant geometry defined in paragraph 3.7.4 makes single point contact (tangency) with the preceding row seat cushion, or any other vehicle component in the preceding row within the allowed lateral offset, excluding only the soft trim of an independently adjustable (incline/recline) seatback.

**Note:** Seat trim, garnish moldings, and closeouts, between the seat cushion and seatback in the preceding row limit the forward location of the OG, as do seat adjusters, adjuster covers, floor consoles, seatbelt anchors, etc., located within the lateral placement zone.

**3.8 Short Couple Seating.** In vehicles with short-coupled seating, the OG will exhibit an interference condition with the preceding row geometry when the shoe is initially placed on the compressed floor covering. Follow paragraphs 3.7.1.1 thru 3.7.1.5 and paragraphs 3.8.1 thru 3.8.4.

**3.8.1** Create the OG as outlined in paragraphs 3.7.2 thru 3.7.4.

**3.8.2** If the preceding row has fore/aft adjustment: Move the seat assembly geometry forward in UGNX, one seat adjuster position, (or along the design H-point travel line for power seat) at a time, until the interference is cleared.

**3.8.3** If the preceding row does not have fore/aft adjustment: move the seat assembly geometry horizontally (to grid) forward in Computer Aided Design (CAD) until the interference is cleared.

**3.8.4** Use the resulting data manipulation to determine Legroom Dimension L51-x: The dimension measured along a line from the ankle pivot center to the SgRP plus 254 mm with the heel of the shoe at the FRP and the bottom of the shoe at the Floor Plane Angle (FPA). The amount of seat track travel, or horizontal distance needed to clear the shoe interference is subtracted. See Figure A3.

The preceding row's seat assembly is translated to obtain the legroom penalty value. Couple distance and knee clearance are determined with the preceding row at SgRP.

**3.9 Long Couple Seating.** In vehicles with long-coupled seating, the ankle angle (A46-x) exceeds 130 degrees before the OG makes initial contact (tangency) with the preceding row. Follow paragraphs 3.7.1.1 thru 3.7.1.5 and paragraphs 3.9.1 thru 3.9.4.

**3.9.1** Create the initial position of the OG as outlined in 3.7.2 thru 3.7.4.

**3.9.2** Move the shoe forward along the compressed floor-covering surface until a long-couple posture is indicated by the VCET.

**3.9.2.1** Accept the maximum heel to SgRP offset value (L53-x).

**3.9.2.2** Check the long-couple box to create a second shoe-leg profile that will be used to determine the passenger legroom. The OG of the second profile is defined at the maximum ankle angle (130 degrees) and must follow the compressed floor covering.

**3.9.2.3** Continue to move the second shoe and leg profile forward until it contacts the preceding row. The shoe can be placed on the Y plane centerline, or up to 127 mm on either side of the centerline of occupant with the Bottom of Shoe on the compressed floor covering. See Figure A4.

**3.9.3** Knee clearance (L48-x) is the minimum distance, within the lateral space 127 mm either side of the occupant centerline, measured from the knee pivot center of the original maximum connected manikin position (3.9.2) to the preceding row seat back assembly, minus 51 mm.

**3.9.4** Legroom (L51-x) is measured from the ankle pivot center of the most forward shoe position (3.9.2.3) to the SgRP, plus 254 mm.

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