

	SURFACE VEHICLE RECOMMENDED PRACTICE	SAE J1100 NOV2009
		Issued 1973-09 Revised 2009-11
		Superseding J1100 SEP2005
(R) Motor Vehicle Dimensions		

RATIONALE

The 2009 revision of SAE J1100 represents a substantial overhaul of its contents. Specifically, dimension procedures and definitions have been:

- harmonized with the Global Car manufacturer's Information Exchange (GCIE),
- coordinated with revisions to other SAE human accommodation standards,
- synchronized with related definitions published by the International Standards Organization (ISO), including the use of HPM-II,
- formalized with certain regulatory procedures defined by the United States (U.S.) Environmental Protection Agency (EPA), and
- made consistent with some definitions found in the U.S. Code of Federal Regulations by the National Highway Traffic Safety Administration (NHTSA).

This revision reinstates some previously deleted SAE J1100 dimensions as well as some older versions of SAE J1100 dimensional definitions (e.g. W27). Additionally, many new definitions, dimensions, and figures were adopted. The document structure was subsequently reorganized for better consistency and to accommodate the number of changes. Most notably, cargo related dimensions were combined whether or not they were used in a Volume Index,, e.g. L505 – Pickup Body Length at Floor was moved from the Exterior Dimensions – Length Table to the Cargo Dimensions – Length Table.

The use of secondary suffixes was expanded to more logically consolidate dimension codes. Consistent with the previous two versions of SAE J1100, the location or designated seating position is identified by the first level suffix. The second level suffix is used to indicate a condition or direction. Additional details are provided in Section 4.

To assist the user in locating information of interest, a detailed Table of Contents was added. Content which underwent the most significant change is described below.

As in the past, all ground-related dimensions are taken normal to the ground plane for any loading condition. The definitions were editorially revised to clarify this point. SAE J1100 also reintroduces the 'EPA-curb' loading condition and describes specific dimensions taken at that load. Further, the document provides new dimensions measured at the manufacturer's declared gross vehicle weight rating, and also assimilates the dimensions from the cancelled SAE J689.

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2009 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: **Tel:** 877-606-7323 (inside USA and Canada)
 Tel: 724-776-4970 (outside USA)
 Fax: 724-776-0790
 Email: CustomerService@sae.org
 <http://www.sae.org>

SAE WEB ADDRESS:

Full document details: SAE J1100_200911

The definition of Designated Seating Position (3.3.8) reflects pending changes to Federal Motor Vehicle Safety Standards (FMVSS) for vehicles manufactured on or after September 1, 2010. Related definitions for seating surface (3.3.17) and seating surface width (3.3.19) were added, as well as a new dimensional metric (SW26) for recording the total number of designated seating positions in each row of seats.

The method for locating the floor reference point (3.5.7) was modified to account for differences between the HPM devices and procedures described in SAE J826 and SAE J4002. This means that SAE J1100 dimensions are applicable to both.

Driver foot control dimensions were revamped to reflect a component-based numbering system which is described in Section 6. Control spacing dimensions based on ISO 3409 were adopted.

H-point travel path dimensions were revised and the points which describe the travel path limits were defined in Section 7. The dimensions were also suffixed (2, 3, 4, ...) to allow the natural expansion into second and succeeding rows of seating.

Daylight Opening (DLO) was replaced with Design Glass Outline (DGO). Several regulated dimensions use or define Daylight Opening, or DLO, that were different from the DLO definition found in prior versions of SAE J1100. DGO was created to reduce confusion with these other dimensions and provide a unique measure devoid of regulatory interpretation.

The X-plane section for defining head clearances (W27, W35, and H35) was revised to reflect the side view top of contour consistent with the historical method. It replaces the use of an X-plane through the head contour centroid, first introduced in 2002. This change results in minimal differences in measures for the driver, and yields equivalent results for second and succeeding rows of seated occupants. The head contour centroid and the side view top of contour for these designated seating positions occur on the same X-plane. See SAE J1052.

Lastly, volume indices were expanded to include passenger volume and interior volume metrics congruent with EPA and NHTSA definitions. See Section 9 and Tables 31-33.

TABLE OF CONTENTS

1.	SCOPE.....	7
2.	REFERENCES.....	8
2.1	Applicable Publications	8
2.1.1	SAE Publications.....	8
2.1.2	U.S. Government Publications and References	8
2.2	Related Publications	9
2.2.1	ISO Publications.....	9
3.	DEFINITIONS	9
3.1	Motor Vehicles	9
3.1.1	Passenger Car	9
3.1.2	Light Truck	9
3.1.3	Heavy Truck.....	9
3.1.4	Additional Vehicle Classifications	9
3.2	Vehicle Loads.....	10
3.2.1	Curb Load, Curb Weight	10
3.2.2	Gross Vehicle Mass (GVM), Gross Vehicle Weight Rating (GVWR)	10
3.2.3	EPA Curb Weight.....	10
3.3	General Vehicle Reference Points and Definitions.....	11
3.3.1	Belt Line	11
3.3.2	Cargo Floor	11
3.3.3	Centerline of Occupant (C/LO)	11
3.3.4	Cowl Point.....	11
3.3.5	Deck Point.....	11
3.3.6	Depressed Floor Covering.....	12

3.3.7	Design Glass Outline (DGO).....	12
3.3.8	Designated Seating Position.....	13
3.3.9	Endgate.....	13
3.3.10	Eyellipse.....	13
3.3.11	Front of Dash.....	14
3.3.12	Head Position Contour.....	14
3.3.13	Liftgate/Lift Glass.....	14
3.3.14	Long-Coupled Seating.....	14
3.3.15	Maximum Hold-Open Position.....	14
3.3.16	Normal Top of Frame-Truck.....	14
3.3.17	Seating Surface.....	15
3.3.18	Seating Surface Width (SSW).....	18
3.3.19	Short-Coupled Seating.....	20
3.3.20	Sill Plate Bead.....	20
3.3.21	Standard-Coupled Seating.....	20
3.3.22	Steering Wheel Center.....	20
3.3.23	Swing Gate.....	20
3.3.24	Top of Contour (TOC).....	21
3.3.25	Trimmed Body Opening.....	21
3.3.26	Undepressed Floor Covering.....	21
3.4	H-Point Devices – Reference Points and Definitions.....	22
3.4.1	Ankle Circumference.....	23
3.4.2	Ankle Point.....	23
3.4.3	Cushion Line.....	23
3.4.4	D-Point.....	23
3.4.5	H-Point.....	23
3.4.6	Knee Point.....	23
3.4.7	Leg Line.....	23
3.4.8	Seating Reference Point (SgRP).....	24
3.4.9	Thigh Line.....	24
3.4.10	Torso (Back) Line.....	25
3.5	Shoe Reference Points and Definitions.....	25
3.5.1	Accelerator Heel Point (AHP).....	25
3.5.2	Ball of Foot (BOF).....	25
3.5.3	Ball of Foot Reference Point (BOFRP).....	25
3.5.4	Bare Foot Flesh Line.....	26
3.5.5	Bottom of Shoe (BOS).....	26
3.5.6	Floor Plane and Floor Plane Angle (FPA) – Passengers.....	26
3.5.7	Floor Reference Point (FRP) – Passengers.....	26
3.5.8	Heel of Shoe (HOS).....	27
3.5.9	Shoe Plane – Driver.....	27
4.	CODE EXPLANATION, VEHICLE SET-UP, AND DIMENSIONING PROCEDURE.....	28
4.1	Codes.....	28
4.1.1	Interior Dimension Codes (Identifiers).....	28
4.1.2	Exterior Dimension Codes (Identifiers).....	28
4.1.3	Cargo, Luggage, and Rear Compartment Codes (Identifiers).....	29
4.2	Vehicle Set-Up and Dimensioning Procedure.....	30
4.2.1	Interior Dimensions and Procedures.....	30
4.2.2	Exterior Dimensions and Procedures.....	30
5.	COORDINATE DIMENSIONS.....	30
5.1	Fiducial Mark Dimensions.....	31
5.2	SgRP Coordinate Dimensions.....	31
5.3	AHP Coordinate Dimensions.....	31
5.4	BOFRP Coordinate Dimensions.....	31
5.5	FRP Coordinate Dimensions.....	31
5.6	Additional Coordinates.....	31

6.	DRIVER'S FOOT CONTROLS, PEDAL CONFIGURATION	32
6.1	Definitions	32
6.1.1	Accelerator Pedal Point (APP).....	32
6.1.2	Edge of Pedal.....	32
6.1.3	Footwell.....	32
6.1.4	Pedal Centerline.....	33
6.1.5	Pedal Pad Midpoint.....	33
6.1.6	Pedal Pad.....	33
6.1.7	Plane N	33
6.1.8	Plane P	33
6.1.9	Side Support Structure.....	33
6.2	Types of Pedal Measurements	34
6.2.1	Pedal Sizes	34
6.2.2	Operational Clearances	35
6.2.3	Pedal Locations.....	35
7.	H-POINT TRAVEL PATH.....	35
7.1	Definitions	36
7.1.1	Actual Travel Path.....	36
7.1.2	Design Travel Path.....	36
7.1.3	Fore-Aft Travel	36
7.1.4	Track Rise	36
7.1.5	Vertical Adjustment	36
7.2	Reference Points.....	36
7.2.1	Rearmost – Lowest H-point (RLP)	36
7.2.2	Foremost – Lowest H-point (FLP).....	36
7.2.3	Rearmost – Highest H-point (RHP)	36
7.2.4	Foremost – Highest H-point (FHP)	36
7.2.5	Rearmost Design H-point (RDH)	36
7.2.6	Foremost Design H-point (FDH)	37
7.2.7	Seating Reference Point (SgRP)	37
7.2.8	Rearmost – Achievable H-point (RAP)	37
7.2.9	Foremost – Achievable H-point (FAP)	37
8.	SEAT PACKAGE DIMENSIONS	37
9.	CARGO DIMENSIONS AND CARGO VOLUME INDICES	37
9.1	Cargo Volume Indices (CVI)	38
9.2	Passenger Volume Indices (PVI)	38
9.3	Interior Volume Indices (IVI)	38
10.	LUGGAGE CAPACITY AND DIMENSIONS.....	38
11.	ISO CARGO VOLUMES	40
12.	GLASS AREA DIMENSIONS	40
13.	FIGURES	40
14.	DIMENSION INDICES	40
14.1	Dimensions Index Listed by Alphanumeric Codes	41
14.2	Dimensions Index Listed by Old Codes.....	41
15.	NOTES	106
15.1	Marginal Indicia	106
APPENDIX A	DIMENSION CROSS REFERENCE TABLES.....	107
APPENDIX B	DECISION TREE FOR COUPLE METHODS - FOR 2ND TO NTH ROW	107

FIGURE 1	BELT LINE	11
FIGURE 2	COWL AND DECK POINTS	12
FIGURE 3	DESIGN GLASS OUTLINE	13
FIGURE 4	LONG-COUPLED SEATING AND FRP LOCATION	14
FIGURE 5A	SEATING SURFACE	15
FIGURE 5B	TRIM SEPARATION (CONDITION 3.3.17.1)	16
FIGURE 5C	VOID (CONDITION 3.3.17.2)	16
FIGURE 5D	HIP ROOM INTERFERENCE ALONG H-POINT (CONDITION 3.3.17.3)	17
FIGURE 5E	ADJACENT OUTBOARD SEATS (CONDITION 3.3.17.4)	17
FIGURE 6A	MEASUREMENT ZONE	18
FIGURE 6B	MEASUREMENT ZONE	19
FIGURE 7	SHORT-COUPLE INTERFERENCES AND FRP LOCATION	20
FIGURE 8	TOP OF CONTOUR	21
FIGURE 9	HPM-II REFERENCE POINTS	22
FIGURE 10	AHP, APP, BOF, BOFRP	26
FIGURE 11	FRP DETERMINATION	27
FIGURE 12	THREE DIMENSIONAL REFERENCE SYSTEM	31
FIGURE 13	NUMBERING SYSTEM FOR PEDAL RELATED DIMENSIONS	32
FIGURE 14	APP AND PLANE P DETERMINATION	33
FIGURE 15	PEDAL CENTERLINE AND MIDPOINT	34
FIGURE 16	PLANE N DETERMINATION	34
FIGURE 17	H-POINT TRAVEL PATH; KEY REFERENCE POINTS	35
FIGURE 18A	LUGGAGE BOXES A-F	39
FIGURE 18B	GOLF BAG	40
FIGURE 19	SIDE VIEW	77
FIGURE 20	FOOT ENTRANCE - FRONT	77
FIGURE 21A	FOOT ENTRANCE - SECOND, SEDAN	78
FIGURE 21B	FOOT ENTRANCE - SECOND, 2 DOOR COUPE	78
FIGURE 22	SIDE VIEW HEAD CLEARANCE	79
FIGURE 23	DRIVER LEG ROOM	80
FIGURE 24	STANDARD COUPLE METRICS	80
FIGURE 25	LONG COUPLE METRICS	81
FIGURE 26	SHORT COUPLE METRICS - SHOE FITS IN FOOTWELL	81
FIGURE 27	SHORT COUPLE METRICS - SHOE DOES NOT FIT	82
FIGURE 28	ENGINE COVER LENGTH AND CARGO COMPARTMENT	82
FIGURE 29	DRIVER WIDTH ACCOMMODATION	83
FIGURE 30	REAR VIEW	83
FIGURE 31	REAR VIEW HEAD CLEARANCE	84
FIGURE 32	MINIMUM HEAD CLEARANCE	84
FIGURE 33	SIDE VIEW	85
FIGURE 34	SIDE VIEW	85
FIGURE 35	STEERING WHEEL ANGLE, PLAN VIEW	86
FIGURE 36	MANIKIN ANGLES	86
FIGURE 37	SIDE VIEW PEDAL CLEARANCES	87
FIGURE 38	SIDE VIEW PEDAL HEIGHT AND CLEARANCES	87
FIGURE 39	PEDAL HEIGHT AND WIDTH IN PLANE N	88
FIGURE 40	PEDAL SPACING AND RELATIONSHIP TO DRIVER: REAR VIEW	88
FIGURE 41	LATERAL PEDAL CLEARANCES: VIEW NORMAL TO PLANE P	89
FIGURE 42	AHP INTERFERENCE OFFSET: VIEW NORMAL TO SHOE PLANE	89
FIGURE 43	H-POINT TRAVEL PATH (6-WAY)	90
FIGURE 44	H-POINT TRAVEL PATH (2-WAY)	90
FIGURE 45	SIDE VIEW OF SEAT	91
FIGURE 46	SEAT WIDTH	91
FIGURE 47	SIDE VIEW - EXTERIOR LENGTH	92
FIGURE 48	PICKUP METRICS	92
FIGURE 49A	PLAN VIEW OF VEHICLE	93
FIGURE 49B	DETAIL VIEW OF TIRE, WHEEL AND SUSPENSION	93
FIGURE 50	PLAN VIEW: VEHICLE WIDTH	94
FIGURE 51	OUTSIDE MIRROR WIDTH	94

FIGURE 52	TAIL DOORS, MAXIMUM HOLD-OPEN	95
FIGURE 53	TAIL DOORS, UNRESTRAINED	95
FIGURE 54	SIDE VIEW - EXTERIOR HEIGHT	96
FIGURE 55	SIDE VIEW - CHASSIS	96
FIGURE 56	SIDE VIEW STEP HEIGHTS	96
FIGURE 57A	COMPARTMENT LOADING METRICS, TWO CLOSURE SYSTEM	97
FIGURE 57B	COMPARTMENT LOADING METRICS, TWO CLOSURE SYSTEM	97
FIGURE 57C	COMPARTMENT LOADING METRICS, SINGLE CLOSURE SYSTEM	98
FIGURE 58	OUTWARD VISION AT VEHICLE C/L	98
FIGURE 59	OUTWARD VISION AT DRIVER C/L	98
FIGURE 60	GLAZING ANGLES	99
FIGURE 61	DECK LID OPENING	99
FIGURE 62	HATCHBACK CARGO LENGTHS	100
FIGURE 63	REAR COMPARTMENT ACCESS	100
FIGURE 64	CARGO COMPARTMENT WIDTH	101
FIGURE 65	SEAT BACK HEIGHT	101
FIGURE 66	REAR COMPARTMENT HEIGHT	102
FIGURE 67	OPEN LIFTGATE HEIGHT	102
FIGURE 68A	MISCELLANEOUS CARGO	103
FIGURE 68B	MISCELLANEOUS CARGO	103
FIGURE 68C	MISCELLANEOUS CARGO	103
FIGURE 68D	MISCELLANEOUS CARGO - FOR L212 THE FOLDED SEAT BACK, NOT THE FLIPPED SEAT, PROVIDES THE MAXIMUM DIMENSION	104
FIGURE 68E	MISCELLANEOUS CARGO	104
FIGURE 69	COMPARTMENT AREA	105
FIGURE 70	TURNING DIAMETER	105
TABLE 1	CLASS A VEHICLES	10
TABLE 2	CLASS B VEHICLES	10
TABLE 3	DSP DETERMINATION	13
TABLE 4	ALPHA PREFIXES	28
TABLE 5	NUMERIC SCHEME (GENERAL)	28
TABLE 6	SUFFIXES; UNLESS OTHERWISE SPECIFIED	29
TABLE 7	SEAT POSITIONING AND ATTITUDE FOR MEASUREMENTS	30
TABLE 8	LUGGAGE SET	39
TABLE 9	FIDUCIAL MARK DIMENSIONS	41
TABLE 10	SGRP COORDINATES	42
TABLE 11	AHP COORDINATES	42
TABLE 12	BOFRP COORDINATES	42
TABLE 13	FLOOR REFERENCE POINT (FRP) COORDINATES	43
TABLE 14	ADDITIONAL COORDINATES	43
TABLE 15	INTERIOR DIMENSIONS - PASSENGER DISTRIBUTION	43
TABLE 16	INTERIOR DIMENSIONS - LENGTH	44
TABLE 17	INTERIOR DIMENSIONS - WIDTH	47
TABLE 18	INTERIOR DIMENSIONS - HEIGHT	50
TABLE 19	INTERIOR DIMENSIONS - ANGLES	53
TABLE 20	INTERIOR DIMENSIONS - PEDALS (SEE SECTION 6)	55
TABLE 21	INTERIOR DIMENSIONS - H-POINT TRAVEL PATH (SEE SECTION 7)	57
TABLE 22	INTERIOR DIMENSIONS - SEATS	60
TABLE 23	EXTERIOR DIMENSIONS - LENGTH	61
TABLE 24	EXTERIOR DIMENSIONS - WIDTH	62
TABLE 25	EXTERIOR DIMENSIONS - HEIGHT	64
TABLE 26	EXTERIOR DIMENSIONS - ANGLES	66
TABLE 27	CARGO DIMENSIONS - LENGTH	69
TABLE 28	CARGO DIMENSIONS - WIDTHS	71
TABLE 29	CARGO DIMENSIONS - HEIGHT	72
TABLE 30	MISCELLANEOUS CARGO DIMENSIONS	74
TABLE 31	CARGO VOLUME INDICES - CVI (SEE SECTION 9 AND 9.1)	75
TABLE 32	PASSENGER VOLUME INDICES - PVI (SEE SECTION 9 AND 9.2)	75

TABLE 33	INTERIOR VOLUME INDICES - IVI (SEE SECTION 9 AND 9.3).....	76
TABLE 34	LUGGAGE CAPACITY DIMENSIONS	76
TABLE 35	GLASS AREA DIMENSIONS	76
TABLE 36	MISCELLANEOUS DIMENSIONS.....	76
TABLE A1.1	DIMENSION INDEX BY 2009 CODE - LENGTH (L).....	107
TABLE A1.2	DIMENSION INDEX BY 2009 CODE - WIDTH (W)	109
TABLE A1.3	DIMENSION INDEX BY 2009 CODE - HEIGHT (H)	110
TABLE A1.4	DIMENSION INDEX BY 2009 CODE - ANGLE (A).....	112
TABLE A1.5	DIMENSION INDEX BY 2009 CODE - PEDALS (PL, PW, PH).....	114
TABLE A1.6	DIMENSION INDEX BY 2009 CODE - H-POINT TRAVEL PATH (TL, TH).....	115
TABLE A1.7	DIMENSION INDEX BY 2009 CODE - SEAT (SL, SW, SH).....	115
TABLE A1.8	DIMENSION INDEX BY 2009 CODE - PASSENGER (PV), CARGO/LUGGAGE (V), AND INTERIOR VOLUME (IV).....	116
TABLE A1.9	DIMENSION INDEX BY 2009 CODE - AREA (F, S)	116
TABLE A1.10	DIMENSION INDEX BY 2009 CODE - DIAMETER AND PASSENGER DISTRIBUTION (D, PD)	116
TABLE A2.1	DIMENSION INDEX BY OLD CODES - LENGTH (L)	117
TABLE A2.2	DIMENSION INDEX BY OLD CODES - WIDTH (W).....	119
TABLE A2.3	DIMENSION INDEX BY OLD CODES - HEIGHT (H).....	121
TABLE A2.4	DIMENSION INDEX BY OLD CODES - ANGLE (A)	124
TABLE A2.5	DIMENSION INDEX BY OLD CODES - PEDALS (P), ...	125
TABLE A2.6	DIMENSION INDEX BY OLD CODES - H-POINT TRAVEL PATH (TL, TH).....	125
TABLE A2.7	DIMENSION INDEX BY OLD CODES - SEAT (SL, SW, SH).....	126
TABLE A2.8	DIMENSION INDEX BY OLD CODES - VOLUME (V), PASSENGER DISTRIBUTION (PD) AND GLASS SURFACE AREA (S).....	126

1. SCOPE

This SAE Recommended Practice defines a set of measurements and standard procedures for motor vehicle dimensions. The dimensions are primarily intended to measure the design intent of a vehicle within a design environment (i.e., CAD). All dimensions in this practice can be measured this way.

In addition, some dimensions can be taken in an actual vehicle. If measurements are taken on physical properties, some differences in values should be expected. Also, care should be taken to not confuse design intent measurements with those taken on a physical property. It is intended that the dimensions and procedures described in this practice be generic in their application to both the HPM, described in SAE J826, and the HPM-II, described in SAE J4002. In some circumstances, the figures may only reflect one or the other.

Unless otherwise specified, all dimensions are measured normal to the three-dimensional reference system (see SAE J182), except ground-related dimensions, which are defined normal to ground. All dimensions are taken with the vehicle at curb weight unless otherwise specified.

All dimensions are measured on the base vehicle and do not include Regular Production Options (RPO) or accessory parts, unless otherwise specified.

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.

2. REFERENCES

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J182	Motor Vehicle Fiducial Marks and Three-Dimensional Reference System
SAE J287	Driver Hand Control Reach
SAE J826	Devices for Use in Defining and Measuring Vehicle Seating Accommodation
SAE J941	Motor Vehicle Driver's Eye Locations
SAE J1052	Motor Vehicle Driver and Passenger Head Position
SAE J1516	Accommodation Tool Reference Point
SAE J1517	Driver Selected Seat Position
SAE J2732	Motor Vehicle Seat Dimensions
SAE J4002	H-Point Machine (HPM-II) Specifications and Procedure for H-Point Determination—Auditing Vehicle Seats
SAE J4003	H-Point Machine (HPM-II)—Procedure for H-Point Determination—Benchmarking Vehicle Seats
SAE J4004	Positioning the H-Point Design Tool—Seating Reference Point and Seat Track Length

2.1.2 U.S. Government Publications and References

Federal Motor Vehicle Safety Regulation—Available from the Superintendent of Documents, U.S. Government Printing Office, Mail Stop: SSOP, Washington, DC 20402-9320.

Federal Register—Published by the Office of the Federal Register, National Archives and Records Administration (NARA), available from Office of the Federal Register, 800 North Capitol Street, NW, Room 700, Washington, DC.

Electronic copies of referenced material may be found at:

<http://www.archives.gov/federal-register/index.html>

<http://www.gpoaccess.gov/fr/index.html>

Vehicle Classification, Title 49 CFR, Part 523, and amendments published in the Federal Register, Volume 74, No.59, page 14449, March 30, 2009

FMVSS definitions, Code of Federal Regulations, Title 49 CFR 571.3

Designation of Seating Positions, Code of Federal Regulations, Title 49 CFR 571.10, and amendments published in the Federal Register, Volume 73, No. 196, pages 58887-58898, October 8, 2008

Classes of comparable automobiles, Title 40 Part 600 Subpart D, CFR 600.315-08

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this specification.

2.2.1 ISO Publications

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 1176 Road vehicles—Masses—Vocabulary and codes

ISO 3409 Passenger cars—Lateral spacing of foot controls

ISO 3832 Passenger cars—Luggage compartments—Method of measuring reference volume

ISO 3833 Road vehicles—Types—Terms and definitions

ISO 4131 Road vehicles—Dimensional codes for passenger cars

3. DEFINITIONS

3.1 Motor Vehicles

3.1.1 Passenger Car

A motor vehicle designed for carrying 10 persons or less, excluding multipurpose vehicles, motorcycles, and trailers.

3.1.1.1 Station Wagon

Passenger car with an extended upper to increase the cargo and/or passenger capacity.

3.1.1.2 Hatchback

Passenger car with the rear access door encompassing the back light.

3.1.2 Light Truck

An open bed or enclosed motor vehicle designed primarily for transporting cargo with a maximum gross vehicle rating (GVWR) of 4536 kg (10 000 lb) or less.

3.1.2.1 Multipurpose, Passenger Vehicle (MPV)

Light truck which has a cargo compartment open to the passenger compartment, and is constructed either on a truck chassis or with special features for occasional off-road operation. This category includes sport utility vehicles (SUV), vans, and cross-over vehicles.

3.1.3 Heavy Truck

A motor vehicle designed primarily for transporting cargo with a maximum gross vehicle weight rating (GVWR) over 4356 kg (10 000 lb).

3.1.4 Additional Vehicle Classifications

See Tables 1 and 2. The classification is based on a set of four dimensions for the driver's seated position (H30, A19, W9 and A40). Seat height (H30) is the primary differentiator between the classes. This classification is used to determine the appropriate procedure in other SAE practices (SAE J287, SAE J1516, SAE J1517, SAE J941, etc.).

TABLE 1 - CLASS A VEHICLES

Dimension	Code	Range
Seat Height	H30-1	127 to 405 mm
Track Rise Angle	A19-1	> 0 degrees
Steering Wheel Diameter	W9	less than 440 mm
Torso Angle	A40-1	15 to 40 degrees

TABLE 2 - CLASS B VEHICLES

Dimension	Code	Range
Seat Height	H30-1	405 to 530 mm
Track Rise Angle	A19-1	= 0 degrees
Steering Wheel Diameter	W9	440 to 560 mm
Torso Angle	A40-1	8 to 18 degrees

3.2 Vehicle Loads

3.2.1 Curb Load, Curb Weight

The weight of the base vehicle (standard equipment only), with all fluids filled to maximum (fuel, oil, transmission, coolant, etc.). For heavy trucks, the curb weight does not include engine fuel.

3.2.2 Gross Vehicle Mass (GVM), Gross Vehicle Weight Rating (GVWR)

Is the reference plane which represents the worst intended loading condition. GVWR is the value specified by the vehicle manufacturer as the maximum loaded weight of a single vehicle.

NOTE: Mass is expressed in SI units of kilogram (kg). Whenever there is a need to report "weight" and/or to relate to "weight" based regulations or ratings, the proper conversion is to multiply the value of mass (in kg) by 2.2046 to find the "weight" (in lbs)

3.2.3 EPA Curb Weight

EPA Curb weight means the actual or the manufacturer's estimated weight of the vehicle in operational status with all standard equipment, and weight of fuel at nominal tank capacity, and the weight of optional equipment computed in accordance below; incomplete light-duty trucks shall have the curb weight specified by the manufacturer.

- 3.2.3.1 Where it is expected that more than 33 percent of a car line, within a test group, will be equipped with an item (whether that item is standard equipment or an option), the full estimated weight of that item must be included in the curb weight computation for each vehicle available with that item in that car line, within that test group.
- 3.2.3.2 Where it is expected that 33 percent or less of the car line, within a test group, will be equipped with an item (whether that item is standard equipment or an option), no weight for that item will be added in computing the curb weight for any vehicle in that car line, within that test group, unless that item is standard equipment on the vehicle.
- 3.2.3.3 In the case of mutually exclusive options, only the weight of the heavier option will be added in computing the curb weight.
- 3.2.3.4 Optional equipment weighing less than three pounds per item need not be considered.

3.3 General Vehicle Reference Points and Definitions

3.3.1 Belt Line

A line in side view (SV) that constitutes the lower edge of the design glass outline (DGO), as defined in 3.3.7. In situations where it is necessary to define the belt line in an area where there is no glass aperture, such as along pillars or in the obstructed region between rear cargo doors, the belt line is defined by a straight line that connects the lower edges of the two adjacent openings. If the lower edges of the adjacent openings are not collinear then connect the endpoints of the two lower edges, not considering any points on a fillet radius.

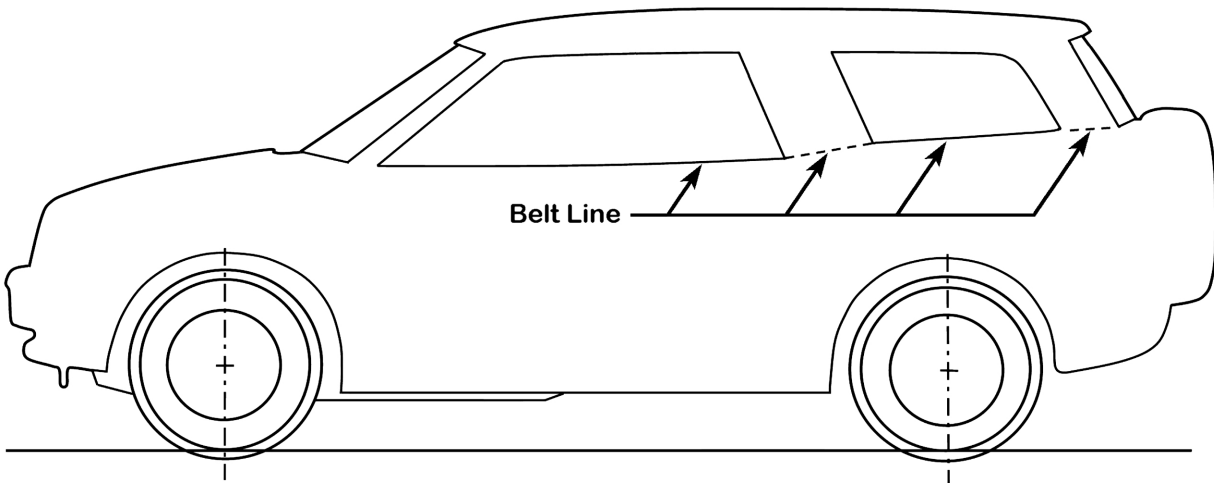


FIGURE 1 - BELT LINE

3.3.2 Cargo Floor

The surface for supporting cargo. If the vehicle floor is covered and unobstructed, the cargo floor is the undepressed floor covering surface. If ribs are present for an uncovered floor, the cargo floor is at the top of the ribs. If one or more rows of seating can be reconfigured – by folding, flipping, sliding, etc – in such a manner that the folded seat surface can support cargo, then the folded surface is considered part of the cargo floor.

3.3.3 Centerline of Occupant (C/LO)

The lateral (Y) centerline of an occupant in a given designated seating position.

3.3.4 Cowl Point

A point on the exterior windshield glazing surface on the zero “Y” plane at the highest height of the Cowl, Hood, or exterior component.

3.3.5 Deck Point

A point on the exterior rear-window glazing surface on the zero “Y” plane at the highest height of the Deck Lid Panel, or exterior components. For some vehicles, this may be the edge of glass.

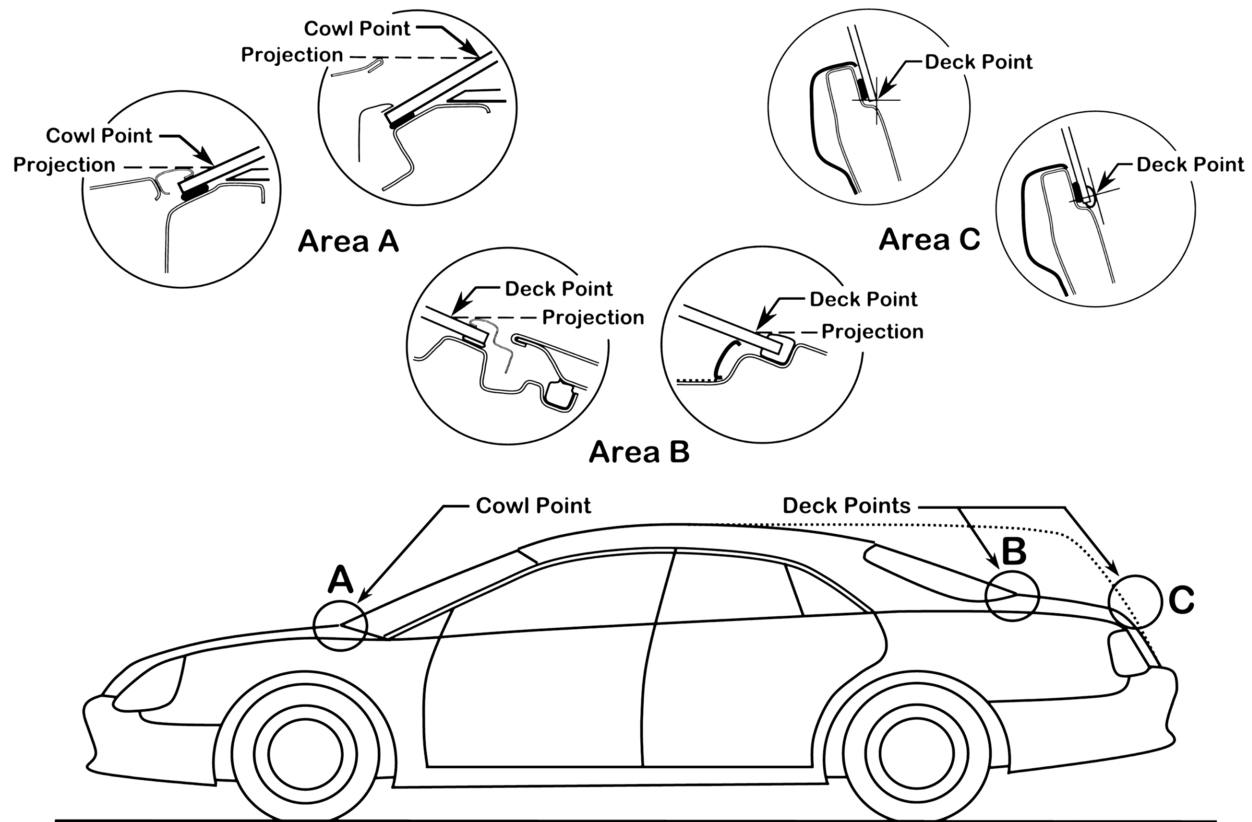


FIGURE 2 - COWL AND DECK POINTS

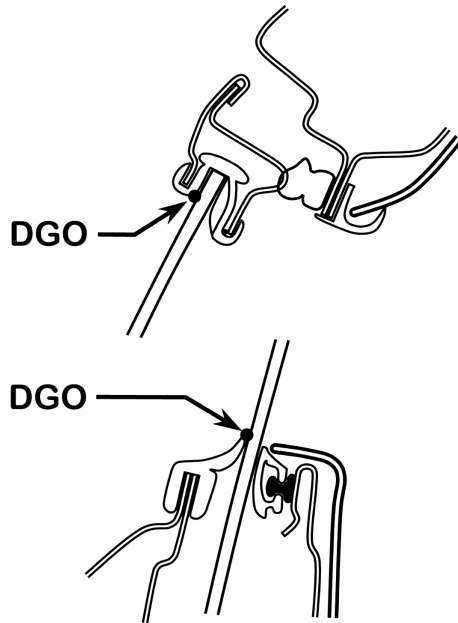
3.3.6 Depressed Floor Covering

The surface of the floor covering at a designated location in the vehicle, with a load applied to the covering as specified by the manufacturer.

3.3.7 Design Glass Outline (DGO)

An outline on the surface of a vehicle glass assembly which defines the boundary of transparent area. It can be used to determine certain vision angle measurements. For fixed glass, the outline is determined by the edge of the solid paint band. When a dot matrix, or other print pattern is used, the outline is offset toward the center of the glass as a percentage of pattern width (as specified by manufacturer). For movable glass, the outline is determined by the perimeter of the exterior glazing surface.

DGO for Movable Side Window on the Outside of the Glass



DGO for Fixed Side Window on the Inside of the Glass, Without Blackout Line

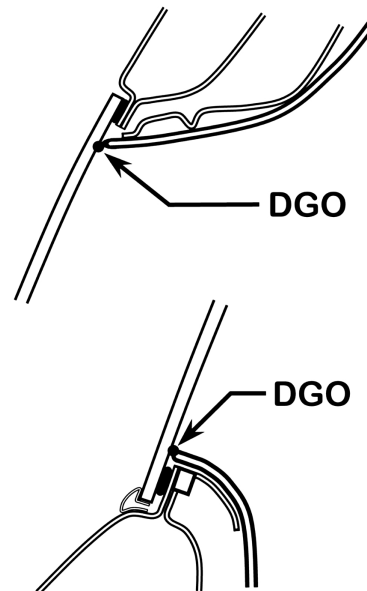


FIGURE 3 - DESIGN GLASS OUTLINE

3.3.8 Designated Seating Position

Any seating location that provides a seat surface width (SSW) of at least 330 mm. The number of DSP's for a given seating surface in a passenger vehicle or light truck is determined from Table 3.

NOTE: In this document physical measurements are taken to one designated seating position at a time for each row of seats. See Table 6.

TABLE 3 - DSP DETERMINATION

Surface Seat Width (mm)			# of DSPs per seating surface
330	—	699	1 ⁽¹⁾⁽²⁾
700	—	1049	2 ⁽²⁾
1050	—	1799	3 ⁽²⁾⁽³⁾
1800	—	2249	4 ⁽³⁾

1. At least one DSP for SSW $\geq$ 330.

2. #DSP = SSW/350, for $350 \leq \text{SSW} \leq 1399$, rounded down to nearest whole number.

3. # DSP = SSW/450, for SSW $\geq$ 1400, rounded down to nearest whole number.

3.3.9 Endgate

A full or partial rear closure hinged at or near the load floor, or bed, which is lowered to access the cargo area of a vehicle. Commonly referred to as a Tailgate.

3.3.10 Eyellipse

See SAE J941. Dimensions specified in this practice are measured in a side view (SV) Y-plane.

3.3.11 Front of Dash

A vertical tangent to the foremost predominant surface of the dash panel at the centerline of the driver, disregarding flanges and small localized formations. The dash panel is usually the vertical extension of the toe panel.

3.3.12 Head Position Contour

See SAE J1052. Dimensions specified in this practice are measured from sections cut through the appropriate 95th percentile head contour. After the head contour is constructed and oriented, sections are cut normal to grid in side view and rear view. The contour attitude is maintained during dimensional evaluation (not tilted or rotated, etc). The side view section is on the SgRP Y-plane and is used for L38, L39, H46, and H47. The rear view section is on the X-plane intersecting the side view top of contour and is used for W27, W35 and H35.

NOTE: The Head Clearance Minimum metrics defined by W38 are measured to a point on the three dimensional head contour surface.

3.3.13 Liftgate/Lift Glass

A full or partial rear closure hinged at or near the roof line which is raised to access the cargo area of a vehicle.

3.3.14 Long-Coupled Seating

Successive row seating (rows 1 to 2, 2 to 3, etc) where the distance between successive SgRP X coordinates for the left outboard seating positions is large enough to permit an H-point device to be installed with an ankle angle greater than 130 degrees.

See Appendix B for a process diagram to help identify the seating type.

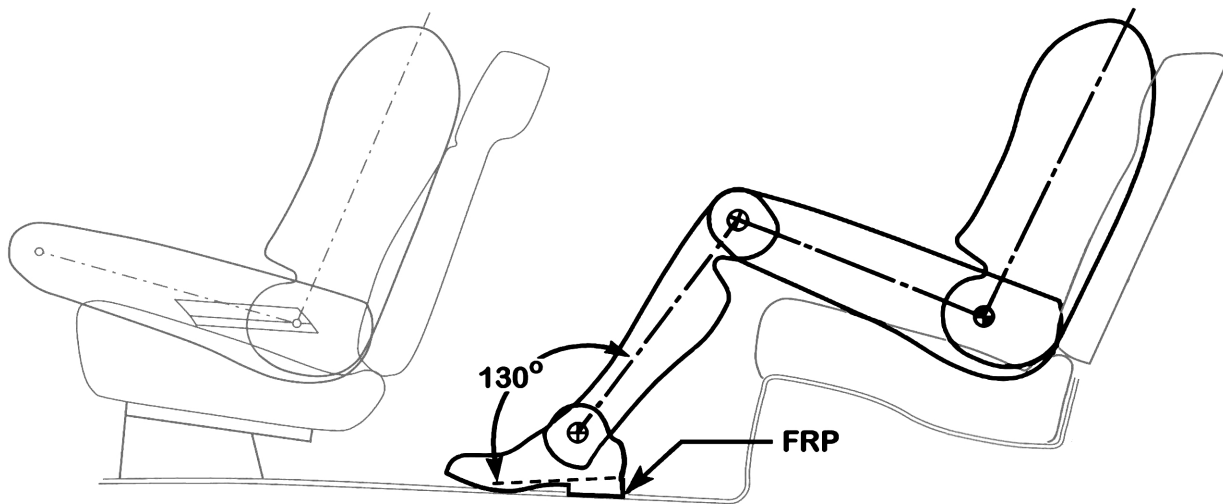


FIGURE 4 - LONG-COUPLED SEATING AND FRP LOCATION

3.3.15 Maximum Hold-Open Position

The maximum position of a vehicle closure that can be maintained without any applied force, or without the removal of any component or restraining device.

3.3.16 Normal Top of Frame-Truck

The longest normal surface of the top flange of the truck frame within the wheel base.

3.3.17 Seating Surface

The plan (top) view profile of the seat cushion throughout all seat travel and attitude adjustments (if any), with the seat and seatback at its design orientation, including any attached trim but excluding any portion of the cushion behind or below the seatback. See Figure 5A.

In instances where more than one seat occupies a row of seating, adjacent seats are considered one continuous surface, unless:

3.3.17.1 Fixed, unpadded trim separates the profiles by at least 140 mm (See Figure 5B), or

3.3.17.2 The seat cushions are separated by a void that is at least 140 mm wide and 140 mm deep (See Figure 5C), or

3.3.17.3 Interior trim interrupts the hip room (See Figure 5D), or

3.3.17.4 Both surfaces are adjacent outboard seats and the cushions are at least 140 mm apart from every point between them (See Figure 5E).

NOTE: Figures 5A – 5E are for illustrative purposes only. Other scenarios or design alternatives are possible.

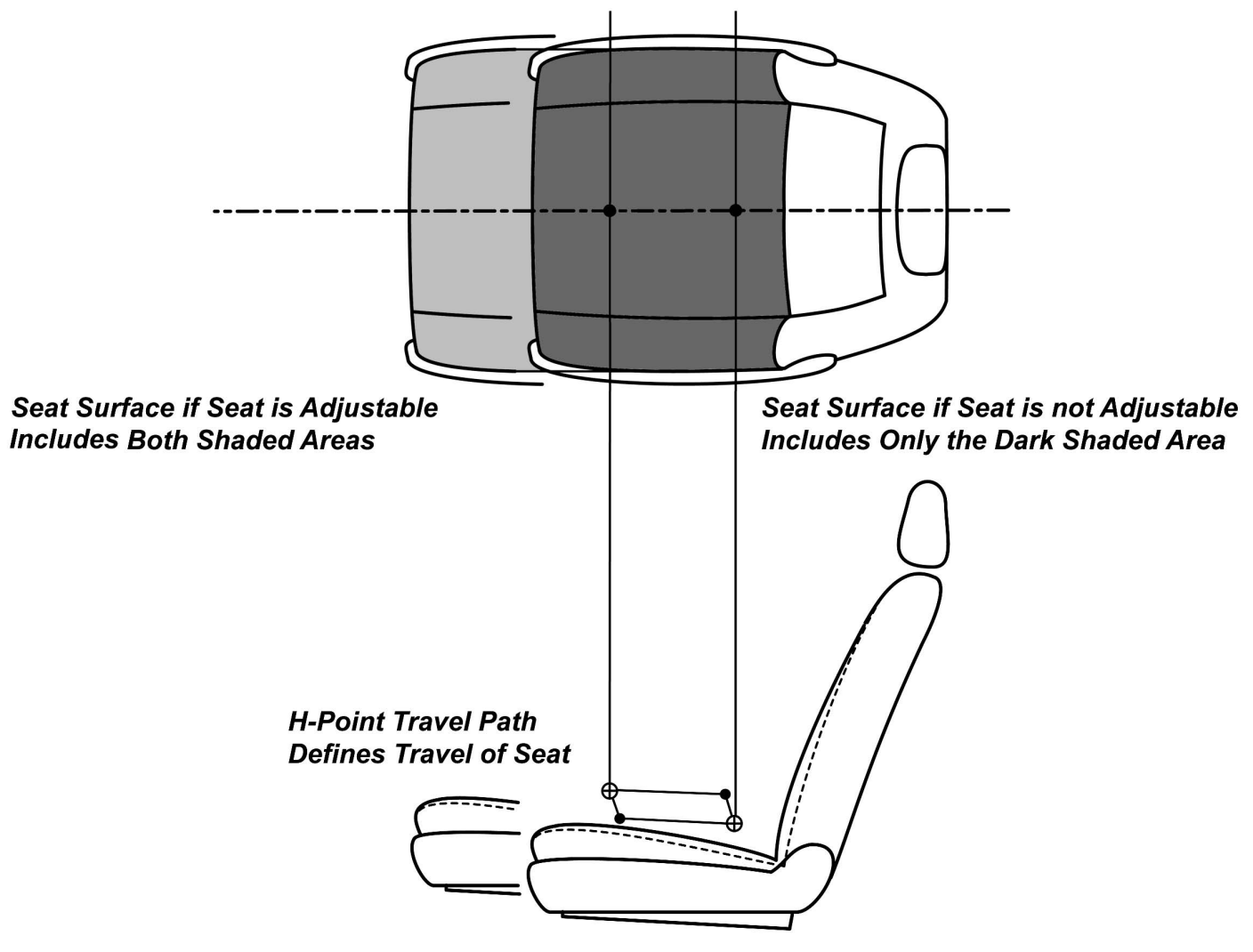


FIGURE 5A - SEATING SURFACE

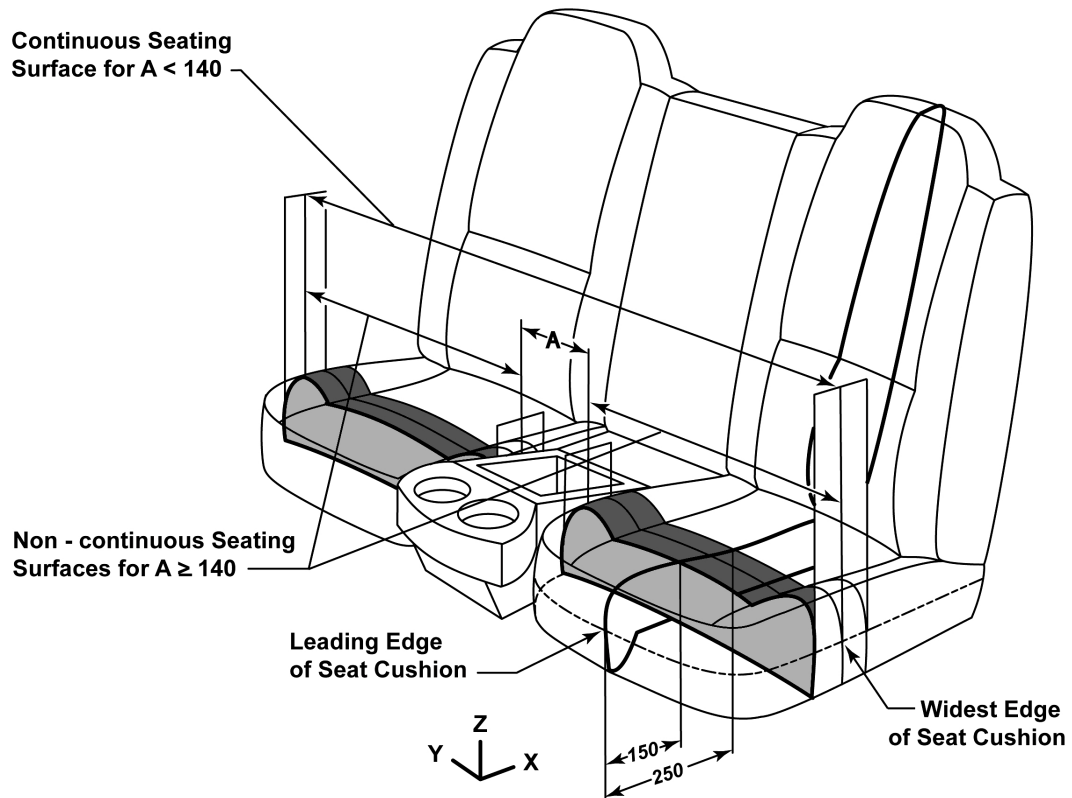


FIGURE 5B - TRIM SEPARATION (CONDITION 3.3.17.1)

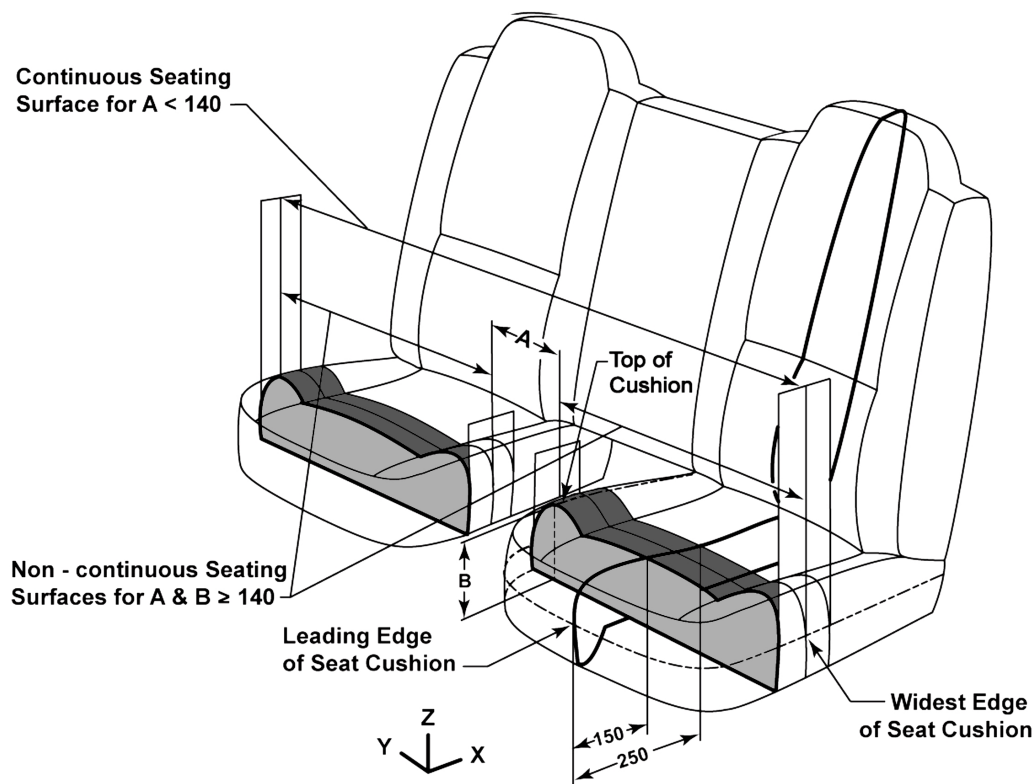


FIGURE 5C - VOID (CONDITION 3.3.17.2)

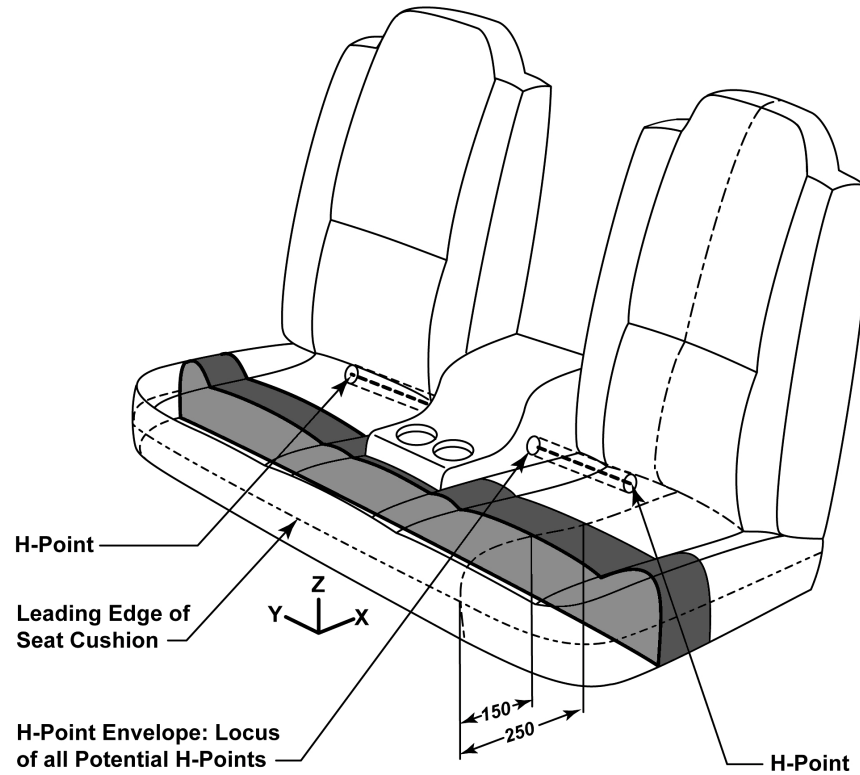


FIGURE 5D - HIP ROOM INTERFERENCE ALONG H-POINT (CONDITION 3.3.17.3)

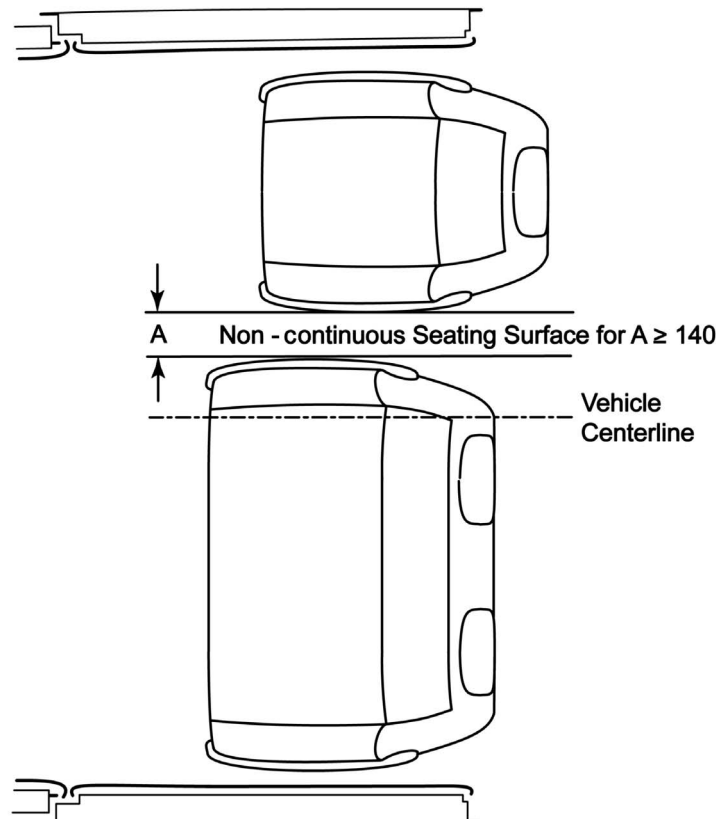


FIGURE 5E - ADJACENT OUTBOARD SEATS (CONDITION 3.3.17.4)

3.3.18 Seating Surface Width (SSW)

The maximum lateral distance of a seating surface in a zone defined by 2 planes 150 and 250 mm behind the forward leading edge. See Figures 6A and 6B.

If the seats can be reconfigured in any manner (fold, remove, adjust, tilt, etc.), measure in the configuration that yields the single largest seating surface width.

NOTE: Seating Surface Width may be measured to the free-foam seat contour, or the finish trim contour, either in a CAD system or on a physical property. Differences in value should be expected depending upon the method. For this reason, the user should state how measured (e.g. Free-foam contour in CAD).

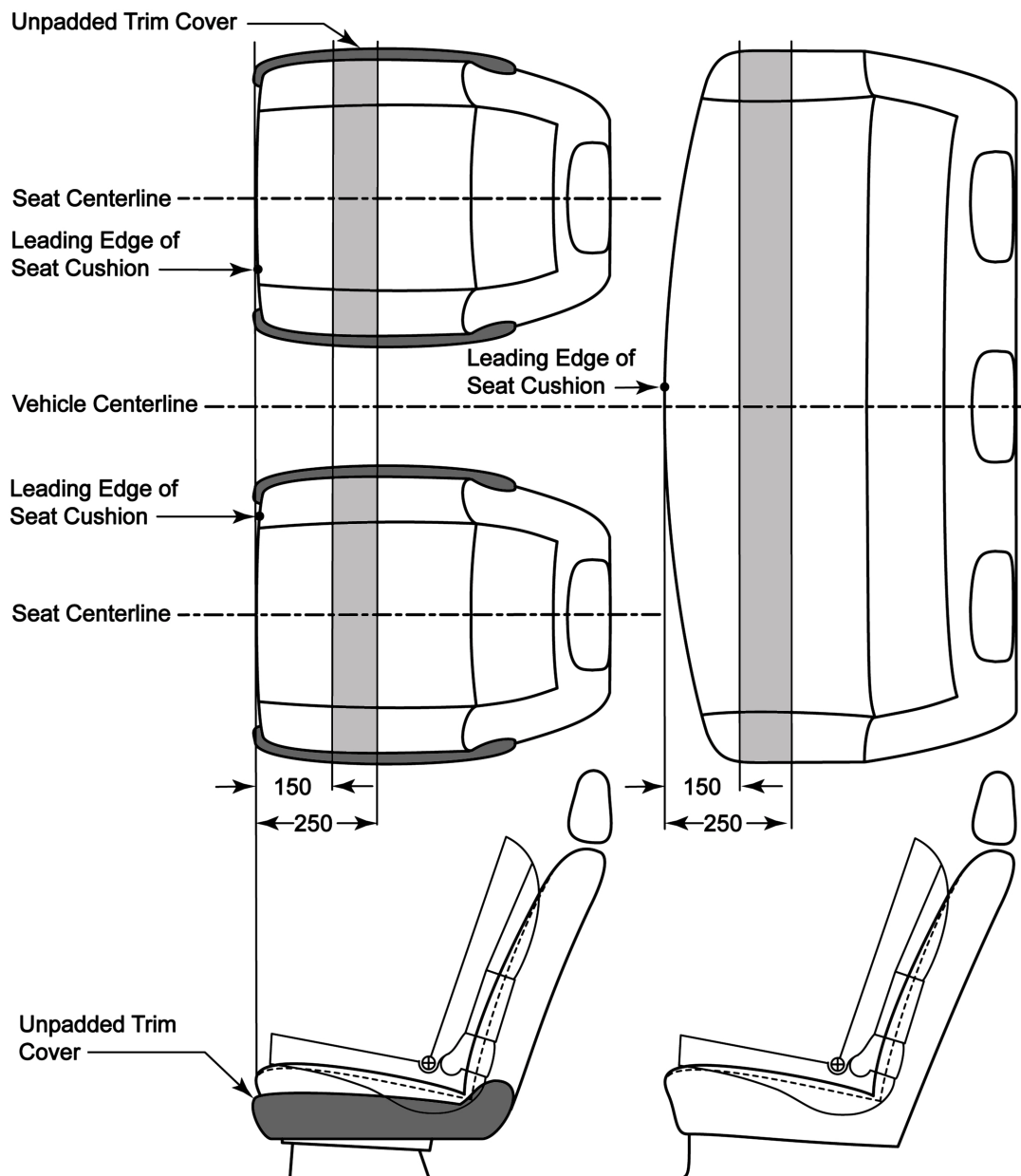


FIGURE 6A - MEASUREMENT ZONE

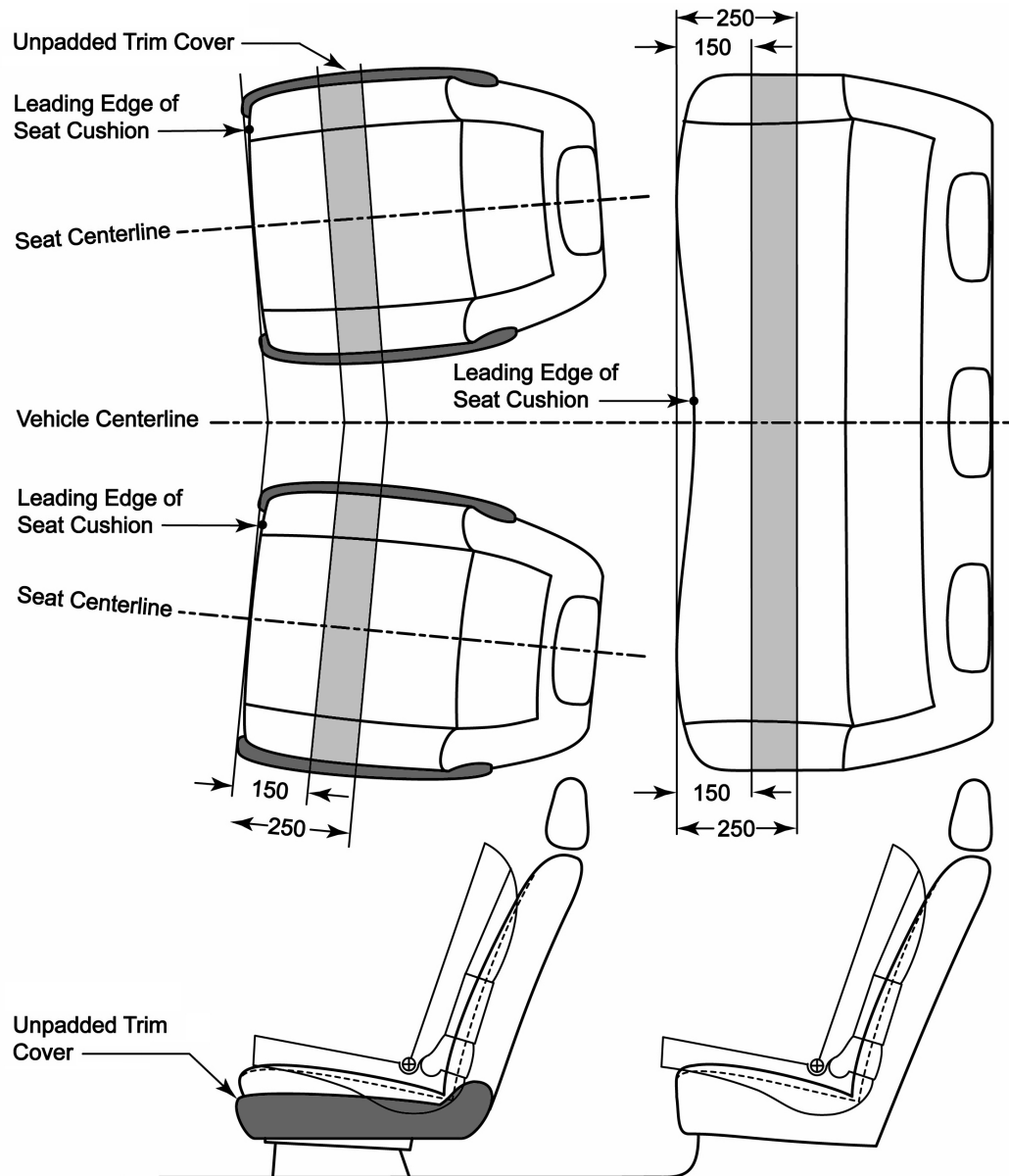


FIGURE 6B - MEASUREMENT ZONE

3.3.19 Short-Coupled Seating

Successive row seating (rows 1 to 2, 2 to 3, etc) where the shoe or leg of an H-point device interferes with the preceding seat trim or structure for the left outboard seating positions when the preceding seat is in its design (SgRP) position.

See Appendix B for a process diagram to help identify the seating type.

NOTE: At least one of the following dimensions – leg room (L51), leg clearance (L58), or knee clearance (L48) – will be affected by this condition.

3.3.20 Sill Plate Bead

Components or parts that make up the lower boundary of the trimmed body opening; including garnish moldings, carpet, seals, and weatherstrips.

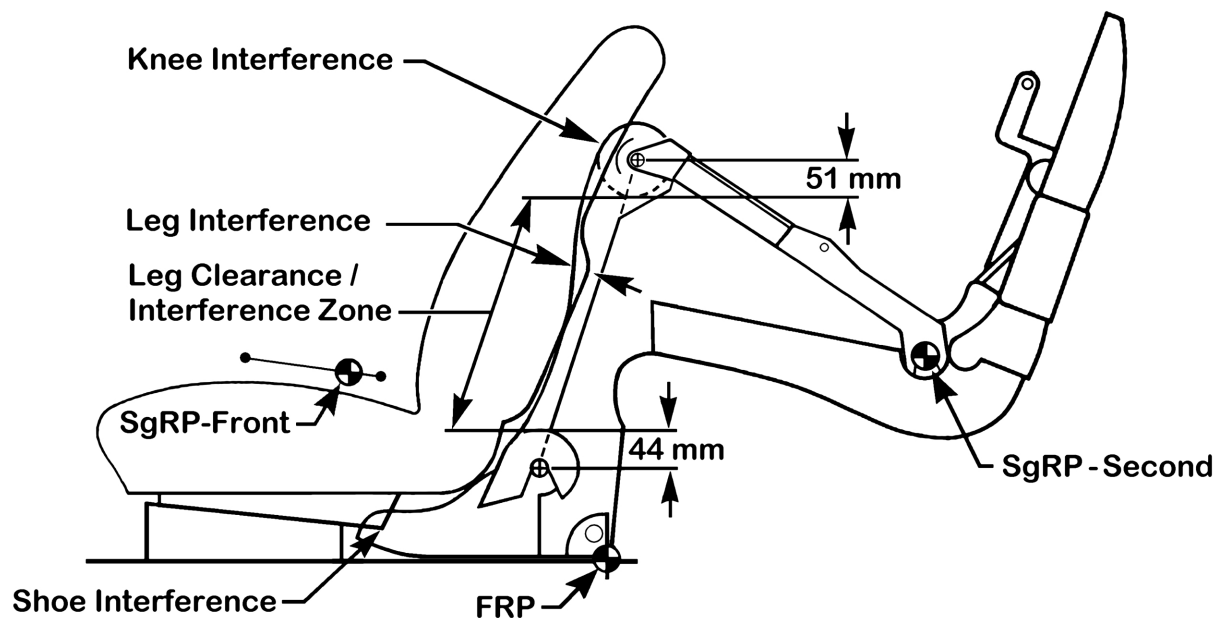


FIGURE 7 - SHORT-COUPLE INTERFERENCES AND FRP LOCATION

3.3.21 Standard-Coupled Seating

Successive row seating (rows 1 to 2, 2 to 3, etc) where the distance between successive SgRP X coordinates for the left outboard seating positions is large enough to permit all components of an H-point device to be installed without interference and having an ankle angle no more than 130 degrees.

See Appendix B for a process diagram to help identify the seating type.

3.3.22 Steering Wheel Center

A vehicle reference point at the theoretical intersection of the steering column axis and a plane tangent to the face of the steering wheel rim, with front wheels in the straight-ahead position.

3.3.23 Swing Gate

A full or partial, vertically-hinged rear closure which spans the full width of the back body opening and opens laterally to access the cargo area of a vehicle.

NOTE: Many swing gates also function as an end gate.

3.3.24 Top of Contour (TOC)

The highest point on a head position contour at the SgRP Y-plane. See 3.3.12 and SAE J1052.

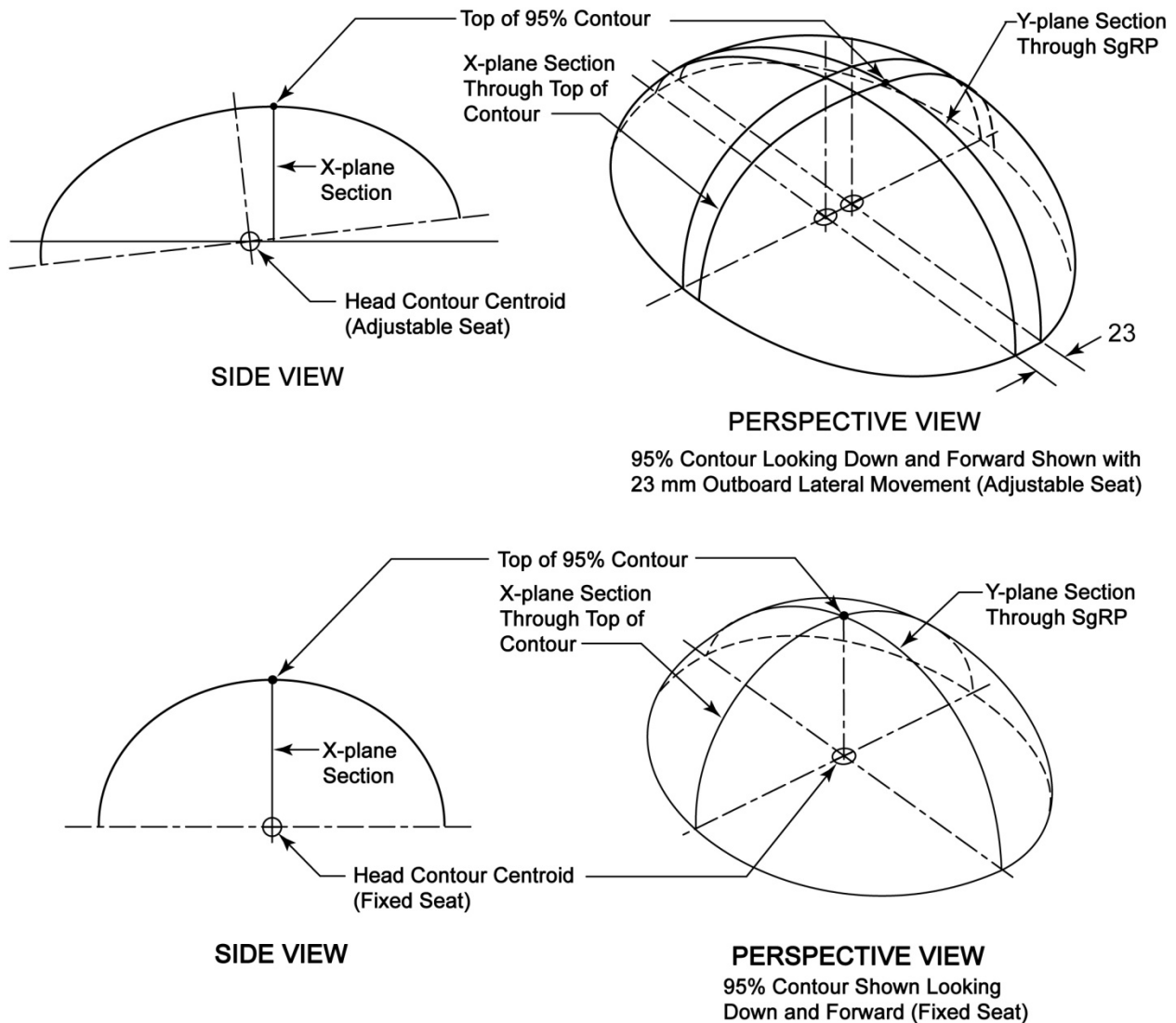


FIGURE 8 - TOP OF CONTOUR

3.3.25 Trimmed Body Opening

Unobstructed openings in the body of a finished vehicle which limit the ingress or egress of people or the installation or removal of cargo.

3.3.26 Undepressed Floor Covering

The nominal surface of the floor covering at a designated location in the vehicle, without any load applied to the covering.

3.4 H-Point Devices – Reference Points and Definitions

See Figure 9.

H-point devices are used to establish key reference points and dimensions in the vehicle's interior. There are four devices that can be used to define H-point locations; the original H-Point Machine (HPM) and 2d template defined in SAE J826, the H-Point Machine (HPM-II) defined in SAE J4002, and the H-Point Design Tool (HPD) defined in SAE J4004. The HPM and HPM-II are physical devices used in physical properties for the purpose of auditing and benchmarking H-point locations. The 2d template and the HPD are CAD tools used during design for establishing H-point locations in the occupant package.

Terms and reference points related to the shoe of an H-point device are listed in section 3.5.

This document defines key terms and definitions used in SAE J826, SAE J4002, SAE J4003, and SAE J4004. However, it does not describe the procedures necessary to properly position and use an H-point device.

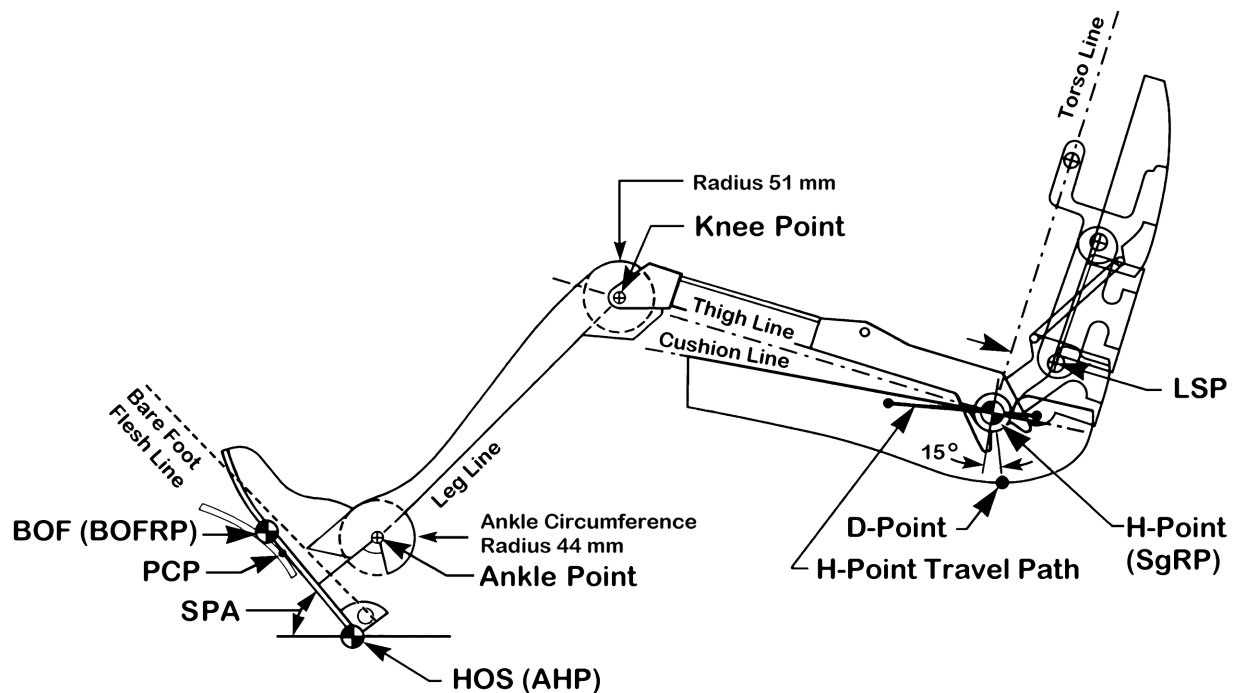


FIGURE 9 - HPM-II REFERENCE POINTS

3.4.1 Ankle Circumference

Side view circumference about the ankle point of the HPM. On the HPD or H-point template, the circumference is constructed to match the HPM devices.

3.4.2 Ankle Point

A point located at the pivot center between the lower leg segment and the shoe on H-point devices.

3.4.3 Cushion Line

A line in side view on the cushion pan of H-point device forward from the H-point that is used to define cushion angle. On the HPM, this line connects to the knee point. See SAE J826.

3.4.4 D-Point

A point on the bottom surface of the HPM-II cushion pan, at the lateral centerline, 25.5 mm (15 degrees) rearward of the H-point. On the HPM, the D-point is the lowest point on the centerline of the bottom of the cushion pan in the installed position.

3.4.5 H-Point

A point on the HPM, HPM-II, or the HPD located at the pivot center of the back pan and cushion pan assemblies, on the lateral centerline of the device. See SAE J826, SAE J4002, and SAE J4004. The H-point on the 2-d template is at the intersection of the thigh line and the torso line.

When an H-point device is properly positioned at a designated seating position within a vehicle – either in CAD or in an actual physical property – the location of the H-point can be used as a vehicle reference point. Unless otherwise noted, this is how the term H-point is used in this practice.

3.4.5.1 Actual H-Point

Is an H-point measured in physical properties with either the HPM, or HPM-II positioned using procedures defined in SAE J826 or SAE J4002.

3.4.5.2 Design H-Point

Is an H-point location whose coordinates, as described in the three dimensional reference system, are established in CAD or on a layout drawing by installing the H-point design tool or 2d template in a seat, with the seat located at any one of its designated seating positions within the range of seat fore/aft or up/down adjustment.

3.4.5.3 H-Point Travel Path, Actual or Design

See Section 7.

3.4.6 Knee Point

A point located at the pivot center between the thigh and lower leg segments on H-point devices.

3.4.7 Leg Line

A line connecting the knee point to the ankle point on H-point devices.

3.4.8 Seating Reference Point (SgRP)

SgRP is a specific and unique H-point established by the manufacturer as the design seat reference point for a given designated seating position which:

- Establishes the rearmost normal design driving or riding position of each designated seating position in a vehicle (considering all modes of seat adjustment - horizontal, vertical, and tilt);
- Has X, Y, Z coordinates established relative to the designed vehicle structure;
- Simulates the position of the pivot center of the torso and thigh; and
- Is the reference point employed to position the 2d drafting template with the 95th percentile leg described in SAE J826 or the HPD described in SAE J4004

Although adjustable seats will have many design H-points within their design H-point travel path, there is one – and only one – H-point defined as the SgRP for any seat/seating position.

The SgRP is established early in the vehicle design process. The most critical SgRP is the one defined for the driver. It is used in positioning many other design tools, defining a number of key vehicle dimensions (e.g., leg room, shoulder room, etc.), and is referenced in several national and international standards and regulations.

The location of the SgRP for the driver may be defined as a function of seat height H30 using a fixed 87 degree ankle angle A46. See SAE J4004.

NOTE: Rearmost normal design driving or riding position is typically not the rearmost location within the travel path. See Section 7.

3.4.8.1 SgRP – Front

SgRP of the driver, unless otherwise specified.

3.4.8.2 SgRP – Second

SgRP of the second row outboard passenger on the driver side of the vehicle, unless otherwise specified.

3.4.8.3 SgRP – Third

SgRP of the third row outboard passenger on the driver side of the vehicle, unless otherwise specified.

3.4.8.4 SgRP – Fourth

SgRP of the fourth row outboard passenger on the driver side of the vehicle, unless otherwise specified.

3.4.8.5 SgRP – Fifth

SgRP of the fifth row outboard passenger on the driver side of the vehicle, unless otherwise specified.

3.4.9 Thigh Line

A line in side view connecting the H-point to the knee point.

3.4.10 Torso (Back) Line

A line in side view on the back pan of the H-point device upward from the H-point that is used to define torso angle. On the HPM-II, this line connects the H-point to the sliding thorax pivot. On the HPM, this line is parallel to the flat portion of the back pan contour. The angle of this line from vertical defines torso angle.

NOTE: Prior to 2008 SAE standards generally used the term “back angle” to describe the A40 dimension of SAE J1100. New or revised standards beginning in 2008 will use the term “torso angle” for this dimension.

3.5 Shoe Reference Points and Definitions

HPM-II has a separate shoe tool that is necessary for the proper positioning of its legs in a vehicle (in CAD or in a physical property) See SAE J4002. For the SAE J826 HPM, the shoe and lower leg are a single integral assembly.

3.5.1 Accelerator Heel Point (AHP)

The heel of shoe location on the floor at the depressed floor covering, when the bottom of shoe is in contact with the undepressed accelerator pedal and the ankle angle is at 87 degrees. See Figure 9. The lateral location (Y coordinate) is aligned with the BOFRP, unless shoe interference with side support structures causes an offset of the AHP from the BOFRP. See Figure 10.

3.5.2 Ball of Foot (BOF)

A point on the lateral centerline of the shoe 203 mm from the heel (HOS). See Figures 9 and 10.

3.5.3 Ball of Foot Reference Point (BOFRP)

A vehicle reference point coincident with the driver's BOF location when:

- The flat portion of the bottom of shoe is coplanar with the driver's shoe plane.
- The driver's heel of shoe is on the driver's depressed floor covering.
- The BOF lies on the accelerator pedal centerline when the centerline is projected to the shoe plane.

NOTE 1: Shoe interferences with the side support structure are ignored when determining the BOFRP location. In some cases, the BOFRP does not lie on the accelerator pedal pad. See Section 6 and Figure 10.

NOTE 2: The BOFRP is a key landmark for occupant packaging. Several SAE tools are positioned relative to the BOFRP (e.g., Eyellipses, SgRP).

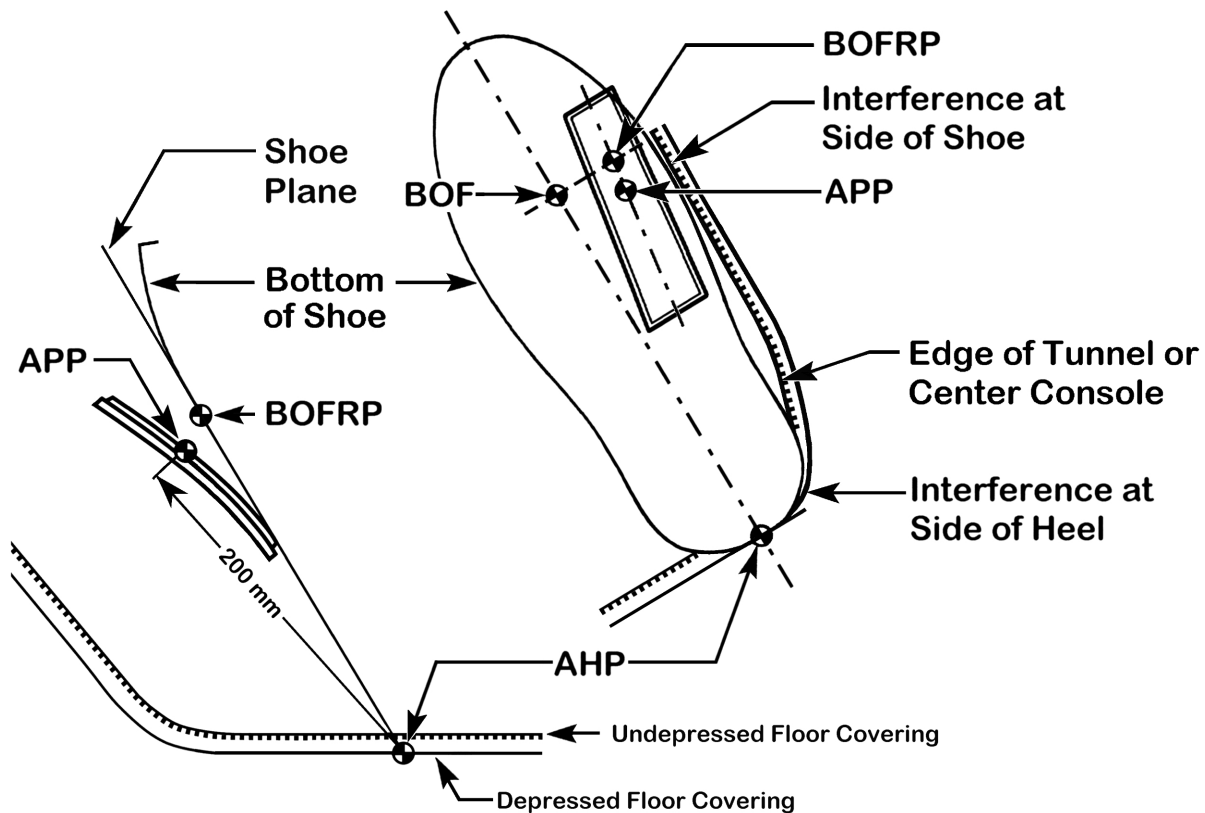


FIGURE 10 - AHP, APP, BOF, BOFRP

3.5.4 Bare Foot Flesh Line

A line in side view, 6.5 degrees from the bottom of shoe. The origin of the angle is 286.9 mm forward of the heel of shoe on a line from AHP through the BOF. See Figure 9.

3.5.5 Bottom of Shoe (BOS)

The underside of the shoe, used in side view to establish planes or angles. Only the flat section of the BOS, from AHP to BOF, is of concern.

NOTE: For the shoe described in SAE J826, construct the flat section by connecting the AHP to BOF.

3.5.6 Floor Plane and Floor Plane Angle (FPA) – Passengers

A plane normal to the Y-Plane, established by the bottom of shoe contacting the floor, with the heel of shoe on the depressed floor covering at the floor reference point. The floor plane angle is the angle of the floor plane measured from the horizontal.

3.5.7 Floor Reference Point (FRP) – Passengers

FRP is the intersection of the heel of shoe and the depressed floor covering, with the bottom of shoe resting on the depressed floor covering. The shoe and lower leg segment are positioned as a single component to the most forward location within 127 mm. to either side of centerline of occupant, until they are tangent to, or rest against, the limiting component directly in front (e.g. contact with the underseat structure, lower portion of the seat back trim, etc.) without any interference or soft trim compression. Ankle angle is restricted to a range from 87 to 130 degrees. See SAE J826, SAE J4002.

When determining the FRP, the HPM-II lower leg shall be attached to the shoe and detached from the H-point device to aid in positioning the shoe. No interference is permitted with the ankle circumference.

For long-coupled seating, the FRP and FPA are established at a maximum ankle angle of 130 degrees using all components of an H-point device. See 3.3.14 and 3.4.

For short-coupled seating, where the shoe cannot be fitted between the seats, the rear of the shoe is moved as far rearward as possible, with the front of the shoe intruding into the preceding seat trim and/or structure. See 3.3.19.

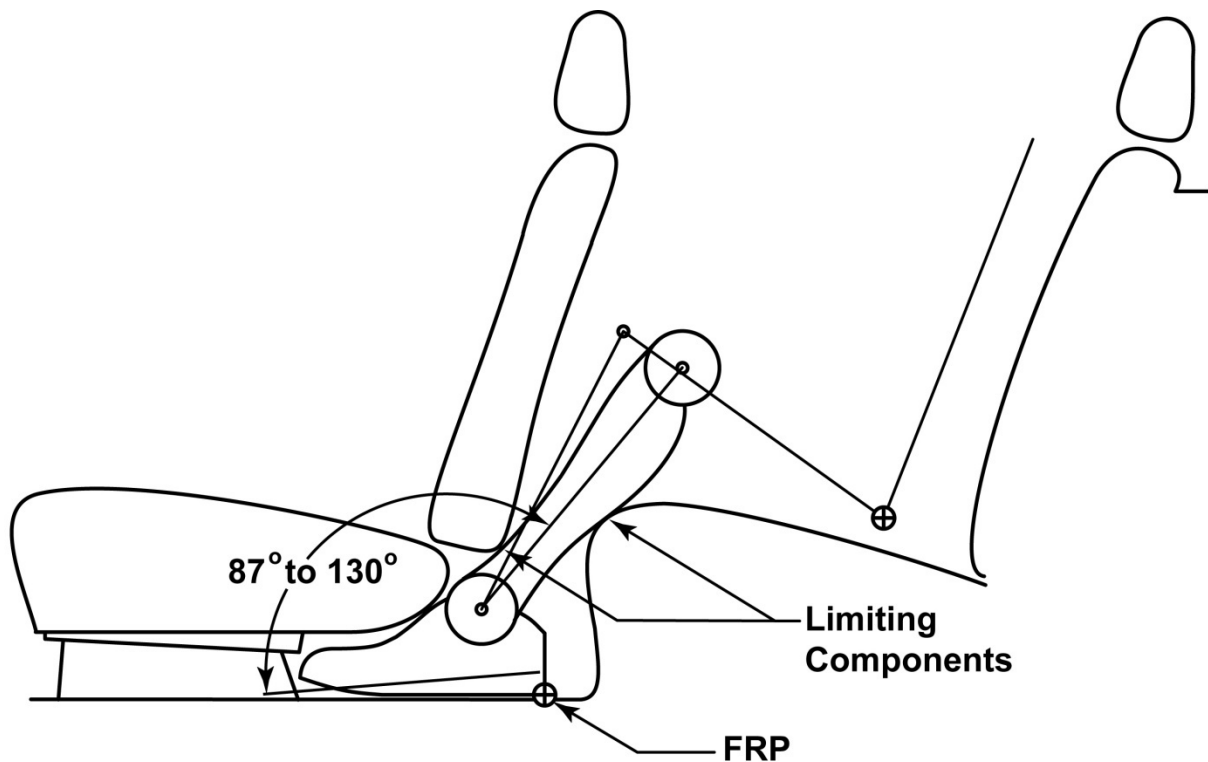


FIGURE 11 - FRP DETERMINATION

3.5.8 Heel of Shoe (HOS)

A point in the lateral centerplane of the shoe tool at the bottom rear of the shoe heel. When properly positioned on the depressed floor covering, it defines the AHP location for the driver and FRP for passengers.

3.5.9 Shoe Plane – Driver

A plane normal to the Y-Plane that defines the side view orientation of the bottom of the driver's shoe when the shoe is in contact with the centerline of the undepressed accelerator pedal at its design position.

NOTE: All other seated positions use Floor Plane and Floor Plane Angle. See 3.5.6.

4. CODE EXPLANATION, VEHICLE SET-UP, AND DIMENSIONING PROCEDURE

4.1 Codes

Each dimension is assigned a code, which consists of an alpha prefix and a number (e.g., H30 or A40) as illustrated in Tables 4 and 5. The letters denote the direction of measurement (e.g., height, width) or type of measurement (e.g., angle), while the numbers denote a general location in or on the vehicle. It is recognized that some metrics deviate from this schematic (e.g. L26, W90, and H197).

TABLE 4 - ALPHA PREFIXES

Letter	Meaning
L	Length measurements (longitudinal distance), or location of X coordinate
W	Width measurements (cross car distance), or location of Y coordinate
H	Height measurements or location of Z coordinate
A	Angular measurements
PL	Lengths associated with pedal and pedal usage
PW	Widths associated with pedal and pedal usage
PH	Heights associated with pedal and pedal usage
SL	Lengths associated with seats
SW	Widths associated with seats
SH	Heights associated with seats
TL	Lengths defining H-point locations/travel
TH	Heights defining H-point locations/travel
PD	Passenger distribution
PV	Passenger volume indices
V	Luggage Volume and Cargo Volume indices
IV	Interior volume indices
S	Surface area measurements
D	Diameter measurements
F	Planar Area measurements

TABLE 5 - NUMERIC SCHEME (GENERAL)

Number Range	Type of dimension
1-99	Interior
100-199	Exterior
200-299	Cargo, luggage, or rear access compartments
400-599	Dimensions unique to trucks, vans, sport utility vehicles, etc.

4.1.1 Interior Dimension Codes (Identifiers)

In addition, many of the interior dimensions can be applied in an identical manner to several designated seating positions. In this event, the basic alphanumeric code remains the same, but a suffix is added (e.g., H30-1, H30-2, H30-3, etc.). The suffix indicates the seating row of the designated seating position to which the particular measurement applies. See Table 6. When codes with suffixes are used in equations, the hyphen (-) is replaced with a tilde (~).

4.1.2 Exterior Dimension Codes (Identifiers)

Many of the exterior dimensions can be applied in a similar manner between the forward half and rearward half of the vehicle. Some examples of this condition are: the front and rear tire sizes (L102-1 and L102-2), step heights (H130-1 and H130-2), and tread widths (W101-1 and W101-2). In this event, the basic alphanumeric code remains the same, but a first level suffix is added. This suffix primarily indicates the location to which the particular measurement applies.

A second level suffix is added to indicate either a condition (A106-1-EPA) or direction (A123-1-U). See Table 6. In some instances, the second level suffix is used without an accompanying first level suffix. In other instances, a dimension code defines a procedure both with and without an accompanying suffix(es). For example, the procedure identified by the code H156 (Table 25) defines three distinct metrics: H156, H156-EPA, and H156-GVM. To assist the user, the suffix statement describes this condition, and the dimension code is footnoted. Appendices A1 through A12 list all of the dimension procedures found in this practice, independent of the identifier.

Consistent with the Interior Identifiers, when Exterior Identifiers with suffixes are used in equations, the hyphen (-) is replaced with a tilde (~).

4.1.3 Cargo, Luggage, and Rear Compartment Codes (Identifiers)

In general, dimension codes having a numeric value in the 200's, refer to metrics taken in or around the rear cargo or rear access opening. Many of these metrics are used to define the cargo compartment volumes found in Table 31. Others are used to quantify the compartment size.

TABLE 6 - SUFFIXES; UNLESS OTHERWISE SPECIFIED

Interior Suffix	Designated Seating Position
-1	(Front) Measurement taken at the driver's designated seating position.
-2	(Second) Measurement taken at the second row outboard passenger's designated seating position.
-3	(Third) Measurement taken at the third row outboard passenger's designated seating position.
-4	(Fourth) Measurement taken at the fourth row outboard passenger's designated seating position.
-5	(Fifth) Measurement taken at the fifth row outboard passenger's designated seating position.
Exterior Suffix	Forward/Rearward Position
-1	(Front) Measurement taken in the front portion of the vehicle.
-2	(Rear) Measurement taken in the rear portion of the vehicle.
Second Suffix	Condition/Direction
-C	(Center) Center passenger's designated seating position.
-CV	(Convertible) Measurement specific to convertibles, or vehicles with folding or retractable roofs
-EPA	Measurement taken at EPA curb loading condition (see 3.2.3)
-GVM	Measurement taken at the GVM load (see 3.2.2)
-L	(Left or Lower) Indicates a measurement to the left of driver, or forward down
-R	(Right) Indicates a measurement to the right of driver's designated seating position
-SR	(Sunroof) Optional coding for vehicles equipped with sunroof
-U	(Upper) Measurement taken to the right of the driver's designated seating position

4.2 Vehicle Set-Up and Dimensioning Procedure

All vehicle dimensions are to be taken with the vehicle set-up in the following configuration:

4.2.1 Interior Dimensions and Procedures

Unless otherwise specified, all interior dimensions, found in Tables 15 through 22, are defined with the seats positioned as indicated in Table 7, and represent 2d measures when viewed normal to the three dimensional reference system (See SAE J182 and Figure 12). Any seat contour adjustment, e.g. lumbar support, is set to the retracted, or least intrusive position. All other adjustable features, such as a steering wheel position and angle and seat height, including head restraint, a seatback that adjusts independently from the seat cushion, power 4-way, 6-way seats, etc., shall be positioned in the design location as specified by the manufacturer. Steering wheel shall be positioned with front wheels in straight-ahead position. Foot controls are positioned in their free state, unless otherwise specified.

Measurements are taken at the centerline of occupant, unless otherwise specified. When an H-point device is required, the 95th percentile leg segment lengths (SAE J826), or SgRP leg lengths (SAE J4002) are used. For consistent application of the metrics, it is recommended that the SgRP seating curve equation from SAE J4004 be used.

TABLE 7 - SEAT POSITIONING AND ATTITUDE FOR MEASUREMENTS

Adjustment	1st Row Seats	2nd and 3rd Row Seats
Seat Position (x, z)	At Driver's SgRP	SgRP Position ⁽¹⁾
Torso Angle	As specified ⁽¹⁾ , or 22 degrees ⁽²⁾	As specified ⁽¹⁾ , or 25 degrees if possible ⁽²⁾
Seat Contour Adjustment (e.g., lumbar support)	Set to retracted position. (i.e., deflated; least intrusive)	Set to retracted position.
Adjustable Pedals	As specified ⁽¹⁾ , or full forward ⁽²⁾	Not applicable
All Other Adjustments (e.g., tilt or telescoping steering wheel, cushion angle, etc.)	Normal Driving Position ⁽¹⁾	Normal Riding Position ⁽¹⁾

1. As specified by the manufacturer.

2. See SAE J4003.

4.2.2 Exterior Dimensions and Procedures

All exterior dimensions terminate at the outside surface of the sheet metal, bumper, or integral moldings, unless otherwise specified. The front wheel shall be positioned in the straight-ahead position. All measurements are taken at curb load on the base vehicle, unless otherwise specified. Tables 23 through 26 provide the codes and definitions for exterior dimensions.

For dimensions involving dual rear axles, measurement is taken to a point halfway between the centerlines of the rear wheels. See Table 23.

5. COORDINATE DIMENSIONS

Points of interest are described as coordinates dimensioned from the intersection of the zero planes in the three-dimensional reference system. X, Y, and Z coordinates are dimensioned to their respective planes. See SAE J182.

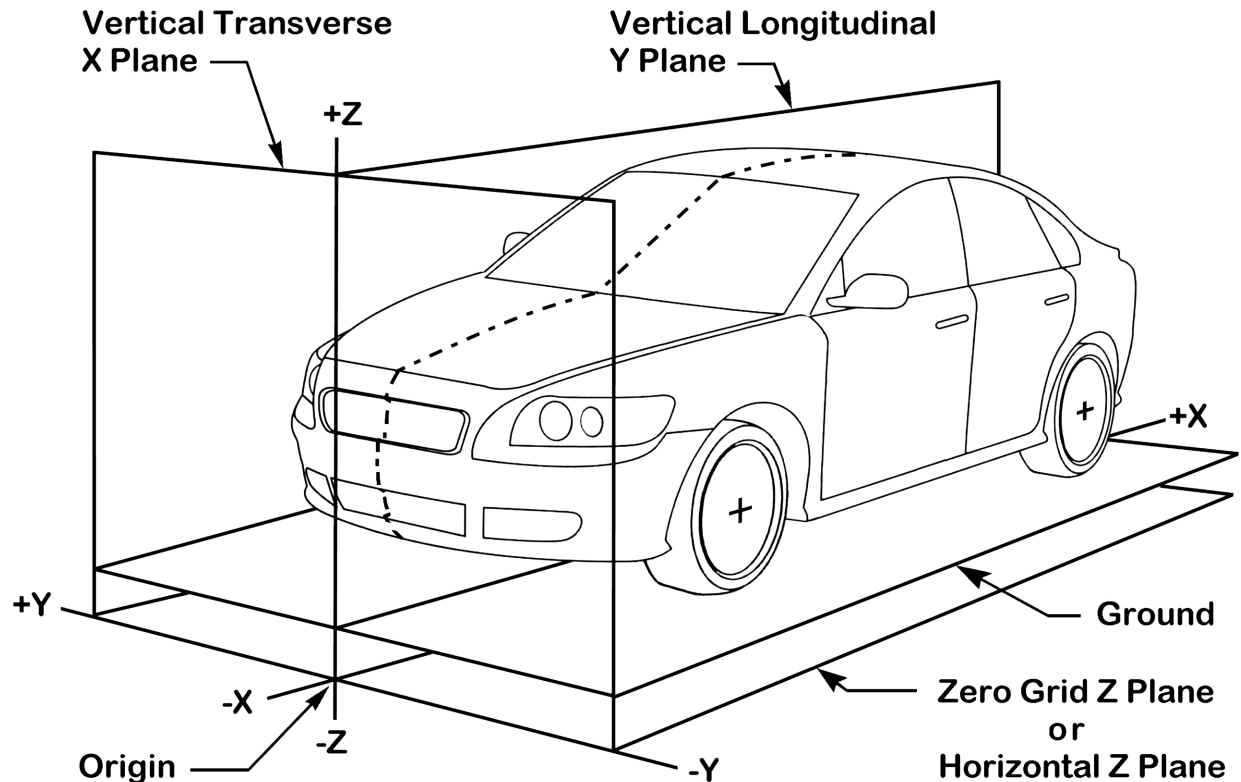


FIGURE 12 - THREE DIMENSIONAL REFERENCE SYSTEM

5.1 Fiducial Mark Dimensions

Fiducial Marks are defined in SAE J182. The dimensions which relate them to the three-dimensional reference system are found in Table 9.

5.2 SgRP Coordinate Dimensions

See 3.4.8 and Table 10.

5.3 AHP Coordinate Dimensions

AHP is defined in Section 3.5.1. The location applies to the driver's position only. The dimensions are defined in Table 11. For additional information, see SAE J4002, SAE J4003, SAE J4004 and SAE J826.

5.4 BOFRP Coordinate Dimensions

BOFRP is defined in Section 3.5.3. The location applies to the driver's position only. The dimensions are defined in Table 12. For additional information, see SAE J4002, SAE J4003, SAE J4004 and SAE J826.

5.5 FRP Coordinate Dimensions

FRP is defined in Section 3.5.6. The location applies to any passenger position. The dimensions are defined in Table 13. For additional information, see SAE J4002, SAE J4003, SAE J4004 and SAE J826.

5.6 Additional Coordinates

Additional coordinate dimensions used in this practice are defined in Table 14.

6. DRIVER'S FOOT CONTROLS, PEDAL CONFIGURATION

Foot controls are evaluated in their natural state – referred to as 'free' or 'undepressed' – with no applied force, displacement or deflection, unless otherwise specified in the dimension procedure. The pedal face is taken to be a single continuous surface bounded by the defined edge, disregarding any tread, groove, or decorative pattern. It represents the maximum surface area that can contact the bottom of shoe. The term brake or brake pedal refers to the service brake in all instances. No metrics are defined for the parking brake.

The dimensions in Table 20 describe the spatial relationships in the driver's footwell and are based on a numbering system illustrated in Figure 13. The dimensions allow users to evaluate the location of the foot controls relative to one another or relative to the driver. They can be used for vehicle-to-vehicle comparisons, to help determine control location for occupant comfort, to develop program objectives, or to validate a design. Metrics taken to a trimmed component (e.g. floor covering, right side support structure, etc.) are intended to be measured to the free surface. In carpeted areas, users may find it convenient to measure to the carpet backing rather than the carpet nap, especially when making vehicle comparisons. In this situation, the dimensional differences should be noted and the method of measure identified.

Number	Component or General Location
0	Reserved for future use
1	Accelerator
2	Service brake
3	Clutch
4	Left side structure, etc.
5	SV step/lift overs (not shown)
6	Floor, etc.
7	Right side structure, etc.
8	Ball of Foot Reference Point (BOFRP)
9	Centerline of driver Y-plane

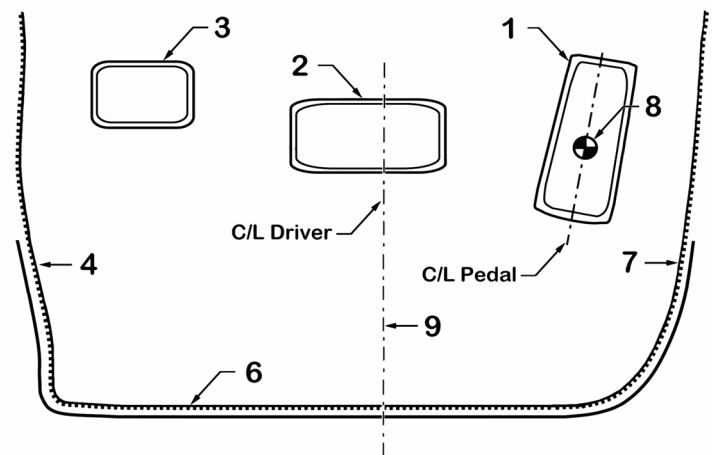


FIGURE 13 - NUMBERING SYSTEM FOR PEDAL RELATED DIMENSIONS

6.1 Definitions

6.1.1 Accelerator Pedal Point (APP)

A point on the accelerator pedal centerline 200 mm from the AHP in side view used in the determination of Plane P. See Figure 10 and 14.

6.1.2 Edge of Pedal

Outer (two-dimensional) boundary of pedal pad, shape, or mounting surface when these surfaces are projected onto a defined plane. For pedal size, the plane is Plane N. For lateral clearances, the plane is Plane P.

6.1.3 Footwell

The volume of space used for foot placement or the operation of foot controls, located in front of and below an occupant's seat cushion and bounded on all sides by trimmed surfaces or support structures.

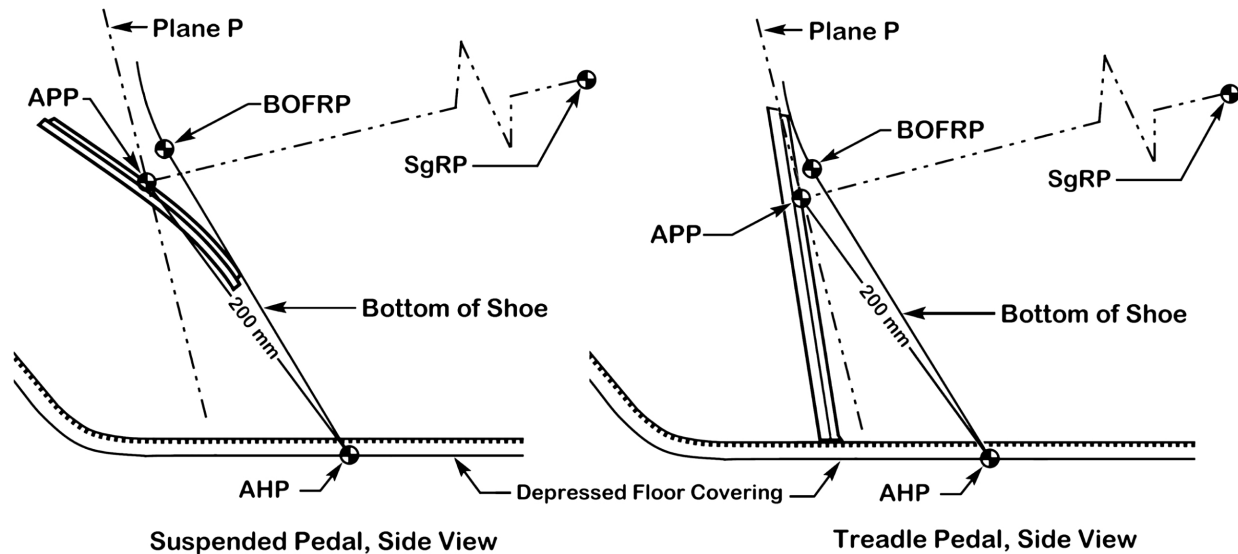


FIGURE 14 - APP AND PLANE P DETERMINATION

6.1.4 Pedal Centerline

A line which connects the lateral midpoints of the edge of pedal. See Figure 15.

6.1.5 Pedal Pad Midpoint

A point on the pedal centerline midway between the top and bottom of the edge of pedal. See Figure 15 and 16.

6.1.6 Pedal Pad

Generic term which refers to the actual shape of the foot control, whether or not it has a physical cover.

6.1.7 Plane N

A plane perpendicular to a surface normal vector at the pedal pad midpoint. See Figure 16.

6.1.8 Plane P

A transverse plane which passes through the Accelerator Pedal Point (APP) perpendicular to the side view line connecting the APP to the driver's SgRP. See Figure 14.

6.1.9 Side Support Structure

Vertical or near vertical surfaces that bound the footwell to the left or right of a designated seating position. On one side it encompasses all trimmed and untrimmed surfaces on the interior of the finished vehicle, including undepressed carpet on the wheelhouse, front body hinge pillar, rocker, etc. On the other side, it includes the tunnel, center console, HVAC system, etc.

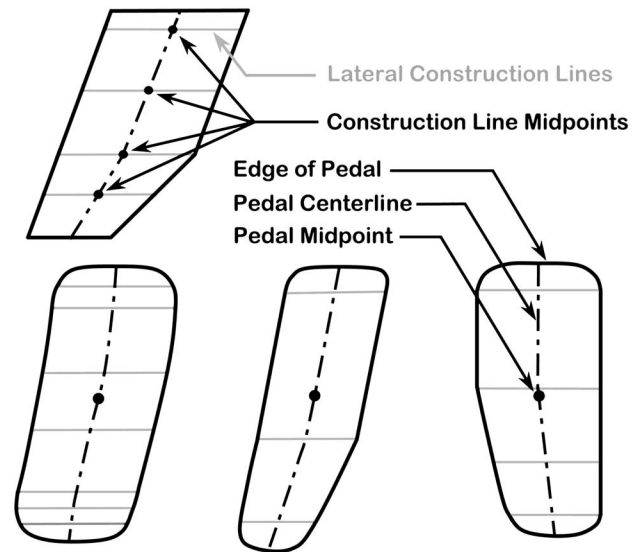


FIGURE 15 - PEDAL CENTERLINE AND MIDPOINT

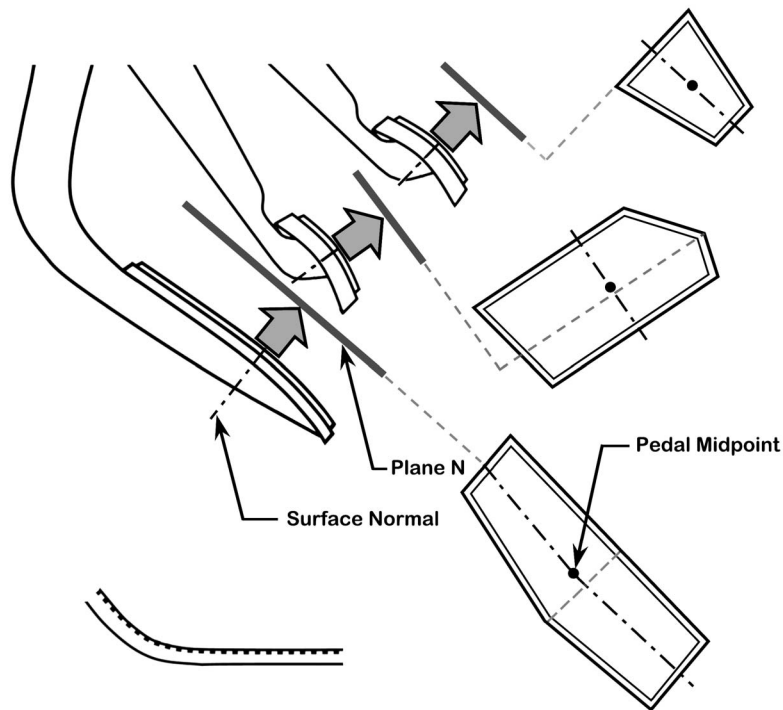


FIGURE 16 - PLANE N DETERMINATION

6.2 Types of Pedal Measurements

6.2.1 Pedal Sizes

Measurements of pedal heights and widths (e.g. PH11, PW11) are generally taken in a view normal to the pedal surface. These dimensions define the physical boundaries of the specific foot control. See Figure 16.

6.2.2 Operational Clearances

These measures describe the space required for operation - such as edge of pedal to edge of adjacent pedal or to a stationary interference. Foot control spacing can be established in two views: a side view and a true view on Plane P.

6.2.2.1 Side View

Clearance metrics between controls (PL52, PL53, etc.) are taken from their respective centerline sections. Vertical measures between the controls and the floor (PH16, PH26, etc.) are taken from the bottom edge of the control to the undepressed floor covering.

6.2.2.2 True View

Lateral clearance metrics are taken in Plane P. Each foot control is orthogonally projected onto this plane, and the footwell boundaries are sectioned to it. Dimensions identified in this plane are consistent with those described in ISO3409.

6.2.3 Pedal Locations

These measures describe a control's position relative to the driver or to an established vehicle reference point, plane, or location. Most are described in a rear view, but any transverse plane would yield the same value.

7. H-POINT TRAVEL PATH

Defines the range of H-point locations provided by seat mechanism(s) for a given designated seating position. Only seat adjustments intended for driving and riding, or used by regulatory agencies are included. Seat adjustments whose only purpose is to facilitate ingress, egress, or cargo storage are excluded.

H-point travel path for any designated seating position is established in side-view relative to the SgRP, and represents the extreme boundaries of adjustments available for the seated occupant. The numbering system for dimension codes illustrated in Figure 17 was developed to describe various multi-link seat adjustment systems and to provide for international harmonization of dimensions. When considering the metrics provided in Table 21, the user should first identify the reference points defined in section 7.2. Less complex seat adjustment systems will result in coincident locations and equivalent dimensions. The suffixes defined in Table 6 allow the H-point travel path to be quantified for passengers as well as drivers.

Number	Code	Description
1	RLP	Rearmost Lowest H-point
2	FLP	Foremost Lowest H-point
3	RHP	Rearmost Highest H-point
4	FHP	Foremost Highest H-point
5	RDH	Rearmost Design H-point
6	FDH	Foremost Design H-point
7	SgRP	Seating Reference Point
8	RAP ⁽¹⁾	Rearmost Achievable H-point
9	FAP ⁽²⁾	Foremost Achievable H-point

1. In a 4-way adjuster system, Point 8 (RAP) is typically coincident with Point 1 (RLP).
2. In a 4-way adjuster system, Point 9 (FAP) is typically coincident with Point 4 (FHP)

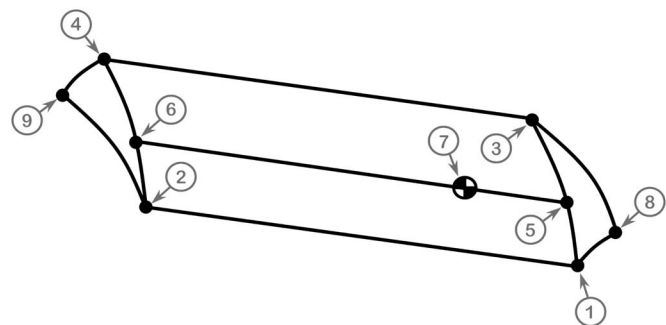


FIGURE 17 - H-POINT TRAVEL PATH; KEY REFERENCE POINTS

7.1 Definitions

7.1.1 Actual Travel Path

Is the envelope or boundary of all possible actual H-points measured in a physical property. See 3.4.5.1.

7.1.2 Design Travel Path

Is the envelope or boundary of all possible design H-points defined in CAD or on a layout drawing which establishes the desired range of seating positions to accommodate a specified population of users. See 3.4.5.2.

7.1.3 Fore-Aft Travel

Is the longitudinal H-point travel distance for the travel path through the SgRP, considering only fore/aft seat adjustment.

7.1.4 Track Rise

Is the vertical rise in H-point for the travel path through the SgRP, considering only fore/aft seat adjustment along an inclined seat track.

7.1.5 Vertical Adjustment

Is the vertical H-point travel distance provided by vertical seat adjustment independent of track rise.

7.2 Reference Points

See Figure 17.

7.2.1 Rearmost – Lowest H-point (RLP)

Is the H-point location with the seat positioned at the rearmost fore/aft setting, full down vertical setting, and design nominal for all other seat adjustments. Illustrated as Point 1 in Figure 17.

7.2.2 Foremost – Lowest H-point (FLP)

Is the H-point location with the seat positioned at the foremost fore/aft setting, full down vertical setting, and design nominal for all other seat adjustments. Illustrated as Point 2 in Figure 17.

7.2.3 Rearmost – Highest H-point (RHP)

Is the H-point location with the seat positioned at the rearmost fore/aft setting, full up vertical setting, and design nominal for all other seat adjustments. Illustrated as Point 3 in Figure 17.

7.2.4 Foremost – Highest H-point (FHP)

Is the H-point location with the seat positioned at the foremost fore/aft setting, full up vertical setting, and design nominal for all other seat adjustments. Illustrated as Point 4 in Figure 17.

7.2.5 Rearmost Design H-point (RDH)

Is the rearmost longitudinal H-point location along the fore-aft travel path through SgRP. Illustrated as Point 5 in Figure 17.

7.2.6 Foremost Design H-point (FDH)

Is the foremost longitudinal H-point location along the fore-aft travel path through SgRP. Illustrated as Point 6 in Figure 17.

7.2.7 Seating Reference Point (SgRP)

See 3.4.8. Illustrated as Point 7 in Figure 17.

7.2.8 Rearmost – Achievable H-point (RAP)

Is the rearmost H-point location within the travel path, using all seat adjustments. Illustrated as Point 8 in Figure 17.

7.2.9 Foremost – Achievable H-point (FAP)

Is the foremost location within the travel path, using all seat adjustments. Illustrated as Point 9 in Figure 17.

8. SEAT PACKAGE DIMENSIONS

Dimensions defined in Table 22 are retained in this publication. They are used to define the spatial relationship of an occupant position relative to the seat. Metrics used to quantify seat characteristics, or to evaluate a specific seat design are found in SAE J2732.

9. CARGO DIMENSIONS AND CARGO VOLUME INDICES

The cargo dimensions and volume indices provide estimates of cargo, passenger, and vehicle compartment size. As with all measurements in this document, they were developed to assist during the design and engineering of a vehicle.

Discrete measurements of irregular spaces – such as the point-to-point measurements made of a vehicle's interior – are often ambiguous to interpret. The procedures provided are intended to be applied to the normal design surfaces, excluding local protrusions, depressions, and pockets.

Tables 27 through 29 contain the codes and definitions for cargo dimensions related to the cargo volume indices. Cargo dimensions in the row of measure, are determined with the seat positioned at the Seating Reference Point (SgRP), as described in Table 7. The head restraints shall be in the stowed position and considered part of the seat. For cargo dimensions measured along the floor, the cargo floor to the rear of the forward measurement point should be unobstructed. Seats to the rear of the forward measurement point must be in their stowed or cargo optimized position. If there is an obstruction, such as that caused by a second row seat being folded up to the rear of the front seat, the measurement is taken from the most rearward surface of the limiting obstruction.

All cargo dimensions that reference the cargo floor use the same floor surface. The cargo floor for the base vehicle may be different from the cargo floor for the same vehicle with optional content. This may result in multiple values for some dimensions (e.g. L202, W201, H201, etc.). When calculating cargo volume behind an optional row of seats, dimensions to the cargo floor and the associated cargo volumes must be calculated separately from the base vehicle.

Table 31 lists the codes and formulas for cargo volume indices (CVI); Table 32 for passenger volume indices (PVI); and Table 33 for interior volume indices (IVI).

The indices are all calculated using the same basic formula:

$$\frac{\text{Length} \times \text{Width} \times \text{Height}}{10^6} = \text{Liters} \quad (\text{Eq. 1})$$

In the formulas, the suffix indicating measurement row is separated from the code by a tilde (~) rather than a dash (i.e., L204~1, W3~2 rather than L204-1 or W3-2) to avoid confusion with a minus sign.

NOTE: In order to calculate the volume indices in English units, the formula is:

$$\frac{\text{Length(inches)} \times \text{Width(inches)} \times \text{Height(inches)}}{1728} = \text{ft}^3 \quad (\text{Eq. 2})$$

Or if dimensions were measured in metric units use: Liters / 28.32 = ft³

9.1 Cargo Volume Indices (CVI)

The intent of the cargo volume indices is to provide reasonable estimates of the cargo compartment potential. They do not yield actual cargo volumes. Further, although due care has been taken to clarify the dimensions used in the calculations, it is possible that innovations to interior design will result in equivocal interpretations. The CVI calculations for V6, V7, V9, V16 and V17 are based on a cargo area that is open and accessible to the passenger compartment. Stowage or convenience areas under the cargo floor, or behind access doors or panels, are not included.

The definitions provided in Table 31 indicate the L dimensions to use for length, the W dimensions to use for width and the H dimensions to use for height. Measurements are taken in millimeters. In Table 31, the maximum cargo volume index behind the front seat represents the maximum cargo volume potential for the vehicle.

9.2 Passenger Volume Indices (PVI)

The intent of the passenger volume indices is to provide reasonable estimates of the passenger compartment volume potential. The PVI calculations are based on those used by the Environmental Protection Agency (EPA) in regulation 40CFR600.315-08 to classify vehicles, and by the National Highway Traffic and Safety Administration (NHTSA) in 49CFR523.2. EPA refers to PVI as seat volume.

The definitions provided in Table 32 indicate the L dimensions to use for length, the W dimensions to use for width and the H dimensions to use for height. Measurements are taken in millimeters.

9.3 Interior Volume Indices (IVI)

The intent of the interior volume indices is to provide reasonable estimates of the passenger compartment volume potential of a standard seating configuration, plus the cargo volume potential of the remaining space. The standard seating configuration consists of all rows of seats that are standard equipment on the base vehicle. When determining the IVI, rows of optional seats are not included. For passenger vehicles, IVI emulates the definitions provided by the EPA as cited in section 9.2. For nonpassenger vehicles, IVI provides a method to quantify the enclosed interior spaces and configurations available. For the purposes of these definitions, enclosed volume means that the space is open and accessible to the passenger compartment. When determining the IVI for pickups, the open air cargo volume index, V5, is not included. See Table 33.

10. LUGGAGE CAPACITY AND DIMENSIONS

The luggage capacity will be measured with the use of simulated luggage in a luggage compartment separate from the passenger compartment. The luggage set is defined in Table 8. Except for Item G (Golf Bag), the simulated luggage pieces are solid rectangular objects with corner radii up to 5 mm. Additionally, items A through F have a fixed, non-deformable handle centered on one face parallel to the longitudinal and lateral axes. See Figure 18A. The Golf Bag is defined in Figure 18B. Luggage capacity metrics, V1 and V4, are defined in Table 34. Capacities are determined with all vehicle standard equipment, including spare tires, convertible tops, tool kits, etc., in place and in their intended stored locations, using the following procedure:

Randomly place as many A through G items as possible in the compartment to be measured. H-boxes (Item H) are then used to complete the loading. One or more pieces of the standard luggage set may be removed to place H-boxes, provided the removed luggage pieces can be replaced. For large compartment spaces, one entire set of luggage (A through G) must be used before adding pieces from a subsequent set. If space is available, more than the standard set of 20 H-boxes may be used. The trunk lid or other access door must close and latch freely after the luggage is fitted.

TABLE 8 - LUGGAGE SET

Simulated Luggage Pieces		No. pieces/set	Size (in mm)	Liters ⁽¹⁾
Item	Description		L x W x H	
A	Men's 2-Suiter	4	610 x 229 x 483	67
B	Small Overnight	4	457 x 165 x 330	25
C	Pullman	2	660 x 229 x 406	61
D	Wardrobe	2	533 x 216 x 457	53
E	Train Case	2	381 x 203 x 229	18
F	Large Overnight	2	533 x 178 x 356	34
G	Golf Bag, containing: 2 woods, 4 irons, 1 putter, 3 golf balls, 1 pair of golf shoes (size 10 ½)	2	See Figure 18B	43
H	H-boxes	20	325 x 114 x 152	5.6

1. Values are rounded to the nearest liter (except H-box).

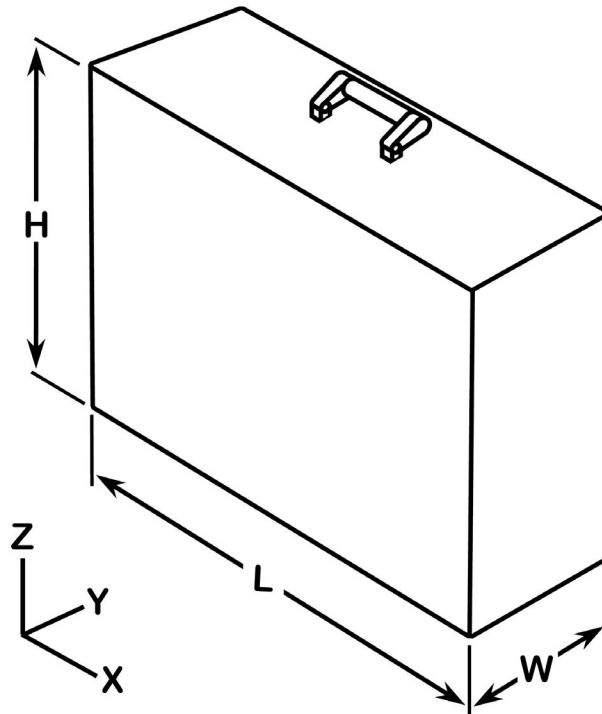


FIGURE 18A - LUGGAGE BOXES A-F