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(R) MOTOR VEHICLE DRIVERS' EYE LOCATIONS —
SAE J941 JUN92   SAE Recommended Practice

Foreword — This SAE Recommended Practice is based on a study involving over 2300 U.S. drivers performing a straight-ahead viewing task without head turning, sitting in seats having fore/aft adjustment and fixed back angles (References 1,2). Elliptical contours were developed from a statistical analysis of the stereophotogrammetric data, using a male-to-female ratio of one-to-one. These contours were given the name Eyellipse, a contraction of the words eye and ellipse. An eyellipse affords a convenient way to represent driver eye locations in a driver workspace in order to determine what drivers can see. In a subsequent study a procedure was developed to position an eyellipse in the driver workspace for various design torso (back) angles ranging from 5 to 40 degrees (Reference 3).

A typical three-dimensional eyellipse is shown in Figure 1. Four different eyellipses are described in this Practice. Each eyellipse was derived as the perimeter of an envelope formed by a infinite number of planes dividing the eye locations so that (P)% of the eyes are on one side of the plane and (100-P) % are on the other. It should be noted that with this derivation the 95th percentile eyellipse will not contain 95% of the eyes inside the ellipse. To illustrate this consider the side view of the eyellipse shown in Figure 2. If a plane seen as a straight line in side view is drawn tangent to the upper edge of the 95th percentile eyellipse, then 95% of the driver eye locations, whether inside or outside the ellipse, will be below the line and 5% of the driver eye locations will be above the line. Further, if a similar plane is drawn tangent to the lower edge of the 95th percentile eyellipse, then 95% of the driver eye locations, whether inside or outside the ellipse, will be above the line and 5% will be below the line. The 95th and the 99th percentile eyellipses are defined in this document and are shown in plan and side view in Figure 3.[1]

Fixed Seat Eyellipses — The eyellipses defined in this practice are valid for seats having horizontal track travel of at least 100 mm. Eyellipses have been developed for seats having no horizontal adjustment (fixed seats), but are not defined here (References 3,4).

Class A and Class B Vehicles — In this practice there are two different procedures for locating an eyellipse, depending on whether or not the driver workspace is like that found in a passenger car or a heavy truck. The need for two different procedures has led to a vehicle classification scheme which labels vehicles as either Class A (passenger cars) or Class B (heavy trucks) according to definitions given in SAE J1100 (Reference 5) and repeated in Tables 2 and 3 in this document.

Rationale for a different locating procedure for Class B vehicles is based on an SAE study of truck-driver eye locations in three heavy truck cab configurations having 381 mm of horizontal seat travel (References 6,7). It was found that an elliptical model having the same axes lengths as the eyellipses previously developed for Class A vehicles provided a good fit to the truck driver eye position data, regardless of the population mix of male or female truck drivers. However, the location of the eyellipse centroid and the slope of the major axis in side view would not be predicted using the location procedure for Class A vehicles (Reference 8). Therefore, a different eyellipse locating procedure was developed for Class B vehicles and is described in Section 5.

New in this Revision. Recent studies in contemporary vehicles have indicated a need to remove the lean factor from the eyellipse lateral positioning procedure and to reduce from 6 to 2 the number of eyellipses for different lengths of horizontal seat track travel (References 4,9,10). Both of these changes have been incorporated in this revision.

Selected eye (E) points and their associated neck pivot (P) points have been defined for Class A vehicles in this revision. These points may be used in lieu of the complete 95th eyellipse to facilitate determination of drivers' field of view for certain viewing tasks (References 11,12). Similar points have not been defined for Class B vehicles.

A most significant revision has been to provide information needed to construct eyellipses in three dimensions (Reference 13). This was necessitated by the increasing use of computer modeling in occupant packaging practices. The use of two-dimensional templates is now described in Appendix A.

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[1] Plan view eyellipses in Figures 3,5,6,8,9,11 are oriented for a left-hand drive vehicle.

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1. Scope — This SAE Recommended Practice establishes the location of drivers' eyes inside a vehicle for the purpose of measuring the drivers' field of view. Elliptical (eyellipse) models in both two and three dimensions are used to represent 95th and 99th percentiles of driver eye locations. The procedure used to locate eyellipses in passenger cars differs from the procedure used for heavy trucks. Selected eye (E) points, useful in certain viewing tasks, are derived from the 95th eyellipse. For application of this Practice refer to SAE J1050 (Reference 14).

2. References and Definitions

2.1 Applicable Documents — The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

1. J.F. Meldrum (1965), "Automobile Driver Eye Position," Paper 650464, SAE Mid-Year Meeting, Chicago, IL.
2. J.F. Meldrum (1965), "Driver Eye Position," Human Factors Research Department, Automotive Safety Office, Ford Motor Company, Dearborn, MI.
3. D.C. Hammond and R.W. Roe (1972), "Driver Head and Eye Positions," Paper 720200, SAE Annual Congress, Detroit, MI.
4. R.W. Roe (1975), "Describing the Driver's Workspace: Eye, Head, Knee, and Seat Positions," Paper 750356, SAE Annual Congress, Detroit, MI.
5. SAE J1100, "Motor Vehicle Dimensions," SAE Handbook, Vol. 4, SAE, Warrendale, PA.
6. M.S. Sanders (1983), "U.S. Truck Driver Anthropometric and Truck Workspace Data Survey," Final Report submitted to SAE, Warrendale, PA.
7. B.E. Shaw and M.S. Sanders (1984), "Female U.S. Truck Driver Anthropometric and Truck Workspace Data Survey," Final Report submitted to SAE, Warrendale, PA.
8. N.L. Philippart and T.J. Kuechenmeister (1985), "Describing the Truck Driver Workspace," Paper 852317 (in SAE Special Publ. 712), SAE Truck & Bus Meeting, Chicago, IL.
9. N.S. Lee and L.W. Schneider (1988), "A Preliminary Investigation of Driver's Lean on Late Model Vehicles with Bench and Bucket Seats," Report to General Motors Corp., CPC Engineering, Pontiac, MI.
10. R.W. Roe (1989), "Data to Support Revisions to SAE 941," Letter to SAE Driver Vision Committee, Troy, MI.
11. W.A. Devlin and R.W. Roe (1968), "The Eyellipse and Considerations in the Driver's Forward Field of View," Paper 680105, SAE Annual Congress, Detroit, MI.
12. W.A. Devlin (1975), "Visibility Design Guide," Proposed SAE Recommended Practice (also, ISO/TC159/SC4(USA1)6), SAE Driver Vision Committee, Troy, MI.
13. A.J. Arnold (1989), "3-D Eyellipse Dimensions," Letter to SAE Driver Vision Committee, Troy, MI.
14. SAE J1050, "Motor Vehicle Driver and Passenger Head Position," SAE Handbook, Vol. 4, SAE, Warrendale, PA.
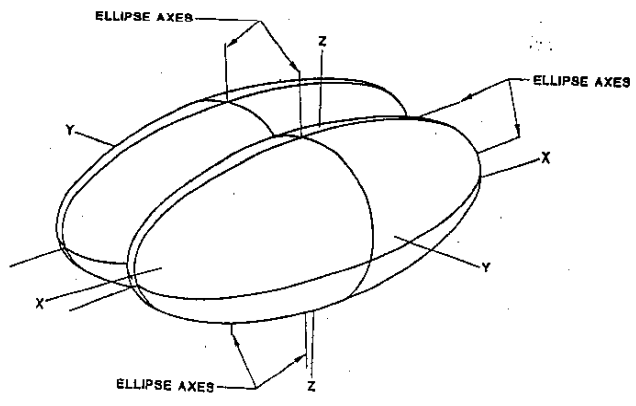
FIGURE 1—TYPICAL 3-DIMENSIONAL EYELLIPSE (BOTH LEFT AND RIGHT EYELLIPSES ARE SHOWN)
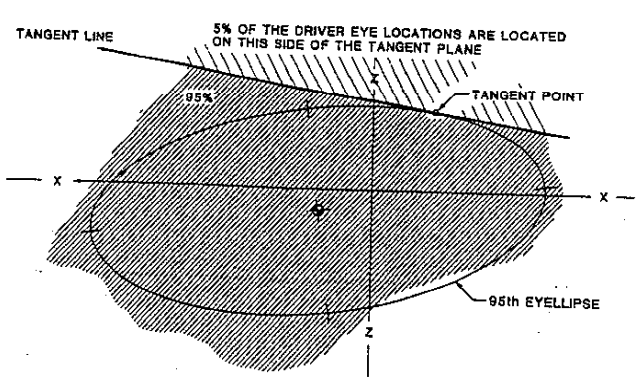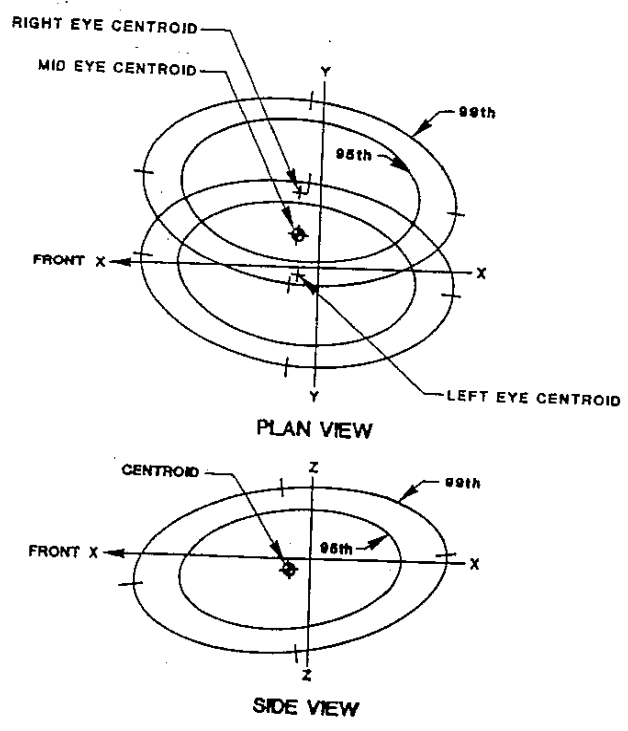

FIGURE 2—TANGENT PLANE

PLAN VIEW

SIDE VIEW

FIGURE 3—TYPICAL PLAN AND SIDE VIEW EYELLIPSES

15. SAE J1517, "Driver Selected Seat Position," SAE Handbook, Vol. 4, SAE, Warrendale, PA.

16. SAE J1516, "Accommodation Tool Reference Point," SAE Handbook, Vol. 4, SAE, Warrendale, PA.

2.2 Definitions

2.2.1 EYELLIPSE—The contraction of the words "eye" and "ellipse" used to describe a statistically derived elliptical model representing driver eye locations in road vehicles (Figures 1 and 3).

2.2.2 EYE POINTS ("E" POINTS)—Two points which represent the left and right eyes of the driver. They are 65 mm apart, are derived from the 95th eyellipse, and are used in conjunction with a Neck Pivot Point (Figure 7).

2.2.3 NECK PIVOT POINT ("P" POINT)—A point about which the driver's head turns on a horizontal plane. Four P Points are defined, each of which is 98 mm rearward of the midpoint between its eye points (Figures 6 and 7).

2.2.3.1 P1 and P2 are used in measuring the driver's binocular obstruction due to the nearest or farthest A-pillars, respectively.

2.2.3.2 P3 and P4 are used in measuring fields of view through rearview mirrors located to the driver's inboard or outboard side, respectively.

2.2.3.3 No P Points have been defined to rotate the driver's head up or down.

2.2.4 EYELLIPSE TEMPLATES—Drafting tools to aid in drawing plan and side view eyellipses at the correct location and orientation (Figure 9 and Appendix A).

2.2.5 EYELLIPSE LOCATOR LINE—A line in side view defining eyellipse x and z location as a function of design seat torso angle (Figure 12).

2.2.6 EYELLIPSE AND HEAD POSITION LOCATOR LINE TEMPLATE—A drafting tool for positioning the eyellipse and head contour in side view as a function of design seat torso angle (Figure 10 and Appendix A).

3. Mathematical Description of 3-D Eyellipses—In this document 95th and 99th percentile eyellipses are defined for each of two different ranges of fore/aft seat track travel (L23). Eyellipses can be constructed in three dimensions using the following information (Figure 4):

3.1 Axes Lengths—Dimensions for the length of the 3 axes in true view for the four eyellipses are as shown in Table 1:

TABLE 1—3 AXES IN TRUE VIEW FOR THE FOUR EYELLIPSES

Seat Track Travel (L23)=	95th Eyellipse 100 to 133 mm	95th Eyellipse >133 mm	99th Eyellipse 100 to 133 mm	99th Eyellipse >133 mm
AXIS				
X	173.8	198.9	242.1	268.2
Y	105.0	104.9	149.0	148.9
Z	86.0	86.0	122.0	122.0

NOTE—The X-axis of both 95th and 99th eyellipses is about 25 mm longer for seat track travel in excess of 133 mm. The effect of the longer track travel is to stretch the front of the eyellipse forward in the workspace without changing the location of the rear.

3.2 Centroids—The centroid of each eyellipse is located at the midpoint of the 3 axes.

3.3 Left and Right Eyes—Eyellipses for the left and right eyes are identical except that their centroids are separated horizontally by 65 mm. A single mid-eye centroid (a cyclopean eye) is located 32.5 mm from the centroid of either eyellipse.

3.4 Ellipsoid Surface vs. Three Axial Sections—The user may construct either a complete ellipsoidal surface or a 3-D ellipse containing only the 3 axial sections defining plan, side and rear views. Use of the ellipsoidal surface gives the greatest accuracy.

4. Procedure for Class A Vehicles—This procedure is applicable to Class A vehicles, which are defined as passenger cars, multipurpose vehicles, trucks, or buses with the following range of driver workspace dimensions as shown in Table 2: (Figure 5)

NOTE—All values in the following equations have units of millimeters except L40 which is in degrees. Equation coefficients provide accuracy to ± 0.05 mm.

4.1 3-D Eyellipse Locating Procedure

4.1.1 LOCATE SgRP—Determine a design H-Point (SgRP), preferably using the procedure for 95% accommodation in Class A vehicles given in SAE J1517 (References 10,15). The (X,Y,Z) coordinates of the SgRP are L31, W20, and H70. Note that W20 must be made a negative number for left-hand drive vehicles.

4.1.2 DETERMINE L40—The design torso angle, L40, is specified by the manufacturer.

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TABLE 2—RANGE OF DRIVER WORKSPACE DIMENSIONS—CLASS A VEHICLES

(H30) SgRP to Heel - Vertical	127 to 405 mm
(H59) H-Point Rise	0 to 50 mm
(L23) Seat Track Travel	more than 100 mm
(W9) Steering Wheel Diameter	more than 450 mm
(L40) Torso Angle	5 to 40 degrees

4.1.3 SELECT AN EYELLIPSE—Determine the seat track travel and select the appropriate 95th or 99th eyellipse.

4.1.4 LOCATE CENTROID—The eyellipse centroid is located to the vehicle's three-dimensional reference system. The left and right eyellipse centroids are calculated as follows:

a. For seat track travel (L23) greater than 133 mm:

$X = L31 - 259.91472 + 10.281641*(L40) - 0.032032*(L40)^2$ (Eq. 1)
(left eye) $Y = W20 - 32.5$ (Eq. 2)
(right eye) $Y = W20 + 32.5$ (Eq. 3)
$Z = H70 + 653.71757 + 0.398747*(L40) - 0.059301*(L40)^2$ (Eq. 4)

b. For seat track travel (L23) from 100 to 133 mm:

$X = L31 - 247.71472 + 10.281641*(L40) - 0.032032*(L40)^2$ (Eq. 5)
(left eye) $Y = W20 - 32.5$ (Eq. 6)
(right eye) $Y = W20 + 32.5$ (Eq. 7)
$Z = H70 + 655.01757 + 0.398747*(L40) - 0.059301*(L40)^2$ (Eq. 8)

4.1.5 ORIENT AXES—Separately rotate each eyellipse about its centroid so the X-axis is inward 5.4 degrees (looking forward) in plan view and down 6.4 degrees (looking forward) in side view.

4.2 Neck Pivot (P) and Eye (E) Points—Locating Procedure (Figures 6 and 7)

4.2.1 DETERMINE SgRP AND L40—See 4.1.1 and 4.1.2.

4.2.2 LOCATE P1 AND P2—These neck pivot points are linked to eye points near the front of a 95th eyellipse. P1 and P2 points are defined for each 95th eyellipse. Use the P1 and P2 points that correspond to the length of your seat track travel (L23). P1 and P2 points have the same Z coordinate.

The X coordinate of P1 and P2 depends on seat track travel.

a. For L23 from 100 to 133 mm

(P1) $X = L31 - 224.01472 + 10.281641*(L40) - 0.032032*(L40)^2$ (Eq. 9)
(P2) $X = X(\text{of P1}) + 28$ (Eq. 10)

b. For L23 greater than 133 mm

(P1) $X = L31 - 250.01472 + 10.281641*(L40) - 0.032032*(L40)^2$ (Eq. 11)
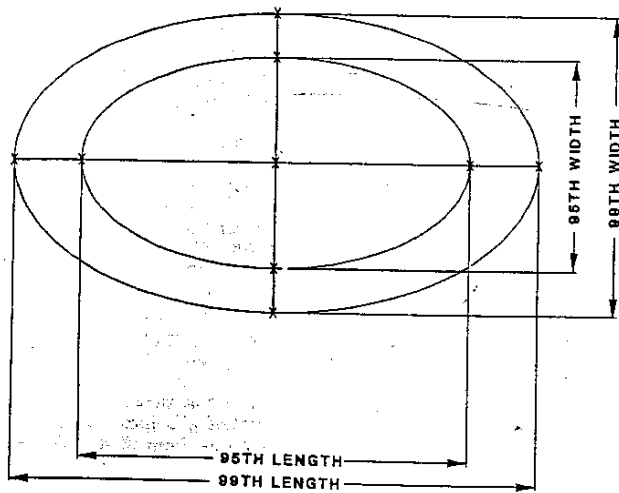(P2) $X = X(\text{of P1}) + 28$ (Eq. 12)

The Y and Z coordinates of P1 and P2 do not depend on seat track travel.

(P1) $Y = W20 - 20$ (Eq. 13)
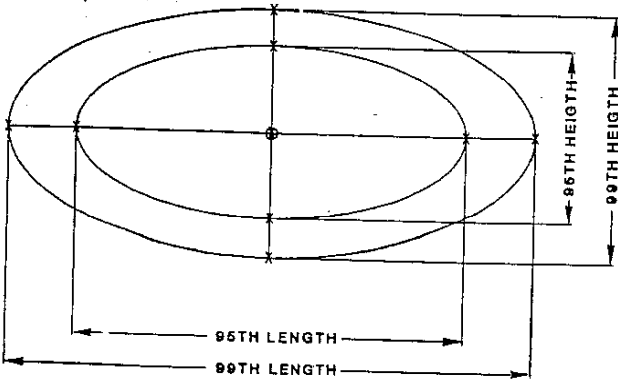(P2) $Y = W20 + 47$ (Eq. 14)
(P1 & P2) $Z = H70 + 654.11757 + 0.398747*(L40) - 0.059301*(L40)^2$ (Eq. 15)

TRUE PLAN VIEW

L23	95TH EYELLIPSE		99TH EYELLIPSE	
	100 to 133 mm	>133 mm	100 to 133 mm	>133 mm
LENGTH	173.8	198.9	242.1	268.2
WIDTH	105.0	104.9	149.0	148.9
HEIGHT	86.0	86.0	122.0	122.0

NOTE: INTERPUPILLARY DISTANCE 65mm

TRUE SIDE VIEW

TRUE REAR VIEW

FIGURE 4—LENGTH, HEIGHT AND WIDTH OF 3-D EYELLIPSE (LEFT OR RIGHT EYE)

NOTE—For right-hand drive, use +20 and -47 in the Y equations.
4.2.3 LOCATE P3 AND P4—These neck points are linked to eye points at the rear of a 95th eyellipse and are valid for any seat track travel greater than 100 mm. Their X and Z coordinates are identical.

(P3 & P4) X = L31 − 87.01472 + 10.281641*(L40) − 0.032032*(L40)^2 (Eq. 16)

(P3) Y = W20 − 40 (Eq. 17)

(P4) Y = W20 + 31 (Eq. 18)

(P3 & P4) Z = H70 + 662.11757 + 0.398747*(L40) − 0.059301*(L40)^2 (Eq. 19)

NOTE—For right-hand drive, use +40 and -31 in the Y equations.
4.2.4 LOCATE E POINTS—E points are positioned relative to any P point as follows:

X = X(P) − 98

(E$_L$) Y = Y(P) − 32.5 (left eye) (Eq. 20)

(E$_R$) Y = Y(P) + 32.5 (right eye) (Eq. 21)

Z = Z(P) (Eq. 22)

where: (Eq. 23)

X(P), Y(P), Z(P) are the coordinates of the P point.

5. Procedure for Class B Vehicles—This procedure is applicable to Class B vehicles, which are defined as trucks, buses, or multipurpose vehicles with the following range of driver workspace dimensions as shown in Table 3: (Figure 6)

TABLE 3—RANGE OF DRIVER WORKSPACE DIMENSIONS—CLASS B VEHICLES

(H30)	SgRP to Heel - Vertical	405 to 530 mm
(H59)	H-Point Rise	0 mm
(L23)	Seat Track Travel	more than 100 mm
(W9)	Steering Wheel Diameter	450 to 560 mm
(L40)	Torso Angle	11 to 18 degrees

5.1 3-D Eyellipse Locating Procedure

5.1.1 LOCATE ATRP—Determine the Accommodation Tool Reference Point (ATRP) using the procedure for Class B vehicles given in SAE J1516. The X and Z coordinates of the ATRP are X(ATRP) and Z(ATRP).

5.1.2 DETERMINE L40—The design torso angle, L40, is specified by the manufacturer.

5.1.3 SELECT AN EYELLIPSE—Determine the seat track travel (L23) and select the appropriate 95th or 99th eyellipse.

5.1.4 LOCATE CENTROID—The eyellipse centroid is located to the vehicle's three-dimensional reference system. The following equations locate the centroid as a function of design torso angle for three different male/female mixes (50/50, 75/25, 90/10 to 95/5) in the driver population. Select the same male/female mix that was used in determining the ATRP. All values are in millimeters except L40 which is in degrees.
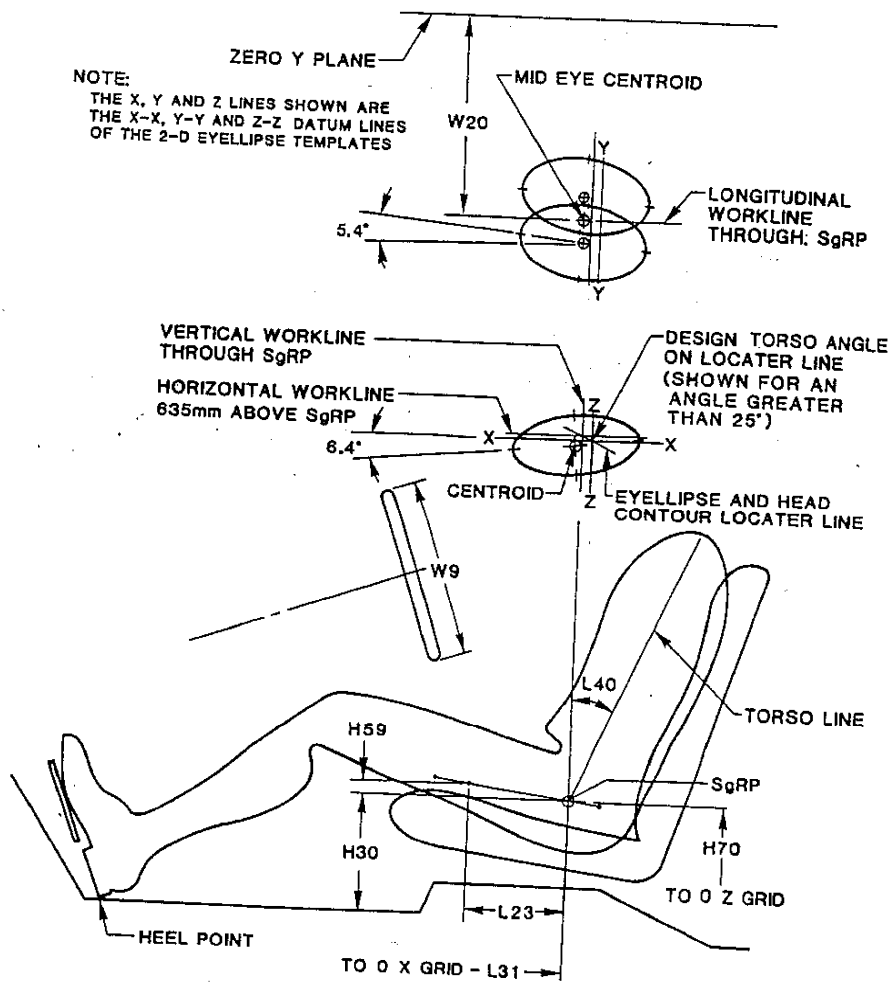
NOTE:
THE X, Y AND Z LINES SHOWN ARE THE X-X, Y-Y AND Z-Z DATUM LINES OF THE 2-D EYELLIPSE TEMPLATES

ZERO Y PLANE

MID EYE CENTROID

W20

5.4°

LONGITUDINAL WORKLINE THROUGH SgRP

VERTICAL WORKLINE THROUGH SgRP

HORIZONTAL WORKLINE 635mm ABOVE SgRP

6.4°

CENTROID

DESIGN TORSO ANGLE ON LOCATER LINE (SHOWN FOR AN ANGLE GREATER THAN 25°)

EYELLIPSE AND HEAD CONTOUR LOCATER LINE

W9

L40

TORSO LINE

H59

SgRP

H30

H70

TO 0 Z GRID

HEEL POINT

L23

TO 0 X GRID - L31

FIGURE 5—EYELLIPSE LOCATION IN CLASS A VEHICLES
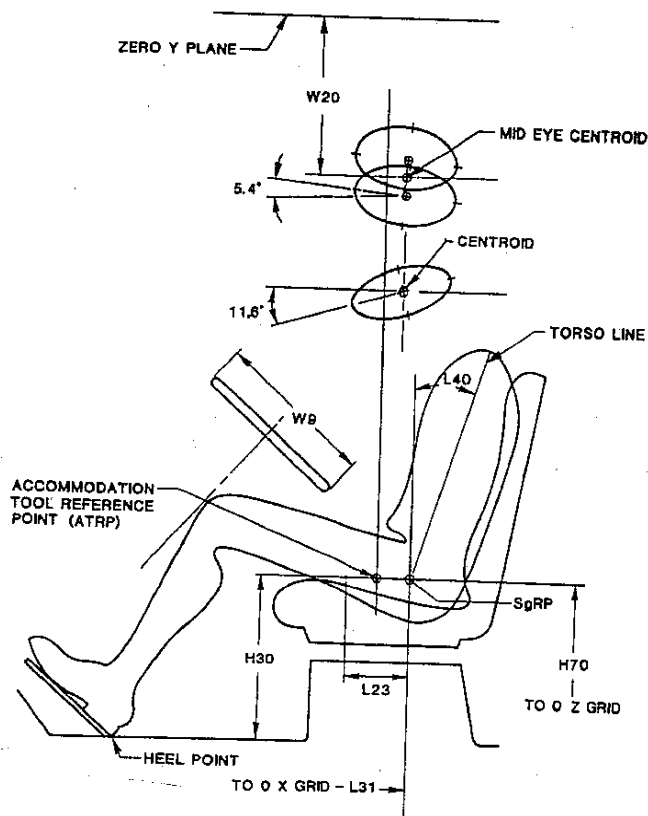
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FIGURE 6—EYELLIPSE LOCATION IN CLASS B VEHICLES

a. For a 50/50 male/female ratio:

$$X = X(ATRP) - 175.26 + 12.68*(L40) \quad \text{(Eq. 24)}$$
$$Z = Z(ATRP) + 691.09 - 3.57*(L40) \quad \text{(Eq. 25)}$$

b. For a 75/25 male/female ratio:

$$X = X(ATRP) - 201.05 + 13.65*(L40) \quad \text{(Eq. 26)}$$
$$Z = Z(ATRP) + 699.66 - 3.82*(L40) \quad \text{(Eq. 27)}$$

c. For a 90/10 to 95/5 male/female ratio:

$$X = X(ATRP) - 184.44 + 12.23*(L40) \quad \text{(Eq. 28)}$$
$$Z = Z(ATRP) + 707.52 - 4.17*(L40) \quad \text{(Eq. 29)}$$

In each case the Y coordinate of the left and right eyellipse centroids is given by:

$$(\text{left}) \ Y = W20 - 32.5 \quad \text{(Eq. 30)}$$
$$(\text{right}) \ Y = W20 + 32.5 \quad \text{(Eq. 31)}$$

where:

W20 must be made a negative number for left-hand drive vehicles.

5.1.5 ORIENT AXES—Separately rotate each eyellipse about its centroid so the X-axis is inward 5.4 degrees (looking forward) in plan view and down 11.6 degrees (looking forward) in side view.

5.2 P and E Points—These points have not been defined for Class B vehicles.

APPENDIX A

A.1 2-D Eyellipse Templates

A.1.1 Description and Availability—There are two sets of plan and side view templates described in this document, representing two different lengths of seat track travel (L23). One set of templates is used for track travels from 100 to 133 mm and is marked with the L23 value of 5.0. The other set is used for track travels greater than 133 mm and is marked with a 6.5 value. The eyellipse templates are shown in Figure 9. Each template contains a 95th and a 99th eyellipse. An eyellipse and head position locator template, which positions the eyellipse for various

design torso angles (L40), is shown in Figure 10. These templates can be obtained from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

A.1.2 Mathematical Description of the 2-D Eyellipse—Four 2-D eyellipses may be constructed using the following information: (Figure 11)

A.1.2.1 AXES LENGTHS—Dimensions for the true length of the major and minor axes are as shown in Table A1:

NOTE—Since the ellipse major axis is skewed approximately the same amount in both side and plan view, its length is essentially the same in either view for the given seat travel, and about 1 mm shorter than the three-dimensional eyellipse major axis.

A.1.2.2 ORIENTATION—See Section 4.1.5 for Class A vehicles and 5.1.5 for Class B vehicles.

A.1.2.3 LEFT AND RIGHT EYELLIPSE CENTROIDS—In plan view the mid-eye centroid is positioned over the centerline of driver (Y = W20). The horizontal distance between the left and right eyellipse centroids is 64.1 mm for shorter seat track travels (L23 = 100 to 133 mm) and 64.6 mm for longer seat track travels (L23 > 133 mm). In developing the three-dimensional eyellipses, the interpupillary distance was adjusted to 65 mm. Because the two-dimensional plan view templates have not been changed, eyellipse applications could yield results which differ very slightly depending on whether a two-dimensional template or a three-dimensional eyellipse was used (Reference 13).

A.1.2.4 TEMPLATE DATUM LINES—An eyellipse template is located in the vehicle interior by longitudinal (X-X), lateral (Y-Y), and vertical (Z-Z) datum lines which are shown on the eyellipse templates (Figure 9). The datum lines are not the eyellipse axes; they are reference lines to aid in positioning and orienting an eyellipse into the workspace. The distance from the template datum lines to the eyellipse centroids differs for the two sets of templates as shown in Table A2:

NOTE: The "y" values assume the template is used with a left-hand drive vehicle. For right-hand drive, invert the sign of all y values and in-

terchange the values for left and right eyes.

A.2 2-D Eyellipse Template Locating Procedure—Class A Vehicles

A.2.1 Locating a Side View Eyellipse Template

A.2.1.1 DETERMINE SgRP AND L40—Use of a design H-Point (SgRP) at 95% accommodation as defined in SAE J1517 (Reference 15) is recommended. See 4.1.1 and 4.1.2.

A.2.1.2 SELECT AN EYELLIPSE TEMPLATE—Choose the template that comes closest to matching the seat track travel (L23). Use the 5.0 Template for seat track travel from 100 to 133 mm. Use the 6.5 Template when track travel exceeds 133 mm.

A.2.1.3 CONSTRUCT WORKLINES ON LAYOUT—These worklines are used to position the X-X and Z-Z template datum lines. Construct a vertical workline through the SgRP. Construct a horizontal workline 635 mm above SgRP. (If the design torso angle (L40) is 25 degrees, skip to A.2.1.5.)

A.2.1.4 ADJUST FOR TORSO ANGLE—Position the X-X and Z-Z datum lines of the "Eyellipse and Head Position Locator Template" (Figure 10) at the intersection of the worklines constructed in A.2.1.3."

A.2.1.4.1 Locate a point on the "Eyellipse and Head Contour Locator Template" that corresponds to the design torso angle (L40) and construct new horizontal and vertical worklines through that point parallel to the lines constructed in A.2.1.3.

NOTE: Instead of using the locator template, this point can be located relative to SgRP from the following equations (Figure 12):

$$X = -237.01472 + 10.281641*(L40) - 0.032032*(L40)^2 \quad \text{(Eq. A1)}$$
$$Z = 662.11757 + 0.398747*(L40) - 0.059301*(L40)^2 \quad \text{(Eq. A2)}$$

Use of these equations replaces steps A.2.1.3 to A.2.1.4. Rounding of

the equation coefficients will adversely affect their usefulness.

A.2.1.5 DRAW EYELLIPSE—Position the eyellipse template datum lines X-X and Z-Z at the intersection of the worklines and trace the eyellipse outline on the layout.

A.2.2 Locating a Plan View Eyellipse Template

A.2.2.1 SELECT AN EYELLIPSE TEMPLATE—Choose the one that matches the side view selection.

A.2.2.2 CONSTRUCT WORKLINES ON LAYOUT—Construct a lateral workline perpendicular to the vehicle centerline through the vertical workline (projected from side view) that was used in A.2.1.5 to position the Z-Z datum line of the side view eyellipse template.

Construct a longitudinal workline parallel to the vehicle centerline at a Y coordinate of W20. Make W20 a negative number for left-hand drive vehicles.

NOTE: Plan view templates may contain an equation (0.85*W7 + 0.075*W3) to account for driver lean. This equation is no longer used (References 9,10).

A.2.2.3 DRAW EYELLIPSES—Position the Y-Y datum line of the plan view template on the lateral workline and the mid-eye centroid on the longitudinal workline developed in A.2.2.2. This centers the left and right eyellipses over the centerline of driver (W20). Trace the eyellipses on the layout.

NOTE: Before positioning the plan view template for a right-hand drive vehicle, the template must be mirror-imaged about the longitudinal workline (Y = W20), i.e., used upside-down, so that the left and right eyellipses are interchanged and their major axes are angled inboard (looking forward).
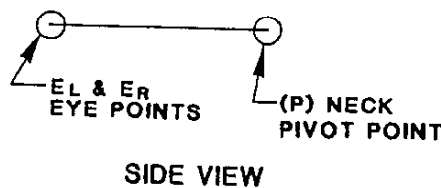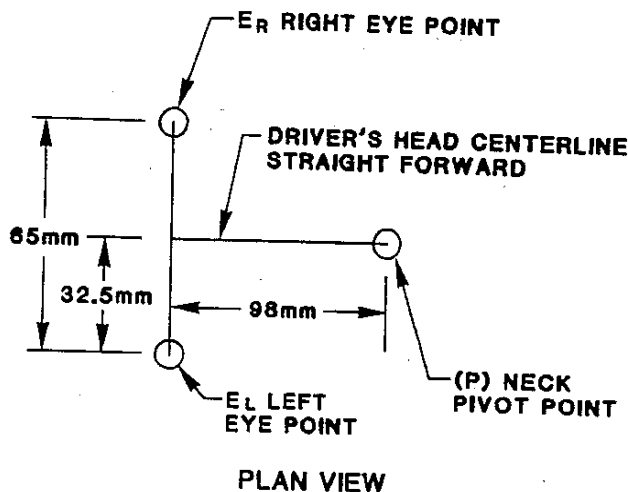
PLAN VIEW

SIDE VIEW

FIGURE 7—E POINTS RELATIVE TO P POINTS

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A.3 2-D Eyellipse Template Locating Procedure—Class B Vehicles— Eyellipse templates for Class A and Class B vehicles are the same. However, the X-X and Z-Z template datum lines cannot be used to orient the eyellipses in side view. The major axis of the eyellipse must be used for orientation.

A.3.1 Locating a Side View Eyellipse Template

A.3.1.1 DETERMINE THE ATRP—See SAE J1516 (Reference 16).

A.3.1.2 SELECT AN EYELLIPSE TEMPLATE—Choose the one that comes closest to matching the seat track travel (L23). Use the 5.0 Template for seat track travel from 100 to 133 mm. Use the 6.5 Template when track travel exceeds 133 mm.

A.3.1.3 LOCATE CENTROID—Use the procedure in 5.1.4 to locate the eyellipse centroid.

A.3.1.4 ORIENT AND DRAW EYELLIPSE—Construct a line through the centroid with a downward sloping angle of 11.6 degrees from horizontal (looking forward). Rotate the major axis of the eyellipse to this line and trace the eyellipse outline on the layout.

A.3.2 Locating a Plan View Eyellipse Template—Use the procedures described in A2.2 for Class A vehicles.
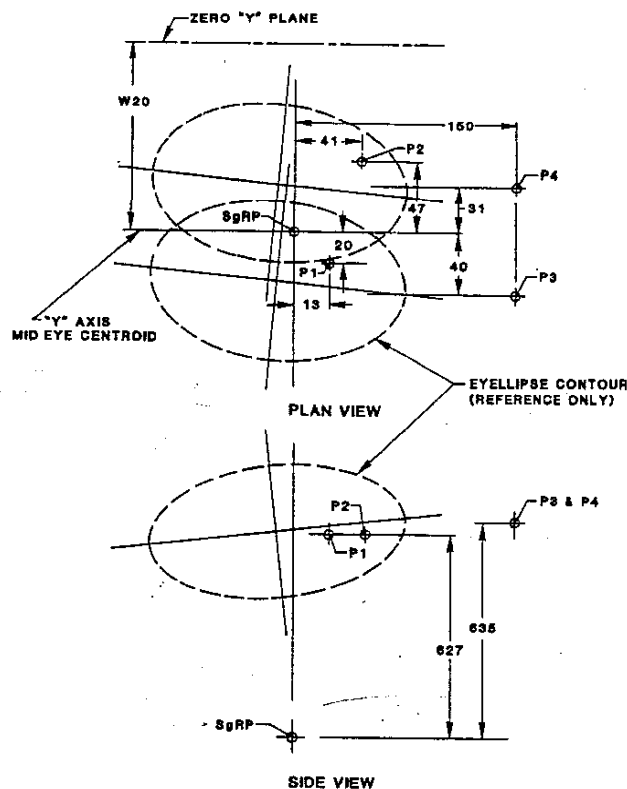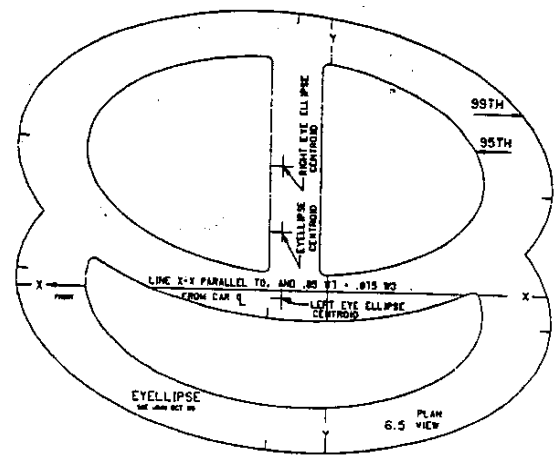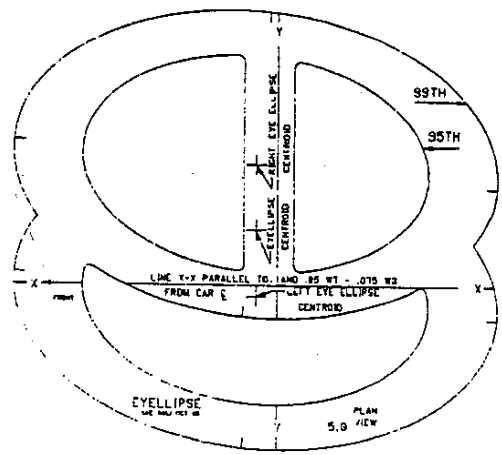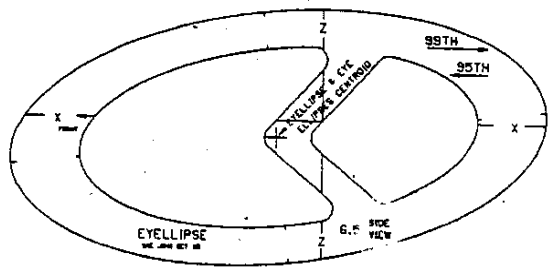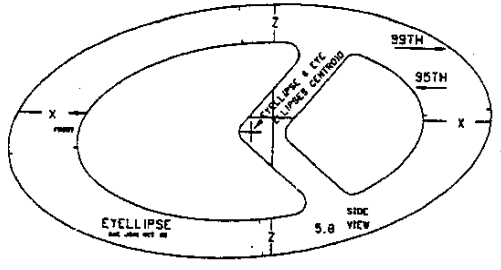

FIGURE 8—P POINTS RELATIVE TO SgRP IN CLASS A
VEHICLES (P1 & P2 ARE SHOWN FOR L23 ≤ 133 mm AND
L40 = 25 °

34.123

NOTE: THE EQUATION FOR PLAN VIEW POSITIONING OF THE
TEMPLATES (.85 W7 & .075 W3) IS NO LONGER USED.

THE 5.0 AND 6.5 INCH TRACK TRAVEL DESIGNATIONS ON THE
TEMPLATES APPLY TO TRACK TRAVELS FROM 100 TO 133mm
AND GREATER THAN 133mm RESPECTIVELY.

TRACK TRAVEL FROM 100 TO 133mm   TRACK TRAVEL GREATER THAN   133mm
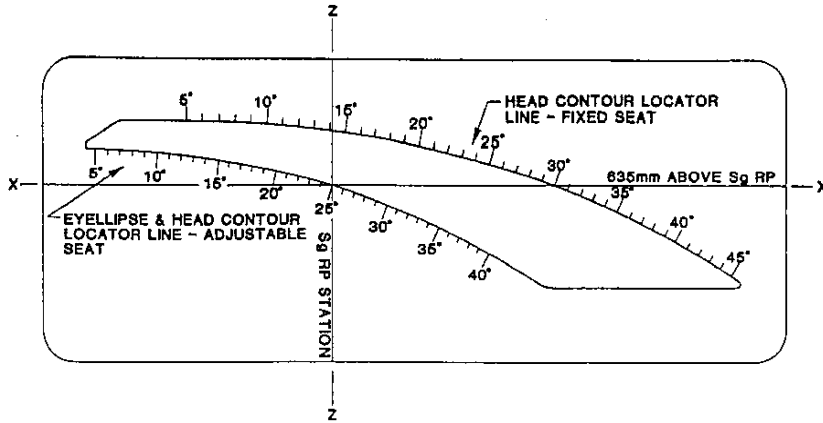
FIGURE 9—2-D EYELLIPSE TEMPLATES

34.124

FIGURE 10—EYELLIPSE AND HEAD CONTOUR LOCATOR LINE TEMPLATE (FIXED SEAT LOCATOR LINE AS USED IN SAE J1052 IS ALSO SHOWN ON THIS TEMPLATE)
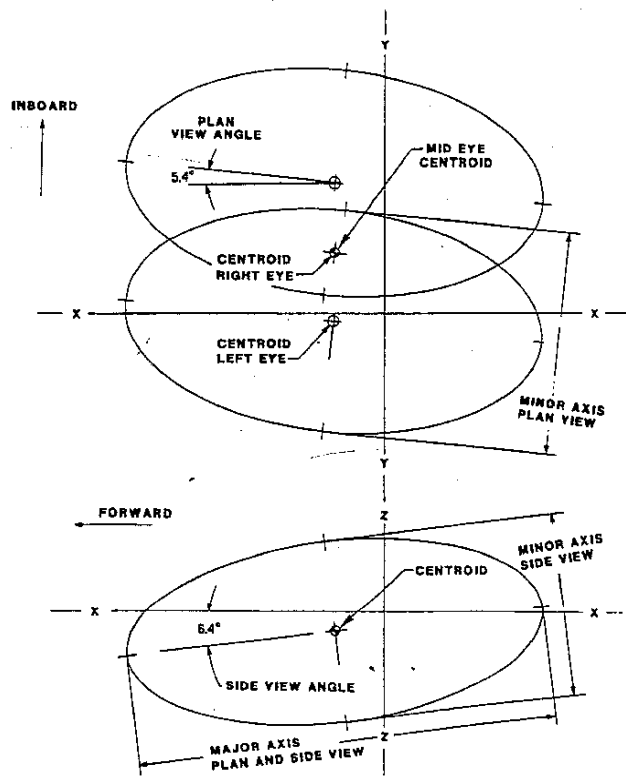

FIGURE 11—MATHEMATICAL DESCRIPTION OF THE 2-D EYELLIPSE IN REFERENCE TO X-X, Y-Y AND Z-Z DATUM LINES FOR CLASS A VEHICLE

34.125

TABLE A1—DIMENSIONS FOR TRUE LENGTH OF THE MAJOR AND MINOR AXES

Seat Track Travel (L23) =	95th Eyellipse 100 to 133 mm	95th Eyellipse >133 mm	99th Eyellipse 100 to 133 mm	99th Eyellipse >133 mm
Major Axis:	173	198	241	287
Minor Axis: Plan View	105	105	149	149
Side View	86	86	122	122

TABLE A2—CENTROIDS RELATIVE TO THE TEMPLATE DATUM LINES

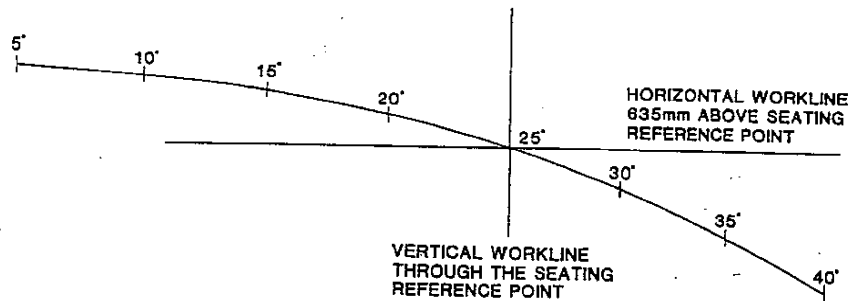|	X	Left Eye	Y Mid-Eye	Right Eye	Z
Seat Track Travel (L23)					
100 to 133 mm (5.0 Template)	-10.7	-5.1	26.95	59.0	-7.1 mm
>133 mm (6.5 Template)	-22.9	-4.1	28.20	60.5	-8.4 mm

FIGURE 12—EYELLIPSE AND HEAD CONTOUR LOCATOR LINE ADJUSTABLE SEAT