12.   COMPLIANCE TEST EXECUTION

12.1   VEHICLE TEST WEIGHT AND ATTITUDE

A.   AS DELIVERED

The "as delivered" condition, or unloaded vehicle weight (UVW), is the vehicle as received at the test site, with 100 percent of all fluid capacities and all tires inflated to the manufacturer's specifications as listed on the vehicle's tire information label or placard.

After the test vehicle is received, fluids shall be added to specified levels or filled to capacity, tires inflated to manufacturer's specifications and the vehicle weight recorded at each wheel to determine the unloaded vehicle weight (UVW). It is preferable to measure all four wheel reactions at the same time or at least assure that the vehicle is kept level during the weighing process. **NOTE:** The scales used to weigh the test vehicle shall be accurate to within 0.1%.

PITCH AND ROLL ANGLES

When the vehicle is in it's "as delivered" condition, locate the vehicle on a flat, horizontal surface to determine the vehicle attitude. This shall be accomplished by measuring the angles relative to a horizontal plane, from front-to-rear and from left-to-right. The front - to-rear angle (pitch) shall be measured along a fixed reference on the driver's and passenger's door sill. Mark where the angle is taken on the door sill. The left-to-right angle (roll) shall also be measured along a fixed reference at the vehicle longitudinal centerline on the front and rear of the vehicle (such as the front and rear bumper or instrument panel and rear deck). Mark where each angle measurement is taken. Record each angle measurement.

B.   FULLY LOADED

The fully loaded condition is the vehicle loaded to its UVW, plus the vehicle's "rated cargo and luggage weight" (RCLW) or 136 kg, whichever is less. The RCLW shall be secured in the luggage/cargo area and centered over the vehicle's longitudinal centerline.

RCLW

For passenger cars, FMVSS 110 requires that the vehicle capacity weight (VCW) and the designated seating capacity (DSC) be recorded on the tire information placard. The information can be used to determine the RCLW as follows:

RCLW = VCW - (68 kg x DSC)

12. COMPLIANCE TEST EXECUTION....Continued

For multipurpose passenger vehicles, trucks and buses, where the VCW is not provided on the label, it can be calculated by the following formula:

VCW = GVW - UVW

RCLW = VCW - (68 kg x DSC)

The vehicle test weight can now be calculated as follows:

CALCULATED TARGET TEST WEIGHT = UVW + RCLW[*]
[*]or 136 kg whichever is less

ACTUAL TEST WEIGHT = CALCULATED TEST WEIGHT
                              (- 4 to - 9 kg)

Load the vehicle with the necessary ballast to achieve the actual test weight. The load placed in the cargo area shall be centered over the longitudinal centerline of the vehicle. The test vehicle should be weighed and the vehicle weight recorded.

PITCH AND ROLL ANGLES

When the vehicle is in it's "fully loaded" condition, locate the vehicle on a flat, horizontal surface to determine the vehicle attitude. This shall be accomplished by measuring the angles relative to a horizontal plane, from front-to-rear and from left-to-right. The front - to-rear angle shall be measured along a fixed reference on the driver's and passenger's door sill. The left-to-right angle shall also be measured along a fixed reference on the vehicle longitudinal centerline at the front and rear of the vehicle. Use the same angle measurement reference locations as for the "as delivered." Record each angle measurement.

C. AS TESTED

The vehicle test attitude (supported off of its suspension), determined by the pitch and roll angles, shall be between the "as delivered" and "fully loaded" attitude of the vehicle. The front-to-rear angle shall be measured along a fixed reference on the driver's and passenger's door sill. The left-to-right angle shall also be measured along a fixed reference on the vehicle's longitudinal centerline at the front and rear of the vehicle. The angle measurement reference location shall be consistent among the "as delivered", "fully loaded", and "as tested". The vehicle attitude shall be fixed with structural support members, so that the vehicle's coordinate system remains fixed while upper interior targets are located, horizontal/vertical approach angles measured and impact tests conducted. The vehicle support fixture must safely allow for the locating, testing and filming of FMH impacts per the requirements of FMVSS 201 and this test procedure.

12. COMPLIANCE TEST EXECUTION....Continued

NOTE REGARDING "SUPPORTED OFF OF ITS SUSPENSION:"

"The regulatory text does not specify whether or not the vehicle is clamped down when not resting on its suspension. Therefore, NHTSA could test the vehicle either clamped or not. NHTSA notes that clamping would make the vehicle body stiffer, and thus is likely to be a worst case condition." (62 FR 16722)

The test vehicle during the conduct of FMVSS 201 compliance testing shall be simply supported off of its suspension.

Prior to the start of the compliance test program, the laboratory shall obtain approval from the COTR for the test vehicle support fixture and methodology.

12.3 APPROACH ANGLES

The regulation defines a range of angles at which the FMH could strike a target located on the upper interior of a vehicle. These angles are referred to as approach angles and are expressed using a specified orthogonal reference system. The direction of travel by the FMH is required to be within the specified range. In addition, a procedure is included that may further limit the horizontal angles for testing the A-pillar and B-pillar and the vertical angles for all components.

The headform launching angle must be within the range specified in Table 1, Approach Angle Limits, as shown on the next page. Details of the procedures used to establish the horizontal and vertical approach angles follow in Sections 12.5 and 12.7, respectively. The launching angle should represent the most severe test condition.

12.   COMPLIANCE TEST EXECUTION....Continued

TABLE 1
APPROACH ANGLE LIMITS

IMPACT ZONES	HORIZONTAL ANGLE	VERTICAL ANGLE
FRONT HEADER	180º	0º to 50º
REAR HEADER	0º OR 360º	0º to 50º
LEFT SIDE RAIL	270º	0º to 50º
RIGHT SIDE RAIL	90º	0º to 50º
LEFT SLIDING DOOR TRACK	270º	0º to 50º
RIGHT SLIDING DOOR TRACK	90º	0º to 50º
LEFT A-PILLAR	195º to 255º	-5º to 50º
RIGHT A-PILLAR	105º to 165º	-5º to 50º
LEFT B-PILLAR	195º to 345º	-10º to 50º
RIGHT B-PILLAR	15º to 165º	-10º to 50º
OTHER LEFT PILLARS	270º	-10º to 50º
OTHER RIGHT PILLARS	90º	-10º to 50º
LEFT REARMOST PILLAR	270º to 345º	-10º to 50º
RIGHT REARMOST PILLAR	15º to 90º	-10º to 50º
UPPER ROOF	ANY	0º to 50º
OVERHEAD ROLLBAR	0º or 180º	0º to 50º
BRACE/STIFFENER	90º or 270º	0º to 50º
SEAT BELT ANCHORAGES	ANY	0º to 50º

12.4   ESTABLISH HEAD CENTER OF GRAVITY REFERENCE POINTS FOR FRONT AND REAR OUTBOARD DESIGNATED SEATING POSITIONS

Head CG's of the Front and Rear Outboard Designated Seating Positions (S8.13):

CG-F1   Center of gravity of the head for the forward front seat position

CG-F2   Center of gravity of the head for the aft front seat position

CG-R   Center of gravity of the head for a rear seat position

12. COMPLIANCE TEST EXECUTION....Continued

NOTE: CG-F1, CG-F2 and CG-R are reference points established relative to the seating reference point (SgRP) in accordance with S8.12.

All dimensions for determining head cg locations are relative to the seat orientation. All measurements shall be accurate to within ± 5 mm.

A. Establish the seat fore/aft travel for the front seat. Measure the horizontal travel distance, M, of the adjustable front seat(s) in the test vehicle.

B. Establish the Seating Reference Point (SgRP). Manufacturer's SgRP will be supplied by COTR. For reference, OVSC Forms 4 and 4B, Seating Reference Point and Torso Angle Data for FMVSS 201, 202, 203 207 and 210, are included in Section 16, Forms.

C. CG-F2 is located at a point 660 mm upward and 160 mm rearward from the SgRP (Figure 3).

ESTABLISH HEAD CENTER OF GRAVITY (CG)
FRONT OUTBOARD DESIGNATED SEATING POSITION (DSP)

Z

CG-F2

660 mm

VEHICLE FRONT

SgRP

X

160 mm

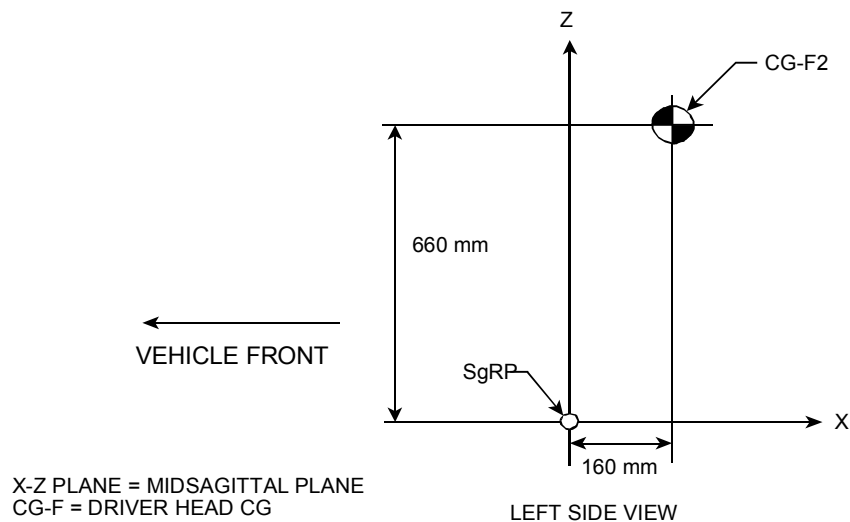X-Z PLANE = MIDSAGITTAL PLANE
CG-F = DRIVER HEAD CG

LEFT SIDE VIEW

FIGURE 3

D. CG-F1 is established by moving the distance M horizontally forward of CG-F2.

E. CG-R represents the rear seat passenger's head CG. As illustrated in Figure 4, CG-R is located 660 mm upward and 160 mm rearward of the SgRP of the rear DSP.

12.   COMPLIANCE TEST EXECUTION....Continued

F.   CG-F1, CG-F2 and CG-R should be established in space with a fixture adjustable in the X, Y, and Z direction.

In addition to defining the horizontal approach angles, the head CG reference locations (CG-F1, CG-F2, CG-R) will be used to determine planes and target points on various upper interior components.

ESTABLISH HEAD CENTER OF GRAVITY (CG)
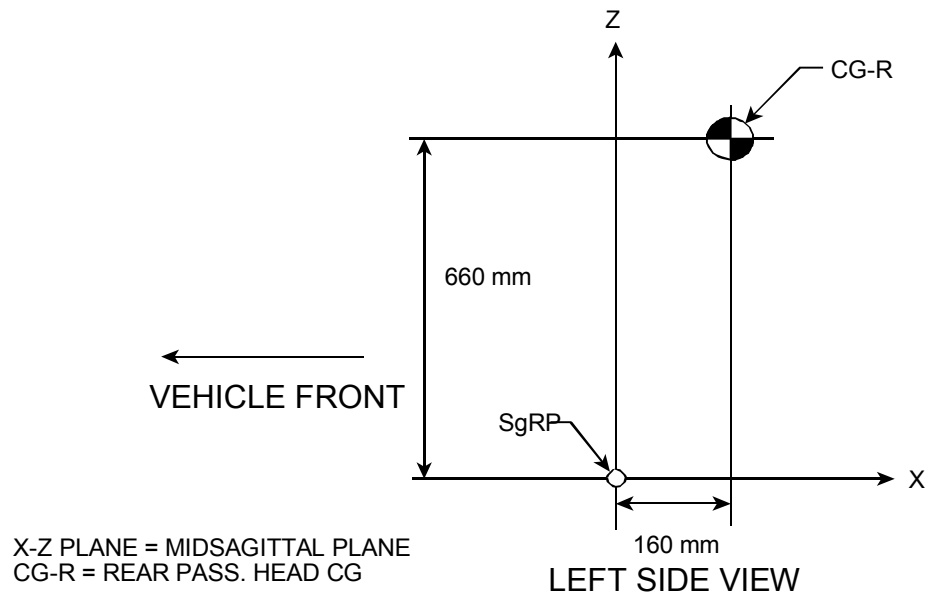**REAR OUTBOARD DESIGNATED SEATING POSITION (DSP)**

Z

CG-R

660 mm

VEHICLE FRONT

SgRP

X

X-Z PLANE = MIDSAGITTAL PLANE
CG-R = REAR PASS. HEAD CG
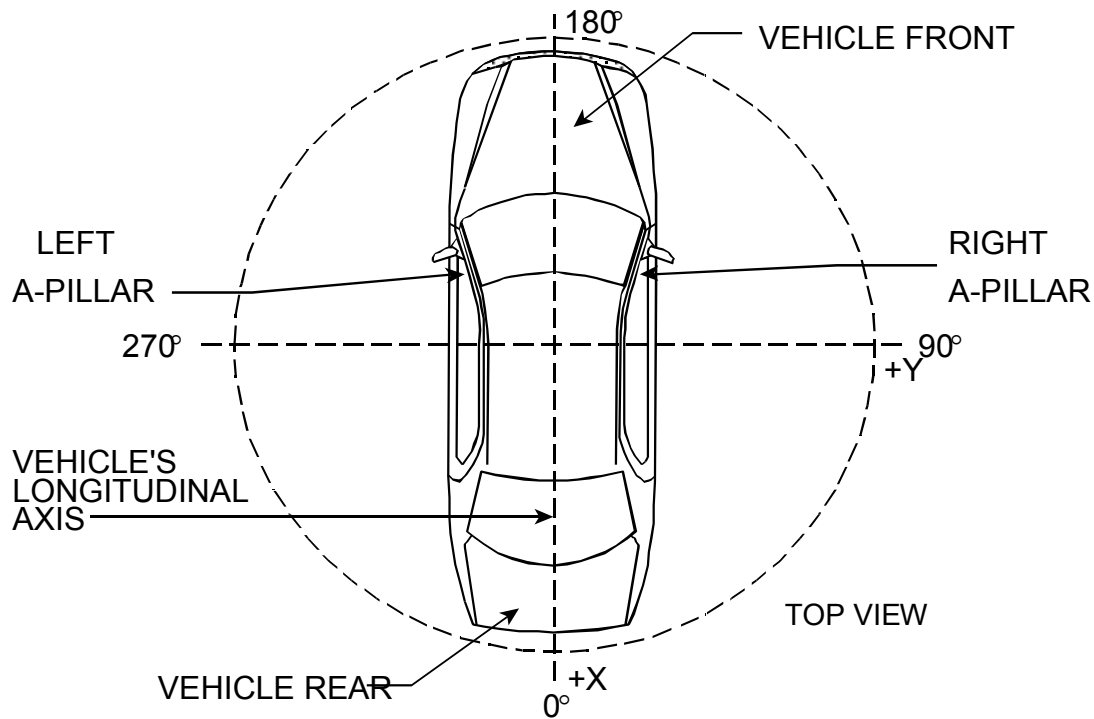
160 mm

LEFT SIDE VIEW

FIGURE 4

FIGURE 5

12.   COMPLIANCE TEST EXECUTION....Continued

12.5   HORIZONTAL APPROACH ANGLES FOR HEADFORM IMPACTS

The headform launching angle is within the limits determined using the procedures specified in this section (S8.13.4.1 and S8.13.4.2), and within the range specified in Table 1, Approach Angle Limits. Record the maximum and minimum horizontal approach angles for the left and right-side A and B-pillars and include in the test report. Angle measurements shall be accurate within ± 0.1°.

12.5.1 Left A-Pillar Horizontal Approach Angles

A.   Maximum Horizontal Approach Angle Left A-pillar

Locate a line formed by the shortest horizontal distance between CG-F1 (head CG forward left front seat, determined in Section 12.4) for the LEFT seat and the RIGHT A-pillar (Figure 6).

Measure the horizontal angle in the counterclockwise direction formed by the line and the X-axis of the vehicle, T°.

12. COMPLIANCE TEST EXECUTION....Continued

The maximum horizontal approach angle for the left A-pillar, A1, equals 360º minus Tº.

$$A1 = 360º - Tº$$

If A1 > 255º then the maximum horizontal approach angle for the left A-pillar, A1, equals 255º.

B. Minimum Horizontal Approach Angle Left A-Pillar

Locate a line formed by the shortest horizontal distance between CG-F2 for the LEFT seat and the LEFT A-pillar.

Measure the horizontal angle in the counterclockwise direction formed by the line and the X-axis of the vehicle, Wº.

The minimum horizontal approach angle for the left A-pillar, A2, equals Wº.

$$A2 = Wº$$

If A2 < 195º then the minimum horizontal approach angle for the left A-pillar, A2, equals 195º.

12.5.2 Left B-Pillar Horizontal Approach Angles

A. Maximum Horizontal Approach Angle Left B-Pillar

Locate a line formed by the shortest horizontal distance between CG-F2 for the LEFT seat and the LEFT B-pillar.

Measure the horizontal angle in the counterclockwise direction formed by the line and the X-axis of the vehicle, Uº.

The maximum horizontal approach angle for the left B-pillar, B1, equals Uº.

If B1 < 270º then the maximum horizontal approach angle for the left B-pillar, B1, equals 270º.

If B1 > 345º then the maximum horizontal approach angle for the left B-pillar, B1, equals 345º.

B. Minimum Horizontal Approach Angle Left B-Pillar

Locate a line formed by the shortest horizontal distance between CG-R for the LEFT seat and the LEFT B-pillar.

12.   COMPLIANCE TEST EXECUTION....Continued

Measure the horizontal angle in the counterclockwise direction formed by the line and the X-axis of the vehicle, V°.

The minimum horizontal approach angle for the left B-pillar, B2, equals V°.

If B2 < 195° then the minimum horizontal approach angle for the left B-pillar, B2, equals 195°.

HORIZONTAL APPROACH ANGLES A1, A2, B1 & B2

FIGURE 6

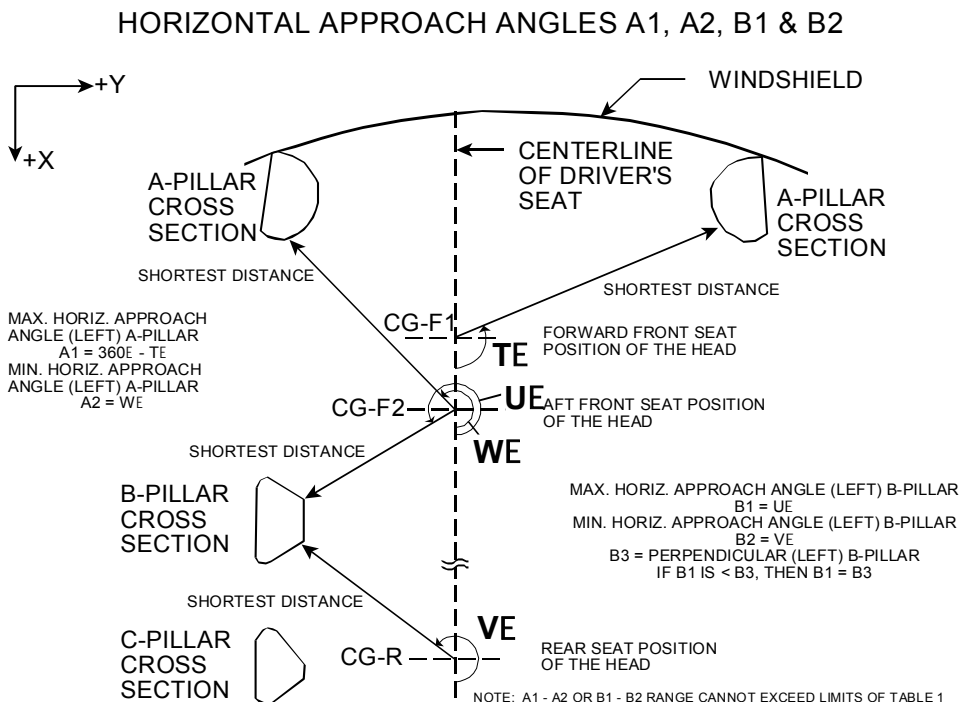### 12.5.3 Right A-Pillar Horizontal Approach Angles

A.   Maximum Horizontal Approach Angle Right A-Pillar

Locate a line formed by the shortest horizontal distance between CG-F2 for the RIGHT seat and the RIGHT A-pillar.

Measure the horizontal angle in the counterclockwise direction formed by the line and the X-axis of the vehicle, W_{right}°.

The maximum horizontal approach angle for the right A-pillar, $A1_{right}$, equals W_{right}°.

$$A1_{right} = W_{right}°$$

12.   COMPLIANCE TEST EXECUTION....Continued

If $A1_{right} > 165°$ then the maximum horizontal approach angle for the right A-pillar, $A1_{right}$, equals 165°.

B.   Minimum Horizontal Approach Angle Right A-Pillar

Locate a line formed by the shortest horizontal distance between CG-F1 for the RIGHT seat and the LEFT A-pillar.

Measure the horizontal angle in the counterclockwise direction formed by the line and the X-axis of the vehicle, $T_{right}°$

The minimum horizontal approach angle for the right A-pillar, $A2_{right}$, equals 360° minus $T_{right}°$.

$$A2_{right} = 360° - T_{right}°$$

If $A2_{right} < 105°$ then the minimum horizontal approach angle for the right A-pillar, $A2_{right}$, equals 105°.

12.5.4   Right B-Pillar Horizontal Approach Angles

A.   Maximum Horizontal Approach Angle Right B-Pillar

Locate a line formed by the shortest horizontal distance between CG-R for the RIGHT seat and the RIGHT B-pillar.

Measure the horizontal angle in the counterclockwise direction formed by the line and the X-axis of the vehicle, $V_{right}°$.

The maximum horizontal approach angle for the right B-pillar, $B1_{right}$, equals $V_{right}°$.

$$B1_{right} = V_{right}°$$

If $B1_{right} > 165°$ then the maximum horizontal approach angle for the right B-pillar, $B1_{right}$, equals 165°.

B.   Minimum Horizontal Approach Angle Right B-Pillar

Locate a line formed by the shortest horizontal distance between CG-F2 for the RIGHT seat and the RIGHT B-pillar.

Measure the horizontal angle in the counterclockwise direction formed by the line and the X-axis of the vehicle, $U_{right}°$

12.   COMPLIANCE TEST EXECUTION....Continued

The minimum horizontal approach angle for the right B-pillar, $B2_{right}$, equals $U_{right}°$.

$$B2_{right} = U_{right}°$$

If $B2_{right} > 90°$ then the minimum horizontal approach angle, $B2_{right}$, equals $90°$.

If $B2_{right} < 15°$ then the minimum horizontal approach angle, $B2_{right}$, equals $15°$.

12.6   TARGET LOCATIONS

UPPER INTERIOR COMPONENTS	TARGET(S)
A-PILLARS	AP1, AP2, AP3
B-PILLARS	BP1, BP2, BP3, BP4
OTHER PILLARS	OP1, OP2
REARMOST PILLARS	RP1, RP2
FRONT HEADER	FH1, FH2
SIDE RAIL (FRONT)	SR1, SR2
OTHER SIDE RAIL	SR3
REAR HEADER	RH
UPPER ROOF	UR
SLIDING DOOR TRACK	SD
ROLL-BAR	RB1, RB2
STIFFENER/BRACE	ST1, ST2 / BT

The targets shall be located on the left and right side of the vehicle per the procedures that follow. All measurements shall be accurate to within ± 3 mm.

12.6.1 A-PILLAR TARGETS - AP1, AP2, AP3

A.   A-pillar Reference Point (APR) and Target AP1:

(1)   On the vehicle exterior, locate a transverse vertical plane, Plane 1, that contacts the rearmost points of the windshield trim. The intersection of Plane 1 (P1) and the vehicle exterior surface is Line 1. Figure 7 illustrates the referenced locations.

12. COMPLIANCE TEST EXECUTION....Continued
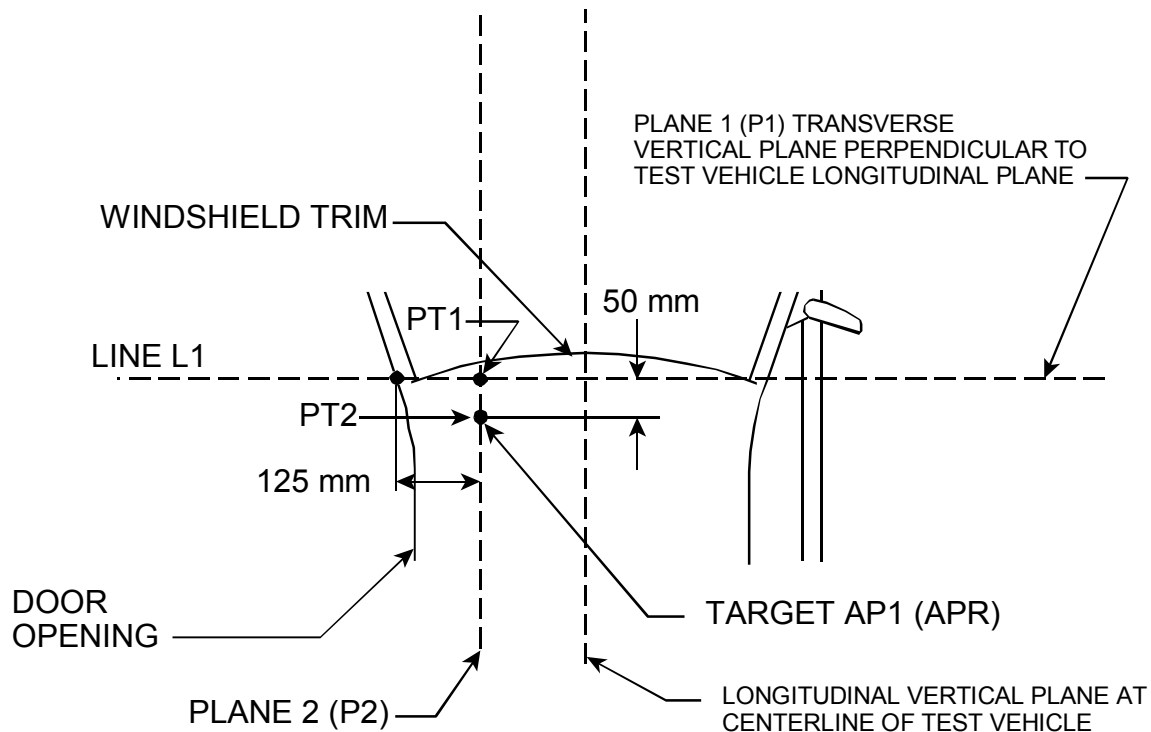
TARGET AP1 (A-PILLAR REF. APR)

FIGURE 7

Windshield trim - molding of any material between the windshield glazing and the exterior roof surface, including material that covers a part of either the windshield glazing or exterior roof surface. (S3. Definitions)

(2)   From the intersection of Line 1 and the outermost edge of the roof, with the door open, measure along the nominal vehicle exterior surface 125 mm inboard - mark Point 1 (PT1).

The outermost edge of the roof is determined with the door open and includes uncompressed weather stripping, trim or rain gutter, if applicable. The linear measurements are to be made with a flexible steel tape (metric graduation) following the nominal vehicle surface (as opposed to following each convolution of weather stripping, rain gutters, or trim components).

(3)   Measure 50 mm from Point 1, along the vehicle exterior surface in a longitudinal vertical plane, Plane 2 (P2), that passes through Point 1 (PT1), mark Point 2 (PT2).

12. COMPLIANCE TEST EXECUTION....Continued

(4)   The A-pillar reference point (APR) is located at the intersection of the interior roof surface and a line perpendicular to the vehicle exterior surface at Point 2 (PT2).

PT2 must be transferred, using calipers, to the interior of the vehicle to establish APR.

Target AP1, the first A-pillar target, is located at APR.

NOTE: "Each sun visor shall be placed in any position where one side of the visor is in contact with the test vehicle interior surface (windshield, side rail, front header, roof, etc.)" (S8.5). Select the sun visor position that allows for the "worst" case impact.

B.   TARGET AP2

(1)   Locate the horizontal plane, Plane 3, intersecting point APR. Figure 8 illustrates the referenced locations.

(2)   Locate the horizontal plane, Plane 4, 88 mm below Plane 3.

(3)   Target AP2 is the point on the interior surface of the A-pillar located at the intersection of Plane 4 and the point closest to CG-F2 for the nearest DSP.

NOTE: Attachments, if applicable, to the A-pillar surface must be considered in determining the target location.

12.   COMPLIANCE TEST EXECUTION....Continued

TARGET AP2

TARGET AP2 ON PLANE 4
AND SHORTEST DISTANCE
FROM A-PILLAR TO CG-F2

APR

PLANE 3
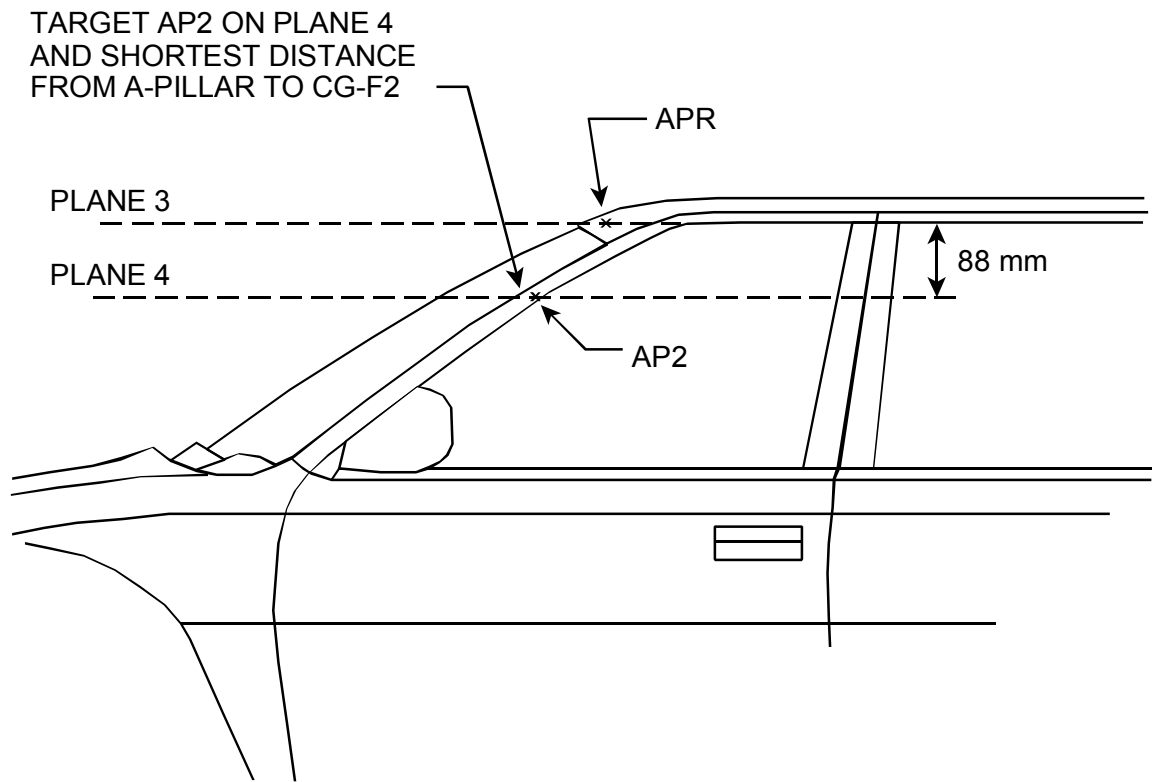
PLANE 4

88 mm

AP2

FIGURE 8

C.   TARGET AP3

(1)   Locate the horizontal plane, Plane 5, containing the highest point at the intersection of the instrument panel and the A-pillar. Figure 9 illustrates the referenced locations.

NOTE: In establishing the highest point at the intersection of the instrument panel and the A-pillar, measure along the nominal surface as there may be a small gap or depression between the components.

(2)   Measure the vertical distance, J, from Plane 3 to Plane 5. Locate the horizontal plane, Plane 6, half the distance (J/2) between Plane 3 and Plane 5.

(3)   From CG-F1 for the nearest DSP, establish the point that is the shortest distance to the A-pillar (considering pillar attachments, if applicable) at Plane 6. Mark AP3.

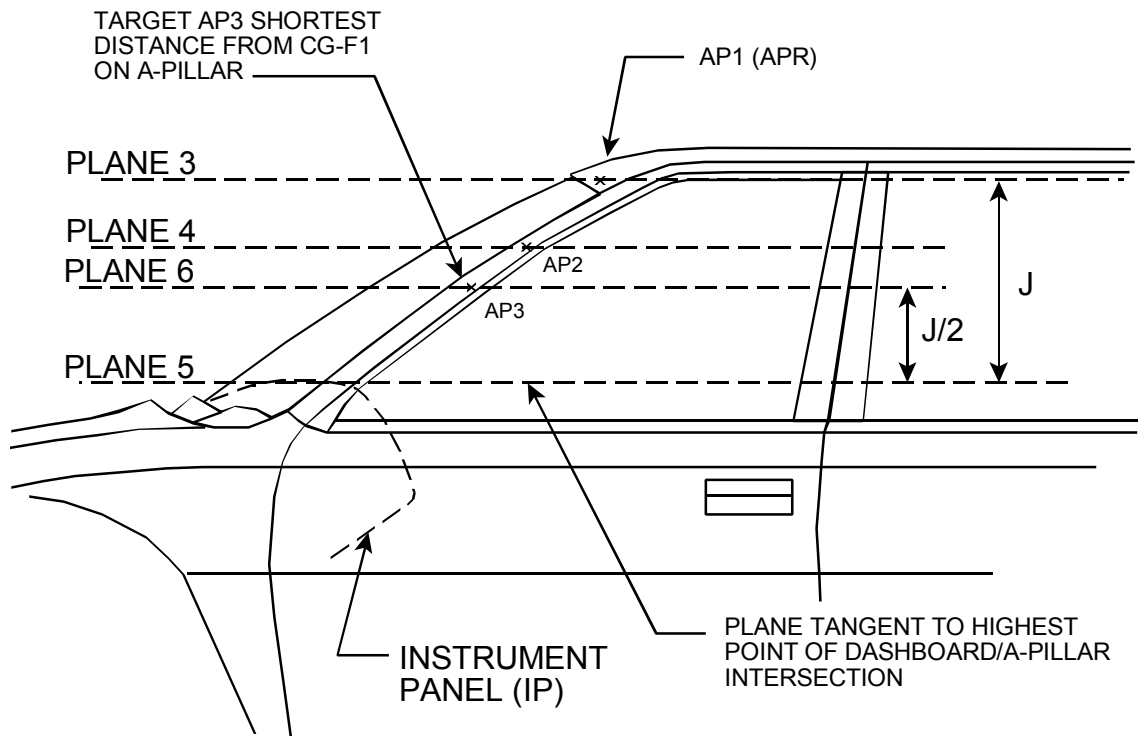**12.   COMPLIANCE TEST EXECUTION....Continued**

TARGET AP3

FIGURE 9

NOTE: Some vehicles may have multiple A-pillars. Where applicable, the procedures above should be used to establish the target locations on each A-pillar.

Triangular vent window(s) located on the door are not considered a pillar.

12.6.2 UPPER ROOF (S6.15) - UR

Target UR is any point on the upper roof. The upper roof is determined as follows:

A.   Locate the transverse vertical plane, A, at the forwardmost point where it contacts the interior roof (including trim but not attachments such as the rearview mirror or center high-mounted stop lamp [CHMSL]) at the vehicle centerline. Figure 10 illustrates the referenced locations.

B.   Locate the transverse vertical plane, B, at the rearmost point where it contacts the interior roof (including trim but not attachments such as the rearview mirror or CHMSL) at the vehicle centerline.

C.   Measure the horizontal distance, D1, between Plane A and Plane B.
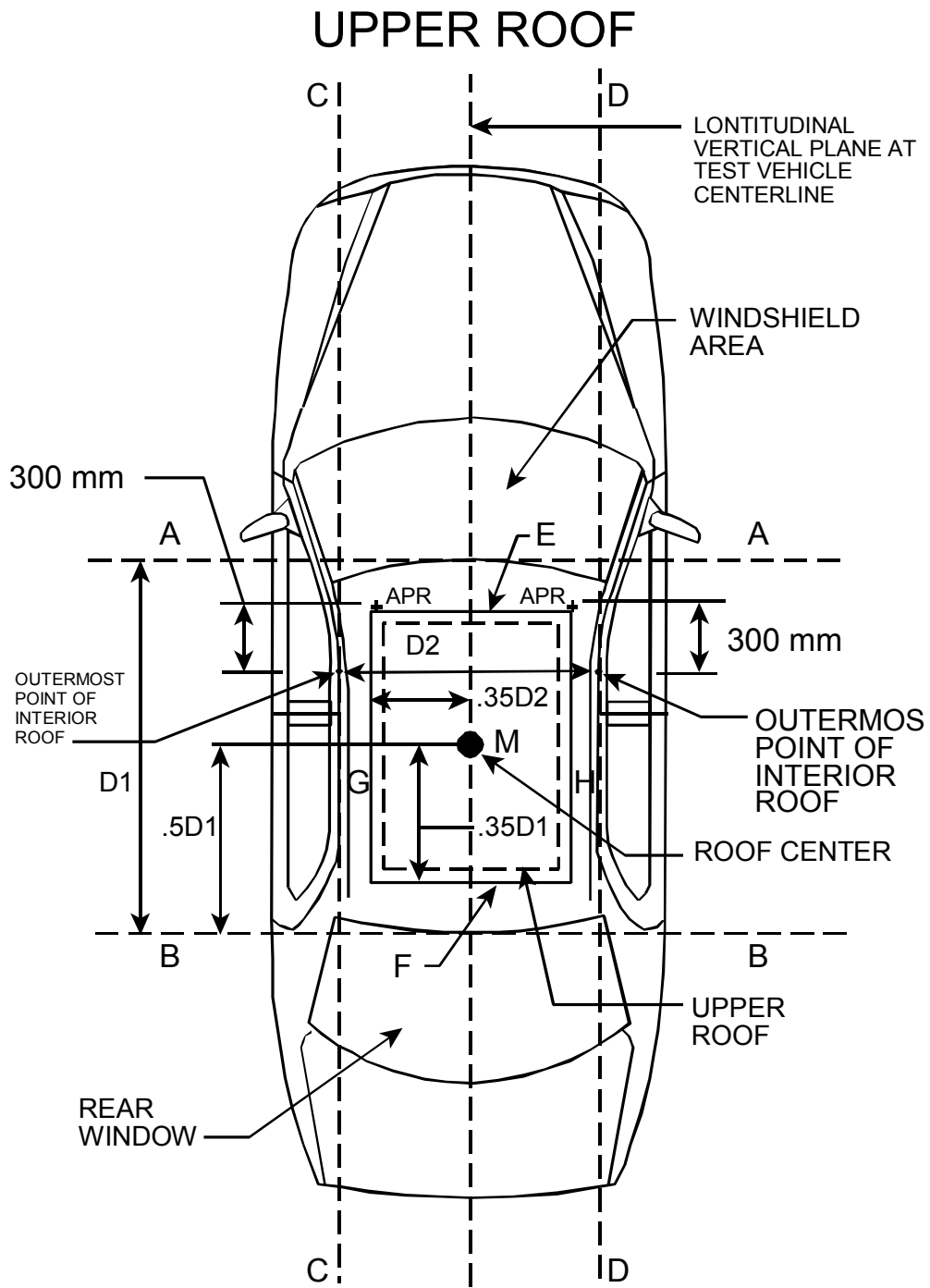
12.   COMPLIANCE TEST EXECUTION....Continued

UPPER ROOF

FIGURE 10

12. COMPLIANCE TEST EXECUTION....Continued

D. Locate the vertical longitudinal plane, C, at the leftmost point at which a vertical transverse plane, located 300 mm rearward of the A-pillar reference point (as determined in section 12.6.1, A-Pillar Targets), contacts the interior roof (including trim).

Plane C is tangent to the outermost point(s) on the interior roof (including trim). The outermost point of the interior roof shall be determined by closing the door and marking where the door components (with weather stripping, if applicable) intersects the roof components (with weather stripping, if applicable) at a horizontal distance 300 mm rearward of APR.

E. Locate the vertical longitudinal plane, D, at the rightmost point at which a vertical transverse plane, located 300 mm rearward of the A-pillar reference point, contacts the interior roof (including trim).

Plane D is tangent to the outermost point(s) on the interior roof (including trim). The outermost point of the interior roof shall be determined by closing the door and marking where the door parts (with weather stripping, if applicable) intersects the roof parts (with weather stripping, if applicable) at a horizontal distance 300 mm rearward of APR.

F. Measure the horizontal distance, D2, between Plane C and Plane D.

G. Locate a point, Point M, on the interior roof surface, midway between Plane A and Plane B along the vehicle longitudinal centerline.

H. The upper roof zone is the area of the vehicle upper interior surface area bounded by the four planes, E, F, G, and H, determined as follows:

(1) A transverse vertical plane, E, located a distance of 0.35D1 forward of Point M, measured horizontally

(2) A transverse vertical plane, F, located at a distance of 0.35D1 rearward of Point M, measured horizontally

(3) A longitudinal vertical plane, G, located a distance of 0.35D2 to the left of Point M, measured horizontally

(4) A longitudinal vertical plane, H, located at a distance of 0.35D2 to the right of Point M, measured horizontally.

12.   COMPLIANCE TEST EXECUTION....Continued

12.6.3 B-PILLAR TARGETS - BP1, BP2, BP3, BP4

   A.   B-Pillar Reference Point and Target BP1

   (1)   Establish the horizontal plane passing through the highest point of the forwardmost door opening. Figures 11 and 12 illustrate the B-pillar target locations.

   As viewed laterally from the vehicle interior, establish the centerline of the width of the B-pillar (B-pillar centerline).

   Point 3 (PT3) is located on the horizontal plane at the centerline of the B-pillar.

   (2)   Locate a transverse vertical plane, Plane 7, that passes through Point 3.

   (3)   At the intersection of Plane 7 and the nearest longitudinal edge of the upper roof, mark Point 4.

   (4)   Measure the distance, along the vehicle interior surface, from Point 3 to Point 4.

   The B-pillar reference point, BPR, is located at the middle of the line from Point 3 to Point 4.

   Target BP1 is located at BPR.

   B.   Target BP2

   If a seat belt anchorage is located on the B-pillar, Target BP2 is located at any point on the anchorage.

   For adjustable anchorages, position the anchorage midway between the two extreme adjustment positions. If the anchorage has distinct adjustment positions, none of which is midway between the two extreme positions, adjust the anchorage to the nearest position above the midpoint.

   NOTE: The COTR will provide a manufacturer's drawing(s) identifying the location of the anchorage components.

12.   COMPLIANCE TEST EXECUTION....Continued

C.   Target BP3

(1)   Locate a horizontal plane, Plane 8, passing through Point BPR.

(2)   Locate a horizontal plane, Plane 9, passing through the lowest point of the daylight opening forward of the pillar.

(3)   Measure the distance, N, between Plane 8 and Plane 9.

(4)   Locate a horizontal plane, Plane 10, half the distance, N/2, between Plane 8 and Plane 9.

(5)   From CG-F2 for the nearest DSP, establish the closest point on the B-pillar at Plane 10. Mark BP3.

D.   Target BP4

(1)   Locate a horizontal plane, Plane 11, half the distance, N/4, between Plane 9 and Plane 10.

(2)   From CG-R for the nearest DSP, establish the closet point on the B-pillar at Plane 11. Mark BP4.