

# **CATIA V5 Automotive Extensions Vehicle Architecture — Manikin (CM9)**

## ***User Guide***

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**BPA Delivery 7 for V5R19 (V 5.7)**

## Instruction symbols used in this guide

The following symbols are used in this guide; they should allow you to navigate throughout the text with greater ease:

### Warning triangle



The warning triangle refers to *critical circumstances*, which should be considered imperatively in order to avoid serious problems in your work.

### Hint symbol



The light bulb relates to *hints*, which provide you with practical examples to simplify your work.

### Note symbol



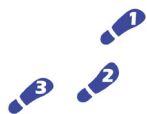
The hand symbol relates to *notes*, which you should pay attention to in order to assure that you can *work without problems*.

### Information symbol



The information symbol relates to background *information*.

### Work steps symbol



The work steps' symbol refers to a *step-by-step instruction* sheet.

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## o. CAVA in General









In order to understand the basics of CATIA, please, read first the General CAVA User Manual. General information on CAVA is given only in that manual. You will find there also information required for work with CAVA MANIKIN, e.g.:

- How CAVA is started?
- How a CAVA feature is created and edited?
- How CAVA is configured?
- What is Standard Mode, what is Free Mode?  
Which parameters can be changed in which mode?
- How measurement in CAVA is executed?
- How to export geometries?

# 1. Functionality of CAVA MANIKIN

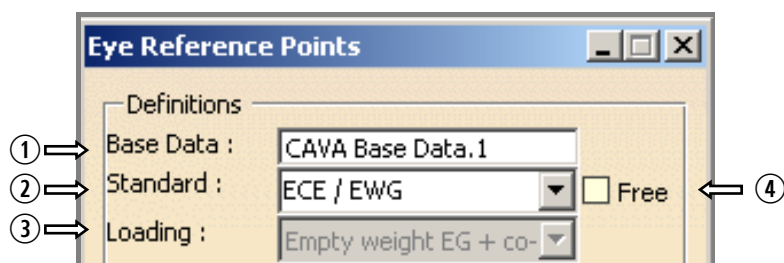
The CAVA MANIKIN module contains functions allowing to define and to represent the passenger geometry and the positioning parameters from it.

In detail this are the following functions:

Product	Functions	Description see ...
CAVA MANIKIN		
		CAVA-Eye Points – section 3 from page 8.
		CAVA-Eye Ellipses – section 4 from page 11
		CAVA-2D-Manikin – section 5 from page 21
		CAVA-Head Position Contour – section 6 from page 29
		CAVA-SRP-Position curves – section 7 from page 35

The eye points and eye ellipses functions will be described separately as they differ in their graphic user interface and in their administration.

## 2. General Input Data for the CAVA MANIKIN Feature



### Definitions

#### ① *Base-data* reference box

The base data on which this feature is based on (see CAVA OVA User Manual— section “Base Data”). After selecting the base data, the required data for the respective vehicle category is activated.

#### ② *Standard* list box

Select a standard. The standard contains the predefined values that are required to create the respective feature. The individual standards and their values, available in this list box, are stored in the respective configuration file (e.g. for the *Eye Ellipses* feature in the `EyeEllipses.xml` file).

By selecting the *Free* mode you can bypass the settings of the standards and can define your own settings for specific values.



When working with one of the standards, some of the boxes are filled with values, but they are deactivated and not editable by the user. These values are set by the standard (common behaviour).

#### ③ *Loading* list box

##### • Deactivated state:

The default value is defined by the standard settings in the configuration file.

##### • Activated state (only in *Free* mode):

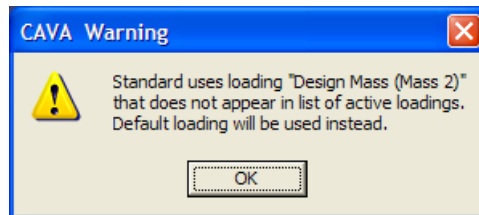
The list box contains all loadings that are activated in the base-data dialog box on the *Preconfigured Loadings* and *User-Defined Loadings* tab cards (see CAVA OVA manual).

#### ④ *Free* mode check box

Some of the MANIKIN features allow to define, beside the preset values, user defined values.

## 2.1 Loadings

In the configuration file for the respective CAVA function a special loading is defined for each standard. If this loading is not activated in the list of the available loadings or is even lacking, an error message is displayed, saying that instead of the required loading the *Default* loading will be used.



### 3. Eye Reference Points

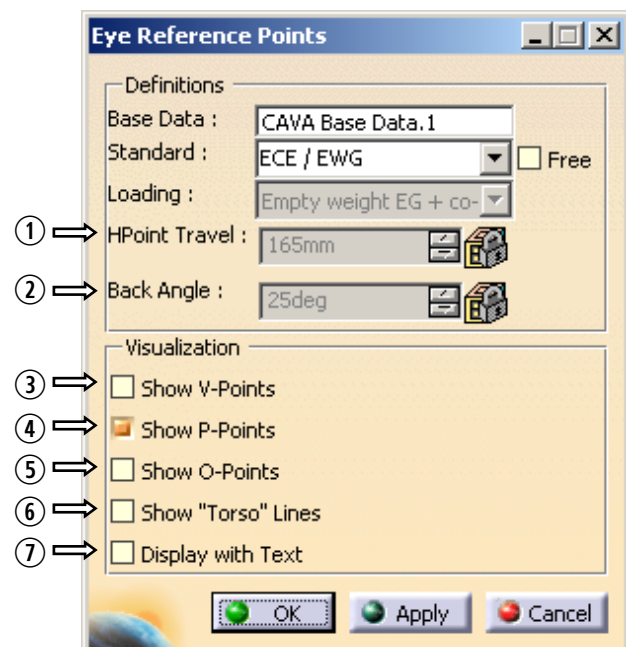


Most of the CAVA functions of the VISION module require as input the exact position of the eye points. The European and American (Australian) approach to this is different. The European standards define eye points, depending on certain vehicle parameters. In the American (Australian ...) standards the eye point's position is defined by eye ellipses, on which the exact points are calculated according to the application, or the ellipses are used for the calculation.

The *Eye points* function calculates the following eye points:

- Eye points for mirror testing according to the 71/127/EWG standard
- Shifted eye points for mirror testing in case of a fixed (non adjustable) seat back angle according to EG/EWG 2003/97 Att.7
- V points for calculation of the A and B fields in the wiper fields according to the standard 78/318/EWG and for the calculation of the multiple reflection
- P points for the calculation of the field of view on the windshield according to the standard 77/649/EWG, incl. the Pm point, used for the A-pillar-obstruction calculation.

#### *Eye reference points* dialog box





### ① *HPoint-Travel* value box

HPoint Travel defines the range of the normal seat positions, within which the manufacturer allows the longitudinal displacement of the seat in  $x$  direction. This length value is defined in the base data and can not be changed here.

### ② *Back Angle* value box

In this box, the current value of the back angle is displayed. This value is defined in the base data and can not be changed here.

### ③ *Show V Points* check box

If this check box is activated, in the model the V points will be displayed.

### ④ *Show P Points* check box

If this check box is activated, in the model the P points (P<sub>1</sub>, P<sub>2</sub> and P<sub>m</sub>) will be displayed. P<sub>m</sub> is not the center point of the points P<sub>1</sub> and P<sub>2</sub>, but is determined by the intersection of the line P<sub>1</sub>—P<sub>2</sub> with the vertical plane, running through SRP.

### ⑤ *Show O Points* check box

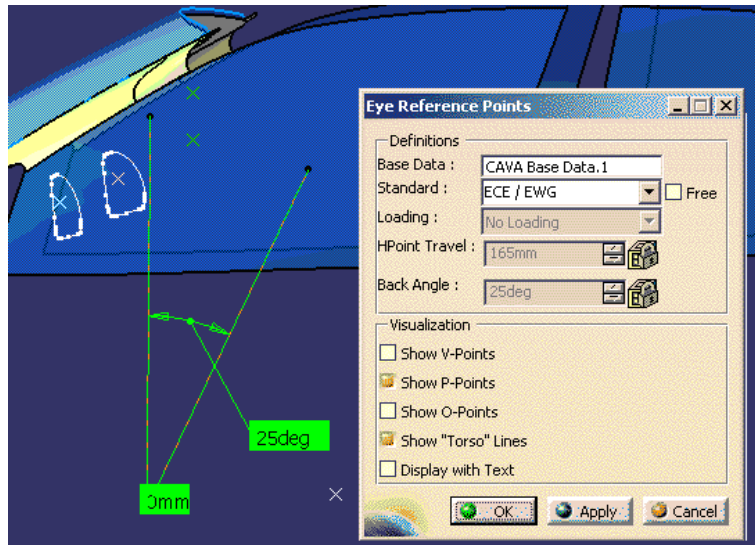
If this check box is activated, in the model the O points will be displayed.

### ⑥ *Show torso lines* check box

If this check box is activated, in the model the torso will be displayed by two lines.

The line 1 is perpendicular to the road and runs from SRP to the standard eye point; its length is defined in the `EyePoints.xml` configuration file.

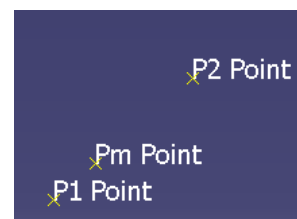
The second line has a constant length and runs from the SRP into the direction of the back angle.



As the figure shows, the angle between the lines is identical with the back angle, defined on the GUI.

#### ① *Display with Text* check box

When this check box is activated, next to the eye points their identifiers are inserted as 3D text (see fig.) Depending on the model perspective, the identifiers may be covered by other features. In order to get a complete view of the identifiers, the model must be turned.



The eye points can be defined only for the driver.

## 4. Eye Ellipses



For the visibility tests according to the American and the Australian standards the position of the eye points is determined, using the eye ellipses. Some of these visibility standards use immediately the ellipses, for instance to determine the fields of view on the windshield; other standards use the ellipses for the exact determination of the eye points, e.g. for the rear-view mirror.

The position of the eye ellipses is defined in the SAE 941 standard. This standard has different versions that are using partially different calculation methods.

In the standards one ellipse is defined in side view, two are defined in top view (for the right and the left eye). Usually the ellipses are given for the 90<sup>th</sup>, 95<sup>th</sup> and the 99<sup>th</sup> percentile, which differ from each other in position and size. For the visibility tests the 95 %-ellipses are required.

In the view-test standards different versions of the eye ellipses are used; it might be also an older version.

- **SAE J941 1965**

In this SAE J941 version the eye ellipses primarily are determined by the back angle and by the HPoint Travel value. An additional shift in  $y$  direction, depending on the steering-wheel center and the  $W_3$  value, in the practice of some manufacturers is avoided by positioning the ellipses centered over the SRP (what is marked with „*centric*“ mark, added to the standard name). This shift is determined with the formula

$$0.85 * W_7 + 0.075 * W_3$$

and defines the position reference point for all other ellipses.

$W_7$ —distance between the steering wheel center and the vehicle midplane.

$W_3$ —Shoulder room

Both values are defined in the Base Data on the *Passengers* tab card.

On the base of the back angle and the H-Pnt-Travel value, the size and the position of the ellipses (i.e. the  $x$  and  $y$  shift relative to the reference point and the length of the two axes of the ellipses) are defined by using discrete values of given tables.

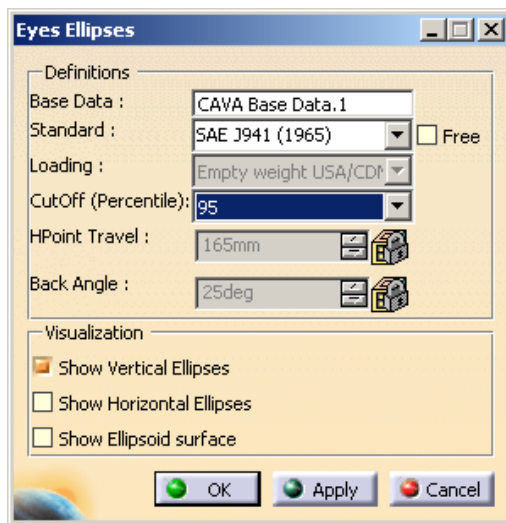
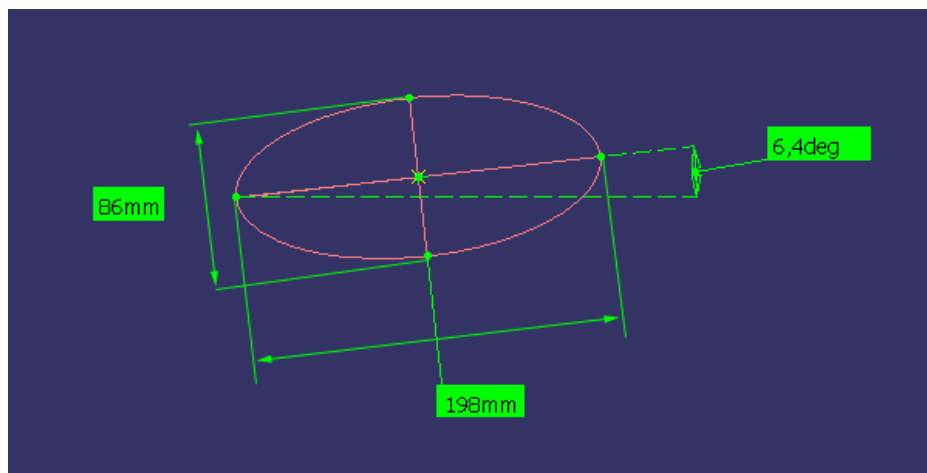


Fig.: Eye Ellipses dialog box with SAE J941 (1965) standard selected

Side view:

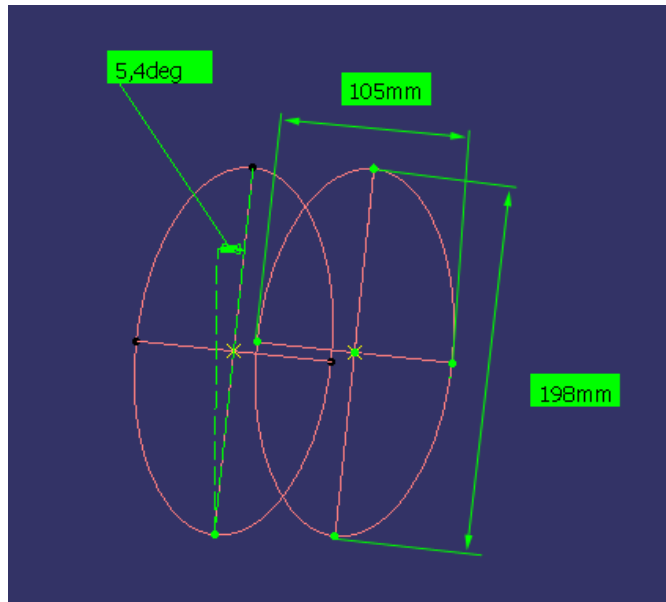
The SAE J941 (1965) standard prescribes that the ellipse template in side view is tilted downward by 6.4 deg in direction of travel.



The indicated HPoint-Travel value 165 mm and the 95<sup>th</sup> percentile result, according to the table, in a major axis length of 198 mm, and a minor axis length of 86 mm.

Top View:

In the top view the ellipsis template is tilted inwards by 5,4 deg in direction of travel.



The indicated HPoint-Travel value 165 mm and the 95<sup>th</sup> percentile result, according to the table, in a major axis length of 198 mm, and a minor axis length of 105 mm.

- **SAE J941 since 1997**

The center points are calculated with the following formulas:

- In case of Seat Track Travel (TL23) greater than 133 mm:

$$X = L31 - 259,91472 + 10,281641 * (L40) - 0,032032 * (L40)^2$$

$$\text{(left eye) } Y = W20 - 32,5$$

$$\text{(right eye) } Y = W20 + 32,5$$

$$Z = H70 + 653,71757 + 0,398747 * (L40) - 0,059301 * (L40)^2$$

- In case of Seat Track Travel (TL23) between 100 mm and 133 mm:

$$X = L31 - 247,71472 + 10,281641 * (L40) - 0,032032 * (L40)^2$$

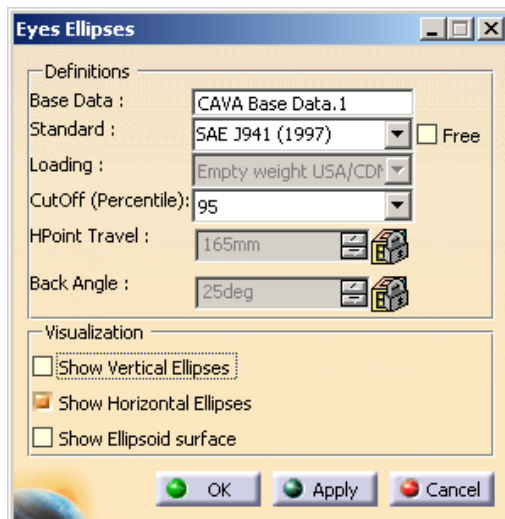
$$(\text{left eye}) Y = W20 - 32,5$$

$$(\text{right eye}) Y = W20 + 32,5$$

$$Z = H70 + 655,01757 + 0,398747 * (L40) - 0,059301 * (L40)^2$$

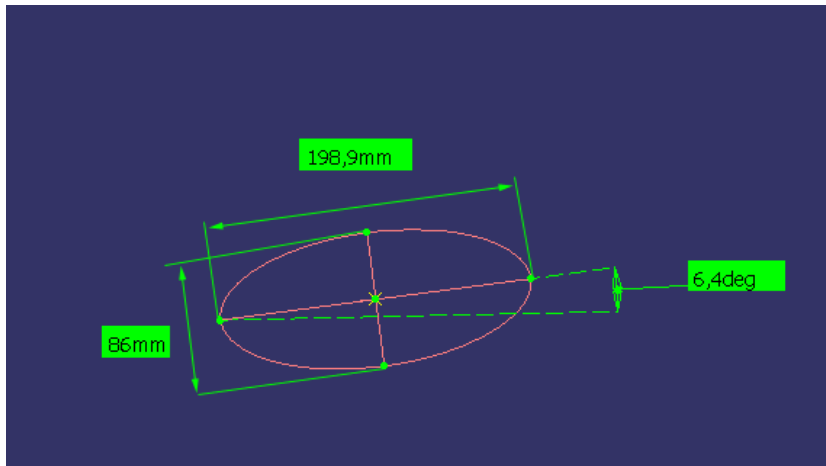
The length of the axes is to be taken from the table below.

	95 <sup>th</sup> percentile	95 <sup>th</sup> percentile	99 <sup>th</sup> percentile	99 <sup>th</sup> percentile
Seat Track Travel (TL23)	100 to 133 mm	> 133 mm	100 to 133 mm	> 133 mm
x axis	173,8	198,9	242,1	268,2
y axis	105,0	104,9	149,0	148,9
z axis	86,0	86,0	122,0	122,0



Side view:

In the side view the ellipsis template is tilted downward by 6.4 deg in direction of travel.

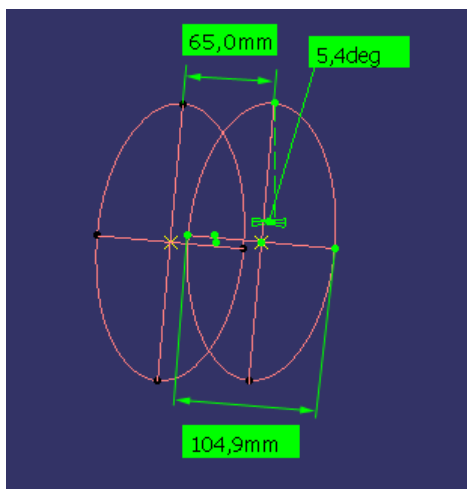


The indicated HPoint-Travel value 165 mm and the 95<sup>th</sup> percentile result, according to the table, in a major axis length of 198.9 mm, and a minor axis length of 86 mm.

Top View:

In the top view the ellipsis template is tilted inwards by 5.4 deg in direction of travel.

The distance of the two ellipsis centers is 65 mm.



The indicated HPoint-Travel value 165 mm and the 95<sup>th</sup> percentile result, according to the table, in a major axis length of 198.9 mm, and a minor axis length of 104.9 mm.

- **SAE J941 since 2002**

The ellipses of version from 2002 differ from the older versions in the following relevant points:

- The top view is parallel to the  $x$  axis, so that the rotation relative to the  $x$  axis is no more applied.
- new values for the axes and for the downward angle (12 deg)
- dependency of the position and the inclination of the ellipsis from SRP, steering-wheel center, pedal reference point, the heel point and the HPoint travel value
- distinction between vehicles with automatic gear and without it.

The positioning procedure is the following:

First the centers of the ellipses are calculated, using the formulas below: The calculated center points are used to position the ellipses and to determine their size, taking the values from discrete tables (according to the HPoint Travel value).

The center points are calculated with the following formulas:

$$X = L1 + 664 + 0.587 * L6 - 0.176 * H30 - 12.5 * t$$

$$Y = W20 - 32.5, \text{ bzw. } = W20 + 32.5$$

$$Z = H8 + 638 + H30$$

with:

L1: pedal reference point  $x$  coordinate

L6:  $x$ -delta between pedal reference point and steering-wheel center

H30:  $z$  delta—vertical distance between SRP and road-parallel plane through the heel point

T: manual gear-box—yes = 1, no = 0

W20: SRP  $y$  coordinate

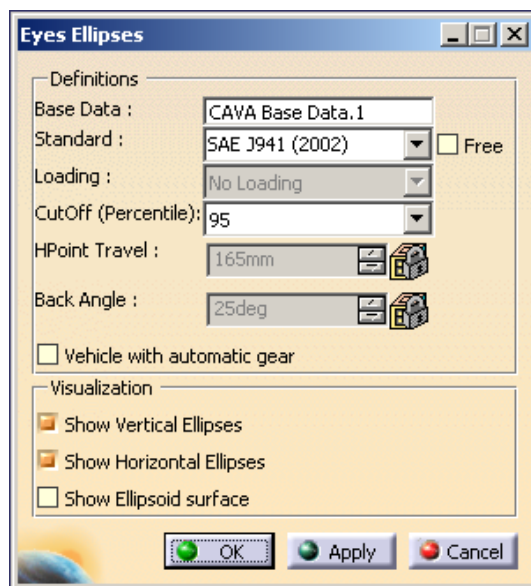
H8: heel-point  $z$  coordinate

The values are to be defined in the *Base Data* dialog box on the *Passengers* tab card.

The length of the axes is to be taken from the table below.



	95 <sup>th</sup> percentile	95 <sup>th</sup> percentile	99 <sup>th</sup> percentile	99 <sup>th</sup> percentile
Seat Track Travel (TL1)	1 to 133 mm	> 133 mm	1 to 133 mm	> 133 mm
x axis	173,8	206,4	242,1	287,1
y axis	60,3	60,3	85,3	85,3
z axis	93,4	93,4	132,1	132,1

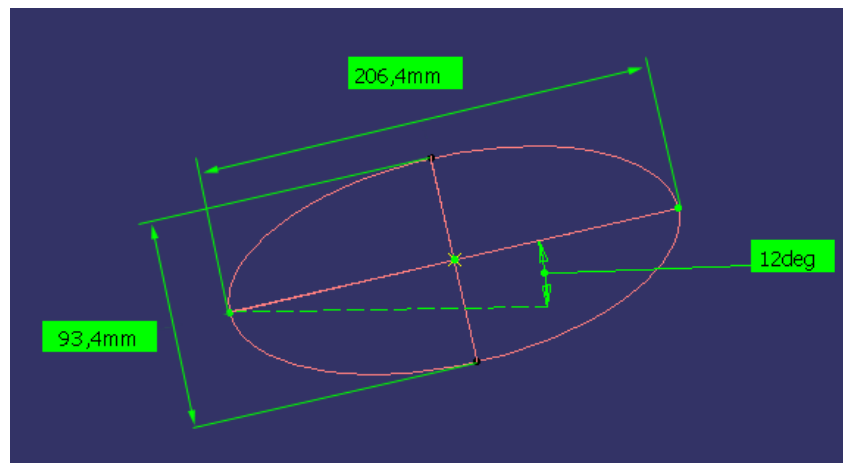


If the *Vehicle with automatic gear* option is activated, the eye ellipses will be shifted by 12,5 mm in *x* direction.

This option is available only for the SAE J941 2002 standard.

## Side view:

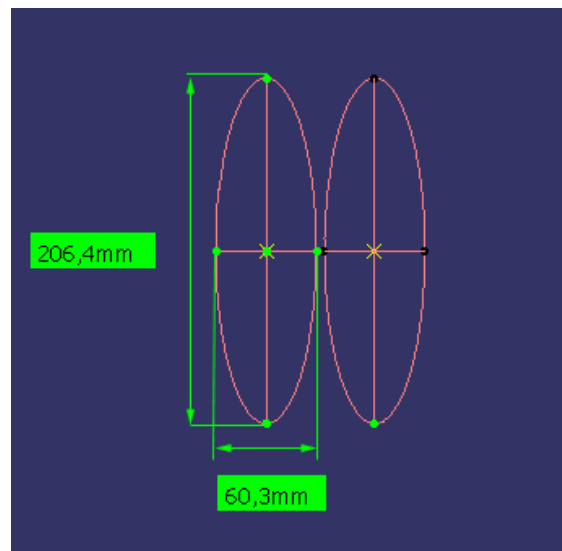
In the side view the ellipsis template is tilted downward by 12 deg in direction of travel.



The indicated HPoint-Travel value 165 mm and the 95<sup>th</sup> percentile result, according to the table, in a major axis length of 206.4 mm, and a minor axis length of 93.4 mm.

## Top View:

According to this standard, in the top view the ellipsis template is not tilted.

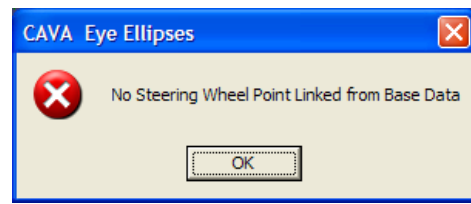


The indicated HPoint-Travel value 165 mm and the 95<sup>th</sup> percentile result, according to the table, in a major axis length of 206.4 mm, and a minor axis length of 60.3 mm.

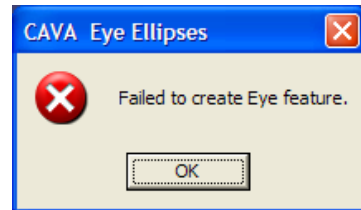


To calculate the eye ellipses, base-data information is required. For that reason, at first the shoulder room and the steering-wheel center point must be defined to be able to calculate the eye ellipses.

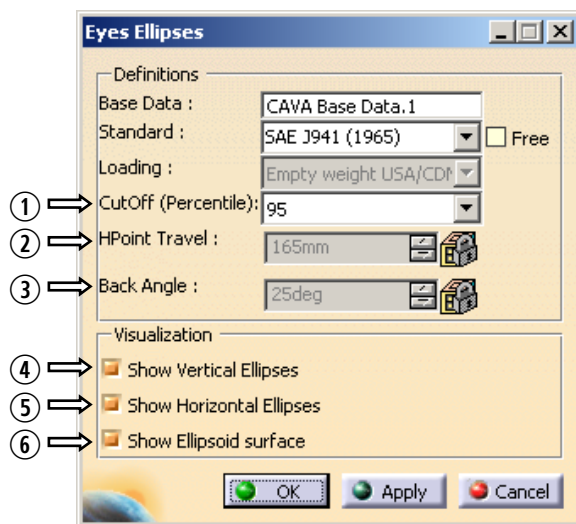
If this data not has been defined, the following error messages will be displayed.



The creation of the eye ellipse is canceled followed by the error message shown below.



### *Eye ellipses* dialog box



① *CutOff (Percentile)* list box

It can be selected between the percentile values 90, 95 and 99.

② *HPoint-Travel* value box

HPoint Travel defines the range of the normal seat positions, within which the manufacturer allows the longitudinal displacement of the seat in  $x$  direction. This length value is defined in the base data and can not be changed here.

③ *Back Angle* value box

In this box, the current value of the back angle is displayed. This value is defined in the base data and can not be changed here.

④ *Show vertical ellipses* check box

If this check box is activated, in the model the vertical eye ellipses will be displayed.

⑤ *Show horizontal ellipses* check box

If this check box is activated, in the model the horizontal eye ellipses will be displayed.

⑥ *Show ellipsoid surface* check box

If this check box is activated, in the model the eye ellipses will be displayed as surfaces.



The eye ellipses can be defined only for the driver.

On closer inspection of the ellipses it can be remarked that they are not situated exactly on the surface, but deviate a little. The reason for that is that the top-view ellipsis is oriented parallel to the road, and the side-view ellipsis is oriented parallel to the  $x$ - $z$  plane. The ellipsoid, however, is slightly turned in both directions so that the curves can not completely projected.

## 5. 2D Manikin Template



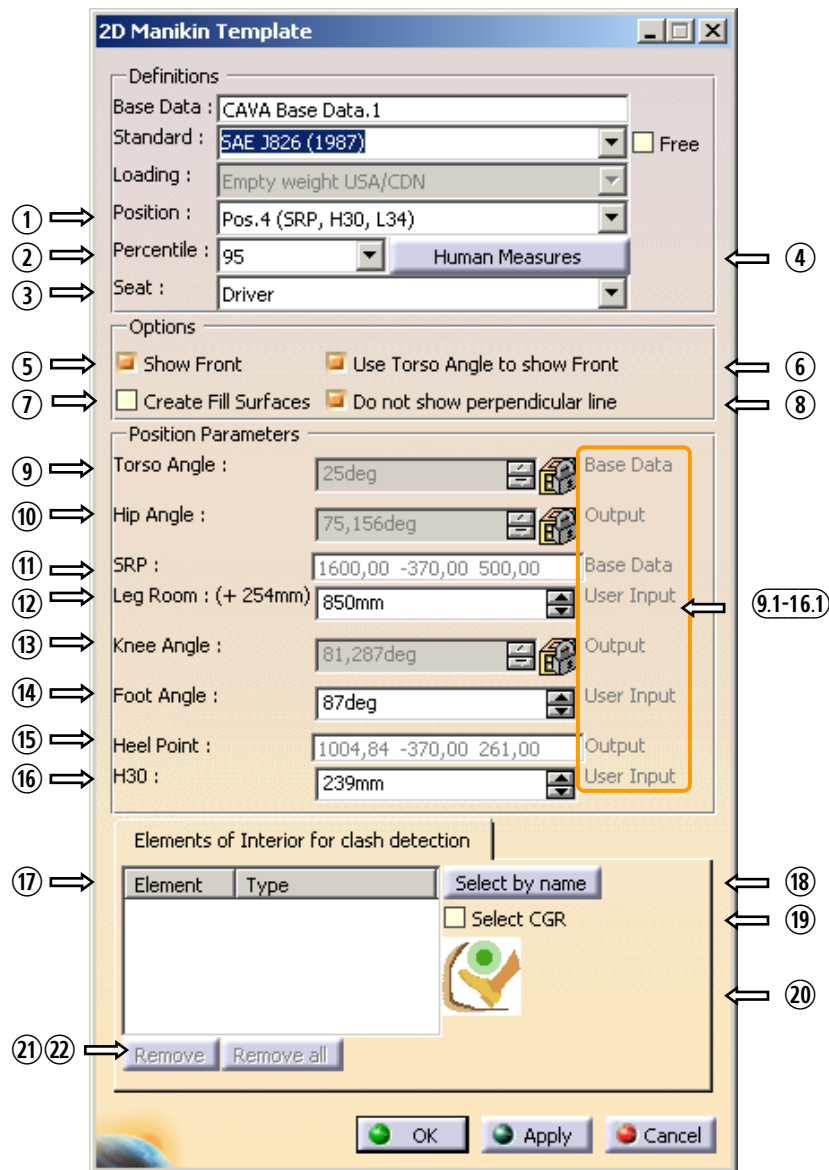
The SAE J826 standard was elaborated to define a two-dimensional universal template of the human body, which can give help for positioning and dimensioning vehicle seats. The template represents the outline of a 10, 50 or 95 percent adult man. This construction consists out of separated parts for the buttocks, the back, the thigh, the lower leg and a foot, that are joint pivotable at the hip (HPoint), at the knee and the ankle to imitate the rotation axes of the human body. The CAVA MANIKIN function allows to determine the different positions of the determinant elements of the driver's position (SRP, heel point, pedal reference point) according to the SAE standard.

In additional to the SAE standard, the MANIKIN Function can create a back view of the manikin, representing the upper part of the body. For each part of the body the measurements can be defined in a configuration file. The form of the body as such, however, in the current CAVA version is predefined by the program. (In the configuration file it can be defined, how long and thick, for instance, the thigh must be for a certain percentile).

It is also possible to create manikins for the back seats. In this case some of the dependencies do not apply (e.g. the pedal reference point). The positioning of the legs is accomplished by positioning the foot on the ground and then moving it forward, maintaining the tangent constraint to the ground, until the front seat or any other vehicle part is touched by the foot, knee or the lower leg. Additionally, in order to optimize the distance to the front seats, it is possible to move the foot sideward at most by 127 mm. Doing so, a maximum value for the foot angle is to be taken in consideration.

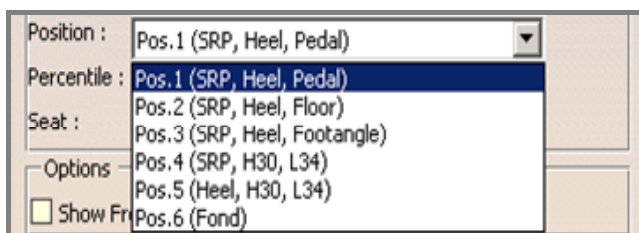
The body parts of the manikin are visualized each by a closed line. This allows the user to hatch the body parts independently from CAVA.

- *2D Manikin Template* dialog box



① *Position* list box

The positions are defined in the `ManikinTemplate.xml` configuration file. The default configuration of the MANIKIN module contains the following positions:



- Pos. 1 (only for driver)  
Input: SRP, heel point, pedal (as line)
- Pos. 2:  
Input: SRP, heel point, floor (as line)
- Pos. 3:  
Input: SRP, heel point, foot angle
- Pos. 4:  
Input: SRP, H30, L34
- Pos. 5:  
Input: heel point, H30, L34
- Pos. 6:  
Input: Back seat SRP, floor geometry (as line/surface), max. distance sideways, front seat geometry (or other limiting geometry)
- Pos. 7:  
Input: SRP, floor (as line), pedal (as line)
- Pos. 8:  
Input: SRP, H30, angles: knee angle, foot angle
- Pos. 9:  
Input: heel point, H30, angles: knee angle, foot angle
- Pos. 10:  
Input: SRP, H30, angles: hip angle, foot angle
- Pos. 11:  
Input: heel point, angles: hip angle, foot angle
- Pos. 12:  
Input: SRP, all angles
- Pos. 13:  
Input: heel point, all angles

After the desired positioning mode has been selected, the respective input boxes are activated or deactivated so that the user can see which input is required.

In some of the positions the foot angle is not defined unambiguously. The standard foot angle is 87 deg, but in the configuration a „*Free*“ definition can be set so that the user can define this angle himself.

## ② *Percentile* list box

The outline of the 2D manikin can be represented as a 10, 50 or 95 percent adult man. The underlying measures for the different percentiles are defined in the `ManikinTemplate.xml` configuration file.

## ③ *Seat* list box

Select one of the seats, which have been predefined on the base-data *Seat* tab card.

For every CAVA 2D manikin feature in the specification tree the name of the referenced seat is displayed.

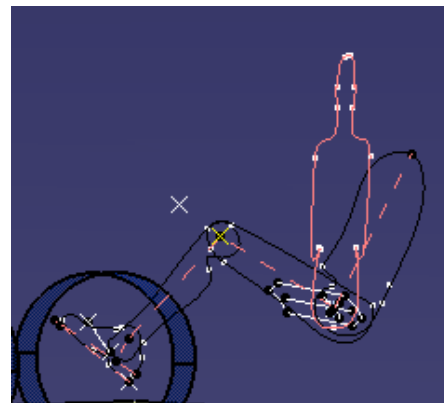
④ *Human Measures* button

Clicking on this button opens a dialog box, containing the defined body measures. When the *Free* mode is activated, the values may be modified by the user.

(The shape of the bodily parts of the manikin is defined by CAVA. In the model only the length of the geometry can be modified.)

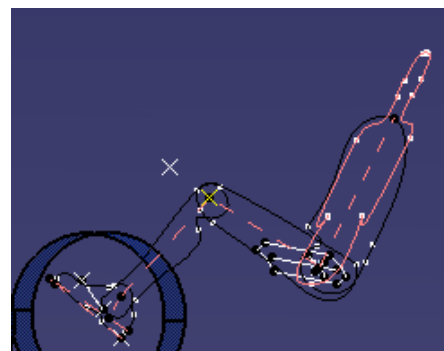
⑤ *Show front* check box

Activating this check box will result in creating the geometry of the back view of the torso of the manikin. The view is orientated in normal position relative to the road plane.

⑥ *Use Torso Angle to Show Front* check box

If this option is activated, for the orientation of the frontal geometry of the manikin the torso angle (see ⑨) will be applied (in difference to ⑤, where the orientation is perpendicular to the road plane).

This option is operative only if the *Show Front* option is activated.

⑦ *Create Fill Surfaces* check box

The geometry is created as surface. This allows the user to hatch the body parts himself.

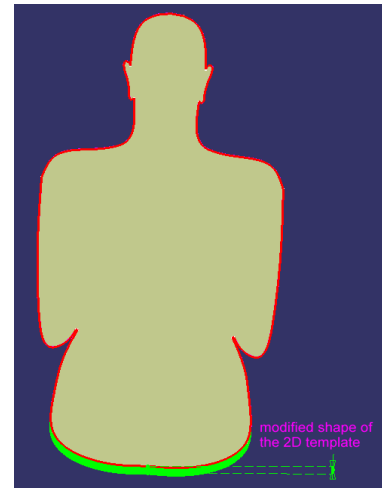


The views ⑤ to ⑦ are not stipulated in the SAE standards.





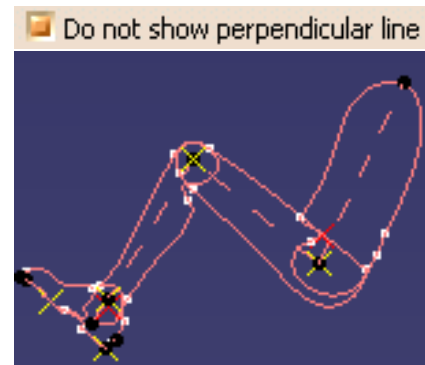
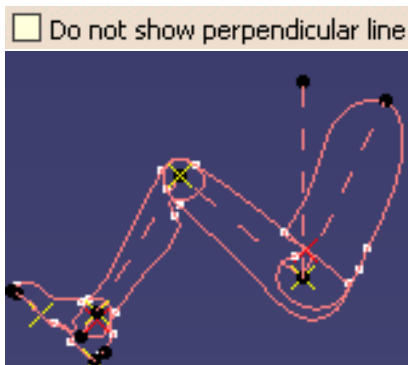
Since Delivery 4 the shape and the position of the front view has slightly changed. As you can see in the figure to the right, the shape is a bit different in length compared to the one that was used so far. This change concerns the view perpendicular to the road and the one for the torso angle (*Use Torso Angle to Show Front*). The position of the shape was also lowered down a little bit. The new shape is only used for CAVA 2D templates that are created with CAVA version 1.8.3 and higher. Older features are not affected by this change.



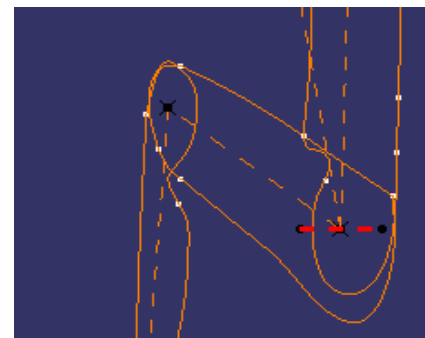
If you want to use the old shape for newly created 2D manikin templates in CAVA version 1.8.3 and higher you have set the system variable CAVA\_MANIKIN\_USE\_OLD\_FRONT.

#### ⑧ Do not show perpendicular line check box

If this option is activated, the road-surface normal will be hidden.



Starting from Version 1.8.3 the visualization of the 2D template also contains a horizontal line through the SRP (50 mm in positive and negative  $y$  directions). The line will be present only for newly created manikins; old ones will not be effected. The line will be present even if no rear view is enabled, but will disappear when the *Hide normal to road* option is enabled.



**9-16** Position parameters

Which parameters are listed in the dialog box and which is their origin type depends from the selected positioning method. Every positioning method has its own input and output parameters. The parameters represented on the screenshot above and described here stand for pos. 4 (SRP, H3O, L34).

**9.1-16.1** The origin type of every parameter is displayed in gray letters behind the value.

- **Base data** The value is taken from the base data. If it is not defined there, an error message will be displayed before creating the manikin.
- **User Input:** The required value is to be specified by the user.
- **Output:** The value is calculated by CAVA on the base of the geometry data. It can not be edited by the user (neither in *Free* mode).

**9** *Torso angle* value box

Back angle, defined in the *Base Data* on the *Seats* tab card.

**10** *Hip angle* value box

Whether this box is shown on the GUI or not depends on the position, selected in the *Position* list box (above ①)

**11** *SRP* value box

Seat reference point, defined in the *Base Data* on the *Seats* tab card or calculated (as e.g. for pos. 5—see above ① *Position* list box).

**12** *Leg Room L34* (+254 mm) spinner box

Distance between SRP and ankle point plus addition of 254 mm

When certain positions have been selected in the *Position* list box ① (e.g. pos. 1, pos. 2 and pos. 3), the leg room is calculated on the base of the geometrical data and is here only displayed.

For the positions 4 and 5 a user input is required for this value.

**13** *Knee angle* value box

The knee angle is an output value, calculated by CAVA on the base of the geometrical data.

**14** *Foot angle* spinner box

When certain positions have been selected in the *Position* list box ① (e.g. pos. 1, pos. 2 and pos. 6), the foot angle is calculated by CAVA on the base of the geometrical data and is here only displayed.

**15** *Heel point* value box

If the heel point is required for calculation, it is taken from the base data. If it is not defined there, an error message will be displayed.

⑩ *H30* spinner box

Vertical distance from SRP to heel point



After changing the data described above the manikin is updated automatically.

*Elements of interior for clash detection* tab card⑪ *Elements* value list

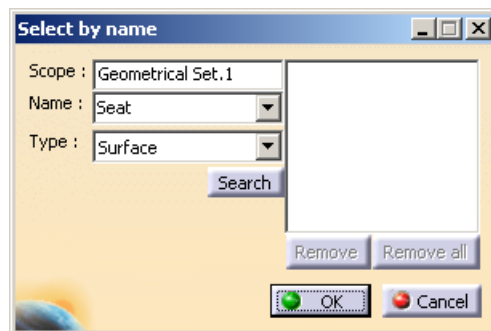
Required as input for foot positioning for the back seat manikins to move the foot in front position.

As an option for other positions (i.e. not pos. 6) it is possible to calculate clashes with the selected geometry elements.

⑫ *Select by Name* button

This button opens a dialog box where several features can be selected by their name and type (in analogy to some of the functions of the CAVA OVA module).

Example:



In the example a search operation is defined where in the Geometrical Set.1 (*scope*) surfaces (*type*) a searched the name of which starts with "Seat" (*Name*). After pressing the *Search* button, the search results will be displayed in the box on the right of the button. With the *Remove* or *Remove all* buttons features can be deleted that are not to be taken over in the selection. After confirming with the *OK* button the list content will be taken over in the list ⑪.

⑬ *Select CGR* check box

When this option is activated, CGR data can be selected. They are calculated on the base of their tessellation.

## ⑭ Result symbols of the clash test



OK

The MANIKIN geometry does not clash the selected vehicle geometry.



Error

The MANIKIN geometry does clash with the selected vehicle geometry. In the specification tree errors are signaled by a red triangle with exclamation mark.





If in the *Position* list box ① the pos. 6 (“Fond”, what means back seats) is selected, in the specification tree and in the *2D manikin template* dialog box no error symbol is displayed, as for this positioning method the clash test is used to position the manikin.

⑪ *Remove* Button

To delete an element from the list, select it by mouse click and click then on the *Remove* button.

⑫ *Remove all* button

Click on the *Remove All* button to delete all elements from the list.

## 6. Head Position Contours



The American standard SAE J1052 defines so called head position contours. Their shape is similar to an ellipsoid the bottom of which is open. This area is used to determine the H35 measure (vertical head clearance, i.e. the vertical distance to the headliner) and W27 (head clearance diagonal—distance under an angle of 30 deg outwards).

These values can be calculated optionally by this feature if the required geometries have been selected.

There are ellipses for the 95 % percentile and the 99 % percentile.

The length of the three axes (in  $x$ ,  $y$  and  $z$  directions) depends on the *HPoint Travel* value and is defined (in analogy to the eye ellipses) in discrete tables.

- **SAE J1052 to 2002 (*version of April 1997*)**

The positioning of the ellipsoid is performed as follows:

The center point of the ellipsis is determined as a function of HPoint Travel, using the following formula:

- for adjustable seats

$$X = L31 - a + 10.281641 * L40 - 0.032032 * L40 * L40$$

$$Y = W20$$

$$Z = H70 + 691.61757 + 0.398747 * L40 - 0.059301 * L40 * L40;$$

- for non-adjustable seats

$$X = L31 - 143.89500 + 13.54328 * L40 - 0.05588 * L40 * L40$$

$$Y = W20$$

$$Z = H70 + 682.14905 + 0.49530 * L40 - 0.068834 * L40 * L40;$$

with:

$$a = 166.91472 \text{ (for } 133 \text{ mm} < \text{HPoint Travel})$$

$$a = 155.21472 \text{ (for } 100 \text{ mm} < \text{HPoint Travel} < 133 \text{ mm)}$$

L40: back angle

$$SRP = (L31, W20, H70).$$

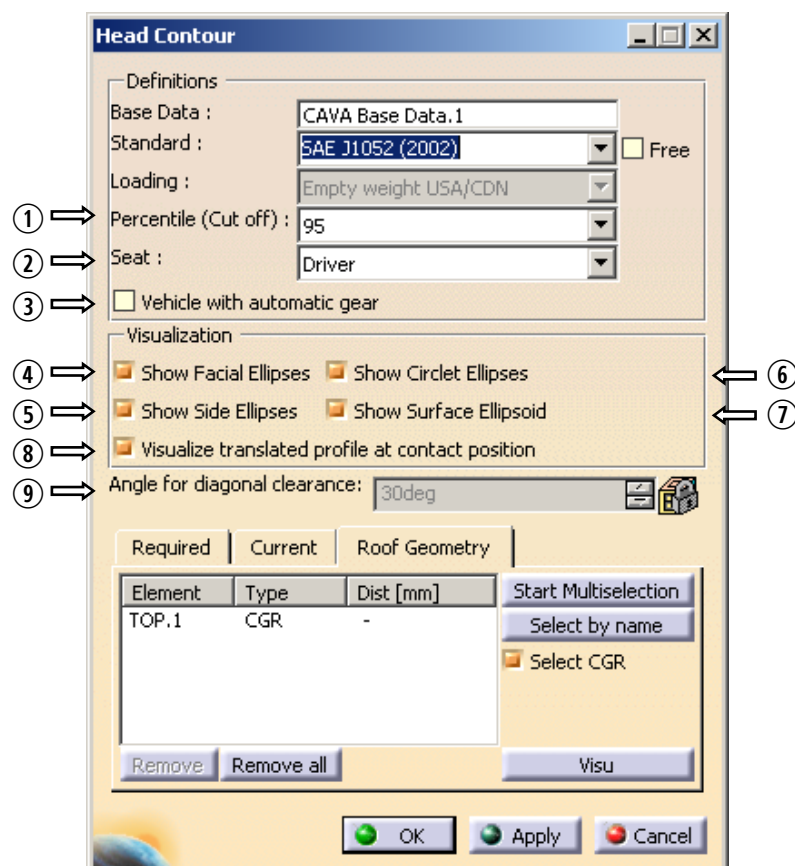
The axis in the side view is tilted forward by 6.4 deg. Thereafter the ellipsoid with the respective axes length is positioned.

For vehicles with seat adjustment ( $H_{\text{Point Travel}} > 0 \text{ mm}$ ) an additional 23 mm-large planar surface is added. For this purpose, the outer quarter of the ellipsoid (cut by the  $y$  plane, running through the center point) is shifted by 23 mm outwards. The empty sector resulting by this operation is filled with a filling volume.

- **SAE J10521 since 2002**

The calculation of the new head position contours is executed according to the new calculation of the eye ellipses. The center point of the ellipsoid is defined in relation to the center point of the eye ellipses and by a translation in  $x$  and  $z$  directions ( $y = 0$ ). Consequently, the same input data is required as for the eye ellipses, i.e. for instance the pedal point. After the calculation of the center point, the positioning is performed in analogy to the old standard version, i.e. the length of the axes of the ellipses is determined on the base of discrete tables. Tilting in side view here is executed only in case of adjustable seats.

### *Head contour dialog box*



① *Percentile (cut off)* list box

Select here the required percentile.

② *Seat* list box

Select one of the seats, which have been predefined on the base-data *Seat* tab card.

To the name of every CAVA head-position-contour feature in the specification tree the name of the referenced seat is added.

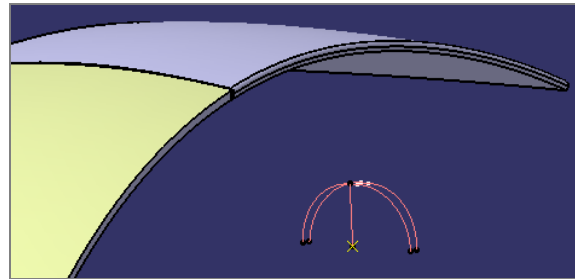
③ *Vehicle with automatic gear* check box

This option is available only for the SAE J1052 (2002) standard.

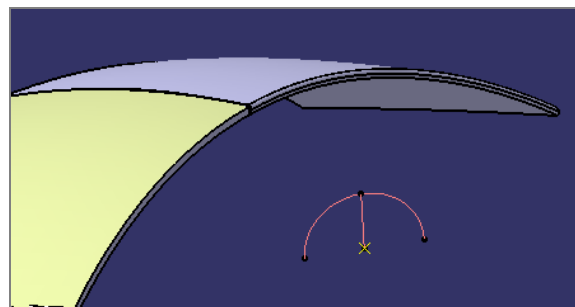
When this option is activated, the head-contour ellipses will be shifted by 12,5 mm in *x* direction.

④ *Show facial ellipses* check box

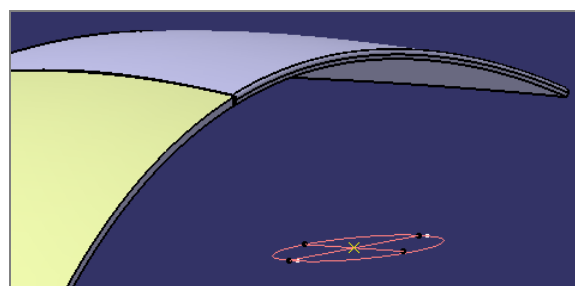
When this option is activated, in the model the ellipsis of the front part of the head position contour is shown.

⑤ *Show side ellipses* check box

When this option is activated, in the model the ellipsis of the side part of the head position contour is shown.

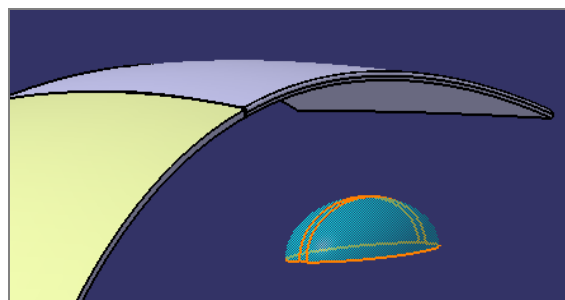
⑥ *Show circlet ellipses* check box

When this option is activated, in the model the ellipsis of the upper part of the head position contour is shown.



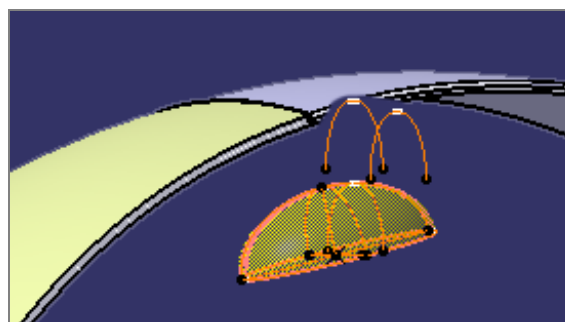
⑦ *Surface ellipsoid* check box

When this options is activated, in the model the ellipses are visualized as surfaces (exterior shell of the ellipsoids).



## ⑧ Visualize translated profile at contact position

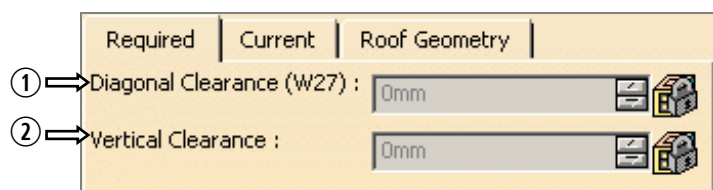
This option visualizes the ellipse lines at the vertical and/or diagonal contact point of the selected roof geometry.

⑨ *Angle for diagonal clearance*

If the *Free* mode is activated, here an angle can be defined which will be used for the diagonal head clearance (see below—*Required* tab card). The default value is 30 deg.

***Required* tab card**

The required values for the head position contour can be modified by the user only if the *Free* mode is activated.

① *Diagonal Clearance (w27)* spinner box

Distance of the outer ray of the Angle for diagonal clearance , defined above under ⑨, to the outer side (normally 30 deg).

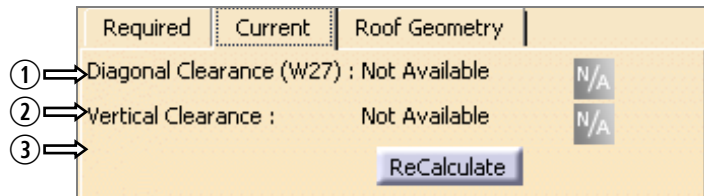
② *Vertical Clearance* spinner box

Vertical distance from head to the headliner.



## Current tab card

On this tab card the measurement results for the features, selected on the *Roof Geometry* tab card are displayed. The result of the comparison between the required values and the current values is displayed in form of an icon and the difference value.



- ① Measurement result for diagonal clearance (w27)

Measured distance of the outer ray of the Angle for diagonal clearance , defined above under ⑨, to the outer side (normally 30 deg).

- ② Measurement result for vertical clearance





Measured vertical distance from head to headliner.

- ③  *Recalculate* button

This button is active only if under *Tools > Options > Infrastructure > CAVA Vehicle Architecture* on the *Defaults* tab card for the *Update of measurements* setting the *Manual* option is selected.

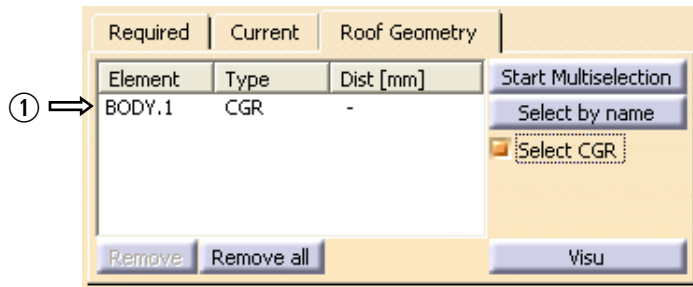
Otherwise this button is deactivated, and recalculation is performed automatically.

For the recalculation of the features (performed automatically or by pressing the *Recalculate* button) there are four result symbols:

	No Calculation	No feature had been selected.
	Not Available	No calculation is possible (e.g. because the selected feature can not intersect the geometry of the CAVA feature).
	OK	The position of the selected feature is OK.
	Error	The selected feature clashes with the geometry of the feature.

## Roof Geometry

Select the *Roof Geometry* tab card.



- ① Select with the mouse in the CATIA workspace (in the model or in the specification tree) one or several features for the clash check. These selected elements will be taken over in the list ①.



The feature is created in the current geometrical set and can be edited after double-clicking on the feature in the specification tree.

If in the CATIA menu *Tools > Options > Infrastructure > CAVA Vehicle Architecture* on the *Defaults* tab card the *Extend Feature-Name by Standard Name* option is activated, the standard name will be displayed also in the specification tree.

## 7. Driver SRP Location Curves



In the American standard SAE J1517 curves are defined, that for certain percentiles (e.g. 95 %, 99 %, ...) determine the position of the H point in function of different measures. These curves can be used to define the seat positions in an easier way, or to verify the ergonomic of existing positions.

The curves are plane curves, situated in the plane, running parallelly to the  $y$  plane through the seat reference point (SRP). The curves are defined for the percentiles 2.5, 5, 10, 50, 90, 95 und 97.5 and correspond to a man-woman-ratio 50:50. For trucks and other Class B vehicles, iso-percentile lines are defined, differentiating between several sex ratios. In CAVA only the 50:50 ratio is applied.

Below we give the formulas with  $x$ —horizontal distance to the pedal point and  $z$ —distance to the heel point in vertical direction to the road.

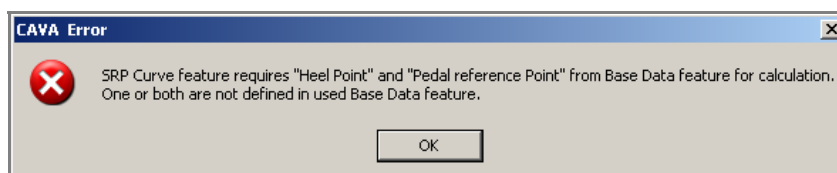
We do not indicate all percentiles, as the formula structure is identical and the different coefficients can be configured.

$$\begin{aligned} 2.5 \% : X &= 687.1 + 0.895336 * Z - 0.00210494 * Z * Z \\ \dots \\ 97.5 \% : X &= 936.6 + 0.613879 * Z - 0.00186247 * Z * Z \\ \dots \end{aligned}$$

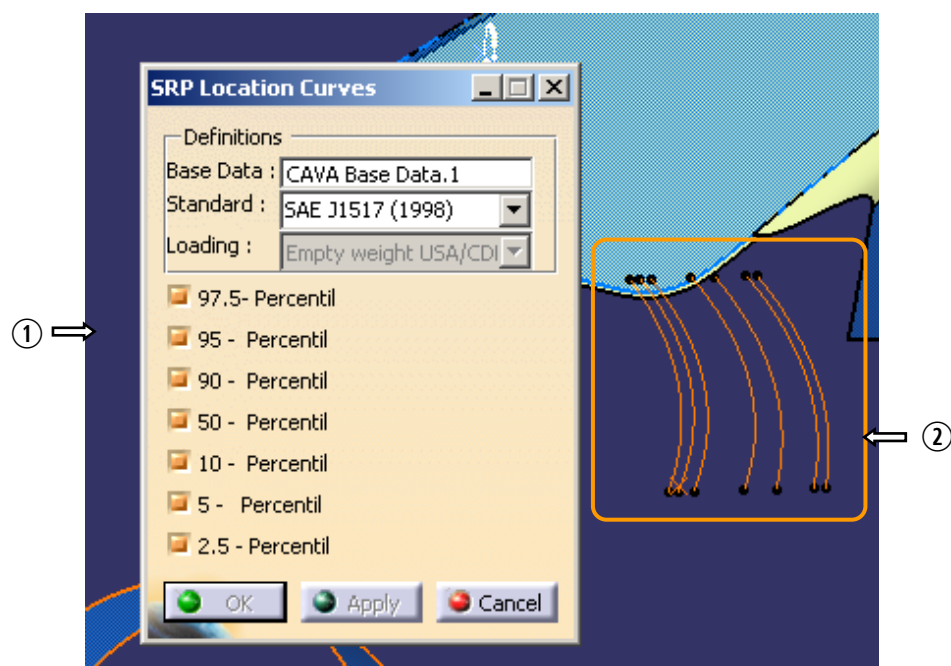
For each of the curves a  $z$  values range must be specified, for which the calculation will be executed. The SAE J1100 standard specifies a range from 127 mm to 405 mm. This range in CAVA is used as default, but may be modified in the `SRPLocationCurves.xml` configuration file.



For the calculation of the SRP position curves the heel point and/or the pedal reference point must have been specified in the base data. If these parameters not have been specified, the following error message will be displayed.



### *Driver SRP Location Curves* dialog box



① *Percentile* check boxes

Select one or several percentiles. For every one of the selected percentiles the SRP position curve is calculated and displayed in the model (②).

\* \* \*