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Awareness of the Proximity of Vulnerable Road Users:
UN Regulation No. 167 (Vulnerable Road Users Direct Vision)

Proposal for Supplement 1 to the original version of UN Regulation No. 167 (Vulnerable Road Users Direct Vision)

Submitted by expert from the United Kingdom *

The text produced below was prepared by the expert from the United Kingdom of Great Britain and Northern Ireland to amend UN Regulation No. 167 for Vulnerable Road Users Direct Vision as adopted at the 188th session of the World Forum for Harmonization of Vehicle Regulations (WP.29) by ECE/TRANS/WP.29/2022/140/Rev.1. The modifications to the current text of the UN Regulation are marked in bold for new or strikethrough for deleted characters.

I. Proposal

Insert new paragraph 2.9.4. to read:

"**2.9.4. Subsection Frontal Visible Volume (SFVV)" is defined as a portion of the assessment volume that includes the volume directly in front of the vehicle, between the offside and nearside planes.**"

Paragraph 5.2.2.1., *Table 1*, amend to read:

"Table 1
Minimum Values of Visible Volume

		Minimum Volume (m^3) of Direct Vision			
		Level 1		Level 2	Level 3
Nearside Visible Volume		3.4		Not Specified	Not Specified
Front Visible Volume	**IAPD ≥ [2156mm]**	1.8	**IAPD ≥ [2154mm]**	1.0	1.0
	IAPD < [2156mm]	**See paragraph 5.3**	**IAPD < [2154mm]**	**See paragraph 5.3**	**See paragraph 5.3**
Subsection Frontal Visible Volume		**0.441**		**0.114**	**0.114**
Offside Visible Volume		2.8		Not Specified	Not Specified
Total Visible Volume		11.2		8.0	7.0

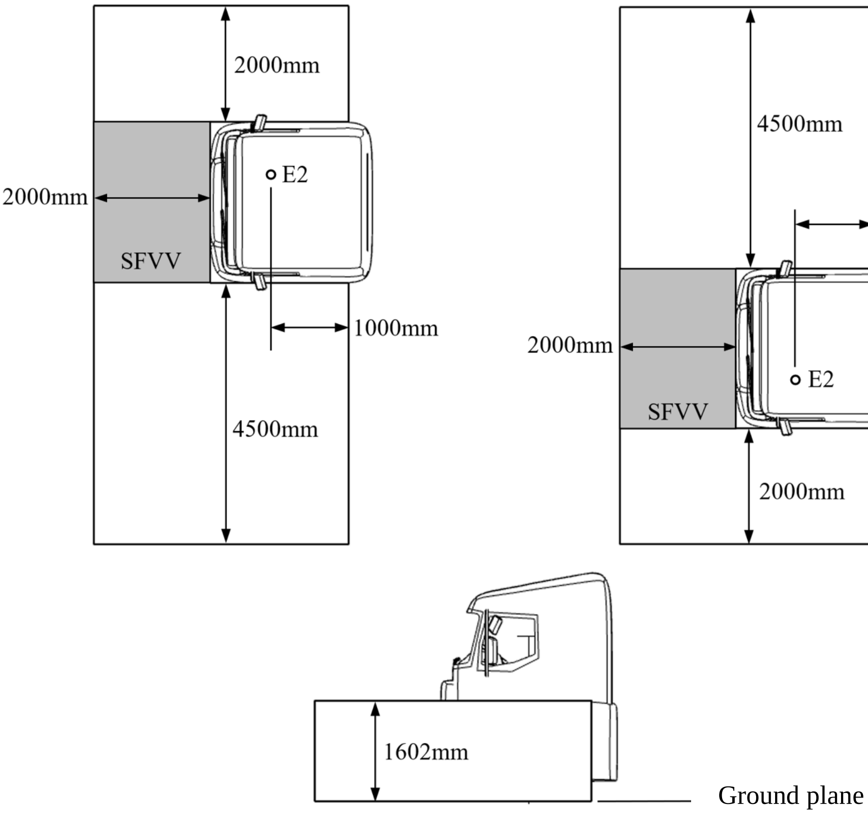
"

Annex 4,

Figure 1, shall be deleted

Insert new Figure 1 which shows the SFVV, to read:

"Figure 1
Definition of the Assessment Volume, Based on a Category N_3 Vehicle as an Example



"

Annex 7,

Paragraph 5.1., amend to read:

"5.1. Each of the views to the driver's nearside, front, **SFVV**, and offside shall be constrained to only those volumes that are within the assessment zone (the visible volume to each side). The remaining volumes of space shall be designated as:"

Insert new paragraph 5.1.4., to read:

"**5.1.4. The Subsection frontal visible volume.**"

Paragraph 5.2., amend to read:

"5.2. The total visible volume is the sum of the ~~visible volumes to each side~~ **nearside, front and offside visible volumes.**"

II. Justification

1. The original version of UN Regulation No. 167 defines the visible volume requirements to the front of the vehicle between the two A-pillars. This was not seen as technology neutral by manufacturers and so a recent proposal for an amendment from the Vulnerable Road User (VRU) Proxi group has introduced a reduction of the front visible volume requirements proportional to any reduction in inter A-Pillar Distance (IAPD) below the thresholds also indicated in the amended Table 1.

2. The analysis that led to this solution also highlighted an additional issue. By moving the A-pillars rearwards in the longitudinal axis with respect to the driver, frontal volume can be gained which is outside of the area of the greatest risk as shown in Figure 1 and Figure 2.

3. This conclusion has been derived from an analysis of four cab designs. Each vehicle was placed at a height that allowed $1m^3$ to be visible from the standardised eye point with the default A-pillar location. In each case the A-pillar structures were moved rearwards in four 25mm increments for a total 100mm.

4. The graph shown in Figure 3 shows the volume that can be gained by moving the A-pillars rearwards in the longitudinal axis for the four test vehicles. Out of the four vehicles tested, the smallest improvement in volume gained through the rearwards movement by 100mm of the A-pillar is $0.2m^3$, and the largest is $0.38m^3$.

5. Therefore, the use of the strategy of moving the A-pillars rearwards by 100mm could allow 20 – 38 per cent of the required visible volume to the front of the vehicle for level 2/3 vehicles ($1m^3$) to be obtained. Figure 1 and Figure 2 show the location of the volume that can be gained for an example vehicle, after moving the A-pillars rearwards by 100mm in the longitudinal axis.

Figure 1
A perspective view of the volume (green) that can be gained in the front of the vehicle by moving the A-pillars rearwards by 100mm.

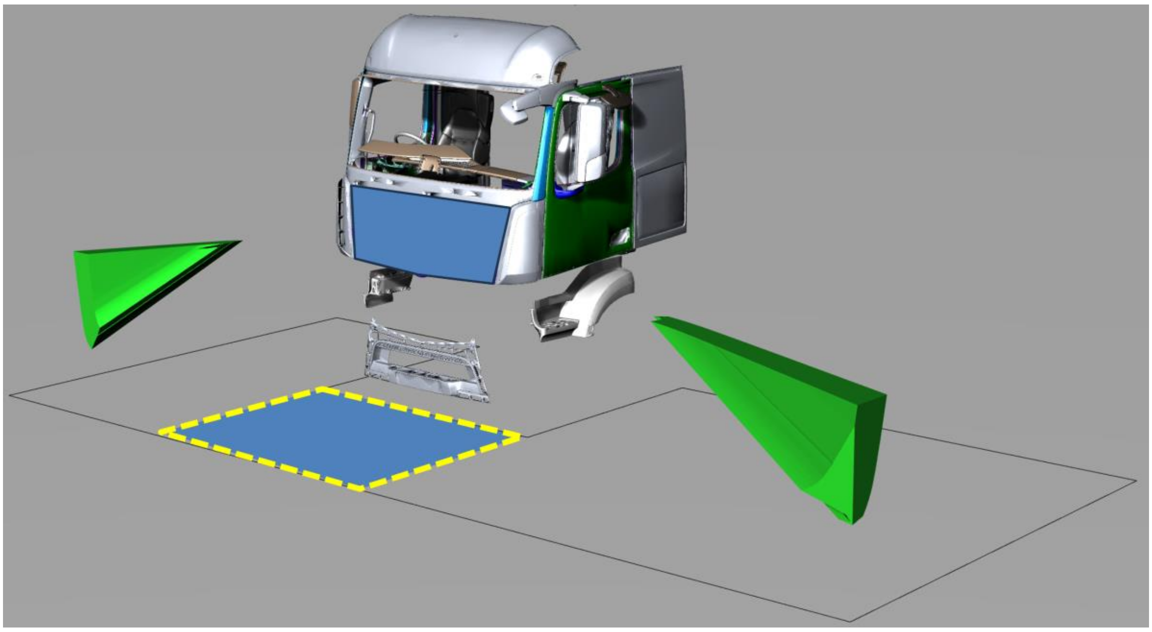


Figure 2

A plan view of the volume (green) that can be gained in the front of the vehicle by moving the A-pillars rearwards by 100mm.

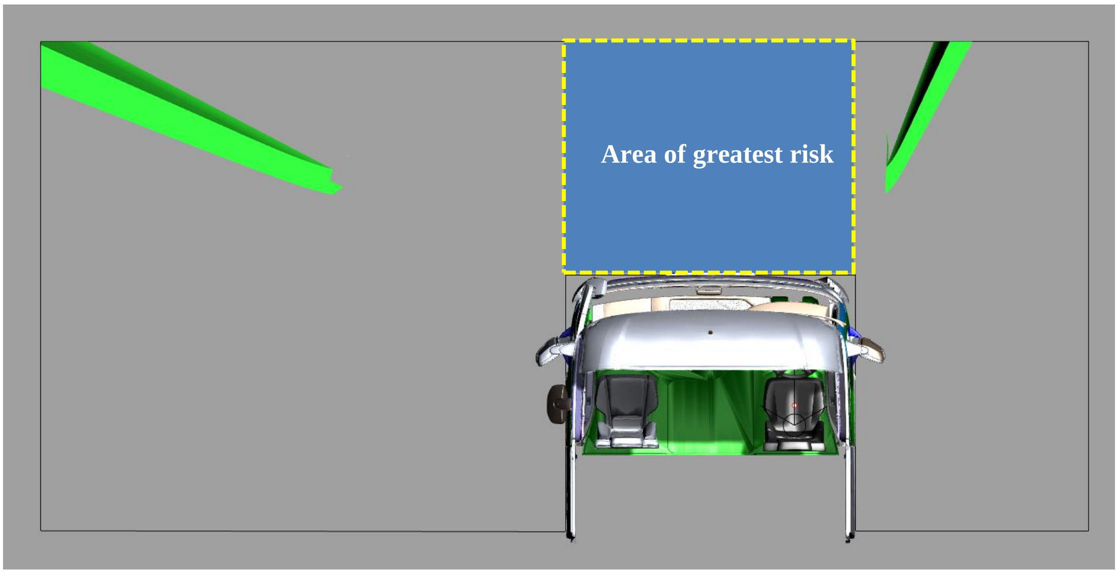
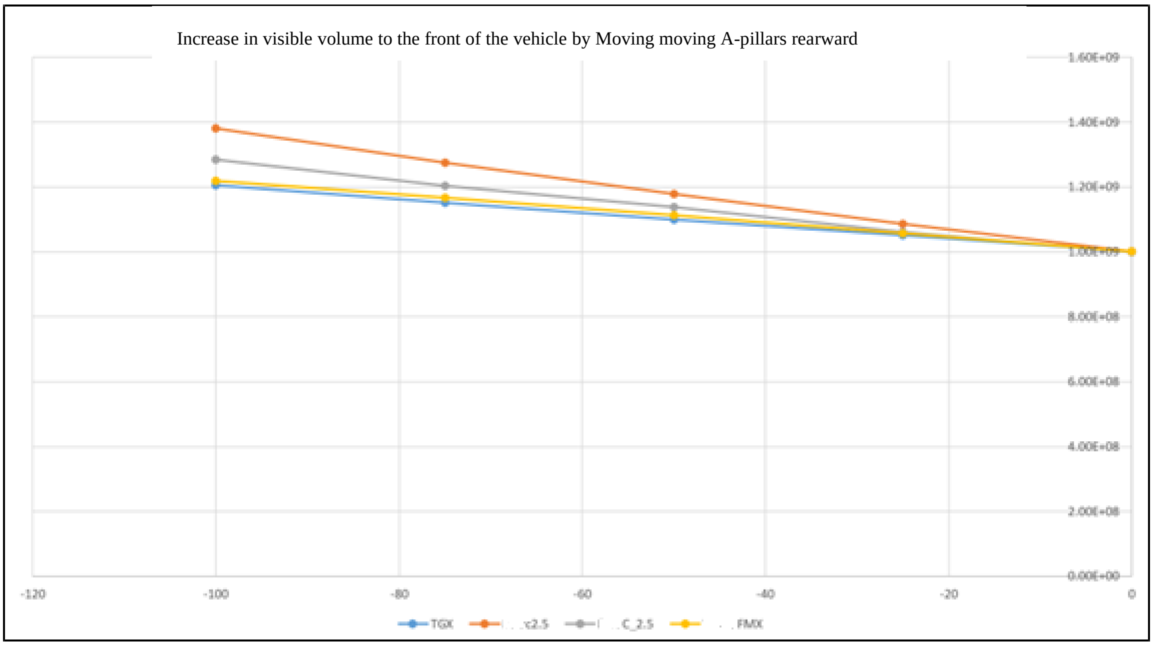


Figure 3

Graph showing the change in frontal volume score by moving the A-pillars rearwards



6. UN Regulation No. 167 was derived from a process by which the volume of the Assessment Volume that is visible from the standardised eye point is quantified in real world terms using the distance at which VRU simulations can be seen from the standardised eye point.

7. The specified minimum volume requirements in the Series 00 version were calculated by using specific VRU simulation distances for level 1 vehicles and level 2/3 vehicles. The average of three VRU distances to the front of the vehicle were defined as 1.653m for level 1 and 1.958m for level 2/3 vehicles. These values were used to calculate the corresponding frontal volume requirement in the Series 00 version.

8. The link to the VRU distances is then removed in the Series 00 version with only a volume requirement needing to be met.

9. The example shown in Figures 1-3 highlights that moving the A-pillars rearwards allows volume to the front of the vehicle to be gained, in locations which do not improve the direct vision of the area of greatest risk as defined by the VRU placement in the work to define the required volumes and accident data analysis.

10. The proposed amendment defines a Subsection Frontal Visible Volume within the area of greatest risk with the aim of ensuring that VRUs directly in front of the vehicle cannot be in a blind spot between direct vision and indirect vision. This is currently possible with the series 00 version. The volumes that must be visible in the SFVV, and shown in table 1, have been derived by following the process stages below for levels 1, 2 and 3;

(a) For a sample of 15 vehicles the volume of the assessment volume that is directly in front of the vehicle, between the offside and near side planes, was calculated for both level 1 and level 2/3 vehicle conditions (level 1, 1.8m3 must be visible, level 2/3, 1m3 must be visible).

(b) These volumes were plotted against the VRU distances at which half of the VRU head was visible as per the method used in the definition of the minimum volume requirements in series 00.

(c) A trend line was added, and the equation of the trend line determined.

(d) The equation of the line was used to determine the volume that must be visible in the SFVV by using the same average frontal VRU distance values that were used in the series 00 version, i.e. 1.653m for level 1 and 1.958m for level 2/3.