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Awareness of the proximity of Vulnerable Road Users

Proposal for a new UN Regulation on uniform provisions concerning the approval of motor vehicles with regard to their Direct Vision

Submitted by the Informal Working Group on Awareness of Vulnerable Road Users proximity in low speed manoeuvres*

The text reproduced below was prepared by the Informal Working Group (IWG) on Awareness of Vulnerable Road Users proximity in low speed manoeuvres (VRU-Proxi) to establish a new UN Regulation on Direct Vision.

* In accordance with the programme of work of the Inland Transport Committee for 2020 as outlined in proposed programme budget for 2020 (A/74/6 (part V sect. 20) para 20.37), the World Forum will develop, harmonize and update UN Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

I. Proposal

UN Regulation No. [XXX]

Uniform provisions concerning the approval of motor vehicles with regard to their Direct Vision

0. Introduction (for information)

0.1. Collisions between vulnerable road users (VRU) and large commercial vehicles that are undertaking low speed manoeuvres, such as turning or moving off from rest, typically occur at low driving speeds. They usually have serious consequences for vulnerable road users (VRU). In the past, the safety of VRU in these situations was increased by an improvement of the driver's indirect vision (blind spot mirrors) and by equipping trucks with side underrun protection. However, these low-speed manoeuvring collisions still happen so further improvements have been considered necessary.

0.2 The cause of this type of collision can be contributed to by many factors. The VRU may have been positioned in a place where they were not available to be seen by the driver through either glazed areas or mirrors. Alternatively, they may have been available to be seen during the build-up to the collision but the driver may have detected their presence too late to avoid collision, or may have failed to detect their presence at all. This late detection, or failure to detect, could be a result of the driver failing to look, looking but failing to see, or seeing but failing to correctly judge the risk.

0.3 Elimination of this type of collision may consider action that mitigates many of these different causes. Other regulations have been introduced concurrently to use electronic sensing systems to detect a VRU in close proximity to the vehicle and to inform the driver of their presence via a low urgency information signal (e.g. light) and to provide a collision warning (e.g. audio-visual) when the situation becomes more critical.

0.4 Blind spot information systems and collision warnings will be most effective when they draw the attention of the driver to a hazard that can be seen and quickly identified as a valid threat. For many VRU collision situations with many designs of vehicle preceding this regulation, the VRU will not be directly visible through the front or side windows of the vehicle. Many will be visible in mirrors but the evidence suggests that this is not sufficient to prevent all collisions.

0.5 Visibility in mirrors can be very beneficial but suffers several limitations compared with direct vision. Human vision has evolved on the basis of two main zones of vision. Foveal vision is the high-resolution area at the centre of the view that is used to see and recognise objects. Peripheral vision contains much less detail but is very sensitive to movement and uses the detection of movement to very quickly draw the attention and the focus of foveal vision on the threat. In the context of this regulation, it is nature’s own collision warning system. Images in mirrors are small and may not show sufficient motion to trigger peripheral vision. They must be deliberately and actively scanned by the driver. Mirrors allow only limited depth perception. Images from convex mirror lenses may be distorted, particularly around the edges, and blind spot mirrors may be positioned in counter-intuitive positions with unexpected orientations of the subject. For example, the driver may need to look up towards the vehicle roofline, to see an image that looks down on the top of the head of a cyclist positioned alongside the vehicle. [JB1]Research has suggested that where VRUs in close proximity are available to be seen around the front or side of a commercial vehicle, the driver’s reaction time is substantially less

when they are available to be seen in direct vision compared with being available to be seen in mirrors.

0.6 Therefore, this UN Regulation asks for commercial vehicles that meet certain minimum standards of direct vision, in order to maximise the chances of a driver recognising and quickly reacting to the presence of a VRU in critical situations during low speed maneouvring. It also seeks to maximise the effectiveness of blind spot information systems and collision warnings.

0.7 However, in some circumstances, it will be significantly challenging for vehicle manufacturers to provide good direct vision without compromising other important operational characteristics, such as driver comfort and wellbeing, high power/cooling for high-capacity transport or high ground clearance for off-road operation. The evidence strongly suggests that the vast majority of potentially relevant close proximity manoeuvring collisions occur in major conurbations and very few on major inter-urban roads. As such, the Regulation has set out differing performance levels for different subcategories of vehicle, based on criteria considered highly likely to be indicative of the likelihood that they will be regularly used in urban areas and recognising certain operational limitations.

0.8 The Regulation recognises that enabling direct vision of any part of a VRU could potentially help a driver to recognise their presence and avoid a collision. In particular, it is considered that innovations such as windows in the lower panels of doors, that help to see VRUs adjacent to the vehicle at around waist height can be beneficial. For this reason, the Regulation calls for a minimum volume of space around the vehicle to be visible rather than simply visibility of an indicator representing head height, or an area on the floor as is the case for other visibility regulations. The use of a volumetric assessment method provides more flexibility for industry to innovate in their provision of the minimum required view.

1. Scope

1.1. This Regulation applies to the approval of vehicles of categories M_2, M_3, N_2 and N_3 with regard to their Direct Vision with the aim of eliminating blind spots to the greatest possible extent.

1.2. The requirements of this Regulation are so worded as to apply to vehicles which are developed for right-hand traffic. In vehicles that are developed for left-hand traffic, these requirements shall be applied by inverting the criteria, when appropriate.

1.3 Vehicles in small volumes and aimed for special purposes are exempted[CJ2][IK3]

Example 1

Example 2

2. Definitions

For the purposes of this Regulation:

2.1. *"Direct Vision*[JB4][CJ5]*"* means the volume of space that is visible through the transparent areas of the vehicle cabin[CJ6], without the aid of any additional devices[IK7].

Or "Direct Vision means the field of vision from the drivers eye point that can be seen through all the glazing situated in front of a plane passing through the drivers eye point and perpendicular to the longitudinal plane of the vehicle

2.2 *"Vehicle type with regard to its Direct Vision"* means vehicles[JB8] which do not differ in such essential respects as:

(a) The manufacturer's trade name or mark;

(b) The dimensions and shapes of the components of the vehicle cab[CJ9][GU10][CJ11][IK12];

(c) The distance in the X axis between the centre of the front axle of the vehicle and the foremost point of the vehicle;[GU13][CJ14][IK15]

(d) The number, size, shape or location of transparent areas[JB16][CJ17] of the vehicle limited in length to 1.0m behind the driver's front view eyepoint;

(e) The direct vision level, as defined by the table in Annex 5, that the vehicle will fall into;

(f) The use of mirrors or camera monitor devices replacing Class V and Class VI mirrors as defined in UN ECE Regulation no. 46.

2.3. "*Transparent area*" means that area of a vehicle windscreen or other glazed surface whose light transmittance measured in a direction perpendicular to the surface is not less than 70 per cent.

2.4 "*Vision occlusion*" means any permanently fitted part of the structure of the vehicle, or of the interior of the driver's cabin, that would obstruct a sightline passing from any of the three defined E-Points to any part of the assessment volume.

2.5 "Sightline" means a straight line representing the driver's line of sight from an eye point either to a target point or at any particular defined angle within the three-dimensional reference system.

2.6 *"Vision Opening Line (VOL)"* means the intersection of a surface with a sight line that is positioned at a tangent to the first vision occlusion that would obstruct that sightline (e.g. A-pillar, lower edge of windscreen, steering wheel etc).

2.7 *"Engine power"* means the maximum net power as defined by UNECE Regulation no. 85.

2.6. *"Sleeper cab"* means a type of cab that has a compartment behind the driver's seat intended to be used for sleeping.

2.7. "*Day cab*" means a type of cab that is not a sleeper cab.

2.8 *"Three-dimensional reference system"* is a coordinate system as defined by appendix 2 to Annex 1 of the Consolidated Resolution on the Construction of Vehicles (R.E.3). In this framework the longitudinal axis of the vehicle is designated the X axis, the lateral axis is the Y axis and the vertical axis is the Z axis.

2.9 *"H-point Manikin"* means a three-dimensional H-Point Machine as defined in Annex 1 of the Consolidated Resolution on the Construction of Vehicles (R.E.3)

2.9 *"R-Point"* means the seating reference point as defined in Annex 1 of the Consolidated Resolution on the Construction of Vehicles (R.E.3)

2.10 *"Accelerator Heel Point"* (AHP) means the lowest point at the intersection of the heel of the foot and the floor of the vehicle, with the shoe positioned on the Undepressed Accelerator Pedal. This shall be measured using the H-Point Manikin and the foot angle (L46) shall be at a minimum of 87 degrees when the manikin H-Point is positioned at the R Point. For vehicles with R Point to heel vertical (H30) greater than 405 mm, the accelerator pedal may be depressed as specified by the manufacturer. If the depressed pedal is used, the foot must be flat on the accelerator pedal.[SS18]

2.9. *"P point"* means the point about which the driver's head rotates when viewing objects on a horizontal plane at eye level.

2.10. *"E points"* means points representing the mid-point between the driver's left and right eye when the head is rotated around the P Point such that the driver is looking forward, 60 degrees to the nearside or 60 degrees to the offside.

2.11. *"Axle configuration"* means a code of the form AxB where A represents the total number of wheel positions available on the vehicle and B represents the total number of wheel positions where tractive force is applied by the vehicle powertrain. Thus, for example, 6x2 represents a 3-axle vehicle with a wheel positioned at each side of the axle (6 wheel positions) with one driven axle (two driven wheel positions). Extended axle configurations considering further sub-variations are included within the basic characteristics. Substituting a number for an X means it represents any number. For example, 10xX includes any axle configuration with five axles.

2.12 *"Vehicle frontal plane*[CJ19]*"* means a plane perpendicular to the median longitudinal plane of the vehicle and touching the foremost point of the vehicle, disregarding the projection of devices for indirect vision[CJ20].

2.13. *"Nearside"* means the right side of the vehicle for right-hand traffic or the left side of the vehicle in left-hand traffic.

2.14. *"Nearside Plane"* The plane parallel to the median longitudinal plane of the vehicle and touching its most outboard point in the nearside direction, disregarding the projection of devices for indirect vision.

2.15. *"Offside"* means the left side of the vehicle for right-hand traffic, or the right side of the vehicle for left-hand traffic.

2.16. *"Offside Plane"* The plane parallel to the median longitudinal plane of the vehicle and touching its most outboard point in the offside direction, disregarding the projection of devices for indirect vision.

2.17. *"Subject vehicle"* means the vehicle being tested

2.18 Proxy average height…….[SS21]

3. Application for approval

3.1. The application for approval of a vehicle type with regard to its Direct Vision shall be submitted by the vehicle manufacturer or by their authorized representative.

3.2. It shall be accompanied by the documents mentioned below in triplicate and include the following particular:

3.2.1. A description of the vehicle type with regard to the items mentioned in paragraph 5., together with dimensional drawings and the documentation as referred to in paragraph 6.1. The numbers and/or symbols identifying the vehicle type shall be specified. A model of information document is shown in Annex 1.

3.3. A vehicle representative of the vehicle type to be approved shall be submitted to the Technical Service conducting the approval tests[CJ22].

4. Approval

4.1. If the vehicle type submitted for approval pursuant to this Regulation meets the requirements of paragraph 5. below, approval of that vehicle type shall be granted.

4.2. The conformity of the requirements in paragraph 5. shall be verified with the test procedure as defined in paragraph 6., however its operation shall not be limited to these test conditions.

4.3. An approval number shall be assigned to each vehicle type approved; its first two digits (00 for this Regulation in its initial form) shall indicate the series of amendments incorporating the most recent major technical amendments made to this Regulation at the time of issue of the approval. The same Contracting Party may not assign the same number to another vehicle type within the meaning of paragraph 2.1 above.

4.4. Notice of approval or of refusal or withdrawal of approval pursuant to this Regulation shall be communicated to the Parties to the Agreement applying this Regulation by means of a form conforming to the model in Annex 2 to this regulation.[CJ23]

4.5. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation, an international approval mark consisting of:

4.5.1. A circle surrounding the letter "E" followed by:

(a) The distinguishing number of the country which has granted approval;[1] and

(b) The number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the circle prescribed in this paragraph;

[or

4.5.2. An oval surrounding the letters "UI" followed by the Unique Identifier.]

4.6. If the vehicle conforms to a vehicle type approved under one or more other UN Regulations annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.5. above need not be repeated. In such a case, the UN Regulation and approval numbers and the additional symbols shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.5. above.

4.7. The approval mark shall be clearly legible and be indelible.

4.8. The approval mark shall be placed close to or on the vehicle data plate.

5. Specifications

5.1. General requirements

5.1.1. E-points[CJ24][IK25]: The direct vision of vehicles shall be measured from three monocular eye points, where E2 is the forward eye point, E1 is the left side eyepoint and E3 is the right side eyepoint. Each point is defined using the three-dimensional reference system. E2 is defined by an offset from the accelerator

[1] The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev.6 - www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html

heel point of 1163.25 in the Z axis, and 678mm rearward in the X axis. The position of E2 in the Y axis is on a vertical plane, parallel to the median longitudinal plane and passing through the centre of the driver's seat. The P point is defined as being 98 mm rearward of E2 in the X axis. Points E1 and E3 are defined by a 60-degree rotation, to the left and right respectively, about the P-point.

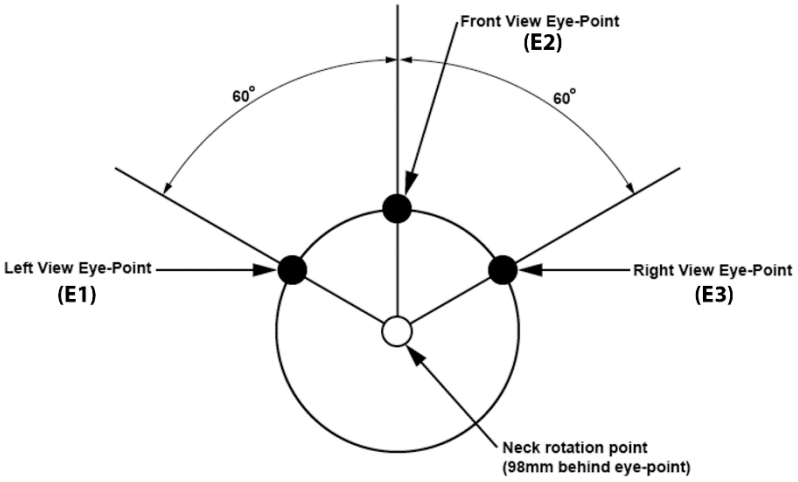


Figure XX

5.2. Performance requirements

5.2.1. Assessment volume [combined zone].[IK26]

5.2.1.1 The [combined] assessment volume shall be defined as the volume of space between the frontal, nearside and offside plane of the vehicle and the horizontal and vertical boundaries of the assessment zone. This is illustrated in a diagram in Annex 4.

5.2.1.2 The forward boundary of the assessment zone shall be formed by a plane parallel to the vehicle frontal plane and positioned 2m forward of the vehicle frontal plane.

5.2.1.3 The nearside boundary of the assessment zone shall be formed by a plane parallel to the vehicle nearside plane and positioned 4.5m further to its' nearside. [IK27][IK28]

5.2.1.3 The offside boundary of the assessment zone shall be formed by a plane parallel to the vehicle offside plane and positioned 2m further to its' offside.

5.2.1.4 The vertical boundaries of the assessment zone shall be formed by the ground plane and a plane parallel to the ground plane but positioned 1.602m above the ground.

5.2.1.5 The rearward boundary of the assessment zone shall be formed by a plane parallel to the vehicle frontal plane and positioned 1.0m behind the driver's front view eyepoint (E2)

5.2.2. [Assessment volume frontal zone][IK29]

5.2.2.1 The frontal assessment volume shall be defined as the volume of space between the frontal plane of the vehicle and the horizontal and vertical boundaries of the assessment zone. This is illustrated in a diagram in Annex 4.

5.2.2.2 The forward boundary of the assessment zone shall be formed by a plane parallel to the vehicle frontal plane and positioned 2m forward of the vehicle frontal plane.

5.2.2.3 The nearside boundary of the assessment zone shall be formed by a plane parallel to the vehicle nearside plane and positioned [4.5m] further to its' nearside.

5.2.2.4 The offside boundary of the assessment zone shall be formed by a plane parallel to the vehicle offside plane and positioned [2m] further to its' offside.

5.2.2.5 The vertical boundaries of the assessment zone shall be formed by the ground plane and a plane parallel to the ground plane but positioned 1.602m above the ground.

5.2.3 Visible volume

5.2.3.1 The visible volume is a volume of space, contained entirely within [one of] the assessment volume zone[s], that is visible via sightlines projected from one or more of the E-Points through one or more of the transparent areas of the vehicle cab, excluding sightlines that are blocked by a vision occlusion.[IK30][SS31][JB32][IK33]

5.2.3.2 The visible volume shall be quantified via the assessment methods defined in Paragraph 6.

5.2.5 Direct Vision limits.

5.2.5.1 Vehicles shall be assigned into one of the following [3] levels in accordance with the table of criteria contained in Annex 5:

5.2.5.1.1 Level 1: Vehicles that often travel in urban areas;

5.2.5.1.2 Level 2: Vehicles that sometimes travel in urban areas but have specific operational limitations;

5.2.5.1.3 Level 3: Vehicles that seldom enter urban areas.

5.2.5.2 Vehicles of each level must achieve visible volumes in excess of the limit values associated with that level in the table [for both the combined zone and the frontal zone]

Vehicle Level	Visible Volume [combined zone]	Visible Volume [Frontal Zone]
1	[11.2m^3]	[1.0 – 1.3m^3][CJ34]
2	[8 - 8.5m^3]	[1.0 – 1.3m^3]
3	[7 - 7.5m^3]	[1.0 – 1.3m^3]

5.2.4. Specific conditions (if applicable).[CJ35]

[For direct vision types equipped with [Camera/monitor device][ED36] replacing Class V and Class VI mirrors], the following table replaces the table in 5.2.5.2.]

Vehicle Level	Visible Volume [combined zone]
1	[8.5 m3]
2	[7.0 m3]
3	[6.0 m3]

6. Test procedure

6.1. The manufacturer shall provide a documentation package which gives access to ...[CJ37][GU38] The documentation package shall give sufficient information for the Type Approval Authority to identify the vehicle type and to aid decision-making on the selection of worst-case conditions.

6.2. Test conditions

6.2.1. The test shall be performed on a flat**,** dry asphalt or a concrete surface.

6.2.2. The ambient temperature shall be between 0° C and 45° C.

6.2.3. The test shall be performed under visibility conditions that clearly allows targets used to quantify the field of view to be correctly observed by a visible light camera.[CJ39]

6.3. Vehicle conditions

6.3.1. The subject vehicle shall be the worst-case vehicle of it's type [JB40]in respect of Direct Vision [SS41][IK42]

6.3.2 The subject vehicle shall be assessed with the accelerator heel point positioned at a height from the ground that represents the mid-point between the height that the manufacturer calculates it would be at for an unladen chassis cab (without body) and that which the manufacturer calculates it would be at when the vehicle is loaded to its technically permissible design maximum.[GU43][GU44][SS45][SS46][JB47]

6.3.3 The orientation of the vehicle cab in terms of pitch and roll angles relative to the ground plane shall be as the manufacturer would expect when the vehicle is positioned on a flat level road.[SS48][JB49]

6.3.4 The steering wheel shall be located in the centre of the possible range, considering all axes of adjustment.

6.3.5 Mirrors (where applicable) shall be adjusted to meet the views required by UNECE Regulation no. 46.

6.3.6 Passenger seat (if fitted):

6.3.6.1 For vehicles where a range of passenger seat designs may be specified, the seat selected for evaluation shall be at the discretion of the manufacturer.

6.3.6.2 If the position of the seat is adjustable the passenger seat shall be placed at its rearmost lowest position with a backrest angle of 18 degrees from vertical.

6.3.6.3 Where the selected passenger seat is foldable, the vehicle may be assessed with the seat in the in-use (deployed) or the not-in-use (stowed) position at the discretion of the manufacturer. The single selected seat position shall be applied throughout the whole assessment.

6.3.6.4 Where armrests are adjustable these may be in the in-use (deployed) or the not-in-use (stowed) position at the discretion of the manufacturer.

6.3.6.5 Head restraints shall be in the lowest position suitable for normal use in service. They shall not be in a position provided solely for stowage when not in use.

6.4. Quantifying the visible volume[RM50][SS51]

6.4.1 The nearside view of the vehicle assessed shall be defined as being inclusive of the view through all transparent areas rearwards of the A-pillar on the near side of the vehicle cabin that lie less than 1m to the rear of the points E1 or E3, where the view from the driver's seat would predominantly lie outboard of the nearside plane of the vehicle.

6.4.2 The offside view of the vehicle assessed shall be defined as being inclusive of all transparent areas rearwards of the A-pillar of the vehicle cabin that lie less

than 1m to the rear of the points E1 or E3, where the view from the driver's seat would predominantly lie outboard of the offside plane of the vehicle.

6.4.3 The front view of the vehicle assessed shall be defined as being inclusive of all transparent areas between the A-pillars of the vehicle cabin that lie forward of point E2, where the view from the driver's seat would predominantly lie forward of the frontal plane of the vehicle.

6.4.4 The visible volume is the sum of the volume that is visible through the nearside, offside and front views of the vehicle, bounded by the assessment volume.[RM52][IK53] It may be quantified by either of the following methods, at the discretion of the vehicle manufacturer and in agreement with the approval authority.

6.4.4.1 The visible volume can be quantified directly via a virtual test method as defined in Annex 7, or an alternative virtual method which the manufacturer can demonstrate to the satisfaction of the approval authority produces results at least as accurate as the method defined in Annex 7.

6.4.4.2 The visible volume can be quantified indirectly via the physical test method defined in Annex 6.

6.5 If a virtual test method is used, the manufacturer shall demonstrate the accuracy of the actual software and technique used by assessing the view from the generic vehicle model defined in Annex 7 and comparing the result to a predefined volume value. A tolerance of ++ will be applied to the result.

6.6 In the event of dispute between manufacturer and approval authority concerning the reliability of any method proposed, the approval authority shall specify the method to be used.[IK54]

7. Modification of vehicle type and extension of approval

7.1. Every modification of the vehicle type as defined in paragraph 2.1. of this Regulation shall be notified to the Type Approval Authority which approved the vehicle type. The Type Approval Authority may then either:

7.1.1. Consider that the modifications made do not have an adverse effect on the conditions of the granting of the approval and grant an extension of approval;

7.1.2. Consider that the modifications made affect the conditions of the granting of the approval and require further tests or additional checks before granting an extension of approval.

7.2. Confirmation or refusal of approval, specifying the alterations, shall be communicated by the procedure specified in paragraph 4.4. above to the Contracting Parties to the Agreement applying this Regulation.

7.3. The Type Approval Authority shall inform the other Contracting Parties of the extension by means of the communication form which appears in Annex 2 to this Regulation. It shall assign a serial number to each extension, to be known as the extension number.

8. Conformity of production

8.1. Procedures for the conformity of production shall conform to the general provisions defined in Article 2 and Schedule 1 to the 1958 Agreement (E/ECE/TRANS/505/Rev.3) and meet the following requirements:

8.2. A vehicle approved pursuant to this Regulation shall be so manufactured as to conform to the type approved by meeting the requirements of paragraph 5. above;[CJ55]

8.3. The Type Approval Authority which has granted the approval may at any time verify the conformity of control methods applicable to each production unit. The normal frequency of such inspections shall be once every two years.

9. Penalties for non-conformity of production

9.1. The approval granted in respect of a vehicle type pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 8. above are not complied with.

9.2. If a Contracting Party withdraws an approval it had previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation by sending them a communication form conforming to the model in Annex 2 to this Regulation.

10. Production definitively discontinued

If the holder of the approval completely ceases to manufacture a type of vehicle approved in accordance with this Regulation, they shall so inform the Type Approval Authority which granted the approval, which in turn shall forthwith inform the other Contracting Parties to the Agreement applying this Regulation by means of a communication form conforming to the model in Annex 2 to this Regulation.

11. Names and addresses of the Technical Services responsible for conducting approval tests and of Type Approval Authorities

The Contracting Parties to the Agreement applying this Regulation shall communicate to the United Nations Secretariat the names and addresses of the Technical Services responsible for conducting approval tests and of the Type Approval Authorities which grant approval and to which forms certifying approval or extension or refusal or withdrawal of approval are to be sent.

Annex 1

Information document for type approval of a vehicle with respect to its Direct Vision

The following information, if applicable, shall be supplied in triplicate and shall include a list of contents.

Any drawings shall be supplied in appropriate scale and in sufficient detail on size A4 paper or on a folder of A4 format.

Photographs, if any, shall show sufficient details.

1. Make (trade name of manufacturer): [CJ56].....

2. Type and general commercial description(s): .....

3. Means of identification of the type, if indicated on the device:[IK57].....

4. Category of vehicle for which the device is intended:[IK58] .....

5. Name and address of manufacturer: .....

6. Location and method of affixing of the approval mark: .....

6.1. Other mean of identification link to the approval mark: .....

7. Address(es) of assembly plant(s): .....

…[CJ59]

Annex 2

Communication

(Maximum format: A4 (210 x 297 mm)

issued by: (Name of administration)
.....
.....
.....

Concerning: [2] Approval granted
Approval extended
Approval refused
Approval withdrawn
Production definitively discontinued

of a type of vehicle with regard to its Direct Vision pursuant to UN Regulation No. [XXX]

Approval No.:.....

1. Trademark:.....
2. Type and trade name(s):.....
3. Name and address of manufacturer:.....
4. If applicable, name and address of manufacturer's representative: .....
5. Brief description of vehicle:.....
6. Date of submission of vehicle for approval: .....
7. Technical Service performing the approval tests: .....
8. Date of report issued by that Service: .....
9. Number of report issued by that Service:.....
10. Reason(s) for extension (if applicable): .....
11. Approval with regard to Direct Vision is granted/refused:[2]
12. Place:.....
13. Date:.....
14. Signature:.....
15. Annexed to this communication are the following documents, bearing the approval number indicated above: .....
16. Any remarks:.....

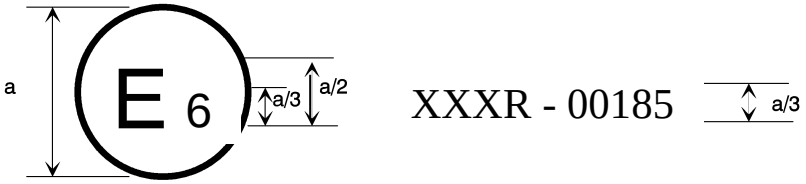
[1] Distinguishing number of the country which has granted/extended/refused/withdrawn an approval (see approval provisions in this Regulation).

[2] Strike out what does not apply.

Annex 3

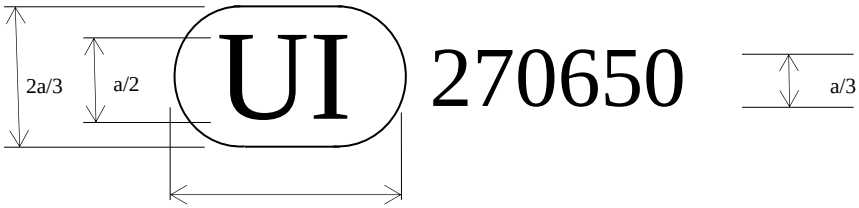
Arrangements of approval marks

(see paragraphs 4.5. to [4.5.2.] of this Regulation)



a = 8 mm min

The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in Belgium (E6) with regard to Direct Vision pursuant to UN Regulation No. [XXX]. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of UN Regulation No. [XXX] in its original form.



The above Unique Identifier shows that the type concerned has been approved and that the relevant information on that type-approval can be accessed on the UN secure internet database by using 270650 as Unique Identifier. Any leading zeroes in the Unique Identifier may be omitted in the approval marking.

Annex 4

Assessment volume[GU60][SS61][GU62]

...

Annex 5

Differentiation table

	Gross Weight (tonnes)	Chassis Execution	Axle Config	Engine Power (kW)	Cab type	Vehicle Category	[Additional Criteria to indicate truck form rather than van form[CJ63]]
Alternative Procedure	All	All	All	All	All	M2	All
	≤12[CJ64]	All	All	All	All	N2 N2G	N[CJ65]
Level 1	≤ [7.5]	All	4x2 [CJ66]	All	All	N2 N2G	Y
	>[7.5] & ≤12	All	4x2 [IK67] [CJ68]	All	All	N2	Y
	>[7.5] & ≤12	All	4x2 [IK69] [CJ70]	All	All	N2G	Y
	≤16	All	4x2 6x2 6x4 8x2 8x4	All	All	N3	All
	>16	Articulated	4x2	All	Day	N3	All
				<265	Sleeper	N3	All
			6x2	All	Day	N3	All
		Rigid	4x2	All	Day	N3	All
				<265	Sleeper	N3	All
			6x2	All	Day	N3	All
			6x4 8x2 8x4	All	Day	N3	All
				<[350]	Sleeper	N3	All
Level 2	>[7.5] & ≤12	All	4x4	[All]	All	N2G	Y[IK71]
	≤16	All	4x2 6x4 8x4	All	All	N3G	All
	>16	Articulated	4x2	All	Day	N3G	All
				<265	Sleeper	N3G	All
		Rigid	4x2	All	Day	N3G	All
				<265	Sleeper	N3G	All
			6x4 8x4	All	Day	N3G	All
				<[350]	Sleeper	N3G	All
Level 3	>16	Articulated	4x2	≥265	Sleeper	N3, N3G	All
			6x2	All	Sleeper	N3	All
			6x4 8x2 8x4	All	All	N3, N3G	All
		Rigid	4x2	≥265	Sleeper	N3, N3G	All
			6x2	All	Sleeper	N3	All

			6x4 8x2 8x4	≥[350]	Sleeper	N3, N3G	All
	All	All	4x4 6x6 8x6 8x8 10xX	All	All	N3, N3G	All

Alternative Procedure candidates:

1. N2 <7.5 tonne exempt
2. Comply with R125
3. Deemed to comply based on meeting the additional criteria (as below)
4. Choice to comply with truck method or R125 at manufacturer discretion

Additional criteria candidates:

a) Definition of forward control vehicle (cab over engine) from R46/29 ("Forward control" means a configuration in which more than half of the engine length is rearward of the foremost point of the windshield base and the steering wheel hub in the forward quarter of the vehicle length.)[IK72]

b) Exemption from class V/VI[IK73] indirect vision *(…shall be mounted on vehicles in such a way that, regardless of their position after adjustment, no part of these mirrors or their holders is less than 2 m from the ground when the vehicle is under a load corresponding to its technically permissible maximum laden mass. These mirrors shall not, however, be mounted on vehicles the cab height of which is such as to prevent compliance with this requirement. In this case another device for indirect vision is not mandatory.)*

c) Height of SRP<X

d) Height of lower edge of windscreen <X[IK74][IK75]

[Swedish proposal for amendments

	Gross Weight	Chassis Execution	Axle Configuration	Engine Power	Cab Execution	Vehicle Category
Level 1	>16 tonnes	Rigid	6x4 8x2 8x4	<[350] kW	Day	N3
Level 2	> 16 tonnes	Rigid	6x4 8x4	<[350] kW	Day	N3G
Level 3	> 16 tonnes	Rigid	6x4 8x2 8x4	≥[350] kW	Day	N3, N3G
				All	Sleeper	N3, N3G

Annex 6

Physical Test Method

The physical test method calculates the visible volume via mapping out the area of a horizontal plane that is visible from the three E points. The view from the E points is provided by three cameras mounted in the specified locations. The area that can be seen from each E point is mapped via the visibility of a calibrated marker object positioned on grid lines within the assessment area relevant to each eye point. The resulting visible area is scaled to quantify the visible volume.

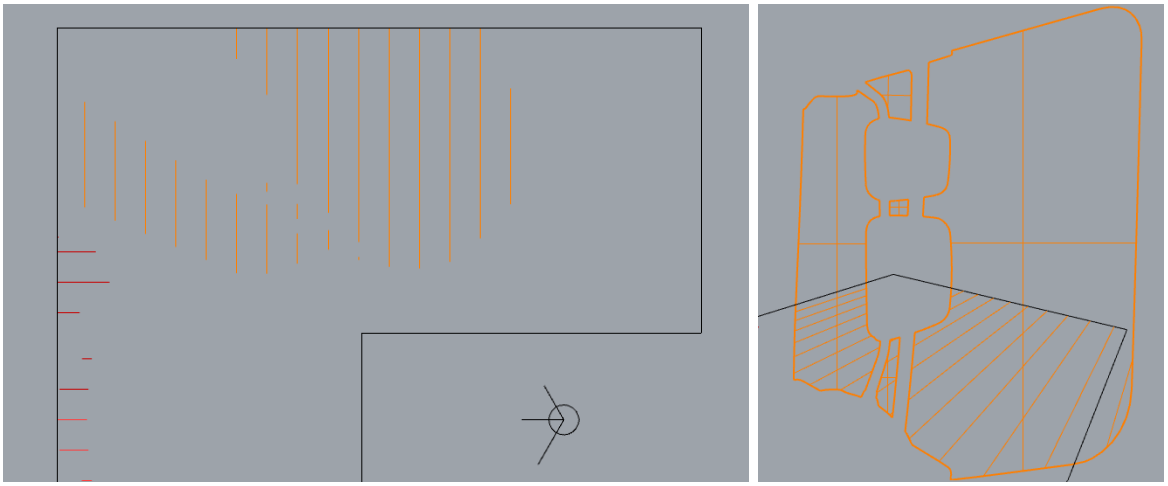


Figure 1. Example of the visible lines identified for the driver's side window

1. Assessment area [combined zone]

1.1 The [combined] assessment area shall be defined by a plane parallel to the ground plane [X-Y plane] at a height offset from zero by [1267mm] [1602mm] in Z, bounded by the assessment volume as defined in 5.2.1.

2 Assessment area grid

2.1 The assessment area grid is formed by a series of lines parallel to the median longitudinal plane of the vehicle (X) and perpendicular to the median longitudinal plane of the vehicle (Y) spaced at [100mm] intervals, bounded by the assessment areas as defined in 5.2.4. The grid is divided into three zones: front, nearside, offside.

2.2.1 Assessment area grid front zone

2.2.1.1 The frontal assessment area grid shall be defined as the region of the assessment area forward of the vehicle frontal plane. The grid is formed by lines parallel to the median longitudinal plane of the vehicle (X), spaced as defined in 5.2.5.1.

2.2.2 Assessment area grid nearside zone

2.2.2.1 The nearside assessment area grid shall be defined as the region of the assessment area to the nearside of the vehicle nearside plane. The grid is formed by lines perpendicular to the median longitudinal plane of the vehicle (Y), spaced as defined in 5.2.5.1.

2.2.3 Assessment area grid nearside zone

2.2.3.1 The offside assessment area grid shall be defined as the region of the assessment area to the offside of the vehicle offside plane. The grid is formed by lines perpendicular to the median longitudinal plane of the vehicle (Y), spaced as defined in 5.2.5.1.

3 Visible area

3.1 The visible area is the proportion of the assessment area, contained entirely within [one of] the assessment area zone[s], that is visible via sightlines projected from one or more of the E-Points through one or more of the transparent areas of the vehicle cab, excluding sightlines that are blocked by a vision occlusion.

3.2 The visible area shall be quantified via the assessment methods defined in Paragraph 6.

4. Physical test procedure setup

4.1 Eye points

4.1.1 The three eye points: E1, E2, E3 shall be located via the use of a physical eye rig (PER) that ensures the appropriate offset from the AHP

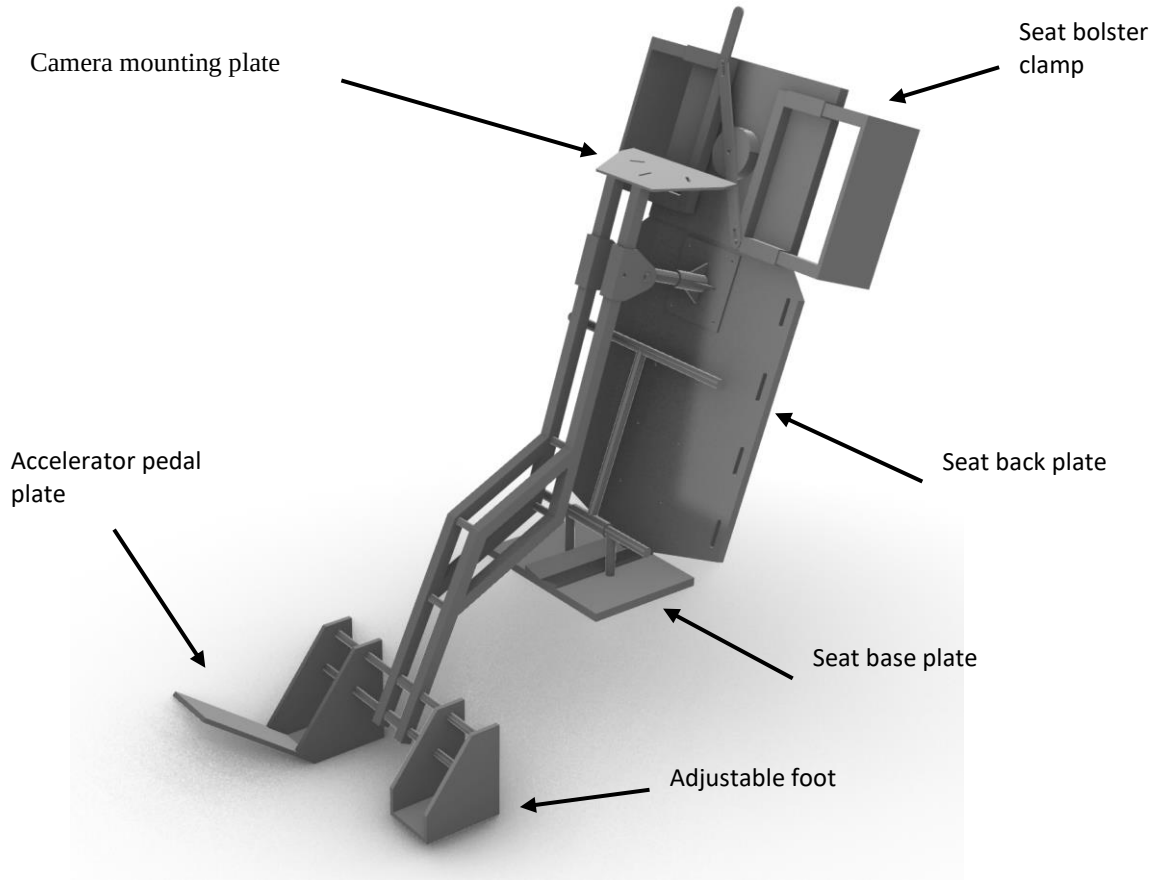


Figure 2. DVS Physical Eye Rig (PER)

4.1.1. The PER should be installed in the driver's seat according to the following procedure:

4.1.1.1. Adjust the driver's seat to its rearmost fore/aft position and mid up/down position.

4.1.1.2 Place the PER into the seat such that the seat base plate is in the centre of the seat base cushion.

4.1.1.3. Slide the PER rearwards until the seat back plate is resting against the back rest of the seat[JB76].

4.1.1.4. Adjust the seat height until the 'feet' of the PER are just supported by the cab floor. [JB77] Adjust the left foot to ensure both feet are supported equally and the seat base plate is parallel with the seat cushion.

4.1.1.5. Slide the seat forward until the accelerator pedal plate makes contact but does not depress the accelerator pedal.

4.1.1.6. Mount the camera holder onto the camera mounting plate.

4.1.1.3. Using the bubble level, ensure that the camera holder is horizontal by adjusting the PER's position. For this final stage it is essential that the operator's weight is not supported by the cab. Thus, the operator will need to perform this final stage whist standing on the floor, on steps, or other similar support.

4.2 Eye point cameras

4.2.1 The PER allows three high-resolution wi-fi connected cameras to be attached via the camera mount. The camera mount is designed to both orientate the cameras appropriately and to set the lens of each camera at the correct height. Each camera shall be accessible remotely via wifi to allow a live signal to be viewed remotely from a suitable device e.g. laptop or tablet.

4.3 Assessment area mats[CJ78]

4.3.1 Assessment area mats (AAM) are used to determine the size of the assessment area for the vehicle and to provide a guide for the evaluation. The mats consist of a vinyl surface printed with a square grid.

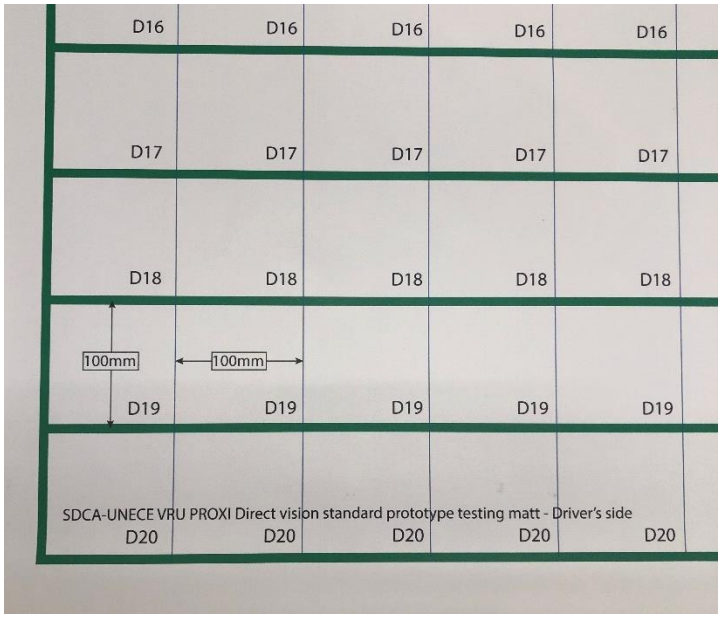


Figure 7. Assessment Area Mat print detail, showing grid layout.

4.3.2 A total of three mats are used to represent the area and to provide flexibility for varying vehicle size. The mats are configured as shown in Figure 8.

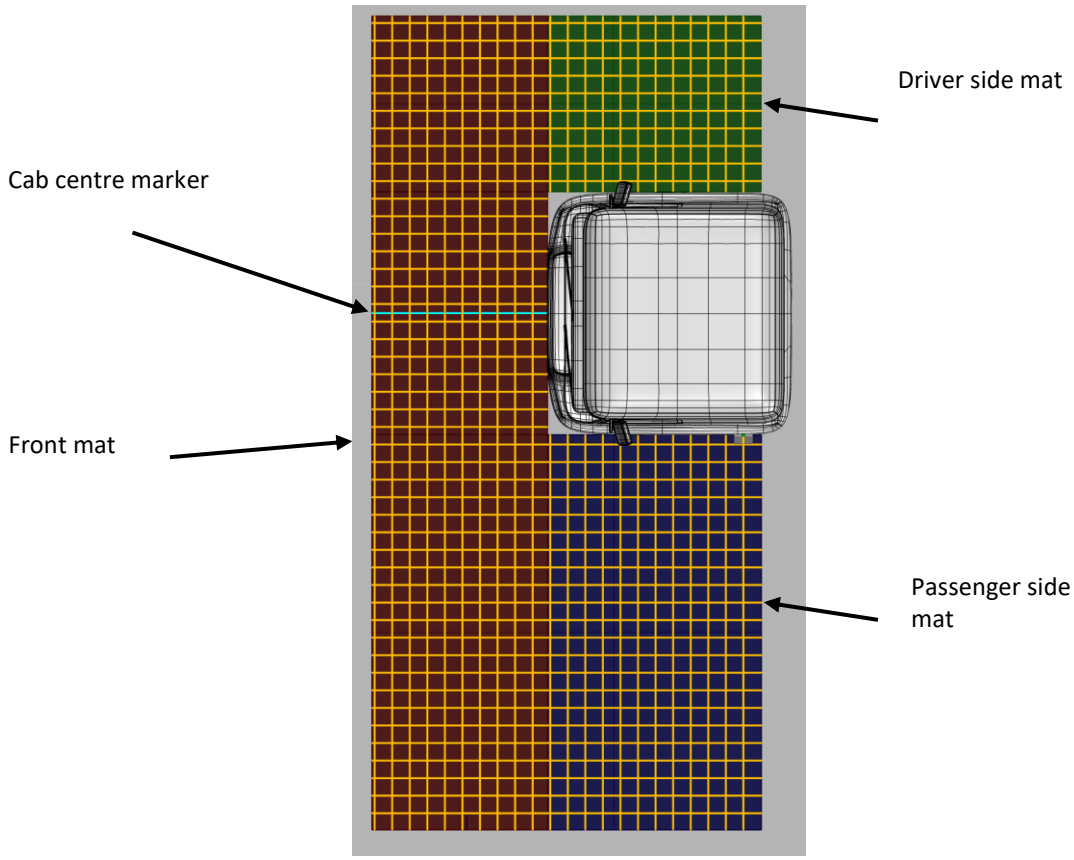


Figure 3. Assessment Area Mats installed around the cab

4.3.3 The assessment area mats are installed on the ground plane (XY) and are used to map the assessment area grids via the marker object.

4.4 The marker object (MO) is a 30mm diameter pole mounted to a 250mm square baseplate. The pole is split into two sections. A lower dark section that is [1264mm] high, and a red (or high visibility and high contrast) section that is a further 6mm high.

4.4.1 The red evaluation height (EH) equates to the [head and neck] [shoulder] height of a [5th %ile Italian female] [95%ile Dutch male] [1267mm] [1602mm] representing the benchmark VRU. The EH marker is the key visual indicator to be used in the assessment.

4.4.2 The EH has a finite thickness (6mm). It extends 3mm below and 3mm above the critical assessment height to ensure it is visible during the evaluation.

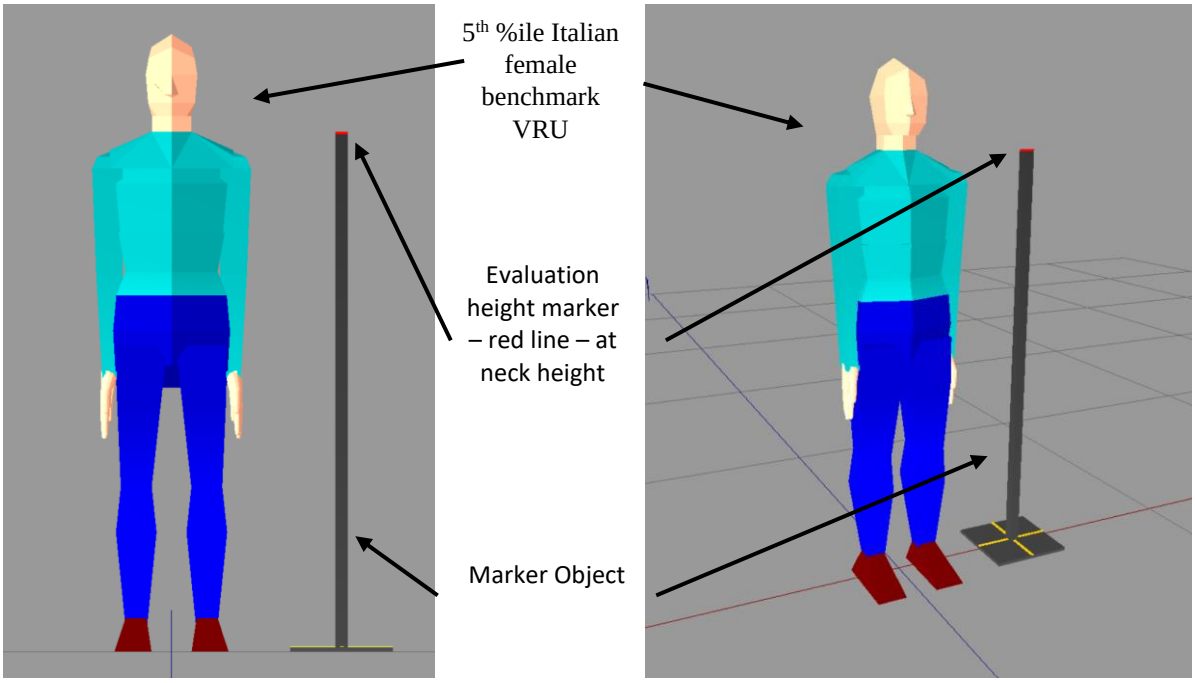


Figure 4. Marker object based on the height of a 5th%ile Italian Female[IK79]

5. Evaluation procedure

5.1 The evaluation consists of moving the MO along each line of the AAM and recording where it is visible in the appropriate camera mounted to the PER. This produces a series of visible lines that are subsequently measured and recorded.

5.2 The assessment is conducted in three stages: front, right, left. Each side should be assessed with the relevant camera / E point i.e. front using the front camera / E2, right using the right camera / E3, and left using the left camera / E1:

5.3 Determine the working order for the assessment (e.g. front to back, left to right) and incrementally assess each line on the AAM.

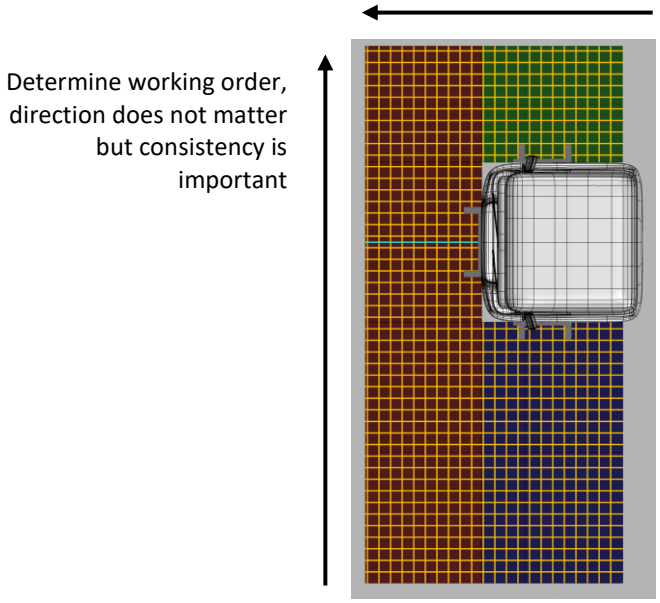


Figure 5. Determine working order in which to progress through the lines on the AAM

5.4 Take the MO and place it at the vehicle end of the first line of the AAM.

5.5 Align the markers on the foot of the MO with the line on the AAM.

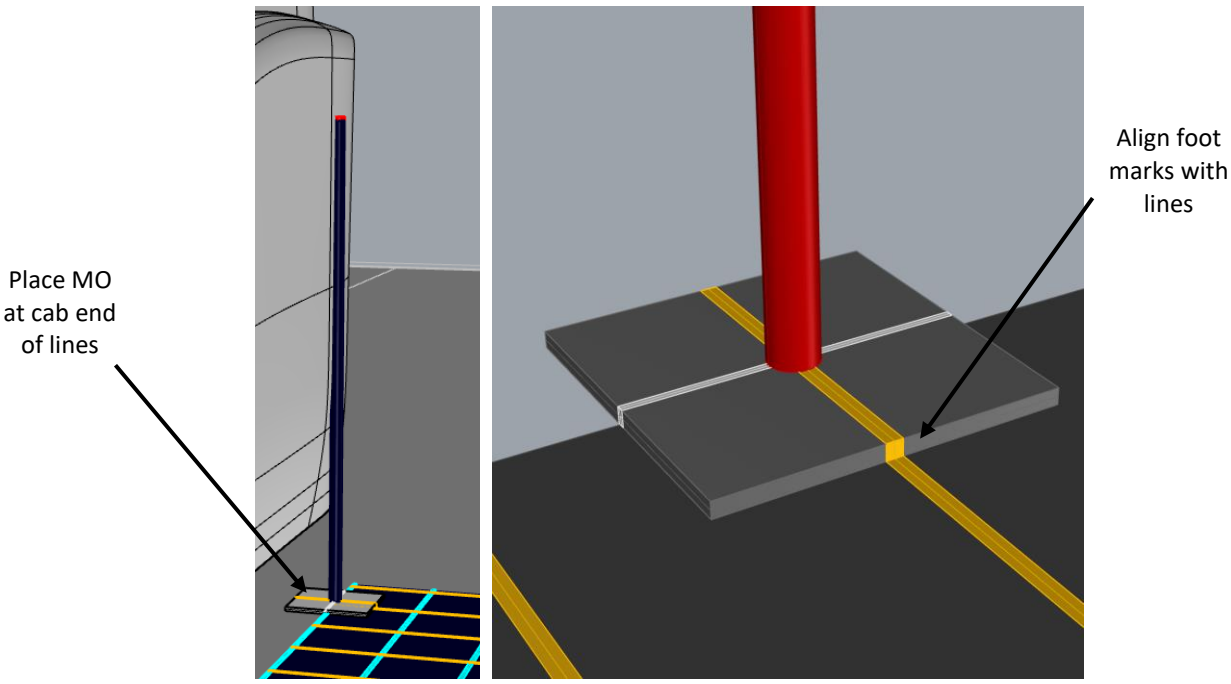
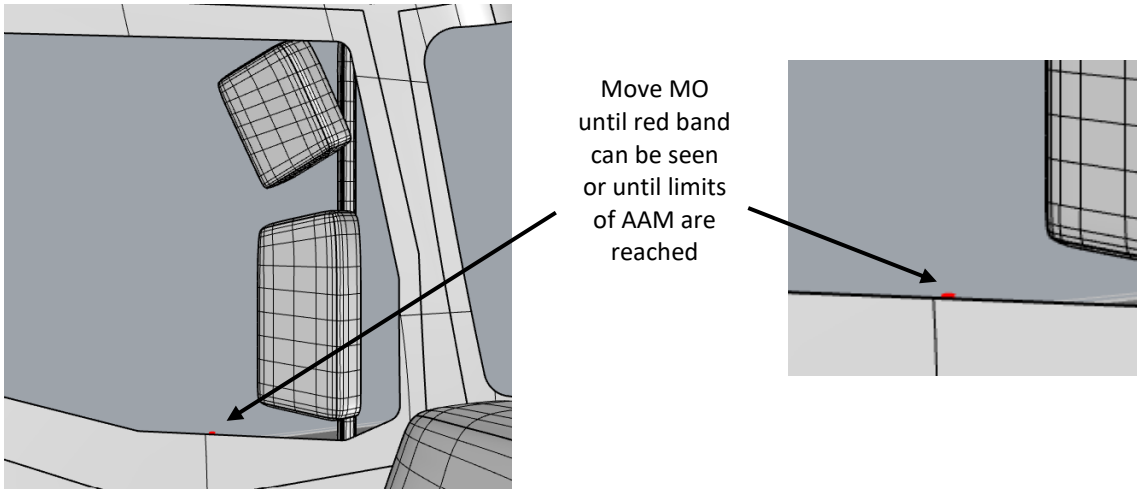


Figure 6. Place MO at cab end of first line and align foot markers with lines on AAM

5.6 Using the appropriate camera view assess whether the EH marker can be seen.

5.6.1 If the EH marker can be seen, record the position of the start of a visible grid line segment.



5.7 Move the MO along the grid line until the point at which the EH marker is no longer visible or the limits of the AAM are reached.

5.8 Place a mark on the AAM to indicate the end of the visible portion of the grid line.

5.9 If the yellow band can always be seen mark the full length of the line (2000mm or 4500mm) in the assessment table shown in **Fout! Verwijzingsbron niet gevonden.**.

5.10 Be sure to move the MO along the full length of the grid line and record all visible lengths of the line. Note that there may be more than one visible section of the line.

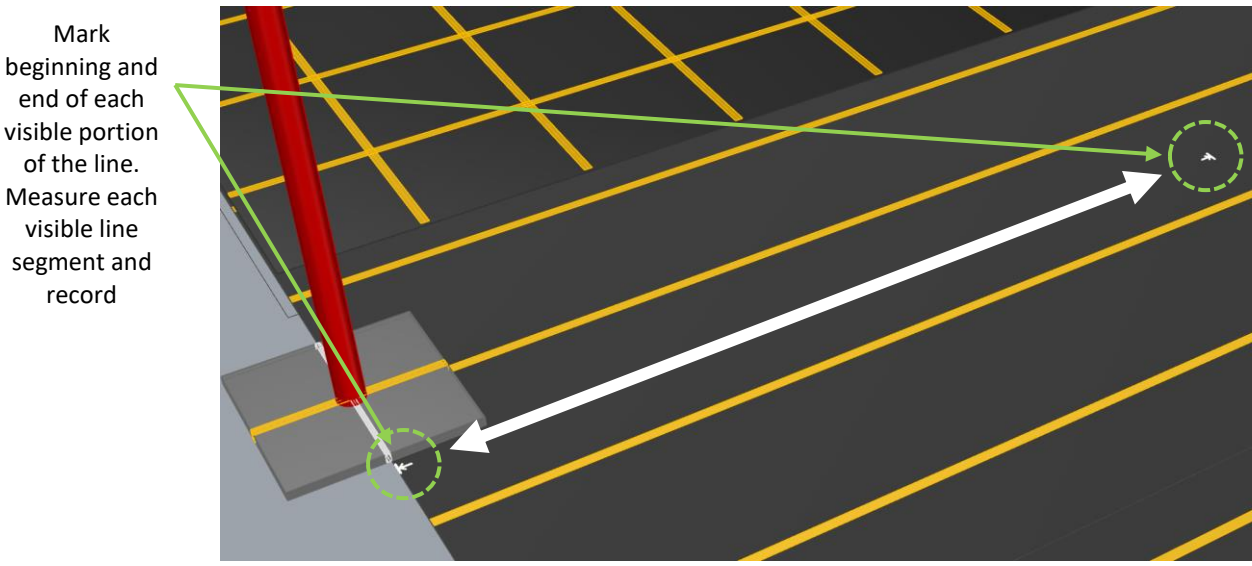


Figure 7. Mark visible sections of each line and record each segment length.

5.11 Once complete add together the length (in mm) of all visible (marked) portions of the grid line and record this in the assessment table.

5.12 If the band cannot be seen move the MO along the grid line until it can be seen and then follow the process in '5.5-5.11'.

5.13 If the MO cannot be seen at any point before it reaches the edge of the AAM, record a zero for that grid line in the assessment table.

5.14 Repeat the above process for every grid line on the AAM, working from one end to the other.

5.15 For the nearside and offside assessment areas, the MO should be moved along the full length of each grid line, laterally from one end to the other.

5.16 For the front assessment area, the MO should be moved along the full length of each grid line, longitudinally from one end to the other.

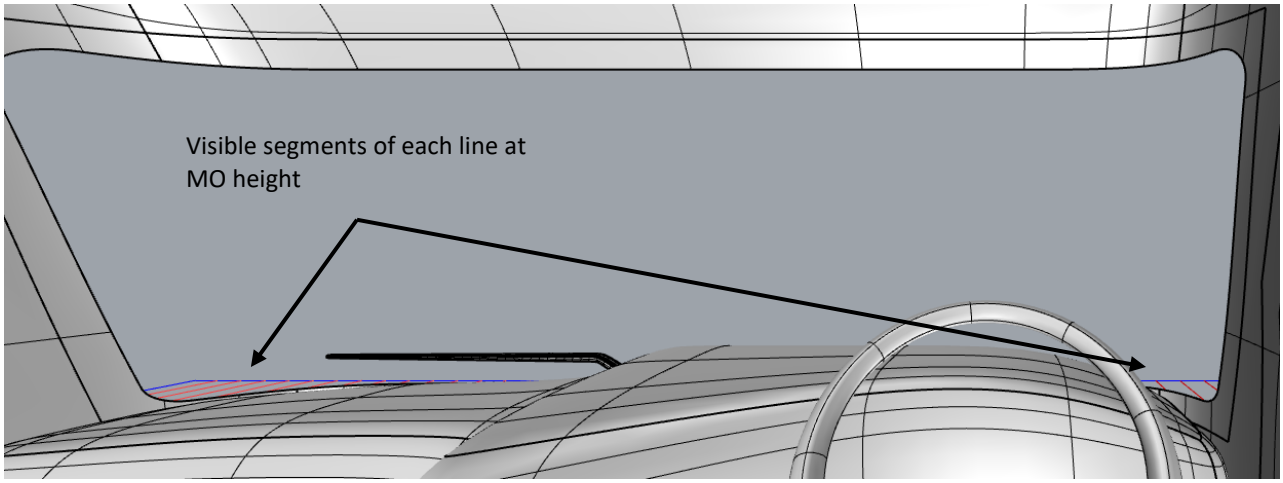


Figure 8. Visible line segments at MO height to the front

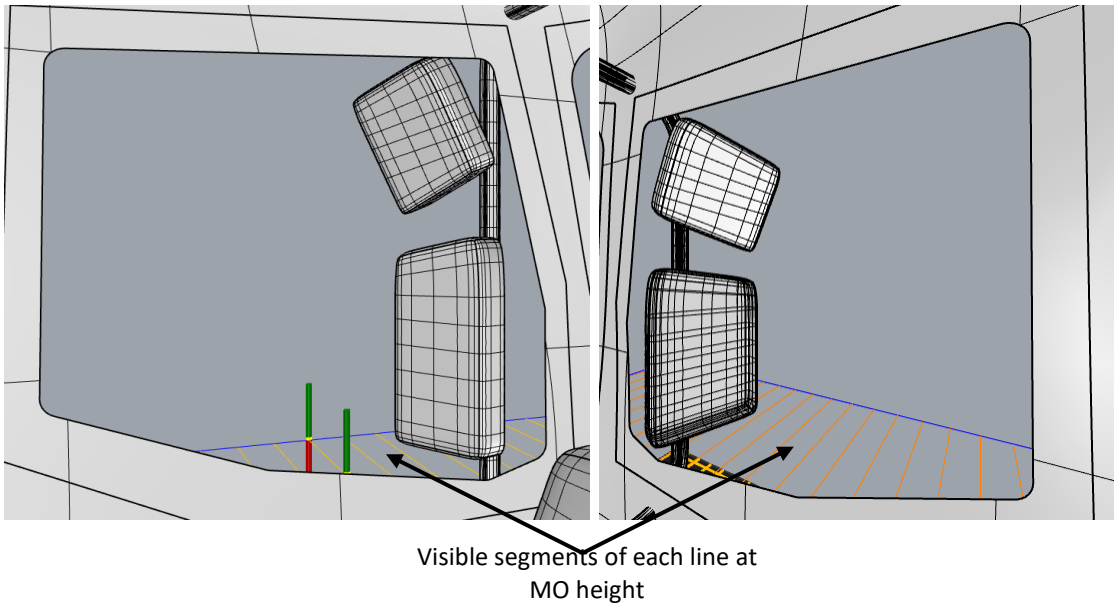


Figure 9. Visible line segments at MO height to the front

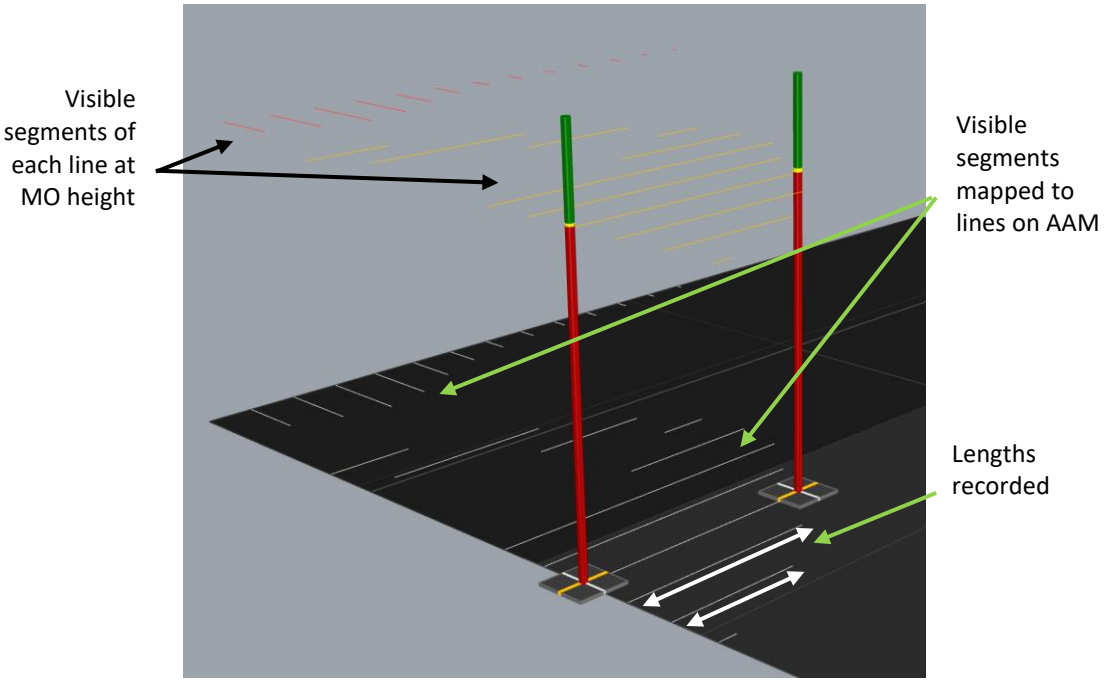


Figure 10. Visible line segments at MO height mapped to the AAM lines and visible segment lengths recorded

5.17 Once all visible grid line segments have been recorded in Table 1. The summed line lengths can be converted to the volumetric score as follows:

5.18 For lower door windows and other transparent areas below the assessment area height, the same procedure detailed above should be followed but without the MO. Instead, visible grid lines should be evaluated directly on the AAM at the ground plane. These additional grid line values should be added to table 1.

...

Annex 7

CAD Test Method

1. Properties of the model

1.1 The CAD model used in the assessment shall include all necessary features and geometry to provide an accurate representation of what would be visible from the defined eye points in a physical vehicle suitable for sale.

1.2 The CAD model should include all possible vision occlusions.

1.3 The CAD software used is at the discretion of the manufacturer but the manufacturer shall demonstrate to the approval authority that the results produced are reliable by applying the process to the generic cab defined in Annex 7, paragraph XX

1.4 In addition to 6.3.3. the CAD data for the vehicle cab shall include pitch and roll values representative of the real world vehicle when on a flat and level surface.

2. Create the assessment volume

2.1 The assessment volume

3. Define the vision opening lines

2.1 The view point within the model shall be positioned at the point E1 for the left view, point E2 for the forward view and point E3 for the right view.

2.2 From this visual perspective, the vision opening line shall be drawn around the edges of the transparent area and its intersections with vision occlusions. Examples are shown in Figure xx, below.

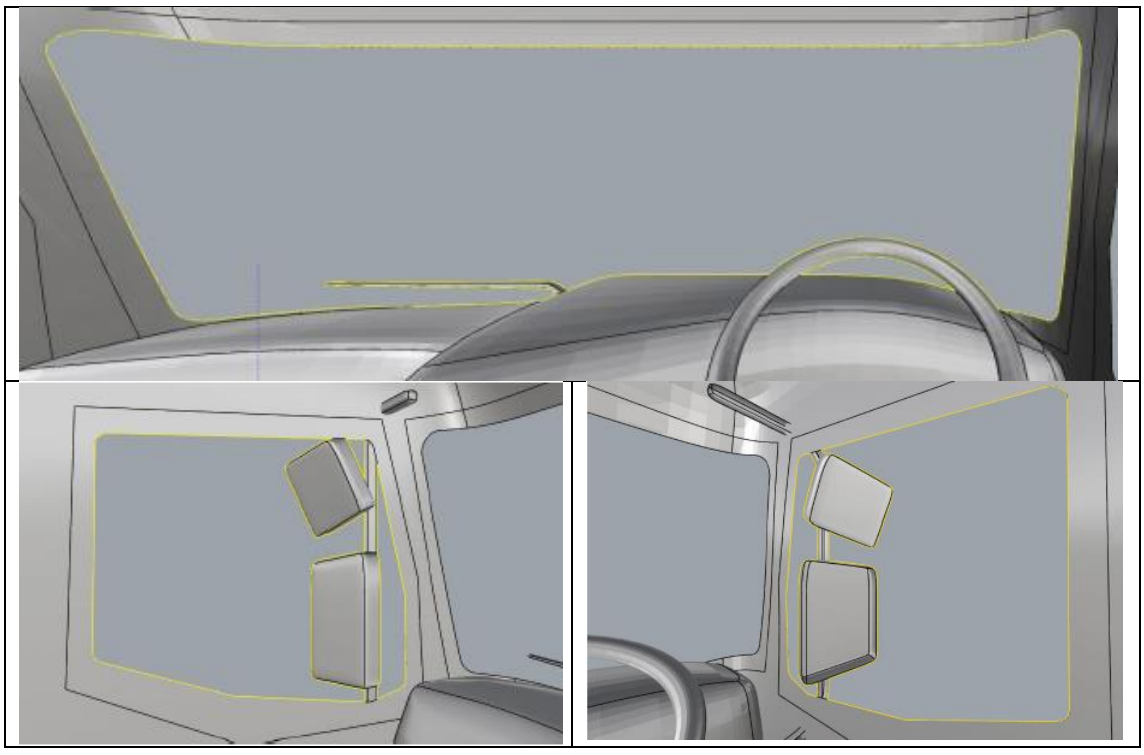


Figure XX: Examples of drawing vision opening lines (yellow) for the frontal view (top), left view (left) and right view (right) in a CAD environment.

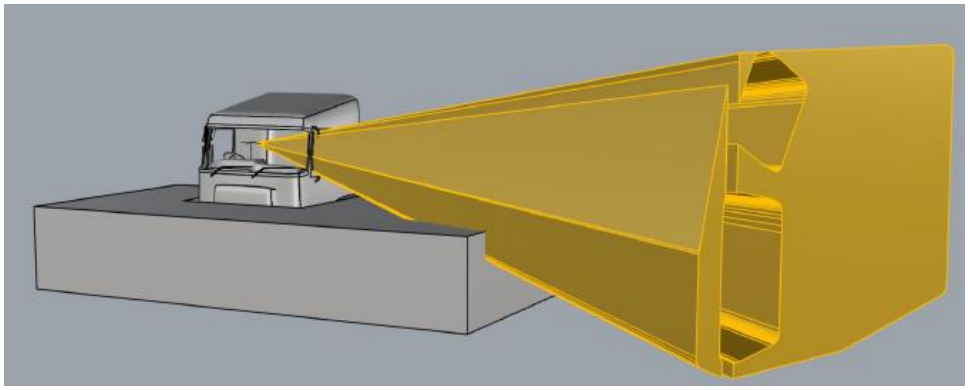
3. Define three dimensional driver views

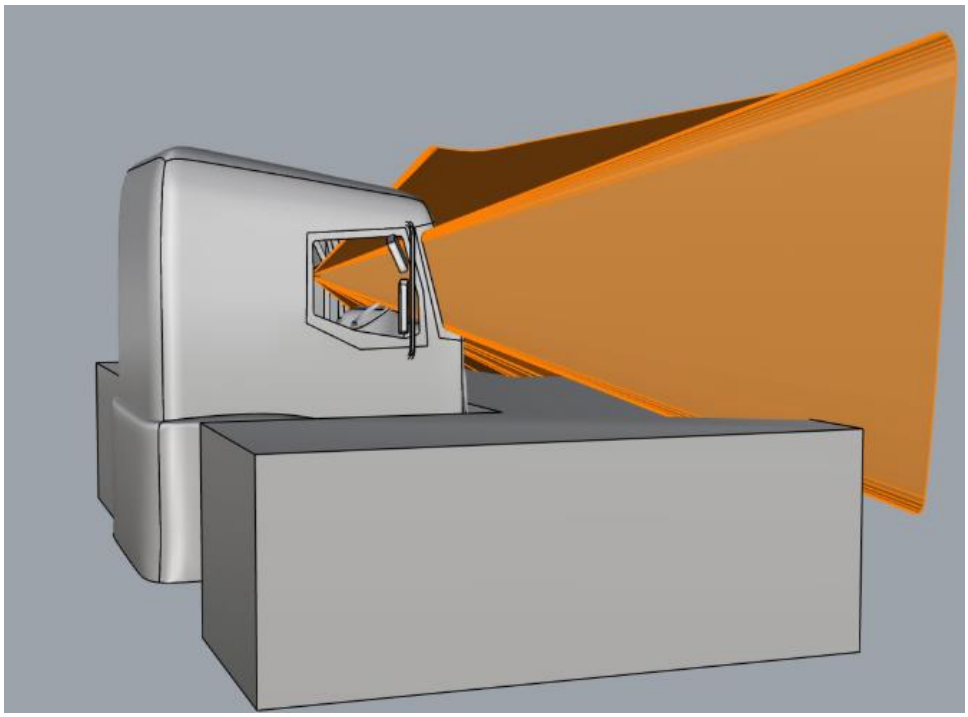
3.1 From the eyepoint E1 project sight lines that intersect with the vision opening lines defining the left view from the vehicle, into the space outside of the vehicle until they either meet the ground or project beyond the assessment volume.

3.2 From the eyepoint E2 project sight lines that intersect with the vision opening lines defining the frontal left view from the vehicle, into the space outside of the vehicle until they either meet the ground or project beyond the assessment volume

3.3 From the eyepoint E3 project sight lines that intersect with the vision opening lines defining the right view from the vehicle, into the space outside of the vehicle until they either meet the ground or project beyond the assessment volume.

3.4 Examples of three-dimensional driver's views are shown in Figure XX below.





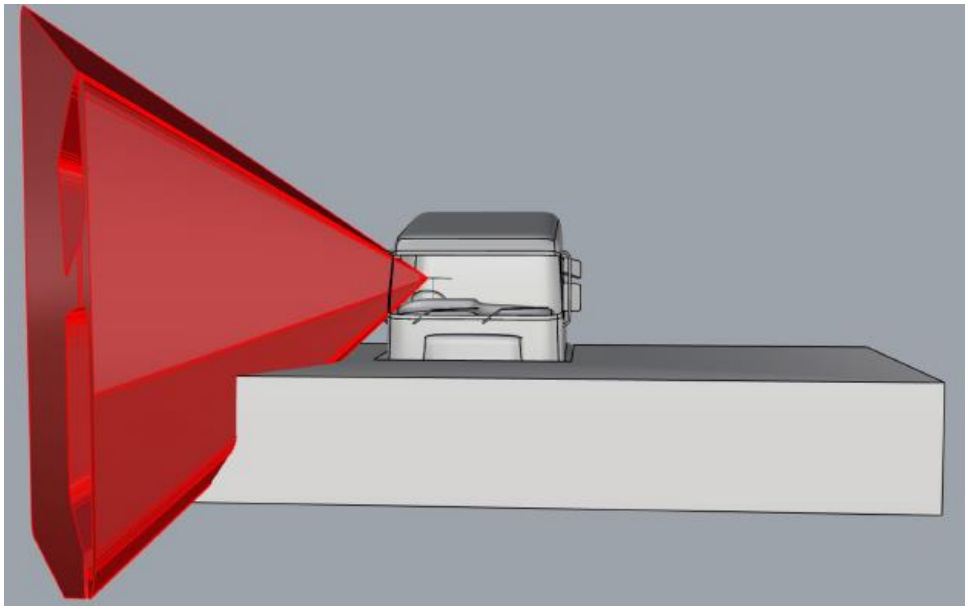


Figure xx: Examples of driver's left view (top), frontal view (middle) and right view (bottom) projected from E1, E2, and E3 respectively

4. Calculating the visible volume

4.1 The sum of all volumes of space that are common to both the assessment volume [combined zone] and one of the driver's views shall be determined to be the visible volume [combined zone]. An example is shown in Figure xx below

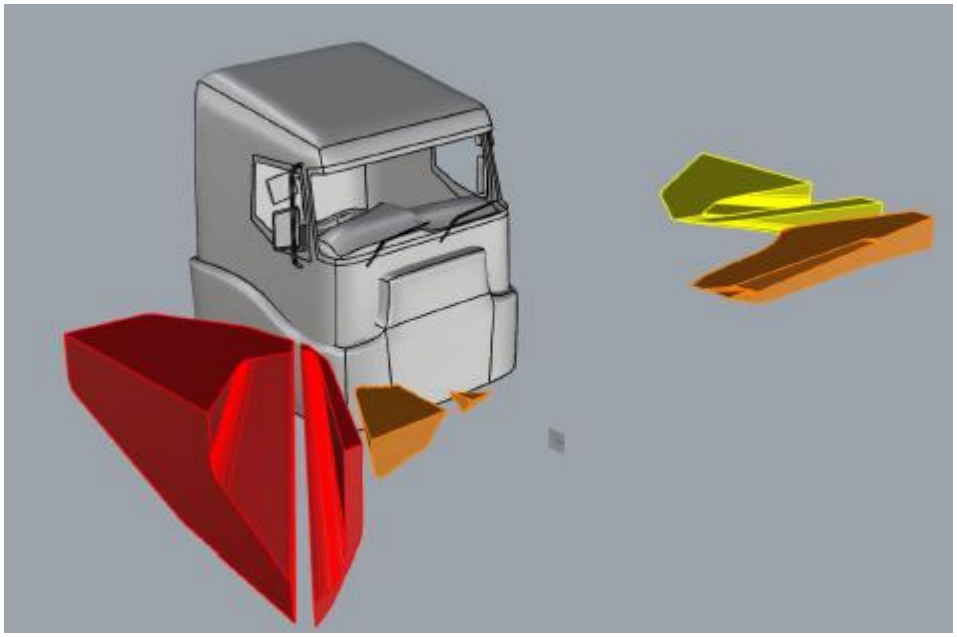


Figure xx: example of visible volumes [combined zone]

4.2 [The sum of all volumes of space that are common to both the frontal assessment volume and one or more of the driver's views shall be determined to be the frontal visible volume [combined zone]. An example is shown below in Figure xx, below

Figure xx: example of visible volumes [frontal zone][GU80]

5 Using the generic truck model to validate the use of virtual methods.

5.1 The process defined in paragraphs 1 to 4 of this annex shall be applied to a standardised generic truck model.

5.2 The generic model is illustrated in figure xx below.

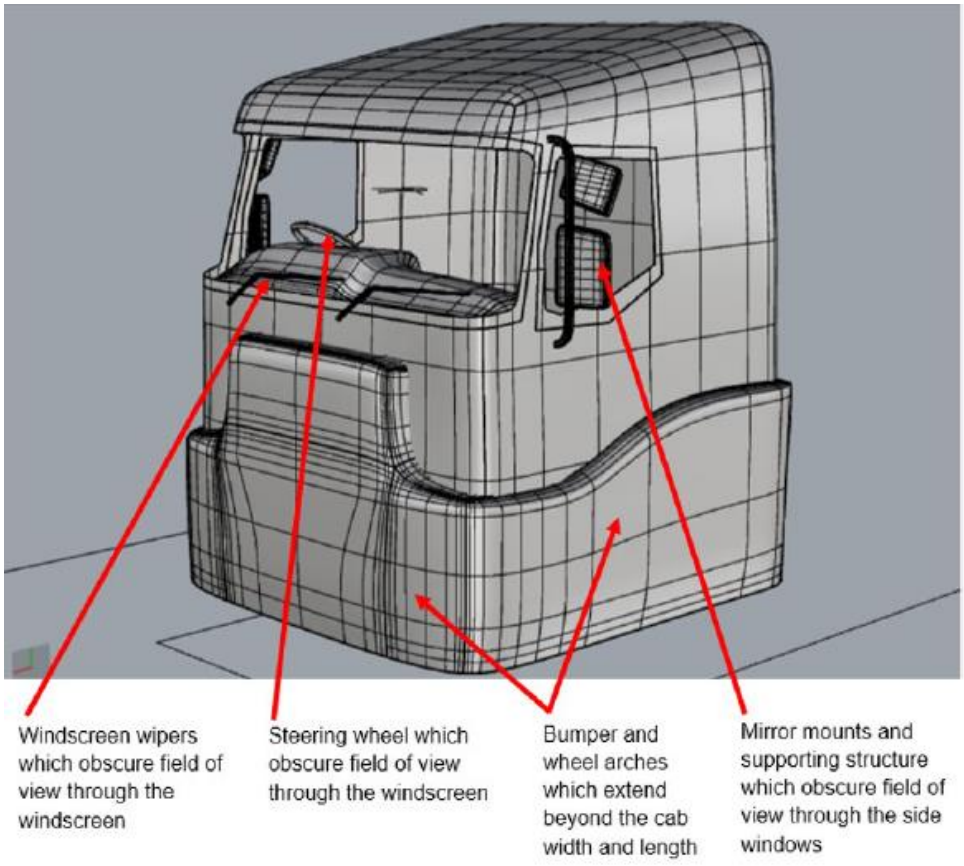


Figure xx: Illustration of the generic cab model

5.3 The full 3-d model for use in this assessment is available from....in .stp format[GU81]

5.4 The results of the assessments shall fall within the limits defined in Table xx, below

Table xx: Expected nominal results from the assessment of the generic cab and permitted limits

[Assessment Volume]	View direction	Expected Volume (mm3)	Permitted range of calculated volume (mm3)	
			Lower	Upper
[Combined Zone]	Nearside	664,547,484	644,611,059	684,483,909
	Front	403,613,754	391,505,341	415,722,167
	Offside	1,979,890,250	1,920,493,543	2,039,286,958
	Total	3,048,051,488	2,956,609,943	3,139,493,033
[Frontal Zone]	Nearside			
	Front			

	Offside			
	Total			

II. Justification

1.The regulation is based around a volumetric level to ensure credit is fairly given to manufacturers who minimise the obstruction to direct vision of mirror clusters and who produce innovations such as city windows enabling parts of VRUs to be seen other than the head. The limit values are, therefore, expressed as volumes as reproduced below

Vehicle Category	Visible Volume [combined zone]	Visible Volume [Frontal Zone]
1	[11.2]	[1.0 – 1.3]
2	[8 - 8.5]	[1.0 – 1.3]
3	[7 - 7.5]	[1.0 – 1.3]

2. These volumes can be considered those that current designs of cabs may typically produce when a sequence of 13 5th percentile female VRUs are positioned around the cab at a distance that they are likely to be visible based on different criteria as defined below. Note that all criteria based on the principle of visibility of less than the head and neck of the dummy, or relating to the separate frontal assessment zone must be considered approximate and subject to validation/alteration at this time.

(a) Combined volume approach

Vehicle Category	Visible Volume [combined zone]	Basis of proposal	VRU distance (m)		
			Nearside	Front	Offside
1	[11.2]	Head & Neck visible at	2.5	1.7	0.6
2	[8 - 8.5]	Cat 3 + 1m3			
3	[7 - 7.5]	Half head visible at	3.0	1.9	0.93

(b) Frontal assessment zone intention is to set a floor value for visibility approximating the elimination of positions where the VRU is in a space blind to both direct and indirect vision. Equivalent to a VRU distance to the front of 2m, based on visibility of the top half of the head.

3.