

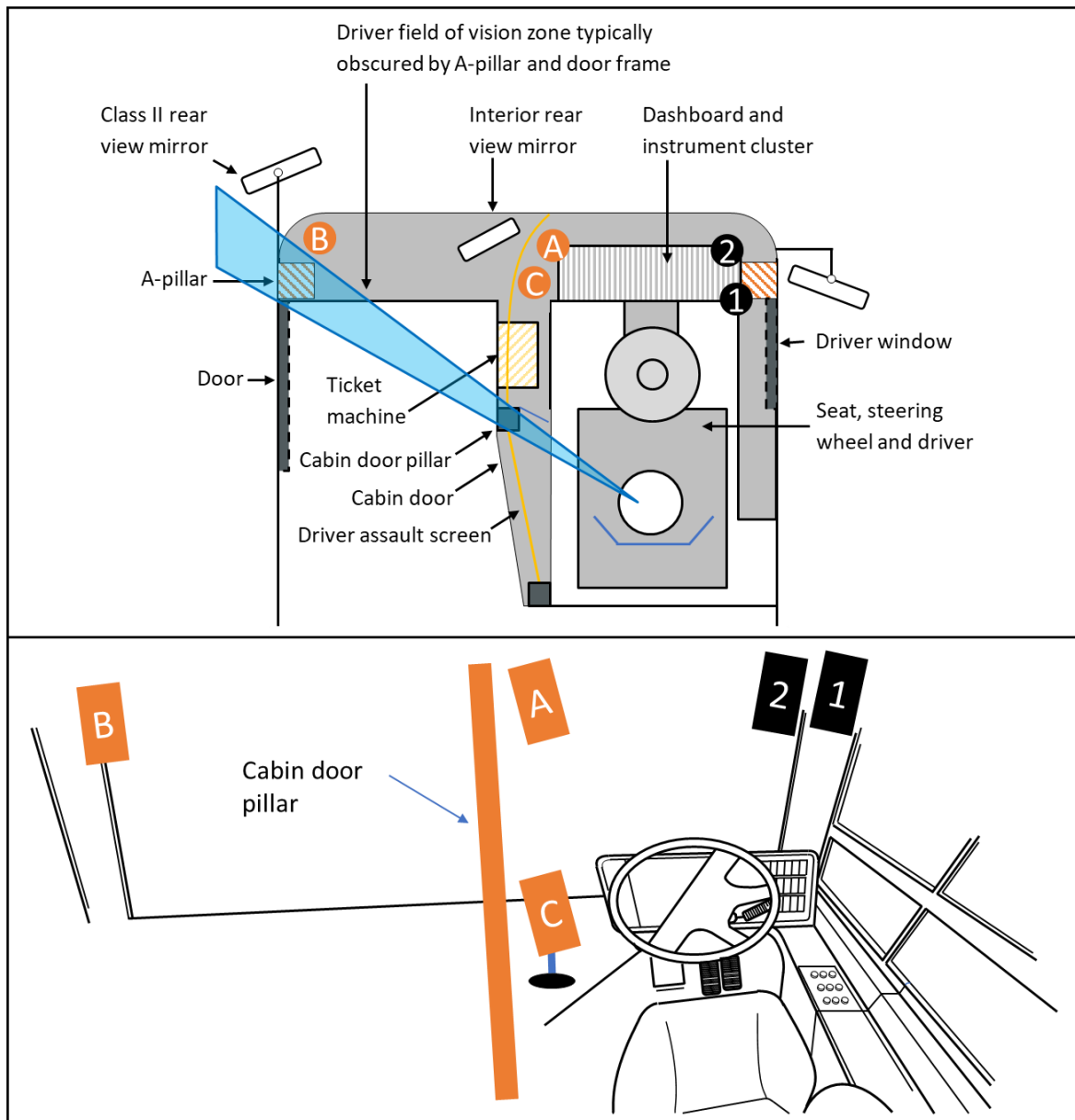
### ***Camera Monitor System (CMS): Mirror Replacement***

All buses shall use Camera-Monitor Systems (CMS) that are compliant with UNECE Regulation 46 to replace physical mirrors on the bus, at least for the Class II and IV fields of vision (FOV) defined by the same Regulation and the blind spot FOV defined by the bus vehicle specifications for blind spot mirrors (blind spot mirrors below).

These requirements shall be evaluated based on the driver's FOV from the ocular reference point as defined by UNECE Regulation 46 (635 mm vertically above the seating reference point specified in Annex 1 of ECE/TRANS/WP.29/78/Rev.6).

In order to ensure the optimum interaction with the driver, the CMS shall meet the following criteria:

- Certified according to UNECE Regulation 46 for all relevant CMS FOV.
- CMS FOVs shall be adjusted by the manufacturer to provide drivers with the relevant FOVs and shall subsequently only be adjusted by trained personnel.
- Images for the offside and nearside FOV shall be presented on the respective side of the driver's ocular reference point.
- The offside CMS monitor shall be located at either Position 1 (on the offside A-Pillar) or Position 2 (inside the offside A-pillar), as illustrated in Figure 4-1, with Position 1 the preferred location.
- The nearside CMS monitor shall be located between Position A (at the centre-top of the windscreen inside the driver cab), Position B (inside the nearside A-pillar) and Position C (on the nearside side console inside the driver cab), as illustrated in Figure 4-1, with Position A the preferred location.
- CMS monitors shall be located such that they do not affect the driver's direct field of vision (FOV). When evaluating the direct vision performance of the bus according to the bus enhanced direct and indirect vision standard (see 4.3.7), there shall be no change in the direct vision performance score (DVS) both with and without the CMS monitors installed in their operational positions.
- CMS monitors shall not be located lower than 30° below a horizontal plane passing through the driver's ocular reference point.
- CMS monitors shall not be located at an angle greater than 55° from a vertical plane formed by the ocular reference point and the neck pivot point (located 98 mm rearward from the ocular reference point in the X axis, see 4.3.7) when rotated in both directions about the neck pivot point.
- Maximum CMS monitor distance from the nearest point of the monitor to the driver's ocular reference point shall be no greater than – Offside: 1.7 m | Nearside: 2.6 m.



**Figure 4-1. Recommended offside (1-2) and nearside (A-C) CMS monitor positions**

- Minimum CMS monitor distances from the nearest point of the monitor to the driver's ocular reference point shall be no less than 0.5 m.
- Minimum magnification factors, as evaluated in UNECE Regulation 46, for the Class II monitor shall be at least – Offside: 0.26 | Nearside: 0.13.
- Average magnification factors, as evaluated in UNECE Regulation 46, for the Class II monitor shall be at least – Offside: 0.31 | Nearside: 0.16.
- Minimum magnification factors, as evaluated in UNECE Regulation 46, for the Class IV monitor shall be at least – Offside: 0.054 | Nearside: 0.016.
- Average magnification factors, as evaluated in UNECE Regulation 46, for the Class IV monitor shall be at least – Offside: 0.091 | Nearside: 0.046.
- Non-continuous images on the monitor shall be clearly separated.

- The driver's view of the monitor shall not be obstructed by components with a transmittance of less than 70%.
- The driver's view of the monitor shall not be obstructed by internal bus glazing with an Angle of Incidence (AOI) of greater than 70° to the driver's sightline, when evaluated according to the enhanced direct and indirect vision standard (see 4.3.7).
- CMS monitors shall not obstruct any internal mirrors used for driver visibility of the saloon or wheelchair bay.
- Driver vision of monitors shall not be obstructed by communication holes in driver assault screen.
- Ambient light (e.g. sunlight and artificial light) illuminating the monitor shall be minimised as far as reasonably practical.
- Reflections on bus glazing as a result of the monitor shall be reduced as far as reasonably practical.
- Monitor vibration shall be minimised as far as reasonably practical, with monitor images interpretable up to 90% of maximum design speed.
- CMS components shall not be located within 5 cm of any radio device emitting electromagnetic radiation in a frequency range that would interfere with the operation of the CMS.
- CMS shall remain fully operational between temperatures of -10°C and +40°C with no reduction in image quality
- Driver CMS familiarisation training shall be provided to all drivers and shall include nearside peripheral vision awareness training for nearside monitors positioned in a different location to the traditional nearside external mirror.
- Eye examinations shall be regularly performed for drivers, in particular looking for presbyopia issues which affect eyesight "accommodation" (i.e. the ability of the driver to switch between different viewing distances, which is associated with a decline with age). Corrective lenses, such as bifocal or progressive lenses, shall be provided to drivers that require support.
- The CMS shall be protected from tampering.

The bus OEM or, where installed as a component on an existing vehicle, the CMS supplier, shall provide documentary evidence of compliance with these requirements.

### ***Blind Spot Mirrors***

All buses shall, in addition to the mandatory fields of vision described in UNECE Regulation 46, be able to see two rectangular areas on the ground plane with boundaries defined as described below.

- Nearside (Left Side) Blind Spot Zone:
  - Forward boundary: parallel to the frontal plane of the bus and 0.5m rearward of the driver's ocular reference point

- Rearward boundary: parallel to the frontal plane of the bus and 4m rearward of the driver's ocular reference point
- Inner boundary: parallel to the longitudinal plane of the bus and passing through the outermost point of the nearside (left side) structure of the bus within the forward/rearward boundaries
- Outer boundary: parallel to the longitudinal plane of the bus and 2m outboard from the inner boundary defined in (c) above.
- Offside (Driver Side) Blind Spot Zone:
  - Forward boundary: parallel to the frontal plane of the bus and 0.5m rearward of the driver's ocular reference point
  - Rearward boundary: parallel to the frontal plane of the bus and 4m rearward of the driver's ocular reference point
  - Inner boundary: parallel to the longitudinal plane of the bus and passing through the outermost point of the offside (driver side) structure of the bus within the forward/rearward boundaries
  - Outer boundary: parallel to the longitudinal plane of the bus and 2m outboard from the inner boundary defined in (c) above.

These ground plane areas should be measured in accordance with the methods prescribed in UNECE Regulation 46.

The reflecting surface and coefficient of reflection of the mirror achieving visibility of the above zone shall comply with the requirements for a class V mirror in UNECE Regulation 46.

The bus OEM or, where installed as a component on an existing vehicle, the mirror supplier, shall provide documentary evidence of compliance with these requirements.