

Explainer for operators: What should your TfL DVS compliant Blind Spot Information System and Moving Off Information System do, and what should it not do?

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I Introduction

The Loughborough University team that authored this document also designed the TfL Direct Vision Standard (DVS), which sets minimum requirements for direct vision from HGVs cabs, and the Progressive Safer System (PSS), which defined safety technology that must be fitted the HGVs if minimum direct vision requirements cannot be met by that vehicle.

The following content is **intended for vehicle operators** who are in the process of sourcing equipment to meet the requirements for the TfL DVS system. There are many providers of this technology. Some systems can meet the detailed specifications provided by TfL, and unfortunately some cannot. The aim of this document is to help operators tell the difference and ensure that they purchase compliant systems.

Therefore, it is strongly recommended that before purchasing systems, that operators test the equipment on an operational vehicle, ensuring that all use cases for the vehicles are included in driver testing. The following document contains notes about issues to be aware of during this testing.

This document does not provide any new requirements when compared to the detailed technical specifications for the Blind Spot Information System (BSIS) and Moving off Information System (MOIS) that have been provided by TfL but aims to clarify the meaning of the technical specifications in plain language and explain the reasoning behind them. DVS system suppliers should review the detailed specifications provided by TfL because the specifications are what determine the legal requirement and contain detail that is not required by operators.

Requirements for systems which alert drivers to the presence of vulnerable road users at the passenger side of the vehicle, known as the Blind Spot Information System (BSIS)

- 1. As a minimum, the BSIS system must** detect pedestrians and cyclists in the detection area that is 2.2m from the side of the vehicle and 9m rearwards of the front of the vehicle as shown in Figure 1 below. As Figure 1 shows, there is a 100mm wide gap between the side of the vehicle and the detection zone. Detection of pedestrians and cyclists should occur for vehicle speeds between 0 km/h and 30 km/h.

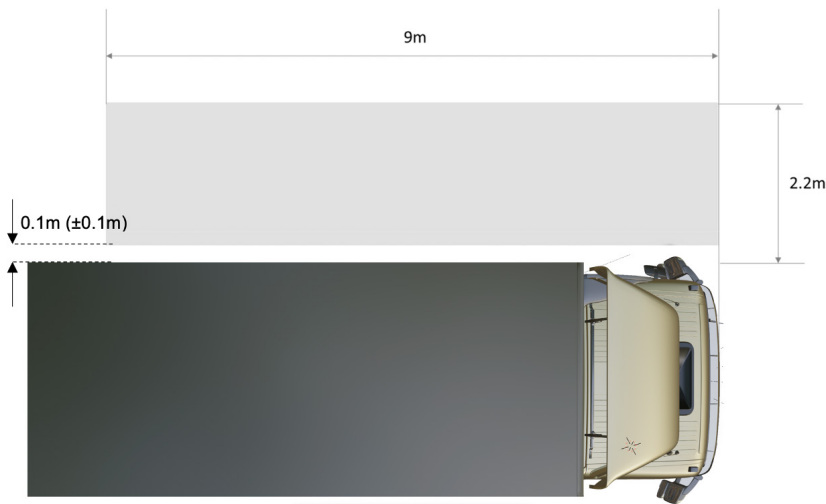


Figure 1. Illustrating the detection area for the BSIS system

2. When a pedestrian or cyclist is in the detection area, **the system must** inform the driver of their presence using an information signal.
 - a. This information signal is intended to activate in common situations where cyclists and pedestrians are in close proximity to the side of the vehicle e.g. a cyclist travelling parallel with the vehicle, or a pedestrian is standing next to vehicle when it is stationary. These situations are part of 'normal driving'. The signal is intended to inform the driver that the person is there, so that they can choose not to make a turn or any other action that might create a collision risk.
 - b. To reduce distraction to the driver in these instances the information signal issued by the system **must not** use an audible alarm.
 - c. Typical display designs will utilise an area or icon which illuminates when there is pedestrian or cyclist in the area.
 - d. This display should be located in the cab in a manner which does not block any part of the direct vision that a driver has through the windscreen. The display should draw the attention of the driver to the side of the vehicle where the hazard is located or where it can be seen (e.g. in a mirror/monitor). The display should be located in the green zone shown in 2. In order to reduce the number of locations that a driver needs to view to gather information, the BSIS information and warning signals can be integrated in the CMS display.

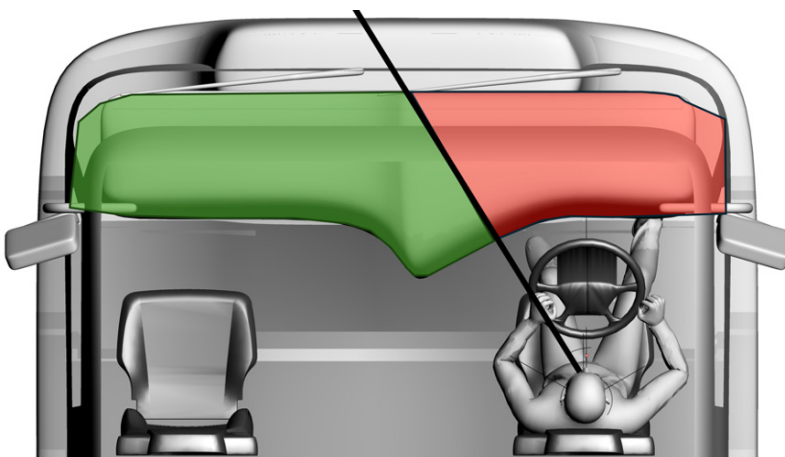


Figure 2. Plan view of a cab interior, illustrating that the BSIS display location should be in the green area of the vehicle interior

3. When a pedestrian or cyclist is in the detection area AND there is an imminent risk of collision, then the **BSIS must WARN the driver**.
 - a. An imminent collision is a collision that will happen in a few seconds if action is not taken. e.g. If a vehicle travelling parallel to a cyclist in the detection zone, makes a significant turn toward the cyclist, then a collision will quickly become imminent, and a warning will be required.
 - b. Other situations could also trigger a warning as long as they would result in a collision a very short time later without avoiding action by the driver. However, it is not mandatory that the system activates for every conceivable imminent collision, only that it activates for the clearly targeted situation where the vehicle turns toward the cyclist.
 - c. **The system must not** rely solely on the use of the left turn indicator as the method to show that a collision is imminent, as drivers sometimes do not use indicators.
 - d. The one example of a situation that does not constitute an imminent collision, is where a cyclist is travelling parallel with a vehicle. They can continue to do so for ever without colliding, even if they are very close, maybe less than 1m apart. In the most extreme example, a pedestrian can stand almost touching a stationary HGV and remain there all day without a collision occurring.
 - e. Simple measures of how close to the vehicle the pedestrian or cyclist is positioned are **NOT** enough to make a collision "imminent".

This sort of situation is no longer 'normal driving', it is a time and safety critical situation, and these are rare. As such an urgent warning is needed:

- f. This warning **signal must be different** to the information signal. It must provide a least two of the following warning types:
 - i. An audible (tonal) warning
 - ii. A visual warning which can be in the same display location as the information signal as long as it is distinctly different to the information signal. E.g. flashing
 - iii. A haptic (vibration) warning
 - g. These requirements are a minimum. Note that audible warnings using the spoken word are not usually considered to be urgent warnings because the time taken to deliver and understand the spoken message is generally too long for a warning where action may be needed in less than 2 seconds from warning start. However, if applied in conjunction with an urgent tonal warning, they can provide context and understanding to the driver as to why the warning was issued.
4. **The BSIS system should not** provide information or warning signals to the driver because there are objects such as cars, signage or other street furniture in the detection area. This is to avoid distracting the driver with information about the presence of objects that do not represent a substantial danger in low speed manoeuvres. However, if systems are sophisticated enough to do so, while still respecting all the requirements for information and warning signals, and avoiding false positives, then a warning is permitted if a collision

with an object other than a pedestrian or cyclist is imminent. This is at manufacturer discretion, TfL do not require a warning in these circumstances.

5. If the system is not operating correctly then **the system must** inform the driver of this so that maintenance can be arranged, with a specific fault warning. This may be because sensors are faulty, or obscured by dirt.
6. The system shall be installed in such a way that it **shall not allow the driver to switch off** the system.

I Testing of BSIS systems that can be performed by operators

System suppliers must satisfy themselves that their system complies with the requirements listed in the requirements section of the BSIS technical specification in real world traffic across a reasonable foreseeable set of circumstances. The technical specification also describes a set of tests, which is the evidence that TfL require of minimum compliance in order to issue a permit.

At present, TfL allow suppliers to self-certify that they pass those tests. It is strongly recommended that operators get their own, or independent, confirmation of that PSS system compliance before purchase.

The following content provides guidance on how operators can perform their own testing should they wish to, and issues that should be noted.

Basic checks of compliance

The detection area shown in Figure 1 should be marked on the ground e.g. using a tape measure and chalk.

1. When the vehicle is stationary and in protected area, a test person should walk parallel to the vehicle, from the rear of the vehicle to the front of the vehicle, parallel to the vehicle. Then a cyclists should do the same.
2. This should be done multiple times at different distances from the side of the vehicle. E.g. 300mm, 500mm, 1000mm, 1500mm, 2000mm for both the cyclist and pedestrian.
 - a. The information signal should be active in detection area indicated in Figure 1 above. No warning signals should be provided by the system.

Without precise measurement and timing equipment, absolute compliance cannot be confirmed if, for example, an information signal does not appear to commence until a short time after entering the zone.

However, if an information signal (visual only) is not present when a pedestrian or cyclist is clearly in the zone, or if a warning signal (e.g. audible) is present during these tests, if no collision is imminent, then it is a very strong indication that the system is NOT compliant.

Assessment of real-world performance

The above tests with a stationary vehicle are not enough to guarantee a system performs well in the real world. One clear intention of the PSS is to reduce the frequency of audible alerts in non-critical 'normal driving' situations, so that when the system provides an audible warning in a situation that really needs it, the driver responds. Therefore it is recommended that a test drive is performed with the vehicle fitted with BSIS system, in the urban environment as detailed below.

Real world performance checks

If an operator wishes to go further than basic minimum compliance, then they can assess this aspect of system performance in a road trial. Such a trial should be performed with the vehicle in an urban area. A passenger should be present in the vehicle.

- a. The driver should be responsible for safe driving only and the passenger should make notes of the situations that are leading to information or warning signals.
- b. A route and time of day should be selected to ensure that there will be other roads users, pedestrians, and cyclists.
- c. The system should not provide information or warning signals due to parked cars, pedestrians on the pavement or signage/railings.
- d. This test would be aided by mounting small cameras (e.g. GO PRO or similar) on the vehicle in the following locations:
 - i. Below the mirrors on the passenger side, pointing rearwards.
 - ii. In the cab pointing forwards, but also able to see the displays for MOIS and BSIS.
 - iii. All cameras should be start recording at the same time so that when the video is reviewed the same time stamp in the video will show the same situation for both camera
 - iv. These videos can then be reviewed to determine what was occurring when an information or warning signal is provided bearing in mind the requirements outlined above.

Notes:

- Collisions between HGVs and cyclists or pedestrians are thankfully not a frequent occurrence
- Testing a system by driving in the urban environment should therefore lead to few or no audible warning signals
- Whilst there may be some warning signals (audible) provided due to situations in which it is possible that a collision may occur, the system should generally be silent.

- If there are lots of warning signals with no apparent critical situations occurring, then the system is highly likely to annoy and distract the driver and the system will not be compliant.
- No attempts should be made to simulate or test collision situations with people at the side or front of the vehicle as this has the potential to cause an accident.
- In new vehicle regulations, testing of collision warning systems is performed by using test dummies as surrogates for cyclists and pedestrians and a sophisticated robot controls to move the vehicle and the dummies around and bring them into the dangerous situation to evaluate what the system does.
- System developers should have done work like this to prove that their warnings work. However, if operators wish to validate this themselves, then they would need to bring in specialist help from organisations with access to the necessary test equipment. Multiple companies in the UK could offer this but it does have significant cost.

Guidance for operators: What should your DVS compliant Moving Off Information System do, and what should it not do?

I Requirements for systems which alert drivers to the presence of vulnerable road users to the front of the vehicle, known as the Moving Off information signal (MOIS)

- 1. When the vehicle is stationary (e.g. at pedestrian crossing) the MOIS system should** detect pedestrians and cyclists in the detection area that is 2m from the front of the vehicle for the full width of the vehicle and 500mm either side of the vehicle as shown in Figure 3.

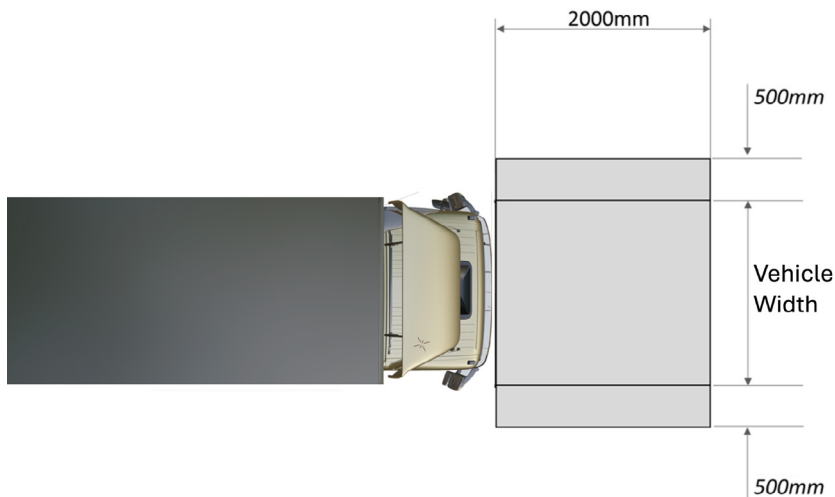


Figure 3. Illustrating the detection area for the MOIS system using the grey box in front of the vehicle

2. When a pedestrian or cyclists is wholly within the detection area, **the system must** inform the driver of their presence.
 - a. As for BSIS the simple presence of pedestrians or cyclists in the zone is part of normal driving and in the vast majority of instances does not represent an imminent collision threat and is dealt with safely by drivers. As such, urgent Audible alarms are not the right action. Pedestrians moving in front of a stationary vehicle, brakes applied, at a pedestrian crossing is not a high-risk situation, it only becomes a high risk when the driver prepares to move off from rest.
 - b. Therefore the system should not** use an audible alarm for this information signal.
 - c. Typical display designs will utilise an area or icon which illuminates when there is pedestrian or cyclist in the area.
 - d. This display should be located in the cab in a manner which does not block any part of the direct vision that a driver has through the windscreen and should be located in the green zone shown in the image below. Acceptable locations include mounted on the dashboard, or at the base of the driver's side A-pillar. Installers should try to minimise how far it takes the drivers gaze away from a direct view through a windscreen.

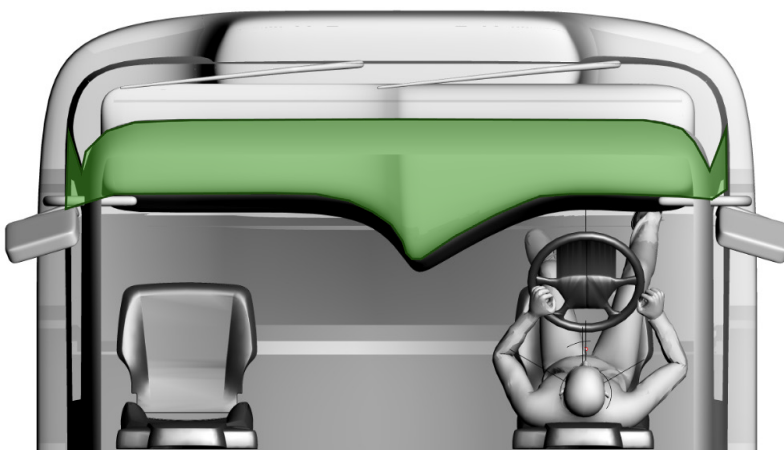


Figure 4. Plan view of a cab interior, illustrating that the MOIS display location should be in the green area of the vehicle interior

3. If the driver prepares the vehicle to move off from rest, while a cyclist or pedestrian is in the detection area the **system should detect** this and provide a **warning signal**.
 - a. The system can detect moving off, or preparing to move off, in a number of ways at the discretion of the system manufacturer. The warning signal could be issued as soon as the brakes (park or service) are released, or only when the brake is released and a gear selected, brake released, gear selected and throttle applied, or only when movement is detected.
 - b. The aim is to identify a high risk of an imminent collision so that an urgent warning is justified.
 - c. These decisions are at the discretion of the manufacturer who must balance effectiveness in genuine collision situations with false positive interventions in situations that are not critical (e.g. providing urgent audible warnings when the driver has no intention of moving).
 - d. If the vehicle is about to move off, or actually moving, then the situation is no longer 'normal driving' and has become critical. A pedestrian is highly likely to be killed within seconds if urgent action is not taken, so urgent warning is justified.
 - e. This warning **signal must be different** to the information signal and must provide a least two of the following warning types
 - i. An audible (tonal) warning
 - ii. A visual warning which can be in the same display location as the information signal as long as it is distinctly different to information signal. E.g. flashing
 - iii. A haptic (vibration) warning
 - f. As for BSIS the above is a minimum, additional modes can be included at manufacturer discretion and audible (speech) warnings should only be an additional mode and not the sole audible content.
4. If the system is not operating correctly then **the system should** inform the driver of this so that maintenance can be arranged, with a specific fault warning. This may be because sensors are faulty, or obscured by dirt.
5. The system shall be installed in such a way that it **shall not allow the driver to switch off** the system.

Testing of MOIS systems that can be performed by operators

As explained for BSIS, even basic compliance with TfLs requirements is self-certified by suppliers so, it is strongly recommended that operators test PSS systems before purchase.

The following content provides guidance on how this testing can be performed and issues that should be noted.

Basic compliance checks

The detection area shown in Figure 3 should be marked on the ground e.g. using a tape measure and chalk.

1. When the vehicle is stationary and in protected area, a test person should walk parallel to the front of the vehicle, from the vehicles nearside and from the offside. This should be done multiple times at different distances from the front of the vehicle. E.g. 500mm, 1000mm, 1500mm, 2000mm for both the cyclist and pedestrian.
 - a. The information signal should be active while the pedestrian or cyclist is in detection area indicated in Figure 3 above. The information signal should become inactive as soon as the pedestrian or cyclist leaves the detection area. No warning signals should be provided by the system in these tests as a collision is not imminent when the vehicle is stationary.
2. NOTE: No attempt should be made to test the warning signal that activates when moving off with a person in front of the vehicle. This would be dangerous.

Assessment of real-world performance

A road trial similar to that defined for BSIS can be used to identify the 'false positive' performance of systems and operators should seek systems with low rates of 'warnings' provided that the test driver applied the brakes when stationary in areas where pedestrians may cross in front of the stationary vehicle.

Assessing the performance of a warning system should only be performed in track trials with strict safety controls required either to ensure a physical barrier eliminates the possibility of collision between vehicle and real pedestrian, or by using appropriate test dummies designed for this purpose in accordance with relevant ISO standards.

■ The design of the displays used in the MOIS and BSIS systems

Although the specifications are separate documents for the BSIS and MOIS systems, operators should consider the cumulative effect on drivers of the whole of the PSS when choosing their equipment. As described in detail above, audible warnings share characteristics with the story of “the boy that cried wolf”. If they go off too often when they are not really needed, then nobody will listen to them when they truly are needed.

As such, even with a BSIS and MOIS fully compliant with the PSS, their warning signals will be less effective if the cab is full of other unrelated equipment that is constantly beeping and warning. The Warning signal should be different from all other sound based signals warnings in the vehicle and ideally warnings should be prioritised such that if two are active simultaneously, only the most urgent is sounded.

Similarly, when manoeuvring a HGV in a busy city, the driver’s workload is already high. Minimising the number of places the driver must look to find safety critical information is beneficial. If a relatively new vehicle already uses camera monitor systems to replace and combine the Class V and Class VI mirrors and is positioned near to direct vision but not

obstructing it, then installing a BSIS/MOIS system with a very simple indicator that can be placed next to the existing OEM monitor may be better than a BSIS that uses an additional monitor system positioned on the dashboard. For systems without OEM monitors, a CMS system display which also includes the information signals for BSIS and MOIS would be seen as advantageous, as all information is contained with one screen, and therefore one viewing location.

Loughborough University is providing support for system manufacturers by testing systems in accordance with the basic compliance requirements. Support for road trials and/or sophisticated track testing to establish warning system performance for MOIS and BSIS can be added, in partnership with other organisations.

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