

# Assessing Field of Vision for Operators of Earth Moving Machinery on Construction Sites

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**Target Audience:**

**HM Inspectors of Health and Safety (Construction)  
HM Construction Engineering Specialist Inspectors  
HM Mechanical Engineering Specialist Inspectors**

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## Summary

This sector information minute gives advice to inspectors on the standards that should be sought in the selection and use of vehicle field of vision aids, together with guidance on enforcement.

## Introduction

1 This sector information minute (SIM) provides information on the requirements relating to the field of vision for the operator around common types of earth moving machinery found on construction sites and describes the measures that users need to take to comply with the Provision and Use of Work Equipment Regulations 1998.

NB There will be additional guidance issued later in the work year regarding the field of vision for telehandler operators.

2 Requirements concerning safe systems of work for the use of vehicles in the workplace, such as exclusion of personnel, are subject to other regulations including Construction (Health Safety and Welfare) Regulations 1996. Information can be found in HSG144: The safe use of vehicles on construction sites and HSG136 Workplace Transport Safety.

3 Vision aids are an interactive control, they require the driver to look at them, accurately detect obstructions or perceive risk, and then take action [similarly sensing systems, such as radar or ultrasonics, that trigger a warning are also interactive controls as they require the driver to react]; segregation is a passive control, once in place, it controls risk without further action and requires positive action to defeat it. Vision aids and other detection systems are also more likely to be affected by external factors such as dirt, vibration, rain, sun etc, and in some instances can fail to danger. For these reasons the construction sector supports the use of segregation in preference to a safe system of work that might include vision aids. (Inspectors should note that Table 3 on page 15 in HSG144 sets out a “hierarchy of control measures for reversing operations”).

**Copies of HSG144 printed prior to 2005 placed the use of vision aids above segregation in that hierarchy; this was not appropriate and has been corrected in later versions).**

4 Risks of being struck by vehicles can occur when vehicles are:

- Moving off from stationary
- Manoeuvring at slow speed over relatively short distances
- Travelling over distance, typically at higher speeds
- Slewing etc.

The precautions needed to control these risks may be different for each of the activities. Construction sites often change physically as work progresses and the tasks performed by any particular vehicle may vary from day to day. It is likely that a combination of several precautions will have to be used and one of those will be the need to ensure adequate driver vision.

5 Although site management will need to ensure adequate driver visibility for most vehicles on most sites, (and that may require them to make improvements to particular machines) they should not rely on good driver visibility alone to control risks. Inspectors should ensure that sites have fully considered and implemented (where reasonably practicable) all of the other precautions such as: minimising vehicle movements, physical segregation, vehicle selection, and workforce training [for further guidance see HSG144 and the relevant section in HSG150.

6 Areas of restricted visibility do not necessarily create unacceptable risks. When assessing whether driver visibility is adequate companies need to assess risk rather than just driver visibility. For example:

- Risk areas exist at the front and rear of vehicles that are moving, (or about to move), but are likely to be less at the sides, apart from those areas into which they can turn when moving in either the forward or reverse direction. The size and significance of those areas will depend on the foreseeable speeds and direction of movement, the type of vehicle and load, and the way in which the machine is manoeuvred. Unless people and vulnerable obstructions are effectively excluded, or protected from those different areas, any areas of restricted visibility in those areas are likely to create an unacceptable risk.
- If a backhoe-loader is stationary and being used as an excavator, the operator is facing to the rear and will not be able to see the front of the machine. There is unlikely to be a significant risk at the front, as the machine is not normally capable of striking anyone in that area and before the vehicle could be moved the operator needs to be facing forwards and would have direct vision into the risk area.

7 For the reasons given in paragraph 6, the use of the common term “All-round vision” is misleading as it could be taken to imply the need to ensure vision into areas around a vehicle where there is no significant risk. Inspectors should avoid using this term.

## **Legal duties and enforcement**

This section looks at the three main types of dutyholder and discusses the steps they should take in order to comply with health and safety legislation.

### **Users**

8 Before considering risks arising from the driver’s field of vision, inspectors should ensure (by formal enforcement if necessary) that users have taken all reasonably practicable steps to control the risks using other means that the hierarchy of control suggests, e.g. avoidance and segregation etc.

9 Regulation 4 of PUWER 98 states that when selecting work equipment for use, employers should have regard to both the working conditions and the way the work equipment is to be used, to ensure that **suitable work equipment** is chosen. For construction vehicles, significant risks may arise from limited driver visibility. Vehicles should be carefully selected to minimise risks in the expected conditions of use and to provide the best direct vision for the driver so as to minimise any reliance on vision aids.

For example: selecting an excavator that has more capacity than is needed will generally mean that the machine is physically larger than necessary and consequently is likely to have larger areas of restricted vision and be more difficult to manoeuvre. A smaller machine may be the suitable choice.

Similarly, if a 360<sup>o</sup> excavator is to be used on a busy site with limited operating space, the use of a 'zero tail-swing' excavator may be suitable as it minimises the risks of striking pedestrians or other vehicles when slewing.

10 Where the driver's direct field of vision is inadequate to ensure safety, PUWER 98 requires the provision of adequate devices for improving visibility from the drivers position of mobile plant, so far as is reasonably practicable. This requirement is risk based and the need for, and selection of, appropriate devices will depend upon: the level of residual risk not controlled by other means, the extent and nature of the field of vision problem, the speed and use of the vehicle, site conditions, etc. Where additional aids have been fitted then additional information and training or instruction may be required to ensure that the aids have been set correctly and the potential benefits are optimised.

### **Hire/lease companies**

11 Hire and lease companies are required, by Regulation 28(e) of PUWER 98, to provide mobile plant fitted, where reasonably practicable, with all necessary driver vision aids whenever a vehicle is supplied to a new workplace. Given that the required standard of driver field of vision depends on the specific use of a machine and the specific site conditions, the hire and lease industry have asked for guidance as to what standards are reasonably practicable for them to meet for their normal hire fleet where the user hiring the machine does not identify any special requirements. As standards for assessing vision on new earth moving machinery is in place, (ISO 5006) it would be appropriate to use similar criteria or equivalent on existing plant of this kind (see below).

### **Manufacturers and suppliers**

12 New construction vehicles should comply with the Supply of Machinery (Safety) Regulations 1992 (SMSR), including Essential Health and Safety Requirement [EHSR] 3.2.1. which implements the European Machinery Directive.

13 Manufacturers/suppliers can choose to produce machines that comply with a relevant harmonised standard. Compliance with such a standard(s) gives a 'presumption of conformity' with the relevant EHSR. [For further guidance see the FOD enforcement guide]

If inspectors believe that a vehicle is not complying with the requirements of the SMSR, they are advised to discuss their concerns with the sector before taking any enforcement action against the manufacturers/suppliers.

## **Assessing driver visibility**

14 Earth moving machinery safety is covered by a set of harmonised standards: the EN 474 series. This standard refers to another standard as the methodology for the assessment of adequate visibility.

15 EN474-1 covers common requirements for earthmoving machinery. It refers to ISO 5006 “Earth-moving machinery – Operator’s field of view – Test method and performance criteria” as the means of assessing adequate driver visibility. ISO 5006 has recently been revised and is due to be published shortly. When this occurs a revision of EN 474 –1 will also be published.

16 The field of view assessment detailed in the standard ISO: 5006 is performed on vehicles without loads or optional attachments (e.g. an excavator with an elevated boom). They are intended as a means of assessing the field of vision from machines when manufactured or supplied new. They will not apply retrospectively.

17 Users wishing to assess the fields of view from a vehicle may find the methods contained in standards a helpful guide, but often need to adapt the methods to take into account: the common configurations of the vehicle when in use, any attachments, and the likely loads. Non-compliance with a standard does not automatically create an unreasonable risk; users and inspectors will also need to consider whether other controls [such as segregation etc.] are adequately controlling the risk.

18 Road-going vehicles, such as tippers, are subject to various regulations and standards covering their construction for use on public roads; the vision requirements in those standards etc. may not be adequate for their use on site. [The risks for tippers on site will be similar to rigid or articulated dumpers (dump-trucks) and it may be appropriate to seek similar vision standards for tippers as those required by ISO: 5006 for those classes of dumper.]

19 The current ergonomic basis of the ISO: 5006 assessment standard, for the close-in [moving off from stationary] assessments, is currently the ability to detect the presence of a standing person, of short stature [approx. 1.5m], 1m out from the perimeter of the machine. The ergonomic basis may change in the near future but inspectors should be aware of the current requirements.

20 Earlier guidance introduced a rule-of-thumb method of assessment: that the operator should be able to see a 1 metre high object 1 metre away from any danger point of a vehicle. The ergonomic basis of this 1m height was the approximate height of a person working crouched or stooped. That idea has been rejected by the standards committees, who accepted that no one should be allowed to work that close to a vehicle if that vehicle is capable of moving at short notice [e.g. if the engine is running] and that such an unsafe system of work should be prevented by site controls. That rule-of-thumb also only considered the ability to see someone close in to the machine [typically the risk when

moving off from stationary] it did not consider the need for longer sight distances [such as when manoeuvring or travelling]. The industry's experience of the 1m x 1m rule was that the approach was often applied in isolation, and the detailed assessment and the assessment of longer sight distances were frequently omitted. This combined with a misunderstanding of the phrase "all-round vision", resulted in vision aids being fitted that were not justified by the risk. Inspectors should avoid promoting the 1m x 1m rule-of-thumb and refer users, hirers etc. to the relevant assessment standard or to the vehicle manufacturer.

21 Certain suppliers of vision aids have produced promotional 1m rules; it is very important that HSE is not seen to be favouring any particular supplier of visibility aids and inspectors should not use those rules or any similar promotional materials on site. If inspectors are asked to suggest possible suppliers, they should decline unless they can refer to several alternative suppliers.

## **Summary**

22 Inspectors should seek to ensure that the risks associated with the use of construction vehicles are adequately controlled in accordance with the hierarchy of controls [avoidance – segregation – system of work]. After assessing any residual risks that cannot be controlled by segregation etc. users may need to ensure adequate driver visibility as part of their system of work for controlling those residual risks. Where an assessment identifies the need for adequate vision, users should select equipment that provides adequate direct vision as far as is reasonably practicable. If unacceptable risks exist and adequate direct vision cannot be achieved, vision aids should be provided.

23 The variety of aids currently available is capable of providing vision to most areas around a machine at reasonable cost. Mounting arrangements must be suitable. Poor mounting arrangements can result in shaky images making adequate vision impossible and can render aids vulnerable to damage.

24 Aids must be maintained in good working order and kept clean. To work effectively aids must be kept properly adjusted. Drivers and plant fitters should be trained and instructed in the correct positioning of the aids on a specific machine.

25 In certain weather conditions vision aids may not perform adequately. In such conditions or if an aid is damaged, users will need to assess whether it is safe to continue to use the vehicle, and if so, under what limitations and with what alternative precautions.

26 Inspectors should give duty holders advice and take enforcement action based on the information contained within this SIM and should consult with the appropriate Sector and SG in cases of uncertainty.

## **Appendix – Selecting visibility aids**

A1 In general users will need to consider the following factors when choosing appropriate visibility aids:

1) **Vehicle speed and stopping performance:** vision aids must be able to allow the driver to respond to a hazard well before the vehicle may hit it.

2) **Vehicle articulation:** as the front cab of an articulated vehicle begins to turn all rearward vision may be lost, including the view from any cab mounted vision aids. Alternative aids may be required [e.g. rear mounted CCTV].

3) **Site conditions:** the type of visibility aid fitted to the equipment should be appropriate for the sites conditions. In certain circumstances, users will prefer to use colour CCTV because of the improved contrast against certain backgrounds it provides. On sites where there is deep mud or slurry, automatic cleaning systems may be required to maintain the performance of visibility aids;

4) **Lighting conditions:** CCTV systems may need to be capable of coping with low, bright and changing light conditions, e.g. a CCTV system may need automatic adjustment and shielding to prevent glare, and brightness control when it is used at night.

5) **Human factors:** The aids should be selected and fitted to maximise the operator's chances of **perceiving** danger. What information can the operator actually use? Too many aids can confuse an operator and render them ineffective. The positioning of monitors and mirrors should take into account the drivers normal operating position for the relevant direction of travel and minimise the number of different locations an operator needs to look. Where frequent, repetitive operations are performed [such as loading from a stockpile] the risk of the driver failing to use a vision aid increases and it may be beneficial to provide additional automatic sensing systems. Some additional aids may also be appropriate for ergonomic reasons, e.g. to reduce the need to repeatedly look at high frequency over your shoulder.

### **Wide angle convex mirrors**

A2 Convex mirrors can provide additional vision along the sides of vehicles and of areas to the rear into which the vehicle can turn. They are used on large vehicles such as rigid dump trucks to view the area immediately in front of the vehicle rear to enable the driver to check that those areas are clear before moving off.

A3 When selecting and mounting convex mirrors users will need to consider that the image provided by a convex mirror is distorted and this distortion is greater in mirrors that are more highly convex. Images can also be disrupted if vibrations from the vehicle transmitted through the mirror mountings cause excessive shake in a mirror. These two effects can result in a particular mirror installation becoming unusable as an aid.

### **Closed circuit television**

A4 CCTV systems, i.e. a CCTV camera and monitor, can be positioned to allow the driver to see into various blindspots. The camera lens is chosen to provide the required angle of view, at wider angles of view interpretation of the image (judging distance) becomes more difficult due to the change in the depth of field, but users generally find the monitor image easier to interpret than heavily convex mirrors. There is often the facility to reverse the image on the monitor so that it mimics a mirror view. Several camera images can be

displayed on one monitor either together in a split screen view, or by switching between views. They are failsafe and are readily accepted by many drivers. CCTV systems can be used for precise positioning of the machine, often removing the need for signallers.

A5 The camera should be located in a position that reduces the possibility of damage from mud, debris, or collisions. If possible the monitor should be fitted at the same height as, and in line with, the external mirrors without obstructing forward vision. This will reduce the number of different locations that an operator needs to view and reduce glare and reflections in the cab. Glare on the monitor significantly reduces the effectiveness of CCTV, and this should be assessed when CCTV is being considered for cabs with large areas of glass. In such circumstances additional, or alternative aids, may also be required. The monitor should be on all of the time not just switched on when in reverse. They can be detachable to stop vandalism and theft.

### **Sensing aids**

A6 Radar systems can either provide an audible and visual warning to the driver or apply the brakes of the machine when an object is detected close to the rear of the vehicle. More sophisticated systems have a two-stage response: warning the driver at a certain distance from the object and automatically applying the brakes at a closer distance. These systems, when fitted to the braking system, have the advantage over CCTV of giving automatic protection to the rear. Radar systems however, are not fail-safe and for this reason users normally fit a warning light to the machine to indicate when the system is switched off. The width and length of the detection zone(s) should be set according to the braking distance of the vehicle and the environment in which they operate, and should be checked periodically.

A7 These and other similar electronic sensing devices (e.g. ultrasonic systems) can be fitted on vehicles where the driver may not look back when reversing. The system either stops the machine, sounds an alarm or gives a visual warning when something is in the vehicles path. This is particularly useful where equipment is used for repeated backwards and forwards motions, for example on loading shovels and larger machines and are often used in combination with CCTVs.

A8 An effective sensing system needs to be able to reliably detect an object in the risk area that it covers; the system should not however be prone to being triggered by objects that are not in the risk area or suffer from other “unwanted alarms” as this will tempt operators to de-activate the system. They may therefore be less tolerable on tight and congested sites.