



Vehicle & Operator Services Agency

**VOSA – Classified**

# **REPORT**

## **Headlamp Aim Research Project**

### **Phase 1 Report – 004/004/0012/02**

## **Recommendations for HGV and PSV Headlamp Aim Testing**

**A report produced by Testing Standards, Policy and Strategy**

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# OVERARCHING REPORT

## Introduction

The UK Government's Cabinet Office's Better Regulation Unit requested this phased project. The report describes the work undertaken in the first phase of the project that is predominantly focussed on HGV and PSV test equipment, methods and standards. The report also provides recommendations on how the in-service test may be improved.

This phase addressed the following topics:

- Current VOSA test facilities, equipment, installation and certified standing levels;
- The ability of headlamps to remain within tolerance in-service;
- Vehicles checked at roadside inspections;
- Affects of loading;
- Legislation.

The studies were undertaken systematically and as prescribed by the Product Descriptions (PD) detailed in the Project Initiation Document (PID) approved on 04 September 2003. PDs and associated Executive Summaries are listed below. Full reports are contained within Annexes.

## Executive Summaries

### PD - Condition and Accuracy of VOSA Testing Facilities and Equipment

This report details the results of a survey carried out on the condition and accuracy of the headlamp aim testing facilities and equipment at a selection of VOSA Goods Vehicle Testing Stations (GVTS). This forms part of a project researching all aspects of headlamp aim and to determine why this issue is the most common failure item at annual test and is often the cause of complaint from operators and maintenance contractors whose own equipment gives a different result. This survey was carried out at five GVTS, which were selected to reflect a cross-section of VOSA test stations. Additionally, Mitcham GVTS was selected as TSPS had been informed that there were particular problems concerning standing areas at this site.

A control vehicle was used which had its headlamp aim adjusted to predetermined settings at Kidderminster GVTS. This site was chosen due to it being VOSA's most recently refurbished site and which should have had equipment and facilities capable of achieving consistently accurate results. The control vehicle then had its headlamp aim re-assessed on the other two lanes at Kidderminster and then on all other HGV test lanes at the other five selected sites, with full details of the results recorded.

The headlamp aim equipment and facilities at each site were also checked and a proforma completed.

The survey found significant variations in the headlamp aim results across the 16 lanes. A deviation of up to 3% in the vertical plane and 6% in the horizontal plane was evident which produced inconsistent test results. The impact of this was that the control vehicle would have passed a headlamp aim test on 9 of the 16 lanes (prior to any re-calibration of the equipment).

Checks of the equipment condition at the selected sites gave an indication of why this inconsistency existed. Many of the beamsetters were defective with excessive play in many parts of the equipment.

Documentation indicated that the condition and calibration of the beamsetters was satisfactory. However, at the time of the survey, defects were found in the beamsetters and in four cases the calibration was significantly incorrect.

The headlamp aim standing areas across the sample sites were not consistent with the 0 +/- 6mm VOSA specification for Designated Premises (DP) and the MOT Scheme. It was also noted that whilst Kidderminster GVTs had recently been refurbished, the beamsetters had not been replaced and were defective.

Four levels certificates showed non-compliance with the specification. One of these showed a variation of 25mm and another of 19mm.

The survey revealed that none of the 16 headlamp aim facilities checked were fully serviceable.

## **PD – In Service Testing**

This report details the results of a survey to determine the ability of headlamp fixings to maintain headlamp aim. This report forms part of a project to research selected aspects of headlamp aim, to determine why this issue is the most common failure item at annual test. It is often the cause of complaint from operators and maintenance contractors whose own equipment gives a different result.

The survey was carried out with the assistance of one PSV and two HGV operators using their vehicles and premises. This ensured a varied range of vehicle manufacturers, body/chassis types, axle configurations and suspension systems were incorporated.

Vehicles were selected on the basis that they were expected to be available twice a week to allow their headlamp aim to be checked. Checks were carried out over a four week period using the Operators own equipment, on the same test facility to ensure consistency.

On the initial check there were significant variations in the headlamp aim results of the vehicles tested. Only four of the 24 HGVs and two of the 16 PSVs checked met the headlamp aim standard for annual inspection.

All three operators had different types of beamsetter which, were all of the convex lens type. None of the beamsetters used projected a clear image of all the lamps tested including the brand new Tecalamit model purchased by TSPS which would indicate that the fault was not

down to the equipment. There were noticeable differences using the same equipment on the same make/model of vehicle with the same headlamp design and mounting. This resulted in considerable difficulty in accurately assessing the image break point of some lamps.

When the survey was completed, a headlamp bulb in one of the LDV vehicles that did not give a clear image was changed to see if it had any effect. Once the bulb had been replaced the aim was reassessed resulting in the headlamp giving a clearer image. Another effect of replacing the bulb was that the headlamp aim altered dramatically, dropping by nearly 3%. This would appear to indicate that replacing a bulb could have a significant effect on headlamp aim.

Preliminary investigations indicate that the quality of a headlamp bulb can have an effect on headlamp aim, which was also confirmed by operators who will only purchase particular brands based on their experience of past problems. It is clear that further investigation into the manufacture and/or fitment of bulbs is required. However, this survey also shows differences in results on vehicles that had a clear image which would indicate that there are other reasons why so many vehicles fail to meet the headlamp aim requirements at annual inspection that may require further investigation.

It was noted during the checks that some headlamp fixings did not adequately retain the headlamp units in service.

## **PD – Roadside Checks**

This report details the results of a headlamp aim survey carried out on Heavy Goods Vehicles (HGV) at selected road check sites, during 'lighting up' time, in October and November 2003.

This survey was carried out using two weighbridge check sites, which were selected due to them having substantially level standing areas. The survey provided statistical information regarding in-service headlamp aim compliance.

At the 2 sites 50 vehicles were checked for headlamp aim using mobile headlamp aim test equipment. Of the 50 vehicles checked 44 failed to meet the annual test standard.

Results show that on the majority of headlamps the aim is too low or too far left.

The headlamp aim failure rate at annual test for HGV is 20.1% (VOSA Effectiveness Report). During this limited study, the headlamp aim failure rate for in-service use was 88%. However, none of the vehicles were issued with a prohibition notice for inadequate illumination of the road ahead. Indeed, several could be brought back into alignment using the in-cab drivers control switch (the in-cab switch adjusts the horizontal plane only), where fitted.

Although 88% non-compliance is high we need to get a perspective of what has gone wrong and why. Of the 50 vehicles checked (100 headlamps) only 6 were found to be above the 0% horizontal plane the worst case was 1.5%.

Headlamp aim could be brought back within test parameters but only using the beamtester as an aid, best guess from the driver or the engineer was not enough in itself. It was noted that drivers were not always aware of the presence of the switch or its correct operation.

## **PD – Affects of Loading**

This report details the results of research conducted to determine the effect on in-use headlamp aim when a pre-determined load is applied to a 2 axle rigid vehicle. The research was conducted using the headlamp aim standing area and the load simulator located within the VOSA training facility. The vehicle used for the research was a box van, steel sprung, with a GVW of 7.5 tonnes. The vehicles interior layout was such that it would only accommodate simulated loading directly above the 2<sup>nd</sup> axle. Given the budgetary constraints on the project, that it is not uncommon for vehicles to be loaded in this fashion, and that this is the worst case scenario for load placement i.e. effect on headlamp aim, this was the sole point of simulated load applied.

In an unladen condition the headlamp aim was recorded at 0% on the vertical plane and - 0.5% on the horizontal plane. With 1 tonne applied there was no change on the percentages due to the suspension state remaining unaffected by such a light load. With 2 tonne applied the horizontal plane rose by 0.5%. With 3 tonne applied the horizontal plane once again increased by a further 0.5%. The vertical plane remained unchanged throughout the loading exercise.

Note - although the maximum axle weight for this vehicle is 4 tonnes it was decided not to simulate to this weight following manufacturers recommendations that only 75% simulated load should be imposed. However, it can be reasonably assumed (unless the axle came to rest on the chassis bump stops which is unlikely on a maintained axle) that a maximum simulated rear axle loading would extrapolate to a further 0.5% increase giving an overall measurement of 1% above the 0% horizontal line.

Overall then, from unladen to maximum load for this type of vehicle, the horizontal percentage increase would be 1.5%. In real terms, this means that an operator who presents a vehicle for test would achieve a 'pass' if the vehicle had a rear axle load of up to 1 tonne, a pass or fail between 1 and 2 tonne and a fail above 2 tonne. The only exception to this would be for vehicles fitted with an in-cab drivers control that can be adjusted to any position (irrespective of weight to setting ratio) to pass the test.

The only way to accurately set headlamps using the control was to use the headlamp tester. It must be appreciated that this research was limited to a single vehicle type with steel suspension. The findings above would not necessarily apply to air suspended vehicles or tractor/trailer combinations, tippers etc. It should also be noted that vehicles fitted with auxiliary equipment e.g hiabs, tail lifts and fork lift carriers, may be affected below a 1 tonne loading.

At the completion of the loading exercise the drivers control switch was used to bring the headlamp aim back into acceptable parameters. The engineers attempted a best guess at where the setting should be which proved difficult due to the lack of consistency between manufacturers i.e vehicle switch settings vary between 0 to 2 and 0 to 9 increments.

## **PD – Legislation**

This report highlights the current standards that are applied to HGV and PSV for headlamp aim at annual test. It also details the legislative limits, both European and Domestic, that apply.

At present GB headlamp aim must be set between -0.5% and -4.0% (-4.0% only applies to some HGVs) on the horizontal plane. Vertical alignment must be between 0% and 2% to the kerbside. A change to regulation would be required for a change to the horizontal plane but not the vertical.

European Type Approval legislation regulates Construction. Road Vehicle Lighting Regulations (RVLR) applies to every vehicle for both Construction and Use. The MOT is for 'Use' and is a pragmatic interpretation of the RVLR.

European Type Approval Regulations (ETAR) differ from GB regulation. ETAR states a minimum horizontal setting of -0.5% for headlamps no more than 0.8m from the ground (GB requirement is 0.85m). European measurement is from the lower edge of the headlamp 'apparent' (lens) whilst GB is from the centre of the lens.

ETAR give minimum and maximum tolerances set against height category. These are -0.5 to -3.0% for headlamps between 0.8m and 1.0m and -1.0 to -3.0% above 1m.

The HGV inspection manual permits a lower horizontal level tolerance to be applied (-4.0%) to two or three axle rigid vehicles where the wheelbase is five metres or less and all two or three axled tractor units in either case not fitted with self levelling rear suspension, self levelling headlamps or a driver's headlamp aim adjustment control. Vehicles that come into this group are known as Category B. Any other vehicle is referred to as Category A. These categories are not mentioned in any domestic or European legislation.

In short, legislation change would be required for a relaxation of the upper horizontal limit. The vertical limits can be changed so long as they do not cause undue dazzle or discomfort to other road users.

## **Conclusions**

The report gives a snapshot of headlamp aim testing at VOSA test stations, operator's premises and in-service operation. It seeks to find answers as to why headlamp aim remains the highest single failure item at annual test and remains a constant source of complaint from operators and vehicle presenters alike. There are several shortcomings reported, not least at VOSA GVTSSs where there are serious issues with equipment, floor levels and the ability to correctly assess headlamp aim.

The selection of VOSA GVTSSs (Kidderminster, Wolverhampton, Bristol, Taunton, Newbury and Mitcham) was on a random basis with the exception of Mitcham which was selected due to reported shortcomings. The selection of roadside checksites was restricted to weighbridge

sites with calibrated standing areas to facilitate mobile test equipment. Two HGV operators and one PSV coach operator were invited to take part due to their close proximity to VOSAs headquarters in Bristol.

The work conducted at GVTs revealed shortcomings that included poorly maintained headlamp test equipment, which had been calibrated by a third party and deemed suitable for use. Unacceptable standing levels that, at worst, were three times over the prescribed tolerances. This has undoubtedly led to errors of 'omission' and 'commission'. Some of the problems with both headlamp test equipment and floor levels were known and previously reported by test station staff. Given that stations were randomly selected it can be reasonably assumed that the above shortcomings will be present nationwide in one form or another.

The annual test headlamp aim fail rate for 2002/3 was 20.1% and 11.4% for HGV and PSV respectively. However, the voluntary headlamp aim checks carried out by the same staff and equipment is recorded as HGV 2.1% (3498 vehicles presented) and PSV 1.8% (9226 vehicles presented). This is probably due to compliant operators presenting their vehicles with headlamp aim correctly adjusted or adjustment screws free and accessible, allowing easy alteration. This indicates that a reduction in fail rate is achievable with proper guidance to operators and maintenance staff on how to present their vehicles for annual test. Unfortunately this has also been a source of complaint from operators who have paid for a voluntary check only to have them failed when presented for annual test.

The checks carried out at operator's premises raised concerns regarding equipment and the maintenance staffs ability to correctly assess headlamp aim. On initial checks, only 4 out of 24 HGVs and 2 out of 16 PSVs met the headlamp aim standard required for annual test. It's difficult to understand why this should be, given that all these vehicles were of testable age and have been properly maintained in accordance with their maintenance arrangements agreed as being suitable for Operator Licensing purposes. Other issues identified during these checks included anecdotal reports of problems with replacement bulbs and their marked effect on headlamp aim. Also, maintenance staff and drivers were not fully aware of the presence and correct operation of the in-cab headlamp aim control that compensates for variable load.

Roadcheck results revealed that out of 50 vehicles tested only 6 met the annual test requirements. However, none of the vehicles were considered to be so far out of adjustment to warrant the issue of a prohibition notice for either being too low so as not to provide an adequate view to the front or so high as to dazzle oncoming traffic. For the majority of vehicles with in-cab controls the switch could be reset using the beamsetter to bring the aim back into tolerance. The engineers noted that without the aid of the beamsetter it was extremely difficult to correctly adjust the aim to the tolerance bands, and that drivers who were aware of the switch were best guessing the position.

The work carried out on the effects of loading and its effect on headlamp aim was very limited but useful just the same. It demonstrated that applying a load over the rear axle of a steel sprung rigid will raise the headlamp aim by approximately 1% per 1 tonne applied. The in-cab control switch compensated for this increase and kept the aim within band tolerances.

Overall, there are several areas of concern that must be addressed before the issues surrounding headlamp aim can be improved. It's clear that VOSA have significantly contributed to the problem by using poorly maintained equipment on uneven standing areas. At present operators who are preparing vehicles for test on their own VOSA specification facilities are running the risk of being failed incorrectly at VOSA sites. It is also apparent that there is a general ignorance by drivers regarding the presence and operation of in-cab control switches. There are also concerns that replacement bulbs may appreciably alter headlamp aim.

Throughout the research programme consideration was given to relaxing the percentage tolerances both higher/lower and left/right to see whether this would reduce the fail rate without having a detrimental effect on road safety. It is considered, however, that no decision can be made until the equipment and standing area levels are base-lined. There is no evidence to suggest that widening tolerances would improve the overall situation other than reducing the fail rate in the short term.

## **Recommendations**

The priority must be to return all VOSA GVTs to at least the minimum requirements but ideally to meet DP Tier 1 conditions. In conjunction with this, operators should be encouraged to play a major role in ensuring in-use compliance through driver and maintenance staff training. It is recommended that a Corrective Action Plan (CAP) be put in place to address the shortcomings through implementing new and/or reviewing existing practices. The CAP should seek to address the following:

- The condition of all existing headlamp aim test equipment and mounting rails. (Equipment that cannot be brought back to specification should be replaced. If replacement is necessary then VOSA should consider alternative equipment such as 3 wheeled headlamp testers, which are more robust and stable than existing stock);
- Standing area levels surveyed and if necessary corrected to meet DP Tier 1 standards;
- A more robust system to ensure that VOSA is getting value for money from the current or any future maintenance contractor;
- Implement/improve audit systems to ensure that work being carried out is to an acceptable standard and that calibration certificates reflect the condition of the headlamp test equipment;
- Station Managers should ensure that equipment and standing area levels remain serviceable through a system of documented reporting and have the authority to suspend testing on sub-standard equipment. Standards Officers should further enforce this through random checks;
- Consideration should be given to suspending the PRS system for headlamp aim testing until the equipment and levels have been base-lined. Operators should be encouraged to

present their vehicles with the headlamp adjusters free and accessible to allow simple adjustment during test;

- Educational material should be made available at test stations detailing; the headlamp aim test; what vehicle presenters can do prior to submitting vehicles for test; what operators can do to ensure in-use compliance; information on in-cab control switches;
- Further work be carried out to fully determine the effects of loading on the vehicle parc and associated suspension types. Also, how the drivers control switch could be better utilised to accurately set headlamp aim in-use with the variable loads vehicles carry.

It is further recommended that either VOSA and/or VCA undertake work on the issue of replacement bulbs and their reported percentage effect on headlamp aim.

Any changes to legislation should only be considered if the recommended action points above do not produce a significant improvement to the current situation.

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