

# PERFORMANCE-BASED STANDARDS – RECENT DEVELOPMENTS IN AUSTRALIA

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## ABSTRACT

Over the two years since the 8<sup>th</sup> Symposium, the development of the Performance Based Standards (PBS) regime for regulating the weights and dimensions of heavy vehicles in Australia has progressed significantly. Performance Based Standards will be an optional regime in lieu of the standard regulatory prescriptive regime of regulating maximum and minimum allowable heavy vehicle weights and dimensions.

The PBS project is being undertaken in six phases, some concurrently, as follows:

*Phase A: Performance Measures and Standards* – identifying the appropriate performance measures and standards and surveying the performance of the current heavy vehicle fleet;

*Phase B: Regulatory and Compliance Processes* – establishing a regulatory system in which Performance-Based Standards can operate as a seamless national alternative to existing prescriptive regulations;

*Phase C: Guidelines* – preparing guidelines detailing the procedures and processes for the consistent application of PBS;

*Phase D: Legislation* – developing the legislative arrangements for PBS to operate as an alternative to prescriptive regulations;

*Phase E: Case Studies* – assembling work previously conducted and demonstrating the practical application of PBS to nationally agreed priorities; and

*Phase F: Implementation* – putting in place the necessary legislative and administrative systems to allow PBS to operate nationally and providing the training and information to support these changes.

This paper outlines the progress and issues encountered with relevant Phases. For example, Phase A is now virtually complete but some of the Performance Measures and Standards have been the subject of rigorous review, particularly the infrastructure standards. Phase B is nearing completion. Significant progress has been made with Phase C, particularly the completion of the *Rules for Assessment of Potential PBS Vehicles*, a major work detailing how assessments of the PBS Standards either by numerical modelling (computer simulation) or field testing must be undertaken. Some case studies from Phase E will also be outlined.

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## **1. INTRODUCTION**

Heavy vehicles in Australia have been regulated by prescriptive standards developed over a long period and some rules still remain different between the States and Territories. The National Transport Commission (NTC), formerly the National Road Transport Commission (NRTC), aims to achieve national harmonisation in transport regulation. As a general principle the NTC's preferred approach is to harmonise transport regulation nationally through the establishment, over time, of a performance-based regulatory reform environment. Of a number of current NTC reform projects being developed on a performance basis, the largest and most advanced is the heavy vehicle Performance-Based Standards (PBS) project.

The performance-based approach to regulation reform attempts to directly specify the required performance or outcomes rather than the traditional prescriptive approach which specifies inputs. These prescriptive regulatory input only (such as mass and dimension limits for heavy vehicles) specifications do not usually fully achieve the aim of the regulation, and can also constrain productivity potential. Performance-based regulation can help overcome these limitations of prescriptive regulation.

The heavy vehicle PBS project has developed the performance outcomes as a set of 20 safety and infrastructure protection performance requirements. These are intended to replace mass and dimension limits and introduce new safety performance requirements which could not be regulated previously. The PBS standards are expected to align more closely with the performance capabilities of vehicles and match these vehicle capabilities to the parts of the road network on which they may be operated. This approach aims to improve safety and provide for productivity increases without increasing infrastructure costs for a specific transport task.

A comprehensive set of rules and guidelines support compliance and enforcement of the PBS standards, and proposals for an administrative structure and approval system are nearly complete.

Access to a PBS regulatory regime will be voluntary for vehicle operators who retain the option to continue to operate under the existing regulations.

Implementation of the PBS standards has now commenced on an interim basis. This paper discusses recent progress and the initial implementation of the set of performance standards. The PBS project and the development of the standards have been described in papers presented at

previous ISHVWDs, and are fully described in a presentation available on the NTC website at [www.ntc.gov.au](http://www.ntc.gov.au) .

## **2. PHASE A: PERFORMANCE MEASURES AND STANDARDS**

The aim of Phase A was to identify the appropriate performance measures and standards and to measure the performance of the current heavy vehicle fleet against these standards. The initial Standards were outlined in NRTC (2003) and the performance of the Australian fleet against the standards is given in NRTC (2002).

Since the initial investigations and choice of initial standards, additional investigations have been undertaken for both the Safety Standards and the Infrastructure Standards. A brief summary of the status of these investigations is given in this Section.

### **2.1 Safety Standards**

Details of the safety standards and issues concerning their initial development were discussed in Edgar (2004) at the 8<sup>th</sup> ISHVWD. Through a rigorous process of consultation and independent review these standards have subsequently been reviewed to provide precise definitions that are intended to be complete, unique and unambiguous. Rules for vehicle assessment have been developed which set out how vehicles shall be assessed against these standard using either simulation or field testing or a combination of both.

Each standard may specify four different performance levels; each level ( L1 to L4) corresponds to network access determined by route assessment using the PBS Route Classification Guidelines (see Section 4 below), subject to any other access policy limitations which may be imposed locally by road authorities

The safety standards, all of which must be met by a PBS vehicle, are:

- Startability
- Gradeability
- Acceleration Capability
- Overtaking Provision
- Tracking Ability on a Straight Path
- Ride Quality ( driver comfort and health – standard not yet developed for implementation)
- Low-speed Swept Path
- Frontal Swing
- Tail Swing
- Steer-tyre Friction Demand
- Static Rollover Threshold
- Rearward Amplification
- High-speed Transient Offtracking
- Yaw Damping Coefficient

- Handling Quality (Oversteer/Understeer)
- Directional Stability Under Braking

As a result of the formal application of the above standards to candidate vehicles in a number of case studies (discussed in Section 6 below) some issues have emerged. First, the performance levels for some standards were found in practice to be highly restrictive or unachievable for preferred vehicles. The performance values for the following safety standards are under review at the time of writing: Acceleration Capability, Directional Stability Under Braking. Second, the requirement that all of the safety standards are met simultaneously has been questioned as being too severe and the use of a risk based approach that still achieves the desired overall safety outcome is being considered.

A further key issue is a requirement for validation of simulation models used for vehicle assessment and the level of further verification of actual on-road performance that must be demonstrated. A period of monitored operation, based on the perceived level of risk, has been incorporated accordingly.

The following key document provides comprehensive definitions of the current standards and rigorous rules to determine compliance with the standards by simulation modelling and or field testing:

**Rules for Assessment of Potential Performance-Based Standards;**

Part A - Discussion Paper

Part B – Rules for Assessment of Potential PBS Vehicles

Appendix A – Approved PBS Infrastructure Standards (not available)

Appendix B – Methods of Calculation for Infrastructure Standards

Appendix C – Approved PBS Safety Standards

Appendix D – Compliance with Prescriptive Standards

Appendix E – Assessing Safety Standards by Numerical Modelling

Appendix F – Assessing Safety Standards by Testing

Appendix G – Form of Certification that a Vehicle meets PBS standards

These documents may be downloaded from the NTC website at [www.ntc.gov.au](http://www.ntc.gov.au) .

## 2.2 Infrastructure Standards

The Infrastructure standards initially adopted were:

- Pavement Vertical Loading;
- Pavement Horizontal Loading;
- Tyre Contact Pressure Distribution; and
- Bridge Loading.

Performance standards have not been developed for Pavement Horizontal Loading and the Tyre Contact Pressure Distribution, and in the interim these requirements are met with prescriptive arrangements.

The infrastructure standards are the main key to improved productivity and hence are critical. At the 8<sup>th</sup> Symposium, Pearson and Leyden (2004) explained some of the pitfalls in developing infrastructure standards. Significant work has since been undertaken on the remaining standards

but no outcomes have yet been determined. It is likely that the Pavement Vertical Loading Standard will change from *Standard Axle Repetitions (SARs) of road wear per Axle Group* to *SARs per Gross Combination Mass (GCM)*, but the general principles of measuring the standard against a reference vehicle will remain. In relation to Bridge Loading, it is likely that the PBS requirements will be met by use of axle spacing/mass schedules in lieu of the comparison of moments and shear forces that was embodied in the initial standard.

### **3. PHASE B: REGULATORY AND COMPLIANCE PROCESSES**

The aim of Phase B was to establish a regulatory system in which Performance-Based Standards can operate as a seamless national alternative to existing prescriptive regulations. A description of the proposed national processes is contained in NTC (2005a).

The set of recommended regulatory processes involves a number of steps:

- applications by vehicle designers, operators or others for a PBS approval;
- assessment of those applications by accredited performance assessors;
- draft approval of the application if the performance assessment demonstrates capacity to meet agreed standards (subject to operating conditions);
- verification of the vehicles as being constructed or modified according to the PBS approval, and certification of the operator as having compliance systems in place necessary to ensure adherence to conditions of PBS approval;
- possible field testing of innovative combinations;
- a period of monitored performance to ensure that actual vehicle performance meets performance expectations;
- final approval based on the outcomes of period of monitored performance;
- recording of PBS approvals in a national PBS database; and
- operation of a PBS approved vehicle in accordance with the operating conditions of each approval.

Key elements of this process are:

- consideration of applications and granting of approvals including approval conditions according to consistent, nationally adopted performance standards and guidelines;
- implementation and operation of a proposed Accreditation, Review and Audit Corporation (ARAC), to be established under Australian law by the state and territory jurisdictions;
- the use of 'performance assessors' to assess applications; and
- performance assessors to be accredited by the ARAC and their assessments to be subject to review and audit by the ARAC.

It is expected that ministerial approval of the proposed processes will be received during 2006.

### **4. PHASE C: GUIDELINES**

Phase C involves preparing technical and administrative guidelines, codes and rules detailing the procedures and processes to support consistent application of PBS.

#### 4.1 Technical documents

The technical documents include:

- Rules for the Assessment of Potential PBS Vehicles;
- Route Classification Guidelines; and
- Bridge Classification Guidelines.

The development of the Rules for Assessment of Potential PBS Vehicles (NTC (2005b)) was a most challenging and controversial task. The work involved taking the actual Performance Standards themselves and specifying in complete detail how an assessment of a vehicle, either by numerical modelling or by field testing, would be undertaken. Differences in approach with computer modeling can result in different results, as reported in NRTC (2001) and so a complete specification is necessary to eliminate any variations in approach that could affect results.

The main issues surrounded the test specifications, where the test vehicle, the test conditions, the test procedure and the test method were laid out. In many cases, very specific requirements had to be introduced for factors such as tyres (tread depth, pressure etc), road surfaces (unevenness in each wheelpath, average and standard deviation for crossfall) and the performance of steering controllers. Among the issues that were debated was the use of international standards when assessing Australia's unique vehicle combinations, where standard vehicles can have up to 70 tyres and weigh about 120 tonnes. Most issues were resolved by negotiation but with a couple of issues the experts could not fully agree.

The final set of Rules, when published during 2006, will provide a rigorous set of assessment procedures that should be of significant value to the international vehicle dynamics community.

The Interim Road Classification Guidelines are available (NTC 2004) and will be used by road authorities throughout Australia to classify routes for PBS vehicles into one of the four road standards.

The Bridge Classification Guidelines are under development and will be published in 2006.

#### 4.2 Administrative documents

Administrative documents include

- Guidelines for the Accreditation and Audit of PBS Assessors;
- Vehicle Assurance and Operating Rules;
- Vehicle Certification Code;
- Operator Certification Guidelines;
- Compliance Assurance Guidelines; and
- Enforcement Guidelines.

It is possible also that some form of guidelines for database management will be required.

The Guidelines for the Accreditation and Audit of PBS Assessors sets out the role of assessors, the eligibility requirements to be an assessor and also contains an individual agreement to be signed by the assessor and the accrediting body (ARAC). A copy of the Guidelines is available from the NTC on request.

The remaining documents listed above are aimed to ensure that the PBS vehicle is built and operated such that it continues to comply with the assumptions made during the assessment of the vehicle by the assessor. Table 1 outlines the focus of each of the documents.

**Table 1: Focus of each of the documents**

Basic question	Focus	Name of document
<b>PRE-OPERATION</b>		
<u>Vehicle requirements</u>		
What <i>should</i> the vehicle look like?	Construction requirements that will <u>give confidence</u> that the vehicle would continue to meet PBS standards	Vehicle Assurance and Operating Rules
What <i>does</i> the vehicle look like?	Inspection requirements that will <u>guarantee</u> that the vehicle is constructed as intended	Vehicle Certification Code
<u>Operator requirements</u>		
What <i>should</i> the operator do?	Minimum operator requirements aimed to <u>give confidence</u> that the vehicle will be operated within PBS approvals	Operator Certification Guidelines
How <i>should</i> the vehicle be operated (based on the vehicle assessment)	Operating conditions that will <u>give confidence</u> that the vehicle will continue to meet PBS safety and infrastructure standards	Vehicle Assurance and Operating Rules
How <i>should</i> the vehicle be operated (regulator assessment)	Additional operating requirements that will <u>give confidence</u> that the vehicle will not cause concerns for the infrastructure or road safety, either by exceeding approved mass and dimension conditions or straying off the route	Compliance Assurance Guidelines
<b>POST OPERATION</b>		
<u>Operator/vehicle activity</u>		
What <i>does</i> the operator do?	To <u>determine</u> if the operator complies with imposed requirements	Enforcement Guidelines
How <i>is</i> the vehicle operated?	To <u>determine</u> if the vehicle is operated in accordance with imposed requirements	Enforcement Guidelines

By way of examples:

- there is a need to ensure that the constructed vehicle has the physical characteristics assumed by the assessor; and
- the centre of gravity height of the vehicle is critical to its continued compliance with the Static Rollover Stability Standard and will require the operator to have in place systems to ensure that the loading assumptions in the vehicle assessment will be adhered to.

The responsibilities for answering the questions raised in Table 1 are allocated to the persons as shown in Table 2.

**Table 2: Responsibilities for the end products in the documents**

Basic question	Responsibility for answering the question	Answer based on
<u>Vehicle requirements</u>		
What <i>should</i> the vehicle look like?	Assessor(s) of the potential PBS vehicle	Assumptions in the assessment
What <i>does</i> the vehicle look like?	Inspector and/or vehicle manufacturer	The as built vehicle
<u>Operator requirements</u>		
What <i>should</i> the operator do?	Regulator	Minimum requirements for operators of PBS vehicles
How <i>should</i> the vehicle be operated (safety assessment)?	Assessor(s) of the potential PBS vehicle	Assumptions in the assessment
How <i>should</i> the vehicle be operated (regulator assessment)?	Regulator	Risk assessment of the operation/route

It is expected that these documents will be published during 2006.

## **5. PHASE D: LEGISLATION**

The legislative arrangements for PBS to operate as an optional alternative to prescriptive regulations are being developed in Phase D.

Phase D requires the development of robust legislative structure to support the establishment and ongoing operating authority for the proposed PBS approval body and complex institutional arrangements to give effect to approvals on a national basis, and to enable enforcement and compliance systems to be applied.

The legislative component of PBS reform was foreshadowed by the recently enacted Compliance and Enforcement Bill that has introduced a "chain of responsibility" accountability structure for a range of road transport offences. By linking into this existing regulatory structure the amount of new legislation to support PBS compliance is reduced, and enforcement and compliance agencies in States and Territories should find that PBS fits readily into local regulatory systems.

Draft legislations will be available for consultation in mid 2006.

## **6. PHASE E: CASE STUDIES**

Assembling work previously conducted and demonstrating the practical application of PBS to nationally agreed priorities is being undertaken in Phase E.

During the development of PBS State road agencies have made increasing use of the available PBS standards, as they have progressively become available, when considering applications for

permits and for assessing innovative vehicle proposals. This resulted in several innovative vehicles being approved as "case studies" that were promulgated by the NTC as early examples of the potential of PBS vehicles. Information sheets on these early examples are on the NTC website [www.ntc.com.au](http://www.ntc.com.au) .

More recently the NTC established, with the approval of the Australian Transport Ministers, a body known as the Interim Review Panel (IRP). The IRP is empowered to receive formal PBS applications which have been submitted by applicants to State Road Agencies and to determine (using the Rules for Assessment of Potential Performance-Based Vehicles) whether the vehicle complies with the standards at a particular performance level, and to determine any operating conditions necessary to ensure continuing compliance.

The process to making an application for PBS vehicle and an application form for use by applicants is available on the NTC website. This application form indicates the full range of policy considerations and vehicle assessment required to support a PBS case study proposal.

At the time of writing the IRP has considered eight formal applications. Only one of the following was found by the panel to comply with the complete set of safety standards, at a particular performance level. The following vehicle concepts were involved in the applications considered:

- A special high cube van semi-trailer car transporter
- An AAB-Quadruple road train
- A forced steer tri-axle group on a semi-trailer ("Trackaxle")
- A BAB-Quadruple road train
- A six-axle full trailer with load divider dolly
- A low-bed semi-trailer with a fully removable floor to facilitate loading a specific product
- A 14 metre long rigid truck for urban deliveries
- A tri axle prime mover for a semi trailer combination

Following assessment of the above vehicles panel members have asked the NTC to review several of the approved performance standards on the basis that even the best performing vehicles of certain categories are not able to achieve the required performance levels. If the performance level cannot be achieved by purpose designed vehicles using the best current technology then there is a risk of PBS not delivering the expected productivity and safety improvements because operators will have to revert to existing vehicle types which are known to have poorer performance.

## **7. PHASE F: IMPLEMENTATION**

The final Phase is putting in place the necessary legislative and administrative systems to allow PBS to operate nationally and providing the training and information to support these changes.

The first step in this Phase has been the establishment of the IRP which is intended to foreshadow the establishment of a permanent body to undertake the approval, review and audit

tasks. The establishment of IRP has also enabled the standards to be tested, allows industry early entry into the PBS system and helps provide information about the operating requirements for the permanent body.

## 8. CONCLUSION

Since the previous report to the ISHVWD, PBS standards and rules for their implementation have been developed in sufficient detail for their use as an optional alternative regulatory system. Operators are now able to make applications for approval of PBS vehicles as a case study. This process has already tested the safety standards and has resulted in several standards being reviewed.

The NTC is considering whether the approved set of standards functions individually and collectively to make the performance benchmark too high, thus potentially affecting take-up and unduly limiting safety and productivity outcomes.

## REFERENCES

Edgar J (2004). *Development of Performance Standards for Australian Heavy Vehicles*. Proceedings of the 8<sup>th</sup> International Symposium on Heavy Vehicle Weights and Dimensions. Gauteng, South Africa.

NRTC (2001). *Comparison of Modelling Systems for Performance-Based Assessments of Heavy Vehicles*. Report Prepared by Dr Hans Prem, (RTDynamics), Euan Ramsay (RTDynamics), Dr John de Pont, (TERNZ), Dr John McLean (Consultant) and John Woodrooffe (Woodrooffe & Associates Inc.). National Road Transport Commission, Melbourne.  
<http://www.ntc.gov.au/DocView.aspx?page=A02302402400470020>

NRTC (2002). *Performance Characteristics of the Australian Heavy Vehicle Fleet*. Report prepared by Dr Hans Prem (RTDynamics), Dr John de Pont (TERNZ), Bob Pearson (PTRC), and Dr John McLean(Consultant). National Road Transport Commission, Melbourne.  
<http://www.ntc.gov.au/ViewPage.aspx?page=A02305401400900020>

NRTC (2003). *Performance-Based Standards – PBS Phase A: Measures and Standards: Regulatory Impact Statement*. Report prepared by Economic Associates Pty Ltd, Pearsons Transport Resource Centre Pty Ltd and RT Dynamics Pty Ltd. ISBN: 1 877093 62 9. National Road Transport Commission, Melbourne.  
<http://www.ntc.gov.au/DocView.aspx?page=A02209501300870020>

NRTC (2004). *Interim PBS Road Classification Guidelines*. Report prepared by ARRB Transport Research Pty Ltd. National Road Transport Commission, Melbourne.  
<http://www.ntc.gov.au/DocView.aspx?page=A02210509300780020>

NTC (2005a). *Performance-Based Standards for Heavy Vehicle Regulation: Proposed Regulatory Framework and Processes: Regulatory Impact Statement*. Report prepared by Economic Associates Pty Ltd, Pearsons Transport Resource Centre Pty Ltd in conjunction with the National Transport Commission, Melbourne.

<http://www.ntc.gov.au/DocView.aspx?page=A02311407400060020>

NTC (2005b). *Rules for Assessment of Potential PBS Vehicles – Discussion Paper and draft Rules*. Report prepared by Pearsons Transport Resource Centre Pty Ltd, Mechanical System Dynamics Pty Ltd and ARRB Group Ltd. National Transport Commission, Melbourne.

Pearson, R., and Leyden, P., (2004). *Performance-Based Standards – Pitfalls in Developing Infrastructure Protection Standards*. Proceedings of the 8<sup>th</sup> International Symposium on Heavy Vehicle Weights and Dimensions. Gauteng, South Africa.