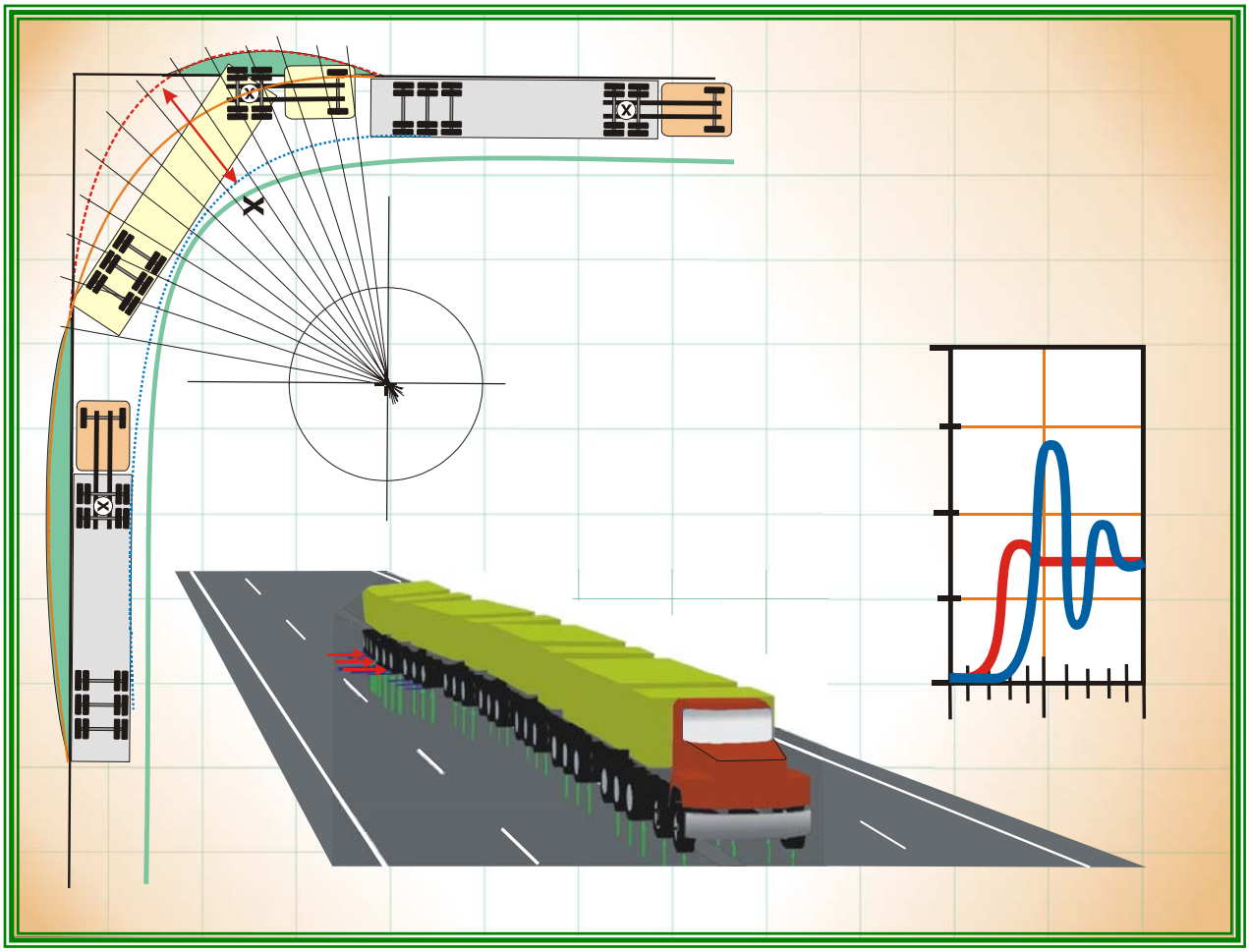
PBS Explained

PERFORMANCE BASED STANDARDS FOR ROAD TRANSPORT VEHICLES



Enhancing Safety, Infrastructure Protection & Productivity

ARTSA
AUSTRALIAN ROAD TRANSPORT SUPPLIERS ASSOCIATION

Issue 1 - September 2003

Foreword

The Australian Road Transport Suppliers Association Inc. (ARTSA) is an industry Association with over 35 members from the component and Original Equipment Manufacturers (OEM) sector. It is focused on providing technical expertise and representation to improve safety, productivity and efficiency in many aspects of the road transport vehicle industry.

ARTSAs interests cover vehicles and their components used in all aspects of the road freight transport and road passenger transport industries. ARTSA provides advice and support to members, regulatory agencies and other transport industry bodies concerning a range of issues. It also provides information in the form of explanatory codes on topics such as air suspension, braking, performance based standards, and load restraint.

This publication has arisen from a close working relationship between ARTSA and the National Road Transport Commission (NRTC). Both organizations felt that there was a need for an easy to read guide to Performance Based Standards for the road transport sector. ARTSA took on this task with financial assistance from the NRTC.

Ian Wright of Ian Wright and Associates undertook the drafting of this publication. A steering committee headed by John Williamson of Marshall Lethlean Industries oversaw its development. All are due considerable thanks as are the National Road Transport Commission's PBS team, who also contributed their time and ideas throughout the development of the publication.

Information on the Australian Road Transport Suppliers Association can be found at http://www.artsa.com.au or by contacting its Executive Officer on exec@artsa.com.au

Dr Peter Sweatman

Chairman
Australian Road Transport Suppliers Association Inc.
Melbourne
September 2003

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NOTE: This document is only able to reflect the current known aspects of the PBS development current at the time of publication. Reference measures may be changed or amended from time to time and such documents can be found via the NRTC website, www.ntc.gov.au As the proposed PBS Standards have not yet been considered by the Australian Transport Council DO NOT rely on this document for detailed advice or decision making.

Disclaimer:
This document is intended to show the reader the basic intentions of how the Performance Standards and the Performance Standards measures might be introduced. It is not possible to take into account all parameters which may have to be considered in an actual PBS application or what different outcomes may evolve for a given vehicle type seeking PBS approval.

ARTSA advises the reader that for all PBS applications they must obtain guidance from an approved assessor and not rely on this general explanatory document. Applicants should also check with the local road authority and local legislation for PBS approvals process.

----- Do not rely on this document for detailed advice or decision making ----

Introduction

Performance Based Standards, or PBS, provides a national alternative to the current system of heavy vehicle regulation as it relates to mass, dimensions and vehicle configuration. These more flexible vehicle regulations include an agreed set of performance measures that can be objectively determined and delivered. Each measure defines a boundary between what is acceptable and unacceptable.

The intention of this document is to set out in a straightforward manner the objectives of the performance measures that underpin the Australian heavy vehicle performance standards. It is an illustrative guide and is not intended to be the technical reference document.

PBS standards seek to align actual vehicle performance efficiencies, productivity and safety objectives as well as meeting road and bridge infrastructure and network characteristics and limitations. Vehicle performance measures are based on engineering and science, supporting superior safety and known road and bridge wear performance criteria. PBS produces "*a results oriented approach*" to improved heavy vehicle operations and safety.

The freight task in Australia is projected to double over the next decade or so. Our community will not accept the doubling of truck numbers to meet such an increase. The smart solution, in part, is seen to be Performance Based Standards.

In the context of our communities, many challenges exist to be able to match new vehicle types with the roads networks they will operate on. PBS is not only for large vehicles. Expectations are that innovative smaller PBS vehicles will also contribute to the transport challenge.

The PBS system is an alternative and voluntary process for heavy vehicle operators in Australia and will sit alongside the long-standing prescriptive regulatory system of limits for all vehicles, which provided only indirect control over operating performance. Particular effort is being made to ensure that the large numbers of smaller transport operators can economically access and obtain PBS approvals along with larger operators.

It should be noted that existing Australian Design Rules (ADRs) including brakes, couplings, turntables and suspensions remain a requirement for ALL heavy vehicles.

The National Road Transport Commission (NRTC) and Austroads have developed the PBS standards in consultation with all stakeholders. For a full technical description the reader is referred to the NRTC publications in the Appendix and the website listed below.

Acknowledgement of NRTC Support

This Guideline is published by the Australian Road Transport Suppliers Association, (ARTSA) with the aid of a grant from the National Road Transport Commission to advance the knowledge and practices of the road transport industry in Australia.

PBS updates are available ***via the NRTC website****.*
www.ntc.gov.au

Performance Based Standards Regulatory Methods

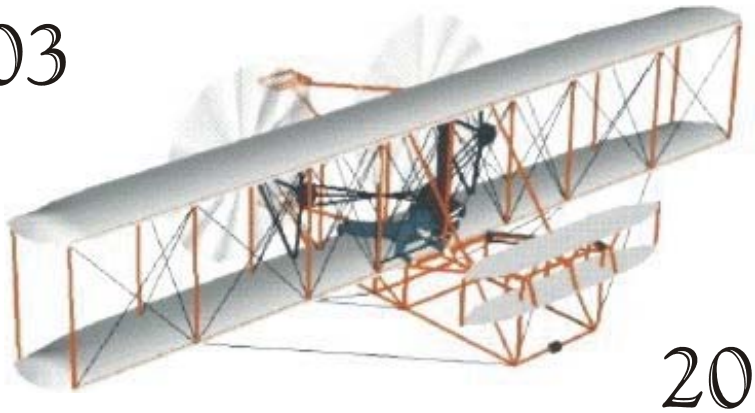
Performance based standards have been used in many different sectors of public policy and industry with very satisfactory results for many years. For example National Health and Safety Standards now include PBS, as do several overseas national testing authorities and training skill standards bodies.

In these applications a key principle is the notion that the performance based services approach is not a "*one-size-fits-all*" process, and that it focuses on specific outcomes and ensures they are measurable to the greatest extent practicable.

Historic example of the use of PBS:

Wright Brothers Performance-Based Specification heavier-than-air flying machine.

1903



2003

"The flying machine must be designed to carry two persons having a combined weight of about 350 lbs, also sufficient fuel for a flight of 125 miles.

The flying machine should be designed to have a speed of at least 40 miles per hour in still air."

Source: US Department of Defence Guidebook for Performance Based Services & Acquisition.

Appendix J, Example - Wright Bros Performance- Based Specification, Signal Corps No 486, Advertisement & Specification for Heavier than Air Flying Machine. Closes 1/2/1908.
Web address: http://www.lrp.usace.army.mil/bus/center.htm

Key Elements of PBS

PBS measures are designed to operate in conjunction with existing Australian Design Rules (ADRs) and Heavy Vehicle Standards and call up certain international standards and Australian Standards.

The measures are in two groups:

Safety **Starting, stopping, turning, overtaking, ride quality, stability, road space, tracking, tail swing, swept path envelope.**

Infrastructure **Pavement and bridge effects – standard axle repetitions (SARs) and bridge loadings** (bending moment & shear).

Designing to these measures allows gains in many aspects of transport productivity: Mass, cube, height, floor length, operating flexibility, operating costs, logistics & vehicle resale values.

Performance Measures are:

Stylised measures of safety and infrastructure impacts producing one or more "figures of merit".

Performance Standards are:

Values of the figures of merit that **must be met**. Compliance with the standard must be capable of being objectively determined. It must be possible to establish that the standard is met or not met, to an acceptable level of legal proof. The means of determining whether the standard is met must be reasonably within the limits of existing technical and operational capabilities.

Road Classes

Performance standards of the vehicle will be matched to road and traffic conditions, assisted by the definition of various road classes as follows:

Level 1	General Access
Level 2	Restricted Access – Major Arterials & Approved Routes
Level 3	Major Freight Routes & Remote Area Combinations
Level 4	Remote Area Designation for Larger Combinations

Some performance measures require the same standards for all road classes while other performance measures apply standards that may vary with road class. Such variations are based on assessment of safety and infrastructure risks.

Administrative Process

The same systems that administer the present prescriptive rules will be adapted to include these key elements:

Applications An applicant identifies an innovation that could be used to improve transport efficiencies or safety.

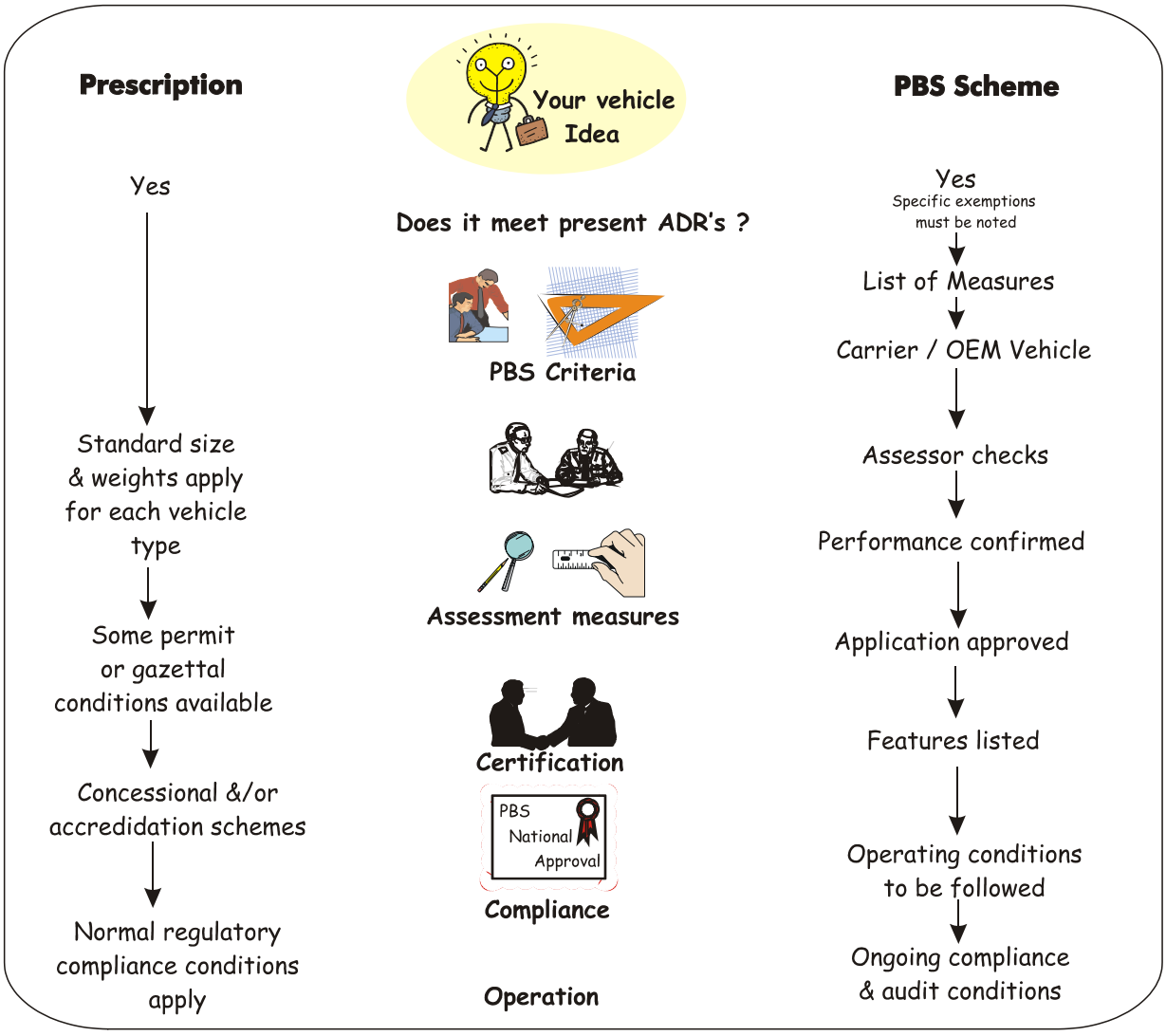
Assessments An application is analysed and assessed against relevant performance measures, on various classes of routes and taking into account the methods of ensuring compliance.

Approvals When an application is approved following assessment, physical features of the vehicles or units will be identified and appropriate operating conditions set for that approval.

Certifications Vehicle(s) or unit(s) are certified and need to match the physical features set out in the approval.

Recording All operating conditions associated with an approval and vehicles certified to operate under it are recorded and monitored.

Operation Vehicles that operate under the PBS approval follow an ongoing compliance regime, which is only valid for a particular operation and may expire when a vehicle is sold to another operator.



A guideline will set out how each measure will be determined by simulation or testing.

Performance Measures and Standards

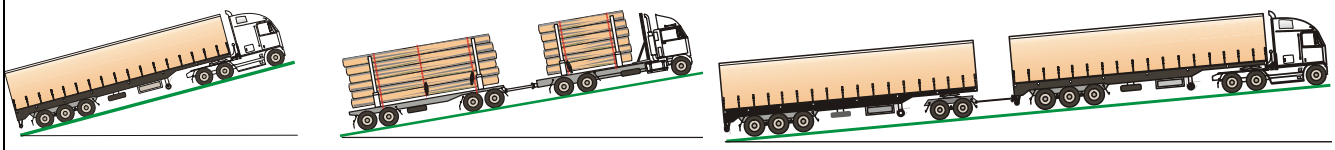
Low Speed – Straight – Line

1. Startability

To start and move forward on a specified grade.

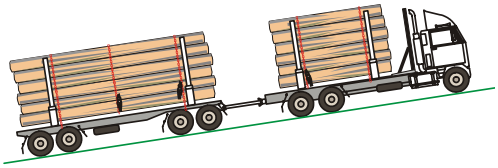
Not less than 15% for Level 1 routes

Not less than 12% on Level 2 routes
Not less than 10% on Level 3 routes
Not less than 5% for Level 4 routes



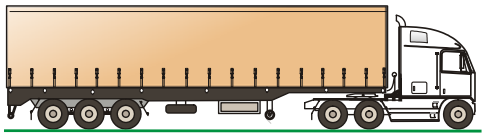
2. Gradeability

To maintain forward motion on a specified grade.



	Low speed areas Max grade the vehicle can climb at any speed	High speed areas Min speed on 1% grade
Level 1: – entire network	20 %	80 km/h
Level 2:	15 %	70 km/h
Level 3:	12 %	70 km/h
Level 4:	8 %	60 km/h

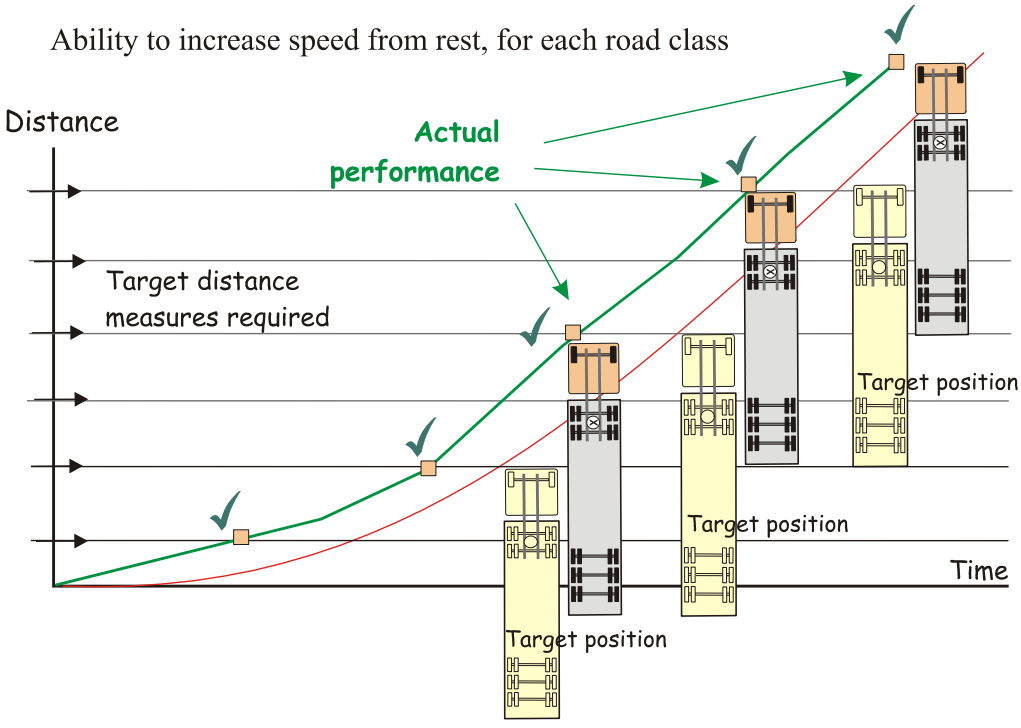
3. Acceleration



Ability to increase speed from rest or to increase speed (with no grade)

Performance requirement is set for each road class or type.

Ability to increase speed from rest, for each road class



4. Overtaking Provision - Time taken for a passenger car to safely overtake the subject PBS vehicle to be no greater than can be accommodated by the overtaking opportunities provided by the road at the specified traffic flow level of service (LoS).

Performance Levels for Overtaking Provisions:

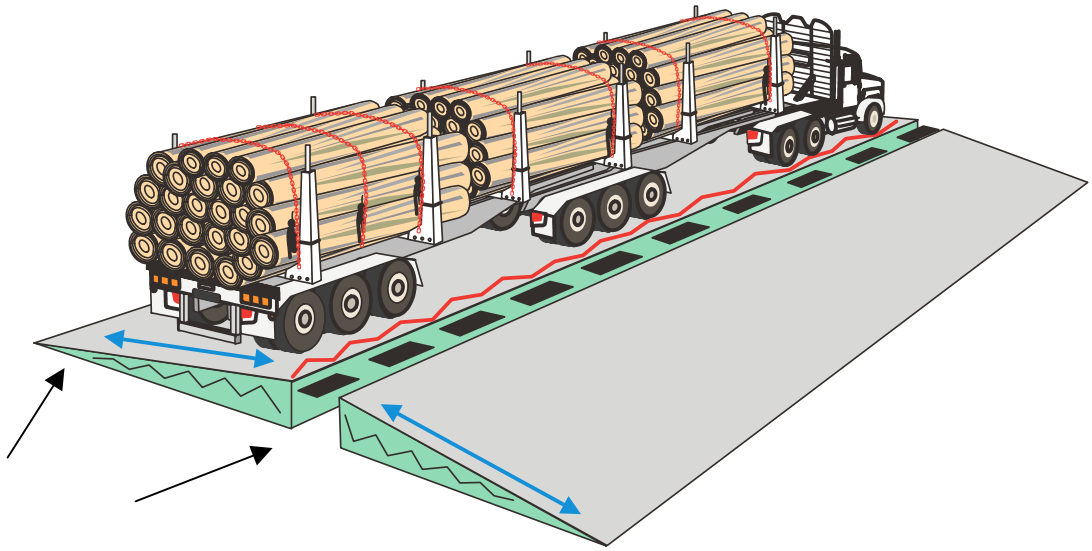
Measure: Levels 1 & 2 **Level of Service:** C
Measure: Levels 3 & 4 **Level of Service:** B

Test specifications will be specific to road and traffic conditions

High Speed – Straight – Line

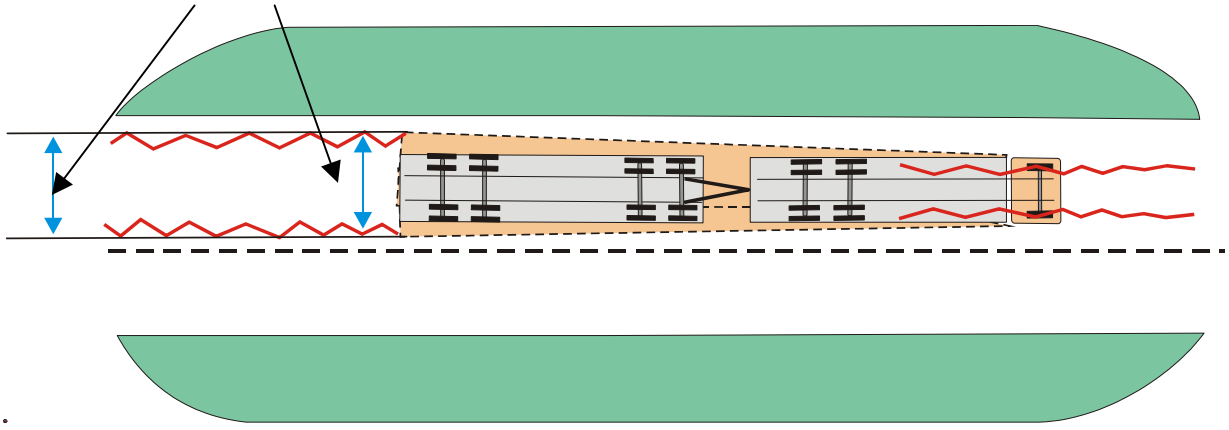
5. Tracking Ability on a Straight Path (TASP)

The amount of lateral movement (swept path) **of the trailing unit** (last trailer) **measured relative to the path or track followed by the hauling unit** (rigid truck or prime mover) **specific to each road class.**



Cross-slope of road surface - 4%
Plus a defined level of surface roughness

TASP is measured as total lateral movement (swept path)



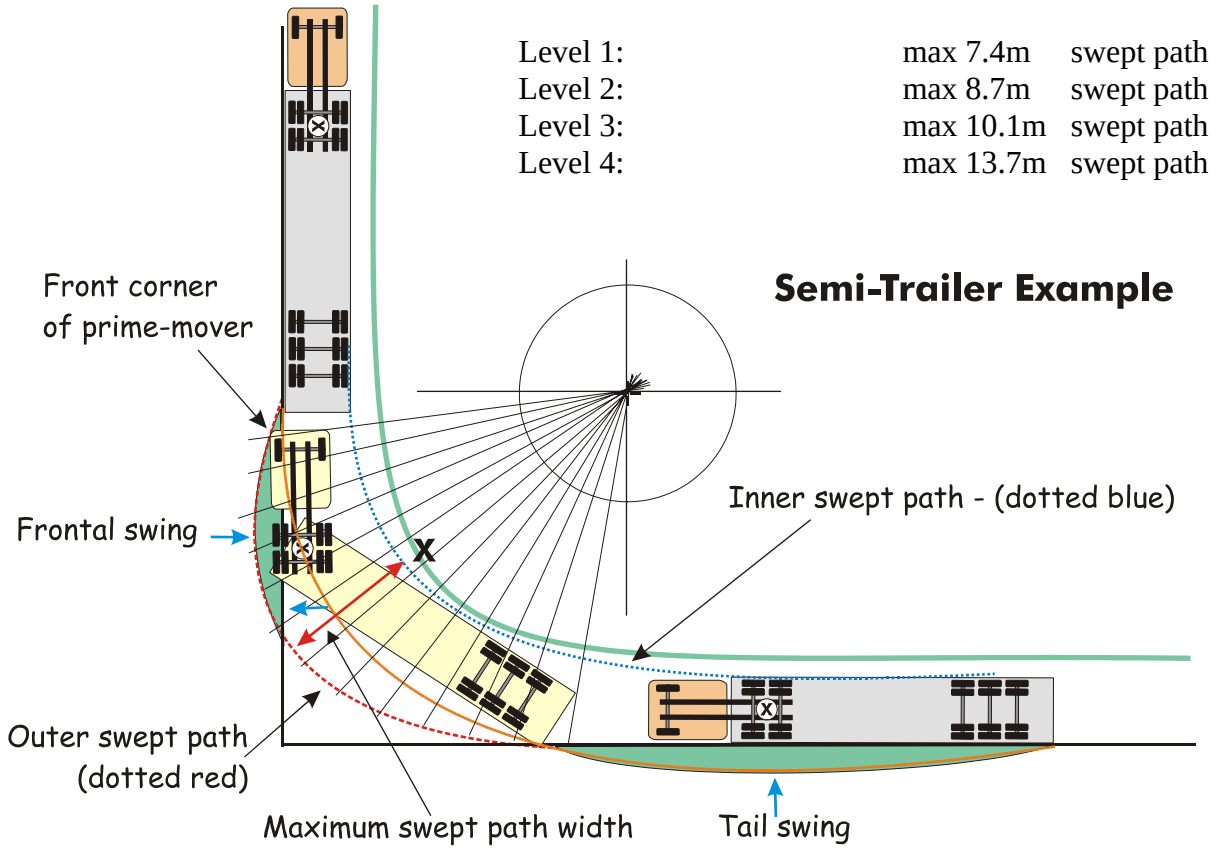
Low Speed Turning

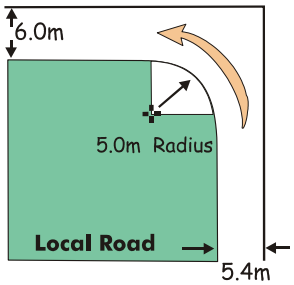
6. Low-Speed Offtracking

Swept path is the maximum width of the road required for the vehicle to complete a low-speed turn.

Centre-line of steer axle to follow path on straight approach to an 11.25m radius 90° circular arc. Vehicle speed to be 5 km/h or less.

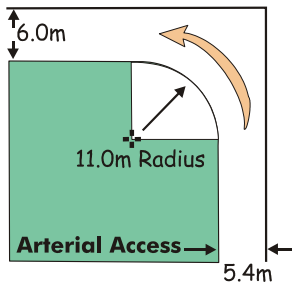
Level 1:	max 7.4m	swept path
Level 2:	max 8.7m	swept path
Level 3:	max 10.1m	swept path
Level 4:	max 13.7m	swept path

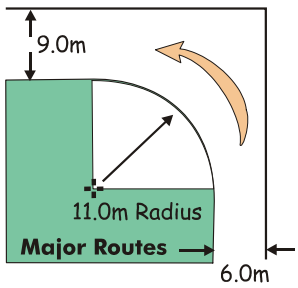


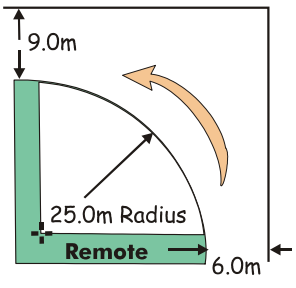


As a general guide, the capacity of road systems for clearance in low speed turns is defined by the envelope examples.

These measures simulate the approximate road space available for the particular vehicle on each of the various network roads.

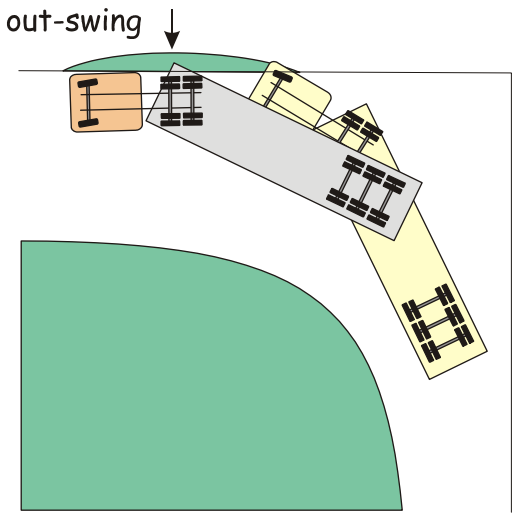






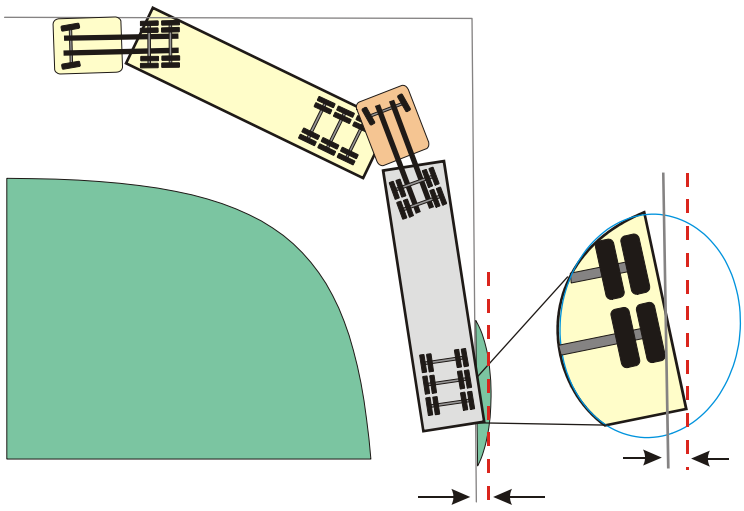
7. Frontal Swing

The maximum lateral out-swing of the outside front corner of the hauling unit and trailer is not to exceed specified values.



8. Tail Swing

The maximum lateral out-swing of the outside rear corner of the truck or trailer as the turn commences, or on the exit.

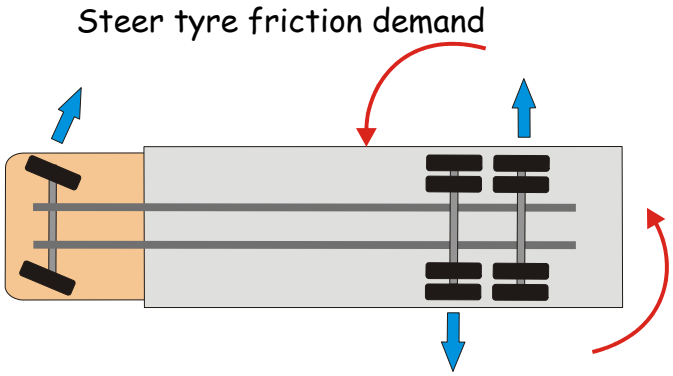


9. Steer Tyre Friction Demand

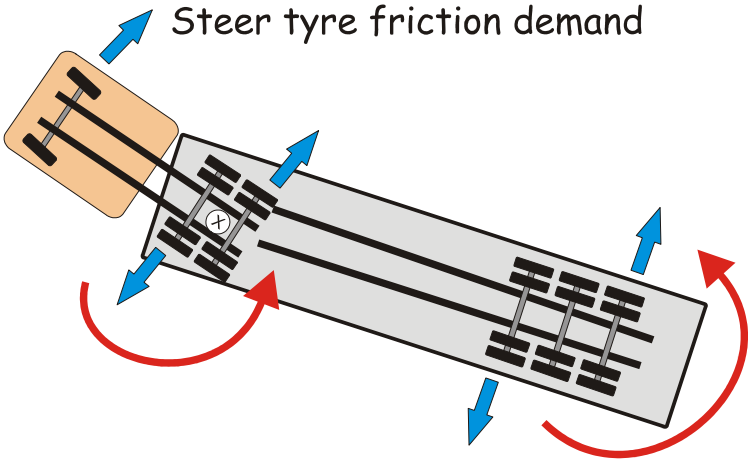
The maximum pavement friction level required by the steer tyres of the hauling unit in a tight low speed turn.

Relates to ability to maintain steering under slippery conditions.

All levels: maximum 80% of the available friction.



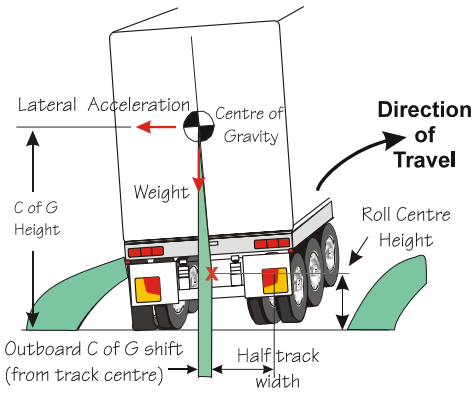
An example of axle group rotation during a slow speed turn. Steer tyres need to overcome axle group scrubbing and therefore create friction demand.



Tyre friction demands apply to articulated vehicles as well as rigid vehicles.

High Speed Turning

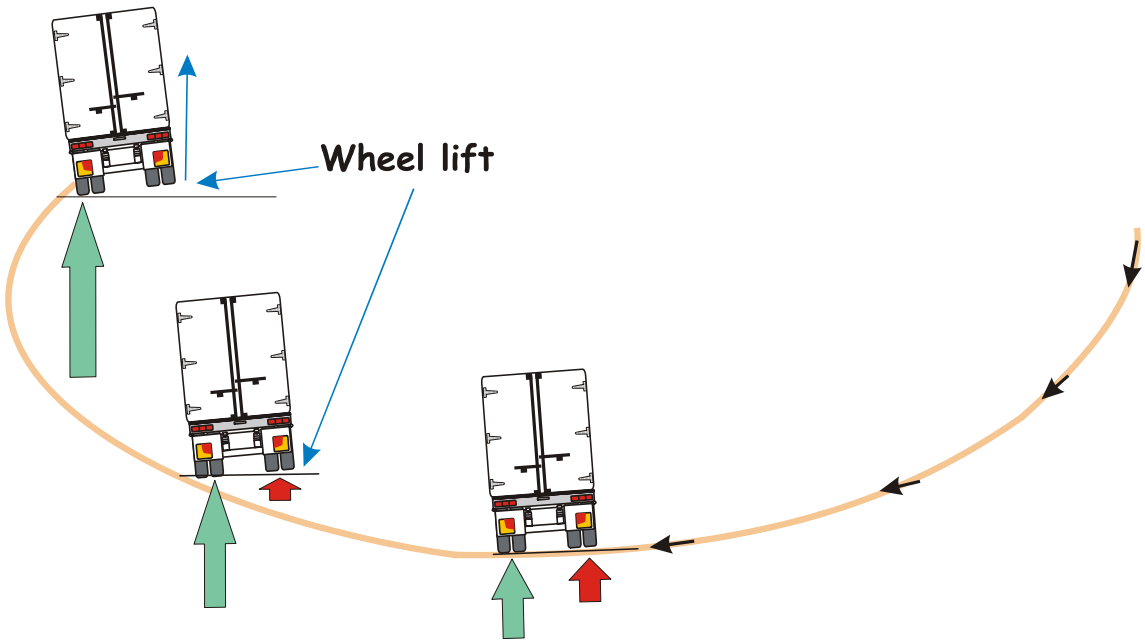
10. Static Rollover Threshold



The lateral acceleration required to lift all wheels on the inside of the turn; could be measured by increasing steer angle at a constant speed or by increasing speed in a constant radius turn.

All levels:

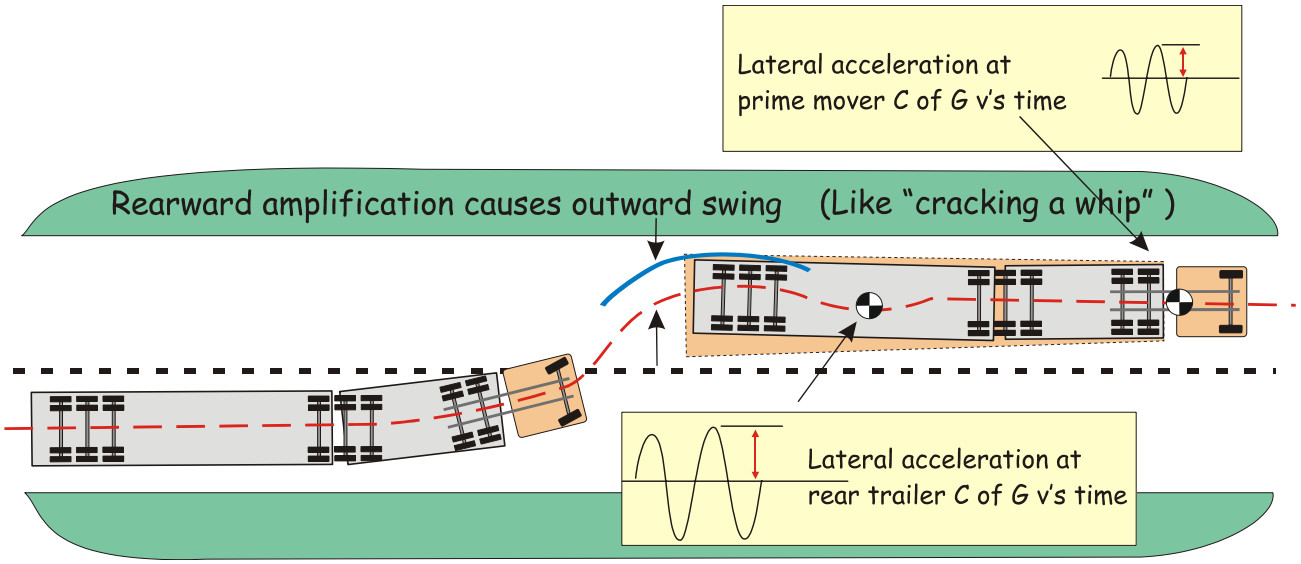
SRT – Dangerous goods vehicles & buses	at least 0.40 g
SRT – All other heavy vehicles	at least 0.35 g



11. Rearward Amplification

The degree to which the trailing unit(s) exaggerate lateral acceleration of the hauling unit.

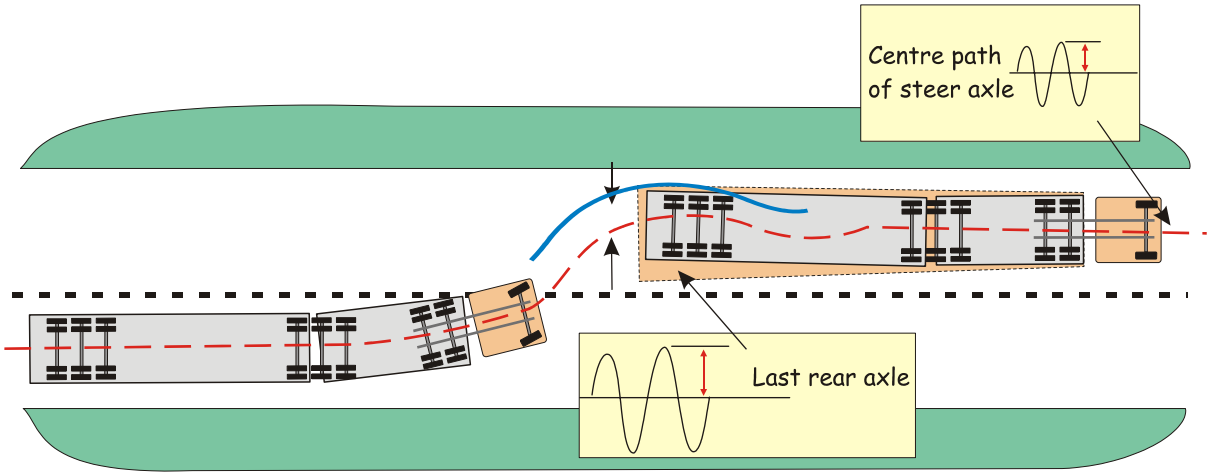
As defined in SAE J2179, or ISO 14791. Prescribed lane change manoeuvre of 1.46 m.
All levels:
RA of the rearmost roll-coupled unit to be no greater than 5.7 times its static rollover threshold



12. High-Speed Transient Off-Tracking

The lateral distance that the last axle on the rear trailer tracks outside the path of the centre of the steer axle in a sudden manoeuvre. Limits vary according to each road class:

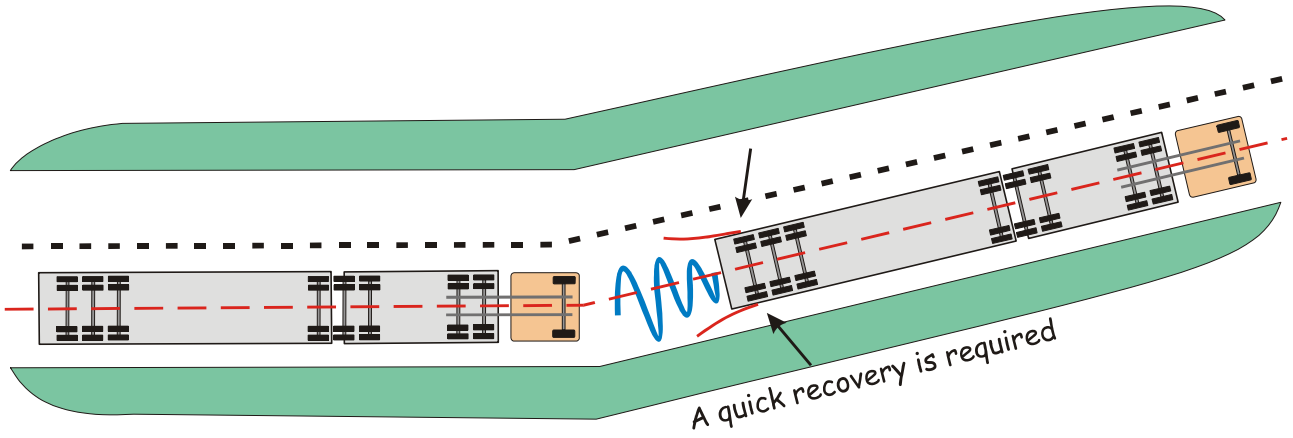
Level 1	0.6 m maximum
Level 2	0.8 m maximum
Level 3	1.0 m maximum
Level 4	1.2 m maximum



13. Yaw Damping

The rate of decay of the "sway" from the rearmost trailer after a single pulse steering movement, measured at a speed of 90 km/h or the maximum certified speed of the vehicle.

All levels: Not less than 15%.



Roads – PBS vehicles are required to cause no more pavement wear than prescriptive vehicles.

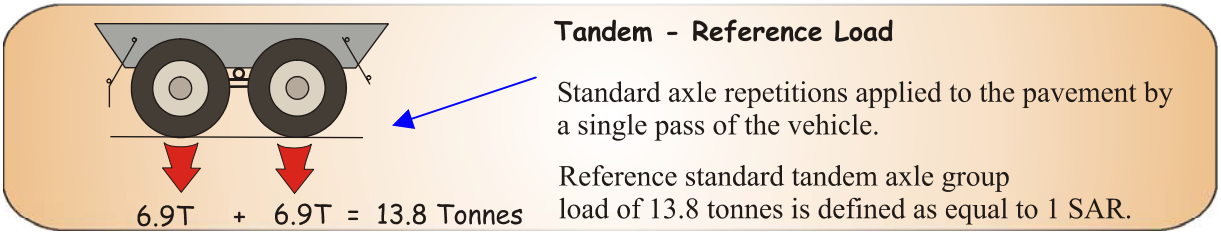
14. Pavement Vertical Loading

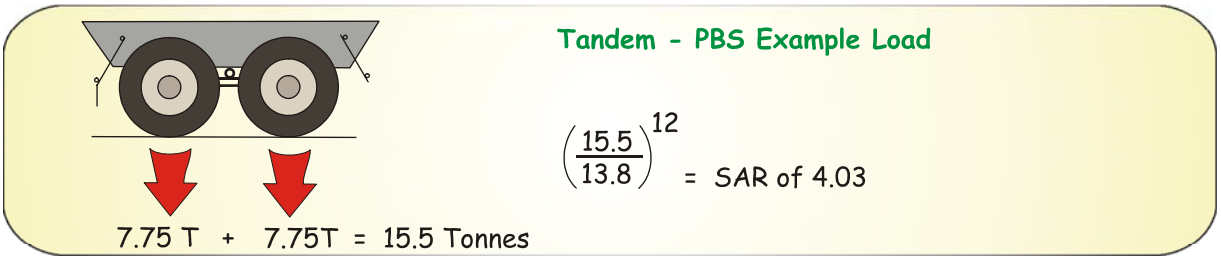
The measures are to limit heavy vehicle road wear by limiting Standard Axle Repetitions (SARs) applied to the pavement by a single pass of the vehicle. The total SARs per vehicle need to be controlled along with the average SAR per axle group.

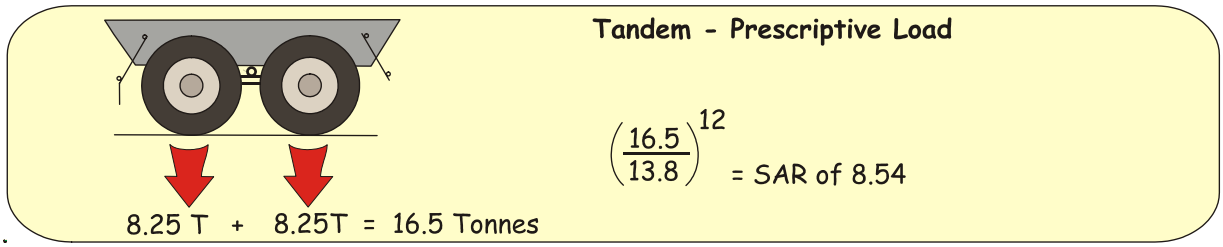
SAR is a standard measure of pavement wear. Each axle group is evaluated individually then summed for the total vehicle.

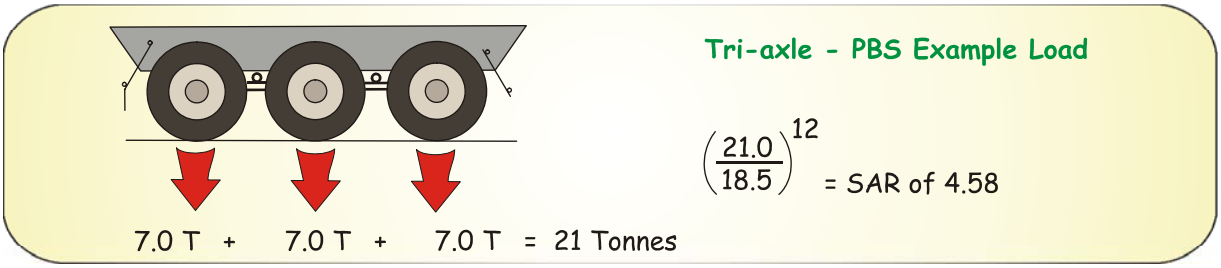
*NOTE: This term is often used in a similar sense to **E**quivalent **S**tandard **A**xle repetitions (ESAs)*

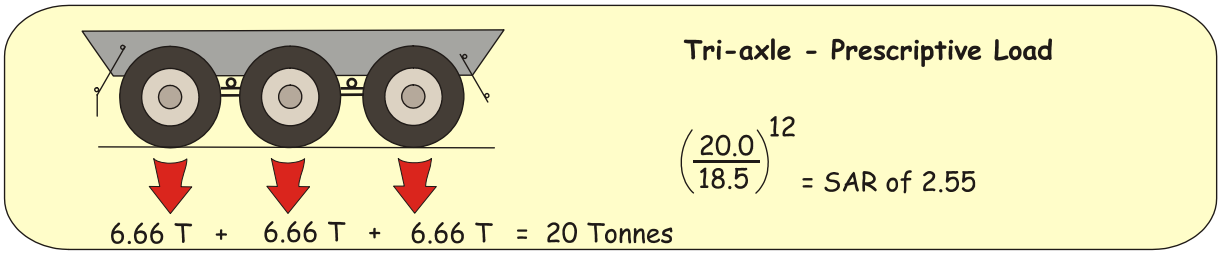
Calculations will assess "Road Wear" for other weights.







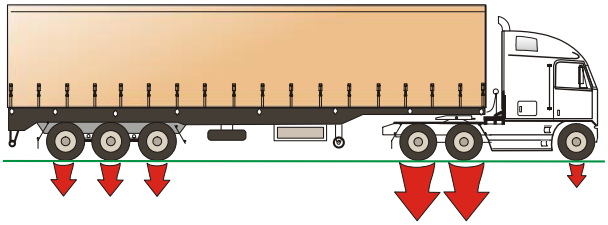




Gross Mass by SAR for a 6 axle example:

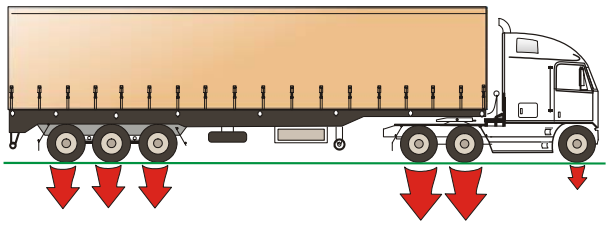
Prescriptive standard axle mass schedule GCM = 42.5 Tonnes

PBS axle weights allowing higher gross mass for the less pavement wear = 43.0 Tonnes GCM.



Note:
For some applications, the average SAR per axle group is a key indicator for comparing a PBS vehicle with a reference vehicle.

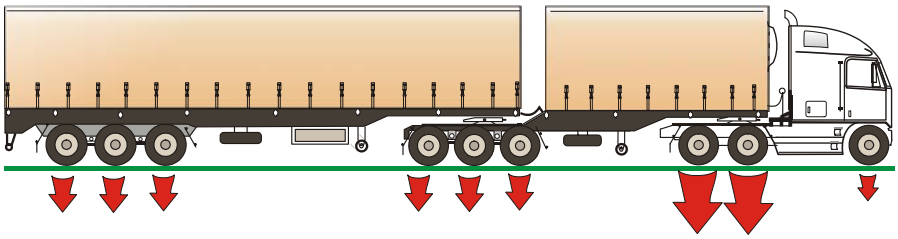
20	**Prescriptive**	16.5	6	= 42.5 Tonnes
2.55	SARs	8.54	3.54	= 14.63 Total



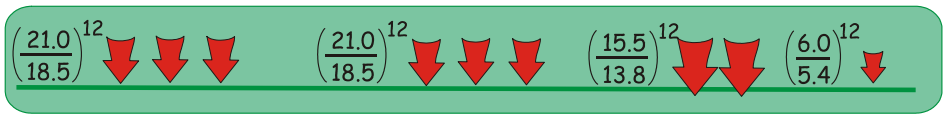
21 ⬅ PBS		PBS ➡ 16.0	6	= 43.0 Tonnes
4.58	SARs	5.90	3.54	= 14.02 Total

Gross Mass by SAR for a 9 axle B Double example:

Prescriptive GCM = 62.5 Tonnes. PBS GCM = 63.5 Tonnes



20	**Prescriptive**	20	16.5	6	= 62.5 Tonnes
2.55	SARs	2.55	8.54	3.54	= 17.18 Total

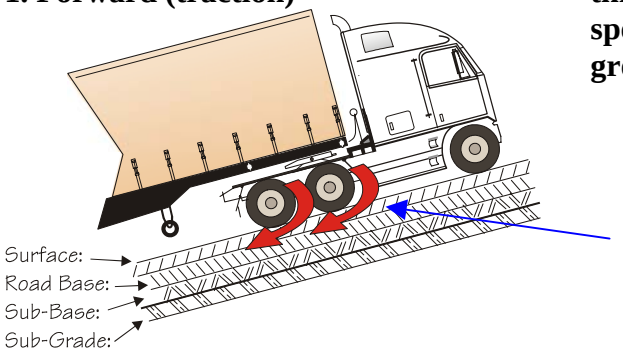


21 ⬅ PBS		PBS ➡ 21	PBS ➡ 15.5	6 = 63.5 Tonnes
4.58	SARs	4.58	4.03	3.54 = 16.73 Total

15. Pavement Horizontal Loading

The degree to which horizontal forces are applied to thin pavements, in low speed turns and at a constant speed on uphill grades, by the tyres of multi-axle groups, and the effect on pavement life.

1. Forward (traction)



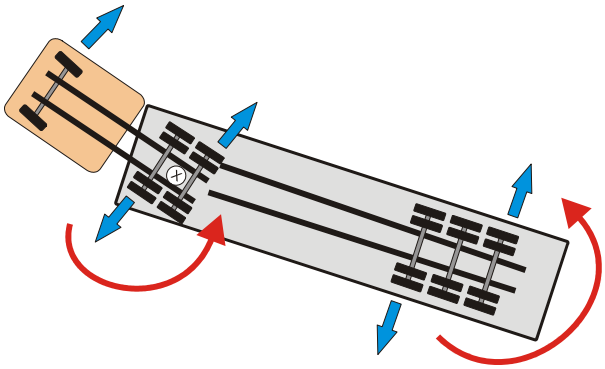
This measure refers to drive axle groups in particular.

Tri-drives are to distribute traction forces equally.

Steerable axles required for tri-axles with wider axle centre spacings than 3.05m and axles with more than 3 axles.

Tri-drive is required beyond particular GCMs above a certain threshold as related to each PBS road level.

2. Lateral (scrubbing in turns)

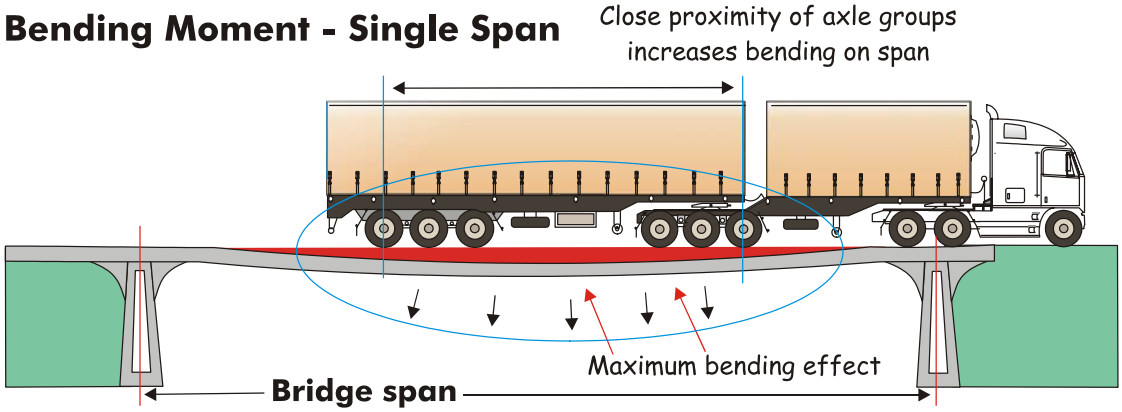


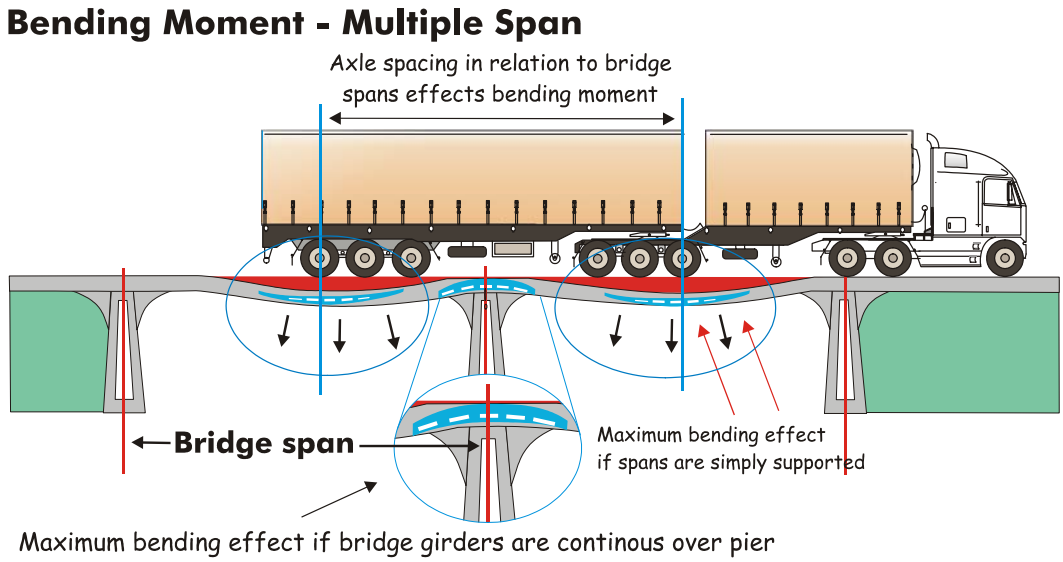
Bridges

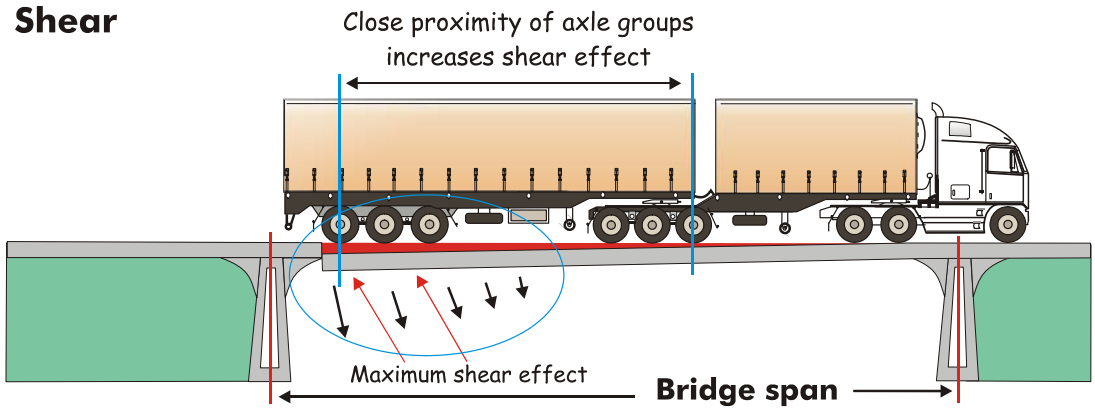
16. Bridge Loading

Measure: The maximum effect on a bridge measured relative to a reference vehicle.

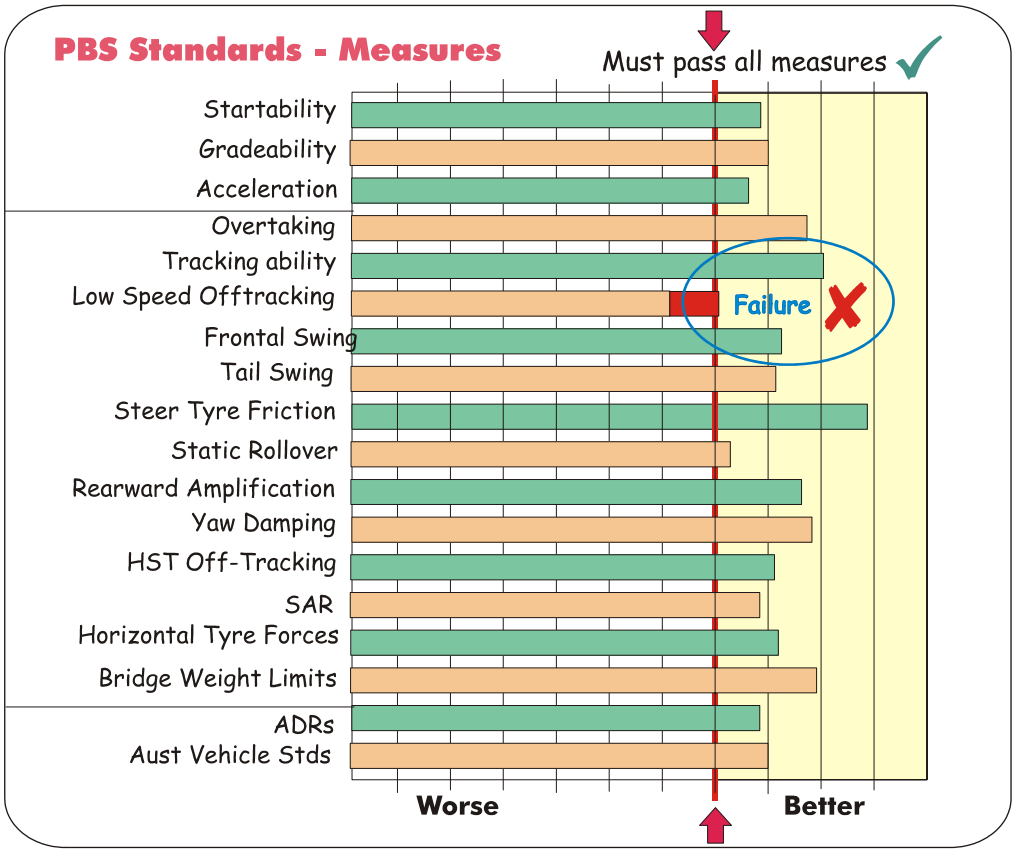
Level: The maximum **bending moment** and **shear force** induced in a set of representative (or route specific) bridges measured relative to a reference vehicle.







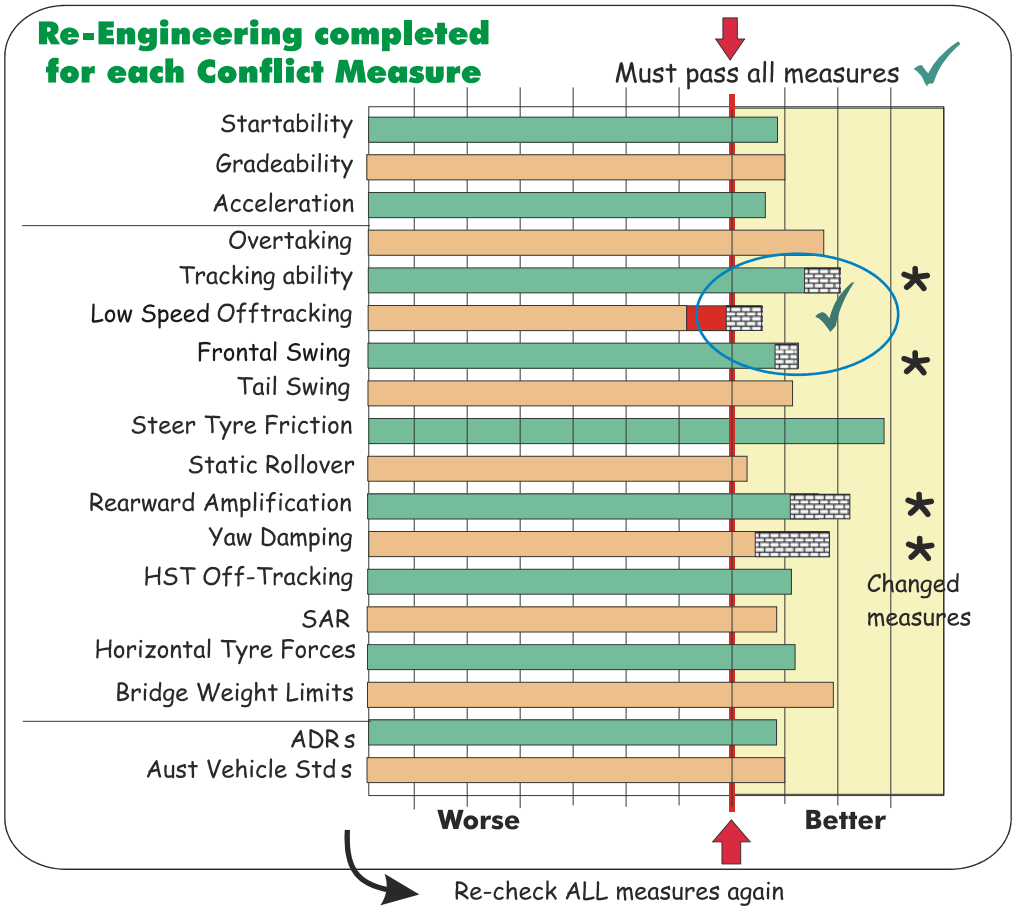
Operator Productivity – Applying the Measures



Note:

- All measures to be assessed using computer simulation modeling or testing with methods in accordance with PBS Assessors' Guidelines.
- All measures must pass
- Potential "trade-offs" between measures will usually show up: - as one measure improves another will get worse. This must be always taken into account.

Re-Engineering Example

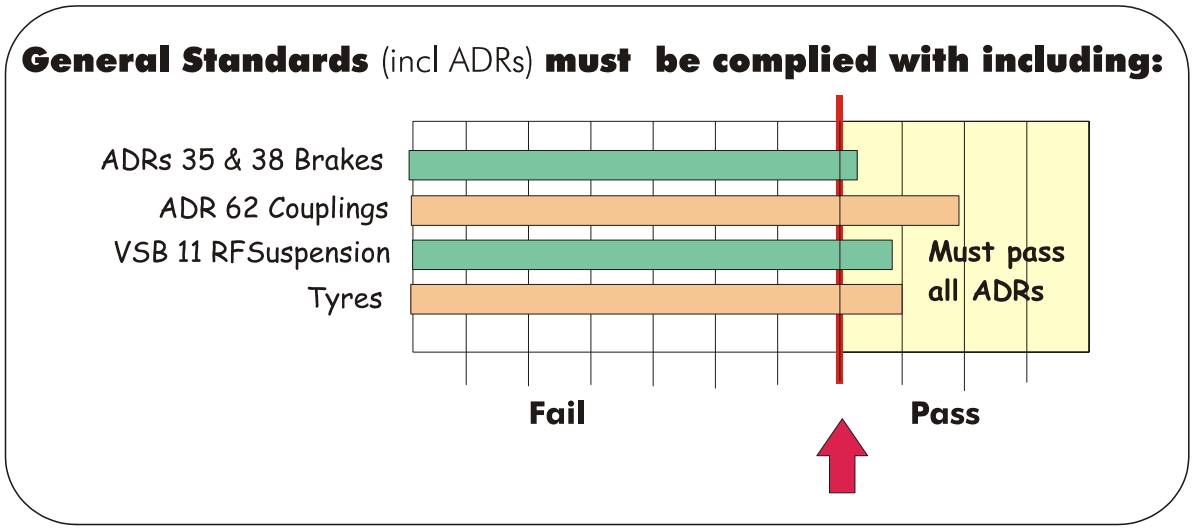


Australian Design Rules (ADR) & Australian Vehicle Standards Regulations (AVSR)

The majority of ADRs applying to new vehicles are intended to be performance based. ADRs primarily relate to single vehicles or units of a heavy combination such as prime movers, trailers and dollies. The dynamic performance of the combination is not usually considered.

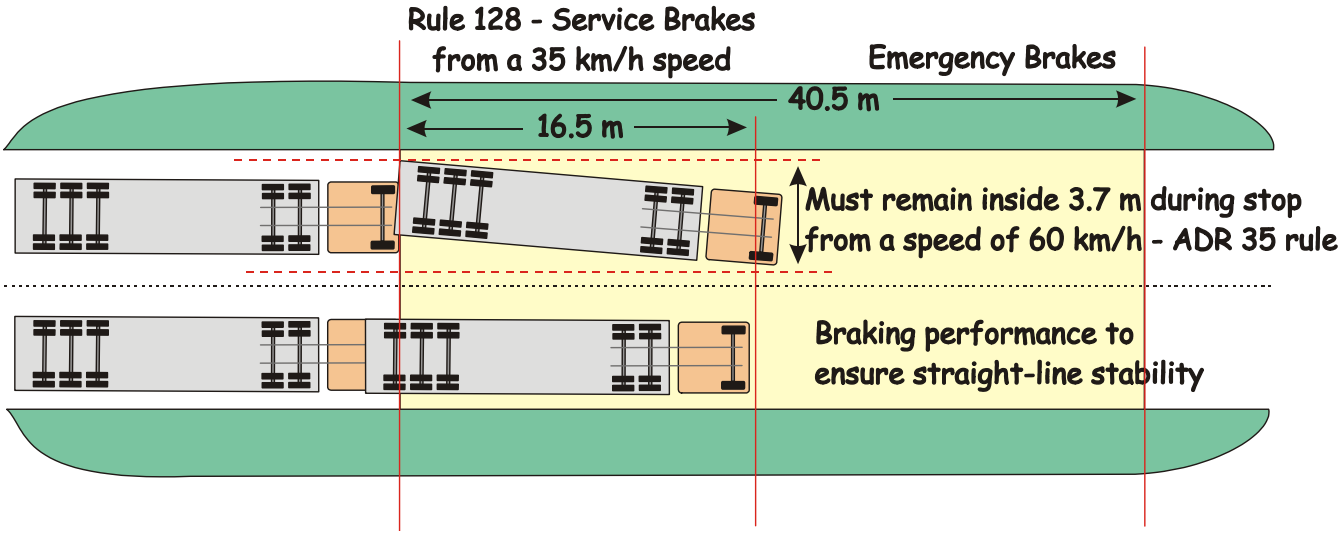
AVSRs and the related Vehicle Operations Regulations additionally cover areas such as mass limits, truck and trailer mass ratio, and size and projection of loads. There are a number of critical issues not addressed by the ADRs and AVSRs that speak to on-road safety related performance of the entire vehicle combination, dollies and trailers included. These are the performance characteristics now covered by the list of "performance measures".

Although all vehicles must meet present Australian Design Rules (ADRs) PBS vehicles may not meet specifically identified ADRs (eg; semi-trailer length dimensions). An ADR requiring specific attention is ADR 62 Couplings. Braking ADRs apply to all PBS vehicles.



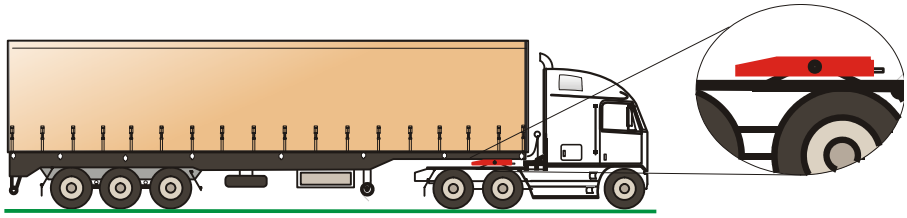
Brakes

The ADRs 35 and 38 and the Australian Vehicle Standards Regulations (AVSRs) determine whether or not a heavy vehicle is in compliance with the national requirements: PBS vehicles must provide adequate brake performance and directional stability under braking.



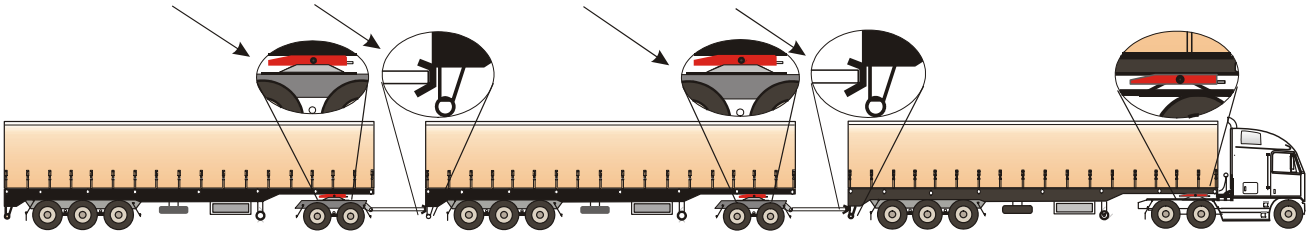
Couplings

ADR 62 covers fifth wheels, turntables, kingpins, skid plates, and pin couplings and calls up applicable Australian Standards (AS 1773, 1771, 4235 & 2175). D- ratings and static overturn ratings must all be met.



Fifth wheel, turntable, king pin, and skid plate must comply.

Fifth wheel assembles and pin-couplings of satisfactory strength are required for combination vehicles.

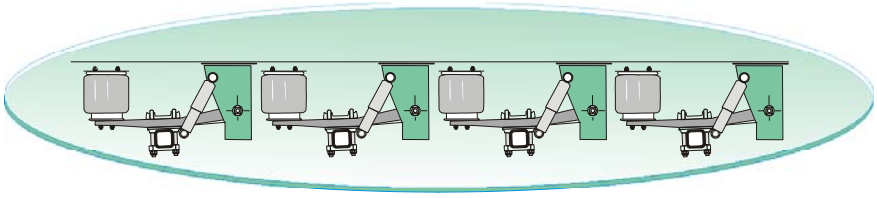


Suspensions

Vehicle Standards Bulletin (VSB 11) sets out the performance criteria for road friendly suspensions, required in some States for vehicles to carry higher mass loads.

All such suspensions are required to be "load-sharing", between axles and must meet frequency and damping criteria. Aside from considerations of road-friendliness, suspensions affect almost every performance measure and require careful selection and evaluation under PBS.

1. Air Suspension

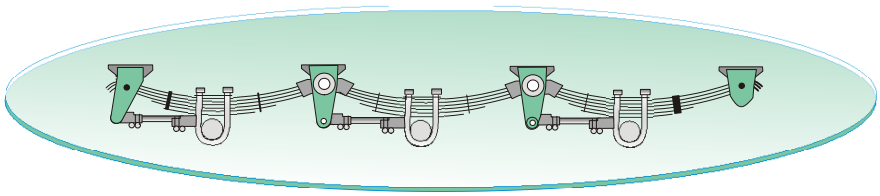


Most air suspensions meet RFS criteria and provide adequate roll stiffness as long as suitable anti-roll bars are fitted. The main features of a modern air suspension are a set of air bags, hanger brackets, trailing arms and shock absorbers, supporting the vehicle body at each axle or axle group. A key element is the shock absorber or damper as air bags alone are poorly damped. They also effectively absorb the energy of the suspension's movement.

Several additional components and advanced features now vastly improve today's air suspension compared to those of 25 years ago. These include, shock absorbers, air compressor design, plumbing and control systems.

The ability to control ride height while giving a relatively soft spring rate as well as good load sharing has improved the air suspension's performance greatly.

2. Steel Spring



In addition to most air suspensions several steel suspensions meet Road Friendly Suspension performance criteria (RFS).

A heavy vehicle suspension system's basic design function is to attach the axles to the frame of the vehicle and to equalize or distribute vehicle weight in specific ratios between axles. Vehicle weight distribution becomes extremely important upon brake application and on negotiating uneven surfaces and cornering.

The design function of a "Road Friendly Suspension" (RFS) is to reduce vibration due to road roughness while maintaining stability, including adequate roll stability. Some steel suspensions are very stiff and provide high roll stiffness and may suit some PBS applications.

More Productive Vehicles

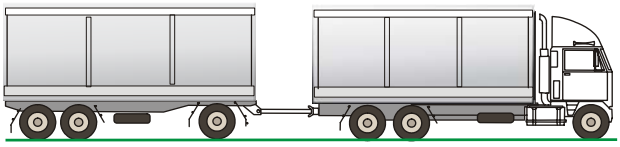
PBS potentially means fewer vehicles on the road for a given freight task.

Mass Limited Loads

To enable carriage of higher gross mass or higher cubic loads, increased overall length, permitted increased gross mass, plus improved dynamic performance.

Example 1.

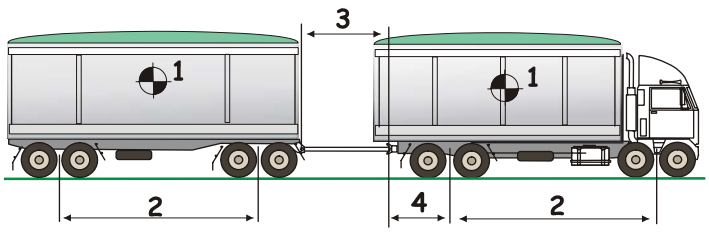
Prescriptive Limits



Key Parameters

Overall length limits
Gross Mass Limit
Axle Mass Limits

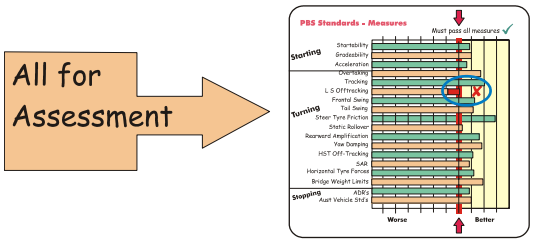
PBS Regulations



Key Parameters

1. Centre of Gravity Heights
2. Wheel Base
3. Drawbar Length
4. Coupling Overhang

And full performance assessment

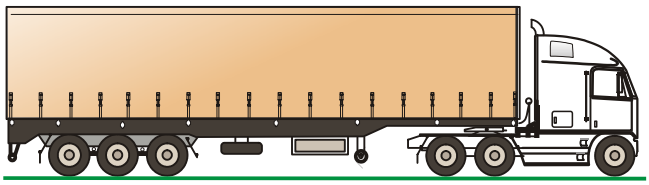


Effects of using PBS

1. Mass increase
2. Possible cubic increase
3. Improved dynamic stability

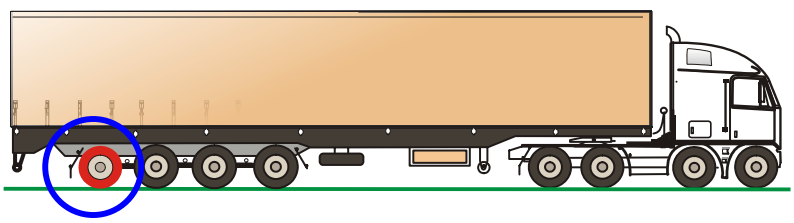
Example 2.

Prescriptive Limits



1. Length limits, for 6 axle articulated to 19m
2. Axle spacing schedules apply
3. Standard axle mass limits 42.5t GCM
4. King pin to rear dimension limit

PBS Regulation



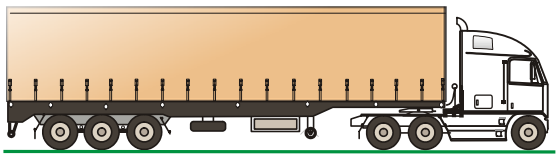
1. Gross mass increase
2. Length increase assisted by a steer axle
3. Possible length increase

Cube Limited Loads

Example 3

Prescriptive Limits

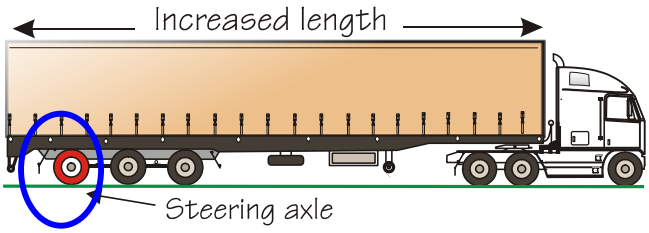
6 Axle Semi -Trailer



Standard 13.7 or 14.6 m long semi-trailer as above.

PBS Regulation

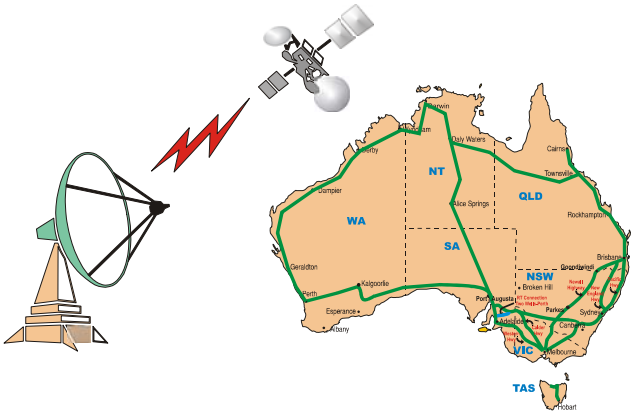
6 Axle Semi –Trailer with Steering Axle



1. Meeting swept path standard at longer length.
2. Cubic volume increased by 15% to 20%.
3. More efficiently sized for commodity loading.
4. Approved route restrictions would apply.

Compliance

Access Management



Many vehicles will be able to be tracked by GPS and satellite systems as part of audit verification programs.

To ensure all PBS vehicles operate on the correct road type. To carry loads more efficiently to wider road network.

Each State and Territory will produce specific routes for vehicles with specific features.

Existing Oversize and Overmass routes exist in all States and Territories. These classified routes will be able to take many types of PBS vehicle.

Some routes will be set for heights, such as 4.6m.

National P B S Application Process

To provide a single assessment, approval & operation.

Standard approval, certification and audit requirements.

On board "key-features" identification to be carried.

APPENDIX

NATIONAL ROAD TRANSPORT COMMISSION
Incorporating functions of the National Transport Commission

Level 15/628 Bourke Street Melbourne VIC 3000 Australia
Telephone (03) 9236 5000 - Facsimile (03) 9642 8922
Website: www.ntc.gov.au E-mail: ntc@ntc.gov.au

PERFORMANCE-BASED STANDARDS Reports

http://www.ntc.gov.au/ReportList.aspx?page=A0240030550000002017

Title	*ISBN*	*Date*	*Author*
Performance-Based Standards for Heavy Vehicles in Australia, Field of Performance Measures,	ISBN - 0 642 54450 6	December 1999	Roaduser International P/L, ARRB Transport Research
Performance-Based Standards for Heavy Vehicles: Assembly of Case Studies	ISBN - 0 642 54449 2	December 1999	ARRB Transport Research
Performance-Based Standards for Heavy Vehicle Regulation	ISBN - 0 642 54463 8	August 2000	Deacons Graham & James, Roaduser International
Specification of Performance Standards & Performance of The Heavy Vehicle Fleet. PBS - NRTC/Austroads Project A3/A4	ISBN - 0 642 54461 1	August 2000	ARRB Transport Research Ltd, Pearsons Transport Resource Centre, Phillips Fox, Economic Associates P/L, Woodrooffe & Associates, Transport Engineering NZ Ltd
Performance-Based Standards Policy Framework for Heavy Vehicle Regulation	ISBN - 0 642 54473 5	November 2000	NRTC
Report on Initial Selection of Potential Performance Measures (PBS – NRTC/Austroads Project A3 & A4) Discussion Paper	ISBN – 0 642 54477 8	January 2001	Dr Hans Prem, Pearsons Transport Resource Centre, Phillips Fox, Economic Associates P/L, Woodrooffe & Associates, Transport Engineering NZ Ltd
Definition of Potential Performance Measures & Initial Standards (Performance Based Standards - NRTC/AUSTROADS Project A3 And A4)	ISBN – 0 642 544796 4	April 2001	Dr Hans Prem, Pearsons Transport Resource Centre, Phillips Fox, Economic Associates P/L, Woodrooffe & Associates, Transport Engineering NZ Ltd

Title	***ISBN***	***Date***	***Author***
Dimension & Mass Characterisation of the Australian HV Fleet (Performance Based Standards - NRTC/AUSTROADS Project A3 and A4)	ISBN – 0 642 54480 8	April 2001	Dr Hans Prem, Pearsons Transport Resource Centre, Phillips Fox, Economic Associates P/L, Woodrooffe & Associates, Transport Engineering NZ Ltd
Performance-Based Standards Policy Framework for Heavy Vehicle Regulation: Regulatory Impact Statement	ISBN – 0 642 54484 0	May 2001	NRTC
Comparison of Modelling Systems for Performance-Based Assessments of Heavy Vehicles (Performance Based Standards – NRTC/Austroads Project A3 and A4), Working Paper	ISBN: 0 642 54489 1	October 2001	Dr Hans Prem (RTDynamics), Euan Ramsay (RTDynamics), Dr John de Pont, (TERNZ), Dr John McLean (Consultant) John Woodrooffe (Woodrooffe & Associates Inc.)
Report On Workshops On Performance-Based Standards: (Performance-Based Standards - NRTC/Austroads Project A3 and A4): Workshop Report	ISBN: 0 642 54499 9	December 2001	ARRB Transport Research Ltd - Kieran Sharp, RTDynamics - Dr Hans Prem
Accreditation Of Assessors: Performance–Based Standards – Discussion Paper	ISBN: 1 877093 03 3	February 2002	Peter Baas (TERNZ Limited), Ron Oliver (Oliver Hatton Limited), Ian Wright (Ian Wright & Associates)
An Overview Of Performance–Based Standards Regulatory And Compliance Processes	ISBN: 1 877093 05 X	February 2002	NRTC
Insurance Requirements For Performance Assessors: Performance–Based Standards – Discussion Paper	ISBN: 1 877093 02 5	February 2002	Phillips Fox
Intellectual Property Issues: Performance–Based Standards – Discussion Paper	ISBN 0 642 54497 2	February 2002	Phillips Fox
In–Vehicle Data Retrieval and Identification Methods: Performance–Based Standards – Discussion Paper	ISBN 1 877 09301 7	February 2002	Pearsons Transport Resource Centre Pty Ltd

Title	***ISBN***	***Date***	***Author***
Performance Characteristics of the Australian Heavy Vehicle Fleet (Performance Based Standards – NRTC/Austroads Project A3 and A4), Working Paper	ISBN: 1 877093 04 1	February 2002	Dr Hans Prem (RTDynamics), Dr John de Pont (TERNZ), Bob Pearson (PTRC), Dr John McLean (Consultant)
Performance Characteristics of the Australian Heavy Vehicle Fleet: Summary (Performance Based Standards – NRTC/Austroads Project A3 and A4), Working Paper	N/A	February 2002	Dr Hans Prem (RTDynamics), Dr John de Pont (TERNZ), Bob Pearson (PTRC), Dr John McLean (Consultant)
Performance Based Standards: Regulatory Impact Statement – *Preliminary Draft*	N/A	May 2002	Economic Associates Pty Ltd, Pearsons Transport Research Centre Pty Ltd, RT Dynamics Pty Ltd
Performance-Based Standards for Heavy Vehicle Regulation: Regulatory Processes - Draft Discussion Paper	ISBN: 1 877093 25 4	December 2002	NRTC
PBS Safety Standards for Heavy Vehicles (Performance Based Standards – NRTC/Austroads Project A3 and A4) – Discussion Paper	ISBN: 1 877093 28 9	January 2003	Dr Hans Prem (Mechanical Systems Dynamics), Dr John McLean (Consultant), John Edgar (NRTC)
PBS Infrastructure Protection Standards for Heavy Vehicles (Performance Based Standards – NRTC/Austroads Project A3 and A4) – Discussion Paper	ISBN: 1 877093 29 7	January 2003	NRTC with Appendices prepared by ARRB TR Ltd and Pearsons Transport Resource Centre P/L
Performance-Based Standards: Phase A – Standards & Measures: Regulatory Impact Statement - Draft	N/A	February 2003	Economic Associates P/L RT Dynamics P/L Pearsons Transport Resource Centre P/L Project Managed by ARRB TR Ltd
Review of Heavy Vehicle Braking Systems Requirements (PBS Vehicle Aspects) Summary Discussion Paper	ISBN: 1 877093 38 6	July 2003	Dr Peter Hart, Hartwood Consulting P/L
Review of Heavy Vehicle Braking Systems Requirements (PBS Vehicle Aspects) Main Discussion Paper	ISBN: 1 877093 8	July 2003	Dr Peter Hart, Hartwood Consulting P/L

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ARTSA is the combined technical resource for improved safety, environment and productivity. This resource is available to government agencies, transport operators and standards organisations.

ARTSA values its relationships with all stakeholders in the transport industry and provides factual and balanced information.

ARTSA membership is broad-based and includes:

- Truck manufacturers
- Trailer manufacturers
- Component manufacturers
- Fuel suppliers
- Driver training providers
- Vehicle repairers
- Test equipment manufacturers
- Providers of testing and compliance services
- Insurance service providers

ARTSA activities include:

- Codes of Practice
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- Research
- Scholarships

ARTSAs activities are managed by an Executive Officer who may be contacted at:

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