



Options Paper

Review of Low Speed Swept Path and Tail Swing Standards in the Performance Based Standards (PBS) Scheme

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1 Project summary

1.1 Purpose

The purpose of this Options Paper is to present options for the review of the Low Speed Swept Path (LSSP) and Tail Swing (TS) standards in the *Performance-Based Standards Scheme – the Standards and Vehicle Assessment Rules*. The review of these standards falls under Phase 2 of the National Heavy Vehicle Regulator (NHVR) PBS Standards Review Project. This work is separate to the ‘PBS 2.0 Project’ which comprehensively reviews the PBS scheme and provides options on how to incentivise industry uptake, accelerate growth in the PBS scheme, and enable continued fleet innovation.

This Options Paper provides a range of options for consideration as part of the review of the existing standards and seeks stakeholder feedback to a preferred approach. Feedback can be provided to the NHVR by completing the feedback form via <https://www.nhvr.gov.au/document/245/> or by written submission.

1.2 Project background

The *Performance-Based Standards (PBS) Scheme – the Standards and Vehicle Assessment Rules* (PBS Standards and Vehicle Assessment Rules) specifies the standards that must be met for a vehicle to be eligible to participate in the PBS scheme. It also specifies the methods of assessment and the procedures for assessment that PBS assessors must use to determine whether particular vehicles – or vehicles built to a design – are likely to meet these standards.

At the May 2018 Transport and Infrastructure Council (TIC) meeting, Ministers endorsed recommendations of the National Transport Commission (NTC) policy paper ‘*Reforming the PBS Scheme*’. The paper included four recommendations relevant to the NHVR:

- Review the standards in the PBS scheme (In progress – recommendation relevant to this Options Paper).
- Lead a communications plan to promote the benefits of the PBS scheme (Business as usual).
- Publish a National PBS Notice for each network level (Delivered).
- Design a nationally consistent infrastructure assessment guideline (Being delivered in partnership with the Commonwealth, state and territory transport governments, and Austroads).

The NHVR commenced delivery against these recommendations in 2019 (the PBS Standards Review Project).

There are 16 safety standards and four infrastructure standards. The NHVR previously consulted with government and industry stakeholders, and determined that not all standards required review at this time.

As per the 2018 ministerial endorsement, the NHVR’s approach to reviewing those PBS standards that required attention was to sequence the review over four phases.

The NHVR is currently implementing the outcomes of Phase 1 and has commenced the review of Phase 2 – the LSSP and TS standards – through release of this Options Paper.

Table 1 – PBS Standards Review Project phases

Phase 1 (Implementation)	Phase 2	Phase 3	Phase 4
<ul style="list-style-type: none"> • C8: Frontal Swing (FS) • A2: Pavement Horizontal Loading (PHL) • C16: Directional Stability Under Braking (DSUB) 	<ul style="list-style-type: none"> • C7: Low Speed Swept Path (LSSP) • C9: Tail Swing (TS) 	<ul style="list-style-type: none"> • C11: Static Rollover Threshold (SRT) • C12: Rearward Amplification (RA) • C13: High Speed Transient Off-tracking (HSTO) 	<ul style="list-style-type: none"> • C1: Startability • C2: Gradeability (A, B) • C3: Acceleration Capability

1.3 Key drivers

This project is driven by, but not limited to, the following:

- Potential misalignment between performance of PBS and prescriptive combinations for equivalent levels of network access. For example, a prescriptive 26m B-double may have PBS Level 3 LSSP performance which would otherwise restrict the vehicle from the PBS Level 2 network (B-double network equivalent).
- Cross linkages between LSSP performance and the prescribed turning templates found in the *Performance-Based Standards Scheme – Network Classification Guidelines* (PBS Network Classification Guidelines) and Route Assessment Guidelines.

In addition, the Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA) is actively considering amendments to the [Australian Design Rules \(ADRs\)](#)¹ to increase vehicle width above the current 2.5m limit. While this has not yet been confirmed, it would have significant impacts on the LSSP and TS standards. As a result, this project seeks to future proof any changes to the Standards and explores the impact of increased vehicle widths.

1.4 Existing standards

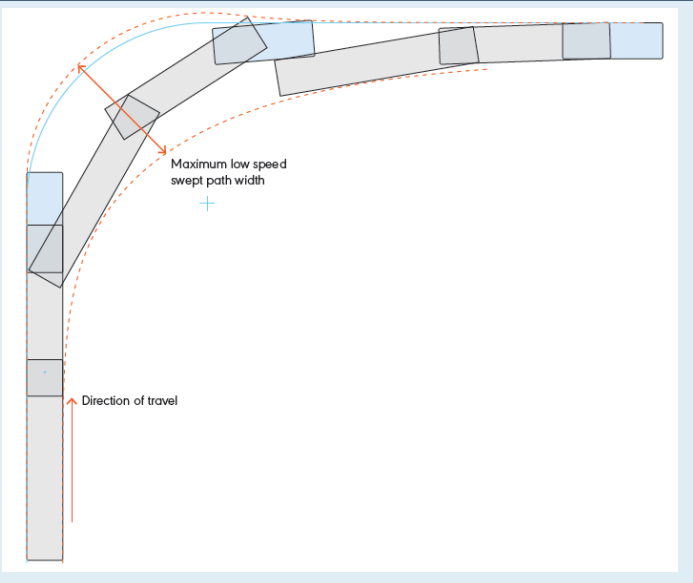
1.4.1 Low Speed Swept Path

The primary purpose of this standard is to manage safety risk associated with turns at intersections by limiting the road space required by a vehicle when making low-speed turns.

LSSP is measured by the maximum width of the swept path in a prescribed 90 degree low-speed turn at a speed no more than 5 km/h. Table 2 shows the performance levels and an illustration of the turning manoeuvre.

Table 2 – LSSP performance levels

PBS road class	Performance level required
Level 1	No greater than 7.4m
Level 2	No greater than 8.7m
Level 3	No greater than 10.6m
Level 4	No greater than 13.7m



¹ **Note:** The ADRs, which are national standards for vehicle safety, anti-theft and emissions, are set by DITRDCA. ADRs are generally performance-based and cover a range of items, including lighting, noise, emissions and braking.

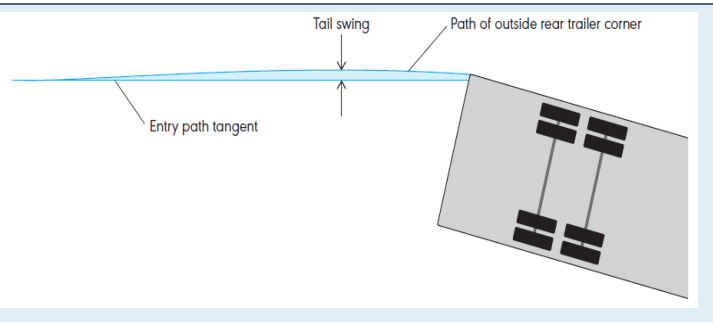
1.4.2 Tail Swing

The primary purpose of this standard is to manage safety risk by limiting the road space requirement of a vehicle when making a tight turn at low speed.

During an LSSP manoeuvre, TS is measured by the maximum outward lateral displacement of the outer rearmost point of a vehicle unit during the initial and final stages of a prescribed 90 degree low-speed turn. Table 3 shows the performance levels and an illustration of TS.

Table 3 – TS performance levels

PBS road class	Performance level required
Level 1	No greater than 0.30m
Level 2	No greater than 0.35m
Level 3	No greater than 0.35m
Level 4	No greater than 0.50m



2 Scope

2.1 In scope

The following factors are considered to be in scope for the review of LSSP and TS:

- Review of existing LSSP and TS requirements to consider potential changes to performance requirements, potential amendments in response to increased width in the ADRs, and potential implications for other standards arising from changes to LSSP and/or TS.
- The current performance distribution of PBS vehicles, resulting compliance challenges, and potential for further innovation that may be associated with any changes to the LSSP and TS standards.
- Consideration of safety and infrastructure risks that may be associated with any changes to the LSSP and TS standards.
- Review of the PBS turning templates in the PBS Network Classification Guidelines and exploring the need for turning templates for other PBS vehicles – such as, PBS buses and rigids.
- Exploring the differences in application between the standards and current infrastructure route assessment guidelines (including the PBS Network Classification Guidelines).
- Exploring alternative assessment methods in other regions that have a scheme similar to PBS – for example, in Europe, the ‘roundabout’ test is used.
- Amendments to the PBS Network Classification Guidelines where applicable, limited to the changes arising from this project.
- Advice to jurisdictions, regarding potential updates to jurisdictional guidelines arising from this project.
- Review of assessment methods for the LSSP and TS standards.

2.2 Out of scope

The following factors are considered to be out of scope for the review of LSSP and TS:

- Consideration of requirements for other vehicle types outside of the PBS scheme – that is, this review is limited to vehicle types shown on the [PBS Vehicle Configuration Chart](#).
- PBS standards outside of those to be considered in this project – other than those potentially impacted by changes arising from this project.
- Amendments to the PBS Network Classification Guidelines outside any changes arising from this project. However, the NHVR will liaise with the NTC with regard to the NHVR progressing any other proposed amendments for ministerial approval.
- Amendments to the *Austroads Design Vehicles and Turning Path Templates Guide (AP-G34-13)* as a result of any changes arising from this project.
- Advice regarding amendments to jurisdictional Route Assessment Guidelines outside any changes arising from this project.

3 Impacts of potential increased vehicle widths

3.1 Background

Austrroads design vehicles play an important role in the assessment and design of intersections in Australia. Austrroads design vehicles are published in the *Design Vehicles and Turning Path Templates Guide* (AP-G34-13), which also includes turning templates for different turning radii and speeds. These vehicles were first developed by the National Association of Australian State Road Authorities (NAASRA) in 1985 and have since been revised by Austrroads on two occasions (in 1995 and 2006).

The PBS Network Classification Guidelines contain turning templates derived from the Austrroads design vehicles where a specific template has been made for each PBS level. The PBS levels represent different thresholds of network classification by vehicle length and are summarised in Figure 1 below.

Vehicle Performance Level	Network Access by Vehicle Length, L (m)	
	Access Class 'A'	Access Class 'B'
Level 1	L ≤ 20 (General Access*)	
Level 2	L ≤ 26	26 < L ≤ 30
Level 3	L ≤ 36.5	36.5 < L ≤ 42
Level 4	L ≤ 53.5	53.5 < L ≤ 60

Figure 1 – PBS levels for vehicle length

Note: * General access is subject to a mass limit prescribed within the *Heavy Vehicle (Mass, Dimension and Loading) National Regulation*, posted local restrictions and restrictions or limitations specified by the jurisdiction.

The turning templates can be found in Appendix B of the PBS Network Classification Guidelines, noting these templates are based on vehicles that are 2.5m wide.

The following is a list of Austrroads design vehicles published in AP-G34-13:

- Single unit truck/bus (12.5m)
- Long rigid bus (14.5m)
- Articulated bus (19m)
- Prime mover and semitrailer (19m)
- Prime mover and long semitrailer (25m)
- B-double (25m)
- A-double (Type I road train) (36.2m)
- A-triple (Type II road train) (53.4m)
- B-double (26m)
- B-triple (35.4m).

Note: The passenger vehicle (5.2m) and service vehicle (8.8m) have been excluded from this list, as they do not fall within the definition of 'heavy vehicle' under the HVNL and are outside the scope of this Options Paper.

3.2 Applying an increased width to current Austroads design vehicles

As the design vehicles play an important role in heavy vehicle route assessment, the NHVR has explored the effects of two increased width scenarios against the existing LSSP and TS standards. This desktop assessment was completed to understand how potential increases in width would impact the various limits in the current LSSP and TS standards.

The following Austroads design vehicles were chosen as part of a desktop assessment as they are often used as a baseline for comparison of productivity benefits that can be achieved through the PBS scheme. Dimensions for the selected vehicles can be found in Appendix A:

- 19m semitrailer
- 26m B-double
- 35.4m B-triple.

Using truck simulation software, the 19m semitrailer, 26m B-double and 35.4m B-triple were assessed against the current PBS standards for LSSP and TS, with the following variations:

- 2.5m prime mover and 2.5m trailer(s)
- 2.5m prime mover and 2.55m trailer(s)
- 2.55m prime mover and 2.5m trailer(s)
- 2.55m prime mover and 2.55m trailer(s)
- 2.5m prime mover and 2.6m trailer(s)
- 2.6m prime mover and 2.5m trailer(s)
- 2.6m prime mover and 2.6m trailer(s).

Limitations of this exercise included the following:

- Results are based on a desktop assessment only, using truck simulation software.
- These vehicles may not represent ‘worst-case’ vehicles currently operating on the road network.
- The assessment is not considered a ‘PBS assessment’ and is only indicative.
- The assessments only consider potential increases in width, and do not consider any changes in existing LSSP and TS performance levels.

3.2.1 Vehicle simulation results

The results from the desktop assessment are presented in Table 4 to Table 6.

Table 4 – 19m semitrailer results

19m semitrailer	LSSP (m)	PBS Level	TS (m)	PBS Level
Scenario 1 (Width increase to 2.55m)				
2.5m wide	7.36	1	0.06	1
2.5m prime mover, 2.55m trailer	7.38	1	0.06	1
2.55m prime mover, 2.5m trailer	7.38	1	0.06	1
2.55m prime mover, 2.55m trailer	7.41	2	0.06	1
Scenario 2 (Width increase to 2.6m)				
2.5m prime mover, 2.6m trailer	7.41	2	0.06	1
2.6m prime mover, 2.5m trailer	7.40	1	0.06	1
2.6m prime mover, 2.6m trailer	7.45	2	0.06	1

Table 5 – 26m B-double results

26m B-double	LSSP (m)	PBS Level	TS (m)	PBS Level
Scenario 1 (Width increase to 2.55m)				
2.5m wide	8.84	3	0.03	1
2.5m prime mover, 2.55m trailers	8.87	3	0.03	1
2.55m prime mover, 2.5m trailers	8.87	3	0.03	1
2.55m prime mover, 2.55m trailers	8.89	3	0.03	1
Scenario 2 (Width increase to 2.6m)				
2.5m prime mover, 2.6m trailers	8.89	3	0.03	1
2.6m prime mover, 2.5m trailers	8.89	3	0.03	1
2.6m prime mover, 2.6m trailers	8.94	3	0.03	1

Table 6 – 35.4m B-triple results

35.4m B-triple	LSSP (m)	PBS Level	TS (m)	PBS Level
Scenario 1 (Width increase to 2.55m)				
2.5m wide	10.56	3	0.06	1
2.5m prime mover, 2.55m trailers	10.59	3	0.06	1
2.55m prime mover, 2.5m trailers	10.59	3	0.06	1
2.55m prime mover, 2.55m trailers	10.61	4	0.06	1
Scenario 2 (Width increase to 2.6m)				
2.5m prime mover, 2.6m trailers	10.61	4	0.03	1
2.6m prime mover, 2.5m trailers	10.61	4	0.03	1
2.6m prime mover, 2.6m trailers	10.66	4	0.03	1

3.2.2 Findings summary

As a result of increased vehicle width, generally the design vehicles exceeded respective performance levels for LSSP when an increased width was applied to the prime mover and trailers. It was also observed that the 26m B-double did not meet LSSP for PBS Level 2 at 2.5m wide.

The findings for each vehicle are summarised in Table 7.

Table 7 – Findings summary

Vehicle	Findings	
19m semitrailer	LSSP	Remained within PBS Level 1 for all variants, except for the 2.55m wide prime mover and 2.55m wide trailer, and where a trailer was 2.6m wide
	TS	Nil effect.
26m B-double	LSSP	All variants fell within the PBS Level 3 limit, noting that a 26m variant commonly falls within PBS Level 2.
	TS	Nil effect.
35.4m B-triple	LSSP	Exceeded PBS Level 3 limit when 2.55m was applied to the prime mover and trailers, as well as all variants where either the prime mover or trailer was 2.6m wide.
	TS	Nil effect.

The findings indicate that any potential increase in width may result in the need for additional road space required on road networks. Prescriptive vehicles generally have higher levels of access via Gazette notices, and it is evident they may not satisfy the same LSSP requirements for PBS vehicles seeking access on equivalent networks.

Overall, the findings warrant a further investigation into the current LSSP limits and performance of both fleets.

4 Approach to review current standards

While the findings in Section 3 demonstrate that increased vehicle width has an effect on compliance with existing LSSP performance levels, it's important to acknowledge that the PBS standards also have an interrelationship with other guidelines and assessment procedures. These include the jurisdictional route assessment guidelines and the [PBS Network Classification Guidelines](#), as published on the NHVR website.

The jurisdictional route assessment guidelines are designed to help road managers make informed decisions about granting heavy vehicle access to their road network. These guidelines generally reference PBS vehicles as a 'class or combination' and can vary between state and territories.

The PBS Network Classification Guidelines are intended to provide a uniform national method to classify road networks to allow access for PBS vehicles, with respect to the four PBS levels.

NHVR has prepared three options that provide potential avenues for the review of LSSP and TS. The NHVR welcomes feedback on all options, as well as indication of stakeholders' preferred option. Feedback will be considered to support – and guide – the review of LSSP and TS.

4.1 Option 1 – Review of current performance levels

The current standards were developed in the early 2000s, based on the composition of the Australian heavy vehicle fleet at that time. While increases to vehicle widths in the ADRs are being proposed, a further review of increased width against the current performance levels may be warranted, as demonstrated by the findings summarised in Section 3.

The current LSSP and TS performance levels are summarised in Table 8 below, and brief descriptions of the standards can be found in Section 1.4 of this Options Paper.

Table 8 – LSSP and TS performance levels

LSSP		TS	
Road class	Performance level required	Road class	Performance level required
Level 1	No greater than 7.4m	Level 1	No greater than 0.30m
Level 2	No greater than 8.7m	Level 2	No greater than 0.35m
Level 3	No greater than 10.6m	Level 3	No greater than 0.35m
Level 4	No greater than 13.7m	Level 4	No greater than 0.50m

The NHVR is considering the review of the current performance levels for LSSP and TS in the context of the following:

- Impact assessment of increased width for the PBS fleet and PBS equivalent vehicles.
- A review of current performance levels due to findings of impact assessment, while considering interrelationship with route assessment and the PBS Network Classification Guidelines.
- If warranted, increasing allowable limits for LSSP and TS for PBS Level 1 to 4.

4.1.1 Questions

- Are the existing LSSP and TS performance levels appropriate for the types of vehicles seeking access to the road network at the individual PBS Levels?
- Would the review of existing performance levels for LSSP be an appropriate approach to allow for any potential increases in vehicle width?
- What would be the effects on the ability to innovate and harmonise standards with a change to these LSSP and TS standards, and what change in risk to safety and infrastructure would result?
- Should a limit be established for PBS rigid vehicles and buses? Is a new category required as an addition to the current standard?
- Is the review of the current performance levels your preferred approach?

4.2 Option 2 – PBS Network Classification Guidelines

The PBS Network Classification Guidelines provide a uniform national method to classify road networks for access by vehicles at four PBS levels. Road networks are required to be classified into these levels so that there is a match between the performance of PBS vehicles and roads on which they operate. The PBS Network Classification Guidelines also incorporate amenity and environmental considerations, as well as the turning templates that are based on the Austroads design vehicles. Figure 2 illustrates the turning templates for each of the PBS levels as published in the PBS Network Classification Guidelines.

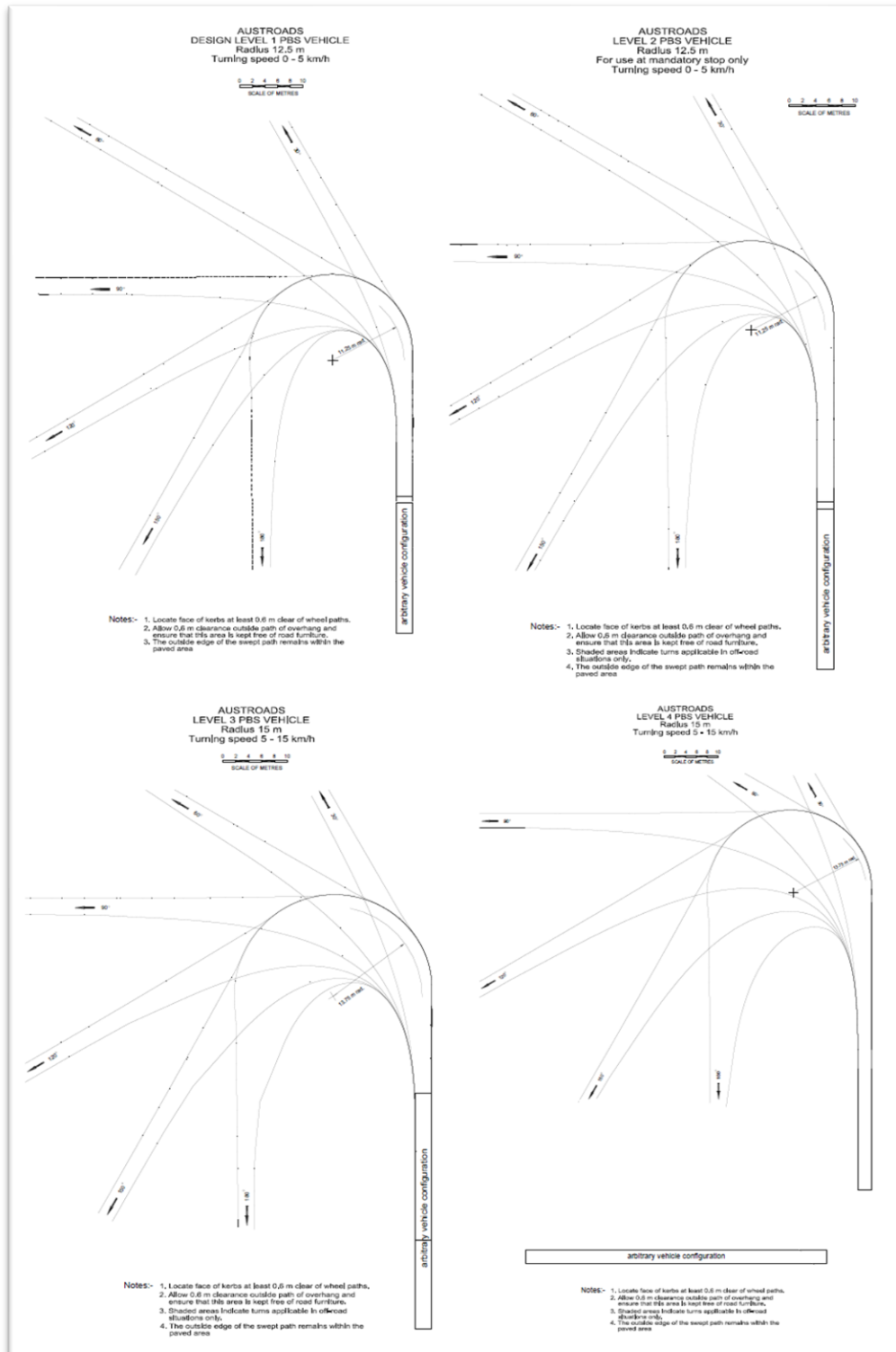


Figure 2 - PBS turning templates

The PBS Network Classification Guidelines were developed by the NTC in early 2007 and approved by the then Australian Transport Council later that year. Furthermore, the PBS Network Classification Guidelines are linked to several standards in the PBS Standards and Vehicle Assessment Rules.

4.2.1 Turning Templates to accommodate for an increased width limit

Due to the relationship with the PBS standards and impacts that will result from increased vehicle width, the NHVR is considering the review of the PBS Network Classification Guidelines in the context of the following:

- Update the PBS turning templates in the PBS Network Classification Guidelines to accommodate vehicles greater than 2.5m in width, with the aim of future-proofing the standards for any potential width increases.
Note: This is only for the PBS turning templates.
- Explore options for turning templates for PBS buses and rigid vehicles.
- The NHVR to provide advice to Austroads regarding potential findings arising from this option that may impact the *Austroads Design Vehicles and Turning Path Templates Guide (AP-G34-13)*.
- The NHVR to provide advice regarding any linkages to existing jurisdictional route assessment guidelines that may be impacted by findings of this option.

4.2.2 Questions

- Should these turning templates be reviewed in the context of width greater than 2.5m?
- Are there any other amendments that need to be made to the PBS turning templates in the PBS Network Classification Guidelines that the NHVR hasn't considered?
- Is the review of turning templates in the PBS Network Classification Guidelines your preferred approach?

4.3 Option 3 – Alternative standard

As stated earlier, the existing LSSP and TS standards were developed in the early 2000s, based on the composition of the Australian heavy vehicle fleet at that time. There are a number of measures that define aspects of the low-speed turn as prescribed in the *PBS Vehicle Standards and Assessment Rules*. These include:

- **Maxima of Difference (MoD)**

The maximum difference between the swing-out of adjacent vehicle units when performing a low-speed turn.

- **Difference of Maxima (DoM)**

The difference between the maximum front swing-out distances between adjacent vehicle units when performing a low-speed turn.

- **Frontal Swing (FS)**

The maximum projection of the front overhang of the hauling unit outside the path of the front steering wheel in a prescribed 90 degree low-speed turn.

MoD and DoM relate to the amount by which the front outside corner of a semitrailer swings out beyond that of the patch of the hauling unit or preceding trailer.

While there are proposed ADR changes to vehicle width, an alternative standard may be effective in replacing the existing LSSP and TS standards, and potentially address other aspects of the low-speed turn defined above.

An example includes the measurement of FS during a low-speed turn. Currently, the low-speed turn accounts for the measurement of FS by the innermost and outermost paths as shown in Figure 3. A review of the low-speed turn to remove the measurement of the innermost path could potentially eliminate the need for an FS standard, subject to investigation and further analysis considering the broad range of PBS vehicles.

It is important to note that for an alternative standard, significant vehicle modelling and validation would be required, inclusive of width changes.

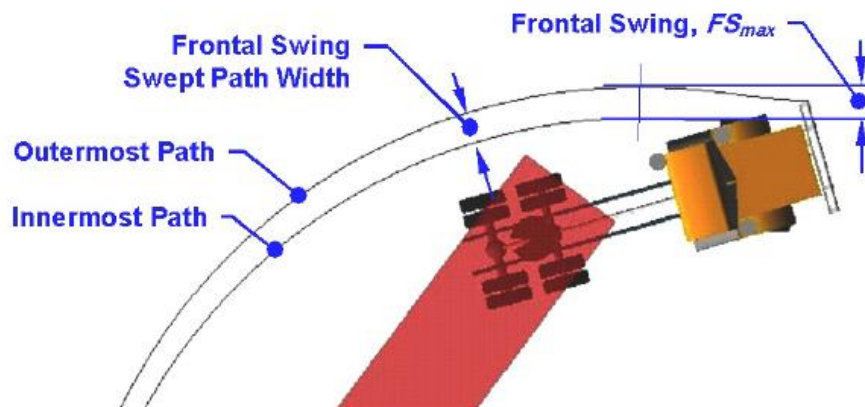


Figure 3 – FS measurement (PBS standards)

4.3.1 European standard

The Australian PBS standards for LSSP and TS currently require a 90 degree turn with a radius of 12.5m. In Europe (EU), heavy vehicle manoeuvrability is assessed using a 'roundabout' test, as outlined in *Commission Regulation (EU) No 1230/2012* and *Directive 97/27/EC (European Parliament and of the Council)*. The following is a brief summary of these requirements:

- Any motor vehicle and any semitrailer must be able to manoeuvre on either side for a complete circular trajectory of 360 degrees inside an area defined by two concentric circles, with:
 - the outer circle having a radius of 12.5m
 - the inner circle having a radius of radius 5.3m.

- The above must be completed without any of the vehicles' outermost points projecting outside the circumferences of the circles.
- In addition to the above, no part of a vehicle may move outside the vertical plane by more than 0.8m for rigids and 1.2m for articulated vehicles, as illustrated in Figure 4 below.

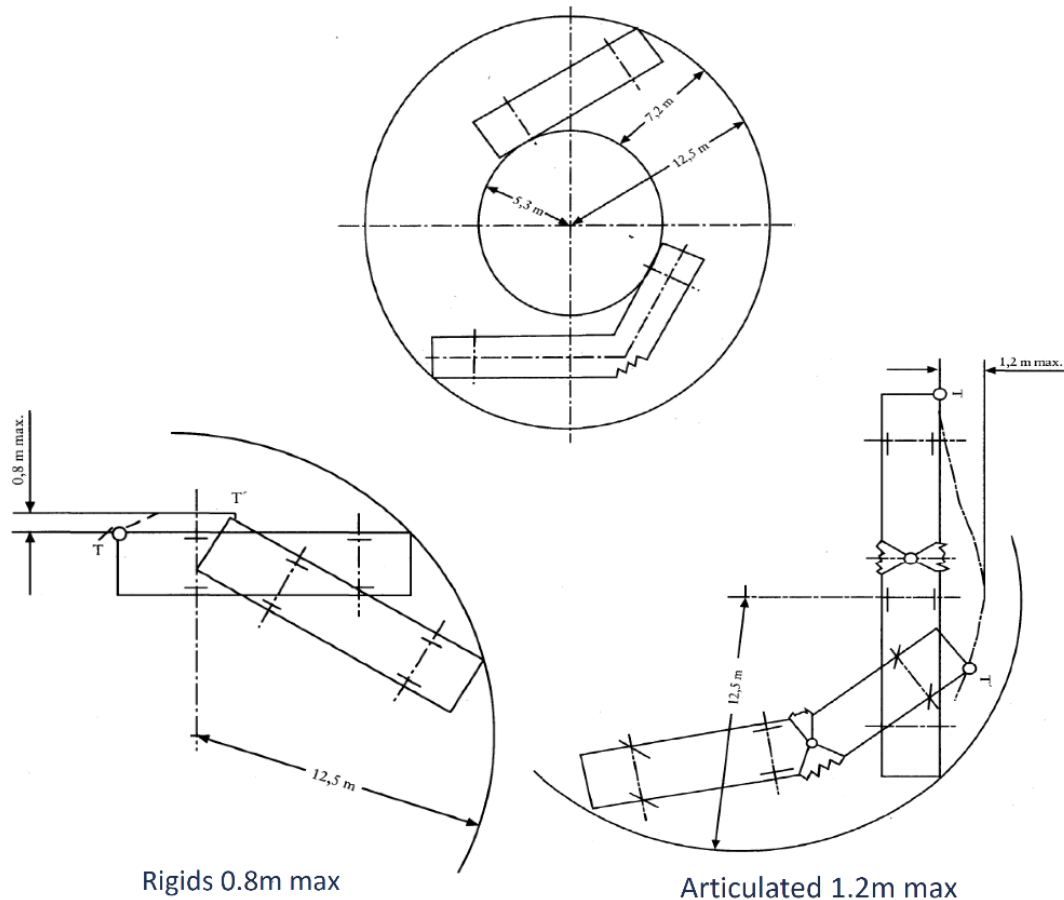


Figure 4 – EU roundabout test

An alternative standard based on the European method may:

- Be a better fit for shorter combinations found within the Australian PBS fleet, while being width agnostic, and potentially reduce the need for other standards, such as MoD, DoM and FS.
- Not be suitable for longer combinations found in the Australian heavy vehicle fleet.
- Future-proof the standards against any future dimension increases (long-term).

4.3.2 Questions

- Is the EU roundabout test an appropriate approach for the Australian PBS fleet?
- Would a roundabout test be required/be suitable for each of the PBS levels (i.e. different size roundabouts)?
- Would the preference be for the standards to be width agnostic? Or is width a key determining factor?
- Would a roundabout test sufficiently capture the considerations of the existing MoD, DoM and FS standards?
- Have you had any experience with the EU method that you could share with the NHVR?
- Is an alternative standard your preferred approach for the review of LSSP and TS?

4.4 Summary

While the options presented in this Options Paper all have advantages and disadvantages, the NHVR aims to ensure the review of these standards is future-proofed in the context of potential ADR and regulation amendments, as well as changes influenced by international markets.

Based on the options presented in this document, the NHVR also seeks feedback on the questions below:

- Is there a particular option the NHVR hasn't considered that relates to a review of LSSP and TS? If yes, please provide detail.
- Is there another approach related to the review of LSSP and TS that would lead to better safety and performance outcomes that maintain productivity levels?
- Are there other ways to design PBS vehicles within the current LSSP and TS standards without limiting innovation?
- What are the safety and infrastructure risks associated with revised LSSP and TS limits?

5 Progression of the preferred option

NHVR welcomes feedback on the options presented in this Options Paper.

Stakeholders may provide written submissions or, alternatively, complete the feedback form via <https://www.nhvr.gov.au/document/245/>. These should be emailed to PBSreview@nhvr.gov.au.

The NHVR will consider feedback received from stakeholders, as well as their preferred options. Once determined, further investigation into that approach will occur, as well as establishing potential links to other standards and guidelines as well as the level of vehicle modelling and validation to be undertaken.

Progress and updates related to the PBS Review Project and Phase 2 can be found via the PBS Review Project page <https://www.nhvr.gov.au/road-access/performance-based-standards/pbs-review-project>

For additional information on the PBS Review Project, please contact the PBS Review Project Team at PBSreview@nhvr.gov.au

Appendix A

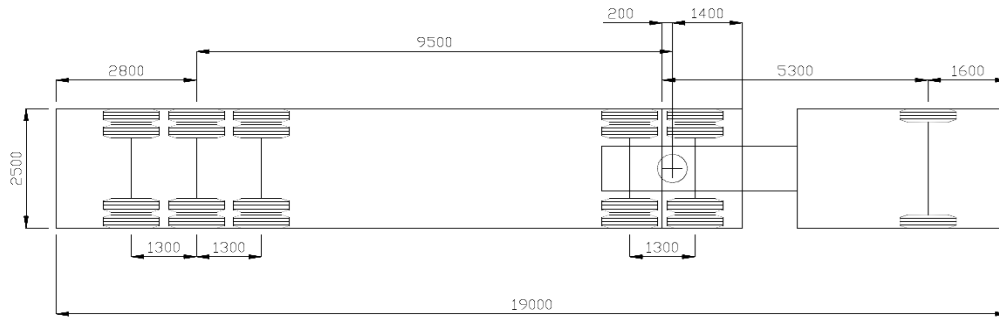


Figure 3.6: Prime mover and semi-trailer (19 m)

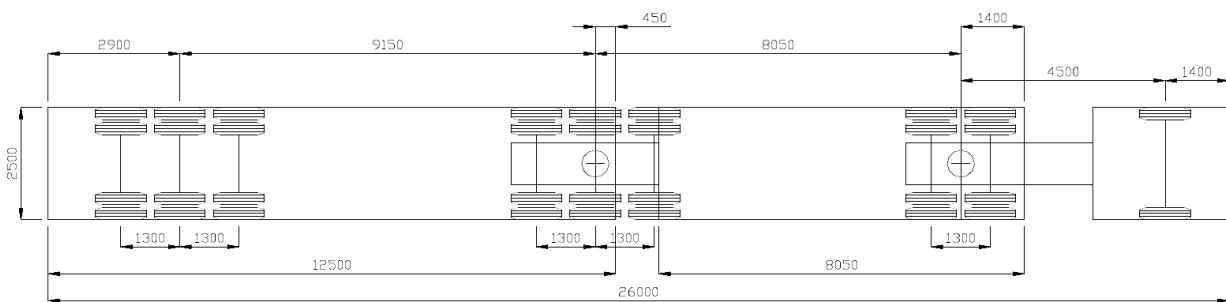


Figure 3.9: B-double (26 m)

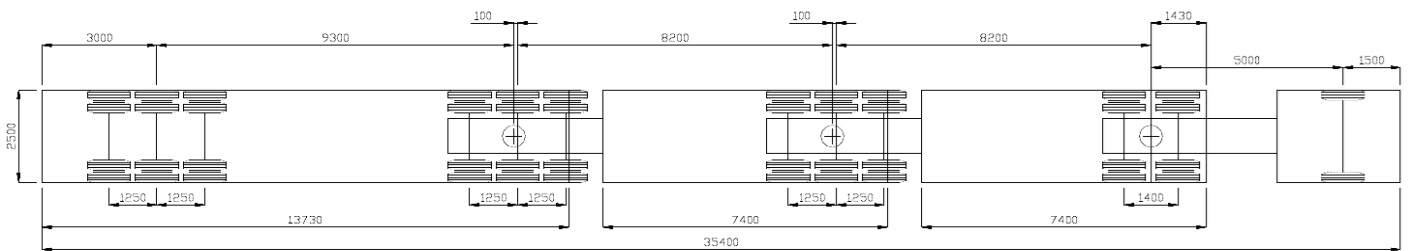


Figure 3.11: B-triple (35.4 m)