**LENGTH LIMITS FOR B-DOUBLES**

**REGULATORY IMPACT STATEMENT**

**April 2005**

**Prepared by**

**Pearsons Transport Resource Centre Pty Ltd**

*National Transport Commission*

**Length Limits for B-doubles – Regulatory Impact Statement**

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**Type of report:** Regulatory Impact Statement

**Objectives:** Increased road safety and transport efficiency

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**Abstract:** The Regulatory Impact Statement (RIS) compares a Regulatory

Proposal that the length limit for B-doubles should be either 25 metres or 26 metres (provided in the latter case additional safety features are fitted and the trailing length is constrained to 20.6m) against the Alternative Proposal that the length limit remain at 25 metres (without any trailing length constraint).

The Draft RIS compares the impacts of the two alternatives in the fields of safety, infrastructure and other (enforcement and the effect on existing equipment).

It is concluded that the Regulatory Proposal has advantages over the present regulation, particularly in relation to the safety issues of safety equipment and vehicle dynamic performance, and has advantage for infrastructure, primarily the potential for reduced road wear.

The constraint on trailing length ensures that the additional overall length would not be taken up by increased trailer length. As a result there is no productivity gain associated with the proposal.

**Purpose:** For voting by members of the Australian Transport Council on a

proposal to amend Australian Vehicle Standards Rules to allow B-double combinations to operate with an overall length up to

26 metres subject to provisions intended to improve safety outcomes for drivers and road users.

**Key words:** B-double, road safety, trailing length, swept path, length

regulation, performance based standards.

**FOREWORD**

The National Transport Commission (NTC) is an independent body established under an Inter-Governmental Agreement. It has an on-going responsibility to develop, monitor and maintain uniform or nationally consistent regulatory and operational reforms relating to road transport, rail transport and intermodal transport.

This Regulatory Impact Statement has been prepared to support a vote by members of the Australian Transport Council on a proposed policy to amend the Australian Vehicle Standards Rules 1999 to allow B-double combinations to operate with an overall length up to 26 metres subject to provisions intended to improve safety outcomes for B-double drivers and road users.

B-doubles were introduced into Australia in the 1980s and were widely accepted by 1990. Initially they were allowed to operate at up to 23m in length on approved routes. This length limit was increased to 25 metres after a trial in 1994 to enable the use of a triaxle group to increase mass limits. Trailers configured for 34 pallets, instead of 32 pallets, were then widely adopted. However, this resulted in a shortening of the space available for the prime mover within the 25 metre length limit which was considered by members of the transport industry to have adverse impacts in terms of handling, stability and driver comfort. A review was undertaken in 1999 but industry agreement on a proposed position was not obtained. Following extensive debate within their industry, the Chairman of the Truck Operators and Suppliers Alliance (TOSA) wrote in 2002 to the then National Road Transport Commission advising that a national industry position had been reached on B-double length, asking it to make a formal proposal to ministers to change the regulations. As a first step in reviewing the TOSA proposal a discussion paper was prepared for consideration by State and Territory jurisdictions in February 2003.

A Draft Regulatory Impact Statement (RIS) was issued for jurisdiction and public comment in January 2004 following the Discussion Paper circulated to State and Territory jurisdictions in February 2003. That Draft RIS modified the approach taken in the previous paper and addressed the concerns raised at that time by jurisdictions. The Regulatory Proposal outlined in the Draft RIS proposed a limit of 20.6m on the distance between the kingpin on the lead trailer and the rear of the B-double (i.e. the trailing length) accompanied by an increase in the overall length of the B-double from 25 metres to 26 metres.

Comments on the Draft RIS were invited prior to the preparation of this final RIS for consideration by Ministers. Responses from transport industry operators and vehicle manufacturers strongly supported the proposal as improving safety and the working environment for drivers through superior vehicles, and benefiting the supply and utilisation of prime movers. However, jurisdiction responses were strongly qualified. Some jurisdictions considered that the claimed vehicle performance and safety benefits were not clearly established, and that the benefits for drivers and operators were not sufficiently quantified to justify the additional metre of prime mover length that the proposal would make available. Jurisdictions responded to the Draft RIS by seeking variations to the proposal that would include more direct and obvious safety outcomes.

Subsequent discussions between the NTC and jurisdictions, and the NTC and transport industry supplier and operator peak bodies, achieved agreement on the regulatory proposal contained in this RIS.

The Commission would like to sincerely thank all those parties who have contributed to the many phases in developing this proposal through participation in seminars, researching and developing proposals and responding to discussion papers.

In particular I wish to acknowledge the significant contributions made by Mr Mark Johnston (Chairman, TOSA), Mr Bob Pearson (Pearsons Transport Research Centre Pty Ltd), Mr Peter Rufford (Avalon Enterprises (ACT) Pty Ltd), Dr Hans Prem (Mechanical System Dynamics) and Mr Les Bruzsa (Queensland Transport) for their work in the preparation of the succession of discussion papers and this RIS; and the following NTC officers: John Edgar and Barry Hendry for their enthusiasm and commitment to this project.

Stuart Hicks Chairman

**SUMMARY**

The Chairman of the Truck Operator and Suppliers Alliance (TOSA) wrote in 2002 to the then National Road Transport Commission advising that a national industry position had been reached on increasing the length of B-double combinations to 26 metres, asking the NRTC to make a formal proposal to ministers to change the regulations. A Draft Regulatory Impact Statement (RIS) was issued for jurisdiction and public comment in January 2004 following a Discussion Paper circulated to State and Territory jurisdictions in February 2003. That Draft RIS modified the approach taken in the previous paper and addressed the concerns raised at that time by jurisdictions.

A B-double consists of a prime mover hauling two semi-trailers. B-doubles were first introduced into Australia in the early 1980s but did not become widely accepted until the early 1990s. B-doubles were originally allowed to operate at up to 23 metres in length on approved routes. These B-doubles were capable of carrying up to 30 pallets (or 60 pallets if double stacked). No internal dimension limits were specified apart from the requirements of the axle spacing mass schedule for mass limitations.

Moves to improve the productivity of B-doubles let to an increase in the overall length to 25 metres to allow a triaxle to replace the tandem axle at the rear of the first trailer. Again, no specific restrictions on trailer length were adopted although some deck length limitations on B-doubles carrying livestock were adopted shortly thereafter.

The pressure for greater productivity led to the widespread adoption of trailer configurations that catered for 34 and in some cases 36 pallets. However, this resulted in a shortening of the space available for the prime mover within the overall 25 metre length limit. This has resulted in concern from truck manufacturers and operators that the lack of internal dimensions did not provide the best outcomes in terms of handling and stability.

The Regulatory Proposal outlined in this Regulatory Impact Statement (RIS) proposes an additional optional regime whereby the maximum overall length of a B-double would be raised from 25 metres to 26 metres provided the distance between the kingpin on the lead trailer and the rear of the B-double (i.e. the trailing length) is limited to 20.6 metres and the increased length is accompanied by additional safety features on the prime mover. These safety features are front underrun protective devices and stronger cabs. Operators would have the choice of remaining with the existing 25 metre regime or moving to the 26 metre regime.

The RIS compares the Regulatory Proposal with the existing regulation and concludes that it will improve road safety, bring cost savings and flexibility to industry and has the potential to reduce infrastructure damage.

B-doubles that comply with the existing regulations have a range in swept path width. By constraining the trailing length, 26 metre B-doubles will have swept paths that are similar to the common B-double under present 25 metre constraints but eliminates the worst swept path outcomes. The Regulatory Proposal will therefore have no effect on access for B- doubles.

As the 26 metre regime under the Regulatory Proposal is optional and the existing 25 metre regulations will remain, B-doubles that currently exceed the 20.6 metre trailing length and/or do not have the additional safety features would be permitted to operate without change.

Net benefits of the Regulatory Proposal are likely to exceed $50 million over a 10 year period.

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# INTRODUCTION

A B-double consists of a prime mover hauling two semi-trailers. B-doubles were first introduced into Australia in the early 1980s but did not become widely accepted until the early 1990s.

B-doubles were originally allowed to operate at up to 23m in length on approved routes. These B-doubles were capable of carrying up to 30 pallets (or 60 pallets if double stacked). No internal dimension limits were specified apart from the requirements of the axle spacing mass schedule for mass limitations.

Moves to improve the productivity of B-doubles led to an investigation of the possibility of increasing the overall length to 25 metres to allow a triaxle to replace the tandem axle at the rear of the first trailer. This would increase the Gross Combination Mass (GCM) from 59.0t to 62.5t.

An extensive 12-month trial involving 165 B-doubles across four States was undertaken in 1994. The trial concluded that no evidence emerged which would preclude the continued use of the 25 metre B-double on approved routes and no significant disbenefits were identified. As a result, the Australian Vehicle Standards Rules were altered to allow an increase in the length of B-doubles to 25 metres. Again, no specific restrictions on trailer length were adopted although some deck length limitations on B-doubles carrying livestock were adopted shortly thereafter.

The pressure for greater productivity led to the widespread adoption of trailer configurations that catered for 34 pallets. However, this resulted in a shortening of the space available for the prime mover within the overall 25 metre length limit. More recently, 36 pallet B-doubles have been introduced which shorten even further the space for the prime mover, although these have generally been dedicated high cube combinations specifically designed for special applications where maximum mass is not achieved, and adverse safety impacts are thus partially mitigated.

Concern was then expressed from truck manufacturers and operators that the lack of internal dimensions did not provide the best outcomes in terms of handling and stability. As a result, Pearsons Transport Resource Centre (PTRC) was engaged to undertake a further review of B-double length in 1999. That report (Pearson 1999) identified the problems that emerged from regulating the operation of B-doubles merely in terms of overall length. It canvassed two other alternatives to the current regulations for the regulation of B-double dimensions to address what was perceived as an emerging safety issue.

The first alternative involved controlling the trailing length dimension (the distance between the front trailer king pin and the rear of the combination) as well as the overall length of the B-double. The second alternative involved abolishing the overall length limit and replacing it with controls on trailer wheelbase and prime mover dimensions.

PTRC concluded that a control on the trailing length and an increase in overall length was preferred over the current regulations as it allowed improvements in ride and handling performance and more directly controlled low speed swept path.

The PTRC assessment brought a varied response from stakeholders. In particular, State and Territory jurisdictions were concerned with any potential increase in low speed swept path. Whilst individual companies responded, there were no responses from representative industry organisations. Clearly, they were not able to formulate a view that had wide support across their industry. As a result, the final report (PTRC 2000) concluded that there was insufficient support for changing the existing regulation at that time and the proposal was put on hold.

However, the issue has not gone away and there is significant concern within industry that the 25 metre overall length constraint does not allow optimal turntable position and adequate trailer clearances when coupled with 34 pallet trailers. Together with short wheelbase prime movers, dynamic performance of the B-double fleet may be compromised. The introduction of future safety standards such as front under-run protection systems (FUPS) may also be compromised.

Following 12 months of debate within their industry, the Chairman of the Truck Operators and Suppliers Alliance (TOSA) wrote to the NRTC1 advising that a national industry position had been reached on proposals to regulate B-double length. The TOSA proposal essentially reflected the alternative preferred by PTRC with a trailing length of 20.6m.

A Discussion Paper (Avalon Enterprises 2003) was the first step in the process of reviewing the industry proposal in conjunction with State/Territory jurisdictions for a possible regulatory change. Following meetings with stakeholders and receipt of comments on the Discussion Paper, a draft Regulatory Impact Statement was prepared that proposed a regime for 26 metre B-doubles to be permitted provided there was a limit on trailing length to allow the additional metre to be used to increase the length of the prime mover.

After consideration of responses to the draft Regulatory Impact Statement, the proposal has been modified to provide for more direct safety benefits to be obtained if 26 metre B-doubles are to be permitted, in particular the provision of front underrun protection systems (FUPS) and stronger cabs. Because the proposals require FUPS to be fitted to all prime movers of 26 metre B-doubles combinations, the proposal has also been amended to permit existing regulations relating to 25 metre combinations to remain. This includes the retention of the deck length limits of B-doubles for the carriage of livestock. In other words, owners of B- doubles will have a choice in which length regime they operate.

The proposed changes now involve additions to Australian Vehicle Standards Rule 69 (1999), which controls the length of combination vehicles.

1 The National Road Transport Commission (NRTC) was replaced by the National Transport Commission (NTC) on 14 January 2004.

# STATEMENT OF THE PROBLEM AND OBJECTIVES OF THE PROPOSAL

## Statement of the Problem

Present length limits for B-doubles place a limit only on the overall length of the combination. Due to external commercial pressure, payload space has increased and the length of prime movers has reduced. The result is a sub-optimal outcome for the community and road agencies. This sub-optimal outcome manifests itself in terms of:

* higher pavement wear due to an elevated steer axle mass;
* imperfect safety returns from shorter wheel base prime movers; and
* lower productivity due to less inter-changeability of prime movers.

In other words, the market has failed to adequately provide for interests other than the main market force of commercial gain for clients of road transport. This market failure is not evident in the other major freight carrying articulated combinations (single articulated vehicles and road trains). In both configurations, all trailer dimensions are restricted as well as the overall length.

To gain maximum productivity in this commercial environment, trailers capable of carrying 34 pallets are common and some trailers have been built that can carry the equivalent of 36 pallets. To remain within the overall length limit, B-double prime movers are shorter than prime movers in other operations. Steer axle loads are a problem and no reserves of steer axle load are available for present and emerging safety requirements and innovations.

Table 1 lists statistics of steer axle loads derived from weigh-in-motion surveys of the Australian fleet as published in NRTC (2001a).

**Table 1 – Distribution of steer axle mass** (tonnes)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Configuration** | **Mean** | **Standard Dev** | **5% ile** | **Median** | **95%ile** |
| single artic (A123) | 5.27 | 0.83 | 4.00 | 5.30 | 6.50 |
| B-double (B1233) | 5.62 | 0.69 | 4.50 | 5.60 | 6.70 |
| double road train (A123T23) | 5.21 | 0.93 | 3.80 | 5.20 | 6.70 |
| triple road train (A123T23T23) | 5.32 | 1.07 | 3.70 | 5.30 | 7.00 |
| Source: NRTC (2001a) |  |  |  |  |  |

In addition, of the remaining load that can be carried by the prime mover, the proportions that can be carried on the steer axles are:

single artic: 16.2% B-double: 10.0% double road train: 21.6%

It can be seen that the steer axle loads of B-doubles are significantly higher than for the other three categories. A significant proportion of B-doubles have greater steer axle loads than road trains, a class of vehicles that requires more powerful and therefore heavier engines. It must also be remembered that some road trains are allowed greater steer axle loads than B- doubles.

Table 2 is also drawn from the Australian fleet report (NRTC 2001a), and shows statistics for the wheelbase of prime movers of various configurations. It can be seen that the wheelbase of B-doubles is the shortest of the four main articulated combinations, with the mean being about 500 mm shorter than for the single articulated vehicle.

**Table 2 – Wheelbase statistics of prime movers of various configurations (**mm)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Configuration** | **Min** | **Max** | **Mean** | **Stand Dev** | **5% ile** | **Median** | **95%ile** |
| single artic (A123) | 2,860 | 6,700 | 4,725 | 579 | 3,820 | 4,815 | 5,585 |
| B-double (B1233) | 3,005 | 6,555 | 4,232 | 490 | 3,680 | 4,100 | 5,365 |
| double road train (A123T23) | 3,235 | 7,455 | 5,029 | 627 | 3,860 | 5,180 | 5,930 |
| triple road train (123T23T23) | 3,630 | 7,325 | 5,424 | 473 | 4,525 | 5,425 | 6,160 |
| Source: NRTC (2001a) |  |  |  |  |  |  |  |

The transport industry has argued that the only way to reduce steer axle loads and to provide safety features on B-double prime movers is to allow greater length of prime movers. Reducing steer axle loads would be achieved by moving (where possible) the king pin rearwards, leading to proportionally more imposed load being carried by the driving axles, which translates to increased overall length. To avoid that additional length being used to increase productivity, a limit needs to be placed on the trailing length in a manner similar to that on other articulated combinations.

On the other hand, increased length would normally be associated with an increase in swept path and the need for greater road space at intersections. Therefore, concerns with the possibility of increased length of B-doubles come also with concerns that the increased length will reduce the number of roads that would be available for B-doubles – i.e. reduce access to critical loading and unloading points such as manufacturing plants and warehouses.

It should be noted that the term *wheelbase* in this Regulatory Impact Statement refers to the distance between the centre of the steer axle and the midpoint between the centres of the tandem drive axles as illustrated below. Of course, when there is only one axle in the driving group, the wheelbase is the distance between that one axle and the centreline of the steer axle.

wheelbase

steer axle drive axles

## Objectives of the Regulatory Proposal

The objectives of the Regulatory Proposal are:

* to improve road safety by giving truck operators access to better performing prime movers and by providing for safety features on B-double prime movers;
* to provide for reductions in road wear; and
	+ to provide dimension controls that do not jeopardise road access for B-doubles.

# THE REGULATORY PROPOSAL AND ALTERNATIVES

## The Regulatory Proposal

The Regulatory Proposal is to allow the option for B-doubles to exceed the present overall length of 25 metres provided:

* + 1. the distance between the point of articulation at the front of the leading semi trailer and the rear of the combination is not over 20.6 metres; and
		2. the prime mover of the combination is fitted with a front underrun protective device that complies with Regulation No. 93 of the United Nations Economic Commission for Europe (UN ECE); and
		3. if the prime mover has a date of manufacture after 2005, it is fitted with a cab that complies with Regulation No. 29 of the United Nations Economic Commission for Europe (UN ECE); and
		4. the prime mover does not have a load carrying area; and
		5. the combination is not over 26 metres long.

Limiting the trailing length (the distance between the point of articulation [kingpin] on the lead trailer and the rear of the vehicle) will ensure that the additional length is not be taken up by increased trailer length, thereby limiting low speed swept path and limiting the impacts on access. The prohibition on the prime mover carrying a load will ensure that all additional length is available for the prime mover and the frontal underrun protection device.

The requirements for the fitting of the additional safety features of front underrun protection and stronger cabs will provide direct safety benefits to supplement the improved handling and comfort that is possible with longer wheelbase prime movers.

UN ECE Regulation No. 93 – Front underrun protective devices – is designed to ensure that the safety features of passenger cars (e.g. air bags and crumple zones) are deployed during a front-on collision and that the vehicle does not underrun the truck. The regulation requires a device at the front of the vehicle that can resist 80 kN and 160 kN test forces without deflecting more than 400mm. The maximum height of the lower part of the device is 400mm above ground level.

UN ECE Regulation No. 29 relates to protection of the occupants of the cab of a commercial vehicle. It requires three tests to be carried out on the cab:

* a front impact test to resist a force of a swinging 1.5 tonne test swing-bob;
* a roof strength test to withstand a static load corresponding to the maximum allowed steer axle mass, up to a maximum of 10 tonnes; and
* a rear wall strength test to withstand a static load of 20% of the permissible useful load on the vehicle.

B-doubles whose owners do not wish to comply with the additional safety requirements or that presently do not meet the 20.6 metre trailing length can continue to operate under the present regulations permitting 25 metre overall length.

Apart from the requirement for the additional safety features, the Regulatory Proposal is similar to the preferred option presented in the 2003 Discussion Paper (Avalon Enterprises 2003). The draft Regulatory Impact Statement (NTC 2004) commented that:

….consultation revealed deficiencies in this approach and it is now not the preferred. These deficiencies relate specifically to the need to address the concerns arising from the market failure of the present regulations and the failure to address the greatest levels of swept width.

Further consultations since the release of the draft Regulatory Impact Statement have suggested that this level of concern no longer exists. States and Territories are managing the greatest levels of swept width permitted by the present 25 metre regulations and the Regulatory Proposal will provide an alternative regulatory environment whereby the market forces should result in a reduction of the overall number of vehicles with high levels of swept width.

## Alternatives to the Regulatory Proposal

### Alternatives under Prescriptive Limits

One possible alternative is to leave the present regulations in place – the do nothing alternative. In effect, this alternative would mean that any operator with major concerns would be required to address the present difficulties under the Performance Based Standards (PBS) regime, which is discussed in Section 3.2.2 below.

Another possible alternative is to retrospectively impose a trailer length constraint to the existing 25 metre length and force operators to reduce their payload to 32 pallets. Whilst this may improve the dynamic performance of a vehicle, it would significantly reduce productivity and cause a major disruption to the industry by making existing trailers obsolete, and would increase the number of B-doubles required to undertake the transport task which would be a negative safety outcome. In reality the bulk of the B-double fleet would be rendered illegal with little prospect of reasonable compliance and enforcement measures being effective. It is not possible that this alternative would deliver net benefits, rather there would be significant net costs.

Another possible alternative is to vary the proposed dimensional controls, such as a 25.5m overall length and a shorter trailing length dimension but analysis has shown that this proposal may not be sufficient to achieve the objectives of the Regulatory Proposal.

A trailing length value less than 20.6m would reduce existing payload space to less than that needed for the current standard of 34 pallets and does not facilitate proper axle mass distribution or provide adequate operational clearances between truck/trailer and trailer/trailer combinations particularly with refrigerated motors.

Another possible alternative is to replace the existing 25 metre overall length limit with a limit of 26 metres but with only the limit on trailing length. This was the proposal put forward in the draft Regulatory Impact Statement (NTC 2004). Consultations on this proposal revealed that many jurisdictions did not view the safety benefits from the proposal as sufficient in themselves to warrant the change and suggested that additional benefits would flow from directly requiring specific safety items. Therefore, this alternative is not considered to be implementable but a summary of the impacts of this proposal is given in Section 4.

The final possible alternative is to *require* all new B-double prime movers to be fitted with the safety features (while allowing the 26 metre overall length) and grandfather all existing non-compliant prime movers and trailers. However, this approach would disadvantage individuals and groups (for example livestock carriers) that do not need the additional length.

It was also considered whether the regulatory proposal would require 26 metre B-doubles to demonstrate compliance with a proposed new in-service standard for heavy vehicle engine brake noise aimed at reducing the noise levels of defective or modified vehicles. As any vehicle that is not defective or modified is likely to meet the proposed in-service standard it was considered that awaiting implementation of the standard would delay the safety outcomes for very small immediate noise reduction benefits.

### The alternative of awaiting PBS

A do nothing alternative would mean that operators seeking relief from the present problems would be forced into PBS at some time in the future. The PBS regime has developed significantly in recent years but full implementation is still some time off. Therefore, while theoretically PBS is an alternative, there are three issues that mitigate considering PBS as a viable alternative:

* the road safety improvements (as explained in Section 4) will be delayed;
* any delay in the full implementation of PBS would delay this important issue of B- double length being addressed and result in the boundaries of road safety being tested; and
* if a large number of B-doubles tried to enter PBS early in its implementation, it would increase the difficulty of obtaining an outcome for other PBS vehicles.

Therefore, forcing operators into a PBS regime that is not guaranteed to be fully operational until some time in the future will not be considered as a viable alternative at this time.

### Conclusions on viable alternatives

For the reasons outlined above, the only formal alternative to be evaluated will be the do nothing alternative – i.e. the existing regulation of 25 metres would remain without access to an overall length of 26 metres.

# IMPACT ANALYSIS

In this Section, the impacts of the Regulatory Proposal will be evaluated against the Alternative of not permitting an increase in length. These impacts are separated into:

* + safety impacts (Section 4.1);
	+ infrastructure impacts (Section 4.2);
	+ industry impacts (Section 4.3); and
	+ other impacts (Section 4.4).

In these sections, the impacts are identified and Section 4.5 deals with quantification of the impacts.

Significant progress has been made in the last three years on the PBS approach to vehicle regulation. This progress has enabled a better appreciation of the role of dynamic performance in vehicle safety and also provides a better benchmark on which to examine the impacts of proposals for change.

## Safety Impacts

### Provision for vehicle safety features

The 25 metre overall length limit causes one of two undesirable design features of present B- doubles:

* + the fifth wheel is positioned further ahead of the drive axles than is optimal, leading to heavier front axle loads than is used on other articulated combinations; and/or
	+ a short wheelbase prime mover is used and the impact on steer axle loads of driver, fuel and imposed load are exacerbated.

These sub-optimal outcomes mean that less mass is available for safety features. These safety features include stronger cabs and front under-run protection (FUP) devices. The Regulatory Proposal will permit the fitting of these safety features.

Neither Australia nor the United States have a cab strength requirement, whereas a European requirement exists with the mandating of the ECE test. Most prime movers sourced from Europe already meet the ECE regulations and advice from other truck manufacturers is that many present B-double cabs would meet the standard. However, unless it is mandated, front axle load difficulties would most likely see lesser strength cabs introduced at a mass saving in the region of 200 kg to 300 kg.

FUP devices were mandated in Europe in August 2003 under ECE R93 by means of Directive 2000/40/EC of the European Parliament. Advice from truck manufacturers with experience in developing FUP devices, has indicated that there is a mass penalty of at least 100 kg. Vehicles are being imported into Australia and indications are that, similar to requests made in other countries, operators are seeking to remove the FUP devices to reduce front axle mass.

A FUP device weighing 100 kg but fitted ahead of the steering axle adds more than 100 kg to that axle because of the cantilever effect. To allow for the additional mass of a FUP device would require the king pin lead of a typical B-double prime mover to be reduced by about 100 mm and increasing length by the same amount. Reducing the steer axle mass by a further 300 kg to permit legal loading would mean a further reduction in king pin lead of between 150 mm and 200 mm, depending on the wheelbase. Alternatively, a longer prime mover wheelbase is necessary to alleviate steer axle loads. Fitting a FUP device can add between 250 mm and 400 mm to the overall length, depending on the design and whether the device is retrofitted. Therefore, overall length must increase, by up to 700 mm but more realistically about 500 mm, simply to correct the already heavy steer axle loads and provide for the fitment of a FUP device, a length increase which is provided for in the Regulatory Proposal.

### Impacts of vehicle safety features

Provision of additional cab strength via ECE R29 is designed to provide a safer environment for occupants of B-doubles, albeit usually the driver only. However, it proved difficult to identify what the safety impact would be, as details of fatalities and injuries for drivers of B- doubles are generally not separately identified from drivers of other types of articulated vehicles in the crash data. However, it would be expected that the numbers of fatalities would be low.

As noted in Section 4.1.1, most prime movers of European origin already meet the cab strength requirement and many non-European prime movers would similarly meet the requirement if tested. For example, the largest supplier of B-double prime movers recently announced that their cabs met the standard without modification. It is likely therefore that the safety impact would be limited to ensuring that the benefits of stronger cabs are retained for already complying vehicles and extended to the B-double prime movers that do not meet the standard at present.

The provision of FUP devices is aimed at reducing the severity of injuries resulting from passenger cars impacting the front of trucks. Detailed research reported in Rechnitzer (1993) based on 25 fatal crashes involving 37 fatalities resulted in the view that reduction in injury severity could be expected with properly designed front protection. Rechnitzer found that 35% of the fatalities would be reduced to serious injury and 30 – 40% of serious injury cases would result in reduced injury severity. He concluded that conservative estimates of savings would be that 15% of crashes would be reduced from fatal to serious injury and 30% of serious injury crashes would be reduced in severity. European researchers reported by Rechnitzer concluded that benefits for car occupants would range from 10% to 30%.

Data from the ATSB Fatal Crash Database indicates there are in the order of 20 to 25 fatal crashes and around 250 to 300 injury crashes involving underrun with articulated vehicles each year. The proportion of these crashes that involve B-doubles is not known. However, based on estimated vehicle numbers and travel distances, it is likely that about 20% of these crashes would involve a B-double. Using the Rechnitzer estimates, fitting FUP devices to *all* B-doubles would result in a reduction of one fatality to a serious injury and 20 serious injury crashes being reduced to minor injury.

These results are probably at the high end, however, considering that:

* + some B-double prime movers are already fitted with FUP devices; and
	+ B-double travel on 100 km/h roads and divided roads is a much higher proportion than for single articulated vehicles; crashes on 100 km/h roads are much less survivable than crashes in lower speed zones while head on crashes on divided roads are rare.

As the Regulatory Proposal provides for an option that fitment of FUP devices is necessary for access to an overall length of 26 metres, the number of operators taking up the option will influence the safety benefits.

### Vehicle dynamic performance

As noted earlier, developments in the PBS project enable comparisons of the dynamic performance of vehicles that would be built to the allowable 26 metre overall length in the Regulatory Proposal compared to the 25 metre overall length mandated by the do nothing alternative. Results of the comparison are given below.

The safety performance of representative 25 metre and 26 metre overall length B-doubles were evaluated for a selection of PBS Safety Standards (NRTC 2002b). Standards were chosen that would be most influenced by prime-mover wheelbase. Key dimensions of the two B-doubles are shown as Figures D1 and D2 in Attachment D.

* + - 1. *Quantified PBS Performance Standards*

Table 3 compares the performance of the two vehicles in Attachment D with the PBS safety measures that have been quantified being:

* + tracking ability;
	+ steer tyre friction demand;
	+ rearward amplification;
	+ high speed transient off-tracking; and
	+ yaw damping co-efficient.

Each vehicle meets the required performance level. However, the 26 metre B-double performs better for steer tyre friction demand, rearward amplification and yaw damping and the performance in the other two measures are almost the same.

**Table 3 – Dynamic performance of 25 m and 26 m B-doubles**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Performance Measure** | **Recommended Performance** | **25m****B-double** | **26m****B-double** | **Improvement for the 26 m** |
|  | **Level** | **(Fig. D1)** | **(Fig. D2)** | **vehicle** |
| Tracking Ability (m) | no more than 3.0 | 2.634 | 2.638 | -0.1% |
| Steer Tyre Friction Demand (%) | no more than 80% | 39% | 36% | +8.6% |
| Rearward Amplification (-) | various | 1.319 | 1.298 | +1.6% |
| High-Speed Transient Off-tracking (m) | no more than 0.8 | 0.291 | 0.293 | -0.7% |
| Yaw Damping Coefficient (-) | no less than 0.15 | 0.430 | 0.439 | +2.1% |

Note: the recommended performance level is for PBS Level 2 routes.

Table 4 shows results from the fleet analysis comparing worst case performances in each of the measures of 25 metre fleet B-doubles. The Table shows that both the 25 metre and 26 metre B-doubles perform better than the worst-case fleet 25 metre B-doubles for all the measures shown.

The Regulatory Proposal therefore has the potential to improve the dynamic handling of B- doubles in most safety standards by permitting the overall length to increase to 26 metres.

**Table 4 – Safety Summary – worst case 25 m versus 26 m B-double**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Performance Measure** | **Recommended Performance Level** | **Worse-Case Fleet 25m B-doubles** | **26m****B-double (Fig. D2)** | **Effect of Regulatory Proposal** |
| Tracking Ability (m) | no more than 3.0 | 2.648 | 2.638 | Better |
| Steer Tyre Friction Demand (%) | no more than 80% | 46% | 36% | 28% improvement |
| Rearward Amplification (-) | various | 1.451 | 1.298 | 12% improvement |
| High-Speed Transient Off-tracking | no more than 0.8 | 0.369 | 0.293 | 26% improvement |
| Yaw Damping Coefficient (-) | no less than 0.15 | 0.410 | 0.439 | 7% improvement |

Notes:

1. The test conditions presented in NRTC (2002) are slightly different from those specified in the fleet report for some of the standards. Lower speeds are used for the pulse steer test for yaw damping (90km/h instead of 100km/h). Slower speeds will lead to an increase in yaw damping in the pulse steer manoeuvre. For consistency the same method of calculating rearward amplification that was used in the fleet report was used in this study.
2. the recommended performance level is for PBS Level 2 routes.
	* + 1. *Driver fatigue (ride quality)*

No agreement has yet been reached on a quantifiable performance standard for ride quality, but the importance of this safety measure for driver fatigue indicated that it should be investigated, particularly as ride quality is influenced by prime mover wheelbase.

For the ride analysis, a simplified seat and biodynamic model of the driver based on those presented in Austroads was developed and included in the models. Both vertical and horizontal accelerations were considered. Two test speeds (60 and 100km/h) and two payload conditions (laden and unladen) were simulated, in accordance with the specifications presented in NRTC (2002b).

The vibration standard BS 6841 provides the following very approximate indications of the likely driver reactions to various magnitudes of frequency-weighted *rms* acceleration:

< 315 mm/s2 Not uncomfortable

315 – 630 mm/s2 A little uncomfortable

500 – 1000 mm/s2 Fairly uncomfortable

800 – 1600 mm/s2 Uncomfortable

1250 – 2500 mm/s2 Very uncomfortable

>2000 mm/s2 Extremely uncomfortable

The above rating scale is only applicable to the frequency weighted vertical vibrations, and it is important to recognise that acceptable conditions in one environment may be unacceptable in others.

The ride quality results are presented in Table 5. These results show there is a significant difference in ride vibration between the unladen and laden vehicles in both the vertical and fore-aft directions, with ride being significantly worse for the unladen vehicles. This result is generally consistent with experience in the field. The results show also that the Regulatory Proposal has the potential to improve ride quality and therefore assist in increasing driver comfort and reducing driver fatigue, even if there is only a marginal improvement in vertical vibrations.

**Table 5 – Ride quality performance summary**

**Ride Quality (Driver Comfort)**

**25m**

**B-double (Fig. D1)**

**26m**

**B-double (Fig. D2)**

**% Change (26m/25m)**

**Effect of Regulatory Proposal**

***Unladen***

***Vertical Vibrations (measured on seat, weighted rms acceleration, mm/s2)***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 60 km/h | 1906 | 1871 | -1.9% | Better |
| 100 km/h***Laden***60 km/h | 1898263 | 1866261 | -1.7%-0.8% | BetterNo change |
| 100 km/h | 695 | 698 | 0.4% | No change |
| ***Fore-Aft Vibrations (measured on floor, unweighted rms acceleration, mm/s2)******Unladen*** |
| 60 km/h | 347 | 322 | -7.8% | Better |
| 100 km/h | 420 | 397 | -5.8% | Better |
| ***Laden***60 km/h | 81 | 67 | -20.9% | Much better |
| 100 km/h | 120 | 102 | -17.6% | Much better |

* + - 1. *Handling quality*

The handling analysis presented here is based on the 3-point measure developed in Canada by El-Gindy and Woodrooffe. This measure is described in the PBS definitions report (NRTC 2001b). Again, whilst handling quality is a performance standard under PBS, further research is needed to come to an acceptable performance level. An explanation of the three points is given in Table 6.

**Table 6 – Explanation of the 3 point handling quality measure**

|  |  |
| --- | --- |
| **Significance** | **Level/Comment** |
| The 1st point on the handling diagram at that at which the understeer gradient is at a lateral acceleration of 0.15g. | Although still subject to debate, the suggested range of understeer at 0.15g for acceptable performance is 0.5deg/g (sensitivity boundary) to 2.0deg/g (steerability boundary. |

|  |  |
| --- | --- |
| **Significance** | **Level/Comment** |
| The 2nd point on the handling diagram addresses the lateral acceleration at which the vehicle’s handling characteristics change from understeer to oversteer. | This measure is designed to ensure that the handling response, and therefore the steering feel, remains essentially constant over the normal operating range of the vehicle. El-Gindy, Woodrooffe and White (1991) recommend the transition should not occur below a lateral acceleration of 0.2g. |
| The 3rd point is evaluated at 0.3g and checks whether the understeer coefficient is higher than the critical understeer coefficient. | Understeer values lower than the critical value would mean a loss of directional stability from even a slight perturbation, a situation that would be difficult (or impossible) for the driver to control or recover from. |

Table 7 summarises the results of the analysis and shows that:

* At the 1st point the 25 metre B-double has significantly more understeer in comparison to vehicles possible under the Regulatory Proposal. Too much understeer means the driver will have difficulty steering the vehicle, too little and the vehicle will be very sensitive to steering. Despite both vehicles being outside the recommended range, the findings of this analysis show that increasing the prime-mover wheelbase reduces heavy understeer.
* Both B-doubles satisfy the 2nd point requirement, but the transition occurs at a higher lateral acceleration for the vehicle with the greater amount of understeer at 0.15g, namely the Alternative Proposal (existing 25 metre B-doubles).
* Both vehicles are acceptable and satisfy the 3rd point criterion.

The results of this analysis indicate that the Regulatory Proposal has the potential to improve the handling of B-doubles, even if only marginally in some cases.

**Table 7 – Handling quality performance summary**

|  |  |  |
| --- | --- | --- |
| **Handling Quality (Understeer/Oversteer)** | **25m****B-double** | **26m % Change****B-double (26m/25m)** |
|  | **(Fig. D1)** | **(Fig. D2)** |  |
| Point #1, Understeer Coefficient, *Ku* (deg/g) | 3.31 | 0.31 | -984.3% |
| Point #2, Lateral Acceleration, *ay* (g) | 0.32 | 0.21 | -50.7% |
| Point #3, Understeer coefficient, *Ku* (deg/g) | 0.63 | -0.48 | 232.2% |
| Critical understeer coefficient, *Kucr* (deg/g) | -2.88 | -3.13 | 8.1% |

## Infrastructure Impacts

Infrastructure impacts comparing the Regulatory Proposal and the Alternative are:

* low speed swept path;
* road wear;
* bridge wear; and
* railway level crossings.

### Low speed swept path

* + - 1. *Comparison of swept path outcomes*

The comparison in this Section is undertaken using the PBS defined low speed swept path

i.e. the maximum width of the swept path in a prescribed 90o low speed turn.

Nine B-doubles were developed for the comparison. Dimensions of the vehicles are given in Attachment C and the major attributes are shown in Table 8, together with the results of low speed swept path modelling. Vehicles 26C, 26D and 26.5A (shaded) do not meet the requirements of the Regulatory Proposal relating to maximum trailing length of 20.6 metres.

It can be seen that the three 25 metre B-doubles have a swept path of between 8.58 metres and 8.77 metres, while the two B-doubles that would comply with the 26 metre dimensional requirements in the Regulatory Proposal have swept paths of 8.65 metres and 8.7 metres. It should be noted that 8.7 metres is the maximum swept width for PBS vehicles at Level 2.

**Table 8 – B-double combinations used in the main swept path analysis**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Vehicle** | **Overall Length m** | **Trailing Length m** | **Max Swept Path Width****(metres)** | **Comment** |
| 25A | 25 | 19.3 | 8.58 | Austroads B-double (intersection design) |
| 25B | 25 | 20.2 | 8.77 | B-double used for PBS simulations (see section 4.1.3) |
| 25C | 25 | 20.8 | 8.60 | A typical legal 36 pallet B-double |
| 25.5A | 25.5 | 20.3 | 8.50 | A mid-length dry freight B-double |
| 26A | 26 | 20.5 | 8.65 | A B-double complying with the proposed package |
| 26B | 26 | 20.6 | 8.70 | An example of the Regulatory Proposal |
| 26C | 26 | 20.8 | 8.76 | Older refrigerated B-double trailers |
| 26D | 26 | 20.9 | 8.94 | A 26m B-double with a very long trailer |
| 26.5A | 26.5 | 20.8 | 8.98 | An extreme example for comparison |

Note: vehicle 25A complied with the Austroads design vehicle used at the time of the analysis

Significant swept path modelling research was undertaken by Mr Les Bruzsa of Queensland Transport using the nine B-doubles in Table 8 plus a wide range of other present and potential vehicles. A summary of this modelling is given in Attachment B.

The worst case 25 metre B-doubles were not included in the nine B-doubles used in the main simulations. The longest present trailing length (lead kingpin to rear) is 21 metres, well in excess of the 20.6 metres for 26 metre B-doubles in the Regulatory Proposal but legal under the 25 metre regime for both the Regulatory Proposal and the Alternative Proposal. The swept width of this B-double (see Attachment B) exceeds 9 metres.

Figures 1 shows the spread of swept path width for all vehicles of 25 metres or less overall length as modelled by Queensland Transport (details in Attachment B). Figure 2 shows the likely spread of 26 metre B-doubles meeting the dimensional requirements of the Regulatory Proposal as found by the modelling.

**Figure 1 – Swept width under the Alternative Proposal (present 25m regulation)**

21.5

21

20.5

20

19.5

19

18.5

18

8

8.2

8.4

8.6

**swept width (m)**

8.8

9

9.2

**trailing length (m)**

**Figure 2 – Spread of likely swept path for 26m B-doubles under the Regulatory Proposal**

21.5

21

20.5

20

19.5

19

18.5

18

8

8.2

8.4

8.6

**swept width (m)**

8.8

9

9.2

**trailing length (m)**

Points to note include:

* + the maximum swept path for 26 metre B-doubles under the Regulatory Proposal will be less than the maximum swept path under 25 metre regulations;
	+ the more common dry freight trailers have a trailing length of about 20.3 metres and will have a swept path less than the 26B vehicle; and
	+ all but two of the B-doubles in Figure 2 have a maximum low speed swept width of 8.7 metres or less, which is the PBS Level 2 maximum.

All vehicles were modelled with a square front.

While it is possible that a combination of dimensions could be adopted under the Regulatory Proposal that would result in a swept path exceeding 8.7 metres, it is likely that few, if any, such vehicles would be built due to difficulties with load distribution. If such vehicles are in fact built, they would be extremely specialised and very limited in number. It is not practical to add further constraints to preclude such vehicles.

The analysis showed that the 26 metre B-doubles will have a spread of swept path width similar to present vehicles but less than the extremes available under the 25 metre regime. It is clear, therefore, that the adoption of the trailing length constraints in the Regulatory Proposal will not emulate the worst swept path outcomes possible under the existing regulations and therefore no additional access constraints for 26 metre B-doubles need be considered.

* + - 1. *The PBS option*

It was suggested during discussions on the 2003 Discussion Paper that the Regulatory Proposal include a requirement for 26 metre B-doubles that the maximum swept path should mirror the proposed PBS level 2 maximum, i.e. 8.7 metres. This suggestion is not favoured for the reasons given below, although for all practical purposes vehicles meeting the Regulatory Proposal will meet the PBS standard.

The Regulatory Proposal is part of the prescriptive regulations. In general, the prescriptive regime will give a variety or spread of outcomes depending on the vehicle design and operation. If the regulations are framed correctly, the spread of outcomes is relatively low. In contrast, PBS is designed to give certainly of outcomes. This is one of the reasons for proposing this new system to supplement existing regulations. Certainty of outcomes is never an expectation of a prescriptive regime.

Another strong reason for not pursuing the PBS path is enforcement. If a single figure for low speed swept path was adopted (say the level 2 limit of 8.7 metres), it would not be possible to enforce in the field. The full PBS regime will have a range of compliance and enforcement regimes in place to support the PBS requirements, including inspection and certification of trailers and prime movers to ensure their dimensions match those specified in the PBS approval and a mechanism for making this information available to enforcement officers making on-road check. These support mechanisms are neither appropriate to a prescriptive regime nor sufficiently developed to put in place nationwide immediately.

Finally, it should be noted that all low speed swept path simulations were undertaken with vehicles with a square front. In practice, the more rounded front of modern vehicles will reduce swept path by at least 200 mm. Therefore, vehicles meeting the Regulatory Proposal will most likely also meet the PBS standard for low speed swept path.

### Issues with Austroads envelopes

Because of general practice, the three Austroads swept path envelopes are often quoted “standards” for swept path comparisons. The smallest envelope is the Arterial and Local Road envelope, which generally applies to general access. This is not used for B-doubles, as they are not general access vehicles. The next level is for Major Freight Routes, which would allow significantly greater swept path than required by both the Regulatory Proposal and the Alternative. The third level is applied to Road Train Areas. These envelopes are not used by the PBS swept path standards.

Therefore, the use of the envelopes as pass/fail criteria is not appropriate although Queensland Transport used the envelopes for comparison of clearances.

### Road wear

The Regulatory Proposal has the potential to reduce road wear.

Presently, the steer axle mass of B-double prime movers is higher than desirable, for the reasons explained in Section 4.1.1. Redistribution of load from the steer axle to the drive axles has the effect of reducing the effective Standard Axle Repetitions (SARs).

Take, for example, a B-double with a legal gross mass of 62.5 tonnes and axle loads of 6.25 tonnes (the tolerance limit) on the steer axle, 16.25 tonnes on the drive axles and 20 tonnes on the trailing groups. Total SARs for the B-double is 6.45. If the kingpin lead was reduced such that the steer axle load was 6.0 tonnes and the drive axle load was 16.5 tonnes, the total SARS drops to 6.30, which is a decrease of 2.4%. Even greater savings are made if the steer axle load is reduced to below 6 tonnes.

The additional mass of FUP devices will, however, increase tare mass and hence reduce payload, resulting in an impact on task related road wear. The addition of FUP devices will reduce payload by about 0.5%, leading to an equivalent increase in the number of trips for fully laden vehicles.

Probably about 60% to 70% of B-doubles are operating with turntable locations that could be modified to lower steer axle loads. The overall impact will depend on take-up and action taken by individual operators, but reductions in steer axle loads will also reduce tyre wear for operators and would therefore be advantageous.

### Bridge wear

Overall, the Regulatory Proposal will reduce bridge wear, although the effects will be very small. The overall axle spacing of 26 metre B-doubles complying with the Regulatory Proposal will be greater than for the 25 metre B-doubles. Therefore, the effect on simply supported bridges will be less with the Regulatory Proposal. With continuous spans, the effect on bridges is neutral.

### Railway level crossings

Concern has been expressed that the Regulatory Proposal will have a negative impact on safety at railway level crossings.

In reality, the likelihood of negative safety impacts is negligible. The greatest apparent risk is with rural level crossings that are either uncontrolled or controlled only by warning lights and bells. If a B-double stops for a train and has to start from stationary, the additional length involved in the Regulatory Proposal will mean that it may take up to an additional 0.2 to 0.3 seconds to clear the rail tracks. However, in rural areas, where trains are relatively long distances apart, the risk of a collision due to the longer length is too small to calculate.

If the B-double is travelling at speed, the additional time taken to clear the tracks for an additional 1 metre length is given in Table 9 below.

**Table 9 – Additional time taken for a 26 m B-double to a clear railway level crossing**

**speed (km/h) time to travel 1 metre**

100 0.036 secs

80 0.045 secs

60 0.06 secs

40 0.09 secs

Therefore, there is no discernable risk to safety at rail level crossings.

Suggestions were made during consultation on the draft Regulatory Impact Statement that it would be desirable to include some form of acceleration capability in the Regulatory Proposal. Investigations were undertaken to assess the capability of present B-doubles to meet the acceleration capability requirements agreed under PBS (NRTC 2002b).

Engine torque-speed data for eight engines were obtained. These engines range in output from 455hp (1650lb.ft peak torque) to 600hp (2050lb.ft peak torque) and cover the range that are fitted to new B-doubles. Driveline details for two transmissions (18-speed manual and 18-speed automatic) were also obtained, together with a range of recommended final drive ratios that could be matched to the eight engines and the two transmissions. Again these gear trains are representative of gear trains that are fitted to the majority of new B-doubles.

Using the above data sets, simulations were run to establish combinations of engine/transmission/final-drives that would give worst case acceleration performances. Using the gear shifting techniques recommended by DECA training, it was found the vehicles fitted with all engines and transmissions met the standard of acceleration capability for PBS Level 2. It therefore appears unnecessary to include a requirement for acceleration capability in the Regulatory Proposal.

Introduction of a surrogate (prescriptive) requirement of minimum engine specifications of 339kW (455hp) output and delivering 2237Nm (1650lb.ft) peak torque was also considered. It appears that all new B-doubles are equipped with engines meeting these minimum requirements. Given that no discernable risk was identified any specification of this type appears unnecessary.

## Industry Impacts

### General

Apart from the benefits of improved handling and ride outlined in Section 4.1, there are other benefits for industry. Reduced steer axle loads (outlined above) would reduce tyre wear. More space for prime movers will increase flexibility and reduce costs. However, there will be costs in complying with the optional requirement to provide and certify the safety features of FUP devices and improved cab strength.

Being an optional system, the number of existing B-doubles that will choose the 26 metre alternative can only be estimated. Options for operators and likely outcomes are shown in Table 10 below.

**Table 10 – Options for operators of existing B-doubles under the Regulatory Proposal**

**Present safety fittings Requirement for 26 metres Likely outcome**

ECE R93 device and ECE R29 cab none All likely to change

ECE R93 device only None are eligible because ECE R29 cabs cannot be retrofitted

ECE R29 cab only Need to fit ECE R93 device to be eligible

Neither safety fitting Need to fit ECE R93 device to be eligible

There are unlikely to be any in this category as only European sourced vehicles would be likely to be fitted with ECE R93 devices and they would also have an ECE R29 cab

Commercial decision depending on perceived benefits, likely that 50% will add ECE R93 device

Commercial decision depending on perceived benefits, likely that 50% will add ECE R93 device

The other possible outcome is that older B-double prime movers may be traded in on new models, with the traded prime mover used for single articulated operations. This will depend on the age of the vehicle and the perceived cost of complying with new requirements.

### Productivity

Increased productivity for operators comes not from any increase in payload, because no more freight can be carried, but from greater flexibility in the choice of and use of prime movers. Efficiency of the B-double fleet is therefore greatly enhanced.

As shown in Table 2, the wheelbase of B-doubles is the shortest of the four main articulated combinations, being about 500 mm shorter than for the single articulated vehicle. The Regulatory Proposal will therefore allow for a greater choice of prime movers and greater flexibility for use in other configurations. There will be savings within individual fleets from greater standardisation of maintenance requirements, i.e. efficiency gains.

Productivity losses will occur due to the mass of the FUP device and any additional tare mass of longer wheelbase prime movers. For a B-double prime mover currently or potentially fitted with a bull bar, the replacement with a FUP device can be made with little effect on payload. For vehicles without a bull bar, the payload penalty will be most likely lie between 100 kg and 200 kg, about 0.5% of payload.

If the cab has to be strengthened to meet the provisions of ECE R29, additional mass could be of the order of 400 kg.

To fit a FUP device to an existing vehicle would generally result in lost productive time while the device is fitted.

### Cost of new equipment

More flexibility will mean cost savings for operators in the purchase of new prime movers. Present prime movers tend to be very specialised for B-doubles and with this specialisation comes additional cost. Manufacturers of B-doubles could make savings in research and development costs if a high proportion of new B-double prime movers met the requirements

for 26 metres overall length. Present research and development costs associated with the provision of 25 metre B-double prime movers are significant.

Savings will be possible with the cost of trailers, as manufacturers will not have to adjust designs for unusual prime mover specifications.

### Operating cost

With lower capital costs and reduced tyre wear, truck operating costs will reduce although the reductions will be minimal. Savings will also accrue to operators who are incurring fines for non-compliance at present and, although these are not strictly operating costs, they are nevertheless a cost of operation.

## Other impacts

### Compliance and enforcement

There will be costs associated with:

* designing and certifying FUP devices and stronger cabs (if not already certified);
* providing proof of compliance with the new requirements; and
* educating industry and enforcement officers about the new requirements.

In addition to enforcing overall length limits, an additional task for enforcement officers will be to enforce the trailing length requirement, but there are unlikely to be significant additional costs as it would be a marginal change to the existing task of enforcing trailer dimensions. Little, if any, additional training would be required for enforcement officers.

Consideration could be given to a requirement that the longitudinal position of the kingpin on the lead trailer be clearly and permanently marked on the side of the trailer to facilitate the location of the kingpin position for enforcement officers. It should be noted, however, that enforcement of the present limit of the length between the point of articulation and the centre of the rear axle group and also the rear of the semi-trailer is not currently assisted by any marking of the king pin position.

### Existing equipment

The Regulatory Proposal would mean that existing B-doubles with a trailing length of more than 20.6 metres will not be eligible for an overall length of 26 metres. However, they would be able to continue operation without change as the new system is optional.

## Quantification of Impacts

### Introduction

The only benefits that are quantified are:

* improved road safety; and
* reduced cost of new equipment and savings from flexibility and maintenance.

Other benefits including savings in research and development costs for truck manufacturers have not been quantified, nor have tyre wear savings as these savings will depend on responses by individual operators. Some road safety benefits such as lower fatigue and better handling vehicles have also not been quantified.

Road wear savings were estimated in the draft Regulatory Impact Statement as being in the order of $2 million annually. With the additional requirement to fit a FUP device, the road wear savings will be reduced but they have not been specifically quantified in this Regulatory Impact Statement.

The savings to operators who are incurring fines for non-compliance at present are transfer payments and have been excluded from the benefit cost analysis.

The only costs that have been quantified are:

* + the cost of designing, manufacturing, fitting and technical certification of the additional safety features; and
	+ administration costs associated with certification.

The cost of reduced payload cannot be quantified with any reasonable accuracy. The present 25 metre length limit is a disincentive to fit bull bars due to their impact on overall length but an unknown numbers still have bull bars fitted. The 26 metre length limit has specific allowance for the length needed to fit a FUP device. However, an order of magnitude is that productivity losses are likely to be in the region of $0.5 million annually.

If an operator chooses to replace an older prime mover that does not have a FUP device with a newer prime mover that does in order to access the additional B-double length, additional costs associated with the replacement have not been considered a cost of the Regulatory Proposal. This is because the Regulatory Proposal does not require the changeover and, if a change is made, the operator will perceive that benefits exceeded costs. Such benefits may or may not be related to the Regulatory Proposal.

As the swept path of vehicles built to the Regulatory Proposal will be no worse than present vehicles, access availability should be the same as at the present time. Therefore, no access costs arise.

Some of the benefits are non-quantifiable. In particular, the monetary savings cannot be put on some of the road safety benefits such as reduction in fatigue or better handling vehicles.

As the Regulatory Proposal provides the option of remaining with the present regulation, only operators that perceive net benefits will choose to move to the 26 metre regime. Therefore, the numbers of operators and the costs and benefits below are an order of magnitude only.

### Present and future fleet of B-doubles

As at the end of 2004, NTC advises that there were 9,758 registered B-double and B-triple prime movers. Allowing for the few B-triples and some B-doubles not in service, it is estimated that the present fleet of B-doubles numbers 9,500.

It should be noted that the estimated fleet of 9,500 includes B-doubles in Western Australia, a State which permits an overall length of 27.5 metres for B-doubles. However, the popularity of B-doubles has fallen in recent years in Western Australia and it is estimated that there are less than 150 B-doubles in that State at lengths exceeding 26 metres, or less than 2% of the national fleet. Therefore, because of uncertainties about other estimates, no reductions have been made to fleet numbers to account for lower take-up in Western Australia.

The proportion with present safety fittings are not known, but it is estimated, based on sales figures, that less than 10% of existing B-doubles would be fitted with FUP devices. The proportion with ECE R29 strength cabs (even if not certified) would be considerably higher.

B-doubles are the fastest growing truck configuration. B-doubles have increased by around 20% per year for the last ten years. B-doubles travel an average distance of close to 200,000 km per year based on the Survey of Motor Vehicle Use. However, for the purposes of the impact analysis, a conservative growth estimate of 6% per year has been made.

Figure 3 provides estimates of the year of manufacture of prime movers in the present fleet. It is probable that around half of these prime movers are less than three years old.

**Figure 3 – Estimated year of manufacture of current B-double prime movers**

**number of vehicles**

Source: Estimated by PTRC based on SMVU data

2000

1500

1000

500

0

1996 1997 1998 1999 2000 2001 2002 2003 2004

For future purchases, it is estimated that over 90% would choose to comply with the safety requirements and be eligible for the 26 metre overall length. Some segments such as livestock operators may choose to remain within the present limits. Livestock B-doubles are already subject to deck length constraints that mean the shorter wheelbase prime movers are rarely used.

### Other assumptions

The fleet of B-doubles, the growth of the fleet and the age of the fleet can be estimated with reasonable reliability.

Assumptions with less reliability include:

* + - * of the present B-double fleet, 5,000 or just over 50% will transfer to the 26 metre regime; and
			* of new B-double prime movers, 90% will be fitted with the required safety features.

Industry pressure for change indicates that a high proportion of the existing fleet will take advantage of the Regulatory Proposal, despite the safety requirements.

### Road safety benefits

In Section 4.1, using assumptions in Rechnitzer (1993), it was concluded that fitting FUP devices to *all* B-doubles would result in a reduction of one fatality to a serious injury and twenty serious injury crashes being reduced to minor injury. However, it was suggested that these results were on the high side, mainly because B-double travel on 100 km/h roads and divided roads is a much higher proportion than for single articulated vehicles. Results of savings in road trauma were reduced by 30% to allow for this pattern of travel. In the first year, with 5,000 B-doubles fitted, estimated road trauma savings are $3.3 million. As more B-double prime movers fitted with FUP devices entered the fleet, together with the growth in the fleet of 6%, savings in the tenth year increased to $7.6 million.

Total savings over ten years at a 5% discount rate are $45.3 million. These savings do not include downstream benefits which will accrue as older B-double prime movers fitted with the safety features are downgraded to single trailer operations.

### Savings in equipment costs

It is estimated that equipment cost savings are:

* $2,000 for each prime mover, incorporating savings from less specialised vehicles, reduced maintenance costs and improved flexibility; and
* $1,000 for each set of B-double trailers resulting from increased standardisation of design and manufacture.

It was assumed that the B-double fleet will increase by 6% each year and that an additional 4% of older prime movers in the existing fleet would be replaced. To account for some replacement of older prime movers, 2,000 new prime movers are expected to be delivered in 2006. Total savings over 10 years at a 5% discount rate would be $45.1 million.

Only 7% of trailers were assumed to be replaced each year, reflecting the longer life of trailers. Total savings over 10 years at a 5% discount rate would be $15.8 million.

### Cost of fitting new safety equipment

The average cost of retro-fitting FUP devices to the existing fleet is estimated at $4,000 per prime mover, leading to a one-off cost of $20 million in the first year. The average cost in the second year is expected to reduce to $2,000, with a further reduction to $1,000 in subsequent years as European designs become standard and are fitted as original equipment. On this basis, the cost over a 10 year period at a 5% discount rate is $43.4 million.

### Administration and certification costs

Administration and certification costs included here are the cost incurred by the vehicle manufacturer to obtain and supply the certification and the cost to jurisdictions of recording this information. It was estimated that these costs would be $400 for the existing fleet and

$200 for each new prime mover, leading to a total cost of $6.4 million over 10 years at a 5% discount rate.

### Impacts identified in the draft Regulatory Impact Statement

The draft Regulatory Impact Statement (NTC 2004) identified the impacts of the previous proposal that the 26 metre overall length limit replace the present 25 metre overall length limit. The draft RIS concluded:

….. when the likely road trauma savings are included, it is probable that the annual savings that would arise from the Regulatory Proposal are in the region of $4 to $5 million. Over a 10 year period at a 5% discount rate, the net savings are likely to be in the region of $30 to $40 million.

Because there were only minor costs involved compared to the likely benefits, the impacts were not calculated with the same rigor as the present impacts and only orders of magnitude were identified. It appears, however, that the present proposal will deliver about the same order of magnitude of net benefits as the previous proposal but it is a much more attractive proposal to jurisdictions as it delivers direct safety benefits to the community.

## Summary of Impacts

A summary of the impacts of the Regulatory Proposal compared to the Alternative Proposal is given in Table 11. The reference to Regulatory Proposal in the table refers to 26 metre B- doubles as an option compared to 25 metre B-doubles only.

**Table 11 – Summary of Impacts**

|  |  |  |
| --- | --- | --- |
| ***Impact of the Proposal*** | ***Measure*** | ***Impact of the Regulatory Proposal compared to the Alternative Proposal*** |
| Road safety | Vehicle Safety Systems | FUP devices and ECE R29 cabs required. |
| Vehicle Dynamic Performance | Improvement in steer tyre friction demand, rearward amplification and yaw damping. |
| Driver fatigue (Ride quality) | Improvement, particularly in the fore and aft movement. |
| Handling quality | Improvement. |
| Infrastructure impacts | Access | Maximum low speed swept path reduced to levels approximating the PBS level. |
| Road wear | Scope for reduced road wear. |
| Bridge wear | Some minor reductions in bridge wear. |
| Railway level crossings | No increase in safety risk. |
| Industry impacts | Flexibility/productivity | Significant improvement. |
| Cost of new equipment | Costs will reduce. |
| Other impacts | Enforcement | Slightly more complicated. |
| Existing equipment | No impact. |

The results of the quantification of costs and benefits is given in Table 12. The costs and benefits are compared to the present regime of allowing only 25 metre B-doubles with the assumed take up of the 26 metre option in the Regulatory Proposal.

**Table 12 – Total benefits and costs over 10 years (5% discount rate)**

|  |  |  |
| --- | --- | --- |
| Benefits | Road safety benefitsSavings in costs – prime movers Savings in costs – trailers*Total Benefits* | $45.3 million$45.1 million$15.8 million*$106.2 million* |
| Costs | Cost of fitting new safety equipment Administration and certification costs*Total costs* | $43.4 million$6.4 million*$49.8 million* |

Therefore, net benefits would be $56.4 million over 10 years. The benefit cost ratio is 2.1. Some sensitivity testing was undertaken and results are shown in Table 13.

|  |  |
| --- | --- |
| **Table 13 – Results of sensitivity testing** |  |
| **Change made to the base assumptions** | **Net benefits** | **Benefit cost ratio** |
| *Base assumptions (for comparison)* | *$56.4 million* | *2.1:1* |
| Discount rate increased from 5% to 10% | $37.4 million | 1.9:1 |
| B-double fleet increases by 12%, not 6% | $92.0 million | 2.4:1 |
| Only 2,000 of the existing fleet convert and fleet increases by 3% | $25.8 million | 2.1:1 |
| Cost savings per prime mover and trailers half base assumption | $26.0 million | 1.5:1 |
| The sensitivity testing showed that: |  |  |

* + - * although net benefits are dependent on the assumptions relating to industry take-up, the benefit cost ratio remains relatively stable if lower take-up occurs; and
			* a very low value of industry savings on prime movers and trailers would still result in net benefits.

The evaluation shows the Proposal has clear benefits for safety with reduced capital costs, leading to reduced operating costs. The safety benefits will be reflected in reductions in road trauma and an improvement in vehicle ride quality, handling and stability and a reduction in driver fatigue.

The quantification has focussed on the orders of magnitude that might be expected as an accurate assessment is not possible due to the uncertainties of take-up of the option of 26 metres. However, all quantified costs and benefits are related to take up of the 26 metres regime so the results are considered robust.

All stakeholders would benefit. The community will benefit from reduced road trauma, road agencies should benefit from reduced infrastructure wear, drivers will benefit from increased safety and improved working environment, and operators will benefit from reduced capital costs, increased flexibility and reduced operating costs.

# CONSULTATIONS

Significant consultation has taken place over many years on the issue of the length limits for B-doubles. Formal consultations have taken place with circulation of proposals in 1999, in early 2003 with the release of the Discussion Paper (Avalon Enterprises 2003) and again early in 2004 when the draft Regulatory Impact Statement was released. Many informal discussions have taken place with individuals and organisations over the intervening years.

The proposals in the draft Regulatory Impact Statement were different to the present Regulatory Proposal. That draft RIS canvassed a modification to the regulations that provided for an overall length of 26 metres (with a trailing length of 20.6 metres) to *replace* the existing 25 metre overall length limit, rather than supplement it and be optional. The trailing length limit of 20.6 metres was the only hurdle to achieving 26 metre overall length.

Below is a summary of the extensive comments made on the draft Regulatory Impact Statement. A full list of respondents is given in Attachment E.

The most common theme arising from comments by State and Territory road agencies was that there were insufficient safety benefits in the proposal or there was doubt about the safety benefits. Some agencies suggested that the length increase, rather than providing for the future safety features (for example front underrun protection) should actually require these safety features as a condition of approval.

Other concerns that arose from road agencies included:

* concerns with the implications for access to the 25 metre B-double network; and
* the conditions for grandfathering of B-doubles made obsolete by the draft proposal.

Some agencies provided full support for the draft proposal.

One agency, RTA NSW, sought an independent review of the proposal. That review found that, while the economic value of the performance, safety, and operational benefits were difficult to quantify, the main arguments of the draft RIS were not refuted and no risks of negative safety or operational outcomes were identified.

A very high number of responses from industry were received. More than 75 respondents expressed full support for the draft proposals. The Truck Industry Council indicated the draft proposals would allow the early introduction of the front underrun protective devices that were mandatory in Europe. Only a few industry respondents expressed reservations. One truck manufacturer suggested that 25.5 metres was all that was needed, not 26 metres. One operator had concerns relating to the proposed grandfathering of B-doubles that did not comply with the 20.6 metre trailing dimensions.

The Regulatory Proposal in this Regulatory Impact Statement has responded to the concerns as follows:

* additional safety features would now be required before being eligible for a 26 metre overall length; and
* grandfathering conditions are now not necessary as the 26 metre overall length will be optional and all 25 metre B-doubles may continue to operate.

There should be no access implications for the existing B-double network as explained in Section 4.

It is therefore considered that the present Regulatory Proposal addresses all concerns raised during the most recent consultations without loss of net benefits.

# CONCLUSION

The Regulatory Proposal (to provide for an optional increase in the overall length limit for B-doubles to 26 metres provided safety features are added to the prime mover and the trailing length does not exceed 20.6 metres) has advantages over the Alternative Proposal (to retain a 25 metre overall length limit) in the following areas:

* safety, where the Proposal:

 requires prime movers to be fitted with front underrun protective devices and stronger cabs; and

 allow longer wheelbase prime movers, which will improve vehicle dynamic performance including better handling and ride, leading to less driver fatigue;

* infrastructure, where the Proposal has the potential to reduce road and bridge wear while not affecting rail crossing safety nor requiring greater roadway area for access for B- doubles; and
* industry costs and flexibility, particularly the cost of new equipment prime movers and semi trailers.

The Regulatory Proposal will reduce costs for stakeholders. For all stakeholders road safety will be improved. For road agencies, there is potential for reductions in road and bridge wear. For operators, costs for equipment will be reduced and there will be greater choice of prime movers and greater flexibility in the use of equipment. Operators are able to choose whether to retain existing types of equipment or invest in new equipment depending on their commercial position. For drivers the working environment and safety will be improved.

Net benefits are likely to exceed $50 million over a ten year period.

Overall, the Regulatory Proposal is superior to the Alternative and should be adopted.

# IMPLEMENTATION/REVIEW

The Regulatory Proposal would be implemented by means of amendment to the Australian Vehicle Standards Rules and equivalent regulations in relevant State and Territory legislation. However, it is unlikely that Western Australia, which presently allows B-double lengths to exceed 26 metres, will adopt the Regulatory Proposal.

Appendix A contains the current rule. The regulatory proposal could be implemented by adding the following sub-rule:

*After Rule 69 (3) insert:*

* 1. *Subrule (1) (a) does not apply if:*
		1. *the distance between the point of articulation at the front of the leading semi- trailer and the rear of the combination is not over 20.6 metres; and*
		2. *the prime mover of the combination is fitted with a front underrun protective device that complies with Regulation No. 93 of the United Nations Economic Commission for Europe (UN ECE); and*
		3. *if the prime mover has a date of manufacture after 2005, it is fitted with a cab that complies with Regulation No. 29 of the United Nations Economic Commission for Europe (UN ECE); and*
		4. *the prime mover does not have a load carrying area; and*
		5. *the combination is not over 26 metres long*.

***Leading semi-trailer*** *means the sem- trailer located towards the front of the B-double.*

It is not economically feasible to retro-fit stronger cabs to prime movers, but a high proportion of existing B-doubles would be fitted with cabs that comply with ECE R29. To enable the few truck manufacturers that are uncertain of the strength of their cabs to undertake testing programs, it is proposed that certification by manufacturers that cabs meet the proposed requirement be implemented in 2006.

At the present time, proposals relating to FUP devices and cab strength are being considered for possible inclusion in Australian Design Rules. If any of these proposals are adopted, the AVSR amendments would be reviewed to ensure consistency with any new ADRs.

The AVSRs are reviewed as necessary by the NTC and the Australian Transport Council. The Australian Design Rules upon which the AVSRs are based are also reviewed from time to time by the Department of Transport and Regional Services.

# COMPETITION POLICY ASSESSMENT

The Regulatory Proposal would be available to all B-doubles after adoption of the applicable legislative change. The Regulatory Proposal does not limit the number of operators nor impose particular requirements on any operator as each has an option to remain with the present 25 metre overall length regime or move to the new option of 26 metres with conditions.

The barrier to entering the 26 metre overall length regime is primarily the fitting of front underrun protection devices. Such fitment will come at a cost, which might be considered to advantage larger operators over smaller operators. However, because there is a choice as to which regime the operator will use and the cost of the device is not large (expected to be less than $4,000), it therefore will be a commercial decision by large and small operators alike. Load space under both regimes is the same.

It perhaps could also be argued that the requirement for prime movers to comply with UN ECE R29 cab strength will advantage truck manufacturers that operate in the European market and already comply with the requirement. It could also be argued that truck manufacturers that have not demonstrated compliance with R29 might choose not to undertake the cost of proving compliance, reducing competition in the market for B-double prime movers. These situations are not anti-competitive due to:

* costs have already been incurred by compliant truck manufacturers and the remaining manufacturers would have only delayed spending proof-of-compliance money;
* the Regulatory Proposal provides a time delay prior to the imposition of the requirement to allow proof-of-compliance to be obtained; and
* the vast majority of truck manufacturers competing in the B-double prime mover market are already compliant, including the largest suppliers of prime movers.

The Regulatory Proposal does not favour any particular group or segment in the market but the prohibition of any load space on the prime mover would prohibit the adoption of the 26 metre option by any B-double car carrier that carries a car on the prime mover above the driver’s cab.

It is concluded, therefore, that the regulatory proposal will not limit competition despite some perceived short term advantages for manufacturers of some present prime movers.

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*Length Limits for B-doubles – Regulatory Impact Statement Page 35*

# ATTACHMENT A – CURRENT AUSTRALIAN VEHICLE STANDARDS RULE NO 69



**69 Length of combinations**

1. A combination must not be over:
	1. for a B-double — 25 metres long; and
	2. for a road train — 53.5 metres long; and
	3. for a combination, except a road train, designed to carry vehicles on 2 or more partly or completely overlapping decks — 25 metres long; and
	4. for another combination — 19 metres long.
2. In a B-double built to carry cattle, sheep, pigs or horses, the 2 semi-trailers must not have over 18.8 metres of their combined length available for the carriage of animals.
3. For sub-rule (2), the length available for the carriage of animals on a trailer is measured from the inside of the front wall or door of the trailer to the inside of the rear wall or door of the trailer, with any intervening partitions disregarded.

**ATTACHMENT B – RESULTS OF SWEPT PATH MODELLING**

*This Attachment is an edited summary of a significant project on the swept path performance of various B-doubles undertaken by Mr Les Bruzsa of Queensland Transport. The work is in two parts:*

1. *The first part includes the simulation results for the B-doubles that were specified by NRTC and are outlined in Part 2 of Attachment C; and.*
2. *Following the release of the Discussion Paper in February 2003, Mr Bruzsa extended considerably the list of B-doubles and the second part includes all combinations.*

**PART 1: INITIAL SIMULATIONS**

Table B1 outlines the B-doubles used in Part 1, with the NRTC designation shown alongside Mr Bruzsa’a designation. With some longer combinations, Mr Bruzsa varied some dimensions to determine the effects on swept path performance.

**Table B1 – Details of the B-double combinations simulated**

**Designation**

**Overall**

**Trailing length (m)**

|  |  |  |  |
| --- | --- | --- | --- |
| **L Bruza** | **NRTC** | **Length (m)** |  |
| AUS 25 | 25A | 25 | 19.3 |
| PBS 25 | 25B | 25 | 20.2 |
| IND 25 | 25C | 25 | 20.8 |
| NRTC 3 | 25.5A | 25.5 | 20.3 |
| NRTC 3.2 | 25.5A | 25.5 | 20.3 |
| NRTC 2.1 | 26A | 26 | 20.5 |
| NRTC 2.2 | 26A | 26 | 20.5 |
| NRTC 4 | 26B | 26 | 20.6 |
| NRTC 4.2 | 26B | 26 | 20.6 |
| TOSA 26 | 26B | 26 | 20.6 |
| NRTC 1 | 26C | 26 | 20.8 |
| NRTC 1.2 | 26C | 26 | 20.8 |
| IND 26 | 26D | 26 | 20.9 |
| IND 265 | 26.5A | 26.5 | 20.8 |
| WA 275 | – | 27.5 | 20.5 |
| Long 25 | – | 25 | 19.1 |
| Gen262 | – | 26.2 | 21.4 |

Notes

* WA275 is a 27.5m B-double that meets the WA requirements;
* Long 25 is a 25 m B-double that has a 14.6 m long rear trailer (which is not permitted); and
* Gen262 is a 26.2 m B-double with long trailers.

In the first part of the project, three different manoeuvres were used for assessing the swept path performance of the different B-double combinations. This more extensive assessment was designed to address any concerns relating to access. The three manouevres were:

* 90 degree left turn with a radius of 12.5 m (the PBS manoeuvre);
* a 150 degree turn with a radius of 12.5 m; and
* a maximum effort turn using the Austroads swept path envelope as a constraint.

**Manoeuvre 1 – the PBS manoeuvre**

This manoeuvre, illustrated in Figure B1, is the manoeuvre specified in the PBS low speed swept path standard. In addition to the PBS low speed swept path results, maximum front swing is shown.

In the initial assessment each of the analysed B-doubles is ranked according to their performance followed by a summary which combines the results of all different assessment methods.

**Figure B1 – Manoeuvre 1 (turning radius 12.5m, angle: 90 degrees)**

Radius: 12.5m; Angle of turn: 90.00 degrees

The Tables B2 to B4 show the rankings of the analysed B-doubles.

**Table B2 – Maximum Low Speed Swept Path**

|  |  |  |
| --- | --- | --- |
| **Designation** | **Low speed swept path (m)** | **Rank** |
| NRTC 3 | 8.50 | **1** |
| NRTC 3.2 | 8.50 | **2** |
| AUS 25 | 8.58 | **3** |
| IND 25 | 8.60 | **4** |
| NRTC 2.1 | 8.63 | **5** |
| NRTC 4.2 | 8.63 | **6** |
| NRTC 2.2 | 8.65 | **7** |
| TOSA 26 | 8.65 | **8** |
| NRTC 4 | 8.70 | **9** |
| NRTC 1.2 | 8.72 | **10** |
| NRTC 1 | 8.76 | **11** |
| PBS 25 | 8.77 | **12** |

|  |  |  |
| --- | --- | --- |
| **Designation** | **Low speed swept path (m)** | **Rank** |
| IND 26 | 8.94 | **13** |
| IND 265 | 8.98 | **14** |
| Gen26.2 | 9.06 | **15** |
| WA 275 | 9.10 | **16** |
| Long 25 | 9.12 | **17** |

**Table B3. Maximum swept path**

|  |  |  |
| --- | --- | --- |
| **Designation** | **low speed swept path (m)** | **rank** |
| NRTC 3.2 | 7.97 | **1** |
| AUS 25 | 7.98 | **2** |
| NRTC 3 | 8.01 | **3** |
| NRTC 2.2 | 8.12 | **4** |
| NRTC 4 | 8.13 | **5** |
| TOSA 26 | 8.14 | **6** |
| NRTC 2.1 | 8.19 | **7** |
| NRTC 1.2 | 8.22 | **8** |
| NRTC 4.2 | 8.23 | **9** |
| NRTC 1 | 8.27 | **10** |
| IND 25 | 8.30 | **11** |
| PBS 25 | 8.40 | **12** |
| IND 26 | 8.51 | **13** |
| Long 25 | 8.52 | **14** |
| WA 275 | 8.57 | **15** |
| Gen262 | 8.69 | **16** |
| IND 265 | 8.73 | **17** |

**Table B4. Maximum frontal swing**

|  |  |  |
| --- | --- | --- |
| **Designation** | **maximum frontal swing (m)** | **rank** |
| IND 265 | 0.27 | **1** |
| IND 25 | 0.31 | **2** |
| Gen262 | 0.38 | **3** |
| PBS 25 | 0.39 | **4** |
| NRTC 4.2 | 0.43 | **5** |
| NRTC 2.1 | 0.47 | **6** |
| IND 26 | 0.48 | **7** |
| NRTC 3 | 0.52 | **8** |
| NRTC 1 | 0.53 | **9** |
| NRTC 1.2 | 0.53 | **10** |
| NRTC 3.2 | 0.53 | **11** |
| TOSA 26 | 0.55 | **12** |
| NRTC 2.2 | 0.58 | **13** |
| WA 275 | 0.58 | **14** |
| NRTC 4 | 0.61 | **15** |
| AUS 25 | 0.65 | **16** |
| Long 25 | 0.65 | **17** |

**Manoeuvre 2 – the 12.5 m radius 150-degree turn (as Fig B2**)

This manoeuvre can be used to assess routes for the different vehicle combinations. During the simulation of this turn, we can simulate the “steady-state low-speed swept path” performance of a combination. The issue is that the low speed swept path of a combination does not reach the maximum value when the vehicle is negotiating a 90 degree turn therefore it is difficult to fully evaluate the performance of a combination. For turns conducted between 150-180 degrees (or bigger angles) the swept path does not increase and it reaches its maximum value during the turn.

**Figure B2 – Manoeuvre 2 (12.5m radius, 150 degrees)**

Radius: 12.5m; Angle of turn: 150.00 degrees

Table B5 illustrates the rankings for this manoeuvre.

**Table B5. Maximum swept path on 150 degree turn**

|  |  |  |
| --- | --- | --- |
| **Designation** | **maximum swept path (m)** | **rank** |
| AUS 25 | 10.26 | **1** |
| TOSA 26 | 10.26 | **2** |
| NRTC 3.2 | 10.28 | **3** |
| NRTC 3 | 10.34 | **4** |
| NRTC 4 | 10.57 | **5** |
| NRTC 2.2 | 10.58 | **6** |
| NRTC 2.1 | 10.68 | **7** |
| NRTC 4.2 | 10.75 | **8** |
| NRTC 1.2 | 10.78 | **9** |
| NRTC 1 | 10.84 | **10** |
| IND 25 | 10.88 | **11** |

|  |  |  |
| --- | --- | --- |
| **Designation** | **maximum swept path (m)** | **rank** |
| AUS 25 | 10.26 | **1** |
| PBS 25 | 11.06 | **12** |
| IND 26 | 11.30 | **13** |
| Long 25 | 11.34 | **14** |
| Gen262 | 11.60 | **15** |
| IND 265 | 11.71 | **16** |
| WA 275 | 12.07 | **17** |

**Manoeuvre 3 – the maximum effort turn**

The third manoeuvre was the “aggressive method” – maximum effort turn using the AUSTROADS envelope as the constraint. (Fig B3).

Mr Bruzsa measured the maximum clearance during this “aggressive” turn (that is the case when the driver uses the maximum road space that is available for conducting the turn by locking up the steering). This is greatly affected by the steering design (maximum wheel cut of the prime-mover) and the front overhang of the prime-mover.

**Figure B3. Manoeuvre 3**

Maximum Clearance AUSTROADS ENVELOPE

The Table B6 illustrates the results.

**Table B6 – Clearance with maximum steering lock**

|  |  |  |
| --- | --- | --- |
| **Designation** | **maximum clearance (m)** | **rank** |
| NRTC 3.2 | 2.37 | **1** |
| NRTC 3 | 2.33 | **2** |
| TOSA 26 | 2.16 | **3** |
| NRTC 2.1 | 2.11 | **4** |
| IND 25 | 2.11 | **5** |
| NRTC 4 | 2.08 | **6** |
| NRTC 1.2 | 2.06 | **7** |
| NRTC 2.2 | 2.04 | **8** |
| NRTC 4.2 | 2.03 | **9** |
| AUS 25 | 2.02 | **10** |
| PBS 25 | 1.94 | **11** |
| NRTC 1 | 1.93 | **12** |
| IND 26 | 1.82 | **13** |
| WA 275 | 1.73 | **14** |
| Gen262 | 1.66 | **15** |
| IND 265 | 1.64 | **16** |
| Long 25 | 1.52 | **17** |

Note that these simulations have been carried out with a coefficient of friction of 0.3 and unladen conditions. It means that these simulations represent the worst case scenarios.

Table B7 shows the overall performance ratings for the combinations, whereby the sum of the rankings for each manoeuvre is taken as a measure of the overall performance.

**Table B7. Overall Performance Rating**

|  |  |
| --- | --- |
| **Designation Sum of Ranking Points** | **Length** |
| **Mr Bruzsa** | **NRTC** |  |  |
| NRTC 3 | 25.5A | 18 | 25.5 |
| NRTC 3.2 | 25.5A | 18 | 25.5 |
| NRTC 2.1 | 26A | 29 | 26 |
| TOSA 26 | 26B | 31 | 26 |
| AUS 25 | 25A | 32 | 25 |
| IND 25 | 25C | 33 | 25 |
| NRTC 4.2 | 26B | 37 | 26 |
| NRTC 2.2 | 26A | 38 | 26 |
| NRTC 4 | 26B | 40 | 26 |
| NRTC 1.2 | 26C | 44 | 26 |
| PBS 25 | 25B | 51 | 25 |
| NRTC 1 | 26C | 52 | 26 |
| IND 26 | 26D | 59 | 26 |
| Gen262 | na | 64 | 26.2 |
| IND 265 | 26.5A | 64 | 26.5 |
| WA 275 | na | 76 | 27.5 |
| Long 25 | na | 79 | 25 |

It should be noted that the Regulatory Proposal (NTRC designation 26B) scores well in this assessment and it is better than several longer B-double combinations. It would mean that the dimensional limits that are proposed would control the low-speed swept path performance.

Figure B4 is a drawing comparison of the present worst legal 25 m B-double, the Regulatory Proposal B-double and the Austroads B-double. This simulation shows that there is only slight difference between the Austroads and the Regulatory Proposal B-doubles, but the worst legal 25 metre B-Double performs badly.

**Figure B4 – Comparison of present worst legal 25 m B-double, the Regulatory Proposal B-double and the Austroads B-double**

**PART 2. ADDITIONAL SIMULATIONS**

Only the PBS designated turn was examined during the additional assessments. Table B8 shows all combinations simulated and Table B9 shows the results.

**Table B8. B-doubles simulated**

**Designation**

**Overall**

**Trailing length (m)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Mr Bruza** | **NRTC** | **Length (m)** |  |
| AUS 25 | 25A | 25 | 19.3 |
| PBS 25 | 25B | 25 | 20.2 |
| IND 25 | 25C | 25 | 20.8 |
| NRTC 3 | 25.5A | 25.5 | 20.3 |
| NRTC 3.2 | 25.5A | 25.5 | 20.3 |
| NRTC 2.1 | 26A | 26 | 20.5 |
| NRTC 2.2 | 26A | 26 | 20.5 |
| NRTC 4 | 26B | 26 | 20.6 |
| NRTC 4.2 | 26B | 26 | 20.6 |
| TOSA 26 | 26B | 26 | 20.6 |
| NRTC 1 | 26C | 26 | 20.8 |
| NRTC 1.2 | 26C | 26 | 20.8 |
| IND 26 | 26D | 26 | 20.9 |
| IND 265 | 26.5A | 26.5 | 20.8 |
| WA 275 |  | 27.5 | 20.5 |
| Long 25 |  | 25 | 19.1 |
| Gen262 |  | 26.2 | 21.4 |
| kenworth25 |  | 24.47 | 20.29 |
| livestock25m |  | 24.922 | 18.6 |
| 25mw146 |  | 24.94 | 19.04 |
| 25m35 |  | 25 | 20.1 |
| 25m36hal1 |  | 25 | 20.8 |
| 25mtypical |  | 25 | 20.1 |
| 25m36p21 |  | 25 | 21 |
| 25mdryfreight |  | 25 | 20.84 |
| scania25m36 |  | 25 | 20.71 |
| quantum25.3 |  | 25.03 | 20.155 |
| mack25mb2 |  | 25.23 | 20.185 |
| Stock25.3m |  | 25.3 | 20.4 |
| livestock25.31 |  | 25.31 | 18.71 |
| livestock25.57m |  | 25.57 | 18.75 |
| freigthliner26 |  | 25.93 | 20.44 |
| volvo25.98 |  | 25.98 | 20.44 |
| 26m36pha3 |  | 26 | 20.77 |
| 26m20.6 |  | 26 | 20.6 |
| livestock26 |  | 26.075 | 19.21 |
| 26mbonneted |  | 26.203 | 20.47 |
| volvo26.28 |  | 26.28 | 20.44 |
| Sterling26.47 |  | 26.47 | 20.245 |
| Austroads mod |  | 25 | 20.6 |

**Table B9. Simulation Results for all vehicles**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Designation** | **Length** | **Trailing length** | **Max. swept path** | **Max. frontal** | **Max. swept path** |
|  | **(m)** | **(m)** | **(m)** | **swing (m)** | **(m)** |
| AUS 25 | 25 | 19.3 | 7.98 | 0.65 | 8.58 |
| PBS 25 | 25 | 20.2 | 8.40 | 0.39 | 8.77 |
| IND 25 | 25 | 20.8 | 8.30 | 0.31 | 8.6 |
| NRTC 3 | 25.5 | 20.3 | 8.01 | 0.52 | 8.5 |
| NRTC 3.2 | 25.5 | 20.3 | 7.97 | 0.53 | 8.5 |
| NRTC 2.1 | 26 | 20.5 | 8.19 | 0.47 | 8.63 |
| NRTC 2.2 | 26 | 20.5 | 8.12 | 0.58 | 8.65 |
| NRTC 4 | 26 | 20.6 | 8.13 | 0.61 | 8.7 |
| NRTC 4.2 | 26 | 20.6 | 8.23 | 0.43 | 8.63 |
| TOSA 26 | 26 | 20.6 | 8.14 | 0.55 | 8.65 |
| NRTC 1 | 26 | 20.8 | 8.27 | 0.53 | 8.76 |
| NRTC 1.2 | 26 | 20.8 | 8.22 | 0.53 | 8.72 |
| IND 26 | 26 | 20.9 | 8.51 | 0.48 | 8.94 |
| IND 265 | 26.5 | 20.8 | 8.73 | 0.27 | 8.98 |
| Long 25 | 25 | 19.1 | 8.52 | 0.65 | 9.12 |
| WA 275 | 27.5 | 20.5 | 8.57 | 0.58 | 9.1 |
| Gen262 | 26.2 | 21.4 | 8.69 | 0.38 | 9.06 |
| kenworth25 | 24.47 | 20.29 | 8.39 | 0.31 | 8.69 |
| livestock25m | 24.922 | 18.6 | 8.00 | 0.5 | 8.47 |
| 25mw146 | 24.94 | 19.04 | 7.91 | 0.66 | 8.53 |
| 25m35 | 25 | 20.1 | 8.11 | 0.39 | 8.47 |
| 25m36hal1 | 25 | 20.8 | 8.84 | 0.35 | 9.17 |
| 25mtypical | 25 | 20.1 | 8.14 | 0.39 | 8.5 |
| 25m36p21 | 25 | 21 | 8.63 | 0.42 | 9.04 |
| 25mdryfreight | 25 | 20.84 | 8.10 | 0.49 | 8.51 |
| scania25m36 | 25 | 20.71 | 8.72 | 0.47 | 9.17 |
| quantum25.3 | 25.03 | 20.155 | 8.01 | 0.53 | 8.52 |
| mack25mb2 | 25.23 | 20.185 | 8.08 | 0.36 | 8.41 |
| Stock25.3m | 25.3 | 20.4 | 8.40 | 0.43 | 8.81 |
| livestock25.31 | 25.31 | 18.71 | 7.79 | 0.41 | 8.17 |
| livestock25.57m | 25.57 | 18.75 | 8.06 | 0.6 | 8.61 |
| freigthliner26 | 25.93 | 20.44 | 8.16 | 0.51 | 8.65 |
| volvo25.98 | 25.98 | 20.44 | 8.24 | 0.4 | 8.61 |
| 26m36pha3 | 26 | 20.77 | 8.47 | 0.54 | 8.97 |
| 26m20.6 | 26 | 20.6 | 8.12 | 0.54 | 8.49 |
| livestock26 | 26.075 | 19.21 | 8.18 | 0.62 | 8.75 |
| 26mbonneted | 26.203 | 20.47 | 8.51 | 0.33 | 8.83 |
| volvo26.28 | 26.28 | 20.44 | 8.24 | 0.54 | 8.74 |
| Sterling26.47 | 26.47 | 20.245 | 8.30 | 0.52 | 8.77 |
| Austroads mod | 25 | 20.3 |  |  | 8.87 |

**ATTACHMENT C – CONFIGURATION OF B-DOUBLES IN SWEPT PATH MODELLING**

Vehicle 25A

Overall length – 25m Trailing length – 19.3m FOH – 1.60m

(The Austroads Vehicle)

Vehicle 25B

Overall length – 25m Trailing length – 20.2m FOH – 1.10m

(The PBS Vehicle)

Vehicle 25C

Overall length – 25m Trailing length – 20.8m FOH – 0.92m

Vehicle 25.5A

Overall length – 25.5m Trailing length – 20.3m FOH – 1.462m

Vehicle 26A

Overall length – 26m Trailing length – 20.5m FOH – 1.24m

Vehicle 26B

Overall length – 26m Trailing length – 20.6m FOH – 1.67m

(The Proposal)

Vehicle 26C

Overall length – 26m Trailing length – 20.8m FOH – 1.462m

Vehicle 26D

Overall length – 26m Trailing length – 20.9m FOH – 1.365m

Vehicle 26.5A

Overall length – 26.5m Trailing length – 20.8m FOH – 0.72m

*Length Limits for B-doubles – Regulatory Impact Statement Page 53*

**ATTACHMENT D – B-DOUBLES USED IN SAFETY SIMULATIONS**



**Fig. D1 - Typical 25.0m overall length 34 pallet fridge van B-double used in safety measures simulations (supplied by Truck Operators and Suppliers Alliance)**



**Fig. D2 - Proposed maximum 26.0m overall length 34 pallet fridge van B- double (supplied by Truck Operators and Suppliers Alliance)**

**ATTACHMENT E – RESPONDENTS TO THE *DRAFT* REGULATORY IMPACT STATEMENT**

**GOVERNMENT AGENCY**

Roads and Traffic Authority, New South Wales VicRoads

Department of Main Roads, Queensland Queensland Transport

Department of Transport and Urban Planning, South Australia Department of Infrastructure, Energy and Resources, Tasmania

Department of Infrastructure, Planning and Environment, Northern Territory Department of Urban Services, Australian Capital Territory

Commonwealth Department of Transport and Regional Services.

Land Transport Safety Authority, New Zealand. (now Land Transport New Zealand) Australian Local Government Association

**INDUSTRY RESPONDENTS** (in alphabetical order)

**Industry association**

Australian Livestock Transporters Association Commercial Vehicle Industry Association (NSW) Commercial Vehicle Industry Association (Qld) Commercial Vehicle Industry Association (SA) Commercial Vehicle Industry Association (Vic) Commercial Vehicle Industry Association (WA) NSW Road Transport Association

Natroad

Queensland Trucking Association Truck Industry Council

**Supplier / distributor**

Aboods Crane Trucks Michelin Australia

Barker Trailers Sci-Fleet Hino

CMV Truck and Bus South Eastern Trucks

CMV Voltruck Southern Cross Trailers

Crokers Truck Centre TruckSmart

Haulmark Trailers Volvo Truck & Bus Brisbane

Isuzu-General Motors Australia Volvo Truck Australia

Iveco Trucks Australia Western Star Trucks JT & PA Croyden

**Transport operator**

AEG Transport O’Connors Carrying Service

Bells Transport P & O Smith Bros

Burkes Haulage Pacific Coast Trucking

Carey’s Freight Lines (Tamworth) Q-Link

Carlswood Transport Q-Rail

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Collins Transport Adelaide R&G Bulk Carriers

Craig Jacobson Transport Richers Transport E Karras Refrigerated Transport & Storage Roadmaster

Frigmobil Robinvale Transport Group (SA)

Gunnings Transport Rocky’s Own Transport Co

Harker Transport Roly Robertson Transport

Hillman’s Transport RT & BF Turner

HMK Transport Russell Transport

Jacktrans Ruttley Freight Lines

Ken Lawson Transport Schmidt’s Livestock Transport

Latter’s Transport Scotts Refrigerated Freightways

Linfox Simon National Carriers

Mcarthur Express SPB Transport

Merri Transport Co Talco Transport

Mills Road Transport Service Toll Linehaul

Murrell Refrigerated Road Freighters Tymana Transport

Nolan’s Interstate Transport Wickham Freight Lines

NQX Freight System Zape Transport

**Consignor**

Bartter Enterprises Harvey Fresh Reliance Petroleum

**Other**

Australian Automobile Association John G Porter