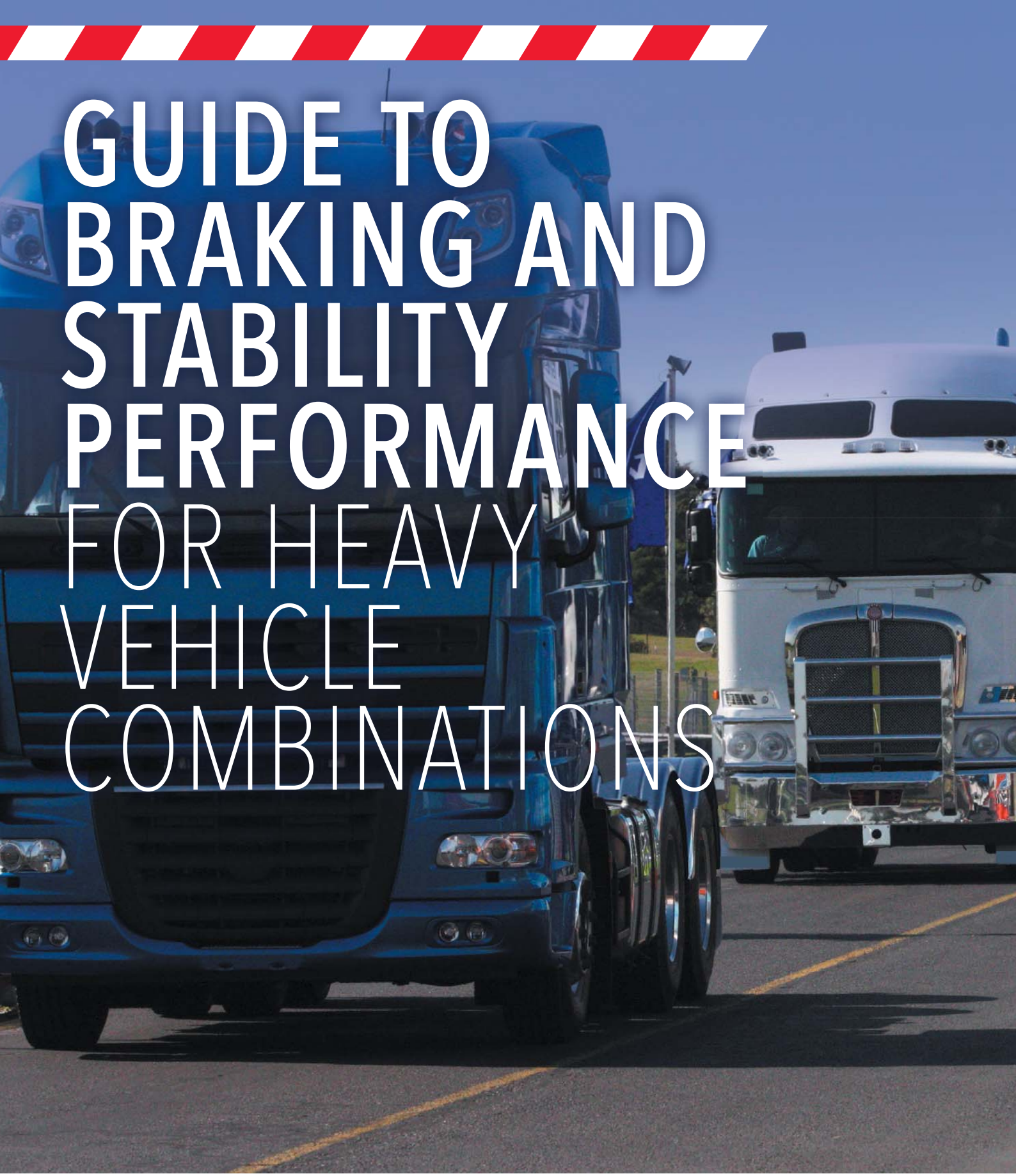

GUIDE TO BRAKING AND STABILITY PERFORMANCE FOR HEAVY VEHICLE COMBINATIONS

ALRTA Australian Livestock and Rural Transporters Association

ARTSA Australian Road Transport Suppliers Association

ATA Australian Trucking Association

CVIAA Commercial Vehicle Industry Association Australia

Heavy Vehicle Industry Australia

TIC Truck Industry Council

VERSION 1.0
ISSUED MAY 2017

This Guide and its use is entirely voluntary. Recommendations or procedures may not be suitable for, or applicable to all operators, up to date, complete or without exception. Operators should consider their own circumstances, practices and procedures when using this Guide.

Operators must comply with the Australian Design Rules (ADRs), the Australian vehicle standards regulations, roadworthiness guidelines and should comply with any specific information and instructions provided by manufacturers in relation to the vehicle systems and components.

This Guide is additional to, and does not seek to replace, the Australian Air Brake Code of Practice that was issued by the Australian Trucking Association in 1999. Please consult that document for further information about brake components and systems. This Guide provides guidance about acceptable brake balance on heavy combination vehicles and on providing updated information about electronically controlled braking systems, which have evolved substantially in the past decade.

Suggestions or comments about this Guide are welcome. Please contact any of the Associations detailed on the front cover.

VERSION 1.0
ISSUED MAY 2017

TABLE OF CONTENTS

APPENDICES

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Finally we also want to acknowledge our leading braking companies who not only contributed expertise but also assisted financially in the printing of this document. Whilst most of the work in this guide has been done on a voluntary basis, there are some things that require payment, and the companies opposite have been generous in assisting with the printing expenses to ensure that this guide can be made freely available.

May 2017

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GUIDE TO BRAKING AND STABILITY PERFORMANCE FOR HEAVY VEHICLE COMBINATIONS

Significant braking performance improvement can be achieved
by making the right choice about which trailer and truck braking technologies are combined. The improvement in safety and the reduction in brake wear can be very significant for any transport operator. This Guide gives performance ratings for light braking, heavy braking and roll stability.

This Guide has been developed by:

- *Australian Livestock and Rural Transporters Association (ALRTA)*
- *Australian Road Transport Suppliers Association (ARTSA)*
- *Australian Trucking Association (ATA)*
- *Commercial Vehicle Industry Association of Australia (CVIAA)*
- *Heavy Vehicle Industry Australia (HVIA)*
- *Truck Industry Council (TIC)*

in co-operation with key brake equipment suppliers and in consultation with the Department of Infrastructure and Regional Development and the office of the National Heavy Vehicle Regulator.

1. INTRODUCTION

This Guide provides brake and stability performance ratings for truck and trailer combinations, with varying brake technologies. It aims to assist the Australian road transport sector to achieve best practice in the braking and stability performance of heavy combination vehicles. It is directed towards operators and purchasers of heavy vehicles, technicians who maintain vehicles and to the suppliers of those vehicles.

The Guide is based on the collective experience of operators, suppliers, regulators and industry groups. It does not replace, vary or modify existing laws and regulations.

This Guide assumes that all parts of the combination are roadworthy, properly maintained to the manufacturers specifications and fitted with appropriate and serviceable tyres that are inflated to the correct (manufacturers recommended) pressures.

2. BACKGROUND

Australia has a range of heavy vehicle brake system types that mirror the mix of vehicle origins: European, North American, Japanese and Australian. This mix, together with the variations in load level and truck/trailer configurations that occur, makes it challenging to achieve optimal levels of braking compatibility and performance.

The brake systems on new and in-service heavy vehicles operating in Australia (and in particular combination vehicles) sometimes deliver performance levels that are significantly lower than could be achieved by the latest available technology. The latest advanced braking technologies offer great potential for improved heavy vehicle braking, but also increases the risk that mixing different brake technologies could worsen braking or stability performance of a heavy vehicle combination.

Trucks and trailers are linked by either a turntable/fifth wheel or drawbar coupling arrangement. Turntables/fifth wheel couplings allow the truck and trailer combination to be roll coupled. That is, the truck and trailer combination roll together. On the other hand, a drawbar coupling allows the truck and trailer combination to roll independently.

The mixing of brake technologies on heavy vehicle combinations should be implemented with caution.

Mixing of brake technology systems can be satisfactorily achieved if the equipment choices and the settings are appropriate.

In terms of road safety, poor braking or stability performance is hard to quantify as it is normally only one of a number of factors that contribute to a possible crash outcome.

The Commonwealth Department of Infrastructure and Regional Development's Regulatory Impact Statement released September 2013 for the National Heavy Vehicle Braking Strategy noted :-

> 'During the 12 months to the end of September 2011, 230 people died from 204 fatal crashes involving heavy trucks or buses. In the past, a wide range of factors have been identified as playing a role in these crashes, including the vehicle, the driver, the road environment and situations such as day/night or rural/metropolitan. For a number of years, it has also recognised that braking and truck instability are significant vehicle factors that relate to crash occurrence.'

Besides the human cost, each year in Australia the road transport industry pays millions of dollars extra for braking maintenance, tyres and downtime that can be attributed to poor heavy vehicle combination brake compatibility.

This Guide details brake performance ratings in three operational areas:

- Light or normal braking - covers issues around brake balance.
- Heavy or harsh braking - covers situations where wheels may lock up.
- Roll stability when cornering - covering both laden and unladen vehicles, worst case situation being laden.

A. BEST PERFORMANCE

The braking and stability performance tables in Chapter 5 show that the best braking and stability performance is achieved by the more advanced braking technology such as Electronic Stability Control (ESC) on both the truck and trailer. Good results can also be achieved by Anti-lock Braking System (ABS) and reasonable results can be achieved using Load Sensing Valve (LSV) braking systems on both the truck and trailer, but often the mixing of different technologies on the truck and trailers can be detrimental to the combinations braking and stability performance.

The improvement in safety and the reduction in brake wear by using compatible braking technologies on heavy vehicle combinations can be very significant for road transport operators.

B. SCOPE

This Guide applies to heavy combination vehicles that have air brake trailer connections.

In this Guide, a heavy combination vehicle is a truck with a gross vehicle mass typically of 12 tonnes or more, pulling at least one trailer with a gross trailer mass of 10 tonnes or more. This category includes, but is not limited to, semi-trailers, tipper and dog trailers, B-doubles and road trains.

In this Guide, truck means the motor vehicle (prime mover or rigid truck), combination vehicle means a truck connected to one or more trailers and vehicle part means either the truck or a trailer as appropriate in the context. All the vehicles under consideration have air brake connections between vehicles.

C. BRAKE BALANCE

A vehicle with good brake balance (even application of the brakes across the combination) should not exhibit gross wheel lock-up during heavy braking. Wheel lock-up is undesirable because a locked wheel has a substantially reduced capacity to manage steering, braking and road handling forces. Therefore, a vehicle in a combination that has many of its wheels locked within an axle group will more likely loose directional control. The characteristics of directional instability associated with the locking up of particular wheels is illustrated in appendix F – vehicle behaviour with wheel lock-up.

Brake balance should be assessed at both light and heavy brake application levels. The control level at which the brakes start to work is called the threshold, or onset air pressure level, and uneven brake threshold pressures between axles can cause uneven brake wear. The brake threshold pressure should be measured at the common datum point of the combination, typically the control coupling. With consistent brake threshold pressure and the same foundation brake setup, all brakes should begin generating usable brake torque at the same or near the same pressure. Good brake balance is necessary for even brake wear on a combination vehicle as well as good brake feel when the brakes are initially applied.

Brake linings should wear evenly on all axles for maximum brake life. For the same foundation brake setups with same linings, industry experience has been that the brakes should operate at similar temperature, within about 10 to 15 degrees centigrade of each other. Drum and disc brakes groups have different temperature profiles and changing linings will change the indicative brake operating temperature.

Good brake balance during light or normal braking levels is important because it minimises uneven brake wear. Most 'normal' day to day brake applications are low pressure (typically 80% or more below about 200 kPa). Brakes that wear prematurely on one vehicle element or one axle group therefore indicates either poor brake balance at low to moderate brake pressures; or poorly adjusted or dragging brakes.

Good brake balance during heavy or harsh braking levels requires the force produced by each wheel to be proportional to the load on the wheel. Brake balance will change significantly between the laden and unladen states. For best balance during heavy brake applications, each trailing part of the combination should have an electronically controlled brake distribution function, such as Anti-lock brakes (ABS) or Electronic Brake System (EBS). Pneumatic/mechanical load sensing valves (LSVs), are an alternative, however, they are not as effective as an electronically controlled brake system.

Vehicles with poor brake balance will generally exhibit uneven brake wear and can develop glazed brake linings, excessively heat-cracked brake drums or rotors. In extreme cases, excessively hot brakes might lead to wheel end fires.

Excessive temperature of some brakes is an indication of poor brake balance or dragging brakes.

3. HEAVY VEHICLE BRAKING SYSTEMS

There are nine aspects that are important for effective heavy vehicle braking:

1. Smooth pedal application with brake force that increases as the pedal is applied further,
2. Generous brake capability that easily meets legal stopping distances,
3. Directional control during heavy braking,
4. Electrical power must be available to advanced brake systems such as ABS and ESC/RSC to allow these systems to operate when fitted to any trailer in the combination,
5. Signal to the brakes is received by each wheel simultaneously, and as soon as possible, after foot pedal application,
6. Braking force that adapts to the load on each axle group,
7. Evenly distributed braking forces across all axles and wheels,
8. Initial setup and installation is critical to suit the operation and componentry,
9. Regular maintenance, using quality and compliant replacement parts.

Note:- Only combinations fitted with electronic braking systems can achieve, or come close to all of the ideal attributes for performance and safety.

Vehicles with good braking and stability performance are preferred because drivers will be able to brake with confidence and achieve shorter stopping distances whilst maintaining directional control and vehicle stability.

Also, operators should experience lower vehicle maintenance costs.

A. BRAKING TECHNOLOGIES EXPLAINED

The braking performance of heavy vehicles has significantly improved with the introduction of various electronic control systems. Advanced brake systems employ a combination of electronic and mechanical control to alter the brake effort and distribution across a combination. The total effect of this enhanced control is to assist the heavy vehicle driver in reducing speed quickly, whilst maintaining stability and directional control.

A key requirement for effective braking and minimum stopping distance is the length of time it takes between the driver pressing the brake pedal and the time it takes for brakes to apply, assuming the tyres maintain grip with the road. The pressing of the brake pedal initiates what is called the "brake control signal". It is important that all brakes receive this signal quickly, and ideally, all vehicle parts receive the signal simultaneously. This is particularly critical on air brake systems, which use air as the means of providing this control signal. A significant time delay can occur to the rear brakes on long-combination vehicles, when air is used as the control signal.

A load sensing valve (LSV) in the brake system alters the available brake force at an axle group in response to the static load on the axle group. This is achieved by using brake valves that typically alter their settings based on air-suspension bag pressures or the mechanical deflection of the leaf spring suspension.

Antilock Braking Systems (ABS) provides wheel lock-up protection and thereby may reduce stopping distances on sealed surfaces and will improve directional stability generally.

Electronic Brake Systems (EBS), or on trailers sometimes referred to as T-EBS may incorporate a combination of traction control, stability control, load sensing and anti-roll functions in addition to ABS functionality. Note that some EBS systems do not incorporate all functions mentioned here and it is important to check your truck or trailer EBS functions with the truck or trailer manufacturer.

Electronic braking systems can reduce brake application delay and uneven brake application/wear. The electronically controlled brake system control signal supplements the air control signal. The electronic brake control signal can improve overall brake response and stability in a combination, and such systems are recommended.

B. ROLL STABILITY AND IMPACTS OF BRAKING TECHNOLOGIES

For the tables included in this guide, the ratings for roll stability are only impacted by a direct link to technology that includes the roll stability feature. Brake technologies that don't directly control the combinations roll stability, such as load sensing and basic ABS are not rated for improved roll stability. They will assist with brake performance, which indirectly will assist with the directional stability of the combination.

4. BRAKING AND STABILITY TERMINOLOGY

Identifying the Brake System Type on Trucks and Trailers:

Many different terms and definitions are used to describe truck and trailer brake and/or stability systems. The following are the definitions and terms used in the tables of this Guide. It is **essential** that these terms are clearly understood and applied correctly when identifying the brake and stability systems on vehicles to be rated. If you are unsure of the brake and/or stability system of a vehicle seek clarification from the truck, trailer or brake system manufacturer, or a heavy vehicle Approved Vehicle Examiner (AVE).

ABS	Anti-lock Brake System used on a truck and/or trailer. Does NOT have Stability Control.
ABS with ESC	Electronic Stability Control system on a truck using ABS as the foundation technology, typically found on North American trucks.
Basic	Standard air brake system on the truck and/or trailer. Does NOT have LSV, ABS, EBS or ESC, or is an UNPOWERED ABS or T-EBS trailer.
EBS – Truck (No ESC)	Electronic Brake System on a truck. This is a "brake by wire" system, typically found on European and some Japanese trucks. It does NOT have Stability Control. Distributor / manufacturer will need to clarify installation.
EBS with ESC	Electronic Stability Control system on a truck using EBS as the operating system, typically found on European and some Japanese trucks.
ESC	Electronic Stability Control system applies the brakes at selected wheels autonomously to improve the vehicle directional and roll stability taking inputs of cornering speed and direction.
Heavy Braking	Rating under Heavy or Harsh braking.
Light Braking	Rating under Light or Normal braking.
LSV	Load proportioning Sensing Valve is used to limit brake force based on the trucks and/or trailer(s) load.
Brake system power or "through power"	Electrical power supplied to the following trailer braking (ABS/EBS) system on the towing truck and/or trailer(s).
Roll Stability	Reduced tendency of a truck or trailer to roll over when cornering / manouvering. Rollover stability of a truck in combination depends on a number of factors including the vehicle speed, centre of gravity height, the track width and the compliance in the tyres, suspensions.
SARN	Sub - Assembly Registration Number, a specific/unique Australian Design Rule (ADR) system approval number for trailer brake system(s).
T-EBS (No Roll Stability)	Electronic Brake System on a Trailer that has the Roll Stability deactivated. Deactivation of the Roll Stability function is NOT recommended by this Guide, however there may be some instances where the Roll Stability function can be safely deactivated, an example would be a non-roll coupled vehicle such as a Dolly. Note: T-EBS trailer systems that have Roll Stability deactivated still have their Load Sensing and ABS functions active.
T-EBS with Roll Stability	Electronic Brake System on a Trailer with Roll Stability control.

5. UNDERSTANDING THE PERFORMANCE RATING TABLES

The performance rating tables in appendix C and D – braking/stability tables, provides a subjective guide to likely brake and stability performance when different brake technologies are used in towing and towed vehicles.

Performance ratings are given for Light Braking, Heavy Braking and Roll Stability categories. Vehicle performance is subjectively predicted for these three operational areas and performance ratings from Poor (1) to Best (5) are indicated.

As well as being numbered from 1 to 5, the five levels of performance in the tables are colour coded for immediate identification as follows:

Ratings	Poor	Base	Good	Better	Best
	1	2	3	4	5

Table 1: Rating levels

Note

While all combinations comply with ADR's and are otherwise legal to operate, the minimum level of compatibility operators should aim to achieve is a base 2. Table 2, on the following page, details the differences between Poor (1) and Best (5) braking and stability performance. However, over time, operators should aim for continuous improvement and higher ratings as new equipment is purchased or in the case of trailers, refurbished.

TIP

If there is concern about the brake wear, stopping performance or directional control during braking of a combination vehicle that you operate:

- *Check that each vehicle in the combination is in good working order with all brake systems set, well maintained and/or adjusted to the manufacturer's settings.*
- *Rate the combination via the tables in appendices C and D of this guide. Does the combination meet the minimum desired subjective compatibility rating of 2 or higher?*
- *If performance issues persist, contact an accredited person or equipment supplier. In the National Heavy Vehicle Law, accredited persons are referred to as Approved Vehicle Examiners (AVE).*

Situation	Rating	
	Poor Braking & Stability (a "1" rating)	**Best Braking & Stability (a "5" rating)**
Light or Normal Braking: This refers to a light or normal application of vehicle brakes. Sometimes referred to as "light pedal pressure" braking. This represents approximately 70% to 90% of all brake use. This would also provide a good guide to brake wear balance for the whole truck and trailer(s) combination.	**Unbalanced braking typically characterised by some or all of the following:** · Brakes apply at uneven pressures. · Some brakes in the combination get much hotter than others. · Increased brake wear and/or uneven brake wear across the combination's brakes. · Uneven brake operation timing, with trailer(s) "pushing" or "pulling" each other and/or the truck. · Regular wheel lock up when applying brakes, particularly when lightly loaded or empty. · Reduced driver confidence in the braking "feel".	**Balanced braking typically characterised by:** · Each wheel brake applies at the same time and at the same pressure. · All wheel brakes reach about the same temperature. · Even brake wear across the combination. · Driver has full confidence in the combination's brake "feel".
Heavy or Harsh Braking: This refers to a heavy or harsh application of vehicle brakes.	**Unbalanced braking typically characterised by some or all of the following:** · Some wheel brakes lock-up, making directional control more difficult, particularly on slippery road surfaces or when lightly laden. · Increased stopping distances. · Reduced driver confidence in the combinations braking capacity. · Uneven brake operation timing causing "jolted" braking.	**Balanced braking typically characterised by:** · Balanced braking without wheel lock up and without loss of directional control of the combination. · Driver has full confidence in the combination's brake "feel".
Roll or Cornering Stability, especially when laden: The tendency for a vehicle to roll over when cornering.	**Poor roll stability control typically characterised by some or all of the following:** · Increased rollover potential, particularly with high centre of gravity loads. · Decreased ability for the truck and/or trailers anti-roll system, if fitted, to detect the point of potential rollover, or to prevent rollover by slowing the combination.	**Good roll stability control typically characterised by the following:** · Decreased roll over potential. · An anti-roll system, if fitted, can better monitor the rollover point of the truck and trailer(s). · An anti-roll system that can more effectively apply the brakes on each part of the combination to slow the vehicle, preventing roll over and allow safe cornering.

Table 2: Overview of the characteristics of subjective poor through to best performance ratings in light and heavy braking plus roll stability during cornering events.

6. HOW TO USE THE PERFORMANCE RATING TABLES

There are performance ratings tables in appendix C, for a truck and single trailer and appendix D for a trailer following another trailer(s) or a multi combinations vehicle.

For a multi combinations vehicle, use appendix C first, then appendix D for the following trailer(s).

The following is a step by step guide for using the tables. Where the combination is a single trailer, only steps 1 & 2 apply. For multi combinations, steps 3 & 4 are also needed.

A. RATING FOR A TRUCK AND SINGLE (LEAD) TRAILER

Step 1

Determine the type of brake systems on the Truck and Trailer(s) by checking if the truck is equipped with a socket to power the ABS or EBS systems of the following trailer(s).

For trailers with a tow coupling or fifth wheel coupling also determine if the trailer is equipped with "through wiring" to power the ABS or EBS system of any following trailer(s).

Note: Please refer to Chapter 4, as well as appendices B and E for more details of the brake system type definitions and how to determine a vehicle's brake system type.

Step 2

Use either table 3 or appendix C to determine light and heavy braking plus roll stability ratings.

Note: Operators should strive for the highest rating achievable from the equipment.

B. RATING FOR FOLLOWING TRAILERS IN A MULTI COMBINATION

Step 3

Determine if the towing trailer(s) is equipped with "through wiring" to power the ABS or EBS system of the following trailer(s).

Step 4

Use either table 4 or appendix D to determine the towing (1st) trailer and towed (2nd) trailer's stability ratings.

Step 5

If reviewing a combination with more than two trailers, repeat steps 3 and 4 for the remaining trailer(s).

7. WORKED EXAMPLES

This section provides two worked examples for assessing the braking performance of B double and semi-trailer combinations. It assesses the performance rating then recalculates that rating based on a different vehicle configuration. The purpose of these worked examples is to show how the braking performance can be improved by changing the vehicle configuration.

A. WORKED EXAMPLE: RATING FOR A B-DOUBLE

The following example of a B-double illustrates the use of the tables in appendix C and D.

Step 1

The brake system types on each part of the truck and 1st trailer are identified as:

- The prime mover: equipped with an ABS brake system and has brake system power (an ABS/EBS socket) for the following trailer.
- The A – trailer (1st Trailer): equipped with an T-EBS with roll stability brake system and has "through wiring" eg has an ABS/EBS socket for the following trailer.
- The B – trailer (2nd Trailer): basic brakes (no ABS, LSV, or EBS).

Step 2

Using either Table 3 or appendix C for the Truck and 1st Trailer, we obtain a score of **1 (Poor)** for **light braking**, a score of **4 (Better)** for **heavy braking** and a score of **4 (Better)** for **roll stability**.

The brake system types and their assessed performance rating have been identified and circled in red below.

Brake System: Truck	Trailer Brake System Power Yes/No	Brake System: Semi Trailer/ Dog Trailer / Lead Trailer/Dolly														
		Basic			LSV			ABS			T-EBS (No Roll Stability)			T-EBS with Roll Stability		
		Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability
Basic	√	2	1	1	1	2	1	2	2	1	1	3	1	1	3	3
	x	2	1	1	1	2	1	2	1	1	2	1	1	2	1	1
LSV	√	1	1	1	3	2	1	1	2	1	4	3	1	4	3	3
	x	1	1	1	3	2	1	1	1	1	1	1	1	1	1	1
ABS	√	2	2	1	1	2	1	2	3	1	1	4	1	1	4	4
	x	2	2	1	1	2	1	2	3	1	2	2	1	2	2	1
ABS with ESC	√	2	3	3	1	3	3	2	4	3	1	5	3	1	5	5
	x	2	3	3	1	3	3	2	4	3	2	3	3	2	3	3
EBS - Truck (No ESC)	√	1	2	1	4	2	1	1	3	1	5	4	1	5	4	4
	x	1	2	1	3	2	1	1	3	1	1	2	1	1	2	1
EBS with ESC	√	1	3	3	4	3	3	1	4	3	5	5	3	5	5	5
	x	1	3	3	4	3	3	1	4	3	1	3	3	1	3	3

Table 3: performance rating for truck and trailer

Rating:	Poor	Base	Good	Better	Best
	1	2	3	4	5

Step 3

Using Table 4 or appendix D for the 1st trailer and 2nd trailer, we have a score of **1 (Poor)** for **light braking**, a score of **3 (Good)** for **heavy braking** and a score of **3 (Good)** for **roll stability.**

Brake System: Towing Trailer	Following Trailer Brake System Power Yes/No	Brake System: Following Trailer or Dolly														
		Basic			LSV			ABS			T-EBS (No Roll Stability)			T-EBS with Roll Stability		
		Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability
Basic	√	2	1	1	1	2	1	2	2	1	1	3	1	1	3	3
	x	2	1	1	1	2	1	2	1	1	2	1	1	2	1	1
LSV	√	1	1	1	3	2	1	1	2	1	4	3	1	4	3	3
	x	1	1	1	3	2	1	1	1	1	1	1	1	1	1	1
ABS-Unpowered	x	2	1	1	1	2	1	2	1	1	2	1	1	2	1	1
ABS	√	2	3	1	1	3	1	2	4	1	1	5	1	1	5	4
T-EBS-Unpowered	x	2	3	1	1	3	1	2	4	1	2	3	1	2	3	3
	x	2	1	1	1	2	1	2	1	1	2	1	1	2	1	1
T-EBS (No Roll Stability)	√	1	1	1	3	2	1	1	4	1	4	3	1	4	3	3
	x	1	1	1	3	2	1	1	1	1	1	1	1	1	1	1
T-EBS with Roll Stability	√	1	3	3	4	3	3	1	4	3	5	5	3	5	5	5
	x	1	3	3	4	3	3	1	4	3	1	3	3	1	3	3

Table 4: performance rating for trailer and trailer

Rating:	Poor	Base	Good	Better	Best
	1	2	3	4	5

Summarising the results for the multi combination trailer:

Truck and 1st Trailer:

Light Braking: 1 (Poor)
Heavy Braking: 4 (Better)
Roll Stability: 4 (Better)

1st Trailer and 2nd Trailer:

Light Braking: 1 (Poor)
Heavy Braking: 3 (Good)
Roll Stability: 3 (Good)

B. WORKED EXAMPLE: CREATING A SAFER B-DOUBLE COMBINATION

Continuing with the previous B-Double example, we can improve the brake performance of the Truck and 1st Trailer, by substituting the prime mover with one that has EBS without ESC.

Repeating steps 1 and 2:

Step 1

The brake system types on each part of the Truck and 1st Trailer are identified and circled in red below in table 5:

The Prime Mover: Is equipped with an EBS without ESC brake system and has Brake System Power (an ABS/EBS socket) for the following trailer.

Step 2

Using table 5 for the alternative Truck and 1st Trailer, we obtain a score of **5 (Best)** for **Light Braking**, a score of **4 (Better)** for **Heavy Braking** and a score of **4 (Better)** for **Roll Stability.**

Brake System: Truck	Trailer Brake System Power Yes/No	Brake System: Semi Trailer/ Dog Trailer / Lead Trailer/Dolly														
		Basic			LSV			ABS			T-EBS (No Roll Stability)			T-EBS with Roll Stability		
		Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability
Basic	√	2	1	1	1	2	1	2	2	1	1	3	1	1	3	3
	x	2	1	1	1	2	1	2	1	1	2	1	1	2	1	1
LSV	√	1	1	1	3	2	1	1	2	1	4	3	1	4	3	3
	x	1	1	1	3	2	1	1	1	1	1	1	1	1	1	1
ABS	√	2	2	1	1	2	1	2	3	1	1	4	1	1	4	4
	x	2	2	1	1	2	1	2	3	1	2	2	1	2	2	1
ABS with ESC	√	2	3	3	1	3	3	2	4	3	1	5	3	1	5	5
	x	2	3	3	1	3	3	2	4	3	2	3	3	2	3	3
EBS - Truck (No ESC)	√	1	2	1	4	2	1	1	3	1	5	4	1	5	4	4
	x	1	2	1	3	2	1	1	3	1	1	2	1	1	2	1
EBS with ESC	√	1	3	3	4	3	3	1	4	3	5	5	3	5	5	5
	x	1	3	3	4	3	3	1	4	3	1	3	3	1	3	3

Rating:	Poor	Base	Good	Better	Best
	1	2	3	4	5

Table 5: Example - B double truck & trailer rating

Continuing with this B-Double example, the brake performance of the 1st Trailer and 2nd Trailer can be improved by substituting the 2nd Trailer with one that has Load Sensing Brakes (LSV).

Repeating Steps 3 and 4:

Step 3

The brake system types on the 1st trailer and the 2nd trailer are identified and underlined below in table 6:

The B – Trailer (2nd trailer): Is equipped with a LSV brake system, this trailer does not have a rear tow coupling so it does **NOT have "through wiring".**

Step 4

Using Table 2 for the 1st Trailer and alternative 2nd Trailer, we find we have a score of **4 (Better)** for **Light Braking**, a score of **3 (Good)** for **Heavy Braking** and a score of **3 (Good)** for **Roll Stability.**

Brake System: Towing Trailer	Following Trailer Brake System Power Yes/No	Brake System: Following Trailer or Dolly															
		Basic			LSV			ABS			T-EBS (No Roll Stability)			T-EBS with Roll Stability			
		Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	
Basic	√	2	1	1	1	2	1	2	2	1	1	3	1	1	3	3	
	x	2	1	1	1	2	1	2	1	1	2	1	1	2	1	1	
LSV	√	1	1	1	3	2	1	1	2	1	4	3	1	4	3	3	
	x	1	1	1	3	2	1	1	1	1	1	1	1	1	1	1	
ABS-Unpowered	x	2	1	1	1	2	1	2	1	1	2	1	1	2	1	1	
ABS	√	2	3	1	1	3	1	2	4	1	1	5	1	1	5	4	
T-EBS-Unpowered	x	2	3	1	1	3	1	2	4	1	2	3	1	2	3	3	
	x	2	1	1	1	2	1	2	1	1	2	1	1	2	1	1	
T-EBS (No Roll Stability)	√	1	1	1	3	2	1	1	4	1	4	3	1	4	3	3	
	x	1	1	1	3	2	1	1	1	1	1	1	1	1	1	1	
T-EBS with Roll Stability	√	1	3	3	4	3	3	1	4	3	5	5	3	5	5	5	
	x	1	3	3	4	3	3	1	4	3	1	3	3	1	3	3	

Rating:	Poor	Base	Good	Better	Best
	1	2	3	4	5

Table 6: Example - B double trailer/trailer rating

Summarising the results for the multi combination:

Truck and 1st Trailer:

Light Braking:	5 (Best) improved rating
Heavy Braking:	4 (Better)
Roll Stability:	4 (Better)

1st Trailer and 2nd Trailer:

Light Braking:	4 (Better) improved rating
Heavy Braking:	3 (Good)
Roll Stability:	3 (Good)

In the example above, by substituting some of vehicle elements in the combination, we have assembled a truck and two trailer B-Double set that is predicted to have better balanced braking performance than the original multi-combination.

C. WORKED EXAMPLE: CREATING A SAFER SEMI-TRAILER COMBINATION

The following example of a prime mover and semi-trailer illustrates the use of the table in appendix C.

Step 1

The brake system types on each part of the truck and the trailer are identified and underlined in red below:

- **The prime mover**: Is equipped with an **ABS** brake system and has **brake system power** (an ABS/EBS socket) for the following trailer.
- **The semi- trailer**: has a **basic brake system**.

Step 2 – A SAFER COMBINATION IN GREEN.

The brake system types on each part of the truck and the trailer are identified below:

- **The prime mover**: is unchanged (in red).
- **The semi- trailer**: now shown in green, has been fitted with **T-EBS with roll stability**.

Brake System: Truck	Trailer Brake System Power Yes/No	Brake System: Semi Trailer/ Dog Trailer / Lead Trailer/Dolly														
		Basic			LSV			ABS			T-EBS (No Roll Stability)			T-EBS with Roll Stability		
		Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability
Basic	√	2	1	1	1	2	1	2	2	1	1	3	1	1	3	3
	x	2	1	1	1	2	1	2	1	1	2	1	1	2	1	1
LSV	√	1	1	1	3	2	1	1	2	1	4	3	1	4	3	3
	x	1	1	1	3	2	1	1	1	1	1	1	1	1	1	1
ABS	√	2	2	1	1	2	1	2	3	1	1	4	1	1	4	4
	x	2	2	1	1	2	1	2	3	1	2	2	1	2	2	1
ABS with ESC	√	2	3	3	1	3	3	2	4	3	1	5	3	1	5	5
	x	2	3	3	1	3	3	2	4	3	2	3	3	2	3	3
EBS - Truck (No ESC)	√	1	2	1	4	2	1	1	3	1	5	4	1	5	4	4
	x	1	2	1	3	2	1	1	3	1	1	2	1	1	2	1
EBS with ESC	√	1	3	3	4	3	3	1	4	3	5	5	3	5	5	5
	x	1	3	3	4	3	3	1	4	3	1	3	3	1	3	3

Rating:	Poor	Base	Good	Better	Best
	1	2	3	4	5

Table 7: Example - Semi-trailer combination

Step 3 – COMPARISON.

Initial rating **2 / 2 / 1**

Revised rating **1 / 4 / 4**

Light braking rating has been reduced slightly, while heavy braking and roll stability have improved significantly. This may not seem logical, but ABS offers no benefit during light braking events. However, load sensing, a feature inherent within T-EBS, enhances light braking events, but not heavy braking. The net result is that for the initial rating, the light braking events was a similar level between truck and trailer, but when one element has load sensing and the other does not, light brake balance is reduced and uneven wear will result.

8. TROUBLE SHOOTING: MODIFICATIONS AND SETTINGS FOR TRAILER BRAKING

Workshop personnel and fleet owners should be aware that changing or modifying factory settings and/or components can affect the vehicles compliance and/or its roadworthiness.

Fleet operators and owners should keep records of certification information for their trailers. The trailer supplier or builder should provide a copy of this information when the trailer is delivered new, or if the trailer is used, the previous owner should pass the certification information to the new owner.

The certification information should include, as a minimum, maximum axle load, lining/pad grade/ specification, booster size, slack adjuster setting and permissible tyre sizes.

If you alter any of the following aspects you will need to get the brake system re-certified, and a modification plate or label fitted by an Approved Vehicle Examiner (AVE):

- Tyre size.
- Brake booster size.
- Slack adjuster length.
- Foundation brake size.
- Foundation brake friction material (linings and pads).
- Change of axle type .

Note, this list is offered as a guide and should not necessarily be considered an exhaustive, or complete list.

For more details on brake modifications, refer to Vehicle Standards Bulletin 6 (VSB6) – National Code of Practice for Heavy Vehicle Modifications, Section G, The web address is **www.nhvr.gov.au/VSB6**

Further information regarding modifications can be found in appendix G.

Auxiliary brakes such as an engine brake or a driveshaft retarder, apply torque to the drive wheels of the truck. The force produced by the auxiliary brakes is additional to the force produced by the service brakes. It is not advisable to use the auxiliary brake on the full setting when the vehicle is lightly laden.

The intent of this guide is to provide basic information only. Seek expert help when considering brake modifications or adjustments not related to routine maintenance.

APPENDICES

APPENDIX A Good practice guidelines and principles

The following guidelines and principles have been used in formulating performance rating tables.

1. Brake system components and setup should not be altered from Original Equipment Manufacturer (OEM) specifications.
2. It is preferable, but not mandatory, to use the same brake technologies on every vehicle in a combination.
3. If a vehicle element has an intelligent brake system that can automatically apply the brakes to improve vehicle directional stability, such as ESC, other vehicle parts in the combination should have wheel anti-lock protection (ABS) brake as a minimum.
4. If a trailer with a brake load sensing system is pulled by a vehicle without one, the use of a towing vehicle with ABS is recommended, to help maintain combination directional control.
5. ABS should be used on towing vehicles, particularly on lightweight ones, to provide direction control.
6. It is recommended all vehicles be fitted with automatic brake slack adjusters.
7. A good voltage supply is essential for reliable EBS operation. Even with multi-volt EBS and ABS systems, reliability can be enhanced by the use of 24V supply. For combination vehicles that are required to power three or more trailers/dollies, a good 24V supply is recommended. The connector at the rear of the prime mover must conform to ISO 7638-1 or -2 standards. The ABS/EBS supply voltage and CAN voltage are interlinked: If the truck voltage output is 24V for the ABS/EBS, the CAN signal must be in the right range (for 24V CAN). If the truck output is 12V for the trailer ABS/EBS, the truck must output a CAN signal that suits 12V. Further details for these are set out in ISO 11992 standard.
8. The adjustment of ABS wheel-speed sensors should be routinely checked when the brakes are serviced. Sensors should be routinely pushed into position when the brakes are checked. Pole wheel sensor gap should be between 0.1mm and 0.5mm to give best results.
9. The ABS / EBS connector on the towing vehicle should be a socket type.
10. Electronic trailer brake communication/signalling (CAN bus signalling) is preferred.
11. Trailer manufacturers, installers and repairers should adopt a clear colour code for pneumatic brake tubing. A suitable code is:

    a. Air supply lines: Red

    b. Service brake control lines: Blue

    Colour coding helps the service personnel trace the air system and speed up fault-finding and servicing of vehicle brake systems.

APPENDIX B Brake system information – truck and trailer fleet

This spreadsheet is an example of the information and format that should be used to identify and record the vehicles in an operator's fleet. This information is vital for the correct use of the brake compatibility tables in appendices C and D.

Brake System Identification Information - Truck and Trailer Fleet

	Date added or updated	Vehicle Identification (at least one of the following)			Vehicle Type	Foundation Brakes	Vehicle Voltage	Brake System Type	Supply Voltage to Following Trailer	LSV, ABS, EBS, T-EBS Brake System Supplier	Trailer SARN Trailer Brake Control System Reference Number	Comments
		Registration Number	VIN (17 digits)	Fleet or Plant Number								
Example	01-Feb-15	ABC-123	12345678901234567	PM1234	Rigid Truck	Disc	12 volt	EBS with ESC	12 volt	OEM	Truck OEM	Got the data from Truck OEM, FRED 29/Jan/2015
Example	23-Apr-15	CBT-666	12345678901234567	12345	Dog Trailer	Drum	Multi-volt	ABS	Unpowered	Knorr	Trailer SARN Req,	Got the data from workshop service ABC Repairs BOB 2/April/2015
Example	24-Apr-15	ABC-129	12345678901234567	D2388C	Rigid Truck	Disc	Multi-volt	T-EBS (No Roll Stability)	Multi-volt	Haldex	Trailer SARN Req,	Got the data from Trailer OEM FRED trailers, BRUCE 1/April/2015
Example	25-Apr-15	ABC-130	12345678901234567	ABC123	Prime Mover	Disc	12 volt	T-EBS (No Roll Stability)	24 volt	Wabco	Truck OEM	Got the data from Trailer OEM FRED trailers, BRUCE 1/April/2016

APPENDIX C Subjective braking compatibility table – Truck and single trailer

Brake System: Truck	Trailer Brake System Power Yes/No	Brake System: Semi Trailer/ Dog Trailer / Lead Trailer/Dolly														
		Basic			LSV			ABS			T-EBS (No Roll Stability)			T-EBS with Roll Stability		
		Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability
Basic	√	2	1	1	1	2	1	2	2	1	1	3	1	1	3	3
	x	2	1	1	1	2	1	2	1	1	2	1	1	2	1	1
LSV	√	1	1	1	3	2	1	1	2	1	4	3	1	4	3	3
	x	1	1	1	3	2	1	1	1	1	1	1	1	1	1	1
ABS	√	2	2	1	1	2	1	2	3	1	1	4	1	1	4	4
	x	2	2	1	1	2	1	2	3	1	2	2	1	2	2	1
ABS with ESC	√	2	3	3	1	3	3	2	4	3	1	5	3	1	5	5
	x	2	3	3	1	3	3	2	4	3	2	3	3	2	3	3
EBS - Truck (No ESC)	√	1	2	1	4	2	1	1	3	1	5	4	1	5	4	4
	x	1	2	1	3	2	1	1	3	1	1	2	1	1	2	1
EBS with ESC	√	1	3	3	4	3	3	1	4	3	5	5	3	5	5	5
	x	1	3	3	4	3	3	1	4	3	1	3	3	1	3	3

Rating:	Poor	Base	Good	Better	Best
	1	2	3	4	5

APPENDIX D Subjective braking compatibility table – Trailer towing a trailer

Brake System: Towing Trailer	Following Trailer Brake System Power Yes/No	Brake System: Following Trailer or Dolly														
		Basic			LSV			ABS			T-EBS (No Roll Stability)			T-EBS with Roll Stability		
		Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability	Light Braking	Heavy Braking	Roll Stability
Basic	√	2	1	1	1	2	1	2	2	1	1	3	1	1	3	3
	x	2	1	1	1	2	1	2	1	1	2	1	1	2	1	1
LSV	√	1	1	1	3	2	1	1	2	1	4	3	1	4	3	3
	x	1	1	1	3	2	1	1	1	1	1	1	1	1	1	1
ABS-Unpowered	x	2	1	1	1	2	1	2	1	1	2	1	1	2	1	1
ABS	√	2	3	1	1	3	1	2	4	1	1	5	1	1	5	4
T-EBS-Unpowered	x	2	3	1	1	3	1	2	4	1	2	3	1	2	3	3
	x	2	1	1	1	2	1	2	1	1	2	1	1	2	1	1
T-EBS (No Roll Stability)	√	1	1	1	3	2	1	1	4	1	4	3	1	4	3	3
	x	1	1	1	3	2	1	1	1	1	1	1	1	1	1	1
T-EBS with Roll Stability	√	1	3	3	4	3	3	1	4	3	5	5	3	5	5	5
	x	1	3	3	4	3	3	1	4	3	1	3	3	1	3	3

Rating:

Poor	Base	Good	Better	Best
1	2	3	4	5

APPENDIX E Description and terminology of brake technologies

Description of the main braking control systems that are used on buses, trucks and trailers.

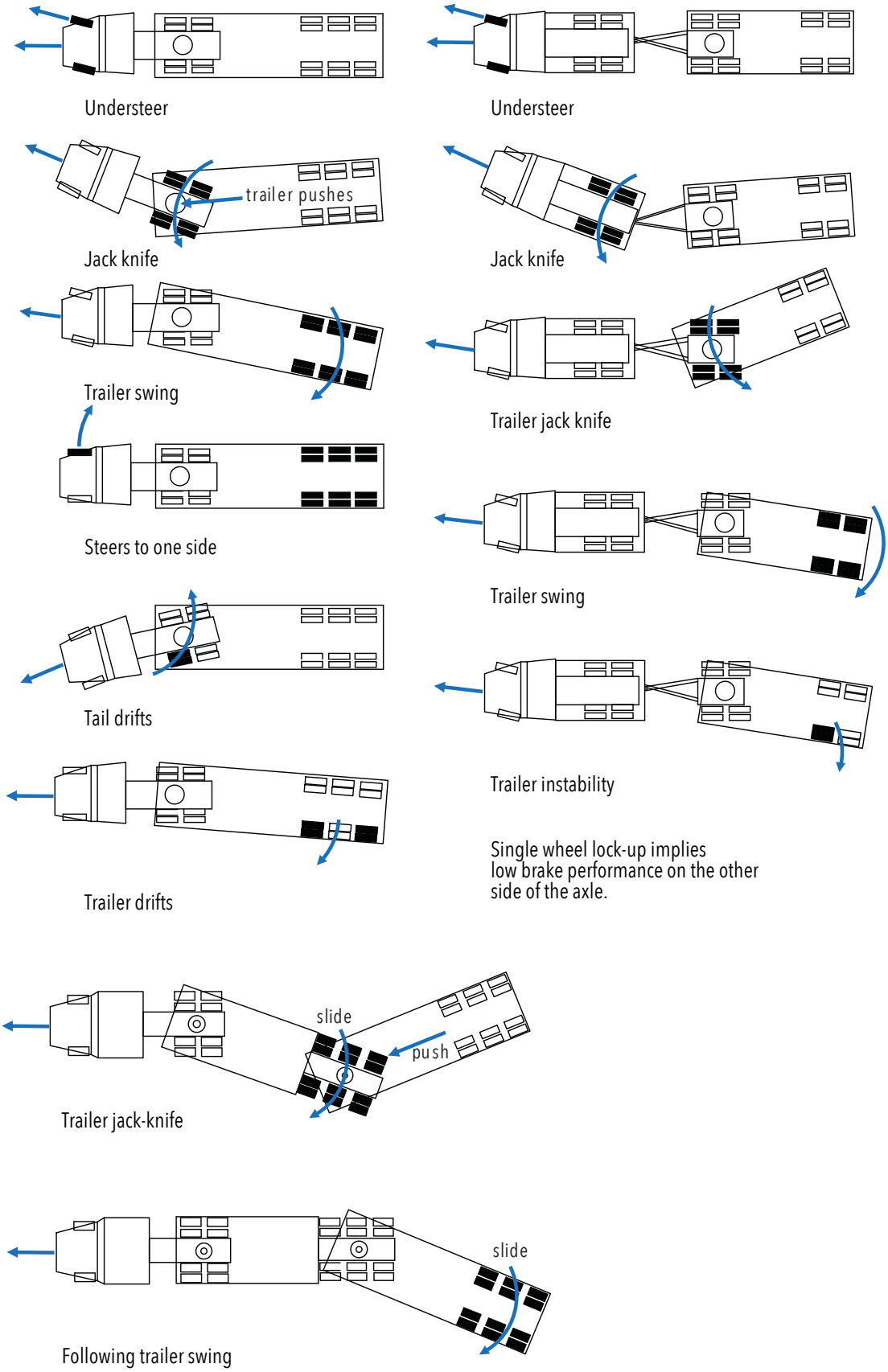
System Name	Function	Sensors	Actuators	Incorporated functions
'ABS Platform'	A basic ABS system to which is added additional functional elements such as ESC, or Brake Assist.			
Automatic Brake Slack Adjuster (ABA)	A mechanical device that adjusts individual service brakes at each brake application to keep the individual brake in good adjustment. An ABA must be set-up correctly each time the brake linings / pads are changed.			Automatic brake adjusters keep brakes in adjustment and this minimises air-usage during ABS modulation. ABS is now mandated by ADR35 for trucks and optional via ADR38 for trailers. If ABS is fitted, automatic brake slack adjusters are required by both ADR35/05 and ADR38/04 for trucks and trailers respectively.
Anti-lock Brake System (ABS) **May also be called Anti-skid.**	It modulates the brakes air supply pressure, for the axle group, to prevent sustained wheel lock-up.	Wheel speed sensors.	Modulator valves. Usually one for each side of each axle group.	ABS can be used on trailers with ATM > 12t to satisfy ADR 38/04. ABS is mandated on trucks with GVM > 12t.
Basic - Foundation Brakes	Basic brake system without any enhancements such as ABS etc		Brake Pedal	

Cont.

System Name	Function	Sensors	Actuators	Incorporated functions
Brake Assist (BA)	Manages emergency braking events. Operation is triggered by a sudden harsh brake-pedal movement.	Wheel speed sensors. Brake pedal sensor.	Electronically- controlled. Actuating modulation valves.	Always coupled with EBS or ESC.
Electronic Stability Control / Program (ESC).	Applies the brakes at selected wheels autonomously to improve the vehicle's directional and roll stability control.	Wheel speed sensors. Steering column angle sensor. Yaw acceleration sensor. Brake pedal sensor. CAN signals to the trailer(s).	Actuating modulator valves at each wheel. CAN instructions to the trailer. Electronically controlled air relay valves.	Wheel lock protection (ABS). Roll-over protection function (RSP). Traction control (ATC). Electronic trailer signalling (U and A). Electronically controlled braking system (EBS – European).
Electronic Brake Force Distribution (EBD)	Electronically sets the brake level on a rear axle group proportional to an estimate of the load carried based on detected wheel slip differences.	Wheel speed sensors. Air-bag suspension pressure sensor.	Electronically-controlled trailer relay valves.	This is a standard feature of an EBS system. EBD is available on some North American and Australian trucks as an 'advanced ABS'.
Electronic Braking System (EBS) * * This is available on European and some Japanese designed or manufactured trucks, but not on American or Australian designed or manufactured trucks. Note that a system that is marketed in Australia as EBSS is not EBS	Manages each braking event to achieve balanced braking. Characterised by CAN communication between all controllers, valves and sensors. T – EBS is the generalised term for trailer stability and will continue to operate even without the an EBS control signal.	Wheel speed sensors. Brake pedal sensor. Brake wear sensors.	Electronically- controlled air relay valves. Actuating modulation valves.	Wheel lock protection (ABS). Traction control (ATC). Trailer response management (TRM). Electronic brake distribution (EBD).
'EBS Platform'	A basic EBS system to which is added additional functional elements such as ESC, ACC and Brake Assist.			
Electronic signalling to the trailer for non EBS trucks.	Electronic signalling can be added to a towing vehicle that does not have EBS.	Usually has a pressure sensor that measures the trailer control air pressure level.	Generated by a pressure-to-CAN signal converter.	A standard feature of EBS and ESC.
Electronic Control Module (ECM)	An electronic unit that implements programmed brake functions in response to signals and switch positions. The actions are implemented electronically via output circuits.	Various	Various	All electronically-controlled systems have one or more ECMs. The ECM is the brain of the system or of subsystems.
Truck or Trailer Roll Stability Program (RSS or RSP or RSC)	Acts to slow the truck when a possible roll-over is detected. Operation is triggered by excessive lateral force and differences in wheel-speeds from side-to-side.	Wheel speed sensors. Lateral acceleration sensor.	Actuating modulator on the drive-group. CAN instructions to the engine to reduce RPM.	Anti-lock brakes. In Australia, trailer RSS is always coupled with trailer EBS. Truck RSS is coupled with EBS on European made trucks and buses.

APPENDIX F Vehicle behaviour during wheel lock up

Directional instability resulting from wheel lock up (black tyres) on a semi-trailer (left top), truck and dog trailer (right top) and B-double (bottom).



APPENDIX G Modifications to trucks or trailers

A new truck or trailer that is supplied to market requires that an identification plate (compliance plate) be fitted to a vehicle. This plate is an assurance to the owner and registration authority (State and National Heavy Vehicle Regulator (NHVR)) that the vehicle complies with the relevant Australian Design Rules for the truck or trailer.

When a truck or trailer is modified after the identification plate is fitted, the modifications may be such that the modified vehicle does not match the vehicle specification as approved under the original identification plate.

If any vehicle modifications are to be carried out, it is vital to seek information from the regulator covering your State of registration, prior to the modification occurring. It is also highly recommended that if your regulator requires assessment by a third party, such as an NHVR Approved Vehicle Examiner (AVE) or WA/NT authorised modifier, they should also be consulted prior to performing modifications.

In general, modifications to the brake system will require certification by your Regulator. The certification process will depend on the specific modification and your Regulator's requirements.

Further information on heavy vehicle modifications:

For ACT, NSW, QLD, SA, TAS & VIC

- National Heavy Vehicle Regulator (NHVR)

www.nhvr.gov.au/safety-accreditation-compliance/vehicle-standards-and-modifications/heavy-vehicle-modifications

For Western Australia

- Department of Transport WA

www.transport.wa.gov.au/licensing/modify-a-heavy-vehicle.asp

For Northern Territory

- Department of Transport NT

www.nt.gov.au/driving/heavy/heavy-vehicle-modifications

APPENDIX H Trailer braking system identification

How to identify which braking system is fitted to a trailer.

1. Does the trailer have an ABS / EBS (ISO 7638) plug or socket installed on the trailer?

7 Pin Socket

Plug

Socket

The socket may have either 5 or 7 pins present. If there are only 5 pins, the unit is not wired for CAN or EBS communications and is an ABS set-up. However, if 7 pins are present, it won't necessarily guarantee CAN or EBS communications. Please check with your distributor/manufacturer.

2. If no, go to step 3. If yes does the trailer have a ABS warning label, T-EBS or LSV Data label fitted?

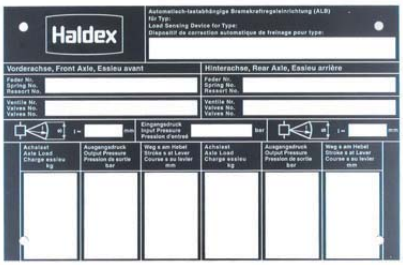
   If an EBS unit has been installed on the trailer an T-EBS Data label like or similar to the following should have also been fitted on the trailer:

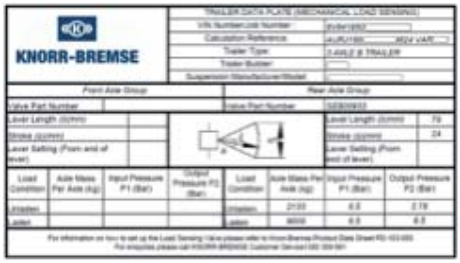
	BPW ADR TÜ.EGG.094-04			4S/2M Stability		S1A S1B	510mm 100t	S2A S2B	510mm 100t
TRAILER MANUFACTURER FAHRZEUGHERSTELLER PRODUCTEUR DE VEHICULE	Byford Equipment			BRAKE CALCULATION NO. BREMSBERECHNUNGSNUMMER CALCUL DE FREINAGE NO.		AUS10IMT1627			
CHASSIS NUMBER FAHRGESTELLNUMMER NUMERO DE CHASSIS	6B9BP5F23A1DR6511			TYPE TYP TYPE		Tri 32327			
THRESHOLD PRESSURE ANSPRECHDRUCK PRESSION D'APPROCHE [bar]	0.20			PRESSURE LIMIT DRUCKBEGRENZUNG LIMITE DE PRESSION [bar]		6.50			
	UNLADEN / LEER / A VIDE			LADEN / BELADEN / EN CHARGE					
	INPUT PRESSURE EINGANGSDRUCK PRESSION D'ENTRÉE [bar]		6.50	INPUT PRESSURE EINGANGSDRUCK PRESSION D'ENTRÉE [bar]		0.60	1.60	-	6.50
[1.00 bar = 100 kPa]	AXLE LOAD ACHSLAST CHARGE ESSIEU [kg]	SUSPENSION PRESSURE BALGDRUCK PRESSION DE SUSPENSION [bar]	OUTPUT PRESSURE AUSGANGSDRUCK PRESSION DE SORTIE [bar]	AXLE LOAD ACHSLAST CHARGE ESSIEU [kg]	SUSPENSION PRESSURE BALGDRUCK PRESSION DE SUSPENSION [bar]	OUTPUT PRESSURE AUSGANGSDRUCK PRESSION DE SORTIE [bar]			
1 AXLE 1 ACHSE 1 ESSIEU	1730	0.60	4.20	7500	4.30	0.40	1.30	-	6.50
2 AXLE 2 ACHSE 2 ESSIEU	1730	0.60	4.20	7500	4.30	0.40	1.30	-	6.50
3 AXLE 3 ACHSE 3 ESSIEU	1730	0.60	4.20	7500	4.30	0.40	1.30	-	6.50

Haldex	EB+ ADR TÜ.EGG.094-04					4S/2M Stability		S1A S1B	517mm 90t	S2A S2B	517mm 100t
TRAILER MANUFACTURER FAHRZEUGHERSTELLER CONSTRUCTEUR						BRAKE CALCULATION NO. BREMSBERECHNUNGSNUMMER CALCUL DE FREINAGE NO.					
CHASSIS NUMBER FAHRGESTELLNUMMER NUMERO DE CHASSIS						TYPE TYP TYPE					
THRESHOLD PRESSURE ANSPRECHDRUCK PRESSION D'APPROCHE [bar]						PRESSURE LIMIT DRUCKBEGRENZUNG LIMITE DE PRESSION [bar]					
						UNLADEN / LEER / A VIDE [1.00 bar = 100 kPa]		LADEN / BELADEN / EN CHARGE [1.00 bar = 100 kPa]			
				[bar]		INPUT PRESSURE EINGANGSDRUCK PRESSION D'ENTRÉE [bar]	6.50	INPUT PRESSURE EINGANGSDRUCK PRESSION D'ENTRÉE [bar]	0.50	1.60	- 6.50
Type	[mm]	[mm]	1.0 TR [daN]	Pz		AXLE LOAD ACHSLAST CHARGE ESSIEU [kg]	SUSPENSION PRESSURE BALGDRUCK PRESSION DE SUSPENSION [bar]	OUTPUT PRESSURE AUSGANGSDRUCK PRESSION DE SORTIE [bar]	AXLE LOAD ACHSLAST CHARGE ESSIEU [kg]	SUSPENSION PRESSURE BALGDRUCK PRESSION DE SUSPENSION [bar]	OUTPUT PRESSURE AUSGANGSDRUCK PRESSION DE SORTIE [bar]
	0	0	0	0	1 AXLE 1 ACHSE 1 ESSIEU						
	0	0	0	0	2 AXLE 2 ACHSE 2 ESSIEU						
	0	0	0	0	3 AXLE 3 ACHSE 3 ESSIEU						
					4 AXLE 4 ACHSE 4 ESSIEU						
					5 AXLE 5 ACHSE 5 ESSIEU						

If TEBS is fitted, one of the above labels must also be fitted. However, ABS equipped trailers are not required to have a data label fitted, but they should have a warning label like or similar to the following fitted on the trailer:

3. If a brake load sensing valve has been installed on the trailer, a LSV data label like or similar to the following should have been fitted on the trailer:





4. If none of the above labels are present, then the trailer will (most likely) have a basic brake system installed (ie No TEBS, ABS or LSV). Always check with the trailer or brake system supplier if you are unsure of which system is fitted on the trailer.

APPENDIX I Quick reference performance rating guide for selected combinations

Prime mover and semi-trailer

Prime mover	Semi-trailer	Rating		
		Light braking	Heavy braking	Roll stability
ABS	Basic	2	2	1
	LSV	1	2	1
	ABS	2	3	1
	T-EBS	1	4	4
EBS with ESC	Basic	1	3	3
	LSV	4	3	3
	ABS	1	4	3
	T-EBS	5	5	5

B-double

Prime mover	A trailer	Rating		
		Light braking	Heavy braking	Roll stability
ABS	Basic	2	2	1
	LSV	1	2	1
	ABS	2	3	1
	T-EBS	1	4	4
A trailer	B trailer	Rating		
		Light braking	Heavy braking	Roll stability
ABS	Basic	2	2	1
	LSV	1	2	1
	ABS	2	3	1
	T-EBS	1	4	4
A trailer	B trailer	Rating		
		Light braking	Heavy braking	Stability
T-EBS	Basic	1	3	3
	LSV	4	3	3
	ABS	1	4	3
	T-EBS	5	5	5

Assumptions:- Power provided through to the last unit.

APPENDIX J Guide development process, history and validation

Guide development process

The authoring Associations approved the need for the creation of this Guide and the triennial routine review of the Guide. The authoring Associations and specialist industry technical members as required, will agree on the guide's content with approval by a majority vote of the authoring Associations. A suitably qualified and experience appointed peer reviewer will further review the publication and if necessary, recommended changes. These changes will then be reviewed and approved again by a majority vote of authoring Association members before the document is released.

The guide was developed jointly by industry experts belonging to these industry Associations:

- Australian Livestock and Rural Transporters Association (ALRTA)
- Australian Road Transport Suppliers Association (ARTSA)
- Australian Trucking Association (ATA)
- Commercial Vehicle Industry Association of Australia (CVIAA)
- Heavy Vehicle Industry Australia (HVIA)
- Truck Industry Council (TIC)

The terms of reference for the preparation of this guide is available from any one of the above industry Associations.

The above industry Associations wish to acknowledge and thank the National Heavy Vehicle Regulator and the Commonwealth Department of Infrastructure and Regional Development Vehicle Standards teams for their assistance in preparing this Guide.

For further information visit:

Guide preparation:

Australian Livestock and Rural Transporters Association (ALRTA)

www.alrta.org.au

Australian Road Transport Suppliers Association (ARTSA)

www.artsa.com.au

Australian Trucking Association (ATA)

www.truck.net.au

Commercial Vehicle Industry Association of Australia (CVIAA)

www.cviaa.com.au

Heavy Vehicle Industry Australia (HVIA)

www.hvia.asn.au

Truck Industry Council (TIC)

www.truck-industry-council.org

Government Heavy Vehicle Regulators

Commonwealth Department of Infrastructure and Regional Development

www.infrastructure.gov.au/vehicles

National Heavy Vehicle Regulator (for QLD, NSW, VIC, ACT, TAS, SA)

www.nhvr.gov.au

Department of Transport WA

www.transport.wa.gov.au

Department of Transport NT

www.transport.nt.gov.au

For further information visit:

www.alrta.org.au
www.artsa.com.au
www.truck.net.au
www.cviaa.com.au
www.hvia.asn.au
www.truck-industry-council.org

ALRTA
Australian Livestock and Rural Transporters Association

ARTSA
AUSTRALIAN ROAD TRANSPORT SUPPLIERS ASSOCIATION

ATA
AUSTRALIAN TRUCKING ASSOCIATION

CVIAA
Commercial Vehicle Industry Association Australia

HEAVY VEHICLE INDUSTRY AUSTRALIA

TIC
TRUCK INDUSTRY COUNCIL

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