



The PBS Tyre Issue

IRTEENZ 16th International Conference

Les Bruzsa
21 August 2019

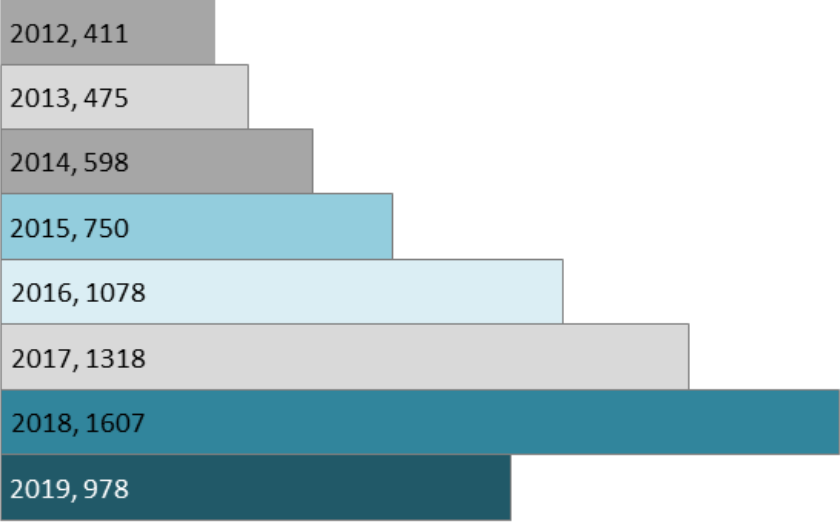


Background

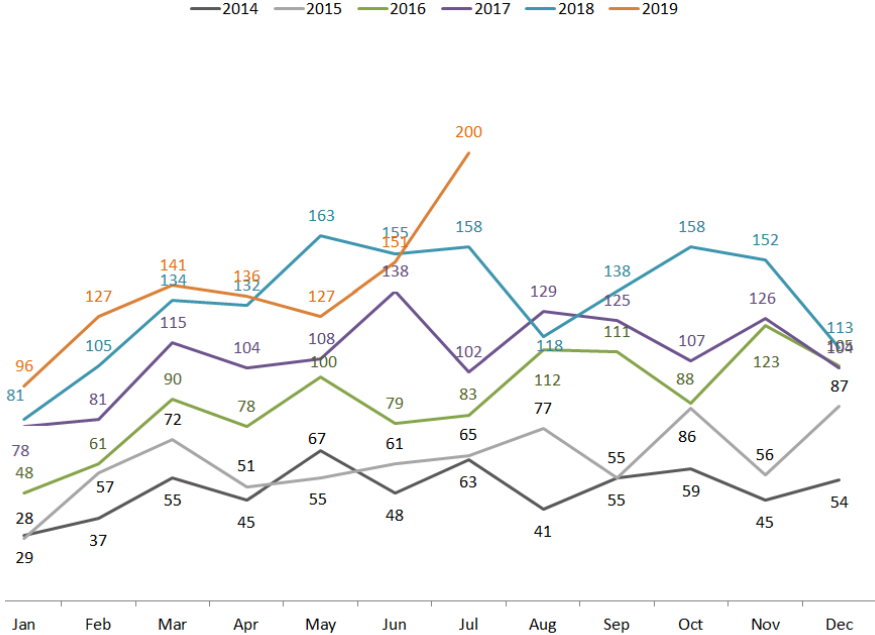
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PBS Vehicle Approvals

PBS VEHICLE APPROVALS YEARLY



PBS Vehicle Approvals - ISSUED

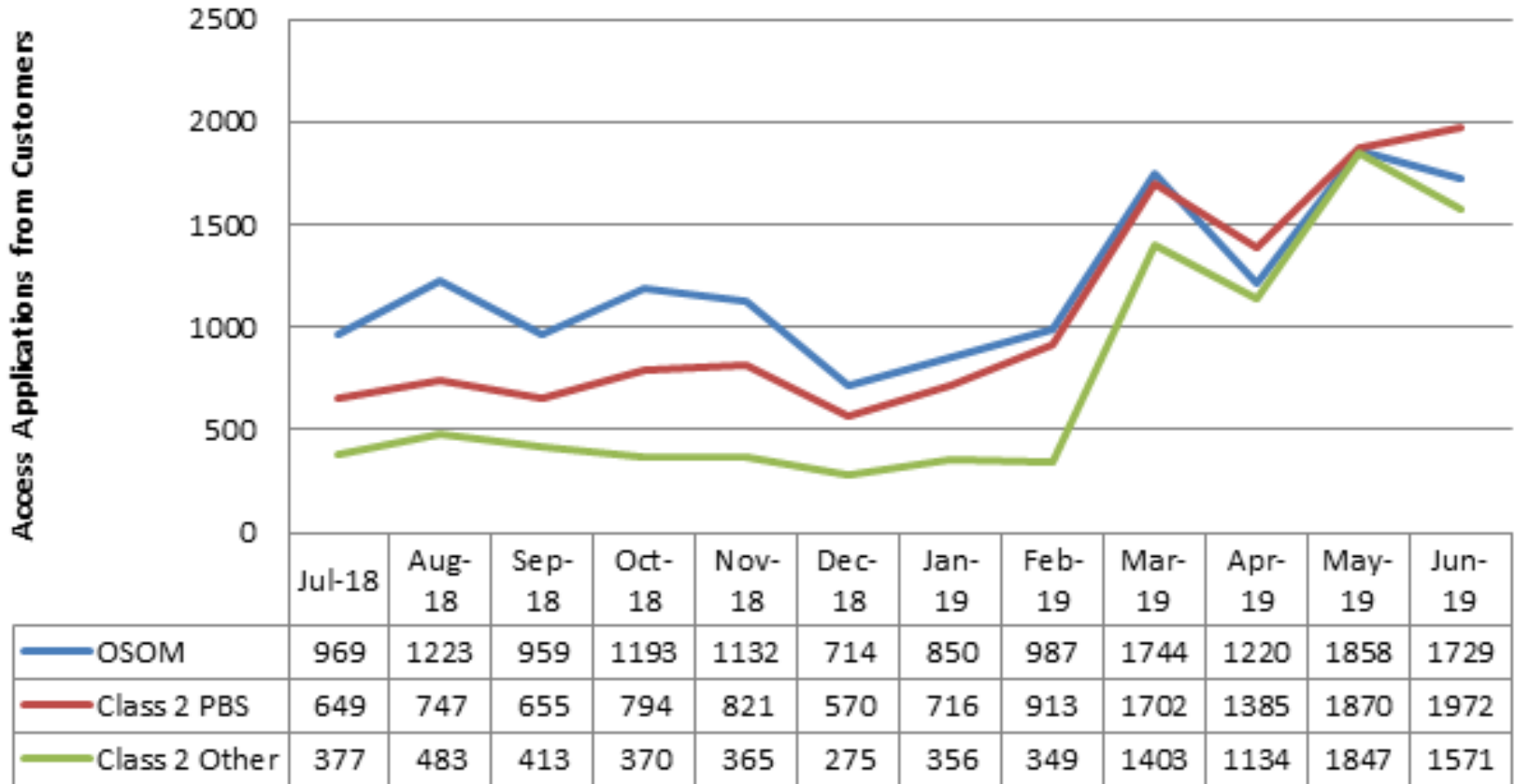


PBS combinations



Access applications

Access Applications by Class



PBS Tyre Issues

2

Issues identified

- Consistency of PBS assessments
 - Sensitive issue
 - Using different tyre data will produce different results particularly for HSTO and RA
 - Any wider analysis of the consistency of PBS assessments from different assessors is outside of the scope of this review
- Complexity of PBS approvals
- Cost for the industry
- Measuring tyre characteristics
- Inflation pressure
 - Tyre properties vary with inflation pressure
 - Tyre testing is usually done at one specified inflation pressure
 - In-service inflation pressures do not necessarily correspond to the test inflation pressure
- Practical, operational issues, compliance

Critical tyre parameters

- Some characteristics are regulated by existing tyre standards
 - Load rating
 - Speed rating
 - Tyre pressure requirement for laden condition
 - Tyre size and rim size
- Some characteristics are not regulated
 - Lateral stiffness characteristic
 - Vertical stiffness characteristic
 - Self-aligning moment
 - Rolling Resistance

PBS Vehicle Approval in 2009

PART A2: TRAILER/SEMI-TRAILER			
TRAILER	Make Model	GTE Semi Trailer	YES <input type="checkbox"/> NO <input type="checkbox"/>
MASS	Aggregate Trailer Mass	46,000 kg	YES <input type="checkbox"/> NO <input type="checkbox"/>
TYRES	Tyre size, make and model <u>OR</u> Tyre rolling radius, cornering characteristics & vertical stiffness	11R22.5 Bridgestone R285	YES <input type="checkbox"/> NO <input type="checkbox"/>
BODY/ CONSTRUCTION	Body type	Side tipper	YES <input type="checkbox"/> NO <input type="checkbox"/>
	Rolling losses	0.0075 (conservative estimate based on UMTRI research)	YES <input type="checkbox"/> NO <input type="checkbox"/>
	Wheelbase	5778 mm For PBS certification purposes, the acceptable tolerance for any dimensional measurement is considered to be $\pm 1\%$, or ± 20 mm, whichever is the lesser.	YES <input type="checkbox"/> NO <input type="checkbox"/>

PBS Vehicle Approval in 2015

VEHICLE PHYSICAL CHARACTERISTICS (A2)			
TYRES	Tyre size, make and model <u>OR</u> Tyre rolling radius and vertical stiffness	<p>Formula 1 (Level 1 & 2)</p> <p>PBS Reference Tyre TS001</p> <p>11R22.5: Bandag BRL3, Bridgestone R109/R168/R187/R285Z/R295Z, Continental HT3, Dunlop SP430/SP431, Firestone FS567, Goodyear LHT, Michelin XTE2/XZA, <u>Haulmax</u>, ATT101/ATT202</p> <p>11R22.5 (Retread): Bandag BRL3 (Minimum tread width 210 mm)</p> <p>255/70R22.5: Goodyear LHTII</p> <p>265/70R19.5: Goodyear LHT</p> <p>305/70R22.5: Michelin XZU2T</p> <p>Or</p> <p>11R22.5 Aeolus HN266/HN06</p> <p>Formula 2 (Level 2 only)</p> <p>PBS Reference Tyre TS003</p> <p>11R22.5: Aeolus HN06/HN266, <u>Austyre</u> 16PR, Bandag BRL3/R4200/RT (203), Bridgestone R109/R168/R187/R285Z/R295Z, Westlake/Chao Yang/Good Ride CR926D/CR960A/CR944, Continental HTR/HT3, Double Coin RR/RR680, Dunlop SP430, Firestone FS567 Goodyear G367(667)/LHT/G182RSD, Michelin XTE2/XZA, <u>Haulmax</u>, ATT101/ATT202</p> <p>275/70R22.5: Double Coin RR680, Dunlop SP430</p> <p>255/70R22.5: Goodyear G661/LHTII</p> <p>265/70R19.5: Goodyear LHT</p> <p>295/80R22.5: Dunlop SP350A</p> <p>305/70R22.5: Michelin XZU2T</p> <p>Or equivalent or better</p>	YES <input type="checkbox"/> NO <input type="checkbox"/>

PBS Vehicle Approval in 2017



PBS Vehicle Approval – V170206 – VA3423

Approved tyre options

Steer – 22.5-inch rim diameter

Drive and Trailer –

DRIVE TYRES	TRAILING UNIT TYRES																											
	Aeolus ADC3 11R22.5	Aeolus HH08 11R22.5	Aeolus HH265 11R22.5	Aeolus HN266 11R22.5	Aeolus HT01 11R22.5	BFGoodrich R蝎蝎蝎 11R22.5	BFGoodrich ST270 11R22.5	Boto HT168 11R22.5	Boto HT170 11R22.5	Bridgestone 11R22.5	Bridgestone R09 11R22.5	Bridgestone R168 11R22.5	Chao Yang CR6360 11R22.5	Continental HEC1 11R22.5	Continental HT1 11R22.5	Continental HTR 11R22.5	Dunlop 11R22.5	Falken RT23 11R22.5	Firestone T558 11R22.5	GT Radial G101 11R22.5	General Tire HA 11R22.5	Goodride 11R22.5 AS478	Goodride CR572 11R22.5	Goodride CR560 11R22.5	Goodride CR604 11R22.5	Goodyear 11R22.5		
Aeolus ADC3 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
Aeolus HH08 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Aeolus HH265 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Austyre Cougar 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Austyre Raptor 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Boto HT168 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Bridgestone 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Bridgestone 295/80R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Chao Yang CM333 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Continental HD 488RD 385/80R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Continental HDC1 295/80R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Continental HDQ2+ 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Continental HSC1 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Dunlop 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Dunlop 295/80R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Falken RT128 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
GT Radial G101 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
General Tire BA 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Goodride MD738 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Goodyear 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Goodyear 295/80R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Hankook AH1 295/80R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Hankook AH2 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Hankook AH2+ 295/80R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Hankook AH2R 295/80R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Hankook AH3 295/80R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Hankook AL10 295/80R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Hankook AM05 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Hankook AM06 295/80R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Hankook DH2 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Hankook DH3 295/80R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Hankook DH5 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Hankook DH56 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Hankook DL00 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Hankook DL07 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Hankook DL10 295/80R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Hankook Z354 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Haulmax AT7302 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Jinyu JW601 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Kumho KR01 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Loadrunner LR835D 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Michelin 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Michelin 295/80R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
O'Green AG47 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Remington R425 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Remington R499 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Triangle TR566 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Triangle TR668 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Triangle TR688 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Triangle TR901 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*



PBS Vehicle Approval in 2017

Steer – 22.5-inch rim diameter

Drive and Trailer –

	TRAILING UNIT TYRES																											
	Aeolus HND6 11R22.5	Aeolus HND8 11R22.5	Aeolus HN266 11R22.5	Austyre ST01 11R22.5	BFGoodrich Route Control S 11R22.5	BFGoodrich ST270 11R22.5	Boto BT168 11R22.5	Boto BT370 11R22.5	Bridgestone 11R22.5	Bridgestone R109 11R22.5	Bridgestone R168 11R22.5	Chao Yang CR926D 11R22.5	Chao Yang CR960A 11R22.5	Continental HSC1 11R22.5	Continental HT3 11R22.5	Continental HTR 11R22.5	Dunlop 11R22.5	Falken RI128 11R22.5	Firestone T559 11R22.5	GT Radial GT01 11R22.5	General Tire RA 11R22.5	Geodide 11R22.5 AS678	Geodide CB972 11R22.5	Geodide CR926D 11R22.5	Geodide CR960A 11R22.5	Goodyear 11R22.5		
Aeolus ADC53 11R22.5	*																											
Aeolus HND8 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Aeolus HN266 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Austyre Cougar 11R22.5																												
Austyre Raptor 11R22.5																												
Boto BT168 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Bridgestone 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Bridgestone 295/80R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Chao Yang CM333 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Continental HD HYBRID 295/80R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Continental HDC1 295/80R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Continental HDR2+ 11R22.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

PBS Tyre Options

PBS Assessors can consider specific needs in their assessments (non specific tyres on trucks)

Approved tyre options – Option 1

Steer –

- non-brand specific 22.5-inch rim diameter

Drive –

- non-brand specific 22.5-inch rim diameter

Trailer –

- **11R22.5** Advance GL671A, Boto BT168, BT370, Bridgestone, Chao Yang CR960A, Continental HT3, HTR, Dunlop, Firestone T559, Goodride AS678, CR926D, Goodyear, Hankook TH22, Haulmax ATT101, ATT202, Michelin, O'Green AG168, Triangle TR668, TRS01, Yokohama RY588

Retread tyres are permitted on the steer and drive axle.

Retread tyres are permitted on the trailer axles provided they are certified by the manufacturer that its performance is equivalent to a new tyre.

Tyre load ratings must be appropriate for the axle mass.

Tyres listed herein are specific for PBS application number V190803.

A different list of tyres will apply for other combination types and different PBS application numbers.



Approved tyre options – Option 2

Steer –

- non-brand specific 22.5-inch rim diameter

Drive –

- **295/80R22.5** Dunlop, Goodyear

Trailer –

- non-brand specific 22.5-inch rim diameter

Retread tyres are permitted on the steer and trailer axles.

Retread tyres are permitted on the drive axles provided they are certified by the manufacturer that its performance is equivalent to a new tyre.

Tyre load ratings must be appropriate for the axle mass.

Tyres listed herein are specific for PBS application number V190803.

A different list of tyres will apply for other combination types and different PBS application numbers.

PBS Tyre Options

Approved tyre options

Steer –

- 295/80R22.5, 305/70R22.5, 315/80R22.5, 385/65R22.5

Drive –

- 11R22.5, 295/80R22.5

Trailer –

- 275/70R22.5 Michelin, Bridgestone, Firestone, Dunlop, Goodyear, Haulmax, Windpower

Retread or regroove tyres are permitted, provided they are either:

- 1) a Michelin retread applied to a Michelin tyre;
- 2) a Bridgestone Bandag retread applied to a Bridgestone 11R22.5 tyre;
- 3) a retread applied at a Goodyear facility or Goodyear Authorised Retreader (GAR) to a Goodyear or Dunlop tyre; or
- 4) certified by the manufacturer to have performance that is equivalent to a new tyre.

Tyre load ratings must be appropriate for the axle mass.

Tyres listed herein are specific for PBS application number V190713.

A different list of tyres will apply for other combination types and different PBS application numbers.

Commercial issues



TRUCK TYRES and PBS ANNOUNCEMENT

BOTO Tyres are at the forefront of the latest truck tyre specifications for PBS fitment

TRUCKPOWER is pleased to announce that three of the high performance BOTO 11R22.5 trailer tyres are now tested and ready for certification for Performance Based Standards (PBS) fitment on Australian trucks and trailers.

Based on up to date test parameters the BOTO 11R22.5 trailer tyres have been performance tested by the world's leading flat bed testing system – the Smithers RAPA facility in Ohio USA. That data has been appraised by a leading Australian Transport Engineering company, PBS Assessor.

The BOTO 11R22.5 BT212N and BOTO 11R22.5 BT370 HD Trailer tyres both achieved Level 1 PBS ranking (TS001), the highest ranking achievable via this authorized assessor. The Level 1 PBS ranking allows these two patterns of BOTO tyres

to be fitted to the majority, if not all, PBS required vehicles in Australia (subject to approval via an authorized assessor).

The BOTO 11R22.5 BT168 all position tyre achieved Level 3 PBS ranking (TS003). This also allows multiple PBS applications. The rating is a function of being an application specific mixed surface tyre with differing design and operational requirements.

All BOTO truck tyres have shown to be industry leaders in quality, retreadability and tread wear, offering real CPK benefits.

For more details on all your truck tyre needs, including PBS approval on tyres please contact the truck tyre experts at Truckpower Tyre Alliance



For inquiries or to locate your nearest dealer phone or visit our website:

1800 919 700
www.truckpowertyres.com.au



Validity of the data

DECLARATION

To whom it may concerns,

We hereby declare that our tires meet the performance level shown in the tables below.

295/80R22.5

		Lateral forces (N) by slip angle and Fz						
		Slip angle (deg)						
		0	1	2	3	4	5	6
Fz (N)	0	0	0	0	0	0	0	0
	7721	0	2500	4243	5743	6615	7074	7318
	15442	0	5729	9677	12170	13527	14087	14281
	23162	0	7771	13147	16805	18622	19668	19910
	30883	0	8431	15017	20079	23010	24493	25124
	38604	0	8553	15480	21969	26305	28679	29603
	46325	0	8168	14973	22137	28383	32016	33601

		Aligning moments (Nm) by slip angle and Fz						
		Slip angle (deg)						
		0	1	2	3	4	5	6
Fz (N)	0	0	0	0	0	0	0	0
	7721	0	40	55	58	47	33	20
	15442	0	156	207	177	117	69	31
	23162	0	309	416	352	239	137	69
	30883	0	441	656	610	432	270	138
	38604	0	563	890	939	713	461	245
	46325	0	657	1095	1299	1096	748	425

Retread issues

Mis-match during the process


Drive tyre case with trailer pattern, steer tyre case with drive tyre pattern

Is that an issue?



Retread issues

To whom it may concern,

 measured the cornering performance of the following retread tyres and found them equivalent or better to new tyres in the same size for PBS performance characteristics.

Drive Tyres:

- 11R22.5 or 295/80R22.5 case and Bandag Retread “**BDRHT**” with tread width **210mm** or greater
- 11R22.5 or 295/80R22.5 case and Bandag Retread “**D4310**” with tread width **203mm** or greater
- 11R22.5 or 295/80R22.5 case and Bandag Retread “**BRL3**” with tread width **210mm** or greater

Trailer Tyres:

- 11R22.5 or 295/80R22.5 case and Bandag Retread “**RT**” or “**RTE**” with tread width **210mm** or greater
- 11R22.5, 275/70R22.5 or 295/80R22.5 case and Bandag Retread “**BRL3**” with tread width **210mm** or greater

PBS Tyre Review

3

Review of Tyre Management Practice in the Australian PBS System

- The NHVR appointed independent road safety expert Dr John de Pont to lead a review of PBS tyre standards and operations in November 2018
- The review is strongly supported by industry
- NHVR Tyre Management Practice Discussions Paper released for consultation on 1 March 2019
- Consultation closed in April 2019

Tyre Review

Current Options:

- Establish a centralised database of tyre data
- Specify one set of generic tyres for all assessments.
- Non-hierarchical classification system.
- Hierarchical classification system.

The NHVR will continue to provide relevant stakeholders with updates as we proceed with the tyre review

Creating a PBS tyre database

- Actual tyre data needs to be available to assessors
- Supported by PBS Assessors
- Not supported by the industry in general
- To achieve quality data we would need to specify the test procedures and conditions in great detail
- This could result in a single approved testing facility either by design or by default

Tyre testing



Generic tyre data

- Using a specified set of tyre data in PBS assessments
- Originally supported by most of the PBS assessors
- Supported by all tyre industry and transport operators
- **Some vehicles are likely to have poorer performance than they would have if the assessment was done on the basis of measured tyre data**
- The Michelin XZA data, which was used to develop the PBS standard, could be the generic 11R22.5 tyre
- Generic data for other tyre sizes could be developed by scaling the Michelin XZA data
- Some research is needed to determine the scaling factors
- Implications:
 - Tyre data becomes a test condition for modelling
 - Vehicle performance relative to the original formulation of the performance standard is maintained

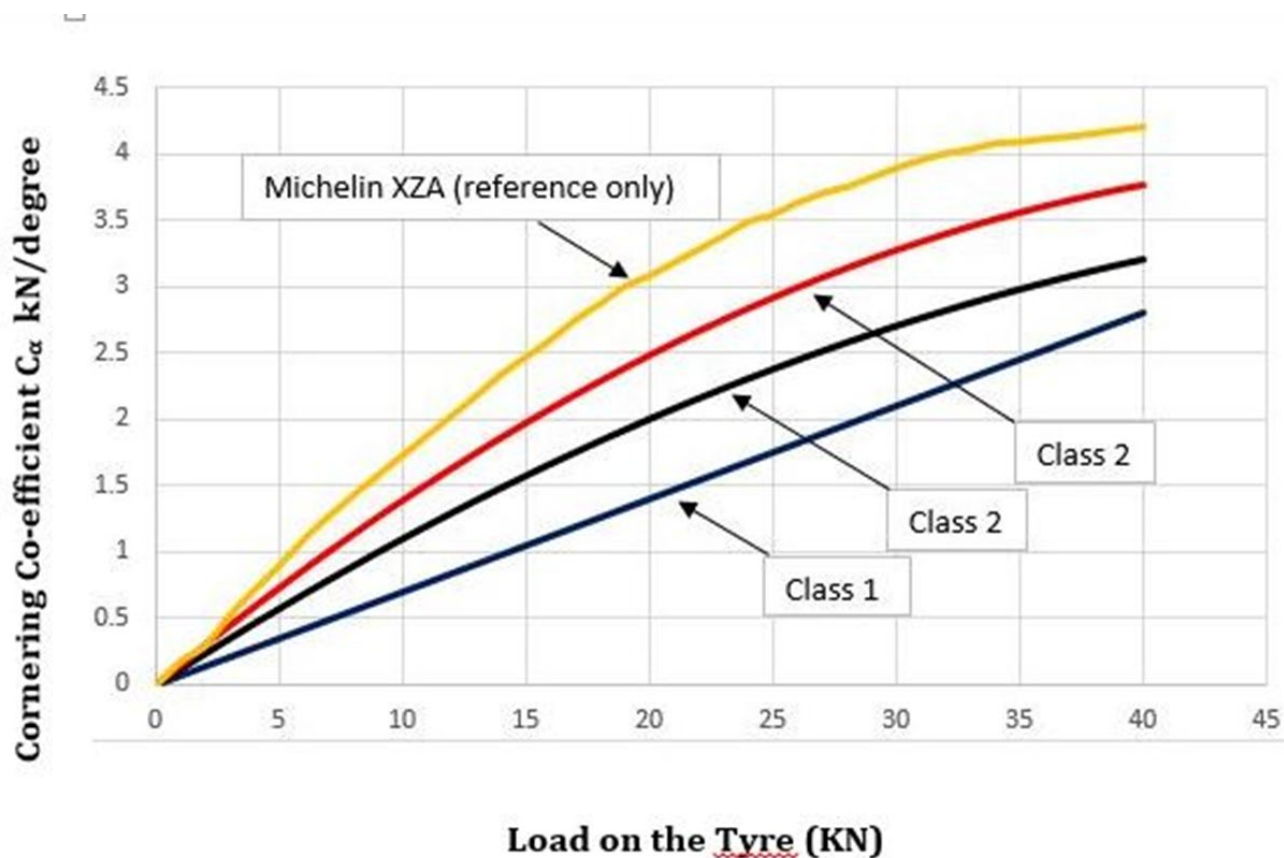
The need for a tyre classification system and database

- Provide consistency between PBS Assessors and assessments
- Maintain flexibility for PBS vehicle operators in the tyre marketplace
- Address critical stakeholder-raised issues currently associated with the implementation, administration and day-to-day workings of the PBS scheme



Hierarchical Classification Scheme

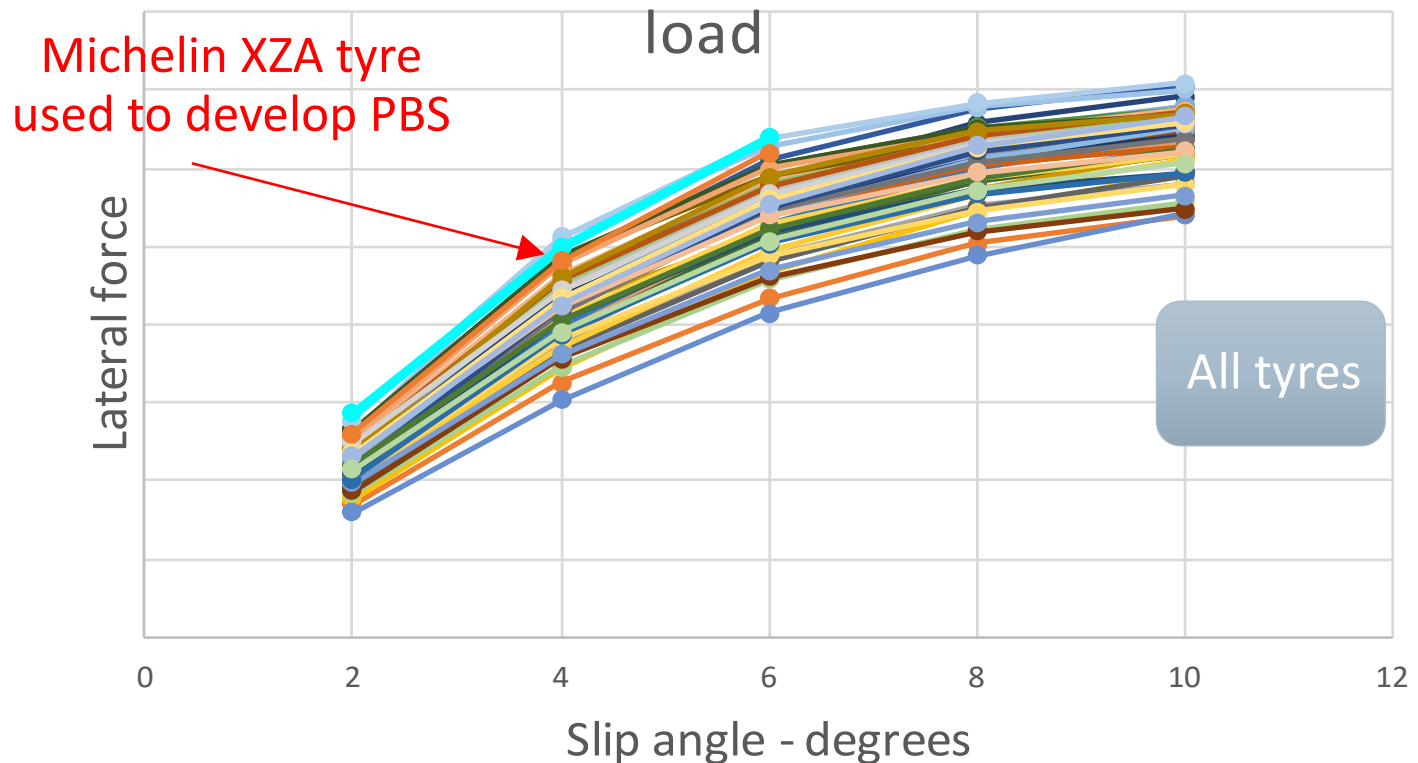
- A tyre classification system is currently in place
- Supported by a number of PBS Assessors
- The current system is not supported by tyre industry



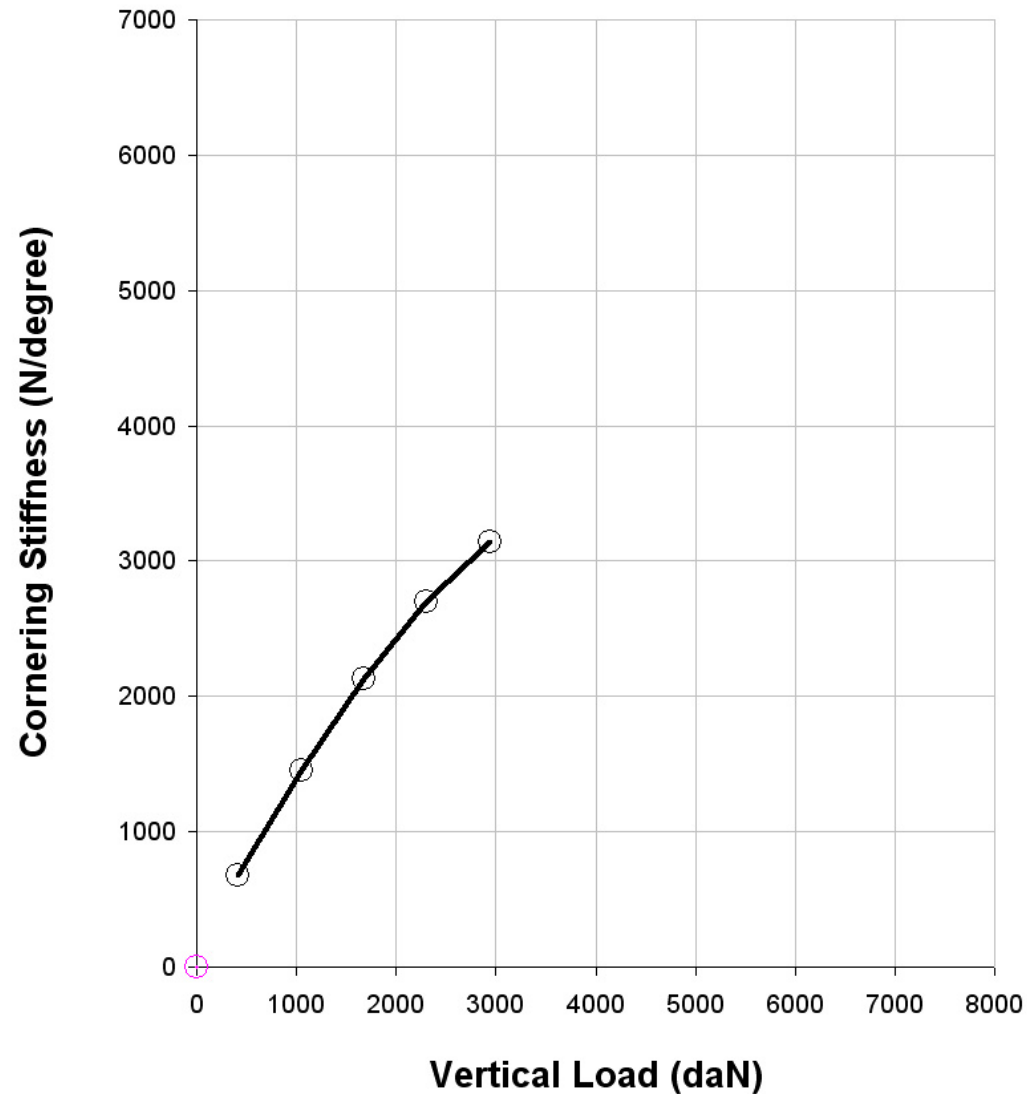
Potential issues

- Some PBS tests will return poorer results with new tyre data than with original data
- Combinations assessed using old tyre data may not pass PBS with new data

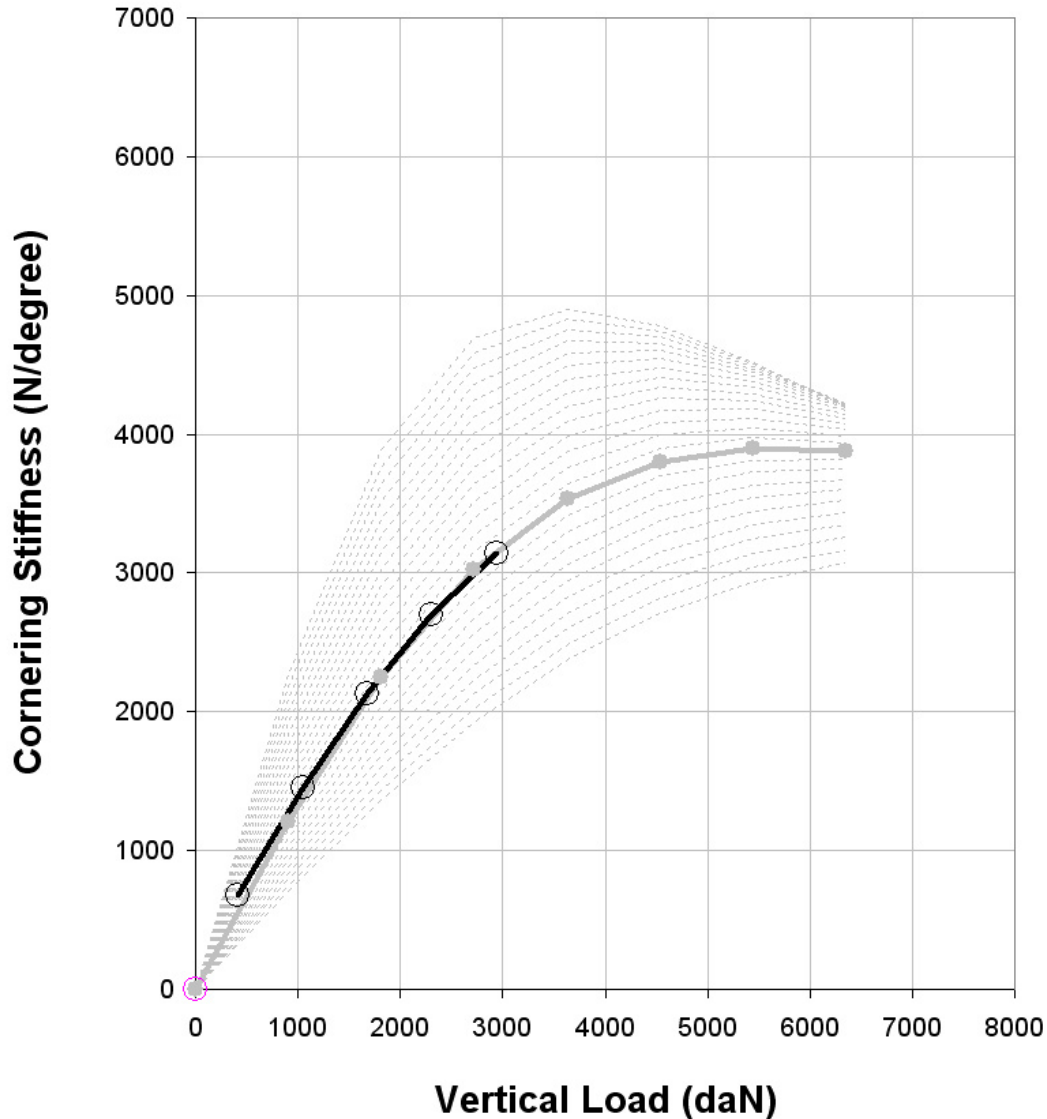
Lateral force by slip angle - 2500 kg vertical load



Key performance characteristics of a tyre



Creating a virtual tyre by fitting a curve based on the test data



Creating a PBS tyre database

- PBS Assessors use virtual tyres corresponding to each cell (1 virtual tyre per cell)
- PBS vehicles can use all (actual) tyres assigned to each cell (new tyres can be added and out-of-production tyres removed)NHVR Website Consultation (open to everyone)

GROUP	CLASS																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
A			1	1	1	1	1																		
B								2		2	1	1													
C			1					1		1			2	2											
D								1			2	1	1	2		3									
E											1	1			1			1							
F																					1				

Source: MSD

Creating a PBS tyre database

Example PBS Vehicle #2 (3-Axle Truck and 4-Axle Dog-trailer)																										
Steer Tyres (37)																										
GROUP	CLASS																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
A			1	1	1	1	1																			
B								2		2	1	1														
C			1					1		1			2	2												
D								1			2	1	1	2		3										
E											1	1			1			1								
F																					1					
Drive Tyres (13)																										
GROUP	CLASS																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
A			1	1	1	1	1																			
B								2		2	1	1														
C			1					1		1			2	2												
D								1			2	1	1	2		3										
E											1	1			1			1								
F																				1						
Trailer Tyre (6)																										
GROUP	CLASS																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
A			1	1	1	1	1																			
B								2		2	1	1														
C			1					1		1			2	2												
D								1			2	1	1	2		3										
E											1	1			1			1								
F																				1						

Source: MSD

PBS Standards

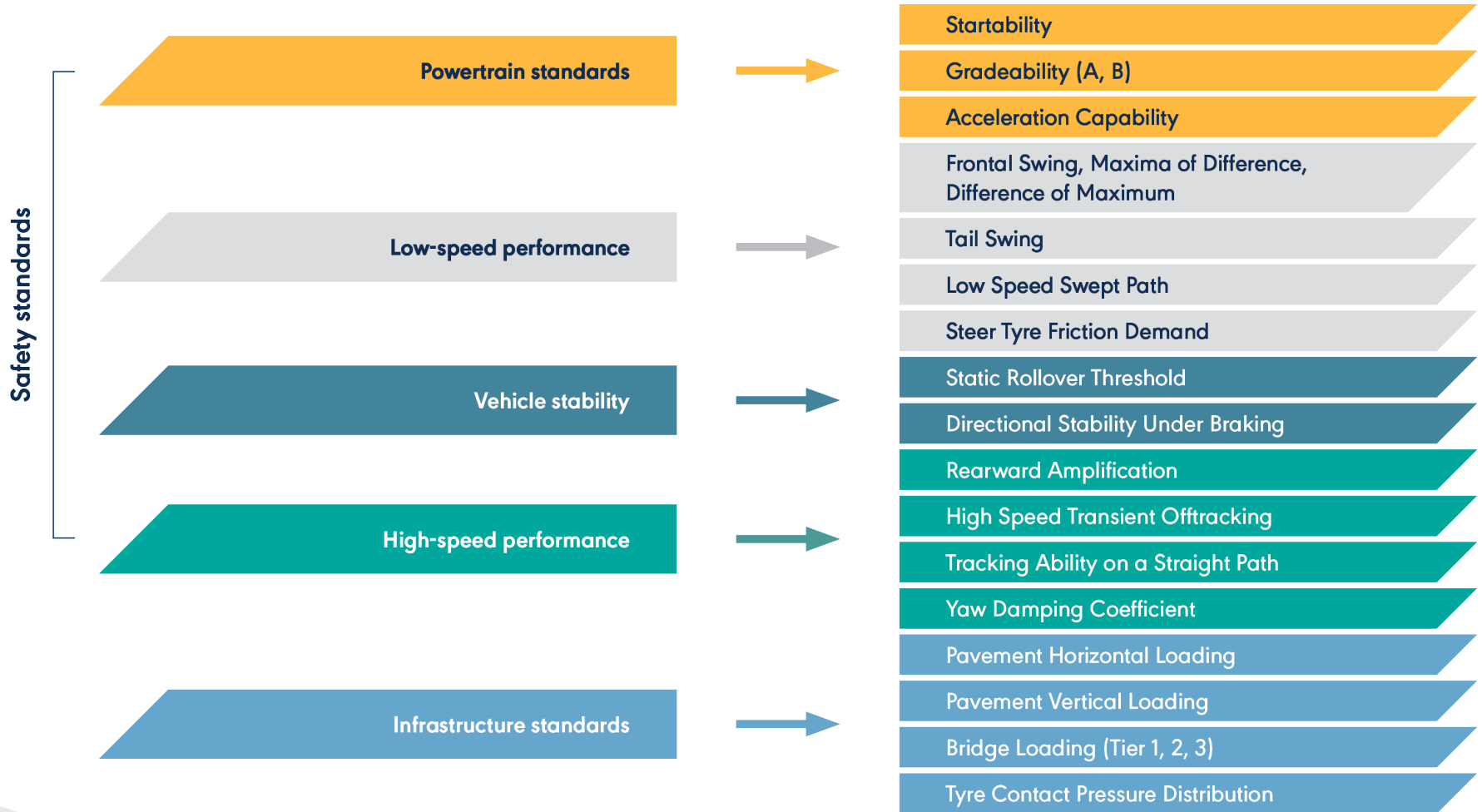
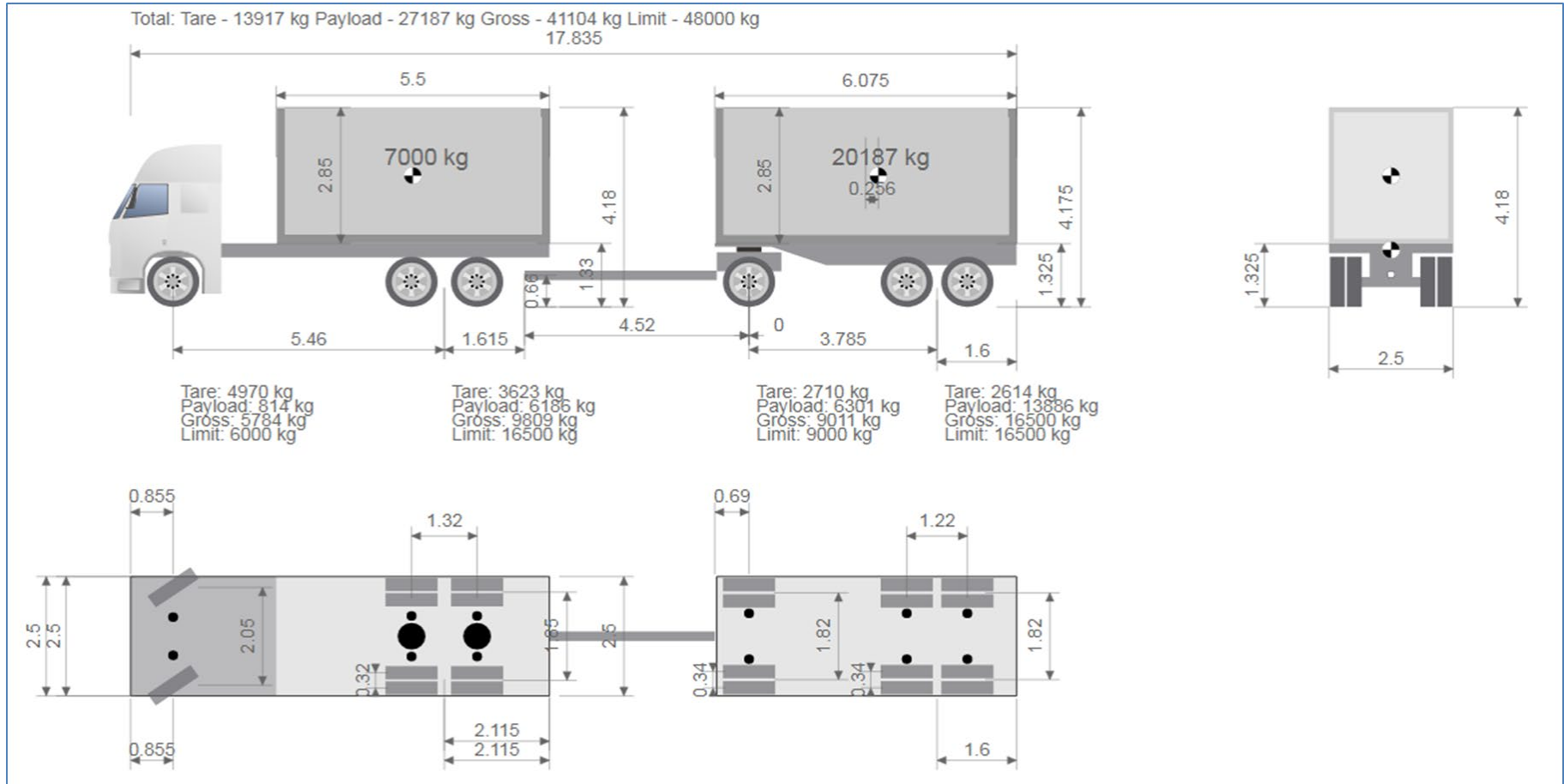


Figure 3. PBS safety and infrastructure standards

Critical tyre properties and affected PBS performance

Performance category	Performance standard	Critical tyre characteristics
Longitudinal driveline	Startability Gradeability Acceleration capability	Longitudinal stiffness Rolling resistance [8]
Low speed manoeuvring	Low Speed Swept Path (LSSP) Frontal Swing (FS) Tail Swing (TS) Steer Tyre Friction Demand (STFD)	Lateral/Longitudinal (cornering) stiffness [9]
Yaw Dynamics	Tracking Ability on a Straight Path (TASP) Rearwards Amplification (RA) High Speed Transient Off-tracking (HSTO) Yaw Damping Coefficient (YDC)	Lateral/Longitudinal (cornering) stiffness Rolling resistance [10]
Rollover	Static Rollover Threshold (SRT)	Vertical stiffness [1]
Infrastructure	Pavement Vertical Loading Pavement Horizontal Loading Bridge Loading Tyre Contact Pressure Distribution	Lateral/Longitudinal [9] (cornering) stiffness Vertical stiffness Contact pressure distribution Rolling resistance

Tyre impacts on performance



Tyre impacts on performance

Generic Tyres

Low Speed Turning

Test	Value	Pbs	Level	Pass
STFD (%)	13.5	14	<=80%	True
Path Error (mm)	28	28	<50mm	True
TS (m)	0.08	0.08	1	True
LSSP (m)	5.34	5.4	1	True
FS (m)	0.33	0.4	1	True
DoM (m)	0	0	<=0.2	True
MoD (m)	0	0	<=0.4	True

Lane Change

Test	Value	Pbs	Level	Pass
HSTO (m)	0.94	1	3	True
RA	2.43	2.44	<5.7 SRT RRCU	False
Path Error (mm)	22	22	<30mm	True
Min Speed (km/h)	86.9	87	>85	True
Max Speed (km/h)	88.5	88	<91	True
Max LTR	1	1	<1	False
Avg Speed (km/h)	87.7	88	+/-2 km/h	True

Pulse Input

Test	Value	Pbs	Level	Pass
YDC	0.14	0.14	>=0.15	False
Min Speed (km/h)	99.6	100	>97	True
Max Speed (km/h)	100.2	100	<103	True
Max LTR	0.84	1	<1	True

Specific Tyres

Low Speed Turning

Test	Value	Pbs	Level	Pass
STFD (%)	19.7	20	<=80%	True
Path Error (mm)	28	28	<50mm	True
TS (m)	0.08	0.08	1	True
LSSP (m)	5.35	5.4	1	True
FS (m)	0.33	0.4	1	True
DoM (m)	0	0	<=0.2	True
MoD (m)	0	0	<=0.4	True

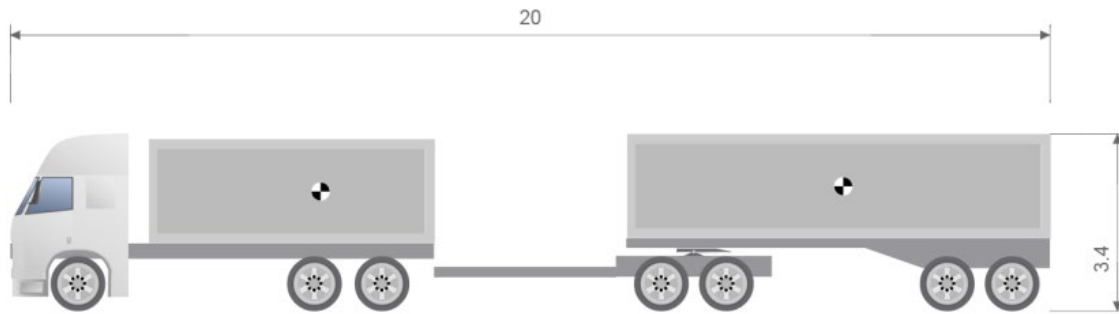
Lane Change

Test	Value	Pbs	Level	Pass
HSTO (m)	0.63	0.7	2	True
RA	2.18	2.19	<5.7 SRT RRCU	False
Path Error (mm)	13	13	<30mm	True
Min Speed (km/h)	87.6	88	>85	True
Max Speed (km/h)	88.2	88	<91	True
Max LTR	1	1	<1	False
Avg Speed (km/h)	87.9	88	+/-2 km/h	True

Pulse Input

Test	Value	Pbs	Level	Pass
YDC	0.15	0.15	>=0.15	True
Min Speed (km/h)	99.6	100	>97	True
Max Speed (km/h)	100.2	100	<103	True
Max LTR	0.67	1	<1	True
Avg Speed (km/h)	99.9	100	+/-2 km/h	True

Level 1 PBS truck and dog

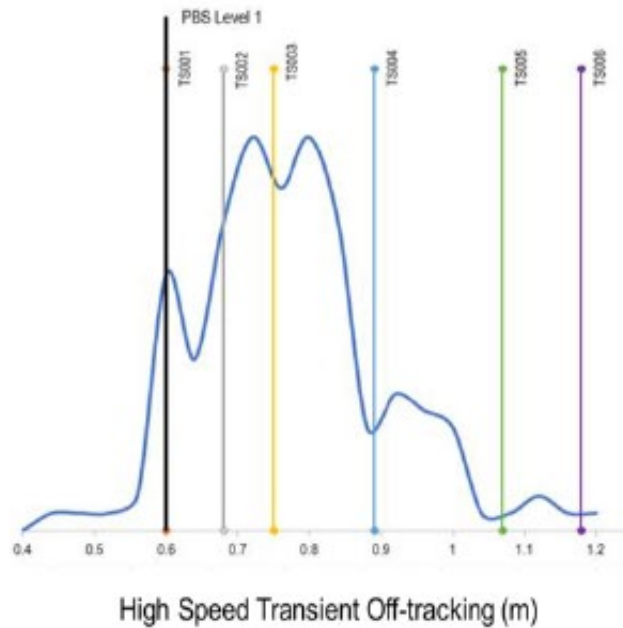


Limit: 6500 kg

Limit: 17000 kg

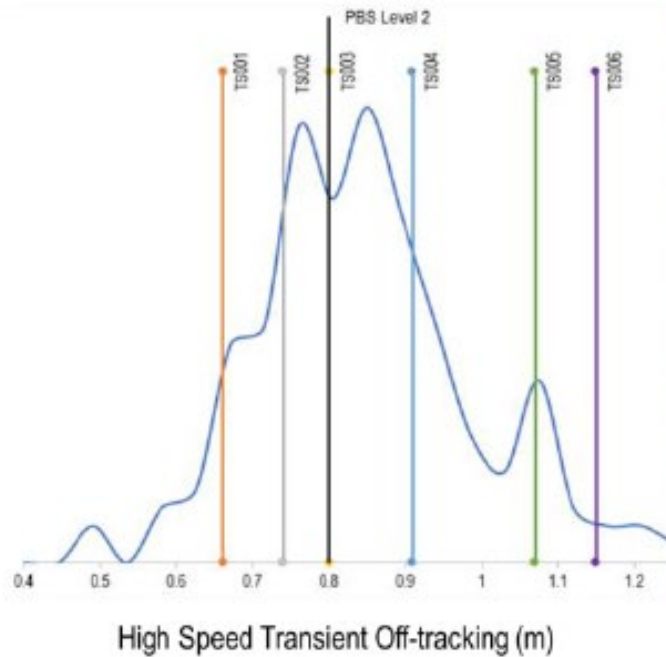
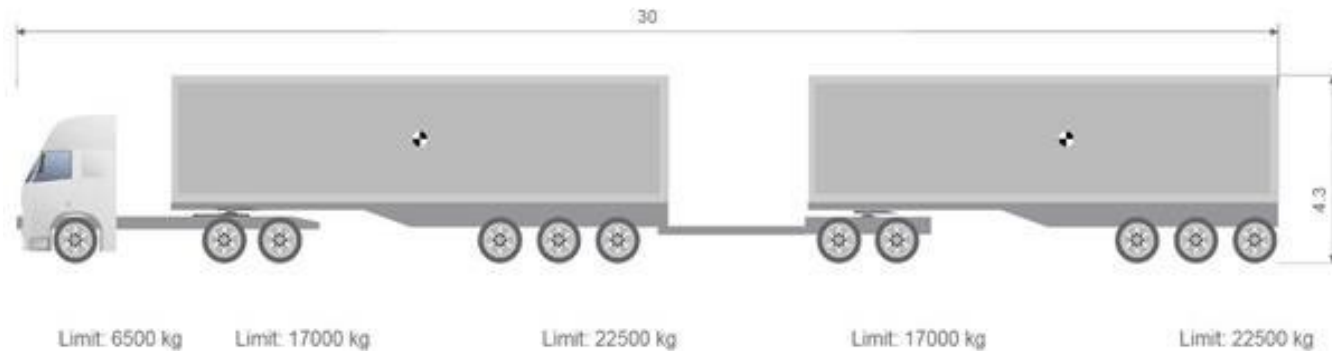
Limit: 17000 kg

Limit: 17000 kg



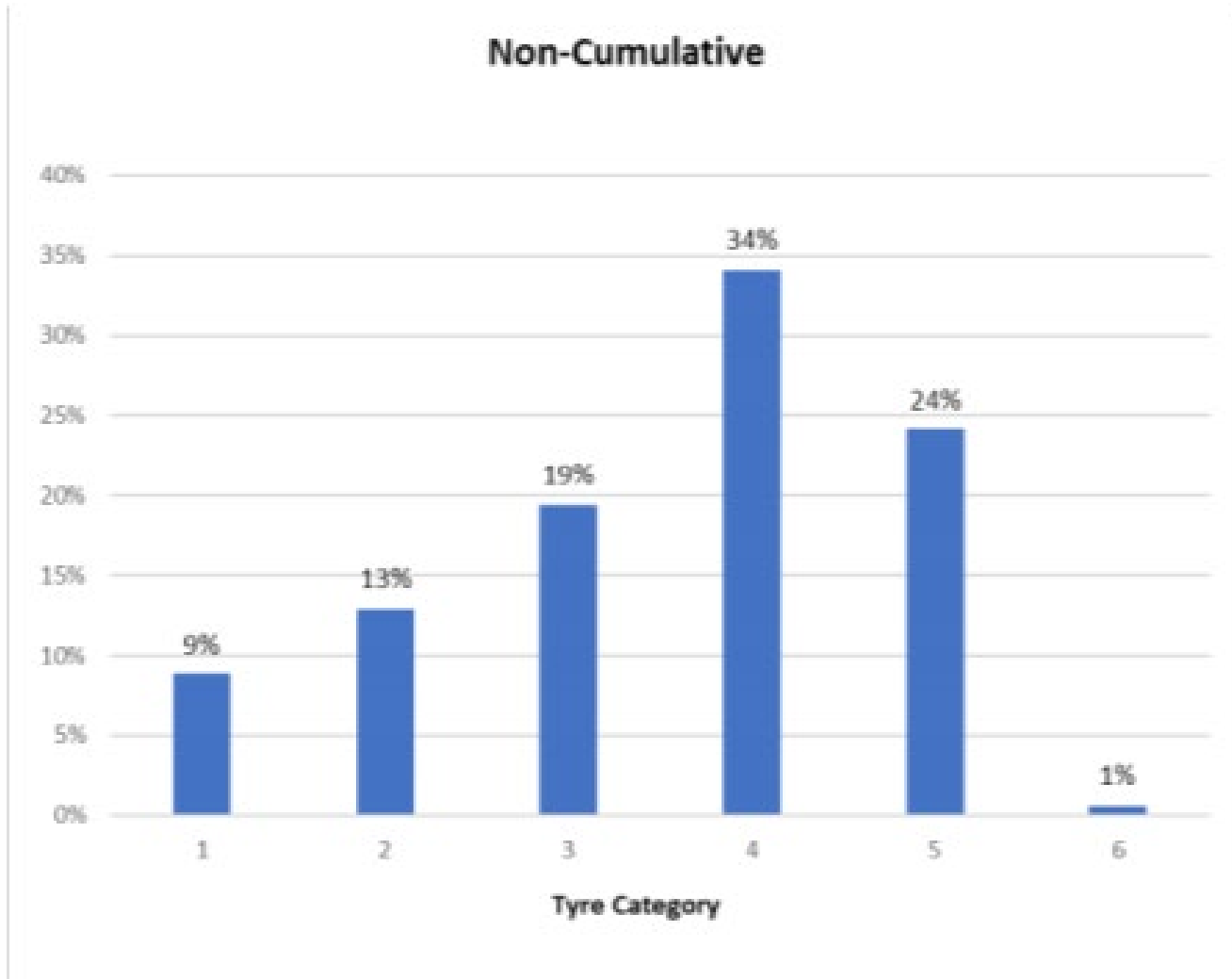
Number of Tyres Simulated	165	
Number of Eligible Tyres	20	12%
Mean	0.76	
Standard Deviation	0.13	
TS001	20	12%
TS002	28	29%
TS003	42	55%
TS004	51	85%
TS005	20	98%
TS006	4	100%

Level 2 A-double



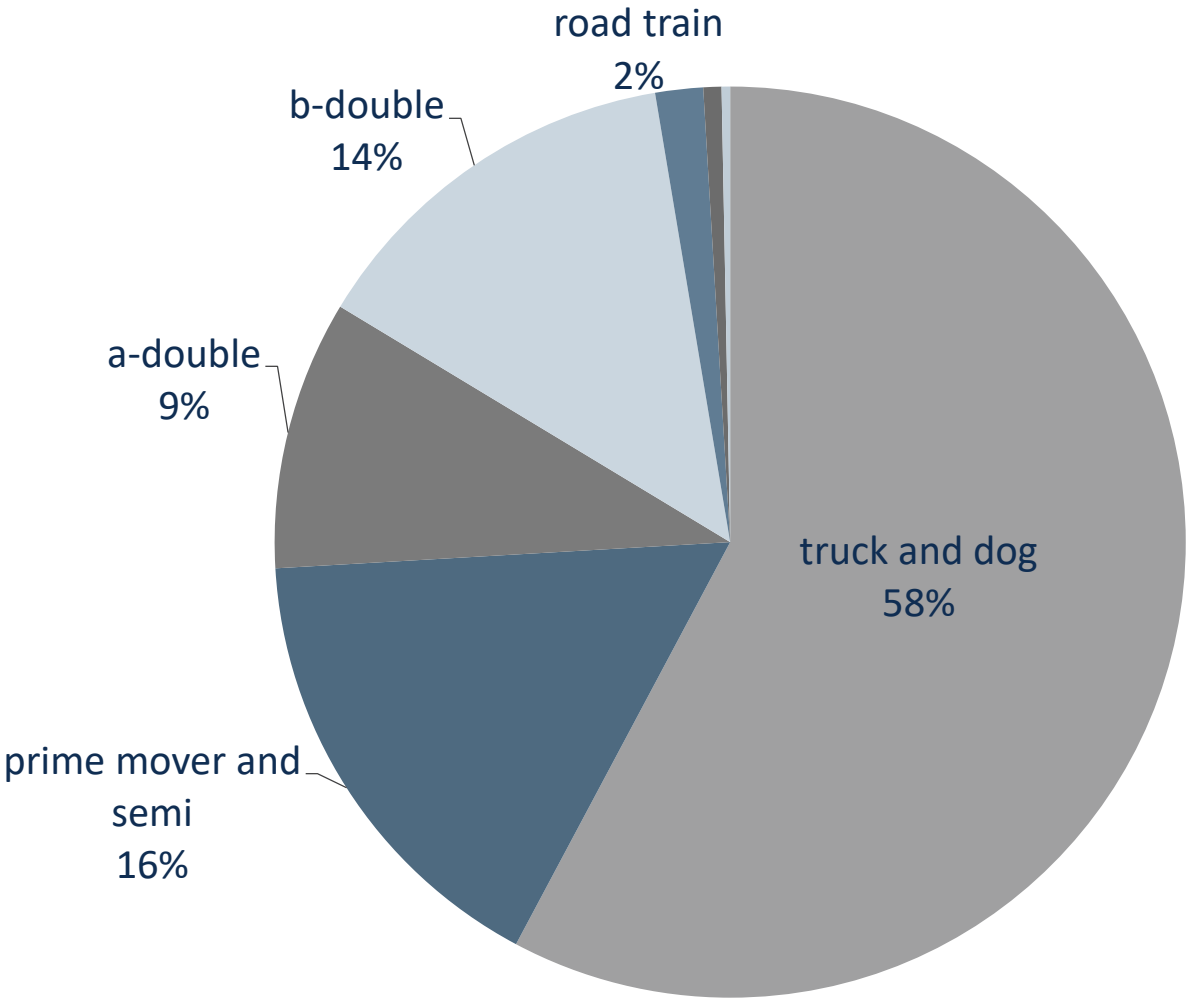
Number of Tyres Simulated	165	
Number of Eligible Tyres	78	46%
Mean	0.83	
Standard Deviation	0.14	
TS001	21	13%
TS002	26	28%
TS003	31	47%
TS004	52	79%
TS005	27	95%
TS006	5	98%

Tyre Categories



Source: Tiger Spider

PBS Fleet



Tyre characteristics – inflation pressure

- Key issues for PBS
 - Tyre properties vary with inflation pressure
 - Tyre testing is usually done at one (sometimes two) specified inflation pressure
 - In-service inflation pressures do not necessarily correspond to the test inflation pressure
- More general heavy vehicle issues
 - Typical in-service inflation pressures for tyres could be higher than manufacturer-recommended values and sometimes exceeds the legal maximum (825kPa)
 - Differences between inner and outer tyres in a dual set when hot
- Proposed options
 - Ignore inflation pressure in PBS assessments
 - Specify inflation pressure in PBS assessments
 - Encourage/require TPMS (ISO/DIN 11992)
 - Encourage CTI

Next steps

- Final recommendations being prepared by the consultant
- Review by NHVR
- Suggested approach will go through a consultation process (industry, jurisdictions, PBS Assessors and Certifiers)
- PBS regulations are part of the National Heavy Vehicle Law (NHVL)
- Final recommendations have to be considered by Transport Ministers



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