Technical Bulletin

TB 2022-01

Rigid Drawbar Converter Dollies

Specification Guidelines

Introduction: In May 2018, the Australian Trucking Association's (ATA) Industry Technical Council embarked on an exciting engineering 'proof of concept' project, exploring the development of a rigid drawbar convertor dolly.

The project was the result of member discussions regarding the dynamic issues with hinged drawbar convertor dollies, especially brake re-activity and tyre wear and other experiences with air suspension dollies.

Consequently, there had been some trending by operators back to mechanical suspensions where braking re-activity seems to be less obvious, but this did not eliminate nor the solve the issues.

Why a rigid drawbar converter dolly? Air suspension converter dollies (with hinged drawbars) have provided challenges to both designers and operators.

Hinged drawbar tandem and triaxle configurations each require two (2) height control valves and are brake reactive, resulting in the dolly "pitching" during deceleration and acceleration events.

The rigid drawbar dolly performs similar to the leading trailer of a B-double, it is not brake reactive and does not "pitch" during deceleration or acceleration.

The ATA-ITC previously issued Technical Bulletin TB 2020-02 for tandem axle converter dollies. This technical bulletin is now superseded.

Design limitations: In the design and manufacture of rigid drawbar converter dollies there needs to be a demonstration of compliance to D_C and V requirements of the coupling (refer AS2213.1:2022).

D_C-value: *An expression of the horizontal longitudinal forces experienced by the coupling or drawbar eye, where the coupling is designed to support imposed dynamic vertical loads.*

V-value: *An expression of the vertical dynamic load capacity of a coupling or drawbar eye.*
Note: The D_C and V-values apply to rigid drawbar couplings.

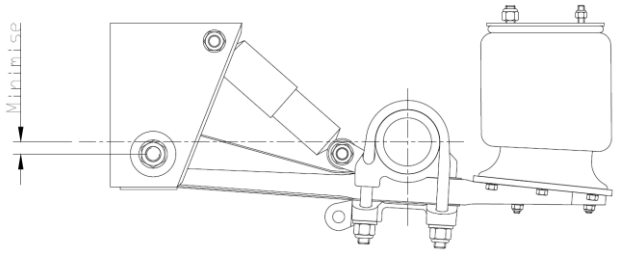
European combinations are typically limited to configurations with a nominal GCM ≤ 85^{tonnes}. A 50^{mm} automatic style pin couplings (there are several suppliers to the Australian market) has a nominal combined D_C/V rating around 125-140^{kN} and 50-90^{kN} respectively. Whilst this provides a technical fit for the typical A-double with a tandem axle dolly at HML, it is restrictive in respect of triple trailer configurations and triaxle converter dollies.

The recent review of AS2213.1 and the technical performance of pin type couplings has highlighted the performance extension (as referenced in UN Regulation 55) whereby as the technical requirement for the

V-rating decreases, then the D_C-value may be increased in accordance with the prescribed graphical extrapolation.

Pin type couplings currently readily available in the Australian market are suitable for applications up to a D_C-value of ≤ 250^{kN}. This allows options for rigid drawbar converter dollies (both tandem and triaxle) in configurations up to a nominal maximum of 165^{tonnes} GCM (gross combination mass).

Suspension: A suspension with neutral roll steer at nominal ride height is preferred (ie: the trailing arm eye bolt and the axle centre are as near as possible to the same height) with one (1) height control valve (HCV). Discuss options with your preferred axle/suspension supplier.



A rigid drawbar MUST only be fitted with a single height control valve (the same as an air suspension trailer). The height control valve may be fitted to either axle of a tandem group (but for access to valve the rear axle may be preferable) however for a triaxle, the height control valve must be fitted to the centre axle.

Drawbar Length: This will largely be determined by combination/application.
ADR 63/00 limits converter dolly drawbar length (for use in a road train combination) to ≥ 3000^{mm} and ≤ 5000^{mm}; however, there is no dimensional restriction on a converter dolly approved as part of a PBS combination, the graph has been extended to 5500^{mm} to assist PBS considerations.

Note: The ATA 35^{m} Modular A-double proposal recommends a minimum drawbar length of 3.95^{metres}.

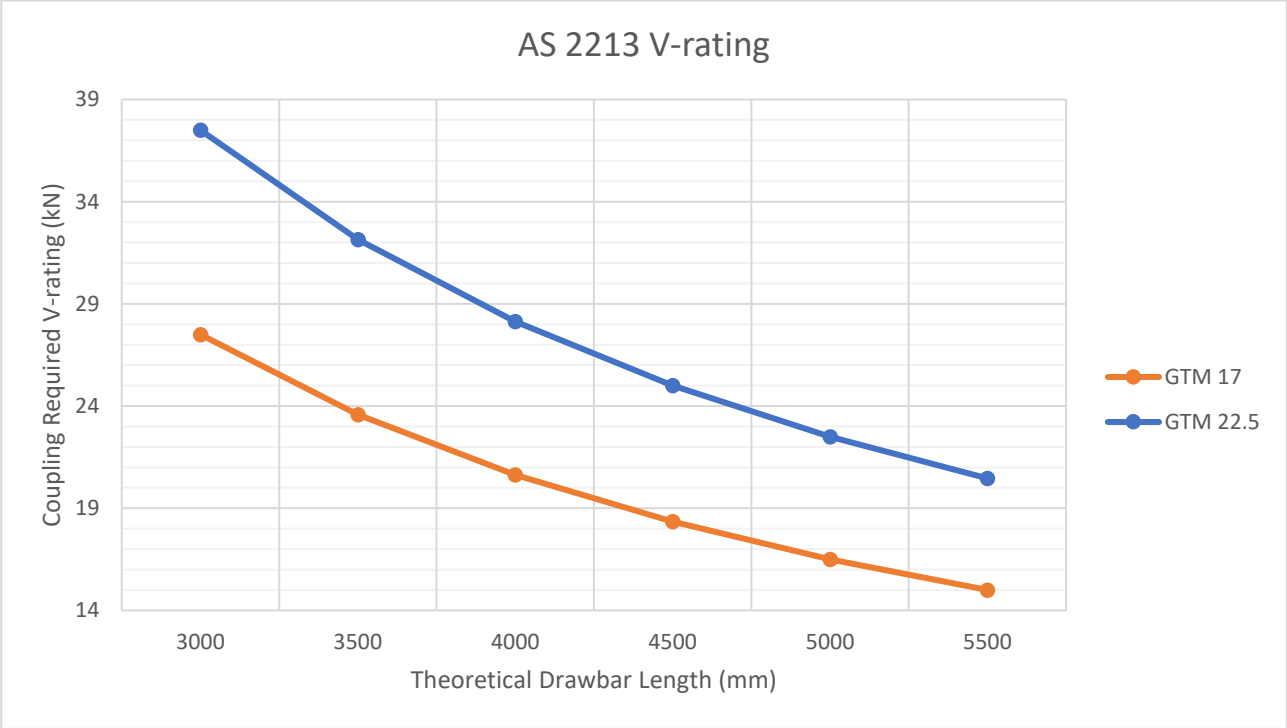
A Rigid Drawbar (tandem) Converter Dolly in a 30^{metre} PBS A-double Combination

Coupling: V-rating design requirement increases as GTM (gross trailer mass) increases and decreases as the drawbar length increases and must be calculated in accordance with AS 2213.1 V = $^{0.51xGTMx9.81}/_{L}$.

Where:

- "GTM" is the gross trailer mass (in tonnes)
- "L" is the theoretical drawbar length (in metres), from centre of the tow eye to centre of the axle group.

The graph (below) shows the V-requirement for the coupling based on a GTM's of 17^{tonnes} and 22.5^{tonnes} for drawbar length in the range of 3000^{mm} to 5500^{mm}.



The coupling tow eye will typically be limited to those displayed below (or similar).

Flanged drawbar eye

Special Flanged drawbar eye

Known suitable 50[mm] towing eyes are available from: BPW Transpec (Ringfeder); JOST (Rockinger); and SAF-HOLLAND (V.Orlandi)

Pin Coupling Selection: The coupling needs have a combined D_C and V-rating. The V-rating is determined by the GTM and drawbar length regardless of the configuration.

Example: Assuming the combination is a Modular BAB Quad, tandem axle converter dolly (GTM = 17[tonnes]), operating at HML (130.5[tonnes]); and the converter dolly drawbar length is 4.4[metres].

- Minimum **V**-required = 0.51*17*9.81/4.4 = 19.78 ⇨ roundup = 20[kN]
- Minimum **D_C**-required = (AS2213.1:2022 calculation) = 192[kN]

Typically, the manufacturer/supplier of a pin coupling potentially suitable for use in a rigid drawbar converter dolly will provide the following technical information:
Example (this is based on hypothetical couplings (ITC50RT1 and ITC50RT2) with hypothetical performance values):

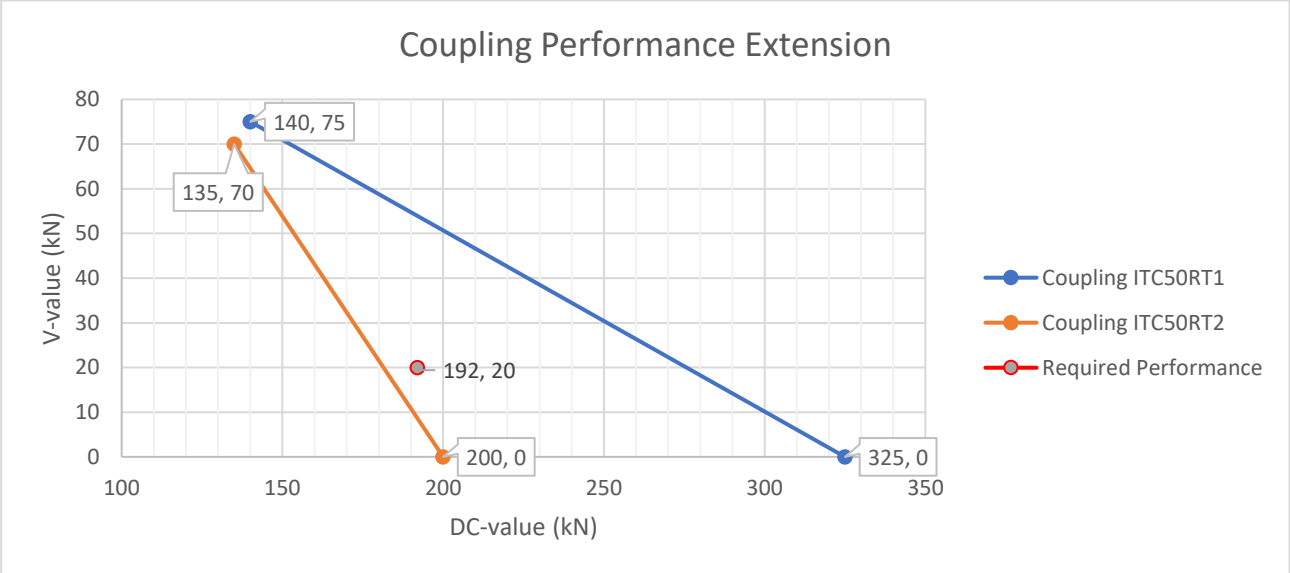
	Value			
Model	**D** (kN)	**D_C** (kN)	**S** ≤ (kg)	**V** (kN)
ITC50RT1	325	140	1000 2500	75 50
ITC50RT2	200	135	1000 2500	70 50

The required **D_C** (192[kN]) exceeds the manufacturers stated **D_C** values, hence a coupling "performance extension" assessment is required to assess coupling application suitability.
Typically, the static vertical load at the coupling will be ≤ 400[kg]. Hence the applicable data will be for couplings where "S" ≤ 1000[kg].

Model	**D** (kN)	**D_C** (kN)	**S** ≤ (kg)	**V** (kN)

ITC50RT1	325	140	1000	75
ITC50RT2	200	135	1000	70

These values may then be plotted on a linear graph (see below) to establish the "performance extension", the required performance 192/20 (D_C/V) must be to the left/below the graph line/s.



As the required performance is to the right/above the performance extension for the **ITC50RT2** coupling, that coupling would **not be suitable** for this proposed application. However, as the required performance is to the left/below the performance extension for the **ITC50RT1** coupling, this coupling would be **suitable** for this proposed application.

Rigid drawbar design: Drawbar length and strength is prescribed by a number of requirements including:

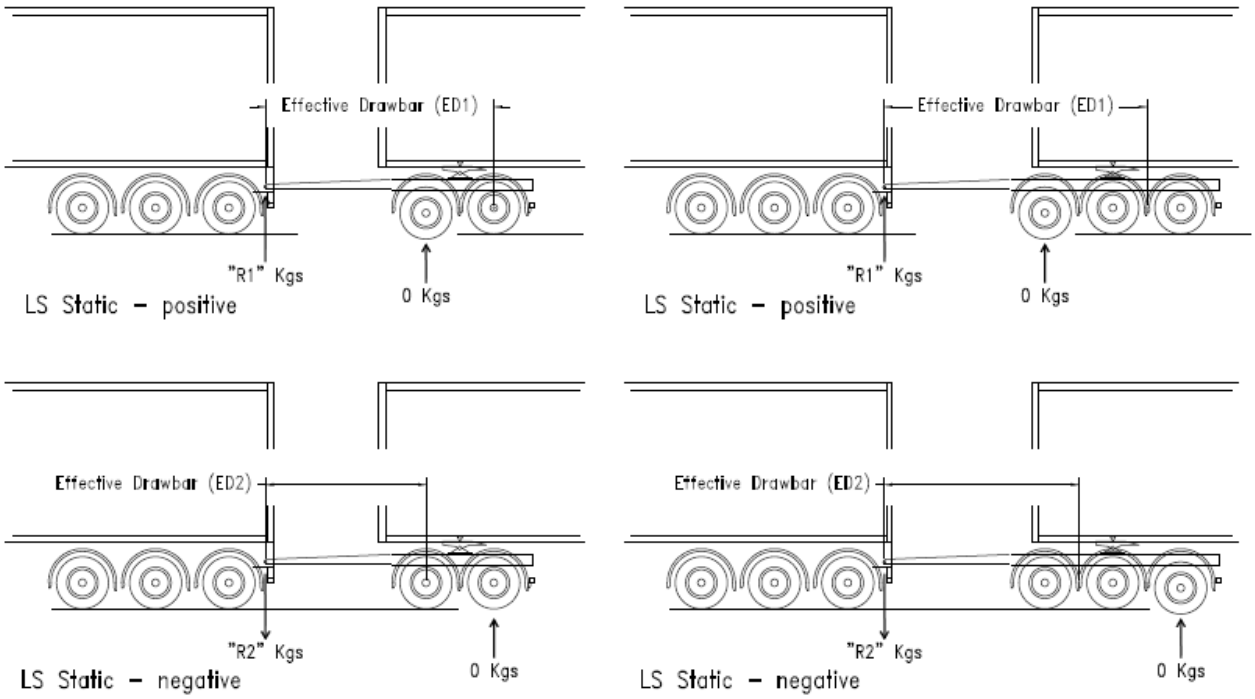
- The drawbar must be designed in accordance with the requirements of the forces prescribed in ADR 62/..
- ASMS (3L+12.5) the minimum dimension from the leading axle of the rear axle group of the towing vehicle to the last axle of the converter dolly being: 8.0^{metres} for a triaxle/tandem; and 9.17^{metres} for a triaxle/triaxle configuration/s.
- The tow coupling (both the coupling and the tow eye) must be selected based on the required D_C and V requirements. The minimum of either component is the applicable in-service capability.
- A longer converter dolly drawbar degrades swept path performance (slightly) but improves high speed dynamic performance. A theoretical drawbar length of approximately 3.95^{metres} (or longer) is preferred.
- When crossing infrastructure inverts accessing or egressing property, it is common for the group loading not to be shared across all axles. This results in less than optimum distribution of loading to the coupling. These are low speed excursions and generally do not impact on coupling performance. However, this technical bulletin recommends a maximum axle group spread of 1.45^{metres} for a tandem; and 2.6^{metres} for a triaxle:

D_C-value (kN):

Configuration:	GCM:	Pin Coupling D_C	V-required	Fifth wheel D
A123T23T23	≤ 125 tonnes	≥ 175 kN	Tandem ≤ 29 kN	≥ 190 kN
A133T33T33	≤ 145 tonnes	≥ 205 kN	Triaxle ≤ 33 kN	≥ 220 kN
B133T33T33	≤ 165 tonnes	≥ 245 kN	Triaxle ≤ 33 kN	≥ 250 kN

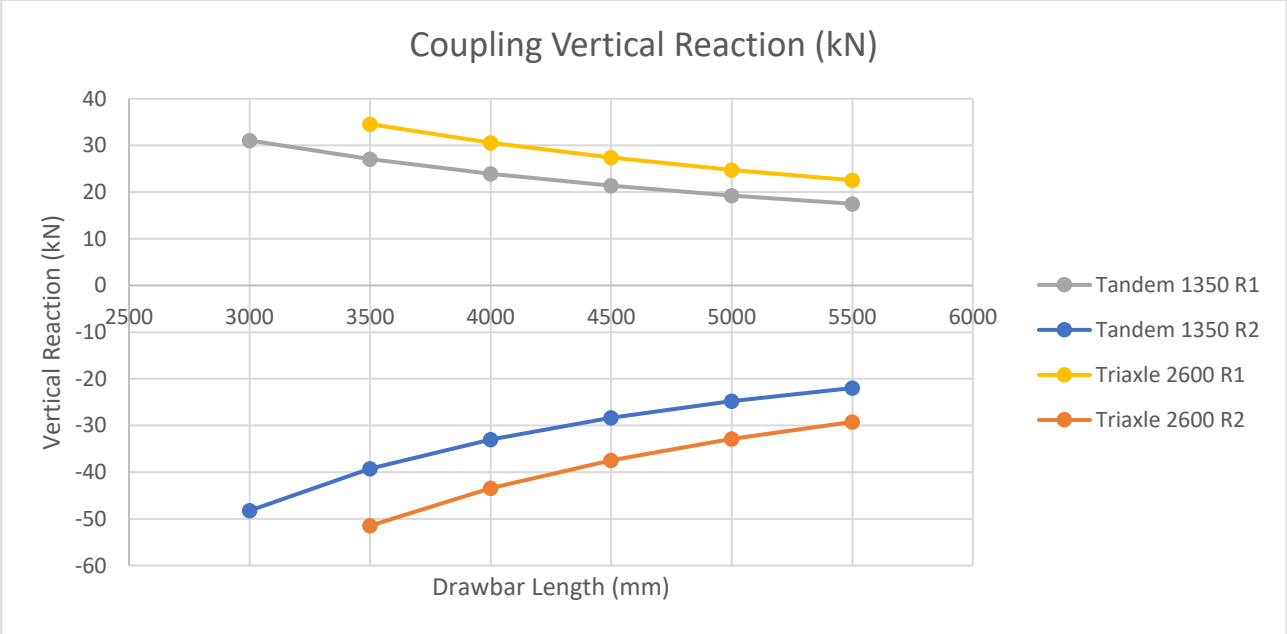
Low speed coupling reactions: Whilst wider axle group spacings may provide some design benefits for axle groups, in a rigid drawbar converter dolly there is a negative. When crossing an obstacle such as an invert, one axle may significantly "unload" and may even be completely clear of ground contact, as a result

in such a situation the low-speed vertical loading at the coupling may be significant (both vertically up and vertically down). To "manage" this vertical loading the axle spacing range should be reduced, especially as the drawbar length reduces.



Tandem Converter Dolly **Triaxle Converter Dolly**

Typically, the vertical static load at the pin coupling will be 0.25 tonnes (+/- 0.05). As one axle is "unloaded" the reaction at the coupling with change. As the leading axle is "unloaded" the coupling equivalent static reaction will increase (R1); as the trailing axle is "unloaded" the coupling equivalent static reaction will decrease (R2): The following graphical shows approximations for both tandem and triaxle groups.



Fifth Wheel: The fifth wheel should be positioned at or near on the theoretical centreline of the axle group and be capable of at least $8^{degrees}$ of fore/aft articulation (a similar specification to would be used on a prime mover).

Safer Braking Technologies: Whilst ADR 38/05 does not mandate ABS and roll stability for converter dollies, the ITC working group recommends the fitment of a T-EBS braking system.

Where the number of towed trailers exceeds two (2), counting a converter dolly as one trailer, then the EBS power supply from the prime mover must be 24-volt.

Further guidance and considerations:

- Triaxle converter dollies may have limited swing clearance at the semi-trailer landing leg, from this perspective the triaxle group spread needs to be minimised.

Reference:	**Tandem**	**Triaxle**
Suspension axle range (mm)	**Optimum 1350** Design range 1250 - 1400	**Optimum 2400 - 2500** Design range 2300 - 2600
Drawbar length (mm)	**Optimum ≥ 3950** Minimum 3500	**Optimum ≥ 4100** Minimum 3800

ITC member suppliers and project partners:

Axle/suspension:

- BPW Transpec
- FUWA K-Hitch
- Hendrickson
- MaxiPARTS
- SAF-Holland

Brake Control Systems:

- HALDEX
- Knorr Bremse
- WABCO

Converter Dolly Manufacturers:

- Barker Trailers
- HAULMARK Trailers
- MaxiTRANS Group

Fifth wheel:

- FUWA K-Hitch
- JOST
- SAF-Holland

Pin Coupling:

- BPW Transpec (VBG/Ringfeder)
- JOST Australia (Rockinger)
- SAF-Holland (V.Orlandi)

Tyres:

- Bridgestone

Wheels (rims):

- ALCOA Wheels
- JOST Australia

This Technical Bulletin supersedes TB 2020-02 September 2020.