Australian Government
Australian Transport Safety Bureau

Derailment of freight train 7MC1

Wallan, Victoria | 4 November 2017

Investigation

ATSB Transport Safety Report
Rail Occurrence Investigation
RO-2017-016
Final – 6 March 2019

Cover photo: Chief Investigator, Transport Safety (Vic)

This investigation was conducted under the *Transport Safety Investigation Act 2003* by the Chief Investigator, Transport Safety (Victoria) on behalf of the Australian Transport Safety Bureau in accordance with the Collaboration Agreement entered into on 18 January 2013.

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Addendum

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Safety summary

What happened

At 1523 on Saturday 4 November 2017, Qube Logistics freight train 7MC1 was signalled into the crossing loop at Wallan, Victoria. Entering the loop from the main line, the leading bogie on the 37th wagon derailed and travelled in a derailed state until the train stopped within the loop. At this stage, the locomotive crew were unaware of the derailment.

Following the passing of an opposing passenger service, and signals clearing, 7MC1 commenced its departure from the loop. Shortly after, a member of the public made the crew of 7MC1 aware that a wagon was derailed and the train was brought to a stand.

What the ATSB found

The ATSB found that the leading left-hand wheel of the leading bogie of wagon LQAY 00025D climbed the left-hand stock rail within the turnout from the crossing loop to the cripple track. The second wheelset of the same bogie derailed several hundred metres into the loop after the train commenced its departure from the loop.

It was found that the derailment occurred within a rapid transition of track superelevation from the main line to the loop track, resulting in the unloading of the leading left-hand wheel. The twist through the location exceeded network requirements and the basis for its acceptance was not documented.

In addition, the track alignment through the turnout to the cripple track probably resulted in the wheel tracking towards the left stock rail. The condition of some sleepers was also degraded resulting in a reduced effectiveness of rail fastenings.

The wagon and its loading was compliant with network requirements.

What's been done as a result

ARTC completed rectification works at the derailment location to address the identified twist exceedances. Works included improving track geometry, the installation of turnout bearers with resilient fastenings and mechanised tamping.

ARTC has also enhanced work management processes for the response to geometry conditions in accordance with ARTC's Safety Management System.

Safety message

Effective management of track defects is critical to minimising the risk of derailment and maintaining safe rail operations.

Contents

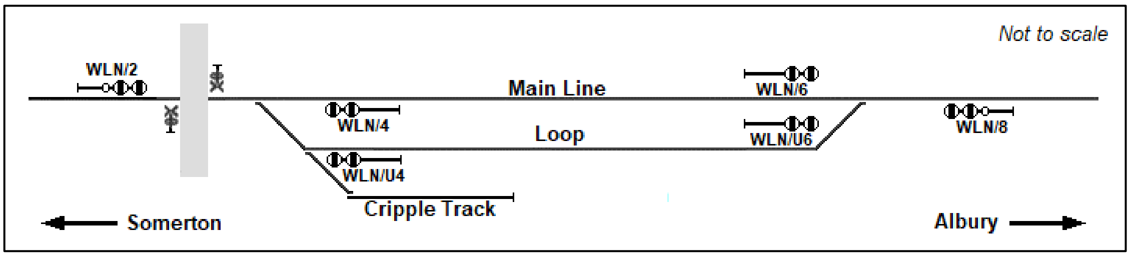
The occurrence

Train 7MC1 was an intermodal freight service between Melbourne and Junee operated by Qube Logistics Rail Services (Qube) on 4 November 2017. It comprised two QBX-class locomotives and 46 wagons. After loading and pre-departure inspections, the train departed Melbourne at 1315.

At Somerton, about 22 km into its journey, there was a change in the train crew. After departing Somerton, the changeover locomotive driver felt that the train was not performing as expected, suspecting that the second locomotive was not powering. The driver stopped the train to check the Multiple Unit (MU) cable connection between locomotives. They attended to the MU connection and on resuming, the driver was satisfied that the second locomotive was powering.

Prior to Wallan, the crew of train 7MC1 was contacted by network control[1] and advised that their train would be routed into the crossing loop at Wallan to allow an opposing passenger train to pass (Figure 1).

Figure 1: Wallan Loop layout and signalling

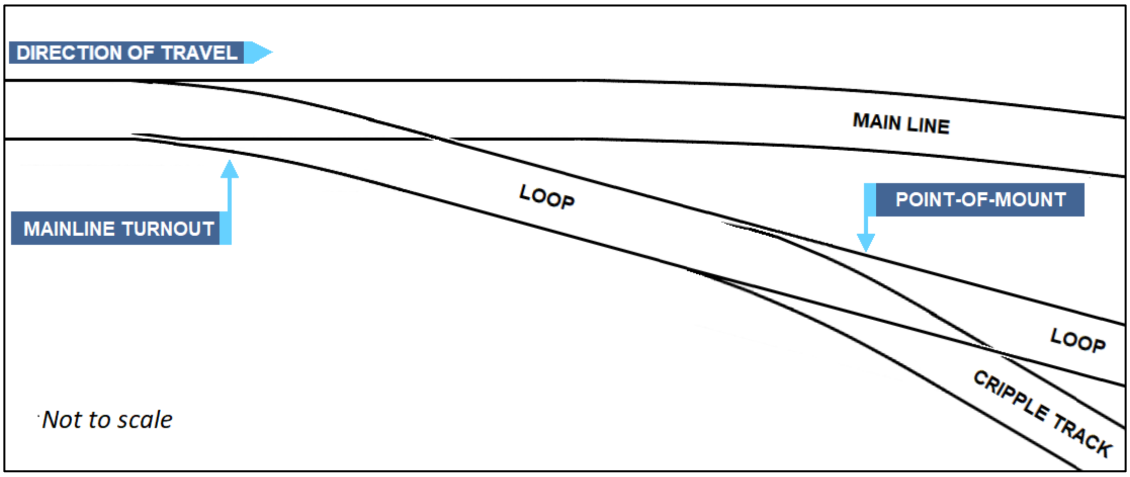


Source: Chief Investigator, Transport Safety (Vic)

Train 7MC1 was stopped prior to the loop at the Wallan Home signal (WLN/2). The signal then cleared to display a Low Speed Caution indication meaning a maximum speed of 15 km/h. The train departed at about 1523[2] and then entered the loop at about 13 to 14 km/h.

As 7MC1 was entering the loop, the leading wheelset of the 37th wagon (LQAY 00025D) derailed. The leading left-hand wheel of the wagon climbed[3] the stock rail[4] beyond the point blade in the cripple track turnout, ran along the railhead and dropped to the outside of the rail (Figure 2).

Figure 2: The location of the point of mount within the cripple track turnout



Source: Chief Investigator, Transport Safety (Vic)

1 The ARTC train control office for the Standard-Gauge network between Sydney and Somerton.
2 All times are in Eastern Daylight saving Time (EDT).
3 The Point of Mount (PoM) at which the wheel flange climbed the rail and commenced running along the rail.
4 The outside, continuous rails of a turnout.

The train continued its entry into the loop at around 13 km/h and then commenced braking for about 240 m before stopping at the Loop Home Departure signal (WLN/U6).[5] The train was now fully within the crossing loop. There was no loss of brake pipe continuity and the train crew were not aware of the derailment.

The V/Line Standard-Gauge passenger service 8620 that was running from Albury to Southern Cross Station then passed 7MC1. Its driver radioed to the crew of 7MC1 that their train was 'complete' and 'looked ok'.[6]

Once the passenger train had cleared, 7MC1 received a signal indication to depart Wallan. As it was departing, the № 2 axle on the same bogie derailed and a member of the public who had seen the derailed wagon drove alongside the locomotive and signalled to the crew to stop.

The train was brought to a stand. Damage to the train was limited to wagon LQAY 00025D that had derailed all wheels of its leading bogie (Figure 3).

Figure 3: The derailed bogie (both wheelsets) after the train was brought to a stop

This picture shows the derailed wagon after the train was stopped when departing Wallan Loop.
Source: Chief Investigator, Transport Safety (Vic)

5 The train speed was logged at about 13 km/h when braking was applied to bring the train to a stand within the loop.

6 Refers to the train being intact from one end to the other, and the last vehicle being properly identified.

The track sustained damage to sleepers over a distance of several hundred metres (Figure 4).

Figure 4: Typical damage to concrete sleepers within the crossing loop

Source: Chief Investigator, Transport Safety (Vic)

Post-occurrence

The locomotive driver contacted the ARTC network controller and informed them of the situation while the driver's assistant went back to inspect their train.

ARTC network control requested that the lead portion of 7MC1 continue its journey, as the train was now blocking the main line. 7MC1 was divided between the 33rd and 34th vehicles and departed Wallan at 1935 to Kilmore East where the train crew were drug and alcohol-tested. The drivers were cleared to continue and 7MC1 departed Kilmore East at 1945.

Recovery

Representatives from Qube's maintenance contractor attended the site on 6 November to re-rail LQAY 00025D. After re-railing, the wagon was transferred to the Melbourne end of the loop. It was then moved towards the cripple track[7] adjacent to the loop. During this move, the leading axle of the wagon in the direction of travel derailed on the cripple track turnout. This was on a different section of track to the earlier derailment and the bogie was in a damaged condition.

This bogie was again re-railed and successfully shunted into the cripple track. The wagon was unloaded and the bogies changed out and transported to Melbourne where they were quarantined for further inspection.

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7 A cripple track is used for stabling disabled rolling stock clear of the main line.

Context

Track

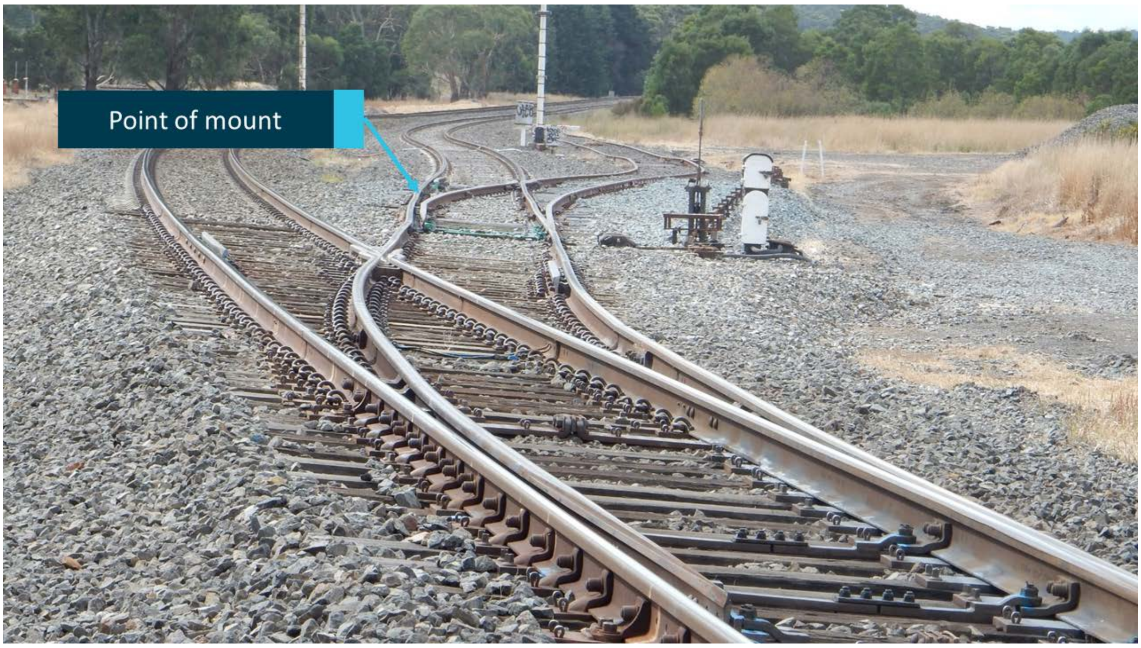
Location

Wallan loop is located about 47.3 rail km from Melbourne on the Victorian North-Eastern Standard-Gauge main line between Melbourne and Albury. The Australian Rail Track Corporation (ARTC) was the Rail Infrastructure Manager. It managed network rail traffic from its control centre in Junee, NSW, and track maintenance for this section of track from Seymour, Victoria.

Wallan crossing loop layout

The track at Wallan included the crossing loop and a cripple track for disabled rolling stock. The southern end of the loop consisted of a right-hand turnout from the main line and a second right-hand turnout to the cripple track. The Normal direction of this second turnout led into the crossing loop proper and to a short left-hand curve before the loop track curved right paralleling the main line (Figure 5).

Figure 5: The southern entry from the mainline into Wallan Loop and the cripple track



Source: Chief Investigator, Transport Safety (Vic)

The turnout at the southern entry to the crossing loop was located on a 1247 m radius main line curve with minimal gradient. The main line track has a superelevation[8] of 100 mm that transitioned to the flat loop track over a distance of about 24 m.

The cripple track turnout was on timber sleepers. At the derailment location, sleepers were in degraded condition with an observable loss of effectiveness in the rail fastenings.

[8] The height difference between the rails. The outer rail on a curve is often elevated above the inner rail to facilitate higher curving speeds.

Track geometry

Standards

The ARTC track geometry standards specified defect categories for track gauge, horizontal alignment (line), vertical alignment (top) and twist (variation in actual cross level). The standard noted that the specified maintenance response was based on an isolated geometric defect, and a more stringent response than that mandated by the geometry alone may be necessary if deterioration of the infrastructure both at the defect and on adjoining track is in evidence.

The required response to a defect varied depending on the permitted train speed. Response requirements reduced as train speed reduced. The standard also defined response timeframes (Figure 6).

Figure 6: Response categories and timeframes

Response category	Inspect (see notes 1 and 3)	Repair (see notes 2 and 3)	Other responses (see note 3)
E1 (Emergency Class 1)	Prior to next train	Prior to next train	Where the response category cannot be reduced below E1 by a reduction in speed, trains may only pass the site under the control of a pilot. Assessment of the defect by a competent worker should be made to determine if the train can be piloted.
E2 (Emergency Class 2)	Within 2 hours or prior to the next train, whichever is greatest	Within 24 hours	If the defect cannot be inspected or repaired within the nominated time and the response category cannot be reduced below E2 by a reduction in speed, trains may only pass the site at speeds up to 20 km/h following assessment by a competent worker.
P1 (Priority Class 1)	24 hours	7 days	
P2 (Priority Class 2)	7 days	28 days	
N			A deviation from design geometry up to the lowest level of P2 defect does not require any action above the normal inspection regime.

Notes:

1. In the event of failure to inspect reported faults by the specified time the allowable speed should be reduced by at least one speed band. A revised inspection period in line with the lower speed band may then be used. If the defect is subsequently inspected the speed may be raised to the higher band subject to repair being achievable within the nominated period for the higher band.
2. In the event of an inability to repair the track, the fault should be reassessed on site prior to expiry of the repair response time. The repair period can only be extended by the Civil Engineering Representative or a person with delegated authority from the Civil Engineering Representative.
3. If the cause of a defect is known and it is known that it will not deteriorate into an unsafe condition an alternative response to that shown is permitted with appropriate documentation and approval by the Civil Engineering Representative or nominated representative.

Source: ARTC Code of Practice, Track Geometry Section 5

Twist criteria

Two criteria applied to track twist. Short twist was measured over 2 m (approximating typical wagon bogie wheel spacing) and long twist was measured over 14 m (approximating a typical spacing of wagon bogie centres). Higher levels of twist were permitted in transition curves.

Track geometry recording car and maintenance response

Prior to the incident, the track geometry of the Wallan Loop was last assessed on 1 September 2017, using the AK Car.[9] The inspection flagged two Emergency twist defects at the southern end of Wallan Loop and near the location of the derailment (Figure 7).

Figure 7: E Class defects identified near the derailment location

Defect type	Category	Category criteria[10]	Measured by AK Car[11]	Chainage[12]
Long twist	E1	>74 mm[13]	77 mm	47.312 km
Short twist	E2	23-24 mm	24 mm	47.317 km

Source: ARTC Track Recording Car and Code of Practice, Track Geometry Section 5

Documentation indicated that the two defects were closed out on the asset management system on the same day as the inspection. There was no indication of any repair activity to correct the defects and no supporting documentation or approvals permitting the defect condition.

The previous two track-recording runs through the derailment site, in April 2017 and December 2016, also identified short and long twist defects categorised for emergency response.

Post-incident geometry measurement

Following the derailment, track gauge and cross level measurements were taken through the derailment location (Figure 8).

Figure 8: Point of wheel mount

Source: Chief Investigator, Transport Safety (Vic)

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9 The AK Car is part of a three-car train that records track geometry on the standard-gauge network.
10 ARTC Code of Practice, Track Geometry Section 5, Table 5.5.
11 Absolute values shown. In the direction of travel, the left-hand rail was descending relative to the right rail.
12 The distance in rail km from a reference point in Melbourne.
13 As specified for a transition curve.

The PoM was at a chainage of approximately 47.316 km.[14] Static twist measurements peaked around this location. A measured peak static long twist of 78 mm[15] extended from 14 m before the PoM, up to the PoM. The measured peak static short twist[16] was about 22 mm about 2 m ahead of the PoM. These values were comparable to the E-defects measured by the AK Car.

The maximum measured (no-load) wide gauge through the location was 20 mm at the PoM. This was within permitted maintenance tolerances. Review of the most recent AK Car data, measured under load, indicated a peak wide gauge of 31 mm at a chainage of 47.319 km. This falls within the P2 (Priority Class 2) defect category for this low speed track.

Track lateral alignment through the cripple track turnout was also sub-optimal and there was a significant dip in both rails at the transition (mechanical joint) from the main line turnout to the cripple track turnout (Figure 9).

Figure 9: Transition from main line turnout to cripple track turnout

This picture shows a close-up view of the track through the derailment location and shows the rail lateral alignment around the point of mount. The deviation in rail line is exaggerated by the telephoto effect.
Source: Chief Investigator, Transport Safety (Vic)

The train

Consist

Train 7MC1 comprised two QBX-class locomotives and 46 loaded wagons conveying shipping containers. It was 1,018 m long and had a gross mass of about 3,300 t. It had been loaded at Westgate sidings at Qube's intermodal terminal in Melbourne. A Melbourne-based crew prepared and examined the train prior to its departure from the terminal, and then operated the train until a crew change-over at Somerton.

Wagon

The derailed wagon was designated LQAY 00025D. It was the 37th wagon from the locomotives and was "B" end leading. There were four wagons of this type in the consist, two ahead of the derailed wagon (2nd and 23rd), and one behind (the 46th and the last vehicle).

14 The estimated error tolerance on chainage at the PoM is +/- 2 m.
15 Track was measured by several parties with small, but inconsequential, variances in the hand measurements.
16 Measured over 2 m.

LQAY wagons are 19.3 m (60’) skeletal container wagons manufactured in China by Meishan Rolling Stock Works. The derailed wagon was one of 100 ordered by Macathur Intermodal Shipping Terminal (MIST) with production commencing in 2005. The use of this type of vehicle and bogie on the ARTC network was approved by ARTC in the form of a TOC Waiver in October 2009. As these wagons were initially operated on the Rail Infrastructure Corporation’s (RIC) NSW network they were required to meet the then RIC Minimum Operating Standards for Rolling Stock. ARTC’s Engineering Standard for Rolling Stock WOS 01 was based on these RIC requirements.

LQAY wagons are fitted with three-piece bogies with a steering arm mechanism linked to primary rubber pad arrangement between the side frame and axle box. They also have variable friction damping on the secondary springs and constant contact side bearers (Figure 10).

Figure 10: The derailed bogie after its transport to Melbourne

Source: Chief Investigator, Transport Safety (Vic)

Wheel profile

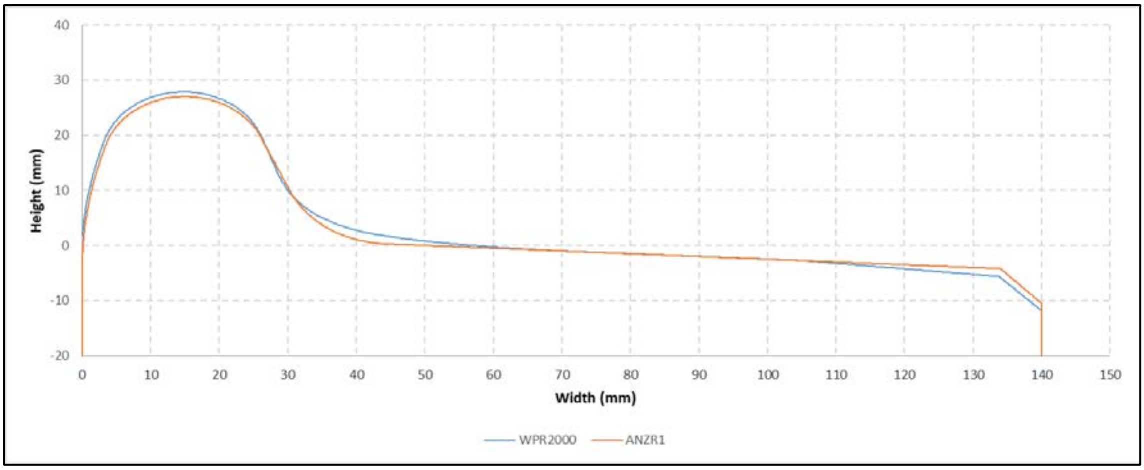
The bogies were delivered in 2005 with wheels profiled to the WPR 2000[17] profile. This was the profile preferred by RIC, the original network destination for this wagon. The profile was subsequently changed to the ANZR-1[18] profile, listed in the ARTC Route Access Standard General Information, for freight rolling stock operating on the Defined Interstate Rail Network. There was no evidence provided by the Rolling Stock Operator of a change management process associated with this change in wheel profile.

The WPR 2000 wheel profile is a worn wheel profile that was designed to increase wheel life compared to the ANZR-1 through limiting wear of the wheel flanges (Figure 11). It achieved this by utilising a more conical tread profile that generates a larger rolling radius difference between the wheels on a common axle. This increased the wheelsets ability to steer through curves and hence placed less load on the wheel flange.

17 Standard AS 7514.2 Australian Standard – Railway Rolling Stock Wheels – Part 2: Freight Rolling Stock (2010) Appendix A.2

18 Standards AS 7514.2 Australian Standard – Railway Rolling Stock Wheels – Part 2: Freight Rolling Stock (2010) Appendix A.1

Figure 11: Comparison between the WPR 2000 (blue) and ANZR-1 (red) wheel profiles



Source: Australian Transport Safety Bureau

While the increased steering capability of the WPR 2000 wheel profile offered less flange wear, it had been shown in use to lower the critical speed[19] for some combinations of wagon type and rail profile leading to undesirable dynamics known as hunting[20]. The ATSB understands that the flatter tread profile of the ANZR-1 was generally less susceptible to hunting and therefore the preferred profile for freight rolling stock operating on the ARTC Defined Interstate Rail Network (DIRN). It was also an option on other track where it could be demonstrated that a vehicle was experiencing bogie instability.

Wagon maintenance

LQAY wagons were on a preventative maintenance (PM) program. Maintenance records for LQAY 00025D indicated that:

- On 30 November 2016 both bogies and all wheelsets were replaced.
- The wagon had its last PM inspection on 24 October 2017.

Wagon type testing

Type testing of the LQAY wagon type was conducted in China in September 2005 and covered wagon numbers 00001 – 00100. The type testing was in accordance with the RIC Minimum Operating Standards for Rolling Stock and witnessed on behalf of MIST by Interfleet Technology. The type testing included a static vehicle twist test and vehicle/bogie swing test.

The twist test examined potential wheel unloading in response to track twist. Twist was simulated by packing wheels on one side of the wagon (Figure 12). For the type testing of the LAQY wagons, the packing used was P1 = 18 mm, P2 = 86 mm and P3 = 86 mm. The wheel unloading (the reduction in wheel load) was measured for the leading wheel (P0).

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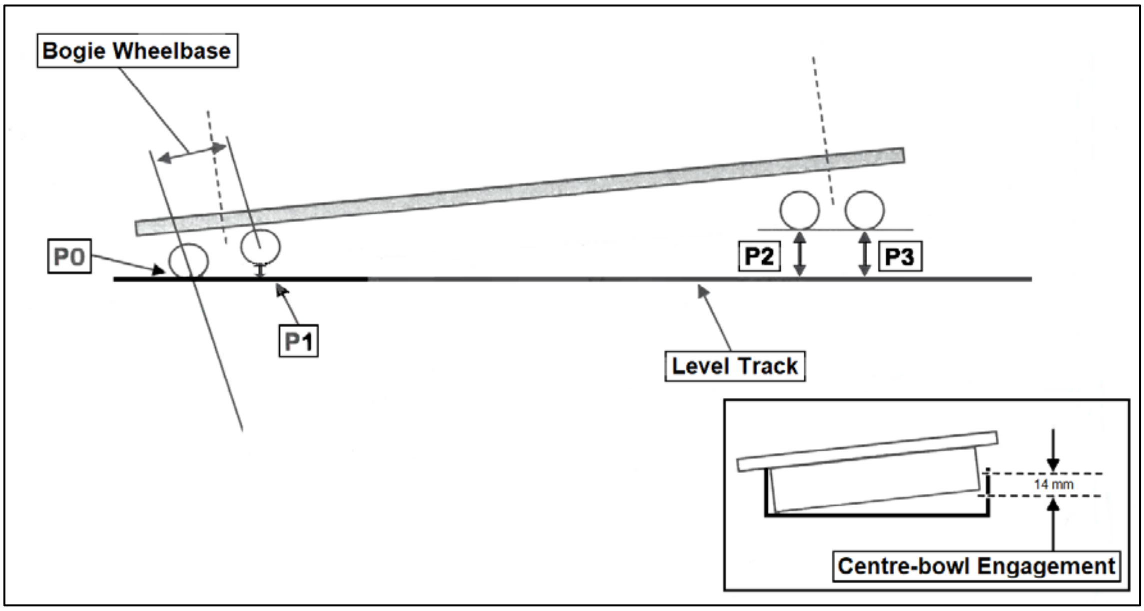
19 Critical speed: The lowest speed at which hunting is demonstrated. Can also be used to describe speed at which a resonant response occurs with cyclic track irregularities.

20 Hunting: Uncontrolled and undesirable cyclic lateral and yaw displacements of the wheelsets of a vehicle, generally worsening with increasing speed.

Figure 12: Test configuration for twist type testing, and centre-bowl engagement criterion



Source: QUBE, modified by Chief Investigator, Transport Safety

During this twist test, a maximum wheel unloading of 23% was measured, compared to the requirement of '…the loss of absolutely no more than 60% of the static wheel load for any wheel'. The measured engagement of the vehicle centre plate within the bogie centre casting was 14 mm, equal to the minimum permitted (Figure 12).

The purpose of the vehicle/bogie swing test is to evaluate clearance when a wagon is navigating tight curves. The criteria used in testing was a 70 m simple curve. This testing found adequate clearances for normal operations. The only adverse finding was fouling when the handbrake was applied.

Wagon loading

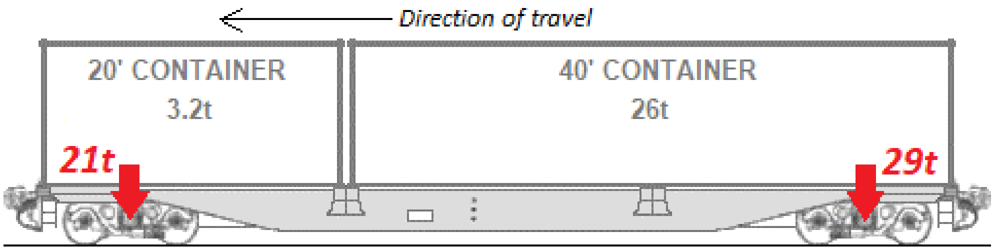
Wagon LQAY 00025D was loaded with two containers. At its leading end was an empty 20-foot refrigerated container with a reported mass of 3.2 t. Behind this was a 40-foot container loaded with strapped bundles of recycled paper and having a reported mass of 26 t (Figure 13). Wagon tare was 19.9 t, giving a total mass of 49.1 t. This compares with the train consist report that records a total mass of 69 t. The reason for this discrepancy is unknown.

Figure 13: Paper bundles loaded in the 40-foot container

Source: Qube Logistics

The two containers wholly occupied the length of the wagon. The mass distribution of the containers and wagon tare resulted in an estimated 21 t at the leading bogie and about 29 t at the trailing bogie of (Figure 14).[21] The difference of about 8 t was within the ARTC Route Access Standard[22] requirement of no more than 20 t.

Figure 14: The container loads and the resultant mass at each bogie



The mass at each end has been rounded up, resulting in a total rounding error of 1 t, and an apparent total mass of 50 t compared to the actual total mass of 49 t.

Source: Chief Investigator, Transport Safety (Vic) based data from Qube

21 The mass distribution is an approximation.

22 This document defines the terms and conditions upon which ARTC grants access to its Network. It is intended to aid Train Operators to ensure trains are planned, constructed, inspected, maintained, loaded and operated in accordance with route attributes.

Post incident inspection

A detailed inspection was conducted on both bogies of wagon LQAY 00025D. The derailed bogie was designated LHSY113 (Figure 15).

Figure 15: The derailed bogie at the post-incident inspection

This picture shows the bogie that derailed. It shows damage to the centre bowl liner and some components, all believed to have occurred after the bogie derailed.
Source: Chief Investigator, Transport Safety (Vic)

No wear or damage conditions were identified that were considered contributory to the derailment. Wear to both bogies was minimal and consistent with the recent December 2016 overhaul. In addition, surface condition of constant contact side bearers did not indicate any unusual behaviour.

Wheel wear was within the operating requirements and similar on both bogies. Wheel wear on the derailed bogie was relatively light and evenly matched from side to side indicating the bogie had been tracking well. Wear on the wheel flanges was more than expected for a steering bogie, but was within tolerance.

The performance of self-steering bogies is, in part, dependant on the wheel profile used. A change was made from the higher steering WPR 2000 wheel profile to the lower steering ANZR-1 wheel profile and this may have contributed to the more than expected wheel flange wear.

Type of bogie

The LQAY wagon bogies were of a 'self-steering' bogie design. The steering mechanism is an adaptation of a design pioneered by Dr Herbert Scheffel in the 1970's in South Africa[23]. The design sought to improve the curving performance of bogies by permitting the wheelsets to steer into curves reducing wheel and rail wear while retaining good stability and resistance to hunting. This bogie design is often referred to as the Scheffel Bogie.

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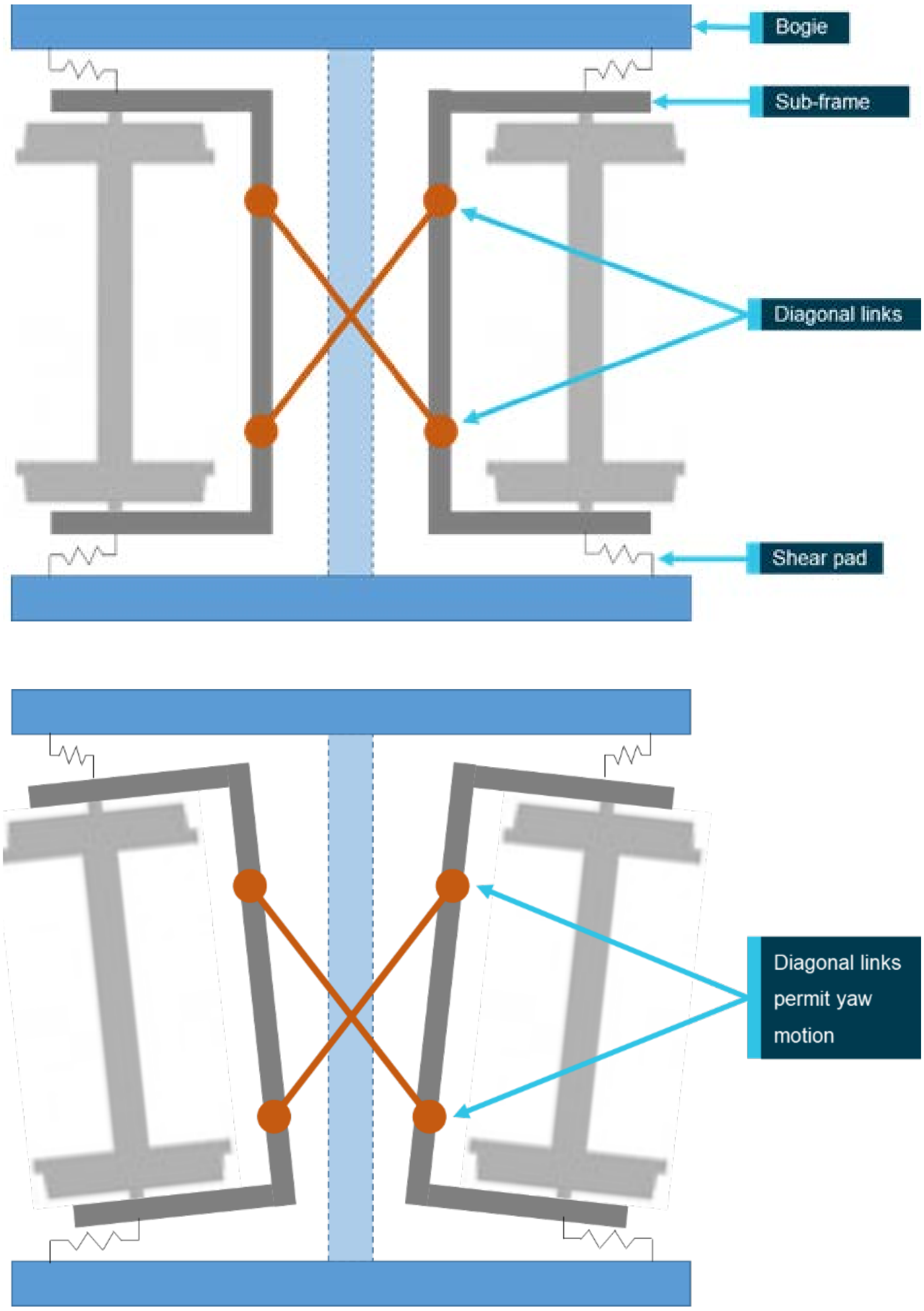
23 Original patent link.

Scheffel's design mounted the wheelsets to sub-frames that were diagonally linked and utilised rubber shear pads (springs) to permit motion between the sub-frame and bogie frame. Configured in this way, the design permits yawing of the axles in response to wheelset steering forces, allowing them to adopt a 'radial' configuration that greatly improves curving performance (Figure 16). The design also resists shear motion between the two wheelsets and is therefore said to have good resistance to hunting.

Figure 16: The principle behind the steering bogie



The figure identifies the key design components (top) and radial steering (lower).
Source: Australian Transport Safety Bureau

The magnitude of response of the steering mechanism is dependent on several factors including the wheel profiles used, with the resulting wheelset steering forces having an influence on the performance of the steering mechanism.

Train handling

Data logger

The lead locomotive was fitted with a data logger that provided a recorded history of the locomotive's movements and train handling, including powering and braking during the sequence of events (Figure 17).

Figure 17: Key sequence of events from the locomotive data logger

Time	Comment
15.21.20	7MC1 stopped at signal WNL/2
15.22.58	Power applied (notch 3) and 7MC1 commenced move towards Wallan Loop The throttle is modulated between notch 3 and notch 1 Speed 13 to 14 km/h
15.31.17	7MC1 brought to a stand at signal WNL/U6. The train then remained stationary for about 17 minutes
15.48.32	7MC1 commenced to depart loop Power applied between notch 1 and notch 3 Maximum speed 14 km/h
15.51.54	7MC1 is brought to a stand

Source: Chief Investigator, Transport Safety (Vic)

7MC1 entered Wallan Loop at low speed and power was being applied between notch 1 and notch 3. In-train coupler action would have been minimal and it is unlikely that there was sufficient in-train forces generated to contribute to the derailment.

Locomotive crew

Both crewmembers were qualified for their respective roles and held current medical certification.

Victoria Police conducted post-incident alcohol and drug tests on the locomotive crew at Kilmore East with non-positive results for all tests.

Safety analysis

The derailment

Site evidence was conclusive that the flange of the leading left-hand wheel on the wagon LQAY 00025D climbed the left-hand stock rail in the turnout to the cripple track, a short distance past the point blade. The derailment was clear of moving turnout components including the point blade.

Flange climb derailment

Flange climb derailments initiate when the outward lateral force (L) applied by the wheel on the rail results in the wheel climbing the rail gauge face. This critical point is determined by several factors including the vertical load on the wheel (V), the angle of the wheel flange and the coefficient of friction between the rail and wheel.

A generally adopted limit for preventing flange climb is known as Nadal's limit.[24] Nadal's limit defines a limiting lateral on vertical force ratio (L/V) for given wheel geometry and friction conditions. Flange climb becomes more likely as the L/V ratio increases beyond this value. This means that either an increase in lateral force, a decrease in vertical force or a combination of both will increase the risk of flange climb.

The lateral force of the wheel against the rail may increase due to a track feature such as a tight curve or lateral misalignment or by a condition of the bogie that affects its tracking. A reduction in the vertical load, also referred to as wheel unloading, can be associated with a track feature such as twist and can also be influenced by wagon condition including loading.

Track geometry

Twist

Near the point of flange climb, there were long and short twist defects. The long twist was of comparable magnitude to the value used in type testing of the LQAY wagon and the short twist was probably at least 20 percent[25] greater than that used in the type testing. The track twist would have contributed to an unloading of the leading left-hand wheel of LQAY 00025D.

Alignment

Site observations indicated that traffic was probably tracking towards the Down leg[26] around the derailment location. For north-bound traffic (the incident train), this meant that vehicles were probably typically tracking to the left towards the stock rail of the turnout to the cripple track. The rail alignment through the cripple track turnout and the track configuration through this location probably influenced wagon tracking behaviour.

Gauge

Track gauge measured statically after the derailment was at its widest at the point of wheel climb, but was within permitted tolerances. Under dynamic conditions, the wide-gauge at this location was about 50 percent higher, but also not at a level that would have required emergency corrective action.

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[24] Nadal, M.J., Locomotives à Vapeur; (Collection: Encyclopédie Scientifique, - Bibliothèque de Mécanique Appliquée et Génie, 1908).

[25] Based on a short twist of 24 mm measured under the dynamic conditions of the AK Car. Under the loading of LQAY 00025D, the dynamic twist in the track may have been greater.

[26] The left-hand rail when facing away from Melbourne.

Sleeper condition and effectiveness of rail fastenings

The most-recent AK Car assessment recorded a wide gauge of 31 mm at a chainage about three metres past the point of mount. This exceeded the static (no-load) peak gauge measurement of 20 mm through this location. Considering the degraded condition of sleepers and the loss of effectiveness of the fastenings, it is probable that there was some movement of the stock rail under dynamic load, probably adversely impacting track geometry.

Track defect management

At and near the point of mount, there were two identified twist defects categorised as requiring immediate emergency response. Records indicated that these twist defects had existed for at least 12 months.

The long track twist through the location was a result of the superelevation being rapidly transitioned from about 100 mm on the main line curve through to the flat crossing loop track. The dynamic short twist within this transition was more severe, and probably the result of localised ballast subsidence under the load of rolling stock.

The acceptance of the track in this condition contrary to the network geometry standards was not supported by documentation and approvals as required by the standard.

Wagon performance

This wagon type and its loading was compliant with network requirements and the post-incident bogie inspection did not identify a condition that may have contributed to the derailment.

It is possible that the response of wagon LQAY 00025D to the track geometry anomalies was different to other wagons. A factor that may have influenced its response was its load distribution.

No conclusion was drawn from the second derailment of the vehicle as it was being transferred to the cripple track. The bogie was damaged and the second derailment occurred on a different part of the track to the first.

Findings

From the evidence available, the following findings are made with respect to the derailment of train 7MC1 at Wallan on 4 November 2017. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Safety issues, or system problems, are highlighted in bold to emphasise their importance. A safety issue is an event or condition that increases safety risk and (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operating environment at a specific point in time.

Contributing factors

- **ARTC allowed identified track twist defects to remain in track contrary to network track geometry requirements. [Safety Issue]**
- Track twist contributed to unloading of the leading left-hand wheel of wagon LQAY 00025D.
- Track alignment probably resulted in the leading left-hand wheel of wagon LQAY 00025D tracking to the left-hand stock rail as the wagon passed through the cripple track turnout.
- When traversing the cripple track turnout towards the crossing loop, the leading left-hand wheel of wagon LQAY 00025D climbed the left-hand stock rail, and the wagon derailed.

Other factors that increased risk

- The degraded condition of some sleepers through the location reduced the effectiveness of rail fastenings, probably adversely affecting track geometry under dynamic load.

Other findings

- The operation of the train was consistent with network practice and unlikely to have contributed to the derailment.
- Post-incident bogie inspection did not identify a condition that may have contributed to the derailment.

Safety issues and actions

All of the directly involved parties were provided with a draft report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

Track defect management

Number:	RO-2017-016-SI-01
Issue owner:	Australian Rail Track Corporation (ARTC)
Operation affected	Rail
Who it affects	Track Managers

Safety issue description:

ARTC allowed identified track twist defects to remain in track contrary to network track geometry requirements.

Proactive safety action taken by ARTC

Action number: RO-2017-016-NSA-03

ARTC has addressed localised processes and enhanced work management processes for the response to geometry conditions in accordance with ARTC's Safety Management System. These initiatives are being driven by the implementation of the AMIP (Asset Management Improvement Program) including improving processes around scheduled maintenance, defects, work orders and responding to AK Car track geometry findings.

Also, as an outcome of the AMIP, a new structure was introduced such that Works Planning Managers and Area Planners are now in place to support Provisioning Centre teams in reviewing known conditions and required responses in order to better manage the maintenance and projects activities across the ARTC Network.

Additional safety action

ARTC has completed rectification works at Wallan to address the twist exceedances in the vicinity of the turnout from the loop to the cripple track. The geometry was initially corrected on 23 December 2017. Follow-up works were completed on 19 March 2018 and included the installation of turnout bearers with resilient fastenings and mechanised tamping (Figure 18).

Figure 18: The derailment location after rectification works

Source: Chief Investigator, Transport Safety (Vic)

General details

Occurrence details

Date and time:	4 November 2017 – 1523 EDT	
Occurrence category:	Incident	
Primary occurrence type:	Derailment	
Location:	Wallan, Victoria	
	Latitude: 37° 24.985' S	Longitude:145° 0.388' E

Train details

Train operator:	Qube Logistics Rail Services	
Train number:	7MC1	
Type of operation:	Freight	
Persons on board:	Crew – 2	Passengers – 0
Injuries:	Crew – 0	Passengers – 0
Damage:	Minor	

Sources and submissions

Sources of information

- Qube Logistics (Rail) Services
- Australian Rail Track Corporation

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003* (the Act), the Australian Transport Safety Bureau (ATSB) may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the Australian Rail Track Corporation, Qube Logistics Rail Services, the Rail Regulator, and the locomotive drivers. Submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Australian Transport Safety Bureau

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Linkedin Australian Transport Safety Bureau

Research

ATSB Transport Safety Report
Rail Occurrence Investigation
Derailment of freight train 7MC1, Wallan, Victoria on 4 November 2017

RO-2017-016

Final – 6 March 2019