



Engineering and Asset Management
Interoperability Standard
M-ST-RS-8103
**Heritage Rail Vehicle
Interoperability**

Document Control

Document No.	M-ST-RS-8103	Issue No.	1.1
Date Effective	12/03/2026		
Prepared (P) Reviewed (R) Amended (A)	(P) A. Raue	Checked and Approved By	Engineering & Asset Management – Professional Heads
		Authorised for Release By	Professional Head – Interoperability

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1. Purpose

This standard sets technical requirements for heritage rail vehicles to be interoperable with the National Rail System. Compliance with this standard is required for KiwiRail as Access Provider to grant Running Rights to Rail Operators for Heritage Rail Vehicles.

2. Scope

This standard applies to heritage rail vehicles of all types for operation on the National Rail System. Compliance to this standard is a requirement for heritage rail vehicle certification under APIS-11 Heritage Vehicle and Train Management, and a prerequisite for KiwiRail as the Access Provider to issue running rights for heritage rail vehicles on the Controlled Network.

3. Associated Documents

Level	Number	Title	Relationship
1	M-PR-GE-8001	Rail Vehicle Interoperability Principle	Superior Document: Clarified / Extended
2	M-ST-RS-8101	Rail Vehicle Interoperability	Companion Document
2	M-ST-RS-8102	Wheelset Dimensional Limits	Companion Document
2	T-ST-DE-5200	Track Design	Companion Document
2	T-ST-DE-5212	Clearances	Companion Document
2	APIS 11	Heritage Vehicle and Train Management	Companion Document

3.1 Withdrawn, closed and superseded

Old Reference	Title	Replaced by
NRSS / 6	Engineering Interoperability Standards	M-ST-RS-8101 M-ST-RS-8102 M-ST-RS-8103

4. Acronyms and Definitions

Acronym	Definition
AAR	American Association of Railroads
AEA	Auckland Electrified Area
AEI	Automatic Equipment Identification
ARL	Above Rail Level
ICP	Independent Competent Person
LA	Line Availability
LAVEN	Line Availability Vehicle Evaluation Number
NIMTEA	North Island Main Trunk Electrified Area
RISSB	Rail Industry Safety and Standards Board (Australasia)
RSSB	Rail Safety and Standards Board (United Kingdom)

WEA	Wellington Electrified Area
WSP	Wheel Slide Protection

Term	Definition
Access Provider	A licensed party or person who controls the use of a railway line by rail operators. Per Railways Act 2005. This means KiwiRail in all contexts for this document.
Bogie	A structure incorporating suspension elements and fitted with wheelsets, used to support rail vehicles and capable of rotation in the horizontal plane.
Carriage	Hauled rail vehicle designed for carrying passengers.
Controlled Network	All track where occupancy and movement by rail vehicles is under the control of the Access Provider (KiwiRail). This means track controlled by KiwiRail's National Train Control Centre and local signal boxes.
Driving Position	Place(s) from which a rail vehicle can be operated. Typically, the driver's seated position for conventional rail vehicles.
Heritage Rail Vehicle	Any rail vehicle formerly operated by KiwiRail, or KiwiRail's predecessor organisations, and that is operated primarily in Heritage Trains. See APIS-11 Definitions for further guidance.
Independent Competent Person	An experienced and knowledgeable person responsible for certifying rolling stock. Must be acceptable to the Access Provider and independent of from the heritage rolling stock restoration, modification, etc. See 7. Equivalent to the term Certifier, as used in APIS-11.
Lead Unit	Any rail vehicle intended for operation at the leading end of a train.
Locomotive	Self-propelled rail vehicle used for hauling or propelling other rail vehicles.
Multiple Unit	Self-propelled passenger train, typically made up of several semi-permanently coupled rail vehicles. Includes electric multiple units and diesel multiple units.
National Rail System	The rail network comprising the Controlled Network and Operator Controlled Territory. It includes all track unless specifically defined as unavailable for rail activity, owned or managed by the Access Provider (KiwiRail), including private sidings and all retained track. Excludes private railways. Excludes private or leased sidings not connected to the Controlled Network.
Operator Controlled Territory	All parts of the National Rail System that are not the Controlled Network and where a Rail Operator or other Rail Participant is responsible for the occupancy and movement of Rail Vehicles. This includes where KiwiRail as a Rail Operator is responsible for occupancy and movement of Rail Vehicles. This includes yards, sidings workshops, rolling stock maintenance depots, and similar.

Rail Operator	A licensed party or person that operates a rail vehicle. Per Railways Act 2005.
Rail Participant	Any organisation or person responsible for the provision or maintenance of rail services. Includes Access Providers and Rail Operators.
Rail Vehicle	Any flange-wheeled vehicle which operates on or uses a railway line.
Railcar	A self-propelled passenger rail vehicle. Typically refers to a single non-articulated vehicle with driving positions at both ends, but exceptions exist to this.
Railway Track Signal	Small explosive device affixed to the rail head for the purpose of providing audible warning when a rail vehicle wheelset passes over. Commonly referred to as a Detonator.
Running Rights	Written authority issued by KiwiRail as the access provider to allow operation of a rail vehicle (or class of rail vehicles) on the controlled network.
Train	A locomotive or other self-propelled rail vehicle, alone or coupled to one or more rail vehicles.
Wagon	Hauled rail vehicle designed for carrying freight.
Wheelset	An assembly consisting of axle, wheels, bearings, and where applicable associated components such as brake discs, traction gears, traction motor support bearings, gearbox, etc.

5. Application

Heritage rail vehicle certification requirements are described in APIS-11 §3.3. This document defines the technical interoperability requirements for heritage rail vehicles to operate on the National Rail System, which form part of the certifier's considerations.

Any reference to NRSS/6 Engineering Interoperability Standards in APIS-11 shall be taken to instead mean this document. Where APIS-11 refers to contemporary standards for interoperability then M-ST-RS-8101 Rail Vehicle Interoperability shall be referred to instead.

Each third-level numbered clause (e.g., 10.1.1) in this document is a technical requirement for heritage rail vehicles to be assessed against.

Clauses that use the term "shall" indicate a mandatory requirement. Clauses that use the term "should" indicate a recommended practice, but are not mandatory. Clause that use the term "may" indicate an allowed practice.

Rationale and guidance notes are provided for select clauses to aid in the application of this standard in heritage rail vehicle certification.

6. Established Operating History

A general presumption of interoperability can be made for heritage rail vehicles with a continuous operating history on the controlled network. This approach is applied to existing revenue service rail vehicles certified or grandfathered under superseded interoperability standards.

A continuous operating history does not exempt heritage rail vehicles from complying with the mandatory requirements within this standard.

Where a heritage rail vehicle has a non-continuous operating history on the National Rail System, special considerations shall be made for potential changes to the infrastructure. E.g., A heritage rail vehicle may have previous operating history on the Auckland network, but prior to its electrification (circa 2013). In such cases, comparison against contemporary requirements in M-ST-RS-8101 Rail Vehicle Interoperability will identify areas where interoperability of heritage vehicles may require further assessment.

7. Independent Competent Person

Independent Competent Person (ICP) is equivalent to the term Certifier used in APIS-11. Refer to APIS-11 §3.3.4 for requirements relating to the ICP.

8. Derogation Process

Non-compliance to any mandatory requirement in this standard must be supported by an approved derogation from KiwiRail as the Access Provider.

Derogations shall be requested by Heritage Rail Vehicle Providers and/or Operators, typically at the the time of registration, and require:

- sound justification of why compliance cannot be practicably achieved or why the requirement is not applicable to a heritage rail vehicle's operating context,
- a risk assessment with supporting mitigations,
- endorsement of the ICP/Certifier,
- endorsement of the Heritage Technical Committee (HTC).

Approved derogations will be recorded in written Running Rights issued by KiwiRail as the Access Provider.

9. Heritage Rail Vehicle Data

Heritage rail vehicle data and documentation, per APIS-11 §3.6, shall be provided to KiwiRail as the Access Provider.

10. Route Authorisation

Loading gauge (clearance) and load capacity of track and structures differs throughout routes on the KiwiRail Network. These values are set out in KiwiRail Standard G-ST-AL-9039, Principal Operating Parameters.

Running Rights issued by KiwiRail will detail route authorisation for rail vehicles or vehicle classes, depending on their route-specific interoperability.

10.1 Clearances

- 10.1.1 Heritage rail vehicles, or vehicle classes, may be presumed as clearance compatible over routes where they have an established operating history.

Guidance: An established operating history may include revenue operating service or heritage service. Where long hiatus periods exist caution should be applied.

- 10.1.2 Heritage rail vehicles operating on routes where they do not have an established operating history shall demonstrate clearance per M-ST-RS-8101 Rail Vehicle Interoperability §15.1.

- 10.1.3 Heritage rail vehicles running in electrified areas shall ensure minimum passing clearance to live overhead equipment is maintained (see 23.1.3).

10.2 Vehicle Mass & Axle Loads

- 10.2.1 Heritage rail vehicles shall have maximum and minimum mass conditions defined.

Guidance: FRONZ guidance allows a maximum 10 additional passengers over the seated capacity for heritage carriages. A passenger mass of 80 kg including luggage (or 70 kg if luggage is considered separately) is a typical assumption, per EN 15663.

Guidance: Additional mass conditions may also be recorded.

- 10.2.2 Static axle loads for each vehicle mass condition shall be calculated and recorded.

- 10.2.3 Static axle loads for a heritage vehicle shall not exceed the maximum permitted limit on the routes of the KiwiRail Network for which it is intended. These limits can be found in M-ST-RS-8101 Appendix 1.

Guidance: Minimum axle loads also apply for train detection compatibility. See 20.1.3.

- 10.2.4 Additional to load limits for individual axles, underline bridge loading as a result of axle spacing arrangement shall be assessed to determine a heritage rail vehicle's LA (Line Availability) rating. This assesses the maximum shear and bending stresses over differing span lengths. A rail vehicle's LA rating shall not exceed that of routes of the KiwiRail Network for which it is intended. These limits can be found in M-ST-RS-8101 Appendix 1.

Guidance: KiwiRail Structures' LAVEN tool is available for assessing LA rating based upon axle loads and spacing. This rating is based upon AS 5100.2 design loads. See KiwiRail Standard B-ST-AS-3121, Rail Bridge Assessment.

Guidance: New underline bridges are designed to 210LA, but this does not reflect the status of existing underline bridges. Existing 18 tonne axle lines are typically 170LA.

- 10.2.5 For heritage steam locomotives, driving wheel static loads shall be multiplied by a factor of 1.2 when calculating an LA rating.

Rationale: This accounts for 'hammer blow' effect, a phenomenon of steam locomotives where cyclical vertical loads produced by wheelset balancing weights are transferred to the track and underline structures (i.e., bridges).

Guidance: This allowance of 20% is a generic value from AS5100 Bridge Design, and specific steam locomotive classes may be evaluated with a reduced factor where a reduced hammer blow effect can be demonstrated by calculation or test.

- 10.2.6 Static wheel load imbalance for any axle shall not exceed 10%, under all loading conditions.

Guidance: Static wheel load imbalance is defined as the difference between individual wheel loads divided by the combined wheel loads, expressed as the percentage. E.g., A wheelset with individual wheel loads of 11 t and 7 t would have a 22% imbalance:

$$\frac{11 - 7}{11 + 7} = 0.22 = 22\%$$

- 10.2.7 Heritage rail vehicle centre of mass shall be no higher than 2000 mm ARL, in all load conditions.

- 10.2.8 Four-wheeled heritage rail vehicles centre of mass shall be no higher than 1650 mm ARL, in all load conditions.

11. Maximum Speed

- 11.1.1 Maximum operating speed for heritage rail vehicles shall be recorded during certification.

- 11.1.2 Maximum operating speed for heritage rail vehicles should not exceed the operating speed of the vehicle class at the end of its revenue service lifetime.

Rationale: Speed restriction is a common mitigation for a range of safety concerns. Where such restrictions were applied during revenue service operation these should generally be retained for heritage operation.

- 11.1.3 Conditional speed restrictions for heritage vehicles shall be recorded during certification.

Guidance: For example, wooden panelled open passenger platform carriages are operated at 70 km/h but restricted to 40 km/h over level crossings and when passing other trains due to their low crashworthiness performance.

12. Track Stresses

- 12.1.1 For rail contact stress, P/D ratio shall not exceed 147 kN/m.

Guidance: P/D ratio can be calculated by dividing the static wheel load (in kN) by the minimum wheel diameter (in mm, measured at the tapping line). This was previously expressed as 30 kg/mm on a per-axle basis in NRSS/6.

13. Curve Negotiation

- 13.1.1 Heritage rail vehicles should be capable of negotiating horizontal curve cases per M-ST-RS-8101 §18.2.

- 13.1.2 Heritage rail vehicles should be capable of negotiating vertical curve cases per M-ST-RS-8101 §18.3.

- 13.1.3 Where heritage rail vehicles cannot meet the above curve negotiation requirements, their actual performance limits (i.e., minimum curve radii, tangent lengths) shall be recorded.

Guidance: It is acknowledged some heritage steam locomotives are not compatible with tight track curvature. This requires operational restrictions in some yards and workshop tracks on the National Rail System.

- 13.1.4 Bogie L/V ratio (R_{LIM}) for heritage rail vehicle shall not exceed 0.71 when assessed in accordance with M-ST-RS-8101 §18.4. Base vehicle and longitudinal force conditions may be altered to reflect actual operating conditions for the assessed heritage rail vehicle.

14. Wheelsets

For in-service wheelset limits see KiwiRail Standard M-ST-RS-8102 Wheelset Dimensional Limits.

14.1 Wheel Material

- 14.1.1 Brinell hardness of wheel treads shall not exceed 363 HB, except by specific agreement with KiwiRail as the Access Provider.

Rationale: This aligns with the upper limit for AAR M-107 / M-208 Grade C wheels and is a consideration for rail wear rates. It is not within the scope of this document to prescribe manufacturing standards for wheels, or to preclude alternative standards being applied (e.g., EN 13262).

Guidance: Existing wheels on heritage rail vehicles may be presumed to not exceed 363 HB.

14.2 Wheel Diameter

- 14.2.1 Wheel tread diameter, measured at the taping line (see Figure 1), shall be a minimum 330 mm.

Rationale: Smaller wheel diameters are not reliably detectable by axle counters used for signalling purposes on the KiwiRail Network.

Guidance: Where heritage rail vehicles with smaller diameter wheels have an established safe operating history this may be used to support a derogation against this requirement, noting that axle counters are a relatively recent technology used on the Controlled Network.

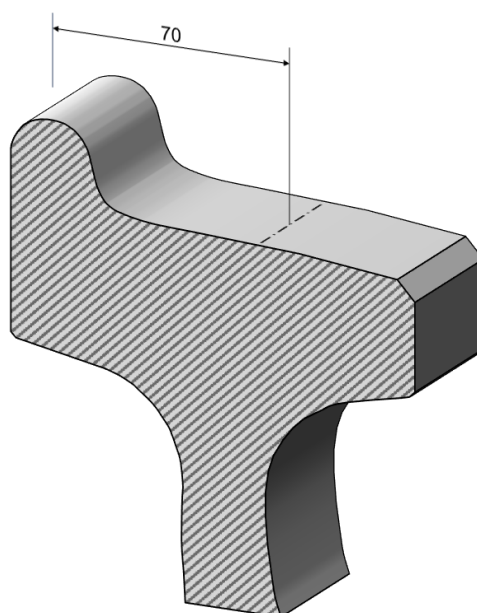


Figure 1: Wheel Taping Line Datum (mm)

14.3 Rim Width

- 14.3.1 Wheel rim width for heritage rail vehicles shall be within the range 114.0 mm – 145.0 mm.

Rationale: Historically, wheel rim widths were as narrow as 114 mm and there are existing wheelsets as wide as 145 mm.

Guidance: For wheel rim widths narrower than the contemporary minimum of 127 mm, mitigations may be required on wheel flange width minimum dimension. See M-ST-RS-8102 §8.2.

14.4 Wheel Profile

- 14.4.1 Heritage rail vehicles may use specific wheel profiles for which they have an established operating history.
- 14.4.2 Heritage rail vehicles may otherwise use a standard KiwiRail wheel profile, per M-ST-RS-8101 §19.5.

14.5 Wheelset Back-to-Back

- 14.5.1 Heritage rail vehicle wheelset back-to-back dimension shall be within the range 994.0 mm – 998.0 mm.

Guidance: Nominal back-to-back was reduced from 997 mm to 995 mm in 2017 and offers several improvements. Heritage rail vehicles may have new wheelsets manufactured to the reduced dimension, but consideration must be given to vehicle compatibility (available space in bogie frame, brake block alignment, etc.).

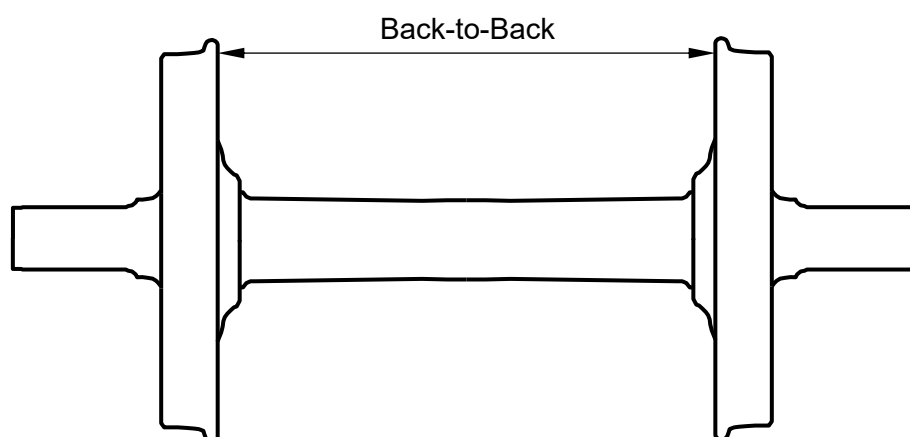


Figure 2: Wheelset Back-to-Back Dimension

15. Braking

15.1 Braking Control

- 15.1.1 All heritage rail vehicles shall be fitted with a brake system that supports a continuous brake throughout a train, and that automatically applies in the event of a parting anywhere throughout a train.
- 15.1.2 Heritage lead units shall be fitted with means to control the train brake so that, at least:
- Brake effort can be gradually applied up to its maximum without wheel locking at speeds above 5 km/h,
 - Train speed can be maintained as constant on a descending grade.

Guidance: Normal wheel-rail adhesion conditions may be assumed ($\mu = 0.12$, see 15.3.1).

- 15.1.3 Where “Westinghouse” type single-pipe air braking is employed in heritage rail vehicles it shall conform to the following nominal pressures:
- Release = 550 kPa
 - Brake Minimum = 510 kPa (40 kPa reduction)
 - Full Service = 400 kPa (150 kPa reduction)
 - Emergency = 0 kPa
- 15.1.4 “Westinghouse” type single-pipe air brake equipment shall be able to operate correctly up to a maximum pressure of 650 kPa.
- 15.1.5 Brake pipe connections between vehicles shall be made with an AAR FP-5 glad hand coupling.
- Guidance: This coupling is defined in AAR S-491 and is also shown in Appendix A of AS 7510.2:2014 (A1.5 to A1.7).*
- 15.1.6 AAR FP-5 glad hand couplings, or compatible couplings, shall not be used at vehicle ends for any purpose other than brake pipe connection.
- 15.1.7 Heritage rail vehicles with “Westinghouse” type single-pipe air brake equipment may operate in direct-release or graduated-release. Mixed-consist heritage trains should be operated in graduated-release and measures taken to avoid excessive brake dragging.
- 15.1.8 Heritage passenger vehicles shall have a means for passengers to initiate an emergency brake application throughout a train, or alternatively to alert the driver that an urgent stop is required.
- 15.1.9 Driver override of passenger emergency brake, per M-ST-RS-8101, may be fitted on heritage passenger trains.

15.2 Braking Performance

Service Braking Stopping Performance

Heritage trains must meet the following requirements in all loading combinations and for all wheel diameters from new to fully worn. These performance requirements relate to the maximum service brake command and apply from the point of the braking command (i.e., brake controller being put into its Full-Service position) to the point of the train coming to a complete stop, on dry, straight, and level track.

Guidance: It is important to recognise train braking performance is determined by the combined effects of all rail vehicles within the train. Speed restrictions may be required for heritage rail vehicles not capable of braking their own weight when operated in short formations.

- 15.2.1 All heritage trains shall not exceed the stopping distances defined by M-ST-RS-8101 Rail Vehicle Interoperability Appendix 6, Curve B.

Rationale: This curve correlates to minimum signal spacing distances on level track as defined in S.26251-1 (Minimum Freight Intermediate Signal Spacing) with a 10 per cent safety margin applied. This combines historic braking performance assumptions for Goods and Express Goods trains.

Guidance: Braking performance is an area where there is limited opportunity for deviation against contemporary standards for heritage rail vehicles, as compatibility with signal spacing is a fundamental interoperability requirement. Under special circumstances, heritage trains exceeding Curve B may be granted running rights with differential line speed restrictions enforced.

- 15.2.2 Locomotive-hauled heritage passenger trains should not exceed the stopping distances defined by M-ST-RS-8101 Rail Vehicle Interoperability Appendix 7, Curve C.

Rationale: This curve preserves the historic NRSS/6 requirement for locomotive-hauled passenger trains to be able to stop within 750 metres from 100 km/h.

Guidance: Adherence to this curve does not assure compliance to S.26251-2 (Minimum Passenger Intermediate Signal Spacing), so does not allow trains to continue at line speed when passing a signal displaying a 'Flashing Yellow' aspect.

- 15.2.3 Heritage railcars and multiple units should meet the stopping distances defined by M-ST-RS-8101 Rail Vehicle Interoperability Appendix 7, Curve D.

Rationale: This curve correlates to minimum signal spacing distances on level track as defined in S.26251-2 (Minimum Passenger Intermediate Signal Spacing) with a 10 per cent safety margin applied. Historically, this curve was derived from DM-class EMU braking performance.

Guidance: Adherence to this curve allows line speed to be maintained when passing signals displaying a 'Flashing Yellow' aspect.

Emergency Brake Stopping Performance

- 15.2.4 For all heritage trains, stopping distances for emergency brake applications shall not exceed the equivalent full-service brake application.

Rationale: For safety, the emergency brake shall always represent the shortest achievable stopping distance available to the operator.

Guidance: Equal performance of service and emergency brakes is acceptable.

Main Brake Holding Performance

- 15.2.5 The main brake, in its Full-Service setting, shall be capable of holding a heritage rail vehicle in its maximum loading condition on a minimum gradient of 1 in 25 (4‰).

Guidance: There is no prescribed minimum period for holding brake to maintain this performance following loss of the braking energy supply (i.e., typically loss of air compressor for lead units, or auxiliary reservoir pressure for hauled vehicles). Operating procedures should however consider this period to ensure park brakes are applied prior to loss of main brake.

Parking Brake Performance

- 15.2.6 Parking brakes shall be capable of holding a heritage rail vehicle in its maximum loading condition on a gradient of 1 in 32 (31.25%) for an indefinite and unlimited period, and without available energy on board.

Rationale: This is increased from the historic performance requirement of 1 in 33 as previously defined in NRSS/6. 1 in 32 reflects actual grades on the controlled network at some locations (Marton New Plymouth Line and North Auckland Line).

Guidance: Safety margin is not included within this requirement and should be considered as part of certification.

Guidance: The City Rail Link Tunnel has a maximum gradient of 1 in 30.8 but is restricted to EMU and engineering trains only.

- 15.2.7 For manually applied parking brakes, the maximum assumed application force is 500 N (applied to lever, handwheel, etc.). It is permissible to assume this force to be applied over a full-service application of the main brake.

Rationale: This allows for the crew of an immobilised train to apply park brakes while the main brake system still has on board energy available. Parking brake holding capability must still consider conditions where on board energy is depleted and the main brake is fully released.

15.3 Wheel-Rail Adhesion

- 15.3.1 For heritage rail vehicles not equipped with wheel slide protection (WSP) systems, demanded wheel-rail adhesion shall not exceed 0.12 in Service and Emergency braking under all load and wheel wear combinations.

Guidance: Demanded wheel-rail adhesion can be increased to 0.15 for rail vehicles equipped with WSP. This is atypical of heritage rail vehicles at present.

- 15.3.2 For parking brakes, the assumed wheel-rail adhesion for holding performance shall not exceed 0.12.

16. End Couplers

- 16.1.1 Heritage rail vehicles may be fitted with hook & pin couplers (i.e., compatible with JL type drawbars and associated hooks and bridle & pin assemblies – drawings 11051167, 11090508, and 11050917).

- 16.1.2 For hook & pin couplers, drawbar centrelines shall be maintained at the following heights while in tare loading conditions:

- Heritage locomotives: 710 – 760 mm ARL
- Heritage passenger rail vehicles: 735 – 767 mm ARL
- Other heritage rail vehicles: 725 – 767 mm ARL

- 16.1.3 Heritage rail vehicles with hook & pin couplers should carry, or otherwise ensure timely access to, a suitable transition head (adaptor) to allow rescue by a mainline locomotive fitted with an automatic knuckle coupler. See Figure 3 below.

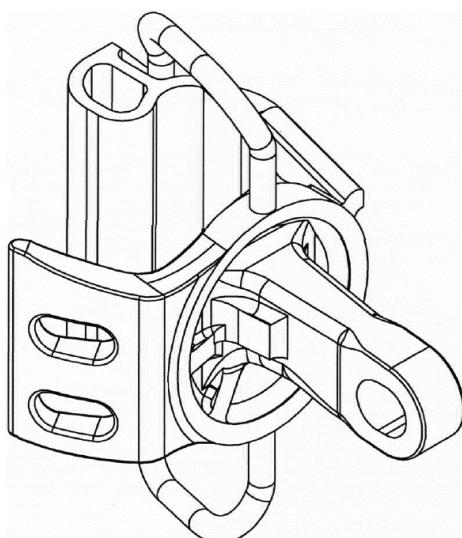


Figure 3: Transition Head (KR Material No. 107346)

- 16.1.4 Heritage rail vehicles may otherwise be fitted with automatic knuckle couplers with a No. 10A contour, as defined in AAR S-106.
- Rationale: This reflects contemporary practice for general use rail vehicles on the controlled network.*
- 16.1.5 Automatic knuckle coupler centrelines shall be maintained to a nominal height of 760 mm ARL, and within the range 725 – 792 mm ARL.
- 16.1.6 Automatic knuckle couplers should feature a bottom interlocking shelf.
- 16.1.7 Heritage rail vehicles may be fitted with alternative end couplers, subject to the conditions described in M-ST-RS-8101 §21.

17. Leading Ends & Frontal Impact

KiwiRail as the Access Provider do not prescribe crashworthiness requirements for rail vehicles, heritage or otherwise.

Crashworthiness of heritage rail vehicles is predominantly a product of their original design. Heritage rail operators must consider heritage rail vehicles crashworthiness and appropriate mitigations as part of their safety case.

Cow Catcher / Lifeguards

- 17.1.1 Leading ends of heritage lead units shall be fitted with a cow catcher, or similar, capable of deflecting an adult cattle beast without derailing the train.
- 17.1.2 Cow catchers, or similar devices, shall be maintained between 100 mm and 175 mm ARL, accounting for all loading conditions.

Anti-Climb Device

- 17.1.3 Where fitted, anti-climb devices on heritage vehicles shall be retained and not modified in any way that impairs their effectiveness.

Guidance: Refer to M-ST-RS-8101 §22 for contemporary anti-climb device requirements.

18. Visibility

18.1 Headlights

- 18.1.1 Leading ends of heritage lead units shall be fitted with a headlight(s) producing white light in the driving direction.

- 18.1.2 Two headlights shall be fitted to each leading end for redundancy, except where a heritage rail vehicle's design featured a single headlight.

Guidance: Lead units supplied to New Zealand prior to 1970 typically feature a single headlight.

18.2 Ditchlights

- 18.2.1 Except for steam locomotives, leading ends of heritage lead units shall be fitted with two ditchlights producing white light in the driving direction.

- 18.2.2 Ditchlights shall be mounted a minimum of 900 mm above rail level and laterally spaced to produce a triangular or rectangular pattern when operated with the headlights.

- 18.2.3 Ditchlights shall be aimed so their beams strike the running surface of the opposing rail on straight track, 240 m forward of the ditchlight.

- 18.2.4 Controls to dim ditchlights shall be fitted.

- 18.2.5 Ditchlights shall feature a flashing function, flashing alternately at full-beam, at a rate of between 40 and 120 flashes per minute for a minimum duration of 15 seconds.

Guidance: An upper limit of 180 flashes per minute was previously allowed under NRSS/6, but no vehicles are known to have ever exceeded 120 flashes per minute. Typical is 85 flashes per minute, which aligns with typical level crossing warning lights.

- 18.2.6 Ditchlight flashing shall be initiated automatically when an audible warning device is sounded or by a separate manual control in the driving cab.

18.3 Tail Lights

- 18.3.1 Two red tail lights shall be fitted to the rear end of heritage rail vehicles intended for operation at the rear end of a train.

- 18.3.2 Tail lights may flash.

- 18.3.3 Circular red reflectorised discs of a minimum diameter of 135 mm may be used in place of tail lights.

18.4 Leading End Livery Colour

- 18.4.1 Heritage lead units may be painted in any existing livery worn throughout the operating history of the vehicle (or vehicle class) on the National Rail System.

Guidance: It is common for rail vehicles to have worn multiple liveries throughout their revenue service lifespans. It is permissible for heritage lead units to be returned to a prior livery that does not meet contemporary requirements for high visibility leading ends where this is demonstrably applicable to the vehicle type.

- 18.4.2 New liveries for heritage lead units shall meet contemporary requirements for high visibility leading ends, per M-ST-RS-8101 Rail Vehicle Interoperability §23.5.

Guidance: This requires front ends to be predominantly yellow.

- 18.4.3 Steam locomotives shall have red headstocks retained, where this is a feature of their original design.

18.5 Reflective Delineators

- 18.5.1 Heritage rail vehicles shall be fitted with reflective delineators, per M-ST-RS-8101 Rail Vehicle Interoperability §23.6.

19. Audibility

19.1 Horns & Whistles

- 19.1.1 Leading ends of heritage lead units shall be fitted with an audible warning device (a horn or whistle).

- 19.1.2 For steam locomotives, a steam whistle operated within its original design parameters shall be considered to meet audibility requirements.

- 19.1.3 For other heritage lead units, air horns operated within original design parameters (mounting, housing, operating pressure, etc.) shall be considered to meet audibility requirements.

Guidance: Refer to M-ST-RS-8101 §24.1 for contemporary requirements relating to horns.

20. Signalling System Compatibility

20.1 Track Circuit Detectability

- 20.1.1 Heritage rail vehicles shall be detectable to track circuits on the KiwiRail Network.

- 20.1.2 Electrical resistance between the running surfaces of opposing wheels on a wheelset shall not exceed 5 mΩ, measured by an open circuit voltage between 1.8 VDC and 2.0 VDC.

Guidance: Heritage rail vehicle wheelsets with an established history of reliable operation in track circuit areas may be presumed to comply with this requirement.

- 20.1.3 Minimum axle load shall be at least:
- 3,500 kg for rail vehicles with wheel tread brakes,
 - 5,000 kg for other vehicles.

20.2 Sanding

- 20.2.1 Sanding devices may be fitted to heritage rail vehicles, for the purpose of improving wheel-rail adhesion for traction or braking.
- 20.2.2 Sand delivery rate shall not exceed 300 g/30s, per sanding device.
- 20.2.3 Sand shall meet requirements in M-ST-RS-8101 Rail Vehicle Interoperability §25.5.6.

20.3 Axle Counter Compatibility

- 20.3.1 Wheels shall have ferromagnetic characteristics and shall be electrically conducting.
- Rationale: Axle counters rely on distortion of their electromagnetic field to detect passing wheels.*

- 20.3.2 Wheel diameter and flange dimensions shall be maintained within the limits described in 14.2.1 and M-ST-RS-8102 Rail Vehicle Wheelset Dimensions.

Guidance: These requirements are repeated to draw attention to the importance of wheel dimensions in the reliable operation of axle counters. Permitted wheel wear limits for the KiwiRail Network allow for wheel flanges significantly thinner than comparable international benchmarks. This is mitigated by the comparably low operating speeds, which increases detectability of passing wheelsets.

- 20.3.3 Spoked wheels are permitted for heritage rail vehicles where they are a feature of the original vehicle design.

Rationale: Axle counters cannot be assured to reliably detect spoked wheels with diameters smaller than 600 mm. Experience with spoked wheels for heritage rail vehicles on the controlled network however has not shown this to be a significant issue and would be expected to result in safe-side failure.

Guidance: The access provider and heritage operators should be vigilant to non-detection of spoked wheelsets, accounting for compounding factors of narrow rim widths, small wheel flange dimensions, and higher speeds.

21. Instruments & Monitoring Equipment

21.1 Speed Indicating Device

- 21.1.1 Driving cabs of heritage rail vehicles shall be fitted with a speed indicating device that displays speed in km/h.
- 21.1.2 A speed indicating device shall be visible at each driving position.

21.1.3 The maximum authorised speed of a heritage rail vehicle shall be marked in red on its speed indicating device(s).

21.1.4 Displayed speed shall be within 5 km/h of actual speed at all speeds between 25 km/h and the maximum authorised speed, and within 10 km/h of actual speed for speeds below 25 km/h.

21.2 Vigilance System

21.2.1 Vigilance systems are not required for double-crewed steam locomotives.

21.2.2 For all other heritage lead units, a vigilance system that monitors crew alertness shall be fitted.

21.2.3 Vigilance systems for heritage rail vehicles shall allow a maximum period of 70 seconds between a crew response/input and a penalty brake application.

21.2.4 Vigilance suppression shall, at a minimum, require the following conditions to be met.

- Vehicle is at standstill.
- Brakes applied to a level that ensures vehicle remains at standstill.

21.2.5 It shall only be possible to reset a vigilance-initiated penalty brake while the heritage rail vehicle is at standstill.

21.3 Event Recorder

21.3.1 Heritage lead units that operate at a speed of 50 km/h or greater shall be equipped with an event recorder.

21.3.2 Event recorders for heritage rail vehicles shall record, at a minimum, the following parameters.

- Date / time.
- Vehicle speed (km/h).
- Brake pipe pressure (kPa).
- Brake cylinder pressure (kPa).

21.3.3 Parameters shall be recorded at intervals not exceeding 10 seconds.

22. Vehicle Markings

22.1 Vehicle Identification

22.1.1 Heritage rail vehicles shall have their unique identifying number (i.e., class designation and running number) displayed on each side, in contrasting lettering at least 50 mm high.

22.2 Functional & Safety Labelling

This standard only defines labelling requirements that relate to KiwiRail as Access Provider. It is left to Heritage Rail Operators to decide appropriate labelling for their vehicles, considering the applicable user groups.

- 22.2.1 Heritage rail vehicles that may travel in electrified areas; and with ladders, handholds, or other facility that allows standing access above 1.8 m ARL shall be fitted with warning signs alerting persons to the overhead electrical hazard.

Rationale: This is a required control for the risk of contact with live electrical overhead equipment that KiwiRail manages as Access Provider.

Guidance: ISO 7010 W012 (electricity hazard) or similar warning signs are suitable for this purpose. Alternatively, KiwiRail drawings 15024439 & 15024440 ('DANGER LIVE WIRES ABOVE') show typical warning signs used on KiwiRail's own vehicles.

- 22.2.2 Electrical warning signs should be situated so they are visible where the likelihood of persons accessing vehicle roofs is greatest (ladder positions, etc.).

23. Electrified Areas

The KiwiRail Network has three separate electrified areas:

- Wellington Electrified Area (WEA)
- North Island Main Trunk Electrified Area (NIMTEA)
- Auckland Electrified Area (AEA)

The extent within the KiwiRail Network for each electrified area is described in KiwiRail Standard G-ST-AL-9039, Principal Operating Parameters. Basic parameters and reference documents for each electrified area can be found in M-ST-RS-8101 Appendix 8.

23.1 Heritage Vehicles that Operate in Electrified Areas

- 23.1.1 Heritage rail vehicles that are operated by persons or carry persons (i.e., passengers or crew) under overhead electrification should be bonded so that conductive vehicle exterior surfaces are equipotential with the running rails.

Rationale: This addresses the electric shock risk associated with high touch voltages if a vehicle structure contacts live elements of the electrification system (dropped contact wire, foreign items on vehicle roof, etc.).

- 23.1.2 Electrical bonding should be capable of withstanding the maximum permissible fault current levels defined in EN 50388-1:2022 Table 7.

Guidance: Copper bonds with a cross-sectional area of 95 mm² or greater are generally sufficient for bonding in all three electrical areas, with the WEA being the most demanding. Consideration should be given to redundancy in bonding schemes.

- 23.1.3 Maximum static height for all heritage rail vehicles that travel under live overhead electrification shall not exceed:

- 3825 mm for the WEA,

- 3950 mm for the NIMTEA,
- 3864 mm for the AEA.

Rationale: This ensures adequate electrical clearance is maintained and includes a 25 mm allowance for vehicle vertical bounce.

23.2 Heritage Electric Vehicles

As of 2026 there are no heritage electric vehicles in operation on the controlled network. The complex nature of vehicle-infrastructure interaction for electric vehicles, and changes that have occurred to electrified areas over time, means that re-entrant heritage electric vehicles must be treated on a case-by-case basis between heritage vehicle owners and KiwiRail as the Access Provider.

- 23.2.1 Heritage electric vehicles shall generally meet all requirements within M-ST-RS-8101 §28.2.

Rationale: These are high level interoperability requirements and even for contemporary electric vehicles the introduction of new fleets is considered on a case-by-case basis.

24. Rail Ferry Compatibility

- 24.1.1 Heritage rail vehicles with an established operating history on rail ferries may continue to use existing procedures, lashing arrangements, etc.

Guidance: Introduction of new rail ferries may require reassessment for all rail vehicles, heritage and otherwise.

- 24.1.2 For heritage rail vehicles without an established operating history on rail ferries, requirements per M-ST-RS-8101 §30 apply.

25. Environmental Restrictions

- 25.1.1 On-board toilets shall not discharge human waste or effluent to the track.

Rationale: Discharge of effluent to track is no longer accepted practice.

- 25.1.2 Permissible sources of vehicle discharge to track are per M-ST-RS-8101 §31.

- 25.1.3 All reasonable steps shall be taken to prevent discharge of coal, grease, oil, fuel, coolant, working fluids, and similar into the rail corridor.

- 25.1.4 All reasonable steps shall be taken to prevent the emission of sparks and embers from vehicles into the rail corridor.

Rationale: Lineside fire risk must be mitigated so far as is reasonably practicable.

Guidance: Cast iron brakes present an increased risk of sparks under heavy braking conditions.

- 25.1.5 Heritage steam locomotives shall have spark arrestors fitted and maintained to a condition at meets or exceeds the original design and construction.

Guidance: KiwiRail as the Access Provider may suspend operation of steam locomotives over routes where dry conditions present elevated risk of lineside fires. Similarly, operating restrictions may be placed on steam locomotives to comply with smoke emission limitations imposed by any outside authority.

26. Radio System

- 26.1.1 Heritage rail vehicle driving cabs shall be equipped with radio equipment to communicate with KiwiRail Train Controllers and with other trains on the KiwiRail Network.
- 26.1.2 Radio equipment shall comply with KiwiRail Control Systems Standard D-ST-RA-7116 Rail Vehicle Radios.

26.2 Railway Track Signals

- 26.2.1 Heritage lead units shall be fitted with a lockable magazine for storing railway track signals ('detonators'), compliant to AS 2187.1-1998.
- 26.2.2 Magazines shall hold a minimum of 24 railway track signals.

26.3 Fire Extinguishers

- 26.3.1 Heritage vehicle driving cabs shall be fitted with a minimum of one fire extinguisher, 4.5 kg ABE dry powder type to AS/NZS 1481 or an alternative of equivalent performance.
- 26.3.2 Heritage vehicle passenger areas should be fitted with fire extinguishers. Type, size, and position shall be appropriate for the vehicle's operating context.

27. Position Reporting

- 27.1.1 Heritage rail vehicles operating as lead units shall report their position to the Access Provider in near real-time.

Guidance: Heritage rail vehicles fitted with Kupe Mobile Controller (KMC) meet this requirement. Alternatives such as Teletrac Navman are also acceptable.

28. Wayside Monitoring System Compatibility

28.1 Automatic Equipment Identification Tags

- 28.1.1 Where already fitted, AEI tags on heritage rail vehicles shall be retained and kept in working order.
- 28.1.2 Heritage rail vehicles may have AEI tags fitted for compatibility with KiwiRail's wayside condition monitoring systems. Where fitted, technical requirements per M-ST-RS-8101 §38 shall apply.

Guidance: AEI tags allow for heritage rail vehicles to be tracked at condition monitoring sites. Condition monitoring capability is site-dependent but can include wheelset weight/impact, wheel profile, and wheelset bearing acoustic monitoring.

Document History

Note page numbers relate to the document at the time of amendment and may not match page numbers in current document.

Issue No.	Section	Description	Page(s)
1.0		First Issue – Published to KiwiRail Intranet only.	
1.1	3 (prev.)	Review & Revision Procedure section removed – replaced by Document History (this table) in current template	5 (prev.)