

# Moseley Railway Trust

PRESERVING OUR INDUSTRIAL NARROW GAUGE RAILWAY HERITAGE

Registered Charity No. 1100827

## Moseley Railway Trust Safety Procedure

### Procedure MRTSP23 – Vehicle Acceptance

Issue:- Five

Author:- S.R.Lomax

Authorised for implementation by:-



Chairman, MRT

Dated:- 14 - 4 - 2018

Document review period:- 60 months

#### 1:- Purpose

The purpose of this document is to define:-

- 1:- The criteria which are used to define if a railway vehicle is acceptable to operate on the railway infrastructure controlled by the Moseley Railway Trust (the AVLR).
- 2:- The process used to confirm that a vehicle is acceptable to be operated, and what actions are available in the event of problems.

The objective of this is to ensure that vehicles can operate safely on the infrastructure without risk of damage to the vehicle or infrastructure, or risk of injury to any person.

This procedure (in an abbreviated form) is also to be applied to locomotives or other vehicles which may make short-term visits to the AVLR.

The document also provides guidance on the necessary processes to be applied to ensure compliance to the ROGS regulations and the MRT Safety Management System in respect of railway vehicle acceptances.

#### 2:- Definitions

In this procedure, the following are used:-

AVLR – Apedale Valley Light Railway

CME – Chief Mechanical Engineer, an officer of the MRT.

HMRI – Her Majesty's Railway Inspectorate (part of the ORR)

MRT – Moseley Railway Trust

ORR – Office of the Rail Regulator

ROGS – Railway and Other Guided Systems (Safety) Regulations 2006

ROTS – Railway and Other Transport Systems (Approval of Works, Plant & Equipment) Regulations 1994

RVAR - Rail Vehicle Accessibility Regulations 1998.

Vehicles – means any locomotive, carriage or wagon, or any other rail mounted contrivance.

Visiting Vehicle – a vehicle which is not normally resident at Apedale, but is visiting the site on a short-term basis. For the purposes of this procedure, a vehicle can be categorised as “Visiting” if its stay at Apedale is not to exceed three months.

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## 3:- Procedure

### 3.1:- Background

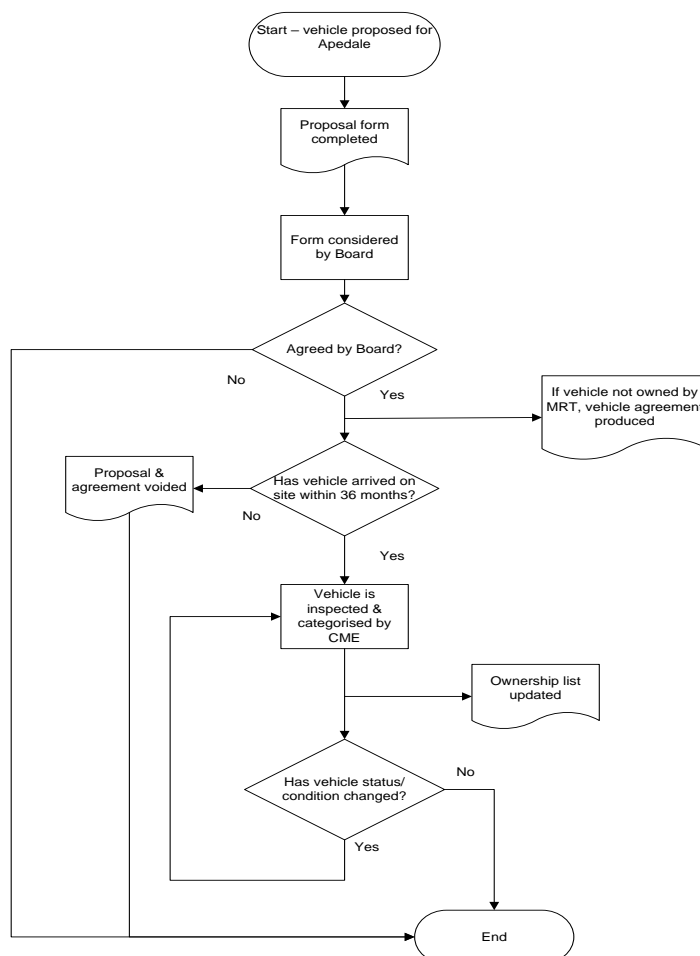
It is recognised that railway vehicles are offered for acceptance onto MRT-controlled infrastructure in a wide variety of conditions; these can range from vehicles which are complete wrecks and in need of full restoration through to vehicles which are ready to be operated.

Therefore, this procedure is intended to define a framework to control this process. It is accepted that a degree of judgement on the part of the CME is necessary; however, it is important that such judgements are appropriately recorded to ensure that risk to the MRT is minimised. This procedure provides a methodology for this.

■ Visiting vehicles are covered by the process at section 3.10.

NOTE:- This procedure does not deal with maintenance of vehicles (i.e. where a vehicle has already been accepted, and its acceptance category does not change). This is covered by procedure MRTSP24.

A simplified view of this procedure is represented by the flowchart below:-



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## 3.2:- Vehicle Proposals

*This is the process for reaching agreement that a vehicle may be brought onto the Apedale site.*

A Proposal Form must be completed for any vehicle which is proposed to be brought onto the Apedale site. A specimen form is provided at Appendix A.

Such a form must be completed for all vehicles arriving onto the Apedale site (except short term-visitors, see 3.10), including those owned by the MRT itself.

The MRT Board, and in particular the CME, shall review such forms. Advice may also be taken from individuals responsible for specific areas within the MRT operation, such as carriage & wagon issues. However, the final decision on acceptance or otherwise shall be taken by the MRT Board.

Appendix C sets out the criteria for vehicles for unrestricted use at Apedale. Vehicles can be accepted onto site which do not comply with these criteria – see 3.3.2 below.

The decision to accept a vehicle shall be recorded in the Board meeting minutes. The Board will document an agreement with the vehicle owner to confirm any conditions which apply to the acceptance of the vehicle.

NOTE:- An agreement will become void if the vehicle has not arrived on the Apedale site within 36 months of the date of the initial proposal. This is to ensure that circumstances do not change markedly between an agreement being made and a vehicle arriving.

## 3.3:- Vehicle assessment & categorisation

### 3.3.1:- Overview

This process is intended to assess the condition of vehicles which have been accepted onto the site via the process set out in 3.2 above. In overview, the CME inspects the vehicle and categorises it; this process is then repeated if the vehicle changes categories.

### 3.3.2:- Process in detail

When a vehicle arrives on site, it must be assessed and categorised. There are three categories:-

Cat A:- “Unrestricted Use”. Vehicle accepted which is fit to run on MRT infrastructure, can be used without restriction and complies with:-

- the requirements of Appendix C AND
- general safety guidelines as below.

For the avoidance of doubt, a vehicle may NOT be categorised into Cat A if there are any SIGNIFICANT issues identified when the CME inspects the vehicle. For

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example, minor leaks would not preclude Cat A. A need for driver training does NOT preclude Cat A categorisation (but must be identified as a hazard).

Any vehicle to be used in passenger service must be in Category A. Any vehicle which will be used regularly must be in Category A.

Cat B:- “Restricted Use”. Vehicles which are unable to be universally used on MRT infrastructure, but can be accepted subject to hazard mitigations being in place. For example, a locomotive in need of restoration, or a vehicle which does not comply with the infrastructure guidelines could be accepted as Cat B.

The MRT has a significant fleet of “museum” vehicles which are used infrequently. Such vehicles should generally be “Cat B”.

Cat C:- “Storage Only”. Vehicle which are accepted for storage only on the site, and will not be operated on MRT infrastructure. This will include vehicles which are not (nominally) 2'0” gauge, and could also encompass vehicles which are for static display only in a museum.

The CME shall inspect each vehicle when accepted onto the Apedale site, or if offered for re-categorisation. The CME shall check for general safety and fitness-for-purpose of the vehicle.

The categorisation is recorded using the pro-forma found at Appendix B.

NOTE:- It is acceptable for the CME to delegate these inspections to an individual who is:-

- In the opinion of the CME, competent to carry out the inspections.
- Is reasonably independent of the outcome – for example, is not the owner of the vehicle in question.
- If the CME owns the vehicle in question, then the inspection work **must** be delegated.

In the event that the inspection is delegated, then the CME must counter-sign the completed pro-forma.

**ONLY** the CME is empowered to make the decisions regarding the Management of Change route to be used on the pro-forma (see section 3.9 for guidance on this).

The procedure below assumes that the CME carries out the inspection work.

NOTE:- It is accepted that the MRT's core mission deals with vintage machinery; such machinery may not comply with the safety standards which would be accepted of present day machinery. The CME is empowered to make judgement-based decisions which balance the need for safety against the need for “authenticity”.

NOTE:- These inspections are Safety Critical Work as defined in MRTSP21.

The CME shall check for the following (this list is NOT exhaustive and is NOT intended to substitute for engineering judgement, experience and common sense):-

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- Vehicle brakes operate and are effective (see also Appendix C)
- There are no components at risk of detachment (for example, vital bolts are tightened, split pins are present and opened up, etc).
- That rotating parts are inaccessible or are guarded to a reasonable extent.
- (especially on electric locomotives) that there are no readily accessible parts which are electrically “live”.
- Reasonable precautions are taken against sharp edges and the like.
- Tripping/slipping/falling hazards.
- That internal combustion engines can be readily stopped if needed.
- Glass should generally be a recognised safety glass – ideally laminated. Safety glass is MANDATORY on passenger carrying vehicles.
- Access to hot surfaces is reduced as far as practicable.
- That the vehicle wheelsets and axles appear to be fit-for-purpose.
- That the axle journal bearings are adequate.
- Items such as final drives are secure.
- Couplings and drawgear are fit-for-purpose, and that coupling heights are compatible with other vehicles.
- That the vehicle is reasonably stable in all conditions.
- Training requirements for the safe operation of the vehicle.
- That there is no asbestos or suspect asbestos on the vehicle (see Appendix C).

For passenger carrying vehicles:-

- Passenger vehicles must be assessed to ensure that their internal fittings are crashworthy, and that finger traps and the like are minimised.
- Consideration must be given to the RVAR accessibility requirements, and any need for exemption therefrom.
- Passenger carrying vehicles must be fitted with air brakes (see Appendix C for air brake specification), and these must provide a retardation rate of 0.7 m/s/s.

Where hazards are identified, a mitigation must be identified. This could include rectification (e.g. making brakes work), or restriction in operation (e.g. not be operated on steeply graded sections of railway), or training (i.e. ensuring that potential drivers are made aware of hazards).

For vehicles in passenger use, there must be a written maintenance regime (see MRTSP24 for more detail). It may be that this maintenance regime may be sufficient to mitigate some risks (eg regular checking of the condition of an item).

It is possible that some hazards may require testing in order to confirm that they are mitigated – see 3.5 below.

Where Training is included as a risk mitigant, then training courses for the vehicle (particularly for locomotives) must ensure that the course content includes these identified risks.

NOTE:- It may, by exception, necessary to move Cat C vehicles; such moves shall take place with the authority of, and under the supervision of the CME (or delegate). For the avoidance of doubt, vehicles in Cat C MUST NOT be operated on a routine

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basis. An example of such a movement may be a 2'6" gauge vehicle moved on an accommodation bogie.

Vehicles can move between categories (for example, completing a restoration project may move a vehicle from Cat B to Cat A). Section 3.8 below covers this.

### 3.4:- Ownership List

The CME shall maintain a ownership list. This shall (as a minimum) identify each vehicle which is on the MRT site, or has been accepted, and state its acceptance categorization.

It is expected that this register will contain further data (such as other assets), but the above is required for the purposes of this procedure.

As and when vehicles change their acceptance category, the CME must update the ownership list to reflect this.

NOTE:- The CME shall categorise all vehicles which were on site as at 1/4/10 as "A", "B" or "C" per the above. No further action will be required to justify these categorisation. Changes to these categorisations will be made in accordance with 3.8 below.

### 3.5:- Verification of Safety to Operate - Testing

If there is any doubt about the safety of a vehicle to operate on MRT infrastructure, the CME shall arrange for the vehicle to be tested. Such tests shall normally be undertaken under the supervision of the CME, and using experienced members as drivers and observers.

Testing vehicles is Safety Critical Work as defined in MRTSP21.

The CME shall check for the following (this list is NOT exhaustive and is NOT intended to substitute for engineering judgement, experience and common sense):-

- That the vehicle sits squarely on the railway – no excessive frame twist (including bogie frame) or suspension lock-ups.
- That wheels are firmly in contact with the railway in all circumstances.
- That the vehicle has an effective suspension, and that the suspension is not (in the case of coil springs) under damped, leading to bounce-off risks.
- That the vehicle appears to have a reasonable weight distribution. This can be verified by measuring the vehicle heights at each corner.
- Vehicles with long fixed wheelbases are able to traverse curves and points without problems.
- Bogie vehicles have reasonable degree of freedom for bogies to rotate, and they are able to traverse curves and points without problems.
- That a reasonable clearance (at least 6") is maintained from fixed obstacles.
- That the vehicle is not excessively top heavy.
- That the vehicle's wheels are in reasonable order, are not flatted and are concentric to the axle.
- That the brakes, both air and mechanical, are effective.

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If the testing produces any problems, then they shall be recorded on the pro-forma and managed as per 3.3 above.

## 3.6:- Pressure Vessels

In the event that a vehicle contains a Pressure Vessel (see MRTSP16 for guidance on this), then the requirements of MRTSP16 must be complied with. In particular, steam locomotives which are to be steamed must have:-

- A current, valid, boiler certificate, and
- A written scheme of examination for the boiler.

Note, however, that larger air reservoirs may also require compliance with MRTSP16 (see procedure for guidance).

## 3.7:- ROTS approved vehicles

The following vehicles have been approved under the ROTS regulations for passenger train use:-

- Motor Rail locomotive No.13
- Hudson brake van
- Penrhyn coach H
- Hudson Toastrack coach

Future vehicles will be accepted under the ROGS regime – see section 3.9.

## 3.8:- Recategorisation of Vehicles

Vehicles may be subject to recategorisation; this may be as a result of on-going restoration work, or other change in circumstances. Similarly, vehicles in category A may deteriorate or develop long-term defects which mandate restrictions being placed upon their use.

The initiation point for recategorisation can be from the CME, or other individuals, such as a vehicle owner, or the leader of the restoration team.

The CME shall inspect the vehicle in accordance with the guidelines in sections 3.3. Findings shall be recorded using the pro-forma in Appendix B; this form is then used to record the amended categorisation of a vehicle (if a change is appropriate).

## 3.9:- Management of Change – ROGS compliance for vehicle acceptance

Due consideration must be given to the Management of Change requirements of the Safety Management System.

***For changes affecting any vehicle used in Passenger carrying service a Management of Change document must be compiled to document the acceptance of a new/changed vehicle.***

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This means both the introduction of new passenger vehicles and significant engineering changes to the existing vehicles. “Significant” in this case means any permanent change which could have an adverse effect on safety. For example:-

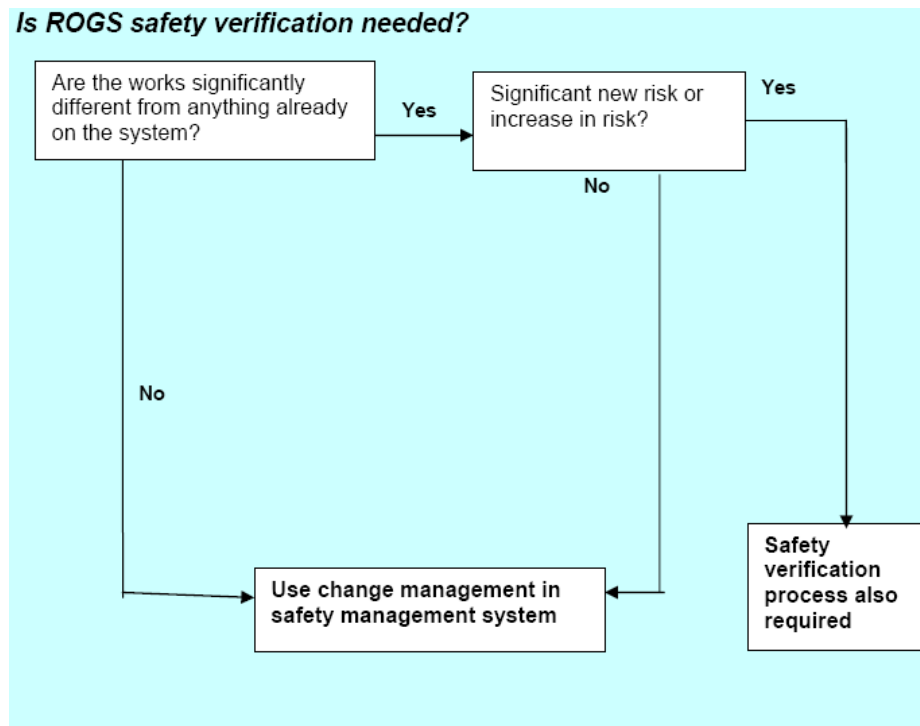
- Fitting a roof to a previously roofless vehicle would require a formal Management of Change assessment.
- Carrying out maintenance work would NOT require a formal Management of Change assessment.
- Fitting Christmas decorations would NOT require a formal Management of Change assessment.

Note that this means both passenger carrying vehicles (coaches) and the locomotives used; in practice, this therefore means ANY locomotive fitted with train air braking equipment, including steam locomotives which may only have an air brake control valve and pipe connections.

For such a vehicle, this document could contain (amongst other items) the Appendix B pro-forma and the Test Report generated from Section 3.5.

The following is NOT intended to be a complete guide to ROGS-compliant change management. For further details, and where any doubt exists, it is strongly recommended that reference is made to the ORR document “A Guide to Safety Verification for Heritage Railways” – see section 6.

ROGS has two routes for vehicle approvals. The route to be used is determined by applying two tests, as shown in the diagram below:-





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If the change – in this case a vehicle approval – fails either test, then the change may be approved via the processes contained within this procedure.

If, however, the change passes BOTH tests, then a Safety Verification process will be required, using an Independent Competent Person. In the event that Safety Verification is required, then the CME and the Board Member responsible for Safety shall agree on the process to be used for this.

The pro-forma at Appendix B includes a requirement that these two tests are considered.

The Board Member responsible for Safety shall, periodically, ensure that this process is being correctly and rigorously applied.

## 3.10:- Visiting Vehicles

See section 2 for definition of Visiting Vehicle.

For a visiting vehicle, the CME shall complete the inspection document at Appendix B in accordance with the guidance at section 3.3 and onwards above.

When negotiations are taking place for visiting vehicle, it is recommended that:-

- An individual is identified as responsible for the visiting vehicle – this will be a representative of the owners of the vehicle. Ideally, that person will also be an MRT member.
- Evidence is provided of the competency of the person responsible for the visiting vehicle, and any staff who will operate the vehicle (see also MRTSP25 AVLR Rule Book).
- If the visitor is a steam loco, a valid boiler certificate will be required (see MRTSP16 for further information on pressure vessels)
- A document pack is provided to the individual responsible for the visiting vehicle; this pack should consist of:-
  - Member's handbook Part B – to provide an overview of the MRT site and the safety management system applied to the Apedale site.
  - MRTSP25 – the AVLR Rule Book – to provide information on how the vehicle is to be operated.
  - This Vehicle Acceptance procedure (MRTSP23) – to provide information on the criteria to be used to accept the vehicle as safe to operate on MRT infrastructure.

The Board Member responsible for Safety will normally be responsible for the provision of the document packs.

## 4:- Records

The following records are generated from this procedure:-

- Vehicle proposal forms – shall be retained by the Company Secretary (or delegate) for the duration of the time for which the vehicle is on-site at Apedale, and then three years. After that time, they may be disposed of.

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- Vehicle agreements - shall be retained by the Company Secretary (or delegate) for the duration of the time for which the vehicle is on-site at Apedale, and then three years. After that time, they may be disposed of.
- CME assessments of vehicles – shall be retained by the CME for the duration of the time for which the vehicle is on-site at Apedale, and then three years. After that time, they may be disposed of.

## 5:- Upward References

None.

## 6:- Supporting References

The wheelset and vehicle dimensional information is derived from Issue 2 of the MRT Trackwork Manual. This information no longer appears in the successor to this Trackwork manual (procedures MRTSP19 and MRTSP20).

MRTSP24 Vehicle Maintenance Procedure

ORR Document “A guide to Safety Verification for Heritage Railways”, located at <http://www.rail-reg.gov.uk/upload/pdf/381.pdf>

## 7:- Document Change Control

Issue	Page/Section	Change
5	Page 1	Up-issued to Issue 5. Review period left at 60 months as no fundamental changes have been made.
	Section 1	“MRT site” changed to “AVLR” to reflect term in more common use.
	Section 3.1	Cross-ref to 3.12 corrected to 3.10
	Section 3.2	Cross-ref to 3.12 corrected to 3.10
	Section 3.3.2	ONLY the CME may decide re MoC route to be followed – this cannot be delegated.
	Section 3.3.2	Note added re the need for vehicle maintenance procedure.
	Section 3.3.2	Cross-ref to testing section 3.9 corrected to 3.5.
	Section 3.9	New leading paragraphs added to add weight and clarity to requirements for passenger vehicles.
	Section 6	Note added re MRTSP19 and MRTSP20. Reference to MRTSP24 added.
	Appendix C	Various extra data and clarification added to wheel dimensions (spec used is that applied to MR1320 project).
	Appendix C	Section Mechanical & Steam brakes now actually describes steam brakes. Section retitled Mechanical, Parking & Steam brakes and requirements clarified.
	Appendix C	Section Air Brakes – various items added to clarify requirements in light of experience with the system.

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## **Appendix A:- Moseley Railway Trust Locomotive and Rolling Stock Proposal Form**

The purpose of this proposal form is to allow the MRT to assess whether the proposed item should be accepted into the Trust and if so on what terms. Your submission, if accepted, will form the basis of a formal agreement with the Trust, which will help to protect the item itself, and also you and the MRT from any legal complications which may arise.

It would be helpful if you read the collection policy before deciding which category you propose the item for.

### **Section 1**

Name	
Address	
Tel No	

### **Section 2**

Vehicle Type (tick box)

Internal combustion loco		Description (If Other)
Battery Loco		
Steam Loco		
Passenger coach		
Wagon (specify type)		
Other (please specify)		

### **Section 3**

Manufacturer	
Model	
Year	
Works number	
Wheel arrangement	
Weight	
Gauge	
Former industry	
Source	

### **Section 4**

What is it to be used for at the MRT?

Passenger

General Use

Museum only

Private Storage

**Sections 5 to 7 do not need to be filled in if the vehicle is for private storage only.**

### **Section 5**

If you ticked "Museum only" under section 4, are there any restrictions on use? If so, use the space below to outline these restrictions.

--

**P.T.O.**

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## Section 6

### What condition is the vehicle in?

Give details of the originality, completeness and general mechanical condition.

Confirmed by MRT Chief Mechanical Engineer

## Section 7

a) To what standard will the vehicle be restored, e.g. ex works/original, cosmetically, as last used before preservation or not at all.

b) If the restoration is to take place at MRT, please try and give an estimate of the amount of time required for the work involved. You should take into account the finance involved in completing the restoration since this is often a limiting factor.

c) If restoration is to take place away from MRT, please indicate when this is planned to start and when you would expect the vehicle to be sent fully restored to MRT.

d) If possible, please try to give a realistic estimate of the cost of the restoration you propose. You should consider your finances in relation to this cost, as well as whether it is financially viable to restore the item before you complete a purchase.

e) What value will it add to the MRT Collection?

**Date:**

**Signed:**

**Signed (on behalf of MRT):**

If there is anything else you would like to add then please write it on a separate sheet of paper and attach to this form – all completed forms can be returned to any member of the MRT board or head of department.

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## Appendix B:- Vehicle Inspection Form

MRT Vehicle Fleet No:-

Other Nos. (e.g. makers):-

Generic type (e.g. diesel loco, wagon etc):-

Reason for inspection:-

Date of inspection:-

Name of inspector (print):-

Hazard	Action Required to close hazard

This is page \_\_\_\_ of \_\_\_\_ pages.

This vehicle is categorised/recategorised as follows (circle applicable)

A	Unrestricted Use	B	Use subject to restrictions due to infrastructure or other non-compliance	C	Not to be used on MRT infrastructure.
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### MANAGEMENT OF CHANGE. For CME use only:-

Is the changed (new or re-categorised) vehicle:-	
Significantly different to any other vehicle?	Yes / No
Does it cause significant new, or increased, risks?	Yes / No

If YES to BOTH, then ROGS Safety Verification will be needed.

Signature of inspector:-

Date:-

CME signature (if not inspector):-

Date:-

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## Appendix C:- Criteria for Vehicles to operate at Apedale Nominal Dimensions

The following are the normal maximum dimensions for vehicles:-

- Width – 7'0"
- Height – 9'0"
- Length - There is no current upper limit on vehicle length; however, and at the CME's discretion, abnormally long vehicles shall be subject to specific testing.
- Fixed wheelbase (which includes bogie wheelbase) – see table 1 below
- Bogie centres – no specific restrictions.
- Maximum weight – 5 tons per axle. It is assumed that vehicles will have their mass evenly distributed. If there is a suspicion that this may not be the case, then vehicles shall be tested.

Rigid Wheelbase	Minimum Curve with no restrictions	Minimum Curve for Occasional Use
5' to 6'	80'	65'
4 ' to 5'	65'	37'
3' to 4'	37'	37'
Less than 3'6"	25'	25'

### Wheelset Dimensions (refer to Figure One for location of dimensions)

Nominal track gauge	24"
Minimum back-to-back	21 1/4" absolute minimum, ideal is 21 1/2"
Maximum front-to-back	22 5/8"
Minimum flange thickness at root	1/2"
Minimum flange root to edge of tyre	25 1/2"
Minimum flange height	1/2". Consult CME if less than 3/4"
Maximum flange height	1 3/16"
Tread conicity	1 in 20
Flange angle	25 degrees from vertical
Radii on flanges (at root and tip)	1/4" minimum.

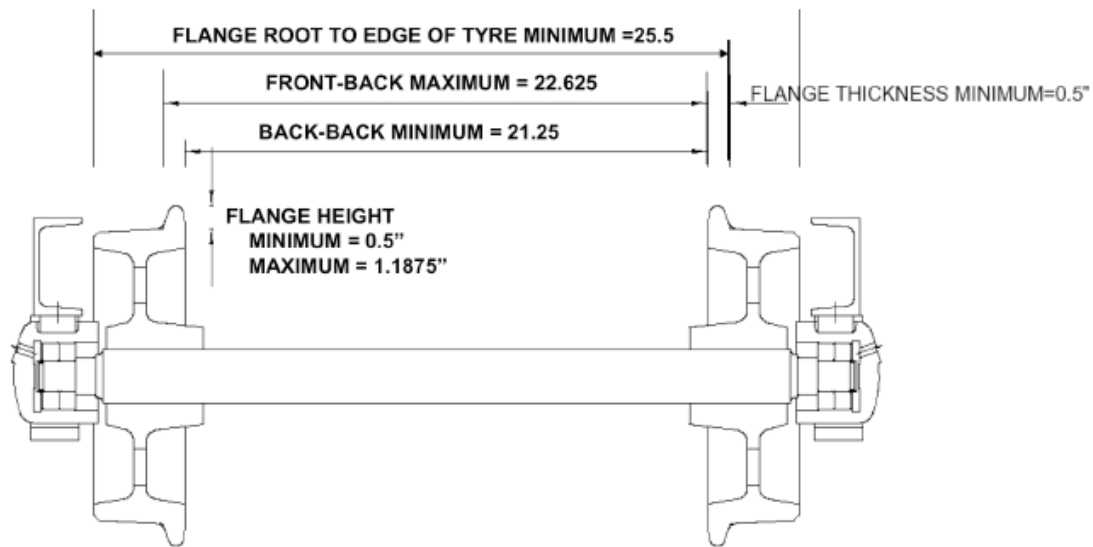
Note – achievement of back-to-back and front-to-back dimensions take precedence over track gauge dimension.

These dimensions are shown on the diagram below:-

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**Figure One:- Wheelset dimensions**

## Vehicle Couplings

The centre line of vehicle couplings shall be between 14" and 15" above rail level.

"Link and pin" couplings are used on AVL R vehicles. Vehicle specific adaptor couplers are to be discouraged, and any proposed use of these should be discussed with the CME.

## Asbestos Prohibition

Locomotives, especially steam, which contain significant quantities of asbestos (any type) are prohibited from the Apedale site. "Significant quantities" means anything over and above asbestos used on gland and other packing materials on steam locomotives. Asbestos boiler lagging is the main risk in this area.

## ■ Mechanical, parking & steam brakes

Mechanical brakes (i.e. not operated by air actuators) should achieve a deceleration of 0.7m/s/s. They should not cause the vehicle wheels to lock when in tare condition.

Parking brakes must be capable of holding the vehicle on the steepest incline at Apedale. If parking brakes are fitted to passenger stock, they are generally secured out of use to prevent unauthorised operation. The Guard's Van is an obvious exception to this.

■ Steam brakes are desirable on steam locomotives; their effectiveness is proportional to boiler pressure, and therefore there is no specific criteria for their performance.

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## Air Brakes

The following requirements, specific to the proposed operation at Apedale, have guided the proposed choice of system:

1. The air brake system should allow flexibility for the compressor to be installed on a vehicle other than the driving locomotive.
2. It should be possible to shunt the train without an air brake fitted locomotive.
3. As far as possible, the system should use a design that is common with other railways, improving interoperability and building on existing experience.
4. The impact of the air braking system on the external appearance of the locomotives and coaches should be minimised. This is to remain in keeping with the heritage nature of the project.
5. The brake system shall deliver a deceleration rate of at least 0.7m/s.
6. The brake system shall fail to safe (i.e. brakes applied on all vehicles) in the event of a train becoming divided.

## Design of the System

A schematic of the AVLr system is shown in Figure 2.

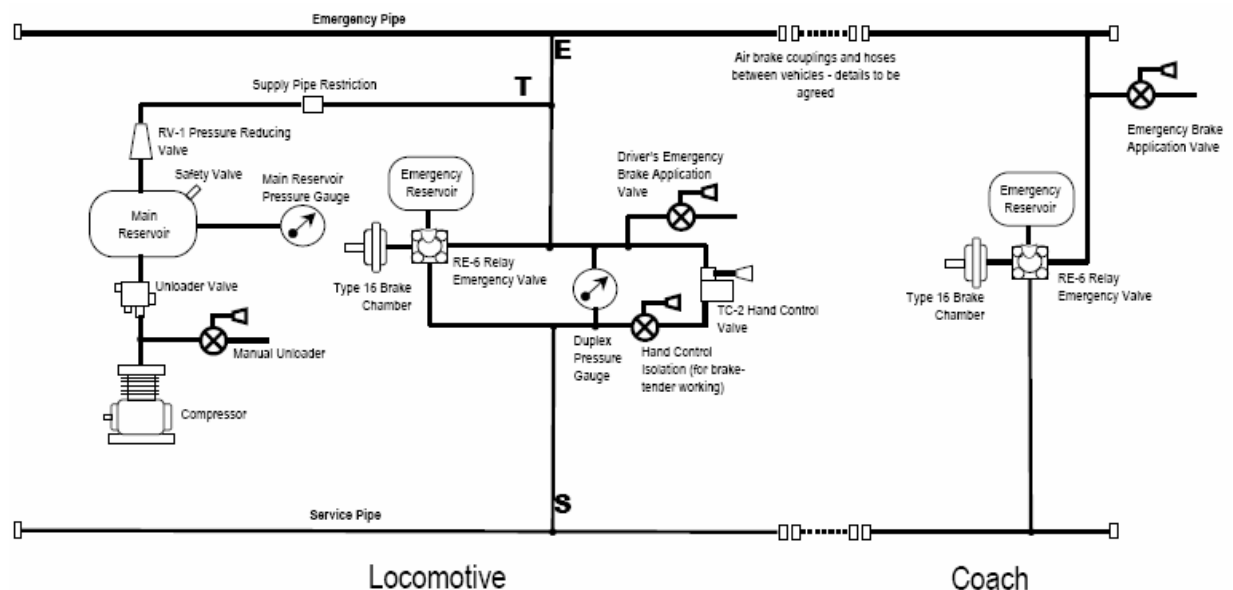


Figure 2 - Schematic of Air Brake System

Note that this is a TYPICAL installation; details vary between vehicles. Installation on some locomotives can be considerably more complex.

A twin-pipe system is used, with service and emergency pipes running the length of the train. The emergency pipe contains full system pressure (80 lb/sq in) and is normally used to charge the emergency tanks in each vehicle. A relay-emergency valve (RE-6) is fitted in each vehicle. In normal operation the service pipe is used to signal a request for a brake application and the relay-emergency valve admits a proportional air pressure from the emergency tank to the brake cylinder. With the driver's valve set at "release", the service pipe is at zero pressure. A brake



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application is requested by the driver admitting air pressure to the service pipe by moving the proportional brake valve towards the “apply” position. The fail-safe feature of this system is provided by the emergency pipe. If pressure is lost in this pipe, the relay-emergency valve in each vehicle immediately applies full pressure from the emergency tank to the brake cylinders. The brake cannot subsequently be released until the emergency pipe is re-charged or each emergency tank is drained.

The specifications of the system are:

- Main Reservoir: 20 litres, operating at a pressure of 115 lb/sq in
- Safety valve operating at 135 lb/sq in
- Emergency tanks 3.9 litres, operating at a pressure of 80 lb/sq in
- Pipework generally 3/8” o/d nylon with brass compression fittings
- Copper pipework in the vicinity of the compressor
- Couplings between vehicles Rectus Series 25KB double shut-off self-sealing
- 3/8” i/d rubber hose between vehicles
- (typically) Brake actuator type 16 with an effective force of 1280 lb at 80 lb/sq in. Note that the actuator to be used must be assessed on a case-by-case basis, with calculations to support the choice. See below for criteria to be used.
- A brake van (a vehicle used by the train Guard) must be provided with a valve to vent the emergency pipe if required and gauges to indicate the pressure in (at a minimum) the emergency pipe and ideally both emergency and service pipes.

Brake hose couplings should be positioned at approximately coupler height. Hoses orientation should NOT change within vehicles. On the AVLIR, vehicles are orientated such that the Emergency hoses are on the West side of vehicles, and Service hoses on the East side. Emergency hose couplings should be tagged with a Red spot, Service hose couplings with a yellow spot.

Reservoirs shall be provided with a means of draining condensate; the means shall be easily accessible to traincrew.

Accessibility for traincrew (coupling, continuity test etc.) should be considered when installing hose couplings.

When isolating valves are provided, consideration must be given to the effect of incorrect use of the valves. If it is possible to reach a “fail-dangerous” (i.e. no brake application when expected) scenario by the inadvertent operation of an isolating valve, then the valve must be sealed in its normal position by means of a cable tie or similar. Checking the integrity of such seals should be included in the maintenance and operating instructions for the vehicle.

The mechanical design of the brake system must be done with care. Considerations include:-

- Ensuring that there are no foul conditions when bogies rotate.
- Ensuring that the system can be maintained in future (e.g. changing brake blocks).
- Ensuring that the design is such that, if a vehicle is fitted with both air and manual brakes, EITHER system can apply the brakes but BOTH must be released to release the brakes. Uncommanded movement of manual brake handles or levers when air brakes are applied can present a finger trap (or

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worse) and should be avoided whenever possible by appropriate use of lost motion devices.

Steam locomotives which are fitted only with a driver's air brake control valve must have a separate valve which allows the venting of the emergency line. This valve must be easily accessible to the driver and must not be sealed. The purpose of this valve is to allow the train to be brought to a stand in the event of a failure of the driver's air brake valve.

## **Criteria to be used when calculating brake forces**

Wheel-rail coefficient of friction – 0.16.

Cast iron brake blocks to wheel coefficient of friction – 0.20.

Friction losses in brake rigging – typically 20% for rigging used on air braked coaches.

Adult weight – 70kg, coaches to have assumed 20% overload.