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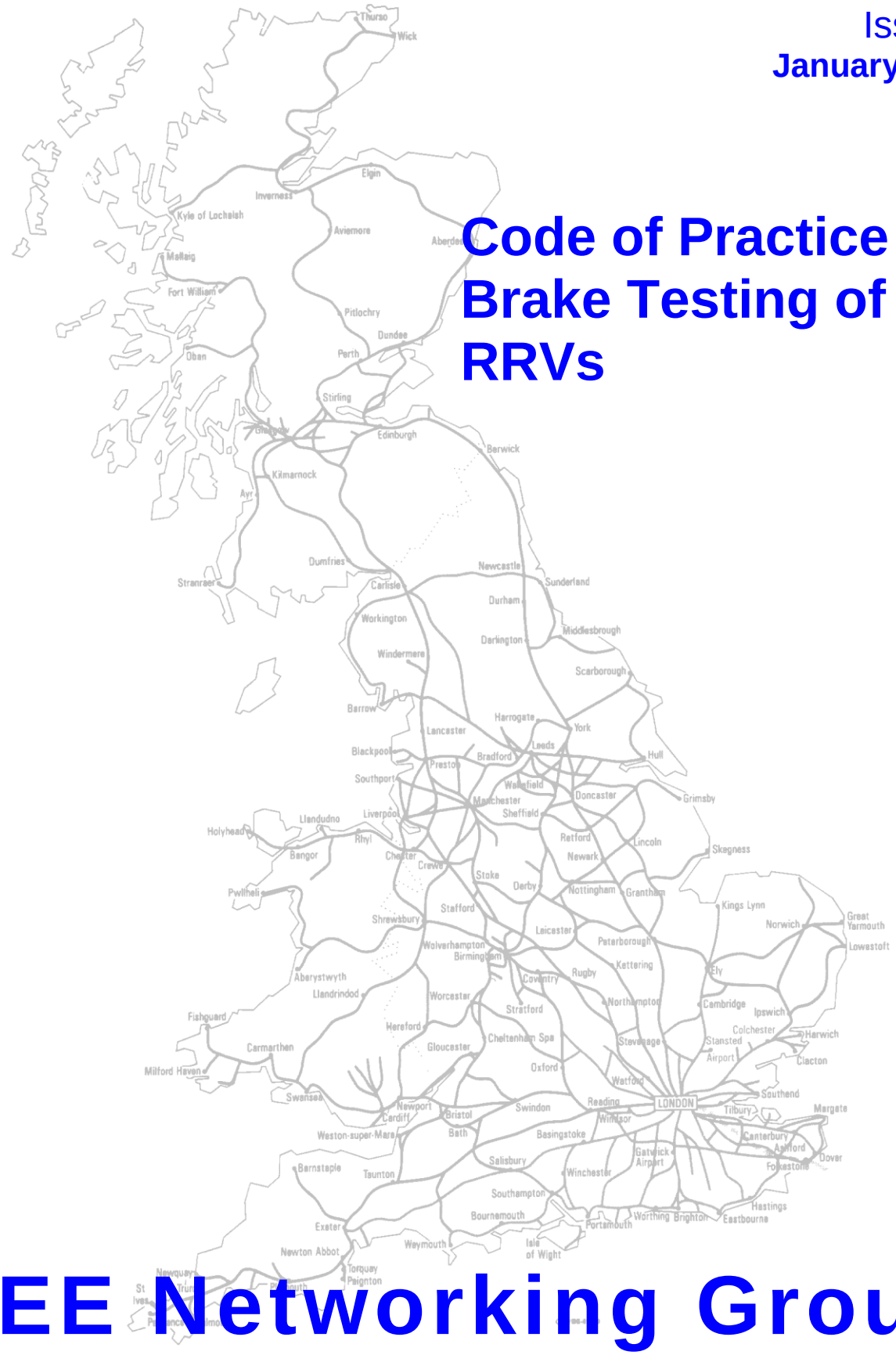
COP0025

Issue 3

January 2015

Code of Practice for Brake Testing of RRVs



M&EE Networking Group

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Document revision history

Issue	Date	Reason for change
1	Nov 10	First issue
2	Jan 13	Revised to clarify the meaning of maximum speed as the maximum speed permitted for the configuration under test. Requirement added for reference test to be repeated following a modification of the braking system.
3	Jan 15	Torque testing added for maintenance brake testing for direct wheel braked machines. Also pull test added for road mode parking brake.

Background

A sub-group of the M&EE Networking Group have looked at the arrangements for brake testing of RRVs including when towing trailers and the effects of direct wheel braking. The M&EE Networking Group recommend this COP as good practice for the industry.

M&EE COPs are produced for the benefit of any industry partner who wishes to follow the good practice on any railway infrastructure. Where an infrastructure manager has mandated their own comparable requirements, the more onerous requirements should be followed as a minimum for work on their managed infrastructure.

The M&EE Networking Group makes no warranties, express or implied, that compliance with this document is sufficient on its own to ensure safe systems of work or operation. Users are reminded of their own duties under health and safety legislation.

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Sign off

The M&EE Networking Group agreed and signed off this Code of Practice on 24th January 2015 and published on 6th June 2015

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Purpose

This Code of Practice details the testing of the braking system of RRVs during routine maintenance examination to be carried out by the owners of the RRVs. The method proposed is safer and saves time and money during the routine maintenance brake tests as it removes the need to use trailers and test loads, or speeds greater than 10 mph. For type 9b machines fitted with direct wheel braking this now removes the need for any dynamic rail brake testing.

Scope

This Code of Practice concerns the routine maintenance brake testing of RRVs, it does not include in-service brake tests, operator pre-work checks or the overhaul of the braking system. It does not include inter-vehicle service brake and parking brake continuity testing (for this see COP0014).
The testing of parking and dynamic/service brake is included in rail mode, and the parking brake only in road mode.

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Definitions

direct wheel braking	where the rail wheel has the brake applied such that it is independent from the road wheel.
manufacturer	the entity which produced the RRV, or converted the host vehicle into an RRV.
maximum permitted speed	the speed shown on the Engineering Acceptance Certificate, or displayed on the vehicle side, or shown in the Instruction handbook to be the maximum speed allowed for the configuration in use at the time.
fully laden	Should be taken as all consumables full, and maximum load, including passengers, on powered machine, (including a simulation of the worst case for the load on hook in lift and carry duty), where applicable
unladen	Should be taken as no variable load (including no passengers) on powered machine (but does include the driver and a minimum of 2/3 capacity of consumables).
calibrated	means test and measurement equipment traceable to ISO/IEC 17025

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1 RRV brake testing

1.1 General testing methodology

1.1.1 Fundamentally brakes in rail mode are able to be tested by physically moving the machine on a piece of track and checking that it will stop (dynamic brake testing) or by either pulling a stationary machine or attempting to rotate a rail wheel (static brake testing). To test a machine's complete brake system it may be possible to perform only dynamic or static brake system test, or some machines could need both types of test.

1.1.2 All machines with direct wheel braking should have a male 1 inch square drive permanently fixed to the centre of each rail wheel, accessible from the outside of the machine. If the machine is modified retrospectively the machine manufacturer should be consulted to ensure the rail wheel design will withstand the torque loads to be applied and that the machine profile remains within its intended gauge.

1.1.3 Consideration should be given to the performance of the brake in road mode, in most cases this will be as specified by the original base machine manufacturers' instructions. It should be noted that some OEM instructions for the original base machine are not as detailed / helpful as the instructions contained within this COP; machine owners might consider using the same or similar methods for the machine in road mode.

1.1.4 The performance for the parking brake in road mode should be capable of holding the machine, with drive train disengaged on a 1 in 5 gradient (20% slope) – this is equivalent to 19.5 % of the maximum machine mass when pulled on a level surface.

1.1.5 It is most important to consider the complete machine braking system and how this should be tested, it is probable that more than one testing method will be needed to test the various road and rail wheel brakes in road and rail modes.

1.2 Test track

1.2.1 Where dynamic brake testing is required, these tests are carried out in dry conditions on level track. This is to prove compliance with existing standards in a repeatable manner.

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1.2.2 Level track should be taken to be a maximum gradient (slope) of 1 in 750. Gradients any steeper than 1 in 750 should not be considered as 'level'.

1.2.3 The rail head should not be covered in a continuous film of rust or other obvious contaminants.

NOTE A period of running over the test track could be required to remove rust covering of the railhead before brake testing is attempted.

1.2.4 The length of track needs to be suitable for acceleration up to a steady test speed, the application of the brake, deceleration under braking and a suitable margin for error to account for unexpectedly reduced braking performance.

NOTE This is either specified by the manufacturer or, for the average RRV travelling at a maximum speed of 10 mph, this could require a minimum length of 100 m for a RRV on its own and a minimum length of 500 m for RRV and trailer(s) combination.

1.3 Reference dynamic brake test for each RRV

1.3.1 Where the RRV owner does not have access to the actual brake test results, they should consult with the manufacturer of the RRV to see if the appropriate braking performance figures are available for the actual RRV (by unique identification number).

1.3.2 If insufficient information is available of actual braking performance figures found for the RRV and permitted trailing load then the RRV owner should carry out one-off reference braking tests as set out in 1.3.4 to 1.3.8.

1.3.3 A reference brake test should be carried out following a modification to the braking system.

1.3.4 If no braking performance figures are available for the actual RRV then the reference brake tests, as applicable, should be carried out as follows:

a) Measure stopping distance of fully laden RRV plus maximum service braked trailing load (maximum number of trailers permitted at front and rear of RRV) at maximum permitted speed for the consist in use.

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b) Measure stopping distance of RRV plus maximum non-service braked trailing load at 10 mph (or maximum speed if this is less than 10 mph).

NOTE . Non service braked trailing loads are now normally restricted to 2 wheeled trailers only.

c) Measure stopping distance of fully laden RRV without trailing load at maximum permitted speed.

d) Measure stopping distance of unladen RRV without trailing load at maximum permitted speed.

e) Measure stopping distance of unladen RRV without trailing load at 10 mph (or maximum speed if this is less than 10 mph).

1.3.5 Record the stopping distances obtained in 1.3.4 a) to d) on the form shown in Appendix A and ensure that none are in excess of the maximum permitted in RIS-1530-PLT (this is illustrated graphically in Appendix E).

1.3.6 Record the stopping distance obtained in 1.3.4 e) on the form shown in Appendix A and calculate the maximum stopping distance as shown in 2.2.

1.3.7 The tests carried out in 1.3.4 a) to e) should be carried out as described in 2.1.

1.3.8 Brake tests should be carried out with RRV in different orientation to see if this is significant, as shown in 2.1.2.

1.4 Routine maintenance dynamic brake test for each RRV

1.4.1 The RRV owner should ensure that a routine maintenance brake test is carried out and the results recorded. The maximum interval between routine maintenance brake tests should not exceed 12 months.

1.4.2 The routine maintenance brake tests should be carried out by measuring the stopping distance of the unladen RRV without trailing load at 10 mph (or maximum speed if this is less than 10 mph), carried out as described in 2.1.

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1.4.3 Record the stopping distance obtained in 1.4.2 on the form shown in Appendix B and ensure that it:

a) does not exceed the maximum stopping distance as shown in 2.2,

and

b) does not exceed the stopping distance obtained in the first of type brake test by more than 10% as shown in 2.2.

1.4.4 If the RRV fails the test shown in 1.4.3 a) it must be prevented from returning to service before the fault is rectified. Once the reason for failure is rectified another routine maintenance brake test should be carried out to ensure compliance with the maximum stopping distance (as shown in 2.2), and test results recorded.

1.4.5 If the RRV fails the test shown in 1.4.3 b), it must either have the fault rectified or the reason for degradation greater than 10% is justified, and recorded on the brake test form.

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2 Dynamic brake test

2.1 Brake test method

2.1.1 During all the tests there should either be an indication of speed to the operator or the RRV should have engineering controls to maintain the maximum speed. In both cases checks should be made with a speed gun (or other equivalent device) during the test to gain assurance of the accuracy of the speed, and the speed gun (or the other equivalent device) should be calibrated.

2.1.2 For some RRVs there could be a difference in stopping distance depending on orientation of the RRV. If this is found to be a significant difference, the reference test and routine maintenance testing should be undertaken in the same direction which gives the worst case stopping distance. The direction that the RRV has to face during the test should be written down in the test method.

2.1.3 The point at which the brakes are applied along the test track should be the same for each test. This should be sufficiently far from the start point that a steady state speed can be reliably achieved.

2.1.4 Immediately the brake application point has been reached the operator should, as quickly as possible, stop applying power and apply the brakes as firmly as possible. No attempt should be made to feather or release the brakes.

2.1.5 The stopping distance is measured from the brake application point to the point where the RRV comes to a complete stand.

2.1.6 Each test required in 1.3.4 a) to e) and 1.4.2 should be carried out three times. If the three results are within 10% of each other they should be averaged to provide the test result. If the three results are not within 10% of each other then further tests should be carried out until three consecutive results are obtained which are within 10%.

NOTE Some manufacturers could provide equipment for brake testing which could simplify the process for measuring and recording distance and speeds.

2.2 Calculation of maximum stopping distance

2.2.1 The stopping distance required by RIS-1530-PLT for the tests set out in 1.3.4 a) to d) should be divided by the actual stopping distance obtained in the tests set out in 1.3.4 a) to d).

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2.2.2 The lowest value obtained in the four divisions required in 2.2.1 should be multiplied by the actual stopping distance obtained in the test set out in 1.3.4 e). Where this value is less than the stopping distance shown in RIS-1530-PLT then it is the ***maximum stopping distance*** for use in routine maintenance brake tests as described in 1.4.3.a).

2.2.3 Example of calculation of maximum stopping distance

1 1.3.4a) test: *Measure stopping distance of RRV plus maximum service braked trailing load (maximum number of trailers permitted at front and rear of RRV) at maximum permitted speed*
= ***26.3*** m @ ***15*** mph

2 1.3.4a) test RIS-1530-PLT permitted distance:
= ***36*** m @ ***15*** mph

3 division required in 2.2.1= ***36*** / ***26.3*** = ***1.37***

4 1.3.4b) test: *Measure stopping distance of RRV plus maximum unbraked trailing load at 10 mph (or maximum speed if this is less than 10 mph)*
= ***15.1*** m @ ***10*** mph

5 1.3.4b) test RIS-1530-PLT permitted distance:
= ***18*** m @ ***10*** mph

6 division required in 3.1= ***18*** / ***15.1*** = ***1.19***

7 1.3.4c) test: *Measure stopping distance of fully laden RRV without trailing load at maximum permitted speed*
= ***42.7*** m @ ***20*** mph

8 1.3.4c) test RIS-1530-PLT permitted distance:
= ***60*** m @ ***20*** mph

9 division required in 3.1= ***60*** / ***42.7*** = ***1.41***

10 1.3.4d) test: *Measure stopping distance of unladen RRV without trailing load at maximum permitted speed*
= ***41.2*** m @ ***20*** mph

11 1.3.4d) test RIS-1530-PLT permitted distance:
= ***60*** m @ ***20*** mph

12 division required in 2.2.1= ***60*** / ***41.2*** = ***1.46***

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13 1.3.4e) test: *Measure stopping distance of unladen RRV without trailing load at 10 mph (or maximum speed if this is less than 10 mph)*
= ***8.2*** m @ ***10*** mph

14 Smallest value in calculations 3, 6, 9 & 12 = ***1.19***

15 Smallest value multiplied by stopping distance in 13
= ***8.2*** x ***1.19*** = ***9.8 m***

16 1.3.4e) test RIS-1530-PLT permitted distance:
= ***18*** m @ ***10*** mph

17 Therefore ***maximum stopping distance*** for future tests
= ***9.8 m***

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3 Static brake test

3.1 Brake test torque method (For Direct wheel brake only)

3.1.1 Where a direct wheel brake wheel has a male 1 inch square drive fixed onto the centre, the rail wheel should be positioned so that it is not externally influenced (e.g. independent of the ground or road wheel) and a torque wrench/multiplier used to ascertain the torque figure is acceptable (see 3.1.2). The torque tests should be carried out on each wheel after the brake components have been visually examined to check there is no contamination. These should be recorded, an example form is shown in appendix C. Ideally this will be part of the manufacturers' routine maintenance brake test instructions.

3.1.2 The torque figure should be supplied by the manufacturer (or rail wheel brake converter). Note that where the parking brake is part of the rail wheel braking system it is probable that there will be two separate figures, one for the service brake and one for the parking brake. Having ensured that these minimum torque figures are obtained it is possible to actually obtain the torque required to start to rotate the wheel, but it should be noted that in some instances this is significantly greater than the minimum torque figure. The advantage of obtaining the actual torque figure is that it is possible to monitor the rate of degradation between tests.

3.1.3 The manufacturer should supply the minimum torque figures derived from the absolute required to stop the machine (or to hold the machine for the parking brake) with an allowance for degradation and wear between tests such that the absolute figure is never reached.

3.1.4 For maintenance brake tests the torque wrench/multiplier used should be calibrated.

3.2 Parking brake test method

3.2.1 Where the parking brake in rail mode is achieved by the direct wheel brake then the tests shown in 3.1 are sufficient. The Road mode parking brake should be tested as shown in 3.2.3.

3.2.2 To check the parking brake in rail mode the parking brake should be applied on flat level dry track and attempt to pull the machine along the track. The force required to commence movement should

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be recorded. The manufacturer should supply the minimum force figure derived from the absolute required to hold the machine on a 1 in 25 gradient with an allowance for degradation and wear between tests such that the absolute force figure is never reached.

3.2.3 The test for the parking brake in road mode should be similarly performed on a flat level surface with the performance figure for the pull test in road mode as shown in 1.1.4.

3.2.4 The results for the road and rail mode parking brakes should be recorded. An example form is shown in Appendix D

3.2.5 The load cell, or alternative device, to measure the force required to move the machine should be calibrated.

3.2.6 The service brake should not be tested using a pull test. Service brakes which cannot be tested as shown in 3.1 should have dynamic tests as shown in 2.1.

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Appendix A Documentation for Reference Dynamic Brake Test

RRV Reference Dynamic Brake Test Record **FRONT SIDE**							
RRV number				Date of test			
Location of test							
Test (a) *Measure stopping distance of RRV plus maximum service braked trailing load (maximum number of trailers permitted at front and rear of RRV) at maximum permitted speed*							
Speed (mph) **Sa**		**Three test stopping distances (m)**				**Average stopping distance (m)** **Da**	
Test (b) *Measure stopping distance of RRV plus maximum unbraked trailing load at 10 mph (or maximum speed if this is less than 10 mph)*							
Speed (mph) **Sb**		**Three test stopping distances (m)**				**Average stopping distance (m)** **Db**	
Test (c) *Measure stopping distance of fully laden RRV without trailing load at maximum permitted speed*							
Speed (mph) **Sc**		**Three test stopping distances (m)**				**Average stopping distance (m)** **Dc**	
Test (d) *Measure stopping distance of unladen RRV without trailing load at maximum permitted speed*							
Speed (mph) **Sd**		**Three test stopping distances (m)**				**Average stopping distance (m)** **Dd**	
Test (e) *Measure stopping distance of unladen RRV without trailing load at 10 mph (or maximum speed if this is less than 10 mph)*							
Speed (mph) **Se**		**Three test stopping distances (m)**				**Average stopping distance (m)** **De**	

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RRV Reference Dynamic Brake Test Record Cont. . . .

REVERSE SIDE

Calculation of maximum stopping distance for future use

RIS-1530-PLT stopping distance required at speed Sa	DaS	**DaS / Da**	Fa
RIS-1530-PLT stopping distance required at speed Sb	DbS	**DbS / Db**	Fb
RIS-1530-PLT stopping distance required at speed Sc	DcS	**DcS / Dc**	Fc
RIS-1530-PLT stopping distance required at speed Sd	DdS	**DdS / Dd**	Fd
Smallest value of figures Fa, Fb, Fc and Fd			Fx

Future maximum brake stopping distance at speed Se (where this is less than RIS-1530-PLT stopping distance required at speed Se)	**De x Fx**	

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Appendix B Documentation for Routine Maintenance Dynamic Brake Test

RRV Routine Dynamic Maintenance Brake Test Record							
RRV number				Date of test			
Location of test							
Date of next test							
Test: measure stopping distance of unladen RRV without trailing load at 10 mph (or maximum speed if this is less than 10 mph)							
Speed (mph)		**Three test stopping distances (m)**				**Average stopping distance (m)**	
Maximum stopping distance permitted from Reference Brake Test (m)							
Stopping distance from previous Routine Maintenance Brake Test (m)							

I confirm that this Routine Maintenance Brake Test does not exceed the maximum permitted by the Reference Brake Test

. . . . . **(signature of tester)**

I confirm that this Routine Maintenance Brake Test has not exceeded the previous Routine Maintenance Brake Test by more than 10%, or has exceeded because:

. . . . . .

. . . . . .

. . . . . **(signature of tester)**

. . . . . **(Approved by supervisor)**

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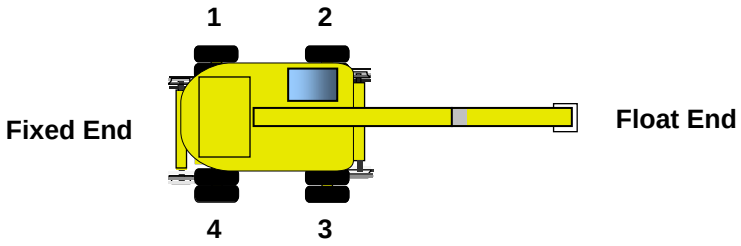
Appendix C Documentation for Routine Maintenance Static Brake Test

RRV Routine Static Maintenance Brake Test Record					
RRV number			Date of test		
Location of test					
Date of next test					



Wheel 1	**Minimum Torque value - Nm**	**Park**	**Achieved**	
		Service		
Wheel 2	**Minimum Torque value - Nm**	**Park**	**Achieved**	
		Service		
Wheel 3	**Minimum Torque value - Nm**	**Park**	**Achieved**	
		Service		
Wheel 4	**Minimum Torque value - Nm**	**Park**	**Achieved**	
		Service		

Torque Wrench serial Number		**Calibrated Next Test Date**	

I confirm that the above RRV has PASSED the Routine Static Maintenance Brake Test

Name of Tester . . . . . .

Signature . . . . . .

Supervisor/Manager approval

Name . . . . . .

Signature . . . . . .

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Appendix D Documentation for Routine Maintenance Parking brake Pull Test

RRV Routine Maintenance Parking Brake Pull Test Record				
RRV number		Date of test		
Location of test				
Date of next test				
Rail Mode	**Minimum Pull Test value - N**		**Achieved**	
Road Mode	**Minimum Pull Test value – N**		**Achieved**	
Load Cell serial Number		**Calibrated Next Test Date**		
I confirm that the above RRV has PASSED the Routine Maintenance Parking Brake Pull Test **Name of Tester . . . . . .** **Signature . . . . . .**				
Supervisor/Manager approval **Name . . . . . .** **Signature . . . . . .**				

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Appendix E Graph of RIS-1530-PLT Maximum Stopping Distances