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GM/RT2044
Issue Four
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Braking System Requirements and Performance for Multiple Units

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Synopsis
This document defines the principles of operation and performance requirements for the braking systems of multiple units for operation on Railtrack controlled infrastructure, in order to ensure safety of operation and safe interworking.

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Part A

Issue Record

This document will be updated when necessary by distribution of a complete replacement.

A vertical black line in the adjacent margin will mark amended or additional parts of revised pages.

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Two	December 1997	Supersedes Issue One
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Technical Content

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Responsibilities

Railway Group Standards are mandatory on all members of the Railway Group * and apply to all relevant activities that fall into the scope of each individual's Railway Safety Case. If any of those activities are performed by a contractor, the contractor's obligation in respect of Railway Group Standards is determined by the terms of the contract between the respective parties. Where a contractor is a duty holder of a Railway Safety Case then Railway Group Standards apply directly to the activities described in the Safety Case.

* The Railway Group comprises Railtrack PLC, Railway Safety, and the train and station operators who hold railway safety cases for operation on or related to infrastructure controlled by Railtrack PLC.

Compliance

Except as detailed below, the provisions of this document are mandatory and compliance is required from 04 August 2001.

The requirements of section 11.2c shall apply to multiple units whose first Design Scrutiny Certification date is after 06 December 1997.

The compliance date for the requirement to retrofit enhanced emergency braking to class 158, 159 and 442 vehicles (removed from exemptions in section 5.4 of issue four) is 01 December 2003.

Any Railway Group member deviating from the requirements set out in this document shall ensure that the situation is regularised in accordance with the requirements of GA/RT6001, GA/RT6004, or GA/RT6006.

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Braking System Requirements and Performance for Multiple Units

Part B

1 Purpose

The purpose of this document is to define the performance requirements and principles of operation of the braking systems of multiple units, to ensure system safety and safe interworking.

2 Scope

The overall scope of Railway Group Standards is as specified in Appendix A of GA/RT6001.

This document contains requirements which are applicable to the duty holders of the Train Operator category of Railway Safety Case.

Specifically the contents of this document apply to multiple units, when operating at speeds not exceeding 125mph whilst running on Railtrack PLC (known as Railtrack) controlled infrastructure. Braking system and performance requirements for multiple units when operating at speeds in excess of 125mph are detailed in GM/RT2046.

3 Definitions

Brake Application
Where an application of the brake results in a brake force being applied to the vehicle.

Brake Controller
The device operated by the driver at the driving position by which means the demand for a brake application or release is relayed to the brake system.

Brake Force
The force applied to the brake block / pad / braking surface interface.

Brake Force Build-up Time
The elapsed time from when the brake controller handle is moved to signal the requirement for a brake application until the brake force has reached a specified value.

Brake System
All the components and sub-assemblies that provide the means by which brake applications on rail vehicles are made and controlled, including the means by which the energy is provided and / or stored to generate the brake retarding force and the equipment which provides the retarding force.

Brake System Couplings
The inter-vehicle couplings that connect the brake systems on adjacent rail vehicles and transmit the brake control signals that provide the system continuity and, where appropriate, also transmit the energy.

Driving Position
The designated position from which a driver controls the braking of a vehicle or train.

Emergency Brake Application
A brake application that uses a more direct and separate part of the control system, that as a result may be quicker, to signal the requirement for a brake application, than that used for the full service brake application. On certain vehicles, the retardation rate may be specified to be higher than that of the full service brake application and is described as enhanced emergency braking.

Fade
A reduction in the coefficient of friction of the braking material, due to the temperature rise of the braking material during a brake application.

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Full Service Brake Application
The brake application that gives the minimum retardation rate that meets the performance requirements.

Maximum Loaded Condition
A defined condition in excess of the normal fully laden condition that may arise during exceptional operating circumstances. Also commonly known as crush laden.

Multiple Unit
For the purposes of this document a multiple unit is a fixed formation of five vehicles or less having a driving position at both outer ends of the formation.

This definition excludes traction units (see GM/RT2042), on-track machines (see GM/RT2400) and freight vehicles (see GM/RT2043).

Fixed formations of more than five vehicles that incorporate traction equipment distributed within the train do not therefore comply with the definition of either a trailer coach (because some vehicles have traction equipment) or a multiple unit (more than 5 vehicles). For the purposes of braking performance, these fixed formations may either meet the requirements of this document GM/RT2044 or the requirements of GM/RT2041. At operating speeds in excess of 125mph, the requirements of GM/RT2046 apply.

New Multiple Unit
A multiple unit whose first Design Scrutiny Certification (see GM/RT2000) date is after 01 May 1994. Such multiple units shall comply with the requirements for new multiple units defined in this document.

Parking Brake
A brake system designed to hold a rail vehicle stationary for an indefinite period without the addition of further energy to maintain the brake force, provided no additional external force is applied to the vehicle.

Power Brake
A means by which the retardation of a rail vehicle or a train can be achieved by the application of a brake force that is generated by energy stored on the vehicle.

Traction Unit
A vehicle with its own source of traction, that is designed to haul other railway vehicles, that has one or more driving positions and is able to control the braking of the vehicles coupled to it.

Tread Braking
A friction braking system where the brake force is applied directly to the wheel tread.

Wheelslide Prevention
Wheelslide Prevention (WSP) is a system designed to make the best use of available adhesion by a controlled reduction of the brake force to prevent wheelsets from locking and sliding.

4 Brake System – General

The braking system requirements are contained in GM/RT2045.

5 Performance

5.1
The braking performance defined in this document shall be achieved by all trains composed of multiple units when operating at speeds not exceeding 125mph on level track with normal levels of adhesion available. See GM/RT2045 for an explanation of normal levels of adhesion. The requirements

for braking performance when travelling at speeds in excess of 125mph are contained in GM/RT2046.

Separate requirements are defined in this document according to whether the train:

a) contains any existing tread braked multiple units, or

b) is composed entirely of new multiple units or existing disc braked multiple units or a combination of these.

The maximum permissible stopping distances depend on which signalling rules have been applied to the route on which the multiple unit is to be operated. The specific stopping distance criteria for each signalling rule are defined in sections 5.1.1 to 5.1.4.

5.1.1
Trains required to operate over routes signalled in accordance with GK/RT0034 Appendix 1, shall have the following braking performance:

a) The stopping distances of trains containing any existing tread braked multiple units or Class 310 or Class 312 multiple units shall not exceed those defined by curve A1 of Figure 1.

b) The stopping distances of trains composed entirely of new multiple units or existing disc braked (except Class 310 & Class 312) multiple units or a combination of these, shall not exceed those defined by curve B1 of Figure 1.

Appendix C details recommended minimum braking distances and Appendix D recommended braking performance requirements.

5.1.2
Trains required to operate over routes signalled in accordance with GK/RT0034 Appendix 2, shall have the following braking performance:

a) The stopping distances of trains containing any existing tread braked multiple units or Class 310 or Class 312 multiple units shall not exceed those defined by curve A2 of Figure 2.

b) The stopping distances of trains composed entirely of new multiple units or existing disc braked (except Class 310 & Class 312) multiple units or a combination of these, shall not exceed those defined by curve B2 of Figure 2.

Appendix C details recommended minimum braking distances and Appendix D recommended braking performance requirements.

5.1.3
Trains required to operate over routes signalled in accordance with GK/RT0034 Appendix 3, shall have braking performance such that the stopping distances do not exceed those defined by curve A3 of Figure 3.

Appendix C details recommended minimum braking distances.

5.1.4
Trains required to operate over routes signalled in accordance with GK/RT0034 Appendix 4, shall have the following braking performance:

a) For trains containing any existing multiple units, the stopping distances shall not exceed those defined by curve A4 of Figure 4.

b) The performance defined in Figure 4 shall not be used for the design of any new multiple units.

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c) For trains composed entirely of new multiple units operating over routes signalled in accordance with GK/RT0034 Appendix 4, the stopping distances shall not exceed those defined by curve B2 of Figure 2.

Appendix C details recommended minimum braking distances and Appendix D recommended braking performance requirements.

5.2
The performance defined in sections 5.1.1 to 5.1.4 shall be:

a) inclusive of any brake force build up time

b) achieved as a result of a full service brake application by any train composed of multiple units

c) achieved in the tare and any loading condition up to and including the maximum loaded condition. If necessary, in order to achieve the performance in the maximum loaded condition, the brake force shall be capable of being varied in proportion to the total vehicle mass

d) inclusive of appropriate allowances for:

i) any fade associated with the increase in temperature of a friction material that may arise during any brake application

ii) tolerances on equipment settings (see also section B5 of Appendix B)

iii) any degradation of braking performance either between maintenance or due to the bedding in of new components.

5.3
An explanation of the contingencies adopted in the performance curves in Figures 1 - 4 is given in Appendix A and guidance notes on the interpretation of Figures 1 - 4 are given in Appendix B.

5.4
All disc braked multiple units shall be provided with a higher braking retardation for a driver initiated emergency brake application and the requirements in sections 5.4.1 to 5.4.2 shall apply except for multiple units in categories a), b) and c) below:

a) existing multiple units in Classes 310, 312, 313, 314, 507 and 508

b) excepting Class 442 multiple units, all other existing multiple units with a stepless brake controller, and

c) existing multiple units with a stepped brake controller with at least seven positions.

5.4.1
To assist drivers in cases of misjudgement or other emergencies, the brake force used to achieve the full service braking retardation shall be increased for the emergency brake application, to give enhanced emergency braking by:

a) a maximum of 30% provided that the stopping distances that result are not less than those recommended in Appendix C, or

b) a minimum enhancement of 15% shall be applied even if the stopping distances that result are less than those recommended in Appendix C.

5.4.2
On multiple units fitted with the enhanced emergency braking defined in section 5.4.1, the control system shall incorporate a deterrent feature to discourage the use of a driver initiated emergency brake application in non-emergency situations. The minimum deterrent shall be that a driver initiated emergency brake application shall bring the train effectively to a standstill (less than 5mph), before a release of the brake application can be commenced.

Enhanced emergency braking shall occur for driver initiated emergency brake applications. It shall also be acceptable for unsolicited emergency brake applications from train safety systems to be at the enhanced rate.

5.5
A brake force that enables the braking performance of all vehicles to be compared on the same basis shall be calculated for inclusion in the Rolling Stock Library, in accordance with GM/RT2040.

5.6
If for any reason it is necessary to reduce the design braking performance of any particular class of existing multiple unit, there shall be sufficient driver training arranged to ensure drivers are familiar with the new braking performance. The new braking performance shall in any case enable the multiple unit to meet the appropriate minimum stopping distance requirements defined in this document for operation over Railtrack controlled infrastructure.

6 Brake System Energy

The requirements for the provision of brake system energy are contained in GM/RT2045.

7 Control System

7.1
The following additional features shall supplement the brake control system requirements described in GM/RT2045:

7.1.1
Any compartment provided specifically for the train crew responsible for the safety of the train, shall be provided with a method to make an emergency brake application, unless the multiple unit also operates through the Channel Tunnel. In this case the devices shall be provided at driving positions only.

7.1.2
If disc brakes are fitted to the vehicle, a WSP system shall be fitted that ensures that the braking force is controlled, where applicable on a per axle basis, to minimise the extension of stopping distance due to low adhesion.

7.1.3
Except on axles that are coupled by a drive system, on new multiple units the WSP systems shall be arranged so that the failure of the individual component that is designed to reduce the brake force, does not result in the loss of brake force to more than one axle on a vehicle of a multiple unit.

7.1.4
On new multiple units, where the failure of a component or sub-assembly would result in the loss of more than 20% of the brake force on that multiple unit, a device shall be provided that gives a warning to the driver if that condition occurs during a brake application on any vehicle of the multiple unit.

7.1.5
On multiple units that can operate as single vehicles, those key elements of the control system whose failure would result in a loss of brake force shall be duplicated. They shall also be independent of one another so that the failure of one does not degrade the performance of the other. This requirement applies to

elements of the control system between the device responding to the signal from the driver's brake controller and the brake force application system. The duplication shall ensure that the failure of one of these components does not result in the complete loss of the brake force on the vehicle. The duplication shall ensure that nominally 50% of the power brake is retained on the vehicle in the event that one element fails.

7.1.6
If there is a method of isolating the energy reservoir on any vehicle of a multiple unit from its source of supply, that is separate from the method of isolating the brake on the vehicle, both the following shall apply:

a) There shall be a method of securing the operating handle of the isolation device in the normal running position.

b) On new multiple units there shall be a device to warn the driver if the energy level is not being maintained at the level required to comply with GM/RT2045 section 6.1b). Note that an automatic brake application would meet this requirement.

8 Brake Force Application System

The brake force application system requirements are contained in GM/RT2045.

9 Brake System Coupling between Vehicles

The brake system coupling requirements are contained in GM/RT2045.

10 Vehicles with Driving Positions

10.1
Requirements for equipment fitted at driving positions are contained in GM/RT2045 and GM/RT2161, which shall be supplemented with the requirement contained in section 10.2 of this document.

10.2
A parking brake control shall be provided that also indicates whether the parking brake is applied or released, where an automatic parking brake as required by section 11.2 is not provided.

11 Parking Brake

11.1
Each multiple unit shall be fitted with a parking brake that is capable of holding the multiple unit stationary on a gradient of 1 in 30 in the tare condition.

11.2
On new multiple units:

a) the application of the parking brake force shall be automatically related to the level of energy used to provide the power brake, so that the failure of the energy supply to the power brake causes the parking brake to apply.

b) in each driving cab there shall be a device which is labelled and is readily accessible, by which the driver, in an emergency, can cause the parking brake to apply to all vehicles in the multiple unit fitted with a parking brake. Note that this shall also apply when a multiple unit is being hauled dead by an assisting locomotive that does not have a compatible brake system.

c) the application of the parking brake force shall be arranged to be applied by more than one actuator, so that in the event of the failure of an actuator, at least 50% of the parking brake force will be retained.

11.3
A manual method of releasing the parking brake shall be available. This shall be accessible to authorised staff only.

12 Testing Requirements

The requirements for testing are contained in GM/RT2045.

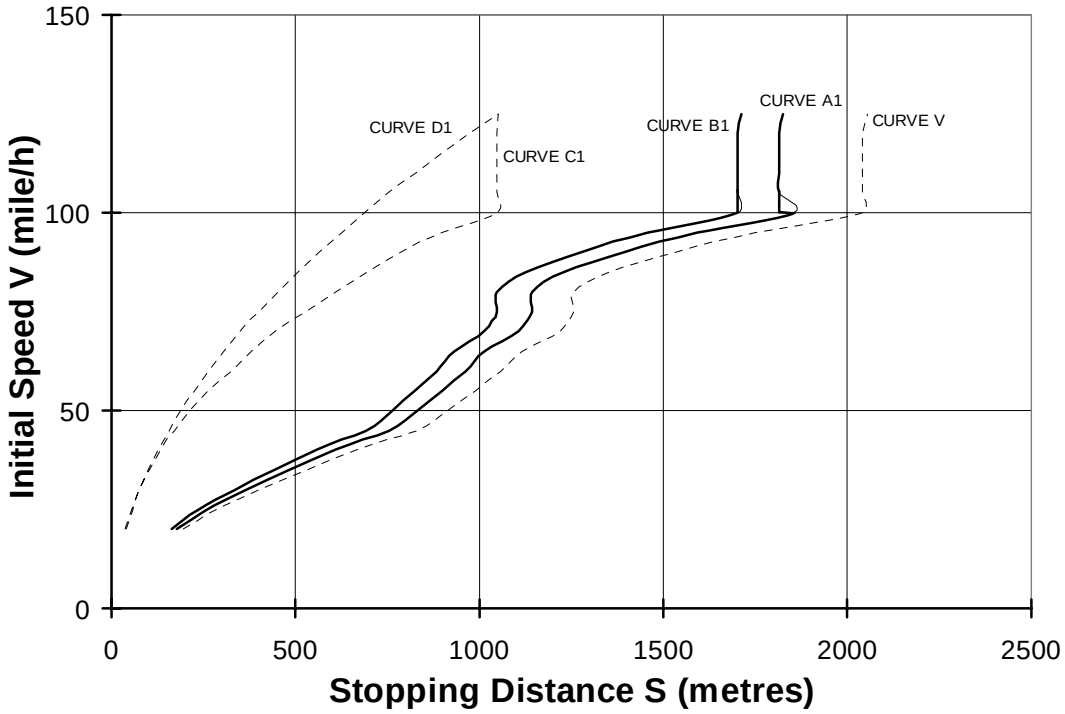

Figure 1 Stopping Distance Curve - Maximum Speed 125mph Performance for Trains Required to Operate over Routes Signalled in accordance with Appendix 1 of GK/RT0034

INITIAL SPEED (mph)	20	25	30	35	40	45	50	55	60	65	70
DISTANCE (metres) (curve V)	195	281	401	532	669	829	916	990	1058	1116	1218
DISTANCE (metres) (curve A1)	177	256	365	483	608	754	833	900	961	1015	1107
DISTANCE (metres) (curve B1)	163	234	334	443	558	691	763	825	882	930	1015
DISTANCE (metres) (curve C1)	41	57	77	103	132	170	214	264	324	381	446
DISTANCE (metres) (curve D1)	38	55	76	99	126	156	189	225	264	306	351

INITIAL SPEED (mph)	75	80	85	90	95	100	105	110	115	120	125
DISTANCE (metres) (curve V)	1258	1258	1354	1537	1750	2041	2041	2041	2041	2041	2054
DISTANCE (metres) (curve A1)	1144	1144	1231	1397	1591	1856	1814	1814	1814	1814	1826
DISTANCE (metres) (curve B1)	1048	1048	1128	1281	1458	1701	1701	1701	1701	1701	1712
DISTANCE (metres) (curve C1)	528	610	694	788	897	1047	1047	1047	1047	1047	1053
DISTANCE (metres) (curve D1)	399	451	506	564	627	688	754	825	898	974	1053

The curve V is defined by the signal spacing distance given for level track in GK/RT0034 Appendix 1. The stopping distances on level track of curves A1 and B1 are derived from the signal spacing distance of curve V as follows:

Curve A1 up to 100mph $= \frac{V}{1.1}$ above 100mph $= \frac{V}{1.125}$ Curve B1 $= \frac{V}{1.2}$

For derivation of stopping distances of curve C1 see curve C2 on Figure 2.
For derivation of stopping distances of curve D1 see curve B3 on Figure 3.
See Appendix A for the derivation of the factors used above.

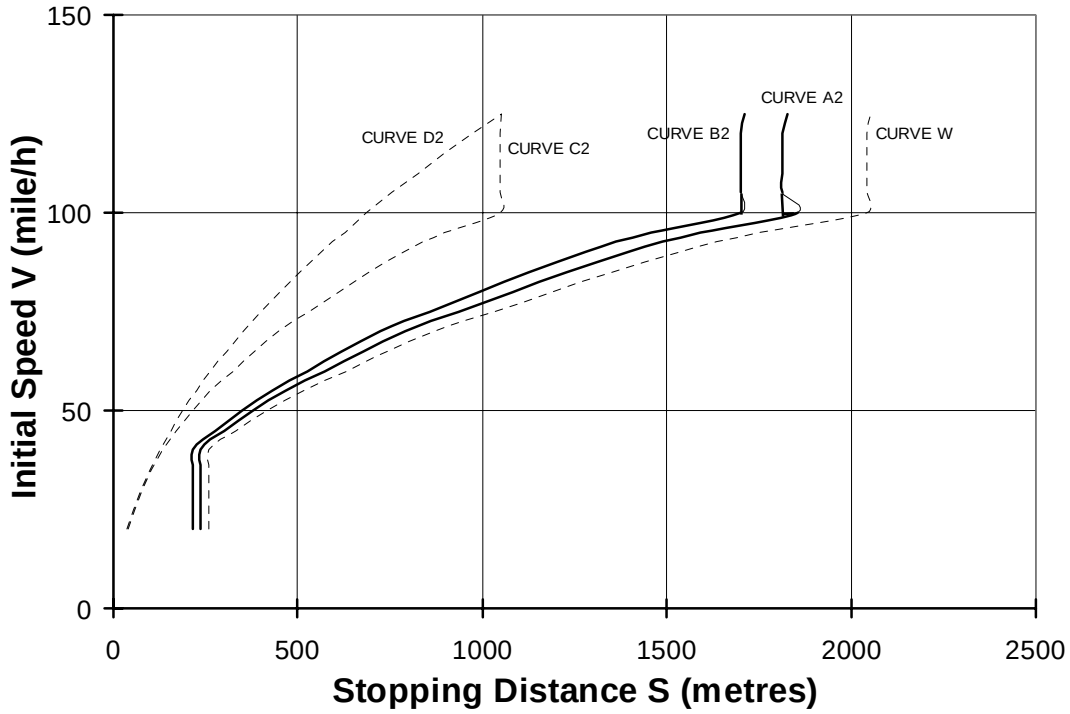

Figure 2 Stopping Distance Curve - Maximum Speed 125mph Performance for Trains Required to Operate over Routes Signalled in accordance with Appendix 2 of GK/RT0034

INITIAL SPEED (mph)	20	25	30	35	40	45	50	55	60	65	70
DISTANCE (metres) (curve W)	258	258	258	258	258	332	418	515	632	742	870
DISTANCE (metres) (curve A2)	235	235	235	235	235	302	380	468	575	675	791
DISTANCE (metres) (curve B2)	215	215	215	215	215	277	348	429	527	618	725
DISTANCE (metres) (curve C2)	41	57	77	103	132	170	214	264	324	381	446
DISTANCE (metres) (curve D2)	38	55	76	99	126	156	189	225	264	306	351

INITIAL SPEED (mph)	75	80	85	90	95	100	105	110	115	120	125
DISTANCE (metres) (curve W)	1030	1190	1354	1537	1750	2041	2041	2041	2041	2041	2054
DISTANCE (metres) (curve A2)	936	1082	1231	1397	1591	1856	1814	1814	1814	1814	1826
DISTANCE (metres) (curve B2)	858	992	1128	1281	1458	1701	1701	1701	1701	1701	1712
DISTANCE (metres) (curve C2)	528	610	694	788	897	1047	1047	1047	1047	1047	1053
DISTANCE (metres) (curve D2)	399	451	506	564	627	688	754	825	898	974	1053

The curve W is defined by the signal spacing distances given for level track in GK/RT0034 Appendix 2. The stopping distances on level track of curves A2, B2 and C2 are derived from the signal spacing distance of curve W as follows:

Curve A2 up to 100mph $= \frac{W}{1.1}$ above 100mph $= \frac{W}{1.125}$ Curve B2 $= \frac{W}{1.2}$

Curve C2 $= \frac{W}{1.95}$ (40 - 125mph)

For derivation of stopping distances of curve D2 see curve B3 on Figure 3. See Appendix A for the derivation of the factors used above. Note that at and below 100mph the curve for level track in GK/RT0034 Appendix 2 is based on the friction characteristic of cast-iron brake blocks.

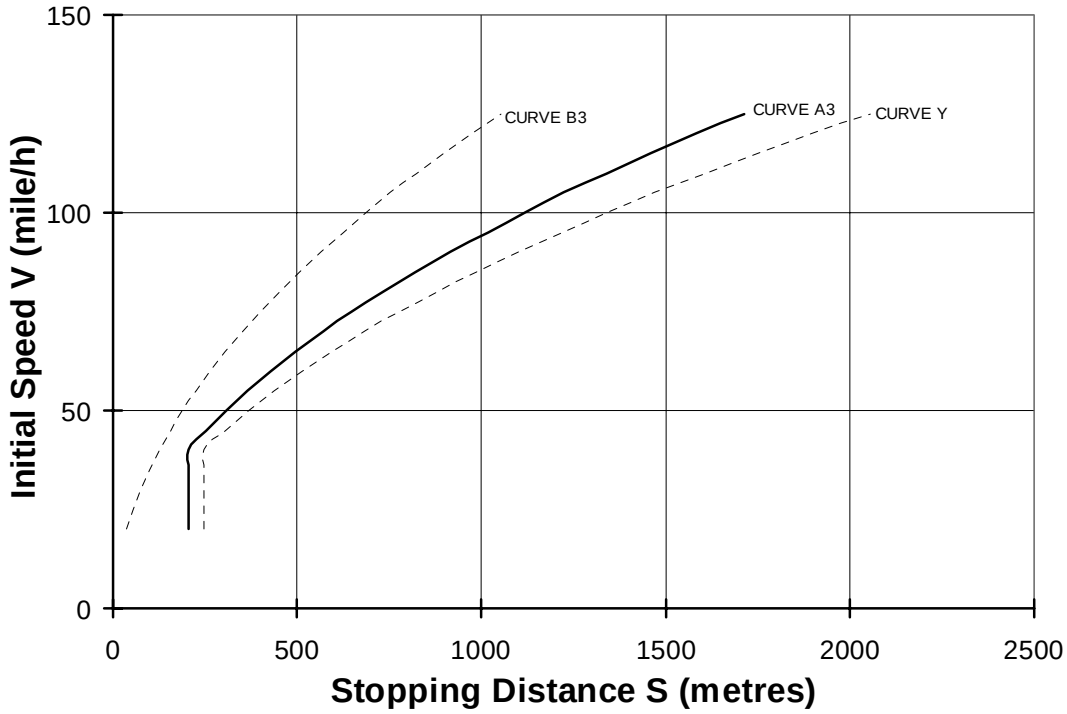

Figure 3 Stopping Distance Curve - Maximum Speed 125mph
Performance for Trains Required to Operate over Routes Signalled in accordance with Appendix 3 of GK/RT0034

INITIAL SPEED (mph)	20	25	30	35	40	45	50	55	60	65	70
DISTANCE (metres) (curve Y)	246	246	246	246	246	304	368	438	514	596	684
DISTANCE (metres) (curve A3)	205	205	205	205	205	253	307	365	428	497	570
DISTANCE (metres) (curve B3)	38	55	76	99	126	156	189	225	264	306	351

INITIAL SPEED (mph)	75	80	85	90	95	100	105	110	115	120	125
DISTANCE (metres) (curve Y)	778	879	986	1101	1222	1341	1471	1608	1751	1899	2054
DISTANCE (metres) (curve A3)	648	733	822	918	1018	1118	1226	1340	1459	1583	1712
DISTANCE (metres) (curve B3)	399	451	506	564	627	688	754	825	898	974	1053

The curve Y is defined by the signal spacing distances given for level track in GK/RT0034 Appendix 3. The stopping distances on level track of curves A3 and B3 are derived from the signal spacing distance of curve Y as follows:

$$\text{Curve A3} = \frac{Y}{1.2} \qquad \text{Curve B3} = \frac{Y}{1.95} \quad (40 - 125\text{mph})$$

See Appendix A for the derivation of the factors used above.

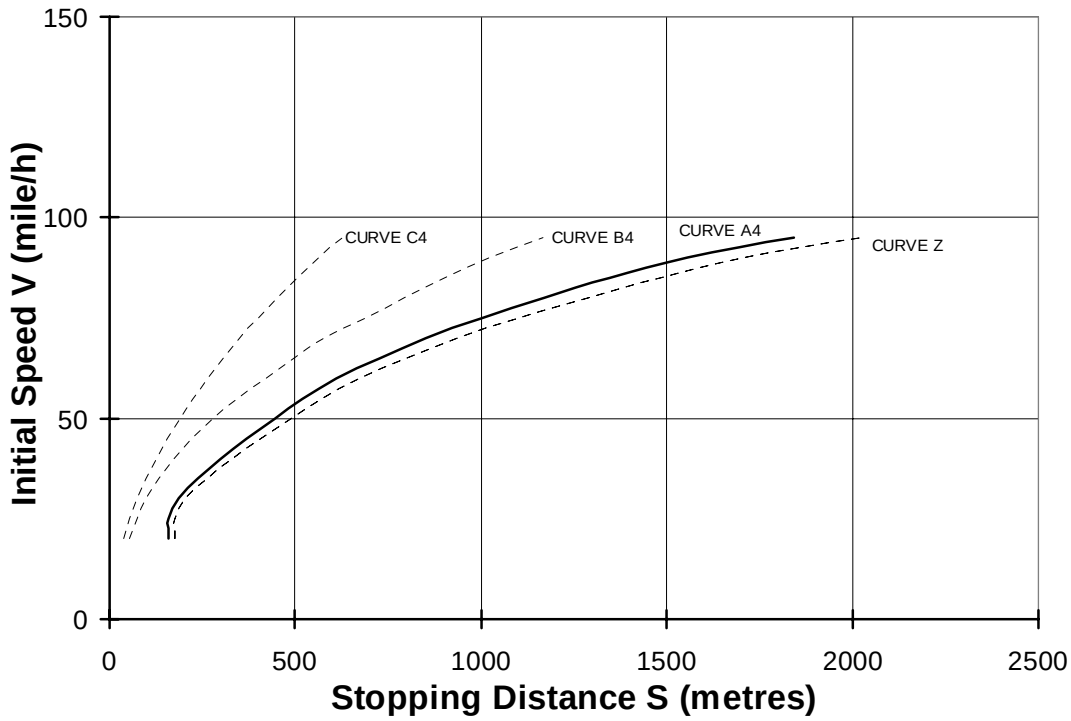

Figure 4 Stopping Distance Curve - Maximum Speed 95mph
Performance for Trains Required to Operate over Routes Signalled in accordance with Appendix 4 of GK/RT0034

INITIAL SPEED (mph)	20	25	30	35	40	45	50	55	60	65	70
DISTANCE (metres) (curve Z)	176	176	205	263	330	406	487	571	671	798	936
DISTANCE (metres) (curve A4)	160	160	186	239	300	369	443	519	610	726	851

INITIAL SPEED (mph)	75	80	85	90	95	100	105	110	115	120	125
DISTANCE (metres) (curve Z)	1100	1288	1482	1711	2025						
DISTANCE (metres) (curve A4)	1000	1171	1347	1556	1841						

The curve Z is defined by the signal spacing distances given for level track in GK/RT0034 Appendix 4. The stopping distances on level track of curve A4 is derived from the signal spacing distance of curve Z as follows:

$$\text{Curve A4} = \frac{Z}{1.1}$$

For the stopping distances of curve B4, see curve C2 on Figure 2.

For the stopping distances of curve C4, see curve B3 on Figure 3. See Appendix A for the derivation of the factors used above.

Note that the curve for level track in GK/RT0034 Appendix 4 is based on the friction characteristic of cast-iron brake blocks.

Braking System Requirements and Performance for Multiple Units

Appendix A

This Appendix is for information only

Derivation of Contingency Factors in Stopping Distance Curves, Figures 1 - 4

Figure 1
The factor of 1.1 used to derive curve A1 for speeds up to 100mph results in a stopping distance for existing multiple units which is less than the signal spacing distance. This is to allow for a 5% error in speed. The factor of 1.125 used to derive curve A1 above 100mph results in a higher contingency which is considered appropriate for existing multiple units operating at speeds above that for which the route was originally signalled.

The factor of 1.2 used to derive curve B1 results in a stopping distance that is less than the signal spacing distance by a margin, equal to the currently accepted contingency for new multiple units. A larger contingency has been adopted for multiple unit trains than locomotive hauled trains in view of the generally shorter formations associated with multiple units.

The stopping distance of curve C1 represents the maximum desirable retardation for tread braked vehicles in order to reduce the possibility of wheel tread damage, and is defined by curve C2 on Figure 2.

The stopping distance of curve D1 represents the maximum desirable retardation for any vehicle in order to reduce the possibility of wheelslide, and is defined by the curve B3 on Figure 3.

Figure 2
The factor of 1.1 used to derive curve A2 for speeds up to 100mph results in a stopping distance for existing multiple units which is less than the signal spacing distance. This is to allow for a 5% error in speed. The factor of 1.125 used to derive curve A2 above 100mph results in a higher contingency which is considered appropriate for existing multiple units operating at speeds above that for which the route was originally signalled.

The factor of 1.2 used to derive curve B2 results in a stopping distance that is less than the signal spacing distance by a margin, equal to the currently accepted contingency for new multiple units. A larger contingency has been adopted for multiple unit trains than locomotive hauled trains in view of the generally shorter formations associated with multiple units.

The factor of 1.95 used to derive curve C2, results in a minimum stopping distance that represents the maximum desirable retardation for tread braked multiple units, in order to reduce the possibility of wheel tread damage.

The stopping distance of curve D2 represents the maximum desirable retardation in order to reduce the possibility of wheelslide, and is defined by the curve B3 on Figure 3.

Figure 3
The factor of 1.2 used to derive curve A3 results in a stopping distance that is less than the signal spacing distance, by a margin equal to the currently accepted contingency for new multiple units. A larger contingency has been adopted for multiple unit trains than locomotive hauled trains in view of the generally shorter formations associated with multiple units.

The factor of 1.95 used to derive curve B3 results in a minimum stopping distance that represents the maximum desirable retardation in order to reduce the possibility of wheelslide, and gives the minimum acceptable stopping distance that should allow for the required differential between the full service and emergency braking rates.

Figure 4
The factor of 1.1 used to derive curve A4 results in a stopping distance that is less than the signal spacing distance by a margin to allow for a 5% error in speed.

The stopping distance of curve B4 represents the maximum desirable retardation for tread braked vehicles in order to reduce the possibility of wheel tread damage, and is defined by curve C2 on Figure 2.

The stopping distance of curve C4 represents the maximum desirable retardation for any vehicle in order to reduce the possibility of wheelslide, and is defined by curve B3 on Figure 3.

Braking System Requirements and Performance for Multiple Units

Appendix B

This Appendix is for information only

Interpretation of Figures 1 - 4 for Braking Performance

B1
The performance curves of Figures 1, 2, 3 and 4 define the maximum permissible stopping distances for trains required to run at line speeds of up to 125mph on lines having the minimum signal spacing distances defined in the appropriate Appendix of the signal spacing document GK/RT0034.

B2
For trains that exceed the braking performance required for the maximum line speed and signal spacing distance on a route, it may be possible for these trains to run at a higher speed on that route, in so far as braking performance is concerned, where permitted by the infrastructure controller.

B3
When checking the performance of multiple units it is important that due consideration is taken of the aspects defined in sections 5.2 c) and d) and where appropriate the values are measured.

B4
A multiple unit that is in an optimum state in terms of the condition of the brake equipment and tolerances on equipment settings but only just meets the required stopping distances, may not meet these requirements when changes take place.

Factors that need to be taken into account are a general deterioration of the brake equipment, or settings that drift to a less favourable value in the tolerance range, or the bedding in of discs/pads.

B5
It should be noted that the contingency factors defined in Appendix A are not intended to take account of changes in equipment condition or settings.

Appendix C

This Appendix is for information only

Guidance on Minimum Braking Distances

Figure 1
It is recommended, in order to reduce the possibility of wheel tread damage, that the minimum stopping distance of trains with tread brakes should not be less than that defined by curve C1 of Figure 1, and the minimum stopping distance of all trains not less than that defined by curve D1 of Figure 1.

Figure 2
It is recommended, in order to reduce the possibility of wheel tread damage, that minimum stopping distance of trains with tread brakes should be not less than that defined by curve C2 of Figure 2, and the minimum stopping distance for all trains not less than that defined by curve D2 of Figure 2.

Figure 3
It is recommended, in order to reduce the possibility of wheelslide, that the minimum stopping distance of trains should be not less than that defined by curve B3 of Figure 3.

Figure 4
It is recommended, in order to reduce the possibility of wheel tread damage, that the minimum stopping distance of trains with tread brakes should be not less than that defined by curve B4 of Figure 4, and the minimum stopping distance of all trains not less than that defined by curve C4 of Figure 4.

Braking System Requirements and Performance for Multiple Units

Appendix D

This Appendix is for information only

Guidance on Braking Performance Requirements

It is strongly recommended that the stopping distances defined below for the appropriate sections are used as the design targets for braking performance in order to provide compatibility with the braking performance of those existing multiple units that either:

a) operate up to 100mph with tread brakes and were designed to meet the braking requirements of Figure 2, or

b) operate with disc brakes and were designed to meet braking requirements equivalent to those of Figure 3.

Section 5.1.1

i) For new multiple units with tread brakes operating up to a speed not greater than 100mph, the stopping distances defined by curve B2 of Figure 2 should be used.

ii) For new multiple units with disc brakes operating up to a speed not greater than 125mph, the stopping distances defined by curve A3 of Figure 3 should be used.

iii) For new multiple units operating at speeds above 125mph, the stopping distances defined by the curve in GM/RT2046, Figure 1 should be used.

Section 5.1.2

i) For new multiple units with disc brakes operating up to a speed not greater than 125mph, the stopping distances defined by curve A3 of Figure 3 should be used.

ii) For new multiple units operating at speeds above 125mph, the stopping distances defined by the curve in GM/RT2046, Figure 1 should be used.

Section 5.1.4

i) For new multiple units with disc brakes operating up to a speed not greater than 125mph, the stopping distances defined by curve A3 of Figure 3 should be used.

ii) For new multiple units operating at speeds above 125mph, the stopping distances defined by the curve in GM/RT2046, Figure 1 should be used.

References

GA/RT6001	Railway Group Standards Change Procedures
GA/RT6004	Temporary Non-Compliance with Railway Group Standards
GA/RT6006	Derogations from Railway Group Standards
GK/RT0034	Lineside Signal Spacing
GM/RT2000	Engineering Acceptance of Rail Vehicles
GM/RT2040	Calculation of Brake-Force Data for Rolling Stock Library
GM/RT2041	Braking System Requirements and Performance for Trailer Coaching Stock
GM/RT2042	Braking System Requirements and Performance for Traction Units
GM/RT2043	Braking System and Performance for Freight Trains
GM/RT2045	Braking Principles for Rail Vehicles
GM/RT2046	Braking System Requirements and Performance for Trains which Operate above 125mph
GM/RT2161	Requirements for Driving Cabs of Railway Vehicles
GM/RT2400	Design of On-Track Machines

The Catalogue of Railway Group Standards and the Railway Group Standards CD-ROM give the current issue number and status of documents published by Railway Safety.