

Ref	NR/GN/SIG/50018
Issue	I
Date	February 2003

Methodology for the determination of interaction with neighbouring Railways (formerly RT/E/C/50018)

This temporary front sheet facilitates change to the new Network Rail Standards referencing nomenclature.

The Ref above will be formally allocated to this standard when it is next changed in the meantime the contents, date and issue number of this Network Rail Standard are UNCHANGED and with immediate effect it should be referred to as “(new ref) formerly (old ref)”.

This document is the property of Network Rail. It shall not be reproduced in whole or part nor disclosed to a third party without the written permission of the Standard Owner.

© Copyright 2004 Network Rail

Uncontrolled copy once printed from its electronic source.

Published & Issued by: Network Rail; 40 Melton Street, London NW1 2EE



Railtrack Company Code of Practice

METHODOLOGY FOR THE DETERMINATION OF INTERACTION WITH NEIGHBOURING RAILWAYS

This document is the property of Railtrack PLC, part of the Network Rail group of companies.

It shall not be reproduced in whole or in part, nor disclosed to a third party, without the written permission of the Standard Owner.

© Copyright 2003 Railtrack PLC, part of the Network Rail group of companies.

ENDORSEMENT & AUTHORISATION

Endorsed by:



A Simmons, Professional Head of Signal Engineering

Accepted for issue by:



P McAleer, Acting Head of Business Standards

Authorised by:



A McNaughton, Chief Engineer

ISSUE RECORD

ISSUE	DATE	COMMENTS
I	February 2003	New Code of Practice

IMPLEMENTATION

The provisions of this code of practice may be used from the date of issue.

DISCLAIMER

Railtrack PLC, part of the Network Rail group of companies, has used its best endeavours to ensure that the content, layout and text of this document are accurate, complete and suitable for its stated purpose. It makes no warranties, express or implied, that compliance with the contents of this document shall be sufficient to ensure safe systems of work or operation. Railtrack PLC, part of the Network Rail group of companies, will not be liable to pay compensation in respect of the content or subsequent use of this document for any purpose other than its stated purpose or for any purpose other than that for which it was prepared except where it can be shown to have acted in bad faith or there has been wilful default.

SUPPLY

Copies of documents are available electronically, within Railtrack's organisation. Hard copies of this document will be available to Railtrack staff on request to the Document Controller and to other organisations from Technical Indexes Ltd (01344 404409).

Published & Issued by **Railtrack PLC (part of the Network Rail group of companies)**
Railtrack House
Euston Square
LONDON
NW1 2EE

Contents

1. OBJECTIVES	4
1.1 PURPOSE	4
1.2 SCOPE	4
2. SOURCE DOCUMENTS	5
2.1 GROUP AND LINE STANDARDS	5
2.2 PREVIOUS SAFETY CASE DOCUMENTATION	5
2.3 OTHER STANDARDS	6
2.4 OTHER DOCUMENTATION	6
3. INFRASTRUCTURE ASSUMPTIONS	6
4. METHODOLOGY	7
4.1 IDENTIFY NEIGHBOURING SYSTEMS	7
4.2 DETAILS REQUIRED	8
4.3 CHARACTERISATION	8
4.4 DETERMINE THE COUPLING FACTORS	9
4.4.1 Calculations	9
4.4.2 Practical Tests	10
4.5 DEMONSTRATION OF COMPLIANCE	10
4.6 SUBMISSION	11
APPENDIX A: MODELLING	12
A1 TYPES OF INTERFACES	12
A2 EQUIVALENT CIRCUIT FOR GENERAL INTERFACE	12
A3 SHARED ELECTRICAL INTERFACE	22
A4 WORKED EXAMPLE	22
APPENDIX B: ASSUMPTIONS	24
APPENDIX C: SOURCES OF TECHNICAL WORK	25

I. OBJECTIVES

I.1 Purpose

The purpose of this code of practice is to provide a methodology to demonstrate compatibility of traction and rolling stock operating on Railtrack electrified lines with the infrastructure of neighbouring railways & vice versa. This document is based on several submissions to railways the neighbour Railtrack lines and it should not be inferred that it has been approved by any particular neighbour neither does its use guarantee acceptance by any neighbour. The authority that constitutes the 'neighbouring' party should be consulted and approval to use the methodology presented here gained in principle.

I.2 Scope

This document is a generic EMC approach to be adopted for assessing compatibility between trains on Railtrack and systems on neighbouring railways' infrastructure.

Demonstration of compliance is achieved by the following process:

- Identify neighbouring systems.
- Determine system susceptibility.
- Establish coupling factors.
- Determine allowable levels on Railtrack.
- Assess permissible levels against train emissions.

These elements allow the wheel/rail interface currents to be defined on the Railtrack infrastructure. These can then be compared to the train emissions under defined operational conditions at the input terminals of the equipment on neighbouring infrastructure after taking into account the possible coupling factors between the adjacent railways. Thus the overall approach for demonstrating compatibility provided in the report is based on level alone.

The appendix to this standard which relates to modelling considers only conductive and inductive coupling. These coupling mechanisms are generally dominant, this should be confirmed for the system under study.

The interference level due to energy coupling to a neighbouring railway's equipment is assessed and compared against existing permissible levels. This assessment includes interference, which has the potential to affect track circuits and other equipment

installed on the neighbouring railway, generated by trains running on adjacent Railtrack lines, when operating normally and when they experience failures. The possibility of Radio Frequency interference shall also be considered, guidance being given in the ITU Directives, ref. [15].

2. SOURCE DOCUMENTS

2.1 Group and Line Standards

1. Electrified Lines Traction Bonding, GL/RT1254, Issue I, April 2000.
2. Railtrack Line Code of Practice - Design and Installation of Negative Bonding and Associated Equipment on D.C. Electrified Lines, RT/E/C/27022, Issue I, March 1998.
3. Railtrack Line Specification - Design of Earthing and Bonding Systems for 25 kV A.C. Electrified Lines, RT/E/S/21085, Issue I, October 1998.

2.2 Previous Safety Case documentation

4. 'Class 92 Locomotive - EMC Interface between Class 92 A.C. Routes and London Underground Ltd', AEAT Rail Ref. ESI9009, Issue 20, November 1999.
5. 'Class 92 Locomotive - EMC Interface between Class 92 A.C. Routes and Docklands Light Railway', AEAT Rail Ref. ESI9025, Issue 20, November 1999.
6. 'Class 92 Locomotive EMC Safety Assessment, Fleet Operation on the 25KV AC Railway between Crewe and WEFOC, Vol.4 - LUL Boundaries', AEAT Rail Ref. DR0483, Issue A0, June 1999.
7. 'LUL Interfaces report for Class 375 "Electrostar" Operating on Connex South Eastern Routes', AEAT Rail Ref. LD00421-I, Issue 1a, February 2000.
8. 'Electric Traction Interference: London Underground and Docklands Light Railway, Juniper Project', Alstom Ref. 10109.4112/Rp17, Issue 4, October 1998.
9. 'Class 357 EMU Compatibility with LUL Infrastructure', Adtranz Ref. 3EER300000-5305, Revision _C 2000-05-03, February 2001.

10. "Class 92 Fleet Operation on the 25 kV AC Railway between Crewe and Doncaster – Reed FDM", AEA Technology Rail ref. I20-dr0458, version b0, dated November 1999.

2.3 Other Standards

11. prEN 50238 'Railway Applications: Compatibility between Rolling Stock and Train Detection Systems' Final draft 1998.
12. BS: EN 50121 'Railway Applications: Electromagnetic Compatibility', 2000.

2.4 Other Documentation

13. Engineering Safety Management, Yellow Book 3, Issue 3, Railtrack PLC 2000
14. S. Ramo, Whinnery J.R., Duzer T.V., Fields and Waves in Communication Electronics, 3rd ed., John Wiley & Sons, Inc., USA, 1994.
15. Directives concerning the protection of telecommunication lines against harmful effects from electric power and electrified railway lines, Vol.II - Calculating induced voltages and currents in practical cases, ITU-T, 1999.
16. Erling D Sunde, "Earth Conduction Effects in Transmission Systems", Bell Telephone Laboratories, 1968.
17. Kraus J.D., "Electromagnetics", McGraw - Hill, Fourth edition, 1996.
18. Tagg G.F, "Earth Resistances", George Newnes Limited, London, 1964.
19. J.C.Brown, J. Allan, B.Mellitt, 'Calculations and Measurements of Rail Impedances Applicable to Remote Short Circuit Fault Currents', IEE Proceedings, July 1992.

3. INFRASTRUCTURE ASSUMPTIONS

The infrastructure assumed during the analysis is as described below, further assumptions are listed in Appendix B:

- The equipment is operating within limits specified by the manufacturer, the design authority or by the infrastructure controller.

- The equipment is correctly installed in accordance with applicable handbook of the time and mandatory subsequent amendments.
- The equipment is correctly maintained in accordance with the relevant standards and procedures.
- The exposure distance between the two railways is equal to the maximum length of the third party's track circuit considered. This assumption is only used for the 'general interface' case.
- The traction bonding arrangements on the RT lines are compliant with [1], [2] and [3].
- The running rails are assumed to be type BSI 13A, normal grade. Check rails are excluded. The sleepers are conventional concrete or wooden type. The track is assumed to be of standard gauge.
- Coupling factors for steady state, transient and fault levels are assumed to be identical.

4. Methodology

4.1 Identify neighbouring systems

When considering the permissible emission levels for trains on Railtrack infrastructure neighbouring railway systems need to be considered taking into account Railtrack's electrification boundaries, principally these systems are underground, light rail and metro railways. These systems whilst not owned by Railtrack must be assessed and the owners of the system satisfied that their integrity is maintained. The Railtrack approvals process requires that sufficient evidence shall be provided to the owners of the neighbouring systems to enable them to do this and to ultimately confirm their acceptance to the proposed change on Railtrack's lines.

The boundary to be considered for interference in a route safety case is defined by line of route and off route boundaries. All neighbouring railways and associated equipment within this boundary form the scope of the assessment. Neighbouring railways can either be:

- Physically connected;
- Running in parallel;
- Crossing on or over lines within 1 mile distance.

Details shall be obtained of the systems installed on the neighbouring infrastructure and written confirmation obtained from the operators to verify the installation details of all relevant interfaces between the two rail infrastructures. Information on any available interference specifications and assumed interference allowances should be sought.

Clearance for running shall be granted by the neighbouring railway party based on a summary document of the background to the project, emission levels (summary of the EMI footprint of the trains) etc. Based on this information the neighbouring administration may need to do their own assessment of acceptability to operate new systems on Railtrack lines. In this case, they usually carry out monitoring of their own circuits during initial operations, to further satisfy themselves that there are no problems relating to operation of the new equipment.

4.2 Details required

The EMC assessments can only be conducted if manufacturers' equipment is assumed to have the characteristics declared and published by them and to have been correctly installed and maintained in accordance with existing standards and procedures. In majority of cases compliance with the requirements laid down in [11] and [12] is sufficient. It must also be assumed that the signalling equipment is operating within its required specification and operating limits.

If additional proof is required by the authorities of adjacent railways then the exact nature of the installation and interfaces shall be studied and assessed correspondingly.

The assessments shall consider the effect on the neighbouring railways' systems of EMI resulting from the operation of the new train. The interference mechanisms considered will be conductive and inductive coupling, this includes induced voltages and Radio Frequency Interference (RFI).

In those cases when the neighbouring authority conducts its own assessment a report shall be produced giving the background to the system. Also a summary of the EMI footprint based on testing and comment on the effect of credible failures on the footprint, with specific reference to frequencies of interest for the third party railway shall be prepared and submitted.

4.3 Characterisation

Once the neighbouring railways' systems have been identified the equipment that may be susceptible to interference will need to be identified [8].