

Written Notice

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UNDERGROUND

1.	Written Notice Completed By	
	Responsible Manager:	J Bradshaw
	Directorate:	ED
	Date issued:	25/09/06
2.	Details of Standard Requiring Clarification	
	Title:	Electromagnetic Compatibility
	Reference No.:	1-222 (formerly 2-01018-001)
	Version.:	A1
	Clause/Paragraph No.:	3.1.3
3.	Details of Definitive LU Interpretation of Requirements	
	Title:	Secondary Effects
	<p>Typically, taking the effects given in the requirement, the secondary effects would include shock, vibration and the number of compressions that could age an emc gasket, which in turn may adversely affect radiated emissions. Humidity may cause corrosion of earthing bonds & vibration may loosen connector screening clamps. A badly designed door may not close properly after a certain number of openings, which again could affect radiated emissions and immunity performance.</p> <p>The designer needs to take these issues into account by the proper selection of materials and components and include any periodic mitigations in maintenance schedules.</p> <p>Para 3.1.3 also states (at the end of the Para). "Permanent effects compromising EMC shall be addressed by appropriate maintenance operations"</p>	
4.	LU Competent Authority Sign off	
	John Downes	

Standard



Category: Cat 1
Number: 1-222
Issue no: A1
Issue date: October 2007

London Underground

Electromagnetic Compatibility

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A Standard is defined as:

A mandatory document which sets out minimum requirements expressed as outputs; or a mandatory document which defines an interaction or commonality which meets a defined LU requirement.

Authorised by: _____	Date: _____
Approved by: _____	Date: _____
Standard owner: _____	Date: _____

1 Purpose

- 1.1** The purpose of this Standard is to describe the basic framework to ensure that the Electromagnetic Compatibility (EMC) aspects of equipment for installation within London Underground Limited (LU) are adequately addressed in Company specifications and procurement processes. Such arrangements are necessary to comply with internal approval and legal requirements in that respect. Further technical details are covered in the various references cited, especially document G-222.
- 1.2** The business objective of this standard is to ensure that LU meets the requirements of the European Union (EU) Directive on EMC, the corresponding United Kingdom (UK) Regulations and applicable railway standards.

2 Scope

- 2.1** This standard applies to electrical equipment and affects LU in the following ways:
- a)** New equipment purchased
 - b)** Equipment manufactured in-house
 - c)** Maintenance of equipment.
- Safety implications are discussed in clause 3.6.
- 2.2** This standard replaces 2-01018-001 A2. The Standard has been re formatted and re-numbered. There were no technical changes.

3 Requirements

3.1 General

- 3.1.1** The following instructions will ensure that LU remains in compliance with the Directive and has a process to address systems EMC. This process includes the requirements for and implementation of an EMC Control Plan. A set of railway standards (references, BS EN 50121) has also been published to apply specifically to the major categories of railway assets.

<p>Note: Additional EMC requirements are also contained within other LU CAT 1 standards. (e.g. The E7000 series for signalling assets. These are currently being amalgamated into the Signalling and Signalling Control – Concept and requirements standard, number 1-082, during the LU phase 3 standard reviews.)</p>
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- 3.1.2** It should be noted that the basic requirement to harmonise the electromagnetic environment also applies to in-house developed equipments and appropriate considerations must therefore be applied in their design.
- 3.1.3** EMC assessments shall also generally include consideration of secondary effects arising from manufacturing tolerances, equipment ageing, shock and vibration, temperature, humidity and similar environmental factors. Permanent effects compromising EMC shall be addressed by appropriate maintenance operations.
- 3.1.4** Specifications prepared from this engineering standard shall clearly define the methods by which the requirements of the standard are to be verified, taking account of any measurable criteria and tests described herein.



3.2 New equipment and systems

Most equipment supplied is required to be CE marked for the environment in which it is to be used, confirming that all relevant directives have been met. Documentary evidence shall be provided in all cases, whether or not any product is CE marked, to confirm that each equipment is suitable for use in its particular environment. Where equipment falls within the scope of BS EN 50121, the relevant part of that standard shall be applied. Further guidance on these issues is covered in document G-222.

3.3 Maintenance

3.3.1 General

An assessment shall be made as to whether the electromagnetic characteristics of an equipment are likely to be affected by maintenance operations. If this is the case, e.g. if like-for-like replacement is not possible, the modified equipment or system shall be treated as for new equipment and systems. The Maintenance Manager will carry out such assessments or refer them to other appropriately qualified personnel.

3.3.2 Like-for-like replacement

A formal EMC assessment is required in accordance with 3.3.1 unless the electrical properties of the replacement are identical with those of the substituted item.

3.3.3 Components

The Directive is not applicable to components in isolation but will generally apply to equipments into which particular components are incorporated.

3.4 Modifications

Project Managers and Project Engineers shall ensure that the electromagnetic characteristics of equipment and systems are assessed within the project. If any modification might affect these characteristics, a formal EMC assessment shall be required.

3.5 Advice

The Engineer's Directorate (ED) is responsible for advice on specific issues.

3.6 LU specific needs

Some specific LU needs are not covered in detail in BS EN 50121. Project Managers and Project Engineers or their nominated representative(s) shall therefore ensure that these aspects, listed below, are addressed within a project:

3.6.1 Signalling compatibility

The maximum levels of interference allowed in LU signalling systems are as stated in SCS-ST0062 (to be updated as 1-193). These requirements must be met, for both normal operational and credible fault conditions, to ensure that the integrity of the signalling system is not compromised.

Note: The updated version of SCS-ST0062 is currently under review, via the LU Proposal for Standard Change (PSC) process, for Infracore agreement.

3.6.2 Psophometric noise

The basic principles are covered in BS EN 50121-3-1, BSI GEL 210 and International Telecommunications Union (ITU) Directives "Protection of telecommunications lines against harmful effects from electrical power and electrified railway lines" – Vol. VI Danger and Disturbance, which stipulates a maximum psophometric interference level of 1 mV. Further details are presented in document G-222.

Note: No formal standard(s) from the above 1996 BSI GEL 210 committee activity reference have yet been published. When published, these will be compared with the above BS EN 50121-3-1 & ITU requirements and any appropriate amendments will be made, for agreement, via the LU PSC process.

3.6.3 DC and low frequency magnetic fields

Such requirements, principally in the context of rolling stock, are to minimise risk to passengers with cardiac pacemakers and to ensure that magnetic media are not corrupted. For train saloons the maximum dc level is 1 mT up to 600 mm from the floor and 0.5 mT elsewhere. The maximum 50 Hz level is 0.1 mT rms throughout the saloon.

3.6.4 Operation of radio

The emission levels specified for the train in BS EN 50121 do not account for the operation of station and train radio and therefore require adjustment in accordance with the properties and characteristics of such equipment. The wide scale and increasing usage of mobile telephones by public and staff represents an additional issue to be addressed in the context of certain installations. The Chief Engineer (Communications) is responsible for the management of licensed frequencies used within LU.

3.6.5 Touch voltage

The basic requirements are derived from the ITU Directives "Protection of telecommunications lines against harmful effects from electrical power and electrified railway lines" – Vol. VI Danger and Disturbance, except that the limit for normal operation is 25V, not 60V, rms. The non-continuous limit is 430V rms. Further details are presented in document G-222.

3.6.6 Electrostatic discharge

Equipments shall be capable of withstanding such effects in accordance with BS EN 61000-4-2 requirements (6 kV contact, 8 kV air discharge).



3.6.7 **Guidance for EMC specifications**

This is covered in document G-222 and typically requires the Technical Construction File (TCF) route to compliance, unless a suitable alternative is proposed and accepted.

Note: that compliance with the standards of other infrastructure operators, especially Network Rail (NR), may also be required, according to asset type and location. Additional information on these issues is also included in G-222.

3.7 **Evidence of compliance**

Compliance with the requirements of this standard shall be demonstrated to LU by each party contracted to LU. Additionally LU may audit compliance as part of its surveillance regime.

4 **Responsibilities**

ED Surveillance Engineer shall be responsible for ensuring that a co-ordinated programme of audit and inspection is implemented to assure that compliance with this and other related standard is ensured.

Maintenance Managers shall be responsible for ensuring that equipment is maintained to the requirements of the Directive.

Procurement Managers shall be responsible for ensuring that equipment purchased meets the requirements of the Directive and is marked accordingly.

Project Engineers shall be responsible for ensuring that the equipments and systems comprising project deliverables, whether newly commissioned or modified, meet the Directive requirements and are marked accordingly.

Project Managers shall have responsibility for ensuring that the total system delivered or modified by a project complies with the requirements of the Directive and is documented accordingly.

Suppliers shall, by enforcing appropriate requirements on manufacturers, designers and other parties in their supply chain, be responsible for achieving and demonstrating full compliance with the Directive, and marking equipment accordingly. To achieve this, suppliers will require either detailed local knowledge on EMC or assistance from suitably qualified consultants and contractors. The three main routes to compliance are:

- a) Meeting the requirements of appropriate standards cited in the Official Journal (OJ) of the EU (product specific where these exist, generic otherwise)
- b) Assessment of a Technical Construction File (TCF), describing relevant equipment design features, by a competent body
- c) Type examination for radio communication transmission apparatus (see note below)

Note:

1. This route is now no longer relevant, for almost all such apparatus, following the implementation of the Radio Equipment and Telecommunications Terminal Equipment (RTTE) Directive; 1999/5/EC, Statutory Instrument (SI) 2000 No 730, in 2000.



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| 2. Compliance with the RTTE Directive is achieved by certification to harmonised standards where these exist, otherwise assessment of a TCF or full quality assurance assessment by a Notified Body. |
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The LU Procurement agent shall be responsible for incorporating the requirements of this engineering standard in any contract to which it is relevant and shall stipulate that a programme of audits are implemented by the contractor which ensures that these requirements are complied with. This programme and its results shall be available for verification by the ED Surveillance Manager.

5 Supporting information

5.1 Background

The EU Directive on EMC (“the Directive”) is a new approach directive laying down basic requirements and relying on standards to define acceptable product characteristics. It was transposed into UK law by the Electromagnetic Compatibility Regulations 1992 and, following a transition period allowed by an amending directive, its provisions have applied fully since 1st January, 1996. This procedure aims to ensure that LU meets these legislative requirements. The provisions of this standard apply to LU procurement agents, suppliers contracted under any subsequent specifications and technical and maintenance staff within LU.

5.2 Safety considerations

Although the Directive is not explicitly safety related, its fundamental aim of promoting EMC in equipments and systems will have benefits in terms of both safety and reliability. In the LU context the principal concern is the avoidance of unsafe conditions from interference effects in signalling and other control equipment. Thus, EMC is an issue which is specifically addressed in internal approval processes, often for submissions to NR, Her Majesty’s Railway Inspectorate (HMRi) and similar bodies.

6 Informative References

6.1 References

References in the text are made to latest editions unless specific editions are cited. Where references are made to other corporate engineering documents which are not yet published, existing documents shall be followed until new documents have been authorised for use.

Note: References to particular EU Directives and Regulations, Acts of Parliament, Statutory Instruments or Common Law are made only if the subject demands them. Users of engineering standards are bound by all the relevant requirements of the law, regardless of whether or not there is any reference to them in the standards.

Statutory documents

Document no	Title
EMC Directive 89/336/EEC	Approximation of the Laws of the Member States Relating to Electromagnetic Compatibility, 3rd May 1989
EMC Directive 92/31/EEC	Amending Directive 89/336/EEC, 28th April 1992
SI 1992 No 2372	UK Electromagnetic Compatibility Regulations. Effective 28th Oct 1992
Directive 99/5/EC	Radio Equipment and Telecommunications Terminal Equipment
SI 2000 No 730	UK Radio Equipment and Telecommunications Terminal Equipment Regulations 2000. Effective 8th April 2000

British Standards

Document no	Title
BS EN 50121-1: 2000	Railway applications. Electromagnetic compatibility – General
BS EN 50121-2: 2000	Railway applications. Electromagnetic compatibility – Emission of the whole railway system to the outside world
BS EN 50121-3-1: 2000	Railway applications. Electromagnetic compatibility – Rolling stock. Train and complete vehicle
BS EN 50121-3-2: 2000	Railway applications. Electromagnetic compatibility – Rolling stock apparatus
BS EN 50121-4: 2000	Railway applications. Electromagnetic compatibility – Emission and immunity of the signalling and telecommunications apparatus
BS EN 50121-5: 2000	Railway applications. Electromagnetic compatibility – Emission and immunity of fixed power supply installations and apparatus
BSI GEL 210	Basic standard for calculation and measuring methods relating to the influence of electric power supply and traction systems on telecommunications systems.
BS EN 61000-4-2	Electromagnetic compatibility. Testing and measurement techniques. Electrostatic discharge immunity test. Basic EMC publication



LU company documents

Document no	Title
1-622	Glossary of terms and abbreviations
2-05107-702	Audit
1-193	Maximum allowable levels of electromagnetic interference in safety signalling equipment
G-222	Manual of EMC Best Practice

Other

Document no	Title
ITU Directive - Vol. VI Danger & Disturbance	Protection of telecommunications lines against harmful effects from electrical power and electrified railway lines
URN 99/639	Department of Trade and Industry (DTI) product standards - Guidance notes on the UK EMC Regulations – April 2000

6.2 Abbreviations

The following abbreviations are created:

- a) within London Underground's Glossary of Terms 1-622;
- b) from published sources that are clearly identified.

Abbreviation	Definition	Source
BS	British Standard	a
CE	Symbol denoting compliance with relevant EU Directives	a
ED	Engineering Directorate	a
DTI	Department of Trade and Industry	a
EMC	Electromagnetic Compatibility	a
EN	European Norm	a
EU	European Union	a
HMRI	Her Majesty's Railway Inspectorate	a
ITU	International Telecommunications Union	a
LU	London Underground	a
NR	Network Rail	a
OJ	Official Journal	a
PFI	Private Finance Initiative	a
PSC	Proposal for Standard Change	a
rms	root mean square	a
RTTE	Radio Telecommunications Terminal Equipment	a
TCF	Technical Construction File	a
UK	United Kingdom	a

6.3 Definitions

The following topic specific definitions are created:

- a) within the engineering function and are listed in 1-622;
- b) from published sources.

Term	Definition	Source
Apparatus	Electrical or electronic product with an intrinsic function, intended for implementation into a fixed installation, which can be placed on the market as a single unit	b - SI 1992 No 2372
Competent Body	Body appointed by an EU member government (i.e. the DTI in the UK) to issue technical reports and certificates of conformance with the basic conformity assessment requirements of the EMC Directive. (89/336/EEC, SI 1992 No 2372)	b - SI 1992 No 2372
Component	Any item which is used in the composition of an apparatus and which is not itself an apparatus with an intrinsic function intended for the final consumer	b - SI 1992 No 2372
Electromagnetic Compatibility	The ability of a device, unit of equipment or system to provide immunity and function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances into that environment	b - SI 1992 No 2372
Excluded Installation	Two or more combined items of apparatus or systems put together at a given place to fulfil a specific objective but not designed by the manufacturer or manufacturers for supply as a single functional unit; [An excluded installation is exempt from the requirements of the UK EMC Regulations but must still comply with the basic protection requirements of the EU Directive, Article 4]	b - SI 1992 No 2372
Installation	Two or more combined items of apparatus or systems put together at a given place to fulfil a specific objective	b - SI 1992 No 2372
Maintenance Manager	Nominated manager responsible for the maintenance of a specific system or equipment	a
Notified Body	Body appointed by an EU member government (i.e. the DTI in the UK) to issue technical reports and certificates of conformance with the basic conformity assessment requirements of the RTTE Directive. (99/5/EC, SI 2000 No 730)	b - SI 1992 No 2372
Notified Body	Body appointed by an EU member government (i.e. the DTI in the UK) to issue technical reports and certificates of conformance with the basic conformity assessment requirements of the RTTE Directive. (99/5/EC, SI 2000 No 730)	b - SI 1992 No 2372
Procurement Manager	Nominated manager with responsibility for acquisition of general and specific goods and services in accordance with defined commercial arrangements	a
Project Engineer	Nominated engineer with overall responsibility for delivering the engineering effort in a project	a



Term	Definition	Source
Project Manager	The person nominated for the activity or work to manage, co-ordinate, and bring it to a satisfactory completion.	a
System	A combination of engineering assets or services or both and end users placed together or arranged in a regular and connected whole.	b - SI 1992 No 2372
Technical Construction File	A file describing the apparatus, sets out the procedures used to ensure conformity of the apparatus with the protection requirements referred to in Article 4 & includes a technical report or certificate; one or other obtained from a competent body	b - 89/336/EEC

6.4 Requirement owner

Paragraph number	Owner
All	The LU EMC Engineer

6.5 Document history

Edition	Date	Changes
R12	August 2007	Standard 2-01018-001 re formatted and re-numbered to 1-222, no technical changes have been made to the content other than changing references to other Standards where their numbers have changed.
A1	October 2007	Authorised for use. Previous authorisation is valid