

Category 2 Standard

S2529

(Formerly E7500)

Signalling and signalling control systems safety critical processes



**Please read the Written Notices
attached to this standard**

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MAYOR OF LONDON

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1. Purpose

- 1.1 The purpose of this Standard is to bring together various key safety critical processes which shall be followed when work is undertaken which disturbs, or may disturb the physical construction or the adjustment to the working of signalling and control systems on the railway.
- 1.2 This standard defines processes directly impacting on the operation of signalling or control systems, which shall be applied in a consistent way in order to facilitate the management or monitoring of safety.

2. Scope

- 2.1 This standard applies to work which disturbs, or may disturb the physical construction or the adjustment to the working of signalling and control systems on the railway.
- 2.2 Attachment 1 records the status of various Departmental and Group Quality Notices (DQNs and GQNs) and their superseding standards or documents, where relevant.

3. Requirements

3.1 General

- 3.1.1 Work which directly impacts upon the signalling and control systems shall be properly controlled to ensure the operational safety and performance of the railway, and the personal safety of staff and customers.

3.2 Instructions

- 3.2.1 This standard defines, as a series of instructions in Attachments 2 to 11, the following key issues associated with work directly affecting signalling and control systems:-

- (i) Wire Counting;
- (ii) The control of access to Signalling Equipment Rooms, and trackside equipment cases;
- (iii) Adjustment of capacitor fed track circuits;
- (iv) Connection of monitoring equipment;
- (v) Product traceability of Signalling and Control System assets;
- (vi) Track circuit operation when running rails are rusty or contaminated;
- (vii) Proving of controlled wiring alterations;
- (viii) The termination and protection of wiring in safety signalling installations;
- (ix) Commissioning Quality Plans;
- (x) 'Authority to Work Certificates' for the control of signal engineering tasks.

3.3 Related Standards

- 3.3.1 Reference shall be made to other relevant Signalling and Control Systems standards, including S1201, Signalling and Signalling Control – Approvals, S1203, Competence of Personnel Working on Signal and Signal Control Systems and E7501, Alterations to the signalling system.
- 3.3.2 References in other standards or documents to the signalling DQNs or GQNs listed in Attachment 1 shall be taken as a reference to their new equivalent, where appropriate, as detailed in that attachment.



3.4 Environmental considerations

- 3.4.1 There are no special environmental considerations applying to the requirements defined in this document.

3.5 Supplier assurance

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

3.6 Safety considerations

- 3.6.1 The primary purpose of railway signalling and control systems is to ensure that train movements are protected from the dangers of collision with other trains or with fixed structures, and of derailment when passing over points.
- 3.6.2 The consequences of such hazards are obviously very severe, and signalling and control systems are therefore designed with numerous safeguards against them. However, any work, which disturbs the signalling arrangements - if not carried out to very strict rules - introduces the risk that the protective features of the design may be compromised.

4. Responsibilities

Managers of signal engineers and technicians in suppliers' organisations are responsible for ensuring that;

- a) this standard, or equivalent local work instructions derived from it, are readily available to all relevant staff;
- b) staff are trained and competent in its application;
- c) staff under their control comply with this standard.

The Professional Head of Signalling is responsible for fulfilling LU's responsibilities as defined in this standard.

Suppliers are responsible for ensuring that:

- a) compliance with the standard is clearly specified as a requirement for all work on the Signalling and Control Systems.
- b) appropriate arrangements to comply with this standard and to verify such compliance are adequately resourced.

5. Supporting information

This standard addresses critical areas where LU requires a consistent approach in detail on matters directly affecting safety. This applies, particularly where it:

- a) facilitates the monitoring or management of such activities across the network;
- or
- b) is essential that different suppliers who may interface or work together have a common approach to safety critical tasks.

6. References

6.1 Documentary 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.

6.1.1 Statutory documents

Ref No.	Title
SI 1988/1657	The Control of Substances Hazardous to Health Regulations 1988

Note: References to particular EC 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.

6.1.2 LU engineering standards

Ref No.	Title
S1622	Glossary of terms and abbreviations
S1201	Signalling and Signalling Control – Approvals
S1203	Competence of personnel working on signal and control systems
E7050	Incident management and provision of evidence for signalling and train control systems
E7501	Alterations to the signalling systems
E7502	Irregular adjustments to signalling systems
E7503	Management of signalling wiring and of degraded wire insulation
E7511	Testing of signalling installations

6.2 Abbreviations

6.2.1 The following abbreviations are used within this document:

Abbreviation	Definition
AWC	Authority to Work Certificate
CQP	Commissioning Quality Plan
DQN	Departmental Quality Notice
GQN	Group Quality Notice
LU	London Underground
SOM	Signal Operations Manager
TiC	Tester in Charge
TO	Technical Officer



6.2.2 Special abbreviations used generally within the engineering function are listed in S1622.

6.2.3 The abbreviations of terms which appear in only one of the attachments to this standard are given in that particular attachment.

6.3 Definitions

6.3.1 The following terms are used within this document:

Term	Definition
Safety critical	Descriptive of the condition of any part of a system or sub-system, which if deficient in design or operation or maintenance may directly lead to people, property or the service being placed at risk;
Supplier	Infracore or other organisation contracted to provide, improve or maintain signals and control systems;

6.3.2 Terms used generally within the engineering function are defined in S1622.

Note: The definitions of terms given in this document are specific to the subject of the section. S1622 may contain alternative wording for these definitions.

6.3.3 The definitions of terms which appear in only one of the attachments to this standard are given in that particular attachment.

6.4 Technical content manager

Paragraph number	Technical content manager
All	The Professional Head of Signalling

6.5 Document history

Issue no	Date	Changes
R1	September 1996	Draft for local review
R2	March 1997	Attachment 1 added
R3	November 1997	Attachments 8 and 10 added
R4	January 1998	Amended in-line with CEG review
R5	November 1998	Attachments added and amendments made. Submitted for CEG approval.
R6	November 1998	Minor amendments and re-submitted to CEG for approval
R7	July 1999	Deleted attachments Table of equivalence amended.
R8	April 2000	Attachments amended and old departmental references removed.



Issue no	Date	Changes
R9	May 2002	Inclusion, contents and presentation of attachments revised, together with text of main standard.
R10	July 2002	Table 2 revised to record new standards to supersede DQNs 0026 and 0033, and consequential amendments.
R11	March 2003	Revised following comments to SQE from Infracos
A1	May 2003	Authorised for use
R12	August 2003	5.2.1 to 5.2.12 reverted to Attachments (1 to 11)
R13	November 2003	Revised following comment to SQE from Infracos and typos corrected.
E7500 A2	December 2003	Authorised for use
S2529 A3	March 2012	As per DRACCT 00609, revised to conform to new format, and incorporate updates Roles, Responsibilities and documentary references. No technical changes.

7 Attachment s

7.1 Status of documents previously issued as GQNs and DQNs

Document No.	Title	Revision at date of issue of E7500	Status/ Replaced by E7500 attachment	Commentary
SCS-GQN-0001	Persons working or inspecting in commissioned signal or communications rooms	-	Withdrawn	
S&CSE-SQ-DQN-0005	Use of ties to secure wiring in signal equipment rooms	A3	DQN-0005 remains in force	Requirements are included in the Installation Handbook (SCS-ST0021 – section 13.3.3)
S&CSE-SQ-DQN-0007	Procedure for notifying railway inspectorate department of transport of major alterations and new works	-	Withdrawn	
S&CSE-SQ-DQN-0008	Dissemination of jointless track circuit data sheets	-	Withdrawn	
S&CSE-SQ-DQN-0009	The control of keys to secure rooms	A2	Attachment 3	
S&CSE-SQ-DQN-0010	The termination and protection of wiring in safety signalling installations	A3	Attachment 9	
S&CSE-SQ-DQN-0011	Preservation of evidence	-	Withdrawn	Covered by E7050 (Incident management and preservation of evidence for signalling and train control systems).
S&CSE-SQ-DQN-0012	Labelling cables	A2	DQN-0012 remains in force	Requirements are included in the Installation Handbook (SCS-ST0021 – section 9.1).
S&CSE-SQ-DQN-0013	Use of Nyloc nuts on jointless track circuits	A1	DQN-0013 remains in force	Requirements are also included in the JTC Handbook (SCS-ST0058).
S&CSE-SQ-DQN-0014	Authority to work certificates	A5	Attachment 11	
S&CSE-SQ-DQN-0015	Pre commissioning certificates	A3	Withdrawn	Covered in E7511



S&CSE-SQ-DQN-0016	Commissioning project quality plans	A5	Attachment 10	
S&CSE-SQ-DQN-0017	Wire Counting	A5	Attachment 2	
S&CSE-SQ-DQN-0022	Electricity at Work Regulations, 1989: Working with or near dangerous voltages	A5	Withdrawn	Reminds users of need to comply with the Electricity at Work Regulations.
S&CSE-SQ-DQN-0023	Log Books for signal and communications rooms	-	Withdrawn	
S&CSE-SQ-DQN-0024	Instruction for labelling equipment at headwalls	A2	Withdrawn	
S&CSE-SQ-DQN-0025	Adjustment of capacitor fed track circuits	A1	Attachment 4	
S&CSE-SQ-DQN-0026	Wiring in signalling equipment rooms	A2		Superseded by S2534 (E7503).
S&CSE-SQ-DQN-0030	Lead covered signalling cables on the Northern Line	A2	Withdrawn	Works notice on Northern Line, therefore appropriate as JNP local instruction
S&CSE-SQ-DQN-0031	Fault and incident management (Post devolution)	A1	Withdrawn	Superseded by E7050



Document No.	Title	Revision at date of issue of E7500	Status/ Replaced by E7500 attachment	Commentary
S&CSE-SQ-DQN-0032	Control of irregular adjustments to signalling systems in devolved Lines	A1/A2	Withdrawn	Superseded by E7502
S&CSE-SQ-DQN-0033	Control and monitoring of staff working hours on safety critical systems	A4	Withdrawn	
S&CSE-SQ-DQN-0034	Preparation of design requirement specifications		Withdrawn	
S&CSE-SQ-DQN-0035	Preparation of system specifications		Withdrawn	
S&CSE-SQ-DQN-0036	Preparation of Quality Assurance specifications		Withdrawn	
S&CSE-SQ-DQN-0037	Preparation of test specifications		Withdrawn	
S&CSE-SQ-DQN-0038	Preparation of technical and installation standards		Withdrawn	
S&CSE-SQ-DQN-0040	Preparation of maintenance specifications		Withdrawn	
S&CSE-SQ-DQN-0043	Pressure systems and transportable gas containers regulations 1989 safe operating limits (Regulation 7)	-	Withdrawn	The 1989 Regulations now replaced by the Pressure Systems Safety Regulations 2000
S&CSE-SQ-DQN-0044	Connection of monitoring equipment	A1	Attachment 5	
S&CSE-SQ-DQN-0045	CCTV Equipment calibration instructions	A1	Withdrawn	Not within the scope of E7500.
SCS-GQN-0046	Leaf fall supplementary signal control protection	A3	Withdrawn	Specific to Metropolitan line and appropriate as Infracore SSL local instruction.
S&CSE-SQ-DQN-0047	Product traceability	A1	Attachment 6	
S&CSE-SQ-DQN-0048	Signalling system operation when running rails are rusty	A2	Attachment 7	
S&CSE-SQ-DQN-0049	Structure gauges		Withdrawn	Superseded by E8013 (Clearance Requirements)
S&CSE-SQ-DQN-0050	JTC Failure reporting	A2	Withdrawn	
S&CSE-SQ-DQN-0051	Proving of controlled wiring alterations	A1	Attachment 8	
S&CSE-SQ-DQN-0056	Limited testing of signalling equipment		Withdrawn	Covered by approvals given under Attachment 101 [CQPs] (E7500) and E7511')
S&CSE-SQ-DQN-0058	Jubilee Line cable runs	-	Withdrawn	
SCS-GQN-0064	Input data to the S&CSE asset database	A2	Withdrawn	
SCS-GQN-0066	JTC Equipment - Precautions with receiver units	A1	Withdrawn	
SCS-GQN-0067	Engineering documentation change		Withdrawn	
SCS-GQN-0068	Fuse Replacement	A1	Withdrawn	

7.2 Wire Counting

1. Purpose and scope

- 1.1 Wire counting is a technique for increasing confidence in the correct connectivity of wiring.

Note: Wire counting alone cannot establish wiring correctness and it is used generally, usually in combination with other testing techniques. However, this instruction deals specifically with wire counting.

- 1.2 This instruction covers the authorising, carrying out, supervising and reviewing of wire counts, and also the actions to be taken if a wire count discrepancy is discovered in a signalling system.

- 1.3 This instruction principally addresses wire counting to schedules. Where it is not reasonably practicable to use schedules, equivalent techniques based on wiring diagrams shall be employed. Such techniques shall be compliant with E7511.

2. Instruction

2.1 Requirement for wire counts

- 2.1.1 Wire counting shall be carried out:

- a) in association with works, maintenance or critical incident testing, in accordance with the requirements of E7511,

and b) when the correctness of an 'as built' wiring drawing is being verified, as required by E7501.

Note: As a guide, this instruction would typically apply to wire counting vital wiring terminations, or non-vital wiring terminated on vital equipment. It may also be regarded as providing guidance on good practice in relation to other non-vital wiring, particularly where the wire type cannot be immediately and easily distinguished from that used for vital circuits.

- 2.1.2 New installations shall be fully wire counted in their final state before being brought into commission.

- 2.1.3 There shall be no interference with the equipment (including the use of temporary connections for pretesting) between the final wire count of a new installation and its entry into service. The final wire count shall be carried out as close to the commissioning as reasonably practicable, and appropriate security arrangements put in place.

Note: This does not preclude use of temporary connections during the change over testing, where removal of such connections will be certified on the AWC.

2.2 Carrying out wire counts

2.2.1 Authorisation

- 2.2.1.1 All wire counts carried out on commissioned signalling or control systems shall be authorised by the issue of an AWC in accordance with Attachment 11 of this standard.

Notes:

- a) The AWC shall normally be issued to the person in charge of the wire count, and may cover a number of separate wire count teams.
- b) Wire counts carried out as part of a wider piece of work, such as a commissioning or alteration, may be covered either by the AWC issued for the alteration itself, or separate AWCs may be issued for the wire counting by the Tester in Charge (TiC) or other holder of the overall AWC.

2.2.1.2 In the event that separate AWCs are issued for wire counting by a TiC (or other holder of an overall AWC for a wider piece of work) then that person shall ensure that all wire counting has been satisfactorily completed, and the associated AWCs signed off, before the overall AWC is signed off.

2.2.2 Staffing and independence

2.2.2.1 The wire count shall be carried out by one or more pairs of staff -a 'Counter' and a 'Marker' -meeting the competence requirements of S1203, and who are known by the person in charge to be familiar with the terminal layout and numbering for the particular equipment concerned. Official drawings of terminal layout and numbering shall be obtained in advance if there is any doubt on this point.

2.2.2.2 When wiring disconnections or alterations have been made, the person acting as 'Counter' shall not be the same person who actually carried out the physical wiring changes. This is to prevent a 'common mode' error of perception or understanding during the wiring work and the count.

2.2.3 Method

2.2.3.1 When wire counting against a schedule, the 'Counter' shall state the terminal concerned and the number of wires on it, e.g. "threes front, one wire - threes armature, two wires". All terminals shall be counted, including those with no wire attached.

2.2.3.2 The 'Marker' shall check the responses of the Counter against the wire count schedule:

- a) If the count agrees with the schedule, the Marker shall tick the relevant terminal on the schedule, all terminals being ticked individually, regardless of whether they are in use or not.
- b) If the count differs from the schedule, the Counter shall be asked to re-count the terminal. If there is still a discrepancy, then the wire count schedule shall be marked with actual number of wires counted, the sheet itself shall be prominently marked to indicate the existence of a discrepancy, and the matter drawn to the attention of the person in charge.

2.2.3.3 On no account shall the counter be told how many wires the marker expects on the terminal as this could compromise the integrity of the count.

2.2.3.4 Markers and Counters shall print their name, licence number and their identifying initials on the front sheet, and both shall initial and date each sheet as it is completed.

2.2.3.5 Care shall be taken that remarks written on the sheets are clear and unambiguous.

2.3 Action to be taken in the event of discrepancies

2.3.1 All discrepancies shall be drawn to the attention of the TiC, or other authorised person in charge, at the earliest practical opportunity, and be investigated with reference to the wiring diagrams.

2.3.2 If the reason for the discrepancy is clear, and the TiC (or other authorised person in charge) is satisfied that it does not represent a hazard, then the details shall be recorded

and forwarded to the Design Authority with the Wire Count Certificate (see section 2.4 below).

- 2.3.3 If there are fewer wires than expected on a terminal, and the reason cannot be resolved, then the TiC (or other authorised person in charge) shall consider whether there is a significant risk that the 'missing' wire is wrongly connected to a different terminal which has not been wire counted. If appropriate, the matter shall be escalated and the wire count extended, or other suitable safeguards agreed.
- 2.3.4 An unexplained discrepancy consisting of an extra wire (i.e. normally a 2nd or 3rd wire) on a working vital signalling terminal over and above the number of wires shown in the circuit drawings shall only be allowed to re-enter service or to continue in service if either monitoring or disconnection has taken place, as detailed below.
- 2.3.5 If the 'extra wire' discrepancy is found during Traffic Hours (or close to the start of Traffic Hours), and if it consists of an extra wire on a working vital signalling terminal over and above the number of wires shown in the circuit drawings, and if it cannot be accounted for and cannot be hand traced, then the situation shall be escalated within the maintenance organisation, and the wire count team's manager advised. The operation of the site shall be monitored until the close of traffic, when the discrepancy shall be investigated and arrangements shall be made for the following steps to be taken by 'competent persons' staff (following the issue of an AWC):
- a) the wire shall be disconnected, insulated, and secured, and both the wire and the terminal from which it has come shall be carefully and prominently labelled;
 - b) the circuits associated with the terminal from which the wire has been removed shall then be tested, together with as many other related circuits as time permits (i.e. circuits that might be expected to require the operation of the affected equipment). If they function correctly, then traffic shall be allowed to run with competent persons standing by to note and react to any failure that may subsequently occur.

A plan for further investigation shall then be established through the escalation arrangements.

- 2.3.6 It shall be noted that clause 2.3.4 and clause 2.3.5 shall only apply where the 'extra wire' is additional to those shown on the wiring diagram.
- 2.3.7 When all discrepancies have been highlighted, full details shall be given to the appropriate Design Authority. When the discrepancies have been resolved, the Design Authority shall revise the drawings and wire count schedules accordingly.

2.4 Completion and review of wire count records

- 2.4.1 Wire counts carried out following the connection, disconnection or disturbance of wiring in a commissioned signalling installation shall be completed, and all discrepancies resolved, before re-entry into service, except as defined under clause 2.3 above.
- 2.4.2 On completion of the wire count, except as provided for in clause 2.4.4, the person in charge shall complete and sign a wire count certificate:
- a) identifying the terminals that have been counted and found correct;
 - b) detailing all terminals that have been counted and found to have a discrepancy from the schedules or wiring diagrams, with full details;
 - c) certifying that all discrepancies have been investigated and confirming that they do not compromise the integrity of the signalling system, or detailing the actions taken to safeguard the system.



The certificate shall be returned to the Design Authority for review and action.

- 2.4.3 On receipt of the certificate, the Design Authority shall review the coverage and discrepancies, and arrange for errors in the drawings or schedules to be corrected. On completion, the Design Authority representative shall sign the certificate to record that drawings and schedules have been satisfactorily resolved.
- 2.4.4 For maintenance activities involving like-for-like disturbance only, details of wire counts carried out and discrepancies found may be recorded on the AWC, as an alternative to a separate wire count certificate. The intent of clause 2.4.3 shall be met by providing a copy of the completed AWC and supporting information to the Design Authority, if discrepancies are found.
- 2.4.5 Wire count certificates and other documentation shall be developed on the basis of the example on the following pages, and controlled under a suitable management system. Suitable arrangements shall be made by the Supplier for the retention of completed certificates.

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Attachment 2, Continued: wire count certificate

(Sample only)

Title: Signalling and Control Systems safety critical processes
Reference no.: E 7500 A2
Issue date: Decemr 2003

Attachment 2

Wire count certificate
Sample only

LONDON UNDERGROUND

Signal & Signalling Control Systems

WIRE COUNT CERTIFICATE

Infraco Asset Engineer's REPRESENTATIVE'S REFERENCE No:

SITE: ROAD/ROOM
LINE:

1. This Wire Count has been completed under AWCs Nos.

2. I certify that I have Wire Counted the terminals specified on the numbered sheets listed on the reverse of this form and found them to be correct.

3. I certify that I have Wire Counted the terminals listed below and found a discrepancy between the following book wiring/wire count sheets and the terminal wire count. I have investigated the discrepancy and ascertained there is no compromise to the Safety Signalling System and the discrepancy has been marked on the relevant circuit diagram attached.

SIGNED: DATE:

PRINT NAME:

I have reviewed the returned wire counts and confirm that the wire count is complete and satisfactory and that the Drawing Originals and schedules have been revised in accordance with the discrepancies identified.

SIGNED: DATE:
(DESIGN AUTHORITY)

PRINT NAME:

REVIEWED: DATE:
(INFRACO REPRESENTATIVE)

PRINT NAME: (PRINTED DOUBLE SIDED)

List the numbered sheets of Terminals Wire-Counted on the reverse of this Certificate