


**NOT PROTECTIVELY MARKED**

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<b>Safety principles for train servicing work in conductor rail premises</b>			
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<b>Summary</b>	This guidance outlines safety principles for train servicing work in conductor rail premises. It focuses on preventing fall and electric shock risk, to which train servicing staff are likely to be exposed. The guidance does not attempt to deal with all risks that might be present in train servicing premises.		
<b>Original consultation</b>	RSD: John Gardner, Quentin Cole, Chris Collett, Mark Gough & Simon Barber RPP: Mark Proctor & Giles Turner External duty holders: LUL, Network Rail, Southeastern, GTR, South West Trains & Merseyrail		
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# Safety principles for train servicing work in conductor rail premises

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## Introduction

1. An exposed ground-level, top-contact, live conductor rail system to provide electric traction power to trains is widespread in the Network Rail South East and Wessex Routes, on the North London line, the Northern City line, Merseyrail and the Glasgow Underground . (The Docklands Light Railway has a shrouded, bottom-contact, conductor rail system which is inherently safer than the traditional top contact system.) London Underground Ltd also uses a top-contact system, incorporating a fourth, return conductor, rail. Across all railways that use this system, nominal conductor rail voltages are mainly in the range of 630 – 750 volts DC (direct current), though peak voltages may approach 1000 volts. Because of its generally accessible position on the ground, conductor rail poses a continuing electrical safety risk, both on the main line and in depots, yards and sidings.
2. DC depots, yards and sidings, unlike the running line in general, are fixed places of work seeing daily, often intensive, activity involving many people. It is appropriate in such locations to take additional steps to reduce risks arising from, among other things, slips, trips and falls, and contact with live uninsulated conductors. Standards of safety in depots, yards and sidings vary according to, among other things, the age of the facility, the space available, levels of investment and the determination of those in charge to make improvements. Given current working arrangements at a number of locations, continuing harm is entirely foreseeable.
3. Data from 2011/12 to 2015/16, from both London Underground and the mainline railway, reveal a number of electric shock incidents caused by direct contact with the conductor rail, one of which was fatal. There was a larger number of slip, trip or fall incidents, the possible consequences of which, in the vicinity of live conductors, can be very serious. That more harm has not occurred is probably largely due to the great care taken by staff when working in difficult conditions. Nevertheless, very clear hazards can remain, creating a continuing level of foreseeable risk to the workforce. It is this risk which dutyholders must seek to minimise.

## Purpose

4. This guidance aims to identify the main features and practices that lead to risk from contact with live rail or train parts in conductor rail premises, and to suggest ways in which this risk can be reduced. Attention is given to the avoidance of slip, trip or fall events, which are a foreseeable precursor to electrical harm. The guidance focusses on generally quick turn-around train servicing work such as interior and exterior cleaning, sanding and tanking that, unlike engineering maintenance, is often performed above or near a live conductor rail. The guidance also covers safe access to trains and certain areas of rolling stock design, which have the potential to reduce electrical risk. It is also of relevance to shunters and points operators, who need a safe working environment amongst the conductor rail infrastructure. The guidance does not cover other important safety considerations, such as the avoidance of persons being struck by trains.
5. It is hoped that the principles set out, agreed in consultation with affected parties, will be helpful to duty holders, such as infrastructure owners and train operating companies, in drawing up their own risk assessments and improvement plans in compliance with the law. It is recognised that certain improvements will run into the medium term or beyond, and it is important to make firm commitments to ensure that progress is maintained.

### **Opportunities to bring about change**

6. In some cases, simple physical measures and changes in working practices can provide short-term and cost effective improvements in safety. Other measures, for instance the provision of isolation equipment, the repositioning of conductor rail and the construction or modification of access platforms, will inevitably take longer. Nevertheless, duty holders are required to assess risks and make definite plans, in consultation with others, for safety improvements, even if these run into the medium-term or beyond. Simply to go on tolerating inadequate conditions is not an option.
7. In addition to incremental improvements, opportunities to make step-changes should not be missed. Such opportunities might include:
  - In the CDM design stage for new premises, ensuring that proper account is made for the day to day safe working needs of depot, siding and yard staff
  - In submitting proposals for periodic funding exercises, making a strong case for much needed premises improvements in line with this guidance
  - Specifying helpful design features for new rolling stock (or when undertaking modifications to existing stock)
  - In franchise exercises, bidding fully to reflect investment needed truly to meet legal compliance. This will require objective asset information being available, as well as a clear message about safety performance expectations, to all bidders.

### **Legal framework**

8. There are clear legal duties on all parties involved, directly or otherwise, in train servicing work. Duty holders include infrastructure owners and maintainers, lessors of premises, train

operators and contractors. The following is a list of some of the most relevant safety legislation placing duties on those involved in train servicing work:

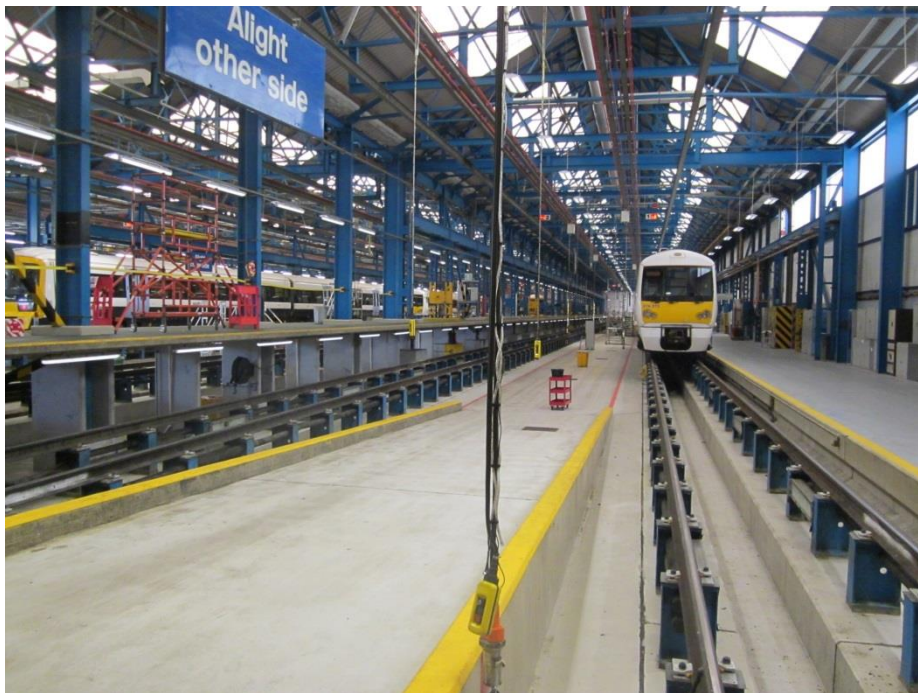
9. The Health & Safety at Work etc. Act 1974 (HSWA)
  - Sections 2(1) & 3(1): duties of employers to ensure, so far as reasonably practicable, the safety of employees and others
  - Section 4: duties of persons having, to any extent, control of work premises to take reasonably practicable measures to ensure the safety of persons, who are not their employees, using the premises or plant. This means that premises leased to operators must be suitable for the purpose.
  - Section 7: duties of employees to take reasonable care for themselves and others and to cooperate for the purpose of securing health and safety
10. The Management of Health & Safety at Work Regulations 1999 (MHSWR)
  - Regulation 3(1): duty of employers to make a suitable and sufficient risk assessment of the safety risks to employees and others whilst they are at work
  - Regulation 4: principles of prevention to be applied, whereby avoidance of risk is the first aim, with instructions to employees seen as the weakest option to be relied upon
  - Regulation 11(1): co-operation and co-ordination between employers sharing a workplace
11. The Electricity at Work Regulations 1989 (EAWR)
  - Regulation 4(3) & (4): work on or near an electrical system shall not, so far as reasonably practicable, give rise to danger, and any protective equipment provided shall be suitable for the task, adequately maintained and properly used
  - Regulation 7: dangerous conductors to be suitably covered, protected or placed to prevent, so far as reasonably practicable, danger
  - Regulation 12(1): where necessary to prevent danger, suitable means shall be available for cutting off power supply to, and isolating, electrical equipment
  - Regulation 14: no persons to work so near a live conductor that danger may arise unless:
    - It is unreasonable for it to be dead
    - It is reasonable for the work to proceed
    - Suitable precautions are taken to prevent injury
12. The Work at Height Regulations 2005 (WAHR)
  - Regulation 6(3): duty of employers to take suitable and sufficient measures to prevent, so far as reasonably practicable, persons falling a distance liable to cause personal injury
13. The Construction (Design and Management) Regulations 2015 (CDMR)
  - Regulation 11(3): so far as reasonably practicable, designers shall identify and eliminate or control foreseeable safety risks to persons using the 'structure' (which includes a railway line or siding) as a workplace.

### **Selection of risk control methods**

14. Risk control measures should be selected on the basis of a sound risk assessment and with regard to the principles of prevention set out in the Management of Health and Safety at

Work Regulations 1999. Tasks should only be undertaken by suitably trained, competent and supervised staff.

15. The most effective way of dealing with electrical risk is to remove or place out of reach all exposed live conductors. For electric trains this means an overhead power supply. Within sheds, a plug-in external 'shore' supply may be provided to supply auxiliary and traction power. This latter approach is commonly adopted for vehicle engineering maintenance activities, particularly when access beneath the sole bar is required. This arrangement permits the complete removal of the conductor rail from the working environment. An overhead shore supply system should include:
- A shrouded conductor beam with moveable trolleys mounted at high level
  - Pendant drop down connections with clear visual indication of status
  - Interlocking to ensure that connections cannot be removed under load
  - Vehicle power collection design that ensures shoe gear is not energised when connected to a shore supply, other than under controlled arrangements on departure when traction supply is being drawn.



Conductor rail removed and power provided by overhead 'shore supply' system

16. The opportunity to eliminate risk locally through, where practicable, the cutting back of conductor rail from buffer stops, crossing points and staffed servicing locations, such as sanding and tanking points, should not be overlooked. Note that the local absence of conductor rail generally does not mean that shoe gear is de-energised.



Conductor rail substantially cut back in vicinity of sanding and tanking point

17. Train servicing activity generally involves fairly short-duration, quick throughput working, for reasons of 'reasonable practicability' commonly undertaken without an isolation of the conductor rail. (Access to a train from a well-designed raised platform, for the purpose of interior cleaning, should pose no electrical risk to staff.) Where contact with live conductors is effectively prevented, and where there is no chance of indirect contact through wet



Full-length platform edge railing system with lightweight removable sections

working, etc., this approach is acceptable, in that danger is prevented. Where this approach is used, all reasonable opportunities must be taken to provide safe access routes, platforms, fixed fencing and barriers to prevent persons coming into close contact with live conductors.

### **Means of isolation**

18. Wherever reasonably practicable, in accordance with the risk control hierarchy, activities likely to bring persons within close proximity of what would be live conductors should be undertaken with the power supply isolated and secured in line with the requirements of the Electricity at Work Regulation 1989.
19. Isolation arrangements must be robust. To encourage routine use, and to enable rapid emergency isolations, these arrangements, in depots, should ideally be under the local control of the premises operator. (For any activities carried out in network sidings, suitable isolation arrangements should be agreed with the infrastructure manager.)
20. When designing a new installation the following should be considered:
  - Appropriate sectioning of the electrical supply in the depot to enable convenient and workable isolations.
  - Depot supply should be independent of main line supply to increase the availability of local isolations (and minimise the impact on depot operations during work on the main line).
  - Isolation equipment must meet the requirements of the EAWR, be suitable for the application and be accessed and operated in a safe manner.
  - Isolation should take account of possible sources of supply from rolling stock, e.g. static converters.
  - Isolation arrangements should be interlocked with depot protection systems and other facilities such as water supply and access to inspection pits or ladders.
  - Local isolation and work procedures should be designed to maximise the availability, security and convenience of isolations within the depot.
21. When existing installations are altered, or working practices are changed, the principles of safety by design should be applied and specific consideration should be given to:
  - Reviewing the adequacy of sectioning requirements
  - The continuing adequacy of equipment
  - The continuing adequacy of isolation and work procedures and any opportunities for strengthening them



Modern isolation equipment (This system also locks off water supply when conductor rails are energised.)

### Electrically live components

22. When considering the electrical hazard, it is important to consider all live uninsulated conductors, including:

- Equipment that forms part of the fixed infrastructure
  - Conductor rails and supports
  - Cable lugs
  - Isolation devices, e.g. hook switches/section switches
- Equipment on vehicles
  - Shoe gear
  - Shoe fuses

23. In the design stages for depots servicing dual voltage rolling stock, consideration must be given to installing overhead, as opposed to conductor rail, electrification. Where conductor rail is the source of traction power, design should include measures to reduce risks to the workforce in accordance with MHSWR and EAWR.

24. The conductor rail and any associated live parts should:

- To the greatest extent practicable, be removed, cut back or gapped in and around areas where persons are routinely required to pass or work. This might mean removal of live rail from sheds in favour of an overhead shore-supply system or the substantial cutting



back of the rail, away from buffer stops, crossing points and places of regular work activity, e.g. the filling of sand hoppers.

- As far as possible, be positioned on the side of the running rails distant from access routes and areas where routine work is carried out. Where conductor rail is present on multiple lines, where practicable it should be paired in alternate six foots, leaving every other six foot free of conductor rail.
  - Only be positioned on the side of the running rails distant from the edge of any raised platform.
  - In areas where persons might foreseeably be at work or need to pass, be fitted with guard boards, which are in good condition and prevent side contact with the live rail. Note, however, that current industry standard guard boarding provides only minimal protection, and effectively none for top-contact events.
  - Be capable of being de-energised and isolated through safe, secure, convenient and well-understood means.
25. Live equipment on vehicles should, as far as reasonably practicable, be insulated or guarded to prevent danger. Examples of what can be done include:
- Access to trains from raised platforms, thereby avoiding the need to use cab steps, which are commonly in close proximity to live shoe gear
  - Fuses are protected with a simple cover.



Simple cover fitted over shoe fuse

- For ballast-level train servicing activities, such as tanking and sanding, effective shielding of live shoe gear can be provided by fixed raised boarding installed alongside the known stopping positions of train shoe gear. Such boarding might be in the region of 500mm high, though optimum dimensions and the extent of fitment will vary according to rolling stock characteristics and train servicing requirements. The boarding should be made of a

sturdy non-conductive material, and should never be used as a step. This measure is useful in that it remains in place and does not rely on individuals' following procedures. (Currently, some locations use this measure, though to be effective the boarding must be sufficiently high and extensive to match all likely rolling stock configurations.)

- Portable shrouding equipment can be used effectively, but is a last choice in that it relies on individuals following procedures and provides only short-term, local protection. Portable shrouding can be an appropriate tool at transient worksites where other means of protection are impracticable, but for sites where predictable, high-frequency and repetitive train servicing work is carried out, reliance on this method is not an acceptable long-term solution.



Raised guard-boards prevent contact with shoe-gear. A gate prevents access on the conductor rail side

### Access routes

26. Spacing between adjacent lines in depots and sidings should be sufficient to allow safe access and places of work.
27. Whether pedestrian or vehicular, access routes should be adequately wide, clear, well-surfaced, illuminated and protected, or at a safe distance, from running rails. Where practicable, access routes should not run directly adjacent to conductor rails, even if the rails are boarded on both sides to the current industry standard, unless they are protected by a fixed fence or barrier or are at a safe distance.
28. Where access routes cross lines, conductor rails should be cut back to a safe distance from the crossing surface.
29. Access to unsafe areas, such as a six foot containing one or more minimally protected conductor rails, should be prevented, where reasonably practicable, by means of a physical barrier.

30. Where routes to hand points give rise to risk, consideration should be given to installing motorised points, or mechanical linkage to enable operation from a safe place.
31. Steps should always be provided with hand rails.
32. The use of existing access routes should be monitored and reviewed with users, for the purpose of identifying any concerns and opportunities for providing safer access.

#### **Access to and egress from trains - platforms**

33. At fixed servicing locations, access to trains should be from well-designed raised platforms, whether short, continuous or of the individual 'hop-up' type. Sturdy mobile steps may offer another acceptable short-term option. Routine use of cab steps, a well-known cause of accidents, is not an acceptable long-term working arrangement for train servicing staff.
34. Platforms should be adequately wide to accommodate safely any persons working on or passing along them. Activities undertaken from such platforms should be carefully risk assessed, taking account of falls, passing trains and the proximity of live conductors, and, where necessary, additional risk control measures, such as edge protection barriers or railings, should be provided.



Access platform, 2.4m wide, with railed steps and conductor rails on distant side

35. In the short-term, given the realities of the inherited infrastructure, risk from using narrow platforms can be reduced by:
  - Installing fall-prevention railings
  - Using other locations, such as stations, with better access for train cleaning work.
  - Carefully planned berthing of trains, to minimise the need for staff, including drivers and train cleaners, to walk along unprotected narrow platforms.
  - Where applicable, moving the conductor rail from the near to the distant side of adjacent lines.

- Cutting back the conductor rail from buffer stop train boarding/alighting points.
- Routinely walking within the train, rather than on a narrow platform adjacent to it.
- Leaving bagged rubbish on board for later safe disposal at a station
- Using a safe walking route, say to distant buffer stops in sidings, that does not involve lengthy walks along unprotected narrow platforms.



Fixed 'hop-up' platform enables safe access to cab and prevents contact with shoe-gear

### **Other actions to reduce risk**

36. Removal of bagged waste from trains should be carefully planned to minimise the risk of persons collecting it coming into contact with live electrical conductors, or other risks. Sometimes it might be best to keep bagged rubbish on the train until it can be disposed of more safely at another location. Situations to avoid include:

- piles of waste ejected from a train forming a heap close to conductor rail or shoe gear
- staff having to retrieve ejected sacks of waste from a 'tight' six foot, in the vicinity of conductor rail or shoe gear
- piling or carrying bulky rubbish sacks along narrow, unprotected, raised platforms

37. Consumables, such as sand and de-icer, may need to be filled from both sides of the train, requiring access below the sole beam. Arrangements vary from site to site, some filling only under isolation/shore supply conditions and others filling over live conductor rail, sometimes from a 'tight' six foot with additional adjacent live shoe gear risk. Whilst in the second scenario portable shrouding is used, this is a last choice risk control method which should not be relied upon into the medium or longer term. Measures to reduce sand filling risk should be taken, including:
- Filling only in the absence of live conductor rail or shoe gear or under isolation
  - Filling at designated facilities with conductor rail cut back and/or with effective fixed guarding in place.
  - Monitoring sand usage so that the frequency of filling can be safely minimised
38. The design of train wash plant should be improved to remove the need for manual external cleaning.

### **Rolling stock design features**

39. When specifying, designing or modifying vehicles or equipment, consideration must be given to reducing electrical and other risk to all affected groups, including train servicing personnel. Features to be considered include:
- Large capacity sand hoppers which can be filled from either side (or internally)
  - Sanding, effluent and tanking ports are remote from shoe gear/live parts
  - The proximity, or shielding, of live electrical equipment in relation to cab access steps
  - All shoe gear is automatically isolated when shore supply is connected
  - Retractable shoe gear
  - Shoe gear on the portion of train not in contact with the conductor rail is not energised (as achieved on LUL 'S' stock)
  - Shore supply connections cannot be withdrawn live
  - Vehicle battery life is sufficient to provide adequate lighting for, say, internal train cleaning activities
  - Fuses are effectively guarded to prevent accidental contact by railway staff or others
  - Safe and easy to use cab steps and grab rails

### **Consultation, monitoring and learning from others**

40. Whilst the above guidance has focussed on infrastructure and equipment issues, good relationships and positive attitudes at work are, of course, just as important for a safe and efficient workplace. Active engagement with staff can, and does, assist greatly with identifying problems and finding solutions, both in the short and longer-term.
41. Effective monitoring of activities is essential, particularly when reliance is placed on individuals following procedures, keeping to walking routes and using portable safety equipment. Assumptions about train servicing work, much of which occurs at night, should be put to the test.
42. Train servicing sites vary in their modernity, and facilities and practices range from the good to the not so good. Duty holders should liaise and share information about best practice across the main line and non-main line sectors.

## **Acknowledgements**

43. Thanks are due to London Underground Limited, Southeastern and GTR Southern for providing helpful comments during the writing of this guidance, and for agreeing to the use of the photographs.

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