

**Detailed Requirements Document (DRD)
Rail Engineering Advanced Technician Level 4
Overhead Line Equipment (OLE) Knowledge & Skills Content**

Purpose

The purpose of this Detailed Requirements Document (DRD) is to provide employers, colleges and training providers and those developing qualifications with an additional level of detail behind the Standard. The DRD should be used to support the delivery of the Railway Engineering Advanced Technician Apprenticeship

This document sets out the Knowledge and Skills required for anyone following the **Overhead Line Equipment (OLE)** pathway. These requirements are in addition to the Rail Engineering Advanced Technician core knowledge and skills.

Once complete this document this document will form part of the Employer Occupational Brief (EOB).

Development process and sources

The detail within this document has been developed from Rail Engineering Technician DRDS which in turn was developed from existing National Occupational Standards (NOS) to which additional requirements were added or items that were deemed no longer necessary (very few) were removed.

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The Standard: OLE Stock Specialism

Core Knowledge. Within a Railway context all Rail Engineering Advanced Technicians need an in-depth knowledge and understanding of:

1. Safe and Professional working practices including legislation, regulation, industry procedures, safety requirements, risk management and environmental impact together with an understanding of human factors and techniques to address these.

2. The scientific, technical, engineering, mathematical and design principles (some of them complex) that are required in undertaking and directing maintenance, renewal and construction of and across The Railway.

3. How to work effectively to design and develop engineering solutions and innovation including understanding of failure modes and their causes; advanced problem solving, diagnostic systems and development of preventative maintenance; asset management and whole life asset costs.

4. How to deliver engineering solutions effectively including project management principles and systems to manage, time, resource, asset and quality management and assurance systems; business improvement and innovation systems, processes and techniques.

5. How the Railway works as a system and their role within it. The critical interfaces across the Railway system and how those interfaces are managed.

6. The importance of 3rd party and internal business requirements and operational interfaces. The need for and understanding of client confidentiality and compliance with corporate policies including ethics, equality and diversity and sustainability.

7. How the Railway works commercially including contractual principles and financial systems, forecasts and budgets, and performance implications and performance management techniques.

8. How the Railway is evolving. Awareness and understanding of new technological developments across the Railway and how these will impact the future operation of The Railway.

The above include the OLE specific Knowledge requirements of the Standard:

OLE Advanced Technicians will have the following specific knowledge regarding different techniques and methods used to construct, install, maintain and renew The Railway and to avoid Railway asset, equipment, process and systems failures:

In depth knowledge and experience of excavation, ground works, different piling methods and foundations.

Understand construction design and bonding layouts, electrical clearance, insulation installation wiring and risks around radial load and correct methodology.

Understand the physical and systems interfaces between Overhead Line assets and systems and other aspects of The Railway and the operating requirements, implications and constraints of these.

Core Skills. Within a Railway context all Rail Engineering Advanced Technicians need to be able to:

9. Keep themselves and others safe by leading and demonstrating safe working practices. Understand, reinforce and comply with statutory regulations and organisational safety requirements, including competence and safe access to work locations.

10. Produce a work plan based on safe systems of work that is informed by technical drawings, schematics and programmes of work needed for the development of rail engineering activity. Prepare contingency arrangements to manage change and risk as appropriate.

11. Undertake and direct a high standard of technical work. Take responsibility for the efficient and effective delivery of technical work activities and projects. Undertake and supervise the operation of equipment & systems. Complete integrity & compliance checks on own work and that of others and ensure appropriate testing is undertaken. Transfer responsibility of assets once work has been completed. Be responsible and accountable for their own work and that of others.

12. Solve problems: Design and develop a structured and/or innovative approach to problem solving and diagnosis. Apply appropriate methods and business improvement techniques. Predict and prevent failures through the analysis of data and the ability to provide feedback on these.

13. Make informed and considered decisions and complex critical judgements as appropriate.

14. Supervise and manage resources including the efficient utilisation of individuals, teams, tools, materials and equipment. Monitor and manage individual and team performance and development.

15. Work collaboratively maintaining effective relationships with colleagues, clients, suppliers and the public. Support the development of others through coaching and mentoring.

16. Communicate effectively across all management levels. Use oral, written, electronic and IT based methods and systems for the accurate communication, technical reporting & recording of information and management reporting.

The above to include the OLE specific Skills requirements of the Standard:

OLE Advanced Technicians will have the following specific skills regarding different techniques and methods used to construct, install, maintain and renew The Railway and to avoid Railway asset, equipment, process and systems failures

Ability to erect and direct the erection of different types of overhead line structure, pre fabrication and installation of main structure and small part steelwork, running wiring systems including sectioning, insulation, registration and in-span components and the installation, enhancement and renewal of earthing and bonding.

Able to use and direct the use of lifting and access equipment while working at heights.

Knowledge

1. Safe and Professional working practices

1. Safe and Professional working practices including legislation, regulation, industry procedures, safety requirements, risk management and environmental impact together with an understanding of human factors and techniques to address these.

The general electrical hazards associated with working on and around overhead line equipment

2. The scientific, technical, engineering, mathematical and design principles

The scientific, technical, engineering, mathematical and design principles (some of them complex) that are required in undertaking and directing maintenance, renewal and construction of and across The Railway.

Rail Overhead Line Technologies (Construction)

Understand basic surveying techniques

- Identify linear surveying terminology and equipment
- Identify levelling surveying terminology and equipment
- Carry out linear surveys using appropriate equipment to produce drawings
- Carry out levelling surveys using appropriate equipment to produce drawing
- Identify angular terminology and equipment

Understand materials in the rail environment

- Describe mechanical, physical, thermal, electrical and magnetic properties of materials used in rail engineering
- Describe the effects of processing on the properties and behaviour of materials used in rail engineering
- Describe the principles of the modes of failure

Understand electrical systems in the rail environment

- Describe the types and function of capacitors
- Explain the relationship between the voltage and current for a charging and discharging capacitor
- Describe the characteristics of a magnetic field
- Describe the principles and applications of electromagnetic induction
- Determine the characteristics of a sinusoidal AC waveform using single phase AC circuit theory
- Use test equipment to test AC circuits
- Compare the results of adding and subtracting two sinusoidal AC waveforms graphically and by phasor diagram

Overhead line Technologies (Maintenance)

Understand basic surveying techniques

- Identify levelling surveying terminology and equipment
- Carry out linear surveys using appropriate equipment to produce drawings
- Carry out levelling surveys using appropriate equipment to produce drawings

<ul style="list-style-type: none"> • Identify angular terminology and equipment
<p>Understand materials in the rail environment</p> <ul style="list-style-type: none"> • Describe mechanical, physical, thermal, electrical and magnetic properties of materials used in rail engineering • Describe the effects of processing on the properties and behaviour of materials used in rail engineering • Describe the principles of the modes of failure
<p>Understand electrical systems in the rail environment</p> <ul style="list-style-type: none"> • Calculate the magnitude, direction and position of the line of action of the resultant and equilibrant of a non-concurrent coplanar force system containing an minimum of four forces acting in different directions • Calculate the support reactions of a simply supported beam carrying at least two concentrated loads and a uniformly distributed load • Calculate the induced direct stress, strain and dimensional change in a component subjected to a direct uniaxial loading and the shear stress and strain in a component subjected to shear loading <p>Solve problems that require the application of kinetic and dynamic principles to determine unknown system parameters</p>
<p>Electrical Technologies</p>
<p>Understanding of the physical system interfaces of overhead line systems and the wider rail network e.g.</p> <ul style="list-style-type: none"> • Overhead line • Electricity supplier DNO, electricity supplier • SCADA • T&RS • Signalling • Telecoms • Control and communications <p>Describe the impacts, implications and constraints of these</p>

In depth knowledge and experience of excavation, ground works, different 'piling' methods and foundations.

NOTE: Network Rail standard NR/L2/CTM/018 foundations has been excluded, a conscious decision made by the OLEC steering group that foundations were a civils issue and did not fall under overhead line, however awareness of foundations required by overhead line personnel

Survey and Setting Out

In depth understanding of the following processes and requirements for inspection.

- Manufacture of components e.g. assembly off-site
- Manufacture e.g. cutting and fastening
- Removal and recovery
- Groundworks – preparation works
- Faults
- Construction of piling and foundations e.g. correct depth, type and set in the right position

Inspection and Testing Plans (ITP)
Understand, identify and ensure tests have been carried out and logged. <ul style="list-style-type: none"> • Depth of foundation • Rebar – re-enforcement of plinth • Concrete density results
Understanding of design processes and ability to interpret drawings for OLE foundations

Understand construction design and bonding layouts, electrical clearance, insulation installation wiring and risks around radial load and correct methodology.
Understanding of the following principles
What equipment operating and care and control procedures are applicable to OLE equipment
Understand how the OLE is designed to function under normal operating conditions including risks related to radial loads
How to follow all relevant drawings and specifications for the installation being carried out
The terminology and methods used to identify OLE and describe operational status of the components and equipment
What each of the OLE component parts contribute to the overall operation of the system
Understand construction methodologies for the installation of: <ul style="list-style-type: none"> • Main steelwork • Small part steelwork • Wiring installation • Earthing and bonding
Principles of electrical sectioning
What each of the component parts contribute to the overall operation of the system
The principles of how communication-electronic or associated systems function and interact e.g. SCADA
The principles of the electrical checks to be carried out on the earthing and bonding cables

3. How to work effectively to design and develop engineering solutions and innovation

How to work effectively to design and develop engineering solutions and innovation including understanding of failure modes and their causes; advanced problem solving' diagnostic systems and development of preventative maintenance; asset management and whole life asset

<p>Know the preparatory activities required for the construction of overhead line infrastructure</p> <ul style="list-style-type: none"> • Describe the legal and financial framework applicable to a project for a new section of railway infrastructure • Describe the development process required for a new build or renewal within a railway environment
<p>Know the scope of earthwork activities that may be undertaken in association with overhead line infrastructure</p> <ul style="list-style-type: none"> • Describe the methodology used for an overhead line earthworks project, including the plant and equipment required • Describe the importance of foundations for the construction of overhead line structures
<p>Understand the forms of construction and material specifications used in overhead line infrastructure</p> <ul style="list-style-type: none"> • Explain the essential design principles for overhead line geometry • Describe the construction methods for initial placement and subsequent maintenance activities to ensure overhead line position and geometry • Describe the materials and quality control processes required to ensure the provision of suitable and sustainable overhead line construction material and waste material disposal
<p>Understand overhead line maintenance processes used to identify and correct defects</p> <ul style="list-style-type: none"> • Describe the maintenance issues that need to be considered to determine rail infrastructure integrity Explain how rail infrastructure defects are identified and the prescribed remedial action for each
<p>Understand construction design and bonding layouts, electrical clearance, insulation installation wiring and risks around radial load and correct methodology.</p>
<p>Design – Planning of construction and work packages</p>
<p>Understanding of methodology to be able to produce basic drawings and interpret complex drawings with regard to construction, renewal, enhancement and modification of OLE in line with Design Drawings and Specifications including:</p> <ul style="list-style-type: none"> • Documentation, Design Drawings and Reporting • Installation Methods and Techniques • Materials, Components and Assemblies • Electrical Safety on OLE systems
<p>Understanding of the purpose for the different types of design drawings used in OLE wire installation (such as layouts and cross section diagrams and OLE system design range (such as OLEMI))</p>
<p>Interpret the component requirements from the following design drawings and specifications (main and small part steelwork):</p> <ul style="list-style-type: none"> • Layouts • Cross sections • OLE system design range (such as OLEMI) (as appropriate)
<p>How to identify the range of cables used in wiring installation and what determines their suitability</p>

4. How to deliver engineering solutions effectively

How to deliver engineering solutions effectively including project management principles and systems to manage, time, resource, asset and quality management and assurance systems; business improvement and innovation systems, processes and techniques.

See Trailblazer document – no OLE specific content

5. How the Railway works as a system and their role within it

How the Railway works as a system and their role within it. The critical interfaces across the Railway system and how those interfaces are managed.

See Trailblazer document – no OLE specific content

6. The importance of 3rd party and internal business requirements and operational interfaces

The importance of 3rd party and internal business requirements and operational interfaces. The need for and understanding of client confidentiality and compliance with corporate policies including ethics, equality and diversity and sustainability.

See Trailblazer document – no OLE specific content

7. How the Railway works commercially

How the Railway works commercially including contractual principles and financial systems, forecasts and budgets, and performance implications and performance management techniques.

See Trailblazer document – no OLE specific content

8. How the Railway is evolving

How the Railway is evolving. Awareness and understanding of new technological developments across the Railway and how these will impact the future operation of The Railway.

See Trailblazer document – no OLE specific content

Skills

9. Keep themselves and others safe by adhering to safe working practices

Keep themselves and others safe by leading and demonstrating safe working practices. Understand, reinforce and comply with statutory regulations and organisational safety requirements, including competence and safe access to work locations.

The hazards associated with OLE activities:

- Structural steel components
- Small part steelwork
- Wiring systems
- Sectioning, insulation, registration and in-span components
- Earthing and bonding

Such as:

- Lifting and handling long and heavy components
- Working at height
- Wire drums
- Tension wires
- Drilling holes
- Cutting and terminating cables
- Radial loads and how the risks can be minimised

The correct methods of moving, lifting, handling and supporting:

- Heavy structural steel sections
- Straightening, supporting steel assemblies
- Small part components
- Wires and associated components
- Cables and associated components
- Produce safety critical documents for the use of lifting and access equipment

Ensuring the following activities during the installation:

- Adherence to safety briefing instructions, risk assessments, COSHH, safe system of work and other relevant safety standards
- Checks to ensure currency of installation documentation (such as drawings, layouts, instructions, manufacturers' data, settings and other documentation)
- Obtain authority before carrying out the installation activities
- Dispose of waste items in accordance with the project plan
- Leave the work area in a safe condition

10. Produce a work plan based on safe systems of work

Produce a work plan based on safe systems of work that is informed by technical drawings, schematics and programmes of work needed for the development of rail engineering activity. Prepare contingency arrangements to manage change and risk as appropriate.

The purpose of engineering specifications associated with OLE equipment (such as overhead line specifications, work/task instructions, inspection/test plan, height/stagger sheet, dropper schedules)

11. Undertake and direct a high standard of technical work.

<p>Undertake and direct a high standard of technical work. Take responsibility or the efficient and effective delivery of technical work activities and projects. Undertake and supervise the operation of equipment & systems. Complete integrity & compliance checks on own work and that of others and ensure appropriate testing is undertaken. Transfer responsibility of assets once work has been completed. Be responsible and accountable for their own work and that of others.</p>
<p>Ability to erect and direct the erection of different types of overhead line structures; pre fabrication, installation of main structure, small part steelwork, running of wiring systems including sectioning, insulation, registration and in-span components and the installation, enhancement and renewal of earthing and bonding.</p>
<p>Installation of Overhead Line Equipment – main steel work, small part steelwork, wiring systems, sectioning, insulation, registration and in-span components and Earthing and bonding</p>
<p>Ensure the following is installed and positioned in accordance with correct procedures, drawings and specifications:</p> <ul style="list-style-type: none"> • Main steelwork and components • Small part steelwork • Wiring systems • Sectioning, insulation, registration and in-span components • Earthing and bonding <p>Including checking:</p> <ul style="list-style-type: none"> • All necessary connections, fittings and components are secure and complete • Installation is complete and that all components are free from damage • The completed installation conforms to the drawings and specification
<p>The understanding of and the ability to use correctly the types of tools and instruments used to position, secure and align:</p> <ul style="list-style-type: none"> • The steelwork (such as podgers, spanners, wrenches, sockets, torque wrenches, levels, alignment and laser devices) • Tension the wiring (such as torque wrenches, winches, tensioners, tension gauges/meters clamps/wedges, and jumpers for earth continuity) • Installed components (such as drills, presses, pullers, torque wrenches) <p>The torque loading requirements of the fasteners and what to do if these loadings are exceeded or not achieved</p>
<p>Install, position, secure and record the position the overhead line equipment and components in accordance with the drawings and specification</p>
<p>How to conduct any necessary checks to ensure the integrity, functionality, accuracy, and quality of the installation</p>
<p>De-commissioning and removal</p>
<p>The procedure for the safe disposal of waste materials and redundant structures</p>
<p>Who is responsible for taking equipment out of operational service and handing the equipment back to operational service</p>
<p>Ensure the installation activity reporting documentation is completed including</p> <ul style="list-style-type: none"> • Installation record • Handover document • Other specific recording documentation

Completed and ensure records are retained and preserved
Understand reporting lines and escalation procedures
Ensure the following installation activities have been completed correctly: <ul style="list-style-type: none"> • Use of lifting equipment • Positioning and fastening of steelwork • Adjustments to level, rake and alignment
Main Steelwork
Ability to direct the installation, renewal and/or maintenance of the following types of main steelwork: <ul style="list-style-type: none"> • Cantilever masts • Two track cantilevers • Head-span masts • Portals • 'A' frames Applying installation methods and techniques, to include the following: <ul style="list-style-type: none"> • Hole and fixing preparation • Shimming and packing (as applicable) • Positioning equipment • Securing using mechanical fixings • Levelling and aligning equipment • Torque loading • Applying locking devices (as applicable) Access OLE construction sites - OLEC1 Basic Introduction to OLE Construction Sites <ul style="list-style-type: none"> • Technical Terminology • Documentation and Reporting • General Safety
Carry out checks appropriate to the type of steelwork being installed, to include the following: <ul style="list-style-type: none"> • Checking that the installed steelwork complies with the installation specification • Checking level, rake and alignment • Making visual checks for completeness and freedom from damage
Small part steelwork
Ability to direct the installation, renewal and/or maintenance small part steelwork components on different types of structures including the following: <ul style="list-style-type: none"> • Two track cantilevers • Head-spans • Portals • Bridge/tunnel • Rigid contact systems • 'A' frames Apply installation methods and techniques, to include the following: <ul style="list-style-type: none"> • Mounting/locating area preparation • Shimming and packing (as applicable) • Positioning equipment • Securing using mechanical fixings • Position, levelling and aligning equipment

- Torque loading
- Applying locking devices

Carry out checks on the small part steelwork being installed ensuring compliance to standards and specifications, to the following:

- Checking that the installed small part steelwork complies with the installation specification
- Checking position, clearances, level and alignment
- Making visual checks for completeness and freedom from damage
- Checking locking devices

Wiring

Interpret-wire run requirements from the following design drawings and specifications:

- Layouts
- Cross sections
- OLE system design range (such as OLEMI) (as appropriate)
- Height/stagger sheet
- Dropper schedules

Ability to direct the following types of wiring activities:

- Recovery of wire
- Running out wire
- Splicing of conductors
- Wire termination
- Wire tensioning

Installation, renewal and maintenance on following types of wiring:

- Catenary wire
- Auxiliary wire (as appropriate)
- Contact wire
- Contenary wire
- Auto transformers feeder
- Return conductors
- Earth wire

Ensure the correct selection and use of specialist plant and equipment including the following:

- Drum carriers
- Winches
- Tensioners

Carry out checks on the wiring being installed, to include the following:

- Checking that the installed wiring complies with the installation specification
- Checking position and tension
- Making visual checks for completeness and freedom from damage
- Checking locking devices

Ability to direct and understand the techniques for:

- Run out, terminate and tension the wiring
- Running out the wire

Sectioning, insulation, registration and in-span components

Ability to direct and check the installation, renewal and maintenance of the following overhead line equipment components:

- Section insulators

<ul style="list-style-type: none"> • Neutral sections • Cross contact assemblies • Droppers and jumpers • Overlaps • Switches and isolators • Booster/auxiliary transformers • Cross track feeders
<p>Ability to direct the adjustment of the registration and installed components for the following:</p> <ul style="list-style-type: none"> • Stagger • Height • Tension (as appropriate)
<p>The methods of securing the installed components and connectors safely</p>
<p>The purpose of contact wire registration, neutral sections and section insulation of the contact wire</p>
<p>Analyse results sheets and make recommendations for corrected works</p>
<p>Carry out checks on the components being installed and adjusted, to include the following:</p> <ul style="list-style-type: none"> • Checking that the installed components comply with the installation specification • Checking final adjustments for position, clearances, level and alignment • Making visual checks for completeness and freedom from damage • Checking locking devices
<p>Earthing and Bonding</p>
<p>Interpret earthing and bonding requirements from the following design drawings and specifications:</p> <ul style="list-style-type: none"> • Layouts • Cross sections • Bonding layouts
<p>Ability to check and direct earthing and bonding activities including the following:</p> <ul style="list-style-type: none"> • Cutting required length of bond • Termination of bond connections • Installation of bonds in the correct sequence • Correct use of tools and equipment • Electrical continuity testing (as appropriate) • Removal of temporary bonding (as appropriate)
<p>Direct the installation, renewal and/or maintenance the following types of bonding systems:</p> <ul style="list-style-type: none"> • Miles Royston (Glenair) • Cembre • Other specific system type
<p>Carry out checks on the earthing and bonding being installed or renewed, to include the following:</p> <ul style="list-style-type: none"> • Checking that the bonds comply with the installation, enhancement or renewal specification • Checking location, form, termination • Making visual checks for completeness and freedom from damage

What terminology and methods are used to identify OLE earthing and bonding and to describe the operational status of the cables
What each of the earthing and bonding component parts contribute to the overall operation of the OLE and how it interfaces with the signalling system
The torque loading requirements of the components or connectors and what to do if these loadings are exceeded or not achieved
The function of the different types earthing and bonding cables used in OLE
How to identify the importance of the correct type and size of earthing and bonding cables required
Understand the methods of securing the installed earthing and bonding components and connections safely
Understand techniques for the use magnet strength and polarity testers
Testing & Gauging
The principles of electrical section proving
Understand and advise the following design drawings and specifications for the testing and gauging requirements: <ul style="list-style-type: none"> • Layouts • Bonding plans • Cross sections • Inspection/test plan • Electrical section diagrams
Testing and Gauging
Ability to direct and record the following testing/gauging activities for installation, renewal and maintenance: <ul style="list-style-type: none"> • Use of measurement and recording equipment to check profile/set up/clearance • Record readings on test plan • Use of test pantographs • Use of bond testers • Use of magnet strength and polarity (S and P) testers • Assist with electrical section proving Carry out and record checks on the OLE to include the following: <ul style="list-style-type: none"> • Checking that the installed components comply with the installation specification • Checking adjustments for position, clearances, level and alignment • Making visual checks for completeness and freedom from damage • Checking locking devices (as appropriate) Check testing and gauging is complete and that all equipment operates to specification
The methods of using test pantographs and run panning test before handing back
Ensure the completion of all relevant testing, gauging and acceptance documentation accurately and legibly
Understand the acceptance parameters for handback
Understand and ensure compliance with safe procedures for testing, gauging and acceptance checks

Overhead Line Electrification Maintenance

Maintenance team would inspect and then contract renewal work

Ability to direct the maintenance of the following types of main steelwork

Able to understand processes for receipt of installed renewed assets back into operational standard

12. Solve problems

Solve problems: Design and develop a structured and/or innovative approach to problem solving and diagnosis. Apply appropriate methods and business improvement techniques. Predict and prevent failures through the analysis of data and the ability to provide feedback on these.

13. Make informed and considered decisions and complex critical judgements

Make informed and considered decisions and complex critical judgements as appropriate

See Trailblazer document – no OLE specific content

14. Supervise and manage resources

Supervise and manage resources including the efficient utilisation of individuals, teams, tools, materials and equipment. Monitor and manage individual and team performance and development.

15. Work collaboratively maintaining effective relationships with colleagues, clients, suppliers and the public

Work collaboratively maintaining effective relationships with colleagues, clients, suppliers and the public. Support the development of others through coaching and mentoring.

See Trailblazer document – no OLE specific content

16. Communicate effectively

Communicate effectively across all management levels. Use oral, written, electronic and IT based methods and systems for the accurate communication, technical reporting & recording of information and management reporting.