- access and egress into and from the Unit;
- all normal, degraded and emergency modes of operation of the Unit; and
- User Population attire such as heavy coats and gloves, which results from the varying climatic conditions the User Population may be exposed to.

3.42.1.4 The human factors analysis shall incorporate the feedback from the use of mock-ups supplied in accordance with section 4.3 in order to finalise cab and saloon designs. TTS-1047

3.42.1.5 The Unit shall be designed and constructed in accordance with a Human Factors Integration Plan (HFIP). The HFIP shall be acceptable to the Purchaser. TTS-1048

TTS-1049

3.43 EMC and Compatibility with Railway Infrastructure Systems

3.43.1.1 The Unit shall be compliant with the Electromagnetic Compatibility Regulations 2006 which enact the EMC Directive 2004/108/EC. TTS-1050

3.43.1.2 The Unit shall not cause failure or undesirable modes of operation as a result of EMI, for both normal and reasonably foreseeable degraded modes, to Network Rail, LO Infrastructure, other third party neighbour Railway Infrastructure, including signalling and radio systems and rolling stock operating on these infrastructures, when the Unit itself is operating on the LO Infrastructure. Particular attention shall be given to any infrastructure where parallel running with LO Infrastructure occurs. TTS-1051

3.43.1.3 The Unit shall not suffer failure or undesirable modes of operation as a result of Electromagnetic Interference (EMI) caused by Network Rail, LO Infrastructure and third party neighbour Railway Infrastructure, when the Unit itself is operating on the LO Infrastructure. TTS-1052

3.43.1.4 The Unit shall not suffer failure or undesirable modes of operation as a result of Electromagnetic Interference (EMI) caused by other classes of rolling stock operating on Network Rail, LO Infrastructure or third party infrastructure when the Unit itself is operating on the LO Infrastructure. TTS-1053

3.43.1.5 The harmonic currents produced by the Unit shall not exceed the limits defined in NR/GN/ELP27233 for AC traction systems. TTS-1054

3.43.1.6 The Unit shall be compatible in all normal and reasonably foreseeable degraded modes of operation, with all train detection and signalling systems in use on the LO Infrastructure. Attention is drawn to the NR/SP/SIG/500XX series of standards but it should be noted that it is for the Manufacturer to determine whether these encompass all train detection systems in use on that infrastructure. TTS-1055

3.43.1.7 If EMC between the Unit and the train detection and signalling systems is achieved by the deployment of purpose built protection systems (such as interference current monitoring units (ICMU)), then the integrity of these protection systems shall be commensurate with the reliability and availability rate of the corresponding train detection and signalling system(s) they are protecting. TTS-1056

3.43.1.8 The Unit shall not cause failure or degradation of performance of any kind to hand held radio systems in use in the vicinity of the Unit. The Manufacturer shall note that these systems may be operating at frequencies of up to TTS-1057

5GHz and include, but may not be limited to:

- London Underground CONNECT;
- portable GSM-R;
- London Fire Brigade Channel 5;
- Airwave; and
- GSM-P.

3.43.1.9 The Unit shall not fail or suffer degradation to performance of any kind due to the operation of hand held radio systems in use in the vicinity of the Unit. The Manufacturer shall note that these systems may be operating at frequencies of up to 5GHz and include, but may not be limited to:

- London Underground CONNECT;
- portable GSM-R;
- London Fire Brigade Channel 5;
- Airwave; and
- GSM-P.

TTS-1058

3.44 Standards

TTS-1059

3.44.1.1 The Unit shall be compliant with the requirements of the CR-TSI's, Transversal TSI's and applicable NNTR's. TTS-1060

3.44.1.2 The Unit shall comply with all Applicable Laws and Standards.

Standards that are not automatically obligatory in consequence of the TSIs and applicable NNTRs, but are considered appropriate (in whole or in part) in defining the Purchaser's requirements, are stated in the relevant part of this specification. TTS-1061

Where no standard is obligatory or explicitly referenced in this specification Euro Norm standards shall be used to demonstrate compliance with the functional requirements.

3.45 Design Life

TTS-1062

3.45.1.1 The Unit shall have a design life of 35 years based on the service specifications outlined in the MSA and TSA. TTS-1063

3.45.1.2 The design of the Unit shall ensure that potential obsolescence of constituent components and systems throughout the design life can be managed to ensure reliability and availability requirements are maintained. TTS-1064

3.46 Other Systems

TTS-1065

3.46.1 Infrastructure Monitoring Equipment

TTS-1066

3.46.1.1 One AC Only Unit and one Dual Voltage Unit shall be fitted with unattended infrastructure monitoring equipment to monitor and record the following parameters:

- track geometry;
- overhead line force and geometry;
- acoustic wheel/rail performance; and
- signalling transponders and radio broadcast strengths.

TTS-1067

3.46.1.2	The Units fitted with infrastructure monitoring equipment shall be able to operate either in passenger service, or as Empty Coaching Stock, over all LO Infrastructure.	TTS-1068
3.46.1.3	The Unit infrastructure monitoring equipment shall require no operator intervention.	TTS-1069
3.46.1.4	The infrastructure monitoring equipment shall be capable of recording the parameters set out in Appendix C, to the prescribed accuracy and time intervals.	TTS-1070
3.46.1.5	The captured data shall be automatically downloaded to the Wayside in a format acceptable to the Purchaser.	TTS-1071
3.46.1.6	The Unit infrastructure monitoring equipment shall be capable of simple replacement and maintenance attention during the normal planned rolling stock maintenance activities.	TTS-1072
3.46.1.7	Defects with or failures of the Unit infrastructure monitoring equipment shall not prevent the Unit entering service, or remaining in service in so far as is practical.	TTS-1073

3.47 Passenger Communication Facilities

TTS-816

3.47.1.1	The Unit shall include on-board equipment to provide a passenger communication network, permitting passengers to access the internet while using their own devices complying with the 802.11 U suite of IEEE standards. The Unit on-board system shall ensure passengers have access to the internet on all parts of the LO Infrastructure.	TTS-817
3.47.1.2	The on-board equipment required by 3.47.1.1 shall be capable of utilising a range of Unit to shore data transmission bearers including GSM-P, Wayside WiFi and Wayside WiMAX networks and shall be designed taking into account existing and planned developments in Unit to shore data transmission capabilities.	TTS-2610
3.47.1.3	The equipment required by 3.47.1.1 shall be designed to provide sufficient capacity to permit good performance taking into account the expected demand for internet access for passenger loadings up to Normal Payload.	TTS-2611
3.47.1.4	The Unit shall include on-board equipment which shall ensure that passengers' devices compatible with GSM-P will be able to send and receive data and calls on all parts of the LO Infrastructure. It is permissible to use the train to shore data transmission facilities defined in 3.47.1.2 to provide this functionality if appropriate.	TTS-2612
3.47.1.5	The on-board equipment required by 3.47.1.1 shall be configured with sufficient Access Points to support 80% of vehicle passenger capacity using WiFi services.	TTS-2643

4 Plans, Documentation and Soft Deliverables

TTS-1074

4.1 Simulator

TTS-1075

4.1.1 General

TTS-1076

4.1.1.1 The Simulator shall consist of a driving cab, one instructor console and a trainee viewing facility. The Simulator shall be designed in modular form such that it can be readily moved and redeployed:

- the Simulator shall be supplied in its own robust and secure container(s) or cabin(s) with suitable weatherproofing and environmental protection for mounting in an external location, along with suitable lighting, heating and air conditioning to maintain a comfortable training environment;
- the Simulator shall be robust and should the Simulator be moved and redeployed it shall be capable of being made weatherproof; TTS-1077
- it shall be possible to prepare the Simulator for loading onto a suitable road lorry for transport, unload after transport and re-commission within 3 working days;
- It shall be possible to use the driving cab Simulator for training without distraction from external sources, or from the instructor's position or the trainee viewing facility; and
- It shall be possible to use the instructor console without distraction from the trainee viewing facility.

4.1.1.2 The Simulator shall be capable of being used for:

- route knowledge training and basic driving competence;
- familiarisation with the cab layout and controls;
- familiarisation with key controls and isolations outside of the immediate cab environment;
- training in Unit fault recovery;
- training of operational and technical failure situations;
- Unit handling under differing railhead adhesion conditions;
- Unit handling under different emergency scenarios (trainborne and infrastructure); TTS-1078
- training in the use of the GSM-R radio;
- training in the use of the TMS;
- training in the Unit operation when completing Traction Power Supply Changeovers;
- training in the use of DOO CCTV and door controls;
- training in the use of the signalling interfaces;
- training in the use of Saloon CCTV and Event Triggers; and
- training in fault finding and maintenance.

4.1.1.3 The Simulator shall be capable of simulating: TTS-1079

- Normal Operation and degraded mode operation;
- bi-directional working;
- changes in environmental conditions such as heavy snow, rain and fog;
- emergency evacuation and detraining;
- rescue and push/pull out; and
- failure of conventional or tunnel signalling.

4.1.1.4 The Simulator shall be capable of being used for driver training and performance assessment. It shall be possible to provide printed records of a driver's assessment and electronic records shall be capable of being stored for recall and replay. TTS-1080

4.1.1.5 The Simulator shall be capable of using downloads from Unit event logs to recreate real life incidents in the simulated environment to aid driver assessment or accident investigations. TTS-1081

4.1.1.6 The Simulator shall operate from a standard UK 230Volts, 50Hz power supply. TTS-1082

4.1.1.7 All power supply and communications cables shall be neatly loomed and secured within the Simulator. All cables shall be routed and terminated to support the connections the Manufacturer shall make during commissioning to the local fixed installations. TTS-1083

4.1.1.8 The Simulator shall be easy to upgrade such that its configuration can keep aligned with that of any modifications made to the actual Units function or operation. TTS-2616

4.1.2 Simulator Development and Delivery TTS-1084

4.1.2.1 The Simulator shall be subject to a programme of design review, development and acceptance testing co-ordinated with the Unit design process. TTS-1085

4.1.2.2 The Simulator shall be made available initially, commissioned and ready for use at the Simulator Initial Location. TTS-1086

4.1.3 Driving Cab TTS-1087

4.1.3.1 The driving cab shall be full size replicas of the interior of the driver's cab including all panels, controls and ancillary equipment. Side cab access doors and their controls shall be represented but need not be functional. TTS-1088

4.1.3.2 Cab switches, indicators and controls shall be real and fully functional components; interior panels may be specifically manufactured but shall be representative of the real cab. TTS-1089

4.1.3.3 The driving cab shall be equipped with a panel to simulate the location and functionality of Unit controls and isolation devices outside of the immediate driving cab environment. TTS-1090

4.1.3.4 The driving cab shall be equipped with a signal post telephone outside of the immediate driving cab environment. TTS-1091

4.1.3.5 The Simulator shall be equipped with simulated GSM-R, TMS HMI and DOO CCTV camera images, all of which shall be capable of simulating realistic fault scenarios. TTS-1092

4.1.3.6 A synchronised progressive information monitor shall be provided to show details of the route ahead as viewed from the driver's seated position. TTS-1093

4.1.3.7 The viewing system shall present a viewing image consistent with the viewing angles from the seating position, including side windows. TTS-1094

TTS-1095

4.1.4 Instructor Console

4.1.4.1 The Simulator shall include an instructor's console for controlling the training simulations and monitoring the driver's actions together with data recording and printing facilities TTS-1096

4.1.4.2 The instructor console shall include monitors displaying:

- the driver's forward views;
- the track information monitors;
- cab camera views, providing continuous monitoring of the driver's actions throughout the training run; TTS-1097
- a view of the cab control systems;
- a view of all HMI screens (TMS, CCTV);
- a view of the status of the Unit systems; and
- instructor's control interfaces.

4.1.4.3 The instructor console shall include:

- a means of printing training reports;
- a Local Area Network (LAN) connection; TTS-1098
- a means of electronically storing reports and predetermined training scenarios; and
- seating and desk.

4.1.4.4 The Simulator shall be secure against unauthorised access to software and operating systems. TTS-1099

4.1.4.5 The Simulator design shall be as simple as practicable and shall only require the instructor to have a moderate level of computer literacy to operate it satisfactorily. TTS-1100

4.1.4.6 The console and the positioning of monitors, handsets controls and other similar equipment shall be ergonomically designed. All monitors, handsets, controls, and push buttons shall be identified with a label. Where appropriate the label shall correspond to that fitted in the cab. TTS-1101

4.1.4.7 The input of data, instructions, parameters and other information into the computer by the instructor should preferably be via a mouse, touch screen or other suitable method. The use of keyboard interfaces shall be kept to a minimum. TTS-1102

TTS-2617

4.1.5 Trainee Viewing Facility

4.1.5.1 The Simulator shall be made available initially with a trainee viewing facility within a container/ cabin as defined in 4.1.1.1, and comprising monitors viewable by up to 10 trainees within the same container/cabin. Suitable desks and chairs shall be provided. The trainee viewing facility shall, in addition to the requirements of 4.1.1.1, have windows to allow natural light, and natural ventilation appropriate for the maximum number of trainees. TTS-2618

4.1.5.2 The trainee viewing facility monitors shall relay:

- the driver's forward views;
- a view of all HMI screens (including TMS, CCTV etc.); TTS-2619
- a view of radio controls; and
- a view of all Unit system controls.

4.1.6 Route Representation TTS-1103

4.1.6.1 The Simulator shall consist of a computer based system showing the track ahead, interfaced with the driver's controls. TTS-1104

4.1.6.2 The visual representation of the infrastructure shall be generated by CGI and the simulation environment shall comprise LO Infrastructure generic routes closely representing the types of track, railway structures and stations, signals and other infrastructure equipment, and environs typically present on the sections of the LO Infrastructure. The required passenger routes are as follows:

TTS-1105

Route 1	London Liverpool Street to Chingford
Route 2	London Liverpool Street to Cheshunt
Route 3	London Liverpool Street to Enfield Town
Route 4	Acton Central – Stratford (London)
Route 5	London Euston to Watford Junction
Route 6	Dalston Junction to West Croydon

4.1.6.3 The simulation of the LO Infrastructure routes shall accurately represent the real environs and as-built design of track, railway structures and stations, signals and other infrastructure equipment over their full length. Other Units shall be accurately represented visually and be shown operating. TTS-1106

The level of detail provided shall be acceptable to the Purchaser.

4.1.6.4 All simulation environments shall be developed in conjunction with, and shall be acceptable to the Purchaser. TTS-1107

4.1.6.5 The Simulator shall include a full route simulation building capability to allow instructors to build new routes and/or adapt those simulated routes supplied with the Simulator. The features available to be built into the new or adapted routes may differ from those provided in routes supplied with the Simulator and shall be acceptable to the Purchaser. TTS-1108

4.1.7 Dynamic movement TTS-1109

4.1.7.1 There is no requirement to simulate dynamic movement of the driving cab. TTS-1110

4.1.8 Unit performance and functions TTS-1111

4.1.8.1 The Simulator shall be capable of realistically modelling the Unit's performance over the specified routes under all passenger loading conditions. TTS-1112

4.1.8.2 The following functions are to be accurately replicated:

- track gradients, curves and adhesion characteristics; TTS-1113
- the Units accelerating and braking performance;
- the Unit's resistance to motion;

- OHL neutral sections or third rail line gaps; and
- the Unit's energy consumption, including energy recovered during Regenerative Braking.

4.1.8.3 The Simulator shall as a minimum permit the following functions and scenarios to be accurately replicated by the instructor in real time:

- weather conditions and associated visibility and wheel/rail adhesion levels during the simulated run;
- lying snow;
- smoke in tunnels;
- windscreen condensation / icing;
- wheel slip or slide as determined by the appropriate track conditions, brake notch and power notch positions;
- status of all colour aspect signals throughout the simulated run and associated AWS/TPWS functions;
- temporary speed restrictions or emergency indications; TTS-1114
- simulated Unit to control centre communication via GSM-R radio equipment;
- passenger contacting the driver via the passenger alarm system;
- activation of the Call For Aid device(s);
- operation of PIS functions;
- display of TMS HMI screen shots for a number of Normal Operation and degraded failure mode scenarios;
- activation of Event Triggers and associated CCTV images; and
- variation of passenger loading, at simulated station stops.

The full set of functional scenarios shall be agreed with the Purchaser.

4.1.8.4 The Simulator shall accurately model no fewer than 100 different faults and their effect on the operation of the Unit.

The simulated faults shall be acceptable to the Purchaser and shall include, as a minimum:

- isolation of the pneumatic brake on one Vehicle;
- sudden loss of main reservoir pressure;
- failure of brakes to release;
- loss of Regenerative Braking; TTS-1115
- operation of a PEA;
- loss of traction power;
- loss of pantograph current collection;
- loss of shoegear current collection;
- failure of DSD vigilance system;
- failure of in cab CCTV (DOO and Saloon CCTV);
- tripping of circuit breakers;

- failure of AWS / TPWS;
- failure of communications systems;
- diagnostic and fault indicating system faults, including TMS HMI;
- failures of a passenger bodyside door system, including inability to obtain interlock;
- failure or obstruction of one or more passenger bodyside doors; and
- operation of Unit control system isolations.

4.1.8.5 The Simulator shall permit the instructor to generate multiple failure scenarios in order to demonstrate prioritisation within the Unit Subsystems and allow the driver to be trained in such situations. TTS-1116

4.1.8.6 During a simulated run the instructor shall be able to input appropriate faults and operational scenarios at any point. TTS-1117

4.1.9 Audible Feedback

TTS-1118

4.1.9.1 The Simulator shall accurately synchronise all recorded audible effects with the track image. TTS-1119

4.1.9.2 The following sounds shall be simulated and shall be automatically cued at the appropriate time in relation to the operation of the Unit:

- wheel/rail sounds on continuous welded rail, switches and crossovers, wheel squeal and flange noises;
- passing sounds for signal posts, platforms, other trains, bridges, tunnels;
- wheel slip / slide prevention activity;
- wheels sliding under low adhesion conditions; TTS-1120
- traction motor noises whilst under traction, under braking or coasting;
- brake noises;
- warning and clear tones given by train protection systems;
- TMS and traction protection and control system alarms; and
- the sound of the warning horn shall be cued by the driver operating the control.

4.1.10 Training in Energy Efficient Driving

TTS-1121

4.1.10.1 The Simulator shall record the Units simulated energy consumption against typical timetable journeys, this shall be used to provide plots of energy usage against time which can then be used for driver training in energy efficient driving techniques. TTS-1122

4.1.10.2 Each trainee driver's energy efficiency performance shall be monitored and plotted against the baseline developed by the instructor. TTS-1123

4.1.11 Training in Fault Finding and Rectification

TTS-1124

4.1.11.1 The Simulator shall be used for training drivers and maintenance staff in fault finding and resolution tasks. TTS-1125

4.1.11.2 The instructor's console shall provide a suitable display for monitoring a maintenance technician's actions throughout a fault finding and rectification TTS-1126

training exercise.

4.1.11.3 The maintenance technician's actions shall be recorded for subsequent replay, review and analysis. TTS-1127

4.1.11.4 The instructor shall have quick access to any portion of the exercise for replay purposes. TTS-1128

4.1.12 Recording and Playback TTS-1129

4.1.12.1 The instructor shall be able to develop training scenarios off-line for later use with trainee drivers. TTS-1130

4.1.12.2 All simulated parameters and driver actions shall be recorded and be capable of being stored and played back through the monitor on the instructor's desk when required. TTS-1131

4.1.12.3 The Simulator shall have the capacity to record 20 days of training operation. TTS-1132

4.1.12.4 It shall be possible for the instructor to mark any position on the route such that this can aid subsequent identification for quick reference. TTS-1133

4.1.12.5 A video camera shall be fitted in the cab from which all the driver's actions shall be visible. TTS-1134

4.1.13 Reports and Output TTS-1135

4.1.13.1 It shall be possible to print out a report of a training exercise showing, as a minimum, the following information as appropriate to the simulation activity being undertaken:

- instructor's name;
- driver's or maintainers name;
- date;
- driver's or maintainer's depot;
- start and finish time of the simulation;
- special conditions - this shall refer to any conditions, faults or similar that have been inserted into the simulation;
- average journey speed; TTS-1136
- maximum journey speed;
- time of arrival and departure from stations, compared with programmed arrival and departure times;
- malfunction of controls;
- misuse of controls;
- failure to respond to a simulated fault;
- failure to respond to a signal correctly;
- number of times wheel slip occurred;
- number of times wheel slide occurred; and
- energy usage.

4.1.13.2 It shall be possible to output a record of a Simulator training exercise to a suitable recordable media. TTS-1137

4.1.14 Simulation Computer System

TTS-1138

4.1.14.1 The Simulator computer systems shall be provided with an uninterruptible power supply to ensure that the system is not damaged nor the electronic storage facilities corrupted in any way by the sudden loss of the electrical supply. TTS-1139

4.1.14.2 On loss of power the system shall revert to a standby mode. The system may require an action from the instructor to reinitiate the system once power is restored. TTS-1140

4.2 Special Tools and Software

TTS-1141

4.2.1.1 Special tools, equipment and software for the Unit for purposes defined below shall be provided by the Manufacturer and supported for the duration of this Agreement:

- those required to support the testing, fault diagnosis, maintenance and repair of the Unit and all Subsystems; and TTS-1142
- those required to send, receive, process, configure, print and interpret Subsystem data.

Where specialist software is required it shall be provided free of charge with no licence limitations in accordance with the terms of the MSA.

4.2.1.2 All necessary jacking, lifting and wheelskate equipment required to recover the Unit after derailment or seizure of a wheelset shall be provided by the Manufacturer. TTS-1143

4.3 Mock-Ups

TTS-1144

4.3.1 General

TTS-1145

4.3.1.1 Full size cab and passenger saloon interior mock-ups shall be provided. TTS-1146

4.3.1.2 The cab and passenger saloon mock-ups shall be fully representative of the final build. The mock-ups shall be used by the Purchaser to assess the final vehicle interior and schedule of finishes during the design assurance process. TTS-1147

4.3.1.3 The cab and passenger saloon mock-ups shall have a representative exterior of the final build design, including windows, windscreens, door controls and passenger information displays. TTS-1149

4.3.2 Passenger Saloon Mock-up

TTS-1150

4.3.2.1 The passenger saloon mock-up shall as a minimum be a full Vehicle length and shall represent the seat layouts of the different interior arrangements and the final scope shall be agreed with the Purchaser. TTS-1151

4.3.2.2 The passenger saloon mock-up shall include one set of open wide gangways. TTS-1152

4.3.2.3 The passenger saloon mock-up shall include all interior features incorporated in the Vehicle design, including, but not limited to: seats, flooring, windows, interior trims, doors, signage, lighting, passenger information displays, grab poles, wheelchair spaces, passenger door controls, call for aid controls, advertising panels and displays. TTS-1153

4.3.2.4 Saloon mock-up finishes shall be representative of the materials, finishes TTS-

and products to be used for the actual Unit. 1154

4.3.2.5 The passenger seating design and comfort shall be consistent with the finished build. TTS-1155

4.3.2.6 The passenger information displays and lighting shall be representative of the final build design. TTS-1156

4.3.2.7 As an aid to the Unit design development process the mock-up construction shall permit the removal of representative passenger information displays and lighting modules and replacement with actual working equipment as will be installed on the Unit. This shall provide the Purchaser with the capability to view the performance of the actual equipment in the mock-up. TTS-2620

4.3.3 Cab Mock-up TTS-1157

4.3.3.1 A full size representative cab mock-up shall be provided. The cab mock-up shall be equipped so that all controls and indications (desk and cab walls) are fully representative of the final build, including:

- main control mechanical functionality (e.g. traction/brake controller), for the purposes of tactile feedback assessment; TTS-1158
- illumination of all control/ indicators; and
- functional internal lighting.

4.3.3.2 Driver and Second Person's seats shall be consistent with the final build, including all seat adjustment functionality. TTS-1159

4.3.3.3 The cab interior space and cab access arrangements shall accurately reflect the final design arrangements. TTS-1160

4.3.3.4 The cab mock-up shall include accurate representations of all cab windows, including demonstration of sightlines and window blinds. TTS-1161

Appendix A Door Passive Anti-Entrapment Requirements

A.1 Door Anti-Entrapment Requirements

A.1.1 With 'Passive' Anti-Entrapment, the door leading edge seal design should allow for items of clothing becoming trapped in closed Unit doors to be extracted without the need for excessive effort.

A.1.2 To test this, a piece of fabric 150 mm wide shall be folded and placed between the door leading edges or between the door leading edge and fixed frame (if applicable), and allow the closing door to clamp it in place (see Figure A) until the door is closed and locked. The fabric shall then be pulled in an outward direction, slowly applying an increasing level of force via a force meter as shown in Figure A-1, until the force is sufficient for the fabric to be slowly withdrawn. The force required shall not exceed 150N measured perpendicularly and at 45° and 135° to the door surface.

A.1.3 Due to the leading edge seal design a dead zone where the fabric pull out test may not be compliant with the maximum force may not be avoided at the top and bottom of the door leaf. This dead zone shall not be higher than 40mm above threshold at the bottom and 40mm down from the top of the throughway.

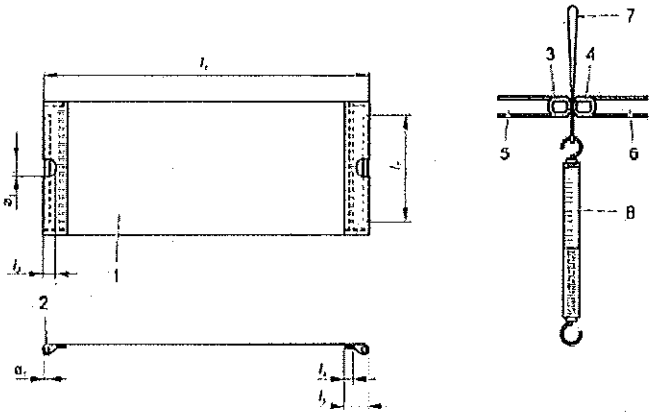
A.1.4 The fabric shall be Wool Abradant Fabric, as currently defined in BS EN ISO 12947-1:1998

	Warp	Weft
Fibre diameter (µM)	27.5 +/- 2.0	29.0 +/- 2.0
Yarn linear density (tex)	R63 +/- 4/2	R74 +/- 4/2
Yarn singles twist (tpm)	540 +/- 20 'Z' twist	500 +/- 20 'Z' twist
Yarn folded twist (tpm)	450 +/- 20 Two fold 's' twist	350 +/- 20 Two fold 's' twist
Threads per 10 cm	175 +/- 10	135 +/- 8

Mass per unit area (g/m^2)	215 +/- 10
Oil content (%)	0.8 +/- 0.3

Table A-1 Door Anti-Entrapment Pull through Test Piece Specification

Dimensions in millimetres

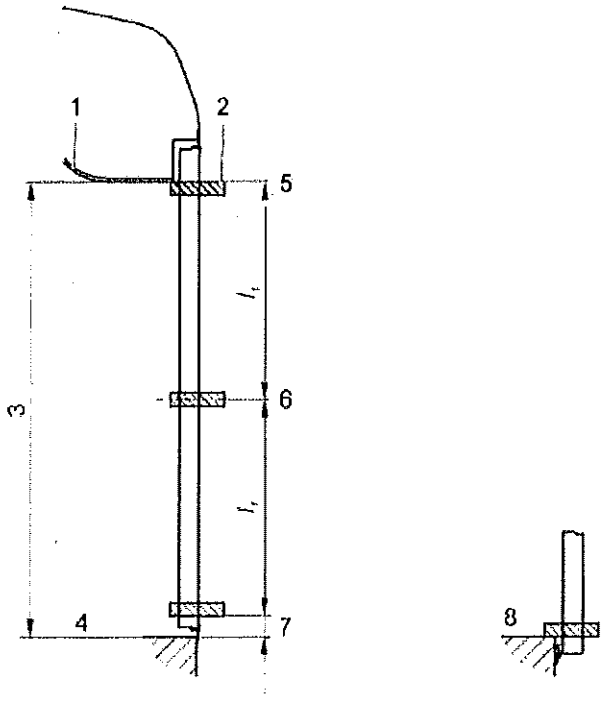


l_1	600 ±5
l_2	130
l_3	15
l_4	10
l_5	30
a	8
a_1	20

Key

1 fabric
2 pin
3 right hand Leading Edge
4 left hand Leading Edge
5 right hand door leaf
6 left hand door leaf
7 canvas sheet
8 force meter

Figure A-1 Door Passive Anti-Entrapment Test Piece



Key

1 gear cover
2 test object in upper position
3 throughway height
4 top of floor
5 top
6 test object in mid position
7 test object above soft horizontal bottom rubber
8 test object at top of floor

Figure A-2 Door Anti-Entrapment Test Arrangement

Appendix B Data Communication Requirements

System & Data		When	Where	Initiated by	Main Data Flow Direction	Permissible Bearers (Note 1)	Comments
TMS	Category A - Instant Messaging / Alerts	Immediate	All locations	Unit	Unit to Wayside	GSM-R	Driver's Safety Device in accordance with Railway Group Standard.
						Mechanism defined by Manufacturer	Refer to section 3.39.1.4.
	Category B - Service Affecting	<30 mins	All locations	Unit	Unit to Wayside	Mechanism defined by Manufacturer	Refer to section 3.39.1.4.
	Category C - Routine data download	< 60 mins	All locations	Unit	Unit to Wayside	Mechanism defined by Manufacturer	Refer to section 3.39.1.4.
	Defect log information	<60 mins	All locations	Unit	Unit to Wayside	Mechanism defined by Manufacturer	Freeform text information entered into the defect log facility by the driver. Refer to section 3.39.2.5.
CCTV	Remote download of Saloon, forward facing and pantograph CCTV	On demand	Depot/ Stabling	Wayside	Unit to Wayside	Mechanism defined by Manufacturer	Download on demand from RCC. Routine downloads are not anticipated. Refer to section 3.32.1.20 and 3.32.2.11.
PIS	Remote updating of PIS Databases.	On demand	Depot/ Stabling	Wayside	Wayside to Unit	Mechanism defined by Manufacturer	Updates to PIS databases, for example as a result of timetable changes. Refer to section 3.37.8.
	Remote updating of PIS Real time information	On demand	All locations	Wayside	Wayside to Unit	Mechanism defined by Manufacturer	Real time updates to Service Information, for example as a result of station closures or delays to connecting services. Also includes freeform visual messages and the display of the TfL Live Service Update Board. Refer to section 3.37.5.

System & Data		When	Where	Initiated by	Main Data Flow Direction	Permissible Bearers (Note 1)	Comments
MISCELANEOUS	Performance Regime Monitoring Data	<60 mins	All locations	Unit	Unit to Wayside	Mechanism defined by Manufacturer	Data to assist with verifying whether a Unit has called at a station, and at what time it called. Also Unit and Subsystem failure data that may be a subset of TMS category A, B and C alarms. See section 3.39.5.
	Subsystem Fault logs	On demand	Depot/ Stabling	Depot	Unit to Wayside	Mechanism defined by Manufacturer	Systems including traction, brakes, air conditioning, PIS, CCTV etc. May be included within scope of category C TMS data. See section 3.39.3.
	OTMR Data	On demand	Depot/ Stabling	Wayside	Unit to Wayside	Mechanism defined by Manufacturer	Not anticipated to be routine downloads but downloads required for incident investigations where removal of the OTMR unit is not required for evidential purposes. See section 3.31.1.3.
	Energy Metering	On demand	All locations	Wayside	Unit to Wayside	Mechanism defined by Manufacturer	Unit energy metering data shall be accessible to the Purchaser. See section 3.4.1.6.
	Intelligent Stabling Control	On demand	Depot/ Stabling	Wayside	Wayside to Unit	Mechanism defined by Manufacturer	Intelligent stabling control to manage energy consumption whilst stabled. To be proposed by the Manufacturer. See section 3.4.1.9.
	Passenger loadweigh and passenger counting data	Automatically on leaving station stop.	All locations	Unit	Unit to Wayside	Mechanism defined by Manufacturer	Units to transmit loadweigh data on leaving station stop, categorised as required by 3.34.2.3 and actual data as defined in section 3.34.2.6.
		On demand	Depot/ Stabling	Wayside	Unit to Wayside	Mechanism defined by Manufacturer	Routine data downloads of passenger loadweigh data from the passenger loadweigh system, does not contain safety critical data, assumed to be downloaded on a daily basis. See section 3.34.1.7 and 3.34.2.7.
	Track Monitoring routine.	On demand	Depot/ Stabling	Wayside	Unit to Wayside	Mechanism defined by Manufacturer	Routine data downloads from the infrastructure monitoring system, contains both safety and non-safety critical data, assumed to be downloaded on a daily basis. See section 3.46.1.
	Track Monitoring Alerts.	Immediate	All locations	Unit	Unit to Wayside	Mechanism defined by Manufacturer	Alarm data downloads from the infrastructure monitoring system does contain safety critical data, assumed to be downloaded via the permissible bearer available at the time of the alarm. See section 3.46.1.

System & Data		When	Where	Initiated by	Main Data Flow Direction	Permissible Bearers (Note 1)	Comments
	Pantograph Monitoring routine.	On demand	Depot/ Stabling	Wayside	Unit to Wayside	Mechanism defined by Manufacturer	Routine data downloads from the Infrastructure Monitoring system, contains both safety and non-safety critical data, assumed to be downloaded on a daily basis. See section 3.46.1.
	Pantograph Monitoring Alerts.	Immediate	All locations	Unit	Unit to Wayside	Mechanism defined by Manufacturer	Alarm data downloads from the infrastructure monitoring system does contain safety critical data, assumed to be downloaded via the permissible bearer available at the time of the alarm. See section 3.46.1.
	Material for electronic advertising displays.	On demand	Depot/ Stabling	Wayside	Wayside to Unit	Mechanism defined by Manufacturer	May include supplementary passenger information – news etc. See section 3.33.11.15.

Note 1: The Manufacturer shall define the optimum permissible bearers for communication of data. Refer to TTS section 3.40. Where the Manufacturer defines a mechanism other than an existing available GSM-P service, the Manufacturer shall be responsible for providing the supporting infrastructure.

Appendix C Unit Infrastructure Monitoring Requirements

C.1 Unit Infrastructure Monitoring Equipment

C.1.1 Units shall be fitted with unattended infrastructure monitoring equipment to monitor and record:

Defined parameters of track geometry, in accordance with the parameters and approach contained in the suite of BS EN 13848 documents;

acceleration levels, in accordance with BS EN 13848-1:2003 Annex A;

acoustic noise emanating from the wheel rail interface of the Unit;

pantograph to overhead line contact force and overhead line geometry; and

signalling transponders and radio broadcast strengths.

C.1.2 The infrastructure monitoring equipment shall be cable of recording the parameters set out in this Appendix, to the prescribed accuracy and time intervals. Details are provided in the suite of BS EN 13848 documents, in particular Part 1 and Part 2 which provide details on parameters to be measured by vehicles specifically modified to carry measuring equipment.

C.1.3 All unattended infrastructure monitoring equipment measurements shall be stamped with the following data:

Vehicle speed (+/- 0.14m/s);

Vehicle geographical location (+/- 2.5m) with a resolution of 0.1m;

Date; and

Time to the nearest second (in the format hh:mm:ss) synchronised to the on-board clock provided by the TMS system.

C.1.4 All recorded data shall be referenced by a combination of Network Rail's track identification protocols of Engineers Line Reference (ELR), Track Identifier (TRID), Miles and Yards and GPS coordinates.

C.1.5 The Unit infrastructure monitoring equipment shall measure and record track parameters in accordance with Table 2.

C.1.6 The Unit infrastructure monitoring equipment shall measure and record acceleration levels in accordance with BS EN 13848-1:2003 Annex A.

C.1.7 The Unit shall have on-board acoustic monitoring equipment capable of recording the wheel to rail interface noise generated by the Unit while operating in service. The system shall be capable of identifying abnormalities in noise generated at the wheel/rail interface associated with track defects and corrugation.

C.1.8 The Unit shall have on-board overhead line force and geometry monitoring equipment. The parameters to be monitored at a frequency of 30Hz shall include:

vertical contact wire position relative to vehicle roof height to a tolerance of +/- 10mm; with a range compatible with Network Rail standard NR/GN/ELP/27088;

horizontal contact wire position relative to pantograph centre point to a tolerance of +/- 10mm; with a range compatible with section 3.14; and

pantograph contact force to the contact wire to a resolution of +/- 5N, a measurement uncertainty of +/- 2N and a range of 0 to 400N.

C.1.9 The Unit shall have on-board equipment capable of monitoring GSM-R signal strength and frequency.

C.1.10 The Unit shall have on-board equipment capable of identifying Eurobalise that the Unit failed to read should ETCS equipment be installed.

C.1.11 The Unit automatic location and identification system shall use a combination of GPS, and Eurobalise positional information where available as the reference for location on the infrastructure. Where necessary to achieve the positional accuracy required, the Unit odometry system shall also be used.

C.1.12 The infrastructure monitoring equipment shall permit the routine download of the measured data from the Unit to the Wayside in accordance with data communication methods outlined in section 3.40 and Appendix B.

C.1.13 It shall be possible to set safety alerts for all monitored and recorded parameters. The track and pantograph alerts shall be reported to the Wayside in accordance with data communication methods outlined in section 3.40 and Appendix B.

C.1.14 The threshold for safety alerts shall be configurable. It shall be possible to set more than one threshold. The safety alerts to be reported for the track parameters shall be in accordance with Table 2. The setting of the alert thresholds for other Subsystems, including the pantograph parameters in C.1.8, shall be agreed with the Purchaser.

C.1.15 The safety alerts provide the Infrastructure Manager with information to permit timely intervention regarding the introduction of operational restrictions or maintenance intervention needs. Alerts where the thresholds exceed levels acceptable for normal operational services to continue shall be processed and reported to the Wayside in less than 5 minutes from the initial detection.

C.1.16 The infrastructure monitoring equipment processing software supplied with the infrastructure monitoring systems shall permit the following:

generation of data files of the detailed track geometry information (at 0.2m spacing);
1/8th mile standard deviations of the main track recording parameters;
exceedance files which list locations where the parameters have exceeded event threshold criteria and subsequent track or infrastructure inspection is required;
data files of the acoustic noise measurements;
data files of the accelerations measured in accordance with BS EN 13848-1:2003 Annex A;
data files of the overhead line position and interaction forces; and
data files of the monitored signal strengths.

C.1.17 All the data shall be of a format suitable for subsequent manipulation and analysis using proprietary software. The format shall be agreed with the Purchaser.

C.1.18 Special tools, equipment and software required for the retrieval, processing and analysis of the infrastructure monitoring equipment data shall allow for the following:

- Retrieval of data for off-board review and /or storage on secure digital media;
- Searching and viewing data by the input of specific date, time, geographical location or events;
- Scrolling through data;
- Editing event threshold criteria; and
- Post processing of recorded data to support subsequent engineering analysis of trends or patterns.

The functionality of the software and tools shall be developed by the Manufacturer to a specification acceptable to the Purchaser.

Parameter	Wavelength	Resolution	Measurement Uncertainty		Range	Alerts	Data Download
Longitudinal Level 1m to 25 m Top (Left and Right)	1m < λ ≤ 25m	≤ 0.5mm	+/- 1mm		+/- 50mm	Yes. Configurable setting of thresholds. Immediate reporting to the Wayside. More than one threshold shall be permitted to meet different intervention criteria.	Yes. Daily routine download at depot.
Longitudinal Level 25 to 70m Top (Left and Right)	25m < λ ≤ 70m	≤ 0.5mm	+/- 3mm		+/- 100mm		
1m to 25m Alignment	1m < λ ≤ 25m	≤ 0.5mm	+/- 1.5mm		+/- 50mm		
25m to 70m Alignment	25m < λ ≤ 70m	≤ 0.5mm	+/- 4mm		+/- 100mm		
Track Gauge	N/A	+/- 0.5mm	+/- 1mm		Nominal Gauge + 50mm / - 15mm		
Track Twist	N/A	+/- 0.5mm	$\ell \leq$ 5.5m	5.5m < $\ell \leq$ 20m	+/- 15mm/m (‰)		
			+/- 1 / ℓ	+/- 2 / ℓ			
Track Cross Level Error	N/A	+/- 0.5mm	+/- 5mm absolute values. +/- 1mm relative values.		+/- 225mm		
Track Horizontal Curve (20m chord)	N/A	TBC	TBC		TBC		

Table 2 Track Geometry Parameters to be Monitored (final data set to be agreed with the Purchaser)

Appendix D Emergency and Safety Equipment

D.1 Emergency and Safety Equipment.

D.1.1 As a minimum the following items of emergency and safety equipment shall be provided on the Unit for use by Authorised Persons only and shall not be available to passengers:

D.1.2 In each driving cab:

Ten detonators;

Two sets of track circuit operating clips;

One red flag with stick;

One fire extinguisher, in accordance with the recommendations of BS 6853:1999 clause 8.2; and

D.1.3 In one location on the Unit, the exact location to be agreed with the Purchaser:

11 metres of 18mm nylon rope;

One multi-purpose saw;

One coupling pole (to assist aligning of couplers during coupling on tight curves);

First aid equipment in accordance with Health and Safety (First Aid) Regulations 1981 approved code of practice;

24 snap lights / glow sticks; and

Carry sheet to support detrainment.

D.1.4 Suitably located within the Unit:

One extending type ladder or step ladder;

One fire extinguisher.

D.1.5 For Dual Voltage Units the following items of emergency and safety equipment shall be provided on the Unit for use by Authorised Persons only and shall not be available to passengers.

In each Driving Vehicle:

One conductor rail short circuiting bar;

One conductor rail hook switch pole;

A shoe fuse key if applicable;

Sufficient shoe paddles to comply with the requirements of GM/RT2130;

One roll of PVC electrical insulating tape;

Cable ties;

Cutters for cable ties;

8m stout cord; and

Insulated rubber gauntlets.

D.1.6 For AC Only Units suitable secure space provision for the emergency equipment listed in clause D.1.5 shall be provided for use by Authorised Persons only and shall not be available for passenger use.

Appendix E Unit Exterior and Interior Design Requirements

E.1.1 The purpose of this appendix is to provide an overview and to give direction as to how the Purchaser requires the Unit interior styling to be developed, and the exterior branding to be applied.

E.1.2 The guidance included in this appendix is intended to set out the Purchaser's underlying design aspirations; they should not be viewed as prescriptive or "blueprints" for the technology.

E.1.3 The Manufacturer shall take the requirements of this appendix fully into consideration in developing their design proposals, but the requirements of the main body of the Train Technical Specification and Applicable Laws and Standards shall at all times take precedence and the Manufacturer shall draw to the Purchaser's attention any areas where this has necessitated designs that are significantly different from the guidance given in this Appendix E.

E.1.4 The Manufacturer's attention is drawn to the requirement to work co-operatively with the Purchaser on their proposal, including the Permitted Design Change and Schedule of Finishes provisions in the MSA which permit the Purchaser to continue to develop its requirements for colours, finishes and design detailing during the Unit design phase.

E.1.5 The Purchaser has the objective of providing high capacity services with modern standards of passenger capacity and comfort, delivering a desirable environment for passengers whether using the Units for commuting or leisure travel.

E.1.6 The Purchaser wishes to make the new Units feel synonymous with RfL and London Overground not just by applying corporate logos and colours, but also by adopting design cues from some existing and other forthcoming RfL rolling stock. The Purchaser envisages this will be achieved by concentrating in particular on the design of the elements highlighted in Figure E-1 in this Appendix E.

E.1.7 The Manufacturer shall prepare interior design and exterior livery proposals that meet the requirements of the main body of the Train Technical Specification while fully taking into account the Purchaser's underlying aspirations as set out in this Appendix E. The Manufacturer is not precluded from proposing subtle adaptations where benefits to, inter alia, appearance, human factors, performance or cost can be demonstrated.

E.1.8 The Manufacturer's proposal shall maximize design effort at key customer touch points and interfaces – i.e. grab rails, seating, doors and door controls, flooring, other amenities and passenger safety and information systems, using a unified design language to create a consistent visual whole.

E.1.9 All interior features and components should be visually well orchestrated and harmonious to create an inviting, resolved and visually integrated environment; they should be designed to be visually consistent in their use of form, colour and materials, aesthetically 'belong' within the interior and collectively create a consistent whole.

E.1.10 Particular attention shall be paid to the ceiling design and the visual integration of lighting, air conditioning diffusers, passenger information displays and other equipment.

E.1.11 The Manufacturer is required to propose layouts that meet the requirements of the main body of the Train Technical Specification. Each Vehicle shall have broadly similar layouts to give an even distribution of seating and standing capacity along the Unit.

E.1.12 Guidance on seat layouts is given in Figure E-2 and Figure E-3 in this Appendix E. The Manufacturer's attention is also drawn to the interior layout flexibility required by the Train Technical Specification.

E.1.13 A visually consistent design language should be used on both the longitudinal and transverse seating to create a consistent and integrated look. The Purchaser requires a "one class of service" environment, which should be positioned between "standard" and "business/first class" in terms of customer experience.

E.1.14 Seat cushions and squabs shall be lightly sculptured using shaped areas and seat cover stitching to add to the visual appeal and comfort. The Purchaser wishes to maintain the appearance of a generous seat pad – using 'roll back' techniques on edges where cushion and squab thickness is limited by other factors.

E.1.15 The grab pole, grab rails and handhold positions and seat layouts shall allow unobstructed access for wheelchairs/ prams etc from doorways to designated areas while giving secure handholds for all standing passengers.

E.1.16 The design shall accommodate the range of advertising options set out in the main body of the Train Technical Specification so that they appear integrated into the ceiling coving (cant rail) area. They shall create a visually balanced and regular rhythm down the length of the interior.

E.1.17 Careful consideration shall be given in the design of the interior layout to where route maps and signage will be displayed and how they will be mounted. Signage shall be logically grouped where possible, and appear integrated into the design rather than 'added on'.

E.1.18 The Purchaser anticipates that lighting will be provided predominantly by ceiling level equipment. Whereas the Purchaser's aspiration is concealed wash lighting to illuminate the Vehicle, including window, door and gangway areas, visible lighting with high-quality-appearance diffusers is not precluded. The type of light source is at the Manufacturer's discretion and it is recognised that energy efficiency and the need to provide adequate levels of illumination under emergency scenarios may also influence the Manufacturer's solution.

E.1.19 The Purchaser has made the following key assumptions about likely materials and finishes;

- Natural finish materials (e.g. brushed aluminium/stainless steel) in high wear areas and for detailing to promote longevity of a high quality and clean appearance with the minimum of maintenance (i.e. so that items develop an attractive patina through use rather than "wear out");

- Quality castings for visible structural features (e.g. seat frames, grab pole supports);
- Elastomeric flooring. The Manufacturer shall assume two base colours, and is expected to take full advantage of currently available manufacturing technology to produce relief effects ('ribbing') in the flooring. Ribbed flooring is a heritage feature on TfL transport modes dating back to the earliest trains with wooden floor surfaces and Purchaser wishes to retain this heritage-link and ribbing shall be proposed by the Manufacturer;
- The Train Technical Specification specifies moquette for seat covers. This shall be predominantly cut-pile but allowance shall be made for areas of uncut pile in the final cover design. The use of alternative materials in high wear areas (e.g. armrests) meeting the Purchaser's touch-point quality aspirations shall be proposed;
- The Purchaser envisages the interior colour scheme shall broadly be realised by the use of a combination of painted or powder coated finishes and judicious use of natural finish materials as outlined above; and
- The Purchaser does not intend to give the Manufacturer direction on the exterior design of the Units, but the Manufacturer shall apply the livery and branding described in Figure E-4 and Figure E-5 in this Appendix E sympathetically to their design, in particular the cab.

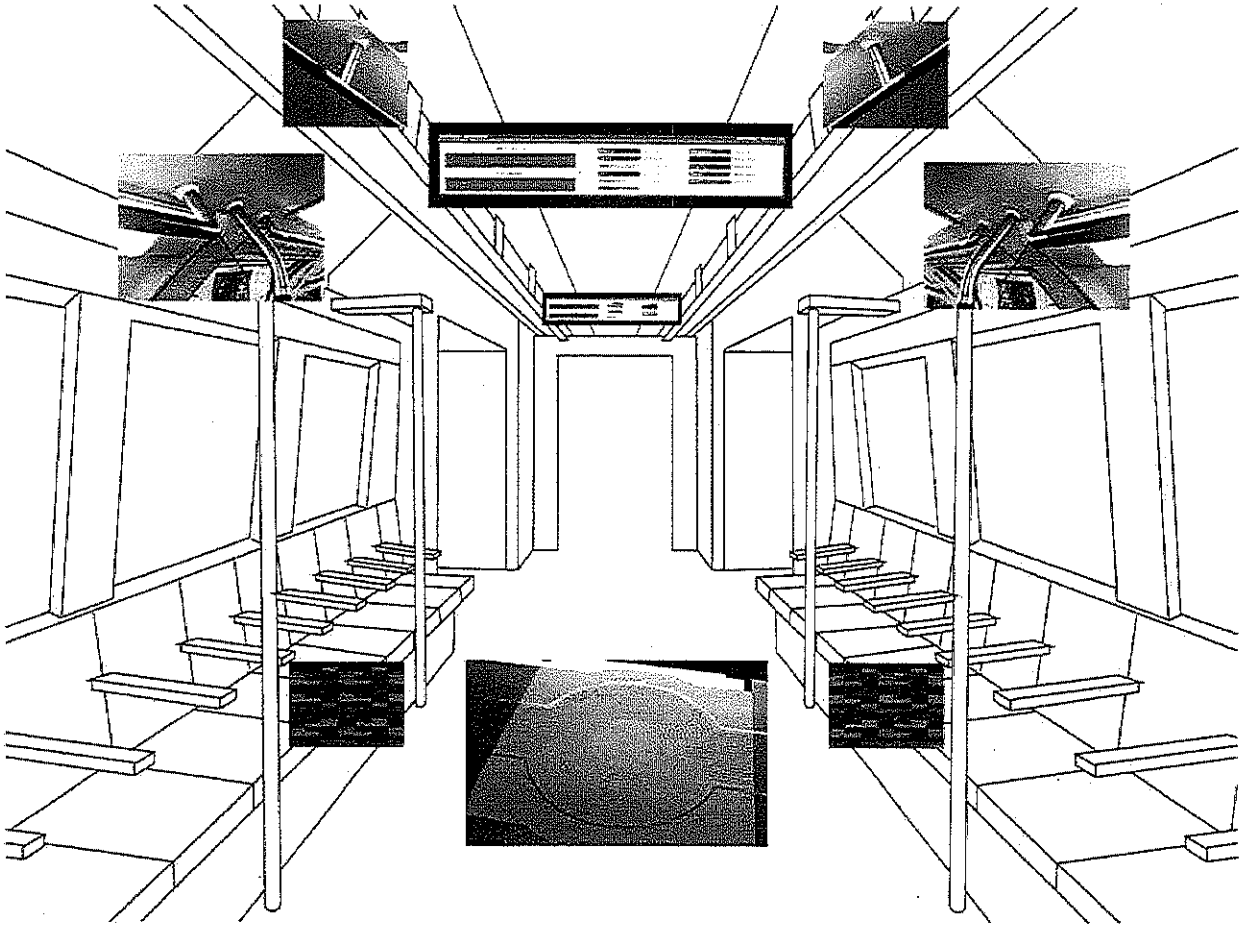
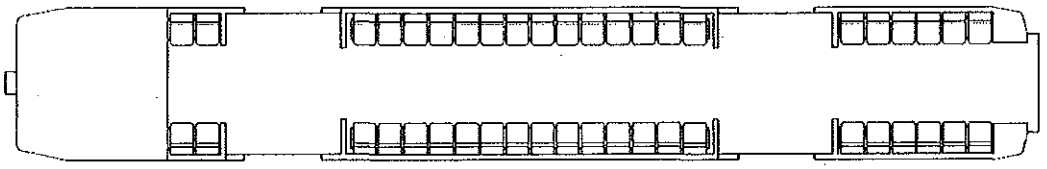
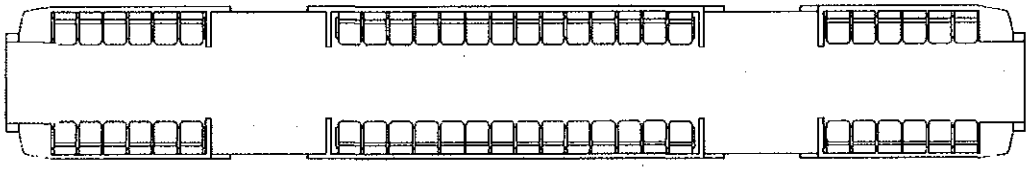


Figure E-1 Areas of particular emphasis for design development.

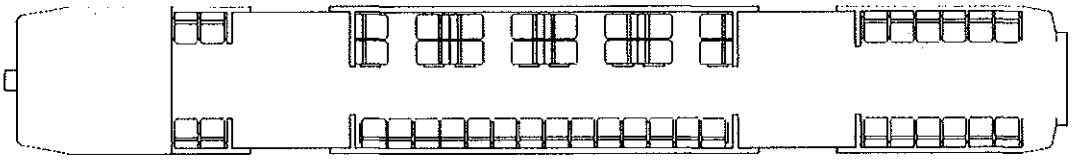


Seats = 44

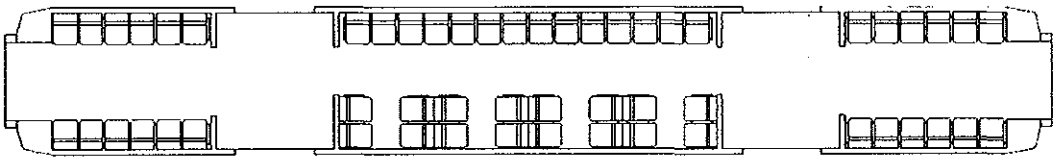


Seats = 52

Figure E-2 Guidance on seat layout for Dual Voltage Units.

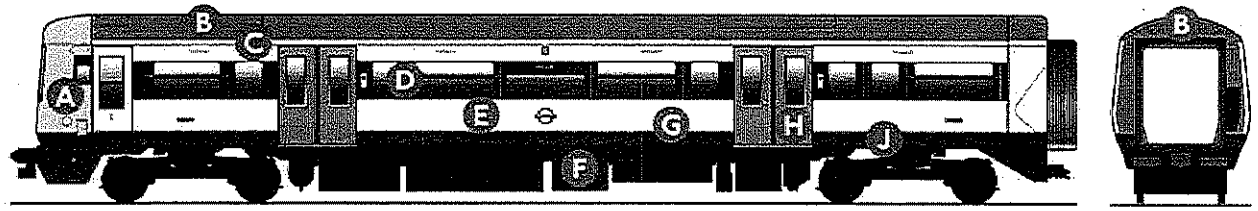


Seats = 46



Seats = 54

Figure E-3 Guidance on seat layout for AC Only Units.



A **Drivers cab front**
Colour: Livery Yellow
(NCS S 1080-Y10R)

B **Roof and ends**
Colour: Livery Mid Grey
(NCS S 4502-G)

C **Warning stripe**
Colour: Cant Rail Orange
(BS381C Ref 557)

D **Window glazing**
Colour: Livery Black
(NCS S 0585-Y50R)

E **Body**
Colour: Livery Light Grey
(NCS S 1502-Y)

F **Train underside**
Colour: Livery Dark Grey
(NCS S 7010-R90B)

G **LO Orange stripe**
Colour: LO Orange
(NCS S 0585-Y50R)
Depth: 80mm

H **Doors**
Colour: LO Orange
(NCS S 0585-Y50R)

J **Lower body**
Colour: Corporate Blue
(NCS S 3560-R80B)
Depth: 335mm

Figure E-4 Livery

COLOUR PALLETTE

Core Overground Branding Colours

Pantone 072 Blue

Pantone 158 Orange

Figure E-5 Branding

Schedule 3
Project Programme

Part A	**Key Programme Dates**
Part B	**Project Programme**

Part A Key Programme Dates

Column A	**Column B**
Milestone summary	**Date**
Purchaser supplied dates	
Contract award	01/07/15
Commencement Date	15/07/15
Latest date for Notice to Proceed from Purchaser	3 months after Commencement Date
Gospel Oak – Barking line development (route electrification)	No later than 30/09/17
Current LOROL operating concession on LO Infrastructure ends	12/11/16
Scheduled date for appointment LOROL replacement Operator	31/05/16
Earliest date for engagement with LOROL replacement Operator	04/07/16
LOROL replacement Operator starts operating passenger services on LO Infrastructure	13/11/16
Manufacturer/Maintainer takes control of Willesden Depot	13/11/16
Design	
Unit Design Submission Programme submitted to the Purchaser for Assurance Acceptance	12/08/15
Assurance Acceptance of Unit Design Submission Programme	14/09/15
Assurance Acceptance of Simulator preliminary design submission	11/03/16
Assurance Acceptance of Simulator detailed design submission	04/07/16
Preliminary Unit Design Phase complete	17/06/16
Detailed Unit Design Phase complete	31/10/16
Permitted Design Change freeze dates	
Passenger Information System – format, wording and triggering of messages (audio and visual)	11/07/16
Selective Door Opening System – platform length settings per station	11/07/16

Column A	Column B
Milestone summary	**Date**
Traction Power Limit Settings	11/01/16
Train Management System – wording of alarms, prompts and messages	11/07/16
Train Management System – prioritisation and routing of alarms and messages	11/07/16
Saloon HVAC system – setting of temperatures and timing of energy-saving modes	11/01/16
Cab HVAC system – setting of temperatures and timing of energy-saving modes	11/01/16
Passenger load weighing – format and routing of data outputs	11/07/16
Interior & Exterior Schedule of Finishes, comprising: • Cab seat trim fabric, colours and pattern • Cab desk and interior panelling colours and application • Cab flooring colour and pattern • Cab fittings; materials and colours • Cab signage; type and location • Saloon flooring colours and patters • Saloon interior panelling colours and application • Inter-car gangway colour • Saloon seats trim fabric, colours and patterns (including 4 colour cut and loop moquette) • Saloon fittings including grab poles and rails; materials and colours • Saloon signage - mandatory and branding; type and location • Exterior Livery colours and application • Exterior signage - mandatory and branding; type and location	11/01/16
Driving Cab ergonomics/ human factors and desk equipment layout (where not mandated by Standards)	11/01/16
Exterior design: cab cosmetic design (including side window aesthetic design, elements that do not effect crashworthiness or sightlines)	11/01/16
Interior design, comprising:	

REDACTED

Column A	Column B
Milestone summary	**Date**
• Passenger seating configuration (within Train Technical Requirements constraints)	11/01/16
• Passenger operated controls and communication devices - location and integration into the interior design	11/01/16
• Longitudinal seat detail design principles	11/01/16
• Transverse seat detail design principles	11/01/16
• Tip up seat detail design principles	11/01/16
• Grab pole/ hand rail/ handhold form and detail design principles (including grab pole top and bottom collar casting design, curved grab pole)	11/01/16
• Armrest design	11/01/16
• Ceiling layout / HVAC grill design/ lighting design	11/01/16
• Draught screen form and detail design principles	11/01/16
• Advert card holder design	11/01/16
• Passenger information display – integration into the interior design	11/01/16
• Electronic advertising display – integration into the interior design	11/01/16
• Key/ Lock types - passenger/ crew areas	11/01/16
• Simulator – simulation environments	11/01/16
• Simulator – parameters for functions and scenarios	11/01/16
• Simulator – simulated faults	11/01/16
• Simulator – training reports content and format	11/01/16
Delivery of cab and saloon Mock-ups to the Purchaser	13/01/17
Key Subcontracts	
Key Subcontracts signed with Key Subcontractors	
• Traction equipment (including all items in the power circuit, traction motors and associated transmission systems)	15/07/15
• Train Management System (Unit and Vehicle equipment, including intercommunication data-bus for train control and subsystem condition monitoring) and Pantograph	21/07/15
• Machined extrusions	17/07/15

Column A	Column B
Milestone summary	**Date**
• Inter-Vehicle and Unit end Couplers	06/08/15
• Mechanical and electrical brake systems	30/07/15
• HVAC (Cab and Saloon)	11/09/15
• Bogie Frames	15/07/15
• Wheelsets	15/07/15
• Passenger Information System	06/08/15
• Door system complete	25/09/15
All orders placed for Initial Spares	30/08/16
All orders placed for Special Tools	30/08/16
Initial Spares Accepted	26/10/17
Special Tools Accepted	26/10/17
Bodyshell delivered to erection stage — Car 1	17/08/16
Testing	
Assurance Acceptance of Network Testing Programme	16/11/15
Assurance Acceptance of Agreed Testing Strategy, Agreed Schedule of Tests and Agreed Testing Programme	30/12/15
Dual Voltage Unit factory Type Test start	15/11/16
Dual Voltage Unit factory Type Test complete	19/07/17
AC Only Unit factory Type Tests start	15/11/16
AC Only Unit Type Testing complete	10/08/17
Relevant Approvals for Dual Voltage Unit testing on the network obtained by the Manufacturer	05/05/17
Relevant Approvals for AC Only Unit testing on the network obtained by the Manufacturer	20/07/17
Dual Voltage Unit Type Testing starts on the network	20/07/17
Dual Voltage Unit Type Testing on the network complete	10/08/17
AC Only Unit Type Testing starts on the network	20/07/17
AC Only Unit Type Testing on the network complete	10/08/17
Relevant Approvals for Dual Voltage Unit passenger service on LO Infrastructure	05/10/17
Relevant Approvals for AC Only Unit passenger service	05/10/17

Column A	Column B
Milestone summary	**Date**
on LO Infrastructure	
Relevant Approvals - Unit Acceptance Unit Number 1. The Unit meets the requirements of clause 15.6(b). MSA)	04/12/17
Pre Provisional Acceptance and Delivery	
First Dual Voltage Unit offered for Pre-Provisional Acceptance	26/10/17
First AC Only Unit offered for Pre-Provisional Acceptance	02/02/18
First Dual Voltage Unit delivered to the Designated Delivery Location	15/09/17
First AC Only Unit (15th Unit) delivered to the Designated Delivery Location	05/01/18
Contractual Provisional Acceptance Date	
Dual Voltage Unit Acceptance 1	04/12/17
Dual Voltage Unit Acceptance 2	11/12/17
Dual Voltage Unit Acceptance 3	22/12/17
Dual Voltage Unit Acceptance 4	02/01/18
Dual Voltage Unit Acceptance 5	09/01/18
Dual Voltage Unit Acceptance 6	15/01/18
Dual Voltage Unit Acceptance 7	22/01/18
Dual Voltage Unit Acceptance 8	28/02/18
Dual Voltage Unit Acceptance 9	06/03/18
Dual Voltage Unit Acceptance 10	12/03/18
Dual Voltage Unit Acceptance 11	19/03/18
Dual Voltage Unit Acceptance 12	26/03/18
Dual Voltage Unit Acceptance 13	03/04/18
Dual Voltage Unit Acceptance 14	09/04/18
Unit Acceptance Unit Number 15	13/04/18
Unit Acceptance Unit Number 16	19/04/18
Unit Acceptance Unit Number 17	25/04/18
Unit Acceptance Unit Number 18	02/05/18
Unit Acceptance Unit Number 19	08/05/18

Column A	Column B
Milestone summary	**Date**
Unit Acceptance Unit Number 20	14/05/18
Unit Acceptance Unit Number 21	21/05/18
Unit Acceptance Unit Number 22	29/05/18
Unit Acceptance Unit Number 23	01/06/18
Unit Acceptance Unit Number 24	07/06/18
Unit Acceptance Unit Number 25	13/06/18
Unit Acceptance Unit Number 26	19/06/18
Unit Acceptance Unit Number 27	26/06/18
Unit Acceptance Unit Number 28	02/07/18
Unit Acceptance Unit Number 29	09/07/18
Unit Acceptance Unit Number 30	13/07/18
Unit Acceptance Unit Number 31	19/07/18
Unit Acceptance Unit Number 32	26/07/18
Unit Acceptance Unit Number 33	01/08/18
Unit Acceptance Unit Number 34	07/08/18
Unit Acceptance Unit Number 35	13/08/18
Unit Acceptance Unit Number 36	20/08/18
Unit Acceptance Unit Number 37	28/08/18
Unit Acceptance Unit Number 38	31/08/18
Unit Acceptance Unit Number 39	06/09/18
Unit Acceptance Unit Number 40	12/09/18
Unit Acceptance Unit Number 41	19/09/18
Unit Acceptance Unit Number 42	04/10/18
Unit Acceptance Unit Number 43	11/10/18
Unit Acceptance Unit Number 44	22/10/18
Unit Acceptance Unit Number 45	26/10/18
Contractual Final Acceptance Dates	
Final Acceptance Unit Number 1 - DV	22/02/18
Final Acceptance Unit Number 2 - DV	27/02/18
Final Acceptance Unit Number 3 - DV	12/03/18
Final Acceptance Unit Number 4 - DV	20/03/18

Column A	Column B
Milestone summary	**Date**
Final Acceptance Unit Number 5 - DV	03/04/18
Final Acceptance Unit Number 6- DV	05/04/18
Final Acceptance Unit Number 7 - DV	10/04/18
Final Acceptance Unit Number 8 - DV	21/05/18
Final Acceptance Unit Number 9 - DV	25/05/18
Final Acceptance Unit Number 10 - DV	31/05/18
Final Acceptance Unit Number 11 - DV	05/06/18
Final Acceptance Unit Number 12 - DV	12/06/18
Final Acceptance Unit Number 13 - DV	19/06/18
Final Acceptance Unit Number 14 - DV	26/6/18
Final Acceptance Unit Number 15	02/07/18
Final Acceptance Unit Number 16	09/07/18
Final Acceptance Unit Number 17	16/07/18
Final Acceptance Unit Number 18	23/07/18
Final Acceptance Unit Number 19	27/07/18
Final Acceptance Unit Number 20	02/08/18
Final Acceptance Unit Number 21	07/08/18
Final Acceptance Unit Number 22	14/08/18
Final Acceptance Unit Number 23	20/08/18
Final Acceptance Unit Number 24	28/08/18
Final Acceptance Unit Number 25	03/09/18
Final Acceptance Unit Number 26	07/09/18
Final Acceptance Unit Number 27	14/09/18
Final Acceptance Unit Number 28	20/09/18
Final Acceptance Unit Number 29	25/09/18
Final Acceptance Unit Number 30	1/10/18
Final Acceptance Unit Number 31	08/10/18
Final Acceptance Unit Number 32	15/10/18
Final Acceptance Unit Number 33	22/10/18
Final Acceptance Unit Number 34	26/10/18
Final Acceptance Unit Number 35	01/11/18

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Column A	Column B
Milestone summary	**Date**
Final Acceptance Unit Number 36	08/11/18
Final Acceptance Unit Number 37	13/11/18
Final Acceptance Unit Number 38	19/11/18
Final Acceptance Unit Number 39	26/11/18
Final Acceptance Unit Number 40	03/12/18
Final Acceptance Unit Number 41	10/12/18
Final Acceptance Unit Number 42	24/12/18
Final Acceptance Unit Number 43	31/12/18
Final Acceptance Unit Number 44	08/01/19
Final Acceptance Unit Number 45	14/01/19
Contractual Fleet Acceptance Date	01/07/19
Training & Manuals	
Simulator Factory Acceptance Test start	23/12/16
Simulator Factory Acceptance Test complete	30/01/17
Simulator delivered to Initial Simulator Location	13/03/17
Simulator site acceptance tests complete	01/05/17
Simulator Accepted	09/08/17
Training Materials delivered to the Purchaser (Simulator and non-Simulator)	13/03/17
Final version of Manuals delivered to the Purchaser	19/07/17
Assurance Acceptance of Manuals	21/08/17
Maintenance Plan submitted to the Purchaser for Assurance Acceptance	02/06/17
Assurance Acceptance of Maintenance Plan	04/07/17
Maintenance Facility / Chingford Stabling Site	
Manufacturer Fit Out Assets Accepted – Willesden	08/01/18
Manufacturer Fit Out Assets Accepted – Ilford A	15/11/17
Manufacturer Fit Out Assets Accepted – Chingford	23/04/18
Payment Milestones (where not shown above)	*See table below*

Numbering as per Appendix 1 to Part B of Schedule 10	Milestone	Scheduled Date for Achievement
13.	Product Introduction, Acceptance and Reliability Growth Cost No. 1	19-Oct-15
15.	Assurance Acceptance of TAP	01-Dec-15
21.	Wooden Mock-Up delivered	29-Jul-16
25.	Bodyshell delivered to erection stage — Car 2	06-Sep-16
26.	Bodyshell delivered to erection stage — Car 3	23-Sep-16
27.	Bodyshell delivered to erection stage — Car 4	11-Oct-16
28.	Product Introduction, Acceptance and Reliability Growth Cost No. 2	17-Oct-16
29.	Bodyshell delivered to erection stage — Car 5	28-Oct-16
31.	Start of Type Testing	15-Nov-16
34.	Bodyshell delivered to erection stage — Car 6	16-Nov-16
35.	Bodyshell delivered to erection stage — Car 7	02-Dec-16
36.	Bodyshell delivered to erection stage — Car 8	21-Dec-16
39.	Bodyshell delivered to erection stage — Car 9	16-Jan-17
41.	Bodyshell delivered to erection stage — Car 10	01-Feb-17
42.	Bodyshell delivered to erection stage — Car 11	15-Feb-17
43.	Bodyshell delivered to erection stage — Car 12	02-Mar-17
46.	Bodyshell delivered to erection stage — Car 13	15-Mar-17
47.	Bodyshell delivered to erection stage — Car 14	29-Mar-17
48.	Bodyshell delivered to erection stage — Car 15	10-Apr-17
49.	Bodyshell delivered to erection stage — Car 16	25-Apr-17
52.	Bodyshell delivered to erection stage —	21-Jun-17

Numbering as per Appendix 1 to Part B of Schedule 10	Milestone	Scheduled Date for Achievement
	Car 17	
53.	Bodyshell delivered to erection stage — Car 18	28-Jun-17
55.	Bodyshell delivered to erection stage — Car 19	05-Jul-17
56.	Bodyshell delivered to erection stage — Car 20	12-Jul-17
60.	Bodyshell delivered to erection stage — Car 21	20-Jul-17
65.	Bodyshell delivered to erection stage — Car 22	17-Aug-17
66.	Bodyshell delivered to erection stage — Car 23	18-Aug-17
68.	Agreed Testing Programme (Type Tests) complete	23-Aug-17
69.	Bodyshell delivered to erection stage — Car 24	24-Aug-17
70.	Bodyshell delivered to erection stage — Car 25	01-Sep-17
71.	Bodyshell delivered to erection stage — Car 26	07-Sep-17
72.	Bodyshell delivered to erection stage — Car 27	12-Sep-17
74.	Bodyshell delivered to erection stage — Car 28	15-Sep-17
75.	Bodyshell delivered to erection stage — Car 29	19-Sep-17
76.	Bodyshell delivered to erection stage — Car 30	21-Sep-17
77.	Bodyshell delivered to erection stage — Car 31	25-Sep-17
78.	Bodyshell delivered to erection stage — Car 32	26-Sep-17
79.	Bodyshell delivered to erection stage — Car 33	27-Sep-17
80.	Bodyshell delivered to erection stage — Car 34	29-Sep-17

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Numbering as per Appendix 1 to Part B of Schedule 10	Milestone	Scheduled Date for Achievement
81.	Bodyshell delivered to erection stage — Car 35	02-Oct-17
82.	Bodyshell delivered to erection stage — Car 36	04-Oct-17
85.	Bodyshell delivered to erection stage — Car 37	05-Oct-17
86.	Bodyshell delivered to erection stage — Car 38	06-Oct-17
87.	Bodyshell delivered to erection stage — Car 39	09-Oct-17
88.	Bodyshell delivered to erection stage — Car 40	11-Oct-17
89.	Bodyshell delivered to erection stage — Car 41	12-Oct-17
90.	Bodyshell delivered to erection stage — Car 42	13-Oct-17
91.	Bodyshell delivered to erection stage — Car 43	16-Oct-17
92.	Product Introduction, Acceptance and Reliability Growth Cost No. 3	16-Oct-17
93.	Body shell delivered to erection stage — Car 44	17-Oct-17
94.	Bodyshell delivered to erection stage — Car 45	19-Oct-17
95.	Bodyshell delivered to erection stage — Car 46	23-Oct-17
96.	Bodyshell delivered to erection stage — Car 47	24-Oct-17
97.	Bodyshell delivered to erection stage — Car 48	25-Oct-17
101.	Bodyshell delivered to erection stage — Car 49	26-Oct-17
102.	Bodyshell delivered to erection stage — Car 50	27-Oct-17
103.	Bodyshell delivered to erection stage — Car 51	30-Oct-17
104.	Bodyshell delivered to erection stage — Car 52	31 Oct-17

Numbering as per Appendix 1 to Part B of Schedule 10	Milestone	Scheduled Date for Achievement
105.	Bodyshell delivered to erection stage — Car 53	02 Nov-17
106.	Bodyshell delivered to erection stage — Car 54	03-Nov-17
107.	Bodyshell delivered to erection stage — Car 55	06-Nov-17
108.	Bodyshell delivered to erection stage — Car 56	08-Nov-17
109.	Bodyshell delivered to erection stage — Car 57	09-Nov-17
110.	Bodyshell delivered to erection stage — Car 58	10-Nov-17
111.	Bodyshell delivered to erection stage — Car 59	13-Nov-17
113.	Bodyshell delivered to erection stage — Car 60	15-Nov-17
114.	Bodyshell delivered to erection stage — Car 61	16-Nov-17
115.	Bodyshell delivered to erection stage — Car 62	17-Nov-17
116.	Bod y shell delivered to erection stage — Car 63	20-Nov-17
117.	Bodyshell delivered to erection stage — Car 64	22-Nov-17
118.	Bodyshell delivered to erection stage — Car 65	23-Nov-17
119.	Bodyshell delivered to erection stage — Car 66	24-Nov-17
120.	Bodyshell delivered to erection stage — Car 67	27-Nov-17
121.	Bodyshell delivered to erection stage — Car 68	29-Nov-17
122.	Bodyshell delivered to erection stage — Car 69	30-Nov-17
123.	Bodyshell delivered to erection stage — Car 70	01-Dec-17
124.	Bodyshell delivered to erection stage — Car 71	04-Dec-17

Numbering as per Appendix 1 to Part B of Schedule 10	Milestone	Scheduled Date for Achievement
127.	Bodyshell delivered to erection stage — Car 72	05-Dec-17
128.	Bodyshell delivered to erection stage — Car 73	07-Dec-17
129.	Bodyshell delivered to erection stage — Car 74	08-Dec-17
131.	Bodyshell delivered to erection stage — Car 75	11-Dec-17
132.	Bodyshell delivered to erection stage — Car 76	13-Dec-17
133.	Bodyshell delivered to erection stage — Car 77	14-Dec-17
134.	Bodyshell delivered to erection stage — Car 78	15-Dec-17
135.	Bodyshell delivered to erection stage — Car 79	18-Dec-17
136.	Bodyshell delivered to erection stage — Car 80	20-Dec-17
137.	Bodyshell delivered to erection stage — Car 81	21-Dec-17
138.	Bodyshell delivered to erection stage — Car 82	21-Dec-17
141.	Bodyshell delivered to erection stage — Car 83	02-Jan-18
142.	Bodyshell delivered to erection stage — Car 84	04-Jan-18
143.	Bodyshell delivered to erection stage — Car 85	05-Jan-18
145.	Bodyshell delivered to erection stage — Car 86	08-Jan-18
146.	Bodyshell delivered to erection stage — Car 87	08-Jan-18
149.	Bodyshell delivered to erection stage — Car 88	11-Jan-18
150.	Bodyshell delivered to erection stage — Car 89	11-Jan-18
151.	Bodyshell delivered to erection stage — Car 90	15-Jan-18

Numbering as per Appendix 1 to Part B of Schedule 10	Milestone	Scheduled Date for Achievement
153.	Bodyshell delivered to erection stage — Car 91	16-Jan-18
154.	Bodyshell delivered to erection stage — Car 92	18-Jan-18
155.	Bodyshell delivered to erection stage — Car 93	19-Jan-18
157.	Bodyshell delivered to erection stage — Car 94	22-Jan-18
158.	Bodyshell delivered to erection stage — Car 95	23-Jan-18
159.	Bodyshell delivered to erection stage — Car 96	25-Jan-18
160.	Bodyshell delivered to erection stage — Car 97	26-Jan-18
161.	Bodyshell delivered to erection stage — Car 98	29-Jan-18
162.	Bodyshell delivered to erection stage — Car 99	30-Jan-18
163.	Bodyshell delivered to erection stage — Car 100	01-Feb-18
165.	Bodyshell delivered to erection stage — Car 101	02-Feb-18
166.	Bodyshell delivered to erection stage — Car 102	05-Feb-18
167.	Bodyshell delivered to erection stage — Car 103	06-Feb-18
168.	Bodyshell delivered to erection stage — Car 104	08-Feb-18
169.	Bodyshell delivered to erection stage — Car 105	09-Feb-18
170.	Bodyshell delivered to erection stage — Car 106	12-Feb-18
171.	Bodyshell delivered to erection stage — Car 107	13-Feb-18
172.	Bodyshell delivered to erection stage — Car 108	15-Feb-18
173.	Bodyshell delivered to erection stage — Car 109	16-Feb-18

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Numbering as per Appendix 1 to Part B of Schedule 10	Milestone	Scheduled Date for Achievement
174.	Bodyshell delivered to erection stage — Car 110	19-Feb-18
175.	Bodyshell delivered to erection stage — Car 111	20-Feb-18
177.	Bodyshell delivered to erection stage — Car 112	22-Feb-18
178.	Bodyshell delivered to erection stage — Car 113	23-Feb-18
179.	Bodyshell delivered to erection stage — Car 114	26-Feb-18
181.	Bodyshell delivered to erection stage — Car 115	27-Feb-18
183.	Bodyshell delivered to erection stage — Car 116	01-Mar-18
184.	Bodyshell delivered to erection stage — Car 117	02-Mar-18
185.	Bodyshell delivered to erection stage — Car 118	05-Mar-18
187.	Bodyshell delivered to erection stage — Car 119	06-Mar-18
188.	Bodyshell delivered to erection stage — Car 120	08-Mar-18
189.	Bodyshell delivered to erection stage — Car 121	09-Mar-18
191.	Bodyshell delivered to erection stage — Car 122	12-Mar-18
193.	Bodyshell delivered to erection stage — Car 123	13-Mar-18
194.	Bodyshell delivered to erection stage — Car 124	15-Mar-18
195.	Bodyshell delivered to erection stage — Car 125	15-Mar-18
197.	Bodyshell delivered to erection stage — Car 126	19-Mar-18
199.	Bodyshell delivered to erection stage — Car 127	20-Mar-18
200.	Bodyshell delivered to erection stage — Car 128	22-Mar-18

Numbering as per Appendix 1 to Part B of Schedule 10	Milestone	Scheduled Date for Achievement
201.	Bodyshell delivered to erection stage — Car 129	23-Mar-18
203.	Bodyshell delivered to erection stage — Car 130	26-Mar-18
204.	Bodyshell delivered to erection stage — Car 131	27-Mar-18
205.	Bodyshell delivered to erection stage — Car 132	29-Mar-18
208.	Bodyshell delivered to erection stage — Car 133	03-Apr-18
209.	Bodyshell delivered to erection stage — Car 134	04-Apr-18
210.	Bodyshell delivered to erection stage — Car 135	05-Apr-18
213.	Bodyshell delivered to erection stage — Car 136	09-Apr-18
214.	Bodyshell delivered to erection stage — Car 137	10-Apr-18
216.	Bodyshell delivered to erection stage — Car 138	11-Apr-18
217.	Bodyshell delivered to erection stage — Car 139	12-Apr-18
219.	Bodyshell delivered to erection stage — Car 140	16-Apr-18
220.	Bodyshell delivered to erection stage — Car 141	17-Apr-18
221.	Bodyshell delivered to erection stage — Car 142	18-Apr-18
223.	Bodyshell delivered to erection stage — Car 143	19-Apr-18
224.	Manufacturer Fit Out Assets Accepted – Chingford	23-Apr-18
225.	Bodyshell delivered to erection stage — Car 144	23-Apr-18
226.	Bodyshell delivered to erection stage — Car 145	24-Apr-18
228.	Bodyshell delivered to erection stage — Car 146	25-Apr-18

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Numbering as per Appendix 1 to Part B of Schedule 10	Milestone	Scheduled Date for Achievement
229.	Bodyshell delivered to erection stage — Car 147	26-Apr-18
230.	Bodyshell delivered to erection stage — Car 148	30-Apr-18
231.	Bodyshell delivered to erection stage — Car 149	01-May-1
233.	Bodyshell delivered to erection stage — Car 150	02-May-18
234.	Bodyshell delivered to erection stage — Car 151	03-May-18
236.	Bodyshell delivered to erection stage — Car 152	08-May-18
237.	Bodyshell delivered to erection stage — Car 153	09-May-18
238.	Bodyshell delivered to erection stage — Car 154	10-May-18
239.	Bodyshell delivered to erection stage — Car 155	11-May-18
241.	Bodyshell delivered to erection stage — Car 156	15-May-18
242.	Bodyshell delivered to erection stage — Car 157	16-May-18
243.	Bodyshell delivered to erection stage — Car 158	17-May-18
244.	Bodyshell delivered to erection stage — Car 159	18-May-18
247.	Bodyshell delivered to erection stage — Car 160	22-May-18
248.	Bodyshell delivered to erection stage — Car 161	23-May-18
249.	Bodyshell delivered to erection stage — Car 162	24-May-18
250.	Bodyshell delivered to erection stage — Car 163	25-May-18
253.	Bodyshell delivered to erection stage — Car 164	30-May-18
254.	Bodyshell delivered to erection stage — Car 165	31-May-18

Numbering as per Appendix 1 to Part B of Schedule 10	Milestone	Scheduled Date for Achievement
257.	Bodyshell delivered to erection stage — Car 166	01-Jun-18
258.	Bodyshell delivered to erection stage — Car 167	05-Jun-18
260.	Bodyshell delivered to erection stage — Car 168	06-Jun-18
262.	Bodyshell delivered to erection stage — Car 169	07-Jun-18
263.	Bodyshell delivered to erection stage — Car 170	08-Jun-18
264.	Bodyshell delivered to erection stage — Car 171	11-Jun-18
267.	Bodyshell delivered to erection stage — Car 172	13-Jun-18
268.	Bodyshell delivered to erection stage — Car 173	14-Jun-18
269.	Bodyshell delivered to erection stage — Car 174	15-Jun-18
270.	Bodyshell delivered to erection stage — Car 175	18-Jun-18
273.	Bodyshell delivered to erection stage — Car 176	20-Jun-18
274.	Bodyshell delivered to erection stage — Car 177	21-Jun-18
275.	Bodyshell delivered to erection stage — Car 178	22-Jun-18
276.	Bodyshell delivered to erection stage — Car 179	25-Jun-18
279.	Bodyshell delivered to erection stage — Car 180	27-Jun-18

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Part B Project Programme

Schedule 4
LO Infrastructure – Routes

[redacted]

Table A: West Anglia

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Tottenham South Junction	South Tottenham	TAH		AC	Passenger service (scheduled)	Services will run on Saturdays, also diversionary route	
South Tottenham	Seven Sisters North Junction	SSL		AC	Passenger service (scheduled)	Services will run on Saturdays, also diversionary route	
Coppermill North Junction	Stratford Central Junctions	SDC		AC	Passenger service (scheduled)	Diversionary routes	
Clapton Junction	Broxbourne	CJC		AC	ECS Movement		
London Liverpool Street 1-18	Cheshunt via Turkey Street	LTN1 HDT		AC	Passenger service (scheduled)		
Bury Street Junction	Enfield Town	ENT		AC	Passenger service (scheduled)		
Hackney Downs	Chingford	BGK HDT CJC		AC	Passenger service (scheduled)		
London Liverpool Street 1-18	Shenfield	LTN1 SSV		AC	ECS Movement		

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
London Fenchurch Street 1-4	Bow Junction	LNE GFB		AC	Passenger service (scheduled)		
Temple Mills East Junction	Lea Junction	LLS1 LLS2		AC	ECS Movement		
Temple Mills East Junction	Channelsea Junction	LLS1 DWW2		AC	ECS Movement		
Ilford Depot		ICS		AC	ECS Movement		
Shenfield Sidings		SSV		AC	ECS Movement		
Gidea Park Sidings		LTN1		AC	ECS Movement		
Chingford Carriage Sidings		CJC		AC	ECS Movement		
Aldersbrook (Up) Car Holding Sidings		To Be Advised		AC	ECS Movement		
Orient Way Sidings		SDC		AC	ECS Movement		

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Coppermill North Junction	Tottenham South Junction	BGK		AC	Passenger service (scheduled)		
Clapton Junction	Coppermill North Junction	BGK		AC	Passenger service (scheduled)		
Tottenham South Junction	Cheshunt	BGK		AC	Passenger service (scheduled)		
Bow Junction	Stratford Central Junctions	LTN1		AC	Passenger service (scheduled)		
Stratford	Temple Mills East Junction	CST CHM LLS		AC	Passenger service (scheduled)		
Forest Gate Junction	Stratford Central Junctions	LTN1		AC	ECS Movement		

Table B: Class 378 Gospel Oak to Barking

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Gospel Oak	Barking platforms 1, 7 and 8	GOJ TAH		AC	Passenger service (scheduled)	New route	To be electrified
Forest Gate Junction	Woodgrange Park	FGW		AC	Passenger service (scheduled)	ECS Movement/ Passenger diversionary	
Harringay Park Junction	Harringay Junction	HPW		AC	ECS Movement	ECS Movement/ Passenger diversionary	To be electrified
Harringay Junction	Ferme Park Down sidings	HPW		AC	ECS Movement	ECS Movement/ Passenger diversionary	To be electrified
Upper Holloway	Tufnell Park Goods	TAH		AC	ECS Movement	ECS Movement/ Passenger diversionary	To be reinstated and electrified
Barking	Upney Junction	FSS		AC	ECS Movement		
Barking	East Ham Depot	FSS1		AC	ECS Movement		
Gospel Oak Junction	Covered Way (0m 43ch)	GOJ		AC	Passenger service (scheduled)	Up and Down lines	To be electrified

Table C: Upminster

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Barking	Upminster	FSS		AC	ECS Movement		
Romford all platforms	Upminster	ROU		AC	Passenger service (scheduled)		

Table D: Core ELL infrastructure

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Canal Junction	New Cross	ELL2		DC	Passenger service (scheduled)		
Dalston Junction Station	New Cross Gate Down Junction	ELL1		DC	Passenger service (scheduled)		
New Cross Gate Up Junction	Canal Junction	ELL1		DC	Passenger service (scheduled)		
Dalston Junction Station	A connection with the North London Line near Canonbury	ELL1		DC	Passenger service (scheduled)		
Highbury & Islington	Dalston Junction	ELL1		DC	Passenger service (scheduled)		
New Cross Gate CSD		ELL4		DC	(ELR carriage servicing depot ECS Movement only)		

Table E: ELR network

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Balham Junction	Clapham Junction 2.66 miles from Vic. on VTB1	VTB1		DC	ECS Movement		
Clapham Junction 2.66 miles from Vic. on VTB1	Pouparts Junction	VTB1		DC	Passenger service (diversionary)		
Bromley Down Junction	Norwood Junction	BJN2		DC	ECS Movement		
Crystal Palace Tunnel Junction	Sydenham Up Junction	SCP		DC	Passenger service (scheduled)		
Factory Junction	Longhedge Junction	FLL1		DC	Passenger service (scheduled)		
Factory Junction	Battersea Park platform 2	ATL		DC	Passenger service (diversionary)	Diversionary	
Falcon Junction	Pouparts Junction	VTB1		DC	Passenger service (diversionary)		
Gloucester Road Junction	Selhurst Junction	WCS		DC	ECS Movement		

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Lavender Hill Junction	Ludgate GW Junction	FLL3		DC	Passenger service (scheduled)		
Longhedge Junction	Pouparts Junction	BSP2		DC	Passenger service (diversionary)		
Longhedge Junction	Lavender Hill Junction	FLL2		DC	Passenger service (scheduled)		
New Cross Gate $2^1/_2$ m.p.	Norwood Junction (West Croydon Junction)	LBW		DC	Passenger service (scheduled)	Access to No. 1 Carriage Road (for ECS Movements)	
Norwood Junction	Bromley Up Junction	BJN1		DC	ECS Movement		
Norwood Junction	Selhurst Junction	NYD		DC	ECS Movement only		
Norwood Junction (West Croydon Junction)	West Croydon Station	NFE		DC	Passenger service (scheduled)		
West Croydon Station	West Croydon Reversing Siding	NFE		DC	ECS Movement		
Peckham Rye Junction	Shepherds Lane Junction	ATL	Atlantics	DC	Passenger service (scheduled)		

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Shepherds Lane Junction	Factory Junction	ATL	Atlantics	DC	Passenger service (scheduled)		
Sydenham Down Junction	Crystal Palace Tunnel Junction	SCP		DC	Passenger service (scheduled)		
Tulse Hill North Junction	Peckham Rye Junction	BTH1		DC	ECS Movement		
Peckham Rye Jn	Site of Old Kent Road Jn (on BTH1 between Old Kent Road and Horshay St)	BTH1		DC	Passenger service (scheduled)		
West Croydon Station	Norwood Fork Junction	NFE		DC	Passenger service (scheduled)		
West Croydon Reversing Siding	West Croydon Station	NFE		DC	ECS Movement		
Selhurst Jn	Windmill Bridge Jn	VTB1	Vic Fast/ Slow	DC	ECS Movement	Diversionary	
Norwood Junction (West Croydon Junction)	Windmill Bridge Junction	LBW	Slow / Fast	DC	Passenger service (diversionary)		

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Windmill Bridge Junction	East Croydon m.p. 10.5	VTB2	Slow / Fast	DC	Passenger service (diversionary)		
East Croydon mp 10.5	South Croydon	VTB2	Slow / Fast	DC	ECS Movement		
Windmill Bridge Junction	Norwood Fork Jns	LBW	Slow / Fast	DC	Passenger service (diversionary)		
No.1 Carriage Road (New Cross Gate)		LBW		DC	ECS Movement only	*(note to be designated as up carriage siding in future)*	
West Croydon platform 1		NFE		DC	Passenger service (scheduled)		

Table F: North London railway

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Acton Central	Acton Wells Junction	BOK5		AC	Passenger service (scheduled)		
Acton Wells Junction	Willesden High Level Junction	BOK4		AC	Passenger service (scheduled)		
Balham Junction	Falcon Junction	VTB1		DC	ECS Movement		
Bromley Jns	Balham Junction	BBJ		DC	ECS Movement		
Camden Junction	Watford Junction	CWJ	DC Lines	DC	Passenger service (scheduled)	4th rail Kilburn - Harrow	
Camden Road East Junction	Dalston Western Junction	BOK1		AC	Passenger service (scheduled)		
Camden Road Junction	Camden Road East Junction	BOK1		AC/DC	Passenger service (scheduled)		
Camden Road Junction	Change of ELR (5m 23ch)	2CRC1		AC/DC	Passenger service (diversionary)		
Change of ELR (5m 23ch)	Primrose Hill Junction	CRC2		AC/DC	Passenger service (diversionary)		
Channelsea North Junction	High Meads Junction	CHM		AC	ECS Movement only		

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Channelsea South Junction	Stratford Central Junction	CST		AC	Passenger service (scheduled)		
Clapham Junction	Richmond station platform 3	RDG1		DC	ECS Movement only		
Clapham Junction platform 2	Latchmere No.2 Junction	CJL	Fast/Slow	DC	Passenger service (scheduled)		
Dalston Western Junction	Victoria Park Junction	DWW1		AC	Passenger service (scheduled)		
Euston	Camden Junction	LEC1	DC lines	AC/DC	Passenger service (scheduled)	Euston platforms 9/10	
Camden Junction	Watford Junction	LEC1	Fast/Slow	AC	ECS Movement only		
Euston (all platforms)	Camden Junction	LEC1	Fast/Slow	AC	Passenger service (diversionary)		
Factory Junction	Herne Hill South Junction	VIR	Chathams	DC	ECS Movement only		
Falcon Junction	North Pole Junction	WLL		DC	Passenger service (scheduled)		

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Gunnersbury Junction	South Acton Junction	SAR1		DC	Passenger service (scheduled)		
Harlesden Junction	Sudbury Junction	WTS	U&D Goods 1/2	AC	ECS Movement only		
Herne Hill South Junction	Tulse Hill North Junction	HHT		DC	ESCS Movement only		
High Meads Junction	Temple Mills East Junction	LLS2		AC	ECS Movement only		
Kensal Green HL Junction	Willesden Junction Low Level	KGW	New Lines	AC/DC	Passenger service (scheduled)	AC/DC changeover midway	
Kensal Green HL Junction	Harlesden Junction	KGC	City Lines	AC	ECS Movement only		
Kensal Green Junction	Camden Road Junction	BOK2		AC	Passenger service (scheduled)		
Lea Junction	High Meads Junction	LLS1		AC	ECS Movement only		
Leigham Junction	Tulse Hill South Junction	LTH		DC	ECS Movement only		

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Longhedge Junction	Latchmere No.1 Junction	CKL		DC	ECS Movement		
Mitre Bridge Junction	Willesden High Level Junction	WMB		AC	Passenger service (scheduled)		
Mitre Bridge Junction	West London Junction	WLL		AC	ECS Movement only		
North Pole Junction	Mitre Bridge Junction	WLL		AC	Passenger service (scheduled)		
Primrose Hill Junction	Camden Junction	CRC2	DC Electric	DC	Passenger service (diversionary)		
Primrose Hill Junction	Camden Junction	CRC2	Slow Line	AC	ECS Movement only		
Richmond station	Gunnersbury Junction	SAR2		DC	Passenger service (scheduled)	4th rail	
Selhurst Junction	Balham Junction	VTB1	Fast/Slow	DC	ECS Movement		
South Acton Junction	Acton Central	BOK5		DC	Passenger service (scheduled)		

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Stratford Central Junction	Temple Mills West Junction 6.25 m.p.	SDC		AC	Section from Stratford Central Jn to Stratford platforms 11&12 is for passenger service (scheduled). Remainder to Temple Mills West Junction is ECS Movement only		
Channelsea South Junction	Stratford (new) platforms 1 and 2	CST		AC	Passenger service (scheduled)		
Stratford Central Junction	Ilford Depot London End Junction	LTN1	Main / Electric	AC	ECS Movement only		
Streatham Common Junction	Streatham Junction	SSC		DC	ECS Movement only		
Streatham Junction	Tulse Hill North Junction	BTH1		DC	ECS Movement only		
Victoria Park Junction	Channelsea South Junction	DWW2		AC/DC	Passenger service (scheduled)		

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
West London Junction	Wembley Central Junction	LLG	Relief Lines	AC	ECS Movement only		
West Norwood Junction	Tulse Hill South Junction	WTH		DC	ECS Movement only		
Willesden High Level Junction	Kensal Green Junction	3BOK2		AC	Passenger service (scheduled)		
Camden Carriage Sidings		LEC1		AC	ECS Movement only		
Harrow & Wealdstone Centre Siding		CWJ		DC 4th rail	ECS Movement only		
Ilford EMU Depot		ICS		AC	ECS Movement only		
Kensal Green Reversing Siding		BOK2		AC	ECS Movement only		
Orient Way (Temple Mills) CSD		SDC		AC	ECS Movement only	Orient Way (Temple Mills) CSD open	

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Stratford platforms 1 and 2 (new NLL platforms)		DWW		AC	Passenger service (scheduled)		
Watford Tip Sidings		LEC1		DC	ECS Movement only		
Watford Yard but **NOT** Watford junction platform 11		WSA		AC	ECS Movement only		
Willesden TMD		WZS		AC/DC	ECS Movement only		
Willesden TMD Loop		LEC1		AC	ECS Movement only		
Camden Rd Central Junction	Copenhagen Junction	CRF1/NLI		AC	ECS Movement only	Over LNE boundary	
Copenhagen Junction		ECM1		AC	ECS Movement only		
Dalston Western Junction	Canonbury West Junction	BOK		AC	ECS Movement only		

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Canonbury West Junction		BOK			ECS Movement only		
Camden Rd West Junction	Camden Rd East Junction	BOK			ECS Movement only		
Camden Rd East Junction	Dalston Junction	BOK		DC	ECS Movement only	Reverse	
Canonbury West Junction	Finsbury Park	CFP		AC	ECS Movement only	Regional boundary	
Finsbury Park	Hornsey dn Rev Sidings	E.L.R. to be confirmed		AC	ECS Movement only	Reverse	
Hornsey dn Rev Sidings	Harringay up Rev Sidings	HPW		AC	ECS Movement only	Reverse	
Harringay up Rev Sidings	Hornsey EMU depot	ECM1		AC	ECS Movement only		
Camden Rd West Junction	Camden Rd East Junction	BOK			ECS Movement only		
Camden Rd East Junction	Kings X Incline	BOK			ECS Movement only	Regional boundary	

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Kings X Incline	York Way Nth Junction	BOK			ECS Movement only		
York Way Nth Junction	Copenhagen Junction	ECM1			ECS Movement only		
Copenhagen Junction	Finsbury Park	ECM1			ECS Movement only		
Finsbury Park	Hornsey dn Rev Sidings	ECM1			ECS Movement only		
Hornsey dn Rev Sidings	Harringay up Rev Sidings	HPW			ECS Movement only		
Harringay up Rev Sidings	Hornsey EMU depot	HPW			ECS Movement only		
Navarino Road Jn	Reading Lane Jn	GRE			ECS Movement only	ECS Movement reversing on the single line	

Table G: Additional routes

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Wandsworth Road Sidings	Battersea Reversible and berthing sidings	ATL BSF BSP		DC	ECS Movement only	New route	
Queens Road Peckham	London Bridge	LBW BTH1 LBC		DC	Passenger service (diversionary)	Previously ECS Movement	
New Cross Gate	London Bridge 8 to 16	LBW LBC		DC	Passenger service (diversionary)	Previously ECS Movement	
Norwood Junction	East Croydon	LBW VTB1 VTB2		DC	ECS Movement only	New route	
Canal Junction	Silwood Sidings	ELL		DC	ECS Movement only	New sidings	
Richmond platform 5	Clapham Junction	RDG1		DC	ECS Movement only	May be required in the future	
Willesden Sidings	Mitre Bridge Junction	WEL WLL		DC	ECs Movement only	May be required in the future	
Harlesden Junction	Works Foundry (TBA)	CAW (BTS4?)		DC	ECS Movement only	May be required in the future	

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
London Bridge 8 to 16	Slade Green Depot via Greenwich and Abbey Wood	LBW LBC NKL		DC	ECS Movement only	New route	
London Bridge 8 to 16	Slade Green Depot via Lewisham, Blackheath and Abbey Wood	LBW LBC BAY BEX BTC NKL		DC	ECS Movement only	New route	
London Bridge 8 to 16	Slade Green Depot via Kidbrooke, Bexleyheath and Slade Green	LBW LBC BAY BEX PSF		DC	ECS Movement only	New route	
Norwood Junction	Ashford Hitachi Depot via East Croydon, Redhill, Tonbridge and Ashford International	LBW VTB RED RED2 RTT XTD		DC	ECS Movement only	New route	

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
London Bridge	Tonbridge via Sevenoaks	LBC LBW XTD BAY RTT		DC	ECS Movement only	New route	
New Cross Gate Depot	Ashford Hitachi Depot via Ladywell Loop, Beckenham Junction, Swanley, Maidstone Barracks and Ashford	XTD LVT LCH NBB VIR SBJ		DC	ECS Movement only	New route	
Ashford International	Ramsgate Depot via Canterbury West, Minster and Ramsgate	XTD ACR		DC	ECS Movement only	New route	
Ashford International	Ramsgate Depot via Folkestone and Dover	XTD FDM		DC	ECS Movement only	New route	
Ashford Hitachi Depot				DC	ECS Movement only		

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Ramsgate EMU Depot				DC	ECS Movement only		
Slade Green EMU Depot				DC	ECS Movement only		
Willesden F sidings	Brent New Junction (Willesden Relief Lines)	MD101 LLG		AC	ECS Movement only		
Brent New Junction (Willesden Relief Lines)	Willesden West London Junction	MD101 LLG WLL		AC	ECS Movement only		
Willesden West London Junction	Mitre Bridge Junction	MD165.2		AC	ECS Movement only		
Brent New Junction	Sudbury Junction	MD101 LLG	Willesden Relief Lines	AC	ECS Movement only		
Willesden No 7 Junction	Acton Canal Wharf Junction	MD170.1 ACW	Up and Down Acton Branch	AC	ECS Movement only	These lines are to be electrified	
Acton Canal Wharf Junction	Acton Wells Junction	MD1360.2 CAW		AC	ECS Movement only	These lines are to be electrified	

From	To	Eng. Line Ref.	Lines	Electrification	Notes 1	Notes 2	Notes 3
Wembley C sidings	Harlesden Junction	LEC1 UHL WEF1 WCL		AC	ECS Movement only		
Harlesden Junction	Kensal Green Junctions	KGC		AC	ECS Movement only		
Wembley C sidings	Willesden Junction (Acton Branch)	BOK WEF1 LLG		AC	ECS Movement only		
Wembley C sidings	Wembley Central	LEC1		AC	ECS Movement only		
Otford Junction	Sevenoaks	OJS		DC	ECS Movement only		
Chislehurst Junction	St. Mary Cray Junctions	CSM		DC	ECS Movement only	Up and Down lines	
Bickley Junctions	Petts Wood Junctions	TLP		DC	ECS Movement only	Fast and Slow lines	
Minster West Junction	Minster South Junction	MSW		DC	ECS Movement only		

Schedule 5
Contract Management

Appendix 1: Key Posts

1. Contract Managers

1.1 The Purchaser shall appoint a person to be its contract manager and authorise that person to act as the Purchaser's representative for all purposes of this Agreement (the ***Purchaser Contract Manager***). The Purchaser shall notify the Manufacturer in writing of the Purchaser Contract Manager's appointment or, where appropriate, the revocation of any such appointment. The Manufacturer shall only be bound by such an appointment or revocation of any such appointment of the Purchaser Contract Manager where it has been given the relevant written notice by the Purchaser of such appointment or revocation. The Purchaser shall endeavour to give one month's written notice to the Manufacturer (or such other period as the Purchaser may consider appropriate) of any replacement of the Purchaser Contract Manager. As at the date of this Agreement the Purchaser Contract Manager is Philip Clarke.

1.2 The Purchaser Contract Manager shall exercise such rights, powers, discretion, functions or options provided for in this Agreement on behalf of the Purchaser and, subject to paragraph 1.1 and the requirements for Purchaser Termination Notices and certain notices pursuant to the Change Procedure to be countersigned by a person authorised by the Purchaser, the Purchaser Contract Manager shall have full authority to act on behalf of the Purchaser for the purposes of this Agreement and the Manufacturer shall in all such matters look to the Purchaser Contract Manager as if such person were the Purchaser.

1.3 The Manufacturer shall appoint a person to be its contract manager and authorise that person to act as the Manufacturer's representative for all purposes of this Agreement (the ***Manufacturer Contract Manager***). The Manufacturer shall notify the Purchaser in writing of the Manufacturer Contract Manager's appointment or, where appropriate, the revocation of any such appointment. The Purchaser shall only be bound by such appointment or revocation of any such appointment of the Manufacturer Contract Manager where it has been given the relevant written notice by the Manufacturer of such appointment or revocation. The Manufacturer shall give one month's written notice to the Purchaser of any replacement of the Manufacturer Contract Manager. As at the date of this Agreement the Manufacturer Contract Manager is Philip Hennessey.

1.4 The Manufacturer Contract Manager shall exercise such rights, powers, discretion, functions or options provided for in this Agreement on behalf of the Manufacturer and, subject to paragraph 1.3, the Manufacturer Contract Manager shall have full authority to act on behalf of the Manufacturer for the purposes of this Agreement and the Purchaser shall in all such matters look to the Manufacturer Contract Manager as if such person were the Manufacturer.

1.5 Save as provided in paragraph 1.2, any instruction, direction or other act of the Purchaser Contract Manager shall bind the Purchaser and any instruction, direction or other act of the Manufacturer Contract Manager shall bind the Manufacturer.

2. Authorisation

2.1 Without prejudice to clause 5 (*Relationship with the Operator and Representatives*) of this Agreement, each Contract Manager may from time to time as he sees fit

authorise an assistant or agent to exercise any of the powers, rights, discretion, options and/or functions vested in him and such authorised functions carried out by such assistant or agent shall bind the Purchaser or the Manufacturer (as the case may be) (***Authorisation***). Each Contract Manager may at any time revoke any such Authorisation (***Revocation***). Any such Authorisation or Revocation shall be in writing signed by the relevant Contract Manager and shall state which rights, powers, discretion, options or functions are thereby Authorised or Revoked respectively. Each such Authorisation or Revocation by a Contract Manager shall take effect upon the other Party being given written notice of such Authorisation or Revocation.

2.2 The terms of such written Authorisation or Revocation shall be conclusive and the other Party shall have no claim if it relies on communication from any person other than the Contract Manager in the absence of such written Authorisation or disregarding such written Revocation (as the case may be).

2.3 If at any time either Party receives what it considers (acting reasonably) to be conflicting communications from the other Party, clarification should be sought from the relevant Contract Manager whose written determination shall be issued within seven Working Days and shall be conclusive as to the Authorisation.

3. Organisational Arrangements

3.1 The Manufacturer's internal organisational arrangements for the management of the Works (including names of Key Posts, reporting lines and organisation charts) shall be as set out in the Management Plan.

3.2 The Manufacturer shall ensure that the holders of Key Posts are appropriately qualified, experienced and available as necessary to undertake their duties under this Agreement. In particular, the holders of Key Posts shall have an appropriate mixture of the following attributes to support delivery of the Works:

(a) leadership skills; and

(b) relevant experience (such as working with relevant stakeholders, relevant standards, relevant planning regimes and the wider UK rail market).

3.3 The Key Posts shall be those roles specified in Appendix 1 (*Key Posts*) to this Schedule 5 and any additional roles that the Purchaser may add from time to time. One person may undertake more than one Key Post if approved by the Purchaser.

3.4 On and from the date of this Agreement, the identity of the person undertaking each Key Post shall be as set out opposite such Key Post in the table in Appendix 1 (*Key Posts*) to this Schedule 5. The Manufacturer shall only make changes to the identity of the Key Posts with the prior written approval of the Purchaser and shall provide curriculum vitae for candidates proposed for Key Posts and all additional relevant information that the Purchaser may reasonably request in order to grant such approval.

3.5 The Purchaser shall have the right, acting reasonably, to instruct that the Manufacturer remove and replace with an alternative candidate any person carrying

out a Key Post and the Manufacturer shall, as soon as practicable, comply with such instructions.

3.6 The Key Posts which shall be based in the Project Office during the respective period of engagement in the Works are indicated with an asterisk(*) in Appendix 1 (*Key Posts*) to this Schedule 5. All relevant staff supporting the Key Posts shall also be based in the Project Office.

3.7 Where a Key Post is required to be away from the Project Office at the Manufacturer's design or manufacturing facilities for a material length of time in order to carry out its obligations, a suitable substitute (approved by the Purchaser) shall be located in the Project Office during his absence.

4. Senior Managers Review Meetings

4.1 Every three Railway Periods from the Commencement Date, the Parties shall hold a meeting (the ***Senior Managers Review Meeting***) to review the progress of the Works and the Manufacturer's performance of its obligations under this Agreement. The Purchaser shall be entitled to call a Senior Managers Review Meeting more frequently if required. The Senior Managers Review Meeting shall continue to meet every three Railway Periods until such time as the Purchaser instructs otherwise.

4.2 The Parties shall each provide a senior representative to attend the Senior Managers Review Meeting (of a more senior position than the Contract Manager), along with each Contract Manager. The senior representative shall be an appropriate director of the Party in each case.

4.3 The Parties may each invite other representatives of their organisations, subcontractors and third Parties to attend the Senior Managers Review Meeting to the extent reasonably necessary to discuss specific agenda items.

4.4 The Manufacturer shall provide to the Purchaser any agenda items for discussion at the Senior Managers Review Meeting at least five Working Days prior to the meeting, accompanied by a paper summarising the issues to be discussed. The Purchaser shall prepare and distribute an agenda and papers in advance of the meeting including any issues the Purchaser wishes to discuss together with details of the location for such meeting. The agenda at each meeting shall also include a discussion of any current Disputes, but this shall be without prejudice to any ongoing formal dispute proceedings.

4.5 The Purchaser shall take minutes at each Senior Managers Review Meeting and circulate copies of the minutes to the Manufacturer for agreement. Once agreed by the Parties, these minutes shall form a full and accurate record of the meeting.

5. Communications and Document Control

Communications

5.1 (a) The Manufacturer shall use such electronic document management systems for written communications as shall be specified by the Purchaser from time to time in respect of the communications taking place during the period of this Agreement.

(b) The Contract Managers shall nominate users for these systems in each case and each Contract Manager shall notify the other Contract Manager of any changes necessary to user accounts and shall co-operate to prevent the misuse of these systems.

Document Control and Management

5.2 (a) Unless instructed otherwise by the Purchaser, the Manufacturer shall submit all written documents (including programmes and drawings) to be provided pursuant to this Agreement to the Purchaser in accordance with clause 47 (*Notices*) and:

(i) in English;

(ii) in electronic form;

(iii) in good legible quality;

(iv) where applicable, incorporating definitions, a graphic scale, and/or any other appropriate guide for interpretation; and

(v) under cover of a document transmittal in a format to be specified by the Purchaser.

(b) The Manufacturer shall submit all programmes (including the Project Programme) to the Purchaser in Primavera Project Planner or in such other form as the Purchaser may specify from time to time.

(c) The Manufacturer shall submit all large drawings to the Purchaser in hard copy as well as in electronic form.

(d) The Purchaser shall provide the Manufacturer with configured electronic document management systems and software which it shall employ for the purposes of the performance of the Works.

(e) The Manufacturer shall be responsible for training its staff and following the document management procedures prescribed by the Purchaser.

(f) Unless otherwise agreed with the Purchaser, each communication shall cover one subject only, and shall bear an individual sequential number in accordance with the system to be prescribed by the Purchaser.

(g) The Purchaser shall prescribe a coding protocol in respect of correspondence which shall be adopted by the Parties.

(h) Subject to clause 5 (*Relationship with the Operator and Representatives*) of this Agreement, all correspondence between the Manufacturer on the one hand and other Parties appointed or under the control of the Purchaser or any member of the TfL Group on the other relating or linked to this Agreement or the subject matter of this Agreement, shall be made through the Purchaser.

Time for communications

5.3 Save as expressly provided to the contrary in this Agreement, each Party shall respond to communications from the other Party within 5 Working Days of their receipt of such communication.

6. Project Programme

Representation and Warranty

6.1 The Manufacturer represents and warrants to the Purchaser that the Project Programme complies with the requirements described in this paragraph 6 and Part A (*Key Programme Dates*) of Schedule 3 (*Project Programme*).

Project Programme Requirements

6.2 (a) The Project Programme shall be in Primavera P6 (version 8.2 or later) and shall clearly identify the start and finish dates and the critical path for the Works up to and including Fleet Acceptance. Interfaces with other Parties, including but not limited to NR and the Operator shall also be shown clearly on the Project Programme.

(b) The Project Programme shall be in logic linked CPM network format showing the critical path(s), early start and finish dates, late start and finish dates and total float. Submissions shall be made in both hardcopy and electronic (Primavera .xer) formats.

(c) The Manufacturer shall maintain a hierarchy of programmes that support each other whilst keeping detail at the appropriate level within the hierarchy. In this way duplication of effort during the update cycle should be avoided.

(d) No activity in the Project Programme should last longer than 20 Working Days with the exception of submission review/acceptance and material fabrication/procurement activities and the through life elements.

(e) The Project Programme shall include activity descriptions which describe which work is to be carried out and where and use of the Primavera Log for additional descriptive information, as required.

(f) No more than 25 per cent. of the activities that constitute the controlling operations or critical path shall be critical (critical activities being defined as float in the range of one to ten Working Days).

(g) The following table identifies each level of the programme hierarchy:

Prog. Level	Description	Comments	Software
Level 1	Manufacturer's summary schedule	1-2 page summary of the Project Programme	Excel
Level 2	Manufacturer's summary engineering,	Logic-linked CPM network. summary of	P6

Prog. Level	Description	Comments	Software
	procurement, fabrication, construction and commissioning Schedule	Level 3 Project Programme	
Level 3	Project Programme	Resource loaded logic-linked CPM network	P6
Level 4	Project Progress Report	Detailed management tool identifying each major deliverable and status	Excel or Access
Level 4	Manufacturer's procurement schedule	Detailed procurement control tool identifying all major purchase orders and subcontracts and their status	Excel or Access
Level 4	Manufacturer's weekly work plan (four week rolling programme)	Suitable level of detail to assess progress and plan work operations on a weekly basis	Excel
Level 4	Manufacturer's Testing, Commissioning, Integration and Assimilation Programme	Logic-linked CPM network for use in co-ordinating the said activities	P6

Contents of Project Programme

6.3 Without prejudice to the Train Technical Requirements and paragraph 6.2, the Project Programme shall set out, as a minimum, start and finish dates and dependencies for each of the following which shall reflect and be consistent with the other requirements of this Agreement:

(a) in respect of the Units:

(i) each Stage and Stage Gate Review within the "'V" life-cycle model for the development and design of each Subsystem and Vehicle Design Area;

(ii) the design review process (including Design Freeze Dates) for each Subsystem and each Vehicle Design Area;

(iii) the procurement of each system, Major Component and Part for each Subsystem and each Vehicle Design Area;

(iv) the manufacture of each Unit, including each stage of production for each Vehicle forming part of that Unit;

(v) Type Testing, including static type testing, testing on test-track and testing on the LO Infrastructure, and in each case detailed by test and in accordance with the Agreed Testing Programme;

(vi) Factory Acceptance Tests of the Units in accordance with the Agreed Testing Programme;

(vii) all Relevant Approvals as required by this Agreement;

(viii) the provision of the Mock-Up and any other mock-ups and the dates for each of the processes associated with the development of each mock-up including inspections and approvals;

(ix) inspections of each Unit (detailed by each inspection and Unit);

(x) the certification by the Manufacturer and external body certification (detailed by item);

(xi) the delivery and commissioning of each Unit;

(xii) achievement of each Acceptance stage for each Unit;

(xiii) the delivery of each Technical Case in accordance with the Technical Case Plan; and

(xiv) the start and finish dates and the critical path for each relevant stage to Fleet Acceptance;

(b) in respect of the Manuals, each stage of the development, review and production of the Manuals;

(c) in respect of each Spare and Special Tool, each stage in the development, design, manufacture, testing, delivery of such Spare or Special Tool, and achievement of Equipment Acceptance for each such Spare or Special Tool;

(d) in respect of the Simulator, each stage in the development, design, manufacture, testing, delivery, installation and commissioning of the Simulator;

(e) in respect of the Manufacturer Fit Out Assets, each stage in the testing, delivery, installation and commissioning of such assets;

(f) the provision of the Initial Spares and the Initial Special Tools and dates for delivery of tranches of each;