

Category 2 Standard

S2503 Wayside signalling

(Formerly E7005)

Issue No.: A3

Issue date: January 2013
Review date: January 2018

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1 Purpose

- 1.1 The purpose of this Standard is to set out the London Underground (LU) functional and performance requirements for the safe system design, application design, installation and maintenance of conventional, fixed block and wayside signalling.

2 Scope

- 2.1 This standard applies to conventional, fixed block, wayside signalling.
- 2.2 This standard does not apply to continuous automatic train protection, automatic train control system, non vital control systems and to depots.
- 2.3 For areas in which multiple aspect signalling is employed to facilitate the operation of other Train Operators, special consideration may be required which shall be agreed with LU.

3 Requirements

3.1 User and system requirement specifications

- 3.1.1 The design of wayside signalling shall be based on a User Requirements Specification and a System Requirements Specification.
- 3.1.2 The design of wayside signalling shall be based on a User Requirements Specification and a System Requirements Specification.
- 3.1.3 The System Requirements Specification shall incorporate the User Requirements Specification and shall include a specification of all the system features, technical requirements and functionality.
- 3.1.4 The Systems Requirements Specification shall define any interim arrangements which may be necessary if a phased implementation of the system is proposed.

3.2 Signalling functional requirements

3.2.1 General

- 3.2.1.1 Train movements shall be controlled as follows:

- a) On main running lines, by a two-aspect colour light signal system;
- b) For shunting movements to, from or across running lines, by mechanical or optical disc.

The following classes of signals are defined in the LU Rule Book;

- a) Fixed signals:
 - 1) Running signals;
 - 2) Junction indicators.
- b) Shunt signals:
 - 1) Calling-on signal;
 - 2) Warning signals.
- c) Repeating signals:

- 1) Running repeating signal;
 - 2) Fog repeating signal;
 - 3) Platform repeating signal;
 - 4) Warning lights in tunnel sidings.
- d) Approach control signalling.
 - e) Draw-up signals.
 - f) "X" signals.
 - g) "A" signs at controlled signals.
 - h) Remote securing signs.

3.2.1.2 Stop signals on running lines (excluding pre-set shunt signals) and shunt signals shall be provided with a trainstop device which operates in conjunction with the signal.

3.2.1.3 If a train passes a stop signal at danger, the associated trainstop shall bring the train to a halt within the overlap, by operation of the trainborne tripcock.

3.2.1.4 Controlled or semi-automatic signals shall be used at junctions and shall protect trains from conflicting and following moves.

3.2.1.5 Automatic signals shall be used on plain sections of track to keep following trains spaced at a safe distance. These signals shall be operated purely by the passage of trains.

Note: Signal sighting is defined in S2507, Sighting of lineside signals; signs and indicators; Signal numbering is defined in S2502, Design of safety signalling.

3.2.2 Signal numbering

3.2.2.1 Automatic signals which are used to protect operational floodgates shall have numbers prefixed by a code consisting of the letter 'F' (identifying the signal as floodgate signal), followed by a letter for the line concerned, and then the letter 'X'. In the case of the East London section of the Metropolitan Line, for example, they carry the code 'FEX'.

3.2.3 Running Signals

3.2.3.1 Colour light running signals shall be installed on open and tunnel sections of the lines. On open sections, a hood shall be provided over each aspect and a facility to assist close-range visibility shall be provided for each aspect. The red aspect shall be positioned below the green aspect.

3.2.3.2 All running signals using incandescent lamps shall have either a double filament bulb or two bulbs per aspect to enable the train service to continue if one filament or bulb fails. The second filament or bulb shall be underrun and shall act as a standby, should the other one fail. It shall be visibly obvious when one filament of the displayed aspect has failed. LED signal lamp replacements shall incorporate redundant features to achieve the above.

3.2.3.3 Fibre optic or LED running signals may be considered but it must be emphasised that they require facilities to assist close-range visibility and have redundant arrangements for each aspect.

- 3.2.3.4 Three signal head types are used on LUL relating to their usage and sighting requirements, namely long range colour light (LRCL), short range colour light (SRCL) and tube tunnel types. LRCL signals shall only be used in outdoor sections and be designed to meet visibility requirements in bright sunlight. SRCL signals may be used where there is no requirement for the signal to be seen at long range, such as on curves, fog repeaters and station starting signals where trains are required to stop.
- 3.2.3.5 Short range colour light signals shall be used for running signals in sub-surface sections.
- 3.2.3.6 Signal sighting requirements are contained in S1195, S2507 and S2502.
- 3.2.3.7 The colour light aspects for running signals are described in 5.2. Colours for aspects shall be in accordance with the requirements of BS 1376.
- 3.2.3.8 Signals shall be of a consistent type in order to assist the train operator by avoiding the continual change of signal types.

3.2.4 Shunt Signals

- 3.2.4.1 Shunt signals shall be either of the mechanical disc type, with a horizontal red band on a white background, which shall be externally illuminated and cleared by the disc rotating 45 degrees in an anticlockwise manner, or the fibre optic type or LED type which are self-illuminating and simulate the action of the mechanical signal by the use of an alternative horizontal or angled red bar of light on a background of white light. Both types of signal authorise shunting movements at caution speed to a reversing mark, limit of shunt or stop board, or as far as the line is clear. Redundancy shall be employed within the lighting arrangement for fibre optic disc signals such that in the event of a failure the signal is recognisable and the fault is self-revealing.
- 3.2.4.2 Shunt signals which authorise movements to, from or across the running line to two or more routes shall be provided with a route indicator. This shall be fixed adjacent to the signal, and indicates the route selected in the form of a numeral which is illuminated on the display. The first route from the left is numbered '1', the second from the left '2', and so on.
- 3.2.4.3 Shunt signals may be situated on the same post as a running signal. In the case of the fibre optic shunt signal on the same post as a running signal, the shunt signal aspect shall only be illuminated when it is required to display proceed and the stop running signal is showing a danger aspect.

3.2.5 Junction Indicators

- 3.2.5.1 Signals authorising movements over diverging junctions shall comprise a two aspect stop signal together with one or more junction indicators.
- 3.2.5.2 Junction indicators shall be mounted on the same post and positioned above the signal, except where they are only required to be sighted at short range and low speed, when they shall be mounted at or close to the driver's eye level.
- 3.2.5.3 A junction signal shall indicate the selected route by illumination of a junction indicator for all except the highest speed route. Where the absence of a junction indicator on the highest speed route may lead to operator confusion (for example when the route over a scissors crossover to the opposite road is in fact the highest speed route) a junction indicator shall be provided for all routes.
- 3.2.5.4 Long range junction indicators shall comprise a line of three white lights dependent on whether 1, 2 or 3;

No. of diverging routes	Position of lights
1	45 degrees from the vertical
2	45 and 90 degrees from the vertical
3	45, 90 and 135 degrees from the vertical.

3.2.5.5 In the case of the standard three lamp junction indicators, at least two lamps shall be proved alight to enable the associated green aspect to clear to proceed. In other cases, the proving shall be such as to ensure that there is no ambiguity about the routing of the signal.

3.2.5.6 Junction indicators of a reduced size shall be provided at repeating signals of diverging running signals where the repeating signal can be sighted at green for the diverging route.

3.2.5.7 Reduced size junction indicators shall be provided at diverging signals in the tunnels.

3.2.5.8 The junction indicator lamps shall only illuminate if the selection for the signal is set and the train has been proved to have passed the associated sighting point.

3.2.6 Repeating signals (or 'repeaters')

3.2.6.1 Running repeating signals shall be installed where there is a possibility of a train operator not sighting a red signal in sufficient time to bring the train to rest using normal service braking at that signal. They shall display a green aspect when the repeated signal is displaying a green aspect and its trainstop is lowered, and any track circuits between the repeater and the repeated signal are unoccupied. At all other times they shall display a yellow aspect.

Note: Trainstops are not required for repeating signals.

3.2.6.2 Some running repeating signals for the signal ahead may be situated below the preceding running signal. Both aspects in the repeating signal shall be extinguished when the red aspect is illuminated in the running signal above. This shall also be considered when a separate repeating signal of another signal is in close proximity to the signal.

3.2.6.3 The requirements for a platform repeating signal shall be determined in consultation with the Business Unit responsible for the platform in question and the owner of the operational standard for such signals.

3.2.6.4 Where platform repeating signals are specified:

- the signals shall repeat the aspects displayed by station starting signals, shunt signals and junction indicators;
- the 'Proceed at caution' aspect of a shunt signal shall be repeated by a black band at 45 degrees to the horizontal on an illuminated white background;
- junction indicator shall be repeated by a line of light at the appropriate angle.

3.2.6.5 Fog repeaters shall be provided at a nominal 120 m in the rear of the signal they repeat and be mounted at train operator's eye level. They shall display a yellow aspect when the signal repeated, is at danger or the tracks in between are occupied, and a green aspect when the signal repeated is at clear to proceed. The yellow aspect lens shall have a black letter 'F' etched into the lens.

Note: Special arrangements exist in multiple aspect areas of the Metropolitan Line where white signals are used in place of green.

- 3.2.6.6 The colour light aspects for fog repeating signals are described in clause 5.2.
- 3.2.6.7 Fog repeating signals mounted on the same post as a running signal are controlled as described in clause 3.2.6.2.
- 3.2.6.8 Additional signals shall be provided in tube tunnels to reduce the risk of collision during the application of the "trip and proceed rules", where the view forward is restricted by the curvature of the track. Reference shall be made to S2502 for details.

3.2.7 Speed Control Signals

- 3.2.7.1 Speed control signals shall be provided up to signals where there is insufficient overlap to permit a full speed approach. When the train occupies the timing section of the speed control signal, the red aspect shall remain on until one the following is satisfied:
- a) a full speed overlap is available;
 - b) the speed of the approaching train had reduced to a level appropriate to the overlap available;
 - c) appropriate 'route-away' conditions are satisfied at the signal ahead.
- 3.2.7.2 Signals which allow a train to draw up to the next signal, by speed control, shall have an extra zero (0) appended to the signal number e.g. EC21 becomes EC210. In case of single digit numbered signals, two zeros (00) shall be appended, e.g. EC2 becomes EC200.

3.2.8 Fixed red lights

- 3.2.8.1 Fixed red lights shall be installed at all locations where there are no further colour light movements in that direction.
- 3.2.8.2 Single aspect fixed red lights shall be located at the ends of sidings and at terminal roads.
- 3.2.8.3 At sidings and terminal platforms, three fixed red lights shall be provided for each track, two side-by-side approximately 3m beyond the normal stopping point and the third at the extreme end of the track, subject to the exception where the third light would be sited less than 5m behind the main pair, in which case it should not be provided.

Note: The third fixed red light is not to be provided (if it would be less than 5m from the main pair) in order to prevent mis-reading by train operators.

- 3.2.8.4 Fixed red lights shall also be located in strategic locations on the running lines in order to assist in preventing 'wrong road' movements. Further details are given in S2502, Design of safety signalling.

3.2.9 Current rail gap indicators

- 3.2.9. Current rail gap indicators shall be used at current rail section gaps to indicate to train operators if the traction current in the next section is off. The indicators shall consist of three lamps with red lenses in a triangular arrangement in a white enamelled front plate with the legend RAIL GAP IND in black letters. The current rail gap repeater shall use the same signal with a yellow front plate with the legend RAIL GAP REP.

- 3.2.9.2 Details of the positioning and sighting requirements are given in S1195 and S2507 respectively.
- 3.2.9.3 Rail gap indicators shall be positioned at the commencement of current-rail sections in the direction of travel. Where a route contains elements of another traction section, a current rail gap indicator shall be mounted on or adjacent to the signal and be appropriately selected for that route.
- 3.2.9.4 If a running signal is located less than 100 m prior to a substation gap, the current rail gap indicator for that gap may be mounted on the same post, to minimise confusion for the train operator in terms of which comes first due to optical effects.
- 3.2.9.5 A repeater need not be provided if the indicator is positioned with a station starting signal. The sighting point need not be recorded on as-built drawings such as scale plans for the site.
- 3.2.9.6 Where a substation gap is located between stations, a co-acting current rail gap indicator shall be provided with the starting signal at the previous station, to prevent trains setting off towards the isolated section.
- 3.2.10 Tripcock tester indicator**
- 3.2.10.1 Tripcock testers shall be sited at locations which allow for functional in service testing at least once per timetabled round trip. The exact location shall be determined by factors such as normal train movements and avoidance of installation in areas of curved track.
- 3.2.10.2 The indicator shall be a single circular aspect which shall be illuminated as the train approaches the tripcock tester. It shall be extinguished if the tripcock is satisfactorily tested. This indicator shall be located under or near the station's starting signal and is described in engineering standard SCS-ST-0021.
- 3.2.11 'A' Sign**
- 3.2.11.1 A controlled signal which under certain circumstances may be treated as an automatic signal shall be provided with an illuminated 'A' sign. The 'A' sign shall be beneath the signal concerned and shall display the letter 'A' when illuminated and be extinguished when the signal is operating as a controlled signal. 'A' signs would typically be provided at sites which are normally left in through running mode, and where the interlocking of the through routes is secured, for example by the use of a king lever.
- 3.2.12 Tunnel siding yellow warning lights**
- 3.2.12.1 In addition to other protective measures, yellow warning lights shall be installed at 15 m nominal intervals in tunnel sidings where there is insufficient protection to prevent trains colliding with a fixed obstruction.
- 3.2.13 Signals not in use**
- 3.2.13.1 All signals not in use shall be covered to prevent the train operator from seeing them. The signal shall have its lamps removed and have an opaque black cover. For outdoor signals a white diagonal cross must be placed on the front of the signal head to indicate that the signal is not in use.
- 3.2.14 Particular signalling requirements**
- 3.2.14.1 All platforms shall be provided with a starting signal to authorise departure of passenger trains from the platform.
- 3.2.14.2 Where headway requirements dictate, a home signal shall be provided to protect a train in the station platform area, while allowing a following train to approach to a safe

distance from the platform. The overlap of the home signal shall terminate not less than 15 m from the entry end of the platform.

- 3.2.14.3 Any track circuit where a service train is likely to stand shall be designated as a berth track. Integrity of train detection at a train berth is particularly critical and shall be safeguarded by diversity or redundancy techniques to provide defence against wrong side failure of any one element of the train detection system.

3.2.15 Telephones at signals

- 3.2.15.1 Signal Post Telephones shall be provided at all stop signals on non-ATO Lines, other than those located at platforms.

Note: Signal Post Telephone Systems are described in Guidance Document G-CM-0003.

3.3 Signs

3.3.1 General functional requirements

- 3.3.1.1 All internally illuminated signs shall be constructed in such a way that the legend is not visible until the light is switched on.
- 3.3.1.2 Internally illuminated indicators shall have a safeguard against unreadable degradation in illumination level. Partial failure shall be readily detectable, where that condition would be detrimental to safety.
- 3.3.1.3 All passive signs, with the exception of signal number plates, shall be reflective to BS 5378 part 2 Class 1 (High Performance) Luminance Factor.
- 3.3.1.4 All signs shall be immune to the effects of detergents and compounds used for the removal of graffiti.
- 3.3.1.5 Signs shall be capable of being mounted in such a way as to meet sighting and gauging requirements of each location.
- 3.3.1.6 The size, shape, mounting and design of all signs shall ensure that they are unmistakably visible to a train operator (including any legend or information conveyed) from the worst case sighting distance required up to and including the point at which a train is standing at the sign.

Note: S1004 (Signage for Operational Purposes) defines the physical requirements for signage.

3.3.2 Permanent speed restriction signs

- 3.3.1.7 The requirement for the maximum permissible speed to be shown on the sign in miles per hour or in kilometres per hour shall be determined by the owner of operational standards in consultation with the respective Service Delivery Unit.
- 3.3.1.8 The requirement for the type of sign to indicate the termination of a permanent speed restriction shall be determined by the owner of operational standards in consultation with the respective Service Delivery Unit.

3.3.3 Remote securing of points

- 3.3.3.1 An internally illuminated sign bearing the legend "Route secured" shall be located on the signal reading over a set of points in areas where remote securing of points is an operational requirement.

3.3.4 Rear cab clear

- 3.3.4.1 An internally illuminated sign, normally provided for confirming stepping-back, shall be provided at the end of the platform to inform train operators that the previous train operator has shut down and alighted from the other end of the train.

3.3.5 End of siding countdown markers

- 3.3.5.1 Countdown markers shall be installed in order to alert train operators that the end of a reversing siding is being approached. Four markers shall be installed approximately one, two, three and four cars length from the stop mark. Each number shall display a number from 4 down to 1 indicating to the train operator the number of cars lengths remaining to the stop mark.
- 3.3.5.2 The countdown numbers shall be white on a reflective blue background. For tube sidings, the markers shall be mounted on the left hand tunnel wall. In open sections, the markers shall be mounted on sleepers in the four foot way to the left of the negative current rail, in a similar manner to stop marks.

3.3.6 Stop signs

- 3.3.6.1 Reflective stop signs shall be provided to reduce the risk of trains making unauthorised wrong road movements, as described in S2502.
- 3.3.6.2 Reflective stop signs shall be installed at the limit between track subject to control by signals and signalled and non signalled areas positioned such as to provide adequate allowances for overruns.

3.3.7 Limit of shunt signs

- 3.3.7.1 Where there is no stop signal to terminate a reversing movement, a reflective limit of shunt sign shall be installed to inform the train operator of the stopping position.

3.3.8 Signal number plates

- 3.3.8.1 All running signals and running repeating signals shall bear a number plate, with the signal number shown in letters and figures and shall be readable from a train stopped at the signal. The number shall be black on a white background for stop signals and black on a yellow background for repeating signals.
- 3.3.8.2 Shunt signal number plates shall consist of black lettering on a white background.
- 3.3.8.3 Where there is a possibility of confusion or mis-reading then the running, repeating, or shunt number plates shall bear an arrow, in black on a white background, pointing towards the track to which the signal applies.

3.4 Interlocking

3.4.1 Aspect control

- 3.4.1.1 The requirements for vital functions of the wayside signalling in controlled areas and junctions to be controlled by the interlocking system are described in . In addition, there are aspect control functions specific to wayside signalling systems, which shall be performed by the interlocking system and sub-systems. These are detailed in the following clauses.

3.4.2 Clear signal aspect

- 3.4.2.1 If the interlocking has identified a route as available and, that route has been requested from the control system, and when the interlocking conditions are confirmed