

Category 1 Standard

1-150 Telecommunications - OPO CCTV



Please read the
Written Notices
attached to this
standard

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Contents

1	Purpose	3
2	Scope	3
3	Requirements	3
3.1	General	3
3.2	Surveys and Design	5
3.3	Human Factors	7
3.4	Image Capture (Coverage of Platform)	8
3.5	Camera Alignment	8
3.6	Camera Assembly Performance	9
3.7	View Adjustment	10
3.8	Presentation of Captured Images	10
3.9	Station Based Equipment	13
3.10	Train Borne Equipment	13
3.11	Track Equipment	13
3.12	Track to Train Transmission System (In Cab Only)	14
3.13	Migration and Dual Running of Alien Stock	15
3.14	Power Supplies	15
3.15	Metrics	16
3.16	Commissioning (Imaging)	18
3.17	Commissioning In Cab only (Train)	19
3.18	Commissioning In Cab only (Track)	19
3.19	Commissioning (System)	19
3.20	Maintenance Regime	20
3.21	Reliability, Availability, Maintainability, Safety (RAMS)	20
3.22	Evidence of compliance	21
4	Supporting information	22
4.1	Background	22
4.2	Safety considerations	22
4.3	Environmental considerations	22
5	References	23
5.1	References	23
5.2	Abbreviations	24
5.3	Definitions	25
5.4	Technical content manager	25
5.5	Document history	26
6	Attachments	27
6.1	Attachment 1 - PTI Overlap Alignment Mark	27
6.2	Attachment 2 - OPO Camera Labels	28
6.3	Attachment 3 - Platform Image Format Presentation Layout	29
6.4	Attachment 4 - Platform Camera Layout	35
6.5	Attachment 5 - Current Written Notices	35

1 Purpose

- 1.1 The purpose of this Standard is to define the operational and technical requirements for a consistent configuration of image capture, logical presentation and system performance in order to mitigate the risk at the Platform Train Interface using only CCTV equipment.

2 Scope

- 2.1 This Standard applies to CCTV systems specifically designed and used for the capture of Real Time images of the PTI for display in Real Time on the platform or in the train Cab, in order that the train operator can mitigate ALARP, the risks for safe departure of the train from the platform in all driving modes, in any direction.

Note: This standard only considers CCTV for mitigating London Undergrounds number one risk at the PTI for the following reasons:

- a) CCTV provides the most efficient and optimal solution capturing the images close to the activity along the PTI;
- b) cameras and mirrors cannot be used together with the optimum image format utilised (HMRI have been critical of mirror and monitor combination format);
- c) mirrors alone cannot meet the Conspicuity requirements for all of the length of the PTI;
- d) mirrors cannot provide images for run out from the platform;
- e) Images from mirrors cannot be transmitted back to a Control Centre for operational use or maintenance monitoring;
- f) Images from mirrors cannot be checked remotely;
- g) Images from mirrors cannot be recorded for FIR's or for Police crime scene investigations.

- 2.2 This issue of the standard replaces SCS-ST0002-A2 Systems Standard for OPO Monitors and Mirrors and SCS-ST0034-A3 System Standard for OPO Track-to Train CCTV. SCS-ST0002-A2 is retained as an LU Category 2 Standard.

3 Requirements

3.1 General

- 3.1.1 The Train Operator shall have a clear view of the complete critical area of the PTI under all conditions at all times.
- 3.1.2 Full colour cameras and displays shall operate in all environmental conditions under which the train is expected to operate.
- 3.1.3 The OPO CCTV system shall be available 24 hours, 7 days a week.
- 3.1.4 A continuous health monitoring facility shall be provided to indicate the status of all aspects of the system, to ensure that the requirements of 3.1.1 and 3.17.1 are satisfied such that the complete system is fit for operational service 24 hours 7 days a week.



- 3.1.5 The correct platform Images shall be provided to the train operator for any combination of the following station platform arrangements:
- a) Island platforms with tracks running on both sides of the platform;
 - b) platforms with one or two track(s) running in between two opposite facing platforms;
 - c) platforms with alternative routes on the approach and departure sides;
 - d) platforms used by trains running in either direction;
 - e) platforms where trains terminate and reverse;
 - f) platforms where trains reverse.
- 3.1.6 As part of the safety justification a risk assessment shall be carried out for each platform in order to determine the following minimum parameters for the design:
- a) platform profile;
 - b) platform passenger loading;
 - c) platform signage;
 - d) camera locations;
 - e) platform furniture;
 - f) obstructions;
 - g) sunlight;
 - h) sunlight reflections;
 - i) differential lighting along a platform (i.e. under and beyond canopies);
 - j) all other environmental conditions.
- 3.1.7 Correct, continuous, stable images shall be presented to the train driver at all times without any sign of break-up, freezing, chrominance shift or any other impairment with a quality/impairment grading as described in 3.15.6 as follows:
- a) whilst stationary at stop position for both fixed platform & In-cab solutions.
 - i) a stopping chevron and the standard track marker (Diamond) shall be installed at the stopping position;
 - ii) or any other approved method. (All markers shall conform to LU standards).
 - b) platform approach (In-Cab solutions only):
 - i) Just before the train comes to rest at the stop mark, anywhere within the Correct Side Door Enable (CSDE) stopping tolerance
 - c) train speed (In-Cab solutions only):
 - i) images shall not be displayed at stations timetabled as non stopping or when the speed is above the threshold of 10KPH for station skip.
 - d) platform departure (Full PTI, In-Cab solutions only):
 - i) for full run out of the train from the PTI.
 - e) terminal platforms:
 - i) images are only required on departure and not on arrival.
 - f) No images shall be displayed once the rear of the train has cleared the stopping position or the PTI whichever is reached last.
- 3.1.8 An indication to show that the display is not used shall be provided on any unused display screen in order to avoid confusion of how many images should be present for any platform without using transmission bandwidth.

3.2 Surveys and Design

- 3.2.1 Following conceptual design and non intrusive site surveys for risk assessment, calculations shall be made to determine the appropriate location for each platform camera lens assembly in order to achieve the image size, appropriate for the number of cameras deemed to be necessary for that platform.

Note: Lens calculations for one third chip cameras for a PTI range of 135 metres can be found in the LU Manual of Good Practice G-150 where the target range, near blind distances and lens focal lengths are tabulated, together with camera and Fence Heights.

- 3.2.2 Full site surveys shall be carried out to validate the theoretical coverage and line of sight, using cameras mounted on tripods to simulate the intended installation (noting any changes to the ideal camera location on the platform, which are caused by any obstructions or fixing issues).
- 3.2.3 The Rotakin shall be used to determine that the target image height (%) is achieved at the far points and indeed throughout the range as defined in Section 3.15.
- 3.2.4 Temporary platform camera alignment and overlap markings and adjustment templates shall be used to ensure that the alignment in vertical and horizontal planes and the overlap between camera views as defined are adequately achieved.

Note: Details of the camera alignment and overlap markings are illustrated in Attachment 1 of this standard and platform templates are outlined in LU Manual of Good Practice G-150.

- 3.2.5 By adjustment of the camera position as defined in 3.5.3:

- a) relative to the area of interest (range);
- b) the height above platform level;
- c) the location relative to the platform edge;
- d) by the adjustment of the focal length of lens.

the vertical view shall provide:

- a) the required percentage target height at the far point;
- b) a top of the elevation 2400mm; and
- c) the centre of the camera overlap alignment platform mark nominally 1500mm from the bottom of the image at platform level (Platform profile dependant).

and the lateral cropped view shall provide:

- a) the coverage of the Defined PTI Corridor of not less than:
 - i) for 8 camera solutions, (4 images per display), 1300mm;
 - ii) for 2, 4 and 6 camera solutions (2 and 3 images per display), 1500mm.
in width parallel to the train body skin, of the platform and the gap.
- b) not less than 100mm of train at the centre of the alignment mark;
- c) sight lines through the centre of the PTI, parallel to the train body at the far range;
- d) visibility of the door portals;
- e) the gap between the train and platform;
- f) the nosing stone and tactile strip.

- 3.2.6 The captured PTI width at the centre of the alignment mark shall be maintained through to the far point for each camera as a minimum.



Note: This can be achieved by simple panning of the camera, provided that the camera is installed at the correct location relative to the platform edge for the nature of the platform profile.

- 3.2.7 The resolution of the camera assembly and any processing at platform level shall be measured in TV Lines Per Picture Height (TVLPPH) and mm/cycle as follows:
- place Rotakin target at near point of each camera and identify that the "F" Band can be clearly seen on the display being used to measure the performance;
 - move the target away from the camera along the PTI, target height diminishing and reference Band "F" reducing in clarity until it ceases to be clearly visible. At this position move the target back so that the point at which the band can just be clearly seen is located;
 - measure the target height by use of an overlay template on an under scanning display (>400TVL resolution) or use a pixel count (thus removing over-scanning errors). Tabulate the results of height and relevant "F" Band mm/cycle and location relative to the platform reference top of ramp;
 - repeat for successive mm/cycle bands to the far point for the camera;
 - repeat the above down the platform for each camera towards the head and tail wall respectively.

Note: This is to ensure that an average value throughout the PTI of 420TVL per picture height is achieved (i.e. values between 410 to 430TVL per picture height). This is to ensure that the overall end to end system horizontal limiting resolution of not less than 400TVL per picture height is achieved and is consistent throughout the PTI.

- 3.2.8 Lighting surveys shall be carried out at the same time to highlight any shortfall in lux levels on any platforms where the performance of the camera assembly may not be able to provide a safe solution in order for the operator to carry out their tasks.
- 3.2.9 The measurement of the illumination shall be carried out by placing a calibrated light meter on the platform in the centre of the PTI facing upwards towards the lighting, at least at 1000mm spacing down the platform from end to end.
- 3.2.10 All elements of the systems within the scope of this standard shall compensate for variations in ambient lighting conditions to the emergency lighting level needed to cope with degraded modes of operation of the railway.
- 3.2.11 Where platforms are subject to sunlight, reflections or both, mitigating methods to reduce their effect on the system's performance shall be included in the design.
- 3.2.12 It shall be possible to clearly view on a monitor, an adult of approx 1.6 metres high, walk the complete length of the PTI along the platform nosing stones, without the adult being in any way obscured for the entire length of the PTI.
- 3.2.13 During this walk test it shall also be possible to clearly see the departure baton held above head height and below the Fence Height of 2400mm above platform level.

Note: A train of the correct stock that will use the CCTV OPO will be required to be berthed in all platforms for final confirmation of coverage and sightlines.

- 3.2.14 Should a train not be available calculations shall be carried out to determine the position of the train in the platform and its profile relative to the platform in order to determine the gap between the train body and platform at the appropriate points along the PTI.

- 3.2.15 A full survey report for each station shall be compiled and submitted as part of the detailed design submission for all platforms with all of the relevant details for that platform and associated equipment as follows:
- tabulated resolution measurements for Rotakin band F down to K (depending upon camera range) together with distances from each camera in mm/cycle and TVLPPH;
 - all camera settings such as focal length, aperture, object focus setting, where appropriate Synch and burst levels and internal camera settings;
 - printed images shall be produced for record purposes of the images achieved and details taken of the dimensions of camera position relative to the platform edge height above the platform and location from top of ramp;
 - full drawings of each platform layout showing camera locations and any transmission equipment (radiating cables, transmitters, beacons etc);
 - full details of the lighting surveys carried out as defined in clause 3.2.9 at the same time to highlight any shortfall in lux levels on any platforms where the performance of the camera assembly may not be able to provide a safe solution in order for the operator to carry out their tasks.
 - details of the above ground platforms surveys of the path of the sunlight and any possible issues with reflections shall be carried out to establish if mitigation is required and how it will be provided.
 - a video clip of the complete walk test shall be provided on such media that replay can be achieved on a standard PC.

3.3 Human Factors

- 3.3.1 For platform based monitors, a human factor study shall be carried out to ensure adequate sight lines are available for all operators to be able to see the platform screens at all times for all stopping positions including stopping error tolerances.

Note: For each fixed platform design, the size and position of the display screens will depend upon the range of distances within the sight line cones to suit the normal operating positions and the dimensions of the operators i.e. 95 percentile male to 5 percentile female seated and standing for each cab design.

- 3.3.2 For In Cab Solutions, a human factor study shall be carried out to ensure adequate sight lines are available for all operators to be able to see the screens at all times.

Note: For in-cab monitors, the size of the display screens will depend upon the design of the control desk and the normal operating positions and the dimensions of the operators i.e. 95 percentile male to 5 percentile female seated and standing and ATO driving position.

- 3.3.3 The optimum viewing angle of the captured target (2 Year old Child) when viewed normal to the plane of the displays, shall be optimised to 54 minutes of arc and never less than 42 minutes of arc subtended to the operator's eye for all viewing positions.

Note: The limit of discernability is defined as 20 minutes of arc.

- 3.3.4 Platform mounted displays shall not obscure any signal sighting.

- 3.3.5 Operator training shall be provided for an understanding of:
- the objectives of the system;
 - how the system works and the background of its design;
 - how to use the system in the most efficient manner in order to detect targets along the PTI;



- d) how to use the system in conjunction with other operator tasks particularly on run out for in Cab solutions without prejudicing any other risks.

3.4 Image Capture (Coverage of Platform)

- 3.4.1 The critical area of the PTI shall be covered by utilising opposing cameras nominally overlapping at the platform centre, facing the head wall and tail wall respectively.
- 3.4.2 A minimum of 2 and a maximum of 8 cameras shall be used, in groups of 2, 4, 6 or 8.
- 3.4.3 The number of cameras facing the head and tail walls shall be determined by a risk assessment for each platform and meet the requirements in Attachment 4.

Note: Either 2 or 4 camera arrangements will satisfy most platforms, the multiples being used only where necessary.

- 3.4.4 The camera grouping shall follow the format illustrated in Attachment 3, such that the images presented are of the same basic format for each platform in order to satisfy consistency and Human Factors.
- 3.4.5 The cameras shall be installed such that the line of sight is centrally positioned through the critical area of the PTI of its coverage range and parallel to the train body up to and including its far point.

Note: Oblique views of the train are unacceptable as visibility along the defined PTI is likely to be severely impaired.

- 3.4.6 The standard camera alignment and overlap platform marking (Attachment 1) shall be used for all overlaps for both consecutive and opposing cameras.
- 3.4.7 Each platform is unique and shall be treated as such safely using the minimum number of images at all times for any platform in mitigating the risk, even if this means at consecutive platforms the numbers of cameras are different.

3.5 Camera Alignment

- 3.5.1 The cameras shall be installed at a height that is sufficient to view the PTI over the heads of customers but low enough for adequate sight line of the platform length and width.

Note: Wherever possible this height should nominally be 2750mm above the platform.

- 3.5.2 In accordance with the Structure gauge LU Category 1 Standard 1-156 Appendices E1 and C1 and LU Category 1 Standard 1-371, the minimum headroom structure clearance for 2000mm from the platform edge laterally is 2500mm above the platform. Therefore cameras shall be installed such that no part of the camera assembly including support structure is below this height and no closer than 300mm to the platform edge.
- 3.5.3 Therefore the cameras shall be installed such that the centre of the lens is as follows:
- for straight platforms with no curvature at all, between 600mm to 700mm in from the platform edge;
 - for Concave Platforms less than 600mm but not less than 350mm from the platform edge;
 - for Convex Platforms greater than 600mm but not more than 2000mm from the platform edge.
- 3.5.4 In all cases the sight line of the camera shall be central to the PTI throughout the range for each camera to its far point parallel to the train body/skin.

Note: LU Category 1 Standard 1-356 provides further information on PTI systems which includes camera locations and their sight lines.

- 3.5.5 The vertical alignment of all cameras shall be adjusted to achieve a minimum Fence Height of 2400mm, without compromising the image capture size or overlap, such that the platform baton can be seen at any point along the critical PTI length.
- 3.5.6 The overall coverage of the PTI shall be 100% without any blind spots.
- 3.5.7 The camera overlap alignment platform mark shall be clearly visible at the bottom of each image where the actual distance on platform of the centre of the mark is nominally 1500mm from the point of incidence of lower elevation of camera view (platform profile may modify this dimension).
- 3.5.8 The horizontal alignment shall be carried out such that each camera is positioned so that the train is always on the far left or right of the image at the camera overlap alignment platform mark.

Note: Cropping removes the unwanted wider platform area towards the back wall or boundary, thus providing the required narrow field of view covering the defined PTI area. However the full images are used remotely at the Lines service control centre and other local and remote viewing facilities.

- 3.5.9 Lateral adjustment (by panning the camera) shall provide the following:
- a) coverage of the PTI Corridor of not less than 1300mm and not more than 1700mm in width parallel to the train body skin, of the platform including the gap from the centre of the alignment mark to the far point;
 - b) not less than 100mm of train at the centre of the camera overlap alignment platform mark;
 - c) the platform outside edge shall dissect the intersection of the vertical and horizontal edges of the picture as shown in Attachment 3;
 - d) sight lines through the centre of the critical area of the PTI.

Note: This provides visibility of the door portals, the gap between the train and platform, the nosing stone and tactile strip.

- 3.5.10 Platform gauge templates shall be used for this alignment process at the near point making an appropriate allowance for the gap which will vary dependant upon the rolling stock and platform profile and car position relative to the camera overlap alignment platform mark.
- 3.5.11 In all cases the lens magnification of each camera shall be closely matched on each platform in order to provide a consistent image size and field of view, when two images are added together via the video splitter/combiner.

3.6 Camera Assembly Performance

- 3.6.1 The lens fitted to the camera shall not significantly reduce the overall optical performance of the system in terms of limiting resolution, Modulation Transfer Function (MTF) or introduce aberrations or distortions significant to the operator tasks.
- 3.6.2 The optical systems, including lens and camera housing faceplate, shall be optimised for maximum depth of focus between the near and far points, ensuring that the system resolution and MTF is uniform throughout the field of view and that they do not fall below that required over the length of the PTI.
- 3.6.3 In order to accurately achieve the optimum and accurate depth of field the Rotakin shall be placed at the calculated optimum object distance and the lens focussed.



- 3.6.4 Only fixed and zoom lenses shall be used, the use of vary-focal lenses are unacceptable unless evidence can be provided that the optical performance complies with clauses 3.6.1 and 3.6.2.

Note: Guidance on back focus and setting the Depth of Field accurately can be found in the LU Manual of Good Practice G-150.

3.7 View Adjustment

- 3.7.1 At no time shall the standard Rotakin be less than the percentage defined in section 3.15 for metrics of picture height anywhere within the operationally critical area of the PTI.
- 3.7.2 The captured Image size and view (area of coverage) shall be obtained by combined adjustments of:
- a) the focal length selection (adjustment) of the lens;
 - b) the installed camera height;
 - c) the angle of depression;
 - d) the distance from the far range point position.
- 3.7.3 The train, white line, yellow line and tactile strip shall be clearly visible from the bottom of the picture to the far point for each camera view.
- 3.7.4 It shall be possible to clearly see both the near and far camera overlap alignment platform marks in each camera on the display monitor from the normal range of operating positions.

3.8 Presentation of Captured Images

- 3.8.1 The images captured shall be cropped and added together with no more than 4 images per display screen.
- 3.8.2 All presented images shall be either a 2 way full vertical split, 3 way vertical split or 4 way vertical split (no full captured image used) as illustrated in Attachment 3.
- 3.8.3 Sufficient display screens shall be provided such that the processed cropped images are provided for the train operator as follows:
- a) for a two (2) camera configuration a single display screen shall be used:
 - i) the two (2) opposing images shall be cropped 50% of picture width from the train interface left or right dependant upon the side the platform is situated;
 - ii) the two (2) images shall be added together via a splitter/combiner unit and fed to the display system as a full image.
 - b) for a four (4) camera configuration, two display screens shall be used:
 - i) each of the two sequential images (Head and Tail Wall) shall be cropped at 50% picture width from the train interface left or right dependant upon the side the platform is situated;
 - ii) each of the two (2) images shall be added together via a splitter unit and fed to the correct display screen as a full image;
 - c) for a six (6) camera configuration; two screens shall be used:
 - i) each of three (3) sequential images (Head and Tail Wall) shall be cropped at 50% picture width from the train interface left or right dependant upon the side the platform is situated;



- ii) the three (3) image patches added together, zoomed down vertically and horizontally to fit the display screen format such that three images are displayed on each display in the correct sequence.