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Level 3

Track Inspection by PLPR system

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1 Purpose

This module describes the management of basic visual inspection using the Plain Line Pattern Recognition (PLPR) Inspection System, to achieve a consistent approach across the network to maintain the reliability and quality of PLPR Inspection and develop the skills and competence of staff.

2 Scope

This module is for use by the Route Asset Manager [Track] (RAM[T]), Route Asset Manager [Buildings and Civils] (RAM[B&C]) (or equivalent role, dependant on Route), Track Maintenance Engineer (TME), Section Manager [Track] (SM[T]), Section Planner/Administrator (SP/SA), On Train Technician (OTT), Examination Inspector (EI), Senior Delivery Manager (SDM), Integrated Control Centre (ICC), the Planning & Logistics Manager (P&LM) and NSC Central Planning Team and applies to basic visual inspection activity as set-out in NR/L2/TRK/001/Mod02 Inspection and Maintenance of Permanent Way - Inspection.

The procedure does not include arrangements for:

- SM[T] and TME Inspections
- Special inspections (for example those associated with hot weather, adverse weather, following an incident report or flooding or assets out of scope).

The PLPR inspection system is to be used for routine basic visual inspection (BVI) of Continuous Welded Rail (CWR) track with Pandrol PR, e and Re or Pandrol Fastclip using OmniVision/TGMS systems.

The PLPR inspection system will not be used for routine BVI of the following assets which are currently out of scope:

- S&C.
- Jointed Track.
- SHC (Spring Hoop Clip) Fastenings
- Fastening types out of scope for use of OmniVision.
- Buffer Stops.
- Adjustment switches.
- Track that has been painted white as a hot weather precaution.
- Items out of scope will continue to be inspected in accordance with NR/L3/TRK/1015/01 – Management of Basic Visual Inspection.

3 Definitions

For the purpose of this standard, the following terms and definitions apply.

≤

Used to define where a curve radius is less than or equal to the figure stated after the symbol.

>

Used to define where a curve radius is greater than the figure stated after the symbol

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3D cameras

Three dimensional cameras that take an image using a laser every 20mm of longitudinal movement to measure the distance from the camera to the nearest object below the train. This is used to provide a profile of the track and support the OmniVision system decision making.

Asset

A track component as reported by the OmniVision system

Boundary Mileage

The location at which two adjacent Section Managers Sections of Track abut.

Candidate

A generic term for an item that is identified by the TGMS/OmniVision system and presented to the Examining Inspector for verification, classification and prioritisation.

Component defect

A fault within any candidate as reported by the TGMS/OmniVision system.

Senior Delivery Manager (SDM)

This is a role within Data Collection Services responsible for management of the On Train Technicians, Examining Inspectors and the inspection trains.

Ellipse

Network Rail maintenance work management system.

Examination Inspector (EI)

Remotely based Track Inspector, competent in identifying faults using the OmniVision system.

Fasteners obscured by ballast

This refers to fasteners that are obscured by ballast to such an extent that the OmniVision system is unable to identify if a fastener is present. In some of these instances a track inspector would be able to see part of the fastener.

Fault Management System (FMS)

The Network Rail system used to record the details of infrastructure faults and follow it through from first instance to final closure.

Halcon

The machine vision software licenced by OEL from MvTec GmbH.

Identifiers

These are created using the machine vision software from a number of separate algorithms. They are used to identify and report on candidates.

Immediate Action Limit Defect (IAL)

A type of geometry or component defect which requires an immediate intervention in order to safeguard the passage of trains. For component defects these are also referred to as M0 defects.

Intervention Limit / Defect (IL)

A type of geometry defect which requires rectification within a specific period of time, in accordance with NR/L2/TRK/001.

Integrated Control Centre (ICC)

Network Rail integrated control centre that deals with all aspects of the operational railway including the logging and escalation of faults and the recording of mitigations.

Linescan cameras

Cameras that record an image one pixel long by either 1024 or 2048 pixels wide. These cameras are triggered every 0.8mm.

Maintenance Scheduled Task (MST)

Set activities that need to be carried out at set intervals, managed through the Ellipse

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system.

Omnicom Engineering Ltd (Omnicom)

The provider of the OmniVision system.

OmniVision

The automated solution for track inspection. It recognises the pattern of specified track components and determines their state based on recognised failure modes.

OmniVision Administrator

Person appointed by Omnicom to manage OmniVision system changes.

On-train equipment operating procedures

Local work instruction developed by the Data Collection Services team to manage the operations of the infrastructure monitoring fleet.

On Train Technician (OTT)

On Train Technician role with responsibility for the operation of the PLPR systems on the train.

Off Train Processing System (OTPS)

Processing System situated at Derby, this system is used to process and combine all the data streams for EI reviews.

Plain Line Pattern Recognition (PLPR) inspection system

For the purposes of this Standard the 'PLPR inspection system' is the combination of OmniVision, TGMS and Additional Inspections/mitigations that deliver the requirements of BVI as detailed in NR/L2/TRK/001.

Real Time Positioning System (RTPS)

System which provides the location of a train on the railway network and which is used predominantly by the infrastructure monitoring fleet. The coordinates for the OmniVision system match those provided for all other Network Rail infrastructure monitoring systems by measuring and taking account of the distance between each system on each train.

Recording deficiency

Where a problem occurs with the PLPR inspection system that results in the partial or complete loss of data from any of the OmniVision system cameras or supporting systems (i.e. track geometry measurement system (TGMS)). These are aligned to SM[T] areas; the extent of a recording deficiency is the cumulative length on a specific SM[T] area

Recording run

A continuous run undertaken by an Infrastructure Monitoring Train. There may be one or more recording runs undertaken during a shift .

Section of track

A continuous length of track under the management of one SM[T].

Thermal imaging cameras

These cameras continually record the temperature of the inside edge of the rail.

Track geometry measurement system (TGMS)

A Network Rail approved system used to measure and produce condition reports concerning the geometry of the track with respect to rail alignment, vertical level, dip angles and track gauge, this system is used to identify candidates to aid the EI in the identification track/component faults.

Working timetable (WTT)

The network timetable for rail services that have been planned under the long term planning process.

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4 PLPR inspection system boundaries

The features required to be observed during BVI are detailed in NR/L2/TRK/001.

The features to be observed in NR/L2/TRK/001 have been assessed to establish which features can be effectively inspected by the OmniVision/TGMS system. The features which are not inspected have been broken into three categories based on risk to the safety and performance of the railway:

- Features/faults that PLPR inspection system can be relied upon to identify using the OmniVision/TGMS systems
- Features/faults that can be relied upon to be identified by other existing inspection methods (e.g. Supervisors Inspection)
- Features/faults that require risk assessment to identify appropriate mitigation

4.1 OmniVision/TGMS general system boundaries

The OmniVision/TGMS system

- Analyses the track asset conditions within the length of the sleeper.
- Utilises track geometry measuring systems to report on track geometry.
- Measures and records ballast profile including the ballast shoulders.

4.2 Features/faults that PLPR inspection system can be relied upon to identify, using the OmniVision/TGMS systems

Inspection using the OmniVision system can identify the following defects:

Defect Details	Additional Comments
Ballast shoulder low or containing excessive ballast if obscuring fastenings.	TEF3227 sent to SM[T]
4ft containing excessive ballast if obscuring fastenings. .	Excessive ballast reported on TEF3227
Clogged and/or polluted ballast or slurried beds with an associated Immediate Action Limit (IAL) or Intervention Limit (IL) track geometry fault.	
Missing or ineffective fastenings.	
Ineffective sleepers (that is unable to provide vertical support or hold gauge) with an associated Immediate Action Limit or Intervention Limit geometry fault.	
Out-of-square sleepers either with an associated Immediate Action Limit or Intervention Limit gauge fault or where sleeper angle causes the fastener to be misaligned to the extent that it is not recognised by the machine vision application.	

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Defect Details	Additional Comments
Loose, damaged or incorrectly fitted gauge tie bars with an associated Immediate Action Limit, Intervention Limit or Alert Limit geometry fault.	If there is no gauge fault tie bars will not be inspected
Missing baseplates and broken baseplates where fastener is either misaligned or missing or associated with a IAL or IL TG fault.	
Defective timber sleepers (e.g. - Gauge pushing (shuffle), baseplate indentation, split along length or through screw holes, chair screw broken or loose, timber rotted) with an associated Immediate Action or Intervention Limit geometry fault	
Cyclic top (significant dips or voids 6m to 18m apart).	<i>All Immediate Action and Intervention Limit geometry defects are found by TGMS; associated image(s) are provided by OmniVision.</i> <i>dip angle thresholds have been reduced to support OmniVision.</i>
Dipped joints (measured over 1m).	
Voiding.	
Vertical and horizontal misalignments, and twist.	
Gauge widening (not designed).	
Insulated Rail Joints (IRJ) – including shop made and site made dry joints. Defects to be identified are: Battered or lipped rail ends. Dipped joint. Broken, damaged or missing bolts/nuts/MGLs/collars. Visibly loose bolts/nuts/MGLs/collars. Missing or defective fishplate insulation. Broken, missing or defective end posts. Broken or missing fishplates. Cracked fishplates where the crack is within the camera field of view.	IRJs will be presented for verification by EI if either: the joint gap is <4mm or >8mm. <i>NOTE not currently configured.</i> there is a dip angle greater than - Cat 1A, 1 & 2 = 10mRads - Cat 3 & 4 =15mRads 5 & 6 = 20 mRads

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Defect Details	Additional Comments
Visible rail head defects, including - cracks - mechanical damage - wheelburns - squats - shelling	Rail head defects will be presented for visible verification by EI if : - rail clamps are fitted - surface defects are greater than 50mm in length and 250mm² in area. <i>NOTE not currently configured.</i> <i>visible cracks are across the entire rail head.</i> <i>NOTE not currently configured.</i> - surface defects are associated with TG faults (i.e. wheel burns often create dip angles) Only defects that are not marked up as ultrasonically tested will be validated by the EI.
Broken rails and broken welds: - Transverse break through rail or weld. - Part of the rail head broken away. - Part of rail foot broken away / rail foot arc damaged. - Visible longitudinal split.	Defects will be presented for verification by the EI where: - the bespoke dip angle thresholds have been exceeded. - there are visible breaks across the entire rail head. <i>Note Rail foot loss cannot be found by OmniVision if ballast is covering the rail foot.</i>
Temporary rail clamping system defects including: - Correct number of clamps fitted. - missing clamps. - visibly loose assemblies. - locking nut not properly engaged (where fitted). - signs of striking by train e.g. inverted fishplates.	All clamps will be presented to EI for assessment. NOTE <i>Looseness of components / clamps is difficult to establish. Additional management arrangements may be necessary.</i>
Rail Flange Lubricator (RFL) defects including: - Dry grease dispensing unit/plates. - Visibly misaligned grease dispensing unit. - Excessive grease application. - Bursts or leakage of pipework within the length of the sleeper.	Asset locations will be provided to the OmniVision system. All RFLs will be presented to EI for assessment

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Defect Details	Additional Comments
Level Crossings - Defects in the level crossing surface system, including loose components and gaps and/or steps between the deck units where visible within the field of view of the cameras - Damage to or missing trespass guards. - Obstruction of flangeways.	Asset locations will be provided to the OmniVision system. All Level Crossings and RRAP's will be presented to EI for assessment Defects will only be identified if visible when not under load from road traffic.
Longitudinal timbers / direct fastening bridge-decks - Loose or dislodged packings / wedges - Broken baseplates - Missing coachscrews - Missing / broken out-of-scope rail fastenings - Damaged / broken transoms / tie bars - Severe timber indentation	Asset locations shall be provided to the OmniVision system All non-ballasted track underbridge decks will be presented to the EI for assessment Defects associated with TG faults will be highlighted.

Table 1 – Features/faults that PLPR inspection system can be relied upon to identify, using the OmniVision/TGMS systems

4.3 Features/faults that can be relied upon to be identified by other existing inspection methods

The following table provides a list of the features that are not specifically inspected by the OmniVision/TGMS system but which already have sufficient other inspections in place to maintain safe performance of the railway.

Features to be observed	Inspection method
Worn, broken, displaced or missing pads and insulators.	The Supervisor inspection assesses the asset condition and initiates any remedial works.
Worn, broken, displaced or missing ferrules.	NOTE i. Increased frequency of gauge measurement by the OmniVision system will provide supporting asset condition information to highlight potential defects associated with insulators and ferrules. ii. Missing pads will affect fastener toe loads leading to missing fastenings which will be identified by OmniVision.

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Features to be observed	Inspection method
Ineffective sleepers (i.e., unable to provide vertical support or hold gauge) with no associated Immediate Action Limit or Intervention Limit track geometry fault.	- Damage caused by On-Track Machines (OTM) and Road/Rail Vehicle (RRV) activity is managed through Supervisor post work checks before hand back to traffic. - Damage caused by defective rolling stock is managed through Supervisor inspection in the absence of a specific incident report. - Slow degradation is managed through Supervisor inspection. NOTE i. The OmniVision system will identify ineffective sleepers with missing or misaligned fasteners. ii. As with manual BVI, ineffective sleepers covered by ballast will be difficult to identify.
Defective timber sleepers (e.g. - Gauge pushing (shuffle), baseplate indentation, split along length or through screw holes, chair screw broken or loose, rotten fabric) without an associated Immediate Action Limit or Intervention Level track geometry fault	The Supervisor inspection assesses the asset condition and initiates any remedial works. NOTE i. Increased frequency of gauge measurement by PLPR inspection system will provide supporting asset condition information to highlight potential defects
Incorrectly spaced sleepers	The Supervisor inspection assesses the asset condition and initiates any remedial works.
Out-of-square sleepers either without an associated Immediate Action Limit or Intervention Level Limit gauge fault or where sleeper angle does not cause the fastener to be misaligned to the extent that it cannot be recognised by the machine vision applications	The Supervisor inspection assesses the asset condition and initiates any remedial works. NOTE i. Increased frequency of gauge measurement by the PLPR inspection system will provide supporting asset condition information to highlight potential defects
Galled baseplates and broken baseplates where fastener is aligned correctly	The Supervisor inspection assesses the asset condition and initiates any remedial works. NOTE i. Increased frequency of gauge measurement by the OmniVision system will provide supporting asset condition information to highlight potential defects
- Minimum rail depths - Rail gall Excessive corrosion	The Supervisor inspection will assess asset condition and initiate any remedial works.
Rail foot loss within level crossings	These defects are managed through a bespoke inspection regime in accordance with NR/L2/TRK/001.

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Features to be observed	Inspection method
Rolling contact fatigue e.g., head checking/ gauge corner cracking	These defects will be found by Supervisor inspection and planned RCF visual inspections in accordance with NR/L2/TRK/001. Supervisory inspections will benefit from the additional track geometry recording to identify anomalies likely to initiate RCF. NOTE <i>i. Images will be provided of Intervention Level Geometry Defects which will support this.</i>
Hot weather precautions Track disturbed (e.g., tamped) immediately before or during hot weather. Unstressed track (not visible).	These items are managed through seasonal Hot Weather Management. NOTE <i>i. OmniVision ballast profile reports will improve the assurance that adequate ballast is provided to maintain track stability.</i>
Geometry defects not associated with Immediate Action Limit and Intervention Limit track geometry faults.	The Supervisor inspection assesses the asset condition and initiates any remedial works.
Detached bonding : signalling or electrical.	Inspection of signalling bonding is in accordance with Signalling Maintenance Specifications. Inspection of the traction bonding is carried out in accordance with work instruction NR/OLE B01 at a frequency stated in NR/L2/ELP/21087. NOTE <i>i. There is a general requirement in the Rulebook for all persons 'on and about the line' to report detached red bonds</i>
Infringement of boundaries by outside parties	These items are managed by the Maintenance Protection Coordinator following reports from both internal and external stakeholders. In addition, if visible from the track these items will be identified as part of the Supervisor inspection. If not visible from the track these will be identified as part of the Lineside inspection in accordance with NR/L2/TRK/5100.
Environmental issues fly tipping. spillage from trains, including coal dust, mineral dusts, chemicals etc. blocked drainage system caused by external influence.	If visible from the track these items will be identified as part of the Supervisor inspection. If not visible from the track these will be identified as part of the Lineside inspection in accordance with NR/L2/TRK/5100. NOTE <i>i. Fly tipping often occurs at access points where it will be identified and reported by the access point users or third parties.</i>

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Features to be observed	Inspection method
Trees/vegetation: overhanging/leaning. uprooted. rotten. obscuring signals/ lineside signs. obscuring road/foot crossings. within 3m of overhead line equipment.	S&TME Cab Rides will identify potential signal sighting issues Supervisor's inspections will identify potential vegetation encroachment issues. The Level Crossing inspection regime in accordance with NR/L2/SIG/19608 will identify Level Crossing sighting issues The work-safe procedure will identify if sighting distances are reduced by vegetation growth
Access Points: overgrown. steps damaged. handrail in poor condition. access gates secured.	There are Maintenance Scheduled Tasks for regular access point inspection. In addition, these items will be identified and reported by all users of the facilities.

Table 2 – Features/faults that can relied upon to be identified by other existing inspection methods

4.4 Features/faults not identified by PLPR System that require risk assessment to identify appropriate mitigation

The following table provides an extensive but non-exhaustive list of the features/faults that are not inspected by the OmniVision/TGMS system and require an assessment of risk associated and appropriate mitigation identified for both implementation and periodic reviews.

Features to be observed	Action Required
Bridges and other structures: obvious new cracks or growth of existing cracks. signs of loose, displaced or fallen material. vandalism or accidental damage. signs of subsidence or ground movement. flooding and signs of obstructions against upstream faces. signs of misuse or significant change in the nature or extent of use. in cold weather – icicles causing risk to traffic. signs of impact with platforms and structures by rolling stock. missing or damaged fixed track position datums or datum plates.	Where BVI using the OmniVision system is being proposed consideration should be given by the RAM[Geotechnical], RAM[Off-track] and the RAM[Civils] to additional patrolling or examination requirements. This should be undertaken with respect to the condition of adjacent assets where the normal patrolling regime has provided regular assurance that no significant change is occurring. Any requests to Maintenance for additional patrolling or examination need to be submitted to the TME with appropriate justification. The list below of typical asset condition issues is intended to provide general guidance as to the level at which additional patrolling should be considered