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Axle Bearing Condition Monitoring

Synopsis

This document sets out requirements and guidance for condition monitoring of axle bearings, whether by trackside or onboard detection systems.

Published by RSSB

Issue record

Issue	Date	Comments
One	June 2023 [proposed]	Original document.

Revisions have not been marked by a vertical black line in this issue because this is a new document.

Superseded documents

The following Railway Group documents are superseded, either in whole or in part as indicated:

Superseded documents	Sections superseded	Date when sections are superseded
GERT8014 - Issue Two - Axlebox Condition Monitoring - Hot Axlebox Detection	All	June 2023 [proposed]
GEGN8614 - Issue One - Guidance on Axlebox Condition Monitoring - Hot Axlebox Detection	All	June 2023 [proposed]

Supply

The authoritative version of this document is available at www.rssb.co.uk/standards-catalogue. Enquiries on this document can be submitted through the RSSB Customer Self-Service Portal https://customer-portal.rssb.co.uk/

Contents

Part 1 Purpose and Introduction

1.1 Purpose

1.1.1 This document sets out requirements and guidance for the condition monitoring of outboard axle bearings by trackside and onboard equipment and inboard axle bearings by onboard equipment only.

1.1.2 This document details the use of condition monitoring systems for axle bearings that:

- Identify unacceptable in-service condition of an axle bearing;
- Reduce the risk of an in-service failure of an axle bearing leading to a hazard for users of the infrastructure; and
- Support a prognostic approach to axle bearing maintenance.

1.1.3 This document does not include requirements for other bearing types, such as traction motor, suspension tube or final drive casing bearings, but the information on dynamic frequency monitoring systems can also be useful in the monitoring these types of bearings.

1.1.4 This document provides guidance on requirements that define the interface and the need for cooperation between different categories of duty holder to manage risks safely.

1.1.5 This document can be adopted by railway undertakings (RUs), rolling stock owning companies (ROSCOs), entities in charge of maintenance (ECMs) and infrastructure managers (IMs) under their respective safety/quality management system or when specifying products and services.

1.2 Introduction

1.2.1 An in-service failure of an axle bearing is a hazard to the safe operation of the railway. The capability to determine axle bearing deterioration offers a strategy for managing the risk of an in-service failure of an axle bearing.

1.2.2 This document is split into three parts:

a) Part 2 provides requirements and guidance for trackside and onboard detection systems which support requirements set out in the Locomotive and Passenger (LOC&PAS) and Rolling Stock Freight Wagons (WAG) National Technical Specification Notices (NTSNs);
b) Part 3 provides requirements and guidance for infrastructure systems, and the management and repair of infrastructure systems; and
c) Part 4 provides guidance on the use of dynamic frequency monitoring systems.

1.2.3 The requirements in the document are not applicable to the following types of vehicle:

a) On-track machines; and
b) On-track plant; and
c) Heritage rail vehicles as defined in RIS-2003-RST.

1.2.4 References are made to BS EN 15437–1:2009 and BS EN 15437–2:2012 throughout this document. Permission to reproduce extracts from British Standards is granted by BSI Standards Limited (BSI). No other use of this material is permitted. British Standards can be obtained in PDF or hard copy formats from the BSI online shop: https://shop.bsigroup.com

1.3 Application of this document

1.3.1 Compliance requirements and dates have not been specified because these are the subject of internal procedures or contract conditions.

1.3.2 If you plan to do something that does not comply with a requirement in this RIS, you can ask a Standards Committee to comment on your proposed alternative. If you want a Standards Committee to do this, please submit your deviation application form to RSSB. You can find advice and guidance on using alternative requirements on RSSB's website www.rssb.co.uk.

1.4 Health and safety responsibilities

1.4.1 Users of documents published by RSSB are reminded of the need to consider their own responsibilities to ensure health and safety at work and their own duties under health and safety legislation. RSSB does not warrant that compliance with all or any documents published by RSSB is sufficient in itself to ensure safe systems of work or operation or to satisfy such responsibilities or duties.

1.5 Structure of this document

1.5.1 This document sets out a series of requirements that are sequentially numbered. This document also sets out the rationale for the requirement, explaining why the requirement is needed and its purpose and, where relevant, guidance to support the requirement. The rationale and the guidance are prefixed by the letter 'G'.

1.5.2 Some subjects do not have specific requirements but the subject is addressed through guidance only and, where this is the case, it is distinguished under a heading of 'Guidance' and is prefixed by the letter 'G'.

1.6 Approval and authorisation of this document

1.6.1 The content of this document will be approved by Rolling Stock Standards Committee on 9 March 2023 [proposed].

1.6.2 This document will be authorised by RSSB on 28 April 2023 [proposed].

Part 2 Rolling Stock

2.1 Background

Guidance

G 2.1.1 A failed or deteriorating axle bearing can result in an increase in heat that raises the temperature of the axle box above normal operating temperatures.

G 2.1.2 A Hot Axle Box Detector (HABD) detects changes to bearing temperatures by either a trackside or onboard detection system.

G 2.1.3 Trackside HABD designs use infrared sensors and cameras to monitor the temperature of outboard axle bearings on rolling stock. Onboard HABD systems use temperature sensors to monitor axle bearing temperatures.

G 2.1.4 Clause 4.2.3.4 of the Wagon (WAG) national technical specification notice (NTSN) requires units to be compatible with trackside HABD systems, or have an onboard detection system fitted.

G 2.1.5 Guidance is given in section 2.2 to support compatibility for trackside HABD systems as set out in clause 4.2.3.3.2.2 of the Locomotive and Passenger (LOC&PAS) NTSN and clause 4.2.3.4 of the WAG NTSN.

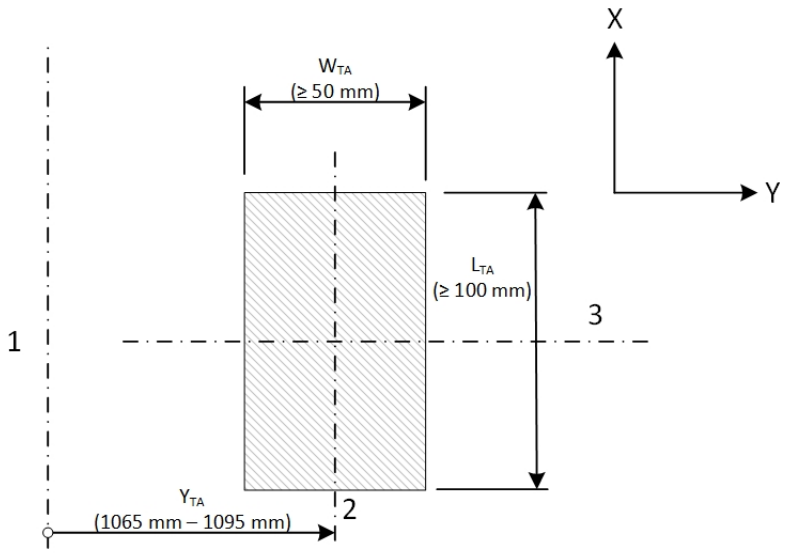
G 2.1.6 Requirements are set out and guidance is given in section 2.3 to support the installation of onboard detection systems as set out in clause 4.2.3.3.2.1 of the LOC&PAS NTSN.

2.2 Rolling stock interface for trackside hot axle bearing detection systems

Guidance

G 2.2.1 The following guidance on the rolling stock interface for trackside hot axle box bearing detection systems supports clause 4.2.3.3.2.2(1) of the LOC&PAS NTSN and clause 4.2.3.4 of the WAG NTSN.

G 2.2.2 Clause 5.1.1 of BS EN 15437–1:2009 describes the target zone as 'an area on the underside surface of an axlebox described by the intersection of the axlebox with a virtual cuboid. The horizontal cross-sectional area of the virtual cuboid is congruent to the plan view area of the target zone in the XY plane, herein named the target area'. The target area is designed to give a good indication of the temperature of the axle bearing and provide a point of focus for trackside HABD equipment. *Figure 1* gives the position and dimensions of the target area in the XY plane, where the X axis longitudinal centre of the target area is congruent with the axle centre line and the Y axis is along the length of the axle.



Key

1 – Centre line of vehicle
2 – Centre line of target area
3 – Centre line of axle
W_{TA} – Lateral width of target area
L_{TA} – Longitudinal length of target area
Y_{TA} – Lateral centre of target area

Figure 1: Dimensions and alignment of the Target Area (TA) in the XY plane (viewed from below)

G 2.2.3 For units that can operate at speeds equal to or greater than 250 km/h (155 mph), clause 4.2.3.3.2(2) of the LOC&PAS NTSN requires the fitment of onboard detection systems and therefore removes the need for units to be designed to be compatible with trackside HABDs. *Table 1* supports compatibility requirements for units operating at speeds equal to or greater than 250 km/h (155 mph) where there is an intention to be compatible with trackside HABDs as well.

Speed, V	**250 km/h < v ≤ 330 km/h (155 mph < v ≤ 205 mph)**	**> 330 km/h (> 205 mph)**
Longitudinal dimension (L_{TA})	≥ 130 mm, centred around W_{TA}	Undefined

Table 1: Longitudinal TA dimensions for speeds greater than or equal to 250 km/h (155 mph)

G 2.2.4 A consistent temperature within the target area is necessary for accurate measurement of axle bearings. It is good practice to avoid features that result in localised variations of temperature, such as ribs and gaps, so that a trackside HABD can focus on any lateral position across the target area.

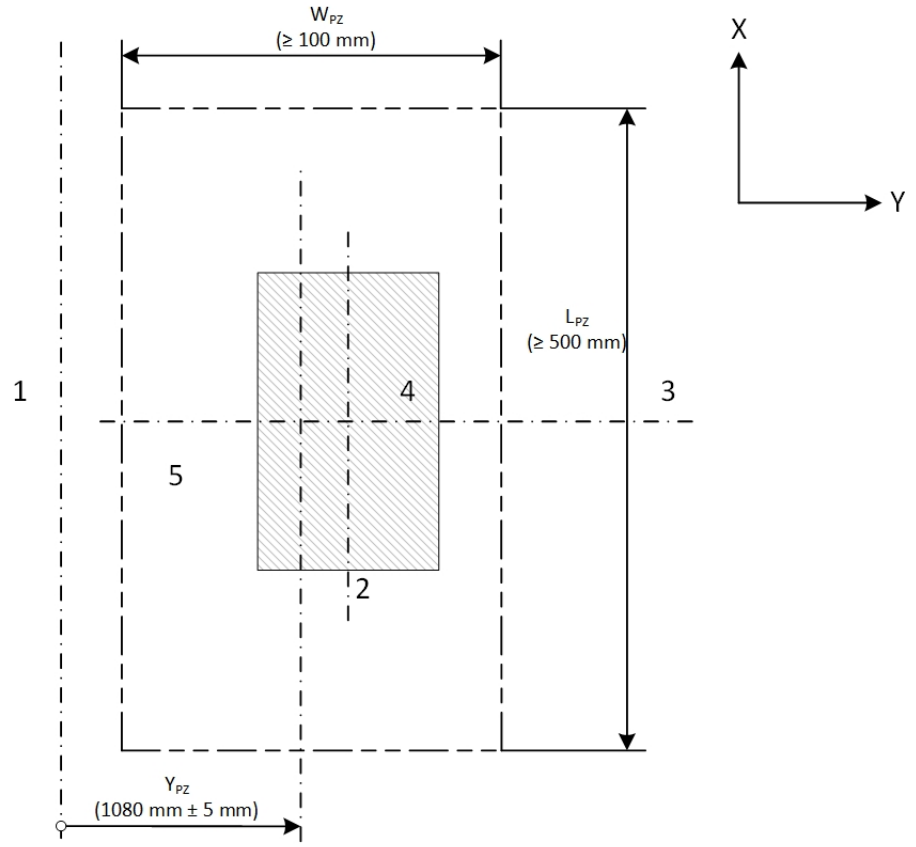
G 2.2.5 Speed probes, strengthening ribs or underframe equipment, such as covers, valances or bogie frames, can cause obstructions and prevent the trackside HABD from focusing on parts of the target area.

G 2.2.6 The minimum dimension of the target area accommodates up to ±10 mm of lateral movement relative to a trackside HABD.

G 2.2.7 It is good practice to consider the design of the thermal path between the target area and outer race of the axle bearing so that a good indication of the temperature of an axle bearing is provided. The following attributes would be considered in the design of the thermal path, including housings and end caps if appropriate:

a) The inclusion of materials with high thermal conductivity;
b) The length of the thermal path and the need for it to be as short as possible; and
c) No thermal insulation interrupting the thermal path.

G 2.2.8 Clause 5.2.1 of BS EN 15437–1:2009 describes the prohibitive zone as 'a rectangular area, which includes the target area, and is extended vertically to form a virtual cuboid. The dimensions of the cuboid are LPZ in the X-axis, WPZ in the Y-axis and HPZ in the Z-axis'. The prohibitive zone is designed to exclude other heat sources from the detection area to reduce the risk of false indications. *Figure 2* gives the position and dimensions the prohibitive zone in the XY plane, where the X axis longitudinal centre of the target area is congruent with the axle centre line ± 5 mm and the Y axis is along the length of the axle.



Key

1 – Centre line of vehicle
2 – Centre line of target area
3 – Centre line of axle
4 – Target area
5 – Prohibited zone for other heat sources
W_{PZ} – Lateral width of prohibitive zone
L_{PZ} – Longitudinal length of prohibitive zone
Y_{PZ} – Lateral centre of prohibitive zone

Figure 2: Dimensions and alignment of the prohibitive zone (PZ) in the XY plane (viewed from below) showing the position of the target area

Note: The longitudinal centre of the prohibitive zone is congruent with the axle centre line ± 5 mm.

G 2.2.9 Clause 5.2.1 of BS EN 15437–1:2009 includes notes on heat sources being contained in a prohibitive zone and that it is good practice to shield such heat sources, even on vehicles which are not designed to be compatible with the trackside HABD system. Heat sources include, but are not limited to:

a) Engine exhaust and heater systems; and
b) Payloads that radiate significant amounts of heat, such as steel billets.

2.3 Onboard detection systems

2.3.1 Onboard detection systems shall be designed to meet the requirements of the following clauses from BS EN 15437–2:2012:

a) Design as set out in clause 4.1; and
b) Reliability as set out in clause 4.2.

2.3.2 The onboard detection system shall initiate an alarm once the maximum safe operating temperature, as used for design assumptions for the target area of the axle box, is exceeded.

2.3.3 When an alarm is triggered, the onboard detection system shall be designed to provide an indication of which axle bearing(s) triggered the alarm and shall initiate the following actions:

a) Alert the driver in the leading cab using an onboard Train Control and Management System; or
b) Automatically apply the train brakes.

2.3.4 For vehicles operating in multiple using onboard detection systems, it shall be possible for the driver to identify hot axle bearings on trailing vehicles from the leading vehicle.

2.3.5 Isolation cocks associated with automatic brake application as part of the onboard detection systems shall be clearly indicated and accessible.

2.3.6 A faulty or isolated onboard detection system shall be identified to the driver if:

a) a vehicle is incompatible with trackside HABD systems; and,
b) the onboard detection system is the primary method of detecting a faulty axle bearing.

2.3.7 The conditions that trigger onboard detection system alarms shall be recorded in the technical file.

Rationale

G 2.3.8 When it is not practical or feasible to make rolling stock design compatible with the minimum requirements of the target area for trackside HABDs, clause 4.2.3.3.2(3) of the LOC&PAS NTSN and part 4.2.3.4 of the WAG NTSN require an onboard detection system to be fitted instead to mitigate the risk of an in-service failure of an axle bearing. Examples of incompatible designs include, but are not limited to, an axle design where clear focus on the target zone can not be provided, such as for inboard axle bearings.

G 2.3.9 Clause 4.2.3.3.2.1(3) of the LOC&PAS NTSN and part 4.2.3.4 of the WAG NTSN require an onboard detection system to make diagnosis messages available onboard. Automatically applying the train brakes is provided as an alternative option for rolling stock where no through communication system may be available to alert the driver to a failed axle bearing.

G 2.3.10 It is important for a driver to be made aware of an axle bearing failure in-service so that necessary action may be taken. It is also important for a driver to know the status of the onboard monitoring system if this is the system that supports compliance with the LOC&PAS and WAG NTSNs.

G 2.3.11 The conditions that trigger and set alarms need to be appropriate and consider all affected parties. The incorrect setting of a temperature alarm can impair the operational efficiency of the railway.

Guidance

G 2.3.12 Inappropriate or inaccurate setting of alarms can result in false positive or false negative axle bearing failure indications, where false negative failures can be considered as a safety risk.

G 2.3.13 Vehicles without means of alerting the driver to an axle bearing failure through a communications system can use technology, such as fusible plugs with a low melting point that vent the brake air pressure to the atmosphere when its set temperature is exceeded, to initiate a warning to the driver.

G 2.3.14 Alerts to the driver can be sent using low-power wireless technologies. If such technologies are used as a means to demonstrate compliance with the LOC&PAS and WAG NTSNs, it is important to consider the reliability and maintenance periodicity of the system, such as equipment battery life.

G 2.3.15 Onboard detection systems alerts can result in a response by the driver which is hazardous, such as the application of the emergency brake when it is not necessary to do so. RSSB research project T326 (2006) includes a good practice guide on managing alarms and alerts.

G 2.3.16 It is good practice to have isolation equipment associated with axle bearings located on the same side of the vehicle that it relates to. This can assist with attending to failed vehicles in service.

G 2.3.17 Isolation systems can be sealed in their operational (normal) position. Effort to break such seals can reduce the likelihood of unintentional or inappropriate isolation, where isolation systems are often operated by train crew without tools (such as side cutters).

G 2.3.18 A broken seal is a method of indicating a system has been operated.

G 2.3.19 The design, location and type of onboard detection system fitted to a vehicle can be determined in agreement between the RU and rolling stock manufacturer.

G 2.3.20 It is good practice to locate an onboard detection system in a position so that an accurate parameter reading can be taken. For example, placing a vibration sensor as close to the bearing as possible to mitigate other vehicle vibrations that could impact the sensor reading.

G 2.3.21 The conditions that trigger alarms are of benefit to entities in charge of maintenance (ECM) to support their maintenance regimes.

G 2.3.22 Information on axle bearing failure rates can be displayed to the driver via different alarms based on different temperature thresholds.

G 2.3.23 It is considered good practice for sensors that react to temperature to have an accuracy of ±5 ˚C or less.

G 2.3.24 When powered down vehicles that have onboard detection systems fitted are moved between locations, such as when freight vehicles are moving powered down vehicles between sites, the risk of a bearing failure increases due to the bearings not being monitored.

Part 3 Infrastructure

3.1 Background

Guidance

G 3.1.1 Trackside HABD systems support the safe in-service operation of rolling stock by providing alarms to signalling and control centres for unsafe temperatures of outboard axle bearings.

G 3.1.2 Trackside HABD systems use single or multiple sensors or cameras to measure the temperature of outboard axle bearings.

G 3.1.3 As clause 4.2.3.3.2(3) of the LOC&PAS NTSN and part 4.2.3.4 of the WAG NTSN provide an option in the requirements for rolling stock to be compatible with trackside HABDs, rather than fitting onboard detection systems, RUs assume trackside HABDs are functional when their units are in-service unless they are informed otherwise.

G 3.1.4 This part provides requirements and guidance for the design, interface and management of trackside HABDs where no requirements for trackside HABDs are set out in the Infrastructure (INF) or Operations and Traffic Management (OPE) NTSNs.

G 3.1.5 Section *3.3* can support the management of dynamic frequency monitoring equipment as well as HABDs.

G 3.1.6 Rolling stock can collide with equipment installed on the trackside if clearances are not maintained. Further information on the positioning of equipment to achieve gauge compatibility with rolling stock can be found in GIRT7073.

3.2 Infrastructure to rolling stock interface

3.2.1 Infrastructure HABD design

3.2.1.1 Trackside HABDs shall be designed to meet the requirements of the following clauses from BS EN 15437–1:2009 for:

a) The interface as set out in clause 6.1;
b) The temperature measuring zone as set out in clause 6.2;
c) Installation as set out in clause 6.3;
d) Functions as set out in sub-clauses (b), (d), (e) and (f) of clause 7.1; and
e) Temperature alarms as set out in sub-clauses (a) and (c) of clause 7.

Rationale

G 3.2.1.2 Part 4.2.3.3.2 of the LOC&PAS NTSN and part 4.2.3.4 of the WAG NTSN require rolling stock to be compatible with trackside HABDs, or have onboard detection systems that monitor axle bearing condition. This requirement is in place to support rolling stock for which the option for compatibility with trackside HABDs has been chosen.

G 3.2.1.3 Without this requirement, rolling stock can be designed to meet the target area and prohibitive zone requirements as set out in section *2.2* but might not be compatible with trackside HABDs that have been put in place.

Guidance

G 3.2.1.4 If trackside HABDs of single sensor design are being set up, it is good practice to focus on the central lateral position of the minimum temperature measurement zone to cover a wider range of positions as target areas can differ.

G 3.2.1.5 Trackside HABDs of a multi-sensor design that focus beyond the boundaries of the minimum temperature measurement zone improve the range of rolling stock for which an axle bearing temperature can be effectively measured.

G 3.2.1.6 If trackside HABDs of multi-sensor design are being set up that take more than a single temperature measurement in the lateral plane, it is good practice to set this so that at least one of the sensors focuses on the central lateral position of the temperature measuring zone.

G 3.2.1.7 It is good practice to consider the environmental conditions relating to the temperature of the axle box, such as the normal ambient air temperature and distance between the HABD and target area.

G 3.2.1.8 It is considered good practice to locate HABD equipment adjacent to railway sites to support the removal of a vehicle from service should an alarm be triggered, such as a loop or yard.

G 3.2.1.9 HABDs placed on networks that use dc conductor rails can interpret arcing from the conductor rail as a hot axle box and result in false HABD alarms. It is important that this is considered when a trackside HABD site is being chosen.

G 3.2.1.10 Automatic Vehicle Identification (AVI) tags and readers can be used to identify rail vehicles passing a bearing monitoring site and enable faster communication of warning and alert data to the respective RU. Further information on AVI tags can be found in RIS-0796-CCS.

3.2.2 Trackside HABD alarms

3.2.2.1 When the trackside hot axle bearing monitoring equipment detects excessive axle bearing temperatures an alarm shall be triggered in the appropriate signalling and operations control centres.

3.2.2.2 Alarm levels for trackside HABDs shall be set for each alarm type, such as hot temperature or differential temperature alarms.

3.2.2.3 To facilitate the setting of temperature alarm levels for each alarm type, the IM shall request the maximum design operating temperatures of the target area for the rolling stock that they operate from:

a) The RU; or
b) The rolling stock manufacturer; or
c) The ECM.

3.2.2.4 To facilitate the setting of temperature alarm levels for trackside HABDs, the RU, rolling stock manufacturer or ECM shall make available to the IM when requested, the maximum safe operating temperatures of the target area as given in *2.2* for the rolling stock that they operate.

Rationale

G 3.2.2.5 Clause 4.2.3.3.2(1) of the LOC&PAS NTSN identifies the objective of the trackside detection system to be capable of detecting deficient axle bearings. To facilitate this, the temperature alarms for the rolling stock are relevant to the axle bearing operating parameters. The WAG NTSN does not set out a similar objective.

G 3.2.2.6 Trackside HABDs monitor all rolling stock that meet the target area and prohibitive zone requirements. The temperature level set for each type of alarm needs to be appropriate for the range of rolling stock axle bearings monitored. To facilitate this, the IM uses information about axle bearing temperatures (preferably in the target zone) to set the alarm levels.

G 3.2.2.7 Clauses *3.2.2.3* and *3.2.2.4* support route compatibility assessments in accordance with RIS-8270-RST.

G 3.2.2.8 Clause 4.2.12.4(3) of the LOC&PAS NTSN and clause 4.4 of the WAG NTSN require that technical documentation relating to control and monitoring systems contains information to allow the identification of safety significant failures of equipment or functions. Requirements *3.2.2.3* and *3.2.2.4* support the NTSN clause through the sharing of alarm settings between parties so that safety related failures can be identified.

Guidance

G 3.2.2.9 Section 7.2 of BS EN 15437–1:2009 provides information on types of temperature alarms.

G 3.2.2.10 Network Rail document NR/L2/MTC/EP0233, clause 7.5.2, defines alarm levels for trackside HABDs as 100 ˚C above ambient for a hot (absolute) alarm and 56 ˚C difference between each axle end for a differential alarm. These values can be used to support requirements *3.2.2.1* and *3.2.2.2*.

G 3.2.2.11 Manufacturers' bearing characteristics can be used to support the setting of alarm levels when undertaking a risk assessment for alarm level settings.

G 3.2.2.12 Temperature alarm levels can consider types of rolling stock axle bearings, variations of axle box designs, the working temperature range of axle bearing grease, ambient temperature and the focal range of the trackside HABDs.

G 3.2.2.13 The temperature alarm levels for each alarm type are set by using at least one of the following options:

a) Using information provided by the railway undertaking, such as the number of bogies, wheelsets and bogie spacing;
b) Monitoring the traffic at individual trackside HABD installations to determine appropriate temperature alarm levels for that installation;
c) Setting the levels to those of other trackside HABDs installed on the same track or with similar in-service traffic characteristics;
d) Adopting the values recommended by the trackside HABD manufacturer; or
e) Adopting the values recommended by the rolling stock manufacturer.

G 3.2.2.14 It is important that trackside HABD alarm trigger levels are verified on a route for the bearing characteristics on the different vehicle types in operation.

G 3.2.2.15 Sources of information for setting alarm levels includes existing installations and manufacturers of trackside HABDs.

3.3 Infrastructure manager

3.3.1 Provision of information on trackside equipment

3.3.1.1 The following information shall be made available by the IM:

a) Details of the location of trackside axle bearing condition monitoring equipment; and
b) Information on the alarm settings for trackside axle bearing condition monitoring installations.

Rationale

G 3.3.1.2 Providing knowledge of the location and setting information for trackside axle bearing condition monitoring installations to an RU aids in the appropriate planning and intervention for taking a vehicle out of service with minimal impact on the operation of the railway. This information will also aid an RU in understanding operational details surrounding the alarm event, including train speed, ambient air temperature at the time of the failure and other environmental conditions.

G 3.3.1.3 The location of existing axle bearing condition monitoring equipment installations is published in the Sectional Appendix.

Guidance

G 3.3.1.4 Information such as the types of alarms, the temperature levels for each alarm type and the measuring zone parameters can be provided by the IM.

G 3.3.1.5 Identifying the need for a trackside HABD, to mitigate the risk from traffic carried on any particular route, requires an agreement between the affected parties. Following the identification of the need for a trackside HABD, the requirements for the placement and operation of the HABD equipment would include:

a) Distance between the trackside HABD equipment and the rolling stock target area;
b) Requirements for rolling stock on the route to have onboard axle bearing monitoring systems fitted; and
c) Alternative approaches for axle bearing monitoring.

G 3.3.1.6 Once a need for a HABD on a particular route has been determined by an affected party or parties, the exact geographical location of a trackside HABD installation is the responsibility of the IM. This location can consider any RU requirements for the placement of equipment.

G 3.3.1.7 Guidance on factors to consider when choosing a location for the installation of trackside HABDs is set out in Annex B of BS EN 15437–1:2009.

G 3.3.1.8 It is considered good practice to put information on the location of any new axle bearing condition monitoring system in the Sectional Appendix.

3.3.2 Management and repair of out of service trackside equipment

3.3.2.1 The IM shall inform all RUs on a route when a trackside axle bearing condition monitoring system is out of service due to being faulty.

3.3.2.2 Out of service trackside axle bearing condition monitoring equipment shall be reinstated at the earliest opportunity, and all RUs that operate over the route shall be informed by the IM when it is reinstated.

Rationale

G 3.3.2.3 This requirement supports part 4.2.3.6.3 the OPE NTSN.

G 3.3.2.4 It is important for an RU to be informed of an axle bearing condition monitoring system failure which impacts the operation of their vehicles. The RU can decide to use alternative measures to mitigate the impact of the failure once it is reported.

G 3.3.2.5 Through informing an RU of the repair status of axle bearing condition monitoring system failures, mitigating actions put in place by the RU can be removed, if deemed appropriate to do so.

Guidance

G 3.3.2.6 It is considered good practice to define and follow a process that informs all affected parties when a trackside HABD is not restored to service following any single planned or unplanned maintenance activity.

G 3.3.2.7 The Network Rail National Operations Centre (NOC) Daily Report is a method of reporting details for trackside HABDs when disabled, activated or when alarms are not confirmed.

G 3.3.2.8 The Control Centre Incident Log (CCIL) supports circulating of information on out of service axle bearing condition monitoring equipment.

G 3.3.2.9 It is good practice to establish procedures to mitigate the risks associated with trackside HABDs being out of service. The risk assessment guidance in GEGN8646 can aid assessment on the impact of axle bearing condition monitoring equipment being out of service. This risk assessment can include:

a) How often the data from the HABD (or HABDs) is used as the basis of operational decision making;
b) The length of time the equipment has been out of use for to date, and its impact on business operations; and
c) The location of the equipment and whether rolling stock passing the equipment has other means of axle bearing condition monitoring onboard.

G 3.3.2.10 Faulty trackside axle bearing condition monitoring equipment might not be reported immediately by the IM to RUs following the discovery of faulty equipment. This can be due to time taken for an IM to attend the site of the faulty equipment, establish the cause of the failure and possibly carry out basic repairs that may bring the equipment back into service.

G 3.3.2.11 Further information for IMs on how to manage axle bearing condition monitoring system faults can be found in the National Operational Procedures Index (Network Rail document NR/L3/OPS/045).

G 3.3.2.12 It is good practice to thoroughly test any repaired equipment, so that reports on equipment fixes that are issued do not have to be revoked.

G 3.3.2.13 The IM might not provide regular updates on the out of service status of trackside axle bearing condition monitoring equipment, but will inform the RU when the equipment is placed back into service.

Part 4 Dynamic frequency monitoring systems

4.1 General

Guidance

G 4.1.1 Dynamic frequency monitoring systems measure acoustic (sound) or vibration frequency and amplitude characteristics of axle bearings, by either trackside or onboard equipment.

G 4.1.2 Trackside dynamic frequency monitoring systems read the axle bearing characteristics of passing vehicles. Onboard frequency monitoring systems use sensors to monitor the characteristics of axle bearings, sometimes continually.

G 4.1.3 There are no other standards that set out requirements or guidance for dynamic frequency condition monitoring systems. This is due to ball pass frequencies (the rate at which a defect in the inner or outer race of a bearing comes into contact with the roller) varying with axle bearing and wheel size.

G 4.1.4 Trends in characteristics from signal amplitude and rate of change can help in determining bearing health and the likelihood of failure.

G 4.1.5 A change in the frequency or amplitude output of an axle bearing outside of established parameters indicates deterioration or failure.

G 4.1.6 Dynamic frequency monitoring systems are generally designed to analyse bearing defects, progressive wear or fatigue-related deterioration trends to support prognostic maintenance that optimises practice bearing life and maintenance planning, and as such do not usually provide an immediate action, or report to the driver.

G 4.1.7 Maintenance provides a means of determining the health and correct operation of onboard dynamic frequency monitoring systems.

G 4.1.8 Dynamic frequency monitoring systems are designed to pre-empt failure by comparing frequency characteristics against known, good values. Generally, these systems are not designed to capture certain failure modes, such as grease failure, and in these cases they are unlikely to alert users to sudden faults occurring on vehicles. When implementing dynamic frequency monitoring technologies, it is considered good practice to implement them as a supplement to HABD equipment as dynamic frequency monitoring technologies are in their infancy on the GB mainline.

G 4.1.9 Fitting AVI tags to vehicles that are programmed with vehicle wheel and bearing design information enable trackside dynamic frequency monitoring systems to operate at their optimum. This is because the measured response by the trackside system varies with wheel size, inner and outer race diameters and bearing roller diameters.

Definitions

Affected Party	A railway undertaking or infrastructure manager responsible for assets on the other side of a physical interface with the potential to be affected by a proposed change.
Axle Bearing Condition Monitoring	A system that monitors bearing condition through the measurement of its heat or its dynamic frequencies. Alarms in this system are associated with bearing condition levels. These alarms are provided to railway control staff and signallers.
Control Centre Incident Log (CCIL)	An incident log used to capture a timeline of events surrounding a railway incident or accident.
Dynamic Frequency Monitoring System	Equipment that measures the different frequency signal outputs of a bearing, including acoustic or vibration.
entity in charge of maintenance of a vehicle (ECM)	An ECM is registered as an ECM for a vehicle in the national vehicle register, and can include people or organisations such as railway undertakings, infrastructure managers, keepers or maintenance organisations. Source: *ROGS*
heritage rail vehicle	A rail vehicle in a livery relating to an earlier, historical state, displaying its earlier rail vehicle number for reasons of historical accuracy. Any operational use of a heritage rail vehicle is limited to less than 15,000 miles per annum.
Hot Axle Box Detector (HABD)	A trackside system that includes sensors for measuring the thermal radiation emitted from a defined area on each axle box of a passing rail vehicle, the data processing that calculates the temperature for each axle box and identifies those that are overheating, and a communication link to transmit and receive data.
Inboard bearing	A bearing mounted on the axle inside of the wheels, usually where the bogie has an inside frame.
infrastructure manager (IM)	Has the meaning given to it in the Railways and Other Guided Transport Systems (Safety) Regulations 2006 (as amended), but is limited to those infrastructure managers who hold a safety authorisation issued in respect of the mainline railway. Source: *ROGS*
National Operations Centre (NOC)	The NOC receives information from Network Rail staff nationwide to help manage the impact of incidents and large planned events on train services.
National Technical Specification Notice (NTSN)	Document published by the Secretary of State pursuant to regulation 3B of the Railways (Interoperability) Regulations 2011 (as amended) which sets out the standards, technical specifications and technical rules in use in the United Kingdom as amended or varied from time to time. These may be standards to be complied with in relation to the design, construction, placing in service, upgrading, renewal, operation and maintenance of the parts of the

	rail system. For the purposes of these Regulations, the essential requirements for a project subsystem conforms with applicable National Technical Specification Notices and National Technical Rules. Source: *RIR*
on-track machine (OTM)	Any rail-mounted machine, whose primary function is for the renewal, maintenance, inspection or measurement of the infrastructure, meeting the requirements of GMRT2400 and permitted by the Rule Book to be moved, either self-propelled or in train formation, outside a possession.
Outboard bearing	A bearing mounted at the ends of the axle, outside of the wheels, usually where the bogie has an outside frame.
Prohibitive Zone	Zone in which heat sources, such as exhausts, which might influence the behaviour of a HABD, are excluded or thermally shielded.
railway undertaking (RU)	Has the meaning given to the term 'transport undertaking' in the Railways and Other Guided Transport Systems (Safety) Regulations 2006 as amended, but is limited to any private or public undertaking the principal business of which is to provide rail transport services for goods and/or passengers, with a requirement that the undertaking must ensure traction. Source*: ROGS*
Rolling Stock Owning Company (ROSCO)	Owners of most of the coaches, locomotives and freight wagons on the rails, which they hire out to train and freight operating companies. Source: *ORR website*
Target Area	Plan view dimensions, that is in the XY plane, of the target zone.
Target Zone	Defined area on the underside of an axle box that is designed to have its temperature monitored by a HABD.

References

The Standards catalogue gives the current issue number and status of documents published by RSSB: https://www.rssb.co.uk/standards-catalogue.

RGSC 01	Railway Group Standards Code
RGSC 02	Standards Manual

RSSB documents

GEGN8646	Guidance on the Common Safety Method for Risk Evaluation and Assessment
RIS-0796-CCS	Train to Infrastructure RFID Compatibility
RIS-2003-RST	Certification and Registration of Heritage Rail Vehicles Operating on the GB Mainline Railway
RIS-8270-RST	Route Level Assessment of Technical Compatibility between Vehicles and Infrastructure
T326 RSSB (2006)	Human factors good practice guide to managing alarms and alerts

Other references

BS EN 15437–1:2009	Railway applications. Axlebox condition monitoring. Interface and design requirements. Track side equipment and rolling stock axlebox.
BS EN 15437–2:2012	Railway applications. Axlebox condition monitoring. Interface and design requirements. Performance and design requirements of on-board systems for temperature monitoring.
INF NTSN	Infrastructure National Technical Specification Notice (INF NTSN). Published by the Secretary of State on 1 January 2021 pursuant to regulation 3B of the Railways (Interoperability) Regulations 2011. This NTSN replaces and substantially reproduces the provisions of Commission Regulation (EU) 1299/2014 of 18 November 2014 (the INF TSI) and includes relevant amendments made by Commission Implementing Regulation (EU) 2019/776 which came into force in June 2019.
OPE NTSN	Operation and Traffic Management National Technical Specification Notice (OPE NTSN). Published by the Secretary of State on 1 January 2021 pursuant to regulation 3B of the Railways (Interoperability) Regulations 2011. This NTSN replaces and substantially reproduces the provisions of Commission Decision 2012/757/EU of 14 November 2012 (the OPE TSI), and includes relevant amendments made by Commission Regulation (EU) 2015/995 of 8 June 2015 and Commission Implementing Regulation (EU) 2019/773 which came into force in June 2019.

LOC&PAS NTSN	Locomotive and Passenger National Technical Specification Notice (LOC&PAS NTSN). Published by the Secretary of State on 1 January 2021 pursuant to regulation 3B of the Railways (Interoperability) Regulations 2011. This NTSN replaces and substantially reproduces the provisions of Commission Regulation (EU) 1302/2014 (the LOC&PAS TSI), and includes relevant amendments made by Commission Implementing Regulation (EU) 2019/776 which came into force in June 2019.
NR/L2/MTC/EP0233	Lineside Hot Axle Box Detectors (Network Rail Standard)
NR/L3/OPS/045	National Operational Procedures Index (Network Rail Standard)
ROGS	The Railways and Other Guided Transport Systems (Safety) Regulations 2006 (as amended)
WAG NTSN	Rolling Stock (Freight Wagons) National Technical Specification Notice (WAG NTSN). Published by the Secretary of State on 1 January 2021 pursuant to regulation 3B of the Railways (Interoperability) Regulations 2011. This NTSN replaces and substantially reproduces the provisions of Commission Regulation (EU) 321/2013 of 13 May 2013 (the WAG TSI), and includes relevant amendments made by Commission Regulation (EU) 1236/2013 of 2 December 2013 and Commission Implementing Regulation (EU) 2019/776 which came into force in June 2019.