

Category 1 Standard

S1189

Variable Adhesion Conditions - Requirements for the Implementation of ATO on any Open Section of the LU Network

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1 Purpose

- 1.1 The purpose of this standard is to define the adhesion management requirements which shall be implemented before Automatic Train Operation (ATO) is introduced on any open section of the LU network.
- 1.2 This standard covers the requirements which are specific to adhesion management. Requirements which are in other standards have therefore not been duplicated in this document.
- 1.3 The implementation of the defined adhesion management measures is required to minimise the likelihood of a “compromised adhesion induced” service incident when operating in ATO on the open sections of the LU Network.
- 1.4 The implementation of appropriate adhesion management measures is also required on manually driven lines to minimise the likelihood of a “compromised adhesion induced” service incident when operating on the open sections.

2 Scope

- 2.1 This standard applies to the expansion or development of existing Adhesion Management systems and any new Adhesion Management system which is retrofitted to existing assets or is installed as part of new asset introduction.
- 2.2 This standard mandates that a predictive adhesion management system shall be implemented before ATO is introduced on any open section of the LU network
- 2.3 The objective of adhesion management is the delivery of the required service performance:-
 - Safely and reliably, with the minimum risk of adhesion induced incidents
 - In accordance with the defined Operational Concept
 - With the risk of sustaining asset damage minimised
 - With the cost of the required mitigation measures reduced as far as practicable
- 2.4 Any Adhesion Management System is cross asset and cross discipline and involves the track, rolling stock and signalling/Automatic Train Control (ATC) assets. The requirements of this Standard are applicable to all of these Asset areas.
- 2.5 The associated Guidance Document (G0183) provides background information, an explanation of the various issues and includes possible means of achieving the requirements defined in this Standard

3 Requirements

3.1 Adhesion Management System Development

Existing adhesion management system expansion and/or new adhesion management system selection and design shall not commence without first consulting with the Technical Content Manager of this Standard and the System Authority for AMS.

Part A – Option Assessment

3.2 Option Modelling and Comparison

This phase of work shall identify the benefits and costs of different open section acceleration and service braking rates, and the mitigation measures required for each, so that the optimal combination of settings can be determined.

3.2.1 Train Performance Definition

The acceleration and service braking rates defined for use in the open section performance modelling shall be consistent with all of the following:-

- a) Defined adhesion limits for individual wheelsets
- b) Range of credible adhesion conditions based on variable weather conditions
- c) Range of credible adhesion conditions based on the line survey and assessment (note that a detailed survey may not be available when conducting preliminary modelling)
- d) Defined capabilities of the rolling stock in compromised adhesion conditions

The associated Guidance document (G0189) provides information on the range of adhesion levels that can be credibly expected and includes recommended adhesion limits for individual wheelsets, as well as train acceleration and braking rates.

3.2.2 Performance Modelling Requirements

Train service modelling shall be undertaken to determine the targeted service level assuming the adhesion conditions will support the targeted performance (i.e. dry rail conditions - “good” adhesion).

In addition, performance modelling shall be undertaken for the suite of compromised adhesion scenarios defined below in order to identify the required mitigation measures to ensure the targeted service level can be operated credibly and reliably with an acceptably low risk of asset damage or service affecting incidents. These scenarios cover both “steady rain” and “degraded” adhesion categories.

3.2.2.1 Compromised Adhesion Scenarios

The scenarios defined below shall be modelled, as a minimum, for compromised adhesion assessments.

Scenario	Title	Description of the Compromised Adhesion Scenario
1	“Defensive”	Motoring The open section acceleration rate shall, as a maximum, be set to 60% of that used in the tunnel sections. This shall not exceed a (train) acceleration rate of 0.8 m/s/s. The same value shall be used for all open section locations. Service Braking The open section service brake rate shall, as a maximum, be set to a value of 0.6 m/s/s for “not leaf fall vulnerable” sites and to 0.4 m/s/s for “leaf fall vulnerable” sites. The relevant value shall be used for each open section location.
2	“Enhanced”	Motoring The acceleration rate for open section stations shall be set to 80% of that used in the tunnel sections. This shall not exceed a (train) acceleration rate of 1.0 m/s/s. The open section acceleration rate for re-acceleration - between stations - shall be set to 50% of that used at open section stations. Service Braking The open section service brake rate shall be set at a value 0.75 m/s/s for “not leaf fall vulnerable” sites and to 0.5 m/s/s for “leaf fall vulnerable” sites The open section service brake rate for braking between stations shall be set to 0.6 m/s/s.
3	“Enhanced Plus”	Motoring The acceleration rate for open section stations shall be set to either the same value as is used for the tunnel stations or 1.2 m/s/s - whichever is the lower. The assessment shall assume that the adhesion conditions will always be sufficient to support the applied motoring effort. The open section acceleration rate for re-acceleration between stations shall be set to 70% of that used at open section stations. Service Braking The service brake rate for open section stations shall be set to 0.6 m/s/s for “leaf fall vulnerable” sites and to either 0.75 m/s/s or 0.9 m/s/s for “not leaf fall

		vulnerable" sites. The open section service brake rate for braking between stations shall be set to either 0.6 m/s/s or 0.75 m/s/s respectively for "leaf fall vulnerable" and "non leaf fall vulnerable" sites.
4	"Maximum"	Motoring The open section acceleration rate shall be set to either the same value as is used for the tunnel stations or 1.2 m/s/s - whichever is the lower. This shall be used for all open section locations. Service Braking The open section service brake rate shall be set to 0.9 m/s/s. This shall be used for all open section locations.

3.2.2.2 Headway and RORIT Assessment

In addition to the above journey time modelling, the effect of any reduced acceleration and braking rates shall be assessed to determine the impact on the headway and run-in/run-out times (RORIT).

For each of the compromised adhesion scenarios defined in Section 3.2.2.1, the headway and run-in/run-out times shall be determined and the loss of benefit - compared to the targeted performance - shall be determined.

3.2.2.3 Performance Impact Assessment

From the performance modelling of the scenarios required in sections 3.2.2.1 and 3.2.2.2, the following outputs shall be obtained:

- The service performance attained if the line is operated using acceleration and service brake rates consistent with the application of manual, defensive driving techniques under adverse conditions
- The service performance when operating with acceleration and service braking rates, and adhesion limits, as defined in each of the compromised adhesion scenarios.
- The performance dis-benefits of operating at reduced acceleration and service braking rates - and hence lower adhesion limits - compared to the targeted performance shall be determined. These shall include the dis-benefits arising from the impact on run time, headway and RORIT.
- The performance benefits from operating at the tunnel section acceleration rate on the open sections shall be determined.

3.2.3 Asset Damage Assessment

Asset damage modelling shall be undertaken to assess the likely extent of wheel and rail damage which would be sustained for each of performance levels used in the Performance Modelling.

3.2.3.1 Asset Damage - Motoring Assessment

The asset damage risks (primarily track related) and likely maintenance costs, (e.g. arising from wheelspin during motoring), when operating at each of the defined compromised adhesion scenarios shall be determined for different levels of mitigation measures.

The potential maintenance benefits of reducing the risk of rail damage and rail defect formation and subsequent development to the point of requiring maintenance intervention shall be determined.