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Signalling Requirements for Dual Gauge Areas

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1.0	20 Oct 22	All	First Issue of document

Table of Contents

1 Introduction

1.1 Purpose

This document describes the signalling requirements in areas of dual gauge track systems across the ARTC railway network.

1.2 Scope

This standard covers the signalling design and guiding principles for dual gauge areas including:

- A general Introduction to a dual gauge track
- The rationale behind why additional controls are required in dual gauge areas
- Principles of signalling system design to ensure correct gauge is determined for each rail vehicle that enters the ARTC network.

1.3 Responsibilities

The Head of Engineering Standards is the document owner. Queries should be directed to standards@artc.com.au in the first instance.

The Signal Designer is responsible for the implementation of this standard in any new signalling designs.

The Signal Design Manager is responsible for managing the process and ensuring consultation with stakeholders. The Signal Design Manager is responsible that the signalling design meets the operational requirements and are safe SFAIRP.

1.4 ARTC Reference Documents

The following documents support this standard:

Standard Ref	Title
ESD-05-14	Frauscher Axle Counter Systems
SDS 17	Track Circuits
ESD-05-01	Common Signal Design Principles – S1
ESD-05-12	Microlok II Design
SDS 07	Single Line Sections
SDS 08	Bi-Directional Signalling
SDS 16	Controls and Indications

1.5 Definitions & Abbreviations

Abbreviation/Acronym	Definition
ARTC	Australian Rail Track Network
SFAIRP	So Far as is Reasonably Practicable

2 Dual Gauge Track

Most railways operate on a single gauge, where only 2 rails are laid with a set distance between them – meaning that only gauge compatible trains may enter that network. As railways around the world have developed, different railways have adopted different rail gauges for a variety of reasons – and from an interoperability perspective this creates issues for cross boundary movements for

both passenger and freight, meaning that passengers had to change trains (often by walking across a platform) or freight had to be trans-shipped in a suitably equipped rail yard.

With the passage of time and greater co-operation between adjoining rail operators dual gauge rail systems have been developed that allow 2 differing gauge trains to travel along the same corridor. This allows both passengers and freight to complete their journeys without the need to move to a different train, increasing efficiency and customer satisfaction.

In Australia there are 3 common track gauges;

- Narrow gauge – nominally 1067mm or 3 ft 6 in,
- Standard gauge – nominally 1435mm or 4 ft 8½ in,
- Broad gauge – nominally 1600mm or 5 ft 3 in.

Considering the photo below, there are 3 rails for each track with the left hand most rail being the common rail (all rail traffic uses this rail) with the next rail to the right (in between) to accommodate narrow gauge trains and the right-hand most rail to accommodate standard gauge trains.

Figure 1 - Typical Dual Gauge Track Arrangement

3 Requirements for Dual Gauge Track

3.1 General Requirements

In dual gauge track, additional controls are required for routes, signals and points to ensure the following requirements are met:

- Trains are only able to be signalled into suitable routes.
- The gauge information being propagated ahead of every train is correct.
- There is provision of safe overlaps for main signals for all gauges.
- Signal aspects displayed are clearly understood by the train crew.

The requirements described herein are based on the assumption that all trains consist of vehicles of a single gauge only – that is either 1067mm (narrow gauge), 1435mm (standard gauge) or 1600mm (broad gauge).

Gauge discrimination is required to be provided in the following cases:

1. Main signals which have one or more overlaps which are not available to trains of all gauges.
2. Junction signals which have any route which is not available to trains of all gauges.
3. Calling On routes.
4. Shunt routes requiring an over-run
5. Points which are required to be set and locked to satisfy the requirements of item (1) above.
6. Ground frame controlled points where the reverse lie is not trafficable to all gauges.

3.2 Determination of Gauge

The gauge of a train is determined either by gauge discrimination managed within the train detection system or by gauge of the source from which the train came, provided the source is trafficable for one gauge only.

Train detection system shall be provided to determine the gauge of the trains entering the signalled territory from the dual gauge area.

In sidings where train detection systems exist and where mixed storage of both gauge trains is permitted, gauge discrimination within the train detection system shall be provided to allow the gauge of a train leaving the siding to be determined prior to the train exiting the siding.

Where gauge discrimination within the train detection system is provided, the gauge of the train shall be determined as described below.

- The gauge of the approaching or in-route train shall be stored using traffic gauge stick functions - one for each gauge.
- The gauge determined by traffic gauge stick functions shall only be considered known if at least one traffic gauge stick function for a specific gauge is energised and all other traffic gauge stick functions are de-energised.
- The gauge of a train shall be considered unknown if both traffic gauge stick functions are de-energised, and invalid if traffic gauge stick functions for both gauges are energised.

Setting of traffic gauge stick functions based on the occupancy of gauge discrimination track sections shall only be allowed where the gauge discrimination track section forms the immediate approach track to a stop signal. Setting of gauge shall not be allowed on the approach to an intermediate shunt signal which is overset by a main route.

Where it is permitted to set the traffic gauge stick functions based on the occupancy of gauge discrimination track sections, the following conditions are to be satisfied to allow the setting of a traffic gauge stick function for a specific gauge energised:

1. The track section of the same gauge as the traffic gauge stick function is occupied.
2. The track section of the other gauge is clear.
3. Conditions (1) and (2) are required to exist continuously for a time which exceeds the longest approach locking applicable to the stop signal.

   The approach locking time may be very long resulting in long gauge establishment times.

   Where it is desired for operational reasons to reduce the gauge establishment time the following strategy may be applied:

a) An additional gauge establishment timer is provided that times whilst the conditions (1) and (2) are satisfied, and the signal in rear is at stop and free of approach locking,

b) The gauge is established when the conditions in (a) above have existed continuously for a time which exceeds the reduced approach locking time.

c) Application of the reduced gauge establishment time is independent of and does not require the implementation of reduced approach locking on the stop signal.

If the information provided by any in-route gauge discrimination track section/s and the information derived from the traffic gauge stick functions do not match with each other, then relevant traffic gauge stick function shall be set to de-energised which will result the gauge of the train being unknown. This is necessary to prevent the propagation of incorrect gauge discrimination information.

3.3 Propagation of Gauge Information

Once the gauge of a train has been determined, the information of the train gauge shall be propagated through the interlocking along the route set for the train.

Propagation of gauge information shall require all in-route dual gauge track sections clear and for main routes the replacement track of the traffic gauge stick function clear. Where part of a route is not trafficable to both gauges, only the dual gauge tracks which can be occupied by trains of either gauge shall be proven clear. For example, in-route points track sections which are trafficable to one gauge only, when in the lie required by the route, shall not be proven clear.

Gauge propagation for the routes of controlled signals shall be initiated by normal locking function of the signal being de-energised. Once initiated, traffic gauge stick functions shall be maintained in the energised state by the occupation of any in-route track section and, in addition for routes of controlled signals, the route stick function of the last in-route track section de-energised. Where the replacement track section of a traffic gauge stick function can be legitimately occupied by a train other than one using the route to which the traffic gauge stick function applies (e.g. if the replacement track section contains a set of trailing points), the application of the replacement track section to the traffic gauge stick function shall be conditioned accordingly (e.g. by the controlled lie of points). Such conditioning is applicable to both the initiation and maintenance of the traffic gauge stick function.

Each traffic gauge stick function shall be proven de-energised in the track stick function for the first in-route track section of the signal at the end of the route to which it applies.

The replacement of all traffic gauge stick functions shall result from the occupation of the first in-route track section for the signal at the end of the route occupied. In this part this track section will be referred to as the replacement track section. For main routes which apply up to a signal without sub shunt, the replacement of the traffic gauge stick functions applicable to the route shall be immediate upon the occupation of the replacement track section. In all other cases replacement shall occur when the replacement track section becomes unoccupied after being occupied.

Note: where replacement as a result of the replacement track section vacating after being occupied is provided, the track stick function for the first in-route track section of the signal at the end of the route will remain de-energised whilst the traffic gauge stick function is energised, therefore the track gauge stick function which proves the traffic gauge stick function de-energised cannot be used to provide the replacement condition. In such cases two levels of track section repeat function shall be provided, the first shall be used for traffic gauge stick function replacement only and the second which shall be the track section stick function, shall prove de-energised the traffic gauge stick function. The second level track section repeat function shall be used for all other purposes.

Where trains are likely to change direction and the gauge reset time for the new direction is greater than 30 seconds, then the gauge information for the initial direction of travel shall be used to allow setting of routes for the new direction.

In train detected sidings where mixed storage of both gauge wagons is permitted, short gauge discrimination track sections shall be provided to allow the gauge of a train leaving the siding to be determined – this may lead to the extension of any sidings to facilitate this requirement. Propagation of gauge through such sidings shall not be provided.

3.4 Route Setting Requirements

3.4.1 Main Routes

Gauge discrimination shall be carried out at the interlocking level.

Single gauge routes shall be permitted to set only when the gauge of the approaching train is known and matches the gauge of the route required to be set. At the time of setting of a main route from either dual gauge track section or single gauge track section, which terminates in dual gauge track section shall prove at the interlocking level all in-route dual gauge track sections clear. This prevents the setting of a route for a train of a different gauge from the train already in-route.

At the time of setting of a route, that does not prove an overlap track section clear, from either dual gauge track section or single gauge track section, which terminates in a dual gauge track section, shall prove all track sections in the route clear and the gauge replacement track section clear at the interlocking level. This prevents the gauge of a route being cancelled by a train ahead occupying its gauge replacement track section. Where the gauge replacement track section is permitted to be occupied by a train other than the one using the route e.g. if the gauge replacement track section contains a set of trailing points, the proof of the gauge replacement track section clear shall be conditioned accordingly (e.g. by the controlled lie of points) in the interlocking.

When the gauge of the approaching train is unknown and dual gauge route has one or more overlaps, a dual gauge overlap shall be set in the interlocking. When the gauge of the approaching train is known and the dual gauge route does not have an overlap trafficable to both gauges, the overlap shall be set and locked to match the gauge of the approaching train. If the gauge of the approaching train is unknown, the route may not be set When the traffic gauge stick functions applying up to the signal controlling entry to the route are in an invalid state (i.e. both traffic gauge stick energised), the setting of the route is not permitted.

3.4.2 Subsidiary Routes

Setting of shunt routes are generally permitted into the occupied track sections, except where a dual gauge track section is occupied by a train not matching the gauge of the train for which the route is being set, and the occupied track section forms part of a route, the destination of which is trafficable to one gauge only.

Setting of shunt routes shall be permitted into occupied track sections where the gauge of the train occupying an in-route dual gauge track section matches the gauge of the train entering the route.

Setting of an intermediate shunt route that is overset by the main route and is available to one gauge only shall require the following:

(i) The gauge of the train approaching the main signal for which it is acting as a preset matches the gauge of the preset shunt route.

(ii) All in-route track sections between the main and the preset shunt are clear.

(iii) All in-route points between the main and the preset shunt are controlled to the lie required for the main route.

(iv) The main route non-vital control is given.

3.5 Signal Aspect Requirements

The aspect of routes which terminate in dual gauge track shall prove that the gauge being propagated to the signal at the end of the route is valid.

- When the gauge of the approaching train is known, the gauge being propagated to the signal at the end of the route shall be proven to match with the gauge of approaching train.
- When the gauge of the approaching train is unknown, all traffic gauge stick functions applying up to the signal at the end of the route shall be proven de-energised.
- When the conditions for propagating gauge are satisfied (e.g. in-route dual gauge track sections clear etc.) correspondence shall be proven between the approaching train gauge information or the gauge of the route, where the route is trafficable to one gauge only, and the gauge information which is being propagated.

Correspondence of the approaching train gauge and the gauge being propagated forward may fail momentarily when the approaching gauge information changes due to propagation delays (e.g. line circuit or vital serial link to an adjacent interlocking). Hence, the relevant signal aspect shall be held clear for sufficient time to allow for the propagation delays. Holding the signal aspect clear shall be effective only when the signal was clear at the instant that the approaching gauge changed. The signal shall remain clear if the approaching gauge is correctly propagated, that is, the signal is clear to a route which is trafficable to and has an overlap available to both gauges. If correspondence does not exist after the elapse of the time allowed for gauge propagation to occur then the relevant signal shall be placed at stop. The timer used to provide this function shall be either a vital slow release timer which is guaranteed to operate in the specified time or less, or a timer within the CBI itself.

The aspect of a junction signal which has one or more routes not trafficable for both gauges shall be placed at stop if the gauge of an approaching train becomes unknown or changes to a gauge other than that appropriate to the route currently set.

When an overlap has been set which is trafficable for one gauge only and the gauge of an approaching train becomes unknown or changes to a gauge other than that of the current overlap, the aspect of the signal shall be placed at stop.

Where a shunt route applies up to another shunt signal (not a sub shunt under a main signal or fixed red) and there is a set of facing points within 50m of the signal at the end of the route and one lie of the points leads to track not trafficable to both gauges, the aspect of the shunt signal shall prove the facing points in correspondence and locked to provide an over-run which is available for the gauge of the approaching train, if known, or is available to both gauges if unknown. Setting of the facing points to achieve this state is not required.

When the gauge of an approaching train is known, displaying a proceed aspect for a shunt route applying into occupied track section shall be permitted, provided all the following conditions are satisfied:

- All in-route gauge discrimination track sections not matching the gauge of the approaching train are clear.
- All traffic gauge stick functions which do not match with the gauge of the approaching train, for the same or another route with the same signal at the end of the route, are de-energised.

- All traffic gauge stick functions which do not match with the gauge of the approaching train, applying up to in-route opposing signals, are de-energised.

When the gauge of an approaching train is unknown, displaying a proceed aspect for a shunt route into occupied track section shall be permitted, provided all the following conditions are satisfied:

- All in-route gauge discrimination track sections are clear.
- All traffic gauge stick functions for the same route, or any other routes with the same signal at the end of the route, are de-energised.
- All traffic gauge stick functions applying up to in-route opposing signals are de-energised.

3.6 Requirements for Points and Ground frames

Points in the overlap of dual gauge routes shall only be free to move to maintain an overlap which matches the gauge of the approaching train or an overlap trafficable to both gauges.

If the gauge of the approaching train is or becomes unknown, the points in the overlap shall only be free to move to maintain an overlap which is trafficable to both gauges.

The locking of overlap points shall be released as required for route holding. This requirement shall also apply where an overrun for a shunt route is required by Section 3.5.

Where the reverse lie of ground frame controlled points is only trafficable for one gauge, the release shall be locked unless one of the following conditions is satisfied:

1. All track sections are clear between the released points and the next end of route object (i.e. signal, Limit of Shunt, buffer stop etc.), in each direction.
2. Any track section occupied within the limits described in item (1) above is occupied by a train the gauge of which, as determined by traffic gauge stick functions, matches the gauge of the reverse leg of the ground frame points.

A pair of gauge discrimination track sections shall be provided extending from the toe of switch of the ground frame points and these shall be used to determine the gauge of the train approaching the ground frame when this is not known. Where the end of route object, as described in item (1) is a signal and the gauge discrimination track sections form the immediate approach to that signal, the traffic gauge stick functions applying up to the signal shall be set as described in Section 3.2. Where no such signal exists, traffic gauge stick functions shall not be set and the gauge discrimination track sections shall be used to determine gauge for the purposes of releasing the ground frame only. In such cases when the gauge of the approaching train as determined from the traffic gauge stick functions is unknown, unlocking the release shall require the track section which matches the gauge of the reverse lie of the ground frame points occupied for the route holding time applicable to the track section whilst the other gauge track section is clear.