**Division / Business Unit:** Corporate Services & Safety
**Function:** Signalling
**Document Type:** Standard

# Unreliable Track Circuit due to Infrequent Train Operations

## ESM-07-04

### Applicability

ARTC Network Wide

SMS

### Publication Requirement

Internal / External

### Primary Source

### Document Status

| Version # | Date Reviewed | Prepared by | Reviewed by | Endorsed | Approved |
|---|---|---|---|---|---|
| 1.0 | 18 Nov 20 | Standards | Stakeholders | Manager Signalling Standards | General Manager Technical Standards 21/11/2020 |

### Amendment Record

| Amendment Version # | Date Reviewed | Clause | Description of Amendment |
|---|---|---|---|
| 1.0 | 18 Nov 20 | | First issue. |

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# 1 Introduction

## 1.1 Purpose

The purpose of this document is to describe the issues with the train detection due to rail head contamination and to provide the preventative measures including engineering and operational controls in known areas of infrequent train operations and following line closures for planned or unplanned works.

## 1.2 Scope

This document applies to train detection systems currently used on ARTC network.

The scope covers engineering and operational solutions that can be implemented to mitigate the risks of unreliable operation of track circuits.

## 1.3 Document Owner

The General Manager - Technical Standards is the Document Owner. For any query, initial contact to be made at standards@artc.com.au.

## 1.4 Responsibilities

The Business Unit Managers, Project Manager, Project Engineer, Signal Maintenance, Control System staff and Signal Design engineers are responsible for compliance with this document.

## 1.5 Reference Documents

- AS 7115:2016 Train Detection
- RISSB Guideline - Management of Rail Traffic with Unreliable Track Circuits
- ESM-07-02 Track Circuits and Train Detection Devices
- ESD-32-01 Rollingstock Interface Standard
- ANGE 220 Unreliable track circuit operation
- ANSY 512 Manual Block working
- ANSY 516 Pilot Staff working
- ANSY 514 Special Proceed Authority
- ANSG 608 Passing signals at stop
- Code of Practice - Code of Practice for the Defined Interstate Rail Network
- TA 20 - ARTC Code of Practice for the Victorian Main Line Operations

## 1.6 Definitions

The following terms and acronyms are used within this document:

| Term or acronym | Description |
|---|---|
| ARTC | Australian Rail Track Corporation Ltd. |
| OEM | Original Equipment Manufacturer |
| HVI | High voltage Impulse |
| GIJ | Glued Insulated Joint |
| RVD | Rail Vehicle Detection |

# 2 Introduction

## 2.1 Principle of the Train Detection System

Train detection systems are used to detect the absence of a train or any other detectable rollingstock whilst occupying a section of track. This is also being historically referred as RVD in some areas of ARTC.

Train detection systems perform a safety critical function providing input to the signal interlocking system on the occupancy status of track sections. This is essential to perform its primary function of preventing collisions and derailments.

The principal reasons for providing train detection systems are:

a. to maintain safe train separation;

b. to manage risk at level crossings; and

c. to assist with train operation

## 2.2 Unreliable Train Detection:

Unreliable train detection can impact the safety of train operation as below:

- Trains not being visible to the Network Control Officer;
- Signal in the rear incorrectly providing a proceed indication for the following train;
- Level crossing protection not activating;
- Network delays
- Movement of points underneath the train
- Signal can be cleared between two conflicting routes

Therefore, unreliable train detection may cause serious accidents including train to train collision, derailment or train to road vehicle accidents resulting in multiple casualties and financial loss.

## 2.3 Types of train detection systems used on ARTC network:

There are different types of train detection systems in use on the ARTC network. Examples are as below but not limited to:

- DC track circuits, conventional and AC immune
- ‘Westrak’ track circuits
- 50 Hz AC track circuits, double and single rail
- Audio Frequency Track Circuits
- High voltage impulse track circuits
- Coded track circuits
- Predictors
- Axle counter
- Treadles as an aid to track circuit operation

- Wheel presence detectors for dual gauge

## 2.4 Potential causes for unreliable track circuit

There can be different causes for unreliable track circuit.

- Design issues – This risk is mitigated by competency requirements for signal designers, design risk assessment and the requirement for independent verification of the design.
- Testing & Commissioning issues – This risk is being mitigated by ARTC Testing and Commissioning standards and competency requirements for signal testing staff.
- Incorrect adjustment/fault introduced during maintenance – This risk is being mitigated by the Technical Maintenance Plan, Service Schedules, Maintenance Standards, defect management through Ellipse, competency requirements for maintenance staff.
- Rail Head Contamination – Infrequent train operation and environmental factors may result in rail head contamination. This document addresses the issue of unreliable track circuit operation due to rail head contamination, provides preventative measures including engineering and operational controls in known areas of infrequent train operations and following line closures for planned or unplanned works.

This document addresses the issue of unreliable track circuit operation due to potential rail head contamination and provides a risk-based approach instead of time-based rule.

## 2.5 Rail head contamination

Reliable operation of the track circuits depends on the wheel-rail interface.

Infrequent train operations can impact on the reliable operation of track circuit due to poor wheel-rail interface resulted from rail head contamination.

Contamination build up rates differ from one place to another depending on factors mentioned in the following section. Therefore, the contamination builds up rate is not similar or consistent across the ARTC network.

### 2.5.1 Factors affecting the rail head contamination

There are several factors which affect the rail head contamination and plays an important role in reliable track circuit operation as mentioned below.

1. Environmental factors (Geographical effect)

These factors will impact on the speed at which contamination builds up. For example, wet and hot areas may see the more rapid build-up of contamination than dry areas. Environmental factors which affect the rail head contamination include:

- Coastal area and ocean salt effect
- Rainfall
- Temperature
- Humidity
- Leaf fall
- Coal dust

- Sanding
- Vegetation
- Other local factors like grains, cement, grease etc.

2. Nature and characteristics of rail traffic

This will impact on the amount of scrubbing of the rail as a result of the passage of each train. Several characteristics of the train will impact rail head contamination including:

- Light Engines
- Mixed trains
- Freight only
- Electric trains
- Speed of train
- Length of train
- Weight of train
- Wheel and Rail Profile

3. Train Frequency

This will impact how often the rail head is scrubbed by the passage of the train.

# 3 Management of unreliable track circuit operation arising from rail head contamination

## 3.1 New or Upgrade works

Selection of the train detection system for new works on the ARTC network shall be based on operational requirements and the signalling functional specification.

Axle Counters shall be preferred as they provide reliable operation where low traffic has been identified in the operational requirements.

The signal design engineer is responsible for selecting the correct type of train detection system. The specific situation shall be risk assessed based on the factors provided in the above section. The risk assessment shall be recorded as part of the design report.

For major upgrades or re-signalling projects, an axle counter system shall be preferred for replacement of existing track circuits, susceptible to rail head contamination in low traffic areas.

## 3.2 Planned Closure works

Following are the examples of planned closure work situations which can cause track circuits to be at risk of unreliable detection.

1. Track circuits directly worked on during trackwork (for example, installation of new or rusty rails, ballast works)
2. Track circuits inside a possession area that are not part of any trackwork.
3. Track circuits outside a possession area that are not traversed due to an operational variance caused by the possession.

Track circuits directly worked on during planned work e.g. rerailing, re-laying or ballast works etc., shall be booked out of use and disconnected per the applicable ARTC standards. Once the work is completed then the track circuits shall be reconnected, tested and certified into use per ARTC standards.

Track circuits which are not directly worked on but not traversed by a train during planned closure works should be considered unreliable.

The following preventative measures shall be considered during planned work or before handing back infrastructure for revenue services for the track circuits which are not directly worked on.

- Run a train over the entire length of the track circuits to remove rail contamination. Several passes may be required to sufficiently remove contamination.
- Arrange the test train to run before the first revenue train
- Run rail head with scrubber attached to road-rail vehicles
- Grinding or milling where useful

In case a test train or other trains ares organised to clean the rust, the signalling maintainer should observe the remote indications to certify the correct operation of the track circuits during the passage of a train. In addition, signal maintenance representative may also decide to perform the shunt test if not satisfied with the indications before allowing the normal train operations.

The project manager or person responsible for the planned closure is to ensure that rail infrastructure is handed back in the same state of integrity as it was before the closure.

Risk assessment in consultation with train operation, signal and track engineering/maintenance staff shall consider all factors which affect the rail head contamination in that particular geographical location, project specific issues and the past operational experience in the affected sections.

Based on the risk assessment, local work instruction should be developed. Items listed in section 3.3 shall be considered when developing the work instruction.

## 3.3 Known areas of infrequent usage

These are the track sections which are not regularly used by train operations because of the normal or varying timetable operation, varying seasonal traffic, yards, sidings and loops etc.

Inspections during maintenance visits are to be made of sections of track where rust or other contaminants are likely to accumulate on the rails of track circuited lines e.g. sidings and entry to sidings, refuges, branch lines.

Whenever signalling maintainers become aware of rails that are rusty or otherwise contaminated such that the track circuit would not reliably detect the presence of trains, they shall inform the network controller and signal maintenance engineer. Signal maintenance staff should book out the track circuits if the rail head is too rusty and if there is any safety concern.

In areas where infrequent traffic is known, business units shall consider the use of Axle Counters to mitigate the issues arising from infrequent usage.

Treadles can be used in other track circuited areas which may be impacted by rail head contamination.

The following measures should be considered by the business unit to minimize the contamination issues in infrequently used areas.

1. Run a train over the track circuits to remove rail contamination. Several passes may be required to sufficiently remove contamination.
2. Run rail head scrubber attached to road-rail vehicles
3. Track and Civil maintenance to clean the rust during maintenance
4. In consultation with track and civil engineering, provision of stainless steel welded into grooves on the rail head or zigzag strips on rail head to ensure electrical connection at wheel rail interface.

Where the above measures are not possible, train operation in such areas shall be managed by the business unit as mentioned below.

- Business unit should identify and document the locations which may be infrequently used such as crossing loops, sidings etc.
- Business unit to perform the risk assessment in consultation with train operation, signal and track maintenance staff. The risk assessment shall consider factors which affect the rail head contamination mentioned above and past operational experience.
- Based on the risk assessment, local work instruction shall be developed.

The following items shall be considered when developing the work instructions.

1. Train length available in affected section to clean the rail.
2. Available train weight in affected section to clean the rail.
3. Train path to be followed to ensure all track circuits have been traversed through.
4. Network controller to ensure that there are no trains in the affected section.
5. Network controller to advise the maintenance staff to observe the track circuit indication as required.
6. Signal protecting the block where the track circuit is unreliable is not to be used for the movement of rail traffic.
7. Network controller can operate the points manually in the desired position. Once the train route is set, network controller to block the points, to mitigate the potential risk of points operating under a train.
8. Disconnection and booking out of points operated by an adjacent ground frame or an adjacent control panel which is not in a position where the operator can easily observe the clearance point.
9. Network Controller can manage train movements to ensure only one train is in the affected area controlled by the signal at one time.
10. CAN warning to be issued for all train movements traversing the level crossing.
11. Rail traffic crews to ensure that the level crossing equipment has activated, and booms are in a horizontal position before traversing the level crossing as per the applicable operational procedure.
12. Network Control to remove the blocks once confirmed by the Signals Rep that the track circuits are operating correctly.
13. Signal maintenance staff to observe the track circuit indication on Phoenix train control system. Where track circuit indications are combined as block indication, system logs can be used to confirm the correct operation of track circuit indications. If Signal maintenance staff are not satisfied with the indications and system logs, they may decide to perform the shunt test.
14. Signal maintenance to certify correct operation of track circuits in the affected area and document it.
15. Once track circuits are certified as operating correctly, the network controller to be informed by signal maintenance staff that normal operation can resume.

## 3.4 Unplanned events

Sometimes rail services over sections of tracks can be suspended for a considerable amount of time which can result in unreliable track circuit operation, due to unplanned events like storms, flood, bushfire, derailment etc.

In such cases, the Network Controller shall contact the signal maintenance engineer and a relevant representative from track maintenance to determine the requirement to ensure safe train operation. Operational procedures and existing local work instruction for infrequent train operation as per section 3.3 should be followed in addition to other requirements identified in the specific situation.