

This is a ARISO Code of Practice development draft

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Preface

This Code of Practice was prepared by the Type Approval – Signalling Development Group, overseen by the ARISO Train Control Systems Standing Committee.

Objective

The objective of this Code of Practice is to provide guidance on the application of AS 7702 for signalling products and promote a common understanding of type approval requirements between suppliers of product for signalling applications and rail transport operators (RTOs).

This Code of Practice provides guidance to support consistent and effective application of AS 7702.

The terms shall, should, and may are used as follows:

- “shall” indicates a requirement that exists because it is mandated by AS 7702, other applicable standards, legislation or an RTO’s SMS.
- “should” indicates a recommended practice or approach that may be adopted by an RTO based on its risk tolerance and operating context.
- “may” indicates an optional practice or discretionary action.

This Code of Practice does not introduce new mandatory requirements.

ARISO products identify known hazards relevant to the railway industry. Appendix A provides a non-exhaustive list of hazards relevant to the scope of this document.

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Section 1 Scope and general

1.1 Scope

This document is intended to be applied to the type approval of signalling products.

It provides guidance to support a consistent, transparent and risk-based approach to the assessment of signalling products prior to their acceptance for use in service. It includes the following:

- (a) Guidance on which products need to be type approved.
- (b) Detailed guidance on information to support type approval.
- (c) Scaling the type approval for the risks on the criticality.
- (d) Addressing incremental adjustments to existing type approvals.
- (e) Addressing incremental adjustments to grandfather approvals.
- (f) Application of provisional or interim approvals.
- (g) Identifying practices for trialling equipment during assessment.
- (h) Guidance on cross acceptance of products.

Any product that affects the interoperability of signalling or onboard systems, whether trackside or train-borne, requires assessment and authorization before entering service.

1.2 Normative references

The following documents are referred to in the text in such a way that *some* or all of their content constitutes requirements of this document:

- AS 7702:2023, *Rail Equipment Type Approval*
- AS/NZS 3112:2017, *Approval and test specification - Plugs and socket-outlets*

NOTE:

Documents for informative purposes are listed in a Bibliography at the back of the document.

1.3 Defined terms and abbreviations

For the purposes of this document, the following terms and definitions apply:

1.3.1

accredited standards authority

International Standards Organisation or International Electrotechnical Commission or its members

Note 1 to entry: Standards Australia, New Zealand Standards Organisation, American National Standards Institute and British Standards Institute are each an example of an accredited standards authority.

1.3.2

application condition

condition applied to a product approval that restricts or limits the use of the product in specific circumstances

Note 1 to entry: Application conditions can constrain use to particular design types, location types, operating environments or operational contexts.

1.3.3

approved supplier

supplier approved to provide goods to the RTO as per the requirements of the RTO procurement processes defined in their SMS

**1.3.4
component**

piece of hardware that is used to make up an elemental part of a product that can be traced to a specific single standardized and recognized set of requirements

Note 1 to entry: If the product has to comply with a range of different standardized set of requirements, it cannot be considered a component.

**1.3.5
derogation**

permanent non-compliance against an RTO specified requirement

Note 1 to entry: All type approval derogations are required to be formally accepted and approved by the assessing RTO with any necessary conditions to control the risk.

**1.3.6
EMC**

electromagnetic compatibility

**1.3.7
grandfather rights**

equipment approved for use based on historical performance, without a product information pack and approval certificate

Note 1 to entry: The RTO will decide under what conditions the equipment can continue to be used and whether it can be used in new installations.

**1.3.8
interim approval**

time-limited approval pending full evidence

**1.3.9
interlocking (IXL)**

system preventing conflicting train movements

**1.3.10
onboard system**

equipment fitted to trains

**1.3.11
product**

single line interchangeable unit, software or system

**1.3.12
Product Information Pack**

uniquely indexed portfolio of information, including all technical data, of verified information references associated with the submission to support a claim of compliance or approved derogations

Note 1 to entry: Each item will have a unique index identification number specific to that pack to facilitate easy reference to the appropriate documentation supporting a compliance claim. Indexes for product type specific Product Information Packs are included in this document.

**1.3.13
provisional type approval**

temporary approval for trial purposes

1.3.14

reference approval

type approval from another RTO other than the assessing RTO that will be referenced as a baseline for the assessing RTO's type approval

1.3.15

rail transport operator (RTO)

As defined in Rail Safety National Law.

1.3.16

RAM/RAMS

reliability, availability, maintainability (and safety)

1.3.17

safe work method statement (SWMS)

document that identifies hazards associated with specified work activities and defines the measures required to control risks and ensure the work is undertaken safely

1.3.18

SCADA

supervisory control and data acquisition

1.3.19

SMS

safety management system

1.3.20

track circuit

electrical train detection system

1.3.21

trackside

equipment beside the railway

1.3.22

type approval

assessment and acceptance process applied to any product that does not meet the criteria for supplier approval only

Note 1 to entry: The assessment process is conducted in accordance with AS 7702.

1.3.23

V&V

verification and validation

1.3.24

wayside

lineside equipment

General rail industry terms and definitions are maintained in the ARISO Glossary. Refer to:

<https://www.ariso.org.au/glossary/>

Section 2 Type approval guidance

2.1 General

Different signalling products impose different levels of risk on the RTO, depending on the functions the product is intended to perform and the operational context in which those functions are delivered.

This document is intended to assist users in making informed decisions in relation to product type approval. Ultimately, the risk associated with approving a product rests with the RTO, which retains the authority to determine whether a product will be type approved, based on business needs, operational context and risks.

The requirements and formal process for type approval are defined in AS 7702, which sets out the overarching framework for the type approval of signalling products.

Type approval is not a substitute for the application of sound engineering judgement. Rather, it provides a level of confidence in the quality of a product and assurance that it is capable of delivering the functionality specified in the product specification for the identified and assessed applications.

This document provides guidance from the point at which a product has been accepted to proceed to a formal type approval assessment and supports the consistent and effective application of the type approval process thereafter.

This document seeks to align with the emerging National Product Type Approval Framework (NPTAF) by supporting a consistent and nationally harmonized approach to type approval for signalling and onboard systems. It aims to:

- (a) Align with the developing national framework to streamline signalling type approval processes and promote consistent practices across jurisdictions.
- (b) Reduce duplicated assessment effort by supporting nationally aligned principles that minimize repeated evaluations of identical or equivalent signalling products, improving interoperability and reducing costs.
- (c) Strengthen cross-acceptance practices to lessen the burden on suppliers and assessors, enabling more efficient deployment of compliant signalling, control command and onboard systems across rail networks.

2.1.1 Product Information Pack

Product Information Packs are fundamental to ensuring that sufficient and appropriate information is provided to the assessing RTO to determine whether a product is suitable for approval for use within the documented conditions of application.

Section 3 provides a series of flow charts that lead to predefined Product Information Pack indexes by product type. These indexes identify the information that should be collated and provided by the supplier in support of type approval.

The Product Information Pack indexes have been mapped to the supplier information requirements specified in Appendix B of AS 7702:2023.

It is intended that each RTO will accept a complete Product Information Pack as an appropriate and sufficient information base for the assessment of a product for type approval.

The RTO would typically cross-reference the Product Information Pack contents against its own requirements as part of the assessment process. The method by which this mapping is undertaken, whether by the supplier, an RTO representative or collaboratively, remains at the discretion of the RTO.

In all cases, a complete Product Information Pack, as identified by the matrix index in Appendix B.4, is expected to be retained for RTO records. This Document provides guidance on circumstances in which it

could be reasonable to limit the assessment of the information provided, based on risk and context of use.

2.1.2 Sample of products requiring signalling type approval

The following provides sample categories and examples of products that typically require signalling type approval, consistent with international practice (EN/IEC) and RTO requirements:

- (a) Interlocking and control systems:
 - (i) Solid-state or computer-based interlocking systems (SSI/CBI).
 - (ii) Relay interlocking equipment and vital relays.
 - (iii) Interlocking modules, logic controllers, vital processors.
- (b) Train detection systems:
 - (i) Track circuits (audio frequency, DC, AFTC).
 - (ii) Axle counters (sensors, evaluator units, detection heads).
 - (iii) Wheel detection equipment.
- (c) Level crossing protection systems:
 - (i) Complete level crossing control systems.
 - (ii) Predictors, timers and monitoring units.
 - (iii) Active control systems (gates, booms, warning lights).
 - (iv) Pedestrian crossing detection systems.
- (d) Points and switches control equipment:
 - (i) Point machines.
 - (ii) Point detection systems.
 - (iii) Swingnose crossing controllers.
 - (iv) Actuators and associated control modules.
- (e) Lineside signalling equipment:
 - (i) LED signal heads and aspects.
 - (ii) Signal control units.
 - (iii) Route indicators and theatre displays.
 - (iv) AWS/TPWS indicators (where applicable).
- (f) Communication based systems:
 - (i) ETCS/ATP onboard and trackside equipment (balises, LEUs).
 - (ii) Safety critical communication systems such as GSM-R/FRS compatible equipment.
 - (iii) Networked signalling communication devices (routers, modems, switches used in signalling networks).
- (g) Control centre and supervisory control and data acquisition (SCADA) interfaces:
 - (i) Signalling control centre software.
 - (ii) Mimic panels and workstation systems.
 - (iii) SCADA components controlling signalling power/points.
- (h) Power supply and vital infrastructure:
 - (i) Signalling power supply units including uninterruptible power supply (UPS) and battery chargers.

- (ii) Vital power distribution boards.
- (iii) Surge protection and earthing devices used in signalling circuits.
- (i) Onboard systems affecting interoperability:
 - (i) Onboard ATP/ATO systems.
 - (ii) TCMS-to-signalling interface modules.
 - (iii) Event recorders interfacing with signalling.
- (j) Ancillary but safety critical signalling components:
 - (i) Cable types used for signalling.
 - (ii) Vital connectors, termination modules.
 - (iii) Trackside housing and environmental protection units for signalling equipment.

2.1.3 Product information categories

To support guidance on potentially limiting assessment effort, each index categorizes the information as described below. The assigned category does not indicate any relaxation of the requirement to provide the information; it is intended solely to assist the RTO in prioritizing its assessment activities.

- **CORE** – This information is always subject to assessment for any product seeking type approval, regardless of in-service history or reference approvals. It comprises the foundational information that must be provided for every newly type-approved product to enable the RTO to establish confidence in the product's quality assurance arrangements.
- **CROSS** – Where there is a potential case for cross acceptance, then this information is relevant to that cross acceptance assessment by the RTO.
- **FULL** – This information will be reviewed when a full assessment is required, along with all other information in the Product Information Pack. This information is also relevant to cross acceptance where there are context differences; the RTO can choose to assess only those items relevant to the context differences.
- **TRIAL** – This is information that is relevant if a trial has taken place as part of the type approval process for any reference type approvals (type approval by another RTO) or for a type approval assessment for a previously granted provisional type approval.
- **ADD** – This section is for additional information that the supplier considers necessary to demonstrate the integrity and performance of their product for approval.

2.2 Failure modes and hazards

To assist users in understanding why specific information is required, this document includes a list of general hazards in Appendix C. The information provided within the Product Information Pack should demonstrate that these hazards have been identified and considered as part of the assurance process.

In addition, suppliers and RTOs are encouraged, where relevant to the product type, to consider hazards identified in the ARISO hazard register.

Suppliers should review both the general hazards listed in Appendix C and the ARISO hazard register included in Appendix A of this document to ensure that the information provided is sufficient to support assurance that the associated risks have been identified and are appropriately controlled.

2.3 Type approval decision

The decision whether to approve a product rests with the assessing RTO. Nothing in the following guidance limits an RTO's discretion to determine the scope or depth of its assessment. This document provides practical guidance on where it could be reasonable to limit the scope of information reviewed and assessment effort during a type approval process, with the objective of improving efficiency while maintaining a high degree of confidence that the product will not introduce unforeseen or unacceptable risks to safety or operations.

Where a product is proposed to be used in accordance with its intended application, the focus of the assessment is expected to be on determining whether there are any material differences between the proposed operational context and the context for which the product was designed and quality assured.

If context differences are identified and there has been an independent assessment by an Independent Safety Assessor (ISA), or the product has previously received a type approval from another RTO, the assessing RTO may determine that the assessment effort can be limited to addressing those identified gaps. In such cases, other aspects of the product that are accepted as having been previously assessed and independently demonstrated, consistent with the guidance provided in this document.

2.4 Cross acceptance of type approval evidence

Any decision to cross-accept previous type approval evidence is made by the assessing RTO on the basis that evidence of context differences is provided by the supplier within the Product Information Pack and supporting cross-acceptance information is supplied.

Cross-acceptance information typically includes one or more type approval certificates issued by other RTOs, endorsed by the assessing RTO's independent technical reviewer, and supported by relevant references from the issuing RTO.

2.5 Assessment of changes to previously type approved products

For type approval of a modified product that already holds an existing type approval from the assessing RTO, an initial decision is required as to whether the change is assessable. A change that materially affects the performance, functionality, or assurance of the product is considered assessable. Conversely, a non-assessable change can involve minor alterations, such as the substitution of equivalent components, which can be managed through the designer's and manufacturer's change control processes as part of an accepted quality management system. Further guidance is provided in Clause 2.4.3

2.6 Changed type approval

2.6.1 General

This section provides guidance to suppliers on whether changes made to a component or to the product design are likely to require assessment by the RTO. Details of any such change should be provided to the assessing RTO.

Each RTO typically makes it a condition of type approval that the supplier notifies the RTO of any changes to the approved product. Any change that could reasonably impact the safe or reliable use of the product is a change that the RTO would expect to be assessed.

In assessing a change, the supplier should factor in the rail application context and how the change could affect the product's safety, performance, or suitability for use. Where there is uncertainty as to whether a change could have an impact relevant to the RTO, the change should be treated as assessable.

For assessable changes, the supplier should provide updated information to support the RTO's assessment, including an updated Product Information Pack where applicable.

2.6.2 Assessable change

An assessable change is any change to one or more of the following:

- (a) The functional principles of the product design.
- (b) Safety-related application conditions.
- (c) A component type (e.g., spring terminal to screw terminal).
- (d) The form, fit or function of the product.
- (e) Specialist tools associated with the product (hardware or software).
- (f) Any of the product associated specifications.
- (g) Any of the product manuals.
- (h) Firmware or software.
- (i) Verified performance criteria, safety, functional or environmental.
- (j) Maintenance, installation or test practices.
- (k) Operating instructions.

Where there is uncertainty as to whether a change is assessable, the classification is determined by the assessing RTO based on its risk tolerance and operational context.

2.6.3 Non-assessable change

A change that is not assessable should be managed and documented by the supplier as per their quality management system change control process. The assessment shall assure that no degradation in the safety or performance of the product is introduced because of the change.

The supplier should provide information about the change that is sufficient to convince the RTO that there is no material change, including any bulletins or updated product information sheets.

The supplier should be satisfied they can justify that there is no impact for the RTO.

2.7 Grandfather rights

Grandfather rights are a form of type approval granted on the basis that the equipment predates the introduction of a formal type approval assessment process. Each RTO applies its own rules regarding the retention of type approval granted under grandfather rights. A common feature of such approvals is the absence of a structured Product Information Pack and a formally documented, risk-based type approval assessment.

For many products approved under grandfather rights, any available Product Information Pack can rely on reports generated by the RTO, rather than supplier test reports or third-party certification.

Where a change triggers the review of a product approved under grandfather rights, a Product Information Pack is required to be provided by the supplier and a formal type approval assessment undertaken. In such cases, allowances can be made for the inclusion of in-service performance and operational data, where appropriate. The scope and extent of the assessment are determined by the assessing RTO.

2.8 Document descriptions

The following table explains the document tools that are available in this document and explains their purpose and whether they are general or tailored to equipment type.

All checklists and appendices provided in this document are decision support tools only and do not substitute for good engineering.

Table 1 Document Tools and Purpose

Document	Purpose	Location in document	Link to other documents	General or tailored? (tailored to a type of equipment)
Product Information Pack Index	To provide a standardized index for suppliers to use for each submission allowing them to maintain a standard portfolio for their product.	Appendix B	Links to Context difference checklist	Tailored in B.3 with guidance in B.4 and example in B.5
Failure Mode and Hazard List	To provide insight into the failure modes and hazards that are key concern to the RTO and that need to be addressed in the justification for type approval.	Appendix C	ARISO Hazard Register	General
Context Difference Checklist	Checklist to support assessment of whether there are any differences between the design or existing approval context and then questions to help the RTO to decide how to deal with those context differences.	Appendix D.1	Links to product information index	General
Change Control Assessment Checklist	Checklist to provide guidance for assessment of a change to assure that the change has been robustly managed.	Appendix D.2		General
Trial Conditions Checklist	Checklist to prompt on potential controls associated with known risks relating to carrying out a trial on an operational site. Conditions and acceptance criteria are stated by life cycle phase.	Appendix E	Links to product information index Trial specific ITP	General & Tailored
Reference Standards	By equipment type, list of reference standards that are likely to be relevant to each equipment type.	Appendix F		Tailored

Section 3 Type approval assessment

3.1 Type approval or supplier approval

Some products are considered low risk, manufactured to well-established standards, and therefore do not require a full type approval assessment. This is subject to the product being used only for its intended purpose, not being altered in any way, and not being configurable by design.

Where products are assessed as not requiring type approval, it is essential that appropriate quality control processes are in place. In these cases, the emphasis is placed on assurance of the supplier and their quality management processes, rather than on detailed assessment of the product itself.

Products identified as not requiring type approval should only be procured from suppliers that have been approved to supply the relevant product.

Provided the minimum requirements for the provision of goods, as defined in the RTO safety management system (SMS), have been satisfied, products assessed as not requiring type approval may be procured from an approved supplier. Where the outcome of the assessment results in supplier approval only required, the assessment should be fully documented, including the outcome and the justification for any intermediate decisions made in reaching that determination.

The following flow chart is provided to support decisions on whether a product requires a full Product Information Pack and formal type approval assessment, or whether supplier approval alone is sufficient.

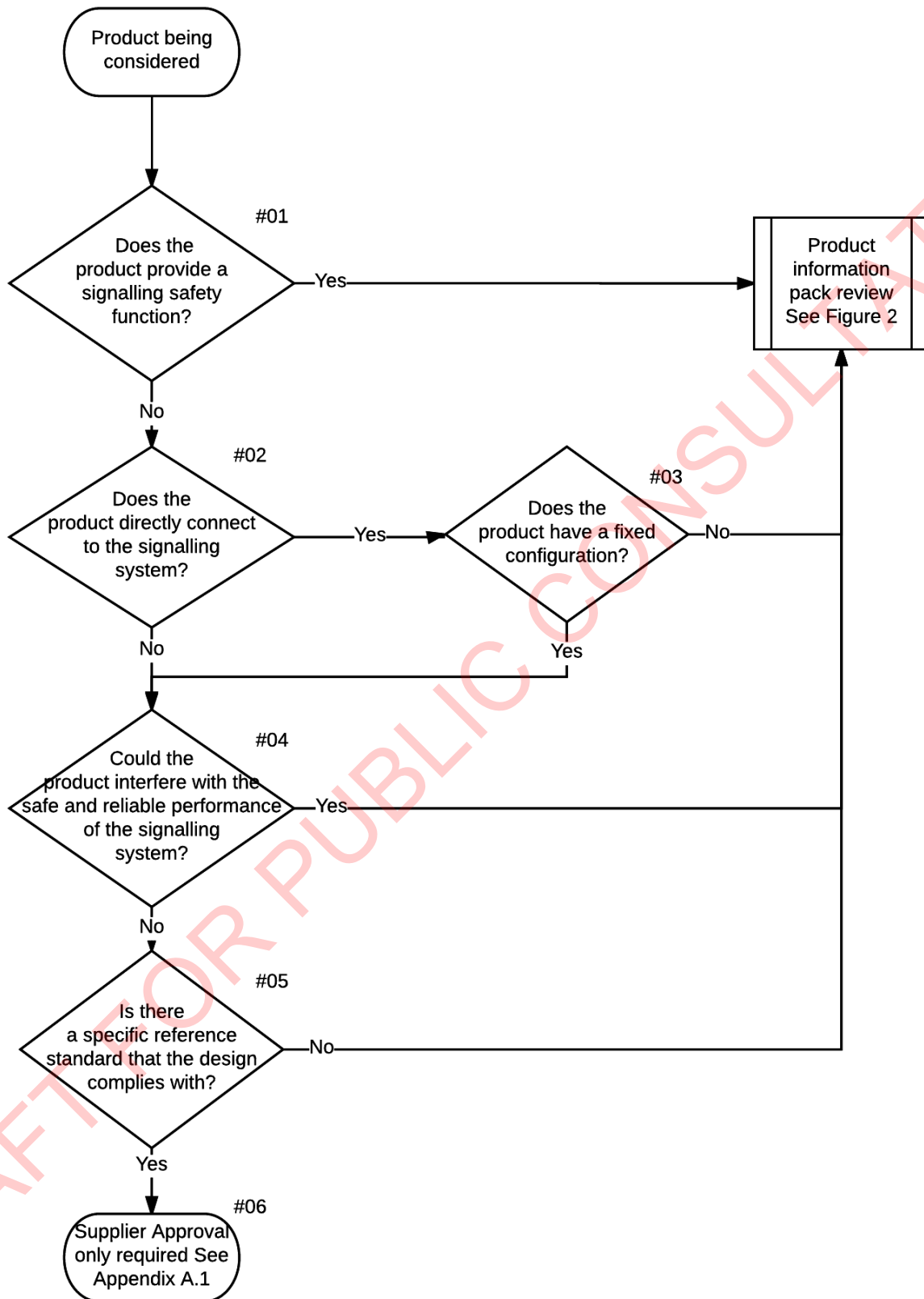


Figure 1 Type approval or supplier approval decision diagram

- **#01** – A product that is integral to the signalling system and provides a safety function. If it is part of the signalling system, directly or indirectly connected and has a state change derived from the condition of direct inputs, then it can be considered to provide a signalling safety function.
- **#02** – If a product is directly connected to the signalling system there is potential, when it is installed, to disrupt the configuration of the system if changed during operational maintenance.
- **#03** – If the product is user configurable, there is a risk of the right product being installed with the wrong configuration.
- **#04** – Could the installation, maintenance, normal operation, degraded operation or failure modes interfere with the integrity of a safety functionality provided by the signalling system? Typical interference considerations will be:
 - electromagnetic interference; and
 - insulation integrity.

NOTE:

This question applies to all products, including non-signalling products that could affect the integrity of the signalling system, for example, ballast enhancers, insulators, transformers, cathodic protection, motors and pumps.

- **#05** – This is referring to a specific reference standard (or set of standards) from an accredited standards authority that covers all the signalling system requirements for the complete product design that can be used for procurement. For example, AS/NZS 3112 for general purpose outlets. This only applies if there are no RTO specific requirements over and above those stated in the reference standard.
- **#06** – RTO supplier approval focuses on the quality assurance and integrity of the supplier to supply the compliant product. Details of the supplier approval checks are listed in Appendix B.1.

3.2 Product Information Pack review

The subsequent flow chart applies to any product that requires a type approval assessment by the RTO, for new product or changed product. Depending on the service history and use of the product there is potential for an RTO to limit the review of information relating to the risk associated with the certainty of the product being fit for the intended purpose.

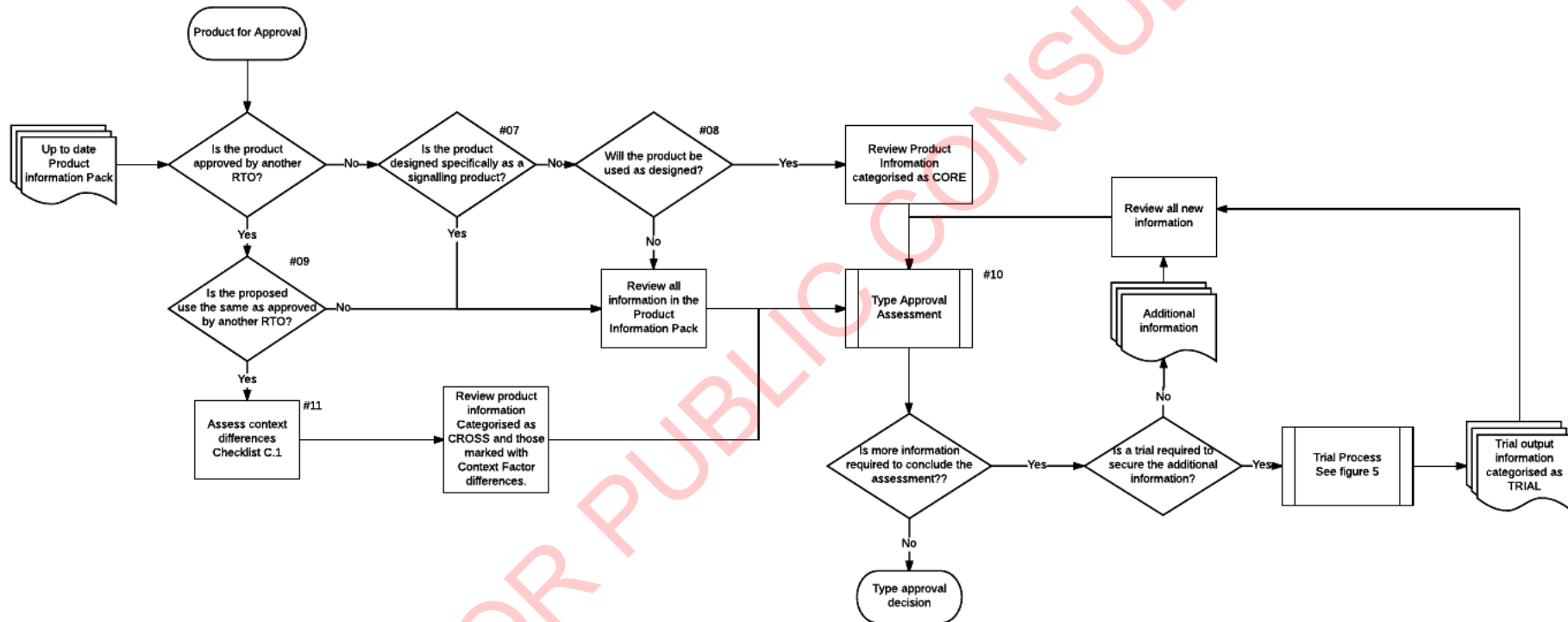


Figure 2 Product Information Pack review decision diagram

- **#07** – A signalling product is a product designed specifically for railway signalling applications as its primary purpose. For example, a track circuit is a signalling product. A power supply used in a signalling system that can be used in other non-railway applications is therefore not a signalling product.
- **#08** – A product can be considered used as designed if there are no deviations from the supplier application conditions and within the supplier defined performance limits. Used only for the intended purpose in the intended environment as defined by the supplier without any modification.
- **#09** – The type approval from another RTO that is most relevant to the RTO that is considering type approval of the product presented should be considered the reference type approval.
- **#10** – The type approval assessment process is defined in AS 7702 and interpreted by each individual RTO. The assessment is to assure that all potential failure modes and hazards associated with the proposed use of the product have been considered and necessary product specific controls defined to allow it to be safely used in the RTO context. In all cases, that assessment will be against a set of requirements defined by the RTO. Guidance on the failure modes and hazards that are applicable to equipment types and relevant to those requirements is given in Appendix C.
- **#11** – Checklist D.1 can be used to identify any potential context differences between the design assumptions or existing approvals for the operating environment for the product and the proposed application. The documents that relate to each context factors are identified in the Appendix B equipment specific indexes. The assessor should focus on those documents relating to a context factor noted as different.

3.3 Changed type approved equipment

This flow chart is for the review process for a product when the RTO has an existing type approval. This section applies to changes defined as assessable in Clause 2.4.2

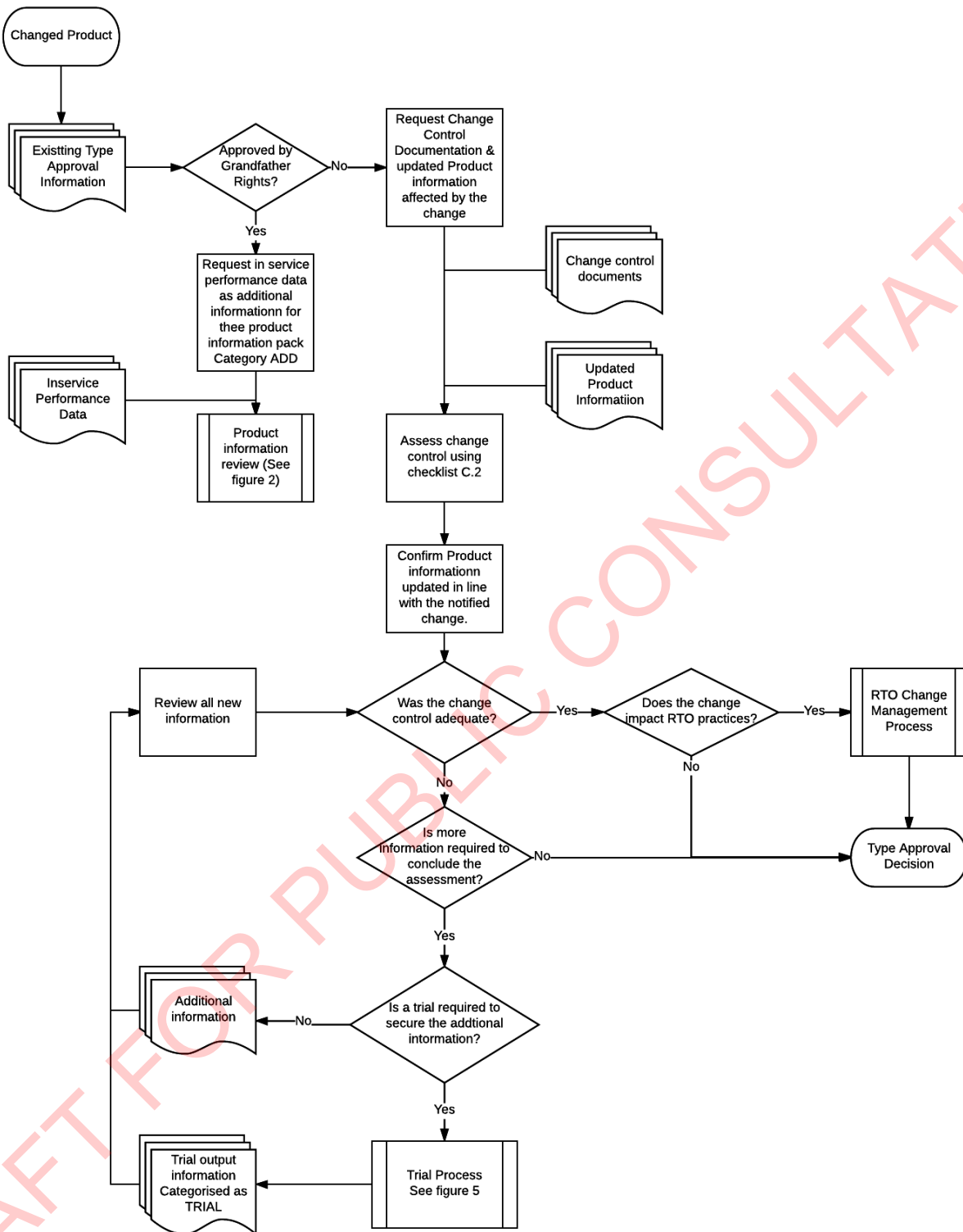


Figure 3 Change assessment decision diagram

3.4 Approval of non-compliances

Review of non-compliances is integral to the type approval assessment. Each assessment by an RTO will be against a baseline set of requirements as defined by the RTO. Each requirement will be assessed as either compliant or non-compliant. The fact that a product is non-compliant with any of the mandatory requirements is not an automatic basis to reject a request for type approval.

To confirm a type approval an RTO will need to confirm that any residual risk associated with those non-compliances against mandatory requirements have an approved derogation against that requirement. RTOs should have a formal waiver or derogation management process that will inform how a derogation is managed. Review of non-compliances is integral to the type approval assessment.

Each assessment by an RTO will be against a baseline set of requirements as defined in the RTO standards compliance matrix. Each requirement will be assessed as either compliant or non-compliant. The fact that a product is non-compliant with any of the mandatory requirements is not an automatic basis to reject a request for type approval.

To confirm a type approval, an RTO shall confirm that any residual risk associated with those non-compliances against mandatory requirements have an approved derogation against that requirement. RTOs should have a formal waiver or derogation management process that will inform how a derogation is managed. Figure 4 is a guide only as to how any non-compliance in relation to product requirements can be closed out.

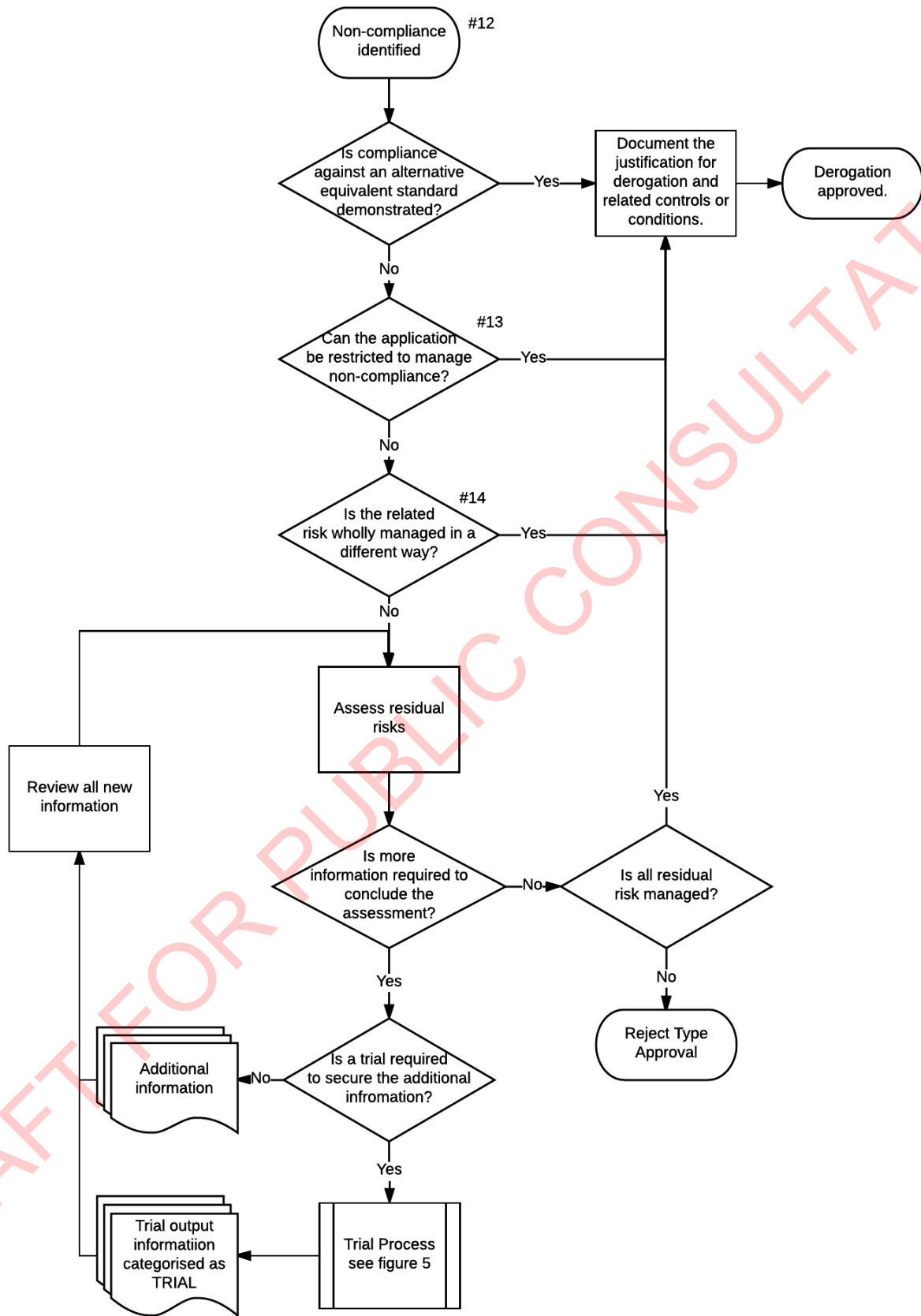


Figure 4 Non-compliance assessment decision diagram

- **#12** – A non-compliance is when a product does not exactly match the requirement as defined in the standards compliance matrix.
- **#13** – Can the application be restricted to locations where the requirement does not need to be so stringent? For example, if the requirement is for temperatures below -10°C but most locations will not reach 0°C and the product is tolerant to 0°C, then restrict the use only to sites where predicted temperatures do not go below 0°C.
- **#14** – Can the supplier demonstrate that the risk associated with the requirement is managed in the design in an alternative way?

For example, a requirement might be... “Product to provide an alarm output or indication when the device temperature is 50°C or above.”

The risk that the alarm is mitigating is equipment operating at 50°C is considered a hazard in some way.

The supplier can have a design feature that prevents the equipment from going over 50°C in operation. However, care should be taken that this feature does not introduce another functional failure mode that introduces other hazards.

Section 4 Trials

4.1 General

The trial guidance in this section describes practices commonly adopted by RTOs. Trial approval, controls and governance remain subject to each RTO's SMS and regulatory obligations.

Where, during either a new or changed product assessment, the information provided does not adequately support a claim of compliance, it could be possible to generate additional evidence to address the gap. This can be achieved through defined inspection and testing activities, or through a trial, where it is identified that the product complies with the requirement without modification.

The purpose of a trial is to generate additional RTO-specific information to support a type approval decision. Any on-site trial must be approved by the RTO, with the product granted provisional type approval to allow the trial to be conducted on or near the operational railway.

Trials are undertaken to verify that the product meets the applicable requirements and is practical for use within the RTO context, preferably without impacting railway operations. However, where available information is insufficient to support approval, residual performance concerns remain, or further clarification of product use is required, these matters may only be addressed through a trial.

To justify a trial, appropriate inspection and testing activities should be undertaken to provide assurance that any residual risk associated with the non-compliance is effectively controlled prior to and during the trial.

Trials are typically undertaken in an operational rail environment rather than in a laboratory setting. However, where it is feasible to conduct the required inspection and testing activities off-site or in a laboratory environment, this should be considered in preference to an on-site trial. Conducting activities off-site reduces exposure to inherent work health and safety risks and operational hazards associated with work on or near the railway.

Figure 5 supports the decision as to whether a trial is suitable and practical to create the additional information.

4.2 Risk and safety considerations for trials

Trials should not introduce any unacceptable risk to the functional safety provided by the signalling system or any other part of the railway. If there is an operational risk, then this should be considered when selecting where to trial.

Where practicable, a trial site with no direct operational impact is desirable. The notes in this section relate to Figure 5 which provides guidance on whether a trial is appropriate.

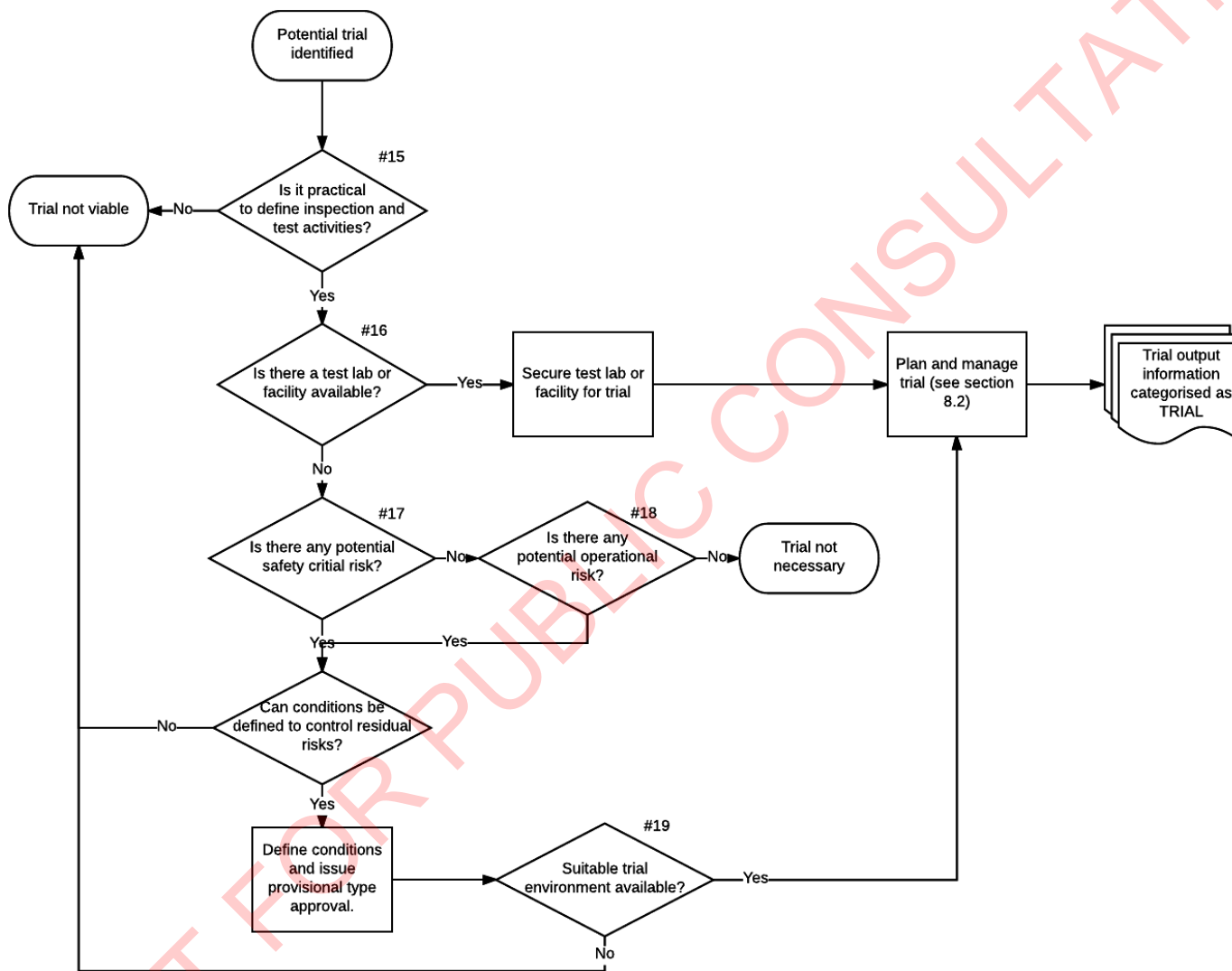


Figure 5 Trial viability decision diagram

- **#15** – For a trial to be of benefit it should define the inspection and test activities to be assessed against defined criteria to produce additional information on the product performance and usability.
- **#16** – Is there an accessible test laboratory or test facility that can be used to carry out the required inspection and test activities? If a product has been designed specifically for a rail environment, then it can be that another rail operator or the original equipment manufacturer has such a facility. If it is for environmental factors, then there could be commercial testing laboratories that could carry out the testing.

NOTE:

A test lab can be created for the test (often referred to as a test rig) but it is to be designed and approved as any other signalling design.

- **#17** – If the product were to be installed in an operational system, are the requirements that are not yet demonstrated as being met associated with any safety function? If the product does not meet the requirement, is there potential to be exposed to an unacceptable safety risk? If there is any uncertainty, then the answer will always be yes.
- **#18** – Is there an operational risk associated with carrying out the trial if the product was used in the service? Could it cause train delays?
- **#19** – Can a trial environment be created or is one available, such that all the provisional type approval conditions can be complied with?

There are three (3) types of safe trial environment. In all cases, there should be easy and safe access for regular inspection and testing to monitor the performance of the product:

- Installed in the operational rail corridor as if in service but not directly connected to the system that provides the operational safety functions.
- Segregated railway or section of railway specifically reserved for trials.
- Low operational impact (only allowed if there is no safety critical risk and agreed with network operations).

4.3 Trial management

4.3.1 General

Where a trial is conducted within, or in close proximity to, the operational railway, there is potential for new hazards to be introduced that must be identified, assessed and controlled. A comprehensive risk assessment should therefore be undertaken to inform the trial design. Documentation and planning

A trial should be managed as any other new signalling works project using the same management process for design, install test and commission. The trial shall have an extended inspection and test plan including the necessary inspection and test activities, beyond commissioning, to assess the performance of the product. The following additional documentation should be developed in consultation with the supplier, before approval by the RTO.

Document	Purpose
Provisional Type Approval	This is a specific type approval granted to allow a trial to go ahead. Conditions are defined associated with a provisional type approval that are to be complied with to manage any residual risk associated with the product from its assessment.
Trial Project Brief	A brief defining the objectives and limitations of the trial in relation to the product stating clearly what factors are being assessed in relation to the product performance and use.
Trial Management Plan	A project management plan to achieve the trial project brief
Trial Risk Assessment	Risk assessment to consider the risk associated with trial. It should cover potential consequential hazards associated with the not yet satisfactorily proven product requirements or usage concerns.
Trial Inspection and Test Plan	Derived from the project brief and the information required for the type approval assessment, this is the inspection and test plan to monitor the product performance and practical use during the trial.
Trial Design Specification	Specification derived from the trial project brief and risk assessment. It should include the monitoring requirements in the trial inspection and test plan, the supplier application conditions and the RTO existing requirements.
Trial SWMS – installation, test, maintenance	As this is new equipment, existing SWMS could be inadequate; therefore, SWMS should be developed for the installation, test and maintenance activities. Particularly important if the methods are novel to those that will be carrying out the work.
Trial Inspection and Test Specifications and Certificates	For each inspection and test activity defined in the trial inspection and test plan, there should be a specification against which the inspection and test outcomes can be certified as acceptable or not.
Trial Testing and Commissioning Plan	As with any project, a Test and Commissioning (T&C) plan should be developed. However, in this case the test plan extends beyond initial commissioning to include the continued monitoring of the equipment.
Trial Installation Work Instructions	The product could be novel to the installers; therefore installation work instructions are required.
Trial Test Work Instructions	The product could be novel, therefore test work instructions are required.
Trial Maintenance Work Instructions	The product could be novel to the maintainer; therefore maintenance work instructions are required.
Trial Evaluation Report	A report detailing the information collected during the trial, the analysis of that information, and conclusions on the product's performance in relation to the aspects of the project brief that required evaluation.

4.3.2 Trial conditions

There are standard controls that should be considered with any trial, guidance on those conditions is given in Appendix E. The guidance provided is general for all trials and specific for the equipment type.

Section 5 Standards

For each product, the requirements defined in the RTO standards compliance matrix are drawn from multiple sources. These typically include requirements arising from the RTO's hazard analysis, existing RTO standards and specifications, and relevant national and international published standards.

While each RTO will tailor product requirements to suit its specific operating context, there are common source documents that are generally applicable across all RTOs when defining product requirements. These reference standards, including both general and product-specific standards, are listed in Appendix F.

Appendix A Hazard Register (Informative)

Hazard number	Hazard
9.1	Communication cables and route lines failure (Design)
9.2	Cables failure (Design)
9.3	Cables route failure (Design)
9.7	Level crossing failure (Design)
9.8	Points and release failure (Design)
9.9	Power supply failure (Design)
9.10	Signals (Design)
9.13	Interlocking failure (Design)
9.28	Control system failure (Test and commission)
9.30	Points and or release failure (Test and commission)
9.32	Signals failure (Test and commission)
9.33	Train authority systems failure (Test and commission)
9.35	Interlocking failure (Test and commission)
9.37	Control systems failure (Operations)
9.39	Field equipment and enclosure failure (Operations)
9.41	Power and supply failure (Operations)
9.45	Interlocking failure (Operations)

Appendix B Product Information Pack Indices (Informative)

B.1 General

This appendix contains information that suppliers use for supplier approval and product type approval.

Section	Equipment Type
B.2	Supplier Approval – For equipment not requiring type approval
B.3	Equipment Categories – For use with matrix in B.4
B.4	Product Information Pack Index matrix
B.5	Example Product Information Pack index

B.2 Supplier approval

Where a product does not require type approval (see Figure 1), then it will be subject to normal supplier approval checks to provide goods to the RTO.

The following is guidance on what types of checks will be expected as part of that supplier approval process.

Check	Reason
Quality management system for manufacture	The product is to be ordered as compliant with a specification, therefore the supplier is required to have a quality management system with processes that confirm that the product meets the defined specification. Typically, this will be ISO 9001 but the RTO procurement process can allow approval by audit.
Solvency	The supplier is likely to be in business and able to continue to supply and support the product for the foreseeable future.
Warranty	The product is provided with an appropriate warranty.
Local support availability	Confirmation of what local support is available or adequate remote support.
Reputation	Verify through referees provided by the supplier that they have a reputation for assured delivery of goods.
Product alerts	Verify that the supplier has a product alert process to notify customers of any performance issues.

B.3 Equipment categories

This is the index of equipment types with information on what it includes. This table is to be used to select the Index Code to identify the Product Information Pack minimum content expectations in using the matrix in Appendix B.4.

Index Code	Equipment Type
SIG	Wayside signals and indicators, it includes hinged masts only sold in standard configuration items. It does not include fixed structures which are considered design items.

Index Code	Equipment Type
PTS	Points and detectors (includes connections to perway and any signalling component that has a perway function such as in bearer machines)
TCS	Track circuits, mechanical treadles and rail circuits
LXS	Level crossing equipment (excludes flashers – see RLY, controller – see SLC, train detection – see TCS or ACS, and monitors – MEQ)
RLY	Relays, timers and flashers
ACS	Axle counters and electronic treadles
SLC	Software configurable logic controllers (including interlocking and level crossing controllers)
APD	Asset protection devices such as DED, SFD and HBD
PSE	Power supply equipment
MEQ	Monitoring equipment (e.g., judicial recorders, historians, condition monitoring)
CPD	Circuit protection devices
TPE	Train Protection Equipment (AWS, Train Stop, TPWS, ATP, Balise)
RTU	Remote Telemetry Units
COM	Data communications equipment

B.4 Product Information Pack index matrix

This matrix can be used to determine what information is to be provided in a Product Information Pack for assessment by an RTO for type approval. See Section B.3 for more information about equipment categories.

- (a) YES, means that a document of that type is expected by the RTO.
- (b) All documents supplied are to be primary documentation except where the * is shown.
- (c) YES* means that secondary evidence will be accepted by the RTO. For example, if a vibration test report is marked YES*, then it is reasonable to supply evidence in another verified document that the vibration testing has been checked. This might be in a safety case or product specific verification and validation report instead of supplying the vibration test report itself.

The CF is the context factor reference (See the checklist in Section D.1) for the assessing RTO if they consider it appropriate to limit assessment to differences with an existing RTO approval.

NOTES:

A type approval report supports the claims that the product is suitable for use by the RTO. It includes any specific controls proposed for the RTO context and guides the RTO through the supplier information. The type approval report provides the opportunity for suppliers to present technical arguments and direct the RTO as to the information that supports a claim of compliance or a claim for a waiver against each requirement.

See Section B.2 for guidance on equipment-specific considerations when collating the supplier information.

CF	Document Description	CAT	SIG	PTS	TCS	LXS	RLY	ACS	SLC	APD	PSE	MEQ	CPD	TPE	RTU	COM	AS 7702 References
	Type Approval Report	CORE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Appendix C.2.2, C.2.3, C.2.4, C.2.7, C.3.1, C.3.4, C.3.5, C.3.7
CF13, CF17	Safety Related Application Conditions	CORE	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	NO	YES	NO	NO	Appendix C.2.2, C.3.1
CF07	Installation and Test instructions	CORE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Appendix C.2.2, C.3.2, C.3.5, C.3.7

CF	Document Description	CAT	SIG	PTS	TCS	LXS	RLY	ACS	SLC	APD	PSE	MEQ	CPD	TPE	RTU	COM	AS 7702 References
CF06, CF16	Maintenance and Fault Finding Instructions	CORE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Appendix C.2.2, C.3.2, C.3.7
	Configuration Instructions	CORE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Appendix C.2.2, C.3.5, C.3.7
CF14	Product Specification	CORE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Appendix C.2.2
	Version Control Certificate - hardware	CORE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Appendix C.2.2
	Version Control Certificate - firmware (if there is embedded software)	CORE	NO	YES	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Appendix C.2.2
	Handling and Storage Instructions	CORE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Appendix C.2.2, C.3.2
	Independent Safety Assessment Report	CORE	YES	NO	YES	YES	NO	YES	YES	NO	NO	NO	NO	YES	NO	NO	Appendix C.2.4
	Standards Compliance Register - Supplier Claim	CORE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Appendix C.2.5, C.3.3
	Example Test certificates	CORE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Appendix C.2.6
	Quality Assurance Certificate	CORE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Appendix C.2.6

CF	Document Description	CAT	SIG	PTS	TCS	LXS	RLY	ACS	SLC	APD	PSE	MEQ	CPD	TPE	RTU	COM	AS 7702 References
CF17	Hazard and Failure Mode Analysis	CORE	YES	YES	YES	YES	YES*	YES*	YES	NO	YES*	NO	YES	YES	YES*	NO	Appendix C.3.1
	Material Safety Data Sheet	CORE	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	YES	NO	NO	NO	Appendix C.3.2
CF09	Interface Specification – Comms. (if equipment has a comms. port)	CORE	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Appendix C.3.4
CF10, CF11	Interface Specification – Electrical	CORE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Appendix C.3.4
CF14, CF15	Interface Specification – Physical	CORE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Appendix C.3.4
CF08, CF13, CF14	Design Instructions	CORE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Appendix C.3.5
	RAM Analysis Report	CORE	YES	YES*	YES*	YES*	NO	YES*	YES	YES*	YES*	YES*	YES*	YES	YES*	YES*	Appendix C.3.6, C.3.7
	Operating Instructions	CORE	NO	YES	NO	NO	NO	NO	NO	YES	NO	YES	NO	YES	NO	NO	Appendix C.3.7
	In-Service References	CROSS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Appendix C.2.4, C.3.6, C.3.7
	Other RTO Type Approval Certificate(s)	CROSS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Appendix C.2.4

CF	Document Description	CAT	SIG	PTS	TCS	LXS	RLY	ACS	SLC	APD	PSE	MEQ	CPD	TPE	RTU	COM	AS 7702 References
	Product Specific V&V reports	FULL	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Appendix C.2.5, C.3.1, C.3.3
	Safety Case	FULL	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	NO	YES	YES	YES	Appendix C.3.1
	Drop Test Report	FULL	NO	NO	NO	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	Appendix C.3.3, C.3.4
CF12	Vibration Test Report	FULL	YES	YES	YES	YES	YES*	YES	YES	YES	YES	NO	NO	YES	YES	NO	Appendix C.3.3, C.3.4
	FEA Report (mechanical structure only)	FULL	NO	YES*	NO	NO	NO	NO	YES*	NO	NO	NO	NO	YES	NO	NO	Appendix C.3.3
	Strain Gauge Test Report	FULL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Appendix C.3.3
	Destructive Test Report	FULL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	NO	NO	Appendix C.3.3
	Life/endurance test report	FULL	YES	YES	YES (treadles)	YES	YES	NO	YES	NO	NO	NO	NO	YES	YES	NO	Appendix C.3.3, C.3.7
	Stress Testing Report	FULL	YES	YES*	NO	YES	NO	NO	YES*	NO	NO	NO	NO	YES	NO	NO	Appendix C.3.3
	Design Specification	FULL	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Appendix C.3.4
CF01	Temperature Testing Report	FULL	YES	YES*	YES	YES	YES	YES*	YES	YES*	YES	YES	YES*	YES	YES*	YES*	Appendix C.3.4
CF02	Humidity Testing Report	FULL	YES	YES*	YES	NO	YES	YES*	YES	YES*	YES	NO	NO	YES	YES*	YES*	Appendix C.3.4
CF03	IP Testing Report (outside equipment only)	FULL	YES	YES	YES	YES	NO	YES	YES*	YES	NO	YES	NO	YES	YES	YES*	Appendix C.3.4

CF	Document Description	CAT	SIG	PTS	TCS	LXS	RLY	ACS	SLC	APD	PSE	MEQ	CPD	TPE	RTU	COM	AS 7702 References	
	Noise Emissions Report	FULL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Appendix C.3.4
	Fluid emissions report	FULL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Appendix C.3.4
	Oil and Chemical Resistance Report	FULL	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	Appendix C.3.4
CF05,	EMC Test Report	FULL	YES	YES*	YES	YES*	NO	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	Appendix C.3.4
CF05, CF08	EMI Test Report	FULL	YES	YES*	YES	NO	NO	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	Appendix C.3.4
CF04	Corrosion Resistance Report (outdoor equipment only)	FULL	YES*	YES*	YES*	YES*	NO	NO	NO	YES*	NO	NO	NO	NO	NO	NO	NO	Appendix C.3.4
	UV Testing (outside equipment only)	FULL	YES	YES	YES	YES	NO	YES	NO	YES	NO	YES	NO	YES	YES	NO	NO	Appendix C.3.4
	Trial Test results	TRIAL	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES	YES	NO	NO	Appendix C.2.2
	Trial Test Report	TRIAL	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES	YES	NO	NO	Appendix C.2.2

B.5 Example Product Information Pack index

Product description	Product number	Supplier name & contact details	Index identification number
LED Long Range Colour Light Signal	LED-003	Supplier PTY Ltd A Contact Acontact@supplier.com.au 0444 444 444	SIG/A Supplier/01

Supplier's declaration

All information listed is supplied and is quality controlled and assured.

Information is confirmed as up to date for the version of the product being assessed.

Index item no.	CF	Document Description (from A.3 matrix)	File name(s) Relevant Section	CAT
SIG/01		Type Approval Report	Type Approval Report v1 Rep-TA-001.pdf	CORE
SIG/02	CF13, CF17	Safety Related Application Conditions	LED-003 Product Manual v2.pdf Appendix A	CORE
SIG/03	CF07	Installation and Test instructions	LED-003 Product Manual v2.pdf Section 2	CORE
SIG/04	CF06, CF16	Maintenance and Fault Finding Instructions	LED-003 Product Manual v2.pdf Section 4	CORE
SIG/05		Configuration Instructions	LED-003 Product Manual v2.pdf Section 3.1	CORE
SIG/06	CF14	Product Specification	LED-003 V2 product datasheet.pdf	CORE
SIG/07		Version control certificate - hardware	LED-003 -configuration control certificate V2.pdf	CORE
SIG/08		Handling and Storage Instructions	LED-003 Product Manual v2.pdf Section 5	CORE

Appendix C General Hazards (Informative)

The following hazards are applicable to all equipment types and are related to safety in design for Workplace Health and Safety considerations, but also potential adversely affect equipment that is not directly connected to the product being assessed.

Not all hazards are relevant to all equipment types. Those that are relevant are repeated in the product type checklist.

Hazards	Risk	Typical Control options
Electromagnetic interference (EMI)	Potential for functionality of adjacent equipment to be affected by interference generated from the equipment being assessed. EMI is to be compatible with the tolerance of already approved equipment.	Electromagnetic compatibility (EMC) compliance. Install in a location away from the sensitive equipment.
Heat emissions	Heat emitted by the product can increase the enclosure or room temperature to a level that is not tolerated by other equipment.	The product design manages operating temperature within defined limits. Protection against over-temperature is achieved through the use of temperature cut-off mechanisms. Adequate clearance is provided to allow effective heat dissipation, and additional passive heat dissipation measures are incorporated where necessary to ensure temperatures remain within tolerable limits.
Exposure to materials hazardous to health, normal handling	Health damage due lack of knowledge that there are materials hazardous to health and no warning or adequate protection provided to remove the risk of exposure.	Contain all hazardous materials so no exposure in normal use. Provide a data sheet listing hazardous materials within the product. Provide disposal instructions.
Exposure to materials hazardous to health, damaged product	Potential health harm may occur due to a lack of awareness that hazardous materials can be released if the equipment is damaged, particularly where no warning is provided or adequate controls are in place to prevent exposure	Use non-hazardous materials in the product design. Design to minimize potential for damage and release of hazardous materials. Provide a data sheet listing hazardous materials within product. Provide handling instructions and PPE requirements for damaged product. Provide disposal instructions. Warning label listing hazard materials to be provided on the product.

Hazards	Risk	Typical Control options
Exposure to electrical shock hazard	Potential for accidental contact with electrical exposed parts in normal operation or using normal tools; It might be due to different assumptions on the installation access rules compared to the design.	Design so that when installed, no exposed parts are immediately accessible to body parts or electrician tools.
Exposure to physical injury – cuts, burns, strains	<p>Sharp edges or protrusions that could cause cut or puncture wounds.</p> <p>Surface temperature could in normal or failed mode reach temperatures that could burn the skin.</p> <p>Physical size and dimension awkward to handle.</p>	<p>Product design to eliminate physical injury list.</p> <p>Control product operating temperatures such that no surface reaches a burn risk temperature (<44°C).</p> <p>Provide physical insulated barrier to protection against accidental touch of hot surface.</p> <p>Provide burn risk warning signs.</p> <p>Minimize product weight.</p> <p>Incorporate lifting and handling design features to allow an easy grip.</p> <p>Provide manual handling warning signs and lifting notice.</p> <p>Install in locations where manual handling can be minimized.</p>

Appendix D Differences and Changes Checklists (Informative)

D.1 General

The following are checklists included in this document for use with type approvals of signalling equipment.

The checklists are tools that can be used by assessors to help them arrive at an assessment decision with respect to the product under review for type approval.

Section	Checklist number	Purpose
D.2	Checklist 1	Context difference assessment
D.3	Checklist 2	Change control assessment

D.2 Checklist 1 – Context differences

D.2.1 Identification of issues

This check list is to identify potential differences between the design assumptions or between the reference type approval for the operating environment for proposed RTO application context. Where possible differences are identified, the Part B question needs to be answered for that context factor.

This checklist does not constitute a full record of context difference assessment but is a tool to support identifying the key items that need additional information of compliance.

Table 2 Context Differences Checklist

Ref.	Context Factor	Different? Yes/No	D.2.1 responses				Example potential concerns
			Required	only	if there is a	potential	
CF01	Temperature						The reference approval might not have considered the extremes of temperature expected to be tolerated by the assessing RTO.
CF02	Humidity						The reference approval might not have considered the levels of humidity tolerance expected to be tolerated by the assessing RTO.
CF03	Particle ingress						Product might be designed for installation in an equipment room, but the RTO might expect it to be installed in a location case.
CF04	Corrosion						The product might be designed for a clean dry air environment and target application being assessed might be coastal.

Ref.	Context Factor	Different? Yes/No	D.2.1 responses				Example potential concerns
							Required only if there is a potential context difference.
CF05	EMC/EMI						The reference approval might be for a new railway with limited potential for EMI when compared with an existing operational railway.
CF06	Location						Reference approval might have a maintenance regime that includes more frequent visits for routine maintenance than practical for the assessing RTO (i.e. remote location).
CF07	Installation/ mounting method						The reference approval might allow the product to be fixed to an assumed structure type, plugboard, rack, sleeper type or rail, that might not be applicable for the assessing RTO. For example, it might have brackets compatible with Pandrol or Fastclip rail clips, but the expected use might be in places that don't use those types of rail fastening. It might be designed for drilled connection which might be prohibited by the RTO.
CF08	Traction electrification						If the product has been used in a non-electrified railway or different electrification system, it might not be tolerant the possible electrical interferences or faults for the assessing RTO.
CF09	Communication protocols						The reference approval might have assumed protocol interfaces that are not relevant to the assessing RTO context.
CF10	Power supply						The reference approval might have assumed an available 240Vac power supply, this might not be available at the assessing RTO assumed sites.
CF11	Switching levels						Reference approvals might have assumed interfaces with devices that have different switching sensitivities than required by the assessing RTO for equipment it is expected to interface with.

Ref.	Context Factor	Different? Yes/No	D.2.1 responses				Example potential concerns
							Required only if there is a potential context difference.
CF12	Vibration						The product might be designed to be installed in a remote location where there is no vibration for example an RTU used for an oil well which is not subject to vibrations.
CF13	Operating principles/ application rules						<p>A reference approval might have been approved in the context of specific operating rules (principles). For example, one railway might allow an individual reset of an axle counter in specific circumstances whereas another might only permit cooperative resets.</p> <p>Design principles and standards include type approval limitations with respect to how devices can be applied. For example, one railway could mandate a relay interface for IXLs which could limit the usefulness of the assessment for a railway which intends to direct drive wayside equipment.</p>
CF14	Driver/operator interface						If the way in which information is communicated to a stakeholder such as a driver or operator is different, then that needs to be considered. For example, if a display looks different to what a driver might be used to, the colour of a signal is different than expected, or the healthy status light is a different colour any risk of confusion in visual or audible information transfer needs to be considered.
CF15	Track Interface						If the equipment is to be connected to the track or any component of the track, rail, bearer, clips then it is to be compatible with the type of track components that are going to be expected.
CF16	Maintenance practices						If the maintenance frequency in the reference approval and the product SRAC requires monthly inspections and the current maintenance regime is quarterly.

Ref.	Context Factor	Different? Yes/No	D.2.1 responses				Example potential concerns
			Required only if there is a potential context difference.				
CF17	Acceptable failures						Acceptable failure modes may vary between railways, as some can tolerate specific failures that others prohibit. For example, a failure of a metal oxide varistor (MOV) within a surge protective device that results in a short-circuit could cause a wrong-side failure if the MOV is connected between an active conductor and earth. This directly affects the suitability and effectiveness of the device for differential-mode surge protection.

D.2.2 Part B – Assessment questions for D.2.1

Question number	Question (Each of these questions is relevant to each context factor where there might be a difference)
1.	For the “context factor”, is the product claimed as compliant with the assessing RTO requirements by the supplier? <ul style="list-style-type: none"> • If yes, assess relevant portfolio information. • If no, go to question 2.
2	Can the approval be restricted to allow the use in most locations on the network? Example: If -10°C is only needed for installations in the Blue Mountains, then exclude use in the Blue Mountains from the approval. <ul style="list-style-type: none"> • If yes, apply the restriction condition and assess relevant portfolio information for stated tolerance. • If no, go to question 3.
3	Can a condition be stated to mitigate the difference in context? Example: If the output range of a power supply is compatible with most equipment that is driven by it but outside the tolerance of one type of piece of equipment, then exclude its use to supply the incompatible equipment. <ul style="list-style-type: none"> • If yes, apply the condition and assess relevant portfolio information for stated tolerance. • If no, go to question 4.

Question number	Question (Each of these questions is relevant to each context factor where there might be a difference)
4	<p>Is it possible that product does comply with the context factor requirements for which V&V activities can be defined?</p> <ul style="list-style-type: none"> • If yes, go to section 4 of this document to consider how to secure information of compliance. • If no, go to question 5.
5	<p>Is it practical to modify the product to meet the requirement?</p> <ul style="list-style-type: none"> • If yes, work with supplier to approve modification and identify additional portfolio information. • If no, then the product cannot be approved

D.3 Checklist 2 – Change control assessment

The purpose of this checklist is to provide guidance in assessing a change to a product has been adequately managed and the potential impact of the change on the RTO practices identified. Safety regulations require that RTOs have processes for the safe management of change, which is a source reference for anyone assessing the acceptability of the change control applied to the product change.

Table 3 Change Control Assessment Checklist

Check	Acceptable	Proposed Action
Is there evidence of a design change request?		
Is there evidence of a risk review associated with the change request?		
Is there evidence the design change request has been through a review and approval?		
Is there evidence that the design requirements were updated?		
Is there evidence of traceability of the change into configuration items?		
Is there information on formal verification and validation of the change?		
Is there a register of all changed documentation (configuration items)?		
Is there a revised product specification?		
Is there evidence that all hazards and risks have been reviewed and closed out?		
Is there a need for any consequential change to RTO design requirements and instructions?		
Is there a need for any consequential change to RTO installation SWMS or installation work instructions?		

Check	Acceptable	Proposed Action
Is there a need for any consequential change to RTO testing SWMS or testing work instructions?		
Is there a need for any consequential change to RTO maintenance SWMS or testing work instructions?		
Is there a need to modify RTO defined maintenance schedule task frequencies?		
Is there a need to modify RTO operating instructions?		
Is there a need to modify RTO handling and storage instructions?		

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Appendix E Trial Checklists (Informative)

The following checklists provide guidance on typical trial conditions that are to be considered when preparing for a trial to support management of safety and performance management. For all trials, a risk assessment is required to be completed with appropriate stakeholders to identify and eliminate or control hazards.

List	Title	Relevant Information Index
D.1	General	All
D.2	Wayside signals and indicators	SIG
D.3	Points and back drives	PTS
D.4	Track circuits, mechanical treadles and rail circuits	TCS
D.5	Level crossing equipment	LXS
D.6	Relays, timers and flashers	RLY
D.8	Axle counters and electronic treadles	ACS
D.8	Software configurable logic controllers	SLC
D.9	Asset protection devices	APD
D.10	Power supply equipment	PSE
D.11	Monitoring Equipment	MEQ
D.12	Circuit protection devices	CPD
D.13	Train protection equipment	TPE
D.14	Remote telemetry units	RTU
D.15	Data communications	COM

E.1 General conditions for trial

Prerequisite conditions for any operational trial:

Condition	Acceptance Criteria
The product is required to have provisional type approval.	Issued Provisional Type Approval Certificate
Trial Brief is to be prepared to define the objectives and limitations of trial	Approved trial brief
The site is assessed as being of low operational risk potential.	Network Operations acceptance of trial site.
Contingency plan to mitigate effects of potential failure modes not yet proven	Network Operations approval of contingency plan.
Define fault reporting requirements for recording by maintenance crew and network fault control centre.	Briefing record from network fault control and affected maintenance workers.

Conditions for all trials:

Condition	Acceptance Criteria
Before installation	
Trial Management Plan completed including detail of roles and responsibilities of all stakeholders.	Trial Management Plan approved by the RTO as part of the assessment.
Trial Design Specification written	RTO approved Trial Design Specification
Any interfaces with existing operational systems are risk assessed in the same manner as other designs involving the installation of additional equipment (e.g., power, heat dissipation, space, terminal requirements, noise mitigation, etc.)	Approved Risk Assessment for trial with all risks addressed.
The trial installation is designed and approved in compliance with existing SMS processes and any applicable interim application conditions.	Approved Design
An inspection and test plan, including monitoring frequency and detailed acceptance criteria targeted at resolving information gaps, is defined and independently checked.	Approved Inspection and Test Plan (Trial)
A test specification is developed for the product in the trial application that meets the RTO new work testing requirements.	Supplier and RTO approved Test Specification for the trial.
A Testing and Commissioning Plan is prepared for the commissioning of the trial in accordance with the RTO SMS requirements for new works.	Supplier and RTO approved Testing and Commissioning Plan.

Condition	Acceptance Criteria
SWMS prepared (installation, test, maintenance)	Supplier and RTO approved SWMS for the trial
Work instruction prepared for the product (installation, test, maintenance)	Supplier and RTO approved work instruction for the trial.
Installation	
Earth measurements for existing equipment are taken before installation.	Requirement listed in the approved installation work instruction
Installation is carried out under the supervision of the supplier and by RTOs.	Trial installation briefing record
After installation	
Testing is carried out by competent persons, as defined by the RTO for new works, in accordance with the Trial Test Specification.	Inspection and Test Plan audited as complete Test Certificates for all items of equipment recording all results from the test specification.
Earth measurements for existing equipment are taken as part of the commissioning tests.	Requirement listed in the approved test specification
The RTO is responsible for the type approval assessment prior to signing off the master Test Certificate for commissioning of the trial.	Master test certificate approved by the RTO for the type approval assessment.
Trial notices to be left on site with contact details	Testing records on master test certificate that Trial notices are confirmed as in place.
After commissioning	
Feedback is requested from the RTO on any practical issues associated with the product under trial.	Design, installation and testing reports associated with the trial.
Full maintenance is carried out by the RTO maintainer under the supervision of the supplier representative at least once during the trial.	Maintenance reports that have been certified.
Carry out trial monitoring as per the Inspection and Test Plan	Complete inspection and test certificates for all planned inspection and test activities.
Maintenance is carried out in accordance with the supplier's recommendations and RTO requirements at least once during the trial by the maintainer under the supervision of the supplier's representative.	Requirement listed in the approved Trial Inspection and Test Plan.
Regular feedback is requested from the maintainers on any practical issues associated with the product under trial.	Feedback reports related to the trial.

Condition	Acceptance Criteria
Monitoring for any context factor gaps is to be checked at least weekly. For example: <ul style="list-style-type: none"> • Max min thermometers • Vibration monitoring 	Requirement listed in the approved Design Specification. Requirement listed in approved Trial Inspection and Test Plan.
At end of trial	
At the end of the trial, a full new works test is carried out in accordance with the Commissioning Test Specification to assess the product condition for comparison with the original commissioning results.	Listed in the approved Trial Inspection and Test Plan. Trial End Master Test Certificate approved by RTO.
Network controller feedback on operational issues	Requirement listed in the approved Trial Inspection and Test Plan
Fault controller feedback on reported failures	Requirement listed in the approved Trial Inspection and Test Plan.
Collate all information generated by the trial and index for the Trial Evaluation Report.	Index included in the approved Trial Evaluation Report.
Review regularly monitored criteria and create trend charts by time with comparison charts for overlay. Typical comparison charts will be traffic patterns, weather details, max, min temperature readings.	Charts available and included in the Trial Assessment Report.
Carry out analysis of trial collected information and evaluate performance of the product and any previously unforeseen hazards, failure modes or risks.	Trial Evaluation Report approved by supplier and RTO.
Map Trial Evaluation Report to the information index for the product.	Type Approval Assessment Report includes updated information index with references to the Trial Evaluation Report.

E.2 Signals and indicators

The type RTO is responsible for the trial addresses the following conditions, regardless of the information gap.

Condition	Acceptance criteria
Signal or indicator to be driven by type approved equipment, co-acting with an existing signal providing the same function.	Requirement listed in the approved Design Specification.
Signal or indicator visible output is blocked from the running railway (except during any pre-planned and controlled testing where there is no risk to operations or if in a dedicated trial site).	Requirement listed in the approved Test Specification.

Condition	Acceptance criteria
Signal or indicator to be installed on the typical structure/mounting.	Requirement listed in the approved Design Specification.
Monitoring is fitted to the signal indication/lamp proving.	Requirement listed in the approved Design Specification.
Inspection and test to verify the lamp output, sighting and conspicuity.	Requirement listed in the approved Test Specification.
Maintenance is to be carried out as per the supplier recommendations and RTO requirements at least once during the trial, by the maintainer under the supervision of the supplier's representative.	Requirement listed in the approved Trial Inspection and Test Plan.
Driver consultation on sighting is required.	Requirement listed in the approved Trial Inspection and Test Plan.

E.3 Points and back drives

The following conditions apply to the RTO when conducting the trial, regardless of the information gap.

Condition	Acceptance criteria
The track switch and crossing system is certified as being within the design gauge prior to trial installation.	Full S&C Inspection Certificate with compliant results.
Correct bearers to be installed compatible with the equipment being trialled.	Requirement listed in the approved Design Specification.
Points or detector to be driven by type approved equipment.	Requirement listed in the approved Design Specification.
Implement safe working rules to manage the potential failure conditions yet unproven.	Train Operations approved special safe work instruction for trains over the points.
Movements over the points are to be restricted to trailing only.	Requirement listed in the approved Design Specification.
All switch blade opening and closing dimensions are verified at the toe, the heel and each intermediate tie position.	Requirement listed in the approved Test Specification.
Drive mechanism monitoring to be fitted that gives magnitude of drive effort and time of operation, for example: <ul style="list-style-type: none"> • Motor current • Air pressure • Hydraulic pressure 	Requirement listed in the approved Design Specification.
Inspection and testing for detection and the facing point lock are carried out at least weekly.	Requirement listed in the approved Trial Inspection and Test Plan.

Condition	Acceptance criteria
All mechanical connections are inspected and torque tested at least weekly.	Requirement listed in the approved Trial Inspection and Test Plan.

E.4 Track circuits, mechanical treadles and rail circuits

The following conditions apply to the RTO when conducting the trial, regardless of the information gap.

Condition	Acceptance criteria
Ballast resistance and rail insulations condition to be verified as within design tolerance prior to the trial.	Certified condition report, compliant results.
Select two sites, one with high traffic and one with low traffic	Requirements listed in the approved Trial Plan.
Track circuit to be installed in axle counter territory and independent from the signalling system.	Requirement listed in the approved Design Specification.
Verify that track circuit type is compatible with the existing train detection and signalling equipment, (EMI).	Requirement listed in the approved Design Specification.
If insulated rail joints (IRJ) are required, then select site with existing IRJs or arrange for IRJs to be temporarily installed at locations. Position IRJs to facilitate restoration after the trial but to create a shadow track circuit of sufficient length for the test.	Requirement listed in the approved Design Specification.
Track circuit status to be monitored continuously using approved signalling data recorder.	Requirement listed in the approved Design Specification.
Collect axle counter operational data for comparison.	Requirement listed in the approved Design Specification. Requirement listed in the approved Trial Inspection and Test Plan.
Rail connections to be of an approved type.	Requirement listed in the approved Design Specification.

E.5 Level crossing systems and equipment

The following conditions apply to the RTO when conducting the trial, regardless of the information gap.

Trial of equipment performance prerequisite to trial with road user.

Condition	Acceptance criteria
Select a site where the level crossing equipment can be installed in shadow mode.	Requirement listed in approved Design Specification.

Condition	Acceptance criteria
Trial equipment does not share a battery supply with operational equipment.	Requirement listed in approved Design Specification.
Any active non-mechanical warning device is to be installed out of vision of the road user but at the level crossing site and blacked out.	Requirement listed in approved Design Specification.
Sighting of actual warning devices is verified as unimpeded by the trial installation.	Requirement listed in the inspection and test specification.
An approved monitor is to be fitted to monitor status of the level crossing equipment. Monitor status of devices for all states including the active, transitional and passive states and any in built monitoring for in service equipment and for trial equipment.	Requirement listed in the Design Specification.

Trial with road user

Condition	Acceptance criteria
Equipment is installed at a location where rail movements over the crossing can be stopped if the functionality of the system is in question.	Requirement listed in the Design Specification.
Audible and visual devices to conform with AS 1742.7.	Requirement listed in the Design Specification.
Warning times in accordance with standards.	Requirement listed in the Design Specification.
All signage to be compliant with AS 1742.7	Requirements listed in the Design Specification.
An approved monitor is to be fitted to monitor status of the level crossing equipment. Monitor status of devices for all states including the active, transitional and passive states and any in built monitoring for in service equipment and for trial equipment.	Requirements listed in the Design Specification.
Video monitoring covering both road approaches and the crossing itself, ideally remotely accessible to the controller.	Requirements listed in the Design Specification.
Notices to be installed at the site notifying road users of trial and video monitoring and contact details for reporting issues.	Requirement listed in the Design Specification.
Crossing to have road user phones to contact the operator.	Requirement listed in the Design Specification.

E.6 Relays, timers and flashers

The following conditions apply to the RTO when conducting the trial, regardless of the information gap.

Condition	Acceptance criteria
Verify compatibility with equipment with existing typical on site equipment.	Requirements listed in the Design Specification.
Relay to be connected to an existing supply with spare capacity.	Requirement listed in the Design Specification.
Trial circuit to be compliant with existing RTO design requirements and in a real configuration for inputs and outputs. End functions do not impact the actual operating system.	Requirements listed in the Design Specification.
Monitoring to be fitted to monitor device states.	Requirements listed in the Design Specification.
Check plug in key arrangement for robustness	Requirement included in the Test Specification.
Type and arrangement of wiring terminations in relay base (for plug ins) to be inspected and recorded.	Requirement included in the Test Specification.
Clear ID type and spec on label.	Requirement included in the Test Specification.
Operating voltage range check.	Requirement included in the Test Specification.

E.7 Axle counters and electronic treadles

The following conditions apply to to the RTO when conducting the trial, regardless of the information gap.

Condition	Acceptance criteria
Axle counter to be installed in shadow mode.	Requirement included in the approved trial brief.
Software configuration management plan to be in place.	Approved software configuration management plan Approve software certificate.
Data source for identifying rail vehicle types passed the axle counter to compare with collected data.	Requirement included in the inspection and test plan.
Monitoring equipment to be installed if not integral to the equipment subject to the trial.	Requirement included in the Design Specification.
Remote access / logging ability to be implemented as part of the trial.	Requirement included in the Design Specification.

E.8 Software configurable logic controllers (including interlockings and crossing controllers)

The following conditions apply to to the RTO when conducting the trial, regardless of the information gap.

Condition	Acceptance criteria
Operational arrangement to be defined in accordance with OEM spec and meets the requirements of the RTO undertaking using the equipment – meets requirements of their standards.	Included in the approved trial brief. Included in approved operational requirements specification.
Degraded mode operation defined for known modes of degraded mode operation in accordance with OEM documentation. Verification in Safety Case documentation.	Included in the approved trial brief. Included in approved operational requirements specification.
Remote control arrangements to be implemented for the controller in accordance RTO requirements and compliant with the OEM spec.	Included in the Design Specification.
Remote diagnostic arrangements to be implemented as part of the trial.	Requirements included in the Design Specification.
Controller to be connected to the expected input and output systems and devices.	Requirement to be included in the Design Specification.
Controller is not relied upon to provide real control unless all safety assurance is complete.	Condition on preliminary type approval certificate.
All inputs and outputs to be monitored for comparison.	Requirement included in the Design Specification.
Peak demand testing from input system to be included in the inspection and test plan for interlockings.	Requirements included in the inspection and test plan.
Define tests to verify system response times from start to end functions to be measured for each route or approach.	Requirement included in the inspection and test plan.

E.9 Asset protection devices

The following conditions apply to the RTO when conducting the trial, regardless of the information gap.

Condition	Acceptance criteria
Device to be installed co-located with an existing device of the same type for comparison.	Condition included in the approved trial brief. Data collection requirements for both to be included in the inspection and test plan.
Remote monitoring to be implemented in compliance with RTO requirements.	Requirement to be included in the Design Specification.
Device is to be independent of any other operational system.	Condition included in the approved trial brief.

E.10 Power supply equipment

The following conditions apply to the to the RTO when conducting the trial, regardless of the information gap.

Condition	Acceptance criteria
Installation to be compliant with RTO requirements for typical loads.	Requirement included in the Design Specification.
Input and output monitoring to be fitted to the equipment.	Requirement included in the Design Specification.
Operation of voltage free contacts (charge fail) to be tested.	Requirement included in the Test Specification.
Overload operation to be tested.	Requirement included in the Test Specification.
Low supply voltage operation to be tested.	Requirement included in the Test Specification.
Electrical noise to be monitored.	Requirement included in the Design Specification.
Temperature monitoring equipment to be installed in trial equipment housing and ideally a comparison similar housing in a nearby location for comparison.	Requirement included in the Design Specification.
Fault simulation to be included in the Test Specification and then retested to commissioning Test Specification to verify condition post fault.	Requirement included in the Test Specification.

E.11 Monitoring equipment

The following conditions apply to the RTO when conducting the trial the trial, regardless of the information gap.

Condition	Acceptance criteria
Install in a site where equipment can be installed in parallel with existing monitoring equipment.	Requirement in approved trial brief.
Remote monitoring capability to be implemented in line with RTO requirements as part of the trial.	Requirement included in the Design Specification.

E.12 Circuit protection devices

The following conditions apply to the RTO when conducting the trial, regardless of the information gap.

Condition	Acceptance criteria
Continuously monitor input and output levels.	Requirement included in the inspection and test plan.
Implement any remote recovery functionality.	Requirement included in Design Specification.
Carry out short circuit, open circuit and function testing and retest normal function.	Requirement included in Test Specification.
Carry out surge testing.	Requirement included in Test Specification.

E.13 Train protection equipment

The following conditions apply to the RTO when conducting the trial, regardless of the information gap.

Condition	Acceptance criteria
Equipment is not trialled unless all safety assurance is complete.	Provisional type approval certificate.
Operational train with compatible on board equipment to be available for testing.	Requirement included in the inspection and test plan.
Install compliant with the existing RTO interface specifications (structure, gauge, air gap, mounting requirements).	Requirement included in Design Specification. Requirement included in inspection and test plan.
Devise tests to verify operational time acceptable.	Requirement included in the inspection and test plan.
Low-speed, medium-speed and high-speed tests to be defined prior to consideration for entry into service.	Requirement included in the inspection and test plan.

E.14 Remote telemetry units

The following conditions apply to the RTO when conducting the trial, regardless of the information gap.

Condition	Acceptance criteria
Simulation of degraded mode operation.	Requirement included in the inspection and test plan.
Simulation of diverse internal systems change over.	Requirements included in the inspection and test plan.
All typical failure modes to be tested.	Requirement included in the inspection and test plan.
Design to be connected to RTO power supply requirements.	Requirement included in the Design Specification.
Security of system to be implemented compliant with RTO security requirements.	Requirement included in the Design Specification.

E.15 Data communications

The following conditions apply to the RTO when conducting the trial, regardless of the information gap.

Condition	Acceptance criteria
A range of typical configurations to be subject to trial.	RTO specific configuration instructions.
Data communication equipment to be installed in parallel with operational equipment.	Requirement included in approved Trial Brief.

Condition	Acceptance criteria
Data monitoring to be implemented or available on active operational system and trial system for comparison.	Requirement to be included in the Design Specification.
Security of configuration in line with RTO requirements.	Approved Network Security Management Plan.
Remote access and monitoring to implemented.	Requirements to be included in the Design Specification.

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Appendix F Standards (Informative)

The following sections lists standards that are relevant to product types.

F.1 General

The following standards have content applicable to products used in electrical signalling systems.

- AS 7722, *EMC Management*
- IEC 62236 or EN50121, *Railway Applications Electromagnetic Compatibility*
 - Part 1
 - Part 2
 - Part 4
 - Part 5
- AS 3000, *Electrical installations* (known as the Australian/New Zealand Wiring Rules)
- IEC 62278, *Railway applications - Specification and demonstration of reliability, availability, maintainability and safety (RAMS)* (EN 50126)
- IEC 62497-1:2010+AMD1:2013 or EN50121 – 1:2017, *CSV Consolidated version Railway applications - Insulation coordination - Part 1: Basic requirements - Clearances and creepage distances for all electrical and electronic equipment*
- IEC 62498-3, *Railway applications - Environmental conditions for equipment – Part 3: Equipment for signalling and telecommunications* (EN50125)
- AREMA *Communications and Signals Manual*

F.2 Signals and wayside indicators

- AS 7721, *Lineside Signals, Indicators and Signal Signage*
- BS 1376, *Specification for Colours of Light Signals*
- AREMA *Communications and Signals Manual Volume 2 Section 7 Signals*

F.3 Points and detectors

- RT/SRS/2001, *Powered Points Operating Devices* (RTO specific)
- AS 7706, *Interface with points*
- AS 7659, *Point Locking, Point Drives, and Point Detection*
- AREMA *Communications and Signals Manual Volume 3 Section 12 Switches*

F.4 Track circuits, mechanical treadles and rail circuits

- IEC 62427, *Railway applications - Compatibility between rolling stock and train detection systems*
- AREMA *Communications and Signals Manual Volume 2 Section 8 Track Circuits*
- AS 7715, *Train Detection*
- AS 7651, *Axle Counters*
- AS 7705, *Level Crossing Monitoring Systems*

F.5 Level crossing systems and equipment

- AS1742.7, *Manual of uniform traffic control devices Part 7: Railway crossing*

- AS 7658, *Level Crossings - Rail Industry Requirements*
- AS 7705, *Level Crossing Monitoring Systems*
- AREMA *Communications and Signals Manual Volume 1 Section 3 Highway -Rail Grade Crossing Warning Systems*

F.6 Relays

- BR 930 (all parts)
- AREMA *Communications and Signals Manual Volume 2 Section 6 Relays*

F.7 Axle counters and electronic treadles

- IEC 62427, *Railway applications - Compatibility between rolling stock and train detection systems*
- AS 7651, *Axle Counters*

F.8 Software configurable logic controllers, (including interlockings)

- IEC 62279, *Railway applications - Communication, signalling and processing systems - Software for railway control and protection systems (EN 50128)*
- IEC 62425, *Railway applications - Communication, signalling and processing systems - Safety related electronic systems for signalling (EN 50129)*
- AREMA *Communications and Signals Manual Volume 1 Section 2 Railroad Signal Systems*

F.9 Asset protection devices

- UIC 501 ED. 1 (2008), *Visibility of Rolling Stock Axle-boxes To Fixed Hot Axle-box Detection Systems*
- EN 15437-1, *Railway Applications - Axlebox Condition Monitoring - Interface and Design Requirements – Part 1: Track Side Equipment and Rolling Stock Axlebox*
- AREMA *Communications and Signals Manual Volume 5 Section 5 Defect Detection Systems*

F.10 Power supply equipment

- IEC 62620, *Secondary cells and batteries containing alkaline or other non-acid electrolytes - Secondary lithium cells and batteries for use in industrial applications*
- AREMA *Communications and Signals Manual Volume 3 Section 9 Power Supply*
- AS 7703, *Railway signalling – Power supply systems*

F.11 Monitoring equipment

- AS 7705, *Level Crossing Monitoring Systems*

F.12 Circuit protection devices

- IEC 62848-1, *Railway applications - DC surge arresters and voltage limiting devices - Part 1: Metal-oxide surge arresters without gaps*
- AREMA *Communications and Signals Manual Volume 3 Section 11 Circuit Protection*

F.13 Train protection equipment

- *ETCS Specifications from European Union Agency for Railways TSI CCS.SRS*

F.14 Remote telemetry units

- *EN 50159, Railway applications. Communication, signalling and processing systems. Safety-related communication in transmission systems*

F.15 Data communications

- *EN 50159, Railway applications. Communication, signalling and processing systems. Safety-related communication in transmission systems*
- *AREMA Communications and Signals Manual Volume 5 Section 21 data transmission*

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