Sydney Trains

Engineering System Integrity

Engineering Procedure
Signalling and Control Systems

PR S 47113

Inspection and Testing of Signalling: Inspection and Testing Principles

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Document control

Version	Date	Author/Prin. Eng.	Summary of change
1.0	8 March 2014	E Pace	New document based on RailCorp document SPG 0711.3
1.1	15 July 2021	Ian Maydew/C Darmenia	Updated to include axle counter requirements

Summary of changes from previous version

Summary of change	Section
Updates to 'Inspection and Testing Activities' section to include axle counters	2.1
Updates to include axle counter test requirements within 'Table of Typical Inspections & Tests to Verify Physical & Functional Compliance'	2.3
Updated to include axle counters within the 'Order of Inspection and Testing' section	2.4
Updates to include axle counters within 'General Apparatus Inspection' section	2.5
Updates to include axle counters within the 'Function Test to Control Tables' section	2.9

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1 Introduction

1.1 General

This procedure sets out the principles required for the planning, implementation and evaluation of the inspection, testing and certification of signalling works.

1.2 References

This procedure shall be read in conjunction with *PR S 47110 Inspection and Testing of Signalling: Introduction*.

2 General Inspection and Testing Requirements

Each new and altered works project shall be planned and programmed in accordance with the provisions included in Procedure *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages*.

Works projects for Signalling installations and Control Systems releases involve the following activities:

- an operational requirements specification
- a signalling functional specification
- a Control Systems functional specification
- detailed design of the Signalling system
- detailed design of the Control Systems
- Control Systems Release documentation
- procurement of system components
- manufacture of system components
- progressive construction quality inspections and testing
- site installation of system components
- interconnection of system components
- powering up and setting to work system separable parts
- certification inspection and testing of the signalling system
- commissioning.

2.1 Inspection and Testing Activities

Inspection and testing activities for new and altered works shall include:

a. Design control activities such as:
    i. Design correlation with existing Signalling
    ii. Design documentation control
    iii. Design documentation certification.
b. Interface Coordination Plan.
c. Quality assurance of supplied equipment including type approvals.
d. General Apparatus Inspection including inspection of the following:

i. Workmanship
ii. Condition
iii. Geographic positioning to check system configuration, component layout, clearance, secureness
iv. Profile
v. Labelling and inscription
vi. Type and rating
vii. Wards, indexing, pin coding and plugs/obturation fittings
viii. Security keys and locks
ix. Protection from and impact on operating environment hazards
x. Temporary wiring/redundant equipment removed/made safe
xi. Null tests.

e. Circuit Testing including:
   i. Bell Continuity Tests
   ii. Wire Count/Null Count
   iii. Insulation Tests
   iv. Circuit Function Tests.
f. Apparatus Function Testing including:
   i. Operation
   ii. Adjustment
   iii. Correspondence to controls and indications
g. Signals System Function Testing including:
   i. Mechanical Interlocking Tests
   ii. Electrical Interlocking and Control Tests (Control Table)
   iii. Operational requirements tests
   iv. Design Integrity Tests
   v. Through System Function Tests e.g. Aspect Sequence, Points Correspondence.
h. Control Systems Functional Testing including:
   i. Formal Qualification Testing
   ii. Factory Acceptance Testing
   iii. Site Acceptance Testing.

The inspection and testing activities shall cover all items of vital signalling equipment and include the following:

- Trackside Apparatus:
  i. Signals
  ii. Trainstops
  iii. Points operating/locking mechanisms and detectors
  iv. Track circuits
  v. Axle counter wheel sensor
  vi. Ground frames and releasing switches

vii. Level crossing lights and booms
viii. Telephones
ix. Notice boards and safeworking signs
x. Mechanical locks and keys
xi. Warning Lights and Guard's Indicators.

- Trackside Locations:
  i. Local control and indicating contactors, relays and modules
  ii. Axle counter evaluating equipment
  iii. Local power supplies.
- Central Interlocking and Control Room:
  i. Interlocking, control and indicating relays, computer interlocking
  ii. Main power supplies
  iii. UPSs
  iv. Mechanical interlocking machines
  v. Electric lever locks
  vi. Mechanical locks and keys.
- Control Systems:
  i. All Apps
  ii. All Hardware Systems.
- Operator's Control Console and Indicator Diagram:
  i. Panel processors
  ii. Keyboards, pushbuttons, switches, levers
  iii. V.D.Us, lamps, audible alarms, train descriptions.
- Power supplies and connecting local and main cables and/or mechanical rodding and signal wire, remote control and indicating systems.

The inspection and testing activities shall be planned and programmed to meet the inspection and testing requirement of the particular works.

2.2 Inspection and Testing Requirements

Certification inspection and testing is required to verify that the installation is:

a. physically in accordance with the designs and specifications
b. functionally in accordance with the design and specifications
c. fail-safe.

Not all fail-safe features are functionally tested and there is reliance on the inclusion of these features (e.g. back proving of relays) in the design, as checked and approved, and on associated Apparatus Inspections, Bell Continuity Tests, Wire Counts and Contact Proving Tests.

Certification testing is required to verify that each item of trackside signalling apparatus operates safely in relation to other items of trackside signalling apparatus, and also operates safely in the presence of a train, in accordance with the design.

Perform certification tests to verify correspondence between each item of trackside apparatus and its individual controls and indications, both locally and centrally. Prove the non-vital link to the operator's control console and indicator diagram.

Where an electrical contact indicates the position of an item of trackside apparatus perform contact proving tests to verify that the contact electrically opens and closes when the trackside apparatus operates and that it electrically opens and closes all indicating and/or repeat relays in correspondence with the apparatus.

When one item of trackside apparatus locks or is released by another then interlocking tests are required to verify the inability of each item to operate when the other item is in the conflicting state.

When one item of trackside apparatus is controlled by another then control tests are required to verify that the item returns correctly to the non-operated position when the status of the other is changed.

Where the item of trackside apparatus is controlled by another that has separate normal and reverse indications, it should also be tested to return to the non-operated position when the wrong control indication is made.

Certification tests are also required to verify that trackside apparatus for train detection reliably detects the presence of a train.

For safety related aspects, the inspection and testing is required to ensure that:

a. Equipment and materials are correctly manufactured to specification.
b. Equipment is correctly located and secured in position, correctly labelled and correctly indexed in accordance with the design.
c. Equipment is correctly interconnected in accordance with the design.
d. Equipment correctly operates, indicates and interlocks in accordance with the design.
e. Equipment is correctly isolated and insulated from false operation, secured against improper movement, and protected against interference, damage, and deterioration, to specification and standards.
f. Redundant equipment is made inoperative and removed.
g. False feeds, temporary wiring, and any extraneous items are removed.
h. Accurate records and certification of all of the above activities are produced and maintained for handover to the nominated officers.
i. Inspections and tests shall verify detailed conformance to the particular vital signalling design drawings, compliance with the applicable signalling standards for safety and reliability, and in the process establish correspondence between controls and indications and trackside apparatus, and correct interlocking between conflicting routes and correct control of routes by train detection and point detection equipment.

The testing of Control Systems shall ensure that the following aspects are covered:

a. The system has been validated as suitable for its intended use.
b. The particular use of the system does not exceed any of its design limits.
c. The physical configuration design is correct.
d. The physical system is installed and configured in accordance with the particular design, using accepted system software and, hardware versions with the correct version of the application data.

e. The system interfaces (both internal and external) have been fully considered, and tested, including failure modes.

f. Application data has undergone a complete integrity test by an independent person.

g. The application data has undergone a complete inspection by an independent person.

h. Each item of hardware has been tested.

i. Non Standard interfaces.

j. Electromagnetic compatibility, and immunity.

k. Surge protection.

l. Reliability.

m. Maintainability.

n. Correspondence testing.

o. Through testing.

p. Response time and performance criteria have been met.

PR S 47116 Inspection and Testing of Signalling: Interface Requirements and Procedures For Alterations, contains additional specific procedures related to conducting alterations to signalling apparatus.

2.3 Table of Typical Inspections and Tests to Verify Physical and Functional Compliance

2.3.1 Signalling

Documentation Check	Verify design analysis sheets – contact analysis, fuse, terminal, rack layouts and relay types to each circuit design sheet.
Correlation Check	Hand trace (verify conductor runs directly i.e. no intermediate connections between two wire termination points) and wire count existing portions of the altered circuit/s sufficiently to verify that the design and the actual circuits are one and the same.
Apparatus Inspection	Verify correct configuration, type, colour, labelling, inscriptions, positioning, clearances, rating, warding/pin coding/indexing, tightness, secureness, lock-up security, damage free, quality workmanship, no loose wires, extraneous items/material removed, temporary wiring/bridging removed, stage work removed.
Wire Count	Verify correct number of conductors on terminals. Also verify tightness and termination workmanship.
Null Count	Verify no conductors on spare terminals.
Insulation Test	Test insulation of conductor and terminal to earth, frame, cable screen/drain and cable spare conductors.
Bell Continuity Test	Bell/meter test for conductor continuity between wire termination points.
Hand Trace	Verify conductor runs directly (i.e. no intermediate connections) between two wire termination points by physically following the conductors path by hand.

Apparatus Function Test	1. Test apparatus operates correctly from its local controls and power source and indicates its status correctly to local indications. 2. Verify apparatus operates its contacts in correct correspondence and adjustment. 3. Verify mechanisms operate freely and within specified tolerances and in correct adjustment and that lights are correctly illuminated and focused/aligned. *(1. Local Operation and Correspondence Test, 2. Contact Proving Test, 3. Adjustment Test)*
Contact Proving Test	Test apparatus opens and closes its contacts in correct correspondence and adjustment.
Circuit Function Test	Test the circuit function energises and de-energises when its control devices change state and when fuses, links, are removed and replaced.
Circuit Strap & Function Test	Test the circuit function is energised and de-energised by the specified contacts of its control devices when those individual contacts open and close; also when fuses, links are removed and replaced.
Through Circuit Function Test	Test the circuit functions over outgoing/incoming cable links and verify correct correspondence.
Through System Function Test	Test correspondence from initial input to final output for controls and indications combined.
Track Circuit Shunt Test	Test track relay is dropped away when the track circuit is shunted by a train (Train Shunt Check) or by a fixed shunt of the correct value at the relay end (Fixed Shunt Check) or by a fixed shunt at all extremities (Fixed Shunt Test).
Track Circuit Drop Shunt Test	A variable shunt applied at the receiver/relay end of a track circuit to identify the drop shunt resistance value.
Track Circuit Polarity Test	Test for polarity reversal at block joints between adjoining track circuits, at all extremities.
Power Supply Polarity Test	Test power supply polarity is correct and has not been reversed when transformers are changed or when wiring is interfered with.
Power Supply Isolation Test	Test that power supply busbars are free of earths. Test that power supplies busbars are not interconnected.
Points Correspondence Test	Test that points detection is obtained at each end of points with all ends of a set of points in the normal position & then reverse. Ensure the relevant detection energises and de-energises whenever each control device in the detection circuit changes state.
Points Out of Correspondence Test	*This test is usually done in conjunction with a Correspondence Test.* Test that points detection is not obtained with one end of a set of points normal and the other end(s) reverse and vice versa, for all combination of ends and including control panel switches.
Facing Point Lock Test	Test lock fails at correct setting.

Closed Switch Detection	Test closed switch breaks detection at the correct setting. Check switch is correctly closed along the entire length of closed switch.
Open Switch Detection and Switch Openings	Test open switch breaks detection at the correct setting. Check switch openings are correct along the entire length of the open switch.
Mechanical Locking Test	Test mechanical locking (to Locking Table, Locking Diagram, Working Sketch) of interlocking frames, release switch locks, electric locks, releasing keys, annett locks, pilotman's locks, half pilot staff locks, mechanical detectors/selectors, emergency operator locks, emergency switch machine locks, point lock detectors, etc.
Aspect Sequence Test	Check that signal indications display the correct colour or position for the various operational sequences and failure conditions.
Function Test to Control Tables	Test that functions interlock and/or control one another, in accordance with the control table.
Design Integrity Test	Similar to the Function Test to the Control Tables and the Aspect Sequence Test but working from the operational requirements and signalling principles, not directly from Interlocking and Control Tables or Aspect Sequence Charts.
Axle counter wheel sensor calibration	Test to confirm the axle counter evaluating system and wheel sensor are correctly setup and tolerances are within specification.
Axle counter occupancy detection test	Test to confirm the correct track occupancy of the associated disturbed wheel sensor.
Axle counter track section reset	Test to confirm the correct track section occupancy is reset to a clear status only after meeting any required system conditions.

2.3.2 Control Systems

Apparatus Inspection	Verify that Control Systems Hardware matches design requirements.
Formal Qualification Test	Verify that Control Systems software to be released meets functional requirements.
Factory Acceptance Test	Verify that the Control Systems software operates correctly with the site-specific data for the specified control area.
Site Acceptance Test	A series of tests that verify that the software/data release works correctly in the operational environment with the site hardware.

2.4 Order of Inspection and Testing

2.4.1 Signals

Separate assemblies shall be progressively inspected and tested at various phases of the works then through tested to prove correct interconnection and functionality.

Ensure that the inspection and testing activities shown in Section 2.1 are covered in the Inspection and Testing Plan and are performed generally in the order shown.

Acceptance inspections and tests shall be performed for externally manufactured equipment for which supplier's certificates of conformance are required.

Preliminary pre-site tests of pre-wired relay racks and locations shall be carried out.

Cable installation tests shall include pre-site insulation test records and certificates, insulation tests as underground cable is progressively trenched and back filled but not terminated, and insulation tests of all external cable after it has been terminated.

As the installation of trackside apparatus to a location is completed or as the equipment installation is completed within a trackside location, or within the centralised interlocking and control location, or within the operator control centre, then these separate parts may be individually set to work and tested, using false feeds where necessary.

Signed test records shall be completed for each separate part tested. Any temporary test supplies, wiring, straps, etc. shall be removed after each completed test.

Certification testing shall be performed when the item to be inspected and tested is complete and not liable to further interference or damage.

General Apparatus Inspections may be carried out separately or in conjunction with other inspections and tests; verification of correct equipment and terminal type, labelling (back and front) and positioning, including the pin coding/indexing of relay plug-in bases, detachable tops and the like, is to be completed prior to circuit Bell Continuity Tests and Wire Counts.

Circuit testing shall be performed after wiring and cabling is terminated.

Documentation Checks are to be completed following completion of testing of each circuit or page.

Apparatus Function Testing shall be performed after the apparatus is installed, powered up and set to work.

Through System Function Testing from the operator's controls shall be performed after the installation is virtually complete.

Before certification function testing is commenced, ensure that circuit wiring testing is complete, that the circuit wiring is secured against interference and that the approved final circuit wiring diagrams are correctly certified by Bell Continuity Test, Wire Count and Insulation Test.

Mechanical Interlocking and/or Electrical Interlocking and Control Tests may be conducted with the operation of the trackside apparatus being simulated, but in this case Correspondence Tests and Through Circuit Function Tests shall follow these tests.

Where it has not been possible to connect and test functions prior to commissioning the Signalling system, then, at the time of commissioning, a Through System Function Test shall be carried out sufficient to complete the testing program.

Also as part of the commissioning, carry out the following tests in all cases to ensure that the trackside equipment is operating correctly and in correspondence with controls and indications:

a. Shunt each track circuit and verify the track indication received.

b. Occupy each axle counter track section and verify the track indication is received.

c. Clear each signal route and verify aspects, route indication and aspect sequence.

d. Operate points normal and reverse and verify correspondence between the control switch, the detection and the lie of the points.

e. Release and operate each ground frame.

f. Operate emergency switch machine/emergency operation locks and verify point detection is lost and interlocked signals return to stop.

g. Any other inspections and tests deemed necessary by the Commissioning Engineer.

If deficiencies are discovered in interlocking or controls during commissioning then all functions affected shall be considered as defective and be rectified and retested.

2.4.2 Control Systems

Control Systems software shall have undergone Factory Acceptance Testing (FAT) prior to install on site – refer ATRICS System Test Plan – ATRIC001006.

Site Acceptance Testing (SAT) is performed on site when a new build release has passed both FQT and FAT in the test facilities prior to being released to site – refer ATRICS System Test Plan – ATRIC001006.

Site Acceptance Testing will show that the software and data for a given release works on site and is ready to be used by the Area Controllers. Testing will demonstrate that new functionalities and assets meet requirements and no errors particular to a given site have been introduced.

2.5 General Apparatus Inspection

Inspections for particular apparatus are found in procedure *PR S 47115 Inspection and Testing of Signalling: Typical Inspections and Tests for Signalling Apparatus*.

Further to a check of workmanship and of the condition of the installed equipment and operating environment, the general apparatus inspection is an analysis, check of the equipment type, rating, labelling, indexing, location etc., to verify conformance with the issued designs.

The following requirements are for the inspection of signalling apparatus generally:

a. Check that the design documents and standards specifications are the latest approved versions including all amendments and modifications.

b. Check that configuration and positioning of trackside apparatus conforms to the Signalling Plan, Track Insulation Plan, and Working Sketch plans. Check structure gauge clearances, clearances to overhead and under track crossings, access ways, point clearance, etc.

c. Check that track circuit connections, track circuit bonding, traction bonding, electrolysis bonding, spark gap connections etc. conform to the Track Insulation Plan. Check that the polarity of each rail of DC track circuits and Impulse track circuits is as shown on the Track Insulation Plan.

d. Check the axle counter wheel sensors are positioned and orientated in accordance with the Track Insulation Plan. Check the vertical and horizontal position of the wheel sensor is correct to the installation requirements for that sensor type. In addition, check traction bonding, electrolysis bonding, spark gap connections, etc. conform to the Track Insulation Plan.

e. Check that signals physically conform with the Signalling Plan, Circuit Book and Signal Sighting Forms.

f. Check that the layout of trackside apparatus conforms with standard specifications and layout drawings.

g. Check that the equipment mounting layout conforms with the profile drawing.

h. Check that identification numbers, etc. marked on the front of location cases, etc. conform with the location numbers on the design drawings.

i. Check that installed equipment items are the correct type, rating, and labelling, and are correctly worded, indexed, pin coded, etc. where applicable e.g.: relay base analysis checks.

j. Check Control Systems equipment is the correct type, form, fit and function.

k. Check Buffer Stop lights for correct location, quantity, installation, and lights.

l. Check Notice boards for correct inscription, location, illumination, and visibility.

m. Check that telephones are correctly installed.

n. Check that signalling apparatus is fitted with the correct security lock.

2.6 Circuit Inspection and Testing

Before a new or altered circuit is brought into use it shall be inspected and tested to the satisfaction of the Commissioning Engineer. Testing shall be documented to certify that it is installed in accordance with the circuit wiring diagram and that it fulfils the requirements for which it was designed.

Circuit Tests shall ensure that:

a. Every contact, terminal, wire, and functional item shown on the circuit diagram is actually in the circuit exactly as shown (Bell Continuity Test and Wire Count).

b. Each contact is electrically opened and closed by operation of its controlling device and is correctly adjusted (Circuit Strap and Function Test or Contact Proving Test).

c. Each contact, fuse, and link effectively opens and closes the circuit under test (Circuit Strap and Function Test or Circuit Function Test).

d. The circuit does not include any contact, terminal, or wires not shown in the circuit diagram (Wire Count and Null Count).

e. The insulation of the circuit is satisfactory (Insulation Test).

The circuit as a whole is function tested before the test is regarded as complete (Through Circuit Function Test or Circuit Function Test).

The Circuit Strap and Function Test (as different to the Circuit Function Test) may be deleted on new circuits with the approval of the Commissioning Engineer provided that other tests prove the control contacts, when operated by the control device, effectively open and close the circuit (Contact Proving Tests together with Circuit Function Tests). Plug-in relays and their contacts are to be proven in a standard plug-in relay test panel, or other electronic or computerised testing device (e.g. Relay Pro).

The Circuit Strap and Function Test is to be conducted on shelf relay installations and for testing circuit alterations.

For new and altered works with plug-in relays it is usual to omit the Circuit Strap and Function Test and rely on the other circuit and function testing.

The Contact Proving Test involves apparatus inspection and testing to prove that equipment contacts are the correct type, are correctly adjusted, and are correctly operated by the operating mechanism to electrically open and close.

Elements of contact proving are incorporated in other inspections and tests such as General Apparatus Inspections, Insulation Tests, Circuit Strap and Function Tests, Apparatus Function Tests, and relay inspection and operation in test panels/devices. The test copy circuit book shall be suitably marked up to include details of how contact proving tests were achieved.

For other mechanisms, such as rotary controllers, point detectors, Annett locks, etc. contact proving would involve a General Apparatus Inspection and Apparatus Function Tests to check that the mechanism electrically opens and closes the contact in correct adjustment.

Procedures and guidelines for circuit testing are found in Procedure *PR S 47114 Inspection and Testing of Signalling: Inspection and Testing Procedures.*

2.7 Apparatus Function Testing

Perform Apparatus Function Tests to prove that the equipment operates in accordance with specified requirements such as the following, where relevant:

a. Correct energisation and de-energisation levels.
b. Correct operating and release times.
c. Correct movement, limits of travel and clearances.
d. Correct display of aspects, etc.
e. Correct fit and interlocking between parts.
f. Correct tension, or compression between parts.
g. Correct power supply values.
h. Correct correspondence with controls and indications.
i. Correct indications and alarms are presented both visually and audibly on the Signalling Control push button or display panel.
j. Correct adjustment of contacts to correctly indicate the apparatus position with all contacts for the same position closing and opening simultaneously and with all contacts insulated from one another and from 'earth,' both when stationary and throughout movement.

Generally the Apparatus Function Test shall be carried out on installed equipment by providing power of the correct value and polarity to the local controls to set to work the apparatus.

The apparatus function tests also confirm the correct operation of the Control System e.g. correct track vacancy information is indicated, correct lie of points or activation of Level Crossing equipment.

2.8 Mechanical Interlocking Testing

Perform a Mechanical Interlocking Test to ensure that the mechanical interlocking items such as interlocking frames, releasing switch locks, electric locks, releasing keys, Annett locks, pilotman's locks, half pilot staff locks, mechanical detectors/selectors, emergency switch machine locks, etc. work correctly in accordance with Locking Tables, Locking Diagrams and Working Sketches.

2.9 Function Test to Control Tables

Perform a Function Test to Control Tables by operation of the equipment from the control panel, keyboard, levers, switches, or visual display unit to verify that the system operates safely in accordance with the electrical interlocking and controls incorporated in the Control Tables.

A Function Test to Control Table shall be carried out after certification testing of related circuits to the circuit diagrams. To facilitate the testing, rail vehicle detection operation shall be simulated by switching track/track section relays or repeat relays where available. If necessary, point and signal operation may also be simulated by turning around outgoing controls to provide respective indications, utilising a specially wired test panel. In such cases, apparatus correspondence and Through System Function Tests are to follow.

Where an axle counter is directly interfaced with a CBI then the function test may use track section blocks to simulate occupied track sections. In such cases, apparatus correspondence and Through System Function Tests are to follow.

Where non-vital interlocking exists in the operator's control console of the transmission equipment, then special measures shall be taken to ensure the vital interlocking and controls are tested.

2.10 Aspect Sequence Testing and Points Correspondence Testing

Carry out Through System Tests at commissioning and after all the trackside apparatus has been finally connected through the interlocking to the Operator's controls and indications; they are final verifications of correspondences and controls of signals/train stops and points.

Finally verify rail vehicle detection correspondence together with any other trackside apparatus connected or interfered with at the time of commissioning.

2.11 Design Integrity Test

This is the same as the Function Test to Control Tables and the Aspect Sequence Test except that it is conducted by a senior, experienced Signal Engineer who does not test from the Control Tables or from Aspect Sequence Charts but from the operational requirements specification and the Signalling Plan to verify that the signalling operates functionally and safely in accordance with standard signalling design principles.

The test is performed based on the engineer’s extensive knowledge of signalling principles and practices, but is marked off by an assistant on the Design Integrity Test Plan/Control Tables and/or Aspect Sequence Charts.

The test would include simulating train movements for parallel routes, attaching and detaching, and long and short train lengths.

2.12 Formal Qualification Testing (Control Systems)

The Formal Qualification Test (FQT) verifies that the software to be released is compliant with functional requirements, as well as meeting required performance and reliability standards including load and stress tests. FQT does not concentrate on testing the accuracy of site-specific data belonging to different control areas.

FQT occurs before new versions of software are to be released prior to the FAT/SAT and Commissioning stages of the testing process. Normally, new versions of software are released as a result of software bug fixes, functional changes or the introduction of new functions due to new requirements.

FQT focuses on software functions independent of site-specific data. All new functionality is to be thoroughly tested to ensure it meets requirements. Existing functionalities are tested to ensure no defects have been created since the last release. Successful FQT will verify that a software build meets all functional requirements and is ready to be tested with site-specific data.

Testing is done on Sydney Trains premises with as-near-to production equipment as possible. Telemetry systems are only used in cases where applications for these systems have changed.

Refer to *ATRIC001006 System Test Plan* and *ATRIC001077 Systems Build and Release* for further details.

2.13 Factory Acceptance Testing (Control Systems)

FAT is performed when a new software and/or data build needs to be released to a control area or as a product. FAT process verifies that the Control Systems software operates correctly with the site-specific data for the specified control area. Furthermore, that the whole system operates correctly under failure and stress conditions.

FAT shall be performed on any data and/or software to be released to site. FAT is run on Sydney Trains premises using site hardware and site data configuration, if possible. The FAT process always uses a software version, which has passed FQT process successfully.

If the product is to be deployed to site for the first time or the site has a very old version of the product, all applicable tests for the site are performed as part of the FAT process. If there are new assets or functionalities, new test cases will be written. The testing verifies that the data and software for a site meets all requirements.

If the product will be deployed as an upgrade to an existing site, Regression FAT is executed for subsequent software and data releases. The focus of this testing is to ensure that new functions and data assets meet requirements and that no additional problems have been introduced since the last release.

Refer to *ATRIC001006 System Test Plan* and *ATRIC001077 Systems Build and Release* for further details.

2.14 Site Acceptance Testing (Control Systems)

Site Acceptance Testing (SAT) will show that the release works correctly in the operational environment with site hardware.

Test cases for FAT can also be used for the test cases for SAT. Therefore, there is no separate test plan for SAT, but each test case is identified for FAT, SAT or both.

The signaller under control of the Test Engineer will perform the test. Since the SAT is performed on the live system, it is important to not disrupt the operation of the system.

SAT is performed on site when a new site release has passed both FQT and FAT.

SAT verifies that the software and data for a given release works on site and is ready to be used by the area controllers. Testing will demonstrate that new functionalities and assets meet requirements and no errors particular to a given site have been introduced.

Refer to *ATRIC001006 System Test Plan* and *ATRIC001077 Systems Build and Release* for further details.

2.15 Illustrations

The following illustrations follow:

a. Signalling System Schematic

b. Certification Testing Schematic

c. Through Correspondence Test and Interlocking/Control Schematic.

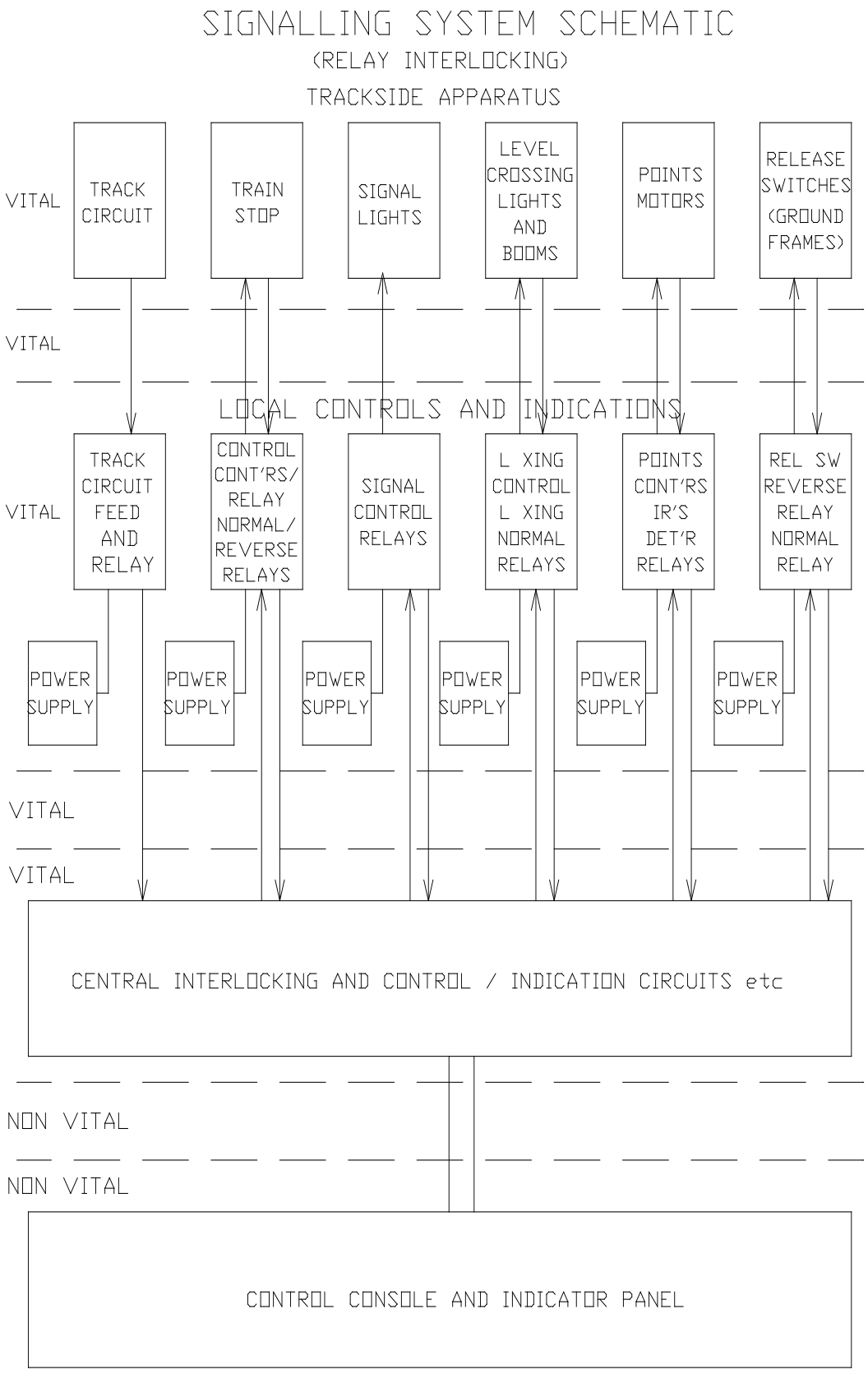

Figure 1: Signalling System Schematic

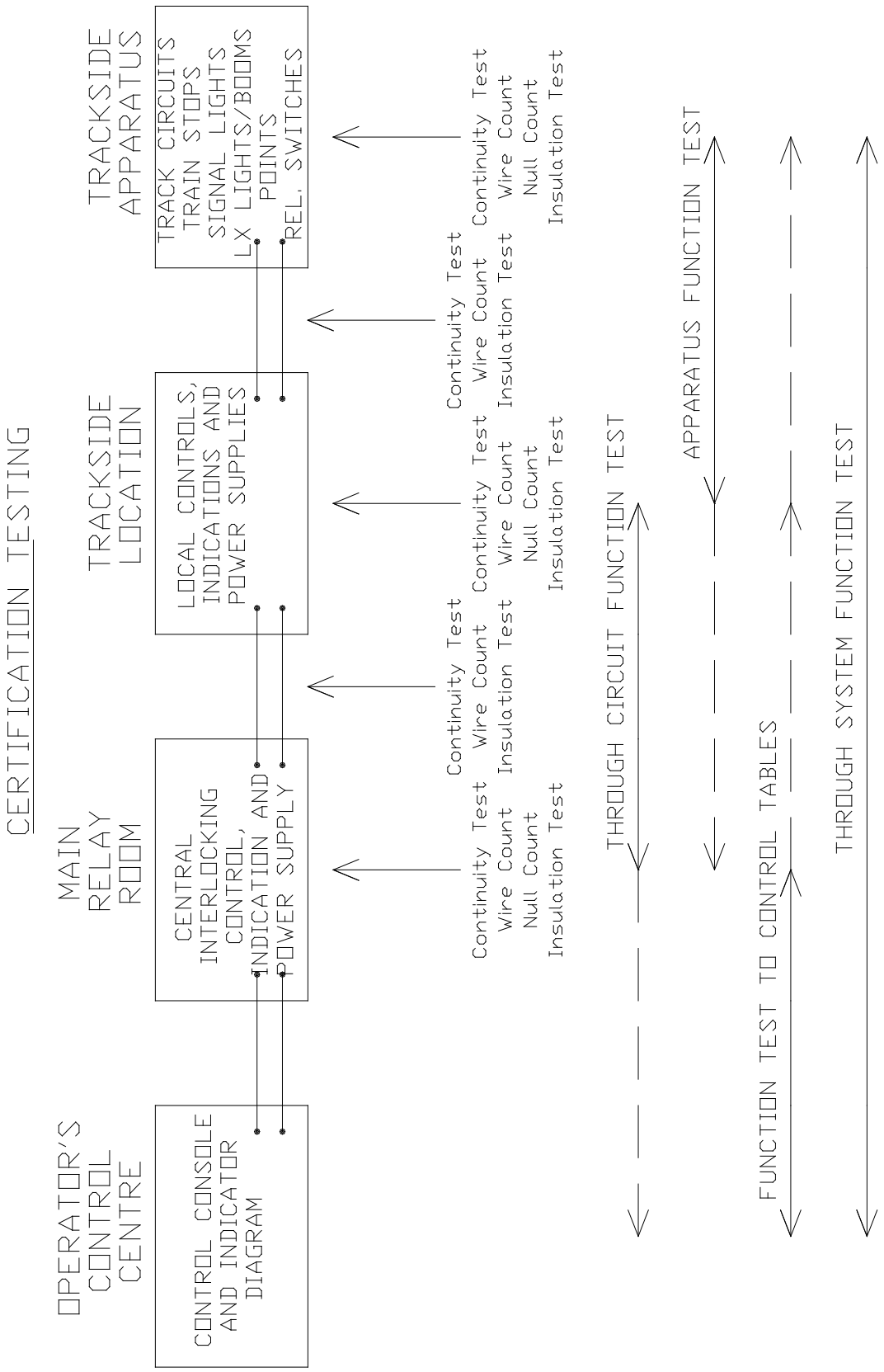

Figure 2: Certification Testing

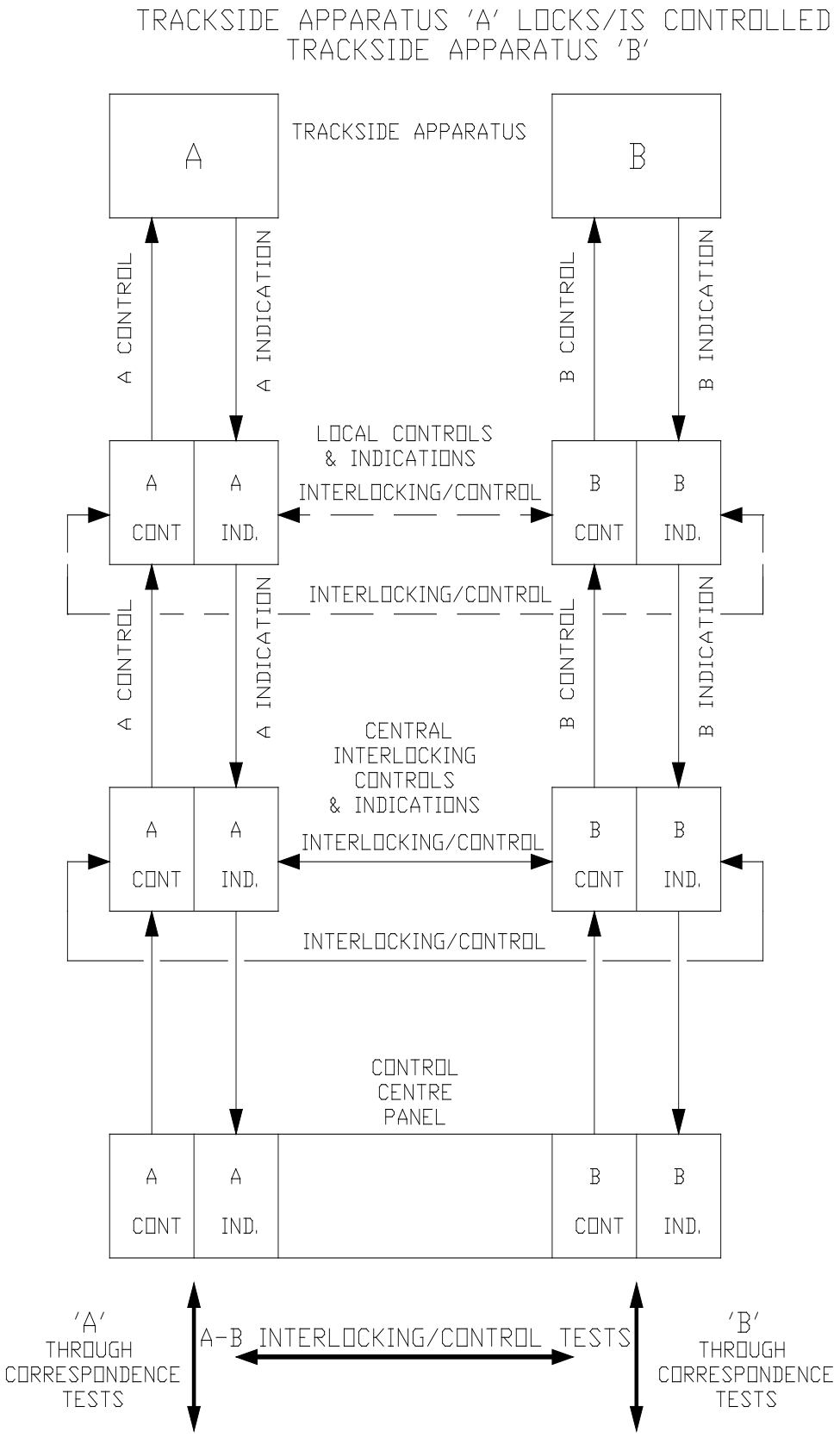

Figure 3: Trackside Apparatus