



**AUSTRALIAN RAIL TRACK CORPORATION LTD**

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**Inspection and Testing of New and Altered Signalling Works – General Requirements**

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## About This Standard

This standard Specification sets out the requirements of the inspections and tests for certifying new and altered signalling works and the standard procedures and practices for carrying out and recording inspections and tests.

This standard Specification shall be read in conjunction with companion standard Specification SCP 07 which sets out the roles, responsibilities, plans, programs and documentation packages for inspection and testing for safety assurance of new and altered signalling works.

Superseded

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# Introduction

## 1. Introduction

### 1.1 General

Standard Specification SCP 08 also includes separate parts SCP 09, SCP 10, SCP 11, and SCP 12.

This standard Specification sets out the requirements of the inspections and tests for certifying new and altered signalling works and the standard procedures and practices for carrying out and recording inspections and tests.

This standard Specification shall be read in conjunction with companion standard Specification SCP 07 which sets out the roles, responsibilities, plans, programs and documentation packages for inspection and testing for safety assurance of new and altered signalling works.

### 1.2 Definitions

The definitions in standard Specification SCP 07 apply to this standard Specification.

The glossary of terms (Section 1.5) in this Specification provides additional definitions.

Where not defined in the Particular or standard Specifications, or the other Contract Documents, signalling terms shall be as described in ARTC's manual 'Glossary of Signalling Terms' SGS 01 unless such meaning is inconsistent with the context and underlying intention of the specified requirements.

### 1.3 Applicable Documents

ARTC Specifications

SCP 07                      Inspection, Testing, Installation and Commissioning Requirements for Safety Assurance of New and Altered Signalling Works.

Roles, Responsibilities, Plans, Programs and Packages.

SCP 06                      Documentation and Drawings.

## 1.4 Alternatives

Refer to SCP 07

## 1.5 Glossary of Terms (relating to inspection and testing of new and altered signalling works)

### Accreditation

Accreditation is the process by which a person's qualifications, experience and competence are assessed in order to certify that person to perform specific inspection and testing duties

### Alterations

Alterations refer to modifications and like for like renewals and are essentially works associated with a maintenance activity except when included as part of New and Altered Works

### Analysis

This is an inspection of items of equipment for conformance of component type, rating, indexing, labelling, and allocation to the documentation details of the design plans, diagrams, analysis sheets and specification. In this document the analysis inspection is embodied in the expression "GENERAL APPARATUS INSPECTION".

### Apparatus

Apparatus shall refer to the signalling equipment system as a whole or as separate items of signalling control and operating equipment, signalling materials, and structures housing signalling equipment.

### Apparatus Function Test

see "Apparatus" and "Function Test" Generally refers to function tests of an item of installed equipment, particularly trackside apparatus when set to work from the local controls.

### Aspect Sequence Test

An aspect sequence test is the verification of the signals aspect and aspect sequence in accordance with the design drawings and any special aspect sequence charts drawn up specifically for this test.

### Bell Continuity Test (Continuity Test)

This is the process whereby the wiring is checked to see that it is in conformity with the wiring diagrams and that all wires are continuous from termination point to termination point.

This test is generally carried out simultaneously with a wire count (see separate definition), and insulation test.

## **Certification**

Certification is the signing of certification documents by qualified, competent persons attesting that the design, product or installation is in accordance with the specification requirements as verified by appropriate inspections and/or tests.

## **Circuit Function Test**

This is the energisation of each circuit, or part of a circuit, and verifying by operation or disconnection that each and every control device, fuse and link is effective in controlling the circuit function in accordance with the circuit diagram. The specific contacts on control devices such as relays are not verified.

## **Circuit Strap And Function Test**

This is a more in-depth circuit function test. It is the energisation of each circuit, or part of circuit, and verifying by operation or disconnection that each and every control contact, fuse and link is effective in controlling the circuit function in accordance with the circuit diagram.

As each control contact is operated to open the circuit, a strap is applied across the contact and re-energisation of the circuit is verified by observation of the voltmeter and circuit function. Where the contact is readily accessible and can be manually opened and closed without detriment then use of the strap is not necessary.

## **Contact Proving Test**

This is an apparatus inspection and apparatus function test to prove that equipment contacts are the correct type, are correctly adjusted and electrically open and close when the equipment is operated.

## **Correspondence Test**

This is a through test to verify that a function is in correspondence with its respective controlling equipment and/or indicating equipment. It includes an out of correspondence test to prove that if the function does not fully respond this is detected.

## **Design Integrity Test**

This is a system interlocking and control function test similar to the Function Test to the Control Tables but working from the operational requirements and signalling principles, not directly from Interlocking and Control Tables or Aspect Sequence Charts.

## **Fail-Safe Design**

Signalling fail-safe systems are designed on the closed loop principle where input energy is necessary to retain a permissive output.

In vital circuit design, a normally energised electric circuit, on being opened or de-energised, will cause the controlled function to assume its most restrictive state. (The opening of any common return conductor will not cause two or more functions to operate in series).



### **Fail-Safe Equipment**

Items of equipment are fail-safe where they are particularly specified, designed, manufactured, installed, inspected, tested and maintained such that the chance of an unsafe side failure is very low. Component parts are robust, electrical leakage distances are long, operating characteristics have large margin, etc.

### **Function Test**

This is a test in which a function is operated by power through its controls to test that it achieves its specified purpose and includes testing that it will assume a safe state when the power is removed.

### **Function Test To Control Tables**

This is the operation of the equipment from the control panel, keyboard, levers, switches, or VDU (Visual Display Unit) to verify that the system operates safely in accordance with the electrical interlocking and controls incorporated in the design drawings, namely the Control Tables.

### **Insulation Test**

This is a test of the resistance of the insulation between an electrical circuit conductor and "earth" or directly between the conductors of two separate electrical circuits. The test is made at a specified voltage which is high compared to the circuit voltage.

### **Level Crossing Test**

This is an operational test of level crossing control circuits to check for adequate protection time, time of operation, etc. The checks are made by comparison with Track Plans, Control Tables etc.

### **Mechanical Interlocking Test**

This is a test of mechanical interlocking in interlocking frames, releasing keys/annett locks, half pilot staff locks, staff instruments, mechanical detectors, etc to Locking Tables, Locking Diagrams and Working Sketches.

### **New And Altered Works**

New and Altered Works comprises new work and any alterations involved with new work interfacing with existing signalling. It is essentially work associated with a construction project.

### **Null Count**

This is a check against the circuit book analysis sheets that there are no wires terminated on spare contacts of relays and other operating mechanisms, nor on spare fuses, links, terminals, and all other spare termination points.

### **On-Site Test**

These are tests using signalling power supplies of equipment and circuits installed in signalling structures with the track side equipment connected.

### **Points Correspondence Test**

This is a test to ensure that the position and detection of all ends of a set of points is in agreement with that required by the interlocking.

### **Pre-Site Test**

These are tests of manufactured equipment and circuits using temporary power supplies prior to site installation. These are not normally certification tests, but rather quality control tests.

### **Set To Work Test**

This is not normally a certification test but part of the process of setting the equipment to work correctly. It is the initial powering up of the signalling circuitry and local apparatus at a relay room or location case to test that it is able to carry out its function correctly.

### **Through Function Test**

This is a circuit function test of a circuit or series of related circuits running between locations, e.g. signal boxes, relay rooms, etc to ensure the fuses, links and control devices effectively control the final output. It includes through function testing from the signaller's control on the operator interface to the operation of the trackside signalling equipment and to its change-of-state indication back to the signaller's indicator diagram.

### **Wire Count**

This is a count of the number of conductors terminated on each wire termination point and at every wire termination point. The count is certified against the circuit wiring diagrams and cross checked against the analysis sheets.

## 2. General Inspection and Testing Requirements

For each New and Altered Works Project for a signalling installation there shall be a Project Works Program of Activities and a parallel Inspection and Testing Program of Activities.

New Works Projects for signalling installations involve the following activities

- An operational requirements specification
- A signalling functional specification
- Detailed design of the signalling system
- Procurement of system components
- Manufacture of system components
- 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:

- i) Design Control activities such as:
  - Design Correlation with existing Signalling
  - Design Documentation Control
  - Design Documentation Certification
- ii) Site Integrity Agreement
- iii) Quality Assurance of Supplied Equipment including Type Approvals
- iv) General Apparatus Inspection including inspection of the following:
  - Workmanship
  - Condition
  - Geographic positioning to check System Configuration, Component Layout, Clearance, Secureness

- Profile

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- Labelling, Inscription
  - Type and rating
  - Wards, indexing, pin coding, plugs/obturations
  - Security keys and locks
  - Protection from and impact on operating environment hazards
  - Temporary wiring/redundant equipment removed/made safe.
- v) Circuit Testing including:
- Bell Continuity Tests
  - Wire Count/Null Count
  - Insulation Tests
  - Circuit Function Tests
- vi) Apparatus Function Testing including:
- Operation
  - Adjustment
  - Correspondence to controls and indications
- vii) System Function Testing including:
- Mechanical interlocking tests
  - Electrical interlocking and control tests (Control Table)
  - Operational requirements tests
  - Design integrity tests
  - Through System Function tests (e.g.. Aspect Sequence, Points Correspondence)
- viii) Signalling Equipment to be inspected and tested

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

a) Trackside Apparatus:

- Signals
- Trainstops
- Points operating/locking mechanisms and detectors
- Track circuits
- Ground frames and releasing switches

- Level crossing lights and booms
- Telephones
- Notice boards
- Mechanical locks and keys
- Warning Lights and Guard's Indicators

b) Trackside Locations:

- Local control and indicating contactors, relays and modules
- Local power supplies

c) Central Interlocking and Control Room:

- Interlocking, control and indicating relays, computer interlocking
- Main power supplies
- Mechanical interlocking machines
- Electric lever locks
- Mechanical locks and keys

d) Operator's Control Console and Indicator Diagram:

- Panel processors,
- Keyboards, pushbuttons, switches, levers
- VDUs, lamps, audible alarms, train descriptions,
- Block instruments
- Staff instruments

e) 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

- physically in accordance with the designs and specifications,
- functionally in accordance with the design and specifications,
- 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 equipment 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.

The control to an item of trackside apparatus operates over the indications of other items of trackside apparatus. Test and certify the interlocking between these controls and indications.

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 which 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:

- i) Equipment and materials are correctly manufactured to specification
- ii) Equipment is correctly located and secured in position, correctly labelled and correctly indexed in accordance with the design
- iii) Equipment is correctly interconnected in accordance with the design
- iv) Equipment correctly operates, indicates and interlocks in accordance with the design
- v) Equipment is correctly isolated and insulated from false operation, secured against improper movement, and protected against interference, damage, and deterioration, to specification and standards
- vi) Redundant equipment is made inoperative and removed
- vii) False feeds, temporary wiring, and any extraneous items are removed
- viii) Accurate records and certification of all of the above activities are produced and maintained for handover to the nominated officers
- ix) 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.

### 2.3 Order of Inspection and Testing

Separate assemblies shall be progressively inspected and tested at various phases of the work then through tested to prove correct interconnection and functionality, as shown in the accepted Inspection and Test Program.

Ensure that the inspection and test activities shown in Paragraph 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 prewired 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

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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 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.

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

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 as bell continuity tested, wire counted, and insulation tested.

Mechanical interlocking and/or electrical interlocking and control tests may be conducted with the operation of the trackside apparatus simulated but in this case correspondence tests and through 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 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:

- i) Shunt each track circuit and verify the track indication received;
- ii) Clear each signal route and verify aspects, route indication and aspect sequence;
- iii) Operate points normal and reverse and verify correspondence between the control switch, the detection and the lie of the points;
- iv) Release and operate each ground frame;
- v) Operate emergency switch machine locks and verify point detection is lost and interlocked signals return to stop;
- vi) Any other inspections and tests deemed necessary by the Tester in Charge

or the Commissioning Engineer.

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

## 2.4 General Apparatus Inspection

Inspections for particular apparatus are found in Part 02 "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 are guidelines for the inspection of signalling apparatus generally:

- i) Check that the design documents and standards specifications are the latest approved versions including all amendments and modifications
- ii) Check that configuration and positioning of trackside apparatus conforms with the Track Plan, Track Insulation Plan, and Working Sketch plans. Check structure gauge clearances, clearances to overhead and undertrack crossings, access ways, point clearance, etc
- iii) Check that track circuit connections, track circuit bonding, traction bonding, electrolysis bonding, spark gap connections etc conform with 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.
- iv) Check that signals physically conform with the Track Plan, Circuit Book and Signal Sighting Forms
- v) Check that the layout of trackside apparatus conforms with standard specifications and layout drawings
- vi) Check that the equipment mounting layout conforms with the profile drawing
- vii) Check that identification numbers etc marked on the front of location cases, etc conform with the location numbers on the design drawings and are legible from a distance of 10 metres
- viii) Check that installed equipment items are the correct type, rating, and labelling, and are correctly warded, indexed, pin coded, etc where applicable e.g., relay base analysis checks
- ix) Check Buffer Stop lights for correct location, quantity, installation, and lights
- x) Check Notice boards for correct inscription, location, illumination, and visibility
- xi) Check that telephones are correctly installed

- xii) Check that signalling apparatus is fitted with standard locking devices.

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## 2.5 Circuit Inspection and Testing

Before a new or altered circuit is brought into use it must be tested to the satisfaction of the Tester in Charge. The Tester must 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 must ensure that:

- i) 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)
- ii) 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).
- iii) Each contact, fuse, and link effectively opens and closes the circuit under test (Circuit Strap and Function Test or Circuit Function Test)
- iv) The circuit does not include any contact, terminal, or wires not shown in the circuit diagram (Wire Count and Null Count)
- v) 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 Tester in Charge 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).

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

For New and Altered Works with plug-in relays it is usual to delete the Circuit Strap and Function Test and rely on the other circuit and function testing and on proving the plug-in relay and its contacts in a standard plug-in relay test panel.

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, and apparatus function tests. However testers must particularly note and sign off that contact proving is fully covered by their other tests.

For plug-in relays, contact proving would involve a general apparatus inspection of the relay, looking for any signs of damage, loose or foreign matter for defective operation, observation of its operation in circuit or in a relay test panel, and checking the operation of its individual contacts either

by a circuit strap and function test or by a test of the contacts in the relay test panel.

For other mechanisms, such as rotary controllers, combined lever locks, point detectors, annett locks etc, contact proving would involve a general apparatus inspection checking that the mechanism is properly secured in its correct position, connecting linkages and rods are secure without excessive free play, adjusting cams etc are secure and tight, contacts are secure and correctly tensioned, where applicable, and also involve an apparatus function test to check that the mechanism electrically opens and closes the contact in correct adjustment.

Procedures and guidelines for circuit testing are found in Part 01 "Inspection and Test Procedures".

## 2.6 Apparatus Function Testing

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

- i) Correct energisation and de-energisation levels
- ii) Correct operating and release times
- iii) Correct movement, limits of travel and clearances
- iv) Correct display of aspects, etc
- v) Correct fit and interlocking between parts
- vi) Correct tension, or compression between parts
- vii) Correct power supply values
- viii) Correct correspondence with controls and indications
- ix) 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.

## 2.7 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, staff instruments, staff contact boxes, bolt locks, bracket locks, mechanical detectors/selectors, train-bars, emergency switch machine locks etc work correctly in accordance with Locking Tables, Locking Diagrams and Working Sketches.

## 2.8 Function Test to Control Tables

Perform function Testing 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.

Control Table Function Tests shall be carried out after certification testing of related circuits to the circuit diagrams. To facilitate the testing, track circuit operation shall be simulated by switching track relays or track repeat relays. 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 system through 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.

## 2.9 Aspect Sequence Testing and Points Correspondence Testing

Carry out through system function 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 track circuit correspondence tests together with any other trackside apparatus connected or interfered with at the time of commissioning.

## 2.10 Design Integrity Test

This is the same as the function test to the control tables and the aspect sequence test except that the Tester is 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 Track Plan to verify that the signalling operates functionally and safely in accordance with standard signalling design principles.

The test is performed based on the Tester's extensive knowledge of signalling principles and practices, but is marked off by an assistant on the 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.



## **2.11 Inspection and Testing Practices (including re-testing of changes)**

Comply with the following inspection and testing practices:

### **2.11.1 False Feeds, Test Straps and Test Equipment**

Do not connect false feeds to existing working circuits.

Keep a record of any false feeds applied during testing.

The record shall indicate where the false feed is applied and shall be endorsed when the false feed has been removed. A check, after set to work testing has been completed, shall then be made to ensure that all such false feeds have in fact been removed.

Test straps used for verifying individual correctness of contacts etc., shall be limited in number and be brightly colour tagged for ease of identification. They shall be approximately 450mm long, individually numbered in sets and kept under lock and key.

Collect and count test straps where used to carry out testing at the end of each individual circuit test. In addition for each day's testing count out and log in and sign in and out all test straps except as follows.

Test straps used for turn around of control functions to create indications, or for test panel frig wiring or for timer straps, may be left in position until testing is complete.

Timer straps shall be logged separately and colour coded in a different colour (yellow); ensure that these straps are removed during timer relay set up procedures.

Ensure all instruments and apparatus which are required to carry out presite and site inspections and tests are fit for purpose, in good order, calibrated and where appropriate bear the certificate of a recognised authority as to their accuracy.

The use of test lamps is forbidden.

### **2.11.2 Temporary Stagework**

Temporary stagework wiring shall be of a distinctive colour. Where there are a number of different stagework wiring stages at the same location then the stagework wire for each stage is to be of a different colour for ease of identification. All subsequent colours shall be approved by the Commissioning Engineer.

### **2.11.3 Modifications to installed, non commissioned wiring**

Where corrective vital or non-vital modifications, or stagework wiring alterations, are to be undertaken and are to cut into newly installed non-commissioned vital circuits during any phase of the testing or

commissioning, the following installation practice must be adhered to at all times:

- i) Undertake modifications only upon receipt of the duly completed and signed copies of the respective Design Drawings, Modification Instruction Forms or agreed equivalent.

The Design Drawings, Modification Instruction Forms, or agreed equivalent shall be differently designated for modifications required during the construction phase, the testing phase and the commissioning phase.

- ii) New wiring for any modifications can be commenced prior to receipt of the duly completed and signed forms on the understanding that:
  - no wires are terminated
  - all ends of wires are suitably insulated

Upon receipt of the Design Drawings, Modification Instruction Forms or agreed equivalent applicable to the particular modification, carry out a wire count for each relay contact, fuse, and termination point utilised to generate the new modified circuit against the pink testing copy of the circuit diagrams and the contact analysis/documentation sheets

This wire count checks that, where contacts, fuses, and termination points have already been utilised to generate other circuits, the wiring at these points has been installed in accordance with the pink circuit diagrams (excluding the modification). If any error in the installed wiring is found then do not implement the modification until such time as the Commissioning Engineer has been advised of the error and that the error has been rectified to the satisfaction of the Commissioning Engineer.

- iv) Once the installed wiring has been verified the modification wiring can be connected into the circuit
- v) Identify the modification wire that has to be connected into the circuit against the pink circuit book diagram and check the wire bead against the pink circuit book contact allocation
- vi) Remove the installed crimp from the relay base, fuse, or termination point and check it's wire beading before cutting the installed crimp from the wiring. Where two connections are in the installed crimp identify the wire that has to be reconnected with the new wire by tracing or bell continuity testing. Label with a tag the installed wire that has to remain. Bell continuity test the wire that is no longer required and disconnect and cut off both ends, and cover them with a grey insulating marker for subsequent removal. After checking the labelling beads crimp and insert the new and the installed wires into the correct position in the existing relay base. When inserting the new wire or new and previously installed wires, carry out another wire count against the modification as drawn on the pink circuit diagram.
- vii) Bell continuity test the circuit alterations to one clear series contact each side of the points of connection.

- viii) Indicate that the changeover has been completed by highlighting the cut-in wires on the modification circuit diagram with the designated test colour and record all tests
- ix) Remove the wires that are no longer required from the wireways. If a wire was connected to a fuse point, also remove the fuse and if connected to a link, disconnect the link.

Wires that do not constitute a part of the working system shall not remain connected to any terminals and, unless impractical, shall be removed from the racks or wireways. Advise the Commissioning Engineer immediately if circumstances occur that prevent removal being achieved.

- x) Complete the testing for the modification and sign the Design Drawings, Modification Instruction Forms or agreed equivalent accordingly, certifying the modification circuit diagrams for bell continuity test, wire count, insulation test and function test.

#### **2.11.4 Modifications to System Software or Site Specific Data for Non-Vital Applications**

In non-vital applications, should modifications to software be required due to errors or changes of scope then the following procedures shall be observed.

- i) Locate the master copy of the source code of the system software or site specific data software, as applicable, and confirm that it is the current version of the source code or site specific data. This should be by comparing the identification of the master copy and the installed copy. If there is any doubt, a byte for byte comparison shall be performed to confirm that the correct master copy has been located.
- ii) Ensure that an archive copy of the current master copy is kept.
- iii) Identify the changes required. Define and document a process that will ensure that only the intended changes are made and all such changes are tested. If this is not possible then a complete re-test of the system shall be performed. In the case of changes to the system software, additionally perform an investigation to determine those areas of the system operation that may be affected and produce a reasoned justification as to why the testing should be limited to the affected areas.
- iv) Perform alterations in accordance with the documented process and generate a new executable version of the system software or site specific data software.
- v) Install and test the alterations only, provided that there is confirmation that only the intended alterations were made, otherwise re-test the whole system.
- vi) Perform a system confidence test by checking that each system function is operating correctly and observe the system operation looking for any errors or anomalies. Observation period shall be at least 30 minutes in the case of changes to the system software or for at least 15 minutes in the case of changes to the site specific data software.

- vii) Update the identification of the new master copy, and installed copy. Then make the back-up copy of the master.

### **2.11.5 Trackside Equipment Isolation**

Ensure that installed trackside equipment is not connected to the power source except at commissioning and when required during testing.

Busbar fuses and links in circuits to external equipment shall be removed and cable links to external equipment shall be opened immediately testing is completed for the day.

Institute measures to ensure new external equipment cannot be inadvertently or mistakenly operated.

Lock all equipment enclosures when unattended.

### **2.12 Illustrations**

The following illustrations are attached :-

Signalling System Schematic

Certification Testing Schematic

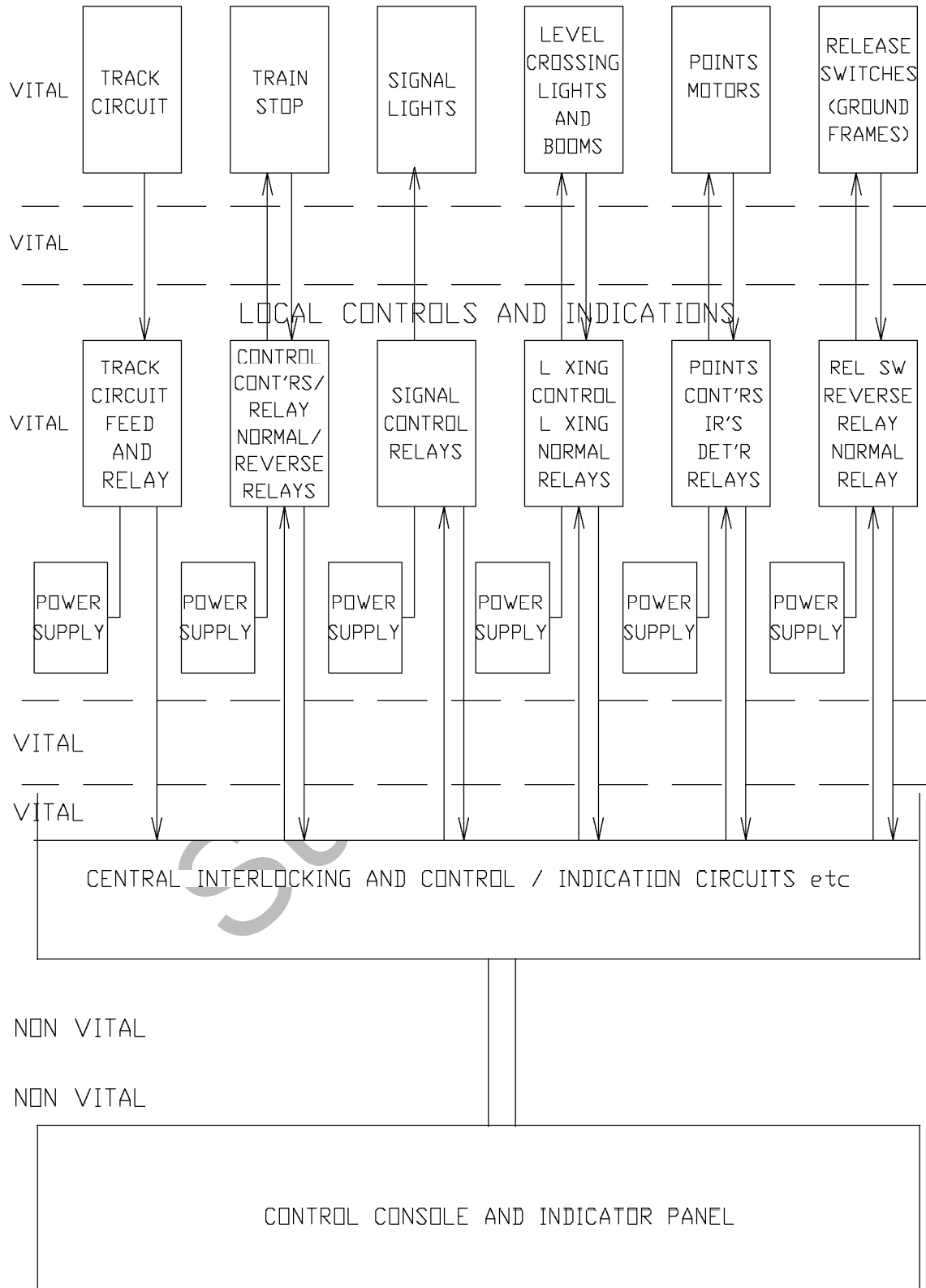
Through Correspondence Test and Interlocking/Control Schematic

Superseded

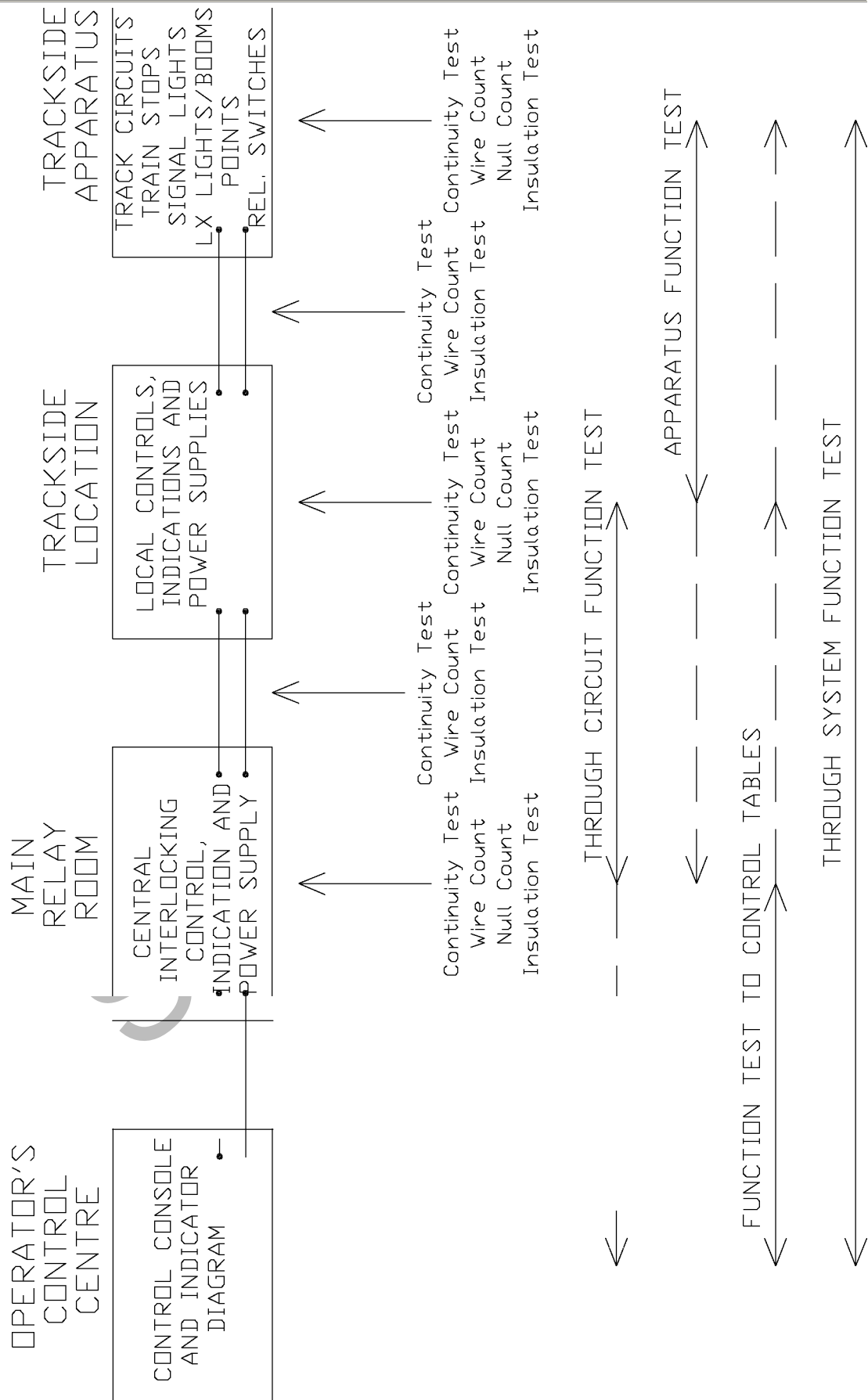
# SIGNALLING SYSTEM SCHEMATIC

(RELAY INTERLOCKING)

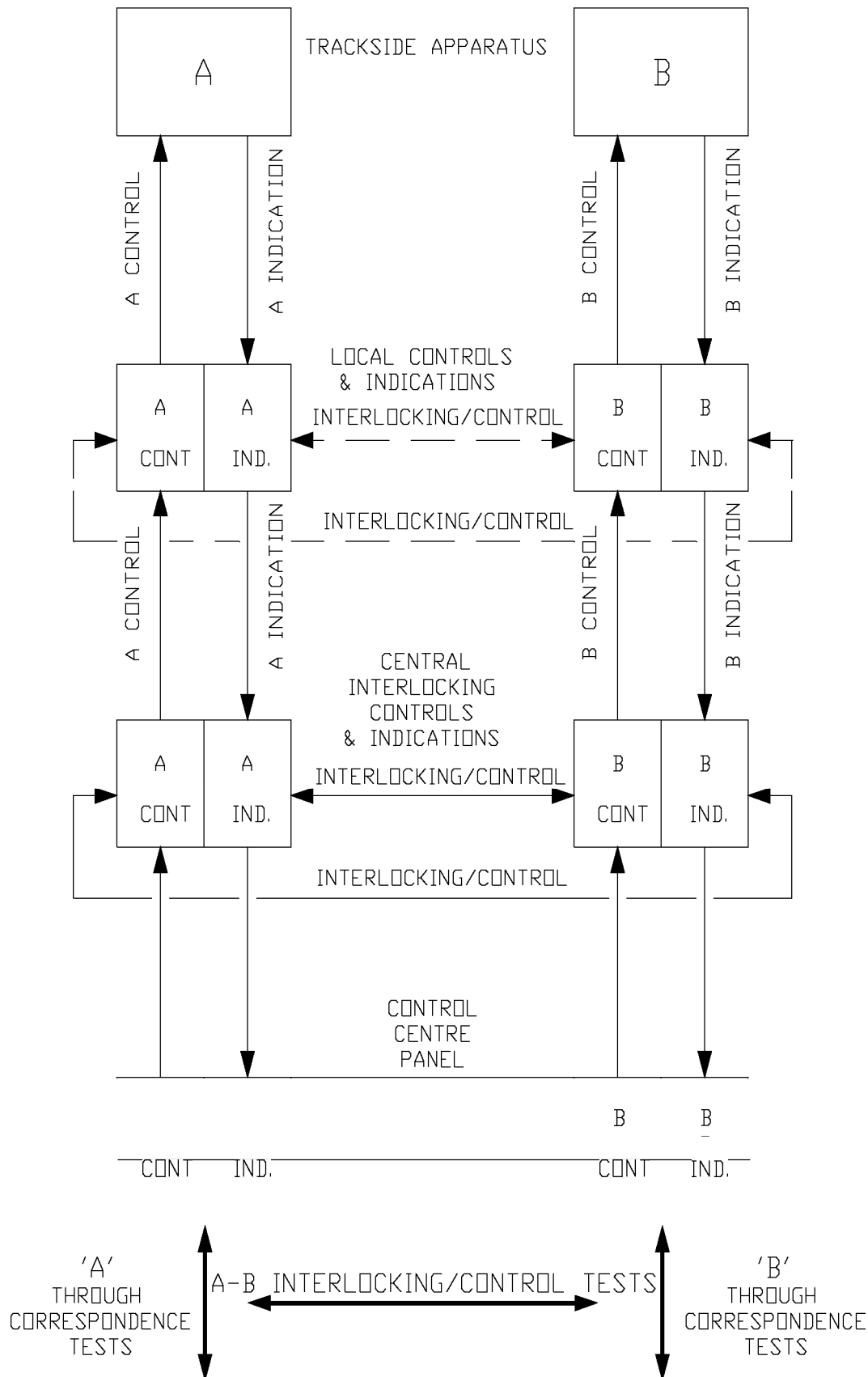
TRACKSIDE APPARATUS



CERTIFICATION TESTING



TRACKSIDE APPARATUS 'A' LOCKS/IS CONTROLLED BY TRACKSIDE APPARATUS 'B'



### **3. CERTIFICATION DOCUMENTATION**

Ensure that inspection and testing certification documents are reviewed, checked, and signed by qualified, competent persons attesting that the design, product or installation is in accordance with the specification requirements as proven by appropriate inspections and/or tests.

Ensure that each and every element of the vital signalling installation is correctly inspected, tested, and signed for.

#### **3.1 Certification Documents**

##### **3.1.1 Design**

The essential certification documents for inspection and testing for signalling safety, reliability, and functionality are the final approved design signalling plans and drawings. Requirements are stipulated in standard Specification SCP 06.

Testing copies of the following design documents shall be marked and signed in an approved, standard manner certifying that the vital installation has been inspected and tested and conforms strictly with the design:

- i) Track Plan/Signalling Plan
- ii) Track Insulation Plan
- iii) Circuit Book of signalling and communications circuits
- iv) Working Sketch
- v) Locking Table and Locking Diagram
- vi) Control Table

Interlocking tests shall be specifically certified on Interlocking Test Certificates.

##### **3.1.2 Adjustment**

Ensure that the following document certifications are performed:

- i) Points facing point lock and detection adjustment tests shall be specifically certified on Facing Point Lock and Detection Test Certificates
- ii) Track Circuit adjustment tests shall be specifically recorded and certified on Track Circuit History Cards
- iii) Correct adjustment of adjustable electrical contacts on operating mechanisms shall be certified in the circuit book as part of the inspection and tests to the circuit wiring diagrams.



### **3.1.3 Insulation**

Ensure that Insulation Test results are specifically recorded and certified on Insulation Test books of circuit diagrams and Cable Insulation Record sheets.

### **3.1.4 Clearances and Positional Relationships**

Ensure that structure gauge clearances, train stop gauging etc, and positional relationships between apparatus, e.g. signal/train stop/blockjoint, are included as part of the certification inspection to the Track Plan, Working Sketch, and Track Insulation Plan.

Train stop gauging should be certified on a separate Test Certificate in major works.

## **3.2 Installation Standard Certification**

Certify the installation as correct to the design documents and to applicable installation standards relevant to signalling safety and reliability.

The Tester is required to be alert for and to notice substandard equipment or work in vital areas that he/she examines as an essential part of his/her certification inspection and testing to the design documents.

Signing the design documents as inspected and tested also certifies that the associated work and equipment complies principally with the applicable equipment and installation standards for signalling safety and reliability.

## **3.3 Design Integrity Certification**

Certify the designs are correct to signalling principles and practices as well as to the operational requirements.

Modifications may be required to the designs prior to commissioning and these shall be certified by the same process.

For new and altered works, signing the locking certificate for mechanical, relay, or route set interlockings to locking tables and control tables also attests that the signalling is consistent with basic signalling design interlocking and control principles.

## **3.4 Interlocking Certification**

Perform a test of interlocking between points, signals, etc. The Interlocking Certification shall be signed by the Tester carrying out the interlocking test.

Mechanical interlocking tests shall be carried out for the mechanical interlocking aspects and the Interlocking Certificate (S4.304A) shall be completed and signed.

Where function tests to the control tables are performed and where these include a comprehensive test of the interlocking between points and signals etc., sign the function testing version of the Interlocking Certificate (S4.304C) and submit it to the Commissioning Engineer.

### **3.5 Design Tests**

Where more than one Tester is involved in design function testing then nominate a Senior Signal Design Engineer to control and co-ordinate the design function tests and to ensure that all the tests are completed. Each Tester is to sign off (certify), in an agreed unmistakable manner, only those tests which he/she has certified. Detailed handover procedures shall apply for shift working.

### **3.6 Completed Testing**

Ensure that there is no alteration or interference, intentional or inadvertent, to the installation once the testing, on which the certification relies, has been performed.

Should any modification take place then ensure that it is appropriately authorised, that the alteration work is strictly controlled, and that the installation is correctly and comprehensively retested and certified to the extent necessary to ensure the integrity of the installation.

### **3.7 Other Test Certificates**

Obtain Test Certificates for manufactured signalling cables and other vital signalling equipments from manufacturers or others in accordance with specification requirements for acceptance.

Other inspection and test documents should be utilised to manage the testing and certification process. This shall include signed records of the results of preliminary pre-site inspections and tests and set to work tests.

A separate Test Certificate should be provided for assurance that redundant equipment has been rendered securely inoperative and, if practical, removed.

The inspection and test documentation to be drawn up and completed shall include "Certification Inspection and Testing Checklists", "Certification Inspection and Testing Summary Checklist" and Test Certificates to cover the typical inspections and test for signalling apparatus shown in Part 03 (SCP 11).

The Commissioning of new work into use for traffic operation shall be subject to the approval of the Commissioning Engineer. Prepare for this purpose a commissioning package of documents comprising work instructions and inspection and test certificates etc.

### **3.8 Commissioning New Work or Alterations into Use**

When the Tester in Charge certifies that new or altered equipment has been connected, the redundant equipment securely disconnected and made inoperative, and the testing and certification is completed the Commissioning Engineer, if satisfied, will commission the new work and sign it into use for traffic operations in accordance with safeworking regulations.

### **3.9 Handover**

Ensure that the documentation necessary for maintaining the as-built system is passed over at commissioning together with stipulated spares and test equipment.

### **3.10 Retention of Certification Documents**

All documents bearing test certification signatures shall be handed over and retained as legal documents.

### **3.11 Test Documentation and Records**

Procedures required for issue and recording of Test Copy drawings are included in Specifications SCP 06 and SCP 07. Certification standard marking shall be in accordance with Paragraph 3.12, unless otherwise documented and agreed by the Commissioning Engineer.

Each person responsible for testing against design drawings and tables shall be designated a unique colour indelible marker.

Allocate the colours to all testing and witnessing personnel.

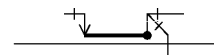
The name, date, signature and colour shall be endorsed on each testing sheet where any testing is carried out. It shall be possible to clearly identify the person testing and the person witnessing each element of a circuit or part of a drawing, even when a number of staff are involved.

All inspections and tests on the testing copies shall be recorded as follows in Paragraph 3.12, unless otherwise documented and agreed by the Commissioning Engineer.

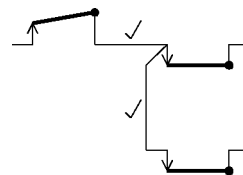
### 3.12 Method of Recording Test on Design Drawings

#### 3.12 METHOD OF RECORDING TESTS ON DESIGN DRAWINGS

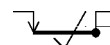
##### 3.12.1 RECORDING ON CIRCUIT BOOK/SHEET



Bell continuity test denoted on circuit diagram by small tick next to the wire or by colouring the wire in

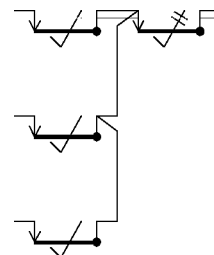


Circuit strap and function test of a contact denoted on circuit diagrams by a large tick through contact

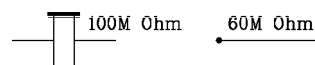


Wire count denoted on the circuit diagram by small stroke across the wire next to the terminal

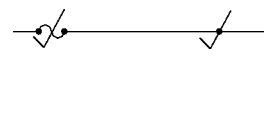
Contact strap and function test for more than one parallel path denoted by stroke across large tick for each additional path



Circuit insulation test denoted on circuit diagram by recording test reading next to the circuit function for complete circuits or on individual circuit wires where applicable



Circuit function test of fuses and link terminals denoted on circuit diagrams by large tick through fuse or terminal



Correct busbar voltage denoted on circuit diagrams by small tick next to the supply details

120v

Circuit function test of a relay denoted on circuit diagrams by a large tick through the relay



3.12.2 RECORDED ON ANALYSIS SHEETS

Relay type and pin code analysis check denoted on contact analysis sheet by large tick

QN1  
12-4  
✓

Analysis check of each entry on the analysis sheet denoted by small tick on each and every entry including spare contacts, wires and terminals (Null Count)

3.12.3 RECORDED ON CONTROL TABLES

Function test denoted by large tick

Through testing of contacts (eg. tracks in auto signals) denoted by T symbol

Aspect check denoted by large tick

3.12.4 RECORDED ON CIRCUIT BOOK SHEETS

Sheet fully tested denoted by large tick in bottom right-hand corner with testers name, signature and date

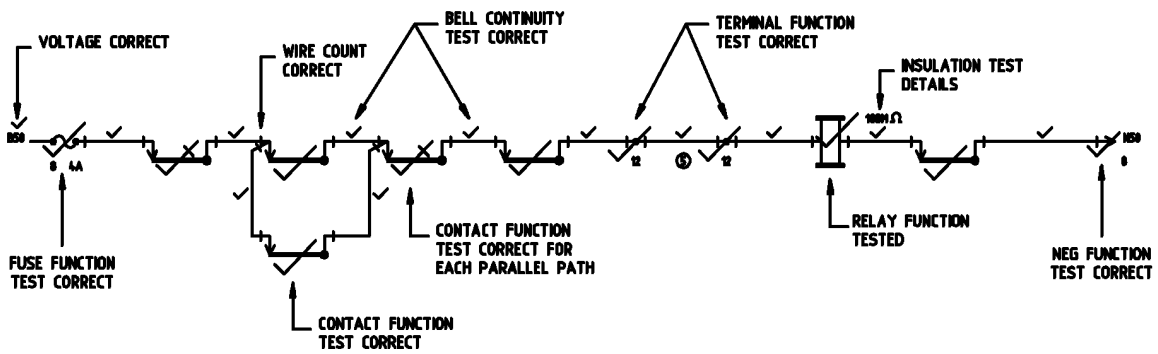
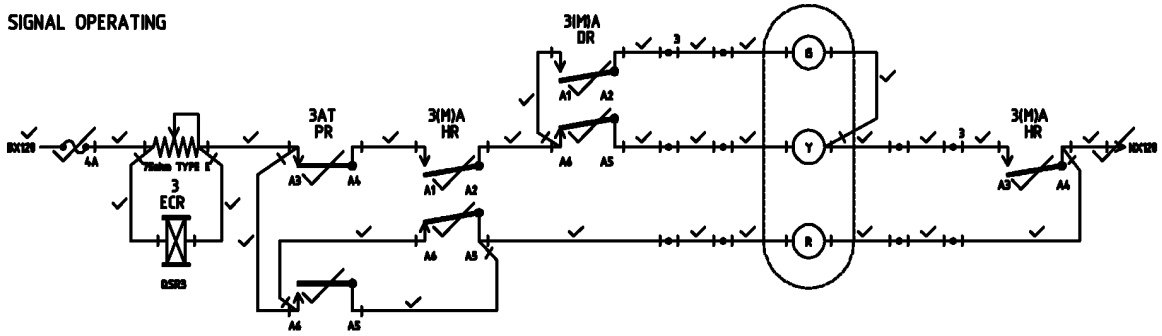
✓JSC

3.12.5 RECORDED ON TRACK AND INSULATION PLANS

Inspection denoted by large tick against item  
checked eg. signal, track circuit limit,

Superseded

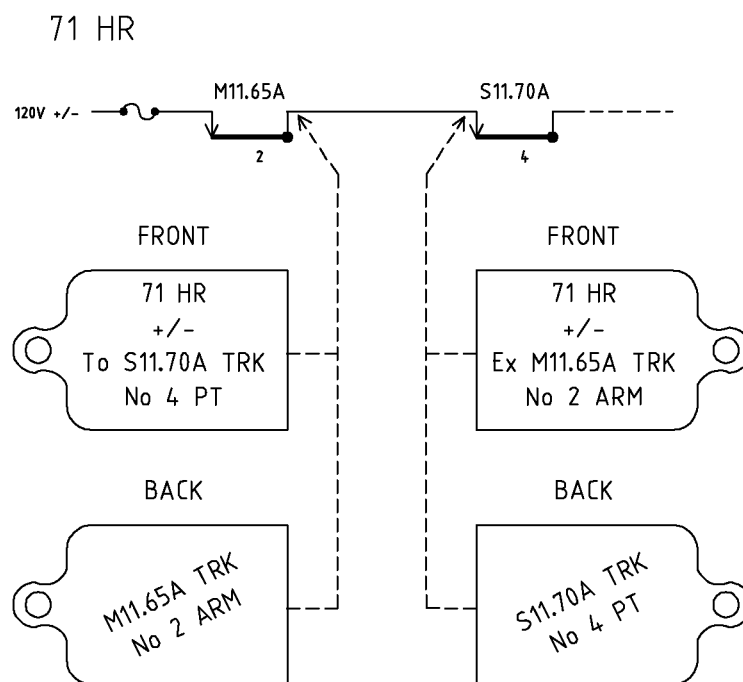
SIGNAL OPERATING



SHEET FULLY TESTED → ✓ S Officer  
 S.OFFICER  
 15/1/91

TEMP-12/12

EXAMPLE OF PAPER TAG IDENTIFICATION LABELS FOR WIRES



TEMP-12/5



### **3.13 Procedure for Recording Aspect Sequence Tests for New or Altered Signalling Work**

Record and certify aspect sequence tests on the Control Table and/or the Signalling/Track Plan.

Also, complete and sign off the Certification Inspection and Testing Checklist for Aspect Sequence Tests.

#### **3.13.1 Control Table**

Where control tables are utilised for recording aspect sequence tests, each aspect test must be marked off in the appropriate column of the control table by the tester.

#### **3.13.2 Signalling/Track Plan**

Where signalling/track plans are utilised for recording aspect sequence tests, each tested aspect must be marked off on the signalling/track plan clearly by the Tester drawing a line through the signal aspect symbol.

The train stop normal and reverse conditions should be marked off as correctly tested by a vertical line and a horizontal line over the train stop symbol respectively.

#### **3.13.3 Aspect Sequence Test Form**

For every signalling area tested, a Certification Inspection and Testing Checklist form for Aspect Sequence tests should be filled in and signed off by the Tester verifying that the tests are complete and correct

If more than one Tester is involved, each Tester shall be designated a different colour indelible marker to identify the tests carried out by them.

Each Tester shall sign off the control table and/or the signalling/track plan to certify their tests using their designated colour indelible marker.

After the commissioning, the certified control table and/or the signalling/track plan used for marking off the aspect sequence shall be returned to the IWMP to be forwarded to the ARTC Documentation Representative.