

Sydney Trains



Engineering System Integrity
Engineering Procedure
Signalling and Control Systems

PR S 47115

Inspection and Testing of Signalling: Typical Inspections and Tests for Signalling Apparatus

Version 1.1

Date in Force: 15 July 2021

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Authorised Engineering Technical
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Document control

| Version | Date | Author/Prin. Eng. | Summary of change |
|---------|--------------|-----------------------|---|
| 1.0 | 8 March 2019 | E Pace | New document based on old RailCorp document SPG 0711.5 |
| 1.1 | 15 July 2021 | Ian Maydew/C Darnenia | Updated with the inclusion of axle counter requirements |

Summary of changes from previous version

| Summary of change | Section |
|--|---------|
| Need to amend to meet the needs of each specific installation and equipment type | 1.1 |
| New section added detailing axle counter apparatus inspection requirements | 7 |

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1 Introduction

1.1 General

This Procedure sets out the requirements for typical inspection and tests for certifying signalling apparatus and the standard procedures and practices for carrying out and recording the inspection and testing.

These typical inspection and tests shall be amended to meet the needs of each specific installation and equipment type.

1.2 References

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

2 Signals

2.1 Apparatus Inspection

- a. Check workmanship and physical condition of the signal equipment and installation.
- b. Check operating environment suitability for safe, reliable operation.
- c. Verify conformance to the Signalling Plan, Signal Sighting Forms and Circuit Book inclusive of the following:

| | |
|-------------------------------|--|
| Identification Plate: | To approved Signal Sighting forms and Signalling Plan |
| Profile: | To approved Signal Sighting Forms, Circuit Book and Signalling Plan |
| Focus/Alignment: | Main aspect, sighting from 200 metres minimum, Subsidiary as required. |
| Site Screens: | Fit for purpose |
| Lens system: | Correct type, colour, phantom indications inhibited on proceed aspects, deflecting sectors correctly angled, spreadlight lens correctly aligned, protective covers fitted if required, LED types and colours correct |
| Lamps: | Correct type, voltage and wattage rating, positioned with main filament spread across lens at focal point |
| Transformers: | Correct type, rating and voltage taps |
| Filament Fail Relays: | Correct type and rating, properly secured |
| Lampcases: | Lens and door gaskets fitted, weather-proof, externally light proof, painted black, matte black internally, moisture free, doors open and close freely and lock to good fit |
| Hoods and Backgrounds: | Correct type, painted matte black, back of backgrounds painted gloss white |
| Sighting | Clear with no ambiguity or conflict with other signals or extraneous lighting |

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| Equipment mountings: | Secure |
| Locking: | Padlocks and locking devices secure |
| Signal Post Disconnection Box: | Securely mounted, weather-proof, locked, cables properly terminated |
| White Crosses: | Correctly fitted |
| Signal/Post and Ladder: | Correct height, installation, galvanised |
| Clearance: | Structure gauge, overhead wire |
| Signal positioning: | Relative to 1500 volt overhead air gap Correct trackside location |
| Redundant apparatus: | Securely inoperative and recovered |

2.2 Circuit Test

- a. Bell Continuity Test, Wire Count, Null Count, Insulation Test and Circuit Function Test the Signal Light Operating Circuit. Additionally, for alterations refer to *PR S 47116 Inspection and Testing of Signalling: Interface Requirements and Procedures for Alterations* for requirements.

2.3 Apparatus Function Tests

- a. Check that installed lamps are operating at the correct voltage setting.
- b. For L.E.D signals with operating circuits wired with other than twisted pair cable, conduct ‘no volts’ tests and record the test results on Test Certificate TC 1 (b) or (c).
- c. Signals fitted with dual filament lamps: test to ensure that a failure of the main filament de-energises the filament change-over relay and operates the auxiliary filament.
- d. Signals fitted with a lamp proving relay: test to ensure relay is energised except when both lamp filaments have failed, ensure relay adjusted to drop effectively with lamp totally out, but pick effectively with main filament out, auxiliary filament on.
- e. Signals fitted with Marker Light: Test to ensure marker light operates with main signal lamps out or at red.
- f. Check flash rate correct for flashing and pulsating aspects.

2.4 System Function Test

Complete remaining tests described in Procedure *PR S 47114 Inspection and Testing of Signalling: Inspection and Testing Procedures* Section 9 Aspect Sequence Test. Record the result of the aspect sequence test as described in *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages* Section 3.8.

2.5 Signals Test Certificates

Record the results of apparatus inspection and testing as nominated in *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages*, with tailored Work Instructions, developed from ITF Checklist 13/1 (a or b) and complete the Test Certificate (TC 1a, 1b or 1c), as applicable provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

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3 Point Machines

3.1 Electric Points Machines

3.1.1 Points Machine Apparatus Inspection: Electric

- a. Check workmanship and physical condition of the points equipment and installation.
- b. Check operating environment suitable for safe, reliable operation.
- c. Verify conformance to the Signalling Plan, Working Sketch and Circuit Book.
- d. Check that point machine and point rodding is correct type.
- e. Check that point machine is mounted on correct side of track, with correct switch normally closed and correct point number on machine and sleeper.
- f. Check multiple drives, additional detectors.
- g. Check that nuts and fittings are properly secured with split pins opened.
- h. Check that all insulations installed and effective in tie-plates, spreaders, point connections, etc.
- i. Check that machine and ground connections are adjusted according to the relevant instruction manual.
- j. Check that the ESML lock and crank handle key or EOL lock and key are to the correct warding/indexing and comply with the warding gauge/indexing list.
- k. Check that the ESML crank handle or EOL key has been correctly inscribed.
- l. Check that the ESML or EOL is mounted on the side of the hut containing the point contactors and isolating relay (single cut circuitry).
- m. Check that the ESML or EOL is positioned for appropriate physical time delay.
- n. Check that all padlocks are secure and lightly lubricated.
- o. Check redundant apparatus made securely inoperative and recovered.

3.1.2 Points Machine – Circuit Test: Electric

Bell Continuity Test, Wire Count, Null Count, Insulation Test and Circuit Function Test all circuits with wires connecting to the points mechanism and associated detector units and emergency switch machine lock (ESML), or emergency operating lock (EOL). In addition, conduct a Contact Proving Test of all contact devices in the external equipment by verification that each specific contact is effective and of the correct type.

Additionally, for alterations refer to *PR S 47116 Inspection and Testing of Signalling: Interface Requirements and Procedures for Alterations* for requirements.

3.1.3 Points Machine – Apparatus Function Test: Electric

- a. Isolate point motors by switching to "off" the power isolating switches and ensure that the point motors are unable to operate.
- b. Check that the points are unable to operate with the isolating relay removed or with the normal contactor removed (from reverse) or with the reverse contactor removed (from normal).
- c. Check and record the running current and the time taken for a complete operation.
- d. Check operation and timing of points cut off timer.
- e. Check clutch setting to relevant instruction manual.

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- f. Check that all contacts electrically open and close in correct adjustment when the points are operated to normal and reverse.
- g. Check ESML/EOL key when turned in lock electrically opens and closes the ESML/EOL contacts correctly.
- h. Check the door of the ESML/EOL case cannot be closed with the key in the unlocked position.
- i. Check ESML/EOL operating handle operates the point machine safety cut out switch, disconnecting the points motor.
- j. Check points operate easily under emergency manual operation.

3.1.4 Points Machine - Facing Point Lock and Detection Test: Electric

Using the ESML crank handle or EOL key where provided manually operate the point machine and:

- a. Adjust the facing point lock, closed and open switch detection as specified in the particular Points Equipment Manual.
- b. Verify that the open switch opens to a distance as specified in the particular Points Equipment Manual.
- c. Where machines have accurately marked lock and detector slides - Nippon 1200A, 1211B, 1211C, ensure that misalignment of the mark from the side of the case is equal to the thickness of gauge inserted between the switch and stockrail - take care to avoid "switch roll" when making this comparison.

3.1.5 Points Machine – System Function Test: Electric

Complete tests described in *PR S 47114 Inspection and Testing of Signalling: Inspection and Testing Procedures* Section 8 Point Correspondence Tests.

3.1.6 Points Machine – Test Certificates: Electric

Record the results of Points Machine Tests on the Point Operating Test Certificate (TC-6) provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

3.2 Electro Pneumatic Points Machines

3.2.1 Points Machines – Apparatus Inspection: Electro-pneumatic

- a. Check workmanship and physical condition of the points equipment and installation.
- b. Check that the operating environment is suitable for safe, reliable operation.
- c. Verify conformance to Signalling Plan, Working Sketch and Circuit Book.
- d. Inspection Detail.
- e. Check that the air motor is the correct size and stroke.
- f. Check that the motor and movement are on the correct side of the track.
- g. Check that the correct switch is normally closed and that air hoses are correctly connected normal to normal and reverse to reverse between the motor and control valve.
- h. Check that cranks are on centre.
- i. Check that bolts and pins are properly secured and split pins spread.
- j. Check that notches are correctly cut in stretcher bar.

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- k. Check that FPL, HLM, detection, indication box and plunger lock are correctly adjusted.
- l. Check that the EOL (Emergency Operation Lock) key is correctly inscribed for indexing and point number.
- m. Check that the EOL key operates correctly in both locks and the emergency push buttons operate the correct normal and reverse valves.
- n. Check that the EOL box is correctly positioned and, on crossovers, that the emergency push buttons operate BOTH ends of the crossover.

3.2.2 Points Machine – Circuit Test: Electro-pneumatic

Bell Continuity Test, Wire Count, Null Count, Insulation Test and Circuit Function Test all circuits with wires connecting to control valve, detector, indication box/escapement slide, plunger lock and EOL box (where fitted). In addition, conduct a Contact Proving Test of all contact devices in the external equipment by verification that each specific contact is effective and of the correct type. Additionally, for alterations refer to *PR S 47116 Inspection and Testing of Signalling: Interface Requirements and Procedures for Alterations* for requirements.

3.2.3 Points Machine – Apparatus Function Test: Electro-pneumatic

- a. Test that the plunger lock engages in the facing point lock plunger to the full depth of the notch and is located (approximately) in the centre of the notch.
- b. Test that the plunger lock normal (lock engaged) contacts, do not make until the lock is engaged in the notch by at least 2 mm and that the reverse (lock disengaged) contacts, do not make until the lock is clear of the plunger by 1mm.
- c. Test that the plunger lock contacts isolate power from the points normal and reverse valves.
- d. Test that indication box escapement contacts operate correctly and drive the mechanism back should the plunger creep.
- e. Test that the plunger passes through the facing point lock notch in the stretcher bar and withdraws clear of the stretcher bar correctly and that the connection to the indication box is correctly adjusted.

3.2.4 Points Machine – Facing Point Lock and Detection Test: Electro-pneumatic

Operate the Points Machine and:

- a. Verify that the open switch opens to a distance as specified in the particular Points Equipment Manual.
- b. Adjust the facing point lock, closed and open switch detection as specified in the particular Points Equipment Manual.

3.2.5 Points Machine – System Function Test: Electro-pneumatic

Complete testing described in *PR S 47114 Inspection and Testing of Signalling: Inspection and Testing Procedures* Section 8 Point Correspondence Tests.

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3.2.6 Points Machine – Test Certificates: Electro-pneumatic

Record the results of apparatus inspections and tests, as nominated in *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages* with tailored Work Instructions, developed from ITF Checklist 13/2 and complete the Test Certificate (TC 6), as applicable provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

3.3 Mechanical Points

3.3.1 Points Apparatus Inspection: Mechanical

- a. Check the workmanship, physical condition and installation of the points equipment, channel rodding drive and ground frame.
- b. Check that the operating environment is suitable for safe, reliable operation.
- c. Verify conformance to Signalling Plan, Working Sketch and Circuit Book.
- d. Check that leading off timbers and cranks are secure (where applicable).
- e. Check that the ground frame is correctly located relative to the points (where applicable).
- f. Check that the ground frame is of the correct type and size (where applicable).
- g. Check that the channel rodding stands and crank stands are secure in the ground and that the run is straight (or evenly curved) and level.
- h. Check that cranks are "on centre" and that compensators are correctly located in the run.
- i. Check that bolts and pins are properly secured and split pins spread.
- j. Check that the FPL casting/HLM case is secure and cannot move on the sleepers.
- k. Check that "spring", FPL, HLM and detection are correctly adjusted.
- l. Check that the points are not excessively heavy to pull.

3.3.2 Points Circuit Test: Mechanical

Bell Continuity Test, Wire Count, Null Count, Insulation Test and Circuit Function Test detection circuits. Strap and Function Test the contacts within the detector. Additionally, for alterations refer to *PR S 47116 Inspection and Testing of Signalling: Interface Requirements and Procedures for Alterations* for requirements.

3.3.3 Points Apparatus Function Test: Mechanical

- a. Ensure that there is no more than 20mm escapement available between bobbin and cradle.
- b. Test that the point lock plunger/tappet travel and clearance is as per the particular Points Equipment Manuals specification.
- c. Test that movement of the cross slide or tappet will break detection before the plunger or tappet disengages from the lock rod i.e. as specified by the particular Points Equipment Manual.
- d. Check that the effort required on the points lever is similar for normal to reverse and reverse to normal.

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3.3.4 Points – Facing Point Lock and Detection Test: Mechanical

Operate the points and:

- a. adjust the facing point lock, closed and open switch detection as specified in the particular Points Equipment Manual
- b. verify that the open switch opens to 114 mm +2mm -0mm.

Note:

With a switch opening of 114mm a mechanical lock will fail to enter, or just bump in, with 1.6mm between switch and stockrail. For mechanical points, switch openings may be increased slightly up to 116mm but shall never be less than 114mm.

3.3.5 Points Test Certificates: Mechanical

Record the results of apparatus inspection and testing as nominated in *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages* with tailored Work Instructions, developed from ITF Checklist 13/2 –13/3 and complete the Test Certificate (TC 6) as applicable provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

4 Ground Frames and Electric Releases

4.1 Ground Frames and Electric Releases Apparatus Inspection

- a. Check workmanship and physical condition of the ground frame or electric releasing switch equipment and installation.
- b. Check operating environment suitable for safe reliable operation.
- c. Verify conformance with the Signalling Plan, Circuit Books, Working Sketches, Locking Tables and Locking Diagrams.
- d. Check positioning of release switch in relation to ground frame particularly where a physical time delay is required.
- e. Check release switch type, rating and labelling.
- f. Check electric lever lock type, rating and labelling.
- g. Check release switch, electric lever lock for correct voltage, lock positions and force down, where applicable.
- h. Check indicators, repeaters for correct type, rating and labelling.
- i. Check Annett keys and lock faces are correctly warded and keys correctly inscribed.
- j. Check the lever nameplates on the mechanical levers.
- k. Check covers secured on mechanical interlocking.
- l. Check redundant apparatus made securely inoperative and recovered.

4.2 Ground Frames and Electric Releases Circuit Test

Bell Continuity Test, Wire Count, Null Count, Insulation Test and Circuit Function Test all circuits connecting to the release switch and/or ground frame. Strap and Function Test contacts in the external equipment. Additionally, for alterations refer to *PR S 47116 Inspection and Testing of Signalling: Interface Requirements and Procedures for Alterations* for requirements.

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4.3 Ground Frames and Electric Releases Apparatus Function Test

- a. Check adjustment of catch handle contacts, lever rotary contacts, electric lever lock and release switch normal and reverse contacts to electrically open and close at the correct relative position of the lever.
- b. Check Annett lock contacts electrically open and close correctly when the Annett key is turned in the lock.
- c. Operate release switches and electric lever locks and ensure that the lock drops and securely locks the lever when de-energised and that the lock proving contact only closes when the lever is locked, physically move around the locking dog to ensure that the locking dog will not ledge on the lock slide.
- d. Check that release switch lock corresponds with the lever controls and operates the release switch normal relay correctly.
- e. Ensure that with the key removed the release switch cannot be normalised.
- f. Check that release switch door cannot close with lever in the release position.

4.4 Ground Frames and Electric Releases System Function Test

- a. Test the mechanical interlocking in the ground frame.
- b. Operate the release switch and frame from the control centre and observe the correct indications on the indicator diagram.

4.5 Ground Frames and Electric Releases Test Certificates

Record the results of apparatus inspection and testing as nominated in *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages* with tailored Work Instructions, developed from ITF Checklist 13/2 –13/3 and complete the Test Certificate (TC 6) as applicable provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

5 Train Stop

5.1 Train Stop Apparatus Inspection

- a. Check workmanship and physical condition of the trainstop equipment and installation.
- b. Check operating environment suitable for safe, reliable operation.
- c. Verify conformance to the Signalling Plan and Circuit Book.
- d. Check trainstop is the correct type.
- e. Check that the trainstop is installed on the correct side of track and that its positioning complies with the trainstop gauge.
- f. Check that tab washer secures the trainstop arm adjustment nut.
- g. Check that sleeper fixing arrangements are secure and the trainstop unit is level and no twisting of the case can occur to impede movement of the trainstop arm.
- h. Check that the trainstop arm strike plate is painted white and its movement is not restricted by ballast or other such objects. Check ballast guard provided where specified.
- i. Check that a trainstop protection ramp is provided.
- j. Check that padlocks are securely fitted.

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- k. Check oil and hydraulic fluid are the correct types and quantities.
- l. Check that manufacturer's Inspection and Test acceptance test certificates for manufactured equipment are available, where applicable.
- m. Check redundant apparatus made securely inoperative and recovered.

5.2 Train Stop Circuit Testing

Bell Continuity Test, Wire Count, Null Count, Insulation Test and Circuit Function Test circuits with wires connecting to the trainstop. Strap and Function Test contacts in the Trainstop. Additionally, for alterations refer to *PR S 47116 Inspection and Testing of Signalling: Interface Requirements and Procedures for Alterations* for requirements.

5.3 Train Stop Apparatus Function Test

- a. Test operation of installed trainstop from local controls.
- b. Test that the trainstop arm cannot be manually suppressed and the safety latch is correctly adjusted.
- c. Check that the trainstop arm contacts electrically open and close in correct adjustment when the trainstop arm is operated. Check that the normal contacts do not open when the arm is manually suppressed against the safety latch.
- d. Check that the trainstop arm returns to stop with loss of power supply.
- e. Check by removal of the arm, the arm detector pin, or examination of the linkages and springs, that if the trainstop arm were broken off the trainstop arm normal contacts open circuit.
- f. Check forced feed lubrication is effective, if installed.
- g. Prior to installation operate the trainstop on a test bench continuously for twenty-four hours at 24 operations per hour.

5.4 Train Stop System Function Test

In conjunction with the Aspect Sequence tests:

- a. Check that the signal in rear is held at stop if the trainstop arm does not fully return to normal and check through correspondence of trainstop with normal and reverse signal repeater and with signal controls.
- b. Check trainstop correctly suppresses where applicable.

5.5 Train Stop Test Certificates

Record the results of apparatus inspection and testing as nominated in *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages* with tailored Work Instructions, developed from ITF Checklist 13/4 and complete the Test Certificate (TC 4) as applicable provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

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6 Track Circuits

6.1 Track Circuit Apparatus Inspection

- a. Check workmanship and physical condition of track circuit equipment and installation.
- b. Check operating environment suitable for safe, reliable operation. Where applicable - terminals insulated or shrouded: for touch and accidental short circuits.
- c. Verify conformance to the Signalling Plan, Track Insulation Plan and Circuit Diagrams inclusive of the following:
 - i. Check length and limits of track circuit, position of insulated joints, fouling point clearance, point and other insulations, traction bonds, electrolysis bonds. Check polarity of each rail of D.C. track circuits and Impulse track circuits is as shown on the Track Insulation Plan.
 - ii. Check track circuit connections, spark gap arrestor connections, track circuit bonding, traction bonding, electrolysis bonding, including series bonds, parallel bonds, rail joints bonds and bonds in points, crossing and check rails.
 - iii. Check loop arrangements and length of track circuit leads.
 - iv. Check type, rating and labelling of track circuit equipment items.
 - v. Check that connections to rail secured and terminated.
 - vi. Check disconnection boxes and track side equipment associated with special track circuits for corrosion and other physical damage, secure mount and that cables are wired neatly and securely terminated.
 - vii. Check that insulated rails are free from spurious bonds or earths.
 - viii. Check fishplates and track fastenings are not bridging out the insulated joint.
 - ix. Check, on special vertical racking for track circuit equipment, every vacant module position above or below a unit of installed equipment is fitted with all obturation fittings and coding plugs to prevent incorrect insertion of the unit.
 - x. Check redundant apparatus made securely inoperative and recovered.

6.2 Track Circuit – Circuit Test

Bell Continuity Test, Wire Count, Null Count, Insulation Test and Circuit Function test the track circuit. Additionally, for alterations refer to *PR S 47116 Inspection and Testing of Signalling: Interface Requirements and Procedures for Alterations* for requirements.

6.3 Track Circuit Apparatus Function Test

- a. Check that all surge protection and earthing arrangements are installed and connected prior to certification testing.
- b. Record track circuit voltages, currents and adjustment settings and check against normal values for the applicable track parameters.
- c. Check double rail AC and audio frequency track circuits for equal current in each rail.
- d. Remove the track circuit feed primary fuse and check the track relay for de-energisation and zero voltage.

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Note:

Residual voltages across the relay or across the rails shall be further investigated and irregular sources rectified.

Some residual traction DC and traction harmonics would be expected with single rail track circuits, as would some circulating current from other single rail track circuits in the vicinity.

Residual voltages could be caused by unbalance in the track circuit under test or in other track circuits in the vicinity, or by false voltage. Unbalance in track circuits could be caused by high resistance rail connections, rail bonds or defective spark gap connections.

On DC tracks any residual voltage shall be less than 30% of the release voltage of the track relay.

- e. Check that structure spark gap connections are open circuit.
- f. Check rail connections and rail bonds for low resistance volt drop.
- g. Check polarity reversal at block-joints between adjacent track circuits at all extremities, where applicable, using a voltmeter. With AC double rail tracks circuits - additionally bridge one block joint and observe the track relay drive down (i.e. not just release).
- h. Conduct drop shunt tests at relay/receiver extremity of the track circuit and fixed minimum shunt tests at all other extremities and at regular intermediate points for compliance with specification shunt values, including between the tuned loops on a jointless track circuit and including all parallel bonded sections. Use non-inductive shunt resistors with rail clamp connections. Shunt tests should be done when the track circuit ballast is dry. Record lowest value on the Track Circuit History Card.

6.4 Track Circuit System Function Test

- a. De-energise the track relay and observe all corresponding track indicating and repeat relays drop away and the track indicator display occupied. Observe track time limit relay energise after set time delay.
- b. Energise the track relay and observe the converse.

6.5 Track Circuits Test Certificates

Record the results of apparatus inspection and testing as nominated in the relevant Set to Work and Test and Certify Manual, complete the required Track Circuit Commissioning Master Sheets and Track Circuit History Cards. Further, the requirements set out in Procedure *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages* with tailored Work Instructions, developed from ITF Checklist 13/5 provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

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7 Axle Counters

7.1 Axle Counter Apparatus Inspection

- a. Check workmanship and physical condition of axle counter equipment and installation.
- b. Check operating environment suitable for safe, reliable operation. Where applicable - terminals insulated or shrouded for touch potential and accidental short circuits.
- c. Verify conformance to the Signalling Plan, Track Insulation Plan and Circuit Diagrams inclusive of the following:
 - i. Check wheel sensor fouling point clearance.
 - ii. Check wheel sensor proximity to metal mass or other axle counter wheel sensors.
 - iii. Check wheel sensor position is as shown on the Track Insulation Plan.
 - iv. Check wheel sensor orientation is as shown on the Track Insulation Plan.
 - v. Check track section spark gap arrestor connections, traction bonding, electrolysis bonding, rail joints bonds and bonds in points, crossing and check rails.
 - vi. Check the wheel sensor vertical and horizontal mounted position is correct to installation requirements.
 - vii. Check that the wheel sensor is securely fixed to the rail via the approved clamping arrangement.
 - viii. Check disconnection box terminations for corrosion and other physical damage, secure mount and that cables are wired neatly and securely terminated.
 - ix. Check type and labelling of axle counter equipment items.
 - x. Check labelling of cables to be inserted within evaluator units is correct to prevent incorrect insertion of the unit.
 - xi. Check redundant apparatus made securely inoperative and recovered.
 - xii. Check firmware and configuration file are correct to the approved design.
 - xiii. Check the equipment type, configuration and installation is correct to the approved design.

7.2 Axle Counter – Circuit Test

For axle counter systems undertake Bell Continuity Test, Wire Count, Null Count, Insulation Test and Circuit Function test the axle counter.

Additionally, for alterations refer to *PR S 47116 Inspection and Testing of Signalling: Interface Requirements and Procedures for Alterations* for requirements.

7.3 Axle Counter Apparatus Function Test

- a. Check that all surge protection and earthing arrangements are installed and connected prior to certification testing.
- b. Calibrate the wheel sensor in accordance with the manufacturer requirements.
- c. Record calibration values and check against the applicable parameters.
- d. Reset (unconditional and preparatory as provided) the track section and ensure the track indicates a clear state.

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- e. Use the approved swiping test tool to simulate a wheel traversal:
 - i. Assignment check.
 - ii. Occupancy check.
- f. Ensure the track relay (if installed) is de-energised and the track section is indicating occupied.

7.4 Axle Counter System Function Test (Relay Interface)

- a. De-energise the track relay and observe all corresponding track indicating and repeat relays drop away and the track indicator display occupied. Observe track time limit relay energise after set time delay.
- b. Energise the track relay and observe the converse.

7.5 Axle Counter Test Certificates

Record the results of apparatus inspection and testing as nominated in the relevant Sydney Trains Equipment Manual and complete the required axle counter wheel sensor history cards.

Further, the requirements set out in Procedure *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages* with tailored Work Instructions, developed from ITF Checklist 13/21 provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

8 Level Crossing Equipment

8.1 Level Crossing Equipment Apparatus Inspection

- a. Check workmanship and physical condition of level crossing equipment and installation.
- b. Check operating environment suitable for safe, reliable operation. Terminals insulated or shrouded: for touch and accidental short circuits.
- c. Verify conformance to the Signalling Plan, Circuit Diagrams and Level Crossing Site Plan, inclusive of the following:
 - Measure approach distances from warning initiation point to the edge of the road and check calculated warning times at line speed.

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| | |
|---|---|
| Road signs, road markings, train driver warning boards, penalty notice boards: | Fitted correctly |
| Lights, booms and bells: | Fitted correctly |
| Test and Emergency keys: | Identification tags correctly inscribed |
| Equipment: | Type, rating and labelling correct |
| Battery and battery charger: | Type and rating correct. Ensure batteries fully charged |
| Focus: | Check near side signals focus and far side signals focus as required by the road traffic approaches |
| Padlocks: | Correct type on emergency box |
| Speed Boards | Check installed and correct, where applicable |
| Redundant apparatus: | Securely inoperative and recovered |

8.2 Level Crossing Equipment Circuit Testing

Bell Continuity Test, Wire Count, Null Count, Insulation Test and Circuit Function Test all circuits connecting to the highway signals, booms and bells. Strap and Function Test contacts in external equipment. Additionally, for alterations refer to *PR S 47116 Inspection and Testing of Signalling: Interface Requirements and Procedures for Alterations* for requirements.

8.3 Level Crossing Equipment Apparatus Function Tests

- a. Operate equipment.
- b. Check boom ascend and descend times and record.
- c. Check boom gate delay time after initiation of lights and bells operation and record.
- d. Check audible warnings sound when protection initiated and that one cuts out when booms have descended.
- e. Check operating voltage at bell.
- f. Check 10v 25w lamps operate at 9.6 volts measured at the base of the pole (temporarily bridge out the flasher contacts for this check).
- g. Check operation of test and emergency keys.
- h. Test low voltage alarms operate at the correct voltage setting and illuminate/extinguish the power supply indicators.
- i. Check test switch operates protection and disconnects the A.C. power supply from the battery charger.
- j. Check protection operates on batteries alone as well as with battery charger by opening the Test Switch and observing operation and power supply indicators for two minutes.
- k. Check booms fall when power lost.

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8.4 Level Crossing Equipment System Function Test

- a. De-energise track circuits individually and ensure protection operates.
- b. De-energise tracks in sequential order to simulate a train and ensure protection operates.
- c. Ensure departure tracks do not operate protection and protection clears when the level crossing track is cleared.
- d. Where interlocked signals protect the level crossing, ensure protection is not cleared until the replaced signal has been at stop for the time limit set.
- e. With approach track circuit occupied ensure qualifying signal at stop will not clear until the level crossing protection has operated for the time set.
- f. Check direction sticks operate correctly.
- g. Check proving of direction sticks in electric train staff line, section control or as otherwise provided by direction stick time limit relays.
- h. Check remote testing or monitoring equipment operates correctly.

8.5 Level Crossing Equipment Test Certificates

Record the results of apparatus inspection and testing as nominated in *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages* with tailored Work Instructions, developed from ITF Checklist 13/6 and complete the Test Certificate (TC 10) as applicable provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

9 Power Supplies

9.1 Power Supplies Apparatus Inspection

- a. Check workmanship and physical condition of power supply equipment and installation.
- b. Check operating environment suitable for safe reliable operation.
- c. Verify conformance to Signalling Plans and Circuit Diagrams inclusive of the following:

| | |
|--|--|
| Fuses, circuit breaks, surge gas discharge units and varistors: | Correct type, rating and labelling |
| Transformers, rectifiers, resistors and capacitors: | Correct type and voltage and current rating, adjustment arrangements and labelling |
| Busbars, mains cables, power supply wiring, terminals: | Correct type, rating and labelling |
| Battery: | Correct type, capacity, number of cells, state of charge |
| Terminals insulated or shrouded: | For touch and accidental short circuits |

- d. Check manufacturer's test certificates and acceptance test certificates for manufactured equipment, where applicable.

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9.2 Power Supplies Circuit Testing

Bell Continuity Test, Wire Count, Null Count, Insulation Test. Additionally, for alterations refer to *PR S 47116 Inspection and Testing of Signalling: Interface Requirements and Procedures for Alterations* for requirements.

9.3 Power Supplies Apparatus Function Test

- a. Test power supplies to operate correctly providing the correct voltage value, polarity and voltage regulation over the range of operating conditions. Record values.
- b. Test voltage drop over power supply mains and circuit wires for maximum operating load.
- c. Test each channel of dual power supplies to individually supply the load.
- d. Test uninterruptable power supplies to supply the load conditions when mains power is interrupted.
- e. Test mains failure plants to start up, provide correct voltage and frequency, supply the load, shut down and indicate correctly.
- f. Test battery chargers for correct operation and charging adjustment.
- g. Test batteries for polarity, voltage, state of charge.
- h. Test emergency changeover arrangements operate correctly.
- i. Test power supply indicators and alarms, local and remote, to operate correctly.
- j. Test power supply busbars to be isolated from any other power supply.
- k. Test power supply busbars to be free from earths. Record busbar voltage leak to earth.
- l. Test earth leakage detectors connected to power supply busbars to operate correctly.
- m. Check phase relationship between normal and emergency supplies, where applicable.

9.4 Power Supplies Test Certificates

Record the results of apparatus inspection and testing as nominated in *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages* with tailored Work Instructions, developed from ITF Checklist 13/7 and complete the Test Certificate (TC 7 and TC 9) as applicable provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

10 Diesel Generators (Mains failure plant)

10.1 Diesel Generators Apparatus Inspection

- a. Check workmanship and physical condition of the mains failure plant equipment and installation.
- b. Check operating environment suitable for safe reliable operation.
- c. Ensure suppliers detailed inspection report is completed and present.
- d. Check that the unit is supplied with the manufacturer's test certificate and at least one complete copy of the manual, including operating and maintenance instructions and circuit diagrams.

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- e. Check that the generating plant is securely fixed to its mounting base and that mains and indication cables are correctly terminated to the control panel.
- f. On a non-portable system, check that fuel tank and control panel are securely mounted, fuel lines are properly run and connected to tank and engine and cabling between control panel and motor/alternator is wired according to the manufacturer's wiring diagram.
- g. Check that the fuel tank is full, the starter battery is properly connected and fully charged and normal mains supply to the control panel is 'on'.
- h. Ensure fuel tank bunding well is in place and adequate for the size of the fuel tank.

10.2 Diesel Generators Apparatus Function Test

10.2.1 Initialisation of plant

- a. Select function switch 'OFF' position.
- b. Close normal mains Circuit Breaker.
- c. Select function switch 'Auto' position.

10.2.2 Testing sequence

- a. Check mains failure function:
 - i. Open normal mains Circuit Breaker.
 - ii. Check that after normal delay, motor cranks and starts, runs up to speed, then Emergency contractor closes and Emergency mains supply is available.
- b. Adjust alternator output voltage to equal, as near as possible, the measured Normal supply voltage.
- c. Check normal shutdown function:
 - i. Close normal mains Circuit Breaker.
 - ii. Check that after normal delay, Normal contactor closes, mains supply is available and after a delay the diesel motor stops.
- d. Check fail to start function:
 - i. Disconnect lead to engine fuel solenoid.
 - ii. Open normal mains Circuit Breaker.
 - iii. Check that engine tries to start 3 times, cranking for about 10 seconds each time, then 'Fail To Start' alarm is displayed.
 - iv. Restore fuel solenoid connection, reset alarm and initialise panel.
- e. Check emergency shutdown function.

For each of the following conditions, with the mains failure plant operating, apply the test condition, observe that the plant shuts down and that the correct alarm is displayed, then reset alarm and initialise the control panel:

- i. Bridge 'low fuel' contact on fuel tank.
- ii. Bridge 'engine temperature' contact.
- iii. Bridge 'engine oil pressure' contact.
- iv. Open generator output Circuit Breaker.

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- f. Check remote test function:
 - i. If the plant is fitted for remote test operation, check that operation and cancellation of the 'remote test' control starts and shuts down the plant as required.

10.3 Diesel Generator Test Certificate

Record the results of apparatus inspection and testing as nominated in *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages* with tailored Work Instructions, developed from ITF Checklist 13/7 and complete the Test Certificate (TC 7, 8 & 9) as applicable provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

11 Earthing for Surge Protection

11.1 Earthing Apparatus Inspection

- Check the workmanship and physical condition of the earth protection equipment and installation.
- Check operating environment suitable for safe, reliable operation.
- Verify conformance to Signalling Plans, Circuit Books and compliance to Specification *SPG 0712 Lightning and Surge Protection* and the Signalling Surge Protection Guidelines, inclusive of the following:
 - a. Check earth stakes are correct type and correctly installed around buildings.
 - b. Check earth cables are the correct type and rating and correctly labelled, securely terminated and with a minimum bending radius of 30 cm.
 - c. Check that all earth wiring is isolated from signalling/power cables inside equipment housings (relay rooms/locations).
 - d. Check that required physical separations are provided between protected and unprotected wiring.
 - e. Check that all earth busbars are remote from other signalling equipment and installed as close as possible to the point where the cables enter the equipment housing (relay rooms/locations). Each earth cable is to be attached separately to the busbar.
 - f. Ensure earths are not connected except as specified.
 - g. Check surge protection equipment type, rating and labelling.
 - h. Check redundant apparatus made securely inoperative and recovered.

11.2 Earthing Apparatus Circuit Testing

Bell Continuity Test, Wire Count, Null Count, Insulation Test. Additionally, for alterations refer to *PR S 47116 Inspection and Testing of Signalling: Interface Requirements and Procedures for Alterations* for requirements.

11.3 Earthing Apparatus Function Test

Check that all earths meet the requirements of Specification *SPG 0712 Lightning and Surge Protection* and the Signalling Surge Protection Guidelines.

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11.4 Earth for Surge Protection Test Certificates

Record the results of apparatus inspection and testing as nominated in *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages* and *SPG 0712 Lightning and Surge Protection*, with tailored Work Instructions developed from ITF Checklist 13/7 and complete the Test Certificate (TC 4) as applicable provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

12 Relays

12.1 Relays Apparatus Inspection

- Check the workmanship and physical condition of relays and installation.
- Check operation environment suitable for safe, reliable operation.
- Verify conformance of relays to Circuit Book details and analysis sheets, inclusive of the following:

| | |
|--|---|
| Relays and bases: | Correctly positioned and labelled on the rack |
| Relays: | Correct type, contact configuration, operating voltage and coil resistance |
| Relay labels: | Secure, details completed, signed by manufacturers' tester. Overhauled shelf relays also labelled as cycled tested |
| Relay bases: | Correctly drilled for indexing pins. Relay indexing pins correct for relay type and in correspondence with manufacturer's label |
| Detachable tops for shelf relays: | Correct type and correctly coded |
| Relay base: | Correct strapping for time limit relays |
| Relay case: | Undamaged and relay internally free of foreign matter |
| Vane relays: | Examine in accordance with maintenance manuals |
| All wiring: | Properly terminated and secure |

12.2 Relays Circuit Testing

Bell Continuity Test, Wire Count, Null Count, Insulation Test and Circuit Function Test all circuits with wires connecting to the relay. This includes a check of the relay base strapping for time limit or time delay relays. Strap and Function Test contacts in shelf relays.

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12.3 Relays Apparatus Function Test

- a. Test plug-in relays in an approved relay test panel/device and fix a signed and dated sticker as nominated to document the contact proving test or apply correct power to shelf relays.
- b. Examine operating movement for correct energisation and de-energisation.
- c. Check contacts electrically open and close in accordance with nameplate contact configuration when the relay is energised and de-energised.
- d. Test and record pick up, drop away and working currents on Signal Branch DC shelf relays.
- e. Also check time limit relays and time delay relays for correct timing in the relay test panel/device.

12.4 Relays System Function Test

Further test time releasing achieved in circuit only with the conditions for correct operation set up.

12.5 Relays Test Certificates

Record the results of apparatus inspection and testing as nominated in *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages* with tailored Work Instructions, developed including ITF Checklist 13/10 if applicable provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

13 Wires, Cables and Terminals

13.1 Wires, Cables and Terminals Apparatus Inspection

- a. Check workmanship and physical condition of wires, cables and terminal equipment and installation.
- b. Check operating environment suitable for safe, reliable operation.
- c. Verify conformance of wires, cables and terminations, with details in the circuit books and verify compliance with equipment specifications including the following:
- d. Check manufacturer's test certificates and acceptance test certificates for manufactured equipment where applicable.
- e. Check wires and cables for correct conductor size, insulation type and labelling.
- f. Check terminals for correct type, rating and labelling.
- g. Check that terminals are insulated with appropriate covers.
- h. Check that wires and cables are neatly run, with insulation undamaged and correctly protected.
- i. Check that wires are not trapped under adjacent terminals.
- j. Check that wires and cables are held clear or doubly insulated from metallic surfaces and that all protective grommets in entry holes are fitted correctly.
- k. Check that wiring runways and cable routes are installed to specification and wires and cables are not under tension, have no tight radius bends, are not bearing heavily on sharp corners and are not chaffing.
- l. Check that wire terminating lugs and pins are the correct type.

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- m. Check that all crimped and soldered connections are mechanically sound and that there are no exposed strands of wire.
- n. Check that terminations are mechanically sound nuts and screws are tight and that, spade type crimps are correctly locked into plug boards or terminal blocks.
- o. Check that there are no loose, unterminated cables, or wires with exposed conductors.
- p. Check that cables are correctly supported with cable clamps.
- q. Check that wiring is tied neatly into looms, where applicable.
- r. Check that buried cable routes emerge within one metre of the trackside equipment.
- s. Check that redundant wires, cables and terminals are made securely inoperative and recovered.
- t. Check the availability of spare cores and wires, as specified.

13.2 Wires, Cable and Terminals Circuit Test

Bell Continuity Test, Wire Count, Null Count, Insulation Test all signalling wires, cables and terminals.

13.3 Wire, Cable and Terminals Test Certificates

Record the results of apparatus inspection and testing as nominated in *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages* with tailored Work Instructions, developed from ITF Checklist 13/11 and complete the Test Certificate (TC 2A, 2B, 2C) as applicable provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

14 Half Pilot Staff, Pilotmans Locks, Duplex Locks, Emergency Releasing Locks, Staff Contact Boxes

14.1 Apparatus Inspection

- Check workmanship and physical condition of equipment and installation.
- Check operating environment suitable for safe, reliable operation.
- Verify conformance with the Signalling Plan, Circuit Book, Working Sketch, Locking Table, Locking Diagram including the following:

| | |
|--|------------------------------------|
| Equipment: | Correct type and labelling |
| Keys, staffs and lock faces etc.: | Correctly warded and inscribed |
| Redundant apparatus: | Securely inoperative and recovered |

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14.2 Circuit Test

Bell Continuity Test, Wire Count, Null Count, Insulation Test and Circuit Function test all circuits connecting to the apparatus. Strap and Function Test contacts in the external equipment. Additionally, for alterations refer to *PR S 47116 Inspection and Testing of Signalling: Interface Requirements and Procedures for Alterations*.

14.3 Apparatus Function Test

Check adjustment of contacts to electrically open and close correctly in relation to the position of the key or staff.

Check that keys and staff when operating locks and lock contacts are captive in the lock.

14.4 System Function Test

Check that keys and staffs when withdrawn correctly lock respective function.

14.5 Test Certificate

Record the results of apparatus inspection and testing as nominated in *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages* with tailored Work Instructions, developed from ITF Checklists and complete the Test Certificates (TC) as generally shown in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

15 Warning Lights, Guards Indicators, Buffer Stop Lights and Illuminated Notice Boards, Banner Signals and Point Indicators

15.1 Apparatus Inspection

- Check workmanship and physical condition of equipment and installation.
- Check operating environment suitable for safe, reliable operation.
- Verify conformance with Signalling Plan and Circuit Book including the following:
 - check standard clearances and secure mounting.

| | |
|-----------------------------|-------------------------------------|
| Equipment type: | Rating and labelling |
| Lamp: | Type, rating and labelling |
| Lamp: | Voltage |
| Lamp focus: | Colour, visibility and illumination |
| Redundant apparatus: | Securely inoperative and recovered |

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15.2 Circuit Test

Bell Continuity Test, Wire Count, Null Count, Insulation Test and Circuit Function Test all circuits connecting to the apparatus. Additionally, for alterations refer to *PR S 47116 Inspection and Testing of Signalling: Interface Requirements and Procedures for Alterations* for requirements.

15.3 Apparatus Function Test

Check operation.

15.4 Test Certificates

Record the results of apparatus inspection and testing as nominated in *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages* with tailored Work Instructions, developed from ITF Checklist 13/1 (a or b) and complete the Test Certificate (TC 1a, 1b or 1c) as applicable provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

16 Telephones

16.1 Telephones Apparatus Inspection

- a. Check workmanship and condition of telephone equipment and installation.
- b. Check operating environment suitable for reliable operation.
- c. Check vandal resistant installation.
- d. Check telephone type and labelling.
- e. Check padlock where provided.
- f. Check operational notices fitted, where applicable.

16.2 Telephones Apparatus Function Test

Check telephone operational over its circuit.

16.3 Telephones Test Certificates

Record the results of Telephone Testing on appropriate Test Certificates with tailored Work Instructions developed in the style of ITF Checklists and Test Certificates (TC) as applicable provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

17 Telemetry and Panel Processor Testing

17.1 General

Testing of Telemetry and Panel Processor systems shall be in accordance with Specification *SPG 1240 Signalling Electronic Systems Verification*. The testing shall include the tests identified in the following sub-sections.

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17.2 Physical Configuration Audit

- a. Check drawings against as-built system.
- b. Check for correct versions of hardware and software.
- c. Check that all hardware (including spares), software, firmware and documentation has been installed and/or delivered to the appropriate person.
- d. Check that the physical aspects comply with Specification *SPG 1240 Signalling Electronic Systems Verification*.

17.3 Start-up/Shut-down tests

- a. Check that the system starts up correctly, reliably, without errors and without manual intervention and in the time specified in Specification *SPG 1240 Signalling Electronic Systems Verification*.
- b. Check that the system can be shut-down without harm.
- c. With the system powered down check that there is an indication that the system is not operational and that all indications and controls are off.

17.4 Disruption Tests

Disrupt power, disrupt communications lines, reset modules, cause a normal/emergency power change-over etc., to determine if the system is likely to require maintenance intervention to restore the system to normal operation. Maintenance intervention should not be required due to events that could be reasonably expected to occur during normal operation.

Check that the system indicates a warning or failure as appropriate during each disruption.

17.5 Arbitration Tests

For dual systems check manual and automatic change-over for correct operation. Check that there is a seamless change-over.

For dual systems check that the standby system does not store indications or controls that are no longer current.

17.6 Correspondence Tests

- a. For dual systems correspondence tests shall be conducted on both sides unless a well-documented justification can be supplied as to why it is not necessary.
- b. Perform a 100% correspondence of all inputs and outputs. Where processing of Inputs/Outputs is performed by the system then the functionality of the processing shall be tested.

17.7 Maintenance Facilities

Check each of the maintenance facilities provided for correct operation.

17.8 Fault Finding Procedure Test

Assume or simulate a failure of the system. Then use the fault finding procedure to find and correct the failure.

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17.9 General System Requirements

- a. Measure each of the performance parameter (indication, control, control and indication, start up, recovery) response times and confirm that they are in accordance with *Specification SPG 1240 Signalling Electronic Systems Verification* and any particular specification.
- b. Check the self-test and failed module isolation facilities.
- c. Check that the system operates for a 24 hour period without any systems errors and a maximum of 2 data communications errors.

17.10 Test Certificates

Record the results of apparatus inspection and testing as nominated in *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages* with tailored Work Instructions, developed from ITF Checklist 13/15 and on the appropriate test documentation similar to the Test Certificates (TC) as applicable provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

18 Control Console and Indicator Diagram

18.1 Control Console/Indicator Diagram Apparatus Inspection

- a. Check workmanship and physical condition of panel, wiring, fittings and finish.
- b. Check face-plate layout, inscriptions, colours, fittings correct to design.
- c. Check positioning of console/diagram is geographically and ergonomically correct.
- d. Check doors, hinged sections, drawers are free moving and properly secured.
- e. Check internal equipment and wiring secured.
- f. Check type, size, colour, rating and labelling of all fittings, equipment and wiring correct to specification.
- g. Check Manufacturers Test Certificates and Acceptance Test Certificates for manufactured equipment, where applicable.

18.2 Control Console/Indicator Diagram Circuit Testing

Bell Continuity Test, Wire Count, Insulation Test and Circuit Function Test all wiring, electrical switches, indicators and alarms within the console/diagram. Additionally, for alterations refer to *PR S 47116 Inspection and Testing of Signalling: Interface Requirements and Procedures for Alterations* for requirements.

18.3 Control Console/Indicator Diagram Apparatus Function Test

- a. Check all lamps, LED's, LCD's, CRT's and alarms operate correctly when energised at the correct voltage and polarity, including flashing supplies.
- b. Check all push-buttons, keys, etc. electrically open and close correctly when operated.
- c. Check cooling system operates effectively, where provided.

18.4 Control Console/Indicator Diagram System Function Test

Test all controls, indications and alarms operate correctly in correspondence with the signalling apparatus.

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18.5 Test Certificates

Record the results of apparatus inspection and testing as nominated in *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages* with tailored Work Instructions, developed from ITF Checklist 13/16 and on the appropriate test documentation similar to the Test Certificates (TC) as applicable provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

19 Control Systems Equipment

19.1 General

The requirements for the inspection and testing of control systems equipment, software and build requirements shall be developed, documented and agreed at the Inspection and Testing Planning phase of the Works.

Testing of Control systems shall be in accordance with Sydney Trains suite of control systems documentation, namely:

- *ATRIC001006 System Test Plan*
- *ATRIC001007 Build and Release Process*
- *ATRIC001917 ATRICS Computer Configuration procedure*
- *ATRIC003607 Windows 7 Professional Build procedure.*

19.2 Testing of Modified Installations

- Hardware modifications (or replacements)** - When Hardware modifications (or replacements) are made the system shall be inspected and tested to confirm that it is correctly configured and the correct version of any application data is installed.
- The system shall then be retested in accordance with Sydney Trains control system requirements.
- System Software modifications** - When System Software modifications are made the system shall be retested in accordance with Sydney Trains control system requirements.
- Application data modifications** - When Application data modifications are made the changes to the applications shall be identified and documented. The impact of the changes on those parts of the system that will not change (with special attention paid to any interfaces) shall be analysed and documented.

19.3 Test Certificates

The changes and any impacted aspects of the system shall be fully tested.

The system shall be tested in accordance with Sydney Trains control systems installation and testing documentation.

Record the results of apparatus inspection and testing as nominated in *PR S 47117 Inspection and Testing of Signalling: Standard Forms* with tailored Work Instructions developed for the varying control systems used on the Sydney Trains network.

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19.4 Certifying Control Systems equipment

Where the inspection and test plan identifies that the Formal qualification testing (FQT) and Factory acceptance testing (FAT) and where required SAT (Site acceptance testing) test results provides insufficient evidence to mitigate all the risks, or needs actual operation to prove the control systems performs to functional and business requirements, then the function is to remain booked out of use until the function is tested and certified for use. Where the test plan has identified that the FAT, FQT or SAT test provides confidence that when the system is made operational, train operations will not be affected and reliability will be maintained, then a system check in accordance with the relevant test case, is sufficient for certification.

20 Location Cases and Relay Rooms

The apparatus within disconnection boxes, location cases, walk-in huts and relay rooms is inspected and tested as shown on other sheets for those individual items of equipment and circuits.

20.1 Location Case/Relay Room General Apparatus Inspection

- a. Check workmanship and physical condition of the structure and installation, including the foundation.
- b. Check operating environment for safe, reliable operation of housed equipment.
- c. Verify conformance to Specification and to Signalling Plan and Circuit Book.
- d. Check identification plates on locations correspond with the Signalling Plan and Circuit Diagrams and other relevant drawings.
- e. Check positioning, alignment in accordance with Signalling Plan, Detailed Site Surveys and clear of the alignment of catchpoints, derails and non-interlocked points.
- f. Check retaining wall, if required.
- g. Check handrails, ladder cages, if required.
- h. Check rubbish or combustible material cannot accumulate at the location.
- i. Check clear of watercourses, drains, roadways. Check access is clear.
- j. Check protective rails or posts provided, where required.
- k. Check protected against corrosion as specified.
- l. Check structure clearance including when doors are open.
- m. Check doors move freely and door stops and fasteners work correctly.
- n. Check that location is water proof, dust proof, fire proof and vandal resistant.
- o. Check cable entry and exit to specification and check cables properly clamped.
- p. Check insect/rodent screening effectively installed.
- q. Check ventilation is adequate.
- r. Check heat sensitive equipment is not mounted above heat producing equipment.
- s. Check rack mounting secure and equipment securely mounted.
- t. Check equipment layout agrees with profile drawing.
- u. Check all rack positions and equipment correctly labelled.
- v. Check that all terminals and wiring is insulated, properly shrouded and labelled.
- w. Check documents to remain in the location are available and in good order.

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- x. Check the fire rating is as specified and that the fire detection and fire-fighting equipment installed as specified.
- y. Check that there are no sharp edges or protrusions that could cause injury.
- z. Check that correct locks are properly fitted.
- aa. Check in-built test equipment.
- bb. Check that all equipment is installed.
- cc. Check equipment accessibility for maintenance.
- dd. Check spare space to accommodate additional equipment.
- ee. Check lighting effectiveness.
- ff. Check clear of train driver's line of sight to signals and, at level crossings, clear of road vehicle driver's line of sight of approaching trains.

20.2 Circuit Testing

Bell Continuity Test, Wire Count, Null Count, Insulation Test. Additionally, for alterations refer to *PR S 47116 Inspection and Testing of Signalling: Interface Requirements and Procedures for Alterations* for requirements.

20.3 Test Certificates

Record the results of apparatus inspection and testing as nominated in *PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages* with tailored Work Instructions, developed from ITF Checklist 13/17 and on the appropriate test documentation similar to the Test Certificates (TC7, 9) as applicable provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

21 Computer Based Systems

21.1 General

The requirements for the inspection and testing of computer-based systems, interfaces and associated telecommunications systems shall be developed, documented and agreed at the Inspection and Testing Planning phase of the Works.

Testing of Computer Based Systems has two separate aspects. Firstly, the Signalling functionality and secondly the technical aspects of the system. This section is intended to cover the second aspect. Testing of the Signalling functionality is covered elsewhere in this specification.

The technical aspects of Computer Based Systems shall be tested in accordance with the relevant parts of Sydney Trains Specification *SPG 1240 Signalling Electronic Systems Verification*. The testing shall include the testing identified in the following sub-sections.

Manufacturers of Computer Based Systems will already have their own inspection and test plan and testing procedures, which shall be accepted by the Professional Head Signalling and Control Systems as providing the same level of testing, as required by this specification.

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21.2 Aspects To Be Tested

The testing of Computer based 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 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 hardware module has been tested.
- i. Vital communications link error rates.
- j. Event logger operation and functionality.
- k. Non-standard interfaces.
- l. Electromagnetic compatibility and immunity.
- m. Surge protection.
- n. Vital Blocking.
- o. Reliability.
- p. Maintainability.
- q. Correspondence testing.
- r. Through testing.
- s. Response time and performance criteria have been met.

21.3 Testing of Modified Installations

- a. **Hardware modifications (or replacements)** - When Hardware modifications (or replacements) are made the system shall be inspected and tested to confirm that it is correctly configured and the correct version of the application data is installed.
- b. The system shall then be retested in accordance with the manufacturer's written recommendation as approved.
- c. **System Software modifications** - When System Software modifications are made the system shall be retested in accordance with the manufacturer's written recommendation as approved.
- d. **Application data modifications** - When Application data modifications are made the changes to the applications shall be identified and documented. The impact of the changes on those parts of the system that will not change (with special attention paid to any interfaces) shall be analysed and documented.

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21.4 Test Certificates

The changes and any impacted aspects of the system shall be fully tested.

The system shall be then tested in accordance with the manufacturers written recommendations, as approved.

Record the results of apparatus inspection and testing adapted from the manufacturers requirements or as nominated in Specification *SPG 0719 Computer Based Interlocking, PR S 47112 Inspection and Testing of Signalling: Plans, Programs, Documentation and Packages* with tailored Work Instructions, developed in the style of ITF Checklist 13/18 and on the appropriate test documentation similar to the Test Certificates (TC) as applicable provided in *PR S 47117 Inspection and Testing of Signalling: Standard Forms*.

22 Signalling Design Checking

22.1 General Requirements to be checked

- a. Signals positioned to protect risks and clearly visible to train drivers.
- b. Adequate braking distances for longest braking trains from warning signal indications to stop signals and to restricted speed turnout points.
- c. Signal indications stepping in appropriate sequence approaching stop signals and turnout signals.
- d. Appropriate overlap distances beyond stop signals to clearance points.
- e. Adequate level crossing warning distances for fastest train.
- f. Track circuit lengths greater than longest wheelbase and track circuit 'dead zones' shorter than the shortest wheelbase.
- g. Point and plunger detection of facing points and trap points in signal controls.
- h. Indication locking.
- i. Track control extending to clearance points, including insulated joints clear of points and crossovers.
- j. Track locking (approach locking and route holding) (overlap maintenance).
- k. Interlocking between conflicting signals, points and level crossings.
- l. Correctly determined time limits (on stop signals and/or track circuits) for releasing track locking, conditionally clearing trainstops, conditionally reducing overlaps.
- m. Correct release arrangements, (not activated by power supply interruptions, bobbing track circuits, intermittent defects, failed track repeat relays).
- n. Correct positioning of release equipment (e.g. release switches, EOL's, ESML's, duplex locks), where reliance is placed on a physical delay time between obtaining the release and operating points equipment.
- o. All interlocked signals replaced and held at stop by points emergency operating facilities.
- p. Fail safe, high reliability design of vital equipment and circuits, with appropriate back proving.
- q. Correct separation between vital and non-vital equipment and circuits.
- r. Reliable power supplies to colour light signals and to level crossing highway signals.
- s. Correct track circuit and traction bonding design including polarity reversal.

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- t. Trainstops as required.
- u. Wiring to Standard Circuit Designs.
- v. Correct discrimination of fuse sizes, circuit breaker ratings.
- w. Operational Requirements satisfied.
- x. Integrity, reliability and maintainability aspects at all interfaces e.g. impulse tracks on poor ballast, new type less tolerant point machines on old points layouts, computer based interlocking interfaces to relay Interlockings (timing aspects), power supply changeovers.
- y. Traffic patterns, to ensure track circuits in all signal routes will be traversed frequently to keep the rail surfaces clean.
- z. Circuit design to ensure no relay race, lock out, back-emf problems and no circuit paths through other functions in series if open circuits occur in normal return paths.
- aa. Adequate protection and/or immunity from electromagnetic or electrostatic interference, lightning and power surges, earth leakage, overheating, external power supply polarity/phasing changes.

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