AUSTRALIAN RAIL TRACK CORPORATION LTD

Discipline: Engineering (Signalling) **Category: Standard**

WB&S FS2500 AF Jointless Track Circuits – Set-Up, Test and Certification

SES 07

Applicability

New South Wales	✓	**CRIA (NSW CRN)**	✓

Primary Source

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Document Status

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Amendment Record

Version	Date Reviewed	Clause	Description of Amendment
1.1	1 September 2004		Reformatting to ARTC standard.
1.2	14 March 2005	Disclaimer	Minor editorial change. Footer reformatted.
1.3	18 June 2010	Various	Transferred WB&S FS2500 Track Circuit History Card to ESI-07-03 and updated references. Transferred document to new template and edited for grammar and style.

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About This Standard

This document describes the activities required for commissioning and certifying WB&S type FS2500 audio frequency jointless track circuits, in a typical ARTC installation.

Commissioning a new track circuit consists of removing any old equipment, connecting the new equipment and any new bonding, powering up the new equipment, then carrying out the final adjustments and certification checks.

1 Set to Work

This section covers the removal of any old track circuit equipment and the connection and powering up of the new equipment.

1.1 Bonding and Track Connections

Where an existing signalling system is being renewed, ensure that all old, redundant track circuit connections, including old feed and relay connections, impedance bonds and spark gap connections, are removed.

Bond out all redundant insulated joints, remove any temporary bonds around new insulated joints, then connect any new parallel and series bonds.

Make all new rail connections and close up all location terminal links.

Walk the length of the track circuit, checking the track against the new track insulation plans. Check that all bonding and connections are complete, that spark gap connections are to the correct rails, that no extra rail connections are left and that there are no spark gap or auxiliary equipment connections within the tuned loops.

1.2 Check Auxiliary Track Equipment

Check that any auxiliary track circuit equipment, such as traction tie-in bonds and electrolysis bonds, has been reconnected.

1.3 Equipment Check

Check that all tuning units, transmitters and receivers are of the correct frequency and type, and that the tuning unit connections are correct for transmitter or receiver, as appropriate.

Check that all lightning protection and earthing at locations and tuning units is installed and correctly terminated.

Where the track circuit terminates on an impedance bond, check that cables from the end tuning unit are correctly terminated.

Check that the transmitter output tapping is correctly set for the track length in accordance with the following table.

Track Length (metres)	Output (%)
50-250	20
250-450	40
450-600	60
600-750	80
750-900	100

Check that the receiver sensitivity straps are set for an initial value of 1.00.

If the track includes an intermediate receiver (DPU), check that the IRx amplifier gain straps are set to High (bridge D1/D2).

Check that all rail connections and location terminal connections are made and properly tightened.

Check that any resonated impedance bonds are preset to the required initial value, listed in Appendix 1: Technical Notes, Note 1.

1.4 Power Up

Insert fuses and links to power up the transmitter and receiver. Observe that transmitter B24 and the O/P lights are illuminated, that the receiver lights are correctly illuminated (B24, 'Input Valid' and 'Output' on steady, 'Processor Running' flashing) and that the relay energises.

If the receiver 'Input valid' and 'output' lights fail to illuminate, check the receiver monitor voltage. If this is below 1 volt, increase the transmitter output tapping.

Measure the transmitter and receiver B24 supply voltages. Set the power supply output to between 24 and 28 volts DC.

1.5 Check Rail Connections

Using a suitable digital meter, measure the millivolts drop on each track connection between the cable core (or the crimp lug, if the core is not accessible) and the rail head. Each connection should read 1 millivolt or less. If any connection is over 5 millivolts it should be retightened. If this is not successful, the connection should be removed, cleaned and reconnected to achieve the low millivolt drop.

1.6 Shunt and Correspondence Check

Using a fixed 0.15 ohm shunt applied outside the tuned loop at the relay end of the track, shunt the track and observe that the relay de-energises.

Where the track circuit is indicated on a signal box diagram, observe the correspondence of the diagram indication to the track circuit as part of this shunt check.

2 Final Adjustment

Final adjustment covers the adjustment of impedance bonds and the setting of receiver gain to achieve the specified drop shunt value.

2.1 Equipment

A frequency selective voltmeter (ML, VS19 or frequency selective adapter use with digital multimeter) is necessary for all track and receiver voltage measurements.

2.2 Resonated Impedance Bonds

Identify any resonated impedance bond installed on the track circuit.

With Jeumont Schneider bonds, set the resonating capacitor connections as shown in the CSEE manual.

On WB&S and Macolo resonated bonds, set the resonating capacitor initially to the values shown in Appendix 1: Technical Notes, Note 1. If necessary, adjust the resonating capacitance to achieve a maximum voltage across the capacitor, but not exceeding 400 volts. Capacitor voltage can range from 35 volts up to over 400 volts, depending on track length and the position of the bond.

On tracks less than 400 metres in length, it is normally satisfactory and preferable to leave the bond unresonated, with the capacitor terminals left open.

2.3 Initial Receiver Adjustment

Check that the receiver input level voltage measured at the monitor terminals is between 1.15 and 1.20 volts.

If necessary, adjust the receiver sensitivity to give this value.

2.4 Drop Shunt Measurement and Receiver Adjustment

Measure and record the drop shunt of the track using a variable shunt unit at the relay end of the track, connected outside the tuned loop at the receiver end rail connections.

The drop shunt should be as close as possible to 1 w. Adjust the receiver gain to obtain a final drop shunt value between 0.8 and 1.2. Leave the gain set at the value which results in a drop shunt nearest to 1. Record the final gain and drop shunt values.

2.5 Intermediate Receiver (DPU)

Each intermediate receiver should be treated as a separate track circuit, sharing a common transmitter end with its parent track. A separate history card should be completed for each intermediate receiver.

Final adjustment of the intermediate receiver should be carried out after the parent track is finally adjusted. The procedure for this is described in Appendix 1: Technical Notes.

Note: If it is necessary to adjust the transmitter level to obtain correct adjustment of the intermediate receiver, then it will be necessary also to readjust the parent track receiver.

3 Certification

Certification covers the proving of correct operation of the track circuit and the completion of all documentation activities.

3.1 Zero Feed Receiver Voltage

With all adjacent tracks operating, disconnect the feed from the track under test and with the selective voltmeter, measure the voltage on the receiver input terminals (R1/R2).

If the remaining voltage exceeds 250 mV (i.e. 30 per cent of the receiver release value), this must be reported as a track circuit fault and the cause of the excessive voltage located and rectified.

3.2 Test Shunt

Test shunt the track using the 0.15 ohm fixed shunt. Sets of three shunts should be made at the following points, at least:

- three metres inside the Tx tuned loop two metres outside the Tx tuned loop
- mid-track
- at both ends of any parallel bonded section of track (where points are involved)
- two metres outside the Rx tuned loop three metres inside the Rx tuned loop.

3.3 History Cards

When all track work is finished, complete individual history cards for all tracks tested by the team. The responsible member of the team shall sign the cards.

4 Appendix 1: Technical Notes

Note 1: Resonated Impedance Bonds – Initial Capacitor Settings (WB&S 2000R/AF)

This table gives initial values to which a WB&S 2000R/AF resonated impedance bond should be preset to ensure operation of the track circuit when initially powered up. The final resonation of the bond should be done as part of the final adjustment of the track circuit.

Track Frequency	Capacitor (nF)
1700	26.8
2000	22.5
2300	20.0
2600	17.8

Note 2: Intermediate Receiver (IRx) Adjustment Sequence

The final adjustment of the intermediate receiver should be carried out after the parent track is finally adjusted.

IRx Amplifier Adjustment

Check that the receiver input current from the intermediate receiver selective amplifier is between 28 mA and 60 mA. If necessary, adjust the amplifier to Low gain by removing the bridge on terminals D1/D2. If the resulting input current is still too high, reduce the transmitter output power

Note: If it is necessary to adjust the transmitter level to obtain correct adjustment of the intermediate receiver, then it will be necessary also to readjust the parent track receiver.

IRx Drop Shunt and Final Adjustment

Measure the IRx drop shunt at a point one metre on the transmitter side of the IRx pickup units. Adjust the IRx receiver gain (and amplifier attenuator, if necessary) to obtain a drop shunt between 0.8 and 1.

Note 3: Track Connection Resistance

It is critical that the rail terminations of track connection cables are as low resistance as possible, in view of the high DC and AC currents flowing through them, and especially in view of the need to keep traction return currents balanced. As a guide, the voltages to be expected on good new connections should be less than 2 mV.

Measure the AC voltage drop at each connection between the connecting cable conductors and the head of the rail near the termination. If the cable cores are not accessible, measure from a point on the connection lug, as close as possible to the insulation.

Note: Where duplicated sideleads are fitted, a low millivolt reading will be measured on both, so long as at least one is making good contact.

Any reading over 5 mV should be taken to indicate a suspect connection. Check the tightness of the securing nuts and, if this does not work, dismantle the connection, then clean all mating surfaces with abrasive or solvent as required, reassemble and tighten carefully.

5 Appendix 2: Track Circuit History Card

The ESI0703F-03 WB&S FS2500 Track Circuit History Card is available on the ARTC Engineering Extranet.

6 Appendix 3: Adjustment of Intermediate Receiver (DPU)