FRONZ / ONTRACK
APPROVED CODE OF PRACTICE
FOR
HERITAGE NETWORK OPERATORS

Mechanical Code
B3.5.1.01

RECOMMENDED ELECTRICAL CODE OF PRACTICE

Issue	Prepared (P), Reviewed (R), Amended (A)	Approved by	Effective Date
1	P McCallum (P)	Heritage Technical Committee	12/12/2006

Reference Material

Source	Description	Date
NRSS 6	National Rail System Standard	
	New Zealand Electricity Act 1992	
	NZ Electrical Regulations 1997	
	NZ Electrical Codes of Practice (NZECP)	
Taieri Gorge Railway	Standard Electrical Code of Practice	14/4/2003

Amendment History

Version	Section	Amendment
1	4.4	Amended workshop equipment testing requirements.

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1.0 Introduction

This code describes recommended practices for the:-

- Installation, maintenance and inspection of electrical equipment on rail vehicles operated by Heritage Network Operators.
- Inspection of electrical plant used by Mechanical and Infrastructure staff.

It is based on NRSS 6 – Section 17, the New Zealand Electricity Act 1992, Electrical Regulations 1997 and Electrical Codes of Practice (NZECP) and incorporates these codes as necessary.

Some existing installations, which were installed in accordance with practises in effect at the time of installation, may no longer comply with amended Codes of Practises. In such cases modification to meet the new requirements is not necessary unless there are safety issues involved.

2.0 Description of Rolling Stock Electrical Systems

Rail vehicle electrical systems may consist of one or more of:-

- Low voltage (230 / 440 volt ac) single or three phase power supplied by an on train generator. Distribution between vehicles may be by flexible jumper cables.
- Extra-low voltage power supplied by axle driven generators and storage batteries. Each vehicle may have a stand-alone system or power may be distributed between vehicles by flexible jumper cables.
- Extra-low voltage power supplied by turbo--generators with optional storage batteries. (Steam locomotives.)
- Extra-low voltage power supplied by low-voltage fed power supply / battery charger / storage batteries.
- Extra-low voltage control and communication systems, which may be distributed between vehicles by flexible jumper cables.
- Diesel-electric locomotives using a self-contained diesel engine and dc generator or ac/dc alternator (typically 600 volts). Power is not provided to other vehicles other than control voltages (up to 110 volt dc) via removable jumper cables.
- Electric locomotives taking power from overhead traction wires. Power is not provided to other vehicles other than control voltages (up to 110 volt dc) via removable jumper cables.
- “Shore supply” where a rail vehicle is supplied from a fixed power installation.

3.0 Installations and Repairs in Rolling Stock

3.1 Low-voltage Generators

Generators shall be installed and maintained in accordance with NRSS 6 – Section 17 and NZECP 04 (Electrical installations - supply by generating systems not exceeding low voltage).

Additions & Exceptions

- Control systems should incorporate protection for train equipment from under or over voltage and frequency.
- The generator compartment shall be secured from entry by other than train staff.
- Generator enclosures shall be fitted with an automatic fire protection system or fire extinguishers shall be provided in, or adjacent to, generator compartments.

- Emergency stops should be fitted where safely accessible by staff in event of fire etc.

3.2 Low-voltage Installations in Rolling Stock

Installation shall be installed and maintained in accordance with NRSS 6 – Section 17 and the relevant Codes of Practise; in particular:-

- NZECP 07 (Extra-low voltage installations)
- NZECP 14 (Control protection and switchboards)
- NZECP 25 (Earthing and equipotential bonding of low voltage electrical installations)
- NZECP 28 (Selection and installation of cables)

Additions & Exceptions

- All external cables shall be protected from mechanical damage, preferably by installation in conduit.
- All cables shall be installed so as to prevent mechanical damage from vehicle movement (chafing etc).
- Each vehicle shall be fitted with a distribution switchboard.
- Switchboards shall be installed so as to be accessible as practical but are exempt from requirements of section 3.3 of NZECP 14 (Accessibility of switchboards) if they cannot be met.
- Over current protection shall be provided.
- Switchboards may incorporate a phase switch to allow balancing of single phase loads.
- Vehicle frames shall be bonded to the earth point on switchboards.
- Electrical connection which may occur between frames of vehicles through the drawgear and from vehicle frames to earth via the wheels must not be regarded as accepted bonding to meet the requirements of NZECP 25 (Earthing and equipotential bonding of low voltage electrical installations).

3.3 Extra Low-voltage Installations in Rolling Stock

Installation shall be installed and maintained in accordance with NRSS 6 – Section 17 and the relevant Codes of Practise; in particular:-

- NZECP 07 (Extra-low voltage installations)
- NZECP 28 (Selection and installation of cables)

Additions & Exceptions

- All external cables shall be protected from mechanical damage, preferably by installation in conduit.
- All cables shall be installed so as to prevent mechanical damage from vehicle movement (chafing etc).
- Batteries used for extra-low voltage circuits shall a sealed type or must be vented external to the vehicle and accessible for maintenance checks.
- Extra-low voltage circuits supplied from batteries shall be fitted with overload protection.

3.4 Diesel-electric and Electric Locomotives

Electrical installation and repair work on locomotives is to be undertaken in accordance with accepted railway practises. Work is only to be done or supervised by competent persons with appropriate electrical awareness training.

3.5 Shore Supply

Installation shall be installed in accordance with NRSS 6 – Section 17. Operators shall have systems in place to prevent simultaneous connection of shore supply and on board generators. (See NZECP 04 - Electrical installations - supply by generating systems not exceeding low voltage).

4.0 Inspections

4.1 Low-voltage Installations in Rolling Stock

All new work in passenger and service vehicles shall be tested before use and existing installations shall be tested annually. Testing shall be done by an approved electrical inspector in accordance with the relevant sections of:-

- NZECP 11 (Inspection and testing of low voltage installations for certification purposes), sections 3, 4 & 5.
- NZECP 1 (Electrical installations, caravans and caravan parks); section 5.
- NZECP 4 (Electrical installations - supply by generating systems)

Inspections shall include any between vehicle flexible jumper cables.

A Certificate of Compliance shall only be issued in respect of an installation or part of an installation which has been inspected and tested in accordance with this Code and has been shown to be compliant with the requirements. Certificates shall be valid for a maximum of 14 months of date of issue.

4.2 Extra-low Voltage Installations

An annual inspection should be made of the condition and security of all wiring, fittings and protection devices.

4.3 Diesel-electric and Electric Locomotives

Testing of locomotive electrical installations shall be done in accordance with the locomotive maintenance schedules.

4.4 Electrical Equipment

Track and workshops power cords, portable electrical appliances and electrically powered equipment shall be tested in accordance with industry standards. Testing shall be done by an approved electrical inspector.

5.0 Operating Instructions

Operating staff shall be provided with clear instructions on:-

- Operating and emergency procedures for generators (these should be clearly displayed adjacent to the generator).
- Procedures for correct coupling and uncoupling of inter-vehicle jumper cables.
- Procedures for correct connection of shore supplies.

Appendix 1 Sample Inspection Forms

Rail Vehicle Electrical Test Sheet
Rail Vehicle Electrical Jumper Cables Test Sheet
Electrical Power Cord Test Form
Electrical Appliance Test Form
Electrical Warrant of Fitness

Rail Vehicle Electrical Warrant - Test Sheet

Test Date: / / Vehicle (Chassis) No: _____ Generator No: _____ (If fitted)

Switchboards & Cabling

Cabling

	Pass	Fail
All cables secured		
Mechanical protection OK		
No damage, deterioration, etc		

Switchboard Visual Checks

	Pass	Fail
Correct labels on controls		
All connections secure		
General - No exposed live parts, basic insulation damage, etc		

Insulation

With 500 volt insulation tester. Minimum value = 1 MΩ

	Main Sw/bd	Sub Sw/bd	Pass	Fail
N - E	MΩ	MΩ		
R (P) - E	MΩ	MΩ		
R (P) - N	MΩ	MΩ		
Y – E	MΩ	MΩ		
Y - N	MΩ	MΩ		
B - E	MΩ	MΩ		
B - N	MΩ	MΩ		
R - Y	MΩ	MΩ		
R - B	MΩ	MΩ		
Y - B	MΩ	MΩ		
	MΩ	MΩ		
Other Circuits	MΩ	MΩ		
	MΩ	MΩ		
	MΩ	MΩ		
	MΩ	MΩ		
	MΩ	MΩ		

Earthing

Continuity

Measure from main switchboard or sub board as appropriate. Max value = 1 Ω

	Pass	Fail
Main to Sub switchboards		
Vehicle Chassis		
All exposed metalwork		
Water pipes (if W/H installed)		
Air conditioning fans, etc		
- compressor		
Generator frame (if fitted)		
- Engine frame		
- Mounting frame		
- Plant enclosure		

Fixed appliances (including zips, pie warmers etc)

	Pass	Fail

Visual Checks

Generator Main Switchboard only	Pass	Fail
Earth / Neutral link fitted		

All other switchboards	Pass	Fail
Earth / Neutral link removed		

Trainline

Continuity (Max value = 1Ω)

Vehicle (Chassis No): _____

	H/S Socket to H/S Socket	Pass	Fail	H/S Socket to Main Switchboard	Pass	Fail	Main Sw/Bd to Sub Sw/Bd	Pass	Fail
R - R	Ω			Ω			Ω		
Y - Y	Ω			Ω			Ω		
B - B	Ω			Ω			Ω		
N - N	Ω			Ω			Ω		
E - E	Ω			Ω			Ω		

Visual Checks

		Pass	Fail
Sockets	- General Condition		
	- Interlock operation		
	- Cable connections		
General	- No exposed live parts, basic insulation damage, etc		

Insulation

With 500 volt insulation tester

Minimum Value = 1 MΩ

		Pass	Fail
R - [Y + B + N + E]	MΩ		
Y - [R + B + N + E]	MΩ		
B - [R + Y + N + E]	MΩ		
N - [R + Y + B + E]	MΩ		
E - [R + Y + B + N]	MΩ		

Heaters & Socket Outlets

Continuity & Polarity

Switchboard to Outlet; P - P, N - N, E – E

Max value = 1 Ω

General

No exposed live parts, insulation damage, etc

Location	Pass	Fail		Pass	Fail

Lights

Earthing

Max value = 1 Ω

(Record highest value)

General

No exposed live parts, insulation damage, etc

Polarity

Switches shall operate in the phase conductor.

Location	Pass	Fail		Pass	Fail		Pass	Fail

Vehicle (Chassis No): _____

Air Conditioning

(Caution - Testing may damage some components.)

Compressor Insulation

Test at contactor with 500 volt insulation tester
Minimum Value = 1 MΩ

		Pass	Fail
E - [R + B + Y] Cable only	MΩ		
Cable & motor	MΩ		

Compressor Continuity

(Compare with previous years.)

		Pass	Fail
R - Y	Ω		
Y - B	Ω		
B - R	Ω		

Visual Checks

	Pass	Fail
System works satisfactorily		
General - No exposed live parts, insulation damage, etc		

Extra Low Voltage Circuits

Visual Checks

Switchboard	Pass	Fail
Main switch fitted		
Circuit breakers/fuses in each circuit		
Batteries		
Non-sealed type ventilated		
No leaks or damage.		
Chargers		
Cooling vents clear.		
No exposed live parts, insulation damage, etc		

Cables	Pass	Fail
No insulation damage		
Adequate mechanical protection.		
Lights (if fitted)		
General condition OK		
Power fail time delay working		
General		
Connections secure		
No exposed live parts in damp situations		

Segregation of LV & ELV Circuits

Test between LV neutral and all unearthed ELV circuits with 250 volt tester.*
Minimum value = 1MΩ

	Pass	Fail
MΩ		

Test between LV neutral and all communications circuits with 250 volt tester.*
Strap all communication circuits together for this test.
Minimum value = 1MΩ

	Pass	Fail
MΩ		

* Note - 250 volt tester used to avoid damage to sensitive components.

Generator Mechanical & Visual Checks

Generator No _____

Generator

	Pass	Fail
Guards over moving parts secure		
Guards over hot equipment secure		
Fuel systems protected		
No fuel or oil leaks		
Exhaust system secure / no leaks		
Electrical equipment protected		
All live parts enclosed.		
No damage, deterioration, etc		

Generator Compartment

	Pass	Fail
Access to generator not impeded		
Adequate ventilation		
No inflammable or toxic chemicals		
Access from compartment clear		
Low voltage lights working		
Fire extinguisher accessible and test certificate current (< 12 months old)		

Controls

	Pass	Fail
Controls protected against damage		
Controls correctly labelled		
Operating instructions displayed		

Cabling

	Pass	Fail
All cables adequately secured		
Adequate mechanical protection		
No damage, deterioration, etc		

Generator Control & Protection Systems

Correct operation of:-

	Pass	Fail
Emergency stop(s)		
Engine isolation switch		
Engine start & stop controls		
Engine protection devices		

Protective devices correctly operate at:-

	Operates At	Pass	Fail
Over current			
Over voltage	Volts		
Under voltage	volts		
Over frequency	Hz		
Under frequency	Hz		
Overspeed shut down (if fitted)			

Generator Main Circuits

Insulation

With 500 volt insulation tester

Minimum Value = 1 MΩ		Pass	Fail
E - [R + Y + B + N]	MΩ		

Normal Operation

No load frequency	Hz	
Load frequency	Hz	@ A
No load voltage	v	
Load voltage	v	@ A

Continuity

		Pass	Fail
R - N	Ω		
Y - N	Ω		
B - N	Ω		

Measure at switchboard. Compare with previous years.

Rail Vehicle Electrical Jumper Cables - Test Sheet

Jumper Identification		**Continuity & Polarity** Max value = 1 Ω	Pass	Fail	**Insulation** With 500 volt insulation tester. Minimum value = 1 MΩ		Pass	Fail	**General Condition** Good connections, no insulation damage, plug in good condition, etc.
	R - R	Ω			R - [Y + B + N + E]	MΩ			Pass / Fail
	Y - Y	Ω			Y - [R + B + N + E]	MΩ			
	B - B	Ω			B - [R + Y + N + E]	MΩ			Test Date
	N - N	Ω			N - [R + Y + B + E]	MΩ			
	E - E	Ω			E - [R + Y + B + N]	MΩ			/ /
	R - R	Ω			R - [Y + B + N + E]	MΩ			Pass / Fail
	Y - Y	Ω			Y - [R + B + N + E]	MΩ			
	B - B	Ω			B - [R + Y + N + E]	MΩ			Test Date
	N - N	Ω			N - [R + Y + B + E]	MΩ			
	E - E	Ω			E - [R + Y + B + N]	MΩ			/ /
	R - R	Ω			R - [Y + B + N + E]	MΩ			Pass / Fail
	Y - Y	Ω			Y - [R + B + N + E]	MΩ			
	B - B	Ω			B - [R + Y + N + E]	MΩ			Test Date
	N - N	Ω			N - [R + Y + B + E]	MΩ			
	E - E	Ω			E - [R + Y + B + N]	MΩ			/ /
	R - R	Ω			R - [Y + B + N + E]	MΩ			Pass / Fail
	Y - Y	Ω			Y - [R + B + N + E]	MΩ			
	B - B	Ω			B - [R + Y + N + E]	MΩ			Test Date
	N - N	Ω			N - [R + Y + B + E]	MΩ			
	E - E	Ω			E - [R + Y + B + N]	MΩ			/ /
	R - R	Ω			R - [Y + B + N + E]	MΩ			Pass / Fail
	Y - Y	Ω			Y - [R + B + N + E]	MΩ			
	B - B	Ω			B - [R + Y + N + E]	MΩ			Test Date
	N - N	Ω			N - [R + Y + B + E]	MΩ			
	E - E	Ω			E - [R + Y + B + N]	MΩ			/ /

Electrical Inspection of Power Cords Located At _____

Inspectors Name	Registration No.	Signature

I.D.	Description	Continuity (Ω)	Insulation Resistance P+N - E (MΩ)	P - N (MΩ)	Test Date	Next Insp. Due
					/ /	/ /
					/ /	/ /
					/ /	/ /
					/ /	/ /
					/ /	/ /
					/ /	/ /
					/ /	/ /
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Electrical Inspection of Appliances Located At _____

Inspectors Name	Registration No.	Signature

I.D.	Description	Class	Visual Insp.	Earthing (Ω)	Insulation Resistance (MΩ)	Test Date	Next Insp. Due
						/ /	/ /
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{Operator Name}

ELECTRICAL WARRANT OF FITNESS

Issued Under The {Operator}
Electrical Code Of Practice

Vehicle No: . . . . . .

Date Issued: . . . . . .

Expires On: . . . . . .

Tested By (Print): . . . . . .

Inspectors Registration No: . . . . . .

Inspectors Signature: . . . . . .

Effective Date -