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

The holder of printed or duplicated copies of this document is responsible for ensuring they are using the latest version.

Amendment History

Version	Section	Amendment
1	4.4	Amended workshop equipment testing requirements.

Index

Secti	ion		Page			
1.0	Introd	duction	1			
2.0	2.0 Description of Rolling Stock Electrical Systems					
3.0	Insta	llations and Repairs in Rolling Stock	1			
	3.1	Low-voltage Generators	1			
	3.2	Low-voltage Installations in Rolling Stock	2			
	3.3	Extra Low-voltage Installations in Rolling Stock	2			
	3.4	Diesel-electric and Electric Locomotives	2			
	3.5	Shore Supply	2			
4.0	3					
	4.1	Low-voltage Installations in Rolling Stock	3			
	4.2	Extra-low Voltage Installations	3			
	4.3	Diesel-electric and Electric Locomotives	3			
	4.4	Electrical Equipment	3			
5.0	Oper	ating Instructions	3			
	Appe	ndix 1 Sample Inspection Forms	3			
		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				

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.

FRONZ / ONTRACK B3.5.1.01

• 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.

Issue 1

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	e (Chas	sis) No:		Generator I (If fitted)		
		Switch	nboards & Ca	abling	(
Cabling			Insulatio	-			
C			With 500) volt insulation t	ester. Minimun	n value =	= 1 MΩ
	Pass	Fail		Main Sw/bd	Sub Sw/bd	Pass	Fail
All cables secured			N - E	MΩ	MΩ		
Mechanical protection OK			R (P) - E	MΩ	MΩ		
No damage, deterioration, etc			R (P) - N	MΩ	MΩ		
			Y – E	MΩ	MΩ		
Switchboard Visual Ch	necks		Y - N	MΩ	MΩ		
	Pass	Fail	B - E	MΩ	MΩ		
Correct labels on controls			B - N	MΩ	MΩ		
All connections secure			R - Y	MΩ	MΩ		
General - No exposed live			R - B	MΩ	MΩ		
parts, basic insulation dan	nage, et	C	Y - B	MΩ	MΩ		
				MΩ	MΩ		
				MΩ	MΩ		
Other Circuits				MΩ	MΩ		
				MΩ	MΩ		
				MΩ	MΩ		

Earthing

Continuity Measure from main switchboard or sub board as appropriate. Max value = 1 Ω Fixed appliances (including zips, pie warmers etc) Pass Fail Main to Sub switchboards Pass Fail 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 **Visual Checks** Generator Main Switchboard only Pass Fail Pass Fail All other switchboards Earth / Neutral link fitted Earth / Neutral link removed

Effective Date:

Page 1 of 4

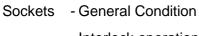
Rail Vehicle Electrical Test Form

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



- Interlock operation

- Cable connections
- General No exposed live parts,

basic insulation damage, etc

Pass

Fail

Insulation

With 500 volt insulation tester

Minimum Va	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 General Switchboard to Outlet; P - P, N - N, E - E No exposed live parts, insulation damage, etc Max value = 1 Ω Pass Location Pass Image: Pass Fail Image: Pass Image: Pass Image: Pass Fail Image: Pass Image: Pass Image: Pass Fail Image: Pass Ima

			Lig	hts						
	Earth	ing	-		Gene	eral			Polari	ty
	Max value			No	exposed	live part	s,	Swite	ches sha	ll operate
	(Record high	iest val	ue)	insı	ulation da	amage, e	tc	in the	<u>e phase c</u>	onductor.
Location	Pass	Fail			Pass	Fail			Pass	Fail
									-	
									1	
	<u> </u>		ļ			l	l		[

Rail Vehicle Electrical Test Form

Vehicle (Chassis No):

Air Conditioning

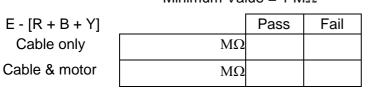
(Caution - Testing may damage some components.)

Compressor Insulation

Compressor Continuity

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

(Compare with previous years.)



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

Visual Checks

System works satisfactorily

General -No exposed live parts, insulation damage, etc

Pass	Fail

Extra Low Voltage Circuits

		VISU				
Switchboard	Pass	Fail	Cables	Pass	Fail	
Main switch fitted			No insulation damage			
Circuit breakers/fuses in each circuit			Adequate mechanical protection.			
Batteries	L		Lights (if fitted)	1		
Non-sealed type ventilated			General condition OK			
No leaks or damage.			Power fail time delay working			
Chargers			General			
Cooling vents clear.			Connections secure			
No exposed live parts, insulation	lo exposed live parts, insulation No exposed live parts in damp					
damage, etc			situations			
S	egrega	tion of	f LV & ELV Circuits			
Test between LV neutra	al and a	ll unear	thed ELV circuits with 250 volt tester.*			
	Mini	mum va	alue = $1M\Omega$	Pass	Fail	
			ΜΩ			
Test between LV neutral and all communications circuits with 250 volt tester.* Strap all communication circuits together for this test.						
	Mini	mum va	alue = $1M\Omega$	Pass	Fail	
			ΜΩ			

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

Effective Date:	Page 3 of 4	Rail Vehicle Electrical Test Form

Visual Chocks

Generator Mechanical & Visual Checks

Generator No

Generator

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

	Pass	Fail
Ī		
-		
-		
-		
-		
-		

Controls

Controls protected against damage Controls correctly labelled Operating instructions displayed

Pass	Fail

Generator Compartment

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)

Pass	Fail

Cabling

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

Pass	Fail

Generator Control & Protection Systems

Correct operation of:-

Protective devices correctly operate at:-

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

Pass	Fail	

Over current Over voltage Under voltage Over frequency Under frequency Overspeed shut dow

	Operates At	Pass	Fail
	Volts		
	volts		
	Hz		
	Hz		
wn	(if fitted)		

Generator Main Circuits

Insulation With 500 volt insulation tester

Minimum Valu	re =
E - [R + Y + B + N]	

1 MΩ		Pass	Fail
	MΩ		

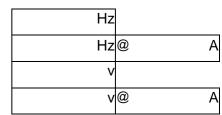
Continuity

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

Measure at switchboard. Compare with previous years.

Normal Operation

No load frequency Load frequency No load voltage Load voltage



Rail Vehicle Electrical Jumper Cables - Test Sheet

Jumper Identification	Continuity & Polarity Max value = 1 Ω			Insulation With 500 volt insulation tester. Minimum value = 1 M Ω			(General Condition Good connections, no insulation damage, plug in good condition, etc.			
			Pass	Fail			Pass	Fail		,	
	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 P+N - E (MΩ)	Resistance P - N (MΩ)	Test Date	Next Insp. Due	
					/ /		
					/ /	/ /	
						/ /	
						11	
						/ /	
					/ /		
					/ /		
					1 1		
					1 1	1 1	
					1 1	1 1	
					/ /	/ /	
					/ /	/ /	
					/ /	/ /	
					/ /	/ /	
					/ /	/ /	

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	
						1	1	/	1
						1	1	/	1
						1	1	/	1
						1	1	/	1
						1	1	/	1
						1	1	1	1
						1	1	/	1
						1	1	1	1
						1	1	1	1
						1	1	1	1
						1	1	/	1
						1	1	/	1
						1	1	1	1
						1	1	1	1
						1	1	1	1
						1	1	1	1
						1	1	1	1
						1	1	/	1
						1	1	1	1
						1	1	1	1

<u>{Operator Name}</u> 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 -