	MODIFICATION PROCEDURE	VMP-RETB-004
	Multipulse Electronics Ltd Units 1-3 Goldsworth Park Trading Estate Kestrel Way, Woking, Surrey, GU21 3BA	

## CLASS 37 RETB INSTALLATION MODIFICATION AND TEST PROCEDURE

Issue: 1      Revision: AD2

January 2015

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### Approval and Authorisation

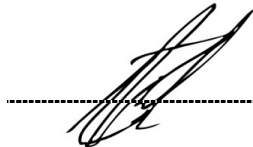
#### Signature

Technical Author:



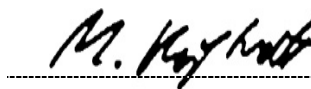
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## 1. INTRODUCTION


### 1.1 General

Network Rail are in the process of developing a replacement RETB (Radio Electronic Token Block) radio system, for the Far North Line (FNL) and West Highland Lines (WHL) in Scotland. After a life extension of infrastructure systems, the Next Generation RETB (RETB NG) project is planned to replace the radio system element (NRN) as the frequencies used are due to be returned to Ofcom at the end of 2015. This requires a new train radio and token exchange unit to be installed in all driving cabs of vehicles used on the FNL and WHL.

A varied fleet of Class 37's still remain in use with Direct Rail Services (DRS) and the West Coast Railway Company (WCR), principally operated out of Carlisle and Carnforth Depots respectively. These Locomotives are currently equipped with National Radio Network (NRN) radio and the Legacy RETB System. This modification procedure describes the installation of the new RETB NG system alongside the Legacy NRN System. The modification design allows interchangeability between the RETB-NG and Legacy systems. Either of the RETB displays can be fixed to a common display mounting bracket and connected to the appropriate cable harnesses. Those harnesses not in use are stowed on dummy connector fittings, located on a bracket above the RETB display unit.

Two antennas are required for the RETB-NG. One is a VHF whip antenna, and the second a GPS 'puck' antenna. The puck antenna is independent of the existing antennas, but the new whip antenna makes use of the existing NRN base location for its installation. Therefore, if it is necessary to change from legacy systems to RETB-NG or vice versa, the antenna whips must be exchanged, as must the antenna feeders from the respective systems.

Although the fleet due for RETB-NG installation have had varied modification histories, the design pack has distilled the principle differences (in the cab) to create two definite designs. Cab type 1 describes cabs which share much of the as-built layout, including dash and gauges. It is expected that peripheral components such as the handset will need subtly different mounting locations, which is catered for by the drawing pack. Cab type 2 suits the cabs modified by Brush in the 1990's and 2000's with relocated dash panels and improved draft proofing/noise reduction.

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**Figure 1 - Photograph showing DRS's Class 37/6 37 610 on shed at Carlisle Kingmoor.**

## **1.2 Purpose and Scope**


This procedure details the modification work required to install the RETB NG System onto the Class 37 Locomotives. The main elements of the modification are:

- Installation of 2 off bonnet-mounted antennas.
- Installation of a junction box.
- Installation of a cab mounted 'Combined Cab Display Unit and Radio' (CDR)
- Installation of a new handset and speaker.
- Installation of a new replacement PSU to supply both the RETB NG system and the existing NRN and RETB systems as required.
- Installation of all associated cabling between the system components being installed.
- Functional testing of the RETB NG system and the existing NRN and RETB systems to confirm correct functionality.

For the Class 37's, there are two different sets of drawings to cover all cab variants. Cab type 1 describes cabs which share much of the as-built layout, including dash and gauges. Cab type 2 suits the cabs modified by Brush in the 1990's and 2000's with relocated dash panels and improved draft proofing/noise reduction.

## **1.3 Safety**

When working to this document, it is the responsibility of the Supplier to ensure that all relevant local and mandatory safety instructions are strictly followed. This shall include, where applicable, adherence to Safety Legislation, Railway Group Standards and Industry Standards.

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#### 1.4 Cable Idents


Where the scope of work within this Modification involves the addition of new cabling or disturbance to existing cabling, the supplier shall ensure all such cabling is correctly labelled using appropriate cable idents that are legible and suitable for purpose.

Cable installations, connections and repairs shall be in accordance with AT/TI0324 (See Reference Documents Item 1) and all spare or redundant cables shall be end-capped and tied back in accordance with CR/TP1084 (See Reference Documents Item 2).

#### 1.5 Standard Definitions


Within this document, any of the terms used from the following list shall be regarded as having the definition stated.

<b>Term</b>	<b>Definition</b>
Adjust	Correct to defined limits.
Approved Cleaner	Cleaning agent suitable for the task in hand.
Caution	Means that negligence may result in material damage or injury.
Change	Remove the original and fit a new or overhauled part or assembly in its place.
Check	Determine a particular nominated condition before, during or after repair, e.g. completeness, security, position.
Clean	Remove all dirt and deposits.
Defect/ Defective	Any fault or faults in a component or assembly, which may prevent the component or assembly from fulfilling its designed purpose.
Discard	Set aside on dismantling or disconnecting for subsequent disposal (scrap) not to be reused.
Dismantle	Take to pieces.
Contracts Manager	The nominated representative of Angel Trains Limited.
Examine	Determine general condition before repair, e.g. wear, cracks, splits, leaks, scoring, corrosion, erosion, breaks, distortion and

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	looseness.
Gauge	Determine a nominated dimension by using suitable measuring equipment.
Inspect	Determine conformity to required standards during and after repair.
Overhaul	Do what is necessary to make a component or assembly re-usable, i.e. dismantle, strip, clean, examine, fit new parts, repair, re-assemble, test and inspect as required (does not include rewinding or renewal).
Re-Assemble	Put together.
Record	Put down in writing the result of any specified examination, test or inspection or Special Check.
Rectify	To set right (does not include rewinding or renewal).
Refit	Put back and reconnect.
Remove	Disconnect and take off.
Renew	Remove and scrap the original part, component or assembly and put a new part, component or assembly in its place.
Repair	Restore an original part to the required condition, e.g. by hand tooling, machining, building up, welding, patching, bending and setting, heat treating, re-securing, etc. (does not include rewinding or renewal).
Report	Convey to the Supervisor the condition of the item examined.
Scrap	Dispose of.
Strip	Remove covering, e.g. paint, polish, fabric.
Supplier	Reference within this and any related documents to the Supplier shall identify an organisation which is contracted to one of the Rolling Stock Companies and their authorised agents for the purpose of undertaking a specified task.
Test	Prove correct operation of component or system.



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## 1.6 Supplier's Responsibilities

### Safety (See Section 1.3)

#### Condition on Release

The condition of the vehicle and all components and systems on completion of overhaul and repairs shall be such that the safety of public and staff alike is not endangered and that any risk has been fully assessed and minimised to become as low as reasonably practicable. If any doubt exists remedial action shall be taken by the Supplier.

#### Railway Group Standards

All applicable Railway Group Standards shall be adhered to, irrespective of whether they are specifically referenced in this document. The Supplier shall advise the Contract Manager if any requirement of a Railway Group Standard conflicts with any requirement of this document or any subsidiary document.

#### Materials and Components

It is the responsibility of the Supplier to ensure that all repaired components and systems conform to the standards authorised and agreed for the specific contractual use. If the Supplier becomes aware that the contractual issue of a document is not the latest issue, he shall advise the Contract Manager who will determine whether the revised issue is to be implemented for the contract.

The Supplier shall not carry out any design changes or change any processes or materials detailed in this document without the approval of the Contract Manager. Requests for changes will be managed in accordance with the Angel Trains Management of Change procedure E01.

Where a component is required to be cleaned, unless otherwise stated, it is the responsibility of the Supplier to identify the most suitable method, which will ensure that the component is not in any way damaged.


Whenever it is necessary to remove or isolate a faulty or redundant cable the work must be carried out in accordance with Technical Procedure CR/TP1084 (Refer to Reference Documents item 2).

#### Competence

All work must be carried out by staff assessed as competent in accordance with the principles of ORR Railway Safety Publication 1 "Developing and Maintaining Staff Competence" March 2007.

#### Sequence of Test

The testing must be undertaken in the sequence indicated.

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If a fault is identified during testing then it should be rectified and the test repeated to confirm that the rectification work has been successful and has not created any other faults.

When the test is repeated it should start from an appropriate point earlier in the sequence to include all of the testing affected by the rectification work. If a suitable point earlier in the sequence cannot be determined then the test should be repeated from the start.

### **Record of Engineering Changes**

Design information (held by the supplier) must be updated for all modifications and any information held in PADS, in accordance with ACOP/EC/01007 (See also Angel Trains Change Management Procedure E01), shall be updated also. The fit, form & function modification status must be visibly recorded on the component.

### **Welding**

All welding shall be to recognised National/International standards. The Supplier shall state the standards and specifications to be used and shall provide documentary evidence to cover the welding procedures, systems and processes. This shall also include preparation of the vehicle and or component prior to welding.

### **Renewal of Fasteners**


All split cotter pins, star washers, locking tabs, spring washers and torque prevailing nuts removed during maintenance or overhaul SHALL BE RENEWED. Unless otherwise specified all other fasteners removed during this overhaul shall be renewed if found to be defective in any way.

### **Tightening of Threaded Fasteners**

Where a torque loading is specified, nuts shall only be tightened by means of a calibrated torque wrench. If the Supplier considers that any joint where torque loadings are not specified is critical, he shall consult the Engineer. Except where otherwise specified, threads are not to be lubricated but a thin film of corrosion inhibitor can remain on the threads.

It is essential to check that all bolts, in a multi-hole fixing, carry their allocated proportion of the load. Unless otherwise specified, they shall first be tightened in a staggered pattern from the centre outwards and subsequently re-tightened in the same sequence. This second tightening is necessary since bolts may lose tension when adjacent bolts are tightened.

Unless otherwise specified, slotted or castellated nuts shall subsequently be over tightened if necessary to align the next slot to allow for the insertion of split cotter pins. Under no circumstances shall nuts be eased back.


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### **Prevailing Torque Nuts**

Where prevailing torque nuts of the bent beam type or nylon insert type are used, at least two complete threads of the bolt must protrude through the nut. However, under no circumstances may a nylon insert type nut be used on a bolt that is cross-drilled in threaded section.

### **Protection of Components**

When disconnected and out of service, all electrical, hydraulic and pneumatic connections shall be sealed to prevent ingress of foreign matter.

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## 2. REFERENCE MATERIALS, SPECIAL TOOLS, DOCUMENTATION & DRAWINGS

### 2.1 Materials Table


Materials			
Item	Description	Qty/Veh	Cat/OEM Pt No
1	Cable Tie 186 X 4.7mm	30	RS 212-8087
2	Cable Tie Bases	10	RS 190-3326
3	Braided Sheath Cable Protection	A/R	Siegrist-Orell SVSR200
4	PSU	1	Martek Power– EBR1400-A/1
5	M6 Hex Nut, EZP	6	003/175112
6	M6 Form A Washer, EZP	6	003/190924
7	M6 Spring Washer, EZP	6	003/195108

**Note 1:** All other materials required for the modification are shown on the relevant reference drawing, see Section 2.4.

### 2.2 Special Tools Table

Special Tools		
Item	Description	Cat/OEM Pt No
1	Torque Wrench 0 -30Nm	Local Supply
2	Digital Multimeter	Local Supply
3	Megger (500V) or equivalent	-
4	Low resistance meter, 4 terminal, resolution 0.1mΩ or better, minimum test current 0.1A	e.g. Cropico DO 4000
5	Rig Expert AA-600 VHF Analyser (Or Equivalent)	-
6	Depot Test Unit (RETB-NG)	-
7	Approved Avdel Euroserts Insertion Tools	-
8	17mm Dia Holesaw	-

**Note 2:** Where 'Local Supply' is shown against a Special Tool, it is the Supplier's responsibility to obtain this tool to suit their local requirements.


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### 2.3 Reference Documents Table

Reference Documents		
Item	Document No	Title
1	AT/TI0324	Cable Connections and Repair
2	CR/TP1084	Removal or Isolation of Defective or Redundant Cables and Provision of Spare Cables
3	TBA	NRN Radio Test
4	TBA	R.E.T.B. Test Procedure
5	CR/PE0102	Repainting of Rail Vehicles
6	PROC-1051-001	On-Train Installation Test Procedure - Antenna
7	PROC-1051-002	On-Train Installation Test Procedure - System

### 2.4 Reference Drawings Table

Reference Drawings		
Item	Drawing No	Title
1	MP-C0-00065	General Arrangement Cab Type 1 Class 37 RETB
2	MP-C0-00066	General Arrangement Cab Type 2 Class 37 RETB
3	MP-C0-00067	CDR Installation Cab Class 37 RETB
4	MP-C0-00068	Handset Installation Cab Class 37 RETB
5	MP-C0-00069	Junction Box and Speaker Installation Cab Type 1 Class 37 RETB
6	MP-C0-00070	Adapter Plate Assembly and Details Class 37 RETB
7	MP-C0-00071	Handset Mounting Box Plinth Assembly and Details Class 37 RETB
8	MP-C0-00083	Class 37 RETB NG Wiring Diagram – Cab Type 2
9	MP-C0-00073	Junction Box and Speaker Installation Cab Type 2 Class 37 RETB
10	MP-C0-00074	Junction Box Enclosure Assembly and Details Cab Type 1 Class 37 RETB
11	MP-C0-00075	Junction Box Enclosure Assembly and Details Cab Type 2 Class 37 RETB
12	MP-C0-00076	Miscellaneous Details Class 37 RETB
13	MP-C0-00077	VHS Whip and GPS Patch Antennas Cab Types 1 & 2 Class 37 RETB
14	MP-C0-00078	Class 37 RETB Schematic
15	MP-C0-00079	Class 37 RETB NG Wiring Diagram – Cab Type 1
16	MP-C0-00082	RETB NG Harness – VHF Vertical Whip Antenna


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## 2.5 Torque Table

Torque Table			
Item	Section No.	Description	Torque Value Nm
1	3.4.1 3.5.1	Dummy Receptacle Support Bracket to Existing RETB Bracket	25
2	3.4.6 3.5.7	P-Clip	6
3	3.4.7 3.5.8	Handset	6
4	3.4.7	Handset Mounting Box	3.5
5	3.4.10 3.5.9	Junction Box Back Plate	6
6	3.4.11 3.5.10	Junction Box	3.5
7	4.7.13	Junction Box Enclosure Cover	6
8	3.4.12	Junction Box Support Bracket	11
9	3.5.4	Brace	11

## 2.6 Cable Bend Radius Table

Cable Description	Minimum Radii
Huber and Suhner TENUIS-TW/S 4 x 2.5mm <sup>2</sup> (RNG007)	27mm
Huber and Suhner TENUIS-TW/S 2 x 1mm <sup>2</sup> (RNG003)	16mm
Huber and Suhner TENUIS-TW/S EMC 4 x 2 x 0.5mm <sup>2</sup> (RNG002)	28mm
Huber and Suhner TENUIS-TW/S EMC 6 x (2 x 1)mm <sup>2</sup> (RNG004)	56mm
Huber and Suhner TENUIS-TW/S EMC 12 x 1mm <sup>2</sup> (RNG001)	30mm
Huber and Suhner SX 04172 B-60 (RNG006 and RNG005)	25mm
Huber and Suhner RADOX 4GKW 6mm <sup>2</sup> (RNGE01)	16mm

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### 3. RETB NG SYSTEM INSTALLATION

#### 3.1 Pre-Modification Legacy NRN Radio and RETB CDU Function Test


- 3.1.1 Ensure the vehicle is adequately scotched in accordance with local depot procedures.
- 3.1.2 Isolate the pump set (to save battery capacity as the locomotive does not need to be started).
- 3.1.3 Switch the BIS and lighting switch in.
- 3.1.4 Ensure the NRN Radio powers up. The NRN powers up by default when the CDU is not connected. Record it has powered up successfully in Appendix A.
- 3.1.5 Undertake NRN full test in accordance with the appropriate VMI task (Refer to Reference Document, item 3). Record it has been completed successfully in Appendix A.
- 3.1.6 Plug the legacy RETB CDU into the existing harness and undertake RETB full test (using the Depot Test Unit – DTU) in accordance with the appropriate VMI task (Refer to Reference documents, item 4). Record it has been completed successfully in Appendix A.
- 3.1.7 Open the BIS and lighting switch.
- 3.1.8 Replace the pump set isolation.

#### 3.2 Vehicle Isolation and Preparation

- 3.2.1 Open the BIS and lighting switch, to ensure the vehicle is fully electrically isolated.
- 3.2.2 Ensure no shore supplies are connected.

#### 3.3 Wiring Removal & Re-location of Electrical Equipment

- 3.3.1 Remove existing NRN speaker wiring in accordance with document No. CR/TP1084 (Refer to Reference Documents, item 2) and as per drawing No. MP-C0-00079 (Type 1 cab) or MP-C0-00083 (Type 2 cab). Refer to Reference Drawings, items 15 and 8.
- 3.3.2 Remove existing NRN PSU wires in accordance with document No. CR/TP1084 (Refer to Reference Documents, item 2) and as per drawing No. MP-C0-00079 (Type 1 cab) or MP-C0-00083 (Type 2 cab). Refer to Reference Drawings, items 15 and 8.

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### 3.4 Install Type 1 Cab Equipment (Mechanical)

With Reference to drawing No. MP-C0-00065 – General Arrangement Cab type 1 Class 37 RETB (refer to Reference Drawings, item 1):

**Note:** The following installation requires the use of an approved Avdel Eurosert Insertion Tool (refer to Special Tools, item 7).

- 3.4.1 Referring to drawing No. MP-C0-00067 (refer to Reference Drawings, item 3), install the adapter bracket (Item A) and dummy connector support bracket (Item J). Torque tighten the bracket fixings to 25Nm (refer to Torque Table, item 1). Witness mark the fasteners with a paint pen.
- 3.4.2 Drill holes for dummy receptacle (Item M) as per detail C on drawing No. MP-C0-00067 (refer to Reference Drawings, item 3) to achieve optimal position for exiting cable. Protect any existing cables when drilling.
- 3.4.3 Fit dummy receptacle (Item M) to dummy connector bracket in accordance with drawing No. MP-C0-00067 (refer to Reference Drawings, item 3).
- 3.4.4 Fit cab equipment CDR unit onto the CDR carrier plate (Item B) as per drawing No. MP-C0-00067 (refer to Reference Drawings, item 3).
- 3.4.5 Install CDR carrier plate to the adapter bracket in accordance with drawing No. MP-C0-00067 (refer to Reference Drawings, item 3).
- 3.4.6 Install M32 conduit (Item W) and P-clips (Item AC) in accordance with drawing No. MP-C0-00067 (refer to Reference Drawings, item 3). Torque tighten P-clip fixings to 6Nm (refer to Torque Table, item 2).
- 3.4.7 Install the mounting box and radio equipment handset as per drawing No. MP-C0-00068 (refer to Reference Drawings, item 4). Torque tighten handset fixings to 6Nm (refer to Torque Table, item 3) and mounting box fixings to 3.5Nm (refer to Torque Table, item 4).
- 3.4.8 Install new cab speaker as per drawing No. MP-C0-00069 (refer to Reference Drawings, item 5).
- 3.4.9 Temporarily remove the existing NRN radio unit cover and chassis plate (containing the NRN equipment). Install the junction box support brackets in accordance with drawing No. MP-C0-00069.



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3.4.10 Install the junction box enclosure back plate as per drawing No. MP-C0-00069 (refer to Reference Drawings, item 5), Torque tighten the back plate fixings to 6Nm (refer to Torque Table items 5).

3.4.11 Install the junction box as per drawing No. MP-C0-00069 (refer to Reference Drawings, item 5). Torque tighten the junction box fixings to 3.5Nm (refer to Torque Table, item 6).

3.4.12 Once junction box is fully positioned, torque tighten support bracket fixings to 11Nm (refer to Torque Table, item 8). Re-fit the NRN housing cover.

### 3.5 Install Type 2 Cab Equipment (Mechanical)

With Reference to drawing No. MP-C0-00066 – General Arrangement Cab type 2 Class 37 RETB (refer to Reference Drawings, item 2):

**Note:** The following installation requires the use of an approved Avdel Eurosert Insertion Tool (refer to Special Tools, item 7).

3.5.1 Install the adapter bracket (Item A) and dummy connector support bracket (Item J) in accordance with drawing No. MP-C0-00067 (refer to Reference Drawings, item 3). Torque tighten the bracket fixings to 25Nm (refer to Torque Table, items 1). Witness mark the fasteners with a paint pen.

3.5.2 Drill holes for dummy receptacle (Item M) as per Detail C on drawing No. MP-C0-00067 (refer to Reference Drawings, item 3) to achieve optimal position for existing cable. Protect any existing cables when drilling.


3.5.3 Fit dummy receptacle (Item M) to dummy connector bracket in accordance with drawing No. MP-C0-00067 (refer to Reference Drawings, item 3).

3.5.4 Fix the brace (Item S) to the dummy connector bracket (Item J) and use as a template to drill hole through window pillar web in accordance with drawing No. MP-C0-00067 (refer to Reference Drawings, item 3). Torque tighten the brace fixings to 11Nm (refer to Torque Table, item 9).

3.5.5 Fit cab equipment CDR unit onto the CDR carrier plate (Item B) as per drawing No. MP-C0-00067 (refer to Reference Drawings, item 3).

3.5.6 Install CDR carrier plate to the adapter bracket in accordance with drawing No. MP-C0-00067 (refer to Reference Drawings, item 3).

3.5.7 Install M32 conduit (Item W) and P-clips (Item AC) in accordance with drawing No. MP-C0-00067 (refer to Reference Drawings, item 3). Torque tighten P-clip fixings to 6Nm (refer to Torque Table, item 2).

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- 3.5.8 Drill and cut through the existing corner trim panel on the cab corner screen pillar as per Section E-E in drawing No. MP-C0-00068 (refer to Reference Drawings, item 4). Install RETB handset in accordance with drawing No. MP-C0-00068 (refer to Reference Drawings, item 4). Torque tighten handset fixings to 6Nm (refer to Torque Table, item 3).
- 3.5.9 Install the junction box enclosure back plate as per drawing No. MP-C0-00073 (refer to Reference Drawings, item 9). Torque tighten the back plate fixings to 6Nm (refer to Torque Table item 5).
- 3.5.10 Install the junction box in accordance with drawing No. MP-C0-00073 (refer to Reference Drawings, item 9). Torque tighten junction box fixings to 3.5Nm (Refer to Torque Table, item 6).
- 3.5.11 Install RETB loudspeaker in accordance with drawing No. MP-C0-00073 (refer to Reference Drawings, item 9).

### **3.6 Install Replacement NRN/RETB PSU**

- 3.6.1 Remove the supply wires from the locomotive to the PSU. These may be idented differently on differing locos (see drawing No. MP-C0-00079 (Type 1 cab) or MP-C0-00083 (Type 2 cab)). (Refer to Reference Drawings, items 15 and 8). Examine the wires and repair or renew damaged wires in accordance with AT/TI0324. Ensure the idents are clear and renew if necessary.
- 3.6.2 Remove the PSU from the NRN chassis plate, taking care given its overhead position. Return to stores.
- 3.6.3 Install the new PSU (refer to Materials, item 4) into the equipment cabinet using 6 off M6 nuts, Form A washers and spring washers (refer to Materials, items 5, 6 & 7).
- 3.6.4 Reconnect the supply wires and equipotential bond to the new PSU as per drawing No. MP-C0-00078 (refer to Reference Drawings, item 14).

### **3.7 Install RETB NG Antenna & Antenna Cable**

- 3.7.1 Without fully fitting the antennae, install the VHF whip and GPS patch antennas in accordance with drawing No. MP-C0-00077 (Refer to reference drawings, item 13). For electrical installation information refer also to drawing Nos. MP-C0-00078, 79 and 83 (Reference Drawings, items 14, 15 and 8).
- 3.7.2 Route the Antenna cables (RNG005 and RNG008), unterminated, from the location of the antennas, through to the cab area. Where possible the antenna cables should not be run alongside other cable bundles, so as to reduce the effects of radiated emissions. Also a minimum 20mm gap should be present between the antenna cables along the route where practical ensuring the two cables are not bundled together.

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Restrain cables with cable ties where required along route (Refer to Materials, items 1 & 2). The cables shall be protected from mechanical damage where necessary with a suitable braided sheath (Refer to Materials, item 3), as shown in the wiring diagrams, see drawings MP-C0-00079 (Type 1 cab) or MP-C0-00083 (Type 2 cab). (Refer to Reference Drawings, items 15 and 8).

**Note:** Before connecting antenna cables to the antenna, carry out cable continuity tests as detailed in Section 4.1.

3.7.3 Connect the antenna end of the antenna cables into the antenna.

3.7.4 Install the antenna in accordance with drawing No. MP-C0-00077 (Refer to reference drawings, item 13).

**Note:** Before connecting antenna cables to the CDR, carry out low-ohm tests as detailed in Section 4.4.

3.7.5 The loose (Radio) end of the antenna cable should be secured onto the dummy connectors, until required for testing.

### 3.8 Install New Wiring


3.8.1 Install new RETB NG radio wiring harnesses (RNG 001, RNG 002, RNG 003, RNG 004, RNG 005, RNG 007 and RNG 008) as per drawing Nos. MP-C0-00079 and MP-C0-00083 (Refer to Reference Drawings, items 15 and 8).

3.8.2 Install the new earth connection (RNGE 01) between the junction box earth stud and the local vehicle earth stud in the vehicle cab.

3.8.3 Loom the new cables using cable ties and bases (Refer to Materials, items 1 and 2), attaching the new wiring to existing looms and existing vehicle trunking where possible. Protect cable where required with a suitable braided sheath (Refer to Materials, item 3). Always ensure bend radius on cables are not tighter than the minimum radius detailed in Section 2.6.

**Note:** Before connecting cables, carry out cable insulation tests as detailed in Section 4.

3.8.4 Complete Installation Record Sheets in Appendix A.

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#### 4. RETB SYSTEM TESTING

Complete Test Record Sheets in Appendix A

##### 4.1 RETB NG Antenna Cables Point to Point Continuity Test

- 4.1.1 Using a Digital Multimeter (Refer to Special Tools, item 2) ensure that the two harnesses which service the antennas (RNG005 and RNG008) have continuity between the following:

Conductor Pin/Socket at each end.  
Sheath outer at each end

- 4.1.2 Ensure an open circuit exists between the following:-

Conductor Pin/Socket and harness sheath outer.  
Outer Sheath and Vehicle Welded Structure  
Conductor Pin/Socket and Vehicle Welded Structure

Record the results in Appendix A.

Return to installation procedure Section 3.7.3.

##### 4.2 RETB NG Cables Insulation Test (Excluding RF Cables RNG 005 and RNG 008)

- 4.2.1 Electrically connect all new conductors together using bonding wire.
- 4.2.2 Clean a suitable local area of vehicle structure to reveal bare metal to be used as a test point.


**Note:** Following insulation testing detailed in Section 4.2.3 refinish the area of exposed structure in accordance with CR/PE0102 – Repainting of Rail Vehicles (refer to Reference Documents, item 5).

- 4.2.3 Using the Megger Insulation Tester set to 500V (Refer to Special Tools, item 3), measure between the following points:-

Vehicle structure and bundled new cable.

Record the result in Appendix A.

If the reading is not equal to or in excess of 20MΩ, the reason for the low value must be identified and remedied before proceeding further.

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### 4.3 VSWR – VHF Harness (RNG008) only

**Note:** Under no circumstances should a VSWR measurement be attempted on the GPS antenna feeder as this will irreparably damage the antenna. Take care to identify the correct VHF feeder (QN-type connector) and avoid the GPS feeder (BNC connector).

- 4.3.1 Undertake an antenna test as described in procedure PROC-1051-001, (refer to Reference Documents, Item 6).


Record the results in Appendix A

### 4.4 VHF (Whip) Antenna and GPS (Puck) Antenna – Electrical Bonding

- 4.4.1 Ensure the antennas are fully installed in accordance with Section 3.7
- 4.4.2 Using a low-ohm meter (refer to Special Tools, item 4); measure the resistance between the loco' nose structure and the VHF antenna ground plane (TNC connector). Place one connector of the low-ohm meter to a clean part of the loco body structure and the other to the BNC antenna connector. Ensure this is 10mΩ or less.
- 4.4.3 Using a low-ohm meter (refer to Special Tools, item 4); measure the resistance between the loco' nose structure and the GPS antenna ground plane (Threaded fixing). Place one connector of the low-ohm meter to a clean part of the loco body structure and the other to the threaded connector. Ensure this is 10mΩ or less.

Record the results in Appendix A. If this is not achieved investigate the cause, rectify and re-test.

Return to installation procedure Section 3.7.5.

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## 4.5 Electrical Bonding

4.5.1 Using a low-ohms meter (Refer to Special Tools, item 4), set the current to 10A and measure the resistance between the following:-

- Junction box bonding stud to vehicle test point (RNGE01).
- PSU stud to vehicle test point.

Record the result in Appendix A.

If the reading is not equal to or less than 10mΩ, the reason must be identified and remedied before proceeding further.

## 4.6 RETB Legacy & RETB NG Radio Point to Point Continuity Test


4.6.1 Using a Digital Multimeter (Refer to Special Tools, item 2) carry out a point to point test (Continuity <0.5Ω) on all new harnesses, using the drawing No. MP-C0-00078 (Refer to Reference Drawings, item 14) as a guide, check for continuity.

**Note:** For harnesses terminated in special connectors, use a suitable mating half, wired with flying lead ends to undertake continuity tests.

Record the result in Appendix A. If this is not achieved investigate the cause, rectify and re-test.

## 4.7 RETB NG Function Test

- 4.7.1 Ensure the RETB NG CDR is NOT connected (all three flying leads disconnected).
- 4.7.2 Isolate the pump set (to save battery capacity as the locomotive does not need to be started).
- 4.7.3 Switch the BIS and lighting switch in.
- 4.7.4 Ensure the NRN Radio powers up.
- 4.7.5 Plug in the CDR connections. Ensure the NRN powers down.
- 4.7.6 Using the CDR menu screen and navigating the options with the 'Up' and 'Down' arrow keys, in the 'Select Signaller' menu select 'NRN Mode' by depressing the 'Menu/Select' button.

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4.7.7 Ensure the NRN powers up. Carry out NRN basic full test in accordance with the appropriate VMI task (Refer to Reference Document, item 3).

4.7.8 Undertake a system test of the RETB NG as described in procedure PROC-1051-002 (refer to Reference Documents, Item 7).

Record it has been completed successfully in Appendix A.

4.7.9 Remove the CDR unit and stable the free connectors on the dummy connectors in the cab.

4.7.10 Ensure the NRN has once again powered up by default.

Plug the legacy RETB CDU into the existing harness and undertake RETB full test (using the Depot Test Unit – DTU) in accordance with the appropriate VMI task (Refer to Reference documents, item 4).

Record the outcome of the tests in Appendix A.

4.7.11 Open the BIS and lighting switch.

4.7.12 Replace the pump set isolation.


4.7.13 Install junction box enclosure cover in accordance with drawing No. MP-C0-00069 (Type 1) and MP-C0-00073 (Type 2) (Refer to Reference Drawings, items 5 & 9), Torque tighten junction box cover fixings to 6Nm (Refer to Torque Table items 7).

## 4.8 Final Vehicle Inspection

4.8.1 Ensure all equipment and tooling has been removed from the vehicle.

4.8.2 Undertake a visual inspection of the vehicle in the areas where modification work has been undertaken. Ensure there is no damage to panels, all panels are secure and clean and the vehicle has been left in the condition that it was received in at the beginning of the modification.

Record it has been completed in Appendix A.

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## 5. APPENDICES

### 5.1 Appendix A -Test Record Sheets (RETB)


#### INSTALLATION, TORQUE, WIRING AND POINT TO POINT TEST RECORD

Locomotive No. 37 .....
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#### INSTALLATION CHECK

REF.	DESCRIPTION		
3.3	WIRING REMOVAL & RE-LOCATION OF EQUIPMENT TO DRAWING.	<input type="checkbox"/>	OK ✓
3.4	INSTALL TYPE 1 CAB EQUIPMENT TO DRAWING	<input type="checkbox"/>	OK ✓
3.5	INSTALL TYPE 2 CAB EQUIPMENT TO DRAWING	<input type="checkbox"/>	OK ✓
3.6	INSTALL REPLACEMENT NRN/RETB PSU	<input type="checkbox"/>	OK ✓
3.7	INSTALL RETB NG ANTENNA & ANTENNA CABLE TO DRAWING	<input type="checkbox"/>	OK ✓
3.8	INSTALL NEW WIRING TO DRAWING	<input type="checkbox"/>	OK ✓



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## Appendix A - cont'd.

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### TORQUE CHECK REF.

### DESCRIPTION

MP-C0-00067	Dummy Connector and Adapter Brackets to Existing RETB bracket fixing screws, M8, 4 off, 25Nm.	<input type="checkbox"/>	OK ✓
MP-C0-00067	Brace to pillar web and Dummy Connector fixing screws, M6, 2 off, 11Nm.	<input type="checkbox"/>	OK ✓
MP-C0-00067	P-clips to window pillar web fixing screws, M5, 6 off, 6Nm.	<input type="checkbox"/>	OK ✓
MP-C0-00068	Handset Mounting Box to bulkhead fixing screws, M5, 6 off, 3.5Nm.	<input type="checkbox"/>	OK ✓
MP-C0-00068	Handset to Mounting box fixing screws, M5, 2 off, 6Nm.	<input type="checkbox"/>	OK ✓
MP-C0-00068	Handset to trim panel fixing screws, M5, 2 off, 6Nm.	<input type="checkbox"/>	OK ✓
MP-C0-00069	Junction Box to Back Plate fixing screws, M5, 4 off, 3.5Nm.	<input type="checkbox"/>	OK ✓
MP-C0-00069	Junction Box Cover to Back Plate fixing screws, M5, 4 off, 6Nm.	<input type="checkbox"/>	OK ✓
MP-C0-00069	Junction Box Back Plate to Support Brackets fixing screws, M5, 8 off, 6Nm.	<input type="checkbox"/>	OK ✓
MP-C0-00069	Support Bracket to NRN Housing fixing screws, M6, 6 off, 11Nm.	<input type="checkbox"/>	OK ✓
MP-C0-00073	Junction Box to Back Plate fixing screws, M5, 4 off, 3.5Nm	<input type="checkbox"/>	OK ✓

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MP-C0-00073	Junction Box Cover to Back Plate fixing screws, M5, 4 off, 6Nm.	<input type="checkbox"/>	OK ✓
MP-C0-00073	Junction Box Back Plate to Bulkhead fixing screws, M5, 4 off, 6Nm.	<input type="checkbox"/>	OK ✓

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## Appendix A - cont'd.

Locomotive No. 37 .....

### Pre-Modification Legacy RETB Function Test

3.1 RETB Pre Modification Tests to Completed OK

OK✓

#### Antenna Cables Point to Point Continuity Test

Recorded  
Value

Pass Value

4.1.1 Conductor Pin/Socket each end

$\Omega$

must be  $\leq 0.5\Omega$

4.1.1 Sheath Outer each end

$\Omega$

must be  $\leq 0.5\Omega$

4.1.2 Conductor Pin/Socket each end and  
Harness Sheath Outer

$\Omega$

must be  $\geq 20M\Omega$

4.1.2 Outer Sheath and Vehicle Welded Structure

$\Omega$

must be  $\geq 20M\Omega$

4.1.2 Conductor Pin/Socket and Vehicle Welded  
Structure

$\Omega$

must be  $\geq 500k\Omega$

#### Cables Insulation Test

Recorded  
Value

Pass Value

4.2.3 Vehicle structure and bundled cable

$\Omega$

must be  $\geq 20M\Omega$

#### VSWR – VHF Harness (RNG008) only

Recorded  
Value

Pass Value

4.3.3 VSWR @ 185MHz

must be  $\leq 3:1$

#### VHF (Whip) Earth Bond Test


Recorded  
Value

Pass Value

4.4.2 VHF Antenna Earth Bond Test

m $\Omega$


must be  $\leq 10m\Omega$

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	Recorded Value	Pass Value
<b>GPS Antenna Earth Bond Test</b>		
4.4.3 GPS Antenna Earth Bond Test	<input type="text"/> mΩ	<i>must be ≤10mΩ</i>
<b>Electrical Bonding</b>		
4.5.1 Junction Box Bond Test (RNGE01)	<input type="text"/> mΩ	<i>must be ≤10mΩ</i>
4.5.1 PSU Bond Test	<input type="text"/> mΩ	<i>must be ≤10mΩ</i>
<b>Continuity Test</b>		
4.6.1 All Harnesses Point to Point Continuity Test as per Schematic Diagram	<input type="text"/> OK ✓	

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**Appendix A - cont'd.**

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**RETB Systems Function Test**

**4.7 RETB Function Test**

Test Completed OK

	OK ✓
--	------


**4.8 Final Inspection**

	OK ✓
--	------

DATE	TESTERS NAME (PRINTED)	TESTERS SIGNATURE

DATE	WITNESS NAME (PRINTED)	SIGNATURE

DATE	OWNER REPRESENTATIVE NAME (PRINTED)	SIGNATURE

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## 5.2 Appendix B - Handback Certificate

<b>Project</b>	RETB Class ____ installation	<b>Unit</b>	
<b>Depot/Road</b>		<b>Date/time</b>	

The following new equipment has be installed as detailed in the Vehicle Mod Procedure

<b>Cab A</b>		<b>Cab B</b>	
<b>Installed Equipment</b>	<b>Serial No.</b>	<b>Installed Equipment</b>	<b>Serial No.</b>
Kit		Kit	
Antenna GPS		Antenna GPS	
Antenna Whip		Antenna Whip	
Junction Box		Junction Box	
Handset		Handset	
CDR	N/A	CDR	N/A

Any Deficiencies, comments or Caveats are as detailed below:

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The above inspection has been carried out in accordance with the required documentation with any deficiencies noted above.

For Multipulse:

<b>Name</b>		<b>Date/Time</b>	
<b>Signature</b>		<b>Position</b>	

Accepted on behalf of:

<b>Name</b>		<b>Date/Time</b>	
<b>Signature</b>		<b>Position</b>	
<b>Company</b>			

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## 6. REVISION LETTER

This revision letter details the changes made in issuing VMP-RETB-004 to Issue 1, Revision A.

Section	Page	Change	Reason for Change
All	All	New Document	First Issue