PRELIMINARY PAGES

1 General Maintenance Notes

1.1 General

This maintenance manual details the maintenance to be carried out on Class 220 and 221 vehicles operated by Crosscountry Trains Ltd and maintained under contract by Bombardier Transportation.

The intervals and sequence of examinations that the work is to be carried out is contained in the Maintenance Star Chart. This is replicated on the Maintenance Management System (MMS) which will control the cycle for each unit and allow appropriate exam job cards to be raised at the required time.

For an explanation of the manual layout, refer to para 1.5 Manual Coding System.

1.2 Maintenance Schedule

The Maintenance Schedule for the preventative maintenance is held within the Maintenance Manual (BTMS/M/0012). This document is separated in to 100 and 200 series tasks, for 'preventative' and 'arising' work respectively. The preventative tasks cover all planned maintenance work anticipated on all of the train systems. Within this document, the periodicity of every preventative maintenance task is defined within the header of each task, however alternatively it can be documented in an approved 'Vehicle Maintenance Schedule'.

The Maintenance Manual provides task periodicities. Scheduled examinations are carried out on the following basis:

1.2.1 Miles Run.

All exams within the balanced ‘CORE’ (C1 and C2) exam regime shall meet the prescribed periodicities of 35,000 miles or 70,000 miles depending on the specific task. If a balanced ‘CORE’ examination is performed early or late, the periodicity to the next exam will be planned from the completion date and actual mileage of the balanced exam.

1.2.2 Calendar Days.

All tasks within the balanced ‘SERVICE (S1-S8) exam regime shall meet the prescribed periodicities of 45 days (+2 days tolerance) or multiples thereof. If a ‘SERVICE’ exam is

performed early or late, the periodicity to the next exam will be planned from the completion date of the Service exam.

1.2.3 Calendar Days or Miles Run.

All exams within the balanced 'MAINTENANCE VISIT (MV1-MV8)' exam regime shall meet the prescribed periodicities of 3 months or 75,000 miles (+5% tolerance) or multiples thereof up to 24 months or 600,000 miles. If a balanced 'MV' examination is performed early or late, the periodicity to the next exam will be planned from the completion date or actual mileage of the balanced 'MV' examination.

Where the task is not included within the scheduled balanced exam then that task shall meet the prescribed periodicities within a tolerance of 5% (up to a maximum of 18 days after the unit has achieved the prescribed periodicity or mileage).

Note: This tolerance **can not** be applied to the following tasks;

- TC104 – Cardan Shaft - Change,
- BB107 – automatic measurement of class 220 brake pads
- BB108 – automatic measurement of class 221 brake pads
- TD105 – Final Drive – Change
- UW113 - HVP Bogie, Wheelsets - Removal and Installation

If an examination is performed early or late, the periodicity to the next exam will remain as planned from the theoretical date of the previous exam.

In exceptional operational circumstances where a vehicle is unable to return to a suitable maintenance location for a scheduled exam prior to exceeding the prescribed periodicities, Central Rivers Engineering shall be consulted and an appropriate course of action agreed, implemented and documented via the concession process.

Where the content/scope of a task is approved within the Maintenance Manual (either as a discreet maintenance instruction or as an element within a maintenance instruction), then this is permitted to be undertaken, at the discretion of The Maintainer, at a more frequent interval than that specified in the Maintenance Schedule.

The examination pattern and periodicities shall be monitored and controlled using the Maintenance Management System (MMS), Maximo.

Moving exams within the balanced exam schedule without changing the task periodicity may be carried out.

If the task periodicity or scope is being changed, the "P/3042 VMI/Maintenance Task Change Approval Process" applies and must be adhered to.

1.2.4 Automated Vehicle Inspection System (AVIS)

Automated Vehicle Inspection, at software revision level: [PRO687**Z**_58-00030_037568_A_VEMS_System_Software] is used at Central Rivers depot to measure and record a number of maintenance parameters as defined in the Maintenance Manual.

The AVIS system is currently approved to measure and report the following parameters;

- Brake pad thickness for class 220 and class 221
- Brake disc thickness for class 221

Manual inspection capability is retained for brake pad and disc measurement in case measurement by AVIS is not available. The maintenance plan therefore refers to a task and periodicity for both methods. The automatic method is the default method. The process for reverting between automatic inspection and manual inspection is defined for brake pads within the tasks BB107 and BB108 (for classes 220 and 221 respectively) and for class 221 brake disc within the task UW110.

The methodology for determination of minimum acceptable brake pad thicknesses is defined in document VXC.BT(JM).20141008.PTD and should be used when making future changes.

Evidence obtained during automatic inspection, and evidence that the inspection took place within the required periodicity is retained by the VEMS module within the AVIS equipment, and broadcast via Internet link to Bombardier. Hence this evidence is an exception to the requirement to retain all vehicle maintenance records with the defined MMS (Maximo).

1.3 Exceptions to the Defined Maintenance Schedule

Important Guidance Notes:

All exceptions/limitations detailed in this section are valid and correct at point of issue of this Maintenance Manual (BTMS/M/0012 Issue 4). Any subsequent amendments to these existing exceptions/limitations and any subsequent new exceptions/limitations shall be documented on the associated fleet's current valid Certificate of Engineering Acceptance.

For the avoidance of doubt, where amendments to exceptions/limitations in this section are detailed on the associated fleet's Certificate of Engineering Acceptance, the relevant exception/limitation on the Certificate of Engineering Acceptance shall always take precedence.

This Maintenance Manual should therefore always be considered in conjunction with the relevant fleet's current valid Certificate of Engineering Acceptance.

Where an undertaking has been made to an approval body (VAB, ICP or Operators) to

further assess components, systems or procedures as part of a mitigation for continued or extended operation, the details of the components to be further assessed, along with the scope of assessment, sample size and date/mileage criteria shall be detailed in VXC.BT(DR).20090819.015 Revision 9 Condition Assessment Plan to Support Maintenance Manual.

Class 221 Exceptions

1. Class 221 Vehicles may operate with bogies that have accumulated up to 1,000,000 miles since the 2nd Bogie Light Overhaul, up to a maximum of 4,040,000 miles from new to the 2nd Bogie Heavy Overhaul cycle. Thereafter the periodicity shall return to a 900,000 miles periodicity to the 3rd Light Overhaul at a maximum mileage of 4,940,000.

2. To support a recurring 1.4m mile periodicity final drive overhaul, and permit vehicles to operate with final drives that have accumulated more than 4,200,000 miles from new, the following operator imposed limitations must be closed out.

Limitations:

1. The 'clarifications' and ' further requirements' raised in VAB letter NS/CB/LL/050/13 dated 05/12/13, and 'close-out' actions/'recommendations' in report VXC.BT(PF).20131107.001 Rev 03, shall be addressed within the time/mileage constraints stipulated.

Extract from approval for recurring 1.4m mile Final Drive Overhaul (MCR 049)

The limitations referred to above will be managed via the Voyager Project Heavy Maintenance Plan and Component Assessment Plan refered to above.

3. Vehicles shall not operate with brake callipers and actuators that have accumulated in excess of 1,800,000 miles since the last overhaul (which formed a part of the bogie heavy overhaul). To remove this limitation, further condition assessments shall be undertaken in accordance with Bombardier document VXC.BT (DR).20090819.015 Revision 9, section 1.1 and 1.2, the results agreed with an ICP, and the Maintenance Plan re-certificated.

4. Vehicles shall not operate with radial arm (Hall) bushes that accumulate in excess of 900,000 miles from fitment (installed at second bogie 'light' overhaul). To remove this limitation, conditional assessment shall be completed in accordance with Bombardier document VXC.BT(DR)20090819.015 Revision 9, section 7.1, results agreed with an ICP and the Maintenance Plan re-certificated.

5. Vehicles shall not operate without a conditional assessment of permanent coupler

condition as detailed in Bombardier document VXC.BT (JM)20150817.001.

6. Not withstanding that under scheduled Task UW113 (HVP Bogie, Wheelsets, Removal and Installation), HVP wheelsets are permitted to operate up to a maximum of 1,400,000 miles between replacements, the axle bearings installed on these wheelsets are subject to the following limitations:

- *Maximum permitted operation for axle bearings fitted from new (R0) of 1,200,000 miles. In addition it is also permitted for a maximum of 3% (at any given point in time) of fleet quantity of wheelsets fitted with R0 bearings to operate to a maximum of 1,300,000 miles.*
- *Maximum permitted operation for axle bearings which have been re-qualified (in accordance with document TF/TT025, Axle Roller Bearing Overhaul Acceptance Standard) once (R1) of 1,200,000 miles from re-qualification, up to a maximum of 2,400,000 total accumulated miles.*
- *Maximum permitted operation for axle bearings which have been requalified (in accordance with document TF/TT025, Axle Roller Bearing Overhaul Acceptance Standard) more than once (R2+) of 900,000 miles from last re-qualification.*

Class 220 Exceptions

1. Bogie dampers.

Both ZF and MSA manufactured dampers are approved to fit to class 220, but with different overhaul periodicities. Vehicles fitted with ZF lateral or yaw dampers must have conditional assessment completed at 600k and 800k miles from new as described within Bombardier document VXC.BT(DR)20090819.015 Revision 9, sections 2.1 and 2.2, the results analysed and any required changes to the Maintenance Plan agreed with an ICP and the vehicles re-certificated.

2. To support a recurring 1.4m mile periodicity final drive overhaul, and permit vehicles to operate with final drives that have accumulated more than 4,200,000 miles from new, the following operator imposed limitations must be closed out.

Limitations:

1. Bombardier shall demonstrate how the 'Clarifications' and 'Further Requirements' stipulated in Atkins letter NS/CB/LL/047/13, dated 19/11/13, will be recorded and planned, such that actions are undertaken at appropriate times in the gearbox life to address these conditions.

2. Bombardier shall supply appropriately signed and dated Final Drive Mileage Extension Examination reports by 28/02/14.

Extract from approval for Recurring 1.4m mile Final Drive Overhaul (MCR 046)

The limitations refered to above will be managed via the Voyager Project Heavy Maintenance Plan and Component Assessment Plan refered to above.

3. Vehicles shall not operate without a conditional assessment of permanent coupler condition as detailed in Bombardier document VXC.BT (JM)20150817.001.

Exam Schedule

Table 1 – Exam task schedule

The following table shows the exam schedule for this fleet. Note: CORE, SERVICE and MV exams are modular.

Exam title	Limitation
CORE	35,000 miles
SERVICE	45 days
MV	3 months or 75,000 miles
O	3 Years or 900,000 miles
P	4 Years or 1.200,000 miles
Q	6 Years or 1,800,000 miles
S	1,950,000 miles
T	9 Years or 2,700,000 miles
U	10 Years or 3,000,000 miles
V	12 Years or 3,600,000 miles
W	15 Years or 4,500,000 miles
S	16 Years or 4,800,000 miles
T*	18 Years or 5,400,000 miles
U	20 Years or 6,000,000 miles
O	21 Years or 6,300,000 miles
Y	24 Years or 7,200,000 miles
T	27 Years or 8,100,000 miles
W*	30 Years or 9,000,000 miles

* - Differs from previous version but highest level content referenced.

1.4 Vehicle Identification

The individual Class 220 and 221 vehicle types are identified by 12 distinct vehicle designations.

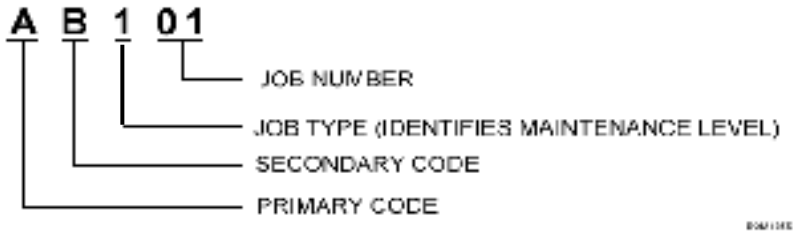
- 'T' refers to Tilting Vehicles
- 'NT' refers to Non Tilt Vehicles
- 'AT' refers to Arriva Tilt Vehicles, where tilt has been de-commissioned

The Rolling Stock Library vehicle designation refers to the car kind and does not distinguish between tilting and non-tilting trains.

The painted number is that painted on the exterior and interior of the vehicles

Painted Vehicle Designation	Bombardier Vehicle Designation	Rolling Stock Library Vehicle Designation	Description of Vehicle
603	NT1/T1/AT1	DMSL	Driving Motor Standard Luggage
607	NT2/T2/AT2	MS(A)	Motor Standard (A)
602	NT3	MS(C)	Motor Standard (C)
608	T3/AT3	MS(B)	Motor Standard (B)
609	T3/AT3	MS(C)	Motor Standard (C)
604	NT4/T4/AT4	DMF	Driving Motor First

1.5 Manual Coding System



Primary Code

Identifies the type of equipment by vehicle system.

Secondary Code

Identifies the type of equipment within a vehicle system.

Job Type

A job which has a maintenance periodicity is a 1xx series Maintenance Instruction.

A job which has no maintenance periodicity is a 2xx series Work Instruction.

Job Number

Defines the job with a unique sequential number.

Example

For the above code:

Primary Code	A	=	Air System
Secondary Code	B	=	Blocks/Pads
Job Type Code	1	=	Maintenance Instruction
Job Number Code	01	=	Unique Number

Up until April 2012, this coding system has been utilised further to identify parts in the stores and on the MMS. This is detailed in P/1501 `coding structure for commodity codes'.

From May 2012 onwards, all new parts will be allocated identification numbers based on the standard Bombardier PDM format, 3EEC2000X-XXXX. This will be reflected in the MMS and maintenance instructions.

1.6 Maintenance Facilities

In order to carry out this Maintenance Schedule, the following minimum level of facilities are required, appropriate to the jobs being undertaken:

	EXAMINATION		
FACILITY DESCRIPTION	**Fuel Point**	**CORE & SERVICE**	**MV & above**
Safe access to the vehicle - including protection from movements.	X	X	X
Covered well-lit accommodation for the vehicle, e.g. maintenance shed.		X	X
Access to the vehicle underframe, e.g. maintenance pit or raised rails.		X	X

Access to roof equipment e.g. un-wired road or facility for local isolation of Overhead Line Equipment. Plus safe system of access and working e.g. fall and arrest system.		X	X
Lift or jacking facilities for raising the vehicle to remove the bogies.		X	X
Handling facilities for removal and refitting of components such as traction and underframe mounted equipment, bodyside doors and buffing and drawgear components.		X	X
Cleaning facilities which will not cause damage to the vehicle or components.		X	X
Facilities for undertaking Non-Destructive Testing in accordance with Railway Group Standard GM/RT2466 and RIS-2701-RST.			X
Maintenance Management System	X	X	X

1.7 Staff Competency

In order to carry out this maintenance plan in a manner that will achieve the required safety and quality, the following minimum level of competence is required:

- All Safety Critical Work must be carried out by persons competent in accordance with Railway Group Standard GO/RT3260 or the process declared by the supplier to the Engineer for compliance with Railway Group Standard GO/RT3260 and Railway Safety Critical Work Regulations 1994. Staff undertaking these tasks should have a Safety Critical Work Identification.

- Persons competent in accordance with Railway Group Standard GM/RT2004 and GM/GN2646 shall carry out all work relating to the maintenance and overhaul of axle bearings.

- The Non Destructive Testing (NDT) of safety critical components (including Ultrasonic Axle Testing) shall be done in accordance with Railway Group Standards GM/RT2466 and RIS-2701-RST.

- **System Trained**

(a) Staff undertaking this task should have completed system training on the relevant system. This level of training should ensure that staff have a good understanding of the system as a whole. They not only recognise what they may find during the task, but also understand how to rectify the situation and the potential effects of their actions.

- **Job Trained**

(a) Staff having gained the relevant skill level and experience together with the knowledge necessary to be deemed capable to undertake the specific task.

- The grades of staff undertaking maintenance to Class 220/221 vehicles are as follows:

Bombardier provides `Training and selection' programmes designed to ensure that employees are suitably equipped to perform the duties to which they are appointed. Employees are provided with the knowledge and capability to:

- perform their duties safely and effectively

- discharge their responsibilities towards safety and

- comply with the requirements specified in legislation and RGSs.

Staff Grades

The grades of staff employed to undertake maintenance tasks on Class 220/221 units at Bombardier sites are as follows:

(a) **Assistant**

- Competent to undertake maintenance tasks, having received the appropriate 'Job' or 'System' training, includes being able to undertake 'Safety Critical Work'.

(b) **Improver**

- An artisan in a transitional role from Assistant to being a Technician after attaining the necessary qualifications, utilised as an Assistant but competent to undertake a degree of fault finding and fault diagnosis.

(c) **Technician**

- Of a skill level higher then an Assistant, will be qualified in an accredited Engineering Technical qualification. Competent to undertake fault finding and fault diagnosis tasks.

(d) **Supplier Approved**

- Accredited to undertake work after attending a supplier approved course. Staff undertaking Maintenance Instruction OR105 `Passenger Doors - General Inspection, are required to be approved to work on Faiveley Doors.

All staff using MMS shall be competent in accordance with P/10042 Competency Management System.

1.8 Standard Instructions Applicable to All Examinations

Before any examination is started all safety precautions must be carried out as detailed in the Safety Notes Section of this Manual and local Depot Instructions.

Before any examinations are carried out the Maintenance Management System (MMS) must be checked by an authorised person (as nominated by the person in overall charge at the maintenance depot/point). If the authorised person has decided a repair can be deferred he must:

- Endorse the MMS that the repair has been deferred.

- Advise Bombardier Transportation Maintenance Control Shift Engineer in all cases.

- If a further deferment is necessary due to lack of spare parts, endorse the MMS to name the component that is awaited as per P/1510.

It is not acceptable to defer repairs in the following circumstances:

- Repairs, which affect the correct operation of the brakes or the effectiveness of the brake system, must not be deferred.

- Repairs which in any way affect the safe operation of the train or vehicles whilst under the control and operation of Arriva Crosscountry must not be deferred.

- Repairs, which limit the operational performance, but not the safe operation of the train or vehicle, can only be deferred with the agreement of the Bombardier

Transportation Maintenance Control Shift Engineer. Where appropriate the Bombardier Transportation On-Call Engineer and responsible representative of Arriva Crosscountry will be consulted.

- The Bombardier Transportation Maintenance Control Shift Engineer shall identify any necessary restrictions on the operation of the vehicle or train and ensure that any restriction applied to the train or vehicle is advised to the relevant operators Service Delivery Centre. The operators Service Delivery Centre shall incorporate the restriction into the relevant operating systems such that all Arriva Crosscountry train lists report the vehicle operation restriction.

- Repairs shall not be deferred beyond the next programmed exam of any type except with the agreement of the Bombardier Transportation Maintenance Control Shift Engineer and where necessary Bombardier Transportation On Call Engineer. In all such cases the MMS should be endorsed, as previously stated.

- In all cases deferred repairs must be controlled within the terms of the Train Service Agreement between Bombardier Transportation and Arriva Crosscountry Trains. Auditable records of the work deferred and subsequent action taken to rectify the situation shall be maintained and retained at a central point. The records should be reviewed regularly by Bombardier Transportation and a periodic report supplied to Arriva Crosscountry Trains identifying trends in deferred work and the necessary corrective action.

Before the unit is returned to service the authorised person must be satisfied that the Examination and the Repairs have been completed and signed:

- Relevant Examination and Repair Job Cards.

- All work arising is logged.

- All job cards are closed and necessary configuration changes and status updates carried out on the MMS.

Each Maintenance Job applies to all relevant components where there are more than one on the unit.

All components deemed critical shall be uniquely identified on all corresponding repair records together with detailed fault/repair details.

All lubrication points must be cleaned prior to lubrication. Lubricant remaining on lubricating points and issuing from seals must be cleaned off on completion.

In all torque tightening operations, after the correct value has been achieved, use a paint

pen to mark a line bridging the torqued fastening and the adjacent surface.

1.9 Welding Operation

When welding operations are being carried out on a vehicle, the welding return lead must be secured as near as possible to the point of welding. All electronic devices must be individually short circuited. The return lead must never be attached to the running rail or in a position where return current may cause damage to vehicle components, especially couplers, wheelsets, axle bearings, etc. Refer to Procedure P/0092 Electrical Isolation of Vehicles Prior to Welding.

1.10 Storage, Handling and Transportation of Wheelsets

The storage, handling and transportation of wheelsets shall be undertaken in accordance with the requirements of 'GM/GN2498 Guidance on Wheelset Handling, Storage and Transportation' and the MMS kept up to date with the location, status and configuration of every wheelset.

1.11 Continuity Testing

Use only an Avometer (Model 8 or 9), or Cirtest (Type 13) or Digital Multimeter (Fluke 77).

Note:

Care should be taken when using Cirtest or Digital Multimeter because of false readings that may be obtained due to false back feeds being highlighted by this type of equipment.

1.12 Isolation of Faulty or Redundant Cables

Whenever it is necessary to remove or isolate a faulty or redundant cable, it is essential that work is carried out in accordance with Technical Procedure CR/TP1084 and BTS-TP-0004 Management of Practice to Maintain System Isolation on Rail Vehicles.

1.13 Electrical Testing

The procedure of ringing out circuits with a bell set or test lamp when they are energised can produce transient voltages, which may damage a semiconductor device. An approved continuity testing device must be used. If none is available all semiconductor devices must be isolated before testing is carried out.

The normal procedure for insulation testing is likely to produce transient voltages, which may damage a semiconductor device. Therefore all such devices must be individually short-circuited before testing is carried out.

Note:

After testing all temporary wiring must be removed.

If any bonds are found to be damaged (any frayed/broken strands, broken insulation or showing signs of heating discoluration or oxidisation), they should be replaced in accordance with P/0056 with reference to the materials table, ensuring that the contact faces are clean and de-greased before tightening to figure above. On completion apply a coating of Denso paste to provide an anti corrosion barrier.

If any bonds are found to have signs of heavy corrosion they should be replaced in accordance with P/0056 with reference to the materials table.

1.14 Power Operated Door Test

Procedure BTMS/P/0041 `Special Investigation – Passenger Exterior Powered Doors' for Class 220/221 vehicles must be carried out when any reported `wrong side' incidents have occurred with the Power Operated Doors.

1.15 Vehicle Interior Cleaning

Vehicle interior cleaning shall be carried out in accordance with BTMS/M/0002 'Class 220/221 Vehicle Cleaning Instruction'.

1.16 Depot Records

Records of examinations and repairs for each vehicle must be kept and be examined monthly by the appropriate person in charge.

All defects revealed by an examination must be entered on to the MMS and brought to the attention of the person in charge.

All paper records of examinations, tests defects and repairs must be kept locally in the depot vehicle history files for a minimum of five years.

Evidence obtained during automatic inspection of brake pads, and evidence that the inspection took place within the required periodicity is retained by the VEMS module within the AVIS equipment, and broadcast via Internet link to Bombardier.

1.17 Safety Related Defects

Safety related defects must be recorded on the MMS and classified as PRIORITY 1 and must be brought to the attention of the person in charge not later than on completion of the Work Block.

1.18 Signalling and Communication Equipment Defects

All failures of train borne signalling and communication equipment must be documented and managed in accordance with GE/RT8106 `Management of Safety Related Control,

Command and Signalling (CCS) System Failures'.

1.19 Product Quality

All materials used for maintenance will be in accordance with the specifications defined in this Schedule. In the event of their non-availability, use of substitute materials will only be with the permission of the Engineer. Only items with QA classifications will be used.

It is the responsibility of the person in overall charge at the maintenance depot/point to ensure that on completion of the specified maintenance examination the vehicle is satisfactory in quality and content of the work authorised by the Engineer, and that all work conforms to the defined standards and the MMS reflects the state of the unit. All materials must be issued from stores to the appropriate job line on the job card.

1.20 Operational limits

Operational limits on the Arriva Class 220/221 fleet are defined by the Engineering Acceptance certificate for each fleet

1.21 Definitions

Within this Instruction, any of the terms used from the following list will be regarded as having the meaning stated:

Term	Definition
Adjust	Correct to defined limits.
Caution	Take care as equipment integrity may be damaged.
Change	Remove the original part and fit replacement part or assembly in its place.
Check	Determine a particular nominated condition. For example, completeness of task, security, position or function.
Clean	Remove all dirt and deposits.
Defect	Any fault or faults in a component or assembly, e.g. structural fractures/Defective or weld fractures, which may prevent the component or assembly from fulfilling its designed purpose.
Dismantle	Take to pieces.

Discard	Scrap the original part and provide a replacement part, new or overhauled.
Examine/Inspect	Determine the general condition of the component. That is, conformity to required specification. For example, wear, cracks, splits, leaks, scoring, distortion, looseness, corrosion, breaks.
Engineer	Authorised representative skilled and trained within the required disciplines.
Gauge/Measure	Determine a nominated dimension by using suitable measuring equipment. For example, ruler, micrometer, callipers, feeler gauge or Go/Not Go gauge.
Note	Helpful information.
Overhaul	Do what is necessary to make a component 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.
Rectify	Set right (does not include rewinding or renewal).
Refit	Put back and reconnect.
Remove	Disconnect and take off.
Renew	Remove and discard the original part and provide a new specified part in its place.
Repair	Restore an original part to the required condition. For example, by hand tooling, machining, building up, welding, patching, bending and setting, heat treatment (does not include rewinding or renewal).
Report	Convey to the person in charge the condition of the item examined.
Safety	Unique instructions to be carried out by the technician conducting the task.
Safety Condition	The state in which the vehicle must be prior to commencing work.
Strip	Remove covering, for example, paint, polish or fabric.
Test	Prove correct operation and performance by specified trial.

Warning Take care as personal safety and or the safety of others may be in danger.

1.22 Water Systems

All water introduced into any system of any vehicle must be considered as potable. The tasks defined in the Maintenance Plan are designed to ensure that all systems comply with legal requirements, ATOC guidance and best practise for drinking water, even if the water is used in a non-potable system (eg toilet fresh water tanks)

1.23 Abbreviations

Abbreviation	Meaning
A/C	Air Conditioning
ACC	Accumulator
ACIC	Auxiliary Control Isolating Cock
ACU	Analogue Control Unit
AFFF	Aqueous Film Forming Foam
ASPS	Air Suspension Pressure Switch
AVIS	Automatic Vehicle Inspection System
AWS	Automatic Warning System
BCU	Brake Control Unit
BPPS	Brake Pipe Pressure Switch
BPVC	Brake Pipe Vent Cock
BSR	Brake Supply Reservoir
BSRPS	Brake Supply Reservoir Pressure Switch

CG	Compressor Governor
DMU	Diesel Multiple Unit
DRA	Drivers Reminder Appliance
ECPU	Electronic Control and Process Unit
EDCU	Electronic Door Control Unit
FFCCTV	Forward Facing Closed Circuit Television
ESD	Electrostatic Sensitive Devices
GSM-R	Global Systems for Mobile Communication - Rail
HST	High Speed Train
LMRG	Low Main Reservoir Governor
MMS	Maintenance Management System
MRBC	Main Reservoir Brake Cylinder
MRP	Main Reservoir Pipe
NRN	National Radio Network
OTMR	On Train Monitor and Recorder
PB	Parking Brake
PBPS	Parking Brake Pressure Switch
PCB	Printed Circuit Board
PSU	Power Supply Unit
SCA	Supplemental Coolant Additive
SS	Stainless Steel
TASS	Tilt Authorisation Speed Supervision
TCA	Track Circuit Assister/Actuator
TCU	Tilting Control Unit (Hydraulic Cylinder)

TLCADP	Tilting Local Controller Adapter Card
TLC	Tilting Local Controller
TMC	Tilting Master Controller
TMCADP	Tilting Master Controller Adapter Card
TMS	Train Management System
TPCU	Tilting Power and Control Unit
TPWS	Train Protection and Warning System
UAT	Ultrasonic Axle Testing
VEMS	Vehicle Equipment Measuring System
VMI	Vehicle Maintenance Instruction
VMP	Vehicle Mounting Plate
WC	Water Closet
WCV	Water Closet Vacuum

1.24 Torque Tightening

In all torque tightening operations, after the correct value has been achieved, use a paint pen to mark a line bridging the torqued fastening and the adjacent surface.

1.24.1 Threaded Fasteners

Tightening of Threaded Fasteners

(a) Where a torque loading is specified, nuts must only be tightened by means of a calibrated torque wrench. If the Maintainer considers that any joint where torque loadings are not specified is critical, he shall consult the Engineer.

(b) Threads are not to be lubricated but a thin film of corrosion inhibitor can remain on the threads.

(c) It is essential to check that all bolts, in a multi-hole fixing, carry their allotted 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. Torque is to be applied slowly and evenly.

(d) Unless otherwise specified slotted 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.

(e) A minimum of 2 complete threads of the bolt must be protruding through the nut when a nut/bolt fastening is used.

Prevailing Torque Nuts

(a) Where Grade 8 or Grade 12 prevailing torque nuts of the bent beam type are specified, the nylon insert type may be used in order to obtain economic supplies. However, under no circumstances may a nylon insert type nut be used on a drilled bolt.

(b) Only Vargal type prevailing torque nuts to be used on bogies.

Castellated Nuts and Split Pins

(a) Where a castellated nut and split pin are specified these must be used.

Renewal Policy

(a) All split cotter pins, star washers, locking tabs spring washers and torque prevailing nuts (except Vargal type if they are not damaged) removed during maintenance **MUST BE RENEWED**. All other fasteners removed during this maintenance shall be renewed if any of them is worn or distorted.

1.25 List of Associated/Reference Documents

The following list details all the documents associated with and used throughout these Maintenance and Work Instructions. If a document is required for a Maintenance or Work Instruction it will be listed in the task's Associated/Reference Documents table.

Instruction	Associated Reference Document

AC201	Knorr-Bremse COI, 2-1159-20 Issue 1 (SOP) & 1-1159-2 Issue 15 (Test) – Screw Compressor
AE201	Knorr-Bremse COI, 2-865-043 Issue 2 (SOP) & 1-865-22 Issue 4 (Test) – Air Dryer Unit
AH202	Trent Instruments COI, HRP4 Issue 3 – 4-Way Control Valve
AH203	Knorr-Bremse COI, 2-1188-30 Issue 1 (SOP) & 1-1188-13 Revision 8 (Test) – Horn Panel
BB107	VXC.BT(JM)20140408.001 rev 1 Brake Pad Thickness Change Supporting Information
BB108	VXC.BT(JM)20140408.001 rev 1 Brake Pad Thickness Change Supporting Information
BH102	BTMS/M/0010 Chap B, Fault Finding
BT103	D85855/001 Issue 01 Voyager 9 year Overhaul [BCU] – Knorr Bremse COI
	6WBL0015 D85300/4801 Brake Intfc Voyager 9 year overhaul Issue 1.0 20/10/09
	6WBL0014 D85300/4768 Brake Slide Voyager 9 year overhaul Issue 1.0 20/10/09
BT201	Knorr-Bremse COI, 2-692-34 Issue 5 (SOP) & 1-692-56 Revision 32 (Test) – Variable Load Valves
	Knorr-Bremse COI, 2-1029-151 Issue 3 (SOP) & 1-1029-151 to 154 Revision 9 and 1-1029-155 to 158 Revision 10 (Test) – Control & Relay Valve
BT202	Knorr-Bremse COI, 2-736-50 Issue 2 (SOP) & 1-736-50 Issue 4 (Test) – Auxiliary Control Valve
BV205	Knorr-Bremse COI, 2-631-055 Revision 2 (SOP) & 1-631-45 Revision 0 (Test) – Combination Valves
BV206	Knorr-Bremse COI, 2-632-14 Issue 3 (SOP) & 1-632-14 Issue 1 (Test) – Anti Compound Double Check Valve
BV207	Knorr-Bremse COI, 2-786-92 Issue 1 (SOP) & 1-786-92 Issue 4 (Test) – Relay Valve
BV212	Knorr-Bremse COI, 2-784-33 Issue 1 (SOP) & 1-784-33-S3 Revision 2 (Test) – Limiting Valve (5 Bar)
DU201	Cummins Overhaul Specification CDUKW1-52-00-0013

EP214	Type Test Program Plan, Televic Doc No 30410/D4
	Type Test General Overview, Televic Doc No 30410/D2
	Final Test Report -Routine, Televic Doc No 30409/C71
	System Description VCS, Televic Doc No 30409/D2
EP227	BTMS/M/0007, Training Manual
EP228	BTMS/M/0007, Training Manual
EP229	BTMS/M/0007, Training Manual
EQ201	Knorr-Bremse COI, 2-1057-28 Issue 3 (SOP) & 1-1057-10 Revision 5 (Test) – Power Brake Controller
	Knorr-Bremse COI, 2-7013-001 Revision 2 (SOP) & 6-7013-86 Revision 3 (Test) – PBC Encoder Unit
EY213	ESDN User Manual, Bulletin No 3885786
EY201	Knorr-Bremse COI, 2-850-04 Issue 5 (SOP) & 1-850-54 Revision 7 (Test) – Duplex Dump Valves
HA109	WI491 Issue B Voyager Saloon HVAC overhaul (FT UK)
HA110	WI492 Issue A Voyager Cab HVAC overhaul (FT UK)
HS201	Faiveley COI, TS072 issue 1, PPV Overhaul
KE105	BTMS/M/0002 Cleaning Manual
KE107	BTMS/M/0002 Cleaning Manual
LT101	Bombardier Transportation Paint Programme 819.E09.VE00
LT208	Unitor Operators Manual
M/1500	Work Instructions for the Maintenance Management System
MF201	BTMS/M/0010 Chap P, Fault Finding
MT107	Alstom Metal Spray Repair Procedure - Reclamation of the 4 EJA 1851 Traction Motor Shaft by Metal Spraying 2445.0128 Rev B
OY201	Interface Drawing E142721
OY207	Interface Drawing E142721

S*101	GE/RT8106, Management of Safety Related Control, Command and Signalling (CCS) System Failures
	GE/RT8250, Reporting High Risk Defects
SK102	BTMS/M/0010 Chap S, Fault Finding
TC104	GKN COI QP3.26 Cardan Shaft Overhaul Instruction
TD105	3EEC200004-7810 Rev_A, Overhaul Instruction – C221 Final Drive
	3EEC200004-8447 Rev_, Overhaul Instruction – C220 Final Drive
U*101	GM/GN2497 Guidance on Railway Wheelset Tread, Gauging and Damage
	GM/GN2498 Guidance on Wheelset Handling, Storage and Transportation
U*102	GM/GN2497 Guidance on Railway Wheelset Tread, Gauging and Damage
	GM/GN2498 Guidance on Wheelset Handling, Storage and Transportation
UA103	GM/RT2004 Rail Vehicle Maintenance
	GM/GN2646 Guidance on Axle Bearing Maintenance
UC101	Dellner COI 50489/0398/AC Issue 1.3 rev A
UC118	Dellner COI 50489/0398/PC Issue 1.4 rev A
UC119	Dellner COI 50489/0398/PC Issue 1.4 rev A
UF101	3EEC200003-9543 Component Overhaul Instruct Class 220 B5005 Bogie Off Vehicle Iss B
UF102	3EEC200006-7493 Overhaul Instruction 221NT HVP Heavy Bogie Overhaul
	WI 080TSL Turton Limited Spring Overhaul Works Instruction for Class 221 Springs (TSL A79/90 and A79/91), Original Issue, 04/05/10
	2.39 Tidy Co Component Overhaul Instruction Class 221 Air Brake Hoses 06/04/2010
	TP-1051-FS ACFM Inspection Procedure for Class 221 Bogie Frames using Bombardier ACFM System Issue 1 07/05/2010
	3EEC200004-1 352 Bush Renewal Spec Class 22X Bogies G-Box Torque Reaction Arm. Rev A 04/05/10
	3EEC200004-3422 Bush Renewal Spec Class 221 HVP Bogie Anti-Roll Bar Link

	Rev_ 04/05/10
UF103	3EEC200004-6904 Rev_, Overhaul Instruction B5005 Bogie Light Class 220
	3EEC200005-9314 Rev_, Overhaul Instruction B5005 Bogie Heavy Class 220
UF104	3EEC20004-9985 Rev_, Overhaul Instruction HVP Light Bogie Overhaul Class 221
UD101	05-03-09 Rev 2, Class 220/221 Component Overhaul Instruction for MSA Dampers (MSA).
UW102	GM/GN2497 Guidance on Railway Wheelset Tread, Gauging and Damage Identification
UW103	Bombardier Test Procedure RP-OPB5005HA (Auto)
	Bombardier Test Procedure ME-OPB5005HA (Manual)
UW109	GM/GN2498 Guidance on Wheelset Handling, Storage and Transportation
UW111	GM/GN2497 Guidance on Railway Wheelset Tread, Gauging and Damage Identification
UW112	Bombardier Transportation Procedure RP-OPHVPHA (Auto)
	Bombardier Transportation Procedure ME-OPHVPHA (Manual)
UW113	GM/GN2498 Guidance on Wheelset Handling, Storage and Transportation
UC203	Training Manual, BTMS/M/0007
UC235	Training Manual, BTMS/M/0007
UC238	Training Manual, BTMS/M/0007
UQ202	Bombardier Procedure 52171-489-919
UQ204	Bombardier Procedure 52171-489-919
UQ205	Bombardier Procedure 52171-489-919
UW203	BTMS/P/4014 Management of Tread Damage Guidance Notes
	BTMS/P/4026 Wheel Damage – Why Codes
UW205	52171-476-902 Bombardier Wheelset Policy Statement
	GM/GN2498 Guidance on Wheelset Handling, Storage and Transportation

	Faiveley (formerly SAB WABCO) Procedure TD5618
UW207	BTMS/P/4014 Management of Tread Damage Guidance Notes
	BTMS/P/4026 Wheel Damage – Why Codes
UW209	GM/GN2498 Guidance on Wheelset Handling, Storage and Transportation
	BTMS-M-0080 Issue B, Overhaul Instruction – Class 220 Wheelsets
UW210	GM/GN2498 Guidance on Wheelset Handling, Storage and Transportation
	BTMS-M-0082 Issue C, Component Overhaul & Repair Instruction – Super Voyager Class 221 Wheelsets
UW212	BTMS/P/0013 - Special Investigation - Collision/Derailment/Fatality/SPAD
	GM/GN2497 Guidance on Railway Wheelset Tread, Gauging and Damage
UW213	BTMS/P/0013 - Special Investigation - Collision/Derailment/Fatality/SPAD
	GM/GN2497 Guidance on Railway Wheelset Tread, Gauging and Damage
WT101	BTMS/M/0002 Cleaning Manual
WT103	BTMS/M/0002 Cleaning Manual
WT104	BTMS/M/0002 Cleaning Manual
All Tasks with Earth Bonds	P/0056 Issue A, Management of practices to maintain the integrity of earth bonding of rail vehicles
AH201	WES – SAF- AH012 Rev 2 Air Horn service maintenance
AH201	WES – SAF- AH013 Rev 1 Air Horn function test
IG201	WES – CAB – GRD 014 Rev 2 Driver seat service maintenance
IG201	WES – CAB – GRD 012 Rev 3 Driver seat function test
KS203	WES – CAT – UVS 014 Rev 3 UV Steriliser service maintenance
KS203	WES – CAT – UVS 013 Rev 4 UV Steriliser function test
ZB201	WES – U/F FBL 014 Rev 2 Fire bottle label fitting
LT207	WES – U/F FSV 014 Rev 2 Fuel flyte valve shut off valve service maintenance

	WES – SUR - CCT- 01 Rev 1 Rock guard foam replacement
BS204	WES – EXT RRB 014 Rev 2 Roof resistor bank service maintenance
WV112	WES – INT - TEA 014 Rev 5 Toilet ejector service maintenance
WV112	WES – INT – TDV 014 Rev 3 Toilet discharge service maintenance
KW206	WES – INT – WT 014 Rev 1 Water heater modification
	WES - UF – PCB 012 Rev 1 Burst cover repairs
ZA201	WES – UF – FSV 014 Rev 1 Fire ring assy repairs
All tasks requiring change	P/3042 VMI/Maintenance Task Change Approval Process

1.26 Maintenance Plan Documentation

The following section details additional documentation that is included in the Maintenance Plan:

Doc Number	Issue	Description	Date
TROS-907.483	Issue C	Traction Motor 4 EJA 1851 EMU – Virgin Cross Country	Sept 2007
P/3022	Issue I	Final Drive Oil Sampling Procedure	April 2013
P/4014	Issue E	Management of Tread Damage	Dec 2011
W/4014	Issue F	Management of Tread Damage – Guidance Notes	Mar 2011
BTMS/M/0002	Iss 1 Rev E	Class 220/221 Cleaning Manual	Nov 2003
BTMS/M/0003	Issue 7	Class 220/221	Feb 2007

		Operators Manual	
BTMS/M/0004	Issue 7	Class 220/221 Rescue and Recovery Manual	Feb 2007
BTMS/P/0006	Issue J	Class 220/221 Maintenance Plan	July 2003
BTMS/P/0014	Issue A	Class 220/221 Special Investigation – Speed indicating/WSP equipment	Mar 2001
BTMS/P/0022	Issue C	Voyager Defect Management Procedure	May 2007
BTMS/P/3001	Issue H	Procedure for Managing High Risk Defects	July 2014
BTMS/P/3011	Issue D	Procedure for Safety Related failures of Signalling and Operation Telecommunications Systems and Equipment (GE/RT8106)	Sept 2005
CDUKW1-52-00-0013	Issue 00	Power Pack Overhaul Specification 2	Oct 2003
VXC.BT(DR)20090819.015	Rev 9	Component Assessment Plan	Oct 2014

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