TRANSNET NUMBERING SYSTEM FOR INTERACTIVE ELECTRONIC MANUALS

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Prepared by	:	Waymark Infotech (Pty) Limited

Tom Higgins **Waymark**	**Date**

Approved by :

	Date
Transnet	

Waymark Infotech (Pty) Limited
P O Box 75434 Lynnwood Ridge 0040
Tel: (012) 369 0000
Fax: (012) 369 0500

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1. INTRODUCTION

The introduction of the updated Class 9E, 11E and 18E locomotives and the purchase of the new 15E and 19E locomotives introduced equipment, particularly in the electronic control systems, that had not been used on SA locomotives before. In addition, Transnet decided to use electronic viewers in order for engineers and technicians to 'view' the technical support documents for these new and updated locomotives over Transnet's Wide Area Network (WAN). This new method of viewing technical manuals 'electronically' required that each 'bit' of data be reduced to a relatively small 'data module' and allocated a unique identity. Technical documents produced as data modules and viewed electronically over a network are referred to as Interactive Electronic Manuals (IEM).

This series of events caused Transnet to review the numbering system used for the development of technical documents that has been in use over many years. The company Waymark Infotech Pty Ltd was selected to work with Transnet's technical personnel to develop a numbering system that satisfies the requirements of the new environment. In addition to the points already listed, the basic requirements for the new numbering system were:

a. The numbering system in use throughout various Transnet affiliations should be retained as far as possible.

b. The new system should make provision for the technical data sets for future locomotive purchases.

c. Uniformity between the different classes of locomotive must be obtained. For example, the Main Compressor on the Class 18E should have the same basic identity as the Main Compressor on the Class 19E, even though they have different specifications and are manufactured by different suppliers.

d. Should the need arise, it should be possible to adapt the numbering system to satisfy the requirements of other types of locomotive such as diesel electric locomotives.

2. PURPOSE

This document provides Transnet with a formal numbering system, as well as the approved data module breakdown, for use in the development of technical data for all electric locomotives that will use IEMs.

Transnet have selected the aXcess EDMan data module management software as their software tool for developing IEMs. The business rules built into the EDMan software will automate a large percentage of the effort involved in allocating a Data Module Code (DMC).

2.1 SCOPE

This document provides a breakdown of the numbering system to the detail of a DMC. It also includes a breakdown of the 3-element code that is used as the 'heart' of a DMC and includes the numbers currently used for the 9E, 18E and 19E equipment.

The nature of changes within locomotives and their equipment will

undoubtedly result in DMCs being required that are not catered for in this document. When such a situation arises, the specific documentation contractor should contact Transnet's Project Manager for advice on how to number such modules.

3. REFERENCED DOCUMENTS

The following documents are also applicable to the contents of this document:

a. Transnet's User Guide for Technical Authors, document number RT/TE/PRO/0217, dated 30 June 2009.

b. Transnet's Document Type Definition Manual, document number RT/TE/PRO/0218, dated 30 June 2009.

c. Transnet's aXcess Electronic Documentation Manager (EDMan) User Manual, document number RT/TE/PRO/0214, dated 30 June 2009.

d. Specification for Manual and Catalogues for Traction Vehicles, document number CSS.213/6.05, dated August 1985.

e. AECMA S1000D, International Specification for Technical Publications Utilising a Common Source Data Base has been used as an aid in compiling this document.

4. ABBREVIATIONS AND ACRONYMS

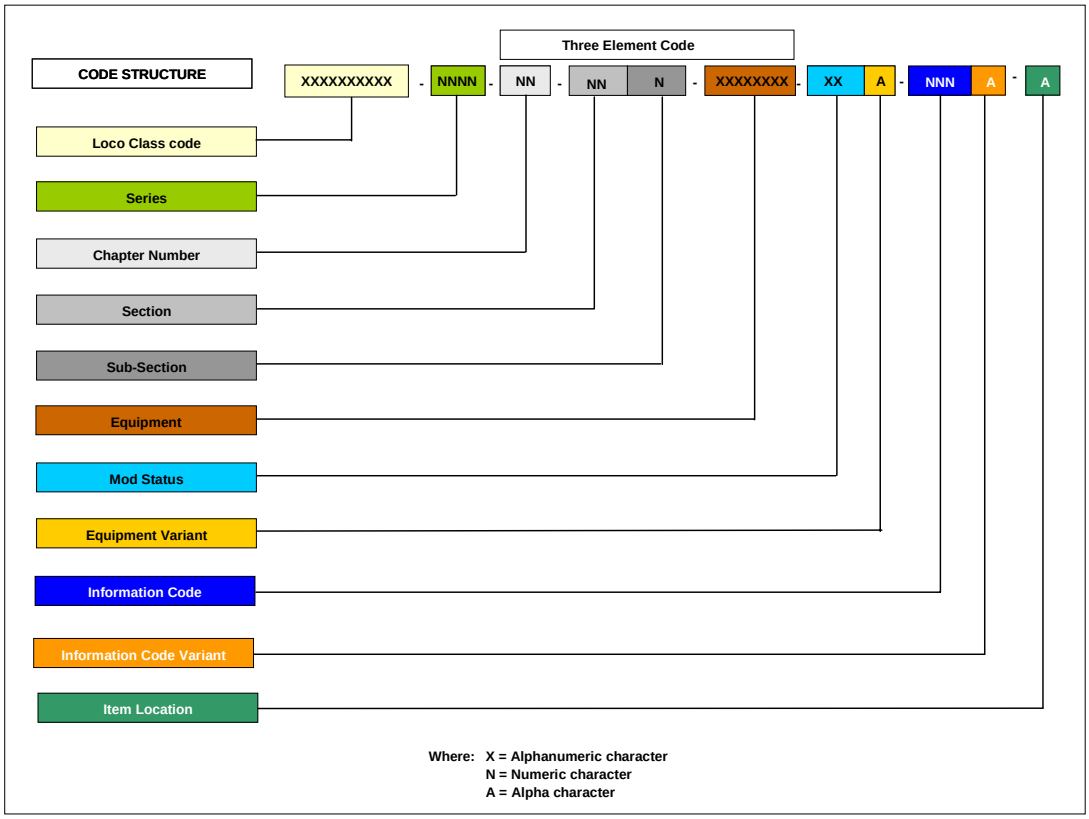
The following abbreviations and acronyms are used in this document.

Term	Meaning
COE	Centre of Excellence (maintenance facility)
DMC	Data Module Code
IEM	Interactive Electronic Manual
Transnet	All Transnet affiliations involved with IEMs
WAN	Wide Area Network

5. SPOORNET NUMBERING STRUCTURE

Figure 5.1: shows the numbering structure for a data module to be developed for a Transnet Electric Locomotive and for viewing as an IEM. The sub-paragraphs of this paragraph elaborate on the details of the elements of this numbering structure.

Figure 5.1: Numbering Structure



The following is an example of a DMC applicable to a data module for a maintenance task for a component on a Class 18E locomotive.

18E-0000-12-011-01-00A-950A-A	
18E - Loco Class Code	Implies the 18E electric locomotive. Refer to paragraph 5.1 below
0000 - Series	Implies the baseline model. Refer to paragraph 5.2 below
12 - Chapter	Implies Chapter 12. Refer to paragraph 5.3.1 below
011 – Section/Sub-section	Implies section 01 and sub-section 1. Refer to paragraph 5.3.2 below
01 - Equipment	Implies the first equipment within this sub-section. Please note that this allocation is project specific.
00A - Mod Status (Equipment) and Equipment Variant	The 00 implies that this is original equipment and the A the first of 26 variants. Refer to paragraphs 5.3.4 and 5.3.5 below.
950A - Information Code and Information Code Variant	The 950 implies general maintenance procedures, eg remove and install, and the A implies that it is the standard procedure. Refer to paragraphs 5.3.6 and 5.3.7 below.
A - Item location	Implies that the procedure will be performed on the locomotive. Refer to paragraph 5.3.8 below

DMC 18E-0000-12-011-01-00A-950A-A refers to an 18E Electric locomotive, baseline model (0000), chapter 12, data module section 01 and sub-section 1 with information relevant to the first component (01) for

the driver's cab ventilator. The modification status and equipment variant (00A) indicates that this is still the original component. The information code and information code variant (950A) indicate it is the standard maintenance procedure and will be performed on the locomotive.

Notes to the above example:

Only three characters are used for the Loco Class Code in this example but please note that up to 10 characters can be used in order to allow for variants to the same basic locomotive class.

Only two characters were used for the Equipment Code in this example, but please note that up to eight characters can be used. Usually only two are used in the case of mechanical components but up to eight might be used in the case of electric components e.g. U1_RY1 will be for Relay No. 1 in Inverter Unit (U1).

5.1 LOCO CLASS CODE (XXXXXXXXXX)

This element identifies the applicable class for the documentation. It refers to the highest level classification of an asset and will normally be the complete electric locomotive.

Examples of codes identified for this number element are 18E, 9E, 11E, etc.

5.2 SERIES (NNNN)

This element identifies the applicability of the data module on possible locomotive series. This refers to the highest level classification of an asset variant, such as the electric locomotive.

Examples of codes identified for this number element are 0000 which implies the locomotive baseline, 0015 implies applicability to series 1 through 4 etc. This is input into the data module as a binary number to cater for the variety of series' that might be applicable to a locomotive class.

5.3 THREE ELEMENT CODE (NN-NNN-XXXXXXXX)

The definitions and allocations for the Three Element Code are defined in the following paragraphs and, as far as possible, comply with the numbering system used for older locomotive types that do not have electronic documentation. The major change to the previous 3-element number is in the allocation of numbers to electrical chapters 20 to 28.

5.3.1 First Element (Chapter Number) (NN)

Codes identified for this number element are shown in Table 5.1 below.

Table 5.1: First Element (Chapter) Code Definition of Three Element Code

First Element	
Chapter	**Description**
01	Vehicle Complete
02	Extract from Driver's Manual

First Element	
Chapter	**Description**
03	General Mechanical Requirements and Procedures
05	Bogie
10	Body and Under-frame
12	Ventilation and Filtration Systems
15	Compressed Air and Vacuum Supply Systems
16	Compressed Air Operated Ancillary Equipment
17	Brake Systems
20	General Electrical Requirements and Procedures
21	Main Power Traction System
22	Auxiliary Systems
23	Driver Ancillary Electrical Systems
24	Locomotive Control
25	Communication Systems
26	Electronic Control Systems
27	Measurement and Detection Systems
28	Indication Systems

5.3.2 Second Element (Section/Sub Section) (NNN)

The Second Element codes, associated with the First Element Codes from 5.3.1 above, are presented in Table 5.2 below for chapters covering mechanical systems.

Table 5.2: Second Element (Section/Sub-section) Code Definition of Three Element Code

Second Element			
Chapter	**Section**	**Title**	**Contents**
01	**Vehicle Complete**		
	000	General	This section provides a basic introduction to the locomotive and its functions as a whole with cross-references where applicable. It also includes information for power circuits, motoring, frame, underframe and bogies.

Second Element			
Chapter	**Section**	**Title**	**Contents**
	010	Technical data	This section includes terms and their meanings as applied to this documentation. It also includes the outline and technical data relevant to the locomotive such as traction and braking curves
	020	Principal Dimensions	This section provides all principal dimensions applicable to the locomotive. Should contain a least a side and end elevation figure with primary dimensions indicated.
	030	Equipment Layout	This section includes the general layout of all major equipment in the vehicle body and the cab(s) equipment layouts. An end view of the locomotive showing the piping and coupling arrangement should be included.
	040	Operating Instructions	This section includes the procedures for starting-up in each different mode, external examination, internal examination and the stabling (shutting down) of the locomotive.
	050	Scheduled Maintenance	This section includes all scheduled maintenance by frequency for all relevant equipment. These should also show 'shedding' periods and the tasks applicable to each shedding.
	060	Lifting And Jacking	This section provides information for, lifting the complete locomotive with bogies, lifting the body and replacing body/bolsters onto bogies.
	070	Mass And Axle - Mass Loads	This section includes information relevant to the mass and axle/mass loads.
	080	Painting	Provides information relevant to the paint procedures of the locomotive, including a painting

Second Element			
Chapter	**Section**	**Title**	**Contents**
			diagram and location of logos.
	090	Safety Factors	This section provides information on safety factors that might influence personnel. This will include the fire extinguisher, warning signs, use of warnings and cautions in modules, etc.
02	**Driver's Manual**		
	010	Preparation for operation	This section provides information on procedures that are applicable to technical personnel who are required to prepare a locomotive for motoring.
	020	Operating Procedures	This section provides information on procedures that are applicable to technical personnel who are required to motor (drive and brake) and/or shut down the locomotive.
03	**General Mechanical Requirements and Procedures**		
	010	Mechanical Requirements	This section includes general mechanical requirements such as torques, lifting of heavy equipment, etc. It will also contain any specific Transnet regulations applicable to mechanical systems in general.
	020	Mechanical Procedures	This section includes general procedures for welding, brazing etc.
05	**Bogie**		
	000	General	This section includes an illustration and functional description of the complete bogie.
05	010	Frame	This section includes information relevant to the frame assemblies, piping and the sanding system.

Second Element			
Chapter	**Section**	**Title**	**Contents**
	011	Frame Assemblies	
	012	Piping	
	013	Sanding System	Covers the mechanical components of the sanding system that are fitted to the bogies, usually from the activating valve to the nozzles.
05	020	Brake Rigging	This section includes information relevant to the brake blocks, brake rigging, brake blocks and shoes, these being components of the brake systems that are fitted to the bogie.
	021	Brake Blocks	
	022	Inner Rigging	
	023	Outer Rigging	
	024	Centre Rigging	
	025	Handbrake Assembly	Components of the handbrake assembly that are fitted to the bogie.
05	030	Spring Rigging	This section provides information relevant to mechanical, hydraulic and pneumatic spring rigging. It covers bolsters, spring planks, equalizing beams, bolster anchors, vibration damping devices and friction snubbers.
	031	Mechanical	
	032	Hydraulic	
	033	Pneumatic	
	040	Wheel sets	This section provides information relevant to fixed wheelset assemblies, self steering wheelset assemblies and wheelset measurement systems. It includes wheels, axles, axleboxes, attachment covers, gearwheels, gearcases and odemeters.
	041	Fixed Wheelset Assembly	

Second Element			
Chapter	**Section**	**Title**	**Contents**
	042	Self Steering Wheelset Assembly	
	043	Measurement	
05	050	Inter-bogie Control	This section provides information relevant to spring boxes, springbox to bogie assemblies, safety cables and suspension equipment.
	051	Spring Boxes	
	052	Frame Assemblies	
	053	Safety Links	
	054	Safety Clamps	
05	060	Weight Transfer Equipment	This section includes information relevant to mechanical weight transfer equipment and pneumatic weight transfer equipment.
	061	Mechanical Weight Transfer Equipment Assembly	
	062	Pneumatic Weight Transfer Equipment Assembly	
	070	Unassigned	
	080	Motor Suspension	This section includes all information relevant to the traction motor suspension systems and equipment fitted to the bogie.
10	**Body and Under-frame**		
10	000	General	This section includes information relevant to the body layout, underframe layout and procedures for structural repairs.
	001	Body Layout	Sides A and B and No 1 and No 2 End
	002	Underframe layout	Location of all equipment attached to the underframe
	003	Structure Repair	Specific procedures for repairs to the loco structure

Second Element			
Chapter	**Section**	**Title**	**Contents**
10	010	Body Structure	This section includes information relevant to driver's cab arrangement, exterior cab fittings, roof layout, flooring, piping, conduit, ducting, cleating arrangements, body mounted equipment, non-driver's cab arrangement and cladding arrangement.
	011	Driver's cab arrangement	Desks and seats, arm rests, sun visor arrangements, small fittings and horn lanyards in the driver's cab.
	012	Exterior cab fittings	Steps and handrails, mirrors, wipers
	013	Roof layout	No 1 end, No 2 end and centre roof(s)
	014	Flooring	Cabs, corridor and compartment flooring
	015	Body ducting	Drains, piping, gutters, piping and ducting
	016	Body mounted equipment installation	
	017	Non-driver's cab arrangement	
	018	Cladding arrangement	
10	020	Doors And Windows	This section includes information relevant to doors, removable covers, panels, interlocking, fixed windows and drop-down & sliding windows.
	021	Doors	Side and end doors, compartment doors and maintenance doors
	022	Covers	Cab's covers and machine compartment covers
	023	Panels	All control panels with legends
	024	Interlocking	Complete interlocking procedure
	025	Not assigned	

Second Element			
Chapter	**Section**	**Title**	**Contents**
	026	Not assigned	
	027	Not assigned	
	028	Fixed windows	
	029	Drop down and sliding windows	
10	030	Under-frame Structure	This section includes information relevant to the drag box, underframe mounted equipment installations and underframe piping, conduit and ducting.
	030-01	Drag Box	
	031	Underframe mounted equipment	Cow catcher, snad box and battery box arrangement
	031-01	Cow catcher	
	031-02	Sanding system	
	031-03	Battery box arrangement	
	032	Piping, conduit and ducting	
10	040	Couplers And Draw-gear	This section includes information relevant to the coupler and drawgear arrangement and the coupler release system.
	041	Couplers and draw gear arrangement	At both ends
	042	Coupler release system	
10	050	Equipment Frames and Equipment Cubicles	This section includes information relevant to all equipment frames and equipment cubicles. Does not include the electrical equipment contained inside.
	051	Frames	HT, LT and air equipment frames. Desk frames, aircon mounting frame, water tank frame and air duct support frames.
	052	Cubicles	The location of all equipment frames is to be illustrated with references out to the specific

Second Element			
Chapter	**Section**	**Title**	**Contents**
			equipment, examples of cubicles are HSCB, toilet, and power conversion equipment cubicles.
10	060	Insulation, lining and trimming	This section includes information relevant to the insulation, lining and trimming used on the locomotive.
	061	Insulation	
	062	Lining and trimming	
10	070	Sanitary System	This section includes information relevant to the sanitary system, including toilet, water storage, waste disposal, basin and piping. Refer out to applicable chapters for toilet ventilation and lights.
	071	Toilet system	
	072	Basin system	
	073	Water supply system	
	074	Drain system	
12	**Ventilation and Filtration Systems**		
12	000	General	This section provides a breakdown of different ventilation systems, cooling systems, heating and filtration systems provided for the locomotive. Electronic control for such systems is covered in chapters 23 and/or 24.
12	010	Compartment Ventilation	Provides information relevant to introducing ambient conditions into a compartment or cubicle and includes systems such as ventilator arrangements, monsoon arrangements and electronic **cubicle** ventilation.
	011	Driver's cab ventilation	
	012	Machine compartment ventilation	

Second Element			
Chapter	**Section**	**Title**	**Contents**
	013	Non-driver's cab ventilation	
12	020	Equipment Ventilation	This section includes information relevant to ventilation systems responsible for providing ventilation to specific equipment and/or the direct environment thereof.
	021	Traction motor ventilation system	On Class 11E and 9E all TM blower ventilation is covered under 12-020.
	022	Resistor enclosure ventilation	
	023	Driver's desk ventilation system	On Class 11E and 9E the Desk Fan is covered under 12-020-07.
	024	Filter Reactor ventilation system	
	025	Power Conversion cubicles ventilation system	
	026	Battery box ventilation	
	027	Communications Cubicle ventilation	
12	030	Domestic Cooling Systems	This section includes information relevant to all domestic cooling systems. Electronic control for such systems is covered in Chapters 23 and/or 24.
	031	Air-conditioning System	
	032	Ancillary Cooling Systems	Used on Class 9E and 11E.
12	040	Equipment Cooling systems	This section provides information relevant to equipment that provides cooling for non-domestic systems and components.
	041	Main Transformer cooling system	This section provides information on the components used to cool the main transformer

Second Element			
Chapter	**Section**	**Title**	**Contents**
	042	PCC cooling system	This section provides information on the components used to cool the Power Converter Cooling system such as the PCC on the 19E or the Converter Cooling equipment on the 11E.
	043	Cooling Tower Ventilation	Describes cooling ventilation equipment that is applicable to more than one item of equipment, for example on the 19E the Cooling Towers provide ventilation to the PCC and the TM blowers.
12	050	Domestic Heating Systems	This section includes information relevant to all domestic heating systems. Electronic control for such systems is covered in Chapters 23 and/or 24.
	051	Foot Heating System	On Class 11E and 9E this is called Cab Heating System.
12	060	Equipment Heating Systems	This section includes information relevant to all arrangements associated with introducing heated conditions (forced or natural ventilation) to specific equipment or systems. Electronic control for such systems is covered in Chapters 23 and/or 24.
12	070	Filtration	This section includes information relevant to the different filtration components.
	071	Ventilation Filters	
	072	Compressed Air Filters	
	073	Vacuum Filters	
	074	Oil filters	
15	**Compressed Air and Vacuum Supply Systems**		

Second Element			
Chapter	**Section**	**Title**	**Contents**
15	000	General	This section provides a breakdown of the air, vacuum and auxiliary supply systems including a functional description of such systems. Electronic control for such systems is covered in Chapters 22 and/or 24.
15	010	Compressed Air Supply Systems	This section includes information relevant to the compressed air supply system including valves, cocks, filters, pressure governors, regulators, switches, piping, drains and reservoirs. On Class 11E and 9E the Compressor is covered under 15-010-01.
	011	Compressed Air Supply	
	012	Valves	
	013	Cocks	
	014	Filters	
	015	Pressure Governors, Regulators and Switches	
	016	Couplings and Piping Arrangement	
	017	Drains	
	018	Reservoirs	
	019	Miscellaneous	
15	020	Vacuum Supply System	This section includes information relevant to the vacuum supply system including valves, cocks, filters, pressure governors, regulators, switches, piping, drains and reservoirs.
	021	Vacuum Supply	
	022	Valves	
	023	Cocks	
	024	Filters	
	025	Vacuum Governors,	

Second Element			
Chapter	**Section**	**Title**	**Contents**
		Regulators and Switches	
	026	Piping Arrangement	
	027	Drains	
	028	Reservoirs	
	029	Miscellaneous	
15	030	Aux Compressed Air Supply Systems	This section includes information relevant to auxiliary compressed air supply system including mini-compressors, valves, cocks, filters, pressure governors, regulators, switches, piping, drains and reservoirs. On Class 11E and 9E the Aux Compressor is covered under 15-030-01
	031	Auxiliary Compressed Air Supply	
	032	Valves	
	033	Cocks	
	034	Filters	
	035	Pressure Governors, Regulators and Switches	
	036	Piping Arrangement	
	037	Drains	
	038	Reservoirs	
	039	Miscellaneous	
15	040	Reduced Auxiliary Compressed Air Supply	
	041	Valves	
	042	Cocks	
	043	Filters	
	044	Measurement and Gauges	
	045	Pressure Governors, Regulators and Switches	

Second Element			
Chapter	**Section**	**Title**	**Contents**
	046	Piping Arrangement	
	047	Drains	
	048	Reservoirs	
	049	Miscellaneous	
16	**Ancillary Mechanical Systems**		
	000	General	This section provides a breakdown of all the ancillary equipment driven by compressed air. This section includes the pantograph, horn, pneumatic windscreen wiper and sanding system.
16	010	Pantograph Systems	This section includes information relevant Electronic control for such systems is covered in chapters 22 and/or 24.to compressed air operated equipment including valves, cocks, filters, measurement and gauges, pressure governors, regulators, switches, piping, drains and reservoirs associated with the pantograph systems. Electronic control for such systems is covered in Chapter 24.
	011	Valves	
	012	Cocks	
	013	Filters	
	014	Measurement and Gauges	
	015	Pressure Governors	
	016	Piping Arrangement	
	017	Drains	
	018	Reservoirs	
	019	Miscellaneous	
16	020	Horn System	Description of the air operated horn system and associated components. Electronic control for such systems is covered in

Second Element			
Chapter	**Section**	**Title**	**Contents**
			Chapter 24.
	021	Valves	
	022	Cocks	
	023	Filters	
	024	Measurement and Gauges	
	025	Pressure Governors	
	026	Piping Arrangement	The Horn Piping Assembly is covered in this section on the Class 11E and 9E.
	027	Drains	
	028	Reservoirs	
	029	Miscellaneous	
16	030	Sanding System	Description of the air operated components of the sanding system and associated components. Electronic control for such systems is covered in Chapter 24.
	031	Valves	
	032	Cocks	
	033	Filters	
	034	Measurement and Gauges	
	035	Pressure Governors	
	036	Piping Arrangement	
	037	Drains	
	038	Reservoirs	
	039	Miscellaneous	
16	040	Windscreen Wiper System	Description of the air operated components of the windscreen wiper system and associated components. Electronic control for such systems is covered in chapters 24. On Class 11E and 9E the Sanding system is covered in this section.

Second Element			
Chapter	**Section**	**Title**	**Contents**
16	050	Sanitary System	Description of the air operated components of the sanitary system and associated components.
	051	Valves	
	052	Cocks	
	053	Filters	
	054	Measurement and Gauges	
	055	Pressure Governors	
	056	Piping Arrangement	
	057	Drains	
	058	Reservoirs	
	059	Miscellaneous	
16	060	HT Equipment Air Supply	Description of the provision of air to specific HT equipment.
	061		
	062		
	063	Filters	
17	**Brake Systems**		
	000	General	This section provides a breakdown of the braking systems on the locomotive. Electronic control for such systems is covered in Chapter 24.
17	010	Automatic Train / Loco Proportional Brake System	This section includes information relevant to the functional operation of the gradual release, direct release vacuum, electro-vacuum and electro-pneumatic control of the train/loco brakes. On Class 11E and 9E the CCBII system is covered in this section.
	011	Valves	
	012	Cocks	
	013	Filters	

Second Element			
Chapter	**Section**	**Title**	**Contents**
	014	Measurement and Gauges	
	015		
	016	Couplings and Piping Arrangement	
	017	Reservoirs	
	018		
	019	Miscellaneous	
17	020	Straight Air Brake System	This section includes information relevant to the operation of the locomotive independent brake system and/or train holding system.
	021	Valves	
	022	Cocks	
	023	Not yet assigned	
	024	Not yet assigned	
	025	Not yet assigned	
	026	Couplings and Piping Arrangement	
	027	Reservoirs	
	028	Not yet assigned	
	029	Miscellaneous	
17	030	Computer Controlled Braking II	This section includes information relevant to the mechanical components of the CCBII system. Details of the electronic equipment are covered in Chapter 26.
	031	Electro-Pneumatic Control Unit	This section includes information relevant to the EPCU
	032	Electronically Controlled Pneumatic Brake System	This section includes information relevant to the equipment used in the ECP Braking System
	033	Wire Distributed Power	This section includes information relevant to the mechanical components of the WDP system. The electronic components are

Second Element			
Chapter	**Section**	**Title**	**Contents**
			discussed in Chapter 26-070 Trainline Control.
17	040	Not Used	Left open for possible future use.
17	050	Electric Dynamic Brake	This section includes information relevant to the mechanical/pneumatic components of the electric brake systems including regenerative and rheostatic braking systems. Include references to 21-050 and 24-030 for electrical interfaces.
	051	Regenerative Braking System	Discuss mechanical and pneumatic components and refer to 21-050 and 24-030 for electrical components and controls.
	052	Rheostatic Braking System	Discuss mechanical and pneumatic components and refer to 21-050 and 24-030 for electrical components and controls.
17	060	Safety Vigilance System	This section includes information relevant to the air operated components responsible for the operation of the vigilance system. Refer to 24-060 for electronic control of the system.
	061	Valves	
17	070	Stationary Braking System	This section includes information on the stationary braking system including the hand/parking brake and the dual pressure/holding brake system.
	071	Hand/Parking Brake	
	072	Dual Pressure/ Holding Brake System	
	080	Piping Diagrams	On Class 11E and 9E piping diagrams are covered in this section.

The Second Element codes, associated with the First Element Codes of 5.3.1 above are presented in Table 5.3 below for chapters covering

electrical systems.

Table 5.3: Second Element (Section/Sub-section) Code Definition of Three Element Code

Second Element			
Chapter	**Section**	**Title**	**Contents**
20	**General Requirements for All Electrical Systems**		
	000	General	Electrical standards, HT requirements, cable and insulation
	001	General electrical practices	Information relevant to electrical practices on the locomotive.
	002	High voltage requirements	
	003	Generic Electrical Component Specifications	
	004	Equipment Earthing Procedures	Information on how individual electrical cabinets and frames are earthed to the locomotive
20	010	Electrical wiring components	
	011	Cable and insulation specifications	
	012	Connection plugs & sockets	
	013	Connectors general	
	014	Not currently used	
	015	Optical Fibres	General details and specifications of optical fibres used on the locomotive.
20	020	Wiring and assembly diagrams	Wiring, circuit and electrical assembly diagrams are normally viewed via the SPC viewer and reference should be made to the applicable collections. On some classes of locomotive the circuit diagrams are covered in this section.

Second Element			
Chapter	**Section**	**Title**	**Contents**
	021	Electrical frame assemblies	Describes the components in each frame and references out for operational data on individual components.
	022	Electrical cubicle / compartment arrangements	Describes the components in each cubicle and references out for operational data.
	023	Electrical rack assemblies	Describes the components in each rack and references out for operational data.
	024	Electrical control panel assemblies	Describes the components in each control panel and references out for operational data.
	025	Electrical Circuit Description	Only used on Class 11E and 9E. Brief description of main and auxiliary power circuits
21	**Main Power Traction System**		
	000	General	
21	010	Main Electrical Power Supply System	Covers all components that supply HT power to the locomotive.
	011	Roof equipment	Describe function & purpose of items in system. Pantograph control will follow in 24-011. Top illustration of roof, brief description of each item
	012	Supply protection systems	Components that protect the main supply such as HSCB, CBR, VCB
	013	Supply Switchgear	Details on switchgear in the circuit of the main power supply such as AC/DC charging contactors, panto isolators, AC/DC changeover switches, etc.
	014	Supply filtering	Describes equipment that provides filtering of the main input supply
	015	Main transformer system	Provides a description of the main transformer and associated

Second Element			
Chapter	**Section**	**Title**	**Contents**
			equipment with references out to equipment cooling, etc
	016	Power Factor Correction Systems	
	017	Not yet assigned	
	018	Not yet assigned	
	019	Miscellaneous	Earth return bushgear, AC down lead and other equipment not falling under any of the above descriptions
21	020	AC Supply Power Converter	
21	030	DC Supply Power Converter	
21	040	Propulsion systems	Includes all HT components/systems used to switch/regulate the main power according to the traction demand.
	041	Traction motors	Describes the operation of the traction motor system and the individual components.
	042	Propulsion Switchgear	Describes the supply to the traction motors via components such as gate amplifiers, IGBTs, inverter, electro-pneumatic contactors and converter units. Covers Four Quadrant Controllers on 19E.
	043	Main resistors	Also covers Armature Converter on Class 9E and 11E.
	044	Weakfield system	Includes Field converter on Class 9E and 11E.
21	050	Electric Braking System	Includes all components/systems used to switch/regulate the electric braking systems. Refer to Chap 17 for mechanical and pneumatic components.
	051	Rheostatic braking system	Refer to Chap 17 for applicable mechanical and pneumatic components. Describe electrical components involved in

Second Element			
Chapter	**Section**	**Title**	**Contents**
			rheostatic braking operations with refs to chap 26 for control
	052	Regenerative braking system	Refer to Chap 17 for applicable mechanical and pneumatic components. Describe electrical components involved in regen braking operations with refs to chap 26 for control
21	060	Electrical interlocking and isolation	
	061	HT isolating system	
	062	HT interlocking system	
21	090	Earthing and Isolating Equipment	Includes systems such as the Earth Return Brushes, Isolating Switches, etc.
22	**Auxiliary Systems**		Secondary/auxiliary electrical systems/equipment that do not form part of the propulsion/braking circuit and without which the locomotive is unable to function properly.
	000	General	
	010	Auxiliary Power Supply Systems	Systems responsible for the electrical supply used by the auxiliary, driver ancillary, locomotive control, electronic control power supply and all other secondary systems. Examples include Motor Alternator circuit, Motor Exciter circuit, Static Inverters, etc.
	011	Motor alternator system	Covers primary aux power supply system on 9E and 11E.
	012	Motor exciter system	Covers battery power and control system on 9E and 11E.
	013	Battery, shore and emergency supply	Describe each individual sub-system and the respective components. Include circuit diagrams to aid in understanding. Covers 12 and 24V supplies on 9E and 11E.

Second Element			
Chapter	**Section**	**Title**	**Contents**
	014	Auxiliary and control positive supply	Describe all components that provide auxiliary electrical supplies to the loco, include circuit diagrams to help understanding. Also covers aux transformer on 9E and 11E.
	015	Steam tender supply	
	016	Power Supply Units	Describe individual PSUs that are not specific to a separate system or sub-system.
22	020	Compressed air supply systems	
	021	Main compressor system	
	022	Auxiliary compressor system	
22	030	Vacuum supply systems	.
	031	Exhauster system	
22	040	Equipment cooling systems	Describe how cooling is provided to electrical equipment and cubicles.
	041	Main Transformer cooling system	Describe how the main transformer is kept cool during operation.
	042	Power Conversion Component Cooling System	Describe how the components inside the PCC are kept cool during operation. Referred to as Converter Cooling System on 9E and 11E.
22	050	Forced ventilation systems	
	051	Brake Resistor enclosure ventilation system	
	052	Driver's desk ventilation system	
	053	Traction Motor Ventilation System	Covers Aux blower on 9E and 11E.
	054	Converter blower	On 9E and 11E

Second Element			
Chapter	**Section**	**Title**	**Contents**
	055	Brake resistor blower	On 9E and 11E
	056	TM blower	On 9E and 11E
	057	Radiator (oil cooler) blower system	On 9E and 11E
22	060	Equipment heating systems	Description of systems that provide heating to specific electronic/electric equipment
22	070	Compartment pressurization systems	Methods and associated equipment for providing pressurization inside compartments or cubicles.
23	**Driver Ancillary Electrical Systems**		This section includes the first level system breakdown description of all the Driver Ancillary Electrical Systems, including a block diagram that illustrates the interaction of the various sub-systems with inter-active links to their respective system descriptions.
	000	General	
23	010	Domestic cooling systems	General description, with references to all domestic cooling systems on the loco.
	011	Air conditioner system	Describe the purpose of the air conditioner system and of the items. System circuit diagram. System interaction at start up. Ref to frame assembly in Chap 20 and to Chap 12 for mechanical components.
	012	Fridge System	Show location and circuit description for fridge.
23	020	Domestic ventilation systems	General description, with references to all domestic ventilation systems on the loco.
	021	Toilet ventilation circuit	Describe the purpose of the toilet ventilation system and of the items. System circuit diagram.
23	030	Domestic heating	General description, with

Second Element			
Chapter	**Section**	**Title**	**Contents**
		systems	references to all domestic heating systems on the loco.
	031	Hot plate circuit	Describe the purpose of the hot plate circuit and of the items. System circuit diagram and locations.
	032	Foot heater circuit	Describe the purpose of the foot heater circuits and of the items. System circuit diagram and locations.
	033	Warming Drawer circuit.	Describe the purpose of the microwave circuit and of the items. System circuit diagram and locations.
23	040	Doors ancillary electrical systems	This section includes all electrical equipment and the control thereof associated with doors e.g. Electronically Controllable Doors, etc
23	050	Windows ancillary electrical systems	This section includes all electrical equipment and the control thereof associated with windows.
	051	Electrical windshield wiper system	Describe the purpose of the windscreen wiper system and of the items. System circuit diagram.
23	060	Domestic electrical sockets	Describe domestic electrical sockets, their supply and location.
23	070	Lighting	Purpose of lighting. List sub-subsystems -71 to -73. Lighting supply and protector and timer circuit diagram How lighting system in general operates e.g. delays, voltage limits. Describe emergency lighting and see-me-home lighting systems where applicable.
	071	Cab Lighting	Describe the purpose of cab lighting and of the items. System circuit diagram
	072	Corridor and Compartment Lighting	Describe the purpose of corridor and compartment lights and of the items. System circuit diagram.

Second Element			
Chapter	**Section**	**Title**	**Contents**
	073	Exterior Lighting	Describe the purpose of exterior lights and of the items. System circuit diagram
	074	Instrument and Gauge Lighting	Describe specific additional lighting that illuminates instruments and/or gauges.
24	**Locomotive Control**		
	000	General	This chapter contains all the electrical control systems, diagrams and circuits associated with the main electrical power system and locomotive motion control systems
24	010	Main Electrical Power Supply Control System	This section includes information relevant to the control of the main electrical power supply. This section includes the pantograph control system and the primary circuit breaker control system.
	011	Pantograph Control	Describe the purpose of pantograph control and of the items. System circuit diagram. Mention auxiliary compressor and main air systems support and status indication Ref chap 16 & 21 use in conjunction with chap 16 (flow diagram, "fill in" electric blocks)
	012	HSCB control	Describe the purpose of HSCB control and of the items. Mention HSCB control instances (e.g. by Agate) and status indication ref HSCB itself. Link to chap 21 Normal open & close as well as trip conditions
	013	Emergency System	Describe the purpose of emergency system and of the pushbutton. Describe operation using the circuit diagram. Consist and alone conditions and leading/trailing.
	014	Current Balance	Describe what happens when

Second Element			
Chapter	**Section**	**Title**	**Contents**
		Protection System	CBR trips. Describe operation using the circuit diagram
	015	PFC Control	
	016	VCB Control	Describe the operation of the VCB control circuit using applicable diagram. Covered under 24-012 on 9E and 11E.
	017	AC/DC Change over control	Describe the operation of the AC/DC control circuit using applicable diagram.
24	020	Propulsion Control System	Describe the purpose of the propulsion control system. State modes of operation. Methodology of control. Driver interface description. Refer to startup control procedure (chap 1 currently) Referring back to 21-40, describe system level operation. List sub-subsections
	021	Stand-Alone, Lead & Trail Control	Describe the stand-alone, lead & trail control concept. What happens on LT circuit, how is loco configured (contactor wise for leading or trailing)
	022	Forward & Reverse Control	This section includes all the control circuits/equipment responsible for Forward and Reverse Operation. This General portion of this section includes the sequence chart, traction effort curves and simplified diagrams of the main power circuit during Forward and Reverse Operation
	023	Series, Parallel and Transition Control	Describe the way series, parallel & transition control is achieved referring to 24-20 and 21-40 and S59.Describe configurations for series, parallel & transit. For 18E use same transition figs as in 6E1
	024	Motoring Notching Control	Describe the way motoring notching sequencing works referring to 24-20 and 21-40. Ref to tractive effort curves in chap 1.

Second Element			
Chapter	**Section**	**Title**	**Contents**
			Referred to as Motor and Braking Control (Traction Control) on 9E and 11E.
	025	Weakfield Control	This section includes all the control circuits/equipment responsible for Weakfield Operation. This General portion of this section includes the sequence chart, traction effort curves and simplified diagrams of the main power circuit during Weakfield Operation
	026	Manual Cut-out	This section includes all the control circuits/equipment responsible for Cut-Out Operation. The effect of cutting out equipment must be indicated as well as the process to do so.
	027	Slow speed control	The purpose and method of selecting slow and/or 2/3 rd speed must be explained. Reference must be made to the tractive effort for each mode. Covers Bogie/Motor Cut-out on 9E and 11E.
24	030	Electric Braking Control	This section includes all the electrical circuits/equipment responsible for rheostatic/electrical braking operations.
	031	Rheostatic Braking Control	Definition of rheostatic braking must be supplied as well as effect of this operation.
	032	Regenerative Braking Control	Definition of regenerative braking must be supplied as well as effect of this operation.
24	040	Pneumatic Braking Control System	Describe the way pneumatic braking control is achieved referring to the system items and 24-40.Ref to braking in chap 17
	041	Pneumatic Braking control	Describe the specific components involved in this operation.
	042	Park brake Control	Describe the specific components

Second Element			
Chapter	**Section**	**Title**	**Contents**
			involved in this operation.
24	050	Adhesion Optimisation	This section contains all the electrical systems responsible for minimising the slipping/sliding of the wheels on the tracks.
	051	Sanding Control System	Operation of the sanding system referring to its elements, indications and the speed sensor/control system interface. Automatic & manual mode, refer buzzer, screen indications.
	052	Wheelslip Control System	Operation of the wheelslip control system referring to its elements, indications and the speed sensor/computer interface.
	053	Wheel slide Control	Operation of the wheel slide control system referring to its elements, indications and the speed sensor/computer interface.
	054	Electric Weight Transfer	
	060	Vigilance System	Purpose of the vigilance system, operation, (times, setting up trip, reset) indications and the control system interface and listing of elements.
	070	Trainline Control System	
	071	Locomotive Trainline Control	Purpose of the trainline control system. Fwd, reverse, emergency, leading & trailing using a circuit diagram. Application of the trainline control system for locomotive control. Show wiring diagrams, socket locations
	080	External Control Signals	
	081	Track Magnet System	
25	**Communication Systems**		

Second Element			
Chapter	**Section**	**Title**	**Contents**
	000	General	Purpose of communication systems & listing of subsystems -10 and -30
25	010	Driver Communications System	Purpose & operation of driver communication systems, listing sub-subsystems
	011	Communications Radio System	Operation and system description of radio communications.
	012	Mobile Phone System	Describe mobile phone installation.
	013	Music & Entertainment Equipment	Describe music & entertainment interfaces and components.
	014	Train Cab System	Description the operation of TCS including components, interfaces and locations.
25	020	Triton System	Provides brief description of function and equipment of the Transnet Triton communications system.
25	030	Tracking & Navigation Systems	Describe tracking & navigation systems
	031	GPS	Interface of GPS with other control systems. Describe equipment, locations, supplies, etc.
	032	Onboard Computer System	Describes the system and equipment used to aid the driver to navigate and track progress.
25	040	Telemeter Systems	
26	**Electronic Control Systems**		
	000	General	This section contains all the pin definitions, circuits diagrams and software associated with Electronic Control equipment/systems.
26	010	AGATE System	Description of AGATE system, listing sub-subsystems -11 through -15. Used for MITRAC system on 9E and 11E.

Second Element			
Chapter	**Section**	**Title**	**Contents**
	011	Power Supply	Describe system power supplies
	012	Controllers & Interface Definitions	Describe controllers and connections. Complete interface (input and output) tables where applicable. List circuit cards and their locations in controller units, for example (MPU/RIOMs)
	013	Display & Indication	Describe operation of DDUs and how to access different screens.
	014	Fault Codes	Describe how to access fault codes and where they are displayed on the DDUs.
	015	Communications Networks	Describe interfaces. Local FIP and train FIP, RS 232 & 485, Data download, DDU programming, MPU connection plug
	016	Data Loggers & Event Recorders	
	017	Programming & Diagnostic Utilities	
26	020	Train Control & Monitoring System	Description of TCMS, listing sub-subsystems -021 through -026 as for above system.
26	030	Train Cab System	Description of TCS, listing sub-subsystems -031 through -036 as for above system.
26	040	Computer Controlled Braking (CCBII)	Description of CCBII, listing sub-subsystems -041 through -046 as for above system.
27	**Measurement and Detection Systems**		
	000	General	This chapter contains all the measurement and detection systems. The entire system must be described from the point of measurement /detection up to where the data is electronically converted and "handed" over for indication/display or control purposes

Second Element			
Chapter	**Section**	**Title**	**Contents**
27	010	Voltage, Current & Power	General notes on voltage, current & power measurement, list items under -011 with locations and concise principle of operation for each type
	011	Main Power Measurement System	Used for voltage measurement equipment on 9E and 11E.
	012	Aux Power Measurement System	List all systems measuring auxiliary power. Used for current measurement equipment on 9E and 11E.
27	020	Speed, Frequency, Period	General notes on speed, frequency & period measurement, tabulate location of listed items with concise principle of operation for each type
	021	Axle Speed Measurement System	Description of operation of axle speed measurement principle and details of equipment.
27	030	Pressure	General notes on pressure measurement, tabulate location of listed items with concise principle of operation for each type
	031	Air & Vacuum Measurement System	
	032	Air Pressure Detection	Details of air pressure detection sensors and their locations.
27	040	Flow	This includes the measurement of the flow rate of liquids/gasses or the flow limit detection thereof (HIGH/LOW) E.g. Diesel consumption measurement using a flow meter system, Low air flow detection, etc.
27	050	Liquid Levels	This includes the measurement of various liquid levels or the level detection thereof (HIGH/LOW) eg. Diesel tank level measurement system, Low oil level detection, etc.

Second Element			
Chapter	**Section**	**Title**	**Contents**
27	060	Digital Feedback	Digital feedback indicating the status (open/close, on/off) of any switch, relay, contactor, control arm, etc.
27	070	Temperature	Details and functions of equipments that measure temperature and provide signals to their control systems.
	071	Air Temperature	Details and functions of equipments that measure the temperature of the air in an area and signal their control systems.
	072	Component Temperature	Details and functions of equipments that measure the temperature of components and signal their control systems.
27	080	Fire Detection System	Description of the operation of components that detect possible fire and provide signals to a control system.
28	**Indication Systems**		
	000	General	This section provides a breakdown of the types and methods of indication systems. This section contains all the electrical/electronic Indication systems/panels. It also serves as a quick reference to simple indication systems that form part of a larger system.
28	010	Bells & Sirens	This section includes all the electrical circuits/equipment responsible for the operation of the bells and sirens.
28	020	Lights	This section includes all the electrical circuits/equipment responsible for the operation of the indication lights.
28	030	Gauges	This section includes all the electrical circuits/equipment responsible for the operation of indication on gauges.

Second Element			
Chapter	**Section**	**Title**	**Contents**
28	040	Matrix Panels	
28	050	Displays	This section includes all the electrical circuits/equipment responsible for the operation of indication circuits reflecting on displays.

5.3.3 Third Element (Equipment) (XXXXXXXX)

The Third Element codes are used for all applicable equipment related to the Chapter/sub-section. This numbering element is user definable and starts with 01 for the first component and can go 99 components for a specific sub-section. For components that have been allocated a component designator, the third element number will be this designator, for example -B22 for the Brake Handle and -KREV for the Reverser Contactor.

When the EDMan software is used, the allocation of data module codes as per this document can be automated by means of a pick list action and the rules of allocating the data module codes can be built into the underlying database. During the use of the above defined numbering system, deficiencies in the numbering system might be identified. Subsequent upgrading of the functional definition and application software will be done in conjunction with the developer and/or other users of the code, following the approved Configuration Management procedures.

5.3.4 Mod Status (XX)

This element identifies the modification status of the equipment. This will therefore start at 00 for all components and as a modification is implemented on a component the element will increase e.g. 00, 01, 02, 0A, 0B etc.

5.3.5 Equipment Variant (A)

Used for alternative equipment differing in design but not enough to change the subject number of the three-element code equipment. For example one of two air conditioning units can be installed on the Class 18E but their fit, form and function are identical.

5.3.6 Information Code (NNN)

This element is used to identify the type of information contained in a specific data module. Examples of Information Codes applicable to electric locomotives are contained in Table 5.4 below.

Definitions have been compiled using the AECMA Specification S1000, AE-A-04-03-0000-00A-040A-A, Chapter 4.3, dated 31 May 2004 as a guideline. Where applicable, categories have been omitted and the terminology has been changed to be suitable for the Transnet

environment. It is recommended that the latest issue of this AECMA Specification be consulted when any definition requires updating or expansion.

Present documentation available within the Spoornet environment is not broken down into data modules. This documentation can be numbered by using the higher levels of the Information Code, for example 280 for general inspections. As circumstances change and/or documentation is converted into electronic media, the documentation can be broken down into data modules and the lower level Information Code allocations can then be implemented, for example 281 for scheduled inspections and 282 for unscheduled inspections.

Although Information Codes 001 to 009 make provision for front matter information (pre-amble pages such as title pages, abbreviations, table of contents, etc.) these codes need not be allocated and pre-amble pages can be seen as part of the documentation (or data module).

Table 5.4: List of Information Codes

INFOCODE	DESCRIPTION	COMMENTS
000	Description and Operation	General description and theory of operation of a system, sub-system or equipment. Details of the structure and content of 000 data modules for the different levels are contained in the Author's Guide.
005	Abbreviations and Acronyms	Lists of abbreviations and acronyms used in the IEM. Does not include standard ISO abbreviations such as AC, DC, etc.
014	Component Lookup Table	Alphanumeric listing of component designators (items of equipment) with reference to the chapter and section where details can be obtained. 014A is used in chapter 3 for mechanical components and 014B is used in chapter 20 for electrical components.
017	List of Related Data	References to Transnet specifications and instructions that are applicable to the specific locomotive or to all locomotives, for example Transnet's High Voltage Regulations
018	Chapter Contents	Brief description of each system/sub-system, taken from this specification. There will be a 018 module for each chapter in the IEM.
021	Reference Module	Used to describe components that are identical to another component except for their inputs, outputs and location. Reference must be made to the Transnet Author's Guide for details on the content and function of reference modules.
110	Controls and Operation	Used to describe the function of controls and indicators on display screens. Specific screen content is to be covered in the applicable description of that

INFOCODE	DESCRIPTION	COMMENTS
		function.
120	Interlock Earth and Unearth Procedure	Description of the interlock system and the procedures to earth and unearth the locomotive.
131	Setting-up Procedure	Set-up a locomotive, system or equipment for operation.
242	Service	Perform a lubrication service to equipment.
251	Clean	Specialised cleaning procedures for a component.
272	Straightening Procedure	
280	Inspect	Procedure to confirm a component is serviceable. Inspections are usually 'time' related and details on when specific inspections should be conducted must also be included in chapter 01-050.
340	Test	Procedure to perform a test of a system, sub-system or equipment to confirm it is operational.
351	Penetrant Inspection	Procedures for inspections that penetrate into the surface of the component such as penetrant dye and infra red.
360	Fits and Clearances	Details on fits and clearances for specific equipment. Details can be included in the applicable maintenance or overhaul task if not too lengthy.
450	Test and Fault Finding	At maintenance level.
460	Test and Fault Finding	At overhaul level.
621	Araldite Bonding Specification	
950	Maintenance Procedures including: Inspect Remove Clean Repair Service Check\Adjust Fits and Clearances Install Test	Provides all procedures applicable to tasks conducted at maintenance level (on or adjacent to the locomotive). Where a specific task is lengthy, a separate module must be compiled and reference made to that module from the 950 module. When a specific time or occurrence related inspection forms part of a maintenance procedure it should be addressed in its own -280 module.
960	Overhaul Procedures including: Disassemble Clean Inspect Check/Adjust Repair	Provides all procedures applicable to tasks conducted at overhaul level (in a specialised workshop, depot or COE installation).

INFOCODE	DESCRIPTION	COMMENTS
	Assemble Test	

5.3.7 Information Code Variant (A)

Used for different data modules applicable to the same subject and type of information. "A" is always used for the first procedure and "B" for the second and so on. For example the procedure to fill the Main transformer's cooling oil using different containers might be different and would therefore have an 'A' and a 'B' module.

5.3.8 Item Location (A)

Used to define the area in which a task will normally be performed, e.g. A for onboard the locomotive, B for at a workshop and C at a COE.

5.4 DOCUMENT REVISION RECORDING

The revision / version of a document is not seen as part of the document number, but is an important identifier of the document status and is an essential part of the configuration management/control process.

In a paper document the revision/version of a document is contained in the header or footer of each document page as well as on the document title page. For an electronic document an electronic tag contains the revision/version control information. The information required for revision/version control purposes is as follows:

a. Issue number.

b. Issue date.

c. Configuration management responsibility.

d. Originator.

e. Applicability.

f. Quality control status.

The issue number is a direct indicator of the configuration control status of a document. During the development of a document issue numbers of 000.00, 000.01 to 000.0n are allocated. Once a formal review by Transnet has approved a document for use, the issue number of the document is upgraded to 001. From this point onwards this document is under formal Transnet configuration control. Changes to the document may only be done after a Change Request has been authorised by the Transnet configuration control process.

Revisions of the document during the development stage after the Change Request has been authorised for implementation, are identified by Issue 001.01, Issue 001.02, etc. These issues of the document are however not for official use within Transnet and are only for use of the project team implementing the authorised change. After formal review of the updated document and approval for use within Transnet, the document revision is

upgraded to Issue 002.00. Issue 002.00 then becomes the only revision of the document authorised for use within the Transnet environment.

When using Transnet's electronic documentation system (EDMan), documents of any issue status are under configuration control as per the inherent functions/features of the software. Documents with an issue status Issue 00X.01, Issues 00X.02 etc as indicated in this paragraph are however not formally under configuration control in terms of the official Transnet configuration management system.