



Engineering Manual

General

CRN GM 004

WRITING REQUIREMENTS AND GUIDELINES FOR ENGINEERING STANDARDS

Version 1.1

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Document control

Revision	Date of Approval	Summary of change
1.0	January, 2012	First Issue
1.1	October, 2015	See Summary of changes below

Summary of changes from previous version

Section	Summary of change
3.5.1	Removed reference to Signalling and Electrical Technical Maintenance Plans
3.6.	Removed reference to CAD manual

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1 Purpose

1.1. About this document

The aim of John Holland Rail's (JHR) Country Rail Network (CRN) Engineering technical publications is to present accurate and up-to-date information to people in the quickest and easiest possible way. Publications must be clear, concise and easy to read. If a technical document is poorly presented, ambiguous, too detailed or not detailed enough then it has failed in its aim.

This manual helps ensure that CRN Engineering publications are of a consistently high standard and a similar format.

This manual takes into account that Engineering Standards, Manuals, Specifications and other engineering publications are used for a variety of purposes including training.

1.2. Who it is for

This manual is for anybody who has to produce CRN Engineering technical publications.

1.3. Scope and application

This manual and accompanying templates apply to all CRN Engineering technical publications. The manual incorporates all the information needed to produce a new publication or to amend an existing manual that was prepared to this standard.

It also details standard formatting procedures to follow for the production of documents that are viewable electronically and printable on A4 paper including layout, design, structure text, numbering and graphics standards.

1.4. Referenced and associated publications

- AS 4292.1-2006 – Australian Standard – Railway safety management Part1: General Requirements
- Style Manuals for authors, editors and printers
- Macquarie Dictionary
- CRN GM 001 – Engineering Standards Systems Manual

2. Document numbering

Documents shall be numbered in accordance with CRN GM 001 – Engineering Standards Systems Manual.

2.1. Version numbering and amendments

The first published version of a document must always be V1.0.

Where alterations to a document with continuous page numbering results in alterations in following page numbers, or if the changes are significant, then issue a complete revision using the next whole number. Therefore a significant revision of V2.3 would result in V3.0.

Where alterations to a document with sections having independent page numbering, or as separate documents that are intended to be collated as a single manual, results in a change in following section numbers, or changes to more than 20% of the content or format, also issue a complete revision using the next whole number for the version number.

Otherwise only increase decimal number of the whole document by 0.1. Therefore a minor revision of V3.1 would result in V3.2.

Amendments recorded in the document control table should refer to sections not pages and should detail the issue or amendment dates of all versions of documents in the manual so that readers can ensure they have the correct version. Issue complete units, not single pages, to make updating as simple as possible for the readers.

2.2. Numbering within documents

Sections are numbered in order and where sections are divided into subsections they are similarly numbered into sub-sections as shown below:

- 3. Timber Sleepers
 - 3.1 General Requirements
 - 3.1.1 Specific Requirements
 - 3.1.1.1 Timber Species

The CRN templates contain heading styles that automate numbering down to 4 levels as above. Do not include subheadings below level 4.

2.3. Document naming

The document type is to be contained in the header of all documents as set in the CRN templates. For example manuals are to have a header which reads 'CRN Engineering Manual – Discipline' as is the case in this document. Similarly Standards are to be headed CRN Engineering Standard – Discipline" and so on for all other CRN document types.

3. Document structure and layout

All engineering publications covered by this manual are to be produced utilising one of the specifically designed CRN templates.

To ensure consistency the standard page size for CRN Engineering documentation is A4. Use the page specifications as pre-set in the Word templates.

Information should be presented in logical sequence so that it flows down from a top level description or requirement.

Requirements should be expressed in the form of shall, should and may in accordance with definitions for these terms contained in AS 4292.1-2006.

As far as possible requirements should be clear and direct with any caveats clearly stated. Statements in the form 'if this and that or something else then you might like to consider.....' should be avoided as they do not establish a standard and any solution could comply.

Tables and sketches may be included as an aid to clarity. However it is not recommended practice to include scanned drawings or other documents. It is better to refer to the primary source.

The following subsections detail the structure and layout for specific document types.

3.1. Engineering Standards

The structure of an Engineering Standard is contained in 'CRN standard template.dot'. Standards should generally adhere to the following structure:

- Cover / title page – contains document number, title, version, issue date, owner, approving and authorising officers.

- Document control – contains a summary of all issued versions and the specific changes from the previous version
- Contents page.
- Introduction and purpose – provides a brief overview of the document and the purpose for which it is to be used. It should contain a statement such as ‘This standard establishes requirements for abc. It is applicable to xyz’.
- Scope and application - provides a succinct statement of the scope of the document as well as the specific application(s) for the equipment covered by the Standard. Where applicable this is to include information on the applicability to existing designs, retrospectivity, implementation date etc.
- Referenced documents – identifies Australian (AS) and International Standards, CRN documents and other documents including legislation that are referred to in the document.
- Definitions and terms – lists specific definitions and terms as they apply in the document.
- Body of document - the remaining sections contain the main set of information within the Standard and the structure will need to be aligned to the specific application. Typical headings and content may include:
 - ~ requirements for managing and reporting compliance with standards for nominated scheduled maintenance tasks.
 - ~ Design & performance – criteria including application of specific section/s of environmental design criteria Standard and other CRN Standards as applicable.
 - ~ Standard configurations – including the definition of standard (approved) configurations (where applicable) e.g. classes of track together with rules for application/use of specific configurations in design of new or altered infrastructure. Where appropriate retrospective application of superseding design standards should be included.
 - ~ Acceptance standards – including damage limits and minimum acceptable standards for unrestricted use/restricted use.
 - ~ Standard designs/specifications – reference to standard designs and standard specifications for material or products.
 - ~ Related standards – application of standards cited, including any variations from Australian Standards and/or related construction standards.

Historical information is generally not appropriate for inclusion in a Standard. The documents should establish the current set of rules with any previous standards/approved configurations that are still in current use being defined separately.

Standards should not include procedural information i.e.: detailed instructions for doing a specific maintenance or construction task.

3.2. Engineering Specifications

The structure of an Engineering Specification is contained in ‘CRN specification template.dot’. Procedures should generally adhere to the following structure:

- Cover / title page – contains document number, title, version, issue date, owner, approving and authorising officers.
- Document control – contains a summary of all issued versions and the specific changes from the previous version
- Contents page.
- Introduction and purpose – provides a brief overview of the document and the purpose for which it is to be used. It should contain a statement such as ‘This specification applies to ... establishes requirements for ... It is applicable to xyz’.

- Scope and application – defines the scope and application of the item covered by the specification
- Applicable standards – lists current standards applicable to this system, sub-system or item. Do not include generic lists that include standards having no relevance to the item in question.
- Definitions and terms – lists specific definitions and terms as they apply in the document.
- Performance requirements – specifies the physical and functional requirements for the system, sub-system or item. The checklist in Table 1 should be used as a guide in each case. Supportability requirements such as reliability, maintainability and access are to be included as performance requirements. OH&S requirements are to be included as a separate mandatory heading.
- Interface definition – either
 - ~ define interface requirements, or
 - ~ refer to applicable specification, drawing or other document where the interface is defined.
- Validation requirements – defines the requirements for validation of a new system, sub-system or item to demonstrate conformance to the specification. Includes type test and demonstration methods. Generally applicable to development specifications but may be included in detail specifications for validation of “first article” provided by a new manufacturer /supplier against the specification.
- Production test and documentation – specifies test and documentation requirements for individual items and batches manufactured to specification. Generally only required in detail specifications.
- Integrated support – provides requirements for delivery of new or additional manuals, spares and maintenance procedures that are normally included in the contract statement of work or purchase order.
- Packaging – specifies any specific requirements for delivery packaging.

Table 1 lists typical requirements that may need to be considered in preparation of an Engineering Specification. Specification headings have been listed as individual characteristics but many factors are related and need to be considered conjointly to avoid conflicts within specified requirements.

Specification Parameters	Typical Requirements
Functional requirements	Define what the item is meant to do
Technical ratings	How well it meets the required performance
Operating conditions	<ul style="list-style-type: none"> - Max-min voltage - Max-min current - Operation under fault conditions
Environmental design criteria	<ul style="list-style-type: none"> - Operating temperature - Exposure to UV - Rain - Wind - Lightning - Vibration - Humidity - Noise - Emissions to atmosphere - Corrosive

Specification Parameters	Typical Requirements
Design life	Total expected service life. Note that this may include periodic refurbishment and/or overhaul.
Reliability	May be specified as a mean time to failure (MTTF) or as a reliability target. See procedure ED 0009 P.
Maintainability / accessibility	<ul style="list-style-type: none"> - Mean time to repair for nominated items within the system/sub-system. - Non-destructive inspection requirements. - Built in test requirements - Access including limitations
EMI / EMC / ESD	Defined operating conditions.
Loading	<ul style="list-style-type: none"> - Max /min/continuous/cyclic - Fatigue requirements
Factors of safety	
OH&S standards	
Interface definition	<ul style="list-style-type: none"> - Physical - Electrical - Software
Physical appearance & characteristics	<ul style="list-style-type: none"> - Dimensions - Mass - Colour - External finish / protective coating
Validation requirements	<ul style="list-style-type: none"> - Specific parameters to be validated. - Validation test standards.
Protection	Specific protective systems, including guarding, isolation, UPS.

Table 1-Specification checklist

3.3. Engineering Manuals

The structure of an Engineering Manual is contained in 'CRN manual template.dot'. A manual is a self contained document representing information about a particular subject.

Manuals are structured in distinct sections that can be amended and added without affecting the rest of the manual. When considered necessary sections may be grouped into parts. When considered beneficial to the audience to publish the manual in separable parts the manual can be divided into volumes. Therefore there can be several types of manual structures as shown below.

Simple Manual			Section 1 Section 2 etc.
Less simple Manual		Part 1	Section 1 Section 2
<i>When parts are used section numbers continue through the manual.</i>		Part 2	Section 3 Section 4 etc.
Complex Manual	Volume 1		Section 1 Section 2 etc.
<i>When volumes are used section numbers restart in each volume.</i>	Volume 2		Section 1 Section 2 etc.
More complex Manual	Volume 1	Part 1	Section 1 Section 2
<i>When volumes and parts are used section numbers continue in each part and restart in each volume.</i>		Part 2	Section 3 Section 4 etc.
	Volume 2	Part 1	Section 1 Section 2
		Part 2	Section 3 Section 4 Section 5 etc.

Manuals should generally adhere to the following structure:

- **Cover / title page** contains the document number, title, version, issue date, owner, approving officer and authorising officer.
- **Document control** - should be used to provide brief details of version history. It does not need to include information about detailed changes but must include details of previous Standards superseded or replaced by the current issue as well as any caveats that may apply.
- **Contents page.**
- **Introduction and purpose** – Brief description of purpose, structure and content as well identifying the intended audience and how it relates to other documentation. Dependent upon need this can also include how to navigate through the manual to find relevant information.
- **Scope and application** – should provide a succinct statement of the scope of the manual and its application.
- **Referenced documents** – includes a list of Australian (AS) and International Standards, CRN Standards and other documents such as legislation that are referenced in the Standard. Inclusion of unreferenced material creates confusion about the potential application of the material/requirements within the CRN environment.
- **Definitions and terms** – lists specific definitions and terms as they apply in the document.
- **Body of document** – the remaining sections form the core of the manual. The content of the manual and the intended users will dictate the way in which the manual is structured. Sections might include:
 - ~ Management requirements
 - ~ Competencies
 - ~ On system maintenance instructions

- ~ Fault diagnosis
- ~ Removal and installation
- ~ Off system maintenance and overhaul instructions
- ~ Technical data and specifications
- ~ Appendices
- ~ Description & operation of the system/equipment
- ~ Physical description of equipment and major components.
- ~ Principles and theory of operation
- ~ Detailed description of components
- ~ General safety requirements
- ~ Operating instructions and procedures
 - Operational and functional checks
 - Removal and Installation procedures
 - On system maintenance procedures
 - List of tasks;
 - Tools and materials;
 - Maintenance tasks.
 - Fault finding guide
 - Overhauling
 - Spare parts list and suppliers
 - Manufacturer's manuals
 - References
 - Records
 - Test certificates
 - Drawing list

3.4. Technical Notes and Engineering Instructions

The document template provides the structure of Technical Notes and Engineering Instructions. Each instruction contains the following information on the right hand side of the first page:

- Audience
- Main Points
- Contacts

The body of the instruction should explain the reason for the instruction. No other structural rules apply.

3.4.1 Numbering

Heading numbers are not generally used in Technical Notes and Engineering Instructions. They may be used if it is considered that they will aid understanding of the content or where it is necessary to refer between parts of the instruction.

3.5. Technical Maintenance Plans (TMPs)

3.5.1 Document structure and layout

The Civil Technical Maintenance Plan is structured as an Engineering Standard.

4. Document templates and styles

Styles define the look of each type of heading and paragraph within a document. This includes the font, size, spacing, tabs and indents. The styles are saved within the CRN templates using the Word styles and formatting function.

You should always use the template styles as it ensures that the document looks consistent throughout no matter who works on it. It is also faster because you do not have to individually format each paragraph as if you change a style all paragraphs formatted in that style are automatically updated.

The CRN templates contain a range of styles that are common to a number of CRN publications.

The following sub-sections largely relate to standards, specifications and manuals. Whilst many of the following styles can be applied to technical notes, engineering instructions and TMPs not all styles are used in these documents.

4.1. Cover page

4.1.1 Document number

The document number uses the 'CRN pg1 doc no' style. This number then automatically appears in the header of all pages following the cover page.

4.1.2 Document title

The title appears under the document number and uses the 'pg1 doc title' style.

4.1.3 Version

The version number uses the 'CRN pg1 version no' style. The version number then automatically appears in the footer of every page following the cover page.

4.1.4 Issued

The date of issue of the document uses the 'CRN pg1 issue date' style. The issue date then automatically appears in the footer of every page following the cover page.

4.1.5 Volumes

When required the volume number should appear centred on the cover page after date issued using the 'CRN volume no' style. It should also be added to the header on pages following the cover page.

4.1.6 Parts

When used part numbers should appear centred on a separate page at the start of the part, using the 'CRN Part Heading' style, and in the footer of every page of the part, before the chapter and page number separated by a dash. (e.g.- Part 2 – Chapter 4 – Page 2 of 12)

4.1.7 Document Authorisation

The document authorisation appears in a table towards the bottom of the cover page and uses the 'CRN doc authorisation' style. The details of the document owner, approving and authorising officers are contained in the table.

4.2. Headers and footers

There is no header on the cover page. The footer on the cover page is different from the remainder of the document.

The header on following pages uses the 'CRN Header' style and should read CRN Engineering Standard or Specification etc. depending upon the type of document, and the document number.

The footer on the cover page uses the 'CRN pg1 Footer' style and includes the words 'uncontrolled when printed' in block letters and Page 1 of the total number of pages.

The footer on following pages uses 'CRN Footer' style and contains the version number, page number of total pages and issue date (all automatically generated) plus copyright notation, and the words uncontrolled when printed in block letters.

4.3. Contents

Where a contents page is included in a document it should be contained on the third page, after the document control page.

4.4. Headings

To enable readers to follow the structure of the document and know when topics or subjects begin and end the templates contain four levels of numbered headings in the '1 CRN heading 1st level', '1.1 CRN heading 2nd level', etc. styles. You should not have more than four levels of headings.

To demonstrate the hierarchical format of headings they are numbered and use different fonts. Level one headings are 14 point, level two are 13 point, level three are 12 point and level four 11 point. All headings are bold.

4.5. Paragraphs

The default for paragraph is contained in the 'CRN paragraph default' style. Whilst the font is Arial 10 point the paragraph spacing is set at 12 point so that lines of text are set not too close together. The spacing before paragraphs is set at 0 point and after is set at 10 point.

There is also another paragraph style, 'CRN paragraph indent', which allows for a paragraph with a further 0.75 centimetre indent for use under numbered or bulleted lists.

The last paragraph before a list (either numbered or bulleted) uses the 'CRN paragraph Bullet' style. It has the same characteristics as the 'CRN paragraph default' style with a 5 point after spacing to maintain the visible connection to the list it introduces.

4.6. Lists

Lists or bullet points are used when there are a number of items described in a paragraph or sentence. Numbered lists are used only for a sequence of events. Bullets are used for all other lists.

Use 'CRN Bullet 1' when required. There are styles for three further levels however no more than two should be used ideally.

Use 'CRN Bullet 1 End' style for the last bullet point. It has the same characteristics as the 'CRN paragraph default' style with a 10 point after spacing to break the visible connection between the list and the following paragraph.

'CRN Bullet 2 End', 'CRN Bullet 3 End' and 'CRN Bullet 4 End' styles are similarly available for indented lists.

If a numbered list is required use the style 'CRN Number'. Use 'CRN Number End" style for the last entry in a numbered list.

4.7. Captions

Use the style 'CRN caption' below figures and tables.

When labelling figures etc. use Figure X - Title of figure, where X is the next number in sequence. Use the "insert/reference/caption" facility in MS Word to insert. This will allow you to insert additional figures and will automatically re-number the subsequent figures. Similarly, use Table X when inserting captions for tables. Figures and tables are numbered separately.

When referring to tables or figures in the text, use the "insert/reference/cross reference" facility in MS Word. Select "Table" or "Figure" and "Only label and number. This inserts a linked reference. If table and figure numbers change the references will also change.

4.8. Tables

When using tables, create a table via the toolbar. For the title row (first) of all tables use the style 'CRN table head'.

For tables that are primarily numerical in nature use the style 'CRN table centre' style which will centre the columns and for tables that are primarily text use the style 'CRN table left' which will left align the column.

Ensure that if the first row of a table identifies information in the column below that the first row is repeated if the table continues to a following page.

4.9. Warnings

A warning highlights situations that may cause injury to personnel. Use the style 'CRN warning' style which appears as:

Warning

Dangerous voltages are contained in this equipment. Remove all external power before opening.

4.10. Cautions

A caution highlights situations that may cause damage to the equipment Use the style 'CRN caution' style which appears as:

Caution

Water can damage this equipment. Install protective covering over the air inlet before washing.

5. Writing guidelines

5.1. General

The purpose of CRN technical documentation is to clearly and concisely convey facts and instructions so that those who need the information will read the document with ease and understand it.

The following should be considered when preparing your document:

- structure of the information to suit the needs of readers
- use plain English and the conventions of spelling and usage acceptable to the readers

- use punctuation, capitals and textual emphasis to clarify meaning.

Do not leave small amounts of text at the bottom or top of pages. There should be at least two lines of text in a single paragraph at the bottom or top of each page.

Ensure headings at the bottom of pages have at least two lines of text following on the same page. If a heading is followed by a three-line paragraph move the heading to the top of the next page. Only insert manual page breaks when you are ready to publish your final document.

When introducing a list of items, make sure that at least two items follow on that page.

Avoid pages of solid text and paragraphs exceeding half a page.

Leave plenty of white space on your pages to help the words lift off the page making reading easier.

Leave sufficient space between text and diagrams so that the page does not appear crowded.

Avoid using different fonts and a variety of colours as they lead to confusion. If you need to emphasise a point structure the paragraph to place it in a dot point or simply italicise, bold or underline the words.

5.2. Consistency

Consistency is an aid to clarity in your document. By using a consistent style and approach across a range of document types readers can more readily read and understand the information as they already understand how the document is structured.

When writing CRN documents you should generally:

- use 'refer to' for references to paragraphs and tables
- use 'see' for references to figures and drawings
- use 'above' or 'below' when referring to preceding and following paragraphs
- use 'right' and 'left' instead of right-handed or left-handed unless 'right' could be misinterpreted to mean 'correct'
- ensure consistent labelling and referral
- write words out in full such as approximately not approx, and
- when first referring to CRN in a document use 'Country Rail Network (CRN)' then continue to use CRN. Similarly when using acronyms or abbreviations express them in full when they appear first in a document with the abbreviation in brackets.

5.3. Titles and headings

The CRN templates contain styles for headings and titles. Document titles are to be in full capitals on the first page.

In all headings use a capital letter only in the first word unless they contain a proper noun or acronym.

Headings are signposts for readers and should be meaningful and no longer than one line.

The templates contain four levels of numbered headings to be used in the body of the document. You should structure your document so that you have no more than four levels of headings.

5.4. Blank pages

Documents that are principally published electronically are to be written without blank pages.

Where a blank page is required move down ten lines from the top of the page and type - This page is intentionally blank - then centre and bold the text.

5.5. Plain English

Use familiar words that readers will understand whilst being precise using enough words to convey your message avoiding unnecessary words. The purpose of the document is to convey information not display the skills of the writer.

Avoid foreign words and phrases, uncommon abbreviations, jargon, colloquialism, euphemisms and excessive references to other documents.

5.6. Effective language

Holding the attention of the reader on the main points is a prerequisite for clear communication. The use of active voice using strong verbs tends to be more direct and is more appropriate for use in technical documents.

Active voice places the focus of the sentence on its first component. For example, 'place the sleeper plate on the sleeper.' By contrast the same information expressed in passive voice would be 'the sleeper plate is placed on the sleeper.'

When writing for a general audience, you should be careful to keep all sentences short. A short sentence is generally easier to understand than a long sentence. This helps to convey your ideas clearly while keeping your writing concise.

When appropriate use a conversational tone using the same language that you would normally speak if conveying the information verbally. Where required, such as where responsibilities are being assigned or there is a legal requirement, a more formal tone may be used.

5.7. Inclusive language

CRN documentation must be sex-neutral. It is not appropriate to assume that all engineers, technicians and managers are male just as it is no longer appropriate to assume that all secretaries and nurses are female. Ensure that your writing does not convey gender stereotypes. There are several ways to avoid using sexist language including the following examples:

Unacceptable	Acceptable
An engineer needs to know what his project budget is going to be.	Engineers need to know what their project budgets are going to be.
A technician must ensure that he follows all procedures correctly.	A technician must ensure that he/she (or she/he) follows all procedures correctly.
The operator needs to equip himself or herself with these protective devices	The operator needs to equip themselves with these protective devices
He can then load the file.	Then load the file.
He/she must clean up the laboratory at the end of each session.	You must clean up the laboratory at the end of each session.
She will find that the Z2000 model has a number of advantages when compared to its predecessor.	Users will find that the Z2000 model has a number of advantages when compared to its predecessor.
The manager or his assistant	The manager or an assistant

5.8. Spelling

The spelling of words is critical to clear and consistent communication. Whilst spell checker in Word is a useful function do not rely on it. There is no substitute for consulting a dictionary and re-reading your work. For instance, if you have meant to type 'for' and typed 'fro' in error or 'manager'

and typed 'manger' instead, a spell checker will not identify the error. Australian not American spelling is standard for CRN documentation. Some examples include:

Australian		American	
-our	colour, labour	-or	color, labor
-ae, -oe	encyclopaedia, foetus	-e	encyclopedia, fetus
-que	cheque	-ck	check
-em	empanel	-im	impanel
-en	enquiry	-in	inquiry
-c	disc	-k	disk
-re	centre, metre	-er	center, meter
-e	acknowledgement	-e omitted	acknowledgment
-ll	travelled, labelled	-l	traveled, labeled
-ise	organisation, utilise	-ize	organization, utilize

5.9. Capital letters

Sentences should always commence with a capital letter whilst initial capitals should be used for proper nouns and proper names. Proper names include personal names, place names, names of organisations and official titles. Registered trademarks, proprietary names and brand names should be capitalised.

In a hyphenated proper name, capitalise both elements such as Charles Kingsford-Smith, Scottish-Australian.

In the body of a paragraph or in general text do not use all capitals to highlight a word. Use bold or italics.

5.9.1 Initial capitals

Use initial capitals in the following cases:

- Motor A
- Pointer marked R
- Pressure at port B

5.9.2 Captions

When labelling captions treat the label as a sentence or heading, applying the rules outlined above, after the respective numeric identifier, as shown below.

- Figure 10.1 - Trainstop assembly
- Table 8.2 - Trainstop not clearing

5.10. Abbreviations

5.10.1 General

Abbreviations are often used in technical publications. Abbreviations should always be defined at the first instance of use and should take the form such as:

- Country Rail Network (CRN)
- John Holland Rail Pty Ltd (JHR)
- Independent Transport Safety Regulator (ITSR)
- GHD Pty Ltd (GHD)

- C. R. Kennedy & Company Pty. Ltd. (CR Kennedy)

Whilst it is acceptable to use an ampersand, that is &, in the title of an organisation as in the last example above, as that is the organisation's official name, use 'and' not ampersands in general text.

Ensure that you use the same abbreviation throughout a publication. Do not use the full name and the abbreviation interchangeably and do not redefine the full name again.

Use the following common expressions in tables and figures or wherever space is limited. Do not use them in general text, for example, in sentences such as this. However, if space is limited it is acceptable to use them in text if they are in parentheses (i.e. like this). Whilst there is a trend to omit the full stops from these abbreviations the general principle is use them as shown below. There is no need to follow abbreviations ending in a full stop with a comma.

- c. – about, approximately
- cf. – compare
- e.g. – for example
- et al – and others
- etc. – and so forth, and so on
- i.e. – that is
- NB – take careful note
- no. – number
- v., vs. – against
- viz. – namely

5.10.2 Spacing

Special attention should be given to spaces between abbreviations in order to achieve a good appearance based on meaning, for example 'a cos x' not 'acosx' or 'a cosx'.

5.10.3 Usually abbreviated terms

In CRN engineering publications the following abbreviations are commonly used. Writers may chose to spell them out to define them the first time they are used:

- HF – high frequency
- LF – low frequency
- rpm – revolutions per minute
- UHF – ultra high frequency
- VHF – very high frequency

5.10.4 Word combinations

Use the following abbreviations whether they are used as nouns or as adjectives:

- Vac – volts alternating current
- Vdc – volts direct current
- cg – centre of gravity
- g – gravity as in acceleration

Write the following abbreviations in full when used as nouns:

- ac – alternating current

- dc – direct current
- RF – radio frequency
- IF – intermediate frequency

5.10.5 Abbreviations starting a sentence

Capitalise an abbreviation which begins a sentence such as:

- DC is used on ships
- RPM must not exceed 2500

5.10.6 Abbreviations and symbols

Use abbreviations for units throughout your document as outlined in Section 5.17.

Use lowercase letters for abbreviations. The exceptions are the L for litre so it is typographically clearer and units named after people such as Pa for pascal and N for newton

Section 5.17 shows the correct presentation, including use of capitals, for various measurements.

Do not use a full stop after a symbol of a unit except at the end of a sentence. Do not make a symbol into a plural, for examples 2 kg not 2 kgs.

If you spell out a unit and it is associated with a number greater than one, then add an 's' to the unit, for example, 1.6 tonnes or one point six tonnes. However, do not add 's' to 'Hertz', 'lux' and 'Siemens', for example 30 Hertz, 4 Siemens or 2.22 lux.

Do not mix symbols and unabbreviated terms in the same context. If you use a symbol for one unit use symbols for all units.

Use the term 'per' when using the full term, for example kilometres per hour not kilometres/hour. Use '/' not 'per' when using symbols, for example km/hr not km per h.

Always use digits with abbreviations, for example 6 kPa not six kPa.

Always include a single space between numerals and symbols, for example 4 km not 4km.

5.11. Numbers

5.11.1 When to use numerals

In text use numerals for numbers greater than 9. If a sentence contains more than one number and one is less than 9 a numeral should be used for that number, for example, '3 screws and 11 bolts' not 'three screws and 11 bolts'.

Use numerals when they accompany a symbol, for example '8 L' not 'eight litres'.

Use numerals for references to other sections of the same or other documents such as table or figure numbers, volume or section numbers.

Use numerals for compound modifiers containing a number such as, '3-phase power', '2 fused board' or '35-year old'. You may need to use the Word feature of a non-breaking hyphen to ensure such terms do not carry over to the next line. To use this feature type your numeral then press CTRL+SHIFT+HYPHEN then the following word.

5.11.2 When to spell numbers

When a number commences a sentence it should be spelt out regardless of the size of the number. In such a sentence if there are other numbers contained in the sentence they should be spelt as well.

Spell out a whole number less than 10, except when it is in the same sentence with a number of 10 or higher and when it does not relate to a unit of measurement.

Spell stand-alone fractions, except when used with a unit of measure, for example 'one quarter of a turn' and '2/3 kg'.

When spelling out decimal numbers use the word 'point' to express the decimal point, for example, six point three kilometres.

5.11.3 Ranges of numbers

Use 'to' instead of a hyphen for ranges of numbers that refer to measurements, physical quantities, or other technical aspects, for example '4 to 5' not '4-5' nor '4 – 5'.

Ensure that symbols follow each numeral where required, for example '4 mm to 5 mm' not '4 to 5 mm'.

Use 'to' instead of a hyphen for ranges of complicated numbers, for example, 'Parts AM 3035 to AM 3060' not 'Parts AM 3035 - AM 3060'.

Use 'and' instead of 'to' when 'between' precedes the first number in the range, such as 'sizes between 15 and 20' not 'sizes between 15 to 20'.

5.11.4 Large numbers

As a comma is used in Europe to indicate a decimal marker international standards now specify the use of a space instead of a comma to separate three digit-groups of numerals, for example '98 123' not '98,123'.

However when large numbers are spelt out commas should be used, for example 'one million, four hundred and twenty thousand and nine'.

It is not necessary to include a space for numbers containing only four digits, such as 1000 or 5297.

5.11.5 'Billion' 'trillion' and 'quadrillion'

Australian and international standards now provide the following definitions of these terms:

- billion = thousand x million (or 1000 million 10⁹)
- trillion = million x million (10¹²)
- quadrillion = thousand x million x million (10¹⁵)

Whilst these terms are commonly used in financial writing technical writers generally avoid using these terms preferring to express critical amounts using powers of ten.

When possible, choose units so that the numerical value expressed lies between one-tenth and a thousand, that is, avoid millions and billions:

- 55.44 m not 0.05 544 km
- 500 kPa not 500 000 Pa

5.11.6 Fractions

5.11.6.1 Decimal fractions

The rule for spacing of large numbers also applies to numerals to the right of a decimal point, for example '10.00 097' or '11.0345'.

Include a zero before the decimal point if the number is less than one, for example '0.89' not '.89'

5.11.6.2 Non-decimal fractions

When spelling out fractions use a hyphen, such as one-eight, three-quarters or two and three-fifths. However, if preceded by 'a' or 'an' simply write a third or an eighth.

When expressing non-decimal fractions as numerals, such as $1/8$, $3/4$ or $2\ 3/5$ etc. Word will automatically reformat some fractions. When more common fractions are typed in Word, such as a $1/2$ or $3/4$, Word automatically formats the appearance to that shown in this sentence as soon as the space bar is depressed after typing the second numeral. To ensure that all fractions expressed as numerals are consistent throughout documents it is necessary to click on the 'Undo Typing' button on the standard tool bar immediately after depressing the space bar.

5.11.7 Ordinal numbers

Spell out ordinal numbers such as first, second etc. Words are preferred in general text for numbers up to one hundred and for large round numbers such as the fourth stage, the sixty-seventh post or the one-hundredth time.

Where there are space restrictions such as in references or tables use numerals with the appropriate suffix, such as the 201st passenger, the 43rd reference or the 22nd mistake. Note that like common fractions Word automatically formats these suffixes as super text, e.g. 1st. Therefore it is also necessary to click on the 'Undo Typing' button immediately after depressing the space bar following the suffix of an ordinal number.

5.11.8 Percentages

Percentages should be expressed as '9%', '9 per cent' or 'nine per cent'. The common usage in Australia is per cent which is closer to the original Latin per centum meaning by the hundred. Percent is the form used in American English. Note there is no space between the numeral and the % symbol.

5.11.9 Phone numbers

To aid recognition phone numbers should include spaces, for example 9569 8124 not 95698124.

Mobile phone numbers should also include spaces, for example, 0404 030 788 not 0404030788.

5.12. Mathematical formula and relationships

When writing mathematical formula it is imperative that it is clearly set out. For example

'25 + 89 = 114' not '25+89=114'

When expressing ratios there is no need to include a space between the numerals, for example '6:2' or '5:1:9'.

5.13. Time

5.13.1 Dates

In text dates should be expressed using a numeral for the day, the word for the month and four numerals for the year, for example '8 August 2008'. There is no need to use an ordinal number for the day of the month or commas within the date. If the day of the week is required do not use punctuation simply write 'Friday 8 August 2008'.

When expressing dates in numerals follow the same sequence, that is, day, month, year, for example 8/8/2008. There is no need to preface days and months less than ten with a zero, however the year should be shown in full so as to avoid confusion between centuries.

5.13.2 Hours of the day

Times should be expressed using a twenty-four hour system to avoid confusion, for example 00:45 not 12:45 am.

5.13.3 Frequency

Do not use the prefix 'bi' when referring to time frequencies as it can lead to confusion as it means both 'two' and 'twice a ...'. As a result bimonthly can mean either 'every 2 months' or 'twice a month'. Whilst biannual means twice a year and biennial means every two years there is often confusion over these terms.

The following terms should be used to refer to frequency:

- Twice weekly, twice a week, two times per week, etc. not biweekly
- Every two weeks, each two week period, etc. not fortnightly
- Twice monthly, twice a month, two times per month, etc. not bimonthly
- Twice yearly, twice a year, two times per year, etc. not biannual
- Every two years, each alternate year, etc. not biennial

5.14. Temperature

Generally temperature should be expressed in degrees Celsius. Numerals should always be used to express temperatures followed by a space, then a degree (°) symbol and the letter 'C' without a full stop unless it is at the end of a sentence, for example 37.8 °C or 0.5 °C.

When expressing a range of temperatures use 'to' instead of a hyphen and °C after each numeral, for example '-0.5 °C to 8.5 °C' not -0.5-8.5°C.

5.15. Dimensions

Use 'by' to express simple dimensions when numbers are spelt, such as 'the pipe measures 16.5 mm by 20 m'.

Use 'x' in tables or figures, such as '16.5 mm x 20 m'.

5.16. AC and DC power

Refer to both AC and DC power sources by their nominal values (the exact values are almost always variable) for example, '115 Vac (line to neutral)' or '240 Vac (line to line, single phase)'.

Refer to relays and lights that operate from basic power by the nominal voltage, for example, '28 Vac relay' and, if necessary, clarify this use, such as '115 Vac power (nominal)'.

5.17. The International System of Units

All measurements are to be specified in metric, not imperial, units using the International System of Units (SI). The main measurements are summarised below:

Physical Quantity	SI Units	Symbol
Length	kilometre	km
	metre	m
	centimetre	cm
	millimetre	mm
	micrometre (micron)	µm

Physical Quantity	SI Units	Symbol
Mass – the measure of a body's inertia	megatonne	Mt
	kilotonne	kt
	megagram (tonne)	Mg(t)
	kilogram	kg
	gram	g
	milligram	mg
Weight - the measure of gravitational force on the body and varies with gravity	newton	N
	decanewton	daN
Area	square kilometre	km ²
	hectare	ha
	square metre	m ²
	square centimetre	cm ²
	square millimetre	mm ²
Volume - liquid measure	megalitre	ML
	kilolitre	kL
	litre	L
Gas and solid measure	cubic metre	m ³
	cubic centimetre (millilitre)	cm ³ (cc)(mL)
Time	day	d
	hour	h
	minute	min
	second	s
Temperature	degree Celsius	°C
	kelvin	K
Pressure	megapascal	MPa
	kilopascal	kPa
	pascal	Pa
Force	newton	N
Torque	newton metre	Nm
Dynamic viscosity	pascal second	Pa.s
Kinematic viscosity	square metre per second	m ² /s
Density	kilogram per cubic metre	kg/m ³
	gram/cubic centimetre (specific gravity)	g/cm ³
Power	kilowatt	kW
	watt	W

Physical Quantity	SI Units	Symbol
Luminance	candela per square metre	cd/m ²
Electrical	volt	V
	ampere	A
Resistance	ohm	Ω or Ω
Frequency	hertz	Hz
Angular Measurements	degree	°
	minute	'
	second	"
	radian	rad
Chemical quantity (corresponding to molecular weight)	mole	mol
Energy	kilowatt hour	kWh
Prefixes	tera	T
	giga	G
	mega	M
	kilo (k)	k
	hecto	h
	deca / deka	da
	deci	d
	centi	c
	milli	m
	micro	μ
nano	n	

5.18. Units expressed as imperial

Always use units shown on the instruments actually on the system or equipment. If the instrument is calibrated in imperial units, convert to SI and put the imperial measurement in brackets, for example '34 kPa (5 psi)'.

5.19. Measurement tolerances

Technical documents often establish quantitative requirements as performance measures.

However problems can arise for the constructor or maintainer in determining whether the quantitative requirements of a specification have been achieved if tolerances or upper and lower limits have not been established in the document.

Similar problems can also result from dimensions on drawings.

The examples in Table 2 indicate the type of problems to be avoided in including quantitative requirements in technical documentation or drawings. To establish if a performance requirement has been achieved, a tolerance, a minimum or a maximum value must be specified.

Unacceptable forms	Acceptable alternative forms
The ballast shoulder shall be a nominal 400 mm	The ballast shoulder shall be a minimum of 400 mm The ballast shoulder shall be 400 mm, + 100 mm
The operating voltage shall be 240 Vac, 50 Hz	The operating voltage shall be 240 Vac (+ 10% and or -15%) at a frequency of 50 Hz \pm 1 Hz Or you may reference a separate technical document which establishes tolerances for voltages, dimensions, frequency, temperature etc.
Drawing dimensions without tolerances	Include a statement clearly on the drawing such as "all dimensions +/- (number) mm unless otherwise specified", or include tolerances with each measurement.

Table 2 – Measurement tolerances

5.20. References

5.20.1 References to other documents and publications

When referring to CRN documents the document number should be expressed with a space between the alpha and numeric characters, such as CSC 220 not ESC220.

When referencing titles of documents, books and reports use of capitals should reflect the original document, such as:

- Style Manuals for authors, editors and printers
- The Cambridge Guide to Australian English Usage
- Rules for the structure and drafting of Australian Standards

All such references should be shown in italics to distinguish them.

5.20.2 References to other parts of the same document

When referring to other parts of the same document make references in one of the following ways (note, only use capitals for 'Part', 'Section', 'Chapter', 'Figure' and 'Table'):

- As a separate sentence and in brackets
- Adjust the flow and temperature controller set points as required. (If necessary, refer to Section 4.2 for adjustment details).
- Within a sentence and in brackets
- Check the track relay and the VRR relay (refer to Section 4.4 and 4.5 respectively).
- As an integral part of the sentence
- Figure 1 shows a block diagram of the compressed air system.

In general you should observe the following rules:

- Use 'refer to' for references to paragraphs and tables
- Use 'see' for references to figures
- Use 'above' or 'below' when referring to previous or later paragraphs. Do not use 'preceding', 'following' or 'succeeding'

5.21. Right and left

Use 'right' and 'left' instead of 'right-handed' and 'left-handed' unless 'right' could be misinterpreted to mean 'correct'.

5.22. Affect or effect

If in doubt whether to use 'affect' or 'effect' the following meanings may be useful:

- affect (verb only) means to influence, or to produce an effect on, for example 'a blocked strainer will affect pump performance'
- effect (verb) means to bring about, for example 'any difference between selected speed and the actual engine speed effects a change in fuel pressure'
- effect (noun) means a result or a consequence, for example 'temperature has no effect on system operation'

5.23. Naming system

Names should always be applied consistently. The following are special circumstances where particular naming conventions shall be used.

5.23.1 Equipment names

The entire name of a piece of equipment is written as identified by the manufacturer / supplier (including capitalisation) when referred to the first time in a document, including initial capital letters for any part of the name that is a brand name. Include the identification number to add clarity or help distinguish between similar items of equipment. For example 'couples to a Van Kaik DIDBI120 brushless alternator'.

After you have used a name once, you can use a shortened version which includes the principal noun(s), but keep to the same abbreviation throughout. At your discretion, you can also use an identification number in text. For example 'waste flows to the waste storage tank (5-T-110)'. In the rest of the document the shortened name tank 5-T-110 can be used.

Normally spell out the word 'number'. Only use the abbreviation 'No.' when it is part of the name as in 'GSE item No. 3'.

5.23.2 Panel names

When referring to panel markings they are to be written exactly as they appear on the panel including spelling, abbreviations, capitalisation and punctuation but without quotation marks. If the panel marking contains quotation marks, then leave them in, such as:

- DC Control Panel
- 'AMPS'

If a control has no panel markings identify it in lower case by function or location whichever is clearer.

If control positions are not marked, describe them in lower case and by location, such as:

- off (downward)
- a quarter of a turn clockwise

6. Writing engineering procedures

To ensure that procedures are carried out correctly they must be written correctly. This means they must be clear, accurate, and complete and must clearly define who is responsible for which actions.

When writing about operating and fault-finding checks and procedures write as if you were giving instructions to an operator. For example, 'Move the brake controller handle to emergency.'

When describing or explaining how something works write it as you would say it. For example, 'when the brake controller handle is moved to emergency the brake pipe exhausts.'

When outlining mandatory requirements use 'shall' or 'shall not', do not use 'must'.

Use present tense for the results of an action. For example, use 'the sign-on screen displays' rather than 'the sign-on screen will display'. Do not use 'will' except for events which are certain to happen at some unspecified time in the future.

6.1. Write chronologically

Make sure the information in each step is written chronologically with each step logically following the previous one. This will avoid the need for phrases such as 'go to step X' at the end of every step.

For more complex steps you might consider the use of a visual aid such as a flow chart.

6.2. Break procedures down to single actions

Each step in a procedure should define a single action that the reader can carry out easily without having to refer back to the manual.

A good rule to use when you are writing procedures is to keep them to fifteen steps or less. This makes them less daunting and easier to follow.

If you have a procedure which is longer than fifteen steps use subheadings to break it into separate procedures.

Do not try to cram a long procedure into fifteen steps by putting a number of sub-steps within each step. This only makes the procedure confusing. Remember that your readers should only have to refer to a step once to carry out the action.

6.3. Instructions for one person

Present instructions for one person as a simple series of numbered steps. However, you still need to define who is responsible for carrying out the steps.

If the document is written for a single group of users you will have defined who they are in the introduction and every procedure will apply to that group.

If the document is for more than one group of users you should define who is responsible for carrying out the steps at the start of the procedure with a statement such as 'this procedure is for substation technicians'.

Instructions or activities are written as numbered steps in the order that they are to be done, for example:

1. fit the trainstop to two 230 by 150 mm sleepers
2. secure trainstop with four 20 mm coach screws
3. tighten bolts on one side of the trainstop.

6.4. Instructions for two or more people

When writing instructions for two or more people you need to define who is responsible for carrying out which steps. The best way to do this is to use a script format which treats each person involved in the procedure as an actor in a play. For example:

This person...	must...
Project Manager	1. Read and approve the report. 2. Forward the approved report to the Quality Manager.
Quality Manager	3. Read and approve the report, and file it.

7. Planning a document

An effective document, which people will use, must be planned from the outset. The information presented to the reader must be easy to find, logically structured, well designed and easy to read.

Before you start writing a document there are some basic questions that need thoughtful consideration.

- What is the purpose of this document?
- Who is the audience?
- How familiar is the audience with the topic?
- What is the best way to present the information?

Answering these questions at the start of the project will enable you to gain a clearer picture of what you are trying to achieve and help you throughout the production of the document. The answers will help you plan the structure and content of the document.

7.1. Defining the purpose

To define the document's purpose, ask yourself the following questions:

- What do I want to say?
- Why do I want to say it?
- What am I trying to achieve?

Do not start writing the document until you have answered these questions and you can state the purpose clearly. Subtle differences in the purpose will affect the order in which you organise the topics and the amount of space you give to each topic.

You need to continually go back to the purpose while you are writing to make sure you do not go astray.

7.2. Defining the audience

The audience will determine what information you include in your document, how you organise it, and the tone, style and language you use.

Ask yourself these questions:

- Who is my audience?
- How much do they know about the topic and how experienced are they?
- How will the document relate to their work?
- What is their general level of education?
- What are the main questions your readers will want answered?

Often you will have more than one audience, for example managers and both experienced and inexperienced staff. It is very important that you try to meet the needs of each group. For example, you might include an introductory chapter for beginners, the general procedures, and then another chapter which is specific to managers.

However you cope with this challenge, you need to make your method clear in the "how to use this document" section of the foreword. Use this section to explain to each audience how they should use the document.

As with the document's purpose, you should keep coming back to the audience when you are writing the document, particularly when you need to make any major decisions.

7.3. Writing the foreword

The Macquarie Dictionary defines a foreword as "...a preliminary statement by the author or editor of a book, setting forth its purpose and scope, expressing acknowledgment of assistance from others."

The information in the foreword details the basis of the document. The foreword should address each of the following issues:

- the document's purpose
- who it is for
- what is in it
- how to use it
- conventions used in it
- other references.

The most important part of this exercise is to define the purpose and audience, both of which have a major influence on the content and design of the document.

7.4. Planning the table of contents

With the purpose and audience of your document clear in your mind, you can decide what information to include and how to organise that information to best suit the needs of the audience.

You do this by drafting a preliminary table of contents.

7.5. Deciding what topics to include

Before you try to enforce any sort of structure on your document, write down a list of all the topics your audience needs to know, both major and minor. (Don't limit yourself to the headings in an existing document as you may end up duplicating any faults in that document's structure).

When you have written down all the topics you can think of, go through your list and remove any entries which don't fit the purpose or audience. Look for any gaps in the information and fill them.

7.6. Organising the topics

Now you can start organising your list of topics into a structure. Think about how your audience will use the document and how they will expect the information to be organised.

Sort related topics into groups, and sort the topics into various weights - decide which topics are chapter headings, which ones are the major headings in each chapter, and which ones are subheadings. It is important to get the headings right because they help readers to see how you have organised the information and to find information they are looking for.

Try to organise the topics logically, in a way that will be immediately clear to the readers, for example according to workflow, or in chronological order, or from simplest to most complex.

Make sure the structure will not lead to duplication of information. Put any common information at the front of the document and refer readers back to it when you need to.

7.7. Preparing sample pages and testing

Before you throw yourself headlong into writing, it is a good idea to prepare some sample pages of your document. This could be part of a chapter, which is representative of the way the rest of the document will look.

The sample pages should illustrate:

- the document structure
- the page layout and design
- the writing style and tone.

When you are happy with the look of the sample pages, give them to some of the people who will be using the document and ask for their comments.

The advantage of testing some sample pages is that you sort out any design problems right at the start when they are easy to fix.

7.8. Including access aids

To make it easy for different types of readers to find the information they need, you should plan to include as many access aids as you can. Access aids include:

- foreword
- table of contents
- headers and footers on each page
- headings which are meaningful, logically structured and well presented
- glossary
- index

7.9. Including an overview or introduction

If your document contains sections or chapters which form part of an overall workflow or process, you should plan to include an overview or introduction at the start. This should provide readers with a broad picture of how the various sections fit together and how each one fits into the workflow or process as a whole.

It should not tell readers how to use the document. That should be in the foreword (refer to Writing the foreword in Section 7.3 for more information).

Generally you should write the overview last, so that you can draw together the various sections more effectively.

In documents where each section or chapter stands alone, there is no need to include an overview or introduction.

7.10. Planning for maintenance

A document is only useful if readers can rely on the information it contains to be accurate and current. This means you need to think about maintenance when you are planning a document, because the frequency and extent of updates will influence the way you publish and distribute it.

You need to include the issue or amendment date at the foot of each page so readers can tell whether they have the current version.

So that readers can check whether a document is up to date, include document control pages with an amendment history. Then each time you issue an amendment, you can issue new document control pages so you can easily tell which documents have been kept up to date.

8. Editing and rewriting

Never expect to write anything perfectly the first time. The main thing is to get down what you want to say then go back and edit and rewrite your words until they sound the way you want them to.

Check that you have followed the rules outlined in this document:

- go through your work and break up long sentences
- change sentences from passive voice to active voice where necessary, and
- substitute simple words for fancy ones and remove any jargon

Doing this will remove the main flaws from your work and allow the more subtle problems to stand out.

Imagine speaking the words you have written.

Would you talk this way in a conversation with a colleague? If your written work comes out sounding stilted then use more natural-sounding expressions.

Allow plenty of time between writing and editing.

Once you have produced a first draft put it aside, read it again after a day or two. Make improvements and put it aside again. Keep repeating this process until you can make no more improvements.

Have a colleague review your draft for readability and if they are qualified for technical proficiency.