



Transport
for NSW

T MU MD 00006 ST

Standard

Engineering Drawings and CAD Requirements

Version 2.0

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Standard governance

Owner: Manager Network Standards, Asset Standards Authority

Authoriser: Director Network Standards and Services, Asset Standards Authority

Approver: Executive Director, Asset Standards Authority on behalf of the ASA Configuration Control Board

Document history

Version	Summary of Changes
1.0	First issue.
2.0	Second issue. Minor updates to provide clarity

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Preface

The Asset Standards Authority (ASA) is an independent unit within Transport for NSW (TfNSW) and is the network design and standards authority for defined NSW transport assets.

The ASA is responsible for developing engineering governance frameworks to support industry delivery in the assurance of design, safety, integrity, construction, and commissioning of transport assets for the whole asset life cycle. In order to achieve this, the ASA effectively discharges obligations as the authority for various technical, process, and planning matters across the asset life cycle.

The ASA collaborates with industry using stakeholder engagement activities to assist in achieving its mission. These activities help align the ASA to broader government expectations of making it clearer, simpler, and more attractive to do business within the NSW transport industry, allowing the supply chain to deliver safe, efficient, and competent transport services.

The ASA develops, maintains, controls, and publishes a suite of standards and other documentation for transport assets of TfNSW. Further, the ASA ensures that these standards are performance-based to create opportunities for innovation and improve access to a broader competitive supply chain.

T MU MD 00006 ST *Engineering Drawings and CAD Requirements* is developed to achieve consistency in all computer-aided drafting (CAD) work performed in-house by TfNSW or by an Authorised Engineering Organisation (AEO) that can be easily lodged into the Virtual Planroom.

The content of this standard is derived from the following documents and supersedes these documents:

- TMD 0001 *CAD and Drafting Manual – All Design Areas*, Version 2.3 (except Section 5, Electrical operating diagrams)
- PR PSA VP 010 *External Party Submissions to Virtual Planroom*, Version 1.0
- 4TP-RL-004 *CAD Protocols and Submission of Drawings to TfNSW*, Version 1.0

The changes to this standard also include the following:

- replacement of RailCorp organisational roles with those applicable to current ASA organisational content
- amendments to the text for clarity and improvement
- conversion of the standard to ASA format and style
- inclusion of recent technology improvements

T MU MD 00006 ST *Engineering Drawings and CAD Requirements* is a second issue.

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1. Introduction

The *Engineering Drawings and CAD Requirements* standard specifies the drawing management and drafting requirements for engineering drawings produced for Transport for NSW (TfNSW).

This standard includes the general CAD requirements section that applies to all engineering disciplines producing drawings for TfNSW. The general CAD requirements section shall be read in conjunction with discipline specific requirements that apply to individual engineering disciplines.

Any matters of drafting not covered by this standard are required to comply with AS 1100 series *Technical Drawing*. Refer to HB 7 *Engineering Drawing Handbook* for guidance information on complying with AS 1100.

2. Purpose

The purpose of this standard is to achieve consistency in the drafting content presented on the drawings and standardise the drawing submission process.

2.1. Scope

This standard specifies TfNSW requirements for creating engineering drawings using computer-aided drafting (CAD). In addition to the CAD drafting requirements for drawings, it covers the drawing management and the drawing submission process for engineering drawings.

2.2. Application

The requirements in this standard apply to assets related to rail transport or assets that are used in conjunction or connection with rail transport. Rail transport includes heavy rail, light rail and rapid transit.

3. Reference documents

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies.

Where multiple parts of a standard are published as separate documents, unless reference to a specific section has been made the main document number has been cited.

Australian standards

AS 1100.101 Technical drawing – General principles

AS 1100.201 Technical drawing – Mechanical engineering drawing

AS 1100.301 Technical drawing – Architectural drawing

AS 1100.401 Technical drawing – Engineering survey and engineering survey design drawing

AS 1100.501 Technical drawing - Structural engineering drawing

AS/NZS 1101.1 Graphic symbols for general engineering - Hydraulic and pneumatic systems

AS/NZS 1101.3 Graphical symbols for general engineering - Welding and non-destructive examination

AS/NZS 1102 series (1102.102 to 1102.113) Graphical symbols for electrotechnical documentation

AS 2067 Substation and high voltage installation exceeding 1 kV a.c.

AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)

AS 4799 Installation of underground utility services and pipelines within railway boundaries

AS 5488 Classification of Subsurface Utility Information (SUI)

Transport for NSW standards

T MU MD 00006 TI Technical Information for CAD and Engineering Drawings

T MU MD 00006 F1 Metadata Spreadsheet for Engineering Drawings

T MU AM 01007 TI Asset Reference Codes Register

T HR EL 10001 ST HV Aerial Line Standards for Design and Construction

T HR EL 11001 PR Design Technical Reviews for Electrical SCADA Equipment

T HR EL 11001 PR F1 SCADA I/O Schedule

EP 08 00 00 10 SP Overhead Wiring Layouts – Requirements and Symbology

EP 20 00 04 06 SP Underground Cable - Location Recording

TMA 0493 Scope Procedure

SPC 211 Survey

SPC 212 Contract Survey

TMC 212 Survey

T HR SC 00001 SP Circuit Design Standard – Typical Circuits

SDG 002 Circuit Design Standard Obsolete Signalling Circuits

SDG 003 Circuit Design Standards ATP

SDG 004 Standard Signalling Symbols

SPG 0703 Signalling Documentation and Drawings

ESG 100 Signalling Design Principles

ESG 100.29 Naming of Locations, Track and Signals

SPG 1230 Design of Microlok II Interlocking

TMG G 1550 Signalling Documentation Guidelines

Transport for NSW drawings

EL0435527 Toongabbie SS Electrical Communication Cabling Block Diagram

Other reference documents

Building Code of Australia

Work Cover Code of Practice – WC00312, Excavation Work

HB 7 Engineering Drawing Handbook

SMS-06-GD-0268 Working Around Electrical Equipment

PR A 00492 Data Capture Procedure

PR A 00493 Scope Procedure

PR A 00494 Work as Executed Procedure

PR A 00495 Infrastructure Services Data Policy

SP A 00496 Specification for Collection of Services Data

GL A 00511 Plan Symbols and Interpretation Guidelines

SMS-06-GD-1574 Managing Construction Hazards

RS 0041CM Fleet Architecture Manual

4. Terms and definitions

The following terms and definitions apply in this standard:

AEO Authorised Engineering Organisation; a legal entity (which may include a Transport Agency as applicable) to whom the ASA has issued an ASA Authorisation

AFC approved for construction

AHD Australian Height Datum

approved appears on the drawing sheet; the approver who certifies that design outputs have been verified as meeting design input specifications and requirements and that the design has been completed in accordance with relevant regulations and standards

AS Australian standard

ASA Asset Standards Authority

AutoCAD proprietary CAD software provided by Autodesk

BIM building information modelling; a digital representation of physical and functional characteristics of a facility

B&W black and white, that is, monochrome

CAD computer-aided drafting

Central Planroom the physical location where drawing information is stored and managed

composite a combination of multiple 3D CAD models in a single file, which can be used for additional value added tasks

concession a deviation from an ASA requirement approved by ASA in advance

designed appears on the drawing sheet; the person responsible for the design of the technical content of the drawing

design check appears on the drawing sheet; the person responsible for checking the technical content of the drawing

This includes conformance to technical standards are met; safety-in-design approach, construction and operation issues are addressed. This check also considers any design interface issue with other disciplines.

design company the AEO responsible for design and drawing content on the drawing

drawn appears on the drawing sheet; the person responsible for drafting the technical and graphical content of the drawing

drawing check appears on the drawing sheet; the person responsible for the drafting check of the drawing

This includes checking the drafting aspects of the drawing and its compliance with TfNSW CAD requirements. This check also considers any drafting interface issues with other disciplines.

DTM digital terrain model

EDMS engineering document management system

engineering drawing a design drawing created using CAD software to fully and clearly define requirements for an engineering asset

hybrid drawing composed of both raster and vector graphics

ID identification

ISG Integrated Survey Grid

MGA Map Grid of Australia

MicroStation proprietary CAD software provided by Bentley

nonconformance a deviation from an ASA requirement that has occurred without prior approval from ASA

NTS not to scale

OHW overhead wiring

PID project identifier

project interface person (for the purpose of this standard) a person within the TfNSW cluster responsible for managing the drawing and other information submissions to the Central Planroom or to the Virtual Planroom for a particular project or a program by a contracted AEO or AEOs

ProjectWise proprietary electronic document management software provided by Bentley

raster file an electronic image file containing computer graphics;` a raster is usually in a dot matrix structure, typically a rectangular or grid-like, of pixels or points stored in files including TIF, JPG, or GIF

Revit proprietary CAD software provided by Autodesk

smart tags predefined data entry fields that permit automated transfer of metadata between drawing file and the Virtual Planroom

SolidWorks proprietary CAD software provided by Dassault Systems

Sydney metropolitan rail area an area bounded by Newcastle (in the north), Richmond (in the northwest), Bowenfels (in the west), Macarthur (in the southwest) and Bomaderry (in the south), and all connection lines and sidings within these areas, but excluding private sidings

symbolology a combination of colour, line-weight, and line-style

TfNSW Transport for New South Wales

unbound drawing CAD drawing in which all references to the drawing are in independent drawing files and attached to the CAD drawing

vector an electronic file containing geometric primitives such as points, lines, curves, shapes, or polygons arranged in a meaningful manner. Types of vector files include DGN, DWG, DXF, STEP, SLDPRT, and SLDASM.

Virtual Planroom TfNSW engineering document management system used for storing and managing electronic data and information

verified appears on the drawing sheet; the person responsible to ensure that the output of a design stage meets the design input requirements

2D CAD use of CAD software to prepare two-dimensional lines for graphical representation of physical objects

3D CAD use of CAD to prepare three-dimensional lines, surfaces or solids for graphical representation of physical objects

File extensions are shown in Table 1.

Table 1 - File extensions

File extension	Description
dgn	MicroStation CAD file format.
dwg, dxf	AutoCAD CAD file format.
dgnlib	MicroStation library file used for storage and distribution of shared resources.
rsc	MicroStation resource file containing symbology information.
stp, step	ISO 10303-21 Standard Data Exchange format encoded in ASCII structure.
pdf	Portable document format (Adobe Acrobat format).
plt	A vector based plotter file used by CAD applications.
nwd, nwf	Navisworks file format used by AutoCAD and Revit applications.
i-model	A container holding compressed graphical and BIM information in a single portable file.
tif	Tagged image file format for storing raster graphics images.
jpg / jpeg	Joint photographic expert group – formatting method for lossy compression for digital images.
sldprt, sldasm, slddrw	SolidWorks CAD file.
rvt, rft, rfa	Revit CAD file.
gif	Graphic interchange format – a bitmap image format.

5. Compliance with legal requirements

The design company carrying out the design shall comply with all design and drawing codes and regulation requirements, whether or not described in this standard.

Drawings shall not include disclaimers and certifications. When required, the design company carrying out the design shall provide the disclaimers and certifications as a separate document with the drawing numbers and amendment levels referenced.

6. General CAD requirements

The general CAD requirements apply to all engineering drawings submitted to TfNSW.

The general CAD requirements shall be read in conjunction with the discipline specific requirements provided in Section 9 through to Section 15. Where conflict exists between the general CAD requirements and the discipline specific requirements, then the discipline specific requirements shall take precedence over the general CAD requirements, unless the general section expressly states otherwise.

All engineering drawings shall be created using CAD and in third angle orthographic projections. Auxiliary sections, isometric, oblique, and other views should be used to supplement the orthographic projections and provide clarity for features that would otherwise be difficult to understand.

The drawing shall be read in conjunction with the design specifications, if any. Where conflict exists between the two, the design specification shall take precedence over drawings, unless the drawing expressly states otherwise.

Completed and approved drawings shall show sufficient details to meet the purpose of the drawings and satisfy TfNSW design and CAD requirements.

6.1. Engineering drawing classification

Engineering drawings are classified as follows:

- sketch
- standard drawing
- design drawing
- production drawing
- as-built drawing

6.1.1. Sketch

A sketch is a rough unfinished drawing that is used to assist in the making of a final engineering drawing. Project participants often use sketches in the first stage of a project to assess the feasibility of proceeding with a project, or to investigate various options. Sketches can include data sheets, charts, design graphs, concept designs, proposals, or options leading up to the final drawings. Sketches can be included in reports to depict concept proposals. They cannot be used for contractual purposes or for wide distribution.

Sketches should be prepared in accordance with the drafting requirements specified in this standard.

6.1.2. Standard drawing

A standard drawing eliminates repetition by showing details that are typical or repetitive for a particular type of project, system or equipment. Standard drawings can be issued without alteration to different clients for different projects. Standard drawings are divided into the following two categories:

- project standard drawing
- ASA standard drawing

Project standard drawing

A project standard drawing is specific to a particular project only. It cannot be used across multiple projects. Project standard drawings shall be prepared, registered and submitted to the Virtual Planroom, the same way as other project drawings.

In a drawing title block, the 'Job Description' field should contain the words 'STANDARD DRAWING'. The design company shall register and submit these drawings to the Virtual Planroom.

Figure 1 shows a typical example of a completed title block for a project standard drawing.

GLENBROOK			
MAIN WEST LINE 66.880 kms.			
STANDARD DRAWING - SINGLE PIPE HEADWALL TO SUIT PIPES 225 - 600mm DIAMETER			
PRECAST REINFORCED CONCRETE DETAILS			
FILE No. F2008/26944	SHEET: 1 OF 1	A1	©
STATUS: FOR CONSTRUCTION			
DRG No. ASOC-145-456-CV-001	2	EDMS No. CV0123456	A

Figure 1 – Project standard drawing

For each project, a full set of design drawings, production drawings and project standard drawings are brought together to form the project drawings. A complete set of project drawings shows the full extent of the work.

ASA standard drawing

ASA standard drawings can be applied across multiple projects and shall be prepared in the same way as other drawings. In addition to the drawing approval process, ASA standard drawings shall be accepted for network use by the relevant discipline Lead Engineer ASA, and updated in the title block accordingly.

In a drawing title block, the 'Location' field shall contain the words 'ASA STANDARD DRAWING'. ASA shall register and submit these drawings to the Virtual Planroom.

Figure 2 shows an example of a completed title block for an ASA standard drawing.

ASA STANDARD DRAWING			
HEAVY RAIL			
SINGLE PIPE HEADWALL - STRAIGHT WINGS TO SUIT PIPES 225 - 600mm DIAMETER			
PRECAST REINFORCED CONCRETE DETAILS			
FILE No. F2008/26944	SHEET: 1 OF 1	A1	©
STATUS: STANDARD DRAWING			
DRG No. ASOC-145-456-CV-001	2	EDMS No. CV0123456	A

Figure 2 – ASA standard drawing

6.1.3. Design drawing

A design drawing is created during the design and planning phase. A set of design drawings includes 3D models, 2D models and 2D drawings to provide sufficient detail for the design of the project.

6.1.4. Production drawing

A production drawing applies to construction, manufacture, and assembly, and forms part of the contract documentation of the project. Production drawings include shop drawings, assembly drawings and subassembly drawings.

6.1.5. As-built drawing

An as-built drawing represents a record of the completed works. It is based on design drawings and standard drawings and is updated to reflect any changes or alterations undertaken during construction. The as-built drawing becomes part of the final drawing package submitted to the Virtual Planroom at the completion of a contract.

6.2. Drawing format

All drawings shall be produced using computer-aided drafting (CAD) only. The design company can use any appropriate CAD software to produce engineering drawings, but the final submission drawings shall be converted to either dgn or dwg format with smart tags attributes for title block extraction. Refer to Section 8 of this standard for more details on the drawings submission process.

6.3. Types of engineering drawings

Engineering drawings are divided into two types:

- drawing
- model

6.3.1. Drawing

A drawing is a CAD design file that contains the drawing sheet and title block information. The title block information assists in lodging the drawings to the Virtual Planroom.

A MicroStation drawing shall contain one sheet model and one design model.

An AutoCAD drawing shall contain one paper space and one model space.

The design model or model space within the drawing shall contain the design data. This includes references, extractions and assembly files. References with geo-referenced design

data (for example, survey data) should be attached to the model space using global coordinates.

The sheet model of the CAD design file shall reference the design model in the drawing sheet at the appropriate scale or scales for publication.

All annotations and dimensioning shall be done in the sheet model or the paper space.

The sheet model shall display a referenced standard size drawing sheet plotted at 1:1, the title block information, and the design data referenced from the design model as indicated in this section.

All drawings created for a project shall have an EDMS number assigned. Refer to Section 8.1 for details on EDMS numbers.

6.3.2. Model

A model is a design file that does not contain the drawing sheet and title block information. A model can contain design model data referenced by multiple drawing files, and is used to form a base for the design; for example, track alignments, overhead wiring, detail survey, and so on.

MicroStation models shall contain only one design model and no sheet model. AutoCAD models shall contain only one model space and no paper space.

An EDMS number shall not be assigned to a model.

6.4. Line weight

The line weight is the pen width value assigned to graphical elements in CAD. The line weight varies with the type of element. A line weight that is assigned to an element should be consistent throughout the drawing and be readily distinguished from other line weights in the drawing.

Table 2 provides the allowed values of line thicknesses associated with line weight.

Table 2 - Line weight

Weight of line	Thickness (mm)
0	0.18
1	0.25
2	0.35
3	0.50
4	0.70
5	1.00

6.5. Line style

The line style defines the appearance of a continuous or non-continuous line on an engineering drawing that is created using CAD. The line styles are categorised as follows:

- standard line style
- customised line style

6.5.1. Standard line style

A standard line style is part of standard CAD install. Refer to AS 1100.101 for details on preparation of these standard line styles.

Figure 3 shows the standard line styles for all TfNSW drawings.

LINE STYLE	DESCRIPTION	APPEARANCE
0	SOLID	
1	DOT	
2	MEDIUM DASH	
3	LONG DASH	
4	DOT DASH	
5	SHORT DASH	
6	DASH DOT DOT DASH	
7	LONG DASH, SHORT DASH	

Figure 3 – Standard line styles

6.5.2. Custom line style

A custom line style is a special line style created to cover a broader requirement in CAD. It is made up of a series of defined requirements including dashes, symbols, intervals or a combination of these. Custom line styles shown in Figure 4 can be utilised by all engineering disciplines. In addition to these, other line styles specific to an engineering discipline may also be used.

Line style resource files are available for download from the ASA website.

Linestyle	Description	Appearance
RC-CAIR-CL	ABOVE GROUND COMPRESSED AIR SERVICE LINE	—A—A—A—A—
RC-CAIR-UG	UNDERGROUND COMPRESSED AIR SERVICE LINE	—A—A—A—A—
RC-DISP-HUTE-LN	GENERAL DISPLAY HIGHLIGHT LINE	=====
RC-DISP-RAIL-GAUG-LN	GENERAL RAIL GAUGE MULTIPLE LINE	=====
RC-DISP-RAIL-TICK-LN	GENERAL DISPLAY RAIL WITH TICKS CENTRELINE	+++++
RC-DRAIN-CL	DRAINAGE SERVICE LINE ABOVE GROUND	—D—D—D—D—
RC-DRAIN-UG	DRAINAGE SERVICE LINE UNDERGROUND	—D—D—D—D—
RC-ELEC-CL	ELECTRICITY (POWER WIRES) ABOVE GROUND LINE	—E—E—E—E—
RC-ELEC-UG	ELECTRICITY (POWER CABLES) UNDERGROUND LINE	—E—E—E—E—
RC-FENC-ARMCO-LN	ARMCO GUARD BARRIER LINE	—□—□—□—□—
RC-FENC-BNDY-LN	FENCE ON BOUNDARY LINE	—/—/—/—/—
RC-FENC-LN	FENCE LINE	—/—/—/—/—
RC-FUEL-CL	FUEL SERVICE LINE ABOVE GROUND	—F—F—F—F—
RC-FUEL-UG	FUEL SERVICE LINE UNDERGROUND	—F—F—F—F—
RC-BASIC-LN	ABOVE GROUND BASIC SYMBOL	—○—○—○—○—
RC-BASIC-UG	UNDERGROUND BASIC SYMBOL	—○—○—○—○—
RC-GENL-DASH-L10	GENERAL DASHED LINE LENGTH OF 10mm	-----
RC-GENL-DASH-L15	GENERAL DASHED LINE LENGTH OF 15mm	-----
RC-HVOL-LN	HIGH VOLTAGE SERVICE (WIRES) LINE ABOVE GROUND	—HV—HV—HV—
RC-HVOL-UG	HIGH VOLTAGE SERVICE (CABLES) LINE UNDERGROUND	—HV—HV—HV—
RC-LVOL-LN	LOW VOLTAGE SERVICE (WIRES) LINE ABOVE GROUND	—LV—LV—LV—
RC-LVOL-UG	LOW VOLTAGE SERVICE (CABLES) LINE UNDERGROUND	—LV—LV—LV—
RC-MASK-RAIL-HEAD-LN	RAIL HEAD LINE	=====
RC-NEG-CL	NEGATIVE SERVICE LINE ABOVE GROUND	—NEG—NEG—NE
RC-NEG-UG	NEGATIVE SERVICE LINE UNDERGROUND	—NEG—NEG—NE
RC-NGAS-CL	NATURAL GAS SERVICE LINE ABOVE GROUND	—G—G—G—G—
RC-NGAS-HPRE-CL	NATURAL GAS HIGH PRESSURE SERVICE LINE ABOVE GROUND	—HG—HG—HG—
RC-OILS-HPRE-UG	NATURAL GAS HIGH PRESSURE SERVICE LINE UNDERGROUND	—H0—H0—H0—
RC-NGAS-UG	NATURAL GAS SERVICE LINE UNDERGROUND	—G—G—G—G—
RC-OFBR-LN	OPTIC FIBRE SERVICE CABLE ABOVE GROUND	—OF—OF—OF—
RC-OFBR-UG	OPTIC FIBRE SERVICE CABLE UNDERGROUND	—OF—OF—OF—
RC-OILS-HPRE-CL	OIL HIGH PRESSURE SERVICE ABOVE GROUND	—H0—H0—H0—
RC-OILS-HPRE-UG	OIL HIGH PRESSURE SERVICE UNDERGROUND	—H0—H0—H0—
RC-PIPE-CL	PIPELINE SERVICE (UNKNOWN) UNDERGROUND	—PPE—PPE—PPE—PPE
RC-PIPE-OVHD-CL	PIPELINE SERVICE (UNKNOWN) OVERHEAD	—O—O—O—O—
RC-POS-CL	POSITIVE SERVICE ABOVE GROUND	—POS—POS—PO
RC-POS-UG	POSITIVE SERVICE UNDERGROUND	—POS—POS—PO
RC-RETG-WALL-LN	RETAINING WALL (GENERIC) CENTRELINE	□□□□□□□□□□□□
RC-SERV-DUCT-LN	SERVICE DUCTING CENTRELINE	—SD—SD—SD—
RC-SEWR-CL	SEWER SERVICE LINE ABOVE GROUND	—S—S—S—S—
RC-SEWR-UG	SEWER SERVICE LINE UNDERGROUND	—S—S—S—S—
RC-SIGL-COMS-CL	SIGNAL & COMMUNICATION SERVICE LINE ABOVE GROUND	—S&C—S&C—S&C
RC-SIGL-COMS-UG	SIGNAL & COMMUNICATION SERVICE LINE UNDERGROUND	—S&C—S&C—S&C
RC-SIGL-RODG-CL	SIGNAL RODING LINE ABOVE GROUND	—R—R—R—R—
RC-TELE-CL	TELSTRA SERVICE LINE ABOVE GROUND	—T—T—T—T—
RC-TELE-UG	TELSTRA SERVICE LINE UNDERGROUND	—T—T—T—T—
RC-TRGH-AGT	SIGNALS TROUGHING ABOVE GROUND CENTRELINE	—AGT—AGT—AGT
RC-TRGH-GLT-CL	SIGNALS TROUGHING GROUND LEVEL CENTRELINE	—GLT—GLT—GLT
RC-WATR-CL	WATER SERVICE LINE ABOVE GROUND	—W—W—W—W—
RC-WATR-UG	WATER SERVICE LINE UNDERGROUND	—W—W—W—W—

Figure 4 - Custom line styles

6.6. Text

The text on drawings shall appear in upper case and be consistent in size and placement. The text should not overlap with the lines or symbols. The text in the drawing shall be readable with the title block at the bottom right corner, or when the drawing is rotated 90° clockwise, the title block appears at the bottom left corner. A visual representation of this concept is provided in Figure 5.

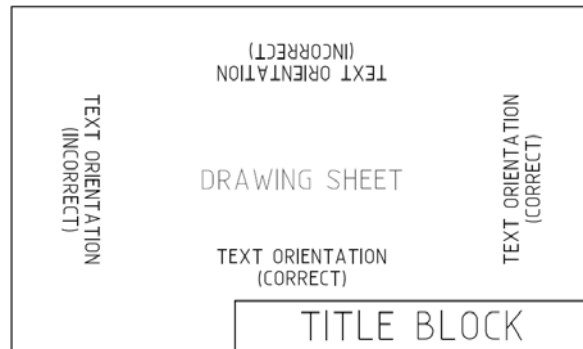


Figure 5 - Correct orientation of text on a drawing

English shall be used as the primary language on a drawing. In case other additional languages are required, the text in other languages shall be a direct translation of English text and should be presented in a similar font. In all of these cases, the text in English takes precedence over any translations.

6.6.1. Text style

A text style is a named set of text attributes such as font, width, height, and colour that allows the user to place text in a drawing in a consistent and automated manner. Text styles shall be based on requirements set out in AS 1100.101 *Technical drawings – General principles*. ASA has defined the basic text styles required for the most common drawings. These text styles are available for download from the ASA website.

6.6.2. Fonts

Table 3 provides the list of fonts to be used on drawings.

Table 3 - Fonts

Font name	Application
Swiss 721 Bold Outline BT	Title blocks headings only
Swiss 721 Condensed BT	Title blocks and general labels
Swiss 721 Light Italic BT	Title block disclaimer
INTL_ISO, STANDARD, ARCHITECTURAL, ISO3098b, INTL_ISO_EQUAL, isocp3	MicroStation fonts

Font name	Application
ISO3098b, iso, isocp3	AutoCAD fonts
ISOCPEUR, Arial, Arial Narrow, ISO3098b	TrueType fonts

6.6.3. Height and line weight of text

The height of the text characters, in relation to the size of the drawing sheet used shall comply with AS 1100.101. Table 4 provides the minimum recommended height of the text for different sheet sizes. Where the drawing is required to be reduced, the character height shall be selected so that the reproduced text height is not less than 1.7 mm.

Table 4 – Recommended minimum height of text

Character use	A0 size sheet (mm)	A1, A2 size sheet (mm)	A3 size sheet (mm)
Title block – Locality and EDMS number	7	7	5
Titles, headings, view and section designation, drawing numbers, version or amendment numbers	5	5	3.5
General notes, dimensions, material lists	3.5	2.5	2.5

The maximum thickness of the lines used to form the text shall be 0.1h, where h is the height of the characters.

6.7. Cell library and blocks

A cell is a drawing of a frequently used feature. TfNSW has created the cell libraries for these frequently used features. The design company can download these cell libraries from the ASA website and use these features to develop the engineering drawings. AutoCAD equivalent blocks for these cells are also available on the ASA website.

The design company is responsible for the appropriate use of cells on the engineering drawing.

6.8. Colours

The screen colours from the ASA MicroStation colour table 'RCSTcolor.tbl' as shown in Figure 6 should be used for various elements. This colour table is attached to the standard seed files listed in Section 6.10 of this standard. AutoCAD files shall use the standard AutoCAD colour table as shown in Figure 7.

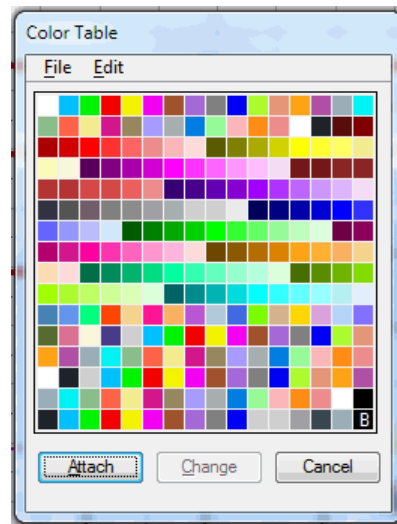


Figure 6 – ASA MicroStation colour table

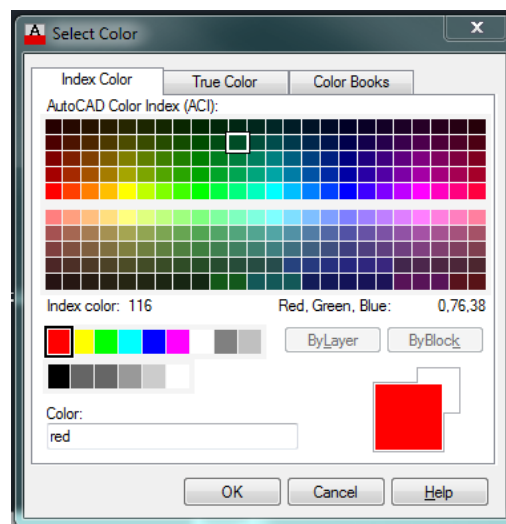


Figure 7 – AutoCAD colour table

6.9. Levels and layers

MicroStation and AutoCAD both use level names or layer names as their primary labelling functionality. This functionality is used to create a reserved range of level numbers for assignment to the level names. Table 5 provides the level number grouping structure.

The grouped ranges of numbers are created for familiarity in sharing design file data. This allows the CAD user to analyse the level, and to understand the design group from which it was created.

Table 5 - Level number grouping structure

Level number band	Discipline code	Discipline group	Description
0 – 999	R	General	Levels accessible for all design groups, containing global shared data.

Level number band	Discipline code	Discipline group	Description
1000 – 1999	F	Field survey	Field survey data (DTM's, detail survey plans, and so forth).
2000 – 2999	D	Design global	Levels specific to globally shared design work.
3000 – 3999	A	Architectural	Levels specifically related to architectural design work.
4000 – 4999	C	Civil design	Levels specifically related to civil design work.
5000 – 5699	E	Electrical design	Levels specifically related to electrical design work.
5700 - 5999	E	Electrical operating diagrams	Levels specifically related to electrical operating diagrams.
6000 – 6999	S	Signal design	Levels specifically related to signal design work.
7000 – 7999	T	Track design	Levels specifically related to track design work.
8000 – 8499	G	Geotechnical	Levels specifically related to geotechnical design work.
8500 – 8999	RS	Fleet	Levels specifically related to fleet design work.

6.9.1. CAD level naming format

The CAD level names that are used within MicroStation and AutoCAD shall have the format A-BBBB-CCCC-DDDD-EEEE, where the letter groupings refer to the following:

- A - discipline code
- BBBB - major element
- CCCC - minor element
- DDDD - minor element
- EEEE - minor element

Table 6 provides further explanation of the format.

Table 6 - CAD level naming format description

Character	Description
Discipline	Discipline prefix 1 character alpha code (track, civil, and so on) – based on Table 5
Major element	Parent element abbreviated code for element (feature)
Minor element	Sub element abbreviated code for part

Some examples of this format include the following:

- F-BRDG-ABUT (Field data - bridge - abutment level)
- F-BRDG-ABUT-TEXT (Field data - bridge - abutment - text level)

A complete range of CAD level tables can be obtained by downloading the resource file from the ASA website.

6.10. Seed files

Seed files are templates used to create a new engineering drawing. Use the following MicroStation seed files as appropriate:

- model2DseedV8.dgn (2D design model (no sheet model))
- model2Dsheet2DseedV8.dgn (2D design model/2D sheet model)
- model3DseedV8.dgn (3D design model (no sheet model))
- model3Dsheet2DseedV8.dgn (3D design model/2D sheet model)

These files are available for download from the ASA website.

AutoCAD equivalents of these files are also available on the ASA website.

6.11. Drawing sheets

All drawing sheet sizes shall comply with AS 1100.101. Table 7 provides the dimensions of drawing sheets. For all drawings, the preferred size is A1 drawing sheet size with landscape orientation. Other sheet sizes A0, A2 and A3 in landscape orientation can be used if required. The title blocks for all these sizes are available for download from the ASA website in both MicroStation format and AutoCAD format.

Table 7 - Dimensions of drawing sheets

Standard designation	Cut sheet and drawing sheet dimensions (mm)
A0	1189 x 841
A1	841 x 594
A2	594 x 420
A3	420 x 297

The roll plan to A1 sheet or A2 sheet width with a maximum length of 5 m may also be used.

6.12. Drawing scale

Scales used for drawings varies with size and character of the feature, and with the degree of the details to be shown. Table 8 shows the scales for full size, enlargement, and reduction ratios.

Views should be drawn to scale. Use distorted scales only in special cases, where the required detail does not show effectively on an undistorted scale. Scales shall be indicated under each heading on the drawing. Views not drawn to scale shall be marked as NTS (not to scale).

Table 8 – Engineering drawings recommended scales

Full size and enlargement scales	5:1	NA	2:1	10:1 1:1
Reduction scales	1:2 1:20 1:200 1:2000	1:25 1:250 1:2500 1:25000	1:5 1:50 1:500 1:5000 1:50000	1:10 1:100 1:1000 1:10000 1:100000

When using different scales for horizontal and vertical dimensions, such as high voltage (HV) aerial lines and cables line, overhead wiring (OHW), and bridge profiles, each scale shall be clearly indicated on the drawing sheet.

For example,

HORIZONTAL SCALE 1:500

VERTICAL SCALE 1:100

The number of different scales used on any one drawing shall be kept to a minimum. Scales shall be large enough to permit clear interpretation of the information and ensure clarity of information on prints. All drawing sheets shall include a scale bar representing the scales used on the drawing.

The scale bar for all scales used on the drawing should be shown on the lower left corner of the drawing sheet.

6.13. Drawing orientation

Drawings should be produced in accordance with the rules of orientation explained in this section. However, if these rules are likely to cause confusion with other drawings, then the clarity of the drawing should not be compromised.

Whenever it is necessary to depart from the rules of orientation, the system adopted shall be clearly noted. Regardless of the system used, the orientation of all views on the drawing should be consistent with that of the site plan view.

Site plans and locality maps should be oriented with north or assumed north to the top of the sheet. If this orientation is not convenient, then north should be towards the left side of the sheet. In special cases, where coordination between disciplines is required, north can be in the direction agreed to between the disciplines.

Site plans and locality maps shall contain a standard north point arrow. Where required, plans and maps should show sufficient grid lines of the relevant grid system to locate accurately the

area covered by the drawing. The standard north point arrow symbol that should be used on a drawing is available in the cell library. The arrow should be marked 'North', or 'Assumed North' as applicable, and placed in the upper left corner of the plan.

For drawings depicting track information (such as track layouts, plan views, elevations and sections of rail infrastructure), tracks shall be drawn horizontally on the sheet, with Sydney on the left. Label the Sydney end of the track as 'From Sydney,' and the other end as 'To ...' (the next main railway station). Where it is necessary to orientate the drawing with Sydney on the right, for example, drawings showing views of retaining walls on the UP side of the track, the orientation shall be clearly labelled.

Plans for overbridges shall be drawn with the track vertical and Sydney at the bottom. Label the Sydney end of an underbridge as 'From Sydney,' and the other end as 'To ...' (the next main railway station after the bridge site). Drawings should show cross-sections perpendicular to the track through bridges as viewed from the Sydney side that is, facing country (towards increasing kilometrage).

6.14. Drawing layout

A drawing should be properly laid in a third angle orthographic projection to show all relevant aspects of an engineering feature; where necessary, additional cross-sections and details of an engineering feature should be drawn to fully illustrate them. A layout should not show hidden lines unless they give details that are not readily apparent on other views. In most cases, interior details should be shown in additional cross-sections, rather than showing hidden lines. Additional isometric views, photographs or rendered sections can be used to add clarity to an engineering feature; however, this should not be used as an alternative to orthographic projections.

6.14.1. Headings

All headings shall be underlined. Headings for sections shall include an 18 mm diameter circle enclosing the identifying letter and, where applicable, a reference drawing number. Similarly, headings of details shall include a hexagon inscribed in an 18 mm diameter circle enclosing the identifying number and, where applicable, a reference drawing number. The scale for all headings shall be indicated below the heading. All these aspects of headings are shown in Figure 8.

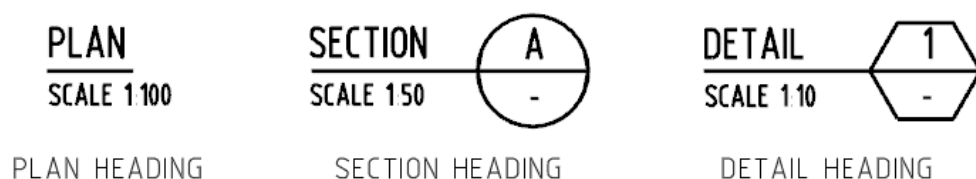


Figure 8 - Headings for plan, section and detail

6.14.2. Sections

Standard section arrows provided in the cell library shall be used to indicate clearly the location of the cutting plane. Figure 9 shows the sections and details symbols. One set of arrows is sufficient for each section; in some cases, a repetition of the arrows may be necessary on other views.

A letter placed inside a circle shall identify a section. The orientation should be consistent with the rules of projection. Sections shall be drawn to the same or larger scale than the original view, using third angle projection. The letters I, O and Q shall not be used as section letters. The sections should be placed as near as possible to the view from where they are cut.

Where a section is drawn on a different sheet to that of the original view, then the last three digits of the section sheet's EDMS number shall be shown in the lower half of the section circle on the original view. The section heading shall include the last three digits of the EDMS number of the original sheet from which the section has been taken, as shown in Figure 9. The last three digits of the design company document number can also be used as an acceptable alternative, provided requirements in Section 6.19 are met. If the section is on the same sheet, as that of the original view, then a dash '-' shall be placed in the lower half of the section circle and section heading as shown in Figure 9.

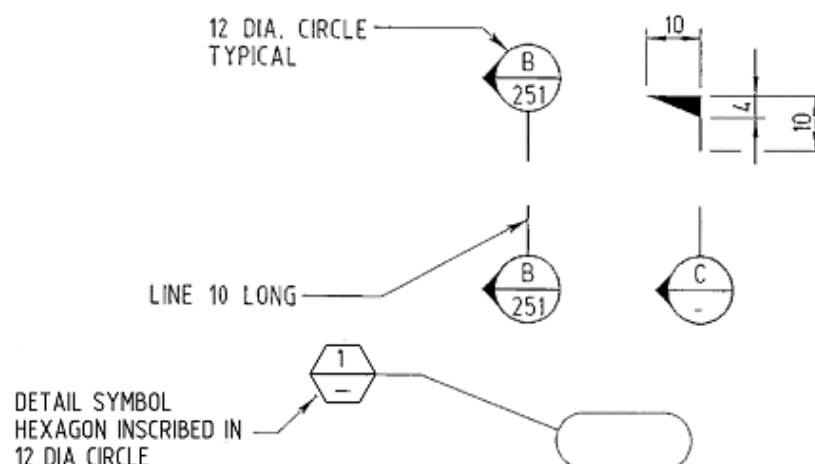


Figure 9 - Sections and details symbols

6.14.3. Details

The details identify particular areas that need clarity and the areas that are not covered by a section. A number shall identify the details. An arrow can be placed as a detail pointer if the item that is detailed is small; however, a circle or an ellipse (solid line and size to suit) should be placed around the area to be detailed. Refer to Figure 9 for sections and details symbols.

Where a detail is drawn on a different sheet to that of the original view, then the last three digits of the detail sheet's EDMS number shall be shown in the lower half of the detail hexagon on the

original view. The detail heading shall include the last three digits of EDMS number of the original sheet from where the detail was taken, as shown in Figure 9. The last three digits of the design company document number can also be used as an acceptable alternative, provided the requirements in Section 6.19 are complied. If the detail is on the same sheet as that of the original view, then a dash '-' shall be placed in the lower half of the detail hexagon.

6.15. Dimensioning

All relevant drawing features shall be completely detailed with dimensions. All dimensions for a particular feature should be shown on a single view where possible. Duplication of dimensions should be avoided. Dimensions shall not be scaled from the drawing.

All dimensions should be in millimetres. Dimension text should be placed on dimension lines. Dimensions should be readable from the bottom or right side of the drawing, similar to text orientation as shown in Figure 5.

All dimensions should be produced using the CAD applications dimensioning tool set. Dimensions shall not be dropped or exploded.

6.15.1. Dimension lines

All dimension and extension lines should be thin, with a nominal thickness of 0.18 mm on printout.

Extension lines should extend half of the text height beyond the dimension line and start at the same distance clear of the outline of the feature. Extension lines should extend half of the text height past intersection points (IPs) and points on surfaces.

Dimension lines wherever practicable, should be placed outside the outline of the feature. Dimensions should be placed above the dimension line, not below or where the dimension line is disturbed. Dimension lines should terminate with easily readable standard filled arrowheads, normally 1.0 to 1.5 text heights long and 0.5 text heights wide. An exception to this is when the application calls for a stroke or a dot. In such cases, the discipline specific requirements should be defined.

A centreline or a line that is an extension of a centreline, or a part of an outline, should not be used as a dimension line. Figure 10 illustrates these characteristics of extension lines and dimension.

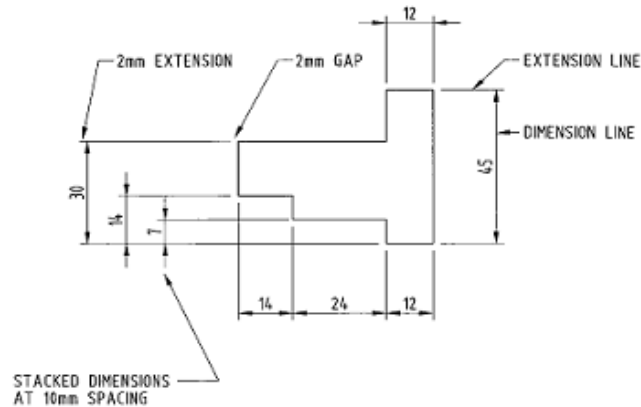


Figure 10 - Dimension lines

If the overall dimension of a chain of dimensions is a critical value, then one of the dimensions in the chain should be omitted as shown in Figure 11. Stacked dimension lines should be spaced at 10 mm intervals.

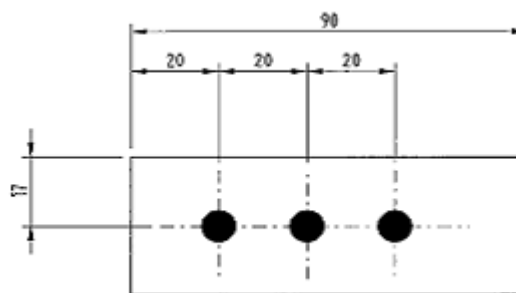


Figure 11 - Dimension chain

Leaders for notes should terminate in arrowheads or filled circles and should originate either at the beginning of a note or at the end of a note (not above or below). Arrowheads should always terminate on a line. Dots should be within the outline of the feature. Figure 12 shows the typical leaders.

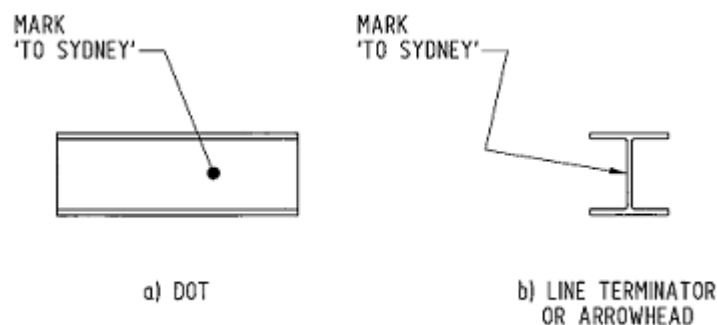


Figure 12 - Typical leaders

Leaders should be drawn as near as possible to and as perpendicular as possible to other lines. Figure 13 depicts the leaders touching other lines. They should not be drawn parallel or adjacent to dimensions or projection lines. The use of long leaders should be avoided.

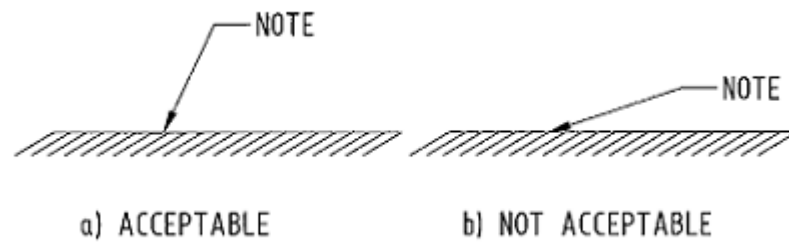


Figure 13 - Leaders touching other lines

6.15.2. Dimension text

Dimension text shall be readable from the bottom or right side of the drawing, similar to the text orientation as shown in Figure 5.

Where it is necessary or desirable to indicate that a particular dimension is not to scale, the abbreviation NTS (not to scale) should be added next to the dimension text as shown in Figure 14.

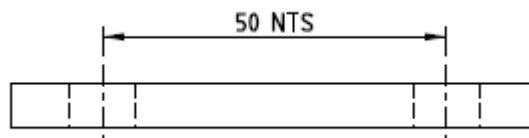


Figure 14 - Not to scale dimension

Radii should be dimensioned by a dimension line that passes through, or in line with the centre of the arc. The dimension line should have one arrowhead only and the abbreviation 'R' should always lead the dimension.

6.15.3. Units

All survey design units and set out points mentioned on drawings should be in the Map Grid of Australia (MGA) coordinate system in metre units. If the project largely involves alterations to the asset owner's existing network and the survey for that network is only available in Integrated Survey Grid (ISG) coordinates, then the new work can use ISG coordinates. This shall be agreed with TfNSW prior to commencing design work for the project.

When a point on a drawing is located by reference to the grid system, the coordinates should be written correct to three decimal places of a metre, as mentioned in the following example:

- E 363 241.271
- N 1 240 401.750

Coordinates shall be written in accordance with the grid system adopted and the grid system shall be populated as smart tag in the title block.

All levels (elevations) should be to the Australian Height Datum (AHD) in metre units.

Decimal numbers usually indicate metres. Whole numbers indicate millimetres. Dimensions in millimetres requiring accuracy to a number of decimal places shall be expressed with the millimetre suffix, that is, '12.5mm'.

The position of the decimal point shall be the same as a full stop and no space shall be left between the number and its units. An example of this format is '9.010m'.

All angular dimensions shall be expressed in the format stated in AS 1100.101.

6.15.4. Track kilometrages for heavy rail

Kilometrages are measured from Sydney along the centreline of the track and are expressed in kilometres; for example, '54.321km'. If they are used for a specific purpose, the kilometrages are measured to the nearest millimetre and written as '54.321 789km'. Views should be oriented with Sydney on the left and so the track kilometrages increase from left to right across a drawing.

6.16. Gradients and batters

The term 'gradient' should be used to refer to the features with gradual slopes such as tracks, roadways, and tunnels. The term 'batter' should be used to refer to steeper slopes such as excavations and faces of walls. The term 'fall' should be used to refer to gradients for drainage systems. 'Slope' is a general term of indefinite meaning and shall not be used.

6.16.1. Gradients

Gradients can be expressed as a percentage. A gradient of 5.0% indicates a displacement of five units vertically in 100 units horizontally.

Gradients can also be expressed as a unit of vertical displacement in a horizontal distance, such as '1 in 20', where 1 is always the vertical dimension and 20 is the horizontal.

In plan views, and where a gradient is given for a surface that is close to the horizontal, such as 1 in 100, an arrow should indicate the direction of the fall. Alternatively, a small right-angled triangle is used to show the gradual gradients or cross falls, with the two sides including the right angle dimensioned, one being unity.

Figure 15 shows examples of gradients with the direction of the fall.

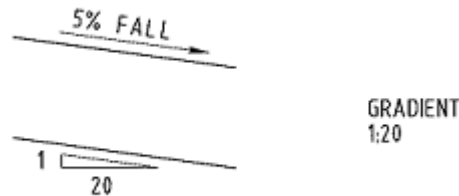


Figure 15 - Indicating gradients

6.16.2. Batters

Batters should be expressed as a horizontal displacement relative to a vertical distance. One of these dimensions is given as unity; for example, '2 to 1', or '0.7 to 1', where the first number should always be the horizontal dimension. A small right-angled triangle can be drawn and dimensioned to indicate batters. Figure 16 shows an example of a batter.

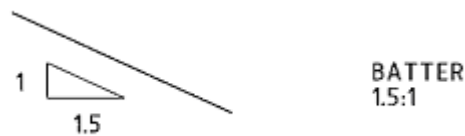


Figure 16 - Indicating batter

6.17. Abbreviations

All abbreviations shall comply with AS 1100.101. Abbreviations shall be in upper case letters. If an abbreviation that is not in AS 1100.101 is used, then the drafter shall define it in the notes or provide a legend on each drawing in which it is used.

6.18. Notes and references

The notes and references should occupy a space of not more than 140 mm wide from the right side margin above the title block for A0 or A1 sheets, and 125 mm wide for A2 or A3 sheets.

Where several notes on particular subjects are required, the notes should be grouped under separate headings such as steelwork, concrete, reinforcement, and so on. Each note, under these headings, should be numbered in sequence.

6.18.1. Notes

Notes should be kept to a minimum. The information related to a particular feature of the drawing should appear in the body of the drawing at the point where it applies.

Where description of materials or similar information is given on third party drawings, the notes should comply with the appropriate specification.

For larger groups of drawings, the general arrangement should include notes that are common to all drawings of the group. The first note of other drawings should be a reference to the general arrangement drawing for general notes.

General arrangement drawings should show the principal design basis; for example, design loading, live loads and wind loads.

Any concession or nonconformance received for a drawing or set of drawings shall be stated along with its description under notes of that drawing or set of drawings.

6.18.2. References

Reference drawings should be listed below the notes. The list should include relevant drawings to enable the construction or fabrication, or both, of a particular feature.

References listed on a particular drawing should include only those drawings necessary to cover that particular part of the work. The general arrangement (or the cover sheet if any) should list all drawings that are relevant to the project.

Drawings by other disciplines that have a direct bearing on a particular drawing (associated drawings) shall be listed on the general arrangement sheet.

In some instances, a reference to a drawing that gives details of a particular section of the work can be added in the body of the drawing at the appropriate place. Such references should be included under the references heading, and in the body of the drawing. Refer to Figure 17 for sample notes and references.

The EDMS numbers should be used to refer the drawings that are listed under reference headings. The design company document number can be used as an acceptable alternative to EDMS numbers, provided the requirements in Section 6.19 are complied.

NOTES

1. DIMENSIONS SHALL NOT BE SCALED FROM THE DRAWING.
2. STRUCTURE NUMBER IS FOR IDENTIFICATION ONLY.
3. CO-ORDINATES ARE FOR MAST CENTRELINES, UNLESS OTHERWISE STATED.
4. ALL PROPRIETARY PRODUCTS ARE TO INSTALLED INACCORDANCE WITH THEIR MANUFACTURER'S SPECIFICATION.

REFERENCES

CV 1234567	DETAIL SURVEY FOR DRAINAGE DESIGN
CV 1234568	DRAINAGE UPGRADE – GENERAL ARRANGEMENT
CV 1234569	DRAINAGE UPGRADE – DETAILS SHEET 1 OF 2

Figure 17 - Typical notes and references

6.19. Using design company document number

When there are cross-references to other drawings, the EDMS numbers of the drawings should be used.

Where this is not possible, the design company document number may be used as an acceptable alternative, provided the following requirements are satisfied:

- A cover sheet or sheets shall be provided that contains a schedule of all drawings for the design package. The cover sheet shall be complete with drawing title description, EDMS number and corresponding design company document number for each drawing. The amendment version and issue date of the drawings shall also be provided.
- Cover sheets shall comply with discipline specific specifications or other discipline specific standards.
- For all drawings in the design package, either the EDMS number or the design company document number shall be used consistently for cross-referencing. The drawings in the design package shall not use a combination of these numbers for cross-referencing.
- When referring to drawings that are not part of project drawings, then the EDMS number shall be used for cross-referencing those drawings. All of these non-project drawings shall be listed under 'OTHER REFERENCED DRAWINGS' on the cover sheet.

6.20. Printing of drawings in colour

Colour on drawings shall only be used when it would otherwise be difficult to interpret the information on the drawing, if printed in black and white, or greyscale. If a colour is used in the engineering content of a drawing, then a box containing the note as shown in Figure 18 shall be added at the bottom of the drawing, centrally aligned above the title block. Use of coloured logos on a drawing would not necessitate the placement of drawing colour coded box.

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR

Figure 18 – Drawing colour coded box

When using colours on a drawing, the following requirements shall be satisfied:

- colour shall not be used for text, dimension lines, and other thin line styles with line thickness less than 0.18 mm
- light shades of colour such as light blue and light colours such as yellow shall not be used
- red and shades of red shall only be used for warning signs and notices or when it is the actual colour of the feature drawn

6.21. Amendment clouds

Amendment clouds are shown on a drawing to draw the attention of the subsequent reader to the changes carried out in the current drawing amendment. Drawing amendment clouds on 'pre-approved for construction' issues are not mandatory. After the first issue of the drawing as approved for construction, all subsequent changes shall be clouded. With every new amendment to a drawing, the previous amendment clouds shall be deleted.

All deletions shall also be clouded and the word 'DELETED' shall be added in an amendment cloud.

A number or character related to an amendment of a drawing enclosed in a triangle shall be drawn next to each amendment cloud.

Figure 19 shows an example of an amendment cloud.

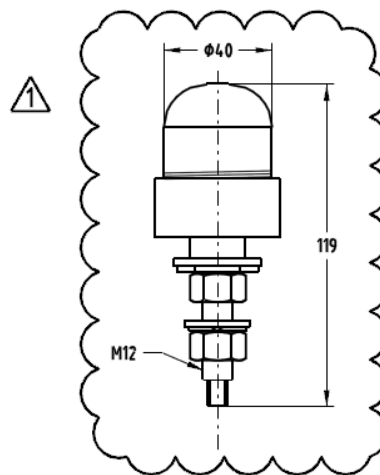


Figure 19 - Amendment clouds

In case where a drawing has many changes, and where clouding each amendment would make the drawing difficult to interpret, then the whole drawing can be clouded as one amendment cloud and the amendment box populated with the words 'Drawing Redrawn'.

When submitting the as-built issue, all amendment clouds referring to previous amendments shall be removed, and the drawing shall be issued without any amendment clouds.

6.22. Hold clouds

Hold clouds shall be drawn to segregate tentative design information during the design development stage of a drawing, so that the drawing can be approved for construction prior to the drawing being completed. For example, a drawing is approved for construction, but the vendor is yet to confirm the location of holding down bolts for a machine.

The use of hold clouds on a drawing should be avoided, and the drawing should be approved for construction only after all design information is complete. Hold clouds should be used only in

extreme situations when the design data that is not confirmed causes a significant impact on the project.

Inverted clouds shall be drawn to represent a hold on an feature in a drawing as shown in Figure 20. Each hold cloud shall be numbered in a sequence; for example, H1, H2. The description of each hold cloud shall be shown next to the drawing notes.

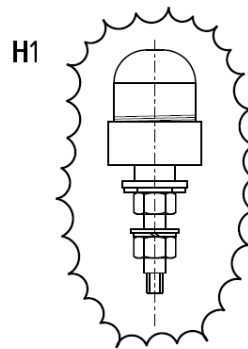


Figure 20 - Example of a hold cloud

When the information that is on a hold cloud is finalised, the relevant hold cloud shall be removed from the drawing, and the related description shall be deleted. The drawing should be re-issued for construction after removal of all such clouds.

6.23. Bill of materials

A bill of materials can be added to the drawing, if required. The preferred location of a bill of material is above the title block on the right side of the drawing. Figure 21 shows an example of a bill of material.

11	H-7	NICKEL ANTI-SEIZE LUBRICANT			LOCTITE OR EQUIV.
10	H-7	UNF 10-32 x 25 TORX BUTTON HEAD SCREW		SS GRADE 304	BLKWOODS BO104-0028
9	C-12	GLUE LINED HEAT SHRINK - ID 19.1 X 61 LONG			CABAC XDW20BK
8	F-1	LOCTITE 222 / LOCTITE 7649 PRIMER			
7	H-8	M6 X 20 TORX BUTTON HEAD M/T SCREW		SS GRADE 18-8	M620 - XYM
6	C-10	CABLE SLEEVE - ID 9.5 X 2.5 THK X 62 LG		HT SILICON RUBBER - BLACK	JEHBCO
5	C-11	WIRE ROPE (7 X 19) - Ø 6 X 64 LONG		SS GRADE 304	
4	C-6	HANDLE CONNECTOR - 35 X Ø 15		SS GRADE 304	
3	D-8	TOP PIVOT - 43 X Ø 28		SS GRADE 304	
2	G-6	HANDLE FORGED		SEE NOTE 12.	
1	H-2	HANDLE ASSEMBLY			
ITEM	LOC'N	DESCRIPTION AND SIZE	PER ASS'Y	MATERIAL SPEC.	PART NUMBER

Figure 21 – Sample bill of materials

6.24. Hybrid drawings

A hybrid drawing is a composite construct of raster and vector data, where the raster data is attached to or referenced in a vector based drawing (CAD).

In general, hybrid drawings shall be created as per the requirements set out in Section 6.

The requirements set out in this section shall only be applied when the raster data is in the form of an image of an old or existing drawing.

The following are some examples:

- for existing Central Planroom registered hand drawn drawings with no associated CAD file
- due to intellectual property issues, TfNSW is not the owner of the design or drawing content; however, TfNSW is allowed to update parts of the drawing for maintenance or safety purposes

If more than 50% of the drawing content is either already updated or in need of updating based on the scenarios mentioned, then a new engineering drawing should be created instead of a hybrid drawing.

The following approach should be taken when creating a hybrid drawing:

- i A new drawing file with the TfNSW title block should be created.
- ii The raster data of an existing drawing in the form of an image should be attached to the drawing. If an image file is created from scanning an existing drawing, then it should be scanned at a minimum resolution of 300 dpi and be set at a scale of 1:1 of the title block size.
- iii If the raster image has an EDMS number, then the same EDMS number should be used. The next amendment level of the drawing should be created and populated in the TfNSW title block.
- iv If the raster image does not have an EDMS number, then the title block should be populated as that of a new TfNSW drawing.
- v The relevant part or parts of the drawing should be updated as per the requirements set in Section 6 and add amendment clouds.
- vi A box above the TfNSW title block should be added with the words 'HYBRID DRAWING – COMPOSED OF BOTH VECTOR AND RASTER DATA'.
- vii The drawing should be signed and submitted as per the requirements set out in Section 7 and Section 8 of this standard.

7. Drawing management

Drawing management covers the requirements for title blocks, smart tags, metadata and file naming conventions that apply to all disciplines.

7.1. Drawing title block

The title block setting and filling of details in the title block shall comply with the procedure explained in Section 7.1.1, Section 7.1.2 and Section 7.1.3.

Figure 22 shows an example of a typical drawing sheet template, which consists of the following three components:

- drawing details box
- sign-off box
- amendment box

The drawing sheet template is a rectangular sheet with a grid of 12 columns and 12 rows. The columns are labeled 1 to 12 at the top and bottom. The rows are labeled A to M on the left and right sides. The template is divided into three main sections:

- DRAWING DETAILS BOX:** Located in the top right corner, it contains a table for drawing details. The table has columns for 'LOCALITY', 'PROJECT', 'DRAWING NO.', 'REVISED', 'DATE', 'BY', 'CHECKED', 'DATE', 'BY', 'DATE', 'BY', 'DATE', 'BY'. A red stamp is placed over the table, reading 'DRAWING IS COLOUR CODED - PRINT ALL COLOURS IN COLOUR'.
- SIGN-OFF BOX:** Located in the middle right, it contains a table for sign-off. The table has columns for 'LOCALITY', 'PROJECT', 'DRAWING NO.', 'REVISED', 'DATE', 'BY', 'CHECKED', 'DATE', 'BY', 'DATE', 'BY'. It also includes the 'Transport for NSW' logo and the text 'LOGO OF AED RESPONSIBLE FOR DESIGN'.
- AMENDMENT BOX:** Located in the bottom right, it contains a table for amendments. The table has columns for 'LOCALITY', 'PROJECT', 'DRAWING NO.', 'REVISED', 'DATE', 'BY', 'CHECKED', 'DATE', 'BY', 'DATE', 'BY'. It also includes the 'Transport for NSW' logo and the text 'LOGO OF AED RESPONSIBLE FOR DESIGN'.

Labels with arrows point to each of these three sections: 'DRAWING DETAILS BOX', 'SIGN-OFF BOX', and 'AMENDMENT BOX'. A red label 'DRAWING IS COLOUR CODED - PRINT ALL COLOURS IN COLOUR' points to the red stamp in the drawing details box.

Figure 22 – Typical TfNSW drawing sheet template

7.1.1. Drawing details box

The drawing details box provides details of the drawing subject matter and contains information about the drawing title and revision.

Figure 23 shows the different fields in the drawing details box.

Table 9 provides the details of the fields in the drawing details box. All data entry fields in the drawing details box are included as smart tags. Refer to Section 7.2 for further details on smart tags.

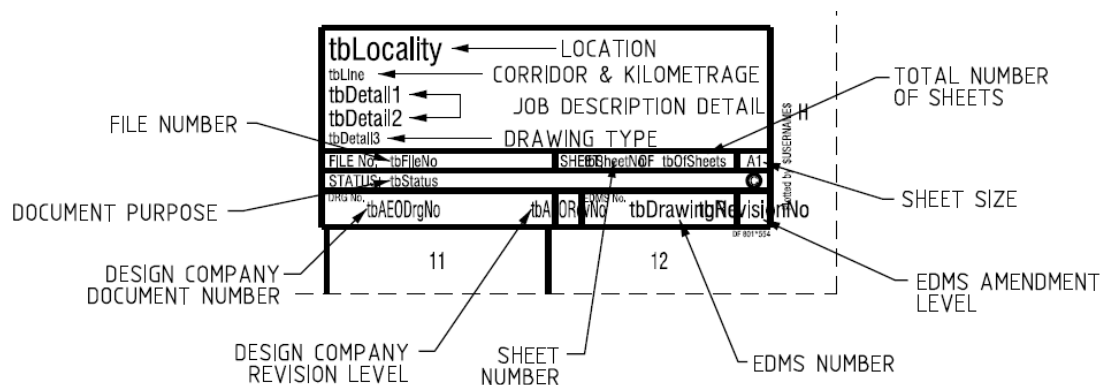


Figure 23 - Drawing details box on a typical TfNSW drawing sheet

Table 9 - Drawing details box - Smart tags description

No.	Field name	Tag	Requirements
1	Location	tbLocality	Include the main location of the drawing. Refer to T MU AM 01007 TI <i>Asset Reference Codes Register</i> for a list of location names.
2	Corridor and kilometrage	tbLine	Include the formal rail corridor name followed by the kilometres. The kilometres can be a single kilometre location or a range designated as a starting kilometres to an ending kilometres which is applicable to that drawing. Refer to T MU AM 01007 TI for a list of corridors and kilometrages.
3	Job description detail 1	tbDetail1	Include the drawing description. The description can include the engineering discipline (for example, Electrical) and sub-discipline (for example, railway overhead wiring) and a full description of the drawing content. Sets of drawings can be labelled similarly.
4	Job description detail 2	tbDetail2	This requirement is same as tbDetail1.
5	Drawing type	tbDetail3	Indicate the type of drawing.
6	File number	tbFileNo	Optional field and the entry is based on the design company to assist the tracking of drawings within their own system.

No.	Field name	Tag	Requirements
7	Document purpose	tbStatus	Indicate the status of the revision of the drawing. The document purpose shall not be additionally stamped elsewhere on the drawing.
8	Sheet number	tbSheetNo	Indicate the sheet number of a drawing in a set of drawings. Where there are no other drawings in the set, this sheet is numbered 1.
9	Total number of sheets	tbOfSheets	Indicate the total number of sheets in a set in which this drawing forms part of. Where there are no other drawings in the set, this sheet is numbered 1.
10	EDMS number	tbDrawingNo	Include the EDMS number (2 characters and 7 numbers) provided to the designer by TfNSW (in consultation with the Central Planroom), and is unique for each drawing. Refer to Section 8.1 for details.
11	EDMS amendment level (revision associated with EDMS number)	tbRevisionNo	Indicate the EDMS amendment level, which is related to the EDMS number and shall be changed only when the drawings are submitted to Virtual Planroom. Refer to Section 7.4 for details.
12	Sheet size	tbSheetSize	Indicate the size of the drawing.
13	Design company document number	tbAEODrgNo	Include the design company document number. Refer to Section 7.3.4 for details.
14	Design company revision level	tbAEORevNo	Indicate the design company revision level related to the design company document number. Refer to Section 7.4 for details.

The fields in the drawing details box are a combination of either free text or pick list (pre-defined) items. Refer to Appendix B for more details.

For fields with 'free text', information shall conform to the following principles:

- Drawing titles shall be correct, comprehensive and compliant with the formats indicated.
- Abbreviations should be avoided but common construction abbreviations are allowed (for example, LV, OHW, DRG and ULX) or ones that are explained on the drawing.
- The drawing title is made up of five lines (location, line and kilometrage, job description detail 1, job description detail 2 and drawing type) and shall contain specific information about the content of the drawing. After a drawing is submitted to the Virtual Planroom, the drawing title shall not be modified in future amendments.

7.1.2. Sign-off box

The sign-off box shall contain the full names of the persons who have performed the design, design check, drawing, drawing check and approval of the document at the time of final concept design, approved for construction or subsequent design change. These fields shall not be updated for drawing amendments when there is no design change.

Note: Where the first name of a person is too long to fit within the space provided in the sign-off box, the first initial and last name of the person is acceptable.

Figure 24 shows the different fields in the sign-off box.

Table 10 provides the details of these fields. All data entry fields in the sign-off box should be populated as smart tags.

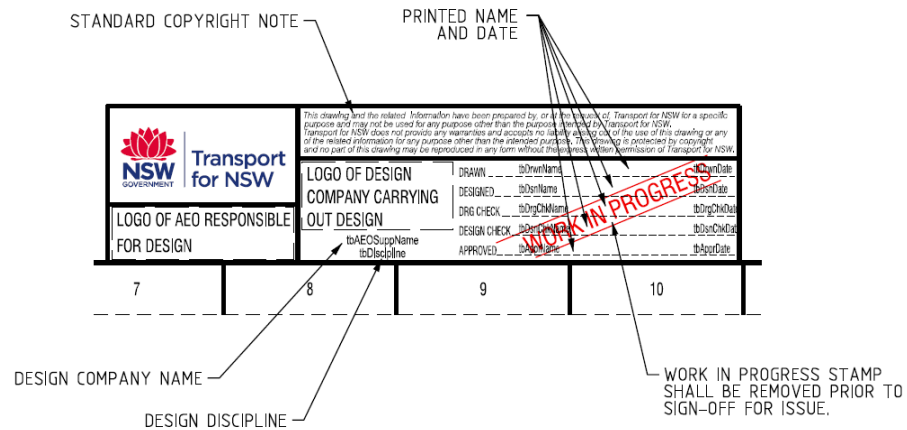


Figure 24 – Sign-off box on a typical TfNSW drawing sheet

Table 10 - Sign-off box - Smart tags description

No.	Field Name	Tag	Requirements
1	Drawn by (Name)	tbDrwnName	Include the full name of the draftsman.
2	Drawn date	tbDrwnDate	Include the date of sign-off by the draftsman.
3	Designed by (Name)	tbDsnName	Include the full name of the designer who designed the design component of the drawing.
4	Designed date	tbDsnDate	Include the date of sign-off by the designer.
5	Drawing checked by (Name)	tbDrgChkName	Include the full name of the person who checked the drafting of the drawing.
6	Drawing checked date	tbDrgChkDate	Include the date of sign-off by the drafting checker.
7	Design checked by (Name)	tbDsnChkName	Include the full name of the person who checked the design component of the drawing.
8	Design checked date	tbDsnChkDate	Include the date of sign-off by the design checker.
9	Approver (Name)	tbApprName	Include the full name of the person who approved the design to be released.

No.	Field Name	Tag	Requirements
10	Approved date	tbApprDate	Include the date of sign-off by the design approver.
11	Design discipline code	tbDiscipline	Include the discipline code to which the drawing relates.
12	Design company name	tbAEOSuppName	Include the name of the design company.

7.1.3. Amendment box

The amendment box records the details of all amendments made to a drawing. The amendment details include EDMS amendment level or the design company revision level, amendment description along with the initials of the designer, verifier and the approver.

The 'AMD' column records the amendment level of the drawing. Refer to Section 7.4 for details.

A brief but informative description of the changes made to the drawing shall be added to the 'Description' column. The initials of the designer, verifier and approver shall be placed in the amendment box for each drawing issue.

Where possible, at least three letters for the initials are required to minimise the possibility of misidentification of approvers with common first initial and last initial.

The oldest amendment entries shall be displayed at the bottom of the list. The amendment history items should be removed only when all available lines have been used. In this case, the oldest amendment information is removed, and the rest of the entries are moved down to create room for the new amendment at the top of the list.

Figure 25 shows the different fields in the amendment box.

Table 11 provides the details of these fields. All data entry fields in the amendment box are included as smart tags.

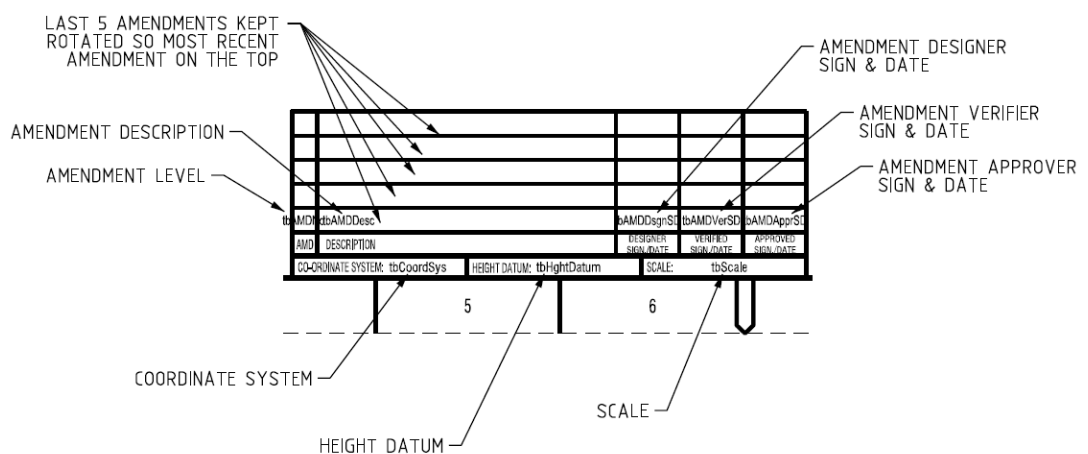


Figure 25 - Amendment box on a standard TfNSW drawing sheet

Table 11 – Amendment box - Smart tags

No.	Field name	Tag	Requirements
1	Co-ordinate system	tbCoordSys	Optional field. Required for drawings containing survey coordinates, generally Integrated Survey Grid (ISG) or Map Grid of Australia (MGA) and not required for mechanical drawings or diagrams.
2	Height datum	tbHghtDatum	Optional field Required for drawings containing survey coordinates, generally AHD and not required for mechanical drawings or diagrams.
3	Scale	tbScale	The major scale of a drawing
4	Amendment level	tbAMDNo	Indicate the amendment level of current revision. Refer to section 7.4 of for details.
5	Amendment description	tbAMDDesc	Include a brief description of the phase of review or approval that the drawing is issued.
6	Amendment designer Sign	tbAMDDsgnSD	Include the initials of the person who designed the amendment and the date of signature.
7	Amendment verifier sign	tbAMDVerSD	Include the initials of the person who verified the amendment and the date of signature.
8	Amendment approver sign	tbAMDApprSD	Include the initials of the person who approved the amendment and the date of signature.

7.1.4. Signatures

A drawing shall not be issued until all designated people have signed the drawing. The names of the persons shall not be populated in a smart tag field unless the person is competent to do the prescribed work, and has completed the assigned work.

The following are the three types of allowable signatures:

- wet signature
- electronic signature
- digital signature

Each drawing shall be signed using one of the signature types and consistency shall be maintained in the signature type on all amendments of a drawing.

Wet signature

A wet signature is an original handwritten signature in ink on an original drawing. In this case, the design company should either submit the hard copy of the drawing to the Central Planroom

or keep hard copies of the drawings for future audits. After all wet signatures are acquired, the design company should type the name of each individual in the drawing title block, and print a PDF copy for the Virtual Planroom submission.

Electronic signature

An electronic signature is the electronic equivalent of a handwritten signature, where a person adopts the contents of an electronic message through any electronic means. An electronic signature creates an audit history that cannot be repudiated, which includes verification of who signed the document and the date and time stamp of when it was signed. It can be done by checking a box on a computer, be typed or applied with a mouse or touchpad.

Digital signature

A digital signature is a kind of electronic signature that includes all of the elements mentioned in electronic signature. Additionally, it also includes a certificate of authority issued by a third party that validates the identity of the signatory and the signature. The application of a digital signature adopts the PKI (public key infrastructure) encryption technology.

7.2. Smart tags

The design company shall use the tag function to fill the attributes in the title block. The drawing title block shall be attached to the drawing sheet as a cell or block containing smart tags, supporting the attribute exchange feature of ProjectWise. This process links the tags in MicroStation and AutoCAD drawings with ProjectWise as metadata.

MicroStation users are required to use the MicroStation EDIT TAGS command and pick the right bottom corner of the drawing sheet frame with the Constructions view attribute turned on. Refer to Figure 26, which illustrates this. The list of attached tag sets available for editing is shown in Figure 27.

To enter the title block information, choose the title block tag set.

Figure 28 displays the Edit Tags [TitleBlock] dialog box that is available in MicroStation.

To edit the AEO information, choose the AEO tag set. This tag set includes two invisible tags required by the Central Planroom.

Figure 29 displays the Edit Tags [AEO] dialog box that is available in MicroStation.

To enter the coordinate system and height datum, choose the TBNPW tag set.

Figure 30 displays the Edit Tags [TBNPW] dialog box that is available in MicroStation.

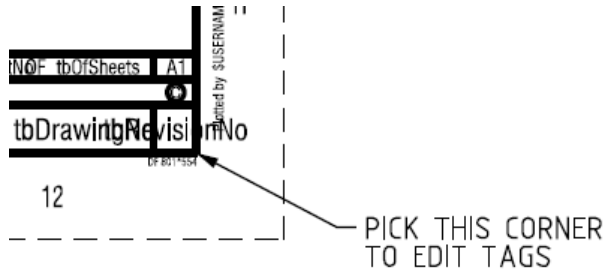


Figure 26 - Pick this corner to edit Tag Sets in MicroStation

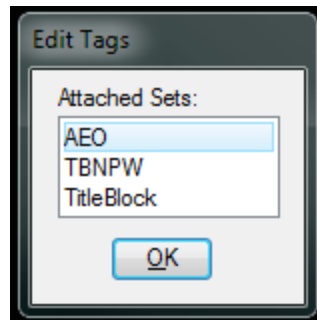


Figure 27 - Edit Tags dialog box in MicroStation

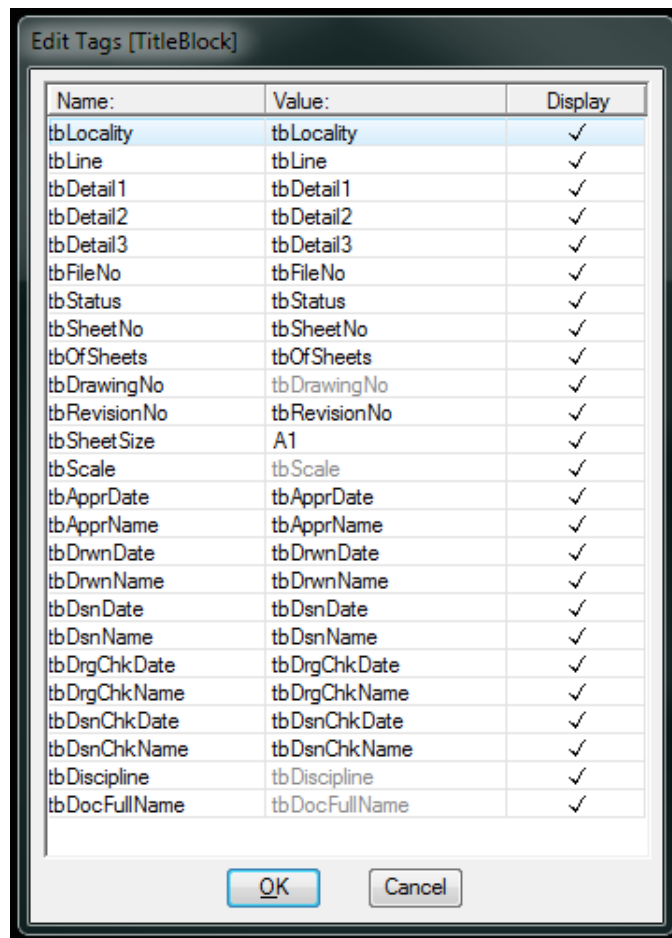


Figure 28 - Edit Tags [TitleBlock] dialog box in MicroStation

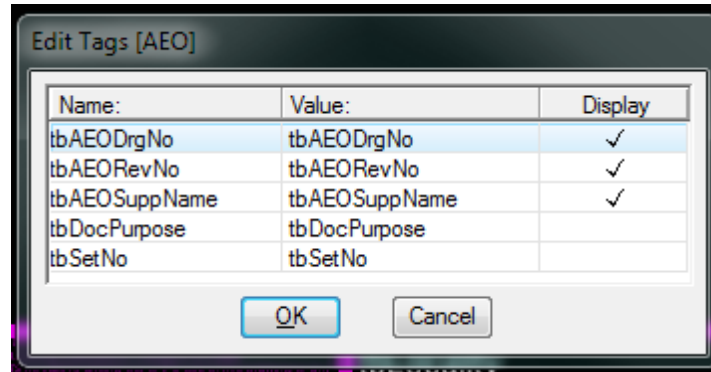


Figure 29 - Edit Tags [AEO] dialog box in MicroStation

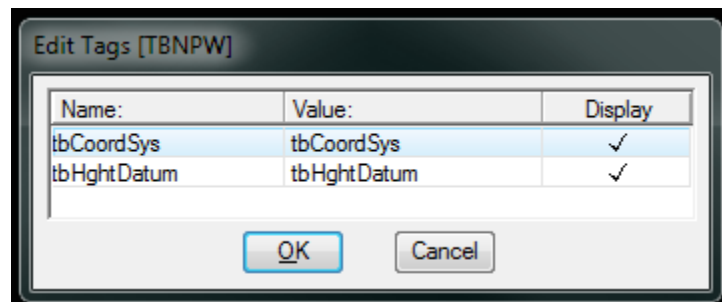


Figure 30 - Edit Tags [TBNPW] dialog box in MicroStation

AutoCAD users are required to use the AutoCAD EATTEDIT command to edit the attributes attached to the title block, AEO, and TBNPW blocks. Invoke the EATTEDIT command or double click any of the tags to display a dialog box as shown in Figure 31 to Figure 34.

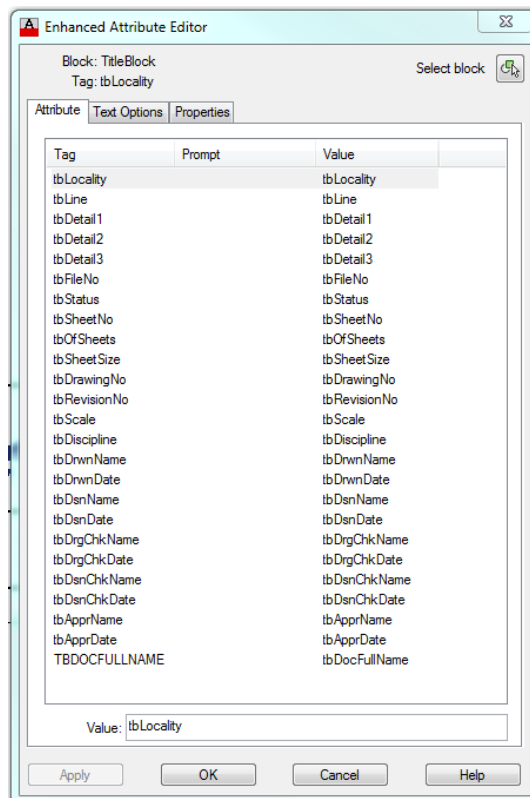


Figure 31 - Enhanced Attribute Editor (TitleBlock) dialog box in AutoCAD

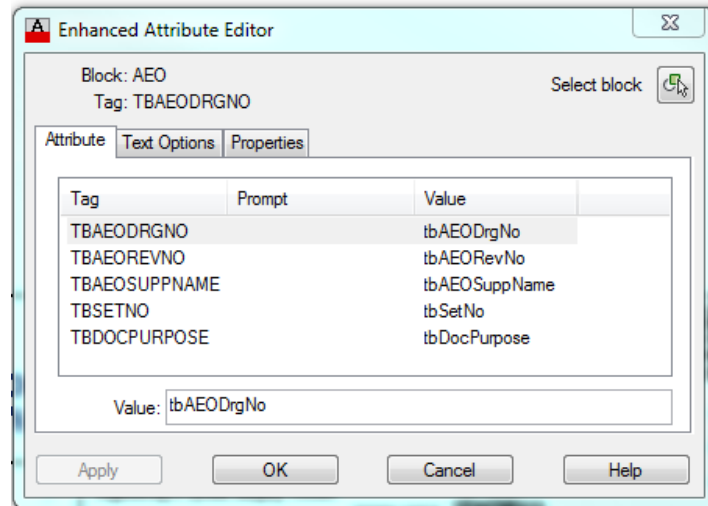


Figure 32 - Enhanced Attribute Editor (AEO) dialog box in AutoCAD

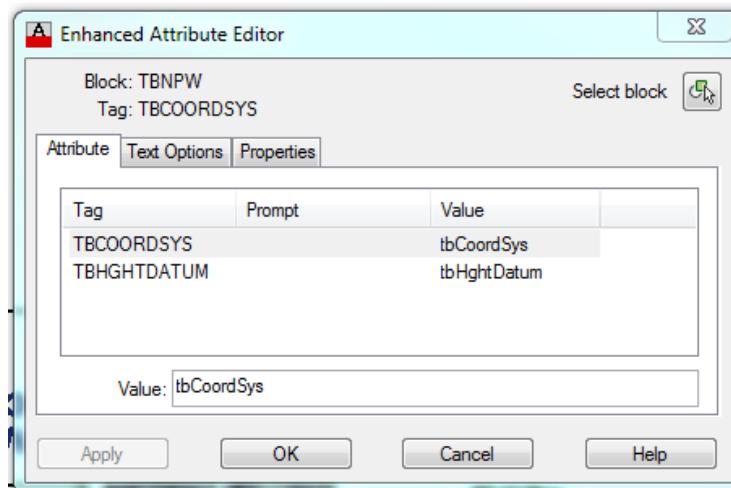


Figure 33 - Enhanced Attribute Editor (TBNPW) dialog box in AutoCAD

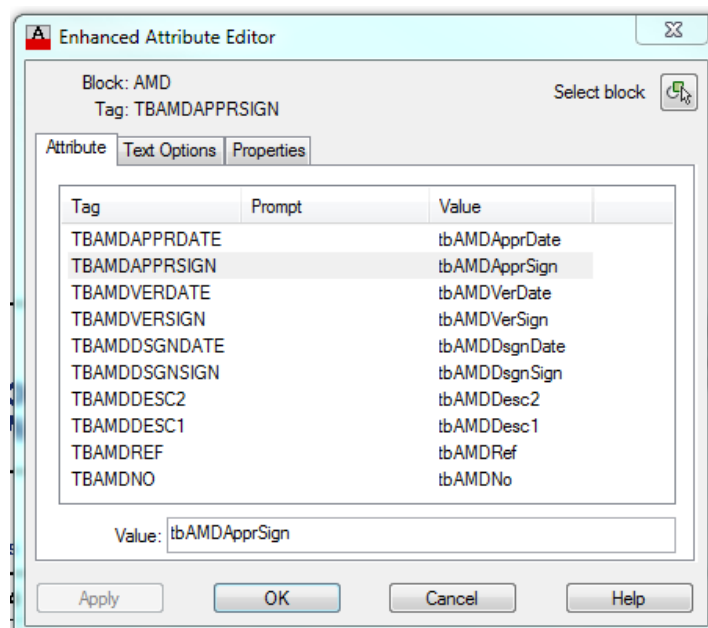


Figure 34 - Enhanced Attribute Editor (TBAMDAPPSIGN) dialog box in AutoCAD

7.3. File naming convention

All engineering drawings produced for TfNSW shall be identified using the unique file naming convention as described in Section 7.3.1, Section 7.3.2 and Section 7.3.3.

The file naming convention for engineering drawings is broadly divided into the following three categories, based on the file type:

- drawing file
- drawing image file
- CAD supportive files

7.3.1. Drawing file

Drawing files are the CAD files with the title block attached and as described in Section 6.3.1.

An EDMS number shall be obtained for all drawings belonging to this group before work is commenced.

The following are the three components of a typical drawing file name:

- discipline code
- file identifier
- file extension

The text format for the file name shall be in upper case only. The underscore '_' shall be used to separate the file name components. A dash or minus '-' character should not be used.

Table 12 shows a typical example of a CAD drawing filename CV_1234567.dgn, EL_7654321.dwg.

Table 12 - File format

Discipline code	EDMS identifier	File extension
AA	_1234567	.ext

Discipline code

The first component of the drawing file name is defined by the two character alpha code which represents the relevant engineering discipline associated with the drawing file.

Table 13 provides the list of discipline codes and discipline names.

Table 13 – Drawing filename - Discipline code

Discipline code	Discipline name
AR	Architecture and Services

Discipline code	Discipline name
CV	Civil and Structures
EL	Electrical
FL	Fleet (Rolling Stock)
SG	Signalling and Control
SS	Surveying
TD	Track

File identifier

The second component of the drawing file name is defined by the seven-digit EDMS identifier. Refer to Section 8.1 of this standard for details on EDMS identifiers.

File extension

The third component of the drawing file name is a three-character file extension. It shall be either dgn or dwg.

Typical examples for a drawing file name are as follows:

- AR_1234567.dgn
- CV_7654321.dwg

7.3.2. Drawing image file

The drawing image file naming convention applies to renditions of drawing files (with a title block) that are submitted to the Virtual Planroom.

TfNSW requires that the drawing image files be named as per the individual EDMS identifier, which is assigned to the respective drawing.

The typical drawing image file name is determined by the following five components:

- EDMS identifier

The first component of the drawing image file name is recorded using a seven-digit EDMS identifier.

- amendment level

The eighth and ninth characters are the representation of the EDMS amendment level of the drawing. When the amendment level of the drawing is only one character, then the eighth character shall be an underscore and the ninth character shall be the amendment level.

- numerical representation

The tenth character is a numerical representation of the configuration version level of a drawing and shall always be zero ('0') for drawings.

- drawing orientation

The eleventh character shall be a lower case 'c' for landscape oriented images, and an upper case 'C' for portrait oriented images.

- file extension

The file extension shall match the relevant file type and shall be in lower case; for example, pdf or tif.

Table 14 shows examples of image file names 1234567_A0c.pdf, 7654321AE0C.pdf.

Table 14 – Drawing image file name

EDMS identifier	Amendment level	Numerical representation	Drawing orientation	File extension
1234567	_A	0	c	.pdf
7654321	AE	0	C	.pdf

7.3.3. CAD supportive files

All other engineering drawings including, but not limited to 3D models, reference drawings, sketches (without title block), reference models, extractions, assembly files, which are part of drawing submission package to TfNSW should follow the naming convention as project code_unique number.

Examples of these files are as follows:

- NWRL_CV_MOD_123456.dgn
- NSRU_EL_DEM_123456.pdf

Project code

The first component of the file name is a unique project code that comprises up to four characters. When a new project is commenced, the design company can either request a code from ASA, via email to assetstewardship@transport.nsw.gov.au, or create this code and get an approval from the Asset Stewardship Manager, ASA. For existing project codes, refer to T MU AM 01007 T1 *Asset References Code Register*.

Unique number

The second component of the file name is a unique number assigned by the design company. The unique number shall consist of a mix of letters, numbers or underscore character (_). The design company is responsible to ensure that this number is unique within the project.

7.3.4. Design company CAD file name

In addition to the TfNSW CAD file name, the drawing title block has a provision for another drawing numbering system for the design company CAD file name, which is optional.

The design company can use their own document management system for creating these drawing numbers, in consultation with the TfNSW project team. At the time of submission of the drawings to the Virtual Planroom, the filename shall be changed so that the drawing file name matches the drawing file name convention, as explained in Section 7.3.1. The design company shall reset all references, extraction and other cross-references across all drawings to make sure that when the drawing file is re-opened all references shall work as required and no missing link is found.

Note: Failure to do this, results in rework for TfNSW. All costs incurred in any rework will be charged to the design company.

7.4. Drawing amendment

The drawing amendment level controls the current version of a drawing. The following two fields in the drawing title block control the current version of the drawing:

- EDMS amendment level

The EDMS amendment level for a drawing shall always be a letter. When the drawing is submitted to the Virtual Planroom for the first time, the EDMS amendment level shall be 'A'. All the subsequent amended versions submitted to the Virtual Planroom shall be B, C, D and so on, excluding O, I and Q. After EDMS amendment level 'Z', the next amendment level shall be AA, AB and so on.

- design company revision level

A drawing design company revision level shall always be a number and shall be '1' for the first issue. For subsequent issues, the design company revision level shall be incremented to the next whole number such as 2, 3, 4 and so on. When the drawing is first submitted to the Virtual Planroom, the design company revision level shall be reset to zero (0) and the revision level for each submission that follows shall increment to the next whole number.

The description of each amendment update shall be recorded in the drawing amendment box as explained in Section 7.1.3. The 'AMD' column shall be populated by concatenating the EDMS amendment level and the design company revision level as one amendment level. Table 15 provides an example of the drawing amendment level at different stages of a drawing.

Table 15 – Examples of amendment level

Amendment description	Virtual Planroom submission	EDMS amendment level (tbRevisionNo)	Design company revision level (tbAEORevNo)	AMD column (tbAMDNo)
Issued for review	Not required	Blank ()	1	1
Issued for comments	Not required	Blank ()	2	2
Approved for construction	Required	A	0	A0
Re-issued for construction	Not required	A	1	A1
Re-issued for construction	Required	B	0	B0

Note: The Virtual Planroom submission requirement and EDMS amendment levels shown in Table 15 are examples only. They can vary in real time projects.

When an amendment is required for an issued drawing, a new version shall be created prior to any of the changes being made. A new version shall carry a 'WORK IN PROGRESS' stamp across the drawing sign-off box until it has been signed off and made ready for issue. Drawing image files submitted to the Virtual Planroom shall not have this stamp.

7.5. As-built drawing presentation

As-built drawings are required to reflect the final work as executed and not the changes that have occurred during the design stages. The design company shall complete the following updates:

- Apply any required changes to the drawings to represent works as completed.
- Remove any markings showing previous drawing changes, such as clouds or red lines and ensure that the drawing reflects the final status.
- Change any use of future tense to current or neutral tense such as changing 'proposed fence' to 'fence'.
- Ensure notes and cross-references are correct.
- Remove instructions and notes specifically related to the construction process.
- Where numbered notes are no longer relevant, replace the words with 'REMOVED' to leave other referenced numbers unchanged.

8. Drawing submission

The TfNSW long-term objectives are to produce all design information in the building information modelling (BIM) format. If a design company uses BIM capabilities and creates 3D models as per the project agreement, then the design company shall submit the 3D models in a native format, along with other project deliverables.

Design companies, using 2D CAD technologies to develop design deliverables as per the project agreement, shall deliver all other documents except 3D models.

As a minimum, TfNSW requires lodgement of drawings at the final concept stage, approved for construction (AFC) stage and as-built stage of a project. At each of these three stages, both drawing files and drawing image files shall be lodged into the Virtual Planroom. Lodgement actions result in an approved drawing being stored in the designated area of the Virtual Planroom.

The requirements and specifications for submitting the engineering drawings to the Virtual Planroom are provided in Section 8.1, Section 8.2 and Section 8.3.

8.1. EDMS numbers

An EDMS number is a key item that is required when lodging a drawing to the Virtual Planroom. The EDMS number shall be included in the drawing's title block prior to lodging the drawing to the Virtual Planroom.

The EDMS number shall be obtained as early as possible during the development stage of any drawing file that needs to be lodged into the Virtual Planroom.

All requests for an EDMS number and submissions to the Central Planroom shall be directed through appropriate persons from the design company and the TfNSW project interface person. This ensures that the integrity of the control and management of drawings and document transfers is maintained.

The EDMS number consists of two parts, Virtual Planroom discipline and EDMS identifier.

The Virtual Planroom discipline is based on the Virtual Planroom designated settings.

Table 16 shows the Virtual Planroom disciplines and their respective codes.

Table 16 – Virtual Planroom discipline code

Virtual Planroom discipline	Code
Civil	CV
Electrical	EL
Signal	SG
Fleet	FL

Note: Based on the filename discipline code classification, architecture and services drawings, surveying drawings and track design drawings, should be registered under the civil (CV) code in the Virtual Planroom.

The EDMS identifier is a unique seven-digit number assigned by the Central Planroom to each drawing file.

8.1.1. Requesting EDMS numbers

The design company shall request EDMS numbers via their TfNSW project interface person, who is usually the project manager.

Each request shall include the following information:

- discipline under which the documents should be registered; for example, Civil (CV), Electrical (EL) Signals (SG) or Rolling Stock (FL)
- number of document numbers to be issued for each discipline
- title of the project
- design company name and AEO authorisation number
- design company's contact person's name
- design company's contact person's business address
- design company's contact person's phone number
- design company's contact person's email address
- name of TfNSW project interface person

The TfNSW project interface person shall email the Central Planroom requesting the issue of the required EDMS numbers.

The Central Planroom staff shall generate the requested EDMS numbers and record the mandatory details as required in the Virtual Planroom.

The Central Planroom staff shall then send an email to the TfNSW project interface person, with a carbon copy (CC) to the design company representative. This email lists the set of EDMS numbers registered in the Virtual Planroom. These EDMS numbers act as placeholders for the eventual drawings and prevent another requestor from using the same EDMS numbers.

Note: An additional 10% of EDMS numbers should be requested for the project to account for unforeseen circumstances. Unused EDMS numbers should be returned to the Central Planroom at the completion of the project.

If the original request for EDMS numbers is insufficient to cover the number of drawings, then the design company representative shall request additional EDMS numbers allocation through their TfNSW project interface person.

Note: These new EDMS numbers are unlikely to be in sequence or in continuation of the original batch of EDMS numbers obtained.

The EDMS number for a drawing shall not be carried over from the concept design through to the detailed design stage. If a drawing is required to be further developed during the detailed design stage, it shall have a new EDMS number.

8.2. Submission process flow

Figure 35 shows the process flow chart for the submission process.

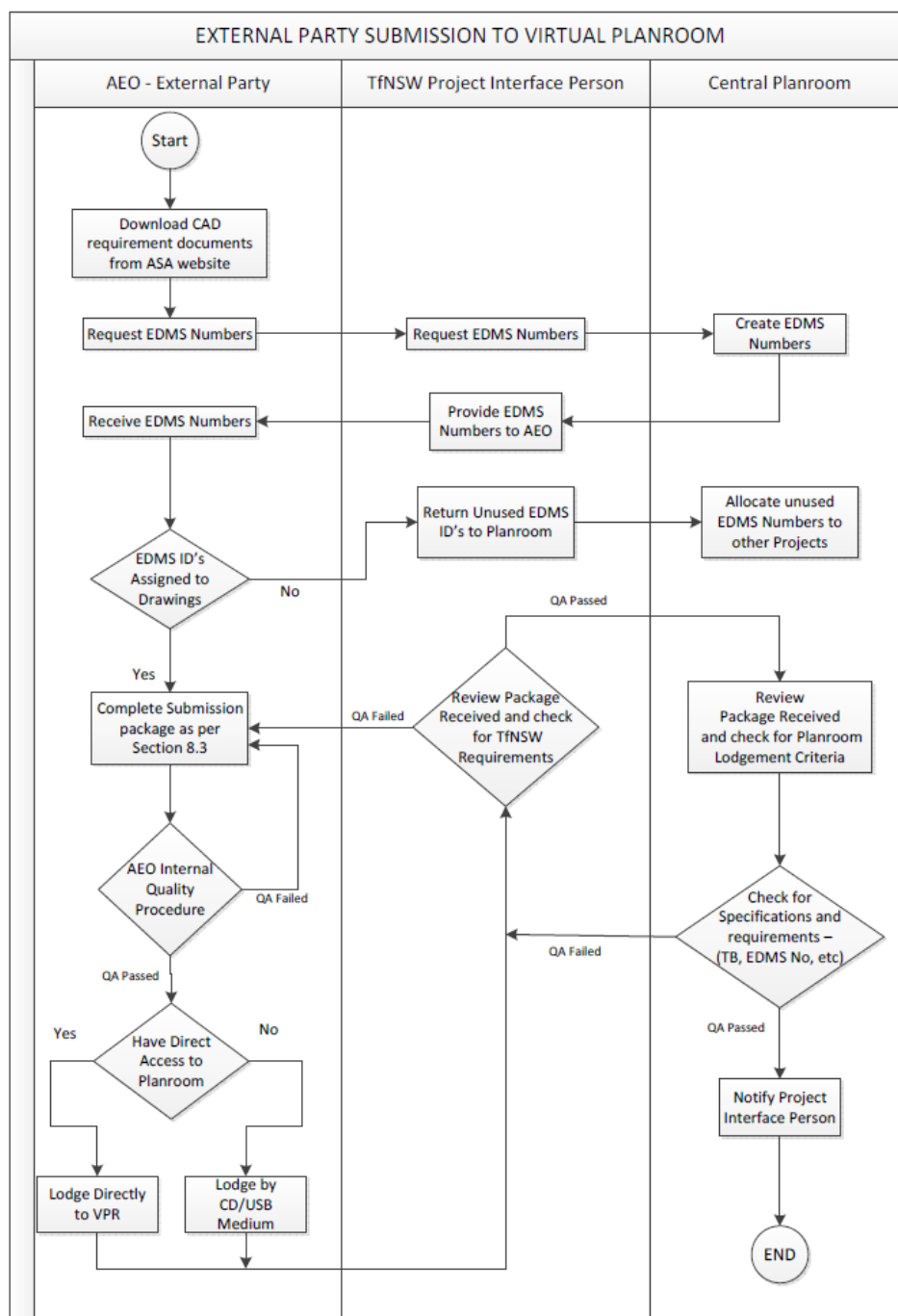


Figure 35 - Design company submission process to the Virtual Planroom

8.3. Submission package

The submission package to TfNSW shall include the following:

- cover letter
- transmittal
- metadata spreadsheet
- drawing hard copies (as advised by the TfNSW project team)
- drawing files
- drawing image files
- any other required documentation such as design reports, manuals, specifications, list of Central Planroom drawings that require superseding, handover documentation, and so on

All these documents shall be submitted to the Virtual Planroom during the following critical design stages:

- reference or final concept stage
- approved for construction (AFC) stage
- as-built stage

8.3.1. Cover letter

Any submission made to TfNSW shall accompany with a cover letter, which identifies the project, the package and the corresponding design stage. The cover letter should include information on which version of ASA or legacy RailCorp drawing requirements the package has been required to meet, in relation to the contracted requirements. It should also include any ASA concessions and nonconformances that affect the submission requirements of the package.

8.3.2. Metadata spreadsheet

The metadata spreadsheet is an excel spreadsheet (xlsx format only) that contains the drawing title block information for drawing image files submitted to the Virtual Planroom. The requirements for filling metadata spreadsheet fields are similar to those of the title block of a drawing file. Refer to Table 9 and Table 10 for these requirements.

T MU MD 00006 F1 *Metadata Spreadsheet for Engineering Drawings* shall be used for providing title block information. This metadata spreadsheet is available for download from the ASA website.

The Virtual Planroom team uses this metadata spreadsheet to apply the drawing title block attributes to the drawing image files in the Virtual Planroom. The design company shall ensure that the description filled in the drawing title block and metadata spreadsheet is identical.

The spreadsheet contains 18 fields in total, of which 16 are mandatory and two are optional.

All of these fields shall be populated either by selecting the options from the drop-down menu, or by typing in the text. Refer to Appendix B for a full list of mandatory and optional fields.

The optional metadata fields are not essential for the Virtual Planroom submissions; however, these fields should be populated if the data is readily available.

All information entered into the metadata spreadsheet shall conform to the format specified in Appendix B.

The file naming convention for the metadata spreadsheet shall be as follows:

Project code_site_document purpose_meta.xlsx

NSRU_DP03_AFC_META.xlsx is an example of North Strathfield Rail Underpass approved for construction package.

8.3.3. Transmittal

The transmittal should contain a list of all CAD supportive files that are submitted to the Virtual Planroom, along with the drawing files and the drawing image files. As a minimum requirement, the transmittal shall include the following:

- CAD supportive file name
- amendment level (if any)
- description of CAD supportive file

8.3.4. Drawing hard copies

The requirement for hard copies is subject to the project controls in place for each individual project. The TfNSW project interface person will advise the design company regarding any hard copies requirement, if any. Where there is a requirement for hard copies, the hard copies should be at a scale of 1:1 to the title block size.

8.3.5. Drawing files

The drawing files shall be submitted in either MicroStation V8i format or AutoCAD 2010 format (even if they have been created using alternative software). In MicroStation files, design history should be initiated. Drawings that are created or amended by hand or using non-CAD software such as Microsoft Paint are not acceptable.

The drawings shall be provided in an unbound form with the electronic drawing file named with the TfNSW drawing name as explained in Section 7.3.1. All model files used for creating the drawing file shall be submitted with their pre-existing names and subfolder locations (as defined by the TfNSW folder structure) so that they are automatically linked to the drawing file when they are opened.

All legacy or unused reference file links from drawing files shall be removed before submission to the Virtual Planroom. The drawing shall also be purged to remove all unused levels or layers, text styles, and so on.

8.3.6. Drawing image files

All drawing image files shall be created in portable document format (PDF). In case where it is not feasible to create a PDF copy of a drawing, the image file in a lossless compression format (tif), is acceptable as an alternative.

Each EDMS number shall have one drawing image file.

The drawing image file shall be correctly oriented so that the drawing can be viewed and read on a computer screen in the correct orientation. The maximum size for a black and white drawing image file shall be less than 10 megabytes (MB) and less than 30 MB for colour files. No password should be applied to the drawing image files. The layers in the PDF version of the drawing image shall be flattened.

The drawing image files shall be created in the same size as that specified in the drawing title block; for example, A1 title block drawings shall be created to A1 size.

All black and white drawing image files shall be created at a minimum resolution of 300 dpi. Scanned colour drawing image files can be created at a lower resolution to reduce the file size to a manageable level, so that the data is not lost and the image quality is retained.

8.3.7. Models native format

All models that are used in preparing design along with related files such as extractions, database, and assembly should be submitted in the native format in which they are created. All the references and other cross-references between these models should be as per TfNSW folder requirements as stated in Section 8.6.

8.3.8. Composite models

A composite model should be submitted in either nwd or i-dgn format showing the extent of design. The files should not be password protected or have an expiry date set. The maximum size of these files should be less than 512 MB. If the project composite file is larger than this size, then the composite models should be divided per site.

8.4. Superseded drawings

All drawings that are either replaced by a higher amendment level of the same drawing or explicitly replaced by a separate drawing are known as superseded drawings.

A drawing can be superseded at any stage of the design development and an appropriate approach shall be adopted in superseding the drawings.

The following are some of the reasons for superseding a drawing:

- a design approach which is discarded
- works such as 'cut and fill', which are early stage works
- lay down areas, which are for staging of works
- temporary works, which are built and then removed
- demolition works or tree removal
- changes to an existing Central Planroom drawing as a result of a new project
- changes to an existing Central Planroom drawing that interfaces with other areas that are being changed by the new project

8.4.1. Approach to supersede a drawing

Drawings shall be submitted to the Central Planroom during the three stages of design development as explained in Section 8.3.

Based on the submission stages, one of the following approaches should be adopted for superseding a drawing:

- prior to first submission to Central Planroom
- prior to as-built submission to Central Planroom
- existing Central Planroom drawings

Prior to first submission to Central Planroom

If a drawing or set of drawings are not required prior to first submission to Central Planroom, then the drawing or drawings shall be removed from the drawing set, along with any associated references; for example, from the drawing cover sheet, section markers and reference list. The EDMS number shall not be applied to these drawings.

Prior to as-built submission to Central Planroom

If a drawing or set of drawings are not applicable after the approved for construction stage, or during the as-built update of the drawing, then the following approach shall be undertaken:

- i Create a new amendment level of the drawing.
- ii Leave the drawing content in place, but add a large diagonal stamp across the centre containing the word 'REMOVED'.
- iii Indicate the reason for removing the drawing in the amendment history; for example, 'Removed - temporary works completed'.
- iv Leave the drawing reference in the list, but strikethrough the text where a separate drawing contains a drawing list such as a cover sheet.

Existing Central Planroom drawings

During the course of a project, new drawings (with new EDMS numbers) can supersede existing drawings that were already registered in the Central Planroom. In this case, the following approach should be adopted:

- i Add a note to the new drawing. This note should appear immediately above the title block, 5 mm high in upper case text with the following words:

'THIS DRAWING SUPERSEDES XX xxxxxxx'.
 - ii Create a new amendment level of the existing drawing.
 - iii Leave the drawing content on the existing drawing in place, and add a note to the drawing. This note shall appear above the title block, 5 mm high in upper case text with the following words:

'THIS DRAWING IS SUPERSEDED by XX xxxxxxx'.
- In situations where an existing drawing is not replaced by a new drawing, then add the note 'THIS DRAWING IS SUPERSEDED'.
- iv In the amendment history of the existing drawing, indicate the reason for superseding the drawing.
 - v In the case of a part update of an existing drawing, an amendment cloud shall be drawn on the superseded part of the existing drawing, and an appropriate note should be added to both the existing and new drawings.

If the CAD version of existing (superseded) drawing is not available or it is beyond the scope of the current project to amend the existing drawing, then the design company shall add a note to the new drawing only.

The design company shall submit a register of superseded drawings, listing both the new and existing (superseded) drawing titles, with the EDMS numbers along with other submissions to the Central Planroom.

8.5. Lodgement to the Virtual Planroom

The design company can submit the CAD drawings, related reference files and data to the Central Planroom, either through the online Virtual Planroom application called ProjectWise or through compact disk (CD), DVD, or USB storage medium. However, the physical media should only be used if the first option is not available.

8.5.1. Lodge directly online into the Virtual Planroom system

The design company can submit drawings online to the Virtual Planroom using the ProjectWise application. The TfNSW project interface person shall advise the design company of a designated area in the Virtual Planroom where drawings can be lodged.

Note: Access to the Virtual Planroom requires prior approval and an account and password established.

When the design company has submitted all drawings into the Virtual Planroom, the nominated TfNSW project interface person shall contact the Central Planroom technical information custodian via email to planroom@transport.nsw.gov.au to process the drawings.

8.5.2. Lodge offline via a TfNSW project interface person

The alternative method for lodging drawings into the Virtual Planroom is by delivering the requisite files on a compact disc (CD), DVD, or USB storage medium to the TfNSW project interface person. The design company shall submit all relevant deliverables in accordance with Section 8.3 and in the folder structure as specified in Section 8.6.

8.6. Folder structure for drawing submission package

Figure 36 shows the folder structure for both online and offline submissions.

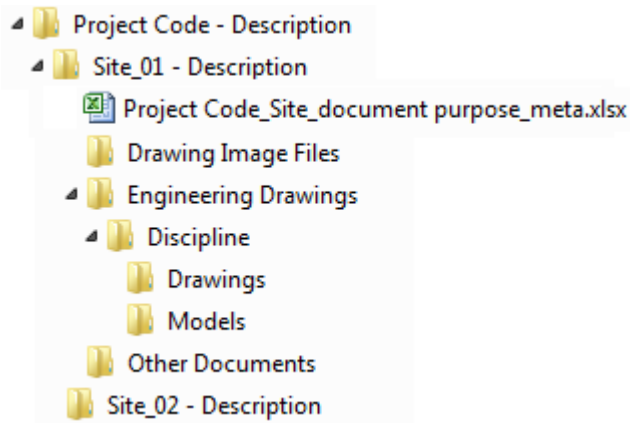


Figure 36 – Folder structure for drawing package

The folder structure should comply with the following:

- The folder structure should comprise a project folder and site-specific folders within the project folder.
- Each site folder shall contain a subfolder for drawing image files, engineering drawings (CAD) and other documents. The metadata spreadsheet shall be at the root level in the site folder.
- The engineering drawing (CAD) folder shall contain subfolders for each discipline as given in Table 13 and each discipline folder shall contain two subfolders, one for the drawing files and another for the models.
- CAD drawing files folder shall have all drawing files with the title block information populated in accordance with Section 7.3.1.
- The models folder shall contain all CAD supportive files such as 3D or 2D models, references, extractions, assembly files and raster images, as described in Section 7.3.3.
- The drawing image folder shall contain copies of all drawing image renditions of design files as described in Section 7.3.2.
- All other project deliverables shall be copied to the 'Other documents' folder.

A sample copy of the folder template is available for download from the ASA website.

For offline submissions, the entire set of CAD files (including drawings and model files) shall be provided in a folder, which is then compressed into a zip file and presented as one file. The recipient shall be able to open and view each complete drawing when the file is unzipped (including all external links).

9. Track CAD requirements

The track CAD requirements are applicable to track drawings produced for TfNSW rail projects. These requirements shall be read in conjunction with the general requirements provided in Section 6 of this standard.

Where conflict exists between the two sections, then the track CAD requirements shall take precedence over the general requirements unless the general requirements expressly states otherwise.

9.1. Title block for track drawings

Track drawings shall use the drawing title block as explained in Section 7.1 of this standard. Refer to Figure 37 for an example of a completed drawing details box for track drawings.

QUAKERS HILL			
RICHMOND LINE - 39.400km TO 39.700km UP & DOWN MAIN			
REGRAIDING FOR THE REMOVAL OF 345 & 347 Pts			
CROSSOVERS			
VERTICAL ALIGNMENT			
FILE No. FSVD2015/1211	SHEET: 1 OF 1	A1	
STATUS: FOR CONSTRUCTION			©
DRG No. -	-	EDMS No. CV1234567	A

DF 801*554

Figure 37 - Typical filled in drawing details box for track drawings

9.2. Seed files for track drawings

Refer to Section 6.10 of this standard for track drawings' seed files.

9.3. Cell libraries for track drawings

The following cell libraries should be used for creating track drawings:

- TD_Trackwork.cel
- TD_Alignment_V8.cel
- TD_MTS_V8.cel
- TP_Features.cel

A complete list of cells can be obtained by downloading these resource files and opening the cell libraries. These files are available for download from the ASA website.

9.4. Level symbology for track drawings

Different drawing features should be drawn on different layers as explained in Section 6.9 of this standard.

9.5. Types of track drawings

Based on design content, track drawings can be classified into the following drawing types:

- horizontal alignments or setting out details
- vertical alignments
- turnout detail - timbering and plating
- detail surveys
- cross-sections
- miscellaneous drawings and diagrams

These drawing types are explained in Section 9.5.1 through to Section 9.5.6.

9.5.1. Horizontal alignments or setting out details

Horizontal alignment drawings depict the coordinated track alignment; they are often referred to as setting out drawings. They shall be prepared to a prescribed degree of accuracy, and show the detail and information necessary to enable field marking and setting out by surveyors, and to provide records for the full asset life cycle.

The horizontal alignment data shown on a drawing should include coordinated frame points, curve details, transition details, straight details, track centres, turnout details, design speed, applied superelevation and superelevation deficiency, kilometrage values, kilometrage adjustments, control marks, horizontal and vertical coordinate origins, and the coordinate system.

9.5.2. Vertical alignments

Vertical alignment drawings or long sections, depict the track grades for track alignment. These drawings, along with horizontal alignment drawings, provide the information necessary to enable field marking and setting out by surveyors, and provide records for the full asset life cycle.

The vertical alignment data should include kilometrage locations, diagrammatic representation of the horizontal alignment, existing rail levels, track lifts, design rail levels, grade values, vertical curve details, grade intersection levels, and existing and proposed design profiles.

All features that affect design grades shall be included in the long section, such as platforms, underbridges, overbridges, underpasses, culverts and turnouts.

9.5.3. Turnout detail

The turnout detail drawings enable the manufacture and installation of the turnouts and turnout components to acceptable standards. These drawings depict and detail track components such as turnout type, turnout parameters and layout configuration.

9.5.4. Detail surveys

The detail survey models depict the existing and natural topographical features. This data can be transformed into a digital terrain model (DTM) for locations where engineering design proposals are planned or considered. The detail survey model also forms the base detail that is necessary for various design procedures, and can be used by other design disciplines. A drawing need not be the product of this process.

9.5.5. Cross-sections

The cross-section models depict a series of cross-sections that are generally perpendicular to the track and are used in the design process. They can be used for determining earthwork formation design, earthwork quantities, and civil works.

The cross-section data shall include levels, offsets from existing or design alignment centreline, labels and features. The kilometrage location for each cross-section should be indicated, and each cross-section viewed and compiled in the direction of increasing metrage, with details specific to the project.

9.5.6. Miscellaneous drawings and diagrams

The miscellaneous drawings can include proposals, layouts, kinematic or clearance investigations, tunnel profiles and diagrams for reports.

9.6. Track drawing requirements

Section 9.6.1 through to Section 9.6.4 provides the minimum requirements for each type of track drawing.

9.6.1. Horizontal alignment drawings

The horizontal alignment drawings are used to document horizontal track alignment, which can also be used by other engineering disciplines. The horizontal alignment drawings should preferably be drawn on a standard A1 sheet, but can be acceptable as a roll plan to A1 sheet width.

The content orientation shall be Sydney on the left, with rail tracks as horizontal as possible. The content should be represented on the drawing at a scale that is fit for purpose. A North point and grid related to the azimuth of the survey should be provided.

Horizontal alignment drawing

Table 17 provides the minimum drawing content requirements that should be displayed on a horizontal alignment drawing. It also provides the reference to respective figures in a sample horizontal alignment drawing.

Figure 38 shows a sample horizontal alignment drawing and Figure 39 to Figure 49 show elements of the drawing that depicts these requirements.

Table 17 – Horizontal alignment drawing content

Requirement	Comment	Figure reference
Detail survey	Detail survey information should be shown in the background in greyscale. Surveyed features should have annotations for all relevant or significant items.	Figure 38
Tracks	Preferably, not more than two tracks should be documented on one drawing sheet. Tracks should be documented in pairs, preferably. Track subject to design should be shaded and shown in the legend.	Figure 38 A1-1 Figure 39
Existing alignment	Existing alignment should be depicted graphically with associated labelling.	Figure 38 A1-2 Figure 40
Horizontal alignment schedule	Horizontal alignment schedule should include point description, kilometrage, centreline name (based on line name), Easting and Northing coordinates. UP and DOWN track frame points should be included in separate schedules.	Figure 38 A1-3 Figure 41
Design centreline	Each drawing sheet should be self-contained. Reference to other sheets to source relevant data need not be made.	Figure 38
Curve details	Curve details should include track name, radius and direction, arc length, design speed, applied superelevation, superelevation deficiency, centre point Easting and Northing coordinates.	Figure 38 A1-5 Figure 43
Transition details	Transition details should include track name, radius, length, Xc, m and ramp rate. Annotate irregular ramps by dimension, with start and finish kilometrage and superelevation values.	Figure 38 A1-6 Figure 44
Straight details	Straights should have bearing and distance information annotated.	Figure 38 A1-4 Figure 42
Design track centres	Where track centres are constant, annotate design value. Where track centres are variable, annotate minimum design value.	Figure 38 A1-11 Figure 49
Turnouts	Basic turnout details should be annotated.	Figure 38

Requirement	Comment	Figure reference
Design speed	Design speeds should be included in the notes.	Figure 38
Kilometrage values	Kilometrage values should be placed perpendicular to the track. Align the drawing in such a way that the kilometrage values can be read in the direction of increasing kilometrage, from top to bottom when the drawing is rotated 90° clockwise.	Figure 38 A1-7 Figure 45
Kilometrage adjustments	Kilometrage adjustments should be placed perpendicular to the track.	Figure 38 A1-8 Figure 46
Survey control marks	Survey control marks should be shown in schedule form. The schedule should include the mark identification number if any, type of mark (State Survey Mark or Brass Triangle) and location. Mark location should also be shown on the drawing, using the appropriate symbol, and labelled from left to right.	Figure 38 A1-10 Figure 48 A1-9 Figure 47
Coordinate system	Horizontal coordinate system (such as MGA, ISG, plane rectangular) and vertical datum origin should be shown in the notes.	Figure 38
From & To	'FROM SYDNEY' and 'TO YYYY' with Sydney on the left, should be shown on the drawing sheet.	Figure 38
Multiple sheets	Design information in the area of the drawing sheet beyond the join lines should be deleted.	Figure 38
Notes & references	All notes and references related to the drawing should be listed under their respective headings.	Figure 38
Legend	All legend elements used on the drawing should be listed with a clear description.	Figure 38
Scale	Scale bars for all scales used on the drawing should be provided on the lower section of the drawing.	Figure 38
North point & grid	North point and grid related to the azimuth of the survey should be annotated, with the grid shown over the whole sheet where appropriate.	Figure 38
Railway boundaries / fence line	Railway boundaries or fence line should be indicated as required.	Figure 38

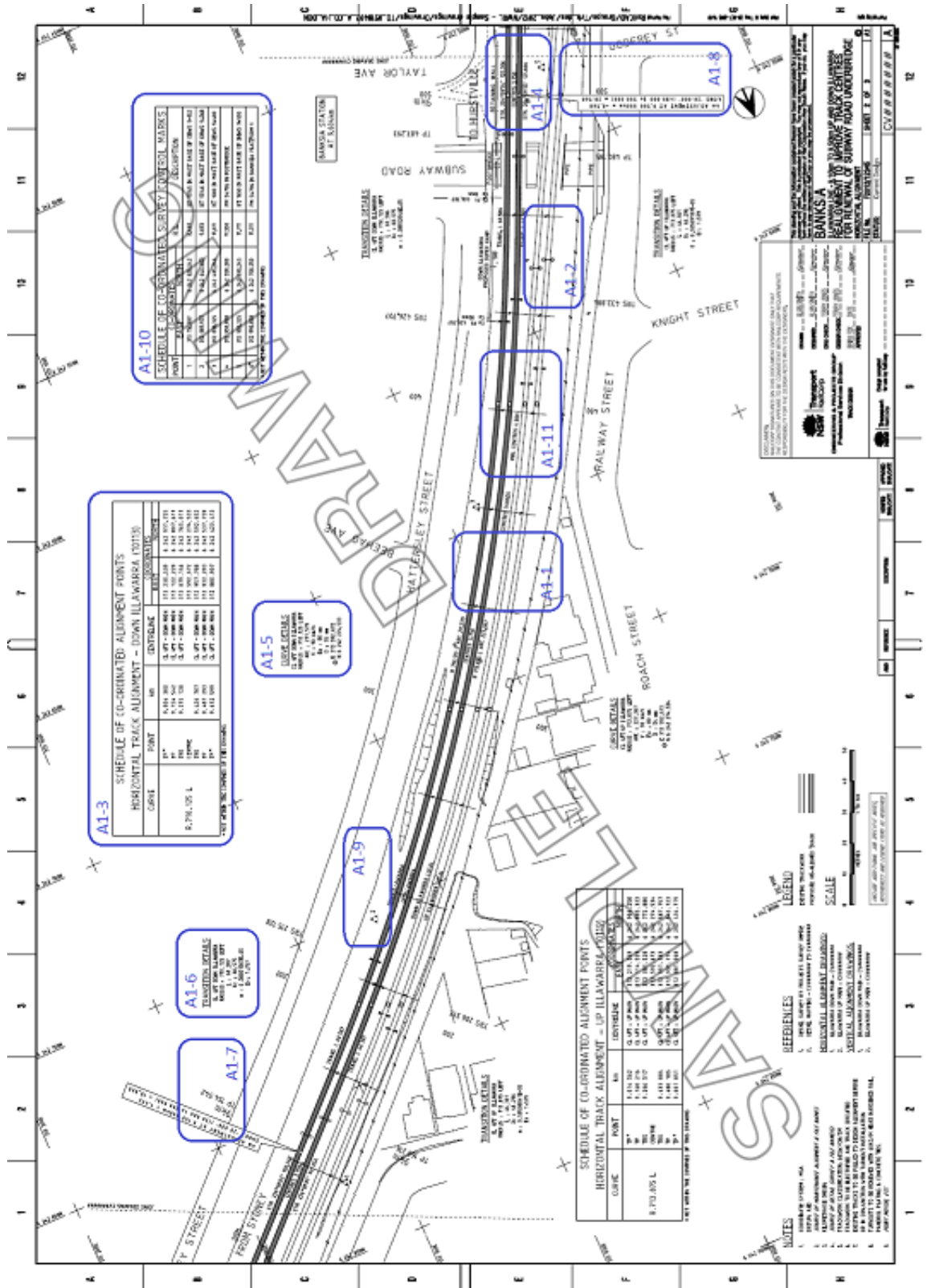


Figure 38 - Horizontal alignment sample drawing



Figure 39 – Tracks

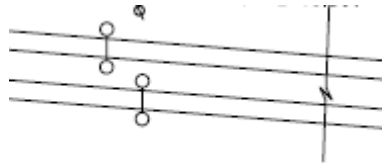


Figure 40 – Existing alignment

SCHEDULE OF CO-ORDINATED ALIGNMENT POINTS HORIZONTAL TRACK ALIGNMENT – DOWN ILLAWARRA (10113)					
CURVE	POINT	km	CENTRELINE	COORDINATES	
				EAST	NORTH
R. 710.125 L	TP*	9.004 300	CL 4FT – DOWN MAIN	313 230.539	6 242 911.725
	TP	9.154 542	CL 4FT – DOWN MAIN	313 122.220	6 242 807.611
	TRS	9.215 128	CL 4FT – DOWN MAIN	313 079.146	6 242 765.011
	CENTRE			313 592.672	6 242 274.533
	TRS	9.426 707	CL 4FT – DOWN MAIN	312 957.788	6 242 592.652
	TP	9.487 293	CL 4FT – DOWN MAIN	312 932.203	6 242 537.739
	TP*	9.612 599	CL 4FT – DOWN MAIN	312 880.907	6 242 423.413

Figure 41 – Horizontal alignment schedule

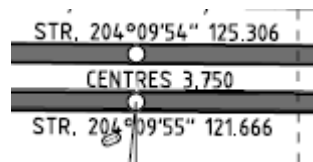


Figure 42 – Straight details

CURVE DETAILS
CL 4FT DOWN ILLAWARRA
RADIUS : 710.125 LEFT
ARC : 211.579
V : 90 km/h
Ea : 80 mm
D : 55 mm
⊙ E 313 592.672
N 6 242 274.533

Figure 43 – Curve details

TRANSITION DETAILS

CL 4FT DOWN ILLAWARRA
 RADIUS : 710.125 LEFT
 L : 60.587
 Xc : 60.575
 m : 0.38851507E-05
 Er : 1.757

Figure 44 – Transition details

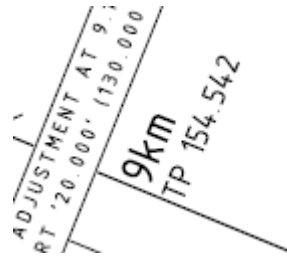


Figure 45 – Kilometrage value

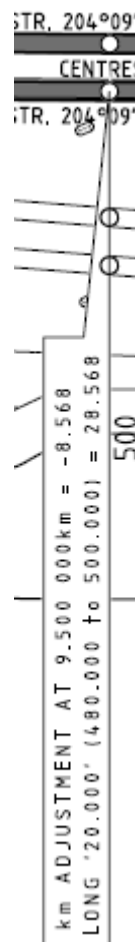


Figure 46 – Kilometrage adjustments



Figure 47 – Survey control marks

SCHEDULE OF CO-ORDINATED SURVEY CONTROL MARKS				
POINT	CO-ORDINATES		R.L.	DESCRIPTION
	EAST	NORTH		
1	313 116.907	6 242 826.542	8.497	BT 15145 IN MAST BASE OF OHWS 9+152
2	312 989.937	6 242 644.053	9.693	BT 15146 IN MAST BASE OF OHWS 9+368
3	312 878.325	6 242 405.244	11.611	BT 1600 IN MAST BASE OF OHWS 9+400
4	312 950.000	6 242 550.200	11.550	PM 54796 IN FOOTBRIDGE
5	312 900.325	6 242 590.245	11.711	BT 1650 IN MAST BASE OF OHWS 9+500
6*	312 990.000	6 242 700.350	11.311	PM 54796 IN BANKSIA PLATFORM 1

Figure 48 – Survey control marks - schedule

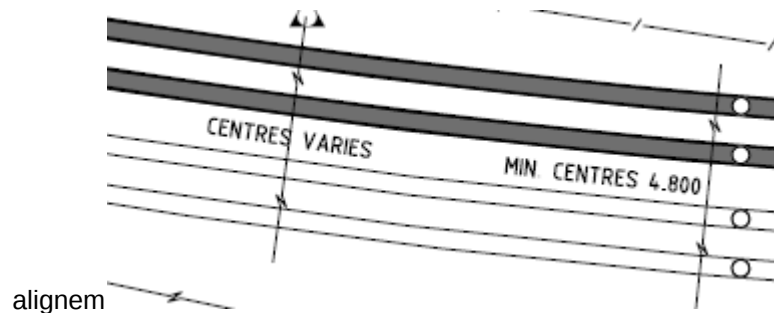


Figure 49 – Design track centres

Track setting out details

Table 18 provides the minimum drawing content requirements that should be displayed on the track setting out drawings. It also provides the reference to respective figures in a track setting out sample drawing.

Figure 50 shows a sample track setting out drawing and Figure 51 to Figure 63 show elements of the drawing that depicts these requirements.

Table 18 – Track setting out details drawing content

Requirement	Comment	Figure reference
Detail survey	Detail survey information should be shown in background in greyscale. Surveyed features should have annotations for all relevant or significant items.	Figure 50

Requirement	Comment	Figure reference
Tracks	Track subject to design should be shaded and shown in the legend.	Figure 50
Horizontal alignment schedule	Horizontal alignment schedule should include point description, kilometrage, centreline name (based on line name), Easting and Northing coordinates. UP and DOWN track frame points should be included in separate schedules.	Figure 50 A2-1 Figure 51
Design centreline	Each drawing sheet should be self-contained. Reference to other sheets to source relevant data need not be made.	Figure 50
Curve details	Curve details should include track name, radius and direction, arc length, design speed, applied superelevation, superelevation deficiency, centre point Easting and Northing coordinates.	Figure 50 A2-2 Figure 52
Transition details	Transition details should include track name, radius, length, Xc, m and ramp rate. Annotate irregular ramps by dimension, with start and finish km and superelevation values.	Figure 50 A2-3 Figure 53
Straight details	Straights should have bearing and distance information annotated.	Figure 50 A2-4 Figure 54
Design track centres	Where track centres are constant, annotate design value. Where track centres are variable, annotate minimum design value.	Figure 50 A2-5 Figure 55
Turnouts	Turnout details should be comprehensively documented, as required for setting out.	Figure 50
Turnout details	Turnout details should be annotated in schedule form. Tangential and conventional turnout details should be annotated as separate schedules.	Figure 50 A2-6 Figure 56
Insulated joint information	Insulated joints shall be annotated in indicative location as per signal design requirements. Traction return requirements should be indicated in the notes.	Figure 50 A2-7 Figure 57 A2-10 Figure 59
Clearance points	Clearance point location should be indicated with an asterix symbol (*) and an arrow in kilometrage label.	Figure 50 A2-8 Figure 58
Design speed	Design speeds should be included in the notes.	NA
Kilometrage values	Kilometrage values should be placed perpendicular to the track. Align the drawing in such a way that the kilometrage values can be read in the direction of increasing kilometrage, from top to bottom when the drawing is rotated 90° clockwise.	Figure 50 A2-9

Requirement	Comment	Figure reference
Kilometrage adjustments	Kilometrage adjustments should be placed perpendicular to the track.	Figure 50
Survey control marks	Survey control marks should be shown in schedule form. The schedule should include the mark identification number if any, type of mark (State Survey Mark or Brass Triangle) and location. Mark location should also be shown on the drawing, using the appropriate symbol, and labelled from left to right.	Figure 50 A2-11 Figure 61 A2-12 Figure 60
Coordinate system	Horizontal coordinate system (such as MGA, ISG, plane rectangular) and vertical datum origin should be shown in the notes.	Figure 50
From & To	'FROM SYDNEY' and 'TO YYYY' with Sydney on the left, should be shown on the drawing sheet.	Figure 50
Multiple sheets	Design information in the area of the drawing sheet beyond the join lines should be deleted.	Figure 50
Track pulls	Track pulls that are required should be shown to reposition existing track location onto design alignment.	Figure 50 A2-13 Figure 62
Track shifts	Shifts required to reposition the existing track location onto a new or revised track alignment.	Figure 50 A2-14 Figure 63
Notes & references	All notes and references related to the drawing should be listed under their respective headings.	Figure 50
Legend	All legend elements used on the drawing should be listed with a clear description.	Figure 50
Scale	Scale bars for all scales used on the drawing should be provided on the lower section of the drawing.	Figure 50
North point & grid	North point and grid related to the azimuth of the survey should be annotated, with the grid shown over the whole sheet where appropriate.	Figure 50
Railway boundaries / fence line	Railway boundaries or fence line should be indicated as required.	Figure 50

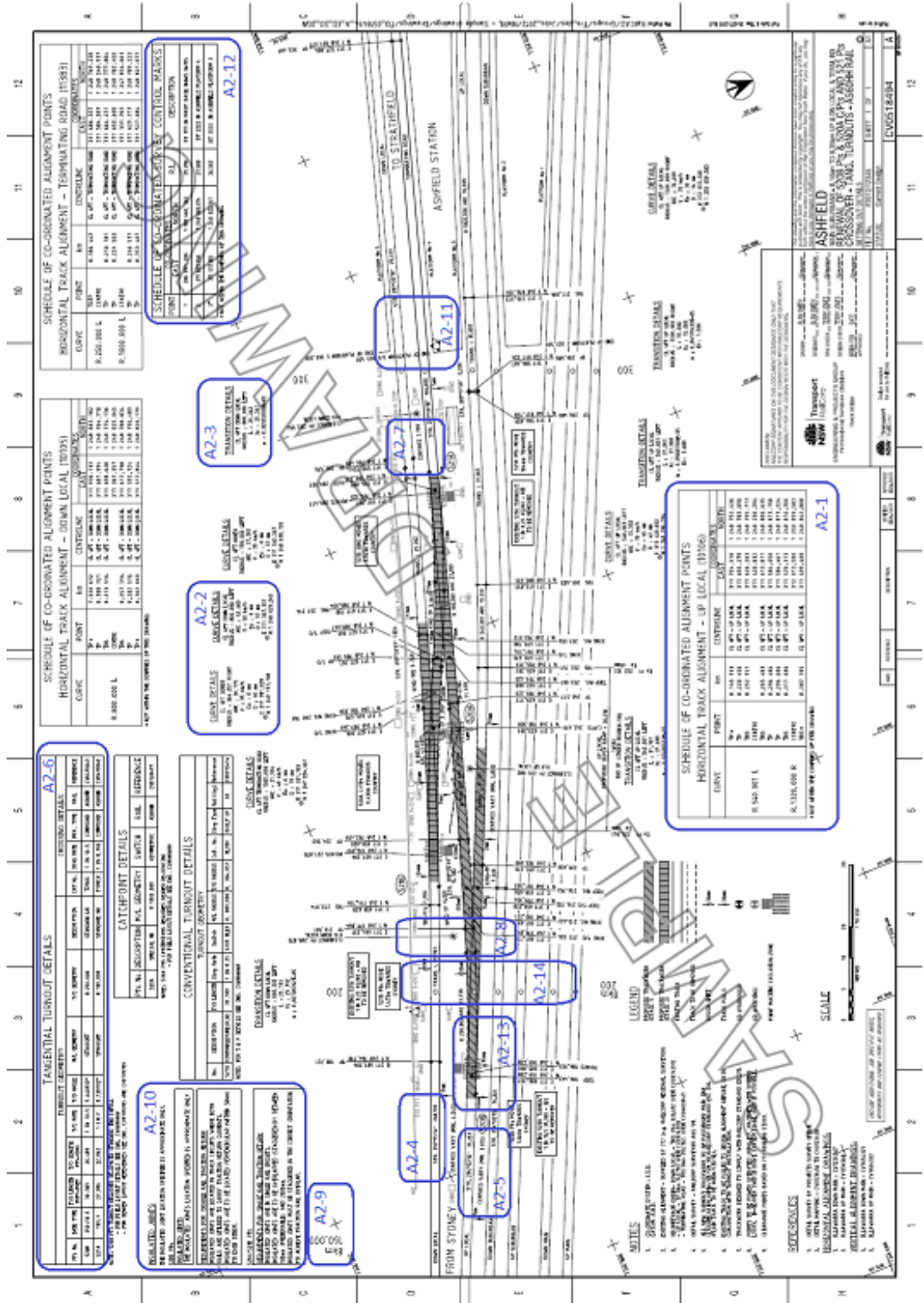


Figure 50- Track setting out sample drawing

SCHEDULE OF CO-ORDINATED ALIGNMENT POINTS HORIZONTAL TRACK ALIGNMENT – UP LOCAL (10106)					
CURVE	POINT	km	CENTRELINE	COORDINATES	
				EAST	NORTH
R. 540.001 L	TP *	8.145 193	CL 4FT – UP LOCAL	311 724.010	1 248 752.436
	TP	8.220 450	CL 4FT – UP LOCAL	311 655.279	1 248 783.090
	TRS	8.252 151	CL 4FT – UP LOCAL	311 626.203	1 248 795.717
	CENTRE			311 420.832	1 248 296.294
	TRS	8.265 483	CL 4FT – UP LOCAL	311 613.811	1 248 800.635
	TP	8.296 486	CL 4FT – UP LOCAL	311 584.650	1 248 811.158
	TP	8.296 686	CL 4FT – UP LOCAL	311 584.461	1 248 811.224
	TRS	8.311 686	CL 4FT – UP LOCAL	311 570.313	1 248 816.206
R. 1320.000 R	CENTRE			312 013.500	1 250 059.583
	TRS *	8.387 785	CL 4FT – UP LOCAL	311 499.408	1 248 843.808

Figure 51 – Horizontal alignment schedule

CURVE DETAILS	CURVE DETAILS
CL 4FT XOVER	CL 4FT DOWN LOCAL
RADIUS : 364.051 RIGHT	RADIUS : 800.000 LEFT
ARC : 30.175	ARC : 43.400
V : 35 km/h	V : 50 km/h
Ea : 0 mm	Ea : 0 mm
D : 40 mm	D : 37 mm
E 311 781.039	E 311 367.357
N 1 249 117.108	N 1 248 029.045

Figure 52 – Curve details

TRANSITION DETAILS
CL 4FT DOWN LOCAL
RADIUS : 800.000 LEFT
L : 25.193
Xc : 25.192
m : 0.82728762E-05

Figure 53 – Transition details

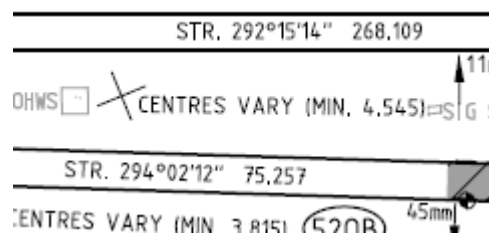


Figure 54 – Straight details

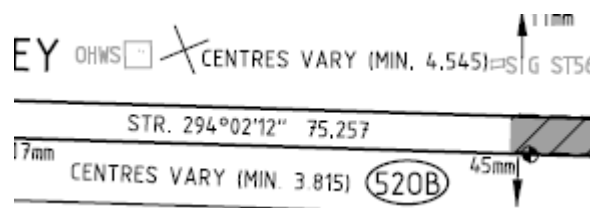


Figure 55 – Design track centres

TANGENTIAL TURNOUT DETAILS													
TURNOUT GEOMETRY									CROSSING DETAILS				
Pts No.	BASE TYPE	T/O LENGTH TOTP-TOEP	T/O LENGTH PTS-XING	T/O RATE	T/O ANGLE	M/L GEOMETRY	T/O GEOMETRY	DESCRIPTION	CAT No.	XING RATE	MIN. TYPE	RAIL	REFERENCE
520B	250:10.5	30.309	26.489	1 IN 10.5	5.440332°	STRAIGHT	R 250.000	STANDARD LH	T250S	1 IN 10.5	COMPOUND	AS60HH	CV0479043
521A	190:7	27.006	22.862	1 IN 7	8.130102°	STRAIGHT	R 190.000	STANDARD RH	T190CR	1 IN 8.106	COMPOUND	AS60HH	CV0479040

Figure 56 – Turnout details

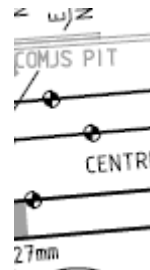


Figure 57 – Insulated joints



Figure 58 – Clearance points

INSULATED JOINTS

THE INSULATED JOINT LOCATION SPECIFIED IS APPROXIMATE ONLY.

520B Pts

INSULATED JOINTS

THE INSULATED JOINTS LOCATION SPECIFIED IS APPROXIMATE ONLY

REQUIREMENTS FOR 'DOUBLE RAIL TRACTION RETURN'

INSULATED JOINTS ARE LOCATED IN TRACK CIRCUITS WHERE BOTH RAILS ARE UTILISED TO CARRY TRACTION RETURN CURRENTS.
INSULATED JOINTS ARE TO BE LOCATED PERPENDICULAR (WITHIN 50mm) TO EACH OTHER.

521A/521B Pts

REQUIREMENTS FOR 'SINGLE RAIL TRACTION RETURN'

INSULATED JOINTS ARE IN SINGLE RAIL CIRCUITS.
INSULATED JOINTS ARE TO BE OVERLAPPED (STAGGERED) BY BETWEEN 100mm (PREFERABLE), AND 2000mm.
INSULATED JOINTS MUST BE STAGGERED IN THE CORRECT ORIENTATION TO ACHIEVE TRACTION RAIL OVERLAP.

Figure 59 – Insulated joints notes

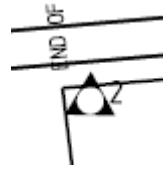


Figure 60 – Survey control marks

SCHEDULE OF CO-ORDINATED SURVEY CONTROL MARKS				
POINT	CO-ORDINATES		R.L.	DESCRIPTION
	EAST	NORTH		
1	286 997.206	1 188 460.362	29.290	BT 1111 IN MAST BASE OHWS 8+195
2	311 603.056	1 248 800.014	27.508	BT 2222 IN ASHFIELD PLATFORM 4
3	311 517.185	1 248 822.141	26.502	BT 3333 IN ASHFIELD PLATFORM 3

Figure 61 – Survey control schedule

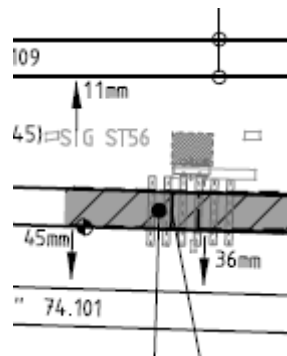


Figure 62 – Track pulls

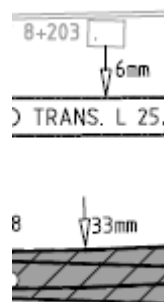


Figure 63 – Track shifts

9.6.2. Vertical alignment drawings

Vertical alignment drawings (long sections) are used to document vertical track alignment.

Vertical alignment drawings should preferably be drawn on a standard A1 sheet, but can be acceptable as a roll plan to A1 sheet width.

Note: All numerical values expressed in metres shall be annotated to three decimal places, unless otherwise indicated. Grading information shall also be shown to three decimal places.

Vertical alignment drawing content

Table 19 provides the minimum drawing content requirements that should be displayed on the vertical alignment drawings. It also provides the reference to respective figures in a sample vertical alignment drawing.

Figure 64 shows a sample vertical alignment drawing and Figure 65 to Figure 72 show elements of the drawing that depicts these requirements.

Table 19 - Vertical alignment drawing content

Requirement	Comment	Figure reference
Track name	Track name should be shown as a heading on the top left corner of the profile.	Figure 64 A3-1 Figure 65
Kilometrage location	The running kilometrage should include labels for the horizontal alignment and vertical alignment frame points. It should include kilometrage adjustments.	Figure 64
Diagrammatic representation of the horizontal alignment	The diagrammatic representation of the horizontal alignment should have the straight and transition frame points, curve radius and design superelevation noted.	Figure 64 A3-2 Figure 66
Existing rail levels	The existing rail levels should be interpolated at 20 m intervals.	Figure 64
Track lifts and falls	From existing rail level to proposed vertical design level (in m).	Figure 64
Grade and intersection points	Intersection Point (IP), metrage and Reduced Level (RL) information should be annotated.	Figure 64 A3-3 Figure 67
Design rail levels	Design rail levels should be annotated.	Figure 64
Grade values	Grade values should be annotated with adjoining grade information shown adjacently.	Figure 64 A3-4 Figure 68
Proposed vertical design	Indicates grade length and value (shown as %), vertical curve length and radius.	Figure 64
Vertical curve details	Vertical curve length, approach and departure length, and vertical curve radius to be shown.	Figure 64 A3-5 Figure 69
Construction or interim grades	Tie in-grades to existing to be included at design stage. This helps to define the scope for survey.	Figure 64 A3-6 Figure 70
Existing and design track profiles	Indicative information only to indicate magnitude of track lifts or falls.	Figure 64
Formation profile	Plotted as required.	Figure 64

Requirement	Comment	Figure reference
Track layout diagram	The track layout diagram should show crossovers and turnouts where necessary, and aligned to profile details if possible.	Figure 64 A3-7 Figure 71
Existing and proposed design structures	The existing and proposed design structures should include overbridges, underbridges, tunnels, pipes, culverts, turnouts, platforms (level or standard) access and topographic features. The profile of these structures and features should be described at their longitudinally plotted location. Underside of girder levels (overbridges). Deck levels (underbridges).	Figure 64 A3-8 Figure 72 A3-8 Figure 72 Figure 64
Ballast depth	For information purposes only, when required.	Figure 64
Contact and catenary wire levels	Contact and catenary wire levels are shown when required for overhead wire design.	Figure 64
Notes & references	All notes and references related to the drawing should be listed under their respective heading.	Figure 64
Legend	All legend elements used on the drawing should be listed with a clear description.	Figure 64
Scale	Preferred scales are 1:1000 horizontal and 1:100 vertical. Scale bars for all scales used on the drawing should be provided on the lower section of the drawing.	Figure 64



Figure 64 - Vertical alignment sample drawing

UP MAIN

DESIGN VELOCITY 115km/h

Figure 65 – Track name

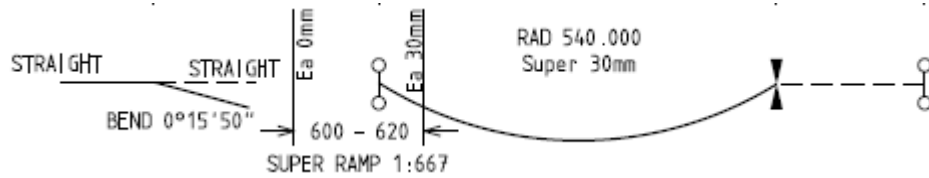


Figure 66 – Diagrammatic representation of the horizontal alignment

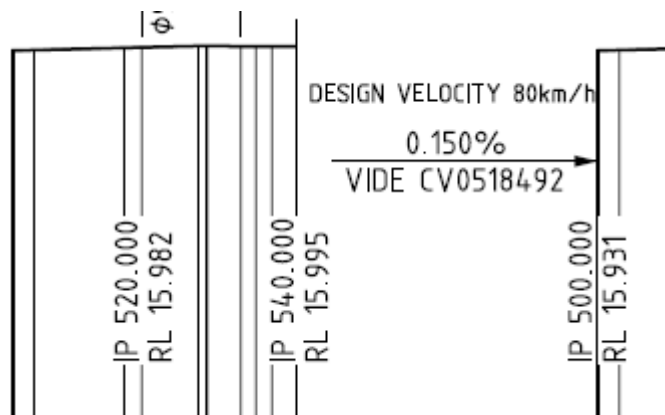


Figure 67 – Grade and intersection points

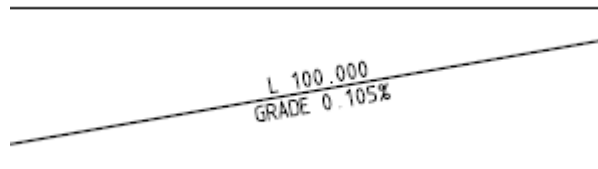


Figure 68 – Grade values

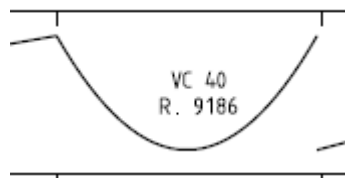


Figure 69 – Vertical curve details

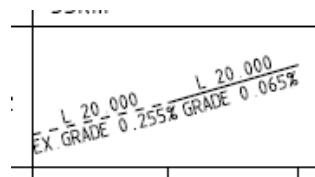


Figure 70 – Construction or interim grades

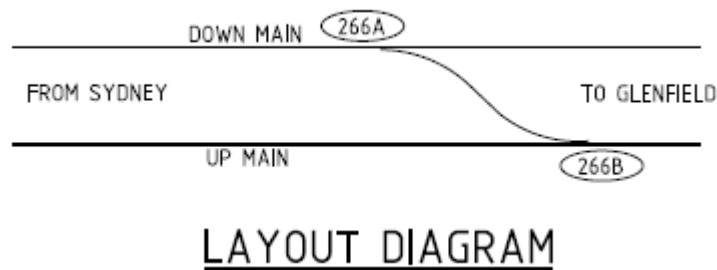


Figure 71 – Track layout diagram

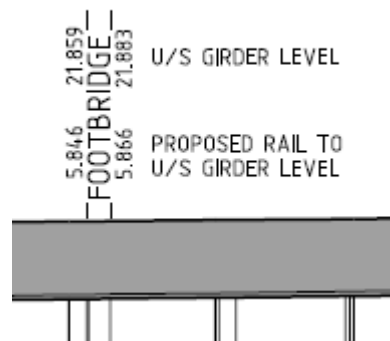


Figure 72 – Existing and proposed design structure

9.6.3. Turnout detail drawings

Turnout detail drawings are used to document the design geometry and various components used to make up a turnout, crossover, diamond, catch point or slip.

Turnout component drawings are used to detail the various track components for manufacturing purposes.

Field layout for tangential turnouts

A field layout drawing for tangential turnouts is intended to provide a plan, laid out in correct orientation, for the constructor. The position and type of insulated joints, and cant plate set requirements should be shown on this drawing. The initial layout of the bearers allows the 'rough' layout to be as close as possible to the final layout. This minimises inaccuracies and reduces rework.

Table 20 provides the minimum drawing content requirements that should be displayed on field layout drawings for tangential turnouts. It also provides the reference to respective figures in a sample tangential turnout drawing.

Figure 73 shows a sample tangential turnout drawing and Figure 74 to Figure 83 show elements of the drawing that depicts these requirements.

Table 20 – Field layout for tangential turnouts

Requirement	Comment	Figure reference
Turnout type configuration	Turnout type configuration information should be provided. Turnout details should include the location, points numbers, type and length.	Figure 73
Bearer layout information	To assist in the layout of turnout bearers and end infill ties. Specific circumstances may require more detailed bearer layout information.	Figure 73 A6-1 Figure 74 A6-2 Figure 75
Setting out dimensions	To assist in laying out turnout and end infill steelwork. This information is also used as a final check of the turnout layout.	Figure 73 A6-3 Figure 76
In-bearers	Indicated in the correct orientation if used.	NA
Insulated joint information	Insulated joints shall be annotated in indicative location as per signal design requirements. Traction return requirements to be indicated in the notes. Standard GIJ units or special units fabricated into closures should also be annotated.	Figure 73 A6-4 Figure 77 A6-5 Figure 78
Closure details	Closure information should include details of special closures with built-in GIJs, and with specific closure requirements annotated.	Figure 73 A6-6 Figure 79
Closure and checkrail carrier details	Closure and checkrail carrier details should be labelled in the traditional sequence that is, A, B, C, D, E, F, G, H, K ...	Figure 73 A6-7 Figure 80 Figure 83
Additional plating requirements (from standard supply)	Additional plating requirements for special infills should be annotated adjacent to GIJs, and tabulated in a schedule.	Figure 73 Figure 82
From & To	'FROM SYDNEY' and 'TO YYYY' with Sydney on the left, should be shown on the drawing sheet.	Figure 73
Notes & references	All notes and references related to the drawing should be listed under their respective headings.	Figure 73 A6-8 Figure 81
Legend	All legend elements used on the drawing should be listed with a clear description.	Figure 73
Scale	Scale bars for all scales used on the drawing should be provided on the lower section of the drawing.	Figure 73

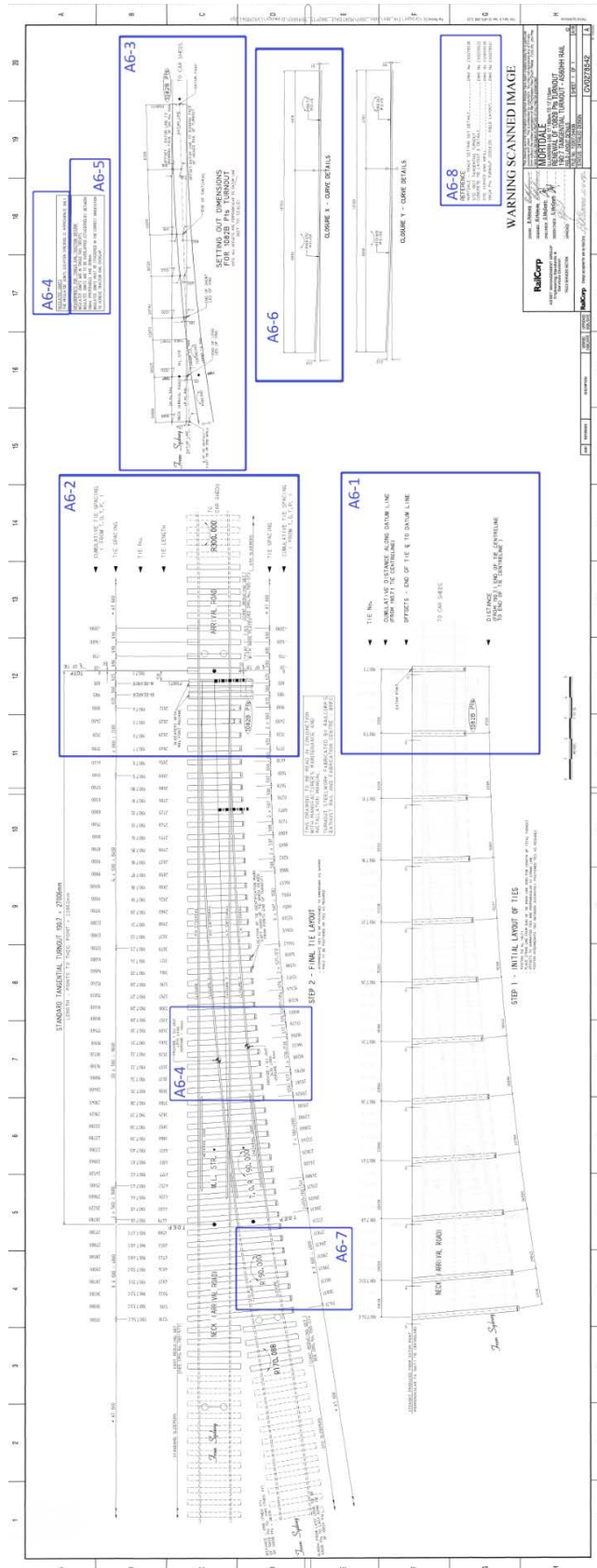


Figure 73 – Sample tangential turnout drawing

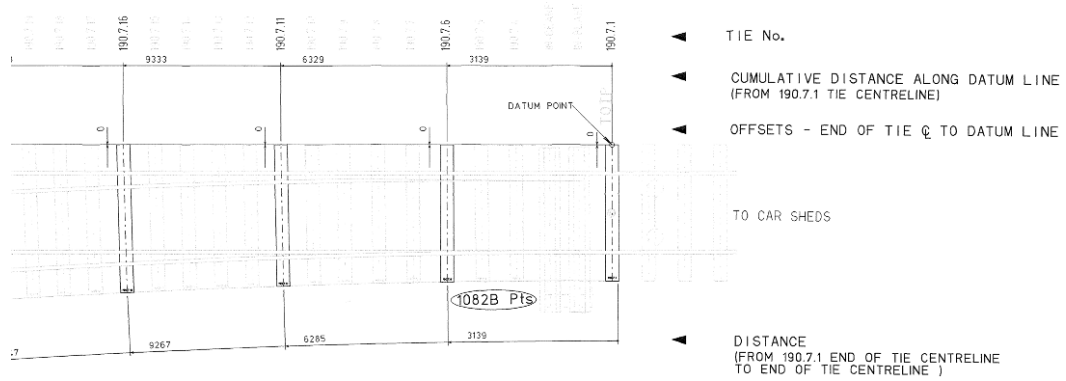


Figure 74 – Initial bearer layout

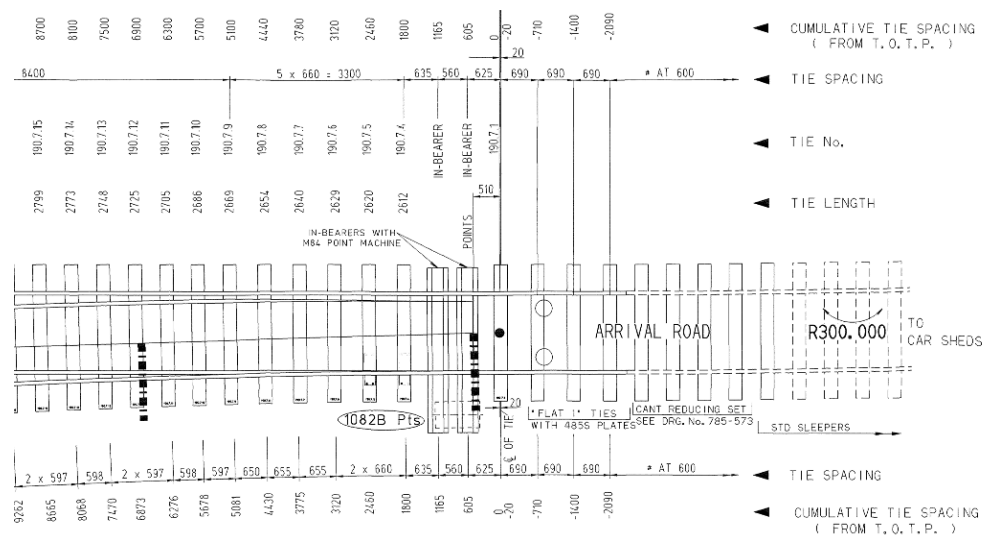


Figure 75 – Final bearer layout

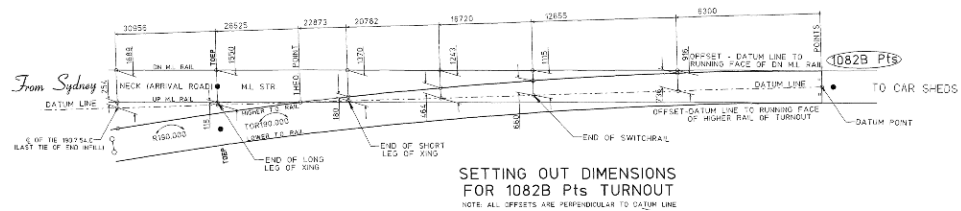
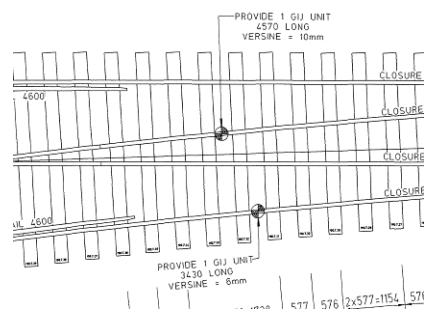


Figure 76 – Setting out dimensions



INSULATED JOINTS
THE INSULATED JOINTS LOCATION SPECIFIED IS APPROXIMATE ONLY

Figure 77 – Insulated joint locations

REQUIREMENTS FOR 'SINGLE RAIL TRACTION RETURN'
INSULATED JOINTS ARE IN SINGLE RAIL CIRCUITS.
INSULATED JOINTS ARE TO BE OVERLAPPED (STAGGERED) BY BETWEEN
100mm (PREFERABLE), AND 2000mm.
INSULATED JOINTS MUST BE STAGGERED IN THE CORRECT ORIENTATION
TO ACHIEVE TRACTION RAIL OVERLAP.

Figure 78 –Traction rail information

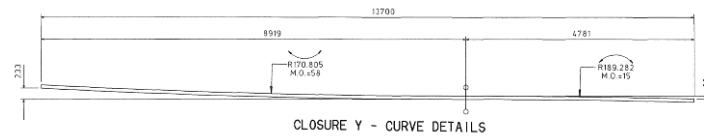


Figure 79 – Closure detail

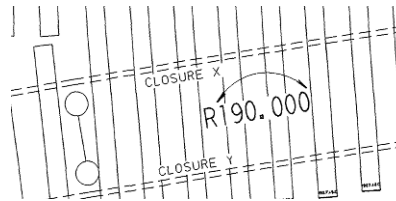


Figure 80 – Closure and check rail carrier labels

REFERENCE
MORTDALE - TRACK SETTING OUT DETAILS.....DWG No CV0278538
STD. 190.7 TANGENTIAL TURNOUT
CONCRETE TIE LAYOUT & DETAILS.....DWG No CV0225622
STD. CURVED END INFILL.....DWG No CV0020230
1092A Pts TURNOUT (250.8.25) - FIELD LAYOUT.....DWG No CV0278541

Figure 81 - References

PLATE	REFERENCE	COMMENTS	REQ'D
PSS	CV0142613	REQUIRED FOR 250.10.5.3734.12.R 250.10.5.3734.13.R	6
MPTS	CV0142615	REQUIRED FOR 250.10.5.3734.13.R	2

Figure 82 – Additional plating information

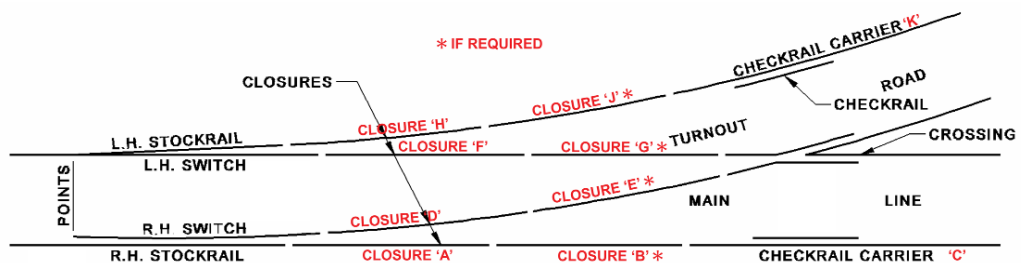


Figure 83 - Closure naming conventions

Tangential turnout – Bearer layout and details

Bearer layout and detail drawings are prepared for special crossover infill areas, where the use of standard bearers is not achievable. The information required includes bearer details, bearer layout configuration, and details regarding resilient pads.

Table 21 provides the minimum drawing content requirements that should be displayed on the tangential turnout drawings. It also provides the reference to respective figures in a sample tangential turnout drawing.

Figure 84 shows a sample tangential turnout – bearer layout and details drawing and Figure 85 to Figure 91 show elements of the drawing that depicts these requirements.

Table 21 - Tangential turnout - Bearer layout and details

Requirement	Comment	Figure reference
Turnout type configuration	Turnout type configuration information should be provided. Turnout details should include the location, points numbers, type and length.	Figure 84
Bearer layout information	Sufficient dimensioning (between bearers and cumulative on both sides) should be provided to allow for accurate layout for bearers. Specific circumstances may require more detailed bearer layout information.	Figure 84 A7-1 Figure 85
Bearer details	Bearer details should include the length of each bearer. It should include the identification number of each bearer.	Figure 84 A7-1, A7-7 Figure 85, Figure 91 Figure 84 A7-1 Figure 85
In-bearers	Indicated in the correct orientation if used.	Figure 84
Resilient pad details	Resilient pad details should include the pad dimensions for all turnout base plates, with specific pad details if required.	Figure 84 A7-2 Figure 86
Insulated joint information	Insulated joints shall be annotated in indicative location as per signal design requirements. Traction return requirements to be indicated in the notes. Standard GIJ units or special units fabricated into closures should also be annotated.	Figure 84 A7-5, A7-6 Figure 89 Figure 90

Requirement	Comment	Figure reference
Closure details	Closure information should include details of special closures with built- in GIJs, and with specific closure requirements annotated.	Figure 84 A7-3 Figure 87
Closure and checkrail carrier details	Closure and checkrail carrier details should be labelled in the traditional sequence that is, A, B, C, D, E, F, G, H, K ...	Figure 84 A7-4 Figure 88
From & To	'FROM SYDNEY' and 'TO YYYY' with Sydney on the left, should be shown on the drawing sheet.	Figure 84
Notes & references	All notes and references related to the drawing should be listed under their respective headings.	Figure 84
Legend	All legend elements used on the drawing should be listed with a clear description.	Figure 84
Scale	Scale bars for all scales used on the drawing should be provided on the lower section of the drawing.	Figure 84

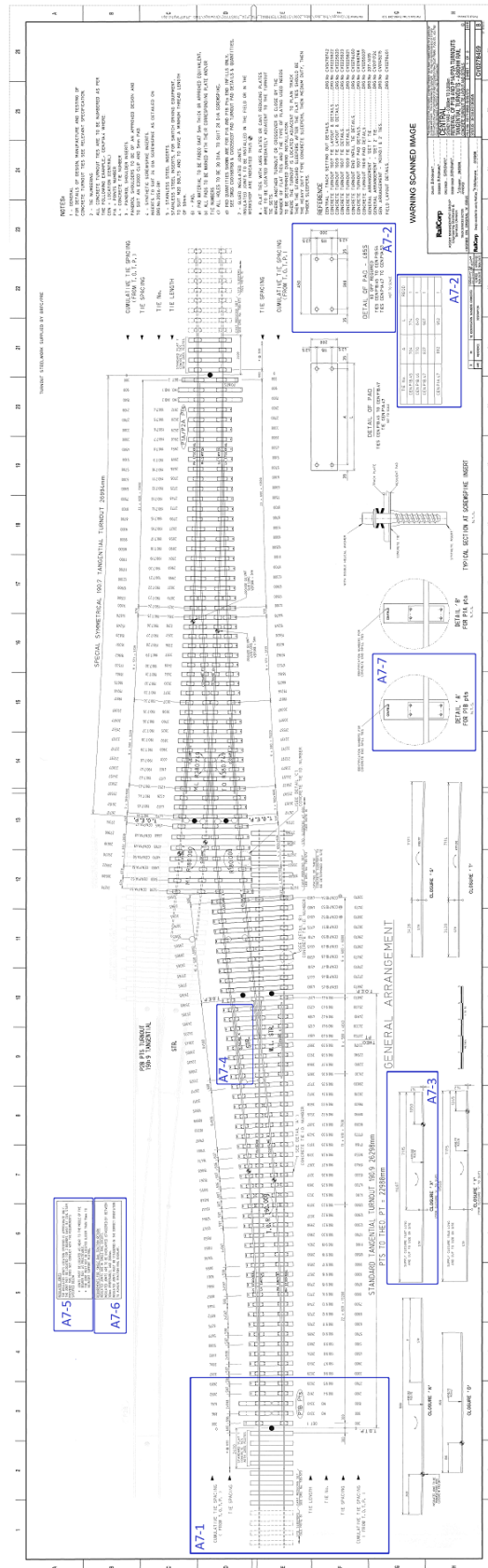


Figure 84 – Sample tangential turnout – tie layout and details

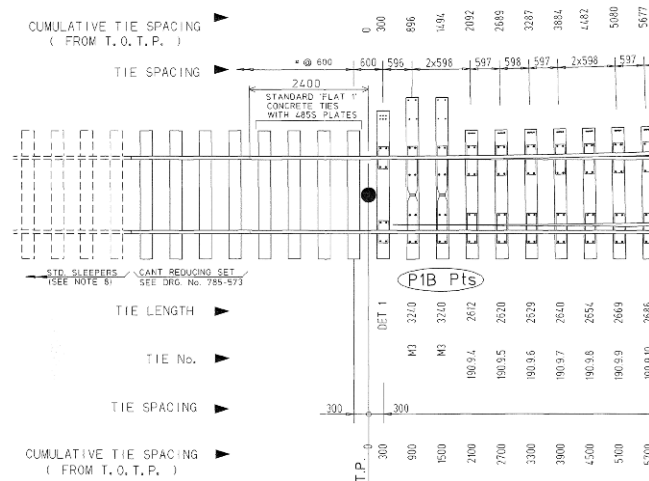


Figure 85 – Concrete turnout and bearer details

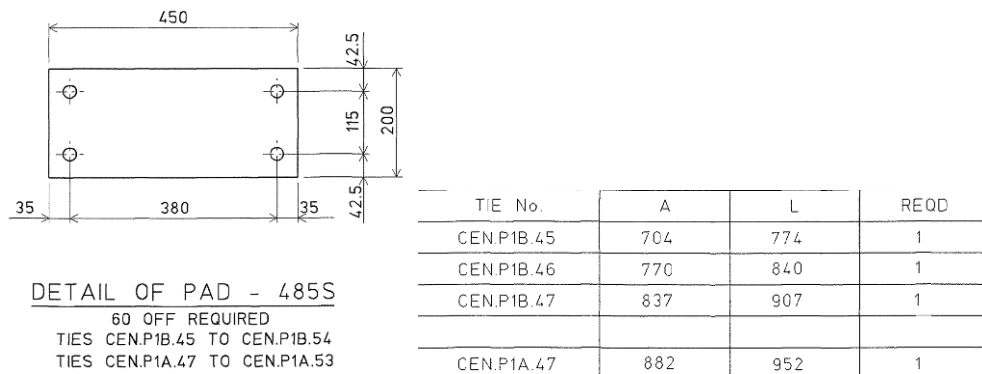


Figure 86 – Resilient pad details

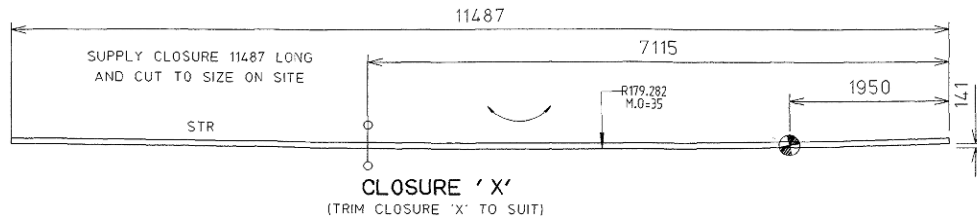


Figure 87 – Closure details

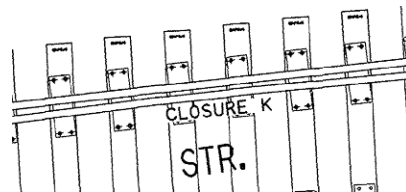


Figure 88 – Closure and check rail carrier labels

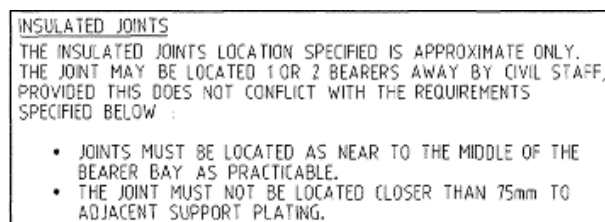


Figure 89 – Insulated joints - notes

REQUIREMENTS FOR 'SINGLE RAIL TRACTION RETURN'
INSULATED JOINTS ARE IN SINGLE RAIL CIRCUITS.
INSULATED JOINTS ARE TO BE OVERLAPPED (STAGGERED) BY BETWEEN
100mm (PREFERABLE), AND 2000mm.
INSULATED JOINTS MUST BE STAGGERED IN THE CORRECT ORIENTATION
TO ACHIEVE TRACTION RAIL OVERLAP.

Figure 90 - Traction return - notes

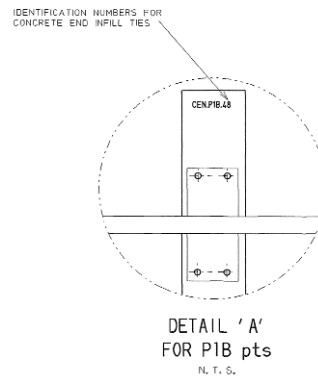


Figure 91 – Bearer details

Conventional turnout – Timbering and plating

Timbering and plating details drawings are prepared for conventional geometry turnouts and other special trackwork configurations. The details provided are used for the manufacture and fabrication of the constituent components, and for layout and component identification required for pre-installation assembly.

Table 22 provides the minimum drawing content requirements that should be displayed on the conventional turnout drawings. It also provides the reference to respective figures in a sample conventional turnout drawing.

Figure 92 shows a sample conventional turnout drawing and Figure 93 to Figure 102 show elements of the drawing that depicts these requirements.

Table 22 - Conventional turnout – Timbering and plating

Requirement	Comment	Figure reference
Timbering and plating details	Timbering and plating details should contain the length, spacing and location of required bearers, from commencement of the cant reducing plates at either end. It should also include the identification number of each plate.	Figure 92 A4-1 Figure 93
Tables of materials	Tables of materials should include tables of pandrol base plates, timber bearers, closures, heelblock dimensions and standard plate information. Item numbers should be referenced to components on the drawing.	Figure 92 A4-2 Figure 94

Requirement	Comment	Figure reference
Tables of materials (continued)	Table of pandrol base plates Table of timber bearers Table of closures Table of heelblock dimensions Table of standard plates	Figure 92 A4-3 Figure 95 Figure 92 A4-4 Figure 96 Figure 92 A4-5 Figure 97 Figure 92 A4-6 Figure 98 Figure 92 A4-7 Figure 99
Setting out dimensions for turnout steelwork	Setting out dimensions for turnout steelwork should include offsets to the mainline and turnout for field layout and check purposes.	Figure 92 A4-8 Figure 100
Switch, stockrail and checkrail details	Switch, stockrail and checkrail details should include the offsets, mid-ordinates, radii and curvature direction of these components.	Figure 92 A4-9 Figure 101
Crossing details	Crossing details should include the crossing rate and XL catalogue number shown in the material list, with reference to the detail drawing.	Figure 92
Insulated joint information	Insulated joints shall be annotated in indicative location as per signal design requirements. Traction return requirements to be indicated in the notes. Standard GIJ units or special units fabricated into closures should also be annotated.	Figure 92
Closure details	Closure information should include details of special closures with built in GIJs, with specific closure requirements annotated.	Figure 92
Closure and checkrail carrier details	Closure and checkrail carrier details should be labelled in the traditional sequence, that is, A, B, C, D, E, F, G, H, K ...	Figure 92 A4-11 Figure 102
Notes & references	All notes and references related to the drawing should be listed under their respective headings.	Figure 92
Legend	All legend elements used on the drawing should be listed with a clear description.	Figure 92
Scale	Scale bars for all scales used on the drawing should be provided on the lower section of the drawing.	Figure 92

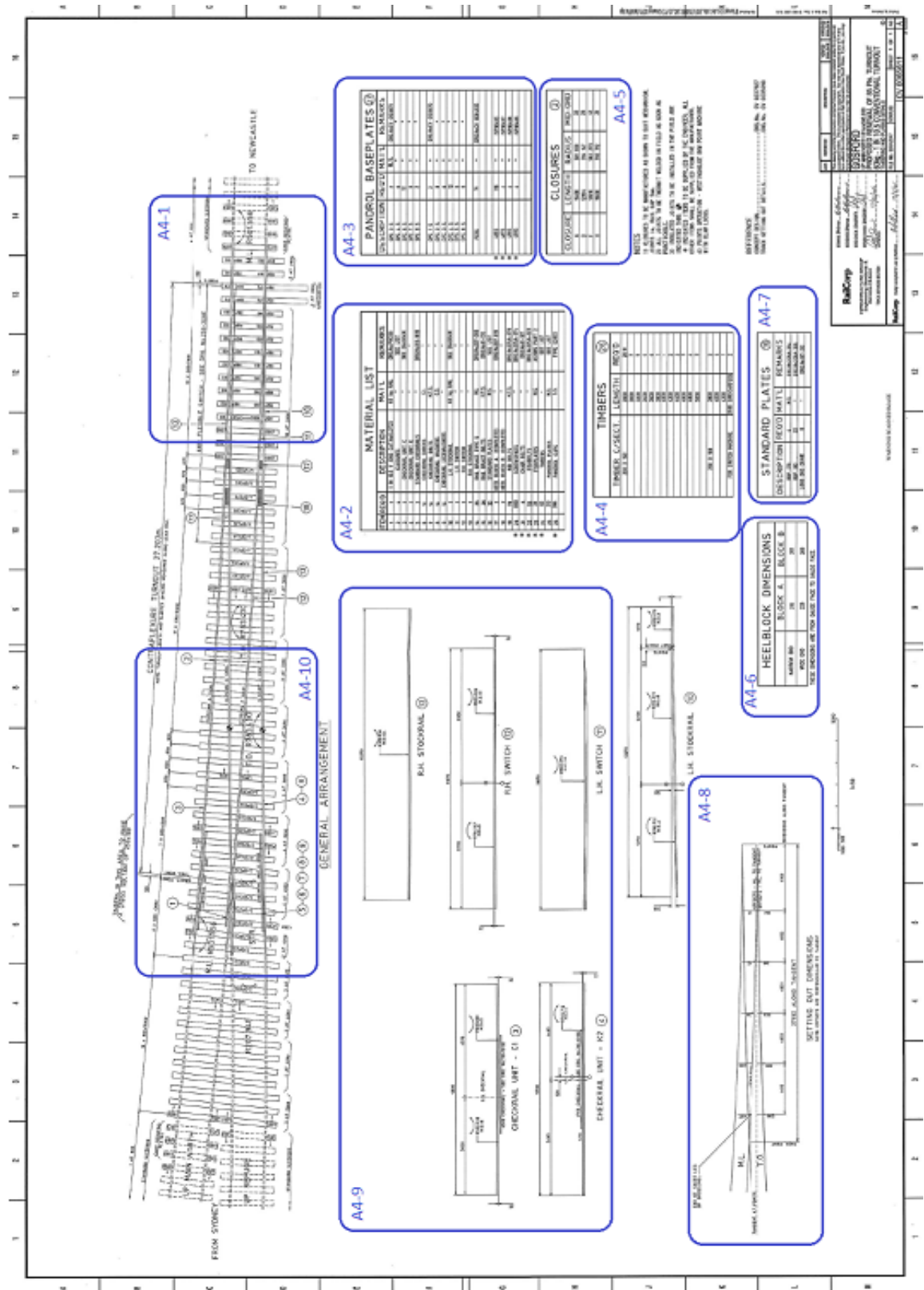


Figure 92 – Sample conventional turnout – Timbering and plating drawing

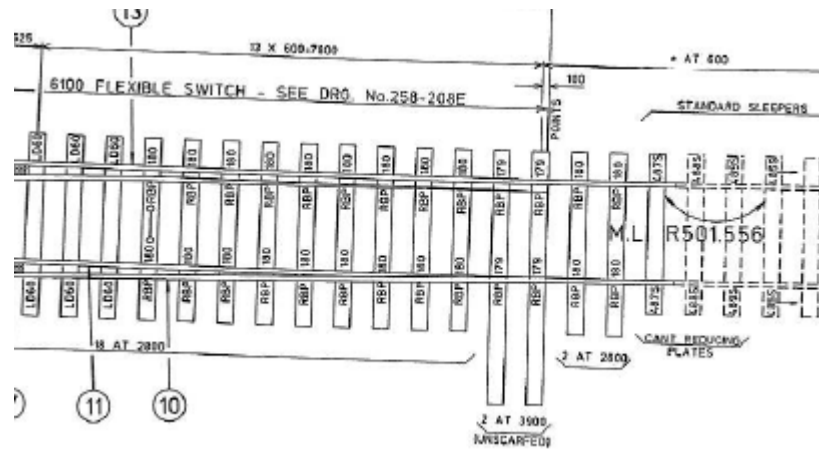


Figure 93 – Timbering and plating details

MATERIAL LIST				
ITEM	REQ'D	DESCRIPTION	MAT'L	REMARKS
1	1	1 IN 105 V XING CATNoXL2723	60 kg RAIL	DRG.No/PW268
2	4	CLOSURES	"	SEE LIST
3	1	CHECKRAIL UNIT C	"	SEE DIAGRAM
4	1	CHECKRAIL UNIT K	"	"
5	2	STANDARD CHECKRAILS	"	DRG.No/310-1019
6	14	CHECKRAIL CHOCKS	C.I.	"
7	14	CHECKRAIL BOLTS	H.T.S.	"
8	14	CHECKRAIL WASHERS	C.S.	"
9	14	CHECKRAIL LOCKWASHERS	"	"
10	1	L.H. STOCKRAIL	60 kg RAIL	SEE DIAGRAM
11	1	L.H. SWITCH	"	"
12	1	R.H. SWITCH	"	"
13	1	R.H. STOCKRAIL	"	"
14	26	RAIL BRACE TYPE 5	M.I.	DRG.No/207-549
15	26	RAIL BRACE BOLTS	H.T.S.	DRG.No/91-170
16	32	STANDARD PLATES	M.S.	SEE LIST
17	2	HEEL BLOCK A (COMPLETE)	"	DRG.No/207-516
18	2	HEEL BLOCK B (COMPLETE)	"	"
19	74	NIB BOLTS	H.T.S.	DRG.No/205A-370
20	840	SCREWS/PINIES	"	DRG.No/205A-374
21	6	CHAIR BOLTS	"	DRG.No/91-197
22	56	FISH-BOLTS	"	DRG.No/205A-323
23	28	FISHPLATES	M.S.	AS1085 PART 2
24	66	TIMBERS	"	SEE LIST
25	212	PANDROL PLATES	M.S.	SEE LIST
26	396	PANDROL CLIPS	S.S.	TYPE E2003

Figure 94 – Material list

PANDROL BASEPLATES (27)			
DESCRIPTION	REQ'D	MAT'L	REMARKS
SPC 3 S	2	M. S.	DRG No CV 0133871
SPC 4 S	6	"	"
SPC 8 S	12	"	"
SPC 7 S	6	"	"
SPC 9 S	2	"	"
DPC 1 S	2	"	DRG No CV 0133870
DPC 2 S	8	"	"
DPC 3 S	6	"	"
DPC 4 S	12	"	"
DPC 5 S	6	"	"
DPC 6 S	6	"	"
PCRS	14	"	DRG No CV 0164935
4855	118	"	ISP36485
4875	4	"	ISP36487
4885	4	"	ISP36488
4895	4	"	ISP36489

Figure 95 – Pandrol base plates

TIMBERS		
TIMBER C/SECT.	LENGTH	REQ'D
250 X 150	2800	20 米
	3000	7
	3200	5
	3600	4
	3800	4
	3800	1
	4000	-
	4200	2
	4400	3
	4600	3
250 X 180	4600	4
	5000	3
	3800	3
	4000	4
FOR SWITCH MACHINE	4200	1
	3900 (UNSCARFED)	2

Figure 96 – Timber bearer details

CLOSURES ②			
CLOSURE	LENGTH	RADIUS	MID-ORD
A	11400	501.838	32
D	12804	784.147	26
F	12810	592.273	41
H	11600	783.712	21

Figure 97 - Closure details

HEELBLOCK DIMENSIONS		
	BLOCK A	BLOCK B
NARROW END	216	261
WIDE END	228	289

THESE DIMENSIONS ARE FROM GAUGE FACE TO GAUGE FACE.

Figure 98 – Heelblock dimensions

STANDARD PLATES (16)			
DESCRIPTION	REQ'D	MAT'L	REMARKS
RBP 129	4	M.S.	DRG No 205A-354
RBP 180	22	"	DRG No 205A-355
LONG DSO CHAIR	6	"	DRG No 197-312

Figure 99 – Standard plate dimensions

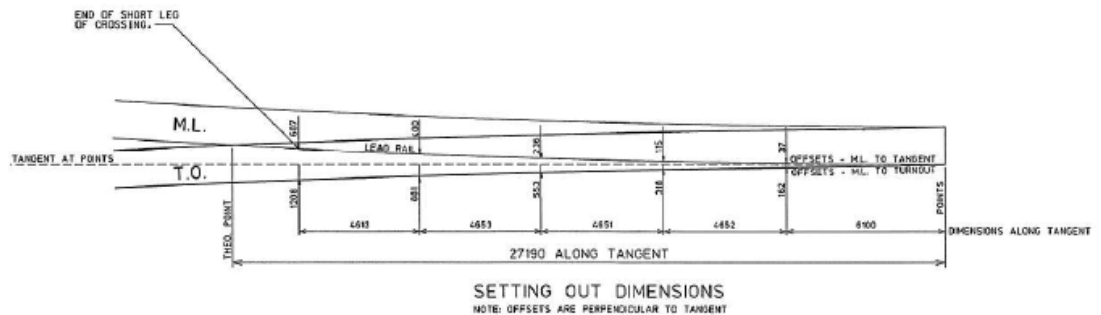


Figure 100 – Setting out dimensions for turnout steelwork

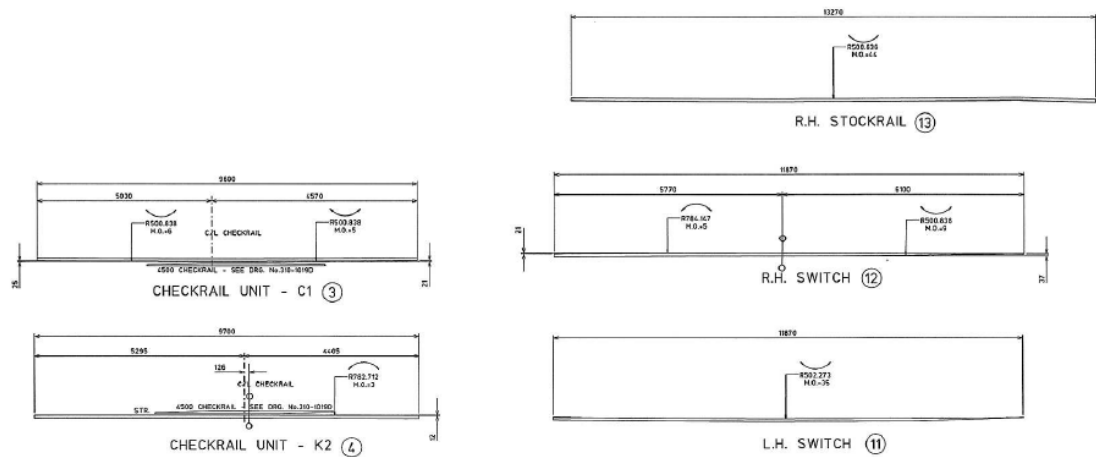


Figure 101 – Switch, stockrail and checkrail details

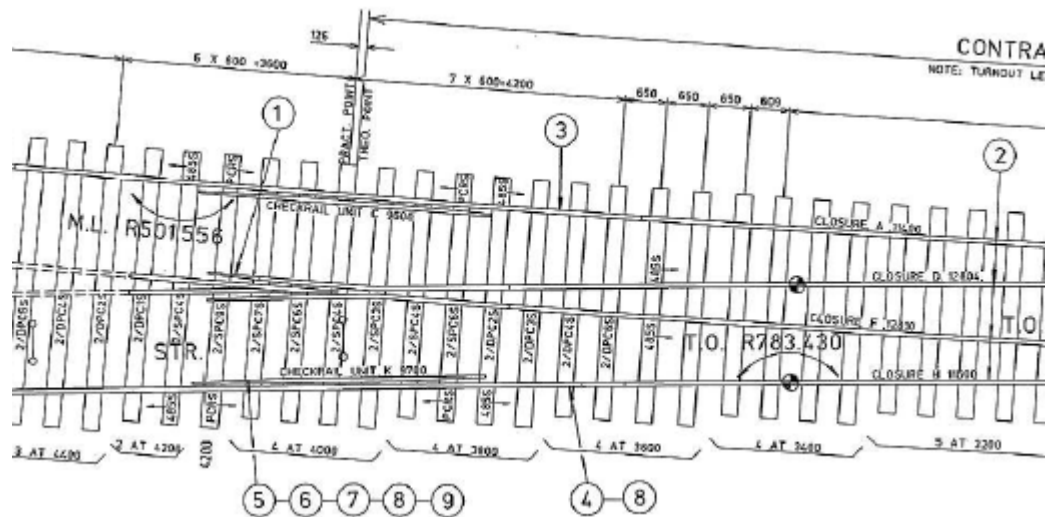


Figure 102 – Closure and checkrail carrier details

Component drawings general requirements

The following are the minimum general requirements for component drawings:

- components should be preferably drawn on A3 sheets
- the scale of the component drawing should be appropriate for the amount of detail being shown
- the component drawing dimensions shall be expressed in mm

Component drawing content

The following drawing content should be included in component drawings, as required:

- general arrangement showing plan, elevation, end elevation and sections as required to fully detail the component
- assembly drawings and procedures

- material specifications and finishes
- welding procedures
- general shape and orientation, and a full listing of coordinates for concrete bearer inserts
- relevant notes and references

9.6.4. Cross-section drawings

Cross-sections are generally drawn perpendicular to the track centreline, and are viewed in the direction of increasing metrage, or in the direction of flow in the case of waterway cross-sections.

Cross-section drawings general requirements

The following should be considered for cross-section drawings:

- cross-section drawings should be drawn on standard A1 sheets
- the preferable scale for cross-section drawings is 1:100; however 1:200 can be used

Cross-sections shall commence at the bottom left side of the drawing sheet, then be drawn upwards in increasing metrage order, keeping the offset origin of each section vertically above each other (where possible).

Drawing content for cross-section drawings

The following are the minimum drawing content requirements for cross-section drawings:

- each cross-section shall have a kilometrage label placed beneath the offset origin
- datum level should be shown on each cross-section
- offset origin should be zero, being either the proposed design centreline or the existing track centreline
- offset distances to the left and right of the offset origin shall have negative and positive values respectively
- features shall be indicated and labelled
- the approximate railway boundary or fence line should be shown
- railway tracks should be labelled
- existing rail or sleeper profiles should be shown

Cross-sections showing the design proposals should include the following details:

- proposed rail or sleeper profile
- proposed track design centreline labelled

- proposed design rail level and superelevation
- proposed design formation
- areas and volumes calculated to earthworks level, if required
- cross-section showing batter slopes, ballast profile, capping layer and all associated dimensions
- cross-section should be referenced facing away from Sydney, with DOWN on the left

10. Civil CAD requirements

The civil CAD requirements are applicable to the civil and structural drawings produced for TfNSW rail projects. These requirements shall be read in conjunction with the general requirements in Section 6 of this standard.

Where conflict exists between the two sections, then the civil and structural drawing requirements shall take precedence over the general requirements unless the general requirements expressly states otherwise.

10.1. Title block for civil drawings

Civil design drawings shall use the drawing title block as explained in Section 7.1 of this standard. Figure 103 shows an example of a completed title block for civil design drawings.

PENNANT HILLS			
MAIN NORTH LINE - 28.600km			
EPPING TO THORNLEIGH THIRD TRACK			
CHELTENHAM ROAD OVERBRIDGE UPGRADE			
CONCRETE DETAILS			
FILE No. 2013/14574	SHEET: 1 OF 4	A1	
STATUS: AS BUILT			©
DRG No.	EDMS No.		
ETTT-2001-ST-164587	0 CV1234567	B	

DF 801*554

Figure 103 - Sample completed drawing detail box for civil drawings

10.2. Cell library for civil and structural drawings

For geotechnical patterns, the geotechnical.cel cell library should be used on civil and structural drawings.

This cell can be obtained by downloading the resource file and opening the cell library. This file is available for download from the ASA website.

10.3. Types of civil and structural design drawings

Based on the design content, the civil and structural design drawings are classified into the following drawing types:

- abutments
- alignment
- architectural detail
- bar shape diagrams
- civil works
- concept design
- concrete details
- cross-sections
- cover sheet
- details
- details and sections
- foundation
- general arrangement
- layout
- marking plan
- miscellaneous details
- notes
- options
- precast concrete details
- precast reinforced concrete details
- precast reinforcement details
- reinforced concrete details
- reinforcement details
- sections
- setting out details
- steelwork details

- steelwork fabrication
- structure diagrams
- suggested construction sequence

The list of types of drawings is based on the drawing contents.

The drawing type name should be populated in tag 'tbDetail3' of the detail box in the title block.

10.4. Structural steelwork drawings

Section 10.4.1 through to Section 10.4.9 provides the structural steelwork design requirements and fabrication drawing requirements along with the reference letters used in structural steelwork.

10.4.1. Designation of steel sections

For the designation of rolled steel sections, reference letters should be used in conjunction with critical dimensions of the section to identify the product and refer to the required length in millimetres, which is given at the end. The reference letters and examples of steel sections are provided in Table 23 and Table 24.

Table 23 - Steel section reference letters

Section	Reference letters
Universal beam	UB
Universal column	UC
Welded beam	WB
Welded column	WC
Angle (equal, unequal)	EA, UA
Channel (parallel flange)	PFC
Square hollow section	SHS
Rectangular hollow section	RHS
Circular hollow section	CHS
Taper flange beam	TFB
Plate	PL
Flat	FL

Table 24 – Steel section examples

Section	Notation
Universal beam	Nominal depth x mass per metre x length (530 UB 92x3000)

Section	Notation
Universal column	Nominal depth x mass per metre x length
Welded beam	(310 UC 158x3000)
Welded column	Nominal depth x mass per metre x length
	(1200 WB 455x15000)
	Nominal depth x mass per metre x length
	(350 WC 197x6000)
Equal angle	Size of legs x thickness x length (75x75x10 EAx3000)
Unequal angle	Size of long leg x short leg x thickness x length
	(150x100x10 UAx3000)
Channel	Depth x length (380 PFCx3000)
Square hollow section	Size of sides x thickness x length (75x75x4.0 SHSx3000)
Rectangular hollow section	Size of long side x short side x thickness x length
	(125x50x4.0xRHSx3000)
Circular hollow section	Outside diameter x thickness x length (76 ODx3.2 CHSx3000)
Taper flange beam	Depth x length (125 TFBx3000)
Plate	Width x thickness x length (100x12 PLx300)
Flat	Width x thickness x length (100x12 FLx300)
Pipe	Nominal bore (40 NB)

10.4.2. Welding symbols

The type, size and position details of basic welds shall be represented as symbols on the drawings. These symbols shall be in accordance with AS 1101.3 *Graphical symbols for general engineering - Welding and non-destructive examination* and are available in the civil design cell library published on the ASA website.

10.4.3. Steelwork marking plans

A marking plan shows the arrangement of structural members in diagrammatical form and is also used as the starting point from which detail drawings are developed. It should show the overall form and dimensions of a structure, member sizes, levels, existing or adjacent members and any future extensions. The marking plans should be drawn to scale without minute details. A single line for each member is sufficient. For smaller structures, the marking plan may be included with the detail drawings.

Design particulars of columns in a building should be shown on a column schedule. The schedule shall include sizes of members, base plate sizes, portions of splices and levels. Any future extension details should be shown in dotted line.

10.4.4. Marking of members

The marking plans serve as key diagrams to the structure and they record the identification marks of the members. As a rule, the identification marks shall use the prefixes that are shown in Table 25.

Table 25 – Steelwork marking prefixes

Member	Prefix	Member	Prefix
Beams	B	Roof bracing	RB
Columns	C	Stringers	S
Crane beam	CB	Ties	T
Girts	G	Trusses	TR
Purlins	P	Vertical (wall) bracing	VB
Rafter	R	Walkways (platform) channels	PC

The numbering of identification marks shall start from the top left corner of the marking plan. Alternatively, in larger buildings, the floor beam marks may be prefixed with different letters for each floor, starting from the lowest floor that is A, then B, C, and so on.

The steelwork sections shall be shown in a table on the marking plan, comprising three columns, such as item, mark and section. If the marking plan has to be shown on several sheets, this table should appear on only one sheet.

Orientation of members made of angle or channel sections shall be clearly shown on the marking plan.

10.4.5. Detail set outs

Before starting the detail drawings, the set outs should be prepared for connections, panel points, and so on.

The set outs shall be set to large scale to enable the scaling of dimensions to the required accuracy. The set outs shall be used to determine the shape and size of gusset plates, the location of bolts and the clearance between members. For simple rectangular joints, which can be computed easily and accurately, the preparation of set outs is not necessary.

10.4.6. Steelwork details

Unless special conditions require otherwise, multiple columns shall be drawn lengthwise with the lower end to the left.

The angles and channels should be drawn with the flanges down, and the thickness shown by short dashed line.

The views of beam endplates shall be shown only when the information cannot be conveyed with notes.

If a frame or member is symmetrical or nearly so about its centre line, only one-half of the frame or member with a note 'symmetrical about centre line' or 'symmetrical about centre line except where noted' may be shown. In such cases, the left half of the frame or member is usually shown and shall be extended slightly beyond the centre line to show that the frame or member does not end at the centre line.

In a view of one side of a heavy truss member or latticed column, only the bracing or lacing on the face depicted shall be shown. All other bracing and lacing is omitted and such omission should be covered by an appropriate note. Tubular members should be shown as outline only and the tube thickness should be indicated by a note.

Filled holes in a steelwork assembly indicate bolt locations. Similarly, filled holes in a member indicate holes for bolts. Unfilled holes indicate holes for purposes other than bolting; for example, drain holes for galvanising.

The bolt hole sizes shall be as follows:

- for bolts up to and including 24 mm diameter, 2 mm larger than bolt diameter
- for bolts greater than 24 mm diameter, 3 mm larger than bolt diameter

The baseplate holes for holding down bolts shall be in accordance with Table 26.

Table 26 - Baseplate hole sizes

HD bolt size	Baseplate hole size
up to M24	bolt dia + 6 mm
M24 - M36	bolt dia + 10 mm
M36 - M48	bolt dia + 12 mm
M48 and larger	bolt dia + 20 mm

10.4.7. Marking of steelwork details

The instructions for marking of members to facilitate erection shall be shown preferably on the flanges. Unless the member is symmetrical, it shall be fully orientated. For example,

MARK – 'NORTH'

MARK – 'TOP'

The identification mark of each member should be positioned on the drawing below the member. Examples of identification marks are as follows:

MARK A1 – 1 REQ'D – AS DRAWN

MARK A2 – 1 REQ'D – OPP HAND AS NOTED

Opposite hand noting should be used with caution unless the component is opposite hand in all aspects.

Monorail beams shall be marked on the web in capital letters at least 75 mm high. For example,
MARK – 'MAXIMUM LOAD NOT TO EXCEED TWO (2) TONNE –
CLASS No. 2 – MONORAIL No. MR1'

10.4.8. Steelwork connections

For welded connections, the category of weld such as SP or GP, and the extent of examination shall be included in the drawing notes; for example, all welds to be category SP, extent of visual inspection 100%, non-destructive testing 10%. The weld preparation for any site welds shall be shown where necessary.

For bolted connections, care shall be taken to indicate the type of bolt to be used and to distinguish between different types of bolts and tensioning methods appearing on one drawing, that is, commercial bolts 4.6/S, and high strength bolts 8.8/S, 8.8/TF and 8.8/TB. The holes shall be located on standard gauge lines for structural steel sections. Standard edge distances and pitches shall be used wherever possible.

10.4.9. Allowance for erection clearances

The diagonal length (in plan view) of a beam is usually shorter than the face-to-face distance between supporting members, sufficient to avoid forcing the beam into position.

However, because the beam is relatively short or wide connection details are required, the diagonal length may exceed the face-to-face distance in such a way that the connection at one end should be shipped loose, or the length of the beam should be shortened.

A study shall be conducted to determine the clearance available for erecting beams of this type. The maximum diagonal length of the beam shall be about 3 mm less than the face-to-face distance between column or girder web. It should also clear any obstructions, such as cleats or stiffeners; otherwise, the obstructing detail shall be shipped loose.

10.5. Reinforcement drawings

The reinforcement drawings show the location, grade, diameter and the number of reinforcement bars in the structure. They shall also show sufficient additional information to enable the bars to be cut, bent and placed in the positions required by the design. The aim shall be to produce a drawing, which clearly indicates the exact intentions of the designer, bearing in mind the problems, which may be encountered during bending and placing of the bars and placing of concrete. The drawings shall also show locations and types of all embedded items such as lifting hooks, ferrules, conduits and HD bolts.

10.5.1. Layout of drawing

Each group of bars (except for straight bars) shall be shown in at least two views. The bars shall be drawn to scale lengthways and in their correct position (except where some displacement is required to separate adjacent bars for clarity). An exploded view can be used to detail heavily reinforced structures. All bars, both near face and far face, shall be drawn as solid line and not as dashed line.

Concrete outlines and other outlines used on a reinforcement drawing shall be drawn to scale. Concrete dimensions and other concrete details are not required if already shown elsewhere. When pipes or other embedded items are cut in section on a reinforcement drawing, they should be drawn to scale, but without dimensions. All joints in the concrete shall be shown on the reinforcement drawing.

10.5.2. Bar detailing

Leaders accompanying bar notations shall be drawn as shown in Figure 104.

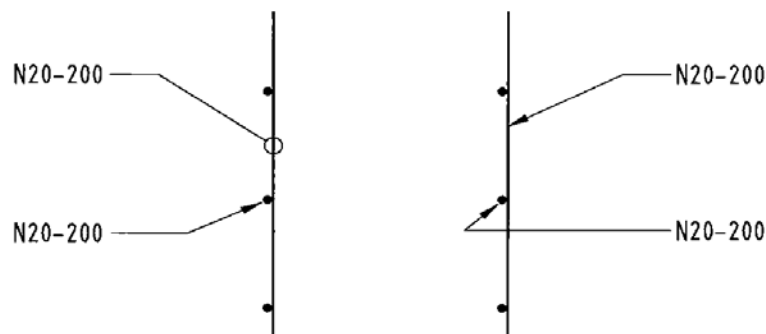


Figure 104 – Leaders for bar notations

10.5.3. Bar notation

Every bar or group of bars shall be identified by means of a notation in the following order:

- number of bars in the group
- bar mark
- bar grade and diameter
- centre to centre spacing

Either the number or spacing information may be omitted if necessary, but not both.

Some examples of the notation are as follows:

- 4/S1 N24-150

- 4/S1 N24
- S1 N24-150

Alternatively, when the reinforcement drawing is not complex, the bar mark may be omitted. The notation would be as follows:

- 4/N24-150
- 4/N24
- N24-150

The full bar notation, using any of the types mentioned in the examples, shall be shown once only and this shall occur on the view in which the extent lines are shown. On all other views only the bar mark, for example 'S1', or (if there is no bar mark) the bar diameter, for example 'N24', shall be used to identify bars. If there are no extent lines, the full bar notation shall be shown on the view in which the shape and location of the bar is most clearly shown.

10.5.4. Reinforcement laps and cogs

The laps and cogs shall be noted or dimensioned on the reinforcement drawing. Where all laps or cogs are the same, a description provided in the notes would be sufficient.

For example, 'All laps to be 500 mm unless noted otherwise. Cogs are similar.'

If laps or cogs vary across the drawing, then they shall either be all dimensioned or alternatively all covered in the bar notation. Examples of bar notation for laps or cogs are as follows:

S1 N24-200 tied to T1 N12-400 LAP 500

L1 N24-200 COG 300

10.5.5. Steel location abbreviations

Table 27 shows the abbreviations that are used to show the location of reinforcement. These abbreviations should be included at the end of the bar notation, separated by a dash or in parentheses; for example, 4/N24-150 T&B.

Table 27 - Abbreviations for reinforcement location

Description	Abbreviation
Bottom	B
Centrally placed	CP
Each face	EF
Each way	EW
Far face	FF
Near face	NF

Description	Abbreviation
Top	T

10.5.6. Steel mesh

Where welded wire mesh is used, the extent of the mesh should be shown and the type of mesh identified with a note such as 'SL62'. Each wire should be shown as a heavy line with sufficient details to indicate the direction in which the main longitudinal wires shall lie. Examples of steel fabric details are given in Figure 105. The mesh in the section may be shown as a dashed line (small scale) or solid lines with filled circles representing main wires.

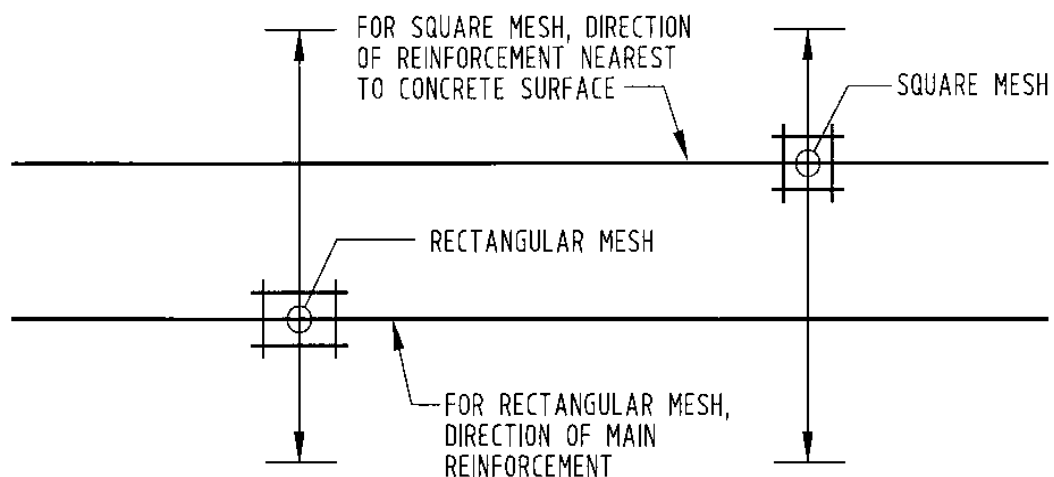


Figure 105 - Steel mesh

10.6. Precast concrete drawings

Precast concrete units shall be clearly identified, particularly when shown on the same drawing as cast in-situ concrete elements. The mass for each unit shall be mentioned.

For heavily loaded structures, the reinforcement pattern shall provide for all openings or blockouts as designed by the engineer. For walls and lightly loaded slabs in which openings are common, the adjacent main reinforcement need not be specially detailed. A note indicating that reinforcement should be moved or cut on site should be provided. For larger openings, additional steel trimmers shall be provided around the opening irrespective of whether the main reinforcement pattern has been altered to suit.

10.7. Order of sheets in a set

The order of the sheets in a set of drawings shall follow the logical order of the construction procedure of the structure.

10.7.1. Bridge drawings

A set of bridge drawings should be in the following sequence:

- cover sheet
- general arrangement
- general notes (where required)
- construction details (where required)
- setting out and piles
- abutments (new abutment, new abutment headstocks, or strengthening)
- abutment concrete
- abutment reinforcement
- piers (new pier, new pier headstocks, or strengthening)
- pier concrete
- pier reinforcement
- girders (steel / pre-stressed concrete (PSC) / re-inforced concrete (RC))
- girder reinforcement (PSC / RC)
- bearings
- approach slabs
- traffic barriers
- pedestrian barriers
- walkways
- miscellaneous (for example, fabrication, miscellaneous items and so on)
- associated drawings
- electrical safety screens
- survey cross-sections
- detail site survey

10.7.2. Station platform drawings

A set of station platform drawings should be in the following sequence:

- cover sheet
- general arrangement

- general notes (where required)
- setting out details
- concrete details
- precast concrete details (if using precast elements)
- miscellaneous details
- services

10.7.3. Overhead wiring structure drawings

A set of overhead wiring structure drawings should be in the following sequence:

- structure diagram
- steelwork details
- miscellaneous details

11. Detailed Site Survey CAD requirements

The Detailed Site Survey (DSS) CAD requirements define the standard codes and equivalent CAD layer numbers, which represent services and their installation type within the rail corridor. These codes and layer numbers should be used as the basis for classification of services and their construction method in CAD file format. The data is collected via field survey, transformed into a DSS compliant CAD file and finally imported into Sydney Trains' Geographic Information System (GIS).

The DSS CAD requirements shall be read in conjunction with the general requirements in Section 6 of this standard. Where conflict exists between the two sections, then the DSS CAD requirements take precedence over the general requirements unless the general requirements expressly states otherwise.

The services data surveyed relates to the underground and above ground utility type services and is defined as 3D vector data with coordinated xyz locations obtained by survey methods.

The services data is required to be compatible with the MicroStation or AutoCAD applications and the Corporate GIS (small world platform).

The DSS CAD requirements stated in this standard do not replace EP 20 00 04 06 SP *Underground Cable - Location Recording* which applies to newly installed high voltage ac and 1500 V dc traction cables. EP 20 00 04 06 SP requires additional information and includes time restraints for the survey of this high-risk cable route, which may be collected prior to backfilling during physical works.

The existing high voltage services do not have to be captured according to EP 20 00 04 06 SP; however, they should be collected using this standard.

Refer to SMS-06-GD-0268 *Working Around Electrical Equipment* for precautions to be observed when working around electrical equipment.

Refer to the following documents for more information:

- AS 4799 *Installation of underground utility services and pipelines within railway boundaries*
- AS 5488 *Classification of Subsurface Utility Information (SUI)*
- PR A 00492 *Data Capture Procedure*
- PR A 00493 *Scope Procedure*
- PR A 00494 *Work as Executed Procedure*
- PR A 00495 *Infrastructure Services Data Policy*
- SP A 00496 *Specification for Collection of Services Data*
- GL A 00511 *Plan Symbols and Interpretation Guidelines*
- SMS-06-GD-1574 *Managing Construction Hazards*

11.1. Application of DSS CAD requirements

DSS CAD requirements apply to assets related to the metropolitan rail network only.

11.2. Title block for DSS drawings

The DSS drawings shall use the drawing title block as shown in Figure 106.

Section 7 of this standard explains all the smart tags in the title block that are common to all disciplines. The smart tags that are specific to DSS are explained in this section.

The preferred size for DSS drawings is A3.

1	2	3	4	5	6
AMENDMENT BOX TO BE REMOVED WHEN COLOURS ARE NOT USED DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR DRAWING DETAILS BOX			Transport for NSW NSW GOVERNMENT Plan accepted for use by Sydney Trains Drawn by: Checked by: Surveyed by: Approved by: Date: Date: LOCALITY Locality: Detail 1: Detail 2: Details:		
DESCRIPTION HEADING: DATE:			LOCALITY Locality: Detail 1: Detail 2: Details:		
COORDINATES HEADING: DATE:			LOCALITY Locality: Detail 1: Detail 2: Details:		
COORDINATES HEADING: DATE:			LOCALITY Locality: Detail 1: Detail 2: Details:		
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COORDINATES HEADING: DATE:			LOCALITY Locality: Detail 1: Detail 2: Details:		
COORDINATES HEADING: DATE:			LOCALITY		

Figure 106 - Typical title block for DSS drawings

11.2.1. Drawing details box for DSS drawings

The fields present in the drawing details box are explained in Section 7.1.1 of this standard. The reference number is an additional field that is specific to DSS and is shown in Figure 107.

Table 28 provides the details and the requirements pertaining to the additional field.

Figure 107 - Drawing detail box – DSS Drawing

Table 28 - Drawing detail box on a DSS Drawing

No.	Field Name	Tag	Requirements
15	Reference Number	tbRefnNo	This is the reference to the survey or the drawing file naming system.

11.2.2. Sign-off box for DSS drawings

The sign-off box for the DSS drawing shall contain signatures, last name and date of signature of the person who performed the tasks including drawn, surveyor, survey checked, services checked, drawing checked and approval of the drawing for release.

Figure 108 shows a sample sign-off box for DSS drawings.

Figure 108 – Drawing sign-off box – DSS drawing

Table 29 provides a list of the field names in the sign-off box of the DSS drawing and their requirements.

Note: Where the first name of the person is too long to fit within the space provided in the sign-off box, the first initial and last name of the person is acceptable.

Table 29 - Sign-off box on a typical DSS drawing sheet

No.	Field name	Tag	Requirements
1	Drawn by (Name)	tbDrwnName	Include the full name of the drafts person.
2	Drawn date	tbDrwnDate	Include the date of sign-off by the drafts person.
3	Surveyor (Name)	tbSurvName	Include the full name of the surveyor who surveyed the area.
4	Designed date	tbSurvDate	Include the date of sign-off by the surveyor.
5	Survey checked by (Name)	tbSurChkName	Include the full name of the person who checked the survey information.
6	Survey checked date	tbSurChkDate	Include the date of sign-off by the survey checker.
7	Services checked by (Name)	tbSerChkName	Include the full name of the person representing the operator and maintainer who checked the services shown on the drawing.
8	Services checked date	tbSerChkDate	Include the date of sign-off by the services checker.
9	Drawing checked by (Name)	tbDrgChkName	Include the full name of the person representing the operator and maintainer who checked the drawing.
10	Drawing checked date	tbDrgChkDate	Include the date of sign-off by the drawing checker.
11	Approver (Name)	tbApprName	Include the full name of the person representing the operator and maintainer who approved the design to be released.
12	Approved date	tbApprDate	Include the date of sign-off by the design approver.
13	Design discipline	tbDiscipline	Include the design discipline for the drawing.
14	Surveyor company name	tbAEOSuppName	Include the name of the surveyor company.
15	Plan accepted for use by Sydney Trains	tbAccpName	Include the full name of the person who approved the plan for use by Sydney Trains.
16	Plan accepted for use by Sydney Trains date	tbAccpDate	Include the date of sign off by the person who approved the plan for use by Sydney Trains.

11.3. Accurate field drawings

The accurate field drawings are intended to show the location of all underground services with all changes of direction or deviations clearly dimensioned from reference points. These drawings are created as sketches by the surveyor working on site. The accurate field drawings should be submitted to the DSS office. These drawings do not have an EDMS number.

The field drawings should include the following information:

- the location of all rail signalling, communication and power cables
- line-side equipment including, but not limited to, signals, train stops, points, catch points, insulated rail joints, warning lights, guards indicators, ground frames, releasing switches, points indicators, level crossings lights and boom posts
- the location of all creek, road, rail and river crossings, underbridges, overbridges, tunnels, platforms, platform ramps, canals, viaducts, drains, culverts, railway cuttings and embankments, retaining walls
- the location of all rail access roads and public level crossings
- the location of all telecommunications equipment such as telephones and exchanges including all external telecommunication suppliers
- the location of external services such as water, sewerage, stormwater drains, gas mains, communications cables, underground power authority cables and any overhead wires
- the location of boundary fences and any internal fences
- the location of rails and overhead wiring structure (OHWS)
- the location of points and crossings

The type and size of all underground services shall be accurately identified so that appropriate control measures are implemented in accordance with the mandatory requirements specified by the utility owner.

If a service is unable to be located accurately, the service shall be clearly marked as unlocated and unsurveyed on the drawing.

This is done by adding the suffix 'U' to the route number (for example, **--16U--**). 'U' routes should only be used when absolutely necessary.

If a service is redundant but its origin is known, then add the suffix 'R' to the route number (for example, **--20R--**).

Unknown redundant services or abandoned routes are shown as **--85--**.

Accuracy of depths for buried services should be shown in accordance with Section 10.4.4 (for example, 1.3A for direct measured depth, 1.3B for electronically measured depth or C for unknown depth).

If all depths on a field drawing are obtained by one method, then an appropriate notation on the face of the drawing should be stated.

11.3.1. Accurate field drawing preparation

All field drawings should be drawn using A3 DSS field drawing form.

The detailed areas shall be drawn in a decipherable way.

All sections should be completed with relevant information including DSS project name, sheet number, file number, start Kms, finish Kms, supervisor name or names, survey company and staff names, and warning details.

Each drawing sheet shall be signed and dated by the person responsible.

All field drawings should be submitted to the DSS office for updating or creating the CAD equivalent survey plans.

The field drawings should be oriented with Sydney on the left while cross-section views should be drawn with the DOWN side to the left (that is, Sydney at back).

Where base plans are provided, base information shall be verified or deleted if no longer present.

11.3.2. Accurate field drawings colour coding

The accurate field drawings shall be colour coded in accordance with Section 11.11.

11.3.3. Dimensioning

The field drawings should be fully dimensioned to show the location of the following:

- underground services
- underline crossings (ULX)
- under road crossings (URX)
- station buildings
- power poles
- signal boxes
- relay rooms
- housings

- location cases
- line-side equipment

Bends or deviations in underground services shall be located by dimensions from adjacent reference points as listed above.

11.3.4. Asset identification number

The TfNSW rail assets bearing identification numbers shall have their numbers shown on all the field drawings. Such assets include, but are not limited to, OHWS, pits, culverts, access gates, points and feeder numbers.

11.3.5. Field measurement

The information collected shall be sufficient for defining the location of services in three dimensions where possible.

Figure 109 shows the field measurement methods.

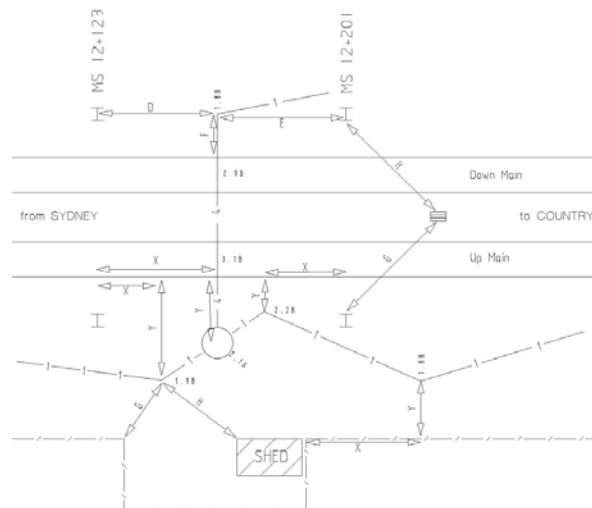


Figure 109 - Field measurement methods

Kilometrage and offset

The kilometrage and offset method should be used for parallel services. Measurements from the nearest OHWS along the nearest rail (X) combined with an offset distance from the rail running face (Y) can be used to locate bends between mast structures. It can also be used along and square to fences. The offset measurement should be square to straight track and radial to curved track. Refer to Figure 109.

Offsets from each OHWS may be added, even if there is no bend at that location.

Intersecting distances

Two distance dimensions also uniquely define a point. The best results are obtained when the angle between the distances is approaching a right angle as shown in Figure 109 (G and H).

Two distances measured to adjacent OHWS in opposite directions do not provide a good result (D and E) and require an extra dimension (F) for a solution as shown in Figure 109.

Depth

Depth measurements for under track installations shall be related to the low rail if possible. A measurement at each ballast toe and the centreline of tracks is sufficient. The depths of parallel services can be measured relative to the survey pins on the OHWS or any other features with height shown on DSS plans.

Where services are distant from points of known height, a dumpy level may be used to determine the heights of services. Staff should be appropriately trained to use and maintain this equipment before implementing this method.

11.3.6. Service route numbers

Internal and external agency services shall be defined using route or layer numbers listed in Section 11.5.

11.3.7. Symbols for DSS drawing

Figure 110 and Figure 111 shows the symbols that shall be used in the DSS drawings and DSS field drawings.

					
1 Air Equipment	6 Antenna	8 Telephone	12 Drainage Pit	13 Drainage Inspection Pit (Flush Point)	16 Junction Box
					
17 Negative Bus Bar	28 Bollard	32 High Pressure Oil Marker	36 High Pressure Gas Marker	39 Gas Equipment	52 Large Round Pit (Rad >1.5m)
					
53 Large Square Pit (Sides >1.5m)	54 Cable Marker	57 Sign	58 Km - 1/2 Km Post	61 Anchor Block	63 O/H Structure
					
72 Small Pit (<1.5m)	73 Optic Fibre Marker	77 Light	79 Power Pole	80 Electric Light Pole	81 Power & Light Pole
					
82 Power & Transformer Pole	86 Sewer Pit	88 Sewer Vent Pipe	89 Small Location	92 Impedance Bond	94 Railway Tuning Unit

Figure 110 – DSS drawing symbols - 1

					
96 Railway Warning Light	97 Points Equipment	98 Train Stop	99 Mechanical Points Lever	100 Surface Feeder Cable	101 Railway Signal
					
102 Railway Level Crossing	103 Buffer Stop	112 Survey Mark	116 Transponder	118 Telstra Distribution Pillar	132 Earth Terminal
					
133 Water Hydrant	134 Water Meter	135 Water Tap	137 Stop Valve	138 Points Indicator	139 Guards Indicator
					
140 Transformer	145 Gas Pipeline Marker	146 Boot Leg Riser	154 Stay Pole	157 Ticketing Machine	159 CCTV Camera
					
160 Track Side Equipment	161 Headwall	177 Telstra Cable Marker			

Figure 111 – DSS drawing symbols – 2

11.3.8. DSS accurate field drawing form

Figure 112 shows a sample DSS accurate field drawing template. This template is available for download from the ASA website.

Mammals (Internal & External Services) Please tick																											
1	2	3	4	5	6	7	8	9	10	11	12	13															
14	15	16	17	18	19	20	21	22	23	24	25	26															
27	28																										
other:																											
Unlocated "U" Services : (please note rule codes, as drawn on sheet)																											

DSS Project Name														Date		Sheet #		of	
File #														Km		Km		Line	
														From		To			
Supervisors														Name		Signature		Name	
Surveyors														Name		Signature		Signature	
														Company				Name/s	
Detailed Site Survey														Ph 02 4902 9099		P.O.Box 157, Islington NSW 2236			

Figure 112 – DSS accurate field drawing form

11.4. Collection of services data by survey

DSS plans provide an accurate representation of rail services and external agency services. They can be used to identify buried hazards, identify service owners, as base information for design and as a base for providing work as executed information.

The methodologies set out in Section 11.4.1 through to Section 11.4.5 should be applied to the following scenarios:

- collection of services data for the preparation of DSS plans
- collection of work as executed data for the update or preparation of DSS plans
- collection of services data to be directly loaded into the corporate GIS
- internal services search where a digital model is required

11.4.1. Survey features and precision

The surveyed features from the selected above ground and underground services data is required for the preparation of base CAD design models and GIS images.

The feature data shall be plotted, either in the form of a string element for linear features or point cell for random single shot features within the CAD and GIS applications.

The semi-major axis of the error ellipse relative to the rail survey control for the coordinated positions shall be 50 mm or less at the 95% confidence level.

11.4.2. Survey control

The coordinate system used shall be either ISG or MGA in conjunction with AHD. The location of survey control marks used shall be plotted where they are within or adjacent to the area of survey.

The control information shall be provided by Sydney Trains.

The control values adopted shall be specified on the cover sheet of the plans.

Any control that is not supplied by Sydney Trains may be used if it is proven consistent with the supplied dataset, or sufficient data is collected to model differences between the coordinate data.

In areas with CORSnet coverage, GPS corrections may be used, if sufficient rail survey control marks are checked to eliminate or model differences between coordinate data.

Where rail survey control is not available, sufficient observations shall be made in accordance with SPC 211 *Survey*, SPC 212 *Contact Survey* and TMC 212 *Survey* to enable a least squares adjustment of any new control. The dataset shall be connected to the existing survey control network of Sydney Trains, remote from the site, or connected to the established NSW State

Survey Control Network. The DSS survey coordinator shall be consulted where supplementation of the provided control is required.

11.4.3. Extent of survey

The services data capture shall cover the area nominated by the DSS survey coordinator with reference to TMA 0493 *Scope Procedure*. The boundaries of the survey shall be clearly defined.

Longitudinally, that is along the corridor, data capture shall start and finish at a significant reference feature. Generally, this will be an OHWS, but points, signals, kilometre posts, tunnels or bridges may also be used.

Laterally, scope is normally defined as fence-to-fence, unless otherwise stipulated.

11.4.4. Data capture

All positional data shall be recorded electronically.

The attribute data shall be recorded electronically (that is, depth and class).

Global positioning system (GPS) or global navigation satellite system (GNSS) and remote sensing methods are allowed, provided the required precisions are obtained.

Ground truth points for each base station dataset shall be used to verify GPS or GNSS positions.

Aboveground survey feature data

The coordinated location of major above ground features located within the railway corridor including OHWS, buildings, poles, fences, anchors, shall be collected and included in the dataset.

Underground service feature data

The coordinated 3D location of all underground services and associated features located within the rail corridor including, but not limited to, empty ducts, gas lines, electrical cables and telecommunications, shall be captured.

The service attribute information shall be included in the drawing models as tags (dgn) or attributes (dwg) attached to the xyz location to which the attribute refers. Character only type MicroStation tags shall be used. Attribute blocks or tags shall be placed in the same layer as the service identified in accordance with Section 11.6.

The two tags, DEPTH (in metres) and CLASS (an indicator of accuracy) are required. Null values are permitted; 'zero' values indicates a ground surface feature and should not be used as the default value.

The methods for determining the depth have associated accuracies.

The methods should be categorised according to the following classes:

- Class A - validated by direct survey measurement of a potholed or exposed service
- Class B - electronic detection - using appropriate surface location technique or techniques to determine the approximate position of subsurface services in three dimensions
- Class C - correlation of aboveground features and approximate position of subsurface services in two dimensions where depth is unknown or not determined

Where possible, a typical cross-section for each section of the service should be included. This cross-section identifies used and empty ducts, and relative positions of different services in a shared trench.

The service routes shall be located at angles of deviation, major below ground cable joints, termination points and at least every 20 m where the service follows a nominal straight path.

Potholing may be used to accurately determine the position and depth of services. Potholing shall be conducted in accordance with *Work Cover Code of Practice – WC00312, Excavation Work*.

11.4.5. Combined service routes

Where multiple services share a common route, the route shall be located and categorised uniquely in accordance with Section 11.5.

Where required, multiple services shall be shown in cross-section. For overhead lines, this shall take the form of a pole top arrangement.

11.5. Code and layer definitions for services identification

Section 11.5.1 provides standard codes and equivalent CAD layer numbers, which represent services and their installation type. This shall be used as the basis for classification of services and their construction method in the CAD file format.

11.5.1. Route codes and definitions

DSS services data shall be segregated into layers as shown in Table 33 and Table 34.

The information in Table 33 and Table 34 represents layer structure for AutoCAD. The layer names and the number descriptors for MicroStation shall be similar to AutoCAD.

Layer 0 is reserved for the under control area boundary.

Layers 1 to 196 are reserved for Sydney Trains services.

Layer 197 is reserved for large pit polygons.

Layer 198 is reserved for small pit centroids.

Layer 199 is reserved for unknown services or undefined service mixes.

Layers 200 to 299 are reserved for external agency services.

Prefixes and suffixes are not permitted, that is, 4, not 04 or cable4.

Surface feature data shall be segregated into layers defined by 'field data level structure' as defined in Table 30, Table 31 and Table 32.

Table 30 – Sydney Trains services descriptor

Descriptor	Meaning
S	Signal cable
C	Copper communications cable
OF	Optic fibre cable
S&C	Signal cable and copper communications cable
LV	Low voltage power - Voltages less than or equal to 1000 V ac or 1500 V dc
HV	High voltage - Voltages greater than 1000 V ac or 1500 V dc
EB	Electrolysis bond cable
CCTV	Closed circuit television
SD	Station data (Smartcard and miscellaneous data cabling)
DC	1500 V dc system cable
CUL	Culvert
TD	Track drainage
CA	Compressed air
AR	Abandoned route
USM	Un-coded service mix

Table 31 – External agency services descriptor

Descriptor	Meaning
PL33	Electric power cable less than 33 kV
EXT	External agency service (consult asset owner)
PG33	Electric power cable equal to or greater than 33 kV
GLP	Low pressure gas main
GHP	High pressure gas main - secondary main or greater
TLS	Telstra
OPT	Optus
PWL	Powertel
UE	UEComm
VS	Vision Stream
WTR	Water
SWR	Sewer

Descriptor	Meaning
OS	Other service(s)
DRE	Drainage service
RMS	Roads and Maritime Services
NBN	National Broadband Network

Table 32 – Other descriptors

Descriptor	Meaning
CAB	Under control area boundary
PIT	Service pit
E	Earth conductor (Sydney Trains or external agency)
F	Liquid Fuel Line (Sydney Trains or external agency)
U	Unlocated unsurveyed cable (approximate position only)
R	Redundant cable (type known, left in situ)
AG	Above ground
DB	Direct buried
GST	Galvanised steel troughing
GLT	Ground level troughing
P	Ducted pipe
UB	Directional under bore
ARL	Aerial
unknown	Unknown

Table 33 – Layer structure for Sydney Trains services

Colour code	Layer no.	Descriptor	Route type	Layer no.	Descriptor	Route type	Colour code
	0	CAB	-	1	S	DB	
	2	S	GST	3	S	GLT	
	4	S	P	5	C	DB	
	6	C	GST	7	C	GLT	
	8	C	P	9	S&C	DB	
	10	S&C	GST	11	S&C	GLT	
	12	S&C	P	13	OF	DB	
	14	OF	GST	15	OF	GLT	
	16	OF	P	17	LV	DB	
	18	LV	GST	19	LV	GLT	
	20	LV	P	21	HV	DB	
	22	HV	GST	23	HV	GLT	

Colour code	Layer no.	Descriptor	Route type	Layer no.	Descriptor	Route type	Colour code
	24	HV	P	25	S&C, OF	DB	
	26	S&C, OF	GST	27	S&C, OF	GLT	
	28	S&C, OF	P	29	C, OF	DB	
	30	C, OF	GST	31	C, OF	GLT	
	32	C, OF	P	33	OF, LV	DB	
	34	OF, LV	GST	35	OF, LV	GLT	
	36	OF, LV	P	37	OF, HV	DB	
	38	OF, HV	GST	39	OF, HV	GLT	
	40	OF, HV	P	41	S, LV	DB	
	42	S, LV	GST	43	S, LV	GLT	
	44	S, LV	P	45	S, HV	DB	
	46	S, HV	GST	47	S, HV	GLT	
	48	S, HV	P	49	S&C, LV	DB	
	50	S&C, LV	GST	51	S&C, LV	GLT	
	52	S&C, LV	P	53	S&C, HV	DB	
	54	S&C, HV	GST	55	S&C, HV	GLT	
	56	S&C, HV	P	57	S, OF	DB	
	58	S, OF	GST	59	S, OF	GLT	
	60	S, OF	P	61	LV, HV	DB	
	62	LV, HV	GST	63	LV, HV	GLT	
	64	LV, HV	P	65	S&C, OF, LV	DB	
	66	S&C, OF, LV	GST	67	S&C, OF, LV	GLT	
	68	S&C, OF, LV	P	69	S&C, OF, HV	DB	
	70	S&C, OF, HV	GST	71	S&C, OF, HV	GLT	
	72	S&C, OF, HV	P	73	S&C, OF, LV, HV	DB	
	74	S&C, OF, LV, HV	GST	75	S&C, OF, LV, HV	GLT	
	76	S&C, OF, LV, HV	P	77	Do not use	NA	
	78	Do not use	NA	79	CUL	unknown	
	80	TD	unknown	81	Do not use	NA	
	82	Do not use	NA	83	CA	DB	
	84	CA	AG	85	AR	unknown	
	86	S	UB	87	C	UB	
	88	S&C	UB	89	OF	UB	
	90	LV	UB	91	HV	UB	
	92	S&C,OF	UB	93	C,OF	UB	

Colour code	Layer no.	Descriptor	Route type	Layer no.	Descriptor	Route type	Colour code
	94	OF, LV	UB	95	OF, HV	UB	
	96	S, LV	UB	97	S, HV	UB	
	98	S&C, LV	UB	99	S&C, HV	UB	
	100	S, OF	UB	101	LV, HV	UB	
	102	S&C, OF, LV	UB	103	S&C, OF, HV	UB	
	104	S&C, OF, LV, HV	UB	105	LV	ARL	
	106	HV	ARL	107	DC	DB	
	108	DC	GST	109	DC	GLT	
	110	DC	P	111	E	unknown	
	112	EB	unknown	113	CCTV	P	
	114	CCTV	GST	115	CCTV	GLT	
	116	CCTV, C	P	117	CCTV, C	GST	
	118	CCTV, C	GLT	119	CCTV, LV	P	
	120	CCTV, LV	GST	121	CCTV, LV	GLT	
	122	CCTV, C, LV	P	123	CCTV, C, LV	GST	
	124	CCTV, C, LV	GLT	125	SD	P	
	126	SD	GST	127	SD	GLT	
	128	S	ARL	129	C	ARL	
	130	OF	ARL	131	F	unknown	
	132	Vacant	P	133	Vacant	GST	
	134	Vacant	GLT	NA	NA	NA	
	197	PIT (polygon)	n/a	198	PIT (point)	n/a	
	199	USM	unknown	NA	NA	NA	

Table 34 – Layer structure for external agencies services

Colour code	Layer no.	Descriptor	Route type	Layer no.	Descriptor	Route type	Colour code
	200	PL33	EXT	201	PG33	EXT	
	202	GLP	EXT	203	GHP	EXT	
	204	TLS	DB	205	TLS	GST	
	206	TLS	GLT	207	TLS	P	
	208	OPT	DB	209	OPT	GST	
	210	OPT	GLT	211	OPT	P	
	212	PWL	DB	213	PWL	GST	
	214	PWL	GLT	215	PWL	P	
	216	VS	DB	217	VS	GST	

Colour code	Layer no.	Descriptor	Route type	Layer no.	Descriptor	Route type	Colour code
	200	PL33	EXT	201	PG33	EXT	
	218	VS	GLT	219	VS	P	
	220	WTR	unknown	221	SWR	unknown	
	222	OS	DB	223	UE	DB	
	224	OS	GST	225	OS	GLT	
	226	OS	P	227	OS	UB	
	228	OS	unknown	229	TLS	UB	
	230	OPT	UB	231	PWL	UB	
	232	VS	UB	233	PL33	ARL	
	234	PG33	ARL	235	DRE	P	
	236	TLS	ARL	237	OPT	ARL	
	238	PWL	ARL	239	VS	ARL	
	240	OS	ARL	241	OF	ARL	
	242	E	unknown	243	F	unknown	
	244	RTA	P	245	RTA	GST	
	246	RTA	GLT	247	RTA	ARL	
	248	NBN	DB	249	NBN	GST	
	250	NBN	GLT	251	NBN	P	
	252	NBN	ARL	253	NA	NA	
	254	NA	NA	255	NA	NA	

11.6. Redundant services

Redundant services are identified by the suffix 'R' after the route number but should be placed on the layer of origin. For example, a redundant signals cable **–4R–** should be placed on layer 4.

If the origin of a redundant route is unknown, it is called an abandoned route **–85–** and placed on layer 85.

11.7. Un-located or un-surveyed services

Services that are known to be in an area, but are not able to be accurately located or surveyed, are given a 'U' suffix and should be placed on their respective layer. For example, an un-locatable optic fibre cable **–16U–** should be placed on layer 16.

The 'U' signifies that the position of that particular service is approximate only, and should be verified by potholing prior to carrying out any design or excavation works.

11.8. Symbols and cell libraries for DSS drawings

The cell library, DSS.cel, should be used for producing DSS drawings.

This file is available for download from the ASA website. This cell can be obtained by downloading the resource file from the ASA website.

Cells or symbols for all point features shall be drawn using this cell library.

All points along a service route that are captured by survey shall be represented by a cross on layer F-SURV-SYMB. This excludes end points of strings where symbology is available for the feature (for example, pits and signals).

Only one cell or symbol shall be used to represent a surveyed point.

11.8.1. Pits

Pits shall be placed on layer 197 or layer 198 depending on the size.

Large pits

Circular pits with a diameter that is greater than 1.5 m and rectangular pits with a side length that is greater than 1.5 m are classified as large pits, and shall be represented by 'closed' polygons to true scale and shape of the pit. Large pits can also contain a point at the centroid. These pits shall be placed in layer 197.

For large pits, the service routes shall extend at least to the interior of the polygon outlining the pit extremities. The services can connect to the centroid point of the polygon if it exists; however, this is not essential.

Small pits

Pits with a diameter or side length of less than 1.5 m are classified as small pits, and shall be represented by a symbol at the surveyed point on layer 198.

For small pits, the service routes should connect to the point feature, which has the symbol attached.

11.8.2. Headwalls

Headwalls with a face length of less than 1.5 m are classified as small headwalls, and shall be represented by a symbol at the pipe invert. Larger pits shall be plotted to scale. Headwalls shall be placed on layer F-DRAN.

11.9. DSS model files

The model file shall contain the surveyed feature data represented in a 3D vector graphical format. The model file shall contain the surveyed feature data placed on layers, as defined in Section 6.3.2 and Section 11.4 of this standard.

Data should either be string lines (defined as a connected line-string with 3D coordinates at all vertices) or random points (defined by cells/blocks) or polygons.

11.10. DSS drawing files

The DSS drawing files shall be created as detailed in Section 6.3.1 of this standard.

The detailed services plans shall be of A3 size at a scale of 1:250, longitudinally orientated with track direction from Sydney on the left. Where the corridor is too wide to fit on A3 sheets, then A2 sheets or A1 sheets may be used. Refer to Section 6.11 for drawing sheet size.

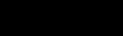
The sheet layout shown on cover sheet(s) shall be plotted at a scale of 1:2000.

Areas of special interest containing condensed services information require plots at a scale of 1:100. If such areas are in the form of diagrams, they shall be delineated and referenced on the main drawing and cover sheet(s).

11.11. Colours for DSS plans

Table 35 provides a list of colours that shall be used on all DSS plans.

Table 35 – Colours for DSS plans

Colour	Sample colour	Description
Black		Existing infrastructure such as fences, buildings, platforms and tracks
Blue		Existing internal (Sydney Trains) services such as signals, communications, electrical, and civil
Green		Existing external agency services such as Telstra, Optus, AGL
Red		Proposed works such as service routes, signals, buildings, level crossings
Pink		Work as executed data identifying infrastructure installed
Orange		Work as executed data identifying infrastructure removed

11.12. Text for DSS drawings

The text fonts provided in DSS seed files shall be used on a DSS drawing.

The text and related linework (that is, leaders and text box information) shall be located on layer F-MISC-TEXT, separate to route layers. The text shall be placed on layers as defined in

Section 6.9 of this standard. For example, stanchion labels for OHWS shall be placed on layer F-OHWS-TEXT.

The height and line weight of the text shall be in accordance with Section 6.6.3 of this standard.

11.13. Line styles for DSS drawings

The line styles for DSS drawings shall match the service route codes listed in Section 11.4. This can be obtained from the DSS CAD template.

Where services overlap and line styles become illegible, text boxes shall be used to clarify route numbers.

Services that cannot be categorised according to standard DSS route codes shall be represented by line style 199 and placed on layer 199 with an explanatory note.

12. Architectural CAD requirements

The architectural CAD requirements are applicable to architectural drawings produced for TfNSW rail projects. These requirements should be read in conjunction with Section 6 of this standard.

Where conflict exists between the two sections, then the architectural CAD requirements shall take precedence over the general requirements unless the general requirements expressly states otherwise.

12.1. Title block for architectural drawings

The architectural drawings shall use the drawing title block as explained in Section 7 of this standard. Figure 113 shows an example of a completed title block for architectural drawings.

QUAKERS HILL RICHMOND LINE - 39.400km TO 39.700km PLATFORM CANOPIES ROOF PLAN AND SECTION ARCHITECTURAL			
FILE No. —	SHEET: 1 OF 3	A1	
STATUS: AS BUILT			
DRG No. ASDC-145678-AR-008	2	EDMS No. CV0123456	B

DF 801*554

Figure 113 - Completed drawing title block for architectural drawings

12.2. Seed files for architectural drawings

Refer to Section 6.10 of this standard for architectural drawings' seed files.

12.3. Level symbology for architectural drawings

Different drawing elements should be drawn on different layers as explained in Section 6.9 of this standard.

12.4. Railway drawing convention

The preparation of architectural drawings for TfNSW shall comply with the following drawing conventions:

- Sydney is always drawn on the left-hand side of the drawing sheet.
- If the work area is adjacent to the running tracks, the tracks should be indicated on the plan. Tracks may be shown as a single thin line, a centreline symbol, or as two thin lines representing the individual rails, depending upon scale and proximity to the work site.
- Other items that can be shown include the following:
 - o railway boundary
 - o road access and adjacent public roads including kerbs, gutters and pavements
 - o railway infrastructure such as overhead wiring masts, signals, power poles, lighting poles, and so on
 - o fences and gates
 - o embankments, cuttings, slopes, and so on
 - o drainage – surface, subsurface, and track related
 - o structure gauge clearances to walls, roofs, and other proposed structures
 - o adjacent property ownership and boundaries

13. Electrical CAD requirements

The electrical CAD requirements apply to electrical drawings that are produced for TfNSW rail projects. These requirements should be read in conjunction with the general requirements in Section 6 of this standard.

Where conflict exists between the two sections, then the electrical CAD requirements take precedence over the general requirements unless the general requirements expressly states otherwise.

13.1. Title block for electrical drawings

Electrical drawings shall use the drawing title block as explained in Section 7.1 of this standard. Figure 114 shows an example of a completed title block for electrical drawings.

LIDCOMBE MAIN SUBURBAN LINE - 15.600km RAILWAYS OVERHEAD WIRING LOCATION MS15 +606 FEEDING ARRANGEMENT			
FILE No. A/03/1235	SHEET: 2 OF 8	A1	
STATUS: CONCEPT DESIGN			©
DRG No. NWRL-145789-EL-002	2	EDMS No. EL1234569	A

DF 801*554

Figure 114 - Sample completed drawing title block for electrical drawings

The following are different electrical job description or categories for electrical drawings:

- railways overhead wiring
- HV aerial lines and cables
- substations
- distribution power supply
- low voltage electrical services
- sectioning huts
- earthing and bonding

The following are some examples of electrical drawing types:

- layout
- general arrangement
- fitting details
- connection diagram
- site plan
- switching arrangement
- cross-section
- schematic diagram
- assembly
- feeding arrangement
- profile
- single line diagram

13.2. Seed files for electrical drawings

The following seed files should be used for creating electrical drawing files (2D drawings with title block):

- EL_model3Dsheetsheet2D_m.dgn
- EL_model3Dsheetsheet2D_mm.dgn

These files are available for download from the ASA website.

13.3. Cell libraries for electrical drawings

The following cell libraries should be used for producing electrical drawings:

- EL_SCHM_AS1102_25M.cel
- EL_OHWiring_V8.cel
- EL_OHWLayout_V8.cel
- EL_Transmission_Line.cel

A complete list of cells can be obtained by downloading the resource files from the ASA website.

13.4. Types of electrical drawings

The electrical design drawings are broadly classified into two types as follows:

- general drawings
- site-specific design drawings, such as substation drawings, overhead wiring (OHW) layout drawings and high voltage (HV) aerial line and cable drawings

13.5. General drawings

General drawings are detail drawings of electrical equipment, fittings or assemblies, which are not site-specific. They can be used on any part of the rail electrical network. These drawings act as a template for creating designs for those repeated features. These drawings are classified as ASA standard drawings and are approved by the Lead Electrical Engineer, ASA.

13.6. Site-specific design drawings

A site-specific electrical drawing shows the layout and location of electrical equipment for a particular site. It shows the basic civil and structural infrastructure along with the electrical equipment. These drawings should be drawn on A1 sheet size (preferably).

13.6.1. Substation drawings

The purpose of the substation drawing set is to show the layout, location and detail drawings for a substation. The typical set of substation drawings required at a site includes but is not limited to the following:

- drawing index
- site plan
- ground plan
- building requirements
- arrangements
- schematics
- pilot wire scheme
- cable schedule
- allocation of conduits
- interconnection block diagram
- crane and float access diagram
- power cable installation procedure
- SCADA I/O schedule
- SCADA and communication block diagram

These drawings are in addition to those produced by the manufacturer of equipment as required by the relevant TfNSW equipment standards.

Table 36 provides a list of the electrical drawing types and the content description for a substation design. The list of drawing types are applicable to locations such as sectioning huts, switching station, substations, low voltage (LV) switchrooms, padmount locations, and 1500 V isolating and rail connection (IRCS) switch yards. Depending on the location and the installed equipment, not all drawings are required.

Table 36 - Substation drawings standard - Drawing contents

Drawing type	Views	Content description and notes
Covering sheet/drawing index (for a location)	NA	The covering sheet should have a document list as an index showing all the electrical substation drawings created for the project. It should also have a list of all the electrical equipment constructed for the project with the cross reference to all relevant drawings and schedules.

Drawing type	Views	Content description and notes
Site plan	Plan view	The purpose of the site plan is to depict accurately the location and site requirements of the substation in relation to its geographical location, geographical details and relationship with surrounding infrastructure and services. The proposed location and extents should be shown and suitably dimensioned to facilitate set out by survey on site and preparation of detailed building requirements. Interfaces with both current and proposed electrical infrastructure should be shown on the drawing. The following contents should be included in the survey information of the site where the substation is proposed to be located: • ground contours • relevant property boundaries and easements • all existing services, both buried (water, gas, sewer) and above ground (HV aerial lines and aerial telephone or communication cables) • major geographical features (trees, creeks, natural drainage) • existing roads and associated gutters or driveways, boundary fences • railway tracks and orientation to Sydney • proposed location of facility and site requirements • OHW structures, signals, gantry structures • route of underground cables to supply points • route of 1500 V positive and negative cables • cross-sections relating to the above cables • relevant notes, if required, detailing easement and property boundary peculiarities
Ground plan	Plan view	The purpose of the ground plan is to accurately display and detail civil infrastructure elements such as equipment footings, concrete hobs and drainage requirements in the substation yard. The following contents should be shown: • perimeter fence • substation building • access roadways • railway tracks and orientation to Sydney • existing infrastructure elements • major geographical features such as embankments • outdoor equipment foundations including construction centrelines

Drawing type	Views	Content description and notes
Building requirements	Plan view	The purpose of building requirements drawing is to show the base parameters. The base parameters enable the production of detailed civil designs for the substation building. The contents should include the requirements of the <i>Building Code of Australia</i> for the following items: • building dimensions and outline, including height of ceilings, doorway heights and widths • pits, conduits, cable access requirements • equipment footprints and associated weight • noise requirements • access requirements (such as concrete landing area at main access doors) • heat loading and associated ventilation requirements • floor tolerances (level and hardness for DCCBs and ac switchgear) • special requirements for ceiling areas above DCCBs
Crane and float access diagram	Plan and section	The purpose of crane and float access drawing is to show the position of the crane and associated float for lifting major items of equipment (typically rectifier transformers, system transformers and reactors). The content should include the following: • plan view of the substation building including the outdoor area, transformer bays, with access roads, fences and access gates detailed • cross-sections detailing critical pinch points in relation to the lift of the equipment • view of the crane in position with outriggers extended and the required transport float in position • detail of buried infrastructure which is relevant to the access roads and positioning of the crane, its outriggers and transport float. Infrastructure that cannot support additional loads other than traversing vehicles shall be clearly identified • table of required crane size with associated equipment that it has been sized on • where required, multiple positioning of the crane and float shall be identified in stages with appropriate diagrammatic representation for each stage • if the transformer requires winching into position after the initial crane lift, this detail is required to be included on the drawing

Drawing type	Views	Content description and notes
Cable schedule	Tabulation	The purpose of the cable schedule is to provide an accurate record of all cables to be installed within the substation and between the substation and the equipment located externally. This document is used to purchase the cables. It is used in conjunction with the block diagram and the allocation of conduit drawings. The contents of this document are derived from a spreadsheet that consists the following: • cable identification numbers, core number • name of equipment that cable originates from, terminal number • name of equipment that cable terminates at, terminal number • function • conductor size, insulation type and grade • comments
Cable installation procedure drawings	Plan and section	The purpose of the cable installation procedure drawing is to document the designer's concept for the procedures for installing large power cables. This is in particular where power winching is required or where a particular sequence or approach is required to ensure that the minimum cable-bending radius is not infringed. The content should include the following: • appropriate plan view and cross-sections of the substation and outdoor yard, transformer bays • illustrative detail of the methodology showing location of pits, required position of cable drums and sequence of events for correct installation
Interconnection block diagram (electrical)	Schematic diagram	The purpose of the interconnection block diagram is to provide a visual representation of the electrical interconnections between items of equipment within the substation and externally located equipment. The diagram is used by the electrical contractor when installing the cables in conjunction with the cable schedule and the allocation of conduit drawings. The following contents should be shown in the drawing: • equipment represented as squares or rectangles with associated labels • interconnections between equipment • cable identification numbers adjacent to each interconnection • blocks depicting equipment with labels

Drawing type	Views	Content description and notes
Allocation of conduits	Plan view /elevations and cross-sections	The purpose of the allocation of conduit drawing is to provide detailing of all aspects of the installation of conduits required in the substation. The drawing is critical for the correct positioning of conduits. It is used in conjunction with the cable schedule and interconnection block diagram. The contents of this drawing show the detailed location of all conduits and should include the following: • dimensions for locating conduits • conduit size, class, radius of bends • conduit spacing • particular requirements for conduits such as bellmouths • elevations and sections to show depth of installation and positioning within pits • conduit identification number • corresponding cable identification numbers • building and features equipment and foundations
Internal arrangement	NA	The purpose of the internal arrangement drawing is to show the interconnectivity between equipment that is installed within the substation building; for example, 1500 V dc cabling, HV cabling, LV cabling and control wiring. The drawing should include the physical outline of the equipment and the associated electrical relationship to other equipment within the substation and the equipment located externally. This drawing should be drawn to scale with all dimensions shown to enable installation of equipment. Critical dimensions shall be shown as specified in AS 3000 <i>Electrical Installations</i> and AS 2067 <i>Substation and high voltage installation exceeding 1 kV a.c.</i>
Internal arrangement (continued)	Plan view	The internal arrangement drawing contents in the plan view shows all the internal equipment for the substation. The drawing should show the position of the equipment within the substation with relevant dimensions shown for mounting of equipment, access and clearance requirements. A broad outline of the interconnection between equipment should be shown, such as cable trays, cable ladders, and conduits. The detailed part listing contains notes detailing particular requirements such as clearances, torques and tensions.
Internal arrangement (continued)	Detailed sections	The internal arrangement drawing contents in the detailed sections view shows detailed sections as required for the internal equipment for the substation. The cross-sections show in detail, the methods of connection of cables, arrangements of equipment, any particular mounting details for equipment and details of how cables and busbar are installed. The detailed parts listing contain notes detailing particular requirements such as clearances, torques and tensions.

Drawing type	Views	Content description and notes
Outdoor arrangement	NA	The purpose of the outdoor arrangement drawing is to show the interconnectivity between the equipment that is installed outside the substation building such as transformer bays, outdoor HV yard, and 1500 V IRCS yard. This drawing should include the physical outline of equipment and associated electrical relationships to other equipment within the substation and equipment located externally. It should also show the identification of high voltage phases. Safety dimensions as specified in AS 2067 are required to be shown. These critical dimensions are required to be identified as such. Any associated restrictions such as maximum vehicle height should be shown. This drawing shall be drawn to scale with all dimensions shown to enable installation of the equipment.
Outdoor arrangement (continued)	Plan view	The drawing contents of the outdoor arrangement in the plan view should contain the substation outline including the following (shown in half tone): • perimeter fence • substation building - plot using full tone, all other features to be displayed in half tone • access roadways • railway tracks and orientation to Sydney • major internal equipment (for interconnection purposes)
Outdoor arrangement (continued)	Cross-sections and details	The drawing contents of the outdoor arrangement in cross-sections and details should contain detailed cross-sections looking at the entire outdoor area, associated equipment and interconnections. It should show the individual detailed sections as required and the complex arrangements. It should also show an elevation of feeder termination structures for the busbars showing arrangement and phasing including connection to first pole of substation feeders. The drawing should show the dimensions for the following: • major centreline distances between equipment • clearance dimensions such as heights of busbars, distances from yard fences and distances between phases, shown using a shaded envelope • minimum distances to meet standards in brackets should be shown adjacently • swing of handles (ABSW) The detailed parts listing include details of signage to be installed and notes detailing torques and tensions, preparation requirements and references to standard designs.

Drawing type	Views	Content description and notes
Earthing arrangement and details	Plan view	The purpose of the earthing arrangement and details drawing is to provide details of the earthing systems associated with the substation. The earthing arrangement details should include the substation outline, earthing details, dimensions and detailed parts listing. Earthing details drawings should include the following: • location of numbered earth electrodes, depth and diameter of hole, type of electrode and material • earth grid location and depth • basic design parameters • earth grid conductor and grid tails for connection to equipment and structures • differentiation between earthing system for earth fault path and bonding for step and touch potential • details of tee and cross connections between earth wires • fence and structure earthing details • location of earthing points for portable earths, and so on • details of high voltage cable screen connections • details of attachment to concrete slab reinforcing • location of earth bars • cable screens • details of blue metal requirements, including grade and depth • location of commissioning test points • water pipe bonds and insulated joint location details Dimensions include the following: • major centreline distances between equipment • clearance dimensions such as heights of busbars, distances from yard fences and distances between phases Minimum distances to meet the standards in brackets should be shown adjacently.
Earthing arrangement and details (continued)	Detail	Detailed parts listing should include the following: • electrodes • clamps • earth cable • earth lugs (no of holes) • notes detailing particular requirements such as clearances, torques and tensions

Drawing type	Views	Content description and notes
Underground electrical services	Plan view	The purpose of the underground electrical services drawing is to provide details of buried electrical services and the method of installation. The contents of the underground electrical services drawing in the plan view should include the substation outline, three themes of underground electrical cables and their common details. Underground electrical cables should be shown according to the following three themes: • high voltage cables • 1500 V positive and negative cables, 600 V rectifier cables • low voltage cables, control cables Each theme should contain the following common details: • de-commissioned cables should be shown • equipment foundations should be shown for reference (half tone) • internal equipment should be shown for interconnection purposes (half tone) • key dimensions from the edge of the cable route to equipment foundations and slabs • notes detailing particular requirements such as clearances between HV cables and LV cables • AUSTEL requirements
Underground electrical services (continued)	Cross-sections and details	This drawing should show cross-sections with the following details: • cable depth below ground • PVC marker tape or methods of protection for the cables • concrete troughing and conduits • details of cables (material, screen type, diameter, and so on) • cable separation • any other relevant details • cable ID number as per the cable schedule • key dimensions • notes detailing particular references to standard drawings and documents • installation type
Underground services	Plan view	The purpose of the underground services drawing is to provide details of buried services (excluding electrical) and their method of installation. The contents should include substation outline and underground services. The underground services (non-electrical) should include the following: • compressed air pipes • water and sewer pipes • drainage pipes • gas pipes • oil bunding Outdoor equipment footings should be shown for reference only.

Drawing type	Views	Content description and notes
Schematic diagram	NA	The purpose of the schematic diagram is to provide detailed information to enable the installation of control and protection wiring of the equipment. This diagram should be used in conjunction with the wiring diagram. This drawing should be drawn to 2.5 mm grid with symbols as described in AS 1102 series snapped to grid intersections. The diagram should include the following details: • control circuit for the specified equipment • control supply fuses or circuit breakers • terminal numbers for relays, control switches, test blocks and so on • termination strips and the associated numbering • cable identification number • specific details about relays, control switches, indication lights and so on The drawing should also have notes detailing particular requirements such as termination blocks, wire size and colour, relay and switch details, references to standard designs and relevant drawings and documents.
Wiring diagram	NA	The purpose of the wiring diagram is to provide detailed information to show the physical layout of the wiring and installation of related equipment for control and protection cubicles. The contents of this drawing should show the cubicle or panel with a physical layout of all the wiring and terminals strips, selection switches, and indication lights. It should also show the details of the terminal strips, selection switches, and indication lights and the cable identification numbers.
Distribution board schematic diagrams	NA	The purpose of the distribution board schematic diagrams is to show the electrical requirements of the low voltage distribution boards. The contents of this drawing should show the electrical details of the distribution board which includes the following: • voltage and fault levels • insulation resistance requirements • details of type of circuit breaker or fuse • colour of board • circuit labels • size of incoming or outgoing cable • number of spares • IP rating and form number • door requirements (hinge side, lock type) • mounting requirements • physical size restrictions The 240 V (415 V) schematic diagram should also show the details of the changeover and its connections if used. This drawing should be drawn to 2.5 mm grid with symbols as described in AS 1102 series snapped to grid intersections.

Drawing type	Views	Content description and notes
Protection concept	NA	The protection concept is produced to document the requirements for high voltage protection schemes. It is accompanied by a Microsoft Word compatible document, which describes in detail the protection requirements. Diagrammatically it shows the HV busbars, ACCBs, VTs, transformers and location of CTs. The interconnection with the interfacing substations is also shown. The HV busbar and the order of associated equipment shall match the approved operating diagram for the location. It includes details on CTs, VTs, protection relays, ratings of the HV switchgear, connection between protection relays and associated CTs and VTs, and connection to the ACCB trip coil. It includes the interconnection to adjacent substations and relevant details of the HV protection scheme at the remote substation. Existing protection equipment and interconnection is shown in blue, new equipment and interconnection in red, and removal in green. The busbar, ACCBs, and VTs are shown in black colour. Electrical ratings of the HV busbar, ACCBs, CTs and VTs are shown.
SCADA and communication block diagram	NA	The purpose of the SCADA and communication cabling block diagram is to show the SCADA, phone, ICT, protection relay, PLC and other serial communication cabling. It also shows the incoming and outgoing connections to communications backbone. For an example, refer to EL0435527 <i>Toongabbie SS Electrical Communication Cabling Block Diagram</i> .
SCADA I/O schedule	NA	The purpose of the SCADA I/O schedule is to provide an accurate record of the input and output signals to the SCADA system, whether through hardwired or serial connections or internal to the RTU. This document is used to size and purchase the SCADA RTU and program the RTU and the master station, and wire the marshalling cubicle. Refer to T HR EL 11001 PR <i>Design Technical Reviews for Electrical SCADA Equipment</i> and T HR EL 11001 PR F1 <i>SCADA I/O Schedule</i> for further details.

13.6.2. Production of overhead wiring, HV aerial lines and cables layout drawings

The electrical layout drawing system comprises a series of primary and secondary CAD model files assembled to enable the production of overhead wiring and HV aerial line and cable drawings.

Each model file should contain the data pertaining to the design, location and graphical representation of features in accordance with the subject theme.

Each model file should display approximately 4 km of rail corridor and provide a base from which A1 size layout drawings are produced at a scale of 1:500.

The primary model files are supported by secondary model files attached as reference files. These secondary files supply additional or ancillary graphic data and are used in the construction of the primary model files.

Primary model files

The following primary model files should be created to support the electrical design:

- overhead wiring model file - this should contain graphic details pertaining to location and design of the overhead wiring system
- HV aerial line and cable model file - this should contain graphic details pertaining to the location and design of the HV aerial line and cable system
- electrical mapping model file - this should contain subset of aerial mapping (where available), and updates from electrical detail surveys
- electrical track model file - this should contain subset of track alignment files (where available)
- grid file - this provides the drawing sheet set out and grid annotation for the layout drawings

Overhead wiring model file

OHW data should be placed in the file in accordance with the following specifications:

- Cells should remain in the model files as cells (not to be dropped).
- Data fields and text nodes should be entered as tags as provided in various cells for annotation purposes. In case the cell contains message text or drawing references as necessary, the cell can be dropped to allow editing of specific text.
- 'As constructed' OHW masts should be placed accurately at locations indicated by survey data (MGA or ISG Coordinates of Ramset Nails placed in masts).
- Cells should be placed at size provided and should not be re-scaled. Cells should be created in cell library at a scale suitable for a production drawing scale of 1:500 and the size should not be altered.
- OHW data should not conflict with HV aerial lines and cable data. The HV aerial line and cable routes should not be broken by OHW data, that is, structure numbers should not be placed across HV aerial lines and cable routes.

Refer to EP 08 00 00 10 SP *Overhead Wiring Layouts – Requirements and Symbolology* for more information on overhead wiring layouts.

The following features should be shown in the electrical overhead wiring model file:

- OHW structures
- OHW structure numbers
- bay lengths
- coding and symbolology

- anchors systems and details
- overlap details
- section insulators
- insulators
- contact wire (in and out of running)
- associated design data, such as, radial load factors, staggers, blowout extents
- mast foundations (existing and as-built)

HV aerial lines and cables model files

The HV aerial lines and cable routes should be placed in the file in accordance with the following file specifications:

- Graphics should not conflict with OHW data; if required, OHW data should be moved to clear off the aerial lines and cable routes.
- Data should be placed in the model in accordance with the file specification.

Note that some data, particularly cable cross-sections are placed in the layout drawing files.

Data and annotation should be placed into the files in accordance with the following specifications:

- Model files should be attached as reference files (graphic data from model files should not be copied into drawing file).
- A1 border sheet file should be moved and rotated to coincide with the relevant location as determined by the grid file.
- Model files should be clipped in accordance with the join lines indicated in the grid file.
- Ancillary notes, warnings, construction tables should be added to the drawing file, where required.
- Where cables are concerned, cable cross-sections and dimensions should be added into the layout drawing file.

The following features should be shown in the electrical HV aerial lines and cables model file:

- HV aerial lines and cables routes
- pole top arrangements
- bay lengths
- deflection angles

- pole numbers
- other aerial lines
- cable routes
- joint locations
- pits, manholes, ducts
- cable depths (covers)
- pipes and other services crossing and adjacent
- other existing cable routes

Electrical mapping model file

Where aerial mapping exists in CAD format, the electrical mapping file should be created and the aerial mapping copied into the file over the full extent of the model.

The following features should be drawn in electrical mapping model file:

- railway boundaries
- miscellaneous boundaries
- street names
- survey marks
- cadastral details
- roads, streets, lanes
- footpaths, concrete slabs
- buildings, ruins
- fences, gates, cattle grids
- bridges, culverts, overpasses
- pipes, walls, tanks, conveyors
- vegetation text
- embankments, (top, toe, cliffs, rocky outcrops)
- embankment symbols
- vegetation boundaries
- natural drainage, rivers, creeks, lakes
- drainage text

- track names and platform numbers
- general mapping annotation
- track elements, switches, buffers
- kilometre marks and text
- OHW structures, OHW anchors
- general signs, crossings
- posts, guideposts, freestanding posts
- power poles and HV aerial lines
- signals and signal gantry structures
- signal and cable troughing, elevated and ground line
- sumps, manholes, hydrants
- platforms
- any unidentified structures

Electrical track model file

The following features should be drawn in the electrical track model file:

- track centrelines
- track frame points, tangent points, transition points, bends, identification text (kilometrage)
- track centres text
- track radius text
- superelevation text
- kilometrage text and symbols
- structures
- platforms
- track componentry, rails, turnouts
- track componentry identification, such as curves, transitions, straights

Grid file

Where a grid file is available, the grid file should be used for the construction of layout drawings.

Where a grid file is not available, the grid file should be produced in accordance with the following specification and requirements:

- A1 sheet pattern should be placed in centre to track centreline with sufficient coverage to incorporate future HV aerial lines and cable requirements.
- Drawing sheets should be oriented at whole angles to simplify plotting and view rotation. Where possible, runs of sheets should maintain the same orientation to provide maximum coverage.
- Sheet joins should be radial from corners to give maximum coverage when sheets are placed at angles.
- Join lines should be placed at approximately 25 mm from side of sheets (at 1:500 scale).
- Join lines should be placed on multiple levels to facilitate display of alternate sheets.
- Grid marks and crosses shall be placed at 50 m intervals over each drawing sheet area in accordance with level map.
- Grid shall be annotated and placed around the inside edge of each sheet area. Annotation should not conflict or overwrite.

Secondary files

The following secondary model files should be referenced from other disciplines:

- civil design files - provides details of civil design and construction such as bridges, retaining walls, culverts
- services files - provides details of utility services, cables, pipes, drainage
- boundary files - provides details of survey boundaries

13.6.3. OHW tension length diagram

The purpose of the tension length diagram is to identify and show the extent of the proposed wire runs together with details of the termination points and anchors.

The extent of each wire run should be shown by a single coloured line between the termination points. The details of the termination anchors and fixed mid points, out of running wire and overlaps should be indicated.

The diagram should show the following:

- individual wire runs, wire lengths, each identified by an individual colour

Only eight colours are allowed due to reproduction identification limitations.
- location of anchor points and details, including type/tension, length/wire run names and for fixed mid points, tension loss figures
- bridges and bridge names
- platforms and platform numbers, station names, station extents (show hatching)
- proposed and existing structures
- track names and to and from Sydney indicators
- interaction with existing wiring (show in black colour)
- substations and sectioning huts (show in shaded grey colour)
- tunnels and tunnel names
- out of running wires (show as dashed lines)
- overlaps (O/L) together with km of locations
- section insulator locations
- notes indicating that the diagram is a coloured drawing
- legend depicting symbols and descriptions

The colours shown for the individual wire runs should be carried through to the concept and detailed design and utilised to identify all design data pertaining to that particular wire run (that is, structure loading, blowout values, stagger values, coding and so on).

Diagrams should be produced in A3 size and identified as a colour drawing.

13.6.4. Combined overhead wiring and HV aerial line and cable drawings

A project may require the production of a combined layout where the overhead wiring aspects and the HV aerial line and cable aspects both appear on the same drawing.

The presentation should be such that OHW details such as coding, tables and bay lengths shall be clear of HV aerial line pole numbers, pole-top arrangements, span lengths and so on.

13.6.5. HV aerial line profiles

HV aerial line profiles shall be developed in CAD format and should be drawn to scale as follows:

Horizontal 1:500 Vertical 1:100

Refer to T HR EL 10001 ST *HV Aerial Line Standards for Design and Construction* for more details.

14. Signal CAD requirements

The signal CAD requirements are applicable to signal drawings produced for TfNSW rail projects. These requirements should be read in conjunction with Section 6 of this standard.

Where conflict exists between the two sections, then the signal CAD requirements shall take precedence over the general requirements unless the general requirements expressly states otherwise.

14.1. Title block for signal drawings

The title block selection for a signal drawing depends upon the drawing type. The signal circuit book and air system drawing shall use a title block that is explained in Section 14.1.1 and Section 14.1.2, respectively. All other signal drawings should use the title block as explained in Section 14.1.3.

14.1.1. Circuit book

A circuit book consists of various sheet types, such as cover sheet, index sheet, correlation sheet, control sheet, amendment sheet and wiring sheets. This standard states the requirements for creating and updating the cover sheet and wiring sheets of circuit book. For other sheets, refer to SPG 0703 *Signalling Documentation and Drawings*.

Each circuit book shall have one EDMS number assigned and all sheets shall be associated with this EDMS number.

Cover sheet of circuit book

The circuit book cover sheet consists of the following four components:

- circuit book title
- circuit book detail box
- circuit book sign-off box
- circuit book revision box

Figure 115 shows a sample circuit book cover sheet with these components marked.

ADDITIONAL DOCUMENTS: tbDocNo

tbLocality
tbDetail1
tbDetail2
tbDetail3

CIRCUIT BOOK TITLE

AMENDMENT BOX

SIGN-OFF BOX

DETAIL BOX

CIRCUIT BOOK No.: tbCBNo
JOB No.: tbJobNo
STATUS: tbStatus
BOOK: tbBookNo OF tbCBBooks
PART: tbPartNo OF tbCBParts
DWG No: tbAEODwgNo
EDW No: tbAEODwgNo
Revision: tbRevisionNo

This drawing and the related information have been prepared by, or at the request of, TNSW for a specific purpose and may not be used for any other purpose without the written permission of TNSW. TNSW does not accept any liability for any loss or damage arising from the use of this drawing for any purpose other than the intended purpose. This drawing is provided by copyright and no part of this drawing may be reproduced in any form without the express written permission of TNSW.

LOGO OF DESIGN COMPANY CARRYING OUT DESIGN
Transport for NSW
LOGO OF AEO RESPONSIBLE FOR DESIGN

DESIGNED
REVIEWED
VERIFIED
APPROVED

DATE
SIGNATURE
DATE
SIGNATURE
DATE
SIGNATURE

DESCRIPTION

Figure 115 – Typical circuit book cover sheet

Circuit book title

The circuit book title provides details about the circuit book subject matter. Figure 116 shows the different fields within the circuit book title.

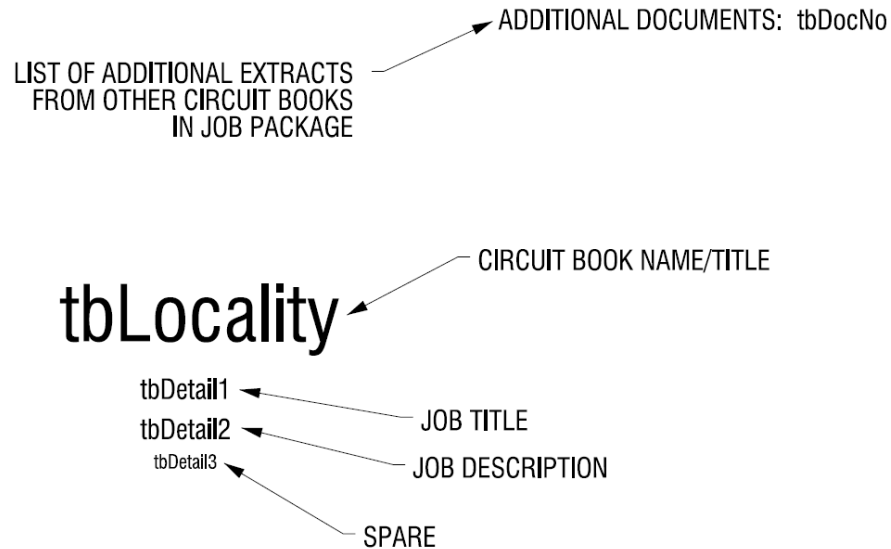


Figure 116 – Circuit book title

Table 37 provides the details of the field names and tags related to the circuit book title.

Table 37 - Circuit book title - Smart tags description

No.	Field name	Tag	Requirements
1	Circuit book name/title	tbLocality	Include the name or title of the circuit book.
2	Job title	tbDetail1	Include the job title. This should be removed on as-built circuit book.
3	Job description	tbDetail2	Include the job description. This should be removed on as-built circuit book.
4	Spare	tbDetail3	Additional field and should be used for additional information.
5	Additional documents	tbDocNo	Include a list of extracts from other circuit books that forms the job package. This should be removed on as-built circuit book.

Circuit book detail box

The circuit book detail box provides details about the circuit book numbering system and current revision level.

Figure 117 shows the different fields in a circuit detail box.

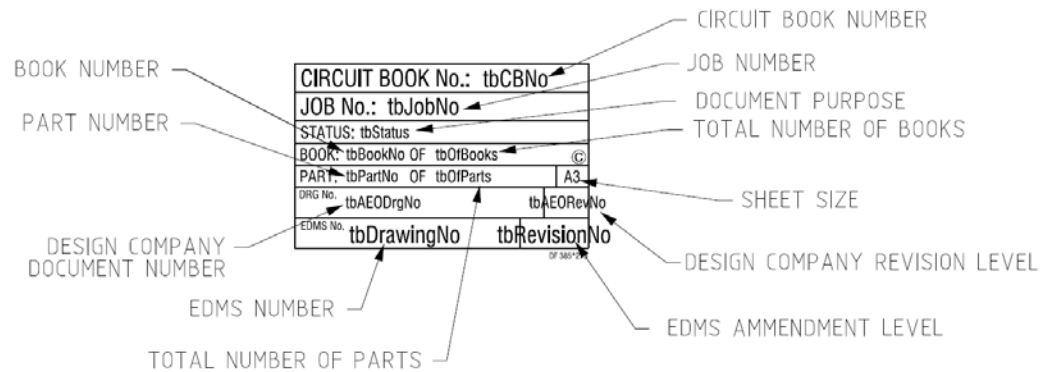


Figure 117 – Circuit book detail box

Table 38 provides the details of the field names and tags of the circuit book detail box.

Table 38 – Circuit book detail box - Smart tags description

No.	Field name	Tag	Requirements
1	Circuit book number	tbCBNo	Include the circuit book number.
2	Job number	tbJobNo	Include the project job number.
3	Document purpose	tbStatus	Include the status of the current revision of the circuit book. Allowable values are as follows: • for review • for construction • for testing • for commissioning • as-built
4	Book number	tbBookNo	Include the book number of a circuit book in a set of circuit books. Where there is no other circuit book in the set, the particular book is book 1.
5	Total number of books	tbOfBooks	Include the total number of circuit books in a set of circuit books. Where there is no other circuit book in the set, the particular book set number is 1.
6	Part number	tbPartNo	Include the part number of a circuit book. Where there is no other part of circuit book, the particular part is part 1.
7	Total number of parts	tbOfParts	Include the total number of parts of a circuit book. Where there is no other part of a circuit book, the particular part set number is 1.
7	Sheet size	tbSheetSize	Include the size of the circuit sheet. Allowable values are only A2 or A3.

No.	Field name	Tag	Requirements
8	EDMS number	tbDrawingNo	Include the TfNSW drawing number (2 characters and 7 numbers) provided to the designer by TfNSW (in consultation with the Central Planroom). This is unique for each circuit book. Refer to Section 8.1 for details.
9	EDMS amendment level (revision associated with EDMS number)	tbRevisionNo	Include the TfNSW revision related to EDMS number. This number shall be updated only when drawings are submitted to Virtual Planroom. The first instance of the circuit book shall always show an 'A' in this box. The timing of this can vary for each circuit book. Refer to Section 7.4 for details.
10	Design company document number	tbAEODrgNo	Include the design company document number. Refer to Section 7.3.4 for details.
11	Design company revision level	tbAEORevNo	Indicate the design company revision level related to the design company document number. Refer to Section 7.4 for details.

Circuit book sign-off box

The circuit book sign-off box shall contain the signature, which includes the full name of the person who performed the tasks including drawn, design, review, verified and approval of the document for release.

Note: Where the first name of the person is too long to fit within the space provided in the sign-off box, the first initial and last name of the person is acceptable.

Figure 118 shows a sample sign-off box for a circuit book.

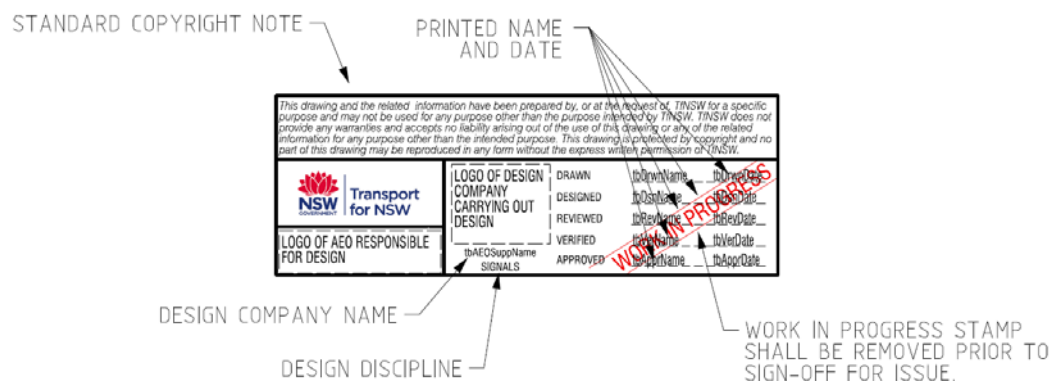


Figure 118- Circuit book – Sign-off box

Table 39 provides the details of the field names and tags of the circuit book sign-off box. Refer to SPG 0703 for definitions for each role type.

Table 39 - Circuit book sign-off box - Smart tags description

No.	Field name	Tag	Requirements
-----	------------	-----	--------------

No.	Field name	Tag	Requirements
1	Drawn by (Name)	tbDrwnName	Include the full name of the person who drafted the circuit book.
2	Drawn date	tbDrwnDate	Include the date of sign-off by the draftsman.
3	Designed by (Name)	tbDsnName	Include the full name of the person who created the design component of the circuit book.
4	Designed date	tbDsnDate	Include the date of sign-off by the designer.
5	Review by (Name)	tbRevName	Include the full name of the person who reviewed the drafting of the circuit book.
6	Reviewed date	tbRevDate	Include the date of sign-off by the reviewer.
7	Verify by (Name)	tbVerName	Include the full name of the person who verified the circuit book.
8	Verify date	tbVerDate	Include the date of sign-off by the verifier.
9	Approver (Name)	tbApprName	Include the full name of the person who approved the design for release.
10	Approved date	tbApprDate	Include the date of sign-off by the design approver.
11	Design company name	tbAEOSuppName	Include the name of the design company.

Circuit book revision box

The revision box records the revision details of TfNSW amendment letter with or without the modification number along with the initial of the designer, reviewer, independent verifier and approver for the current revision.

Figure 119 shows a revision box for the circuit book.

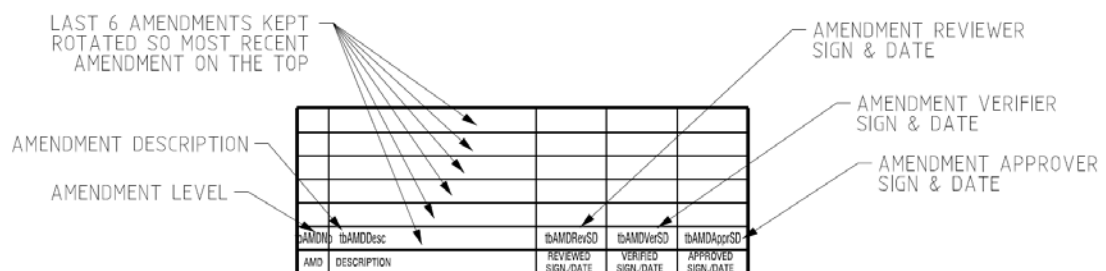


Figure 119 - Circuit book - Revision box

Table 40 provides the details of the field names and tags of circuit book revision box.

Table 40 - Circuit book revision box - Smart tags description

No.	Field name	Tag	Requirements
1	Amendment level	tbAMDNo	Include the current amendment. Refer to Section 7.4 for details.
2	Amendment description	tbAMDDesc	Include a brief description of the phase of review or approval that the drawing is issued.
3	Amendment reviewer sign and date	tbAMDRevSD	Include the initials of the person who reviewed the revision and sign date.
4	Amendment verifier sign and date	tbAMDVerSD	Include the initials of the person who verified the revision and sign date.
5	Amendment approver sign and date	tbAMDApprSD	Include the initials of the person who approved the revision and sign date.

Circuit book wiring sheet

The circuit book wiring sheet contains smart tags values for the current sheet. These values are populated in line with smart tag values of the circuit book cover sheet.

Figure 120 shows a sample format of the circuit book wiring sheet.

[illegible]

Figure 120 – Typical circuit book wiring sheet

Table 41 provides the details of the fields and tags of the circuit book wiring sheet.

Table 41 – Circuit book wiring sheet - Smart tags description

No.	Field name	Tag	Requirements
1	Job number	tbJobNo	Include the project job number.
2	Version date	tbDateTime	Include the date when the design was created or altered.
3	CAD filename	tbFilename	Include the CAD file name for the sheet.
4	Sheet title	tbTitle	Include the title for the sheet.
5	EDMS number	tbDrawingNo	Include the EDMS number of the book.
6	Sheet number	tbShtNo	Include the sheet number for current sheet.
7	Book number	tbCBNo	Include the circuit book number.

14.1.2. Air supply book

The air supply book consists of various sheet types, such as cover sheet, index sheet, correlation sheet, control sheet, amendment sheet and wiring sheets. This standard states the requirements for creating and updating the cover sheet and airline diagram sheets of air supply book. For other sheets, refer to SPG 0703.

Each air supply book shall have one EDMS number assigned and all sheets shall be associated with this EDMS number.

Cover sheet of air supply book

The air supply book cover sheet consists of the following four components:

- air supply book title
- air supply book detail box
- air supply book sign-off box
- air supply book revision box

Figure 115 shows a sample air supply book cover sheet with these components marked.

[illegible]

Figure 121 – Typical air supply book cover sheet

Air supply book title

The air supply book title provides details about the air supply book subject matter. Figure 122 shows different fields within the air supply book title.

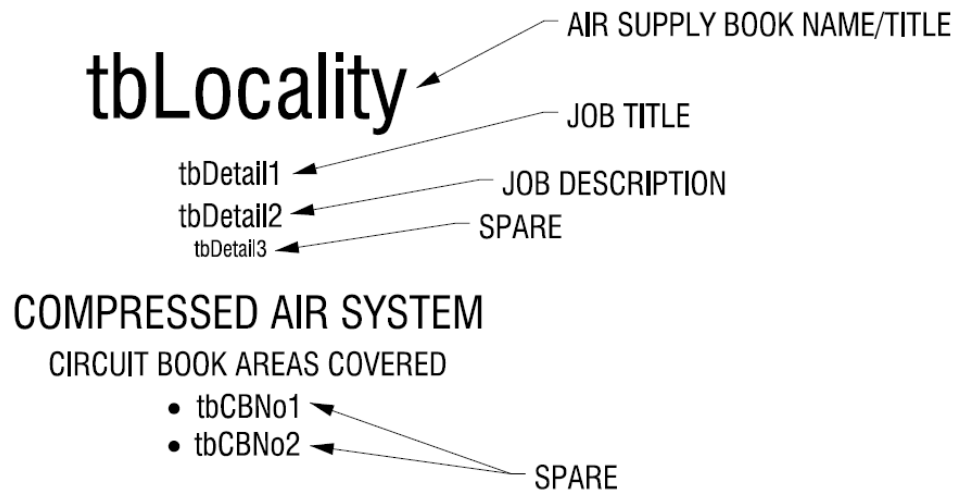


Figure 122 – Air supply book title

Table 42 provides the details of the field names and tags related to the air supply book title.

Table 42 - Air supply book title - Smart tags description

No.	Field name	Tag	Requirements
1	Air supply book name/title	tbLocality	Include the name or title of the air supply book.
2	Job title	tbDetail1	Include the job title. This should be removed on as-built air supply book.
3	Job description	tbDetail2	Include the job description. This should be removed on as-built air supply book.
4	Spare	tbDetail3	Additional field and should be used for additional information.
5	Additional documents	tbDocNo	Include a list of extracts from other air supply books that forms the job package. This should be removed on as-built air supply book.

Air supply book detail box

The air supply book detail box provides details about the air supply book numbering system and the current revision level.

Figure 123 shows the different fields in an air supply book detail box.

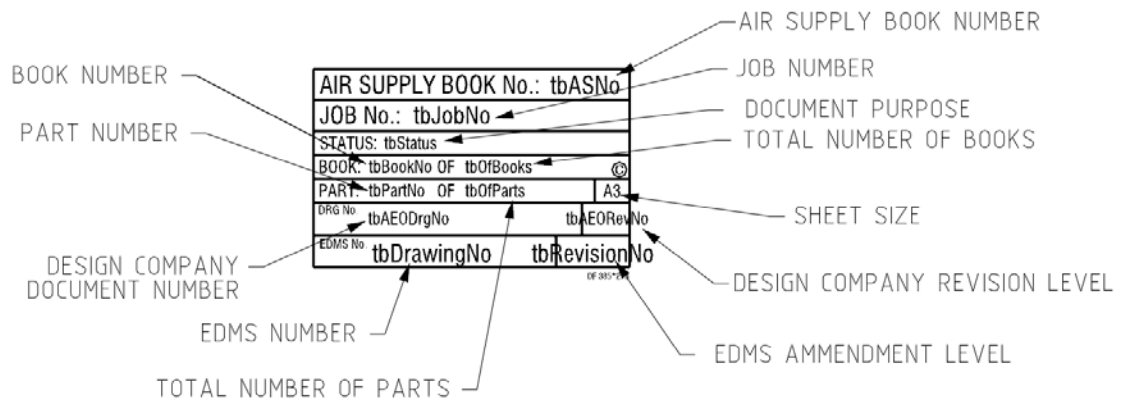


Figure 123 – Air supply book detail box

Table 43 provides the details of the field names and tags of the air supply book detail box.

Table 43 – Air supply book detail box - Smart tags description

No.	Field name	Tag	Requirements
1	Air supply book number	tbCBNo	Include the air supply book number.
2	Job number	tbJobNo	Include the project job number.
3	Document purpose	tbStatus	Include the status of the current revision of the air supply book. Allowable values are as follows: • for review • for construction • for testing • for commissioning • as-built
4	Book number	tbBookNo	Include the book number of an air supply book in a set of air supply books. Where there is no other air supply book in the set, the particular book is book 1.
5	Total number of books	tbOfBooks	Include the total number of air supply books in a set of air supply books. Where there is no other air supply book in the set, the particular book set number is 1.
6	Part number	tbPartNo	Include the part number of an air supply book. Where there is no other part of air supply book, the particular part is part 1.
7	Total number of parts	tbOfParts	Include the total number of parts of an air supply book. Where there is no other part of an air supply book, the particular part set number is 1.
7	Sheet size	tbSheetSize	Include the size of the air supply sheet. Allowable values are only A2 or A3.

No.	Field name	Tag	Requirements
8	EDMS number	tbDrawingNo	Include the TfNSW drawing number (2 characters and 7 numbers) provided to the designer by TfNSW (in consultation with the Central Planroom). This is unique for each air supply book. Refer to Section 8.1 for details.
9	EDMS amendment level (Revision associated with EDMS number)	tbRevisionNo	Include the TfNSW revision related to EDMS number. This number shall be updated only when drawings are submitted to Virtual Planroom. The first instance of the air supply book shall always show an 'A' in this box. The timing of this can vary for each air supply book. Refer to Section 7.4 for details.
10	Design company document number	tbAEODrgNo	Include the design company document number. Refer to Section 7.3.4 for details.
11	Design company revision level	tbAEORevNo	Indicate the design company revision level related to the design company document number. Refer to Section 7.4 for details.

Air supply book sign-off box

The air supply book sign-off box shall contain the signature, last name and initial of the person who performed the tasks including drawn, design, review, verified and approval of the document for release.

Note: Where the first name of a person is too long to fit within the space provided in the sign-off box, the first initial and last name of the person is acceptable.

Figure 124 shows a sample sign-off box for an air supply book.

STANDARD COPYRIGHT NOTE

PRINTED NAME AND DATE

LOGO OF DESIGN COMPANY CARRYING OUT DESIGN

LOGO OF AEO RESPONSIBLE FOR DESIGN

tbAEOSuppName SIGNALS

DESIGN COMPANY NAME

DESIGN DISCIPLINE

WORK IN PROGRESS STAMP SHALL BE REMOVED PRIOR TO SIGN-OFF FOR ISSUE.

DRAWN	tbDrawName	tbDrawDate
DESIGNED	tbDesignName	tbDesignDate
REVIEWED	tbReviewName	tbReviewDate
VERIFIED	tbVerifyName	tbVerifyDate
APPROVED	tbApprName	tbApprDate

Figure 124- Air supply book – Sign-off box

The fields present in the air supply book sign-off box are same as that of the circuit book sign-off box and are explained in Table 39 of this standard.

Air supply book revision box

The air supply book revision box records the revision details of the TfNSW amendment letter with or without the modification number along with the initial of the designer, reviewer, independent verifier and approver for the current revision.

Figure 125 shows a revision box for the air supply book.

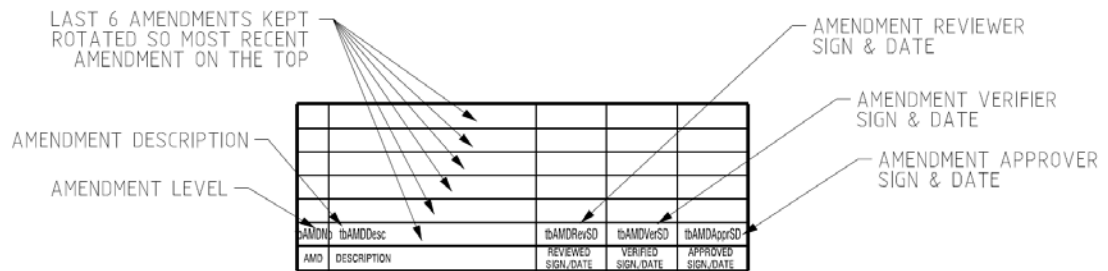


Figure 125 - Air supply book - Revision box

The fields present in the air supply book revision box are same as that of the circuit book revision box and are explained in Table 40 of this standard.

Air supply book airline sheet

Figure 126 shows a sample format of the air supply book airline sheet.

Table 44 provides the details of the fields and tags of the air supply book airline sheet.

Table 44 – Air supply book airline sheet - Smart tags description

No.	Field name	Tag	Requirements
1	Job number	tbJobNo	Include the project job number.
2	Version date	tbDateTime	Include the date when the design was created or altered.
3	CAD filename	tbFilename	Include the CAD file name for the sheet.
4	Sheet title	tbTitle	Include the title for the sheet.
5	EDMS number	tbDrawingNo	Include the EDMS number of the book.
6	Sheet number	tbShtNo	Include the sheet number for current sheet.
7	Book number	tbCBNo	Include the air supply book number.

The form is a rectangular sheet with a header section at the top and a main body. The header section contains several fields with labels pointing to them:

- VERSION DATE:** Points to the first field in the header.
- TO FILENAME:** Points to the second field in the header.
- CAD FILENAME:** Points to the third field in the header.
- SHEET TITLE:** Points to the fourth field in the header.
- EDMS NUMBER:** Points to the fifth field in the header.
- SHEET NUMBER:** Points to the sixth field in the header.
- BOOK NUMBER:** Points to the seventh field in the header.
- AR SUPPLY BOOK NO. TO AS'No:** Points to the eighth field in the header.

The main body of the form is a large rectangle with a grid of small squares along the right edge. The right edge is labeled **JOB NUMBER** and **TO, 0000**. The bottom right corner of the form has a small box labeled **JOB NUMBER** and **TO, 0000**.

Figure 126 – Typical air supply book airline sheet

14.1.3. Other signal drawings

Other signal drawings, including signalling plans, track insulation plans and mechanical drawings shall use the title block as shown in Figure 127.

AMENDMENT BOX

TO BE REMOVED WHEN COLOURS ARE NOT USED

SIGN-OFF BOX

DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR

DRAWING DETAILS BOX

This drawing and the related information have been prepared by, or at the request of, TNSW for a specific purpose and may not be used for any other purpose without the express written permission of TNSW. TNSW does not accept any liability for the use of this drawing for any purpose other than the intended purpose. This drawing is protected by copyright and no part of this drawing may be reproduced in any form without the express written permission of TNSW.		tbLocality tbLine tbDetail1 tbDetail2 tbDetail3	
LOGO OF DESIGN COMPANY CARRYING OUT DESIGN		tbFileNo tbStatus tbECORNo tbDrawingRevision	
LOGO OF AEO RESPONSIBLE FOR DESIGN		tbECORNo tbDrawingRevision	
COORD: tbCoordSys		tbDrawingRevision	

Figure 127 – Typical signal drawings title block

The smart tag fields for other signal drawings details box shall be populated in accordance with Section 7.1.1 of this standard.

The smart tag fields for other signal drawings sign-off box and revision box shall be populated in accordance with Table 39 and Table 40 of this standard.

14.2. Seed files for signal drawings

The following seed files should be used for creating signal drawings files (2D drawings with title block):

- A3circuitbookcovesheet.dgn file should be used for circuit book cover sheet
- A3circuitbookwiringsheet.dgn file should be used for circuit book wiring sheet
- A3airsupplybookcovesheet.dgn file should be used for air supply book cover sheet
- A3airsupplybookairlinesheet.dgn file should be used for air supply book airline diagram
- Model2Dsheetsheet2DseedV8.dgn seed file should be used for signalling plans, track insulation plans.

These files are available for download from the ASA website.

14.3. Cell libraries for signal drawings

The following cell libraries should be used for creating signal drawings:

- AC Vital Relays.cel
- Air Main Supply.cel
- Banner.cel
- Bushbar Couplers Links.cel
- Coils.cel
- Contractors.cel
- DC Vital Relays.cel
- Electrical Components.cel
- Electrical Detector Contacts.cel
- Flasher Units Contact.cel
- General.cel
- Indicators.cel
- Instrument Contacts.cel

- Lever Contacts.cel
- Level Lock Symbols.cel
- Lightning Arrestors.cel
- Locations.cel
- Lquad.cel
- Miscellaneous.cel
- Motors.cel
- Non Vital Contacts.cel
- Non Vital Relays.cel
- Power Supply.cel
- Push Button.cel
- Relay Rack.cel
- SD_ATP.cel
- SD_SIG_PLANS.cel
- SD_SIG_POWR.cel
- SD_SIG_SPEED.cel
- SD_TRACK_INS.cel
- Signal Contacts.cel
- Signals.cel
- Solenoids.cel
- Switch Machine Contacts.cel
- Switches.cel
- Timers.cel
- Track Relays.cel
- Train Stop.cel
- Vital Contacts.cel

A complete list of cells can be obtained by downloading these resource files and opening the cell libraries. These files are available for download from the ASA website.

14.4. Signal drawings general requirements

The current digitised signalling plans, track insulation plans and circuit diagrams should be updated and converted to MicroStation V8 DGN format. The new and amended plans, including signalling plans, track insulation plans, circuit diagrams, compressed air system drawings, driver's diagrams, weekly notice insertions, equipment housing plans and level crossing plans shall be prepared using MicroStation V8 DGN format.

SolidWorks should be used for modelling 3D mechanical components.

14.4.1. Design history

For revision control purposes and change management in MicroStation, design history should be initiated. After a drawing file amendment is signed off, the changes shall be committed to the design history. The file is then saved and the modified date of the drawing file (dgn) is recorded.

For drawings that do not have a design history initialised, the design history should be initiated prior to starting amendments and then committed on completion of the changes.

All seed files for signal drawings have design history initialised, by default.

14.4.2. Submission package

The signal drawings shall follow the submission package requirements as explained in Section 8.3 of this standard.

The circuit book and air supply book shall be submitted to the Virtual Planroom at the as-built design stage.

Other signalling drawings, using typical signal drawing title block as explained in Section 14.1.3 shall be submitted to the Virtual Planroom during the following design stages:

- reference or final concept stage
- approved for construction (AFC) stage
- as-built stage

14.4.3. Folder structure

The following folder structure shall be used for submitting the drawing files and drawing image files for signalling drawings.

Circuit book and air supply book

Individual drawing files belonging to a circuit book or air supply book shall be stored in an EDMS number folder, which shall be a sub folder in the circuit book folder or air supply book folder.

Single image file, containing multiple sheets shall be created for each EDMS number. Image file shall be stored in the drawing image file folder.

Other signal drawings

Drawing files belonging to all other signalling drawings shall be stored in Others folder, which shall be a sub folder under 'signal' folder.

Single image file, containing single sheet shall be created per EDMS number and shall be stored in drawing image file folder.

Figure 128 shows the folder structure of the circuit book and air supply book drawing package; a template of this folder structure can be downloaded from the ASA website.

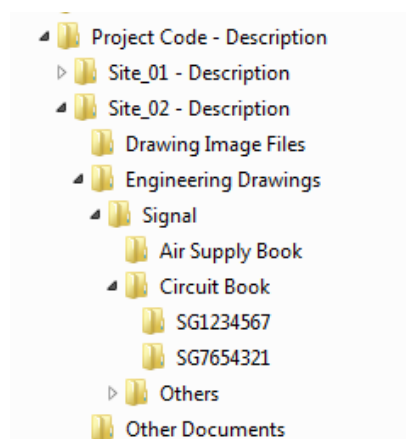


Figure 128 – Folder structure for signal drawings

14.5. Types of signal drawings

Based on the design content, signal drawings are classified into the following drawing types:

- signalling circuit diagram
- air system drawing
- signalling plans
- track insulation plan
- mechanical drawings
- fuse and terminal analysis
- rack layout
- relay contact analysis

14.6. Signalling circuit diagrams

Signalling circuits shall include the details in accordance with SPG 0703.

All circuits shall be drawn in a clear, logical and uncluttered manner with adequate vertical spacing between circuit elements. Ease of reading and understanding should be given priority in setting out circuits.

The circuits should be placed onto the drawing grid. All wires and components should have points snapped together.

The circuits shall be laid out to minimise wires crossing each other. Where wires cross each other, the vertical wire shall be broken at the point where it crosses the horizontal wire.

The circuits shall have the circuit name as the heading printed on the left side of the sheet.

14.6.1. Signal drawing levels

The signalling circuit and analysis drawings use various levels, colours, and line styles to indicate 'new', 'removed' and 'maintenance' information. All elements in circuit drawings shall be drawn on levels, line work, and text styles pre-set to levels.

If other levels, colours or line styles for temporary work are created, then they shall be removed from the drawing before the final drawings are submitted to the Virtual Planroom.

14.6.2. Text styles for signalling circuit diagrams

Text should be placed in the drawing using the menu toolbar, provided by TfNSW. The menu toolbar can be imported into MicroStation by setting up the dgnlib file. The text shall always be in upper case format.

The text styles should be used when placing text. The text style settings should not be modified.

Table 45 provides the list of text sizes and styles for circuit diagrams.

Table 45 – Text styles and sizes for circuit diagrams

Text style	Text size	Purpose
CB_Text_18	1.8 mm	Detail (for example, relay contact numbers), part numbers, notes
CB_Text_25	2.5 mm	Element (for example, relay and contact names), notes
CB_Text_35	3.5 mm	Circuit headings
CB_Text_50	5.0 mm	Miscellaneous labels

14.6.3. Master sheet templates

Borders, covers, indexes and analysis drawings such as 'Q' type relay analysis sheet, cable analysis sheet, fuse and terminal list sheets should be created from respective templates. The drawings shall be created using the standard prototype dgn as a template.

Note: The master sheet templates are the only acceptable dgnos that can be placed in any circuit drawing for the purpose of a master sheet.

Where a master sheet that is not listed needs to be created, then the full details of the sheet shall be referred to ASA for approval.

14.6.4. Signalling circuit symbols

The signalling circuit symbols shall be in accordance with SDG 004 *Standard Signalling Symbols* and shall be placed in the circuit drawing in the form of cells. For circuit diagram cell libraries, refer to Section 14.9 of this standard.

The cells should be inserted on a 5 mm grid in the circuit drawing and connected to other cells using smart lines only. To edit the text values in cells, the Edit Tag tool should be used. The cells should not be dropped or exploded. When drawing a second wire from a connection point, this line should be offset by 2 mm using the 1 mm grid for reference.

The source records should show the way it exists, and those standard cells shall not be used where they do not accurately represent the installed item. In this case, the item should be represented, as it exists.

Figure 129 shows the alignment of cells on a grid system.

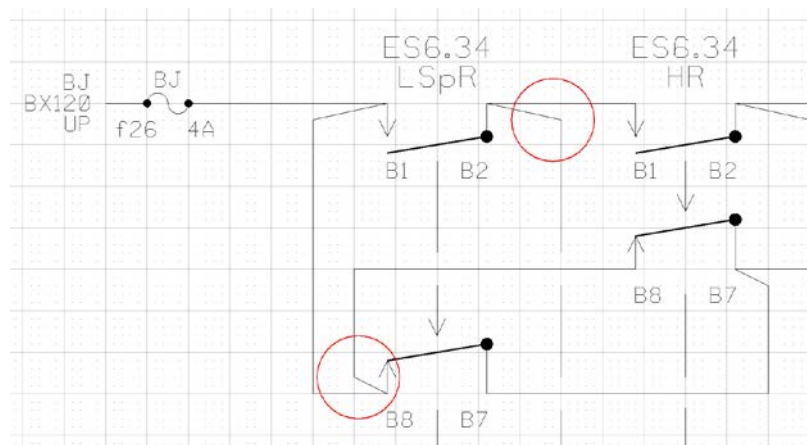


Figure 129 - Circuit drawing alignment on grid

14.6.5. Equipment rack layouts

The rack layouts shall be drawn to full size in design model and referenced into an A3 circuit sheet model. The dimensions should be placed in the A3 sheet view with reference units enabled and association lock activated. Annotations such as tables shall be placed in the A3 sheet view.

The rack layouts shall show the correct positions of all items of equipment mounted on the rack, including spare spaces. Terminations, fuses and other items shall be drawn to their correct length including end posts and spacers.

The following details are also required for each item:

- function name of the item (mandatory)
- configuration (or voltage)
- type or brand

Figure 130 shows an example of an annotation for a relay.

258
NLR
12V
QN1
8-8

Figure 130 – Relay annotation

The annotations for a relay are as follows:

- relay name - 258 NLR, 8-8, QN1 in the format
- voltage – 12V
- contact configuration – 8-8
- type QN1

Where descriptions are long, an identifier marker may be used. A reference table is permitted; however, this is not preferred.

The cells are provided for the most commonly used equipment. New equipment or equipment without a cell can be drawn as per design requirement.

To improve the legibility of the equipment rack layouts, the text styles as shown in Table 46 should be used when placing the text.

Table 46 – Text styles and sizes for rack layout

Text style	Text size	Purpose
CB_Narrow_18	1.8 mm	Labels
CB_Narrow_25	2.5 mm	Details and labels

14.7. Compressed air system diagrams

The air system diagrams shall include details in accordance with SPG 0703.

The schematic single line diagrams shall be provided for compressed air systems.

The starting and finishing kilometres and equipment kilometres should be provided on air main schematics to enable pinpointing of valve locations.

14.7.1. Air supply drawing format and composition

New and amended air supply drawings shall be prepared using MicroStation software.

For the air supply drawing seed file, refer to Section 14.2 of this standard.

The air supply diagrams shall be provided in A3 size books of drawings. These books shall have control pages and amendment sheets, similar to the circuit book requirements. An index and legend sheet should also be provided.

Refer to SPG 0703 for more information.

14.7.2. Air supply drawing levels

The air supply diagrams use various levels, colours, and line styles to indicate 'new', 'removed' and 'maintenance' information. If other levels, colours or line styles for temporary use are used, then they shall be removed from the drawing before the final drawings are submitted to the Virtual Planroom.

14.7.3. Text styles for compressed air system diagrams

Text should be placed in the drawing using the ASA menu structure. Text shall always be in upper case format.

Table 47 provides a list of text sizes and styles for air supply diagrams.

Table 47 – Text style and size for compressed air system diagrams

Text style	Text size	Purpose
AS_Text_18	1.8 mm	General text
AS_Text_25	2.5 mm	General text
AS_Text_35	3.5 mm	General text
AS_Text_50	5.0 mm	General text

14.7.4. Air supply pneumatic symbols

The air supply symbols shall be in accordance with AS 1101.1 *Graphic symbol for general engineering – Hydraulic and pneumatic systems* and SDG 004 *Standard Signalling Symbols* and shall be placed in the circuit drawing in the form of cells.

Where an air supply element that is not listed is required to be created, then the full details of the element shall be referred to the ASA for approval.

14.8. Signalling plans

A signalling plan shows the layout and location of signalling equipment.

The signalling plans shall be drawn on a drawing grid by setting one grid unit space equal to 10 m in the model space.

14.8.1. Signalling plan composition

The signalling plan should display any structure, equipment or feature in or adjacent to the rail corridor which can affect the signal controls or signal sighting.

Refer to SPG 0703 for details on signalling plan composition.

14.8.2. Scale

The signalling plan should use scales from the range 1:1000, 1:2000 and 1:10 000. The standard scale for interlocking areas shall be 1:2000 subject to full details being clearly and legibly shown. Changes to scale shall take place only at kilometre points. Signalling plans should be scaled longitudinally.

14.8.3. Track centreline

The centreline of all symbols for equipment and structures shall be as longitudinally correct to scale as possible and laterally correct relative to the track centre lines and laterally spaced for legibility.

14.8.4. Text styles and sizes for signalling plan

The 'working' text style should be used for signalling plans. This text style is available for download from the ASA website. The text should be placed using the appropriate style with the assigned height and width. The text should not be copied and then the height and width modified.

14.8.5. Global origin

The global origin is the primary set out point for the drawing. It is the basis for the diagram and the starting point for the linear track measurement for the section being documented.

Figure 131 shows an example of global origin marked in the drawing.

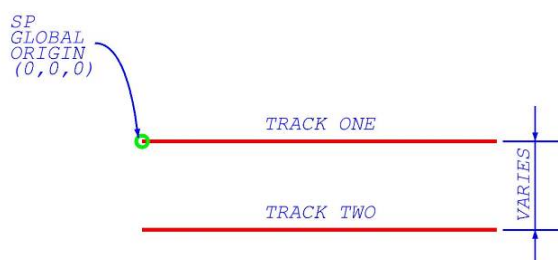


Figure 131 – Global origin

14.8.6. Signalling plan file continuation

Figure 132 shows the continuation of tracks in the signalling plan.

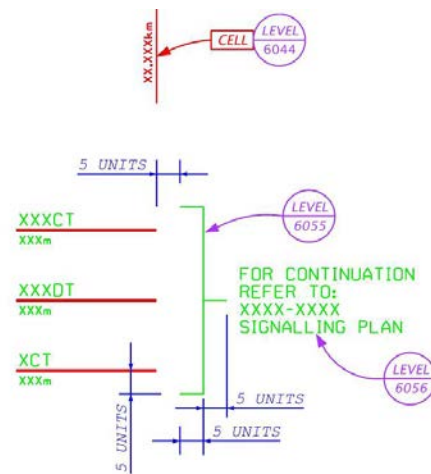


Figure 132 – Continuation of tracks

14.8.7. Curvature and gradient

The curve and gradient diagrams are drawn above the track centrelines set out with track distances. The power system supply and distribution information together with the trackside cabling details including the number of cables, cable sizes, termination points, joints and other information shall be drawn below the track layouts.

The curve component of the diagram should illustrate where they occur in the track and the curve radius should be shown in metres. The gradient details that are shown relative to the track, illustrate the differing gradients by the ratio of the rise or fall, to the distance of the gradient run.

Figure 133 and Figure 134 show the geo-physical layout of the track. It shows both gradients and curvatures. This information is essential in the spacing and positioning of signals. For example, if a signal is placed on a curve then the sighting distance of the signal is affected.

The curvature and gradient information shall be kept compact and closely spaced to avoid occupying excessive space on the plan. A gradient or curvature profile may be restarted to avoid the information being excessively wide.

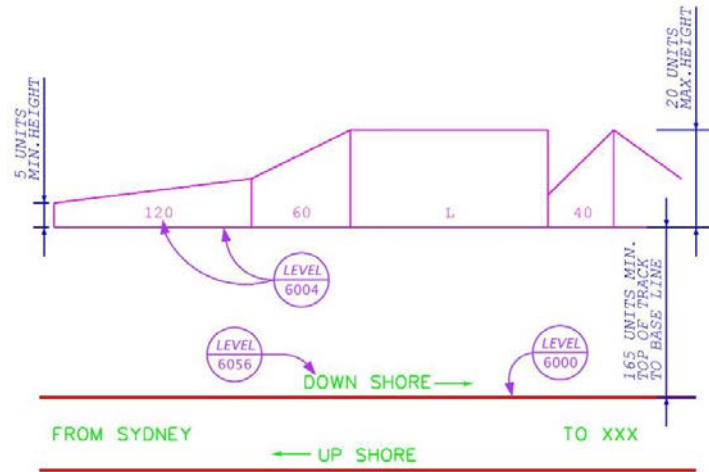


Figure 133 - Gradients

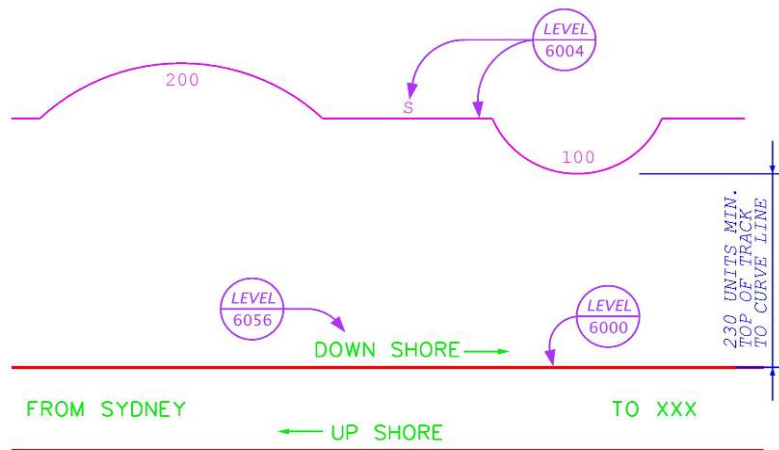


Figure 134 - Curvatures

14.8.8. Placing equipment and text on signalling plans

Care should be taken to minimise drawing clutter to maintain clarity and readability.

The signals and equipment should be placed along the track. They should be represented by graphic cells or text.

Equipment placement on the schematic diagram is based on linear kilometrage location and is either determined by survey or designated by the signalling engineer.

Equipment on diagrams should be represented using cells from the cell library to ensure that only standardised symbols are used.

In case the equipment is not located on the diagram at its specified location, due to a conflict with other plan items, then the items may be located in a slightly different location and indicated by an arrow to locate the correct position.

Signal bases, trainstops and insulated rail joints shall generally be shown adjacent to each other or as per the requirements of SPG 0703. They shall be shown as close as practically possible to the signal or infrastructure that the balise group is applicable.

The flat end of a point machine should be in line with the facing point lock. The machine should be shown on the side on which it is located.

For track circuit identification, track lengths and track names (which include the letter 'T') such as 167BT are required. The audio frequency track circuits should show applicable frequencies such as 1700Hz, 2300Hz, 2000Hz or 2600Hz.

Figure 135 shows two parallel tracks with one-track circuit in the DOWN direction and one in the UP direction. The track lengths are shown and measured between the insulated rail joints (IRJ's) or tuned loops. The tracks shown are of the frequency type.

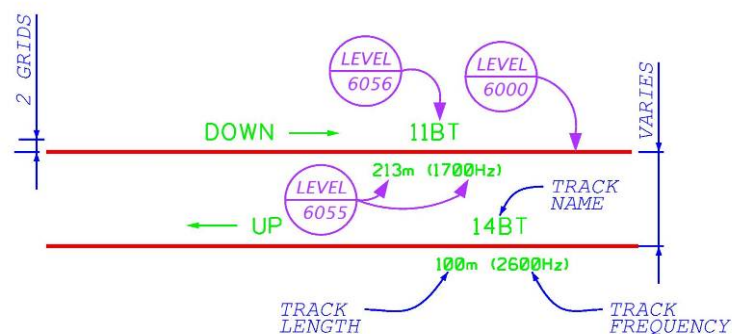


Figure 135 – Track description

Kilometre posts

Figure 136 shows the kilometre and half kilometre posts that should be shown with the distance noted above the post.

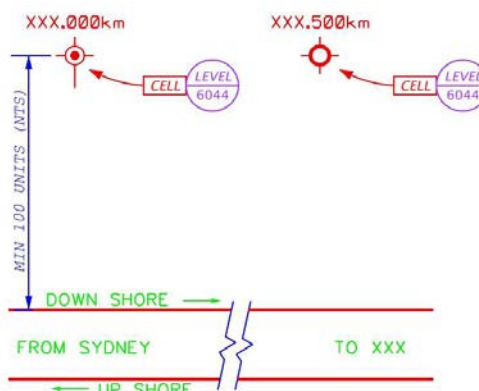


Figure 136 – Kilometre posts

Platforms and station names

Figure 137 shows a station platform in relation to the running tracks. The station name is placed in relation to the platform.

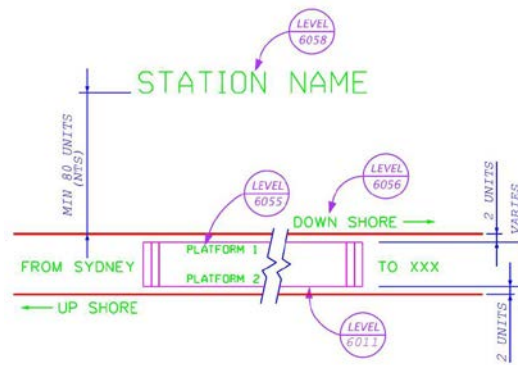


Figure 137 – Platform and station name

Figure 138 shows a station platform in relation to the curved running tracks.

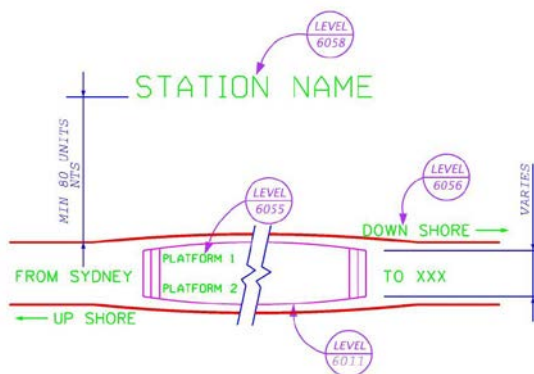


Figure 138 – Curved platform

Streets, bridges crossings over/under

Figure 139 shows the over line crossing and under line crossing for a signalling plan.

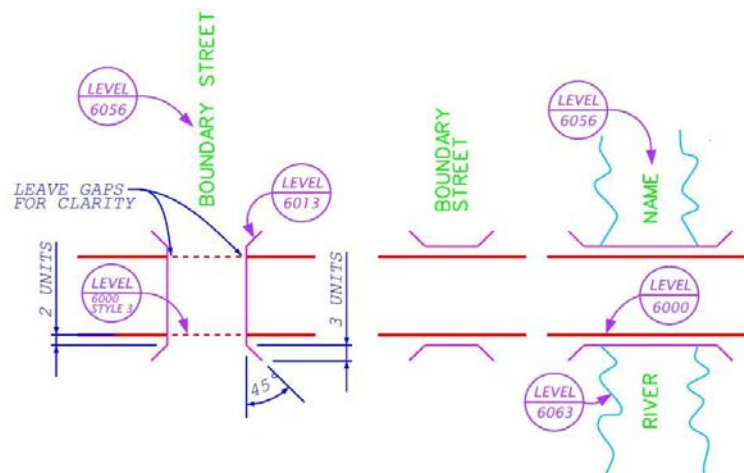


Figure 139 - Over line crossing and under line crossing / bridge

Crossovers and turnouts on signalling plans

Figure 140, Figure 141 and Figure 142 show the crossovers and turnouts in a signalling plan.

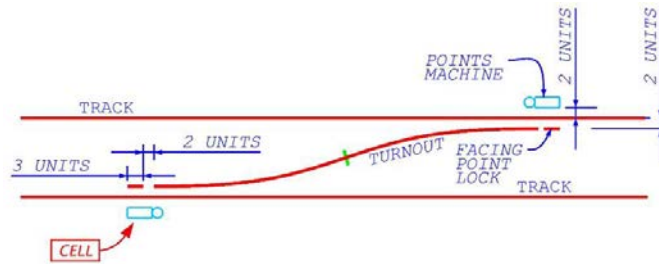


Figure 140 – General layout

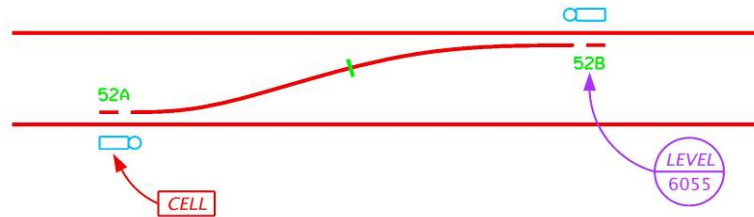


Figure 141 - Facing point locks (FPL) both ends

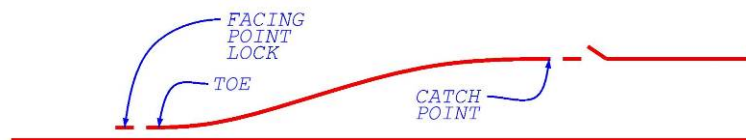


Figure 142 – Turnout with catchpoints

14.9. Track insulation plans

The track insulation plan (TIP) is a full sized CAD drawing that is drawn using the civil permanent way as a basis and then presented as a scaled track schematic diagram of the rails, showing detailed insulated joints, track circuit, traction return, track insulation and bonding arrangements. It shows the basic civil and structural infrastructure including gantries, stanchions, location of insulated joints, level crossings (road crossing and pedestrian crossings), platforms and stations.

The track layouts shall be taken from the permanent way CAD files as a reference.

14.9.1. Scale

The track insulation plans when printed shall have a longitudinal and lateral scale of 1:500. A larger scale such as 1:250 is permissible in complex yard areas; however, symbols are placed as standard cells and not scaled.

14.9.2. Orientation

The track insulation plans are oriented in such a way that Sydney is always on the left side of the drawing. Where there are no junctions, the track lines may be drawn as a straight line and each rail is represented by one line. Where there are diverse routes (junctions), the tracks shall be drawn to represent the curvatures of those tracks.

14.9.3. Drawing sheets

All drawings sizes shall be in accordance with AS 1100.101. The maximum height of a 'roll plan' is A1 (594 mm) up to a maximum of five linear metres in length. The drawings should be manageable in size, and a smaller width is preferred to permit safe use in outdoor conditions.

14.9.4. Track insulation plan global origin

The global origin is the primary set out point for the drawing. It is the basis for the diagram and the starting point for the lineal track measurement for the section being documented.

Figure 143 shows an example of TIP global origin.

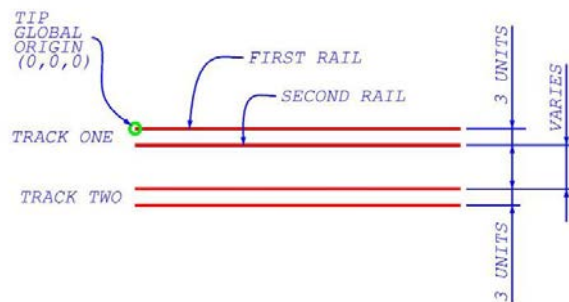


Figure 143 – TIP global origin

14.9.5. Track insulation plan file continuation

Figure 144 shows the TIP file continuation of tracks.

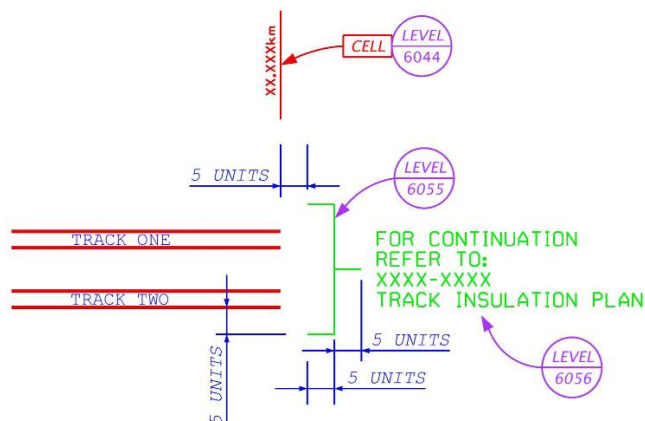


Figure 144 – File continuation

14.9.6. Track insulation plan drawing arrangement

For new designs, the track insulation plan shall be on a single length of track with a maximum roll length of five metres.

14.9.7. Track insulation plan composition

Refer to SPG 0703 for information on track insulation plan composition.

Track description

The track description should include the following information:

- track types such as CSEE, AC, Jeumont Schneider
- for jointless track circuits, the measurement shall be in metres, measured between block joints

If there are no block joints in a jointless track, then the measurement position should be in the middle of the tuned loop.

- track name which refers to the line where it is installed – that is, 'IL' would be Illawarra or where there are multiple lines it can be 'S' for suburban or 'L' for local included in the description.

Refer to ESG 100.29 *Signalling Design Principles – Naming of Locations, Track and Signals* for names of tracks and signals.

- frequency for audio track circuits

Figure 145 shows an example of a track description.



Figure 145 – Track description

Stanchions (OHWS)

Stanchions are provided to support the overhead wiring (1500 V) to power electric trains. Stanchions come in various types such as portal and single post.

The position of the stanchions is recorded on civil plans. These plans should be used as a base for the TIP to ensure correct placement of stanchions.

The kilometre placement of stanchions on the TIP should be done by measuring the distance from the main kilometre post.

For example, MH14+046 = Stanchion Name

14.046km = Stanchion Placement

Figure 146 shows an example of a stanchion.

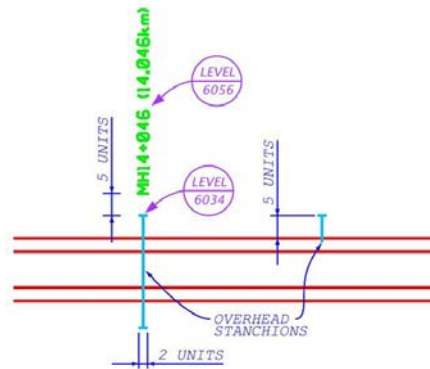


Figure 146 - Stanchions

Spark gap connections

Figure 147 shows an example of placement of spark gaps.

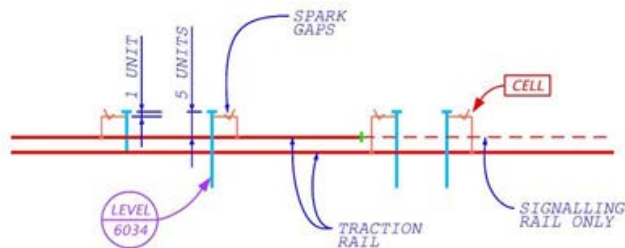


Figure 147 – Spark gap connection

Kilometre posts

The kilometre and half kilometre posts should be shown with the distance noted above the post as shown in Figure 148.

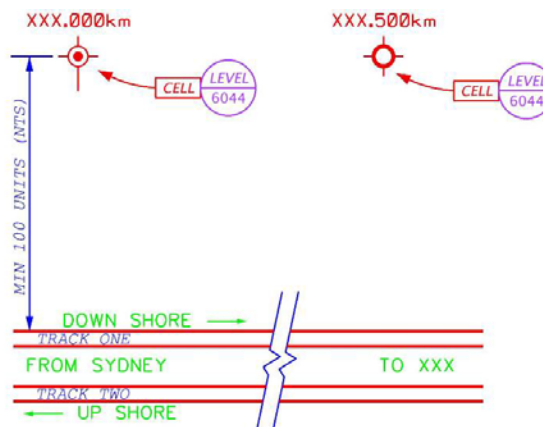


Figure 148 – Kilometrage post

Platforms and station names

Figure 149 shows a station platform in relation to the running tracks. The station name is placed in relation to the platform.

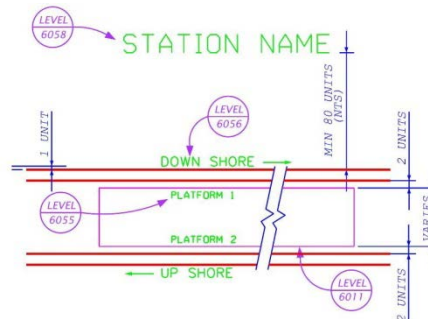


Figure 149 – Platform and station names

Overline and under line structures

Figure 150 illustrates the underbridge or overbridge on a track insulation plan.

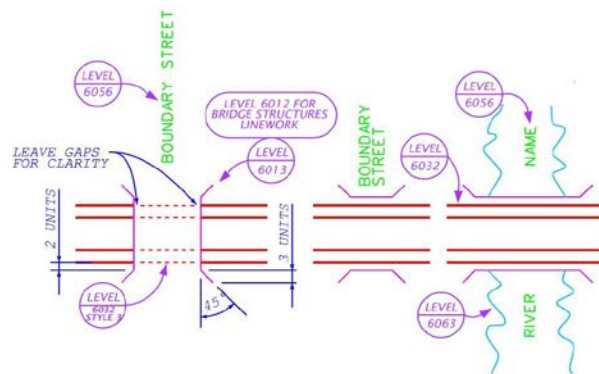


Figure 150 - Over line crossing, under line crossing and bridge

Audio frequency track (20 m) for track insulation plan only

With the audio tracks, adjacent tracks shall be of a different frequency.

All UP tracks should have even frequency that is, 2000 Hz or 2600 Hz.

All DOWN tracks should have an odd frequency that is 1700 Hz or 2300 Hz.

Figure 151 shows an example of an audio track circuit arrangement.

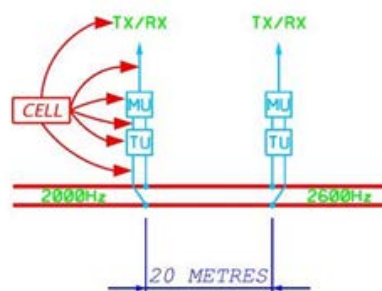


Figure 151 – Audio track circuit arrangement

CSEE tuning units with SI Unit (23 m)

Figure 152 shows a CSSE tuning unit.

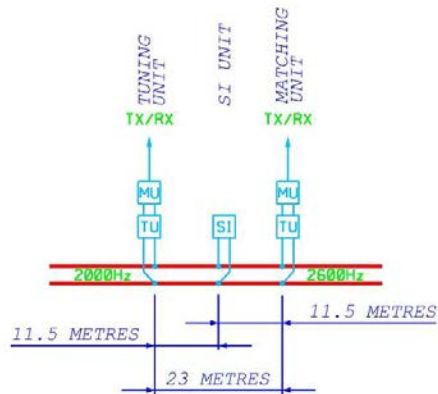


Figure 152 – CSEE tuning units

14.9.8. Equipment symbols placement

Figure 153 and Figure 154 show adjacent tracks of a different type. When this occurs, the joints shall be installed. The type of impedance bonds installed should be specified by the designer in accordance with SDG 004 *Standard Signalling Symbols*.

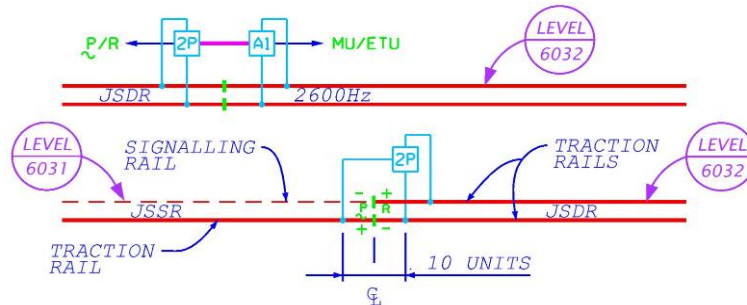


Figure 153 - Jeumont Schneider single rail to Jeumont Schneider double rail

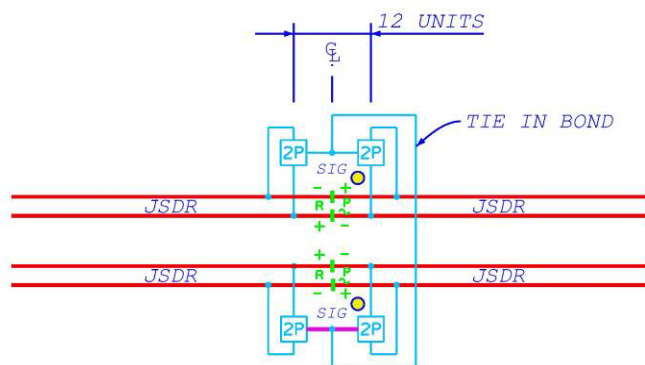


Figure 154 - Jeumont Schneider double rail to Jeumont Schneider double rail

14.9.9. Locations of signals and signal names on track insulation plan

Figure 155 shows signals location on a TIP.

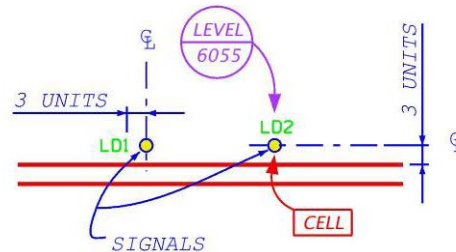


Figure 155 – Signal location

14.9.10. Insulated rail joints, parallel bonds on typical crossover

Figure 156 shows a typical crossover with double rail track circuits and parallel bonds. The insulated rail joints (IRJs) between the UP and DOWN roads shall separate the two roads electrically.

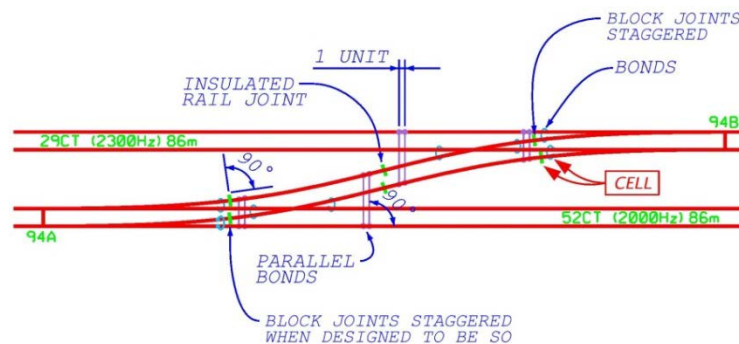


Figure 156 – Insulated rail joints

The IRJs should be drawn at right angles to the track line and centred at the centre of the radius of the curve and as close as possible.

Parallel bonds should be drawn as close as possible to the block joints and at right angles to the main track.

In some cases, the insulated rail joints in adjacent rails may be staggered. This stagger should be shown on the track insulation plan. If necessary, a larger scale detail may be provided to make this clear.

Figure 157 shows a staggered rail insulated joint.

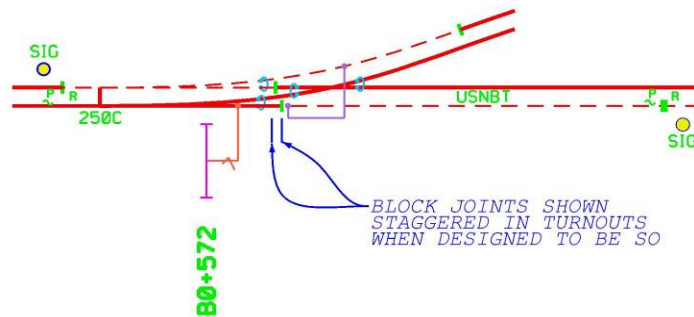


Figure 157 – Staggered insulated rail joint

14.10. Mechanical drawings

Mechanical drawings should be drawn utilising the SolidWorks application and should be generated from a 3D SolidWorks model.

All new drawings shall be produced in SolidWorks format.

For existing drawings, minor changes may be retained in the same format (for example, *.dgn or *.dwg) and significant changes shall be upgraded to SolidWorks format.

The drawings shall show the arrangements of mechanical equipment. The mechanical systems shall be fully detailed and include all fixtures, fittings, manufacturing, fabrication and finishing details in accordance with SPG 0703. If a drawing is converted from one format to another, a full check of the drawing is required before release.

14.10.1. Section symbols

The section symbols for cutting plane and detail shall be in accordance with Section 7 of AS1100.101.

14.10.2. Levels for mechanical drawing

The mechanical component and assemblies in SolidWorks models do not use levels. Levels are used only in the mechanical drawing format.

14.10.3. Text styles for mechanical drawing

The text for mechanical drawings should be placed in the drawing in accordance with AS 1100.101. The text shall always be in upper case format.

The text style for mechanical drawing is restricted. Table 48 provides the standard sizes for the clarity of drawing presentation.

Table 48 – Text style and size for mechanical drawing

Text style	Text size	Purpose
Arial Narrow	2.5 mm	General text
Arial Narrow	3.5 mm	General text
Arial Narrow	5.0 mm	Title text
Arial Narrow	7.0 mm	Big title text

14.10.4. Model filenames for assembly, subassemblies and components

The SolidWorks filename of a new assembly shall begin with M (in upper case only) followed by a catalogue number and drawing number. The file extension is .SLDASM in upper case; for example, M10-001.SLDASM.

The subassemblies of a larger item may be identified as sections. The filenames of subassemblies shall have the same drawing number as the general arrangement with the addition of -1, -2 and so on, such as M10-001-1.SLDASM, M10-001-2.SLDASM.

Each component is identified by its design part number which is formed by its drawing number along with A, B, or C and so on to link each other. The component may be listed in different subassemblies. The filename of the component model shall begin with M (in upper case only) followed by the catalogue number and drawing number and _A or _B or _C and so on to identify the item. The file extension is .SLDPRT in upper case.

For example, Design Part Number: M02001A, M02001B, M02001C

Filename: M02-001_A.SLDPRT, M02-001_B.SLDPRT, M02-001_C.SLDPRT

14.10.5. Format for bill of materials

Figure 158 shows the format and information required in the bill of materials (BoM) for a mechanical drawing.

ITEM No	PART No	ITEM DESCRIPTION	QTY	MAT/SPEC	FINISH	DWG REF	STOCK CODE
1	AE 1.5600	ENCLOSURE 300X380X210MM WITH SWING HANDLE	1	STAINLESS STL		M06-313 SHT 5/5	
2	M06313B	FRONT ENGRAVED PANEL	1	WHITE TRAFFOLYTE		M06-313 SHT 3/5	
3	M06313A	FRONT METAL MOUNTING PANEL	1	STEEL	ZINC PLATED	M06-313 SHT 3/5	
4		FRONT PANEL MOUNTING STUD ASSEMBLY	4			M06-315 SHT 3/4	

Figure 158 – Bill of materials – sample format

14.11. Other signal drawings

The type of drawings explained in Section 14.11.1 through to Section 14.11.4 shall include details in accordance with SPG 0703.

14.11.1. Equipment housing

The layout plans for equipment housings including huts, relay rooms, signal boxes and control centres shall be to scale and shall detail precise floor, wall and ceiling positions for all items.

14.11.2. Level crossings

The level crossing layout plans shall show, to a scale of 1:50, the physical arrangements at road/rail or controlled pedestrian crossings.

14.11.3. Structures and drawings

The working drawings for structures and buildings shall be fully detailed and shall include architectural and structural details, specifications, computations, arrangements for services together with assembly, mounting and erection details where appropriate.

14.11.4. Clearance diagrams

The trackside structures such as signals and signal gantries, which have been expressly approved in writing to protrude into the area of the standard structure gauge shall be detailed on clearance diagrams. Such diagrams shall detail the precise location of structures, including associated ladders, stays and fittings, in relation to the standard structure gauge including distances from rail level, running edge and overhead traction wires and equipment. The track curvature and superelevation shall also be shown on these diagrams.

14.12. Other reference material

The following documents can be referred for additional information on drafting signal drawings:

- T HR SC 00001 SP *Circuit Design Standard – Typical Circuits*
- SDG 002 *Circuit Design Standard Obsolete Signalling Circuits*
- SDG 003 *Circuit Design Standards ATP*
- ESG 100 *Signalling Design Principles*
- SPG 1230 *Design of Microlok II Interlocking*
- TMG G 1550 *Signalling Documentation Guidelines*

15. Fleet CAD requirements

The fleet CAD requirements are applicable to the fleet drawings produced for TfNSW rail projects. These requirements should be read in conjunction with Section 6 of this standard.

Where conflict exists between the two sections, then the fleet CAD requirements shall take precedence over the general requirements unless the general requirements expressly states otherwise.

15.1. Title block for fleet drawings

The fleet drawings shall use the drawing title block as explained in Section 7.1 of this standard. Refer to Figure 159 for an example of a completed title block for fleet drawings. The standard title block is common to all disciplines. The smart tags and fields that are common for a standard title block are explained in Section 7 of this standard and they apply across all disciplines. Some fields in the title block may vary and are specific to the discipline.

The smart tags and fields specific to the fleet design title block are explained in this section.

The fleet design drawings shall use the drawing title block as shown in Figure 159.

The preferred size for fleet drawings is A3.

The titles for fleet drawings shall be kept short and definitive. Where possible the titles should be based on the technical maintenance code (TMC) available in the RS 0041CM *Fleet Architecture Manual*. For example,

- Tangara - Passenger Body Side Door - Torque Cylinder Upgrade Bracket
- Double Deck Inter City – Bogie Axle Box - Bracket for Heat Sensor

Where the TMC does not apply, the first word should be the key noun.

For example, Hook for Bogie Removal.

[illegible]

Figure 159 - Typical title block for fleet drawings

15.1.1. Drawing details box for fleet drawings

The fields present in the drawing details box are explained in Section 7.1.1 of this standard. The 'TMC code' is an additional field that is specific to fleet design and is shown in Figure 160.

Table 49 provides the details and the requirements pertaining to these additional fields.

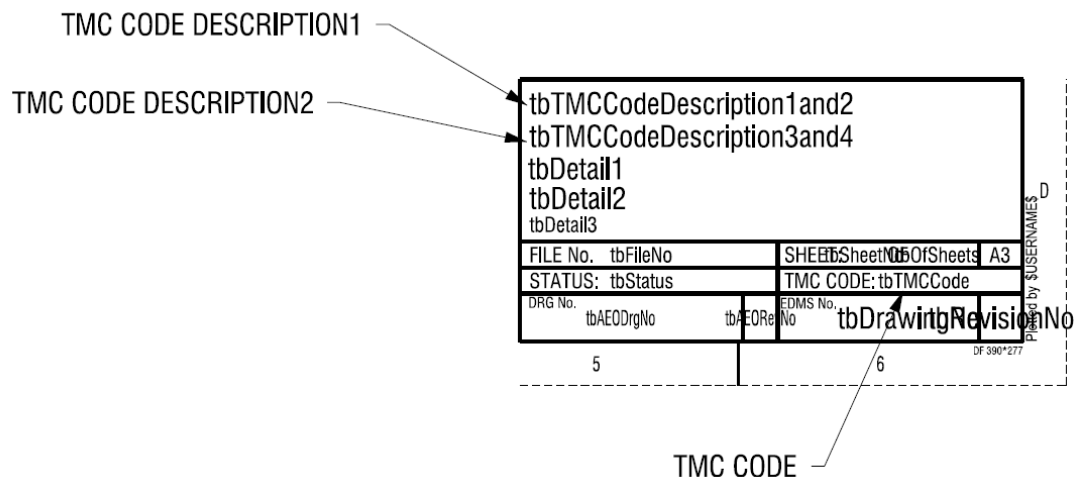


Figure 160 - Drawing detail box – Fleet design drawing

Table 49 - Drawing detail box on a fleet drawing

No.	Field Name	Tag	Requirements
1	TMC code description 1	tbTMCCodeDescription1and2	This is the description of TMC code 1 and code 2 for the drawing.
2	TMC code description 2	tbTMCCodeDescription3and4	This is the description of TMC code 3 and code 4 for the drawing.
15	TMC code	tbTMCCode	This is the TMC code for the main mechanical component.

The fields in the sign-off box and revision box are explained in Section 7.1.3 of this standard and they apply to fleet design drawings.

15.2. Amendments to fleet drawings

The following should be considered when amending a fleet drawing:

- i The person reading the amended drawing should be able to visualise the drawing prior to amendment.
- ii No information should be lost from the drawing as a result of the amendment.

These considerations are best achieved using one of the following methods:

- Method 1 - All modifications are detailed in the amendments column in such a way that any information deleted or changed on the drawing is preserved in writing.
- Method 2 - Details not applicable for future work are 'hatched' or 'shaded' out leaving the details legible beneath the hatching or shading.

The locations of the details should be marked or tagged with the appropriate amendment marker, which is a 6 mm diameter circle with the amendment letter centrally located.

Figure 161 shows a sample circle with the amendment letter centrally located.

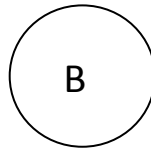


Figure 161 – Sample circle with amendment letter

All amendments should be detailed in the amendment box, as explained in Section 7.1.3 of this standard.

15.3. Reference list

The first sheet of each drawing shall have a reference list nominating all related documents and their relationship with the subject drawing. Typical relationships include the following:

- i superseded drawings
- ii reference documents (including specifications)
- iii associated documents (including standards)

All drawings, where possible, should be appropriately referenced to the drawing lists, general arrangements and to the next assembly drawings. This should be achieved by including references on the new detail drawing and by amending applicable assembly/application drawings and drawing lists to call up the new drawing. Where a drawing is of a standard component, which is used on many different assemblies, then this requirement may be waived.

Appendix A CAD support documents

The following is a list of CAD support documents that are available on the ASA website.

- Cell libraries
- Seed template files
- Line style resource file
- Text style resource file
- Level structure – dgnlib file
- Folder template
- Metadata spreadsheet
- General - Title block template
- DSS - Title block template
- DSS – Accurate filed drawing template
- Signal – Title block template
- Fleet – Title block template

Appendix B Format and examples of smart tag and metadata fields

Table 50 provides the format and examples for smart tags and metadata fields used in the CAD drawings.

Table 50 - Smart tag format and examples

S.no.	Field name	Metadata	Smart tag	Format	Example	Additional information
1	Engineering discipline	M	M*	Pick list	CV,EL,FL or SG only	
2	EDMS ID	M	M*	Free text - 7 characters	1234567	
3	EDMS amendment level	M	M	Free text up to 2 characters (alphabets - upper case)	A, B, AB, etc.	
4	EDMS amendment date	M	NR	Date (dd/mm/yyyy)	28/03/2014	
5	Location	M	M	Free text up to 40 characters (alphanumeric - upper case)	JANNALI, EAST HILLS, EPPING	
6	Corridor and kilometrage	M	M	Free text up to 40 characters (alphanumeric - upper case)	ILLAWARA LINE 22.617 km	
7	Job description detail 1	M	M	Free text up to 40 characters (alphanumeric - upper case)	PLATFORM RECONSTRUCTION	
8	Job description detail 2	M	M	Free text up to 40 characters (alphanumeric - upper case)	CONCRETE DETAILS	
9	Drawing type	M	M	Free Text up to 40 characters (alphanumeric - upper case)	ALIGNMENT, SECTIONS, PLAN	

S.no.	Field name	Metadata	Smart tag	Format	Example	Additional information
10	Document purpose	M	M	Pick list	CONCEPT DESIGN, PRELIMINARY DESIGN, DETAILED DESIGN, FOR CONSTRUCTION, AS-BUILT, TENDER or STANDARD DRAWING only	
11	Design company name	M	M	Free text up to 20 characters (alphanumeric - upper case)	XYZ CONSULTANTS	
12	Design company document number	M	R	Free text up to 30 characters (alphanumeric - upper case)	NSRU_UGL_124578_CV_001	if not same as EDMS drawing number
13	Sheet size	M	M	Pick list	A0, A0R, A1, A1R, A2 or A3 only	
14	Sheet number	M	M	Free text up to 2 characters (numerals)	2	
15	Total number of sheets	M	M	Free text up to 2 characters (numerals)	6	
16	Document set name	M	O	Free text - 9 characters (alphanumeric - 2 letters and 7 numerals)	CV1234567, usually the name of first image file of submission package	Hidden tag in title block
17	Document type	M	O	Pick list	DRAWING, PHOTOGRAPH, PARTS LIST, SPECIFICATION, TECHNICAL DATA, UNKNOWN/OTHER	Hidden tag in title block
18	SRA document number	O	NR	Free text up to 20 characters (alphanumeric - upper case)	275-1264	
19	File number	NR	O	Free text - 10 characters (alphanumeric - upper case)	M-101-457	

S.no.	Field name	Metadata	Smart tag	Format	Example	Additional information
20	Design company revision level	NR	R	Free text up to 2 characters (alphanumeric - upper case)	0, 1, 2, 3 etc.	if design company document number field is used
21	Drawn by	NR	M	Free text up to 15 characters (alphanumeric - upper case)	D.KNIGHT	
22	Drawn date	NR	M	Free text up to 10 characters (numerals)	15/12/2015	
23	Designed by	NR	M	Free text up to 15 characters (alphanumeric - upper case)	L.WHITE	
24	Designed date	NR	M	Free text up to 10 characters (numerals)	15/12/2015	
25	Drawing checked by	NR	M	Free text up to 15 characters (alphanumeric - upper case)	M.MARSH	
26	Drawing checked date	NR	M	Free text up to 10 characters (numerals)	16/12/2015	
27	Design checked by	NR	M	Free text up to 15 characters (alphanumeric - upper case)	H.SIMPSON	
28	Design checked date	NR	M	Free text up to 10 characters (numerals)	16/12/2015	
29	Approver	NR	M	Free text up to 15 characters (alphanumeric - upper case)	C.KENNEDY	
30	Approved date	NR	M	Free text up to 10 characters (numerals)	18/12/2015	

S.no.	Field name	Metadata	Smart tag	Format	Example	Additional information
31	Design discipline code	NR	M	Pick list	AR, CV, EL, FL, SG, SS, TR, or TE only	
32	Co-ordinate system	NR	O	Pick list	MGA, ISG, LOCAL or '-'	
33	Height datum	NR	O	Pick list	AHD, ASSUMED or '-'	
34	Scale	NR	M	Free text up to 10 characters (alphanumeric - upper case)	1:100, 5:1, NTS, etc.	
35	Amendment level	NR	M	Free text up to 3 characters (alphanumeric - upper case)	1, 2, A0, A1, B0, B1, etc.	
36	Amendment description	NR	M	Free text up to 32 characters (Alphanumeric - upper case)	APPROVED FOR CONSTRUCTION, ISSUED FOR REVIEW	
37	Amendment designer sign and date	NR	M	Free text up to 14 characters (Alphanumeric - upper case)	L.W., S.R.S., 15/12/15	
38	Amendment verifier sign and date	NR	M	Free text up to 14 characters (Alphanumeric - upper case)	H.S., T.L.C., 16/12/15	
39	Amendment approver sign and date	NR	M	Free text up to 14 characters (alphanumeric - upper case)	C.L.K., D.S., 18/12/15	

M - Mandatory

M - Mandatory, it is one field in smart tag - EDMS drawing number*

O - Optional

NR - Not required

R - Required, see additional information column