

 Eskom	Standard	Technology
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Area of Applicability: **Engineering**

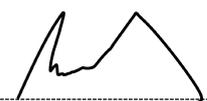
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Executive Summary

Subsequent to the restructuring of Eskom a need arose to consolidate Eskom Drawing Practice Standards to ensure consistency and alignment in the drawing office practice of the Eskom wires business, namely Transmission and Distribution engineering divisions.

The further restructuring of Eskom this document will apply to Transmission PDE the PTMC drawing office.

1. Introduction

Further restructuring of Eskom the need now arises for this Drawing Practice Standard to ensure consistency and alignment in the drawing office practice of the Eskom Transmission PDE business.

Engineering drawings communicate all needed information from the design engineer to the people who will apply the drawings. This document sets out the drawing requirements for Secondary Plant staff.

2. Supporting clauses

2.1 Scope

The following document serves as a reference document to ensure all drawing work in Transmission conforms to the same standard. This document defines general rules and code of practices to be followed by all designers and drafters to produce design drawings of consistent and professional quality.

2.1.1 Purpose

The purpose of this document is to define the standard and requirements that must be followed by the Eskom Drawing offices, Contractors and Consultants, for the production and control of all drawings

2.1.2 Applicability

This document shall apply to the PTMC drawing office of Eskom Holdings Limited Divisions.

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

The following documents must be read in conjunction with this specification. However, in cases of conflict, the provisions of this specification will take precedence.

2.2.1 Normative

- [1] ISO 9001, Quality Management Systems.
- [2] 240-71555472, Drawing Creation and Change Control of Secondary Plant Drawings Procedure
- [3] ISO 128-24, Technical Drawings General Principle of Presentation.
- [4] DST 34_195 Standard drawing practice for CAD users in the Power Plant and Control Plant technologies environments and for Electrification Networks

2.2.2 Informative

- [5] NRS 002 (2.0), Graphical Symbols for Electrical Diagrams
- [6] SANS 10111-1, Engineering Drawing Part 1: General principles
- [7] SANS 10111-2-1, Engineering Drawing Part 2: Geometrical tolerancing Section 1
- [8] SANS 10400, National Building Regulations
- [9] SANS 10143, Building Drawing practice
- [10] 01D 26508 - GSE1/95/P0025, Drawing Storage and Retrieval Processes Procedure

2.3 Definitions

2.3.1 General

Definition	Description
As Built Drawing	Drawing which is verified as an exact representation of a plant or a section of a plant that has been completely built, but does not indicate the revision to the drawing.
Contractor	A party appointed by Eskom to render services.
Designer	The designer is the Engineer or Consultant designing the electrification project.
dgn File	A dgn file is a Microstation file which contains the models, level structure and line style library of the project.
Drawing	A drawing drawn on CAD with an electronic drawing package is a vector format. A drawing drawn on a drawing board is scanned and is a raster format
Microfilm	An original drawing reproduced on a 35-mm silverhalide negative and mounted in an aperture card, will conform to SABS code of Practice No. 0111.
MicroStation Descartes	Bentley product for updating drawings, currently V8i is used
Paper Print	A clear, legible reproduction of a CAD print on PPC 80 g bond.

2.3.2 Disclosure classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 Abbreviations

Abbreviation	Description
AC	Alternating Current
CAD	Computer Aided Design
CO	Colour
CT	Current Transformer
DC	Direct Current
Dgn, Tif, Dwg	Drawing file extensions – Microstation, Raster, AutoCAD
ProjectWise	Document Management System
DSF	Drawing Submission Form
IED	Intelligent Electronic Device (e.g. protection relay, meter etc).
MCB	Miniature Circuit-Breaker
MWP	Megawatt Park
PDF	Acrobat
Pr Eng	Professional Engineer registered in terms of the Engineering Profession Act, 2000
SC	Study Committee

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Abbreviation	Description
SPN	Simmerpan
TL	Top Level Foundation
VT	Voltage Transformer

2.5 Roles and responsibilities

The accuracy and adequacy of the design and drafting work and its compliance with the applicable standards remain the responsibility of the Designer or Draughtsperson.

The Chief Engineer / Professional Engineer / Applications Manager / Applications Engineer / Technologist authorising drawings are accountable for the technical content of the drawing.

Design / Application Engineers are responsible for ensuring that the correct technical solution is applied to the drawings which must include all relevant plant information. They are also responsible for ensuring that the drawings are completed on time and with the correct level of accuracy prior to authorisation.

The Application Planner is responsible for ensuring the application task and the drawings are completed within reasonable time and the project time frame.

The primary / secondary plant Manager will be accountable for ensuring that the drawings on site are an accurate reflection of the plant, and is the latest revision.

The Drawing Office Supervisor is responsible for the flow of the drawings within the drawing office and ensuring that the change management and control of drawings are in accordance with the Drawing Office Standard.

The CAD Draughtsperson is responsible for the following:

- creation, updating and approval of drawings
- on the drawing management system ensuring that the metadata is created, and
- ensuring that drawings are checked in and signed off within the drawing management system,
- also a set of signed prints are required for issue to MWP, and as per the drawing submission form, prints required, must be given to the submitter.

2.6 Process for monitoring

Drawings are monitored by the items listed in this standard.

2.7 Related/supporting documents

This document supersedes all other documents.

3. Document content

3.1 Eskom logo

All new or revised drawings within PDE, when complete will bear the Eskom logo and Eskom Holdings Limited registration number; Figure 1.



Figure 1: Eskom Logo

The substation name, description of drawing, drawing number, revision number and signatures of drawn, checked and approved by; Figure 2.

REV	REVISION DESCRIPTION		BY	CHKD	APP	DATE
PROJECT APPROVED	DESIGN APPROVED		Eskom Holdings SOC Ltd Reg No 2002/015527/30			
NAME	NAME					
DATE DD/MM/YYYY	DATE DD/MM/YYYY	SUBSTATION NAME DRAWING TITLE LINE 1 DRAWING TITLE LINE 2 JB CABLING DIAGRAM				
PROJECT CHECKED	DESIGN CHECKED					
NAME	NAME					
DATE DD/MM/YYYY	DATE DD/MM/YYYY	©	DRAWING NUMBER			
PROJECT DRAWN BY	DESIGN DRAWN BY					
NAME	NAME	SHEET NUMBER		REVISION		
DATE DD/MM/YYYY	DATE DD/MM/YYYY	0		0		
SCALE		PANEL TYPE DESIGNATION XXXX-XXXX				SIZE GROOTTE A1L

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Figure 2: Title Block

Title blocks shown in figure 3 are examples of previous versions. The indicated text heights, widths, weight and levels are only used when a new drawing is created. For all existing drawings the text must remain as is and not changed. Only if the revision is for the text, revised or added, then the indicated sizes and levels are used.

The symbol © for COPYRIGHT is placed in the title block for all Transmission drawings.

The current drawing sheet has the copyright logo in the title block, when a drawing is revised and the title block is of the old type, then this is revised as well and will be noted in the revision description of the title block that the drawing is copyright protected.

3.2 Drawing Sheet Format

Only standard drawing boards, sizes from A0 – A4 per ISO 216, as indicated in figure 4 is used. For drawings produced, A1 – A3 is the normally used sizes, the following standard drawing sheet size must be used.

- A0 = 1189 x 841 mm
- A1 = 841 x 594 mm
- A2 = 594 x 420 mm
- A3 = 420 x 297 mm

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- A4 = 210 mm x 297 mm

				SHT.4	CABLE BLOCK
				SHT.3	CABLING DIAGRAM
				SHT.2	KEY DIAGRAM
				SHT.1	CONSTRUCTION DETAILS
O		FIRST ISSUE / EERSTE UITREIKING			
REV	AUTH MAG	DATE DATUM	REVISION/REVISIES	BY DEUR	CHKD NAGES
			INDEX REF/INDEKSVERW	REFERENCE DRAWINGS VERWYSINGSTEKENINGE	
SKELETON	DRG. TEK REGISTR		TRANSMISSION NATIONAL PTM&C	JUNO 66kV BUSBAR 2 SHT 3 OF 4 V.T. JUNCTION BOX 2 PROT. & METERING CABLING DIAGRAM	
	CH DR				
	CHKD NAGES	E.RAMOKHOASE	26-02-1999		
PROJECT	DRAWN GETEKEN	L.GUYONNAUD	26-02-1999	APPROVED M. G. DUNSTAN	GOEDGEKEUR
	SCALE SKAAL		26-02-1999	0.03/12679	
				REV	0

REV	REVISION DESCRIPTION			BY	CHKD	AUTH	DATE
PROJECT APPROVED	DESIGN APPROVED	 Eskom		Eskom Holdings SOC Ltd Reg No 2002/015527/30			
R. MAVUSO	V. j.v.RENSBURG						
DATE 05-2015	DATE 30/10/2009	INCANDU 132kV BUSZONE COVER SHEET					
SCHEME APPROVED	DESIGN CHECKED						
V. MSIBI	J. CUNNINGTON						
DATE 05-2015	DATE 30/10/2009	© 0.07/18227					
PROJECT CHECKED	DESIGN DRAWN BY						
P. MOROKE	R. VILJOEN	SCALE		SHEET NUMBER	REVISION		
DATE 05-2015	DATE 15/10/2009			0	0		
PROJECT DRAWN BY							
Q. OTTE							
DATE 12-2014							

Figure 3: Title block from a previous version

3.2.1 Drawing Sheet Electronic Format

A Transmission approved software package must be used for all drawings produced on a CAD workstation.

All vector drawings must be saved with a .dgn extension format.

All raster drawings must be saved with a .tif extension format.

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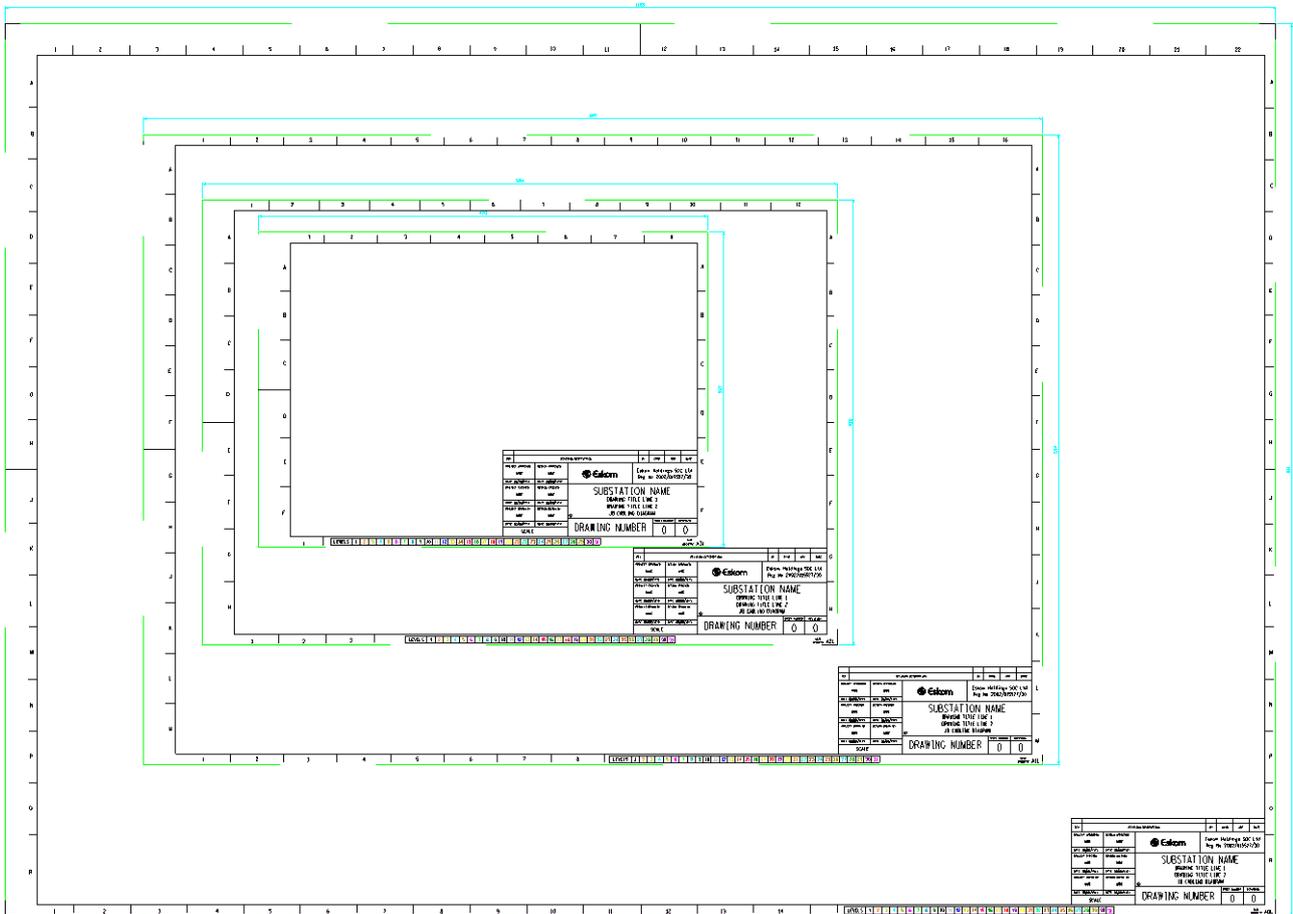


Figure 4: Standard sizes for drawing sheets

3.3 Drawing Numbering Format

The following is a list of the registering centres and regional identifiers.

3.3.1 Registering Centres

The following is a list of the registering centres and regional identifiers.

- Megawatt 0
- Simmerpan (Distribution) 10
- Rosherville 13
- Peaking 18
- Witbank 19
- Matimba 20
- Tutuka 21
- Lethabo 23
- Duvha 24
- Hendrina 25

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- Arnot 26
- Kriel 28
- Matla 29

3.3.2 Regional Identifiers

- 00 Head Office
- 01 Witbank Power Station
- 02 Salt River Power Station
- 03 West Cape Region
- 04 Sabie Gorge Scheme
- 05 Congella Power Station
- 07 Natal Region
- 08 East Transvaal Region
- 09 Umgeni Power Station
- 10 Hex River Power Station
- 11 Central Power Station Kimberley
- 12 North Cape Region
- 13 Wilge Power Station
- 14 Klip Power Station
- 15 Hendrina Power Station
- 16 Border Generation
- 17 Border Region
- 18 Rand and Orange Free State Region
- 19 Grootvlei Power Station
- 20 Municipal Schemes
- 21 Vaal Power Station
- 22 Vierfontein Power Station
- 23 Brakpan Power Station
- 24 Simmerpan
- 25 Rosherville
- 26 Robinson Compressor Station
- 27 Canada Compressor Station
- 28 Vereeniging Power Station
- 29 East Cape Region
- 30 Taaibos Power Station
- 31 Highveld Power Station
- 32 Eskom Centre and Randkom Buildings

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- 33 Komati Power Station
- 34 Eskom Building, Cape Town
- 35 Ingagane Power Station
- 36 Camden Power Station
- 37 Orange River Region
- 38 Hendrik Verwoerd Power Station and Dam
- 39 Van der kloof Power Station and P.K. Le Roux Dam
- 40 Torquay Power Station and Dam
- 41 Arnot Power Station
- 42 Ruacana Power Station
- 43 Van Eck Power Station
- 44 Swawek Distribution Region
- 45 Kriel Power Station
- 46 Koeberg Nuclear Power Station
- 47 Matla Power Station
- 48 Pumped Storage Stations
- 49 Gas Turbine Power Stations
- 50 Megawatt Park Complex
- 51 Transmission Line Towers (all Regions)
- 52 Control and Protection Equipment (all Regions)
- 53 Communication (all Regions)
- 54 Circuit Breakers, Current Transformers, Isolators, Surge Arresters and Similar Equipment with Bulk Purchases (all Regions)
- 55 Swawek Generation
- 56 Research and Development
- 57 Duvha Power Station
- 58 Matimba Power Station
- 59 Operations
- 60 Eskom College
- 61 Tutuka Power Station
- 62 East Cape Region
- 63 Lethabo Power Station
- 64 Kendal Power Station
- 65 Strategic Spares (under Operations Dept. Control)
- 66 Majuba Power Station
- 67 Lekwe Power Station

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-
- 68 765 kV Projects
 - 69 Eskom (Copyright) Line Towers
 - 70 Megawatt Park Tenants Properties
 - 71 Megawatt park Special Projects
 - 72 Epupa Project
 - 73 Modular

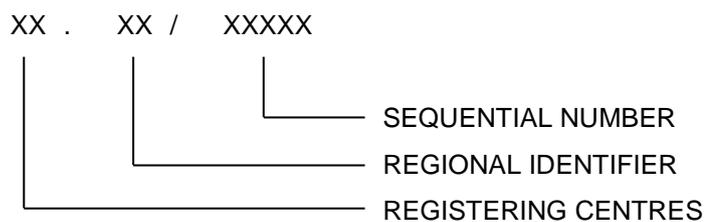
3.3.3 Regions

- O-WC West Cape Region
- O-SC South Cape Region
- O-NC North Cape Region
- O-EC East Cape Region
- O-FS Orange Free State Region
- O-CT Central Transvaal Region
- O-ST South Transvaal Region
- O-WT West Transvaal Region
- O-NT North Transvaal Region
- O-ET East Transvaal Region
- O-WN West Natal Region
- O-EN East Natal Region

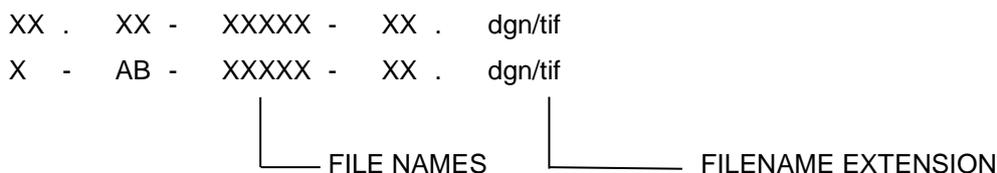
3.3.4 The CAD workstation numbering convention is the following format

3.3.4.1 Drawing numbering

The drawing number format is from the above list:



The MicroStation format.



The naming convention on the document management system is in the following format:

Metadata:

- XX . XX / XXXXX - XX

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- XX - AB - XXXXX - XX

Filename:

XX . XX - XXXXX - XX . dgn/tif

XX - AB - XXXXX - XX . dgn/tif



File names use the drawing number of the drawing e.g.

- 0.12/12345 Sheet 5 0.12-12345-05.dgn

The drawing number on the drawing and the document management system has 5 characters and the sheet number is indicated as a single character on the drawing but denoted as two characters within the document management system.

Drawings that have more than one sheet must have the same drawing number, this should be indicated as such on the drawing, in numerical order starting from sheet 1 (one). Drawings which have a sheet 0 (zero) cover sheet, indicates the sheet number, title, design and project revision and date pertaining to that scheme. Also indicated are the levels used and the description of that particular level.

3.4 Protection Standard scheme identification

Protection schemes are identified by a 7- or 8-digit code as follows:-

6	FZ	2	5	03
Generation of scheme (see 3.4.1)	Scheme group code (see 3.4.2)	Manufacturer code (see 3.4.3)	Series number (e.g. 5th scheme in the series)	Major revision number

3.4.1 Generation of scheme

Protection scheme generations are identified in accordance with Table 1.

Table 1: Scheme generation indices

Phase	Technology	Approx years
1	Electromechanical	Up to 1981
2	Electronic	1982 - 1993
3	Numerical	1993 - 2009
4	Numerical integrated into IED, adaptive	2004 - 2013
5		2014
6		2015 - current

3.4.2 Scheme group code

The function of a scheme will be identifiable via the scheme group code of Table 2.

Table 2: Scheme group codes

Code	Description	Code	Code Description
AC	AC board	FZ	Distance protection feeder
AD	AC/DC Modules	FZD	Distance/Diff protection feeder
BC	Bus coupler/section	GD	Differential generators
BP	Busbar protection	LM	Under Frequency Load shedding
BZ	Bus Zone	LS	Load shedding
CB	Capacitor Bank	MP	Metering panel
CF	Cable Feeder	MS	Metering statistic
CO	Chop-over/Change-over	MT	Metering tariff
DC	DC Board	RF	Rural feeder
FC	Phase comparison feeders	SR	Shunt Reactor
FD	Differential feeder	TC	Tap changer
FP	Pilot wire feeder	TM	Power transformer

3.4.3 Scheme manufacturer

The scheme manufacturer will be identifiable by a number following the scheme group code:

- 0 = GENWEST
- 1 = Alstom
- 2 = Siemens
- 3 = ABB
- 4 = Reyrolle
- 5 = IST
- 6 = VAMP SOLUTIONS
- 7 = Consolidated Power Projects (CONCO)
- 8 = Woodbeam Technologies
- 9 = Conco

3.4.4 Cable numbers and circuit identification

3.4.4.1 Cable numbers

Unless superseded by a documented regional standard:

- a) Cables are numbered in ranges appropriate to their applicable voltage level and/or function as per Table 3.
- b) Each cable number is prefixed by a letter identifying the panel to which it is associated (e.g. Transformer 1 = A, Transformer 2 = B etc).
- c) Wherever possible, cable numbering are kept consistent between bays (e.g. x301 is the cable between the Red phase CT and the CT Junction Box on all 132kV bays).

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Voltage level of Function	Cable Number series
765kV	8000 to 8065
400kV	100 to 165
275kV and 220kV	200 to 265
132kV	300 to 365
88kV, 66kV & 44kV	400 to 465
33kV, 33kV & 11kV	500 to 565
(Bulk) auxiliary power supplies	600 to 690
AC/DC supplies	700 to 790
IDF Cabling	800 to 999
Measurements IDF Cabling	1000 to 1099

Table 3: Standardised cable number series per voltage level and function

3.4.4.2 Circuit identification

Each lead has a letter to denote its function (adopted from the obsolete standard BSS 158) as per Table 4

Letter	Description
A	Current transformers for primary protection
B	Current transformers for bus zone protection
C	Current transformers for secondary or back-up protection
D	Current transformers for metering and measurements
E	Reference voltage for instruments, metering and protection
F	Reference voltage for voltage control
G	Reference voltage for synchronising
H	AC supplies and AC/DC supplies for motorized isolators and circuit-breakers
J	Primary DC supplies
K	Protection, closing and tripping circuits
L	Alarms and indication initiated by auxiliary switches and relay contacts excluding those for remote selective control and for general indication equipment
M	Auxiliary and control motor devices, governor motor, rheostat motor, generator AVR control, spring charging motors, transformer cooler motor control, motors for isolator operation
N	Tap-change control including AVC, tap position and progress indication
P	DC tripping circuits used solely for busbar protection
R	Interlock circuits and Transfer circuits
S	DC Instruments and relays, exciter and field circuits for generators
T	Pilot conductors between panels, independent of the distance between them, for pilot wire protection, for inter tripping or for both
U	Spare cores and connections to spare contacts
W	Supervisory Controls and Analogues, Energy pulsing
X	Supervisory Alarms and indications
Y	Telephones

Table 4: Circuit identification

3.4.4.3 Level Indicator

a) Below the title block a level indicator indicates which levels are selected for viewing, hardcopy or pdf drawings. This box is located at the bottom right hand side of the sheet.

LEVELS	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	29	30	31	32	33	34	35	36	37
--------	---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

b) The information on sheet 0 of the scheme must correspond to the level indicator.

3.4.4.4 Colour Indicator

Colour table used in MicroStation is colour.tbl, indicated in Table 5 below.

Level 1	CO = 0	Level 13	CO = 60	Level 25	CO = 78
Level 2	CO = 6	Level 14	CO = 102	Level 26	CO = 124
Level 3	CO = 11	Level 15:	CO = 10	Level 27	CO = 39
Level 4	CO = 7	Level 16	CO = 114	Level 28	CO = 98
Level 5	CO = 100	Level 17	CO = 36	Level 29	CO = 108
Level 6	CO = 21	Level 18	CO = 3	Level 30	CO = 85
Level 7	CO = 2	Level 19	CO = 13	Level 31	CO = 5
Level 8	CO = 95	Level 20	CO = 4	Level 32	CO = 74
Level 9	CO = 170	Level 21	CO = 22	Level 33	CO = 36
Level 10	CO = 0	Level 22	CO = 12	Level 34	CO = 39
Level 11	CO = 9	Level 23	CO = 118	Level 35	CO = 77
Level 12	CO = 41	Level 24	CO = 71	Level 36	CO = 78
				Level 37	CO = 79

Table 5: Circuit identification

3.5 Power Delivery (PTMC)

Drawing Sheet Summary as from Figure 5;

REV	REVISION DESCRIPTION		BY	CHKD	APP	DATE
PROJECT APPROVED NAME	DESIGN APPROVED NAME		Eskom Holdings SOC Ltd Reg No 2002/015527/30			
DATE DD/MM/YYYY	DATE DD/MM/YYYY					
PROJECT CHECKED NAME	DESIGN CHECKED NAME	SUBSTATION NAME DRAWING TITLE LINE 1 DRAWING TITLE LINE 2 JB CABLING DIAGRAM				
DATE DD/MM/YYYY	DATE DD/MM/YYYY					
PROJECT DRAWN BY NAME	DESIGN DRAWN BY NAME					
DATE DD/MM/YYYY	DATE DD/MM/YYYY	DRAWING NUMBER	SHEET NUMBER	REVISION		
SCALE			0	0		

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PANEL TYPE DESIGNATION XXXX-XXXX

SIZE GROOTTE A1L

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Figure 5: Title block

Title Block (as per latest communiqué update, August 2015)

Substation name, Drawing number, Sheet, Revision – TH=7, TW=5, WT=3, CO=0, LV=10

Drawing title description - TH=3.5, TW=2.5, WT=2, CO=0, LV=10

Revision description, project checked, approved, drawn by - TH=2, TW=1.5, WT=1, CO=0, LV=10

Scale – 1:1, 1:10; 1:50; 1:100

Master tracing description - TH=3, TW=2.5, WT=1, CO=0, LV=10

Panel type description - TH=4, TW=3.5, WT=1, CO=0, LV=10

Level number indicated - TH=3, TW=2.5, WT=1, CO=0

Text Font = 80

All other text on sheet - TH=3.5, TW=2.5

Colour – as indicated in 3.4.4.4 (colour table used per drawing office compiling drawings)

3.5.1 MicroStation Requirements

The following MicroStation design file settings is used (MicroStation menu: “Settings>Design File”):

Table 6: MicroStation settings

Requirements	Description
Grid	GU = 2,5 mm GR = 6 mm Axis Lock = On / Off Grid Lock = On / Off Display = On
Working Units	Master unit = mm Sub unit = th (100 th = 1 mm) Note: Once in Microstation, select: “Settings>design file>working units”, then select the “Advanced” button and make the resolution : 100 per mm.
Levels	Level 1 = On (border) Level 2 = On (revision to master) Level 10 = On Other levels in accordance with scheme requirements.
Snap Lock	Snap = On at all times Key point = On at all times Divisor 2 for tentative control
Fence	Inside = On
Font	FT = 80
Seed	Seed2d D:\Documents and Settings\All Users\Application Data\Bentley\MicroStation V8i (SELECTseries)\WorkSpace\System\seed

Requirements	Description
Text	All sheets in the scheme TH = 3 mm (text height) TW = 2,5 mm (text width) Line spacing = 2 mm WT = 1 (weight) LC = 0 (line style)
Line Style	LC = 0 (Solid lines) LC = 2 (Linking lines or loop options) LC = 4 (Relay casing outline)
Weight	WT = 1 (Text) WT = 2 (Lines) WT = 5 (Busbars, cable terminal strips and description block) View 1 = On View 5 = On View 6 = On View 7 = On View 8 = On
Views	View 1 - Fit full drawing View 5 - Fit full drawing (all levels on) View 6 - Right Top corner View 7 - Left Bottom corner View 8 - Title block

3.5.2 Text Justification

Examples of text justification.

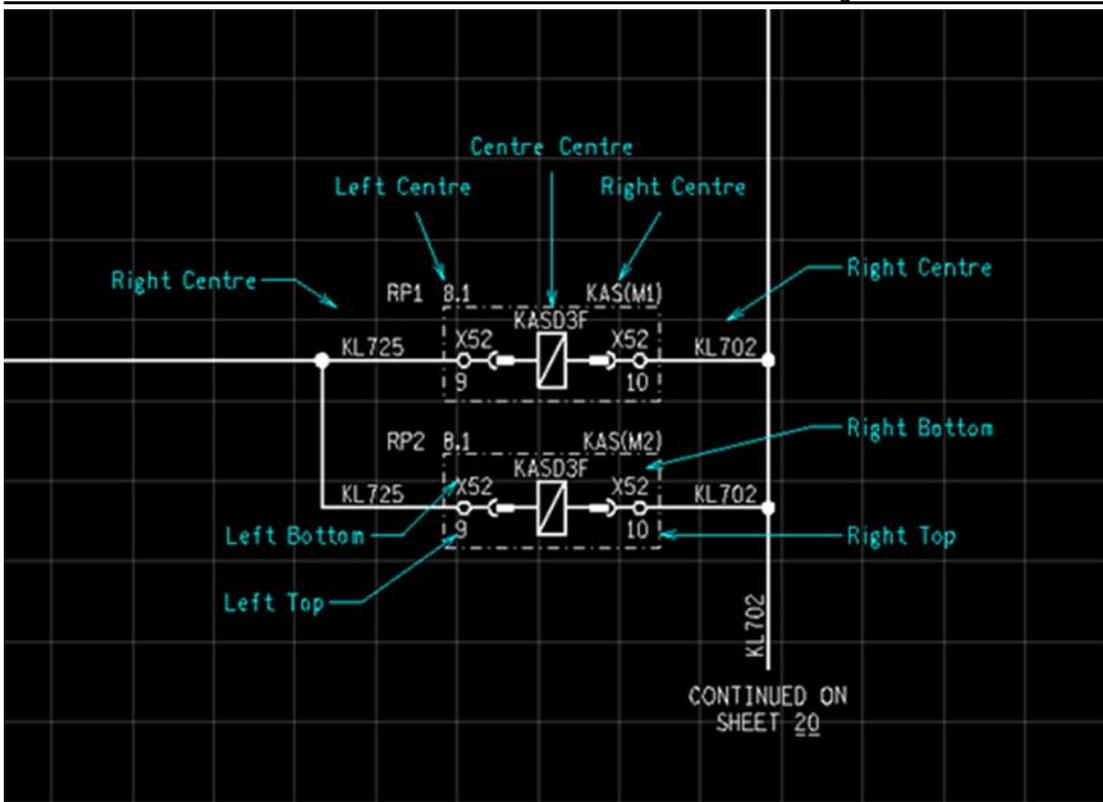


Figure 6: Text Justification

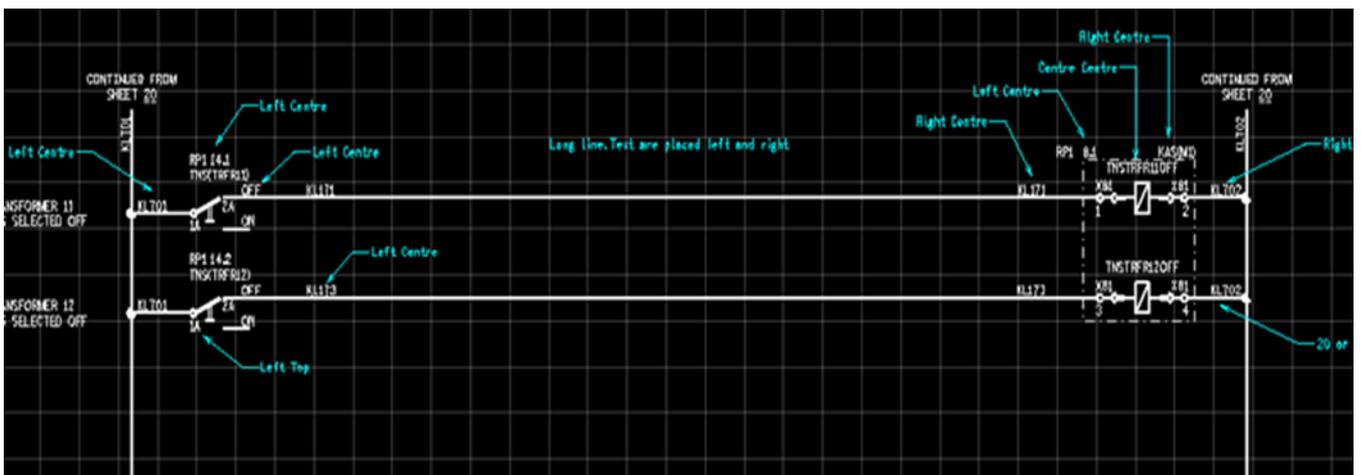


Figure 7: Text Justification

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3.6 Text Font, Line Types and Dimensioning (General)

3.6.1 Text Font

Text font used in Transmission is font 80 as indicated in figure 8. The text justification should be done in such a way that editing does not require the text to be moved. The text justification of single-line text and multi-line text shall snap onto the grid.

3.6.2 Types of Lines

Only the types and thickness of lines shown in figure 9 are used.

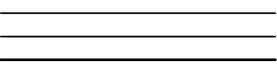
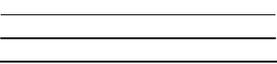
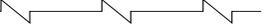
In cases where other types of lines are used for special fields, or if lines specified in the table are used for application other than those detailed in the second last column of the table, the conventions adopted are indicated or explained by notes on the drawings concerned.

3.6.3 Thickness of Lines

In general, no more than two thicknesses of lines should be used on any one drawing. However, for lines that do not represent a real feature, it is preferable to use a line that is "thin", (i.e. the thinner line for centre lines and dimension lines, and the thicker line for certain physical features, e.g. hidden detail, outlines of revolved sections, bus bars, etc.). Where it is possible to restrict the drawing to two-line thickness, the ratio of the thick line to the thin line must not be less than 2:1.

FONT 80					
LETTERS & DIGITS			SPECIAL CHARACTERS		
FONT 80			FONT 80		KEYBOARD
A	a	0	Ω	,	↓
B	b	1	"	>	"
C	c	2	#	.	#
D	d	3	Σ	θ	\$
E	e	4	%	/	%
F	f	5	&		&
G	g	6	'		'
H	h	7	((
I	i	8))
J	j	9	=		=
K	k		-		-
L	l		^		^
M	m		~		~
N	n		@		@
O	o		⊗		'
P	p		φ		{
Q	q		°		[
R	r		∅]
S	s		::]
T	t		+		+
U	u		;		;
V	v		*		*
W	w		:		:
X	x		≡		\
Y	y		≠		:
Z	z		<		<

Figure 8: Font 80 – Text Font

LINE	DESCRIPTION	GENERAL APPLICATIONS	LINE WEIGHT	LINE CODE
A1 	CONTINUOUS	A1 VISIBLE OUTLINES	2, 3 or 5	0
A2 		A2 VISIBLE OUTLINES	1 OR 2	0
B 	CONTINUOUS THIN (STRAIGHT OR CURVED)	B1 IMAGINARY LINES OF INTERSECTION B2 DIMENSION LINES B3 PROJECT LINES B4 LEADER LINES B5 HATCHING B6 OUTLINES OF RESOLVED SECTIONS IN PLACE	0 0 0 0 0 0	0 0 0 0 0 0
C 	CINTINUOUS THIN	C1 LIMITS OF PARTIAL OR INTERRUPTED VIEWS AND SECTIONS, IF THE LIMIT IS NOT A CHAIN THIN LINE	0	0
D 	CONTINUOUS THIN (STRAIGHT) WITH ZIGZAGS	D1 LIMITS OF PARTIAL OR INTERRUPTED VIEWS AND SECTIONS, IF THE LIMIT IS NOT A CHAIN THIN LINE	0	0
E 	DASHED THICK	E1 EMPHASISED APPLICATIONS	5	3
F1 	DASHED THIN	F1 HIDDEN OUTLINES	2 OR 3	3
F2 		F2 HIDDEN EDGES	1 OR 2	3
F3 		F3 LINKING LINES	1	2
H 	CHAIN THICK AT ENDS AND CHANGES IN DIRECTION	H1 CUTTING PLANES	0 (CHAIN) 5 (ENDS)	4 OR 7 0
J 	CHAIN THICK	J1 INDICATION OF LINES TO WHICH SPECIAL REQUIREMENTS APPLIES eg. X Y SETTING OUT	2	4 OR 7

LINE WEIGHT AND CODE IS DEPENDENT ON DISCIPLINE AND APPLICATION

Figure 9: Types of lines

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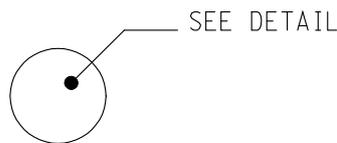
3.6.4 Spacing of Lines

To allow for the present limitations of printing and viewing of microfilm copies, the adjacent parallel lines should be spaced at least 1 mm apart (it is accepted that in some cases the scale of the drawing will thus be violated).

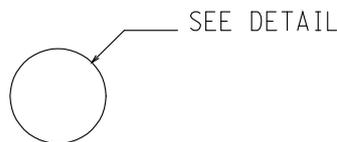
3.6.4.1 Termination of Leader Lines

Leader lines should terminate: -

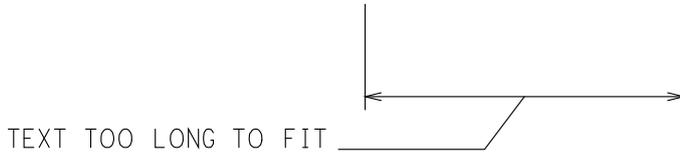
- with a dot, if the line ends within the outlines of an object, at an angle of 135°.



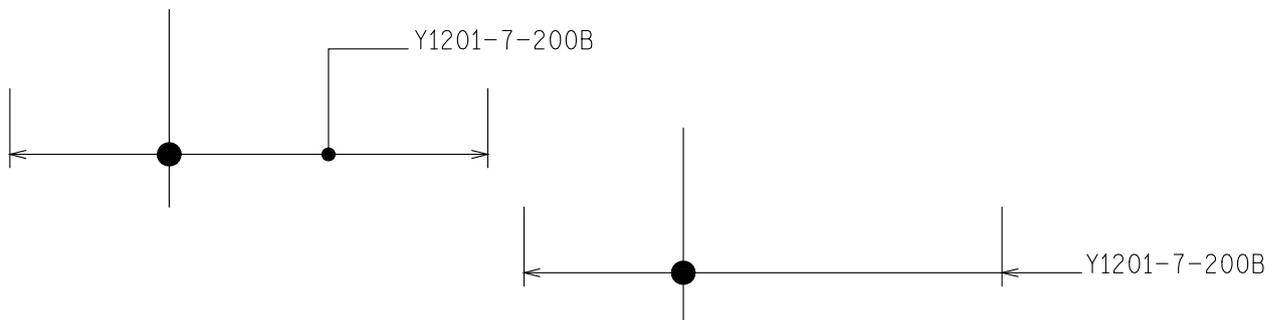
- with an arrowhead, if the line ends on an outline of an object, at an angle of 135°.



- without a dot or arrowhead, if the line ends on a dimension line.



- with a dot or arrowhead, without any dimension lines, e.g. reinforcement detail.



3.6.5 Dimensioning

Dimension line termination and origin indication is indicated with an arrowhead as far as possible. The arrowhead is drawn as short lines forming barbs at 15 and 90°. The arrowhead is closed and filled in, as available in the standard cell. Use can also be made of the auto-dimensioning arrow. Length of the arrow is 1 x text width and height is 0,5 x text height. Where the space is too small for an arrowhead, the oblique stroke (short line inclined at 45°) or a dot (1.5 mm), may be used, as shown below.

Auto-dimensioning or manual dimensioning may be used, but must conform to the standards as set out in this manual, and shown in figure 10. Do not drop dimensions, unless lines that take preference as stated in the points below.

- Give overall dimensions.
- Write smaller dimensions first, (1) then (2) then (3).

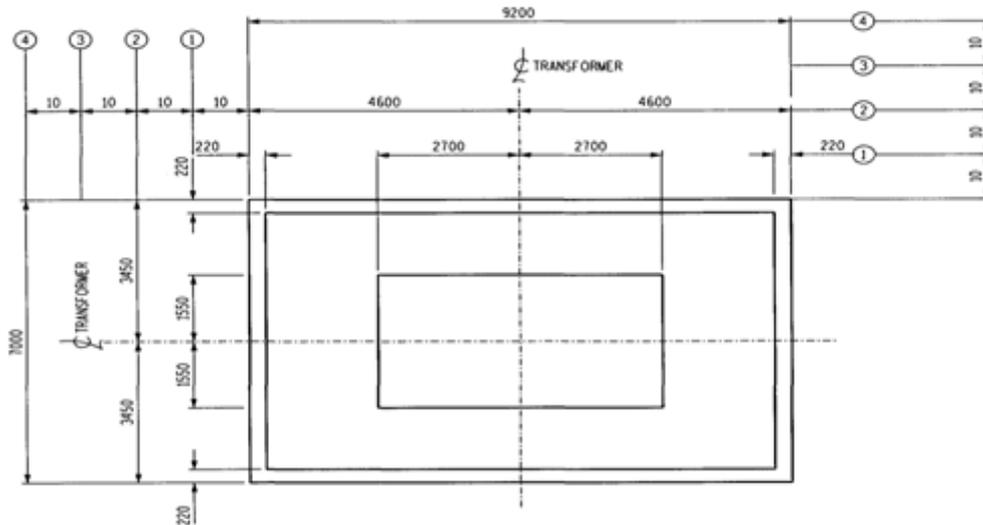


Figure 10: Dimensioning

- Draw witness lines 10 mm apart, starting at the same distance away from the drawing.
- Dimension lines cutting-drawing lines should be deleted at points of interference, as the drawing line takes preference.
- When a dimension line sits over a centre line, delete the dimension line as the centre line takes preference.
- Always use the station setting out lines and centre lines as the base for dimensioning.
- When a number is greater than 1 metre, write 2340 and not 2 340, i.e., do not leave a space.

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3.6.5.1 Drawing Layout

- Where practical, place the plan in the top left-hand corner of the sheet. Start from the top left hand corner on big layouts. Sections and elevations to be placed to the right or below the plan.
- Long sections of roads should be placed below the plan, preferably with the 0 change in line. Only 1 000m of road should be shown on the sheet at a scale of 1: 1 000. The long section should be exaggerated 2, 5 or 10 times, depending on the topography of the ground.
- Do not cram the drawings - rather use another sheet if there is too much detail.
- Do not place boxes around separate details - drawings should be laid out so that details are clearly separated.
- Line up descriptive notes to details and draw leader lines to the detail as close as possible.

3.7 Scales, Co-Ordinates and Grid

3.7.1 Scales

The number of scales on each drawing is kept to a minimum. The final drawing to indicate the following scales as specified in table 1 below, where possible. All drawings are created on CAD at 1:1 (full size) to an accuracy of 1 mm. This complies with the Transmission CAD system requirements.

Table 7: Scales for different types of drawings

TYPE OF DRAWING	SCALE
Locality Plan	1:50 000
Key Plan	1:1000
Contour Plan	1:750 1:500 1:200
Layout drawing (plans, sections, elevations)	1:500 1:200 1:150 1:100 1:50
Component drawing (details)	1:50 1:20 1:10 1:5 1:2 1:1

When work is completed for a drawing (at scale 1:1) then the scale of certain details and sections are adjusted to prepare the final drawing for plotting. Likewise the text height and width are altered to suit the final scale of the border sheet, as shown in table 8 below.

Table 8: Text height and width for scaled drawings

	DRG. No SHEET REVISION	STATION TITLE	DRG. TITLE	SCALE NOTES DIMENSIONS	REV./REF. NOTES SIGNATURE
SCALE: 1					
TEXT HEIGHT	10	6	4	3	2
TEXT WIDTH	6	4	3	2.5	1.5
WEIGHT	5	3	2	1	1
SCALE: 2					
TEXT HEIGHT	20	12	8	6	4
TEXT WIDTH	12	8	6	5	3
WEIGHT	5	3	2	1	1
SCALE: 5					
TEXT HEIGHT	50	35	20	15	10
TEXT WIDTH	30	20	15	12.5	7.5
WEIGHT	5	3	2	1	1
SCALE: 10					
TEXT HEIGHT	100	60	40	30	20
TEXT WIDTH	60	40	30	25	15
WEIGHT	5	3	2	1	1
SCALE: 20					
TEXT HEIGHT	200	120	80	60	40
TEXT WIDTH	120	80	60	50	30
WEIGHT	5	3	2	1	1
SCALE: 50					
TEXT HEIGHT	500	300	200	150	100
TEXT WIDTH	300	200	150	125	75
WEIGHT	5	3	2	1	1
SCALE: 100					
TEXT HEIGHT	1000	600	400	300	200
TEXT WIDTH	600	400	300	250	150
WEIGHT	5	3	2	1	1
SCALE: 150					
TEXT HEIGHT	1500	900	600	450	300
TEXT WIDTH	900	600	450	375	225
WEIGHT	5	3	2	1	1
SCALE: 250					
TEXT HEIGHT	2500	1500	1000	750	500
TEXT WIDTH	1500	1000	750	625	375
WEIGHT	5	3	2	1	1

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	DRG. No SHEET REVISION	STATION TITLE	DRG. TITLE	SCALE NOTES DIMENSIONS	REV./REF. NOTES SIGNATURE
SCALE: 750					
TEXT HEIGHT	7500	4500	3000	2250	1500
TEXT WIDTH	4500	3000	2250	1875	1125
WEIGHT	5	3	2	1	1

3.7.1.1 Co-Ordinates

To ensure uniformity is maintained for any scale on all CAD drawings the working units are set permanently on the seed file at 100:1 UNITS. When upgrading from one electronic CAD package version to another, the working units must be set to 100:1 units for all drawings.

The working plane origin (WPO) is set at X & Y as 0,0 x 0,0. The Global Origin (GO) 2147836, 21474836.

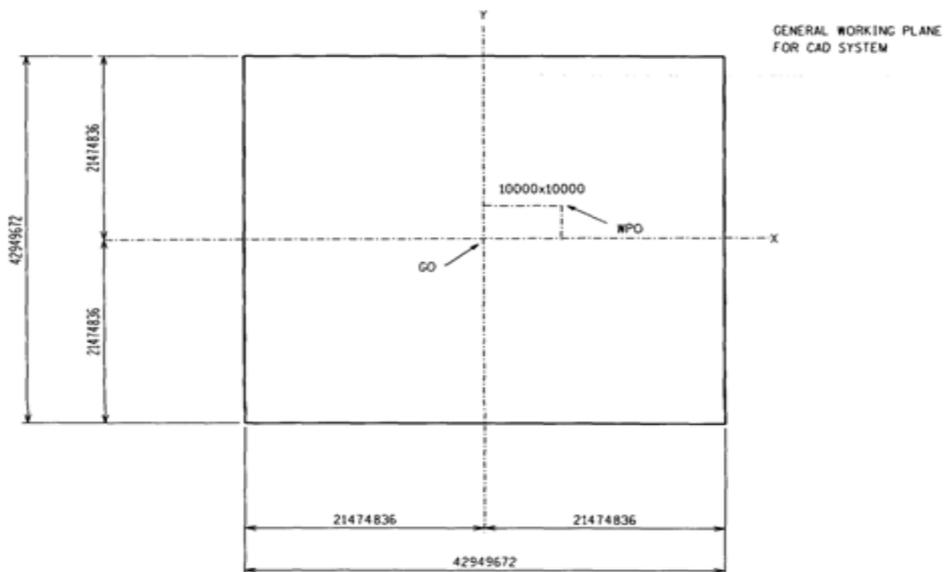


Figure 11: Working plane origin

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The above figure 11 details on how to set out the working plane origin to place a drawing in the global origin. The working plane origin is commonly used to place schematic drawings on an electronic CAD file for ease of locating drawing files at a familiar source point and for ease of plotting.

However, all layout drawings such as the key plan are oriented around the X,Y,Z 0,0,0 origin.

3.7.1.2 Grid

The grid size on an electronic CAD file is set to GR = 2,5 and GU= 10. In most cases the origin of elements shall be drawn on the grid, the only exception is where drawings are full size and are drawn to a scale of 1:1.

3.8 Mark-ups, Redlining and Checking

3.8.1 Marking-up of Drawings

All drawing sheets are marked up with the following listed colours, which represent what function needs to be performed by the draughtsperson. No other markings of any sort, eg. pencil or pen, will be added to the drawing.

3.8.2 Colour Codes for mark-ups

- Corrections Red
- Delete Yellow
- Correct work Green
- Comments Blue

3.8.3 Check List

The table 9 below provides a systematic, non-exhaustive, suggested approach to aid checkers in checking work and training new people.

Table 9: Drawing Checklist

No	Description of activity	Check
1	Good checking = good screening. Problem approach should be systematic and methodical, going through the job step by step, gradually covering the whole subject.	
2	Obtain all information pertaining to the drawing, e.g. design file, tif file, and relevant reference drawings.	
3	The latest revision should be used related to all sources of information.	
4	Obtain a clear conception of design prior to checking.	
5	All reference drawings are listed in the list of reference drawings. Protection reference drawings are on sheet 0.	
6	Correct spelling.	
7	Quantities are correct and in the correct units.	
8	Check all abbreviations. If possible all words should be spelled out. Use only standard abbreviations. Be consistent throughout the drawing.	
9	Check all dimensions and locations of all items on the drawing.	
10	Check for interference from equipment of other disciplines.	
11	Notes are clear and concise.	
12	Lines, text, symbol, scales, etc., as prescribed.	

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No	Description of activity	Check
13	On scanned drawings (i.e. raster files) replace the old symbology with the new symbology.	
14	A cancelled or superseded drawing must be revised. Place " CANCELLED " or " SUPERSEDED " in large bold text at an angle across the drawing. The comments column in drawing management system must be updated to reflect the status of the drawing as well as the new superseded drawing number.	
15	Drawing items to be well spaced and clearly readable.	
16	The revision block must contain a clear description of the changes for the particular revision. "As built" and "Mark-up as per print on site" are NOT acceptable.	
17	Check work thoroughly. Problem approach should be systematic and methodical. Strive for RIGHT FIRST TIME.	

3.8.4 Guide to Acceptable Drawing Practice

3.8.4.1 General

Take a logical approach towards creating the drawing: -

- Understand what you must draw.
- Think how to draw it.
- Ensure what you draw is feasible, practical and economical.
- Pay attention to spelling.
- Avoid the use of trade names e.g. rocia, bidim, etc.
- Indicate pipe diameters as 0900 or 900DIA and not DIA900 or 9000.

When writing a word, dimension etc., ensure that you do not write over something else. Partial delete the least important elements.

- Write the scale under every layout, plan, elevation, detail, etc. and only "as shown" in the title block.
- Section arrows should point to the top of the sheet and from right to left.

3.9 Revision and General Notes and References

When adding revision notes, be explicit do not add "**As built**" or "**Mark-up as per print on site**".

Adhere to text sizes and weights as noted in this document.

The following symbol is added to the drawing in the immediate area of the present revision if the revision note is not explicit enough, with the current revision number in it.



The symbol must be deleted from all the past revisions.

All general notes on a drawing are positioned in such a way as been readable and pertains to the drawing. These notes are headed with the word "**Notes**" in bold.

Any drawing that has information taken off from another drawing must have that drawing number stated in the reference column above the title block.

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This symbol gets used, if information is not readily available is illustrated in figure 12 below. The word "HOLD" is denoted within the cloud.

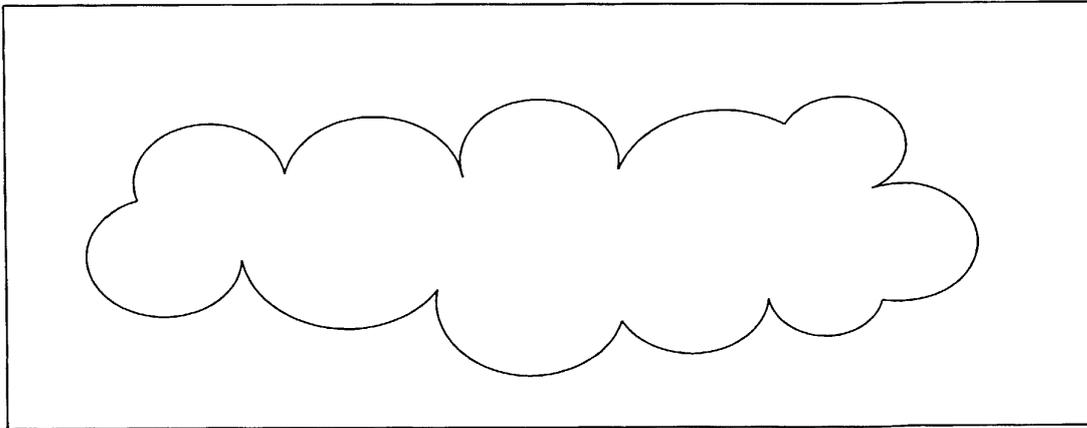


Figure 12: Cloud

4. Authorization

This document has been seen and accepted by:

Name and surname	Designation
R McCurrach	Senior Manager PTM&C Engineering
N Msibi	Application and Drawing Manager
A Oommen	PASC/SC Chairperson

5. Revisions

Date	Rev	Compiler	Remarks
November 2017	1	E Dalbock	Discipline updates
June 2020	2	E Dalbock	Updated document for PTMC

6. Development team

- Eddie Dalbock

7. Acknowledgements

Not applicable.