# CAD / Drawings Guide

0.1.1.8 Rev. 1

Date: 2005-11-25



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# Revision History

| *Revision* | *Date* | *Description* | *Author* |
|---|---|---|---|
| A | 2000-04-30 | Original Draft (for PIM) | B. Hawkins |
| B | --- | PIM Updates | J. Swirsky |
| C | 2003-07-31 | Updated to CLS document format | H. Engel |
| D | 2003-11-12 | Meeting comments incorporated | J. Swirsky |
| E | 2004-06-21 | Review comments incorporated | J. Swirsky |
| 0 | 2004-06-25 | Issued for Use | J. Swirsky |
| 1 | 2005-11-25 | Revised Sketch Section 2.3.2 | J. Swirsky |

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# 1.0 INTRODUCTION

## 1.1 PURPOSE

This guide identifies the types of drawings produced at the CLS and the procedures that shall be used in the preparation, review, revision, and approval of these documents. The primary objective of these documents is to communicate requirements to CLS staff, suppliers and users to allow cost-effective construction, fabrication and installation of components.

## 1.2 DEFINITIONS AND ABBREVIATIONS

ANSI: American National Standards Institute

BOM: Bill Of Materials; a list of parts or items used to assemble a product, automatically generated with MDT

CAD: Computer-aided Design

CLS: Canadian Light Source, the working name of the facility

CSA: Canadian Standards Association

MDT: Mechanical Desktop; an AutoCAD plug-in

ETS: Engineering and Technical Services

# 2.0 DRAWINGS

## 2.1 GENERAL INFORMATION

1. All drawings created for the CLS shall conform to the CLS standards. Exceptions may be accepted by CLS.
2. The CLS Standard follows the following CSA National Standards:
   a) CAN3-B78.1-M83 Technical Drawings – General Principles
   b) CAN/CSA-B78.2-M91 Dimensioning and Tolerancing of Technical Engineering.

   Exceptions:
   a) Automated drawing features of AutoDesk's Mechanical Desktop use ANSI standards.
   b) Drawings automatically generated by tools that do not support custom settings (e.g. Siemens Step 7 program outputs, Eagle automatic functions).
3. CLS drawings should be developed utilizing the following software packages: AutoCAD R2002, Mechanical Desktop 6.0, AutoCAD LT, Microsoft Visio, and CadSoft Eagle.
4. Each drawing shall utilize a standard sheet layout, title block, and naming/numbering standards.
5. The CLS title block contains specific data sort fields that are used to file, retrieve and report on extent of drawing production in MDT and AutoCad.

## 2.2 DRAWING CONTROL

### 2.2.1 General

Drawing control within the CLS facility will use the following guidelines:

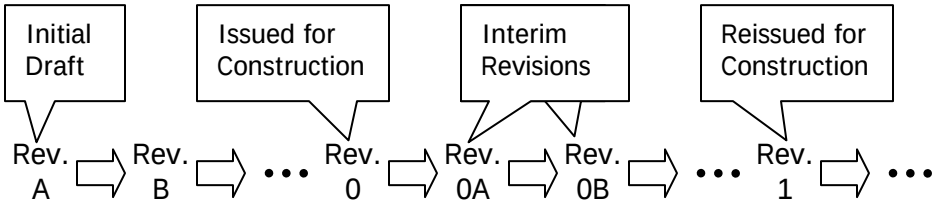
1. The CAD Directory shall be mapped to "F:\" on all networked computers.
2. Drawings are not to be kept in personal directories.
3. When work begins on a project/drawing, the file location shall be assigned by the ETS Manager or designate.
4. All designated CLS personnel shall have read permissions to the CAD directories, only specific groups will have write permissions in specific directories.

### 2.2.2 Revision Control

#### 2.2.2.1 Revision "Number"

Drawing revisions shall follow the following sequence with all initial revisions being alphabetic, all revisions issued for construction being numeric and all interim revisions being a numeric and alphabetic combination.

**Figure 1 – Revision Sequence**




#### 2.2.2.2 Revision Clouds (AutoDesk drawings)

Revision clouds with revision number triangle should be used to surround the last revisions made to a drawing. The clouds are only to appear for the last revision, previous revisions should have their clouds removed.

#### 2.2.2.3 As Built Changes for Electronics Drawings (Eagle drawings)

In many electronics drawings, small changes need to be made that do not affect the overall drawing or layout (e.g. a change in resistor value). In this case, an as built change is implemented and recorded in subsequent revisions.

#### 2.2.2.4 Work In Progress

Prior to any approved revision to a drawing, a working copy of the drawing shall be created and named xxxxxxxwork.dwg (or appropriate file extension). The "Work In Progress" stamp shall be added to the working copy and all relevant revisions shall be made on this drawing. When all changes have been made, the drawing shall be issued to the checker(s). Once checked and deemed acceptable the approver will be issued mark ups and check prints for review and approval. Once approved, the revision block shall be updated with checker and approver initials, and the "Work In Progress" stamp removed. For AutoDesk drawings, an email notification shall be sent to the drawing Checker and Approver indicating

that the drawing has been electronically signed on their behalf. The ETS manager and CAD Work Coordinator shall be carbon copied if they are not the Checker or Approver.

The revision process is outlined in Appendix A.

### 2.2.3 Drawing Archival

When a drawing is revised and a new revision exists, the older revision shall be archived in the following manner:

Add .archive as an additional file extension, e.g. xxxxxxxR0.dwg.archive.

In the case of Eagle drawings where multiple files are created from one document, a new folder will be created where the previous revision will be stored. Both the folder and the files within it will have ".archive" added to the end as above.

### 2.2.4 External Firm Revision Control

CLS drawings created by external firms shall be tracked:

1. External firm will be issued a drawing database table with fields identical to the CLS drawing database.
2. External firm shall keep this drawing database up-to-date with drawings they are creating.
3. The ETS manager or designate shall have the CLS drawing database updated at intervals determined by the ETS manager or designate.

Revisions to existing CLS drawings by external firms shall be tracked. The procedure below outlines the steps that will be followed:

1. Ensure the drawing is a current revision with no "work in progress".
2. Add "work in progress" stamp.
3. Add contractor revision control box to drawing (F:\lib\mech\bib \contractor revision list.dwg)
4. All new information added to the drawing shall be on new layers with the contracting company's name as the layer name prefix. All revisions of this drawing by the contractor shall be tracked in the contractor revision control box, e.g. xxxxxx.dwg is actually xxxxx rev 6 "work in progress"; contractor revision control would be rev 6.A, 6.B, 6.0, etc.
5. Take a copy of the drawing and add it to F:\DRAWINGS OUT FOR REVISION BY CONTRACTORS\"contractor name".
6. Bind all xref's
7. Add contractor's name to database field "out for revision".
8. If CLS requires the drawing to be revised, and the revision has no impact to the work the contractor is completing, a new revision can be issued.
9. CLS will take the contractor's information and add it to the CLS master drawing. This allows multiple contractors to work on the same drawing simultaneously.

### 2.2.5 Defunct Drawings

When a drawing is no longer to be used or contains erroneous information, it shall be defunct.

1. Add .defunct as a file extension after .dwg, e.g. xxxx.dwg.defunct. This will hide the files in the AutoCAD browser, but they are still accessible in the Windows browser.
2. Enter the information in the CLS drawings database. If the drawing is replaced by another drawing, add to the "description" field "defunct dwg xxxx replaced with dwg yyyy, where xxxx and yyyy represent the drawing numbers. Enter "yes" in the defunct field.

In the case of Eagle drawings where multiple files are created from one document, a new folder will be created where the previous revision will be stored. Both the folder and the files within it will have ".defunct" added on to the end as above.

## 2.3 DRAWING TYPES

### 2.3.1 Vendor Drawings

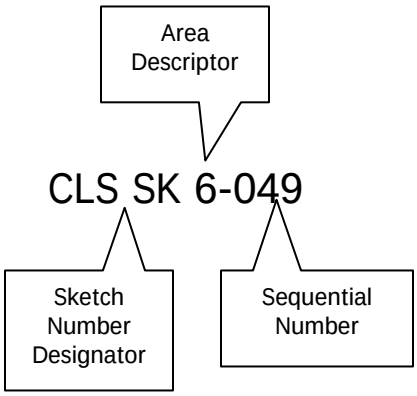
Drawings and specification sheets produced by external companies with non-CLS borders shall be considered vendor drawings. Vendor drawings shall be reviewed and accepted by CLS prior to fabrication.

### 2.3.2 Sketches

A sketch is part of an informal drawing process that is used to deliver drawings to the fabrication/installation staff when the formal CAD drafting resources are not available. The sketch process is not intended to be used on a frequent basis or to replace the formal CAD procedures. A sketch can be as simple as a hand drawn drawing or as formal as a CAD drawing.

The required steps are described below:

- The sketch shall include the drawing title, author, date and sketch drawing number. The sketch drawing numbers are controlled through the "sketches" table in the "CLS Drawing Number" database located at \\Canopus\CAD\DATABASE\CLSdrawings.mdb
- The sketch numbers are assigned sequentially with an area descriptor. The area descriptors are described in Section 2.1 and Appendix A of the Document and Records Management Guide 0.1.1.13.




- The electronic CAD sketch drawings shall be filed in \\Canopus\CAD\SKETCHES
- The CAD sketch should use the appropriate CLS drawing templates.
- The sketch shall not use the official CLS drawing borders.
- The sketch shall be approved by the ETS or CID manager or designate before being issued for fabrication/installation.
- A copy of the sketch shall be given to the CAD Foreman.
- When the sketch needs to become a formal drawing, the sketches table has a data column to enter the formal CLS drawing for reference.

### 2.3.3 CLS Bordered Drawings

Drawings which contain the CLS border shall follow the processes outlined in this Section.

## 2.4 DRAWING NUMBERING

**Figure 2 – AutoDesk Drawing Number Example**

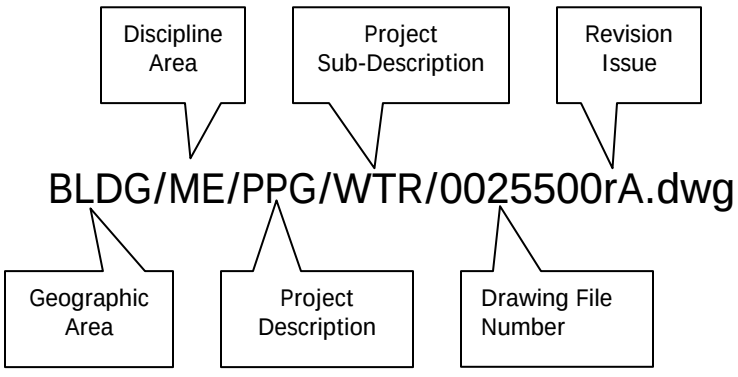
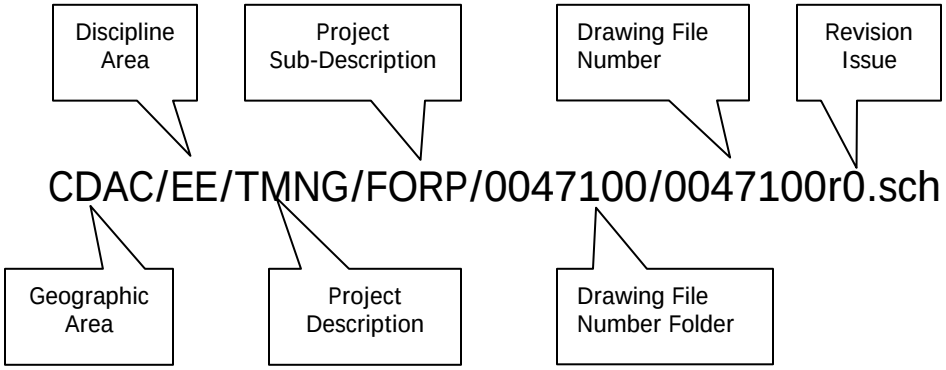


**Figure 3 – Eagle Drawing Number Example**




1. Drawing numbers include both the directory path and serial number of the drawing.
2. Drawing numbers shall be assigned when work commences on a design project.
3. All drawings used within a design shall be assigned a number.
4. Drawing numbers shall be assigned in blocks of 100 sequential numbers.
5. Drawing numbers assigned shall be recorded in the drawings database "F:/Database/CLSdrawings.mdb."

## 2.5 DRAWING TITLE BLOCK

**Figure 4 – Drawing Title Block**

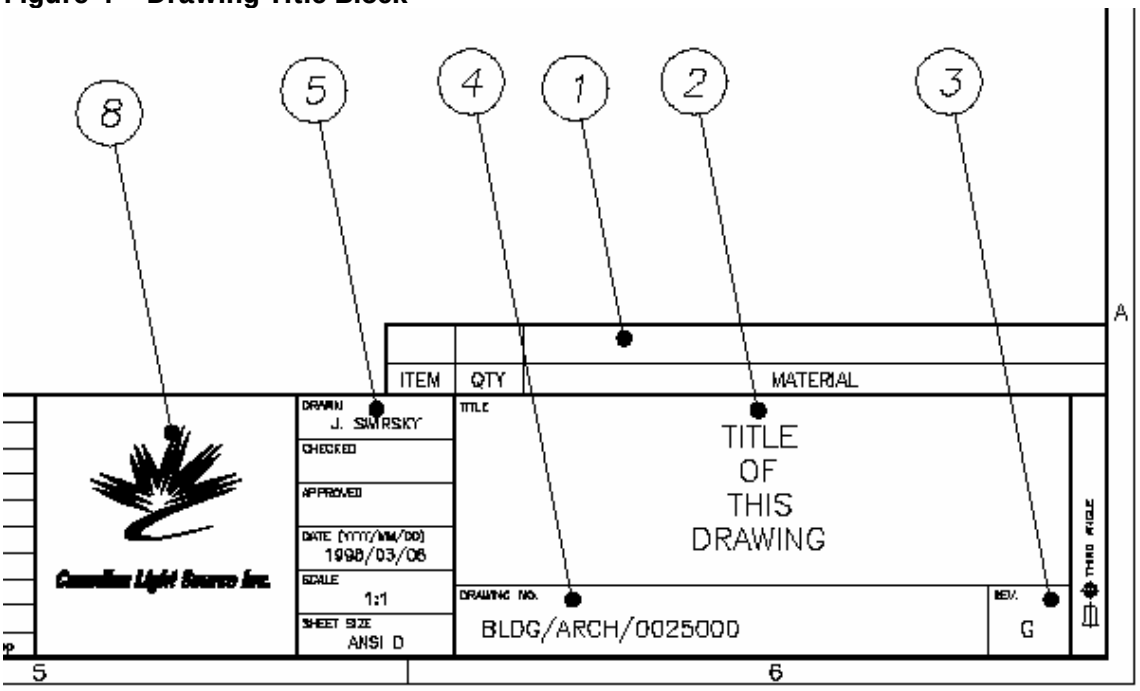



Figure 4 – Drawing Title Block (continued)

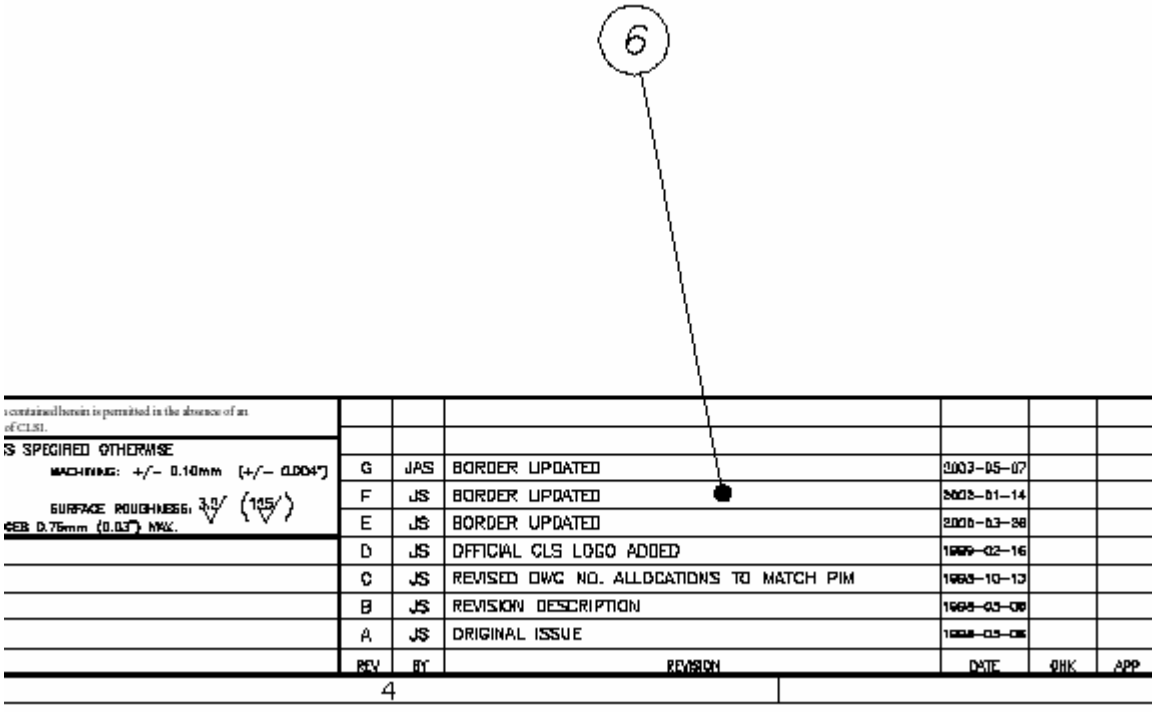



Figure 4 – Drawing Title Block (continued)

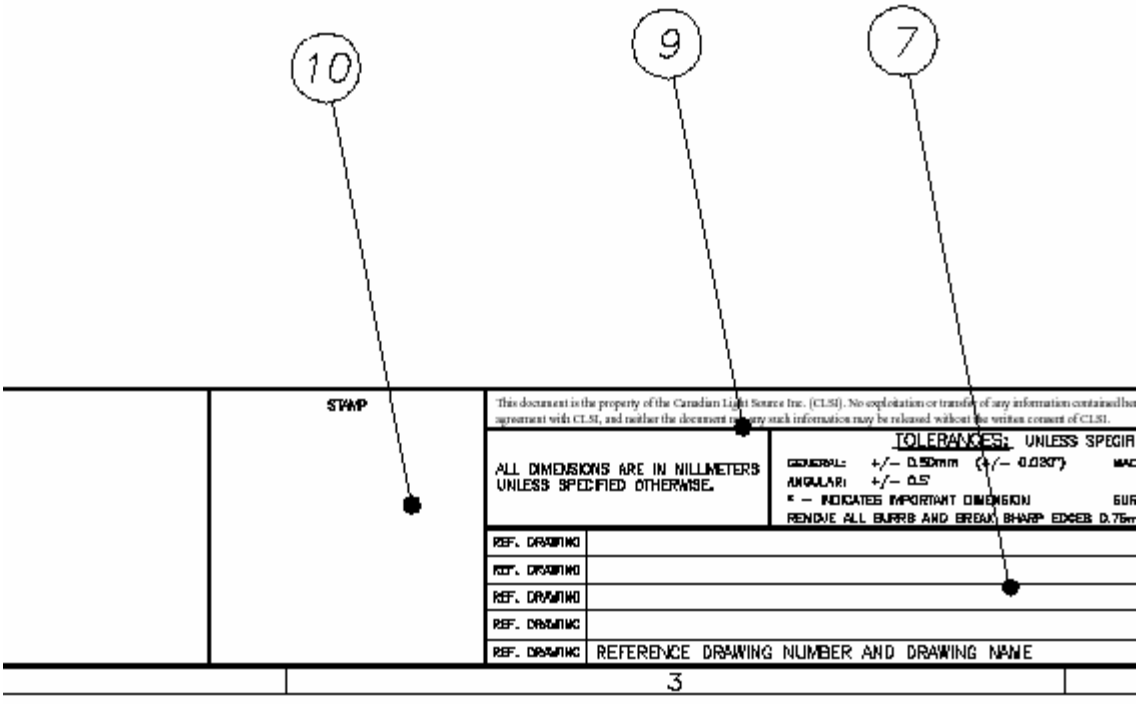



Figure 4 – Drawing Title Block (continued)


The CLS title block contains the following specific sections (Figure 4):

1. Bill of material section (optional) - allows the inclusion of specific quantities of materials contained within the drawing. In general, only the technical facilities drawings would contain information within this section of the title block.
2. Drawing description section - contains the textual description of the drawing contents.
3. Revision section - revisions to previously issued drawings will be controlled by identification with an alpha designation starting with "A" once the drawing has reached a controlled status, which is usually after approved as concept design. When the drawing is issued for fabrication, the drawing revision status is changed to a numeric designation starting with "0." Subsequent revisions are identified by ascending alpha-numeric and numeric characters.
4. Drawing number – see section 2.2.2.1. Each drawing is to be assigned a drawing number to allow for filing, tracking and progress status reporting.
5. Identification section - information identifying the people responsible for design, drafting and checking, plus date of original issue and drawing scale is placed within this section of the title block.
6. Revision index section - contains specific information relevant to each revision issued. The information includes: revision designation; person responsible for revision issue; brief description of revision; date revision is issued; persons responsible for checking and approving of revised information prior to issue.
7. Drawing reference section - contains references to other drawings which are relevant to this specific drawing.
8. CLS logo - all CLS drawings will contain the CLS logo.

9. Dimension notification - this note is standard on all technical facilities drawings. The conventional facilities drawings need not contain this note. There are no dimensions on EAGLE schematics, and no scale. Instead, the units for resistors, capacitors, and inductors are given in the title block, while the components only show the numerical values.
10. Stamp (optional) - this area is reserved for the stamp of the certified professional responsible for the information contained on the drawing.
11. Company identification section (optional) - this area is provided to allow the design consultants to identify their drawings with the company name and logo.
12. EAGLE allows using more than 1 sheet for 1 schematic. There is a sheet number in the title block. MS-Visio UML models are also multi-page drawings.

**Note:** Only the date in the revision index section changes with successive revisions.

## 2.6 CAD STANDARDS

CAD standards shall be as defined in the following sections, unless otherwise determined by the ETS manager or designate.

### 2.6.1 Sheet Sizes

CLS drawing sizes may vary and shall be selected from a pool of standard drawing sizes, which will be selected to suit the intended use of the document. CLS drawing sizes are optimized for CLS printers and conform to CAN3-B78.1-M83.

### 2.6.2 Lettering (AutoDesk Drawings)

1. Lettering size will be as mentioned in the CSA standard, 3.5mm. The exceptions are:
   a) Section Titles, Detail Titles & Part List Balloons, 5mm.
   b) Text within the Title Block and Revision Block which will be set in the CLS drawing sheet.
   c) In locations where extensive text is required for clarification (e.g. labeling of terminal blocks).
2. Thickness of Lines

   There shall be two thicknesses of lines:
   a) 0.13mm for wiring, center and hidden lines
   b) 0.35mm for all other lines

   The line thicknesses are set in the CLS plot style tables.

### 2.6.3 Drawing Scales

In AutoDesk, drawing scales shall follow table 4 in CAN3-B78.1-M83. Exceptions from these scales will only be allowed for large size layout drawings.

In Eagle, the drawing grids for all schematic, board layouts, library symbols and foot prints shall be as large as possible, 0.1 inch spacing being the largest, decreasing by a factor of two for smaller scales. Exceptions are made for component footprints that are in millimeters.

### 2.6.4 Drawing View Projection (AutoDesk)

All drawings shall use 3rd angle projection (mechanical drawings only).

### 2.6.5 Drawing Features controlled by MDT (AutoDesk)

The following features are controlled by MDT in the CLS drawing template:

1. Section view and section lines
2. Thread representation
3. Detail views
4. Weld symbols
5. Surface finish
6. Geometric tolerances

### 2.6.6 Model Space/Paper Space (AutoDesk)

1. All components, parts, assemblies, layouts, etc. shall be drawn full scale (1:1) using millimeters in Model Space.
2. Drawing borders will be inserted into Paper Space at full scale (1:1).

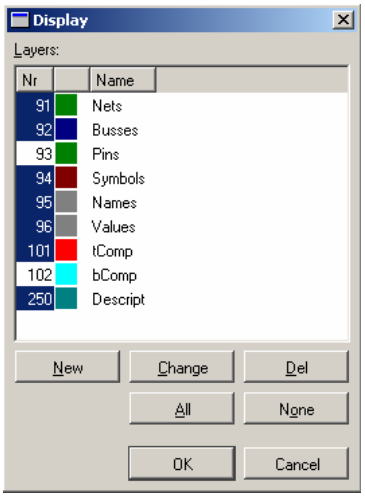
### 2.6.7 Layers

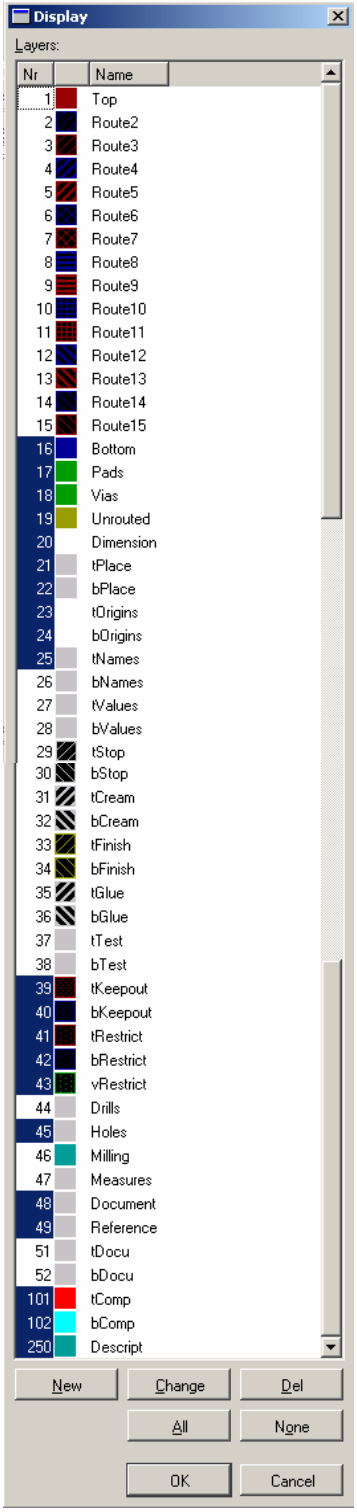
1. The CLS drawing template contains most of the basic layers.
2. Any new layer name should be full length, avoiding abbreviations when possible.
3. All CLS drawings in Eagle shall use the standard default layers listed (not just selected) in Figure 5.

**Figure 5 – Eagle Drawing Layers**

a) Schematic b) Board Layout

Layers 101 and 102 are utilized in older schematics and layouts. These are not utilized in any new designs.



### 2.6.8 Blocks (AutoDesk)

AutoCAD blocks shall be created on layer 0.

### 2.6.9 Other

1. The color “yellow” should be avoided since it is not easily seen on white paper.
2. Drawing Origin and Orientation:
   Conventional building origin will have Model space details orientated with the existing linac in East/West direction (XX axis) and the origin 0,0 will be the northwest corner of the original 1964 building.

Technical building origin will have Model space details orientated with the existing linac in West/East direction (XX axis) and the origin 0,0,0 will be the apparent intersection of the linac and the North/South leg of the linac to booster transport line at linac elevation.

### 2.6.10 MDT 3d Modeling Standards

1. All 3d components and parts will be created using the NEW PART file environment.
2. All 3d assemblies will be created using the NEW ASSEMBLY file environment.
3. All 3d components shall be created with the 2d geometry on LAYER “SK” and the 3d model on LAYER “PART” (layer dialogue box and MDT browser window).
4. ALL 3d component information shall be entered in the individual components BOM environment.
5. All 3d assemblies should be built using externally linked files rather than local parts. An exception would be a purchased component consisting of a few parts.
6. Any 2d drawings that are created from exported views from a 3d model shall have a “-2d” suffix. Example: 0039600-2d and 0039600a-2d.

### 2.6.11 UML Models and Software Related Drawings

1. UML drawings shall be based on the OMG Unified Modeling Language Specification Version 1.3, June 1999. The MS-Visio CLS_UML template shall be used.
2. Relational Databases Designs shall be documented using Entity Relationship Drawings based on Shlaer/Mellor notation.

## 3.0 DESIGN VERIFICATION (CHECKING)

For procedures on design verification (checking) see the “System Engineering Guide” (0.1.69.1).

## 4.0 FILING AND DOCUMENT CONTROL

Any mechanical drawings related to electronics drawings (e.g. chassis drawings for a PCB) shall be located in the same directory as the electronic drawing and under the same drawing number and use the same revision number.

For procedures on filing and document control see the “Document and Records Management Guide” (0.1.1.13).

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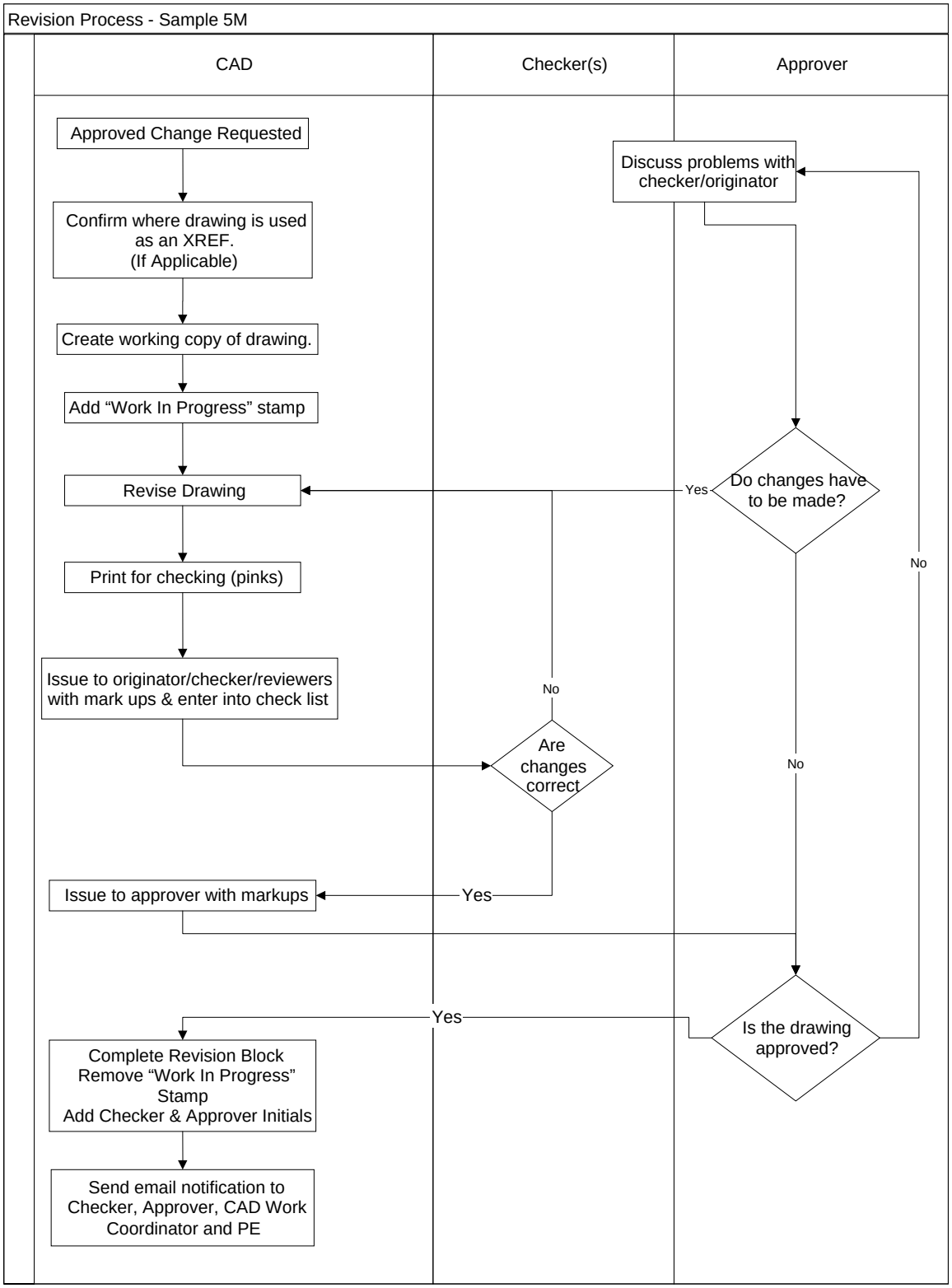
## Appendix A – Revision Process



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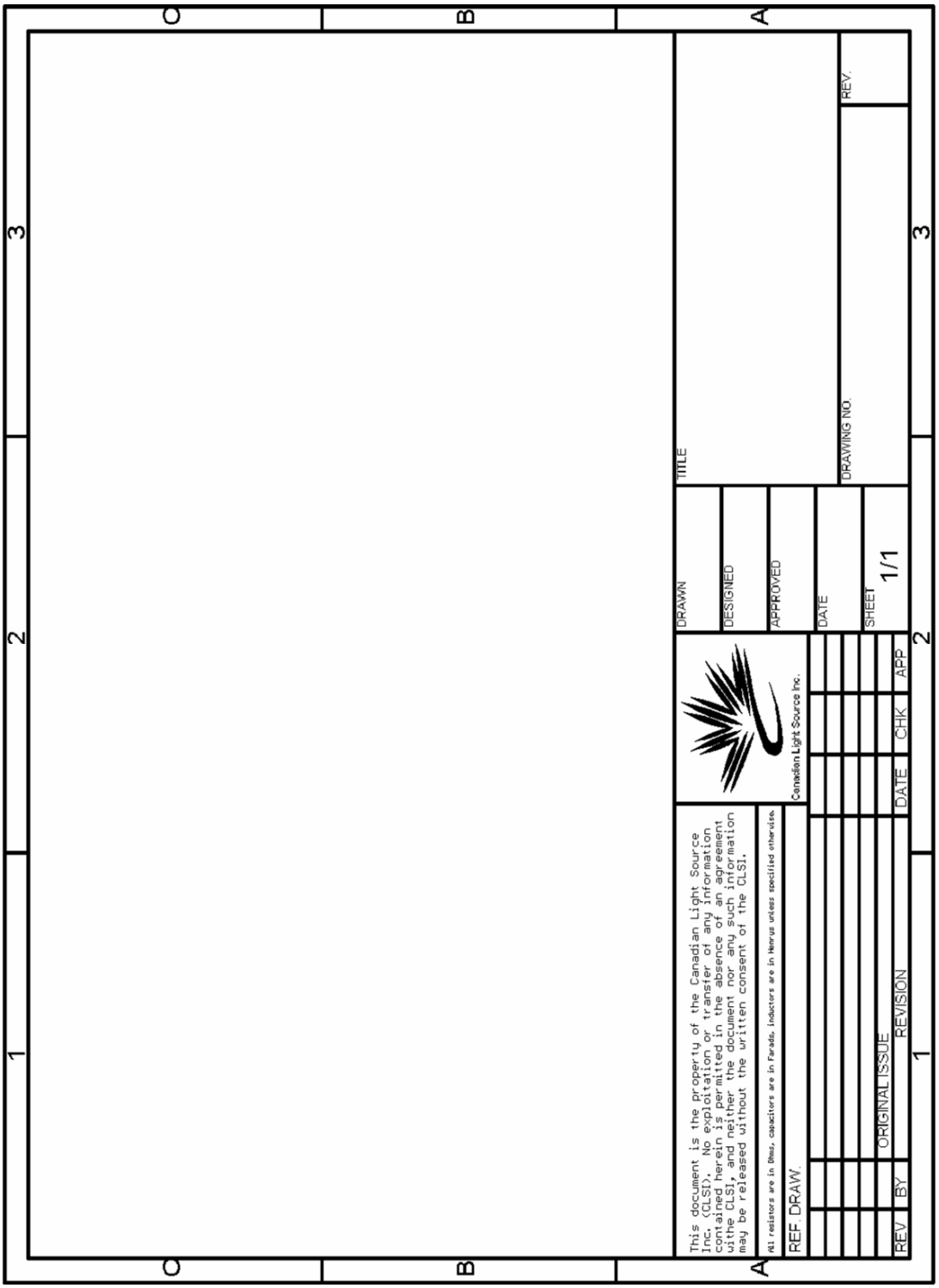
## Appendix B – Eagle Frame



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# Appendix C –VISIO Drawing Frame