



# Engineering Handbook

## Volume 9

# Computer-Aided Design (for Rocky Mountain and Pacific Power)

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## 9A—Computer-Aided Design (for Rocky Mountain and Pacific Power)

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## 9A.1—General

### I. Scope

This section of the company's Engineering Handbook contains general drafting standards applicable to all disciplines. For discipline-specific drafting standards, see Engineering Handbook Volume 9B.

The requirements described in this handbook and in 9B shall apply to all engineering design drawings created or revised either by internal personnel or by external engineering firms.

## 9A.2—Borders

### 1. Scope

This document standardizes the border format, which includes consistent drawing areas, revision block layout, and title block, for company engineering drawings. Multiple drawing sizes are provided to accommodate various needs. Modifications may not be made to standard company title blocks.

With company approval, any consultant's logo or insignia placed on the company's standard border shall remain as an independent block. The location of the consultant's logo or insignia on other types of standard company borders shall be evaluated on a case-by-case basis. All consultant logos or insignias shall be removed from electronic files prior to plotting the "FINAL" or "AS-BUILT" drawings (to be signed prior to the distribution and return of the files to the company).

### 2. General

Company standard AutoCAD borders shall be used during the creation of a new drawing or the editing of an existing drawing. These border template files contain standard layouts with the attributed title block.

All borders will have a border revision date in the lower left corner, just outside the border line. Each AutoCAD drafter/designer is responsible for ensuring that the most current version of the company border template is used. The most current borders are located in AutoCAD Support\Borders and the template files are located in the AutoCAD Support\Templates folder.

### 3. Border Insertion Point

All borders are to be inserted on layer zero at coordinates 0,0 in the paperspace layout environment. This configuration will set up the drawing area to conform to company standard printing and plotting capabilities.

### 4. Border and Paper Size

The borders shown below in Table 1 have been developed for use on all company drawings. Where possible, they are in conformance with ANSI Y14.1 standards to utilize the maximum paperspace.

Table 1 lists each border file name and provides drawing size, paper size, revision date, and suggested use.

**Table I—Borders and Sizes**

File Name	Size	Rev. Date	Paper Size	Orientation	Suggested Use
CORP-A.dwg	A	11/01/06	8-1/2" × 11"	portrait	Sketches and details
CORPA-TRAN.dwg	A	05/02/14	11" × 8-1/2"	landscape	Sketches and details For Transmission use only
CORP-ECA.dwg	A	05/02/14	11" × 8-1/2"	landscape	Communication block and level diagram
CORP-B.dwg	B	03/12/15	17" × 11"	landscape	Sketched conductor details
CORPB-TRAN.dwg	B	11/01/06	17" × 11"	landscape	Sketched conductor details For Transmission use only
CORP-D.dwg	D	05/02/14	34" × 22"	landscape	Recommended for project size and all new standards drawings and XREF files
CORPD-TRAN.dwg	D	09/18/15	34" × 22"	landscape	Recommended for plans & profiles and all new standard drawings For Transmission use only
CORP-C3D.dwg	D	05/02/14	34" × 22"	landscape	For Civil 3D drawings only
SPCC11X17	B	03/12/15	17" × 11"	landscape	Sketches and details. For SPCC use only
SPCC8X11	A	03/12/15	11" × 8-1/2"	landscape	
CORP-B-GEN	B	09/16/15	17" × 11"	landscape	Sketch details conductor and cable list For Generation Thermal use
CORP-B2-GEN	B	09/16/15	17" × 11"	landscape	Sketch, details conductor and control wiring diagrams For Generation Thermal use (Dave Johnston Plant only)
CORP-D-GEN	D	09/16/15	34" × 22"	landscape	For Generation Thermal use
CORP-E-GEN	E	10/21/15	44" X 34"	landscape	For Generation Thermal use

## 5. Layer Control

Standard layers are contained in various template files. They can be imported via discipline-specific AutoCAD palettes, or through the design center by accessing them in the AutoCAD support directory. These are standard layers and are not to be modified. Layers can be created on a case-by-case basis at the discretion of the CAD manager. Layers should be named in full without abbreviation and fitting to the entity, (e.g., "EASEMENT" rather than "ESMT"). Layer colors should be chosen so as to result in the appropriate line weight. See Table 7. Layers should not be turned off, but may be frozen so the LAYER ISOLATE command can be used. Never freeze or turn off the DEFPOINTS layer.

Use colors corresponding to company's color table to differentiate objects, dimensions, and other lines. See Table 7 for weights and screening.

## 6. Revision Block

See Engineering Handbook 9B. , for revision block procedures that apply to generation thermal.



An area to record drawing revisions is provided within each border. Any changes made to a drawing must be recorded in this area by inserting the revision block appropriate to that border. Revision blocks corresponding to the various border sizes are located at AutoCAD Support\Borders. Revision blocks may also be accessed via company tool palettes. Revision blocks are not to be modified, burst, exploded, or replaced with floating single line text. Editing to remove the hard text “WO#” is not permitted, nor is stretching/moving an attribute off its original X, Y location. Text shall not hover over the revision area of the title block. If multiple WO#'s are used, then the additional numbers are added to prompt 4 (REV-1 tag) followed by the revision description. Each revision block includes the following nine attribute prompts which must be completed when a revision is made to the drawing:

- Prompt 1** REVISION NUMBER — The record starts with the first revision being “1”. Each additional revision assumes the next higher number. The latest revision information shall always be placed in the next available space, with prior revisions noted in ascending order. When space is needed for another revision, delete the oldest revision and move the others up. Do not place the new revision in front of older revisions. Revision zero drawings may have a blank revision block.
- Prompt 2** DATE — The date the revision is made (mo/dd/yy); the date must be consistent and current on all newly-issued, rev'd up project drawings.
- Prompt 3** WO (work-order) NUMBER — company charge number. In certain circumstances where a number is not provided, or the WO number has closed, please follow these procedures:
1. If the number has expired, effort shall be made to have asset accounting reopen it.
  2. If it cannot be reopened, the number is still used in the revision block, but time is charged to a capital number under the appropriate cost center.
  3. If a modification is not associated to a WO number, then FM (Field Modification) is used as the WO number in the revision block. Time is charged to a capital number under the appropriate cost center.
- Prompts 4&5** REVISION — A description/summary of changes to the drawing. This may be two lines if necessary. The description shall be specific for each drawing, including notes on what has been removed or added. For as-builts, the description shall be preceded by “AS-BUILT,” followed by a detailed description of the change if possible. If it is not possible, a description such as “AS-BUILT MISC. WIRING CORRECTIONS” is sufficient. Descriptions are not used on communication block & level drawings.
- Prompt 6** ENGINEER — The first initial and last name of the engineer (or consulting firm, if applicable).
- Prompt 7** DESIGNER/DRAFTER — The first initial and last name of person (or consulting firm, if applicable) who drafted the changes.

- Prompt 8** CHECKED — The first initial and last name of the person (or consulting firm, if applicable) responsible for checking the drawing
- Prompt 9** APPROVED — The first initial and last name of the person who approved the changes to the drawing. If approvals are provided by an external engineering firm, the firm's acronym shall follow the signature with a forward slash ("/") separating the approver name and firm acronym.

## 7. Drawing Numbers

Company document control shall use the following procedures when assigning new drawing numbers:

### 7.1. When to Assign New Numbers

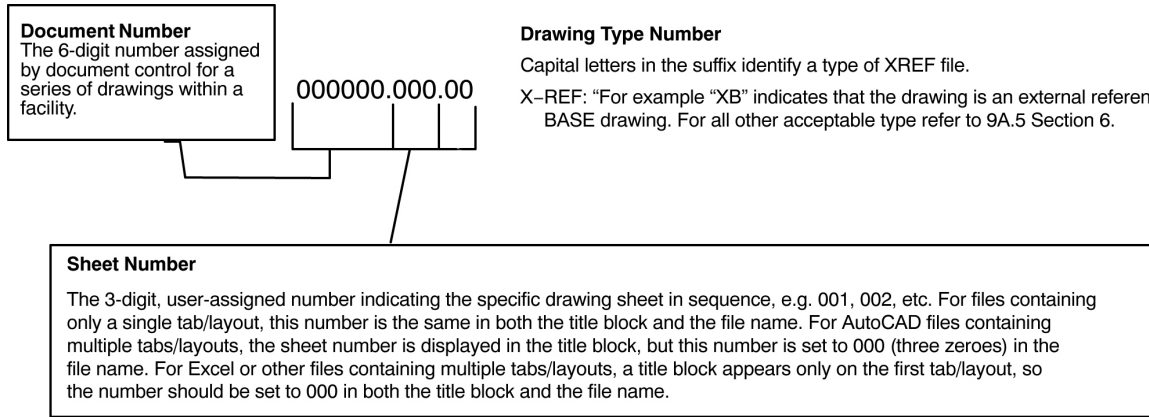
New drawing numbers shall be assigned when the need arises for new drawings to be created for new or existing company facilities. For new substation drawing numbers, contact PacifiCorp document control at [Document Control Substation](#); for new transmission drawing numbers contact document control at [Document Control Transmission Design](#).

### 7.2. How to Use New Numbers

Once the user has determined how many new numbers are needed, he or she shall contact PacifiCorp document control. The user will be given new numbers (the next in the drawing number series). New numbers are six digits with a suffix indicating the sheet number or the type of file. See Engineering Handbook 9B. for generation thermal numbering conventions for plant facilities.

### 7.3. Numbering Convention

The numbering convention shown in Figure 1 consists of a document number, a sheet number, and a drawing type number. It must appear as indicated in the drawing title block and the drawing file name. Table 2 contains some examples of drawing/document numbers for various types of files. Example title blocks are shown in Figure 2 and Figure 3. Instructions for non-AutoCAD files used in design projects (e.g. Excel files) may be found at AutoCAD Support\Forms. See Engineering Handbook 9B. for generation thermal numbering conventions.



**Figure 1—Drawing Number Diagram**

**Table 2—Borders and Sizes**

Description	File Name	Title Block Name
Single sheet stand-alone drawing	100366.001.dwg	100366.001
<b>Drawing with multiple tabs/layouts (see Engineering Handbook 9B.3):</b>		
Layout 1	110273.000.dwg	(Tab name) 001
Layout 2	110273.000.dwg	(Tab name) 002
Layout 3	110273.000.dwg	(Tab name) 003
Layout 4	110273.000.dwg	(Tab name) 004
<b>Multi-tab Excel file (e.g. drawing list, bill of materials, conduit &amp; cable list, RTU list, etc.):</b>		
Layout	109639.000.xls	109639.000
Sheet 10 of a Transmission line plan drawing	100012.010.dwg	100012.010
Sheet A for Transmission line plan for plan drawing #100012.001	100012.001A.dwg	100012.001A
Sheet B for Transmission line profile for plan drawing #100012.001	100012.001B.dwg	100012.001B
Substation Base XREF for foundation plan #123459.001	123459.000.XB.dwg	123459.000.XB
Substation Topo XREF for grading plan #123457.001	123457.000.XT.dwg	123457.000.XT
Raster image file for #100205.001	100205.001.tif	

**Note:** This table does not apply to generation thermal.

The “base” drawing will have its own drawing number series, with the appropriate file extension.

A raster file will have the same number as the drawing to which it is attached, with the appropriate file extension.

## 7.4. Legacy Numbering Systems

Drawings created prior to the use of the six-digit numbering system that have new XREFs or raster images attached shall retain the legacy drawing number.

If necessary, new drawings may be added to an existing legacy drawing number series. For example, if sheet 10 is added to a series of nine sheets, the total number of sheets shall be updated on sheet one (from “1 OF 9” to “1 OF 10”). The new, sheet-10 drawing shall use the legacy drawing number, and shall have all new information in the title block, even if the drafting is taken in part from one of the other sheets. The new sheet shall be revision zero.

This procedure does not apply to transmission or generation drawings; see Engineering and Asset Management Procedure 097, *Transmission Documentation* and Engineering Handbook 9B.

The examples in Section 7.5 show one legacy numbering system but may be applied to other legacy numbering in a similar manner.

## 7.5. XREF Drawing Numbers

General plans, foundation plans, grounding plans, and conduit & cable plans shall always have XREFs attached. Drawings and XREFs shall be numbered as follows:

52362A01.dwg (General Plan), XREF name = 52362A00.XE  
 52363A01.dwg (Foundation Plan), XREF name = 52363A00.XB  
 52364A01.dwg (Grounding Plan), XREF name = 52364A00.XG  
 52365A01.dwg (Conduit & Cable Plan), XREF name = 52365A00.XC

A new XREF shall use a legacy number if no XREFs exist for drawings with legacy numbers. For example, a new base plan for existing drawing 52363A01 shall be numbered 52363A00.XB.

Raster images shall be titled with the same number as the associated drawing. For example, 52351A00.XB.tif for drawing 52351A00.XB.dwg.

1. The foundations will become the XB and effort will be made to extract existing entities that belong to the XB such as:
  - a. Foundations
  - b. Fence
  - c. Property lines
  - d. Roads

These XREFs will follow the criteria in 9A.5, Section 6.2, *Building the XREF File*, which includes baselines (if the location is known). The insertion point will be at 0,0.

## 8. Title Blocks

Title blocks are attributed for use with the electronic drawing management system (DM). The attributed title blocks have been designed to be inserted into new or existing drawings and are required in all company engineering AutoCAD files. See Engineering Handbook 9B. for generation thermal title blocks.

The following is a list of the attributes that AutoCAD prompts when the title block is inserted:

1. DISCIPLINE — The discipline name should be chosen from the controlled vocabulary list (CVL) provided in DM. For a complete list of discipline names available for entry at this prompt, please see Engineering Documentation Policy 104, *Indexing of Discipline and Document Type*.
- 1.A. FACILITY NAME AND TYPE — This field shall display the facility name and the type without voltage. An exception to this is that Dixonville 500 (without the KV) is a valid name and 500 is not to be removed
2. FACILITY NAME/EDMS (D-style title block only) — For DM indexing purposes only; the facility name is not visible in drawing.

LINE NAME/FACILITY NAME (CORPD-TRAN title block only)

3. FACILITY TYPE/EDMS (D-style title block only) — For DM indexing purposes only; the facility type is not visible in the drawing.

VOLTAGE/FACILITY TYPE (CORPD-TRAN title block only)

4. FACILITY LOCATION (CORP-D title block only) — City, State (if the location is in a city); County, State (if the location is in a county).
5. DOCUMENT TYPE — The document type should be chosen from the controlled vocabulary list provided in DM. For a complete list of allowable document types, please see Policy 104, *Indexing of Discipline and Document Type*.
6. DRAWING TITLE — No entry is required. This field may be used for additional drawing information, such as substation voltage.
7. DRAWING NUMBER — Five- or six-digit drawing number with the appropriate sheet number suffix.
8. REVISION NUMBER — Current revision number. If the drawing hasn't yet been revised, the default revision (or "rev") number is zero. The revision block for rev-zero drawings shall remain blank. Drawings under review shall have a letter designation entered behind the proposed revision number; the alpha character shall be removed once the design is approved. See Engineering Procedure 211, *Substation Engineering AutoCAD Review for External Consultants*, for more details.
9. SHEET NUMBER — The first drawing of a set should indicate the current sheet number ("1") and the total number of drawings in the set, e.g. sheet "1 OF 4" (or "1 OF 1" if sheet 1 is the only sheet). All other sheets in the set should indicate only the current sheet number, e.g. "2," "3." If new drawings are added to the set, the total number of

sheets must be revised on the first sheet. For transmission plans & profiles, each sheet shall indicate the total number of drawings. For example, “1 OF 4,” “2 OF 4,” etc..

10. DRAWING SCALE — As noted, none, or a valid scale.
  - e. HORIZONTAL SCALE (CORPD-TRAN title block only) — horizontal scale, e.g., HOR. 1"=400'.
  - f. VERTICAL SCALE (CORPD-TRAN title block only) — vertical scale, e.g., VER. 1"=40'.
11. PROJECT/ER NUMBER — Department-specific
12. PL NUMBER — Plant locality number. This is required on all drawings.
13. DRAWING DATE — The issue date of the ORIGINAL drawing (“revision 0”), in the format MM/DD/YYYY. The date must be consistent and current on all newly-issued revision zero project drawings. Once issued, the date in the title block shall remain unchanged for the life of the drawing.
- 13A.LINE CODE (CORPD-TRAN title block only) — alphanumeric transmission line designation
14. ENGINEERED BY — The engineer’s first initial and last name, e.g. “J. DOE.”
15. DESIGNED BY — The designer’s first initial and last name, e.g. “J. DOE.”
16. DRAWN BY — The drafter’s first initial and last name, e.g. “J. DOE.”
17. CHECKED BY — The checker’s first initial and last name, e.g. “J. DOE.”
18. DISCIPLINE ENGINEER — The discipline engineer’s full name. This field may sometimes be blank.
19. PROJECT ENGINEER — The project engineer’s full name.
20. APPROVAL ENGINEER — The approval engineer’s full name.

**NOTE:** If signatures are from an external engineering firm, signature fields 14 through 19, above, shall contain signatures, and shall also be followed by the acronym of the firm separated by a forward slash, for example, “J. DOE/CRA.”

Names shall be entered consistently (including spacing) in order for the BAD audit tool to review common attributes. No leading or trailing spaces shall be inserted within the attribute fields.

### 8.1. Converting Legacy Title Blocks to New Title Blocks

See Engineering Handbook 9B. for converting generation thermal title blocks

All legacy drawings being modified shall have the title blocks updated to the latest D-style title blocks. The nomenclature of existing title blocks is transferred to the new title block. Certain missing fields or incorrect nomenclature shall be placed or corrected; other missing nomenclatures remain unchanged. See Volume 9B.2, Section 3.1 for further information on which nomenclatures shall be placed or corrected.

It is not necessary to transfer the legacy revision information when converting the title blocks.  
The drawing is rev'd up to the next number with a description of the current modifications.

## 9A.3—Font and Text Style

### 1. Scope

This engineering handbook document specifies the font and the codes for symbols and fractions used in AutoCAD drawings.

### 2. General

Text on new company drawings shall use the simplex1.shx font as supplied by the company. Company AutoCAD technical support will provide this font for in-house personnel and for consultants who develop or edit AutoCAD drawings for the company. Before simplex1.shx can be used, the font file must be copied to the user's font directory.

The generation thermal group does not use the simplex1.shx or allow the use of custom fonts. See Engineering Handbook 9B. for generation thermal font preferences.

### 3. Use of Text, Symbols, and Fraction Codes

The simplex1.shx font contains all standard keyboard characters, fractions, and other special characters. Smaller-sized characters, subscripts, underscoring, special expanded ASCII characters and fractions can be provided using %% codes, as described in Sections 3.1 and 3.2.

#### 3.1. Special Characters

The following table below gives %% codes for commonly used symbols.

**Table 3—Codes for Special Characters**

Symbol	Code	Symbol	Code	Symbol	Code
° ( <i>degree</i> )	%%127 or D	±	%%128 or P	∅	%%129 or C
ℓ	%%168	¢	%%169	☒	%%199

**Note:** This table does not apply to generation thermal.

#### 3.2. Fractions

The table below lists the %% codes for fractions. Fractions can also be typed into MTEXT and tables with stacked properties, set to diagonal at 70 percent of text size.



**Table 4—Codes for Common Fractions**

Character	Code	Character	Code	Character	Code	Character	Code
1/4	%%130	5/16	%%138	5/32	%%146	21/32	%%154
3/4	%%131	7/16	%%139	7/32	%%147	23/32	%%155
1/8	%%132	9/16	%%140	9/32	%%148	25/32	%%156
3/8	%%133	11/16	%%141	11/32	%%149	27/32	%%157
5/8	%%134	13/16	%%142	13/32	%%150	29/32	%%158
7/8	%%135	15/16	%%143	15/32	%%151	31/32	%%159
1/16	%%136	1/32	%%144	17/32	%%152	1/2	%%160
3/16	%%137	3/32	%%145	19/32	%%153		

**Note:** This table does not apply to generation thermal.

#### 4. Text Size

Regular text shall plot at a height of 3/32", or 1/8" for headings/subheadings.

For communication drawings only, on D-size sheets regular text shall plot at a height of 1/8" and headings/subheadings at 3/16". On A-size, block and level drawings regular text and headings/subheadings shall plot at a height of 1/16".

Single-line text (DTEXT) is preferred throughout drawings where single strings of text are used. The company has predefined text styles S1 through S8 for use when the text needs to be narrowed. The text style shall be changed in lieu of manually modifying the text width through Chprop or the attribute editor.

Multiline text (MTEXT) is preferred where multiple lines of text are needed, such as notes.

#### 5. Tables

AutoCAD tables may be used where applicable for notes, charts, and legends. Predefined table styles specific to power delivery are accessed from the standard palette. Tables shall not be exploded.

## 9A.4—Drawing Revision

### I. Scope

This section of the company engineering handbook lists the procedures to be followed when revising drawings.

### 2. Revision Clouds

#### 2.1. General

All engineering groups, contractors, and consultants shall use revision clouds to identify changes on drawings for construction purposes.

Revision clouds from previous revisions are to be removed and only the clouds for current revisions shall be shown. If construction for the previous revision is still ongoing, the construction crew(s) will be required to work from two or more prints of the same drawing. It is not acceptable to show multiple revisions on the same drawing.

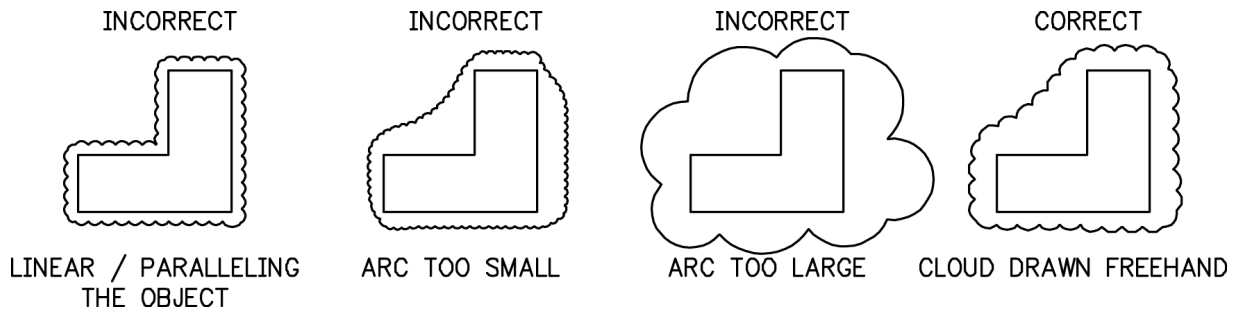
#### 2.2. Revision Cloud Command

The company encourages the use of AutoCAD's REVLOUD command for creating revision clouds. The arc sizes of revision clouds shall appear consistent throughout the drawing, and shall be relative to the size of the object being clouded. Rev clouds shall be placed on the rev layer, and broken when necessary to avoid crossing through text or obstructing the design.

In general, ORTHO shall be turned off to avoid linear clouds running parallel to the object being clouded. The clouds are to be placed around entities in their current space (e.g., entities in modelspace will have the cloud also in modelspace). The calligraphy option of the cloud command shall not be used. Any text or leaders associated with the clouds are to be on the rev layer.

Triangles shall not be used to label revision clouds when different work order numbers occur at the same time. In such cases, a string of text or the dynamic rev-block may be used to associate clouds to the appropriate number. Such labels and leaders are to be placed on the rev layer.

**Note:** Generation thermal continues to use triangles to denote areas of revision where clouds interfere with the drawing content.



**Figure 4—Revision Clouds**

### 3. Updating with Revisions

#### 3.1. Update Drawing Process

Changes may be made to drawings in two ways: 1) in project design prior to construction, or 2) in as-builts provided after construction. In project design, revision clouds shall be used to highlight changes on the drawings. In as-builts, construction revision clouds from all previous designs shall be removed.

If an existing drawing is being modified by 40 percent or more, it is recommended that the whole file be brought up to current drafting standards.

When creating or modifying drawings with content is derived from another drawing, the use of a “taken-in-part” note is used to create a reference. These notes are taken from the standard palette and tailored to the circumstance. The note is placed in the drawing that receives the content and the information in the note comes from the drawing that gives it up. For example:

1. THIS DRAWING TAKEN IN PART or TAKEN FROM DRAWING \_\_\_\_, REV \_\_\_\_, DATE \_\_\_\_
  - a. The drawing that the content was taken from would have some reference noted in the revision block as to what drawing the content was moved to. The content moved would have a cloud place around the area where the content was.
2. THIS DRAWING BASED ON or IN PART FROM DRAWING \_\_\_\_, REV \_\_\_\_, DATE \_\_\_\_
  - b. This would be used where a drawing type did not exist and a new one was created based on another drawing type.

This process is used when creating key sheets where the existing drawings are moved up one drawing number and a note is needed in each sheet following the key sheets.

#### 3.2. Revisions and Versions

See Engineering Procedure 211, *Substation Engineering AutoCAD Review for External Consultants*, for further detail.

### 3.2.1. Versions

Versions are modifications that are being reviewed prior to issuing. The current revision will be incremented to the next revision number with a sequential alpha designation placed behind it for review purposes (e.g., 0A, 0B, or 1A, 1B, etc.). The alpha character shall be removed when the project is issued. These alpha/numeric notes shall also be placed near the clouded design change to delineate various design reviews. Place all text, leaders associated with the revision cloud on the rev layer with a text height of 3/32". Versions are not used on communication drawings.

### 3.2.2. Revisions

When a design change becomes an approved revision, the version labels and associated revision blocks used for the versions shall be removed, leaving only one revision block. The final revision description will denote all the changes to the drawing. Revision numbers shall be numeric, whole-digit numbers. All current, finalized revision changes shall be clouded without a revision label.

Newly-created revision zero drawings do not have revision blocks and typically do not contain clouds. However, in certain circumstances (for example, revision zero manufacturer drawings with wiring being added) revision zero drawings shall contain revision clouds.

Each time a drawing has a new, approved change its revision number is incremented. The newest revision block shall appear beneath the previous revision block. If room at the bottom is needed, the oldest revision(s) shall be removed and the remaining revisions shifted upward such that the newest revision is always listed at the bottom.

One revision description line is preferred. Therefore, the descriptions should use abbreviations, if necessary, to accommodate the parameters of the first attribute field.

### 3.3. As-Builts

The marked-up as-builts are prepared by the field after construction is complete. The revision cloud shall not be removed until the marked-up as-builts are reviewed and approved by the engineer responsible for the work and the files have passed a drawing quality control check. After approval and quality control check, the revision clouds shall be removed and the file rev'd up. Additional changes without revision clouds may be added to the as-builts by an internal reviewer.

All construction notes are to be removed while all other remaining notes, legends, and layering or line types that indicate proposed shall be converted to existing.

Drawings in a construction package that have not been marked up by the field shall not be considered "as-built" or "rev'd up".

All drawings shall be returned to the company's document management system in the native AutoCAD .dwg file format. The format shall be that of the same release of AutoCAD currently used by PacifiCorp. Pdf files will not be accepted in lieu of editable CAD files and are not to be issued as final drawings.

All final as-built drawings shall contain final approval signatures, both wet and electronic.

### 3.4. Update of Revision Block

Upon removing the revision cloud or inserting changes from the as-builts, the AutoCAD user shall update the provided revision block in the standard border template as described in 9A.2, Section 6.

### 3.5. Redlining Drawings

The originator of any drawing changes must provide the drafter/designer with a color-coded drawing and the name of a contact person if there are any questions. Details should include:

- Updated information in the revision block such as revision number, description of change, work order or project number
- Date of change
- Name of individual responsible for the change

The drafter/designer shall make the changes as requested and print the revised drawing. Upon completion, the drafter/designer will then return the marked-up drawing and a print of the revised drawing to the originator for review.

### 3.6. Color Code Key

Field markups in as-builts or in project design are to follow the below criteria.

Legible penmanship shall be used so the drafter can properly interpret the red lines. Eights that look like “B,” and fives that look like “S” are not acceptable.

When changes or corrections are being sketched on a drawing, the following color codes shall be used to assist the drafter:

- Additions: red
- Deletions: green
- Area checked, no change made: yellow
- Notes to drafter: blue (no black or pencil)

All changes to drawings must be clearly marked with the appropriate color code. This provides the drafter/designer with precise, detailed information regarding the changes requested.

### 3.7. Voiding & Superseding CAD or Image Files

See Engineering Handbook 9B. for generation thermal voiding and superseding procedures.

#### 3.7.1. Voiding CAD Files

Void Stamps: Drawings being voided shall have the void stamp placed in the lower right-hand area of the drawing with the attributes completely filled in. If the drawing is being

superseded by another drawing, the drawing number(s) shall be referenced in the void stamp. The drawing that supersedes the voided drawing shall have a string of text placed along the lower right edge of the title block stating, for example, "THIS DRAWING SUPERSEDES DRAWING 123456.001, REV 3, DATE 6/11/03." The revision number and revision date shall be that of the latest revision of the voided drawing.

If a drawing is partially superseding another drawing, the superseded note shall state this accordingly:

THIS DRAWING PARTIALLY SUPERSEDES DRAWING...

If the drawing is just being voided and not superseded, "N/A" shall be placed in the attribute field of the void stamp and the drawing shall not be rev'd up.

Transmission plans & profiles may be an exception to this rule; contact transmission document control for guidance.

Communications drawings do not use void stamps in the drawing file, but will be marked as void in the document management system.

Drawings can only be voided if the entire drawing series is voided. If the whole drawing series is being voided, the drawings are not updated or rev'd up and normal void/superseding procedures are to be followed.

If the entire series is not voided, then the affected drawings will have the content removed, clouded, and a description placed in the revision block stating "DRAWING LEFT BLANK FOR FUTURE USE, CONTENT MOVED TO 123456.XXX," or if the series is not superseded or the content moved, the description shall read "DRAWING LEFT AS PLACE HOLDER FOR FUTURE USE." The drawing is rev'd up and the title block updated to current standards for future use. As-builts will not have a cloud placed where the content was removed.

The 4th line (Attribute tag 6) of the title block should have "FUTURE USE" added to the existing nomenclature.

The new rev 0 drawing that replaces the one being voided or left as a place holder shall have a supersede note taken from the standard palette and placed in the lower right-hand corner of the drawing. The fields of the note shall have the following taken from the drawing that is being removed:

1. The full drawing number.
2. The revision number of the last revision of the voided or the blank drawing that contained the content before it was removed or voided, not the revision that it will become if left as a place holder, i.e., the note should not refer back to a blank place holder.
3. The date, unless it is a rev zero, is the date of the revision block, not the earlier date of the title block.

THIS DRAWING SUPERSEDES DRAWING ----, REV ----, DATE ----

A partial supersede note is placed if two or more drawings are superseding one drawing. The note shall read:

THIS DRAWING PARTIALLY SUPERSEDES DRAWING ----, REV ----, DATE----

A taken-in-part note is placed in drawings where the content is taken from an existing drawing and a portion of that existing drawing will continue to be used and not voided or left blank for future use.

THIS DRAWING TAKEN IN PART FROM DRAWING ----, REV ----, DATE ----

### 3.7.2. Voiding Image Files

To void a stand-alone image file, the file should be temporarily attached to a CAD file as a means of editing and saving the image file through Raster Design or other image editing software. In AutoCAD, attach the image, bring in the void stamp, and fill it in. Using raster design, use the command IVMERGE to merge the block into the image. Save the image file, not the CAD file, and detach it. Use this method only if the image is not already attached to a CAD file.

The following process is performed where a .tif image is part of a drawing series that cannot be voided. When the drawing content is either removed or transferred to another drawing, the drawing number is retained with the original title block history for future use as described below.

1. The title block information of the .tif image will be transferred to appropriate D size title block, and the new title block will be rev'd up and reserved for new drawing content.
2. The old legacy revision information from the .tif is not transferred over to the REV-D blocks. The drawing is rev'd up and not backward to a rev 0 drawing. The 4th line (attribute tag 6) of the title block should have "FUTURE USE" added to the existing nomenclature.
3. The revision block will read "DRAWING SUPERSEDED BY DRAWING(S) 123456.XXX or if not superseded, the description shall read "DRAWING VOIDED AND LEFT AS PLACE HOLDER FOR FUTURE USE."
4. The image is not attached, but a cloud is placed where the image would have been placed, representing that the content was removed.
5. The drawing that will supersede the old .tif will not inherit any of the old title block or revision history. It will be a new rev 0 drawing with only the drawing content transferred from the old drawing, and a supersede or partially taken note is placed in the lower right-hand corner of the drawing.

## 9A.5—Drawing Practices

### 1. Scope

This section details drawing practices required to provide uniformity and ease of use.

### 2. Quality and Neatness

All drawings created or modified for the company must be neat and professionally-drafted, clearly illustrating the necessary detail for the proposed construction or for producing final as-built drawings.

Some practices to abide by include:

- Object lines should meet at corners.
- Dimension extension line nodes should be snapped to the object being dimensioned. They shall not lay over the top of line types making the line type appear continuous, nor shall the node snap to the center of circles or arcs giving the appearance that the extension line is tangent to the circle or the dim gap is buried within the circle.
- All drawing content shall be shown within the paperspace border.
- Objects in modelspace should be drawn to the actual scale. Do not “free pick” object lines.
- Details drawn in modelspace that can be shown through a single viewport with the same scale shall be grouped together so they can be shown through a single viewport and not multiple viewports with the same scale. Viewports should not be drawn on a layer that plots so as to frame in the details. The detail frames, if used, should reside in modelspace with the details and be shown through the viewport.
- Use appropriate text justifications when placing or modifying text.
- Standard layers are to be used to depict line weights, linetypes, and color. All CAD entities are to be “bylayer” and are not to be modified by individually changing the linetype scale, color or linetype by entity.
- The drawing units are to be Architectural, with a minimum precision of 1/32”, and the insertion set to “inches.” The only exceptions to this rule are civil survey files, generation, and transmission files. The units of the survey file are to remain decimal. The units for these drawings shall have a length precision of 0.0000, an insertion scale in feet, angle type of deg/min/sec, and angle precision of 0d00’00”.
- New drawings shall use the company blocks placed in AutoCAD’s palette system.
- Legacy drawings saved as new drawings shall have the modified content converted to current CAD standards as required by 9A.7 *CAD Standards and Template Files*. In case-by-case scenarios, a 'taken from' or 'taken in part' note may need to be placed in the lower right-hand corner of the drawing stating where the drawing originated. This note shall relieve the burden of bringing certain portions of the drawing up to current standards, leaving important non-standard scenarios in place. The note shall follow the procedures in Handbook 9A.4, Section 3.7.1, *Voiding CAD Files*.



- New drawings shall not use certain existing non-standard entities within the drawing that are then copied to other areas for use in the new design.
- Drawing files shall not contain embedded VBA macros.

### 3. Drawing Scale

All modelspace objects are to be drawn to actual scale (1:1). In some instances it is necessary to plot the drawing in a manner that will allow users to scale off dimensions from a paper copy. Care should be taken when doing this to avoid confusion when copies or reductions of the original plot are made.

**Table 5—Table of Drawing Scales (in feet)**

Drawing		Text Factor	
Scale	Scale Factor	Size 0.09375	Size 0.125
1'=10'	10	0.9375	1.25
1'= 20'	20	1.875	2.5
1'=30'	30	2.8125	3.75
1'=40'	40	3.75	5
1'=50'	50	4.6875	6.25
1'=100'	100	9.375	12.5
1'=200'	200	18.75	25
1'=400'	400	37.5	50
1'=600'	600	56.25	75
1'=800'	800	75	100

**Table 6—Table of Drawing Scales (in inches)**

Drawing		Text Factor	
Scale	Scale Factor	Size 0.09375	Size 0.125
3/4"=1"	1.33	0.125	0.17
5/8"=1"	1.6	0.15	0.2
1/2"=1"	2	0.1875	0.25
3/8"=1"	2.67	0.25	0.33
1/4"=1"	4	0.375	0.5
1/8"=1"	8	0.75	1
1/16"=1"	16	1.5	2
1"=1"	1	0.09375	0.125
1/16"=1'	192	18	24
3/32"=1'	128	12	16
1/8"=1'	96	9	12
3/16"=1'	64	6	8
1/4"=1'	48	4.5	6
3/8"=1'	32	3	4
1/2"=1'	24	2.25	3
3/4"=1'	16	1.5	2
1"=1'	12	1.125	1.5
1-1/2"=1'	8	0.75	1
2"=1'	6	0.5625	0.75
3"=1'	4	0.375	0.5
1"=10'	120	11.25	15
1"=20'	240	22.5	30
1"=30'	360	33.75	45
1"=40'	480	45	60
1"=50'	600	56.25	75
1"=100'	1200	112.5	150
1"=200'	2400	225	300
1"=400'	4800	450	600
1"=600'	7200	675	900
1"=800'	9600	900	1200
1"=1000'	12000	1125	1500

Example: (for all text):  
Text size (3/32" text): Scale factor x 0.09375  
Text size (1/8" text): Scale factor x 0.125  
Block Insertion Scale = 1 / Scale factor

## 4. Paperspace / Modelspace

Paperspace layouts shall be used in all power delivery drawings in the following manner, excluding generation thermal. All non-scalable entities such as one-lines, schematics, block and level diagrams, etc. shall be drawn in the paperspace layout tab with the border unless an image is being used. All entities associated with the image shall reside in modelspace. The following steps detail the procedures for utilizing paperspace / modelspace for scaled drawings requiring a viewport:

1. Draw the objects in modelspace at full scale using true measurements.
2. Typically, only one viewport is used and should be traced along the inner edge of the title block using the rectangular (not polygonal) viewport command. Viewports shall be placed on the DEFPOINTS layer.

If needed, multiple viewports can be cut in the paperspace environment, as long as they fit within the 1:1 border. If multiple viewports are used with different scales, the scale of the detail is noted within the subtitle block and “AS NOTED” is placed in the title block. Details shown in one viewport shall have the scale noted in the title block and not beneath each detail.

3. Use the ZOOM command to precisely scale each view, or use the scale dropdown in the viewports toolbar to set the desired scale.
4. The layer properties manager can be used to set the appearance in a drawing with multiple viewports by freezing the layers within them.
5. All viewports shall be locked to avoid accidental changes.
6. Set the LTSCALE to .25 and PSLTSCALE to 1 to ensure that all line types plot the same in multiple viewports.
7. Fill out the title block and/or add the revision block, or other notes and legends. All notes, legends, and the reference drawing block shall be placed in the lower right-hand corner of the drawing in paperspace. Vertical lines of these notes and legends are to line up with each other. See Engineering Handbook Volume 9B for discipline-specific drafting standards related to the orientation of notes and legends.

## 5. Multiple Paperspace Layouts (Tabs) Within One File

See Engineering Handbook 9B.3, *Civil Drafting Standards*, regarding multiple paperspace layouts within one file.

## 6. External Reference Drawings

See Engineering Handbook Section 9B for discipline-specific XREF procedures.

## 6.1. XREF Naming

Below are examples of the suffixes used for XREF file names. XREFs are not permitted on transmission drawings.

<b>New Numbering File Name</b>	<b>Legacy Numbering File Name</b>
*.000.XT (topographic file)	*.A00.XT (topographic file)
*.000.XB (base file)	*.A00.XB (base file)
*.000.XE (electrical file)	*.A00.XE (electrical file)
*.000.XCH (control house file)	*.A00.XCH (control house file)
*.000.XG (grounding file)	*.A00.XG (grounding file)
*.000.XC (conduit file)	*.A00.XC (conduit file)
*.000.XL (landscape file)	*.A00.XL (landscape file)
*.000.XI (irrigation file)	*.A00.XI (irrigation file)
*.000.XEC (erosion control file)	*.A00.XEC (erosion control file)
*.000.UXE (future electrical use)	*.A00.UXE (future electrical use)
*.000.UXB (future base file)	*.A00.UXB (future base file)
*.000.UXC (future conduit file)	*.A00.UXC (future conduit file)

### 6.1.1. XT Topo Drawing Names (Civil Discipline)

The XT topo drawing name (i.e., the 5 or 6 digit number that precedes the suffix shown above) is the same number as the grading plan sheet file. This XT file contains surveyed land contours and features and base lines. This drawing is set to decimal rather than architectural units, and keeps its world coordinates. This file is based on civil survey data and is not to be modified without first consulting with the civil group.

With the use of Civil 3D, the XT file is not used.

The XT drawing is XREFed into the following sheet files:

- Grading Plan
- Topographic Survey
- Landscaping Plan

### 6.1.2. XB Base Drawing Names (Foundation Discipline)

The XB base drawing name (i.e., the 5 or 6 digit number that precedes the suffix shown above) is the same name as the foundation plan sheet file. This XB file contains existing and proposed property features (e.g., fence, road, property line, control house foot print, foundations, cable trench, ground mats, and base lines). This file is not to be created or modified without first consulting with the civil group.

The XB is XREFed into the following sheet files:

- General Plan
- Conduit & Cable Plan
- Grounding Plan
- Foundation Plan
- Fence Plan
- Landscaping Plan
- Grading Plan
- Plans & Elevations

### 6.1.3. XE Electrical Drawing Names (Electrical Discipline)

The XE electrical drawing name (i.e., the 5 or 6 digit number that precedes the suffix shown above) is the same name as the general plan sheet file. This XE file contains existing and proposed electrical facilities, bus layout, connections, and base lines.

The XE is XREFed into the following sheet files:

- General Plan
- Plans & Elevations

### 6.1.4. XCH Control House Drawing Names (Electrical Discipline)

The XCH control house drawing name (i.e., the 5 or 6 digit number that precedes the suffix shown above) is the same name as the control house arrangement and wiring sheet file. This file contains detailed control house facilities such as cable tray, lighting and equipment. AutoCAD's layer manager is used to toggle between cable tray, lighting plan, and equipment drawings.

### 6.1.5. XG Grounding Drawing Names (Electrical Discipline)

The XG grounding drawing name (i.e., the 5 or 6 digit number that precedes the suffix shown above) is the same drawing number as the grounding plan sheet file. This XG file contains only the grounding grid network without ground mats.

The XG is XREFed into the following sheet files:

- Grounding Plan

### 6.1.6. XC Conduit Drawing Names (Electrical Discipline)

The XC conduit drawing name (the 5 or 6 digit numbers that precedes the suffix shown above) is the same name as the conduit & cable plan sheet file.

The XC is XREF'ed into the following sheet files:

- Conduit Plan

### 6.1.7. XL Landscape File Names (Electrical Discipline)

The XL (landscape file) shall follow the same naming conventions as the landscape plan.

### 6.1.8. XEC Erosion Control Drawing Names (Civil Discipline)

The XEC erosion control drawing name (i.e., the 5 or 6 digit numbers that precedes the suffix shown above) if needed, is part of the grading plan. The file name should follow that naming convention. The XEC is a civil drawing, and in the title block, the third line document type will read “grading plan.” “Erosion control” is entered on the fourth line of the title block.

XREFs are created only to show the plan view of various portions of a site. Entities not to be included in an XREF are dimensions, text, details, elevations, section views, or anything specific to a sheet file.

If an electrical XREF file (XE) is to be created for an existing substation, and if there were an existing general plan of 12345A01, the new XE would follow the name of the old legacy number of 12345A00.XE, not the new six digit naming convention of 123456.000.XE.

## 6.2. Building the XREF File

All XREF files, except the .XCH, are to contain vertical and horizontal baselines with the intersection of these baselines placed at 0,0. All XREF files will now have the CORP-Z block replaced with the appropriate, discipline-specific D-size title block, and undergo the same placement and revision procedure as any other sheet file.

The D-size title block is placed in paperspace and filled in just as the sheet files. The scale shall be 1:1 and the sheet number shall be "1 OF 1."

The document type will be “X-REF” and the fourth line, (attribute tag #6) will describe the type of base file.

The XREF file will only be rev'd up if the file is checked out for modifications. All revision clouds will be shown in the sheet files and not in the XREF file.

To keep from twisting the views of the viewports of the sheet files we do not keep the real world coordinate of all XREFs with the exception of the XT. The XT shall remain at real world coordinates and the baselines are to coincide with the baselines of the other drawings within the yard.

Dimensions and text are not to be used within XREFs. These entities are placed within the individual sheet files.

When establishing baselines in new facilities, care should be taken so as to not cross through any existing or proposed foundations or equipment. If moving foundations and equipment during the design phase of the project is necessary, and in doing that, they cross through any baselines, then adjusting the lines becomes necessary. The adjustment of the baselines in one file requires the adjustment in all the other files. The drafter will then need to move the entire drawing back to 0,0 via the intersection of the two baselines. The AutoCAD command BASE is not to be used in lieu of repositioning the entire file. Be aware of any layers that are locked or frozen before moving all.

If the XREF files exist with baselines, the baselines may not be moved even if they interfere with new design. This is due to these baselines being set with a marker in the yard.

If a new XREF is being created from existing drawings where the baselines are not present and a field-check or survey cannot be performed, the lower left-hand corner of the yard or fence corner shall be at 0,0.

### 6.3. XREFs in Sheet Files

All XREFs are to be placed in modelspace on the XREF layer at a coordinate of 0,0, attached with the NOPATH option. The XREF files are not to be moved, aligned, or rotated off this coordinate. Use DVIEW and TWIST, or ROT, to orient the viewport. An exception to this is when the XB is aligned to the XT in its real-world coordinate. The baseline layers from the multiple attached XREFs are frozen in all but one XREF so as not to have overlapping line types.

Attachments are to be one level deep (i.e., no nesting). Building an XREF by attaching another to it, and then attaching that file to a sheet file creates a nesting situation. To alleviate this, use the overlay option when one XREF file is attached within another.

XREF files are not to be bound to the sheet file and exploded or inserted as a block rather than attaching as an XREF.

### 6.4. Revising XREFs

When modifications are made to an XREF, it shall be rev'd up using a revision block with a description of what was modified. If modifications are made and the title block is not "rev'd-up," the file will not be uploaded to the company's Document Management system.

### 6.5. Unacceptable Attachments

- Sheet files into other sheet files
- Blocks from block libraries
- Details

## 7. Hybrid Drawings

### 7.1. Attached Raster Drawings

The purpose of attached raster images is to reduce drafting time and eliminate redrafting of existing manual drawings. Rasters should only be used when it is not feasible to produce a full CAD re-draw. Raster images should always be attached in modelspace, on layer “IMAGE,” , color 7, with “retain path” unchecked, transparency set to ON, and frame turned OFF. Any CAD entities added to the image are to be located in modelspace.

Attached raster images may be used when the revision being performed affects 30-60% of the drawing. However, the entire drawing may be redrawn in AutoCAD at the drafter/designer’s discretion instead. Remember, when creating composites, the goal is to work toward a fully-vectorized drawing. The only type of raster edit that should be performed is erasing. Eventually, all drawings will be converted to AutoCAD. The drafter should, if time and budget allow, convert raster images whenever possible.

Before the raster image may be used, it must be scaled, despeckled, deskewed, and otherwise prepared to ensure that all portions are legible. Areas that cannot be successfully repaired by such methods shall be redrawn in AutoCAD.

Only the pertinent title block information is transferred from the image to the current title block. The revision is incremented to the next revision, but the previous revision descriptions are not transferred, nor are they retained in the image file. If any of the existing title block nomenclature is incorrect, it is to be corrected to standard. See Vol. 9B 3.1.1 regarding nomenclature revision.

Raster images may only be linked to drawings using AutoCAD. The company’s preferred raster editing software is Raster Design. However, any image-editing software capable of saving the file as a stripped CCITTG4 compressed “tif” image is acceptable.

**Note:** Raster Design versions later than 2010 have a known issue with the degradation of the image after modification and a save is performed: therefore, these versions should be avoided by using other image editing software or version 2010 should be used for the modifications.

Raster images may be attached to XREFs and be referenced as part of the XREF into multiple sheet files. In this case, the raster image file name shall match the XREF file name (e.g., 123456.000.XB.dwg = 123456.000.XB.tif). In cases where it is necessary to use multiple images to assemble one XREF, those images shall be combined into one image with a consistent DPI density across all images. The command IDENSITY in AutoDesk’s raster design can be used to accomplish this by setting the pixels/inch density to a higher number (e.g., from 300 to 600).

Images used in tabbed drawings and shown through multiple viewports must be combined into one image file as described above. The one attached image shall not be copied to other areas within modelspace and shown through multiple viewports. Raster Design is used to reposition or copy different details within a single image frame to show them in drawings with multiple layouts.



Only pixelated .tif images that can be edited with Raster Design shall be attached. File types such as .bmp or .jpg files are not to be attached to the AutoCAD drawing file.

Attached raster images may only be referenced to one parent. If more than one parent drawing uses the raster image, and the image is not inordinately large, copies of the image file will be referenced to each parent. The raster file name and the CAD file name must be the same (e.g., 123456.001.dwg = 123456.001.tif or 12345A01.dwg = 12345A01.tif).

If an image file name is the generic scanned file name, such as 01390073.tif, it shall be renamed to the correct document number that will match the CAD file. This shall be done even if the image is not attached to a CAD file and is being voided. If the image is attached to a CAD file and needs to be renamed, the image will need to be re-pathed or reattached.

## 7.2. Compound Externally-Attached Raster Drawings

Compound raster drawings are created when it is desirable to provide a topological or other land-base image behind the actual drawing, and there is no intent to vectorize this image in the future. This normally occurs only with transmission lines, although other special cases may be defined. Multiple layouts may be used to fit raster images across the file.

## 8. Plotter Setup - Line Color to Line Width Assignment

All AutoCAD drawings shall use the PacifiCorp.ctb color table file for plotting and line weight control. The company's color table is designed for full-size plots (i.e., D-size); therefore, plotting on smaller paper sizes may require toggling the linetype scaling.

Below is a table of modified line widths and screening. All other colors of AutoCAD's 250 colors are a standard width of .012 with screening set to 100 percent. No modifications to the company's color table file are permitted. Colors not shown in Table 7 are a standard weight of 0.0120 with no screening.

**Table 7—Line Color to Line Width Assignment**

CTB COLOR TABLE FILE		
NO.	WEIGHT	SCREENING %
1	0.0220	
2	0.0120	
3	0.0071	
4	0.0280	
5	0.0120	
6	0.0120	
7	0.0120	
8	0.0120	20
9	0.0059	
10	0.0177	
11	0.0197	
13	0.005	
15	0.0071	70
30	0.0236	
32	0.0071	
34	0.0157	
41	0.0098	
52	0.0098	
54	0.0098	
61	0.0079	
63	0.0079	
140	0.0220	
151	0.0157	
190	0.0138	
201	0.0050	10
211	0.0138	
213	0.0059	
215	0.0059	
230	0.0256	
242	0.0050	30
251		15
252		25
253		35
254		45

## 9. Exiting a Drawing

When exiting a drawing, use the following procedure to ensure that the drawing is in a clean state for other users and that the drawing file size has been reduced to saving disk space.

1. Before exiting a drawing, the user should execute a ZOOM EXTENTS command to display all drawing entities in both paper and modelspace.
2. If there are any entities outside of the border other than the date stamp, they should be erased.
3. Use purge command to clean up all unwanted, unreferenced data.

4. Set the current layer to “0”.
5. Cursor is to be current in paperspace and not within the viewport.
6. All loose entities, found by entering Ctrl-A and shift to deselect all visible entities, either in paperspace or modelspace shall be deleted as with any entities not shown through a viewport.

## 10. SNAP, OSNAP, and ORTHO Settings

These settings should be used to ensure alignment, closure, and accuracy of lines or objects created by AutoCAD.

The tools used to control drawing alignment and accuracy are SNAP, OSNAP, and ORTHO:

- If SNAP is used to accurately place lines, blocks, and text in a drawing, it should be set to a minimum value of .03125 inches or (1/32") and must be in multiples of .03125 inches multiplied by the scale factor.
- OSNAP allows users to quickly and easily find the most commonly-used pick points on a drawing object and to ensure that lines, arcs, and circles meet accurately.
- ORTHO is used to create or align drawings, lines, and text that are horizontal or vertical.

## 11. Associative Dimensioning

### 11.1. General

Dimensions are to be associative or real unless they are being used for a note or text string. (Stick-building dimensions by assembling lines, text, and arrowheads or architectural tics is prohibited.) This will ensure that the dimensioning is consistent and dynamic throughout the drawing. DIM styles are obtained via the appropriate discipline’s tool palette, or through the appropriate template files found in the AutoCAD Support\templates folder.

Place dimensioning on a dim layer, color bylayer (color 3). The dim style naming convention should be associated with the scale factor. For example, if the scale factor is 48, then the dim style used should be 48, with the viewport scale set to 48.

No modification of existing dim styles or the creation of new styles is permitted (i.e.: modifying existing style 48 (1/4" = 1'0") to accommodate a change of scale in the viewport from a 48 to 32 (3/8" = 1'0") is not acceptable drafting practice). The style of 48 is to be replaced with the style of 32. The dim style STANDARD is not one that should be used or tailored to fit the scale of the drawing.

Where the STANDARD style is in use, it shall be updated to the correct style based on the scale of the drawing.

### 11.2. Guidelines for Associative Dimensioning

When dimension arrowheads of continuous linear dimensions are forced outside, the dimension is to be offset from the other dimensions so as not to have overlapping arrowheads. The text of the dimension is then moved and centered (not above) between either side of the outward dimension. Additional guidelines for dimensioning variables are outlined below:

- Layer: DIM, color 3, line type continuous. (All bylayer)
- Location of text is always above or off to the side and centered. Never below or centered on the dimension line.
- Be sure variable DIMASO is set to on (turns associative dimensioning on).
- Do not override dimension values. The exception to this is the addition of a note or text string within the dimension.
- Variable DIMASSOC should be set to the two (2) to keep dimensions linked to their objects.

### 11.3. Leaders

All leaders (QLEADER or MLEADERS) shall be associative, and drawn using the dimension style matching the scale factor of the viewport. Leaders should be drawn with no more than three points (i.e., two line segments). Leaders associated to text are placed on the same layer as the text.

When using QLEADERS, the operator should escape out of the “place text” option so the text and the leader can be oriented correctly.

### 11.4. Drawing Units

See Engineering Handbook 9B. for discipline-specific unit types.

Drawing units are to be architectural with a minimum precision of 1/32" and the insertion set to inches. An exception to this is the civil survey file, grading plan, and transmission drawings where the units are decimal with an insertion scale of feet.

## 12. Line-Type Scale

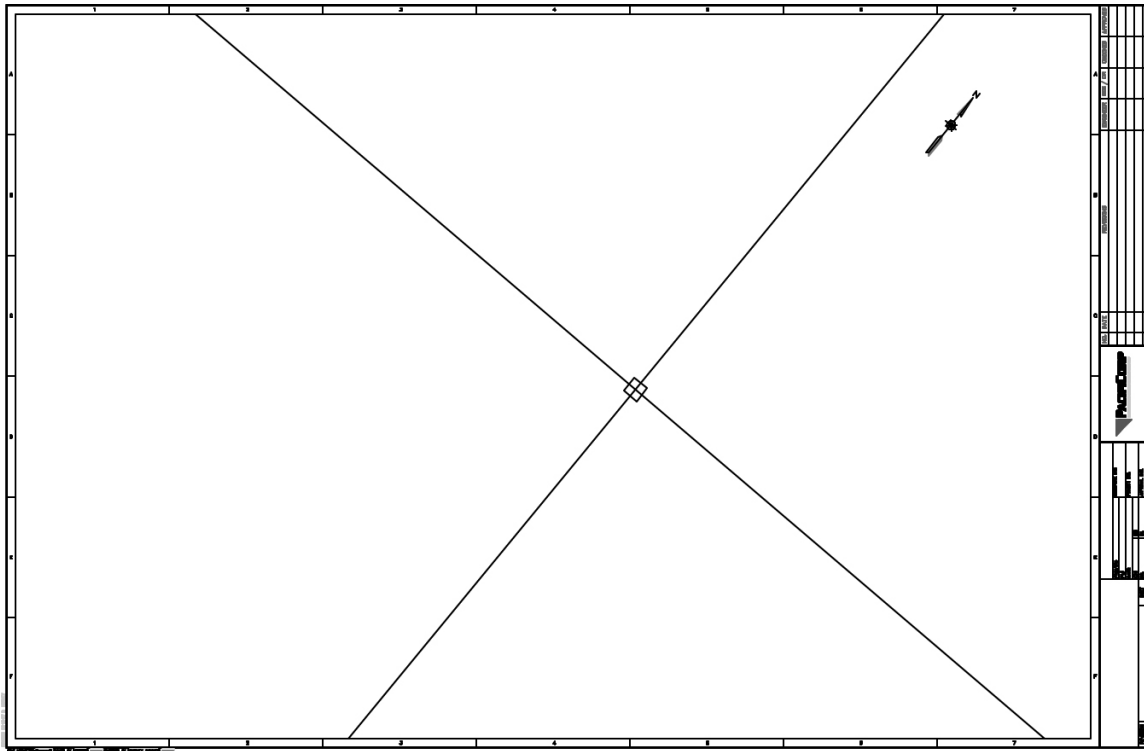
The LTSCALE command sets the scale factor to be applied to all line types within the drawing. A global line-type scale factor is provided for each new drawing with a default value of 1.0. To maintain a consistent line type appearance on drawings the line-type scale (LTSCALE) is set at 0.25. The PSLTSCALE SETVAR should be set to 1.

## 13. North Arrows

North arrows are to be placed in the upper right hand corner of the title block in paperspace. When working with twisted views or changing the rotation in the viewport, be sure that the north arrow is also rotated correctly. In a twisted viewport (likely in the grading plan), where the survey file is kept in its real-world coordinate, the north arrow is aligned with the crosshairs with the UCS set to WORLD. The north arrow is then brought to the paperspace environment via CHSPACE and the viewport is locked.

The orientation of the north arrow should be true north and not what is referred to as substation north.

An exception to this is that transmission and generation thermal will use Plant North and the north arrow is placed in modelspace.



**Figure 5—North Arrow With Twisted Viewport**

North arrows are used in the following sheet files which show the plan views of the yard. Such sheet files will also use a scale bar:

- General Plan
- Conduit & Cable Plan
- Grounding Plan
- Foundation Plan
- Fence Plan
- Landscaping Plan
- Grading Plan
- Plans & Elevations
- One-Line Diagram (no scale bar)
- Landscape Plan
- Erosion Control Plan

#### **I 4. Scale Bars**

Architectural scale bars found on the Standard palette and are to be placed in the lower middle to right-hand area of the drawing. Decimal scale bars are found on the civil palette, and are to be

used in the civil drawings that require a scale bar. The grading plan drawings using decimal units shall use the decimal units scale bars, i.e., 1" = 20' and not 1" = 20'-0".

Transmission drawings do not use scale bars.

The creation of non-standard scale bars in which field personnel cannot place a standard engineering scale to, such as 1/12" = 1'-0" is prohibited.

## 15. Manufacturer Drawings

When placing manufacturer drawings within company title blocks:

Using the appropriate standard D-size title block, place the manufacturer's drawing into modelspace by copying/pasting from the original file then show it through a viewport. The viewport is given a scale that allows the entire manufacturer's drawing to be shown with the text plotting at or near a height of 3/32". If the drawing is too large to accomplish this, then zoom extents and reduce the scale, leaving a margin of approximately 1" between the company's title block and the manufacturer's title block.

Manufacturer files are not to be opened and "saved-as" a project file. These files are often developed with software other than an Autodesk product, or come from other countries, which can bring in hidden issues that cannot be purged out.

In the Layer Properties Manager, group any layers that are using the color cyan, red, #30, #140, and #230, and change those colors to white so they will not plot heavy. Change any entity that has the colors forced to those colors, back to color bylayer.

If adding any wiring or other information to the manufacturer's file, use company drafting standards. These modifications should have revision clouds even on revision zero drawings.

## 16. Vicinity Maps

1. Vicinity maps are to be created and modeled after the example vicinity map block found on the standard palette.
2. The map should not be an attached image such as a .bmp or .jpg. It may be temporarily attached, then duplicated by using the entities found within the template block.
3. The new vicinity map is then made into a block so the audit routine will not recognize the forced layer properties. The block is then placed on the vicinity map layer.

## 9A.6—Block Usage and Development

### 1. Scope

This section of the Engineering Handbook contains a general description of block usage and development.

Blocks are no longer kept as individual CAD files, but are categorized by type and placed within various files where they can be brought in using AutoCAD's design center or from shared palettes (palettes being the preferred method). Blocks provided by the company shall not have the properties altered without approval.

### 2. General Guidelines

All entities that reside in blocks are to be developed on layer 0 using company standards (i.e., text style, height, and justification). If a block is intended to be placed on the steel layer, then all entities considered to be steel within the block are to be on layer 0, color and line type bylayer. Other entities such as hidden lines, center lines, holes, or fittings can be on their respective layers. The attributes and text within a block, even though on layer 0, should be forced to color 7 (white), and not placed on the text layer, so as to always appear white when placed on various layers.

Blocks should be created with insertion point at a position where it will be useful in snapping the block to neighboring objects.

The command MINSERT shall not be used when placing blocks.

### 3. Insertion Point

The insertion point is the reference point for subsequent insertions of the block. It is also the point about which the block can be rotated during insertion. When inserted, blocks are to be placed on designated layers and should not be xclipped.

## 9A.7—CAD Standards and Template Files

### I. Standard Files

The company has compiled hundreds of standard files that are available upon request. Many of these files were drafted years ago and should be brought up to current drafting standards, including:

- Current title block and its proper placement
- Correct dimension styles
- Correct text styles, uniform heights, and justifications
- Drawing units
- Layers
- Correct LTSCALEs and PSLTSCALEs
- Entities bylayer and not forced to a color and line type
- Entities in their proper paperspace or modelspace environment.

To ensure the above are within the guidelines of the Volume 9A, use the following procedures in an effort to provide the company with clean CAD files:

1. Use AutoCAD's LAYER WALK to ensure entities are on their proper layers.
2. Use company-provided routines to correct and standardize CAD files. See company engineering procedure 240, *AutoCAD BAD (Batch Drawing Audit) Procedure* for the use of audit tools.

### 2. Template Files

Template files are available that contain standard settings of layers, text and dimension styles, units, and various title blocks used by the company. These files are discipline-specific for substation/civil, communications, generation, and transmission and are located within the AutoCAD Support/Templates folder.

### 3. Checking Out Files for Modification

Active drawings intended to be modified are to be checked out of Document Manager. Modifications shall not be made to copies if original drawings are not available for checkout.

### 4. Final Issue For Construction (IFC) Procedures

The following requirements apply to files returned by consultants:

1. All internal and external modifications to company -owned drawings shall adhere to Engineering Handbook Volume 9, *Computer-Aided Design* and all other supplemental procedural documents or discipline-specific publications.



2. Drawings to be modified shall be legitimately checked out of DM. Modifications made to copies of drawings, or to drawings from private libraries not obtained from a document control employee is prohibited.
3. All internal and external drafters, designers, or checkers will be responsible for ensuring that CAD standards are being met, prior to submitting to the company, at all review stages.
4. Outside firms shall be pre-approved vendors. They shall insure that all CAD files are submitted to the company at each step in the review process. See item 5 below.
5. To ensure CAD standards are adhered to for company-owned CAD files, review procedures are outlined in company Procedure 211, *Substation Engineering AutoCAD Review for External Consultants*. This publication is referenced in EPC Exhibit A, Section 1 General.
6. The final issuing dates on new rev zero title blocks and revision blocks are to be the same on all drawings being signed and issued. These dates should be on or around 10 days from the issue date. This can be accomplished using the batch routine provided by the company. The Void stamp should also have matching dates. Please contact PacifiCorp AutoCAD Technical Support at (503) 331-4392 or (503) 813-6615.
7. Upon delivery to the company's document control, CAD files associated with AutoCAD's sheet sets and standards checks are to be disassociated.
8. It is advisable to use AutoCAD's ETRANSMIT to ensure all files are bundled together when returning a completed project for final issue. This will minimize missing XREF and image attachments.
9. Files that are returned, checked in, and issued are then available for others to check out for modification. Backup copies shall not be retained in private libraries for future use.
10. Project files for external engineering are re-checked out to consultants to ensure that the files are available for as-building. These files, not backup copies, must be used. Minor corrections are occasionally made to the files upon check in; those changes are lost when as-built modifications are made to files from private libraries.

## 5. CII (Critical Infrastructure Information) Drawings or Documents

See separate CII Procedure V1.05.

## 6. Handbook Issuing Department

The engineering standards and technical services department of the company published this document. Questions regarding editing, revision history and document output may be directed to the lead editor at [eampub@pacificorp.com](mailto:eampub@pacificorp.com). Technical questions and comments may be directed to Dennis Hurley, substation engineering, (503) 331-4392. This handbook document shall be used and duplicated only in support of company projects.

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