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RECORDS OF REVISION

| <u>Rev.</u> | <u>Date</u> | <u>Description</u> | <u>POC</u> | <u>OIC</u> |
|--------------------|--------------------|--|---------------------------------------|-----------------------------------|
| 0 | 06/29/99 | Rewritten/formatted to support LIR 220-03-01, Facility Engineering Manual. Superseded LANL Engineering Standards Drafting Manual, Vol. 2, Rev. 7, dated 4/17/98. | Danny Nguyen, <i>PM-2</i> | Dennis McLain, <i>FWO-FE</i> |
| 1 | 10/29/01 | Dwg size & format defined; added grid reference; title blocks modified for new numbering system; title sheets required, fonts, line widths, text height, line types explained; location plan pinpointed; north symbol generated & location defined; partial & key plans defined; graphic scales defined; drawing scales expanded. | Richard Trout, <i>FWO-SEM</i> | Mitch Harris, <i>FWO-SEM</i> |
| 2 | 07/15/02 | Added Section 201 Subsection 5.0 Grid System. Editorial changes throughout. | Richard Trout, <i>FWO-SEM</i> | Kurt Beckman, <i>FWO-SEM</i> |
| 3 | 9/16/04 | Moved line width assignment to section 211.2.0. Changes/adds to 201.2, 202 Table Note (d), 201.4, 207.2, 208.6, 210.1A, and 214.1A. Change from LEM to ESM. Editorial and figure mods. | Richard Trout, <i>FWO-DECS</i> | Gurinder Grewal, <i>FWO-DO</i> |
| 3 chg 1 | 07/29/05 | Minor change. Corrected grid lines on Figs. 202-1, 202.2, 202-3, 213.2, 213.9, and org name changes. | Richard Trout, <i>ENG-DECS</i> | Gurinder Grewal, <i>ENG-CE</i> |
| 4 | 10/27/06 | Org and contract reference updates from LANS transition. ISD number changes based on new Conduct of Engineering IMP 341. Master Spec number changes. Other admin changes. | Richard Trout, <i>FM&E-DES</i> | Kirk Christensen, <i>CENG</i> |
| 5 | 4/27/15 | Major update. Eliminated ANSI "A" sheet size for dwgs; new universal title blocks for drawings and sketches. Eliminated "plates" (sketches supplant). New drawing number scheme. Deleted "Submittal Sheets" and "Submittal Schedules" from drawing sets. Reduced req'ts for sketches, particularly when hand-drawn. Clarified req'ts for the use of Paper Space versus Model Space. Changed standard font from Romans and Romand to Arial and Arial Black. Updated terms, standards, and procedure refs. App A and H eliminated; title block template posted separately. | Scott Richardson, <i>ES-EPD</i> | Larry Goen, <i>ES-DO</i> |
| 5 chg 1 | 11/19/20 | Admin change. Updated Section 214 3.0.D from "2014 or newer" to "2021 or newer" | Scott Richardson, <i>ES-EPD</i> | Jim Streit, <i>ES-DO</i> |
| 5 chg 2 | 01/05/21 | Admin change. Updated Section 214 3.0.D from "2021 or newer" to "2020 or newer" | Scott Richardson, <i>ES-EPD</i> | Jim Streit, <i>ES-DO</i> |

PLEASE CONTACT THE CAD STANDARDS POC
for updates, interpretations, and variance issues

| | |
|-----|--|
| CSM | CAD Standards Manual POC |
|-----|--|

NOTE: This manual is online (LANL external) at <http://engstandards.lanl.gov/index.shtml>

201 DRAWINGS

1.0 DRAWING SHEET SIZES AND FORMAT

- A. Produce construction drawings and individually controlled drawings (priority drawings i.e., PFDs, P&IDs, electrical one-lines, etc.) on an “ARCH D” size sheet. (**Note:** LANL has chosen “ARCH D” size sheets for ease in reproduction media machinery available and “ANSI B” size reproduction use by Operations.)
 1. Exception: New facilities with a base floor plan of 50,000 sq. ft. or larger may use “ARCH E” size with approval of the CAD Standards POC prior to design layout.
- B. Produce Engineering Studies, Conceptual Design Reports, and Design Criteria sketches on an “ANSI B” size sheet whenever possible.
- C. Use a consistent size of drawing sheet throughout the Drawing Set.
- D. Provide a continuous line sheet border, as illustrated below that is 0.75 mm thick (1 /16 inch).

Standard drawing sheet sizes, borders, and formats are shown below. The overall dimensions are the sheet cut size. *AutoCAD drawing templates (DWT) for standard LANL title blocks can be downloaded from the LANL CAD Standards Manual website (link above).*

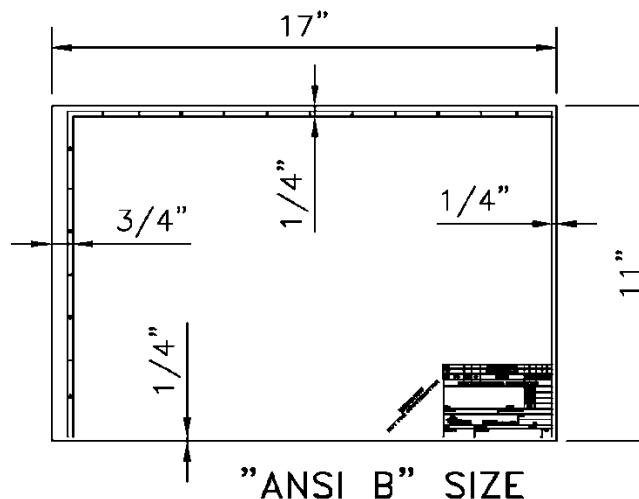


Figure 201-1. “ANSI B” Size

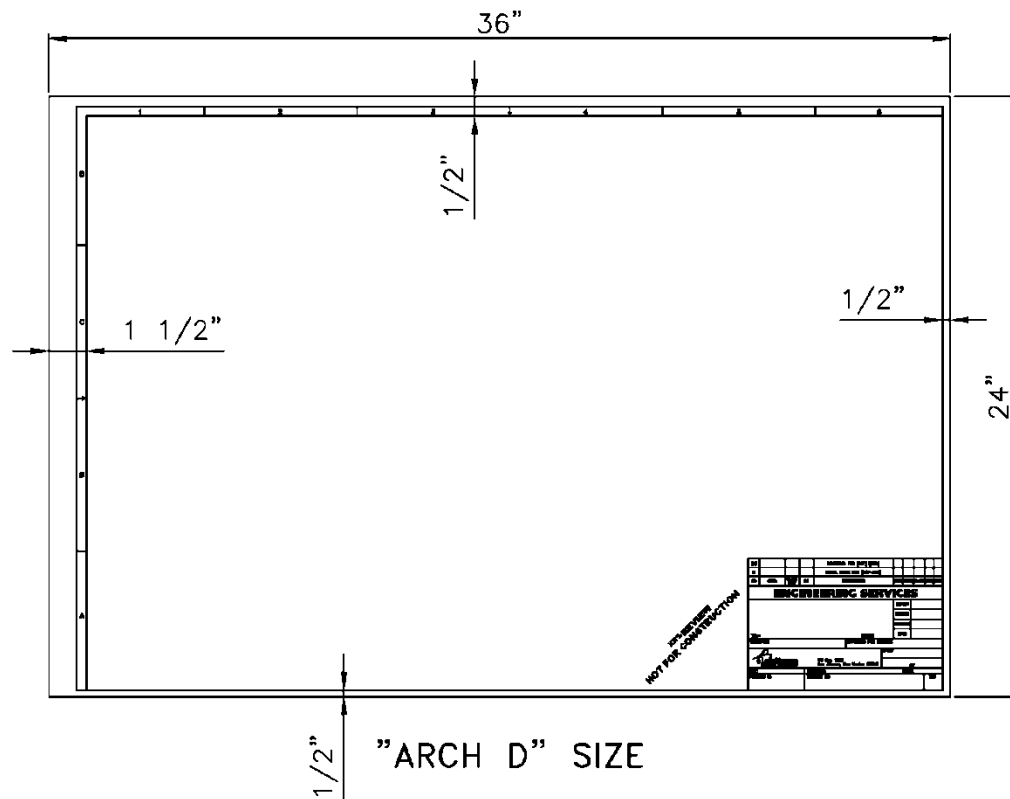


Figure 201-2. "ARCH D" Size

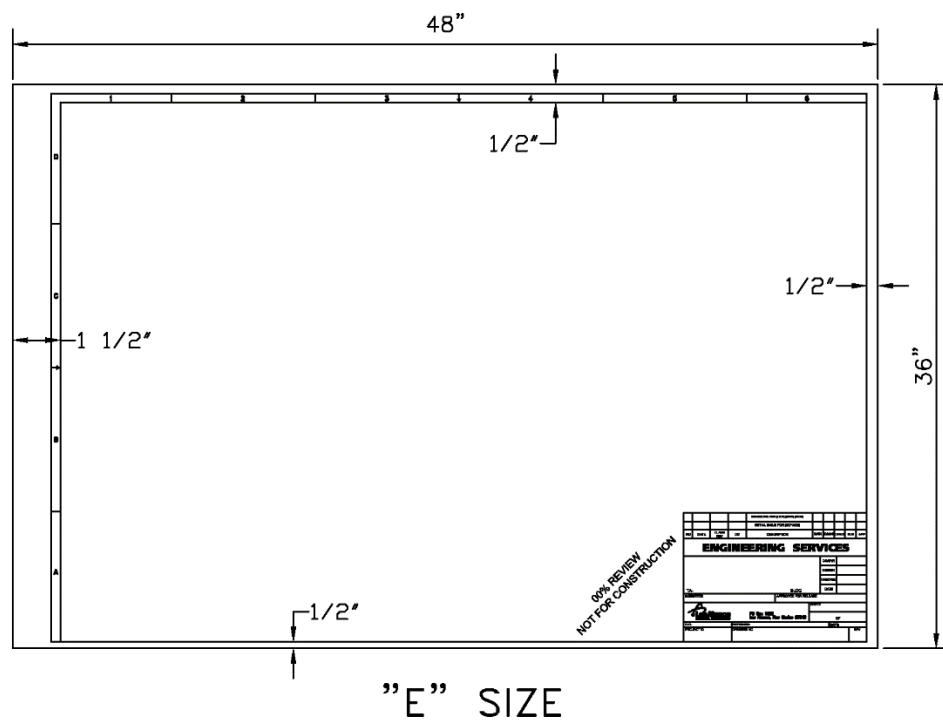


Figure 201-3. "ARCH E" Size

2.0 FINAL DRAWING SUBMITTALS (PROJECT RECORDS/AS-BUILTS)

- A. Construction drawing design packages and supporting documentation (calculations, specifications, statement of special inspections, vendor drawings, shop drawings, submittals, etc.) generated by LANL personnel and subcontractors shall be submitted to the SI-DC Team.
- B. Submit paper prints and CAD files as follows:
 - 1. **Final, approved, and stamped paper prints:** ARCH “D” size, with all required signatures/initials signed off. Use black line on a minimum 0.003 inch paper thickness. Do not use stick-on, appliques, Zip-a-tone, etc. on final drawing sheets.
 - 2. **CAD files:** Refer to Section 214 for requirements.
- C. Paper prints and CAD files are required for submittal for final (stamped) design, ready “For Construction”, and final project record documents (as-builts).

3.0 “NOT FOR CONSTRUCTION” NOTATION

The note “NOT FOR CONSTRUCTION” (without the quotation marks) is to be marked on all in-progress construction drawing sheets in a Construction Drawing Set. Print the review stage (%) above “Not for Construction” and do not remove this notation until the drawings are approved for final release.

| Appearance | Font | Location |
|----------------------|-------------|---|
| Letter size 1/4 inch | Arial Black | Left of the title block at a 45-degree angle, read from left to right |

4.0 SEALED DRAWINGS

- A. Comply with the LANL Engineering Standards Manual (ESM) [Chapter 1](#), Z10 for the requirements of sealing (stamping) construction documents.
- B. The location of the Engineer’s seal is to the immediate left of the title block just above the sheet border (if required).
- C. Revisions to drawings may require an Engineers Stamp. The Engineers Stamp shall appear on the DCF, DRN or FCR documentation but not on the drawing or on sketches.

5.0 GRID SYSTEM¹

- A. Grid system is used to indicate structural columns, load-bearing walls, shear walls and other structural elements on the drawings.
- B. Grid lines are used as a basis for dimensioning.
- C. Vertical grid lines shall have designators at the top of the grid lines, numbered from left to right.
- D. Horizontal grid lines shall have designators at the right side of the grid alphabetized from bottom to top.

¹ Basis: National CAD Standard

- E. To eliminate confusion with the numerals 0 (zero) and 1 (one), do not use letters “O” or “I.”
- F. In some cases, grid designators may be shown at both ends of the grid line to facilitate references.
- G. Where additional intermediate structural support elements occur between grid lines, a fractional designation is used (e.g., a column occurring at mid-point between grid lines 2 and 3 would be designated as 2.5, a column occurring between grid lines B and C would be represented as B.5.
- H. Show grid lines on a single layer titled “GRID”, 0.35 mm (0.015 inches) lineweight, centerline line style and with 1/2 inch diameter circles for grid designators.
- I. All disciplines shall use this convention for grid lines.
- J. For existing conditions match existing grid line designators.
- K. Terminate grid lines 1/8 inch from structure.
- L. Designator text size shall be 3/16 inch Arial.

202 TITLE BLOCKS

1.0 GENERAL

- A. Maintain consistency and accuracy in title block format and content throughout the Drawing Set.
- B. The extent of the drawing field and an example of the title block are shown below. *This allows for the consistent placement of notes, General Notes, security classification stamps, and key plans. The preferred extent of the drawing field is illustrated, for clarity purposes only, with the dashed line. See Section 206 for the location of key plan.*
 - 1. Do not graphically show this border on the drawing.

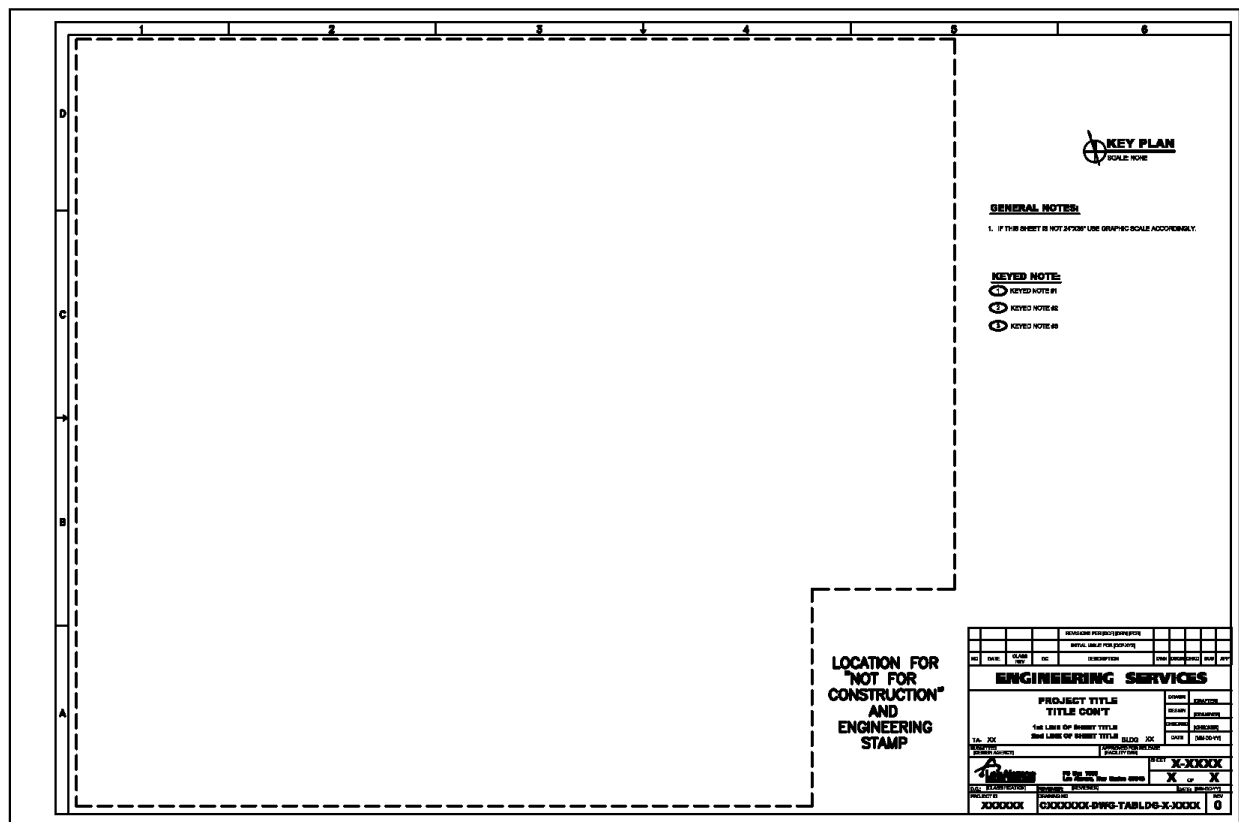


Figure 202-1. Drawing Field, Title Block, and Other Features

- C. Only priority drawings (e.g., P&IDs, electrical one-lines, etc.) and General Notes/Legends sheets may encroach into the no-draw zone. Note location of General Notes and Keyed Notes.

2.0 TITLE BLOCK FOR CONSTRUCTION DRAWINGS AND SKETCHES

- A. The standard Title Block for construction drawings and for sketches is nearly identical – the differences between them are the drawing number format and the level of required approvals. The standard Title Block for construction drawings is shown in Figure 202-2. See Table 202-1 for legend and description of the required Title Block contents.


| | | | | | | | | | |
|--|------|---|----|--|---------|-----------------|---------------|-----|-----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | | | | REVISIONS PER [DCF] [DRN] [FCR] | | | | | |
| | | | | INITIAL ISSUE FOR [DCF-XYZ] | | | | | |
| NO | DATE | CLASS REV | DC | DESCRIPTION | DWN | DSGN | CHKD | SUB | APP |
| 11 ENGINEERING SERVICES | | | | | | | | | |
| 12 PROJECT TITLE 13 TITLE CON'T 14 1st LINE OF SHEET TITLE 15 2nd LINE OF SHEET TITLE | | | | | DRAWN | 18 | | | |
| | | | | | DESIGN | 19 | | | |
| | | | | | CHECKED | 20 | | | |
| | | | | | DATE | 21 | | | |
| SUBMITTED [DESIGN AGENCY] 22 | | | | APPROVED FOR RELEASE [FACILITY DAR] 23 | | | | | |
|  24 P.O. Box 1663 Los Alamos, New Mexico 87545 | | | | SHEET 25 X-XXXX 26 X OF X 27 | | | | | |
| D.C.: 28 | | REVIEWER: 29 | | | | DATE: 30 | | | |
| PROJECT ID 31 XXXXXX | | DRAWING NO 32 CXXXXX-DWG-TABLDG-X-XXXX | | | | | REV 33 | | |

Figure 202-2. Standard Title Block when used for a Construction Drawing

- B. Figure 202-3 is an example of the standard Title Block when used for a sketch.


| | | | | | | | | | | |
|--|------|--------------|----|---|---------|------------|------|------------------|-----------------|--|
| | | | | REVISIONS PER [DCF] [DRN] [FCR] | | | | | | |
| | | | | INITIAL ISSUE FOR [DCF-XYZ] | | | | | | |
| NO | DATE | CLASS REV | DC | DESCRIPTION | DWN | DSGN | CHKD | SUB | APP | |
| ENGINEERING SERVICES | | | | | | | | | | |
| PROJECT TITLE TITLE CON'T 1st LINE OF SHEET TITLE 2nd LINE OF SHEET TITLE | | | | | DRAWN | [DRAFTER] | | | | |
| | | | | | DESIGN | [DESIGNER] | | | | |
| | | | | | CHECKED | [CHECKER] | | | | |
| | | | | | DATE | [MM-DD-YY] | | | | |
| TA- XX | | | | BLDG XX | | | | | | |
| SUBMITTED N/A | | | | APPROVED FOR RELEASE N/A | | | | | | |
|  | | | | SHEET SK-X X OF X | | | | | | |
| | | | | P.O. Box 1663 Los Alamos, New Mexico 87545 | | | | | | |
| D.C.: [CLASSIFICATION] | | | | REVIEWER: [REVIEWER] | | | | DATE: [MM-DD-YY] | | |
| PROJECT ID XXXXXX | | | | DRAWING NO DCF-FY-TABLDG-XXX-SK-X | | | | | REV 0 | |

Figure 202-3. Standard Title Block when used for a Sketch

- C. A standard LANL Title Block templates (DWT) in AutoCAD format must be used and are available on the CAD Standards Manual webpage immediately below this document.
- D. Hand drawn sketches: The standard sketch title block can be filled in by hand or use an improvised title block with the following information provided:
1. Project Identification number if applicable
 2. Drawing number with associated document name embedded (DCF, DRN, FCR, etc. See Figure 202-3)
 3. Project title
 4. Sheet title
 5. Sheet number (if applicable)
 6. Author's name, signature and date.

Table 202-1
Construction Drawing & Sketch Title Block Contents

| Item | Description | Character/Size Font | Notes | Data Definition |
|------|----------------------------------|---------------------|-------|--|
| 1 | Revision Number | 3/32" Arial | | Number of revision made to the drawing. |
| 2 | Date of Revision | 3/32" Arial | | Date the revision was made to the drawings. |
| 3 | Classification | 3/32" Arial | 1, 4 | The LANL DC familiar with the project or area of construction will classify the revision and place his/her initials. |
| 4 | Derivative Classifier (DC) | 3/32" Arial | | |
| 5 | Revision Description | 3/32" Arial | | A description of the changes made to the drawing, P.I. number, A/B date, etc. |
| 6 | Drawn | 3/32" Arial | 1 | Initials and/or last name of the designer/drafter. |
| 7 | Design | 3/32" Arial | 1 | Initials and/or last name of the designer/engineer. |
| 8 | Checked | 3/32" Arial | 1 | Initials and/or last name of the checker. |
| 9 | Submitted | 3/32" Arial | 3, 5 | See item #22 |
| 10 | Approved for Release | 3/32" Arial | 3, 5 | See item #23 |
| 11 | Drawing Originating Organization | n/a | | The logo/name of the organization or firm doing the design. |
| 12 | Project Title | 3/16" Arial Black | 2 | A project title will be filled in for: new facility construction, new addition to an existing facility, the installation of a new system in an existing facility, or Standards Manual Drawing. Work descriptions are required for modifications or upgrades to existing facilities or systems. |
| 13 | Project Title Line 2 | 3/16" Arial Black | | |
| 14 | Sheet Title | 1/8" Arial Black | 2 | A descriptive title of the information contained on the drawing sheet. Typically, the type of drawing (e.g., Process and Instrumentation Diagram) |
| 15 | Sheet Title Line 2 | 1/8" Arial Black | 2 | Space for continuation of the Sheet Title. Typically, the detail information (e.g., Compressed Air system) |
| 16 | Technical Area | 1/8" Arial | | The geographical area designation assigned to LANL properties. |
| 17 | Building Number | 1/8" Arial | | The unique identifying number for a building or structure within a designated technical area; see field #33 for additional detail. |
| 18 | Drawn | 3/32" Arial | 1 | First initial and last name of the drafter/designer. (Not required for issuance after revision 0.) |
| 19 | Design | 3/32" Arial | 1 | First initial and last name of the designer/engineer. (Not required for issuance after revision 0.) |

| Item | Description | Character/Size Font | Notes | Data Definition |
|------|---|--|-------|---|
| 20 | Checked | 3/32" Arial | 1 | First initial and last name of the person who checked the drawings, but not the same person who designed or produced the drawing. (Not required for issuance after revision 0.) |
| 21 | Date | 3/32" Arial | 1 | Date the final drawing set is issued. Date all sheets the same. |
| 22 | Submitted | 3/32" Arial | 3 | Typed name and signature of the Design Professional in Responsible Charge or other individual acceptable to the LANL Design Authority. Not required for Sketches. |
| 23 | Approved for Release | 3/32" Arial | 3 | Typed name and signature of the LANL Facility Design Authority Representative (FDAR). Not required for Sketches. |
| 24 | Responsible Organization | LANL logo | | Logo/name of the organization for whom the drawing is produced (LANL). |
| 25 | Discipline Sheet Number | 1/4" Text height and 0.85 text width Arial Black | | Alphanumeric characters sequentially numbered, by discipline through the project drawing set. For Sketches, since multiple disciplines may be on a single sheet, the alpha designator is not used. Also see Section 210. |
| 26 | Project Sheet Number | 1/4" Text height and 0.85 text width Arial Black | | A sequential number assigned to each drawing sheet in a project drawing set. |
| 27 | Number of sheets in a project drawing set | 1/4" Text height and 0.85 text width Arial Black | | Total number of drawings in the project drawing set. |
| 28 | Classification | 3/32" Arial | 1, 4 | The security classification of the drawing set uses a designation of: "UNCL." for Unclassified; "OUO" for Official Use Only; "C" for Confidential; "UCNI" for Unclassified Controlled Nuclear Information; and, "S" for Secret. The LANL DC can provide the classification requirements. For a drawing set that contains security information, each drawing shall be stamped with the classification with text of not less than 1/8". Example: Appendix B symbol G39 UCNI stamp. Locate the stamp to the left of the "Not for Construction/Engineer's Stamp" |
| 29 | Classifier/ Reviewer | 3/32" Arial | 1, 4 | The signature or initial and name of the person authorized to classify drawings. |
| 30 | Classification Date | 3/32" Arial | 4 | Date of classification signature. |
| 31 | Project Identification Number | 1/4" Arial Black | 5 | A unique number assigned to a project by the LANL. PI is requested per AP-350-100 , Project Planning (<i>FM01</i>) |

| Item | Description | Character/Size Font | Notes | Data Definition |
|------|---|------------------------|-------|--|
| 32 | Drawing Number when “C” Construction Drawings | 1/4” Arial Black | | <p>A unique number assigned to the drawing set by SI-DC. It is an alphanumeric/multi-field number and begins with the letter “C”. After the as-built/project records turnover phase, for Technical Baseline drawings, the “CXXXXX” prefix is removed.</p> <p>Where:</p> <ol style="list-style-type: none"> 1. CXXXXX- is the unique alphanumeric construction drawing number (see Note 5 below for usage details) 2. –DWG- indicates the document is a drawing. 3. –TABLDG- is the 2 digit TA number and 4 digit Structure number. <p>If the project involves multiple facilities, use MULT for the Structure number.</p> <p>If the project involves multiple TA numbers (i.e. – roads, utilities, walkways, etc.) use INFR for the TA and Structure number.</p> 4. “-X-XXXX” is the discipline designator, level 1 followed by the sequential sheet number (A-0001, A-1050, etc. -- same as item #25). <p>See Section 214 for a complete example.</p> |
| | Drawing Number when “SK” sketch | 1/4” Arial Black | | <p>A unique sketch number associated with (and includes) the DCF, DRN, FCR, ES, DC, or CDR number.</p> <p>The format is DCF-FY-TABLDG-XXX-SK-X.</p> <p>Where:</p> <ol style="list-style-type: none"> 1. DCF is the abbreviation for Design Change Form. Alternately, use “DRN”, “FCR”, “ES”, “DC”, or “CDR” as appropriate. 2. FY is the 2 digit fiscal year. 3. TA is the 2 digit technical area number. 4. BLDG is the 4 digit structure number. 5. XXX is the unique 3 digit parent document (DCF, DRN, FCR, ES, DC or CDR) number. 6. SK designates the drawing is a sketch. 7. X is the unique sketch sheet number (1, 2, 3, etc.) |
| | Drawing Number when “ST” Standard Detail | 1/4” Arial Black | | <p>A unique number assigned to the standard drawing by the Eng. Standards Manager. It is an alphanumeric number preceded by “ST-.”</p> |
| 33 | Revision Number | 1/4” Arial Black | | Number of revisions made to the drawing. |

Notes:

1. Enter appropriate names and dates. When issuing drawings for design review, only typed initials or names are required for all blocks. For the final issue, signed initials or signatures are required above or alongside all printed names (except “submitted” and “approved for release” for Sketches).
2. Do not underline titles or subtitles.
3. Except for Sketches the title block contents 9, 10, 22 & 23 require signed approvals.
4.
 - a. This section of the title block must be filled in when the record document package is signed off for approval.
 - b. Follow LANL’s Classification (*SAFE-I*) Group requirements for review/signature.
 - c. *Guidance: Use a Derivative Classifier/Reviewing Official (DC/RO) associated and/or familiar with the project. The DC/RO should be contacted and informed about the project during the early stages of design development.*
 - d. A DC determination shall appear in title block on all technical design review drawing package submittals.²
5. For Items 31/32, when PI and/or C numbers are required, refer to Table 202-2.

Table 202-2. PI#/C# Application in Complex Projects

| Project Type | Type of Design Work | Package Requirements |
|--|--|--|
| New Project (not Design Build) | a) single TA and single Bldg. | 1 (one) PI# and 1 C# |
| | b) single TA and multiple Bldgs. Note: Use <u>one</u> Title Sheet and separate facilities into individual facility sets within the drawing package. | 1 PI#-and separate C#'s for each facility |
| | c) multiple TAs and multiple Bldgs. Note: Organize final submittal as follows: Lowest TA# first with individual facility subsets in numerical order, followed by next TA# and facility sequence. | 1 PI# and separate C#'s for each facility |
| | d) LANL-wide project (i.e., road or utility projects) | 1 PI# and 1 C# |
| New Project (Design Build) | a) single TA and single Bldg. submitted in separate design phase packages. Note: When project is submitted to SI-DC, consolidate a list of drawings on the first (1st) Title Sheet, void all other title sheets and renumber the drawing sheets sequentially, reflecting the modification in each title block (items #26 & #27) and the 1st Title Sheet. | 1 PI# and 1 C# with each design phase package labeled 1, 2, 3, 4, etc. |

² DOE Order 475.2A, Identifying Classified Information

| Project Type | Type of Design Work | Package Requirements |
|--|--|---|
| Existing Facility (existing system modification) | a) Locate all existing drawings pertinent to the project and follow the drawing revision procedure per Section 103 of this manual as well as Conduct of Engineering AP-341-517, Design Change Form. b) If new drawing sheets are to be generated, follow this manual for new drawing requirements. c) New sheets generated to accompany a drawing package primarily composed of existing drawings that have been revised: d) New drawings generated for a drawing package comprised of revised drawings from existing multiple packages with several PI# and C#s: | Will have the same PI # as the revised sheets BUT a new C#. The new drawings will have New PI#s and New C#s – with references in the General Notes to the existing drawings. |
| Existing Facility (New system and/or new addition) | Follow applicable New Project row above | |

5. *Guidance: additional “submittal” or “approved” blocks may be added to suit project sign-off requirements.*

203 TITLE SHEET

1.0 GENERAL REQUIREMENTS

- A. Provide a Title Sheet for drawings regardless of the number of drawing sheets in the drawing set.
- B. *Guidance: Title sheets are not required but recommended for sketch packages.*

2.0 EXAMPLE OF TITLE SHEET

- A. The following graphic is an example of the Title Sheet (see Table 203-1 for content description). An AutoCAD drawing template (DWT) and pdf for a title sheet is available on the CAD Standards Manual webpage immediately below this document.

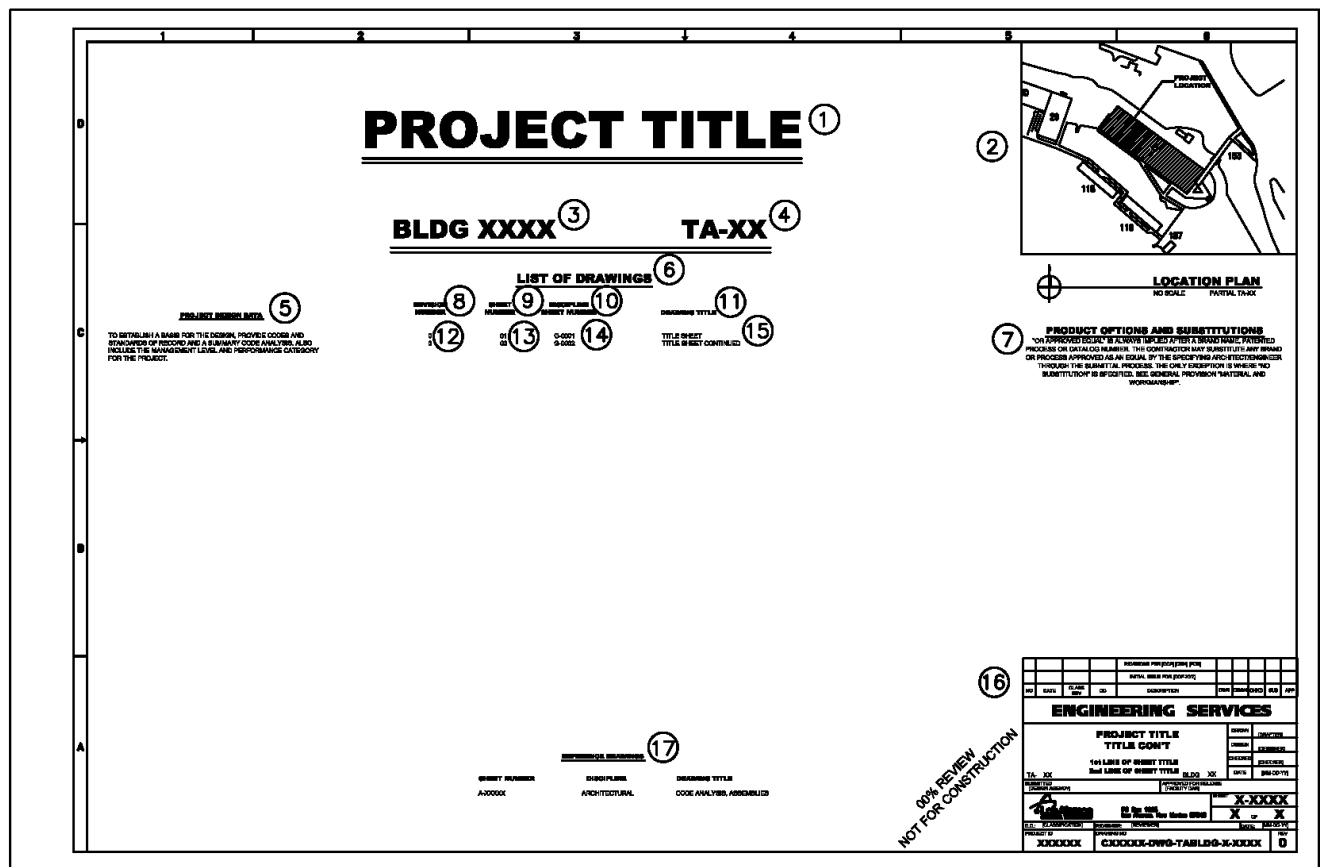


Figure 203-1. Title Sheet

**Table 203-1
Title Sheet Contents**

| Item | Description | Character Size / Font | Data Definition |
|-------------|--|---|--|
| 1 | Project Title | 1 inch, Arial Black, double underline 0.50 mm line width, continuous | The descriptive name of the project. Project title and title sheet required for new facility construction. |
| 2 | Location Plan | No scale | A plan that illustrates the location of the project - see Figure 203-1. |
| 3 | Building Number | 1/2 inch, Arial Black, double underline 0.50 mm line width, continuous | The unique identifying number for a building or structure within a designated technical area. |
| 4 | Technical Area | 1/2 inch, Arial Black, double underline | The geographical area designation assigned to LANL properties. |
| 5 | Project Design Data | 1/8 inch Arial Black, single underline, 0.50mm line width, continuous | This information is required (if not covered in specifications) - usually pertinent code analysis information is inserted here. Reference the code used and date of the code. [See Engineering Standards Manual, Chapter 4 – Architectural, Section B-C GEN (<i>Project Design Data</i> .)] |
| 6 | List of Drawings | 1/4 inch Arial Black, single underline 0.50 mm line width, continuous | The header for the Drawing List. |
| 7 | Product Options and Substitution Statement | 1/8 inch, Arial Black | A brief LANL procurement policy statement if required - see subpart 4.0 herein. |
| 8 | Revision Column Header | 1/8 inch Arial Black | The column header for the list of revisions that affect the drawing sheets. |
| 9 | Sheet Number Header | 1/8 inch Arial Black | The column header for the list of drawings sheet numbers. |
| 10 | Discipline Sheet Number Header | 1/8 inch Arial Black | The column header for the list of drawings discipline sheet numbers. |
| 11 | Drawing Title Header | 1/8 inch Arial Black | List of the drawing sheet titles - show exactly as they appear in the title blocks of the drawing sheets. |
| 12 | Revision Number | 1/8 inch Arial | Revision number of each drawing sheet. |
| 13 | Sheet Number | 1/8 inch Arial | The number shown in the title block of each drawing sheet. |
| 14 | Discipline Sheet Number | 1/8 inch Arial | The number shown in the title block of each discipline drawing sheet. |
| 15 | Drawing Titles | 1/8 inch Arial | List of drawing sheet titles - show exactly as they appear in the title blocks of the drawing sheets. |
| 16 | Title Block | - | See Section 202. |
| 17 | Reference Drawings | 3/16 Arial Black | See definition in Section 101.D |

Note: All text on the title sheet, except within the title block, will be on layer G-TEXT, 0.35 mm line weight.

3.0 LOCATION PLAN

A Location Plan is an area map that graphically illustrates the general location, by technical area, where the construction is planned.

- A. All drawing sets (except hand drawn sketches) are required to have a Location Plan.
- B. Locate this plan, as illustrated in Figure 203-2 below, on the Title Sheet in the upper right hand corner of the sheet (see Fig. 203-1). The plan and all text shall not cover more than a 7.5" x 7.5" square maximum.
- C. Show enough of the surrounding areas (streets, buildings, structures, etc.) to clearly identify the project location.
- D. Orient the Location Plan on the drawing sheet so that the north arrow points to the top of the sheet, as illustrated below.
- E. Annotated maps or satellite images are acceptable.

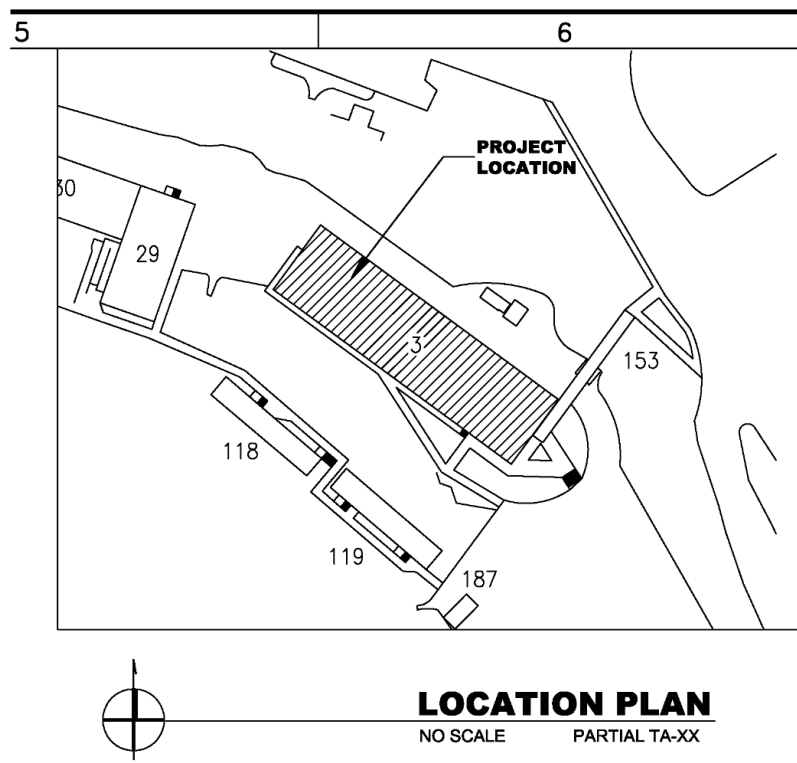


Figure 203-2. Location Plan Example

- F. The borderline around the location plan shall be 0.20 mm line width.
- G. Text requirements (all capitalized):

| | |
|--------------------|-----------------------|
| Project Site | 3/16 inch Arial Black |
| Location Plan | 1/4 inch Arial Black |
| Scale: None and TA | 1/8 inch Arial |
| Layer: G-TEXT | |

4.0 PRODUCT OPTIONS AND SUBSTITUTIONS

Note: This block is used only if a specific manufacturer's product is listed in the drawing package.

1. Enter the substitution statement below (or as stated in Section 01 2500 rev. 3 or later) of the LANL Master Specifications; layer G-TEXT.

PRODUCT OPTIONS AND SUBSTITUTIONS

(3/16" text height, Arial Black)

"Or approved equal" is always implied after a brand name, patented process or catalog number. The contractor may substitute any brand or process approved as an equal by the specifying Architect/Engineer through the submittal process.

The only exception is where "no substitution" is specified.

See General Provision "Material and Workmanship."

(1/8" text height, Arial)

2. For location of this block see Section 203, subpart 2.0, Example of Title Sheet.
3. See ESM Chapter 1 Section Z10, Attachment F, Specifications, for guidance on placing specifications on drawings.

204 PLAN ORIENTATION

1.0 GENERAL

- A. Except for Civil Plan and Section (profile) drawings, comply with the following for plan orientation on drawing sheets. *Guidance: Whenever possible orient the site plan in the same manner as the floor plan.*
 1. Place the principal plans on the drawing sheet with the building lines parallel to the sheet borders.
 2. Orient all principal plans in the drawing set identically for continuity and clarity.

3. Orient the plans on the drawing sheet so that the north arrow (true and plan north) are pointing in the direction of either the upper left or upper right quadrants of the sheet.

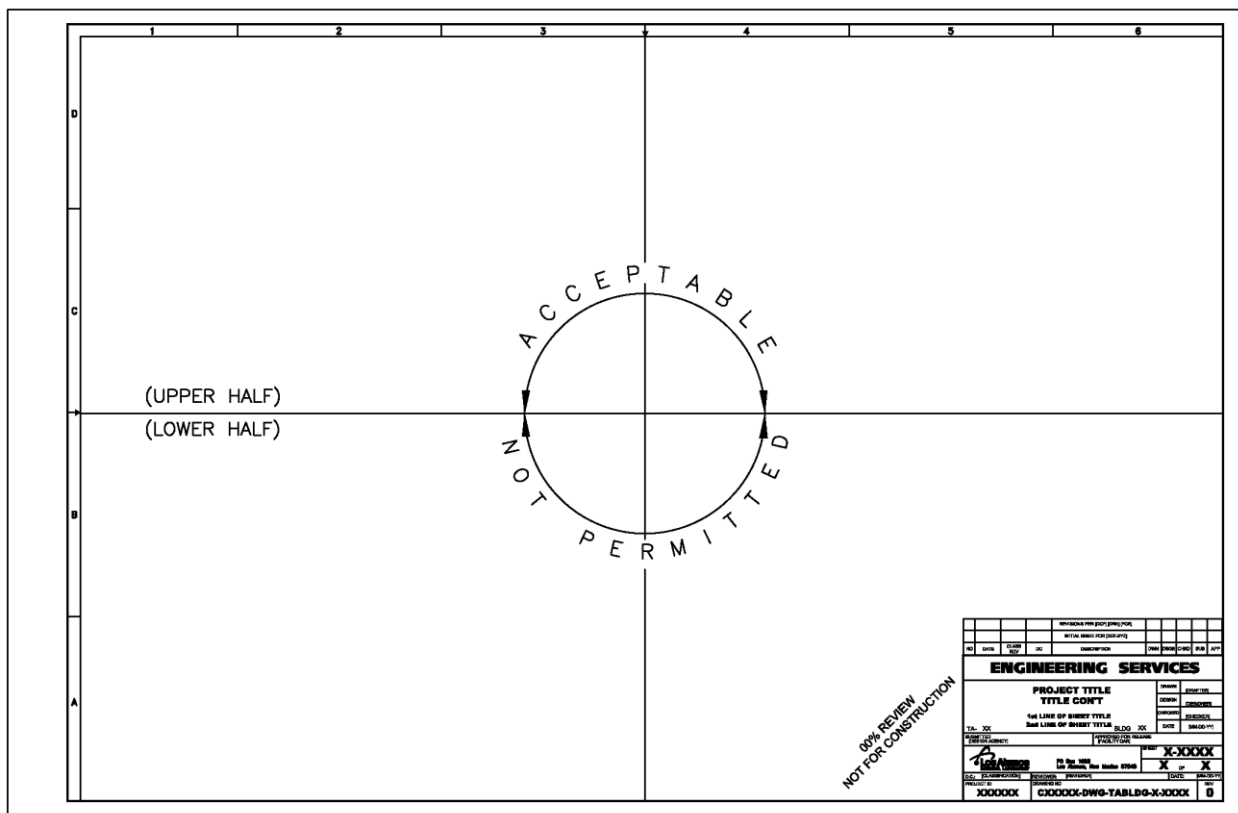


Figure 204-1. Acceptable North Orientation

205 NORTH ARROW SYMBOL

1.0 EXAMPLES OF NORTH ARROW³

Guidance: The graphic below is an example of an acceptable North Arrow showing “Plan North” and “True North”, Appendix B - G01, General Graphic Symbols.

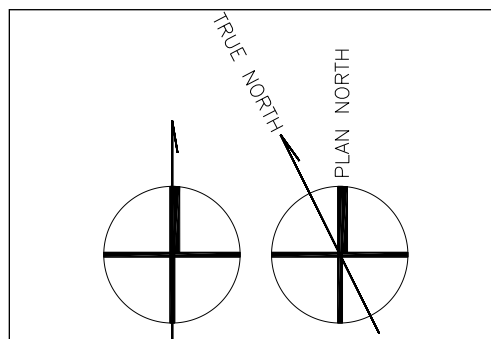


Figure 205-1. North Arrow for Internal Work

³ Basis: National CAD Standard

2.0 GENERAL REQUIREMENTS FOR NORTH ARROW

- A. All plans shall have a north arrow showing “plan North” and “true North”. The text “Plan North” and “True North” shall not appear on actual drawings.
- B. North arrows shall be placed in Paper Space whenever possible.
- C. Internally produced drawings shall use the north arrow shown above consistently throughout the drawing set. Externally produced drawings shall use the same north arrow throughout each discipline at a minimum.
- D. Place the North Arrow symbol at the left end of the horizontal line under the title as shown below.
- E. For ARCH “D and “E” size sheets make the circle 5/8 inches in diameter.

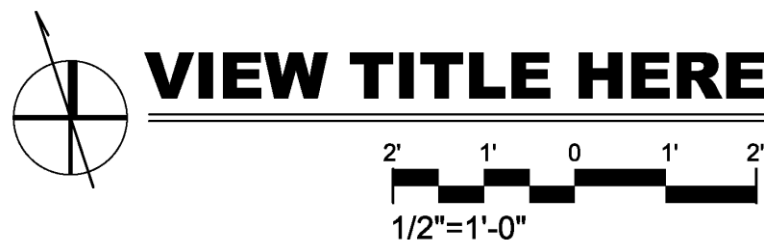


Figure 205-2. Placement of North Arrow Symbol

206 PARTIAL PLANS**1.0 KEY PLANS**

- A. Use a small scale "key plan" for each drawing sheet on which a partial plan appears.
- B. Clearly indicate on the "key plan" where the partial plan occurs in the overall building layout.
- C. Orient partial plans and key plans identically.
- D. Locate the “key plan” in the upper right hand corner of the sheet and occupy a space no larger than a 5” x 5” square including all text (see Figure 206-1 below).
- E. Enlarged plans are considered partial plans if the enlarged plan only depicts a portion of the complete floor plan.

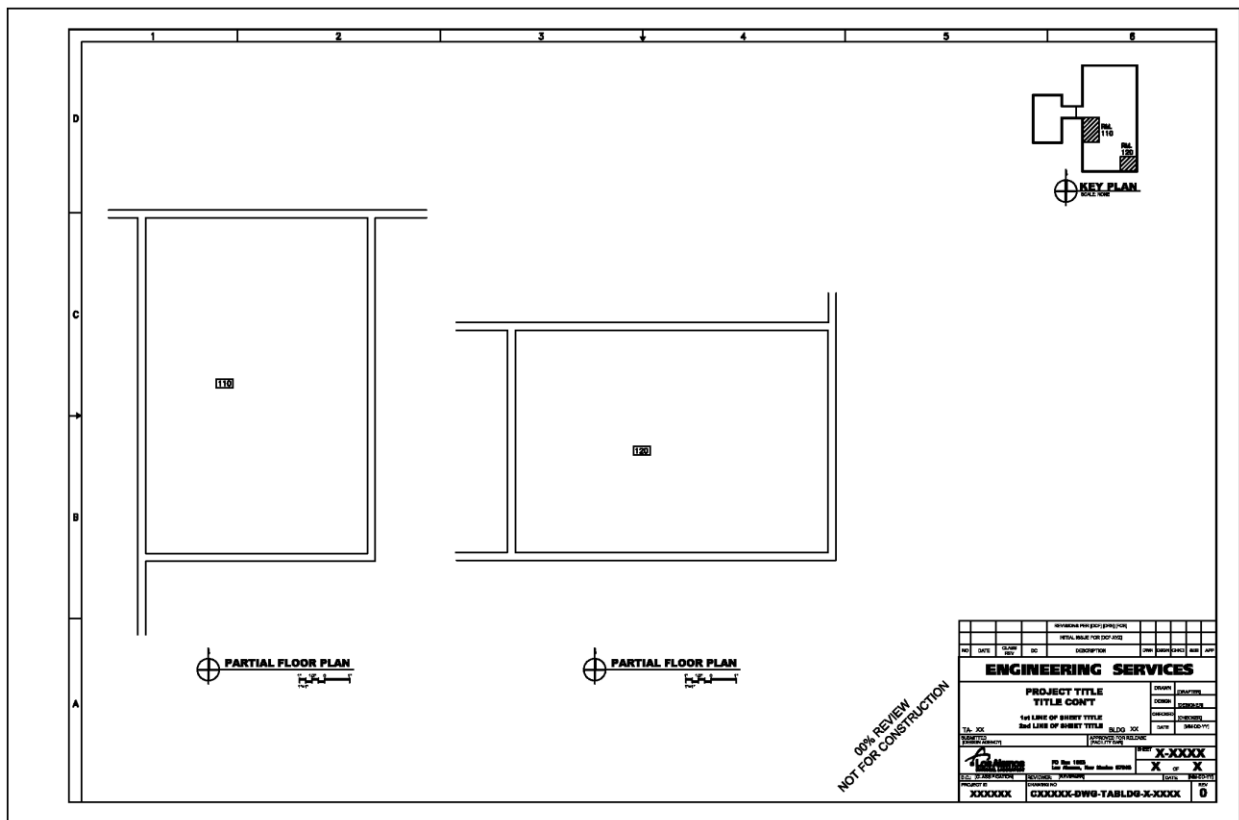


Figure 206-1. Location of Key Plan in Upper Right

2.0 MATCH LINES

- A. When a plan is too large for one drawing sheet, divide the plan into logical sections.
- B. Provide a match line that is 0.80 mm (0.031") thick, center line type.
- C. Use a 1/4" text height, Arial Black font, 0.50 mm line width to clearly indicate where the plan continues on another sheet, as illustrated below.
- D. Use a key plan (see Figure 206-2 below).
- E. Place the match line and text in Paper Space whenever possible.

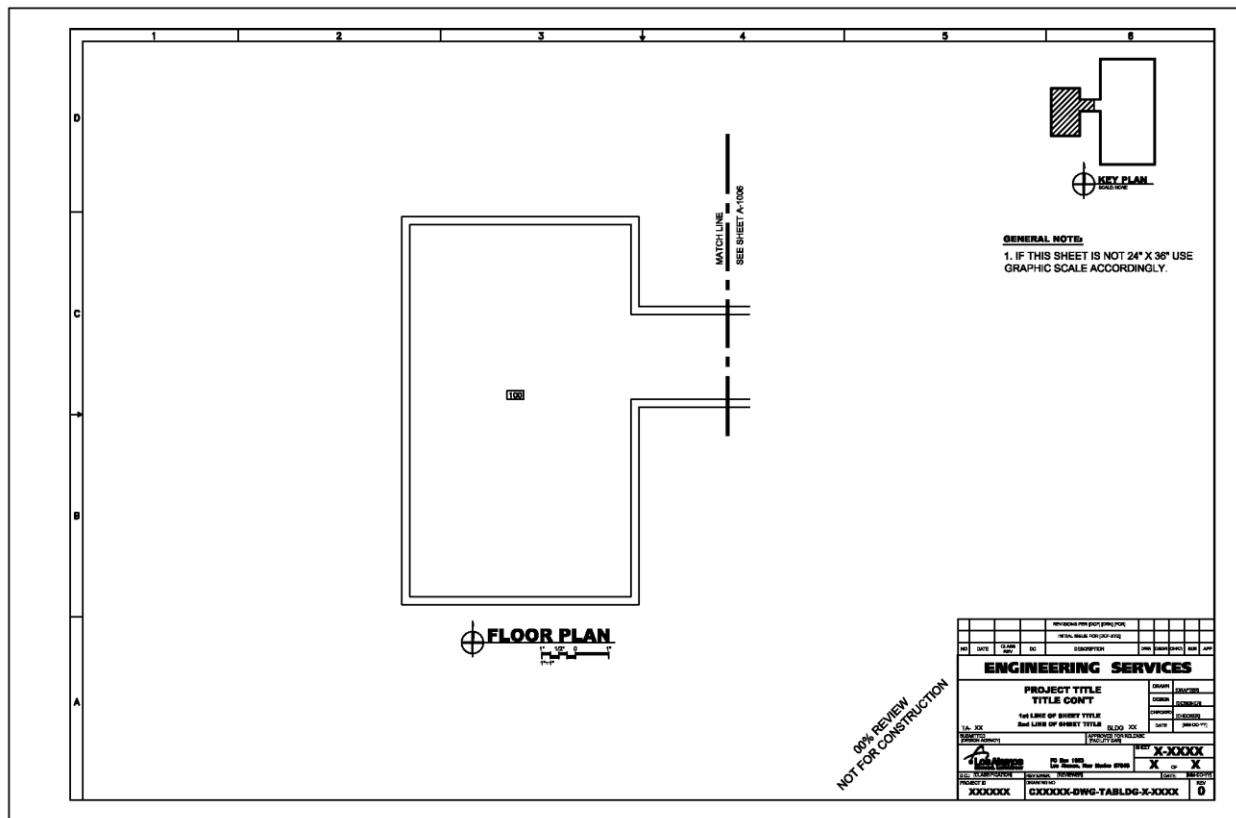


Figure 206-2. Match Lines and Key Plan

207 DRAWING SCALES AND TOLERANCES

1.0 GRAPHIC SCALES

- A. When drawings are produced to scale, insert graphic scales illustrating the drawing scale. Use these formats for standard graphic scales:

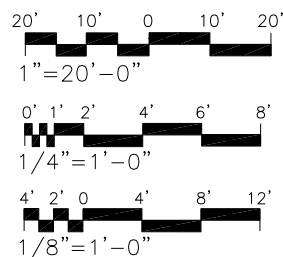


Figure 207-1. Acceptable Graphic Scales

- B. In the illustration above, 3/32" text (the minimum allowable) is shown for the distance designations for all graphic scales because of the limited space available. The drawing scale designation text is shown at 1/8". These text heights were selected for graphic clarity. Graphic scales are to be right justified⁴ and 1/4" below the drawing title, all located in Paper Space whenever possible -- see Figures 205-2, 206-1 and 206-2 for examples.

⁴ Per National CAD Standard

- C. Include the following statement as a General Note on any drawing sheet that includes a scaled drawing (i.e. has a graphic scale):
- “If this sheet is not (state the original plot size, i.e., 24” x 36”) use graphic scale accordingly.”

2.0 DRAWING SCALES⁵

- A. Acceptable drawing scales and the call out protocol for drawings are as follows:

| <u>Item</u> | <u>Scale</u> | <u>Item</u> | <u>Scale</u> |
|--|---|---|--|
| Contour, Grading, Landscaping, Site, Utility, Plans | 1" = 10' 1" = 20' 1" = 30' 1" = 40' 1" = 50' 1" = 60' 1" = 100' 1" = 200' 1" = 500' 1" = 1000' | Plan & Profiles Horizontal Scale: Vertical Scale: | 1" = 10'; 1" = 20" 1" = 5'; 1" = 10' |
| | | Sections | 1/8" = 1'-0" 1/4" = 1'-0" 1/2" = 1'-0" 3/4" = 1'-0" 1" = 1'-0" |
| Floor Plans and Elevations | 1/16" = 1'-0" 3/32" = 1'-0" 1/8" = 1'-0" 3/16" = 1'-0" 1/4" = 1'-0" 3/8" = 1'-0" | Partial/Enlarged Plans | 1/4" = 1'-0" 3/8" = 1'-0" 1/2" = 1'-0" 3/4" = 1'-0" |
| Details | 1/2" = 1'-0" 3/4" = 1'-0" 1" = 1'-0" 1 1/2" = 1'-0" 3" = 1'-0" 6" = 1'-0" | | |

- B. If a graphic scale is used then the use of “SCALE”: x" = x'-0" is not required under title. If “SCALE: NONE” is used under title, then the graphic scale is not required.

3.0 CONSISTENCY OF DRAWING SCALES

Draw all principal plans in a drawing set at the same scale, line type and line width.

4.0 EQUIPMENT ROOM DRAWING SCALES

- A. Layout all equipment, piping, conduits, trays, ducts, wiring, etc., located within the equipment rooms on an enlarged or partial floor plan shown at 1/4" = 1' - 0" scale minimum.

⁵ National CAD Standard

- B. In rooms, areas, and spaces that are designed to accommodate equipment, show the equipment layout in detail plans, interior elevations and sections, as required for clarity.
- C. Use enlarged sections and details to show congested areas at minimum scale of 1/2" = 1' - 0" for clarity.

5.0 NO SCALE DRAWINGS

Certain details, diagrams, and plans cannot or need not be drawn to a specific scale (i.e., wiring, P&IDs, schematics, and control diagrams). For the drawing scale notation type "SCALE: NONE" indicating that no scale was used in generating the drawing, see Figure 207-2.



Figure 207-2. No Scale Representation

6.0 TOLERANCES

Guidance: Tolerances, when used, should be noted per ANSI Y14.5, "Dimensioning and Tolerancing for Engineering Drawings (inches)," and client design criteria.

208 DIMENSIONING & LEADERS

1.0 GENERAL

- A. Specify dimensions of less than one foot in inches, for example:
 $11 \frac{1}{2}"$
- B. Specify dimensions one foot and over in feet and inches, for example:
 $2' - 6 \frac{1}{4}"$
- C. Exception to these rules occurs when dimensioning civil drawings, mechanical ductwork and piping, electrical control cabinets and boxes, or architectural woodwork.
- D. Do not stack fractions.
- E. Dimensions and leaders are to be located in Paper Space to the greatest extent possible.

2.0 DIMENSION LINE CONVENTION AND TEXT ORIENTATION

- A. Use unbroken dimension lines with the dimension text located above the line. All dimension text must be read from the bottom or right side of the drawing sheet.

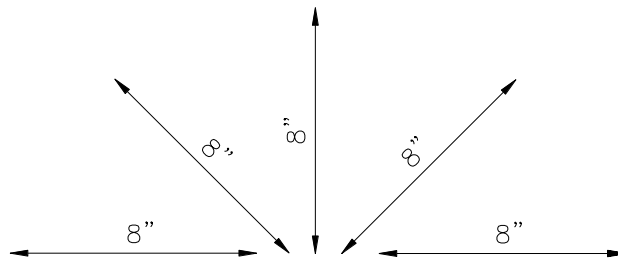


Figure 208-1. Dimension Text Location/Orientation

- B. *Guidance: For examples of text orientation for isometric drawings refer to Global Engineering Documents, current edition, Section 3 and 4; DOE Handbook 1016⁶, or AIA Architectural Graphic Standards.*

3.0 DIMENSION LINE TERMINATION

- A. Arrowheads, slashes, and dots are all acceptable terminators for dimension lines.
- B. Draw a heavy terminator (arrowhead 1/8" in length, 45 degrees diagonal, 0.80 mm line width tic mark, or 1/16" diameter solid circle) to ensure readability when reproduced or reduced to smaller size. Use a consistent terminator throughout all drawing sheets for a discipline in a drawing set. AutoCAD setting for terminator to be 1/8 inch. Text shall be 1/8" Arial.

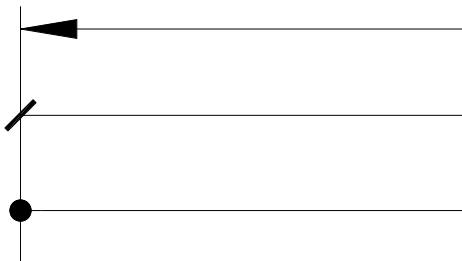


Figure 208-2. Acceptable Dimension Line Terminators

- C. "Tic" marks shall be used in the architectural discipline.
- D. Do not mix termination symbols within a discipline.

4.0 PLAN DIMENSIONS

- A. Keep dimension lines clear of the building footprint whenever possible.
- B. Place dimension lines in a logical progression (i.e., centerlines, projections, overall, etc.).
- C. Keep the dimensions consistent on all plans.
- D. Tie all building portions together clearly.
- E. Do not dimension to hidden features.
- F. Refer to the National CAD Standard's Drafting Conventions for hierarchy of dimensioning.

6 DOE Fundamentals [Handbook](#) 1016 -- Engineering Symbolology, Prints, and Drawings (2 Vol)

5.0 LEADERS

- A. Leaders with single text notations shall start from the leader terminator (arrow) and end 1/16" from the text notation. See Figure 208-4 (its Figure 1)
- B. Leaders with multiple text notations shall start from the leader terminator (arrow) and end 1/16" from the text notation. Hence: upper left corner or lower right corner of the note. See Figure 208-4 (its Figure 2).
- C. Leaders for use with Keyed Notes shall start from the leader terminator (arrow) and end/attach at the edge of the Keyed Note Bubble. See Figure 208-4 (its Figure 3).
- D. Crossing of leaders is not allowed.
- E. Leader terminator is a 1/8" arrow when plotted 1:1 on a "D" size drawing.
- F. Use a 1/8" dot for a leader terminator to indicate a surface point on a "D" size drawing when plotted 1:1.

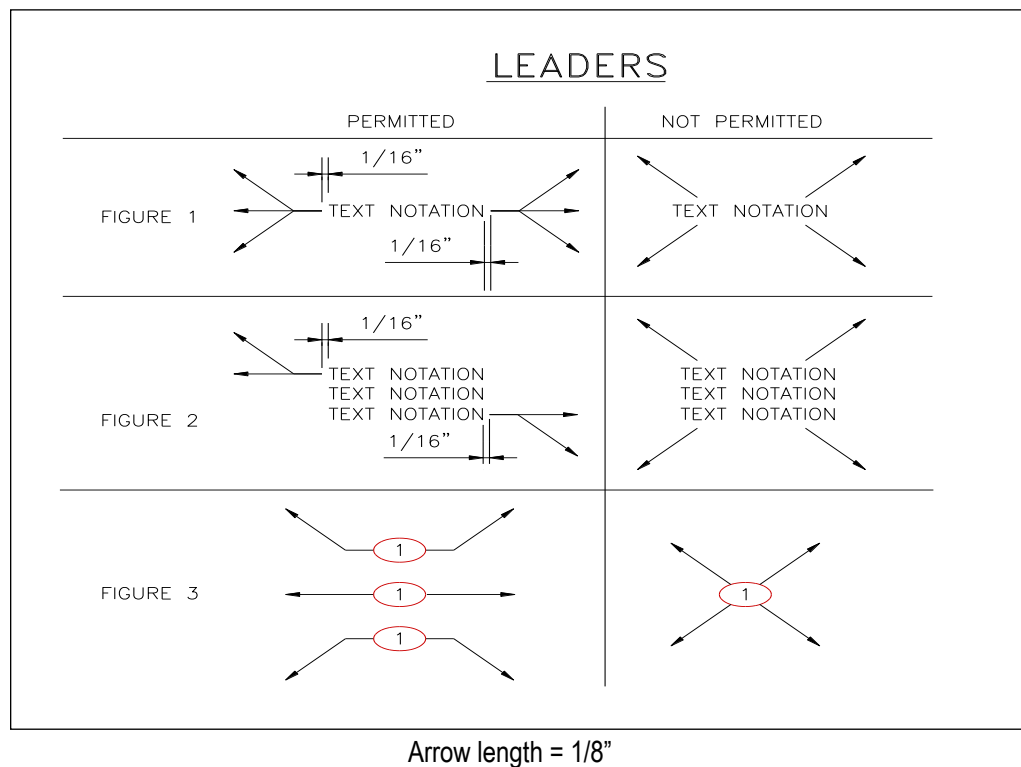
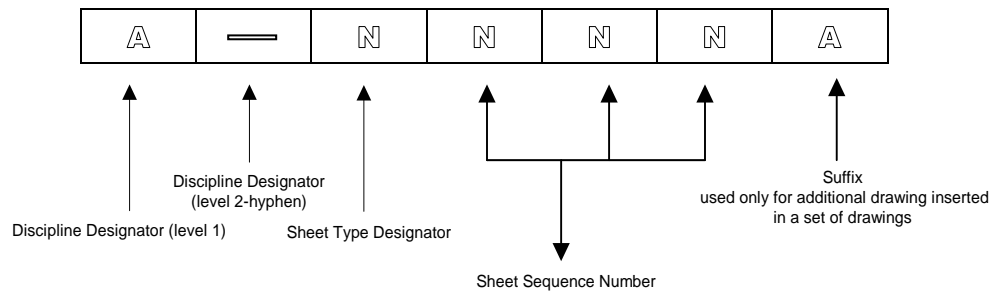


Figure 208-4. Acceptable Leaders

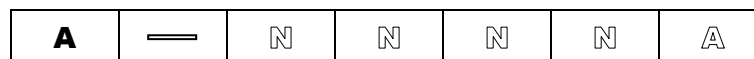
209 DRAWING SET ORGANIZATION

1.0 STANDARD SHEET IDENTIFICATION (NUMBERING)

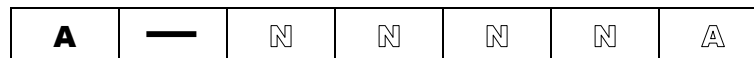
- A. The required sheet identification format is applicable to all construction drawing production (this does not include ESs, DCs or CDRs).⁷ The Uniform Drawing System (UDS) by the Construction Specifications Institute (CSI) sheet identification format depicted here has three components:



First, a Level 1 Discipline Designator consisting of 1 alphabetical character (bold A in schema below):

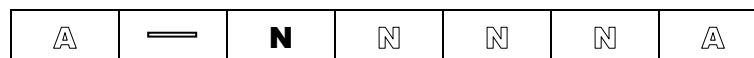


A Level 2 discipline designator is not used at LANL; replace with a hyphen as shown:



- B. Next, the **Sheet Type Designator**, which identifies the type of information on the sheet and is followed by the **Sheet Sequence Number**.

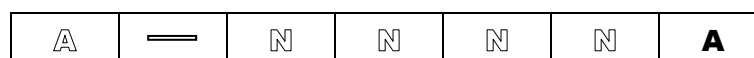
Position of **Sheet Type designator**, consisting of 1 numerical (bold N in schema below) character:



Position of **Sheet Sequence number**, consisting of 3 numerical characters:



Position of **Supplemental Drawing Sheet** alpha character if needed for an additional drawing insertion:



- C. The one-character **Discipline designator** identifies the sheet as a member of a subset.
1. Within the discipline designator, the first character is the discipline character. The discipline character identifies the creator of the drawings on the sheet.

⁷ It is consistent, yet flexible enough for a wide range of project scopes.

2.0 LEVEL 1 - DISCIPLINE DESIGNATOR

- A. The first component of the sheet identification format, the discipline designator, is based on the traditional system of alphabetical discipline designators.
- B. Organize the drawing sets by discipline in the following order (as applicable):

| Order Sequence | Discipline Code | Discipline |
|----------------|-----------------|--|
| 1 | G | General (Title Sheet, General Notes, Scope of Work, Submittals) |
| 2 | H | ¹ Hazardous Materials |
| 3 | V | Survey/Mapping |
| 4 | B | Geotechnical |
| 5 | W | ¹ Civil Works (User Defined) |
| 6 | C | Civil |
| 7 | L | ¹ Landscape |
| 8 | S | Structural |
| 9 | A | Architectural |
| 10 | I | Interiors |
| 11 | Q | Equipment (laboratory, food service parking lot, site) |
| 12 | F | Fire Protection |
| 13 | P | Plumbing |
| 14 | D | ² Process (e.g., gloveboxes and process piping to and from gloveboxes), fumehoods and process equipment |
| 15 | M | Mechanical |
| 16 | E | Electrical |
| 17 | T | Telecommunications |
| 18 | J | ¹ Instrumentation & Controls |
| 19 | R | ¹ Resources |
| 20 | X | Other Disciplines (i.e., Safeguards & Security) |
| 21 | Z | ¹ Contractor/Shop Drawings |
| 22 | O | Operations |

¹ NCS Uniform Drawing System (UDS) discipline code not used at LANL

² UDS discipline code modified for LANL application

3.0 SHEET TYPE DESIGNATOR

- A. The second component of the sheet identification format is the sheet type designator. The sheet type is identified by a single numerical character. All sheet types may not apply to all discipline designators. It is not necessary to use all the sheet types for a project or within a discipline.
- B. Organize the Sheet Types in the following order (as applicable):

Table 209-1. Sheet Order within each Discipline

| | |
|----------|---|
| 0 | General (symbols legend, notes, etc.) |
| 1 | Plans (horizontal views including civil plans & profiles) |
| 2 | Elevations (vertical views) |
| 3 | Sections (sectional views) |
| 4 | Large Scale views |
| 5 | Details |
| 6 | Diagrams |
| 7 | Schedules |
| 8 | User Defined (for types which do not fall in other categories) |
| 9 | 3D Representations (isometrics, perspectives, models, and photographs) |

4.0 SHEET SEQUENCE NUMBER

- A. The third component of the sheet identification format is a three-digit sheet sequence number that identifies each sheet in a series of the same discipline and sheet type. The first sheet of each series is number **000**, followed by **001** through **999**.⁸

| | | | | | | |
|---|---|---|---|---|---|---|
| A | — | N | N | N | N | A |
|---|---|---|---|---|---|---|

- B. On plan sheets, it may be desirable to replicate the floor name within each discipline. This makes sheets **A-1002**, **M-1002**, and **E-1002** the second floor plan for each of the various disciplines. This system may become cumbersome when basements and mezzanines or split level plans are involved. Evaluate each project carefully before deciding to implement this option.
- C. Additional drawings inserted in a set of drawings after a sheet identification organization has already been established can be identified with a suffix. *This suffix may be comprised of a defined designator; starting with the letter "A."*

⁸ A 3-digit sequence number is required for efficient CAD file sorting and facility management databases

210 ARRANGEMENT AND NUMBERING SEQUENCE

1.0 DRAWING SETS

- A. Sets shall be arranged in a defined order and assigned a unique number, within each discipline, as specified in Table 210-1. These sheet sequence numbers must be unique within the drawing set and combined with the drawing set "C" number becomes unique with respect to ALL other drawings for each structure.
- B. See also Table 202-2 for drawing set organization and PI/C# application for complex projects.

Note: Drawing sets will not always include all of the types of drawings listed below, and table only shows the commonly used disciplines.

Table 210-1. Drawing Set Organization

| Numbering Sequence | Order of Drawings |
|-----------------------------|--|
| (G) General | |
| 0001 - 0999 | General (Title Sheet, Legend, General Notes; Scope of Work, Construction Sequence, Project Specifications (3), and Orientation Maps) |
| (V) Survey / Mapping | |
| 0001 - 0999 | General (Design Criteria Information, Legend, General Notes; Scope of Work, and Construction Sequence) |
| 1000 - 1999 | Plans, (Demolition dwgs first, followed by New Construction), Boundary, Contour, Archaeological, and historical features |
| 2000 - 2999 | Elevations |
| 3000 - 3999 | Sections |
| 4000 - 4999 | Large Scale Views |
| 5000 - 5999 | Details |
| 6000 - 6999 | Diagrams |
| 7000 - 7999 | Schedules |
| 8000 - 8999 | User Defined |
| 9000 - 9999 | 3D Representation (isometrics, perspectives, photographs) |
| (B) Geotechnical | |
| 0001 - 0999 | General (Design Criteria Information, Legend, General Notes; Scope of Work, and Construction Sequence) |
| 1000 - 1999 | Plans Demolition drawings first, followed by New Construction |
| 2000 - 2999 | Elevations |
| 3000 - 3999 | Sections |
| 4000 - 4999 | Large Scale Views |
| 5000 - 5999 | Details |
| 6000 - 6999 | Diagrams |
| 7000 - 7999 | Schedules |
| 8000 - 8999 | User Defined |
| 9000 - 9999 | 3D Representation (isometrics, perspectives, photographs) |

| (C) Civil | |
|--------------------------|---|
| 0001 - 0999 | General (Design Criteria Information, Legend, General Notes; Scope of Work, and Construction Sequence) |
| 1000 - 1999 | Plans (Demolition drawings first, followed by New Construction, Site, Grading, Utility, Soil Boring logs, Plan & Profile) |
| 2000 - 2999 | Elevations |
| 3000 - 3999 | Sections |
| 4000 - 4999 | Large Scale Views |
| 5000 - 5999 | Details |
| 6000 - 6999 | Diagrams |
| 7000 - 7999 | Schedules |
| 8000 - 8999 | User Defined |
| 9000 - 9999 | 3D Representation (isometrics, perspectives, photographs) |
| (S) Structural | |
| 0001 - 0999 | General (Design Criteria Information, Legend, General Notes; Scope of Work, and Construction Sequence) |
| 1000 - 1999 | Plans (Demolition drawings first, followed by New Construction) |
| 2000 - 2999 | Elevations |
| 3000 - 3999 | Sections |
| 4000 - 4999 | Large Scale Views |
| 5000 - 5999 | Details |
| 6000 - 6999 | Diagrams |
| 7000 - 7999 | Schedules |
| 8000 - 8999 | User Defined |
| 9000 - 9999 | 3D Representation (isometrics, perspectives, photographs) |
| (A) Architectural | |
| 0001 - 0999 | General (Design Criteria Information, Legend, General Notes; Scope of Work, and Construction Sequence) |
| 1000 - 1029 | Reserved for Floor Plans of Record |
| 1030 - 1049 | Reserved for Roof Plans of Record |
| 1050 - 1999 | Plans (Demolition dwgs first, followed by New Construction) |
| 2000 - 2999 | Elevations |
| 3000 - 3999 | Sections |
| 4000 - 4999 | Large Scale Views |
| 5000 - 5999 | Details |
| 6000 - 6999 | Diagrams |
| 7000 - 7999 | Schedules |
| 8000 - 8999 | User Defined |
| 9000 - 9999 | 3D Representation (isometrics, perspectives, photographs) |
| (I) Interiors | |
| 0001 - 0999 | General (Design Criteria Information, Legend, General Notes; Scope of Work, and Construction Sequence) |
| 1000 - 1999 | Plans (Demolition drawings first, followed by New Construction) |

| | |
|----------------------------------|---|
| 2000 - 2999 | Elevations |
| 3000 - 3999 | Sections |
| 4000 - 4999 | Large Scale Views |
| 5000 - 5999 | Details |
| 6000 - 6999 | Diagrams |
| 7000 - 7999 | Schedules |
| 8000 - 8999 | User Defined |
| 9000 - 9999 | 3D Representation (isometrics, perspectives, photographs) |
| (Q) Equipment | |
| 0001 - 0999 | General (Design Criteria Information, Legend, General Notes; Scope of Work and Construction Sequence) |
| 1000 - 1999 | Plans (Demolition drawings first, followed by New Construction) |
| 2000 - 2999 | Elevations |
| 3000 - 3999 | Sections |
| 4000 - 4999 | Large Scale Views |
| 5000 - 5999 | Details |
| 6000 - 6999 | Diagrams |
| 7000 - 7999 | Schedules |
| 8000 - 8999 | User Defined |
| 9000 - 9999 | 3D Representation (isometrics, perspectives, photographs) |
| (F) Fire Protection | |
| 0001 - 0999 | General (Design Criteria Information, Legend, General Notes; Scope of Work and Construction Sequence) |
| 1000 - 1999 | Plans (Demolition drawings first, followed by New Construction) |
| 2000 - 2999 | Elevations |
| 3000 - 3999 | Sections |
| 4000 - 4999 | Large Scale Views |
| 5000 - 5999 | Details |
| 6000 - 6999 | Diagrams |
| 7000 - 7999 | Schedules, |
| 8000 - 8999 | User Defined |
| 9000 - 9999 | 3D Representation (isometrics, perspectives, photographs) |
| (P) Plumbing ¹ | |
| 0001 - 0999 | General (Design Criteria Information, Legend, General Notes; Scope of Work and Construction Sequence) |
| 1000 - 1999 | Plans (Demolition drawings first, followed by New Construction) |
| 2000 - 2999 | Elevations |
| 3000 - 3999 | Sections |
| 4000 - 4999 | Large Scale Views |
| 5000 - 5999 | Details |
| 6000 - 6999 | Diagrams |
| 7000 - 7999 | Schedules and Lists |

| | |
|------------------------------------|--|
| 8000 - 8999 | User Defined |
| 9000 - 9999 | 3D Representation (isometrics, perspectives, photographs) |
| (D) Process | |
| 0001 - 0999 | General (Design Criteria Information, Legend, General Notes; Scope of Work and Construction Sequence) |
| 1000 - 1999 | Plans (Demolition drawings first, followed by New Construction) |
| 2000 - 2999 | Elevations |
| 3000 - 3999 | Sections |
| 4000 - 4999 | Large Scale Views |
| 5000 - 5999 | Details |
| 6000 - 6999 | Diagrams (Process Flow, Piping & Instrumentation for process systems, gloveboxes and fume hoods) |
| 7000 - 7999 | Schedules, Lists |
| 8000 - 8999 | User Defined |
| 9000 - 9999 | 3D Representation (isometrics, perspectives, photographs, risers) |
| (M) Mechanical ² | |
| 0001 - 0999 | General (Design Criteria Information, Legend, General Notes; Submittals, Scope of Work Construction Sequence, Schedules) |
| 1000 - 1999 | Plans (Demolition drawings first, followed by New Construction) |
| 2000 - 2999 | Elevations |
| 3000 - 3999 | Sections |
| 4000 - 4999 | Large Scale Views |
| 5000 - 5999 | Details |
| 6000 - 6999 | Diagrams (PFDs, P&IDs, Logic) |
| 7000 - 7999 | Schedules, Lists |
| 8000 - 8999 | User Defined |
| 9000 - 9999 | 3D Representation (isometrics, perspectives, photographs) |
| (E) Electrical | |
| 0001 - 0999 | General (Design Criteria Information, Legend, General Notes; Scope of Work and Construction Sequence) |
| 1000 - 1999 | Plans (Demolition drawings first, followed by New Construction) (floor, equipment, power, lighting, grounding, lightning, emergency, special systems) |
| 2000 - 2999 | Elevations |
| 3000 - 3999 | Sections |
| 4000 - 4999 | Large Scale Views |
| 5000 - 5999 | Details |
| 6000 - 6999 | Diagrams (one-lines, ladder grounding lightning wiring, logic, schematics (control systems i.e.: PLC cabinet), Riser - Fire Alarm Public Address Communication Security. |
| 7000 - 7999 | Schedules (Bill of Material, Nameplate, etc.) |
| 8000 - 8999 | User Defined |
| 9000 - 9999 | 3D Representation (isometrics, perspectives, photographs) |

| (T) Telecommunication | |
|---|---|
| 0001 - 0999 | General (Design Criteria Information, Legend, General Notes; Scope of Work and Construction Sequence) |
| 1000 - 1999 | Plans (Demolition drawings first, followed by New Construction) |
| 2000 - 2999 | Elevations |
| 3000 - 3999 | Sections |
| 4000 - 4999 | Large Scale Views |
| 5000 - 5999 | Details |
| 6000 - 6999 | Diagrams |
| 7000 - 7999 | Schedules |
| 8000 - 8999 | User Defined |
| 9000 - 9999 | 3D Representation (isometrics, perspectives, photographs) |
| (J) Instrumentation & Controls | |
| 0001 - 0999 | General (Design Criteria Information, Legend, General Notes; Scope of Work and Construction Sequence) |
| 1000 - 1999 | Plans (Demolition drawings first, followed by New Construction) |
| 2000 - 2999 | Elevations |
| 3000 - 3999 | Sections |
| 4000 - 4999 | Large Scale Views |
| 5000 - 5999 | Details |
| 6000 - 6999 | Diagrams |
| 7000 - 7999 | Schedules |
| 8000 - 8999 | User Defined |
| 9000 - 9999 | 3D Representation (isometrics, perspectives, photographs) |
| (R) Resources | |
| 0001 - 0999 | General (Design Criteria Information, Legend, General Notes; Scope of Work and Construction Sequence) |
| 1000 - 1999 | Plans (Demolition drawings first, followed by New Construction) |
| 2000 - 2999 | Elevations |
| 3000 - 3999 | Sections |
| 4000 - 4999 | Large Scale Views |
| 5000 - 5999 | Details |
| 6000 - 6999 | Diagrams |
| 7000 - 7999 | Schedules |
| 8000 - 8999 | User Defined |
| 9000 - 9999 | 3D Representation (isometrics, perspectives, photographs) |
| (X) Safeguards & Security | |
| 0001 - 0999 | General (Design Criteria Information, Legend, General Notes; Scope of Work and Construction Sequence) |
| 1000 - 1999 | Plans (Demolition drawings first, followed by New Construction) |
| 2000 - 2999 | Elevations |
| 3000 - 3999 | Sections |
| 4000 - 4999 | Large Scale Views |

| | |
|--------------------------------------|--|
| 5000 - 5999 | Details |
| 6000 - 6999 | Diagrams |
| 7000 - 7999 | Schedules |
| 8000 - 8999 | User Defined |
| 9000 - 9999 | 3D Representation (isometrics, perspectives, photographs) |
| (Z) Contractor/ Shop Drawings | |
| 0001 - 0999 | General (Design Criteria Information, Legend, General Notes; Scope of Work and Construction Sequence) |
| 1000 - 1999 | Plans (Demolition drawings first, followed by New Construction) |
| 2000 - 2999 | Elevations |
| 3000 - 3999 | Sections |
| 4000 - 4999 | Large Scale Views |
| 5000 - 5999 | Details |
| 6000 - 6999 | Diagrams |
| 7000 - 7999 | Schedules |
| 8000 - 8999 | User Defined |
| 9000 - 9999 | 3D Representation (isometrics, perspectives, photographs) |
| (O) Operations | |
| 0001 - 0999 | General (Design Criteria Information, Legend, General Notes; Scope of Work and Construction Sequence [for construction by Support Services Subcontractor only], Schedules/Lists) |
| 1000 - 1999 | Plans (Demolition drawings first, followed by New Construction) |
| 2000 - 2999 | Elevations |
| 3000 - 3999 | Sections |
| 4000 - 4999 | Large Scale Views |
| 5000 - 5999 | Details |
| 6000 - 6999 | Diagrams |
| 7000 - 7999 | Schedules |
| 8000 - 8999 | User Defined |
| 9000 - 9999 | 3D Representation (isometrics, perspectives, photographs) |

Table 210-1 Notes

1. Drainage (for plumbing systems see Section 307 of this manual).
2. Air conditioning, ventilation, cooling, heating, refrigeration, fuel oil, compressed air, laboratory gas steam and condensate systems.
3. Refer to ESM Chapter 1, Section Z10 for specification requirements.

211 LINE WORK

1.0 BASIC LINES AND LINE WIDTHS

A. Requirement:

1. Use a heavy line width to indicate new construction for a given discipline.
2. Use a medium line width for text and to delineate new construction above or below the drawing plane.

3. Use a light line width to delineate existing construction or new background base plans, and for dimension lines, leader lines and extension lines.

B. Contrast the three line widths definitively as illustrated below:


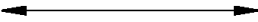

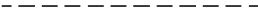
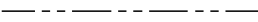


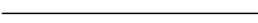




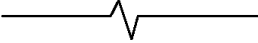
| <u>LINE DESCRIPTION</u> | <u>LINE APPEARANCE</u> | <u>LINE TYPE</u> | <u>LINE WIDTH</u> |
|---|--|------------------|--|
| CENTER LINE |  | CENTER | 0.25 MM 0.010 INCH |
| DIMENSION LINE |  | CONTINUOUS | 0.25 MM 0.010 INCH |
| LEADER LINE |  | CONTINUOUS | 0.25 MM 0.010 INCH |
| FUTURE CONSTRUCTION |  | DASHED | 0.25 MM 0.010 INCH |
| EXISTING CONSTRUCTION |  | PHANTOM | 0.25 MM 0.010 INCH |
| HIDDEN LINE |  | HIDDEN | 0.35 MM 0.015 INCH |
| NEW CONSTRUCTION AND REVISION CLOUD |  | CONTINUOUS | 0.35 MM 0.020 INCH |
| NEW CONST. BACKGROUND (ARCHITECTURAL) |  | CONTINUOUS | 0.35 MM 0.010 INCH |
| NEW CONST. BACKGROUND (ALL OTHER DISCIPLINES) |  | PHANTOM | 0.35 MM 0.010 INCH |
| MATCH LINE |  | CENTER | 0.80 MM 0.031 INCH |
| EXISTING TO BE REMOVED |  | PHANTOM | 0.25 MM 0.010 INCH LINE 0.50 MM 0.020 INCH ASTERISK |
| P&ID PROCESS LINES, SECTION CUTS, HIGHLIGHT BOX AROUND TEXT |  | CONTINUOUS | 0.50 MM 0.031 INCH |
| BREAK LINE |  | CONTINUOUS | 0.35 MM 0.015 INCH |
| HATCH LINES | VARIES | VARIES | 0.25 MM 0.010 INCH LINE |

Figure 211-1. Acceptable Lines

Note: Make sure that the Line Type scale is set properly for the drawing scale.

2.0 LINE WIDTH ASSIGNMENT IN CAD FILES

- A. Assign lines a width by creating the line or entity in an appropriate layer. Each layer is assigned a line width of entities created in that layer. Line widths are then set "By Layer" for consistency.

Note: Some LANL groups and projects may require or prefer color reproductions; the color yellow is not legible and should not be used in these cases.

212 STANDARDIZATION OF TEXT

1.0 FONT STYLES AND TEXT SIZE REQUIREMENTS

- A. Use only standard AutoCAD fonts: Arial and Arial Black. Do not use stylized fonts or fonts not standard to AutoCAD.
- B. Fonts other than Arial and Arial Black can be used on the title sheet (Section 203) for the Design Agency logos. If a logo contains a font that is not standard to AutoCAD, convert the logo to a drawing or change the logo to a CAD format that can be read by the standard AutoCAD package.

- C. Match the existing font style and height for uniformity of presentation when revising existing drawings.
- D. The minimum text height in the drawing field in Paper Space for ARCH “D” & “E” size sheets is 1/8 inch. If plotted on ANSI “B” size sheets this will scale proportionately and maintain legibility.
- E. The minimum text height only applies in circumstances when another convention is not specified in this document.

2.0 TEXT FORMATTING CONVENTIONS

- A. Create all text in upper case letters, with the exception of certain unit designations such as kVA, mm, kHz, Vac, Vdc, mA, which are recognized as an industry standard.
- B. Sheets that are predominantly text (sequence of operations, etc.) may use Sentence Case for improved readability provided the lower case letters meet the size requirements of “D” above. *Guidance: If a lower case “l” mistaken as “i” will cause a problem, use upper case.*
- C. Leave a minimum space of one-half the text height between text lines and special marks to maintain legibility.
- D. Maintain standard text conventions throughout a drawing set.
- E. Orient text to read horizontally from left to right and/or vertically from the bottom to the top of the sheet.
- F. Font width factor shall be “1” unless otherwise specified in this manual.
- G. When inserting text into an ARCH D or E size drawing comply with the following:

Table 212-1. Text Formatting

| TEXT FOR | EXAMPLE | LINE WIDTH | FONT |
|---|---|--|------------------------|
| MAIN TITLE (DRAWING, SECTION, ELEVATION AND DETAIL TITLES) | <div> <div>ABCDEFGFG</div> <div>RSTU= 1/4"</div> <div>WXYZ= 1/4"</div> </div> | <div>0.35 MM</div> <div>0.015 INCH</div> | ARIAL BLACK |
| SUB TITLE (KEYED NOTE & GENERAL NOTE TITLES) | <div> <div>ABCDEFGFG</div> <div>RSTU= 3/16"</div> <div>WXYZ= 3/16"</div> </div> | <div>0.35 MM</div> <div>0.015 INCH</div> | ARIAL BLACK |
| ALL TITLE BLOCK TEXT | (SEE SECTION 202 FOR CHARACTER SIZE) | <div>0.35 MM</div> <div>0.015 INCH</div> | SEE SECT. 202 FOR FONT |
| ALL OTHER TEXT | <div>MINIMUM TEXT SIZE</div> <div> <div>ABCDEFGG</div> <div>WXYZ= 1/8"</div> <div>ABCDEFGG</div> <div>WXYZ= 1/8"</div> </div> | <div>.035 MM</div> <div>0.015 INCH</div> | ARIAL |

NOTE: UNLESS OTHERWISE SPECIFIED FOR NON-CONSTRUCTION PROJECTS

Note: The "Sub Title" designation in the table above is most commonly used in schedules; in this case, the schedule title is the main title (1/4" Arial Black) and the column headers for the schedule are the sub titles (3/16" Arial Black).

- H. Using Paper Space and Model Space on drawings, after setting the scale of the view port, lock the view port to prevent the moving of the Model Space in the view port. Do **not** use password protection when locking view ports.
- I. Be consistent throughout the design drawing package by using Paper Space for all text dimensions, symbols and other annotations to the greatest extent possible.

213 SECTIONS, ELEVATIONS, DETAILS, AND CALLOUTS

1.0 GENERAL

- A. Identify sections, elevations, and details by referencing them with symbols or callouts.
- B. Font width for sheet numbers in detail, elevation, and section bubbles shall be 0.75.
- C. Do not duplicate letter or numbers on either the Sections or Detail sheets.
- D. Start lettering or numbering sequence at the Upper Left Corner and finish at the Lower Right Corner of drawing.
- E. Do not explode blocks generated for sections, elevations, and/or details.
- F. All symbols and callouts are to be in Paper Space to greatest extent possible.

2.0 REFERENCE DESIGNATIONS

- A. Identify sections and elevations by **LETTERS**, and details by **NUMBERS**. Reference sections, elevations and details with the discipline sheet number, for example: A-1000, C-1000, S-1000...

3.0 PROTOCOL FOR REFERENCES AND CALLOUTS

- A. On the sheet where details, sections or elevations are drawn, number or letter them independently by sheet, as opposed to consecutively by discipline or project. Order the numbers and letters sequentially in each drawing sheet that contains elevations, details or sections. Begin with the number 1 for details, and the letter "A" for the elevation or section designation. Start at the upper left corner of the sheet and finish at the lower right corner, working from left to right-like reading a page in a book.
- B. When a detail or section is eliminated, the deleted detail or section number or letter may be reused or left blank. The details or sections do not have to be renumbered as the result of a deletion.

4.0 EXAMPLES OF PROTOCOLS

A section, detail or elevation drawn on the same sheet with a plan or collectively is not permitted. [Exception: see Section 100 on Definitions (*101.3.0D*) and Sketches (*103.4.0*)]. An example of a detail, section, or elevation **not** drawn on the sheet it is referenced or cut from is shown on Figures 213-1 and 213-2.





Standard Section Symbol:



- A. Acceptable Section Symbols when space for referencing is severely restricted:

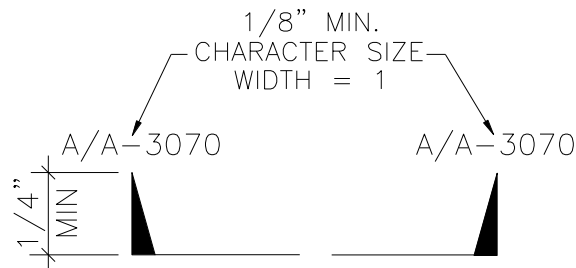


Figure 213-4. Section Symbol when Constricted

- B. Detail Symbol

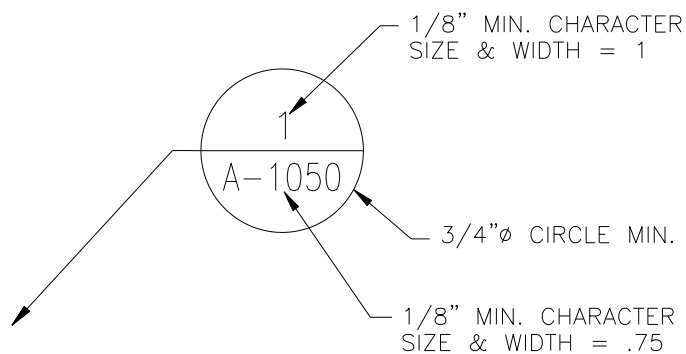


Figure 213-5. Detail Symbol

- C. Detail Projection Element Method:

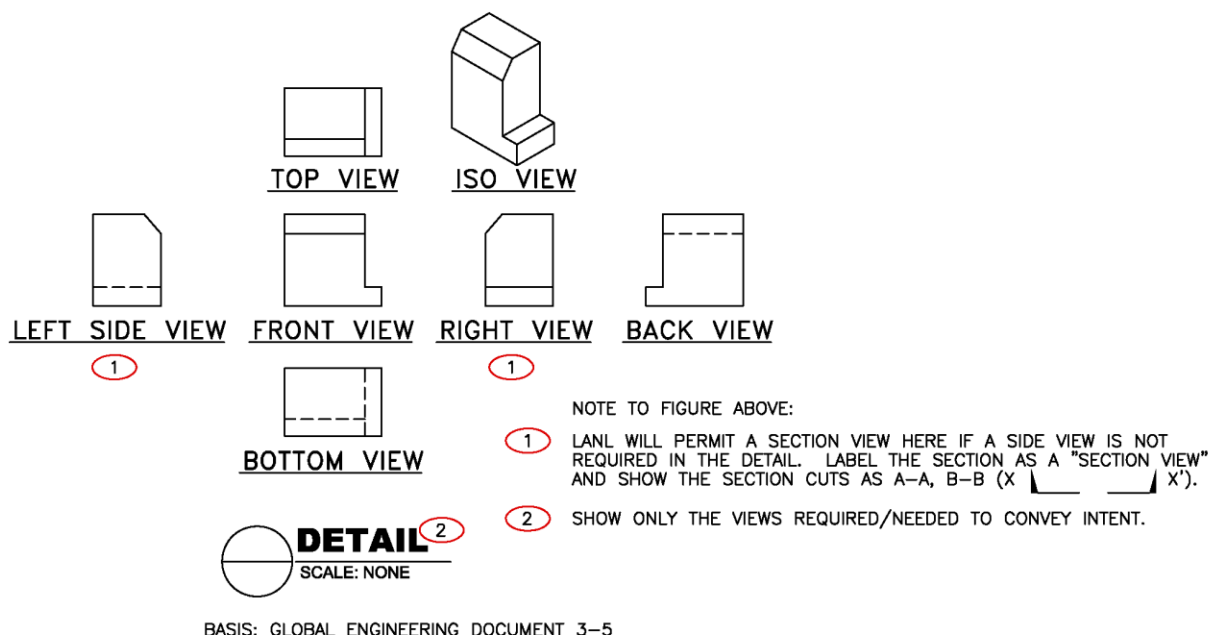


Figure 213-5A. Detail Projection Element Method

6.0 SECTION, ELEVATION, AND DETAIL TITLES

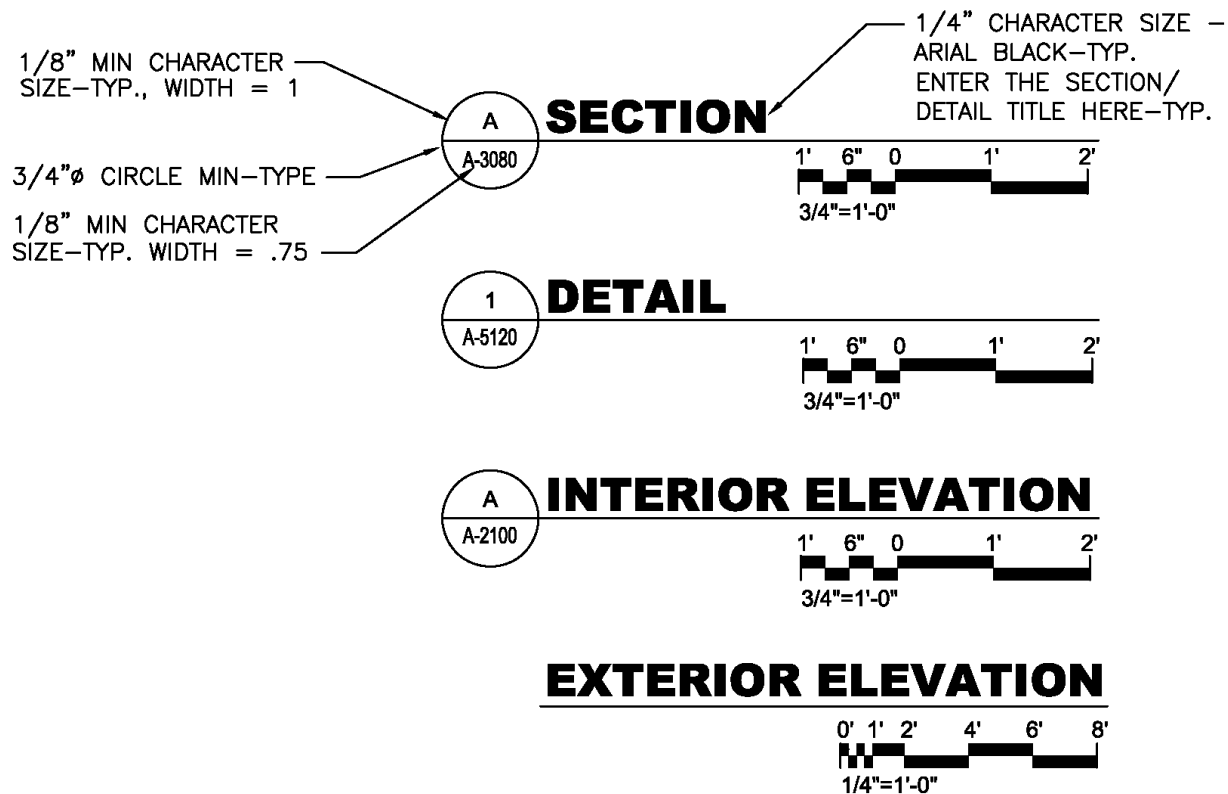


Figure 213-6. Section, Elevation, and Detail Titles

7.0 INTERIOR ELEVATIONS SYMBOL

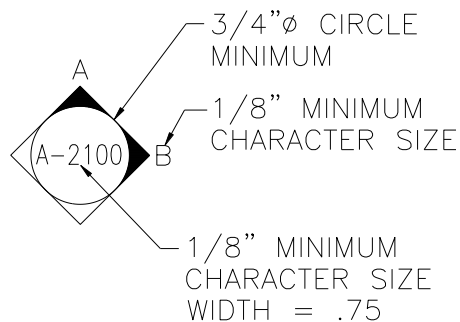


Figure 213-7. Interior Elevations Symbol

8.0 EXTERIOR ELEVATIONS

- A. Reference exterior elevations by the plan direction (i.e., North, South, East, and West).

9.0 KEYED NOTES

- A. Use keyed notes where space is limited in the drawing field. Keyed Notes shall be located below General Notes as shown in Figure 202-1. As with General Notes, Keyed Notes shall be placed in Paper Space to greatest extent possible.

- B. Keyed Notes headers shall be 3/16" Arial Black.
- C. Number Keyed Notes independently by sheet, as opposed to consecutively by discipline or project.
- D. Begin numbering Keyed Notes on each sheet that contains keyed notes with the number one. Number each note sequentially in ascending order.
- E. If a Keyed Note is deleted, insert the comment "not used" in place of the deleted note or re-use the number for another note. It is not necessary to re-number Keyed Notes because of a deletion.
- F. When a Keyed Note is used, show the Keyed Note legend on the same sheet where reference is made. See Figure 202-1 for location of the Keyed Note legend.
- G. Do not use Keyed Notes for dimensions, air flows (CFMs), or under any other circumstances that are inappropriate.
- H. The Keyed Note symbol is an oval with a number designation. The standards established for text apply to the numeric character in the Keyed Note bubble. See Figure 213-8 for an example of the Keyed Note style.
- I. The following is the example of the format for the Keyed Note(s) legend.

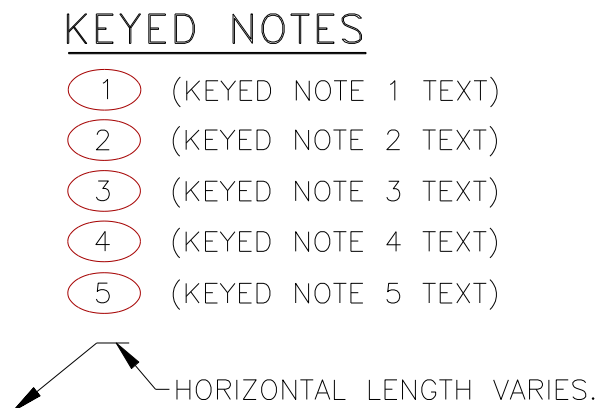


Figure 213-8. Keyed Notes Legend Format Example

10.0 GENERAL NOTES⁹

- A. When a General Note is used, show the General Notes on the same sheet where reference is made.
- B. The General Notes legend shall be located in Paper Space whenever possible, above the Keyed Note legend as shown in Figure 202-1. Add plot size note (See Section 207.1C).
- C. The General Notes legend header shall be the same as the Keyed Notes header.
- D. General Note headers shall be 3/16" Arial Black.

⁹ Basis: National CAD Standard

- E. The following is the example of the format for the General Note(s) legend:

GENERAL NOTES

1. (GENERAL NOTE 1 TEXT)
2. (GENERAL NOTE 1 TEXT)
3. (GENERAL NOTE 1 TEXT)
4. (GENERAL NOTE 1 TEXT)
5. (GENERAL NOTE 1 TEXT)

Figure 213-9. General Notes Legend Format Example

214 CAD FILE CONVENTIONS

1.0 CAD FILE NAMING CONVENTION

- A. Each DWG file will represent a single drawing sheet and shall be named with the drawing number string including as shown:

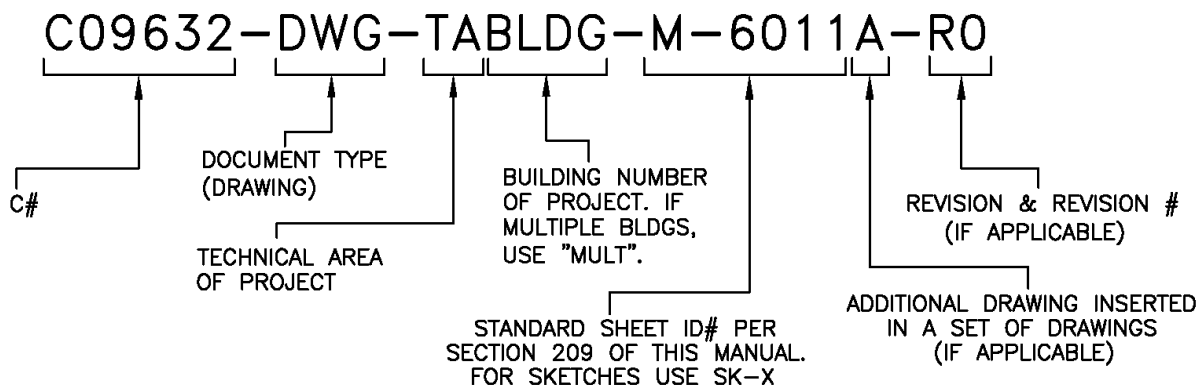


Figure 214-1. CAD File Naming Schema/Syntax

2.0 CAD LAYERING GUIDELINES

2.1 Number of Layers

- A. Minimize the number of layers in a drawing file to the least needed.

2.2 Layer Naming Convention

- A. Use the US National CAD Standard's AIA CAD Layer Guidelines for establishing layer names for all drawings. The only exceptions to those guidelines are:
 - 1. The addition of a "G" (for general) group in the major groups. The "G" major group is added for general information that is not discipline specific, such as Title Blocks, Title Sheets, and General Notes sheets and Symbols that are applicable to all disciplines.

3.0 CAD FILE FORMAT FOR FINAL ELECTRONIC DELIVERABLES

- A. One complete set of the CAD files in DWG format shall be sent to SI-DC¹⁰ with a transmittal letter itemizing the contents and confirmation that the project has been approved and completely signed-off for construction and as-builts. Projects developed in 3D (BIM) software shall submit the native file model in addition to DWG CAD files of the drawings.
- B. Include, within the transmittal, the following data:
 - LANL Project ID#
 - LANL Drawing # (C#& DCF#, FCR# or SK#)
 - TA and Building
 - Title of Project
 - Number of CAD files submitted: X of X
- C. Email transmittals shall not contain classified or (if the submission is originating external to the LANL yellow network) unclassified controlled information identified as such per SAFE-1 and/or DC instructions. **Note: LANL Document Control (SI-DC) does not handle classified documents.**
- D. AutoCAD 2020 or newer version shall be used in creating drawing files. Third party software that is completely compatible and supportable by AutoCAD 2020 or newer version is also acceptable.
- E. A PDF version of all documents shall be included in the submission. The PDFs shall have been created from the native DWG files (i.e. not scanned from hardcopies).
- F. Provide a "read me" file if special instructions are needed for other users to understand the drawing files.
- G. Bind all externally referenced (X-REF) drawing files using the X-REF Bind command sequence and lock all view ports with the Lock Command. Refer to the AutoCAD Users Guide for instructions on binding x-refs.
- H. Identify the plot scale on the drawing file as well as on the delivered media. It is not necessary to identify the plot scale if it is 1:1. If the LANL title block template (DWT) was used, the plot scale will always be 1:1 unless manually changed.
- I. To minimize plotting discrepancies for color, dithering, gray scale, screening, line-type, line weight, end styles, join styles, and fill styles, set the AutoCAD plot style to selection "AutoCAD monochrome.ctb." *Refer to the AutoCAD Users Guide, "Plotting Your Drawing" for assistance in setting this plotting style.*

¹⁰ Flash drives from outside LANL may not be accepted; use CD, DVD, or electronic transfer.

- J. Shading (if required) in a drawing shall be done by using the standard AutoCAD Hatch and Gradient Patterns.
- K. Final deliverables shall be “As-Built” documents with the conversion requirements implemented from Section 103, “As-Built Revision Procedures” of this manual.
- L. “Purge” all unnecessary blocks, text styles, and layers on all drawings prior to SI-DC submittals. Refer to the AutoCAD Users Guide for the “purging” procedure.

215 FOLDING DRAWING PRINTS

1.0 PRINT FOLDS¹¹

- A. *Guidance: Drawing sizes “B” through “E” and roll sizes are normally folded after printing to 8 1/2 x 11 inches to fit standard-size file folders and filing cabinets.*

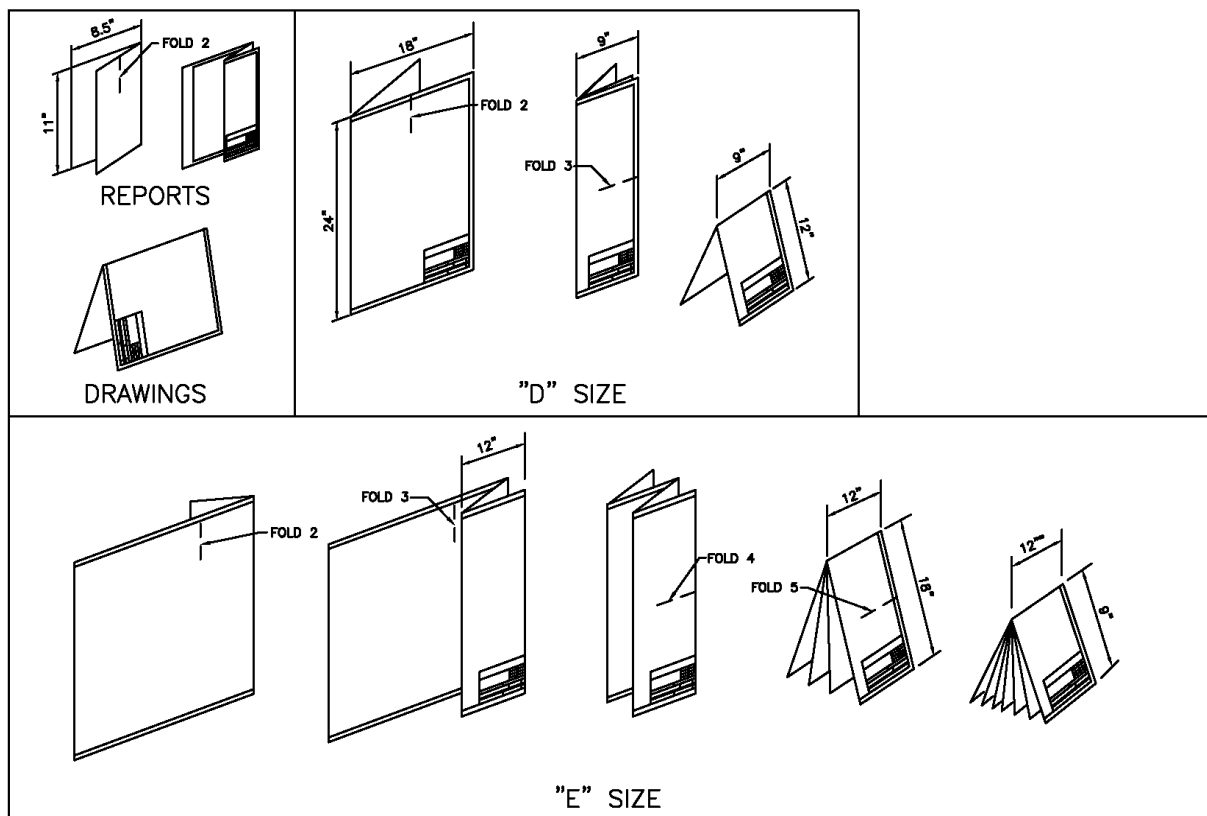


Figure 215-1. Print Folding

¹¹ From Drawing Requirements Manual (10th Ed; now 11th Ed, 6.24, Fig 4-46)