CHPRC-00263
Revision 0

Off-Site Vendor Instructions for the Preparation and Control of Engineering Drawings

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

CH2MHILL
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Approved for Public Release;
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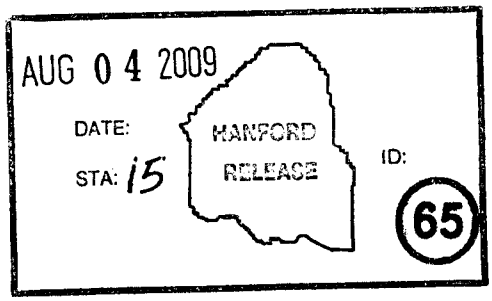

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1.0 PURPOSE

This document provides mandatory directions for preparation and control of engineering drawings, developed for CHPRC.

2.0 SCOPE

Engineering drawings developed specifically to depict permanent installation of structures, systems, and components shall comply with the Hanford drawing format described in this standard.

This standard covers drawings that will become part of the configuration baseline for associated Structures, Systems, and Components (SSCs). Process Flow Diagrams (PFDs) and Piping and Instrumentation Diagrams (P&IDs) are considered key baseline drawings. Appendix D contains additional information for PFDs, and Appendix E contains additional information for P&IDs.

Drawings used to provide temporary construction designs are exempt from this instruction, except for drawings identifying buried items, for example, direct buried electrical lines and potable water lines.

Vendor Information (VI) describing commercially available items and associated data covering such items as installation, operations and maintenance where the criteria of the item is in the engineering design are also exempt from this standard, except for the requirement to reference the VI file number for configuration control of engineering VI data. The Statement of Work and Submittal Register provide the criteria for handling VI data.

3.0 CONTROL OF DRAWINGS AND DATA FILES

3.1 CAD Program

Use AutoCAD Release 2007 or later versions for preparing all engineering drawings identified as engineering baseline documentation.

3.2 Control of Master CAD Data Files and Approved Plotted (Original) Drawings

Vendors are responsible for maintaining configuration control of approved engineering drawings and associated data files to ensure that the Master CAD data file accurately reflects the plotted and approved engineering drawing. This includes managing and limiting access to approved drawings (original) and Master CAD data files to ensure safekeeping of the latest approved revision.

This standard does not address configuration control of 'in process' design documents (i.e. documents under development). This is the responsibility of the contractor.

3.3 Final Turnover of Engineering Drawings

All drawings identified for final turnover shall be contractor-approved drawings with all outstanding approved changes incorporated. All identified drawing originals and master CAD files are turned over to CHPRC before release of structures, systems, or components for operational use. The following directions apply to all H-Series Drawing originals submitted to CHPRC.

- Convert all drawings developed on CAD programs other than AutoCAD to AutoCAD "DWG" format prior to turnover to CHPRC.
- Generate Final plots from the .DWG format.
- Final turnover, requires both engineering drawing originals and associated Master CAD data files (those with a "DWG" extension used to develop the final plotted drawing).
- Bind all AutoCAD X-Reference data before submitting the data files to CHPRC. See Section 4.9, X-Reference Files.
- Plot all drawing originals in Black and White; colored plots are not acceptable for the final turnover.
- Develop all drawings in full scale, using model space. See Section 4.14 Paper Space/Model Space.
- All "layers," except the view port layers and MEDADATA layer (explained below), shall be turned on and plotted; extraneous data shall be removed (e.g. construction reference data).
- Any metadata (information about the drawing that is beneficial to future CAD users) is located on a layer titled "MEDADATA" (e.g. XP scale, block information). See 4.15, Metadata.
- Each drawing shall have a drawing number (H-Series Drawing) provided by the CHPRC Design Authority (DA). See 7.2, Drawing Number.
- For revisions to existing drawings, identify the authorizing Facility Modification Package (FMP) number in the revision block of the drawing with a brief description, for example, "DRAWING AS-BUILT PER PRC-FMP-YY-NNNNN". See 7.3.3, Formal Revision Designation.
- Check all drawings for adherence to these directions. See Section 7.7 Drafting Approved.

4.0 COMPUTER AIDED DRAFTING (CAD)

4.1 AutoCAD Discipline Layering

Uniform layering makes exchange of AutoCAD data files among organizations and companies easier through logical separation and identification of drawing data. It also permits the user to view and plot related aspects of a drawing separately or in combination.

4.2 Layering

Designating layers by color and line type is preferred. It is acceptable to assign layers on an entity basis. This section and Appendix B, *Layer Naming for AutoCAD Drawings by Discipline* describe the steps used when assigning layers. Drawing template files establish specific discipline layers for routine use. See 4.8, New Drawing Set Up Files.

Tables 1 through 9 in Appendix B cover the following:

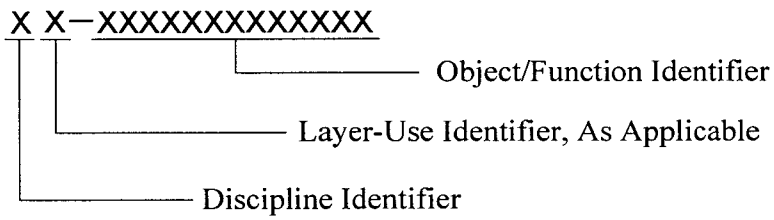
- Table B1, General Layering for All Disciplines
- Table B2, Architectural Drawings
- Table B3, Civil/Structural/Environmental Drawings
- Table B4, Electrical Drawings
- Table B5, Fire Protection Drawings
- Table B6, HVAC Drawings
- Table B7, Instrumentation & Control (I&C) Drawings
- Table B8, Mechanical Drawings
- Table B9, Piping Drawings

The CHPRC CAD Design Authority shall approve all third-party software with built-in layering before use.

4.3 Layer Naming

Figure 1 shows the layer-naming convention for CAD drawings developed for Hanford.

Figure 1
Layer Naming Convention



Note: *A dash is used to separate the first characters from the Object/Function Identifier*

4.4 Discipline Identifier

This identifier defines the specific discipline. A unique identifier enables users to distinguish discipline layers within a drawing file and provides a logical separation of discipline information, as defined by Table 1, Discipline Identifiers.

Table 1
Discipline Identifiers

Identifier	Discipline
A	Architectural
C	Civil
E	Electrical
F	Fire Protection
G	General (non-specific applications)
H	HVAC
I	Control Systems
M	Mechanical/Machine
P	Piping
S	Structural

4.5 Layer-Use Identifier (As Applicable)

The layer-use identifier designates what the layer depicts (e.g., primary objects, existing equipment, hidden objects, or text). Use the layer-use identifier when a single line type and color is assigned to an individual layer as defined by Table 2, Layer Use Identifier. Normally, this identifier is not used for entity-based layers.

Table 2
Layer-Use Identifiers

Identifier	Layer-Use	Line type
O	New or main object, visible lines, primary line work	Continuous
E	Existing equipment - For A/E use to depict existing	Phantom
F	Future items - For A/E use to depict future items	Dashed
D	Demolition - For A/E use to depict demolition information	Dashed
T	Text	Continuous
M	Dimensioning	Continuous
C	Center lines	Center
H	Hidden items/lines	Hidden
X	Hatching	Continuous
P	Mechanical details depicting repeated details (for example, spring and screw thread details or alternate positioning of absent parts)	Phantom
V	Viewing and Cutting Planes	Varies

Certain conditions may make it desirable to link layer data together but still keep the data separate. For example, if a piping modification called for installation of new equipment after removal of old equipment, it is allowable to use the layer-use identifier to separate data as follows:

- PE-PIPING - Existing piping
- PD-PIPING - Piping to be removed (demolition)
- PO-PIPING - New piping to be installed
- PF-PIPING - Piping to be considered for future installation

When the modification is completed, remove extraneous layers (for example, demolition data), which deletes all the data along with the layer.

4.6 Object/Function Identifier

The object/function identifier provides a semi-descriptive name of layer contents or function. The identifier is limited to 28 characters in length and may contain letters, numerals, and special characters, such as $ (dollar), - (hyphen), and _ (underscore). The layer name should assist the reader is understanding what is contained on the layer. See Appendix B, *Layer Naming for AutoCAD Drawings by Discipline*, Tables 1 through 9.

4.7 Line Widths and Line Color Assignments

All line widths and line colors are to comply with Table 3 – Line Width and Color Assignments. Users need to assure the selected color/line weight produces the desired line width on the final drawing plot. The color and line thickness in Table 3 provides optimum contrast between lines. Also, see Appendix B, *Layer Naming for AutoCAD Drawings by Discipline* for assigning line thickness to line types.

Configure Plotters to produce line widths based to colors (using an AutoCAD, CBT file) or assigned line widths through AutoCAD. Designating specific AutoCAD colors to the plotter

pens and using the same color that corresponds with the color by line allows use of either plotting method.

Use of Polylines where there is a justified need is acceptable. Specific line weights generated by the plotter minimize the need to use AutoCAD Polylines within a drawing. Selecting the Polyline feature limits the minimum Polyline width to the plotter line width established by the line color when configured to plot line weight by color.

Table 3
Line Width and Color Assignments

Line Weight	Color Assignment	
	Primary	**Optional**
0.25 mm (0.010 in)	8 (8)	X3 (e.g., 13, 53, 123, 243)
0.35 mm (0.014 in)	5 (Blue) 6 (Magenta) 7 (White)	X2 (e.g. 12, 32, 152, 222)
0.50 mm (0.020 in)	4 (Cyan)	X1 (e.g., 11, 71, 181, 241)
0.70 mm (0.028 in)	2 (Yellow) 3 (Green)	X0 (e.g., 10, 90, 100, 230) X5, X6, X7, X8, X9
0.90 mm (0.035 in)	1 (Red)	X4 (e.g., 14, 64, 134, 214)

4.8 New-Drawing Setup Files

4.8.1 New-drawing setup files

The CHPRC supplied template drawings (.dwt) have the basic layering convention as defined in this standard. See Appendix B, *Layer Naming for AutoCAD Drawings by Discipline* Tables 1 through 9. The drawing templates for the various drawing types and disciplines are available from the CHPRC Design Authority.

4.8.2 Additional Layers

The startup files does not contain an all-inclusive list of layers. Develop additional layers as needed. Additional layers shall comply with the specified naming convention described in Figure 1 – Layer Naming.

4.9 X-Reference Files

Prior to final drawing turnover to CHPRC, all X-Reference files shall be bound to the AutoCAD "DWG" drawing file.

4.10 Manual Modification or Revision of CAD-Generated Drawings

All plotted and approved drawings and the Master CAD Data Files shall be the latest revision and contain identical graphical data. Inaccurate engineering graphical data found before or during final review and approval, requires the contractor to update the Master CAD data file to reflect the changes and the drawing re-plotted and re-approved before issuing the drawing for final turnover.

4.11 Third-Party CAD Software

Third-party software used in the development of AutoCAD-based drawings shall not require access of the third-party software to view or revise the drawing.

The contractor may request an exception for third-party software that automatically assigns/establishes layers.

4.12 Shape Files and Non-Standard Fonts

Do not use nonstandard shape files or fonts (font files not supplied by AutoCAD). Also see Section 8.7, Lettering.

4.13 CAD Auxiliary Support Files/Information

Auxiliary support files and information are available from the CHPRC Design Authority. The available files and information are as follows:

- The electronic file of this standard
- Drawing Title Block formats with the drawing dimvars and setvars setup by discipline. These .dwt templates include the drawing start models (AutoCAD template/prototype drawings), see Section 4.8.1, New-drawing setup files
- Symbols (for example, PFD, P&ID, architectural, electrical, control systems; and HVAC), see Section 8.3, Symbology
- Extra drawing blocks for convenience

4.14 PaperSpace / Model Space

Develop all drawings in model space including all drawing text, and dimensions. One exception is for a drawing developed in full scale (one-to-one), for example: PFD, P&ID and plotted drawing used as templates in fabrication. Place the following data in the PaperSpace layout area, as appropriate:

- Title block,
- General Notes
- Parts List/Bill of Materials
- View Port Layer
- Drawing status information, for example
  - Approved for Design stamp
  - Approved for Construction stamp
  - Electronic PE stamps

4.15 Metadata

Excluding AutoCAD attribute data (refer to AutoCAD attribute functions in AutoCAD documentation), it is acceptable to place drawing metadata considered beneficial to future CAD users on a separate layer titled "MEDADATA." Set the layer to the non-plot setting in the layer control box to prevent this information from plotting.

5.0 DRAWING CATEGORIES

5.1 New Project Drawing Types

New baseline drawings are given unique Hanford H-Series drawing numbers (see section 7.2, Drawing Number). The Design Authority shall provide H-Series drawing numbers. These drawings are permanent records and are subject to as-built requirements at the completion of construction/fabrication. The DA will identify the baseline drawings needing to be as-built and will provide as-built criteria.

Certain fabrication and construction drawings may not normally be included as engineering drawings. Piping spool piece and installation drawings, rebar bending and installation drawings, concrete lift and block-out drawings, and weld map drawings are project record drawings that may be required as submittals, but are not normally identified as baseline engineering documentation needing retention in the Hanford Document Control System (HDCS). These drawings are developed using the contractor's drawing standards, unless otherwise specified in the Statement of Work.

5.2 Modification Drawings

A Modification Drawing is developed for changing an existing facility and its baseline drawings which are impacted by vendor engineering designs. The changes shall be identified and coordinated with the Design Authority.

5.3 Altered-Item Drawing

An Altered-Item Drawing documents modifications to commercially available vendor-supplied items (off-the-shelf) that require modification to support a design. The Altered-Item drawing establishes a new part number and configuration control of the modified vendor item. Develop an Altered-Item Drawing to control a new configuration using the original vendor item. See Section 8.10.9, Altered Item.

5.4 Process Flow Diagrams (PFDs)

The Process Flow Diagram (PFD) is a simplified graphic description of the basic process flow showing equipment, piping, and controls necessary to clarify the process, heat and material balance, and control concept. The PFD includes a material balance depicting operating conditions. See Appendix D, *Process Flow Diagram (PFD) Standards.*

5.5 Piping and Instrumentation Diagram (P&ID)

The Piping and Instrumentation Diagram (P&ID) is a detailed graphical representation of a system used to develop system design and provide documentation for configuration control of a System, Structure or Component (SSC). The P&ID shows equipment, instrumentation, piping, and any other miscellaneous items required for the mechanical design of the system. System interfaces are also included on the P&ID. See Appendix E, *Piping and Instrumentation Diagram (P&ID) Standards.*

6.0 DRAWING SIZES AND MATERIAL

6.1 Sizes

6.1.1 General Drawing Standards

Drawings sizes are in accordance with ANSI/ASME Y14.1, *Decimal Inch Drawing Sheet Size and Format*, or ANSI Y14.1M, *Metric Drawing Sheet Size and Format.*

6.1.2 Preferred Drawing Sizes

For inch-pound system drawings, the ANSI "F" (28" x 40") and "D" (22" x 34") size are the preferred inch size Drawings.

For Metric dimensioned drawings, the ISO "A1" size drawing (594 mm x 841 mm) is the preferred metric size. The following applies to the use of drawing sizes:

The following applies to either imperial or metric drawings:

- All drawing sheets of a multiple sheet drawing are to be the same size.
- Avoid mixing metric system and inch-pound system on drawing sheets on the same set of drawings (multiple disciplines) for the same project.

6.1.3 Discouraged Drawing Sizes

Use ANSI "E" size, ISO "A0" size, and roll or elongated size drawings is discouraged.

6.2 Drawing Material

Plot drawings intended for final turnover on a minimum 20 lb opaque bond paper.

7.0 DRAWING ARRANGEMENT

The general drawing arrangement conforms to ANSI Y14.1 or ANSI Y14.1M except for the location of the Parts/Materials List and the REVISION Block. Drawing arrangement is as shown in Figure 2 – Drawing Arrangement and as defined in this instruction.

Figure 2 - Drawing Arrangement

DRAWING ARRANGEMENT

Table of Contents for
HNF-14660, Off-Site Vendor Directions for Preparation and Control of Engineering Drawings

OPTIONAL AREA
PARTS / MATERIAL LIST
AND GENERAL NOTES
OR LEGEND

PARTS / MATERIAL LIST,
GENERAL NOTES
OR LEGEND

PARTS LIST/MATERIAL LIST

QTY REQD -020	QTY REQD -01C	PARTS / DASH NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHEET	ITEM NO
	X		ASSEMBLY			1
X	1					2
1	1					3

8.10 PART/MATERIAL LIST

7.1.4 BUILDING NUMBERS LOCATION FOR ADDITIONAL NUMBERS
7.13 DRAWING STATUS AREA
7.1.5 INDEX NUMBER, LOCATION FOR ADDITIONAL NUMBERS
10.4 THIRD ANGLE PROJECTION (AS APPLICABLE)
7.1 TITLE BLOCK
10.3 METRIC NOTATION (IF APPLICABLE)
7.11 TRACEABILITY BLOCK
7.10 NEXT USED ON BLOCK
7.9 REFERENCES BLOCK

THIRD ANGLE PROJECTION
METRIC
BLDG. NO.
INDEX NO.
THE SPACE RESERVED FOR BUILDING AND INDEX NUMBERS
NAME DATE COMPANY
DRAWN BY
DRAFTING APPROVED
DESIGN AUTHORITY
U.S. DEPARTMENT OF ENERGY
Richland Operations Office
SIZE F
BLDG NO INDEX NO DWG NO REV
SCALE SHEET OF
DRAWING TRACEABILITY LIST
DWG NO TITLE
NEXT USED ON
REFERENCES
REF NUMBER TITLE
REVISIONS
ZONE DESCRIPTION DATE

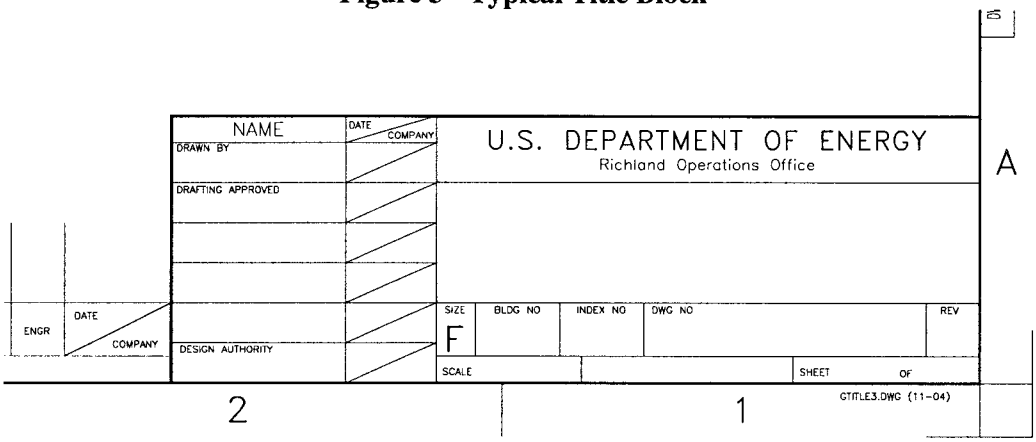
7.1 Title Block

A specially attributed drawing title block is required for all H-Series Drawings. Each Discipline has specific attributes and specially developed AutoCAD start models are available (AutoCAD .dwt file). See Section 4.13, CAD Auxiliary Support Files/Information for additional information on accessing the required .dwt files.

7.1.1 Title Block Configuration

The Title Block conforms to ANSI Y14.1 or ANSI Y14.1M except as modified by this standard. The H-Series drawing Title Block provides additional space for Hanford data used to file and retrieve engineering drawings. A complete Title Block is placed on each drawing sheet (i.e., the continuation sheet drawing format per ANSI Y14.1 is not used). See Figure 3. Only one title block shall exist in a CAD data file.

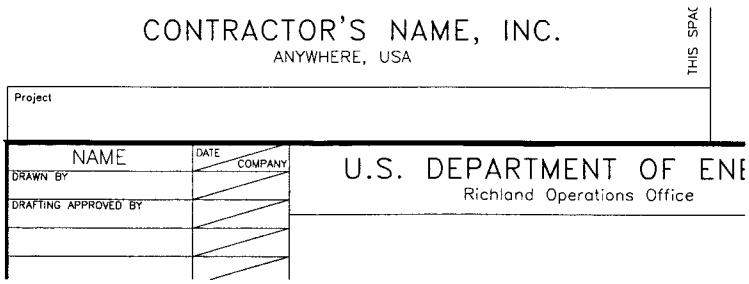
Figure 3 - Typical Title Block



7.1.2 Company Name

For A/E contract drawings, place the name of the firm centered above the title block. In the approval section of the title block, place the acronym of the company for each identified name next to the date. See Figure 4 – Formal Project Title Block.

Figure 4 - Formal Project Title Block



7.1.3 Drawing Title

- Clearly identify the subject matter
- Do not include capitol project numbers or building numbers (for example, W-120), see 7.1.4, Building Number
- Use of Hanford area numbers are acceptable for area-wide presentations, see 7.1.4, Building Number
- Limit the total number of characters and spaces to sixty (60) or less
- The minimum height of the lettering in the title is 6 mm (.24") for ISO A1 and ANSI D and F size drawings. Height of the lettering is 3 mm (.12") for all other drawings.
- Arrange titles in one, two, or three lines centered in the block. All sheets of multiple-sheet drawings shall have the exact same title. The title identifies the system/project, subsystem/subproject, and/or component, as appropriate, using the first and second lines of the title block. Identify the drawing type on the second line of a two line drawing title, or the third line of a three line drawing title.
- For capital projects, enter the project number and project title in a supplemental block above the Title Block. See Figure 4 - Formal Project Title Block.

7.1.4 Building Number

- Enter the building or area number in the corresponding block located within the Title Block. The Design Authority will provide the Hanford Site building numbers for the project.
- For a drawing with 3 to 12 building numbers, the title block template will automatically place all the Building Numbers in the supplemental block, which is located directly above the title block and along the right border of the drawing. The template automatically places the words "SEE ABOVE" in the building number block within the title block. For the location of the supplemental block, see Figure 2 – Drawing Arrangement.
- If more than 12 buildings are affected, assign an area number followed by the letter G, for example: 200G, 400G.

7.1.5 Index Number

- The Design Authority will provide the Hanford Site index numbers. An index number shall be assigned and affixed to the drawing prior to approval.
- Each drawing sheet is limited to a maximum of twelve index numbers. When assigned Index numbers exceed two, the title block template automatically places the Index Numbers in the supplemental block directly above the title block (see Figure 2 – Drawing Arrangement). The supplemental block is located along the right border of the drawing and the title block template automatically places the words "SEE ABOVE" in the index number block within the title block when more than two Index Numbers are entered. For the location of the supplemental block, see Figure 3 – Typical Title Block,

7.2 Drawing Number

Obtain drawing numbers through the Design Authority. There are two locations for the drawing number, in the title block and outside the right border of the drawing in zone "B." See Figure 2, Drawing Arrangement. Place the drawing number in the title block using 6 mm to 8 mm (.24" to .35") high lettering. See Figure 3 - Typical Title Block.

7.3 Drawing Revisions

7.3.1 Revisions Block Size and Location

Each drawing has revision number recorded in three places on the drawing, see Figure 6 Revision Number Locations. The size of the revision block is according to ASME Y14.1 and configured as shown in Figure 5 – Typical Revision Block. For the location of the revision block, see Figure 2 – Drawing Arrangement.

Figure 5 – Typical Revision Block

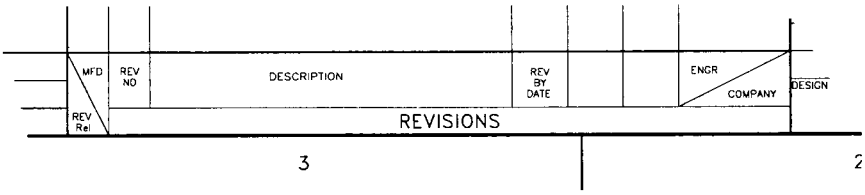
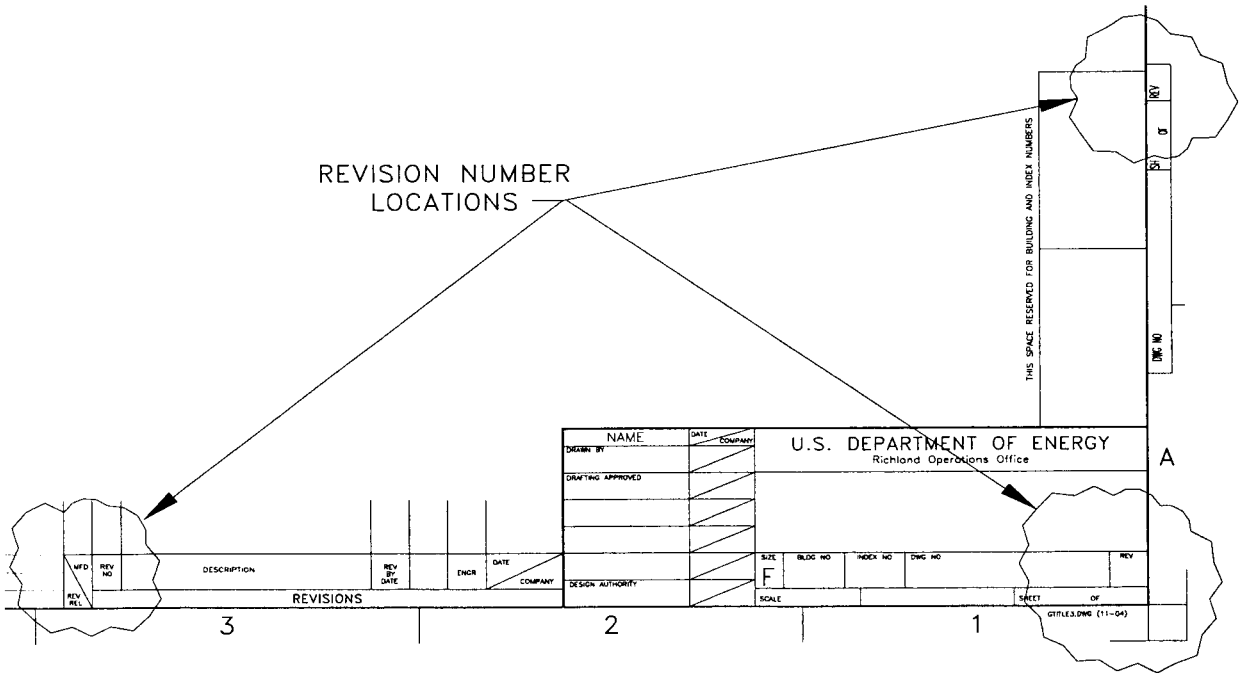


Figure 6 - Revision Number Locations



7.3.2 In Process Revision Designations

All drawings under initial development (prior to final approval) use Alpha revisions, for example, A, B, C. Alpha revisions are used for in process control and may be identified with the review cycle of the drawing, for example, A=30%; B=60%; C=90%. For released Hanford drawings placed into "project status" the alpha designator is placed behind the formal revision number, for example, 3A, 4B, etc. Do not use the next

sequential numeric revision designation until the drawing is ready for approval and issue to construction (via Project document control) or release into HDCS (via a Facility Modification Package Process [FMP]).

7.3.3 Formal Revision Designation

At the point final reviews are complete and CHPRC is ready to approve an engineering drawing, all in process alpha revisions are removed and the drawing is identified with a numeric revision designator beginning with "0" (zero).

Revision "0" (zero) and higher drawings are identified as project baseline drawings and all subsequent revisions require CHPRC approval. All revisions are completed using the next higher numerical revision indicator, (1, 2, 3, etc).

7.3.4 Revision Approval and Designation

For new a drawing, place revision 0 (zero) approval signatures in the approval block within the title block, see Figure 3 - Typical Title Block. No signatures are placed in the REVISION block of a drawing being approved at Revision 0. Place Revision 0 (zero) in the three locations as identified in Figure 6 - Revision Number Locations.

For revision to an approved drawing, place approvals (revision 1 and higher) within the REVISION block, see Figure 5 – Typical Revision Block and advance the revision number in the three locations as identified in Figure 6 - Revision Number Locations.

7.4 Scale

Enter predominant scale of the drawing or enter "NONE" when no scale is used. Enter "SHOWN" if the predominant scale of the drawing cannot be determined; place a scale under each graphic presentation, as applicable.

The use of a standard Architectural, Engineering/Civil or Mechanical scale is preferred (e.g. 1/4" = 1'-0"; 3' = 1'-0"; 1 = 10; 1 = 100; 1/2; 2/1). The use of non-standard scales (e.g. 1/3; 1.315 = 1) is discouraged.

7.5 Sheet Number

On the first sheet, enter sheet 1 and the total number of sheets to the drawing set. Number all sheets in sequential order without the total number of sheets except on sheet 1. Each subsequent sheet after sheet 1, only shows the next sequential sheet number without total number of drawing sheets.

7.6 Drawn By

Print the initials and surname of the drawing originator.

7.7 Drafting Approved

Check all drawings for compliance to this direction, which includes checking the electronic data file to assure that the data file also complies with this direction.

Preferably, the Checker is someone other than an individual(s) involved in the creation of the design or drawing, but never the person who developed the drawing (Drawn By and Drafting Approved shall not be the same individual). Print the initials and surname with the signature placed next or below the printed name.

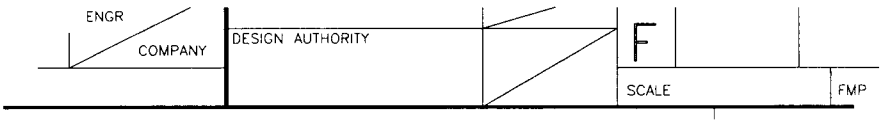
7.8 Approval Signatures

Approvals are in accordance with individual company procedures. Print the initials and surname with the signature placed next to or above the printed names. See Figure 3 - Typical Title Block.

The Design Authority signs and dates the Title Block in the bottom approval space. See Figure 7 – Design Authority. The CHPRC Design Authority approval signifies that all necessary reviews are completed and that the design is accepted. Place the company designator in the block provided next to the approver's signature and date.

When required AE/PE stamps are placed above the title block, see 7.13, Drawing Status Area.

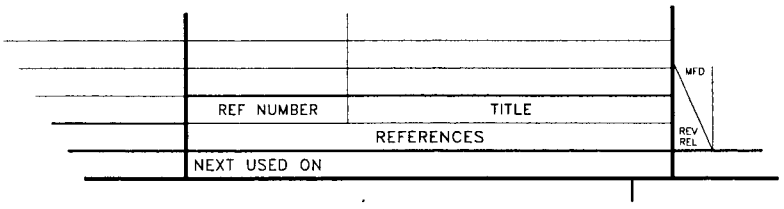
Figure 7 - Design Authority



7.9 References Block

List the reference documents that interface with existing design for construction contractors. See Figure 8 – Typical Reference Block. It is acceptable to abbreviate Titles to save space. Do not list national consensus standards or new drawings depicting new construction in the Reference Block. Show the new and definitive design references in the body of the drawing, as necessary.

Figure 8 - Typical Reference Block



7.10 Next Used On Documentation

Enter the drawing number of the next drawing that the drawing supports. This links the drawing to the next higher-level drawing, such as in a drawing tree.

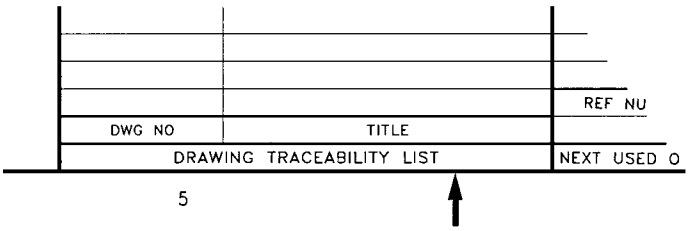
The NEXT USED ON block documents drawing links for easy traceability of the engineering design. For example, a subassembly drawing lists the drawing number of the assembly or the installation drawing. For the location of the block, see Figure 8 – Typical Reference Block.

Enter the words "END ITEM" if the drawing is the top drawing.

7.11 Drawing Traceability List

List all existing drawings affected by the new design and all new Vendor Information File numbers for two-way traceability. For the location of the block, see Figure 9 – Drawing Traceability List.

Figure 9 - Drawing Traceability List



7.12 General Notes

7.12.1 Location

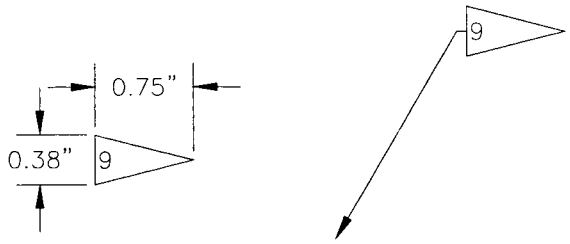
The preferred location of the General Notes is directly above the Title Block along the right side of the drawing. An alternate location is to the left as shown in Figure 2 – Drawing Arrangement. On multiple-sheet drawings, General Notes start on sheet 1, but may continue on subsequent sheets, as necessary.

7.12.2 Flag Note

When there is a definite advantage to add a specific note to the General Notes the specific note is "flagged" by placing the number of the note in a pennant flag symbol, see Figure 10 – Flag Note Size and Configuration. This notifies the drawing user that a flagged General Note applies to a specific location(s) on the drawing and there will be a corresponding flag in the body of the drawing as a reference to the General Notes. Alternately, a notation (for example, "SEE GENERAL NOTE 5") is acceptable in place of the flag note.

Place the reference to the General Note (flag or notation) near the affected area. Use leader lines from the flag note or notation for clarification of the reference, as needed.

Figure 10 - Flag Note Size and Configuration



7.13 Drawing Status Area

Reserve a space approximately 75 mm (3") high above the Title Block for recording additional Title Block information and for the application of A/E and PE stamps according to individual contractor procedures. See Figure 2 - Drawing Arrangement.

7.14 Parts/Material List

If required, a Parts/Material List is located, or started, in the upper right-hand corner on the first sheet of the drawing. To determine if a Parts/Material List is required, see Section 8.10, Parts/Material List, and Table 6 - Material and Parts - Drawing Types and Classifications.

8.0 DELINEATION

8.1 General Practice

Drafting is according to applicable ASME/ANSI Y14 series standards as well as nationally accepted discipline codes, standards and practices. Where national practice differs from the direction of this document, this document prevails as the priority direction.

8.2 Abbreviations and Acronyms

8.2.1 Abbreviations

- Abbreviations conform to the latest edition of ANSI/ASME Y14.38, *Abbreviations and Acronyms for Use on Drawings and Related Documents* except where commonly accepted industry or specific discipline usage dictates a deviation from ANSI/ASME Y14.38. For example, PFDs and P&IDs comply with the abbreviations and acronyms listed on Hanford drawing H-9-006015, *Master Abbreviations Legend Drawing*.
- Fully use Industry-accepted abbreviations, such as DIA for diameter, SCH for schedule, and REF for reference. All other abbreviations are used only when space does not permit the word(s) to be spelled out, such as in the drawing title, parts list, or a reference drawing list.
- Punctuation marks, except the slant (/) and the hyphen (-), are not used. Add a period (.) to an abbreviation only if its context does not obviously represent an abbreviation (for example, ADD indicates addition or addendum).
- Exercise care before using abbreviations to assure proper interpretation by the end users of the drawing.

8.2.2 Acronyms

- Always use acronyms for industrial and professional societies (for example, ASME, ANSI, AWS [American Welding Society], and IEEE [Institute of Electrical and Electronic Engineers]).
- Avoid non-industry-accepted Acronyms. However, if repeated use of a word in text (for example, General Notes) makes the use of an acronym an obvious advantage, the acronym may be created. Clearly define the Hanford site-specific acronyms by spelling out the acronym in the LEGEND or in a General Note.

8.3 Symbology

8.3.1 General Requirements

Symbology used on new drawings that defines components shall be traceable to a LEGEND. The LEGEND is located either on the drawing or on a separate legend drawing maintained for the system or facility.

For revision to an existing drawing, utilize the existing drawing legend with new additions as required.

Do not identify or reference metric system symbols (for example, mm, Pa) in the drawing LEGEND.

8.3.2 New Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID) Master Legend Drawings

New PFDs, P&IDs, Electrical Elementary and One-Line, and Electrical Plan drawings generated for use at the Hanford Site shall comply with the symbology specified in Table 4 – Mandatory Master Legend Drawings and/or as specified by the Design Authority. See Section 4.13, CAD Auxiliary Support Files/Information.

Table 4
Mandatory Master Legend Drawings

Drawing No.	Sheet No.	Drawing Title
H-9-006010	1	Master PFD and P&ID Legend Drawing
H-9-006010	2	Master PFD and P&ID Legend Drawing
H-9-006010	3	Master PFD and P&ID Legend Drawing
H-9-006010	4	Master PFD and P&ID Legend Drawing
H-9-006010	5	Master PFD and P&ID Legend Drawing
H-9-006010	6	Master PFD and P&ID Legend Drawing
H-9-006015	1	Master Abbreviations Legend Drawing
H-9-006020	1	Master Electrical Elementary and One-Line Legend Drawing
H-9-006021	1	Master Electrical Plan Symbology Legend Drawing

Do not reference these drawings as the legend. These drawings are the master listing of symbols for new PFDs and P&IDs, Elementary and One-Line diagrams, and Electrical Plan drawings and are used to develop or revise legends of individual projects.

Each symbol on a PFD or P&ID shall be traceable to a legend. Unless otherwise directed by the Design Authority all drawings shall have a legend on the drawing or reference to a legend drawing developed by the contractor using these criteria.

If a symbol is needed that is not identified on the Master PFD and P&ID Legend Drawings, consult the appropriate national consensus standards for the correct symbol. If no symbol is available, it is permissible to develop the needed symbol by adding it to the PFD/P&ID legend.

8.3.3 Optional Symbology (Drafting Aids)

The symbology specified by the drawings in Table 5 – Drafting Aid Drawings is optional and provided as a drafting aid to increase efficiency in producing/revising drawings.

Note that there are a number of old legacy symbols in these drawings for use when revising existing drawings, which are not used in new designs unless directed by the Design Authority.

Table 5
Drafting Aid Drawings

Associated Drawing	Sheet No.	Drawing Title
H-6-14982	1	Hanford Standard General Symbology
H-6-14983	1	Hanford Standard Civil Symbology
H-6-14984	1	Hanford Standard Structural Symbology
H-6-14985	1	Hanford Standard Architectural Symbology
H-6-14986	1, 2	Hanford Standard Machine Symbology
H-6-14987	1	Hanford Standard HVAC Symbology
H-6-14988	1	Hanford Standard Fire Protection Symbology
H-6-14989	1	Hanford Standard Control Sys Symbology
H-6-14990	1, 2	Hanford Standard Electrical Symbology

Associated Drawing	Sheet No.	Drawing Title
H-6-14991	1, 2	Hanford Standard Piping Symbology

8.4 Criticality Dimensions

Under the direction of the Design Authority, identify Criticality Prevention Limit (CPL) dimensions on the face of a drawing as illustrated in the Figure 11 - CPL Symbol. A Criticality Engineer is responsible for critical dimensioning and determines the need for the placement of the criticality symbol on a drawing. The critically symbol on a drawing also requires a note defining the symbol.

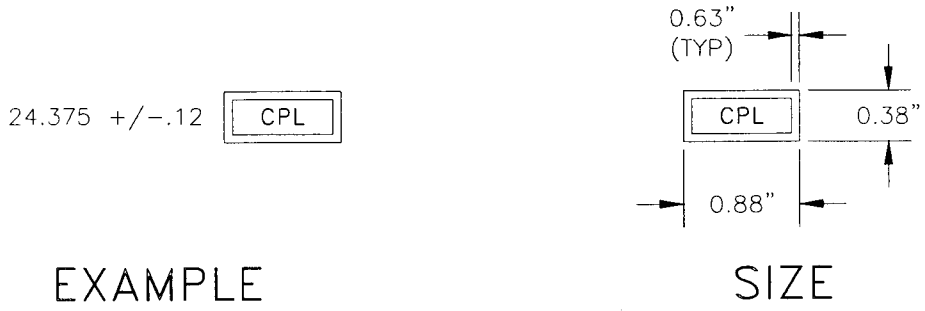
- Placement
  Place the CPL symbol immediately after the designed dimension. Each CPL dimension needs its own tolerance, for example, 3' -7" + 1/8" or 7" + 1/16".

- Size and shape
  Draw the CPL symbol as a double-lined rectangle (1/16" line separation) with the letters "CPL" centered inside the symbol box, as shown.

- Local or Flag Note
  The following note defines the CPL symbol on a drawing:

  "THE CRITICALITY PREVENTION LIMIT DIMENSIONS (CPL) IDENTIFIED IN THE DOUBLE BOX SYMBOL ARE CRITICAL DIMENSIONS AND NEED VERIFICATION AND DOCUMENTATION IN THE WORK PACKAGE AND AT FABRICATION OR INSTALLATION BY QUALITY CONTROL INSPECTION."

Figure 11 - CPL Symbol



8.5 Legibility

Drawings shall be prepared so prints are legible when reduced. As an example, parallel lines have at least 1.5 mm (.06") spacing on the plotted drawing to maintain distinction. The final released drawing has to be capable of passing a fifth-generation copy test.

8.6 Drawing List (Drawing Tree)

Place a drawing list (Drawing Tree) on the first drawing if the project drawing set contains 20 or more drawings. The drawing list may be placed on a separate or title sheet. The list contains, as a minimum, the following information:

- Drawings
  - Number
  - Sheet number
  - Index number
  - Building numbers (if more than one building is involved in the project)
  - Title of each drawing
- Vendor information (VI)
  - CHPRC assigned VI file retrieval number
  - Title
- Specifications
  - CHPRC assigned PRC retrieval number
  - Title

8.7 Lettering

Lettering is all upper case Gothic as defined in ANSI/ASME Y14.2, *Line Conventions and Lettering*. Use only fonts supplied with the AutoCAD program, see Section 4.12, Shape Files and Non-Standard Fonts

- AutoCAD's supplied fonts ROMANS and ROMAND comply with ANSI/ASME Y14.2.
- Letter height is a minimum of 3 mm (.12"), except for lower case letters or metric symbols (for example, mm, and g). Lower case letters and symbols are to be proportional to the upper case lettering
- In cases where smaller letter height is needed and the drawing cannot be expanded a minimum height of 2.5 mm (.1") is allowable

8.8 Drawing Orientation (North Arrow)

North is oriented to the top or left side of the sheet. Exceptions where modifications are being made to existing facilities where the orientation of the existing drawings is different or where industry practices dictate, for example, civil drawings showing plan view strips with corresponding profiles. All plans on a given set of drawings are oriented the same and match the existing plant drawing orientation. Place a north arrow on all maps, plans, layouts, and other drawings where applicable.

8.9 Coordinate System and Geodetic Elevation Data

For new construction, the coordinates and elevation is as follows:

- **Coordinates** - The Washington Coordinate System of 1983, south zone (1991) (WCS83S[1991])
- **Elevation Data** - The North American Vertical Datum of 1988 (NAVD88)

8.10 Parts/Material List

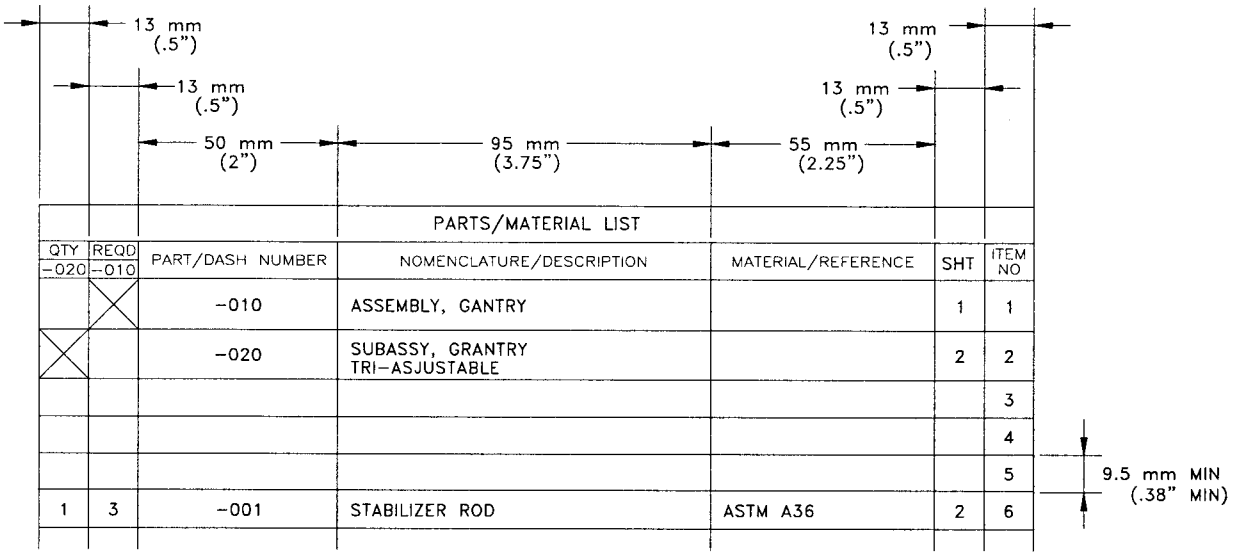
Use a Parts/Material List on fabrication and assembly drawings, but not on project construction drawings where separate specifications control materials (see Table 6 - Material and Parts - Drawing Types and Classifications). Figure 12 – Parts/Materials List defines the general attributes of a Parts/Materials list. For additional guidance on developing a Parts/Material List, see, Appendix C, Parts/Material Lists.

Table 6
Material and Parts - Drawing Types and Classifications

Engineering Drawing Type	Parts/Material List *Not* Used	Formal Parts/Material List, Required (See Code Key Below)	Material Call-Out On Field Of Drawing (See Code Key Below)
Architectural			All
Civil			All
Structural		1	5
Electrical		1-4	5
Piping		1-2-3	5
Instrumentation		1-4-5	5
Heating, Ventilation, and Air Conditioning		1-2-6	5
Mechanical		1	5
Drawing Classification			
Fabrication		All	
Construction		4	5
Altered Item		1	5
Specification Control			All
Non-Fabrication/Construction Drawings (maps, conceptual layouts, cell arrangements, diagrams, schematics, wire run list, and drawings made for operational use).	All		

Code Key for Figure 15
1. *Fabrication or shop-oriented drawings*
2. *In parts/material list description column, enter all pipe ells, tees, etc., as "size of pipe and miscellaneous fittings"*
3. *Prefabricated*
4. *Electrical, instrumentation, and HVAC disciplines (non-project)*
5. *Project construction type drawings*
6. *Process hood systems (supply and exhaust) and process exhaust systems drawings only*

Figure 12 - Parts/Material List



PARTS/MATERIAL LIST

QTY REQD -020	QTY REQD -010	PART/DASH NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHT	ITEM NO
	X	-010	ASSEMBLY, GANTRY		1	1
X		-020	SUBASSY, GRANTRY TRI-ASJUSTABLE		2	2
						3
						4
						5
1	3	-001	STABILIZER ROD	ASTM A36	2	6

8.10.1 Arrangement and Size

The minimum width of the Parts/Material List block having one quantity column is 240 mm (9.5"). Add quantity columns as necessary. The parts/material list is located, or begins, in the upper right-hand corner on the first sheet of the drawing.

8.10.2 Contents

The parts/material list contains all material and separable components on the drawing. Do not number individual pieces of weldments or other inseparable assemblies.

8.10.3 Part Arrangement/Order

Initially, arrange the parts/material list in a hierarchy (assemblies, subassemblies, detail parts, catalog items). It is not necessary to rearrange the parts/material list merely to add later entries.

8.10.4 Part Number

For engineered items, assign a unique part number to identify a designed item. The part number is a unique, non-duplicated number assigned to control a design configuration to maintain and controlled using an H-Series Drawing (e.g. an assembly, subassembly and/or individual component). Identify non-interchangeable items with separate and unique part numbers. For items specifically engineered, designed and fabricated of use on the Hanford site, the official part number is the drawing number and dash number. When referencing a Hanford part number both drawing number and the dash number is used.

8.10.5 Parts and Assembly Numbers

Assign each assembly, subassembly, and detailed part a separate and unique part (dash) number. Assign the primary assembly -010 dash number. Additional assemblies and subassemblies are assigned every tenth number consecutively (for example, -020, -030, -040, etc). Assigned the first detailed part -001 dash number then additional detailed parts are assigned -002, -003, -004, etc., with every tenth digit reserved for assemblies.

8.10.6 Interchangeable Parts

Interchangeable parts are equivalent in performance and durability. They are capable of being exchanged one for the other without alteration of the item or of adjoining items, except for nominal adjustment. They are also interchangeable in terms of fit and performance. If needed for clarity, explain the interchangeability in the General Notes.

8.10.7 Part Number Revisions

When a revision is necessary to the parts/materials list including material deletions the following methods apply for changing the parts/material list:

- Place a line through the text of the part or material item description, or
- Erase the part or material item description and add the word "Deleted," and
- Place a line through deleted part number.

8.10.8 New Part Number

Assign new part numbers, including applicable altered item part numbers when the design of a part, fabricated assembly, or procured item is changed. Assign a new part number if any of the following conditions apply:

- Performance or durability is affected to the extent superseded items have to be discarded for reasons of safety, failure, or malfunction.
- Interchangeable with respect to installation and/or specified performance is altered in existing designed parts, assemblies, or subassemblies such that the new designs are not directly and completely interchangeable
- Replaced /redesigned parts are limited to use in specific applications and the newly designed items are not so limited.
- Alteration of an existing Hanford item, or vendors' purchased item, for an application.
- Rework of existing items cannot be directly and completely interchangeable with the new design.

NOTE: Add new/replacement parts at the end of the parts/materials list using sequential part numbers. Do not use existing Part numbers to identify new or different parts/material -- assign new part numbers.

8.10.9 Purchased Items

Identify purchased items in the parts/materials list with the manufacturer's part number or Vendor Information (VI) number as applicable. Control of the design is by the vendor, unless modified for a design application (i.e. Altered-Item).

8.10.10 Altered-Item

Develop a new Altered-Item Drawing for a vendor-supplied item that requires alteration after purchase for a Hanford Site application as specified in a new engineering design. The following applies:

- The words "ALTERED ITEM" are the first two words of the drawing title.
- Place the words "ALTERED FROM (manufacturer's part number and part name or existing Hanford part number and part name)" in the description column of the parts list.
- Assign a new Hanford part number to the altered item and place the part number column.

- Detail the alteration using visible lines in accordance with ANSI/ASME Y14.2, *Line Conventions and Lettering*.
- Use phantom lines identified in ANSI/ASME Y14.2 for reference features. Limit reference features (features not needing alteration) to orientation for alterations.

8.10.11 Quantities and Customary Trade Units

Enter quantities in customary trade units.

8.10.12 As Required (AR) Designation

Enter AR if the quantity is unknown or if the quantity can vary.

8.10.13 Part Description

Enter a generic description, except for where it is necessary for a specific commercial item purchased as a sole source. List the name of the item first with supplemental descriptive words following. The description of an item must be complete and provide specifications sufficient to procure the item.

Use standard industry language to define the item. If the item described in the Parts/Materials List text is complete without the aid of detailed graphics, a detailed graphic is not placed on the drawing.

9.0 COMPONENT NUMBERING

Off-site architect/engineers obtain component numbers from the Design Authority.

10.0 METRIC MEASUREMENT SYSTEM

Use the following direction as applicable for drawings where the metric system is used:

- Metric designations, for example, mm, Pa, L m^2, cm^2, etc, are symbols within the metric system and used to the fullest extent possible for clarity on engineering drawings.
- Use (SI) symbology, as identified in the latest edition of ANSI/IEEE Standard 268, *American National Standard for Metric Practice*.
- ANSI/ASME Y14.38, does not address metric symbols and is not applicable for metric designations.
- Modifications to drawings containing English units may continue to use the English system unless otherwise specified by the contract.

10.1 Metric Measurement versus Inch-Pound Measurement in Design

In designs specifying metric system of measurement, use hard metric measurements. Do not use the inch-pound system to develop a design and then convert the design from inch-pound measurements to metric measurements. See soft metric conversion, and hard metric conversion.

10.2 Metric Dimensioning

Show all linear dimensions on engineering drawings in millimeters, except on large site plans and civil drawings. Large site plans and civil drawings show linear dimensions in meters with the decimals carried out to one, two, or three places.

- Do not use commas in metric system numbers. Spaces are used in place of commas to separate digits into groups of three (for example, 500 000 mm). A comma is not used in four-digit numbers, (for example, 5000 m). Use a space to separate the numeric value from the measurement unit (for example, mm, m), but do not allow the number and unit to be separated between lines of text.
- Metric dimensions and unit symbols are always in upright type (vertical lettering), even when the surrounding text is in italics.
- Use square meters or sub-multiples to specify areas (for example, m^2, cm^2, and mm^2). Fluid volumes are specified in liters (symbol is upper case L), except large volumes may be expressed in cubic meters (m^3) (for example, 1000 L = 1 m^3).
- Avoid dual dimensioning (both inch-pound and metric shown for the same dimension). In cases where dual dimensioning is determined to be needed, such as an interfacing point with existing items, the following applies:
- Show metric dimensions first with the inch-pound equivalent shown in parentheses
- Add a General Note to the drawing stating the inch-pound dimensions shown in parentheses are equivalent to the metric dimensions they follow, but are not to be used for fabrication/construction
- If an interfacing point requires an inch-pound dimension, show the specific tolerance for each dimension at each inch-pound dimension occurrence.

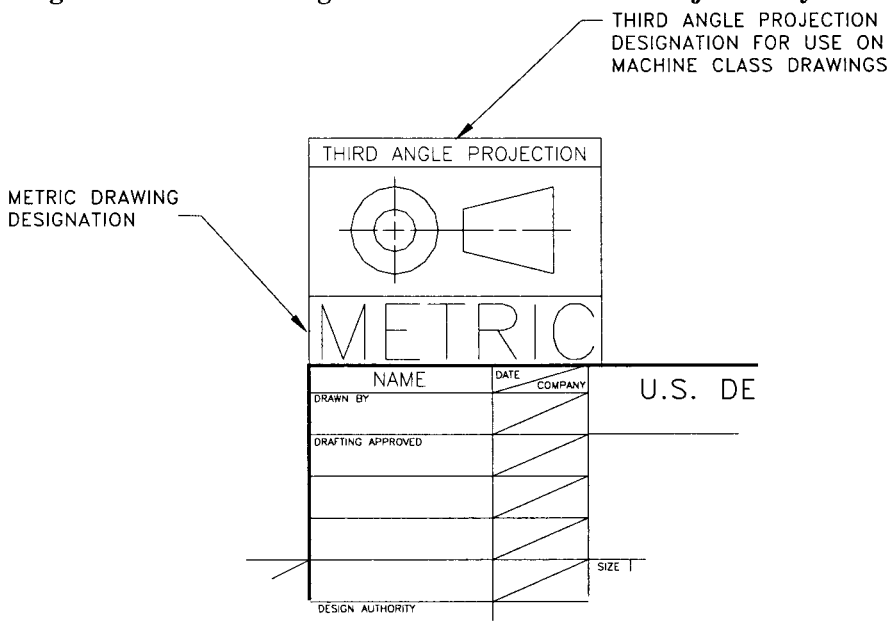
10.3 Metric Notation

Drawings delineated in the metric system have the word "METRIC" placed directly above the Title Block in 6 mm bold gothic lettering as defined by ANSI Y14.2M (see Figure 13 – Metric Designation and International Projection Symbol.

10.4 Third Angle Projection

All metric drawings developed using the multiview system of orthographic presentation as specified in ASME Y14.3, *Multiview and Sectional View Drawings* use the third angle projection method. Place the international projection symbol and the words "THIRD ANGLE PROJECTION" directly above the metric notation as shown in Figure 13.

Figure 13 – Metric Designation and International Projection Symbol



10.5 Converted Metric Designations for Construction Materials and Parts

Converted metric designations are designations of materials and parts converted from the inch-pound system (for example, 2" pipe converted to DN 50 pipe; 2x4 lumber stud converted to 50 x 100 mm lumber stud). Show these conversions where items have equivalent metric designation.

Many industrial products are available in metric designations and follow the appropriate industry organization standards for designations. In some cases where designations lose their proper meaning, inch or metric equivalents are not shown (for example, 1/4-20 thread loses its proper meaning if designated as 6.35 mm-20 thread; conversely, a 6 mm-20 thread loses its proper meaning if designated as a .236-20 thread).

11.0 Working References

ANSI/ASME Y14 Series, *Drafting Practices*
ANSI/ASME Y14.1, *Decimal Inch Drawing Sheet Size and Format*
ANSI/ASME Y14.1M, *Metric Drawing Sheet Size and Format*
ANSI/ASME Y14.2, *Line Conventions and Lettering*
ANSI/ASME Y14.3, *Multiview and Sectional View Drawings*
ANSI/ASME Y14.38, *Abbreviations and Acronyms for Use on Drawings and Related Documents*
IEEE Standard 268, *American National Standard for Metric Practice*

Washington Coordinate System of 1983, south zone (1991) (WCS83S[1991])
The North American Vertical Datum of 1988 (NAVD88)

Appendix A
Glossary

Altered-Item drawing: An engineering drawing used to depict an alteration to a commercial item and to place the altered item under configuration control through assigning a new part number. An altered-item drawing reflects only the change and is not intended to show complete fabrication detail.

applied material: Material not normally shown on the graphic presentation of a drawing (for example, glues, adhesive, paint, cleaner). It may or may not have a manufacturer's identification number. Identify special instruction on applied material in the General Notes. Weld rod is not included in this definition.

architectural floor plan: A floor plan is a horizontal section through a structure showing floors, exterior walls, and interior partitions, with appropriate symbols for materials used.

arrangement/installation drawing: The top-level drawing where multiple related details, assemblies, subassemblies, and certain connecting parts and/or instructions depict the relationship of the drawing with one another. Arrangement/installation drawings are prepared to show particular equipment locations. This helps in identifying the desired location and identifies where potential interferences are likely.

As Required (AR): Used for notation where exact quantities are not known or cannot be determined. The notation is placed in the "Quantity Required" column of the parts list.

assembly: A term used to describe parts and/or subassemblies joined to complete a designed relationship. Due to the difficulty, in some cases, in establishing a clear distinction between the terms "assemblies" and "subassemblies," these two terms have the same meaning and are used interchangeably.

assembly drawing: An assembly drawing is the top-level drawing showing the engineering instructions for assembly of the depicted design. It identifies the subassemblies, components, and assembly methods. It provides traceability to the engineering drawings that detail the end-product engineering design.

baseline documentation: Engineering documentation that detail the design requirements used to construct, fabricate, and maintain a structure, system, or component. Baseline documentation is placed under configuration control for the useful life of the depicted design.

block flow diagram: A precursor to the development of the Process Flow Diagram and P&ID drawing is the understanding of the expected end process. The block flow diagram shows the major elements used in the process.

Brand name: Brand name implies the manufacturer, model, catalog name/number (manufacturer), trademark, or identifying name other than generic.

civil plan drawing: Civil Drawings are graphic and symbolic representations of existing and/or planned surface features of a region showing the necessary construction required for development of a site.

These drawings show natural and manmade features or objects (such as hills, valleys, streams, swamps, buildings and structures, power transmission lines, railroads, etc.), indicating their geometric configuration and physical relationship to other structures and boundary lines.

component number: A component number consists of letters and/or numbers that initially serve to identify a type of equipment/instrument. The component number identifies the relative location of the component on a schematic, flow diagram, one-line, or similar type of engineering drawing. After completion of fabrication/construction and installation, the component number serves as a key in various maintenance and operational activities.

Computer-Aided Design (CAD) data file: The CAD data file is the computer data file used to produce a hard copy drawing. Also, see definition of Master CAD File.

connection diagram: A connection diagram shows the connections of devices contained within a console/cabinet or panel. It is used as a guide for installation of wires or cable.

configuration control: Managing engineering drawings by processing the drawing and maintaining the history of the latest revision to the drawing. Additionally, any changes to the drawing require a process to assure incorporation of the changes into the affected drawing.

construction drawing: Construction drawings depict information necessary to build and or assemble a structure or system and come in a variety of different disciplines. These drawings are normally depicted in orthographic projection with each view containing the necessary dimensions to support making or assembling the depicted structure/system.

customary trade units: Refers to identifying items in accepted units for purchasing specific items, fabrication materials and construction consumables through identifying accepted unit of weight or measurement. One of the important variables is whether the design is in metric or the inch-pound system as the quantities for the design can be dependent on which system is used. For example, inches, millimeters, pairs, pounds, ounces, liters, etc. Each industry has its customary units for either metric or inch-pound and identifying the correct unit is necessary to assure purchase of the proper quantity.

dash number: A dash number is a unique numerical identification assigned to an item for configuration design control. When suffixed to the drawing number, the dash number provides a unique part number for that item. Assigned dash numbers identify two or more items or an assembly depicted on a drawing and used for unique identification and configuration control of the item. The dash number consists of a three-digit number following the drawing number, as follows:

Part Number	Drawing Number	Dash Number
H-3-60670-010	H-3-60670	-010

designed item: For the purpose of this instruction, a designed item is an individual fabricated item engineered and designed to meet the requirements of an engineering application/function that requires an assigned part number for configuration control.

detailed item (Piece Parts): An individual item or units of material needing a specific part (dash) number identification because of traceability and accountability needs for that item.

document control: The function of managing the acceptance, routing, tracking and revision history of engineering documents that demonstrate the fabrication, construction and installation of structures, systems, and components on the Hanford Site.

drawing tree drawing: A drawing list showing all the drawings that make up a project and shows how the drawings link together (forward and backward traceability). The drawing tree provides an over view of the drawing and is the first drawing of a project drawing set.

drawing original: Is the plotted drawing that is approved by signatures of authorized company personnel that attest to the accuracy and quality of the engineering contents of the drawing (for new drawings) or for the revision to an approved engineering drawing.

electrical one-line diagram: A one-line diagram showing the electrical power distribution through single lines and graphic symbols. It shows component devices of an electrical circuit or system of circuits. One-line diagrams are useful in depicting the overall relationship between component devices of circuits and between circuits. A one-line diagram records a maximum amount of significant electrical system information in a minimum amount of space.

engineering document: An approved and released engineering graphical or textual document representing a facility structure, system, or component which is retained for its lifetime. This can be the original signed document and/or the electronic version of the engineering document.

engineering drawing: For the purpose of this direction, an engineering drawing is an engineer approved drawing, including architectural and civil that depicts by means of graphics, pictorial, and textual presentations, the form, fit, and function needs of an engineering approved structure, system or component.

envelope drawing: There are two different definitions covering this drawing type, as follows:

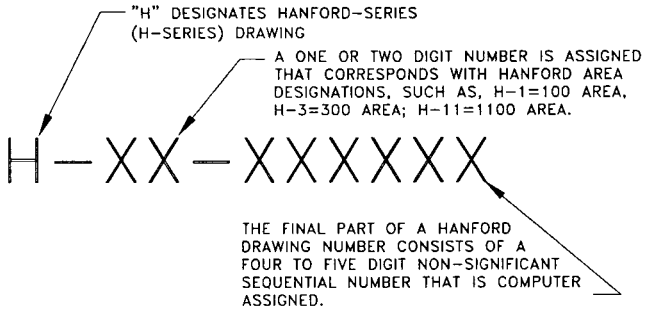
- Customer developed drawing that defines the area that an item is required to fit within, in some cases, the area available for maintenance, is called the envelope of the design, is normally used when, an item is being purchased to ensure that it will fit in the area reserved during the design process.
- Manufacturing Vendor developed drawing that defines the dimensions of an item for the purpose of installation and may include additional space requirements for maintenance.

fifth-generation copy test: The fifth-generation copy test consists of making a full size copy (first-generation copy) from the original document, using a high quality copier, then making a copy of the copy (second-generation); a copy of that copy (third-generation copy), etc., until achieving a fifth-generation copy of the original. The graphics and text of the fifth-generation copy have to be clearly legible without magnification, special lenses, or editing.

final plot: See definition for drawing original.

Design Authority For the purpose of this instruction, the design authority is the person or organization representing the client with responsibility for establishing the design requirements and ensuring that design output documents accurately reflect the *Basis of Design*.

H-Series drawing: An official Hanford engineering drawing assigned a unique drawing number. H-Series drawing numbers start with the letter H, are the followed by a dash with one or two numbers corresponding to a Hanford area designators, then another dash and a non-significant sequential number. These drawings require development with specific standards for releasing retrieving and maintaining the drawing for the life of the Hanford structure, system, or component they represent.



Hanford Document Control System (HDCS): The official database that tracks the current and historical status of all engineering related documents deemed important to both current and past operations of CHPRC. For example, drawings, specifications, supporting data, vendor information data, and environmental data are released into HDCS, and all changes to these documents are identified, released, and tracked.

hard copy drawing: See definition for drawing original.

hard metric conversion: The process of changing measurements from inch-pound units into metric units by converting dimensions into SI metric dimensions (base 10 system). This conversion of inch-pound design directly to metric dimensions to achieve duplicate (equivalent) design is called a hard metric conversion. For example, an item measuring 3/4-inch by 5 1/4 inches would result in a hard metric conversion that is approximately 19 mm x 133 mm with the tolerances then specified in metric; neither the dimensions nor tolerance will be equivalent. Hard metric conversion establishes a complete new item design that rarely interchanges with the inch-pound design. Also, see soft metric conversion, inch-pound system, and metric system.

inch-pound system: For the purpose of this instruction, Inch-pound system identifies units of measurement (a.k.a. English System or Imperial System). Inches, yards, miles, pounds, degrees Fahrenheit, gallons, etc, are recognized inch-pound units as defined by the National Institute of Standards and Technology (NIST).

inseparable assembly: Parts/material joined in such a manner that they are incapable of disassembly without destroying the intended function of the item (for example, weldments, or bonded assembly).

item number (find number): A number assigned to every line entry of a Parts/Materials Lists to tabulate items in the list; used to locate an item in the field of the drawing. The find number is not the part number. The term "Find Number" is interchangeably with the term "Item number".

loop sheet: Instrument Loop drawings normally show each component from field device to final receiver including physical location, initiating device, its terminal number, and junction box with its terminal number, cable number with pair number/polarity, receiver instrument terminals/cabinet terminals, and system functional blocks of loop in simplified schematic format.

Master CAD data file: The Master CAD Data File is the latest formally approved CAD data file containing the electronic drawing used to plot/print the hard copy drawing that is approved and released. This file needs special handling and care to ensure that it is available for subsequent revision of the engineering drawing.

metadata: Embedded data that provides information to future users about the data file (data about the drawing data). Examples include drawing view port XP scales, and block information.

metric system (International System (SI) of Units): Adopted metric measurement system approved by the 11th General Conference on Weights and Measures (CGPM) in 1960, and recognized by the worldwide standard setting organizations such as ISO, ANSI, German Institute of Standards (DIN), Japan Instrument Society (JIS), and Center for Studies of Nuclear Energy (CEN).

modification drawing: A drawing type developed to show modification to an existing system or structure and used during the construction/modification phase. Modification drawings also include drawings showing required demolition to facilitate modifications. Modification drawings provide as-built documentation for updating the primary engineering drawing used for operations and maintenance. When modification work is complete it is typically incorporated into the baseline drawings (for example, essential or support) to reflect the As-Built configuration.

part number: Items specifically engineered for the Hanford site are assigned part numbers that consist of the drawing number (H-Series Drawings) plus an assigned dash number. Part numbers for purchased items are the manufactures assigned part number part number. A vendor item number from a catalog (for example, Grange or McMaster Carr) is not a part number and may only be use as a reference.

Part Number	Drawing Number	Dash Number
H-3-60670-010	H-3-60670	-010

parts/materials list: A tabulation of parts and/or material needed for construction, fabrication, or procurement of an items depicted on a drawing.

process flow diagram (PFD): A simplified schematic description of a process, including the following elements:

- Basic equipment and stream flows necessary to define the process
- Temperatures, pressures, flow rates, and duties that define normal operation.

- Material balances that define the quantities of raw materials and products, and the physical and thermal condition of every major stream in the process
- Instrumentation sufficient to illustrate the basic Process Control concept

PFDs use specific symbology traceable to a Legend for identification of equipment, piping, instrumentation, and process lines.

piping and instrumentation diagram (P&ID): An engineering design document used to define the details of how a process works and how it is controlled. This drawing shows the interconnection of process equipment and the instrumentation used to control the process schematically (without regard to the physical system layout). P&IDs use specific symbology traceable to a Legend for identification of equipment, piping, instrumentation, and process lines.

plot plan drawing: The plot plan often functions as "top drawing" for a set of civil, architectural, structural, HVAC, piping and instrumentation and electrical drawings, which together comprise the complete design. Plot Plans are permanent records, which depict the basis for design of new facilities. This type of drawing shows the limits of the facility footprint; therefore, its accuracy is of extreme importance.

release: The formal Hanford process of making an engineering document into a record.

revision: The formal act of incorporating approved changes onto an engineering document. The revised drawing replaces the previously approved and released document.

schematic diagram: Schematic diagrams define functions, without regard to physical size, shape, or location of components, devices, or parts. Graphic symbols and reference designations show connections and junctions of a specific circuit arrangement. Schematic diagrams are useful in circuit analyses and evaluations, as an aid to manufacturing installation testing, quality inspection, engineering changes, operations, and maintenance.

sections and details: Sections cut partially, or entirely, through an area to show construction and treatment of the depicted information (architectural, piping, structural, HVAC). The cutting plane of a section need not be continuous. Sections depict the true position with regard to the cutting plane.

soft metric conversion: This is the process of changing measurement language from inch-pound measurement units to equivalent metric units within acceptable measurement tolerances without changing the actual physical size of the configuration of the part, product, or process. Soft metric dimensions result from taking a dimension already designed to inch-pound system dimensions and converting those dimensions to (approximately equivalent) metric dimensions. For example, an item measuring 3/4-inch by 5 1/2 inches could result in a "soft" metric conversion yielding 19 mm by 140 mm (which includes rounding off the numbers). Soft metric conversion can create a situation where tolerances will not work when using the metric dimensions, therefore a General Note stating this fact is highly recommended. See also Hard metric conversion, inch-pound system, and Metric System (International System (SI) of Units.

stock/material item: Material used in an inseparable assembly whose final configuration is contained within the configuration of that assembly (for example, a weldment). Also, see Inseparable Assembly definition.

subassembly: An assembled unit designed for incorporation with other units. See definition of Assembly.

two-way traceability: Two-way traceability provides for cross-referencing of engineering information.

Vendor Information (VI) drawing: A drawing prepared by a vendor according to the manufactures individual company requirements that may provide information on configuration, installation, maintenance, and/or operation of a procured item that is commercially available for sale in the open market.

third-party software: Third-Party Software is any add-on software used in conjunction with the CAD Standard software (e.g. AutoCAD) to develop a CAD data file. Some of these programs require they be loaded with CAD software to work on the CAD data file.

vendor (supplier) item: an item procured from an off-site manufacturer to a vendor's specification that has specific functional, physical features needed a depicted design, for example, valves, pumps, and condensers. The item has a specific part number identification assigned by the manufacturer.

(engineering) Vendor Information (VI) data: Any type of vendor supplied technical documentation / information that has been determined by the responsible engineer to be necessary for the operation and/or maintenance of items in a system or structure. The types of documents typically procured and maintained as VI include the following:

- Certified Test Data
- Data Sheets
- Equipment Weight
- Illustrative Cuts
- Instructions
- Installation Drawings
- Installation Instructions
- Maintenance Manual
- Operations Manual
- Power Requirements
- Schematics and Control Diagrams
- Spare Parts List
- Specifications

x-reference: An AutoCAD program feature that allows drawing data to be shared between data files. The shared data is not permanently part of the drawing until bound into the master (main) data file

Appendix B
Layer Naming for AutoCAD Drawings by Discipline

TABLE B1
General Layering For All Disciplines

NOTE: ***Selected layers from the general layering for all disciplines are added to the drawing setup models as determined appropriate and necessary to define and separate drawing data.***

Layer Name	Description	Line Color	Line Type	Line Weight
Autocad Program				
0	AutoCAD generated. Not for project drawings; used for symbol creation	White	Continuous	0.35mm 0.014"
DEFPOINTS	AutoCAD generated; associative dimensioning definition points automatically on this layer; used for display, only, as AutoCAD does not print this layer.	White	Continuous	0.35mm 0.014"
General Layers				
*?O-BRD	Title block , associated blocks, and drawing border	132	Continuous	0.35mm 0.014"
*?M-DIM	Dimensioning	253	Continuous	0.25mm 0.010"
*?T-TXT	Text, General associated with a specific layer	White	Continuous	0.35mm 0.014"
*?T-BTXT	Text, Bold	Yellow	Continuous	0.70mm 0.028"
*?T-REF	Reference items and notes that aid CAD uses during construction of the drawing	213	Continuous	0.25mm 0.010"
*?T-CHK	Checker's marks (informal only)	11	Continuous	0.50mm 0.020"
*?O-VPT	Paper space Viewport border	White	Continuous	0.35mm 0.014"
*?O-CLD	Clouded areas for Hold, FMP/ECN, and revision	White	Continuous	0.35mm 0.014"
*?E-EXST	Anything existing to remain	8	Phantom	0.25mm 0.010"
*?D-DEMO	Existing items /equipment required to be removed or demolished	Cyan	HiddenX2	0.50mm 0.020"
*?C-CLINE	Center line	Blue	Center	0.35mm 0.014"
*?X-HATCH	Cross-section lines	Blue	Continuous	0.35mm 0.014"
*?H-HIDL	Hidden lines	Blue	Hidden	0.35mm 0.014"

TABLE B1
General Layering For All Disciplines

NOTE: *Selected layers from the general layering for all disciplines are added to the drawing setup models as determined appropriate and necessary to define and separate drawing data.*

Layer Name	Description	Line Color	Line Type	Line Weight
*?V-MLN	Matchlines	Red	Phantom	0.90mm 0.35"

*** The "?" in the layer name is replaced with the correct Discipline Identifier. See Section 4.3**

TABLE B2
Architectural Drawings

NOTE: *When additional layers are created to specify discipline information, other than architectural, the object/function identifier from the appropriate discipline table should be used to define the drawing data. As appropriate, the architectural discipline identifier should be used.*

Layer Name	Description	Line Color	Line Type	Line Weight
General Layers				
AO-BRD	Title block, associated blocks, and drawing border	132	Continuous	0.35mm 0.014"
AM-DIM	Dimensioning	253	Continuous	0.25mm 0.010"
AT-TXT	Text, General associated with a specific layer	White	Continuous	0.35mm 0.014"
AT-BTXT	Text, Bold	Yellow	Continuous	0.70mm 0.028"
AT-REF	Reference items and notes that aid CAD users during construction of the drawing	213	Continuous	0.25mm 0.010"
AO-VPT	Paper space Viewport border	White	Continuous	0.35mm 0.014"
AO-CLD	Clouded areas for Hold, FMP/ECN, and revision	White	Continuous	0.35mm 0.014"
AE-EXST	Anything existing to remain	8	Phantom	0.25mm 0.010"
AD-DEMO	Existing items /equipment required to be removed or demolished	Cyan	HiddenX2	0.70mm 0.028"
AX-HATCH	Cross-section lines	Blue	Continuous	0.35mm 0.014"
AV-MLN	Matchlines	Red	Phantom	0.90mm 0.35"
Specific Layers				
AO-ACCESSORY	Accessory items - including furniture, HVAC equipment, plumbing fixtures, people, trees, vehicles, etc.	White	Continuous	0.35mm 0.014"
AO-CEILING	Ceiling - SATC, hanger wires, etc.	White	Continuous	0.35mm 0.014"
AC-COLUMN	Building column lines	White	Center	0.35mm 0.014"
AO-DOOR	Interior and exterior	Magenta	Continuous	0.35mm 0.014"
AO-DOORSPEC	Door tag (Architectural Steering Group users only)	White	Continuous	0.35mm 0.014"
AO-FLOOR	Floor plan and background	8	Continuous	0.35mm 0.014"
AO-HEADER	Door header (use with ceiling plan)	White	Continuous	0.35mm 0.014"
AO-SCHEDULE	Room, door, finish, and window	Cyan	Continuous	0.70mm 0.028"
AO-STAIR	Interior and exterior	White	Continuous	0.35mm 0.014"
AO-TAG	Tags for miscellaneous equipment, windows, etc.	White	Continuous	0.35mm 0.014"
AO-WALLS	Interior and exterior	Cyan	Continuous	0.70mm 0.028"
AO-WINDOWS	Interior and exterior	White	Continuous	0.35mm

TABLE B2
Architectural Drawings

NOTE: *When additional layers are created to specify discipline information, other than architectural, the object/function identifier from the appropriate discipline table should be used to define the drawing data. As appropriate, the architectural discipline identifier should be used.*

Layer Name	Description	Line Color	Line Type	Line Weight
				0.014"

TABLE B3
Civil/Structural/Environmental Drawings

NOTE: *When civil and structural items exist in the same drawing, use both layer naming as applicable.*

Layer Name	Description	Line Color	Line Type	Line Weignt
General Layers				
*?O-BRD	Title block, associated blocks, and drawing border	132	Continuous	0.35mm 0.014"
*?T-TXT	Text, General associated with a specific layer	White	Continuous	0.35mm 0.014"
*?T-REF	Reference items and notes that aid CAD users during construction of the drawing	213	Continuous	0.25mm 0.010"
*?O-VPT	Paper space Viewport border	White	Continuous	0.35mm 0.014"
*?V-MLN	Matchlines	Red	Phantom	0.90mm 0.35"
* Specified general layers are used in both the civil and structural drawings. The "?" is replaced with the correct Discipline Identifier. See Section 4.3				
Civil Drawing Specific Layers				
CO-GRID	Site Grids, Profile Grids, etc.	253	Continuous	0.25mm 0.010"
CO-SITE	Property lines, boundaries, fences, etc.	60	Continuous	0.70mm 0.028"
CO-ROAD	Roads, trails, parking, etc.	10	Continuous	0.70mm 0.028"
CO-STRL	Structural work	210	Continuous	0.70mm 0.028"
CO-GND	Contours, grade breaks, etc.	Green	Continuous	0.70mm 0.028"
CO-PIPE	Pipelines and piping	Yellow	Continuous	0.70mm 0.028"
Structural Drawing Specific Layers				
SC-GRID	Building column grid	253	Center	0.25mm 0.010"
SO-GND	Grade or earth shown on sections	Green	Continuous	0.70mm 0.028"
SO-CONC	Concrete	Yellow	Continuous	0.70mm 0.028"
SO-FRWK	Framework	Cyan	Continuous	0.50mm 0.020"
SO-RBR	Rebar	130	Continuous	0.70mm 0.28"
SO-MECH	Piping or other mechanical	11	Continuous	0.50mm 0.020"
SO-EMBED	Embedments	131	Continuous	0.50mm 0.020"
SO-STL	Steel	130	Continuous	0.70mm 0.028"

TABLE B4
Electrical Drawings

Layer Name	Description	Line Color	Line Type	Line Weight
General Layers				
*EO-BRD	Title block, associated blocks, and drawing border	132	Continuous	0.35mm 0.014"
EM-DIM	Dimensioning	253	Continuous	0.25mm 0.010"
ET-TXT	Text, General associated with a specific layer	White	Continuous	0.35mm 0.014"
ET-BTXT	Text, Bold text	Yellow	Continuous	0.70mm 0.028"
* Specified general layers are used in both the LGT/SITE and DIAG/SCHED drawings.				
Lighting/Site Drawing Specific Layers				
EE-BKG	Background	8	Phantom2	0.25mm 0.010"
EO-BLD	Building	171	Continuous	0.50mm 0.020"
EO-CND	Conduit, cable, raceway, boxes, ductbanks	51	Continuous	0.50mm 0.020"
EO-CPT	Cathodic protection	11	Continuous	0.50mm 0.020"
EO-EQP	Equipment	211	Continuous	0.50mm 0.020"
EO-LTG	Lighting	Cyan	Continuous	0.50mm 0.020"
EO-MS1	Electric miscellaneous 1	32	Continuous	0.35mm 0.014"
EO-MS2	Electric miscellaneous 2	51	Continuous	0.50mm 0.020"
EO-OHD	Overhead lines	11	Continuous	0.50mm 0.020"
EO-RCP	Receptacles, (120, 208, 480V)	Cyan	Continuous	0.50mm 0.020"
EO-SGD	Signaling devices	211	Continuous	0.50mm 0.020"
EO-UGD	Underground lines (hidden)	13	Hidden	0.25mm 0.010"
Diagram/Schedule Drawing Specific Layers				
EO-DIA	Diagrams, one-line, elementary, etc.	91	Continuous	0.50mm 0.020"
EO-MS1	Electric miscellaneous 1	32	Continuous	0.35mm 0.014"
EO-MS2	Electric miscellaneous 2	51	Continuous	0.50mm 0.020"

TABLE B5
Fire Protection Drawings

Layer Name	Description	Line Color	Line Type	Line Weight
***General Layers**				
FO-BRD	Title block, associated blocks, and drawing border	132	Continuous	0.35mm 0.014"
*FM-DIM	Dimensioning	253	Continuous	0.25mm 0.010""
FT-TXT	Text, General associated with a specific layer	White	Continuous	0.35mm 0.014"
FT-BTXT	Text, Bold	Yellow	Continuous	0.70mm 0.028"
FE-EXST	Anything existing to remain	8	Phantom	0.25mm 0.010"
FD-DEMO	Existing items /equipment required to be removed or demolished	Cyan	HiddenX2	0.50mm 0.020"
**FC-CLINE	Center line	Blue	Center	0.35mm 0.014"
FV-MLN	Matchlines	Red	Phantom	0.90mm 0.35"
Fire Detection Drawing Specific Layers				
FO-AD	Alarm and detection system	211	Continuous	0.50mm 0.020"
FO-FW	Fire water underground	211	Hidden	0.50mm 0.020"
Sprinkler Drawing Specific Layers				
FO-FW	Fire water underground	211	Hidden	0.50mm 0.020"
FO-SS	Sprinkler system	211	Continuous	0.50mm 0.020"
FO-HS-1	Standpipe hose system	211	Continuous	0.50mm 0.020"

* Specified general layers are used in both the fire detection and sprinkler drawings, except as noted.
** Sprinkler drawing only.

TABLE B6
HVAC Drawings

Layer Name	Description	Line Color	Line Type	Line Weight
***General Layers**				
HO-BRD	Title block, associated blocks, and drawing border	132	Continuous	0.35mm 0.014"
HM-DIM	Dimensioning	253	Continuous	0.25mm 0.010"
HT-TXT	Text, General associated with a specific layer	White	Continuous	0.35mm 0.014"
HT-BTXT	Text, Bold	Yellow	Continuous	0.70mm 0.028"
*HT-REF	Reference items and notes that aid CAD users during construction of the drawing	213	Continuous	0.25mm 0.010"
**HO-VPT	Paper space Viewport border	White	Continuous	0.35mm 0.014"
HV-MLN	Matchlines	Red	Phantom	0.90mm 0.35"
* Specified general layers are used in both the HVAC and HVAC/Instrumentation Drawings, except as noted. ** HVAC drawing only.				
HVAC Drawing Specific Layers				
HO-EQP	HVAC or piping equipment	51	Continuous	0.50mm 0.020"
HO-EXH	HVAC exhaust system	171	Continuous	0.50mm 0.020"
HO-PIP	Piping and piping fixtures and hardware	51	Continuous	0.50mm 0.020"
HO-PLM	Plumbing and plumbing fixtures and hardware	201	Continuous	0.50mm 0.020"
HO-RTN	HVAC return system	Cyan	Continuous	0.50mm 0.020"
HO-SUP	HVAC supply system	51	Continuous	0.50mm 0.020"
HVAC/Instrumentation Drawing Specific Layers				
IO-ELEC	Electrical equipment	71	Continuous	0.50mm 0.020"
IO-DCS	Distributed control system instruments	Cyan	Continuous	0.50mm 0.020"
IO-ELINE	Electrical signal lines	42	Hidden	0.35mm 0.014"
IO-ILINE	Instrument lines, such as pneumatic	Magenta	Continuous	0.35mm 0.014"
IO-CVAL	Control valves	Cyan	Continuous	0.50mm 0.020"
IO-SLINE	Software link line	Magenta	Continuous	0.50mm 0.020"

TABLE B7
Instrumentation & Control (I&C) Drawings

NOTE: *When creating additional layers to specify existing and future layers, the preferred color is 8.*

Layer Name	Description	Line Color	Line Type	Line Weight
***General Layers**				
IO-BRD	Title block, associated blocks, and drawing border	132	Continuous	0.35mm 0.014"
**IM-DIM	Dimensioning	253	Continuous	0.25mm 0.010"
IT-TXT	Text, General associated with a specific layer	White	Continuous	0.35mm 0.014"
IT-BTXT	Text, Bold	Yellow	Continuous	0.70mm 0.028"
IT-REF	Reference items and notes that aid CAD users during construction of the drawing	213	Continuous	0.25mm 0.010"
IT-CHK	Checker's marks (informal only)	11	Continuous	0.50mm 0.020"
IO-VPT	Paper space Viewport border	White	Continuous	0.35mm 0.014"
IO-CLD	Clouded areas for Hold, FMP/ECN, and revision	White	Continuous	0.35mm 0.014"
IE-EXST	Anything existing to remain	8	Phantom	0.25mm 0.010"
ID-DEMO	Existing items /equipment required to be removed or demolished	Cyan	HiddenX2	0.50mm 0.020"
IC-CLINE	Center line	Blue	Center	0.35mm 0.014"
IX-HATCH	Cross section lines	Blue	Continuous	0.35mm 0.014"
IH-HIDL	Hidden lines	Blue	Hidden	0.35mm 0.014"
IV-MLN	Matchlines	Red	Phantom	0.90mm 0.35"
* Applicable to all instrumentation and control drawings, except as noted. ** Plans, Elevations, Details, and Assembly drawing only.				
P&ID Drawing Specific Layers				
IO-ELEC	Electrical equipment	71	Continuous	0.50mm 0.020"
IO-INS	Instruments	211	Continuous	0.50mm 0.020"
IO-DCS	Distributed control system instruments	Cyan	Continuous	0.50mm 0.020"
IO-ELINE	Electrical signal lines	42	Hidden	0.35mm 0.014"
IO-ILINE	Instrument lines, such as pneumatic	Magenta	Continuous	0.35mm 0.014"
IO-CVAL	Control valves	Cyan	Continuous	0.50mm 0.020"
IO-SLINE	Software link line	Magenta	Continuous	0.50mm 0.020"
IO-EQP	Equipment	141	Continuous	0.50mm 0.020"
IO-MAJ	Major process lines	Red	Continuous	0.90mm 0.35"

TABLE B7
Instrumentation & Control (I&C) Drawings

NOTE: *When creating additional layers to specify existing and future layers, the preferred color is 8.*

Layer Name	Description	Line Color	Line Type	Line Weight
IO-MIN	Minor process lines	Yellow	Continuous	0.70mm 0.028"
IO-PROC	Process line	152	Continuous	0.35mm 0.014"
IO-PIP	Piping valves and fittings	121	Continuous	0.50mm 0.020"
Plans, Elevations, Details, and Assembly Drawing Specific Layers				
IO-TUBE	Tubing	52	Continuous	0.35mm 0.014"
IO-BGND	Background	8	Continuous	0.25mm 0.010"
IO-PIPE	Piping	12	Continuous	0.35mm 0.014"
IO-BLDG	Building	8	Continuous	0.25mm 0.010"
IO-EQP	Equipment	143	Continuous	0.25mm 0.010"
IO-INS	Instruments	210	Continuous	0.70mm 0.028"
IO-FRM	Panels, racks, cabinets	32	Continuous	0.35mm 0.014"
IO-WRG	Wiring	92	Continuous	0.35mm 0.014"
IO-CVAL	Control valve	130	Continuous	0.70mm 0.028"
Wiring/Tubing Diagram Drawing Specific Layers				
IO-WRG	Wiring	Green	Continuous	0.70mm 0.028"
IO-INS	Instruments	Magenta	Continuous	0.35mm 0.014"
IO-DCS	Distributed control system instruments	132	Continuous	0.35mm 0.014"
IO-TBLK	Terminal blocks	152	Continuous	0.35mm 0.014"
IO-SLINE	Software lines	12	Continuous	0.35mm 0.014"
IO-TUBE	Tubing	Yellow	Continuous	0.70mm 0.028"
Logic/Block Diagram Drawing Specific Layers				
IO-GATE	Logic gate/memory latch	Green	Continuous	0.70mm 0.028"
IO-SPATH	Software signal path	12	Continuous	0.35mm 0.014"
IO-HPATH	Hardware signal path	152	Continuous	0.35mm 0.014"
IO-INS	Instruments	211	Continuous	0.50mm 0.020"
IO-DCS	Distributed control system instruments	Cyan	Continuous	0.50mm 0.020"

TABLE B8
Mechanical Drawings

Layer Name	Description	Line Color	Line Type	Line Weight
General Layers				
MO-BRD	Title block, associated blocks, and drawing border	132	Continuous	0.35mm 0.014"
MM-DIM	Dimensioning	253	Continuous	0.25mm 0.010"
MT-TXT	Text, General associated with a specific layer	White	Continuous	0.35mm 0.014"
MT-BTXT	Text, Bold	Yellow	Continuous	0.70mm 0.028"
MT-CHK	Checker's marks (informal only)	11	Continuous	0.50mm 0.020"
MO-VPT	Paper space Viewport border	White	Continuous	0.35mm 0.014"
MC-CLINE	Center line	Blue	Center	0.35mm 0.014"
MX-HATCH	Cross-section lines	Blue	Continuous	0.35mm 0.014"
MH-HIDL	Hidden lines	Blue	Hidden	0.35mm 0.014"
MV-MLN	Matchlines	Red	Phantom	0.90mm 0.35"
Specific Layers				
*MO-1DET	Detail	Yellow	Continuous	0.70mm 0.028"
MO-2DET	Detail	Green	Continuous	0.70mm 0.028"
MO-FAST	Fasteners	Cyan	Continuous	0.50mm 0.020"
MO-VEND	Vendor information	8	Continuous	0.25mm 0.010"
MP-PHANT	Moving parts, alternate positions, simplified drafting techniques, e.g., screw threads, springs	8	Phantom	0.25mm 0.010"
MO-LAYOUT	Layout and/or construction lines	Magenta	Continuous	0.35mm 0.014"

* Add auxiliary details as needed. Example: 3DET, etc.

TABLE B9
Piping Drawings

Layer Name	Description	Line Color	Line Type	Line Weight
Piping Drawing, Jumper Assembly 1 Drawing, Jumper Assembly 2 Drawing, and Jumper Assembly 3 Drawing General Layers				
PO-BRD	Title block, associated blocks, and drawing border	132	Continuous	0.35mm 0.014"
PM-DIM	Dimensioning	253	Continuous	0.25mm 0.010"
PT-TXT	Text, General associated with a specific layer	White	Continuous	0.35mm 0.014"
PT-BTXT	Text, Bold	Yellow	Continuous	0.70mm 0.028"
PT-REF	Reference items and notes that aid CAD users during construction of the drawing	213	Continuous	0.25mm 0.010"
PO-VPT	Paper space Viewport border	White	Continuous	0.35mm 0.014"
PO-CLD	Clouded areas for Hold, FMP/ECN, and revision	White	Continuous	0.35mm 0.014"
PE-EXST	Anything existing to remain	8	Phantom	0.25mm 0.010"
PD-DEMO	Existing items /equipment required to be removed or demolished	Cyan	HiddenX2	0.50mm 0.020"
PC-CLINE	Center line	Blue	Center	0.35mm 0.014"
PX-HATCH	Cross-section lines	Blue	Continuous	0.35mm 0.014"
PH-HIDL	Hidden lines	Blue	Hidden	0.35mm 0.014"
PV-MLN	Matchlines	Red	Phantom	0.90mm 0.35"
Specific Layers				
PO-PIPINGS	Single-line pipe, valves and fittings	Yellow	Continuous	0.70mm 0.028"
PO-PIPINGD	Double-line pipe, valves and fitting	52	Continuous	0.35mm 0.014"
PO-EQP	Pumps, vessels, etc.	Magenta	Continuous	0.35mm 0.014"
PO-GND	Grade	8	Continuous	0.25mm 0.010"
PO-CONC	Concrete	8	Continuous	0.25mm 0.010"
PO-STRUCT	New structures	8	Continuous	0.25mm 0.010"
PO-PSUPT	Supports	White	Continuous	0.35mm 0.014"

Appendix C
Parts/Material Lists

C1. Location

The Parts/Material List is located, or begins, in the upper right-hand corner on the first sheet of the drawing.

C2. Application

A Parts/Material List is used on fabrication and assembly drawings, but not on project construction drawings as shown in Figure C1.

FIGURE C1
Drawing Types and Classifications

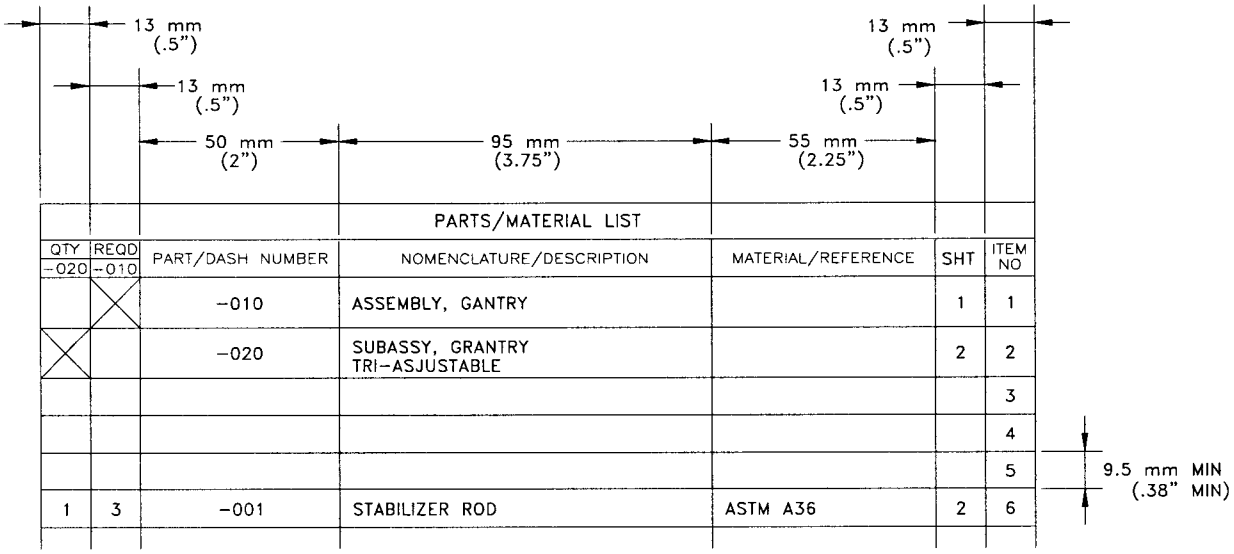
Engineering Drawing Type	Parts/Material List Not Used	Formal Parts/Material List, Required (See Code Key Below)	Material Call-Out On Field Of Drawing See Code Key Below)
Architectural			All
Civil			All
Structural		1	All
Electrical		1, 4	5
Piping		1, 2, 3	All
Instrumentation		1, 4, 5	5
Heating, Ventilation, and Air Conditioning		1, 2, 6	5
Mechanical		1	All
Drawing Classification			
Fabrication		All	
Construction		4	All
Altered Item		1	All
Specification Control			All
Non-Fabrication/Construction, i.e., maps, conceptual layouts, cell arrangements, diagrams, schematics, wire run list, drawings made for operational use.	All		

Code Key for Figure 1:
1. Fabrication or shop-oriented drawings.
2. In parts/material list description column, enter all pipe ells, tees, etc., as "size of pipe and miscellaneous fittings" prefabricated.
3. Electrical, instrumentation, and HVAC disciplines (non-project).
4. Project construction type drawings only.
5. Process hood systems (supply and exhaust) and process exhaust systems drawings only.

C3. Arrangement and Size

The minimum width of the Parts/Material List block having one quantity column is 239 mm (9.5"). Refer to Figure C2. Quantity columns may be added as necessary. The parts/material list is located, or begins, in the upper right-hand corner on the first sheet of the drawing.

FIGURE C2
Parts/Material List Placement



PARTS/MATERIAL LIST

QTY -020	REQD -010	PART/DASH NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHT	ITEM NO
	X	-010	ASSEMBLY, GANTRY		1	1
X		-020	SUBASSY, GRANTRY TRI-ASJUSTABLE		2	2
						3
						4
						5
1	3	-001	STABILIZER ROD	ASTM A36	2	6

C4. Contents

The parts/material list contains all material and separable components on the drawing. The individual pieces of weldments or other inseparable assemblies are not normally numbered separately.

C5. Part Arrangement/Order

The parts/material list should be arranged in a hierarchy (i.e., assemblies, subassemblies, detail parts, catalog items). It is unnecessary to rearrange the parts/material list merely to add an entry later.

C6. Quantities and Customary Trade Units

Quantities are counted accurately and shown in customary trade units. The letters As Required (AR) designation is used where the quantity is not known, or where the quantity could vary.

C7. Part/Dash Number

Unique part numbers are assigned where control of a design configuration (i.e., assembly, subassembly and detail) is controlled on an H-Series drawing. A part number is used to uniquely identify a specific item. Non-interchangeable items are identified with separate and unique part numbers.

The official part number is the drawing number and the assigned dash number. When a part number is referenced, both the drawing number and the dash number are needed as shown.

Part Number	Drawing Number	Dash Number
H-3-60670-010	H-3-60670	-010

C7.1. Parts and Assembly Numbers

Each assembly, subassembly, and detailed part is assigned a separate and unique part (dash) number. The primary assembly is assigned the -010 dash number. Additional assemblies and subassemblies are assigned every tenth number consecutively, for example, -020, -030, and 040. The first detailed part is assigned the -001 dash number. Additional detailed parts are assigned -002, -003, -004, etc., with every tenth digit reserved for assemblies.

C7.2. Interchangeable Parts

Interchangeable parts are equivalent in performance and durability. They are capable of being exchanged one for the other without alteration of the item or of adjoining items, except for nominal adjustment. They are also interchangeable in terms of fit and performance. Interchangeability is also explained in the General Notes with a statement in the parts/material list to see the applicable General Note.

C7.3. Part Number Revisions

The parts/materials list periodically needs to be revised and/or material deletions due to fabrication changes or modifications to the original design. Either of the following is accepted methods for changing the parts/material list, when authorized by a DCN or FMP:

- Remove a part or material item by placing a line through the part or material item. This applies to either CAD or manual drawings.
- Remove a part or material item and add the word "Deleted," in place of the part or material item (e.g., CAD revision).

C7.4. New Part Number

New part numbers, including applicable altered item part numbers are assigned when the design of a part, fabricated assembly, or procured item is changed. The following conditions determine if a new part number is needed:

- Performance or durability is affected to the extent superseded items have to be discarded for reasons of safety, failure, or malfunction.
- Parts, assemblies, or subassemblies are changed so the new designs are not directly and completely interchangeable with respect to installation and/or specified performance.
- When replaced/redesigned parts are limited to use in specific applications and the newly designed items are not so limited.
- When an existing Hanford item, or vendors' purchased item, needs alteration.

- When existing items cannot be reworked to be directly and completely interchangeable with the new design.

New parts and materials are added at the end of the parts/materials list using sequential part numbers. Part numbers are not to be reused for new or different parts/material. New part numbers are assigned.

C7.5. Purchased Items

Purchased items are identified in the parts/materials list with the manufacturer's part number or Vendor Information (VI) number as applicable. These items are normally controlled by the vendor, by industrial or government codes, standards, or file number.

C8. Part Description

The Part Description is to be generic, except where a specific item is needed, and the design depends on or is tailored to the specific item. The name of the item is listed first with supplemental descriptive words following. The description of an item is to be complete and provide specifications sufficient to procure the item.

Standard industry language is used to define the item. If the item can be completely described in the parts/materials list, it is not delineated on the drawing. If description/specification is lengthy, it may be in the General Notes or in a separate specification. If the description/specification is placed in the General Notes or in a separate specification, the General Note or separate specification is referenced in the description column of the parts list, as needed.

C9. Parts/Materials List Industry Practices

The following practices are industry proven and assist in achieving the Parts/Materials List.

C9.1. Arrangement

The Parts/Materials List should be arranged according to the following category hierarchy:

1. Arrangement/installation or assembly
2. Subassemblies
3. Detailed items
4. Designed items
5. Commercial/catalog items
6. Hardware, e.g., bolts and nuts.
7. Material items

Three spaces should be provided between each category for future entries. The sequence of items in the Parts/Materials List may be broken when items added by drawing development, progress, or revisions have used all reserved spaces.

C9.2. Item Number/Find Number System

Items listed in the Parts/Materials List (assemblies, subassemblies, detailed items, commercial items,

and material items) should be identified/located on the field of the drawing by item number as shown in Figure C3. Using this system allows the part number to be located in the Parts List and ensures that unique part numbering is maintained.

The item number is placed in a nominal 13 mm (.50") diameter circle with a radial leader pointing to the depicted item. See Figure C3a.

FIGURE C3
Part Call-outs

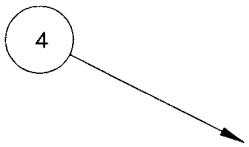


Figure C3a

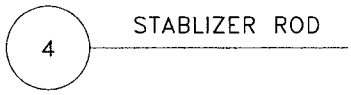


Figure C3b

Views detailing parts or assemblies should always have the item number centered below the primary view in a nominal 16 mm (.63") circle. The nomenclature/description shown in the Parts List should always be used. The lettering height should be 6 mm (.24") high and underlined. See Figure C3b.

All associated items are to be located on the primary view where possible. Duplicate item number call-outs needed for clarification may be used but held to a minimum and identified as reference call-outs by adding "REF" beside the circle.

C9.3. Multiple Item Call-outs

Where more than one item is called out at one location, circled item numbers connected to one leader line may be stacked and quantities indicated as shown in Figure C4 and Figure C5.

C9.4. Items Not Needing Pictorial Depiction

Items that do not need pictorial description for detail are completely described, including dimensions, in the Parts/Materials List.

C9.5. Parts List Vertical Spacing

To describe the part adequately, the Parts/Materials List vertical spacing may vary as needed. Minimum spacing should not be less than 10 mm (.38") as shown by Figure C6.

C9.6. Applied Material

Applied material when needed for fabrication, assembly, or installation, should be identified in the General Notes with application instructions, unless covered by a separate specification. See Appendix B – Glossary.

C9.7. Optional/Alternate Parts/Materials

The words "or equal" are not used for parts or material substitution on drawings. Optional or alternate materials may be provided for on engineering drawings in the following ways:

- By referencing multiple brands/materials in the Parts List and/or in the field of the drawing, as applicable.
- By specific instructions for optional or alternate items placed in the General Notes.

C9.8. Quantity - Quantity Required Column

The quantities (number of items required) are always for one arrangement, one installation, or one assembly only.

C9.9. Counted Quantities

Counted quantities are to be accurate and described in customary trade units.

C9.10. As Required (AR)

Use AR only when an exact quantity is not known or cannot be easily predetermined (e.g., piping, structural steel shapes, tubing, shims, gasket material).

C9.11. Identifying Assemblies

For ease in identifying assemblies, place an "X" in the quantity (QTY) column where the assembly is placed. The "X" can be used to quickly identify the items needed for the assembly and to indicate all the quantities in that column are for that assembly.

C9.12. Reference Designation Column (Electrical/Electronic/Instrumentation Applications Only)

This column should be used when unique identifiers are needed for electrical, electronic, or instrumentation items. When used, the designator corresponds with the designator used in the field of the drawing. The width of the column is determined by the information needed in the column. See Figure C7.

C9.13. Part/Dash Number Column

See Paragraph 7 of this Appendix.

C9.14. Vendor Part Number

Vendor part numbers are the manufacturer's part numbers. See definition of "Vendor (Supplier) Item" in Appendix B – Glossary.

The manufacturer's part number is to be used for commercial items. When only a distributor/vendor (e.g., McMaster Carr, Hanford Stores) is known as a source, catalog numbers are noted as reference (in parentheses) in the Description Column or Material/Reference Column.

C9.15. Nomenclature/Description Column

Enter the basic name (a noun name) first. The noun name is a noun or noun phrase best establishing the basic concept of the item. It describes what the item is and what it is used for, not the material or method of fabrication. A compound noun or noun phrase is used only when a single noun is inadequate.

Basic Name Example	
Bracket	(noun)
Piston	(noun)
Gear Box	(noun phrase)
Terminal Board	(noun phrase)

Use modifiers only when there is more than one type of the basic item used in the assembly (e.g., where two brackets are identified in an assembly, identified as bracket, mounting, and bracket, support).

C9.16. Description (Vendor [Supplier] Item)

Specify parts to obtain the most cost-effective item. Where possible, use generic descriptions rather than brand names. The description is to specify characteristics that are sufficient for intended end use, but still broad enough in definition to permit open purchasing.

C9.17. Hardware and Material Items

List the basic names with modifiers for fasteners and materials (e.g., SCH CAP SCR, 1/4-20-UNC-2A, etc). List material items by form and size description (e.g., TUBE STEEL, 4 X 4 X 1/4; PLATE, 1/2 THK).

C9.18. Material/Reference Column

List the controlling specification for the material (e.g., ASTM, ACI) followed by the kind of material (e.g., SST, 6061-T6A, CS). Never use the word "COMMERCIAL" to indicate any acceptable grade. The words "ANY GRADE" may be used where the grade of material is not a design factor. Always identify the specific material grade when welding.

List the name of the supplier for commercial item and other separate documents controlling material, General Notes, etc.

C9.19. Sheet Column

For improved readability, always use this column to note where assemblies, arrangements, or detailed items are depicted on a multi-sheet drawing.

C9.20. Item Number Column

Enter consecutive numbers starting with the numeral 1. An item number should always be used for each vertical space, including spaces left blank for future use.

FIGURE C4
Single/Stacked Item Call-Outs

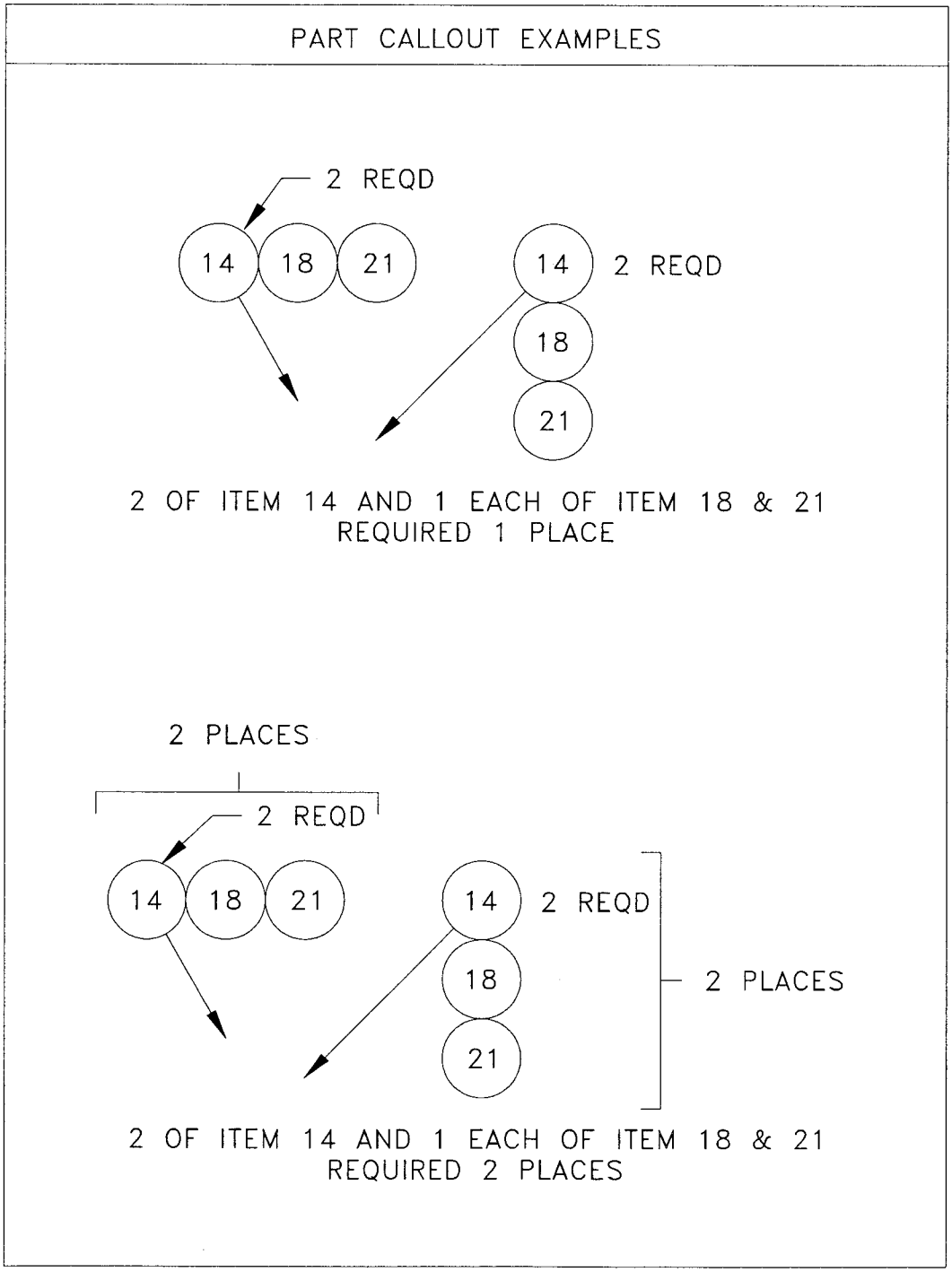


FIGURE C5
Single/Stacked Item Call-Outs

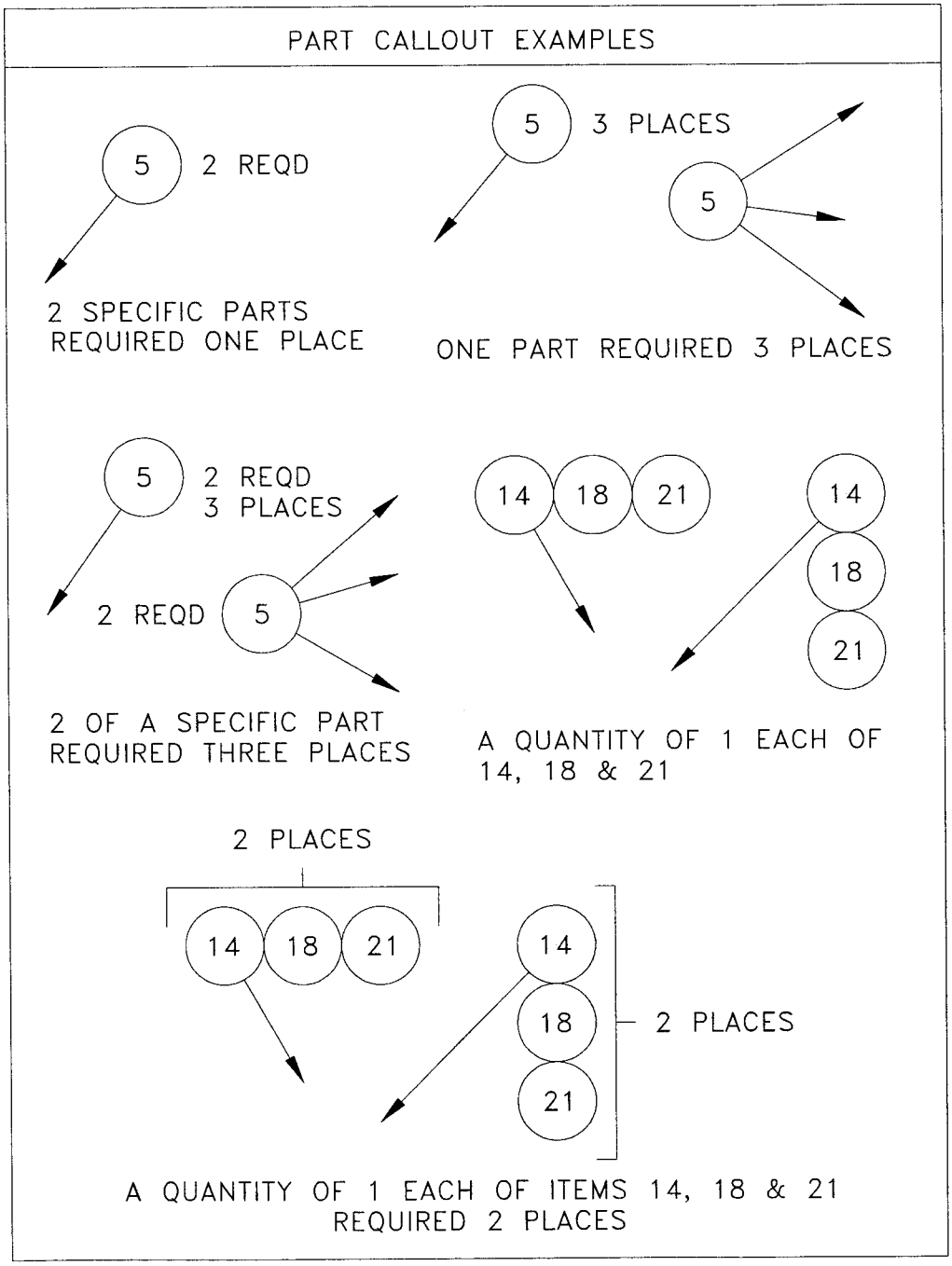


FIGURE C6a
Parts List

PARTS/MATERIAL LIST						
QTY REQD -020	QTY REQD -010	PART/DASH NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHT	ITEM NO
	X	-010	ASSEMBLY, GANTRY		1	1
X		-020	SUBASSY, GRANTRY TRI-ASJUSTABLE		2	2
						3
						4
						5
1	3	-001	STABILIZER ROD	ASTM A36	2	6
	8	-002	HOLD DOWN CLAMP	ASTM A36	2	7
	1	-003	INSTRUMENT RACK	ASTM A36	2	8
	6	-004	MOUNTING BRACKET	ASTM A36	3	9
						10
						11
						12
	3	H-1-48149-020	SCAFFOLD ASSEMBLY			13
						14
						15
						16
	1	FR211-73	DUPLEX PUMP	MILTON ROY CO		17
	2	(SSS60TF8)	VALVE, BALL, 12 mm FNPT, CL 150	ASTM A275 (WHITNEY)		18
						19
						20
						21
						22
	4		SCREW, SCHD CAP, HEX M6X1-4g6gX50 mm L	ASTM A574M		23
AR	AR		TUBING, TS, 101.6 mm X 101.6 mm X 6.35 mm (4"X4"X.25")	ASTM A500, GR B		24
AR	AR		PLATE, 6.35 mm (.25") THK	ASTM A36		25
2	1		CONTINUOUS HINGE, BLANK, W/PIN 1.52 mm (.060") THK X 38.1 mm (1.50") WIDE X 1828.8 mm (72") LONG	TP 304 SST		26

FIGURE C6b
Materials List

QTY	REF DES	PARTS / DASH NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHEET	ITEM NO
AR			11 GA. (.120) SHEET	300 SERIES SST	2	1
AR			ANGLE, 2 X 2 X 1/8	300 SERIES SST	2	2
24			NUT, HEX 3/4-10UNC-2B	300 SERIES SST	2	3
1			FLAT BAR 3/4 X 2 X 14"L	300 SERIES SST	2	4
1			PLATE 1/4 X 3 1/2 X 14'L	300 SERIES SST	2	5
AR			SCREW, HEX HEAD CAP 1/4-20UNC-2A X 1"L	300 SERIES SST	1	6
AR			NUT, HEX 1/4-20UNC-2B	300 SERIES SST	1	7
AR			WASHER, FLAT 1/4	300 SERIES SST	1	8
AR			SCREW, HEX HEAD SHEET METAL #14 X 1 1/2"L	18-8 SST	2	9
AR			ROD, 1/8" DIA	300 SERIES SST	2/3	10
10			THUMBSCREW 1/4-20UNC X 3/4"	MCMASTER-CARR	3	11
1			ANGLE, 1 1/2 X 1 1/2 X 1/8	300 SERIES SST	3	12
12			STUD, 3/4-10UNC-2A X 3 1/2" L	300 SERIES SST	3	13
A/R			1/8" TUBING	300 SERIES SST	1	14
1		SS-200-6-1BT	1/8" TUBE COUPLING	SWAGELOK	1	15
2		SS-200-2BT	1/8" TUBE X 1/8" FNPT	SWAGELOK	1	16
1			ANGLE, 1 X 1 X 1/8 X 1'-11 3/4" L	300 SERIES SST	2	17
1		4596K153	3/4" 150# FLANGE THREADED	MCMASTER-CARR	1	18
A/R			3/4" SCH 80 PIPE (TOE)	PVC	1	19

FIGURE C7
Parts/Materials List Example (Reference Designation)

PARTS/MATERIAL LIST

QTY -020	REQD -010	REF DES	PART/DASH NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHT	ITEM NO
	X			INSTALLATION			1
							2
	1	SW-EV-CS-2	10250T1371	SWITCH, OPR, 3 POSN, SPR RTN FR RIGHT	CUTLER HAMMER		3
	3	SW-P-X37 SW-P-X36-1 SW-P-X36-3	10250T20KB	SWITCH, SELECTOR, 2 POSN MAINTAINED, 1 NO-1 NC CONTACT OIL TIGHT	CUTLER HAMMER		4
	7	DS-11,13,16,18, 19,20,21	10250T37R	INDICATING LIGHT, 120 VAC, XFMR TYPE WITH 6V LAMP & RED LENS, OIL TIGHT, PRESS TO TEST	CUTLER HAMMER		5
	2	DS-12,14	10250T37G	INDICATING LIGHT, 120 VAC XFMR TYPE WITH 6V LAMP & GREEN LENS, OIL TIGHT, PRESS TO TEST	CUTLER HAMMER		6
	1	BQ-C5	G0-405	TOTALIZER, DIGITAL, 110 VAC WITH EXTERNAL RECTIFIER	MOORE INDUSTRIES		7
	1	PS2	111-24-125	POWER SUPPLY, 115 VAC/24 VDC, 125 WATT	RONAN		8
	1	LELL-X37	4130-0X-601	PROBE, LEVEL ASSY WITH CABLE PROBE, WITH ENCLOSURE LENGTH: 145.5"	ENDRESS HAUSER		9

AR

Appendix D
Process Flow Diagram (PFD) Standards

D1. Purpose

This Appendix provides standards used for new PFDs. Standardized PFDs allow personnel to quickly get an overview of the process and understand its operation. The PFD is a simplified schematic description of a process that includes the following data:

- Basic equipment and stream flows necessary to define the process
- Temperatures, pressures, flow rates, and duties that define normal operation
- Material balances that define the quantities of raw materials and products and the physical and thermal condition of every major stream in the process
- Instrumentation sufficient to illustrate the basic process control concept.

D2. Scope

This Appendix details the requirements for Process Flow Diagrams (PFDs) and is in agreement with the national standard *Process Industry Practices (PIP),* except where noted. It is used in conjunction with the drawing standards contained in this document.

Modifications to existing PFDs may not be required to follow these directions; the Design Authority shall be consulted for determination of whether or not to apply this standard to modifications affecting existing PFDs.

This Addendum comprises the minimum direction for developing PFDs. The PFD is developed to provide data to design disciplines in the early stages of engineering design as well as to operations after project turnover.

D3. Application

These directions apply to any project that requires development of a PFD. The PFD accomplishes, as applicable, the following:

- Serves as a starting point for defining the process
- Establishes interrelation between equipment and controls that will accomplish the process goal
- Establishes material and energy balances and process conditions
- Provides information to other disciplines actively involved in the design work
- Provides a basis for equipment list and datasheets, line sizing, modes of control, instrument datasheets, P&IDs, safety evaluations, and material selection
- Provides a check for overall process continuity and integrity
- Serves as a basis for other system sketches, diagrams, and engineering documentation that includes the following:
    - Operating and design conditions
    - Materials selection, Materials Selection Diagram
    - Line sizing
    - Temperature and pressure profiles

- Safety and isolation
- Process Control philosophy
- Control and non-control instrumentation
- Winterization and insulation
- Environmental emissions diagram
- Preliminary safety review

- Provides a means to develop and review operating procedures
- Provides a basis for a proposal

D4. Format and Overall Arrangement

PFDs are created on standard drawing sizes stipulated in Section 6.0, Drawing Sizes and Material

- The data on the drawing must be legible when reduced to 11 inches by 17 inches, also see Section 8.5, legibility
- The PFD is developed in accordance with the drawing standards identified in this document
- Process flow on the drawing is generally from left to right
- PFDs must be arranged to allow for future revisions
- Limit detail to a level appropriate with project status. Excessive detail at an early stage only complicates changes. Details are picked up on P&IDs
- An overall PFD may be made for processes with many PFDs to enhance understanding of the process
- Only major equipment and flows are shown; startup, bypass, and minor lines with unspecified flow rates are ***not*** shown
- PFDs should be presented on only one sheet, if possible. A BFD (Block Flow Diagram) may be appropriate and serve the intended purpose in place of a PFD

D5. Drawing Issuance

PFDs in development, which are issued for review and comment, are annotated with "PRELIMINARY" above the Title Block and given an alphabetic based revision designator starting with the letter "A." Each subsequent version (e.g. versions issued for 30, 60, or 90 percent design reviews) are issued with the next sequential alpha letter designations (i.e. "B", "C", etc.). When the design is 100% complete and ready for final review/approval and initial issue/release the revision designation is given a numeric based revision number starting with 0 (zero). These drawings are now placed under configuration control. Subsequent revisions are provide with the next sequential numeric designation (i.e. "1", "2", "3", etc.).

D6. Equipment Arrangement

Major process equipment is shown and arranged on the PFD using the normal sequence of flow. For visual understanding, relative equipment elevations should be used, particularly where gravity flow is involved.

- Relative equipment sizes should be shown such as when tower diameters change size.
- Major internals of equipment are to be shown only if improved understanding of the process results.
- Do not show detail items such as vortex breakers, flanges, or man ways.
- Show decanting baffles, strategic trays (top, bottom, and feed), and demisters. Number the trays from bottom to top.

- Identify tube side flow through exchangers.
- Control valves and seal legs may be shown to clarify operation and control scheme.
- Pumps, compressors, and blowers can be located where convenient. The preference is to locate pumps slightly below their suction vessels.
- Do not crowd the diagram. Limit the number of equipment items on a drawing so that adequate space remains for future revisions.
- If more than one frame is required for the process, equipment, frames should be grouped into logical sections; for example, reaction and product recovery.
- Show equipment numbers within the outline of the equipment, if possible, or next to the item.
- Equipment numbers and names of equipment are generally shown on the top of the drawing above the equipment except for pumps, compressors, and exchangers. Other information may be added if it is necessary for understanding the process.
- Designations must match the equipment list, equipment datasheets, and P&IDs.
- Operating pressures and temperatures should be shown within equipment outlines.
- Usually, only one of multiple identical train units and spared equipment should be shown. The equipment number will indicate the other trains or spares.
- Typical equipment items which should not be shown on the PFD are as follows:
  - utility systems (for example, refrigeration, cooling water, tempered water, and hot oil)
  - Chemical feed systems, which require a separate PFDs, if sufficiently complicated or if considered necessary
- Packaged units can be shown as boxes if they are not important to understanding the process. If important, the essential details may be shown enclosed by dotted lines or by appropriate labeling.
- Drives are not normally shown on PFDs unless they are part of a control loop. An exception may be made when a drive is part of a standard equipment symbol.
- Equipment design conditions with material of construction are sometimes shown on separate PFDs.

D7. Material Balance

The material balance for normal operating conditions or batch operation is shown as a table in the lower left portion of the drawing. If additional space is needed to show the table, it is placed on a continuation sheet of the PFD. The following table provides an example of a Material Balance Format:

Material Balance Format					
Component	Stream Number	1		8	
		Benzene Feed		Reactor Product	
	MW	Mol/hr	Lb/hr*	Mol/hr	Lb/hr*
Hydrogen	2.0				
Methane	16.0				
Nitrogen	28.0				
Benzene	78.1				
Heavies	200.0				
Total					
Total (lb/hr)*					
Square Cubic Feet Per Minute (SCFM)					
Gallons per Minute (GPM), at operating conditions					
Density at operating conditions, (lb/ft^3)					
Viscosity, Centipoise (cP)					

Pressure, pounds per square inch gage (psig)				
Operating Temperature, degrees F				
* Component mass flow listing is optional. If not listed, show the total mass flow on a separate line.				

If more than one operating case is presented, completely separate PFDs should be used. Where only minor differences exist between two or more cases, they may be shown on the same PFD with the appropriate designations.

The following data are typically provided on a PFD material balance table:

- Component molecular weight
- Component molar flow (moles per hr to nearest 100th)
- Component mass flow (optional, lb per hr to nearest lb)
- Total mass flow, pounds per hour
- Total volumetric flow
- Gases, Standard cubic feet per minute (scfm)
- Liquids, gallons per minute (gpm) at operating conditions
- Stream density (substituting specific gravity for liquids is optional)
- Stream viscosity, cP
- Operating pressure, psig or Pounds per square inch absolute (psia)

The order for components should be from the lowest to the highest molecular weight (from top to bottom of the material balance). If a component is not present on a sheet (even if it is on others), it may be deleted from the material balance if the space is needed.

Stream numbers and descriptions should be consistent with calculations and computer simulations. Stream numbers should increase from left to right on the material balance. Identical numbers and descriptions should be maintained on any stream shown on more than one sheet.

Utility flows are not shown in the material balance table, unless they become part of a process stream. Utility flows are sometimes shown on the utility line.

Batch processes should utilize batch quantities and cycle times in the Material Balance Table (refer to the Operating Temperature, degree F, block in the Material Balance Format table above).

D8. Lines

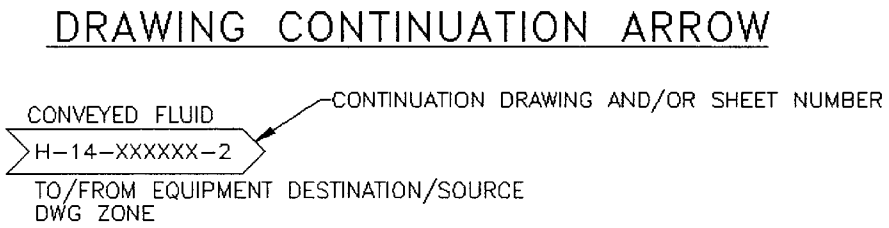
Main process streams are shown in heavy (Thick) lines for ease of following the process.
Minor lines such as intermittent flows, startup lines, shutdown lines, and blowdowns are generally not shown.

- Where lines are designated by stream numbers, pressure and temperature information at that point should also be shown.
- Utility lines are pigtailed to indicate tie-points and type of utility only. They are not carried to the edge of the page. Next to the pigtail, show appropriate utility abbreviation symbol. Steam lines are to be identified with pressure in psig.
- Minimize crossing of lines. Process lines have priority over utility lines and utility lines have priority over instrument lines. Utility lines are broken when they cross process lines, and instrument lines are broken when they cross process or utility lines. Otherwise, vertical lines are

broken when they cross horizontal lines.

- Flow arrows are used liberally to indicate flow direction. As a minimum, arrows are located at the end of a line and when the line changes direction.
- The following lines should not be shown:
  - Startup and shutdown
  - Decommissioning
  - Sewers
  - Vents and drains

Lines showing the transition to and from multiple trains are shown on the PFD. Lines entering and leaving the flow sheet are identified by the commodity, source or destination, equipment name and number, and drawing number as shown below.



- Process tie-ins should extend to and from the edge of the drawing.
- Normal operating temperatures are indicated on inlet and outlet process streams associated with heat exchangers.
- Valves (except control valves) are generally shown as gate valves.

D9. Process Flow Diagrams Symbology and Legends

New PFD drawings generated for use at the Hanford Site shall comply with the symbology specified in the Master Legend Drawings (see Section 8.3.2 New Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID) Master Legend Drawings). These drawings are the master listing of symbols for new PFDs and P&IDs drawings and shall not be used as legends for other drawings. Each symbol on a PFD or P&ID shall be traceable to a legend. PFD and P&ID drawings must have a legend on the drawing or reference to a legend drawing developed using these criteria and/or as specified by the contract. Should a symbol be needed that is not covered by the PDF/P&ID Master Symbology, consult the appropriate national consensus standards for the correct symbology; if no symbology is available, it is permissible to develop the needed symbology by adding it to the PFD/P&ID legend.

D10. Instrumentation

Only the loops and instruments required to understand normal process operation and control should be shown.

- No alarms, safety instrumentation, or indicators are shown unless required to understand normal process operations.
- Instrument control lines are shown as dashed lines regardless of signal type (e.g. pneumatic, electronic).
- Do not show whether a controller is indicating or recording, local or panel, hardware or software,

unless it is important to understanding basic control philosophy.

- Continuous online analyzers are shown according to Instrument Society of America (ISA) standards.
- The type of flow measurement device is not shown.
- The location of instrumentation on trayed columns must be clearly shown as to which tray it is on.

D11. Miscellaneous PFDs

Additional PFDs may be needed.

- PFDs that show feed and product tankage may be required.
- PFDs may be required for special process situations such as startup, catalyst conditioning, regeneration, and cleaning.
- Additional PFDs can be required to describe complex systems associated with the main process.
- PFDs can be modified to show air and water (liquid waste) emissions. These diagrams are usually renamed and become part of the Environmental Permit Package.

Appendix E
Piping and Instrumentation Diagram (P&ID) Standards

E1. Purpose

This Appendix provides the standards used in the creation of new P&IDs. Standardized P&IDs allow personnel to quickly get an overview of the system and understand its operation. The standards in this Appendix are of a general nature and are considered minimum format directions needed to achieve a consistent quality P&ID.

E2. Scope

This Appendix details the requirements for Piping and Instrument Flow Diagrams (P&IDs) and is in agreement with the national standard, *Process Industry Practices (PIP)*, except where noted. It is used in conjunction with the drawing standards contained in this document.

Modifications to existing P&IDs may not be required to follow these directions; the Design Authority shall be consulted for determination of whether or not to apply this standard to modifications affecting existing P&IDs.

This Addendum comprises the minimum direction for developing P&IDs. The P&ID is developed to provide data to design disciplines during engineering design as well as for configuration control by engineering and operations after project turnover.

E3. Flow Diagram Presentation

The principle objectives in the layout of a flow diagram are to:

- Clearly convey design information in an orderly manner consistent with Hanford drawing standards and industry practices
- Minimize rework that may be required by subsequent revisions to the drawing

P&IDs contain the greatest amount of detail of any type of flow diagram. With few exceptions, all equipment, piping, and instrumentation are shown in schematic representation.

E4. General Layout Preparation

When initiating the layout of a P&ID, a brief review of the following considerations will greatly enhance the final appearance and quality of the drawing:

- Review and confirm the extent of equipment, piping, and instrumentation to be included on the drawing and consider the possibility of equipment, piping, or instrumentation that may be added in the future.
- Investigate similar systems on other flow diagrams to ensure consistency among drawings in the same package.
- Identify major process streams.
- Investigate origins and destinations of lines entering and leaving the drawing.

The following practices should be observed:

- The final drawing should have an appearance of uniform density. Components should be arranged in so the P&IDs are clear and uncluttered.
- The process should read from left to right across the page. Feed stock should enter on the left and product should exit on the right. There should be continuity of the process stream flow from sheet to sheet.
- Primary process lines shall be kept as direct and uninterrupted as possible. Primary process line paths should take priority over secondary process lines (e.g. bypasses, jump-overs) and utility lines. Piping arrangement should take priority over instrumentation configuration.
- Drawing sheet size shall be a preferred drawing size as described in Section 6.0, Drawing Sizes and Materials.
- Each project shall establish the required units of measure—English or metric.

E5. Piping & Instrumentation Diagrams (P&ID) Symbology and Legend

New P&ID drawings generated for use at the Hanford Site shall comply with the symbology specified in the Master Legend Drawings (see Section 8.3.2 New Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID) Master Legend Drawings). These drawings are the master listing of symbols for new PFDs and P&IDs drawings and shall not be used as legends for other drawings. Each symbol on a PFD or P&ID shall be traceable to a legend. PFD and P&ID drawings must have a legend on the drawing or reference to a legend drawing developed using these criteria and/or as specified by the contract. Should a symbol be needed that is not covered by the PDF/P&ID Master Symbology, consult the appropriate national consensus standards for the correct symbology; if no symbology is available, it is permissible to develop the needed symbology by adding it to the PFD/P&ID legend.

E6. P&ID Layout

P&IDs are typically an evolutionary document, and proper layout can be a challenge. In addition to the level of detail required on these drawings, P&ID layout demands the designer to plan for additional design information that may need to be added later in the development process.

The following process will serve as a basic guide for P&ID layout:

- Ensure the entire system is reviewed and resolve any questions prior to initiating the drafting process. Prepare a preliminary sketch of the system if needed.
- Allocate space in the drawing area for equipment titles, notes, details, and other text type information
- Establish preliminary locations for equipment and preliminary routes for major process streams
- Locate line continuations for adjacent drawings
- Use the preliminary framework as a skeleton upon which detailed information can be added
- Develop the entire drawing simultaneously. Do not completely detail one area before starting another. This will prevent unnecessary rework required by subsequent information that requires more space than expected.

After building a preliminary framework, work through the drawing adding detailed information for equipment, instrumentation, and piping as discussed in the following sections.

E7. EQUIPMENT

Add equipment and associated data to the P&ID. When adding equipment, perform the following criteria:

- Ensure equipment titles on P&IDs are identical to those on the equipment list.
- Ensure design information (e.g. dimensions, design pressure, and temperature, insulation requirements) are consistent with the Equipment Datasheet.
- Ensure materials are consistent with the Material Selection Diagram, if applicable, and with the Equipment Datasheet.
- Show Equipment numbers (underlined) adjacent to the equipment outline.
- Show critical dimensions or elevations between equipment required for process (e.g. elevation of vessels required for gravity flow).

The following sections provide additional information for various equipment types.

E7.1. Vessels/Columns

Vessels and columns depictions shall include the following information:

- Specific component information at the top of the drawing above the vessel\column:
  - Vessel \ Column number
  - Title
  - Size (inside diameter (ID) x length tangent to tangent)
  - Design pressure and temperature
  - Number and type of trays
  - Tray spacing
  - Number of packed beds, bed height, type and size of packing
  - Materials of Construction (MOC) for shell/tray/packing
- Lines, instrumentation, and sample connections
- Packing, demisters, vortex breakers, and chimney trays
- Tower internals including:
  - Catalyst beds
  - Packing (Identify height and size of packing, if required)
  - Demisters
  - Chimney trays
  - Draw-off trays
  - Other internals
- Vessel/column relative size
- Vessels in elevation view only
- Vessel internals in dashed lines to depict dip legs, coils, baffles, tube bundles, vortex breakers, demisters, catalyst beds and supports and internal piping supplied by the equipment vendor.
- Vessel nozzle sizes and designations inside the vessel, or outside the vessel and beside the nozzle, if needed
- Nozzle connection type (flange, or special fitting)
- Valves located directly on the vessel nozzle are depicted with no pipe between nozzle and valve
- Access ways and hand holes
- Tangential nozzles in proper orientation

- Tower internals including catalyst beds, packing, demisters, chimney trays, draw-off trays, and any other internals with height and size (if required) of packing identified.
- Height of bottom tangent line of vertical vessels above grade; height of bottom above grade for horizontal drums. Verify the height is consistent with the pump requirement; unmarked elevations indicate "Minimum".
- Agitator, type, speed (rpm), motor horsepower (HP), and material of construction. Show agitators as a solid line and include the agitator equipment number.

E7.2. Air Coolers

Air Cooler depictions shall include the following information:

- Specific component information at the top of the flow diagram above the air cooler outline:
  - Equipment Number (underlined)
  - Equipment Title (underlined)
  - Design Duty (e.g. 1000 BTU/Hr, extended surface ft^2)
  - Design Pressure and Temperature/Minimum Temperature
  - Material
  - Insulation: (symbol for type or "None")
- Type of fan pitch control (auto variable / manual).
- Winterizing details such as louvers, steam heating coils, etc.
- If symmetrical inlet and outlet piping is required for multiple bay air-cooled exchangers, show the actual piping scheme with a note highlighting this requirement.

Air coolers can be shown with only one bay represented. If a single bay is shown, add a note detailing the actual number of bays required and all instrument tag numbers tabulated in table format.

E7.3. Shell and Tube Exchanger

Shell and Tube Exchanger depictions shall show the correct Tubular Exchanger Manufacturers Association (TEMA) type of exchanger, number of shells or sections, flow arrangement, etc. For TEMA symbology for types of exchangers, see the Master PFD and P&ID Legend Drawing H-9-006010, Sheet 3.

Include the following information in Shell and Tube Exchanger depictions:

- Specific component information at the top of the flow diagram above the exchanger outline:
  - Equipment Number (underlined)
  - Equipment Title (underlined)
  - Design Duty (e.g. MM BTU/Hr)
  - Shell Design Pressure and Temperature
  - Tube Design Pressure and Temperature
  - Materials of Construction (Shell/Tube)
  - Insulation (symbol for type or "None")
- Height of the exchanger above grade (if elevated per process requirements); other reference points are permissible if appropriate.
- Pressure level of steam and condensate system for steam-heated reboilers
- Elevation view of shell and tube exchangers in a stacked configuration; flow scheme through the

shell side of the exchangers and all necessary trim valves, vents, and drains
- Elevation view of single shell and tube exchanger
- End view of double pipe exchangers to allow flexibility of showing the correct piping hook-up of multiple units.

E7.4 Pumps

Show correct type of pump and driver. For symbology covering the types of pumps and drives, see the Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID) Master Legend Drawings. Pump depictions shall include the following information:

- Specific component information at the top of the flow diagram above each operating pump:
  - Equipment Number (underlined)
  - Equipment Title (underlined)
  - Design Capacity (rated flow at Design Differential Pressure)
  - Power Requirements (BHP / Motor HP)
  - Material
  - Case
  - Impeller
  - Insulation (symbol for type or "None")
  - Cooling Water, Flushing Oil, Seal Oil, etc. required
- Equipment number (underlined) under each pump symbol with the spares noted
- Size of pump suction and discharge flanges; swages to suction or discharge piping
- External relief protection (for positive displacement pumps)
- Heating fluid details and piping (for jacketed pumps)

E7.5 Compressors, Blowers and Fans

Use the appropriate equipment symbol for each type of compressor per the Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID) Master Legend Drawings. If multistage reciprocating equipment is used, show each stage separately with only one driver. Compressor, Blower, and Fan depictions shall include the following information:

- Specific component information at the top of the flow diagram above each compressor outline:
  - Equipment Number (underlined)
  - Equipment Title (underlined)
  - Number of Stages
  - Design Capacity
  - Differential Pressure
  - Power Requirements (BHP / Driver HP)
  - Materials
- Equipment number (underlined) and stage number under each compressor symbol
- Compressors in process units in proper respect to other process equipment; auxiliary systems (e.g. lube oil, seal oil systems) on a separate auxiliary P&ID
- Blowers, fans, and reciprocating compressor information such as suction / discharge pulsation dampeners, intercoolers

E7.6 Tanks

Show correct type of tank. For symbology covering the types of tanks, see the Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID) Master Legend Drawings.
Tank depictions shall include the following information:

- Specific component information at the top of the flow diagram above the tank outline:
  - Equipment Number (underlined)
  - Equipment Title (underlined)
  - Inside Diameter and Height
  - Net Capacity
  - Design Pressure
  - Design Temperature
  - Material
  - Insulation (symbol for type or "None")

E7.7 Miscellaneous Equipment

Show correct type of equipment. For symbology covering types of equipment, see the Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID) Master Legend Drawings. Packaged equipment shall be enclosed by a dashed line with the words "Provided by Supplier" and the assigned Vendor Information included.

Equipment depictions shall include the following information:

- Specific component information at the top of the flow diagram above the equipment outline:
  - Equipment Number (underlined)
  - Equipment Title (underlined)
  - Design Conditions
- Additional pertinent information depending on the type of equipment; examples include:
  - Design Capacity)
  - Design rating
  - Differential Pressure (DP)
  - Dimensions (envelope or overall)
  - Power (rating)
  - Micron Size

E8. INSTRUMENTATION

The P&ID depicts the basic system control scheme and/or process conditions measured by instrumentation. The P&ID details the principal piping, valve sequencing, locations necessary to accomplish the required control and/or measurements, and instrumentation details.

All instrument and control design and symbology shall be consistent with the appropriate standards of the Instrument Society of America (ISA) and Institute of Electrical and Electronic Engineers (IEEE). Symbology shall comply with the Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID) Master Legend Drawings for new P&IDs. Where differences occur between the national standards and the Master Legend Drawings, the symbology contained on the Master Legend Drawings shall be used.

Add the following as appropriate when depicting instrumentation:

- Provide unique identification to all instruments shown on the P&ID
- Show the proper location for all sampling points, particularly to analyzing instruments
- Show all flushing and purge connections for instruments. Detail this design on the right-hand side of the flow diagram
- Show all alarms, solenoid valves, timers
- Show all detail logic (e.g. pump shutdown on low liquid level)
- For complex logic, show a logic table for the location of the equipment, or show it on a separate P&ID, or logic diagram
- Complex control systems shall be provided with "first-out" indication so operators can determine what first caused the problem
- Show Distributed Control System (DCS) points that manipulate the process, receive information from the process, or are essential to understanding the functional operation of the controls.

E8.1 Control Valves

Show size and action (fail close, open, or last position) of control valves. Show the control valve stations block and by-pass valves. Show by-pass valve size.

E8.2 Relief Valves

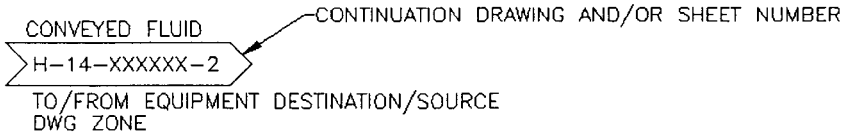
For Pressure Safety Valve (PSVs), show size of valve with orifice designation, valve number, and set pressure. Tag block valves on the P&ID that are locked or sealed open. Identify the tagged valves on the P&ID as full port valves. Show drain valves or a plugged drains between the block and PSV.

E9. PIPING

P&ID piping symbology shall be in accordance with the Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (P&ID) Master Legend Drawings.

Lines entering and leaving the flow sheet are identified by the commodity, source or destination, equipment name and number, and drawing number as shown below.

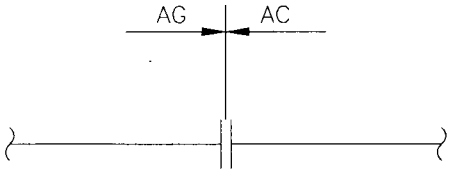
DRAWING CONTINUATION ARROW



For lines routed outside of the process unit's boundary, use a general name and associated equipment number for a source or destination. Use the Equipment Number for the source or destination if the line is routed within the same process unit or system.

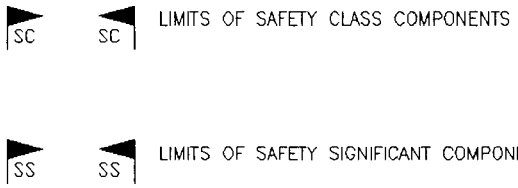
Clearly indicate where a line specification change occurs. This will require a new line number. The

example below shows a specification change at a flange where the line specifications change.



Identify underground lines with a specification break between AG (aboveground) and UG (underground) piping.

Identify where the Limits of Safety Class (SC) Components and Limits of Safety Significant (SS) Components occur as shown below. This will also require a new line number.



E9.1 Utility and Auxiliary Lines on the P&ID

Each process line and utility line shall be identified by a line number. Line numbers will appear on top of the horizontal line or to the left of the vertical line.

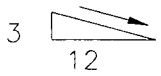
Utility lines originate and terminate adjacent to the equipment involved. Only the length of line necessary for valving, instrumentation, and line numbering is shown. Utility line origin and terminus is indicated by descriptive title only. Main utility headers are not shown on the unit P&ID; they are shown on the utility P&ID for that process area. Compressor utility piping is shown only when minor in scope; otherwise, it is shown on a compressor auxiliary P&ID.

The following utility line items should be depicted on the P&ID:

- Show control and bypass valve sizes. Line size valves need not have their size indicated at the valve
- Show line size reductions for continuous drawn lines. Reducer symbols are not required for stub-ins
- Show corrosion allowance, which is beyond the normal allowance (as indicated in the individual line class).
- Identify Piping components not identified by Instrument or Mechanical Equipment Numbers or not included in the Piping Material Specification by assigning an Item Code Number with the identification symbol (refer to the Legend Sheets).
- Indentify packaged equipment or modules by a dashed line or cloud surrounding the package. Use arrows or spec break designations to indicate the juncture between Contractor and Supplier

provided piping.

- Do not show flange breaks except when needed for clarification
- Show tracing or jacketing on equipment, instruments, or piping
- Place notes beneath a horizontal process line; to the right of a vertical process line
- Show high point vents and drains only when they connect to a closed system or are required for process or safety reasons.
- Show all startup and shutdown lines
- Identify sloped lines with the slope symbol, as shown below:



SLOPED PIPE

E9.2 Pump Piping

Symbology shall conform with the Master Legend Drawings. Pump piping shall depict the following:

- Show temporary and permanent screens or strainers as required.
- Show block valves, check valves, and pressure gauge connections in the discharge line as required.