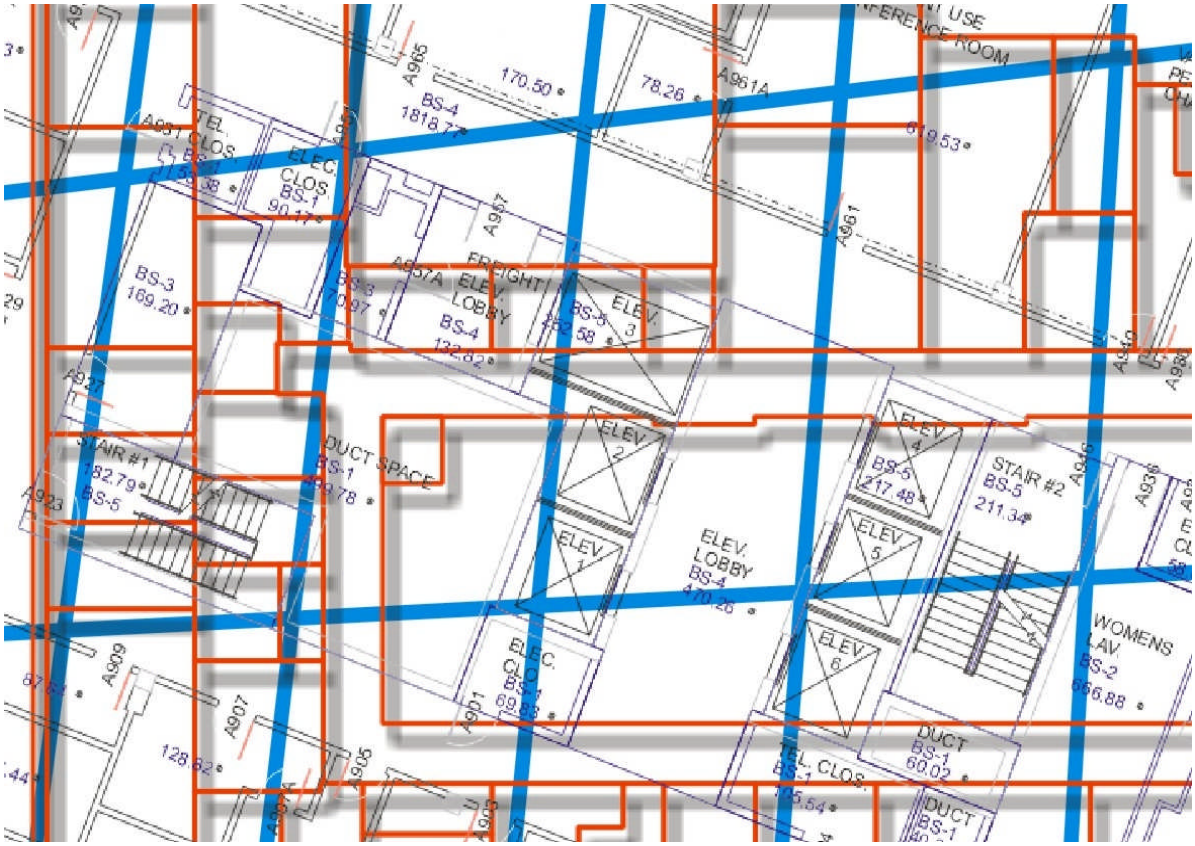
Public Buildings Service

PBS CAD STANDARDS

March 25, 2004



Washington, DC 20405
www.gsa.gov/cifm

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INTRODUCTION

Goal: To represent information to users of two-dimensional (2D) electronic drawings, consistent data and representation ('standards') are needed.

The purpose of the *PBS CAD Standards* is to ensure:

- Consistent 2D drawings
- An accurate source of spatial data for rent billing
- Uniform requirements for contractor design deliverables

Moreover, the CAD standards aid the business of PBS by providing:

- Accurate space assignment and rent billing data
- Drawings suitable for client agency use (such as, space planning and furniture layout)
- Maintenance and operation data
- Record drawings for management and future renovations of PBS buildings

Therefore, the *PBS CAD Standards* set mandatory procedures for the creation and delivery of all 2D design, construction, and engineering drawings, including assignment drawings. The CAD standards are for all PBS contractors and associates. Differing regional requirements are accommodated by the addition of regional supplements.

In principle, the *PBS CAD Standards* conform to the National Institute of Building Sciences (NIBS) *U.S. National CAD Standard* Version 2.0 (NCS 2.0). The NCS consists of:

- *CAD Layer Guidelines*, published by the American Institute of Architects (AIA)
- *Uniform Drawing Systems (UDS) Modules 1-8*, published by the Construction Specifications Institute (CSI)
- *Tri-Service Plotting Guidelines*, published by the Tri-Service and the U.S. Coast Guard

PBS encourages contractors and associates to refer to NCS 2.0 as an additional resource. For example, the use of NCS UDS Modules 1-8 (Drawing Set Organization, Sheet Organization, Schedules, Drafting Conventions, Terms and Abbreviations, Symbols, Notations, and Code Conventions) can help to standardize drawing production and identify errors.

Another recommended reference is the CADD/GIS Technology Center for Facilities, Infrastructure, and Environment (CTCFIE) *A/E/C CADD Standard*, published by the U.S. Army Engineer Research and Development Center. Release 2.0 has been recognized by NIBS to be compliant with NCS 2.0. The *A/E/C CADD Standard* is a good source for graphic concepts and standard symbols.

Links to AIA, CSI, CTCFIE, and NIBS may be found at www.gsa.gov/cifm.

Last, PBS is aware of the impact building information modeling (BIM) software will have on electronic building design and representation. The PBS Commissioner has set a goal of fiscal year 2006 and beyond for the use of BIM. Guidance and standards are under development.

1.0 APPLICABILITY

The *PBS CAD Standards* apply to all design, engineering, and construction related to PBS capital facilities projects. Major (prospectus level) PBS projects receiving design authorization and funding in fiscal year 2006 and beyond are excepted as a class, provided that they conform to all forthcoming guidance on use of Building Information Modeling. See also 3.4 Building Information Modeling (BIM).

2.0 PBS CAD STANDARDS

2.1 The *PBS CAD Standards* set mandatory procedures for the creation and delivery of all 2D drawings, including assignment drawings. Assignment drawings are a specific type of facility management drawing conveying occupancy information. When PBS requests submission of assignment drawings, contractors must follow the direction given by the *PBS Assignment Drawing Guidance,* in addition to the *PBS CAD Standards*.

2.2 The contractor shall submit a written request for approval of any deviations from the *PBS CAD Standards*. No deviation shall be permitted unless prior written approval of such deviation has been received from the Regional CIFM Manager. The contractor shall list approved deviations in the Deliverables Readme Microsoft Excel workbook required with every submission. See 5.3 Project and Drawing Documentation.

2.3 PBS provides templates (layer seed files), titleblocks, and other files to help contractors and associates prepare drawings that comply with the *PBS CAD Standards*. See www.gsa.gov/cifm.

3.0 SOFTWARE REQUIREMENTS

3.1 Drawing Formats.

3.1.1 All CAD drawings shall be supplied in DWG format and be readable by the PBS-supported CAD desktop software (Autodesk AutoCAD). Being 'readable' means the ability to open a file without any errors (such as proxy, font substitution, xref resolution, etc.) and with objects, layers, and other file properties remaining intact. See also 3.3 Third Party Software.

3.1.2 All digital files (such as model files, sheet files, reference files, and other data files) shall be compatible with the software vendors' currently supported versions. The contractor shall consult with the Regional CIFM Manager to confirm software versions prior to all submissions.

3.1.3 The contractor shall be responsible to supply drawing files and other data files in the format as set forth in the solicitation and the contract. Final submission may require the contractor to update all files to the most current version of the PBS desktop software suite. Various software and data upgrades are at the discretion of the Regional CIFM Manager. Use of only AutoCAD 2000 or later format will be permitted. The contractor shall consult with the Regional CIFM Manager regarding current PBS-accepted versions prior to all submissions.

3.2 Other Formats.

3.2.1 File formats for word processor documents, spreadsheet documents, or slide presentations shall be those used by the Microsoft family of office software such as Word, Excel, and PowerPoint. Contact the Regional CIFM Manager for version. Macros may be included with these documents provided they are virus free, their function is explained next to the code, and they are not write-protected.

3.2.2 Graphics shall be submitted in TIF, GIF, JPG, CALS, or PDF file format (compressed image formats only). This option is intended for photos, conceptual sketches, etc., and not to indicate that raster file drawings will be accepted in place of AutoCAD DWG files.

3.2.3 Data file formats for projects that employ information contained in a database or spreadsheet shall be those used by one of the following: Oracle, Microsoft Access, Microsoft SQL, or Microsoft Excel. All linkages of non-graphical data with graphic elements, relationships between database tables, and report formats shall be maintained. All database tables shall conform to the structure and field naming guidance provided by PBS. The contractor shall confirm database file format preference with the Regional CIFM Manager prior to issuance of database file.

3.2.4 File formats for project management documents shall be either that used by Microsoft Project or P3 Primavera (used for some prospectus level projects). Confirm file format with Regional CIFM Manager. Save project files with baseline.

3.2.5 Deliverables integrating multiple file formats may be submitted as a PDF (version 4 or later) in addition to the base file structure. Examples include reports, photographs, and manuals created by using a variety of software packages and file formats.

3.3 Third Party Software.

3.3.1 A written request must be submitted to PBS and approved in order to submit electronic data in a format other than those given above. When it is considered in the best interest of the Government, PBS may permit third party software. Obtain approval from the Regional CIFM Manager. Note: this includes applications such as Autodesk Architectural Desktop, Building Systems, or similar, which leave non-native objects in DWG files.

3.3.2 When third party software has been approved, submit with each DWG file the following if applicable: styles, blocks, and attribute information. Intelligent blocks and objects shall retain all of their data and intelligence within the file when submitted. All information shall be maintained in model space. Software must support layer name formats in NCS 2.0, Volume 1, AIA CAD Layer Guidelines, or *AIA CAD Layer Guidelines NCS Version 2*.

3.3.3 Drawings that are rendered for presentation purposes, such as walkthroughs, shall be AVI files. Include supporting surface materials files with submissions.

3.4 Building Information Modeling (BIM). The PBS Commissioner has set a goal to have Industry Foundation Classes (IFC) based BIM in support of all national office concept reviews on projects receiving design funding in fiscal year 2006 and beyond. The Office of the Chief Architect has been charged to develop and issue implementing guidance, including regional pilot project opportunities.

3.4.1 Projects and project teams are encouraged to utilize 3D object model and other building information model technology and software applications (including during project stages of planning, design, construction, and handover to space management and facility operations and maintenance). Outputs from these applications are acceptable as deliverables to GSA, provided that 2D output is also submitted that fully complies with all provisions herein.

4.0 DISSEMINATION OF SENSITIVE BUT UNCLASSIFIED BUILDING INFORMATION (SBU)

4.1 PBS policy on the dissemination of sensitive but unclassified (SBU) paper and electronic building information about GSA controlled space, including owned, leased, or delegated Federal facilities is set forth in PBS Order 3490.1, March 8, 2002. A major goal of GSA and the Federal Government is the safety and security of people and facilities under the care and control of GSA.

4.2 The contractor and those who are disseminating or handling SBU building documents shall take ***reasonable care*** to protect this information from being used for dangerous or illegal purposes. This includes electronic and paper format copies of SBU documents such as construction drawings and specifications for buildings, security equipment and installation, and contract guard information [PBS 3490.1, 9].

4.2.1 Labeling of information. All SBU building information, including all building drawings and specifications either in electronic or paper formats, shall have imprinted on ***each*** sheet or page of the information [PBS 3490.1, 7d(1)]:

PROPERTY OF UNITED STATES GOVERNMENT
FOR OFFICIAL USE ONLY
Do not remove this notice
Properly destroy documents when no longer needed

4.2.2 The following paragraph will be included on the ***cover*** page of the information (such as the cover page on the set of construction drawings and on the cover page of the specifications) and on the label of all magnetic media [PBS Order 3490.1, 7d(2)]:

PROPERTY OF THE UNITED STATES GOVERNMENT
COPYING, DISSEMINATION, OR DISTRIBUTION OF THESE DRAWINGS, PLANS, OR SPECIFICATIONS TO UNAUTHORIZED PERSONS IS PROHIBITED
Do not remove this notice
Properly destroy documents when no longer needed

4.2.3 The previous two statements shall be ***prominently*** labeled in bold type in a size appropriate for the document. On a set of construction drawings, for example, the statements shall be in a minimum of 14 point bold type (3 mm or about 1/8") [PBS Order 3490.1, 7d(3)].

5.0 ELECTRONIC DELIVERABLES

5.1 Electronic files and documentation are due with the final submission (and any required interim submission) for each project. (A sample set might be requested up front.) This includes studies, data, or graphics, which may or may not include drawings. Final submissions that do not include all files and documentation are *incomplete*. PBS reserves the right to reject, require corrective action, and withhold final payment until the files and documentation are complete. PBS places particular emphasis on the receipt of final record drawings. These drawings are used in the management of PBS buildings, which have a significant amount of change evolution in tenant space and renovation over their life span.

5.1.1 All deliverables must have any addenda, changes, and modifications included in the conformed, as-built, or record document so that there is no need to cross reference with separate addenda or modification documents.

5.1.2 The contractor shall retain a copy of all electronic deliverables for at least one year. During this time if requested, the contractor shall provide up to two additional copies of each at no additional cost to PBS.

5.2 A copy of all electronic files and documentation shall be delivered to the appropriate PBS regional office on CD-R, DVD-R, or DVD+R. Media used shall be in a format that can be read and processed by PBS current hardware and software. File compression is prohibited. Permission to submit on other media must be obtained from the Regional CIFM Manager.

5.2.1 Scan all files for viruses before placing on media.

5.2.2 Media jewel cases shall be labeled with the information below. Include SBU imprint. Label the media itself to contain as a minimum: date, GSA project name/number, and building name/number.

Label Checklist	
1	Date
2	GSA project name, project number
3	Building name, number, and address
4	Short description of media content
5	Contractor name, contact name, telephone number
6	PBS Contact name, telephone number
7	CAD and operating system software name, version
8	Virus-scanned, date, software used
9	Sequence number of digital media
10	SBU imprint [PBS 3490.1, 7d(2)], see 4.2.2 above

5.3 Project and Drawing Documentation. With every submission, the contractor shall include a completed Deliverables Readme Microsoft Excel workbook. See www.gsa.gov/cifm.

Deliverables Readme Contents	
1	Project Documentation and Drawing Information. Identifies project and software versions.
2	Deviations List. Approved deviations from the *PBS CAD Standards*. Lists user-defined Model File Types or Sheet File Level 2 Designators, user-defined layer names, user-defined linetypes, and nonstandard fonts. Note: Regional CIFM Manager must approve all deviations in writing prior to submission.
3	Bulk Import Templates. Spreadsheets for importing project drawings, assignment drawings, and/or other files into the PBS electronic document management system (EDMS). Complete as needed for type of deliverables submitted.

5.4 Quality Control. The contractor is responsible to quality control check their submissions. PBS will visually and electronically check these submissions to verify compliance. PBS will reject and require correction of any required deliverables or formats that do not meet requirements. For final deliverables, verify that all entities outside the drawing limits are deleted. Remove all extraneous graphics outside border area. PURGE all blocks, layers, attributes, etc. not referenced in the drawing. Verify that all xrefs are attached without drive or directory specifications. (Users of AutoCAD 2000 or later must check that all unused layout tabs are deleted.)

PBS CAD Standards Electronic Checks	
Name of check	**What requirement is checked (section/paragraph number)**
Unresolved xrefs	Include all xrefs with submission (3.1.1)
Unresolved image xrefs	Include all referenced images with submission (3.1.1)
Missing shape files	Include all referenced shapes with submission (3.1.1)
Internal drawing errors (corruption)	No internal errors (3.1.1)
AutoCAD version	Only 2000 and later permitted, and only up to the currently supported release specified in the regional supplement (3.1.3)
Filename validation	Name files as specified (9.0)
Layer names	Use AIA layers (8.3.9)
Objects on layer 0	Use AIA layers, not layer 0 (8.3.9)
Xref paths	Don't include paths in xrefs (8.3.21)
Xrefed sheet files (incorrect assembly)	Assemble files as prescribed directed (8.2.2)
Fonts	Use only approved fonts (8.3.18)
Big Fonts (not just regular fonts)	Use only approved fonts (8.3.18)
Paper size check	Drawings shall plot from paper space with plot scale of 1:1 (8.2.2 and 10.0)
Lineweights assigned to layers	Assign lineweights to layers (8.3.12)
Object color set to BYLAYER	Entity properties shall be BYLAYER (8.3.6)
Object linetype set to BYLAYER	Entity properties shall be BYLAYER (8.3.6)
Object lineweight set to BYLAYER	Entity properties shall be BYLAYER (8.3.6)
Drawing variables	Set as prescribed (8.3.20)
Block definition subentities on layer 0	Draw objects used to create blocks on layer 0 (8.3.2)
Nested blocks	Avoid nested blocks (8.3.2)
List PURGE-able objects	PURGE all entities not referenced in the drawing (5.4)
Unused layouts	Don't leave unused layouts (5.4)
ZOOM-ed to extents	ZOOM to extents (8.3.20)
Security imprint	Include security imprint (4.2.1)

6.0 PAPER FORMAT DELIVERABLES

6.1 All deliverables must be submitted and received in a timely manner. A transmittal letter shall accompany each electronic deliverables submission. The letter shall be signed by the appropriate contractor's representative and state the total number of CDs or DVDs submitted.

6.2 The contractor shall provide two paper format copies of drawings with each submission, unless PBS specifies otherwise.

6.3 If required, the contractor shall affix the professional seal to paper format drawings. Electronic copies of sealed drawings shall contain a statement that the paper format drawings bear the seal. This statement should be placed near where the seal would appear on the paper format drawing.

7.0 OWNERSHIP

The Government, for itself and such others as it deems appropriate, will have unlimited rights to all information and materials developed under this contract and furnished to the Government. This includes any documentation thereof, reports and listings, and all other items pertaining to the work and services pursuant to this agreement including any copyright. Unlimited rights under this contract are rights to use, duplicate, or disclose data and information, in whole or in part, in any manner and for any purpose whatsoever without compensations to or approval from the Contractor. The Government will, at all reasonable times, have the right to inspect the work and will have access to and the right to make copies of the above-mentioned items. All digital files, associated data, and other products generated under the contract shall become the property of the Government.

8.0 DRAWING SETUP

8.1 Accuracy.

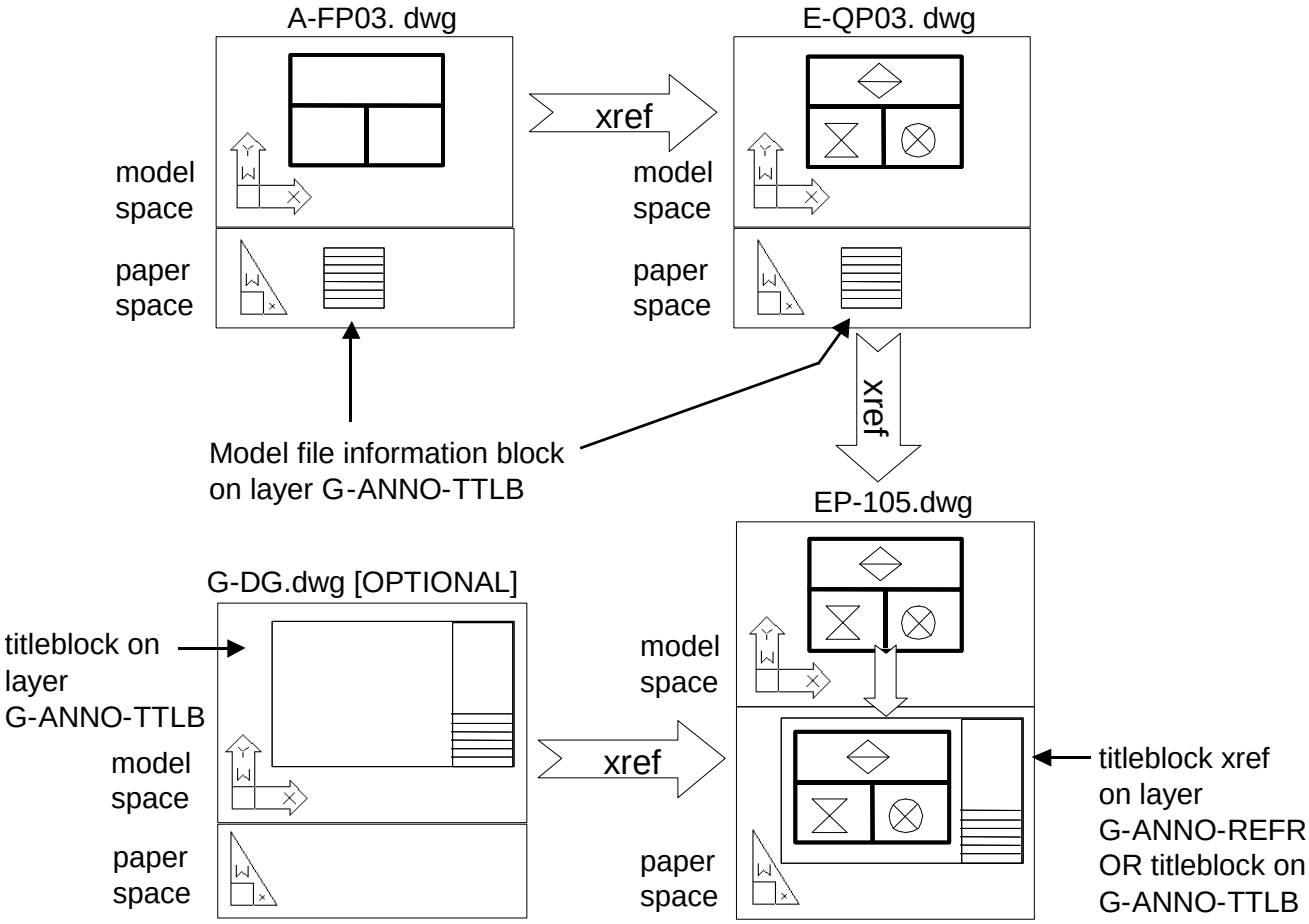
8.1.1 Contractors are responsible for the accuracy of all CAD drawings delivered to PBS. For all drawing entities, all lines meet at intersections, straight lines are straight, blocks are inserted properly and only once per each insert point, and all entities coexist without overlap (for example, without duplicate lines on different layers). PBS may provide contractors with existing CAD drawings for convenience. However, these drawings shall be used as a base reference only. Unless otherwise specified by the contracting documents, the contractor is responsible for field verification of existing conditions, and ensuring that all electronic documents comply with the *PBS CAD Standards*.

8.1.2 The minimum standard for building measurement accuracy is 3 mm or 1/8". When using electronic equipment, the error tolerance is very small, therefore, the tolerance should be the smallest allowed by the equipment use.

8.2 Drawing Organization and Assembly.

8.2.1 Model and sheet files are two types of files used in electronic construction documentation. Model files contain a drawing (or model) of the building or site, which is drawn full scale (1:1). Sheet files organize information for plotting. They consist of views of the model file(s), titleblock, border, and other information to appear on the printed sheet. In Autodesk AutoCAD, there are two types of workspaces: model space and paper space. See also 9.0 FILE AND LAYER NAMING.

8.2.2 Assemble drawings as shown below. The base model file is xrefed into the discipline specific model file at full size in model space. The reference must be placed in the World Coordinate System at 0,0,0 with 0 degrees rotation. The discipline specific model is xrefed into the sheet file at full size in model space. Viewports are drawn in paper space. The drawing content is scaled through the viewports and plotted at 1:1. The titleblock may reside in an xref or in the sheet file. The titleblock shall reside on Layer G-ANNO-TTLB, the titleblock text, on Layer G-ANNO-TTLB-TEXT. For titleblocks, see www.gsa.gov/cifm.



8.3 Other Drawing Requirements.

8.3.1 Attributes. Attributes may be used to store data in the drawing. Do not use attributes to store large amounts of data (greater than 10% of drawing size) or types of data that are better stored in external databases. (Facility data drawings are the only exception on a case-by-case basis).

8.3.2 Blocks. Any graphic entity that occurs repeatedly in drawings should be made into a block. Do not block the entire drawing or large portions of the drawing. Attributes contained within a block should pertain to the current project. Use logical insertion points such as the center of a circle or the lower-left corner of a square. Keep names simple and descriptive. Purge all unused blocks from the drawing. Nested blocks are permitted but should be avoided whenever possible. Draw objects used to create blocks on layer 0, so that the block inherits the properties of the layer on which it is inserted. Do not insert blocks on layer 0 (zero).

8.3.3 Dimensioning. All dimensions shall update automatically when the distance they are measuring changes (associative dimensioning). Metric dimensions shall conform to PBS PQ260 *GSA Metric Design Guide*. Dimensions should be scaled using the system variable DIMSCALE.

8.3.4 Drawing Limits. Do not set the limits any larger than necessary to accommodate the drawing. No entities shall be located outside the drawing limits.

8.3.5 Drawing Origin. Organize drawings in model space so that the lower left intersection of the outermost column lines that remain constant on most floors is placed at 0,0,0. In order to ensure proper insertion of xrefs and the stacking of floor plans, the origin point for an entire building must be consistent between model files. Once the origin is established, it cannot be changed. For sheet files, place the lower-left corner of the sheet at 0,0,0.

8.3.6 Entity Properties. Entity properties (color, linetype, and lineweight) shall be BYLAYER.

8.3.7 Graphic Standards. Drafting standards and symbols shall be in accordance with the *AIA Architectural Graphic Standards.* Suggestion: consult NCS 2.0 UDS Modules 1-8 for drafting conventions and symbols.

8.3.8 Hatching. Do not use polylines with increased width for poché or hatching. All hatching shall be associative. Hatching shall not deviate from AutoCAD defaults.

8.3.9 Layers. All drawing files shall be produced using AIA layer names and layer name formats. See 9.0 FILE AND LAYER NAMES. When submitting drawings, no objects will be on layer 0 (zero) unless otherwise specified. Script files that turn on and off layers in order to produce different drawings within the same file are prohibited.

8.3.10 Layer Colors. Choice of layer colors is at the discretion of the contractor. Note: do not use yellow or bright colors (especially in hatches) for color plots on white paper. Such colors compete with the information conveyed by the drawing. Use of darker colors and half tones is recommended.

8.3.11 Linetypes. Contour lines, dashed lines, and other fonted lines shall be made of one continuous line segment and not of a series of separate line segments. If linetypes other than standard AutoCAD linetypes are used the LIN file must be provided with the submission. Use of toned or pochéd lines are acceptable for distinguishing between various types of work, such as new from existing, one phase from another, or background floor plans. Curved entities such as circles, arcs, and ellipses shall be created of one continuous line segment, except for entities that have to be physically constructed in a segmented fashion. These may be segmented to represent the joints in the actual construction.

8.3.12 Lineweights. Assign lineweights to layers. In the layer properties dialog box, select the lineweight of a layer. Once the layer lineweight is set, it applies to all entities on that layer.

8.3.13 Scale. Create drawing entities at full size. For example, a 100-foot wall will be drawn to 100 feet and a 36-inch column will be drawn to 36 inches. Drawings considered schematic in nature can be drawn to any scale. Some examples of schematic drawings are schedules, riser diagrams, schematic diagrams, and single line diagrams.

8.3.14 Plan Drawings. Create a separate model file for each drawing. Use sheet files to combine floor plans with non-plan information or multiple elevations. Do not combine several drawings such as elevations, sections, and details in one model file. When a floor plan is too large to fit on a single sheet at the desired scale use viewports in separate sheet files to show portions of the floor. DO NOT create individual model files for portions of a floor. For sheet sizes, see 10.0 SUPPLEMENTAL TABLES.

8.3.15 Plotting. Paper format drawing deliverables need not be plotted from AutoCAD. However, electronic drawing deliverables are required to be able to accurately reproduce those paper format deliverables when plotted from AutoCAD using HDI drivers and the following settings:

Plot Style Parameter Table	Setting
Plot Color	For black and white: 7 For color plots: Use object color
Dither	For black and white: On For color plots: Off
Grayscale	Off
Pen Number	Automatic (unless required by your plotter)
Virtual Pen	Automatic (unless required by your plotter)
Screening	For black and white: Refer to pen table For color plots: 100
Linetype	Use object linetype
Adaptive	On
Lineweight	Use object lineweight
Line End Style	Use object end style
Line Join Style	Use object join style
Fill Style	Use object fill style

Note: Make sure the Plot with Plot Styles option is checked in the Plot dialog box. Screening is not used for color printing because colors already have various degrees of color intensity.

The following files are available for download at www.gsa.gov/cifm:

CTB Files Containing the Standard Pen Tables	
r200X monochrome screening.ctb	For plotting black and white r2000 and later drawings in r2000 and later with screening
r200X color nonscreening.ctb	For plotting color r2000 and later drawings in r2000 and later without screening

Pen Tables for Previous AutoCAD Releases	
The following pen table files are not used for plotting drawings produced in accordance with the current *PBS CAD Standards*. They are provided for accurately plotting background drawings provided by PBS, which were produced under previous PBS Standards.	
r14 monochrome nonscreening.ctb	For plotting black and white r14 and earlier drawings in r2000 and later without screening
r14 color nonscreening.ctb	For plotting color r14 and earlier drawings in r2000 and later without screening
r200X monochrome nonscreening.ctb	For plotting black and white r2000 and later drawings in r2000 and later without screening

8.3.16 Screening. Screening (graying printed lines to varying degrees) can be accomplished by selecting a color, which corresponds to the level of screening desired (smaller values produce lighter lines), from the GSA Screening Pen Table. See www.gsa.gov/cifm. If screening is not desired, avoid using colors with screening values less than 100.

8.3.17 Templates (layer seed files) and titleblocks. PBS-provided templates (layer seed files) and titleblocks shall be used to prepare all drawings. Model files are required to have a model file information block. See www.gsa.gov/cifm.

8.3.18 Text and Fonts. Use only standard AutoCAD or approved True Type fonts. For file with acceptable fonts list, see www.gsa.gov/cifm. The minimum plotted text size for all full size drawings shall be 3/32". It may be necessary to use other text sizes for clarity and presentation purposes

8.3.19 Units. Metric units shall be the standard system of measurement for new facilities and most design and construction projects unless otherwise specified. Refer to PBS PQ260 *GSA Metric Design Guide*. However, imperial units may be approved for use for projects in existing buildings when existing drawings are imperial. Contact the PBS Project Manager if either metric or imperial units have not been specified. Assignment drawings shall be in imperial units. Base units for metric shall be millimeters, for imperial, inches. Note: Merely changing the unit system variable does not convert the drawing from metric to imperial or vice versa.

8.3.20 Variables and Commands. Set as follows for all drawings submitted to PBS:

Variables	Settings
ISAVEPERCENT	0, ensures every SAVE is a full SAVE
PDMODE	0, controls how point objects are displayed
PDSIZE	0, sets the display size for point objects
TILEMODE	1 (model space) for model files; 0 (paper space) for sheet files; For TILEMODE = 0, PSPACE shall be active, not MSPACE (floating model space)
VISRETAIN	1

Note: A script for setting variables automatically is available for download at www.gsa.gov/cifm. This utility is offered AS IS, is not supported, and GSA makes no warranty as to its use or performance. In no event will GSA be liable for any consequential, incidental, or special damages. This utility is an aid to compliance, but is not guaranteed to work in all versions of AutoCAD, and is not guaranteed to make drawings compliant. As always the party responsible for producing the drawing is ultimately responsible for compliance with policy.

Commands	Settings
BASE	Insertion base point (0,0,0)
GRID	Off
LAYER	Current layer is on
LIMITS	Off, drawing limits to drawing size
LINETYPE	Current entity linetype BYLAYER
POINT	Display mode 0, size 0.0
QTEXT	Off
SNAP	Off
TEXT	Style STANDARD
UCS	Set UCS to world
UCSICON	Set UCSICION to no origin
UNITS (linear)	As appropriate for drawing
UNITS (angular)	Decimal degrees (surveyor's units for civil drawings)
ZOOM	To drawing extents

8.3.21 Xrefs. AutoCAD term for external reference. Xrefs help to organize drawing information, enhance coordination, and minimize redundant data. The xref path shall not include drives, directory designations, or relative paths (AutoCAD Release 2004 feature). Place the xref on a layer whose name contains the AIA Minor Group REFR. Document the relationship between drawing file and xref on the project documentation report and deliverables matrix available at www.gsa.gov/cifm. Circular references are prohibited.

8.3.22 Attached Image Files. Images may be incorporated into drawings by the IMAGEATTACH command (which produces a link, much like an xref), or by the INSERTOBJ command, which can produce a linked or embedded OLE object, or by the PASTE command, which produces an embedded OLE object. Images may be used for renderings, maps, etc. If images are attached, include image files with the submission.

8.3.23 AutoCAD 2004 Features. Digital signatures are allowed. Password protection is prohibited.

9.0 FILE AND LAYER NAMES

9.1 Model File Names.

9.1.1 Model files graphically represent the building's physical layout and components such as floor plans, sections, elevations, and schematic details, each requiring its own separate model file. Model files are drawn full size in model space with the exception of schematic diagrams, which can be at any scale.

9.1.2 Model files shall include a PBS-provided information block, which describes the content of the model file. The information block is inserted on layer G-ANNO-TTLB at 0,0,0 in paper space.

9.1.3 Name model files as shown below. The Regional CIFM Manager must approve any user-defined Model File Types. Submit list of user-defined types with drawing submissions.

Model File Names

Step		Number of Characters	Example
1	Start with Discipline Designator	One followed by hyphen	A-
2	Follow with Model File Type	2	FP
3	Follow with Floor Number	2 followed by hyphen	01-
4	To create unique file name, follow with ASID number for funded projects. For formative Prospectus projects where ASID number is not available, use Congressional line item number. Verify with Regional CIFM Manager.	8 followed by period	RNY00339. SAL96001.
5	End with file extension	3	dwg

Result **A-FP01-RNY00339.dwg (funded project with ASID number)**
A-FP01-SAL96001.dwg (formative Prospectus project with Congressional line item number)
First floor Architectural plan

Note: Supplemental PBS guidance for other drawing types may require use of an underline instead of the hyphen. Verify with Regional CIFM Manager.

Model File Name Guidelines

Discipline Codes	
A	Architectural
B	Geotechnial
C	Civil
D	Process
E	Electrical
F	Fire Protection
G	General
H	Hazardous Materials
I	Interiors
L	Landscape
M	Mechanical
O	Operations
P	Plumbing
Q	Equipment
R	Resource
S	Structural
T	Telecommunications
V	Survey/Mapping
W	Civil Works
X	Other Disciplines
Z	Contractor/Shop Drawings

Drawing Type Codes that Apply to All Disciplines	
3D	Isometric/3D
DG	Diagrams
DP	Demolition Plan
DT	Detail
EL	Elevation
FP	Floor Plan
QP	Equipment Plan
SC	Section
SH	Schedules
SP	Site Plan
XP	Existing Plan

Discipline Codes Specific to Particular Disciplines	
Architectural	
A-CP	Ceiling Plans
A-EP	Enlarged Plans
A-NP	Finish Plans
A-RP	Roof Plan

Civil	
C-EP	Environment
C-GP	Grading
C-RP	Roads / Topographic
C-SV	Survey
C-UP	Utility

Electrical	
E-CP	Communications
E-GP	Grounding
E-LP	Lighting
E-PP	Power

Fire Protection	
***-VP**	Evacuation Plan (may be other disciplines)
F-KP	Sprinkler Plan

Interiors	
I-CP	Ceiling Plans
I-EP	Enlarged Plans
I-RP	Furniture Plans
I-NP	Finish Plans

Mechanical	
M-CP	Control Plans
M-HP	HVAC Ductwork Plans
M-PP	Piping Plans

Plumbing	
P-PP	Plumbing Plans

Structural	
S-FP	Framing Plans
S-NP	Foundation Plans

Telecommunications	
T-DP	Data
T-TP	Telephone

Operations (Assignment Plans only)	
O_KY	Key Drawing
O_SR	Source Drawing
O_AP	Assignment Plan

Note: If using sheet grid coordinates, refer to NCS 2.0 UDS Module 1 for direction on naming detail files and coordinating the individual detail file to the specific detail sheet.

Floor Number	
01-99	First to 99th Floor
B1	Basement
G1	Ground Floor
K1	Parking Level
M1	Mezzanine
P1	Penthouse
RX	Roof Plan A through Z
SB	Subbasement

Note 1: If more than one, use increment number on Basement, Parking Level, Mezzanine, and Penthouse.
Note 2: Floor Number may not apply to all drawings, especially details.

9.2 Sheet File Names.

9.2.1 Sheet files are used to assemble model files for plotting and viewing purposes. Every sheet file has a drawing area, title block, and border, and represents one plotted drawing. Sheet files shall be assembled in paper space and set up to be plotted at 1:1 scale. In AutoCAD, set plot scale 1:1.

9.2.2 Name sheet files as shown below. The Regional CIFM Manager must approve any user-defined Level 2 Designators. Submit list of user-defined designators with drawing submissions.

Sheet File Names			
Step		**Number of Characters**	**Example**
1	Start with Discipline Designator Level 1	One followed by a hyphen	A-
2	Or, use Discipline Designator with Level 2 Designator	2 followed by a hyphen	AD-
3	Follow with Sheet Type Designator	One	1
4	Follow with Sheet Sequence Number	2 (3 if needed) followed by a hyphen	01-
5	To create unique file name, follow with ASID number for funded projects. For formative Prospectus projects where ASID number is not available, use Congressional line item number. Verify with Regional CIFM Manager.	8 followed by period	RNY00339. SAL96001.
6	End with file extension	3	dwg

Result **A-101-RNY00339.dwg (funded project with ASID number)**
A-101-SAL96001.dwg (formative Prospectus project with Congressional line item number)

Or **AD-101-RNY00339.dwg**
AD-101-SAL06001.dwg
First Architectural plan in set
First Architectural Demolition plan in set

Note: Supplemental PBS guidance for other drawing types may require use of an underline instead of the hyphen. Verify with Regional CIFM Manager.

Discipline Designators Level 1 and Level 2			
Level 1	**Level 2**	**Description**	**Content**
A	**-**	**Architectural**	All or any portion of subjects included in Level 2
	AS	Architectural Site	
	AD	Architectural Demolition	Protection and removal
	AE	Architectural Elements	General Architectural
	AI	Architectural Interiors	
	AF	Architectural Finishes	
	AG	Architectural Graphics	
	AJ		User defined
	AK		User defined

Discipline Designators Level 1 and Level 2 (continued)

Level 1	Level 2	Description	Content
C	**-**	**Civil**	All or any portion of subjects included in Level 2
	CD	Civil Demolition	Structure removal and site clearing
	CS	Civil Site	Plats, dimension control
	CG	Civil Grading	Excavation, grading, drainage, erosion control
	CP	Civil Paving	Roads, driveways, parking lots
	CI	Civil Improvements	Pavers, flagstone, exterior tile, furnishings, retaining walls, and water features
	CT	Civil Transportation	Waterways, wharves, docks, trams, railways, airfields, and people movers
	CU	Civil Utilities	Water, sanitary sewer, storm sewer, power, communications, fiber optic, telephone, cable television, natural gas, and steam systems
	CJ		User Defined
	CK		User Defined
W	**-**	**Civil Works**	All or any portion of subjects included in Level 2
	WJ		User Defined
	WK		User Defined
Z	**-**	**Contractor/Shop Drawings**	All or any portion of subjects included in Level 2
	ZJ		User Defined
	ZK		User Defined
E	**-**	**Electrical**	All or any portion of subjects included in Level 2
	ES	Electrical Site	Utility tunnels, site lighting
	ED	Electrical Demolition	Protection, termination, and removal
	EP	Electrical Power	
	EL	Electrical Lighting	
	EI	Electrical Instrumentation	Controls, relays, instrumentation, and measurement devices
	ET	Electrical Telecommunications	Telephone, network, voice, and data cables
	EY	Electrical Auxiliary Systems	Alarms, nurse call, security, CCTV, PA, music, clock, and program
	EJ		User Defined
	EK		User Define
Q	**-**	**Equipment**	All or any portion of subjects included in Level 2
	QA	Athletic Equipment	Gymnasium, exercise, aquatic, and recreational
	QB	Bank Equipment	Vaults, teller units, ATMS, drive-through
	QC	Dry Cleaning Equipment	Washers, dryers, ironing, and dry cleaning
	QD	Detention Equipment	Prisons and jails
	QE	Educational Equipment	Chalkboards, library
	QF	Food Service Equipment	Kitchen, bar, service, storage, and processing
	QH	Hospital Equipment	Medical, exam, and treatment
	QL	Laboratory Equipment	Science labs, planetariums, observatories
	QM	Maintenance Equipment	Housekeeping, window washing, and vehicle servicing
	QP	Parking Lot Equipment	Gates, ticket, and card access
	QR	Retail Equipment	Display, vending, and cash register
	QS	Site Equipment	Bicycle racks, benches, and playground
	QT	Theatrical Equipment	Stage, movie, rigging systems
	QV	Video/Photographic Equipment	Television, darkroom, studio
	QY	Security Equipment	Access control and monitoring surveillance
	QJ		User Defined
	QK		User Defined
F	**-**	**Fire Protection**	All or any portion of subjects included in Level 2
	FA	Fire Detection and Alarm	
	FX	Fire Suppression	Fire extinguishing systems and equipment
	FJ		User Defined
	FK		User Defined

Discipline Designators Level 1 and Level 2 (continued)

Level 1	Level 2	Description	Content
G	**-**	**General**	All or any portion of subjects included in Level 2
	GI	General Informational	Drawing index, code summary, symbol legend, orientation maps
	GC	General Contractual	Phasing, schedules, contractor staging areas, fencing, haul routes, erosion control, temporary and special requirements
	GR	General Resources	Photographs, soil borings
	GJ		User Defined
	GK		User Defined
B	**-**	**Geotechnical**	All or any portion of subjects included in Level 2
	BJ		User Defined
	BK		
H	**-**	**Hazardous Materials**	All or any portion of subjects in the following Level 2 Designators
	HA	Asbestos	Asbestos abatement, identification, or containment
	HC	Chemicals	Toxic chemicals handling, removal or storage
	HL	Lead	Lead piping or paint removal
	HP	PCB	PCB containment and removal
	HR	Refrigerants	Ozone depleting refrigerants
	HJ		User Defined
	HK		User Defined
I	**-**	**Interiors**	All or any portion of subjects included in Level 2
	ID	Interior Demolition	
	IN	Interior Design	
	IF	Interior Furnishings	
	IG	Interior Graphics	Murals and visuals
	IJ		User Defined
	IK		User Defined
L	**-**	**Landscape**	All or any portion of subjects included in Level 2
	LD	Landscape Demolition	Protection and removal of existing landscape
	LI	Landscape Irrigation	
	LP	Landscape Planting	
	LJ		User Defined
	LK		User Defined
M	**-**	**Mechanical**	All or any portion of subjects included in Level 2
	MS	Mechanical Site	Utility tunnels, site lighting
	MD	Mechanical Demolition	Protection, termination, and removal
	MH	Mechanical HVAC	Ductwork, air devices, and equipment
	MP	Mechanical Piping	Chilled and heated water, steam
	MI	Mechanical Instrumentation	Instrumentation and controls
	MJ		User Defined
	MK		User Defined
O	**O-**	**Operations**	All or any portion of subjects included in Level 2
	OJ		User Defined
	OK		User Defined
X	**-**	**Other Disciplines**	All or any portion of subjects included in Level 2
	XJ		User Defined
	XK		User Defined
P	**-**	**Plumbing**	**All or any portion of subjects included in Level 2**
	PS	Plumbing Site	Extension and connection to Civil Utilities
	PD	Plumbing Demolition	Protection, termination, and removal
	PP	Plumbing Piping	Piping, valves, and insulation
	PQ	Plumbing Equipment	Pumps and tanks
	PL	Plumbing	Domestic water, sanitary and storm drainage, fixtures
	PJ		User Defined
	PK		User Defined

Discipline Designators Level 1 and Level 2 (continued)

Level 1	Level 2	Description	Content
D	**-**	**Process**	All or any portion of subjects included in Level 2
	DS	Process Site	Extension and connection to civil utilities
	DD	Process Demolition	Protection, termination, and removal
	DL	Process Liquids	Liquid process systems
	DG	Process Gases	Gaseous process systems
	DP	Process Piping	Piping, valves, insulation, tanks, pumps, etc.
	DQ	Process Equipment	Systems and equipment for thermal, electrical, materials handling, assembly and manufacturing, nuclear power generation, chemical refrigeration, and industrial processes
	DE	Process Electrical	Electrical exclusively associated with a process and not the facility
	DI	Process Instrumentation	Instrumentation, measurement, recorders, devices and controllers (electrical and mechanical)
	DJ		User Defined
	DK		User Defined
R	**-**	**Resource**	Data furnished without warrant to accuracy
	RC	Resource Civil	Surveyor's information and existing civil drawings
	RS	Resource Structural	Existing facility structural drawings
	RA	Resource Architectural	Existing facility architectural drawings
	RM	Resource Mechanical	Existing facility mechanical drawings
	RE	Resource Electrical	Existing facility electrical drawings
	RJ		User Defined
	RK		User Defined
S	**-**	**Structural**	All or any portion of subjects included in Level 2
	SD	Structural Demolition	Protection and removal
	SS	Structural Site	
	SB	Structural Substructure	Foundations, piles, slabs, and retaining walls
	SF	Structural Framing	Floors and roofs
	SJ		User Defined
	SK		User Defined
V	**-**	**Survey/Mapping**	All or any portion of subjects included in Level 2
	VA	Aerial Survey	
	VF	Field Survey	
	VH*	Hydrographic Survey	
	VI	Digital Survey	
	VU	Combined Utilities	
	VJ		User Defined
	VK		User Defined
T	**-**	**Telecommunications**	All or any portion of subjects included in Level 2
	TA	Audio Visual	Cable music, and CCTV systems
	TC	Clock and Program	Time generators and bell program systems
	TI	Intercom	Intercom and public address systems
	TM	Monitoring	Monitoring and alarm systems
	TN	Data Networks	Network cabling and equipment
	TT	Telephone	Telephone systems, wiring, and equipment
	TJ		User Defined
	TK		User Defined

Sheet Type Designators

0	General (symbols, legends, notes, etc.)
1	Plans (horizontal views)
2	Elevations (vertical views)
3	Sections (sectional views)
4	Large Scale Views (plans, elevations, or sections that are not details)
5	Details
6	Schedules and Diagrams
7	User Defined
8	User Defined
9	3D Representations (isometrics, perspectives, photographs)

9.3 Layer Names.

9.3.1 All drawing files shall be produced using the layer name formats in NCS 2.0, Volume 1, AIA CAD Layer Guidelines, or *AIA CAD Layer Guidelines NCS Version 2*. Due to copyright reasons, contractors and associates must refer to these publications for a list of AIA-approved layer names.

9.3.2 PBS has developed templates (layer seed files) with the most common layers for each discipline. See www.gsa.gov/cifm. If other layers are needed, follow the AIA layer name format to create additional layers. AIA layer names consist of a discipline code, major group, minor group, and optional status field. For example, A-WALL-FULL-E is the layer name for a full height architectural wall existing to remain. Layer names may be upper or lower case. Do not use major or minor groups in conjunction with disciplines under which they are not listed. The Regional CIFM Manager must approve user-defined layers. Also, a list and description of such layers must be submitted to PBS along with the drawing submission.

9.3.3 AIA layer guidelines allow different layer names for the same information such as A-COLS, I-COLS, and S-COLS. PBS does not allow the use of duplicate names and requires that the information be placed on the layer of the discipline responsible for the information. For example, columns should always be placed on the structural layer (S-COLS), lighting should always be placed on the electrical layer (E-LITE), and plumbing fixtures should always be placed on the plumbing layer (P-FIXT).

10.0 SUPPLEMENTAL TABLES

Typical Line Weights / Uses in Construction Drawings

Type	Line Weight	Layer Name*	Description
Thin	0.18 mm/ 0.007 in.	THIN	Dimension leaders/ witness lines, dimension lines, object lines seen in the distance, and most patterns
Medium	0.25 mm/ 0.010 in.	MEDM	Minor object lines, line terminators (arrowheads and ticks), hidden lines, and note leader lines
Medium Thick	0.35 mm/ 0.014 in.	MEDT	Most object lines, text, schedule boxes, and charts
Thick	0.50 mm/ 0.020 in.	THIK	Minor title underlining, title text, object lines requiring special emphasis
Extra Thick	0.70 mm/ 0.028 in.	XTHK	Use sparingly for underlining titles and separating portions of drawings, elevation grade lines, building footprints, and top of grade markings
Optional	1.00 mm/ 0.040 in.	OPTI	

* Layer name modifier to use when layers are separated by line weights such as title blocks and details

Imperial Text Height Guide

		Plotted text height **3/32”**	**1/8”**	**5/32”**	**3/16”**	**¼”**	**3/8”**	**½”**
Scale		*Actual text height in CAD drawing*						
1/32” = 1”-0”	Text Height =	3’	4’	5’	6’	8’	12’	16’
1/16 ”= 1’-0”	Text Height =	1’-6”	2’	2’-6”	3’	4’	6’	8’
3/32” = 1’-0”	Text Height =	1’-1 ½”	1’-6”	1’-8”	2’-3”	3’	4’-6”	6’
1/8” = 1’-0”	Text Height =	9”	1’	1’-3”	1’-6”	2’	3’	4’
¼” = 1’-0”	Text Height =	4 ½”	6”	7 ½”	9”	1’	1’-6”	2’
3/8” = 1’-0”	Text Height =	3”	4”	5”	6”	8”	1’	1’-4”
½” = 1’-0”	Text Height =	2 ¼”	3’	3 ¾”	4 ½”	6”	9”	1’
¾” = 1’-0”	Text Height =	1 ½”	2”	2 ½”	3”	4”	6”	8”
1” = 1’-0”	Text Height =	1.13”	1 ½”	1.875”	2 ¼”	3”	4 ½”	6”
1 ½” = 1’-0”	Text Height =	¾”	1”	1 ¼”	1 ½”	2”	3”	4”
3” = 1’-0”	Text Height =	.38”	½”	.625”	¾”	1’	1 ½”	2”

Metric Text Height Guide

		Plotted text height					
		2 mm	**3 mm**	**5 mm**	**6 mm**	**12 mm**	**24 mm**
		Actual text height in CAD drawing					
Scale							
1:200	Text Height =	400 mm	600 mm	1000 mm	1200 mm	2400 mm	4800 mm
1:100	Text Height =	200 mm	300 mm	500 mm	600 mm	1200 mm	2400 mm
1:50	Text Height =	100 mm	150 mm	250 mm	300 mm	600 mm	1200 mm
1:25	Text Height =	50 mm	75 mm	125 mm	150 mm	300 mm	600 mm
1:10	Text Height =	20 mm	30 mm	50 mm	60 mm	120 mm	240 mm
1:5	Text Height =	10 mm	15 mm	25 mm	30 mm	60 mm	120 mm
1:1	Text Height =	2 mm	3 mm	5 mm	6 mm	12 mm	24 mm

Plotting Sheet Sizes

Designation	**Size (in)**	**Size (mm)**
ANSI A	8.5 x 11	216 x 279
ANSI B	11 x 17	279 x 432
ANSI C	17 x 22	432 x 559
ANSI D	22 x 34	559 x 864
ANSI E	34 x 44	864 x 1118
ISO A4	8.3 x 11.7	210 x 297
ISO A3	11.7 x 16.5	297 x 420
ISO A2	16.5 x 23.4	420 x 594
ISO A1	23.4 x 33.1	594 x 841
ISO A0	33.1 x 46.8	841 x 1189
Architectural A	9 x 12	229 x 305
Architectural B	12 x 18	305 x 457
Architectural C	18 x 24	457 x 610
Architectural D	24 x 36	610 x 914
Architectural E	36 x 48	914 x 1219
Architectural F	30 x 42	762 x 1067

Acceptable Drawing Scales for Sheets

(Note: full size sheet files shall be assembled in paper space and plotted at 1:1.)

Architectural Scales		**Engineering Scales**		**Metric Scales**	
Drawing Scale	**Plot Scale**	**Drawing Scale**	**Plot Scale**	**Drawing Scale**	**Plot Scale**
		1” = 5000’	60000		
		1” = 2500’	30000		
		1” = 1250’	15000		
		1” = 1000’	12000		
		1” = 500’	6000	1:5000	5000
		1” = 200’	2400	1:2500	2500
		1” = 100’	1200	1:1250	1250
		1” = 50’	600	1:1000	1000
		1” = 40’	480	1:500	500
		1” = 30’	360		
1/16” = 1’-0”	192	1” = 20’	240	1:200	200
1/8” = 1’-0”	96	1” = 10’	120	1:100	100
¼” = 1’-0”	48	1” = 5’	60	1:50	50
3/8” = 1’-0”	32			1:30	30
½” = 1’-0”	24	1” = 2’	24	1:20	20
¾” = 1’-0”	16	1” = 2’	24	1:20	20
1” = 1’-0”	12	1” = 1’	12	1:10	10
1 ½” = 1’-0”	8			1:10	10
3” = 1’-0”	4			1:5	5
6” = 1’-0”	2			1:2	2
Full size	1			1:1	1

Conversion Factors

Quantity	From Inch-Pound Units	To Metric	Multiply by
Length	Mile	km	1.609 344*
	Yard	m	0.914 4*
	Foot	m	0.304 8*
	Foot	mm	304.8*
	Inch	mm	25.4*
Area	Square Mile	km^2	2.590 00
	Acre	m^2	4 046 87
	Acre	ha (10 000 m^2)	0.404 687
	Square Yard	m^2	0.836 127 36*
	Square Foot	m^2	0.092 903 04*
	Square Inch	mm^2	645.16*

*Denotes exact conversion

Units and Conversion Guide / Comparison of Drawing Scales

Inch-Foot Scale	Inch-Foot Ratio	Metric Scale
Full Size	1:1	1:1
Half Size	1:2	1:2
4” = 1’-0”	1:3	
3” = 1’-0”	1:4	1:5
2” = 1’-0”	1:6	
1-1/2” = 1’-0”	1:8	1:10
1” = 1’-0”	1:12	
¾” = 1’-0”	1:16	1:20
½” = 1’-0”	1:24	1:25
¼” = 1’-0”	1:48	1:50
1” = 5’-0”	1:60	
1/8” = 1’-0”	1:96	1:100
1” = 10’-0”	1:120	
1/16” = 1’-0”	1:192	1:200
1” = 20’-0”	1:240	1:250
1” = 30’-0”	1:360	
1/32” = 1’-0”	1:384	
1” = 40’-0”	1:480	1:500
1” = 50’-0”	1:600	
1” = 60’-0”	1:720	
1” = 80’-0”	1:960	1:1000