



Beth Israel Deaconess  
Medical Center



A teaching hospital of  
Harvard Medical School

# **CAD & Image Standards** for Construction Projects & Facility Documentation

Version 1.0



## ***TABLE of CONTENTS***

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### ***1.0 INTRODUCTION***

### ***2.0 FILE FORMAT and SETUP***

- 2.1 Electronic File Format
- 2.2 Scale, Unit and Tolerances
- 2.3 Text Styles and Fonts
- 2.4 Title Block
- 2.5 Blocks
- 2.6 AutoCAD® Model/Paper Space
- 2.7 External References
- 2.8 Image Files

### ***3.0 LAYERING***

- 3.1 Layer Name Formatting
- 3.2 Layer Attributes
- 3.3 Plotting

### ***4.0 DRAWING SET ORGANIZATION***

- 4.1 Sheet Identification

### ***5.0 DELIVERABLES***

- 5.1 Required Documents
- 5.2 Archival File Format (TIF)
- 5.3 Error-free AutoCAD® Deliverables
- 5.4 Translation Testing
- 5.5 Review Period

### ***6.0 APPENDICES***

- A. BIDMC CAD Standards Check List
- B. Standard Layer List



## ***1.0 INTRODUCTION***

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This document outlines how to produce and deliver as-built construction documents as CAD drawings and raster images (TIF format) to the Beth Israel Deaconess Medical Center (BIDMC) Facilities Department in a way that maximizes the short and long term utility of CAD data and ensures the integrity of our archives.

The Facilities Department at BIDMC maintains this document as a means to standardize incoming CAD data and ensure an unimpeded transfer of information to the Medical Center's space inventory database.

All materials specified in this document must be provided in compliance with the BIDMC CAD standards at the time of project close out. Final payment from BIDMC will only be rendered upon the delivery of said materials with a signed copy of the CAD Standards Checklist. The checklist can be found attached to this document as *Addendum A*.

The BIDMC CAD standards comply with *The United States National CAD Standard® Version 4.0* (USNCS). If formatting information not outlined in this document is required, refer to the USNCS for guidance.

Questions or comments regarding the information in this document can be directed to:

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## 2.0 FILE FORMAT and SETUP

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**2.1 Electronic File Format:** As-built construction drawings must be submitted to BIDMC in AutoCAD® DWG format. They must be compatible with the most recent version of AutoCAD® or the version prior at the time of submission.

**2.2 Scale, Units and Tolerances:** Drawing models in CAD should be in architectural units and drafted at full scale. One drawing unit is to equal one inch. Drawing tolerances should be consistent with industry standards.

**2.3 Text Styles and Fonts:** ROMANS.shx is the preferred text font, but other fonts packaged with the AutoCAD® software are allowed. Special fonts not part of the AutoCAD software package are not allowed. Any printed text (labels, dimensions or notes) must be a minimum of 1/8" in height.

**2.4 Title Block:** Each electronic CAD file may have only one title block, located in paper space, inserted with the lower left corner at the origin (0,0,0). At minimum, the following information must be present on every sheet.

<b>Project Information</b>	BIDMC Logo	Provided by BIDMC
	Project Name	Provided by BIDMC
	Firm Name	Author of drawing content
	Building Name	Provided by BIDMC
	Project Number	Provided by consultant
	BIDMC Project Number	Provided by BIDMC
<b>Sheet Information</b>	Drawing Title	Identifies drawing content
	Sheet ID	Unique sheet number (see section 4.1)
	Date of Submission	Provided by BIDMC
	Drawing Scale	If applicable
	Key Plan	Indicate scope of work and drawing view if applicable

**2.5 Blocks:** All entities within a block must be created on layer 0. Drawing entities translated into blocks from non-AutoCAD® systems must revert to layer 0 when exploded in AutoCAD®. File translation from other systems which result in wall blocks are unacceptable.

**2.6 AutoCAD Model/Paper Space:** All building information and associated annotation should be drawn in model space at full scale. One drawing unit equals one inch or one millimeter. Only the title block may be drawn in paper space.

**2.7 External Reference Files:** BIDMC will not accept the submission of any CAD drawing deliverable that contains unbound external references to drawing source files. All externally referenced data sources that were used during the production of as-built CAD drawings should be inserted and retained as a block within a single drawing file, including the title block, upon project completion and prior to drawing delivery. The resulting self-contained drawing file is an acceptable deliverable to BIDMC.

**2.8 Image Files (JPGs, BMPs, PNGs):** BIDMC will not accept the submission of any CAD drawing deliverable with referenced images. All images included in a drawing must be cut-and-pasted into the drawing so that they are embedded within the CAD file. If it is not possible to embed the images please contact the BIDMC Facilities staff to determine an alternative.



### 3.0 LAYER STANDARD

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BIDMC has adopted the layer naming conventions defined in *The United States National CAD Standard version 4.0* (USNCS). The rules and layer names listed in this section are a subset of those found in the standard that will suffice for most projects. Consult the USNCS for more a more detailed layer list and complete coverage of the layer naming rules.

#### 3.1 Layer Name Formatting

A layer name consists of four hyphen-separated fields. The first two (discipline code and major group) are mandatory. The second two (minor group and status code) are optional. A layer name may include both optional fields, just one, or none. They combine in the following format, with the optional fields in grey:

**A-FLOR-HRAL-E = Discipline Code + Major Group + Minor Group + Status Code**

**3.1.1 Discipline Code:** This is a one letter field that designates the discipline or trade that the layer belongs to. The USNCS provides for an optional second character that may be useful on large, complex projects. For most projects the one letter discipline code will be plenty. The following table shows the allowed values.

##### Discipline Code Values

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

**3.1.2 Major Group:** This is a four letter field that designates the major building system. Things like doors, walls, floors, and glazing each have a major group. Any major group defined in the USNCS can be paired with any discipline code, but use combinations that make logical sense like A-WALL.

Major groups must come from the list contained in the USNCS. User defined major groups are not allowed. To ensure you comply with the standard use names from the layer list in Appendix B.

**3.1.3 Minor Group:** This is an optional four letter field that further defines the major group designation. For example A-WALL-FULL would designate full height walls as opposed to partial height walls (PRHT). E-LITE-IDEN would be for light fixture identification tags.

Any minor group can be used with any major group and, while optional, they should be used as often as possible.

New minor groups can be defined as needed, but consult the list in the USNCS before doing so to ensure that none of the predefined values meet your needs. *Always prefer the predefined values.*



**3.1.4 Status Code:** This is an optional single letter field that designates the status of work. In general, status codes should be used on layers that are not part of the dominant phase of a project. Most layers should have no status code, while those that “stand out” should use one. Choose from the table below.

**Status Code Values**

E	Existing to Remain	X	Not in Contract
N	New Work	1-9	Phase Numbers

**3.1.5 Sections, Elevations, and Details:** In addition to major groups that designate major building systems there are major groups defined for sections, elevations, and details. They are as follows, with commonly associated minor groups (where □ is any discipline code).

- DETL-IDEN Identification tags
- DETL-MBND Material beyond section cut
- DETL-MCUT Material cut in section
- DETL-PATT Textures and hatch patterns
  
- ELEV-IDEN Identification Tags
- ELEV-OTLN Outline
- ELEV-PATT Textures and hatch patterns
  
- SECT-IDEN Identification tags
- SECT-MBND Material beyond section cut
- SECT-MCUT Material cut by the section
- SECT-PATT Textures and hatch patterns

**3.1.6 Annotation Layers:** The major group ANNO is for annotative information This includes notes, leaders, and symbols, and also drawing elements that do not represent the physical aspects of a building like schedules, title blocks, and logos.

The ANNO major group should be used with all discipline codes for annotative information. The annotation layers listed in Appendix B show minor groups typically used with ANNO. These can also be used to modify any major or minor group in the list. In particular IDEN can be used on layers for ID tags that identify specific equipment or building elements like E-LITE-IDEN, or A-FLOR-IDEN.

**3.2 Layer Attributes**

BIDMC assigns attributes per layer. All drawing entities should have their line weight, line type, and color set to “ByLayer.”

**3.2.1 Line Weight:** Assign line weights to each layer. The standard layer list in Appendix B specifies weights for each layer. This is done in order to ensure consistent graphic presentation across projects, and to ensure that drawings can be accurately reproduced from archived CAD files.

If a layer is required that is not in the standard list, choose a reasonable USNCS compliant weight using the given weights as a guide.

**3.2.2 Layer Color:** BIDMC does not use color dependant pen tables. Colors should be assigned to facilitate good readability on screen. Layer colors are at the discretion of the consultant creating the drawings.

**3.2.3 Line Type:** All layers should be Continuous unless specified otherwise in the included layer list.



### 3.3 Plotting

All electronic drawing deliverables must be able to accurately reproduce hard copy deliverables when plotted from AutoCAD using one of the given BIDMC plot style tables.

**3.3.1 Plot Styles:** BIDMC will provide plot style tables for black and white plotting with and without screening, and for color. The plot style settings are below, with variations noted for color and black and white.

#### Plot Style Table Settings

Color	B&W: 7 (Black) Color: Use object color
Dither	B&W: On Color: Off
Grayscale	Off
Pen #	Automatic (unless required by your plotter)
Virtual pen #	Automatic (unless required by your plotter)
Screening	B&W: refer to pen table Color: 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

**3.3.2 Screening:** Specify whether the screened or non-screened style table is required for each file in the electronic file index that is submitted with as-built documents.

For convenience, if one or more files in a discipline require the unscreened style table specify no screening for the entire discipline. Otherwise specify screened printing by default.



## 4.0 DRAWING SET ORGANIZATION

BIDMC has adopted the sheet identification and organization standards defined in *The United States National CAD Standard version 4.0* (USNCS). For additional formatting options for large, complex projects consult the USNCS.

### 4.1 Sheet Identification

The sheet identifier has three parts. The discipline designator, sheet type designator, and the sheet sequence number. They combine in the following format, where A is a letter and N is a number.



**4.1.1 Discipline Designator:** This is a single character, always followed by a hyphen, which designates the discipline of the content in the drawing. Acceptable values are the same as those used for layer names. See section 3.1.1 for a list.

**4.1.2 Sheet Type Designator:** This is a single numerical character that identifies the sheet type, as defined in the following table. Note that on small projects where more than one type may be placed on the same sheet the lowest applicable sheet type should be used.

#### Sheet Type Designators

0	General	Symbols legend, notes, drawing list, etc.
1	Plans	Horizontal views
2	Elevations	Vertical views
3	Sections	Sectional views, wall sections
4	Large-Scale Views	Drawings from 1, 2, or 3 at larger scale
5	Details	Non-typical details
6	Schedules & Diagrams	
7	User Defined	Typical details or types that do not fall in other categories
8	User Defined	Types that do not fall in other categories
9	3D Representations	Isometrics, perspectives, photographs

**4.1.3 Sheet Sequence Number:** This is a two digit number that identifies each sheet in a particular discipline and sheet type. Each sequence begins with **01** (do not use 00) and runs through **99**. Always use both digits, regardless of the number of sheets required in a sequence.

Sheet numbers need not be sequential. Gaps in the sequence can accommodate the insertion of additional sheets as the project matures, and allow for further organization within sheet types. Sub-sequences created in this way should begin on the tens, i.e. at 10, 20, 30, etc.





## 5.0 DELIVERABLES

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**5.1 Required Documents:** All files must be submitted on a compact disk (CD-ROM or DVD). The lead design or construction professional will coordinate the deliverables for all other consultants or trades and provide all of the information in one submission. All submissions must include:

- Completed Index of Electronic Files
- Signed CAD Standards Checklist
- One DWG file per drawing sheet
- One TIF file per drawing sheet

**5.2 Archival File Format (TIF):** A raster image in TIF format must be submitted for each drawing sheet. This is a duplicate of each sheet at the same scale and must be functionally identical to a hard copy generated from the CAD file.

The files may be uncompressed or compressed using LZW lossless data compression. All TIF images should be created at a resolution of 300ppi. At this resolution a 24"x36" original will result in an image 7,200 pixels by 10,800 pixels. Higher resolution may be used if 300ppi will not accurately reproduce all content on a sheet. Do not adjust paper settings to achieve 300ppi.

No image should be created with a bit depth greater than 8-bit, unless prior arrangements have been made with the Facilities Department at BIDMC.

**5.3 Error-free AutoCAD® Drawing Deliverables:** BIDMC recognizes that many of its architects, engineers and construction managers do not use the same version of AutoCAD®. However, BIDMC expects that firms who work with other file formats will submit DWG formatted CAD files upon project closeout that are fully compliant with all of the standards outlined in this document, and which have no significant loss of drawing entities or project data that can result from standard CAD file translation procedures.

All DWG files and CAD drawing entities submitted at the end of a project must be able to be manipulated using standard AutoCAD® drafting procedures. Non-compliance with this policy may result in the rejection of CAD files submitted at project closeout in addition to delayed rendering of final project payment. DXF files will not be accepted at project closeout as a substitution for DWG CAD file deliverables.

**5.4 Translation Testing:** For firms translating their native CAD file format into AutoCAD® format and are concerned about delivering error-free CAD files to BIDMC upon project closeout, it is strongly recommended that thorough file translation testing be conducted **before** the drawing development phase of the project. This will assure early detection of file conversion issues, if any, and allow for corrective measures to be taken before the project closeout period.

**5.5 Review Period:** BIDMC reserves the right to review the final submission for up to one year after delivery and resubmit the files to the consultant for correction *at no charge* to BIDMC.