



ECE CAD & IT Guideline

Section 1:

DWG Specifications

Revision 3.0

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Change Log

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General Introduction

The ECE CAD & IT Guideline has been developed to improve the quality of Computer-Aided Design (CAD) standardization efforts within ECE. The purpose of this manual is to set a basic CAD standard to ensure consistent electronic deliverables to and within ECE.

All externally produced documents delivered to ECE must be submitted in accordance with these standards.

The ECE CAD & IT Guideline is broken down into separate sections as follow:

- Section 0 defines the general CAD organizational structure.
- Section 1 addresses the general DWG Specifications for drawings.
- Section 2 addresses the Layer standard that will be used at ECE and that should be used when creating CAD files for ECE.
- Section 3 addresses the plan- and file naming convention and shows some examples (according to the requirement and rules for usage of a project room).
- Section 4 defines basic topics around BIM models

Each section was created to stand alone. Sections 0, 1 & 2 represent the complete ECE CAD Standard. It is expected that external architectural design firms use sections 0, 1 & 2 for general CAD rules and Section 3 for file naming and file organisation in general, especially if a project room is used for a project. Section 4 is to be considered in the case of project execution according to the BIM method.

This regulation does not specify any detailed definitions for projects conducted with the BIM method. For projects in which the BIM method is used, the project specific documents Client-Information Requirement (German: AIA, Auftraggeber Informationsanforderung) and BIM-Plan of Procedure (German: BAP, BIM-Ablaufplan) are created and provided to all project participants.

Acronyms

ACA	AutoCAD Architecture
ACA 2018	AutoCAD Architecture, Version 2018
AEC	Architecture, Engineering and Construction (or Civil)
AIA	American Institute of Architects related to CAD/Layer-Context or
AIA	German: Auftraggeber Informationsanforderung in BIM-Context (English: Client-Information Requirement)
BAP	German: BIM-Ablaufplan (English: BIM-Plan of Procedure)
BIM	Building Information Modeling (Method)
CAD	Computer aided Drafting / Design
DWG	Drawing (AutoCAD file format)
ECE	ECE Projektmanagement G.m.b.H. & Co. KG
FM	Facility Management
IAI	International Alliance for Interoperability
IFC	Industry Foundation Classes
ISO	International Organization for Standardization
LEED	Leadership in Energy and Environmental Design
NCS, USNCS	United States National CAD Standard
NIBS	National Institute of Building Sciences
UDS	Uniform Drawing System

File Format

In the case of a classical, plan-oriented method of project execution, the drawings for construction projects submitted to ECE must be 100% compatible with the AutoCAD Architecture 2018 software (file extension = .DWG). The file format “Original DWG” (between release 2010 and 2018) by Autodesk is required for all work phases. When AutoCAD Architecture AEC Objects are used, the DWG file format version has to be 2018. Use of more recent versions shall be coordinated with ECE.

Throughout this document, the use of the name AutoCAD or ACA always implies “AutoCAD Architecture 2018” unless otherwise noted. File names, layers and colors in the structure and in the designation are mandatory for everyone involved in the project.

For projects in which the BIM method is used, the project specific documents Client-Information Requirement (German: AIA, Auftraggeber Informationsanforderung) and BIM-Plan of Procedure (German: BAP, BIM-Ablaufplan) are created and provided to all project participants.

Plot style mode

All drawings should be operated in “Color-Dependent” plot style mode. “Color-Dependent” plot style mode forces AutoCAD to work with “*.ctb” files (Color-Tables). Please note that drawings submitted in “Named” plot style mode will be considered an issue of non-compliance. If CAD drawings are not created in the “color-dependent plot style mode” then the contractor shall do so if requested at his own expense.

Scale & Units

All CAD drawings should be drafted at full scale in metrical units, so that one drawing unit equals one meter for all plan types of all trades if a drawing is used for planning coordination.

For explicit detail- and production drawings (or similar, stand-alone plans) it is possible to use millimeters as a drawing unit. However, such a special agreement always requires the consent of the client.

The draft-units for the paper space must be in millimeter.

2D drafting and 3D building model data

If a 3D building model exchange has not been explicitly agreed upon for the project, all objects of drafts for data exchange have to be 2D. The object height and elevation = 0 has to be secured for all draft elements.

In the case of project execution according to the BIM method, the requirements for the design and transfer of 3D building models are defined in the project-specific documents Client-Information Requirement (German: AIA, Auftraggeber Informationsanforderung) and BIM-Plan of Procedure (German: BAP, BIM-Ablaufplan)

Zero Point & World Coordinate System

The origin of the complete drawing must lie at the absolute zero point of the AutoCAD world coordinate system.

The zero point for everyone involved in the planning process is considered to be the insertion point which can be entered and named in the current drawing header. This is stipulated specifically during the initialization phase of the project. The file required for this purpose shall be distributed to everyone participating in the planning process.

As a rule, the zero point and the plot limits shall be entered in the surveyor's digital layout plan; in this case, a corresponding file shall be distributed to everyone involved in the planning process. This site plan and the corresponding zero point are considered as binding default for everyone involved in the planning process. All CAD drawings intended for transfer must be "positioned spatially" according to these details.

For each detail deriving from the file name structure (e. g. floors, levels) a separate file has to be created. It is not allowed to overlay several floors in a file by different layers or by a change in the position reference.

If a project is to be processed using the BIM method, the object planner must define the uniform use of a defined coordinate system and describe this in the BIM-Plan of Procedure (German: BAP, BIM-Ablaufplan). Project zero point and project orientation must be agreed during the test phase and must not be changed in the further course of the project. A project-specific coordinate system on the coordinates 0,0,0 and a parallel alignment of the horizontal main building axes to the project-specific "west-east" axis are recommended.

AutoCAD System variables

These AutoCAD system variables must be set to following values:

Variable	Value	Comment
MEASUREMENT	1	Controls whether the current drawing uses imperial or metric hatch pattern and linetype files. Forces usage of metric files.
INSUNITS**	6	Specifies a drawing-units value for automatic scaling of blocks, images, or xrefs inserted or attached to a drawing.
INSUNITS**	4	Specifies a drawing-units value for automatic scaling of blocks, images, or xrefs inserted or attached to a drawing.
INSBASE	0,0,0	Stores the insertion base point, which gets expressed as a UCS coordinate for the current space.

**) depending on drawing units – 4 means millimeter, 6 means meter

The global line type factor (LTFAKTOR) may vary according to demands, but the line type scaling factor of drawing objects (CELTSCALE) normally has to be left at the standard of 1.

Fonts & Text Styles

The following text fonts are the only ones approved for use. Please note that use of special fonts not included in AutoCAD or Windows XP will be considered an issue of non-compliance. The use of a Text style named "Standard" is not allowed in any case.

- Isocpeur.ttf

If a non-approved text font is used then the contractor shall exchange the text fonts if requested at his own expense and shall use one of the above mentioned text fonts.

For compatibility reasons the following textfonts are permitted for existing files supplied by ECE, but may not be used for newly created texts & objects containing text elements under any circumstances:

- Romans.shx
- Iso.shx
- Isocp.shx
- Arial.ttf

Naming convention for non-annotative Text styles

Non-annotative Text style names generally have to be derived from the respective text fonts (*.shx or *.ttf).

Example (Filename of Textfont = Text style name):

- Isocpeur.ttf = "Isocpeur"

Naming convention for annotative Text styles

Annotative Text style names generally have to be derived from the respective text fonts (*.shx or *.ttf) PLUS their default height in paper space as a suffix.

Example

(Name of Textfont & Space & Paper space height & Space & mm = "Text style name"):

- Isocpeur.shx & 1.8 = "Isocpeur 1.8 mm"
- Isocpeur.ttf & 2.5 = "Isocpeur 2.5 mm"
- Isocpeur.ttf & 3.5 = "Isocpeur 3.5 mm"

Plotted Text sizes

All texts shall be produced in four sizes (Text height when plotted). There are slight differences depending on what kind of project you are working for (new building=Project or existing building/refurbishment project=Object):

Project:

- 5.0 mm (for titles, road names, etc.)
- 3.5 mm (for axis grid)
- 2.5 mm (for room names, standard text, axis grid dimension, slope ratios, fire safety class details, leasing border, height indicators, etc.)
- 1.8 mm (parapet information, annotation of slab and wall openings, etc.)

Object:

- 5.0 mm (for titles, road names, etc.)
- 3.5 mm (for axis grid)
- 2.5 mm (for room names, standard text, axis grid dimension, notes, etc)
- 1.8 mm (for slope ratios, fire safety class details, leasing border, height indicators, etc.)

As a general rule, all Text objects should get their visual properties by the text style they are associated with. “Inside Text formatting” (e.g. Text style is Romans but all characters are formatted as Arial) is not allowed.

A template drawing shall be provided on request from the general planning engineer.

Entity properties (non-block-definition elements)

As a basic principle the entity properties for color, linetype, linewidth and transparency of each entity should be set to “ByLayer”. The Linetype scaling factor for all entities has to be set to 1. Exceptions to these principles are allowed only in special cases and have to be coordinated with the CAD-Administration of ECE.

Lineweight property and colors

Lineweights shall only be dictated by ctb files. They must not be allocated to the layer/object. Exceptions are allowed only in special cases and have to be coordinated with the CAD-Administration of ECE.

Relation of Color & linewidth = Plotstyletables

ECE has implemented the “Tri-Services Color Mappings” of the USNCS. This system follows some simple rules. The rules are as follows:

1. All AutoCAD Index colors are printed black (except 250 to 255, printed 50% black)
2. Each AutoCAD Index color is assigned to a line weight (see below)
3. Layers that should be printed in color must use a true-color value (RGB value, non-AutoCAD index color) and a defined line weight.

Normal lineweights and AutoCAD Index colors

Lineweight	One digit color	Two & Three digits colors	50% Black
0.18mm	1	All colors ending with 0, e.g. 10, 30, 240	250
0.25mm	2	All colors ending with 1, e.g. 11, 31, 241	251
0.35mm	3, 4	All colors ending with 2, e.g. 12, 32, 242	252
0.50mm	5	All colors ending with 3, e.g. 13, 33, 243	253
0.70mm	<i>not applicable</i>	All colors ending with 4, e.g. 14, 34, 244	254
1.00mm	6	All colors ending with 5, e.g. 15, 35, 245	255
1.40mm	7	All colors ending with 6, e.g. 16, 36, 246	<i>n.a.</i>
0.13mm	<i>n.a.</i>	All colors ending with 7, e.g. 17, 37, 247	<i>n.a.</i>
0.09mm	8	All colors ending with 8, e.g. 18, 38, 248	<i>n.a.</i>
2.00mm	9	All colors ending with 9, e.g. 19, 39, 249	<i>n.a.</i>

A corresponding ctb-file will be provided by ECE. There are also four alternative ctb files available, making it possible to shift the line weight per color either in two steps up or in two steps down:

Type	Filename	Lineweight Multiplier	Goal
Fine	\$ECEColors-.25-Fine.ctb	0.707 x 0.707	~ Scales > 1:500
Thin	\$ECEColors-.5-Thin.ctb	0.707	~ Scales > 1:250
Normal	\$ECEColors-1-Normal.ctb	1	~ Scales 1:50 to 1:250
Bold	\$ECEColors-x2-Bold.ctb	1.414	~ Scales < 1:50
Extra Bold	\$ECEColors-x4-ExtraBold.ctb	1.414 x 1.414	~ Scales < 1:10

Example:

If the color property of a layer is set to 63, all objects on this layer will be plotted with 0.50mm when using the "\$ECEColors-1-Normal.ctb". By replacing this ctb file with "\$ECEColors-.5-Thin.ctb" it will be plotted with 0.35mm ($0.50 \times 0.707 = 0.35$)

Linetypes

Only line types supplied with AutoCAD or additionally defined by ECE are permitted. All line types, used in a project, shall be provided as an acadiso.lin file. Standard AutoCAD linetypes are preferable. Deviations require prior written consent from the Client. On obtaining consent from the Client, the Contractor provides the Client with the elements deviating from the standard, free of charge for an unlimited period of use.

Recommended value for the global AutoCAD variable "LTSCALE" is:

Units	Ltscale value
Meters	0.05
Decimeters	0.5
Centimeters	5
Millimeters	50

(Valid if: using metric units, default AutoCAD linetypes and MSLTSCALE is set to 0)

Hatches

The necessary hatch patterns shall be provided as an acadiso.pat file as agreed. Standard AutoCAD hatch patterns are preferable. Deviations require prior written consent from the Client. Solid hatches must be created by using the "Solid" hatch pattern not by using any other pattern with extreme small scaling value.

Blocks (Block-definitions and block-references)

ECE is currently not imposing the use of any particular block definitions or block libraries. The following general rules be employed when handling block entities:

Drawing entities translated into AutoCAD blocks from non-AutoCAD systems must revert to layer 0 when exploded within AutoCAD. File translations from non-AutoCAD systems which result in non AutoCAD objects are unacceptable.

"Block in Block" structures are invalid. Exceptions are only permitted in consultation with the Client.

Block structures must not be exploded to their ORIGINS. They have to be inserted into the correct layer. Objects within block definitions should as a rule have the following properties:

- Layer: 0
- Color: ByBlock
- Linetype: ByBlock
- Lineweight: ByBlock
- Insbase: 0,0,0
- Insertion point clearly geometrically defined (e. g. centre of circle, end of a line)

Justified exceptions are acceptable but should be rare.

The use of block attributes is allowed, however the names of the attribute definitions have to be unique for each block definition.

All blocks used have to be documented in a summary:

- Block name (Names should be understandable, as short as possible and without any special characters)
- graphic specifications
- intended use

- usual scaling / unit reference (e. g. m / mm)
- attributes and their intended use

have to be named in all cases.

Dimensioning

The type of dimensioning has to be determined for each project within the initialization phase. Dimensioning types could be:

- Standard AutoCAD dimensions, annotative or non-annotative
- AEC Dimensions, annotative or non-annotative

Axis grid (optional)

The main axes are determined according to the planning in cooperation with the individual planning offices and handed over to all parties involved as files.

The typology and description of main and secondary axes as well as the position of the main axes are determined in an axis plan which is developed on the basis of the consolidated overall planning and distributed to all planners involved afterwards.

Furniture

The furniture needed for the plans (e. g. sanitary areas and flats) is chosen according to established furniture standards. If needed, standards have to be defined in a sample file showing the basic demands for the graphic design and the composition of the CAD data. Furthermore the same rules as for the above mentioned block structures apply.

Page formats, Title blocks & Margins

The maximum drawing format is: 914mm x 3200mm (Height x Width). Deviations require prior written consent from ECE. As a rule, only DIN formats shall be used. Exceptions are only permitted in consultation with the Client.

Every drawing shall have a margin as per DIN 824 including folding marks.

The title block in accordance with the design guidelines of the general planning engineer shall be provided as a file.

Each CAD file submitted to ECE should have only one title block. Depending on the purpose of the drawing, facility documentation or construction, the drawing's title block should contain certain essential information that ECE needs to store in and retrieve each drawing from its library.

Pictures (e. g. for logo) are strictly forbidden. Instead vector data and normal AutoCAD objects have to be used.

The title block should be checked, approved and distributed by ECE CAD Administration.

Consulting architects and engineers must use the ECE title block template.

At minimum, these title blocks should contain all of the information listed below.

Project Information:

- Firm Name - representing the drawing author
- Project Name - as specified by ECE
- Project Number - as specified by ECE

- Building Name - specify only if the project name does not include this information already, and the project is building specific

Drawing Information:

- Drawing Title - indicating the drawing content, e.g. floor plan, section, detail, etc.
- Drawing Number
- Date of Drawing - original drawing date including significant revision dates
- Drawing Scale - representing the intended plot scale of the drawing with title block
- North Arrow

Policy on Model Space and Paper Space

Plots have to be made only from paper space area. Thus ensuring that all layers, line types, line thicknesses and plan headers are defined correctly and that the information meant to be presented and printed is included in the layout index.

ECE requires that each CAD file submitted as a project deliverable contains only one drawing model with one title block, using either of the following setup methods.

Method #1 – Model Space and Paper Space Separated.

There are at least two files. One file contains only the building model and the other file contains just the title block and viewport(s) in paper space. The file with the model is referenced as XREF in the file with the paper space.

Method #2 – Model Space and Paper Space Combined.

Each CAD file is set up to contain only one title block & viewport(s) in paper space which references the building model contained in model space.

Policy on External Reference Files (XREFs)

Non-AutoCAD Architecture 2018 Applications

Upon the submission of states of planning set forth by contract to the ECE it is to be taken into consideration that no CAD drawings with references to external CAD drawings will be accepted. All required external drawings including the title block, the scope or raster are to be integrated in the drawing as separate block. Exclusively such complete and independent CAD drawings are accepted by ECE when a CAD-Application other than AutoCAD Architecture 2018 is used.

AutoCAD Architecture 2018 Application

Only if AutoCAD Architecture 2018 is used by a contractor, the use of external References can be agreed. If this method is used, it is very important to coordinate the precise conditions, structures and settings between all of the parties concerned. Refer to paragraph "Data exchange coordination process" in the document "Planning Directory".

Error-free AutoCAD Drawing Deliverables:

ECE recognizes that many of its construction and facility documentation service providers do not use the same CAD systems as ECE. However, ECE expects that service providers who work with non-AutoCAD file formats will submit DWG formatted CAD files upon project closeout that are fully compliant with all of the standards outlined herein, 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.

Translation Testing Recommended:

For firms translating their native CAD file format into AutoCAD format also concerned about delivering error-free CAD files to ECE 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.

Please see “Data exchange coordination process” paragraph in the “Planning Directory” for more details.

Layers

The Layer system is explained in the separate document “ECE CAD & IT Guideline, Section 2: Layer Guideline”.