3 Graphic Concepts

Presentation Graphics

The first step in establishing an effective CADD standard is the development of a uniform approach to presentation graphics. Presentation graphics typically consist of drawing elements such as lines, arcs, shapes, text, and their attributes (line color, line width, and line style). This chapter presents brief overviews of the characteristics of presentation graphics and the philosophy used to standardize them.

Line widths

Although "monotone" line work is not contractually improper, varied line widths substantially improve readability. Most commercial CADD systems provide an extensive variety of line widths. However, for the majority of A/E/C drawings, the five line widths defined in Table 8, with the optional 1.00 mm, 1.40 mm, and 2.00 mm lines, are considered sufficient and should not be expanded unless an appreciable improvement in drawing clarity or contrast can be realized. The following are typical usages for the line widths shown in Table 8:

- Fine (0.18 mm). Fine lines should be used sparingly, mostly for poche/patterning (this line thickness typically does not reproduce well in blue-line format and/or in photocopies).

- Thin (0.25 mm). Thin lines should be used for depicting dimension lines, dimension leader/witness lines, note leader lines, line terminators (arrowheads, dots, slashes), phantom lines, hidden lines, center lines, long break lines, schedule grid lines, and object lines seen at a distance.

Table 8
Comparison of Line Widths

Line Thickness	Technical Pen Designation[1]	mm	in.	MicroStation Line Weight[2]	Line Weight Example
Fine	0000	0.18	0.007	wt = 0	
Thin	000	0.25	0.010	wt = 1	
Medium	0	0.35	0.014	wt = 2	
Wide	1	0.50	0.020	wt = 3	
Extra Wide	2.5	0.70	0.028	wt = 5	
Option 1	3.5	1.00	0.040	wt = 7	
Option 2 [3]	n/a	1.40	0.055	wt = 10	
Option 3 [3]	n/a	2.00	0.079	wt = 15	

[1] Technical pen designation derived from Rapidograph and Rotring pen sizes.
[2] The weight of MicroStation lines remains constant when plotted, no matter if the design is scaled up or down.
[3] Pens not standard for ink pen plotters.

- Medium (0.35 mm). Medium lines should be used for depicting minor object lines, dimension text, text for notes/callouts, and schedule text.

- Wide (0.50 mm). Wide lines should be used for major object lines, cut lines, section cutting plane lines, and titles.

- Extra wide (0.70 mm). Extra wide lines should be used for minor title underlining, schedule outlines, large titles, and object lines requiring special emphasis. For very large scale details drawn at 3 in. = 1 ft-0 in. or larger, the extra wide width should be used for the object lines. Extra wide widths are also appropriate for use as an elevation grade line, building footprint, or top of grade lines on section/foundation details.

- Option 1 (1.00 mm). This line weight should be used for major title underlining and separating portions of drawings.

- Option 2 (1.40 mm). This line weight should be used for border sheet outlines and cover sheet line work, and as an option for the designer as required.

- Option 3 (2.00 mm). This line weight should be used for border sheet outlines and cover sheet line work and as an option for the designer as required.

Note: *AutoCAD polyline widths must be uniform throughout the extent of the line. Variable line width polylines do not translate between CADD packages.*

Line types/styles

The line types/styles selected for this standard are listed in Table 9. Only line IDs 0, 2, 7 and 11 are included in International Standards Organization (ISO) 128 (ISO 1982). The TSTC has created line style files for MicroStation and AutoCAD (called tsaec.rsc and tsaec.lin, respectively) which include the

Table 9
Standard Line Types/Styles

ID	Description	Example	MicroStation Designator	AutoCAD Designator	Dimensions[1]
0	Continuous		0	Continuous	
1	Dotted		1	ACAD_ISO07W100	0.5, -3
2	Dashed		2	ACAD_ISO02W100	12, -3
3	Dashed spaced		3	ACAD_ISO03W100	12, -18
4	Dashed dotted		4	ACAD_ISO10W100	12, -3, 0.5, -3
6	Dashed double-dotted		6	ACAD_ISO12W100	12, -3, 0.5, -3, 0.5, -3
10	Dashed triplicate-dotted		--[2]	ACAD_ISO14W100	12, -3, 0.5, -3, 0.5, -3, 0.5, -3
7	Chain		7	ACAD_ISO08W100	24, -3, 6, -3
11	Chain double-dashed		--[2]	ACAD_ISO09W100	24, -3, 6, -3, 6, -3

[1] For line type dimensions, positive numbers signify length of dashes, negative numbers signify length of spaces.
[2] This line style is not found in the default MicroStation line style resource file.

line styles in Table 9, as well as additional discipline line styles. These files are available on the Release 1.8 CD, as well as on the TSTC's Internet site at *tsc.wes.army.mil*.

Line color

The primary reason to use color in CADD drawings is to improve the clarity of the drawing on a computer monitor. However, in some CADD applications, color is also used to delineate individual layers/levels and/or define the line thicknesses of drawing elements on the final (plotted) drawing sheet.

Note: *For this standard, specific colors are assigned (standardized) to individual layers/levels, and every line color is associated with a particular line width. This procedure is normal for AutoCAD users but new to most MicroStation users.*

Note: *Future updates of* Uniform Drawing System *(CSI 1997) will address the use of color in final plotted drawings. This standard addresses only the use of color to control/define plotted line widths on black and white drawings.*

The variety of colors available in a CADD application depends on the capabilities of the computer monitor and its video card. Today, most systems are capable of displaying from 16 to 256 colors. Based on the limitations of monitor color display capabilities and differing CADD system plotting methods, this manual recommends that all A/E/C drawings be created using the basic colors presented in Table 10 whenever possible.

Note: *The recommended colors are best viewed on a monitor with a black background.*

Appendix D contains a 256-color map for the AutoCAD and MicroStation color palettes. The table maps AutoCAD's default color palette to MicroStation's default color palette. A recommended line weight is also assigned to each color. Using this table, drawings can be translated between systems with the assurance that line weights will be maintained even though the displayed color may vary. The color table is also provided for those users who require more colors than the eight recommended by this standard.

Note: *For spatial data applications such as FM and GIS, the eight-color standard is too restrictive and inadequate. Line color standards for these applications are covered in the "Tri-Service Spatial Data Standards" available from the Tri-Service CADD/GIS Technology Center (1998a).*

Table 10
Screen Color Comparison and Associated Line Widths

Color	Color Number		Line Width mm	Ratios of RGB, %		
	AutoCAD	MicroStation		Red	Green	Blue
Blue	5	1	0.18	0	0	255
Gray	8	9	0.18	128	128	128
Green	3	2	0.25	0	255	0
Red	1	3	0.25	255	0	0
Yellow	2	4	0.35	255	255	0
Magenta	6	5	0.35	255	0	255
Cyan	4	7	0.50	0	255	255
White	7	0	0.70	255	255	255

Note: Color numbers for AutoCAD and MicroStation were taken from default color tables.

Screening (halftoning)

Screened images are created through a process called halftoning in which the density and pattern of black and white dots are varied to simulate different shades of gray. Varying the intensity of gray scales allows users to distinguish different aspects of a drawing when it is plotted. For example, an area on a site designated for demolition can be assigned a color that has been assigned a screening percentage. When plotted, the area will be shown at a lighter shade compared with other elements in the drawing. This will allow the contractor to immediately identify the demolition area on the drawing.

Table 11 lists colors recommended to be used for screening along with a recommended screen-ing percentage. Using Table 11, MicroStation users can edit a plotter driver, using a text editor, to assign a screening percentage to the specific colors (see the MicroStation user's manuals for information on working with plotter/printer drivers).

AutoCAD users must specify requirements for halftones according to the output device used. Due to the number of output devices AutoCAD supports, users should consult the help documentation provided within AutoCAD for information on assigning recommended screening percentages.

Text styles/fonts

Contrasting text styles (or fonts) are used within a drawing to delineate types of information. In most A/E/C drawings, the five fonts shown in Table 12 should be sufficient.

- Monotext font. This font creates text characters that are evenly spaced. Monotext font should be used where text fields need to be aligned such as in schedules or, in some cases, title blocks. In AutoCAD, use the monotxt font and in MicroStation use Font #3.

- Proportional font. This font creates text where the characters are proportionally spaced. It is appropriate for general notes, labels, or title blocks. In AutoCAD, use the romans (Roman Simplex) font with a width factor of 0.8. In MicroStation use Font #1.

- Slanted font. A slanted font is used where text needs to be easily distinguished from other text. This font can be created in AutoCAD by using the romans font with the Obliquing Angle set to 21.8 deg to achieve the American Standard slope of 2 in 5 (68.2 deg). In MicroStation use Font #23.

- Filled font. Filled fonts are used primarily for titles and on cover sheets. For AutoCAD, the recommended font is the swiss TrueType font (Note: The TEXTFILL system variable needs to be set to "1"). MicroStation users should use Font #43 (the Microsoft arialbd.ttf font file can be used as an alternate text style for the filled font).

- Outline font. When a pen plotter is used for final output, the outline font is used as a substitute for filled fonts for major titles such as cover sheet information to save plotting time. For AutoCAD, the recommended font is the sasb (Sans Serif-bold) PostScript font. For MicroStation, use Font #42.

Plotting

Printers and plotters are controlled by files called pen tables or feature tables. These files (tables) convert thicknesses and/or color in an electronic file to line thicknesses on a paper drawing.

This manual standardizes presentation graphics as they relate to electronic drawing files (screen display) and not the final printed or plotted paper drawing. By employing pen tables, each agency can ensure that consistent drawings are produced from an electronic file regardless of the type of printer or plotter used. It is the responsibility of each field activity to develop

Table 11
Halftone Colors

AutoCAD				MicroStation			Gray Scale Ratios (RGB), percent		
Color No.	Pen Plotter mm	Laser/Elec InkJet, in.	Screen percent	Color No.	Line Weight	Screen percent	Red	Green	Blue
10	0.18	0.007	10	10	0	10	230	230	230
11	0.25	0.010	10	19	1	10	230	230	230
12	0.35	0.014	10	27	2	10	230	230	230
13	0.50	0.020	10	35	3	10	230	230	230
14	0.70	0.028	10	43	5	10	230	230	230
15	1.00	0.039	10	51	7	10	230	230	230
16	1.40	0.055	10	59	10	10	230	230	230
19	2.00	0.079	10	83	15	10	230	230	230
50	0.18	0.007	20	20	0	20	204	204	204
51	0.25	0.010	20	28	1	20	204	204	204
52	0.35	0.014	20	36	2	20	204	204	204
53	0.50	0.020	20	44	3	20	204	204	204
54	0.70	0.028	20	52	5	20	204	204	204
55	1.00	0.039	20	60	7	20	204	204	204
56	1.40	0.055	20	68	10	20	204	204	204
59	2.00	0.079	20	92	15	20	204	204	204
90	0.18	0.007	30	82	0	30	179	179	179
91	0.25	0.010	30	106	1	30	179	179	179
92	0.35	0.014	30	92	2	30	179	179	179
93	0.50	0.020	30	122	3	30	179	179	179
94	0.70	0.028	30	114	5	30	179	179	179
95	1.00	0.039	30	138	7	30	179	179	179
96	1.40	0.055	30	130	10	30	179	179	179
99	2.00	0.079	30	170	15	30	179	179	179
130	0.18	0.007	40	87	0	40	153	153	153
131	0.25	0.010	40	95	1	40	153	153	153
132	0.35	0.014	40	103	2	40	153	153	153
133	0.50	0.020	40	111	3	40	153	153	153
134	0.70	0.028	40	119	5	40	153	153	153
135	1.00	0.039	40	127	7	40	153	153	153
136	1.40	0.055	40	135	10	40	153	153	153
139	2.00	0.079	40	159	15	40	153	153	153
170	0.18	0.007	50	97	0	50	128	128	128
171	0.25	0.010	50	105	1	50	128	128	128
172	0.35	0.014	50	113	2	50	128	128	128
173	0.50	0.020	50	121	3	50	128	128	128
174	0.70	0.028	50	129	5	50	128	128	128
175	1.00	0.039	50	137	7	50	128	128	128
176	1.40	0.055	50	145	10	50	128	128	128
179	2.00	0.079	50	169	15	50	128	128	128
210	0.18	0.007	50	85	0	50	128	128	128
211	0.25	0.010	50	109	1	50	128	128	128
212	0.35	0.014	50	101	2	50	128	128	128
213	0.50	0.020	50	125	3	50	128	128	128
214	0.70	0.028	50	117	5	50	128	128	128
215	1.00	0.039	50	141	7	50	128	128	128
216	1.40	0.055	50	133	10	50	128	128	128
219	2.00	0.079	50	173	15	50	128	128	128
250	0.25	0.010	50	8	1	50	128	128	128
251	0.35	0.014	50	200	2	50	128	128	128
252	0.50	0.020	50	168	3	50	128	128	128
253	0.70	0.028	50	120	5	50	128	128	128
254	1.00	0.039	50	56	7	50	128	128	128
255	2.00	0.079	50	24	15	50	128	128	128

Table 12
Comparison of Font Types

MicroStation	AutoCAD
Monotext font **(Font #3)** ABCDEFGHIJKLMN□PQRST UVWXYZ abcdefghijklmnopqrst uvwxyz	**Monotext font** **(monotxt)** ABCDEFGHIJKLMN□PQRST UVWXYZ abcdefghijklmnopqrst uvwxyz
Proportional font **(Font #1)** ABCDEFGHIJKLMNOPQRST UVWXYZ abcdefghijklmnopqrst uvwxyz	**Proportional font** **(romans)** ABCDEFGHIJKLMNOPQRST UVWXYZ abcdefghijklmnopqrst uvwxyz
Slanted font **(Font #23)** *ABCDEFGHIJKLMNOPQRST* *UVWXYZ* *abcdefghijklmnopqrst* *uvwxyz*	**Slanted font** **(romans, obliquing angle = 21.8)** *ABCDEFGHIJKLMNOPQRST* *UVWXYZ* *abcdefghijklmnopqrst* *uvwxyz*
Filled font **(Font #43)** **ABCDEFGHIJKLMNOPQRST** **UVWXYZ** **abcdefghijklmnopqrst** **uvwxyz**	**Filled font** **(swiss)** **ABCDEFGHIJKLMNOPQRST** **UVWXYZ** **abcdefghijklmnopqrst** **uvwxyz**
Outline font **(Font #42)** ABCDEFGHIJKLMNOPQRST UVWXZY abcdefghijklmnopqrst uvwxyz	**Outline font** **(sasb)** ABCDEFGHIJKLMNOPQRST UVWXZY abcdefghijklmnopqrst uvwxyz

pen tables based on the printer/plotter used at that activity.

Border Sheets

Sheet sizes

Typical A/E/C projects (contract documents) will be prepared on A1 sheets in accordance with the ISO sheet size shown in Table 13, which also shows American National Standards Institute (ANSI) equivalents (American Society of Mechanical Engineers (ASME) Y14.1 (1995)).

The ISO A0 sheet is recommended for large maps (i.e., installation master plans and drawings for civil works projects).

Note: *Those users plotting A1 size drawings on ANSI D-size paper should reduce the width of the A1 border from 594 mm (23.39 in.) to 559 mm (22.0 in.). The length can remain the same. This revised border will fit on an ANSI D-size sheet (22 by 34 in.) and can be reproduced on standard office photocopiers.*

Title block

The TSTC recommends the use of a vertical title block placed in the right-hand margin of the border sheet as shown in Figure 11. Use of the vertical title block provides the most usable drawing space on a sheet. The vertical title block also ensures that the most prevalent and pertinent information remains at the bottom right of the sheet. In compliance with the *Uniform Drawing System* (CSI 1997), title block data will include the following:

- Designer identification block
- Issue block
- Management block
- Project identification block/sheet title block
- Sheet identification block

Note: *Local standards may modify the content of the title block but should not alter its size or configuration if possible. See the* Uniform Drawing System *for additional recommendations.*

Note: *An A1 size border sheet has been developed by the TSTC which allows for the use of professional seals in the designer identification block. This border sheet is available on the Release 1.8 CD (called A1_MOD.dwg/dgn) as well as on the TSTC's Internet site at tsc.wes.army.mil.*

Designer identification block. The designer identification block (Figure 12) contains the logo or name of the agency that designed the sheet. This space could also be expanded (by reducing the size of the issue block) to accommodate professional seals when required.

Table 13
ISO, ANSI, and Architectural Sheet Size Comparison

	Width		Length		ANSI Equivalent		Architectural Equivalent	
ISO Designation	mm	in.	mm	in.	Letter	in.	Letter	in.
NA	NA	NA	NA	NA	F	28.0 x 40.0	F	30.0 x 42.0
A0	841	33.11	1189	46.81	E	34.0 x 44.0	E	36.0 x 48.0
A1	594	23.39	841	33.11	D	22.0 x 34.0	D	24.0 x 36.0
A2	420	16.54	594	23.39	C	17.0 x 22.0	C	18.0 x 24.0
A3	297	11.69	420	16.54	B	11.0 x 17.0	B	12.0 x 18.0
A4	210	8.27	297	11.69	A	8.5 x 11.0	A	9.0 x 12.0

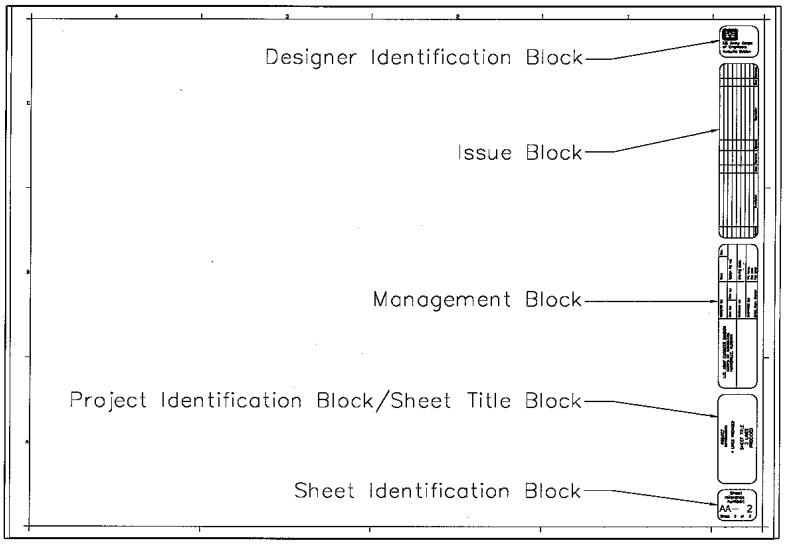

Figure 11. Sample metric drawing sheet with vertical title block

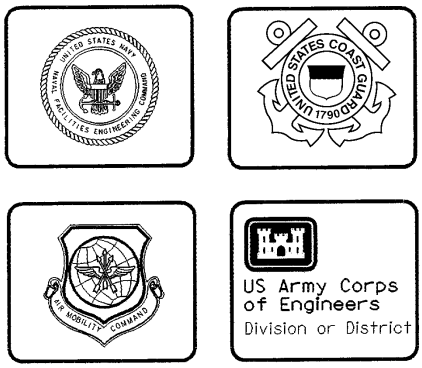

Figure 12. Designer identification block (typ.)

Issue block. The issue block (Figure 13) contains a history of revisions, addenda, and/or clarifications to the sheet. The first entry should be placed on the lower left-hand line of the issue block and subsequent entries should be made above it.

Management block. The management block (Figure 14) contains information about the designer, reviewer, and submitter. This block can also be used to maintain filing information about the drawing, such as the file name, plot scale, and drawing code (this information is sometimes plotted outside the drawing sheet cut line). If an A/E has developed the drawings, there is room for information about the firm in the lower left portion of the block.

Project identification block/sheet title block. The project identification block/sheet title block (Figure 15) contains two sets of information. First, the project name is identified, possibly with the location or phase of the project identified. If small enough, a project logo can be presented in this block. The second set of information contains a description of the content of the sheet (e.g., Architectural Floor Plan). If more than one type of information is presented on the sheet (i.e., plans, schedules, details, etc.), the most important information is identified.

Sheet identification block. The sheet identification block (Figure 16) contains the sheet identifier. This sheet identifier is composed of the discipline code/designator, the sheet type designator, and the sheet sequence number described in the section, “Electronic Drawing File Naming Conventions” (Chapter 2). The “number of sheets” listing is optional and can contain either the total number of sheets for the entire project drawing set or the number of sheets for that particular discipline code/designator.

Drawing Scales

Typical drawing scales for both SI and inch-pound measurements are indicated in Table 14.

The A/E/C CADD Standards recommend text heights for these scales in accordance with Leroy lettering sizes. Table 15 lists recommended text sizes using inch-pound scales. Table 16 lists recommended text sizes using metric scales.

Mark	Description	Date	Appr.	Mark	Description	Date	Appr.

Figure 13. Issue block (typ.)

U.S. ARMY ENGINEER DIVISION CORPS OF ENGINEERS HUNTSVILLE, ALABAMA	Designed by:	Date:	Rev:
	Dwn by: / Ckd by:	Design file no.	
	Reviewed by:	Drawing code:	
	Submitted by:	File name: Plot date: Dwg scale:	

Figure 14. Management block (typ.)

PROJECT
INFORMATION

4 LINES PROVIDED

SHEET TITLE
3 LINES
PROVIDED

Figure 15. Project identification block/sheet title block

Sheet
Reference
Number:

X-000

Sheet 0 of 0

Figure 16. Sheet identification block

Table 14
Drawing Scales

Drawing Type	Metric	Inch-Pound
Site plans	1:200	1" = 20' - 0"
	1:400	1" = 30' - 0"
	1:500	1" = 40' - 0"
	1:600	1" = 50' - 0"
	1:700	1" = 60' - 0"
	1:1000	1" = 100' - 0"
	1:2000	1" = 200' - 0"
	1:5000	1" = 400' - 0"
	1:6000	1" = 500' - 0"
	1:10000	1" = 1000' - 0"
	1:20000	1" = 2000' - 0"
Floor plans	1:50	1/4" = 1' - 0"
	1:100	1/8" = 1' - 0"
	1:200	1/16" = 1' - 0"
Roof plan	1:200	1/16" = 1' - 0"
Exterior elevations	1:100	1/8" = 1' - 0"
	1:200	1/16" = 1' - 0"
Interior elevations	1:50	1/4" = 1' - 0"
	1:100	1/8" = 1' - 0"
Cross sections	1:50	1/4" = 1' - 0"
	1:100	1/8" = 1' - 0"
	1:200	1/16" = 1' - 0"
Wall sections	1:20	1/2" or 3/4" = 1' - 0"
Stair details	1:10	1" or 1-1/2" = 1' - 0"
Details	1:5	3" = 1' - 0"
	1:10	1" or 1-1/2" = 1' - 0"

Table 15
Inch-pound Text Sizes

Leroy Lettering Sizes		60	80	100	120	140	175	200	240	290	350	425	500	1000
Decimal Inch Equivalents		0.060	0.080	0.100	0.120	0.140	0.175	0.200	0.240	0.290	0.350	0.425	0.500	1.000
		Text Sizes In Feet And Inches												
Drawing Scale =	1" = 2000'-0"	120:0	160:0	200:0	240:0	280:0	350:0	400:0	480:0	580:0	700:0	850:0	1000:0	2000:0
Drawing Scale =	1" = 1000'-0"	60:0	80:0	100:0	120:0	140:0	175:0	200:0	240:0	290:0	350:0	425:0	500:0	1000:0
Drawing Scale =	1" = 500'-0"	30:0	40:0	50:0	60:0	70:0	87:6	100:0	120:0	145:0	175:0	212:6	250:0	500:0
Drawing Scale =	1" = 400'-0"	24:0	32:0	40:0	48:0	56:0	70:0	80:0	96:0	116:0	140:0	170:0	200:0	400:0
Drawing Scale =	1" = 200'-0"	12:0	16:0	20:0	24:0	28:0	35:0	40:0	48:0	58:0	70:0	85:0	100:0	200:0
Drawing Scale =	1" = 100'-0"	6:0	8:0	10:0	12:0	14:0	17:6	20:0	24:0	29:0	35:0	42:6	50:0	100:0
Drawing Scale =	1" = 60'-0"	3:7	4:10	6:0	7:2	8:5	10:6	12:0	14:5	17:5	21:0	25:6	30:0	60:0
Drawing Scale =	1" = 50'-0"	3:0	4:0	5:0	6:0	7:0	8:9	10:0	12:0	14:6	17:6	21:3	25:0	50:0
Drawing Scale =	1" = 40'-0"	2:5	3:2	4:0	5:0	5:8	7:0	8:0	9:8	11:8	14:0	17:0	20:0	40:0
Drawing Scale =	1" = 30'-0"	1:10	2:5	3:0	3:7	4:2	5:3	6:0	7:2	8:8	10:6	12:9	15:0	30:0
Drawing Scale =	1" = 20'-0"	1:2	1:7	2:0	2:5	2:10	3:6	4:0	4:10	5:10	7:0	8:6	10:0	20:0
Drawing Scale =	3" = 1'-0"	:0.2	:0.3	:0.4	:0.5	:0.6	:0.7	:0.8	:1	:1.2	:1.4	:1.7	:2	:4
Drawing Scale =	1-1/2" = 1'-0"	:0.5	:0.6	:0.8	:1	:1.1	:1.4	:1.6	:2	:2.3	:2.8	:3.4	:4	:8
Drawing Scale =	1" = 1'-0"	:0.7	:1	:1.2	:1.5	:1.7	:2.1	:2.4	:2.8	:3.5	:4.2	:5	:6	1:0
Drawing Scale =	3/4" = 1'-0"	:1	:1.3	:1.6	:2	:2.2	:2.8	:3.2	:3.8	:4.6	:5.6	:7	:8	1:4
Drawing Scale =	1/2" = 1'-0"	:1.5	:2	:2.4	:3	:3.4	:4.2	:4.8	:5.8	:7	:8.4	:10	1:0	2:0
Drawing Scale =	3/8" = 1'-0"	:2	:2.5	:3	:4	:4.5	:5.6	:6.4	:7.7	:9.3	:11	1:1	1:4	2:8
Drawing Scale =	1/4" = 1'-0"	:3	:4	:5	:6	:7	:8.4	:9.6	1:0	1:2	1:5	1:8	2:0	4:0
Drawing Scale =	1/8" = 1'-0"	:6	:8	:10	1:0	1:1	1:5	1:7	1:11	2:4	2:10	3:5	4:0	8:0
Drawing Scale =	3/32" = 1'-0"	:8	:10	1:0	1:3	1:6	1:10	2:1	2:6	3:1	3:8	4:6	5:4	10:8
Drawing Scale =	1/16" = 1'-0"	1:0	1:3	1:7	2:0	2:3	2:10	3:2	3:10	4:8	5:7	6:10	8:0	16:0
Drawing Scale =	1/32" = 1'-0"	2:0	2:6	3:2	3:10	4:6	5:7	6:5	7:8	9:4	11:2	13:7	16:0	32:0
Drawing Scale =	FULL	:0.060	:0.080	:0.100	:0.120	:0.140	:0.175	:0.200	:0.240	:0.290	:0.350	:0.425	:0.500	1:000

Table 16
Metric Text Sizes

Leroy Lettering Sizes		60	80	100	120	140	175	200	240	290	350	425	500	1000
Millimeter Approximates		1.5	2	2.5	3	3.5	4.5	5	6	7.5	9	11	12	25
		Text Sizes In Millimeters												
Drawing Scale =	1:20000	30000	40000	50000	60000	70000	90000	100000	120000	150000	180000	220000	240000	500000
Drawing Scale =	1:10000	15000	20000	25000	30000	35000	45000	50000	60000	75000	90000	110000	120000	250000
Drawing Scale =	1:6000	9000	12000	15000	18000	21000	27000	30000	36000	45000	54000	66000	72000	150000
Drawing Scale =	1:5000	7500	10000	12500	15000	17500	22500	25000	30000	37500	45000	55000	60000	125000
Drawing Scale =	1:2000	3000	4000	5000	6000	7000	9000	10000	12000	15000	18000	22000	24000	50000
Drawing Scale =	1:1000	1500	2000	2500	3000	3500	4500	5000	6000	7500	9000	11000	12000	25000
Drawing Scale =	1:700	1050	1400	1750	2100	2450	3150	3500	4200	5250	6300	7700	8400	17500
Drawing Scale =	1:600	900	1200	1500	1800	2100	2700	3000	3600	4500	5400	6600	7200	15000
Drawing Scale =	1:500	750	1000	1250	1500	1750	2250	2500	3000	3750	4500	5500	6000	12500
Drawing Scale =	1:400	600	800	1000	1200	1400	1800	2000	2400	3000	3600	4400	4800	10000
Drawing Scale =	1:200	300	400	500	600	700	900	1000	1200	1500	1800	2200	2400	5000
Drawing Scale =	1:100	150	200	250	300	350	450	500	600	750	900	1100	1200	2500
Drawing Scale =	1:50	75	100	125	150	175	225	250	300	375	450	550	600	1250
Drawing Scale =	1:20	30	40	50	60	70	90	100	120	150	180	220	240	500
Drawing Scale =	1:10	15	20	25	30	35	45	50	60	75	90	110	120	250
Drawing Scale =	1:5	7.5	10	12.5	15	17.5	22.5	25	30	37.5	45	55	60	125
Drawing Scale =	1:2.5	3.75	5	6.25	7.5	8.75	11.25	12.5	15	18.75	22.5	27.5	30	62.5
Drawing Scale =	FULL	1.5	2	2.5	3	3.5	4.5	5	6	7.5	9	11	12	25

Dimensioning in Metric (SI)

Methodologies for dimensioning metric (SI) drawings are based upon the recommendations of the Construction Metrication Council of the National Institute of Building Sciences (NIBS), Washington, DC. These recommendations comply with the American Society for Testing and Materials (ASTM) E 621-94, "Standard Practice for the Use of Metric (SI) Units in Building Design and Construction" (ASTM 1995).

Millimeters

The preferred unit of measure for most A/E/C work is millimeters. Unit notations are unnecessary and should not be used. The dimension is provided as a whole number as shown in Figure 17. Also, a note should be added to the drawing stating, “All dimensions and/or dimensions shown in callouts/notes are in millimeters unless otherwise noted."

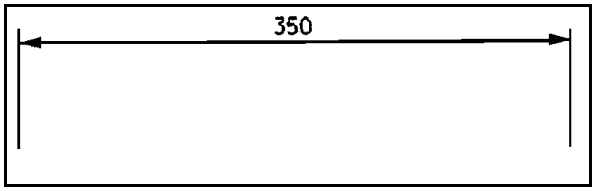

Figure 17. Dimension in millimeters. Always shown as a whole number

When meter measurements are included on the same sheet, the meter dimension is provided as a real number taken to three places past the decimal point (Figure 18). Again, unit notations are unnecessary.

Note: *In circumstances where very small dimensions are used (e.g., machine details), it is permissible to use real numbers for millimeter dimensions. A note should be placed on the detail regarding this fact.*

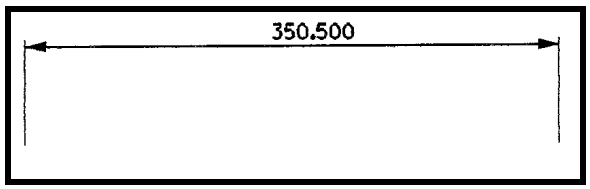

Figure 18. Dimension in meters. Always shown as a real number (with decimal)

Meters

For site plans or other drawings drawn to scales over 1:200, the unit of measure is typically meters. Where greater accuracy is required, show dimensions to three decimal places (Figure 18). A note should be added to the drawing stating, "All dimensions and/or dimensions shown in callouts/notes are in meters unless otherwise noted."

Large units of measure

Commas shall not be used when providing large units of measure; instead, a space replaces the traditional comma in numbers containing five or more digits (e.g., the number 45,000 is displayed as 45 000). In numbers containing four digits, no space is used (e.g., 5000). Both methods are shown in Figure 19.

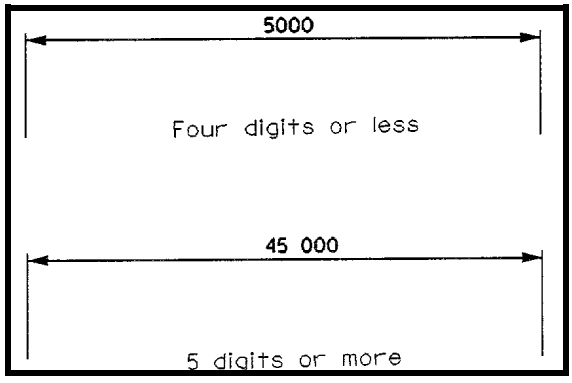

Figure 19. Proper dimension presentations for metric measurements with four or more digits

The default dimension setting for *Unit Format* in MicroStation's Default Workspace needs to be set as shown in Figure 20**.** The unit separation toggle switch needs to be turned off for dimensions less than 10000 mm; otherwise, four-digit numbers will display using the space as a unit separator (Figure 19).

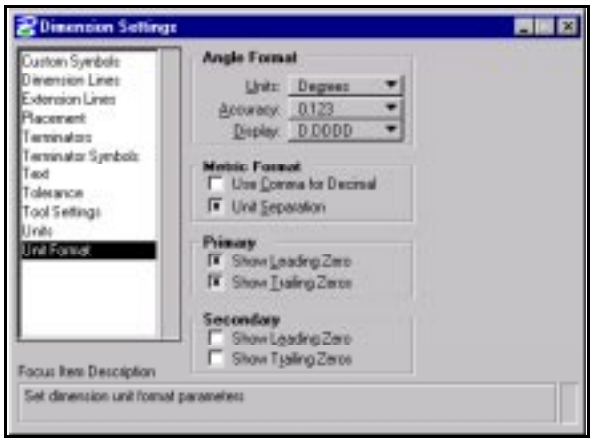

Figure 20. Unit format

Note: *The automatic dimensioning features of AutoCAD do not allow users to replace commas with spaces in dimension text. The dimension text will presently have to be edited to provide the spacing required by ASTM E 621-94 (ASTM 1995).*

Dual units

To avoid confusion, dual units (both inch-pound and metric) should not be used. As stated in Construction Metrication Council (1998), use of dual units "increases dimensioning time, doubles the chance for errors, makes drawings more confusing, and only postpones the (metric) learning process."

Exceptions to this include certain "standard building designs" where dual dimensions ensure that the design can be used in either SI or inch-pound projects and in situations where products/components used in an SI project are available only as inch-pound products.