

2.7 Lines

A. Introduction

Final Contract Plans involve a variety of line weights and line patterning to graphically provide the information needed to bid and construct a project. The line symbology developed for the Caltrans CADD system was intended to show various features with different symbology to easily distinguish them on a plan sheet, and to standardize the symbology for consistency.

More recently, line styles have been created which depict Caltrans standard line symbology, but allows an element to retain its geometry. The Caltrans standard resource file is "ctlstyle.rsc". A complete listing of all the Caltrans line styles is shown in Appendix A4 of this manual.

Line styles depict symbology for several functional units within Caltrans. For a listing containing Symbology for Design Features, Utilities and Photogrammetric Mapping Lines and Symbols, see the Caltrans Standard Plans.

In the Amendment to the Standard Specifications (5-1.04 Contract Components) it states that the written numbers and notes (callouts) on a drawing govern over graphics. So even though symbology is used to represent various design elements, the labeling or callout of a specific item takes precedence over the symbology of that item.

B. Line Weights

Line quality is extremely important to the readability of 11" x 17" Contract Plan Bid Documents. Line weights (width) are varied to distinguish certain classes of features from others. The more basic outlining features are emphasized with heavier (wider) lines (e.g., alignment lines, construction layout lines and basic outline of objects).

Medium-weight lines are used for proposed construction and Right of Way. Light-weight lines are used for existing topography, dimensioning and other less important details.

Weight	Feature	Visibility of Line
1	Object Lines	Dark, bold and sharp
0	Dimension Lines	Sharp, thin lines
0	Object Center Lines	Sharp, thin lines
1	Hidden Lines	Dark and sharp
0	Station Callout Lines	Dark, sharp and thin lines
1	Right of Way	Dark, bold and sharp
4	Sheet Borders	Heavy, dark and sharp

Weight	Feature	Visibility of Line
3*	Alignment lines for Main route(s)	Dark, bold and sharp
2*	Alignment Lines for Ramps and Local Streets	Dark, bold and sharp
1	Stationing for all Alignment Lines	Dark, bold and sharp

- * Using varying line weights allows the main route alignment to be shown more prominently than secondary alignment lines, which in turn, allows secondary alignment lines to be shown more prominently than the proposed construction lines (edge of pavement, edge of shoulder, median barriers, etc). If the weight of an alignment line obscures or interferes with proposed construction lines, the weight of the alignment line may be reduced to provide greater clarity of the work to be performed.

Examples

TYPE OF LINE	SAMPLE	WEIGHT	DESCRIPTION
LC = 0		0	Dimension Lines, object centerlines and station callout lines. Interior horizontal lines (for rows) within a quantity table.
LC = 0		1	Edge of pavement, shoulders and gutters; obliteration; resurfacing; P.I. tangent lines and interior vertical lines (for columns) and framing lines within a quantity table. Various data including drainage facilities, object lines, various details, and R/W lines.
LC = 0		2	Alignment Lines for Ramps and Local Streets. Exterior borders for quantity tables and profile grade line.
LC = 0		3	Alignment Lines for Main Route(s).
LC = 0		4	Sheet Borders.

Line Weights for Structures Design are defined (within a table) in each Structures Design seed file.

C. Line Codes

Line codes (particularly the solid line, LC = 0) depict a recognizable symbology used for the majority of features shown on the contract plans. Line codes should not be confused with line styles or linear patterning.

There are eight (8) standard line codes built into MicroStation. The seven (7) dashed lines are symbolic and are not geographic, which means the view zoom or plot scale does not affect how it looks in the monitor or when printed out. This will not happen with line styles or linear patterning.

Line Code	Sample	Definition
0	_____	Solid or continuous line. Use for proposed design elements, objects (not hidden) and dimension lines.
1	Dotted Line - sometimes used for existing features.
2	-----	Short Dashed Line – sometimes used for existing features.
3	-----	Long Dashed Line - used for depicting hidden details & existing non-structural features. Also used to show Fill (toe of slope).
4	- . - . - . - .	Dash – Dot.
5	-----	Medium Dashed Line - used to show Cut (top of cut).
6	-----	Dash-Dot-Dot – used to show existing structural features.
7	-----	Long Dash-Short Dash – used to show object centerlines.

D. Dashed Lines

Dashed lines sometimes represent existing information. Other times they allow for a different symbology to be used to graphically distinguish one item of work from another. Dashed lines may represent a variety of miscellaneous uses like easements, environmentally sensitive areas or various boundary lines. Dashed lines may be line codes, line styles or linear patterning. When dashed lines are used, they MUST be labeled for the specific use or item it is graphically representing.

E. Line Styles and Linear Patterning

1. Overview

In most circumstances, line styles are replacing the need for linear patterning. Line styles allow the user to modify the line style directly while linear patterning requires the user to drop the pattern back to the original line/line string, modify the line/line string and then re-pattern it. Also, larger design files are created when linear patterning is used.

With the latest versions of Interplot, to place, display and plot line styles, the individual workstation (computer) must have the line style resource file loaded on it. Line styles are not part of the design file, unlike linear patterning (cells). With earlier versions of Interplot, to plot line styles the line style resource file must also be loaded on the plot server.

Caltrans roadway software (CAiCE) does not display line styles, as it is restricted to displaying just eight (8) different line codes. If there are more than eight (8) line styles in a design file, CAiCE then reuses and repeats the 8 line codes in an attempt to display the additional line styles.

When using line styles, CAiCE needs to use the positive ID value (line style code) of each line style. Every line style in the Caltrans Line Style resource file, "ctlstyle.rsc", has a positive ID value. When line styles are placed in CAiCE using the positive ID value and then exported to MicroStation, a translation table (mdgntype.tbl) is referenced and the appropriate line style is defined and displayed correctly in the MicroStation file. See Appendix A4 for positive ID values for each line style.

2. Scale Factor for Line Styles

- For U.S. Customary Units (English) Projects:

The base scale for English is 1" = 50', which expressed as a **ratio** is 1:600. **1" = 50' * 12"/1'** is really a ratio of **1:600**. The ratio now makes the English base scale compatible with the Metric base scale.

The **Caltrans Scale Factor** is determined by the formula:

$$\text{Scale Factor} = (\text{desired scale} / \text{base scale})$$

There is only one Caltrans line style resource file (ctlstyle.rsc) and it is based on the Metric base scale 1:500. Thus for English projects, an English Scale Factor needs to be applied to all line styles when placing any line style in an English DGN file. This English Scale Factor has three parts; a ratio, the Caltrans scale factor and the Metric-to-U.S. Customary Units (M2E) Conversion Factor:

Convert English Scale to Ratio
Base scale = 1:500 (Metric)
M2E Conversion Factor = 3937/1200

English Scale Factor Formula =
Ratio / Metric base scale x M2E Conversion Factor

Example 1: for a 1"=20' scale drawing (1" = 20' * 12"/1' = 1:240 ratio)

Caltrans Scale Factor = 240/500 = 0.48

M2E Conversion Factor = 0.48 x 3937/1200 = **1.5748**

Example 2: for a 1"=50' scale drawing (1" = 50' * 12"/1' = 1:600 ratio)

Caltrans Scale Factor = 600/500 = 1.2

M2E Conversion Factor = 1.2 x 3937/1200 = **3.937**

Example 3: for a 1"=100' scale drawing (1" = 100' * 12"/1' = 1:1200 ratio)

Caltrans Scale Factor = 1200/500 = 2.4

M2E Conversion Factor = 2.4 x 3937/1200 = **7.874**

- For Metric Projects:

All that is needed to set the proper scale factor in a Metric DGN file is to use the Caltrans scale factor as shown below:

Scale Factor = desired scale / base scale

Example 4: for a 1:200 scale drawing

Scale Factor = 200 / 500 = **0.4**

Example 5: for a 1:500 scale drawing

Scale Factor = 200 / 500 = **1.0**

Example 6: for a 1:1000 scale drawing

Scale Factor = 1000 / 500 = **2.0**

F. Line Symbology

The following table describes and shows some of the line symbology for utilities that are used to prepare final contract plans as well as utility verification maps. A complete listing and display of all the Caltrans Line Styles are shown in Appendix A4 of this manual. Some of the Caltrans line styles are also shown in the Caltrans Standard Plans.

One major change that has occurred with line symbology concerns utilities. The current leveling convention standard for existing utilities in a pre-V8 MicroStation file is level 5, while level 40 is for proposed utilities (this was set years ago by Photogrammetry). This standard still stands in a pre-V8 MicroStation file. But level 5 is a dropout level, prompting many districts to move existing utilities to a non-dropout level in order to make the existing utilities more legible on the final contract plans. To accommodate this desire for the districts, a symbology was needed to differentiate the proposed utilities from the existing. There are now two graphical distinctions between proposed and existing utilities.

The two differences are as follows:

1. Proposed utilities will have uppercase letters within the symbology of each utility while existing utilities will have lowercase letters.
2. Proposed utilities will be shown thicker (wider) than existing utilities. The suggested width of the utility lines is a weight of 3 for proposed and a weight of 1 for existing. Depending on the plotting scale and how crowded the contract plan sheet is, the widths can be adjusted to better show the information (such as a weight of 2 and a weight of 0). The important factor that must be graphically shown is the difference in width between the proposed and existing utilities (with the proposed utility always shown thicker).

EXAMPLES OF UTILITIES SYMBOLOGY

	Underground electric line (Proposed).
	Underground electrical line (Existing)
	Overhead electrical line (Proposed).
	Overhead electrical line (Existing).

If, in the future, utility verification maps need to be plotted in color for the utility companies, the colors have been established. The line styles depicting utilities have been created to default to those established colors. A cell in the Caltrans Cell Library (ctcellib.cel) shows the proper color for the various utilities. The name of the cell is "autil". The color yellow is not used because it plots so poorly and is not legible. The colors are as follows:

Color Number	Color Value	Utility Type
0	White	Joint (Overhead or Trench)
1	Blue	Water
2	Green	Gas
3	Red	Electrical
5	Purple	Telecommunications
6	Orange	Sewer
7	Brown	Oil

Note: The Caltrans standard color table "ctcolor.tbl" must be used for proper color values to be displayed.

G. Leveling Convention for a Full V8 MicroStation Design File

To accommodate the future utilities database in each district, each Caltrans line style representing a specific type of utility will now be placed on its own level in a full V8 MicroStation design file. For more information on the leveling convention standard for utilities, see Section 2.4 or Appendix A9 of this manual.

The levels for utilities are located on level slot numbers 812 to 849. All utilities (whether existing or proposed) are on non-dropout levels. If the decision is made to show existing utilities as dropped out, the color should be changed per Section 2.8 of this manual to obtain the dropped out plotting effect. Any line style representing a utility is to remain on its Caltrans standard designated level. Do not move any utility to an "undefined dropout level" to obtain the dropped out plotting effect.