



User's Manual

Tecplot Focus 2023 Release 2

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Part 1 Introduction to Tecplot Focus

1

Introduction

Tecplot Focus is a powerful tool for visualizing a wide range of technical data. It offers line plotting, 2D and 3D surface plots in a variety of formats, and 3D volumetric visualization.

The user documentation for Tecplot Focus includes these resources:

- [User's Manual](#) (this document) - This manual provides a complete description of working with Tecplot Focus features.
- [Scripting Guide](#) - This guide provides Tecplot macro command syntax and information on working with macro files and commands.
- [Quick Reference Guide](#) - This guide provides a handy reference for dynamic text, macro variables, keyboard shortcuts, special characters, and more.
- [Data Format Guide](#) - This guide provides information on outputting simulator data to Tecplot Focus file format.
- [Installation Guide](#) - These instructions give a detailed description of how to install Tecplot Focus on your system.
- [Release Notes](#) - These notes provide information about new and/or updated Tecplot Focus features.

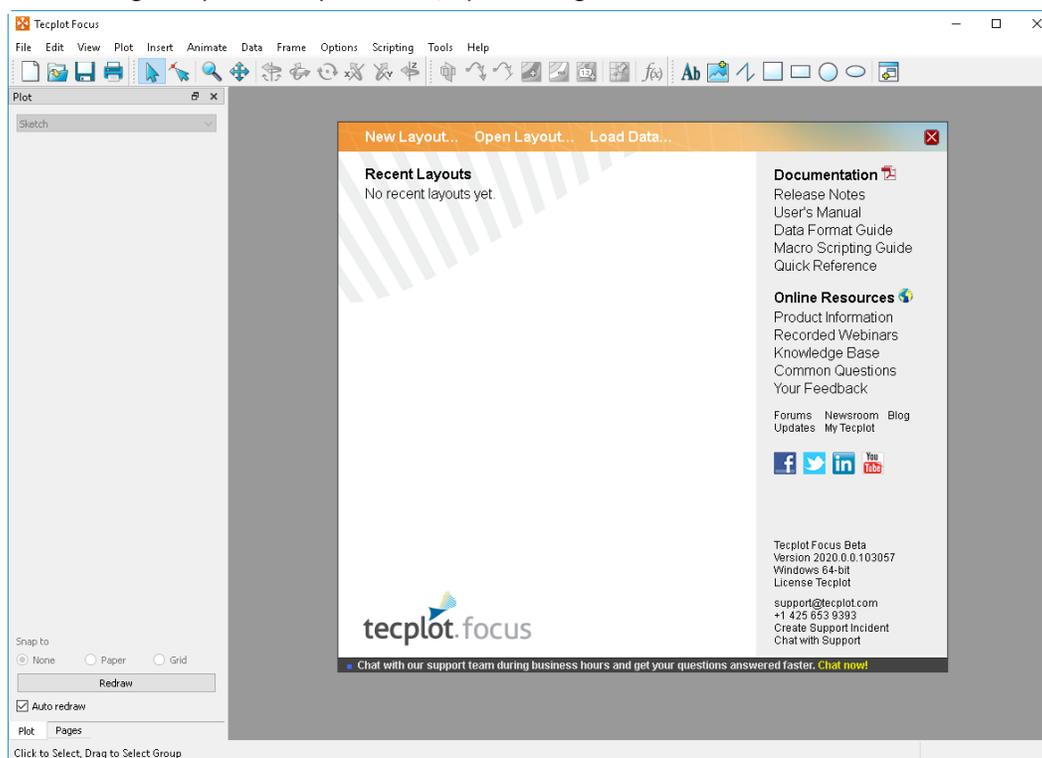
1 - 1 Tecplot Focus vs. Tecplot 360 EX

Tecplot Focus is based on Tecplot 360 EX, Tecplot's flagship visualization product, and has much of the same power. If you need any of the following features, we suggest you consider Tecplot 360 EX.

- The ability to load data files containing more than 5 million data points
- CFD analysis tools, found on the Tecplot 360 EX Analyze menu, including integration capabilities
- Access to Tecplot's new high-performance subzone data file format, *.szplt*
- Data loaders for CFD data formats such as Fluent, FLOW-3D, EnSight, ANSYS, OpenFOAM, and more through native data loaders
- The ability to load data files containing face-based (polygonal and polyhedral) zones
- The ability to extract a blanked zone

1 - 2 Welcome Screen

When you start Tecplot Focus, the Welcome Screen, shown below, appears. You can also open it at any time (even while working on a plot in Tecplot Focus) by choosing **View>Welcome Screen**.



The Welcome Screen contains links that help you quickly get started working with your data and Tecplot Focus.

- Across the top are links for creating a new layout and for opening existing layouts and data files.
- The left section provides a list of layouts you have recently worked with.
- The right column contains links to documentation and other resources to help you get the most out of Tecplot Focus.
- At the very bottom of the right column is information for contacting Technical Support, including the version and platform information you will need for a support incident.

The Welcome Screen automatically disappears when you open a layout or create a new one. You may also close it manually by clicking the red X button in the upper right corner; this returns you to your existing layout if you have chosen **View>Welcome Screen** while you were working with a plot.

1 - 3 Input Devices

Tecplot Focus supports the following input devices:

- **Standard mouse** - Used for pointing at, selecting, and manipulating objects in the workspace; changing the view; choosing fields and manipulating controls in dialogs and sidebars; and performing actions or commands using the toolbar or menus. Most mice have multiple buttons and a scroll wheel, which provide quick access to specific functions.
- **Keyboard** - Used for entering data and text and for activating commands using menu shortcuts. In conjunction with a mouse, can be used to switch modes when clicking or dragging.

- **3D mouse** - A secondary input device that allows 3D Cartesian plots to be zoomed, translated, and rotated with a touch. Additionally, the always-active 3D mouse doesn't make you select mouse modes, commands, or keyboard shortcuts. A 3D mouse can therefore enable faster exploration of your data and improve the experience of working with your 3D plots.



Tecplot Focus supports 3D mouse products from 3Dconnexion, such as the SpaceMouse, SpaceNavigator, and SpacePilot lines, and only on the Windows platform.

Actions available with a 3D mouse include:

- **Translation** - Push the mouse cap left or right, pull it up, or push it down, to translate the plot left/right or up/down on the screen.
- **Zooming** - Push the mouse cap toward you or away from you to zoom the plot. Hold down the Alt key while zooming to switch zoom methods.

The default zoom method depends on whether the current frame's 3D view mode is perspective or orthographic (see [Section 7 - 4.6 "Three-dimensional View Details"](#) on page 145). The results of zooming using the 3D mouse and the Alt key are shown here.

Pushing or pulling mouse cap	In perspective mode	In orthographic mode
Normal (without Alt key)	Changes view distance	Changes view width
Alternate (pressing Alt key)	Changes view width	Changes view distance

- **Rotation** - Rotation is around the defined center of rotation, by default the center of the data. However, the axis of rotation is relative to the screen rather than to the data.
 - *X axis* - Tilt the mouse cap forward or back to rotate around the screen's X axis, as if rolling your plot toward you or away from you.
 - *Y axis* - Twist the mouse cap clockwise or counterclockwise to rotate around the screen's Y axis, as if on a lazy susan.
 - *Z axis* - Tilt the mouse cap left or right to rotate around the screen's Z axis, like the hands of a clock.

With practice, it is possible to perform more than one of these operations at the same time. At first, though, it is best to be careful to invoke only one function at a time.

Most 3D mice also have one or more buttons, which can be mapped to commands that you use frequently using the software provided with the device.



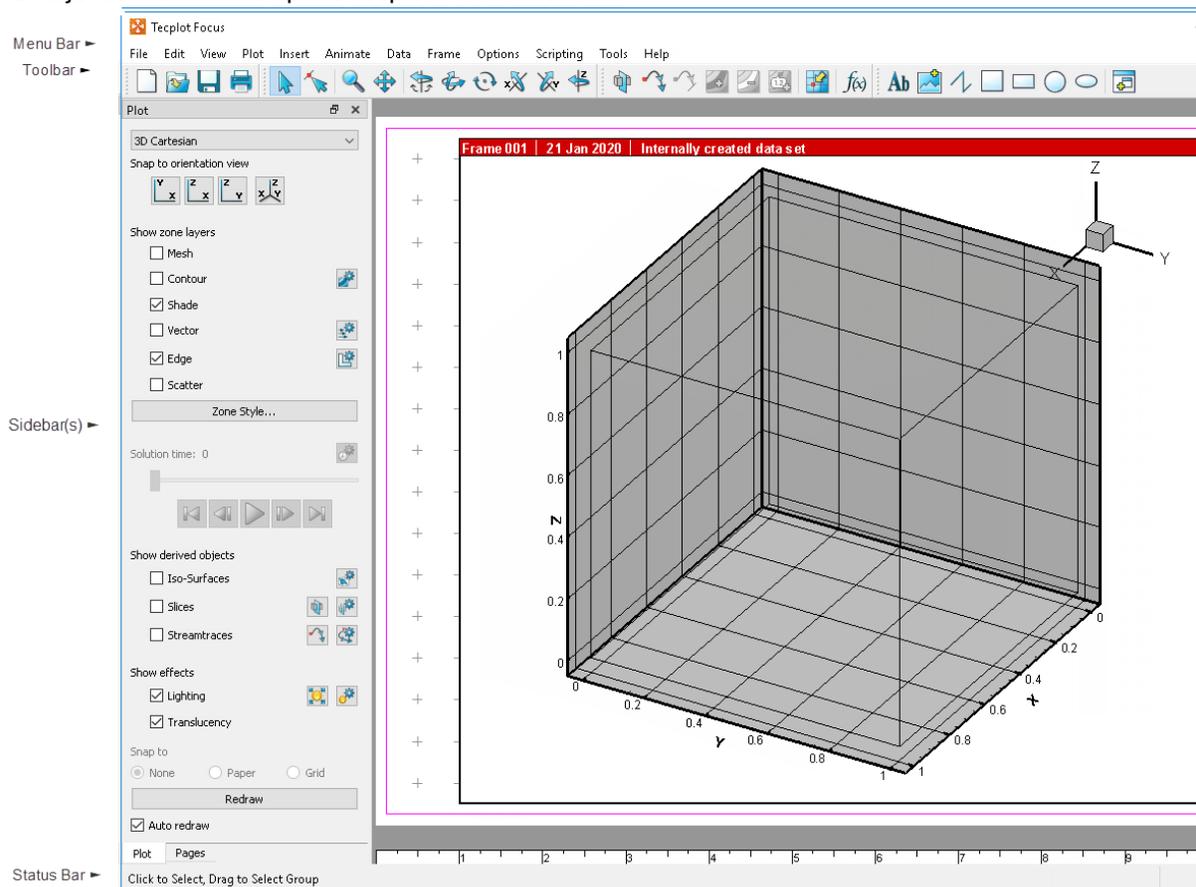
An area of interest can be inspected in greater detail from any angle if the origin of rotation is assigned to it. Mapping the "o" key (orientation change) to a 3D mouse via the device GUI may facilitate a more natural workflow. Simply point the regular mouse cursor at the area of interest and press the orientation change button.

Tecplot Focus supports the following actions (built-in to the 3D mouse software) that may be mapped to buttons using the device software:

- Fit (same as **View>Fit Surfaces**)
- Front, Back, Top, Bottom, Left, and Right View
- Isometric View 1 (Tecplot Focus default view) and 2 (theta 180° from default)
- Roll CW and CCW (in 90° increments)

1 - 4 Interface

Five major sections make up the Tecplot Focus interface.



1 - 4.1 Menu Bar

The menu bar offers access to Tecplot Focus features.

File Edit View Plot Insert Animate Data Frame Options Scripting Tools Help

Tecplot Focus's features are organized into the following menus:

- **File** - Use the **File** menu to read or write data files and plot layouts, and print and export plots.
- **Edit** - Use the **Edit** menu to select, undo, cut, copy, paste, and delete objects, and to change the draw order for selected items.



Generally, **Cut**, **Copy**, and **Paste** of items other than text work only within Tecplot Focus. You can, however, copy an image of a selected frame or the text of a selected text object to the clipboard. See ["Clipboard Exporting to Other Applications"](#) on page 322.

- **View** - Use the **View** menu to manipulate the way your data is shown or to open a sidebar or the Welcome Screen. See ["View Modification"](#) on page 47.
- **Plot** - Use the **Plot** menu to control the style of your plots. The menu items available depend on the active plot type (chosen in the Plot sidebar).

- **Insert** - Use the **Insert** menu to add text and geometries (polylines, squares, rectangles, circles, and ellipses). If you have a 3D zone, you may also use the **Insert** menu to insert a slice. If the plot type is set to 2D or 3D Cartesian, you may insert a streamtrace.
- **Animate** - Use the **Animate** menu to create animations of your plot.
- **Data** - Use the **Data** menu to create, manipulate, and examine data. Types of data manipulation available in Tecplot Focus include zone creation, interpolation, triangulation, and creation or alteration of variables.
- **Frame** - Use the **Frame** menu to create, edit, and control frames.
- **Options** - Use the **Options** menu to control your Tecplot Focus experience, including rulers, grids, and performance.
- **Scripting** - Use the **Scripting** menu to play or record macros, and to access the **Quick Macros Panel**.
- **Tools** - Use the **Tools** menu to launch an add-on.
- **Help** - Get help for Tecplot Focus features, or view the About dialog, which contains version and platform information.

1 - 4.2 Context Menu and Toolbar

In many places within Tecplot Focus, clicking with the right mouse button displays a *context menu* that gives you quick access to just the operations most relevant to what you're clicking. Often, these operations are also available in some other way, such as using a toolbar button, the pull-down menus, or a dialog.

In the Tecplot Focus workspace, the following objects have context menus with the specified functions:

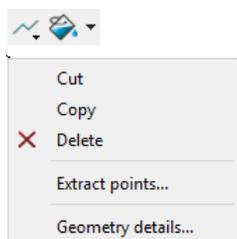
- *Frames* - Change frame order, load and save frame style, frame details
- *Axis* - Axis settings
- *Slices* - Hide, edit slice details, extract slices, slice style
- *Iso-surfaces* - Hide, choose variable, edit iso-surface details, extract surfaces, change iso-surface style
- *Zones* - Hide, deactivate, zone style
- *Streamtraces* - Extract, delete, streamtrace settings
- *3D orientation axis* - Hide axis, axis settings
- *Line maps* - Deactivate, copy, change curve type, mapping style, Fourier transform (when applicable), show curve details on plot; write curve details or data to file
- *Legends* - Hide, change box type, legend settings
- *Geometries (shapes)* - Change line and fill color, delete, edit geometry settings. For polylines, you may also extract data along the line.
- *Text* - Change color, cut, copy, delete, align(left, right, center, top, bottom), text settings.



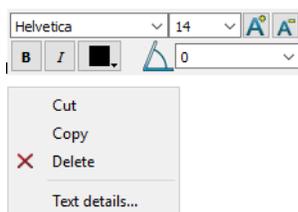
When working with zones, slices, and iso-surfaces, a context toolbar appears above the context menu. This toolbar allows you to turn on or off the grid, contour, vector, shade, edge, and translucency layers for the selected object(s) by clicking the icons. (Iso-surfaces do not have vector or edge layers.) Additionally, you may adjust frequently-used style settings for each layer using the drop-down menu to the right of each icon, for example selecting a color for the grid (or choosing a variable by which to color it).



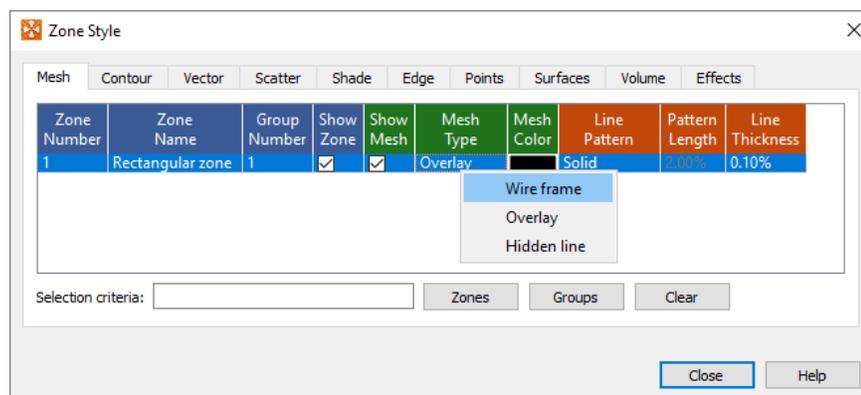
A different context toolbar appears when you right-click a line in XY or polar line plots. This toolbar allows you to turn on or off the line, symbol, and error bars for the selected line map by clicking the icons. You can also adjust the attributes of these (for example, line color, symbol shape, or error variable) using drop-down menus to the right of each icon.



When a geometry object is right-clicked, the Geometry context menu appears. This menu allows you to Cut, Copy, Delete the object as well as adjust the line and fill attributes. When multiple geometries are selected, the Alignment of the objects can be adjusted as well.



Right-clicking on a Text object brings up the Text context menu. This menu allows you to Cut, Copy, Delete the object as well as change the alignment or open the Text details dialog. You can also adjust the text attributes such as bold, italics, color, and text angle.



In some places, such as in the Mapping Style and Zone Style dialogs, right-clicking is the primary way to alter the displayed data.



The right mouse button is also used for translating (moving) the plot. This doesn't conflict with its use for context menus. The context menu appears when you right-click without moving the mouse; *dragging* with the right mouse button performs the translation operation.

1 - 4.3 Sidebars

Tecplot Focus's three main sidebars provide easy access to frequently-used functionality:

- [Plot Sidebar](#) - Includes controls for manipulating the appearance of your plot.
- [Pages Sidebar](#) - A list of the pages currently open, allowing you to switch between them, and to create, rename, and delete pages.
- [Frames Sidebar](#) - A list of the frames in the current page, allowing you to easily manage their order and other characteristics.

Initially, the Plot and Pages sidebars appear "docked" on the left side of the workspace—attached to the left side of the plot area. The Frames sidebar is initially hidden, but appears on the left side of the workspace when enabled using the **View** menu.

Any visible sidebar may be moved to the right side of the workspace, or even dragged out of the workspace entirely (for example, to move it to another display) by dragging its title bar.

When more than one sidebar is docked to the same side of the workspace, they can be combined in two ways:

- **Tabbed panels** - Only one sidebar is visible at a time; tabs appear at the bottom of the sidebar are to choose which sidebar you want to use. This is the default mode; the screen image in [“Interface”](#) on page 19 shows how this looks.
- **Sharing space vertically** - Both sidebars are visible at the same time. You can drag the boundary between the two sidebars to adjust the proportion of the space used by each.

Which style is used depends on where you dock the second sidebar: drag to the top or bottom of the already-docked sidebar to split the area, or drag to the middle to combine them and use tabs to switch between them.

Additional sidebars are available for certain other features throughout Tecplot Focus. For example, the [Quick Macro Panel](#) is a sidebar that initially appears docked to the right side of the workspace. Like the other sidebars, it may be "torn off" from the window or share space with another sidebar. The [Probe Sidebar](#) is another; it displays the results of probe operations.

Any sidebar may be closed if it is in your way. To open it again, choose the desired sidebar from the appropriate menu, or right-click any sidebar or the menu bar and choose the desired sidebar from the context menu.

Sidebar	Menu Command
Plot	View>Plot sidebar
Pages	View>Pages sidebar
Frames	View>Frames sidebar
Probe	Data>Probe sidebar
Quick Macro Panel	Scripting>Quick Macros

Plot Sidebar

The controls available in the Plot sidebar depend on the plot type of the active frame. For 2D or 3D Cartesian plot types, you can show or hide zone layers, and zone effects, and derived objects from your plot. For line plots (XY and polar) you can show or hide mapping layers.

You can open the Plot sidebar from the **View** menu if it is not currently visible. To customize your plot, simply:

- Select a plot type from the [Plot Types](#) drop-down menu.
- Use the toggle switches to add or subtract [Zone Layers/Map Layers](#), or [Zone Effects](#), or [Derived Objects](#). Use the **Zone Style/Mapping Style** dialogs to further customize your plot by showing or

hiding zones in specific plot layers/mappings, changing the way a zone or group of zones is displayed, or changing various plot settings.

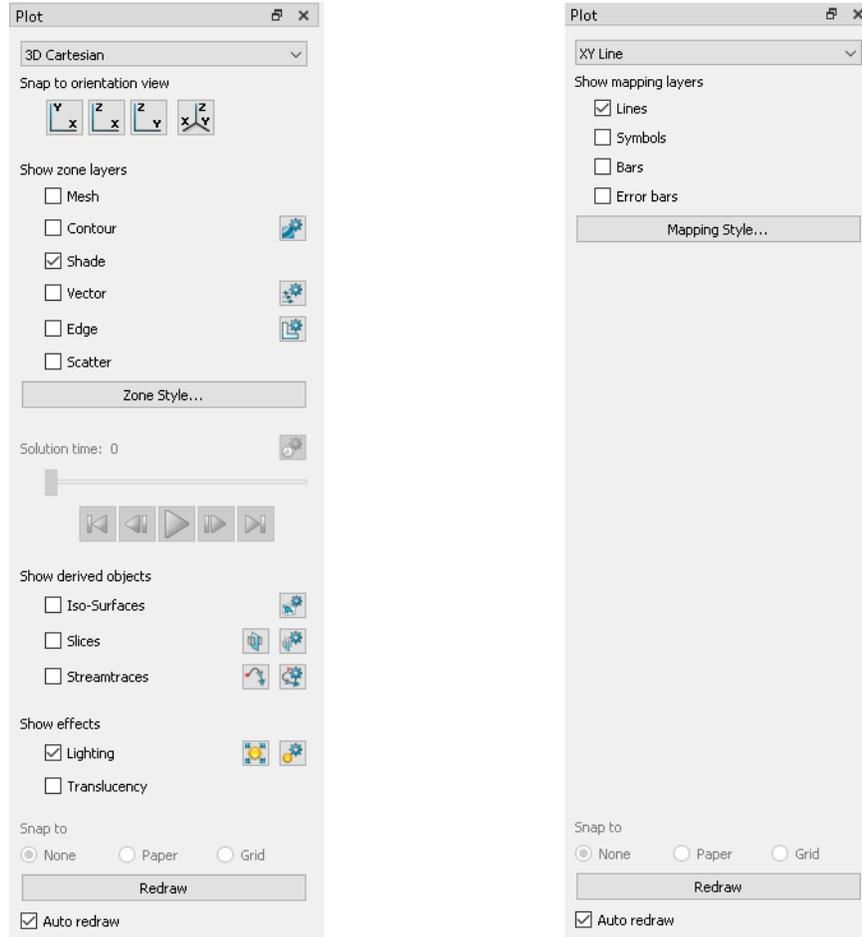


Figure 1-1. The Plot sidebar as it appears for a 3D Cartesian plot (left) and XY Line plot (right).

Plot Types

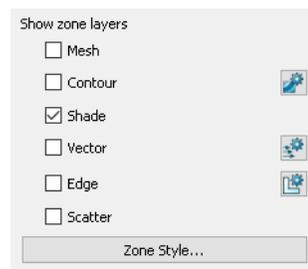
The Plot Type, combined with a frame's dataset, active layers, and their associated attributes, define a plot. Each plot type represents one view of the data. There are five plot types available:

- **3D Cartesian** - 3D plots of surfaces and volumes.
- **2D Cartesian** - 2D plots of surfaces, where the vertical and horizontal axis are both dependent variables (i.e. $x = f(A)$ and $y = f(A)$, where A is another variable).
- **XY Line** - Line plots of independent and dependent variables on a Cartesian grid. Typically the horizontal axis (x) is the independent variable and the y -axis a dependent variable, $y = f(x)$.
- **Polar Line** - Line plots of independent and dependent variables on a polar grid.
- **Sketch** - Create plots without data such as drawings, flow charts, and viewgraphs.

Zone Layers

A layer is a way of representing a frame's dataset. The complete plot is the sum of all the active layers, axes, text, geometries, and other elements added to the data plotted in the layers. The six zone layers for 2D and 3D Cartesian plot types are:

- **Mesh** - A grid of lines connecting the data points within each zone.
- **Contour** - Iso-valued lines, the region between these lines can be set to contour flooding.
- **Shade** - Used to tint each zone with a solid color, or to add light-source shading to a 3D surface plot. Used in conjunction with the Lighting zone effect you may set Paneled or Gouraud shading. Used in conjunction with the Translucency zone effect, you may create a translucent surface for your plot.
- **Vector** - The direction and magnitude of vector quantities.
- **Edge** - Zone edges and creases for ordered data and creases for finite element data.
- **Scatter** - Symbols at the location of each data point.



Zone Style

Select the [Zone Style] button to launch the **Zone Style** dialog. The **Zone Style** dialog is used to customize the zone layers that you have added to your plot. Refer to the chapter for each zone layer for details on working with the **Zone Style** dialog.

Transient Controls

When working with transient data, simply press the Play  button in the Plot sidebar to animate over time. The active frame will be animated from the Current Solution Time to the last time step. You may also drag the slider to change the Current Solution Time of your plot.



The Animation Controls have the following functions:

-  - Jumps to the Starting Value. (Keyboard: Home)
-  - Jumps toward the Starting Value by one step. (Keyboard: Left arrow)
-  - Runs the animation as specified by the 'Operation' field of the **Time Details** dialog. The Play button becomes a Pause button while the animation is playing. (Keyboard: Space bar)
-  - Jumps toward the Ending Value by one step. (Keyboard: Right arrow)
-  - Jumps to the Ending Value. (Keyboard: End)

Use the  button to launch the **Time Details** dialog.

See [Section 7 - 2 "Time Aware"](#) for more information on Time controls and the **Time Details** dialog.

Derived Objects

For Cartesian plot types (2D and 3D): Toggle-on Iso-surfaces, Slices, or Streamtraces from the Plot sidebar to add any or all of these elements to your plot. For convenience, the tool buttons for Slices and Streamtraces also appear here. The **Details** dialogs for each of the derived objects can be accessed via their respective buttons (, , ). Refer to [Chapter 16: "Iso-surfaces"](#), [Chapter 14: "Slices"](#), or [Chapter 15: "Streamtraces"](#) for details on working with these objects.



Zone Effects

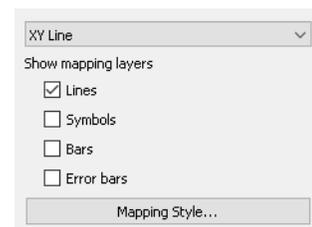
For 3D Cartesian plot types, use the Plot sidebar to turn lighting and translucency on or off. Only shaded and flooded contour surface plot types are affected. Refer to [Chapter 12: “Shade Layer”](#) and [Chapter 13: “Translucency and Lighting”](#) for additional information.

Map Layers

A layer is a way of representing a frame's dataset. The complete plot is the sum of all the active layers, axes, text, geometries, and other elements added to the data plotted in the layers.

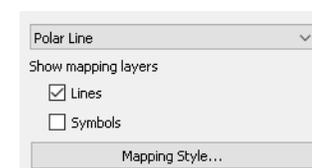
The four XY Line map layers are:

- **Lines** - Plots a pair of variables, X and Y, as a set of line segments or a fitted curve.
- **Symbols** - A pair of variables, X and Y, as individual data points represented by a symbol you specify.
- **Bars** - A pair of variables, X and Y, as a horizontal or vertical bar chart.
- **Error Bars** - Allows you to add error bars to your plot.



The two map layers for Polar Line are:

- **Lines** - A pair of variables, X and Y, as a set of line segments or a fitted curve.
- **Symbols** - A pair of variables, e.g. X and Y, as individual data points represented by a symbol you specify.



Select the [Mapping Style] button to launch the **Mapping Style** dialog. The **Mapping Style** dialog allows you to customize the style settings for each of the plot layers and specify the points to plot. The pages of the dialog are discussed in detail in [Chapter 6: “XY and Polar Line Plots”](#).

Snap Modes

Snap modes allow you to easily place objects at convenient reference points, either on the axis grid or on the workspace paper. Most movable objects (including text, images, geometries, frames, axes, legends, and the orientation axis) can be snapped. Data points in zones and line maps are also subject to snap modes when being adjusted.

The snap controls in the Plot sidebar become available when such objects are selected using the Selector  or the Adjustor , or, in the case of text and geometries, when they are being placed initially using the appropriate tool.

- **None** - No snapping is performed; objects may be positioned freely.
- **Snap to Grid** - Constrain object movement to whole steps on the axis grid as defined in the Grid page of the Axis Details dialog (**Plot>Axis**); see [Axis Grid Options](#). This can be useful for aligning objects with points of interest in a plot.
- **Snap to Paper** - Constrain object movement to whole steps on the paper's grid as defined in the Ruler/Grid dialog (**Options>Ruler/Grid**); see [Grid and Ruler Set-Up](#). This can be useful for positioning frames precisely for printing, or for absolute positioning of text, geometries, and other plot elements.

One or the other of the snap modes may be unavailable depending on the plot type or the kind of object being moved. For example, a frame cannot be aligned to the grid because it *contains* the grid, so the Grid snap mode is disabled when moving a frame.

Redraw Buttons

The redraw buttons allow you to keep your plot up to date: Clicking the middle mouse button redraws the current active frame.

Auto Redraw

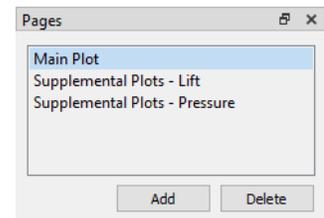
Use Auto Redraw - When selected, the plot will be automatically redrawn, whenever style or data changes. Some users prefer to turn this option off while setting multiple style settings and then manually press the [Redraw] or [Redraw All] button on the Plot sidebar to see a full plot.



You can interrupt an auto-redraw at any time with a mouse click or key press.

Pages Sidebar

In Tecplot Focus, a page is a container for any number of frames, each of which is a container for a plot. A layout can contain any number of pages (although many layouts contain only one). You can use the Pages sidebar to see the pages in the current layout, to choose which page is displayed in the workspace, and to create, rename, and delete pages.



The Pages sidebar may be opened from the View menu if it is not currently visible. In the Pages sidebar, you may:

- Click **Add** to add a new page. The new page is initially named "Untitled."
- Click a page to view it in the workspace. Only one page is visible at a time.
- Double-click a page to specify or change its name. The name becomes editable in the sidebar; simply type the new name, then press Enter.
- Click **Delete** to delete the active page.



The **Cut**, **Copy**, and **Paste** commands on the Edit menu can be used to move or copy frames between pages. Click a frame border to select it, copy or cut it to the clipboard, then switch to the destination page using the Pages sidebar and paste it.

Frames Sidebar

The Frames sidebar allows you to manage the frames on the current page, including activating and ordering them, which is particularly useful when you have many overlapping frames on a page. It is initially hidden, but may be opened from the **View** menu. See [Section 2 - 3 "Frames"](#) on page 38 for more information on working with frames.

1 - 4.4 Toolbar

Each of the tools represented in the Toolbar changes the mouse mode and allows you to interactively edit your plot.



The Toolbar is actually up to four separate toolbars, with buttons grouped by function.

- *File toolbar* - Buttons for dealing with files (hidden by default)

- *View toolbar* - Buttons for manipulating the view
- *Data toolbar* - Buttons for working with data
- *Insert toolbar* - Buttons that insert objects into the workspace.

In the default toolbar configuration, shown above, the toolbars appear next to each other. Each, however, can be moved independently to any edge of the workspace by grabbing the drag handle at the left edge of the toolbar. To hide or show a toolbar, right-click the menu bar and choose the desired toolbar.

Selector Tool



Use the Selector tool to select objects in your workspace. To select multiple objects, hold down Shift while clicking the second and subsequent objects. The selected objects can then be moved (translated) using the Selector tool itself.

The following kinds of objects can be moved (translated) using the Selector tool:

- frames
- axis grid area
- text
- geometries
- contour labels
- streamtraces
- streamtrace termination line
- legends
- 3D frame axis

To select an object and open that object's attributes dialog, double-click any object

Adjustor Tool



Use the Adjustor tool to perform any of the following modifications to your plot and data:

- Location of individual or groups of data points in the grid.
- Values of the dataset variables at a particular point.
- Length or placement of individual axes (2D Cartesian and XY Line plot types only).
- Spacing between an axis label and its associated axis (2D Cartesian and XY Line plot types only).
- The points in a polyline (and therefore its shape).

The Adjustor tool behaves like the Selector tool when you click objects other than those listed above. For example, if you click a rectangular geometry, the entire object is selected, since the Adjustor tool has no special functionality with a rectangular geometry. When adjusting a polyline, click close to the points in the polyline to avoid the entire object being selected.



The Adjustor tool can alter your data. Be sure you want to use the Adjustor tool before dragging points in the data region.

Click a point or object to select it. To select multiple points, you can hold Shift while clicking additional points after the first. In line plots, you can select points from only one mapping at a time.

Once you have selected all desired points, move the Adjustor over the selection handles of one of the points, then click-and-drag to the desired location of the first data point. The other selected points will move as a unit with respect to the chosen data point, maintaining their relative positions.



For XY Line plots, if several mappings are using the same data for one of the variables, adjusting one of the mappings will result in simultaneous adjustments to the others. You can avoid this by pressing the H or V key on your keyboard while adjusting the selected point. The H and V keys restrict the adjustment to the horizontal and vertical directions, respectively.

Zoom Tool



Zoom into or away from the plot. Geometries zoom with the plot; however, text does not.

When a mouse-click occurs (without dragging), the zooming is centered at the location of your click.

There are two zoom modes: plot zooming and paper zooming.

For plot zooming - drag the magnifying glass cursor to draw a box around the region that you want to fit into the frame. The box may be larger than the frame. Making the box larger than the frame zooms away from the plot. The region within the view box will be resized to fit into the frame.



If **Snap to Grid** (located in the Sidebar) is selected, you cannot make the zoom box larger than the grid area.

To return to the previous view, choose **View>Last** menu (Control-L). To restore the original 2D view, choose **View>Fit Everything** (Control-E) or **View>Fit to Full Size** (Control-F).

The results of plot zooming for the 2D plot type are dependent upon the axis mode selected in the **Axis Details** dialog (accessed via the **Plot** menu):

- **2D Independent Axis Mode** - Allows the selected region to expand to exactly fit in the frame. The axes are rescaled independently to fit the zoom box.
- **2D Dependent Axis Mode** - In dependent mode, the axes are not fit perfectly to the zoom box. The longest dimension from the zoom box is applied to an associated axis, and the other axis is resized according to the dependency relation.

For paper zooming - Shift-drag the magnifying glass cursor to draw a box about the region that you want to magnify. The plot is resized so that the longest dimension of the zoom box fits into the workspace. You can fit all frames to the workspace by using "Fit All Frames to Workspace" on the **View** menu.



Clicking anywhere in your plot while the zoom tool is active will center the zoom around your click. Alternatively, Control-click centers the plot on the point that was clicked and zooms out.

Use the center mouse button and drag (or hold down the scroll wheel and drag) to interactively zoom into or out of the plot.

3D mouse - Tecplot Focus also supports a 3D mouse, an input device that allows zooming (and translation and rotation) of 3D plots with a touch. You do not need to activate the Zoom tool to use the 3D mouse for zooming. Simply push the mouse's cap toward or away from you to zoom. Hold the Alt key while zooming with the 3D mouse to switch the zoom method (see "[Input Devices](#)" on page 17 for details).

Avoid tilting the mouse cap, as this may induce unintended rotation.

Translate Tool

Use the Translate tool to translate data within a frame or the paper within the workspace.

While in Translate mode, drag the cursor to move the data with respect to the frame, or Shift-drag to move the paper with respect to the workspace.



You may translate even when some other tool is selected by dragging with the right mouse button.

While the Translate tool is active, you can zoom your image by pressing "+" to magnify, "-" to shrink. If you are Shift-dragging to move the paper, the rescale buttons "+" and "-" will magnify or shrink the paper, as long as you have the mouse button depressed.

3D mouse - Tecplot Focus also supports a 3D mouse, an input device that can be used to translate 3D plots at any time with just a touch, regardless of the tool or mode selected.

- Pull the mouse's cap up or push it down to translate up or down on the screen.
- Move the mouse's cap left or right to translate left or right on the screen.

Avoid tilting or rotating the mouse when using these motions to avoid rotating the plot.

Three-dimensional Rotation

There are six 3D rotation mouse modes:

Spherical  - Drag the mouse horizontally to rotate about the Z-axis; drag the mouse vertically to control the tilt of the Z-axis.

Rollerball  - Drag the mouse in a direction to move with respect to the current orientation on the screen. In this mode, your mouse acts much like a rollerball.

Twist  - Drag the mouse clockwise around the image to rotate the image clockwise. Drag the mouse counterclockwise around the image to rotate the image counterclockwise.

X-axis  - Drag the mouse to rotate the image about the X-axis.

Y-axis  - Drag the mouse to rotate the image about the Y-axis.

Z-axis  - Drag the mouse to rotate the image about the Z-axis.

Once you have selected a rotation mouse mode, you can quickly switch to any of the others using the following keyboard shortcuts:

Drag	Rotate about the defined rotation origin with your current Rotate tool.
Alt-drag	Rotate about the viewer position using your current Rotate tool.
Middle-click-and-drag/Alt-right click-and-drag	Smooth zoom in and out of the data.
Right-click-and-drag	Translate the data.
Control-right-click-and-drag or Command-right-click-and-drag (Mac)	This option can be used without first selecting a rotation mouse mode. Simply hover over your intended point of origin, and then Control-right-click-and-drag to translate the image.

3D mouse - Tecplot Focus also supports a 3D mouse, an input device that can be used to rotate 3D plots at any time regardless of the tool or mode selected. The axis of rotation is relative to the screen rather than to the data.

- Tilt the mouse's cap forward or backward to rotate around the screen's X axis, as if rolling toward or away from you.
- Twist the mouse's cap clockwise or counterclockwise to rotate around the screen's Y axis, as if on a lazy susan.
- Tilt the mouse's cap left or right to rotate around the screen's Z axis, like the hands of a clock.

Slice Tool



Use the Slicing tool to control your slice(s) interactively.

The following keyboard/mouse options are available when the Slice tool is active:

+	Primary Slices, Start End Slices Active - Turn on intermediate slices (if not already active) and adds a slice. Primary Slices active [ONLY] - Turns on Start/End Slices and adds a slice. Start/End Slices active [ONLY] - Turns on Start/End Slices and adds a slice.
-	Primary Slices, Start End Slices Active - Removes start and end slices. Primary Slices active [ONLY] - Removes the primary slice. Start/End Slices active [ONLY] - Removes the Start and End Slices.
Click/Drag	Updates the position of the primary slice (if active). If only start and end slices are visible, click updates the position of the starting slice.
Alt-click/Alt-drag	Determine the XYZ-location by ignoring zones and looking only at derived volume objects (streamtraces, slices, iso-surfaces).
Shift-click	Switches from one Primary slice to Start/End Slices by adding a slice.
Shift-drag	Move the start or end slice (whichever is closest to the initial click location). Show Start/End Slices is activated, if necessary.
I, J, K (ordered zones only)	Switch to slicing constant I, J, or K-planes respectively.
X, Y, Z	Switch to slicing constant X, Y, or Z-planes respectively.
1-8	Numbers one through eight switch to the corresponding slice group.

Add Streamtrace

 Select the Add Streamtrace tool to add a streamtrace interactively by clicking anywhere in your plot. Select the number of streamtraces to include with each click (rake) using 1-9 on the keyboard.



Keyboard Shortcuts

D - Switch to streamrods

R - Switch to streamribbons

S - Switch to surface lines

V - Switch to volume lines

1-9 - Change the number of streamtraces to be added when placing a rake of streamtraces

Shift - Draws a rake on concave 3D volume surfaces. These rakes are normally not drawn, as they occur outside of the data

Refer to [Chapter 15: "Streamtraces"](#) for more information.

Streamtrace Termination Line

 Select the Add Streamtrace Termination Line tool to add a streamtrace termination line interactively.

To draw a Streamtrace Termination Line:

- Move the cursor into the data region.
- Click once at the desired starting point for the line.
- Click again at each desired break point.
- When the polyline is complete, double-click on the last point of the polyline, or press ESC on your keyboard.
- The drawn polyline ends any streamtraces that pass through it.

Add Contour Level

 Select the Add Contour Level tool to add a contour level by clicking anywhere in the active data region. A new contour level, passing through the specified location, is calculated and drawn.

The following keyboard and mouse shortcuts are related to the Add Contour Level tool.

Alt-click	Place a contour line by probing on a streamtrace, slice, or iso-surface.
Click	Place a contour line.
Control-Click	Replace the nearest contour line with a new line.
Drag	Move the new contour line.
-	Switch to the Delete Contour Level tool.

Delete Contour Level



Select the Delete Contour Level tool to delete a contour level by clicking anywhere in the active data region. The contour line nearest the specified location is deleted.



Use the "+" key to switch to the Add Contour Level tool and the "-" key to switch back to the Delete Contour Level tool.

Add Contour Labels



Select the Add Contour Label tool to switch to the Contour Label mode, enabling you to add a contour label by clicking anywhere in the active data region.

A contour label is added to the plot at the specified location; its level or value information is taken from the nearest contour line. This allows you to place labels at a slight offset from the lines they label.



The Contour type must be lines or lines and flood in order for this tool to be active. You can set the contour type on the Contour page of the **Zone Style** dialog.

Probe Tool



Select the Probe At Tool to probe for values of the dataset's variables at a particular point.

To obtain interpolated values of the dataset variables at the specified location, click at any point in the data region.

To obtain exact values for the data point nearest the specified location, Control-click at the desired location.



For XY plots, when you move into the axis grid area, the cursor cross hair is augmented by a vertical or horizontal line, depending on whether you are probing along the X-axis or the Y-axis. You can change the axis to probe simply by pressing X to probe the X-axis or Y to probe the Y-axis.

Specify Equations



Opens the Specify Equations dialog. See [Section 20 - 1 "Data Alteration through Equations"](#).

Insert Text



Select the Add Text tool to add text to any frame.

When this tool is in use, the Snap To buttons in the Plot sidebar become available to allow you to easily align your text with features of your plot.

Insert Image/Georeferenced Image



Select the Insert Image tool to insert an image or Georeferenced image to the plot.

See [Image](#) and [Georeferenced Images](#) for more information.

Insert Geometries

Use the geometry buttons to insert geometries into your plot. When these tools are in use, the Snap To buttons in the Plot sidebar become available to allow you to easily align your geometry with features of your plot.



Polylines



Squares



Rectangles



Circle



Ellipse

Create New Frame



Select the Create Frame tool to create a new frame.

To add a frame:

- Click once in the workspace to anchor one corner of the frame.
- Drag the diagonal corner until the frame is the desired size and shape.



If you have data loaded before you create a new frame, you can attach the existing dataset to the new frame by changing the plot type.

1 - 4.5 Status Line

The status line appears along the bottom of the Tecplot Focus window to provide a progress bar and other information when Tecplot Focus computes lengthy calculations. Other "hints," such as coordinates and tips for using the currently-selected tool, also appear here.

1 - 4.6 Tecplot Focus Workspace

In the Tecplot Focus **workspace**, you can create sketches and plots. You create each sketch or plot within a **frame**. Each visible measure of the workspace is called a **page**. The current state of the workspace, including the sizing and positioning of frames, the number and contents of pages, the location of the data files used by each frame, and all current attributes for all frames, makes up a **layout**. By default, the workspace displays a representation of where the paper plots are drawn, as well as a reference grid and rulers. The frame most recently selected is called the **active frame**.

You can include multiple pages in your layout, each of which can contain multiple frames. Use the [Pages Sidebar](#) (open it from the View menu if it's not visible) to create and manage pages.

1 - 5 Getting Help

Tecplot Focus features a fully integrated Help system. Detailed help is accessible by:

- Selecting "Tecplot Focus Help" from the **Help** menu.
- Clicking the **Help** button in any dialog.

Introduction

The **Help** dialog supports text search, has hypertext links, and provides detailed information on all menus and dialogs.

You may also send an e-mail to support@tecplot.com with your questions.

2

Using the Workspace

This chapter discusses the structures and features of Tecplot Focus that act the same regardless of the data type or plot layers you are using. These include:

- [Data Hierarchy](#) - How Tecplot Focus manages data
- [Interface Coordinate Systems](#) - Tecplot Focus's use of different coordinate systems, and when and where they occur
- [Frames](#) - Areas in the workspace in which you can create plots and control formatting
- [Workspace Management Options](#) - Factors that determine the color and orientation of your paper, as well as the ruler and grid, in order to precisely size and position objects. For in-depth information on Display Performance, refer to [Section 28 - 3 "Performance Dialog"](#)
- [View Modification](#) - The commands to zoom, translate, and fit plots within frames
- [Edit Menu](#) - The commands to cut, copy, and paste plot elements in the workspace

2 - 1 Data Hierarchy

Tecplot Focus structures data in two levels: datasets, which display in frames, and zones, which make up a dataset. Each dataset is composed of one or more zones, and each zone contains one or more variables. All zones within a dataset contain the same set of variables.

This chart, [Figure 2-1](#), displays a visual representation of Tecplot Focus's data hierarchy.

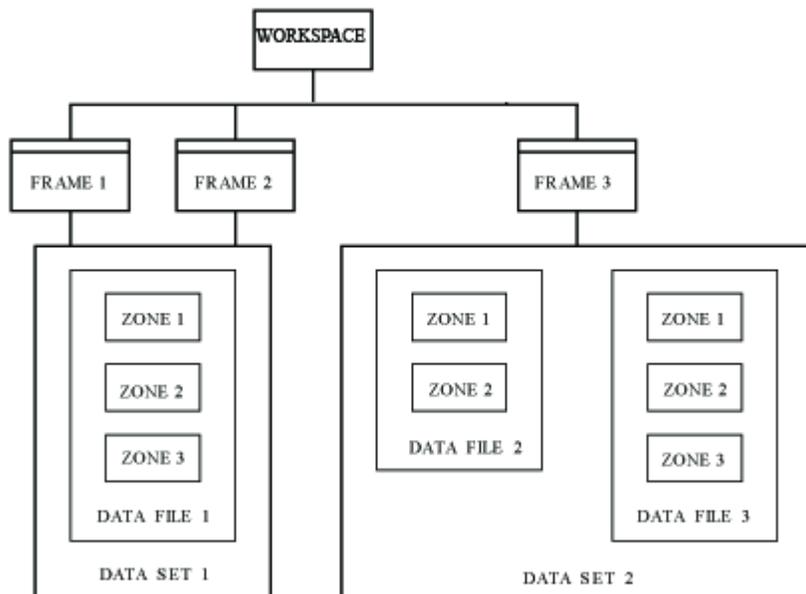


Figure 2-1. Data Hierarchy in Tecplot Focus. Frames 1 & 2 display Dataset 1, and Dataset 1 contains three zones from one data file. Frame 3 contains Dataset 2, which is composed of five zones (two from data file 2 and three from data file 3).

2 - 1.1 Data Displays in Frames

Tecplot Focus always displays data in a window called a "frame". By default, Tecplot Focus opens one frame when you launch Tecplot Focus or open a new layout, but you can display multiple plots concurrently in Tecplot Focus by adding additional frames. You can add frames to the workspace using the **Frame** menu. You can display one dataset in one frame, or you can share one dataset between multiple frames. Using the same dataset in multiple frames allows you to generate different plots of the same data. To learn more about working with frames, go to [Section 2 - 3 "Frames"](#).

Frames appear on pages. You can manage multiple pages in Tecplot Focus using the [Pages Sidebar](#) and macro commands in the default [Quick Macro Panel](#). Each page has its own collection of frames.

2 - 1.2 A Dataset Includes All Data in a Frame

A dataset is defined as "all of the data in a frame". To create a dataset, load one or more data files into an empty frame in Tecplot Focus, or create a zone in a frame.

2 - 1.3 Datasets Are Made of Zones

A zone represents a subset of a dataset. A dataset can be composed of a single zone or several zones. Zones are either defined in a data file or created directly in Tecplot Focus. The number of zones in a dataset is the sum of the number of zones in each of the data files included in the dataset, plus any zones created within Tecplot Focus.

Typically, a data file is divided into zones based on its physical coordinates. For example, a dataset of an airplane may consist of a zone for each wing, each wheel, the nose, etc. Alternatively, zones may be defined

based on the material. For example, a dataset of a fluid tank may have a zone for the tank itself and additional zones for each fluid inside the tank.



All zones in a given dataset must have the same variables defined for each data point.

2 - 2 Interface Coordinate Systems

Tecplot Focus incorporates a number of coordinate systems, including the paper, frame, and the physical coordinate systems for the plot (2D, 3D, XY, or Polar). The origins of each coordinate system and their relationship to one another is shown in [Figure 2-2](#).

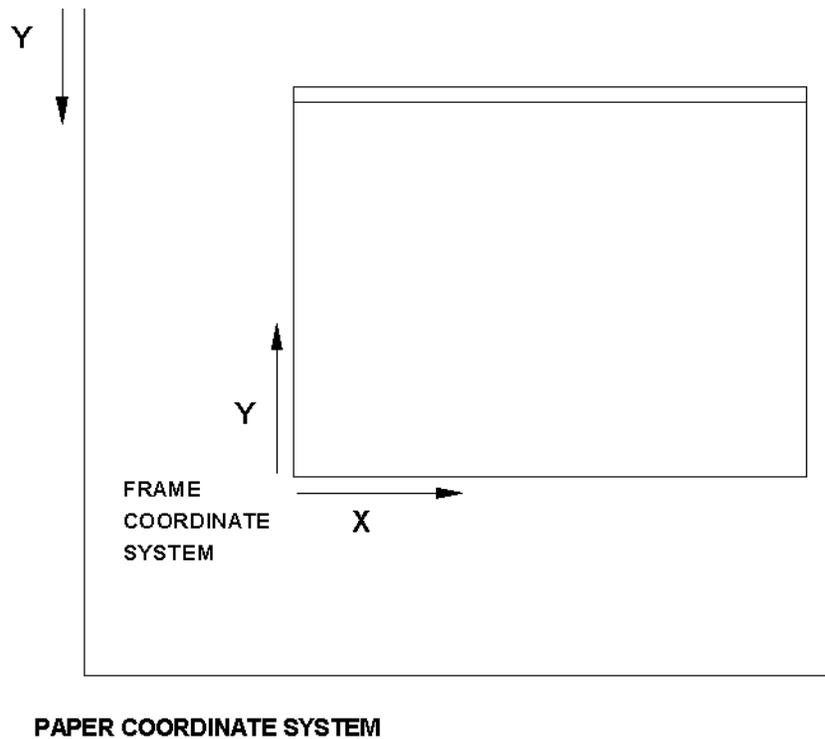


Figure 2-2. Tecplot Focus Coordinate System. The physical coordinate system(s) of the dataset (for example, 3D Cartesian or 2D Cartesian) are encompassed in the Frame Coordinate System.

The physical coordinate system (2D or 3D) depends on the plot type of the active frame. Two-dimensional physical coordinates are often referred to as *grid coordinates*. The Grid coordinate system is aligned with the coordinate system used by the plot axes; the Frame coordinate system is fixed to the frame and does not change when the plot is zoomed, translated, or rotated.

In 2D Cartesian plots, objects such as text labels and geometries are drawn in either the Frame or the Grid coordinate system. In 3D Cartesian plots, these objects are drawn in either the Frame coordinate system, or in what is known as the *Eye coordinate system*. The eye coordinate system is aligned with the Grid coordinate system; so objects drawn in the Eye coordinate system move with the data as you zoom and translate, but remain fixed when you rotate the plot.

[Figure 2-3](#) shows a 3D volume plot with streamribbons and a streamtrace termination line. This figure illustrates how the termination points vary as the plot is rotated. Notice that the termination line itself remains in place on the screen as the plot is rotated.

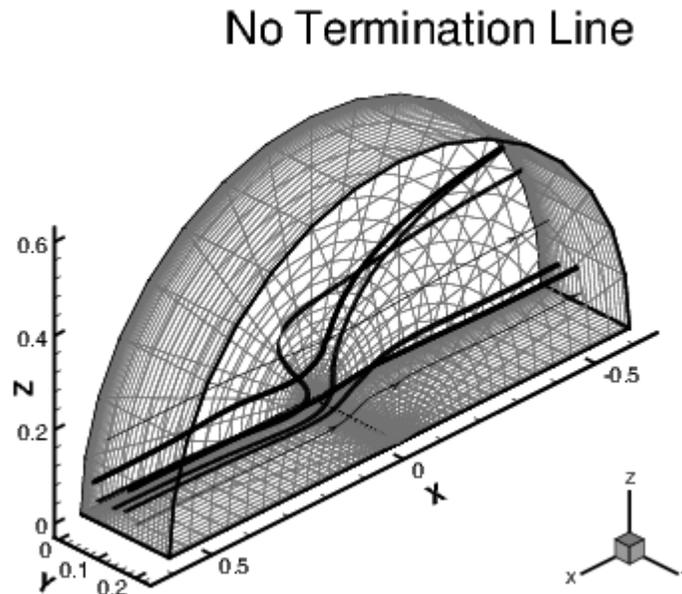


Figure 2-3. Rotating Volume streamtraces with a termination line in the eye coordinate system.

2 - 3 Frames

All plots and sketches are displayed within frames. Initially, the Tecplot Focus workspace contains one frame. You may add additional frames, resize and reposition frames, modify background color, and specify border and header appearance. Tecplot Focus acts upon only one frame, [The Active Frame](#), at any given time (however, frames may be linked, so that changing one may also change others). The active frame displays with a darker, thicker border than the inactive frames so that you can easily see which frame is active.



Tecplot Focus uses the height of the frame for objects scaled by frame units, such as font size. When you enter a frame unit value into a dialog or when you set frame size and position on the paper, you may specify a different unit system (inches, points, centimeters, or pixels). Tecplot Focus automatically converts the values into frame units.

2 - 3.1 The Active Frame

The active frame, indicated by default with a darker and thicker border, is the frame in your workspace affected by all operations you do in Tecplot Focus. To make a frame the active frame, click anywhere inside that frame with the Selector tool (or any other tool except the Create New Frame tool). Reference the following sections for additional actions you can perform on frames.

2 - 3.2 Frame Creation

To create a new frame, which you can use to display a new dataset or another view of an already-loaded data set, select the New Frame  button in the toolbar. Or select "Create New Frame" from the **Frame** menu. Selecting either the New Frame tool or "Create New Frame" in the **Frame** menu will change your selector

tool into a small "+" symbol. Click with this tool in your workspace where you want one corner of your new frame, and drag across the workspace to where you would like the opposite corner of your new frame.



Tecplot Focus automatically makes the new frame the active frame.

For optimal printing of your plot(s), draw frames that sit completely within the paper displayed in the workspace. See [Section 29 - 3.3 "Create Multiple Frames"](#) for information on simultaneously creating multiple frames.



Data Set Inheritance After creating a new frame, you can assign the frame to share the dataset of another frame by changing the frame order and the plot type of the new frame. When you switch a frame without data out of Sketch plot type, Tecplot Focus searches for another frame with which to share data. It performs this search in the order that the frames are drawn on-screen, starting from the top and moving down. The empty frame will inherit data from the first frame in the draw order that contains data.

2 - 3.3 Edit Active Frame

The **Edit Active Frame** dialog (accessed from the **Frame** menu) allows you to adjust the dimensions and style of your active frame. When you are working with multiple frames, select a frame with your selector tool to make that frame active. Then select "Edit Active Frame" from the **Frame** menu to adjust the position and properties of that frame.

Edit Active Frame

Frame dimensions (paper ruler units)

Left side: Width:

Top side: Height:

Show border Thickness (%):

Show header Header color:

Show background Background color:

Change foreground color when background color is the same: Yes No

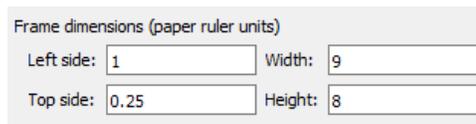
Frame name

Frame Dimensions

You can size and position a frame using your mouse, the keyboard, or a dialog. To use only your mouse, select the frame to activate the resizing handles (black boxes on the edges and corners of the frame). Click and drag

on a handle to resize a frame, or click and drag on an edge in a location without a handle to change the frame location. To specify size or position with a dialog, select "Edit Active Frame" from the **Frame** menu.

In the **Edit Active Frame** dialog, you may specify the exact location for the frame's left and top sides, along with width and height.



Frame dimensions (paper ruler units)

Left side:	1	Width:	9
Top side:	0.25	Height:	8

- **Left Side** - Left edge of the frame, relative to the workspace
- **Top Side** - Top edge of the frame, relative to the workspace
- **Width** - Width of the frame (coordinates are: *left side* to *left side + width*).
- **Height** - Height of the frame (coordinates are: *top side* to *top side - height*).

The units in the Frame Dimensions region of the dialog are based on the units set for the **Ruler Spacing** in **Options>Ruler/Grid**.



You may also use the mouse or the arrow keys to resize and position frames. Click anywhere on a frame's header or border to activate resizing handles for the frame. To scale frames proportionally (maintaining the vertical to horizontal aspect ratio) select the frames, then press "+" on your keyboard to enlarge or "-" to reduce.

After selecting frames, you may position them using the arrow keys on your keyboard. You can move frames up, down, left, or right in one-pixel increments for precise location.



To fit the active frame to the entire printable region of US letter-size paper (landscape orientation), set Left Side=0.127, Top Side=0.125, Width=10.75, and Height=8.25. Or, set Width=8.25 and Height=10.75 for portrait orientation.

Frame Border and Header Controls

Use the **Edit Active Frame** dialog (accessed from the **Frame** menu) to adjust the frame border or header.



Show border Thickness (%): 0.1

Show header Header color: Red

Toggling-off "Show Border" makes the frame border invisible. Use the Thickness box in the **Edit Active Frame** dialog to adjust the line thickness of the border.

Remember that Tecplot Focus uses a thicker border to indicate [The Active Frame](#), so making borders thicker can make it become more difficult to determine which frame is active.

The frame header displays when both "Show Border" and "Show Header" are toggled-on. If you turn off the border by toggling-off "Show Border", the header turns off as well.

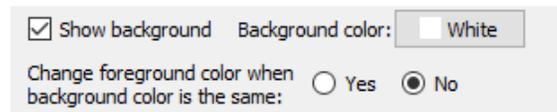
The frame header contains user-configurable information which defaults to:

```
"&(FrameName) | &(date) | &(DataSetTitle)"
```

where `FrameName` is the frame's name, `date` is the date the frame was created or revised, and `DataSetTitle` is the title of the active dataset. You can change these defaults in your configuration file using the `!GLOBALFRAME` command (see the [Scripting Guide](#)).

Frame Background Color Modification

Select the Color box in the **Edit Active Frame** dialog (accessed from the **Frame** menu) to adjust the frame background color. Toggle-off "Show Background" to set the frame background to transparent.



Frame Name Modification

Enter text in the Frame Name region of the **Edit Active Frame** dialog (accessed from the **Frame** menu) to change the name of the active frame. The text entered here is displayed as the name of the frame.

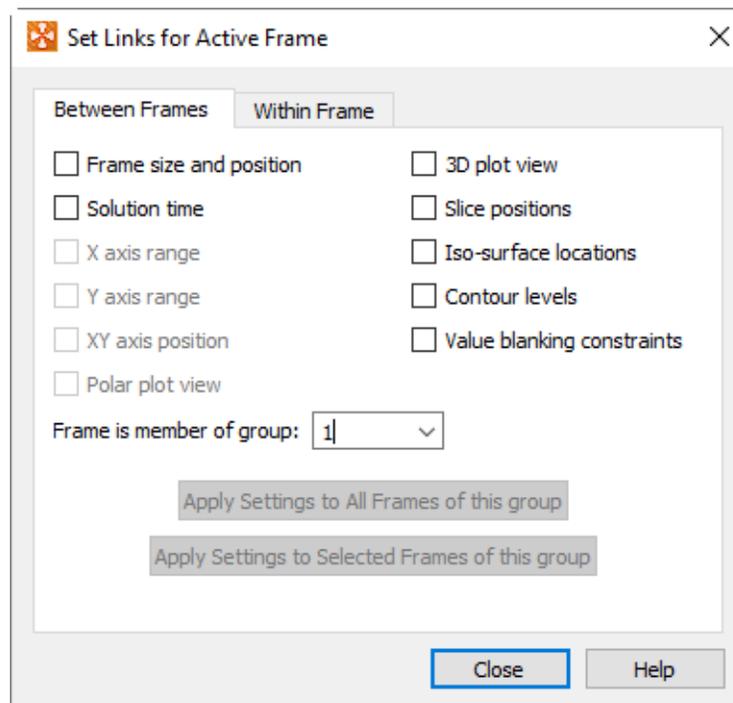


2 - 3.4 Frame Linking

The **Set Links for Active Frame** dialog, accessible through **Frame>Frame Linking**, allows you to link specific style attributes either *between* frames or *within* a frame. Linking between frames, on the Between Frames page of the dialog, allows you to quickly make changes in one frame and propagate them to a number of other frames. Linking within frames, on the Within Frame page, links attributes between similar objects within a frame.

Attribute Linking Between Frames

Use the Between Frames page of the **Set Links for Active Frame** dialog (accessed from **Frame>Frame Linking**) to link the following attributes (shown below):



- **Frame Size and Position** - Use this option to overlay transparent frames. (See "[Frame Background Color Modification](#)" on page 41.)

- **Solution Time** - All frames display the same solution time.
- **X Axis Range, Y Axis Range** (For XY Line and 2D plots) - Links the X-Axis or Y-Axis range and the positioning of the left and right sides of the viewport.



For XY Line plots, axis range linking applies only to the first axes, X1 and/or Y1.

- **XY Axis Position** (For XY Line and 2D plots) - Links the positioning of the X and Y-Axes between frames, including the method used for positioning the axes, such as aligning with an opposing axis value.
- **Polar Plot View** - Link views for frames using the Polar Line plot type.
- **3D Plot View** - Link the 3D axes and 3D view.
- **Slice Positions** - Link slice positions and slice planes for active slices (not slice style).
- **Iso-Surface Locations** - Link iso-surface values (but not iso-surface plot style).
- **Contour Levels** - Link the values and number of contour levels for 2D and 3D plots.
- **Value Blanking Constraints** - Link all value-blanking attributes.



It is not necessary to close and reopen the dialog between frames. Simply select another frame with the dialog open to edit linking for the newly active frame.

Frame Linking Groups

You can segregate frames into groups so that only frames in that group receive changes made in the linked attributes. By default, all frames are added to *Group 1*. Add a frame to a group by selecting the appropriate group number from the "Frame is a Member of" drop-down menu on the Between Frames page of the **Set Links for Active Frame** dialog. You can assign frames to groups 1-20. New frames added to a group take on the characteristics of previous members of the group.

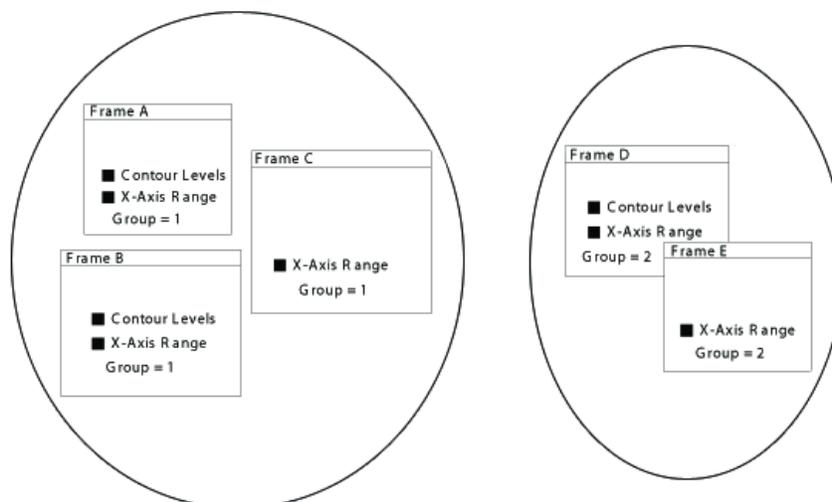


Figure 2-4. Five frames in two groups with different linking options.

Propagating Between-Frame Link Attributes to Other Frames

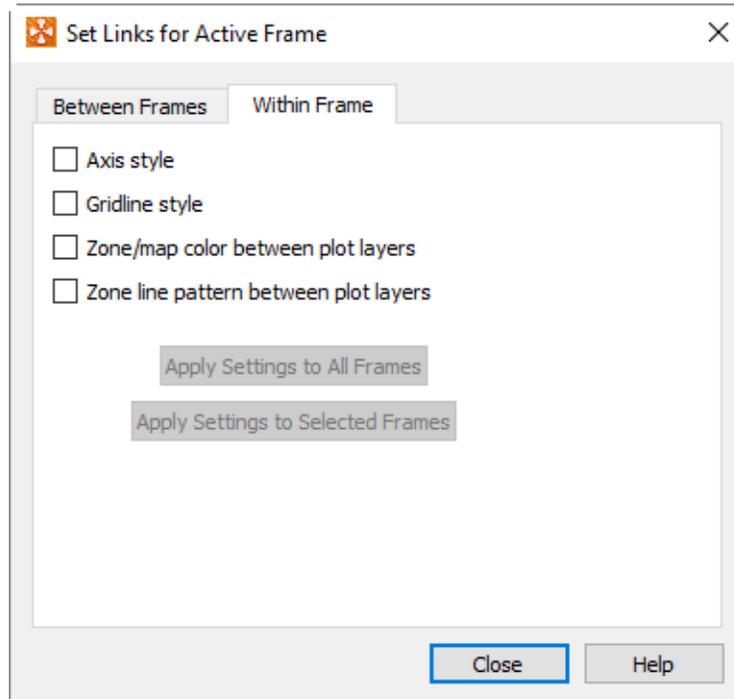
Once link attributes are set in a frame group, you must set these same attributes in other frames for linking to occur. Each frame may have each of the attributes selected or not linked. If you want all or a selected group of frames to have the same link attributes, select the appropriate [Apply Settings to...] button to quickly propagate the link settings. Alternatively, you can select each frame individually, making the same selections on the **Set Links for Active Frame** dialog for each chosen frame.



When 2D or XY Line frames have dependent axes and these axis ranges are linked, a "best-fit" attempt is made to match the axis ranges between frames. Misalignments can occur when the aspect ratios for the lengths of the axes is not the same between two frames with linked X and Y-axes. Setting the X and Y-axes to be independent allows a precise match.

Attribute Linking Within A Frame

The Within Frame page of the **Set Links for Active Frame** dialog (shown below) allows you to link the following attributes:



- **Axis Style** - Link activation, colors, line styles, and font styles for objects associated with axes.
- **Gridline Style** - Link activation, colors, and line styles for gridlines.
- **Zone/Map Color between Plot Layers** - Link the color of meshes, contour lines, and other zone layers for Cartesian plots, or link the color of lines, symbols, and other map layers for line plots.
- **Zone Line Pattern between Plot Layers** - Link line pattern style and length for meshes, vector, and contour lines for Cartesian plots.

Settings changed on this dialog take effect immediately. You may also apply the settings to all frames or just to selected frames using the buttons in the dialog.



Keep in mind that within-frame Linking only links attributes between similar objects within a frame. These attributes are not linked to other frames. The [Apply Settings] buttons turn on the same Within-Frame Linking properties in other frames.

2 - 3.5 Frame Deletion

Delete a frame by selecting the frame and then choosing **Edit>Delete** or pressing the Delete key. This action is not undoable.

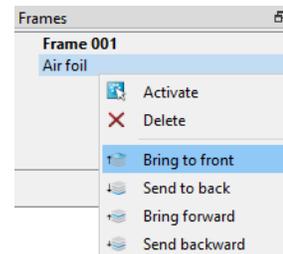
2 - 3.6 Managing Frame Order

Frames can overlap, and when they do, one is drawn in front of the other. You can think of the frames as a stack of papers pinned to a bulletin board. The order of frames can be managed by right-clicking a frame name in the Frames sidebar and choosing one of the following options.



The Frames sidebar is initially hidden. To display it, choose **View>Frames Sidebar**.

- **Bring Forward** - To move a frame one step closer to the front of the frame stack, right-click its name and choose "Bring Forward" from the context menu.
- **Send Backward** - To move a frame to one step closer to the back of the frame stack, right-click its name and choose "Send Backward" from the context menu.
- **Bring to Front** - To move a frame to the front of the frame drawing order, right-click its name and choose "Bring to Front" from the context menu. That frame will then appear in front of all other frames.
- **Send to Back** - To move a frame to the bottom of the frame drawing order, right-click its name and choose "Send to Back" from the context menu. That frame will then appear behind all other frames.



The context menu in the Frames sidebar also contains an option to **Activate** the selected frame. This does not change the drawing order of the frame, but does make it [The Active Frame](#).

2 - 3.7 Save Frame Style

You can save a frame's style for later use or to share with another frame by selecting "Save Frame Style" in the **Frame** menu. This will open the **Save Style** dialog, in which you can name and save the style of your active frame as a stylesheet (with the extension .sty). Use the [Load Frame Style](#) action to retrieve your frame style in another frame or layout.

The following data is saved:

- All plot style information
- Text elements
- Geometries (shapes such as boxes, circles, and polylines)
- Stream positions
- Contour levels

2 - 3.8 Load Frame Style

To load a saved frame style into your active frame, select "Load Frame Style" in the **Frame** menu. With the **Load Frame Style** dialog that appears, you can load a frame style saved from another frame (with the extension .sty) to dictate the frame attributes of your active frame. This will affect only the [The Active Frame](#). To save a frame style, use the [Save Frame Style](#) function.

The following data is retrieved from the file and applied to the current frame:

- All plot style information
- Text elements
- Geometries (shapes such as boxes, circles, and polylines)
- Stream positions
- Contour levels

2 - 4 Workspace Management Options

The workspace is the region in which you can create frames. The paper layout is a subset of the workspace and is correlated to the printer settings

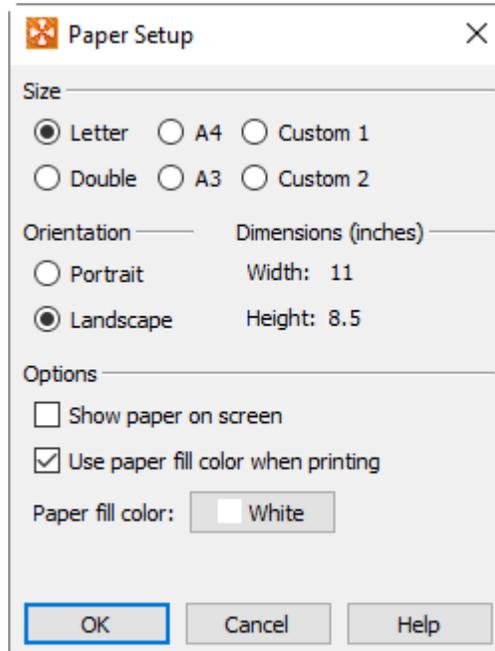


The paper is hidden by default in Tecplot Focus. Select "Show Paper on Screen" in the **Paper Setup** dialog under the **File** menu to include the paper.

2 - 4.1 Paper Setup

Tecplot Focus's representation of paper in the workspace allows you to lay out plots precisely the way you want them printed. If you place a frame on the paper and print the resulting plot, the frame appears in the exact relative location on the printed paper.

You can control the size, orientation, and color of your paper by going to **File>Paper Setup**.



Paper Size Controls

Tecplot Focus offers the following six paper sizes:

- **Letter** - Standard U.S. letter size, 8 1/2 by 11 inches.
- **Double** - Standard U.S. ledger size, 11 by 17 inches.
- **A4** - Standard European letter size, 21 by 29.7 centimeters.
- **A3** - Standard European size, 29.7 by 42 centimeters.
- **Custom 1** - Default is 8.5 by 14 inches.
- **Custom 2** - Default is 8 by 10 inches.

All paper sizes may be customized using options in configuration or macro files. It is recommended that you only change the dimensions of the Custom 1 and Custom 2 paper sizes. To change the Custom sizes see the `!PAPER` command in the [Scripting Guide](#).

Paper Orientation Controls

Layouts can be landscape or portrait. In landscape (the default), the long axis of the paper is horizontal, while in portrait, the long axis is vertical. Portrait orientation uses the width of the specified paper for the horizontal dimension, while landscape uses this for the vertical dimension. You specify the orientation as part of paper set-up.

Screen Paper Controls

If you are creating plots for display on your screen, you can toggle-off the screen representation of the paper and use the full workspace by deselecting "Show Paper on Screen".

Dimensions (display only)

The units displayed in the "Dimensions" region of the **Paper Setup** dialog are determined by the units established in **Options>Ruler/Grid**.

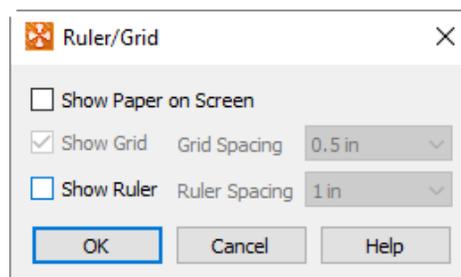
Paper Color Controls

You can set up your paper to show any color as a background color (the "paper fill color") on your screen, as well as use that color when printing to a color printer. When you are printing, the paper can be flooded with your specified fill color. (By default, the paper fill color is ignored during printing.) To use the paper fill color when printing, select "Use Paper Fill Color when Printing" from the **Paper Setup** dialog.

2 - 4.2 Grid and Ruler Set-Up

The workspace grid provides a convenient guide for placing objects on your paper. When placing text or geometric shapes, you can choose to snap the anchor points of the shapes to the grid. Rulers provide a reference length for sizing objects.

To customize the ruler/grid settings, select "Ruler/Grid" from the **Options** menu.



Workspace Grid Controls

Tecplot Focus allows you to select grid spacing from several pre-set sizes in centimeters (cm), inches (in), or points (pt) with the Grid Spacing drop-down menu. You can also specify not to show the grid by toggling-off "Show Grid".



The grid does not display if "Show Paper on Screen" or "Show Grid" are toggled-off.

Workspace Ruler Controls

You can select the ruler markings from several pre-set sizes in centimeters (cm), inches (in), or points (pt) with the Ruler Spacing drop-down menu. You can also specify not to show the ruler by toggling-off "Show Ruler". With "Show Ruler" toggled-on, rulers appear on the bottom and right-hand sides of the workspace.

2 - 5 View Modification

Use the **View** menu to adjust the view of the active frame, sidebars, or toolbars, or to adjust the view of the entire workspace. The **View** menu is discussed in the following subsections.

2 - 5.1 Show a Sidebar or Toolbar

You may close a sidebar by clicking its close box. Once closed, you may reopen it by choosing the desired sidebar from the appropriate menu.

Sidebar	Menu Command
Plot	View>Plot sidebar
Pages	View>Pages sidebar
Frames	View>Frames sidebar
Quick Macro Panel	Scripting>Quick Macros

You may also show or hide a sidebar or a toolbar by right-clicking any toolbar (or the menu bar) and choosing the toolbar or sidebar you wish to show or hide from the context menu.

2 - 5.2 Redraw Frame

When "Auto Redraw" is toggled-off, click the Redraw button in the Plot sidebar to redraw the active frame.

2 - 5.3 Zoom

There are two zoom modes: axis (dataset) zooming and paper zooming. To use either, first activate the Zoom tool  from the Toolbar.

Plot Zooming

With the Zoom tool selected, drag the magnifying glass cursor to draw a box. The region within the view box will be resized to fit into the frame according to the longest dimension of the view box. If "Snap to Grid" is selected (on the Plot sidebar), you cannot make the zoom box larger than the grid area.



To return to the previous view, select "Last" (CTRL-L) from the **View** menu or "Undo" (CTRL-Z) from the **Edit** menu.

3D mouse - Tecplot Focus also supports a 3D mouse, an input device that allows zooming (and translation and rotation) of 3D plots with a touch. You do not need to activate the Zoom tool to use the 3D mouse for zooming. Simply push the mouse's cap toward or away from you to zoom.

Hold the Alt key while zooming with the 3D mouse to switch the zoom method (see ["Input Devices"](#) on page 17 for details).

Avoid tilting the mouse cap, as this may induce unintended rotation. Hold down the Alt key to switch between zooming by moving the data and by moving the viewer.

Paper Zooming

With the Zoom tool selected, SHIFT-drag the magnifying glass cursor to draw a box about the region that you want to magnify. The plot is resized such that the longest dimension of the zoom box fits into the workspace.



You can fit all frames to the workspace by using the "Fit All Frames to Workspace" option of the **View** menu.

Mouse Zoom and Translation

The middle and right mouse buttons allow you to smoothly zoom and translate your plot. The middle mouse button zooms smoothly, and the right mouse button translates (moves).

3D mouse - Tecplot Focus also supports a 3D mouse, an input device that can be used to zoom and translate 3D plots at any time regardless of the tool or mode selected.

- Push the mouse's cap toward or away from you to zoom. Hold the Alt key while zooming with the 3D mouse to switch the zoom method (see ["Input Devices"](#) on page 17 for details).
- Pull the mouse's cap up or push it down to translate vertically.
- Move the mouse's cap left or right to translate horizontally.

Avoid tilting or rotating the mouse when using these motions to avoid rotating the plot.

2 - 5.4 Fit Everything

View>Fit Everything (Control-E) resizes 3D Cartesian plots so that all data points, and all text and geometries positioned using grid coordinates, are included in the frame. By default, geometries use grid coordinates, while text objects use frame coordinates, so typically this means that Fit Everything fits

geometries but not text objects, although if a text object has been set to use grid coordinates, it will be included. Use **View>Data Fit** to consider only data in the resizing.



Long text strings may still extend out of the frame even if positioned using grid coordinates.

2 - 5.5 Fit Surfaces

View>Fit Surfaces (Control-F) resizes 3D Cartesian plots so that all surfaces are included in the frame, excluding any volume zones. If there are no surfaces plotted, **View>Fit Surfaces** fits all data points, text, and geometries into the frame.

2 - 5.6 Fit to Full Size

View>Fit to Full Size (Control-F) resizes non-3D plots so that all zones or lines, geometries, and text fit within the frame.

2 - 5.7 Data Fit

View>Data Fit resizes the plot so all data points are included in the frame. Text and geometries are not considered. The text and geometries must be set to grid coordinates to be considered in the resizing.

2 - 5.8 Fit All Frames to Workspace

View>Fit All Frames to Workspace (Control-Shift-A) resizes all frames proportionally so the frame(s) fill the workspace either vertically or horizontally.

2 - 5.9 Nice Fit to Full Size

View>Nice Fit to Full Size (Control-I) sets the axis range of 2D Cartesian, XY Line, and Sketch plot types to begin and end on major axis increments. If axes are dependent, the vertical axis length is adjusted to accommodate a major tick mark.

2 - 5.10 Make Current View Nice

View>Make Current View Nice (Control-K) modifies the range on a specified axis of 2D Cartesian, XY Line, and Sketch plots to fit the minimum and maximum of the variable assigned to that axis, then snaps the major tick marks to the ends of the axis. If axis dependency is not independent, this may affect the range on another axis.

2 - 5.11 Center

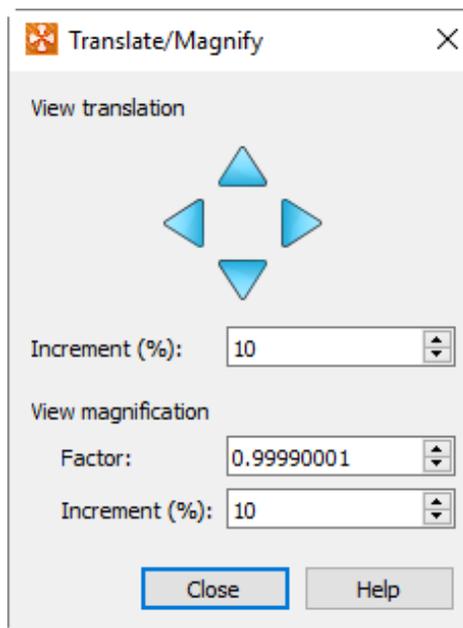
Centers the plot within the frame. Only the data is centered; text, geometry, and the 3D axes are not considered. Neither the axes nor the plot is changed in size.

2 - 5.12 Translate/Magnify

The **Translate/Magnify** dialog (accessed via the **View** menu), allows you to move and resize your plot within a frame. Translating using this dialog moves the image of your data with respect to the active frame. You can translate plots in any direction within a frame.

The following options are available in the **Translate/Magnify** dialog:

- **Up, Down, Left, Right** - Use the arrows to translate (move) the image.
- **Increment (%)** - Controls the step size for each arrow as a percentage of the workspace.
- **View Magnification - Factor** - Change magnification using the up and down arrows to the right of the text field, or enter a value in the text field.
- **View Magnification - Increment (%)** - The step size for each click of the arrows in the Factor field, as a percentage of the current magnification.



The Translate/Magnify tool  (located in the Toolbar)

allows you to translate/magnify the data within the frame or the entire workspace. Use the Shift key to translate/magnify the workspace instead of the data.

When the Translate/Magnify tool is active, type +/- on your keyboard to increase/decrease the scale of the image.



To use the Magnify tool on the workspace, hold the SHIFT key and click on the workspace. Then, use the "+" or "-" keys on the keyboard to change the magnification of the workspace. Single-click on the data to change the mode back to dataset magnification.

2 - 5.13 Last

View>Last (Control-L) restores the previous view. The "Last" command allows you to step backward through the resizings and repositionings of plots. Any time you change the view of a frame, either by zooming, centering, translating, or fitting the plot, the previous view is placed in a view stack. Each frame is allotted four view stacks, one for each plot type. Each view stack stores up to sixteen views, including the active view.

2 - 5.14 Rotate

Available in the 3D Cartesian plot type only; calls up the **Rotate** dialog for image rotation. For further information, see ["Three-dimensional Rotation"](#) on page 29.

2 - 5.15 3D View Details

Available in the 3D Cartesian plot type only; calls up the **3D View Details** dialog for setting the view position and angle of 3D objects. For further information, see ["Three-dimensional Rotation"](#) on page 29.

2 - 5.16 Copy View

Use the **View>Copy View** menu option to copy the active frame view to the frame view buffer, where it can then be pasted to other frames having the same plot type. The copied view includes all the attributes of the view that are affected by the **View** menu: the amount of zoom, translation and scale, and (in 3D Cartesian plot type) the amount of rotation and perspective projection.

2 - 5.17 Paste View

View>Paste View pastes a copied view onto the active frame. When you are working with multiple frames attached to the same dataset, it is often useful to make your view changes to one frame and then propagate those changes to the other frames.

2 - 5.18 Fit All Frames to Workspace

View>Fit All Frames to Workspace resizes all frames proportionally so that all frame(s) fill the workspace either vertically or horizontally.

2 - 6 Edit Menu

You can duplicate frames, text, and geometries with the cut, copy and paste options of the **Edit** menu (or their keyboard equivalents, Control-X, Control-C, and Control-V). You can also cut objects from one location and paste them into another, or throw them away completely using the Delete option.

2 - 6.1 Undo

All plot and mapping style modifications can be undone. In addition, you can undo a variety of other plot alterations. As a rule, Tecplot Focus allows undo for reversible operations that can be restored without significant impact on the operation's performance. To undo an operation, select "Undo" from the **Edit** menu, or press Control-Z in the workspace.

Specifically, the Undo option is allowed for the following conditions:

- All zone and map style changes.
- Some (though not all) frame control operations.
- Creating new frames.
- Moving and copying line maps.
- View operations.
- Some pick operations.
- Streamtrace actions.
- The following data alterations:
 - Deleting zones and variables.
 - Renaming datasets and zones.
 - Creating rectangular or circular zones.
 - Duplication zones.
 - Processing Equations. (Except equations containing derivatives.)



Undo is unavailable for all data operations once an Undo operation has been performed on an un-allowed item. In addition, once an operation is performed that cannot be undone, the entire undo history for that frame is erased.

2 - 6.2 Cut

Edit>Cut or Control-X removes the selected item from the plot and the active dataset (if applicable), and stores the removed item in the Paste buffer.



Generally, the Cut, Copy, and Paste options work only within Tecplot Focus. However, you can copy selected frames and text objects and paste them into other applications. See [Section 24 - 5 "Clipboard Exporting to Other Applications"](#).

2 - 6.3 Copy

Edit>Copy or Control-C stores the selected item in the Paste buffer but leaves it in your plot or the active dataset.



Generally, the Cut, Copy, and Paste options work only within Tecplot Focus. However, you can copy selected frames and text objects and paste them into other applications. See [Section 24 - 5 "Clipboard Exporting to Other Applications"](#).

2 - 6.4 Paste

Use **Edit>Paste** or Control-V to add the contents of the Paste buffer to the active plot. If the object is being copied into the same frame, the new object will be overlaid directly over the original object. Use the Selector or the Adjustor tool to move the copied item to different locations in the frame.



Pasting from the Paste buffer is allowed only between compatible frames. Attempting to copy an object into a frame that does not hold an appropriate data type results in an error message.

2 - 6.5 Delete

Remove the selected item from the plot and from the active dataset. Deleted items are not stored in the Paste buffer.



If you cut or clear the only Tecplot Focus frame in the workspace, Tecplot Focus automatically creates a blank frame to replace it.

2 - 6.6 Send to Back

Pushes the selected item to the bottom of the active draw stack. The plot is drawn on your screen from the bottom of the draw stack to the top; elements lying further down in the stack may be partially obscured by elements higher up. The following types of objects may be pushed: text, geometries, 2D or X-Y grid areas, and frames.

2 - 6.7 Bring to Front

Pop the selected item to the top of the active draw stack. The following types of objects may be popped: text, geometries, 2D, or X-Y grid areas, and frames.

3

Data Structure

Tecplot Focus accommodates two different types of data: [Ordered Data](#) and [Finite Element Data](#).

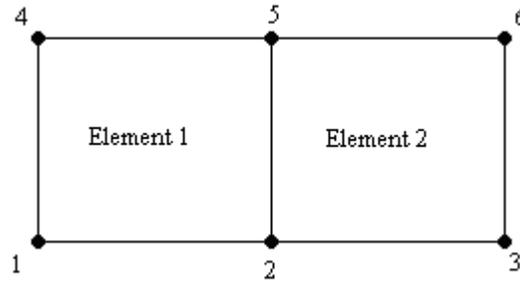
- **Ordered data** is a set of points logically stored in a one-, two-, or three-dimensional array, where I, J, and K are the index values within the array. The number of data points is the product of all of the dimensions within the array.
- **Finite-element** data is arranged in two arrays, a variable array and a connectivity matrix. The variable array is a collection of points in 2D or 3D space that are connected into polygonal or polyhedral units called *elements*. The connections between the nodes are defined by the connectivity matrix.

3 - 1 Connectivity List

A connectivity list is used to define which nodes are included in each element of an ordered or cell-based finite element zone. You should know your zone type and the number of elements in each zone in order to create your connectivity list.

The number of nodes required for each element is implied by your zone type. For example, if you have a finite element quadrilateral zone, you will have four nodes defined for each element. Likewise, you must provide eight numbers for each cell in a BRICK zone, and three numbers for each element in a TRIANGLE zone. If you have a cell that has a smaller number of nodes than that required by your zone type, simply repeat a node number. For example, if you are working with a finite element quadrilateral zone and you would like to create a triangular element, simply repeat a node in the list (e.g., 1,4,5,5).

In the example below, the zone contains two quadrilateral elements. Therefore, the connectivity list must have eight values. The first four values define the nodes that form Element 1. Similarly, the second four values define the nodes that form Element 2.



The connectivity list for this example would appear as follows:

```
ConnList[8] = {4,5,2,1, /* nodes for Element 1 */
               5,6,3,2}; /* nodes for Element 2 */
```

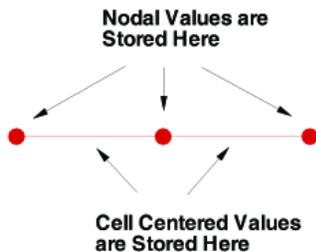


It is important to provide your node list in either a clockwise or counter-clockwise order. Otherwise, your cell will twist, and the element produced will be misshapen.

3 - 2 Ordered Data

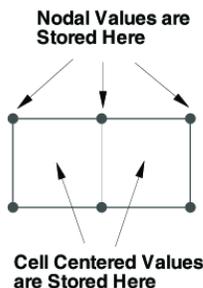
Ordered data is defined by one, two, or three-dimensional logical arrays, dimensioned by IMAX, JMAX, and KMAX. These arrays define the interconnections between nodes and cells. The variables can be either nodal or cell-centered. Nodal variables are stored at the nodes; cell-centered values are stored within the cells.

- One-dimensional **Ordered Data** (I-ordered, J-ordered, or K-ordered)



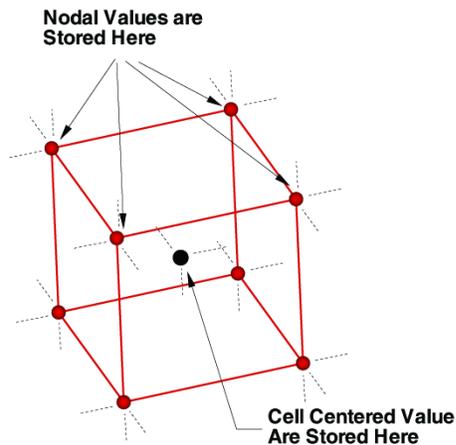
A single dimensional array where either IMAX, JMAX or KMAX is greater than or equal to one, and the others are equal to one. For nodal data, the number of stored values is equal to $IMAX * JMAX * KMAX$. For cell-centered I-ordered data (where IMAX is greater than one, and JMAX and KMAX are equal to one), the number of stored values is $(IMAX-1)$ - similarly for J-ordered and K-ordered data.

- Two-dimensional **Ordered Data** (IJ-ordered, JK-ordered, IK-ordered)



A two-dimensional array where two of the three dimensions (IMAX, JMAX, KMAX) are greater than one, and the other dimension is equal to one. For nodal data, the number of stored values is equal to $IMAX * JMAX * KMAX$. For cell-centered IJ-ordered data (where IMAX and JMAX are greater than one, and KMAX is equal to one), the number of stored values is $(IMAX-1)(JMAX-1)$ - similarly for JK-ordered and IK-ordered data.

- Three-dimensional **Ordered Data** (IJK-ordered)



A three-dimensional array where all IMAX, JMAX and KMAX are each greater than one. For nodal ordered data, the number of nodes is the product of the I-, J-, and K-dimensions. For nodal data, the number of stored values is equal to IMAX * JMAX * KMAX. For cell-centered data, the number of stored values is (IMAX-1)(JMAX-1)(KMAX-1).

3 - 2.1 Indexing Nodal Ordered Data

For nodal ordered data, the n-dimensional array of values are treated as a one dimensional array. For example, given an IJK-ordered zone dimensioned by 10x20x30. To access the value at I=3, J=4, K=5 (one based) you would use:

```

IMax      = 10
JMax      = 20
KMax      = 30
I         = 3
J         = 4
K         = 5
NodeIndex = I + (J-1)*IMax + (K-1)*IMax*JMax
    
```

3 - 2.2 Indexing Cell-centered Ordered Data

For cell-centered ordered data, the index that represents the cell center is the same as the nodal index that represents the lowest indexed corner of the cell.

For example, the figure below shows an IJ-ordered zone dimensioned 3x4.

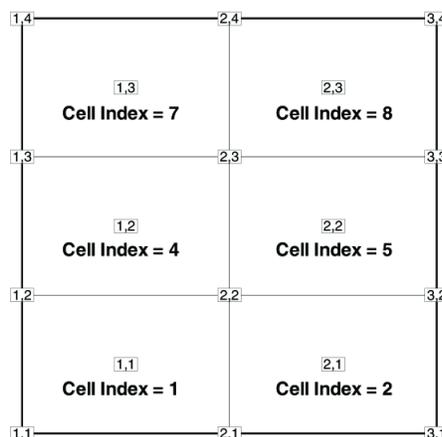


Figure 3-1. An IJ-ordered zone dimensioned 3x4. Cell index numbers are based on the point number in the lowest corner of the cell.

To access a cell-centered value for the cell in the upper right hand corner, use the following:

```

IMax      = 3
    
```

$$\begin{aligned}
 J_{\text{Max}} &= 4 \\
 K_{\text{Max}} &= 1 \\
 I &= 2 \\
 J &= 3 \\
 K &= 1 \\
 \text{CellIndex} &= I + (J-1)*I_{\text{Max}} + (K-1)*I_{\text{Max}}*J_{\text{Max}}
 \end{aligned}$$

You'll notice that the equations are exactly the same as with nodal data. As a result there are gaps of unused values at IMax, JMax, and KMax that *must* be left unassigned.

The above equation is generic for 1D, 2D and 3D data. It simplifies for the lower dimensions.

3 - 2.3 One-dimensional Ordered Data (I, J, or K)

Values for XY Line plots are usually arranged in a one-dimensional array indexed by one parameter: I for I-ordered, J for J-ordered, or K for K-ordered, with the two remaining index values equal to one.

At each node, *N* variables (*v*₁, *v*₂, . . . , *v*_{*N*}) are defined. If you arrange the data in a table where the values of the variables (*N* values) at a node are given in a row, and there is one row for each node, the table would appear something like that shown below.

V1	V2	V3	...	VN	(Values at node <i>l</i> = 1)
V1	V2	V3	...	VN	(Values at node <i>l</i> = 2)
V1	V2	V3	...	VN	(Values at node <i>l</i> = 3)
V1	V2	V3	...	VN	
V1	V2	V3	...	VN	
V1	V2	V3	...	VN	(Values at node <i>l</i> = IMax)

Table 3 - 1: Table of values for I-ordered Nodal Data (typical for XY plots).

See [Chapter 6: "XY and Polar Line Plots"](#) for more information on XY plots.

IJK-ordered Data Plotting

In one or two-dimensional datasets, all data points are typically plotted. However, for IJK-ordered data you can designate which surface will be plotted by using the **Surfaces** page of the **Zone Style** dialog. You may choose to plot just outer surfaces, or you may select combinations of I, J, and K-planes to be plotted. Refer to [Section 7 - 1.2 "Surfaces"](#) for in-depth information.

3 - 2.4 Logical versus Physical Representation of Data

A family of I-lines results by connecting all of the points with the same I-index, similarly for J-lines and K-lines. For IJ-ordered data, both families of lines are plotted in a two-dimensional coordinate system resulting in a 2D mesh. When both the I and J-lines are plotted in a three-dimensional coordinate system, a 3D surface

mesh plot results. An example of both meshes is shown below. As you can see, logical data points can transform into an arbitrary shape in physical space.

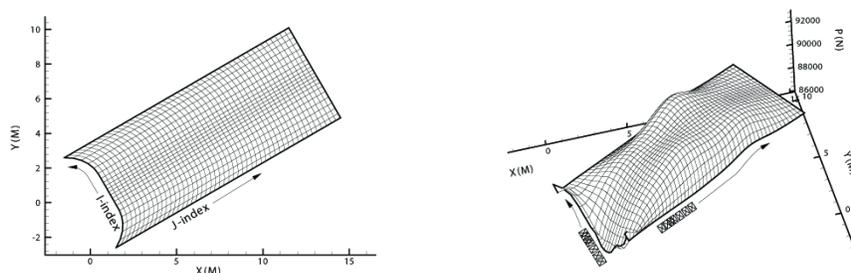


Figure 3-2. Left, a 2D mesh of IJ-ordered data points. Right, a 3D mesh of IJ-ordered data points.

3 - 3 Finite Element Data

While finite element data is usually associated with numerical analysis for modeling complex problems in 3D structures (heat transfer, fluid dynamics, and electromagnetics), it also provides an effective approach for organizing data points in or around complex geometrical shapes. For example, you may not have the same number of data points on different lines, there may be holes in the middle of the dataset, or the data points may be irregularly (randomly) positioned. For such difficult cases, you may be able to organize your data as a patchwork of elements. Each element can be independent of the other elements, so you can group your elements to fit complex boundaries and leave voids within sets of elements. The figure below shows how finite element data can be used to model a complex boundary.

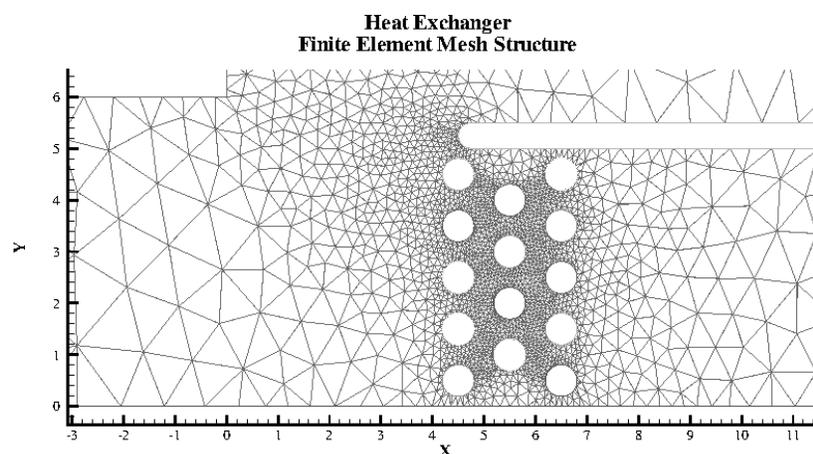


Figure 3-3. This figure shows finite element data used to model a complex boundary.

Finite element data defines a set of points (nodes) and the connected elements of these points. The variables may be defined either at the nodes or at the cell (element) center. Finite element data can be divided into three types:

- **Line data** is a set of line segments defining a 2D or 3D line. Unlike I-ordered data, a single finite element line zone may consist of multiple disconnected sections. The values of the variables at each data point (node) are entered in the data file similarly to I-ordered data, where the nodes are numbered with the I-index. This data is followed by another set of data defining connections

between nodes. This second section is often referred to as the connectivity list. All elements are lines consisting of two nodes, specified in the connectivity list.

- **Surface data** is a set of triangular or quadrilateral elements defining a 2D field or a 3D surface. In finite element surface data, you can choose per zone to arrange your data in three-point (triangle) or four-point (quadrilateral), elements. The number of points per node and their arrangement are determined by the element type of the zone. If a mixture of quadrilaterals and triangles is necessary, you may repeat a node in the quadrilateral element type to create a triangle.
- **Volume data** is a set of tetrahedral or brick elements defining a 3D volume field. Finite element volume cells may contain four points (tetrahedron) or eight points (brick). The figure below shows the arrangement of the nodes for tetrahedral and brick elements.

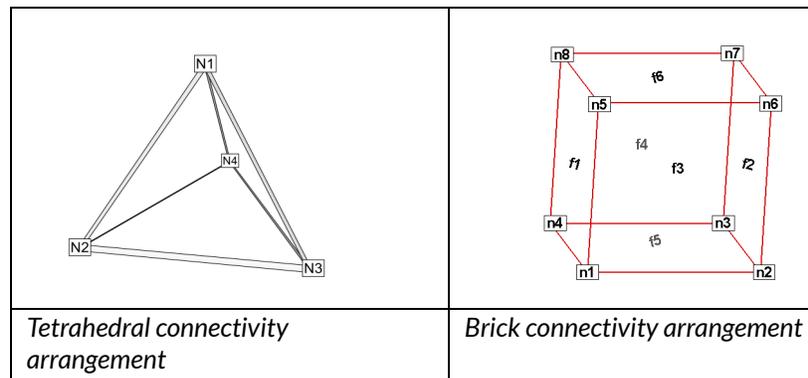


Figure 3-4. Connectivity arrangements for FE-volume datasets

In cell-based element types (triangular, quadrilateral, tetrahedral, or brick), points may be repeated to achieve elements containing a smaller number of points. For example, a connectivity list of "n1 n1 n1 n1 n5 n6 n7 n8" (where n1 is repeated four times) results in a brick-based pyramidal element. Any of the points could be repeated; for example, "n1 n1 n3 n3 n5 n5 n7 n7" would also be a valid way to define a pyramidal element in a brick zone.

In Tecplot Focus, each FE data zone must be composed exclusively of one element type. However, you may use a different data point structure for each zone within a dataset, as long as the number of variables defined at each data point is the same.

[Data Format Guide](#) provides detailed information about how to format your FE data in Tecplot's text file format.

3 - 3.1 Finite Element Data Limitations

Working with finite element data has some limitations:

- XY-plots of finite element data treat the data as I-ordered; that is, the connectivity list is ignored. Only nodes are plotted, not elements, and the nodes are plotted in the order in which they appear in the data file.
- Index skipping in vector and scatter plots treats finite element data as I-ordered; the connectivity list is ignored. Nodes are skipped according to their order in the data file.

3 - 4 Variable Location (Cell-centered or Nodal)

Data values can be stored at the nodes or at the cell centers.

- For finite element meshes, cell-centers are the centers (centroids) of elements.
- For many types of plots, cell-centered values are interpolated to the nodes internally.

3 - 5 Face Neighbors

A cell is considered a neighbor if one of its faces shares all nodes in common with the selected cell, or if it is identified as a neighbor by face neighbor data in the dataset. The face numbers for cells in the various zone types are defined below.

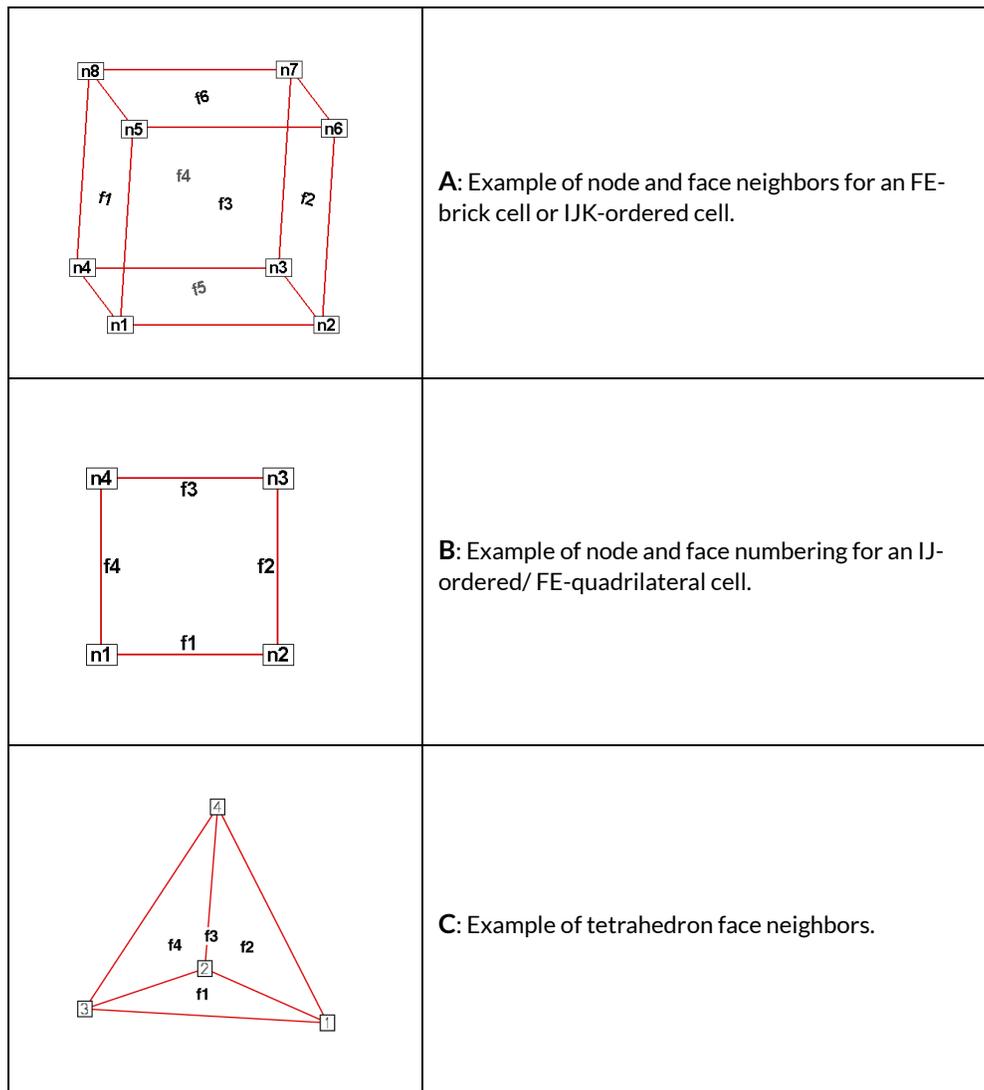


Figure 3-5. Examples of face neighbors for various zone types.

The implicit connections between elements in a zone may be overridden, or connections between cells in adjacent zones established, by specifying face neighbor criteria in the data file. Refer to [TECFACE](#) in the [Data Format Guide](#) for additional information.

3 - 6 Working with Unorganized Datasets

Tecplot Focus loads unorganized data as a single I-ordered zone and displays them in XY Mode, by default. An I-ordered zone is considered irregular if it has more than one dependent variable. An I-ordered data set with one dependent variable (i.e. an XY or polar line) is *not* an irregular zone.

To check for irregular data, you can go to the **Data Set Info** dialog (accessed via the **Data** menu). The values assigned to: IMax, JMax, and KMax are displayed in the lower left quadrant of that dialog. If IMax is greater than 1, and JMax and KMax are equal to 1, then your data is irregular.

It is also easy to tell if you have irregular data by looking at the plot. If you are looking at irregular data with the Mesh layer turned on, the data points will be connected by lines in the order the points appear in the data set.

You can organize your data set for Tecplot Focus in the following ways.

- Manually order the data file using a text editor.



Use the "Label Points and Cells" feature from the **Plot** menu to see if your data set can be easily corrected using a text editor by correcting the values for I, J, and/or K.

- Use one of the **Data>Interpolation** options. See [Section 20 - 9 "Data Interpolation"](#).

3 - 6.1 Example - Unorganized Three-Dimensional Volume

To use 3D volume irregular data in field plots, you must interpolate the data onto a regular, IJK-ordered zone. To interpolate your data, perform the following steps:

1. Place your 3D volume irregular data into an I-ordered zone in a data file.
2. Read in your data file and create a 3D scatter plot.
3. From the **Data** menu, choose **Create Zone>Rectangular**. (**Circular** will also work.)
4. In the **Create Rectangular Zone** dialog, enter the I-, J-, and K-dimensions for the new zone; at a minimum, you should enter 10 for each dimension. The higher the dimensions, the finer the interpolation grid, but the longer the interpolating and plotting time.
5. Enter the minimum and maximum X, Y, and Z values for the new zone. The default values are the minimums and maximums of the current (irregular) dataset.
6. Click [Create] to create the new zone, and [Close] to dismiss the dialog.
7. From the **Data** menu, choose **Interpolate>Inverse-Distance**. Kriging may also be used.
8. In the interpolation dialog, choose the irregular data zone as the source zone, and the newly created IJK-ordered zone as the destination zone. Set any other parameters as desired (see [Section 20 - 9 "Data Interpolation"](#) for details).
9. Select the [Compute] button to perform the interpolation.

Once the interpolation is complete, you can plot the new IJK-ordered zone as any other 3D volume zone. You may plot iso-surfaces, volume streamtraces, and so forth. At this point, you may want to deactivate or delete the original irregular zone so as not to conflict with plots of the new zone.

[Figure 3-6](#) shows an example of irregular data interpolated into an IJK-ordered zone, with iso-surfaces plotted on the resultant zone.

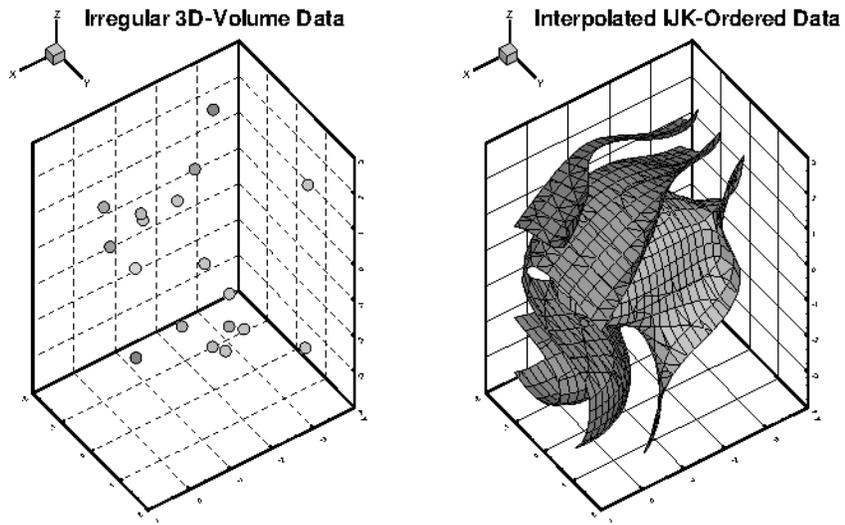


Figure 3-6. Irregular data interpolated into an IJK-ordered zone.

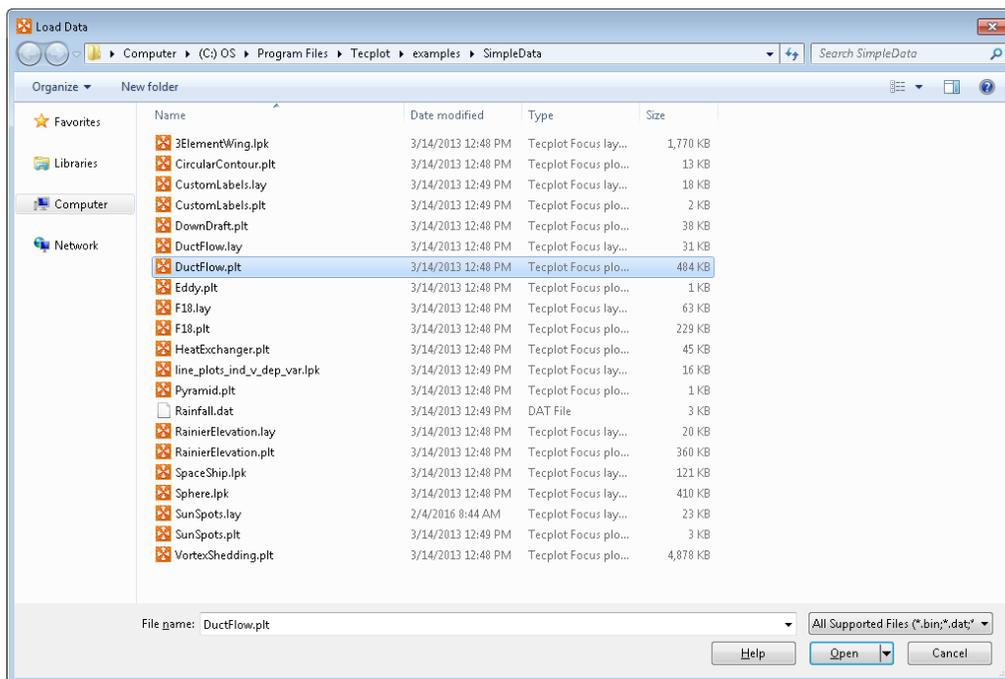
Part 2 Loading Your Data

4

Loading Data

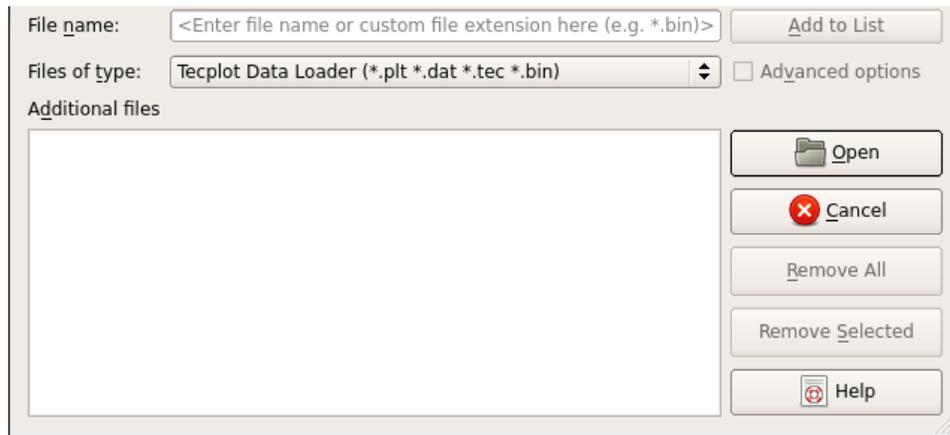
Tecplot Focus can load data from files on your local machine or accessible from a network file share using modules called *loaders*, each of which understands data in a particular format. A number of loaders are provided with Tecplot Focus for commonly-used general scientific and engineering formats as well as various Tecplot formats.

Tecplot Focus can load data files containing up to 5 million data points. Use the **File>Load Data** command to load a data file using the Load Data dialog, shown below.



Loading Data

Normally, this dialog works slightly differently on Windows and non-Windows platforms. The controls at the bottom of the dialog are different. For example, this is the lower portion of the dialog as seen on CentOS Linux.



On Windows, you can switch to this version of the Load Data dialog by choosing **Options>Use Extended Load Data Dialog**. Using this version of the dialog on Windows may be slower to navigate depending on your network; however, you may want to try it if you regularly load multiple data files from more than one directory.

On any platform, you may use the Load Data dialog to navigate to the file you wish to open, or simply type or paste the filename or the full pathname of the file in the File Name field.



If the file you are loading is a Tecplot-format file, you may also load it by simply dragging it from your file manager (e.g. Windows Explorer or Mac Finder) into the Tecplot Focus workspace, bypassing the Load Data dialog entirely. You can also load data files via the macro language; refer to \$!READDATASET in the Scripting Guide for details.

The **Files of Type** menu below the file list allows you to choose a data loader corresponding to the format of data file that you wish to load, or you may select *All Files* to see all the files in the directory and have Tecplot Focus automatically choose a loader for you if possible. When you choose a loader, the file list changes to show only files that can be loaded by that loader.



If the name of the file you are trying to load has a non-standard extension, type the extension in the File Name field like **.foo*, then press Enter to show all files having this filename extension. You may also enter **.** to show all files regardless of their extension, or choose **All Files** from the **Files of Type** menu to have Tecplot Focus try to determine which loader is needed.

- If the chosen loader needs only a single file, simply navigate to and select the file you want to load in the file list and click **Open**.
- If the chosen loader supports or requires loading more than one file at once, or you are choosing from *All Files* or *All Supported Files*, you may select multiple files. On Windows (using the standard version of the Load Data dialog), you can choose additional files by holding down Control or Shift while clicking the second and subsequent files in the dialog, then clicking **Open**.

On other platforms (or on Windows using the extended version of the Load Data dialog), the **Add to List** button becomes enabled. Select each file to be loaded and click **Add to List** to add it to the Additional Files list. You may choose files from more than one directory. You may also remove selected files from the list by clicking the **Remove All** or **Remove Selected** button. Click **Open** to open all the files using the loader you chose.

When using *All Files* or *All Supported Files*, all of the files should be in the same format. If the loader for that format cannot load multiple files, you must load them individually, appending the second and subsequent files.

- Some file formats are very flexible, so you may need to specify exactly how the data was written in order for Tecplot Focus to load it correctly. Some loaders always display an options dialog, since they are needed almost every time. Others only display an options dialog when you request it. On Windows (using the standard dialog), click the menu triangle next to the Open button and choose **Open With Advanced Options** instead of clicking **Open** after selecting your file(s). On non-Windows platforms (or when using the extended dialog on Windows), an **Advanced Options** checkbox becomes enabled and may be selected before clicking **Open**. The loader's options dialog is then displayed before loading the selected file(s).

Available file formats include:

- [CONVERGE CGNS File Loader](#)
- [DEM Loader](#)
- [DXF Loader](#)
- [Excel Loader](#)
- [General Text Loader](#)
- [HDF Loader](#)
- [HDF5 Loader](#)
- [PLY Loader](#)
- [Tecplot-Format Loader](#)
- [Tecplot Layout Loader](#)
- [Text Spreadsheet Loader](#)



Tecplot Focus cannot load data files that contain polygonal or polyhedral zones, nor files that contain more than 5 million data points.

Loading by Position

In most CFD data formats, it is valid to have multiple variables with the same name. When loading such a file, Tecplot Focus warns you that this situation exists and offers to load the variables by position: each variable will be identified by the order in which it appears in the file rather than by its name. This may make some aspects of working with the data different or more complicated.

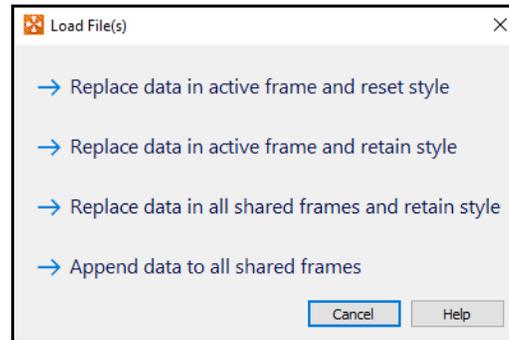
For example, when manipulating data using equations, you *must* use the *v#* syntax to refer to such duplicate variables, rather than the {VariableName} syntax, as the latter cannot uniquely identify the variable. (See [“Equation Variables and Values”](#) on page 261.) Macros may also be affected.

When possible, we advise obtaining a data file with a unique and consistent name for each variable, for example by adjusting your solver's configuration.

Appending or Replacing Data

You may append new data to your dataset at any time by choosing **File>Load Data**. You cannot append a grid file that contains only FE connectivity data without appending a solution file along with it. In addition, to append a solution file you must also append a grid file at the same time. In this case, the grid file must be loaded before the solution file.

Some loaders allow you to choose how you wish to append or replace data.



Depending on the circumstances, you may have the following choices:

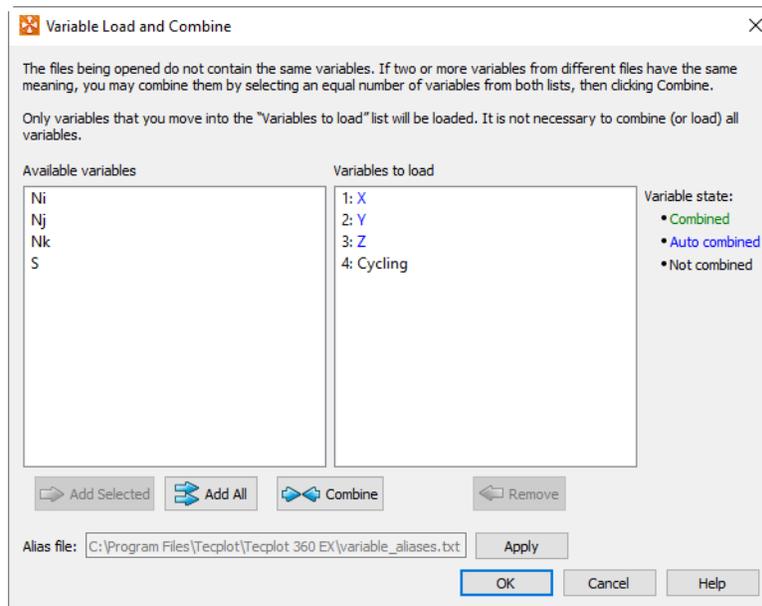
- *Replace Data in Active Frame and Reset Style* - The new data is loaded in place of the existing data. The plot styles are reset to their defaults, as if the new data was loaded immediately after starting up Tecplot Focus.
- *Replace Data in Active Frame and Retain Style* - The new data is loaded in place of the existing data. The plot styles in effect for the existing data are applied to the new data as best as possible and in some cases some style settings may need to be turned off or reassigned. The configuration option `!COMPATIBILITY USENAMESFORVARIABLEASSIGNMENTS`, when set to `TRUE` will make style settings match variable assignments based on the variable names, regardless of their position in the old and new datasets. If `!COMPATIBILITY USENAMESFORVARIABLEASSIGNMENTS` is set to `FALSE` then the variable offsets from the old style assignments will be used with the new data regardless of the old and new variable names. This option works best when the incoming data is similar to the existing data.
- *Replace Data in All Shared Frames and Retain Style* - This is the same as "Replace Data in Active Frame and Retain Style" except the same operations and rules are applied to all frames that share the same dataset with the active frame.
- *Append Data to All Shared Frames* - The active dataset is shared among multiple frames. Choose this option to append the newly loaded data in all the frames. Default plot styles are used.
- *Append Data to Active Frame* - Choose this option to append the newly loaded data in the current frame.
- *Replace* - When loading a layout, replaces the existing layout with the new one.
- *Append* - When loading a layout, creates new frames for the dataset referenced in the new layout.
- *Cancel* - Do not load the data and return to the Tecplot Focus workspace.

Loading and Combining Variables from Multiple Files

In Tecplot Focus, you can load multiple data files in two different ways:

- All at once by choosing all the files in the Load Data Files dialog.
- By appending data to the data that has already been loaded.

The Variable Load and Combine dialog appears when loading multiple data files in certain formats, whether you load the files all at once or append new data to previously-loaded data, if the names of the variables in the data files do not match. The dialog allows you tell Tecplot Focus which variables (if any) have the same meanings across the files, as well as which variables should not be loaded at all.



This feature works only with data in the following formats:

- Tecplot - text (.dat), binary (.plt), and subzone (.szplt)
- Excel
- HDF and HDF5
- Text (using the Text Spreadsheet or General Text loader)

The Variable Load and Combine dialog appears only when the files you are loading do not all contain exactly the same variable names (or, when appending, if the variable names in the file being loaded do not exactly match those of the data already loaded). When all variable names match in the files being loaded, this dialog does not appear; instead, Tecplot assumes that all the variables have the same meaning in all the files.

The dialog allows you to indicate that variables with different names have the same meaning (referred to as *combining* the variables) in two different ways.

- Select variables having the same meaning, one in each list, then click **Combine**.
- Apply a previously-defined variable alias file that indicates which variable names have the same meaning.

The two methods can also be used together. For example, you might first apply a variable alias file that deals with the most common equivalent variables in your typical data sets, then clean up any remaining variables (uncommon variables, or variables that don't always have a well-defined meaning) by hand.

The dialog has the following parts:

- The Available Variables list initially displays all the variables declared in the files you are loading. As you choose variables to combine or load, they move to the Variables to Load list. Any variables remaining in the Available Variables list when you click **OK** are not loaded.
- The Variables to Load list displays variables that are slated to be loaded in the current load operation. If you are appending data, variables that have already been loaded in previous load operations also appear here. Variables are colored according to the following rules:
 - *Black* - Variable is not combined; it is either already loaded, or will be loaded

- *Blue* - Variable appears under the same name in multiple files and has been automatically combined
- *Green* - Variable has different names in different files and has been combined by the user, either using the **Combine** button or by applying a variable alias file
- The **Add Selected** button moves a variable from the Available Variables list to the Variables to Load list, adding it to the set of variables that will be loaded in the current operation. The added variable's name appears in black. By default, variables that are unique to one file are not loaded.
- The **Add All** button moves all variables listed in the Available Variables list to the Variables to Load list, indicating that you want to load all of them in the current operation. The variable names appear in black.
- The **Combine** button combines the variable selected in the Available Variables list with the variable selected in the Variables to Load list, indicating that the variables have the same meaning. The variable is given a name derived from both the selected variables, and this name appears in the Variables to Load list and is colored green. See [Combining Variables Manually](#).
- The **Remove** button removes the selected variable from the Variables to Load list, if possible. If the variable is already part of the current data set (that is, you are appending data, and the variable is from a previous load operation), it cannot be removed.
When removing a combined variable, all the original variables that were combined are separated and moved back to the Available Variables list, again except for any which have already been loaded from a previous operation.
- The **Apply** button applies a variable alias file to the variables being loaded, combining variables if they are defined in the file as having the same meaning as another variable. See [Creating and Using a Variable Alias File](#).
- Click **OK** to proceed with loading after setting up the variable combining the way you want it.

Variables that have the same name are automatically combined, as this is almost always what you will want to have happen. They appear in blue in the Variables to Load list. If you do not want this to happen, load the files one at a time and, before loading the file with duplicate variable names, rename the existing variables you do not want to combine with newly-loaded variables of the same name. (You can rename variables by double-clicking them in the [Data Set Information](#) dialog.)

Combining Variables Manually

To combine two variables manually, telling Tecplot Focus that they have the same meaning, you select the first variable in the Available Variables list and the second in the Variables to Load list, then click the **Combine** button. The combined variable is added to the Variables to Load list and given a name consisting of both original variable names separated by a semicolon.

If the variables to be combined are in the Available Variables list, as may be the case when loading all the files at once instead of appending, select one in the Available Variables list and click **Add Selected** to select it to be loaded. Then combine them as above.

If there are more than two variables that have the same meaning, combine the first two, then select the combined variable in the Variables to Load list and combine it with the next variable having the same meaning in the Available Variables list as above.

You may combine multiple sets of variables at a time. If you select more than one variable in the Available Variables list, and the same number in the Variables to Load list, clicking **Combine** combines the first selected variable from the Available Variables list with the first selected variable from the Variables to Load list, the second with the second, and so on.

You may not combine variables from the same file.

Creating and Using a Variable Alias File

The *variable_aliases.txt* file found in the Tecplot Focus installation directory lists sets of variables that should be considered equivalent. See [Section 28 - 1 "Custom Files loaded on Startup"](#) for information about how variable aliases are loaded.

The *variable_aliases.txt* file must begin with a `#!VA 1` line to indicate that it is a variable alias file (format version 1). On subsequent lines, the `#` character indicates the beginning of a comment; everything following the `#` on a line is ignored. Variable aliases are specified by listing the equivalent names on a line separated by semicolons. For example:

```
#!VA 1
p;press;pressure
t;temp;temperature      # temperature variables in Celsius
m;mach
a;alpha;aoa             # angle of attack in radians
b;beta;aos              # angle of sideslip in radians
```

Variable names found in this file are case-insensitive. Excess whitespace is ignored.

When you click **Apply**, Tecplot Focus combines variables as indicated in *variable_aliases.txt*. Where two or more files contain variables whose names appear on the same line, these variables are combined, and the resulting Tecplot Focus variable is given a name containing the original variable names (as they appear in the datasets being loaded) separated by semicolons. The new variables then appear in the Variables to Load list in the dialog.

For example, if you load two files with the variables "P" and "Pressure," and the lines shown above appear in the *variable_aliases.txt* file, when you click **Apply**, these two variables appear in the Variables to Load list as a single variable called either "P;Pressure" or "Pressure;P" depending on the order in which the files were loaded.

If multiple lines in *variable_aliases.txt* might apply to the data sets being loaded, these conflicts are resolved based on the order in which the files are loaded. For example, if you load three files containing variables "M," "Mach," and "Mass," in that order, and *variable_aliases.txt* contains lines equating "M" with "Mach" and also "M" with "Mass," the resulting data set would have a variable named "M;Mach" and a second variable "Mass." Because the file containing the variable "Mach" was loaded before the file containing the variable "Mass," "M" was combined with "Mach" when that file was loaded and cannot also be combined with "Mass."

You may change the names of combined variables after loading the data by double-clicking the variable in the [Data Set Information](#) dialog (**Data Set > Data Set Info**).

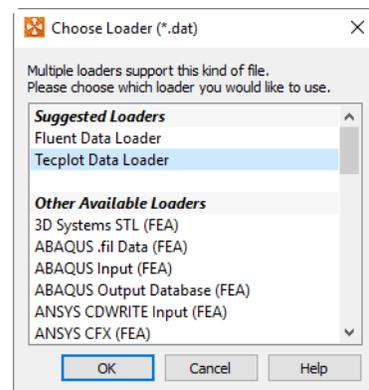
4 - 1 All Files and All Supported Files

With *All Files* and *All Supported Files*, Tecplot Focus tries to automatically choose a loader based on the names of the files you select.

With *All Files*, you see literally all of the files in the directory you're browsing. With *All Supported Files*, you see the files that Tecplot Focus knows it can load using any of the installed loaders, based on the files' names, but excluding other files. Either choice allows you to load files without having to specify in advance what loader will be used.

These options are particularly useful if you regularly work with multiple data file formats, or (in the case of *All Files*) if your data files often have unconventional names, such as a nonstandard or absent filename extension.

If the names of the selected files unambiguously indicate a single data file format, the appropriate loader is automatically chosen and the data is loaded without further ado. If more than one loader might be able to open the files, or if the files chosen do not have names that are recognized as



belonging to a particular loader, the Choose Loader dialog appears. This dialog may recommend one or more loaders in a "Suggested Loaders" section at the top of the list. Choose the loader to be used, then click **OK**.

All selected files must be in the same format.

4 - 2 DEM Loader

The DEM Loader allows you to load Digital Elevation Map files that have the same file format as the U.S. Geological Survey's standard DEM format. The DEM Loader will not accept Spatial Data Transfer Standard (SDTS) formatted data.

DEM files are available on the Web for a number of states within the U.S. For more information, refer to http://www.webgis.com/terr_us1deg.html

The DEM Loader first launches a multi-file selection dialog. After choosing one or more DEM files to load, you are presented with a simple dialog where you can set the I and J-skipping. For large DEM files, you may want to set both of these to be 10 or more.

4 - 3 DXF Loader

The DXF Loader add-on can import AutoCAD® DXF™ (drawing interchange) files. When importing a file, Tecplot Focus creates an appropriate geometry for each of the following entity types:

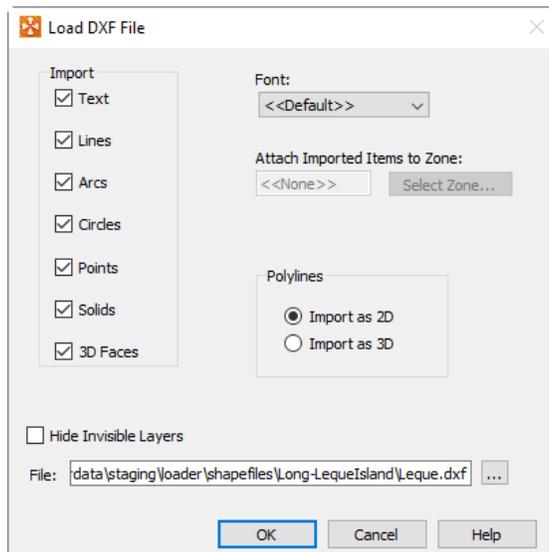
- Text
- Lines
- Arcs
- Circles
- Points
- Solid
- 3D faces



When importing a DXF file, no zones are created. Instead, the geometries representing each entity type are simply added to the frame. Be aware that a typical DXF file can contain several thousand geometries, and these are all included when you save a layout file.

4 - 3.1 Load DXF File Dialog

The Load DXF File dialog has a variety of features. You can select any of the following:



- **Import** - Select any or all geometries to import: Text, Lines, Arcs, Circles, Points, Solids, 3D Faces.
- **Font** - Select the font to use for text. (See [Section 18 - 1.2 "Font Folders and Fallback"](#) on page 231 for more information on how fonts work with Tecplot Focus.)
- **Attach Imported Items to Zone** - Specify a zone to which all imported geometries will be attached. Clicking the [Select Zone] button produces a menu of zone options.
- **Polylines/Import as 2D** - All lines and polylines are stored with three coordinates in DXF files. If you select this option, the loader will add 2D line geometries for all lines and polylines in the DXF file (the third coordinate will be ignored).
- **Polylines/Import as 3D** - If you select this option, the loader will add 3D line geometries for all lines and polylines in the DXF file. To view a 3D DXF file, create or load a 3D zone, import your DXF file, then choose "Fit Everything" from the **View** menu.
- **Hide Invisible Layers** - If this option is checked, objects in layers that are "off" in the DXF file will be imported with the background color.

4 - 3.2 DXF Loader Limitations

The DXF Loader does not create any field data. Loading a DXF file only adds geometries to your existing frame.

Since most geometries in Tecplot Focus are 2D, best results will be obtained by loading "flat" DXF files, such as maps.

Binary AutoCAD® DWG™ are not supported in this release.

4 - 4 Excel Loader

The Excel Loader can read numeric data from .xls files for Microsoft® Excel® version 5.0 or higher.



The **Excel Loader** is available for Windows platforms only.

The Excel Loader is intended primarily for users who record experimental or simulation data using Excel. Your Excel file must contain only values (no equations). We recommend the use of the Excel add-on from the *Util/Excel* folder as an easier method to open Excel data with Tecplot Focus (see [Section B - 1 "Excel Add-In"](#)). Use the Text Spreadsheet loader for delimited files ([Section 4 - 11 "Text Spreadsheet Loader"](#)).

If your spreadsheet is arranged as [Table Format](#) or [Carpet Format](#), the Excel Loader is a point-and-click operation. Once you have selected an Excel file to load, the Excel Loader leads you through a series of dialogs, prompting you to specify a variety of attributes, including the data format in the Excel spreadsheet, the variables to be read, and zone information.



Refer to [Section B - 1 "Excel Add-In"](#) for instructions on loading Excel data into Tecplot Focus from Excel.

4 - 4.1 Spreadsheet Data Formats

The Excel Loader will automatically identify blocks of data in [Table Format](#) or [Carpet Format](#). The loader will list blocks of data in standard notation for Microsoft Excel. For example, a block found on worksheet sheet1, cells A1-D8, is listed as follows: (sheet1! A1:D8).

If you select a user-defined format (or if the loader did not identify any carpet or table blocks), you will be prompted to enter the names and number of variables, and one or more zones and associated properties. You will also need to enter the location of the field data in the spreadsheet for each zone.

Table Format

Use Table format for data that will be plotted in line plots (i.e. data with an independent and one or more dependent variables). Many spreadsheets containing data to be plotted in 2D or 3D Cartesian plots will also satisfy the conditions of table format.

A table formatted dataset has the following characteristics:

- The dataset is arranged in one or more adjacent columns.
- Each column is the same length.
- Each cell contains numeric data.
- The first row is a header row containing the variable name for its corresponding column.
- The spreadsheet dataset is imported as a single I-ordered zone in POINT format with N variables, where N is the number of columns in the table.



The block of data must be surrounded by empty cells, text-filled cells, or table boundaries. The loader will not recognize a block of data as being in table format if any cell adjacent to the block contains a number.

The block of data can contain no empty cells. An empty cell will prevent the loader from recognizing the block. You can satisfy this condition by filling blank cells with 0.0.

Figure 4-1 shows a block of data in table format in Excel.

	A	B	C
1	Month	Seattle Rainfall	
2	1	4.3	
3	2	4.5	
4	3	4	
5	4	4.2	
6	5	3.5	
7	6	2.1	
8	7	2	
9	8	1.5	
10	9	2.1	
11	10	2.5	
12	11	3.3	
13	12	3.5	
14			

Figure 4-1. A block of data in table format.

Carpet Format

Use carpet format for spreadsheet data to be plotted in a 2D or 3D Cartesian plot. The carpet formatted dataset, shown in Figure 4-2, has the following characteristics:

- The spreadsheet dataset is imported as an IJ-ordered zone. See [Chapter 6: “XY and Polar Line Plots”](#).
In Figure 4-2, the spreadsheet is imported as I=4 and J=4. The three variables are X, Y, and V. In the spreadsheet cell 2B is index 1, 1, cell 3B is index 2, 1.
- The top row in the block contains the values of the X-variable, the first column of the block contains the values of the Y-variable, and the V-values are the interior data. This format is useful if your dataset was generated from a function f , such that $f(X, Y) = V$.
- The block is a rectangular arrangement of numeric data in the spreadsheet, with a blank cell in the upper left hand corner.
- There must be no blank cells within the block of data. An empty cell will prevent the loader from recognizing the block. You can satisfy this condition by filling blank cells with $\emptyset.\emptyset$.
- The block of data must be surrounded by empty cells, text-filled cells, or table boundaries. The loader will not recognize a block of data as being in carpet format if any cell adjacent to the block is filled with a number.

	A	B	C	D	E	F
1		1	2	3	4	
2	1	1	2	3	4	
3	2	2	4	4	8	
4	3	3	6	9	12	
5	4	4	8	12	10	
6						

Figure 4-2. This carpet table shows values as a simple arithmetic function of X and Y.

Other Formats

The Other format option gives you a great deal of flexibility in loading data into Tecplot Focus. A series of dialogs leads you through the process of describing your data, similar to the way you would specify this information in a Tecplot-format ASCII file.

- **Default format** - The Excel Loader offers a semiautomatic option that requires only that you specify the upper left and lower right corners of your data block. Once you've specified those corners, it handles the data in the same way that Tecplot Focus handles an unformatted block in an ASCII file. It assumes one zone of I-ordered data in POINT format.
- **Custom format** - Using the Custom format option, you can specify characteristics of your dataset. Custom format has the following features:
 - It allows you to work with spreadsheets containing blank cells or text cells.
 - For XY, IJ, and IJK-ordered data, specify the boundaries of the block to load, and how many data points there are within that block (IMax, JMax, KMax).
 - For finite element data, the number of data points is implied by the number of nodes and number of elements.
 - Allows you to load blocks of cells that you delimit interactively.
 - It is the only option for loading finite element, IJK-ordered, or zone data from Excel. If you want to read data from an Excel spreadsheet into more than one zone, you must use custom format. By default, all data read is put into a single I-ordered zone.

4 - 4.2 Excel Loader Restrictions

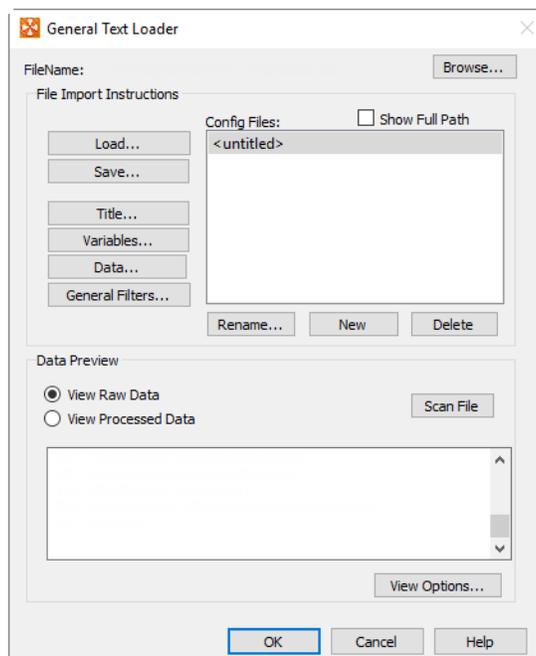
A block of data is a rectangular group of numbers in the spreadsheet. The Excel Loader places the following restrictions on blocks:

- Carpet and table format (which the loader detects and loads automatically) are narrowly defined. All other formats must be loaded on the user-defined pathway.
- Numeric cells within each block should contain only numbers or numeric characters such as +, -, and so forth. A cell containing "X=34" is interpreted by the loader as text, because it begins with text.
- Cells containing formulas (therefore displaying calculated values) will be skipped by the loader. You can convert the formulas to values within Excel, by pasting your table using the "Paste Special" function, with "values only" selected.
- The spreadsheet file must have been written by Excel Version 5.0 or higher. For newer versions of Excel (Office 2007 and later) that save in .xlsx format by default, please switch to the older .xls format when saving your file.

4 - 5 General Text Loader

The General Text Loader add-on allows you to read ASCII text data files in a variety of formats. You can specify variable and dataset title information or indicate specific places to read them from in your data file. Instruction settings for reading a type of file can be saved and restored so they do not have to be entered again each time a new file of the same type is loaded.

The following options are available:



- **Filename** - The name of the file to be loaded. This is automatically filled in with the name of the file selected in the Load Data dialog, but may be changed using the **Browse** button.
- **Titles** - Launches the [Dataset Title](#) dialog, which allows you to specify dataset title properties.
- **Variables** - Launches the [Variable Import Instructions](#) dialog which allows you to specify dataset variable properties.
- **Data** - Launches the [General Text Loader: Data](#) dialog which allows you to specify dataset field properties.
- **General Filters** - Launches the [General Text Loader: Filters](#) dialog which allows you to specify general filters when reading your file.
- **Configuration File List** - This list shows available configuration files. Configuration files can be edited using a text editor, although this is not usually necessary and is not recommended. The format of these files is listed on the Configuration page.
 - **Load** - Loads a single configuration file from any location.
 - **Save** - Saves a single configuration file to any location.
 - **Rename** - Renames a configuration file.
 - **Delete** - Deletes a configuration file.
 - **New** - Creates a new, untitled configuration file.
- **Data Preview**
 - **View Raw Data** - This displays the data exactly how it looks in the file without any processing.
 - **View Processed Data** - This displays the processed and filtered data that will be loaded.
 - **View Options** - Launches the [General Text Loader: View Options](#) dialog.

4 - 5.1 Dataset Title

The **Dataset Title** dialog allows you to specify options for General Text Loader titles.

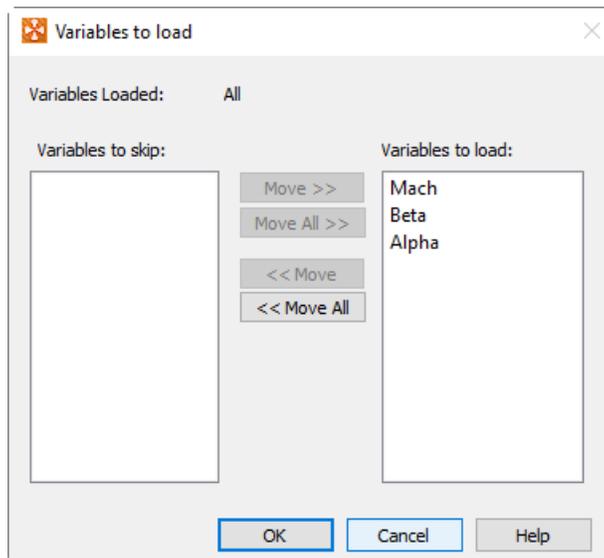
- **Use Title** - Manually enter the dataset title, rather than have General Text Loader scan the file for it.
- **Use line number** - Enter the line number of the dataset title in the file. The General Text Loader skips white space on the line until text, and then reads until the delimiter indicated is found. To include spaces in the title, enclose them in double quotes.
- **Use first line containing keyword** - Enter a keyword for the dataset title line. The title will read the first line containing this keyword (case insensitive). General Text Loader searches for a title on this line in the following order, (unless the delimiter is specified as fixed):
 - a. First, it will look for any text enclosed in double quotes. If it finds this, then the enclosed text will be read as the title.
 - b. If no text in double quotes is found, the first non-white space text after the keyword ending with the indicated delimiter will be used.
- **Text Delimiter** - The text delimiter indicates when the end of text has been reached. You can set it to one of the following:
 - **Auto** - Space, tab, comma, semicolon.
 - **Fixed** - Each width number of characters on the line is a token field. White space is removed from the beginning and end of the field.
 - **Width** - If the delimiter is fixed, enter the width of each field here.

4 - 5.2 Variable Import Instructions

The **Variable Import Instructions** dialog of the General Text Loader allows you to scan for the location of the variable names in the data file, and enter which variables to load.

- **Scan for variable names** - Specify the following:
 - **Start line** - Enter the starting line of variable names in the file.
 - **End line** - Enter the ending line of the variable names in the file. This is typically the same as the starting line.
 - **Delimiter** - The delimiter indicates when the end of each variable name has been reached. You can set it to one of the following:
 - **Auto** - Space, tab, comma, semicolon.
 - **Fixed** - Each 'width=n' number characters on the line is a variable. White space is removed from the beginning and end of the field. For example, if the line length is 60 and the width is ten, the columns 1-10, 11-20, 21-30, and so forth, are variable names. Spaces are removed from the beginning and end of the variable names.
 - **Width** - If the delimiter is fixed, enter the width of each field here.
- **Enter Variable Names** - Select this option to enter a list of variable names in the dialog box. Variable names should be separated by carriage returns.

- **Select Variables to Load** - Launches the **Variable to Load** dialog.



- **Variables to Skip** - Displays a list of variables that will be skipped.
- **Variables to Load** - Displays a list of variables that will be loaded.

Use the [Move], [Move All], [Remove], or [Remove All] buttons to edit the "Variables to Load" list.

4 - 5.3 General Text Loader: Data

The **Data Import Instructions** dialog of the General Text Loader allows you to specify the location of the data names in the data file, and what data to load.

- **Start Identification**

- **First all-numeric line** - Select if the data begins at the first line of a file that contains only numbers. If you have specified multiple zones, all non-numeric lines will be skipped at the beginning of each zone.
- **First line after line with keyword** - Select if the data begins at the first non-blank line after the line containing the specified keyword. The keyword is case insensitive.
- **Start at line number** - Select to specify the line number where the data begins. Blank lines are ignored in the data section.

- **End Identification**

- **All lines up to first non-numeric line** - Select if the data ends at the first non-blank line containing any text.
- **Stop at line number** - Select to specify the line number where the data ends.
- **All lines up to line with keyword** - Select if the data ends at the first line before the line with the specified keyword. The keyword is case insensitive.
- **End of file** - Select if the data ends at the end of file.

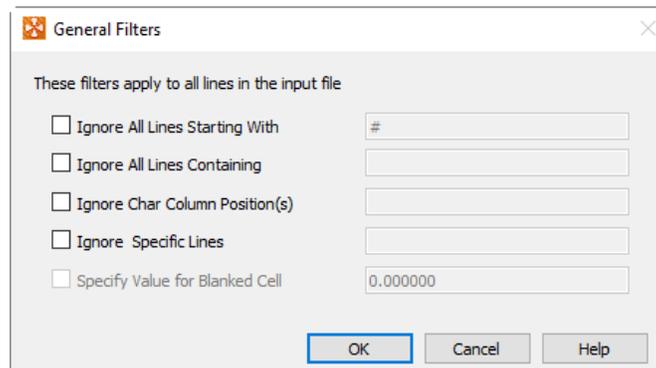
- **Data Identification**

- **Point format** - In this format all values of all variables are given for the first point, then the second point, etc.

- **Block format** - In this format all values for the first variable are given, then all values for the second variable, etc.
- **Data value delimiter** - The data value delimiter indicates when the end of a data value has been reached. You can set it to one of the following:
 - **Auto** - Space, tab, comma, semicolon.
 - **Fixed** - Each 'width=n' number characters on the line is a token field. White space is removed from the beginning and end of the field. For example, if the line length is 60 and the width is ten, the columns 1-10, 11-20, 21-30, and so on, are token fields.
 - **Width** - If the delimiter is 'fixed', enter the width of each field here.
- **Data Dimension** - If the data dimensions are entered, General Text Loader adds zones as necessary depending on the number of data points found in the file. There must be an equal number of data points for each zone (equal to the product of the IJK dimensions).
 - **Auto-Calculate IMAX** - The I-dimension is calculated based on the number of data points found. J and K-max are set to one.
 - **Specify Dimensions** - Specify the I, J, and K-dimensions for the data. There must be enough data points found in the file to match the indicated dimensions.
 - **Allow Multiple Zones** - If checked, General Text Loader will attempt to read more than one zone from the data file.
 - **Zone ends on line with keyword** - If Allow multiple zones is selected and Auto-calculate IMax is selected, then you must enter a keyword here to mark the end of one zone and the beginning of the next. Zones are ended when a line containing this text is found.
- **Ignore non-numeric tokens** - If checked, then any non-numeric information in the data sections is ignored. If not checked, General Text Loader displays an error if any non-numeric data is found in the data section.

4 - 5.4 General Text Loader: Filters

Use the **General Filters** dialog of the General Text Loader to filter the data file.



- **Ignore All Lines Starting With** - If checked, all lines beginning with the entered string are ignored.
- **Ignore All Lines Containing** - If checked, all lines containing the indicated text are ignored.

- **Ignore Character Column Position(s)** - If checked, then the entered columns are ignored when scanning the file. Columns are entered as a single number or a hyphenated range, one or more of which may be separated by commas.



If there are tabs in the data file, they are not expanded in this filter. For example, if column 1 is a tab and you wish to skip column 2, you should enter 2, even though a text editor will show more than one space after expanding the tab.

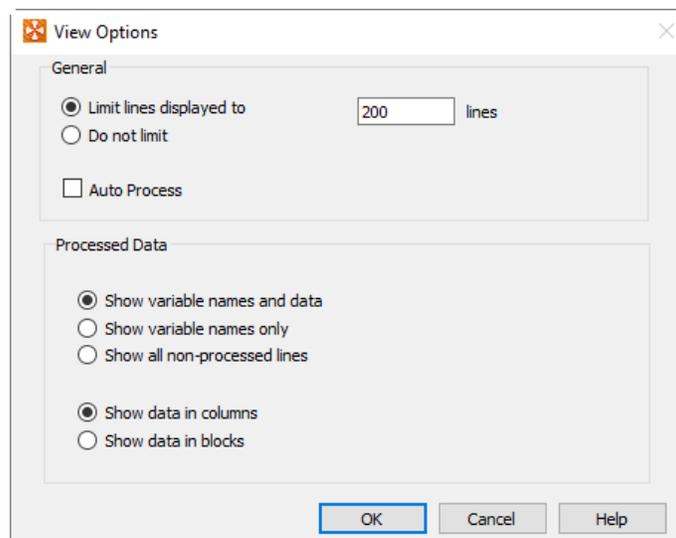
- **Ignore Specific Lines** - If checked, entered lines are ignored when scanning the file. Lines are entered as a single number or a hyphenated range, one or more of which may be separated by commas. You may also use "end" to specify the last line of the file.
- **Specify Values for Blanked Cell** - If checked, you can specify a value which the loader uses for blank cells.



This option is only available if the data delimiter is a comma or semicolon. You can change the data value delimiter using the **Data Import Instructions** dialog.

4 - 5.5 General Text Loader: View Options

The **View Options** dialog of the General Text Loader allows you to specify the data display.



General Options

- **Limit lines displayed** - Limits the number of lines displayed in the preview window. For large files, you may want to set this to a number less than the total number of lines. The fewer number of lines, the faster the preview display.
- **Do not limit** - If you select this toggle, the entire file will be displayed in preview mode.
- **Auto Process** - If selected, General Text Loader automatically refreshes all information about the file whenever any loader settings are changed. For very large files (multi-megabyte), this option is not recommended, since re-scanning a large file can be time consuming.

Processed Data

- **Show variable names and data** - If selected, variable names and processed data will be displayed in the preview window.
- **Show variable names only** - If selected, only variable names will be displayed in the preview window.
- **Show all non-processed lines** - If selected, all lines which will not be loaded will be displayed in the preview window.
- **Show data in columns** - Shows the data in columns where each column is a variable.
- **Show data in blocks** - Shows the data in blocks where each block is a variable.

4 - 5.6 General Text Loader Configuration File

A configuration file contains all of the instructions that tell the General Text Loader how to load a particular type of text file. This information is collected from the dialog fields and written to a file when you click [Save] on the main dialog. The configuration file format is similar to the Tecplot macro language. Configuration files for the general text loader are ASCII text files which use a command set that can describe all loading instructions. Normally you do not need to edit these files, as they are automatically written by the loader when you select New on the main dialog.



Editing these configuration files by hand is not recommended.

General Text Loader CONFIGNAME Command

When reading a dataset using General Text Loader, instead of specifying individual parameters in \$!READDATASET, you may use the CONFIGNAME command.

This consists of:

```
CONFIGNAME = <string>
VERSION = <integer>
# version of the template file (default is 100)
# Note: changing the version number may cause unpredictable behavior
TITLE
{
  SEARCH = [NONE|LINE|KEYWORD] # default = NONE
  NAME = <string>
# default = "New Dataset", ignored if SEARCH is not NONE
  LINE = <integer> # 1-based, ignored if SEARCH is not LINE
  KEYWORD = <string> # ignored if SEARCH is not KEYWORD
DELIMITER = [AUTO|TAB|SPACE|SEMICOLON|COMMA|FIXED]
  WIDTH = <integer> # Valid only if DELIMITER = FIXED
}

VARIABLES
{
  SEARCH = [NONE|LINE]
  NAMES = <string> # ignored if SEARCH is SCAN
  # <string> is a comma separated string
  LOADED = <all|n1,n2,...nn> # list of variables to be loaded
  STARTLINE = <integer> # 1-based, ignored if SEARCH=NONE, default = 1
  {
  STARTID = [FIRSTNUMERICLINE | LINE | KEYWORD]
  {
  KEYWORD = <string> # ignored if STARTID is not KEYWORD

  ENDLINE = <integer> # 1-based, ignored if SEARCH=NONE, default = 1
  DELIMITER = [AUTO|TAB|SPACE|SEMICOLON|COMMA|FIXED]
```

```

    WIDTH = <integer> # Valid only if DELIMITER = FIXED
}
DATA
{
  IGNORENONNUMERICTOKENS = <boolean> # default = TRUE
  IMPORT
  LINE = <integer>
  # 1-based, ignored if STARTIDENTIFICATION is not LINE
}
ENDID = [FIRSTNONNUMERICLINE | LINE | KEYWORD]
{
  KEYWORD = <string> # ignored if ENDID is not KEYWORD
  LINE = <integer> # 1-based, ignored if ENDID is not LINE
}
  FORMAT = [POINT|BLOCK] # default POINT
DELIMITER = [AUTO|TAB|SPACE|SEMICOLON|COMMA|FIXED]
  WIDTH = <integer> # Valid only if DELIMITER = FIXED
}

DIMENSION
{
  AUTO=<boolean> # default = TRUE
  IMAX=<integer> # ignored if AUTO = TRUE, default = 1
  JMAX=<integer> # ignored if AUTO = TRUE, default = 1
  KMAX=<integer> # ignored if AUTO = TRUE, default = 1
  USEMULTIPLEZONES = <boolean> # ignored if AUTO = TRUE, default false
  KEYWORD=<string> # ignored if USEMULTIPLEZONES = FALSE
}
}
GLOBALFILTERS # filters are applied cumulatively, so lines matching
# any of the criteria are filtered
{
  COMMENT = <string> # ignore lines beginning with <string>
  NUMBER = <integer> # ignore all lines starting with line number
  <integer>
  KEYWORD = <string> # ignore all containing <string> (case insensitive)
  COLUMNS = <list> #<list> is a comma separated list of number ranges
  # example: "1-80,100-end", etc. Must be in double quotes
  ROWS = <list> # same as above
  USEBLANKCELLVALUE = <boolean> # if TRUE, then the value of blank cells
  is BLANKCELLVALUE
  BLANKCELLVALUE = <double> # blank cell value. Ignored if
  USEBLANKCELLVALUE is FALSE
}
}

```

Where <string> is a file name or file path. Settings will be loaded from the file name specified in <string>. This command is only allowed in conjunction with the \$!READDATASET command as described below. It may not be used inside a configuration file.

For example, instead of:

```

$!READDATASET 'C:\test.txt' "VERSION=100 FILEEXT=\"*.txt\"
FILEDESC=\"general text\" "+"\"TITLE{SEARCH=NONE NAME=\"New
Dataset\" LINE=1 DELIMITER=AUTO WIDTH=10
}"+\"\"VARIABLES{\"SEARCH=LINE LOADED= All STARTLINE=1 ENDLINE=3
DELIMITER=SEMICOLON WIDTH=5
}"+\"\"DATA\"+\"{\"IGNORENONNUMERICTOKENS=TRUE
IMPORT\"+\"{\"STARTID=LINE {\"LINE=4
}"+\"\"ENDID=FIRSTNONNUMERICLINE {\"LINE=1 }\"+\"\"FORMAT=IJKPOINT
DELIMITER=AUTO WIDTH=1 }\"+\"\"DIMENSION\"+\"{\"AUTO=TRUE
CREATEMULTIPLEZONES=FALSE
}"+\"\"GLOBALFILTERS\"+\"USEBLANKCELLVALUE=TRUE
BLANKCELLVALUE=0.000000 }\"'
DATASETREADER = 'General Text Loader'

```

Using the CONFIGNAME command, you can write:

```
$!READDATASET ' "myfile.dat"  
"CONFIGNAME=c:\config_files\myconfig.lgc" ' # contains all of the  
instructions in the example above DATASETREADER='General Text  
Loader'
```

Components of the Configuration File

- All General Text Loader configuration files must start with the line:
#!TECPLOT_LOADGEN
- **Instruction Syntax** - Each instruction file contains commands which describe the loading instructions.
- **Comments** - Any text following '#' to the end of the line is ignored.
- **String Format** - The <string> parameter must be enclosed in double quotes. You can include a double quote character in the string by preceding it with a backslash '\.' For example:
 - "This is a normal string"
 - "This is a \"quote\" inside a string"
- **List Format** - The <list> parameter type is defined as one or more number ranges, separated by commas, enclosed in double quotes. A number range may be a single number or two numbers separated by a dash. Optionally, you may use "end" to indicate the last valid number. For example:
 - "1"
 - "1,2-7,3"
 - "10-end,3,2-5"
- **Command List** - The commands in the file may appear in any order, and any command may be divided into any number of lines (that is, all white space, including carriage returns, is ignored).

4 - 6 HDF Loader

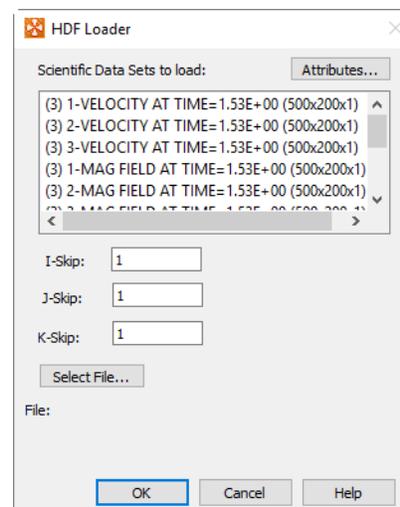
The HDF Loader add-on can load 1D, 2D, and 3D Scientific Data Sets (SDS) from HDF files¹. When a dataset from an HDF file is imported, the file is scanned and a list of all SDS in the file is displayed in the Scientific Data Sets to load portion of the **HDF Loader** dialog. Select one or more SDS to import. **Every SDS that you select must have the same dimension.** A rectangular I, IJ, or IJK-ordered zone (for 1, 2, or 3D data, respectively) is created for each SDS that you select to load.

1. The HDF Loader uses the public-domain HDF API code library from the National Center for Supercomputing Applications (NCSA), University of Illinois, Urbana-Champaign.

The **HDF Loader** dialog has the following options:

- **Scientific Data Sets to load** - Select one or more SDS's to load. Each SDS that you select must have the same rank (dimension).
- **I-Skip** - Select the I-Skip value. A skip value of one loads every data point, a skip value of two loads every second data point, and so on.
- **J-Skip** - Select the J-Skip value.
- **K-Skip** - Select the K-Skip value.
- **Select File** - Select an HDF file.
- **Attributes** - Displays attributes of each SDS found, such as number type, rank, label, and so on.

You may also click **Select File** to choose a different file.



4 - 6.1 HDF Loader Limitations

The HDF Loader can import only Scientific Data Sets from HDF files, and these are imported in a manner similar to NCSA's own HDF viewer. The way in which the data file is interpreted cannot be altered in this release of the loader.

4 - 7 HDF5 Loader

The HDF5 loader add-on allows you to import general HDF5 files into Tecplot Focus. The loader provides a mechanism for importing generic data from multiple HDF5 datasets or groups. The HDF5 loader will load datasets within user selected groups, load one or more user selected datasets to one zone, load multiple user selected datasets to multiple zones, execute macros after data has been loaded, create implicit X, Y, and Z grid vectors as needed, sub-sample loaded data, and reference user selected vectors for X, Y, and Z grids. Datasets must be ordered data. The HDF5 library used is version 1.12.0.

4 - 7.1 Data Selection

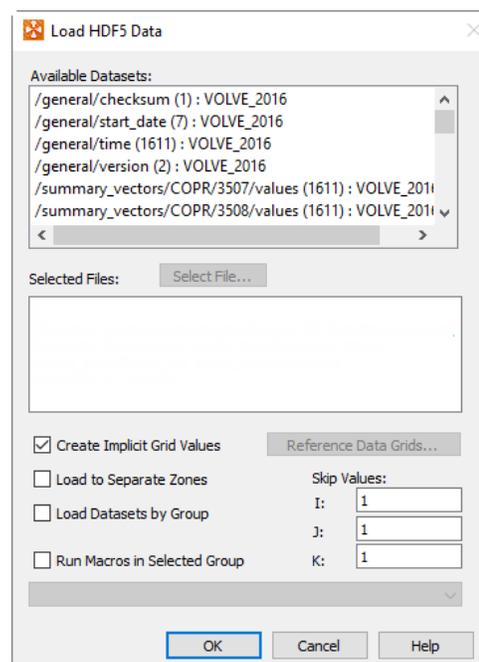
One or more files may be opened if all selected files have an identical hierarchy. Hierarchy information for the selected HDF5 files is displayed in the form: /group/[group].../dataset - the dimension of each dataset is displayed immediately following the dataset name. In this window, one or more datasets or groups may be selected for loading.

4 - 7.2 Importing/Loading Data

Datasets may be loaded using one of three methods: 1) [Loading Multiple Datasets to One Zone \(default\)](#), 2) [Loading Multiple Datasets to Separate Zones](#), or 3) [Loading Datasets by Group](#).

Loading Multiple Datasets to One Zone (default)

Loading multiple datasets to one zone is the default method of importing HDF5 files. Using this method, the HDF5 loader will create one zone with N variables, where N is the number of HDF5 datasets selected.



Selected datasets may have one to three dimensions. The dimension of loaded Tecplot Focus variables will match the I, J, and K values of the selected datasets. Variable names are assigned the corresponding names of selected datasets. **All selected datasets must have equivalent dimensions.**

To import your data, select one or more datasets from the **Available Datasets** window. All selected datasets must be identical in dimension; dataset dimensions are shown immediately to the right of dataset names in the **Available Datasets** window.

Loading Multiple Datasets to Separate Zones

Using this method, the HDF5 loader will create N zones, where N is the number of datasets selected in the **Available Datasets** window. Each zone contains one variable per selected dataset where each dataset must have one to three dimensions. The I, J, and K values of each Tecplot Focus zone will match the dimensionality of each selected dataset. Variable and zone names are automatically assigned. **Dimensionality may vary between selected datasets.**

To import your data using this method, select the "Load to Separate Zones" toggle. Select one or more datasets from the **Available Datasets** window. One zone will be created for each selected dataset and each zone will contain exactly one variable (unless you selected Create Implicit Grid Values or Reference Data Grids).

Loading Datasets by Group

Using this method, the HDF5 loader will create N zones with M variables, where N is the number of groups selected in the **Available Datasets** window and M is the number of datasets in each group. The I, J, and K indices of the Tecplot Focus variables will be equivalent to the respective dimension of selected datasets. Datasets in any selected group must be equal in dimension; however, datasets may be unequal in dimension between groups. When selecting multiple groups, all groups must contain an equal number of datasets and dataset names must be identical between groups. The HDF5 loader will only load datasets within the root directory or within a subgroup, i.e., the HDF5 loader will not load data within nested groups.

To import your data using this method, select the "Load Datasets by Group" toggle. Press [Select File] to open a HDF5 file. Select one or more groups from the **Available Datasets** window; all groups must contain an equal number of datasets where all datasets have identical names between groups. The number of selected groups determines the number of zones that load into Tecplot Focus. Zone names will match the name of the corresponding group. Variable names will match the respective dataset name. Each zone will include as many variables as datasets per selected groups.

4 - 7.3 Additional Options

Additional options may be specified when loading HDF5 data into Tecplot Focus. These options include: [Using Macros](#), [Sub-Sampling Data](#), [Referencing Data Grids](#), and [Grid Generation](#).

Using Macros

Macros may be defined within a HDF5 vector and placed in any group. Each character string in the selected vector must be a valid one-line Tecplot macro. Macros are executed in the order encountered after all data are loaded.

To run a macro defined as a character vector in your HDF5 file, select the "Run Macros in Selected Group" toggle. Select the macro you want to execute from the **Select Macro** pull-down menu. Your macro will run after your data has been successfully loaded into Tecplot Focus.

Sub-Sampling Data

The HDF5 loader will sub-sample the first, second, and third dimensions of loaded datasets respectively as defined by the user. The default skip-value is 1. When specifying non-unitary skip values, the dimensionality

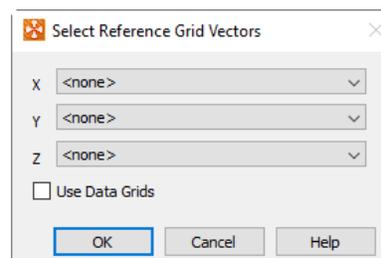
of all selected datasets must be equivalent. Datasets will be sub-sampled using the user defined I-Skip, J-Skip, and/or K-Skip values – skip values must be whole numbers.

To sub-sample data in the first, and/or second, and/or third dimensions of selected datasets, change the respective I-Skip, and/or J-Skip, and/or K-Skip values located in the **HDF5 loader** dialog. If the skip-values are non-unitary then selected datasets must have equivalent dimensions.

Referencing Data Grids

The HDF5 loader allows users to specify X, and/or Y, and/or Z grid vectors. Selected vectors are used for plotting all zones. Vectors are of dimension 1 and length M. The X grid vector length must be equal to the first dimension of selected datasets, the Y grid vector length must be equal to the second dimension of selected datasets, and the Z grid vector length must be equal to the third dimension of selected datasets. The number of selected grid vectors must equal the rank of selected datasets.

To define the grid vectors, first toggle off "Create Implicit Grid Values" option, then click the **Reference Data Grids** button. In the Select Reference Grid Vectors dialog that appears, select the vector you want to use as the corresponding grid using the menus. You **MUST** toggle on "Use Data Grids". The number of grid vectors you specify must equal the rank of selected datasets.



Grid Generation

The HDF5 loader can automatically create X, Y, and Z grid vectors as necessary for selected datasets. Grid vectors will be of length equal to the corresponding dimension.

To automatically create X, Y, and Z grid vectors, accept the default setting of "Create Implicit Grid Values" in the **HDF5 loader** dialog. The grid vectors will be created upon loading your data into Tecplot Focus.

4 - 8 PLY Loader

Use this loader¹ to load 3D triangular surface files with the *.ply* extension. This format is often used to store surfaces generated from tessellation of 3D range measurement data. Files may be either ASCII or binary, but must contain both vertex and face elements (sections). This loader is included in your Tecplot Focus installation.

4 - 9 Tecplot-Format Loader

This section describes the process for loading Tecplot-format data files with the extensions *.dat* for ASCII files and *.plt* for binary files. Some other products that write Tecplot binary files use the filename extension *.bin* or *.tec*, and these are also recognized by the Tecplot-Format loader. (Refer to the [Data Format Guide](#) for information on outputting data into Tecplot Focus file format.)

There are four ways to create and work with Tecplot-format data files:

- **Generate a Tecplot-format ASCII data file** - Read the file into Tecplot Focus and work without conversion. If the dataset is altered, save it as an ASCII data file. This method works well for smaller datasets where the convenience of an ASCII file outweighs any inefficiencies.

1. Copyright for Third Party Library. This loader utilizes a modified version of a library written by Greg Turk while at Stanford University. The copyright for this library is: Copyright © 1994 The Board of Trustees of The Leland Stanford Junior University. All rights reserved. Permission to use, copy, modify and distribute this software and its documentation for any purpose is hereby granted without fee, provided that the above copyright notice and this permission notice appear in all copies of this software and that you do not sell the software. The software is provided "as is" and without warranty of any kind, express, implied or otherwise, including without limitation, any warranty of merchantability or fitness for a particular purpose.

- **Generate a Tecplot-format ASCII data file and convert it to a binary file with Tecplot Focus** - Read it into Tecplot Focus, then save it as a binary data file, then work with the binary file. Once you have saved a binary version, you can delete the ASCII version. This works well for large datasets where ASCII inefficiencies are noticeable. See [Section 22 - 2 "Data File Writing"](#).
- **Generate a Tecplot-format ASCII data file, then convert it to a binary file with Preplot** - Preplot, a utility program included with Tecplot Focus, converts ASCII to binary Tecplot-format data files. Once the binary file is created, delete the ASCII version to save space. This works well for identifying problems with data files, since Preplot's error messages include precise details. This method also works well in batch processing, or if the ASCII data files are generated on another machine. (See the [Data Format Guide](#) for a description of Preplot.)
- **Generate a Tecplot-format binary data file** - Read the binary data file into Tecplot Focus and work without conversion. You must use routines provided by Tecplot as part of the TeCIO library to write Tecplot-format binary files from C or FORTRAN programs. (See the [Data Format Guide](#) for complete details.)

4 - 9.1 Tecplot Data File Loading

The Tecplot Data Loader (accessed via **File>Load Data**) allows you to load ASCII (.dat) and binary (.plt) Tecplot-format data files. For both kinds of files, Tecplot Focus supports full data files, grid files, and solution files, where the file types are defined as follows:

- **Full** - Full files contain both grid and solution data. Data files produced for Tecplot Focus Version 2006 and earlier are treated as full data files. Full files can be loaded in any order.
- **Grid** - Grid files contain static data for all zones. They have at least one variable or FE connectivity; they may contain both variables and connectivity simultaneously.
- **Solution** - Solution files contain time-varying data for all zones in the file.

You may load more than one Tecplot format file at a time by selecting multiple files in the Load Data dialog. In fact, this is required when loading solution data because the corresponding grid file must be loaded at the same time.

Loading Grid and Solution Data Files

When you are loading grid and/or solution files, please keep the following in mind:

- Each solution file must be read in **after** the grid file it is associated with has been loaded.
- If you load multiple grid and solution files into Tecplot Focus, the order the files are listed will be used to determine which grid is used for which solution file(s). For example, if you load a set of grid and solution files in the following order:
 - Grid A
 - Solution A
 - Solution B
 - Solution C
 - Grid B
 - Solution D

Grid A will be shared for Solution Files A, B, and C. Grid B will be used for Solution File D.



You may select multiple files to load by holding the Shift key. However, the order is not always preserved with this method. We strongly recommend that you use the [Add to List] button when loading grid and solution data to make sure the files are added in the order you require.

- You may load a grid file with variables or variables and connectivity without loading a solution file. However, you may not load a grid file that contains only FE connectivity data.

4 - 10 Tecplot Layout Loader

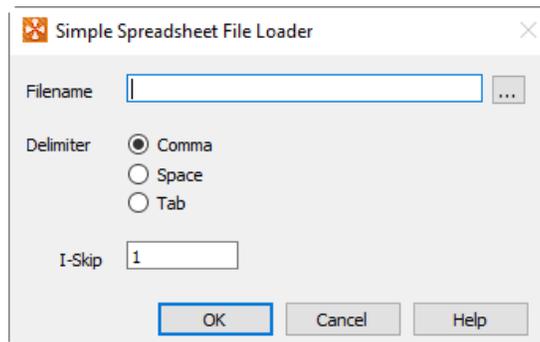
The Tecplot Layout loader is used for loading Tecplot layouts (.lay) and layout packages (.lpk). Layouts include only links to the original data files; layout packages include the subset of data needed to view the layout. See [Section 22 - 1 "Layout Files, Layout Package Files, Stylesheets"](#) on page 302 for more details on creating these files.

Usually it is most convenient to load these kinds of files using the Welcome screen, the **File>Open Layout** or **File>Recent Layouts** commands, or double-clicking the file in your file manager (e.g. Windows Explorer). However, you can also load layouts and layout packages by choosing **File>Load Data** and selecting this loader in the Load Data dialog.

This loader has no options; simply choose the desired .lay or .lpk file, and it will be opened.

4 - 11 Text Spreadsheet Loader

The Text Spreadsheet Loader add-on allows you import simple data from ASCII files. Select the delimiter and I-skip (if necessary) from the **Simple Spreadsheet File Loader** dialog.



the **Text Spreadsheet Loader** dialog has the following options:

- **Filename** - Enter the path to the file you would like to load.
- **Delimiter** - Choose whether your data is separated by a comma, space, or tab.
- **I-Skip** - Select an I-skip value. A value of 1 loads all values, a value of 2 loads every other value, and so on.

The Text Spreadsheet Loader can read ASCII files of the following format (blank lines are ignored):

```
Variable 1, Variable 2, ..., Variable N
datapoint1,datapoint2, ..., datapoint N
.
.
.
datapoint1,datapoint2, ..., datapointN
```

Here is an example of a valid ASCII spreadsheet file:

```
Month, Rainfall
1, 15.0
2, 21.0
3, 21.0
4, 32.0
5, 10.3
```

6, 5.1
7, 2.3
8, 0.2
9, 1.4
10, 8.3
11, 12.2
12, 15.4



Text Spreadsheet Loader Limitation

The first line must contain all of the variable names.

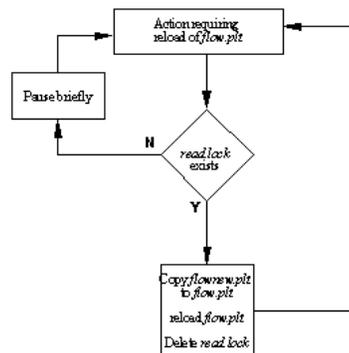
4 - 12 page 132 Overwriting Data Files

Tecplot Focus employs *load-on-demand* to allow you to start working with your data as soon as possible. With load-on-demand, after you load a data file, the actual loading of individual variables may be deferred until the variables are actually needed. Depending on available memory, some variables may even be loaded, then unloaded, and then loaded again.

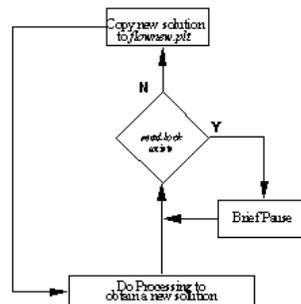
Load-on-demand requires that Tecplot Focus keep the data file(s) being used open while you are using them to create plots, which may present problems if you need to update the data files during this time.

If you have a workflow that requires a Tecplot Focus data file be overwritten while it is in use (most likely to simulate real-time data acquisition or a similar process), the following is suggested as a possible solution.

Tecplot



Data Producing Application



In this example, the cycle on the top illustrates the method used for Tecplot Focus to update *flow.plt* and the cycle on the bottom illustrates the method used by the application that generates the data to update *flow.plt*. Both systems are checking for the existence of *read.lock*. If you are using a macro in Tecplot Focus to do this, then you can use the extended macro command, `query.fileexists`, to determine if the file exists. If the file exists, Tecplot Focus will disconnect from *flow.plt*, copy *flownew.plt* to *flow.plt*, and delete *read.lock*. If *read.lock* exists and the application that generates the data has an update for *flow.plt*, the application should either wait a few seconds and try-again or skip the data set (this is determined by the application, not Tecplot Focus). If the file does not exist, the application that generated the data is free to copy new data to *flownew.plt*.

If you use a macro in Tecplot Focus, you can use the capabilities of `extendmcr` to query for file existence. Disconnecting from *flow.plt* can be done in a number of ways, one of which is to issue a `$(NEWLAYOUT)` command. This will completely disconnect Tecplot Focus from the dataset and thus from the associated data file.

The file *read.lock* is like a baton. If it exists, then *flownew.plt* is said to be "owned" by Tecplot Focus. If it does not exist, then *flownew.plt* is said to be "owned" by the data producing application. *flow.plt* is always owned by Tecplot Focus.

One minor issue not addressed in the above example is what the data producing application should do if the data is being read by Tecplot Focus. It can either block (wait) until Tecplot Focus is finished or discard the current solution and go back to generating another one.

Part 3 Creating Plots

Creating Plots

5 - 1 Creating Plots

The basic steps for creating a plot in Tecplot Focus are:

1. Define your dataset using one of the following methods:
 - a. Use the Load Data command from the **File** menu. Please refer to [Chapter 4: "Loading Data"](#) for information on working with a specific data loader.
 - b. Use the "Open Layout" command from the **File** menu to load linked layout or layout package files. (See [Section 22 - 1 "Layout Files, Layout Package Files, Stylesheets"](#) for more information on layout files.)
 - c. Use any combination of the options in the **Create Zone** submenu of the **Data** menu or the **Insert** menu to create your datasets directly within Tecplot Focus. [Section 20 - 5 "Zone Creation"](#) and [Chapter 18: "Text, Geometries, and Images"](#) for more information.
2. Select the Plot Type (3D, 2D, XY Line, Polar Line, or Sketch) from the Plot sidebar. Refer to [Chapter 7: "Field Plots"](#) for information regarding 3D and 2D plots, [Chapter 6: "XY and Polar Line Plots"](#) for information on XY Line and Polar Line plots, and [Chapter 18: "Text, Geometries, and Images"](#) for information on sketch plots.
3. Toggle-on any mapping or zone layers from the Plot sidebar. The following mapping and zone layers are available:
 - [Mesh Layer](#)
 - [Contour Layer](#)
 - [Shade Layer](#)
 - [Vector Layer](#)
 - [Scatter Layer](#)
 - [Edge Layer](#)
 - [Line Map Layer](#)
 - [Symbols Map Layer](#)
 - [XY Line Error Bars](#)
 - [XY Line Bar Charts](#)

The layers available in the Plot sidebar are dependent upon the active plot type.



In order to view surfaces on your plot, open the **Zone Style** dialog, select the Surfaces tab, and use the [Surfaces to Plot] drop-down menu to choose an available surface plotting option.

The **Zone Style** dialog is available by either double-clicking on your plot, selecting the [Zone Style] button from the Plot sidebar, or selecting **Plot>Zone Style** from the Menu bar.

4. Use the options in the **Plot** menu (such as Blanking or Axis) to customize how your data is displayed. Refer to [Section 7 - 4 "Three-dimensional Plot Control"](#) or [Chapter 17: "Axes"](#) for additional information.
5. Use the options in the **Data** menu (such as **Alter>Specify Equations** or **Interpolate**) to alter the dataset. Refer to [Chapter 20: "Data Operations"](#) for additional information.
6. **[3D only]** toggle-on zone effects (translucency and lighting). Refer to [Chapter 13: "Translucency and Lighting"](#) for details.
7. Use the **Zone Style** or **Mapping Style** dialogs to opt zones in and out of plot layers or the entire plot. Refer to [Section 7 - 1 "Field Plot Modification and the Zone Style Dialog"](#) and [Section 6 - 1 "Mapping Style and Creation"](#), respectively, for details.
8. **[2D or 3D only]** add derived objects ([Slices](#), [Streamtraces](#) or [Iso-surfaces](#)). Use their respective buttons (, , ) to customize any derived objects.

You are not limited to working with only one plot at a time. You can create multiple plots on a single page using frames and frame linking, and you can create multiple pages. See [Section 2 - 3 "Frames"](#) for more information.

5 - 2 Data Journaling

On occasion you may modify data prior to making a final plot. Some (but not all) of the data operations mentioned in this chapter modify data. Tecplot Focus "journals" the data modifications you make in the form of macro instructions as well as performing them. If you then save a layout file, the layout file can reference the original data and include the instructions necessary to reconstruct the plot. This way, the original data file is not modified. You can also generate a new plot using a different data file by reusing the layout. (Layout files are text files and may be modified in an editor.)

If you perform an operation that Tecplot Focus is unable to journal, you are prompted to save the dataset to a new file when you save a layout file. This is necessary for the layout to reproduce exactly what you have in your plot.

The following operations are included in the data journal:

- Data alteration except for derivatives in equations.
- Creation of rectangular zones, circular zones.
- Slice extraction of a primary slice through volume or surface zones for X, Y, Z, or arbitrary planes.
- Zone duplication and mirroring.
- Zone and variable deletion.
- Fourier transform.

5 - 3 Data Sharing

In order to conserve computer memory and disk space, Tecplot Focus shares variables between zones whenever possible. Variable sharing typically occurs with any of the following scenarios:

- When a variable is calculated for two or more zones, Tecplot Focus determines if the results will be the same in the different zones, and shares the variable where appropriate. See [Section 20 - 1.1 "Equation Syntax"](#) and [Section 20 - 1.5 "Variable Sharing Between Zones"](#).
- When zones are duplicated, all variables are shared between the source zones and their duplicates. See [Section 20 - 5.3 "Zone Duplication"](#).
- When mirrored zones are created, the mirrored zone shares all variables with the original. See [Section 20 - 5.4 "Mirror Zone Creation"](#).
- When a data loader supporting data sharing loads a variable that is identified for two or more zones, that variable is shared among the specified zones. This often occurs with time dependent data, where the physical coordinates (e.g. X, Y, and Z) are typically the same for all time steps.



If a zone is altered (independently of zones it is sharing data with), any variable that is changed will no longer be shared.

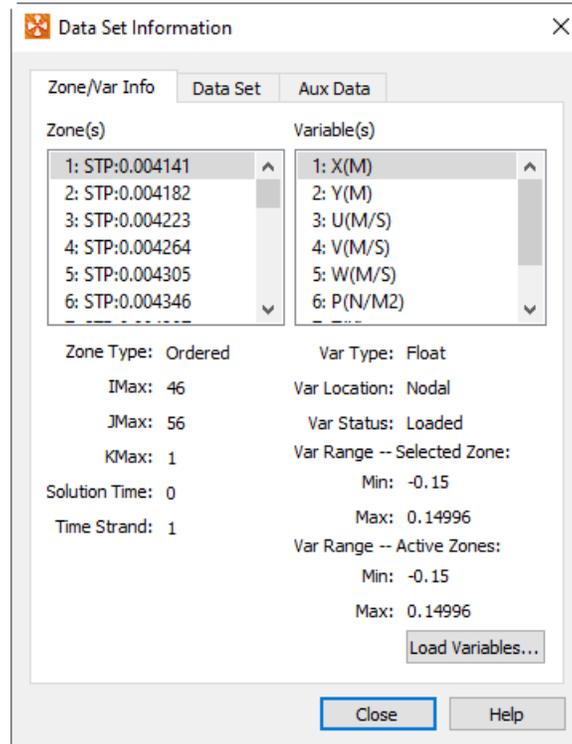
Variable sharing and connectivity sharing (for finite element zones) can also be established in a Tecplot data file by supplying the appropriate parameters to the TECZNE function when writing the file (see the [Data Format Guide](#)). In addition, multiple solution files can share the same grid file.

5 - 4 Data Set Information

The **Data Set Information** dialog, accessed from the "Data Set Info" option on the **Data** menu, gives summary information about the current dataset, including the dataset title, zone and variable names, and the minimum and maximum values of a selected variable. You can modify the dataset title, zone and variable names of any dataset.

5 - 4.1 Zone/Variable Info Page

The following information is provided on the Zone/Variable Info page:

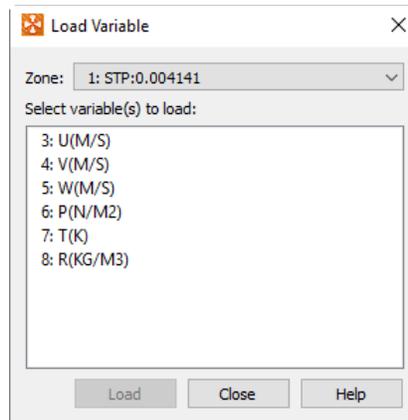


- **Zone(s)** - Lists all zones by number, with their titles.
- **Zone Type (Ordered or FE data)** - Displays the type of zone selected in the Zone(s) listing. For ordered data, it is followed by the index values for IMax, JMax, and KMax (shown below). For finite element data, it is followed by the element type, number of points, and number of elements:
 - **IMax (ordered data)** - Displays the IMax value of the zone selected in the Zone(s) listing.
 - **JMax (ordered data)** - Displays the JMax value of the zone selected in the Zone(s) listing.
 - **KMax (ordered data)** - Displays the KMax value of the zone selected in the Zone(s) listing.
 - **Pts (finite element data)** - Displays the number of data points in the zone selected in the Zone(s) listing.
 - **Elem (finite element data)** - Displays the number of elements in the zone selected in the Zone(s) listing.
- **Solution Time** - Displays the solution time for the selected zone (see also [Section 7 - 2 "Time Aware"](#)).
- **Time Strand** - Displays the strand ID for the selected zone (see also [Section 7 - 2 "Time Aware"](#)).
- **Variable(s)** - Lists all variables by number, with their names.
- **Var Type** - Displays the type of data of the selected variable in the Variable(s) field.
- **Var Location** - Indicates if variables are located at nodes or cell-centers.
- **Var Status** - Use the Var Status field in the dialog to determine the status of the current variable. The variable status can indicate the variable passivity and if the variable is "loaded" or "not loaded."
- **Var Range - Selected Zones** - Displays the Min and Max values for the selected variable in the selected zones.

- **Var Range - Active Zones** - Displays the Min and Max values for the selected variable for all active zones.
- **Load Variables** - If a variable was not initially loaded, "Not Loaded" will be displayed in Var Range portions of the dialog. Use the [Load Variables] button to display the [Load Variable](#) dialog, with which you can load any variables from your dataset that were not initially loaded.

Load Variable

The Load Variable dialog allows you to load variables into memory if they are not currently loaded. Choose the zone containing the variables you wish to load using the Zone menu at the top of the dialog, then select one or more variables from that zone.

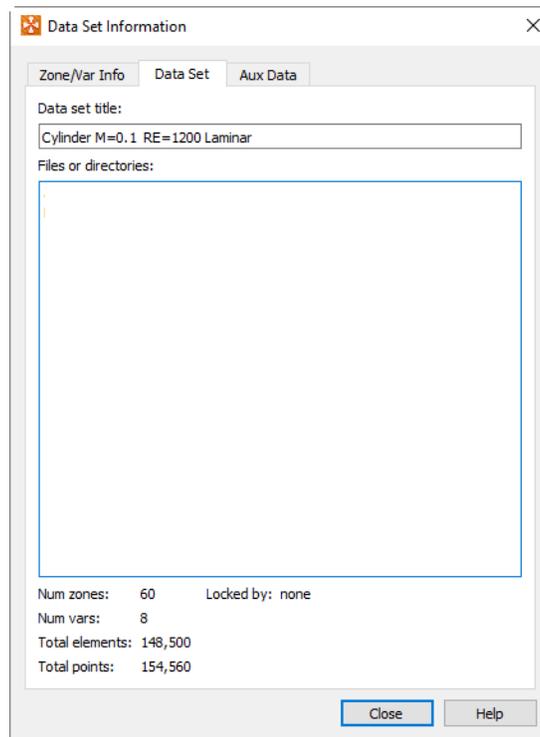


- Click once to select only a single variable
- Hold the Shift key while clicking a second variable to select a contiguous range of variables
- Hold the Control key while clicking to toggle individual variables on and off
- Press Control-A to select all variables

Click the [Load] button to load the selected variables. See ["Load On Demand"](#) on page 360 for more information about this function.

5 - 4.2 Data Set Page

The Data Set page provides information about your data set, including: title, filenames, number of zones, variables, elements, and lock status.

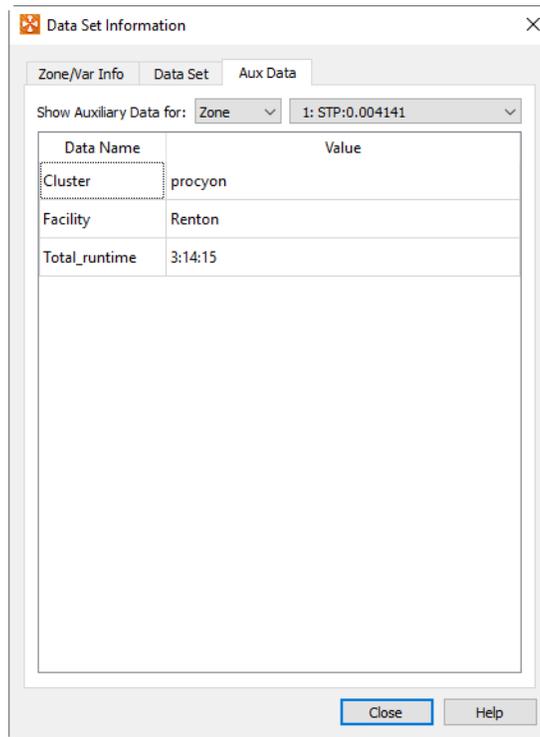


The following information can be found on the Data Set page:

- **Data Set Title** - Enter a title for the current dataset, or edit an existing title. The default is the result of concatenating the titles specified in each Title record encountered in the data files making up the dataset.
- **Files or directories** - Lists the names and paths of all external data files making up the current dataset. Some file formats use directories as containers; these will list only the directory name.
- **Num Zones** - Number of zones in the dataset.
- **Num Vars** - Number of variables in the dataset.
- **Total Elements** - Total number of elements in the dataset.
- **Total Points** - Total number of points in the dataset.
- **Locked By** - This field will inform you if the current dataset has been locked by an add-on. Add-ons can lock a dataset which in turn prevents you from deleting zones or deleting the last frame associated with the dataset.

5 - 4.3 Aux Data Page

Auxiliary data is metadata attached to zones, datasets, or frames. Auxiliary data is added to the plot via the data file.



The Auxiliary Data page has the following information:

- **Show Auxiliary Data** - Use the drop-down to display auxiliary data for zones, datasets, frames, or names.
- **Data Name/Value** - Displays the names and values of any auxiliary data.

Refer to the [Data Format Guide](#) for information on creating Tecplot Focus data files that include auxiliary data.

5 - 5 Color Chooser

Each attribute of your plot can be set to a different color or color type using the **Color Chooser**. Use the **Select Color** dialog to apply contour groups, a basic color palette, or RGB coloring to the selected plot attribute.



There are three types of color assignments:

- [Contour Groups](#) - The Contour Variables (Multi 1, 2, 3, 4, 5, 6, 7, and 8) are defined in the [Contour & Multi-Coloring Details](#). The Contour Variables are typically used for coloring mesh, contour, vector, and scatter layers.
- [RGB Coloring](#) - Select RGB to use RGB coloring established in **Plot>RGB Coloring>Variables/Range**. RGB coloring is used to illustrate the relationship between two or three variables in your dataset, by setting R, G, and B to each of the variables.
- [Basic Color Palette](#) - Use the basic color palette to apply a single, constant color to a plot attribute.

For example, you can create a 3D field plot with a contour layer (with colors defined by a contour variable), an edge layer (with colors from the basic color palette), and a vector layer (with colors defined by RGB vectors).

5 - 5.1 RGB Coloring

RGB coloring occurs when Red, Green, and Blue values are supplied at each vertex. It may be used to create special flooding such as for Oil/Water/Gas or vector direction plots. RGB coloring may be used for each field plot object: zone layers, the mesh or contour layer for streamtraces or iso-surfaces, or any of the layers for slices. This affects multi-coloring for that object as well as any contour flooding. With RGB coloring, multi-colored objects such as vectors or scatter symbols have their color determined based on the RGB components of the field variables at their location. Multi-colored mesh and contour lines use the average value across the mesh line.

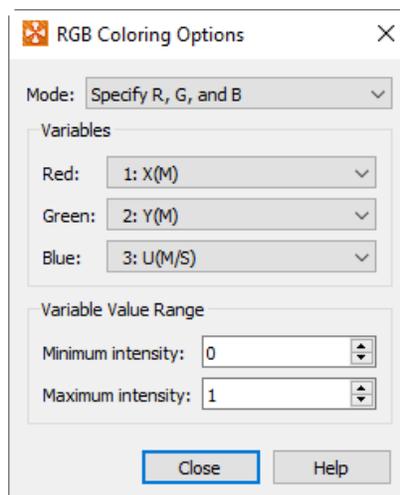


Exported Vector-based Files Limitation in RGB Coloring

Vector-based export files such as WMF cannot show continuous RGB flooding. Objects that use RGB flooding are reduced to contain average cell flooding where each cell is flooded a solid color based on the averages of the RGB values at each vertex. The user is warned before such output is generated.

RGB Coloring Options

If your data has only two RGB variables, or if the sum of the variables is not normalized, you can adjust the settings using the **RGB Coloring Options** dialog (accessed via **Plot>RGB Coloring>Variables/Range**). The **RGB Coloring Options** dialog (shown below) has the following options:



- **Mode** - You can either specify all three variables or specify two of the three variables and calculate the third. The third variable is calculated using the following formula $f(R)+f(G)+f(B)=1.0$ (assuming $f()$ is a function that maps R,G,B values into $[0,1.0]$).
- **Variables** - Assign the variables which supply the values for the color components, as specified in the RGB Mode.
- **Variable Value Range** - By default, it is assumed that the minimum value for any of the Channel Variables is zero, the maximum is one, and the sum of the three variables is one at every point. If the sum is not normalized, you can set a new minimum and maximum. For example, if your variables sum to 100 at every point, you can enter 100 in the field for Value at Maximum Intensity.

5 - 5.2 Basic Color Palette

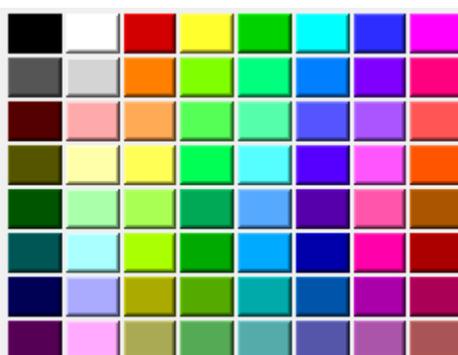


Figure 5-3. The Basic Color Palette region of the **Select Color** dialog.

Use the Basic Color Palette to define a constant color to the selected plot attribute(s).

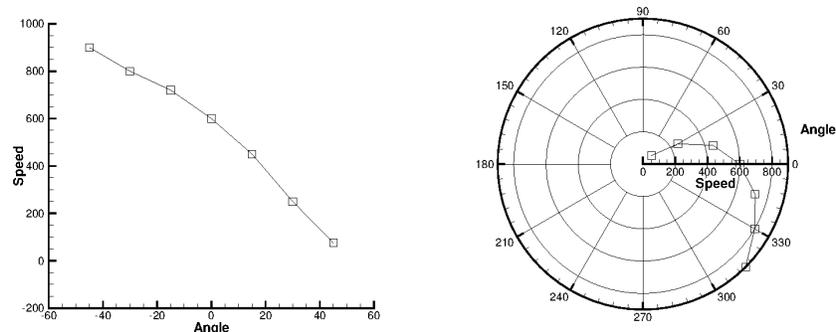
6

XY and Polar Line Plots

A line plot is the simplest type of graph you can produce with Tecplot Focus. A typical line plot includes a dependent variable (usually the vertical axis for XY plots) and an independent variable (usually the horizontal axis for XY plots). Each line on the line plot represents one series of data points, where each data point is defined by its independent and dependent variable values. A series of data points is referred to as a mapping (or map, for short).

Tecplot Focus supports two types of line plots, XY plots and Polar plots. XY plots are plotted on Cartesian coordinates using X & Y as the independent and dependent variables (See [Section 17 - 2 "Axis Variable Assignment"](#)). XY plots can include line, symbols, bar and/or error bar layers. Polar plots are plotted on polar coordinates using Theta and R values. Polar plots can include line and/or symbol layers.

An example of XY and Polar Line plots is shown below.



Line plots are usually created from one-dimensional, I-ordered data. The data used for line plots must have at least two variables defined at each data point. The same number of variables must be defined at each data point.

You can also create line plots from two or three-dimensional data in the IJ or IJK-ordered structure, or from finite element data by selecting "XY Line" from the plot type menu in the Plot sidebar. If "XY Line" is selected, finite element data sets will be treated as I-ordered (the connectivity list is ignored), IJ-ordered datasets will be treated as a family of J-sets of I-ordered data, and IJK-ordered datasets will be treated as K-planes of J-families of lines. Use the Indices page of the **Mapping Style** dialog to select different ranges and skip intervals for the I, J, and K-indices. See [Section 6 - 6 "I, J, and K-indices"](#) later in this chapter for more information.

When you first create a line plot, the Create Mappings dialog appears automatically so you can choose the mappings to be created (see [Section 6 - 1.2 "Mapping Creation"](#) on page 106). Names, colors, symbol types, and line patterns are automatically assigned to each mapping. These and other line plot attributes can be changed using the pages of the **Mapping Style** dialog. To bring up the **Mapping Style** dialog, go to the **Plot** menu and select "Mapping Style", or select the [Mapping Style] button on the Plot sidebar.

6 - 1 Mapping Style and Creation

Line plots are composed of the graphs of one or more pairs of variables (XY pairs in XY Line plots or Theta-R pairs in Polar Line plots). These pairs and their dependency relations are referred to as mappings. Mappings are defined for each frame; the same dataset can have a different set of mappings in each frame it is attached to.

Mappings can include any combination of the following mapping layers:

- **Lines** - Can be drawn as linear segments or curve that fit the data points.
- **Symbols** - Each data point is represented by a symbol.
- **Error Bars** (XY only) - Error bars are drawn for each data point. The error bar value is determined by a third variable.
- **Bar Charts** (XY only) - Each data point is represented by a vertical or horizontal bar.

XY Line plots can have up to five x-axes and five y-axes simultaneously. Polar Line plots can have only one Theta-axis and only one R-axis.

Open the **Mapping Style** dialog by clicking the Mapping Style button on the Plot sidebar to set attributes for lines and symbols and, in XY Line plots, bar charts and error bars. Initially, any linemaps selected in the workspace are selected in the Mapping Style dialog. You may also double-click a line in your plot to open the dialog with that mapping selected. You can set the style of any mapping independently of all other mappings.



Each page of the **Mapping Style** dialog is divided into three color-coded regions. The blue columns (Map Number, Map Name, and Show Map) apply to the mapping itself and are repeated on each page. The green and orange columns represent primary and secondary settings specific to the selected mapping page.

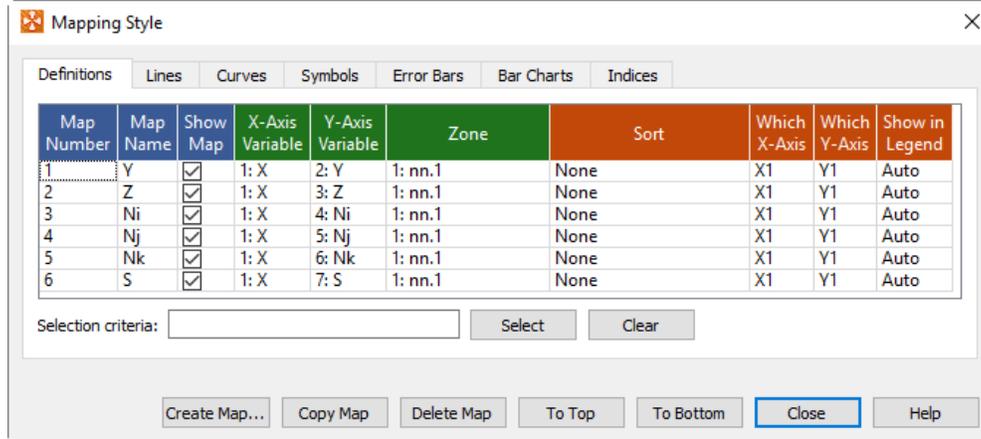


You can also use the line map context menu and toolbar to change some of these settings quickly and easily by right-clicking on a line on your plot. The toolbar allows you to turn on or off the line, symbol, and error bars for the selected line map by clicking the icons. You can also adjust the attributes of these (for example, line color, symbol shape, or error variable) using drop-down menus to the right of each icon.

6 - 1.1 Mapping Definitions

Existing mappings are edited with the **Plot** menu's **Mapping Style** dialog. From the Definitions page of the **Mapping Style** dialog, you can modify names, activate and deactivate mappings, assign axis variables, assign

zones, sort data points in a mapping, control the mappings appearance in the line plot legend, and assign particular X and Y-axes to XY-line plots.



Some settings are represented by checkboxes, which can be toggled on and off by clicking them. Other settings require a right-click. In general, select the mapping or mappings you want to change, then right-click the selection in the column of the setting to be edited. Most of the time this will activate a pop-up menu; in other cases, a dialog appears. You may change mappings whether they are shown on the plot or not (activated or deactivated).

- **Map Number** - Displays the number of each map. This cannot be edited.
- **Map Name** - Double-click the map name to edit it. Type Enter to complete the edit or Escape to cancel without saving the edit.
- **Show Map** - Each mapping can be opted in and out of a plot by toggling the checkbox or by right-clicking and choosing one of the following options:
 - **Activate** - Turns selected mappings on.
 - **Deactivate** - Turns selected mappings off.
 - **Show Selected Only** - Turns on selected mappings, and turns off all other mappings.
 - **Invert** - Switches the current activation settings for the selected map(s).
- **Axis Variables** - The choice of variables is the heart of the mapping. Each mapping is defined by two variables: X and Y in XY Line plots and Theta and R in Polar Line plots. You may change the variables assigned to a mapping by right-clicking or double-clicking.
- **Zone** - Each mapping uses variable values from a specified zone. If your dataset has multiple zones, specify the zone for each mapping by right-clicking or double-clicking the displayed zone name.

The pop-up field chooser appears. Display a list of all zones by clicking the downward-pointing arrow next to the filter field, or start typing to display a filtered list of the zones whose name contains what you type.



- **Sort** - By default, mappings are sorted by the order in which they occur in the data file. You can change this order with the Sort option on the Definitions page of the **Mapping Style** dialog.

Choose from one of the following Sort options:

- **None** - Default behavior of sorting by the order in the data file.
- **By Independent Variable** - Points are sorted in ascending order of the values of the independent variable.
- **By Dependent Variable** - Points are sorted in ascending order of the values of the dependent variable.

- **By Specific Variable** - Select a variable from the **Select Variable** dialog. The points of the selected mappings are sorted in ascending order of the values of this variable.



Only Line Segment and Parametric Spline curve types are affected by the Sort options. Splines are always sorted by the independent variable. See [Section 6 - 2.2 "Curve Types"](#) for more information on curve types.

- **Which Axes** - XY Line plots support five X-axes (X1-X5) and five Y-axes (Y1-Y5). Newly created mapping use the X1 and Y1-axes. You can change these assignments by right-clicking. The ranges and scales for each axis are defined in the **Axis Details** dialog (accessed via the **Plot >Axis**).

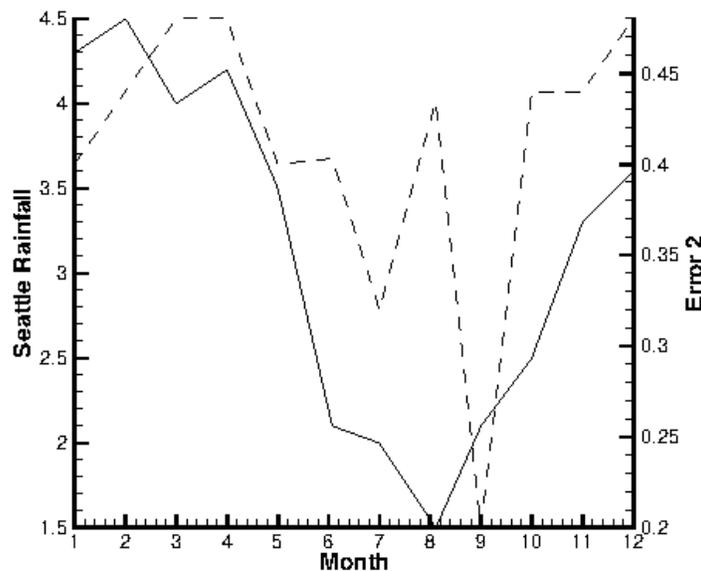


Figure 6-4. An XY Line plot using two Y-axes.

By default, the X1 axis is placed at the bottom of your axis grid area, and subsequent X axes at the top. Similarly, it places axis Y1 at the left of your axis grid area and subsequent Y-axes at the right. Thus, in [Figure 6-4](#), the Seattle rainfall observations are shown along axis Y1 at the left of the axis grid area, while the error observations are shown along Y2 at the right.

You can also use multiple axes to cycle through mappings with different ranges or axis settings. You may find it convenient to assign different mappings to different axes so that you can set axis ranges, axis positions, or other axis attributes independently for each mapping.

- **Show in Legend** - By default, all active mappings appear in the line legend. However, the legend only lists mappings with identical entries once. (See [Section 6 - 7 "Line Legend"](#) for details on the Line Plot Legend.) The [Show in Legend] button has three options:
 - **Always** - The mapping appears in the legend even if the mapping is turned off (deactivated) or its entry in the table looks exactly like another mapping's entry.
 - **Never** - The mapping never appears in the legend.
 - **Auto** - The mapping appears in the legend only when the mapping is turned on. If two mappings would result in the same entry in the legend, only one entry is shown.

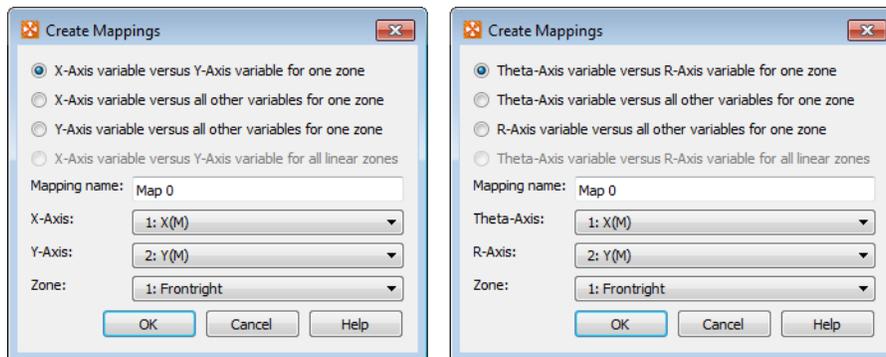
- **Selection Criteria** - Enter a wildcard pattern and click **Select** to select one or more mappings based their name. In wildcard patterns, most characters match themselves, but the * and ? characters have special meaning.

Character	Meaning
?	Matches any single character.
*	Matches any number of characters, including none.

- **Clear** - Clear the selection and the pattern field.

6 - 1.2 Mapping Creation

To define a new mapping, select the [Create Map] button in **Mapping Style** dialog. The dialog also appears automatically the first time you choose the XY Line or Polar Line plot type. As shown below, the dialog is slightly different for the two plot types.



In XY Line plots, you have the following options:

- **X-axis Variable versus Y-axis Variable for One Zone** (default) - Add a single mapping with one X and one Y-variable for one zone.
- **X-axis Variable versus All Other Variables for One Zone** - Create a new set of mappings using one variable as the X-variable and each of the other variables in the zone as Y-variables.
- **Y-axis Var versus All Other Variables for One Zone** - Create a new set of mappings using one variable as the Y-variable and each of the other variables in the zone as X-variables.
- **X-axis Variable versus Y-axis Variable for All Linear Zones** - Define one map for each zone, with the specified X-axis and Y-axis variables. If you choose this option, you specify only the X-axis and Y-axis variables.

The options for polar line plots are the same as above, but with respect to the Theta-axis and R-axis variables.

Specify the mapping name and the axis variables in the bottom section of the dialog. The default name is "Map n," where n is the number of the mapping to be created. If you are creating a mapping for one zone, you also select the zone here.

When you first load an ordered dataset, some mappings are automatically created for you. If your dataset has more than two variables, mappings are created that associate the first variable with each of the other variables for the first zone only.

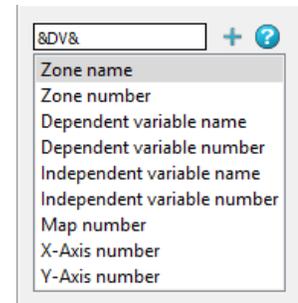


Selecting variables in a 3D finite element zone may require significant time, since the variable must be loaded over the entire zone. XY and Polar line plots are best used with linear or ordered data, or with two-dimensional finite element data. The defaults used in the Create Mappings dialog favor the types of zones that yield good performance.

6 - 1.3 Mapping Names

Tecplot Focus automatically assigns a name to each mapping. The nature of the name depends on the type of data used to create the mapping. If your data has only one dependent variable, the default is to use the zone name for the mapping. If your data has multiple dependent variables, then the default is to use the dependent variable name for the mapping. In either case, Tecplot Focus assigns each mapping a special name (&ZN& or &DN&) that is replaced with the zone or variable name when the name is displayed.

You can modify any mapping's name by right-clicking the name of the mapping in the Mapping Style dialog. A small window pops up to allow you to enter a new name for the mapping, as shown here (note the default name of &DN& in our example; our data has multiple dependent variables, and the name of each is used as the mapping name).



You may add other dynamic text placeholders like &DN& to the displayed mapping name by clicking one of the options below the edit field, then clicking + (or simply double-clicking). The placeholders will be replaced with the indicated value when the name is displayed. By combining static text with these placeholders, you can construct a name in any format you like.

The placeholders available in this window are:

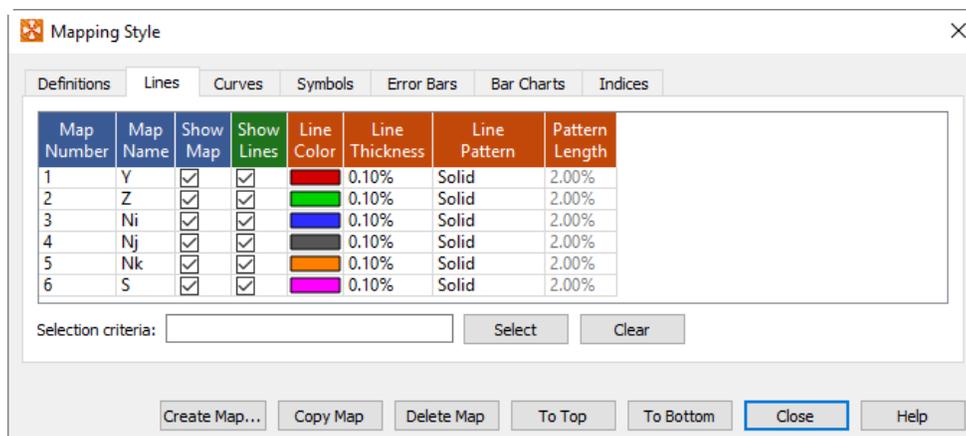
- **Zone name** - Adds &ZN& to the mapping name. This will be replaced with the actual name of the zone assigned to that mapping.
- **Zone number** - Adds &Z#& to the mapping name. This will be replaced with the actual number of the zone assigned to the mapping.
- **Independent variable name** - Adds &IV& to the mapping name. This will be replaced with the actual name of the independent variable assigned to that mapping.
- **Independent variable number** - Adds &I#& to the mapping name. This will be replaced with the actual number of the independent variable assigned to the mapping.
- **Dependent variable name** - Adds &DV& to the mapping name. This will be replaced with the actual name of the dependent variable assigned to that mapping.
- **Dependent variable number** - Adds &D#& to the mapping name. This will be replaced with the actual number of the dependent variable assigned to the mapping.
- **Map number** - Adds &M#& to the mapping name. This will be replaced with the actual number of the mapping.
- **X-Axis number** - Adds &X#& to the mapping name. This will be replaced with the actual number of the X-axis assigned to that mapping for XY Line plots. (This option is not available for Polar Line plots.)
- **Y-Axis number** - Adds &Y#& to the mapping name. This will be replaced with the actual number of the Y-axis assigned to that mapping for XY Line plots. (This option is not available for Polar Line plots.)

6 - 2 Line Map Layer

The Line map layer is available for both XY and polar line plots. Activate the layer by toggling-on "Lines" in the Plot sidebar. When the Lines map layer is on, the dataset is represented by a connected line for each mapping, which may be either a simple collection of line segments connecting all the data points, or a curve fitted to the original data.

6 - 2.1 Line Attributes

The Lines page of the **Mapping Style** dialog (accessed via the Plot sidebar or **Plot>Mapping Style**) is shown below.



The first two columns, Map Number and Map Name, list the mapping number and the mapping name. The Map Show field lists which mappings are currently active. These columns behave the same as the corresponding columns on the Definitions page (see "[Mapping Definitions](#)" on page 103). The remaining columns of the Lines page of the **Mapping Style** dialog contain specific line attributes.



In order for the changes made in the Lines page to be visible in your plot, the Lines mapping layer must be toggled-on in the Plot sidebar.

- **Show Lines** - This option allows you to turn off lines for selected mappings, while keeping both the selected mappings and the Lines map layer active overall.
- **Line Color** - Set line color for line plots. Right-clicking displays the Color Chooser.
- **Line Thickness** - Set the thickness of lines. Right-clicking allows you to choose from preset line widths of 0.02, 0.10, 0.40, 0.80, or 1.50 percent, or enter any thickness using a dialog.
- **Line Pattern** - Right-click to choose line patterns for line plots.
- **Pattern Length** - Set the pattern length for patterned lines. Pattern length is measured as a percentage of the frame height for one complete cycle of the pattern.



For information on using the controls at the bottom of the Mapping Style dialog to select mappings by name, see the description of these at the end of "[Mapping Definitions](#)" on page 103.

6 - 2.2 Curve Types

Tecplot Focus offers a variety of curve-fits and spline fits. By specifying the curve type, you control how the data points are connected in a line (see "[Line Map Layer](#)" on page 108).

The first two columns, Map Number and Map Name, list the mapping number and the mapping name. The Map Show field lists which mappings are currently active. These columns behave the same as the corresponding columns on the Definitions page (see [“Mapping Definitions”](#) on page 103).

Set the type of curve plotted for a mapping by right-clicking the desired Curve Type entry on the Curves page of the **Mapping Style** dialog.

Tecplot Focus offers the following curve types:

- [Line Segment \(No Curve-fit\)](#) - A series of linear segments connect adjacent data points. In XY Line plots, these will be line segments.
- [Linear Fit](#): A linear function is fit to the data points. In XY Line plots, this will be a straight line.
- [Polynomial Curve-fit](#) - A polynomial of order N is fit to the data points (where $1 \leq N \leq 10$, for $N=1$ a Linear Fit is done).
- [Exponential Curve-fit](#) - An exponential curve-fit that finds the best curve of the form $Y=e^{b \ln X + c}$ (equivalent to $Y=a \cdot e^{b \cdot X}$, where $a = e^c$). To use this curve type, Y-values for this variable must be all positive or all negative. If the function dependency is set to $X=f(Y)$ all X-values must be all positive or all negative.
- [Power Curve-fit](#) - A power curve fit that finds the best curve of the form $Y=e^{b \cdot \ln X + c}$ (equivalent to $Y=a \cdot X^b$, where $a = e^c$). To use this curve type, Y-values for this variable must be all positive or all negative; X-values must be all positive. If the function dependency is set to $X=f(Y)$, X-values must be all positive or all negative, and the Y-values must all be positive.
- [Spline](#) - A smooth curve is generated that goes through every point. The spline is drawn through the data points after sorting the points into increasing values of the independent variable, resulting in a single-valued function of the independent variable. The spline may be clamped or free. With a clamped spline, you supply the derivative of the function at each end point; with a non-clamped (natural or free) spline, these derivatives are determined for you. In XY Line plots, specifying the derivative gives you control over the initial and final slopes of the curve.
- [Parametric Spline](#) - Creates a smooth curve as with a spline, except the assumption is that both variables are functions of the index of the data points. (For example in XY Line plot, ParaSpline fits $x=f(i)$ and $y=g(i)$ where $f(i)$ and $g(i)$ are both smooth.) No additional sorting of the points is performed; the sorting specified on the Definitions page of the **Zone Style** dialog is used for the order of the data points. This spline may result in a multi-valued function (of either or both axis variables).
- [Extended Curve-fit](#) - Uses a curve-fit supplied by an add-on. These curve-fits may be provided by Tecplot Focus, a third party, or written by users. The functionality of each extended curve-fit is defined by its creator.

Linear Fit, Polynomial Fit, Exponential Fit, and Power Fit are all determined by using a least squares algorithm. Examples of each curve-fit type are shown in [Figure 6-5](#).

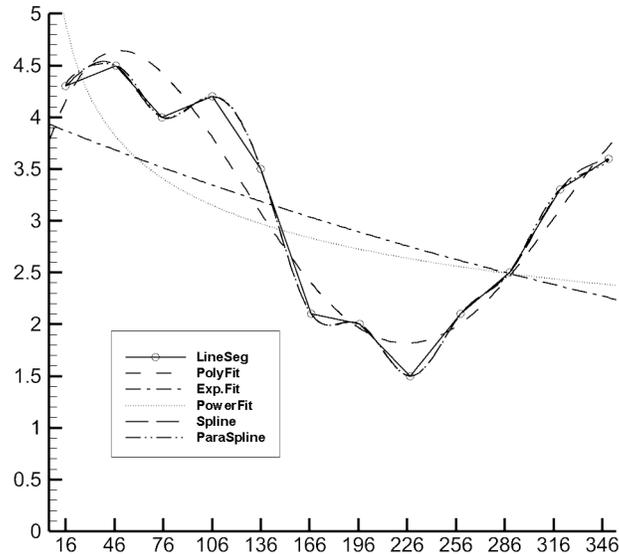


Figure 6-5. Tecplot Focus's curve-fit types.

The Curves page also contains fields for controlling the following attributes:

- **Dependent Variable** - Right-click to choose how curve fits and splines are interpreted. Dependent Variable has no effect on mappings of the Line Segment curve type.
- **Curve Points** - Controls the number of points used to draw curve fits and splines. Right-click to choose a preset number of points or to enter your own. Raising the number of points increases the accuracy of the curve but also increases plotting time and the size of print files.
- **Curve Setting** - Displays options specific to the curve type, such as weighting for curve fits or starting derivatives for splines. Right-click to set these options.

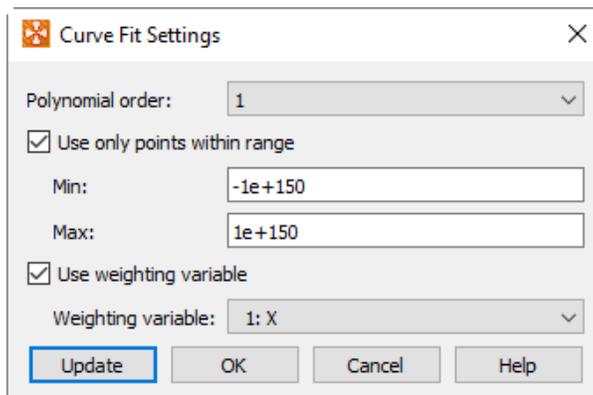


For information on using the controls at the bottom of the Mapping Style dialog to select mappings by name, see the description of these at the end of ["Mapping Definitions"](#) on page 103.

Linear Fit

Tecplot Focus fits the data to a linear function using the standard least-squares algorithm. It calculates the function for which the sum of the squared differences from the data points is a minimum. For the XY Line plot type, the linear function is a straight line.

To fit a linear function to your data, right-click in the Curve Type column on the Curves page of the **Mapping Style** dialog and select "Linear Fit." Then right-click in the Curve Setting column and choose Settings to display the Curve Fit Settings dialog, shown below.

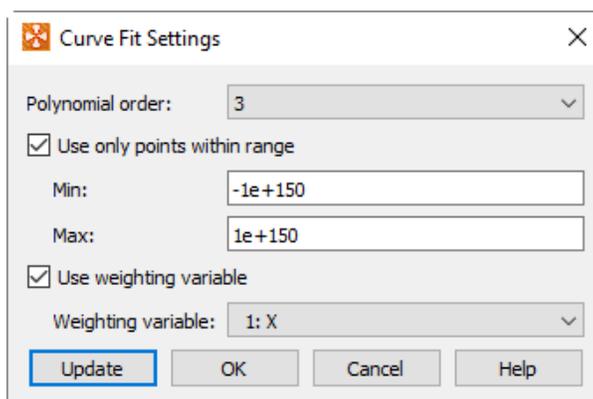


- **Polynomial Order** is shown on the dialog, but should always be "1" for a linear fit. If you change this from 1, the curve type is changed to [Polynomial Curve-fit](#).
- **To limit the points used in the mapping(s):** select "Use Only Points Within Range", and enter minimum and maximum values.
- **To assign a curve weighting variable:** select "Use Weighting Variable", and select the variable from the drop-down. For more information on curve weighting, see [Curve-fit Weighting Variables](#).

Polynomial Curve-fit

Tecplot Focus uses a standard least-squares algorithm to fit data to a polynomial function. You specify the order of the polynomial (from one to ten), and the polynomial for which the sum of the squared differences from the data points is a minimum is calculated.

To fit a polynomial function to your data, right-click in the Curve Type column on the Curves page of the **Mapping Style** dialog and select "Polynomial Fit." Then right-click in the Curve Setting column and choose Settings. The Curve Fit Settings dialog appears.



By default, this option fits a cubic polynomial, using all the points in the mapping and weighting them equally.

- **Polynomial Order** drop-down. Select the desired polynomial order (1 to 10). An order of 2 is a quadratic polynomial, an order of 3 is a cubic polynomial, etc. If you select 1, the curve type is set to Linear Fit, as a polynomial of order 1 is a linear function. (See [Linear Fit](#).)

- **To limit the points used in the mapping(s)** - Select "Use Only Points Within Range", and enter minimum and maximum values.
- **To assign a curve weighting variable** - Select "Use Weighting Variable", and select the variable from the drop-down. For more information on curve weighting, see [Curve-fit Weighting Variables](#).

Exponential Curve-fit

Tecplot Focus fits the data to an exponential function using the standard least-squares algorithm.



The dependent-variable values must be either all positive or all negative.

For XY plots (where X is the independent variable): Tecplot Focus finds the best curve of the form:

$$Y = e^{b \cdot X + c} \text{ (equivalent to } Y = a \cdot e^{b \cdot X} \text{ where } a = e^c \text{).}$$

Similarly when Y is the independent variable.

For Polar plots (where Theta is the independent variable): Tecplot Focus finds the best curve of the form:

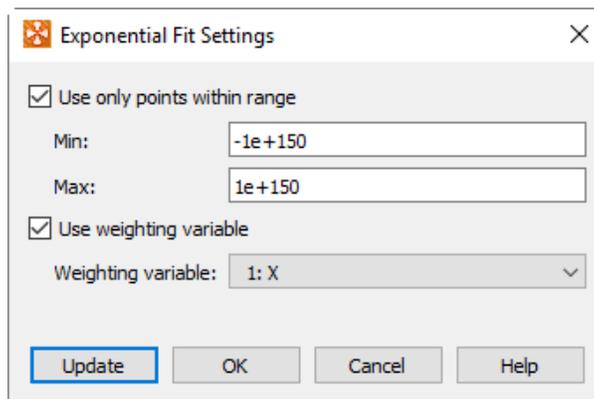
$$R = \pm e^{(b\theta + c)} \quad \text{or} \quad R = \pm a e^{b\theta}$$

Similarly when R is the independent variable.

To fit an exponential function to your data, right-click in the Curve Type column on the Curves page of the **Mapping Style** dialog and select "Exponential Fit."

By default, this option uses all the data points in the mapping, weighting them equally.

Use the **Exponential Fit Settings** dialog (accessed by right-clicking in the Curve Setting page on the Curves page of the **Mapping Style** dialog) to specify different settings. The dialog is shown below.



- **To limit the points used in the mapping(s)** - Select "Use Only Points Within Range", and enter minimum and maximum values.
- **To assign a curve weighting variable** - Select "Use Weighting Variable", and choose the variable from the drop-down. For more information on curve weighting, see [Curve-fit Weighting Variables](#).

Power Curve-fit

Tecplot Focus fits a power function to data using the standard least-squares algorithm. The dependent-variable values must be either all positive or all negative, and the independent values should be all positive. Data points with zero or negative independent values are ignored.

For XY plots (where X is the independent variable): Tecplot Focus finds best curve of the form:

$$Y = e^{b \ln X + c} \text{ (equivalent to } Y = a * X^b \text{ where } a = e^c \text{).}$$

Similarly, when Y is the independent variable.

For Polar plots (where Theta is the independent variable): Tecplot Focus finds the best curve of the form:

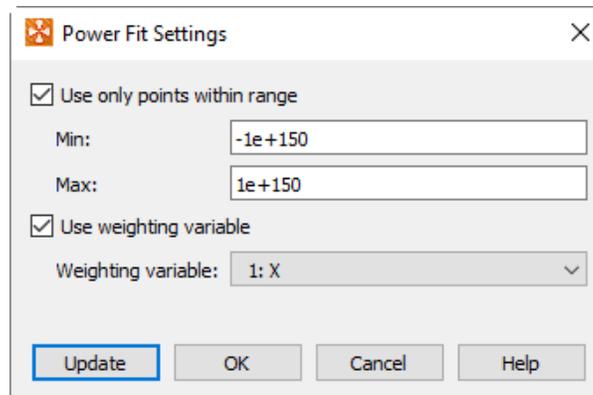
$$R = \pm e^{b \ln(\theta) + c} \quad \text{or} \quad R = \pm a \theta^b$$

Similarly, when R is the independent variable.

To fit a power-curve function to your data, right-click in the Curve Type column on the Curves page of the **Mapping Style** dialog and select "Power Curve."

This option uses all the data points in the mapping, weighting them equally.

Use the **Power Fit Settings** dialog (accessed via the [Curve Settings] button) to specify different settings. The dialog is shown below.



- **To limit the points used in the mapping(s)** - Select "Use Only Points Within Range", and enter minimum and maximum values.
- **To assign a curve weighting variable** - Select "Use Weighting Variable", and select the variable from the drop-down. For more information on curve weighting, see [Curve-fit Weighting Variables](#).

Spline

A spline is a mathematical function defined to link a specified set of points with a function that is continuous and smooth (differentiable) at every point. The most common type of spline, the cubic spline, is defined using a set of cubic polynomials, one for each interval between the data points.

Splines can be natural or clamped: natural splines are twice-differentiable at the end points and the second derivative is zero at those points, while clamped splines have known first-derivatives at the boundary points. Before plotting the spline, the data points are sorted in increasing value along the independent axis.

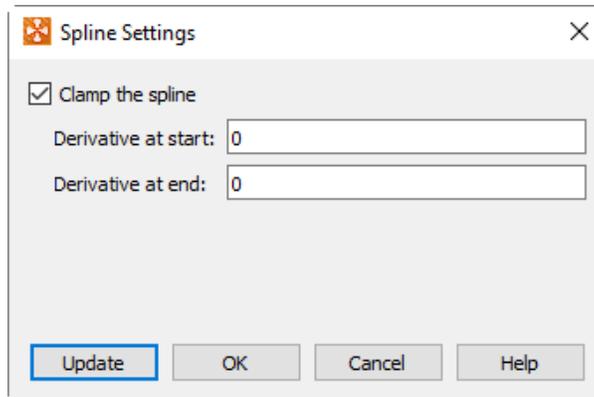


The Sort option of the Definitions page of the **Mapping Style** dialog has no effect on splines.

To fit a spline function to your data, right-click in the Curve Type column on the Curves page of the **Mapping Style** dialog and select "Spline." By default, this option fits a natural cubic spline.

To specify a clamped spline:

1. Right-click in the Curve Setting column on the Curves page of the **Mapping Style** dialog and choose **Settings**.
2. In the **Spline Settings** dialog (shown below), select "Clamp the Spline", and enter values for the derivative at the start and end of the spline.



Parametric Spline

The cubic spline fit assumes that the spline function is a single-valued function of the independent variable.

Sometimes, however, you have data that curves back upon itself, but you would still like to have a spline-like curve fit to it. Parametric splines solve this problem by presuming that both variables (X & Y or Θ & R) are functions of the data-point index. The spline is then defined by two single-valued functions of the data-point index.

Unlike cubic splines, parametric splines are plotted in the order set in the *Sort* option of the Definitions page of the **Mapping Style** dialog. By default, the points are unsorted, and thus the spline is drawn in the order the data points appear in the data file. See [Section 6 - 1.1 "Mapping Definitions"](#) for a discussion of sorting.

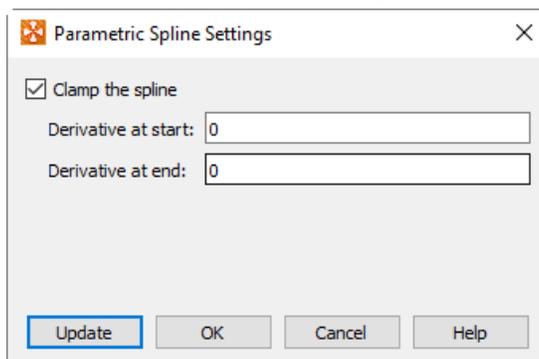
To fit a paraspline function to your data, right-click in the Curve Type column on the Curves page of the **Mapping Style** dialog and choose "ParaSpline."

By default, This option fits two natural cubic splines to the data point index.

To specify a clamped spline:

1. Select Para Spline from the Curve drop-down menu, and then select Curve Settings.

- In the **Parametric Spline Settings** dialog (shown below), select "Clamp the Spline", and enter values for the derivative at the start and end of the spline.



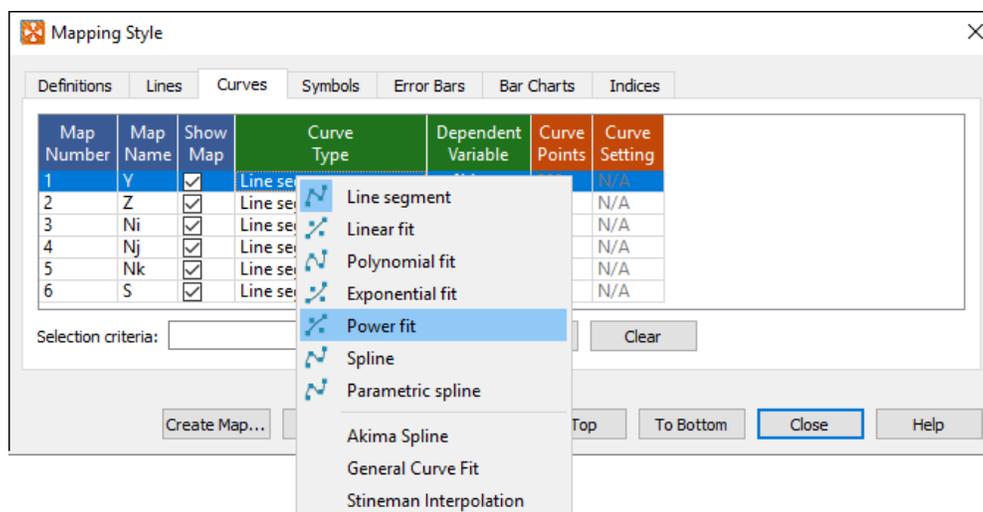
For the XY Line plot type, the derivatives are either dy/dx or dx/dy depending on the Function Dependency for the mapping. Tecplot Focus calculates dx/ds and dy/ds from these values (where s is the parametric variable). For the Polar Line plot type, the derivatives are either $dR/d\theta$ or $d\theta/dR$ (depending on the Function Dependency for the mapping), and dR/ds and $d\theta/ds$ are calculated from these values (where s is the parametric variable). See [Section "Dependent and Independent Variables"](#) on page 117 for a full description of the Function Dependency option.

Extended Curve-fit

Tecplot Focus add-ons can provide new curve-fit types. These curve types are called extended curve-fits. These curve-fits may be provided by Tecplot Focus, a third party, or written by users. The functionality of each extended curve-fit is defined by its creator.

To fit an extended curve to your data:

- Use the Curves tab of the **Mapping Style** dialog to select the mappings for which you want to apply an extended curve-fit.
- Right-click Curve Type, and select an option from the drop-down.
- The extended curve fit options are located below the separation line (shown below).



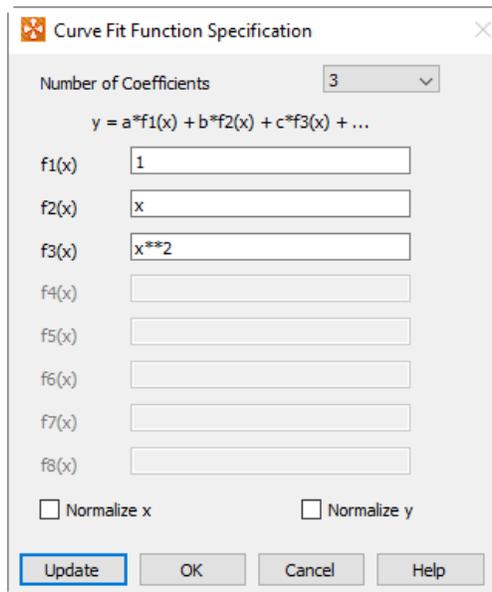
Extended Curve fits can also be selected by the right-click context menu on a line plot. Simply right-click on the line you wish to change, hover over Curve Type, and a similar drop-down menu will appear as above.

Three extended curve fit add-ons are supplied with Tecplot Focus:

- **Akima** - The Akima spline is an alternative that exhibits less dramatic overshoots and undershoots than the classical spline. The slopes at the end of each segment are computed using a nonlinear average of the segment slopes¹. The Akima spline is always unclamped. There are currently no options available for the Akima spline.
- [Extended Curve Fit - General](#)
- [Extended Curve Fit - Stineman](#)

Extended Curve Fit - General

The General Curve Fit add-on fits an equation composed of a linear combination of user-specified sub-functions to the data in the specified map. The optional parameters can be accessed by selecting the *Curve Settings* option on the Curves page of the **Mapping Style** dialog.



The curve fit computes (least squares) the optimal curve fit coefficients by multiplying these sub-functions.

The following options are available:

- **Number of Coefficients** - Specify the number of coefficients (and number of sub-functions) for the desired curve fit. The default is three. You must specify a sub-function for each coefficient in the text fields labeled f1(x) through fn(x), where n is the number of coefficients.
- **f1(x) through f8(x)** - Enter the sub-functions for the curve fit using the syntax described in [Section 20 - 1 "Data Alteration through Equations"](#).



In these equations use the variable x as the independent variable, even if x is specified as the dependent variable in the **Dependent Variable option of the Mapping Style** dialog.

- **Normalize X** - Causes the curve to be fit using a normalized independent variable. In particular, the independent variable will be translated and scaled to vary from zero at the smallest value of the independent variable to one at the largest value of the independent variable. For most curves other than polynomials, this option will alter the shape of the curve fit. It is useful when

1. For details, see: Lancaster, Peter and Salkauskas, Kestutis "Curve and Surface Fitting, An Introduction", 1986, Academic Press.

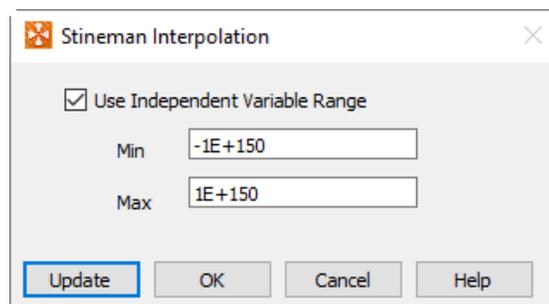
you get the "Rank reduced for at least one curve fit" warning message, but otherwise is not recommended.

- **Normalize Y** - Causes the curve to be fit using a normalized dependent variable. In particular, the dependent variable will be translated and scaled to vary from zero at the smallest value of the dependent variable to one at the largest value of the dependent variable. For most curves other than polynomials, this option will alter the shape of the curve fit. It is useful when you get the "Rank reduced for at least one curve fit" warning message, but otherwise is not recommended.

Extended Curve Fit - Stineman

This method of interpolation generates a curve that will never have more inflection points than are clearly required by the given set of data points. The interpolating curve passes through the data points and exactly matches the computed slopes at those points¹.

The optional parameters can be accessed by selecting the Curve Settings option on the Curves tab of the **Mapping Style** dialog.



Line Segment (No Curve-fit)

By default, a series of linear segments are drawn between each set of points for the XY Line plot type.

To turn off curve fits for your data and use linear segments between points:

1. From the Curves page of the **Mapping Style** dialog, select the mappings you want to show as linear segments.
2. Right-click in the Curve Type column on the Curves page of the **Mapping Style** dialog and select "Line Segments."

Line Segments are plotted in the order set in the Sort option of the Definitions page of the **Mapping Style** dialog. By default, the points are unsorted, and lines segments are drawn in the order the data points appear in the data file. See [Section 6 - 1.1 "Mapping Definitions"](#) for a discussion of sorting.

Dependent and Independent Variables

Every mapping has a dependent variable and an independent variable. The dependency relationship determines the shape of your plot for most curve types. This dependency has no effect on line segment curve types, and for parametric splines, the dependency is only used to determine starting derivatives for clamped parametric splines. Extended curve-fits are free to use or not use this dependency depending on the type of curve-fit supplied.

You specify the dependency relationship between your axis variables by right-clicking in the **Dependent Variable** column on the Curves page of the **Mapping Style** dialog.

For the XY Line plot type, the default setting is $y=f(x)$ (you may change the value to $x=f(y)$). With $y=f(x)$, the X-axis variable is the independent variable and the Y-axis variable is the dependent variable. With $x=f(y)$, the Y-

1. For more information see Russell W. Stineman's "A Consistent Well-behaved Method of Interpolation" in the July, 1980, issue of Creative Computing.

axis variable is the independent variable and the X-axis variable as the dependent variable. Two polynomial curve-fits of the same data using different dependency settings are shown in [Figure 6-6](#).

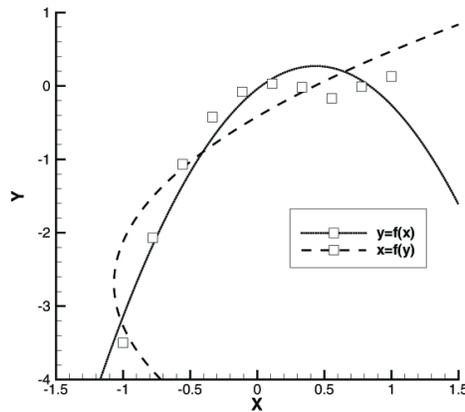


Figure 6-6. An XY Line plot type dependencies.

Similarly for Polar Line plots, the default setting is $R=f(\text{Theta})$ (you may change the value to $\text{Theta}=f(R)$). With $R=f(\text{Theta})$, the Theta-axis variable is the independent variable and the R-axis variable is the dependent variable. With $\text{Theta}=f(R)$, the R-axis variable is the independent variable and the Theta-axis variable is the dependent variable.

To change the dependency setting:

1. From the Curves page of the **Mapping Style** dialog, select the mappings to change.
2. Right-click in the Dependent Variable column on the Curves page of the **Mapping Style** dialog choose either $R=f(\text{Theta})$ or $\text{Theta}=f(R)$.



For the XY Line plot type, the dependency setting determines the direction of bar charts. To create a vertical bar chart, set the dependency to $y=f(x)$; to create a horizontal bar chart, set the dependency to $x=f(y)$. See [Section 6 - 5 "XY Line Bar Charts"](#) for information on bar charts.

Curve-fit Weighting Variables

Linear and polynomial fits allow you to specify a weighting variable. By default each data point is weighted equally. With the weighting variable, individual points can be given more or less weight. Relatively larger numbers in the *curve weighting variable* mean more significance for a given point. **If the curve-weighting variable is zero at a data point, that data point has no effect upon the resulting curve.** Therefore if your data contains outliers that would affect the overall curve fit, adding a zero weight at the point of the outlier will remove it from the overall curve fit calculation.

The weighting coefficients must be integers in the range of zero to 9,999. Weighting coefficients defined as floating-point numbers are truncated. That is, a weighting coefficient of 1.99 is truncated to 1.0.

Curve Information

You can view information about curve-fits and splines by right-clicking the curve in the plot and choosing an item from the Curve Details submenu. The available functions include

- **Show On Plot** - Displays information about the curve directly on the plot, including the zone, the variables, the [Goodness of Fit](#), and other information specific to the curve type (such as the polynomial for the Polynomial Fit type). This information is in a standard text element, and you

can reposition it as usual, or change its appearance (its font, size, and color) using the [Text Details](#) dialog. It is automatically updated if you change the curve fit settings.

- **Write Curve Points to File** - Write the points of the curve to a Tecplot-format data file (.dat file).
- **Write Curve Details to File** - Writes the same information displayed by Show On Plot to a text file. Note that this text file includes some Tecplot text formatting tags such as <sup>.

Goodness of Fit

R^2 is displayed in the curve details for linear, polynomial, exponential, and power curve fits. It is a statistical calculation that measures the success of the curve-fit in modeling the variation of the data. R^2 is defined as the ratio of the sum of the squares of the regression (SSR) and the total sum of the squares (SST).

$$SSR = \sum_{i=1}^n W_i (y_{curvefit_i} - y_{mean})^2$$

$$SST = \sum_{i=1}^n W_i (y_i - y_{mean})^2$$

$$R^2 = \frac{SSR}{SST}$$

Where:

SSR = sum of the squares of the regression

SST = total sum of the squares

W_i = the value of the weight variable at index i

y_i = the value of the dependent variable at index i

y_{mean} = the mean value of the dependent variable y

$y_{curvefit_i}$ = the value computed using the curve-fit at the i -index value of the independent variable (x_i).

i = current index number

n = total number of data points



R-square can take any value between zero and one, with a value closer to one indicating a better fit.

A fundamental error term in least-squares curve fits is the sum of the squares residual (SSE), defined by

$$SSE = \sum_{i=1}^n W_i (y_{curvefit_i} - y_i)^2$$

This is the number that is minimized when computing the curve-fit coefficients. Using the equation $SST = SSE + SSR$, R^2 can be related to SSE:

$$R^2 = 1 - \frac{SSE}{SST}$$

Using this form to compute R^2 , it is easier to see that an R^2 closer to one ($SSE=0$) indicates a better curve-fit.

Goodness of Fit (Residual Degrees of Freedom Adjustment)

One problem with R^2 is that it will always indicate a good curve-fit when the number of data points, n , equals the number of degrees-of-freedom, m . (For example, a quadratic curve-fit through three data points.) In this case, the curve passes through all data points so $SSE=0$ and r -square=1. However, there are no other data points so, in reality, no estimate can be made on the quality of the curve fit away from the specified data points. In general, any time m (degrees-of-freedom) is close to n (number of data points), r -square will overstate the quality of the curve fit. For this reason, we include the second goodness-of-fit parameter: degrees-of-freedom adjusted R^2 :

$$R^2_{dof} = 1 - \frac{SSE(n - 1)}{SST(m - n)}$$

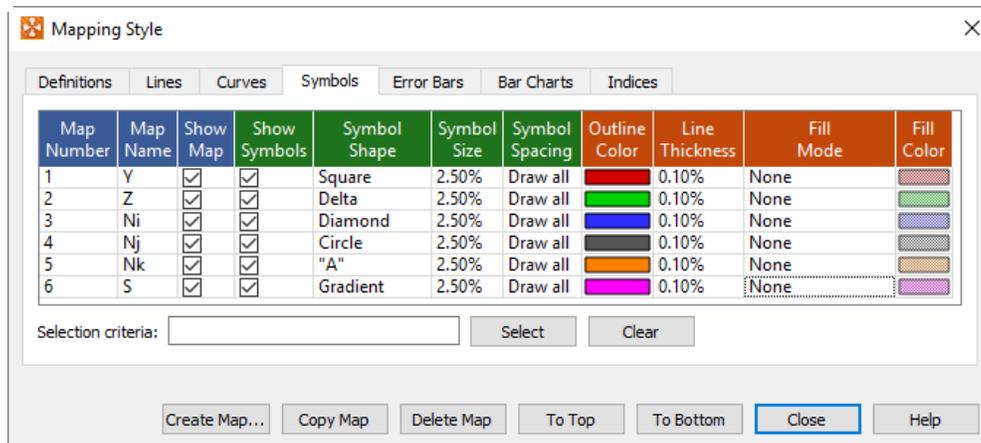
Like the standard R^2 , R^2_{dof} will vary from zero to one with values closer to one indicating a better curve fit. R^2_{dof} will be less than R^2 when the degrees-of-freedom are close to the number of data points, but will be nearly equal to R^2 when the number of data points is significantly greater than the degrees-of-freedom.

6 - 3 Symbols Map Layer

The Symbols map layer is available for both XY and polar line plots. Activate the layer by toggling-on "Symbols" in the Plot sidebar. When the Symbols map layer is on, each data point is represented by a symbol on the plot. For each mapping, you may choose the plotting symbol used, and whether to use filled or plain symbols.

6 - 3.1 Symbol Attributes

Use the Symbols page of the **Mapping Style** dialog (shown below) to modify the attributes of the Symbols layer.



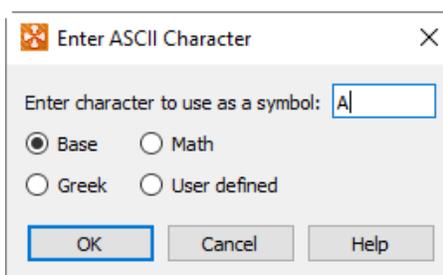
The first two columns list the mapping number and name. The Show Map column indicates currently active mappings. These columns behave the same as the corresponding columns on the Definitions page (see [“Mapping Definitions”](#) on page 103).

The remaining columns of the Symbols page of the **Mapping Style** dialog contain specific symbol attributes: Symbol Show, Symbol Shape, Symbol Size, Symbol Spacing, Outline Color, Line Thickness, Fill Mode, and Fill Color.



In order for the changes made on the Symbols page to be visible in your plot, the Symbols mapping layer must be toggled-on in the Plot sidebar.

- **Show Symbols** - Allows you to turn off symbols for selected mappings, while keeping both the selected mappings and the Symbols map layer active overall.
- **Symbol Shape** - Right-click and choose a symbol type. In addition to the predefined symbols, you may use any ASCII character by selecting *Character*. Enter the ASCII character to use as a symbol in the **Enter ASCII Character** dialog (shown below), and select a font from which to display the symbol. See [Table 18 - 2](#) on page 233 for further information on the symbols available in each character set.



You can change the base font in the Scatter Size/Font dialog, accessible via **Plot>Symbol Font**. See [Section 11 - 2 “Scatter Size/Font”](#) on page 176.

- **Symbol Size** - Right-click and choose the symbol size for your line plotting symbols. Symbol size is measured as percentage of the frame height. You can choose a preset size or enter your own.
- **Symbol Spacing** - Right-click to specify the spacing between symbols. The spacing is specified either as a percentage of the frame height or as a number of indices to skip. You may either enter a value or use a pre-set value.
 - **Draw All** - Symbols are drawn at every data point.
 - **ISkip=2, 3 or 4** - Symbols are drawn every second, third, or fourth data point.
 - **Distance=1, 2 or 3%** - Symbols are drawn at the first data point and subsequently at data points that are at least one, two, or three percent of the frame height distant from the previously plotted data point.
 - **Enter Index** - Enter an index skip between symbols.
 - **Enter Distance** - Enter a distance between symbols in frame units.
- **Outline Color** - Right-click to choose a color using the Color Chooser.
- **Line Thickness** - Right-click to choose the thickness of lines used to draw the plotting symbols. You may either enter a value or use a pre-set value.
- **Fill Mode** - Right-click to specify Fill Mode:
 - **None** - The symbols are not filled.
 - **Use Line Color** - The symbols are filled with the same color specified in Outline Color and appear as a solid color.

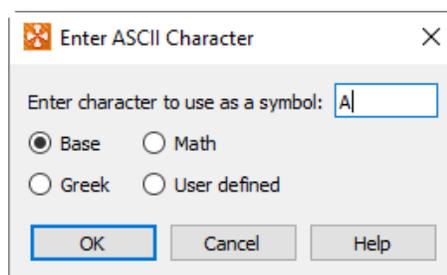
- **Use Back Color** - The symbols are filled with background color of the grid area, and appear hollow, blotting out objects behind the symbol (such as grid lines or other mappings).
- **Use Specific Color** - The symbols are filled with the color specified in Fill Color.
- **Fill Color** - If the Fill Mode is set to "Use Specific Color", right-click in this column to choose the fill color in the Color Chooser.



For information on using the controls at the bottom of the Mapping Style dialog to select mappings by name, see the description of these at the end of ["Mapping Definitions"](#) on page 103.

6 - 3.2 Enter ASCII Character

Use the **Enter ASCII Character** dialog to specify an ASCII character to use as a plotting symbol in either a field scatter plot or an XY symbol plot. You enter the desired character, and then choose the character set from which to draw the character. See [Table 18 - 2](#) on page 233 for further information on the symbols available in each character set.



This dialog has one text field for specifying the ASCII character and four option buttons representing the available character sets, as follows:

- **Enter Character to use as a Symbol** - Enter the desired ASCII character in this text field.
- **Base** - Select this to use the English-text character set as the source of the plotting character.
- **Math** - Select this to use the math character set as the source of the plotting character.
- **Greek** - Select this to use the Greek character set as the source of the plotting character.
- **User-defined** - Select this to use the user-defined character set as the source of the plotting character. See [Section 28 - 4 "Custom Character and Symbol Definition"](#) on page 361.

6 - 4 XY Line Error Bars

In the XY Line plot type, you can assign one or more variables to be used to compute error bars for another variable. Each mapping can be associated with only one error bar variable. If you want to assign multiple error bar variables to a mapping, create a copy of the mapping for each error bar variable.

An example plot with error bars is shown in [Figure 6-7](#).

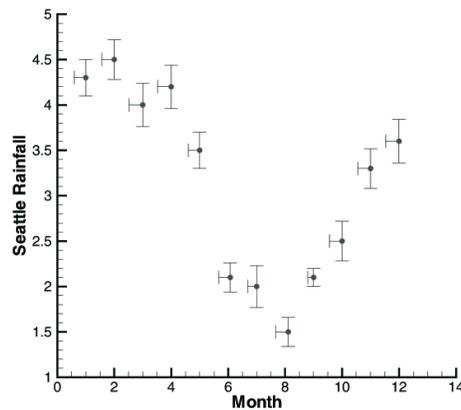


Figure 6-7. An XY Line plot with symbols and error bars.

You can use any variable in your dataset as an error bar variable. However, for them to be meaningful, they should have the same units as the axis along which they are drawn.



If error bar values are not included in your original dataset, you may create error variables using Tecplot Focus's data manipulation utilities. For example, if you know that the values of some measured variable are accurate only to within ten percent, you may create a new variable to use as the error bar variable by multiplying the measured variable by "0.10" via **Data>Alter>Specify Equations**. See [Chapter 20: "Data Operations"](#).

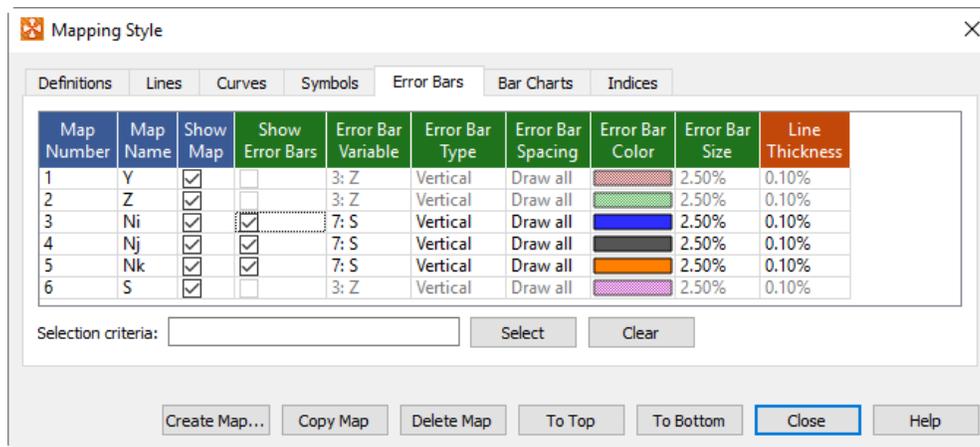
6 - 4.1 Select Variable

Use the **Select Variables** dialog to choose:

- A single variable, as when assigning a variable to the X or Y-axis in a mapping. The text and labels will vary with the particular action being performed, but the operation of the dialog is the same in all cases. Select a variable from the drop-down of the dataset's variables and select [OK].
- Two variables, as when assigning 2D axis variables or choosing 2D vector components. The text and labels will vary with the particular action being performed, but the operation of the dialog is the same in all cases. For each of the two variables required, select a variable from the drop-down of the dataset's variables.
- Three variables, as when assigning 3D axis variables or choosing 3D vector components. The text and labels will vary with the particular action being performed, but the operation of the dialog is the same in all cases. For each of the three variables required, select a variable from the drop-down of the dataset's variables.

6 - 4.2 Error Bar Attributes

You can modify most of the attributes with which error bars are drawn—their color, their thickness, their spacing, and the width of the endpoint crossbars. You can make these changes from the Error Bars page of the **Mapping Style** dialog (shown below).



In order for the changes made on the Error Bars page to be visible in your plot, the Error Bars mapping layer must be toggled-on in the Plot sidebar.

The first two columns list the mapping number and name. The Show Map column indicates currently active mappings. These columns behave the same as the corresponding columns on the Definitions page (see [“Mapping Definitions”](#) on page 103). The other settings are:

- **Show Error Bars** - Indicates whether error bars are displayed for this mapping.
- **Error Bar Variable** - Right-click or double-click to choose the error bar variable.
- **Error Bar Type** - Right-click to choose from seven types of error bars.
 - **Up** - Extends upward for positive values (and downward for negative values) of the error bar variable.
 - **Down** - Extends downward for positive values (and upward for negative values) of the error bar variable.
 - **Left** - Extends to the left for positive values (and to the right for negative values) of the error bar variable.
 - **Right** - Extends to the right for positive values (and to the left for negative values) of the error bar variable.
 - **Horizontal** - Extends left and right.
 - **Vertical** - Extends up and down. (This is the default value.)
 - **Cross** - Extends up, down, left, right.



Although the values are called Left, Right, Up and Down, the direction is determined by the direction of positive values in your plot. If you reverse the direction of an axis (using the Reverse Axis Direction option on the Range page of the **Axis Details** dialog), the error bars point in the opposite direction.

- **Error Bar Spacing** - Right-click to specify the spacing between error bars. The spacing is specified either as a percentage of the frame height or as a number of indices to skip. You may either enter a value or use one of the following pre-set values:
 - **Draw All** - Error bars are drawn at every data point.
 - **ISkip=2, 3 or 4** - Error bars are drawn every second, third or fourth data point.
 - **Distance=1, 2, or 3%** - Error bars are drawn at the first data point and subsequently at data points that are at least one, two or three percent of the frame height distant from the previously plotted data point.
- **Error Bar Color** - Right-click to specify the error bar line color in the Color Chooser.
- **Error Bar Size** - Right-click to specify the size of the crossbar. Crossbar size is measured as a percentage of frame height. You may either choose a preset value or enter an exact value yourself.
- **Line Thickness** - Right-click to specify the line thickness of the error bars. The error bar line thickness is measured as a percentage of frame height.



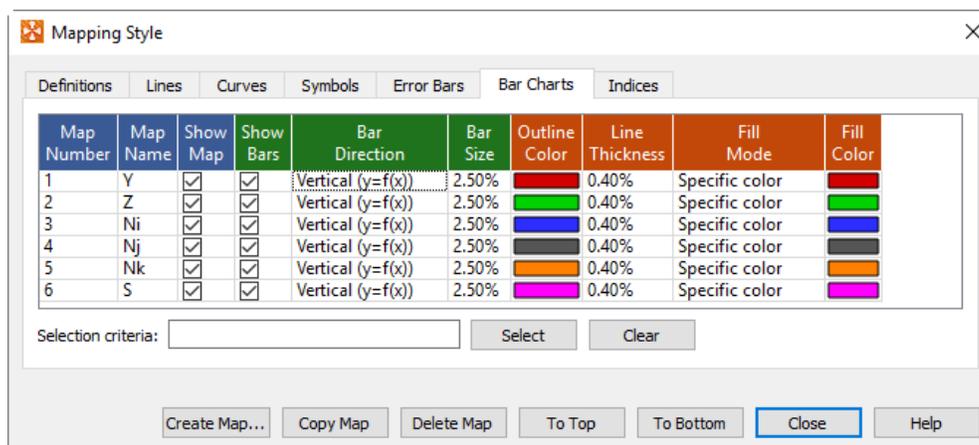
For information on using the controls at the bottom of the Mapping Style dialog to select mappings by name, see the description of these at the end of ["Mapping Definitions"](#) on page 103.

6 - 5 XY Line Bar Charts

A bar chart is an XY Line plot that uses vertical or horizontal bars placed along an axis to represent data points. You can create bar charts by activating the Bars map layer on the Plot sidebar.

6 - 5.1 Bar Chart Attributes

The style of the bar chart is controlled on the Bar Charts page of the **Mapping Style** dialog, shown below.



The first two columns list the mapping number and name. The Show Map column indicates currently active mappings. These columns behave the same as the corresponding columns on the Definitions page (see ["Mapping Definitions"](#) on page 103).

- **Show Bars** - Toggle on or off the bar chart for this mapping.
- **Bar Direction** - Right-click to change between vertical or horizontal bars.

Changing the direction of the bars changes the dependent variable attribute used for line curves (either $y=f(x)$ or $x=f(y)$), and vice versa. By default, all mappings use $y=f(x)$ and appear as vertical bar charts. If a mapping uses horizontal bars, the mapping will also use $x=f(y)$ for curve fits. Of

course, this only matters if you plot bars and curve-fits for the same mapping. For more information about dependency, see [Section “Dependent and Independent Variables”](#) on page 117.

To modify other attributes (*Bar Size, Outline Color, Line Thickness, Fill Mode, Fill Color*) on the Bars page, follow the same procedures used to set [Section 6 - 3.1 “Symbol Attributes”](#).



For information on using the controls at the bottom of the Mapping Style dialog to select mappings by name, see the description of these at the end of [“Mapping Definitions”](#) on page 103.

6 - 6 I, J, and K-indices

Each mapping can show either I, J, or K-varying families of lines. By default, Tecplot Focus displays the I-varying family of lines. [Figure 6-8](#) shows the family of I-varying lines for Zone 1 of the data.

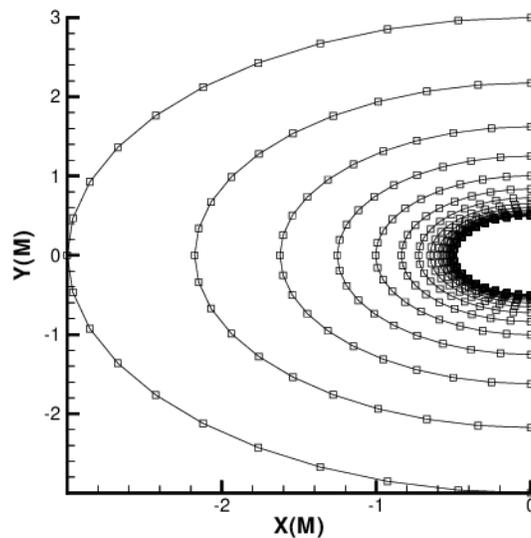
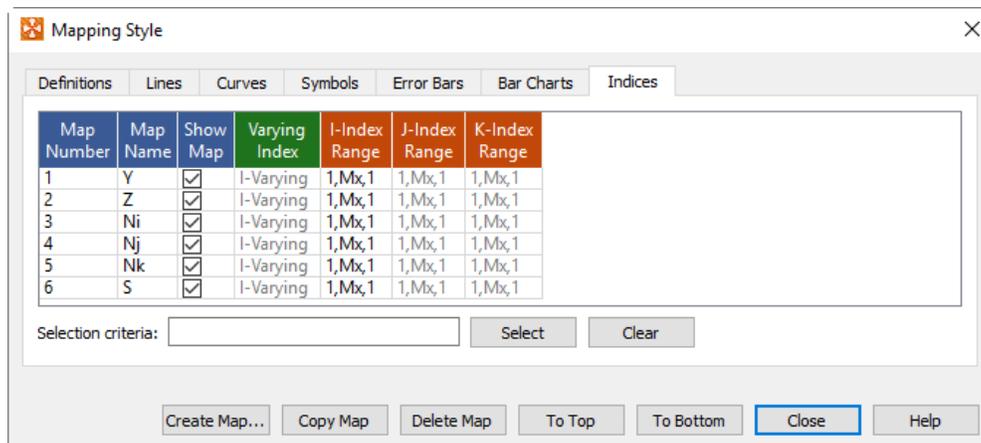


Figure 6-8. A family of I-varying lines for the cylinder data.

You can change the family of lines using the Indices page of the **Mapping Style** dialog as shown below.



The first two columns list the mapping number and name. The Show Map column indicates currently active mappings. These columns behave the same as the corresponding columns on the Definitions page (see ["Mapping Definitions"](#) on page 103).

You can also choose which members of the family are drawn (and using which data points), by specifying index ranges for each of I, J, and K. The index range for the varying index tells Tecplot Focus which points to include in each line, and the index ranges for the other indices tell Tecplot Focus which lines in the family to include. Thus, you may use this option for selecting a subset of an I-ordered zone to plot.

- **Varying Index** - To choose the varying index, and thus specify the family of lines to be drawn, right-click the Varying Index column and choose the desired family (I, J, or K-varying). K-varying is only available if the mapping is using an IJK-ordered zone.
- **Index Ranges** - By default, the entire range of points is plotted in your mapping. For IJ- and IJK-ordered data, you may want to specify an index range to limit the number of lines drawn. Or, for any type of data, you may want to limit the points drawn to a select range. Right-click and choose Enter Range to specify the range.

Enter a starting index in the Begin field, an ending index in the End field, and a skip factor in the Skip field. A skip of one means "use every point in the range," a skip of two means "use every other point," and so on.

The screenshot shows a dialog box titled "Enter Range" with a close button (X) in the top right corner. It contains three input fields: "Begin" with a value of 1, "End" with a value of 0, and "Skip" with a value of 1. Each field has a small up/down arrow on its right side. At the bottom of the dialog are three buttons: "OK", "Cancel", and "Help".



For information on using the controls at the bottom of the Mapping Style dialog to select mappings by name, see the description of these at the end of ["Mapping Definitions"](#) on page 103.

6 - 7 Line Legend

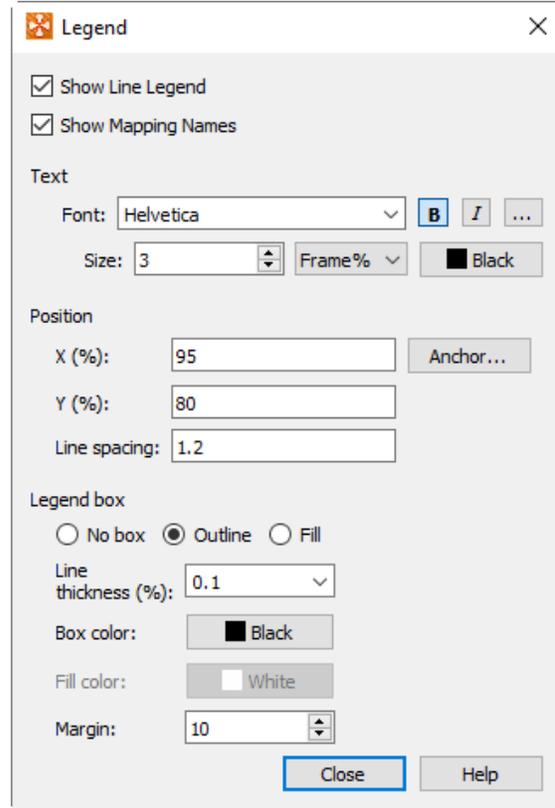
You can generate a legend that shows the line and symbol attributes of the mappings. In XY Line plots, this legend includes the bar chart information. The legend can be positioned anywhere within the line plot frame.

The mappings that are shown in the legend are selected on the Definitions page of the **Mapping Style** dialog. By default, all mappings are shown, but Tecplot Focus removes redundant entries.

To include the line plot legend, open the **Line Legend** dialog (accessed via the **Plot** menu) and toggle-on "Show Line Legend".

The **Line Legend** dialog has the following additional options:

- **Show Mapping Names** - Toggle-on or off to include mapping names in the legend.
- **Text** - Format the text for the legend by choosing a color, font, and size. (See [Section 18 - 1.2 "Font Folders and Fallback"](#) on page 231 for more information on how fonts work with Tecplot Focus.)
- **Position** - The legend is automatically placed for you. You may specify the position of the legend by entering values in the **X (%)** and **Y (%)** text fields. Enter X as a percentage of the frame width and Y as a percentage of the frame height.
- **Line Spacing** - Spacing between items in the legend as a multiple of the font size.
- **Anchor** - You may also specify the anchor location of the legend using the [Anchor Alignment](#) dialog. By default, the legend is anchored in the top right.
- **Legend Box** - Choose No box, Outline, or Fill mode. If the legend box mode is Outline or Fill, the box attributes may be changed with the following controls:
 - **Line Thickness** - Specify the line thickness as a percentage of frame height.
 - **Box Color** - Choose a color for the legend box outline.
 - **Fill Color** - Choose a color for the legend box fill (Fill mode only).
 - **Margin** - Specify the margin between the legend text and legend box as a percentage of the text height.



6 - 7.1 Specify Number Format



Not all fonts have Bold and/or Italic variants. For fonts that do not have these styles, the **B** and/or *I* buttons may have no effect.

- **Format** - Choose the format for numbers in the legend from the drop-down:
 - **Integer** - Display the number as an integer; if the exact value is not an integer, it is truncated.
 - **Float** - Display the number as a floating-point number. The value is shown to the number of decimal places specified in the Precision field.
 - **Exponent** - Display the number using FORTRAN exponential format (for example, 1.0125E + 02). The number of decimal places is specified using the Precision field.
 - **Best Float** - Display the number as a floating-point number, with its exact form determined by Tecplot Focus.
 - **Range Best Float** - Tecplot Focus selects the best floating-point representation of the tick mark labels, taking into account the range of values on the axis. (Available only for axis labels.)
 - **Superscript** - Display the number in scientific notation, using a number times a power of ten. The number of decimal places shown is specified using the Precision field.
 - **Custom** - Not a number format at all, Custom specifies that a set of custom labels (specified by number in the Custom Set field) should be used in the contour legend. The first label in the set is used for the value one, the second label for two, and so on. All non-integer numbers are rounded to the nearest integer. If the number of levels exceeds the number of custom labels, the labels are reused cyclically as needed. For example, if you have defined the custom labels Mon., Tue, Wed, Thu, Fri, Sat, and Sun, then a value of eight would display Mon, nine would display Tue, and so on.
 - **Time/Date** - You can specify a Time/Date format for your labels by selecting Time/Date from the Format drop-down menu. See [Section 17 - 11 "Time/Date Format Options"](#) for more information on specifying your labels in Time and/or Date format.

- **Precision** (Float, Exponent, or Superscript only) - Enter the number of decimal places each number is to show.
- **Custom Set** (Custom only) - Enter the number of the set of custom labels. You define custom label sets as records in standard Tecplot-format data files.
- **Show Decimal on Whole Numbers** - When this toggle is checked, whole numbers include a trailing decimal (that is, the number 2 is displayed as 2).
- **Remove Leading Zeros** - When this toggle is checked, leading zeros are removed from numbers (that is, 0.25 is displayed as .25).
- **Show Sign on Negative Numbers** - When this toggle is checked, negative numbers show the negative sign. When unchecked the negative sign will be removed (that is, -1.43 is displayed as 1.43). This is useful if you have specified a special prefix or suffix for negative values.
- **Prefix and Suffix** - You can specify a custom prefix and/or suffix for numbers in Tecplot Focus using the Prefix/Suffix text fields. Tecplot Focus allows you to specify separate prefixes and suffixes for zero values and negative values as well.

Field Plots

Field plots are 2D Cartesian or 3D Cartesian plots. The axes in a field plot are all independent variables. In Tecplot Focus, field plots can be created using any combination of the following zone layers:

- [Mesh Layer](#)
- [Contour Layer](#)
- [Vector Layer](#)
- [Scatter Layer](#)
- [Shade Layer](#)
- [Edge Layer](#)

By default, 2D and 3D field plots are initially displayed with Mesh and Edge zone layers ([Figure 7-1](#)).

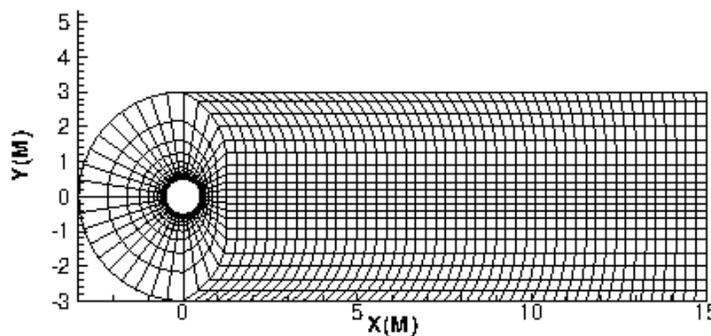


Figure 7-1. A 2D mesh and edge plot.

3D field plots may be enhanced with lighting effects and translucency (see [Chapter 13: “Translucency and Lighting”](#)).



Bounding boxes are displayed in 3D plots for volume-only zones when the plot contains only such zones and the zones themselves are not otherwise visible due to having no style. These bounding boxes may be turned off in the Options menu.

Field plots may also contain any combination of the following objects (which are derived from the values in the dataset):

- [Iso-surfaces](#) (3D only)
- [Slices](#) (3D only)
- [Streamtraces](#)

This chapter discusses the plot attributes that are common to all of the plot layers.

7 - 1 Field Plot Modification and the Zone Style Dialog

Once you have loaded your data, you can modify field plot attributes using the **Zone Style** dialog or the context toolbar.



The context toolbar appears above the context menu when you right-click a zone in your field plot. This toolbar allows you to turn on or off the grid, contour, vector, shade, edge, and translucency layers for the selected zone(s).

Additionally, you may adjust frequently-used style settings for each layer using the drop-down menu to the right of each, for example selecting a color for the grid (or choosing a variable by which to color it).

The **Zone Style** dialog may be opened by clicking the Zone Style button in the Plot sidebar or from the **Plot** menu. Initially, any zones selected in the workspace are selected in the Zone Style dialog. You may also double-click any zone in your plot to open the dialog with that zone selected.



Field plots containing transient data work slightly differently from static datasets in the Zone Style dialog. If a zone contains no data at the current time step, that entire line in the Zone Style dialog is grayed out. See [Section 7 - 2 "Time Aware"](#) for more information on working with transient datasets.

The following pages are available in the **Zone Style** dialog, each representing a plot layer:

- **Mesh** - See [Chapter 8: "Mesh Layer and Edge Layer"](#).
- **Contour** - See [Chapter 9: "Contour Layer"](#).
- **Vector** - See [Chapter 10: "Vector Layer"](#).
- **Scatter** - See [Chapter 11: "Scatter Layer"](#).
- **Shade** - See [Chapter 12: "Shade Layer"](#).
- **Edge** - See [Chapter 8: "Mesh Layer and Edge Layer"](#).
- **Points** - See [Section 7 - 1.1 "Points"](#)
- **Surfaces** - See [Section 7 - 1.2 "Surfaces"](#).
- **Volume** - See [Section 7 - 1.3 "Derived Volume Object Plotting"](#). (3D only)
- **Effects** - See [Chapter 13: "Translucency and Lighting"](#).

The values in the **Zone Style** dialog can be modified in place. For example, some settings, such as Show Zone, are represented by checkboxes, and can simply be clicked to toggle their state. Other settings allow you to right-click to display a context menu or other method for changing them. These allow you to change the setting for multiple zones at once by selecting the desired zones (hold down Shift or Control while clicking), then right-clicking in the column for the setting you wish to change.



Each page of the **Zone Style** dialog is divided into three color-coded regions. The blue columns apply to the zone itself and are the same on all pages of the dialog. The green and orange columns represent primary and secondary settings specific to the corresponding plot layer.

The following attributes in the **Zone Style** dialog apply to the zone in general and appear on all pages of the dialog.

- **Zone Number** - The number of each zone.
- **Zone Name** - The name of each zone. Strands are indicated by an "*" after the name.



For transient data, the first zone of the strand applicable to the current time step is displayed in the Zone Name and Zone Number columns.

- **Group Number** - Displays the zone's group number. Double-click to change the number.
- **Show Zone** - By default, all zones are displayed. Turn zones or groups of zones on or off by toggling the checkboxes in this column on or off.
- **Select Zones by Pattern** - Enter a wildcard pattern in the Selection criteria text box and click **Zones** or **Groups** to select one or more zones based their name or group number. Selecting Zones will match the selection criteria with the Zone Name while selecting Groups will match the selection criteria with the Group Number. In wildcard patterns, most characters match themselves, but the * and ? characters have special meaning.

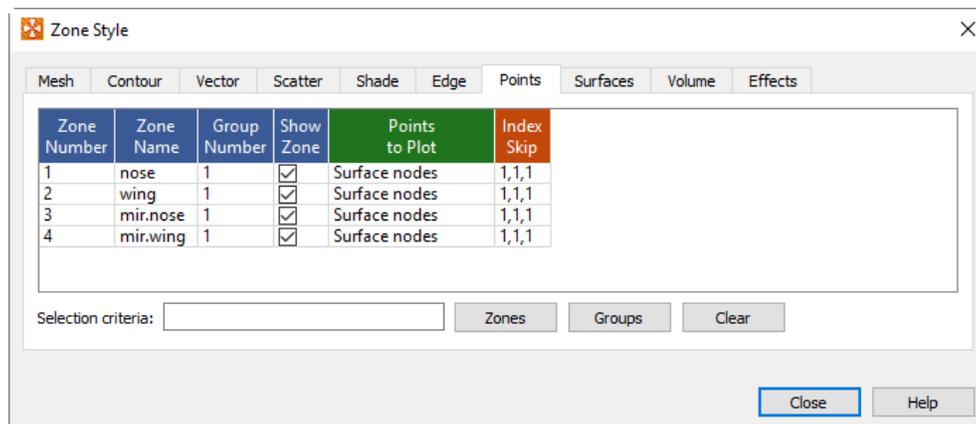
Character	Meaning
?	Matches any single character.
*	Matches any number of characters, including none.

- **Clear** - Clear the selection and the Selection criteria field.

The remaining columns in the **Zone Style** dialog are dependent upon the active page and are discussed in their corresponding sections.

7 - 1.1 Points

You may select the source for the data points used to plot vectors and scatter symbols from the Points page of the **Zone Style** dialog (shown below).



For information on using the controls at the bottom of the Zone Style dialog to select zones by name, see the description of these at the end of ["Field Plot Modification and the Zone Style Dialog"](#) on page 132.

[Figure 7-2](#) shows a plot where zone 1 is plotting scatter symbols only on one plane ($J=5$) and zone 2 is plotting all symbols.

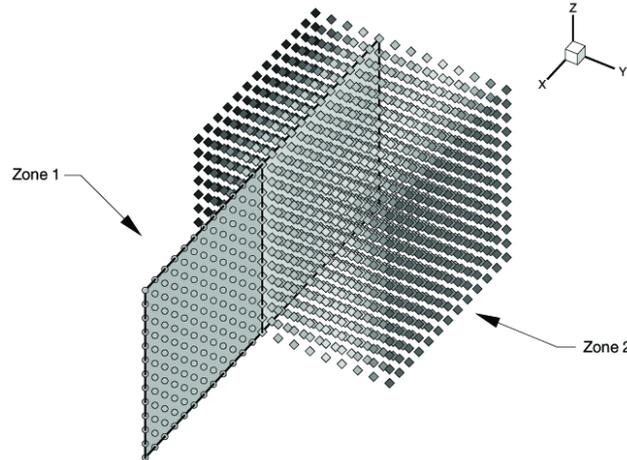


Figure 7-2. A plot showing two zones set to show only J-planes equal to five, with scatter symbols plotted on the surface in zone 1 and all symbols in zone 2.

- **Points to Plot** - Right-click to select how the points are plotted:
 - **Nodes on Surfaces** - Draws only the nodes that are on the surface of the zone.
 - **All Nodes** - Draws all nodes in the zone.
 - **All Connected** - Draws all the nodes that are connected by the node map. Nodes without any connectivity are not drawn.
 - **Cell Centers Near Surfaces** - Draws points at the cell centers which are on or near the surface of the zone.
 - **All Cell Centers** - Draws points at all cell centers in the zone.
- **Index Skip** - Right-click to specify the skip intervals for the I, J, and K-indices. The menu options are as follows:
 - **No Skip** - Set the I, J, and K-skip intervals to one; plot all points or vectors.
 - **Enter Skip** - Specify I, J, and K-skip intervals on the **Enter Index Skipping** dialog.

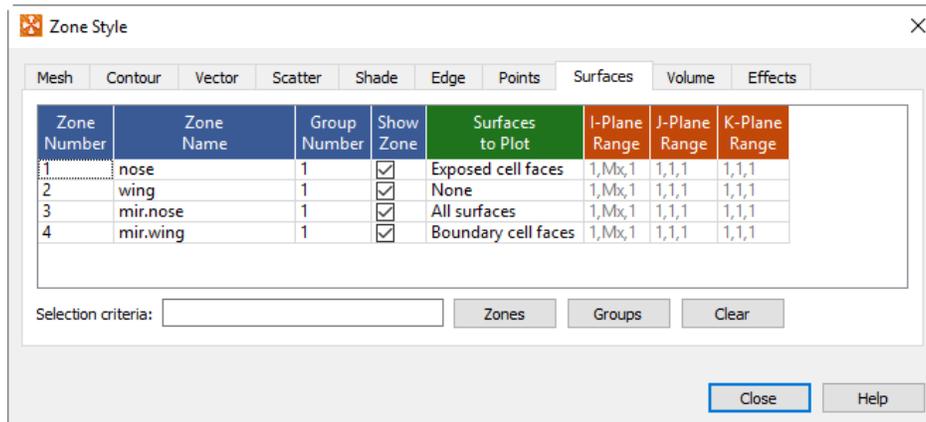


For irregular and finite element data, only the I-Skip has an effect. I-skip will allow you to skip through nodes in the order they are listed in the data file.

7 - 1.2 Surfaces

There are many ways to divide volume data for plotting. One way to view volume data is to select surfaces from part of the data. In Tecplot Focus you may choose which surfaces to plot for volume zones from the

Surfaces page of the **Zone Style** dialog (accessed by double-clicking on a zone via the Plot sidebar, or via **Plot>Zone Style**).



For information on using the controls at the bottom of the Zone Style dialog to select zones by name or by group number, see the description of these at the end of [“Field Plot Modification and the Zone Style Dialog”](#) on page 132.

Right-click in the Surfaces to Plot column to choose one of the following:

- **None** - None of the volume zone surfaces are plotted (edges still appear). This is the default Surfaces setting for your plot.
- **Boundary Cell Faces** - Plots all surfaces on the outside of the volume zone. This includes:
 - **IJK-ordered data** - The minimum and maximum I, J, and K-planes are plotted.
 - **Finite element volume data** - All faces that do not have a neighbor cell (according to the connectivity list) are plotted.

If blanking is turned on, the boundary cells in the blanked region will not be drawn and you will be able to see the interior of the volume zone. [Figure 7-3](#) shows plots of a volume zone with Surfaces to Plot set to "Boundary Cell Faces": without blanking, with value blanking, and with IJK-blanking. See [Chapter 19: "Blanking"](#) for information on working with Blanking.

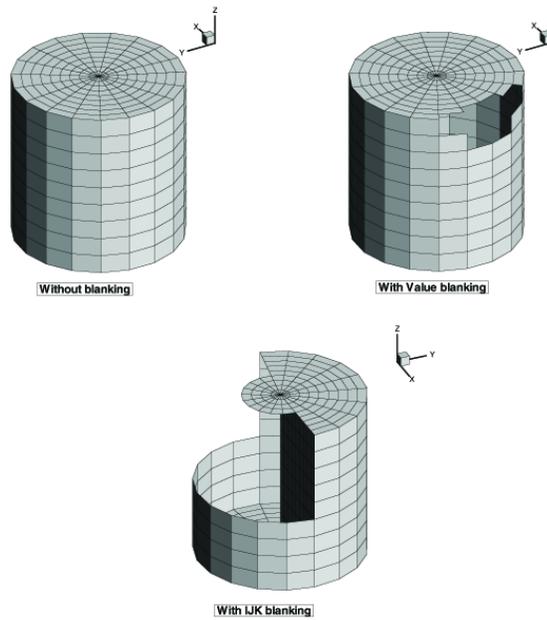


Figure 7-3. Boundary Cell Face plotting without blanking, with value-blanking, and with IJK-blanking.

- **Exposed Cell Faces (default)** - This setting is similar to the "Boundary Cell Faces" setting, unless value blanking is active. When value blanking is used, the outer cell faces between blanked and non-blanked cells and the outer surfaces of the data are drawn. [Figure 7-4](#) shows a plot of a volume zone with Surfaces to Plot set to "Exposed Cell Faces" with and without value blanking. See [Chapter 19: "Blanking"](#) for information on working with Blanking.

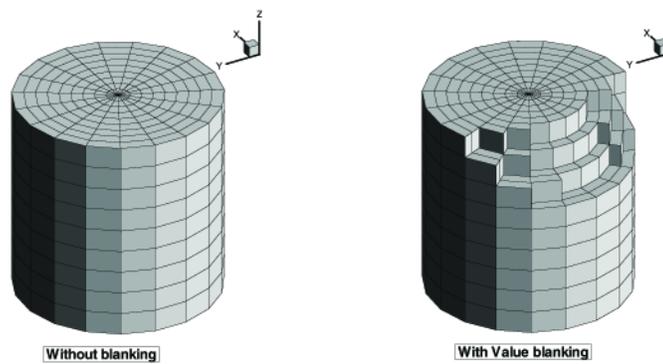


Figure 7-4. Examples of plots where Surfaces to Plot has been set to "Exposed Cell Faces" with (left) and without (right) value-blanking.

- **Planes Settings (I, J, K, IJ, JK, IK, and IJK-planes)** - Plots the appropriate combination of I, J, and/or K-planes. The planes are determined by the Range for each plane, which can be set by right-clicking in a range column. **These settings are available only for IJK-ordered data.** [Figure 7-5](#) shows a number of examples of plotting I, J, and K-planes.

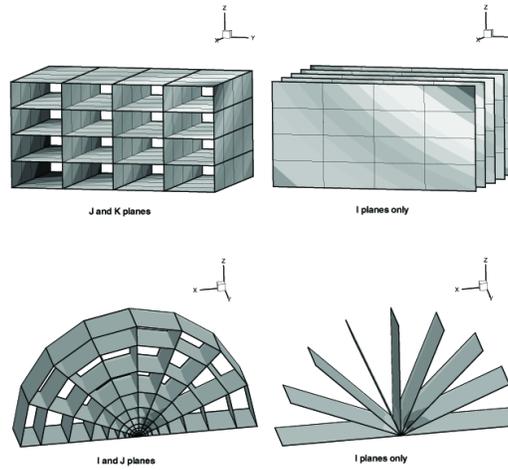


Figure 7-5. Examples of plotting I, J, and K-planes.

- **Every Surface (Exhaustive)** - This setting will plot every face of every cell in volume data. It is not recommended for large datasets. Unless the surfaces are translucent, the plot will appear the same as the Exposed Cell Faces setting.
- **Ranges** - The Range for I, J, or K Planes options allow you to specify the ranges for the corresponding planes. Right-click in the appropriate Range column to enter the range as the beginning plane, the ending plane (0 indicates the maximum index, -1 the next highest, and so on) and the skip factor in the **Enter Range** dialog. Use a skip factor of two to display every other plane, a skip factor of three to display every third plane, and so on.

7 - 1.3 Derived Volume Object Plotting

The Volume page of the **Zone Style** dialog allows you to specify whether or not to show streamtraces, iso-surfaces, or slices for the selected zone(s). Right-click in the appropriate column to choose yes or no. [Figure 7-6](#) shows a plot with two zones where streamribbons and an iso-surface have been excluded from zone 2.

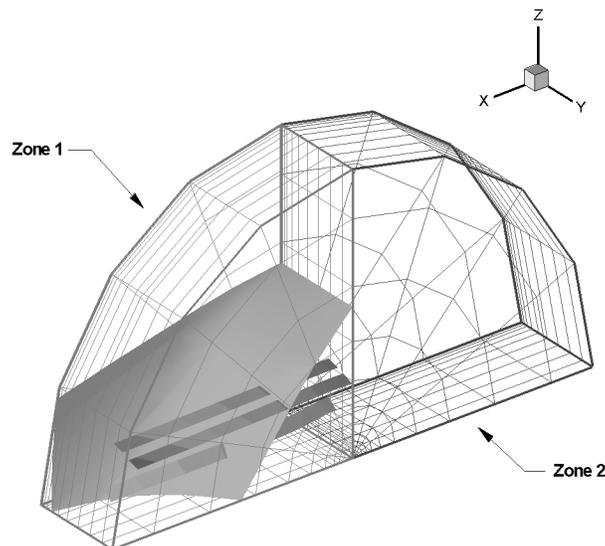


Figure 7-6. A plot where streamribbons and an iso-surface have been excluded from zone 2.

7 - 2 Time Aware

For transient datasets, you can use the Tecplot Focus interface to display your data at a given time or to animate your data over time. The zones loaded into Tecplot Focus can be linked to a specific solution time, and the active solution time is used to determine which zones are displayed.

For the following definitions, consider the following fictitious dataset:

Table 7 - 1: Sample Time Aware Dataset

Zone	Time	StrandID
1	n/a	n/a
2	0.0	2
3	0.18	3
4	0.22	1
5	0.25	2
6	0.28	1
7	0.32	3
8	0.38	2
9	0.42	1
10	0.52	1
11	0.57	2
12	0.58	3
13	0.62	1
14	n/a	n/a

- **Transient zones** - Zones associated with time. The transient zone(s) displayed in the current frame are dependent upon the current solution time. Zones 2-13 in [Table 7 - 1](#) are transient zones.
- **Static zones** - Zones not associated with time. They are displayed regardless of the current solution time. Zones 1 and 14 from [Table 7 - 1](#) are static.
- **Current Solution Time** - The value that determines which transient zones are displayed in the current frame.
- **Strand** - A series of transient zones that represent the same part of a dataset at different times. Zones 2, 5, 8, and 11 in [Table 7 - 1](#) all have the same StrandID and therefore, they are part of the same strand.
- **StrandID** - An integer value defined for each transient zone. The StrandID of a given zone is determined by the data loader.



Changes made in the Zone Style dialog to any zone in a given StrandID are propagated to all zones with that StrandID. See also [Section 7 - 1 "Field Plot Modification and the Zone Style Dialog"](#).

- **Relevant Zone** - Only "relevant zones" are plotted at a given solution time. Tecplot provides two different policies for determining what zones are relevant at any given solution time. Please refer to `!GlobalTime TransientZoneVisibility` macro command in the Scripting Guide for more information. The default option is, `ZonesAtOrBeforeSolutionTime`. The rules for the different transient zone visibility options are as follows:

- **ZonesAtOrBeforeSolutionTime:** For each strand at a given solution time, the zones shown are those that are at the solution time, within a tolerance. Except for the very first or last time step, if no zones exist at the given solution time, zones shown are those from the first prior solution time showing zones.
- **ZonesAtSolutionTime:** For each strand at a given solution time, the zones shown are those that are at the solution time, within a tolerance.

Static zones are always considered relevant. Refer to [Figure 7-7](#).

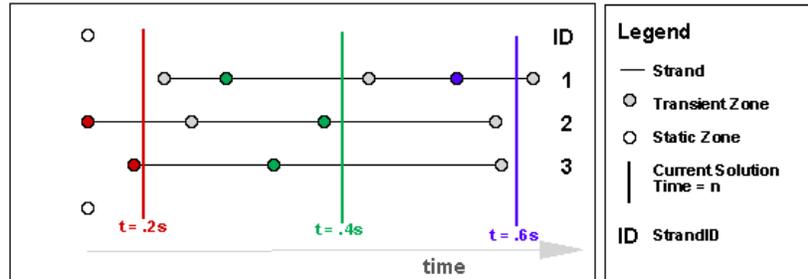


Figure 7-7. An illustration of how relevant zones are determined (based on the data in [Table 7-1](#) using the default transient zone visibility, ZonesAtOrBeforeSolutionTime). For a given solution time, the relevant zones ONLY are displayed in the plot. NOTE: static zones are always considered relevant zones.

$t = .2s$ - The red-colored transient zones and both static zones are plotted. NOTE: no zones from the first strand are represented because the strand is not defined at that time.

$t = .4s$ - The green-colored transient zones and both static zones are plotted.

$t = .6s$ - The blue-colored transient zones and both static zones are plotted. NOTE: no zones from the second and third strands are represented because the strands are not defined at that time.

7 - 3 Data Point and Cell Labels

Field Plots - You can label all or some of the data points or nodes in your field plots with either the index value(s) of the data point or the value of some specified variable at each point. You can also label each cell or element of the data with its index (which for finite element data is its element number).

Line Plots - You can label all or some of the data points or nodes in your line plots with either the index of the data point, the value of the dependent variable at the point, or both the values (**X&Y** or **Theta & R**) for the data point. For example, [Figure 7-8](#) shows an XY Line plot with each data point labeled with its X-Y value pair.

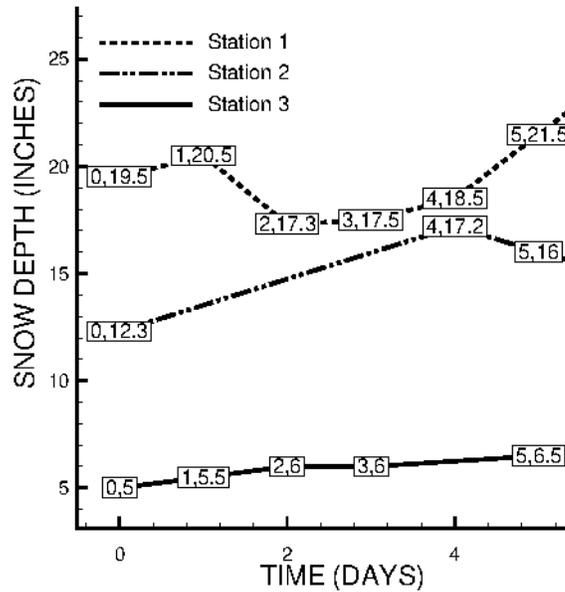
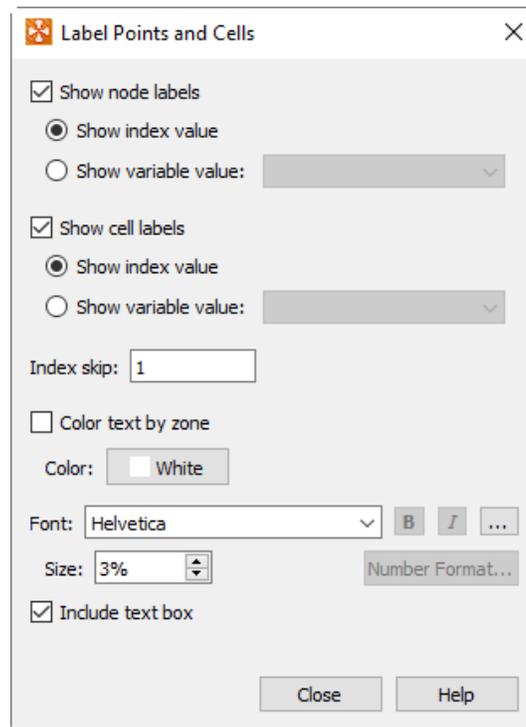


Figure 7-8. An XY-line plot with data labels.

To add data labels to your plot, go to **Plot>Label Points and Cells** dialog (accessed via the **Plot** menu). The **Label Points and Cells** dialog has the following options:



- **Show Node Labels** - Toggle-on to show node labels. Select either Index Value or Variable Value.

- **Show Cell Labels** - Toggle-on to show cell labels. Select either Index Value or Variable Value.
- **Index Skip** - If labeling by index values, select an index skip.
- **Color Text by Zone/Map** - Toggle-on and choose the color, font, font size, and number format for the labels.
- **Include Text box** - Toggle-on "Include Text Box" to include a box around each label.

7 - 4 Three-dimensional Plot Control

You can view any type of data as a 3D plot by selecting 3D Cartesian from the plot type drop-down menu in the Plot sidebar. IJK-ordered data and finite element volume data are displayed in 3D automatically.

Three-dimensional plots can be manipulated with the following controls, which can be accessed via the **Plot** menu:

- [Reset 3D Axes](#) - Reset the 3D axis sizes and the 3D origin of rotation.
- [Three-dimensional Axis Limits](#) - Control the data and axis aspect ratios for 3D plotting.
- [Three-dimensional Orientation Axis](#) - Control the optional 3D orientation axis, which displays the current orientation of the three axes in the workspace.
- **Light Source** - Control the light source position, as well as the intensity of the light, the background light, and the surface color contrast. See [Section 13 - 4 "Three-dimensional Light Source"](#) for more details.
- [Advanced 3D Control](#) - Specify the default lift fraction for 3D lines, symbols, and tangent vectors, as well as the 3D sorting algorithm for the plot.

The following controls can be accessed via the **View** menu.

- [The Rotate Dialog](#) - Control the 3D orientation of the plot.
- [Three-dimensional View Details](#) - Set the specifications for parameters affecting the 3D display of your plot, including the perspective, field of view, angular orientation of the plot, and view distance.

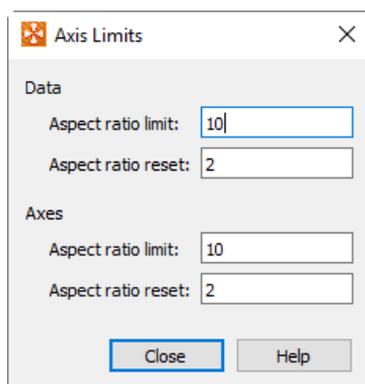
7 - 4.1 Reset 3D Axes

By default, the 3D axes are calculated to fit the data. If you alter your data to expand or contract the overall data size, the axes will not automatically adjust to the new size. Use the Reset 3D Axes option (accessed via the **Plot** menu) to reset the axes to fit the data.



The Reset 3D Axes option also resets the 3D origin. If you have modified your 3D origin using the **3D Rotate** dialog (see [Section 7 - 4.5 "The Rotate Dialog"](#) for details), the **Reset 3D Axes** option will reset it to approximately the centroid of the data.

7 - 4.2 Three-dimensional Axis Limits



In a 3D plot, whenever you read a data file, manipulate the values of variables assigned to the axes, or change variables assigned to the axes, Tecplot Focus examines the data and determines how to plot it. The data may require scaling in one or more axis directions, a change of the axis dependency, an adjustment of the space between the data and the axis box, and/or an adjustment of the shape of the axis box.

Because there are many valid forms in which the data could be plotted, by using the **3D Axis Limits** dialog (accessed via the **Plot** menu), you can input information to help Tecplot Focus determine how to automatically configure the plot the way you want.



Aspect Ratio - Ratio of the range of the variable assigned to one axis (multiplied by the axis size factor) and the range of the variable assigned to another axis (multiplied by the axis size factor).

- **Data Aspect Ratio Limit** - When the data aspect ratio of any two axes exceeds the Data Aspect Ratio Limit, Tecplot Focus automatically rescales the longer axis so that the new data aspect ratio is equal to the Data Aspect Ratio Reset value.

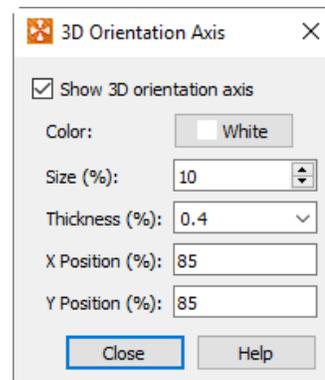
If your plots are usually unscaled (such as plots of real physical objects), you should set the data aspect ratio maximum to a large number like 30. Use a smaller number for evenly scaled axes.

- **Axes Aspect Ratio Limit** - Works similarly to the Data Aspect Ratio Limit, except Axes Aspect Ratio Limit attends to the shape and size of the axes box.

7 - 4.3 Three-dimensional Orientation Axis

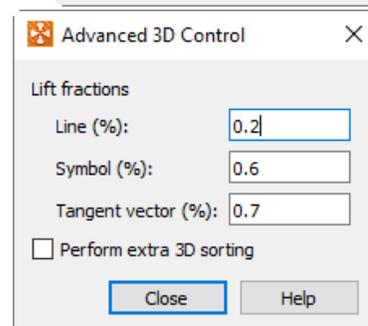
The 3D orientation axis is a representation of your axes that immediately shows you the orientation. By default, all 3D plots show the 3D orientation axis in the upper right of the frame.

Using the **3D Orientation Axis** dialog under the **Plot** menu, you can control whether the 3D orientation axis is shown in your plot, and if so, its color, size, line thickness, and the position of the axis origin. You can also position the 3D orientation axis by simply clicking on it and dragging the axis to the desired location in the frame.



7 - 4.4 Advanced 3D Control

- **Lift Fractions** - The lift fraction is the fraction of the distance from the 3D origin of the object to your eye. If you specify lift fractions for 3D lines, tangent vectors, or scatter symbols, plotted objects of the appropriate type are lifted slightly towards you so that they lie on top of surface elements.
- **Perform Extra 3D Sorting** - For some 3D plots (i.e. plots with translucency), Tecplot Focus uses a painter's algorithm. A quick sorting algorithm is used by default. The data objects are divided into smaller objects. The smallest object is usually a cell, finite element, vector, or scatter symbol. These objects are sorted based upon the distance from viewer, starting with the objects farthest from the viewer and working forward. This does not detect problems such as intersecting objects. If



the "Perform Extra 3D Sorting" check box is selected, a slower, more accurate approach is used to detect problems for you.

There are instances when Tecplot Focus cannot sort correctly. For example, consider elements A, B, and C, where element A overlaps part of element B which overlaps part of element C which overlaps part of element A. Since Tecplot Focus draws only whole elements, one of these elements will be drawn last and each will cover (incorrectly) a portion of another element. If this occurs while printing or exporting, choosing an image format will often resolve the problem



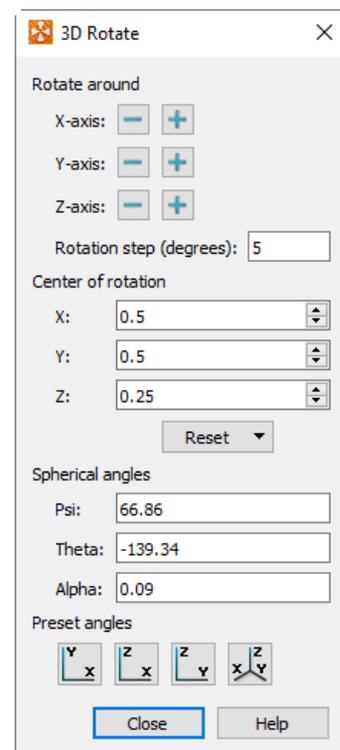
All of the settings in the **Advanced 3D Control** dialog are specific to the current frame.

7 - 4.5 The Rotate Dialog

You may rotate your 3D plots using the **3D Rotate** dialog accessible via **View>Rotate**. The 3D rotation tools located in the toolbar are discussed in ["Three-dimensional Rotation"](#) on page 29.

The **3D Rotate** dialog has the following options:

- **Rotate around**
 - Click the + or - buttons next to an axis to rotate the plot incrementally around that axis.
 - The Rotation Step field specifies the increment by which each click of the + or - button rotates the plot.
- **Center of Rotation**
 - **X** - Rotation of the eye/origin ray about the X-axis. Enter a value in the text field, or use the increase or decrease arrows at the right to specify a value.
 - **Y** - Rotation of the eye/origin ray about the Y-axis. Enter a value in the text field, or use the increase or decrease arrows at the right to specify a value.
 - **Z** - Rotation of the eye/origin ray about the Z-axis. Enter a value in the text field, or use the increase or decrease arrows at the right to specify a value.
 - **Reset** - Use this drop-down to set the center of rotation to be the Center of Data (the center of the bounding box of the data) or Center of View (the point hit by a probe at frame coordinates 50%, 50%).



Center of View can result in an error if there is no data in the center of the frame. In this situation, the center of rotation will not move.

- **Spherical Angles** - Eye origin view. The angular orientation of the plot is defined by three spherical rotation angles:
 - ψ (**Psi**) - Tilt of eye origin ray away from Z-axis. (Range -720 to 720.)
 - θ (**Theta**) - Rotation of the eye origin ray about the Z-axis. (Range -720 to 720.)
 - α (**Alpha**) - Twist about the eye origin ray. (Range -720 to 720.)

The eye origin ray is a line from the origin of the 3D object to your eye. The eye origin ray is perpendicular to the plane of the computer screen. These angles define a unique view. These angles are shown in [Figure 7-9](#)

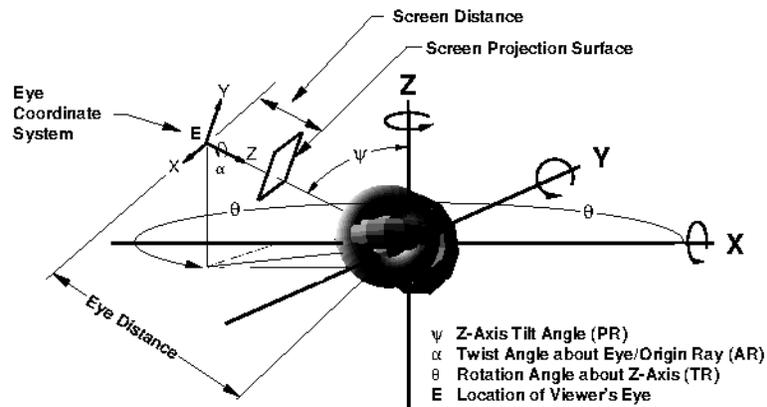


Figure 7-9. 3D angles and 3D projection.

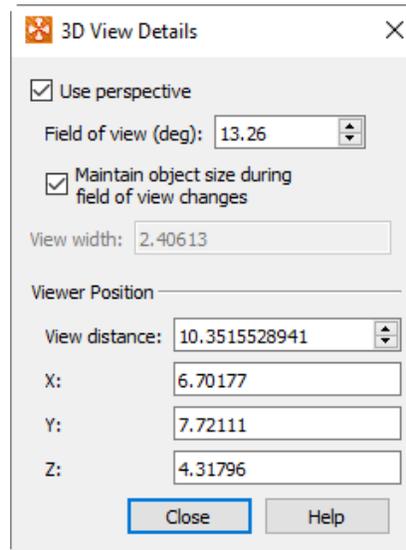
- **Preset Angles** - Specify one of four pre-defined orientations: the XY-Plane, the YZ-Plane, the XZ-Plane; or a default orientation with a Psi=60, Theta=225, and Alpha=0).

Rotate About the Viewer Position

In addition to the rotation capabilities described above, you may also use the [Alt] key and mouse to rotate about the viewer (instead of rotating the object). Although you may use this feature while in orthographic projection, it is best suited for when perspective projection is being used. The [Alt] key and your middle mouse button may be used to simulate fly-through type motion. You may move closer to the object using the [Alt] key and middle mouse button, then turn your head using the [Alt] key and left mouse button.

7 - 4.6 Three-dimensional View Details

Use the **3D View Details** dialog (accessed via the **View** menu) to control a variety of parameters affecting the display of 3D plots.



- **Use Perspective** - Sets Tecplot Focus's projection type. If selected, Tecplot Focus draws the current frame with perspective projection. If not selected, Tecplot Focus draws the current frame with orthographic¹ projection. (Range is 0.1 to 179.9.)
- **Field of View (deg)** - Sets the amount of the plot (in terms of spherical arc) in front of the viewer that may be seen. Zooming in or out of a 3D perspective plot changes this number and the viewer's position.
- **Maintain Object Size During Field of View Changes** - If selected, Field of View changes result in the viewer's position being moved so that approximately the same amount of the plane is visible after the change.
If not selected, Field of View changes do not change the viewer's position and result in the entire plot appearing to grow or shrink.
- **View Width** - Sets the amount of the plot (in X-axis units) in front of the viewer that may be seen. Zooming in or out of a 3D orthographic plot changes this number, but not the viewer's position. Not available when using perspective.
- **Viewer Position** - Change the viewer's relation to the image by resetting the X, Y, or Z-location, or by changing the view distance.

7 - 4.7 Three-Dimensional Zooming and Translating

Just as in all other plots, you may zoom and translate your plot using the mouse. This may be done using either the Zoom or Translate tools. For most tools, you may also use your middle and right mouse buttons (or [Ctrl]+right mouse button) to zoom and translate.

When the plot projection is orthographic, zooming by dragging with the middle mouse button magnifies the plot. When the plot projection is perspective, zooming by dragging with the middle mouse button changes the viewer angle, making the plot appear larger or smaller. If you want to change the viewer's position by

1. With orthographic projection, the shape of the objects is independent of distance. This is sometimes an "unrealistic" view, but it is often used when preserving true dimension is important (such as in drafting).

Field Plots

moving closer to or further away from an object, hold the [Alt] key down while using the middle mouse button or while using the 3D mouse.



Working with very large datasets may result in slow zooming, rotating, and translating. See [Section 28 - 3 "Performance Dialog"](#) for further information on plot approximation if zoom, rotate, or translate performance is poor.

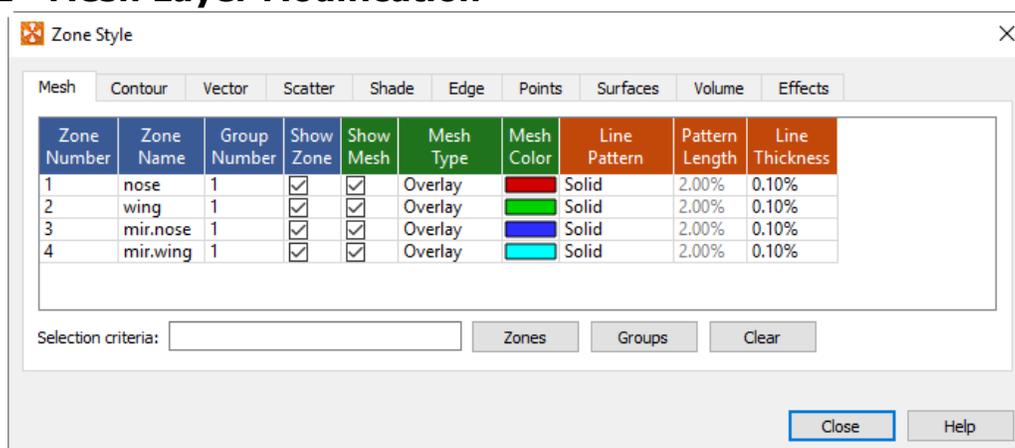
Mesh Layer and Edge Layer

When working with two or three-dimensional field plots, Tecplot Focus allows you to interactively add or subtract any combination of plot layers. These layers can be applied to any set of zones in the active data set. This chapter discusses the [Mesh Layer](#) and the [Edge Layer](#).

8 - 1 Mesh Layer

Toggle-on "Mesh" in the Plot sidebar to add a mesh layer to your plot. The mesh plot layer displays the lines connecting neighboring data points within a zone. For I-ordered data, the mesh is a single line connecting all of the points in order of increasing I-index. For IJ-ordered data, the mesh consists of two families of lines connecting adjacent data points of increasing I-index and increasing J-index. For IJK-ordered data, the mesh consists of three families of lines, one connecting points of increasing I-index, one connecting points of increasing J-index, and one connecting points of increasing K-index. For finite element zones, the mesh is a plot of every edge of all of the elements that are defined by the connectivity list for the node points. See [Chapter 3: "Data Structure"](#) for an in-depth description of ordered (IJK) and finite element data structures.

8 - 1.1 Mesh Layer Modification



Once you have loaded your data, you can modify your mesh plot attributes using the Mesh page of the **Zone Style** dialog (accessed via the Plot sidebar or **Plot>Zone Style**). As discussed in [Section 7 - 1 "Field Plot](#)

[Modification and the Zone Style Dialog](#), the changes made using the first four (blue) columns apply to the entire plot, while changes in the other columns apply to the active plot layer.



In order for the changes made on the Mesh page to be visible in your plot, the Mesh layer must be turned on. You can turn on the Mesh layer using the checkbox in the Plot sidebar.

- **Show Mesh** - Checkbox that determines whether the mesh is visible for each active zone.
- **Mesh Type** - Right-click to choose wire frame, overlay, or hidden line. See [Section 8 - 1.2 "Mesh Types"](#) below.
- **Mesh Color** - Right-click to choose the mesh color using the Color Chooser.
- **Line Pattern** - Right-click to choose the line pattern for the mesh.
- **Pattern Length** - Right-click to choose the pattern length in percentage of frame height. You may choose a preset pattern length or enter your own.
- **Line Thickness** - Right-click to choose the mesh line thickness. You may choose a predefined setting or enter your own.



For information on using the controls at the bottom of the Zone Style dialog to select zones by name, see the description of these at the end of ["Field Plot Modification and the Zone Style Dialog"](#) on page 132.

8 - 1.2 Mesh Types

Tecplot Focus has three distinct mesh types:

- **Wire Frame** - Wire frame meshes are drawn below any other zone layers on the same zone. In 3D Cartesian plots, no hidden lines are removed. For 3D volume zones (finite element volume or IJK-ordered), the full 3D mesh (consisting of all the connecting lines between data points) is not generally drawn because the sheer number of lines would make it confusing. The mesh drawn will depend upon your choice of "Surfaces to Plot" on the Surfaces page of the **Zone Style** dialog. See [Section 7 - 1.2 "Surfaces"](#) for further details. By default, only the mesh on exposed cell faces is shown.
- **Overlay** - Similar to Wire Frame, mesh lines are drawn over all other zone layers except for vectors and scatter symbols. In 3D Cartesian plots, the area behind the cells of the plot is still visible (unless another plot type such as contour flooding prevents this). As with Wire Frame, the visibility of the mesh is dependent upon your choice of "Surfaces to Plot" on the Surfaces page of the **Zone Style** dialog. See [Section 7 - 1.2 "Surfaces"](#) for further details.
- **Hidden Line** - Similar to Overlay, except hidden lines are removed from behind the mesh. In effect, the cells (elements) of the mesh are opaque. Surfaces and lines that are hidden behind another surface are removed from the plot. For 3D volume zones, using this plot type obscures everything inside the zone. If you choose this option for 3D volume zones, then choosing to plot every surface (using the Surfaces page of the **Zone Style** dialog) has the same effect as plotting only exposed cell faces, but is much slower.



The opaque surfaces created by Hidden Line are not affected by the Lighting Zone effect (there is no light source shading). However, it is affected by translucency.

[Figure 8-1](#) shows the available mesh plot types, along with the effects of choosing Overlay and Wire Frame in combination with contour flooding.

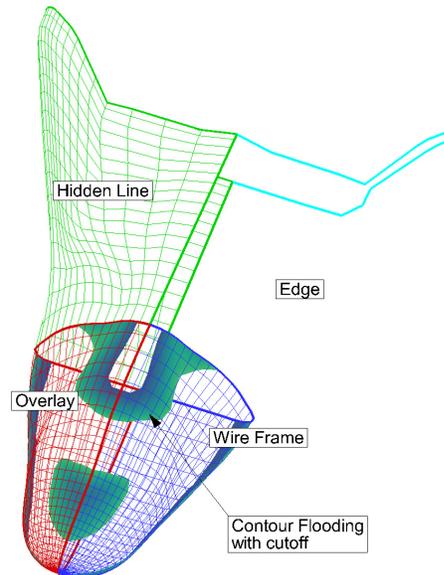


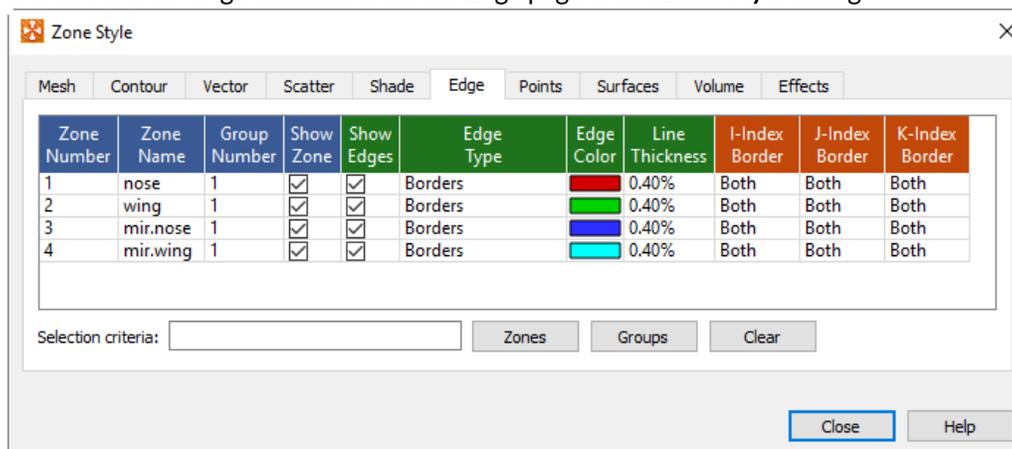
Figure 8-1. Mesh plot types.

8 - 2 Edge Layer

An edge plot layer displays the connections of the outer lines (IJ-ordered zones), finite element surface zones, or planes (IJK-ordered zones). The Edge layer allows you to display the edges (creases and borders) of your data. Zone edges exist only for ordered zones or 2D finite element zones. Three-dimensional finite element zones do not have boundaries.

8 - 2.1 Edge Layer Modification

You can control the following attributes from the Edge page of the **Zone Style** dialog:



In order for the changes made on the Edge page to be visible in your plot, the Edge layer must be turned on. You can turn on the Edge layer using the checkbox in the Plot sidebar.

- **Show Edges** - Checkbox that determines whether the edges are visible for each active zone.
- **Edge Type** - Right-click to choose borders and/or creases. See [Section 8 - 2.2 "Edge Type"](#) below.
- **Edge Color** - Right-click to choose the edge color using the Color Chooser.
- **Line Thickness** - Right-click to choose the edge line thickness. You may choose a predefined setting or enter your own.
- **Index Borders** - Right-click to choose whether to show the corresponding index border: None, Min Only, Max Only, or Both (Min and Max).



For information on using the controls at the bottom of the Zone Style dialog to select zones by name, see the description of these at the end of ["Field Plot Modification and the Zone Style Dialog"](#) on page 132.

8 - 2.2 Edge Type

There are two types of edges in Tecplot Focus: creases and borders. An edge border is the boundary of a zone. An edge crease appears when the inside angle between two cells is less than a user-defined limit. The inside angle can range from 0-180 degrees (where 180 degrees indicates coplanar surfaces). The default inside angle for determining an edge crease is 135 degrees. You can change the crease angle by going to **Plot>Edge Details**.



For 2D plots, only edge borders are available, and for FE-volume zones, only edge creases are available.

You can change the Edge Type using the Edge Type column on the Edge page of the **Zone Style** dialog.

8 - 2.3 Edge Display

For IJ-ordered zones, the available edges are the lines $I=1$, $I=IMax$, $J=1$, and $J=JMax$.

When the Surfaces to Plot option is set to "Boundary Cell Faces", "Exposed Cell Faces", or "Every Surface" for IJK-ordered zones, the edges of the surface areas form a "box" that contains the data. Surfaces to Plot can be set on the Surfaces page of the **Zone Style** dialog.

When the Surfaces to Plot option on the Surfaces page of the **Zone Style** dialog is set to one of the planes options, such as I, J, or K-planes, for IJK-ordered zones the edges are the edges of each plane (I, J, or K-plane). By default, all available edges are drawn when the Edge layer is active. You can specify which of the available edges are plotted using the **Zone Style** dialog.

Contour Layer

Contour plots can be used to show the variation of one variable across the data field. To add a contour layer to your plot, toggle-on "Contour" in the Plot sidebar.

 Contour plots can only be plotted with organized data, such as IJ-ordered, IJK-ordered, or FE-data. Refer to [Section 3 - 6 "Working with Unorganized Datasets"](#) for information on organizing your dataset.

Additional options can be set on the [Contour & Multi-Coloring Details](#) (accessed via  to the right of Contour in the Plot sidebar or **Plot>Contour/Multi-Coloring**) and the Contour page of the **Zone Style** dialog.

An example of each contour plot type is shown in [Figure 9-1](#).

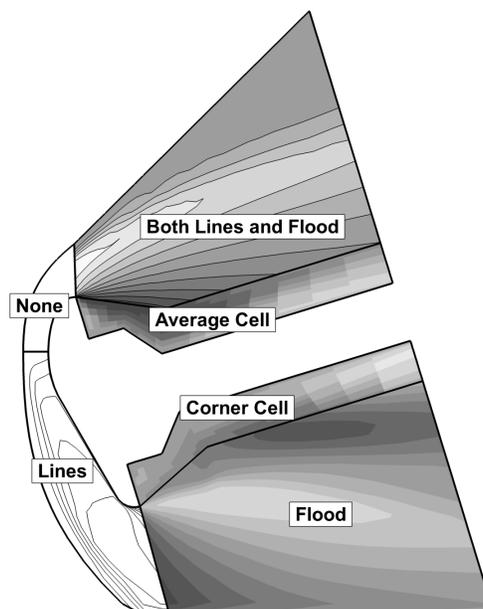


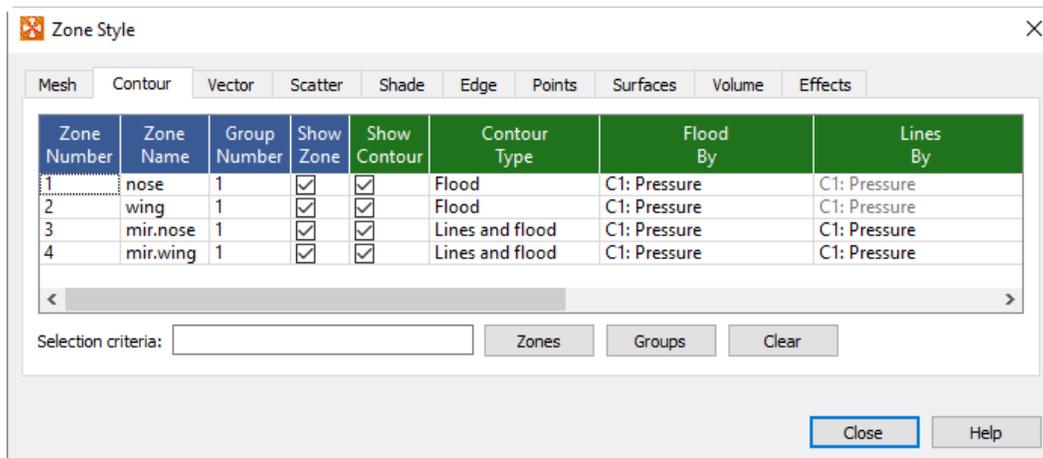
Figure 9-1. Contour plot types.



Contour plots for streamtraces, iso-surfaces, and slices are controlled by their respective details dialogs and are not discussed here. (Refer to [Section 15 - 1.3 "Rod/Ribbon Page"](#), [Section 16 - 3 "Iso-Surface Contour and Shade"](#) and [Section 14 - 1.3 "Contour Page"](#), respectively.)

9 - 1 Contour Layer Modification

You can modify the following attributes of your contour plot using the Contour page of the **Zone Style** dialog



In order for the changes made on the Contour page to be visible in your plot, the Contour layer must be active. You can turn on the Contour layer in the Plot sidebar.

- **Show Contour** - Toggle-on to show the contour for the selected zone(s).
- **Contour Type** - Right-click to choose the contour plot type:
 - **Lines** - Draws lines of constant value of the specified contour variable.
 - **Flood** - Floods regions between contour lines with colors from a color map.

The distribution of colors used for contour flooding may be banded or continuous. When banded distribution is used for flooding, a solid color is used between contour levels. If continuous color distribution is used, the flood color will vary linearly in all directions. See ["Contour Coloring"](#) on page 156 for details.
 - **Both Lines and Flood** - Combines the above two options.
 - **Average Cell Flood** - Floods cells or finite elements with colors from a color map according to the average value of the contour variable over the data points bounding the cell. If the variables are located at the nodes, the values at the nodes are averaged. If the variables are cell-centered, the cell-centered values are averaged to the nodes and the nodes are then averaged.

Go to **Data>Data Set Info** to determine whether the variables are nodal or cell-centered.
 - **Primary Value Flood** - Floods cells or finite elements with colors from a color map according to the primary value of the contour variable for each cell. If the variable is cell centered, the primary value is the value assigned to the cell. If the variable is node located, the primary value comes from the lowest index node in the cell.

If the variables are located at the nodes, the value of the lowest indexed node in the cell is used. When plotting IJK-ordered, FE-brick or FE-tetra cells, each face is considered independently of the other faces. You may get different colors on the different faces of the same cell.

If the variables are cell-centered, the cell-centered value is used directly. When plotting I, J, or K-planes in 3D, the cell on the positive side of the plane supplies the value, except in the case of the last plane, where the cell on the negative side supplies the value.

Go to **Data > Data Set Info** to determine whether the variables are nodal or cell-centered.

- **Flood By** - Right-click to select either a contour group (C1, C2, C3, C4, C5, C6, C7, or C8) or assign variables to the RGB color map. For contour groups, the associated variable is shown in this column and the menu next to the group number. See [Section 9 - 2.1 "Contour Groups"](#) and [Section 5 - 5.1 "RGB Coloring"](#) for more information. Applicable only when the contour type includes a flood.
- **Lines By** - Right-click to select which contour group identifies the contour lines (the variable associated with each contour group is also shown). Applicable only when the contour type includes lines.
- **Line Color** - Right-click to choose the contour line color using the [Color Chooser](#).
- **Line Pattern** - Right-click to choose the line pattern for the mesh.
- **Pattern Length** - Right-click to choose the line pattern length as a percentage of frame height. You may choose a preset pattern length or enter your own.
- **Line Thickness** - Right-click to choose the contour line thickness. You may choose a predefined setting or enter your own. Line Color
- **Use Lighting** (3D only) - Turn on or off the lighting effects. See [Chapter 13: "Translucency and Lighting"](#) for more information on lighting effects.

Options such as contour labels, contour legends, and special settings for contour bands or contour lines are set by the selected contour group (see [Section 9 - 2.1 "Contour Groups"](#)).



For information on using the controls at the bottom of the Zone Style dialog to select zones by name, see the description of these at the end of ["Field Plot Modification and the Zone Style Dialog"](#) on page 132.

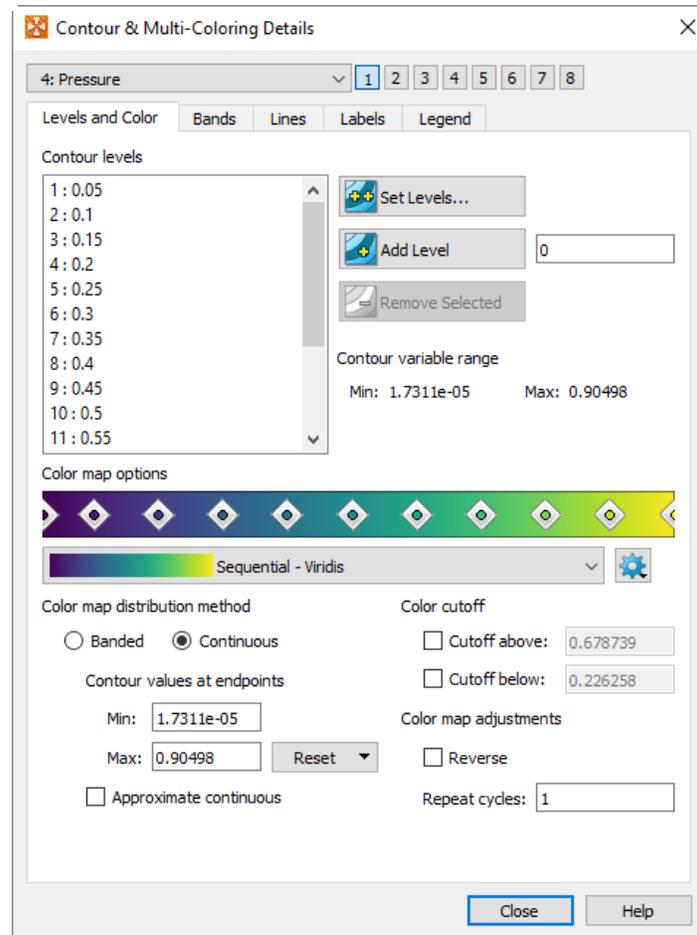
9 - 2 Contour & Multi-Coloring Details

Opening the **Contour & Multi-Coloring Details** dialog from **Plot > Contour/Multi-Coloring** or from the Plot sidebar lets you specify:

- [Contour Groups](#)
- [Contour Levels and Color](#)
- [Contour Bands](#)
- [Contour Lines](#)
- [Contour Labels](#)
- [Contour Legend](#)
-

9 - 2.1 Contour Groups

The **Contour & Multi-Coloring Details** dialog is shown below. This dialog is divided into five pages. The controls at the top for choosing a contour group and variable are available regardless of what page of the dialog is displayed.



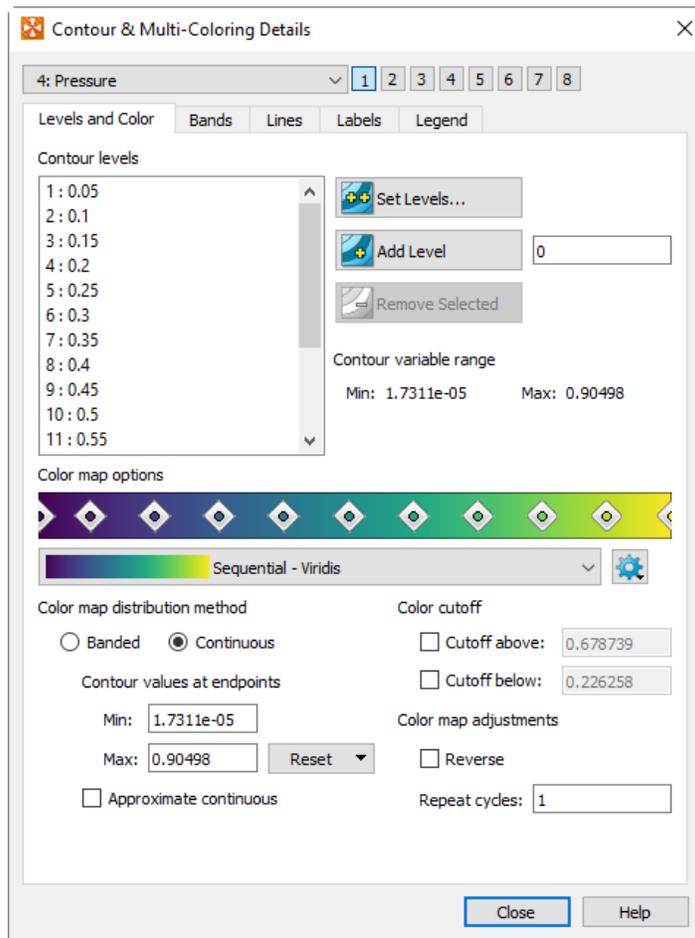
- **Variable** - Assign a variable from your dataset to the active Contour Group (1, 2, 3, 4, 5, 6, 7, or 8). The variable selected here will be contoured subject to the controls in the dialog.
- **1, 2, 3, 4, 5, 6, 7, 8** - Use the [1], [2], [3], [4], [5], [6], [7], and [8] buttons to specify attributes for a specific contour group. Each contour group has its own settings for the contour attributes established in the dialog.

The Contour Group Variables (1-8) can be used to color contour, mesh, scatter, or vector zone layers, as specified in the [Color Chooser](#) dialog and the Flood By and Lines By columns on the Contour page of the **Zone Style** dialog.

9 - 2.2 Contour Levels and Color

A contour level is a value at which contour lines are drawn, or for banded contour flooding, the border between different colors of flooding. Adjust contour levels using the Levels and Color page of the **Contour & Multi-Coloring Details** dialog (accessed via the Plot sidebar or the **Plot** menu, or from the [Contour Page](#) of the Slice Details dialog).

From the Levels and Color page of the dialog, you can add, subtract, and rearrange contour levels using the top part of the dialog. The bottom part of the dialog allows you to choose or modify the color map to be used for coloring the contour variable.



The minimum and maximum value of the contour value is also displayed here.

Contour Level Addition

You can add new levels in one of three ways:

- Enter a value in the text field in the Levels and Color page of the **Contour & Multi-Coloring Details** dialog and click **Add Level** to propagate it to the Levels list on the left.
- Add a new range of contour levels to the existing set by clicking **Set Levels**, then using the **Enter Contour Levels** dialog as described in [“New Contour Level Specification”](#) on page 156.
- Choose  from the Toolbar, then click at any location in the contour plot where you would like to add a new contour level. Tecplot Focus adds a new contour level that goes through the specified point. By holding down the mouse button you can drag and interactively position the new contour level until you release the button.

Contour Level Removal

You can remove contour levels by:

- Selecting one or more contour levels on the Levels and Color page of the **Contour & Multi-Coloring Details** dialog, then clicking **Remove Selected Levels**.

- Selecting  from the Toolbar, then clicking any contour line in your contour plot. Tecplot Focus deletes the specified contour level, or the nearest contour level to the specified point.

Contour Level Adjustment

You can interactively adjust a contour level with the  tool from the Toolbar. Hold down the Control key, then click-and-drag the contour level you want to adjust. Move the contour to the desired location and release the mouse button. The new value of the contour level can be viewed on the Levels and Color page of the **Contour Details** dialog.

New Contour Level Specification

You may specify a new set of contour levels by clicking the **Set Levels** button on the Levels and Color page of the **Contour Details** dialog. This button calls up the **Enter Contour Levels** dialog.

You can create contour levels in two ways:

- **Exact levels** - Specify the levels exactly using one of three methods.
 - **Min, Max, and Number of Levels** (default) - Enter a minimum and maximum level value, together with the number of levels to be distributed equally throughout the range.
The Reset Range drop-down menu, available with this method, allows you to reset the Min and Max values to the contour variable's minimum and maximum, optionally excluding the effects of blanking.
 - **Min, Max, and Delta** - Enter a minimum and maximum level value together with a delta (step-size between levels).
 - **Exponential Distribution** - Enter a minimum and maximum level value together with the number of levels to be distributed exponentially throughout the range.
- **Approximate levels** - Enter the number of contour levels you want and let Tecplot Focus choose their values. The values chosen will be "nice" levels based on the values of the current contour variable.

Contour Coloring

You can choose a built-in color map, edit an existing color map, or create a new color map in the Levels and Contour page.

The built-in color maps cannot be changed. When you begin to modify a built-in color map by moving, adding, or removing control points, the built-in color map is automatically and immediately copied to a custom color map. The copy is given a name ending with the word "modified" and a number, and it is this copy to which further changes apply. Custom color maps can be edited, renamed, or deleted using the gear icon next to the color map menu.

You can create a new color map, then, by first choosing a built-in color map that is close to the color map you want to create (if none is particularly close, any will do) and beginning to modify it. You can then give it a proper name by clicking the gear icon and choosing Rename Custom Color Map.

Custom color maps are automatically saved with layouts. You can also use them in other plots by using the export and import functions on the gear menu.

- **Color Map Control Points** - You can control how colors are distributed across the color map here.



- *Adjust a control point* - Drag the diamond-shaped control points horizontally to control the intervals between them. The color gradations in the color map will be stretched or compressed as necessary as you move the control points.
 - *Create a new control point* - Right-click a part of the color map where there is not yet a control point, then choose Add Control Point to create a control point there. The control point's left and right colors will initially be set to the colors in effect at the clicked location.
 - *Change the control point colors* - Right-click a control point to change its left (primary) or right (secondary) color by choosing Set Control Point Color, then choosing the color to be set from the submenu. The [Color Chooser](#) appears to let you choose the color to be used. The colormap will consist of a gradient of color between one control point's right color and the next control point's left color. (The first and last control points have only right and left colors, respectively.)
 - *Delete a control point* - Right-click a control point and choose Remove Control Point to delete it.
- **Color Map** - Select the color map to use for contour coloring. The default is "Sequential - Viridis", a perceptually linear color map from blue to yellow.

Click the gear menu to the right of the Color Map menu to rename or delete a color map, or to import or export custom color maps.

- **Exporting Custom Color Maps** - Saves all custom color maps as a .map file. These can be imported to other projects to maintain consistency.
- **Import Color Maps** - Opens a browser window to import a .map file.

Custom color maps may also be created by using the \$!CREATECOLORMAP command in a macro, configuration, layout, map, or stylesheet file.



When exporting, all the color maps that aren't one of Tecplot's original set of 45 build-in, immutable, color maps are saved into one .map file.

A short example for loading custom color maps is shown below. Custom color maps may also be loaded via the \$!INCLUDEMACRO command. The \$!GLOBALCONTOUR command in the script below assigns a color map to one of the eight contour layers. For more information see the [Scripting Guide](#).

```
$!INCLUDEMACRO "|MACROFILEPATH|/Macaw.map"
$!GLOBALCONTOUR 1 COLORMAPNAME = 'Sequential - Macaw'
$!GLOBALCONTOUR 2 COLORMAPNAME = 'Sequential - Macaw'
$!GLOBALCONTOUR 3 COLORMAPNAME = 'Sequential - Macaw'
$!GLOBALCONTOUR 4 COLORMAPNAME = 'Sequential - Macaw'
$!GLOBALCONTOUR 5 COLORMAPNAME = 'Sequential - Macaw'
$!GLOBALCONTOUR 6 COLORMAPNAME = 'Sequential - Macaw'
$!GLOBALCONTOUR 7 COLORMAPNAME = 'Sequential - Macaw'
$!GLOBALCONTOUR 8 COLORMAPNAME = 'Sequential - Macaw'
```



For Tecplot Focus 2017 R3 and later, the \$!CREATECOLORMAP macro command is allowed in the configuration file. This allows users to define their own color maps and select the default for each contour group. See the [Scripting Guide](#) for more information.

• **Color Distribution Methods**

- **Banded** - A solid color is assigned for all values within the band between two levels. (See [Section 9 - 2.3 "Contour Bands"](#).)
- **Continuous** - The color distribution assigns linearly varying colors to all multi-colored objects or contour flooded regions. You can vary the default assignment of colors by entering a "Min" or "Max" value for Color Map Endpoints. You may reset the endpoints to the contour variable's min/max (considering the effects of blanking), the contour variable's min/max excluding the effects of blanking, or to the contour level's min/max using the **Reset** menu to the right of these fields.
- **Approximate Continuous** - Causes each cell to be flooded using interpolation between the RGB values at each node. When the transition from a color at one node to another node crosses over the boundary between control points in the color spectrum, approximate flooding may produce colors not in the spectrum. Leaving this option unchecked is slower, but more accurate.
- **Color Cutoff** - Lets you specify a range within which contour flooding and multi-colored objects (such as scatter symbols) are displayed.
- **Color Map Adjustments** - The following optional adjustments are applied to the color map generated by the above settings.
 - **Reversed Color Map** - You can reverse the color map by toggling on "Reverse". Two plots, one with the color map going in the default direction and one with the color map reversed, are shown in [Figure 9-2](#).

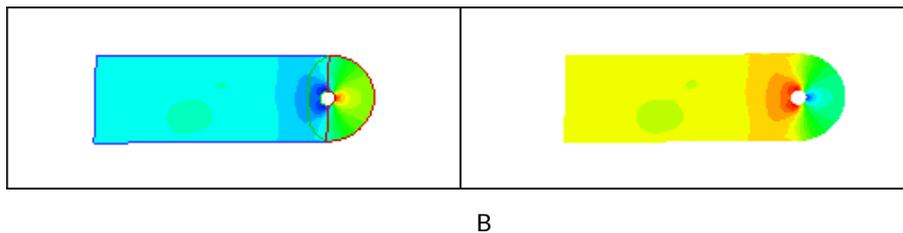


Figure 9-2. A) Flooded contour plot with default settings. B) Flooded contour plot with a reversed colormap.

- **Repeat Cycles** - You may choose to cycle the color map. This is useful if you have data where there is a great deal of activity in multiple ranges of the contour variable, and you want to cycle through all colors in each region. A plot with the color map cycled twice is shown in [Figure 9-3](#).

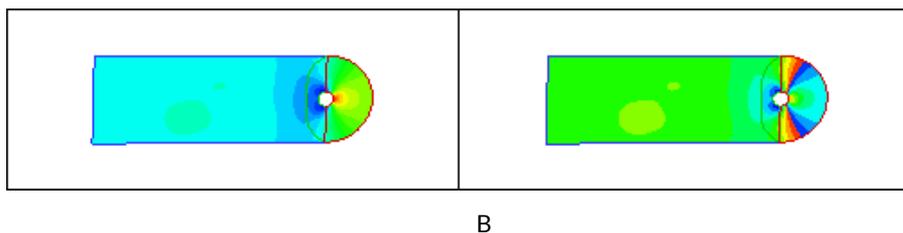
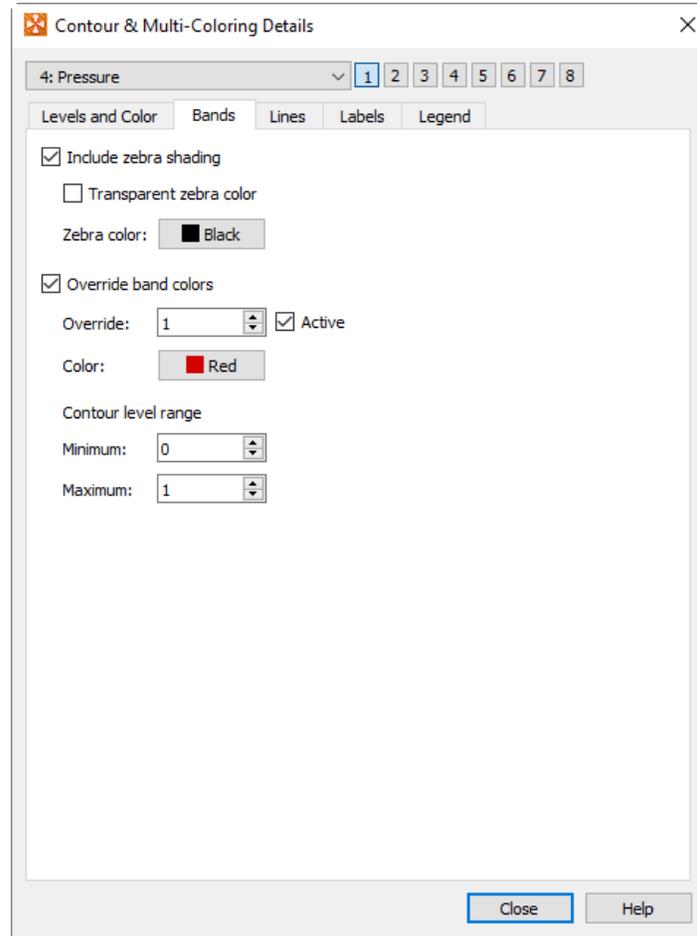


Figure 9-3. A) Flooded contour plot with default settings. B) Flooded contour plot with the color map cycled two times.

9 - 2.3 Contour Bands

When Coloring Distribution for a group is set to "Banded" (via the Levels and Color page of the **Contour & Multi-Coloring Details** dialog), you may customize the color bands on the Bands page of the dialog.

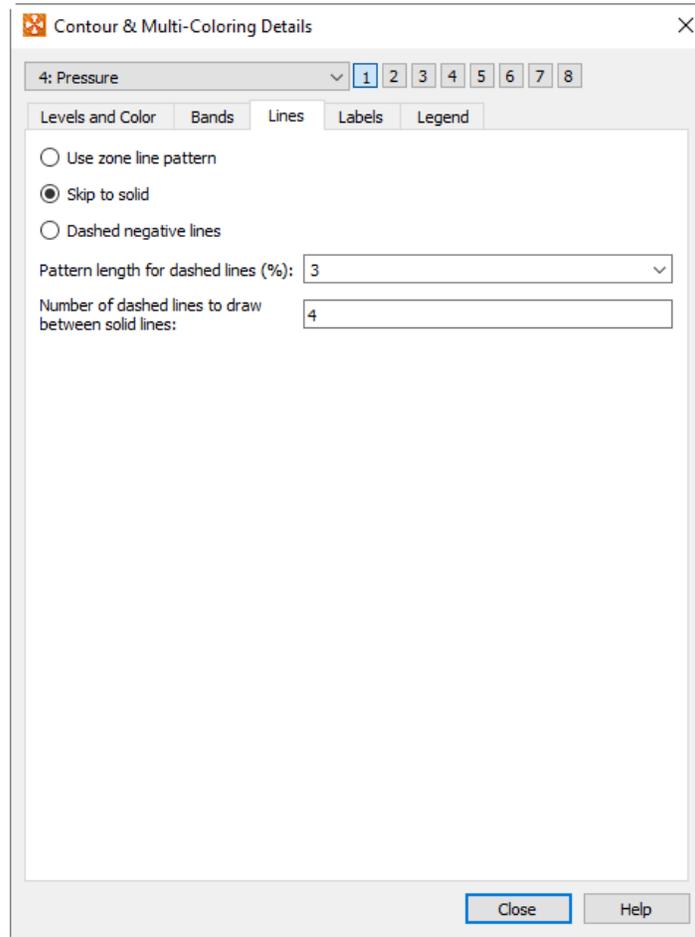


The Bands page of the **Contour Details** dialog has the following options:

- **Include Zebra Shading** - This effect colors every other band with a specific color (or no color at all).
- **Override Band Colors** - Specific contour bands can be assigned a unique basic color. This is useful for forcing a particular region to use blue, for example, to designate an area of water. You can define up to 16 color overrides.
 - *Override* - Specifies which override is being edited.
 - *Active* - Toggle this checkbox to turn the override on or off.
 - *Color* - Select the color for the override using the [Color Chooser](#).
 - *Minimum, Maximum* - Choose the range which will be overridden to the specified color.

9 - 2.4 Contour Lines

The contour line settings determine how contour lines are drawn for all zones in the active frame's dataset. The settings are established on the Lines page of the **Contour & Multi-Coloring Details** dialog.



- **Use Zone Line Pattern** - For each zone, draw the contour lines using the line pattern and pattern length specified in the Contour page of the **Zone Style** dialog.
- **Skip to Solid** - Draw n dashed lines between each pair of solid lines, where n is an integer you enter in the text field Number of Dashed Lines to Draw between Solid Lines.
- **Dashed Negative Lines** - Draw lines of positive contour variable value as solid lines and lines of negative contour variable value as dashed lines.

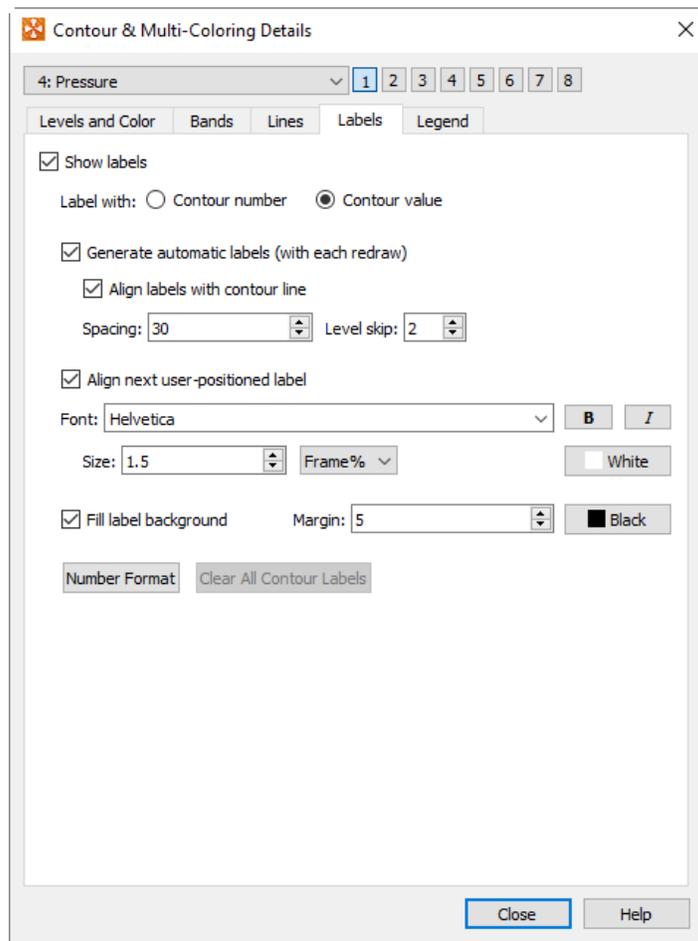
9 - 2.5 Contour Labels

Contour labels are labels that identify particular contour levels either by number or by value. You can place contour labels interactively, or have Tecplot Focus create them for you automatically. You can also have Tecplot Focus create and save a set of contour labels automatically, then interactively add contour labels to this saved set.



The contour plot type must be lines or lines and flood in order to use Contour labels.

Contour labels may be configured in the Labels page of the **Contour & Multi-Coloring Details** dialog or with the Add Contour Label mouse mode tool from the Toolbar. You can modify the following options using the Labels page of the **Contour Details** dialog.

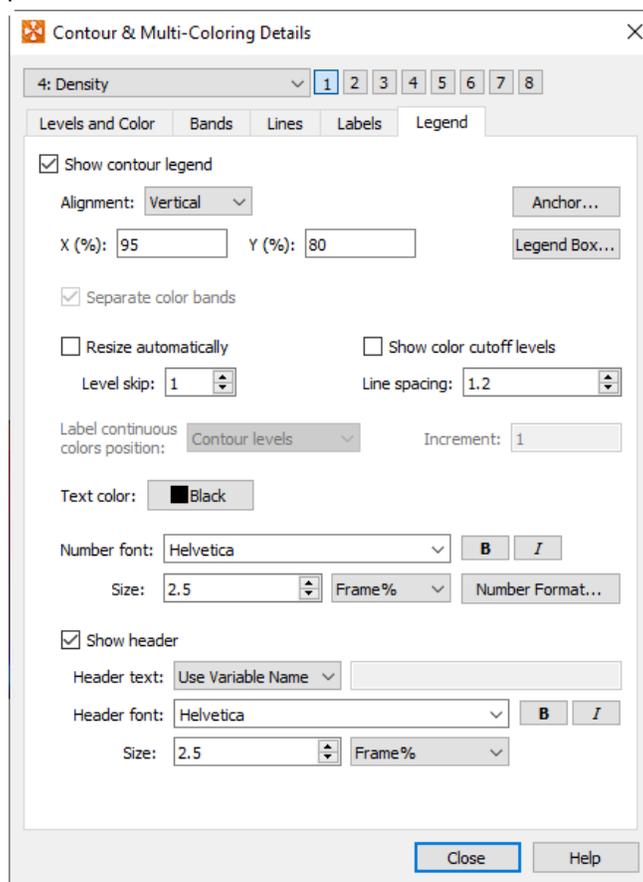


- **Show Labels** - Toggle-on "Show Labels" to include contour labels in your plot. You can then label the contour levels by selecting either:
 - **Use Contour Number**
 - **Use Contour Value**
- **Label Format** - Use the midsection of the dialog to customize label color, font, and fill settings. (See [Section 18 - 1.2 "Font Folders and Fallback"](#) for more information on how fonts work with Tecplot Focus.)
- **Generate Automatic Labels (with each Redraw)** - At each Redraw, Tecplot Focus creates a new set of contour labels. At any time, you can deselect the "Generate Automatic Labels" (with each Redraw) check box, and Tecplot Focus retains the last set of labels generated.
- **Align Labels with Contour Line** - Use the Spacing field to specify the spacing of the contour labels along the contour line, as a percentage of the frame. Use the Level Skip field to specify a skip value between the contour levels to be labeled.
- **Align Next User-Positioned Label** - If the "Align Next User-Positioned Label" is selected, the next label is aligned with the contour line. Otherwise, the label is written with normal, upright text.
- **Number Format** - Use the [Number Format] button to specify the number formatting of the Contour labels. See [Section 6 - 7.1 "Specify Number Format"](#) for more details.

- **Clear All Contour Labels** - When "Generate Automatic Labels" is deselected, you can click this button to erase the current set of contour labels.

9 - 2.6 Contour Legend

To include a contour legend, select the Legend page of the **Contour & Multi-Coloring Details** dialog for the appropriate contour group.



The following options are available:

- **Show Contour Legend** - Select this option to show the contour legend on your plot.
- **Alignment** - Select Vertical or Horizontal.
- **Anchor** - Specify which part of the legend is anchored in the selected position using the [Anchor Alignment](#) dialog.
- **Position** - X (%) and Y (%) as percentages of the frame width and height. (You can also move the legend interactively.)
- **Legend Box** - Displays the [Legend Box](#) dialog to adjust the appearance of the box around the legend, or turn it off entirely.
- **Separate Color Bands** - Select this check box to separate the color bands in the legend with black lines. Use this option to visually separate similar colors. If this box is not selected, similar adjacent colors may tend to blur together.
- **Resize Automatically** - Automatically skips some levels to create a reasonably sized legend.
- **Include Color Cutoff Levels** - Color bands and labels for levels affected by Color Cutoff are shown in the legend.

- **Label Continuous Colors Position** - If you have selected "Continuous Color Distribution" on the Levels and Color page of the **Contour Details** dialog, you have three options for placement of labels on the legend:
 - **Contour Levels** - This option places one label for each contour level. See [Section 9 - 2.2 "Contour Levels and Color"](#).
 - **Specified Increment** - Enter a value in the Increment text field.
 - **Color Map Divisions** - Places one label for each control point on the color map.
- **Level Skip** - Enter the number of levels between numbers on the legend. This also affects the number of levels between contour labels on the plot. Skipping levels on the contour legend compresses the color bar (if one appears); it does not change the spacing between text entries on the legend.
- **Line Spacing** - Enter the spacing between contour legend numbers. This does not change the number of entries in the legend, so a large value here creates a large legend. Use Level Skip to reduce the number of entries in the legend.
- **Text Color** - Affects the color of all text in the legend.
- **Number Format** - Adjust the format of numbers in the legend. See [Section 6 - 7.1 "Specify Number Format"](#) for more details on numeric formatting
- **Number font** - Choose the font used for numbers in the legend, including size and variety (boldface or italic). See [Section 18 - 1.2 "Font Folders and Fallback"](#) for more information on how fonts work with Tecplot Focus.
- **Show Header** - Toggle-on to display the contour legend header text.
 - **Header Text** - Allows selection of content displayed in the legend header.
 - **Use Variable Name** - The legend header will display the variable name assigned to the contour group.
 - **Use Text** - The legend header will display text entered into the text field next to the options widget. The text can contain dynamic text (See [Section 18 - 1.5 "Dynamic Text"](#) for information on dynamic text) and formatted using tags (See [Section 18 - 1.1 "Text Details"](#) for information text formatting tags).
 - **Use LaTeX** - The legend header will display a processed LaTeX expression. See [Section 18 - 1.6 "LaTeX Expressions"](#) for information on LaTeX formatting.
 - **Header Format** - Adjust the font and height for the legend header or the legend labels, including font size and variety (boldface or italic). (See [Section 18 - 1.2 "Font Folders and Fallback"](#) for more information on how fonts work with Tecplot Focus.)

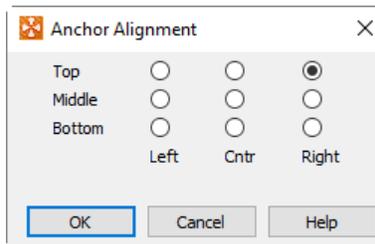


Not all fonts have Bold and/or Italic variants. For fonts that do not have these styles, the **B** and/or *I* buttons may have no effect.

Anchor Alignment

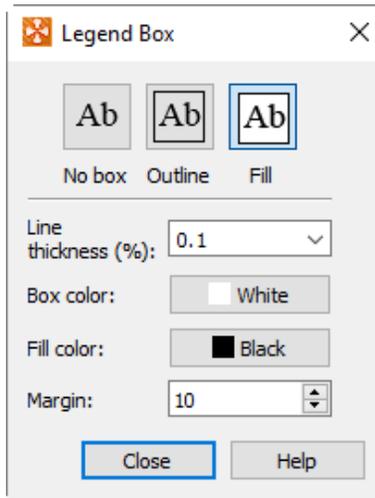
The **Anchor Alignment** dialog allows you to specify the anchor point, or fixed point, of the object. As the box grows or shrinks, the anchor location is fixed while the rest of the box adjusts to accommodate the new size.

There are nine possible anchor points, corresponding to the left, right, and center positions on the headline, midline, and baseline of the box.



Legend Box

The Legend Box dialog appears when you click the Legend Box button in the Legend page of the Contour Details dialog.

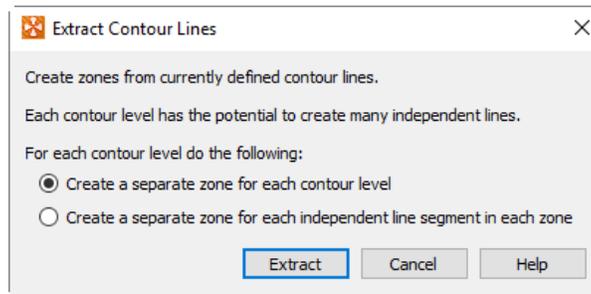


- **Box Type** - Choose (left to right) No Box, Outline, or Fill. If you choose Outline or Fill, the following options control the appearance of the box.
- **Line Thickness** - Specify the line thickness as a percentage of frame height.
- **Box Color** - Choose a color for the legend box outline.
- **Fill Color** - Choose a color for the legend box fill (Fill mode only).
- **Margin** - Specify the margin between the legend text and legend box as a percentage of the text height.

9 - 3 Extract Contour Lines

Normally, contour lines are derived from the dataset "on the fly" and do not add any data to the dataset. To extract existing contour lines to Tecplot zones, allowing you to retain them even if the contour details are

changed, go to **Data>Extract>Contour Lines**. Your data will be altered by the creation and naming of new zones.



Using the **Extract Contour Lines** dialog, you have the following options:

- **Create a separate zone for each contour level** - A new zone will be created for each contour line plotted. The number of new zones will equal the number of contour levels. The created zones are FE-line segment type zones.
- **Create a separate zone for each independent line segment in each zone** - With this option you may create many more zones than there are contour levels. New I-ordered line segment zones are created in each source zone for each topologically independent contour line.

After generating the zones, we recommend you activate the [Mesh Layer](#) when plotting the new zones.

Vector Layer

You can create vector plots by activating the Vector layer in the Plot sidebar, and specifying the vector component variables. Vector plot attributes can be modified using the Vector page of the **Zone Style** dialog.

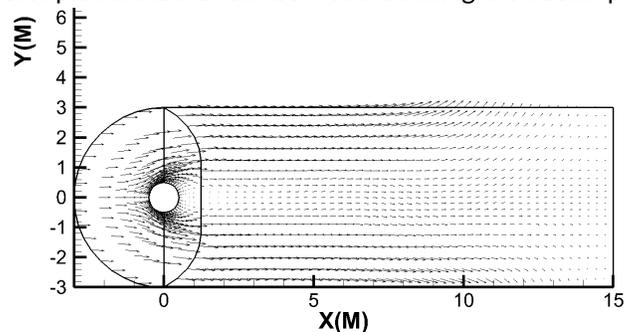


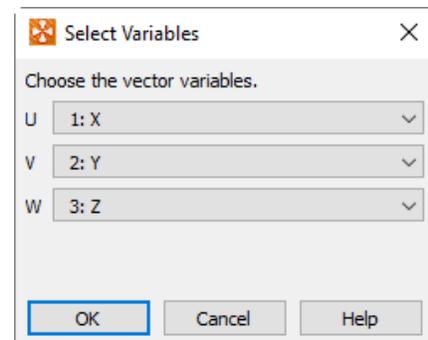
Figure 10-1. A vector plot of the cylinder data (with the edge layer also active).

10 - 1 Vector Variables

When you activate the Vector zone layer (via the Plot sidebar), Tecplot Focus checks to see whether vector components have been assigned for the current dataset in the current plot type. If you have not assigned vector components, the **Select Variables** dialog, shown here, will be launched.

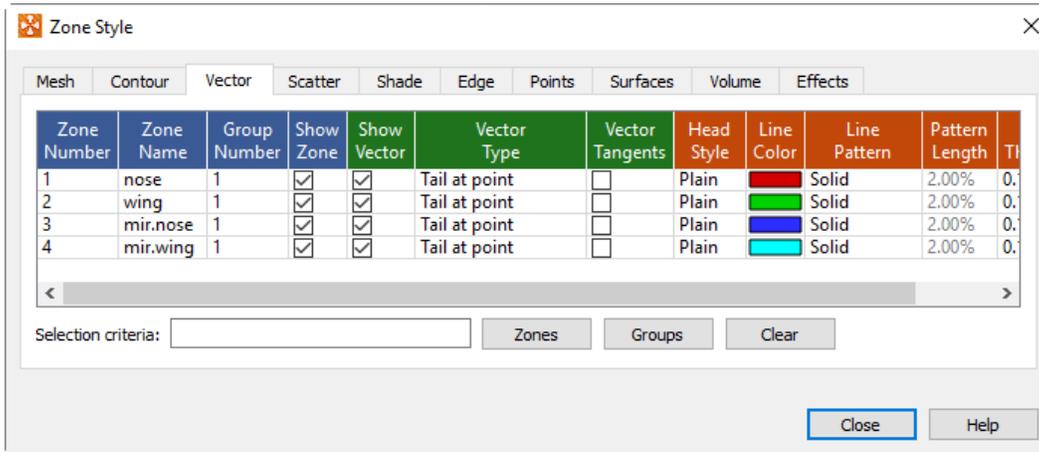
Choose variables by selecting the desired U, V, and W (3D only) variables from their respective drop-downs. You may select any of the current dataset's variables as any component. You can change the component variables at any time by choosing **Vector>Variables** from the **Plot** menu.

Once you have selected the Vector check box in the Plot sidebar and have chosen your vector components, your vector plot will appear. If vectors are not visible, refer to [Section 10-3.1 "Definition Page"](#).



10 - 2 Vector Plot Modification

You can modify your vector plot attributes using the Vector page of the **Zone Style** dialog. You can control any of the following attributes from the Vector page of the **Zone Style** dialog.



In order for the changes made on the Vector page to be visible in your plot, the Vector layer must be active (toggled on in the Plot sidebar).

- **Show Vector** - Toggle-on to show the vector for a particular zone.
- **Vector Type** - Select from the following options:
 - **Tail at Point** (default) - Draws the tail of the vector at the data point.
 - **Head at Point** - Draws the head of the vector at the data point.
 - **Anchor at Midpoint** - Positions the midpoint of the vector at the data point.
 - **Head Only** - Draws the head of the vector at the data point and does not draw a tail.

[Figure 10-2](#) shows examples of each of the vector plot types.

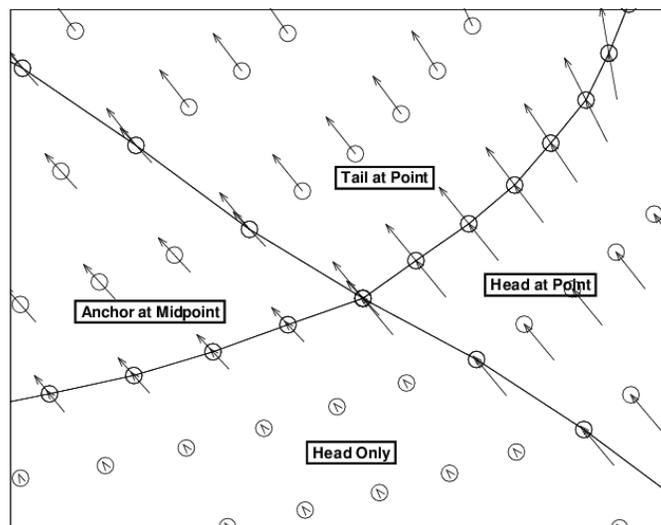


Figure 10-2. The Vector plot types: tail at point, head at point, anchor at midpoint, and head only.

- **Vector Tangents** - Toggle-on to display only the tangent component of vectors, not both tangent and normal components. Tangent vectors are drawn on 3D surfaces only where it is possible to determine a vector normal to the surface. A plot where multiple surfaces intersect each other

using common nodes is a case where tangent vectors are not drawn because there is more than one normal to choose from. An example of this would be a volume IJK-ordered zone where both the I and J-planes are plotted. If tangent vectors cannot be drawn, then regular vectors are plotted instead.

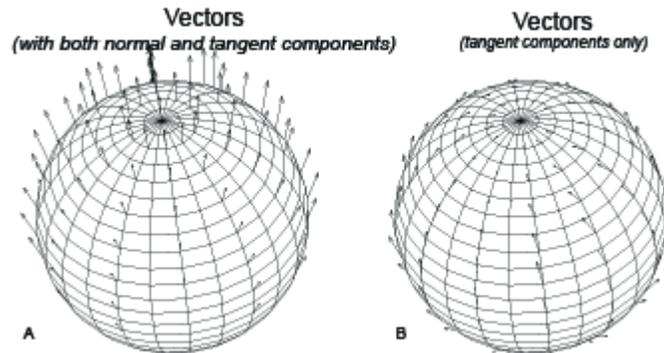


Figure 10-3. Comparison of the Vector Tangent options. A) vectors are drawn with both the normal and tangent components. B) vectors are drawn with only the tangent components.

- **Head Style** - Right-click to choose an arrowhead style for the vectors. [Figure 10-4](#) displays the available styles.
 - **Plain (default)** - Line segments drawn from the head of the vector.
 - **Filled** - Filled isosceles triangles with apex at the head of the vector.
 - **Hollow** - Hollow isosceles triangles with apex at the head of the vector.

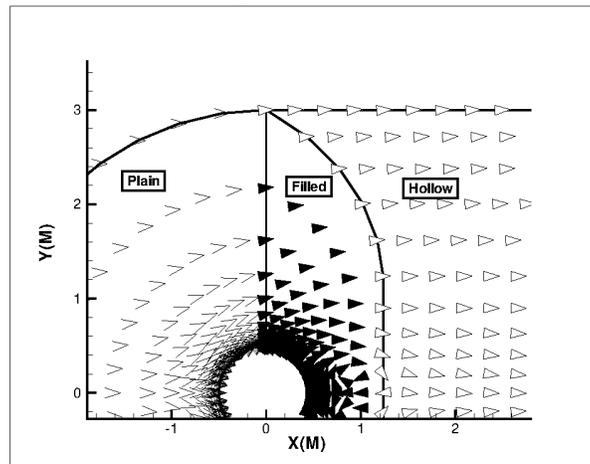


Figure 10-4. Arrowhead types for vector plots (plain, filled and hollow).

- **Line Color** - Right-click to choose the vector color in the Color Chooser dialog
- **Line Pattern** - Right-click to choose the vector line pattern.
- **Pattern Length** - Right-click to choose the vector line pattern length as a percentage of frame height. You may choose a preset length or enter an exact number.
- **Line Thickness** - Right-click to choose the vector line thickness as a percentage of frame height. You may choose a preset thickness or enter an exact number.



If your data consists of a dense mesh of points, a vector plot may be too crowded to be of much use. You can "thin" the plot by plotting only a certain subset of the data points with the Index Skip attribute from the [Points](#) page of the **Zone Style** dialog.



For information on using the controls at the bottom of the Zone Style dialog to select zones by name, see the description of these at the end of ["Field Plot Modification and the Zone Style Dialog"](#) on page 132.

Use the Vector Details dialog to adjust other Vector layer settings, including length scaling, arrowhead appearance, and reference vector. See [Section 10 - 3 "Vector Details"](#)

10 - 3 Vector Details

The Vector Details dialog (**Plot>Vector>Details**) lets you specify the length of vectors and the appearance of arrowheads. You can also display a reference vector. on your plot. These settings are all global to the current frame.



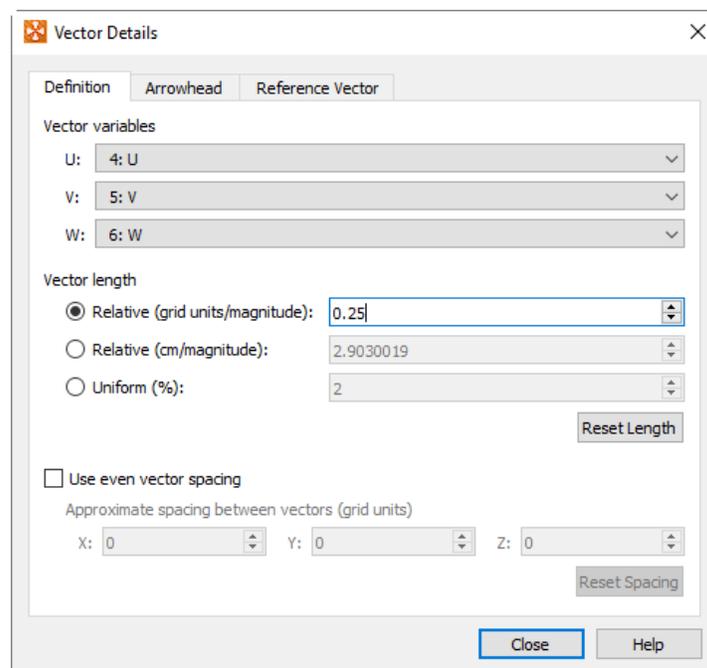
In order for most changes made on the Vector Details dialog to be visible in your plot, you must have the Vector layer toggled on in the Plot sidebar, and the vectors of at least one zone must be visible (see [Section 10 - 2 "Vector Plot Modification"](#) on page 167).

The Vector Details dialog has three pages:

- [Definition Page](#)
- [Arrowhead Page](#)
- [Reference Vector Page](#)

10 - 3.1 Definition Page

The Definition page of the Vector Details dialog allows you to change the vector variables, adjust the length of displayed vectors, and use even vector spacing.



The Definition page of the Vector Details dialog has the following options:

- **Vector variables** - Select the variables for U, V, and W (3D only) vector variables. Selecting new vector variables will update the plot if any vectors are displayed.

- **Vector length** - The following options are available for the length of the vector:
 - **Relative (grid units/magnitude)** - Specify the vector length as the number of grid units per unit of vector magnitude.
 - **Relative (cm/magnitude)** - Specify the vector length as the number of centimeters per unit of vector magnitude.
 - **Uniform (%)** - Specify the vector length as a percentage of frame height.
 - **Reset Length** - For relative vector length, the default is based on the size of the longest vector. Click **Reset Length** to change the vector length to a relative vector length with the scale factor expressed in grid units per unit of vector magnitude. Not available when Uniform is selected.

For either of the "Relative" options for vector length, the value you specify is a scale factor that is multiplied by the vector magnitude to determine the length of the vector.

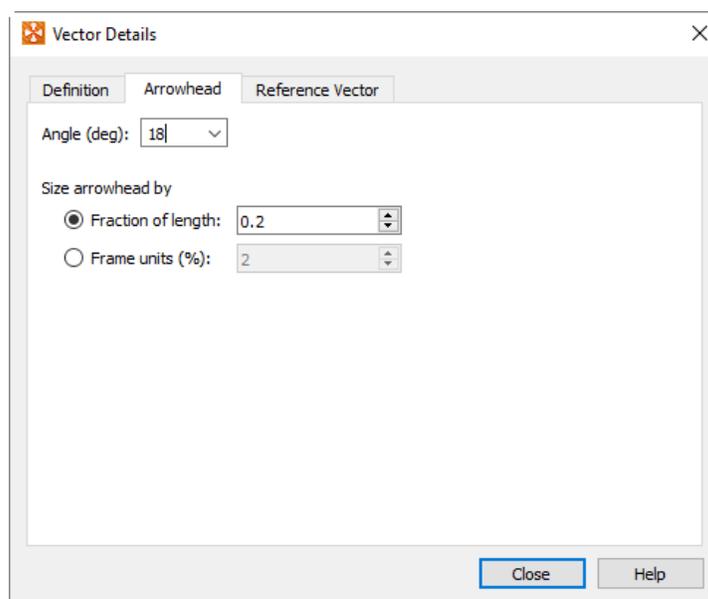


Since 3D vectors are plotted in the plane of the screen, a 3D vector's length will depend on both the vector length settings and the orientation of the vector. The length may be distorted more if the length setting is Relative and the 3D projection is Perspective.

- **Use even vector spacing** - Select to turn on even spacing for vectors based on grid units of X, Y, and Z (3D only). Turning on even vector spacing (with vectors displayed) will selectively remove some of the vectors in the plot to approximately enforce the display intervals specified in the spacing controls. This is useful for clarifying areas of the plot that are cluttered with an excess number of vectors. When turned on, the initial values of spacing, specified in grid units, are set to attempt to display a maximum of 40 vectors in each direction across the frame based on current view. This default number of vectors can be changed in Tecplot's configuration file, *tecplot.cfg*; refer to the VECTORDEFAULTSPACINGCOUNT option of the \$!FRAMESETUP macro command.
 - **Reset Spacing** - Resets the spacing intervals to these default values. Selecting new axis variables will also reset the vector spacing values.

10 - 3.2 Arrowhead Page

You can specify arrowhead sizes as either a fraction of the vector length or in frame units (that is, as a percentage of the frame height). By default, Tecplot Focus specifies size as a fraction of the vector length.

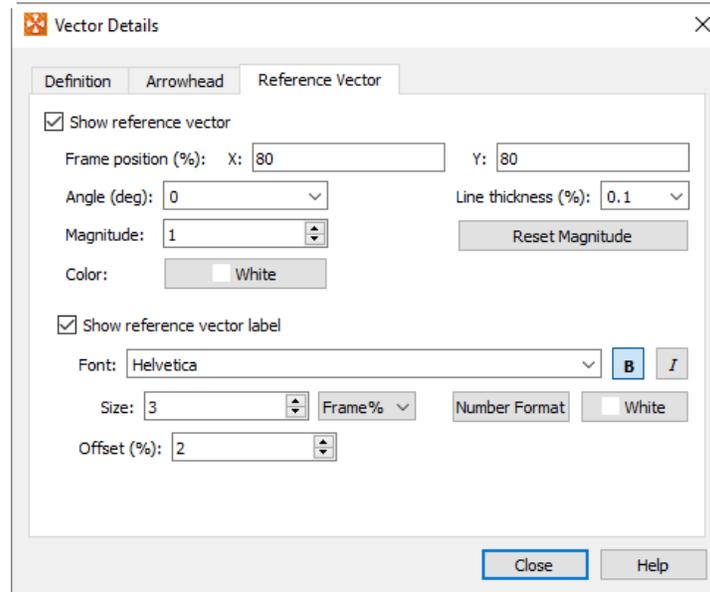


The Arrowhead page of the Vector Details dialog has the following options:

- **Angle (deg)** - The arrowhead angle is the angle that one side of the arrowhead makes with the vector, i.e. the apex angle is twice the arrowhead angle. To specify the arrowhead angle, enter a value from 1 to 90, or choose a value from the drop-down, indicated by the down-arrow button.
- **Size arrowhead by:**
 - **Fraction of Length** - Enter a decimal value from zero to ten.
 - **Frame Units (%)** - Enter a percentage value from zero to 100.

10 - 3.3 Reference Vector Page

A reference vector is a vector of specified magnitude placed on the plot as a visual measure of vector length.



The Reference Vector page of the Vector Details dialog has the following options:

- **Show Reference Vector** - Toggle-on to include a reference vector in your plot.
- **Frame Position** - Enter the coordinates of the starting point of the reference vector, as a percentage of the frame width (X) and frame height (Y).
- **Angle (deg)** - Enter the orientation of the vector in degrees from horizontal, or choose a value from the drop-down.
- **Magnitude** - Enter the magnitude of the reference vector. The units correspond to those of the vector components.
- **Color** - Choose a color with the Color Chooser. Multi-color and RGB coloring are not available.
- **Line Thickness (%)** - Enter the desired line thickness, or choose a value from the drop-down.
- **Reset Magnitude** - Resets the magnitude of the reference vector based on the average vector magnitude.
- **Show Reference Vector Label** - Toggle-on to include the magnitude of the reference vector in the label. Select and modify any of the following options:
 - **Font** - Choose or enter the name of the font to be used for the label. Click the **B** or **I** buttons to select the bold and/or italic variety of the font. (See [Section 18 - 1.2 "Font Folders and Fallback"](#) for more information on how fonts work with Tecplot Focus.)
 - **Size** - Enter the size and choose units either of frame height percentage or points.
 - **Number Format** - Click to specify how the number will be formatted using the Specify Number Format dialog. See [Section 6 - 7.1 "Specify Number Format"](#) for a discussion of this dialog.
 - **Color** - Choose a color with the Color Chooser. Multi-color and RGB coloring are not available.
 - **Offset (%)** - Choose the spacing between the label and the reference vector as a percentage of frame height.

A plot with a reference vector is shown here. The units for the reference vector were added using a text object (see [Section 18 - 1 "Text"](#) on page 229).

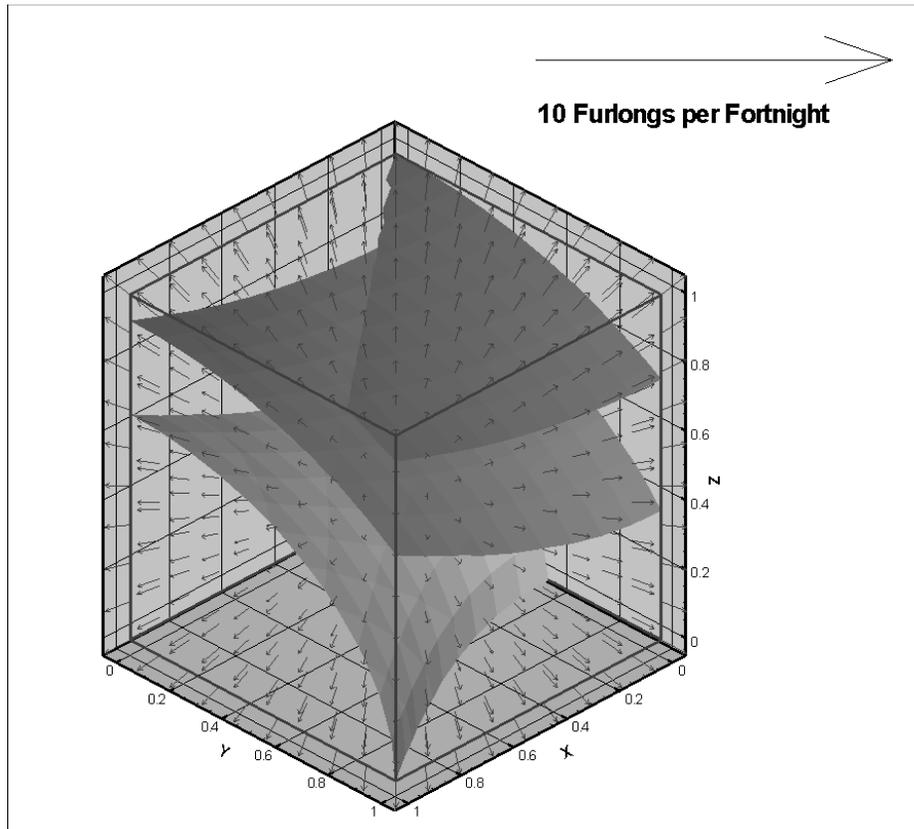


Figure 10-5. Reference Vector with Units Added

11

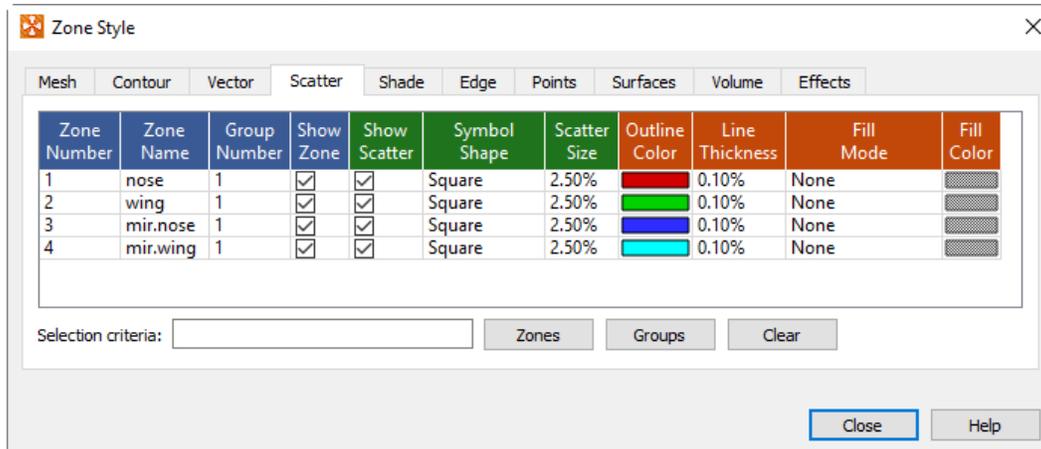
Scatter Layer

Scatter plots are plots of symbols at the data points in a field. The symbols may be sized according to the values of a specified variable, colored by the values of the contour variable, or may be uniformly sized or colored. Unlike contour plots, scatter plots do not require any mesh structure connecting the points, this allows you to make scatter plots of irregular data.

To add a scatter layer to your plot, activate the "Scatter" toggle in the Plot sidebar. You can modify your Scatter plot using the Scatter page of the **Zone Style** dialog and the **Scatter** submenu of the **Plot** menu.

11 - 1 Scatter Plot Modification

Once you have loaded your data, you can modify your scatter plot attributes using the Scatter page of the **Zone Style** dialog. You can control any of the following attributes for a zone or group of zones from the Scatter page of the **Zone Style** dialog.



For information on using the controls at the bottom of the **Zone Style** dialog to select zones by name, see the description of these at the end of ["Field Plot Modification and the Zone Style Dialog"](#) on page 132.



In order for the changes made on the Scatter page to be visible in your plot, the Scatter layer must be turned on in the Plot sidebar.

- **Show Scatter** - Right-click to choose whether or not to show the scatter layer for the highlighted zone(s).
- **Symbol Shape** - Right-click to choose one of the following symbol shapes:
 - Square (default)
 - Delta
 - Gradient
 - Left Triangle
 - Right Triangle
 - Diamond
 - Circle
 - Cube (rendered as a square in 2D)
 - Sphere (rendered as a circle in 2D)
 - Octahedron (rendered as a diamond in 2D)
 - Point
 - Character - Use a specified ASCII character from a selected font (as specified in the [Enter ASCII Character](#) dialog). See also [Table 18 - 2](#).



3D scatter symbols should only be used if your dataset is on the order of thousands of points. If your dataset is large (e.g. millions of points), try using 2D scatter symbols instead for better interactive performance.

- **Scatter Size** - Right-click to select the symbol size either by a constant percentage of the frame height or from a variable in the dataset. For constant size, you may choose a preset size or enter one of your own. (See [Section 11 - 2 "Scatter Size/Font"](#) for complete instructions for sizing scatter symbols by variable.)
- **Outline Color** - Right-click to choose a color from the Color Chooser. Besides a constant color, you can also choose:
 - **Multi** - Each symbol is colored according to the value of the selected contour variable at that data point. Choose a contour group at the bottom of the Color Chooser dialog.
 - **RGB** - Each symbol is colored according to the values at that data point for the variables assigned to RGB. Click the **RGB** button at the bottom of the Color Chooser dialog.
- **Line Thickness** - Right-click to choose the thickness of the scatter outlines for each highlighted zone(s), either a preset from the menu or by entering your own value.
- **Fill Mode** - The 3D symbol shapes, Cube, Sphere, and Octahedron are filled with the line color, but the other shapes have other fill modes available. Right-click to choose:
 - None (default)
 - Use Specific Color - Uses the color shown in the Fill Color column.
 - Use Line Color - Matches outline color.
 - Use Background Color - Matches frame color.

- **Fill Color** - Right-click to select a fill color using the Color Chooser.



Spheres, Cubes, and Octahedrons are always light-source shaded. Spheres are Gouraud shaded, and Cubes and Octahedrons are Panel shaded. Cube edges are aligned with X, Y, and Z-axes. Octahedrons are oriented so one vertex points in the Z-direction and one vertex points in the X-direction. For best appearance of 3D shapes, adjust the Light Source to use Specular Highlighting. Scatter Size and Line Thickness are not available for the point symbol. Points are always one pixel in size.

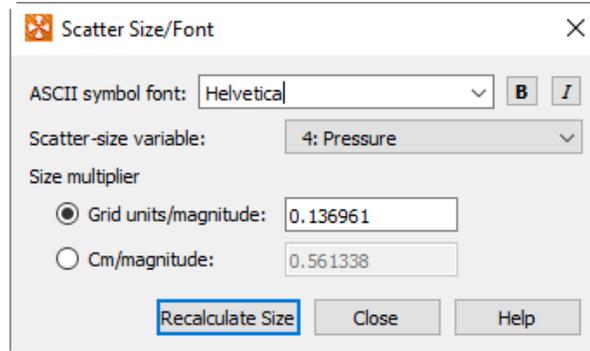


If your data consists of a dense mesh of points, a scatter plot may be too crowded to be of much use. You can "thin" the scatter plot by plotting only a certain subset of the data points with the Index Skip attribute from the [Points](#) page of the **Zone Style** dialog.

The Point scatter symbol allows for quick viewing and panning in 3D plots. It is also a useful tool for identifying features in volume zones.

11 - 2 Scatter Size/Font

Use the **Scatter Size/Fonts** dialog (accessed via **Plot>Scatter>Size/Font** in 2D/3D or **Plot>Symbol Font** in line plot modes) to choose the base font used for ASCII character symbols and the scatter-size variable used to scale scatter symbols. This dialog is also available by right-clicking a scatter size in the Scatter page of the Zone Style dialog and choosing **Select Variable**. The **Scatter Size/Font** dialog is shown below:



The following options are available:

- **ASCII Symbol Font** - Select a font from the drop-down and optionally a bold and/or italic style. (See [Section 18 - 1.2 "Font Folders and Fallback"](#) for more information on how fonts work with Tecplot Focus.) For XY and Polar line plots, this is the only option available.



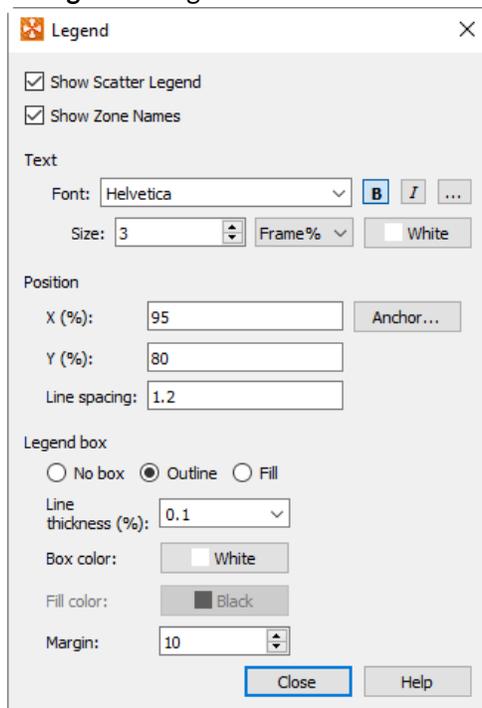
Not all fonts have Bold and/or Italic variants. For fonts that do not have these styles, the **B** and/or *I* buttons may have no effect.

- **Scatter-size Variable** - Select a variable from the drop-down of the dataset's variables. If the Scatter Size field is set to "Size by Variable" on the Scatter page of the **Zone Style** dialog, this variable is used to calculate the scatter symbol size at each data point. The actual size of each symbol is determined by multiplying the value of the variable at each point by the Size Multiplier. If the Scatter Size field is not set to "Size by Variable", this field has no effect.
- **Size Multiplier** - Enter the scale factor that multiplies the values of the Scatter-size Variable to size the scatter symbols. If the Scatter Size field on the **Zone Style** dialog is not set to "Size by Variable", this field has no effect. The Size Multiplier multiplied by the scatter variable value gives the size of the scatter symbol at a point, in units, specified by the following option buttons:

- **Grid Units/Magnitude** - Select this to express the Size Multiplier in terms of grid units per unit of variable magnitude.
- **Cm/Magnitude** - Select this to express the Size Multiplier in terms of screen centimeters per unit of variable magnitude.
- **Recalculate Size** - Select to reset the Size Multiplier to Tecplot Focus's initial value.

11 - 3 Scatter Legends

To include the scatter legend, select "Scatter Legend" from the **Scatter** sub-menu of the **Plot** menu. Select the following options in the **Scatter Legend** dialog.



- **Show Scatter Legend** - Toggle-on to include a scatter legend in the plot.
- **Show Zone Names** - Toggle-on to include zone names in the legend.
- **Text** - Format the text for the legend by choosing a color and font, and specifying the text height. (See [Section 18 - 1.2 "Font Folders and Fallback"](#) for more information on how fonts work with Tecplot Focus.) Click the (...) button to display the Select Font dialog.
- **Position** - Specify the location of the anchor point of the legend by entering values in the X (%) and Y (%) text fields. Enter X as a percentage of the frame width and Y as a percentage of the frame height.
- **Legend Box** - Select the type of box to draw around the legend (No Box, Outline, or Fill).

If you choose Outline or Fill, format the box using the following controls:

- **Line Thickness** - Specify the line thickness as a percentage of frame height.
- **Box Color** - Choose a color for the legend box outline.
- **Fill Color** - Choose a color for the legend box fill (Fill mode only).
- **Margin** - Specify the margin between the legend text and legend box as a percentage of the text height.

Shade Layer

Although most commonly used with 3D surfaces, shade plots can also be used to flood 2D plots with solid colors, or to light source shade the exterior of 3D volume plots. In 3D plots, zone effects (translucency and lighting) cause color variation (shading) throughout the zone(s). Shading can also help you discern the shape of the plot.

Toggle-on "Shade" in the Plot sidebar to add shading to your plot. Use the Shade page of the **Zone Style** dialog to customize shading. Refer to [Chapter 13: "Translucency and Lighting"](#) for information on translucency and lighting zone effects.



Shade plots require IJ or IJK-ordered, or finite element data. I-ordered, or irregular data cannot be used to create shade plots.

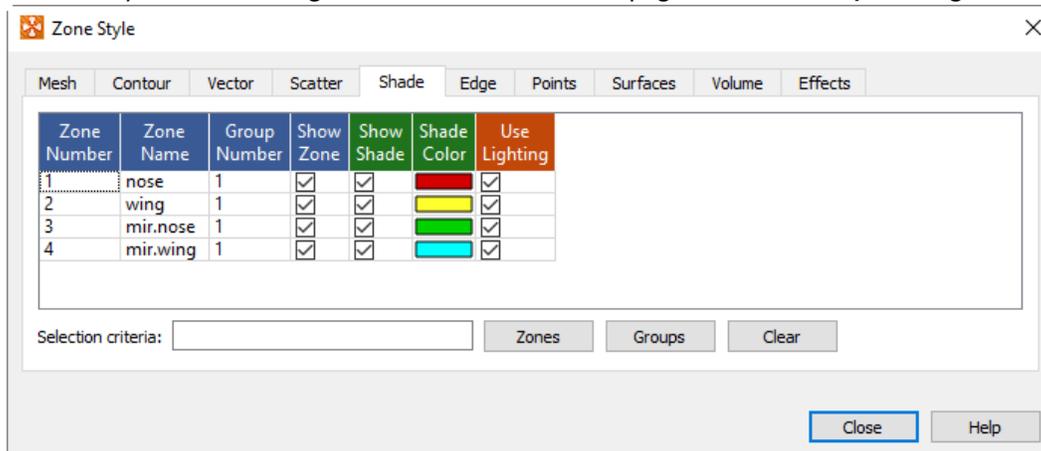
12 - 1 Shade Layer Modification

You can modify your shading attributes using the Shade page of the **Zone Style** dialog (accessed via the Plot sidebar or **Plot>Zone Style**).



In order for the changes made on the Shade page to be visible in your plot, the Shade layer must be turned on in the Plot sidebar.

You can control any of the following attributes from the Shade page of the **Zone Style** dialog:



- **Show Shade** - Turns the shade layer on or off for each active zone.
- **Shade Color** - Right-click to select the shade color using the Color Chooser. In 2D Cartesian plots, only solid zone flooding is available (i.e. no lighting effects).
- **Use Lighting** - (3D only) Turns the lighting zone effect off or on. When "no" is selected, the shade color is used to uniformly color the zone. Refer to [Chapter 13: "Translucency and Lighting"](#) for information on translucency and lighting zone effects.



For information on using the controls at the bottom of the Zone Style dialog to select zones by name, see the description of these at the end of ["Field Plot Modification and the Zone Style Dialog"](#) on page 132.

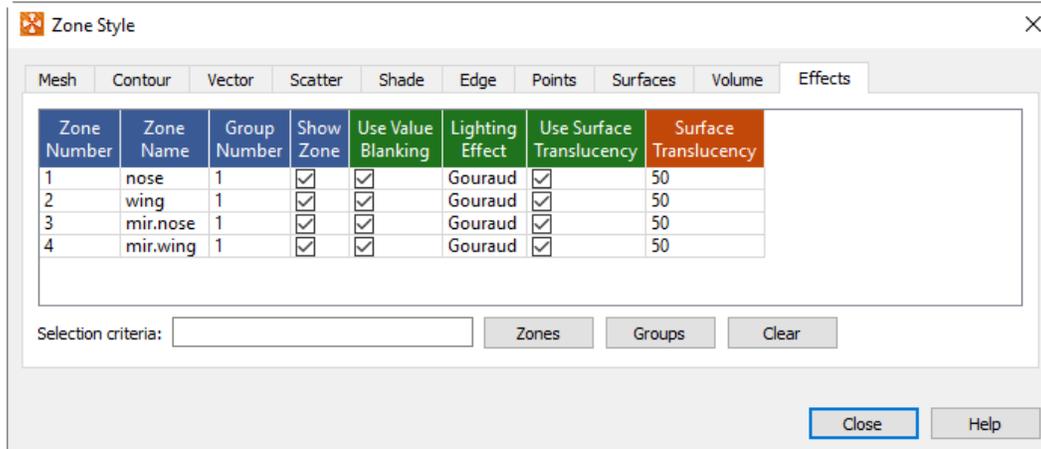
Translucency and Lighting

You can enhance the shade and contour zone layers in 3D plots using [Translucency](#) and [Lighting Effects](#) (referred to collectively as the "3D zone effects"). The 3D zone effects for streamtraces, slices, and iso-surfaces can be activated using their respective dialogs (accessed via the **Plot** menu or the Plot sidebar).



For changes related to lighting or translucency to be visible, the desired effect must be toggled-on in the Show Effects section of the Plot sidebar.

The Effects page of the **Zone Style** dialog, which controls translucency and lighting effects, is shown below.



For information on using the controls at the bottom of the Zone Style dialog to select zones by name, see the description of these at the end of ["Field Plot Modification and the Zone Style Dialog"](#) on page 132.

13 - 1 Translucency

Turn on the translucency zone effect by toggling-on "translucency" in the Show Effects region of the Plot sidebar. When a zone is translucent, you may view objects inside or behind the zone. You can control the translucency of a zone using the Surface Translucency attribute in the Effects page of the **Zone Style** dialog. The level of translucency may be set to a value between 1 (nearly solid) and 99 (nearly invisible). There are nine pre-set percentages ranging from 10 to 90. You may also use the "Enter" option to define a percentage of your own. An example of a translucent plot is shown in [Figure 13-1](#).

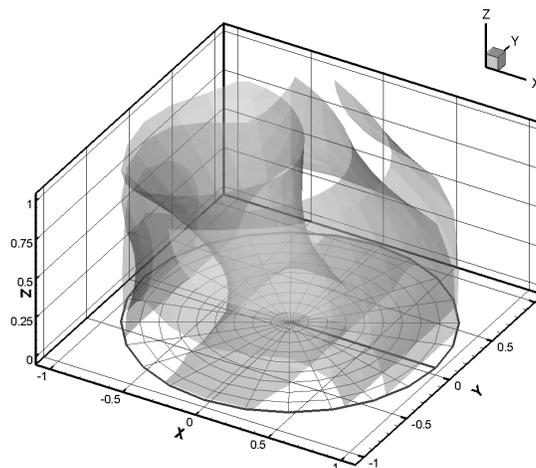


Figure 13-1. An example of a plot using translucency.

All surfaces in 3D Cartesian plots may be made translucent. A different translucency may be assigned to individual zones, and may also be assigned to derived objects such as slices, streamtrace ribbons or rods, and iso-surfaces. Use the Effects page of the **Zone Style** dialog to change translucency settings for zones.

13 - 2 Blanking

The Use Value Blanking column on the Effects page of the Zone Style dialog enables you to constrain the display of each zone - that is, instruct whether each zone should obey or ignore any blanking settings present in the plot. To constrain a zone to obey value blanking, select the zone, toggle-on the Use Value Blanking checkbox. To learn more about blanking, see ["Blanking"](#) on page 251.

13 - 3 Lighting Effects

There are two types of lighting effects: Paneled and Gouraud. Right-click in the Lighting Effect column of the Effects page to choose either Paneled or Gouraud shading for the selected zone(s).

- **Paneled** - Within each cell, the color assigned to each area by shading or contour flooding is tinted by a shade constant across the cell. This shade is based on the orientation of the cell relative to your 3D light source.
- **Gouraud** - This plot type offers smoother, more continuous shading than Paneled shading, but it also results in slower plotting and larger print files. Gouraud shading is not continuous across zone boundaries unless face neighbors are specified in the data¹. Gouraud shading is not available for finite element volume zones when blanking is active; the zone's lighting effect reverts to Paneled shading in this case.

If IJK-ordered data with Surfaces to Plot is set to Exposed Cell Faces, faces exposed by blanking will revert to Paneled shading.

1. Refer to the [Data Format Guide](#) for details regarding face neighbors.

[Figure 13-2](#) shows two shade plots. The one on the left uses a Paneled lighting effect and the one on the right uses a Gouraud lighting effect.

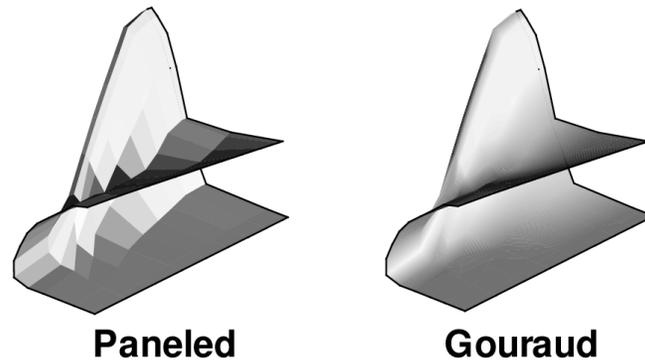
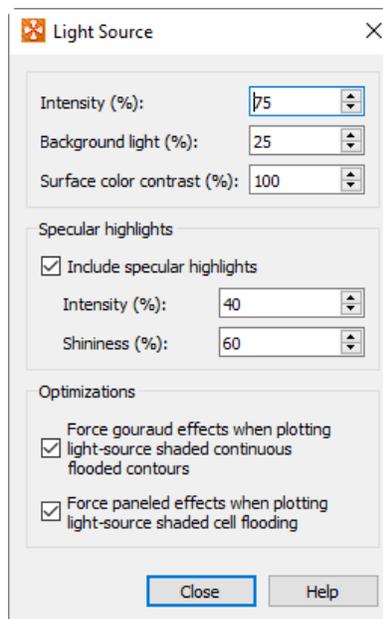


Figure 13-2. A comparison of the paneled (left) and Gouraud (right) lighting effects.

13 - 4 Three-dimensional Light Source

The light source is a point of light infinitely far from the drawing area. You can open the **Light Source** dialog (shown below) by selecting the button () next to Lighting effect toggle the Plot sidebar, or by selecting "Light Source" from the **Plot** menu.



The **Light Source** dialog has the following options:

- **Intensity (%)** - Controls the amount of lighting effect produced by the directional light source. An intensity of 100 produces the maximum contrast between lit and unlit areas, and fully lit areas use the full surface color. Lesser values produce less contrast between lit and unlit areas, and fully lit areas use darker colors. An intensity of zero means the light source produces no contrast between lit and unlit areas, and all areas are black.
- **Background Light (%)** - Controls the amount of lighting effect applied to all objects regardless of the light source position. A background light of zero means that areas unlit by the directional light source receive no lighting at all and are entirely black, while areas lit by the directional light source get only the effect of that light. Larger values produce more lighting effect in areas not lit by the directional light source, making these areas show some of the surface color. A background

light of 100 means that all areas are lit by the maximum amount, and areas unlit by the directional light source use the full surface color.



Intensity and Background Light are cumulative; they can add up to more than 100 and result in colors lightened beyond the base surface color. For example, reds will become pink and grays will become white.

- **Surface Color Contrast (%)** - Controls the contrast of the color of the light source shaded surfaces before applying lighting effects. A surface color contrast of 100 means that light source shaded surfaces use the full surface color for applying lighting effects. Lesser values mean that the surface color is blended with progressively more white, making light source shaded surface colors lighter. A surface color contrast of zero means that colors are pure white before applying lighting effects (the plot will only be shades of gray).
- **Include Specular Highlights** - Turns on/off specular highlight for all light-source shaded objects in the plot, adding the semblance of reflected light to 3D shaded or flooded objects.
 - **Intensity (%)** - Controls intensity of specular highlights (that is, the amount of reflected light, which controls the amount of whiteness at the peak of the highlight).
 - **Shininess** - Controls shininess of specular highlight (that is, roughly the size and spread of specular highlight).
- **Lighting Optimizations** - Some combinations of lighting type and plot style may result in very slow redrawing of plots. Tecplot Focus provides lighting optimizations to avoid such conditions and instead draws a similar, but less computationally-intensive plot. These optimizations are on by default. Turn them off if you need to see the exact effects you have specified. You may want to turn off the graphics cache before turning off those optimizations for plots with large amounts of data. (See [“Graphics Cache”](#) on page 358 for information on the graphics cache.)

13 - 4.1 Moving the Light Source

You may move the light source interactively by clicking the  sun button next to the lighting effect toggle in the Plot sidebar. With the light source tool active, click or drag in the workspace to position the light source in 3D space. Choose another tool from the toolbar or sidebar to exit this mode.

Slices

You can add slices to volume and surface zones in your plot in order to view X, Y, or Z planes within your data. With IJK-ordered data, you can also add slices on the I, J, or K planes. It is also possible to create slices with arbitrary orientations.

Slices can include lighting effects, contours, meshes, and more. To customize these and other attributes of slices, use the **Slice Details** dialog, accessible in the Plot sidebar or the Plot menu, or use the context menu and context toolbar.



The context toolbar appears above the context menu when you right-click a slice in your plot. This toolbar allows you to turn on or off the grid, contour, vector, shade, edge, and translucency layers for the selected slice(s).

Additionally, you may adjust frequently-used style settings for each layer using the drop-down menu to the right of each, for example selecting a color for the grid (or choosing a variable by which to color it).

Tecplot Focus includes a simple interactive method for creating slices. Select the Slice tool  in the toolbar or in the Plot sidebar to activate a crosshair cursor, then click in a volume or surface zone to "drop" a slice into that zone. You can then drag the slice to change its position. Refer to ["Slice Tool"](#) on page 30 for more information on working with the Slice tool.

For additional control, additional slices, or another way to insert slices derived from the dataset, use the Definition page of the **Slice Details** dialog. You can open the **Slice Details** dialog by clicking the  button next to the Slices toggle in the Plot sidebar or by choosing Slices from the Plot menu.

Interactively created slices are derived from the dataset and are defined by a constant X, Y, or Z location (or constant I, J, or K indexes, for IJK ordered zones). Tecplot Focus considers this type of slice as part of your plot's style and does not add it to the dataset unless you extract it to a zone (using **Data>Extract>Slices**).

14 - 1 Interactively Created Slices

Use the **Slice Details** dialog to customize interactively created slices (that is, slices derived from your dataset). Click the  button next to the Slices checkbox in the Plot sidebar, or select "Slices" from the **Plot** menu, to launch the **Slice Details** dialog. To add slices to your plot in the dialog, toggle-on "Show Group n" in the **Slice Details** dialog.

The **Slice Details** dialog includes the following pages: [Definition Page](#), [Contour Page](#), [Vector Page](#), [Other Page](#), and [Animate Page](#).



You must toggle-on "Show Group n " in order for the changes made in the **Slice Details** dialog to be visible in your plot.

14 - 1.1 Slice Groups

Up to eight different slice groups can be set. Each slice group can use different slice planes or different ranges for the same slice plane. Changing the settings in the **Slice Details** dialog allows you to make the appearance of each slice group unique. The slice group is specified using the numbers at the top of the **Slice Details** dialog.



You must toggle-on "Show Group n " (where $n = 1-8$) in order to include the Slice group in your plot.

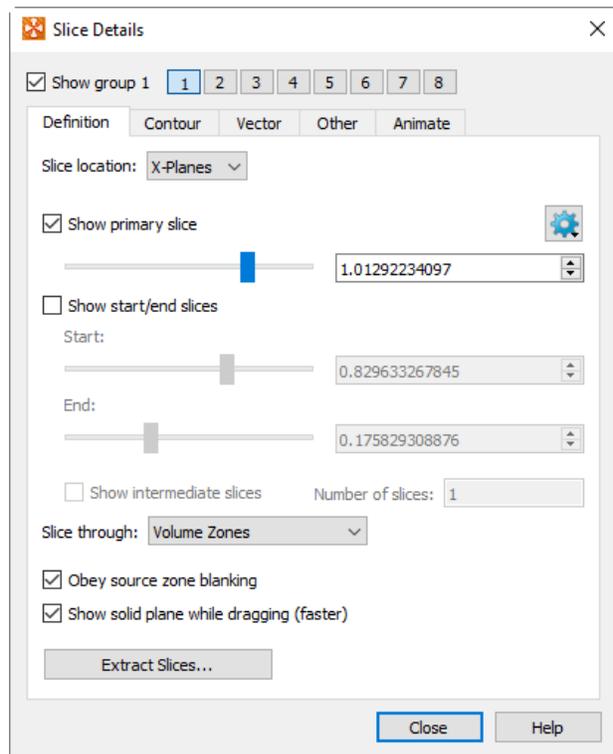
14 - 1.2 Definition Page

Use the Definition page of the **Slice Details** dialog to customize the position of the active slice group (accessed via the Plot sidebar or **Plot>Slices**).

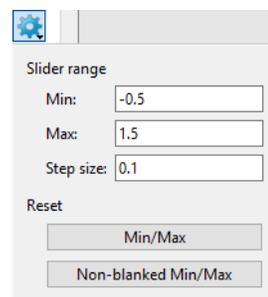
You can toggle-on "Show Start/End Slices" and use the Start slider to move the first (start) slice, or type in the slice position. Activate the last (end) slice and move it with the End slider.

The following options are available:

- **Slice Location** - Select which plane the slice is drawn on (X,Y,Z, I, J, or K). You may also choose Arbitrary to place the slice on an arbitrary plane; see "[Arbitrary Slice Orientation](#)" on page 186.
- **Show Primary Slice** - Toggle-on to include the primary slice (first slice placed) in your plot. Use the slider or the text field to position the primary slice.
- **Show Start/End Slices** - Toggle-on to include start and end slices in your plot. Use the corresponding sliders or text fields to position the slices.
- **Show Intermediate Slices** - Toggle-on to show intermediate slices evenly distributed between the start and end slices.
 - **Num Slices** - Enter the number of intermediate slicing planes in the text field. (Range 1-5000.)
- **Range for all Sliders** - Click the gear icon next to Show Primary Slice to reveal a flyout dialog (right) that sets the range of the sliders.
 - **Min, Max, Step Size** - Specify the start, end, and step for the slider range.



- **Reset Slider Range** - Automatically selects the min/max of values based on Slice location or the min/max of the non-blanked values based on Slice location. Non-blanked Min/Max is disabled for I-, J-, and K-Planes.
- **Slice Through** - Choose to slice through volume zones, surface zones, or the surfaces of volume zones.
- **Obey Source Blanking** - When active, slices are subject to any blanking used for the data. When inactive, slices are generated for blanked and unblanked regions. See also [Chapter 19: "Blanking"](#).
- **Show solid plane while dragging** - Toggle-on to show a solid-colored plane in place of the slice while dragging. Since the data within the slice does not need to be drawn to the screen, this can make dragging noticeably faster and smoother, particularly with large data sets.



The **Show solid plane while dragging** checkbox is a global setting that applies to all slice groups, not just the selected group. It is not available if the slice plane is I, J, or K.

- **Extract Slices** - Select the Extract Slices button to open the Extract Slices dialog. See [Section 14-2 "Extracting Slices to Zones"](#) for more information.

Arbitrary Slice Orientation

To orient slices in an arbitrary direction, choose "Arbitrary" from the Slice Location menu. As with other slices, you may specify origin points for a primary slice and/or for start and end slices. Slices pass through the indicated origin point(s), so you can easily align the edge of a slice or group of slices along some other feature of the plot, such as an axis. If intermediate slices are activated, they are drawn equally spaced between the slices defined by the start and end origins.



An arbitrarily-oriented slice may be manipulated interactively. When the slice tool is active, a slice-normal interactor appears in the plot.

- Drag the far end of the interactor to change where the normal points and thus the orientation of the slice(s).
- Drag the near end of the slice normal to move the origin point of the slice.
- If multiple slices are active, you may click a slice to move the normal to that slice.



Interactive orientation of arbitrary slices is not available with scaled axes or perspective view. In these cases, the interactor does not appear.

You may adjust the orientation of the slice in small increments using the + and - buttons for the X, Y, and Z axes to rotate the slice a step at a time around an axis.

With an arbitrary slice, you may also:

- [Orient a Slice by Specifying a Normal](#) - Click the gear icon to enter a normal vector in a flyout dialog.

- [Orient a Slice by Entering Three Points](#) - Click the Three Points button to specify three points on the cutting plane using the Enter 3 Points dialog.
- [Orient a Slice by Probing Three Points](#) - Click the  three-point probe icon on the Definition page of the Slice Details dialog to specify three points on the cutting plane by clicking the plot.

Orient a Slice by Specifying a Normal

Click the gear icon to reveal a flyout dialog (right) that lets you choose the orientation of the slice by numerically specifying its normal. A normal vector is established between the slice origin and the specified coordinates, and the slice is oriented perpendicular to this vector, as shown below.

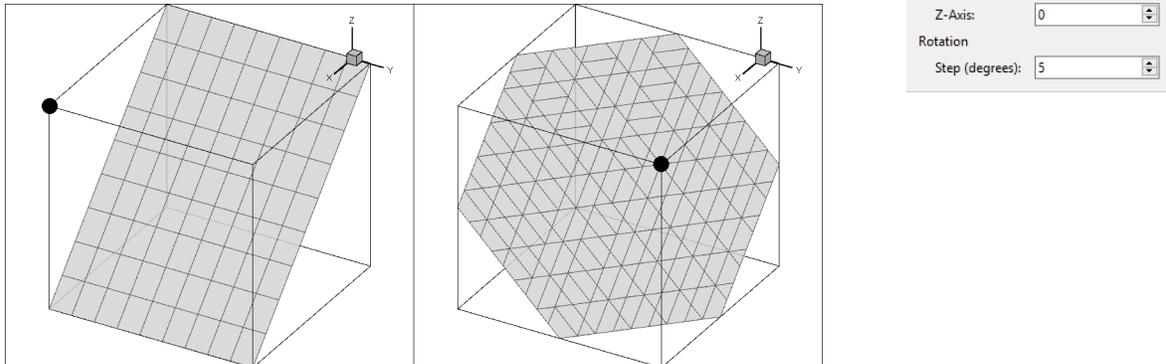


Figure 14-3. Arbitrarily-oriented slices in a unit cube. 0, 0, 0 is at back corner; the black dot is the specified normal. Left: normal at 0, 1, 1. Right: normal at 1, 1, 1.

You can also adjust the step value by which the + and - buttons rotate the slice in this flyout.

Orient a Slice by Entering Three Points

You can orient a slice by specifying the coordinates of three points on a plane. These points must form a triangle; they cannot be coincident or collinear.

Click the **3 Points** button in the Slice Details dialog to open the Enter 3 Points dialog, shown here, then enter the X, Y, and Z coordinates of the three points. When you click **Apply**, the origin and normal vector of the slice are recalculated so that the slice plane passes through all three specified points. (The third entered point is used as the slice origin.)



The values in the Enter 3 Points dialog are not updated when the slice orientation is adjusted using the other available methods.

In this dialog, you may also click the  three-point probe button to [Orient a Slice by Probing Three Points](#).

Orient a Slice by Probing Three Points

In the Slice Details dialog or the Enter 3 Points dialog, click the  three-point probe button, then click three points in your plot. The X, Y, and Z coordinates of the three points are collected in the Enter 3 Points dialog.

After the third point is clicked, the slice's origin and normal are recalculated so that the cutting plane passes through all three clicked points. The third point is used as the slice's origin.



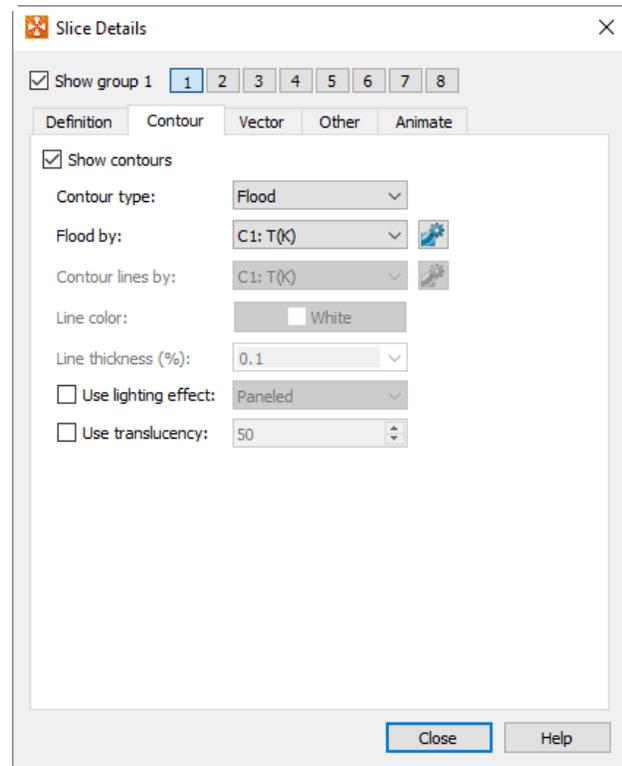
The probe tool keyboard shortcuts may be used when clicking to change the points selected, for example choosing the nearest data point by holding the Control key while clicking. See ["Probe Tool"](#) on page 398 for other shortcuts.

14 - 1.3 Contour Page

Use the Contour page to control the contour attributes of the active slice group (determined by the number buttons on the top of the page).

The following options are available:

- **Show Contours** - Select this check box to show contours.
- **Contour Type** - Select the contour type from the drop-down. Lines, Flood, Average Cell Flood, and Primary Value Flood are available.
- **Flood by** - If you chose contour flooding, select the contour group by which to flood, or RGB flooding.
 -  **Icon** - Use this button to bring up the [Contour & Multi-Coloring Details](#) dialog.
- **Contour Lines by** - If you chose contour lines or lines and flood, select the contour group by which to draw the lines.
 -  **Icon** - Use this button to bring up the **Contour Details** dialog.
 - **Line Color** - Choose the line color in the Color Chooser. Multi-Color will color the slice contour lines based on the contour group variable.
 - **Line Thickness** - Specify the line thickness as a percentage of the frame width. You may enter a value in the text field, or choose one of the values in the drop-down.
- **Use Lighting Effect** - Select this check box to enable the lighting effect drop-down menu where you may choose "Paneled" or "Gouraud" shading. See [Section "Translucency and Lighting"](#) for more details on lighting effects.
- **Use Translucency** - Select this check box to enable the surface translucency text field, where you may set the surface translucency from one (opaque) to 99 (translucent).

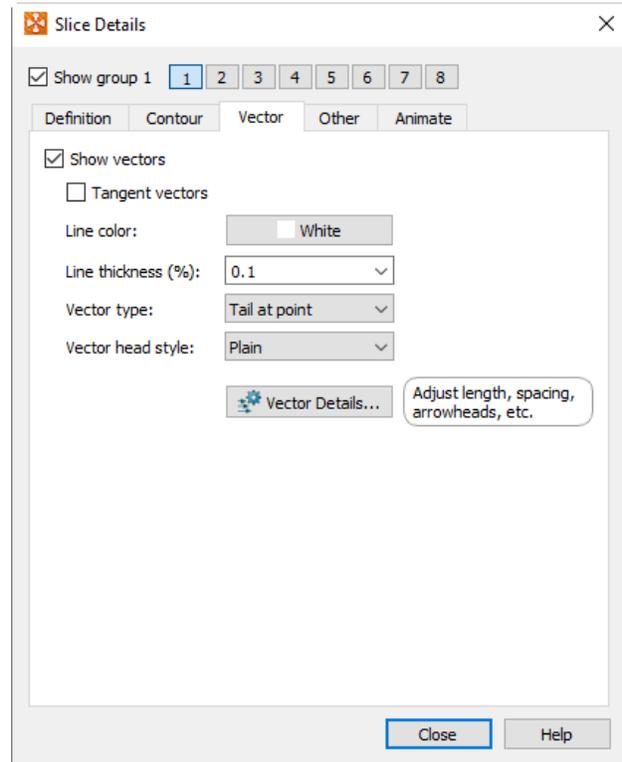


14 - 1.4 Vector Page

Use the Vector page of the **Slice Details** dialog to control the vector attributes of the active slice group (determined by the group number buttons on the top of the page).

The following options are available:

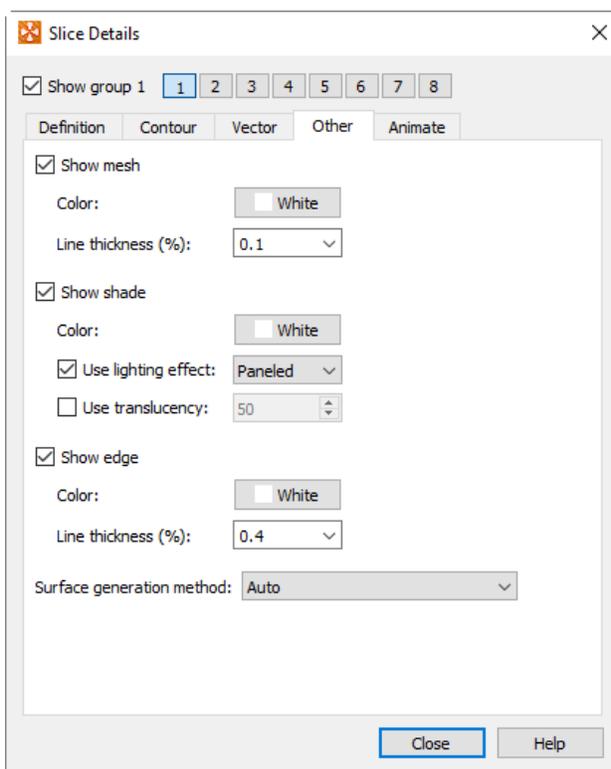
- **Show Vectors** - Select this check box to show vectors.
- **Tangent Vectors** - Select to use tangent vectors for your slices. See [Section 10 - 2 "Vector Plot Modification"](#) for more information.
- **Line Color** - Choose the line color from the Color Chooser. Multi-color will color vectors based on the contour group variable. If no contour variable is set for the selected contour group, the **Contour Details** dialog will appear.
- **Line Thickness** - Specify line thickness as a percentage of the frame height. You may enter a value in the text field, or choose one of the values in the drop-down.
- **Vector Type** - Use this drop-down to set the vector type for your slices. Choose from Tail at Point, Head at Point, Anchor at Midpoint, and Head Only.
- **Vector Head Style** - Use this drop-down to set the vector head style for your slices. Choose from Plain, Filled, and Hollow.
- **Vector Details...** - Opens the Vector Details dialog to adjust Vector length, spacing, arrowheads, etc.



14 - 1.5 Other Page

The Other page of the **Slice Details** dialog controls the mesh, shade, and edge attributes of the active slice group. (The active slice group is determined by the group number buttons on the top of the page.) The following options are available:

- **Show Mesh** - Select this check box to show mesh lines.
 - **Color** - Choose the line color in the Color Chooser. Multi-color will color meshes based on the contour group variable. If no contour variable is set for the selected group when selecting Multi-color, the **Contour Details** dialog will appear.
 - **Line Thickness** - Specify the mesh line thickness as a percentage of the frame width. You may enter a value in the text field, or choose one of the values in the drop-down.
- **Show Shade** - Select this check box to show shading on the slice when Show Contour has not been selected or is set to Lines on the Contour page of this dialog.
 - **Color** - Choose the shade color from the Color Chooser. Multi-color and RGB coloring are not available—use flooded contours for multi-color or RGB flooding.
 - **Use Lighting Effect** - Select this check box to enable the lighting effect drop-down, where you may choose "Paneled" or "Gouraud" shading.
 - **Use Surface Translucency** - Select this check box to enable the surface translucency text field, where you may set the surface translucency from one (opaque) to 99 (translucent). By default, slice translucency is toggled-on at 10 percent when your plot is loaded.
- **Show Edge** - Select this check box to show selected edge lines on all slices.
 - **Color** - Choose the edge color from the Color Chooser. Multi-color and RGB coloring are not available.
 - **Line Thickness** - Specify the edge thickness as a percentage of the frame width. You may enter a value in the text field, or choose one of the values in the drop-down.
- **Surface Generation Method** - Determines how the surface is generated.
 - *Auto* selects one of the surface generation algorithms best suited for the zones participating in the slice generation. "All Polygons" is used if one or more of the participating zones is polytope, otherwise slices use "Allow Quads".
 - *Allow Quads* can produce quads or triangles, and the resulting surface more closely resembles the shape of the volume cells from the source zone. Since the quads are not arbitrarily divided into triangles, no biases are introduced, and the resulting surface may appear smoother. This method is preferred when the source zone is FE-Brick or IJK-Ordered and the surface is aligned with the source cells.
 - *All Triangles* is an advanced algorithm that can handle complex saddle issues and guarantees that there will be no holes in the final surface. As the surface is composed entirely of triangles, it can be delivered more efficiently to the graphics hardware.



- *All Polygons* is similar to the "All triangles" method except that all interior faces generated as a result of triangulation that are not part of the original mesh are eliminated. This preserves the original mesh of the source zones on the resulting slice.

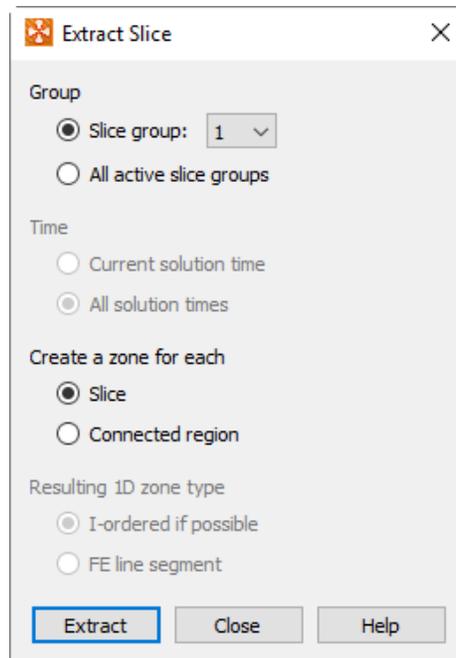
14 - 1.6 Animate Page

See [Section 27 - 1.6 "Slice Animation"](#).

14 - 2 Extracting Slices to Zones

Normally, slices are derived from the dataset "on the fly" and do not add any data to the dataset. To extract slices to Tecplot zones, allowing you to retain them even if the slice details are changed, use **Data>Extract>Slices**.

In most cases it is not necessary to extract slices to zones, as it is possible to apply most style options directly to a slice. When you need to display multiple sets of slices in various directions, or simply want to "freeze" a slice for some other reason, you may wish to extract at least some of the slices to zones.



Extracting slices has the following options:

- **Group:** Select between an individual group extraction or all active groups extraction, where active means slices visible on the screen.
 - **Slice Group:** Select from the dropdown menu which group is extracted to a zone.
 - **All Active Slice Groups:** Extracts slice groups that are set to active.
- **Time:** Specify between extracting a slice for all solution times or the current solution time.
 - **Current Solution Time:** Extract a slice for the active solution time.
 - **All Solution Times:** Extract a slice for each solution time.
- **Create a zone for each:** Specify how each slice is extracted into single or multiple zones.
 - **Slice:** Extracts each slice to a single zone.
 - **Connected Region:** Extracts each slice to its connected regions. Connected regions are defined by zone boundaries and areas of disconnected meshes.
- **Resulting 1D Zone Type:** Only active when the slice source is not a volume.

Slices

- **I-ordered If Possible:** Creates an I-ordered zone for each slice zone that is a single connected region.
- **FE Line Segment:** Creates all extracted linear zones as FE-LineSeg zones.

Values in the extracted slice are nodal unless Contour Type is set to Primary Value flood on the Contour page of the Slice Details dialog. In this case, the value location for the extracted slice is the same as for the source zones.

Streamtraces

A streamtrace is the path traced by a massless particle placed at an arbitrary location in a steady-state vector field. Streamtraces may be used to illustrate the nature of the vector field flow in a particular region of the plot.

Because streamtraces are dependent upon a vector field, you must define vector components before creating streamtraces in Tecplot Focus. However, it is not necessary to activate the Vector zone layer to use streamtraces.

To add streamtraces to your plot, toggle-on "Show Streamtraces" in the **Streamtrace Details** dialog or in the Plot sidebar and use either the Add Streamtrace tool  in the toolbar or the Plot sidebar, or the **Create Streams** button on the Position page of the **Streamtrace Details** dialog, to specify the location of your streamtraces.

When working with the Add Streamtrace tool, click to individual streamtraces, or drag to seed a rake (group) of streamtraces.

To create streamtraces with a format other than Surface Line, select a format from the "Create Streamtraces with Format" drop-down menu on the Position page of the **Streamtrace Details** dialog.

If you are drawing a rake on concave 3D volume surfaces using the Add Streamtrace tool, hold down the Shift key to draw the rake outside of the data.

There are two main categories of streamtraces:

- **Surface line streamtraces (or streamlines)** - Surface streamtraces are confined to the surface on which they are placed. They can be placed in zones displayed as a 2D or 3D surface, or on a displayed boundary of a 3D zone, such as the K=1 face of an IJK-ordered zone. If you try to place surface streamtraces in the interior of a zone displayed as a 3D volume, an error message appears, and no streamtraces are drawn. See [Section 15 - 1.2 "Lines Page"](#). When surface streamtraces are placed on a no-slip boundary surface, they will propagate according to the flow field very near the surface (see [Section 15 - 2 "Surface Streamtraces on No-slip Boundaries"](#) for more information).
- **Volume streamtraces** - Volume streamtraces can be created in 3D volume zones only (IJK-ordered or FE-volume zones). See [Section 15 - 1.3 "Rod/Ribbon Page"](#). Volume streamtraces are subdivided into three categories:
 - Volume Lines, or volume streamlines.

Streamtraces

- Volume Ribbons, or streamribbons.
- Volume Rods, or streamrods.



If you have added streamtraces to your plot, but cannot see them, go to the Volume page of the **Zone Style** dialog and verify that Show Streamtraces is set to "Yes". Refer to [Section 7 - 1.3 "Derived Volume Object Plotting"](#) for details.

15 - 1 Streamtrace Details dialog

You can control the style of your streamtraces using the **Streamtrace Details** dialog (accessed via **Plot>Streamtraces** or the  button to the right of the Streamtraces checkbox in the Plot sidebar). These style attributes affect all streamtraces in the active frame, including those already placed. They do not affect extracted streamtrace zones, discussed in [Section 15 - 3 "Streamtrace Extraction as Zones"](#), because these are ordinary ordered zones, and not streamtraces.



In order for the changes made on the Streamtrace Details dialog to be visible in your plot, you must have Show Streamtraces toggled on in the dialog, or Streamtraces toggled on in the Plot sidebar.

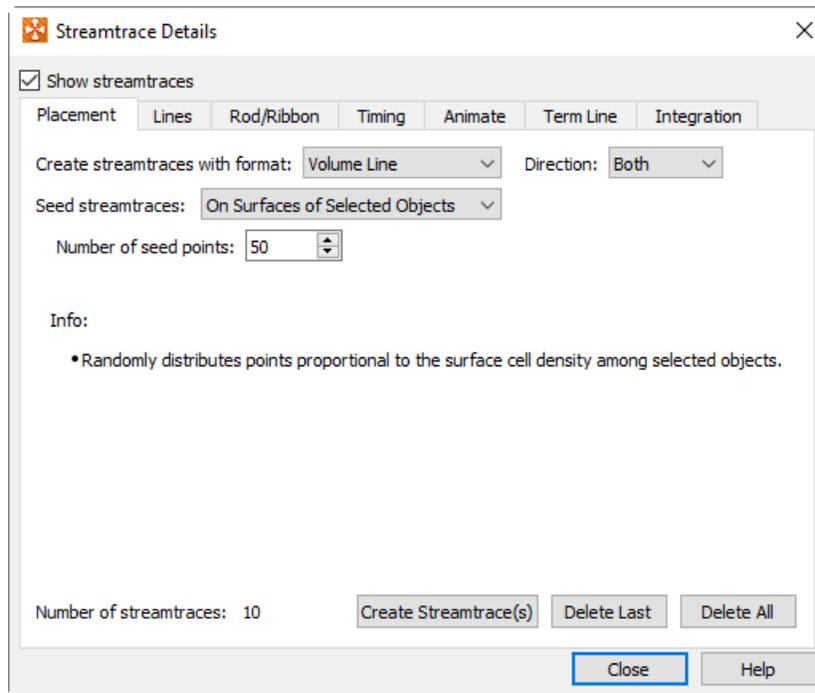
The Streamtrace Details dialog has seven pages:

- [Placement Page](#)
- [Lines Page](#)
- [Rod/Ribbon Page](#)
- [Animate Page](#)
- [Term Line Page](#)
- [Integration Page](#)

The dialog includes a checkbox at the top to globally turn the display of streamtraces on or off. This is available on all pages of the dialog and is the same as the corresponding checkbox in the Plot sidebar.

15 - 1.1 Placement Page

Use the Placement page of the **Streamtrace Details** dialog (accessed via the Plot sidebar or **Plot>Streamtraces**) to control the next streamtrace or streamtrace rake to be placed.



Alternatively, you can add streamtraces using the Add Streamtrace tool . See also "[Add Streamtrace](#)" on page 31.

The following options are available:

- **Create Streamtraces with Format** - Choose the format for the next streamtrace from the drop-down. The options are as follows:
 - **Surface Line** - Two-dimensional and 3D surface streamlines. Surface lines are confined to the surface upon which they are placed, which may be surface zones or displayed boundaries of volume zones. If placed in the interior of a 3D volume zone (such as on a slice through the zone), these streamtraces are not plotted.
 - **Volume Line** - Three-dimensional volume streamline plotted through 3D space. The streamline path is integrated in three dimensions within the 3D volume field.
 - **Volume Ribbon** - Three-dimensional volume streamtrace with a defined thickness that twists in accordance with the local stream-wise vorticity of the vector field: a streamribbon. When you select this option, you should also check the ribbon width on the Rod/Ribbon page of the **Streamtrace Details** dialog. The width affects all streamtraces, including those already placed. The default width is automatically calculated based on the extent of your data, but it may still be too large. The center of the streamribbon is a 3D volume streamline. The streamribbon rotates about this streamline in accordance with the local vector field. Streamribbons have an orientation at each step.
 - **Volume Rod** - Three-dimensional volume streamtrace with a defined thickness and a polygonal cross-section: a streamrod. The cross-section of a streamrod rotates around a volume streamline in accordance with the local stream-wise vorticity. The center of the streamrod is a regular 3D volume streamline. Streamrods have an orientation at each

step. As with streamribbons, you should check the rod width on the Rod/Ribbon page of the **Streamtrace Details** dialog, as well as the number of rod points (three, by default). The number of points indicates the cross-sectional shape of the rod. Three is an equilateral triangle; four, a square; five, a regular pentagon; and so forth. Like the width parameter, the number of points applies to all streamrods, including those already placed.

- **Seed Streamtraces** - Choose the method for seeding the streamtraces. This will determine the options available in the central portion of the dialog.
 - **Using Streamtrace Placement Tool** - Click on the plot to seed a stream at the clicked point. Click and drag to seed a rake (a series of streamtraces) of the specified number of equally-spaced points along the path.
 - **On Surfaces of Active Zones** - Tecplot Focus randomly distributes the specified number of seed points on the active zones.
 - **On Surfaces of Selected Objects** - Tecplot Focus randomly distributes the specified number of seed points on the surfaces of the selected objects.
 - **By Entering XYZ Positions** - Specify the placements of the seed point or rake numerically by entering XYZ coordinates in the position fields, which appear when you choose method of placing streamtraces.
 - **By Entering IJK Positions** - Same as above, except you enter IJK coordinates in the position fields. In this case you must also choose a zone.
- **Direction** - Select the stream integration direction from the following options:
 - **Forward** - Select for forward integration from the starting point.
 - **Backward** - Select for backward integration from the starting point. When the streamlines are calculated backwards, the arrowheads still point in the forward direction.
 - **Both** - Select for both forward and backward integration from the starting point. (For streamribbons and streamrods, you should avoid this option.)
- **Number of Seed Points** - Enter the number of seed points here. When placing streamtraces using XYZ or IJK positions, this field is available only when creating a rake; the specified number of streamtraces will be created at equal intervals between the
- **Position fields** (Only for XYZ or IJK Positions) - Specify the position of the start point, or the range of the rake (series of streamtraces), in IJK or XYZ coordinates.
 - **Zone** (Only for IJK) - Select from the drop-down the zone for which the I, J, (and K) indices are being specified.
 - **Create Rake** - Select to identify the starting position as the start of a rake and to activate the Rake Ending Position fields.
 - **Streamtrace Start Position** - Specify the starting position for a single streamtrace, or (if "Create Rake" is selected) the beginning of a rake of streamtraces. There are two or three fields, labeled either X, Y, (and Z) or I, J, (and K). Enter the desired value in each field, or use the up and down arrows to increase or decrease the values.
 - **Rake End Position** (Only if Create Rake is selected) - Specify the end position for a rake of streamtraces. There are two or three fields, labeled either X, Y, (and Z) or I, J, (and K). Enter the desired value in each field, or use the up and down arrows to increase or decrease the values.
- **Create Streamtraces** - Click to seed the streamtrace or rake of streamtraces. Not available when using the streamtrace placement tool; click on the plot instead.
- **Number of Streamtraces** (Information only) - The number of streamtraces currently placed.
- **Delete Last** - Select to delete the last streamtrace or rake placed.

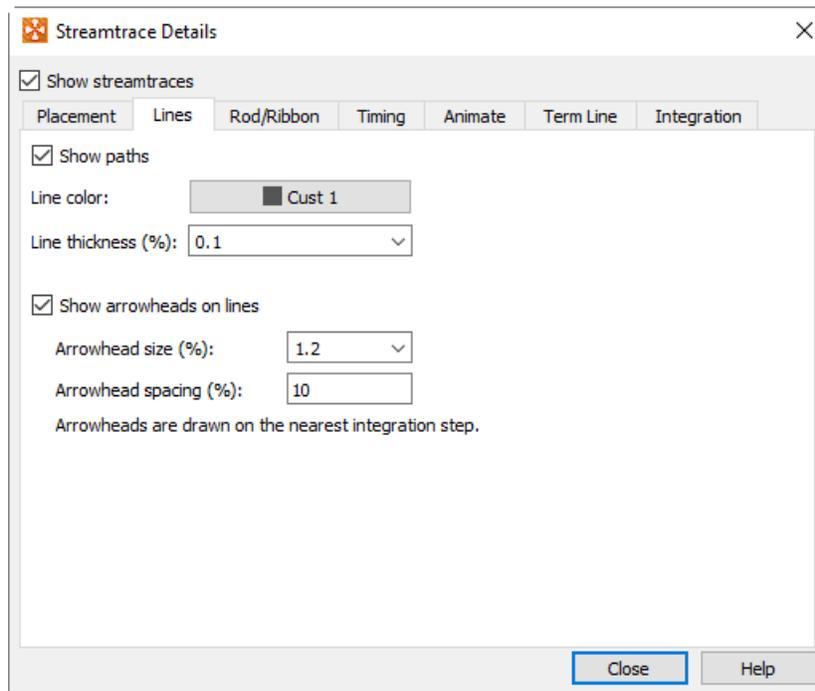
- **Delete All** - Select to delete all streamtraces in the current plot.



1, 2, 3, 4, 5, 6, 7, 8, 9 - When the Streamtrace tool is selected, press 1-9 to change the number of streamtraces to add when placing a rake of streamtraces.

15 - 1.2 Lines Page

Surface streamtraces or streamlines are confined to the surface on which they are placed. They can only be placed in zones displayed as a 2D or 3D surface. If you try to place streamlines in a zone displayed as a 3D volume, an error dialog appears, and no streamlines are drawn. The following attributes may be set with the Lines page of the **Streamtrace Details** dialog. You cannot customize streamtraces using the Lines page until after at least one streamtrace has been drawn.



- **Show Paths** - Toggle-on to include streamtraces in your plot.
- **Line Color** - Select the color for all streamtraces in the Color Chooser. You may set the color to Multi-color to color the streamtraces by the chosen contour group variable in the same manner as color flooding. (If the contour variable is not currently defined, the **Contour Variable** dialog appears so that you can define it.) You can use the Multi-color option, for example, to color the streamtraces by the local temperature or by the velocity magnitude. You can also specify RGB coloring.

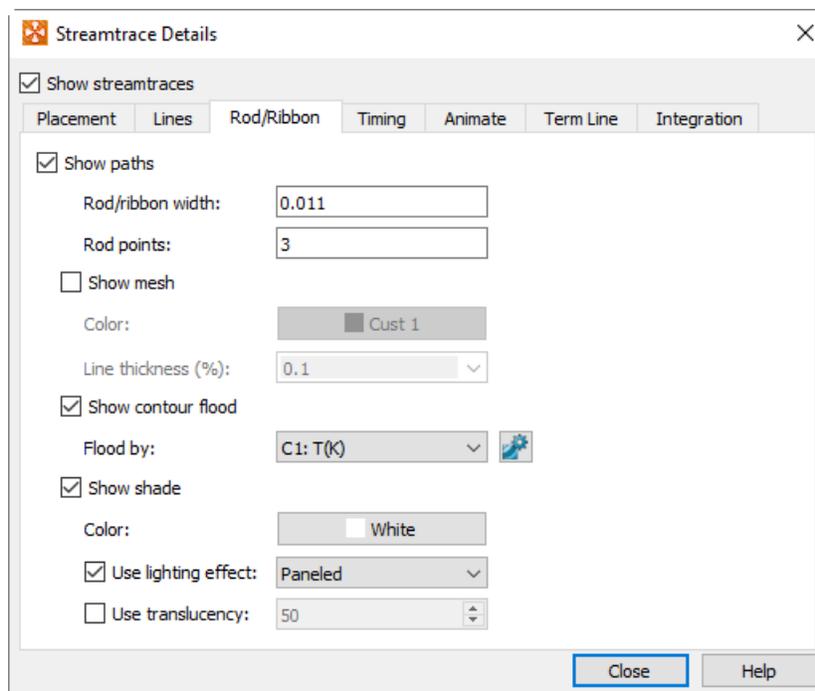
The following attributes affect surface and volume streamlines:

- **Line Thickness** - Enter a value, or choose a pre-set value for the streamline thickness (as a percentage of the frame height for 2D lines and as a percentage of the median axis length for 3D surface lines and volume lines), or choose a pre-set value from the drop-down menu.
- **Arrows** - Toggle-on **Show Arrowheads on Lines** to display arrowheads along all streamlines (surface and volume) in the active frame. Arrows are not shown on volume ribbons or volume rods. You can also control the following attributes of the displayed arrows:

- **Arrowhead Size** - Either enter a value for the arrowhead size (as a percentage of the frame height), or choose a pre-set value from the drop-down menu.
- **Arrowhead Spacing** - Enter the distance between arrowheads in terms of Y-frame units. A value of ten percent will space arrowheads approximately ten percent of the frame height apart from each other along each streamline.

15 - 1.3 Rod/Ribbon Page

The following attributes may be set with the Rod/Ribbon page of the **Streamtrace Details** dialog. They affect volume ribbons and volume rods only. You cannot customize streamtraces using the Rod/Ribbon page until after at least one streamtrace has been drawn.



- **Show Paths** - Toggle-on to include streamtraces in your plot.
- **Rod/Ribbon Width** - Enter a width for the volume ribbons and volume rods. The width is expressed in grid units. If you want two sets of streamtraces with different widths, you must create them individually by creating a set of streamtraces with a specific width, extracting the set as a zone, and then configuring a new set of streamtraces with the second width. See [Section 15 - 3 "Streamtrace Extraction as Zones"](#).
- **Rod Points** - Volume rods have a polygonal cross-section; this parameter tells Tecplot Focus what that cross-section should be. (Three is an equilateral triangle, four is a square, five is a regular pentagon, and so on.) If you want two sets of volume rods with different cross-sections, you must create one set and then extract the set as a zone, then configure a new set of streamtraces with the second cross-section. See [Section 15 - 3 "Streamtrace Extraction as Zones"](#).
- **Show Mesh** - Toggle-on to display a mesh.
 - **Color** - Select a mesh color in the Color Chooser, or choose a custom color or multi-color.
 - **Line Thickness** - Select a line thickness from the drop-down menu, or enter your own number in the text field.
- **Show Contour Flood** - Toggle-on to display contour flooding.
 - **Flood by** - Select the contour group to flood.

-  - Use this button to display the [Contour & Multi-Coloring Details](#) dialog.
- **Show Shade** - Toggle-on to display shading.
- **Color** - Select a shade color in the Color Chooser. Multi-color and RGB coloring are not available (use contour flooding instead).
- **Use Lighting Effect** - Toggle-on to enable the lighting effect drop-down menu, from which you can select "Paneled" or "Gouraud" shading.
- **Use Surface Translucency** - Toggle-on to enable the surface translucency text field, where you can set the surface translucency from one (nearly opaque) to 99 (nearly transparent).

15 - 1.4 Timing Page

Use the Timing page of the **Streamtrace Details** dialog (accessed via the Plot sidebar or **Plot>Streamtraces**) to control timed markers for streamlines, and timed dashes for all types of streamtraces. Stream markers are drawn at time locations along streamlines. The spacing between stream markers is proportional to the magnitude of the local vector field.

Stream markers are symbols plotted along streamtrace paths to identify the positions of particles at certain times. [Figure 15-1](#) shows a plot with both streamtrace markers and dashes.

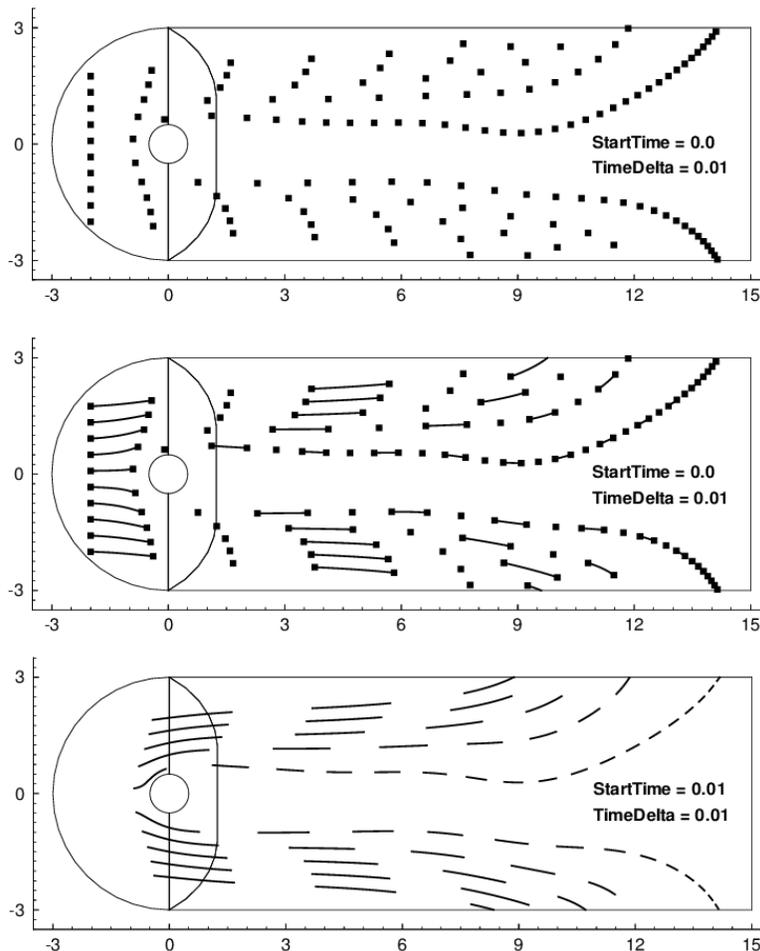


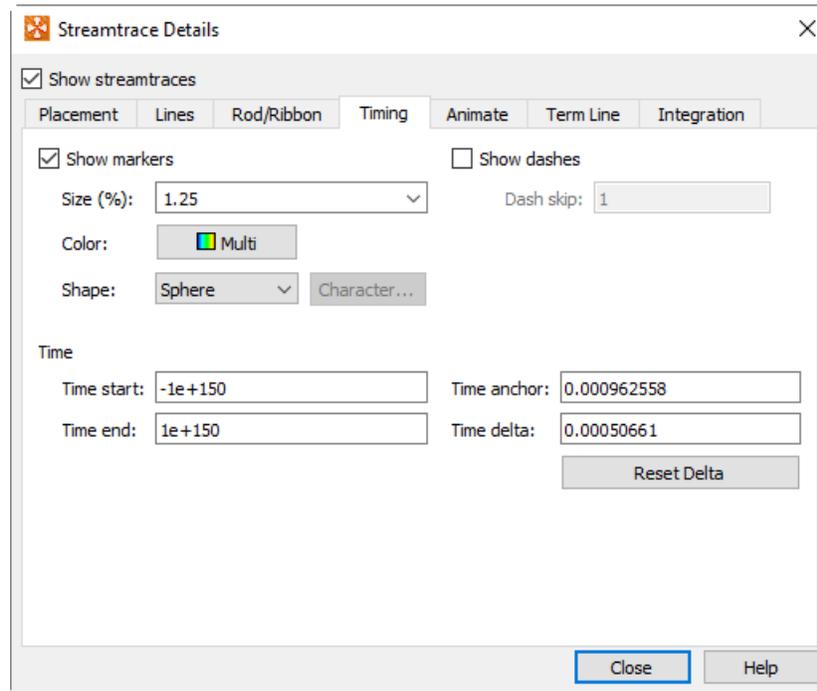
Figure 15-1. Streamtrace markers (top), dashes (bottom), and both (middle).

The spacing between stream markers is proportional to the magnitude of the local vector field. You can adjust the spacing between stream markers by specifying the time interval (or delta) between stream

markers. Increasing the delta time will increase the space between stream markers and vice versa. The actual spacing is the product of the local vector magnitude and the specified delta.

You may also select the shape of your stream marker using the pre-set list under the **Shape** drop-down menu on the Timing page of the **Streamtrace Details** dialog. Selecting "Other" from the list activates the Enter ASCII Character option, where you may enter an ASCII character to be used as your stream marker.

To place stream markers or dashes along your streamtraces, open the Timing page of the **Streamtrace Details** dialog (accessed via the Plot sidebar or the **Plot** menu).

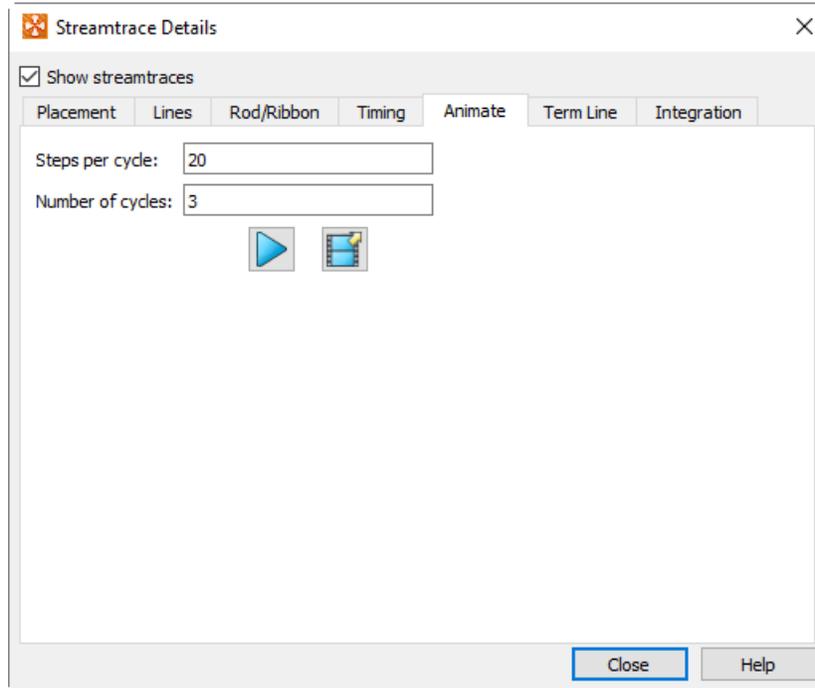


The Timing page has the following options:

- **Show Markers** - Toggle-on to include stream markers. Stream markers are only available for streamlines (surface and volume). Specify the size, color, and shape of the markers in the fields provided. The default marker shape is a sphere (in 3D plots) or a circle (2D).
- **Show Dashes** - Toggle-on to include stream dashes. The lengths of the dashes and the spaces between the dashes are controlled by the value of Delta. Enter a value into the Dash Skip field to control the number of time deltas used for the "off" sections of the streamtraces.
- **Time Start** - Enter the time at which the first marker should be drawn. A start time of zero means that the first marker is drawn at the starting point. A start time of 2.5 means that the first stream marker is drawn 2.5 time units downstream of the starting point.
- **Time End** - Enter the time after which no more stream markers are drawn.
- **Time Anchor** - Enter the time that a dash is guaranteed to start, provided the start and end time surround the dash.
- **Time Delta** - Enter the time interval that measures the time between stream markers. The actual distance between markers is the product of this number and the local vector magnitude. Click **Reset Delta** to reset this to the default value.

15 - 1.5 Animate Page

The Animate page controls animation of streamtraces.



You may specify the number of steps per cycle, the number of cycles, and the destination for animation (the screen or a file). Click the **Animate** button to begin animation and see [Chapter 27: "Animation"](#) for further details.

15 - 1.6 Term Line Page

A streamtrace termination line is a polyline that terminates any streamtraces that cross it. The termination line is useful for stopping streamtraces before they spiral or stall. [Figure 15-2](#) shows the cylinder data with some streamtraces terminated by a 2D streamtrace termination line.

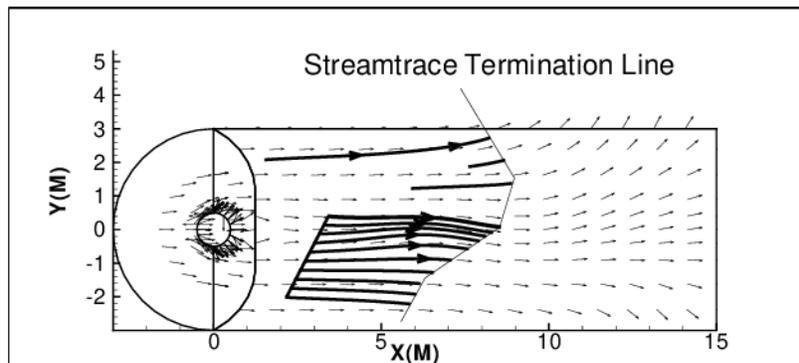
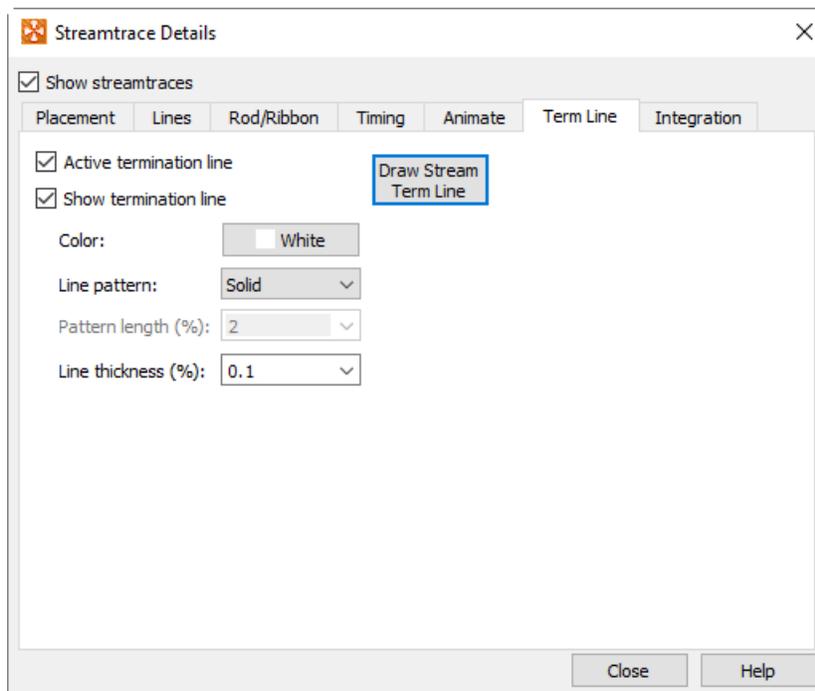


Figure 15-2. A streamtrace termination line drawn through surface streamlines.

Streamtraces are terminated whenever any of the following occur:

- The maximum number of integration steps is reached.
- Any point where the streamtrace passes outside the available data.
- The streamtrace reaches a point where the velocity magnitude is zero.

You control the streamtrace termination line from the Term Line page of the **Streamtrace Details** dialog.



From the Term Line page, you can control the following attributes of the termination line:

- **Active Termination Line** - Toggle-on to activate the termination line and terminate any streamtraces that cross it. Toggle-off this option and redraw the plot to view unterminated streamtraces.
- **Draw Stream Term Line** - Click to draw the termination line on the plot. This is the same as choosing the  button on the toolbar. Click the individual points on the plot that make up the termination line, then double-click to end the line construction.
- **Show Termination Line** - Toggle-on to display the termination line. Toggle-off this option and redraw the plot to display terminated streamlines (if the termination line is active), but not the termination line itself.
 - **Color** - Choose the color of the termination line in the Color Chooser.
 - **Line Pattern** - Choose the pattern for the termination line.
 - **Pattern Length** - The length of the pattern as a percentage of frame height.
 - **Line Thickness** - The thickness of the termination line as a percentage of frame height.

You can select a termination line with the Selector or Adjustor tool. This allows you to interactively move the line (with the Selector), modify the line (with the Adjustor), or delete the line (with either tool).



Only one termination line can exist at any one time in a given frame. If you draw a second termination line, the first one is automatically deleted.

Termination Lines in the Eye Coordinate System

The streamtrace termination line is drawn in the grid coordinate system, which in 2D Cartesian plots moves with the data as you zoom and translate. In 3D Cartesian plots, the termination line is drawn in what is known as the *eye coordinate system*. Grid coordinates align with the eye coordinate system, therefore the termination line moves with the data as you zoom and translate, but remains fixed when you rotate the plot.

When you rotate a 3D dataset after drawing a streamtrace termination line, streamtraces previously terminated by the termination line may be terminated at different places, or not terminated at all if the rotated streamtrace no longer intersects the termination line. [Figure 15-3](#) shows a 3D volume plot with streamribbons and a streamtrace termination line. This figure illustrates how the termination points vary as the plot is rotated. Notice that the termination line, being rendered in the eye coordinate system, remains in place on the screen as the plot is rotated.

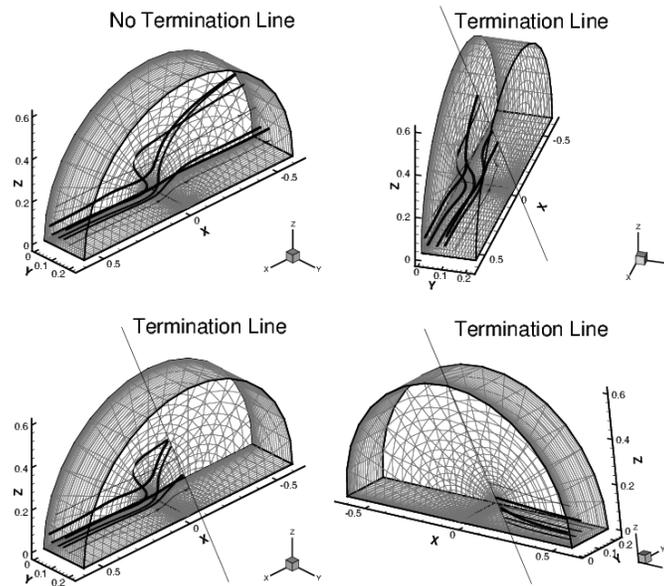
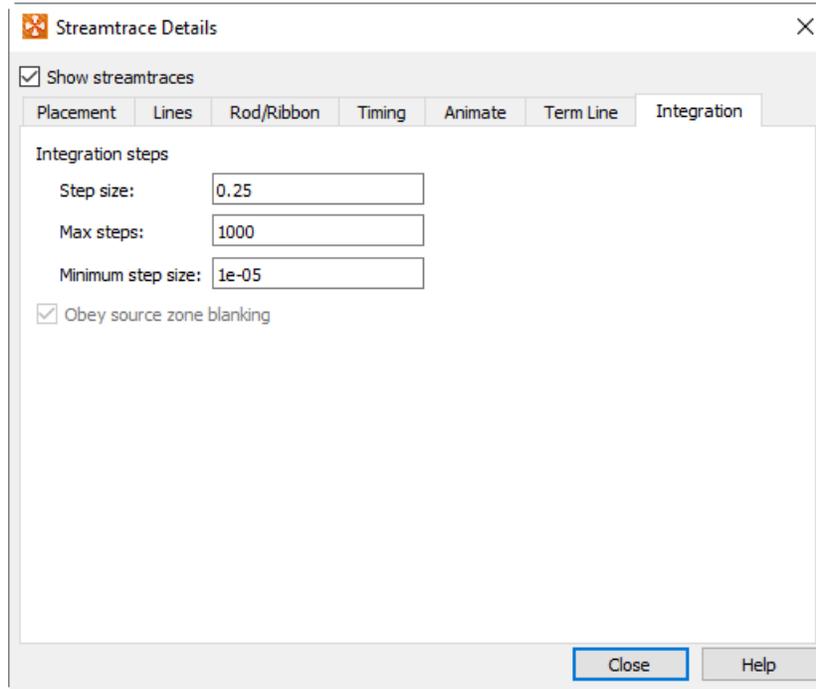


Figure 15-3. Rotating Volume streamtraces with a termination line in the eye coordinate system.

15 - 1.7 Integration Page

Tecplot Focus uses an adaptive step-size, trapezoidal integration algorithm to calculate streamtraces. This creates the streamtrace by moving it in a series of small steps from the starting point in the direction of (or in opposition to) the local vector field. Each step is only a fraction of a cell or element. Tecplot Focus automatically adjusts the step size based on the local cell shape and vector field variation.

You can control the streamtrace integration by modifying the following parameters in the Integration page of the **Streamtrace Details** dialog:



- **Step Size** - Enter the initial and maximum step size Tecplot Focus uses while integrating through the vector field as a decimal fraction of the local cell or element width. A typical value (and the default) is 0.25, which results in four integration steps through each cell or element. The value for Step Size affects the accuracy of the integration. Setting Step Size too small can result in round-off errors, while setting it too large can result in truncation errors and missed cells.
- **Max Steps** - Enter the maximum number of steps before the streamtrace is terminated. This prevents streamtraces from spinning forever in a vortex, or from wandering into a region where the vector components are very small, very random, or both. If you choose a small Step Size, you should enter a larger Max Steps.
- **Minimum Step Size** - The smallest step size for Tecplot Focus to use. Setting this too small results in integration problems. Setting this greater than or equal to the Step Size results in a constant step size.
- **Obey Source Zone Blanking** - When active, streamtraces are generated for non-blanked regions only. When inactive, streamtraces are generated for both blanked and unblanked regions.

During the integration, a streamtrace is terminated if any of the following conditions occur:

- The maximum number of integration steps (Max Steps) have been taken.
- Any point the streamtrace passes outside the available data.
- The streamtrace reaches a point where the velocity magnitude is zero.
- The streamtrace crosses the stream termination line.

When there is a small gap between the zones, streamtraces will terminate at a zone boundary even if there is an adjacent zone into which the streamtraces should proceed. Specifying face neighbors in the data file to connect the zones can reduce this issue. Increasing the minimum integration step size can also ameliorate this problem.

15 - 2 Surface Streamtraces on No-slip Boundaries

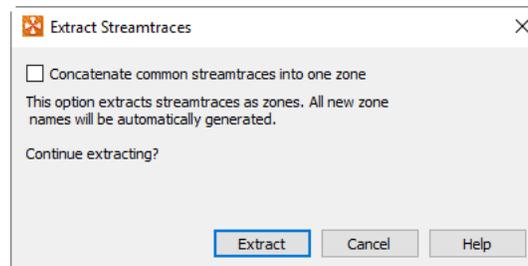
A no-slip boundary is the boundary of a volume zone whose vector variables are either passive or are zero throughout the boundary. The boundary may be either a displayed boundary of a volume zone (included in the zone's Surfaces to Plot setting in the Zone Style dialog), or a surface zone that resides on the boundary of a volume zone. In the latter case, the surface zone's nodes must coincide with nodes on the exterior of one or more volume zones. For either case, blanked regions of the surface are not considered when determining whether a boundary is a no-slip boundary. That is, if value blanking or IJK blanking is enabled, then only the non-blanked portion of the surface is examined to determine if it is a no-slip boundary.

When surface streamtraces are placed on a no-slip boundary, they propagate according to the normal gradient of tangential velocity (proportional to shear stress) at the surface, calculated using vector variable values from the nearby interior of the volume zone. If the solution is unsteady, only volume zones in the currently displayed solution time will be used. If the boundary is a surface zone, then corresponding volume zones needn't be displayed in the current plot (they may be turned off in the Zone Style dialog), but preference will be given to volume zones that have non-zero velocity, and that are active (not turned off in the Zone Style dialog).

If you extract a surface streamtrace, the velocity component variables in the resulting zone (which would normally be set to zero because the velocity on the surface is zero) are replaced with the gradient of the tangential velocity that was used to calculate the streamtrace.

15 - 3 Streamtrace Extraction as Zones

Normally, streamtraces are derived from the dataset "on the fly" and do not add any data to the dataset. To extract existing streamtraces to zones, allowing you to retain them even if streamtrace settings are changed, choose **Extract>Streamtraces** from the **Data** menu.



If you want all streamtraces of a given format extracted to a single zone, select the toggle-on "Concatenate common streamtraces into one zone" in the **Extract Streamtraces** dialog. If you select this option, Tecplot Focus extracts all surface lines into one zone, all volume lines into another, all volume ribbons into a third, and all volume rods into a fourth. Tecplot Focus uses FE zones (FE-Line segment for streamlines and FE-Quad for rods and ribbons). If you do not select this option, and timing is not turned on to show dashes, each streamtrace is extracted into its own ordered zone (I-Ordered for streamlines and IJ-Ordered for rods and ribbons).

After you have extracted your streamtraces, you will still see the original streamtraces, which may obscure the plotted streamtrace zones. Once you have extracted the zones, you can delete the original streamtraces by selecting [Delete All] on the Position page of the **Streamtrace Details** dialog. If timed dashes are active, all extracted streamtraces will be finite element zones. Otherwise, all extracted streamline zones are I-ordered, and extracted volume ribbon and volume rod zones are IJ-ordered.

15 - 4 Streamtrace Errors

Streamtraces will not appear under the following conditions:

Streamtraces

- Unorganized data (I-ordered zones). Refer to [Section 3 - 6 "Working with Unorganized Datasets"](#) for information on organizing unorganized data.
- Zero-valued vectors. Refer to [Chapter 10: "Vector Layer"](#) for information on working with vectors.
- The streamtrace was placed outside of the data. If you are drawing a rake on a concave 3D volume surfaces, hold down the Shift key to draw the rake outside of the data.
- Inappropriate integration step size. Refer to [Section 15 - 1.7 "Integration Page"](#) for information on integrating streamtraces.

Iso-surfaces

An iso-surface displays a constant value of the contour variable as a surface on your plot. Iso-surfaces require that the data set contains volume zones (IJK-ordered, brick or tetrahedral zones). You can modify iso-surfaces in the **Iso-Surface Details** dialog, which you can access by selecting the  button next to the Iso-surfaces toggle in the Plot sidebar. Or you can open the **Iso-Surface Details** dialog by selecting "Iso-Surfaces" from the **Plot** menu. Finally, you may right-click an iso-surface in your plot and use the context menu and toolbar to make quick changes to its settings.

The context toolbar appears above the context menu when you right-click an iso-surface. This toolbar allows you to turn on or off the grid, contour, shade, and translucency layers for the selected iso-surface(s). Additionally, you may adjust frequently-used style settings for each layer using the drop-down menu to the right of each, for example selecting a color for the grid (or choosing a variable by which to color it).



To view changes made in the **Iso-surface Details** dialog in your plot, you must have "Iso-surfaces" toggled on in the Plot sidebar.

16 - 1 Iso-Surface Groups

You can work with up to eight different iso-surface groups in Tecplot Focus. Zone layers or other objects that reference the same group for an attribute show the same plot style for that attribute. Each iso-surface group has its own settings for the attributes set in the **Iso-surface Details** dialog. Refer to the following sections for details on each attribute. Choose the desired group number from 1-8 at the top of the dialog, then toggle-on the "Show Group *n*" checkbox to include the corresponding iso-surface group in your plot.



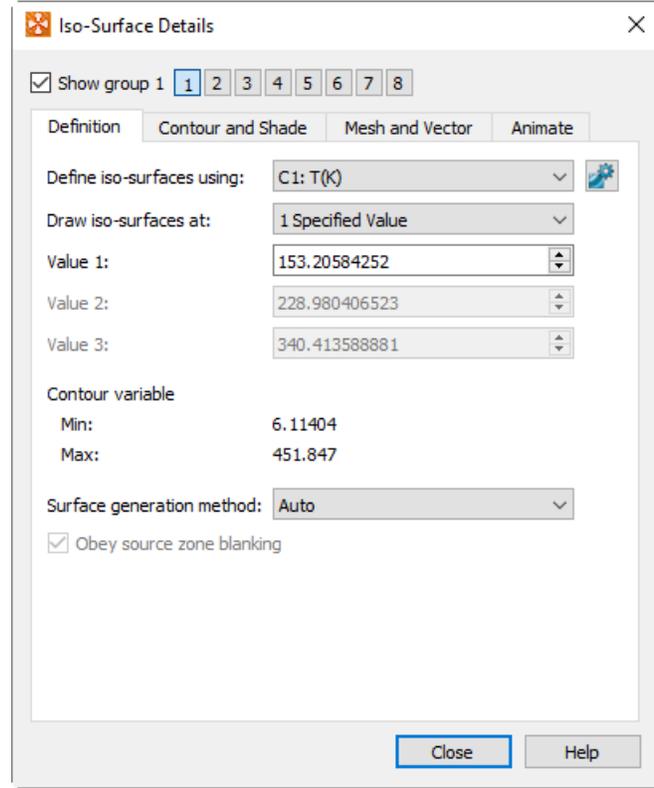
If you have added iso-surfaces to your plot, but cannot see them, go to the Volume page of the **Zone Style** dialog and verify that Show Iso-surfaces is set to "Yes". Refer to [Section 7 - 1.3 "Derived Volume Object Plotting"](#) for details.

16 - 2 Iso-Surface Definition

Use the Definition page of the **Iso-Surface Details** to control Tecplot Focus's rendering of iso-surfaces. Tecplot Focus applies the attributes set on this page (and on every page of the dialog) to the Iso-Surface group selected at the top of the dialog next to the Show Group toggle.

The Definition page of the dialog includes the following controls:

- **Show Group n** - Select this check box to display iso-surfaces, where *n* can be 1-8.
- **Define Iso-Surfaces using** - Use this drop-down menu to select the desired contour group. Use the nearby  button to display the **Contour & Multi-Coloring Details** dialog, where you can define contour groups. (See [Section 9 - 2 "Contour & Multi-Coloring Details"](#).)
- **Draw Iso-Surfaces at** - Use this drop-down menu to have Tecplot Focus draw iso-surfaces at:
 - **Contour Group Levels** - Go to the **Contour & Multi-Coloring Details** dialog (accessed with the  button) to alter the Contour Levels. Refer to [Section 9 - 2.2 "Contour Levels and Color"](#) for details.
 - **At Specified Value(s)** - Specify up to three values of the contour variable at which to draw iso-surfaces.
- **Contour Variable Min/Max** - Indicates the minimum and maximum values of the contour variable.
- **Surface Generation Method** - Determines how the surface is generated.
 - *Auto* selects one of the surface generation algorithms best suited for the zones participating in the iso-surface generation. "All Polygons" is used if one or more of the participating zones is polytope, otherwise iso-surfaces use "All Triangles" unless the iso-surface is defined by a coordinate variable in which case "Allow Quads" is used.
 - *Allow Quads* can produce quads or triangles, and the resulting surface more closely resembles the shape of the volume cells from the source zone. Since the quads are not arbitrarily divided into triangles, no biases are introduced, and the resulting surface may appear smoother. This method is preferred when the source zone is FE-Brick or IJK-Ordered and the surface is aligned with the source cells.
 - *All Triangles* is an advanced algorithm that can handle complex saddle issues and guarantees that there will be no holes in the final surface. As the surface is composed entirely of triangles, it can be delivered more efficiently to the graphics hardware.
 - *All Polygons* is similar to the "All triangles" method except that all interior faces generated as a result of triangulation that are not part of the original mesh are eliminated. This preserves the original mesh of the source zones on the resulting iso-surface.
- **Obey Source Zone Blanking** - When active, iso-surfaces are generated for non-blanked regions only. When inactive, iso-surfaces are generated for blanked and unblanked regions.

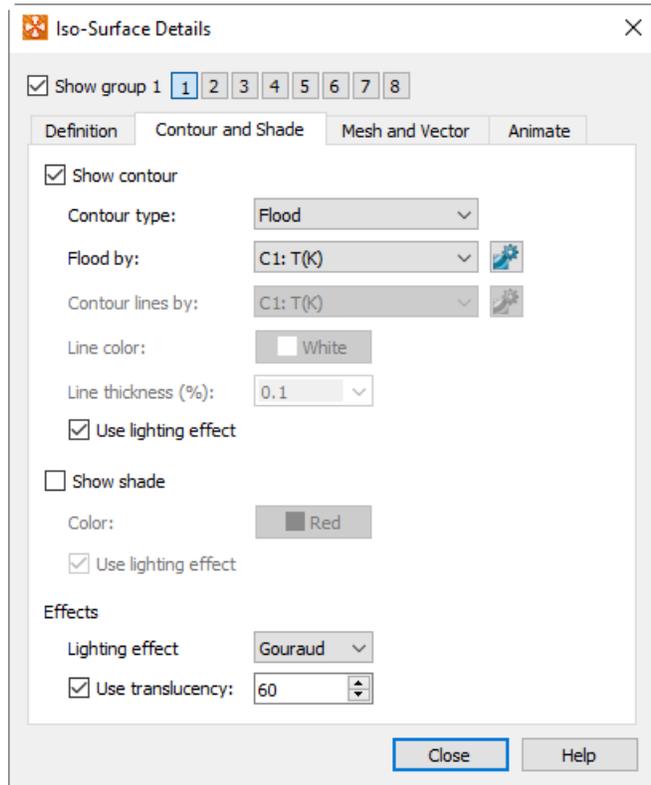


16 - 3 Iso-Surface Contour and Shade

The Contour and Shade page of the **Iso-Surface Details** dialog controls the contour and shade style settings for all iso-surfaces. (These styles act independently of the style assigned to zones by the **Zone Style** dialog.) Tecplot Focus applies the attributes set on this page (and every page of the dialog) to the Iso-Surface group selected at the top of the dialog next to the Show Group toggle.

The Contour and Shade page of the dialog includes the following controls:

- **Show Contour** - Toggle-on "Show Contour" to display contours on iso-surfaces.
 - **Contour Type** - Select the contour type from the drop-down. Lines, Flood, Lines and Flood, Average Cell Flood, and Primary Value Flood are available.
 - **Flood by** - If you chose contour flooding, select the contour group by which to flood the contours, or select RGB flooding. Use the nearby  button to bring up the **Contour & Multi-Coloring Details** dialog, where you can define contour groups. (See [Section 9 - 2 "Contour & Multi-Coloring Details"](#).)
 - **Contour Lines by** - If you chose contour lines, select the contour group by which to draw lines. Use the nearby  button to display the **Contour & Multi-Coloring Details** dialog to define contour groups.
 - **Line Color** - If you chose contour lines, click Line Color to select a line color in the Color Chooser.
 - **Line Thickness** - If you chose contour lines, select a contour line thickness from the drop-down menu, or enter your own number in the text field.
 - **Use Lighting Effect** - Toggle-on to enable the lighting effect selected in the Light effect drop-down menu.
- **Show Shade** - Toggle-on to display shading on iso-surfaces.
 - **Color** - Select a shade color using the Color Chooser.
 - **Use Lighting Effect** - Toggle-on to enable the lighting effect selected in the Light effect drop-down menu.
- **Effects:**
 - **Lighting Effect** - Select between Paneled or Gouraud shading.
 - **Use Translucency** - Toggle-on to enable the surface translucency text field, where you may set the surface translucency from 1 (nearly opaque) to 99 (nearly transparent).

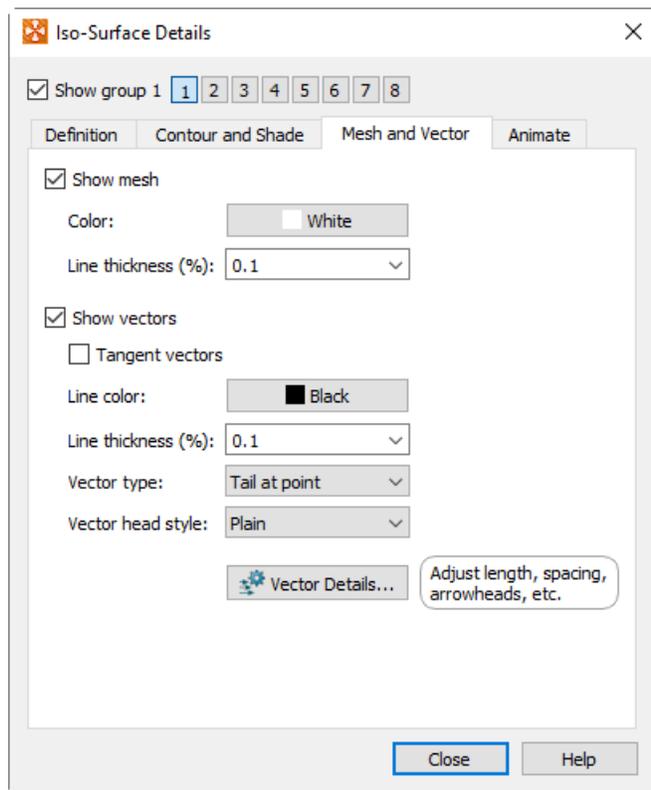


16 - 4 Iso-Surface Mesh and Vector

The Mesh and Vector page of the **Iso-Surface Details** dialog controls the mesh and vector style settings for all iso-surfaces. (These styles act independently of the style assigned to zones by the **Zone Style** dialog.) Tecplot Focus applies the attributes set on this page (and every page of the dialog) to the Iso-Surface group selected at the top of the dialog next to the Show Group toggle.

The Mesh and Vector page of the dialog includes the following controls:

- **Show Mesh** - Toggle-on "Show Mesh" to display the mesh on iso-surfaces.
 - **Color** - Select a mesh color in the Color Chooser.
 - **Line Thickness** - Select a mesh line thickness from the drop-down menu, or enter a number in the text field.
- **Show Vectors** - Toggle-on "Show vectors" to display the vectors on iso-surfaces.
 - **Tangent Vectors** - Select to use tangent vectors for your iso-surfaces. See [Section 10 - 2 "Vector Plot Modification"](#) for more information.
 - **Line Color** - Choose the line color from the Color Chooser. Multi-color will color vectors based on the contour group variable. If no contour variable is set for the selected contour group, the **Contour Details** dialog will appear.
 - **Line Thickness** - Specify line thickness as a percentage of the frame height. You may enter a value in the text field, or choose one of the values in the drop-down.
 - **Vector Type** - Use this drop-down to set the vector type for your iso-surfaces. Choose from Tail at Point, Head at Point, Anchor at Midpoint, and Head Only.
 - **Vector Head Style** - Use this drop-down to set the vector head style for your iso-surfaces. Choose from Plain, Filled, and Hollow.
 - **Vector Details...** - Opens the Vector Details dialog to adjust Vector length, spacing, arrowheads, etc.

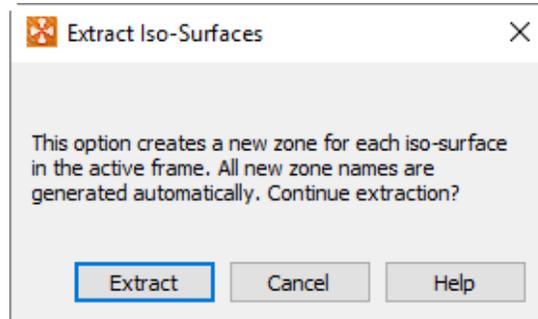


16 - 5 Iso-Surface Animation

Refer to [Section 27 - 1.4 "Iso-surfaces Animation"](#).

16 - 6 Iso-Surface Extraction

Normally, iso-surfaces are derived from the dataset "on the fly" and do not add any data to the dataset. To extract existing iso-surfaces to Tecplot zones, allowing you to retain them even if the contour variable is changed, select **Extract>Iso-Surfaces** from the **Data** menu.



When you click Extract, one new iso-surface zone is created for each iso-surface visible in your plot. All of the variables in the dataset are interpolated from the 3D volume zones to the data points of the iso-surfaces.

Iso-surface zones are FE-surface quadrilateral element-type zones, regardless of the original 3D volume zone types. The mesh of the iso-surfaces is derived from the mesh of the original zones so that, in regions where the original mesh was coarse, the iso-surface mesh is coarse, and where the original mesh was fine, the iso-surface mesh is fine.



After creating the new iso-surface zones, it is often a good idea to turn off or reconfigure the current settings for iso-surfaces because the new zones will occupy the same physical space as the original iso-surfaces.

Axes

Tecplot Focus automatically enables the axes for 3D, 2D, XY, and Polar plot types. There are five distinct sets of axes, one for each plot type. When the axes are generated, the axis labels, position, spacing, and tick mark labels are created. You can adjust any of these settings by using the **Axis Details** dialog (accessed via the **Plot** menu). Each page of the **Axis Details** dialog controls a different aspect of the axis, and each page is available for each axis.

17 - 1 Axis Display

Use the "Show Axis" toggle in the **Axis Details** dialog to turn on an axis display. By default, displaying an axis shows the axis line, tick marks, tick mark labels, and title for the axis. It is possible to disable any of these components separately, including the axis line.

To edit an axis from the **Axis Details** dialog, use the axis buttons ([X], [Y], [R], etc.) at the top of the dialog to indicate which axis you are working with. To edit a different axis, select a different axis button.



17 - 2 Axis Variable Assignment

For 2D and 3D Cartesian plots, Tecplot Focus initially assigns the first and second variables in the dataset to the X- and Y-axes, respectively. For 3D axes, the third variable in the dataset is assigned to the Z-axis.

To change variable assignments for 2D and 3D axes, select "Assign XY" or "Assign XYZ" from the **Plot** menu. For line plots, assigning axis variables is part of defining the mappings. See [Chapter 6: "XY and Polar Line Plots"](#) for more information.

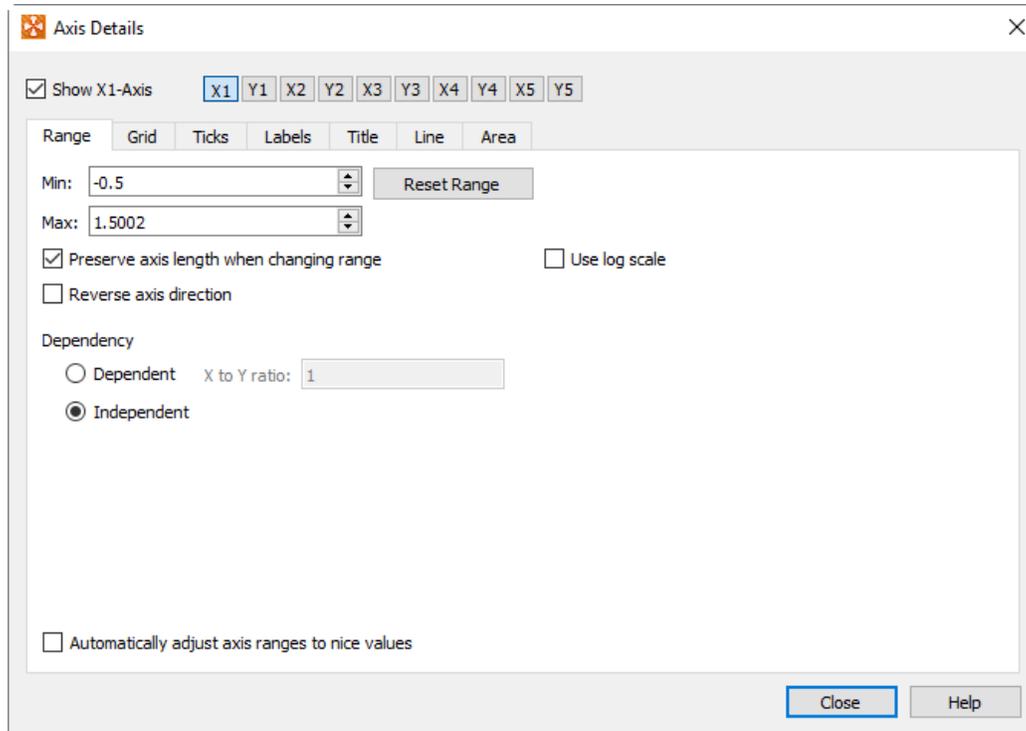
The axis range may be modified using the Range page of the **Axis Details** dialog, accessed via the **Plot** menu or by right-clicking an axis in a plot. See [Axis Range Options for XY and 2D/3D Plots](#) and [Axis Range Options for Polar Plots](#).

When working with axis ranges, please keep the following definitions in mind:

- **Axis Range** - Specifies the minimum and maximum data values displayed along the axis. The range for an axis fits the value of the first variable assigned to that axis. If you deactivate the current layer and activate another layer, it may be necessary to reset the axis range.
- **Axis Length** - Specifies the physical length of the axis on the screen or paper.
- **Axis Scale** - Specifies the ratio of the axis length to the axis range.

17 - 3 Axis Range Options for XY and 2D/3D Plots

This section discusses the options for XY Line, 2D Cartesian, and 3D Cartesian plots that can be found on the Range page of the **Axis Details** dialog.



The Range page has the following options:

- **Show Axis** - Toggle-on this checkbox to show the selected axis (n) on the plot. Use the buttons [X], [Y], etc. to the right of this checkbox to select the axis to show.
- **Min** - Enter the minimum value of the axis range.
- **Max** - Enter the maximum value of the axis range.
- **Reset Range** - Reset the **Max** and **Min** fields by selecting one of three options from the drop-down menu:
 - **Reset to Nice Values** - Sets the range to slightly larger than the current axis variable range in order to begin and end the axis at major axis increments.
 - **Set to Variable Min/Max** - Sets the range to the minimum and maximum variable values, considering the effects of blanking.
 - **Make Current Values Nice** - Rounds the axis range to the nearest major axis increment.
- **Preserve axis length when changing range** - If toggled-on, and your axes are Independent, changes to the X to Y Ratio will affect the axes' range, but not their scale. Toggle-off to change both the axis range and axis scale simultaneously. See [Figure 17-4](#) for an illustration of the difference.

- **Use log scale** - The X and Y axes of 2D or XY Line plots can have a linear scale (default) or logarithmic scale. When "Auto Spacing" is selected with logarithmic scale, large numbers are displayed in scientific notation (i.e., 3.48×10^5). It is strongly recommended that you use "Auto Spacing" with log axes. Navigate to the Ticks or Labels page of the dialog, and toggle-on "Auto Spacing" to use this option.
- **Reverse axis direction** - Toggle on to display the axis from high to low rather than from low to high. Not available for 3D Cartesian plots.
- **Dependency** - Select whether to set the axes as dependent upon or independent of each other. For XY Line or 2D Cartesian, select "Independent" or "Dependent".



When a logarithmic scale is being used in a 2D or XY Line plot, the axes must be independent.

For 3D Cartesian, select from one of the following options:

- **Independent** - All axes are independent.
- **XY Dependent** - The X and Y axes are dependent upon each other. The Z axis is independent.
- **XYZ Dependent** - Changing the scale on any axis results in a proportional change in scale on the other two axes, so that the specified X to Y Ratio and X to Z Ratio are preserved.
- **Ratios (For 2D and 3D plots only)**
 - **2D Plots** - If "Dependent" is selected, enter the X to Y Ratio.
 - **3D Plots** - If "XY Dependent" is selected, enter the X to Y Ratio.
 - **3D Plots** - If "XYZ Dependent" is selected, enter the X to Y Ratio and the X to Z Ratio.
- **Automatically Adjust Axis Range to Nice Values** - Automatically adjusts the axis ranges to the nearest major axis increments.
- **Size Factors (For 2D and 3D plots only)** - If the axes are XY-dependent, changing the X or Y size factor changes the other. If the axes are XYZ-dependent, changing one size factor changes the other two.
- **Reset Size/Dependency** - Resets the Dependency controls to their defaults.

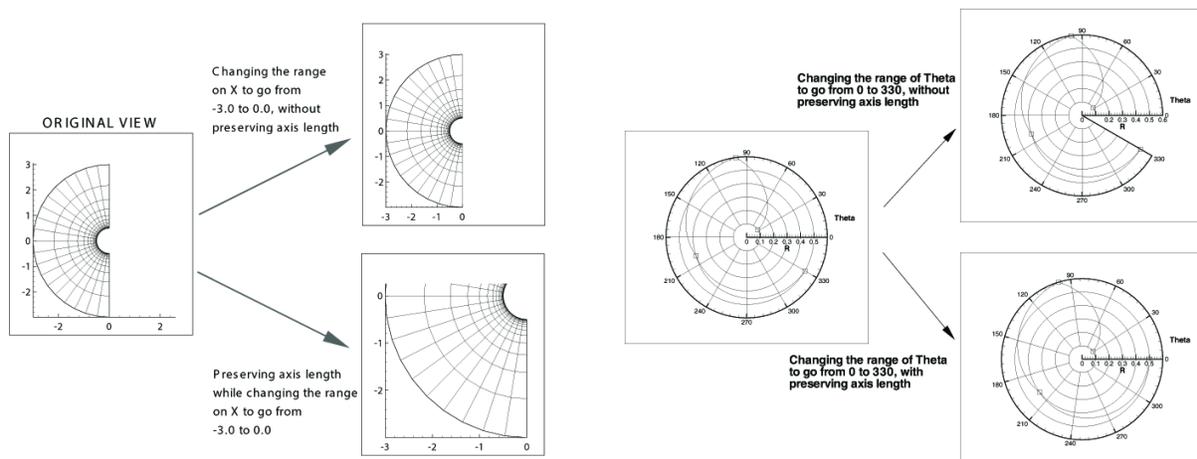
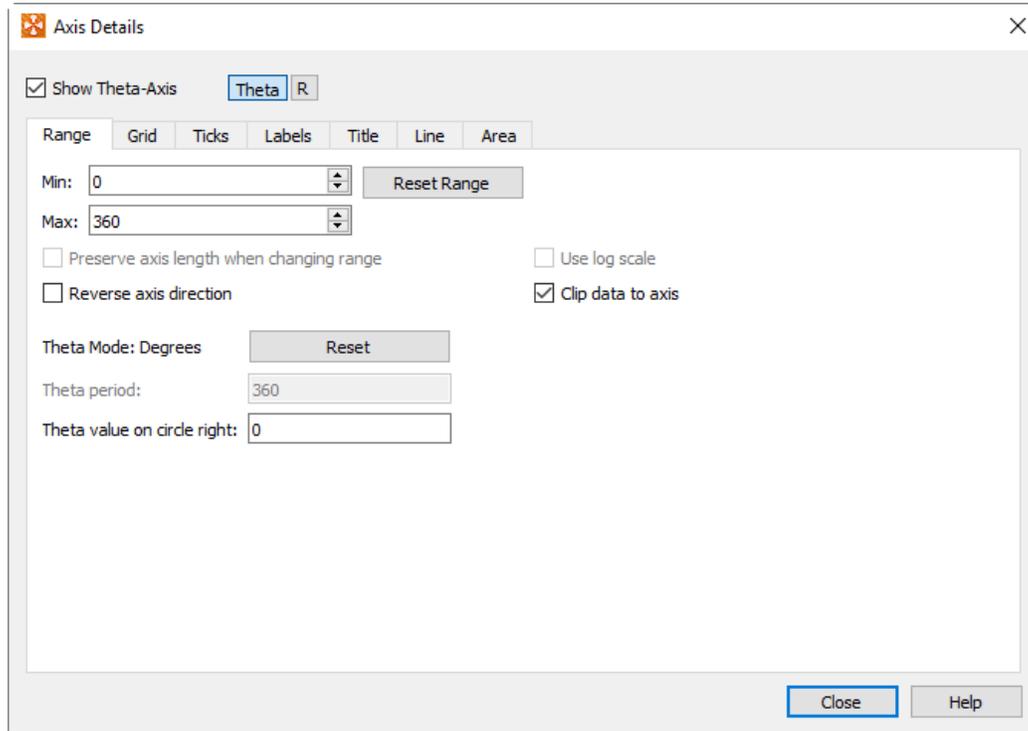


Figure 17-4. Preserving length versus preserving scale while changing range (left); preserving length versus preserving scale while changing range in a Polar Line plot (right).

17 - 4 Axis Range Options for Polar Plots

Polar axes are different from any other axis type due to their cyclical nature. Each polar axis (Theta and R) has very different settings, unlike XY or XYZ axes. For the Theta-axis you can change the Theta Mode, Theta Period, and Theta Value on Circle Right; for the R-axis you can change the origin; and for both axes you can clip the data to the axes.



- **Show Axis** - Toggle-on this checkbox to show the selected axis on the plot. Use the buttons [Theta], [R], etc. to the right of this checkbox to select an axis.
- **Min** - Enter the minimum value of the axis range.
- **Max** - Enter the maximum value of the axis range.
- **Reset Range** - Reset the **Max** and **Min** fields by selecting one of three options from the drop-down menu:
 - **Reset to Entire Circle** - Sets the range of Theta to encompass an entire circle.
 - **Reset to Nice Values** - Sets the range to slightly larger than the current axis variable range in order to begin and end the axis at major axis increments.
 - **Set to Var Min/Max** - Sets the range to the minimum and maximum variable values.
 - **Make Current Values Nice** - Rounds the axis range to the nearest major axis increment.
- **Preserve length when changing range** - If toggled-on, changes to the Theta to R Ratio will affect the axes' range, but not their scale. Toggle-off to change both the axis range and axis scale simultaneously. See [Figure 17-4](#) for an illustration of the difference.
- **Use log scale** - The R axis can have a linear scale (default) or a logarithmic scale. When "Auto Spacing" is selected with logarithmic scale, large numbers are displayed in scientific notation (i.e., 3.48×10^5). It is strongly recommended that you use "Auto Spacing" with log axes. Navigate to the Ticks or Labels page of the dialog, and toggle-on "Auto Spacing" to use this option.
- **Reverse axis direction** - Toggle on to display the axis from high to low rather than from low to high. Not available for 3D Cartesian plots.

- **Clip Data to axis** - For Polar Line plots, it is possible to have data that extends beyond the edges of the axes. Use this feature to eliminate data drawn outside of the range of the axes. Clipping data can be set independently for each axis. To activate or deactivate clipping, toggle "Clip Data to Axis" on or off. This feature is illustrated in [Figure 17-5](#).

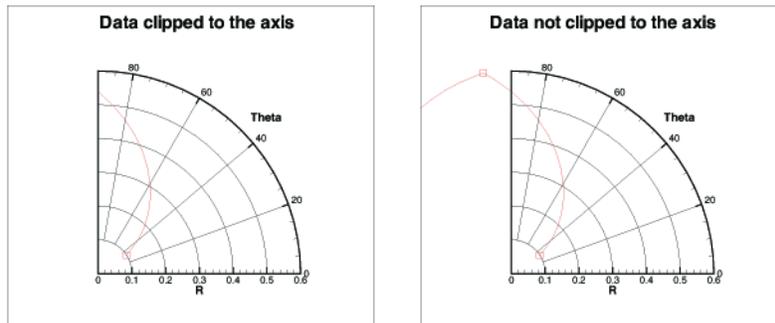


Figure 17-5. An example of clipping polar data to an axis.

- **Theta Mode** - By default, the Theta-axis is expressed in degrees mode with a range of 0 to 360. For the Theta axis, you can plot the angles in units of Radians, Degrees, or Arbitrary (where arbitrary sets the Theta range to the maximum and minimum values of the Theta-axis variable). To set the Theta Mode, choose from the following options:
 - 0 - 360 Degrees
 - -180 - 180 Degrees
 - 0 - 2Pi Radians
 - Pi-Pi Radians
 - Fit to Var Min/Max

Selecting any of these options changes the Theta Mode, resets the Theta-axis range, and resets the Theta Period. When the Theta Mode is Radians, Tecplot Focus draws Theta labels as fractional units of Pi.

- **Theta Period** - The Theta Period specifies the Theta range that is required to create a complete circle. If your Theta Mode is "Degrees", the Theta Period is forced to 360; for "Radians", the period is 2 Pi; for "Fit to Var Min/Max", the period can be set to any value.
- **Theta Value on Circle Right** - The "Theta Value on Circle Right" setting changes the orientation of the Theta-axis. By default, this value is zero, which means that the value zero (or equivalent value, 360 degrees, 720 degrees, and so forth) is displayed on the right hand side of the circle. You can change this value to change the orientation of the axis.
- **R-origin** - The R-origin specifies what value of R is represented at the center of the axis. The effect of changing the R-origin is displayed in [Figure 17-6](#).

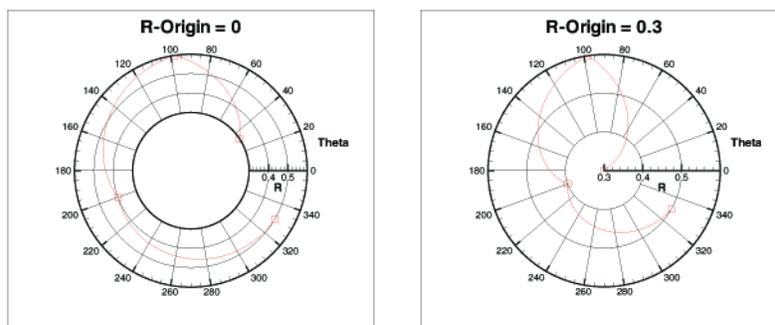


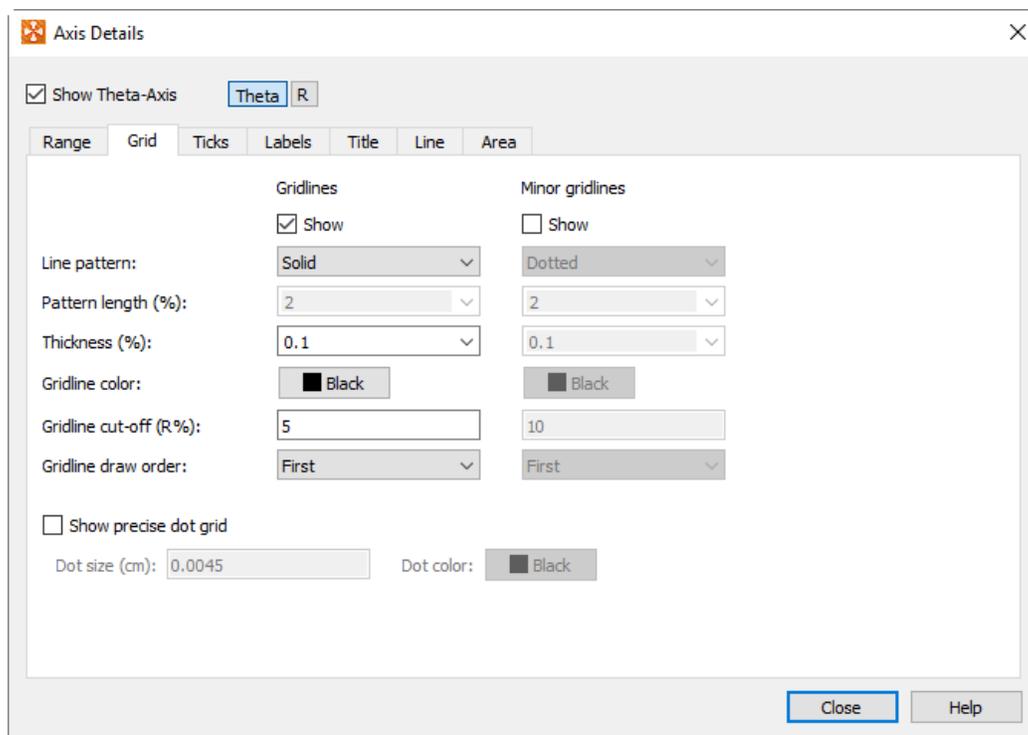
Figure 17-6. An example of changing the R-origin from a range of 0.3 to 0.6 on a polar plot.

17 - 5 Axis Grid Options

You control the gridlines and precise dot grid from the Grid page of the **Axis Details** dialog, as shown below. On this page, you can customize the line pattern, pattern length, line thickness, and gridline color for Gridlines and Minor Gridlines.

- **Gridlines** - Match the spacing of tick marks.
- **Minor Gridlines** - Subdivisions of Gridlines.

The spacing of Gridlines is controlled by the tick mark spacing; see [Section 17 - 6 "Tick Mark Options"](#) for more information.



- **Gridlines, Minor Gridlines** - To activate Gridlines or Minor Gridlines, toggle-on "Show" under these headings on the Grid page. Both kinds of gridlines have the following options:
 - **Line Pattern** - From the Line Pattern drop-down menu, choose one of the following line patterns: Solid, Dashed, DashDot, Dotted, LongDash, or DashDotDot.
 - **Pattern Length (%)** (Theta axis only) - Select a pattern length from the drop-down menu, or enter in your own.
 - **Thickness (%)** - Select a line thickness from the drop-down menu, or enter your own as a percentage of frame height.
 - **Gridline Color** - Select the color of your gridlines using the Color Chooser.
 - **Gridline Draw Order** - For all axes except 3D, you may specify a gridline draw order. Gridlines may be drawn either first, before any of the other plotting layers, or last, so they overlay any plotting layers.

- **Gridline Cutoff (R%)** (Theta axis only) Select the point along the R-axis where you want to stop drawing Theta lines.

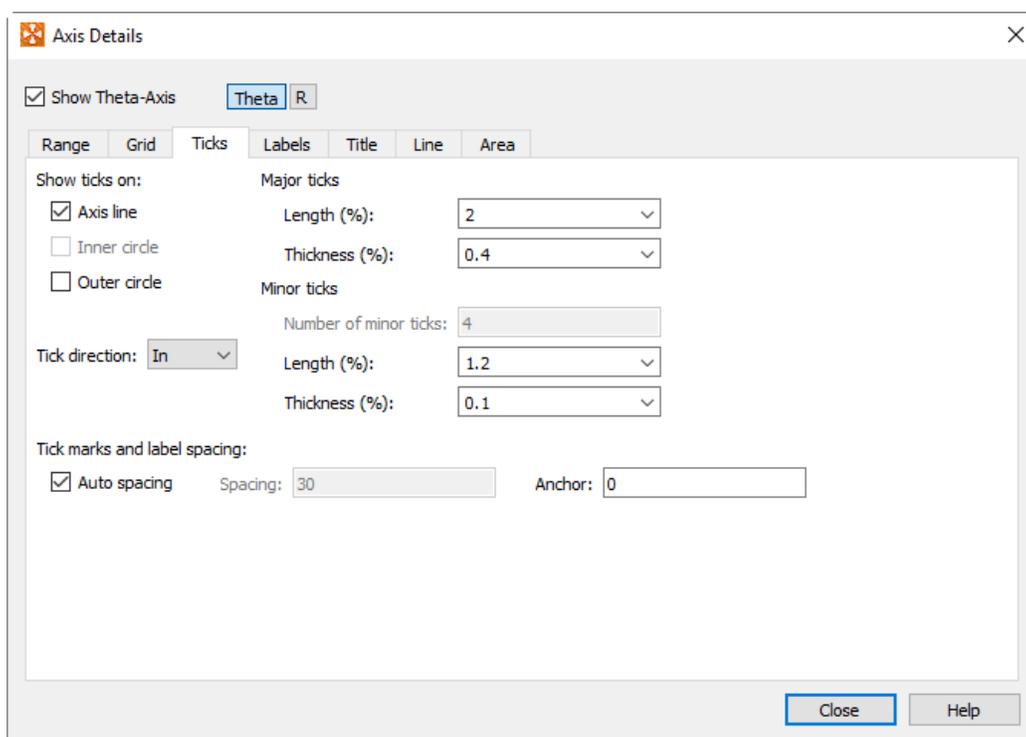


In a Polar Line plot, the abundance of gridlines at the center may obscure data. You can specify a gridline cutoff along the R-axis of Polar plots on the Grid page of the **Axis Details** dialog for the Theta-axis.

- **Show Precise Dot Grid** - The precise dot grid is a set of small dots drawn at the intersection of every minor gridline. In line plots, the axis assignments for the first active mapping govern the precise dot grid. The precise dot grid option is disabled for the 3D Cartesian plots and Line plots when either axis for the first active line mapping uses a log scale.

17 - 6 Tick Mark Options

Tick marks can be placed on each axis and labeled with either numbers or text strings. You can define your tick marks and their placement using the Ticks page of the **Axis Details** dialog. You can define the tick mark labels using the Label page of the **Axis Details** dialog.



- **Show Ticks On** - For each plot type, you can display tick marks at different sections of the axis. (This description also applies to Labels and Titles.)

Sketch, XY Line, and 2D Cartesian axes allow tick marks to be displayed in the following areas:

- **Axis Line** - The line that represents the specified axis.
- **Grid Border Bottom** - By default, the axis line and grid border left/bottom are in the same position. Grid Border Bottom is the lower left-most position of the grid as defined by the viewport settings on the Area page of the **Axis Details** dialog.
- **Grid Border Top** - Grid Border Top is the top right-most position of the grid as defined by the viewport settings on the Area page of the **Axis Details** dialog.

3D Cartesian axis tick marks can be displayed in the following areas:

- **Axis Line** - The line that represents the specified axis.
- **Opposite Edge** - The complimentary line that is opposite the axis line.

Polar R-axis tick marks can be displayed in the following areas:

- **Axis Line** - The line that represents the R-axis.
- **All R-axes** - Only available if "Draw Axis in Both Directions" or "Draw Perpendicular Axis" is toggled-on for the R-axis. The All R-axes setting will draw tick marks on the additional axes that are drawn.
- **Grid Border Start** - Start point of the polar grid area.
- **Grid Border End** - End point of the polar grid area.



Grid Border Start and Grid Border End are only available if the polar plot does not form a complete circle. If the data forms a complete circle, there is no start or end point on which to draw the ticks.

Polar Theta-axis tick marks can be displayed in the following areas:

- **Axis Line** - The line that represents the Theta-axis.
- **Inner Circle** - Only available if the minimum (Min) value on the R-axis is greater than the R-origin (Max) value. The Min and Max values are located on the Range page of the **Axis Details** dialog (see [Axis Range Options for Polar Plots](#)). When this is the case, the center of the polar plot is a circle rather than a single point; therefore, ticks can be drawn on the inner circle.
- **Outer Circle** - The outer edge of the polar grid area.
- **Major Tick Mark Length and Thickness** - Tick mark length and thickness can be set independently for major and minor tick marks using the Length and Thickness fields o.
- **Number of Minor Ticks; Length and Thickness** - To specify the number of minor tick marks, you must first toggle-off "Auto Spacing" at the bottom of the page. The number of minor tick marks can be set in the "Number of Minor Ticks" text field in the Minor Ticks section of the dialog. You may also set their length and thickness

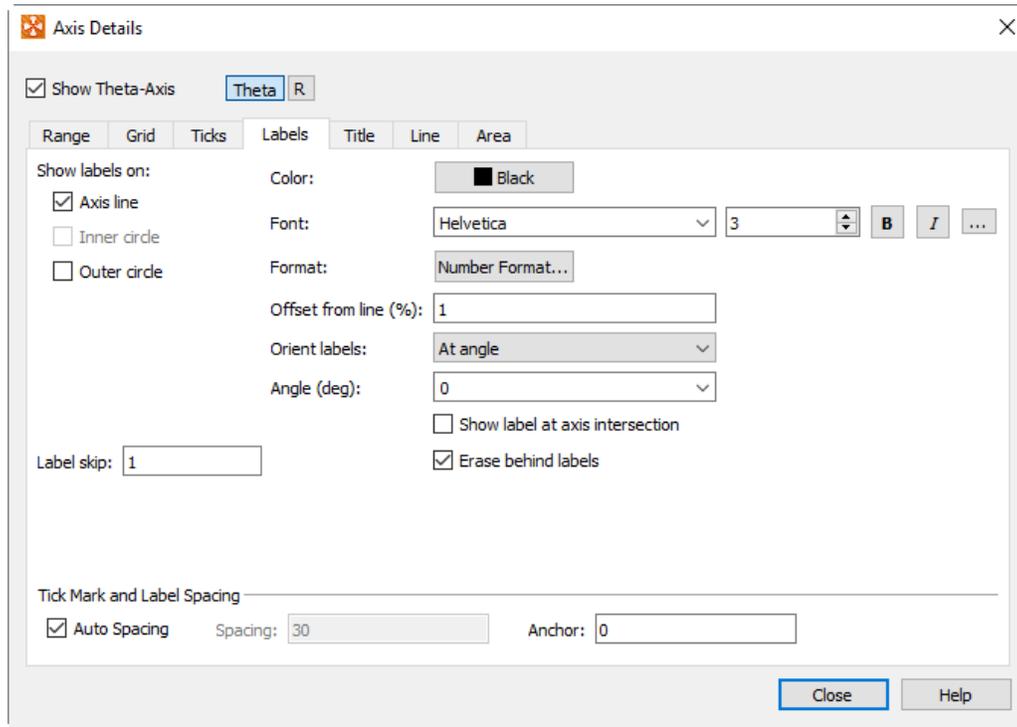


There is not a separate control for showing minor tick marks. To hide minor tick marks, enter zero in the "Number of Minor Ticks" text field.

- **Tick Mark and Label Spacing** - You can control tick mark and label spacing directly, or use "Auto Spacing" (the default) to calculate an optimal spacing for tick marks and tick mark labels. As you change views, particularly in zooming, Tecplot Focus recalculates the spacing. With "Auto Spacing" selected, Tecplot Focus also calculates the number of minor tick marks for you. Spacing values are shared between tick marks and tick labels. You can change the spacing by adjusting the Auto Spacing, Spacing, and Anchor controls at the bottom of the page under "Tick Mark and Label Spacing".

17 - 7 Tick Mark Label Options

From the Labels page of the **Axis Details** dialog, you can specify the label attributes for the tick marks of each axis.

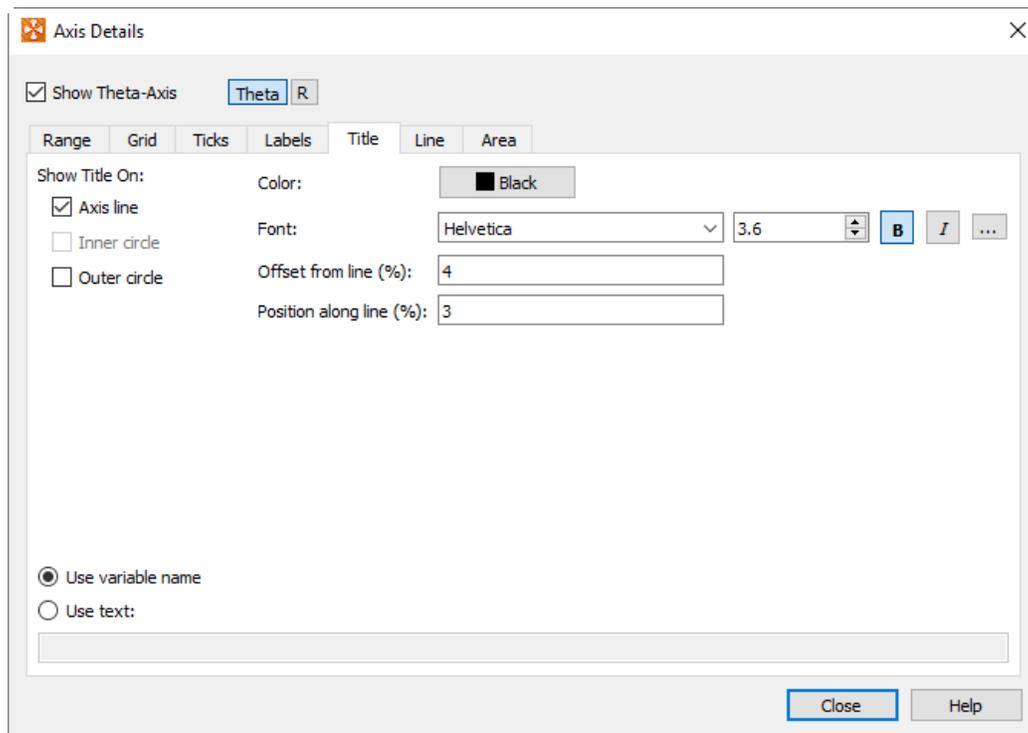


- **Show Labels On** - Toggle-on the appropriate options for label display. The available options are dependent on plot type.
 - For Sketch, XY line, and 2D Cartesian line plots, choose from:
 - **Axis Line** - When toggled-on, axis labels will display on the selected axis line.
 - **Grid Border Bottom** - When toggled-on, axis labels will display on the bottom of the grid.
 - **Grid Border Top** - When toggled-on, axis labels will display on the top of the grid.
 - For 3D Cartesian line plots, choose from:
 - **Axis Line** - When toggled-on, axis labels will display on the selected axis line.
 - **Opposite Edge** - When toggled-on, axis labels will display on the opposite edge of the plot.
 - For Polar Line plots, choose from:
 - **Axis Line** - When toggled-on, axis labels will display on the selected axis line.
 - **Inner Circle** - When toggled-on, axis labels will display on the inner edge of the polar grid area. (Only available if the minimum value on the R-axis is greater than the R-Origin value.)
 - **Outer Circle** - When toggled-on, axis labels will display on the outer edge of the polar grid area.
- **Color and Font** - Select the color and font in which you want your labels to appear. (See [Section 18 - 1.2 "Font Folders and Fallback"](#) for more information on how fonts work with Tecplot Focus.)
- **Number Format** - Choose how the numbers should be formatted for axis labels using the Specify Number Format dialog.
- **Offset from Line (%)** - Enter the offset of the tick mark labels from the axis.
- **Orient Labels** - Select from the following additional options for label display:

- **At Angle** - Labels oriented at the angle specified in the **Angle** drop-down menu.
 - **Parallel** - Labels are parallel to the axis.
 - **Perpendicular** - Labels are perpendicular to the axis.
 - **Angle (deg)** - If Orient Labels is set to "At Angle", specify the orientation of the tick mark labels relative to the axis. The angle is measured in degrees counter-clockwise from the axis.
- **Show Label as Axis Intersection** [2D, XY, and Polar Only] - Toggle-on to draw a label at the point where two axes intersect. Use this toggle if you have axis labels that are colliding, or are stacked on top of one another at the intersection of two axes.
 - **Erase Behind Labels** - Toggle-on to include a rectangle (with the color of the frame background) behind the label to increase the visibility of the label.
 - **Label Skip** - Specify the interval between tick mark labels.
 - **Tick Mark and Label Spacing** - You can control tick mark and tick mark label spacing directly, or use Auto Spacing (the default) to calculate an optimal spacing for tick marks and tick mark labels. As you change views, particularly in zooming, Tecplot Focus recalculates the spacing. With Auto Spacing selected, Tecplot Focus also calculates the number of minor tick marks for you. Spacing values are shared between the tick marks and tick labels. You can change the spacing by adjusting the Auto Spacing, Spacing, and Anchor controls at the bottom of the Ticks or Label pages of the **Axis Details** dialog.

17 - 8 Axis Title Options

An axis title is a text label that identifies the axis. By default, Tecplot Focus labels each axis with the name of the variable assigned to that axis.



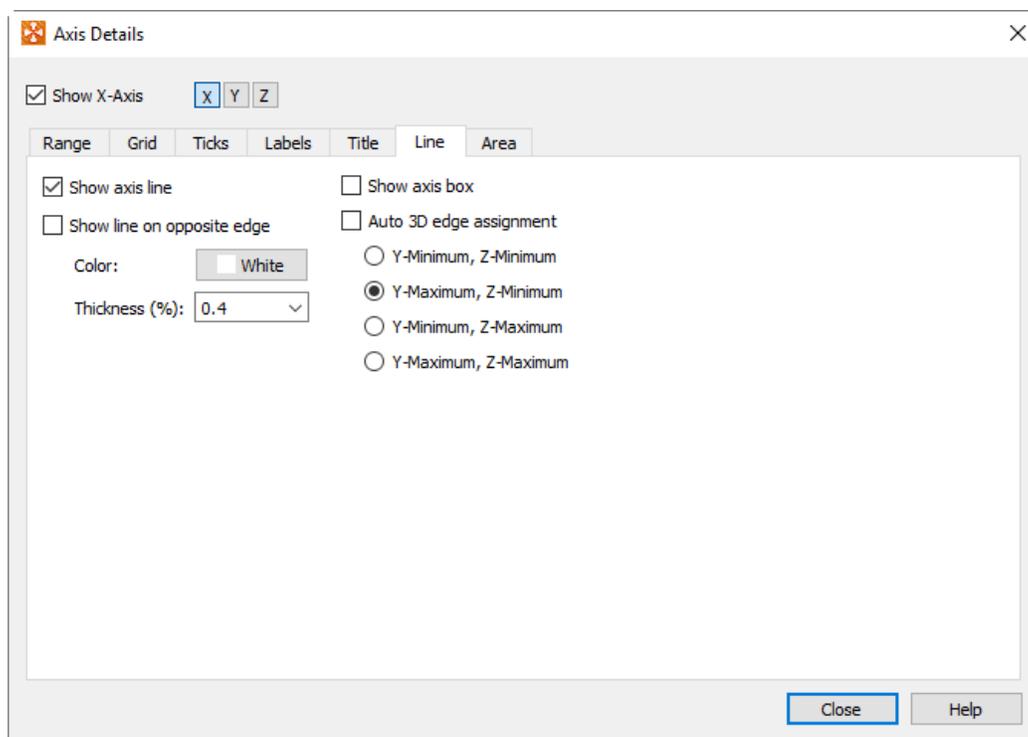
From the Title page of the **Axis Details** dialog, you can specify the following attributes for each axis title:

- **Show Title On** - For any plot type, you can specify where to show the axis title. Toggle-on "Axis Line" to show the axis title directly on the corresponding axis. The remaining available options are dependent upon plot type.
 - **For 3D** - Opposite Edge.
 - **For 2D, XY Line or Sketch** - Grid Border Bottom or Grid Border Top.
 - **For Polar Line plots** - Inner Circle or Outer Circle.
- **Color and Font** - Select the color and font in which you would like your axis to appear. (See [Section 18 - 1.2 "Font Folders and Fallback"](#) for more information on how fonts work with Tecplot Focus.)
- **Offset from Line** - Prevents Tecplot Focus from printing your axis title directly on top of the axis. You may specify a positive or negative offset from one side or the other of the axis. An offset of zero prints the edge of the axis title on the axis.

You may also adjust the axis title offset using the Adjustor  tool from the Toolbar (not available for 3D Cartesian plots).
- **Position along Line** - Specify the start position of the axis title as a percentage of axis length.
- **Title** - Choose one of the following display options:
 - **Use Variable Name** - The legend header will display the variable name assigned to the contour group.
 - **Use Text** - The legend header will display text entered into the text field next to the options widget. The text can contain dynamic text (See [Section 18 - 1.5 "Dynamic Text"](#) for information on dynamic text) and formatted using tags (See [Section 18 - 1.1 "Text Details"](#) for information text formatting tags).

17 - 9 Axis Line Options

The actual axis line is shown by default whenever the axis is shown. However, you can hide the axis line without turning off the axis as a whole. To show or hide the axis line, select the Lines page of **Axis Details** dialog (accessed via the **Plot** menu).



The options in this dialog vary depending on the plot type and, for some plot types, the axis selected. All of the available options are described below, but not all will be available at any one time.

- **Show Axis Line** - Toggle-on or off to display or hide an axis line.
 - **Color** - Select the color of your axis line using the Color Chooser.
 - **Thickness** - Select the thickness of your axis line.
- **Show Line on Opposite Edge** (3D Cartesian only) - Toggle-on or off to draw a line on the opposite edge from the selected axis line.
- **Show Grid Border** - Turning on the grid border draws a border around your grid. Toggle-on or off to display or hide the borders of your grid. Not available for 3D Cartesian plots.
 - **Color** - Select the color of your grid border.
 - **Thickness** - Select the thickness of your grid border.
- **Align Axis With** - Select what part of your plot with which you would like to align your axis. Not available for 3D Cartesian plots.

Sketch, XY line, and 2D Cartesian plots, choose from **Axis Value**, **Bottom**, **Top**, or **Viewport**. If you choose Axis Value (e.g. Y Value), enter the desired value in the text field. For Bottom or Top, enter the offset from the bottom or top. For Viewport, enter the position within the viewport.

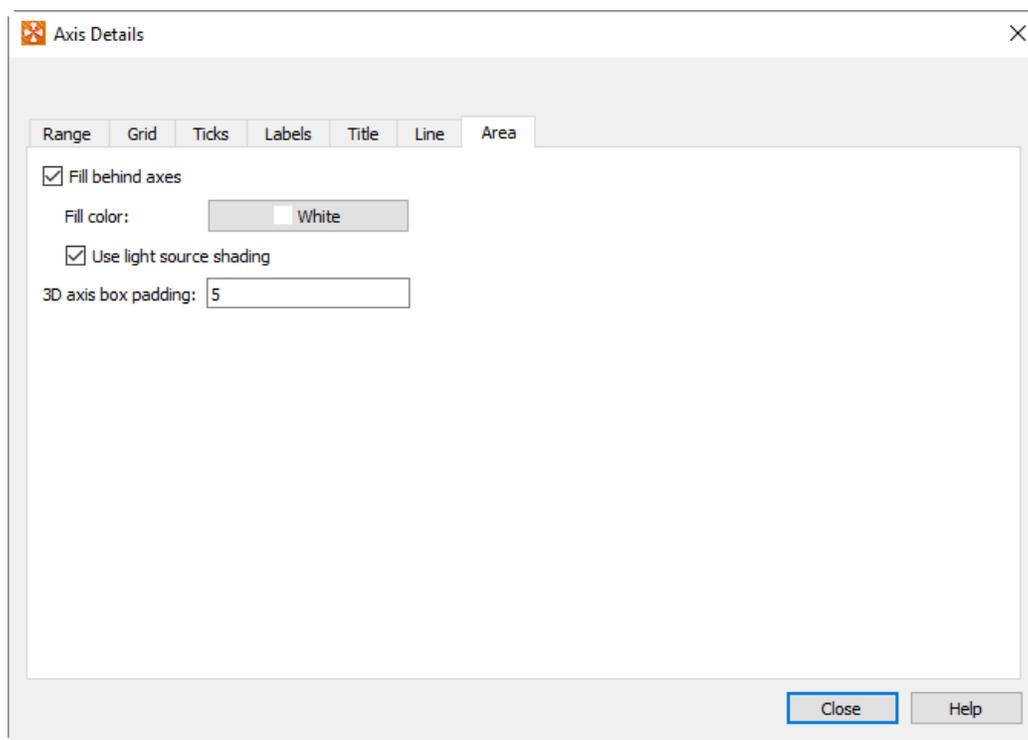
Polar plots (Theta-axis), choose from **R Value**, **Inner Circle**, or **Outer Circle**. When aligning with an R Value, you may enter an R-axis Value to specify the position of the axis line. When aligning with the inner or outer circle, specify an offset. With a zero offset, the axis line is on the inner or outer circle, a positive offset moves the axis line outside the grid area. A negative offset moves the axis line within the grid area.

Polar plots (R-axis), choose from **Theta Value**, **Inner Circle**, or **Outer Circle**. When aligning with a Theta Value, you may enter a Theta axis value to specify the position of the axis line. When aligning with the inner or outer circle, specify an offset. With a zero offset, the axis line is on the inner or outer circle, a positive offset moves the axis line outside the grid area. A negative offset moves the axis line within the grid area.

- **Theta Value** - Align the R-axis with a specific Theta B=Value. The axis is limited to the grid area.
- **Grid Border Start** - Align the R-axis with the start of the grid border. The axis is limited to the grid area.
- **Grid Border End** - Align the R-axis with the end of the grid border. The axis is limited to the grid area.
- **Specific Angle** - Align the R-axis with a specific screen angle. The axis is limited to the grid area.
- **Top of Grid Area** - Align the R-axis with the top of the grid area. The axis may be drawn outside the grid area.
- **Bottom of Grid Area** - Align the R-axis with the bottom of the grid area. The axis may be drawn outside the grid area.
- **Left of Grid Area** - Align the R-axis with the left side of the grid area. The axis may be drawn outside the grid area.
- **Right of Grid Area** - Align the R-axis with the right side of the grid area. The axis may be drawn outside the grid area.
- **Theta-Axis Value** - Specify a Theta-axis value to specify the position of the axis line.
 - **Offset (%)** - Enter the offset of the line from the axis.
 - **Angle** - Enter the angle of the line from the axis.
- **Draw Axis in Both Directions** - In addition to setting the alignment of the R-axis, you may choose to extend the R-axis by drawing an axis line perpendicular or parallel to the existing axis line. Toggle-on "Draw Axis in Both Directions" to extend the axis line so that it spans the width of the grid area.
- **Draw Perpendicular Axis** - Toggle-on "Draw Perpendicular Axis" to draw an axis line perpendicular to the main axis line.
- **Show Viewport Border** (Polar line plots only) - Toggle-on "Show Viewport Border" to show the viewport border. The viewport border is defined on the Area page of the **Axis Details** dialog.
 - **Color** - Select the color of your viewport border.
 - **Thickness** - Select the thickness of your viewport border.
- **Show Line on Opposite Edge** (3D Cartesian only) - When toggled-on, axis lines will display on the opposite edge of the plot.
 - **Color** - Select the color of your grid border.
 - **Thickness** - Select the thickness of your grid border.
- **Show Axis Box** (3D Cartesian only) - Toggle-on "Show Axis Box" to display all edges of all axes.
- **Auto 3D Edge Assignment** (3D Cartesian only) - Toggle-on "Auto 3D Edge Assignment" to place the three axis lines so they will not interfere with the drawing of the plot. If toggled-off, you have the option to place the line at any pair of edges, such as Y-Minimum & Z-Minimum, Y-Maximum & Z-Minimum, Y-Minimum and Z-Maximum, or Y-Maximum & Z-Maximum. The available pairs depend on the axis selected to edit.

17 - 10 Grid Area Options

The grid area of your plot is the area defined by the axes. From the Area page of **Axis Details**, you control whether the grid area or viewport are color-filled. The Area page is shown below.



The Area page has the following options, some of which may not be available depending on plot type and, for Polar line plots, the selected axis:

- **Fill Grid Area** - For Sketch, XY Line, and 2D Cartesian plots, you can alter the size of the grid area by changing the extents of the viewport. (For these plot types, the viewport and grid area are synonymous.) Click the **Color** button to select the color using the Color Chooser.

For 3D Cartesian and Polar Line plots, the grid area is altered by changes to the axis ranges.

3D Cartesian options:

- **Fill Behind Axes** - Select this option to fill the area behind the axes (your grid area) with a specific color.
 - **Fill Color** - Select the color with which to fill your grid area in the Color Chooser.
 - **Use Light Source Shading** - Select this option to light source shade the axis planes.
 - **3D Axis Box Padding** - Enter the minimum distance from the data to the axis box. Lowering this value does not immediately affect the appearance of the plot, since the existing axes still meet the new constraint; you can use Reset Range on the Range page (see [Axis Range Options for XY and 2D/3D Plots](#)) to force the plot to redraw.

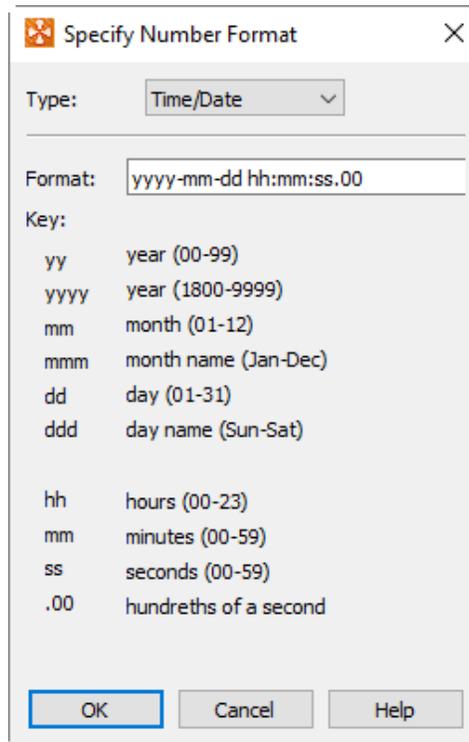
Polar Line options:

- **Fill Grid Area** - Select this option to fill the grid area with a specified color.
- **Fill Viewport** - Select this option to fill the viewport area with a specified color.
- **Viewport Position (%)** - Select the position of the Viewport. The Viewport is the percentage of the entire plot area occupied by the plot grid. Select the location (as a percentage of the entire plot area) in which to place the Left, Right, Top, and Bottom borders of your grid area.

17 - 11 Time/Date Format Options

The **Specify Number Format** dialog is available for all plot types, including Sketch. You can use this dialog to display your axis labels in a number of different formats, including Time/Date format. The **Specify Number Format** dialog can be accessed by going to the **Plot>Axis>Label** or the **Plot>Axis>Range** page, and selecting the [Number Format] button. See [Section 6 - 7.1 "Specify Number Format"](#) for more information on the **Specify Number Format** dialog.

You can also display elapsed time, instead of absolute time, on any axis. To do this, the original time/date data in your data file must indicate the elapsed time.)



To specify your axis label using Time/Date format, select "Time/Date" from the **Type** drop-down menu. Data is read forward from December 30, 1899. Tecplot Focus also accepts negative values to support dates back to January 1, 1800.

You can format your labels by entering the available Time/Date codes in the Format field. When entering a format, any combination or subset of the Time/Date formula may be used.



If you use "m" immediately after the "h" or "hh" code or immediately before the "ss" code, Tecplot Focus displays minutes instead of the month.

Use the following formula and table to enter your Time/Date codes:

Time Date Formula:

years-months-days hours:minutes:seconds

Time/Date Codes:

	Time/Date Code	Display Format
Years	YY	00-99
	YYYY	1800-9999
Months^a	mmmmm	first letter of the month
	m	1-12
	mm	01-12
	mmm	Jan-Dec
	mmmm	January-December
Days	[d] ^b	total number of elapsed days
	d	1-31
	dd	01-31
	ddd	Sun-Sat
	dddd	Sunday-Saturday
	dddddd	S,M,T,W,T,F,S
Hours^c	[h]	total number of elapsed hours
	h	0-23 or 1-12
	hh	00-23 or 1-12
	AM/PM	AM or PM
	A/P	AM or PM as "A" or "P"
Minutes	[m]	total number of elapsed minutes
	m	0-59
	mm	00-59
Seconds	s	0-59
	ss	00-59
	.0	Tenths
	.00	Hundredths
	.000	Thousandths

- a. Codes can be entered as upper or lower case letters; however, letters will be displayed as shown in the display format. Numbers that cannot be formatted as a time or date will be displayed as asterisks.
- b. Total number of elapsed days, hours, and minutes are valid for time values greater than or equal to zero, and equal to or less than 1,000,000 days.

- c. NOTE: If you enter "AM/PM" or "A/P" in your Time/Date format, the "h" and "hh" hour codes are expressed using a 12-hour clock. Otherwise, hours are expressed in military time (24 hour clock).



Placing a backslash in front of a y, m, d, or s in the Time/Date formula will keep it from being processed as part of the formula. All characters not part of the Time/Date formula will appear as entered.

For example, "\year yyyy" will appear as "year 2008", as the backslash keeps the first y from being processed as part of the formula.

Examples

To display the time and date on your plot as a "Sat-Jan-05-2008", enter the following code:

```
ddd-mmm-dd-yyyy
```

To display the time and date on your plot as a "1-3-08", enter the following code:

```
m-d-yy
```

To display the time and date on your plot as a "9:30:05 AM", enter the following code:

```
h:mm:ss AM
```

To display an elapsed time, such as "3:10:15", enter the following code:

```
[d]:hh:mm
```

17 - 11.1 Microsoft Excel Support

Tecplot Focus supports Microsoft Excel¹ Time/Date number strings, with the exception of AM/PM time specifications, long day names, and long month names. This support allows you to create number formats in Excel and import them for use with your Tecplot Focus plots, or vice versa.



Time/Date number strings can be transferred from Excel to Tecplot Focus from Mar 1, 1900 forward.

17 - 11.2 Loading Time/Date Data

You can load time/date data into Tecplot Focus in the same way as any other data point. The following methods load time/date data as a floating-point number. (After loading, use **Plot>Axis>Labels>Number Format** to change the axis format to a time/date display.) The following methods can be used to load time/date data into Tecplot Focus.

1. **Excel Macro (add-on)** This add-on offers more options to load data from Excel. Although it requires installation into Excel, after installing, this method enables quick and simple data loading from Excel into Tecplot Focus. Refer to [Section B - 1 "Excel Add-In"](#) for details.
2. **Text Spreadsheet Loader** For loading delimited files, use this loader. Refer to [Section 4 - 11 "Text Spreadsheet Loader"](#) for instructions. Time/date data included in this format must be represented by the floating point number used by Excel and Tecplot Focus. (See the [Data Format Guide](#) for more information on this formatting.)

1. Tecplot Focus does not currently support Mac Excel "1904" format.

Text, Geometries, and Images

You can enhance any plot, or create a drawing from scratch, using Tecplot Focus's text and drawing tools. Tecplot Focus provides tools for creating polylines, circles, ellipses, squares, rectangles, and text. You can also insert BMP, JPEG, or PNG images to enhance your plot.

A plot that contains only these add-on elements and no plotted data is referred to as a *sketch* and can be created with the "Sketch" plot type. [Figure 18-1](#) shows a sketch created with Tecplot Focus drawing tools.

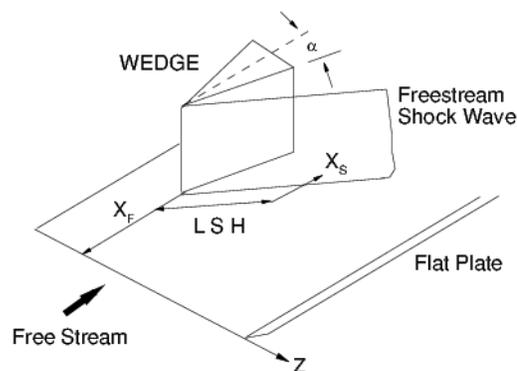


Figure 18-1. A sketch created with Tecplot Focus.

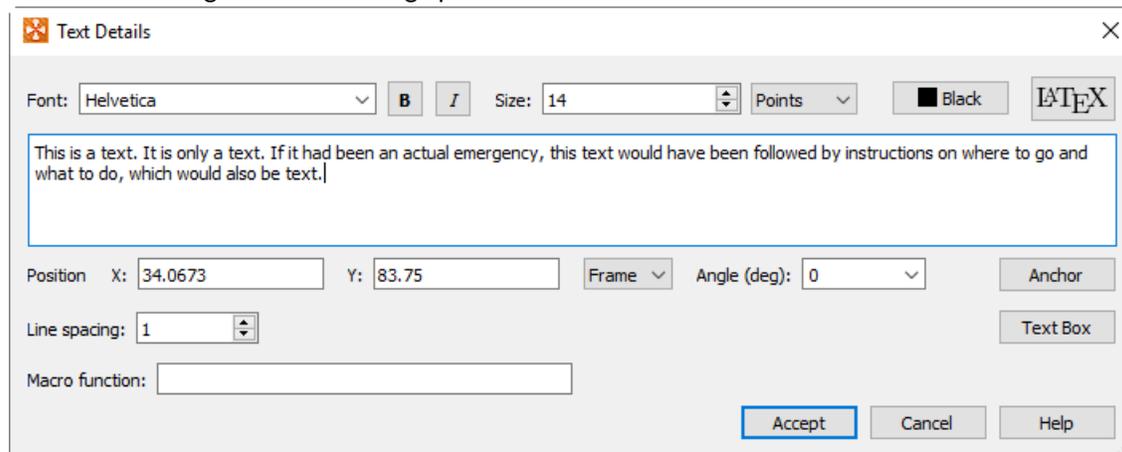
18 - 1 Text

To add text to your plot or sketch, either select the **Text** tool  from the Toolbar or **Text** from the **Insert** menu. Click anywhere in a frame to indicate the location of the text. Use the **Text Details** dialog to enter and modify text and its formatting. To create additional text elements, you may click in the Tecplot Focus workspace at the desired location of the next text element while the dialog is open.

You can edit existing text by first choosing the  Selector tool, then double-clicking the text element to open the **Text Details** dialog. Alternatively, right-click the text element and many of the text attributes can be changed in the **context menu** as well as selecting **Text Details**.

18 - 1.1 Text Details

The **Text Details** dialog has the following options:



- Type the desired text in the large text field at the top of the dialog.

You can embed **Greek**, **Math**, and **User-defined** characters into English-font strings by enclosing them with text formatting tags, together with the keyboard characters. See [Section 28 - 4 "Custom Character and Symbol Definition"](#) on page 361 for more information on defining your own characters.

The text formatting tags and their effects are as follows (format tags are not case sensitive and may be either upper or lower case):

- `...` - Boldface
- `<i>...</i>` - Italic
- `<verbatim>...</verbatim>` - Verbatim
- `_{...}` - Subscripts
- `^{...}` - Superscripts
- `<greek>...</greek>` - Greek font.
- `$...$` - Math font.
- `<userdef>...</userdef>` - User-defined font.
- `<helvetica>...</helvetica>` - Helvetica font.
- `<times>...</times>` - Times font.
- `<courier>...</courier>` - Courier font.



Not all fonts have Bold and/or Italic variants. For fonts that do not have these styles, the `` and/or `<i>` tags may have no effect.

Embedding and escaping special characters work only in English-font text; they have no effect in text created in **Greek**, **Math**, or **User-defined** character sets.

You can produce subscripts or superscripts by enclosing any characters with `_{...}` or `^{...}`, respectively. Tecplot Focus has only one level of superscripts and subscripts; expressions requiring additional levels, such as e^{x^2} , must be created by hand using multiple Tecplot Focus text strings. If you alternate subscripts and superscripts, Tecplot Focus positions the superscript directly above the subscript. Thus, the string `a_b^c` produces a_b^c . To produce consecutive superscripts, enclose all superscript characters in a single pair of tags. The string `x^(a+b)` produces $x^{(a+b)}$ in your plot.

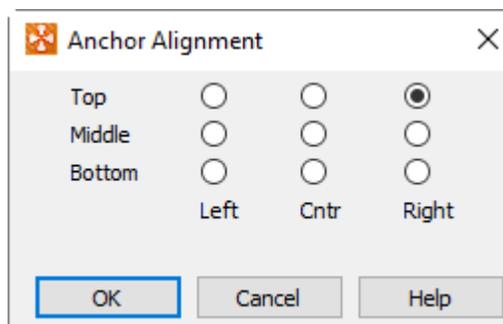
To insert a tag into text literally, precede the first angle bracket with a backslash (""). To insert a backslash in the text, just type two backslashes ("\\"). In ASCII input files, the number of backslashes must be doubled (two to precede a special character, four to create a backslash) because the Preplot program also requires a backslash to escape special characters.

- **Font** - Select a font for the text. (See [Section 18 - 1.2 "Font Folders and Fallback"](#) for more information on how fonts work with Tecplot Focus.) You may click the **B** and **I** buttons as shortcuts for selecting a bold, italic, or bold italic variation of the chosen font.



Not all fonts have Bold and/or Italic variants. For fonts that do not have these styles, the **B** and/or **I** buttons may have no effect.

- **Size** - Select a character height unit from the drop-down menu, then enter the size in the associated field:
 - **Points** - Specify character height in points. One point is 1/72nd of an inch.
 - **Frame%** - Specify character height as a percentage of frame height.
 - **Grid** - Specify character height in grid units. (Available only when Position By is set to Grid.)
- **X/Y Position** - Choose the position of the text element's anchor point (see Anchor button).
- **Position by** - Choose to position the text using the frame or grid coordinate system.
- **Macro function** - Enter the name of the macro function to be linked to this text object. See [Section 18 - 3 "Linking Text and Geometries to Macros"](#) for more information. To run the linked macro function, hold down Control while right-clicking the text object in the workspace. (On Mac, hold down Command while right-clicking.)
- **Color** - Select a color for the text using the Color Chooser.
- **Angle (deg)** - Specify the orientation of the text relative to the axis. The angle is measured in degrees counter-clockwise from horizontal. Horizontal text is at zero degrees; vertical text is at 90 degrees. You can either enter an angle in degrees, or select from one of the preset angles in the drop-down.
- **Line Spacing** - Enter the line spacing when multiple lines of text are entered: 1 for single-spacing, 2 for double-spacing, etc. Fractional values are permitted.
- **Text Box** - Opens the Text Box dialog to specify the appearance of the box around the text (if any). See [Section 18 - 1.3 "Text Box"](#) for more information.
- **Anchor** - Choose how the text is aligned with the anchor point. As new text is added, the text expands away from the anchor point chosen in the Anchor Alignment dialog.



18 - 1.2 Font Folders and Fallback

Tecplot Focus supports TrueType (.ttf) and OpenType (.otf) fonts. Fonts installed in the standard folder for fonts on your operating system (for example, C:\Windows\Fonts on a Windows computer) appear in the font selection menu in the **Select Font** dialog and in other places where you choose a font.

If the fonts you want to use with Tecplot Focus are installed in other folders, or if your operating system does not have a default system location for fonts, you can edit the `tecp1ot.cfg` file in your Tecplot Focus

installation directory, using Notepad or another text editor, to indicate the directories where the fonts you want to use are installed. Add a line like one of the following:

```

$!Interface FontPath = ' "/font/path" '
$!Interface FontPath = ' "C:\Windows\Fonts" "C:\More Fonts" '
$!Interface FontPath = ' "/first/path/" "/second/path" "/third/path" '

```

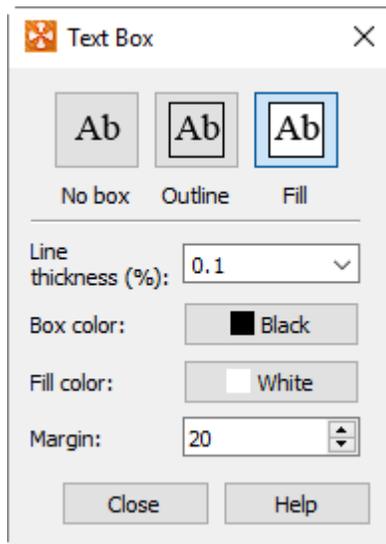
Replace the paths with the paths to the folders that contain the fonts you wish to use, taking special note of the single quote marks that wrap the entire list of folders and the double quotes around each folder's path. You can use just one or several font folders. As shown in the second example, if you wish to use your computer's standard fonts as well as fonts from other folders, you must manually specify the standard font folder along with the others.

If you open a layout that specifies a font that Tecplot Focus does not have access to on your system, the text "falls back" to Times. If the layout specifies a style you do not have (for example, a bold version of a font you have but which does not include a bold version on your system), the correct font is used, but the style (boldface, in this case) is not displayed.

It is possible to choose a font by typing its name directly into the font selection field in the **Text Details** dialog and other places where a font can be chosen, instead of choosing the desired font from the provided menu. If the font you specify in this way is not available to Tecplot Focus on your system, the text will appear as Times on your computer. However, the name you typed is recorded when you save a layout, and the text appears in the correct font if the layout is later opened on a computer on which the font is available.

18 - 1.3 Text Box

Use the **Text Box** dialog (accessed via the Text Box button in the **Text Details** dialog) to control the appearance of a box around the text. The following options are available:



- **None** - Select this option to specify that no box is drawn around the text.
- **Outline** - Select this option to specify an outline box around the text. The box is not filled, so any underlying Tecplot Focus object can still be seen.
- **Filled** - Select this option to specify a filled box around the text. A filled box is opaque; if you place it over another Tecplot Focus object, the underlying object cannot be seen.
- **Line Thickness (%)** - Specifies the thickness of the text box as a percentage of the frame width.
- **Box Color** - Select the box outline color from the **Color Chooser** dialog.
- **Fill Color** - Select the box fill color from the **Color Chooser** dialog.
- **Margin** - Specify the margin as a percentage of the text character height.

18 - 1.4 Special Characters

Tecplot Focus supports Unicode text encoding. Your operating system should provide ways to enter Unicode text in non-English character sets, and any Unicode characters you can enter using these methods will display and print correctly in Tecplot Focus.

If your system does not have the ability to enter Unicode text, characters in the ordinal range 160-255 provide support for most of the major European languages. The following table shows the characters in this range supported by Tecplot Focus. Note that the two right-hand columns represent the extended European characters. Text formatting tags for Greek, Math, or User-defined characters work only with characters in the range 32-126 and is not available for the extended European characters. If your system is configured for European text entry, the European characters should appear and print automatically with no additional setup.

Character Index	English Text	Greek	Math	User Defined	Character Index	English Text	Greek	Math	User Defined	Character Index	Extended Character	Character Index	Extended Character
32	(space)				80	P	Π	<	∅	160		208	Ð
33	!	!	Υ		81	Q	Θ	∇	∅	161	ı	209	Ñ
34	"	∇	'		82	R	Ρ	⊗	∅	162	ϕ	210	Ó
35	#	#	≤		83	S	Σ	⊙	∅	163	£	211	Ô
36	\$	∞	/		84	T	Τ	™	∅	164	¤	212	Õ
37	%	%	∞		85	U	Υ	Π	∅	165	¥	213	Ö
38	&	&	f		86	V	ς	√	∅	166	!	214	Ë
39	'	ε	♣		87	W	Ω	·	∅	167	!	215	×
40	(	(	♦		88	X	Ξ	∩	∅	168	!	216	Ø
41	)	)	♥		89	Y	Ψ	∧	∅	169	©	217	Ù
42	*	*	♠		90	Z	Ζ	∨	∅	170	®	218	Ú
43	+	+	↔		91	[	[	⇄	∅	171	«	219	Û
44	,	,	↑		92	\	\	⇄	∅	172	¬	220	Ü
45	-	-	↑		93	] ]	] ]	⇄	∅	173	-	221	Ý
46	.	.	→		94	^	^	⇄	∅	174	®	222	Þ
47	/	/	↓		95	-	-	⇄	∅	175	-	223	ß
48	0	0	°		96	-	-	∅	∅	176	°	224	à
49	1	1	±		97	a	α	<	∅	177	±	225	á
50	2	2	~		98	b	β	⊗	∅	178	²	226	â
51	3	3	≥		99	c	χ	⊙	∅	179	³	227	ã
52	4	4	×		100	d	δ	™	∅	180	´	228	ä
53	5	5	∞		101	e	ε	Σ	∅	181	μ	229	å
54	6	6	∂		102	f	φ	∫	∅	182	¶	230	æ
55	7	7	•		103	g	γ	∫	∅	183	·	231	ç
56	8	8	÷		104	h	η	}	∅	184	˘	232	è
57	9	9	≠		105	i	ι	}	∅	185	˘	233	é
58	:	:	≡		106	j	φ	}	∅	186	˘	234	ê
59	;	;	≡		107	k	κ	}	∅	187	»	235	ë
60	<	<	∴		108	l	λ	}	∅	188	¼	236	ì
61	=	=	|		109	m	μ	}	∅	189	½	237	í
62	>	>	|		110	n	ν	}	∅	190	¾	238	î
63	?	?	∟		111	o	ο	}	∅	191	¿	239	ï
64	@	≡	℥		112	p	π	}	∅	192	À	240	ð
65	A	A	∑		113	q	θ	}	∅	193	Á	241	ñ
66	B	B	℥	+	114	r	ρ	}	∅	194	Â	242	ó
67	C	X	∞	×	115	s	σ	}	∅	195	Ã	243	ô
68	D	Δ	⊗	*	116	t	τ	}	∅	196	Ä	244	õ
69	E	E	⊕	Δ	117	u	υ	}	∅	197	Å	245	ö
70	F	Φ	⊗	∇	118	v	ϖ	}	∅	198	Æ	246	ø
71	G	Γ	∩	□	119	w	ω	}	∅	199	Ç	247	÷
72	H	H	∩	∅	120	x	ξ	}	∅	200	È	248	ø
73	I	I	∩	∅	121	y	ψ	}	∅	201	É	249	ù
74	J	∂	∩	∅	122	z	ζ	}	∅	202	Ê	250	ú
75	K	K	∩	*	123	{	{	}	∅	203	Ë	251	û
76	L	Λ	∩	•	124	|	|	}	∅	204	Ì	252	ü
77	M	M	∩	+	125	}	}	}	∅	205	Í	253	ý
78	N	N	∩	∅	126	~	~	}	∅	206	Î	254	þ
79	O	O	∩	∅	127			}	∅	207	Ï	255	ÿ

Table 18 - 2: Character Indices in Tecplot Focus.

If your keyboard is not configured to produce a specific character, you can generate it by including the sequence `\nnn` in your text, where *nnn* is from the character index table found in the table. For example, if your keyboard will not generate the `é` and you want to show the word "latté," enter:

```
latt\233
```

Custom Characters

You can create symbols, characters, and even custom fonts for use in Tecplot Focus. See [Section 28 - 4 "Custom Character and Symbol Definition"](#) for further instructions.

18 - 1.5 Dynamic Text

You can add special placeholders, called dynamic text, that change with the data or the display environment. For example, you can add a date placeholder that Tecplot Focus will replace with the current date at each redraw. Similarly, you can add a zone name or variable name placeholder.

For placeholders that represent an attribute of a Tecplot Focus object of which Tecplot Focus supports multiple instances (such as a frame, a dataset, or a zone), the placeholder by default refers to the current or active instance: for example, to the active frame if the placeholder refers to an attribute of frames. If there is no obvious default or active instance, the placeholder by itself usually refers to the first instance.

For such placeholders, you may specify the desired instance of the referenced type of object by enclosing an index in square brackets immediately following the placeholder name. For example, `&(AUXZONE[3]:BC)` refers to the zone auxiliary data named BC in the *third* zone.

In most cases, the index may also be written as `ACTIVEOFFSET=n` to specify the *n*th active instance of an object type. For example, `&(ENDSLICEPOS[ACTIVEOFFSET=2])` refers to the end position of the *second* active slice group.

The complete list of placeholders is as follows:

Variables	Notes
<code>&(AUXDATASET:name)</code>	The value of the named auxiliary data attached to the dataset.
<code>&(AUXFRAME:name)</code>	The value of the named auxiliary data attached to the frame.
<code>&(AUXPAGE:name)</code>	The value of the named auxiliary data attached to the page.
<code>&(AUXVAR[nnn]:name)</code>	The value of the named auxiliary data attached to variable <i>nnn</i> .
<code>&(AUXLINEMAP[Q]:name)</code>	The value of the named auxiliary data attached to linemap Q, where Q = either <i>nnn</i> or <code>ACTIVEOFFSET = nnn</code> and <i>nnn</i> = linemap number. If <code>ACTIVEOFFSET=</code> is used, the integer value indicates the first linemap associated with the <i>nnn</i> th active fieldmap.
<code>&(AUXZONE[Q]:name)</code>	The value of the named auxiliary data attached to Q, where Q = either <i>nnn</i> or <code>ACTIVEOFFSET = nnn</code> and <i>nnn</i> = zone number. If <code>ACTIVEOFFSET=</code> is used, the integer value indicates the first zone associated with the <i>nnn</i> th active fieldmap.
<code>&(AXISMAXn)</code>	Maximum value of the current <i>n</i> -axis range, where <i>n</i> is one of: A ^a , R, X, Y, or Z.
<code>&(AXISMINn)</code>	Minimum value of the current <i>n</i> -axis range, where <i>n</i> is one of: A ^a , R, X, Y, or Z.
<code>&(BYTEORDERING)</code>	Displays the platform's byte ordering (INTEL or MOTOROLA).
<code>&(DATE)</code>	The current date, in the format <i>dd Mmm yyyy</i> .
<code>&(DATASETFILENAME[nnn])</code>	Filename of the <i>nnn</i> th file associated with the current dataset. If <i>nnn</i> is omitted, then all dataset filenames are shown, separated by new lines.
<code>&(DATASETTITLE)</code>	The current dataset title.

Variables	Notes
&(ENDSLICEPOS[<slice grouporactiveoffset>])	The position of the ending slice plane.
&(EXPORTISRECORDING)	Returns "YES" if recording is active, otherwise returns "NO".
&(FRAMENAME)	The frame name.
&(INBATCHMODE)	Returns a value of 1 if the software is in batch mode, 0 if interactive.
&(ISDATASETAVAILABLE)	Returns a value of 1 if a dataset exists for the current frame, 0 if nonexistent.
&(ISOSURFACELEVEL[<isosurfacegrouporactiveoffset>][nnn])	The value of the contour variable on the nnn^{th} iso-surface.
&(LAYOUTFNAME)	The name of the current layout file.
&(LOOP)	Innermost loop counter.
&(MACROFILEPATH)	Path to the folder containing the most recently opened macro file.
&(MAX n)	Maximum value of the n variable, where n is one of: A ^a , R, X, Y, or Z. For 2D or 3D Cartesian plots, the value is calculated from all active zones. For line plots, the value is calculated from the zone assigned to the first active linemap.
&(MAXB)	Maximum value of the blanking variable for the first active constraint. For 2D or 3D Cartesian plots, the value is calculated from the active zones. For line plots, the value is calculated from the zone assigned to the first active linemap.
&(MAXC)	Maximum value of the contour variable for contour group 1. For 2D or 3D Cartesian plots, the value is calculated from the active zones. For line plots, the value is calculated from the zone assigned to the first active linemap.
&(MAXI), &(MAXJ), &(MAXK)	[I, J, K]-dimension of the first active zone. For finite-element zones, MAXI is the number of nodes, MAXJ is the number of elements, and MAXK is the number of nodes per element (cell-based) or total number of faces (face-based).
&(MAXS)	Maximum value of the scatter sizing variable of the active zones.
&(MAXU), &(MAXV), &(MAXW)	Maximum value of the variable assigned to the [X, Y, Z]-vector component of the active zones.
&(MAXVAR[nnn])	Maximum value of variable nnn .
&(MIN n)	Minimum value of the n variable, where n is one of: A ^a , R, X, Y, or Z. For 2D or 3D Cartesian plots, the value is calculated from all active zones. For line plots, the value is calculated from the zone assigned to the first active linemap.
&(MINB)	Minimum value of the blanking variable of the first active blanking constraint. For 2D or 3D Cartesian plots, the value is calculated from all active zones. For line plots, the value is calculated from the zone assigned to the first active linemap.
&(MINC)	Minimum value of the contour variable of contour group 1. For 2D or 3D Cartesian plots, the value is calculated from all active zones. For line plots, the value is calculated from the zone assigned to the first active linemap.
&(MINS)	Minimum value of the scatter sizing variable for the active zones.
&(MINU), &(MINV), &(MINW)	Minimum value of the variable assigned to the [X, Y, Z]-vector component for the active zones.

Variables	Notes
&(MINVAR[<i>nnn</i>])	Minimum value of variable <i>nnn</i> .
&(NUMFRAMES)	Number of frames.
&(NUMPAGES)	Number of pages.
&(NUMPROCESSORS USED)	Number of processors used. This may be different than the total number on the machine because of the \$!Limits MaxAvailableProcessors configuration file command, or because of a product limitation.
&(NUMVARS)	Number of variables in the current dataset.
&(NUMXYMAPS)	Number of XY-linmaps assigned to the current frame.
&(NUMZONES)	Number of zones in current dataset.
&(OPSYS)	Displays the current operating system. 1=Linux/Macintosh, 2=Windows.
&(PAPERHEIGHT)	The paper height (in inches).
&(PAPERWIDTH)	The paper width (in inches).
&(PLATFORM)	The platform type (e.g. LINUX or WINDOWS).
&(PLOTTYPE)	Plot type of the current frame: 0 for Sketch, 1 for XY Line, 2 for Cartesian 2D, 3 for Cartesian 3D, and 4 for Polar Line.
&(PRIMARYSLICEPOS [<i><slicegroupactiveoffset></i>])	The primary slice position.
&(PRINTFNAME)	The name of the current print file.
&(SLICEPLANETYPE[<i><slicegroupactiveoffset></i>])	The type of the slice plane (X, Y, Z, I, J or K-planes).
&(SOLUTIONTIME)	The current solution time.
&(SOLUTIONTIME[<i>Q</i>])	Solution time of <i>Q</i> , where <i>Q</i> = either <i>nnn</i> or <i>ACTIVEOFFSET = nnn</i> and <i>nnn</i> = zone number. If <i>ACTIVEOFFSET=</i> is used, the integer value indicates the first zone associated with the <i>nnn</i> th active fieldmap. &(SOLUTIONTIME[5]) displays the solution time of the 5 th zone. &(SOLUTIONTIME[ACTIVEOFFSET=3]) displays the solution time of the first zone in the 3 rd active fieldmap.
&(STARTSLICEPOS[<i><slicegroupactiveoffset></i>])	The position of the starting slice plane.
&(STRANDID[<i>x</i>])	The strandID of a zone in dynamic text.
&(STREAMSTARTPOS [<i>nnn</i>])	Starting position (X, Y, Z) of the <i>nnn</i> th streamtrace.
&(STREAMTYPE[<i>nnn</i>])	Type (Surface Line, Volume Line, Volume Ribbon, Volume Rod) of the <i>nnn</i> th streamtrace.
&(\$string)	The value of the system environment variable <i>string</i> .
&(TECHOME)	Path to the home directory.
&(TECPLOTVERSION)	Displays the version number.
&(TIME)	The current time, in the format <i>hh:mm:ss</i> .

Variables	Notes
&(VARIABLE[<i>nnn</i>])	The variable name of variable <i>nnn</i> .
&(ZONEMESHCOLOR[<i>Q</i>])	Color of the mesh for zone <i>Q</i> , where <i>Q</i> = either <i>nnn</i> or <i>ACTIVEOFFSET</i> = <i>nnn</i> and <i>nnn</i> = zone number. If <i>ACTIVEOFFSET</i> = is used, the integer value indicates the <i>nnn</i> th active zone for field plots or the zone associated with the <i>nnn</i> th active linemap for line plots.
&(ZONENAME[<i>Q</i>])	The zone name of zone <i>Q</i> , where <i>Q</i> = either <i>nnn</i> or <i>ACTIVEOFFSET</i> = <i>nnn</i> and <i>nnn</i> = zone number. If <i>ACTIVEOFFSET</i> = is used, the integer value <i>nnn</i> indicates the <i>nnn</i> th active zone for field plots. For line plots, indicates the zone associated with the <i>nnn</i> th active linemap that will be defaulted to upon deactivation of a previous zone.

a. where *A* represents the theta (or angle) axis variable in Polar Line plots.

The placeholders should be typed exactly as shown, although the index or offset parameters shown must be replaced with the actual index or offset you wish to use.

You can, of course, embed the dynamic text strings in text records in a Tecplot-format data file, as in the following example:

```
TEXT CS=FRAME HU=POINT T="&(DATE)"
```

Environment Variables

System environment variables can be accessed directly from Tecplot Focus by using `&($string)`, where *string* is the name of the desired environment variable. Using environment variables within Tecplot Focus can add another degree of flexibility by taking advantage of your customized environment. If an environment variable is missing, the environment variable name itself will appear on the screen. Note that all environment variables are treated as text strings.

Formatting Numbers and Strings

If you want a dynamic text string to be formatted in a specific way, you may include C-style formatting strings in the macro variable specification.

The syntax for including a format string is:

```
&(DynamicTextString%formatstring)
```

The *formatstring* should be in the following format. Note that the flags, the width, and the precision are all optional; only the specifier is required. The square brackets [] are not a part of the format string.

```
[flags][width][.precision]specifier
```

The following are available as flags:

- - - Left-justify (default is right justification)
- + - Precede positive numbers with + sign (default is sign only for negative numbers)
- space - A blank space will be written in place of the sign if the number is positive
- 0 - Left-pads numbers with zeroes to fill the specified width (rather than spaces)

The *width* specifies the minimum number of characters to be printed. If the dynamic text string is shorter than this length, it is padded with spaces. The string is not truncated if it is longer than this length.

The *precision* specifies the following:

- For character strings: The maximum number of characters to be printed.
- For integers: The minimum number of digits printed; the number will be padded with leading zeroes to fulfill this requirement.
- For floating-point values: the number of digits to be printed after the decimal point.

When no *precision* is specified, the default is 1. When printing a character string value in a fixed-width field, then, you will want to specify the same value for both the *width* and the *precision* to achieve the desired result (otherwise you will print a maximum of 1 character due to the default *precision* of 1).

The following letters may be used as the *specifier*:

- **s** - string of characters
- **d** - signed integer
- **e** - scientific notation with a lowercase "e"
- **E** - scientific notation with an uppercase "E"
- **f** - floating point
- **g** - use %e or %f, whichever is shorter
- **G** - use %E or %f, whichever is shorter
- **u** - unsigned integer, written out in decimal format
- **o** - unsigned integer, written out in octal format
- **x** - unsigned integer, written out in hexadecimal (where a - f are lowercase)
- **X** - unsigned integer, written out in hexadecimal (where A - F are uppercase)

Example 1:

To display the message "Maximum contour value is: XXXXXX" where XXXXXX only has two digits to the right of the decimal place. You would use:

```
"Maximum contour value is: &(MAXC%.2f)"
```

If |MAXC| currently has a value of 356.84206 then the dialog would show:

```
"Maximum contour value is: 356.84"
```

Example 2:

If, in the above example, you wanted to use exponential format you could use:

```
"Maximum contour value is: &(MAXC%12.6e)"
```

Here the result would be:

```
"Maximum contour value is: 3.568421e+02"
```

Formatting Dates and Times

For dynamic text strings that represent a date and/or time, such as &(SOLUTIONTIME), the following may be used:

- **yy** - Two-digit year ("09")
- **yyyy** - Four-digit year ("2009")
- **m** - Month number ("3", "12"), or minute if preceded by hours token
- **mm** - Zero-padded two-digit month ("09") or minute if preceded by hour token
- **mmm** - Abbreviated month ("Oct" for October)
- **mmm** - Full month ("October")
- **mmmmmm** - Single-letter month ("O")
- **d** - Day of month ("9", "10")
- **dd** - Zero-padded two-digit day of month ("09")

- **ddd** - Abbreviated day of week ("Sun" for Sunday)
- **dddd** - Spelled-out day of week ("Sunday")
- **dddddd** - Single-letter day of week ("S")
- **h** - Hour ("7", "11")
- **hh** - Zero-padded two-digit hour ("07")
- **s** - Seconds ("5", "22")
- **ss** - Zero-padded two-digit seconds ("04")
- **.0, .00, .000** - Milliseconds to 1, 2, or 3 digits
- **am/pm, a/p** - AM/PM indicator. All times are 24-hour unless an AM/PM indicator is included in the format string, in which case 12-hour formatting is used.
- **[d], [h], [m]** - Elapsed days, hours, or minutes.
- **** - Escapes (removes the special meaning of) the following character. May be used if your format string includes static text containing any of the above tokens.

Example:

Here is a date and time format string for a solution time:

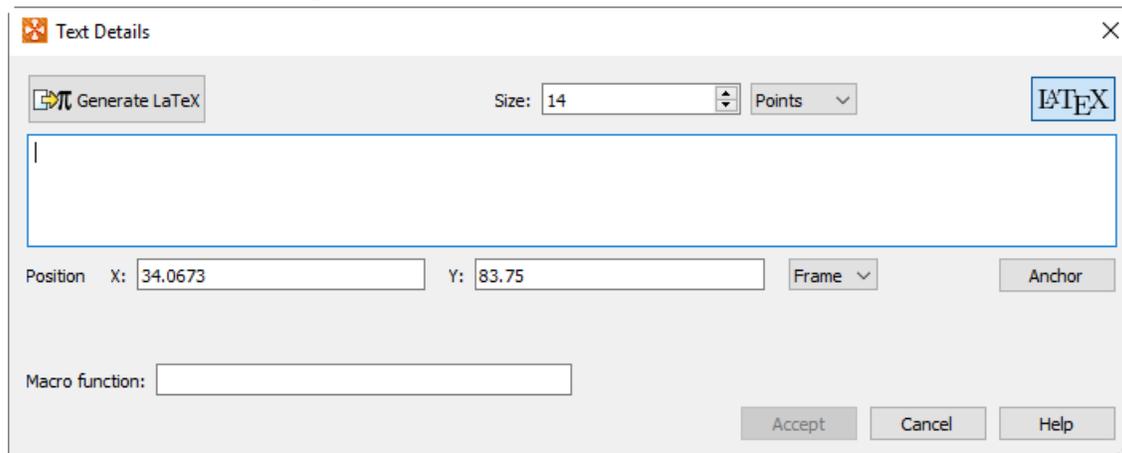
```
"Recorded on &(SOLUTIONTIME%dddd dd-mmm-yyyy at hh:mm:ss am/pm)"
```

The result would be similar to:

```
"Recorded on Monday 14-Sep-2009 at 04:31:42 PM"
```

18 - 1.6 LaTeX Expressions

LaTeX is a computer language designed for typesetting. The most popular use of LaTeX is math and Greek fonts for technical purposes. Use the **LaTeX** option of the **Text Details** dialog (accessed via the LaTeX Box button in the **Text Details** dialog) to switch between normal and LaTeX text.



The following options are available:

- **Generate LaTeX** - Renders the LaTeX output based on the current text field.
- **Size** - Select a character height unit from the drop-down menu, then enter the size in the associated field. LaTeX size commands are still valid and will resize relative to the Size value:
 - **Points** - Specify character height in points. One point is 1/72nd of an inch.
 - **Frame%** - Specify character height as a percentage of frame height.

- **Grid** - Specify character height in grid units. (Available only when Position By is set to Grid.)
- **LaTeX** - Switches between regular and LaTeX output in the text field.
- **X/Y Position** - Choose the position of the text element's anchor point (see Anchor button).
- **Position by** - Choose to position the text using the frame or grid coordinate system.
- **Anchor** - Choose how the text is aligned with the anchor point. As new text is added, the text expands away from the anchor point chosen in the Anchor Alignment dialog (See [Section 18 - 1.1 "Text Details"](#) for a complete image of the Anchor Alignment dialog).
- **Macro function** - Enter the name of the macro function to be linked to this text object. See [Section 18 - 3 "Linking Text and Geometries to Macros"](#) for more information. To run the linked macro function, hold down Control while right-clicking the text object in the workspace. (On Mac, hold down Command while right-clicking.)

A few requirements are needed before LaTeX outputs can be generated. In order to generate LaTeX outputs, see [Appendix E: Section "LaTeX Setup"](#) for more information on how to install recommended LaTeX engines.

LaTeX Examples

Example 1: Mathematical Symbols

LaTeX allows for easy configuration symbol production. The example below shows how to create simple vector and square root symbols:

```
$$\vec a =\sqrt 2$$
```

The dollar signs denote the start of an equation. The output is shown below:

$$\vec{a} = \sqrt{2}$$

Figure 18-2. Vector a equals square root of 2

Example 2: Mathematical Formula

In LaTeX, syntax is crucial to produce a correct output. Each symbol has its own syntax. The formula for Kirchhoff's current law, for example, is used like so:

```
Kirchhoff's current law\dots  
\begin{equation}  
\sum_{k=1}^n I_k = 0 \ ; .  
\end{equation}
```

Notice in the Figure 18-3 below how the begin and end equations separate the equation from regular text. LaTeX changes paragraph spacing as well as symbols.

Kirchhoff's current law...

$$\sum_{k=1}^n I_k = 0. \quad (1)$$

Figure 18-3. Kirchhoff's Current Law in LaTeX



To prevent equation numbering, use the `\begin{equation*}...\end{equation*}` syntax.

Example 3: How to add summations in inline text versus display style

Note the difference in typesetting style between inline text style and display style equations.

```
\noindent
This is the inline text style:
 $\lim_{n \to \infty} \sum_{k=1}^n \frac{1}{k^2} = \frac{\pi^2}{6}$ .
\newline\noindent
And this is display style:

$$\lim_{n \to \infty} \sum_{k=1}^n \frac{1}{k^2} = \frac{\pi^2}{6}$$

or
\begin{equation*} \lim_{n \to \infty} \sum_{k=1}^n \frac{1}{k^2} = \frac{\pi^2}{6}
\end{equation*}
```

This is the inline text style: $\lim_{n \rightarrow \infty} \sum_{k=1}^n \frac{1}{k^2} = \frac{\pi^2}{6}$.

And this is display style:

$$\lim_{n \rightarrow \infty} \sum_{k=1}^n \frac{1}{k^2} = \frac{\pi^2}{6}$$

OR

$$\lim_{n \rightarrow \infty} \sum_{k=1}^n \frac{1}{k^2} = \frac{\pi^2}{6}$$

Figure 18-4. Inline text versus display style

Example 4: Sizing and Accented Phrase

LaTeX allows for easy alphabetical accents. The following example shows the variety of accented phrases that can be accomplished by LaTeX typesetting. The phrase:

```
\huge ?`D\`onde est\`a el avi\`on? \\\
```

Is easily converted to non-English symbols. In LaTeX, these symbols are converted inline with other text allowing fluid transitions between both.

¿Dónde está el avión?

Figure 18-5. Multi-lingual phrases in LaTeX

Example 5: Color, Sizing, and Text Boxes

LaTeX allows for easy customizability with certain keywords. Some keywords and formatting are dependent on packages that do not come preinstalled with your LaTeX engine. The following example uses the xcolor package to show custom formatting. To initialize xcolor in the preamble, add the following to the end of the preamble in the tecplot_latex.mcr file:

```
\usepackage{xcolor}
```

Now your Tecplot Focus installation will be ready to use the xcolor package. Use the following phrases as an example for color, size, and text box formatting:

```
\fcolorbox{red}{gray!20}{\color{red} Colors are fun} but \ldots \\\  
\emph{\small sometimes they are not ideal} \\\  
\color{blue}\framebox{This might be better.} \\\  
But \colorbox{orange}{whatever you do,} \\\  
\color{black}don't make a {\huge Big Deal} about it.
```

This example shows three different text boxes each with different parameters. \fcolorbox allows for a colored frame as well as a background. \framebox has a transparent background and takes

the frame color of whichever color is currently being used. `\colorbox` creates a highlight in the color specified. The output is shown below:

Colors are fun but ...
sometimes they are not ideal
 This might be better.
 But whatever you do,
 don't make a **Big Deal** about it.

Figure 18-6. LaTeX Color, Sizing, and Text Boxes

Additional Examples

Example 6:

Example of LaTeX color with equations. See Example 5 for information about `xcolor` package.

```
 $\color{white}\overline{u^\prime v^\prime}$
```



Figure 18-7. Overline LaTeX with color

Example 7:

Example of complex fractions

```
 $\frac{T - T_{\infty}}{T_f - T_{\infty}}$
```

$$\frac{T - T_{\infty}}{T_f - T_{\infty}}$$

Figure 18-8. Complex LaTeX fraction

Example 8:

Example of simple inline equation

```
\textbf{Normalized Mean Velocity,  $\overline{W}/U_{\infty}$ }
```

$$\textbf{Normalized Mean Velocity, } \overline{W} / U_{\infty}$$

Figure 18-9. Inline LaTeX Equation

Additional LaTeX Resources

See this page for greek letter and math symbol syntax: https://www.overleaf.com/learn/latex/List_of_Greek_letters_and_math_symbols

For more examples on LaTeX use, syntax, or concepts check Tobias Oetiker's PDF, [The Not So Short Introduction to LaTeX](#).

Many frequently asked questions can also be found on the TeX StackExchange website: <https://tex.stackexchange.com/>

18 - 2 Geometries

Geometries in Tecplot Focus are simply lines and shapes, including polylines (a set of line segments), circles, ellipses, rectangles, and squares. Images are also considered geometries. [Figure 18-10](#) shows some examples of geometries.

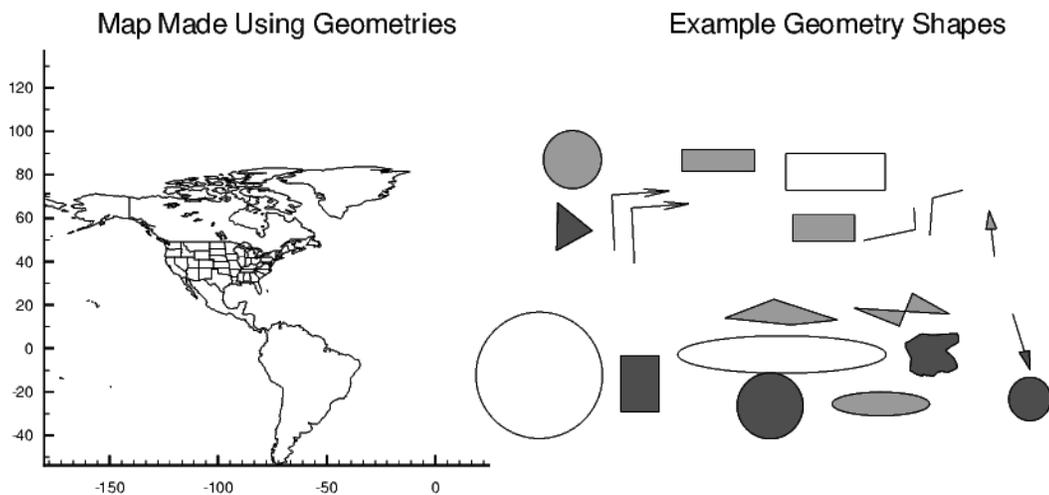


Figure 18-10. Sample Geometries

18 - 2.1 Geometry Creation

Geometries are created by drawing them in a frame using tools from the Toolbar or the **Insert** menu. (There is no tool for inserting an image; to insert an image, choose **Insert>Image/Georeferenced Image**).

Polyline

A polyline is a single geometry consisting of one or more line segments. Add a polyline to your plot by using the  button from the Toolbar or by selecting **Insert>Polyline**. To draw the polyline, move the mouse (without dragging) to the desired end point of the first line segment, then click the left mouse button. Move the pointer to the next end point, click, and so on. After placing the last segment, double-click on the final end point, right-click, or press Escape on your keyboard. To draw a horizontal or vertical line segment, press the H or V keys, respectively, while drawing the segment. After you place the segment's end point, the horizontal or vertical restriction is lifted. To lift the horizontal or vertical line segment restriction without placing the end point, press A on your keyboard. You can draw unconnected line segments in a single polyline; press U on your keyboard to "lift the pen." You can then move the pointer to the start of the next line segment.

A	Allow translation of polyline segments in all directions.
H	Restrict translation of current polyline segment to horizontal.
U	Pen up, while drawing polyline.
V	Restrict translation of current polyline segment to vertical.

Table 18 - 3: Keyboard Shortcuts for Polylines

Circle

Add a circle to your plot by using the  button from the Toolbar or by selecting **Insert>Circle**. To draw the circles, click at the desired center point of the circle; drag the mouse until the circle is the desired radius, then release.

Ellipse

Add an ellipse to your plot by using the  button from the Toolbar or by selecting **Insert>Ellipse**. To draw the ellipse, click at the desired center point of the ellipse; drag the mouse until the ellipse is the desired size and shape, then release.

Square

Add a square to your plot, using the  button from the Toolbar or by selecting **Insert>Square**. The anchor point of the square is either the lower left-hand corner or the upper right corner of the square. Drag the mouse to the right of the anchor to create a square with the anchor at lower left; drag the mouse to the left to create a square with the anchor at upper right. Release when the square is the desired size.

Rectangle

Add a rectangle to your plot, using the  button from the Toolbar or by selecting **Insert>Rectangle**. To draw the rectangle, drag the mouse until the rectangle is the desired size and shape. In contrast to squares, rectangles can propagate in any direction.

Image

Tecplot Focus can import images from *JPEG*, *BMP*, and *PNG* files. These images can be used as logos or as a backdrop to your plot. To add an image to your plot, choose **Insert>Image/Georeferenced Image** and browse to the desired image file. When you insert an image, the image is initially centered in the frame at a preset size. It can be resized by dragging its handles (at the corners and at the midpoints of its edges) when it is selected.

Images cannot be included in data files. When you save a data file, even if you indicate that you wish to include geometries, any images in the plot are not saved.

In layout and style sheet files, the image is referenced from its original location. This reference can be a relative reference or an absolute (as with data files). See "[Layout Files, Layout Package Files, Stylesheets](#)" on page 302 for details.

Images *are* included in layout package files.

Georeferenced Images

Georeferenced images can be added if they are paired with world files. Valid world files include .bmpw, .bpw, .jpgw, .jgw, .pgw, .pngw, .wld. When a world file is selected in the Insert Image File loader, it will automatically look for a corresponding image file of the same name.

World files supply information about the image's coordinate system including the location, scale, and rotation of the image on a defined coordinate system. For more information about how each line in a world file represents the coordinate system, see this [Wikipedia World File article](#).

Georeferenced Image Dialog

Displays information about the georeferenced image and allows the georeferenced image to be moved.

- **File Name** - Displays the path of the original georeferenced image file.
- **Resolution** - Displays the original resolution of the georeferenced image in pixels.
- **Z Position** - Enter the Z-coordinate of the anchor position of the georeferenced image.
- **Z min** - Displays the minimum value of the Z-coordinate.
- **Z max** - Displays the maximum value of the Z-coordinate.
- **Show in all Frames with the Same Data** - Toggle-on this option to display the geometry in all frames sharing the active frame's dataset.

18 - 2.2 Geometry Details

Use the **Geometry Details** dialog to specify attributes of polylines, circles, ellipses, squares, rectangles, and images. To access the **Geometry Details** dialog, first choose the  Selector tool, then double-click the geometry or image, or right-click it and choose Geometry Details or Image Details from the context menu. From the **context menu** the line and fill attributes can be changed easier than selecting **Geometry Details**.

The following options are available for most types of geometries (the line-related options are not, however, available for images):

- **Line Color** - Select a color for the geometry from the Color Chooser.
- **Line Pattern** - Select the desired pattern (Solid, Dashed, Dotted, LongDash, or DashDotDot).
- **Pattern Length (%)** - Specify the length of the line pattern as a percentage of the frame width.
- **Line Thickness (%)** - Specify the thickness of the line as a percentage of the frame width.
- **Fill with Color** - Toggle-on to fill a circle, ellipse, square, rectangle or line segment polygon. Then select a color for the fill using the Color Chooser.
- **Clipping** - Clipping displays only the portion of an object that falls within a specified region of the plot. If you have specified your geometry position in the Frame coordinate system, the geometry will be clipped to the frame: any portion of the geometry that falls outside the frame is not displayed. For this reason, the clipping options are not available for geometries using frame coordinates.

If you have specified the Grid coordinate system, you can choose to clip your geometry to the frame or the viewport. The size of the viewport depends on the plot type as follows:

- **3D Cartesian** - The viewport is the same as the frame, so viewport clipping is the same as frame clipping. This option is therefore unavailable in 3D Cartesian plots.

- **2D Cartesian/XY Line** - The viewport is defined by the extents of the X and Y-axes. You can modify this with the **Area** page of the **Axis Details** dialog.
- **Polar Line/Sketch** - By default, the viewport is the same as the frame. You can modify this with the **Area** page of the **Axis Details** dialog.
- **Draw Order** - Geometries can be drawn either before the data, or after the data. If a geometry is drawn before the data, the plot layers, such as mesh, contour lines, etc. will be drawn on top of the geometry. If a geometry is drawn after the data, the geometry will be drawn last, obscuring the data.



You can place text and geometries in any order you like. Tecplot Focus draws all geometries first, in the order in which they were placed, then all text. Use the **Send to Back** and **Bring To Front** commands on the **Edit** menu to reorder objects.

- **Attach to Zone/Map** - Toggle-on "Attach to Zone/Map" to attach the geometry to a particular zone or mapping by entering the number of the zone or mapping. Geometries that are attached to an inactive or non-existent zone are not displayed.
- **Show in all Frames with the Same Data** - Toggle-on this option to display the geometry in all frames sharing the active frame's dataset.
- **Macro Function** - Specify the name of the macro function to be linked to the geometry. See [Section 18 - 3 "Linking Text and Geometries to Macros"](#) for more information. To run the linked macro function, hold down Control while right-clicking the geometry in the workspace. (On Mac, hold down Command while right-clicking.)
- **Coordinate System** - Specify the coordinate system for the geometry (**Frame** or **Grid**). When created, screen objects default to the grid coordinate system. Changing the coordinate system automatically converts position and size fields so that the geometry will remain in the same place at the same size in the current view.
 - **Frame** - The geometry is always displayed at constant size and position when you zoom in or out of the plot.
 - **Grid** - The geometry resizes and moves with the data grid. However, the geometry remains fixed when you rotate the plot. Changing the center of rotation may cause the geometry to move.
- **X, Y** - Enter the X and Y-coordinates of the anchor position of the geometry (in frame units if the coordinate system is frame; in grid units if the coordinate system is grid). This point is the center for a circle, the upper left corner for a rectangle, etc.

The following fields are specific to a single geometry type:

- **Polyline** - The Arrowhead Style options control the appearance of an arrowhead on the polyline.
 - **Attachment** - Choose the end or ends of the polyline by selecting the appropriate check boxes.
 - **Style** - Plain, filled, or hollow.
 - **Size(%)** - Specify the size of the arrowhead as a percentage of frame height.
 - **Angle** - Specify the angle the arrowhead makes with the polyline.
- **Circle** - Controls the radius and precision of approximation of the circle:
 - **Radius** - Set the radius of the circle (in coordinate system units, **Frame** or **Grid**).
 - **Number of Sides** - Enter the number of polylines used to approximate the circle.
- **Ellipse** - Controls the shape and precision of approximation of the ellipse:
 - **Horizontal Axis** - Set the horizontal axis of the ellipse (in coordinate system units, **Frame** or **Grid**).

- **Vertical Axis** - Set the vertical axis of the ellipse (in coordinate system units- **Frame** or **Grid**).
- **Number of Sides** - Enter the number of polylines used to approximate the ellipse.
- **Square** - Controls the size of the square:
 - **Size** - Set the size of the square (in coordinate system units, **Frame** or **Grid**).
- **Rectangle** - Controls the size and shape of the rectangle:
 - **Width** - Set the width of the rectangle (in coordinate system units, **Frame** or **Grid**).
 - **Height** - Set the height of the rectangle (in coordinate system units, **Frame** or **Grid**).
- **Image** - Displays information about the image and allows the resizing method to be set.
 - **File Name** - Displays the path of the original image file.
 - **Resolution** - Displays the original resolution of the image in pixels.
 - **Filter** - The Resize filter determines how the image is resized to fit the screen. The following filters are available:
 - **Fast (textures)** - *default*- Tecplot Focus uses OpenGL textures to resize the image. This is the fastest option (given sufficient graphics space). However, the accuracy of the image may suffer, especially when reducing an image to a size much smaller than it was before.
 - **Pixelated** - Choose this option when the image is much larger than its original size and you want to see the individual pixels. This option is slower than the Fast (textures) for increasing the size of images.
 - **Smooth** - There are seven smooth options, all producing slightly different effects. These options are slower than the Fast (textures), but produce better effects for highly reduced images. In general, use the Smooth (Lanczos2) option unless you have specific image processing needs.



The resize filter has no effect on vector-based output, only on the screen and for exported images.

18 - 2.3 Three-dimensional Line Geometries

Three-dimensional line geometries cannot be created interactively; they must be created in a data file or using an add-on. In order to display 3D geometries, you must either include at least one zone in the data file with the 3D geometries or read the 3D geometries in, using the **Add to Current Data Set** option, after having first read a dataset into the frame.

18 - 3 Linking Text and Geometries to Macros

Each text or geometry you create, or image you insert, can be linked to a macro function. This macro function is called when you hold down the Control key (Command key on Mac) and click the right mouse button on the text or geometry or image. Macro functions are specified with the Macro Function field in the **Geometry Details** dialog or in the **Text Details** dialog (accessed by selecting your object and right-clicking).

In order to be attached to a text or geometry object, the macro function must be a "retained" macro function. A macro function is "retained" via either of the following scenarios:

- running a macro file that contains the required macro functions
- including it in your *tecplot.mcr* file (which is run at startup, making it a special case of the preceding scenario)

In both cases, the macro function is defined using the **\$(MACROFUNCTION)** macro command. Refer to the [Scripting Guide](#) for additional information.

Part 4 Data Manipulation

Blanking

Blanking allows you to exclude specific portions of zones from being plotted (in other words, selectively display certain cells or data points) based on variable values. In 3D, the result is analogous to a cutaway view.

Blanking settings apply only to the active frame, but Value Blanking settings for multiple frames may be synchronized using frame linking. Refer to [Section 2 - 3.4 "Frame Linking"](#) for more information on linking. Blanking results for volume zones depend upon the Surfaces to Plot setting on the Surfaces page of the **Zone Style** dialog (See [Section 7 - 1.2 "Surfaces"](#) for more details).

In the following discussions, the term "cell" is used. In I-ordered datasets, a cell is the connection between two adjacent points. In IJ-ordered datasets, a cell is the quadrilateral area bounded by four neighboring data points. In IJK-ordered datasets, a cell is the six-faced (hexahedral) volume bounded by eight neighboring data points. For finite element datasets, a cell is equivalent to an element.

The forms of blanking are as follows:

- [Value Blanking](#) - Cells (or portions of cells) of selected zones or line plot mappings are excluded based on the value of the value blanking variable at the data point of each cell or at the point where each cell intersects a constraint boundary.
- [IJK Blanking](#) - Cells of one IJK-ordered zone are included or excluded based on the index values. (IJK-ordered zones only)

All types of blanking may be used in a single plot. They are cumulative: cells blanked from any of the options do not appear. Value Blanking and Depth Blanking affect selected zones of all types, while IJK Blanking affects a single IJK-ordered zone.

Blanking

In general, all types of blanking affect all field layers, zones, and all other plot attributes except for edge layers. with the following exceptions:

Type of Blanking	Attribute Not Blanked
Value Blanking	Edge Layer
IJK Blanking	Derived Objects ^a (slices, streamtraces, or iso-surfaces) Finite-element zones

Table 19 - 1: Plot attributes not affected by blanking.

- a. Derived Objects can opt in or out of blanking. (See [Section 19 - 6 "Blanking Settings for Derived Objects"](#).)

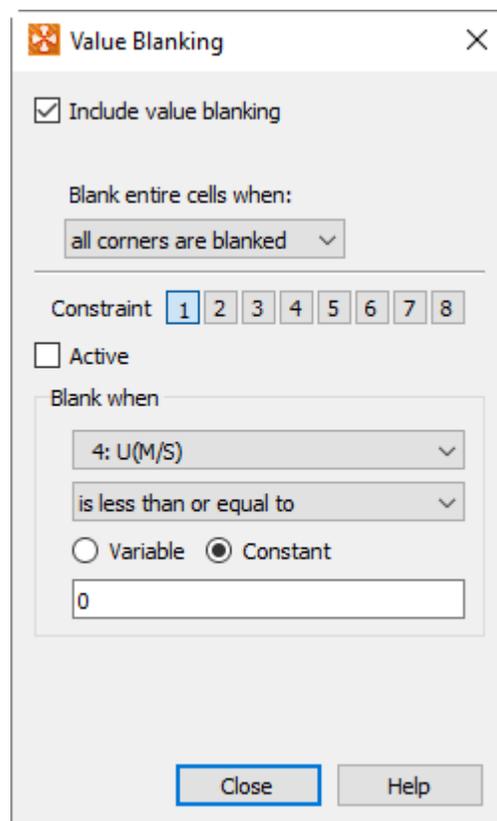
19 - 1 Value Blanking

Value blanking allows you to selectively eliminate or trim cells (only) and elements from Line and 3D field plots. For each active constraint, you specify a value blanking variable, a constant value or another variable, and a conditional statement telling Tecplot Focus to blank that region in relation to the specified variable or constant.

19 - 2 Value Blanking for Field Plots

To include value blanking in your plot, go to the **Plot** menu and select **Blanking>Value Blanking**. The **Value Blanking** dialog has the following options:

- **Include Value Blanking** - Toggle-on to include value blanking.
Note that it is possible to edit the settings in the Value Blanking dialog without actually activating blanking. This can make it faster to set up blanking since the plot won't need to redraw after every change of settings.
- **Blank entire cells when** - Select one of the following blanking styles:
 - **All corners are blanked** - Cells are removed from the plot if all of their data points satisfy one or more of the active blanking constraints.
 - **Any corner is blanked** - Cells are removed from the plot if any of their data points satisfy one or more of the active blanking constraints.



- **Primary value is blanked** - Cells are removed from the plot based on the primary value for a cell. The primary value for the cell is dependent upon the zone type and the variable value location, as outlined in the following table.

Zone Type	Value Location	Source of Primary Value
Ordered	Cell Centered	Cell value
Finite element	Cell Centered	Cell value
Ordered	Nodal	Lowest indexed corner in the cell
Finite element	Nodal	First node in the connectivity list for the cell

Refer to the [Zone/Variable Info Page](#) of the **Data Set Information** dialog to determine the Zone Type and Value Location.

- **Constraint** - You can establish up to eight value blanking constraints. Click a numbered button here to choose the constraint to be added or changed.
- **Active** - Toggle-on to activate the chosen constraint.
- **Blank when** - For each constraint, set the following parameters:
 - Select the variable to use for value blanking.



It is often convenient to create a new variable for use as the value blanking variable. This allows you to manipulate its values without changing any other part of the plot. You can create a new variable using the **Specify Equations** dialog (accessed via **Data>Alter**). See [Section 20 - 1.1 "Equation Syntax"](#).

- Specify an operation to describe how the blanking variable will be compared to the constant or variable following it.
- Choose to compare the blanking variable to either another variable or to a constant. If you are comparing to a variable, select the variable; if comparing to a constant, enter the constant.
- **Show Constraint Boundary** - Toggle-on to display a line that separates the region of your data that is blanked from the region which is not blanked. Set the appearance of this line using the following controls:
 - **Color** - Select the color of the boundary in the Color Chooser.
 - **Line Pattern** - Select the line pattern for the boundary.
 - **Pattern length** - Select the length of the pattern as a percentage of frame height.
 - **Line thickness** - Select the width of the boundary line as a percentage of frame height.



Value Blanking has no effect on edges of an ordered zone. If the edge is turned on, the edge of the entire zone (without value blanking) is plotted.

The following figure illustrates the various value blanking modes for plots.

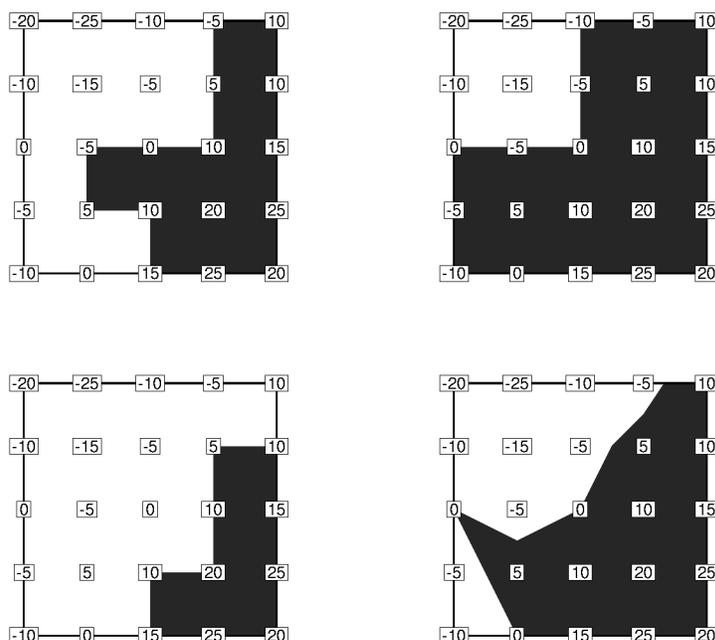


Figure 19-11. The effects of the different value blanking options in field plots for a constraint where a variable is less than or equal to zero. The dark shading indicates the areas that are not blanked. Clockwise from upper left: Blank cell when primary value is blanked. Blank cell when all corners are blanked. Trim cells along mathematical constraint boundary. Blank cell when any corner is blanked.

19 - 3 Value Blanking Settings for Individual Zones

Using the Effects page of the **Zone Style** dialog (accessed via the **Plot** menu or the Plot sidebar), you can turn value blanking on and off for individual zones. Simply highlight the zone(s), and toggle the checkbox in the Use Value Blanking column.

19 - 4 Value Blanking for Line Plots

For line plots, value blanking excludes data points from consideration in the resulting plot. The settings are the same as for [Value Blanking for Field Plots](#), except that you cannot choose the behavior of blanking relative to cells, as this does not apply to line plots.

As alternatives or adjuncts to value blanking, you can use the Indices page of the **Mapping Style** dialog to limit index ranges per mapping. The Curves page can provide another form of blanking by allowing you to limit the range of the independent variable for individual mappings.

[Figure 19-12](#) shows two plots. The original data for the plots contain some "bad" data points. The bad data points were identified as those with a Y-value greater than 0.6. The plot on the left uses all data points, including the bad data points, to draw a curve. The plot on the right has filtered out the bad data points by

using value blanking, where all points are removed if $Y > 0.6$. Blanking does not necessarily have to be on the independent or dependent variable.

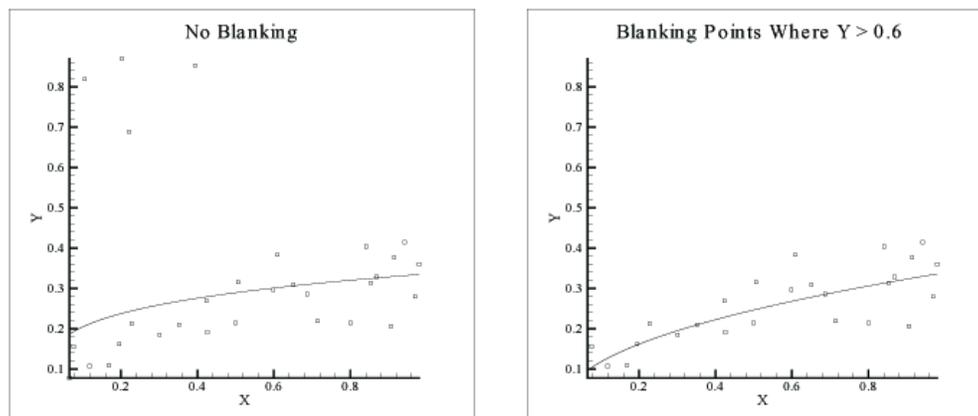


Figure 19-12. XY Line plots showing the effect of value blanking.

19 - 5 IJK Blanking

IJK Blanking is available for 2D and 3D ordered zones, in the 2D and 3D Cartesian plot types. IJK Blanking removes a selected portion of one IJK-ordered zone from the plot. This allows you to create cutaway plots: plots showing the exterior of some dataset with a section "cut away" to show the interior, such as the plot shown in [Figure 19-13](#).



To use IJK-blanking, you must have a 2D or 3D IJK-ordered zone, and the current plot type must be 2D or 3D Cartesian. Unlike [Value Blanking](#), which operates on all zones within a single frame, IJK Blanking can only be used on a single zone within a frame.

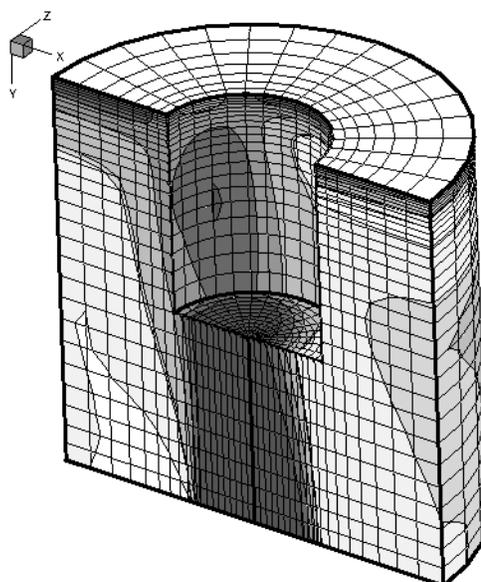
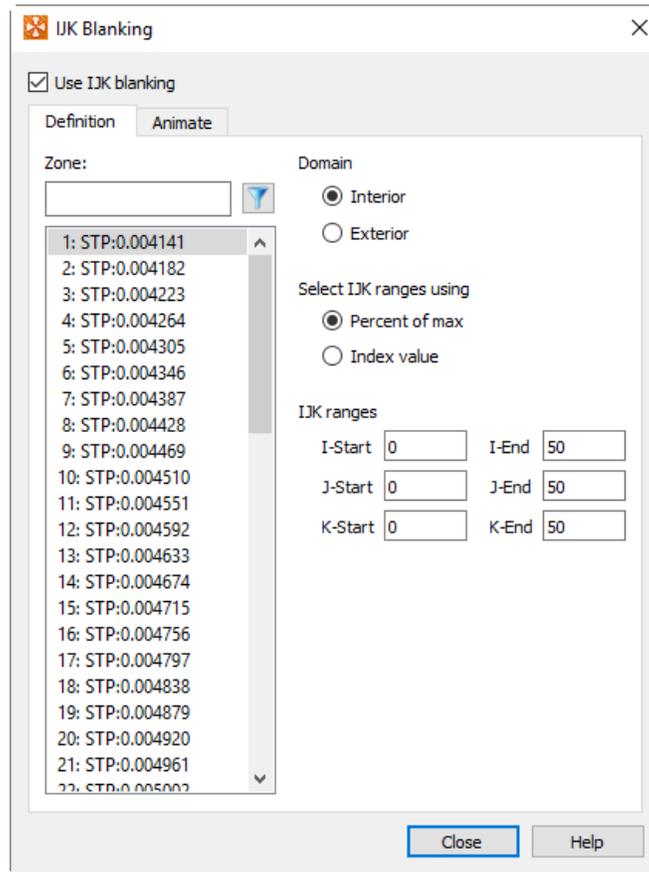


Figure 19-13. A cutaway plot created with IJK Blanking.

Blanking

To use IJK-blanking, select **Blanking>IJK Blanking** from the **Plot** menu. This option is available only when your data set has at least one IJK ordered zone.



The **Use IJK Blanking** checkbox at the top of this dialog turns IJK blanking on or off. The Definition page has the following options.

- **Use IJK Blanking** - Toggle-on to include IJK Blanking in your plot.
- **Zone** - Select the zone to which to apply IJK Blanking by clicking in the displayed list of IJK ordered zones. You may select only one zone.
If your data set has many zones, it is useful to filter the zone list. Type part of a zone name and press Enter (or click the filter button next to the zone name field) to display only the zones having a name containing the entered text.
- **Domain** - Specify the domain of the IJK Blanking by choosing one of the following options:
 - **Interior** - Cells within the specified index ranges are blanked. Those outside are plotted. This creates a "hole" in the zone. The left side of [Figure 19-14](#) shows an ordered zone with IJK Blanking with Interior domain.

- **Exterior** - Cells outside the specified index ranges are blanked. Those inside are plotted. Exterior plots a sub-zone of the zone. The right side of [Figure 19-14](#) shows an ordered zone with IJK Blanking with Exterior domain.

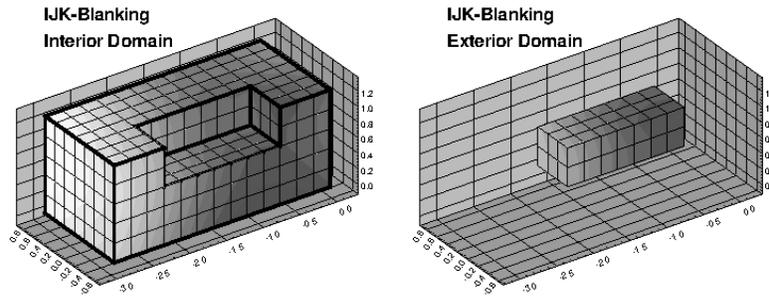


Figure 19-14. IJK Blanking with Interior domain (left) and Exterior domain (right).

- **Select IJK ranges using** - Specify the format in which you will specify the index ranges by selecting one of the following option buttons:
 - **Index Value** - Specify the I, J, and K-index ranges using absolute index values.
 - **Percent of Max** - Specify the I, J, and K-index ranges as start and end percentages of the maximum index. For example, you could blank the middle third of a dataset by setting the start percentage to 33.3 and the end percentage to 66.6.



When you save a layout, macro, or stylesheet, the IJK Blanking index ranges are stored as the percentage of the maximum index regardless of how you chose to enter them. This way, one layout can easily be used for data sets containing zones of various sizes.

For information on using the Animation page, see [“IJK Blanking Animation”](#) on page 339.

19 - 6 Blanking Settings for Derived Objects

You can opt to turn blanking on or off for derived objects (iso-surfaces, streamtraces, or slices) in their respective **Details** dialogs.

- **Iso-surfaces** - The option is located on the Style page of the **Iso-surface Details** dialog (click the  button to the right of Iso-Surfaces in the Plot sidebar). Refer to [Section 16 - 3 “Iso-Surface Contour and Shade”](#) for details.
- **Streamtraces** - The option is located on the Integration page of the **Streamtrace Details** dialog (click the  button to the right of Streamtraces in the Plot sidebar). Refer to [Section 15 - 1.7 “Integration Page”](#) for details.
- **Slices** - The option is located on the Definition page of the **Slice Details** dialog. Refer to [Section 14 - 1.2 “Definition Page”](#) for details.

Data Operations

Plots in Tecplot Focus rely on the datasets attached to each frame. You can modify, create, transform, interpolate, duplicate, and delete the data in the current dataset using the **Data** menu. You can also use the data operation capabilities of Tecplot Focus to create plots of analytical functions. By using layout files, macros, and/or equation files, you can create complex data operations that can be repeated on different datasets.

Changes to the dataset within Tecplot Focus do not affect the original data file(s). You can save the modified data by choosing Write Data from the **File** menu. When you save a layout file, a journal of data operations is saved and those operations are repeated when the layout file is read at a later time. If the data in the file has changed, or the data file is overwritten with new data, the operations are applied to the new data.

Alternatively, any datasets that have been modified are also saved to data files (see [Section 22 - 1 "Layout Files, Layout Package Files, Stylesheets"](#) for details).

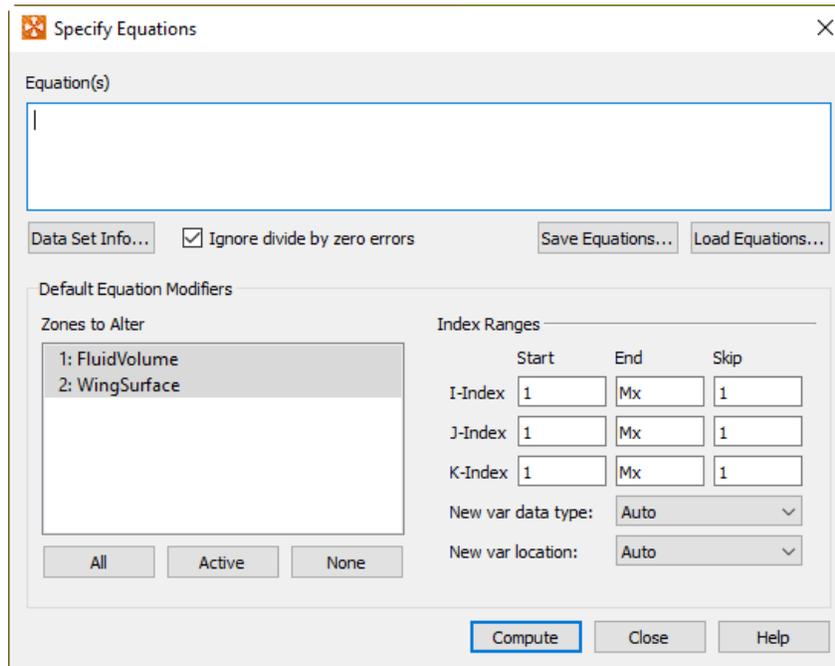
20 - 1 Data Alteration through Equations

Use **Data>Alter>Specify Equations** (or click the  toolbar button) to alter data in existing zones. The dialog allows you to change the values of entire variables or specific data points. You can also use this dialog to create new variables.

Changes made to the dataset in the **Specify Equations** dialog are not made to the original data file. You can save the changes by saving a layout file or writing the new data to a file. Saving a layout file will keep your data file in its original state, but use journaled commands to reapply the equations.



Variables defined in your data file, or variables you create yourself, are referenced in equations by surrounding them with curly braces, like {RPM}. This syntax must be used even when first defining a variable, for example {RPM} = {RPS} * 60 to define a new RPM variable from an existing RPS variable. Variable and function names provided by Tecplot Focus do not require the braces.



The **Specify Equations** dialog has the following options and fields:

- **Equation(s)** - Enter the equation(s) using the syntax described in [Section 20 - 1.1 "Equation Syntax"](#).
- **Data Set Info** - Opens the Data Set Info dialog (see [Section 5 - 4 "Data Set Information"](#)).
- **Ignore divide by zero errors** - When activated, suppresses the error dialog and returns the largest or smallest possible value depending on the sign of the dividend when a divide by zero condition occurs. 0/0 will return 0.
- **Save Equations** - Save all equations in the Equation(s) field to a text file with an *.eqn* format.
- **Load Equations** - Load an equation file previously saved.
- **Zones to Alter** - Select which zones to alter. You can manually select the zones in the list (holding Shift when clicking to create a range, or Control to toggle individual zones on or off). You may use the buttons below the list to select all zones, all active zones, or no zones.



When creating a new variable, if all zones are not selected, Tecplot will create a passive variable as a placeholder for any zones that are not included in the data alteration since all zones in a dataset must have the same number of variables. Passive variables effectively return zero for every point or cell value, do not consume any memory, and can be replaced at any time with other data alterations.

- **Index Ranges** - Select the index ranges to alter in the selected zones. You may skip this step if you want to apply the equation to all points of the selected zones. Use the special value \emptyset or *Mx* to specify the maximum index. You can also use the values *Mx-1* (to specify the index one less than the maximum index), *Mx-2*, and so forth.

For Ordered Data, the I-Index, J-Index, and K-index options correspond to the I, J, and K values in the dataset. For finite element data, the I-Index corresponds to the range of nodes and the J-Index corresponds to the cell-centered values. The K-index has no bearing on finite element data.

The Skip field indicates the increment between indexes. 1 means apply the calculation to every data point, 2 means to every other data point, 3 to every third point, and so on. When creating a new variable, the new variable's value is set to zero at any index value that is skipped.

- **New Var Data Type** (if applicable) - Select the data type of the new variable. The following data types are available:
 - **Auto** - Tecplot Focus assigns the data type based upon the variables used in the right-hand side of the equation.
 - **Single** - Four-byte floating point values.
 - **Double** - Eight-byte floating point values.
 - **Long Int** - Four-byte integer values.
 - **Short Int** - Two-byte integer values.
 - **Byte** - One-byte unsigned integer values (can contain values from zero to 255).
 - **Bit** - Either zero or one.
- **New Var Location** (if applicable) - Select the location of the new variable. The options are:
 - **Auto** (default) - "Auto" is set to node unless all variables in the equation are located at the cell center.
 - **Node**
 - **Cell-Center**
- **Compute** - Click the Compute button to alter the data. If an error occurs during the alteration (because of division by zero, overflow, underflow, etc.), an error message is displayed, all of the zones are restored to their previous state as of the beginning of processing that equation, and processing stops. The results of equations that have been successfully processed, however, are retained.

For example, if you enter three equations, and the second contains an error, the final state is the result of processing only the first equation. The second equation is rolled back due to the error, and the third is not processed at all.



Every time you hit the [Compute] button, the equations are calculated. Be sure to remove previously computed equations before computing new ones.

20 - 1.1 Equation Syntax

You can enter multiple equations in the Equation(s) text field of the **Specify Equations** dialog. Each equation occupies one line of the text field as demarcated by the Enter key (not necessarily by where they wrap in the text field). The equations are applied in order to all specified zones and data points.

Tecplot Focus equations have the following form:

$$LValue = F(RValue1, RValue2, RValue3, \dots)$$

Where: $F()$ - A mathematical expression.

$LValue$ - An existing or new variable.

$RValueN$ - A value (such as a constant, variable value, or index value).

If $LValue$ already exists in the dataset of the active frame, the equation is used to modify that variable. (The same variable may be used on the right side of the equation to refer to the pre-calculation value and thereby modify it based on its original value.) If the variable does not already exist, the equation is used to create a new variable as a function of existing variables.

There may be any number of spaces within the equation. However, there cannot be any spaces between the letters of intrinsic-function names nor in variables referred to by name. (See [Equation Operators and Functions](#).)

Equation Variables and Values

A variable is specified in one of the following ways:

- **Its order in the data file** - A variable may be referenced according to its order in the data file, where v1 is the first variable in the data file, v2 is the second, and so forth. To create a new variable using this specification, you must specify the number of the next available variable (i.e. if there are 5 variables in the dataset), the new variable must be called v6. You will receive an error message, if you attempt to assign an invalid variable number.



You can confirm the number and order of variables in the data file in the **Data Set Information** dialog (choose **Data>Data Set Info**). The variables in the dataset are listed on the right-hand side of the page.

- **By its name** - To reference a variable by its name, enclose the name with curly braces ("{" and "}"). For example, to set v3 equal to the value of the variable named R/RFR, you can enter:

$$v3 = \{R/RFR\}$$

Variable names are not case sensitive. Leading and trailing spaces are also not considered. However, spaces within the variable name are significant.

If two or more variables have the same name, the first variable is used when the variable is referred to by name. So, if both v5 and v9 are named R/rfr, v5 is used.

The curly braces can also be used on the left-hand side of the equation. In this case, if a variable with that name does not exist, a new variable is created with that name for all zones.

- **By a letter code** - Variables and index values may be referenced by the following letter codes:
 - **I** - Depends on the data type and the new variable's 'New Var Location' value:
 - Ordered data:
 - If 'New Var Location' is set to 'Node', I is the I index number of a node.
 - If 'New Var Location' is set to 'Cell center', I is the lowest I index associated with the cell.
 - FE data:
 - If 'New Var Location' is set to 'Node', I is the node index number.
 - If 'New Var Location' is set to 'Cell center', I is 1.
 - **J** - Depends on the data type and the new variable's 'New Var Location' value:
 - Ordered data:
 - If 'New Var Location' is set to 'Node', J is the J index number of a node.
 - If 'New Var Location' is set to 'Cell center', J is the lowest J index associated with the cell.
 - FE data:
 - If 'New Var Location' is set to 'Node', J is 1.
 - If 'New Var Location' is set to 'Cell center', J is the element number.
 - **K** - Depends on the data type and the new variable's 'New Var Location' value:
 - Ordered data:
 - If 'New Var Location' is set to 'Node', K is the K index number of a node.

- If 'New Var Location' is set to 'Cell center', K is the lowest K index associated with the cell.
- FE data:
 - If 'New Var Location' is set to 'Node', K is 1.
 - If 'New Var Location' is set to 'Cell center', K is 1.
- **X** - The variable assigned to the X-axis. In XY-plots, all active mappings must have the same X-variable in order for this variable name to be valid.
- **Y** - The variable assigned to the Y-axis. In XY-plots, all active mappings must have the same Y-variable in order for this variable name to be valid.
- **Z** - The variable assigned to the Z-axis (if in 3D Cartesian).
- **A** - The variable assigned to the Theta-axis for Polar plots. For this variable to be valid, the plot type must be set to Polar Line. In addition, all active mappings must have the same Theta-variable.
- **R** - The variable assigned to the R-axis for Polar plots. The plot type must be Polar Line, and all active mappings must have the same R-variable for this variable name to be valid.
- **U** - The X-component of vectors (if defined).
- **V** - The Y-component of vectors (if defined).
- **W** - The Z-component of vectors (if defined).
- **B** - The value-blanking variable for the first active constraint (if applicable).
- **C** - The contour variable for contour group 1 (if defined in the **Contour Details** dialog).
- **S** - The scatter-sizing variable (if defined in the **Scatter Size/Font** dialog).
- **SOLUTIONTIME** - The current solution time.
- **ZONENUM** - The current zone number.

Letter codes may be used anywhere on the right-hand side of the equation. Do not enclose them in curly braces.

Those letter codes representing variables (all letter codes except I, J, and K) may be used on the left-hand side of the equation as well.

The variables referenced by the letter codes are for the current frame.

Equation Operators and Functions

Binary Operators

In an equation, the valid binary operators are as follows:

+	Addition
-	Subtraction
*	Multiplication
/	Division
**	Exponentiation

Binary operators have the following precedence:

**	Highest precedence
*,/	
+,-	Lowest precedence

Operators are evaluated from left to right within a precedence level.

Functions

The following functions are available. Arguments may be variables, constants, expressions, other functions.

SIN(X)	Sine of X (must be specified in radians)
COS(X)	Cosine of X (must be specified in radians)
TAN(X)	Tangent of X (must be specified in radians)
ABS(X)	Absolute value of X
ASIN(X)	Arcsine of X (result given in radians)
ACOS(X)	Arccosine of X (result given in radians)
ATAN(X)	Arctangent of X (result given in radians)
ATAN2(A,B)	Arctangent of A/B (result given in radians)
SQRT(X)	Returns the positive square root of X
LOG(X), ALOG(X) ^a	Natural logarithm (base e) of X
LOG10(X), ALOG10(X) ^b	Logarithm base 10 of X
EXP(X)	Exponentiation (base e); EXP(X)=e**X
MIN(A, B)	Minimum of A or B
MAX(A, B)	Maximum of A or B
SIGN(X)	Returns -1 if X is negative, +1 otherwise
ROUND(X)	Round X to the nearest integer
TRUNC(X)	Remove fractional part of X
RAND(N)	Returns random number between 1 and N inclusive, different for each element in the variable

a. LOG and ALOG are equivalent functions

b. LOG10 and ALOG10 are equivalent functions

Conditional Expressions

Conditional expressions may be written using the IF function.

IF(P,T,F)	If the predicate expression P is true (has a non-zero value), returns the value of expression T, otherwise returns the value of expression F. Both T and F are fully evaluated regardless of the value of P; there is no "short-circuiting."
-----------	--

The predicate expression may include comparison and Boolean operators, as summarized in the following table.

Operator	Description	Example
==	Equal To	{A} = IF(X==2.0, 3, 4) assigns to variable A: 3 if X equals 2.0, otherwise 4
!=	Not Equal To	{A} = IF(X != Y,Z,2) assigns to variable A: Z if X does not equal Y, otherwise 2
>	Greater Than	{A} = IF(X > 1.0, 4, 5) assigns to variable A: 4 if X > 1.0, otherwise 5
>=	Greater Than or Equal To	{A} = IF(X >= Y, 4, Z) assigns to variable A: 4 if X >= Y, otherwise Z
<	Less Than	{A} = IF(X < Y, 4, Z) assigns to variable A: 4 if X < Y otherwise Z
<=	Less Than or Equal To	{A} = IF(X <= Y, 4, Z) assigns to variable A: 4 if X <= Y, otherwise Z
&&	Logical AND	{A} = IF(X < Y && X > 3, 8,9) assigns to variable A: 8 if X < Y AND X > 3, otherwise 9
||	Logical OR	{A} = IF(X == 2 || X > 3, 5,6) assigns to variable A: 5 if X == 2 OR X > 3, otherwise 6

These operators are valid only within the first argument of an IF function. They may not be used elsewhere in an expression. For example, {A} = X > 1 is invalid. Instead, use {A} = IF(X > 1, 1, 0) or similar.

Python-style operator chaining (such as A < B < C) is not supported. Although this construction is syntactically valid, it will not produce the expected result. Use A < B && B < C instead.

&& has a higher precedence than (will be evaluated before) ||. When in doubt, use parentheses.

Derivative and Difference Functions

The derivative functions can be called in the same manner as intrinsic functions. Derivative and difference functions can be calculated with respect to the following variables:

Variable	Definition	Restricted to:
x, y, z	variable assigned to the x-axis, y-axis or z-axis, respectively	XY Line ^a , or 3D
a	variable assigned to the theta-axis	Polar Line
r	variable assigned to the radial-axis	Polar Line
i, j, k	index range	Ordered Zones

- If you have multiple x-axes or y-axes in an XY line plot, the variables assigned to the x and y-axis in the first available mapping will be used.

The complete set of first and second-derivative and difference functions are listed below:

Type	Function Calls	Applicable Variables
First Order	ddx, ddy, ddz, dda, ddr	x, y, z, a, or r
Second Order	d2dx2, d2dy2, d2dz2, d2da2, d2dr2	x, y, z, a or r
Second-Order (cross derivatives)	d2dxy, d2dyz, d2dxz, d2dar	xy, yz, xz, or ar

The derivative function ddx is used to calculate $\frac{\partial}{\partial x}$; d2dx2 calculates $\frac{\partial^2}{\partial x^2}$; and d2dxy calculates $\frac{\partial^2}{\partial x \partial y}$.

Type	Function Calls	Applicable Variables
First Order	ddi, ddj, ddk	i, j, or k
Second Order	d2di2, d2dj2, d2dk2	i, j, or k
Second Order (cross derivatives)	d2dij, d2djk, d2dik	ij, jk, or ik

The difference functions ddi, d2di2, and so forth, calculate centered differences of their argument with respect to the indices I, J, and K based on the indices of the point. For example:

$$ddi(V) = \frac{V_{i+1} - V_{i-1}}{2}$$

For ordered zones, spatial derivative functions are calculated using the chain rule with difference functions. For example:

$$\frac{\partial \varphi}{\partial x} = \frac{\partial \varphi}{\partial i} \frac{\partial i}{\partial x} + \frac{\partial \varphi}{\partial j} \frac{\partial j}{\partial x} + \frac{\partial \varphi}{\partial k} \frac{\partial k}{\partial x}$$

or:

$$ddx(\varphi) = ddi(\varphi) \cdot ddx(i) + ddj(\varphi) \cdot ddx(j) + ddk(\varphi) \cdot ddx(k)$$

The spatial derivatives of indices, such as $ddx(i)$, are calculated from their inverses, such as $ddi(x)$, using standard curvilinear coordinate transformations.

For finite-element zones, spatial derivatives are calculated using the Moving Least-Squares technique. The variable at a particular node or cell center is assumed to vary quadratically in space about that point, and least-squares is used with all nodes surrounding the point to fit a polynomial function, whose coefficients then become the first and second derivatives of the variable.

Boundary Values

Boundary values for first-derivative and difference functions (ddx, ddy, ddz, ddi, ddj, and ddk) of ordered zones are evaluated in one of two methods: simple (default) or complex¹.

1. The `!INTERFACE` parameter in the configuration file `tecplot.cfg` selects the method to use:
`!INTERFACE DATA {DERIVATIVEBOUNDARY=SIMPLE}`
 Change the parameter SIMPLE to COMPLEX to use the complex boundary condition.

For simple boundary conditions, the boundary derivative is determined by the one-sided first derivative at the boundary. This is the same as assuming that the first derivative is constant across the boundary (i.e., the second derivative is equal to zero).

For complex boundary conditions, the boundary derivative is extrapolated linearly from the derivatives at neighboring interior points. This is the same as assuming that the second derivative is constant across the boundary (i.e. the first derivative varies linearly across the boundary).

For second-derivatives and differences (d^2dx^2 , d^2dy^2 , d^2dz^2 , d^2dxy , d^2dyz , d^2dxz , d^2di12 , d^2dj2 , d^2di1j , d^2dk2 , d^2dj1k , and d^2dik), these boundary conditions are ignored. The boundary derivative is set equal to the derivative that is one index in from the boundary. This is the same as assuming that the second derivative is constant across the boundary.



You can create your own derivative boundary conditions by using the index range and the indices options discussed previously.

The use of derivative and difference functions is restricted as follows:

- Derivatives and differences for IJK-ordered zones are calculated for the full 3D volume. The IJK-mode for such zones is not considered.
- If the derivative cannot be defined at every data point in all the selected zones, the operation is not performed for any data point.
- Derivative functions are calculated using the active frame's axis assignments. Be careful if you have multiple frames with different variable assignments for the same dataset.
- Derivatives at the boundary of two zones may differ since Tecplot Focus operates on only one zone at a time while generating derivatives.

20 - 1.2 Auxiliary Data

You may use auxiliary data containing numerical constants in equations. The syntax for using auxiliary data in equations is:

```
AUXZONE[ nnz ] : Name  
AUXDATASET : Name  
AUXFRAME : Name  
AUXVAR[ nnv ] : Name  
AUXLINEMAP[ nnm ] : Name
```

where

```
nnz = the zone number(s)  
nnv = the variable number(s)  
nnm = the line map number(s)  
Name = name of the auxiliary data
```

For example, a dataset auxiliary data constant called Pref would be referenced using `AUXDataSet:Pref`. Equations using this auxiliary data might appear as:

```
{P} = {P_NonDim} * AUXDataSet:Pref
```

20 - 1.3 Zone Number Specification

By following a variable reference with square brackets ("`[`" and "`]`"), you can specify a specific zone from which to get the variable value.

The zone number must be a positive integer constant less than or equal to the number of zones. The zone specified must have the same structure (I, IJ, or IJK-ordered or finite element) and dimensions (**IMax**, number of nodes) as the zone(s) the equation(s) will be applied to.



If you do not specify a zone, the zone modified by the left-hand side of the equation is used.

Zone specification works only on the right-hand side of the equation.

20 - 1.4 Index Specification

By following a variable reference with parentheses, you can specify indices for ordered data only. Indices can be absolute or an offset from the current index.

Index offsets are specified by using the appropriate index "i", "j" or "k" followed by a "+" or "-" and then an integer constant. Any integer offsets may be used. If the offset moves beyond the end of the zone, the boundary value is used. For example, $v3(i+2)$ uses the value $v3(IMAX)$ when $i=IMAX-1$ and $i=IMAX$. $v3(i-2)$ uses the value of $v3(1)$ when $i=1$ or $i=2$.

Absolute indices are specified by using a positive integer constant only. For example, $v3(2)$ references $v3$ at index 2, regardless of the current i index.

If the indices are not specified, the current index values are used.

20 - 1.5 Variable Sharing Between Zones

For zones with the same structure and index ranges, you can set a variable to be shared by specifying that the variable for those zones have the values from one zone. For example, if zones 3 and 4 have the same structure and you compute $v3=v3[3]$ for zones 3 and 4, $v3$ will be shared.



Subsequent alteration of the variables may result in loss of sharing.

20 - 1.6 Equation Restriction

The zone and index restrictions specified in the **Specify Equations** dialog can be overridden on an equation by equation basis. To specify restrictions for a single equation add the colon character (:) at the end of the equation followed by one or more of the following:

Equation Restrictor	Comments
<Z=<set>>	Restrict the zones.
<I=start[,end[,skip]]>	Restrict the I-range.
<J=start[,end[,skip]]>	Restrict the J-range.
<K=start[,end[,skip]]>	Restrict the K-range.
<D=datatype>	Set the data type for the variable on the left hand side. This only applies if a new variable is being created.
<V=valueolocation>	Set the value location (NODAL or CELLCENTERED) for the variable on the left hand side. Only applicable if a new variable is being created.

For example, to add one to X in zones 1, 3, 4, and 5:

```
X=X+1:<Z=[1,3-5]>
```

The following example adds one to X for every other I-index. Note that zero represents the maximum index.

```
X=X+1:<I=1,0,2>
```

The next example creates a new variable of type Byte:

```
{NewV}=X-Y:<D=Byte>
```

20 - 1.7 Macros and Equations

Tecplot Focus allows you to put your equations in macros. A macro with just equations in it may be referred to as an equation file, and in fact equation files saved using the Save Equations button are macro files with an .eqn extension. An equation in a macro file is specified using the \$!ALTERDATA macro command. Equation files may also include comment lines and must start with the comment #!MC 1410, like other macro files. If you are performing complex operations on your data, and/or the operations are repeated frequently, equation files can be very helpful.

You can create equation files from scratch using an ASCII text editor, or you can create your equations interactively by using the **Specify Equations** dialog and then save the resulting equations. The standard file name extension for equation files is .eqn.

For example, you might define an equation to compute the magnitude of a 3D vector. In the **Specify Equations** dialog, it would have the following form:

```
{Mag} = sqrt(U*U + V*V + W*W)
```

In a macro file, it would have the following form:

```
#!MC 1410
$!ALTERDATA
EQUATION = "{Mag} = sqrt(U*U + V*V + W*W)"
```

The interactive form of the equation must be enclosed in double quotes and supplied as a value to the EQUATION parameter of the \$!ALTERDATA macro command.

To read an equation file, select **Load Equations** on the **Specify Equations** dialog. In the **Load Equation File** dialog, select an equation file that contains a set of equations to apply to the selected zones of your data. The equations in the equation file will be added to the list of equations in the dialog. All equations are applied to your data when you click **Compute**.

Equations in equation files may be calculated somewhat differently depending on whether the computation is done from within the **Specify Equations** dialog or by running the equation file as a macro. When loaded into the **Specify Equations** dialog, equations that do not contain zone or index restrictions use the current zone and index restrictions shown in the dialog. When processed as a macro file, the equations apply to all zones and data points. To include zone and index restrictions, you must include them in the equation file as part of the \$!ALTERDATA command.

Refer to the [Scripting Guide](#) for more information on working with the \$!ALTERDATA command.

20 - 1.8 Equation Examples

In the following equation, v1 (the first variable defined in the data file) is replaced by two and a half times the existing value of v1:

```
V1 = 2.5*v1
```

The following equation sets the value of a variable called Density to 205. A new variable is created if a variable called Density does not exist.

```
{Density} = 205
```

In the next equation, the values for Y (the variable assigned to the Y-axis) are replaced by the negative of the square of the values of X (the variable assigned to the X-axis):

$$Y = -X^{**2}$$

The following equation replaces the values of V3 with the values of V2 rounded off to the nearest integer. A new variable is created if there are only two variables currently in the data set.

$$V3 = \text{round}(V2)$$

In the following equation, the values of the fourth variable in the data set are replaced by the log (base 10) of the values of the third variable.

$$V4 = \text{ALOG10}(V3)$$

Suppose that the third and fourth variables are the X and Y-components of velocity and that there are currently a total of five variables. The following examples create a new variable (V6) that is the magnitude of the components of velocity.

$$V6 = (V3*V3+V4*V4)**0.5$$

or

$$V6 = \text{sqrt}(V3**2+V4**2)$$

You can also accomplish the above operation with the following equation (assuming you have already defined the vector components for the active frame):

$$\{\text{Mag}\} = \text{sqrt}(U*U + V*V)$$

The following equation sets the value of a variable named diff to the truncated value of a variable named depth subtracted from the existing value of depth:

$$\{\text{diff}\} = \{\text{depth}\} - \text{trunc}(\{\text{depth}\})$$

In the next equation, C (the contour variable) is set to the absolute value of S (the scatter-sizing variable), assuming both C and S are defined:

$$C = \text{abs}(S)$$

In the following example, a new variable is created (assuming that only seven variables initially existed in the data file). The value for V8 (the new variable) is calculated from a function of the existing variables:

$$V8 = \text{SQRT}((V1*V1+V2*V2+V3*V3)/(287.0*V4*V6))$$

The above operation could have been performed in two simpler steps as follows:

$$V8 = V1*V1+V2*V2+V3*V3$$

$$V8 = \text{SQRT}(V8/(287.0*V4*V6))$$

The following equation replaces any value of a variable called TIME that is below 5.0 with 5.0. In other words, the values of TIME are replaced with the maximum of the current value of TIME and 5.0:

$$\{\text{TIME}\} = \text{max}(\{\text{TIME}\}, 5)$$

The following equation creates variable V4 which has values of X at points where $X < 0$; at other points, it has a value of zero (this does not affect any values of X):

$$V4 = \text{min}(X, 0)$$

Another example using intrinsic functions is shown below:

$$V8 = 55.0*\text{SIN}(V3*3.14/180.0) + \text{ALOG}(V4**3/(V1+1.0))$$

You can also reference the I, J, and K-indices in an equation. For example, if you wanted to cut out a section of a zone using value blanking, you could create a new variable that is a function of the I and J-indices (for IJ-ordered data). Then, by using value-blanking, you could remove certain cells where the value of the value-blanking variable was less than or equal to the value blanking cut-off value.

Here is an example for calculating a value-blanking variable that is zero in a block of cells from I=10 to 30, and is equal to one in the other cells:

$$V3 = \text{min}((\text{max}(I, 30) - \text{min}(I, 10) - 20), 1)$$

The following equation replaces all values of Y with the difference between the current value of Y and the value of Y in zone 1. (If zone 1 is used for the data alteration, the new values of Y will be zero throughout that zone.)

$$Y = Y - Y[1]$$

The following equation replaces the values of V3 (in an IJ-ordered zone) with the average of the values of V3 at the four adjacent data points:

$$V3 = (V3(i+1,j)+V3(i-1,j)+V3(i,j+1)+V3(i,j-1))/4$$

The following equation sets the values of a variable called TEMP to the product of the values of a variable called T measured in four places: in zone 1 at two index values before the current data point, in the current zone at an absolute index of three, in zone 4 at the current data point, and in the current zone at the current data point.

$$\{TEMP\} = \{T\}[1](i-2) * \{T\}(3) * \{T\}[4] * \{T\}$$

Indices may be combined with zone specifications. The zone is listed first, then the index offset. For example:

$$V3 = V3 - V3[1](i+1)$$

$$Y = Y[1] - Y[2](1) + Y(1,j+3) + Y$$

Referencing variables by letter code:

$$V3 = I + J$$

$$V4 = \cos(X) * \cos(Y) * \cos(Z)$$

$$\{Dist\} = \text{sqrt}(U*U + V*V + W*W)$$

$$\{temp\} = \text{min}(B,1)$$

Specifying the Zone number for a given variable:

$$V3 = V3 - V3[1]$$

$$X = (X[1] + X[2] + X[3]) / 3$$

$$\{TempAdj\} = \{Temp\}[7] - \{Adj\}$$

$$V8 = V1[19] - 2*C[21] + \{R/T\}[18]$$

20 - 2 Data Smoothing

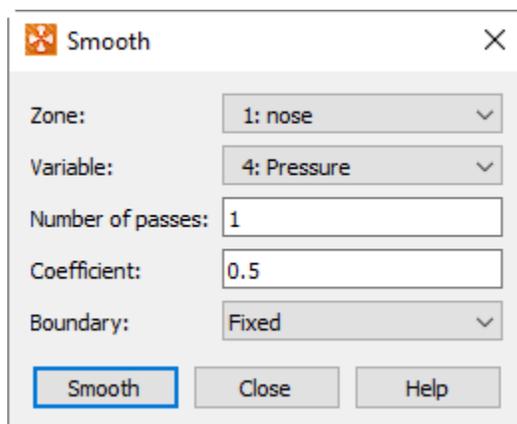
You can smooth the values of a variable of any zone (2D or 3D) or 1D line map (plotted in either XY or Polar) to reduce "noise" and lessen discontinuities in data.

Smoothing can be used after inverse-distance interpolation to reduce the artificial peaks and plateaus this type of interpolation can produce. Each pass of smoothing shifts the value of a variable at a data point towards an average of the values at its neighboring data points.



Zones must be mesh-based to be smoothed. If your data consists of disconnected points, see ["Inverse-Distance Interpolation"](#) on page 285 and ["Irregular Data Point Triangulation"](#) on page 289 for possible approaches to converting it to a form suitable for use with the Tecplot Focus smoothing feature.

To smooth data in Tecplot Focus, select **Alter>Smooth** from the **Data** menu.



The **Smooth** dialog has the following options:

- **Zone** - Specify the zone to smooth from the **Zone** drop-down. The zone should not intersect itself.
For a given plot type, the dimension of the zone must be less than or equal to the dimension of the plot type. That is, in 3D Cartesian plots, volume, surface and line zones may be smoothed, while in 2D Cartesian plots, volume zones cannot be smoothed.
- **Variable** - Select the variable to smooth. For line plots, the variable must be a dependent variable for an active mapping for that zone.
- **Number of Passes** - Specify the number of smoothing passes to perform. The default is 1. A greater number of passes results in greater smoothing, but takes more time.
- **Coefficient** - Specify the relaxation factor for each pass of smoothing. Enter a number between zero and one (exclusively). Large numbers flatten peaks and noise quickly. Small numbers smooth less each pass, rounding out peaks and valleys rather than eliminating them.
- **Boundary** - Select the boundary conditions by which to smooth from the Boundary drop-down.
 - **Fixed** - The points at the boundary are not changed in value. For finite element data, only fixed boundary conditions may be used.
 - **First Order** - The points at the boundary are smoothed based on the assumption that the first derivative normal to the boundary is constant. This will tend to cause contour lines of the smoothed variable to be perpendicular to the boundary.
 - **Second Order** - The points at the boundary are smoothed based on the assumption that the second derivative normal to the boundary is constant. This option may overextrapolate derivatives at the boundary.
- **Smooth** - Click to perform smoothing. While the smoothing is underway, the progress is displayed in the status bar. A Stop button displayed in the status bar allows you to interrupt the operation.

20 - 2.1 Smoothing Method

Tecplot Focus uses the Jacobi method with the Coefficient used as a relaxation factor (always < 1 , so it's under-relaxed). For ordered zones, Tecplot Focus does this in generalized curvilinear coordinates, which has the effect of length- (or area- or volume-) weighting a node's neighboring values. For the fixed boundary condition, boundary values remain unchanged. For first-order boundaries, the boundary values are relaxed toward the neighboring interior values, and for second-order boundaries, they are relaxed toward a constant slope (zero curvature) relative to the two neighboring interior points. For finite-element zones, Tecplot Focus relaxes each value toward the inverse-distance weighted average of its neighbors. Only the fixed boundary condition is available for FE zones.

20 - 2.2 Limitations of Smoothing

- Finite element zones cannot be smoothed with anything other than Fixed boundary conditions.
- Tecplot Focus uses the active frame's axis assignments to determine the variables to use for the coordinates in the smoothing, and also to determine whether the smoothing should be done with XY Line, Polar, and 2D or 3D Cartesian plot types. Be sure to select the correct frame if you have multiple frames with different variable assignments for the same dataset.
- Any axis scaling is ignored while smoothing.
- For I-ordered or finite element line segment zones, the active frame can be in the XY Line, or 3D Cartesian plot types. In XY Line, the variable must be the dependent variable of one active mapping for that zone.
- For IJ-ordered, finite element triangle, or finite element quadrilateral zones, the active frame can be a 2D or 3D Cartesian plot type, but you cannot smooth the variables assigned to the X and Y-axes in Cartesian.
- For IJK-ordered, finite element tetrahedral, or finite element brick zones, the plot type must be 3D Cartesian, and you cannot smooth the variables assigned to the X, Y, and Z-axes. The IJK-mode is ignored. The zone is smoothed with respect to the entire 3D volume.
- Smoothing does not extend across zone boundaries. If you use a boundary condition option other than Fixed (such that values along the zone boundary change), contour lines can be discontinuous at the zone boundaries.
- Smoothing is performed on all nodes of a zone, and disregards value blanking.

20 - 3 Fourier Transform

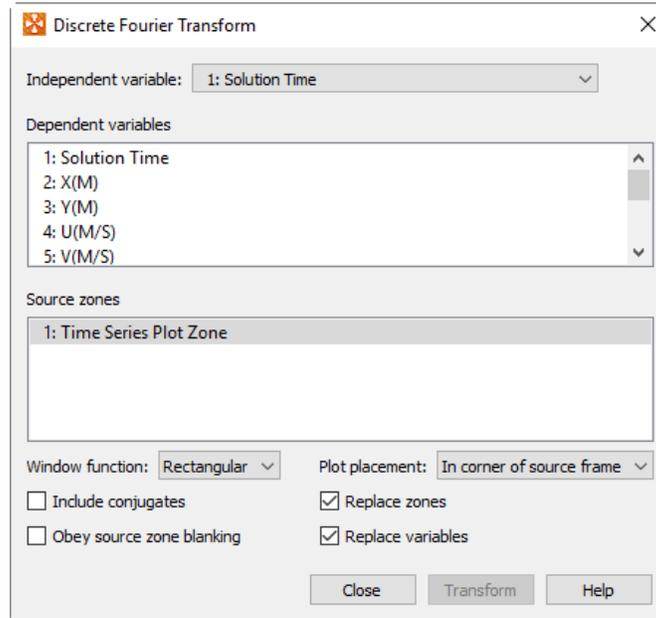
The Fourier transform feature (**Data>Fourier Transform**) allows you to transform one-dimensional ordered linear data into the frequency domain. One or more dependent variables in the data set are taken to be a representation of some function of a single independent variable, such as time, and this function is decomposed into its constituent sine waves. Variables are added to the data set to indicate these waves' frequency in Hertz, phase, and amplitude in each selected zone, and an XY of the resulting amplitudes is created in a new frame.

The dependent variables for a Fourier transform must be single-valued. The independent variable domain need not be constantly spaced; data will be resampled linearly if necessary.

The resulting frequency, amplitude, and phase variables (three for each dependent variable) are stored in Fourier transform result zones, one for each source zone. The result zones are given the name "Fourier Transform" followed by text indicating the source zone, independent variable, and window function used to calculate them. Result zones are assigned new time strands using the same groupings as the source zones if they belong to time stands; otherwise the resulting zones are static.

The result variables in the result zone are given the names Frequency, Amplitude and Phase followed by text indicating the dependent variable involved in the calculation. If the independent variable is non-uniform, Frequency is a uniform interpolation of the original data.

Newly-created zones are assigned passive variables for all variables that previously existed in the dataset, and all previously-existing zones are assigned passive variables for all new variables created by the Fourier transform.

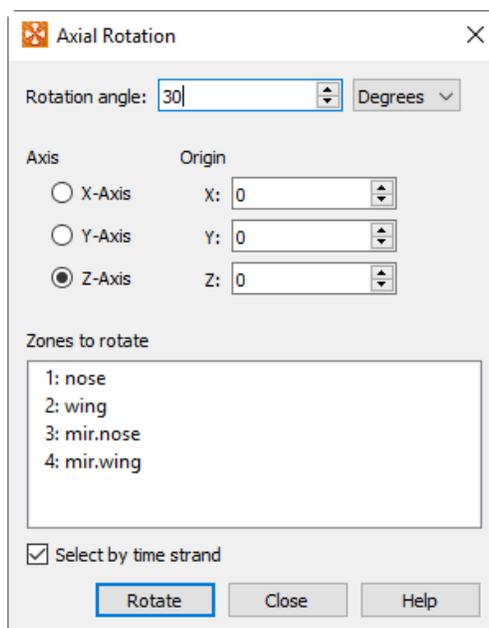


- **Independent Variable** - The variable used as the frequency domain. If this variable's spacing is non-uniform, this variable is used in conjunction with each dependent variable for interpolation to create a uniform frequency for the Fourier transform.
- **Dependent Variables** - Choose the dependent variables to be transformed. Each will appear on the resulting XY plot as its own linemap.
- **Source Zones** - Choose the zones for which the transform should be calculated.
- **Window Function** - A function applied to the dependent variables before performing the transform (but after interpolation) to taper the data. Rectangular, triangular, Hann, and Hamming filters are provided.
- **Plot Placement** - Where to initially place the result plot of the transform showing the distribution of frequencies in the data. The plot can be moved and resized as desired afterward.
 - *In corner of source frame* - A new frame is created for the frequency plot in the upper right corner of the frame containing the data being transformed.
 - *Tile with existing frames* - All frames, including the new one, are adjusted to the same size and arranged on the paper in a grid.
- **Include Conjugates** - For purely real numbers, fully half of the results of the Fourier transform are conjugates (values with the same real part but opposite imaginary parts, which behave identically in situations where a real number is required). Toggling-off this option will allow the transform to be performed approximately twice as fast, as only one conjugate is calculated.
- **Obey Source Zone Blanking** - If value blanking is active and this option is toggled-on, value blanking is applied to the values of both independent and dependent variables before interpolation is performed. If data values eliminated by blanking cause the data to be non-uniform, the values are interpolated appropriately. All blanked data values up to the first non-blanked value, and all blanked data values after the last non-blanked value, are ignored, providing a way to constrain the domain of the transform.
- **Replace Zones/Variables by Name** - If either or both are toggled-on, the results of the transform are stored in existing result zones and/or variables, based on their names, if such zones and/or variables exist. Otherwise, new result zones and/or variables are created.

You may also access this feature by right-clicking a line map and choosing Fourier Transform from the context menu. In this case, the line map you click defines the independent and dependent variable used. All other settings are taken from last values entered in the dialog; the dialog does not appear.

20 - 4 Axial Rotation

The Axial Rotation dialog, available from the **Alter** submenu of the **Data** menu, allows you to rotate one or more 2D or 3D zones using the right-hand rule. The variables rotated are the spatial variables (X, Y, and, for 3D zones, Z) and the vector variables assigned using **Plot > Vector > Variables**. For 3D zones, you may also choose the axis of rotation.



The Axial Rotation dialog has the following options:

- **Rotation Angle** - The angle by which the data should be rotated. May be specified in degrees or radians using the drop-down menu to the right of the entry field.
- **Axis** - For 3D zones, choose the axis around which rotation should occur. Not available for 2D zones, which are always rotated about a notional axis perpendicular to the zone.
- **Origin** - For rotation around a point other than (0, 0) or (0, 0, 0), enter the location of the origin using the X, Y, and (for 3D zones) Z fields.
- **Zones to Rotate** - Click, Control-click, and/or Shift-click in the zone list to select one or more zones.
- **Select by Time Strand** For transient data, if this checkbox is toggled on, the zones in the Zones to Rotate list are grouped by time strand, so that selecting a zone selects all the zones in that time strand.



Using a macro, it is possible to rotate around arbitrary axes rather than just X, Y, and Z, and to specify exactly which variables, if any, should be rotated as spatial variables and which as vector variables, including no spatial variables at all, or multiple vector variables. See \$!ROTATEDATA in the [Scripting Guide](#).

20 - 5 Zone Creation

The **Create Zone** submenu of the **Data** menu allows you to add data to your plot. The menu has the following options:

- [Rectangular Zone Creation](#)
- [Circular or Cylindrical Zone Creation](#)
- [Zone Duplication](#)
- [Mirror Zone Creation](#)

20 - 5.1 Rectangular Zone Creation

Creating a rectangular zone is often the first step in interpolating irregular data into an ordered grid

Tecplot Focus allows you to create a new ordered rectangular zone with the dimensions in the I, J and K-directions you specify. This is done either with the **Create Rectangular Zone** tool (only) or the **Create Rectangular Zone** dialog. The zone that you create has the same number of variables as other zones in the dataset.

To create a rectangular zone, select **Create Zone>Rectangular** from the **Data** menu.

The **Create Rectangular Zone** dialog has the following options:

- **Dimensions** - Enter the number of data points in the I, J and K-directions.
 - To create an I-ordered zone, enter 1 for both the J and K-dimensions.
 - To create an IJ-ordered zone, enter 1 for the K-dimension. The z-axis variable will equal **ZMin** throughout the created zone.
 - To create an IJK-ordered zone, enter a K-dimension greater than one.
- **Coordinates** - Enter the start and end points of the physical coordinates (X,Y and Z).
- **Create** - Select the [Create] button to create the zone.

Tecplot Focus uniformly distributes the data points in the I, J and K directions. Any variable not assigned to an axis is set to zero.

By using the **Specify Equations** dialog under the **Data>Alter** menu, you can modify the X, Y, and Z-coordinates, and the values of the other variables as well, by using equations or Equation files. See [Section 20 - 1 "Data Alteration through Equations"](#).

20 - 5.2 Circular or Cylindrical Zone Creation

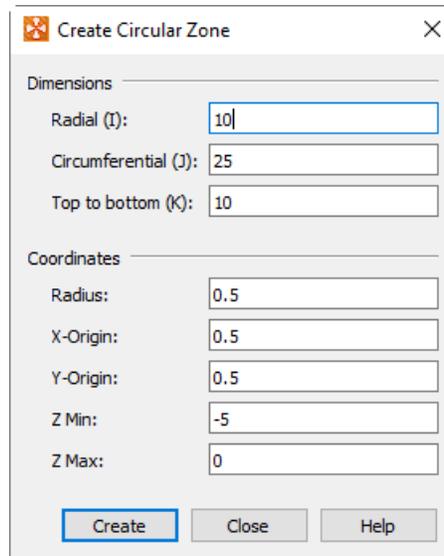
Tecplot Focus allows you to create a new ordered circular or cylindrical zone with the dimensions in the I, J, and K-directions you specify. The I-dimension determines the number of points on each radius of the zones.

The J-dimension determines the number of points around the circumference. The K-dimension determines the number of layers in the zone, creating a cylinder.

You create a circular or cylindrical zone with the **Create Circular Zone** dialog (accessed via **Data>Create Zone**, or with the **Create Circular Zone** tool (only). The zone that you create has the same number of variables as other zones in the dataset.

If you have no current dataset, Tecplot Focus creates one with two or three variables, depending on the K-dimension. If you specify $K=1$, the dataset is created as IJ-ordered, and has two variables. If you specify $K>1$, the dataset is created as IJK-ordered, and has three variables.

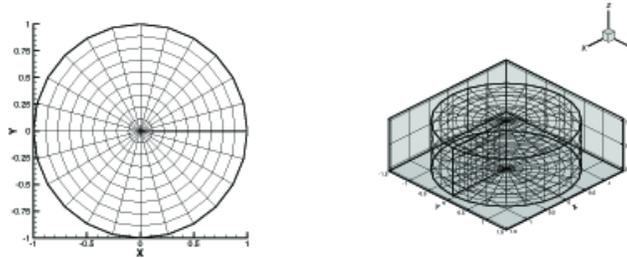
To create a circular zone select **Create Zone>Circular** from the **Data** menu.



The **Create Circular Zone** dialog has the following options:

- **Dimensions** - Enter the dimensions of your circular zone:
 - **Radial (I)** - Specify the number of points the radial direction (I)
 - **Circumferential (J)** - Specify the number of points in the circumferential direction (J)
 - **Top to Bottom (K)** - Specify the number of points for the height of the cylinder (K). Set K equal to one to create a circular zone.
- **Coordinates**
 - **Radius** - Enter the length of the radius.
 - **X-Origin** and **Y-Origin** - Enter the coordinates for the zone center
 - **ZMin** and **ZMax** - Enter the minimum and maximum Z-coordinates. For a circular zone (where $K=1$), the Z variable is set to ZMin for all points.
- **Create** - Select the [Create] button to create the zone.

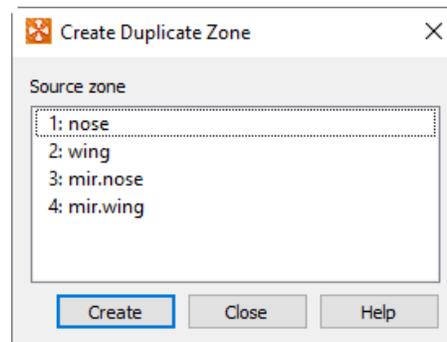
For IJ-ordered, Tecplot Focus creates a zone in which I-circles are connected by J-radial lines. For 3D ($K > 1$), Tecplot Focus creates a K-layered cylindrical zone having I-circles connected by J-radial planes. All other variables are set to zero. These two scenarios are shown below.



Using the **Alter** option from the **Data** menu, you can modify the X-, Y-, and Z-coordinates, and the values of the other variables as well, by using equations or equation files. See [Section 20 - 1 "Data Alteration through Equations"](#).

20 - 5.3 Zone Duplication

To create a full duplicate of one or more existing zones, select **Create Zone>Duplicate** from the **Data** menu. In the **Create Duplicate Zone** dialog, select the source zone(s). Each duplicate zone has the same name as its source zone.



After a zone is duplicated, all variables in the newly created zone(s) will be shared with their corresponding source zone(s).

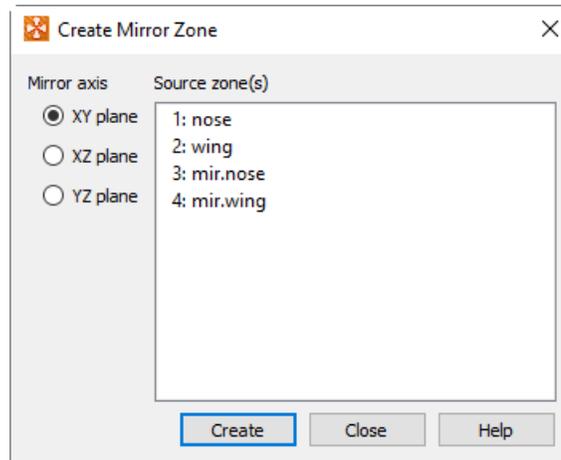
20 - 5.4 Mirror Zone Creation

To create a duplicate zone that is the mirror image of an existing zone, select **Create Zone>Mirror** from the **Data** menu.



You can only create mirrored zones along one of the standard axes (2D) or the plane determined by any two axes (3D).

The **Create Mirror Zone** dialog has the following options:



- **Source Zone(s)** - Select the Sources Zone(s).
- **Mirror Axis** - Specify the axis () or axis plane (3D) to mirror about.
- **Create** - Select the [Create] button to create the zone.

Each mirror zone has a name of the form "Mirror of zone *sourcezone*", where *sourcezone* is the number of the zone from which the mirrored zone was created.

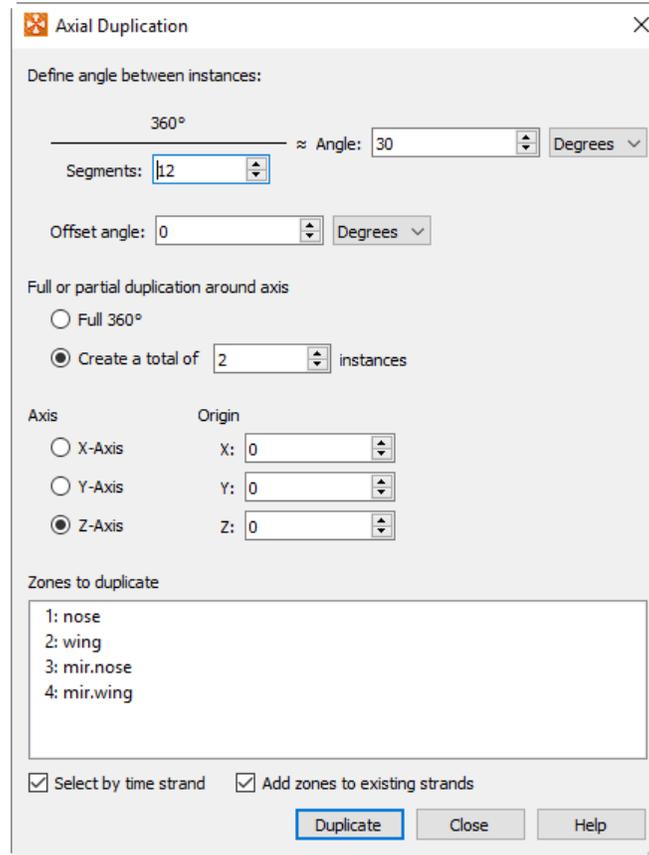


The variables in the newly created zone(s) are shared with their corresponding source zone(s), except for the coordinate and velocity normal to the symmetry plane.

20 - 5.5 Axial Duplication

The Axial Duplication dialog, available from the **Create Zone** submenu of the **Data** menu, allows you to create successively-rotated duplicates of one or more 2D or 3D zones using the right-hand rule. For example, if your data set contains a simulation of one blade of a turbine, and there are thirty blades in the full turbine, you can create 29 duplicates, each rotated twelve degrees from the previous, to be able to visualize the entire turbine.

The variables rotated are the spatial variables (X, Y, and, for 3D zones, Z) and the vector variables assigned using **Plot > Vector > Variables**. For 3D zones, you may also choose the axis of rotation. Streamtraces are not duplicated; place streamtraces after zone duplication.



The Axial Duplication dialog has the following options:

- Define Angle Between Instances** - Contains two interdependent fields, Angle and Segments, which are used to specify how many duplicates are in a full 360° rotation of the zone. The number of segments is determined by dividing the angle into 360°, and the angle is calculated by dividing the number of segments into 360°. Editing one automatically updates the other. You may choose to specify (or calculate) the angle in either degrees or radians.
- Offset Angle** - The additional amount by which the first duplicate should be rotated; may be specified in degrees or radians. For example, if you specify an angle between instances of 20° and an offset of 40°, the first duplicate will be made at 60°, the second at 80°, the third at 100°, and so on. This field may be used, for instance, when you have already created some duplicates and want to create additional duplicates that do not overlap the ones you have already created. In the example just given of angle 20° and offset 40°, perhaps you have already created two duplicates (at 20° and 40°) and wish to create additional duplicates. In this case, offset of 40° specifies that the last existing duplicate is at 40° and that new duplicates should be created in the next "slot" beyond that, at 60°.
- Full or Partial Duplication** - Choose to create as many new zones as are necessary for a full rotation by choosing Full 360° (this will result in the number of duplicates entered or calculated in the **Define Angle Between Instances**, less the original zone(s) being duplicated) or create a specified number of rotated duplicates.

- **Axis** - For 3D zones, choose the axis around which rotation should occur. Not available for 2D zones, which are always rotated about a notional axis perpendicular to the zone.
- **Origin** - For rotation around a point other than (0, 0) or (0, 0, 0), enter the location of the origin using the X, Y, and (for 3D zones) Z fields.
- **Zones to Duplicate** - Click, Control-click, and/or Shift-click in the zone list to select one or more zones.
- **Select by Time Strand** - For transient data, if this checkbox is toggled on, the zones in the Zones to Duplicate list are grouped by time strand, so that selecting a zone selects all the zones in that time strand
- **Add Zones to Existing Strands** - For transient data, adds the duplicate zones to the same time strand as the original zones if toggled on. Otherwise, the duplicate zones are assigned new strand IDs if the source zones belonged to strands, otherwise they are made static.



Using a macro, it is possible to rotate around arbitrary axes rather than just X, Y, and Z, and to specify exactly which variables, if any, should be rotated as spatial variables and which as vector variables, including no spatial variables at all, or multiple vector variables. See \$!AXIALDUPLICATE in the [Scripting Guide](#).

20 - 6 Data Extraction from an Existing Zone

You may create new zones by extracting (or interpolating) data from existing zones in a number of ways. Derived objects, such as contour lines, FE-boundaries, iso-surfaces, slices, or streamtraces may be extracted to be independent zones. You may also extract data using a specified slice plane, discrete points, points from a polyline, or points from a geometry.

The procedures for extracting derived objects are discussed in the chapters related to those objects. For details see [Chapter 9: "Contour Layer"](#), [Section 15 - 3 "Streamtrace Extraction as Zones"](#), and [Section 16 - 6 "Iso-Surface Extraction"](#). Extracting slices, both derived and arbitrarily defined, is described in [Section 14 - 2 "Extracting Slices to Zones"](#).

20 - 6.1 Subzone Extraction

To create a subzone of an existing ordered zone, select **Extract>Subzone** from the **Data** menu.



Subzone extraction is available for ordered zones only.

The **Extract Subzone** dialog has the following options:

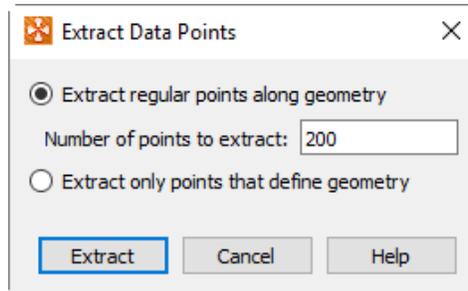
- **Source Zone** - Select the source zone (ordered zones only).

- **Index Range from Source Zone** - Specify the desired subzone as a range of I, J, and K-indices. You may use the special value 0 or Mx to indicate the maximum of that index, and the values Mx-1 to represent one index less than the maximum, Mx-2 for two less than the maximum, and so forth.
- **Extract** - Select the [Extract] button to create the zone. Each extracted subzone is given the name "Subzone."

20 - 6.2 Data Point Extraction

You may create an I-ordered zone by extracting data points from the current dataset along a polyline that lies within the edges of a zone with connectivity. To extract points along a polyline:

1. If necessary, create the polyline geometry using the  polyline tool. Click each of the points in the polyline, then double-click the last point (or press Escape) to finish the polyline. You may also extract points along an already-existing polyline.
2. Right-click the polyline geometry in the workspace and choose Extract Points from the context menu to open the **Extract Data Points** dialog.



3. Use the **Extract Data Points** dialog to control how data points are extracted. The dialog has the following options:
 - **Extract regular points along geometry** - Select this option to extract the specified number of points distributed uniformly along the geometry.
 - **Number of points to extract** - Enter the number of points to extract. This field is available only if you are extracting regular points along a geometry.

- **Extract only points which define geometry** - Select this option to extract only the endpoints of the segments in the geometry.



Any necessary interpolation is performed using the same method used in probing. The spatial interpolation method is piecewise-linear by default. Cells are, in effect, divided by adding nodes at their center and face centers, until all cell pieces are tetrahedral. The extra nodes are calculated by arithmetically averaging the variable values at all nodes (for the cell-center node) or all face nodes (for the face-center nodes). Within each of these sub-cells, variables are interpolated linearly.

From triangular faces, linear interpolation is used to determine the value of the extracted points. On quadrilateral faces, a point of the center of mass of the quadrilateral is created and assigned a value equal to the average of the four corners. The surface is then broken down into four triangles using this center point and the four corners, and the extracted point value is interpolated linearly on the face of the triangle that surrounds it.

If a surface utilizes cell-centered values, the nodal values at the corners are interpolated, then the extracted points are interpolated from those nodal values.

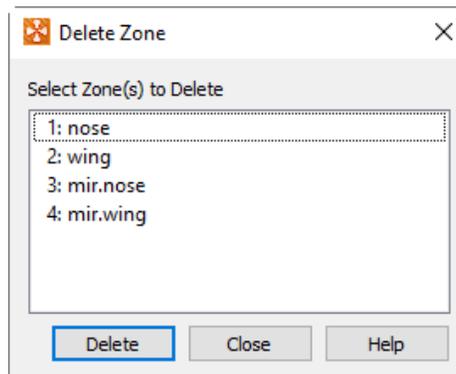
Volume interpolation, piece-wise by default, calculates to first-order accuracy. For second-order accuracy (tri-linear interpolation), add the following line to your *tecplot.cfg* file:

```
$!INTERFACE DATA {VOLUMECELLINTEROPLATIONMODE = TRILINEAR}
```

4. If you created a new polyline for the extraction operation, you may wish to delete it by again right-clicking it, then choosing **Delete** from the context menu.

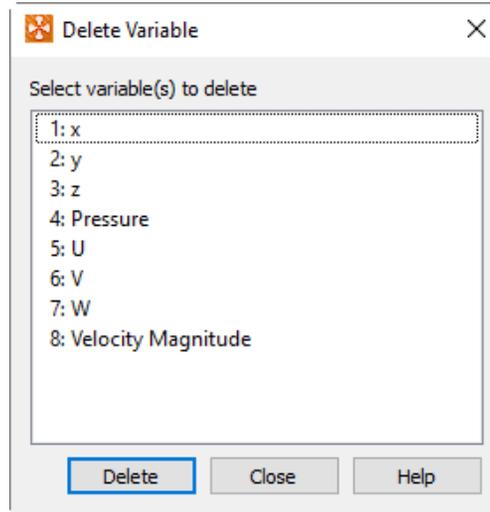
20 - 7 Zone Deletion

In any dataset with more than one zone, you can delete any unwanted zones. To delete a zone, select **Delete>Zone** from the **Data** menu. You cannot delete all zones; if you attempt to delete all zones, the lowest numbered zone is not deleted.



20 - 8 Variable Deletion

To delete a variable, select **Delete>Variable** from the **Data** menu. The **Delete Variable** dialog is shown below.



When deleting a variable, keep in mind that deleting a variable removes it from all zones. .

20 - 9 Data Interpolation

In Tecplot Focus, interpolation refers to assigning new values for the variables at data points in a zone based on the data point values in another zone (or set of zones).

For example, you may have a set of data points in an I-ordered zone that are distributed randomly in the XY-plane. This type of data is sometimes referred to as unordered, ungridded, or random data. In Tecplot Focus, it is referred to as irregular data. Using data in this form, you can create mesh plots and scatter plots, but you cannot create contour plots, light-source shading, or streamtraces.

In Tecplot Focus, you can interpolate the irregular I-ordered data onto an IJ-ordered mesh, and then create contour plots and other types of field plots with the interpolated data. You can also interpolate your 3D, I-ordered irregular data into an IJK-ordered zone and create 3D volume plots from the IJK-ordered zone. You can even interpolate to a finite element zone.

The accuracy of the interpolation will depend on your data, the density of the destination grid, how well the grid fits the area of your unorganized zone and the settings used for interpolation.

There are two types of interpolation available:

- [Linear Interpolation](#) - Interpolate using linear interpolation from a set of finite element, IJ-ordered, or IJK-ordered zones to one zone.
- [Inverse-Distance Interpolation](#) - Interpolate using an inverse-distance weighting from a set of zones to one zone.
- [Kriging](#)- Interpolate using Kriging from a set of zones to one zone.

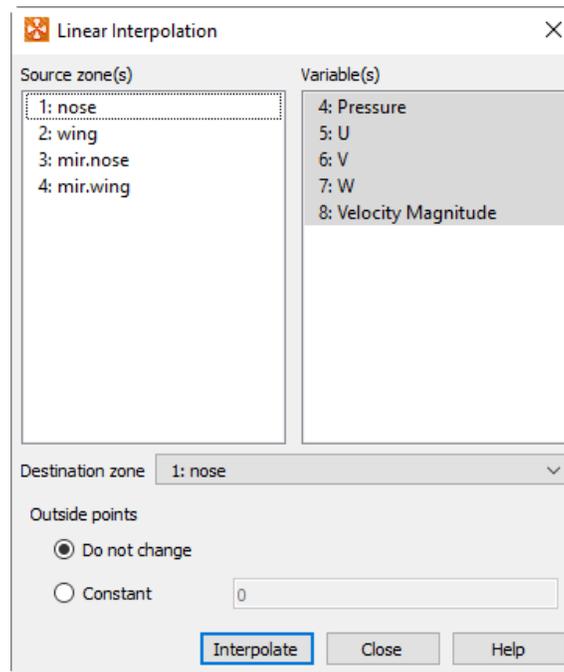
20 - 9.1 Linear Interpolation

Use the **Linear Interpolation** dialog to interpolate data from one or more ordered or finite element zones onto a destination zone. Irregular I-ordered data cannot be used for the source zones in linear interpolation; you may be able to first create a finite element zone from an irregular, I-ordered zone by using triangulation. (See [Section 20 - 10 "Irregular Data Point Triangulation"](#).)

Linear interpolation finds the values in the destination zone based on their location within the cells of the source zones. The value is linearly interpolated to the destination data points using only the data points at the vertices of the cell (or element) in the source zone(s).

To perform linear interpolation:

1. Read the dataset to be interpolated into Tecplot Focus (the source data).
2. Read in or create the zone onto which the data is to be interpolated (the destination zone).
3. From the **Data** menu, choose **Interpolate>Linear**.



4. From the **Linear Interpolation** dialog, select the zones to be interpolated from those listed in the **Source Zone(s)** scrolled list.
5. Select which variables are to be interpolated from those listed in the **Variable(s)** scrolled list.
6. Select the destination zone into which to interpolate. Existing values in the destination zone will be overwritten.
7. **Outside Points** - Optionally, choose how to treat points that lie outside the source-zone data field. You have two options:
 - **Do Not Change** - Preserves the values of points outside the data field. **Do Not Change** is appropriate in cases where you are using one interpolation algorithm inside the data field, and another outside.
 - **Constant** - Sets all points outside the data field to a constant value that you specify.
8. Click the [Interpolate] button to perform the interpolation.
9. While the interpolation is proceeding, a working dialog appears showing the progress of the interpolation.



If you select [Cancel] during the interpolation process, the interpolation is terminated prematurely. The destination zone will be left in an indeterminate state, and you should redo the interpolation.

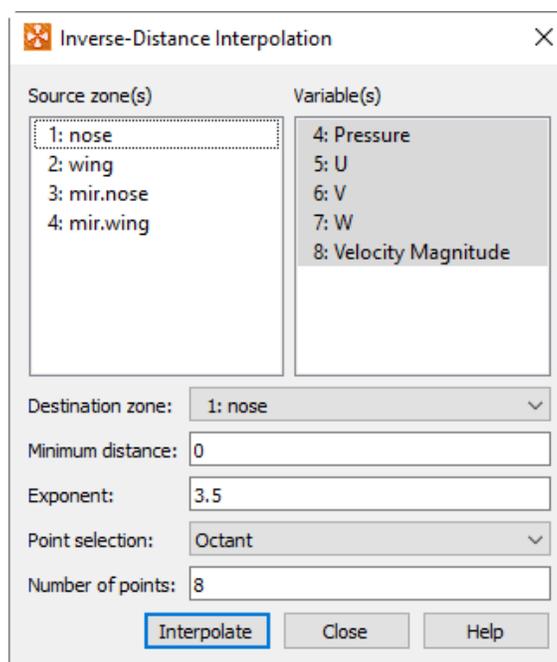
20 - 9.2 Inverse-Distance Interpolation

Inverse-distance interpolation averages the values at the data points from one set of zones (the source zones) to the data points in another zone (the destination zone). The average is weighted by a function of the distance between each source data point to the destination data point. The closer a source data point is to the destination data point, the greater its value is weighted.

In many cases, the source zone is an irregular dataset—an I-ordered set of data points without any mesh structure (a list of points). Inverse-distance interpolation may be used to create a 3D surface or a 3D volume field plots of irregular data. The destination zone can, for example, be a circular or rectangular zone created within Tecplot Focus (see [“Zone Creation”](#) on page 275).

To perform inverse-distance interpolation in Tecplot Focus, use the following steps:

1. Read the dataset to be interpolated into Tecplot Focus (the source data).
2. Read in or create the zone onto which the data is to be interpolated (the destination zone).
3. From the **Data** menu, choose **Interpolate>Inverse Distance**.



4. From the **Inverse-Distance Interpolation** dialog, select the zones to be interpolated from those listed in the **Source Zone(s)** list.
5. Select which variables are to be interpolated from those listed in the **Variable(s)** list.
6. Select the **Destination Zone** into which to interpolate. Existing values in the destination zone will be overwritten.
7. **[OPTIONAL]** Enter the minimum distance used for the inverse-distance weighting in the **Minimum Distance** text field. Source data points which are closer to a destination data point than this minimum distance are weighted as if they were at the minimum distance. This tends to reduce the peaking and plateauing of the interpolated data near the source data points.
8. **[OPTIONAL]** Enter the exponent for the inverse-distance weighting in the **Exponent** text field.



The exponent should be set between 2 and 5. The algorithm is speed-optimized for an exponent of 4, although in many cases, the interpolation looks better with an exponent of 3.5.

9. [OPTIONAL] Select the method used for determining which source points to consider for each destination point from the **Point Selection** drop-down. There are three available methods, as follows:

- **Nearest N** - For each point in the destination zone, consider only the closest n points to the destination point. These n points can come from any of the source zones. This option may speed up processing if n is significantly smaller than the entire number of source points.
- **Octant** - Like **Nearest N** above, except the n points are selected by coordinate-system octants. The n points are selected so they are distributed as evenly as possible throughout the eight octants. This reduces the chances of using source points which are all on one side of the destination point.
- **All** - Consider all points in the source zone(s) for each point in the destination zone.

10. Click **Interpolate** to perform the interpolation.



If you select the [Cancel] button during the interpolation process, the interpolation is terminated prematurely. The destination zone will be left in an indeterminate state, and you should redo the interpolation.

Inverse-distance interpolation ignores the IJK-mode of IJK-ordered zones. All data points in both the source and destination zones are used in the interpolation.



Tecplot Focus uses the active frame's axis assignments to determine the variables to use for coordinates in interpolation. However, axis scaling is ignored.

The Inverse-Distance Algorithm

The algorithm used for inverse-distance interpolation is simple. The value of a variable at a data point in the destination zone is calculated as a function of the selected data points in the source zone (as defined in the **Point Selection** drop-down, accessed via **Data>Interpolate>Inverse-Distance**).

The value at each source zone data point is weighted by the inverse of the distance between the source data point and the destination data point (raised to a power) as shown below:

$$\varphi_d = \frac{\sum w_s \varphi_s}{\sum w_s} \quad (\text{summed over the selected points in the source zone})$$

where φ_d and φ_s are the values of the variables at the destination point and the source point, respectively, and w_s is the weighting function defined as:

$$w_s = D^{-E}$$

D in the equation above is the distance between the source point and the destination point or the minimum distance specified in the dialog, whichever is greater. E is the exponent specified in the **Exponent** text field.

Smoothing may improve the data created by inverse-distance interpolation. Smoothing adjusts the values at data points toward the average of the values at neighboring data points, removing peaks, plateaus, and noise from the data. See [Section 20 - 2 "Data Smoothing"](#) for information on smoothing.



Kriging and Inverse Distance Interpolation Improvements

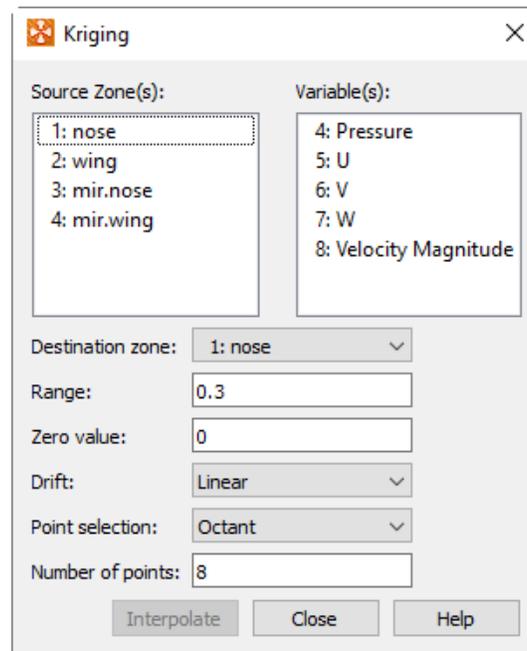
For better results with 3D data, try changing the range of your Z-variable to one similar to the X-range the Y-range. Also, set Zero Value to 0.05.

20 - 9.3 Kriging

Kriging is a more complex form of interpolation than inverse-distance. It generally produces superior results to the inverse-distance algorithm but requires more computer memory and time.

To perform kriging in Tecplot Focus, perform the following steps:

1. Read the dataset to be interpolated into Tecplot Focus (the source data).
2. Read in or create the zone onto which the data is to be interpolated (the destination zone).
3. From the **Data** menu, choose **Interpolate>Kriging**



4. From the **Kriging** dialog, select the zones to be interpolated from those listed in the **Source Zone(s)** scrolled list.



Tecplot Focus uses the active frame's axis assignments to determine the variables to use for coordinates in kriging. However, any axis scaling is ignored.

5. Select which variables are to be interpolated from those listed in the **Variable(s)** scrolled list.
6. Select the destination zone into which to interpolate. Existing values in the destination zone will be overwritten.
7. In the **Range** text field, optionally enter the distance beyond which source points become insignificant for the kriging. The value is stated as the fraction of the length of the diagonal of the box which contains the data points. A range of zero means that any point not coincident with the

destination point is statistically insignificant; a range of one means that every point in the dataset is statistically significant for each point. **In general, values between 0.2 and 0.5 should be used.**

8. In the **Zero Value** text field, optionally enter the semi-variance at each source data point on a normalized scale from zero to one. Semi-variance is the certainty of the value at a data point. A value of zero means that the values at the source points are exact. Greater values mean the values at the source points have some uncertainty or noise. Zero is usually a good number for the zero value, and it causes the interpolated data to fit closely to all the source data points. Increasing the zero value results in smoother interpolated values that fit increasingly more to the average of the source data.
9. Select the overall trend for the data in the **Drift** drop-down. This can be **Linear** (default), **None**, or **Quadratic**.



If the **Drift** is set to Linear or Quadratic, Tecplot Focus requires that the points selected be non-collinear (non-coplanar in 3D). To avoid this limitation, set **Drift** to None. Alternatively, you can eliminate coincident points by [Irregular Data Point Triangulation](#) before you interpolate.

10. Select the method used for determining which source points to consider for each destination point from the **Point Selection** drop-down. There are three available methods, as follows:
 - **Nearest N** - For each point in the destination zone, consider only the closest n points to the destination point. These n points can come from any of the source zones.
 - **Octant** (default) - Like Nearest N above, except the n points are selected by coordinate-system octants. The n points are selected so they are distributed as evenly as possible throughout the eight octants. This reduces the chances of using source points which are all on one side of the destination point.
 - **All** - Consider all points in the source zone(s) for each point in the destination zone. In general, you should not use the All option unless you have very few source points.



The **Point Selection** option is very important for kriging, because kriging involves the computationally expensive inversion and multiplication of matrices. The computational time and memory requirements increase rapidly as the number of selected source data points increases.

11. Click **Interpolate** to begin kriging. While kriging is proceeding, a progress bar appears in the status bar, along with a Stop button that can be clicked to interrupt the operation.



If you interrupt the kriging process, the destination zone is left in an indeterminate state, and you should redo the kriging or delete the destination zone.

The Kriging Algorithm

For a detailed discussion of the kriging algorithm refer to: Davis, J. C., *Statistics and Data Analysis in Geology*, Second Edition, John Wiley & Sons, New York, 1973, 1986.

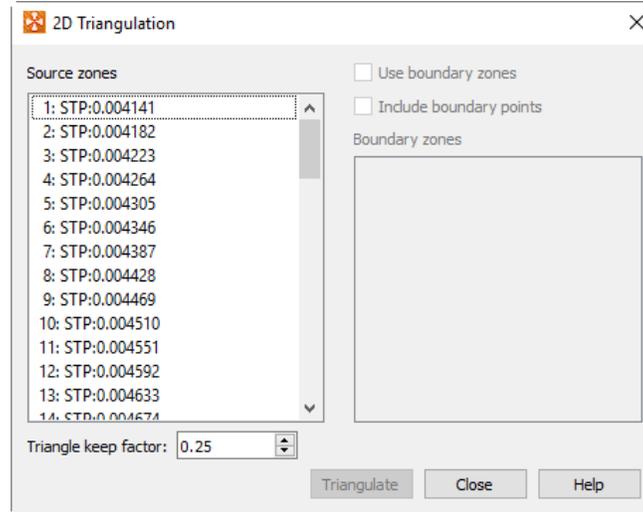


Kriging and Inverse Distance Interpolation Improvements: For better results with 3D data, try changing the range of your Z-variable to one similar to the X-range the Y-range. Also, set Zero Value to 0.05.

20 - 10 Irregular Data Point Triangulation

Triangulation is a process that connects data points to form triangles. You can use triangulation to convert irregular I-ordered datasets into a finite element surface zone. Triangulation is one of the two options for creating field plots from irregular data. The other is interpolation, discussed in [Section 20 - 9 "Data Interpolation"](#). Triangulation preserves the accuracy of the data by creating a finite element surface zone with the source data points as nodes and a set of triangle elements. Triangulation works best for irregular data.

To triangulate 2D data, make sure your plot is in 2D Cartesian mode and select **2D Triangulation** from the **Data** menu. The **2D Triangulation** dialog has the following options:



- **Source Zone(s)** - Select the zone or zones to triangulate from the list.
- **Use Boundary Zone(s)** - Toggle-on to specify a boundary zone for the triangulation. Select the boundary zone or zones from the list. The boundary zones define the boundaries in the triangulation region. If you do not include boundary zones, Tecplot Focus assumes the data points lie within a convex polygon and that all points in the interior can be connected.
 - **Include Boundary Points** - Toggle-on to include the points in the boundary zones in the triangulated zone.
- **Triangle Keep Factor** - This factor is used to define which triangles on the outside of the triangulated zone are "bad" and not included in the triangulation.

At the completion of triangulation, Tecplot Focus attempts to remove bad triangles from the outside of the triangulation. The keep factor is a description of the shape of the triangle between zero (three collinear points) and 1.0 (an equilateral triangle). Typical settings are values between 0.1 and 0.3; settings above 0.5 are not permitted. Bad triangles will not be removed if removing the triangle strands a data point.

- **Triangulate** - Click the [Triangulate] button to perform the triangulation.

After triangulating your data, you can use the resulting finite element surface zone to create plots. Generally, you turn off the original zone(s) and plot the new zone only, but you can, for example, plot a scatter plot of the original zone(s) along with the contours of the new zone.

20 - 11 Data Spreadsheet

All ordered and finite element data can be viewed using Tecplot Focus's data spreadsheet (accessed via **Data>Spreadsheet**). The data may be modified within the spreadsheet in order to change the plots Tecplot Focus produces.



Changes to the spreadsheet do not immediately alter the original data file stored on disk. However, saving the plot of altered data as a layout file will save the changes in the data journal. You have the option of overwriting your original data file or creating a new file with the altered data.

The spreadsheet displays Tecplot Focus's data differently depending on the type of zone being examined. An example of the **Data Spreadsheet** dialog for a finite element zone is shown here; note the X, Y, and Z variables.

I \ J	1	2	3	4	5	6	7	8
1	0	0	0	0	0	0	0	0
2	0.038605	0.038231	0.03763	0.036611	0.035112	0.033147	0.030845	0.028082
3	0.081945	0.081196	0.079625	0.076849	0.072881	0.067923	0.062275	0.055953
4	0.12587	0.12477	0.12224	0.11768	0.11117	0.10304	0.093753	0.083386
5	0.17292	0.1715	0.16804	0.16165	0.15238	0.14065	0.12707	0.11177
6	0.21117	0.20952	0.20537	0.19753	0.18597	0.17115	0.15371	0.13386
7	0.24376	0.24193	0.23722	0.22818	0.21469	0.19711	0.1761	0.15191
8	0.27125	0.26926	0.2641	0.25408	0.23897	0.21905	0.19482	0.16659
9	0.29448	0.29228	0.28667	0.27582	0.25943	0.23762	0.21059	0.17874
10	0.3146	0.31225	0.30623	0.29468	0.27733	0.25408	0.22476	0.18971
11	0.33224	0.32906	0.3227	0.31155	0.29265	0.26945	0.23941	0.20557

I-ordered and finite element datasets are displayed with each zone's variable displayed in a column. IJ-ordered datasets are displayed in the spreadsheet with I along the rows and J along the columns. IJK-ordered datasets are displayed one plane at a time: selecting the K-plane displays I along the rows and J along the columns, selecting the J-plane displays I along the rows and K along the columns, and selecting the I-plane displays J along the rows and K along the columns. With IJK-ordered data, the slice of interest can be selected by entering a specific index or using the up and down arrows provided.

If a variable is not needed in your plot, it may not currently be loaded into memory. In this case, "Not Loaded" is displayed in every cell of that variable's column. Using the variable in your plot will cause it to be loaded. Click the [Load Variables] button to open the [Load Variable](#) dialog and load any variables you wish to view and edit in the spreadsheet.

To change the data spreadsheet's display format, select the desired format (Integer, Float, Exponent, or Best Float) from the Format drop-down menu. When Float or Exponent is selected, you may also specify the precision in the Precision field. These options do not affect the actual data, only how it is displayed.

To modify data:

1. In the **Data Spreadsheet** dialog, select a zone and variable to modify. Use the menu at the top of the dialog to choose the zone, then find the column representing the desired variable.

2. If the variable is shared with another zone or zones, the **Alter in all Shared Zones** toggle is enabled. Select this toggle to keep the variable shared as you modify data, propagating changes to the other zones that share the variable. If this toggle is not selected, the variable will be changed in the selected zone and no longer shared with any other zones. See also [Section 5 - 3 "Data Sharing"](#).
3. Select the value of interest from the spreadsheet by finding its row. This will highlight and expand the value to its full precision.
4. To replace the highlighted value, simply enter the new value. The value is instantly replaced with the new digits entered.
5. To modify only a few digits from a highlighted value, double-click the cell to switch to edit mode. Click again or use the arrow keys to position the edit cursor at the desired position. Make any desired modifications to the existing value such as inserting or deleting digits.
6. To undo a modification of a given cell before you have committed it, press `Escape`. To commit a modification, press `Enter`, `Tab`, or `Shift-Tab` to move to the next cell, or simply select on another cell.

Probing

The **Probe** tool  allows you to select a location in your plot and view the values of all variables at that location in the Probe sidebar. You can also view information about the dataset itself while probing. With the **Probe At** dialog (accessed via **Data>Probe At**), you can specify the location of the probe as a set of spatial coordinates X, Y, and Z, one of the polar coordinates Theta and R, or as a set of I, J, and K-indices. You select one or more locations in the data field where information is to be collected, and the resulting information is displayed in the **Probe** sidebar.

When you probe with the mouse, you can probe in either of two modes: **Interpolate** or **Nearest Point**. In **Interpolate** mode (accessed by a single mouse click) the value returned is the linearly interpolated value for the specified locations. In **Nearest Point** mode, accessed by Control-click, the value returned is the exact value at the closest data point in the field.



If Tecplot Focus appears to be unloading variables that you are trying to Probe, you may need to adjust your memory threshold in **Options>Performance>Misc**.

21 - 1 Field Plot Probing with the Mouse

The most direct method of probing is to use the **Probe** tool . Click at any point in your plot to probe in **Interpolate** mode, which displays the Probe sidebar with information interpolated for that point. Control-click at any location to probe in **Nearest Point** mode, which will obtain probe information for the data point closest to the crosshair cursor and display it in the Probe sidebar.

The following table shows the information returned for each type of probe action for field plots. (All mouse click operations are using the left mouse button.)

Probe Action	Information Returned
Click	<p>If the pointer is over a valid cell, the value returned is the interpolated field values from all nodes in the cell.</p> <p>2D Cartesian plots - If multiple cells are candidates, the cell from the highest-numbered zone is used.</p> <p>3D Cartesian plots - The closest cell in a zone, slice, iso-surface or streamtrace is selected. If multiple cells are candidates, the cell closest to the viewer is used, with priority given to surfaces drawn with mesh, flooded contours, or shading. Translucent zone surfaces are excluded from probing priority.</p>
Control-Click	<p>If the pointer is over a valid cell, the field value from the nearest node in the cell is returned.</p> <p>If multiple cells are candidates: 2D Cartesian plots - The cell from the highest number zone is used 3D Cartesian plots - The cell closest to the viewer is used. If the pointer is not over any cell, then the field values from nearest data point (as measured in distance on the screen) are returned.</p>
Shift-Control-Click	<p>Return the field values from the nearest point on the screen (ignoring surfaces, zone number or depth of the point).</p> <p>This is useful in 3D for probing on data points that are on the back side of a closed surface without having to rotate the object.</p> <p>In 2D this is useful for probing on data points for zones that may be underneath other zones because of the order in which they were drawn.</p>
Alt-Click (3D only)	<p>Same as Click except ignore zones while probing. (Probe only on streamtraces, iso-surfaces, or slices.)</p>
Alt-Control-Click	<p>Same as Control-Click except ignore zones while probing. (Probe only on streamtraces, iso-surfaces, or slices.)</p>
Alt-Control-Shift-Click	<p>Same as Shift-Control-Click except ignore zones while probing. (Probe only on streamtraces, iso-surfaces, or slices.)</p>

The probe results are displayed in the **Probe** sidebar. To copy data from the Probe sidebar, select the range of cells to be copied by dragging (or by clicking a start position, then Shift-clicking an end position), then right-click and choose Copy from the context menu.



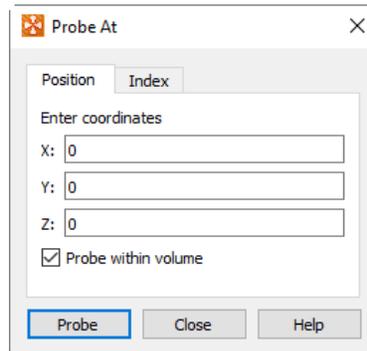
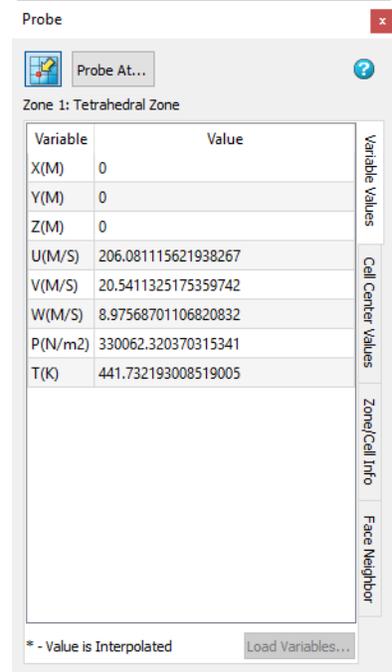
Interpolate mode does not work for I-ordered data displayed in a 2D or 3D Cartesian plot; if you probe such data you will always get the error message "Point is outside of data field," because Tecplot Focus cannot interpolate without a field mesh structure. You should instead use the Nearest Point mode in such situations.

21 - 2 Field Plot Probing by Specifying Coordinates and Indices

Use the **Probe At** dialog for precise control over your probe location, probing using I, J, and K-indices, or probing inside a 3D volume. You can launch the **Probe At** dialog from the **Data** menu.

21 - 2.1 Probe At Position

To probe at a specified location using spatial coordinates (in Interpolate mode), launch the **Probe At** dialog via the **Data** menu or the **Probe** sidebar.



The **Position** page of the **Probe At** dialog has the following options:

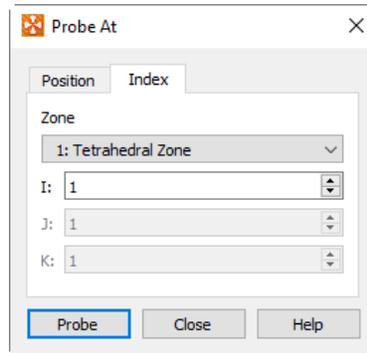
- **Enter Coordinates** - Enter the X, Y, and Z-coordinates of the desired probe location.
- **Probe Within Volume [DEFAULT]** - If the zone you are probing is a 3D volume zone, toggle-on **Probe Within Volume** to ensure that the probe is performed at the indicated point. If you specify a position within a 3D volume zone and the **Probe Within Volume** is not selected, Tecplot Focus probes at the surface of the zone nearest to the user.
- **Probe** - Select the [Probe] button to perform the probe. The **Probe** sidebar will display the interpolated values for the specified location.



If the entered location is not within a cell, Tecplot Focus will return the closest surface to the entered location along the line-of-sight ray.

21 - 2.2 Probe at Index

To probe at a specified location using dataset indices (in **Nearest Point** mode), launch the **Probe At** dialog (accessed via the **Data** menu or the Probe sidebar) and select the Index page (shown below).



The **Index** page of the **Probe At** dialog has the following options:

- **Mapping/Zone** - Select the desired zone or mapping from the drop-down.
- **I, J, K** - Enter the I, J, and K-indices of the desired probe location. (For finite element and I-ordered data, you can enter only the I-index. For IJ-ordered data, you can enter both I- and J-indices. For IJK-ordered data, you can enter I, J, and K-indices.)
- **Probe** - Select the [Probe] button to perform the probe. The **Probe** sidebar will display interpolated values for the specified location.

21 - 3 Probe Sidebar

You can view probed data in the **Probe** sidebar, which appears automatically when probe results need to be displayed. It can also be opened from the Data menu.

The Probe sidebar initially appears docked on the right side of the workspace, but it can be docked to the left side as well, or combined with other sidebars. It may also be "torn off" from the workspace and dragged anywhere on any of your displays.

You can choose what the **Probe** sidebar displays via the tabs along its side. (The tabs may appear on either the right or left side of the sidebar depending on where it is docked.) Available tabs are:

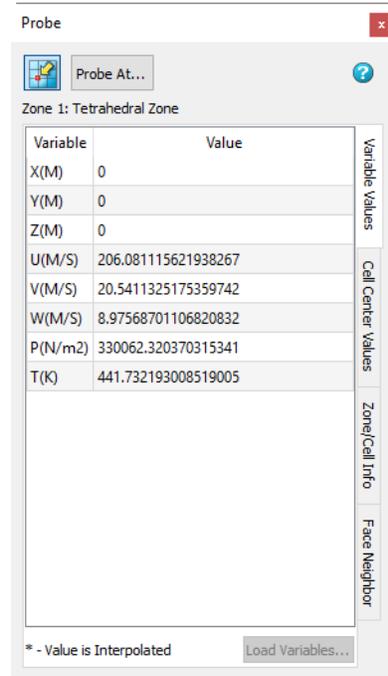
- [Variable Values](#) - Examine values of all variables at any selected location.
- [Cell Center Values](#) - Examine values of all variables at the center of the clicked-on cell.
- [Zone and Cell Information](#) - Report characteristics of any location in a data field. The characteristics reported include the indices of the selected cell or point, the zone number, the dimensions of the zone, and the type of zone (ordered or finite element).
- [Face Neighbor](#) - Examine neighboring cells of the clicked-on cell.

To copy data from the Probe sidebar, select the range of cells to be copied by dragging (or by clicking a start position, then Shift-clicking an end position), then right-click and choose Copy from the context menu.

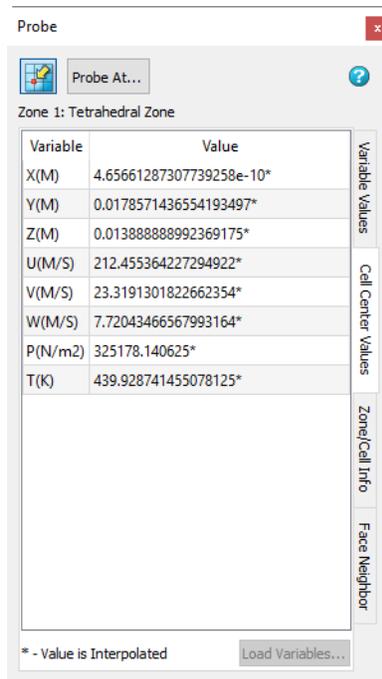
21 - 3.1 Variable Values

Choosing the **Variable Values** tab in the **Probe** sidebar lists every variable in the current dataset, together with its value at the specified probe point. The zone name and number and the current solution time (if the data set contains transient data) also appear.

The **Probe At** button opens the Probe At dialog (see [Field Plot Probing by Specifying Coordinates and Indices](#)). Click the [Load Variables] button to open the [Load Variable](#) dialog and load any variables you wish to view when probing.



21 - 3.2 Cell Center Values



Choosing the **Cell Center** tab in the **Probe** sidebar lists the value of every variable in the current dataset at the center of the cell that was selected. The Zone name and number and the current solution time (if the data set contains transient data) are also displayed.

The **Probe At** button opens the Probe At dialog (see [Field Plot Probing by Specifying Coordinates and Indices](#)). Click the [Load Variables] button to open the [Load Variable](#) dialog and load any variables you wish to view when probing.

21 - 3.3 Zone and Cell Information

Choosing the **Zone/Cell Info** tab in the **Probe** sidebar lists the following information about any probed data point, regardless of the format of the data.

The following information appears:

- The number and name of the probed zone.
- The format of the zone, either ordered or one of the finite element formats (FE-Triangle, FE-Quad, FE-Tetra or FE-Brick).
- The Current Solution time of the probed point.

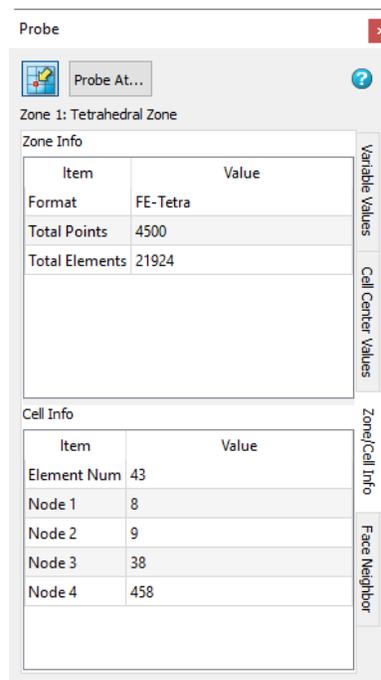
For ordered zones, the following additional information is displayed:

- **I-Max** - Maximum I-index of the zone.
- **J-Max** - Maximum J-index of the zone.(J-Max is one for I-ordered data.)
- **K-Max** - Maximum K-index of the zone. (K-Max is one for IJ-ordered data).
- **Plane** - Shows the type of plane. I, J, or K displays the index of the point at the principal data point of the cell containing the probed point. (If the point is probed using Control-click for **Nearest Point**, the label reads "I,J or K-Index.")
- **Face Plane** - The I, J, or K-plane that is probed.
- **Face Indices** - The planes that are not mentioned in Face Plane, these are the other faces that are showing in 3D, or are the axes in 2D.

For cell-based finite element zones (FE-Triangle, FE-Quad, FE-Tetra or FE-Brick), the following additional information is displayed:

- **Total Pts** - Total number of points in the zone.
- **Total Elems** - Total number of elements (cells) in the zone.
- **Node Num** - Number of the probed node. This field is filled in only if the point is probed using Control-click for Nearest Point.
- **Elem Num** - Number of the probed element.
- **Node 1 - 8** - Number of the node defining Node 1-8 of the cell.
 - **Node 4** -FE-Quad, FE-Tetra, and FE-Brick only.
 - **Node 5-8** - FE-Brick only.

The **Probe At** button opens the Probe At dialog (see [Field Plot Probing by Specifying Coordinates and Indices](#)).



21 - 3.4 Face Neighbor

Choosing the **Face Neighbor** tab in the **Probe** sidebar displays cells that neighbor the selected cell.

The **Probe At** button opens the Probe At dialog (see [Field Plot Probing by Specifying Coordinates and Indices](#)).

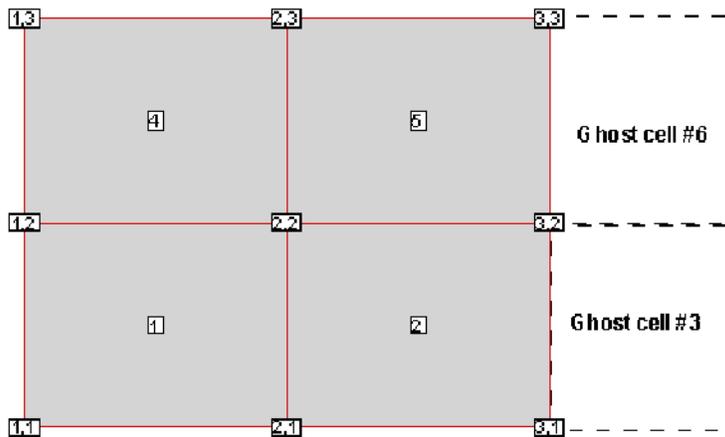
A cell is considered a neighbor if one of its faces shares all nodes in common with the selected cell, or if it is identified as a neighbor by face neighbor data in the dataset. The current solution time is also displayed.

For ordered (IJ or IJK) zones, cell numbers are defined by the index value of the first node

$$Index = i + (j - 1)I_{max} + (k - 1)I_{max}J_{max}$$

where, i, j, and k are the i, j, and k values for the location of the first node.

Because the number of nodes in each direction is one greater than the number of cells in that direction, there is no cell to correspond with the last point in each row. In the example below, there is no cell numbered "3", yet the first cell in the second row is numbered "4". As you define face neighbors, it may help you to think of a "ghost cell" at the end of each row (where I = MaxI) and at the end of each column in 3D (where J = MaxJ).

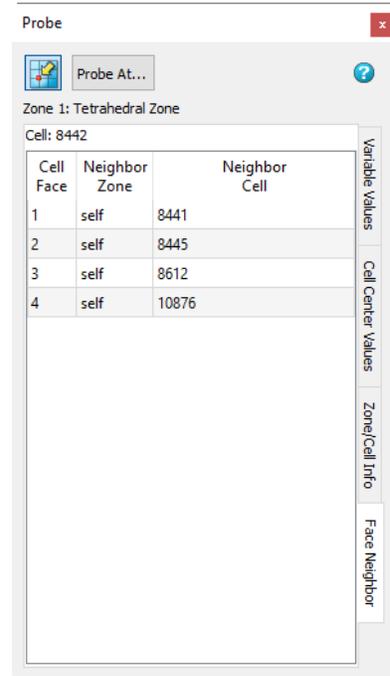


For FE zones, the cells are numbered in the order that they appear in the connectivity list. In the following example "7 8 19 11" is the cell number 2:

```
#Example connectivity list of 3 cells:
2 4 8 19
7 8 19 11
1 2 4 5
```

21 - 4 Line Plot Probing with the Mouse

You may probe XY and Polar Line plots in much the same way you probe field plots. You can use the probe mouse mode to obtain interpolated variable values at any given location, or obtain exact values from a specified (X, Y) or (Theta, R) data point. When you probe an XY Line plot in the standard mode, Tecplot Focus displays a vertical or horizontal line, depending on whether you are probing along an X- or a Y-axis. When you probe a Polar Line plot, a radial line or a circle is displayed depending on whether you are probing along the Theta- or R-axis. In either case, the probe is performed along the displayed line (or circle).



To probe in interpolate mode: activate the probe tool and click anywhere on your plot. Axis variable values of all active mappings that lie along the probe line are interpolated and displayed in the Probe sidebar.

To probe in **Nearest Point** mode, activate the probe tool and Control-click anywhere on your plot. When you Control-click, Tecplot Focus displays the exact X and Y, or Theta and R-values of the data point closest to the location clicked.

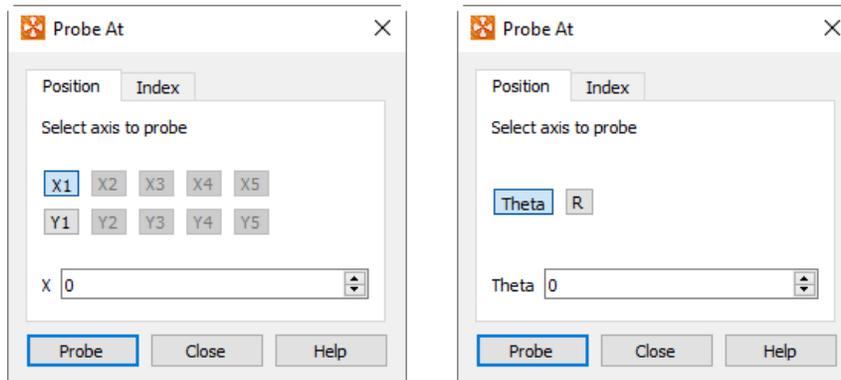
21 - 4.1 Line Plot Probing in Interpolate Mode

Interpolate mode is the standard probe mouse mode in line plots just as for field plots. For XY Line plots, you can probe along any of Tecplot Focus's five X-axes, or along any of Tecplot Focus's five Y-axes. By default, probing is performed along the X1 axis. For Polar Line, probing is done along the Theta-axis by default.



In Polar Line plots, many combinations of Theta- and R-values can result in the same point on the screen. When using the mouse in Interpolate mode to probe along the Theta-axis, Tecplot Focus uses the Theta-value within the current Theta-axis range to determine the corresponding R-values reported in the Probe sidebar. This behavior may result in no probe information shown for a mapping that has Theta-values entirely outside the current Theta-axis range, even though the mapping crosses the probe line on the screen. (For example, probing along the Theta-axis in interpolate mode misses a mapping representing only Theta-values several cycles outside the current Theta-axis range.) Similarly, when using the mouse in Interpolate mode to probe along the R-axis, Tecplot Focus uses the R-value within the current R-axis range and may miss mappings that are shown on the plot but have R-values different from the R-axis range.

To enter the **Probe Interpolate** mode, choose Probe At from the Data menu. The **Probe At** dialogs for XY and Polar Line plots are shown below:



Select the button corresponding to the axis you want to probe along, then enter the position. Click **Probe** to perform the probe.

The **Probe** sidebar appears if it is not already visible. For interpolated values, the **Probe** sidebar lists every active mapping and the interpolated value the opposing axis variable for that mapping. The value along the probed axis is listed at the bottom of the Probe sidebar.

In the **Probe** sidebar, the probe value is dashed (---) if the probe is out of range for the mapping. The probe value is gray (inactive) if the mapping is not using the specific axis which you are probing (for example, you probe the X1 axis and the mapping uses the X2 axis). This will only happen in XY Line plots with multiple X or Y-axes.

By default, each mapping is shown on a single line, which allows display of about the first ten characters of the mapping name and seven significant digits of the variable value.

- **X-Value, Y-value** - X, Y-value of the nearest data point to the probe position.
- **I, J, or K-Index** - I, J or K-index of the nearest data point to the probe position.
- **Map** - Number and name of the nearest map to the probe position.
- **Zone** - Number and name of the nearest zone to the probe position.
- **I, J, or K-Max** - Maximum I, J or K-index of the current zone.
- **X or Y-Axis** - X or Y-axis associated with the current map.

21 - 4.2 Line Plot Probing in Nearest Point Mode

Nearest Point probe mode provides the exact X and Y or Theta and R-values of the data point closest on the screen to the probed location, together with information on the mapping and the zone to which the probed point belongs. If a data point is common to multiple mappings, the probe returns information on the highest numbered mapping. For example, if a data point is plotted as part of two mappings, numbered 1 and 2, the probe results are displayed for mapping 2.

To enter the **Probe Nearest Point** mode select the **Probe** tool,  from the Toolbar and Control-click at the desired probe location. The nearest point is calculated from the actual location of the cross-hair and is independent of the axis you were probing along.

The following information about the nearest data point is displayed in the Probe sidebar:

- X or Theta-value.
- Y or R-value.
- I, J, or K-index.
- The number and name of the mapping associated with the data point.
- The number and name of the zone referenced in the mapping.
- The maximum I, J, and K-indices of the zone.
- For XY Line plots, the X-axis and Y-axis associated with the mapping.

21 - 5 Data Editing

Using the **Adjustor** tool, you can actually modify the coordinates of your data with the mouse. See "[Adjustor Tool](#)" on page 27 for more information.



If you attempt to double-click, but move the mouse between clicks, you may find that you have moved your data point.

Part 5 Final Output

Output

Tecplot Focus provides a variety of formats for you to output and export your complete plots. This chapter discusses saving your settings using layout files or stylesheets, preparing plots for web publishing, and writing data files to a file.

For information on exporting or printing your completed plot(s), please refer to: [Chapter 24: "Exporting"](#) or [Chapter 23: "Printing"](#), respectively.

22 - 1 Layout Files, Layout Package Files, Stylesheets

Tecplot Focus has three different types of files for storing plot information:

- [Stylesheets](#) (.sty) - Stylesheets store information about a single frame and do not include any information about the data used by the frame.
- [Layout Files](#) (.lay) - Layout files store information about all the frames in the workspace, including identification of, and links to, the data used by each frame.
- [Layout Package Files](#) (.lpk) - Layout package files are an extension to layout files where data and an optional preview image are included.

Layout and layout package files are the preferred method for saving the style of your plot. They save a complete picture of the workspace and are quick-and-easy to load and save. Stylesheets contain the style of a single frame in Tecplot Focus.

22 - 1.1 Working with Layout Files from Previous Releases

If you are working with layout files from previous releases of Tecplot 360 EX, Tecplot 360, Tecplot Focus, or their precursor called simply Tecplot, please note the following:

- 2016 and later releases of Tecplot Focus can load a maximum of 5 million data points.

22 - 1.2 Exporting Backward Compatible Data Files

While Tecplot Focus layouts and layout package files are not backward compatible, you do have the option to export data files written in one version of Tecplot Focus to be read by an earlier version. To do this, use the **Write Data Options** dialog as described in [Section 22 - 2 "Data File Writing"](#).

22 - 1.3 Stylesheets

Stylesheets are useful when:

- Pre-processing must be done to a dataset prior to attaching a style. You may need to load a dataset and run some equations or do interpolation or zone extraction before assigning a style. The style may reference objects or variables that do not exist in the original data and it is necessary to assign the style after they are created.



Tecplot Focus's data journaling capabilities together with layout files eliminate this situation in many cases.

- Switching styles on large datasets. You may want to load a large dataset and generate two full page plots. Each plot has a different style. By using a stylesheet for the second plot you avoid having to reload the dataset.
- Copying the style of one frame to another frame in the same layout.
- Saving just part of a frame's style, such as just the contour levels.

A stylesheet includes the following attributes ([Figure 22-15](#)):

- Type of plot (a 2D contour plot in 2D or an XY Line plot)
- Colors used
- Current view of the data
- Axes display
- Text and geometry

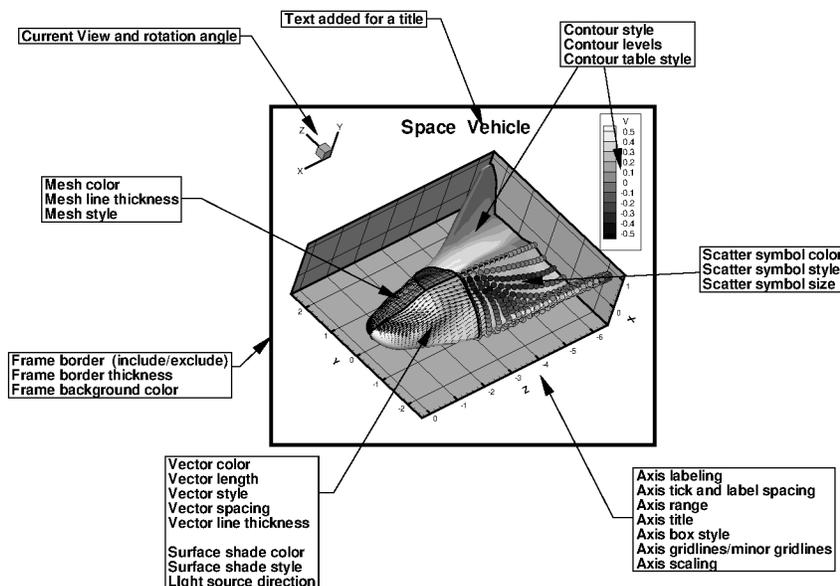


Figure 22-15. Some of the items considered part of the frame style.



To learn how to use a stylesheet, see [Section 2 - 3.7 "Save Frame Style"](#) and [Section 2 - 3.8 "Load Frame Style"](#).

22 - 1.4 Layout Files

A plot often consists of multiple frames or even multiple datasets. Layout files allow you to capture all the information on the plot. Layout files include instructions on how to create the data used in the plot, the frame layout and dataset attachments, axis and plot attributes, the current color map, and so forth.

[Figure 22-16](#) shows a layout with four frames. The frame in the upper left-hand corner is attached to dataset 1. The two frames on the right are both attached to dataset 2. The frame in the lower left is not attached to a dataset.

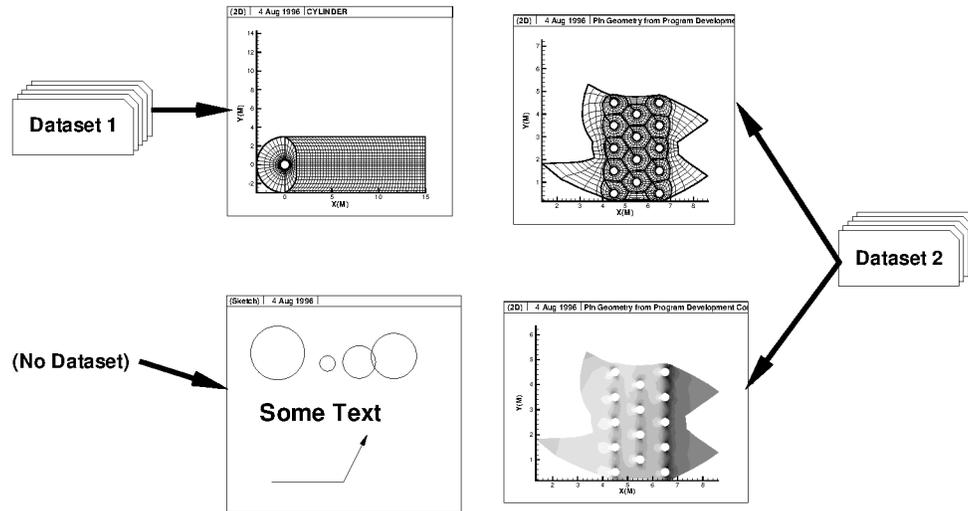


Figure 22-16. Layout of four frames using two datasets.

If a frame defined in a layout file requires an attached dataset, the data files necessary to build the dataset are referenced in the layout file. These data files can be referenced using absolute paths or relative paths. When using relative paths on Windows operating systems, the data files must be on the same drive as the layout file.

A layout file may also contain the data journal; a set of macro commands which alter the data or create new data. The data journal commands replicate the data modifications made to the original data (in files) during prior Tecplot Focus sessions. Not all data operations are supported by the data journal. For more information, see [Section 5 - 2 "Data Journaling"](#).

In addition to storing the individual style of each frame, layout files record:

- Page layout information (including the size and orientation of the paper).
- Color spectrum information, including the color maps in use.

To include the field data with a layout, use a layout package file. For more information, see [Section 22 - 1.5 "Layout Package Files"](#).

22 - 1.5 Layout Package Files

Layout package files allow you to transmit raw data, along with style information in a single file. With layout package files the view can be changed, different plot types tested, and so forth.

Layout package files have the same properties as standard layout files. (See [Section 22 - 1.4 "Layout Files"](#)). Layout package files also contain all data associated with frames in the layout, and an optional preview image of the Tecplot Focus workspace. An extension of *.lpk* is used.

22 - 1.6 Working with Layout and Layout Package Files

New Layout

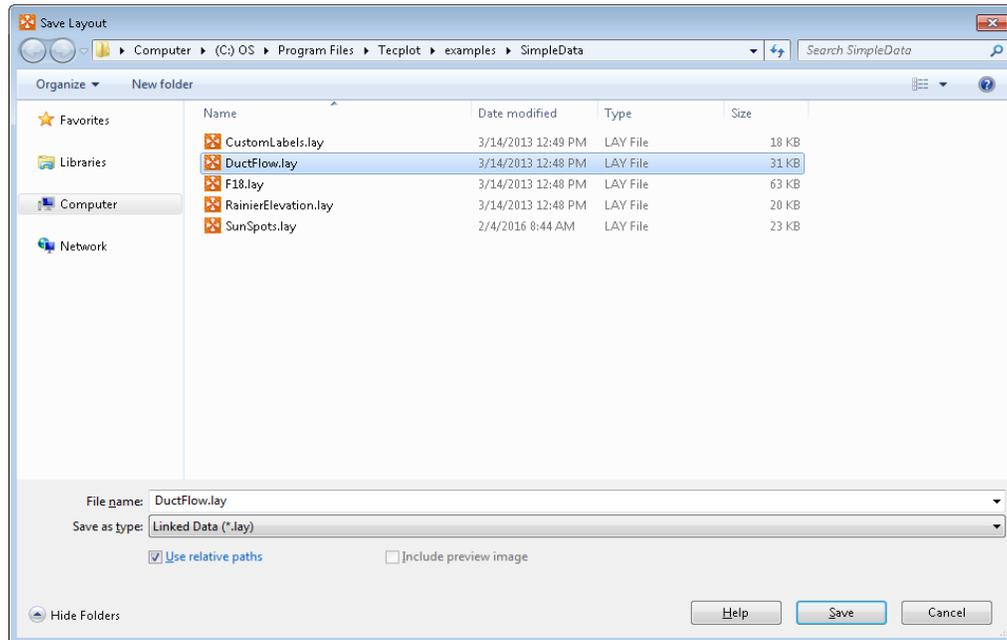
File>New Layout creates a new layout in your workspace after removing any existing frames and resetting the paper setup to the default configuration. Anything not saved before this action will be lost.

Layout Saving

Save layout files using the **Save Layout (Control-S)** or **Save Layout As (Control-W)** options under the **File** menu.

The **Save Layout** dialog has the following options:

- **Save As Type** - Choose "Linked Data (*.lay)" or "Packaged Data (*.lpk)"



- **Use Relative Path (Linked Layout Only)** - By default, Tecplot Focus saves the name of the data files used in the layout with their relative file paths. To save your layout using absolute file paths, toggle-off **Use Relative Path**.
- **Include Preview Image (Layout Package Files Only)** - Toggle-on **Include Preview Image** to include a preview image with the file.

After saving the layout file, you will be asked how to handle any dataset changes. See [Dataset Changed](#) for more information.

Dataset Changed

In Tecplot Focus, layout files contain **references** to the data files in use. The datasets are not copied directly into the layout file. Therefore, if you make changes to the dataset using Tecplot Focus and wish to save the layout, Tecplot Focus will ask you whether you want to create new data files reflecting the changes made. If you answer in the affirmative, Tecplot Focus prompts you for a file name under which to save the changed data. (If your layout has multiple datasets, Tecplot Focus prompts you for a file name for each modified dataset.) The new data is then referenced in the layout instead of the original.

Layout File Opening

Open layout files using the **Open Layout** (Control-O) option from the **File** menu. You can also access this function by choosing **File>Load Data** and selecting Tecplot Layout Loader from the file type menu.

22 - 2 Data File Writing

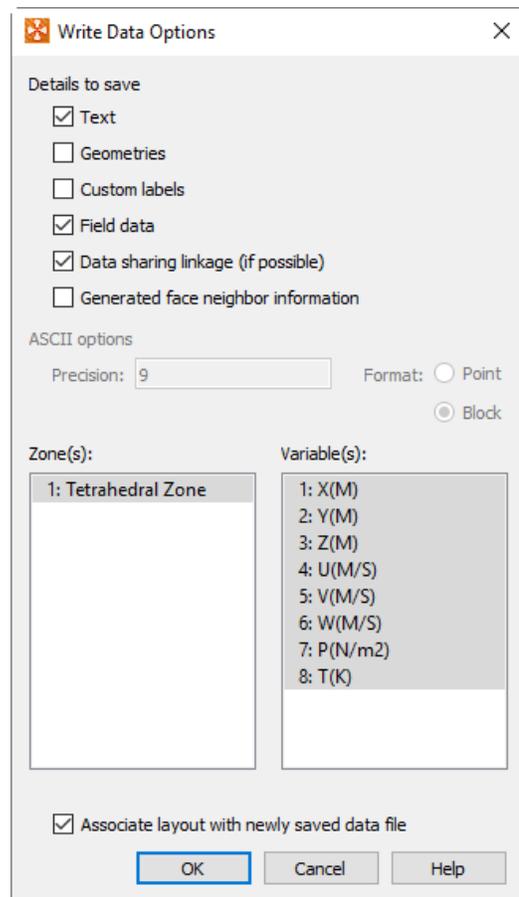
You can write out the dataset in the active frame in various Tecplot file formats, including backward-compatible binary formats. You must choose which zones and variables of the data to write, as well as the format for the saved file (if applicable).

To write the dataset in the active frame to a file, choose **Write Data** from the **File** menu. The **Write Data** dialog appears to let you name the file and to choose its format from the following:

- *Tecplot Binary Data Writer (current)* - Use the current Tecplot binary file format, the best choice for small to moderately-sized data sets. Files are saved with the filename extension *.plt*.
- *Tecplot Binary Data Writer (older)* - Several previous versions of the Tecplot binary format are supported if you need to exchange data with users of older version of Tecplot products.
- *Tecplot ASCII Data Writer* - Uses the Tecplot ASCII data format. You will generally not want to use this loader except in very limited circumstances, as it is much slower to load than binary format and does not support load-on-demand. Files are saved with the filename extension *.dat*.

When writing data in Tecplot binary or ASCII format, the **Write Data Options** dialog appears with the following options:

- **Details to Save** - Specify which record types you want to include in the data file by selecting the appropriate checkboxes. By default, all record types present in the active frame's dataset are selected. These details include:
 - **Text, Geometries, Custom Labels**
 - **Field Data** - Select this detail to save zone data.
 - **Data Linkage (If Possible)** - Save the variable and connectivity sharing between zones existing in the dataset, reducing its size and loading time.
 - **Generated Face Neighbor Information** - Automatically save the face neighbor information generated by Tecplot Focus for finite element zones. This increases the dataset size and loading time, but improves performance after loading.
- **Zone/Geometry Format** - For ASCII, choose to write the file in POINT format or BLOCK format (BLOCK is required if any variables are cell-centered).
- **Zone(s)/Variable(s)** - Select the zones and variables to include.
- **Associate Layout with Newly Saved Data File** - If activated, Tecplot Focus replaces internal references to loaded data with a reference to the new file. When you later save a layout, this layout file will refer to the new file, not to the original data file..

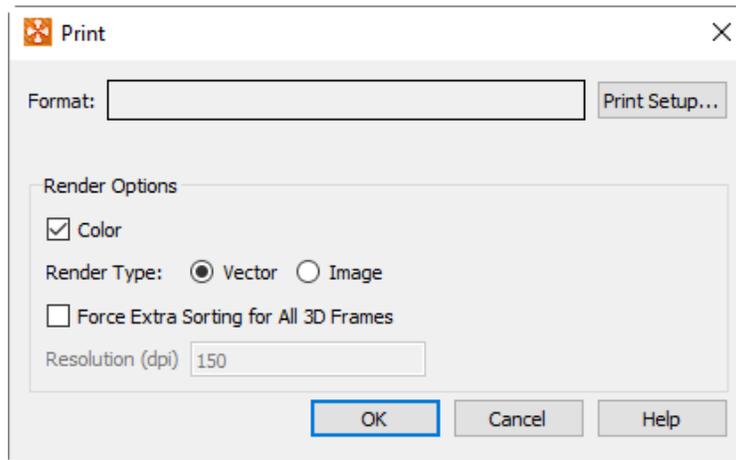


Printing

Printing your plot is the process of sending the plot image to an output device, print spooler, or a file. Typically the output device is a printer, but it may be a plotter, film recorder, file or typesetter. If you are creating files for use in another program, you should use Tecplot Focus's **Export** option (accessed via the **File** menu) to create your files—**Export** includes all the supported print file types, as well as several standard graphics formats. See [Chapter 24: "Exporting"](#) for complete details.

23 - 1 Plot Printing

To print a plot, select "Print" from the **File** menu.



Tecplot Focus supports the standard printer drivers for the supported operating systems.

The **Print** dialog has the following options:

- **Format** - Indicates the printer chosen to print the plot. You can choose a different printer in the Print Setup dialog.
- **Print Setup** - Calls up the [Print Setup Dialog](#), in which you can choose a printer and other printing settings.
- **Color** - Select this check box for color output; deselect the check box for monochrome output.

- **Render Type:**

- **Vector** - Select this option to create print output using the drawing commands of the printer. The printer renders the plot, yielding higher resolution, but some plot options are not available.



Vector graphics formats do not support:

- Translucency
- Contour flooding with Gouraud shading
- Contour flooding using the continuous color distribution method

- **Image** - Select this option to create print output using an image. Rendering is done by Tecplot Focus at the specified resolution, usually less than the printer's resolution. However, all plot options are available.



To preserve quality of color in your plot (translucency, contour flooding with Gouraud shading, or continuous contour flooding), select the **Image** render type.

To preserve the quality of text in your plot, select the **Vector** render type.

- **Force Extra Sorting for all 3D Frames** - This option is available when the Vector option has been selected and overrides the setting in the [Advanced 3D Control](#) dialog. If this check box is not selected, Tecplot Focus will choose sorting algorithms based on the advanced 3D options that were chosen for each frame. When printing 3D plots in a vector graphics format, Tecplot Focus must sort the objects so that it can draw those farthest from the screen first and those closest to the screen last. By default, Tecplot Focus uses a quick sorting algorithm. This is not always accurate and does not detect problems such as intersecting objects. If Extra Sorting is selected, Tecplot Focus uses a slower, more accurate approach that detects and resolves such problems.
- **Resolution (dpi)** - Available when the Image option is selected. Enter the resolution in terms of dpi in the text field. Larger resolutions may result in an out-of-memory condition, or produce very large files. Lower resolutions may yield less-attractive output images.



Control-P is the shortcut command for the **Print** dialog.

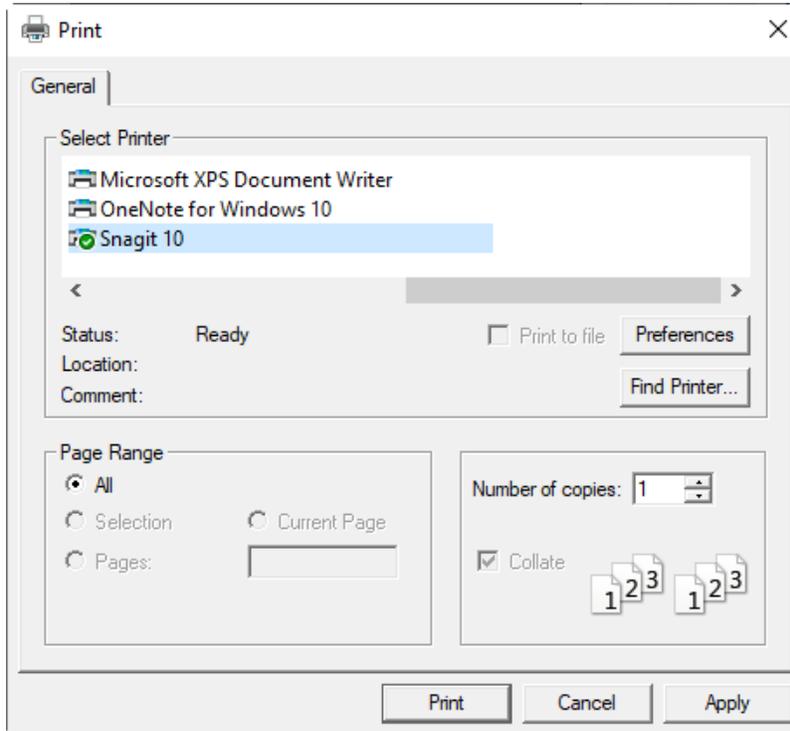
23 - 2 Setup

You can set various parameters relating to the paper, including paper size and orientation, using the **Paper Setup** dialog or the **Print Setup** dialog. A change to your paper settings in either the **Paper Setup** dialog or the **Print Setup** dialog will automatically update the other.

23 - 2.1 Printing Setup for Windows

Print Setup Dialog

On Windows platforms, use the **Print Setup** dialog to set up your paper. The **Print Setup** dialog is accessed via the **Print** dialog (accessed via the **File** menu) and has the following options:



- **Printer** - Choose the printer and set its properties.
- **Paper** - Specify the paper size and source tray using the following drop-downs:
 - **Size** - Select the paper size. The choices are printer-dependent.
 - **Source** - Choose a paper tray from the drop-down.
- **Orientation** - Specify one of the following options:
 - **Portrait** - The horizontal axis of the plot is aligned with the short side of the paper.
 - **Landscape** - The vertical axis of the plot is aligned with the short side of the paper.

By default, Tecplot Focus uses the standard Windows print drivers. You can choose to use Tecplot's print drivers by adding the following line to your tecplot.cfg file:

```
$!INTERFACE USETECPLOTPRINTDRIVERS=YES
```

If you use Tecplot's print drivers, you will use the **Print Setup** dialog for subsequent printing.

Paper Setup Dialog

To adjust the paper size, orientation, and background color for your plots, select the **Paper Setup** option from the **File** menu. The current settings for these options are reflected in the representation of the paper in the workspace. (To view the paper, select the "Show Paper on Screen" check box in either the **Paper Setup** dialog or the **Ruler/Grid** dialog (accessed via the **Options** menu). This check box is selected by default.)

The **Paper Setup** dialog, in contrast with the **Print Setup** dialog on Windows platforms, offers you only six paper sizes. These may not be compatible with the paper sizes your printer supports. You cannot select from multiple paper trays with the **Paper Setup** dialog. You may set screen display options and fill colors with the **Paper Setup** dialog.

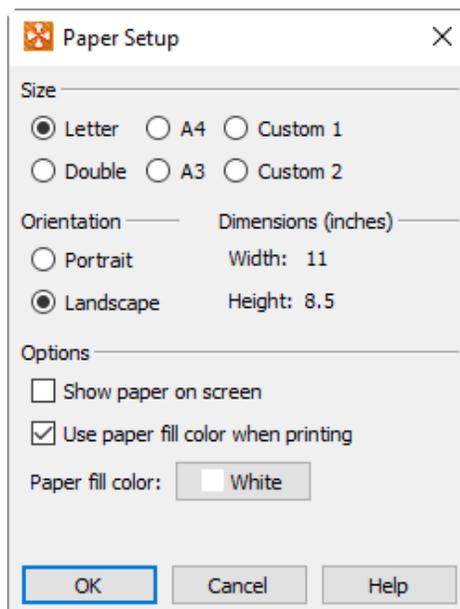
The following options are available in the **Paper Setup** dialog:

- **Size** - Choose the size of the paper from the following six selections:
 - Letter (8.5 x 11 inches).
 - Double (11 x 17 inches).
 - A4 (21x 29.7 cm).
 - A3 (29.7 x 42 cm).
 - Custom 1 (8.5 x 14 inches).
 - Custom 2 (8 x 10 inches).

On Windows systems, paper size **Custom 2** is overwritten with the size selected in **Print Setup** if that size does not exist in Tecplot Focus.

You can customize all six paper sizes in the configuration file, as well as their hard-clip limits. The hard-clip limits are the lines on the edges of the paper that show where your printer cannot print. You can set the hard-clip limits to larger values for use as guides in placing your plots on the paper.

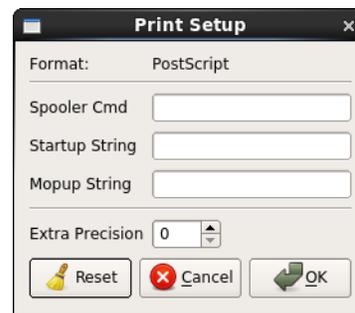
- **Orientation** - Choose the paper orientation. You have two options: Portrait and Landscape. In Portrait orientation, the long axis of the paper is aligned with the vertical axis of the plot. In Landscape orientation, the long axis of the paper is aligned with the horizontal axis of the plot.
- **Paper Fill Color** - Select a color to use for the paper background. This color is used to display the paper in the workspace. You can select the check box **Use Paper Fill Color** when Printing to have Tecplot Focus print this background color on the hard-copy as well.



23 - 2.2 Printing Setup for Linux

The Print Setup dialog on Linux operating systems includes a field for entering a spool command, along with startup and mopup strings. Contact your system administrator if you have any questions about how to set up these commands.

- **Spool Command** - Printers on Linux systems are accessed via print spoolers that manage the print queue. Typically you use either the `lp` or `lpr` commands to send files to the print spooler. There may be command-line options that need to be set on your system, as well, such as a flag to specify a particular printer.



In the **Spooler Cmd** text field, enter the appropriate spool command for your system, using the @ symbol to represent a file name.

For example, suppose you routinely use the following spool command to print a file named `myfile.ps`: `lpr -m -r myfile.ps`. The appropriate spooler command to enter in the Spooler Cmd field is then `lpr -m -r @`.



When printing to a spooler, Tecplot Focus creates temporary files with names of the form `tp?????`, where the ?s are randomly generated characters. Tecplot Focus does not delete these temporary files automatically; commands to do so should be included in your spool command. In our example, the `-r` flag says to remove the file when done.

- **Startup and Mopup Strings** - A startup string is an initialization string that sets up your output device to accept the plot created by Tecplot Focus. A mopup string is a reset signal that tells your output device that the special output has ended. For most devices no startup or mopup strings are needed.

Enter the appropriate startup string or mopup string in the appropriate text field. Special characters are generated by using Macro Codes (such as `%E` for the escape character and `^nnn` for any ASCII character with a decimal ordinal value of `nnn`). Check your printer documentation for the appropriate strings.

- **Extra Precision** - For PostScript output, you can control the numerical precision used in your print files. **Print** files contain numbers that define sizes and positions of pieces of the plot on the output paper. These numbers are defined as integers between zero and about 8,000. Usually, this provides sufficient resolution for most output devices. Occasionally, you may need more resolution. For example, printing to a high-resolution output device like a Linotronic typesetter may require more precision; making print output with very small cells or elements may also require more precision.

To increase the precision of the output, increase the value in the **Extra Precision** field of the **Print Setup** dialog. You specify one **Extra Precision** value for all formats that supports precision control. The precision is defined as the number of digits to the right of the decimal. Normally, precision is zero. The disadvantage of setting precision high is that the print files increase in size. The higher the **Extra Precision** setting, the larger your print files, but the more accurate the plot. The maximum setting for the precision is eight.

Exporting

The **Export** dialog, accessible from the **File** menu, can be used to create files for export to other applications. Tecplot Focus can export files in variations of three types: vector graphics, image, and movie file formats.

Tecplot Focus exports the following **vector** formats:

- [EPS Export](#) - Vector or image graphics in a special type of PostScript file designed for inclusion in other applications.
- [PostScript \(PS\) Export](#) - Vector or image graphics suitable for direct printing, but usually unsuitable for import into other applications. It is recommended that you use the Encapsulated PostScript (EPS) format for importing into other applications.
- [WMF Export](#) - Vector graphics to import into various Windows applications.

Tecplot Focus exports the following **image** formats:

- [BMP Export](#) - Image in Windows Bitmap format.
- [JPEG Export](#) - JPEG files are very small for their resolution and quite common on the internet, but they do involve some loss of image quality that may affect certain plot images.
- [PNG Export](#) - Also common on the internet, PNG images have a high image quality but larger file size than JPEG.
- [TIFF Export](#) - Image in Tagged Image File Format.

Tecplot Focus can also export animations to various movie file formats. For more information on exporting animations, see [Chapter 27: "Animation"](#). Tecplot Focus can also export animations to sequenced image files. See [Section 27 - 4.6 "Sequenced Image Files"](#) for more information.

Certain image formats support anti-aliasing, a feature that smooths jagged edges on text, lines and edges. This feature is discussed at the end of this chapter. See [Section 24 - 4 "Antialiasing Images"](#).

Tecplot Focus can also export images directly to the clipboard instead of to a file. See [Section 24 - 5 "Clipboard Exporting to Other Applications"](#) for more information.

Performance Tips

If exporting is taking an unusually long time, or you get an error message saying that the image cannot be exported, the most likely cause is that the image width you are trying to export is too large. Selecting a smaller image width should speed up the export process.

For an image export size of Length x Width, the file size for an uncompressed true color image is approximately Length x Width x 3. Memory requirements to export such an image can be up to twice this size.

For 256 color images, the maximum file size is approximately Length x Width, but is usually less since all 256 color image files are compressed. However, the memory requirements for exporting are the same as they are for a true color uncompressed image.

Anti-aliasing can dramatically increase the memory and time requirements of image export, since a large image is rendered first and then downsized to the final image dimensions. Furthermore, some graphics card drivers may not report an error if they cannot allocate enough memory for this operation, instead producing a black image or other rendering issues. See [Section 24 - 4 "Antialiasing Images"](#).

24 - 1 Layout Packages

As an alternative to exporting image and vector representations of plots, Tecplot Focus supports the Packaged Data layout format, or layout packages. A layout package (exported from Tecplot Focus as an *.lpk* file rather than as a *.lay* file) contains the data needed for the layout, and only that data. You can reload the resulting file into Tecplot Focus for viewing and rotation. The plot will appear visually identical to the original plot, although you cannot manipulate the variables and other plot elements as in the source plot.

By streamlining the elements included in the exported file, the Packaged Data export reduces the size of the resulting LPK to an average of 25% of the original file size (although the reduction varies greatly depending on what the original layout includes).

To export your current (3D Cartesian) plot with the Tecplot Viewer export format, choose "Save Layout As" from the **File** menu. In the dialog that appears, select "Packaged Data" as the format, and click OK.

To reduce the file size, the lightweight file includes only the following.

- Data for only the current surfaces and lines drawn for the current plot
- Derived elements (such as slices and iso-surfaces) as zones
- The variables necessary to draw each zone (For example, if an iso-surface displays a contour flood, only the spatial variables and the contour variable data will be output to the file for that iso-surface's zone)
- Text, geometries, custom labels, and all visible data elements displayed on your plot

The following restrictions apply.

- Only the active frame of a 3D Cartesian plot may be exported
- Only the current time step of a transient data set may be exported
- The plot must include at least one zone, slice, streamtrace, or iso-surface
- Several plot features will not be reflected in the exported plot:
 - Finite element volume zones with the Contour or Shade layer enabled and a "Surfaces to Plot" setting other than "None" or "Boundary Faces" will not display.
 - Volume zones with the Scatter layer enabled and a "Points to Plot" setting other than "Nodes on Surface" or "Cell Centers Near Surfaces" will not display.
 - Finite element volume zones with the Scatter layer enabled and a point index I-Skip other than one (1) may render scatter symbols in different locations.
 - IJK blanking of ordered zones will not display.
 - Streamtrace arrowheads may render at different locations and with different sizes.

24 - 2 Vector Graphics Format

Vector export files have device-independent resolution and thus can be easily resized, but they have the same limitations as vector print output. [Table 24 - 1](#) provides a summary of the advantages and disadvantages of using vector graphics file formats.

Advantages	Disadvantages
Resolution Independent (can be re-sized over and over to any size)	Does not support translucency
Always journal quality (suitable for publication)	Lines can appear different than on screen
Small file sizes for XY and 2-D output	Very large 3D output files
	Not Web-friendly
	Can be manipulated in third-party programs, but those programs are usually more expensive
	Needs a PostScript printer for proper output

Table 24 - 1: Advantages and Disadvantages of Vector Graphics format

24 - 2.1 EPS Export

Encapsulated PostScript file (EPS) are PostScript files with additional commands that another program can use to determine the size of your plot. After you import your EPS file into another program, you can position it and usually resize it before printing.



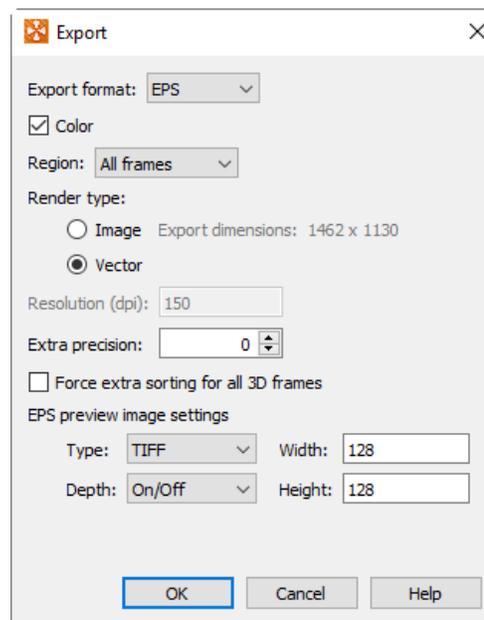
If you try to send an EPS directly to a printer, it may not be positioned correctly on the paper. Import the EPS to a word processor or page layout software to position it on the page. Use the PostScript export format to create files to send directly to a printer.

The **Export** dialog for EPS format has the following options:

- **Color** - Mark the checkbox to output in color. Otherwise output will be in grayscale.
- **Region** - Choose to export only the current frame, the smallest rectangle containing all frames, or the full work area.
- **Render Type** - If you choose Vector, the individual PostScript commands required to draw the image are saved. If you choose Image, a bitmap image is embedded in the file.

Vector mode generally results in a smaller file, and such graphics remain smooth when enlarged, but Image mode can accurately represent translucency or smooth color gradations, like other bitmap formats. In most cases, however, a TIFF, BMP, or PNG is a better choice than an Image EPS, as such files are more widely compatible.

When printing a vector EPS file to a non-PostScript printer, only a low-resolution preview image may be printed, depending on the operating system and



print drivers. On Windows platforms, you must specify that the printer is a PostScript printer to print vector EPS files at their full quality. In most cases, Image mode EPSs will be printed correctly on any printer.

If you choose the **Image** render mode, the following option is available:

- **Resolution** - Enter the resolution of the image in dots per inch. Larger values create more accurate plots, but result in larger file sizes.

If you choose the **Vector** render mode, the following options are available:

- **Extra Precision** - Specify the number of decimal places to specify the size and position parameters in the vector-based EPS output. Larger values create more accurate plots, but result in larger file sizes.
- **Force Extra Sorting for All 3D Frames** - Toggle on to use extra sorting in all 3D frames. Overrides the setting in the [Advanced 3D Control](#) dialog. If selected, Tecplot Focus uses a slower, more accurate approach that detects and resolves problems with how, for example, intersecting objects are rendered.
- **EPS Preview Image Settings** - Tecplot Focus provides the following options for the preview image:
 - **Type** - The type of the preview image, or None.
 - **None** - No preview image information is included. If your application will not use such information, this minimizes the file size. However, the graphic will appear blank in most applications; it will appear correctly only when printed.
 - **TIFF** - Include a monochrome or grayscale TIFF preview image. This is the most common preview image format. You may specify an image depth for the preview image in the **Depth** drop-down.
 - **EPSIV2** - Include a monochrome (one bit per pixel) Encapsulated PostScript Version 2 preview image. This is also a common preview image type in EPS files.
 - **FrameMaker** - Include a monochrome preview image compatible with older versions of Adobe® FrameMaker®. This preview image type is rarely necessary, as newer versions of FrameMaker support TIFF previews.
 - **Depth** - Specifies the number of shades of gray for the preview by how many bits of information is used per pixel. The larger the number of bits per pixel, the larger the resulting file, but the larger the number of shades available. Your options are:
 - **On/Off** - One bit per pixel using an on/off strategy. All background pixels are made white (on), and all foreground pixels, black (off). This setting creates smaller files and is good for images with lots of background, such as line plots and contour lines.
 - **1 Bit/Pixel** - One bit per pixel using gray scale values of pixels to determine black or white. Those pixels that are more than 50 percent gray are black; the rest are white. This setting creates small files that might be useful for a rough draft or a preview image.
 - **4 Bit/Pixel** - Four bits per pixel resulting in sixteen levels of gray scale. This setting generates fairly small image files with a fair number of gray levels. This setting works well for most preview image purposes.
 - **8 Bit/Pixel** - Eight bits per pixel resulting in 256 levels of gray. This setting is useful for full image representation, but the files generated by this setting can be large.
 - **Width, Height** - The size of the preview image.



When using a Render Type of Image, these preview image width, height, and depth values are separate from the characteristics of the EPS image itself. The EPS image size is determined by the Resolution setting and the depth is determined automatically.

24 - 2.2 PostScript (PS) Export

The **Export** dialog allows you to export plots in PostScript (PS). This format is usually used for printing directly to a printer or print spooler. It is recommended that you use the Encapsulated PostScript (EPS) format for importing into, for example, page layout or illustration applications. See [Section 24 - 2.1 "EPS Export"](#) for details.

The Export dialog for the PostScript format has the following options:

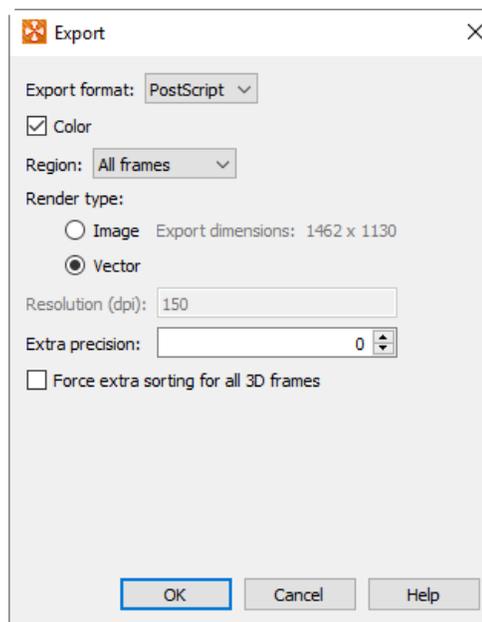
- **Color** - Mark the checkbox to output in color. Otherwise output will be in grayscale.
- **Region** - Choose to export only the current frame, the smallest rectangle containing all frames, or the full work area.
- **Render Type** - If you choose Vector, the individual PostScript commands required to draw the image are saved. If you choose Image, a bitmap image is embedded in the file.

Vector mode generally results in a smaller file, and such graphics remain smooth when enlarged, but Image mode can accurately represent translucency or smooth color gradations, like other bitmap formats. If you choose the **Image** render mode, the following option is available:

- **Resolution** - Enter the resolution of the image in dots per inch. Larger values create more accurate plots, but result in larger file sizes.

If you choose the **Vector** render mode, the following options are available:

- **Extra Precision** - Specify the number of decimal places to specify the size and position parameters in the vector-based EPS output. Larger values create more accurate plots, but result in larger file sizes.
- **Force Extra Sorting for All 3D Frames** - Toggle on to use extra sorting in all 3D frames. Overrides the setting in the [Advanced 3D Control](#) dialog. If selected, Tecplot Focus uses a slower, more accurate approach that detects and resolves problems with how, for example, intersecting objects are rendered.

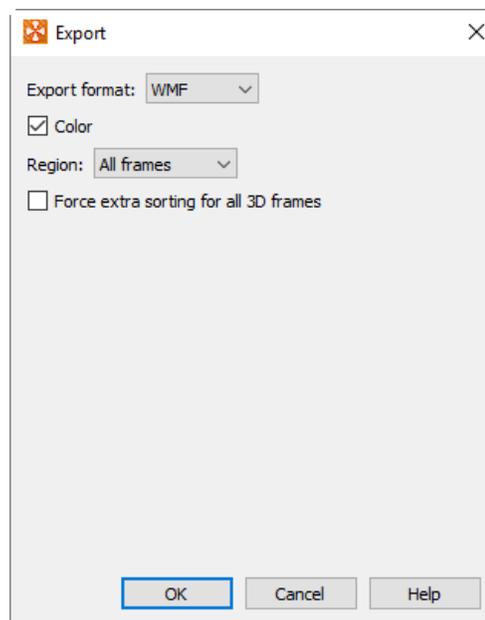


24 - 2.3 WMF Export

WMF (Windows Metafile) is a Microsoft vector graphics format widely accepted by Windows applications. Since WMFs are vector graphics, they can be easily resized by the importing application without the introduction of visual artifacts, but they cannot accurately represent plots with translucency or smooth color gradations.

Selecting WMF from the **Export** Format drop-down displays WMF options:

- **Color** - Mark the checkbox to output in color. Otherwise output will be in grayscale.
- **Region** - Choose to export only the current frame, the smallest rectangle containing all frames, or the full work area.
- **Force Extra Sorting for All 3D Frames** - Toggle-on to use extra sorting in all 3D frames. Overrides the setting in the [Advanced 3D Control](#) dialog. If selected, Tecplot Focus uses a slower, more accurate approach that detects and resolves problems with how, for example, intersecting objects are rendered.



24 - 3 Image Format

Image output has the advantage of accurately representing translucency and smooth color gradations, but with the disadvantage of generally being larger than vector output, particularly when a high image resolution is specified, as may be necessary for printing. Image files are sometimes called raster or bit-mapped. [Table 24 - 2](#) provides a summary of the advantages and disadvantages of image file formats.

Advantages	Disadvantages
Looks like the screen image, or better	Resolution-dependent (starts to lose quality if enlarged too much)
Adjustable export size	For professional-quality printing, images will be very large
Supports translucency	
Relatively small file size	
Easily managed by presentation packages	
Web friendly	
Easily manipulated in inexpensive 3rd party programs	
Prints on any printer	

Table 24 - 2: Advantages and Disadvantages of Image file formats

24 - 3.1 Exporting Images with a Specific DPI

A characteristic of image files is a dots-per-inch setting (DPI), which interacts with the pixel dimensions of the image to determine how large it will be printed. To customize the DPI of your exported image, first set the width of the frame to the size of the image that you wish to export, using the **Edit Active Frame** dialog (accessible by selecting "Edit Active Frame" from the **Frame** menu). Next, when actually exporting the image, multiply the frame width (in inches) by the desired DPI, and enter that number in the Enter Width field of the **Export** dialog.

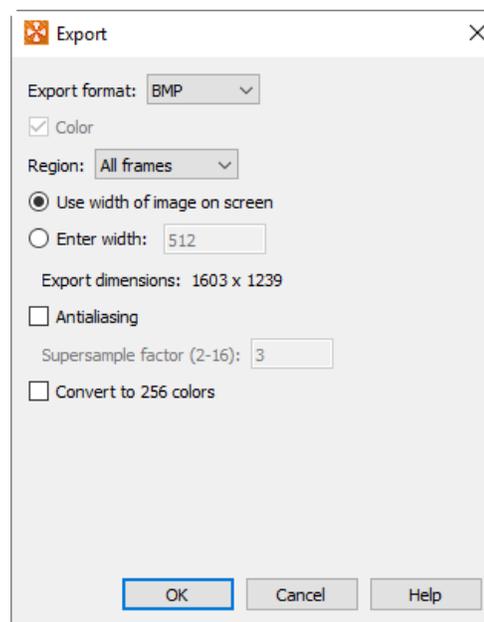
For example, to export a 4 inch by 6 inch image at 300 DPI, set the frame dimensions to 4 inches by 6 inches, and then when exporting, enter a width of 1200 (4 times 300).

24 - 3.2 BMP Export

BMP (Bitmap) is an image format, and thus accurately represents plots with translucency and smooth color gradations. Although it originated on Windows, it is widely accepted on other platforms by many applications. However, it does not perform any compression, so file sizes are larger than more modern formats such as JPG and PNG.

BMP is always exported in color. The BMP export options are shown below.

- **Region** - Choose to export only the current frame, the smallest rectangle containing all frames, or the full work area.
- **Use Width of Image on Screen** - Select this option to generate an image file the same size as the current plot on the screen.
- **Enter Width** - Select this option to specify a width (in pixels) for the generated image. A larger width increases the quality of your image. However, the greater the width you specify, the longer it will take to export the image and the larger the exported file.
- **Antialiasing** - Select this option to smooth jagged edges in the image. See [Section 24 - 4 "Antialiasing Images"](#) for details.
 - **Supersample Factor** - Control the amount of antialiasing used in the image. See [Section 24 - 4 "Antialiasing Images"](#) for details.
- **Convert to 256 Colors** - Select this option to generate an image with only 256 colors (down from a possible 16 million colors). Tecplot Focus selects the colors. This option can help reduce file size, but the results may be suboptimal; using it with transparency, smooth color gradations, or antialiasing may result in poor image quality.



24 - 3.3 JPEG Export

JPEG (Joint Photographic Experts Group) is an image format, and thus accurately represent plots with translucency and smooth color gradations. However, JPEG is a highly-compressed, "lossy" format, meaning the exported file may not be identical to the plot. This can result in poor image quality for some types of images. The advantage of JPEG is very small file sizes and near-universal acceptance on the Internet.

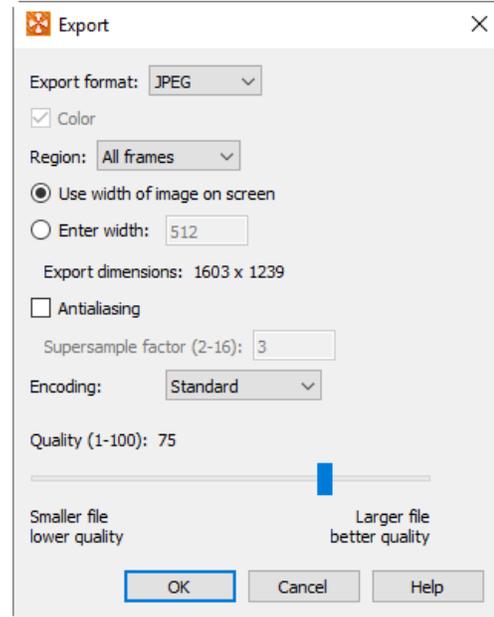
JPEG supports different levels of compression, and Tecplot Focus allows you to control the image quality (and thus, inversely, the file size).

JPEG images are always exported in color. When you select JPEG in the **Export** dialog, you have the following options:

- **Region** - Choose to export only the current frame, the smallest rectangle containing all frames, or the full work area.
- **Use Width of Image on Screen** - Select this option to generate an image file the same size as the current plot on the screen.
- **Enter Width** - Select this option to specify a width (in pixels) for the generated image. A larger width increases the quality of your image. However, the greater the width you specify, the longer it will take to export the image and the larger the exported file.
- **Antialiasing** - Select this option to smooth jagged edges in the image. See [Section 24 - 4 "Antialiasing Images"](#) for details.
 - **Supersample Factor** - Control the amount of antialiasing used in the image. See [Section 24 - 4 "Antialiasing Images"](#) for details.
- **Encoding** - Choose an encoding method for the JPEG file.
 - **Standard** - Encodes a JPEG one line at a time, starting at the top line. In most Web browsers, this means nothing appears until the image has been completely loaded.
 - **Progressive** - Encodes the JPG in two passes, first at lower quality and then at higher quality. In a Web browser, this means that a lower-quality version of the image appears quickly, then is replaced with a larger version of the image when the file has been completely loaded.

Given the same Quality level, **Standard** encoded JPEG files generally look better than equivalent **Progressive** encoded JPEG files. However, they have a larger file size.

- **Quality** - Select the quality of JPEG image. Higher quality settings produce larger files and better looking exported images. Lower quality settings produce smaller files. A quality setting of around 75 is usually optimal; settings much below this may visibly degrade image appearance, while higher settings usually do not provide much visible improvement but create larger files.

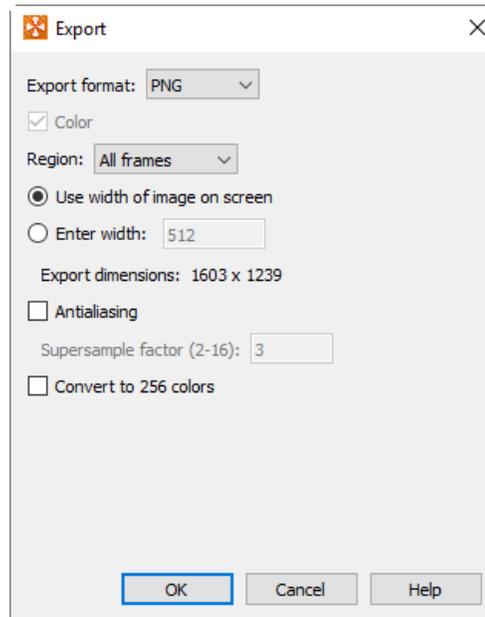


24 - 3.4 PNG Export

PNG (Portable Network Graphics) is an image format, and thus accurately represent plots with translucency and smooth color gradations. Unlike JPEG images, PNGs can exactly represent a plot without losing any nuance.

PNG images are always exported in color. When you select PNG in the **Export** dialog, you have the following options:

- **Region** - Choose to export only the current frame, the smallest rectangle containing all frames, or the full work area.
- **Use Width of Image on Screen** - Select this option to generate an image file the same size as the current plot on the screen.
- **Enter Width** - Select this option to specify a width (in pixels) for the generated image. A larger width increases the quality of your image. However, the greater the width you specify, the longer it will take to export the image and the larger the exported file.
- **Antialiasing** - Select this option to smooth jagged edges in the image. See [Section 24 - 4 "Antialiasing Images"](#) for details.
 - **Supersample Factor** - Control the amount of antialiasing used in the image. See [Section 24 - 4 "Antialiasing Images"](#) for details.
- **Convert to 256 Colors** - Select this option to generate an image with only 256 colors (down from a possible 16 million colors). Tecplot Focus selects the colors. This option can help reduce file size, but the results may be suboptimal; using it with transparency, smooth color gradations, or antialiasing may result in poor image quality.

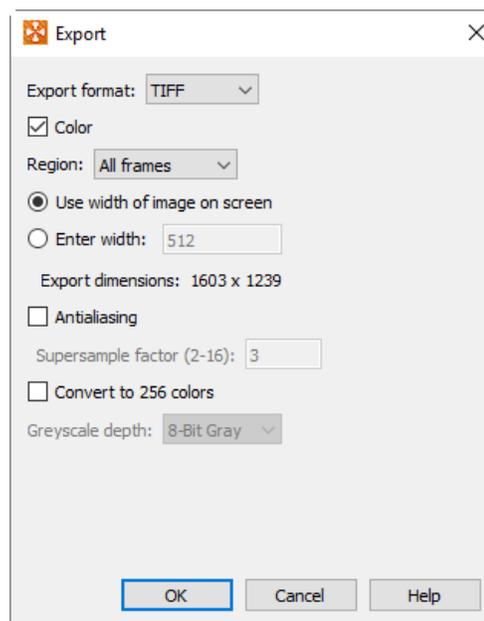


24 - 3.5 TIFF Export

TIFF (Tagged Image File Format) is an image format, and thus accurately represent plots with translucency and smooth color gradations. Tecplot Focus generates both color and gray-scale TIFF images.

When you select TIFF in the **Export** dialog, you have the following options:

- **Color** - Mark the checkbox to output in color. Otherwise output will be in grayscale.
- **Region** - Choose to export only the current frame, the smallest rectangle containing all frames, or the full work area.
- **Use Width of Image on Screen** - Select this option to generate an image file the same size as the current plot on the screen.
- **Enter Width** - Select this option to specify a width (in pixels) for the generated image. A larger width increases the quality of your image. However, the greater the width you specify, the longer it will take to export the image and the larger the exported file.
- **Antialiasing** - Select this option to smooth jagged edges in the image. See [Section 24 - 4 "Antialiasing Images"](#) for details.
 - **Supersample Factor** - Control the amount of antialiasing used in the image. See [Section 24 - 4 "Antialiasing Images"](#) for details.
- **Convert to 256 Colors** - Select this option to generate an image with only 256 colors (down from a possible 16 million colors). Tecplot Focus selects the colors. This option can help reduce file size, but the results may be suboptimal; using it with transparency, smooth color gradations, or antialiasing may result in poor image quality.
- **Grayscale Depth** - For grayscale images, this specifies the number of shades of gray by how many bits of gray-scale information is used per pixel. The larger the number of bits per pixel, the larger the resulting file. Your options are:
 - **On/Off** - One bit per pixel using an on/off strategy. All background pixels are made white (on), and all foreground pixels, black (off). This setting creates small files and is good for images with lots of background, such as line plots and contour lines.
 - **1 Bit/Pixel** - One bit per pixel using gray scale values of pixels to determine black or white. Those pixels that are more than 50 percent gray are black; the rest are white. This setting creates small files that might be useful for a rough draft or a preview image.
 - **4 Bit/Pixel** - Four bits per pixel resulting in sixteen levels of gray scale. This setting generates fairly small image files with a fair number of gray levels. This setting works well for most preview image purposes.
 - **8 Bit/Pixel** - Eight bits per pixel resulting in 256 levels of gray. This setting is useful for full image representation, but the files generated by this setting can be large.



24 - 4 Antialiasing Images

Antialiasing smooths jagged edges on text, lines, and edges of image output formats by the process of supersampling. A large intermediate image is rendered and then reduced to the final image size. Each pixel

on the final image is created from multiple rendered pixels. The width and height of the intermediate image are the width and height of the final image times some scale factor. This scale factor is called the Supersample Factor. You can use values from 2 to 16. Factors greater than 3 are seldom necessary. Large scale factors take a lot more time and memory. Some graphics cards limit the dimensions of rendered images to a maximum of 2048x2048 or 4096x4096 pixels, and thus Tecplot Focus cannot antialias if the intermediate image would be larger than this limit. Some graphics drivers do not report an error in such situations, instead producing blank or garbled images.

Antialiasing uses many colors. If you are exporting with the **Convert to 256 Colors** option activated, antialiasing works for plots with a very limited selection of colors (like a red mesh on a black field). Otherwise, antialiasing to 256 colors wastes time and may decrease plot quality.

Using animation formats can amplify the antialiasing and 256-color problem, as the same 256 colors must generally be used for colors in all frames of the animation. For these formats, try a test animation of a few steps with antialiasing on before creating the entire animation.

24 - 5 Clipboard Exporting to Other Applications

In general, the Cut, Copy, and Paste commands on the Edit menu work only within Tecplot Focus. However, it is possible to copy the plot in a frame to the clipboard as an image using the following procedure:

1. With the  selector tool active, click the frame border to select the frame. Black dots appear at the frame's corners and at the midpoints of its edges.
2. From the **Edit** menu, choose **Copy**.

An image of the frame's plot is now on your system clipboard and can be pasted into documents in other applications. Note that the image captures the plot exactly as it appears on the screen, including its size.

Text may be copied and pasted into other applications using a similar procedure. Select the text object, choose **Edit>Copy**, then paste the text into the other application.

Part 6 Scripting

Macros

Tecplot Focus provides two methods of scripting or automating your workflow: macros and batch processing. This chapter focuses on the Tecplot Focus menu options for recording and playing back macros. The [Scripting Guide](#) describes the Tecplot Focus macro language in detail.

Macros are very useful for performing repetitive operations such as setting up frames, reading in data files and layout files, manipulating data, and creating plots. Macros can also be used to drive Tecplot Focus batch jobs. For information on batch processing, see [Chapter 26: "Batch Processing"](#).

25 - 1 Macro Creation

Tecplot Focus's **Macro Recorder** records a macro as you perform a sequence of actions interactively. Macros are recorded in Tecplot (.mcr) format. After recording your macro, you can edit your macro file with a plain text editor to remove redundant operations, compress repetitive actions into loops, replace references to files with variable names, and otherwise modify the macro to make it more generic and flexible.

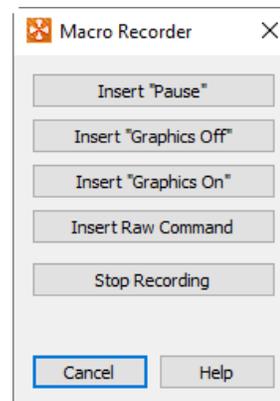
To record a macro with the **Macro Recorder** dialog, select "Record Macro" from the **Scripting** menu. Specify a macro file name in the **Write Macro File (.mcr)** dialog and click Save to initiate the recording. The **Macro Recorder** dialog remains open during the recording session.



Auto Redraw is disabled during macro recording. If necessary, you can manually redraw your plot by clicking the Redraw button in the Plot sidebar.

While recording macros, you can use any of the following buttons on the **Macro Recorder** dialog to add specific macro commands to your macro:

- **Insert "Pause"** - Adds a "pause" command to the macro. When you play a macro including a pause command, Tecplot Focus displays a message box when it reaches the pause command, and waits for you to click OK before continuing to process the macro.
- **Insert "Graphics Off"** - Adds a "graphics off" command to the macro. When you play a macro containing a "graphics off" command, Tecplot Focus stops displaying graphics in the workspace from the "graphics off" command until a "graphics on" command is encountered.
- **Insert "Graphics On"** - Adds a "graphics on" command to the macro.
- **Insert Raw Command** - Brings up a dialog in which you can enter any valid Tecplot macro command. For example, you can add "\$!LOOP 10" at the start of a section you want to repeat 10 times, then "\$!ENDLOOP" at the end. See the [Scripting Guide](#) for information on the Tecplot Focus macro language.
- **Stop Recording** - Select when you have completed the sequence of actions you want recorded.



The commands in a macro file typically rely on Tecplot Focus being in a particular state. It is a good practice to use commands at the start of a macro that force Tecplot Focus into a known state. For example, the \$!NEWLAYOUT command deletes all data sets and frames and creates a single empty frame with a default size and position.



Macros are guaranteed to be forward compatible (i.e. work with future releases of Tecplot Focus) only if the macro begins with a new layout or stylesheet. Refer to the [Scripting Guide](#) for more information.

25 - 1.1 Macro Functions

When editing a macro file in a text editor, you can add macro function definitions and macro function calls. Macro functions have the following form:

```

$!MACROFUNCTION
  NAME = functionname
  :
  :
  :
$!ENDMACROFUNCTION

```

Between \$!MACROFUNCTION and \$!ENDMACROFUNCTION, you can include any legal macro command except \$!MACROFUNCTION.

For example, the following macro function turns on the Contour zone layer, turns off the Mesh zone layer, sets the contour plot type to **Both Lines and Flood** for zones 1, 2 and 3, then chooses gray scale color mapping:

```

$!MACROFUNCTION
NAME = "graycontour"
RETAIN = Yes
$!FIELDLAYERS SHOWCONTOUR = YES
$!FIELDLAYERS SHOWMESH = NO
$!FIELDMAP [1-3] CONTOUR{CONTOURTYPE = BOTHLINESANDFLOOD}
$!GLOBALCONTOUR 1 COLORMAPNAME = "Grayscale"
$!REDRAW
$!ENDMACROFUNCTION

```

The `RETAIN` parameter tells Tecplot Focus to retain the macro function definition for use in subsequent macro calls; this allows you to define a macro function once in some macro you load every time you run Tecplot Focus, and continue to use it throughout your Tecplot Focus session.

Use the `!RUNMACROFUNCTION` macro command to call your macro function. For example, to call the "graycontour" macro function defined above, use the following macro command:

```
!RUNMACROFUNCTION "graycontour"
```

You can use the `!RUNMACROFUNCTION` command within other macro functions; calls may be nested up to ten deep.

To access parameters from within a macro function use "`|n|`", where *n* is the parameter number (do not include the double quotes). For example, the following function uses two parameters for the assignments to `SHOWCONTOUR` and `SHOWMESH`:

```
!MACROFUNCTION
NAME = "AssignContourAndMesh"
!FIELDLAYERS SHOWCONTOUR = |1|
!FIELDLAYERS SHOWMESH = |2|
!ENDMACROFUNCTION
.
.
.
!RUNMACROFUNCTION "AssignContourAndMesh"
(YES,NO)
```

25 - 1.2 Macro Linking to Geometries

Each geometry you create can be linked to a macro function. This macro function is called whenever the user holds down the control key and clicks the right mouse button on the geometry. Macro functions are specified with the **Link to Macro function** field in the **Geometry** dialog. Only one macro function may be specified for each geometry.

The macro function must be defined in a macro file using the `!MACROFUNCTION` instruction as described in ["Macro Functions"](#) on page 325. The macro file containing the variable must then be executed so that the function is loaded into memory and available for use in the current Tecplot Focus session.

A convenient way to handle this is to record a macro that opens the layout that contains the linked objects and then edit this macro using a text editor to also include the necessary macro functions. You can also simply include the macro functions in your `tecplot.mcr` file.

25 - 2 Macro Playback

Once you have created a macro file, you have four methods in Tecplot Focus for playing it back:

- **From the command line** - You can play a macro when Tecplot Focus is launched by including the name of the macro file on the command line, i.e.:

```
tecplot mymacro.mcr
```

 If your macro file does not have the `.mcr` extension, run Tecplot Focus with the macro file by including the `-p` flag on the command line, such as:

```
tecplot -p mymacro.mmm
```
- **From the Tecplot Focus interface** - You can play a macro from within Tecplot Focus by using the "Play Macro/Script" option on the **Scripting** menu.
- **Using the Macro Debugger** - Use the **Macro Debugger** (accessed via **Scripting>View/Debug Macro**) to open, inspect, step through, and debug your macro file. See [Section 25 - 3 "Macro Debugger"](#) for more information.

- **Using the Quick Macro Panel** - The **Quick Macro Panel** (accessed via the **Scripting** menu) allows you to quickly play a macro function by clicking on the button in the panel that is linked to that macro function. See [Section 25 - 2.1 "Quick Macro Panel"](#) for more information.



On Windows operating systems, you can also launch Tecplot Focus and run a macro by dragging and dropping a macro file onto the Tecplot Focus icon. However, in this case, the macro file must have the .mcr extension. Otherwise, the file will be treated as an ASCII data file.

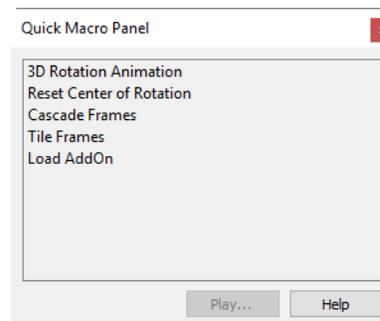
25 - 2.1 Quick Macro Panel

The **Quick Macro Panel**, accessible by selecting "Quick Macros" from the **Scripting** menu, is a sidebar for playing your favorite or frequently-used macros. It initially appears docked to the right side of the main Tecplot Focus window, but like the other sidebars, it can be dragged out of the workspace to become a floating window, or docked with one or more other sidebars to suit your working habits. (See ["Sidebars"](#) on page 21 for more information on working with sidebars.)

This panel comes with a number of useful macro functions already defined. To run any of these macros, select it in the list, then click the Play button, or simply double-click the macro name.

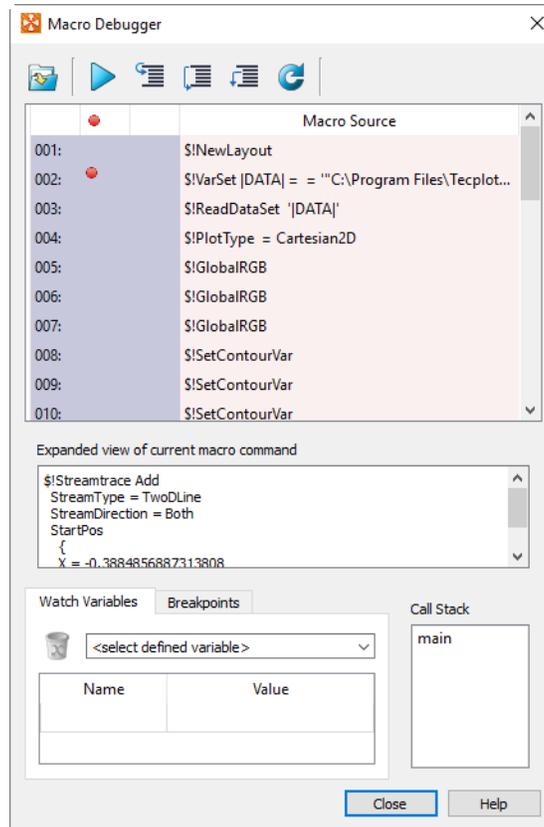
The Quick Macro Panel is linked to a special macro file that should contain only macro function definitions (\$!MACROFUNCTION instructions). The macro definitions having SHOWINMACROPANEL = TRUE appear in the Quick Macro Panel. Other functions may be defined in this file without this flag; these can be called by the macro(s) displayed in the panel. You may also use the \$!INCLUDEMACRO instruction to include macro instructions from other files into the quick macro file.

For information on how to load a quick macro file, see [Section 28 - 1 "Custom Files loaded on Startup"](#).



25 - 3 Macro Debugger

Use the **Macro Debugger**, accessed via **Scripting>View/Debug Macro**, to step through and debug a macro file. This dialog allows you to add and delete breakpoints, view and set watch variables, and view the call stack.



The **Macro Debugger** displays the text of the currently loaded macro file at the top of the dialog in the Macro Source area. The black arrow  marks the line about to be executed; it moves to the next command after the current command is executed. Below this is a second area (Expanded View) showing the complete command about to be executed, as many macro commands are lengthy and may not be readable in their entirety in the Macro Source area.

The Macro Debugger has the following buttons in its toolbar:

-  **Load a Macro file** - Loads a macro file using the **Open Macro** dialog, in which you can specify which macro file to load. Tecplot macro files typically have the extension `.mcr`. Once you have loaded a macro file, it stays loaded in the Macro Debugger until you load a different one.
-  **Continue** - Plays the macro without stopping after each step, until the macro finishes or the Macro Debugger encounters a breakpoint.
- **Step buttons** - These three related buttons help you step through your macro line by line, pausing after each instruction has been processed. Checking the values of variables after each step is very helpful in finding and fixing problems. These buttons have slightly different functions, described below.
 -  **Step Into** - Executes the current macro command. When a `#!RUNMACROFUNCTION` command is encountered, the **Macro Viewer** steps into the called function, so it too can be executed line by line.

-  **Step Over** - Executes the current macro command. When a `#!RUNMACROFUNCTION` command is encountered, the entire function is processed as a single operation, instead of allowing you to step through it line by line.
This is useful for functions that you have already verified to be working correctly and/or do not wish to step through, especially long ones.
-  **Step Out** - Executes the rest of the current function at full speed, rather than line by line, until the end of the function (`#!ENDMACROFUNCTION`) is encountered, then resumes single-stepping at the line after the `#!RUNMACROFUNCTION` instruction that called the function.
This is useful when you have verified that a function is working correctly, and don't need to continue stepping through it (especially in functions with loops) or have accidentally stepped into a function you don't want to step through.
-  **Reset** - Stops the running macro, if any, and resets the macro to start running at the beginning again.
If your macro relies on Tecplot Focus being in a particular state when it starts processing (that is, it does not begin with loading or creating a layout), make sure Tecplot Focus is in this state before you click **Reset**. Otherwise, the results of the macro may not be what you expect.

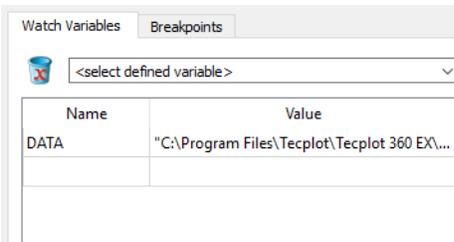


A convenient way to handle state with macro resets is to save a layout before beginning debugging, then reload this layout if you need to reset.

The Macro Debugger has the following three areas at the bottom of the dialog. Watch Variables and Breakpoints share the same space; use the provided tabs to switch between them.

- Watch Variables** - Displays the values of selected macro variables as you step through the code, and allows you to add and remove variables to be watched. See [Watching Variables](#).
- Breakpoints** - Displays the breakpoints set in your macro and allows you to delete any or all of them easily. See [Using Breakpoints](#).
- Call Stack** - Displays all function calls currently executing. When one function calls another, which calls another, and so on, this area displays the name of all these functions in the order they were called. The name *main* represents the top-level script (instructions outside of any functions).

25 - 3.1 Watching Variables



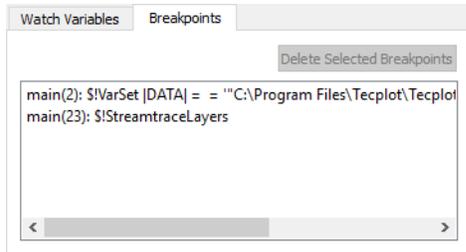
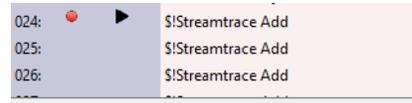
The Watch Variable panel at the bottom of the Macro Debugger allow you to set variables to be displayed while your macro runs. You can add a variable to be watched by choosing it from the pop-up menu here. To stop a variable from being watched, click it in the list of watched variables, then click the delete (trash) icon.

25 - 3.2 Using Breakpoints

A *breakpoint* is a point in your code where you wish to pause execution, usually just before some macro instructions you are having trouble with. Using the Continue button, your macro runs at full speed until it reaches a breakpoint. You can then inspect variables or the call stack and see the next several lines to be executed, then step through the macro a line at a time using the appropriate Step buttons in the toolbar to see how they behave.

Macros

Breakpoints are shown as red discs to the left of each line of code in the Macro Source field. To set a breakpoint at a particular line of your macro, click to the left of that line. A red disc appears next to that line to indicate that execution will pause just before that line is executed. You can remove the breakpoint by clicking again.



The Breakpoints area at the bottom of the Macro Debugger dialog display information about where each breakpoint is set: the function it's in ("main" if it's outside a function), its line number, and the macro command. You can delete breakpoints from this area by selecting them and clicking **Delete Selected Breakpoints**. (This is the fastest way to delete all breakpoints.)

Batch Processing

You can run Tecplot Focus in batch mode to create plots without displaying any graphics to the screen. This saves time when processing multiple files for printing or export. In batch mode, Tecplot Focus can be executed locally on your workstation computer or remotely using a terminal (Linux only).

26 - 1 Batch Processing Setup

To prepare for batch processing, follow these basic steps:

1. Create a macro file to control the batch processing. You may do this either by using **Scripting>Record Macro** and recording a Tecplot Focus session, or by using any text editor. See [Chapter 25: "Macros"](#).
2. Create layout and stylesheet files, as necessary.
3. Prepare data files.
4. Debug the macro file by running Tecplot Focus while not in batch mode.



Macros are guaranteed to be forward compatible (i.e. work with future releases) only if the file is started with a layout or stylesheet. Refer to the [Scripting Guide](#) for more information.

When you launch Tecplot Focus in batch mode, you provide the name of a macro file to execute. The minimal command to launch Tecplot Focus in batch mode is as follows:

```
tecfocus -b -p macrofile
```

The `-b` flag instructs Tecplot Focus to run in batch mode and the `-p macrofile` tells Tecplot Focus the name of the macro file to execute.

26 - 1.1 Batch Mode and Linux

See [Appendix A: Section A - 1 "Tecplot Focus Command Line"](#) for information on batch mode command line arguments for Linux. If you have any issues with running in batch mode, see the [Rendering and Export Troubleshooting](#) guide for more information.

26 - 1.2 Batch Mode and Windows

Under Windows, invoking Tecplot Focus from the command line or in a *.bat* file returns immediately rather than waiting for the application to finish working, as is normal on Linux and Mac.

When using batch mode, however, you generally want to wait until Tecplot Focus has finished one operation before proceeding with the next. To do this, precede the command with `start /wait`. For example:

```
start /wait tecfocus -b -p macrofile
```

26 - 1.3 Batch Mode and Mac

When running batch mode on a Mac, the full path to the executable must be called:

```
"/Applications/Tecplot Focus 2023 R2/Tecplot Focus 2023 R2.app/Contents/MacOS/Tecplot Focus 2023 R2" -b mymacro.mcr
```

If you are running many files in batch mode, it may be helpful to set up an alias for the full executable path. To set up an alias, type the following in `~/bashrc`:

```
alias tecFocus="/Applications/Tecplot Focus 2023 R2/Tecplot Focus 2023 R2.app/Contents/MacOS/Tecplot Focus 2023 R2"
```

With the alias defined, running macros in batch mode becomes easier. Simply add the `-b` flag followed by the macro you wish to use:

```
tecFocus -b mymacro.mcr
```

For more information on setting an alias and running Tecplot from the command line in Mac see the [Installation Guide](#).

26 - 2 Batch Processing Using a Layout File

Combining layout files with batch processing is both powerful and flexible, and is also the recommended procedure. With layout files, you can organize a plot using one or more frames in a single file. The layout file manages datasets and can be altered on the fly, either on the command line or within a macro that loads the layout file.



The layout file must contain a `!READDATASET` macro instruction compatible with the data being loaded. The easiest way to create such a layout is to load a file similar to the file(s) you wish to process into Tecplot Focus, then set up the plot as desired and save the layout. The filename specified in the layout's `!READDATASET` instruction will be overridden by the filename specified on the command line (see below).

For example, to do the following sequence of tasks in batch mode:

- Load a data file from a user-supplied file name.
- Create a specific style of plot.
- Create a PostScript file of the plot.

You can set up the batch script as follows:

1. Obtain a representative data file to be plotted.
2. Create a layout of the style of plot you want. (For this example, name the file `batch.lay`).

3. Use a text editor to create the following macro (For this example call this macro `batch.mcr`):

```
#!/MC 1410
$!EXPORTSETUP ExportFormat = PS
$!PRINTSETUP PALETTE = MONOCHROME
$!EXPORTSETUP PRINTRENDERTYPE = VECTOR
$!EXPORT
EXPORTREGION = CURRENTFRAME
$!Quit
```

4. Use the following command to run the job in batch mode:

```
tecFocus -b -p batch.mcr -y psoutput.ps batch.lay mydatafile.
```

<code>tecFocus -b</code>	Launches Tecplot Focus in batch mode
<code>-p</code>	Tells Tecplot Focus to use the following macro file
<code>batch.mcr</code>	Macro file
<code>-y</code>	Tells Tecplot Focus to use the following export file
<code>psoutpt.ps</code>	Export file
<code>batch.lay</code>	Layout file to use
<code>mydatafile</code>	Data file to use; overrides the file specified in the layout

26 - 3 Multiple Data File Processing

In [Section 26 - 2 "Batch Processing Using a Layout File"](#), we set up Tecplot Focus to process a user-supplied data file (or files) and create a single output file. If the above procedure is to be repeated for a large number of input files (one at a time), you can do this by using a loop: either outside Tecplot Focus in the operating system using your shell's looping constructs, or within Tecplot Focus using the flow-of-control commands in the Tecplot macro language.

26 - 3.1 Looping Outside Tecplot Focus

The following examples show the command files for launching Tecplot Focus in an operating system loop on two different operating systems. Tecplot Focus processes five data files named `dnn.plt` and creates ten output files named `dnn.out` where `nn` goes from 1 to 10.

Looping Outside Tecplot Focus (Linux): Create a shell script with the following commands:

```
#!/bin/sh
n=1
while test $n -le 10
do
    tecFocus -b -p batch.mcr -y d$n.out batch.lay d$n.plt
    n=`expr $n+1`
done
```

Looping Outside Tecplot Focus (Windows): Create a batch file with the following commands:

```
for %%f in (d1 d2 d3 d4 d5 d6 d7 d8 d9 d10)
do tecFocus -b -p batch.mcr -y %%f.out batch.lay %%f.plt
```

26 - 3.2 Looping Inside Tecplot Focus

In [Section 26 - 3.1 "Looping Outside Tecplot Focus"](#) we set up Tecplot Focus to process multiple data files using the shell to do the looping. There are two drawbacks to this procedure:

- The shell languages are not portable between different operating systems.
- Tecplot Focus must be repeatedly started and stopped to process each dataset.

A more efficient approach is to loop through the data files inside Tecplot Focus. Here, the layout file and the data files are all named within the macro. The command line in this example is simple, as follows:

```
tecFocus -b -p batch.mcr
```

The macro is as follows:

```
#!MC 1410
$!EXPORTSETUP EXPORTFORMAT = PS
$!PRINTSETUP PALETTE = MONOCHROME
$!LOOP 10
$!OPENLAYOUT "batch.lay"
  ALTDATALOADINSTRUCTIONS = "d|LOOP|.plt"
$!EXPORTSETUP PRINTRENDERATYPE = VECTOR
$!EXPORTSETUP EXPORTFNAME = "d|LOOP|.out"
$!EXPORT
EXPORTREGION = CURRENTFRAME
$!ENDLOOP
$!QUIT
```

The `$!OPENLAYOUT` command loads in `batch.lay` but replaces the data file referenced in the layout with the file names in the `ALTDATALOADINSTRUCTIONS` sub-command. The `$!EXPORTSETUP` command is used in two places. Initially it is used to set the export format. Later it is used just to change the name of the file to export to. The `$!EXPORT` command does the actual exporting.



If you want to make many different plots using the same dataset, stylesheets will be more efficient than layout files.

26 - 4 Batch Processing Diagnostics

Each time Tecplot Focus is run in batch mode, it creates a file defined by the name in the `BATCHLOGFILE` environment variable, or, if the environment variable is not defined, by a file named `batch.log` in the directory where Tecplot Focus was started. If the name given in the `BATCHLOGFILE` environment variable is a relative path, the directory name where Tecplot Focus was started is prefixed. A running commentary on actions performed in Tecplot Focus, as well as warning and error messages, are sent to the `batch.log` file.

Part 7 Advanced Topics

Animation

Tecplot Focus provides a variety of methods for creating animated plots and exporting them to movie or sequences of static image files for playback at a later time. The basic animation methods available include:

- [Animation Tools](#) - Create animations using the **Animate** menu, the Slice Details dialog, or the Streamtraces dialog. The animation can be viewed within Tecplot Focus or exported to a movie file.
- [Movie File Creation with Macros](#) - Use a macro to perform multiple, repetitive changes, and write each image to a movie file.

27 - 1 Animation Tools

Use a built-in animation tool to have Tecplot Focus cycle through your data, automatically displaying zones, slices, or streamtraces one after the other.

- [Time Animation](#)
- [IJK-plane Animation](#)
- [IJK Blanking Animation](#)
- [Iso-surfaces Animation](#)
- [Mapping Animation](#)
- [Slice Animation](#)
- [Streamtrace Animation](#)
- [Zone Animation](#)



When you need a particular size for your animation image, such as 300 by 250 pixels, first resize your frame to the desired width and height. Then export only the active frame.

27 - 1.1 Time Animation

To animate over time, simply press the play  button in the Plot sidebar or in the **Time Animation Details** dialog. (This dialog can be launched from the Animate menu or by clicking the  button above the Solution Time slider in the Plot sidebar.) The active frame will be animated from the current time step to the last time step. The current Solution Time determines which transient zones are displayed in the active frame. The slider control can be used to interactively change the Current Solution Time.



This option is available for transient field plot data only.

The **Time Animation Details** dialog has the following options:

- **Starting Time** - Enter the value of the first solution time to include in the animation. If the Solution Time entered does not exist, the nearest Solution Time less than the entered time is used, or the first solution time if no such time exists. The default value is the first Solution Time. The value of the first Solution Time in the dataset is displayed in **Min**.
- **Ending Time** - Enter the value of the last Solution Time to include in the animation. If the Solution Time entered does not exist, the nearest Solution Time less than the entered time is used. The default value is the last Solution Time. The value of the last Solution Time in the dataset is displayed in **Max**.
- **Time Step Skip** - Enter the skip number between time steps. A value of 2 results in every other time steps being animated, a value of 3 animates every 3 time steps, and so on.
- **Number of Steps** - Displays the number of time steps in the data between the Start Time and the End Time.
- **Animation direction** - Select the direction for the animation: forward, backward, loop (forward repeatedly), or bounce (forward, then backward, then forward, then backward...).
- **Current Step** - This field displays the time step for the active frame of the animation. The field is updated while an animation is in progress.
- **Go To** - Use the Go To button to jump to the animation step entered in the Current Step field.

- **Slider** – The slider can be dragged to change the current solution time. The following buttons may also be used.

-  – Jumps to the value in Start Time.
-  – Moves one step toward the value in Start Time.
-  – Plays the animation as specified by the Animation Mode field. The Play button becomes a Stop button while the animation is playing.
-  – Moves toward the value in End Time.
-  – Jumps to the value in End Time.

Click the filmstrip icon to export the animation to a file. See [Section 27 - 4 “Animation Export”](#) on page 348. Note that some of the settings in this dialog (such as direction and speed) do not apply when exporting to a file. Instead, you may add these effects later using a video editor, if desired.

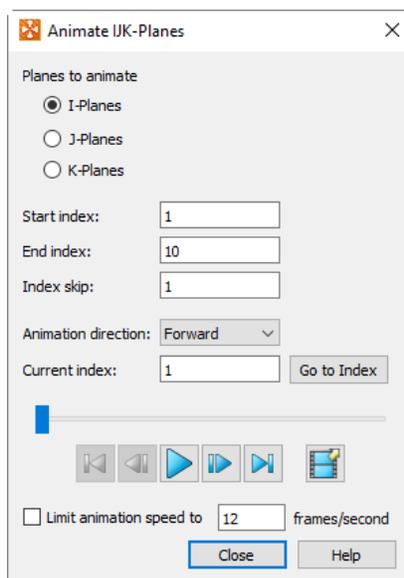
- **Limit Animation Speed to** - Toggle-on to limit the animation speed to the value specified in the text box.
- **For strands with no zones at the current solution time** - Determines what is shown when no zones with a given Strand ID exist at the current solution time, within a small time tolerance:
 - Show zones at or before solution time (default)- Show zones for the closest prior solution time where the zone with that Strand ID does exist.
 - Show zones only at solution time: Only show zones for the current solution time.

Note that, in addition to the above setting, the fieldmap must be active for it to be shown.

27 - 1.2 IJK-plane Animation

Use the **Animate IJK-Planes** dialog to display all or a specified subset of the IJK-planes in the current dataset, one at a time. You can choose to animate either the I, J, or K-planes.

To animate IJK-planes, select "IJK-planes" from the **Animate** menu. The **Animate IJK-Planes** dialog has the following options:



- **Planes to Animate** - Specify the set of planes to animate: I, J, or K-planes.
- **Initial Index, End Index, Index Skip** - Specify an Initial Index (the first plane you want to display), an End Index (the last plane you want to display), and an Index Skip in the fields provided. A skip of 1 displays every index, 2 displays every other index, etc.

- **Animation direction** - Select the direction for the animation: forward, backward, loop (forward repeatedly), or bounce (forward, then backward, then forward, then backward...).
- **Current Index** - Displays the number of the current plane index, which can be edited. Click **Go to Index** after editing to move to the chosen step.
- **Slider** - The slider can be dragged to change the current plane index. The following buttons may also be used.
 -  - Jumps to the first index.
 -  - Moves one step toward the first index.
 -  - Plays the animation as specified by the Animation Direction field. The Play button becomes a Stop button while the animation is playing.
 -  - Moves toward the last index.
 -  - Jumps to the last index.

Click the filmstrip icon to export the animation to a file. See [Section 27 - 4 "Animation Export"](#) on page 348. Note that some of the settings in this dialog (such as direction and speed) do not apply when exporting to a file. Instead, you may add these effects later using a video editor, if desired.

- **Limit Animation Speed to** - Toggle-on to limit the animation speed to the value specified.

[Figure 27-1](#) shows an example of animating I-planes in an IJK-ordered zone.

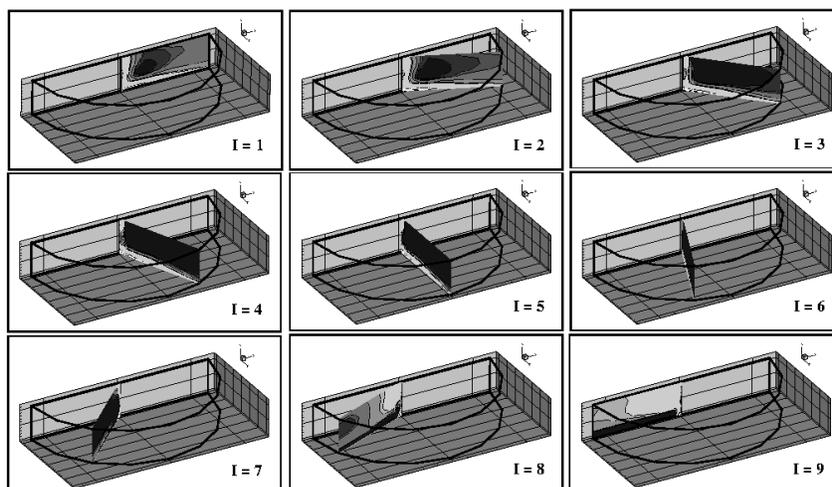


Figure 27-1. An animated sequence of I-planes.

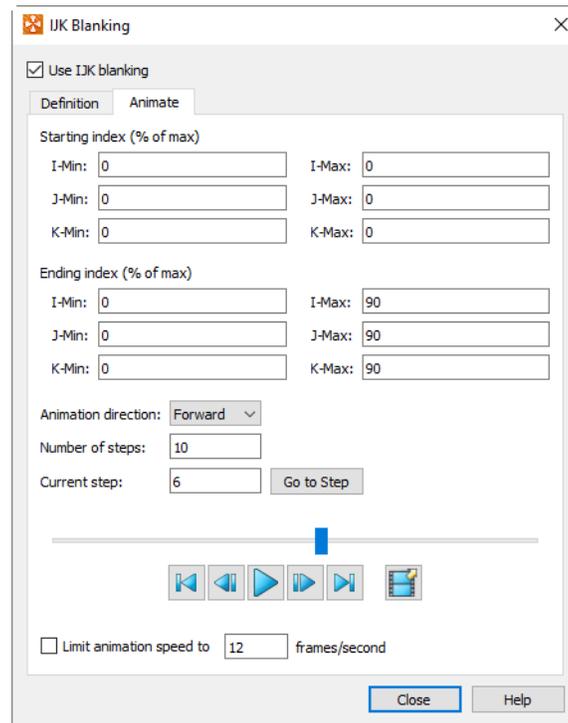


To restore the workspace back to its normal view after the IJK animation, go to **Edit>Undo Style Change**.

27 - 1.3 IJK Blanking Animation

Use the Animation page of the **IJK Blanking** dialog (Plot > Blanking > IJK Blanking) to animate a sequence of Tecplot Focus renderings, starting with an initial set of blanked IJK indices and proceeding in a series of interpolated steps to a final set of blanked IJK indices.

To animate a sequence of IJK blankings, you must first turn on IJK blanking using the checkbox at the top of the IJK Blanking dialog. For more information on initially setting up IJK blanking, see [“IJK Blanking”](#) on page 255.



The Animation page of the IJK Blanking dialog has the following settings:

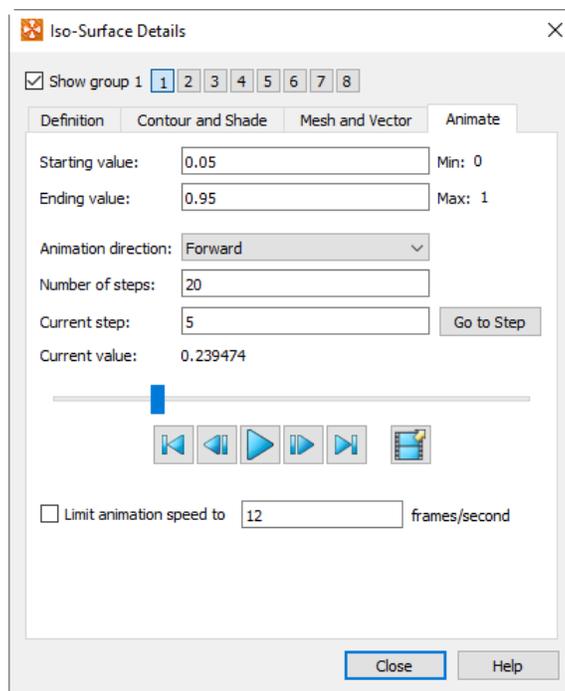
- **Starting Index (% of Max)** - Specify an initial set of blanked IJK-indices in the text fields. Enter a range of indices for: I, J, and K (index values are entered as percentages of the maximum index).
- **Ending Index (% of Max)** - Specify a final set of blanked IJK-indices. Enter a range of indices for each: I, J, and K.
- **Animation direction** - Select the direction for the animation: forward, backward, loop (forward repeatedly), or bounce (forward, then backward, then forward, then backward...).
- **Number of Steps** - Specify the number of steps. The minimum is two.
- **Current Step** - Displays the number of the current step, which can be edited. Click **Go to Step** after editing to move to the chosen step.
- **Slider** - The slider can be dragged to change the current step. The following buttons may also be used.
 -  - Jumps to the first step.
 -  - Moves one step toward the first step.
 -  - Plays the animation as specified by the Animation direction field. The Play button becomes a Pause button while the animation is playing.
 -  - Moves toward the last step.
 -  - Jumps to the last step.

Click the filmstrip icon to export the animation to a file. See [Section 27 - 4 “Animation Export”](#) on page 348. Note that some of the settings in this dialog (such as direction and speed) do not apply when exporting to a file. Instead, you may add these effects later using a video editor, if desired.

- **Limit Animation Speed to** - Toggle-on to limit the animation speed to the value specified in the field.

27 - 1.4 Iso-surfaces Animation

Use the Animation page of the **Iso-surface Details** dialog to define iso-surfaces to animate either on screen or to a file. You can reach this page directly by choosing "Iso-Surfaces" from the **Animate** menu, or you can open the **Iso-Surfaces Details** dialog from the **Plot** menu or Plot sidebar and click the Animation tab.



- **Starting Value** - The starting iso-surface value for the animation.
- **Ending Value** - The ending iso-surface value for the animation.
- **Animation direction** - Select the direction for the animation: forward, backward, loop (forward repeatedly), or bounce (forward, then backward, then forward, then backward...).
- **Number of steps** - The range defined by the Starting and Ending value fields above is divided into the specified number of steps for the animation.
- **Current Step** - Indicates the active step of the animation. You can jump to a specific step by entering the desired value and clicking **Go to Step**.
- **Current Value** - Displays the iso-surface value at the current step.
- **Slider** - The slider can be dragged to change the current step. The following buttons may also be used.
 -  - Jumps to the first step.
 -  - Moves one step toward the first step.
 -  - Plays the animation as specified by the Animation direction field. The Play button becomes a Pause button while the animation is playing.
 -  - Moves toward the last step.
 -  - Jumps to the last step.

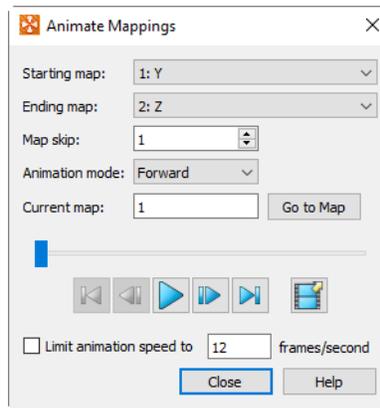
Click the filmstrip icon to export the animation to a file. See [Section 27 - 4 "Animation Export"](#) on page 348. Note that some of the settings in this dialog (such as direction and speed) do not apply when exporting to a file. Instead, you may add these effects later using a video editor, if desired.

- **Limit Animation Speed to** - Toggle-on to limit the animation speed to the value specified in the field.

27 - 1.5 Mapping Animation

Use the **Animate Mappings** dialog to display all or a specified subset of the XY or Polar Line mappings defined in the active frame, one at a time.

To animate mapping, select "Mappings" from the **Animate** menu. The **Animate Mappings** dialog has the following options:



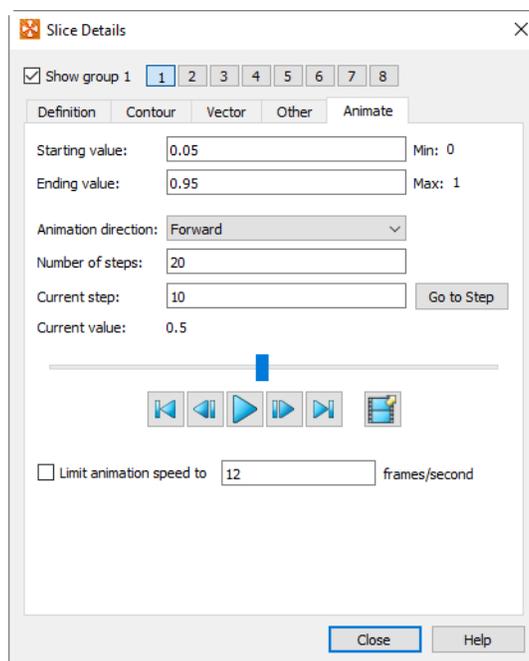
- **Start Map** - Specify the first line mapping you want displayed.
- **End Map** - Specify the last line mapping you want displayed.
- **Map Skip** - Specify the number of maps to skip per step.
- **Animation Mode** - Select whether to animate forward, backward, loop (forward, then back to the beginning for another pass forward), or bounce (forward, then backward, then forward, then backward...).
- **Current Map** - Indicates the map currently displayed. You may jump to a different map by editing the value in the text box and clicking **Go to Map**.
- **Slider** - The slider can be dragged to change the current step. The following buttons may also be used.
 -  - Jumps to the first map.
 -  - Moves one step toward the first map.
 -  - Plays the animation as specified by the Animation direction field. The Play button becomes a Pause button while the animation is playing.
 -  - Moves toward the last map.
 -  - Jumps to the last map.

Click the filmstrip icon to export the animation to a file. See [Section 27 - 4 "Animation Export"](#) on page 348. Note that some of the settings in this dialog (such as direction and speed) do not apply when exporting to a file. Instead, you may add these effects later using a video editor, if desired. .

- **Limit Animation Speed to** - To limit the animation speed, toggle on the checkbox and enter a frame speed value in the text box.

27 - 1.6 Slice Animation

To animate slices, choose **Animate>Slices**. You may also get to this feature by opening the **Slice Details** dialog from the **Plot** menu or the Plot sidebar and choosing the **Animate** page.



Specify a Starting Value, an Ending Value, and the Number of Steps in the fields provided.



Only the primary slice of the current slice group (specified on the Position page) is changed during animations. The start and end slice and any intermediate slices of the current slice group are unchanged. It is possible that the animated primary slice will overlap the start slice, end slice, or an intermediate slice. The animation will proceed, without changing those values.

For arbitrary slices, the start and end origin positions are specified in XYZ coordinates. Arbitrary slices are oriented using the normal defined on the Definition page of the Slice Details dialog (see [“Arbitrary Slice Orientation”](#) on page 186). The slice's origin point is moved between the start and end origins specified here; at each step of the animation, the slice is drawn through the origin point, and oriented against the normal.

After choosing the starting and ending positions and the number of steps, you can animate on the screen or export the animation to a file..

- **Animation Direction** - Select whether to animate forward, backward, loop (forward, then back to the beginning for another pass forward), or bounce (forward, then backward, then forward, then backward...).
- **Current Step** - Indicates the active step of the animation. This may be edited to jump to a specific step. Click the **Go to Step** button to display the entered time step in the workspace.
- **Current Value or Origin** - Displays the value being varied (e.g. X for an X-plane slice) at the current step. For arbitrary slices, shows the XYZ coordinates of the slice origin (through which the slice will be drawn) at the current step.
- **Slider** - The slider can be dragged to change the current solution time. The following buttons may also be used.

-  - Jumps to the value in Start Time.
-  - Moves one step toward the value in Start Time.
-  - Plays the animation. Becomes a Stop button while the animation is playing.
-  - Moves one step toward the value in End Time.
-  - Jumps to the value in End Time.

Click the filmstrip icon to export the animation to a file. See [Section 27 - 4 "Animation Export"](#) on page 348. Note that some of the settings in this dialog (such as direction and speed) do not apply when exporting to a file. Instead, you may add these effects later using a video editor, if desired.

- **Limit Animation Speed** - Toggle-on to limit the animation speed to the value specified in the text field.

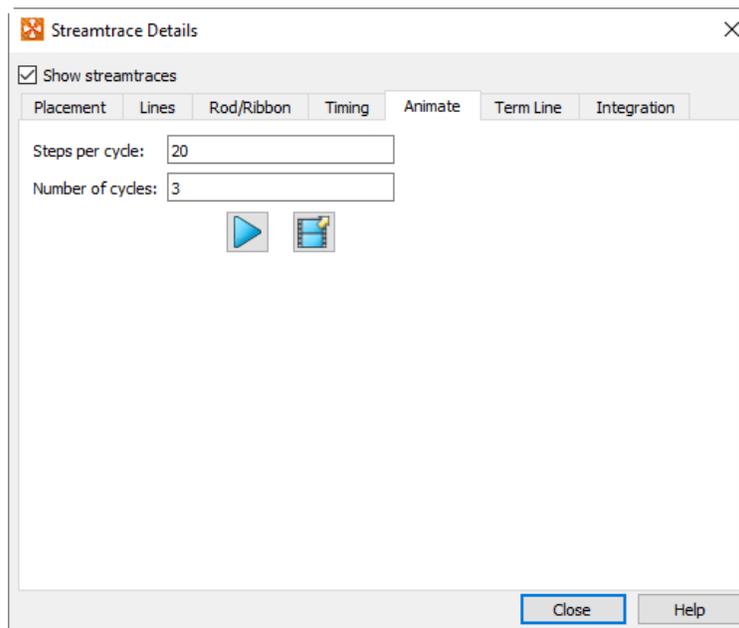
27 - 1.7 Streamtrace Animation

To animate your streamtraces, choose **Animate>Streamtraces**. You may also access this feature by opening the Streamtrace Details dialog from the Plot menu or the Plot sidebar and switching to the Animate page.



When you animate streamtraces, timing markers are automatically turned on. You can change the appearance of these markers in the Streamtrace Details dialog. See [Section 15 - 1.4 "Timing Page"](#) for details.

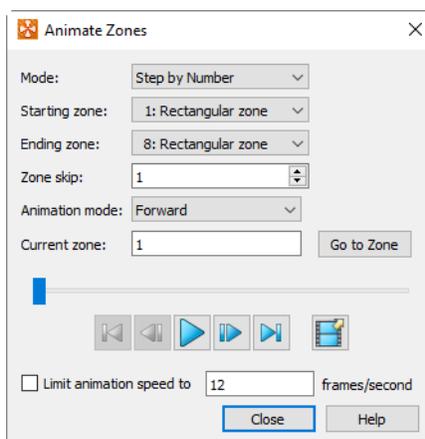
Specify the number of steps per cycle and the number of cycles in the fields provided on the **Animate** page of the **Streamtrace Details** dialog.



Click the Play button to view the streamtrace animation on the screen , or click the filmstrip icon to export the animation to a file. See [Section 27 - 4 "Animation Export"](#) on page 348.

27 - 1.8 Zone Animation

To animate zones, select "Zones" from the **Animate** menu. From the **Zone Animation Details** dialog, specify the animation mode, Start Zone, End Zone, and Zone Skip in the fields provided.



You can animate to a file or "On Screen". (See also [Section 27 - 4 "Animation Export"](#).)

Use the **Mode** drop-down menu to select one of the following two options:

- **Step by Number** - Animate all zones from the first zone to the last zone with a skip specified in the Zone Skip field. A Zone Skip of 1 animates all zones.
- **Group Step by Number** - Animate zones in groups (as specified by the Group Size field). For example, a Group Size of 2 will animate all zones in groups of 2 (i.e. zones 1 and 2, followed by zones 3 and 4, and so on).

The following fields are also available:

- **Starting zone** - The first zone in the animation.
- **Ending zone** - The last zone in the animation.
- **Zone Skip or Group Size** - The label on this field changes depending on the setting of the Mode drop-down menu, described previously. Decides the increment for switching zones (for Step by Number) or the size of the zone group (for Group Step by Number).
- **Animation Mode** - Select whether to animate forward, backward, loop (forward, then back to the beginning for another pass forward), or bounce (forward, then backward, then forward, then backward...).
- **Current Zone** - Indicates the zone displayed. This may be edited to jump to a specific zone; click Go to Zone after editing.
- **Slider** - The slider can be dragged to change the current step. The following buttons may also be used.
 -  - Jumps to the first map.
 -  - Moves one step toward the first map.
 -  - Plays the animation as specified by the Animation direction field. The Play button becomes a Pause button while the animation is playing.
 -  - Moves toward the last map.
 -  - Jumps to the last map.

Click the filmstrip icon to export the animation to a file. See [Section 27 - 4 "Animation Export"](#) on page 348. Note that some of the settings in this dialog (such as direction and speed) do not apply when exporting to a file. Instead, you may add these effects later using a video editor, if desired.

- **Limit Animation Speed** - Toggle-on to limit the animation speed to the value specified in the text field.



The Animate Zones dialog is not available for transient datasets.

27 - 2 Movie File Creation with Macros

The Tecplot macro language expands the capabilities of the standard animation features. The macro commands allow you to do anything you can do interactively—and more. You can also use loops to repeatedly rotate 3D objects, cycle from one active zone to another, and so on, to create your movie. See [Chapter 25: “Macros”](#) for further information about the Tecplot macro language.

A typical macro file for making movies has the following form:

```
#!MC 1410
... optional commands to set up the first image
$!EXPORTSETUP EXPORTFORMAT = AVI
$!EXPORTSETUP EXPORTFNAME = "mymovie.avi"
$!EXPORTSTART
EXPORTREGION = CURRENTFRAME
$!LOOP 50
... commands to set up next image
$!REDRAWALL
$!EXPORTNEXTFRAME
$!ENDLOOP
$!EXPORTFINISH
```

For example, the following macro file can be used to animate zones:

```
#!MC 1410
## Set up Export file type and file name.
$!EXPORTSETUP EXPORTFORMAT = AVI
$!EXPORTSETUP EXPORTFNAME = "C:\temp\timeseries.avi"
## Begin Animating
$!LOOP |NUMZONES|
## The |Loop| variable is equal to the current
## loop cycle number.
$!ACTIVEFIELDZONES = [|Loop|]
$!REDRAWALL
## This series of $!IF statements ensures
## that a new AVI file will be created when
## the macro is started.
$!IF |Loop| == 1
  $!EXPORTSTART
  EXPORTREGION = CURRENTFRAME
$!ENDIF
$!IF |Loop| != 1
  $!EXPORTNEXTFRAME
$!ENDIF
$!ENDLOOP
$!EXPORTFINISH
```

27 - 3 Advanced Animation Techniques

27 - 3.1 Text Changes

There may be times when you want to include information in your animation which tells viewers about the time step, current zones, or a mapping. There are two ways this can be done.

Using Dynamic Text

The best way to do this is to add dynamic text to your text box. See [Section 18 - 1.5 "Dynamic Text"](#).

Attaching Text to Zones

This method works best if you are animating zones. First, create several text strings in your data file, and use the ZN= parameter to attach each text string to a zone or mapping. You should have a separate text string for each zone that will be used in your animation. For example

```

ZONE T= "Temp. distribution, Distance = 0.5 m" I=51, J=51 F=POINT
.
.
.
list of variable values
.
.
.
TEXT X=70, Y=90, T= "Distance = 0.5 m", F=COURIER, CS=FRAME, H=2, ZN=1

ZONE T= "Temp. distribution, Distance = 1.0 m" I=51, J=51 F=POINT
.
.
.
list of variable values
.
.
.
TEXT X=70, Y=90, T= "Distance = 1.0 m", F=COURIER, CS=FRAME, H=2, ZN=2

```

You can also use Tecplot Focus's dynamic text feature (see [Section 18 - 1.5 "Dynamic Text"](#)) to insert a zone name into your text strings. For example

```

ZONE T= "Distance= 1.0 m" I=51, J=51 F=POINT
.
.
.
list of variable values
.
.
.
TEXT X=70, Y=90, T= "&(ZONENAME:2)", F=COURIER, CS=FRAME, H=2, ZN=2

```

27 - 3.2 Multiple Frame Animation

Synchronized animation of plots in multiple frames requires the use of a macro. Macros can use the \$!FRAMECONTROL commands to switch between each frame. The following template demonstrates how this is done with a layout where each frame contains a similar plot:

```

#!MC 1410
##Set the number of images (movie frames) in the animation.
$!VARSET |NumCycles| = 10
$!EXPORTSETUP EXPORTFORMAT = RASTERMETAFILE
$!EXPORTSETUP EXPORTFNAME = "2frames.rm"
BITDUMPREGION = ALLFRAMES
.
Insert commands to set up first frame, if necessary.
.
## Outer loop
$!LOOP |NumCycles|
## Inner loop cycles through each frame in the current layout.

```

```

$!LOOP |NumFrames|
.
Insert commands to change the plot in the active frame.
.
## Push the top (active) frame to the back.
$!FrameControl MoveToBottomByNumber
## Activate new top frame
$!FrameControl ActivateTop
$!EndLoop
## This series of $!IF statements ensures
## that a new AVI file will be created when
## the macro is started.
$!IF |Loop| == 1
    $!EXPORTSTART
    EXPORTREGION = CURRENTFRAME
$!ENDIF
$!IF |Loop| != 1
    $!EXPORTNEXTFRAME
$!ENDIF
$!ENDLOOP
$!EXPORTFINISH

```

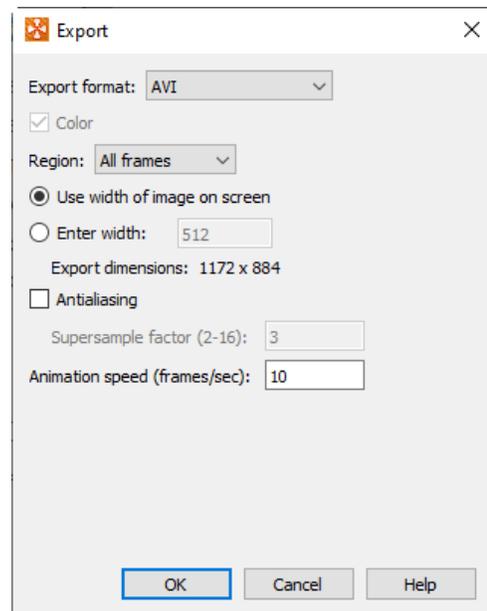
27 - 4 Animation Export

When you choose to animate to a file in a dialog with animation options, the Export dialog appears. Choose the desired export format from the menu at the top of the dialog, then set the options as desired. Two different types of export formats are available:

- Movie formats (e.g. mpeg-4), which produce a single file for a given animation.
- Sequenced image formats (e.g. png etc.), which produce a sequence of static image files for a given animation. See [Section 27 - 4.6 "Sequenced Image Files"](#).

Most of the available formats share a set of similar options, which are described here.

- **Region** - Select the region of the workspace to animate.
 - **Current Frame** - Captures only the active frame.
 - **All Frames** - Captures the smallest rectangular area containing all frames.
 - **Work Area** - Captures the workspace.
- **Use Width of Image on Screen** - Select this option to generate an image file the same size as the current plot on the screen.
- **Enter Width** - Select this option to specify a width (in pixels) for the generated image. A larger width increases the quality of your image. However, the greater the width you specify, the longer it will take to export the image and the larger the exported file.
- **Antialiasing** - Select this option to smooth jagged edges in the image. The image is rendered at a higher resolution than that at which it will eventually be displayed, then reduced in size.
- **Supersample Factor** - Control the amount of antialiasing used in the image. The higher this number, the larger the temporary image used for antialiasing will be, and the more time may be required.



- **Animation Speed (frames/sec)** - Enter a value in the text field to set your animation's speed in frames per second.

The following sections describe any settings unique to specific formats, as well as providing additional useful information about each format (references, viewers, etc.).

- [AVI Files](#)
- [Flash Files](#)
- [MPEG-4 Files](#)
- [Raster Metafiles](#)

Performance Tips

If exporting is taking an unusually long time, or you get an error message saying that the animation cannot be exported, the most likely cause is that the width of the image you are trying to export is too large. Choosing a smaller width may greatly speed up the export process. Note that antialiasing multiplies the image's width and height by the entered supersampling factor, so choosing a lower factor also speeds up export.

For an export size of Length x Width, with a supersampling factor of SSF, the size of an uncompressed true color frame is approximately Length x SSF x Width x SSF x 3. Memory requirements to export such a frame can be up to twice this.

27 - 4.1 AVI Files

AVI format is an older video format for Windows platforms, and is widely compatible with Windows applications. Below are some applications that can be used to view and/or edit AVI files:

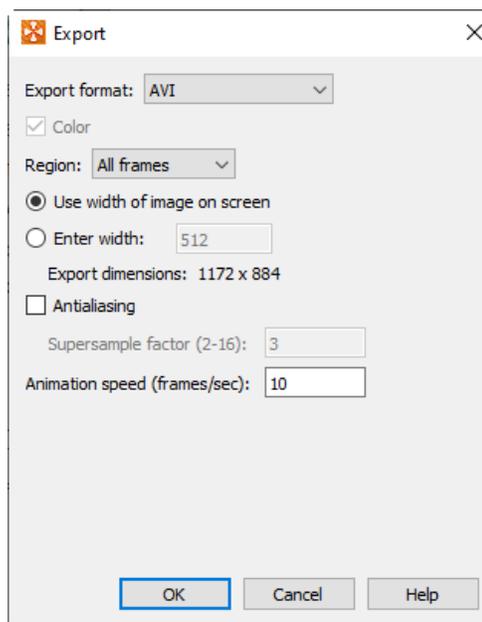
- **Windows Media Player** - A standard movie viewer included with Windows distribution. More information is available at <https://support.microsoft.com/en-us/windows/windows-media-technologies-ebf04fdc-dc47-9944-c160-ae22d8413116>
- **QuickTime** - Included with Mac, Apple's QuickTime can play AVI files and export them to other formats as necessary.
- **Xanim** - A program for playing a wide variety of video formats on Linux (and UNIX) systems with X11. More information is available at <http://xanim.polter.net>.
- **VideoLan Client (VLC)** - Free player that supports many video formats, including AVI, on Windows, Mac, Linux, and several other platforms. <http://www.videolan.org/vlc/>
- **Adobe® Premier®** - A powerful tool for professional digital video editing. More information is available at <https://www.adobe.com/products/premiere.html>.

AVI Export Options

For options common to all supported export formats, see "[Animation Export](#)" on page 348.

27 - 4.2 Flash Files

Adobe® Flash® is a popular tool for creating interactive Web content, including animations and movies. The Flash product is not required to create Flash-format movies



using Tecplot Focus, nor to view them. Flash files have a filename extension of *.swf* and are therefore also widely referred to as SWF files.

Playback

- Flash movies can be played in several freely distributed Flash players. For example, [Swiff Player](#) is a stand-alone player for Windows that enables Flash users to easily play their Flash movies.
- You can play Flash movies using the QuickTime software included with Mac.
- There are several tools at [download.com](#) that can help manage, browse, convert, and display all kinds of Flash files on your computer.

Flash in PowerPoint

The easiest way to insert and SWF into Microsoft® PowerPoint® presentations is to download [ShowRoom](#), a Microsoft PowerPoint add-in that incorporates a free Flash player formerly called Swiff Point Player. It's from the same developer as the standalone Swiff Player described under Playback, above. (Some other features of ShowRoom are not free of charge, but these need be paid for only if you want to use them.)

A secondary option is to play it in a PowerPoint presentation using a Microsoft ActiveX control and the Macromedia Flash Player. To run the Flash file, you add an ActiveX control to the PowerPoint slide and create a link from it to the Flash file. You also have the option of embedding the Flash file in the presentation; see:

- <https://support.office.com/en-us/article/Play-an-Adobe-Macromedia-Flash-animation-in-a-presentation-3b681b8e-6ca9-413f-b41a-eb748babc588>

Flash on the Web

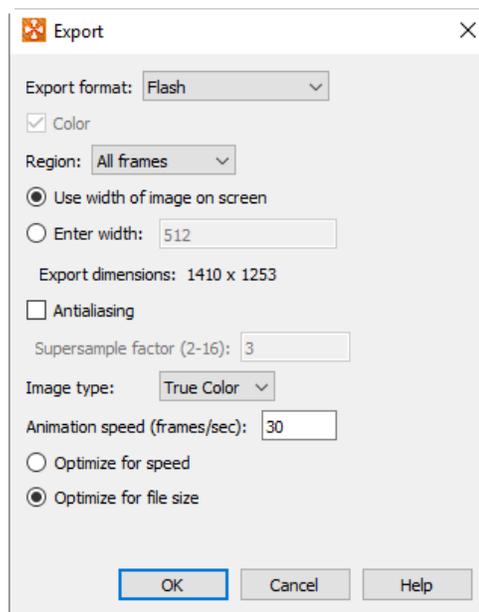
Flash files can be inserted into Web documents using Web design tools such as Adobe® Dreamweaver® (although this is only one such tool). You can also create Web documents by writing HTML directly in a text editor.

Once inserted in a Web page, Flash movies play directly within your browser, assuming the Flash plug-in is installed. (Most browsers on today's desktop operating systems come with the Flash plug-in pre-installed; if your browser did not, you can easily install it.) An outside media player is not needed to launch the animation.

Flash Export Options

The following options are unique to Flash files. For options common to all supported export formats, see [“Animation Export”](#) on page 348.

- **Image Type** - Choose an image type. Your options are:
 - **True Color** - Select this option to create twenty-four-bit images with lossless (ZLIB) compression.
 - **JPEG** - Select this option to create twenty-four-bit images with lossy compression. This produces smaller files than True Color, and the images will be of lower quality.
 - **256 Colors** - Select this option to reduce each image to 256 colors and compress it with ZLIB.
- **Optimize for Speed** - For True Color or 256 Colors image types, select this option to create the output as quickly as possible. This reduces the compression level and results in larger files. It does not affect playback speed.
- **Optimize for File Size** - For True Color or 256 Colors image types, select this option to produce the smallest possible files. This setting does not affect playback speed.



27 - 4.3 MPEG-4 Files

MPEG-4 is the modern ISO standard for video playback. MPEG-4 files can be played by a wide variety of computer software, portable devices, and set-top boxes. We suggest:

- **QuickTime** - Included with Mac, Apple's QuickTime can play MPEG-4 files and export them to other formats as necessary.
- **Windows Media Player** - A standard movie viewer included with Windows distribution. More information is available at <https://support.microsoft.com/en-us/windows/windows-media-technologies-ebf04fdc-dc47-9944-c160-ae22d8413116>.
- **VideoLan Client (VLC)** - Free player that supports many video formats, including MPEG-4, on Windows, Mac, Linux, and several other platforms. <http://www.videolan.org/vlc/>

MPEG-4 export does not have any options besides the ones that apply to all animation export formats; see [“Animation Export”](#) on page 348.

27 - 4.4 Windows Media (WMV) Files

Windows Media Video (WMV) files are widely supported by Windows applications, including Windows Media Player and Microsoft Office (PowerPoint, etc.). They may also be played on Macintosh computers using Microsoft's free Windows Media Components for QuickTime.

- [Windows Media Components for QuickTime](http://windows.microsoft.com/en-us/windows/windows-media-components-quicktime)
<http://windows.microsoft.com/en-us/windows/windows-media-components-quicktime>

WMV export does not have any options besides the ones that apply to all animation export formats; see [“Animation Export”](#) on page 348.

27 - 4.5 Raster Metafiles

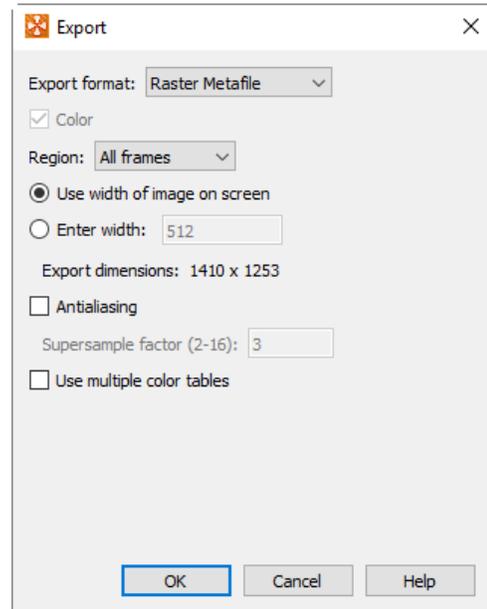
Raster Metafile is a NASA-defined standard format for storing bitmap images and may contain one or more images, allowing it to be used for animations. The format is defined in the following reference:

Taylor, N., Everton, E., Randall, D., Gates, R., and Skeens, K., NASA TM 102588, *Raster Metafile and Raster Metafile Translator*. Central Scientific Computing Complex Document G-14, NASA Langley Research Center, Hampton, VA. September, 1989.

Raster Metafiles support only 256-color images (Tecplot Focus selects the best colors). Plots with many colors may have poor results when exported as Raster Metafiles when compared to exports as true-color formats. Using Raster Metafiles for animations with transparency or smooth color gradients may result in poor image quality.

When you select Raster Metafile in the **Export** dialog, you have the following additional options:

- **Use Multiple Color Tables** - Select this check box to create a Raster Metafile with a separate color table each step in the animation. If this check box is not selected, Tecplot Focus scans all steps in the animation and creates one color table for the entire animation. Multiple color tables can provide better per-step image quality for the animation, but may result in flicker during playback.



27 - 4.6 Sequenced Image Files

With sequenced image formats, Tecplot will produce separate image files (e.g. png, tiff, etc.) with a sequence number appended to the body of the filename. For example, if you specify to output to "mymovie.png", the following files will be generated:

mymovie_000001.png

mymovie_000002.png

... and so on.

Note that every time an animation is exported with sequenced image files the files will be numbered starting at 1 and incrementing by 1. Even if you are doing something like a J-Planes animation and are starting at a J-Plane other than 1.

The following image file formats are available when generating animations: BMP, JPEG, PNG, and TIFF. All settings for these formats when making animations is the same as are available when exporting a single image (via the File/Export dialog). See the corresponding section for each format:

BMP: [Section 24 - 3.2 "BMP Export"](#).

JPEG: [Section 24 - 3.3 "JPEG Export"](#).

PNG: [Section 24 - 3.4 "PNG Export"](#).

TIFF: [Section 24 - 3.5 "TIFF Export"](#).

Customization

This chapter discusses how custom files are loaded on startup, how to manually open those files via the command line, the customizations that can be made by editing the Tecplot Focus configuration file, and customizations that can be made using the **Options** menu.

28 - 1 Custom Files loaded on Startup

On startup, Tecplot Focus will load certain configuration files. These files are editable and can be placed in different locations depending on preference. The different files types are as follows:

- tecplot.add (See “Add-on Loading” on page 364.)
- tecplot.cfg (See “Configuration Files” on page 354.)
- tecplot.fnt (See “Custom Character and Symbol Definition” on page 361.)
- tecplot.mcr (See “Quick Macro Panel” on page 327.)
- tecplot_latex.mcr (See “LaTeX Expressions” on page 239.)
- variable_aliases.txt (See “Creating and Using a Variable Alias File” on page 69.)

When Tecplot Focus first launches, it looks for the above tecplot* files in the following locations, in the order listed below. Tecplot* specifies any of the above filenames.

- The file tecplot* specified on the command line. (See [Section 28 - 1.1 “Loading custom files via the Command Line.”](#))
- The file tecplot* in the current working directory.
- The file tecplot* in your home directory when using -h flag on the command to set the home directory.
- The file tecplot* in the Users home directory. On Mac and Linux, the tecplot* file must be preceded by a period in the users home directory. For example, .tecplot.add.
- The file tecplot* in the Tecplot Focus installation directory.

The first file found in the above search order is used; others are ignored even if they exist. To see what tecplot* files are being loaded, in Focus go to Help->About Tecplot Focus (on Mac, Tecplot Focus->About Tecplot Focus) and look for the files in the Runtime environment.

28 - 1.1 Loading custom files via the Command Line

You can specify a different custom file by adding an option flag in front of the custom file name to the command line when launching Tecplot Focus.

The following command starts Tecplot Focus and installs the custom file specified at startup.

```
tecFocus -flag tecplot*
```

Where `-flag` is the flag of the certain file you want to load. Refer to the table below for the correct flag to be used.

<code>-addonfile filename</code>	Supply a custom list of addons via the <i>tecplot.add</i> file.
<code>-c cfgfile</code>	Use <i>cfgfile</i> for the configuration instead of the default configuration file, <i>tecplot.cfg</i> .
<code>-f fontfile</code>	Use <i>fontfile</i> instead of the default font file, <i>tecplot.fnt</i> .
<code>-p scriptfile</code>	Use <i>scriptfile</i> like <i>tecplot_latex.mcr</i> instead of the default, <i>tecplot_latex.mcr</i> .
<code>-qm quickpanelfile</code>	Place the macro functions in <i>quickpanelfile</i> in the Quick Macro Panel, instead of using the macros from the default file, <i>tecplot.mcr</i> .

To see an example of any of these files, open the file in the your Tecplot Focus installation.

28 - 2 Configuration Files

A Tecplot Focus configuration file is a special type of macro file that Tecplot Focus reads on start up. Use customized configuration files to override any or all of Tecplot Focus's factory default settings.



You can create a configuration file from scratch using any plain text editor, or by editing a copy of an existing configuration file.



A configuration file should include only those options for which you want to override defaults.

See [Section 28 - 1 "Custom Files loaded on Startup"](#) for information on how it is loaded.

28 - 2.1 Editing Configuration File

You are not limited to merely customizing those settings that appear in an existing configuration file. Most settings that can be modified by the `!Field`, `!LineMap`, or `!Interface` macro commands can be changed in the configuration file directly. The `!LIMITS` macro command can be used in the configuration file only.

The simplest way to do this is to create a layout or macro with the settings you want, then copy and paste the appropriate commands into your configuration file. See the [Scripting Guide](#) for complete details on macro commands.

SetValue Commands

SetValue Commands are macro commands used to specify the value of a given plot attribute. You may add SetValue commands to your *tecplot.cfg* file to override any of Tecplot Focus's default settings. For example, suppose you want your 2D axes to appear cyan. You can add this preference to your configuration file as follows:

1. Using the Tecplot Focus interface, create a 2D plot with cyan axes while either recording your steps as a macro, or else save the resulting plot as a Tecplot layout.
2. Edit the resulting macro or layout, scanning for the lines that set the 2D axis colors. The following example shows the commands that specify the X- and Y-axis details in a layout of a 2D plot with cyan axes:

```

$!TWODAXIS XDETAIL{RANGEMIN = -3}
$!TWODAXIS XDETAIL{RANGEMAX = 15}
$!TWODAXIS XDETAIL{GRIDLINES{SHOW=YES}}
$!TWODAXIS XDETAIL{AUTOGRID=NO}
$!TWODAXIS XDETAIL{GRSPACING = 5}
$!TWODAXIS XDETAIL{GRIDLINES{COLOR = CYAN}}
$!TWODAXIS YDETAIL{GRIDLINES{SHOW = YES}}
$!TWODAXIS YDETAIL{GRIDLINES{COLOR = CYAN}}

```

3. Discard everything but the lines that actually set the color:

```

$!TWODAXIS XDETAIL{GRIDLINES{COLOR = CYAN}}
$!TWODAXIS YDETAIL{GRIDLINES{COLOR = CYAN}}

```

4. Paste the resulting lines into your configuration file.

Plot Default Setting - FIELDMAP and LINEMAP

A single \$!FIELDMAP command can be included to set plot defaults. The zone cannot be specified in the configuration file, and the command is not effective for values set dynamically by Tecplot Focus, such as Mesh Color. In the example below, the default contour type is Flood, scatter symbol shape is Delta, and scatter size is 1.8.

```

$!FIELDMAP CONTOUR{CONTOURTYPE = FLOOD}
$!FIELDLAYERS SHOWSCATTER = YES
$!FIELDMAP SCATTER{SYMBOLSHAPE{GEOMSHAPE = DEL}}
$!FIELDMAP SCATTER{FRAMESIZE = 1.8}

```

In the same way as above, a single \$!LINEMAP command can be added for line mapping defaults. In the example below, XY and Polar Line mappings will have a dashed line pattern, and symbols will be filled circles.

```

$!LINEMAP LINES{LINEPATTERN = DASHED}
$!LINEPLOTLAYERS SHOWSYMBOLS = YES
$!LINEMAP SYMBOLS{SYMBOLSHAPE{GEOMSHAPE = CIRCLE}}
$!LINEMAP SYMBOLS{FILLMODE = USELINECOLOR}

```

Override Automatic View>Fit

When loading a 3D plot, Tecplot Focus automatically fits the plot to the frame. To revert to the old Tecplot Focus behavior, which used a fixed zoom factor, remove the # from the following line in your *tecplot.cfg* file:

```

# $!FrameSetup Initial3DScale = 0.7

```

Interface Configuration

The many members of the \$!INTERFACE macro help you configure Tecplot Focus's user interface and graphics drawing capabilities. Although some of these commands can be executed in any macro, the best place to put these is in the Tecplot Focus configuration file: *tecplot.cfg*. Below are a few examples. Refer to the [Scripting Guide](#) for a complete listing.

General Interface Configuration Options

\$!INTERFACE followed by:

- `MOUSEACTIONS {MIDDLEBUTTON {SIMPLEDRAG=ZOOMDATA}}` - Specify the action of the middle mouse button click and drag. Several other options for the middle and right mouse buttons are listed in the [Scripting Guide](#). These commands can only be executed in the Tecplot Focus configuration file.
- `USESTROKEFONTSONSCREEN = (YES, NO)` - If set to YES, all text drawn in the work area will be drawn using Tecplot Focus's internal stroke fonts. If set to NO, the native True Type fonts will be used instead.
- `USESTROKEFONTSFOR3DTEXT = (YES, NO)` - If set to YES, all 3D text drawn in the work area will be drawn using Tecplot Focus's internal stroke fonts. 3D text consists of ASCII scatter symbols and node and cell labels when the active plot type is 3D Cartesian. For 3D text, this setting overrides the setting of `USESTROKEFONTSONSCREEN`. If set to NO, TrueType fonts will be used instead.

OpenGL-Specific Configuration Options

Several options are available to further tune Tecplot Focus to operate with the OpenGL capabilities of your platform. To assign values to these parameters you must use the `$!INTERFACE OPENGLCONFIG` command. A complete list of these options is given in the [Scripting Guide](#).

\$!INTERFACE OPENGLCONFIG followed by:

- `{ALLOWHWACCELERATION = (YES, NO)}` - In some cases, bugs in OpenGL drivers cause problems in Tecplot Focus. In these situations, Tecplot Focus will typically behave better if this options is set to NO. However, Tecplot Focus will also be slower.
- `{SCREENRENDERING {DOEXTRADRAWFORLASTPIXEL = (YES, NO)}}` - Some OpenGL implementations use an optimization for line drawing that omits the last pixel in the line. Set this to YES to change all line drawing to force the last pixel to be drawn. This setting applies only to drawing on the screen.
- `{SCREENRENDERING {STIPPLEALLLINES = (ALL, CRITICAL, NONE)}}` - Set to ALL to make all lines drawn using stippling. Set to CRITICAL to use stippling for stroke and user-defined fonts. Set to NONE to disable stippling. This setting applies only to drawing on the screen.
- `{SCREENRENDERING {MAXMULTISAMPLES = <integer>}` - Specifies the number of multisamples to be used for antialiasing displayed images. The default is 4. A value of 0 may be used for faster rendering (with some roughness in the display). Higher values may be used at some cost in performance.
- `{IMAGERENDERING {DOEXTRADRAWFORLASTPIXEL = (YES, NO)}}` - Some OpenGL implementations use an optimization for line drawing that omits the last pixel in the line. Set this to YES to change all line drawing to force the last pixel to be drawn. This setting applies only to exporting images from Tecplot Focus.
- `{IMAGERENDERING {STIPPLEALLLINES = (ALL, CRITICAL, NONE)}}` - Set to ALL to make all lines drawn using stippling. Set to CRITICAL to use stippling for stroke and user-defined fonts. Set to NONE to disable stippling. This setting applies to exporting images from Tecplot Focus.
- `{IMAGERENDERING {MAXMULTISAMPLES = <integer>}` - Specifies the number of multisamples to be used for antialiasing exported images. The default is 4.
- `{PRETRANSLATEDATA = (AUTO, ON, OFF)}` - Applies a translation to data before sending it to OpenGL for rendering, reducing jitter when data is far from the origin but has small differences between data points. The default is AUTO, which applies the translation automatically when appropriate.

28 - 2.2 Default Temporary Directory

Tecplot Focus writes out a number of temporary files. To tell Tecplot Focus where to place these files, put the following macro command in the *tecplot.cfg* file:

```
#!FILECONFIG TEMPFILEPATH = "tempfilepath"
```

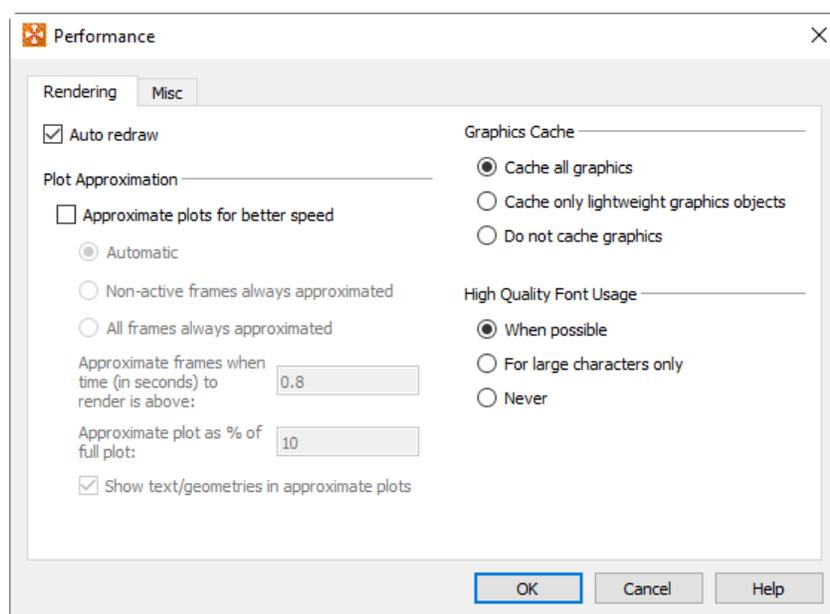
where *tempfilepath* is the new path. The default path is system dependent.

28 - 3 Performance Dialog

Use the [Rendering Settings](#) page of the **Performance** dialog (accessed via the **Options** menu) to adjust the [Plot Approximation](#), [Graphics Cache](#). Use the [Miscellaneous Settings](#) page of the **Performance** dialog (accessed via the **Options** menu) to adjust [Data I/O](#), [Load On Demand](#), [Variable Derivation](#), and [Status Information](#).

28 - 3.1 Rendering Settings

The Rendering page of the **Performance** dialog has the following options:



- **Auto Redraw** - When selected, Tecplot Focus will automatically redraw the plot whenever style or data changes. Some users prefer to turn this option off while changing multiple style settings, and then manually pressing Tecplot Focus's [Redraw] button on the Plot sidebar to see the full plot.



Auto-redraw can be interrupted with a mouse click or key press.

Plot Approximation

- **Approximate Plots for Better Speed** - An approximate plot may be used when manipulating the plot to improve interactive performance. This feature is most useful on older, slower hardware and defaults to off. Approximate plots may also be used for non-active frames. The degree of detail of the approximation is controlled by the following settings:

- **Automatic** - When the time to render (in seconds) is above the set threshold, Tecplot Focus will render the approximate plot for style, data, and interactive view changes, followed immediately by the full plot. This option provides for good interactive performance with the final plot always displayed in the full representation.
- **Non-Active Frames Always Approximated** - When only one frame exists, this option is equivalent to automatic mode. If more than one frame exists, the active frame is set to automatic mode while the other frames are approximated.
- **All Frames Always Approximated** - When the number of data points is above the point threshold, Tecplot Focus will render the approximate plot in any frame. To see the full representation press the [Redraw] button on the Plot sidebar.
- **Approximate Frames when Time (in seconds) to Render is Above** - Use this value to determine when to automatically turn on plot approximation for all frames. All frames will be approximated when the time to render the plot (all frames) while doing interactive view changes (rotation, translation, scaling) is greater than the supplied value. This setting does not apply when using the "All Frames Always Approximated" mode.
- **Approximate Plot as % of Full Plot** - This value controls the percentage of geometric detail represented by the approximate plot. The larger the percentage the more closely the approximation represents the original plot. However, the interactive performance is reduced. This number should be adjusted until there is a balance between good interactive performance and sufficient detail. Typically, the percentage should be set to be less than or equal to 50. If values larger than 50% are needed to provide sufficient detail, consider not using approximate plots.

Graphics Cache

Tecplot Focus uses OpenGL to render plots. OpenGL provides the ability to cache graphic instructions for rendering and can re-render the cached graphics much faster. This is particularly true for interactive manipulation of a plot. However, this performance potential comes at the cost of using more memory. If the memory need is too high, the overall performance could be less.

Use one of the following Graphics Cache modes to optimize your computer's performance:

- **Cache All Graphics** - When selected, Tecplot Focus assumes that there is enough memory to generate the graphics cache. If this is valid, Tecplot Focus's rendering performance will be optimal for interactive manipulation of plots.
- **Cache Only Lightweight Graphics Objects** - Lightweight objects include approximate plots and some other minor items, but do not include full plots. This is a good setting for memory constrained problems. Consider using this option in conjunction with the "[Plot Approximation](#)" mode set to "All Frames Always Approximated".
- **Do Not Cache Graphics** - Consider using this option when memory is very limited. If you intend to interact with the plot, also consider setting the "[Plot Approximation](#)" mode set to "All Frames Always Approximated".



In order to optimize animation, graphics caching is temporarily disabled during animations that include zones, line mappings, time, or blanking elements. Graphics caching is not altered during animations that include slices, streamtraces, or iso-surfaces.

High Quality Font Usage

Tecplot Focus supports high quality TrueType fonts and can use any TrueType font installed on your system. (See [Section 18 - 1.2 "Font Folders and Fallback"](#) for more information on how fonts work with Tecplot Focus.)

Tecplot Focus has three high quality font modes:

- **When Possible** (Default setting for Windows) - Tecplot Focus uses available TrueType fonts for any size text. This produces the best rendering quality; however, performance is slower for large amounts of text.
- **For Large Characters Only** - Tecplot Focus uses the TrueType fonts for large characters only. Small characters will use Tecplot Focus's built-in stroke fonts. This is a good blend of quality and performance. However, small characters may not have the same appearance as large characters.
- **Never** - Tecplot Focus never uses TrueType fonts.

Best Practices For Rendering Performance

The factory settings in the **Performance** dialog are designed for moderately-sized data and occasionally may need to be adjusted to optimize Tecplot Focus's rendering performance. For example, if you are doing a lot of interactive work with your data, you may wish to turn on [Plot Approximation](#) to make these operations more responsive. If you do not have much spare memory, you may wish to turn off the [Graphics Cache](#), or set it to "Cache only Lightweight Graphics Objects."

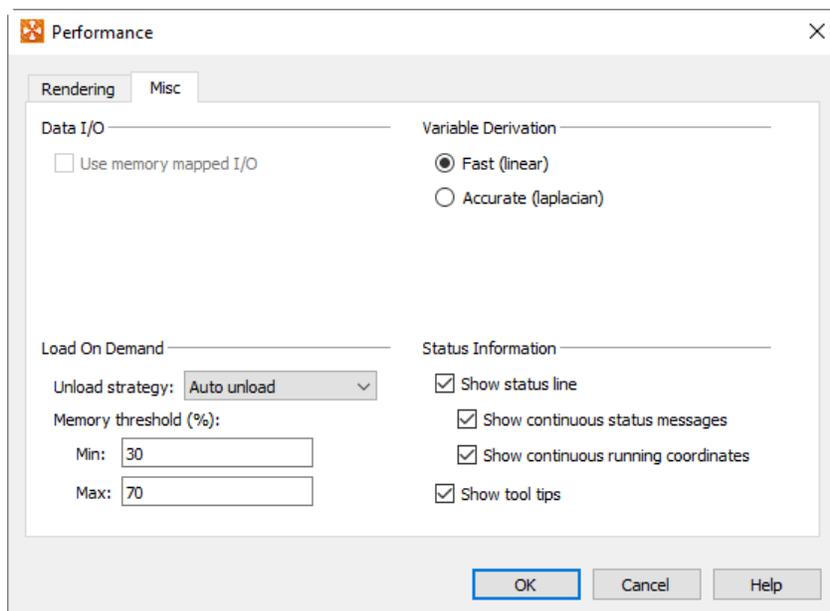


The size of the data isn't the only factor when rendering in Tecplot Focus. If your plot includes slices or iso-surfaces, you may also need to adjust your plot approximation mode and graphics cache settings.

If you are using [Plot Approximation](#), adjust the "Approximate Plot as % of Full Plot" value to give an acceptable balance between interactive performance and plot detail.

28 - 3.2 Miscellaneous Settings

The Miscellaneous page of the **Performance** dialog has the following functions:



Data I/O

- **Use Memory Mapped I/O** - When toggled-on, Tecplot Focus will use system level memory mapping functions to map Tecplot Focus variables directly over block data in a binary data file or

layout package file. Doing this at the system level generally provides the best available performance for loading the data.

The advantage of mapping variable data is that Tecplot Focus will only load the variable when it is needed, not when initially opening the file (but see also Load On Demand in this dialog). In addition, the mapped variable data can be shared between other Tecplot Focus sessions running on the same machine, saving memory. Memory mapped I/O is most useful when there are a large number of data points to load from a file and they are not all being used by Tecplot Focus at the same time. Only variable data that is in a binary block format (the default for *.plt* files generated by Tecplot Focus) can be memory mapped.

Load On Demand

With load-on-demand activated, Tecplot Focus generates plots faster and using less memory by only loading data that is needed for the plot. If changes to the plot style require additional variables to be loaded, Tecplot Focus will automatically load them, and if necessary, unload variables that are no longer used. Tecplot Focus's ability to automatically load and unload variables on demand allows you to examine data that is much larger than the physical or virtual memory of your computer.



This setting does not affect reading data in Tecplot Subzone (*.szplt*) format, also known as SZL. SZL data is always loaded on demand, and in the smallest possible amount, which may be less than a full zone's worth of a variable.

For large datasets, only the zones and variables currently in use will be loaded. However, for small datasets, some other zones and variables may be loaded for you (based on the Memory Threshold).

- **Unload Strategy** - Specifies how to manage unloading variables and other load-on-demand resources.
 - **Auto Unload** - This strategy attempts to keep Tecplot Focus's memory use within the defined Min and Max Memory Thresholds. Tecplot Focus uses these values to determine when and how much it should unload **This is the best option for exploring data as Tecplot Focus only unloads if and when the memory threshold has been exceeded**; if the threshold is not exceeded, data loaded on-demand remains available in memory if you need it again.
 - **Minimize Memory Use** - This strategy is used if more aggressive unloading of variables and other load-on-demand resources is required. **This option is best suited for animating through a very large number of time steps, where each time step consumes a significant part of the computer's available physical and virtual memory.**
 - **Never Unload** - This strategy disables the unloading capability of load-on-demand while still preserving the ability to load variables on demand.



Most users should select either the "Auto Unload" or "Minimize Memory Use" options.

- **Memory Threshold (%) [Auto Unload ONLY]** - When Tecplot Focus uses at least the maximum percentage of the available physical and virtual memory, it will attempt to unload variables and other load-on-demand resources until the available physical and virtual memory is at or below the specified minimum percentage.

Variable Derivation

When Tecplot Focus needs to create a nodal variable from a cell centered variable, it uses a prescribed derivation method. Tecplot Focus provides two such derivation methods: fast and accurate.

- **Fast (Linear)** - When selected, Tecplot Focus uses simple averaging to derive a nodal variable from a cell centered one.
- **Accurate (Laplacian)** - When selected, Tecplot Focus uses Laplacian interpolation to derive a nodal variable from a cell centered variable.

Status Information

Use the following controls in the Status Line region of the **Performance** dialog to customize what is displayed in the status line:

- **Show Status Line** - Turn this preference on/off to control the display of status messages.



If you are remotely displaying Tecplot Focus on an X terminal, updating the status line can slow down processing. If this is the case, turn off the Show Status Line control.

- **Show Continuous State Messages** - Turn on this control to receive context-sensitive commentary in the status line.
- **Show Continuous Running Coordinates** - Turn on this control to display the coordinates of your mouse cursor in the status line.
- **Show Tool Tips** - Use this option to turn tool tips on or off.

28 - 4 Custom Character and Symbol Definition

Generally, you will use TrueType fonts for displaying text on your screen and for printing. However, you can configure Tecplot Focus to use stroke fonts instead using the settings on the Rendering page of the Performance dialog (see [“High Quality Font Usage”](#) on page 358) or adding the USESTROKEFONTSONSCREEN and USESTROKEFONTSFOR3DTETEXT macro commands to your configuration file (see [“General Interface Configuration Options”](#) on page 356). Stroke fonts define characters to be displayed on the screen using a set of straight lines (called strokes, naturally). Stroke fonts, if enabled, are also used in exported images (however, vector printing and file formats may use TrueType or PostScript fonts).

The stroke fonts are faster to draw than TrueType fonts, which can be important if you create plots with a lot of complex text. Another advantage of the stroke fonts is that you can redefine or modify the strokes that make up the characters, as they are stored in a plain text file called *tecplot.fnt*, which can be modified using an editor. For information on how to load a custom font file, see [Section 28 - 1 “Custom Files loaded on Startup”](#).

The Font File is structured as follows:

```

#!FF 4
CharCellHeight
Stroke command set for Helvetica Font
Stroke command set for Greek Font
Stroke command set for Math Font
Stroke command set for User-Defined Font
Stroke command set for Times Font
Stroke command set for Times Italic Font
Stroke command set for Courier Font

```

The file type and version are on the first line ("FF" refers to Font File). CharCellHeight is the interline spacing (the height of a capital M plus some vertical space) in the units of a two-dimensional coordinate system used to define the stroke-font characters. The baseline of the characters is at zero. Before Tecplot Focus uses the character definitions, they are normalized by the character cell height.

Following the character cell height, there are seven sets of stroke commands, one set for each font as shown above. Each stroke command set consists of definitions for the characters in the font. Each font has a base set of 96 characters (character indices 32 to 127). Some fonts also include an extended set of characters (character indices 160 to 255). The extended characters are needed to complete the character sets for most of the common European languages.

All seven stroke command sets must be present, and each must have at least one character defined. Each stroke command set begins with the definition for a space (character index 32). After that, characters within a stroke command set may be defined in any order. If a character is not defined in the Font File, it is drawn as a blank.

Each character in a stroke command set is defined as follows:

```
CharIndex NumCommands CharWidth
Command1
Command2
Command3
.
.
.
CommandNumCommands
```

CharIndex is the character index that ranges from 32 to 127 and 160 to 255 for each font (see [Table 18 - 2](#) for the matching of the character index to the English, Greek, Math, and standard User-Defined font characters). NumCommands is the number of stroke commands defining the character that follows. CharWidth is the character width, which determines the spacing of the characters.

A command may be in one of the following forms:

- **m** x y.
- **d** x y.
- **mr** dx dy.
- **dr** dx dy.

Where:

- A command that begins with an **m** is a move command.
- A command that begins with a **d** is a draw command.
- Commands **mr** and **dr** are relative move and relative draw commands.
- The **x** and **y** are the absolute coordinates within the character cell.
- The **dx** and **dy** are the relative coordinates with respect to the previous location (increments from the position attained by the previous command).
- All coordinates are specified as integers.

Figure 28-2 shows an example of a character cell and the commands used to define the lowercase letter "y". The height of the character cell is 48.

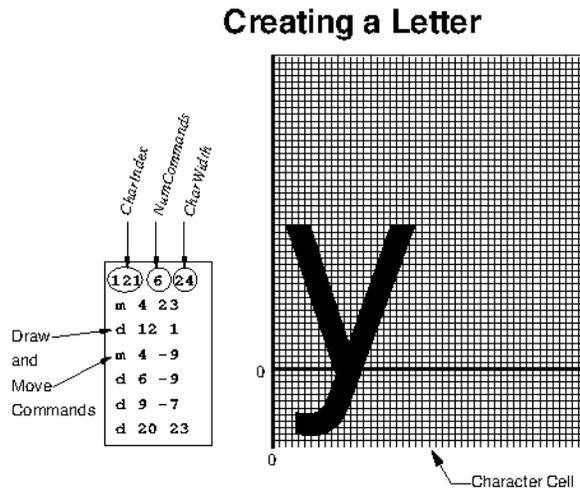


Figure 28-2. Defining a user-defined character.

Figure 28-3 shows a symbol being defined. Symbols should generally be centered about (0,0) so that they are drawn centered on the point they mark (an exception might be an arrow symbol or similar, where you want the arrow's tip to indicate the marked point). The font file included with Tecplot Focus contains many User-Defined font stroke commands. Most of these are for creating extra plotting symbols, accessible when you use the Symbol Type "Other", enter an ASCII character, and specify the User-Defined font.

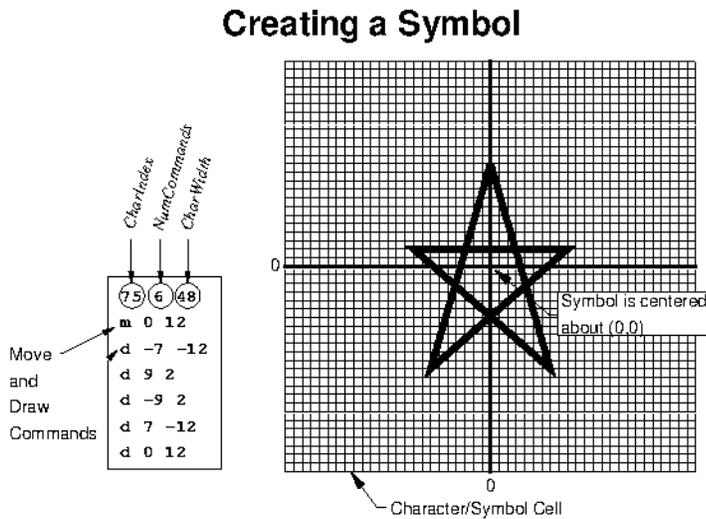


Figure 28-3. Defining a user-defined plotting symbol.

Add-ons

Add-ons are a way to extend the basic functionality of Tecplot Focus. They are executable modules designed to perform specific tasks. A number of add-ons are available that load data in a variety of formats, allow advanced editing, or extend Tecplot Focus's capabilities.

Add-ons are external programs that attach themselves to Tecplot Focus and are accessed through the Tecplot Focus interface. When Tecplot Focus launches, it goes through various initialization phases, including the processing of the *tecplot.cfg* file, the loading of the Tecplot Focus stroke font file (*tecplot.fnt*), and the initialization of the graphics. After completing this, Tecplot Focus looks for add-ons.

29 - 1 Add-on Loading

You can load add-ons by several different methods: using the [Drag-and-Drop Method](#), editing the [Tecplot.add File](#), using the [Specifying Add-Ons on the Command Line](#), or by [Specifying a Secondary Add-On Load File](#).



Add-ons created for versions of Tecplot Focus prior to Tecplot Focus 2014 R1 will not work with Tecplot Focus 2023 R2.

29 - 1.1 Drag-and-Drop Method

The easiest method for loading an add-on for a single use is the drag-and-drop method. This method loads the add-on for the current session of Tecplot Focus (rather than every subsequent launch of Tecplot Focus).

To use this method, find the library file of the add-on you wish to load in the *bin* subdirectory of your Tecplot Focus installation. Select the library, and, while holding down the mouse button, drag the library into the Tecplot Focus window. Then release the mouse button to "drop" the add-on into Tecplot Focus. The add-on will be loaded and made available immediately.

This action will load the add-on only for the rest of the current Tecplot Focus session. The next time you close and reopen Tecplot Focus, you will need to load the add-on again if you wish to in the new session.

29 - 1.2 Tecplot.add File

Every time Tecplot Focus launches, it reads a file called *tecplot.add* from the Tecplot Focus home directory and loads all add-ons indicated in that *tecplot.add* file.

The *tecplot.add* file contains multiple `#!LoadAddOn` commands that load add-ons into Tecplot Focus. This special macro file accepts only `#!LoadAddOn` macro commands, which require this syntax:

```
#!LoadAddOn "libname"
```

In this example, *libname* represents the name of an add-on's shared object library file. The *libname* must be enclosed in quotes.

To unload an add-on (that is, to prevent Tecplot Focus from loading that add-on when launching), comment out the appropriate line in *tecplot.add* by adding a pound ("`#`") symbol in front of the load command. For example, the pound ("`#`") symbol at the beginning of the following line will prevent the Auxiliary Data Editor add-on (*libname* "tecutiltools_editauxdata") from loading:

```
# !LoadAddOn "tecutiltools_editauxdata"
```

To load an add-on that does not load automatically, remove the pound ("`#`") symbol from in front of the `#!LoadAddOn` command that includes the *libname* of the add-on you wish to load. If the *tecplot.add* file does not list the *libname* of the add-on you wish to load, add a `#!LoadAddOn` command followed by the *libname* of that add-on.

For information on loading the *tecplot.add* file, see [Section 28 - 1 "Custom Files loaded on Startup"](#).

Libname

Special rules govern how the *libname* name is specified in the *tecplot.add* file. In all cases, the filename extension is omitted. If you assign *libname* to the basename of the shared object library, then Tecplot Focus will do the following:

- **Linux** - The shared library to load will come from the file specified by: *Install-Directory/lib/lib+basename.so*.
- **Windows** - Tecplot Focus will search for the add-on *basename.dll* in the following directories (in this order):
 - The directory where the Tecplot Focus executable resides.
 - The Windows system directories.
 - The directories in your `PATH` environment variable.

When using v7ActiveX style add-on libraries on Windows, Tecplot Focus connects to the add-on via the *libname* entry in the registry.

If an absolute path name is used in *libname*, then on Windows platforms, *.dll* is appended and on Linux platforms, *.so* is appended.

29 - 1.3 Specifying Add-Ons on the Command Line

You can also instruct Tecplot Focus to load a particular add-on by using the command line. The following flags are available:

```
-loadaddon libname
where:
libname - The full name (including path and extension) of an add-on
```

You may specify the `-loadaddon` flag as many times as you want in a single invocation of Tecplot Focus to load more than one add-on.

If your add-on is named with the proper suffix for your platform (`.dll` for Windows, `.so` for Linux) you can simply name the add-on on the command line without using the `-loadaddon` flag.

After add-ons are loaded, Tecplot Focus re-processes all command line arguments not processed earlier (for graphics and add-on initialization). This allows a data loader add-on to be used to load data specified on the command line.

29 - 1.4 Specifying a Secondary Add-On Load File

You may also instruct Tecplot Focus to load a different list of add-ons by naming a second add-on load file using one of the following methods:

- Include `-addonfile addonfilename` on the command line.
- Set the environment variable `TECADDONFILE`.

Both of these methods tell Tecplot Focus the name of an additional add-on load file to process. This secondary file will be processed after the main `tecplot.add` file.

29 - 2 Add-ons included in the Tecplot Focus distribution

Your Tecplot Focus installation includes the add-ons listed following (alphabetically) and described in [Section 29 - 3 "Working with Add-ons"](#). Some of these load automatically with your installation; others require you to load the add-on by uncommenting the appropriate line from your `tecplot.add` file (located in your Tecplot Focus home directory), or by any of the other methods described in [Section 29 - 1 "Add-on Loading"](#).

- [Advanced Quick Edit](#)
- [Auxiliary Data Editor](#)
- [Create Multiple Frames](#)
- [Extend Macro](#)
- [Extend Time Macro](#)
- [Extract Over Time](#)
- [Key Frame Animator](#)
- [Measure Distance](#)
- [Multi-Frame 3D](#)
- [Solution Time and Strand Editor](#)
- [Tensor Eigensystem](#)
- [Time Series](#)
- [Write Data as Formatted Text](#)

29 - 3 Working with Add-ons

The default Tecplot Focus installation includes the add-ons discussed in this section. To load or unload them, use the methods described in [Section 29 - 1 "Add-on Loading"](#).

29 - 3.1 Advanced Quick Edit

The Advanced Quick Edit add-on, with the libname `tecutiltools_advqet`, loads automatically, and causes the "Advanced Quick Edit Tool" to appear in the **Tools** menu. This add-on allows you to make rapid changes to text and geometries selected in the active frame. It also allows additional editing operations that the standard **Quick Edit** dialog (accessible from the Plot sidebar) does not support.

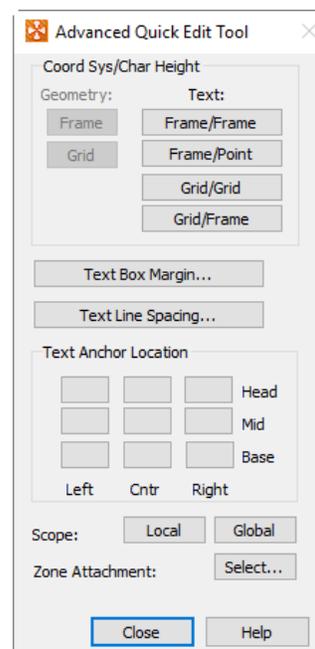
To unload this add-on, comment out the line in your [Tecplot.add File](#) (located in your home directory) that loads the advqet library by adding a "#" symbol at the beginning of the line with the text `#!LoadAddon "tecutiltools_advqet"`.

To use this add-on, select "Advanced Quick Edit Tool" in the **Tools** menu to open the **Advanced Quick Edit Tool** dialog.

Controls in the **Advanced Quick Edit Tool** dialog are active only when you have one or more text and/or geometries selected. Some controls are specific to either text or geometries, while others apply to both. If the selected objects are a mix of text and geometries, the controls that apply only to geometries will affect the specific geometries you have selected. Similarly, controls that apply specifically to text will only affect text, even if the selected objects are a mix of text and geometries.

The **Advanced Quick Edit Tool** dialog includes the following options:

- **Geometry Coordinate System** - Change selected geometries to the Frame or Grid coordinate system by selecting the appropriate button in the Coord Sys/Char Height region of the dialog. Changing the coordinate system in this dialog will modify each geometry's anchor position and size so that it appears visually unchanged in your plot.
- **Text Coordinate System and Character Height Units** - Change the position coordinate system and character height units of all selected text by selecting the appropriate button in the Coord Sys/Char Height region of the dialog. There are four valid combinations: [Frame/Frame], [Frame/Point], [Grid/Grid], and [Grid/Frame]. Changing a coordinate system in this dialog will modify each text object's anchor position and character height so that it appears visually unchanged in your plot.
- **Text Box Margin** - Change the text box margin of all selected text with the [Text Box Margin] button.
- **Text Line Spacing** - Change the line spacing of all selected text by using the [Text Line Spacing] button.
- **Text Anchor Location** - Change the text anchor location for all selected text by selecting one of the nine possible anchor points from the button grid located in the Text Anchor Location region of the dialog.
- **Text and Geometry Scope** - Change the scope of all selected text and geometries by selecting either [Local] or [Global] scope. Objects with local scope appear only in the frame in which they were originally created. If the objects are defined as having global scope they will appear in all "like" frames, that is, those frames using the same data set as the one in which the objects were originally created.
- **Text and Geometry Zone or Map Attachment** - Change the zone or map with which the selected text or geometries are associated by selecting Zone Attachment [Select]. This calls up the **Attachment Selection** dialog. The **Attachment Selection** dialog lists zone names or numbers when Tecplot Focus is in the 2D or 3D Cartesian or Sketch plot types, and mappings when Tecplot Focus is in the XY Line plot type. The "<Unattach Object>" entry dissociates each selected text or geometry from its zone or map.



29 - 3.2 Auxiliary Data Editor

The Auxiliary Data Editor add-on loads automatically with Tecplot Focus. This add-on enables you to edit auxiliary data within Tecplot Focus and journal the results into the saved layout file. To unload the add-on, comment out the line including the libname `tecutiltools_editauxdata` in your [Tecplot.add File](#).

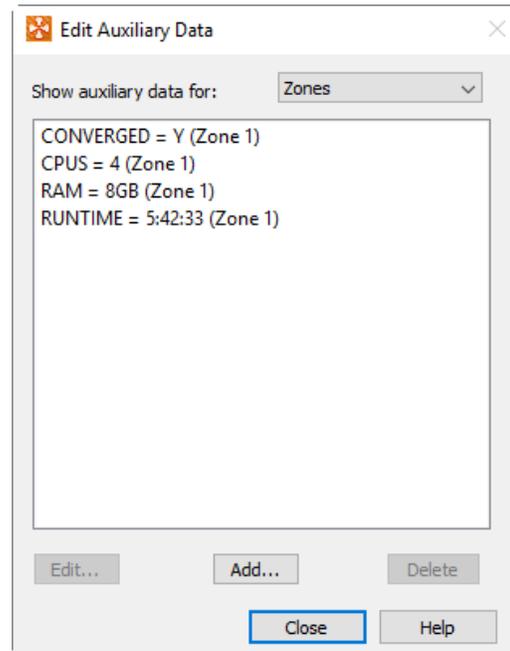


Auxiliary data are name-value pairs associated with a data set, frame, line map, page, variable, or zone, which Tecplot Focus stores as text strings. You can view all auxiliary data included in your layout in the **Data Set Information** dialog (by going to **Data>Data Set Info**).

To use this add-on, select "Auxiliary Data" from the **Data** menu to open the **Edit Auxiliary Data** dialog.

The **Edit Auxiliary Data** dialog contains the following controls:

- **Show auxiliary data** - In the drop-down menu at the top of the dialog, select the level at which you wish to view, add or delete auxiliary data. Choose from Zones, Variables, Line Maps, Active Frame, Active Page, Data Set, Layout, or Everything.
- **Auxiliary data box** - In the box in the middle of the dialog, all auxiliary data for the selected level will display. You can select any item in this box to edit it or delete it, with the [Edit] button or [Delete] button, respectively.
- **Add auxiliary data** - With the [Add] button, you can add auxiliary data at any of the available locations (zone, variable, etc.).
- **Edit auxiliary data** - With the [Edit] button, you can edit any existing auxiliary data. First select the item you wish to edit in the Auxiliary data box, and then select the [Edit] button.
- **Delete auxiliary data** - Use the [Delete] button to delete any existing auxiliary data. Select the item you wish to delete in the Auxiliary data box, and then select the [Delete] button.



You can view auxiliary data on the Aux Data page of the **Data Set Information** dialog (accessible by going to **Data>Data Set Info**).

Tecplot Focus will journal all added or edited auxiliary data to layout and packaged layout files when you save your layout or packaged layout file after editing the auxiliary data.

Macro Commands

You can add auxiliary data using the `#!EXTENDEDCOMMAND` macro, with the following syntax:

```
#!EXTENDEDCOMMAND
COMMANDPROCESSORID = 'Aux Data Editor'
COMMAND = '<operator> Name = <string> Value = <string> Location = <location>
LocationIndex = 1'
```

With this syntax, the following rules apply:

- **Operator** - Use "Add" or "Delete" as the operator

- **Name** - Use an alphabetic character followed by zero or additional alphanumeric characters and underscores (no spaces)
- **Value** - Use a value only for the Add operator, to associate a value to the named data piece. Surround the value with quotation marks if it has spaces
- **Location** - Use Zone, Var, Frame, Page, DataSet, LineMap, or Layout as the location
- **LocationIndex** - This value indicates which Zone, Var, Frame, or LineMap to which Tecplot Focus attaches the auxiliary data. If adding auxiliary data to a Page or DataSet, do not indicate a LocationIndex.

Following is an example of a macro command adding an auxiliary data piece named "TestID" with the value of "Sequence 23, test 2" to the first zone.

```

$!EXTENDEDCOMMAND
COMMANDPROCESSORID = 'Aux Data Editor'
COMMAND = 'Add Name = TestID Value = "Sequence 23,
test 2" Location = Zone LocationIndex = 1'

```

Adding Auxiliary Data

The **Add Auxiliary Data** dialog enables you to add auxiliary data at any of several levels. To reach this dialog, select the [Add] button in the **Edit Auxiliary Data** dialog. Data added in the **Add Auxiliary Data** dialog will subsequently appear in the **Edit Auxiliary Data** dialog, in the Auxiliary Data display box. The **Add Auxiliary Data** dialog has the following controls:

- **Location** - Choose the level at which to add the data from the Location drop-down menu. You can choose to add it at the zone, variable, line map, active frame, active page, layout, or dataset level.
- **Number** - When the Location indicates "Zone", "Variable", or "Line Map", the Number box will activate for you to specify the Zone Number, Variable Number, or Line Map number at which to add the auxiliary data.
- **Name** - Enter the name of your data in the Name box.
- **Value** - Enter the value of your data in the Value box.

Select the [OK] button in the **Add Auxiliary Data** dialog to finish adding a piece of auxiliary data to the selected location.

29 - 3.3 Create Multiple Frames

Use the Create Multiple Frames add-on to make a set of new frames with uniform size and spacing within the active frame. This add-on does not load automatically; load this add-on using "tecutiltools_mulframe" as the *libname* in one of the methods discussed in [Section 29 - 1 "Add-on Loading"](#).

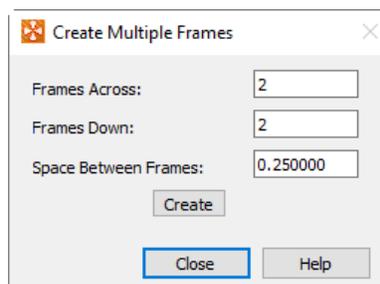
To use this add-on, select "Create Multiple Frames" in the **Tools** menu. This will open the **Create Multiple Frames** dialog.

The **Create Multiple Frames** dialog has the following options:

- **Frames Across** - Enter the number of frames to be displayed in each row of frames.
- **Frames Down** - Enter the number of rows of frames.
- **Space Between Frames** - Enter the amount of space to display between each frame in each direction, in paper ruler units.

Select the [Create] button to create the multiple frames as specified.

See [Section 2 - 3.2 "Frame Creation"](#) for information on creating a single frame.



29 - 3.4 Extend Macro

The Extend Macro add-on, libname "tecutilscript_extendmcr", extends the Tecplot macro language to include additional commands. You may use the Extend Macro add-on by adding the following function call to your macro file:

```
$!EXTENDEDCOMMAND COMMANDPROCESSORID='extendmcr' COMMAND='command option'
```

The commands supported by the add-on are listed in the following table



When specifying a macro variable name in an Extend Macro command, you should not surround the variable name with vertical bars. For example, ZONENUM rather than |ZONENUM|.

Command	Notes
QUERY.ZONENAMEBYNUM nnn VVV	Get the string for zone <i>nnn</i> and assign to variable <i>VVV</i> .
QUERY.VARNAMEBYNUM nnn VVV	Get the string for variable <i>nnn</i> and assign to variable <i>VVV</i>
QUERY.ZONENUMBYNAME "zonename" VVV	Get the number of zone named <i>zonename</i> and assign to variable <i>VVV</i>
QUERY.VARNUMBYASSIGNMENT assignment VVV	Get the number of variable by assignment and assign to variable <i>VVV</i> . <i>VVV</i> may have any of the following values: <ul style="list-style-type: none"> • X, Y or Z - Variable assigned to the X, Y or Z-axis. • U, V or W - Variable assigned to be the U, V or W-vector component. • C - Variable assigned to contours. • S - Variable assigned to scatter sizing. • B - Variable assigned to the first constraint for value-blanking.
QUERY.DATASETTITLE VVV	Get the string for the dataset title and assign to variable <i>VVV</i>
STRING.LENGTH StrSource VVV	Get the length of string <i>StrSource</i> and assign to variable <i>VVV</i> .
STRING.FINDPATTERN StrSource StrPattern VVV	Get the sub-string from <i>StrSource</i> starting at pattern <i>StrPattern</i> and going to the end of <i>StrSource</i> . Returns "NOTFOUND" if not found.
STRING.SUBSTRING StrSource start end VVV	Get the sub-string from <i>StrSource</i> starting at position <i>start</i> and ending at position <i>end</i> . Put the result in <i>VVV</i> .
QUERY.ACTIVEZONES VVV	Get the set of active zones and put the result in <i>VVV</i> . Note: The set string does not include any blank spaces. If zones 2, 4, 6, 7 and 8 are active, <i>VVV</i> would have the string "2, 4, 6-8."
QUERY.MAPNAMEBYNUM nnn VVV	Returns a string (the name of the map) and places it in variable <i>VVV</i> . The active plot must be XY-Line or Polar-Line.

Table 29 - 3: Command Options for Extend Macro

QUERY.ISADDONLOADED COMMANDPROCESSORID VVV	Return "YES" if Add-on COMMANDPROCESSORID is loaded, otherwise return "NO"
QUERY.FILEEXISTS "filename" VVV	If the file exists, VVV will be "YES" otherwise VVV will be "NO"
QUERY.ISZONEACTIVE ZZZ VVV	Test to see if zone ZZZ is active. If so, VVV is set to "YES," otherwise it is set to "NO."
QUERY.LINEMAPZONEASSIGNMENT nnn VVV	Get the zone number assigned to line map nnn and put the result in VVV.
QUERY.ACTIVELINEMAPS VVV	Get the set of active line maps and put the result in VVV. Note: The set string does not include any blank spaces. If linemaps 2, 4, 6, 7, and 8 are active, VVV would have the string "2,4,6-8."
QUERY.ISLINEMAPACTIVE nnn VVV	Test to see if line map nnn is active. If so, VVV is set to "YES," otherwise it is set to "NO." VVV is set to "INVALID" if nnn <=0.
FILE.APPENDSTRING "FileName" "String"	Appends the given string to the indicated file, creating the file if necessary. FileName may be a relative path from Tecplot's working directory or an absolute path.
FILE.APPENDLASTERROR "FileName"	Appends the last error message, if any, to the indicated file, creating the file if necessary. FileName may be a relative path from Tecplot's working directory or an absolute path. If no Tecplot errors have occurred, this command will have no effect.

Table 29 - 3: Command Options for Extend Macro

If you have declared macro variables and would like to use them with the Extend Macro add-on, you can do so by surrounding the command call with single quotes and the macro variable with double-quotes.

For example:

```

$!VarSet |ZoneName| = "Unknown"
$!EXTENDEDCOMMAND
  COMMANDPROCESSORID = "extendmcr"
  Command = 'query.zonenamebynum 1 "ZoneName"'
$!RemoveVar |ZoneName|

```

Refer to the [Scripting Guide](#) for additional information on working with Tecplot Focus's macro language.

QUERY.DATASETTITLE

The following example, uses the QUERY.DATASETTITLE command to place the title of the dataset at a specific position on the plot.

```

$!VARSET |ZNUM| = "blank"

$!EXTENDEDCOMMAND COMMANDPROCESSORID='extendmcr'
COMMAND='QUERY.DATASETTITLE ZNUM'

$!ATTACHTEXT
  XYPOS
  {
    X = 5
    Y = 90
  }

```

```
}
TEXT = "Title is: |ZNUM|"
```

QUERY.VARNAMEBYNUM

The following example uses QUERY.VARNAMEBYNUM to place the name of variable 2 at a specific position on the plot.

```
#!VARSET |VNAME| = "X"

#!EXTENDEDCOMMAND COMMANDPROCESSORID = 'extendmcr'
COMMAND='QUERY.VARNAMEBYNUM 2 VNAME'

#!ATTACHTEXT
XYPOS
{
  X = 5
  Y = 85
}
TEXT = "Var 2 is: |VNAME|"
```

QUERY.ZONENAMEBYNUM

The following example uses QUERY.ZONENAMEBYNUM to place the title of Zone 1 at a specific position on the plot. QUERY.ACTIVEZONES

```
#!VARSET |ZNAME| = "HELLO"

#!EXTENDEDCOMMAND COMMANDPROCESSORID = 'extendmcr'
COMMAND='QUERY.ZONENAMEBYNUM 1 ZNAME'

#!ATTACHTEXT
XYPOS
{
  X = 5
  Y = 80
}
TEXT = "Zone is: |ZNAME|"
```

The follow example uses QUERY.ACTIVEZONES to display a list of the active zones.

```
#!VARSET |ZNUMS| = "blank"

#!EXTENDEDCOMMAND COMMANDPROCESSORID='extendmcr'
COMMAND='QUERY.ACTIVEZONES ZNUMS'

#!ATTACHTEXT
XYPOS
{
  X = 5
  Y = 70
}
TEXT = "Active zones are: |ZNUMS|"
```

Refer to the [Scripting Guide](#) for additional information on working with Tecplot Focus's macro language.

29 - 3.5 Extend Time Macro

The Extend Time Macro add-on simplifies the macro interface by allowing you to use a simple loop to query the number of solution times in the dataset and advance the time step. This differs from the native Tecplot macro language as it does not require that you know the solution time of your data.

This add-on uses a different algorithm than Tecplot Focus for sorting the solution times. Because Tecplot Focus combines time steps that are sufficiently close together, the number of time steps reported by this add-on may differ from the number of time steps reported by Tecplot Focus.

You can load this add-on by adding the following line to your [Tecplot.add File](#).

```
#!LoadAddOn "tecutilscript_extendtimemcr"
```

Macro Processing

The Extend Time Macro add-on can be invoked from the macro language by using the following commands:

These two lines retrieve the number of time steps. This number is represented here as the macro variable VVV.

```
#!EXTENDEDCOMMAND COMMANDPROCESSORID='extend time mcr'  
COMMAND='QUERY.NUMTimesteps VVV'
```

This line sets the solution time at time step nnn. The acceptable value range number for nnn is: 1 - NumTimeSteps.

```
#!EXTENDEDCOMMAND COMMANDPROCESSORID='extend time mcr'  
COMMAND='SET.CURTIMESTEP nnn'
```

This line retrieves the solution time at time step nnn. This number is represented here as the macro variable VVV.

```
#!EXTENDEDCOMMAND COMMANDPROCESSORID='extend time mcr'  
COMMAND='QUERY.TIMEATSTEP nnn VVV'
```

The following is a sample loop that uses the Extend Time Macro add-on:

```
#!EXTENDEDCOMMAND COMMANDPROCESSORID='extend time mcr'  
COMMAND='QUERY.NUMTimesteps NUMTimesteps'  
#!LOOP |NUMTimesteps|  
  #!EXTENDEDCOMMAND COMMANDPROCESSORID='extend time mcr'  
  COMMAND='SET.CURTIMESTEP |LOOP|'  
  #!EXTENDEDCOMMAND COMMANDPROCESSORID='extend time mcr'  
  COMMAND='QUERY.TIMEATSTEP |LOOP| CURTIME'  
  #!PAUSE "Current time is: |CURTIME|"  
#!ENDLOOP
```

See also: [Section 29 - 3.6 "Extract Over Time"](#), [Section 29 - 3.11 "Solution Time and Strand Editor"](#), [Section 29 - 3.4 "Extend Macro"](#), [Section 29 - 3.13 "Time Series"](#), [Section 7 - 2 "Time Aware"](#).

29 - 3.6 Extract Over Time

The Extract Over Time add-on, which loads automatically with Tecplot Focus, extracts iso-surfaces, streamtraces, and points from polyline geometries in transient data. The resulting zones are assembled into a new strand with proper solution times set for each zone.



To save a layout file, you must also save a data file when using this add-on.

To unload this add-on, add a "#" symbol in front of the following line in your [Tecplot.add File](#).

```
#!LoadAddOn "tecutiltools_extractovertime"
```

To use this add-on, go to **Data>Extract** and select one of the following menu options.

- **Extract Slices Over Time** - This option has moved to the Extract Slices dialog. See [Section 14 - 2 “Extracting Slices to Zones”](#). The macro, below, can still be used.
- **Extract Polyline Over Time** - Extracts a polyline geometry to a zone for each solution time. It allows you to define the number of points along the polyline to extract. It has the following requirements:
 - The frame must be in 2D or 3D.
 - Only a single polyline can be selected.
 - The data must be transient.
 - The polyline must be positioned over an existing zone.
- **Extract Iso-Surfaces Over Time** - Extracts an iso-surface to a zone for each solution time. It has the following requirements:
 - The frame must be in 3D.
 - The frame must contain one or more iso-surfaces.
 - The data must be transient.
- **Extract Streamtraces Over Time** - Extracts a set of streamtraces to a zone for each solution time. It has the following requirements:
 - The frame must be in 2D or 3D.
 - The frame contains one or more streamtraces
 - The data must be transient.

After extracting, the new strand is available and may be animated or saved to a file.

Macro Processing

The Extract Over Time add-on can be invoked from the macro language by using the following commands:

Slices	<pre> \$!EXTENDEDCOMMAND COMMANDPROCESSORID='Extract Over Time' COMMAND='ExtractSliceOverTime' </pre> <p>Note: Prefer using the \$!EXTRACTSLICES macro command instead. See the Scripting Guide for more details on this command.</p>
Iso-Surfaces	<pre> \$!EXTENDEDCOMMAND COMMANDPROCESSORID='Extract Over Time' COMMAND='ExtractIsoSurfaceOverTime' </pre>
Streamtraces	<pre> \$!EXTENDEDCOMMAND COMMANDPROCESSORID='Extract Over Time' COMMAND='ExtractStreamOverTime' </pre>
Geometries	<pre> \$!EXTENDEDCOMMAND COMMANDPROCESSORID='Extract Over Time' COMMAND='ExtractGeomOverTime' </pre> <p>Optionally, you may specify the number of points to extract by using the following format:</p> <pre> \$!EXTENDEDCOMMAND COMMANDPROCESSORID='Extract Over Time' COMMAND='ExtractGeomOverTime:nnn' </pre> <p>Where nnn >= 2. If this condition is not met when the macro is played back, the action will silently fail and your macro will continue processing.</p>

See also: [Section 29 - 3.5 “Extend Time Macro”](#), [Section 29 - 3.11 “Solution Time and Strand Editor”](#), [Section 29 - 3.4 “Extend Macro”](#), [Section 29 - 3.13 “Time Series”](#), [Section 7 - 2 “Time Aware”](#).

29 - 3.7 Extract Precise Line

The Extract Precise Line add-on (libname: *tecutiltools_extractpreciseline*) allows you to extract points along a line to a new zone or to a Tecplot ASCII data file. You specify the precise X, Y, and Z coordinates of the start and the end points of the line, along with the number of points along this line to extract.

To use the Extract Precise Line add-on, choose Data > Extract > Extract Precise Line.

- **Start, End X/Y/Z** - Enter the X, Y, and Z coordinates of the start and end points of the line.
- **Number of Points** - The number of points between the start and end points to be extracted. (The start and end points themselves are always extracted and this number does not include them.)
- **Extract To** - Whether to extract to a zone or a file. If extracting to a file, you must also specify an output file path in the File Name field.
- **Extract From** - Choose whether to extract from the surface the line passes across or the volume it passes through.

When extracting from a surface in 3D, extraction is view-dependent: the specified line is projected from the plane of the screen onto the surface being extracted. Changing the view (e.g. rotating) will change the points extracted.

- **File Name** - The path of the file to extract to. You may type the path, paste it, or click the ... button to open the Write Tecplot ASCII File dialog and navigate interactively.

Click **Extract** to perform the extraction.

Macro Processing

There is no macro command syntax specific to this add-on. Instead, it records an `$(EXTRACTFROMPOLYLINE)` command. See the [Scripting Guide](#) for more details on this command.

29 - 3.8 Key Frame Animator

The Key Frame Animator add-on loads automatically with Tecplot Focus. With this add-on, you can easily animate a smooth progression through two or more specified views (key frames) and export them as an AVI, Flash, or Raster Metafile animation.

To use this add-on, first create a layout and use the 3D Cartesian mode to view your plot. Then select "Key Frame Animation" in the **Animate** menu to open the **Key Frame Animation** dialog.

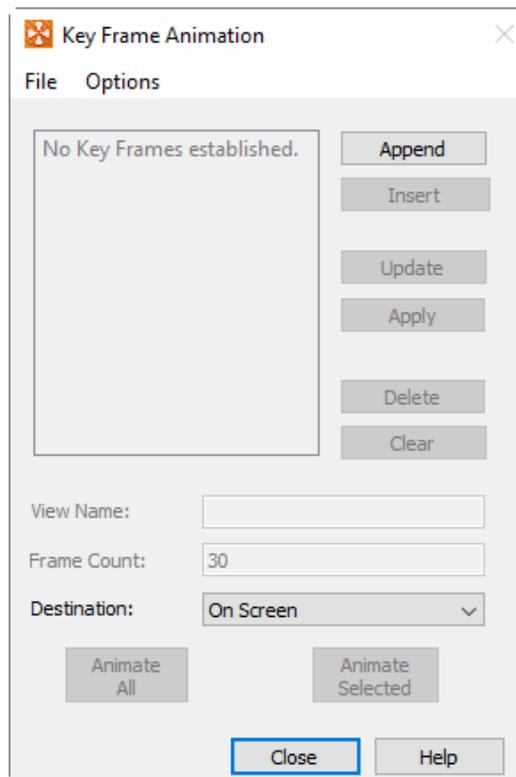


You must be in 3D Cartesian mode to use the Key Frame Animator add-on.

To unload this add-on, comment out the line containing the *libname* "tecutilttools_keyframe" in your [Tecplot.add File](#).

To create a key frame animation using this dialog, follow these general steps:

1. Rotate and/or zoom the plot to the initial view for the animation, and select the [Append] button in the dialog. If you wish, you may change the name of the view (key frame) by selecting the frame ("View 1") in the Key Frame box and editing the name in the View Name field of the dialog (for example, "End of Airfoil").
2. Rotate and/or zoom the plot to the next view you wish your animation to include, and select the [Append] button to add that view to the end of the animation. Or you can select the [Insert] button to insert a view above the selected one in the list. These key frames are snapshots of the view in Tecplot Focus, so limit rotations to 180 degrees or less between key frames, or the animation may not rotate as you expect.
3. Continue to rotate and/or zoom and select [Append] or [Insert] to add additional key frames to your animation, if desired.
4. When finished adding key frames, select [Animate All] to perform a complete animation of your views, or [Animate Selected] to animate only the views selected in the Key Frame box. Tecplot Focus will interpolate all views in between your views to create an animation.
5. To export an animation, change the Destination from "On Screen" to "To File". Then select the [Animate All] or [Animate Selected] to open the **Export Options** dialog. You can choose to export the file as AVI, Flash, or Raster Metafile. Refer to [Chapter 24: "Exporting"](#) for details on exporting your file.



The **Key Frame Animation** dialog includes these controls:

- **Append** - The [Append] button adds the current view in the active frame to the list.
- **Insert** - Use the [Insert] button to insert the current view above the currently selected view in the key frame list.
- **Update** - The [Update] button replaces the view selected in the list with the current view in Tecplot Focus. This also re-captures the current solution time.
- **Apply** - Use the [Apply] button to display the selected view as the current view of your plot.
- **Delete** - Select the [Delete] button to delete the selected key frame from the list.
- **Clear** - Use the [Clear] button will delete all key frames from the list.
- **View Name** - Use the View Name field to rename the view selected in the key frame list. By default, Tecplot Focus names the views as "View 1", "View 2", etc.
- **Frame Count** - The Frame Count box sets the number of frames drawn by Tecplot Focus between the selected view and the next view in the animation.
- **Destination** - In the Destination drop-down menu, choose whether to animate the key frames On Screen or To File.
- **Animate All** - Select [Animate All] to animate through all the key frames in the list.

- **Animate Selected** - Select [Animate Selected] to animate only the selected views. This allows you to refine a subset of animation without performing the complete animation.

Animation Customizations

The Key Frame Animator add-on includes additional capabilities in customized **File** and **Options** menus at the top of the Key Frame Animation dialog. These menus give you the following additional options:

- **File>Open/Save Animation** - In the **File** menu, you can save an animation that you have created, or you can open an animation that you have previously saved. An animation file stores settings and all key frames, and defaults to the name *animation.keyframe*. The ability to save and load animation files enables you to keep track of created animations without having to recreate them.
- **Options** - In the **Options** menu, each choice is a toggle except for "Time Animation Options" (which opens the [Time Animation Options](#) dialog). Select an option from this menu to turn on that preference. When an option is toggled-on, a checkmark will appear next to that option in the **Options** menu.
 - **Animate Time Concurrently** - Select this option to animate time when animating the key frames, as specified in the Time Animation Options dialog.
 - **Animate Streamtraces Concurrently** - If streamtraces display as markers or dashes in your plot, enable "Animate Streamtraces Concurrently" to animate streamtrace markers or dashes concurrently with key frame animation.
 - **Fade In/Fade Out** - Toggle-on "Fade In" and/or "Fade Out" to fade lighting intensity and background lighting during the start and/or end of the key frame animation. The fade will last either 30 frames or the first ten percent of all frames, whichever is shorter. Fade In and Fade Out work best with a black background and without any plot features that do not have light sensitivity (mesh lines, edge lines, etc.).

Time Animation Options

Time Animation Options - With the **Time Animation Options** dialog (opened by selecting "Time Animation Options" in the **Options** menu), you can specify additional options for animating your key frames. Choose to animate the frames by any of the following methods.

- **Forward** - With "Forward" selected, Tecplot Focus will display the earliest solution time in the first key frame, and will progress solution time throughout key frame animation so that the latest solution time displays with the final frame of the animation.
- **Loop** - With "Loop" selected, the solution time will progress as in the "Forward" option, except that the complete cycle of solution times displays multiple times over one key frame animation cycle. Set the number of solution time cycles to display in the Num Cycles box.
- **Bounce** - With "Bounce" selected, the solution time will progress forward during animation, until the solution time cycle completes. The solution time will then decrement in equal intervals until the initial solution time displays. Specify the number of times to repeat this bounce in the Num Cycles box.
- **As Captured** - Select "As Selected" to link each key frame with the solution time that the frame displayed when that frame was added to the key frame list. During the key frame animation, the solution time will vary in equal intervals between successive pairs of key frames so that each key frame displays the linked solution time.

See Also: [Section 29 - 3.8 "Key Frame Animator"](#).

Export Animation Options

In the **Key Frame Animation** dialog, when animating a set of key frames, you can export your animation by selecting "To File" from the Destination drop-down menu. Then select either [Animate All] or [Animate

Selected] to launch the **Export Options** dialog. In this dialog, you can customize the export settings for your animation. Then select [OK] to select file location and export your animation.

The **Export Options** dialog includes the following export settings for your animation:

- **Format** - Select the format of your exported file.
- **Region** - Select the portion of your workspace that you wish to export. You can export the Active Frame, All Frames, or the entire Work Area.
- **Width** - Choose the width of the exported animation. You can use the default width of image on screen, or enter your own dimensions.
- **Animation Speed** - Enter a number to indicate how quickly you would like your animation to progress, in units of frames per second.
- **Antialiasing** - Toggle-on "Antialiasing" to use antialiasing in your exported animation. For more information on antialiasing, refer to [Section 24 - 4 "Antialiasing Images"](#).
- **Image Type** - If exporting as Flash, choose the type of image on which to base your animation.
- **Optimize** - With the two Optimize choices at the bottom of the dialog, you can choose to optimize your animation for either faster speed or smaller file size.

Macro Processing

To invoke the Key Frame Animator from the macro language, use the following commands:

Save Animation File:

```

$!EXTENDEDCOMMAND COMMANDPROCESSORID = 'Key Frame Animation' COMMAND =
'Animate AnimationDestination=<animationdest>'

```

In this command, use either OnScreen or ToFile for the <animationdest>.

Open Animation Settings File:

```

$!EXTENDEDCOMMAND COMMANDPROCESSORID = 'Key Frame Animation' COMMAND =
'OpenSettingsFile FileName = <string>'

```

Save Animation Settings File:

```

$!EXTENDEDCOMMAND COMMANDPROCESSORID = 'Key Frame Animation' COMMAND =
'SaveSettingsFile FileName = <string>'

```

Use the \$!ExportSetup commands to set up the necessary parameters for exporting to file (to set format, filename, etc.)

See Also: [Section 29 - 3.8 "Key Frame Animator"](#).

29 - 3.9 Measure Distance

The Measure Distance add-on loads automatically with Tecplot Focus by default. Its library name is *tecutiltools_measuredistance* and it can be disabled by placing a hash or pound character (#) at the beginning of the following line to your [Tecplot.add File](#):

```

$!LoadAddon "tecutiltools_measuredistance"

```

The Measure Distance add-on provides two menu items on the Tools pull-down menu, which are available only in 3D and 2D cartesian plots.

- *Measure Distance* - Choose this command from the Tools menu, then click two points on your plot. After the second click, a dialog appears indicating the coordinates of the two points, the differences in their coordinates, and the linear distance between the two points.

In three dimensions, the distance measured is the shortest distance between the different points selected and does not follow the surfaces. In two dimensions, the distance is in the 2D plane.

- *Measure Angle* - Choose this command from the Tools menu, then click three points on your plot. After the third click, a dialog appears indicating the distance from point 1 to point 2, the distance from point 2 to point 3, and the angle in radians and degrees.

In three dimensions, the angle measured is the angle between vectors 1-2 and 2-3 in the plane defined by points 1,2, and 3. In two dimensions the angle is in the 2D plane.

29 - 3.10 Multi-Frame 3D

The Multi-Frame 3D add-on, which loads automatically with Tecplot Focus, adds two menu items to the Frame pull-down menu: Tile Frames and 3D Multi-Frames. Each command displays a small dialog giving you options for managing the frames in your plot.

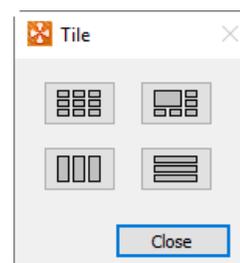
To unload this add-on, add a "#" symbol in front of the following line in your [Tecplot.add File](#):

```
$!LoadAddon "tecutiltools_multiframe3d"
```

Tile Frames

The Tile Frames dialog lets you quickly arrange multiple frames on a page in a variety of layouts. Clockwise from upper left, these are:

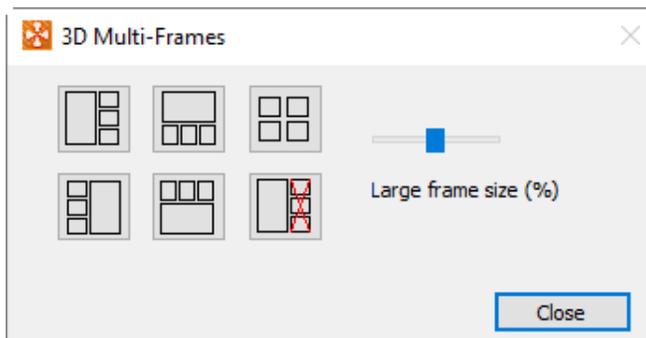
- *Square* - Frames are made as close to square as possible and arranged in a grid with approximately equal numbers of rows and columns.
- *Wrap* - The first frame is displayed in a larger size and the rest of the frames are wrapped around the right and bottom edge. The size of the main frame depends on the number of additional frames that need to be wrapped around the page.
- *Horizontal* - Equal-size horizontal frames are stacked vertically.
- *Vertical* - Equal-sized vertical frames are arranged horizontally.



When frames are resized, no attempt is made to re-fit the data to them. If a frame's aspect ratio changes, data may no longer fit the frame as it did before tiling.

3D Multi-Frames

The 3D Multi-frames dialog, available only when the active frame is in 3D Cartesian mode, creates three additional frames displaying top (XY), front (XZ), and side (YZ) views of the 3D frame.



You may choose from five options for arranging the frames. Four of these options use a large frame for the original 3D frame and place the top, front, and side views along the top, bottom, or side of the large frame. For these views, the slider chooses the size of the large frame from 25% to 75% of the paper area. A grid arrangement giving equal prominence to all four frames is also provided. The button with the red X is for deleting the auxiliary frames (they may also be deleted manually).

When the new frames are created, the data and styles are shared with the original frame, and the new views are fit to their frames. The program also links field layer toggles, such as Mesh, Contour, Lighting, and so forth, so that a change in one frame is automatically reflected in the others.

Macro Processing

To tile frames using the Tecplot macro language, use the following command.

```
#!EXTENDEDCOMMAND  
COMMANDPROCESSORID = 'Multi Frame Manager'  
COMMAND = 'TILEFRAMESQUARE'
```

The command can be TILEFRAMESQUARE, TILEFRAMESVERT, TILEFRAMEZHORIZ, or TILEFRAMESWRAP.

To generate the top/front/side frames from a 3D view, use the following command.

```
#!EXTENDEDCOMMAND  
COMMANDPROCESSORID = 'Multi Frame Manager'  
COMMAND = 'MAKEFRAMES3D ARRANGE=LEFT SIZE=25'
```

ARRANGE may be LEFT, TOP, RIGHT, BOTTOM, or TILE, and the first four accept the SIZE parameter, which indicates a percentage of the paper size and can be 25-75.

To delete the top/front/side frames, use the following command.

```
#!EXTENDEDCOMMAND  
COMMANDPROCESSORID = 'Multi Frame Manager'  
COMMAND = 'DELETEFRAMES3D'
```

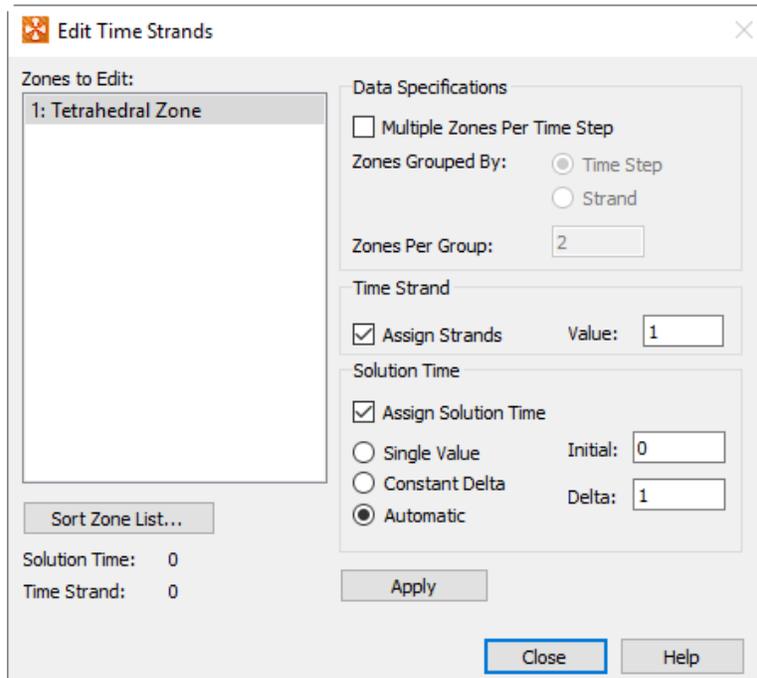
29 - 3.11 Solution Time and Strand Editor

The Solution Time and Strand Editor add-on allows you to modify the strand and solution time values from the user interface. This helps when loading a series of data files that do not have a solution time or strand ID. Adding the solution time simplifies both animating and setting component styles.

This data loads automatically with Tecplot Focus. To unload the add-on, comment out the following line from your [Tecplot.add File](#).

```
#!LoadAddon "tecutiltools_strandeditor"
```

To access this add-on, select "Edit Time Strands" from the **Data** menu. The **Strand Editor** dialog has the following options:



- **Zones to Edit** - In the Zones to Edit box, select a set of zones to edit.
- **Data Specifications** - Toggle-on "Multiple Zones Per Time Step" in order to select grouping by time step or strand. Use this Data Specifications region of the dialog to specify how the add-on groups zones.
- **Strand ID** - In the Time Strand region of the dialog, toggle-on "Assign Strands" to assign strand IDs.
- **Solution Time** - In the Solution Time region of the dialog, toggle-on "Assign Solution Time" to assign the solution time using one of the following options:
 - **Single Value** - The Single Value option assigns the specified solution time to all selected zones.
 - **Constant Delta** - The Constant Delta option applies a constant delta between zones (or groups of zones, depending on the Data Specification settings).
 - **Automatic** - The Automatic option attempts to determine the solution time for each zone in this order:
 - Examines the Common.Time auxiliary data attached to the zone.
 - Tries to read a number from the zone name.
 - Tries to find a dataset variable that contains the time value. If found, uses the minimum value of this variable for that zone.
 - If an existing solution time is defined for the zone, the Automatic option uses it.
 - If all previous efforts fail, the Automatic option will fall back to use the Constant Delta option.

29 - 3.12 Tensor Eigensystem

The Tensor Eigensystem add-on loads automatically with Tecplot Focus. This add-on enables you to calculate the eigenvalues and eigenvectors of a 3-by-3 symmetric tensor whose components are stored in

your data set. The add-on calculates for each node in the data set and stores the results as new data set variables.

To use this add-on, select "Tensor Eigensystem" from the **Tools** menu to open the **Tensor Tools** dialog. To unload the add-on, comment out the line including the *libname* "tecutiltools_tensoregn" in your [Tecplot.add File](#).

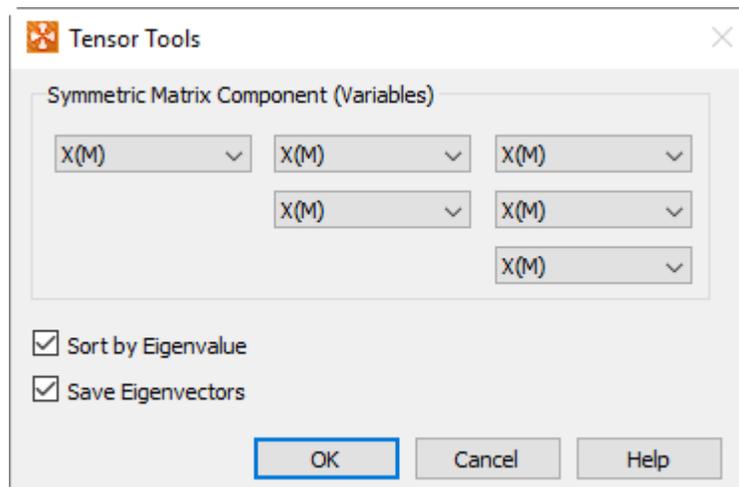
In the **Tensor Tools** dialog, select variables from your data set to represent the 6 components of the tensor. Toggle-on "Sort by Eigenvalue" to sort the results by the eigenvalues, and/or toggle-on "Save Eigenvectors" to store the calculated eigenvectors in addition to the calculated eigenvalues, which the calculation always saves. Then select [OK] to perform the calculation.

Tecplot Focus will store the eigenvalues of the tensor as variables EgnVal1, EgnVal2, and EgnVal3 in your data set. If you choose to save the eigenvectors as well, they are stored as variables EgnVec11 through EgnVec33. If you toggled-on "Sort by Eigenvalue", the eigenvalues and their corresponding eigenvectors will be sorted largest-to-smallest at each grid node. The association of EigenValue to EigenVector is as follows:

EigVal1 ---> EgnVec11, EgnVec21, EgnVec31

EigVal2 ---> EgnVec12, EgnVec22, EgnVec32

EigVal3 ---> EgnVec13, EgnVec23, EgnVec33



Remember that the Tensor Eigensystem add-on can only analyze 3-by-3 symmetric tensors (not 2-by-2, anti-symmetric, or non-symmetric tensors).

Macro Processing

To invoke the tensor eigensystem add-on with a macro, use the following syntax.

```

$!EXTENDEDCOMMAND
COMMANDPROCESSORID = 'Tensor Eigensystem'
COMMAND = 'T11VarNum = <varref>\nT12VarNum = <varref>\nT13VarNum =
<varref>\nT22VarNum = <varref>\nT23VarNum = <varref>\nT33VarNum =
<varref>\nSortEgnV = <Boolean>\nSaveEgnVect = <Boolean>'
    
```

Where <varref> can be an integer or the variable name contained within double quotes.

29 - 3.13 Time Series

The Time Series add-on, *libname* "tecutiltools_timeseries," loads automatically with Tecplot Focus. It extracts a single point over time and plots the result in a new frame as an XY Line Plot. The solution time of the time series plot's frame is linked to that of its parent, and a marker gridline is added to show the current solution time. If a nearest-point probe is performed (using Control-click), you may follow a particular node through time, or through an XY(Z) location.



When tracking a node through time, each zone must have the same node map (or a shared node map).

This add-on may not work as expected when there are multiple zones in the same strand at the same solution time.

To use the Time Series add-on, choose one of the following menu options from the **Tools** menu:

- **Probe To Create Time Series Plot** - This option sets the mouse mode to probe. You can use either the mouse or the **Probe At** dialog to probe a point. The probed location will be sampled over time (for transient data) and a resulting XY Line Plot will be created. If a nearest point probe is done (Control-click), a dialog appears to ask if you want to track the node or the XY(Z) location through time. If you track the node, it is important that your data has the same node map for each zone through time.
- **Send Time Series Data To New Frame** - This option creates a new frame for each point extracted. By default, the frame used for the time series data is reused to avoid creating an excess of frames.

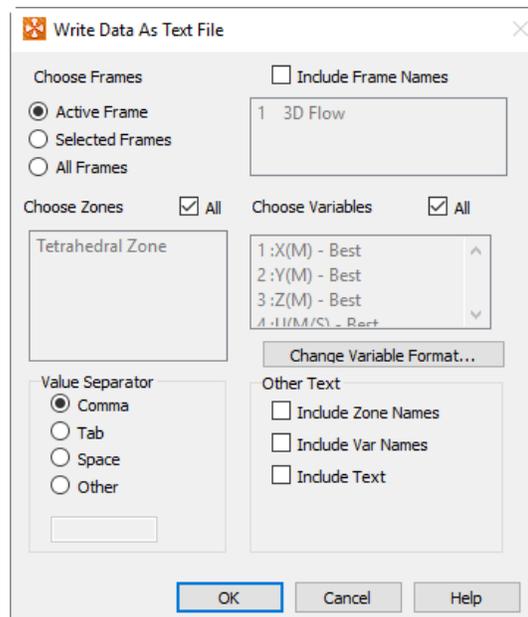
See also: [Section 29 - 3.6 "Extract Over Time"](#), [Section 29 - 3.5 "Extend Time Macro"](#), [Section 29 - 3.11 "Solution Time and Strand Editor"](#), [Section 29 - 3.4 "Extend Macro"](#), [Section 7 - 2 "Time Aware"](#).

29 - 3.14 Write Data as Formatted Text

The Write Data as Formatted Text add-on, which loads automatically with Tecplot Focus, enables you to write data from an XY Line Plot to a text file in *.csv format (for comma separated data) or in *.txt format (for any other data separators). To use it, select "Write Data As Formatted Text" from the **Tools** menu. This will open the **Write Data as Text File** dialog.

The **Write Data as Text File** dialog includes the following options:

- **Choose Frames** - Use the Choose Frames region of the dialog to specify which frames to include in the text file. Choose from the following options:
 - **Active Frame** - Select to include the active frame only.
 - **Selected Frames** - When "Selected Frames" is active, the box to the right will become sensitive. Use the Shift and Control keys to select multiple items in the list.
 - **All Frames** - Select "All Frames" to include data from all frames in the text file.
- **Choose Zones** - Toggle-off the "All" option to select a subset of zones to include in the text file. Because different frames may have different zones, this option is available only when "Active Frame" is selected in the Choose Frames region of the dialog.
- **Choose Variables** - Toggle-off the "All" option to select a subset of variables to include in the text file. Because different frames may have different variables, this option is available only when "Current Frame" is selected in the Choose Frames region of the dialog.
- **Value Separator** - Use the Value Separator options to specify the delimiter to use in the text file.
- **Change Variable Format** - Click to launch the [Change Format](#) dialog. If you choose not to change the variable format, values will be written in the "best" format, except variables named "Time" or "Date."
- **Other Text** - Toggle-on any of the options in the Other Text region of the dialog to include the desired values in the text file.

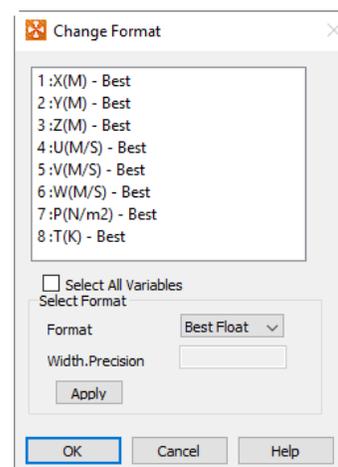


Change Format

Use the **Change Format** dialog (accessible using the Change Variable Format button in the Write Data as Text File dialog) to change the format for one or more variables. To change the format for all variables simultaneously, toggle-on "Select All Variables".

Choose a new format with the Select Format section of the dialog. Available formats are Best Float, Integer, Float, and Exponent. "Best Float" automatically selects either regular floating point or scientific notation depending on the value and uses as many digits as are necessary to represent the value. "Float" and "Exponent" use standard and scientific notation, respectively.

When you have chosen "Float" or "Exponent," you may use the Width.Precision box to specify the width and precision of your new variable format using a C-style numeric formatting specifier (see examples following). Width refers to the total number of characters (including the decimal point; numbers are space-padded on the left if necessary), while Precision refers to the number of places beyond the decimal point. Precision is a hard limit, while Width is a soft limit: the specified number of digits of precision are always used, but numbers are not



cut off if they do not fit in the specified width (see second example following). Leading zeroes are not displayed, except for one immediately preceding a decimal point (that is, for values between -1 and 1).

For example, a width.Precision of 10.2 yields:

Month	Seattle Rainfall	Dallas Rainfall	Miami Rainfall	Error 1
1.00,	4.30,	4.00,	4.00,	0.20,
2.00,	4.50,	4.00,	4.10,	0.22,
3.00,	4.00,	3.50,	4.50,	0.24,
4.00,	4.20,	3.40,	4.20,	0.24,

While a width.Precision of 3.2 yields:

Month	Seattle Rainfall	Dallas Rainfall	Miami Rainfall	Error 1
1.00,	4.30,	4.00,	4.00,	0.20,
2.00,	4.50,	4.00,	4.10,	0.22,
3.00,	4.00,	3.50,	4.50,	0.24,
4.00,	4.20,	3.40,	4.20,	0.24,

Part 8 Appendices

A

Command Line Options

A - 1 Tecplot Focus Command Line

The general form of the Tecplot Focus command line is:

```
tecFocus [options] [layoutfile] [datafiles] [macrofile]
```



Most Tecplot Focus command line options are available for Windows operating systems, not just Linux and Mac. To use them, start Tecplot Focus from the Run command or at the command prompt (cmd.exe).

Under Windows, invoking Tecplot Focus from the command line or in a *.bat* file returns immediately rather than waiting for the application to terminate. If you are using Tecplot Focus to convert files or run a macro, you probably want to wait until Tecplot Focus has finished one operation before proceeding with the next. Otherwise, the next step may be working with partially-written data. To do this, invoke it with `start /wait tecFocus` followed by the desired options.

Where:

[layoutfile] - File with extension *.lay* or *.lpk*. See also [Section 22 - 1 "Layout Files, Layout Package Files, Stylesheets"](#).

[datafiles] - One or more data files. If both a layout file (*.lay* only) and data files appear on the command line, Tecplot Focus substitutes the data files referenced in the layout file with the data files listed in the command line.

[macrofile] - Macro file name. See also [Chapter 25: "Macros"](#).

[options] - one or more of the following:

-addonfile <i>filename</i>	Supply a custom list of addons via the tecplot.add file.
-b macrofile	Run in batch mode.

Command Line Options

-c <i>cfgfile</i>	Use <i>cfgfile</i> for the configuration instead of the default configuration file, <i>tecplot.cfg</i> .
-display <i>computername</i>	Display on computer <i>computername</i> (Linux only). The target system must have X-server capability with the GLX extension.
-datafile <i>filename</i>	Load data file <i>filename</i> .
-debug <i>ddebugfile</i>	Send debug information to the file <i>ddebugfile</i> . Information is displayed to aid in debugging a new configuration file, macro file, or binary data file. You may specify the minus sign ("-") for <i>ddebugfile</i> to send the debug output to the "standard output" (Mac/Linux only).
-f <i>fontfile</i>	Use <i>fontfile</i> instead of the default font file, <i>tecplot.fnt</i> .
-h <i>homedir</i>	Use <i>homedir</i> for the home directory instead of the default home directory.
--help	Open help message for command-line flags.
-loadaddon " <i>addonname</i> "	Load an add-on named <i>addonname</i> .
-m <i>colormapfile</i>	Use <i>colormapfile</i> as the initial color map file.
--max-available-processors <i>numprocs</i>	Restrict the number of processors (processor cores) employed by Tecplot Focus to the <i>numprocs</i> specified. Some tasks can be performed in parallel, so using all available processors greatly increases performance of those tasks. By default, Tecplot Focus uses all processors available on the machine to provide the best performance in most cases. Assign a value less than the total number of available processors to limit the number of processors used by Tecplot Focus to the assigned number.
--mesa -mesa (deprecated)	Linux Only – Use a version of the OpenGL rendering library which uses software rendering (using CPU) rather than hardware rendering (using the GPU and installed/native drivers). Use this flag in situations when a graphics card and/or driver do not exist or it is not working. For assistance troubleshooting see the Troubleshooting Appendix in the User's Manual. Mesa libraries are used for both on- and off-screen rendering, if you are only working in batch use --osmesa. Mesa may be slower and lower quality on-screen rendering than hardware rendering (using the GPU) but will be reliable. For Windows - copy the opengl32.dll from the bin\mesa directory to the bin directory in order to use mesa rendering.
--mesa-swrast --osmesa-swrast	Linux Only – Use when the standard versions of mesa and osmesa libraries conflict with default libraries. Use these options only as a last resort. They cannot be used with regular --mesa or --osmesa commands.
-nobanner	Do not show the opening banner (i.e. splash screen).
-nobatchlog	Suppress creation of the file <i>batch.log</i> during batch mode operation.
-nostdaddons	Do not load the add-ons listed in the <i>tecplot.add</i> file.
-nowelcomescreen	Do not display the Welcome Screen at startup (it may still be opened after launch from the View menu)
--osmesa	Linux Only – Use a version of the OpenGL rendering library which is designed for off screen export using software rendering (using CPU) where there is no X server connection. OSMesa is automatically used when running in batch mode without an X server connection. Also use this flag if Focus crashes in batch mode.
-p <i>scriptfile</i>	Play the macro commands in the file <i>scriptfile.mcr</i> .
-q	Use quick playback mode. Ignores delay and pause commands.

-qm <i>quickpanelfile</i>	Place the macro functions in <i>quickpanelfile</i> in the Quick Macro Panel, instead of using the macros from the default file, <i>tecplot.mcr</i> .
-quiet	Turns off all standard-out messages (Linux only).
-r <i>printfile</i>	Set the filename for routing Print Files to <i>printfile</i> .
-s <i>stylefile</i>	Use <i>stylefile</i> as a stylesheet for the first frame (*.sty).
-showpanel	Open the Quick Macro Panel upon startup.
--use-openssl	Linux Only - Force the use of supplied OpenSSL libraries instead of installed system libraries. For systems with unusual OpenSSL configurations, this may enable the Load Remote Data option in the file menu (the SZL Client add-on).
--use-sys	Use the libraries from the bin/sys sub-folder below the tecplot home directory when running Tecplot. The sys sub-folder contains the version of libstdc++ that was used to build Tecplot and may be required when running older Linux systems. (Linux only).
-v	Display the version number.
-y <i>exportfile</i>	Set the filename for export files to <i>exportfile</i> .

Command Line Input	Result
tecFocus	Run Tecplot Focus without pre-loading any data files
tecFocus ex1.plt	Run Tecplot Focus loading the data file <i>ex1.plt</i> as the first dataset
tecFocus ex1.plt ex2.plt ex3.plt	Run Tecplot Focus loading the data files <i>ex1.plt</i> , <i>ex2.plt</i> , and <i>ex3.plt</i> as the first dataset
tecFocus -h /usr/myhome -c /usr/myhome/myset.cfg	Run Tecplot Focus using /usr/myhome as the Tecplot Focus home directory and loading the Tecplot Focus configuration file /usr/myhome/myset.cfg
tecFocus sumtr1.lay	Run Tecplot Focus using layout file <i>sumtr1.lay</i>
tecFocus calc.lay temp.plt	Read a Tecplot Focus layout file <i>calc.lay</i> and replace the first dataset referenced in the layout file with the data file <i>temp.plt</i>
tecFocus -p a.mcr	Run Tecplot Focus and play a macro called <i>a.mcr</i>
tecFocus infile.dat -o outfile.szplt	Reads <i>infile.dat</i> , writes <i>outfile.szplt</i> in batch mode. Does not require a license.

A - 2 Using Command Line Options in Windows Shortcuts

All of the command line options that can be entered at the DOS or WCommand prompt by using the Run command can also be used in a Windows shortcut.

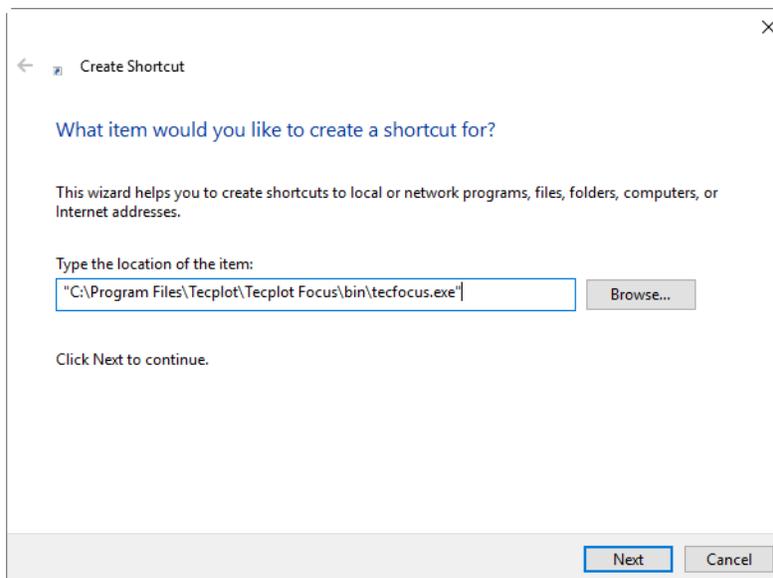
Command Line Options

If you frequently run Tecplot Focus using the same command line flags, it may be useful to create a shortcut on your Windows desktop that launches Tecplot Focus with the desired command line flags. Here's how this can be done:



This process may vary slightly in different supported versions of Windows. The Windows 7 dialogs are shown here.

1. Right click any blank space on your Windows desktop.
2. Select **New>Shortcut** from the resulting Menu.



3. In the **Create Shortcut** dialog, type the location of the Tecplot Focus executable, along with any command flags you want to specify. An example command line is:

```
"C:\Program Files\Tecplot\Tecplot Focus 2023 R2\bin\tecFocus.exe" -p C:\Me\mymacro.mcr
```

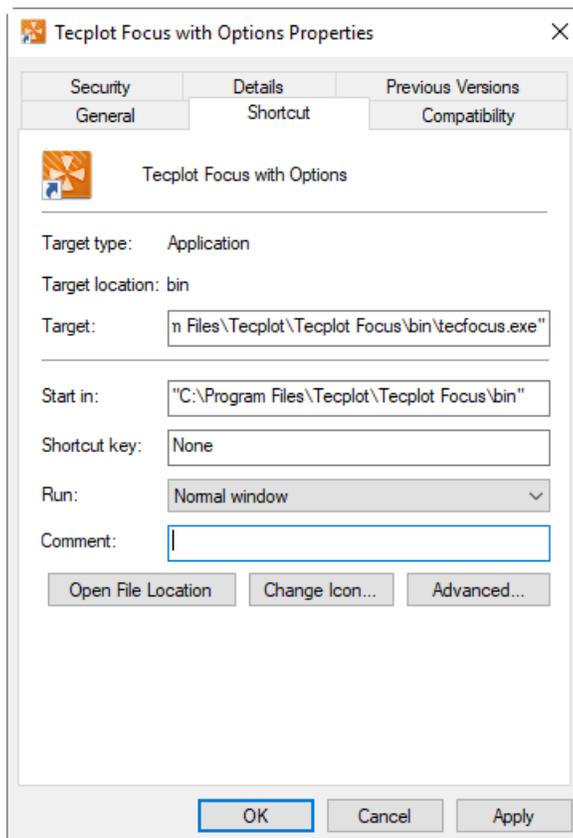
You may also click the Browse button to choose the executable using an Open dialog, instead of typing the path.W
4. Click [Next].
5. Select a name for your shortcut, then click [Finish].
6. A new shortcut icon will be placed on your Windows desktop.

A - 2.1 Changing Shortcuts

You can alter an existing shortcut by doing the following:

1. Right-click on the shortcut icon you want to change and select **Properties**.

2. On the Shortcut page, modify the command line by changing the setting for Target. To change the working directory that Tecplot Focus runs under, change the Start in location.



A - 3 Exit Codes

Upon completing execution, Tecplot Focus returns an exit code, which can be used in scripts to determine whether a problem occurred. This exit code is 0 (success) if execution completed without error, or 1 (error) if execution was terminated by an error.

B

Tecplot Focus Utilities

The following utilities are included with the Tecplot Focus distribution:

- [Excel Add-In](#) - Allows you to load Excel spreadsheet data directly into Tecplot Focus from inside Microsoft Excel.
- [LPK View](#) - A utility to catalog, preview or unpack a layout package file into its component data and layout files.
- [Preplot](#) - A utility to convert an ASCII data file into a Tecplot binary file.
- [Pltview](#) - A utility to view the header information for a Tecplot binary file.

B - 1 Excel Add-In

The **Excel Add-In** provides a convenient way to load data directly from your Microsoft Excel spreadsheet into Tecplot Focus. When loaded, it adds a Tecplot section to the Add-Ins ribbon, which contains a button that lets you open the highlighted region of the spreadsheet in Tecplot Focus. (In older versions of Excel, previous to the ribbon user interface, this command appears on the Tools menu and as a button in the toolbar.)



The Excel Add-In is available on Windows platforms only and requires Microsoft Excel be installed. Visual Basic for Applications, a component of Microsoft Office, must also be installed; if you receive an error about the workbook having lost its VBA project, make sure that Visual Basic for Applications is installed by using the Programs and Features dialog (Add/Remove Programs in older versions of Windows) to modify your Microsoft Office installation. Visual Basic for Applications can be found under the Office Shared Features heading in the Office installer.

The Excel add-in features:

- **Highlight and Plot** - It's easy to plot just a portion of your data. Click in the upper left cell of the region or highlight the entire region, and then click on the Tecplot button in the Add-Ins ribbon or toolbar or on the Tecplot option in Excel's **Tools** menu.
- **Multiple Zones** - The **Excel Add-In** makes loading multiple zones much easier. Highlight the entire region and then click on the Tecplot button in the Add-Ins ribbon or toolbar or on the

Tecplot option in Excel's **Tools** menu. If your zones are separated by blank rows or columns, the add-in will automatically detect them and load them into Tecplot Focus.

- **Formulas** - The highlighted region of the spreadsheet can contain formulas, or can be created entirely with formulas.

The first time you use the Excel Add-In, you will be prompted to choose the Tecplot Focus executable to be launched from Excel. This will be the *tecFocus.exe* file in the *bin* folder of your Tecplot Focus installation. Your choice will be remembered and you will not be asked again unless the Excel Add-In cannot find the previously-chosen executable. A button in the Tecplot section of the Excel ribbon (or the Tools menu), Find Tecplot, will allow you to choose a different Tecplot Focus executable if you have upgraded or wish to use the Excel Add-In with more than one installed version of Tecplot Focus.

A Read Me file, located in the *Util/Excel* directory, further describes installation and use of this add-in.

As an example, let's say you have 3D data obtained by drilling a number of wells and measuring contaminant concentrations of various chemicals at different depths. Your data is in an Excel spreadsheet, and you want to load the data into Tecplot Focus to get a visual representation of the contamination. The data has nine variables and twenty-seven zones. A small part is shown in [Figure B-4](#).

	A	B	C	D	E	F	G	H	I	J	K
1	x	y	z	TCE	logTCE	PCE	logPCE	CB	logCB	1,2DCB	log12DCB
2	2120886.41	417687.32	34.43	2	0.3	2	0.3	4	0.6	4	0.6
3	2120886.41	417687.32	28.21	0.2	-0.7	4	0.6	2	0.3	2	0.3
4	2120886.41	417687.32	23.16	9	1	21	1.3	7	0.8	3	0.5

Figure B-4. The beginning well data displayed in Excel.



Make sure you have a blank row separating the zones in your Excel spreadsheet.

Perform the following steps to import your data and visualize the contaminant plumes:

1. Starting with the top left-hand cell, highlight all twenty-seven zones and nine variables.
2. Click on Tecplot in Excel's Add-Ins ribbon. The menu option launches Tecplot Focus with the selected data loaded.

3. Switch to 3D Cartesian plot mode to see the location and measurement depths of the well samples. The resulting plot is shown in [Figure B-5](#).

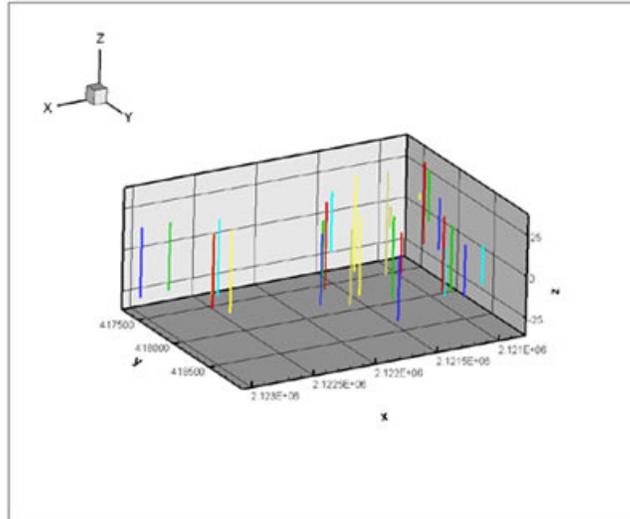


Figure B-5. The Excel well data plotted in Tecplot Focus.

Your wells have different depths, so the number of measurements are not the same for each well (there are only three measurements at well five).

B - 2 LPK View

As a convenience a command line utility, `lpkview`, is provided to catalog and unpack layout packages. In its simplest form (when no options were included), the utility to unpack the preview image (if present), the layout, and all associated data files into the directory in which the utility was run.

For example:

```
lpkview myplot.lpk
```

might unpack the following files in the current directory:

```
myplot.png
myplot.lay
myplot_1.plt
myplot_2.plt
myplot_3.plt
```

Tecplot Focus determines the names for unpacked files when the package is created. Tecplot Focus eliminates name conflicts within the package by appending unique numbers to non-unique names. However, no attempt is made by `lpkview` to ensure that names are unique with other files located in the directory where the items are unpacked.

The utility's syntax is as follows:

```
lpkview [[-t] | [-ild] | [[-c <preview command>] -p]] filename
```

Brackets ([]) surround optional parameters and the vertical bar (|) separates one mutually exclusive set of options from another. The options are described as follows:

-t	Show table of contents.
-i	Extract image (for example, a Portable Network Graphics or .png format).
-l	Extract layout.

-d	Extract data.
-c	Specify preview command. The executable must be in a directory specified in the PATH or else a complete pathname. In the specified command, %s is substituted with the path of the temporary preview image exported by lpkview. (Mac/Linux only)
-p	Preview image using the command specified with -c. (Mac/Linux only)

Option -t may not be used with any other options, and options -i, -l, and -d may not be used with options -c and -p. If no command line options are specified -i, -l, and -d are assumed by default.

B - 3 Preplot

The Preplot executable included in the standard Tecplot Focus installation converts Tecplot format ASCII data files to binary data files. The following options are available:

-d	Turn on debug echo. Use -d2, -d3, -d4 for more detailed debug information.
-foreignplt	Reverse the bytes of the output binary data file (generally not required).
-iset [zone], [start], [end], [skip]	
	Create the binary data file using only the specified range and skipping for the I-index. The zone parameter specifies which zone this option affects; if not specified, all zones are affected. The start parameter is the starting I-index; the default is one. The end parameter is the ending I-index; the default is the last index value. The skip parameter specifies the I-interval, that is, the distance between indices; one means every index is used, two means every other index, and so on. For example, -iset 1, 3, 7, 2 indicates that for zone 1 only I-index values of 3, 5, and 7 are used. Only one -iset option is allowed per zone.
-jset [zone], [start], [end], [skip]	
	Same as -iset above, except with respect to the J-index.
-kset [zone], [start], [end], [skip]	
	Same as -iset above, except with respect to the K-index.
-zonelist start[:end[:skip]], ...	
	Specify the zones to process. You may supply more than one specification. By default Preplot processes all zones.

B - 4 Pltview

Pltview is a command line utility to examine the header information for binary Tecplot data files. It is included in your Tecplot Focus distribution and installed in the *bin* directory. To run pltview:

1. Launch the Command Prompt
2. navigate to the *bin* directory of your Tecplot Focus installation.
3. in the command prompt, type:

```
pltview "fullpath/filename.plt"
```

You must enter the full path for your file.

4. The command prompt will display:

- File Name
- File Version

Tecplot Focus Utilities

- File Type
- Data Set Title
- Number of Zones
- Number of Variables
- Variable Names
- Auxiliary Data
- I, J and K Max for each ordered zone
- Total number of Nodes, Elements, Faces, as well as the element type, for each finite element zone

An example session using the pltview utility is shown here.

```
C:\Temp>pltview chem.plt
FileName      : chem.plt
File Version  : 7.0
DataSetTitle  : Time versus Concentration
NumZones     : 2
NumVars      : 6
Var Names    : Time, Concentration, U3, U4, U5, U6

ZoneName      IMax   JMax   KMax   Node   Elmt   ET type
-----
y=x**3.21     20    1     1     ---    ---    ---
y=1.7**x      20    1     1     ---    ---    ---

C:\Temp>
```

C

Shortcuts

C - 1 Keyboard Shortcuts



On some platforms, Num Lock may interfere with some keyboard shortcuts. If shortcuts don't work, try toggling Num Lock.

C - 1.1 3D Rotate Tools

Alt-Click-and-drag	Rotate about the viewer position using the active Rotate tool.
Middle-click-and-drag	Smoothly zoom in and out of the data.
Right-click-and-drag	Translate the data.
Control-right-click-and-drag (Mac: Command-right-click-and-drag)	Rotate about the rotation origin (any tool may be active).
C	Move the rotation origin to the probed point, ignoring zones.
O	Set the center of rotation.
R	Switch to Rollerball rotation.
S	Switch to Spherical rotation.
T	Switch to Twist rotation.
X	Switch to X-axis rotation.
Y	Switch to Y-axis rotation.
Z	Switch to Z-axis rotation.

C - 1.2 Contour Add Tool

Alt-click	Place a contour line by probing on a streamtrace, slice, or iso-surface.
Click	Place a contour line.
Control-click	Replace the nearest contour line with a new line.
Click-and-drag	Move the new contour line.
-	Switch to the Contour Remove tool.

C - 1.3 Contour Remove Tool

Click	Remove the contour line nearest to the probed location.
+	Switch to the Contour Add tool.

C - 1.4 Geometry Polyline Tool

A	Allow translation of polyline segments in all directions.
H	Restrict translation of the current polyline segment to horizontal.
U	End the current polyline at last clicked point and start a new one.
V	Restrict translation of current polyline segment to vertical.

C - 1.5 Probe Tool

Click	<p>If the pointer is over a single valid cell, the interpolated field values from all nodes in the cell are returned.</p> <p>If multiple cells are candidates, the action is dependent upon the plot type: For 2D, the cell from the highest number zone is used. For 3D, the cell closest to the viewer is used.</p>
Control-click	<p>If the pointer is over a single valid cell, the field values from the nearest node in the cell are returned.</p> <p>If multiple cells are candidates, the action is dependent upon the plot type: For 2D, the cell from the highest number zone is used. For 3D, the cell closest to the viewer is used.</p> <p>If the pointer is not over any cell, then the field values from nearest data point (as measured in distance on the screen) are returned.</p>
Shift-Control-click	<p>The field values from the nearest point on the screen are returned (ignoring surfaces, zone number, and depth of the point).</p> <p>This is useful in 3D for probing on data points that are on the back side of a closed surface without having to rotate the object. In 2D, this is useful for probing on data points for zones that may be underneath other zones.</p>

Alt-click	Probe only on streamtraces, iso-surfaces, or slices. If multiple cells are candidates, the action is dependent upon the plot type: For 2D, the cell from the highest number zone is used. For 3D, the cell closest to the viewer is used.
Alt-Control-click	Probe only on streamtraces, iso-surfaces, or slices. If multiple cells are candidates, the action is dependent upon the plot type: For 2D, the cell from the highest number zone is used. For 3D, the cell closest to the viewer is used. If the pointer is not over any cell, then the field values from nearest data point (as measured in distance on the screen) are returned.
Alt-Control-Shift-click	Probe only on streamtraces, iso-surfaces, or slices. The field values from the nearest point on the screen are returned.
X, Y T, R	When probing, press X or Y in XY Line to switch dependencies, or R or T in Polar Line.

C - 1.6 Slice Tool

+	Turn on start/end slices, or increment the number of intermediate slices.
-	Turn off start/end slices, or decrement the number of intermediate slices.
Click	If no slices are displayed for the current slice group, place the primary slice. Otherwise, move the closest displayed start, end, and primary slice from its current position to the clicked position.
Alt-click	Place the start, end, or primary slice (whichever is closer to the click position) on the nearest derived object (streamtrace, slice or iso-surface).
Control-click	Place the start, end, or primary slice (whichever is closer to the click position) on the nearest data point.
I, J, K	Switch to slicing constant I, J, or K-planes, respectively. Available for ordered zones only.
X, Y, Z	Switch to slicing constant X-, Y-, or Z-planes, respectively.
A	Switch to arbitrary slice mode.
1-8	Switch between slice groups.

C - 1.7 Streamtrace Placement tools (3D Cartesian plots only)

D	Change the streamtrace style to streamrods.
R	Change the streamtrace style to streamribbons.
S	Change the streamtrace style to surface lines.
V	Change the streamtrace style to volume lines.
1-9	Change the number of streamtraces to be added when placing a rake of streamtraces.

C - 1.8 Translate Tool

-	Reduce the magnification of the data.
+	Increase the magnification of the data.
Drag	Translate the data.
Shift-drag	Translate the paper.
Shift - -	Reduce the magnification of the paper.
Shift - +	Increase the magnification of the paper.

C - 1.9 Zoom Tool

Click	Center the zoom around the location of your click.
Control-click	Center the zoom around the location of your click and zoom out.
Drag	Draw a box to set the frame view.

C - 1.10 Selector Tool

Click	Select the frontmost object at the clicked location.
Control-click	Select the next object behind the currently selected object ("dig").
Shift-click	Multiple selection. Click the first object, then shift-click subsequent objects to add them to the selection
Alt-click	Ignore zone objects when selecting.

C - 1.11 Selected Object Options

-	Reduce the size of the object. If multiple objects are selected, all object positions will be shifted towards the first object selected.
+	Increase the size of the object. If multiple objects are selected, all object positions will be shifted away from the first object selected.
Delete	Delete selected object(s).
Control-C	Copy selected object(s) to the clipboard.
Control-V	Paste selected object(s) from the clipboard.
Control-X	Cut selected object(s) to the clipboard, deleting them from the plot.

C - 1.12 Time Navigation

Home	Jump to start.
Left Arrow	Step backward.
Space bar	Play or pause animation.

Right Arrow	Step forward.
End	Jump to end.

C - 1.13 Other Keyboard Operations

Control-F	Fit Surfaces (3D Only) - Resize plot so that all surfaces are included in the frame, excluding any volume zones. Fit to Full Size (2D, XY, Polar, Sketch) - Fit the entire plot into the frame (including data, text and geometries).
Control-E	Fit Everything (3D Only) - Resizes plot so that all data points, text, and geometries are included in the frame.
Control-L	Last - Restore the last frame view.
Control-O	Open a layout file.
Control-P	Print.
Control-Q	Exit.
Control-S	Save the current layout to its file.
Control-W	Save the current layout to a specified file.

C - 2 Extended Mouse Operations

The middle and right mouse buttons are powerful tools you may use to immediately zoom and translate your data without having to switch to the Zoom or Translate tools on the Toolbar. This advanced mouse/keyboard functionality is available when using any 3D rotate, Contour, Geometry (except Polyline), Probe, Slice, Streamtrace Placement, Translate, Zoom, or Zone Creation tools. If you have a two button mouse use the Control key in conjunction with the right mouse button to achieve middle mouse button capabilities.

The following table lists all of the capabilities of the middle and right mouse buttons, when the active mouse tool is the "Selector"  or the "Adjustor". .

Action	Middle Button ^a	Right Button
Click	Redraw. If the pointer is in the active frame, Tecplot Focus will redraw the active frame. Otherwise, redraw all frames.	Switch from the current tool to the Selector.
Drag	Smoothly zoom in or out. An upward motion zooms out. A downward motion zooms in.	Translate.
Alt-Drag	In 3D Cartesian plots, move the viewer further from (upward motion) or closer to (downward motion) the object. In all other plot types, this behaves like the Drag action	Smoothly zoom in or out. An upward motion zooms out. A downward motion zooms in.

- a. Mac users can simulate a click of the middle button by holding down the Control key on the keyboard while clicking the right mouse button. Hold any additional keys (such as Alt/Option) along with Control to invoke extended mouse operations.

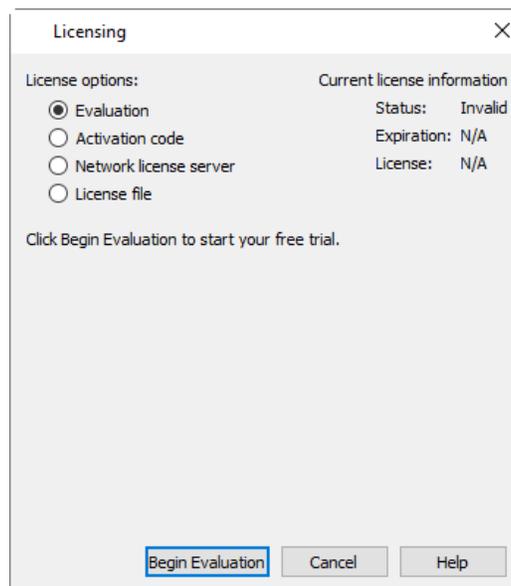
The above actions (and other mouse gestures) are configurable by editing your *tecplot.cfg* file. Find the \$!INTERFACE MOUSEACTIONS command and look for the MIDDLEBUTTON or RIGHTBUTTON section within that command.

D

License Management

D - 1 Entering Your License

The first time you launch Tecplot Focus after a fresh installation, you will be prompted to enter your license information:



You will also see this dialog if Tecplot Focus cannot validate your license information (for example, because your evaluation license has expired, or because the network license server is not available). Additionally, you may change your license information at any time from the **Help** menu.



SYSTEM ADMINISTRATORS

Tecplot products store their license configuration file in a platform-specific location. Each Tecplot product has its own license configuration file.

Windows: C:\Users\\AppData\Local\Tecplot

Linux: ~/.local/share/data/tecplot

Mac: ~/Library/Application Support/Tecplot

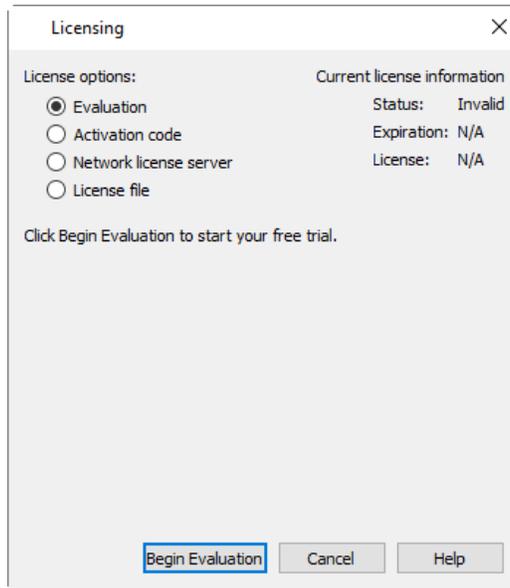
The above directories are specific to the individual workstation users. If you want all users of the computer to use the same license configuration for a given Tecplot product, you may move the license configuration file to the product installation directory after initial license setup.

To prevent users from editing the license configuration, you may then change the permissions on the license file to be writable only by an administrator or root user.

How you install your license information depends on what type of license you have.

- If you wish to evaluate the product before purchasing, you may obtain an **Evaluation** license with a single click. See [Evaluation License Setup](#).
- If you have an Activation Code for a **Single-User** license and have Internet access, you enter the activation code. See [Single-User License Setup Using An Activation Code](#).
- If you have a License File for a **Single-User** license, you select the license file. See [Single-User License Setup Using A License File](#).
- If you have a **Network** license, you specify the server name and port number of the RLM license server on your network. See [Network License Setup](#).
- If you have a License File for a **Single-User** license, you select the license file. See [Single-User License Setup Using A License File](#).

D - 1.1 Evaluation License Setup

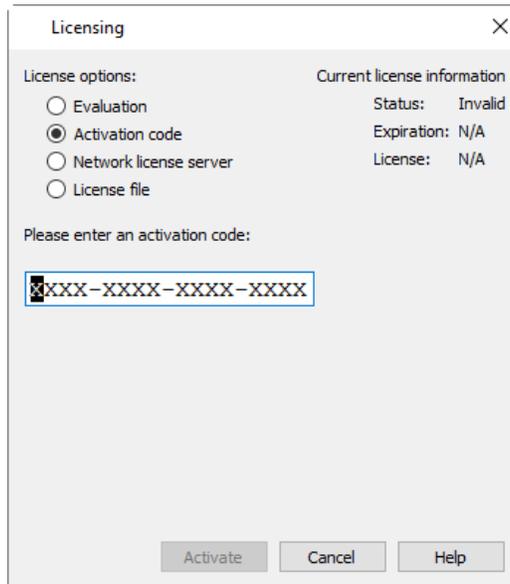


To obtain a time-limited evaluation license key so you can try the product before purchasing, make sure the "Evaluation" license type is selected in the Licensing dialog, then click **Begin Evaluation**. The product evaluation period begins. You will see a notice on the product's Welcome Screen indicating when your evaluation license will expire.

This procedure requires an active Internet connection. If for some reason you cannot fully evaluate Tecplot Focus on an Internet-connected computer, or if you need additional time to complete your evaluation, contact [Tecplot Support](#) for a time-limited single-user license file, which may then be installed using the instructions in "[Single-User License Setup Using A License File](#)" on page 405.

D - 1.2 Single-User License Setup Using An Activation Code

If you received an activation code for your product, allowing it to be activated over the Internet, follow the instructions below. If you received a license key file, or if the workstation you have installed the product on does not have Internet access, see [“Single-User License Setup Using A License File”](#) on page 405.

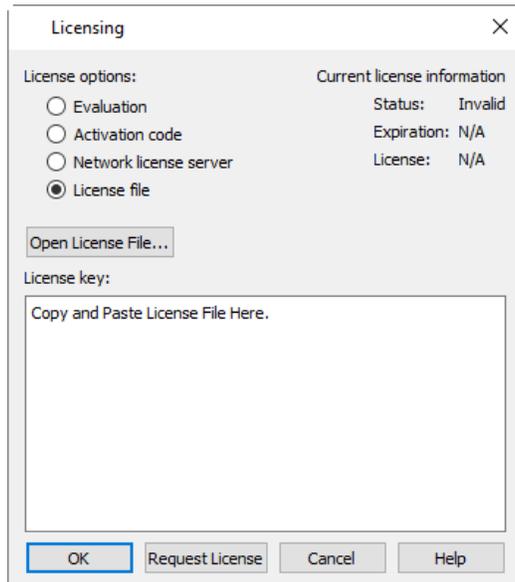


To activate the product, simply enter or paste your activation code in the field provided. Then click **Activate**. The license key corresponding to your activation code is downloaded to your computer, and Tecplot Focus uses that license.

D - 1.3 Single-User License Setup Using A License File

License Management

You will need the license file sent to you by Tecplot as an e-mail attachment. Please save it to a file on your computer in an easy-to-find location, such as the Desktop.



If you do not have your license file, or have lost it, click **Request License** in the Licensing dialog for instructions on how to obtain it.

1. Make sure the "License File" option is selected in the Licensing dialog.
2. Click **Open License File**. A file browser appears. Select the license file e-mailed to you, then click **Open**.
Alternatively, you can Copy and Paste the contents of the license file to the available field.
The message "Status: Valid" appears in the Current License Information panel at the upper right.
3. Click **OK** to save the license information.

Tecplot Focus now uses the chosen license.

D - 1.4 Network License Setup

Licensing

License options:

Evaluation
 Activation code
 Network license server
 License file

Current license information

Status: Invalid
Expiration: N/A
License: N/A

Please enter the name of the computer on which the license manager is installed. The license manager is installed separately from your product.

License server name:

Port number:

OK Request License Cancel Help

To use a network license, you or your system administrator must first install the Reprise License Manager (RLM) version 11 or newer and the license key for your product on a network server. (See the installation instructions included with the RLM download.) Once this has been accomplished, follow these steps:

1. Make sure the "Network" license type is selected in the Licensing dialog.
2. Enter the server name (you may use a hostname or IP address) and port number of the license server in the fields provided.
3. Click **OK** to save the license information.

Tecplot Focus will now use a license obtained from the license server.

If the product is unable to obtain a license key, an error message will appear, and you should verify that you have specified the correct network license information.

D - 2 License Roaming

Network license users who need to use Tecplot Focus while not connected to the same network as their license server (for example, while traveling) can use license roaming. License roaming allows you to use the product without access to the license server for a limited period of time. The roaming license is considered "in use" by the server continuously until it expires or is returned.

To manage license roaming, choose **License Roaming** from the **Help** menu. The License Roaming dialog appears.

License Roaming

Max roam: 90 days

Roaming expiration:

Begin Roam Cancel Help

D - 2.1 Starting Roaming

To start roaming, choose the expiration date for the roaming license using the pop-out calendar that appears when you click the roaming expiration date. Your license will expire at the end of that day, at midnight.



To account for time zones, we suggest roaming for a day longer than you think you need when you will be traveling.

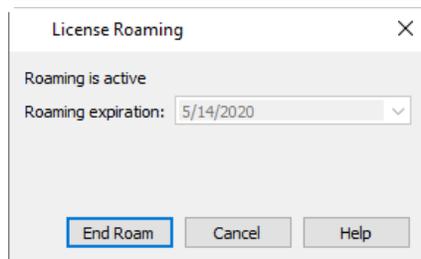
Click **Begin Roam** to obtain the roaming license and begin roaming.



The license server administrator and the license key may restrict the maximum amount of time users may roam and/or the total number of licenses that may roam at a given time.

Additionally, only one instance of Tecplot Focus may be run while roaming.

While roaming, the license status is noted as Roaming in the Licensing dialog, and the expiration date of the roaming session is also shown. You may not change license information while roaming.



When you are getting close to your roaming license's expiration date, a notification appears in the Welcome Screen at startup.



Do not upgrade Tecplot Focus while roaming. If you do, your license may no longer work correctly. Set the RLM_ROAM environment variable to -100 before launching to rectify this situation (see [RLM_ROAM](#)).

D - 2.2 Ending Roaming

Your roaming license expires automatically at the end of the day (that is, midnight) on the day you selected when you began roaming. After this date, your computer must be able to connect to the network license server to run Tecplot Focus.

You may also end roaming early and make your license available for other users. To do this, you must first connect your computer to a network that allows you to reach the license server. Then choose **License Roaming** from the **Help** menu and click the **End Roam** button in the License Roaming dialog.

D - 2.3 RLM_ROAM

You can initiate roaming from the command line by setting the RLM_ROAM environment variable to the number of days you wish to roam, then starting Tecplot Focus from that command line session. The roaming session expires at the end of the day after the number of days specified (for example, if it is noon Tuesday, and you set RLM_ROAM to 2, the roaming license expires at the end of the day Thursday). RLM_ROAM may also be set to the special value today to have the roaming license expire at the end of the current day (the value 0 means that no changes to roaming will be made).

If RLM_ROAM is set permanently (for example, using the System Properties in Windows), the license roaming will be refreshed each time you run Tecplot Focus while connected to the network. If RLM_ROAM is 1, for example, each time you start Tecplot Focus, the roaming license is refreshed to expire at midnight the following day. This allows you to easily take your computer home with you any night and continue using Tecplot Focus while disconnected from the license server, without needing to explicitly roam each day.

You may end a roaming session early by setting RLM_ROAM to -1 before launching Tecplot Focus.



If you are having trouble ending your roaming early (a common cause is upgrading Tecplot Focus while roaming), try setting RLM_ROAM to -100 before launching Tecplot Focus. The roaming license will be forcibly removed from your workstation, and Tecplot Focus will begin requesting a regular license from a license server at each startup. At this point you can obtain a fresh roaming license, if desired. The reservation for your previous roaming license will, however, continue to be held on the license server that issued it until it expires.



LaTeX Setup

A few requirements are needed before LaTeX outputs can be generated. The first is to have a LaTeX engine installed. LaTeX distributions are largely free and available on many different operating systems. For installation recommendations, see the [LaTeX Project page](#).

The second requirement is to have the **tecplot_latex.mcr** file correctly configured in your installation directory. Each LaTeX engine will come configured with different ways to parse commands. Details of how to configure it can be found in the **tecplot_latex.mcr** file. The default settings have been tested with MiKTeX and TeXLive engines. If using the default install options for MiKTeX, the zhmetrics package will also need to be installed.

For information on how to load a custom tecplot_latex.mcr file, see [Section 28 - 1 "Custom Files loaded on Startup"](#).



Troubleshooting

F - 1 Rendering and Export Troubleshooting

As a software with high graphical and rendering requirements, Tecplot Focus has a few alternative libraries and configurations which allow use on machines which have limited graphics hardware. Some example cases where these configurations may be needed include use on HPC systems, X-Display or other remote desktop solutions.

F - 1.1 Sample Interactive Rendering and Export Test

Try these steps. If you have any problems check the OS specific section below.

1. Start Focus
2. Setup sample data:
 - a. Create data from: Data > Create > Create Rectangular Zone.
 - b. Select defaults to create the zone
 - c. Turn on contour checkbox on the plot sidebar.
3. Try interacting with the plot:
 - a. Use <Ctrl> + right mouse drag to rotate the plot
 - b. Right click to display the context menu
 - c. Left click and drag to select multiple objects in the plot.
4. Go to File > Export, use default PNG settings and select a place to save a sample image. Once export is complete, ensure that the image was created as expected.

F - 1.2 Linux Troubleshooting for Interactive Rendering and Export

The following is a set of tests to determine what are the best set of rendering command line options for a Linux system. Run each test in order and STOP when a test was successful.

1. Run **tecFocus** without any additional command line arguments and step through the sample test above. If everything is successful and performant continue to use Tecplot Focus this way.
2. If any of the sample steps failed:

- a. Ensure your graphics drivers are up to date. If you are using native Linux drivers (usually nouveau) try installing drivers supplied by your graphics card manufacturer.
- b. If you are on the most up to date drivers, try **tecFocus --mesa**, then repeat the sample test above. Mesa uses software rendering and will be slower than using graphics hardware but will be the most reliable software rendering option. See the --mesa option in [Section A - 1 “Tecplot Focus Command Line”](#) for additional information.

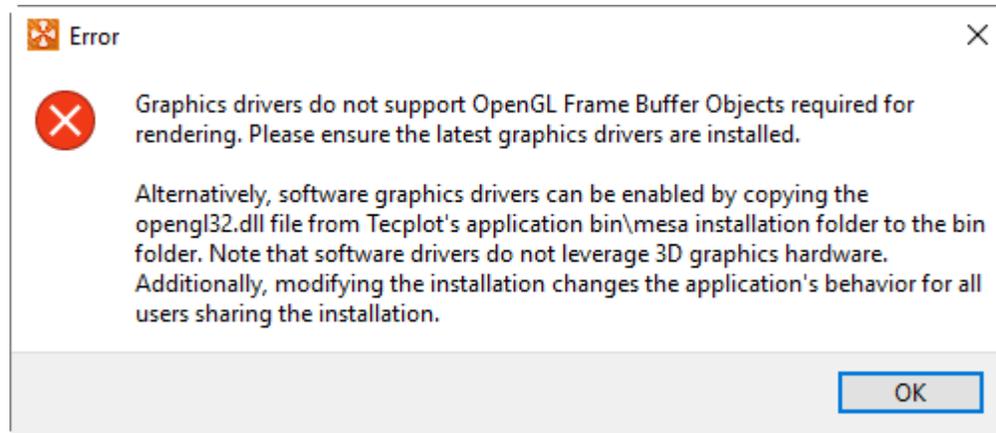
If you struggled following these steps or none of these solutions worked, contact support@tecplot.com.

F - 1.3 Linux Batch Mode Troubleshooting

On some systems with limited graphics resources Tecplot Focus may crash in batch mode. If this occurs run **tecFocus -b - -osmesa**.

F - 1.4 Windows Troubleshooting

When remoting to or running on some windows systems, either in rendering the work area or during export, you may encounter an error similar to:



This error indicated that the graphics drivers on the machine are not sufficient. In this case, find the mesa version of the OpenGL library in `C:\Program Files\Tecplot\Tecplot Focus 2023 R2\bin\mesa\opengl32.dll` and copy it to the bin directory `C:\Program Files\Tecplot\Tecplot Focus 2023 R2\bin`. This will enable software rendering for the Windows version of Tecplot Focus.

Note that in some cases this same error is presented when exporting images with larger extents. If you are seeing this error exporting images know that in most cases super sample factors larger than 3 show no increase in render quality. As such, try with smaller width and do not go over 3 for a super sample factor.

F - 1.5 Mac Troubleshooting

Most, if not all Mac systems, have stricter hardware and software requirements for running MacOS. As such Tecplot Focus does not currently supply any alternative rendering libraries or options today. Contact support@tecplot.com if you need assistance.



Glossary

The following terms are used throughout the Tecplot Focus User's Manual and are included here for your reference.

2D	Plotting in two dimensions. Line plots of one or more variables (XY and Polar Line plots) are not considered.
2D Cartesian Plot	A plot displaying a 2D scattering of points, surfaces, or volumes using two orthogonal axes.
3D	Plotting in three dimensions. Three-dimensional plotting can be subdivided into 3D surface and 3D volume.
3D Cartesian Plot	A plot displaying a 3D scattering of points, surfaces, or volumes using three orthogonal axes.
3D Sorting	The process that Tecplot Focus uses to determine which surface to plot first. In this process, the cells are sorted relative to the viewer and plotted beginning with the farthest point away and ending with the closest. Sorting is used when printing 3D plots or rendering translucent 3D objects on the screen.
3D Surface	Three-dimensional plotting confined to a surface. For example, the surface of a wing.
3D Volume	Three-dimensional plotting of data that includes interior data points of a volume, as well as those on the surface. For example, the vector field around a wing.
Active Zone	A zone that is displayed in the active plot, as determined in the Zone Style dialog.
Add-on	Any component or program which provides additional functions to Tecplot Focus.
Anchor point	The fixed point of an object on the plot.

Antialiasing	The process of removing or reducing the jagged distortions in curves and diagonal lines.
ASCII Data File	A data file composed of code in a human-readable and editable format, using the ASCII character set encoding.
Aspect Ratio	The ratio of lengths of the sides of an object. In the 3D Cartesian plot type, the ratio is that of the longest side to the shortest side.
Auxiliary Data	Metadata attached to zones, datasets, and frames.
Banded Contour Flooding	A field plot where the region between contour lines is filled with a constant color that corresponds to each variable.
Bars Mapping Layer	Mapping Layer (XY line plots only) where bars are used to depict the relationship between the dependent and independent variables.
Binary Data File	A data file composed of machine-readable data. This type of file is created by converting ASCII data files with Preplot, or by directly creating them from an application.
Blanking	A feature of Tecplot Focus that excludes certain cells and points from a plot.
Block	A data file format in which the data is listed by variable. All the point values of the first variable are listed first, then all the point values of the second variable, and so forth.
Boundary Cell Faces	A set of un-blanked cell faces in a 3D volume zone which have only one neighboring volume cell. In contrast, interior cell faces have two neighboring volume cells, one on either side, which share the face. For an IJK-ordered zone the boundary cell faces are on the exterior of the zone. That is, the first and last I-planes, the first and last J-planes, and the first and last K-planes. For a finite element 3D volume zone, boundary cell faces are on the exterior of the zone and the surface of any voids within the zone.
Bounding Box of Data	The smallest rectangular box, aligned with the coordinate axes, which completely encloses all data points.
Brick	An element type of finite element volume data composed of eight node points arranged in a hexahedron-like format. This element type is used in 3D volume plotting.
Carpet Plot	A 3D surface plot where a variable is plotted in the third dimension and is singular-valued with respect to the independent variables.
Cartesian Plot	A 2D or 3D plot of some variable by location on a single plane using two axes (or in a volume using three axes).
Cell	Either an element of finite element data, or the space contained by one increment of each index of IJK or IJK-ordered data.
Cell-centered Values	Values located at the center of the cell (assumed to be the centroid).
Coordinate	Any of a set of numbers used in specifying the location of a point on a plot.
Configuration File	File (tecplot.cfg) containing Tecplot Focus defaults. See Section 28 - 2 "Configuration Files" on page 354.
Color Map	A color spectrum used to plot contour flooding and multi-colored objects.

Connectivity List	The portion of a finite element data file which defines the elements or cells by listing the relationships between points. The number of points per cell is determined by the element type.
Continuous Contour Flooding	A field plot where a color is assigned to each point in a mesh, based upon the contour variable and the color map. Each face is filled with colors interpolated between the corner nodes. This results in a smooth variation of color over the surface.
Contour	A field plot type that plots iso-valued lines, or color flooding based on the values of a specified variable.
Curve Type	The function used to fit the data points in an XY-plot.
Custom Labels	Text strings contained within a data file or text geometry file which define labels for your axes or contour table. You may select Custom Labels anywhere you can choose a number format, the result is the text strings in place of numbers.
Cutaway Plot	A 3D volume plot where a portion of a 3D volume zone is cut-away by blanking to reveal the interior.
Cutting Plane	A planar surface used to slice 3D volume or surface zones.
Data File	A file that contains data used for plotting in Tecplot Focus.
Data Format	The type of zone data as specified by the format parameter in a Tecplot data file, such as BLOCK or POINT.
Data Loader	A Tecplot Focus add-on which allows you to read non-Tecplot data files.
Data Point	An XYZ-point at which field variables are defined.
Data Smoothing	A process that shifts the value of a variable at a data point towards an average of the values at its neighboring data points to reduce "noise" and lessen discontinuities in data.
Dataset	A set of one or more zones. A dataset may be plotted in one or more frames. However, a single frame may only plot one dataset. A dataset may be created by loading one or more data files.
Dependent	An axis mode requiring the axes to maintain a fixed ratio to one another.
Depth	For image export, the number of bits stored per pixel.
Derived Volume Objects	Graphic objects which are visible in the plot and created from zone data, but are not zones, i.e. an Iso-Surface , a Slice , or a Streamtrace .
Display List	A group of OpenGL commands that have been stored for subsequent execution. Using a display list can, depending upon the hardware involved, dramatically speed up graphics rendering. Using display lists also requires more memory.
Draw Level	A draw behavior setting for modifying the image quality and rendering speed during various operations, such as rotation. Options vary from Trace (a simplified wire-frame mesh which is rendered quickly) to Full.
Dynamic Text	Special placeholders added to text that change with the data or the display environment.

Edge	A 2D or 3D field plot option. Plotting the edge of a zone plots the connection of all outer lines (IJ-ordered zones), finite element surface zones, or planes (IJK-ordered zones).
Element Type	The form of individual elements in a finite element zone. There are four types of cell-based finite element zones: Triangle and Quadrilateral (finite element surface types), and Tetrahedron and Brick (finite element volume types). For cell-based finite elements, the element type of a zone determines the number of nodes per element and their orientation within an element. There are two types of face-based finite element zones: polygonal (2D) and polyhedral (3D). For face-based elements, the number of nodes per element is variable.
Error Bars Mapping Layer	XY Line mapping layer where a second dependent variable (error) is used to show the accuracy of the first dependent variable, typically used in conjunction with the Bars Mapping Layer .
Exposed Cell Faces	The set of those cell faces in 3D volume zones that have only one un-blanked neighboring volume cell. By comparison, interior cell faces have two neighboring cells, one on either side, which share the face. The exposed cell faces include boundary cell faces and interior cell faces exposed by blanking. (One of the neighboring cells has been blanked.)
Eye Coordinate System	Coordinate system aligned with the Grid coordinate system so that objects that are drawn move with the data as you zoom and translate, but remain fixed when you rotate the plot.
Extra 3D Sorting	Perform extra work to resolve hidden surface problems encountered during 3D sorting.
Face Neighbor	A neighboring cell whose faces share all nodes in common with the selected cell.
FE	An abbreviation for finite element (a common means of arranging data for calculations, often referred to as "unordered" or "unstructured").
Fence Plot	A plot of planes of a 3D data field.
FE Surface	A finite element zone of the element type Triangle or Quadrilateral. These zones are used for 2D and 3D surface plots.
FE Volume	A finite element zone of the element type Tetrahedron or Brick. These zones are used for 3D volume plots.
Field Map	A collection of zones for 2D and 3D field plots. A common style can be easily applied to all zones in the selection.
Field Plot	Includes 2D Cartesian and 3D Cartesian plot types. Generally used to display the spacial relationship of data. Mesh, Contour, Vector, Scatter, and Shade are all considered field plots. XY and Polar Line plots and the Sketch plot type are not field plots.
File Path	A way to specify the directory for Tecplot Focus to locate a given file. For instance, a linked layout saved with an absolute file path contains the complete directory structure to load the associated file starting with the root directory or (on Windows) the drive letter.

Finite Element	A type of data point ordering. Data is arranged by listing the data points (called nodes), and then listing their relationships (called elements). The element type of the zone determines the number of nodes which are contained in each element, as well as the exact relationship of nodes within an element. There are <i>four</i> different element types supported by Tecplot Focus: Triangle , Quadrilateral , Tetrahedron , and Brick . See also: Connectivity List and Node .
Font Modifier	The modifier used to embed Greek, Math, or User-Defined characters in a text string.
Frame	Area within the workspace where sketches and plots are created. The workspace shows a page at a time, and each page can contain multiple frames.
Frame Coordinate System	Coordinate system fixed to the frame that does not change when the plot is zoomed, translated, or rotated.
Gouraud Shading	Shading used to achieve smooth lighting on low-polygon surfaces by linearly interpolating a color or shade across a polygon.
Grid Area	One or more rectangular regions defined and bounded by the grid axes.
Grid Axes	An axis option which displays the coordinates of the grid along the various spatial dimensions.
Grid Coordinate System	The grid coordinate system consists of two dimensional physical coordinates that are aligned with the coordinate system used by the plot axes.
Gridline	A set of lines drawn from one or more axes that extend from the tick marks on an axis across the grid area.
Grid Point	In 2D, the intersection of gridlines.
Hidden Line	Mesh type where mesh lines that appear behind other plot layers are not drawn.
I-Ordered	A type of data point ordering where each point is listed one at a time (that is, by one index). Used mainly in XY plots. In 2D or 3D, this type of data point ordering is sometimes called irregular, and is only useful for scatter plots, or for interpolating or triangulating into 2D, 3D surface, or 3D volume zones. (This type of data can also be used for 2D or 3D vector plots if streamtraces are not required.)
IJ-Ordered	A type of data point ordering where the points are arranged in an array used for 2D and 3D surface plotting.
IJK-Ordered	A type of data ordering where the points are arranged in a 3D array. Used for 3D volume plotting as well as 2D and 3D surface plotting.
Image Format	Any of the raster or bit-mapped graphic formats supported by Tecplot Focus.
Inactive Zone	A zone loaded into Tecplot Focus which does not appear in the plot. A zone can be deactivated using the Zone Show option on any page of the Zone Style dialog.

Independent	Axis mode allowing each axis to have a range that is not affected by the ranges of any other axis or axes.
Interpolate	To assign new values for the variables at data points in one zone based on the data point values in another zone (or set of zones).
Interpolate Mode	When probing is activated using a single mouse click, the value returned is linearly interpolated from all nodes in the cell. See also: " Nearest Point Mode " on page 419.
Internal Macro Variable	A read-only macro variable which allows you to access certain key values in Tecplot Focus. For example, \$NUMVARS gives the number of variables.
I-Plane	In an ordered zone, the connected surface of all points with a constant I-index. In reality, I-planes may be cylinders, spheres, or any other shape.
Irregular Data	Points which have no order, or at least no order which can be easily converted to IJK or IJK-ordering.
Iso-Surface	A surface within a 3D zone where the contour variable has a constant value at all locations.
Journal	Log of data manipulation/creation/deletion instructions.
J-Plane	In an ordered zone, the connected surface of all points with a constant J-index. In reality, J-planes may be cylinders, spheres, or any other shape.
Kriging	A technique to interpolate the value of a random field at an unobserved location from observations of its value at nearby locations.
K-Plane	In an IJK-ordered zone, the connected surface of all points with a constant K-index. In reality, K-planes may be cylinders, spheres, or any other shape.
Layout File	A specialized macro file with extension .lay which preserves a plot created within Tecplot Focus. When the layout is opened, it restores Tecplot Focus to the state it was in when the layout file was saved.
Layout Package File	A binary layout file with the .lpk extension which has the data embedded in the file.
Line Map	A set of points from a single zone where one variable is assigned to an X-axis and another is assigned to a Y-axis. You can define many XY-maps for an XY-plot.
Macro	A file containing a list of instructions, called macro commands, which can duplicate virtually any action performed in Tecplot Focus.
Macro Command	An instruction given to Tecplot Focus in a macro file. Macro commands always start with a dollar sign and then an exclamation mark. For example, \$!Redraw refreshes a plot view.
Macro File	A file which contains a series of macro commands. Macro files are run from the command line, or through the Play option of the Scripting menu.
Macro Function	A self-contained macro sub-routine.
Macro Variable	A holding place for numeric values in a macro file. There are two types of macro variables: user-defined (you set and retrieve the value), or internal (Tecplot Focus sets the value and you may retrieve it).

Map Layer	One way of displaying a line mapping, such as with line, bars, symbols, and so forth. One mapping may be displayed with one or more layers.
Median Axis	In 3D, the grid axis which when scaled is not the shortest nor the longest axis.
Menu Bar	The top bar of the Tecplot Focus screen used to select menu options.
Mesh	A 2D or 3D field plot type which plots connections between data points.
Multi-Colored	Any Tecplot Focus object which is colored by the value of the contouring variable. Multi-colored objects may include mesh, scatter symbols, vectors, contour lines, and streamtraces.
Nearest Point Mode	When probing is activated using a Control+click, the value returned is the precise value of the closest data point. See also: Section "Interpolate Mode" on page 418.
Node	A point in finite element data.
Number Format	The style of numbers to display for a data or axis label; exponent, integer, float, and so forth.
OpenGL	A graphics library for high-end 3D graphics. It commonly takes advantage of hardware acceleration for 3D rendering.
Ordered Data	A type of data point organization which consists of a parameterized series of points. There are seven types of ordered data: I, J, K, IJ, JK, IK, and IJK-ordered. I, IJ, and IJK-ordered are the most common.
Orthographic Projection	A plot view in which the shape of the object is independent of distance. This is used for displaying physical objects when preserving the true lengths is important.
Overlay	Mesh type where mesh lines are drawn over all field-plot layers, except for vector and scatter layers.
Pick	Select an item in the plot area by clicking on it with the mouse.
Plot Type	Determines the type of plot which is displayed in a frame. For example, 2D Cartesian plot, 3D Cartesian plot, XY Line plot, Polar Line plot, or Sketch plot.
PLOT3D	A plotting package developed by NASA.
Polar Line Plot	A plot of radius versus angle, or vice versa. The polar axes are the radial axis (by default zero at the origin) and theta axis (by default zero for any data on the right running horizontal line).
Polytope	The generalization to any dimension of "polygon" in two dimensions, "polyhedron" in three dimensions, and "polychoron" in four dimensions
Pop	Bring selected geometries or text to the top of the viewstack.
Precise Dot Grid	The points of intersection of the imaginary lines extending from the X- and Y-axes' tick marks.
Primary Corner	The point in an ordered zone's cell that has the minimum index values for that cell, or the first listed node of a finite element cell.

Glossary

Probe	To obtain interpolated values of the dataset variables at a specified location by clicking on a point in the data region.
Push	Send selected geometries or text to the bottom of the viewstack.
Quadrilateral	An element type of finite element surface data which is composed of four node points arranged in a quadrilateral. Used in 2D and 3D surface plotting.
Quick Macro Panel	A user-defined panel accessed from the Scripting menu which allows quick access to your macro functions.
Rake	A line along which a number of streamtraces may be seeded.
RGB Color Flooding	The assignment of color based on Red, Green, and Blue components defined at field data locations.
Ribbon	(See Streamribbon.)
Richardson Extrapolation	A sequence acceleration method, used to improve the rate of convergence of a sequence.
Rod	(See Streamrod.)
Scatter	A 2D or 3D field plot type which plots a symbol at each data point.
Shade Plot	A 2D or 3D field plot type which plots solid color or colors with lighting effect over the cells of the data.
Sharing	Variable sharing allows a single storage location to be used by more than one party. For example, if the X-variable is shared between zones five and seven, only one storage location is created. The storage is not freed by Tecplot Focus until the number of parties accessing the data is reduced to zero. Variables and connectivity information may be shared.
Sidebar	A movable, dockable panel (by default located on the left side of the Tecplot Focus window) which provides quick access to frequently-used functionality. Tecplot Focus includes multiple sidebars: Plot, Frames, Pages, Probe, and Quick Macro.
Sketch Plot	A plot which displays only text and geometries, not any data-derived elements.
Slice	A set of data created by the intersection of a plane with 3D zones.
Snap-to-Grid	Lock any object on the screen to the closest grid point. The position and size of the object will be affected by changes to the grid.
Snap-to-Paper	Lock any object on the screen to the underlying paper. The position and size of the object will not be affected by changes to the grid.
Sorting	The process of resolving hidden-surface problems during display of a 3D plot.
Specular Highlights	Highlights with qualities similar to those of a smooth reflecting surface such as metal, where light is reflected so intensely from some points that the plot appears white (or the color of the light) at those points.
Status Line	The bar located at the bottom of the Tecplot Focus screen which provides "hover" help for tools and acts as a progress bar during calculations.

Strand	A series of transient zones that represent the same part of a dataset at different times.
Stream	Particle traces through a vector field.
Stream Format	The type of streamtraces being placed in Tecplot Focus. For example, Surface Line, Volume Line, Volume Ribbon, or Volume Rod.
Streamline	A 2D or 3D line which is parallel to the vector field along its entire length. For a steady state vector field, this is the same as a simple particle trace which marks the path of a massless particle in the vector field.
Streamribbon	A particle trace with a width which not only follows the flow field (its center being a regular streamline), but which also twists with the vorticity of the vector field.
Streamrod	A particle trace with a polygonal cross-section and a width which not only follows the flow field (its center being a regular streamline), but which also rotates with the vorticity of the vector field.
Streamtrace	Any type of particle trace: streamlines, streamribbons, or streamrods.
Streamtrace Termination Line	A polyline that terminates any streamtraces that cross it.
Streamtrace Zone	Any streamtrace which has been extracted to form a new zone.
Stylesheet	A type of file which contains the definition of how the plot in a single frame is to be plotted. The stylesheet does not contain any zone data but does contain information about views, axes positions, zone attributes, and so forth.
Supersampling Factor	When antialiasing an image for export, the factor Tecplot Focus uses when creating an intermediate image that is then resized down to the final image size. The larger the value, the smoother the resulting image at the cost of performance. Values of more than 3 are seldom necessary.
Surface Line	A type of 3D streamline which is confined to remain on a 3D surface. Also used to refer to streamlines.
Symbols Mapping Layer	Line plot where symbols are used to depict the relationship between the dependent and independent variables.
Time/Date	A type of axis label format with which you can label axes by using a multitude of codes that can display data in years, months, days, hours, minutes, and seconds.
Toolbar	The bar at the top of the Tecplot Focus workspace.
Tetrahedron	An element type of finite element volume data which is composed of four node points arranged in a tetrahedron. (Used in 3D volume plotting.)
Transient Data	Data that has a time component in addition to a spatial coordinate.
Translucency	A property allowing you to see through an object to areas within or beyond it. In Tecplot Focus you may vary the amount of translucency, controlling the extent that an object closer to you obscures an object it overlays.

Glossary

Triangle	An element type of finite element surface data which is composed of three node points. (Used in 2D and 3D surface plotting.)
Unordered or Unorganized Data	(See Irregular Data.)
Value-Blanking	A feature of Tecplot Focus used to trim or eliminate cells based on one or more user-defined constraints for variable values.
Variable	One of the values defined at every data point in a dataset.
Vector Layer	A field plot showing the direction and or the magnitude of vector quantities.
Volume Line	A type of 3D streamline which is not confined to remain on a surface and may travel through 3D volume data.
Volume Zone	Any zone that is IJK-ordered, finite element tetrahedron, or finite element brick.
Vorticity	The measurement of the tendency of a vector field to rotate about a point. (Also called "curl.")
Wire Frame	Mesh type where mesh lines are drawn behind all other plot layers.
Workspace	The portion of your screen where you can create Tecplot Focus frames. This includes but is not limited to the region covered by the displayed paper.
XY-Dependent	A 3D axis mode where X and Y are fixed (dependent), but Z is free to vary in ratio (independent).
XY Line Plot	Plots one variable assigned to one axis versus another variable assigned to another axis. Log plots, bar charts, and curve fitted lines are all examples of XY Line plots.
Zone	A subset of a dataset which is assigned certain plot types. Zones may be activated (plotted) or deactivated (not plotted). Each zone has one type of data ordering: I, IJ, IJK, or finite element. Zones are typically used to distinguish different portions of the data. For example, different calculations, experimental versus theoretical results, different time steps, or different types of objects, such as a wing surface versus a vector field around a wing.
Zone Layers	One way of displaying a 2D or 3D plot's dataset. The plot is the sum of the active zone layers, which may include mesh, contour, vector, shade, scatter and edge.



Functional Limits

H - 1 Hard Limits

The following hard limits are designed into Tecplot Focus. Your workstation's memory may, however, not always be sufficient to allow the product to reach these limits.

Table H - 1: Hard limits for Tecplot Focus

Item	Limit
Maximum number of data points per data set	5 million
Maximum number of data points per zone	5 million
Largest floating point absolute value	10^{150}
Smallest non-zero floating point absolute value	10^{-150}
Maximum number of datasets	2048
Maximum number of zones	More than 2 billion (in practice, much lower due to the 5 million data point limit)
Maximum number of variables	More than 2 billion
Maximum number of frames	2048
Maximum number of pages	2048
Maximum number of macro variables	400
Maximum number of value blank constraints	8
Maximum number of contour groups	8

Table H - 1: Hard limits for Tecplot Focus

Item	Limit
Maximum number of geometries	Limited only by memory
Maximum number of polylines per line geometry ^a	50
Maximum number of points per circle or ellipse	720
Maximum number of custom label sets	Limited only by memory
Maximum number of custom labels per set	5000
Minimum frame width or height	0.1 inches
Maximum frame width	500 inches
Maximum streamtraces per frame	32,000
Maximum number of streamtrace steps	10,000
Maximum number of color map overrides	16
Maximum preview width for EPS files	1024
Maximum preview height for EPS files	1024
Maximum number of user-defined color map control points	50
Maximum number of raw user-defined color map entries	800
Maximum number of characters in variable name	128
Maximum number of characters in zone title	128
Maximum number of characters in dataset title	256
Maximum number of views per view stack	16
Maximum number of characters in an auxiliary data string	32,000
Line length limit in ASCII <i>.dat</i> files (character limit per line)	32,000

a. A polyline is a continuous series of line segments, and can be a subset of a line geometry.

Table H - 2: Hard Limits for plot styles

Item	Limit
Printing Gouraud shaded plots with continuous flooding	On screen or exported bitmap image only
Printing plots with translucency	On screen or exported bitmap image only

H - 2 Soft Limits

The following soft limits may be changed by editing your Tecplot Focus configuration file. The configuration file, *tecplot.cfg*, is installed in your Tecplot Focus home directory.

Table H - 3: Soft limits for Tecplot Focus

Limit	Soft Limit	Hard Limit	Macro Parameter
Points per line ^a	20000	Quintillions	MAXPTSINALINE
Contour levels	150	5,000	MAXNUMCONTOUR
Characters per text label	16,000	100,000	MAXCHRSINTEXTLABELS
Picked objects	1500	More than 2 billion	MAXNUMPICKOBJECTS
Available processors	0 ^b	64	MAXAVAILABLEPROCESSORS

- a. Points per line is the limit on the number of points allowed in the following: line segment geometries, stream termination lines, and contour lines. For line segment geometries, this is the total number of points used in all polylines contained in the geometry.
- b. If MAXAVAILABLEPROCESSORS is 0, Tecplot Focus queries the hardware for the number of processors and uses that value.

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