USER MANUAL

TracTrix™

Version 6

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TracTrix™ User Manual, Rev. 6.2.3.5, 5/7/07

PREFACE

To get the most benefit from *TracTrix*, you should take a few minutes to become familiar with its basic concepts and features by browsing through the manual.

This manual is structured into six sections:

- **Table of Contents**
- Section 1, **Overview**—general introduction of *TracTrix* and it's capabilities
- Section 2, **Functions**—a table of reference for each function and control
- Section 3, **Getting Started**—features viewing and quick-start conversion instructions
- Section 4, **Raster-to-Vector Conversion in Detail**—from scanning to exporting
- Section 5, **Additional Details**—scaling and measuring, and mark-up techniques
- Section 6, **Tutorials**—step-by-step exercises for converting *TracTrix* sample files
- Appendix 1, **Supported Format**—a list of supported raster and vector file formats
- Appendix 2, **Measurement conversion tables**—charts points and inches to millimeters
- **Index**

What's New in Version 6

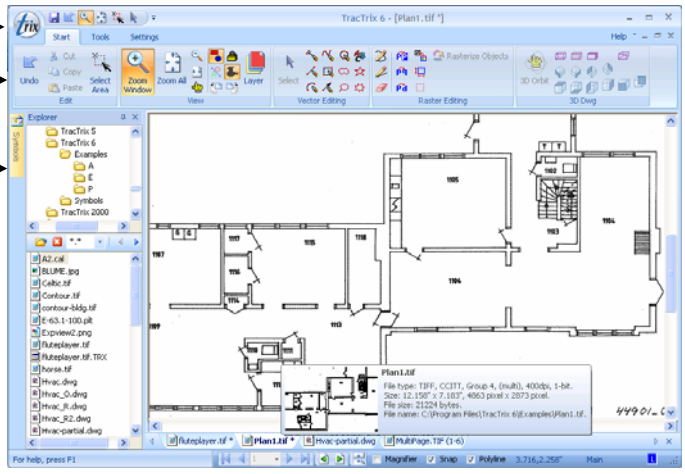
A new interface gives you easier access to tools and functions.

The **Quick Access Toolbar** can be customized so the tools you use most are always visible.

Menu Ribbons provide access to all tools; switch them with the scroll wheel.

The **Explorer File Browsers** provides direct access to files and existing **Symbol** libraries.

When hovered with the mouse, hotspots on file tabs and vector entities display file and object properties in the form of a bubble.



3D DWG and DWF files have been added to the many file types that *TracTrix* supports. The new 3D Orbit tool supports free rotation of the image and various view settings are offered, including wire-frame and shaded.

The **Drawing Comparator** enables you to rapidly see the difference between two drawing versions, and works with both raster and vector files.

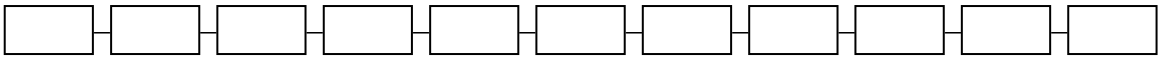
Table of Contents

Section 1: Overview

INSTALLATION

Activation

License activation is initiated using the serial number and instructions that you received in your product delivery email. Print the email and store it with a printed copy of this documentation. Or carefully record the serial number here, for safe keeping.

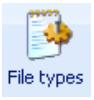


You must complete the activation process upon registering your license in the *Trix Systems License Manager*. If activation fails, you will receive a message to that effect. Failure to successfully activate your license will result in the program running in demo mode.

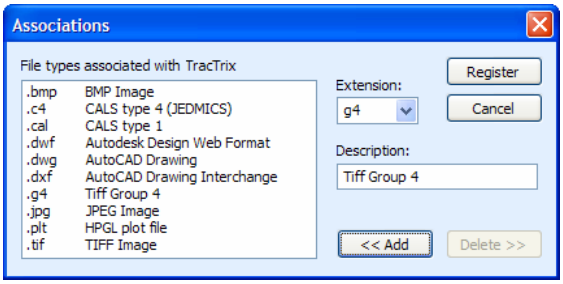
Details about how the Trix Systems License Manager works is provided in the separate *Trix Activation Manual*.

Set basic preferences

Register file-types by association



The first time you run *TracTrix* the File Type Associations dialogue opens on start-up. Here you can register the file extensions that you wish to open with *TracTrix*.



Directly, it is accessible in the Settings tab.
The list on the left shows file types already associated with *TracTrix*. The drop-down menu shows standard file extensions to add. Alternately, your own extension and description can be entered [*].

Change file associations

File associations can also be changed within the Windows Folder Options control panel. Choose File Types, select the extension you wish to change, and click Change to identify the application you wish to associate with the extension.

Unit of measure

In the **Program Settings** you can set the default unit for measuring and other settings (see page 22).

[*] Adding a file extension here doesn't mean *TracTrix* can open that particular format. See Appendix 1 for supported file formats.

Moving the license to another computer

You must first deactivate the license on the original computer. Use the *Trix Systems License Manager* to do this before shutting down the original computer:

1) Press Deactivate License... . Complete the on-screen deactivation. You will receive an email notifying you that your license has been successfully deactivated. Call us if it doesn't go through.
2) If you do not have a record of your serial number, press Settings... in the *Trix Systems License Manager* dialog box. Copy the text from log in the bottom box and email it to yourself—it contains your serial number which you'll need for the reactivation.
3) Download the latest installers on the new computer from http://www.trixsystems.com/sw/TracTrixInstallers.zip.
4) Use the instructions above as though you were making the installation for the first time.

Support

If you experience any difficulty with *TracTrix* we suggest you first check that you are using the most updated version. Do this using Search for updates.. located in the Help menu. This will prompt your internet browser to check if there is a newer version than the one installed.

It is usual for *TracTrix* to write information back and forth between RAM and your hard drive as it processes your images. Any damage to your hard drive or file tables may cause problems.

We also recommend you work off of your local hard drive, work in a .trx file, and save often.

If you experience trouble you can contact us by going to http://www.trixsystems.com/support.

FILE-CONVERSION BASICS

The difference between raster, vector, and .pdf

TracTrix handles three different types of image files. As a *TracTrix* user it is important to understand the difference because it is detrimental to understanding the conversion process.

The first type is the **raster image**, usually produced by a scanner or a 'screen shot'. Raster images are usually referred to as bitmaps. The basis for these images is simple—one rectangular grid-based layer of 'dots'.

The second type is the **vector image.** This can be a DWG, DXF or DWF file created in a CAD application such as AutoCAD, or an HP-GL file (usually with the extension .plt) created by a Hewlett-Packard plotter driver in a CAD application. All vector formats are mathematically based. There may be multiple layers and views in a single vector file. And vector files may use font descriptions stored elsewhere on your computer as TrueType or SHX fonts. One vector file may 'call' other vector or raster files to display as part of the overall image. These are sometimes called external references or x-ref files.

The third type is the **Acrobat PDF image**. Although every PDF file can be viewed in Acrobat Reader, the contents of the file can be quite different. The approach you take to converting the PDF to vectors for use in CAD will depend on the content type:

- Vector-based—All the lines in the image are created from mathematical vector descriptions. Usually created from a CAD program by the full version of Acrobat The success and popularity of the PDF format has led to a massive increase in numbers of engineering and architectural drawings and documents published as PDF. Although easily read in the Adobe Reader, conversion of PDF information into a format that can be used in CAD or NC cutting is challenging.
- Raster-based—The image is stored as rows of individual pixels. Adobe refers to this as *image-only* PDF.
- Hybrid—Both raster and vector components are present in the same image. Typically this is produced when Acrobat creates a PDF from a page or drawing which contains both vector line-work and raster illustrations.

TracTrix enables you to simultaneously open all three kinds of files. The tools available at any one time will differ according to the type of file that is open and active.

All of these formats are digital. It is strongly recommended that you go through the Tutorials in Section 6.

What does *TracTrix* do?

The primary function is raster-to-vector conversion. *TracTrix* facilitates, and executes vectorization, the process of tracing raster lines and images to a vector representation.

Additionally *TracTrix* provides the user with tools to:

- edit raster images.
- view, resize, print, and markup raster files and vector files with x-refs and SHX fonts.
- measure and scale drawings.

- easily share your edits and markups with others.
- convert between many raster and vector formats.
- add symbols and markup into a DWG or DXF so for editing in an AutoCAD application.
- compare between two revisions of one drawing.
- convert vectors to rasters or PDF.
- convert DWF to DWG/DXF

The original raster file you open in *TracTrix* is not modified by vectorizing—it acts as an underlying layer that can be toggled on and off (separate from the layer or layers on which you perform edits or create vectors). *TracTrix* saves your work in its native file-format: .trx.

Some conversions consist of simply opening a file of one type and saving it as another. Raster-to-vector conversion however requires vectorization (which can be easy or time-consuming, depending on what you're starting with). *TracTrix* is a conversion program—it doesn't replace a CAD program. The vector editing tools are for editing vectors created in *TracTrix* only (not for editing vectors in a DWG that is open in *TracTrix*).

One-color or spot-color images work best for vectorizing

TracTrix creates vectors in or along the boundaries of two spot colors (or grays). A spot color is an area of color where every pixel has the exact same color. True spot colors have no gradation between colors. Take a look at the following images:

The grays in this image move gradually from very light on the left to very dark on the right. It is impossible to say where to put a boundary line because there are no boundaries. There are no spot grays in this image. Like a photograph, it is entirely tonal. Contrast this with the image below where there is a clear boundary between the two spot shades of gray.

In this image it is easy to see where to draw a line down the boundary, or line of demarcation. And, just like our eyes, *TracTrix* prefers a well-defined boundary in order to know where to create the vector line.

QUICK-STARTS

Raster scans to CAD vectors

Examples	Logo	Floor plan
Explorer [Ctrl + O] or use the Explorer File Browser	Open the TracTrix 6/Examples folder (usually in the Program Files folder). Select…	
	Logo.tif	Plan1.tif
Despeckle Fill Holes Invert Pixel depth Vertical Change size Horizontal Crop	Notice the dirt on the drawing. Clean the image with Despeckle in Tools tab. Accept defaults and click OK. Notice how dirt is automatically cleaned.	This image is clean.
Vectorizing	With the mouse over the menu ribbon, roll the mouse wheel to switch menus until you locate Vectorizing on the Tools tab. Drop-down the setting menu and choose…	
	Outline	**Architecture**
	Notice the green progress bar at the foot of the window.	
	TracTrix creates blue vectors around the black logo.	*TracTrix* creates blue vectors along the centerline of the plan.
	Control-S to save it as a .trx file.	
	Use **Drawing** (in the Start tab) to hide the raster image underneath.	
Orthogonal	The logo does not require orthogonal adjustment.	Notice how many of the lines are crooked. Use Orthogonal to straighten lines and square-up corners automatically.
Save As… [Ctrl – S]	Save the vectors using Save As… and choose Control-S to save the .trx file. (DWG, DXF, IGES, HPGL, etc).	

Use Select Area to export a specified area; switch on Only selected area in the export dialogue.

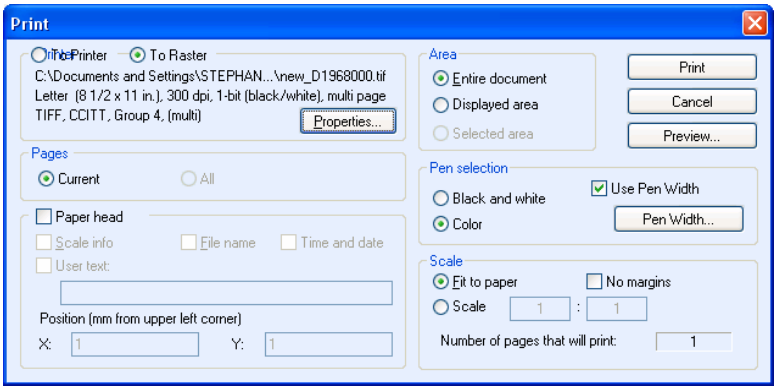
DWG/DXF, DWF, or HPGL to raster or PDF file

Use Print or [Ctrl-P], or to access the Print panel.

Turn on To Raster radio button.

Make adjustments in this panel for any settings you wish to change.

Use Properties... to specify the sheet size, dpi, and bit depth of the export file. 'Pen selection' options enable you to convert color vectors to different line widths for output to 1-bit raster files (see page 50 for details).



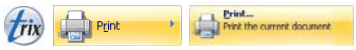
DWF to DWG or DXF

Open the DWF file and use 

to save the file as a DWG or DXF.

PDF to vector

You must first convert the PDF to a raster image before vectorizing.

Use [Ctrl-P], or 

to access the Print panel.

Turn on 

radio button.

Setup the print to create a TIFF CCITT Group 4 file. Select a page size equal to the original.

Check the 'Open raster file' box so that the image is opened immediately in *TracTrix*.

At this point the conversion becomes a raster-to-vector conversion as described above.

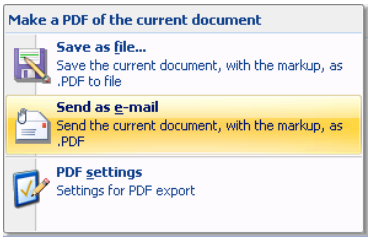
Convert from the TIF image that appears in the *TracTrix* window.

DWG, DXF, DWF, HPGL, or raster to e-mail PDF

Use 

Send as email—this creates a PDF file and adds it as an attachment to a blank email in your default email application.

Use **PDF Settings** to specify the file size, dpi, and more.



Raster to raster

Open the file and save it as another raster file type using 

.

Use Select Area  to export a specified area; switch on 

in the export dialogue.

Section 2: Functions—Table of Reference

SHORTCUTS FOR QUICKER PROGRESS

Mousing tips

- Right-click/HOLD & Drag to enable the **Pan** tool  to move the drawing in the window
- Roll the mouse wheel to zoom in and out
- Scroll the mouse wheel over the menu Ribbon (or tabbed menus) to switch menus
- Right-click often for hidden menus

Keyboard commands

+ = press keys together at the same time
– = press each key one at a time

Key-code customization is available in 

accessible in the Quick Access Toolbar.

Standard function shortcuts

TracTrix supports the following universal and commonly-used key codes:

Invert selection	[Ctrl + I]	Copy	[Ctrl + C]
Undo	[Ctrl + Z]	Cut	[Ctrl + X]
Exit active tool	[Esc]	Paste	[Ctrl + V]

Menus shortcuts

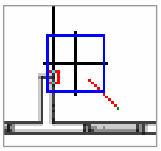
Quickly gain access to basic file-menu functions:

 Menu	New	[Alt – F – N]	Start tab	[Alt – S]
	Open	[Alt – F – O]	Tools tab	[Alt – T]
	Close	[Alt – F – C]	Settings tab	[Alt – E]
	Save As	[Alt – F – A]	Help tab	[Alt – H]
	Acquire	[Alt – F – Q – I]		
	Print	[Alt – F – R – R]		
	Print Preview	[Alt – F – R – V]		
	Print Setup	[Alt – F – R – S]		
	Publish PDF	[Alt – F – P]		
	Properties	[Alt – F – E]		
	Exit	[Alt – F – X]		

Toggle keys

Snap

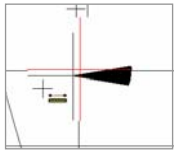
[Keyboard toggle: S]



Many tasks include cursor and image interaction. Like a paperclip to a magnet, **Snap** enables the cursor to snap to lines, intersections, and nodes on the underlying image. Snap works best when the image is zoomed out. Snap activation can be toggled on the keyboard by pressing the S key, or by clicking the checkbox in the Status Row.

Magnifier

[Keyboard toggle: Z]



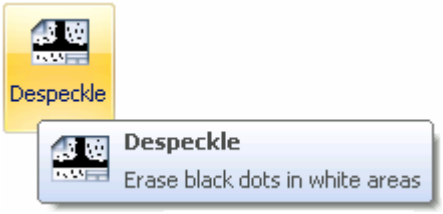
Instant on-the-fly magnification, the **Magnifier** works best on images that are zoomed out. Press Z to activate the magnifier, then hover the mouse over the image for a bird's eye view. Red cross-hairs indicate the original position of the cursor. Magnification disappears upon clicking the target point—press Z again to reactivate it for locating the next target point.

Some keyboard shortcuts are displayed on screen by pressing the Alt button which toggles the key-codes on and off. Key-codes appear over the controls; press a corresponding key to use the control or access another menu.

Tool-tips

Hover the mouse over any tool displays a tool-tip that shows the tool name and function.

Object and file information is at your fingertips with the Hover functions enabled in the Program Settings (Settings tab).



QUICK ACCESS TOOLBAR

You can customize the Quick Access Toolbar to display the tools you use most often. Press the down arrow to view options. Choose More Commands... to view the selection of tools that can be added. Select Show Below the Ribbon if you prefer the bar to appear closer to your workspace. Use Minimize the Ribbon to toggle the Ribbon on and off.

This toolbar is always available and visible. The tools that are shown by default are:

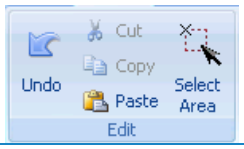
Save markup	[Ctrl + S]	Markup files have the file extension .trx—native to all Trix applications.
Undo	[Ctrl + Z]	Undo the previous action (may be repeated for multiple undos).
Zoom in	[Alt – 3]	Left mouse click/drag to create a rectangular area to view. Your mouse wheel can also be used for zooming in and out.
Zoom all	[Alt – 4]	Adjusts zoom so that entire image fits in the window.
Select area Add area with SHIFT Deduct area with Ctrl	[Alt – 5]	Use to select regions of a raster document for copying, printing, manipulating, or deleting. Left-click and drag to select the required area.
Select	[Alt – 6]	Use to select vector entities and markup, including lines, symbol, circle, text, object, image sheet or markup for edit or deletion.

TRIX MENU

New	[Alt – F – N]	Creates a blank, unsaved .trx file.
Open...	[Ctrl + O]	Launches a dialogue box to open a file. See Appendix 1 for a complete list of supported file formats.
Save	[Ctrl + S]	Saves your work. This will save your work to a .trx file.
Save As...	[Alt – F – A]	Prompts for dialogue box to export a file. Exportable file types are listed in the *Save As Type* drop-down menu.
Publish PDF	[Alt – F – P]	Save or email a PDF of the current document (see page 52).
Acquire	[Alt – F – Q – I]	Drives a peripheral scanner (see page 27).
Print	[Ctrl + P]	Accesses Print menu-controls, including Setup and Preview.
Close	[Alt – F – C]	Closes the current document.
Properties...	[Alt – F – E]	Displays dimensions and other details about the file.

START TAB

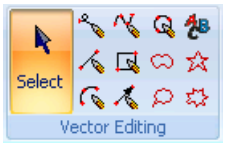
Edit Group



Undo	[Ctrl + Z]	Undo the previous action (may be repeated for multiple undo).
Cut	[Ctrl + X]	For cutting markup from the markup layer and placing it in the clipboard.
Copy	[Ctrl + C]	For copying selected markup to the clipboard.
Paste	[Ctrl + V]	For pasting markup from the clipboard onto the markup layer.
Select Area	[Alt – 5] Add area with + SHIFT Deduct area with + Ctrl	Use to select regions of a raster document for copying, printing, manipulating, or deleting. Left-click and drag to select the required area.

View Group

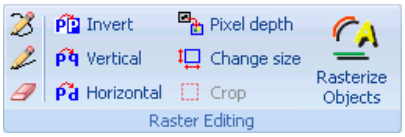
Zoom Window	Zoom in or use scroll wheel	When you open a file, the zoom tool is automatically selected. Click and drag to select the required area to view. The region defined by dragging is indicated by a dashed rectangle.
Zoom All	[Alt – 4]	Adjusts zoom so that entire image fits in the window.
	Zoom out or use scroll wheel	Click to zoom out to previous magnification.
	Adjust to width	Adjust the image width to the window's width.
	Lock Zoom	All images will be displayed at the current level of zoom.
	Pan Right-click/HOLD + Drag	Use this tool to view parts of the image hidden from view (under the edges of the window).
	Filled objects	Toggle fill-displays in areas.
	Vectors and Markup	Toggles display of markup, vectors, and symbols on and off.
	Drawing	Toggles display of raster image on and off.
	Rotate tools	Rotates raster document in 90° increments CW or CCW.
Layer		Accesses markup layers and DWG/DXF layers in DWG or DXF files. To learn how to use and control Layers, see page 44.



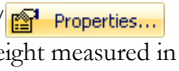
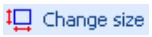
START TAB

Vector Editing

Use to select vector entities and markup, including lines, symbol, circle, text, object, image sheet or markup for edit or deletion.	Select [Alt – 5]	
Use to create a new text entity.	Text	
Use to draw vectors and markup. Vector markup never changes the content of the original file—all work is saved to a .trx file (native to *TracTrix*).	Vector drawing tool	
Use to draw markup clouds.	Cloud markup	



Raster Editing

Use to select regions of, or items in, a document for copying, printing, manipulating or deleting Left-click and drag to select the required area.		Select [Alt – 5] Add area with + SHIFT Deduct area with + Ctrl	
Right-click/  to adjust weight measured in pixels. Images must be 8-bit or less (see page 32). Works well with Snap.	Draws a freehand path of pixels.	Freehand pen	
	Draws a straight line.	Line pen	
	Deletes freehand path of pixels.	Raster eraser	
Invert the color values in the raster image (e.g. black becomes white).			
Rotate the raster image on a vertical or horizontal axis.			
Reduce or increase the bit depth of an image.			
Use to edit the sheet size and DPI of a raster image. Select a new size from the list or enter a new width and height to size the raster.			
Crop is only enabled when a raster area has been selected using with Select Area.			
Use to imprint vector lines or markup to the raster layer.		Add items with + SHIFT Deduct items with + Ctrl	

3D DWG/DWF

Inactive for 2D files

3D Orbit activates the rotate and perspective tools below. Use with Right-click/Pan.

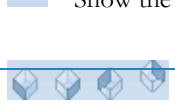

Display a wire frame image without surfaces.

Remove hidden lines.

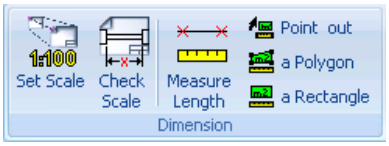

Top, side or end views.


Shade surfaces fully.

Show the model in perspective.

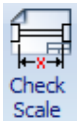
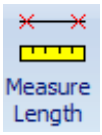

View from corners.

TOOLS TAB

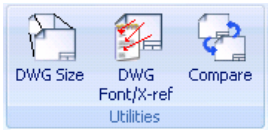


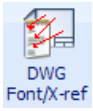
Dimensions Group

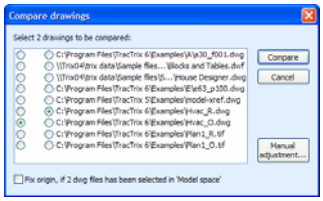
Scaling and measuring techniques are covered in detail beginning on page 47.

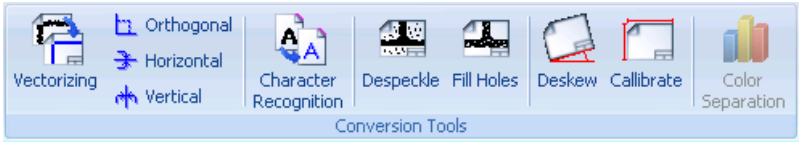
		Use this to set the scale of the drawing if you know the scale.
	Works well with Snap.	If you do not know the scale of a drawing, but there are known dimensions in the drawing, use this tool. *TracTrix* will then calculate the scale.
	Works well with Snap.	**Before taking any measurements the appropriate scale must be established.** Once a scale has been set in a drawing you can take measurements by clicking successively on two points in the drawing, then right-click/Exit to see the length.
	Add area with + SHIFT Deduct area with + Ctrl	Automatically locates the boundary of an area, such as a room, and measures area and perimeter. Within the rolling boundary, right-click/Create an area object to display measurements. If the tool misinterprets the desired area try starting from another point. Use 'Save the area object' to imprint polygon as visible, hatched markup.
	Works well with Snap.	Use this tool to take measurements from a non-rectangular region. Click successively on boundary points, and then right-click/Close the polygon. Select a node and drag to edit polygon shape. Use 'Save the area object' to imprint measuring area as visible, hatched markup.
	Works well with Snap.	Use this tool to define and take measurements of a rectangular region. Use 'Save the area object' to imprint rectangle as visible, hatched, markup.

Utilities Group



	Resize DWG, DXF or DWF files for printing by selecting a pre-set document size (e.g. ANSI C), entering dimensions or changing the scale.
	Displays names of fonts and x-refs called by DWG files, and substitutions made if any fonts are unavailable. If an x-ref is missing the panel displays a message to this effect. Resize the panel to see path names.
	When two versions of the same drawing are open, raster and/or vector, use Compare to see the differences between the two. Select the original version on the left, and the revised version on the right, then click on Compare. The application will display deletions in red and additions in blue. If the drawings are different sizes use the Manual Adjustment to align content before starting the comparator. Check the 'Fix origin' box if two DWG files are to be compared in Model Space.





TOOLS TAB

Conversion Tools

Active only for raster images, this button launches the dialogue box used to begin vectorizing.	Vectorizing
Use on vector/markup layer after tracing to 'square-up' vector line corners and intersections.	Orthogonal
Realigns vector lines horizontally and vertically.	Horizontal Vertical
Active only for raster images, this button launches the OCR program to convert raster text to ASCII text.	Character Recognition
Active only for 1-bit images, this tool cleans by removing dirt (small clumps of pixels).	Despeckle
Active only for 1-bit images. *TracTrix* prefers a **solid** black line to trace. This feature fills any white pixels that are dispersed within the black line. Adjust settings as necessary.	Fill Holes
Rotates the raster entities to an exact position; essentially deskewing a crooked drawing.	Deskew
Adjusts the image size and scale in both x and y axis according to your dimensions.	Callibrate
Use to reduce the bit depth of the image. This panel provides precise controls for separating colors.	Color Separation

SETTINGS TAB

Settings Group

Program Settings are applied to the entire program. Checkboxes toggle functions on and off.

Default Unit—Sets the default units used in *TracTrix*.

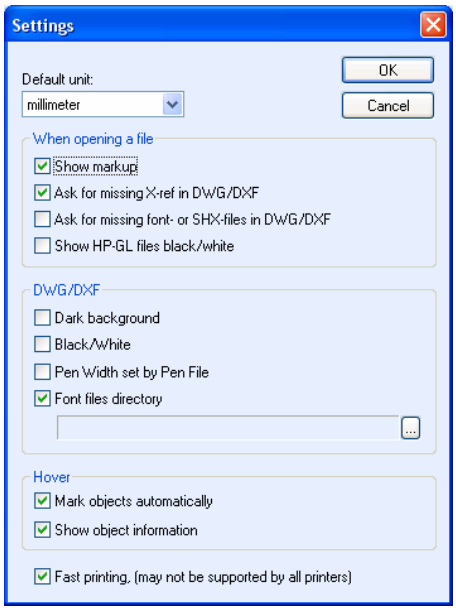
Show markup—Sets application to display associated markup and vectors upon opening in *TracTrix*. The Vectors and Markup toggle is enabled regardless of this setting.

Ask for missing X-ref in DWG/DXF—Check this box to be warned if any x-ref files cannot be found. See page 49 for details about how *TracTrix* looks for x-refs.

Ask for missing font- or SHX-files in DWG/DXF —*TracTrix* looks for the TrueType and SHX fonts called by vector files in order to display text as in the original. Check this box if you wish to be prompted when a font cannot be located. Or specify a font file directory in the field described below. For detailed information about how *TracTrix* looks for and replaces fonts see page 49.

Show HP-GL files black/white—Displays color HP-GL and PLT files as black and white.

Dark background—Defaults to displaying vector files against a black background.



Black/White—Check this to display all lines as black-on-white (or white-on-black if combined with Dark Background checkbox).

Pen widths set by Pen File—Without Pen widths single color printers print all vector lines the same width. Pen files enable vector colors to be displayed as different line weights as defined by the active Pen file. Pen files are simple ASCII text files that can be opened and edited in Notepad. The active Pen file is specified in **Pen Settings** (see page 50).

Font files directory—SHX fonts are not stored in the Windows operating system. If you wish to have them display correctly in *TracTrix* you must point to the directory that stores them. To do this, check the box, then click on the **…** button to browse to the directory where the SHX fonts are stored. See page 49 for details.

Hover is on, by default, and makes working with vectors easy. It provides instant access to needed information, such as file and markup information. **Mark objects automatically** enables vector and markup entities to be activated when hovered over with the pointer. **Show object information** enables display of object information bubbles, like the one on the right.

Fast printing—Leave this checked, unless you experience problems printing. Turning off Fast Printing may resolve failure to print.

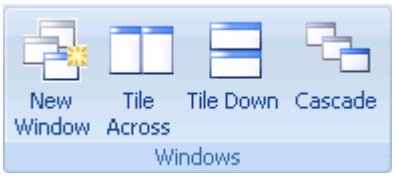
Use Pen Settings to set specific line weights for corresponding colors in a vector file. Instructions for how to use Pen Settings are detailed on page 50.

Specify default color attributes for new vector and markup entities (see page 41).

There are two choices for the default color used by the markup and vector tools. You can either have the color defined by the color of the markup layer in which you are working, or choose a color to use regardless of layer. Go to the Settings tab and click on **New Entities**. Use the radio buttons in the window that appears to select *Color by layer* or *Custom*. If *Custom* is selected the *Select color* button is enabled. Use this to select the color to use.

In the same window there is a setting for the default line width to be applied to markup. Markup line width can be changed by selecting the markup on screen and right-click/ Properties… .

Used to manage file type associations (by file extension) with *TracTrix*.

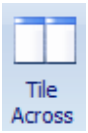


SETTINGS TAB

Windows Group

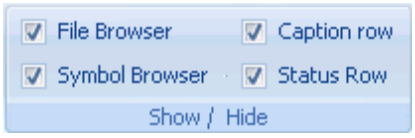
Opens a new window containing a copy of the current document.
Use this to zoom in to details in different regions of a file and view them side by side.

Displays all open windows or files in vertical tiles, side by side.



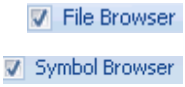
Displays all open windows or files in horizontal tiles, one over the other

Cascades tiles in window.



Show/Hide Group

With this option turned on, roll your mouse over the orange tab on the left to reveal the Explorer File Browser (page 25) or the Symbol library (page 43).



When turned on, this displays an information caption above each document. This information is also displayed for a hover over file name tab at the foot of the window.

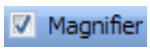
File type: PDF. Size: 8.265" x 11.680". File size: 10104386 bytes. File name: \\Trix04\trix data\Sample files\sample PDFs\02-628 schema.pdf.

Displayed at the foot of the window the Status Row provides access to valuable viewing and navigation tools, and key points of reference:

Navigate pages or layouts in multi-page documents.

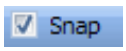
Navigate between documents (if multiple documents are open).

In multi-page documents, this control toggles the activation of the scroll wheel between page navigation mode and zoom mode. In navigation mode, the scroll wheel tool can instead be used to pan.



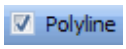
Toggle key: Z

Enables the magnifier; works best zoomed out. The cursor will act as a hovering magnifying glass. For details on using the Magnifier and other viewing techniques, see page 25.



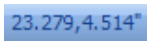
Toggle key: S

Check Snap to have your markup and measuring tools snap (jump to) lines and nodes on the underlying image (see page 25).



Toggle key: P

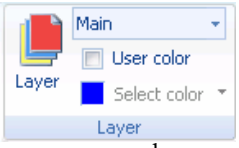
Use Polylines to join vector-line endpoints to form a continuous polyline. A key icon appears, enabling the points to snap together.



Displays the cursor coordinates. 0,0 is top left.

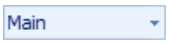
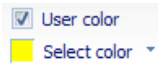
Displays the name and color of the active markup layer.

OBJECTS

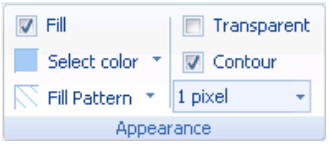


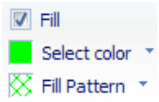
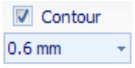
Layer Group

The Objects tab is available whenever a markup entity is selected.

 Layer	Opens the **Layer Control** tool window. See page 40.
 Main	Use this drop-down menu to assign the selected entity (or entities) to a specific markup layer. The name of the assigned layer is then displayed in the panel. See techniques for using markup layers and sharing markup on page 52.
 User color, Select color	Use to change the color of an entity from the default (which is set by the Layer properties) to a user-selected color.

Appearance Group



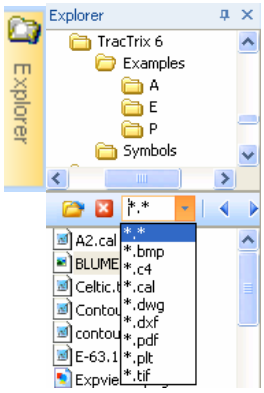
 Fill, Select color, Fill Pattern	Use this box to select a fill color and pattern for entities with boundaries (i.e. rectangles, polygons). When the Fill box is checked, Select color and Fill Pattern become available.
 Transparent	Set transparency on vector and markup entities.
 Contour, 0.6 mm	The solid edges of filled entities are displayed if the Contour box is checked. Use the sizing window below to set the width of the edge.

Area Tool

 Area SHIFT to select multiple entities	Use to select multiple measured areas; **Area** sums the total area. See page 47 for detailed techniques on measuring and creating areas.

Section 3: Getting Started

Opening and Viewing Files

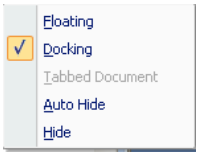


Accessing your files

The Explorer File Browser

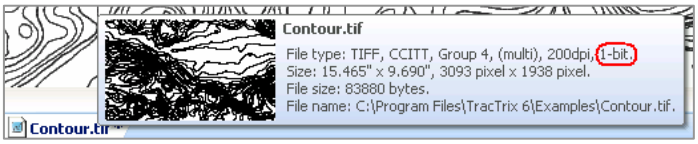
To access your files, use the Explorer File Browser.

Roll-over the orange **Explorer** tab and press the **Push Pin** to dock the window. Access networks and directories in the top frame and individual files in the bottom frame. Double-click on a directory to open/close.



Repositioning the Explorer FileBrowser is possible; right-click in the lower panel for menu of options. Float the window to make more workspace available. Use the file-type drop-down box to filter for the file type that you want.

File properties



Hovering the mouse over the filename tab at the bottom (or use Properties...) displays file name, type, path, and size on disk, as well as the dpi, bit depth, dimensions, and AutoCAD version (if applicable).

Particular details or 'red flags' to observe if you intend to vectorize the image include bit depth, dpi, and file type. See page 32 for more information about the best file properties for vectorizing.

Viewing files: controls and features

Zoom tools

All zoom controls are located in the Start tab.

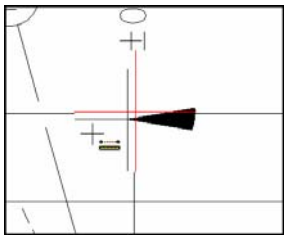
By default, files always open with **Zoom Window** as the active tool, and **Zoom All** as the magnification. Basically *TracTrix* fits the image to the window and gives you the right tool to look at it closely.

←After zooming in, right-click to quickly access the next viewing tool, or roll your **mouse wheel** to zoom in and out.

Right-click/HOLD+ Drag to **Pan** or move the raster or vector image inside the window.

Page and layout navigation

The view controls in the status bar (at the foot of the display window) enable you to navigate between pages, layouts, and files.



Keyboard toggle: Z—Magnifier provides a bird's eye view of the cursor area. Red cross-hairs indicate the original position of the cursor. The Magnifier works best on images that are zoomed out.

When the cursor is positioned over the target point, click the mouse to register a point; the magnification disappears. Press Z again to reactivate it for locating the next target point.

Slide show feature

The **File Browser** enables you to 'slide show' files in the same directory.

Open the file you wish to start the slide show with, then use the **Start** button to launch the show. Each image in the folder will successively display for 3 seconds (3s); duration can be changed with the drop-down menu. Use the **Stop** button to end the show. Turn on **Close Previous** to reduce memory usage and increase display speed—otherwise all files will simply stay open in the application.

The **Lock Zoom** control in the Start menu freezes the viewing position and magnification during slide shows—convenient for browsing the same area of many drawings such as title blocks.

Other viewing options

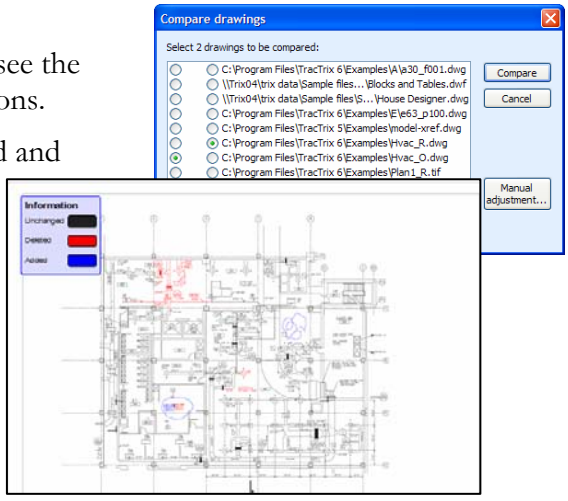
The View group in the Start tab has tools to rotate raster images clockwise or counter-clockwise with the **Rotate** controls , and to invert images and/or rotate them vertically and horizontally .

To show only the outline and hide the fill, click **Filled objects**.

Drawing version comparator

In the Tools tab, **Compare** enables you to see the differences between any two drawing revisions.

Differences are displayed as colors—deletions in red and additions in blue.



In the Compare window, use the left radio button to identify the original drawing, and the right radio button to select the revised version, and then click on **Compare**. If the drawings are of different sizes you can use Manual Adjustment to align content before starting the comparator. If two DWG files are to be compared in Modelspace, check the 'Fix origin' box.

SCANNING

Pre-scan checklist

It's assumed that you are scanning to vectorize the raster image in *TracTrix*. The advice that follows is based on that assumption.

- Prepare the original document to be as clean and sharp as possible (don't damage the drawing when you brush off the dust).
- Avoid scanning from a glossy paper—it creates noise, uneven lines, and/or mirroring effects on the scan; instead use a copy machine to generate a print on a flat-finished paper.
- Make sure that the original is placed in the upper right corner of the scanner, or in the corner marked by 0,0 and that it is straight. Ensuring that the image is scanned straight eliminates the need to deskew it later—one less task.

Scanning poor quality or tonal images

Scan it in both grayscale and 1-bit, in case you find that there is insufficient intelligible information to enable automatic vectorization. Capturing a better quality image while the drawing is on the scanner is worthwhile and convenient. *TracTrix* has tools for 'head-up' digitizing— in the vector editing section.

Advice for scanning and vectorizing photographs

Photographs create images full of subtly blending tones. The processing power of the human brain enables us to render objects in photographs as discrete objects. But vectorizing software works best with distinct breaks between colors. It's much easier to draw an accurate line along the boundary between two solid, unvarying, colors than along a boundary between tones.

Under excellent lighting conditions it is possible to take good quality photographs with clear boundaries and no shadows. Most photos are not taken in these conditions. If you want to convert a photograph into CAD vectors we recommend that you split the task between what the human brain does best and what *TracTrix* does best.

Take a piece of tracing paper. Place it over the photograph. Take a solid black pen and trace the lines you want to have represented in CAD. Then scan the tracing paper into *TracTrix* as a 1-bit image, and convert the lines to vectors. Your brain will do a much better job of analyzing shades and tones than any computer software will. And *TracTrix* will convert your interpretations to the vector format(s) you require.

Scanning settings

TracTrix enables you to scan directly into the program from a desktop scanner, and save the scan in a variety of raster formats, including TIFF, CALS, JEDMICS, C4, and more. Within *TracTrix*, you can choose to proceed using the built-in software, or your own scanning software.

Establish a connection to your scanner by choosing  

Select Source. If your scanner has a TWAIN interface, you will see its name listed; select it (most desktop scanners are supported). Use 

to access the scanning software where you can adjust scanning settings.

Use the scan **Preview** repeatedly until you achieve the best possible quality.

Scanning settings

- Turn off dithering (or anti-aliasing). Dithered images look great on screen, but we want well defined boundaries along which *TracTrix* can create vectors. It may also be necessary to turn off any 'Color Enhancement' setting.
- Scan at 100% scale.
- If the lines on your drawing are light (pencil drawing), the reflectivity of the penciled lines varies considerably, and the scanner creates a raster image with black lines full of white gaps. To compensate for this, adjust the Brightness.

The Best Option for Vectorizing			
1-color		Grayscale	Multi-color
For: black & white monochrome spot-color	line art drawings schematics blueprints	tonal images photographs images with shading worn & discolored drawings	
300 dpi (to start)		300 dpi (to start)	
1-bit		4-8 bit	8-24 bit
Scan to: TIFF CCITT Group 4		Scan to: TIFF with LZW compression	

Resolution

For vectorization purposes set the resolution (dpi) to 300 initially, and increase it if you find the scan doesn't adequately capture enough detail. Bear in mind, however, that high resolution images require more processing time and more disk space.

Line Width	Set resolution at
>= 0.02" (0.5mm)	200 dpi
0.01" (0.25mm)	400 dpi
< 0.01" (0.25mm)	600 or 800 dpi

For the best possible results ensure that the raster lines are at least 3 pixels wide. This table relates line widths as they appear in the original image to the raster resolutions you should use for scanning the drawing. Scan at 400 to 600 dpi if you plan to use your vector file with a vinyl or laser cutter, engravers, routers, or for N/C cutting and machining

Color-depth (a.k.a. bit depth)

Color depth refers to not only colored images, but also to grayscale images. It describes the number of bits used to represent the color of a single pixel in a bitmapped image—also known as bits per pixel (bpp) or bit-depth. (Most scanners scan to 16.7 million colors which is a 24-bit image).

TracTrix prefers images scanned with a 1-bit setting—this captures the image in the form of crisp black pixels. In scanning software, 1-bit is frequently referred to as a monochrome or line art.

When you scan a grayscale or color image in as 1-bit, or monochrome, your scanner has to make a decision about which pixel is black and which is white. It's easier for the scanner to do this down-sampling task than it will be for you.

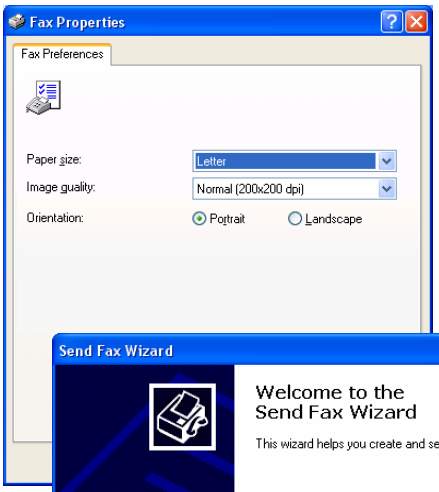
File type

Save scan as a 1-bit CCITT TIFF, Group 4. If you have to use a 4-8 bit settings, save the file as a TIFF with LZW compression.

Scanning alternatives—obtaining images elsewhere

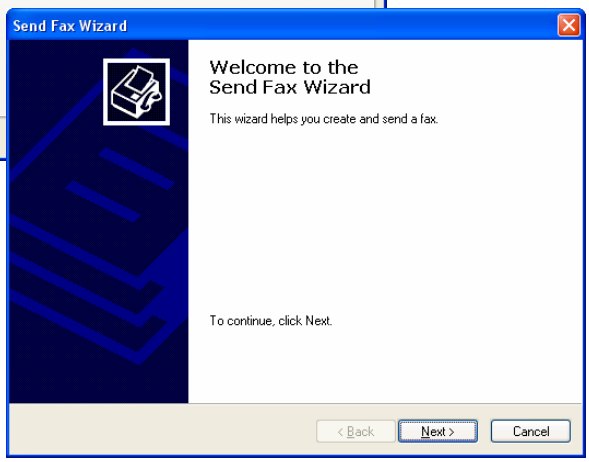
Use Windows Fax driver to open any on-screen image in TracTrix

Fax machines of the past have been replaced in many offices with fax drivers on computers, enabling people to send and receive faxes directly from their desktop. Even if your computer isn't set up to send and receive faxes, most are equipped with the Windows Fax driver, which acts like a



scanner. This enables you to print any image from any program to a TIFF file that will open automatically in *TracTrix* (if *TracTrix* is associated with the TIF file extension).

To use this method, choose File→Print in the program in which you're viewing the image (not all print dialogues are the same). Choose Fax as the printer, then click Preferences or Properties, or something of the sort to open the Fax Properties.



Specify the sheet size and set image quality to 200 dpi (presuming that 200 dpi is sufficient for your image); then select OK.

The 'Send Fax' wizard appears. Enter some bogus data in the required fields and follow through the series of screens. In the last screen choose Preview Fax ...—the 'fax' will open in whichever imaging editing program is associated with the TIFF file extension. Using this method you create a 1-bit TIFF CCITT Group 4 file—exactly what we recommend for vectorizing.

Using a fax machine to capture your image

Present fax machines are technically printer drivers, older fax machines usually are scanners. In the absence of a desktop scanner, use a fax machine to transmit the image to a fax line that is received on a computer. To generate a file with a fax machine, dial to a fax number that is received on a computer to which you have access. Turn on 'fine setting' for better resolution.

Using a digital camera to capture your images

In addition to taking regular photographs, a digital camera doubles as substitute to a scanner, for taking pictures of line art. To capture the best image, place the drawing on a flat surface and illuminate it with as much light as is possible. This will have the effect of making the white background in the raster image whiter rather than gray. Set the camera to take a gray-scale picture.

Position the camera squarely over the center of the line art to be captured (mounting it on a tripod if possible), and snap the picture. Then use the camera's own software to bring the picture into your computer and view it. Save the image as a raster format supported by *TracTrix*. (See the list in Appendix 1 on page 74.)

Section 4: Functions in Detail

The raster-to-vector conversion process includes five steps:

1) Raster editing and clean-up to define boundaries for *TracTrix* to trace.
2) Converting the text (otherwise they convert to unnecessary vectors).
3) Vectorizing the image, adjusting settings and re-tracing as necessary.
4) Vector editing and clean up.
5) Saving the vectors in a CAD file format.

The **required** steps are scanning, vectorizing and exporting, and raster-editing is required if your image is more than 8-bit—the others steps are optional.

PDF files must first be converted to raster files before any raster editing and vectorizing can be done. Each step is described in greater detail in this section.

RASTER EDITING AND CLEAN-UP

Techniques for selected areas

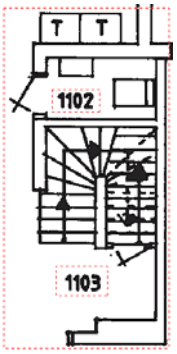
Everything visible in the raster image will convert to vectors.

You can choose to vectorize an entire drawing, or only a specific area.

To vectorize a specific area use the Select Area tool  .

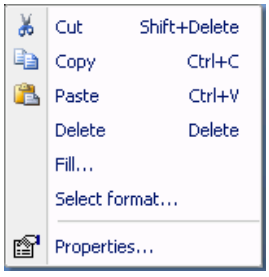
A selected area can be adjusted to accommodate your needs.

Use hot keys to add to, deduct from, or invert a selected area.



Add area to selection	**+**	**SHIFT**
Deduct area from selection	**–**	**Ctrl**
Invert selection		**Ctrl + I**

Selected areas can be deleted, edited, or vectorized, leaving the areas outside of the selection untouched. Right-clicking on a selected area provides access to standard editing functions, including cut, copy, paste, and delete.



Fill... enables you to fill the selected area with a chosen color. This imposes on the underlying raster image; 1-bit images can only be filled with black or white. To add a solid colored shape to a 1-bit or grayscale raster image, use the Vector and Markup tools.

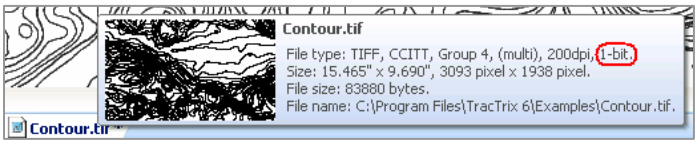
You can resize the moving red-dashed boundary to a specific paper size with the Select format... button. This reveals a menu of standard paper sizes—the selection resizes to the sheet size you select. This makes it easy for printing an area of a big drawing to a small letter size sheet.

Erasing content

To erase large areas of the raster image (such as unwanted text areas) use Select Area, then press Delete. Use the **Raster eraser** for relatively small areas and detailed line editing. Right-click/ Properties... to increase or decrease eraser size.

Down-sample bit depth

Bit-depth must be reduced in 8-bit files, and PDF files must be converted to raster before vectorizing.



Always check bit-depth

When you open your image file in *TracTrix*, hover the mouse over the filename tab at the bottom to see the file settings (or use Properties...).

File Properties displays file name, type, path, and size on disk, as well as the dpi, bit depth, and dimensions. Particular details or 'red flags' to observe include bit depth, dpi, and file type (see chart).

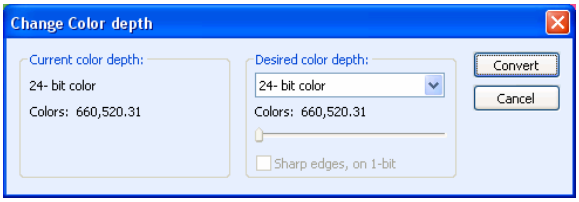
	Usable	Questionable	RED FLAG
Bit depth	1-bit	4-8 bit	16 or higher
dpi	=>300	~150	<100
File type	TIFF	Anything else	JPG, GIF, PDF

TracTrix can vectorize images up to 8-bit—anything higher requires down-sampling. *TracTrix* has a Color Separation tool to do this. It is better to scan 1-bit in the first place. When a grayscale or color image is scanned in as 1-bit to 8-bit in the beginning, the scanner does the down-sampling for you. If your image is color or grayscale, consider rescanning if you have access to the original document.

Avoid using JPG images—they are pretty on-screen, but they're not good for vectorization.

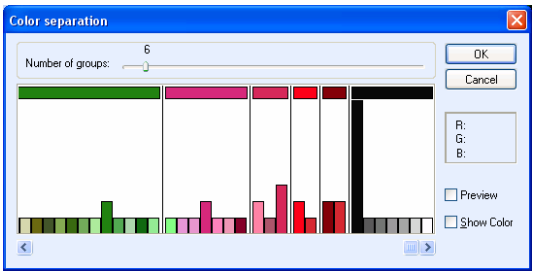
Automatically reduce bit depth

Use Pixel depth to automatically and quickly reduce bit depth. For more control over reducing the color depth, use Color Separation instead.

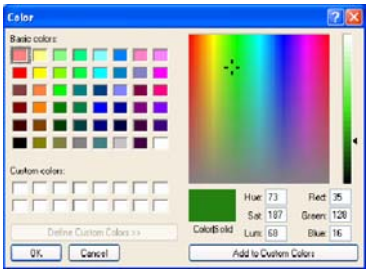


Manually reduce bit depth

Color Separation categorizes every single pixel color into groups (adjusted with the slider on top) and displays them as a histogram. Each color group is separated by a vertical line called a delimiter. The height of each colored bar represents the relative quantity of pixels of that color.



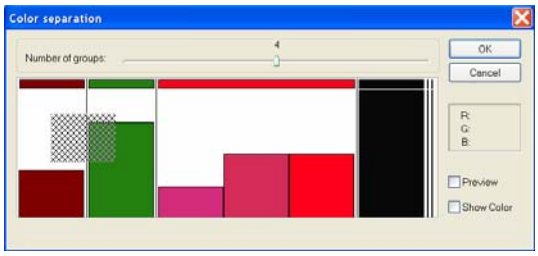
Here, you can edit the hues within each group, categorizing the colors in a way that makes sense to the human eye.



The bar at the top of each group indicates the spot color that will be used to replace the original colors in the group. **Change the group color** by clicking on the color you wish to edit to open the color palette.

To **edit a bar location,** drag it to a target group and release—in effect graphing the distribution of colors.

With **Show Colors** checked, *TracTrix* will find the corresponding color bar in the histogram and indicate its location by flashing a solid bar around it.



Alternately, to locate the areas in image that match the color of a color bar, position the cursor over a color bar. *TracTrix* will find and display the corresponding colored pixels in the original image.

To **split a group,** right-click/Insert delimiter on the bar where you want to split.

To combine groups, move the delimiters.

The **Preview** switch immediately updates the image to reflect your edits.

Edit lines and edges for optimal vectorization

Fixing imperfections on the pixel paths

In the example on the right there are two problems:

1) there is a gap in the lower line of the original raster, and
2) two lines 'touch' near where they meet the vertical line.

If left untouched, vectors will be created to perfectly reflect the imperfections in the original raster.

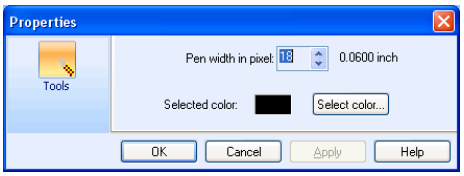
Use the **Raster Pen**, **Line**, and **Eraser** to perform raster edits. In this image, the pixel clumps between the lines were erased and the broken line was repaired. This task produces a better quality raster image to trace, which in turn produces higher-quality vectors.

The Raster Pen, Line and Eraser

The Pen and Eraser tools draw and erase freehand.

The Line tool draws straight lines.

Use these tools to fill smooth edges.

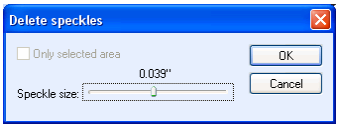


Right-click/ Properties... to change the tool width or color for the *Pen* or *Line* tools use the Objects tab.

Use the raster tools with Snap (page 16) to enhance faint lines, smooth edges, and fill pixels with little precision. Snap is best used when zoomed out.

Despeckle

'Dirt' in the form of clumps of pixels can be automatically removed using the **Despeckle** tool. From left to right, the slider adjusts from removing small pixel clumps 0.10mm, to removing larger clumps 2.00mm.



Fill

For faded, broken, thin, or 'holey' lines and gaps, use **Fill.** If left unfilled, what could be a single vector line becomes split into two, to go around the hole or gap. From left to right, the slider adjusts for filling pixel gaps of 0.10mm up to gaps of 2.00mm.

Use a cycle of Despeckle and Fill to enhance thin lines

Sometimes you cannot avoid using a raster image that contains lines of less than three pixels width. Although it may seem a somewhat contradictory approach, a cycle of Despeckle and Fill can fill the holes and enhance a lines edges—as if to smooth them. To obtain the best possible results when you start with this less-than-ideal original, try Despeckle an image to remove dirt, then Fill to add back 'body' to faint lines or lines with white holes. Sometimes it works better to Fill first, and then Despeckle.

CHARACTER RECOGNITION

Text conversion options

Text should be converted before vectorizing; otherwise all your text will be converted to vectors.

It can be done manually with the Text tool or, if the quality of the raster text is good enough, semi-automatically with the OCR tool.

Examples of both good-quality and poor-quality text are shown below. Notice how the characters in the poor-quality text touch each other, versus the well-spaced characters in the good-quality text. Then notice how the text would convert using *TracTrix'* default text library.

	Good-quality text	Poor-quality text
Original raster text.	COUPLING	COUPLNG
OCR conversion with *TracTrix* default text library.	C0UPLING	C???

The text converted from the poor-quality raster is virtually useless—converting the text manually using the Text tool would be best in this instance (see next section).

An alternate technique is to use Select Area to select good quality text to convert with the automatic OCR/Character Recognition, and manually enter the rest. Vectorizing the text is also an option. This is what it might look like based on the example above:

COUPLING COUPLNG	Vectorized with an Outline setting.
COUPLING COUPLNG	Vectorized with a Centerline setting.

Step-by-step instructions for **Character Recognition** are contained in the tutorial in Section 6.

Manual text conversion

You might use this instead of the text recognition capability for images in which there is only a small amount of text.

Zoom the text you wish to replace. Position the cursor at the top of the tallest letter.

Note the Y coordinates in the status bar when the cursor is both at the top of the raster text character and at the bottom. Subtract to determine the appropriate text height.

Point Size	Height (inches)	Height (mm)
8	0.07	1.9
10	0.09	2.4
12	0.11	2.8
14	0.13	3.3
16	0.15	3.8
18	0.17	4.2
24	0.22	5.6
36	0.33	8.5
72	0.44	16.9

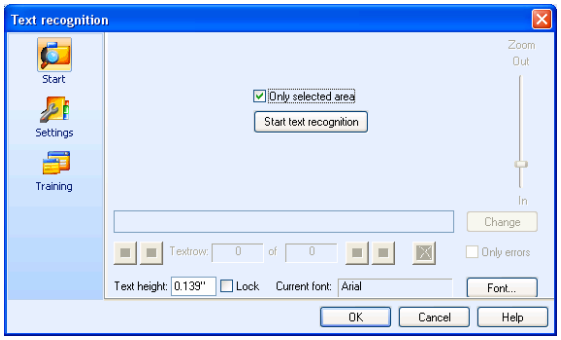
Select the text tool —the cursor changes to a cross hair with an 'A' beside it. Click the upper left corner of the first character to launch the text editor. After entering text and clicking OK, proper ASCII text is placed on the vector layer of the image. Delete the underlying raster text so it

doesn't convert to vectors when you vectorize. Right-click/ Properties... to change the text font and size.

Using built-in OCR feature

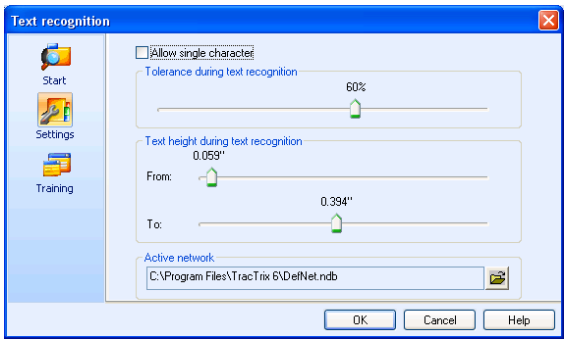
Character Recognition has a default database of raster characters and their ASCII equivalent. It will work with the demo images provided with *TracTrix,* but it should be replaced with a text recognition database of your own making before you use OCR for converting your drawings. This is done by "training" the database to interpret new characters. Click on Character Recognition to launch the OCR function box.

Start



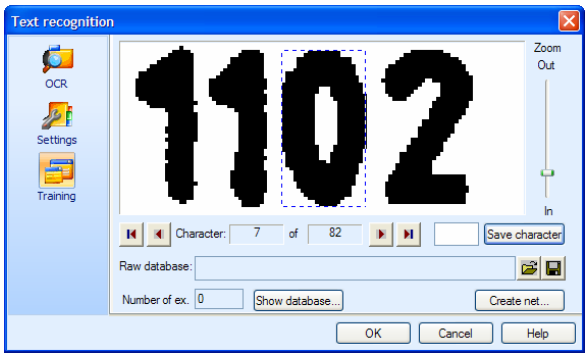
- Current font—displays the currently selected font. Change this to resemble the text on your drawing.
- Font—click to change.
- Text height—shows the text height of the currently selected text.
- Lock—sets the same text height for all new text.
- Only errors—only shows the text that *TracTrix* couldn't identify.
- Change—change the found text to the text in the text box. You may have typed-in the text, or it may appear based on the OCR Training.

Settings

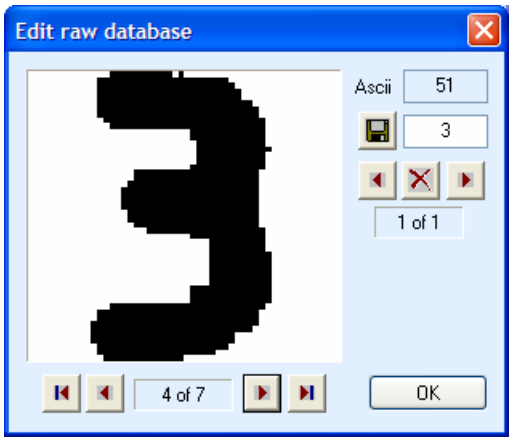


- Allow single characters—finds single characters. If not selected text found has to consist of at least two characters in order to be recognized and converted.
- Tolerance during text recognition: sets the acceptance value for a character. Increasing the value requires the program to have a higher confidence that it has correctly recognized a raster character before it will convert it. Experiment with this adjustment to find what setting works best with your recognition database and drawing portfolio.
- Tolerance for text heights—sets the highest and lowest character height to be accepted.
- Active network—the character recognition database that is currently in use.

Training



- Show database… shows which database will be used. Open a different database in the OCR Settings.
- Create net...—creates a new database.
- Save character—saves the classification of the character to the raw database.
- Number of ex.—shows how many example characters are in the raw database.



Show database displays this window to view and edit the characters in the raw database.

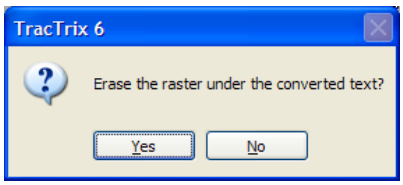
Ascii shows the ascii value of the character in the window, while the Edit field shows the actual character equivalent. Press the disk to save a new value for the character.

Use the Arrows to browse the different raster images stored for the character, and the X to delete a character image from the database.

Use the bottom arrows to browse the different text characters.

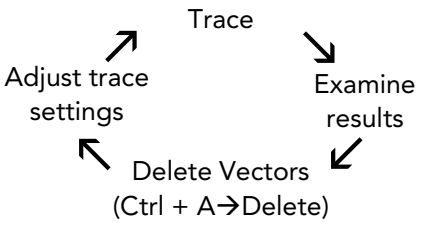
Once you have gone through each text area in the document with the OCR tab, click OK to convert the raster text to vector text as identified.

TracTrix will ask if you want to delete the raster text underneath. It is a good idea—otherwise the text will convert to vector lines when you vectorize.



VECTORIZING

The quality of the vector *TracTrix* creates is greatly affected by the raster file attributes and the settings with which they were traced. Accurate trace settings combined with a good-quality, well-scanned image does a near perfect job.



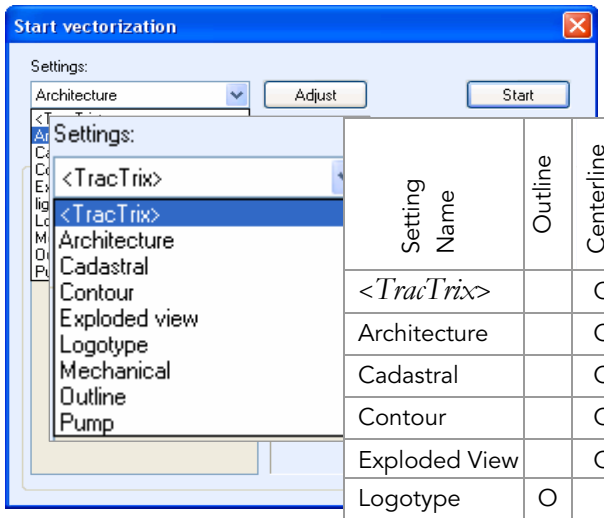
Vectorizing entails a cycle of simple tasks performed repeatedly until you are ultimately happy with the results.

The image attributes and quality play a considerable factor in the results; sometimes it's a good idea to rescan. Read through the scanning section that begins on page 26 for recommendations on how to obtain the best possible image for vectorizing in *TracTrix*.

Start vectorization

To initiate vectorization, choose Vectorizing in the Tools tab.

Settings are conveniently available. Clicking **Adjust** provides access to the **Trace Settings** where they can be edited, added to, and saved.

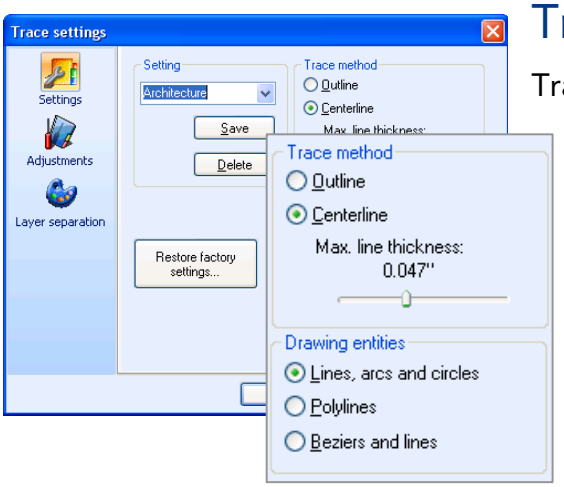


The chart below shows the different pre-defined trace settings and their trace setting properties, for reference.

Setting Name	Outline	Centerline	LPB	Layer setting	Max. arc	Maximum line width (mm)	Precision (mm)	Noise (mm)
<TracTrix>		C	L		100	1.2	0.70	0.2
Architecture		C	L			1.2	0.40	0.2
Cadastral		C	L		10	0.8	0.20	0.2
Contour		C	B	Yes	100	1.2	0.50	0.2
Exploded View		C	B			1.2	0.40	0.2
Logotype	O		B		100	-	0.20	0.2
Mechanical		C	L			1.2	0.60	0.2
Outline	O		B		100	-	0.20	0.2
Pump		C	L		100	1.2	0.60	0.2

If a specific area has been selected with the Select Area tool, only this area will be vectorized—the areas outside of the selection remain untouched.

If no area has been selected the entire drawing will be vectorized.



Trace settings

Trace method

The centerline method traces the center of raster lines in the image; the outline method traces the solid edge of an image.

Maximum line width sets a tolerance for thick lines. Lines thicker than the width dimension shown on the slider will be vectorized on the outline.

Drawing entities

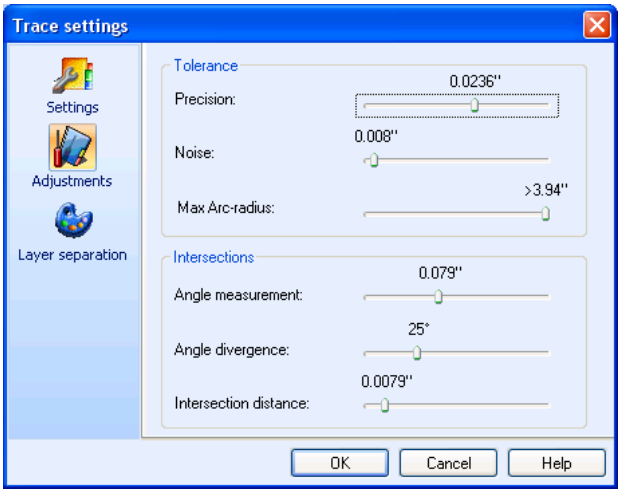
Choose which is best for your needs.

Tolerance

Precision sets how far the vectors can deviate from the original raster line (higher value settings tend to reduce number of vectors created).

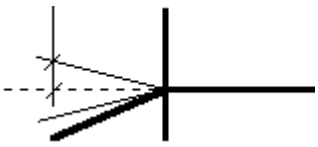
Noise sets the diameter of the clump of pixels to be vectorized. Smaller clumps will be ignored. With a Noise setting of 0, *TracTrix* will process every single pixel, reducing the likelihood of 'steps'.

Max Arc-radius—sets largest arc you will allow on the drawing. By setting this value to 0, infinitely large arcs can be created.



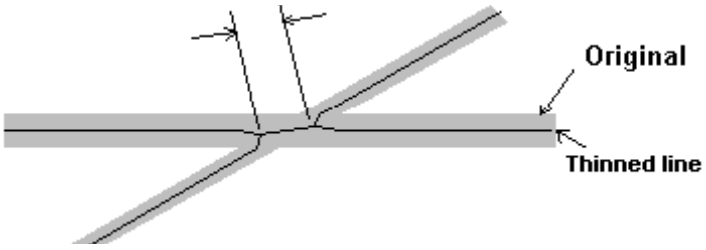
Intersections

Angle measurement is used to adjust the direction coefficient for the lines in an intersection. Drawings with small details (e.g. exploded views having radii under 2-3 mm) may be improved by reducing this value. The disadvantage is that long straight lines could become hard to connect in the intersection. This can be compensated for by increasing the angle divergence (next setting).

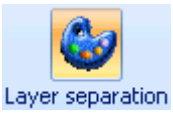


Angle divergence is used to adjust the angle at the intersection between two close lines that will make the lines connect. Lines within the divergence are connected but lines outside the divergence are not. Too large an angle divergence could give the unwanted effect of lines that do not intersect.

Intersection distance gives the maximum distance between 2 intersections that will still allow them to be drawn together to one point. This is necessary to be able to connect the lines at the intersection.

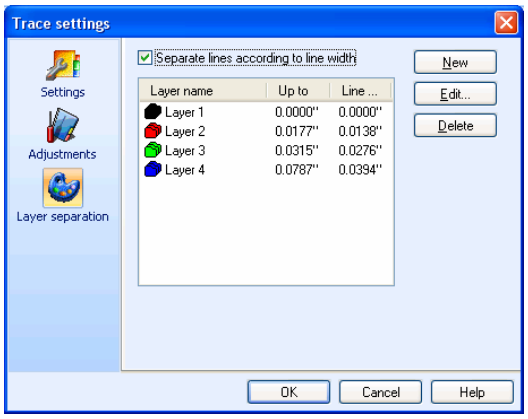


Layering separation



When a 1-bit color depth raster image is vectorized, a single vector layer is created and all the vectors are placed on that layer.

When a color image is vectorized a new layer is created for each vector color. Vectors can be moved from one layer to another. New layers can be defined prior to vectorization. Once defined you can make a layer active and select raster areas to vectorize onto the active layer.



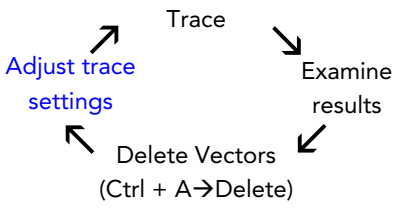
TracTrix enables you to place vectors on different layers based on the widths of the original raster lines with "Separate lines according to line width". The Layer name, Up to, and Line weight are saved together with the current trace setting. A new layer is sorted on the value given for "up to". The layer is not created until New is clicked.

Trace the lines and examine the results

Click Start when you are ready to trace. You will see a green progress bar at the bottom left of the screen; blue vectors will appear when tracing is finished.

Look at the vector quality close-up to see what adjustments can be made to improve them. To show only the outline and hide the fill, click **Filled objects** . Or hide the raster layer altogether.

Pay attention to the raster image too, as it may need additional editing. *TracTrix* clean-up tools help to automatically tidy up the vector entities. See next section for details.



Restart the cycle if necessary

Ctrl + A, Delete
If you wish to adjust settings and re-trace, you must delete all of the vector entities first, providing an empty vector layer to work on.

Saving the vectors in TRX files

TracTrix vectors, markup, and settings are saved to a file named the same as the original file but adds the file extension .trx. While you work, click on the Save icon on the Quick Access Toolbar.

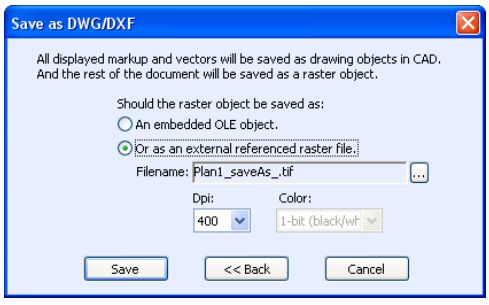
Saving as a DWG/DXF

To save a vector file, use 

. Supported vector formats are listed in Appendix 1.

Once the file has been saved you can open it or import it to your CAD, NC, GIS or other program.

When saving vectors to a DWG or DXF file, *TracTrix* will embed the raster layer as an x-ref or OLE object.



To exclude the raster image from the exported CAD file; turn off the raster layer first. Or, if you want to save only some of the vectors, select them first with Select and save 'selection only'.

VECTOR EDITING: TECHNIQUES AND FEATURES

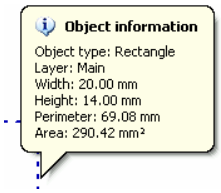
Object properties

Select vector entities

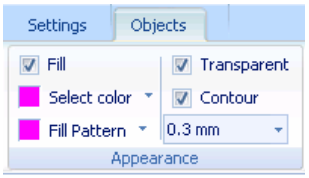
Use **Select** arrow to select the markup that you wish to edit (use with Shift to choose multiple entities, or Control-A to select all markup). To resize an entity click on a control point (a square box on a corner of a markup element) and drag with the mouse.

View object information

An object information bubble displays size and entity detail, like the one on the right, when the cursor hovers over a vector entity. This feature is enabled by default; it be toggled in the Program Settings.



Here you can edit and define layer assignments, colors, and other properties. Colors can be set by vector/markup layer (active layer shows with the L in the lower right-hand corner of the window) or by a color you assign.



The Fill option is only available when a closed or completely bounded vector area has been selected. Various fill colors and patterns are available and will transfer to any CAD package that supports fills. For fills, transparency and frame weight can also be specified.

See page 24 for a detailed description about the features on the Object tab.

Set the default color and pen

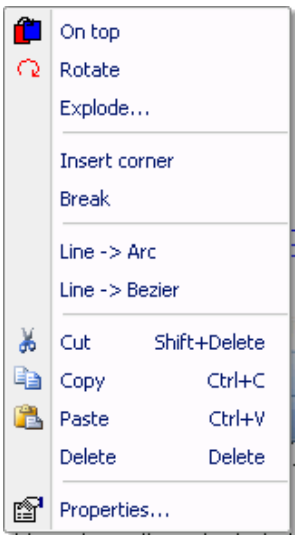
From the Settings tab you can set a default colors for all new entities:

1) by the color of the active Vector/Markup layer (evident with the L at the lower right of the screen L), or
2) choose a color to regardless of layer.

Use the radio buttons in the window that appears to select Color by layer or Custom. If Custom is selected the Select color button is enabled. Unless otherwise configured, new vectors are placed on the default layer titled 'Main'; it is blue in color.

For more information about how *TracTrix* manages layers, see page 49.

Editing vector lines and objects



Right-clicking on a vector entity displays a menu of standard editing tools*.

These tools are available for editing all vector types:

- On top
- Rotate Outlines the markup and transforms the cursor into a crank. Drag the mouse to turn the crank and rotate the markup.
- Explode...
- Cut Shift+Delete Cuts the markup and places a copy on the clipboard.

* Options available in this menu will vary depending upon the type of entity selected (text, rectangle, line, Bezier, etc).

- Copy Ctrl+C Copies markup or selected area to the clipboard. All or part of the image can be copied to the computer's clipboard for pasting.
- Paste Ctrl+V Pastes markup clipped from *TracTrix*.
- Delete Delete Deletes the selected markup.
- Properties... For markup shapes, displays the aperture for the Snap feature, and a switch to Create polylines; for markup text, enables editing of the text; for raster clips it displays properties of raster entity/region.

Standard editing functions

These tools are available for straight line, arc, and bezier curve vectors:

- Insert corner Insert corner enables you to insert a corner (add a node) anywhere on the line or entity. To remove a corner, select the node and press the Delete key. New corners are always unlocked.
- Break
- Line -> Arc Line -> Bezier
  Provides a means to select and change a single vector line to either an arc or bezier curve.
- Arc -> Line Arc -> Bezier
  Provides a means to select and change a single vector arc to either a line or Bezier curve.
- Bezier -> Line Bezier -> Arc
  Provides a means to select and change a single bezier curve to either an arc or vector line.
- Circle -> Arc
  Provides a means to select and change a single circle to an arc.
- Move side Enabled only for polylines, this tool allows you to grab and skew a segment of a polylines, leaving some points intact.

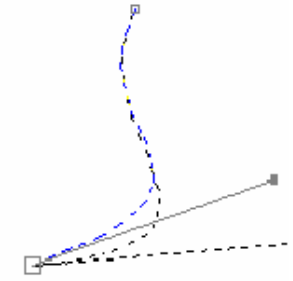
Join points to form polylines

With both the Snap and Polyline options enabled in the Status Bar, you can snap two points together to form or add to a polyline. The "key" cursor indicates that the two lines will be connected upon releasing the click.

Disconnect lines

To disconnect (add a "break" in a line), select the point on the vector line where you want the break, then right-click/Break. The line is no longer one, but the end points of the two separate lines remain coincident at the point where the break was selected.

Control bezier curves

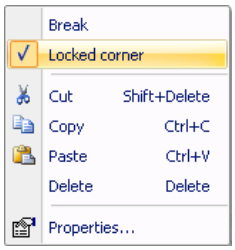


You control the shape of a Bezier curve in three ways:

- the location of the end points;
- the direction of the handle;
- and the length of the handle.

The creation and manipulation of beziers is best understood by practice. Experiment with them on a new, blank document.

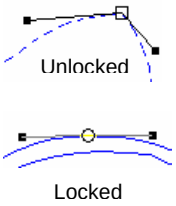
Corners on beziers can be locked to maintain the shape of the curve on either side of the corner.



To lock a corner on a bezier, select the node and right-click/ Locked corner.

The same action applies to unlock a bezier corner.

Locked corner nodes on beziers appear as circles; on unlocked corners they are square.

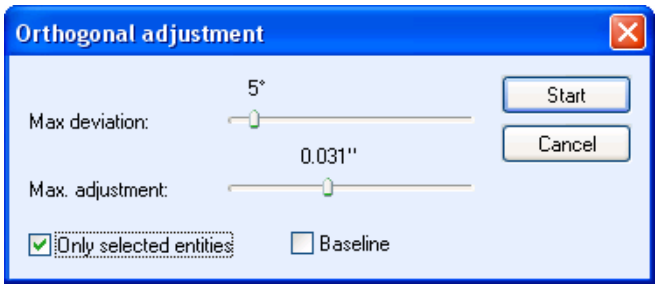


Vector clean-up

Orthogonal adjustment

Orthogonal Use Orthogonal to straighten lines in the horizontal/vertical plane or baseline.

A dialog box is displayed in which the deviation angle and adjustment distance can be adjusted.

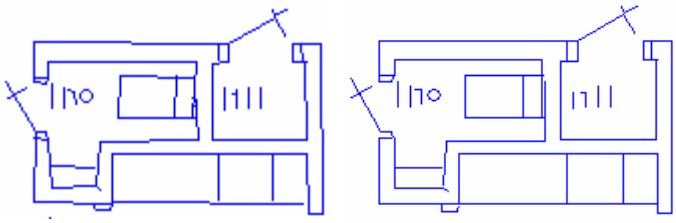


Maximum deviation sets the degree for which only those lines lying within the set value will be orthogonally adjusted.

Maximum distance gives the maximum distance a line segment can be lengthened or shortened to achieve the adjustment.

If Baseline is unchecked, the horizontal plane is used as baseline.

Use with Select to identify a group of vectors to be adjusted—other vectors will remain untouched.



Horizontal and vertical adjustment

Vertical Horizontal

Use to align all vectors to be on the same horizontal or vertical axis as an entity you select—all vectors will be simultaneously rotated so that they maintain the same spatial relationship with the selected vector. If you select a point on a bezier curve *TracTrix* will use a tangent to that point in determining the proper horizontal or vertical axis.

This action adjusts all vectors in a file. To adjust specific vectors, select them with Select, and check "Only selected entities" in the action dialogue box.

Add vector entities

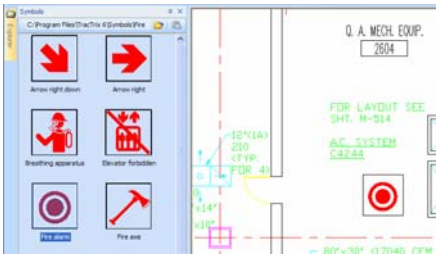
Lines, arcs, circles, shapes, hatching, symbols, and text

Use the vector tools in the Start tab to add new vectors lines, arcs, circles, markup shapes, and ASCII text. These tools behave as other standard line, freehand, shape, and text tools.

Adding bezier curves require a little more dexterity. In practice you should expect to first lay down a rough approximation to the curve you desire, then to use the handles to precisely position your curve.

Symbols from symbol libraries can be placed added in *TracTrix*—when exported, they are editable in your CAD program.

This feature, new to version 6, enables users without CAD applications to add symbols to drawings.

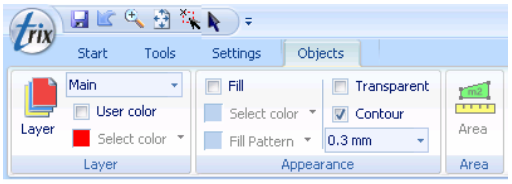


Open your own symbol libraries with Change library.

Working with layers

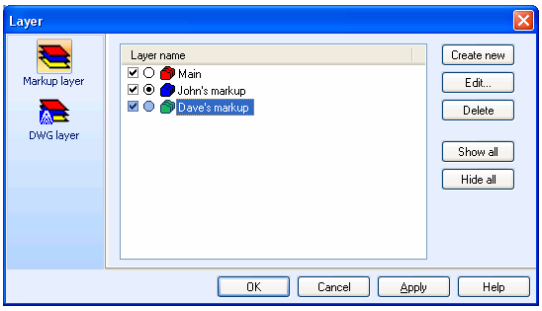
Access the **Layer** control panel from the Start tab (or in the Objects tab for selected entities).

When a file is first opened a single empty markup layer is created, titled 'Main'; by default it is blue in color.



Add layers using **Create new**. Edit the color of the layer using **Edit...**. Create a different markup layers for each user or team. The checkboxes identify if a layer is set to be visible, or use the Show all and Hide all buttons.

While many vector/markup layers can be seen at the same time, only one vector/markup layer can ever be active at a time—the active layer being the one currently being used for markups. Use the radio buttons to designate the active markup layer.

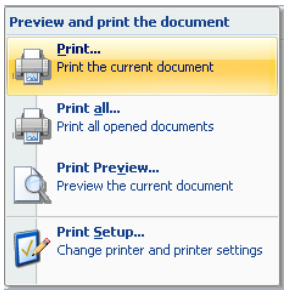


The active layer color is also indicated in the Status Bar at the bottom right of the window (evident with the L at the lower right of the screen).

Markup/vector layer management is easily also accessible in the Objects tab, which becomes active only after markup is selected. You can quickly assign or edit markup layers as they apply to the selected entity (or entities).

PRINTING

Use [Ctrl + P], or  **Print…** to initiate printing.

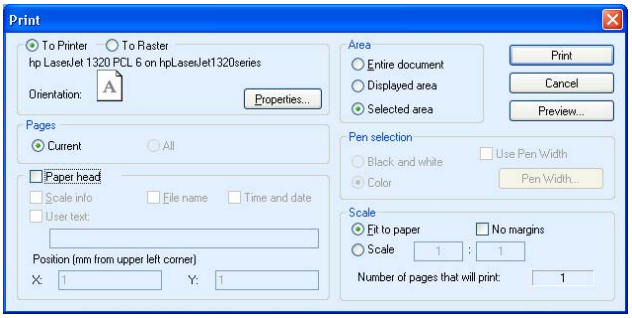


Layer control

Use the Drawing on/off tool  toggle to hide raster layer before printing.

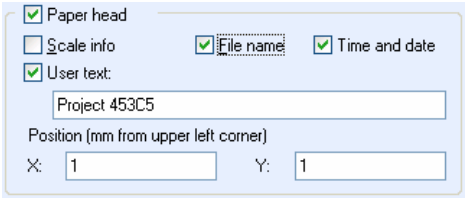
Use the vector/markup on/off toggle  to hide markup before printing.

Print dialogue box



Options in the **Print** control box are explained below. Use  to setup your printer, selecting the name of your printer in the pull-down menu.

Pages: For multi-page documents, choose to print just the current page or all of the pages in the document.

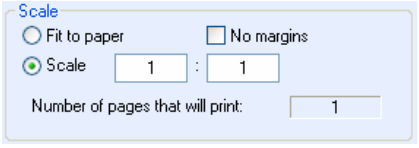


Paper head: By using the appropriate check boxes, you can include the scale, date and time, file name or a user text string at the head of the print. You can also position the heading on the page using the Position settings.

Area: Choose to print the entire image, the displayed area, or the selected area (defined with the Select Area tool ).

Pen selection: Pen selection is available only with color vector files. See page **Error! Bookmark not defined.** for details.

Scale: To use as much of the printable area as possible, select Fit to paper. To use a scale which is in a fixed proportion to the original scale of the image, click the Scale radio button, then enter the ratio that you want to use to scale the image. (For example, to quadruple the size, enter 4:1. To halve the size enter 1:2.)



When the ratio is entered, the number of printed pages that will be produced is indicated below the scale. By default, *TracTrix* adds a small margin to the edge of each image. To switch this off, check the No margins box.

HP-GL and raster files are opened 'actual size'--this means that if you print them at a scale of 1:1, they will print just as they were originally intended. DWG/DXF/DWF files are much more complex as they may not contain any size information. DWG, DXF and DWF files are 'unitless'. Nevertheless *TracTrix* makes an attempt to best establish a size for you. You can view and change the sheet size using the Tools-Utilities-DWG size tool.

Section 5: Additional Features

TracTrix also includes tools to scale, measure, markup, and print raster- and vector-based files.

- Use *TracTrix* to scale and measure.
- Use *TracTrix* as a File Viewer (special ability for vector-based files—layers, shx, xref)
- As a complete markup program for viewing, annotating, and converting files of all types, and sharing it all with your colleagues.

X-refs and SHX fonts are fully supported.

SCALING AND MEASURING FUNCTIONS

TracTrix does the arithmetic for you

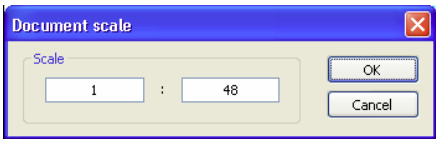
Why scale?

A drawing must be accurately scaled in order to obtain accurate measurements. *TracTrix* provides tools to measure lengths, perimeters, and areas in real world units (e.g. millimeters, inches, square yards). In order to measure accurately, you must scale in *TracTrix*.

Most raster images need to be scaled because they do not contain scale data, and are assigned a 1:1 ratio by default. AutoCAD files, on the other hand, usually have scale information as 'drawing units' built-into the file. To see this, go to the Modelspace layout and click **Set Scale** from the Tools tab. Scales work only in drawings on a single plane, typically a front, side or top view. Scaling will not operate in drawings presenting isometric (3D) perspectives.

Calculating the scale of a raster image

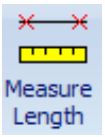
Scale tools are featured in the Tools tab. There are two ways to scale your drawing:



1) Use **Set Scale**, and then enter the scale shown on the drawing* in the Document scale panel that appears. A drawing showing a scale of [¼" = 1'- 0"] translates to a scale ratio of [1:48]. A fraction/decimal conversion table is featured in Appendix 2.

2) Use **Check Scale** to specify the known distance between any two given points. Click once on a starter point—a visible line appears and moves with your cursor (if needed, press Z to activate the magnifier)—then click once on an end point. The document scale dialogue box opens enabling you to enter the known distances and specify the unit of measurement. Then round to the closest ratio (i.e. 1: 48.065 would be correctly rounded to 1:48).

Scale need only be set once for each file. The application will remember the scale (and markups created for the image) in the TRX file associated with the original file.



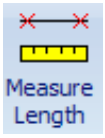
Cross-checking a scale

You can cross-check your scale with the **Measure Length** tool in the Tools tab (tool details are provided below). *TracTrixr* provides the measurement of a length you define according to the scale that is set for the drawing. If this is the same dimension as that shown on the drawing or the scale you specified scale setting is correct.

* This method requires your drawing to have been scanned at 100% (i.e. full size).

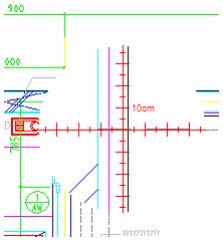
Note: There may be different scales within a drawing—different parts of a drawing may contain details drawn at different scales. Check to see that the scale you have set is appropriate to the detail you are measuring.

Measuring length and perimeter



Use the **Measure Length** tool in the Tools tab to measure a length on the drawing, or to check your scale. To use the tool, position the crosshair cursor on one point and click once, then drag the crosshair cursor to the end point and click once. End by clicking left to register the point, then right-click/Exit. The measured length will appear. Use consecutive clicks around an area to measure perimeters.

If the Magnifier check box at the foot of the window is checked you can magnify the region under the cursor. A cursor cross-hair will appear over a magnified image of the region. This will assist you to select points with greater precision. The Magnifier can be toggled by pressing the Z key. Note: The resulting measurement could be very close but not exact - you may not have exactly selected the limits when you mouse clicked the ends of the measurement.

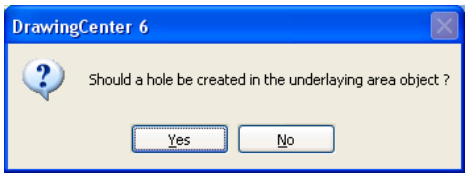


Measuring area

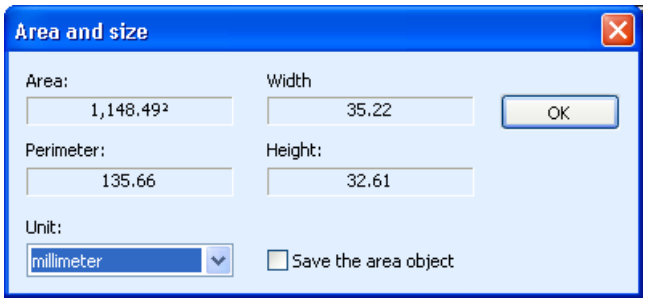
The drawing must be properly scaled in order to obtain accurate measures (see above).
The measuring tools are located in the Tools tab. Each measuring tool is described below.

The easiest measuring tool to use is **Auto**. This tool auto-selects a rectangular area; add to the area by pressing the Shift key and clicking again, or subtract from the area using the Control key.

The Polygon and Rectangle tools work best with Snap turned on (see page 10). Use the **Polygon** to create a custom shape, then right-click/Close to display measurements. The **Rectangle** simply measures a rectangle. Use hot keys to add to, deduct from, or invert a selected area.

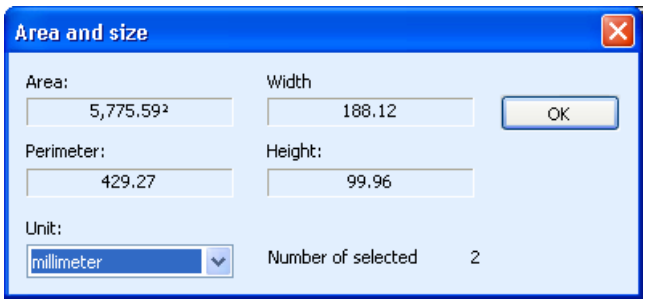


Add area to selection	**+**	**SHIFT**
Deduct area from selection	**–**	**Ctrl**
Invert selection		**Ctrl + I**



In the measurement window that displays, check 'Save the object area' to create a hatched markup entity of the area you measured. Adjusting the unit of measure will automatically recalculate the dimensions.

To sum the measurement of multiple hatched areas, press the Shift key while using **Select** to point out the multiple hatching; then use the **Area** tool in the Objects tab to display the total measurement.



SPECIFIC FUNCTIONS FOR VECTOR-BASED FILES

Viewing vector files

Program Settings

Show on a dark background

To display vector files against a black background, check Dark Background in **Program Settings**.

Show HP-GL files in black & white

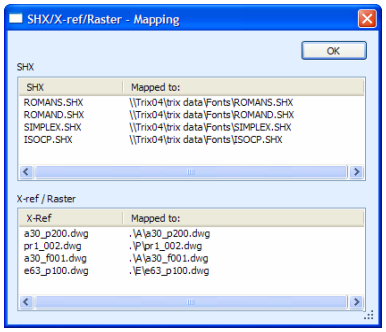
Use **Program Settings** in the Settings tab to show color HP-GL and PLT files in black and white.

Viewing 3D files

If a 3D file is open, the 3D Orbit tool is activated, enabling you to rotate the image to view it from different perspectives.

Displaying x-refs and SHX fonts in DWG/DXF files

SHX fonts are used only in AutoCAD design, and are not stored in the file. When reading DWG and DXF files, x-refs and SHX fonts are fully supported in *TracTrix*, assuming they're made available. The program looks for x-ref files in the following three ways:



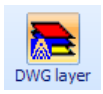
1) Using the absolute path specified in the source DWG file;
2) If not found, uses the specified path applied relative to the directory now containing the source DWG (for x-ref's with filenames like ...\...\x-ref.dwg);
3) If still not found, searches same directory as CAD file.

The font substitution rules apply to both TrueType and SHX fonts.

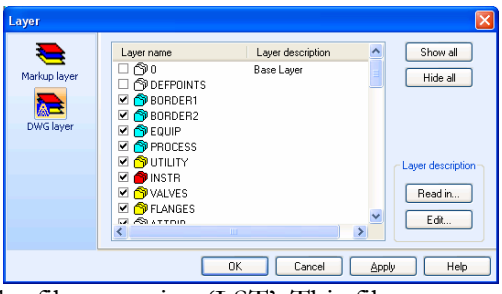
View the x-refs and fonts called-for in a file with **DWG Font/X-ref** in the Tools tab. Substitute fonts are shown here if an original font is not available. If an x-ref is missing the panel displays a message to this effect. Resize the panel to view long path names.

In **Program Settings** in the Settings tab you can enable a warning to display for missing x-refs and fonts upon opening an AutoCAD file. Also in Program Settings you can set a path to your SHX font directory.

Controlling DWG/DXF layer visibility



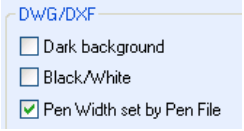
DWG/DXF layers are defined in the original file. They can not be altered in *TracTrix*. But you can use the check boxes in the Layer control panel to control the visibility of each layer, accessible by clicking on DWG layer.



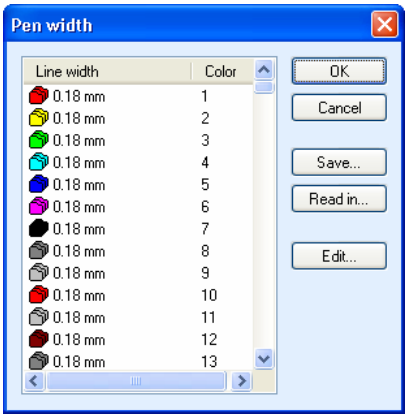
To save a selection of layers for repeated use click the *Read in* button. This will create a file containing the selection with the file extension 'LST'. This file may be given any name you choose. To reuse a layer file click on the *Edit* button and select the file you require.

Setup pen files to show colors as different line widths

To view different colors as different line weights (or pen widths) 'Pen Width set by Pen File' must be turned on in **Program Settings** in the Settings tab and the pen file adjusted in the **Pen Settings,** also in the Settings tab.



The Pen width window displays the pen widths in the active pen file. By default all colors* have an 0.18 mm pen width.



Pts.	Millimeters
1	0.35 mm
2	0.71 mm
3	1.06 mm
4	1.41 mm
5	1.76 mm

To edit a pen width click once on the Line width to highlight it, then click Edit... . (The chart on the left will help you convert millimeters to points.)

Save... enables you to save the pen widths in a pen file for future use. Pen files simple text files with the extension .pen. The first line contains a width for color 1; the second, a width for color 2, and so on. Pen files can be opened and edited in Notepad. Logically, Read in... enables you to open previously defined pen files.

Print or rasterize vector files

Resizing for sheet size

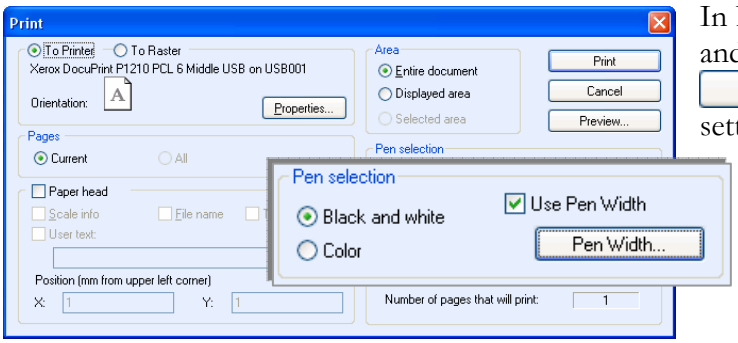
Use **DWG Size** in the Tools tab to specify a unit of measure and select a document size. Changing the document size automatically adjusts the height, width, and scale in the fields below. Manual entry of the desired width, height, or scale is allowed—*TracTrix* automatically adjusts the document size to accommodate.

Recreating colors as varied line widths for monochrome output

Line work in DWG, DXF and HP-GL files is typically orchestrated in a variety of colors making it easy to distinguish between design elements when viewing it on screen. To recreate the distinctions in the form of different line widths (or line weights) for printing to monochrome printers, *TracTrix* uses pen files.

Use [Ctrl + P] or 

Print… to access the print dialogue.



In Pen selection turn on 'Black and white' and 'Use Pen Width', then click Pen Width... to access the Pen width settings. (also accessible from **Pen Settings** in the Settings tab.)

Pen files are best setup before printing. See Show colors as different line widths (above) for details.

* Multiple layers can have duplicate colors; pen files graph colors to line widths (not layers to line widths).

MARKUP AND SHARE YOUR DRAWINGS

Enabled for raster and vector files

Markup is only possible on raster or vector files. PDF files must first be converted to raster first.

Create markup with the Vector Editing tools

The vector editing tools are double as markup tools, and are available by clicking on their respective icons in the Start tab.

With the Hover option enabled in Program Settings, markup and vector entities are automatically magnified on rollover, and object information is automatically displayed in the form of a bubble on hover.

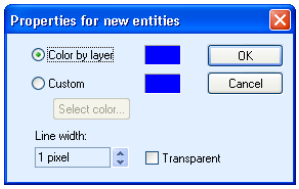
Set the color and pen width for new markup

There are two ways to define the markup/vector color:

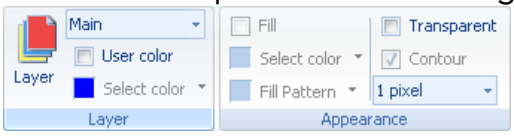
1) by the color of the layer in which you are working (see more about layers below), or
2) by choosing a custom color, regardless of the vector layer.

To edit the default color, go to the Settings tab and click **New Entities**.

In the window that appears, select 'Color by layer' or 'Custom'. If 'Custom' is selected, **Select color** is enabled, allowing you to pick a color. In the same window there is a setting for the default line width.



Edit color and pen width of existing markup/vectors



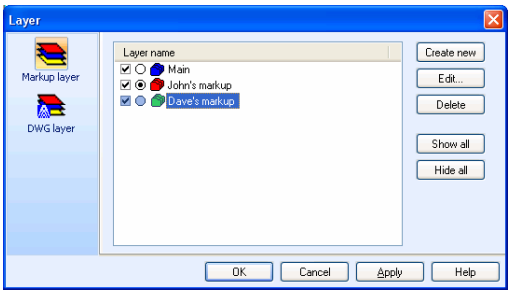
Properties of existing markup and vectors can be edited in the Objects tab, which activates only after markup is selected. Use this to edit and define layer assignment, color and line weights.

Fill is available only if the markup is a closed entity (i.e. it is a continuous line with no end points), enabling you to specify color, pattern, transparency, and weight of markup frame.

Markup layers

When a file is first opened in *TracTrix* a single empty markup/vector layer is created—by default *TracTrix* assigns it to be blue in color, and titles it 'Main'.

While many markup layers can be seen at the same time, only one markup layer can ever be *active* at a time—the *active* layer being the one currently being used for markups. The active layer is indicated by the color in the L in the Status Row at the bottom of the *TracTrix* window. Any markup you create is placed on this layer by default.



Layers can be added, deleted, and edited in the Layers control panel, accessible from the Start tab (or from the Objects tab if markup or vectors are currently selected).

The checkboxes toggle layer visibility; radio buttons designate the active markup layer.

Add or delete layers using 'Create new' or 'Delete', or use 'Edit' to change the color or the name of a layer.

Saving markup with TRX files

Markup and settings created in *TracTrix* must be saved into a separate file. *TracTrix* maintains the filename, but adds the extension .trx. For many users the only noticeable effect of this is the appearance of what appears to be a duplicate file in the directory containing the image files. If the original file extension has been associated with *TracTrix*, clicking on either file will open the file. All the markup information is stored in the .trx file.

Click **Save** in the Quick Access Toolbar to save your work.

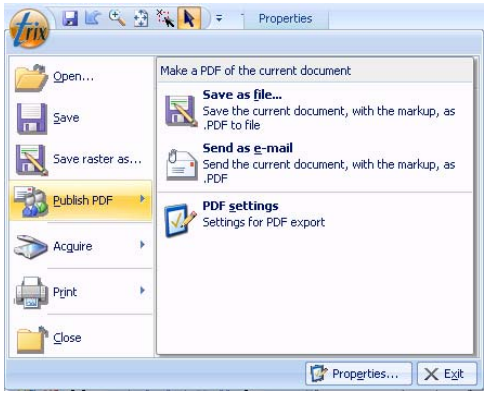
By default *TracTrix* saves .trx files to the same directory in which the original image file is stored. This is the most logical place to store the markup data when working in collaboratively with other *TracTrix* users as this enables them to see the same markup when they open the file from the same directory.

Sharing markup

Markup can be shared with other *TracTrix* users by simply sending the .trx file to them.

Alternately, you can share files (with or without markup, depending on layer visibility) by publishing the file as a PDF using the **Publish to PDF** option in the application menu.

Choose **Send as e-mail** to automatically create a new email message with the PDF attached. The size of the PDF you create, as well as the dpi and other attributes, can be adjusted in **PDF Settings**.



USING DDE COMMANDS

Dynamic Data Exchange (DDE) provides a way for Windows programs to share data and interact with one another within your Windows operating system. Using DDE commands, Windows exchanges information by request data from one application and instruct another applications to do things.

Here is a list of the DDE commands available for *TracTrix* and an explanation of usage for each:

`#Open(File name[;File2;File3;...])`	Opens one or many files.
`#Close([File name])`	With no filename all files will be closed.
`#Exit()`	Exit the application.

`#Print(Filename;Scale;Printer;Paperhead;Scaleinfo;Showname;Time;Textinfo;Text)`

`Filename`	File to print	`Showname`	0=No, 1=Yes
`Scale`	0=Fit(default), 100=1:100	`Time`	0=No, 1=Yes
`Printer`	"Printer name"	`Textinfo`	0=No, 1=Yes
`Paperhead`	0=No, 1=Yes	`Text`	`"User text"`
`Scaleinfo`	0=No, 1=Yes		

Examples of how it could look in the Explorer:

Open: `#Open(%1)`

Print:
```
#Open(%1)#Print(%1)#Close(%1)
// Default printer and fit to page and no paperhead info
```

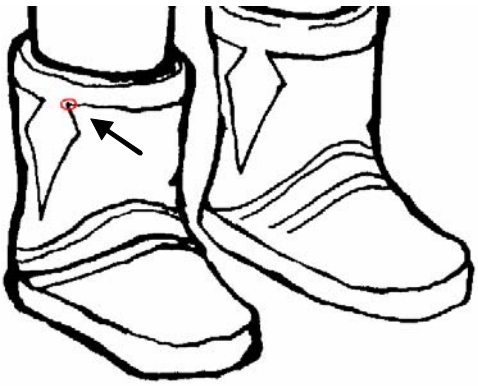
Print to:
```
#Open(%1)#Print(%1;1;%2)#Close(%1)
// Selected printer, 1:1 no paperhead info
```

Section 6: Tutorials

The first tutorial on raster to vector conversion is a rather longer lesson; allow an hour to complete it. Subsequent tutorials are substantially shorter, and require less than fifteen minutes each. Most importantly, though, once you understand the conversion techniques described in these tutorials you will produce faster and better-quality conversions.

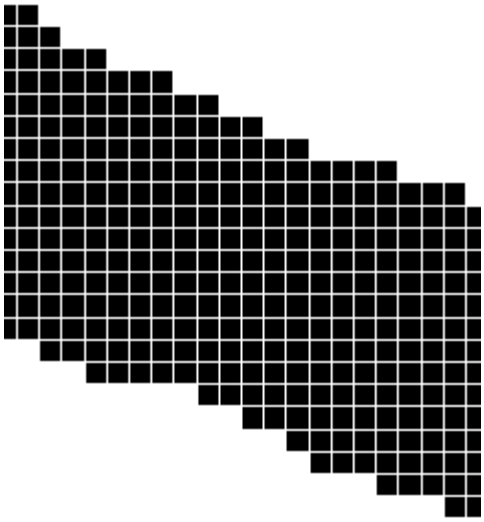
RASTER-TO-VECTOR CONVERSION

What comes out of your scanner?



Imagine we've scanned this picture of a pair of boots and we're viewing it on our computer screen (the image shown is from the tawademo.tif file in the Examples folder). We see continuous lines.

But if we zoom-in on the tiny circled area on the trim at the top of the left-hand boot we'd see a grid of black squares. The scanner creates the 'lines' on a computer screen using square dots, known as 'pixels'. It's conventional to refer to them as dots only in the context of scanner resolutions (dots per inch or dpi). Scanner resolution is always referred to as dpi (dots per inch) whether you are in the metric (mm) or Imperial (inch) units of measure.



Where black dots are clustered together we see lines.

Where white dots are clustered together we see nothing (although the white dots are actually there).

Any file in which pictures are saved as a sequence of black and white or different colored dots is called a raster file. And any picture presented this way is called a raster image. Scanners create raster images and nothing else. They cannot create vectors. The same is true for digital cameras and 'paint' software programs.

Raster images are wonderful for viewing or printing. This is because our eyes and brain interpret what is a line and what is not. Unfortunately raster images are completely useless for any computer software which depends on vector descriptions of lines. CAD, CAM, numerical control and GIS software can only do their job with vectors. So *TracTrix* traces the little dots that form the raster lines and automatically converts the lines into vectors which you can export as a standard vector file format. In the illustration to the right you can see how *TracTrix* converts the raster image of the boots to vector lines.

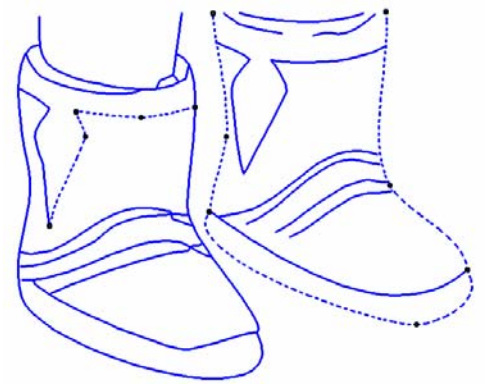
To duplicate this, **Zoom-in**  on the boots in tawademo.tif, and use **Select Area**  to select the area around the boots.

Vectorize the raster image with by clicking **Vectorize**.

Click on Adjust and select Polylines.

Click OK then Start. The boots will be vectorized.

 Use the **Select** tool to click lines that you can see.

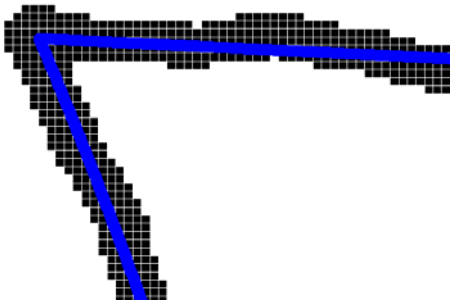


Instead of being made up of hundreds of little dots each line is now described by control points and mathematical coordinates, and descriptions of curves and lines.

These are the vectors.

A single control point on a vector line now represents the corner on the trim that we previously zoomed-in on.

If we look at the vectors we've created on top of the original raster lines (as you can do in *TracTrix*) we see something like this:



The vector lines have been created along the dots that make up the original raster lines. This is at the core of how *TracTrix* works.

Why have we devoted so much time to explaining what a raster is and how it differs from a vector? Because to get the best out of *TracTrix* it pays to start with a good quality scan and use *TracTrix* raster editing tools to optimize the raster before it is converted to vectors. Understanding that a raster is made up of masses of little dots is key to this process.

Creating vectors from rasters

What it takes for Vectorization

There are normally four distinct stages in raster to vector conversion:

1) Scanning the image to be vectorized;

2) Editing the raster image created by the scan, if necessary;

3) Conversion to vectors;

4) Cleaning up the new vectors.

5) Saving the vectors in a specific CAD vector format.

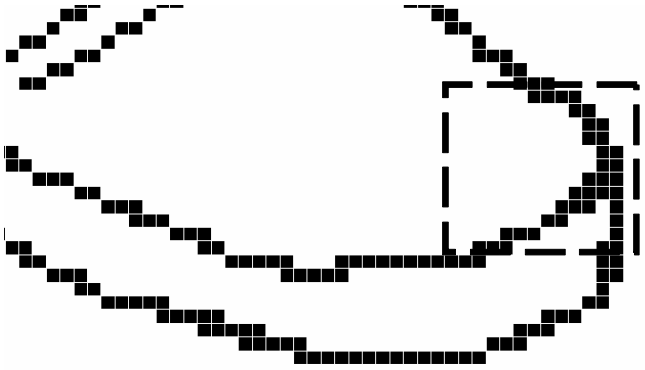
Successful Vectorization Rule #1:
Attention to the preparatory work saves on clean up later.

SCANNING

Your scanner provides you with a variety of options. While these settings are quite independent of *TracTrix*, your choices from these options can radically alter vectorizing performance. The two key scanning options to consider before using *TracTrix* are resolution and bit depth.

Resolution is usually set as a measure of dots per inch (or dpi). This is the number of raster dots your scanner will create for each inch of paper it scans. This is very important for accurate vector creation. In general, *TracTrix* prefers that the lines in the raster image are at least three pixels wide on screen.

By setting the scanner resolution high enough we ensure that lines in the raster contain enough pixels across their width. At the same time we don't want to set resolution any higher than necessary because this creates large files and slows down the conversion process.

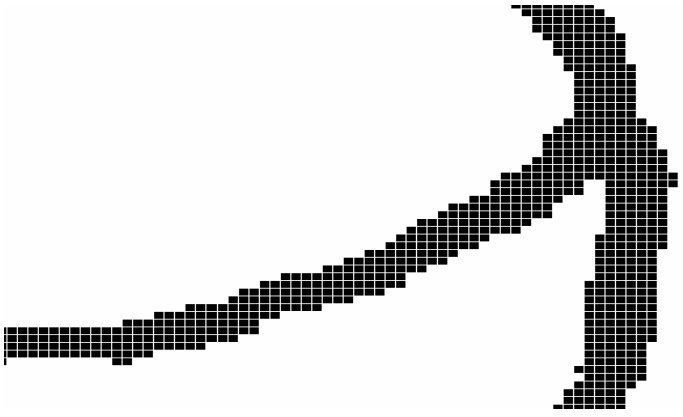


To see the reason for the 3-pixel width requirement take a look at the picture of the front of a moccasin. It shows a raster image consisting of single pixel wide lines. Take a pencil and try to draw a centerline through the line of pixels.

It's quite difficult to draw smooth curves through these pixels. And *TracTrix* experiences the same sort of difficulty.

The illustration to the right is scanned at four times the previous resolution. Looking across any line you'll see at least three pixels. It's much easier to draw a continuous smooth line through the centerline of these dense pixel strings.

Scans with lines at least three pixels wide provide better information for *TracTrix* to calculate and create smoother vectors. You can ensure that your scans have 3-pixel wide lines by selecting a high enough resolution in your scanner's settings. Next we'll apply this rule to a real scan.



Scanning directly into *TracTrix*

If you don't have a scanner, open tawademo.tif provided in the *TracTrix* Examples folder.

Open the Examples folder and open the tawademo.tif file. Then print it. We will be using the print as an example for scanning into *TracTrix*. (The image is shown on the next page of the manual.)

The thinnest line on this print appears to be between 0.010" and 0.020" (0.25mm - 0.5mm) wide. To scan this to create at least 3 pixels width in the narrower raster lines we need to set a scanner resolution of 400 dots per inch (dpi).

Place the 'tawademo' print in your scanner. Align the edges of the print along the edge of the scanner bed. (*TracTrix* can de-skew vectors, but lining up the print now will save you editing work later.)

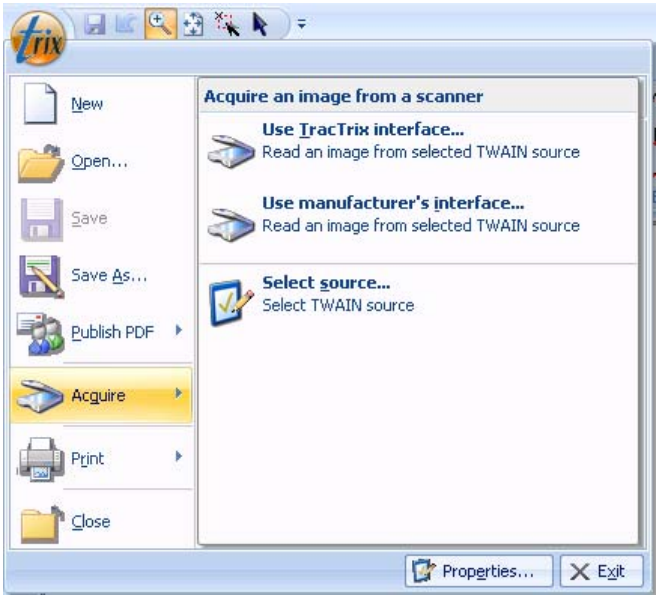
Establish a connection to your scanner by choosing  **Select Source**. If your scanner has a TWAIN interface, you will see its name listed; select it (most desktop scanners are supported).

Use  to access the scanning software where you can adjust scanning settings. Choose to use either the *TracTrix* interface or the scanner manufacturer's interface for scanning.

Set the resolution to the 400 dots per inch as suggested for the *tawademo* print.

Next set your scanner to scan the image as a black & white, 1-bit, image. We do this because *tawademo* is a black and white image--it contains no gray-scale tones or colors. Various terms are used to describe this setting control in different scanner software packages. Look for names that are synonymous with a 1-bit image such as 1 bit-depth, 1 bit color-depth, line art or monochrome.

Check also that the scanner is set to scan at 100% scaling.

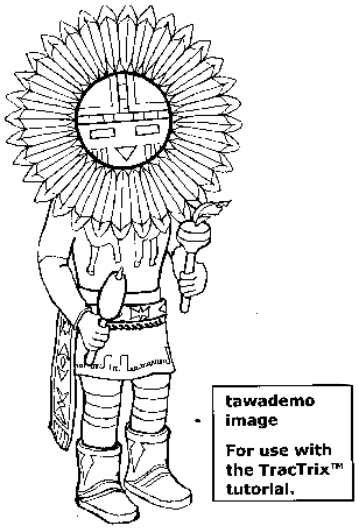


If your scanner software supports a preview mode, click on this. The preview image will appear on your screen. Examine the preview image. You may need to adjust your scanner's brightness control to make the lines on the image as bold, crisp and clear as possible.

When you are satisfied with the appearance, click on the button that instructs your scanner to complete the scan (it may be labeled Final, Scan, or something of this sort.)

The scanner will run again and the *tawademo* image will appear in the *TracTrix* window. By carefully choosing the scanner settings, you'll have the best possible raster image for Vectorization in *TracTrix*.

Successful Vectorization Rule #2:
Good quality vectors start with good quality scans.



RASTER EDITING

TracTrix provides a variety of raster editing tools. In this tutorial we will use the **Eraser** tool and the **Pen** tool. The scan should be open in *TracTrix*, or open the 'tawademo.tif' image instead.

Start by selecting the **Zoom** tool under the Start tab.

Look closely at the blob of dirt outside the text box, just to the left of the word 'image'. Let us use the eraser to remove it.

Again from the Start tab, select the **Eraser** icon in the Raster Editing group. The eraser works like a 'freehand tool.' Move the cursor over the blob. Hold down the left mouse button and drag back and forth over the blob to erase it. **Zoom All** (or roll your mouse scroll) to display the entire image.

Just because we're using computers doesn't mean we have to ignore pens, erasers, or white-out. If you see blemishes on prints, it's often just as simple to make corrections on them before scanning.

Save from the Quick Access Toolbar. The edited file will be saved as 'tawademo.tif.TRX' in the Examples folder. .trx is the extension to *TracTrix* native files that store.

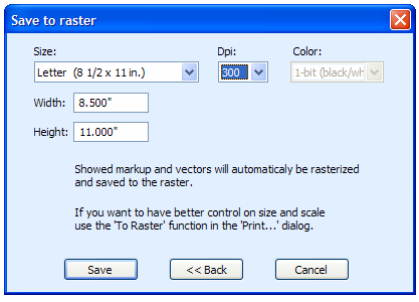
Zoom-in on the 'feathers' at the very top of the image. The tips of the top two feathers are missing (**Illustration 1**). We'll use the Raster pen tool to correct this error.

Illustration 1

Select the pen tool. The cursor changes to a pen. Right-click/Properties…; set the pen width to 5 pixels. Click OK.

Illustration 2

Use the pen tool to draw in the tips of the feathers. If you make mistakes use the eraser tool to correct them. Don't worry about being too exact. You should end up with something like in **Illustration 2**.



Save As…

Select CALS Type 1 from the file type menu. Enter 'tawademo.cal' as the file name; click **Save.**

You'll be prompted for a size and resolution. Select Letter as the size and 400 dpi resolution; **Save.**

You've now saved a copy of the raster file that you opened or scanned in, complete with the edits you made to it.

In this exercise, you chose to save to the CALS format—any supported raster file format could have been chosen.

You've now used the eraser to eliminate dirt and the pen to add missing detail. The image is now ready for Vectorization. But before we go on, take a moment to experiment with zooming in on

the Precision of the raster image. Zoom down until you can see the individual pixels (at high levels of zoom a grid will automatically appear so that you can see the individual pixels).

You should see that the edges of the raster lines are quite jaggy in many places when viewed as individual pixels. Junctions between lines are often irregular. *TracTrix* can deal with most of this. By dealing with the major raster irregularities and omissions you'll assist *TracTrix* in its automatic conversion in the next stage.

Successful Vectorization Rule #3:
It's quicker to clean up problems in a raster
before they become bigger problems as vectors.

CONVERTING THE RASTER TO VECTORS

You and your designs are unique. No one else in the world uses *TracTrix* quite like you do. *TracTrix* has some easy-to-use settings so that you can adjust to control exactly how *TracTrix* converts your images to vectors. In this exercise we are going to vary these settings to see how *TracTrix* creates different results based on the settings you choose.

When would you want outline vectorization rather than centerline? Typically you'd use this when you have a large filled raster area in silhouette, such as a logo, where you want to have vector definitions of the edges.

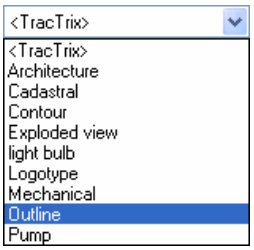
See ornament.tif in the Examples folder.

Outline Conversion

You should have *TracTrix* open and your *tawademo* scan up on screen. (Open the *tawademo.cal* file if you are returning to the tutorial.)

Click Vectorizing in the Tools tab.

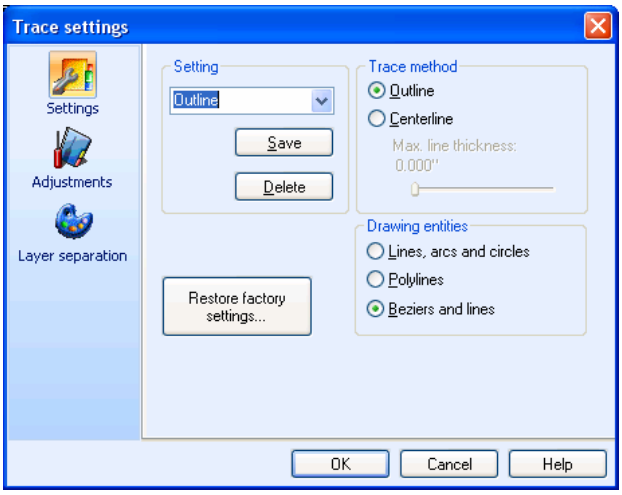
When you first launch *TracTrix* the default setting is the basic <*TracTrix*> setting.



Additional pre-defined settings are provided in the menu.

Start by choosing the Outline setting in the menu, then click **Adjust**.

The Trace Settings window displays—notice that the Trace method is set to Outline vectorization. This means *TracTrix* will create lines along the outside edges of the raster lines.

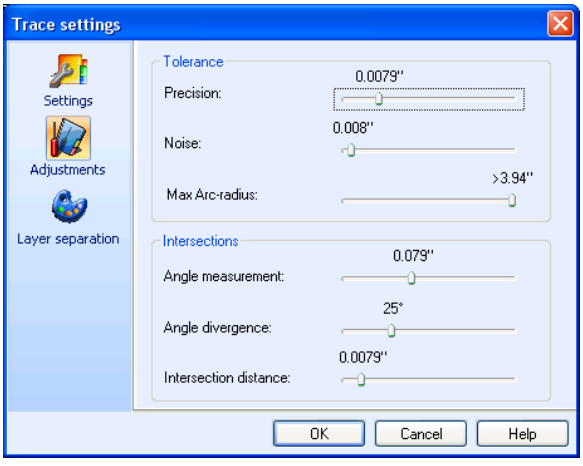


Now click on **Adjustments**.

The new window contains settings for the tracing parameters.

The Precision tolerance parameter is set to 0.20 mm (0.0079”). We are sometimes asked why we wouldn’t want absolute precision.

There are two primary reasons: The closer you follow your original jaggy raster, the more vector entities you will create, and this can create unmanageably large CAD files. Also, the raster lines are imperfect in the first place because of cumulative discrepancies from original drafting, paper stretch, and scanner wobble. There is no point in absolutely replicating an already somewhat imperfect original.



This tells *TracTrix* to follow the raster lines so that the vectors created are never more than 0.20 mm away from the original raster. You may want to think of this as the setting for the level of detail you want from *TracTrix*. If you prefer to work in inches go to **Program Settings** in the Settings tab and change ‘units’ from mm to inches.

The Noise tolerance parameter tells *TracTrix* what size of speckle is to be ignored. Many raster images have very small areas of dirt on them where lines may have been erased or dust particles appear as black specks. As we do not want these

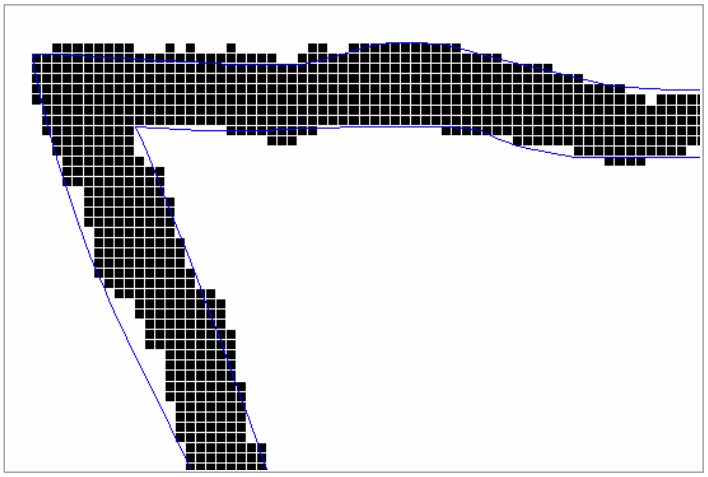
to appear as vectors we tell *TracTrix* to ignore them. The current setting is 0.20 mm. This means *TracTrix* will ignore any group of pixels less than 0.20 mm across.

The other settings enable even finer tuning of *TracTrix* conversion. To keep this tutorial simple we'll skip these for now.

Now let's see what happens when you convert the *tawademo* image using these settings. Click OK. Check that the Outline setting is still showing, then click **Start**. The cursor changes to an hourglass.

The progress of the vectorization is shown in the foot of the *TracTrix* window.

Within a few seconds vectorization is complete and blue vector lines appear overlaying the black of the *tawademo* raster scan. Note that the outline is filled with blue. Turn off the 'fill' to show only the outline by clicking the **Filled objects** button .



Zoom-in closely anywhere on the image. Notice how the blue vector lines smoothly flow around the jaggy edges of the underlying raster image, always keeping within the 0.20 mm limit set in the *Precision* setting. You'll also see how *TracTrix* has handled intersections.

Right-click/HOLD + Drag to activate and use the *Pan* tool (also in the Start tab).

Turn the raster layer off by using the Drawing button icon. You can now see the vector lines without the black raster lines underneath. To see the underlying raster again click again on the button again. Then click the to toggle the display of the vector layer.

Centerline Conversion

When you want to return to see the entire image, click on the *Zoom all* icon.

Now we'll do the conversion again, but this time we'll create centerline vectors. We first have to delete the outline vectors we just created (Ctrl+A to Select all). Every blue vector line on the screen will be highlighted with gray control points. Press the Delete key on your keyboard. All the vectors will disappear, leaving the original raster on screen.

To create centerline vectors press the **Vectorizing** again. Select the 'Mechanical' setting from the pull-down Settings menu.

Click on **Adjust**. The setting for Maximum line thickness, which was previously grayed out, is now available. Increase this setting to its maximum, 3.0mm.

The maximum line width setting enables you to have both centerline and outline vectorization performed simultaneously, depending upon the line widths. We want centerlines only for this demonstration.

In the Drawing Entities select 'Beziers and lines'. This will create Bezier vector line segments and straight line vector line segments and connect individual vector line segments together.

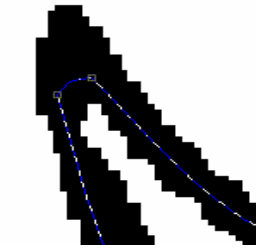
Now click on **Adjustments** to take a look at the other settings. Adjust the Precision to 0.14 mm. Leave Noise set to 0.20 mm.

Go back to the **Settings** screen. Click to highlight 'Mechanical' in the setting field, key in 'Tawa demo', then click **Save**. This creates a permanent record of the setting with our adjustments. Click OK to close the Trace settings. Since you saved your setting, the Mechanical Setting is will be restored for future use.

The words '*Tawa demo*' will appear in the box.

This shows that the settings you just saved will be used for the vectorization. Click **Start**. *TracTrix* will convert the raster image to vectors. This time it will create vectors which follow the centerlines of the original lines within the +/- 0.14mm tolerance set for Precision in the Trace parameters box.

When the vectorization is complete the blue vector lines are displayed on screen.



Save your work. It will be named 'tawademo.cal.TRX'. This .trx file contains a copy of your original raster image and the vectors created from it.

The .trx format is used only by *TracTrix* to save and store work. It can contain raster only images or hybrid raster with vector images.

Exercise

In your own time we suggest you experiment with the effect of changing the Precision setting in the Trace parameters box. Start by zooming in on the vectors we've just created. Note how closely they follow the original center lines. Then delete all the vectors (see the instructions earlier on how to do this). Change the *Precision* settings and vectorize again. Zoom in and examine the new vectors. You'll see how this change in setting effects how closely *TracTrix* follows the original. See the examples opposite. Although *TracTrix* settings are simple, it pays to think about them before each vectorization. Once you have experimented a little with the effects of changing the settings you'll find it easy to establish the optimum settings.

Industry-specific techniques

SIGN-MAKING

Vinyl cutters, laser-cutting machines, engravers and routers have 2D motion systems that require smooth and continuous vector lines.

CONVERTING FOR USE IN NC

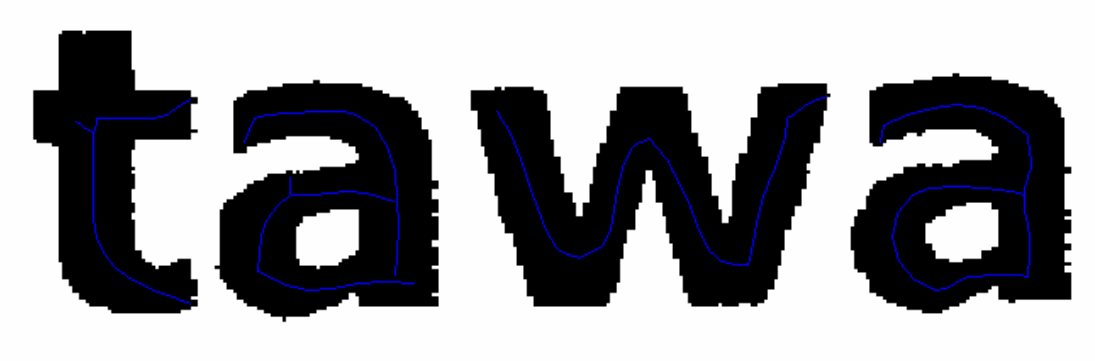
NC machines have motion systems that move in 2, 2½ or 3D increments, which needs smooth and continuous vector lines.

To reduce points and for smoother lines,
set Precision (in Trace Settings) to 1mm. This tells *TracTrix* to follow the original line but allows it to deviate within +/- 1mm for optimum smoothing and minimum vector points. This effectively adheres to the line but reduces vector points by ignoring the small jaggies that are present in all raster files. Each vector point is a signal for the machine either to stop, start, or change direction. Fewer vector points allow the machine to cut longer and smoother continuous lines.

Successful Vectorization Rule #4:
Careful selection of trace settings will optimize the type and quantity of vector entities you create.

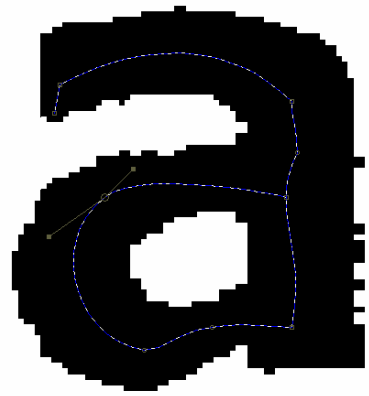
EDITING THE VECTORS THAT YOU CREATED

TracTrix provides tools to edit the newly created vectors. Open the 'tawademo.cal.TRX' file in your Examples folder. Use the zoom tool to zoom in on the text in the lower right-hand corner of the image. You should see something like this:



We will use the vector editing tools to tidy up the vectors that represent the text. Click on the vector editing tool icon. Start by clicking once on any blue vector. The entire vector 'entity' is selected and appears as a dashed line.

Position the point of the cursor arrow over any part of the dashed line. Hold down the left mouse button and drag. The entire vector entity moves. Release the mouse button. To return the vector to its original state select, Undo from the top menu bar or type Alt-backspace.



Click on the vector line again to select it. Position the cursor exactly on the center of one of the small circles or squares on the dashed line. These small squares or circles are called corners. Again hold down the left mouse button and drag. This time the dashed line on either side of the corner moves while the remainder of the line remains in its original position.

You will also see that when you select a corner it 'sprouts' gray lines or handles. These gray lines and squares are called handles. They control the shape of a line on either side of a corner. (Corners at the end of a vector line sprout only one handle.)

Position the cursor over a solid gray square at the end of a handle and hold down the left mouse button. Slowly drag the mouse. Watch how the shape of the line changes.

Some corners are represented as circles, others as squares. Try manipulating the handles on each type. When you select and move a handle on a square corner the vector line adjacent to the handle changes shape but the vector line on the far side of the square corner does not move.

When you select and move a handle on a circular corner it changes the shape of the lines on both sides of the corner. Circular corners are called locked corners because the shape of the line on one side of the corner is 'locked' to the shape on the other side. The square corners are called unlocked corners.

You can also snap two lines together to form a single connected line using the Polygon and Snap.

Select an endpoint of a line. The cursor changes to show a box with a key icon. Continue dragging until the points snap to one another—the connection is indicated when both vectors become one dashed entity.

Experiment with adjusting the shape and positions of the lines using the corners. You can also delete entire lines once they have been selected. Use the Delete key for this.

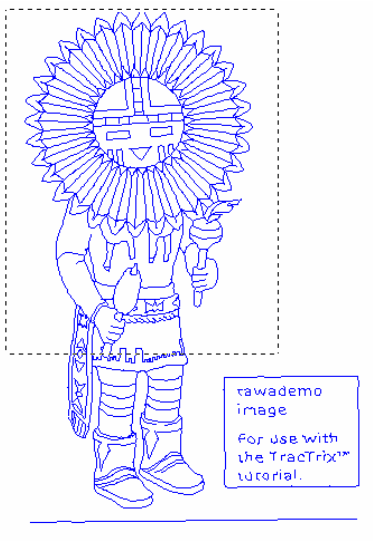
You'll probably have noticed by now that each line segment in the vector lines created by *TracTrix* is joined to its neighbor. This is because the 'Beziers and lines' box in the Trace settings was selected prior to vectorization. To disconnect two lines use the left mouse button to select a corner point where you want a disconnect to occur (you'll see the handles appear when the corner has been correctly selected). Right-click/**Break**. Deselect the vector line by clicking outside it. The dashed appearance changes to a solid blue line. Then reselect it. Hold the left mouse button down and drag the line. The line segment on the other side of the break remains in position. You can also insert a break in the middle of a selected vector line segment by putting the cursor where you want the break to occur and hold down the right mouse button and proceed as above where you separated lines at a corner. Entirely new vectors can be added by using the vector line, arc, circle or bezier tools available under the Start tab.

Experiment with vector editing until you are comfortable with manipulating the vectors.

Successful Vectorization Rule #5:
Edit vectors in *TracTrix* (where you have access to specifically-deisgned tools)
before you save in a specific CAD format.

SAVING YOUR VECTORS

Before saving the vectors in a specific vector file format refer to your CAD, CAM, NC or Design software manual to check which vector file format or formats it will import or open.



Click the **Drawing** toggle switch the raster layer off. For this exercise we will export the vectors representing the Tawa figure but omit the text box and base line.

Select an area of vectors in the top half of the image.

Now hold down the Shift key and select the lower-right box of text—the remaining vectors in the tawa figure are added to the selection. The text box and footer line should be outside this rectangle.

Save As... Enter *tawavect* as the file name and select the output vector format you require, then click on **Save**.

A new dialog box will appear on screen entitled 'Save as DWG/DXF'. Select: 'Or as an external referenced raster file.' Click on 'Save'.

TracTrix gives you the option to save the vector lines as any one of several CAD formats and automatically appends the three-character extension to the *tawavect* name. For example, if you selected DXF output *TracTrix* has saved the file as *tawavect.dxf*.

Open your CAD, NC or Design software and follow its instructions for importing the vector file that you have just created. *TracTrix* does not need to be open while you do this.

OCR TO CONVERT RASTER TEXT TO ASCII

In this section of the tutorial we convert raster text to vector text. In Exercise 1 we demonstrate text recognition by converting an example file using our supplied text recognition library. In the next exercise create a new text recognition library.

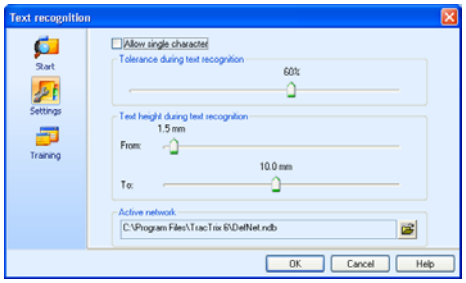
Using an existing text recognition library

In *TracTrix*, navigate to the Examples folder in the *TracTrix* folder and open Plan1.tif.

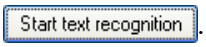
The image shows an architectural drawing. We want to create vectors from the centerlines of the drawing and we want to create ASCII text from the characters and digits in the raster image. The text is processed first–this enables us to delete the raster text before vectorizing the linework.

Click on the **Character Recognition** icon on the Tools tab.

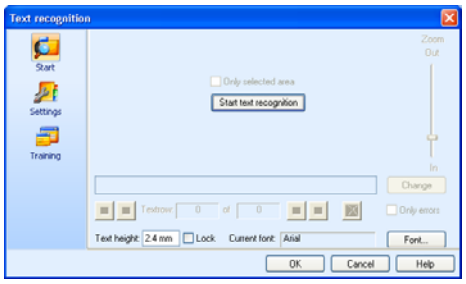
In the Text Recognition window select **Settings**, and check that the 'Active network' field at the foot of the window shows a file path to 'DefNet.ndb.'



If it does not click  , navigate to the Program Files/TracTrix folder and select it.

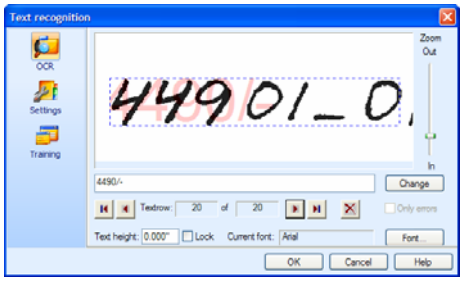
Click on **Start,** then on 

TracTrix 'looks' through the drawing to locate text regions and presents them one at a time in the window.



The large field shows the raster text being processed; the text field underneath shows *TracTrix'* interpretation of this text (also shown in red behind the raster text window).

Use the slider for zooming the raster text. Also, as you can see at the bottom of the window, there is a font specified. Change the TrueType font by clicking on the Font buttons and making the necessary adjustments.



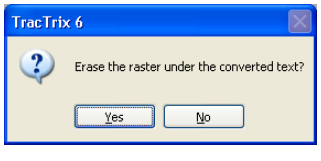
If *TracTrix* converted the text correctly, use  to move on to the next text string. All the text should be correctly identified until you get to the drawing number 44901_01.

Edit the incorrectly converted text in the text field and confirm the change by clicking on the 

button.

You have now reviewed and edited each text row. Click OK.

TracTrix asks if it's ok to 'erase the raster under the converted text'; click Yes and the raster text in the drawing is replaced with ASCII text (in the same color as the vector layer in which you are working).



TracTrix may have ignored solitary raster 'T' and 'G' shapes where they are boxed-in by lines. This occurred because 'Allow single characters' was left unchecked in the OCR settings. In instances such as this, use the Text tool  to add the characters.

Now that you've completed the text conversion you can move on to vectorizing the lines.

Click on Vectorizing; a dialogue box appears. Choose Architecture from the drop-down menu of predefined settings, and click Start.

All the raster elements remaining in the drawing are vectorized as line work that can be edited as needed. Finally use  

to export the CAD format you require.

Creating a character recognition library

There are an almost infinite number of text styles in drawings. In addition to the many typefaces produced as output from CAD programs there are characters manually created using stencils and, particularly on older drawings, hand-drawn text.

TracTrix provides the user with the ability to create and save custom libraries (or databases) of raster image text and the equivalent ASCII text. For example, you might create a specific library to be used when converting drawings hand-drawn by one or more individuals. This library would be trained to recognize the characters created by each of them. For another set of drawings where the draftsperson employed a unique set of stencils, a separate text recognition library would be created.

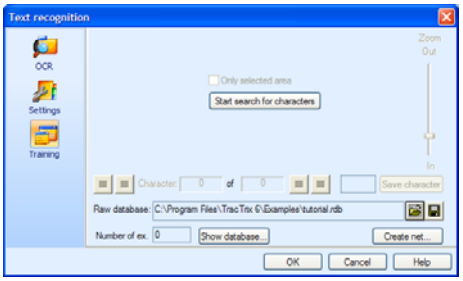
TracTrix creates text recognition libraries in two stages. In this first stage you create a raw database which contains 'pictures' of the raster text characters and the actual text which you choose to associate with them. When you have completed this database of pictures and text, TracTrix will take care of the second stage by processing it using neural network technology to create the text recognition library. These text recognition libraries are called *net databases*.

The initial creation of a library requires a semi-manual conversion process. This can be quite time-consuming compared with the subsequent automatic conversions. This time is the investment necessary to enable later automatic conversions of drawings from the same type or font 'family'.

For this exercise we'll recreate a text recognition library suitable for use with Plan1.tif. (If you have just completed the exercise above, close the file, do not save changes, and reopen it so that no vectors are showing.)

Click on the **Character Recognition** icon on the Tools tab and select **Training**.

Click on  to create a new raw database. Name it 'tutorial.rdb' and save it in the TracTrix/Examples folder.



Open the database--click  and select tutorial.rdb.

Click Start search for characters. *TracTrix* searches the raster image identifying the raster elements which it sees as characters. The first raster character is presented in the large window.

Use your keyboard to enter the actual character in the smaller window below. Use Enter to save the character and move on to the next one. You should find that, although there are quite a large number of characters, rapid progress can be made.

When all the characters have been manually identified click  , and then click Create net... to save a new net database—save it as 'tutorial.ndb'. Wait patiently as *TracTrix* saves this net database which contains the text recognition information created from the unique text in the *Plan1.tif* image.

In order to use the 'tutorial.ndb' that you have just created select it in the Text Recognition Settings Active network box at the foot of the window.

Begin the OCR process by selecting Start text recognition. This repeats the first exercise in this tutorial using your new net database. You may need to change the font to one that closely resembles the

one on the drawing. As you've just used Plan1.tif to train and create the tutorial.ndb net database, the results of this conversion will be satisfactory, as you expect.

A fairer test and illustration is to take a set of your own drawings created by one individual draftsperson or employing the same fonts, open a typical drawing from the set in *TracTrix* and use the training function to develop an .rdb database. Once you have identified all the characters, create an .ndb file from the .rdb as you did above. Then select and use this .ndb file on the remainder of the drawings from your set. If the characters used in the training file were reasonably representative of those in the entire set you should find that text is correctly recognized most of the time.

Additional characters can be added to the raster database (rdb) files at any time from new drawings. When the rdb database is then recompiled into the neural net database (ndb), file recognition will be improved across the entire set.

CONVERTING COLOR IMAGES

The ideal color original contains only spot colors, as opposed to blended colors or colors that fade into one another. We have included an example of such a file in the *Examples* folder. The file name is *spotclr.png*. Open the file and zoom in on the colors and color boundaries in this image to see examples of pure spot colors.

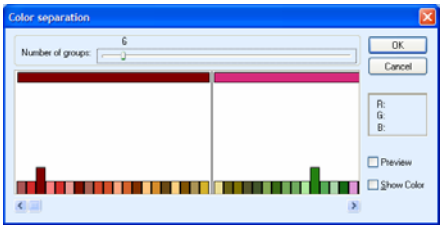
Real life rarely provides such simple images. Now go to *File→Open* and choose the file *Blume.jpg* from the *Examples* folder.

The *blume.jpg* flower image is far more typical of the sort of a color image. It has thousands of different color hues. Converting this image in its original state, *TracTrix* would convert the colors into 256 individual vector layers. This is unlikely to be of practical use. Instead we change the raster in *blume.jpg* so that it contains a manageable, relatively few, colors for *TracTrix* to vectorize. These colors have to be ordered in such a way that the resulting vectors reasonably depict the petals and leaves in the original image. This is no small task, given the multitude of colors and tones, which run together in the original image.

TracTrix places a limit of 256 colors on its separation tool. 8-bit images can contain up to 256 colors. All images of more than 8-bit depth must therefore be converted to 8-bit before they can be processed by the color separation tool.

The process used to achieve this is known as *color separation*. This separates all the colors in the image into a few groups, each containing similar colors. Once this is done each group is replaced with a single spot color that represents the colors in the group.

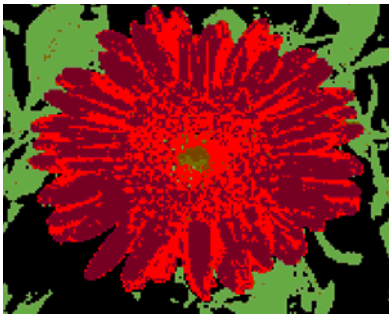
To demonstrate this, click Color Separation under the Draw tab. A window appears stating. *This file contains more than 256 colors and must be converted.* Click **OK.**



TracTrix then analyses the image and reduces the number of colors to a selection of 6, which it calculates as representative of the original thousands of colors. The colors in the *blume.jpg* image will change to reflect this.

Each group of colors is separated in the color separation window by a vertical line known as a *delimiter*. Use the scroll bar at the foot of the window to examine how *TracTrix* has separated the original colors. The height of each colored bar represents the relative quantity of pixels of that color. In effect we are graphing the distribution of the colors. This graph is known as a color *histogram*.

It is possible to edit the position of each color. However, for the purposes of this example, accept *TracTrix* selection of 6 groups and click on *OK*.



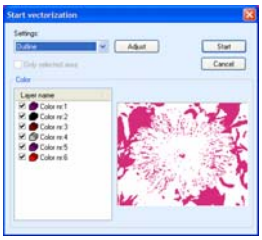
The *blume* image changes to reflect the reduction in colors from 256 to six colors. Although not as attractive as the original, the shapes of the petals and leaves can be seen clearly as spot colors in the new image.

Beauty is clearly in the eye of the beholder. Our human eyes liked the original with its thousands of colors. TracTrix would have hated it. If you are a vectorizing machine a few spot colors are your ideal.

Go to the vectorizing tool under the Tools tab. Click **Adjust**.

The trace settings box is displayed.

Select Outline as the trace setting (this will give us outline vectors around the petals). Now vectorize it by clicking on Start.

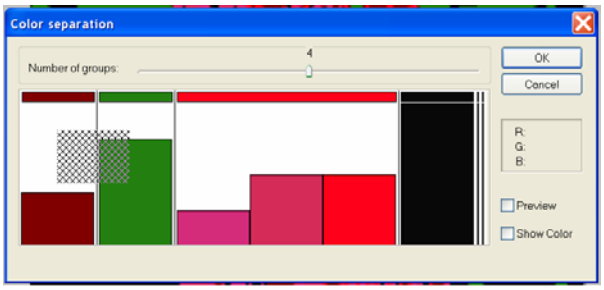


The resulting vectors can then be edited in the normal way using the *TracTrix* vector editing tools before they are exported to the required CAD or NC format. Each color is saved to a separate vector layer for vector editing.

Merging color groups

Re-open the original blume.jpg image and choose Color Separation. The window appears stating. *This file contains more than 256 colors and must be converted.* Click on *OK*. Again, six color groups are created. You can manually merge two groups together as follows.

Place the cursor in one of the two columns to be merged. Click and hold down the mouse button and drag. A cross-dashed representation of the group appears. Drag it to the target group's column. Release the mouse and the two groups will be merged in one new group. This will reduce the number of groups and therefore the number of vector colors eventually produced.



Producing more or fewer vector color groups

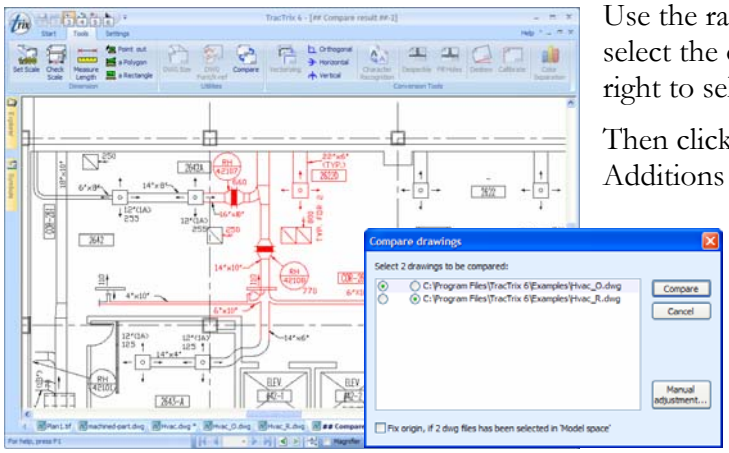
TracTrix starts its automatic color separation by estimating the number of individual color groups to create. If you would prefer a greater or smaller number of color groups, use the slider bar beside the *Number of groups*. *TracTrix* will recalculate and display a new set of groups.

COMPARING DRAWINGS REVISIONS

Use open the Example files Hvac_O.dwg (Original drawing) and Hvac_R.dwg (Revised drawing).

From the Tools tab select **Compare**.

In the Compare Drawings window check the 'Fix Origin' box as these drawings are displayed in Model space.



Use the radio button in the left-hand column to select the original drawing and the button on the right to select the revised drawing.

Then click on Compare. A new panel is opened. Additions are shown in blue and deletions in red.

The compare function may also be used with raster images. The Example images Plan1_O.tif and Plan1_R.tif may be used to test this.

If the drawings are of different sizes you can use *Manual Adjustment* to align content before starting the comparator. If two DWG files are to be compared in Modelspace, check the 'Fix origin' box.

CREATE A NEW IMAGE FROM OTHER FILES

It's very useful to be able to create a new raster or PDF file made up of individual details from other drawings or images. Here's an example of how to do this. We'll take some details from DWG and TIFF files in the *TracTrix* Examples folder and create a file that can be read by someone who does not have CAD or inserted into a word processed document for use in a presentation or report.

Start *TracTrix*. Use File – Open and navigate to the Examples folder at C:\Program Files*TracTrix* 6\Examples. Open **model-xref.dwg** and **Contour.tif**.

Used 'File - New' to create a blank raster sheet and choose a small sheet size (say Letter or A4).

Switch back to the original TIFF and zoomed in on any detail you choose. Use the 'Select area' tool to select the exact boundaries of the required detail. Then use Ctrl-C to copy the detail.

Switch back to the blank sheet, select the 'arrow' tool to activate the sheet and use 'Ctrl-V to paste in the detail. Then drag it into the position you want.

Repeat the process with the next detail and then save the final TIFF out to a PDF format.

Appendix 1: Supported formats

Raster-file formats

Raster files of this type are supported (including 🗐=Multipage files or ❖=color if indicated as such):

AFP		❖	IBM Presentation PTOCA (AFP)*
ANI	🗐	❖	Windows Animated Cursor
AVI		❖	Windows AVI*
AWD			Microsoft Fax
BMP		❖	OS/2 Bitmap, v1 and v2
	🗐	❖	Windows BMP Uncompressed
		❖	Windows BMP RLE
C2			CALS Type 2
C4			C4 JEDMICS
CAL			CALS Type 1
CIN		❖	Kodak Cineon
CIT			Intergraph CCITT G4
CLP		❖	Microsoft Windows Clipboard
CUR	🗐	❖	Windows cursor
CUT		❖	Dr. Halo
DCR		❖	Kodak PDC*
DCS		❖	Kodak PDS*
DJV		❖	DjVu*
ECW		❖	Enhanced Compressed Wavelet
EPS		❖	EPS (Encapsulated PostScript)
			EPS with Embedded TIFF file
FAX		❖	FAX, raw, CCITT Group 3 1D
			FAX, CCITT Group 3 1D, no eol
			FAX, CCITT Group 3 2D
			FAX, CCITT Group 4 1D
FPX	🗐	❖	FlashPix
	🗐	❖	FlashPix, JPEG
	🗐	❖	FlashPix, Uncompressed
GIF	🗐	❖	GIF (Compuserve)
ICA	🗐		IOCA, CCITT Group 3, 1d, -MO
	🗐		IOCA, CCITT Group 3, 2d, -MO
	🗐		IOCA, CCITT Group 3, 1d
	🗐		IOCA, CCITT Group 3, 2d
	🗐		IOCA, CCITT Group 4, 1d
	🗐		IOCA, CCITT Group 4, 1d, -MO
	🗐		IOCA, IBM MMR (+MO/–MO)
	🗐		IOCA, uncompressed (+MO/-MO)
ICO	🗐	❖	Windows icon
IFF	🗐	❖	Interchange File
		❖	Interchange File, RLE*
		❖	Interchange File - uncompressed
IMG		❖	GEM Image
ITG			Intergraph RLE
JPG		❖	Exif JPEG
		❖	Exif JPEG 4:1:1
		❖	JPEG
		❖	JPEG (4:1:1 and 4:2:2)
		❖	JPEG CieLAB
		❖	JPEG CieLAB (4:1:1 and 4:2:2)
KDC		❖	Kodak DC*
LSD			Laser Data*
MAC		❖	Mac Paint
MSP		❖	Microsoft Paint
NIF	🗐		CALS Type 3
PCD		❖	Kodak PhotoCD*
PCT	🗐	❖	MacPict
PCX		❖	ZSoft PCX
PDF	🗐	❖	Adobe Acrobat
PGM		❖	Portable Greymap ASCII
		❖	Portable Greymap Binary
PNG		❖	Portable Network Graphics
PPM		❖	Portable Pixelmap, ASCII
		❖	Portable Pixelmap, Binary
PSP		❖	Paint Shop Pro
		❖	Paint Shop Pro, RLE
		❖	Photoshop (Adobe)
PTK		❖	IBM Presentation PTOCA*
RAS		❖	Sun Raster
RAW			Raw BitField*
		❖	Raw Packbits*
		❖	Raw RLE4* & RLE8
		❖	Raw uncompressed data
RTF		❖	RTF Format*
SCT		❖	Scitex continuous tone
SFF	🗐		Structured Fax File Format
SGI		❖	Silicon Graphics Image
		❖	Silicon Graphics Image - RLE
SID		❖	Mr. Sid*
SMP		❖	Xionics
			Xionics CCITT Group 3 1D/2D
			Xionics CCITT Group 4
TFX			Tiff -FX CCITT Group 3 1D
			Tiff -FX CCITT Group 3 2D
			Tiff -FX CCITT Group 4
			Tiff -FX JBIG black/white*
		❖	Tiff -FX JBIG color/gray*
		❖	Tiff -FX JBIG color/gray 2
		❖	Tiff -FX JPEG*
TGA		❖	Targa
		❖	Targe RLE
TIF		❖	Exif TIFF, Uncompressed
		❖	Exif TIFF, Uncompressed, YCC
	🗐	❖	GeoTIFF
	🗐		Tiff - CCITT Group 3 1D and 2D
	🗐		Tiff, CCITT Group 4
	🗐		Tiff, CCITT Huffman
	🗐	❖	Tiff, JBIG
	🗐	❖	Tiff, JPEG 2000
	🗐	❖	Tiff, JPEG 4:2:2
	🗐	❖	Tiff, LZW compression
	🗐	❖	Tiff, Uncompressed CMYK
	🗐	❖	Tiff, Uncompressed YCC
	🗐	❖	Tiff, Uncompressed
	🗐	❖	Tiff, Packbits CMYK/YCC
	🗐	❖	Tiff, Packbits
	🗐	❖	Tiff, Uncompressed
	🗐	❖	Tiff, Wavelet CMP
TIX		❖	Trix files (v5 and earlier)
WBM		❖	Wireless Bitmap file
WFX			Winfax, CCITT Group 3 2D
			Winfax, CCITT Group 4
WPG		❖	Word Perfect Graphics
XBM		❖	XBitMap
XPM		❖	XPicMap
XWD		❖	X Window Dump (v10-11)

*Read Only files of this type cannot be exported

Vector-file formats

Vector files of this type are supported by *TracTrix* v6:

- AutoCAD DXF and DWG
  Versions 12, 13, 14, 2000, 2002, 2004, 2005, 2006, 2007, and 2008
- Autodesk DWF
- 3D DWG, DXF, and DWF
- HP-GL, HP-GL/2 and PLT files (*Read important information below regarding PLT files.*)
- Acrobat PDF

HP-GL and plotter files (.HP-GL, .hpg, .gl, .hp2, .plt, .pl2)

PLT and HP-GL files are **pl**o**t** files usually created with the **H**ewlett **P**ackard **G**raphics **L**anguage—a printer-control language that The Hewlett-Packard Company developed in 1989 to drive their new line of pen plotters (commonly found in engineering departments and typical to the industry). The simplicity of HP-GL commands made it a desirable language to all plotter manufacturers, and HP-GL went on to set the standard for pen plotters of the day.

Plotters print their output by moving a pen across the surface of a piece of paper. The quality of the pen plotters was impressive with the crisp lines it produced, and the precise, mechanical movement of the pens, but this made it draw very slowly. Ultimately the pen technology restricted plotters to printing only line art (no raster art) at a very slow rate, so they faded out with the introduction of laser and ink-jet printers

Plotters have been replaced with faster and more adaptable wide-format ink-jet and laser-jet printers. HP-GL/2 was developed to enable printers to act as plotters; to read, print, and create HP-GL/PLT files of their own. Third-party HP-GL/2 drivers were created, and while these variants are usually based on standard HP-GL, they also contain additional commands that do not conform to the original H-P specification. HP-GL files created using a plot driver that employs original H-P commands are fully supported by *TracTrix*.

Appendix 2: Measurement conversion tables

Points to Millimeters

Pen Files are set up using the international metric system: millimeters. As engineers, we are familiar with millimeters; as computer users we are familiar with lines measured in points.

Pts.	Millimeters
1	0.352777778
2	0.705555556
3	1.058333334
4	1.411111112
5	1.76388889
6	2.116666668

Inches and Millimeters

As a general rule of thumb, to convert inches to mm, multiply inches by 25.4. To convert mm to inches, multiply mm by 0.03937. (For slightly greater accuracy when converting mm to inches, divide mm by 25.4.)

Inches		
FRACTION	DECIMAL	mm
.	0.0039	0.1000
.	0.0079	0.2000
.	0.0118	0.3000
1/64	0.0156	0.3969
.	0.0157	0.4000
.	0.0197	0.5000
.	0.0236	0.6000
.	0.0276	0.7000
1/32	0.0313	0.7938
.	0.0315	0.8000
.	0.0354	0.9000
.	0.0394	1.0000
.	0.0433	1.1000
3/64	0.0469	1.1906
.	0.0472	1.2000
.	0.0512	1.3000
.	0.0551	1.4000
.	0.0591	1.5000
1/16	0.0625	1.5875
.	0.0630	1.6000
.	0.0669	1.7000
.	0.0709	1.8000
.	0.0748	1.9000
5/64	0.0781	1.9844
.	0.0787	2.0000
.	0.0827	2.1000
.	0.0866	2.2000
.	0.0906	2.3000
3/32	0.0938	2.3813
.	0.0945	2.4000
.	0.0984	2.5000
7/64	0.1094	2.7781
.	0.1181	3.0000

Inches		
FRACTION	DECIMAL	mm
.	0.5512	14.0000
9/16	0.5625	14.2875
.	0.5709	14.5000
37/64	0.5781	14.6844
.	0.5906	15.0000
19/32	0.5938	15.0813
39/64	0.6094	15.4781
.	0.6102	15.5000
5/8	0.6250	15.8750
.	0.6299	16.0000
41/64	0.6406	16.2719
.	0.6496	16.5000
21/32	0.6563	16.6688
.	0.6693	17.0000
43/64	0.6719	17.0656
11/16	0.6875	17.4625
.	0.6890	17.5000
45/64	0.7031	17.8594
.	0.7087	18.0000
23/32	0.7188	18.2563
.	0.7283	18.5000
47/64	0.7344	18.6531
.	0.7480	19.0000
3/4	0.7500	19.0500
49/64	0.7656	19.4469
.	0.7677	19.5000
25/32	0.7813	19.8438
.	0.7874	20.0000
51/64	0.7969	20.2406
.	0.8071	20.5000
13/16	0.8125	20.6375
.	0.8268	21.0000
53/64	0.8281	21.0344

Inches		
FRACTION	DECIMAL	mm
.	1.8898	48.0000
.	1.9291	49.0000
.	1.9685	50.0000
2	2.0000	50.8000
.	2.0079	51.0000
.	2.0472	52.0000
.	2.0866	53.0000
.	2.1260	54.0000
.	2.1654	55.0000
.	2.2047	56.0000
.	2.2441	57.0000
2 1/4	2.2500	57.1500
.	2.2835	58.0000
.	2.3228	59.0000
.	2.3622	60.0000
.	2.4016	61.0000
.	2.4409	62.0000
.	2.4803	63.0000
2 1/2	2.5000	63.5000
.	2.5197	64.0000
.	2.5591	65.0000
.	2.5984	66.0000
.	2.6378	67.0000
.	2.6772	68.0000
.	2.7165	69.0000
2 3/4	2.7500	69.8500
.	2.7559	70.0000
.	2.7953	71.0000
.	2.8346	72.0000
.	2.8740	73.0000
.	2.9134	74.0000
.	2.9528	75.0000
.	2.9921	76.0000

Inches		
FRACTION	DECIMAL	mm
1/8	0.1250	3.1750
.	0.1378	3.5000
9/64	0.1406	3.5719
5/32	0.1563	3.9688
.	0.1575	4.0000
11/64	0.1719	4.3656
.	0.1772	4.5000
3/16	0.1875	4.7625
.	0.1969	5.0000
13/64	0.2031	5.1594
.	0.2165	5.5000
7/32	0.2188	5.5563
15/64	0.2344	5.9531
.	0.2362	6.0000
1/4	0.2500	6.3500
.	0.2559	6.5000
17/64	0.2656	6.7469
.	0.2756	7.0000
9/32	0.2813	7.1438
.	0.2953	7.5000
19/64	0.2969	7.5406
5/16	0.3125	7.9375
.	0.3150	8.0000
21/64	0.3281	8.3344
.	0.3346	8.5000
11/32	0.3438	8.7313
.	0.3543	9.0000
23/64	0.3594	9.1281
.	0.3740	9.5000
3/8	0.3750	9.5250
25/64	0.3906	9.9219
.	0.3937	10.0000
13/32	0.4063	10.3188
.	0.4134	10.5000
27/64	0.4219	10.7156
.	0.4331	11.0000
7/16	0.4375	11.1125
.	0.4528	11.5000
29/64	0.4531	11.5094
15/32	0.4688	11.9063
.	0.4724	12.0000
31/64	0.4844	12.3031
.	0.4921	12.5000
1/2	0.5000	12.7000
.	0.5118	13.0000
33/64	0.5156	13.0969
17/32	0.5313	13.4938
.	0.5315	13.5000
35/64	0.5469	13.8906

Inches		
FRACTION	DECIMAL	mm
27/32	0.8438	21.4313
.	0.8465	21.5000
55/64	0.8594	21.8281
.	0.8661	22.0000
7/8	0.8750	22.2250
.	.8858	22.5000
57/64	.89063	22.6219
.	.9055	23.0000
29/32	.90625	23.0188
59/64	.92188	23.4156
.	.9252	23.5000
15/16	.93750	23.8125
.	.9449	24.0000
61/64	.95313	24.2094
.	.9646	24.5000
31/32	.96875	24.6063
.	.9843	25.0000
63/64	.98438	25.0031
1	1.000	25.40
.	1.0039	25.5000
.	1.0236	26.0000
.	1.0433	26.5000
.	1.0630	27.0000
.	1.0827	27.5000
.	1.1024	28.0000
.	1.1220	28.5000
.	1.1417	29.0000
.	1.1614	29.5000
.	1.1811	30.0000
.	1.2205	31.0000
1 1/4	1.2500	31.7500
.	1.2598	32.0000
.	1.2992	33.0000
.	1.3386	34.0000
.	1.3780	35.0000
.	1.4173	36.0000
.	1.4567	37.0000
.	1.4961	38.0000
1 1/2	1.5000	38.1000
.	1.5354	39.0000
.	1.5748	40.0000
.	1.6142	41.0000
.	1.6535	42.0000
.	1.6929	43.0000
.	1.7323	44.0000
1 3/4	1.7500	44.4500
.	1.7717	45.0000
.	1.8110	46.0000
.	1.8504	47.0000

Inches		
FRACTION	DECIMAL	mm
3	3.0000	76.2000
.	3.0315	77.0000
.	3.0709	78.0000
.	3.1102	79.0000
.	3.1496	80.0000
.	3.1890	81.0000
.	3.2283	82.0000
.	3.2677	83.0000
.	3.3071	84.0000
.	3.3465	85.0000
.	3.3858	86.0000
.	3.4252	87.0000
.	3.4646	88.0000
3 1/2	3.5000	88.9000
.	3.5039	89.0000
.	3.5433	90.0000
.	3.5827	91.0000
.	3.6220	92.0000
.	3.6614	93.0000
.	3.7008	94.0000
.	3.7402	95.0000
.	3.7795	96.0000
.	3.8189	97.0000
.	3.8583	98.0000
.	3.8976	99.0000
.	3.9370	100.0000
4	4.0000	101.6000
.	4.3307	110.0000
4 1/2	4.5000	114.3000
.	4.7244	120.0000
5	5.0000	127.0000
.	5.1181	130.0000
.	5.5118	140.0000
.	5.9055	150.0000
6	6.0000	152.4000
.	6.2992	160.0000
.	6.6929	170.0000
.	7.0866	180.0000
.	7.4803	190.0000
.	7.8740	200.0000
8	8.0000	203.2000
.	9.8425	250.0000
10	10.0000	254.0000
20	20.0000	508.0000
30	30.0000	762.0000
40	40.0000	1016.000
60	60.0000	1524.000
80	80.0000	2032.000
100	100.0000	2540.000

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