Predator Virtual CNC Basics

For help press F1 at any time.

Features vs. Models Predator Virtual CNC supports 4 different simulation and verification models. Most features work on every model type, some by design do not apply to a particular model. The following chart outlines the features that require a specific model type.

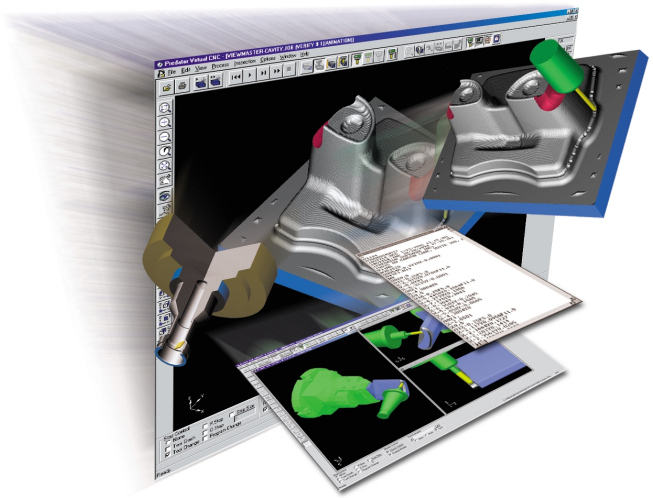
Feature	Backplot	Anima-tion	Solid	Turbo	Simula-tion
Indexing	☑	☑	☑	☐	☑
4 Axis Milling	☑	☑	☑	☐	☑
5 Axis Milling	☑	☑	☑	☐	☑
Custom Tools	☑	☑	☑	☐	☑
STL Compare	☐	☐	☑	☑	☐
Inspection	☐	☐	☑	☑	☐
Export STL	☐	☐	☑	☑	☐
Tool Display	☑	☑	☐	☐	☑
Translucent Stock	☐	☑	☐	☐	☑
Deep Zoom	☐	☐	☑	☑	☐
Custom Stock	☐	☑	☑	☐	☑
Panning	☑	☑	☑	☑	☑

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Getting Started with

Predator Virtual CNC™

for Windows® ME, 98, 2000 and Windows NT®



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09/05/01

Code	Description
G50	Scaling Off
G51	Scaling On
G52	Local Coordinate System Setting
G54	Work Coordinate System 1 Selection
G55	Work Coordinate System 2 Selection
G56	Work Coordinate System 3 Selection
G57	Work Coordinate System 4 Selection
G58	Work Coordinate System 5 Selection
G59	Work Coordinate System 6 Selection
G60	Single Direction Positioning
G61	Exact Stop Mode
G64	Cutting Mode
G65	Custom Macro Simple Call
G66	Custom Macro Modal Call
G67	Custom Macro Modal Call Cancel
G68	Coordinate System Rotation On
G69	Coordinate System Rotation Off
G73	Peck Drilling Cycle
G74	Counter Tapping Cycle
G76	Fine Boring
G80	Canned Cycle Cancel
G81	Drilling Cycle, Spot Boring
G82	Drilling Cycle, Counter Boring
G83	Peck Drilling Cycle
G84	Tapping Cycle
G85	Boring Cycle
G86	Boring Cycle
G87	Back Boring Cycle
G88	Boring Cycle
G89	Boring Cycle
G90	Absolute Programming
G91	Incremental Programming
G92	Programming Of Absolute Zero
G94	Feed Per Minute
G95	Feed Per Revolution
G96	Constant Surface Speed Control
G97	Constant Surface Speed Control Cancel
G98	Return To Initial Point In Canned Cycles
G99	Return To R Point In Canned Cycles

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Fax	(503) 292-7671
E-mail	support@predator-software.com
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Thank you again for selecting Predator Software Inc.

At your service,



Jim Abbassian
President
Predator Software Inc.

Appendix A

Common G Codes

The following is a list of commonly used G Codes for CNC milling machines and their functionality.

G Codes Milling

Code	Description
G00	Rapid Linear Positioning
G01	Linear Feed Interpolation
G02	CW Circular Interpolation
G03	CCW Circular Interpolation
G04	Dwell
G07	Imaginary Axis Designation
G09	Exact Stop
G10	Offset Value Setting
G17	XY Plane Selection
G18	ZX Plane Selection
G19	YZ plane Selection
G20	Input In Inches
G21	Input In Millimeters
G22	Stored Stroke Limit On
G23	Stored Stroke Limit Off
G27	Reference Point Return Check
G28	Return To Reference Point
G29	Return From Reference Point
G30	Return To 2nd, 3rd and 4th Ref. Point
G31	Skip Cutting
G33	Thread Cutting
G40	Cutter Compensation Cancel
G41	Cutter Compensation Left
G42	Cutter Compensation Right
G43	Tool Length Compensation + Direction
G44	Tool Length Compensation - Direction
G45	Tool Offset Increase
G46	Tool Offset Double
G47	Tool Offset Double Increase
G48	Tool Offset Double Decrease
G49	Tool Length Compensation Cancel

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Help Menu
The Help menu contains the following commands.

Contents
Selecting contents from the Help menu launches a window showing a list of help topics.

Search On...
This command allows you to search for help on a specific topic. Entering a word or phrase you wish to find in the top text box reveals a list of close matches in the lower box. Double clicking one of the listed topics in the lower window will reveal the appropriate help details.

Help on Help
Selecting 'Help On Help' will provide assistance if you are having difficulty using STL-Fix's help facility.

About STL-Fix
Selecting About STL-Fix reveals a small information window containing our copyright notice and a brief explanation of the most important program features. To close the About STL-Fix window, click the OK button.

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Menus

The Main Menu is made up of a number of sub-menus. Each sub-menu contains commands that are used to control an STL-Fix session. Most of the menu commands have buttons assigned to them on the Tool Bar. However, some commands are only available from the menus. These are:

File Menu
The file menu contains the following additional commands:

Save As
The Save As command opens the Windows Standard Save dialogue and allows the user to save the current STL file using a different file name. The file can be saved either in ASCII or binary mode.

Print Preview
The Print Preview command prints the STL model details to screen for review prior to printing.

Print Set-up
The Print Set-up command opens the Windows Printer Set-up dialogue. For more information consult your Windows manual.

Last opened file list
The last opened file list shows recently opened files. To re-open one of these files, click the filename on this list.

Exit
Choosing exit from the File menu will close down the STL-Fix utility.

Edit Menu
The Edit Menu contains the following additional commands:

Select All
The Select All command selects all the triangles in the current STL model.

Select None
The Select None command deselects all of the triangles selected previously.

View Menu
The View Menu contains the following additional commands:

Tool Bar
The Tool Bar command toggles the Tool Button Bar on or off.

Status Bar
The Status Bar command toggles the Status Bar on or off.

Options Menu
The Options menu contains commands that can be found on the button bar.

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These Operations apply to currently selected triangles. Triangles can be selected by clicking each with the mouse cursor or dragging a window around multiple triangles.
This vector may be different from the STL normal vector that is listed inside the STL file for each triangle. Triangles, which have the triangle orientation inconsistent with the STL surface normal, will be shown in magenta.
STL-Fix can cure the following problems:

- Reverse the STL normal so that normal is consistent with other, neighboring surface normals (e.g. so all normals point out of a solid or a surface).
- Re-set the STL normal to be consistent with the triangle orientation.
- Re-set the order of the triangle co-ordinates (e.g. clockwise to counter clockwise order) to be consistent with the STL vector.
- Reverse the sense of the STL normal along the Z direction so all normals point up.

The buttons associated with each of these corrections and their functions are:

Invert Normals
The Invert Normals button reverses the selected triangle normal vector direction. Use this option so the selected triangle or triangles have a coloring (yellow or cyan) that is consistent with neighboring triangles.

Recalculate Normals
The Recalculate Normals button recalculates the selected triangle normal vectors, based on the triangle vertex co-ordinates.
This Option is suited for STL triangles that have a correct triangle orientation, but an incorrect STL surface normal.
Triangle normals are calculated using the right hand rule.

Reorient Polygons
The Reorient Polygons button changes the orientation of selected STL triangles from clock-wise to counter clock-wise or vice versa. This Option is suited for STL triangles that have a correct STL surface normal, but an incorrect triangle orientation.
Triangle orientation is re-set to comply with the right hand rule.

Positive Z-direction
The Positive Z-direction button reveres normal vector Z-components of selected triangles that have a negative Z component. This option is useful when STL files contain triangles where it is known that all normals should be pointing upwards, as in the case of surface modeling. This applies where all surface normals have a unique Z value for a given X and Y pair.

Help
The Help button opens the STL-Fix help file.

Status Bar
The Status Bar displays the name of the STL file loaded and the number of triangles that it contains. The status of Caps, Num. and Scroll Lock keys is also shown.

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Main Window
The Main Window is an area of screen where the STL model is displayed. The window can be resized, maximized or minimized, using standard Windows controls.

Tool Bar
The Tool Bar consists of a number of buttons; each is associated with an STL-Fix command. The following graphic shows the Tool Bar in a typical state when a STL file is loaded. Depressed buttons indicate active options. Buttons that are not available will be grayed out.
The buttons and their functions are:

File
The File button opens the standard Windows File Open dialogue where you may select the required STL file.

Save
The Save button saves the current STL file to disk in its modified form.



Print
The Print button prints the current STL view

Section - 2 View Options

Display Origin
The Display Origin button shows or hides the STL origin position. The origin is marked with a cross (+).

Bounding Box
The Bounding Box button shows/hides the STL bounding box. The bounding box is calculated from the minimum and maximum extents of the STL triangle co-ordinates.

View
The View button allows the view angle and light source associated with the Main Window to be changed. When the View button is clicked with the left mouse button, the STL image in the Main Window can be dragged to a new position. Likewise, holding the right mouse key down allows the light source to be changed.
To disable this operation, the View button must be pressed again.

Zoom In
The Zoom In button magnifies an area of the STL model. To select an area, drag a window using the left mouse button.

Zoom Out
The Zoom Out button restores a zoomed view to the original size.

Operation Options

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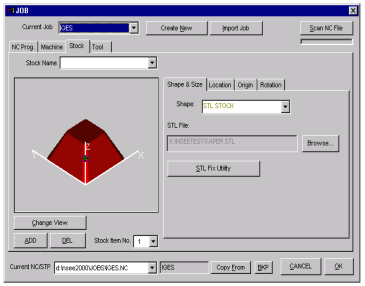
Clicking triangles with the left mouse button selects triangles. Using the right button deselects triangles. This is also valid when dragging windows around many triangles. Selected triangles are shown in dark color.

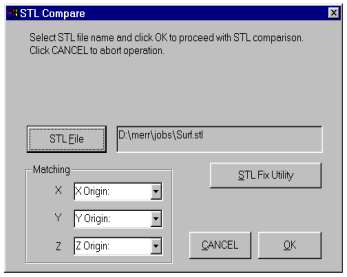
Installation & Execution

STL-Fix is a stand-alone program that can be executed from inside Predator Virtual CNC or as a stand-alone Windows application. If launched from within Predator Virtual CNC, STL-Fix will automatically load the currently selected STL file. If launched as a stand-alone program, the STL file must be selected.
STL-Fix is included with the Predator Virtual CNC distribution CD-ROM and is copied to your system when Predator Virtual CNC is installed. However, it will be operate only if Advanced Stock or STL Compare modules are licensed.
STL-Fix can be launched when selecting an STL file within the Stock dialogue or STL Compare dialogue.
The following diagrams show how to run STL-Fix from Predator Virtual CNC:
From the Stock dialogue, select a file and click the STL-Fix button.
From the STL Compare dialogue, click the STL-Fix button.

Screen Layout

All STL-Fix functions are selected from the Main Menu or Tool Bar. The following diagram shows a typical STL-Fix session.
As you can see the screen is made up of the following areas:9





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Chapter 9

STL-Fix Utility

Product Overview

STL-Fix is a software utility that is supplied with Predator Virtual CNC for correcting some problems associated with importing STL (Stereo Lithography) files into Predator Virtual CNC´s STL file compare and STL stock import modules. STL file data consists of a collection of triangles and their normal vectors. Some STL files include triangles with inconsistent or incorrect normals. An example would be a description of a solid that has some normals pointing out and some into the solid, rather than all pointing out of the solid. To help you understand the uses of each STL-Fix option and the terminology used in this manual, we recommend that you read this product overview.

Operations

The application includes the following operations:

- Recalculate Normal Vectors
- Reorient Polygons
- Reverse Normal Vectors
- Reverse Normal Vectors to point always upwards

View Controls

The following display controls may be used to manipulate a view of an STL model:

- Display STL Origin
- Display STL Bounding Box
- Change View Angles
- Zoom In
- Zoom Out

Colors

Colors are used to show the orientation and consistency of the triangle normal vectors. The following colors and their use are:

- Yellow - Triangles with normal vectors pointing toward the user.
- Cyan - Triangles with normal vectors pointing away from the user.
- Magenta - Triangles with normal vectors that are incorrect for the triangle orientation.

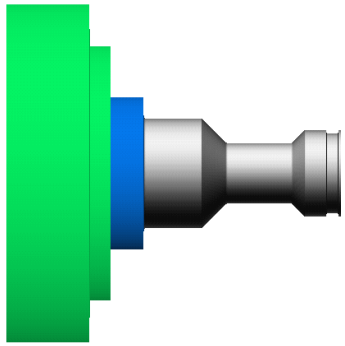
STL Triangle Selection

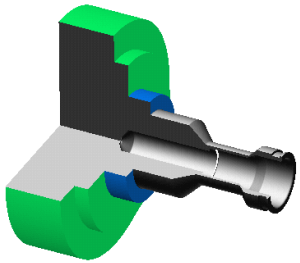
The STL triangles may be selected at any time by clicking each of them with the mouse cursor, using the left mouse button, or dragging a window around many triangles. However, if the View option is active, triangle selection is not possible. Selected polygons will be displayed with bright colors, while deselected areas will be lighter.

Mouse

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4. From the Job list, select LATHE.
5. Click the OK button and wait for the message and click NO when prompted to re-process?
6. Click the New Verify button to open a window and then select the Animation button.
7. Click the Turbo button to open a Turbo window.





8. Select Tile from the Window menu to automatically arrange the two windows.
9. Click the Play button to start processing.

Having processed the Job, you will have seen a 3-D animation of the process in the one window and a 2D animation in the turbo window. It would be a good idea to visually check the part from all angles.

To do this:

1. Click the mouse cursor in the Turbo window to make it active.
2. Click the 2D button on the View Bar. Notice the 2D image becomes a 3D image.
3. Click the ¾ Section button on the View Bar. See the full 3-D image in the turbo window becomes a sectioned image. We can now see inside the part.

1. Click the Zoom window button on the View Bar. Then, drag a window around a section of the part in the turbo window. The resulting zoomed view may require changes in the View angle and Light to allow a clear view inside the part.
2. Click the View Button on the View Bar. Drag the View and Light positions until you are happy with them and click the Apply button. Notice that the Light and view angle have been changed, but the view is now unzoomed. To get a closer look, use the Zoom Window button again. Close the View/Light control if you are finished with it.

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CHAPTER SIX - INSPECTION

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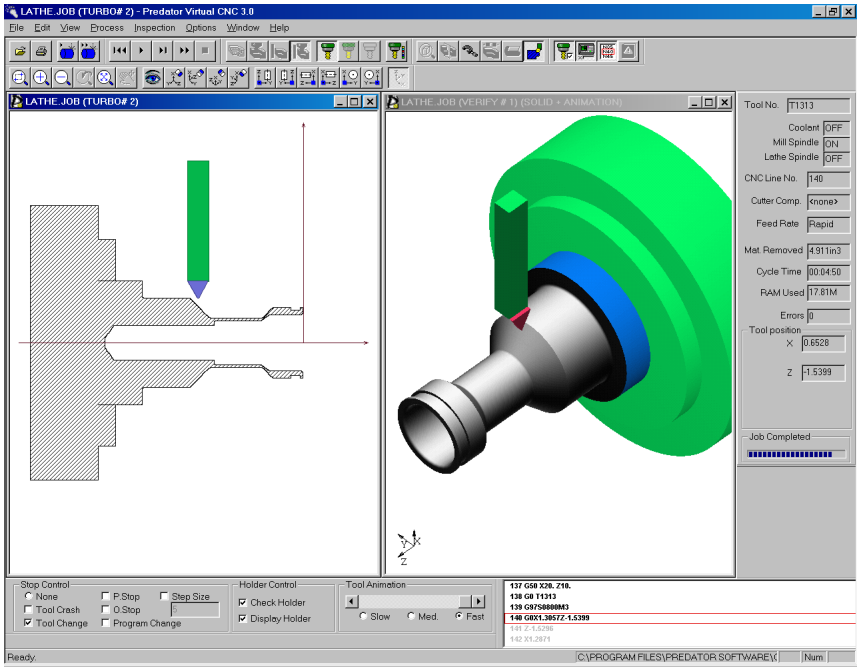
the Zoom and Deep Zoom buttons to inspect the machined surface. To use Deep Zoom:

1. Click the Deep Zoom button on the Inspection Bar. The mouse cursor will change to an arrow with a box attached to it.
2. Click the surface of the job at the center of the area to be zoomed. With the left-hand mouse button depressed, drag a box over the area to be zoomed. If you drag too far, the box will not grow. This will ensure that the Deep Zoomed view will be to a higher resolution to that of the original view.
3. A new window will open and the deep zoomed view will be shown with a surrounding bounding box. This view is a solid model that can be rotated and measured and further zoomed.

LATHE.JOB

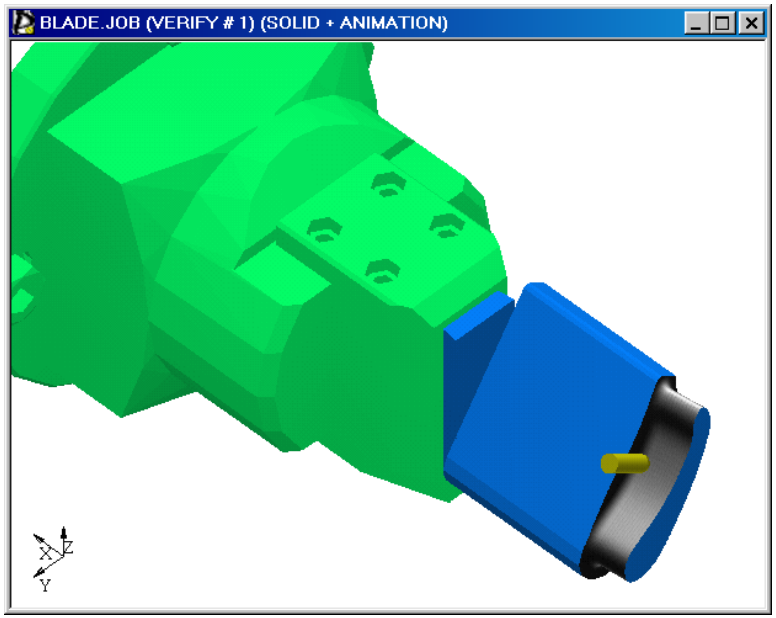
LATHE.JOB is a typical 2-axis turning job with both OD and ID turning, threading, grooving and contouring operations. The Job is held in a chuck and machined from one end only. To run LATHE.JOB:

1. Start Predator Virtual CNC.

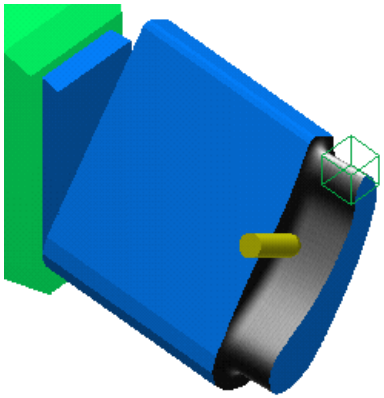


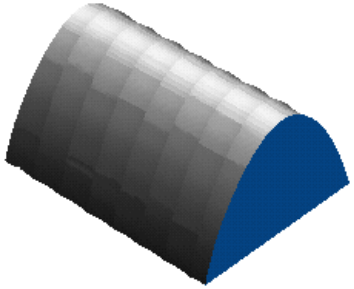
2. From the File menu, select Open or click the Open button on the tool-bar.
3. Click the arrow to the bottom right of the Current Job list box.

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2. From the File menu, select Open or click the Open button on the Tool Bar.
3. Click the arrow to the right of the Current Job list box.
4. From the list of Jobs, select BLADE.
5. Click the OK button at the bottom right of the Job dialog and click NO when prompted to re-process.
6. Click on the New Verify button on the Tool Bar. This will open a window.





7. Click on the Animated & Solid button on the View Bar. This will set the View attributes for the Predator Virtual CNC window.
8. Using the mouse to locate the cursor along the window's edge, drag the window to a suitable size.
9. Click the Play button on the Tool Bar.

Once the job is completed, you can use

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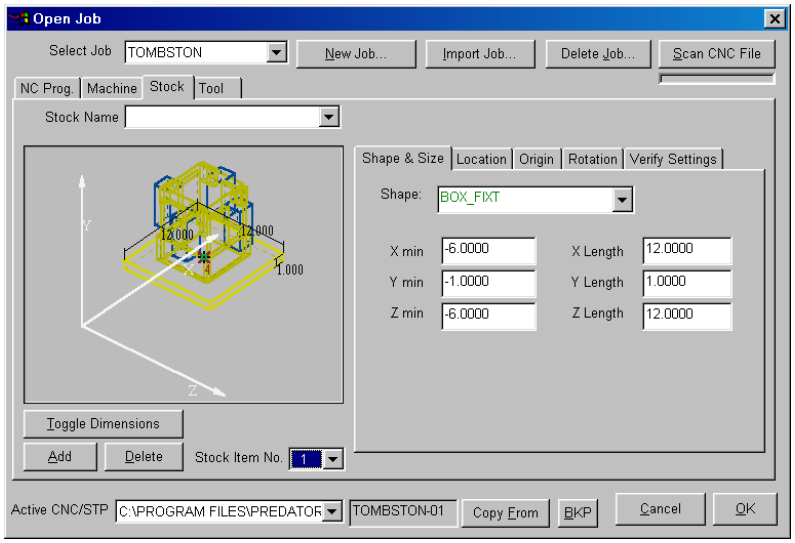
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running. At the end of the current tool move you will see that the holder animation is switched off. Leaving the Holder Check box in the checked state will still check for holder collisions with the stock or fixture.

5. Stop the animation at any time.

To see how the stock and fixture have been created:

1. Click the Job button on the Tool Bar.
2. Click the Stock tab on the setup dialog.
3. Click the arrow on the Stock Item No. list box at the bottom of the dialog box. Select a numbered item from the list and see the item highlighted in the graphic window.
4. See also the dimensions and shape details on the Shape & Size dialog. Looking at each item, you will notice that each stock and fixture element is specified in the stock co-ordinate system from a single point (the stock Datum).
5. Cancel the setup dialog when you have seen enough.

BLADE.JOB

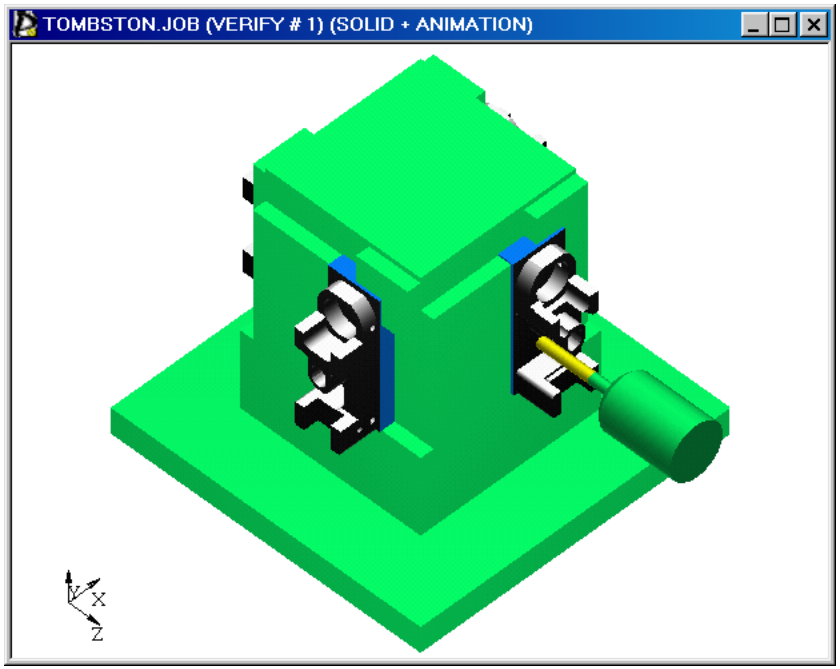
The BLADE job has been provided to demonstrate Predator Virtual CNC's 5-axis milling capability and the STL stock and fixture import facility. This part also provides an excellent opportunity to experiment with Deep Zoom.
To run BLADE.JOB:

1. Start Predator Virtual CNC.

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dow.

5. Click on the Animated & Solid button on the View Bar. This will set the View attributes for the Predator Virtual CNC window.
6. Using the mouse to locate the cursor along the window's edge, drag the window to a suitable size.
7. Click the Play button on the toolbar to begin the verification session. You will see the tool cutting the 4 jobs located on the tombstone fix-



ture.

8. Stop the animation at any time using the Stop button.

So far, we have seen only the tool cutting the part. Now let us add tool shank and holder to the animation.

1. Click the rewindt button on the toolbar. This will restart the CNC program to the beginning and repaint the stock in its starting state.
2. Check the Holder Check and Holder Display boxes on the Control Panel.
3. Click the Play button. This time you will see the tools and tool holders are animated.
4. Click the holder display check box to uncheck it while the animation is

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Chapter 1

Introduction

Predator Virtual CNC is a software application for verifying CNC machine tool programs and operation. To help you understand the uses of each Predator Virtual CNC model and the terminology used in this manual, we recommend that you read this product overview.

CMS (Common Model Structure)

CMS is a new modeling technique developed by Predator Software Inc. with characteristics that ideally suit the requirements of CNC program verification and simulation. CMS is the term given to the imbedded technology employed within Predator Virtual CNC. This technology is presented to the user in the form of 'views'. Each view is displayed in a window and has certain attributes that can be set by the software or user to provide optimal performance for a given task. For instance, an animation view will require different attributes than a solid view. Predator Virtual CNC sets many of these attributes automatically, so you don't need to be concerned about them. Other attributes like light source, orientation, model resolution, etc. can be set by the user according to the needs of the job in hand.

Machining Simulation & Modeling

Predator Virtual CNC's provides animation, showing tools cutting the part, and solid model representations of the machined component that can be inspected as if it was the real part. Predator Virtual CNC can model machining processes by all supported machine tool types and can combine milling and turning operations on the same part. Predator Virtual CNC can be operated in one or more of the following:

- Wireframe
- Animation
- Solid
- Turbo
- Machine Simulation—Optional

Predator Virtual CNC integrates several mathematical models together similarly to the way CAD/CAM systems integrate wireframe, surface and solid models.

Animation

When in animation only mode, Predator Virtual CNC produces animated simulation of the machined part. The resulting screen images are not solid model based and therefore have limitations regarding accuracy and the ability to change views.

Multiple animated windows can be opened, each having different view attributes. View attributes such as zoom settings, view angle, light source, etc. can be set for each window. If these settings are changed after some processing has taken place, the job will reprocess completely before any new view update. On long

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jobs, this can be very time consuming, so it is recommended that animated only views be set prior to processing.

Animated only views cannot be measured in any way, but they do provide a useful visual check that the program is doing what was intended.

The main advantage of running animated only views is the small amount of memory used. This makes this mode ideal for users with limited computer system resources.

Solid

Predator Virtual CNC solid views provide solid model representations of the machined part without providing animated simulation. While processing, no changes in the model displayed until processing is stopped. Only when processing has stopped, either by manual intervention or automatic stop controls, does the model view change to show the state of the part.

Multiple solid views can be opened but this is not usually necessary, as a single solid view can be rotated, zoomed, panned, sectioned and measured quickly at any time. The window view angle and light source can be changed with the mouse by dragging the part in the model window.

After changing view attributes, there is a short delay while the new view is produced. The job is not reprocessed so, regardless of the number of CNC program lines processed, the time to change views is constant for each job.

Predator Virtual CNC's solid model resolution can be changed to suit the conditions for each Job. Higher model resolution requires more memory and longer processing times but on physically large jobs that include fine detail, a higher resolution may be required. For most jobs, the Predator Virtual CNC default settings will provide a good combination of speed, resolution and memory use.

The resolution of Predator Virtual CNC's model does not affect the accuracy of measurement. The resolution does impact image quality on jobs containing fine detail, but this can be negated by using the Deep Zoom capability. Deep Zoom allows selected areas of the model to be refined to bring out detail that may have been hidden in the normal view. Each Deep Zoom view is shown in a separate window and consists of a miniature model.

Model resolution affects the accuracy of tool collision detection, but extreme accuracy in this area is not generally a desirable thing. Allowing a tool to rapid close to the part within thousandths of an inch or hundredths of a millimeter without indicating a tool collision is not a good idea.

Memory requirement for solid views is based on the physical dimensions of the job and the model resolution. When processing, you will notice that the memory requirement remains almost constant, making Predator Virtual CNC the ideal solution for modeling large jobs.

Animation + Solid.

Animation + solid views provide the best of both worlds. Animated simulation of the part being cut is shown, while solid model data of the part is being stored. Animated and solid views use more memory than either views shown separately but, in most cases, this is not a problem. Combining animated and solid views in a single window does allow the fast dynamic rotation and zooms of animated views. All measurement and view controls associated with solid only views are available.

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the red area on the part surface and wait for the window to repaint. Predator Virtual CNC will zoom in around the gouge. Notice the quality of the image and detail.

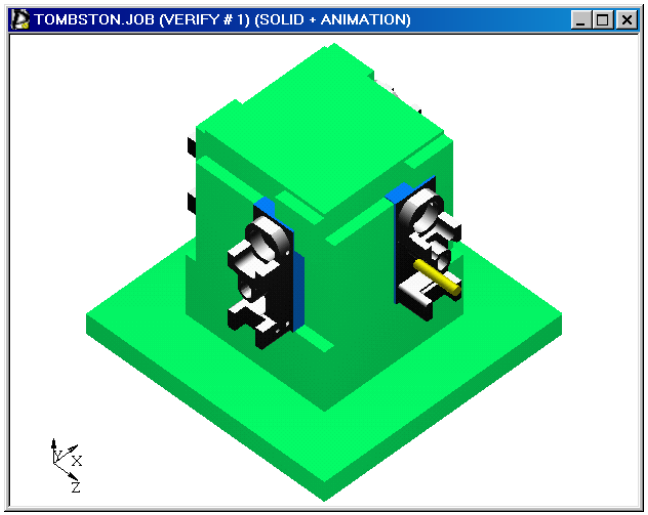
8. Click the Inspection button.
9. Click a point on the part surface within the red area. See that the information relating to the chosen point in the gouge has been displayed in the top Inspection window. Notice that the information given now includes the deviation from the STL 'ideal' surface (STL Error).
10. Click on a green high spot adjacent to the gouge. See similar point data appears in the Inspection window.
11. Select the two point data lines in the Inspection window and see the small 'Z' difference between the high spot and the gouge.
12. When you have finished, close the Inspection window and deselect STL compare by clicking the STL button on the View menu.

TOMBSTON.JOB

This part has been provided to show how easy it can be to build complex stock and fixture arrangements from simple geometric primitives.

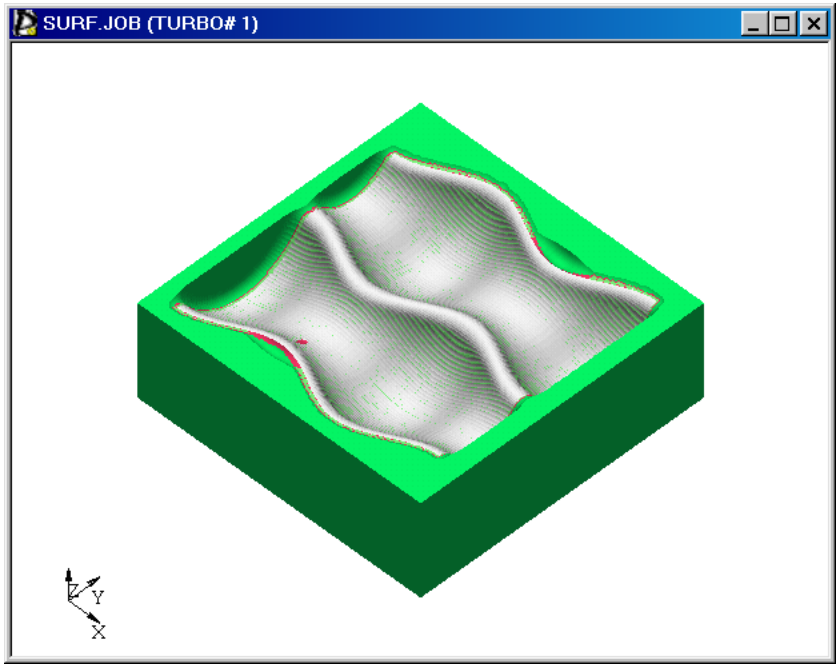
To load TOMBSTON.JOB:

1. From the File menu, select Open or click the Open button on the toolbar.
2. Click the arrow to the right of the Current Job list box and select TOMBSTON.
3. Click the OK button and click NO when prompted to re-process.
4. Click on the New Verify button on the toolbar. This will open a win-



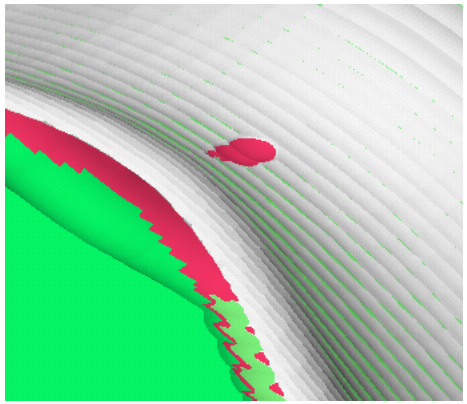
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1. Click the STL Compare button on the View Bar. The STL File dialog box will open.
2. Click the STL file button. From the list of files (there will probably only be one, if you are a new user) select SURF.STL and click the OK



button. The SURF STL file will load and a Compare dialog will appear.

3. Click inside the Compare Tolerance box and enter 0.002. The SURF part is programmed in inches, so we are entering a tolerance of 0.002 inches.
4. Click the Turbo image check box. After a little while you will see that areas of the model have changed color.



5. You should see a small area of red on the part surface and several green stripes. The green stripes are cusps that exceed 0.002 or excess material and the red areas shows gouges.
6. Click the Zoom Window button.
7. Drag a small window around

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Turbo - Solid Modeling for 3-axis Surface Milling.

Turbo is a second generation Turbo solid modeling system for parts made from complex surfaces. Turbo offers a supreme combination of speed and accuracy for modeling certain 3-axis milled parts. Turbo does not support all tool shapes and machining operations are restricted to the top face of the part only. However, Turbo is the perfect modeling system for the mould & die manufacture and similar industries. Turbo models can be zoomed and dynamically rotated. CMM inspection includes our very powerful Advanced Inspection (STL Compare) inspection capability. STL Compare uses STL (Stereo Lithography) files to compare the 'machined' model with the original design model. As with the our other models, Deep Zoom can also be used with Turbo. Virtual CMM measurement is possible, but feature measurement is not.

Machine Tools

Predator Virtual CNC supports 3-axis, 4-axis and 5-axis milling machines and 2-axis turning machines. CNC programs for most CNC controllers and machine tool configurations can be converted into accurate models of the finished part.

Tooling

Predator Virtual CNC supports a wide range of standard tool types for both milling and turning applications. In addition, a tool geometry language called NTG (Predator Virtual CNC Tool Geometry) is provided, allowing the end-user to create his own complex tool and tool holder shapes for both milling and turning jobs.

Standard milling tool shapes supported are:

- Flat ended tools
- Drills
- Ball end tools
- Bull end tools
- Radius form tools
- Chamfer tools
- Dovetail tools
- Tapered ball end tools
- Spherical tools

Standard turning cutting insert shapes:

- Diamond tips.
- Triangular tips
- Square tips
- Pentagonal tips
- Hexagonal tips
- Grooving tools
- Button tipped tools
- Threading tools
- Drills

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Stock

Predator Virtual CNC allows the user to create stock, fixtures and clamps from simple geometric primitives. These primitives can be 'assembled' into complex stock and fixture shapes. Alternatively, for the CAD user, Predator Virtual CNC can accept CAD geometry in the form of STL files for the creation of stock and fixture assemblies.

CNC Program Translators and Reverse Posts

Predator Virtual CNC processes all input CNC data to merge the tool path information with tooling and stock data. Predator Virtual CNC supports two methods of pre-processing, translators and reverse posts. Translators are developed by Predator Software and can not be configured. Reverse posts can be configured by anyone capable of editing an ASCII file. Both translators and reverse posts are unique for each supported CNC controller or machine type and are designed to handle the following processes.

- Checking that arc end points are calculated correctly (within CNC controller tolerances).
- CNC program syntax checking.
- Rotary moves that exceed rotary axis limits.

Translators are binary files and are stored in three computer directories. Translators for milling applications are stored in a sub-directory named ..\RPOST\MILL\MCF with a file extension of .MCF. Lathe translators use a file extension of .LCF and are stored in the ..\RPOST\LATHE\LCF sub-directory. Advanced translators for multi-axis machining are stored in the ..\RPOST\MILL-5\A5F sub-directory. Reverse posts are ASCII files and are stored in three computer directories. Translators for milling applications are stored in a sub-directory named ..\RPOST\MILL with a file extension of .RPM. Lathe translators use a file extension of .RPL and are stored in the ..\RPOST\LATHE sub-directory. Advanced translators for multi-axis machining use a file extension of .RP5 and are stored in the ..\RPOST\MILL-5 sub-directory.

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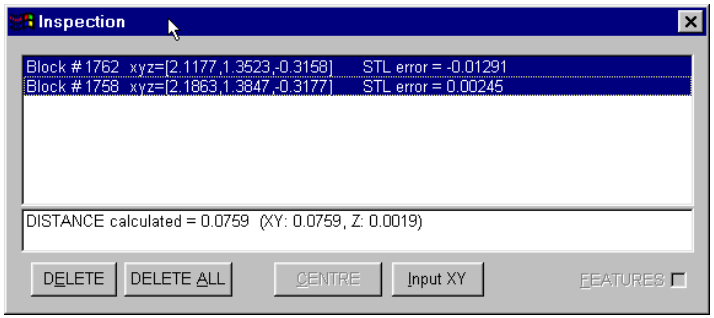
7. Right click in the window and select Zoom Fit fill the window.
8. Click the Play button. The Job will process and the machined part will appear in the Turbo window. Please note that processing is slowed down if the NC Panel is open.

Having simulated the machining of the part, we will now inspect it. To do this, we can use two inspection techniques.

- Virtual CMM Measurement
- Advanced Inspection (STL file compare).

First, let us measure some points on the surface using Predator Virtual CNC's virtual CMM capability.

1. Click the Inspection button. The now familiar empty Inspection dialog will open. You will notice that the Feature measurement check box is grayed out, as Turbo windows do not support feature based measurement.
2. Click the mouse cursor anywhere on the part surface. Notice the X, Y



& Z co-ordinates are returned in the upper inspection window together with the program block that machined that point.

3. Select another point on the surface. Another line of point data appears in the upper inspection window.
4. Click the top line of point information in the inspection window. With the left mouse button held down, drag the highlight to include the second line and release the mouse button. A line appears in the lower inspection window showing the shortest distance between the two points, the X-Y distance and difference in Z values.
5. Select as many points as you wish and measure distances between them. If you have two lines in the top inspection window that are separated by another line, select each with the CTRL key held down.
6. When you are finished, close the inspection window by clicking the Inspection button again.

Now for the powerful STL compare feature. To demonstrate this feature effectively, we have introduced a small gouge in the surface of the job. This may be already visible to you, depending on the resolution of your computer display. To use STL compare:

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to make the cross-section.

3. Click the CUT X-SECTION button. The Solid model will refresh in a sectioned view. Notice that Predator Virtual CNC always removes the part of the model nearest to the user.

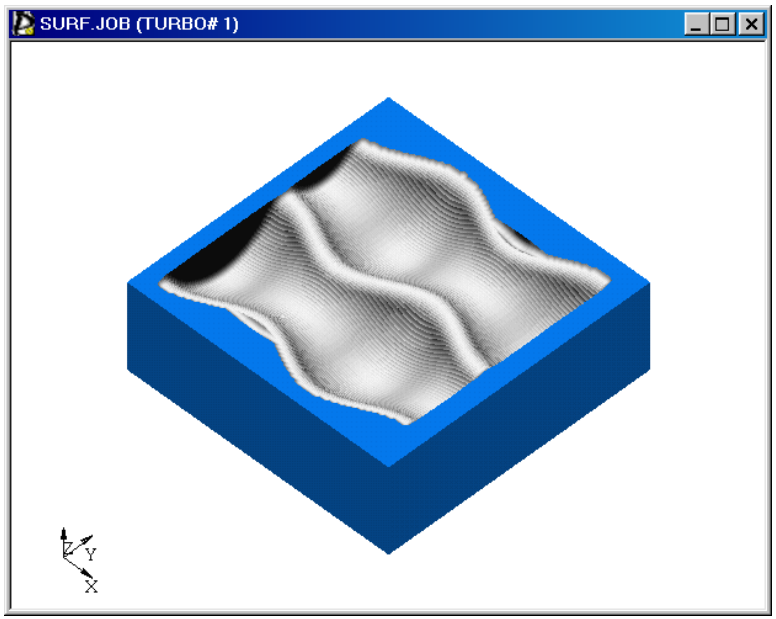
Often, it is necessary to make cross-sections that are not conveniently parallel to any of the part axes. To make such a cross-section:

1. From the X-Section list, select the 'Any Plane' option.
2. On the Verify model, pick three points on the plane you wish to cross-section through.
3. Click the CUT X-SECTION button.

SURF.JOB

To run SURF.JOB:

1. Start Predator Virtual CNC.
2. From the File menu, select Open or click the Open button on the Toolbar.
3. Click the arrow to the right of the Current Job list box.
4. From the list of Jobs, select SURF and click the OK button.
5. When Predator Virtual CNC asks 'Re-Process?' Click the NO button.
6. Click the New Turbo button on the toolbar. A window will open and the stock for SURF.JOB will appear.



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Chapter 2

Installation

System Requirements

Predator Virtual CNC is a true 32-bit application that operates with Microsoft Windows ME, 98, 2000 and Windows NT 4. Multiple things that can impact Predator Virtual CNC's performance, including:

- Processor Speed
- RAM Memory
- Graphics Card
- Graphics Drivers
- Screen resolution
- Number of colors
- Number of open windows
- Size and complexity of Job being processed
- The operating system being used

However, the following minimum guidelines should be followed for general use.

Hardware Requirements

- Pentium series or equivalent CPU
- 800x600 display resolution with 256 colors
- 64 Megs of RAM memory
- Hard drive with a minimum of 60 Megs free space
- Mouse or similar pointing device
- Parallel printer port (to attach Predator SIM)

Installation

This section covers basic installation of Predator Virtual CNC. The supplied Setup program must be used.

Setup for Predator Virtual CNC

Follow these basic steps to install Predator Virtual CNC.

1. Verify that Windows ME, 98, 2000 or NT is installed.
2. Plug the Predator SIM into the parallel port.
2. Insert the Predator CD-ROM into the CD-ROM drive.
3. The following dialog will automatically appear. If not select AutoPlay from the Start Menu.
4. Click the blue Virtual CNC icon to run the install.

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5. The setup program will prompt you for further actions, just follow these instructions.

Predator Licensing

Predator Virtual CNC is protected from illegal copying and unlawful use by a hardware protection key (SIM) in conjunction with an 'Upgrade Code' supplied by Predator Virtual CNC Software. Upgrade codes are entered by the end-user at the time of installation, updating or upgrading.
If Predator Virtual CNC is started without a protection key, the system will run in demonstration mode. This will allow access to the standard demonstration Jobs supplied on the CD-ROM. Demonstration mode will allow you to process the first 50 lines of G code within a new job.

Predator SIM (Protection Key or Dongle)
For Predator Virtual CNC to operate, the Predator SIM must be plugged into the computer's parallel printer port. The Predator SIM appears transparent to other devices and will not affect the use of your printer or other equipment attached to the parallel port.
If no SIM is detected, Predator Virtual CNC runs in 'demonstration mode' using only the sample files provided on the distribution CD-ROM.

Upgrade Screen
The Upgrade screen is opened from the Upgrade command on the Options menu. This screen contains details of your Predator Virtual CNC software license and controls for updating or upgrading your Predator Virtual CNC software.

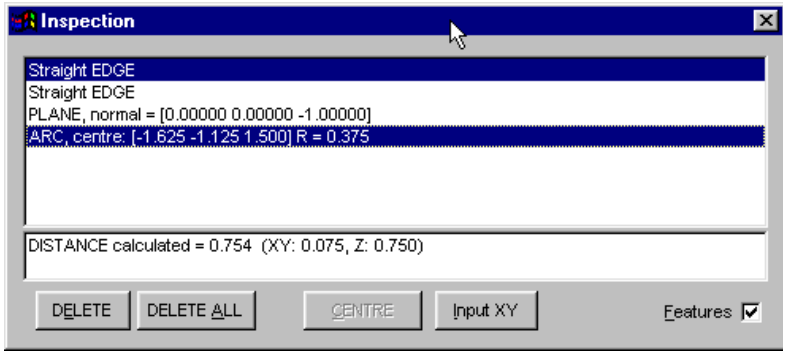
Serial Number or License Code
Each SIM is programmed with a unique Serial Number or License Code. This number can be viewed by selecting About Virtual CNC... from the Help menu.

The Serial Number should also be recorded. When purchasing software updates or upgrades please provide the serial number.

Days Left for Evaluation
Predator Virtual CNC's SIM can optionally be programmed to allow operation for a period of days. The box labeled 'Days left for evaluation' shows the number of

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5. Hold down the CTRL (control) key on your computer and click on two items in the top window. We suggest an edge and the arc center would make good choices. Notice that a new line of information appears in the bottom window. This information describes the relationship between the two chosen items. It is usual for Predator Virtual CNC to provide the straight-line distance between the two features, the X-Y distance and Z distance. The Inspection will now look like this.

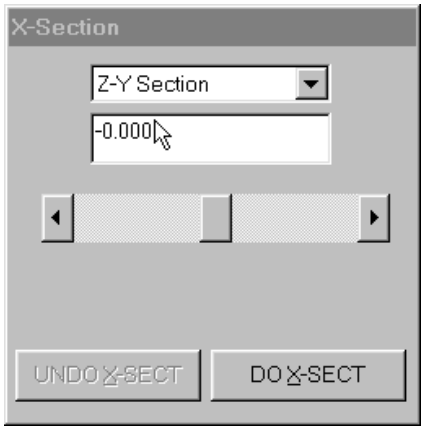


6. To delete any single item in the top window, select it with the mouse cursor and click the DELETE button. To delete all items in the top window, click the DELETE ALL button. The contents of the lower window empties as its related items in the top window are deleted.

7. Now, uncheck the FEATURE check box and try selecting features on the solid model. You will find that only points on surfaces are now found. The software is now in virtual CMM (Co-ordinate Measuring Machine) mode.

8. When you have finished, click the Inspection button to close the Inspection window.

You may have noticed that some features were difficult to select due to them being hidden by other part features. In these circumstances, rotating the model and zooming will help. However, what if the feature to be measured is inside the job? The only answer is to cross-section the job (X-section). To cross-section the Job in the Solid window:



1. With the Solid window still selected, click on the Cut Section button on the Inspection Bar. The following dialog box appears.

2. Click the arrow to the right of the section type list box and select the Z-Y option. Using keyboard input or the slider control locate the green sliding window at the point you wish

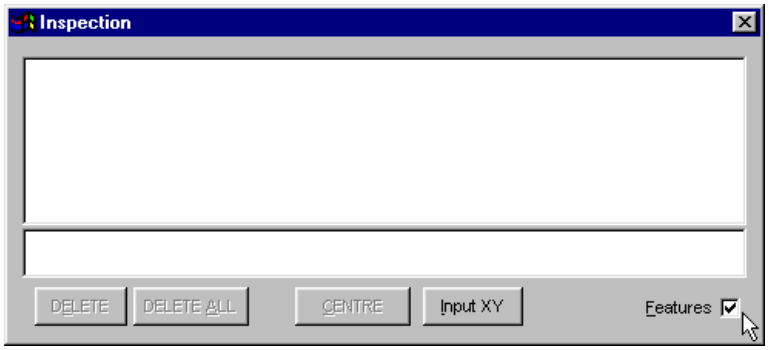
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the display to regenerate.

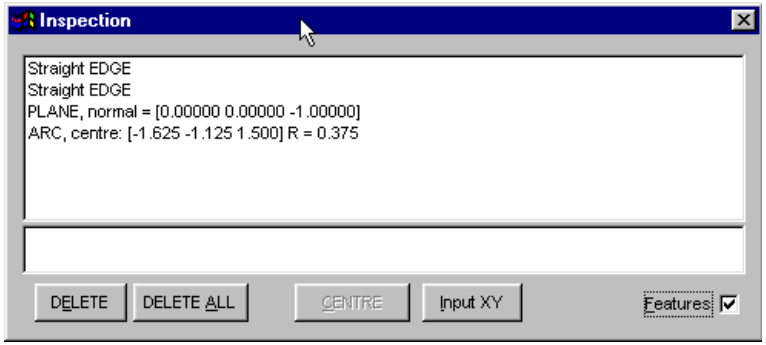
3. Zoom out using the Zoom Out button.
4. Try rotating and zooming the part to check it all over.

Having done a visual check of the part, let us check some dimensions.

1. First choose the Verify 2000 Solid view (you cannot measure animated only views) and rotate and zoom to show the features to be measured. We recommend that you choose a view that shows straight edges and holes or slots with rounded corners.



2. Click the Inspection button. An empty dialog box appears.
3. Make sure that the Features check box is checked. Then, using the mouse cursor, pick some features on the Solid model. Select an edge, an arc and a flat surface (Plane). In the top window, you will see a list of features (planes, arcs, edges, complex surfaces, etc.). Each feature will also show its location in Cartesian co-ordinates with relation to the program origin and other useful geometric data.
4. Click on an arc description. Then click the Center button. You will see a new line of information appearing in the top window. This line indicates an arc Center and gives the arc's normal and its location in X, Y & Z co-ordinates.). Your Inspection dialog box will look something like this now.



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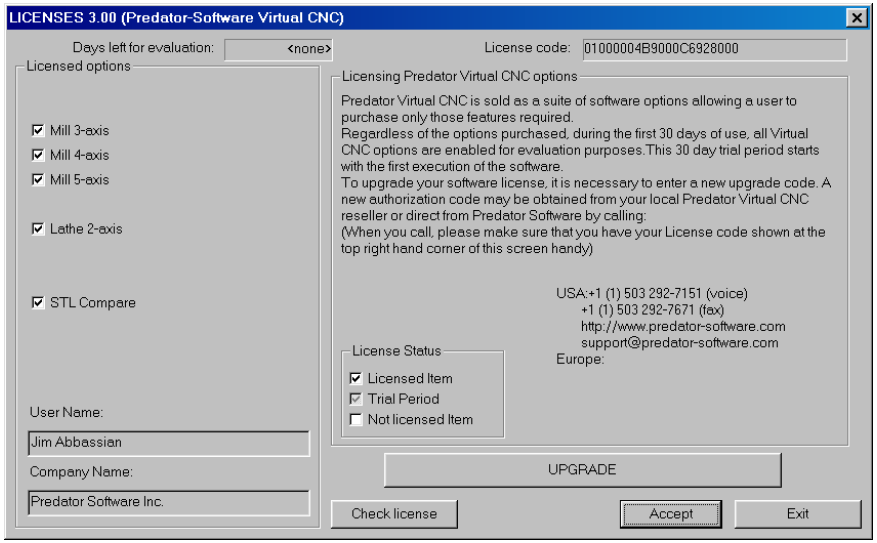
days left before this period expires.

Important note: While the evaluation period is running, you should not change the system clock on your computer or move the protection key from one computer to another. If you do, Predator Virtual CNC may detect unusual changes to the system clock settings and disable the SIM, causing Predator Virtual CNC to become inoperable.

When the evaluation period has expired, additional serial numbers and access codes can be provided to re-activate the SIM.

Licensed Modules

The panel labeled 'Licensed modules' contains a number of check boxes. These boxes cannot be edited by the user, as they are checked or unchecked by the status of your SIM. Each item checked is licensed and should be fully operational. If a section becomes unchecked, that feature is unlicensed and will not function.



License Status

The License Status panel shows a key to the license status of each Predator Virtual CNC feature. The key shows that there are three possible states for each license checkbox:

- Licensed - the module is licensed indefinitely.
- Evaluation - the module is licensed temporarily.
- Unlicensed - the module is unlicensed and inoperable.

Check License

The Check License button is used to read the state of the software protection key. If clicked, the software protection key is interrogated and the license screen updated with the current license details.

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Upgrade Code

To operate the software after the initial 30-day period, the user must enter an Upgrade Code. This upgrade code will enable the purchased Predator Virtual CNC modules for an indefinite period. To install an Upgrade Code follow the following simple steps:

1. Select Upgrade from the Options menu.
2. In the Upgrade Code dialog box, enter the code and click Accept.
3. Check that the correct modules are licensed by selecting the License command from the Options menu. Licensed modules will have a check mark against them and licensed controls will be displayed in black type (non-licensed controls are not listed).

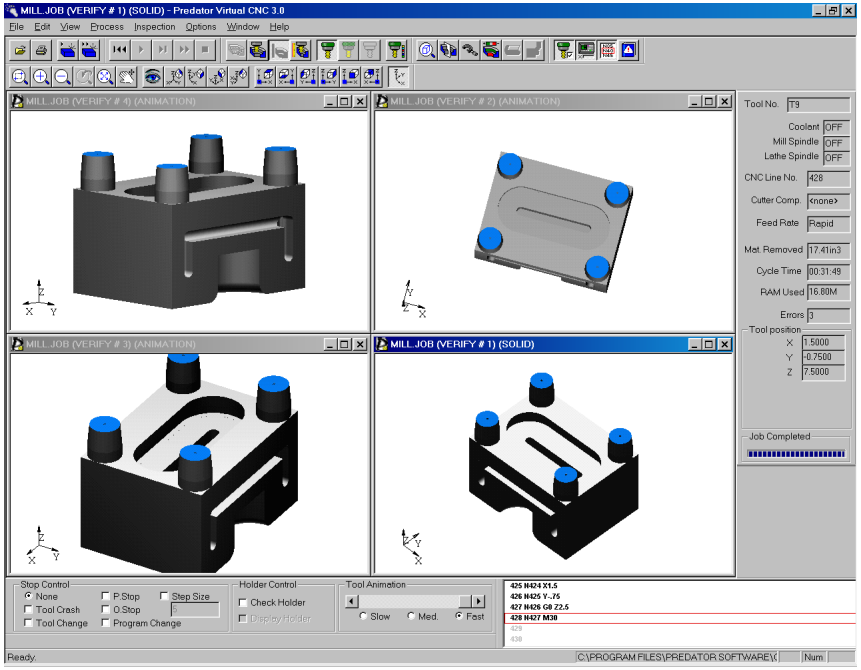
Uninstalling Predator Virtual CNC

Predator Virtual CNC may be uninstalled from the Windows Control Panel by:

1. Selecting Settings from the Windows Start Menu.
2. Select Control Panel from the Settings menu.
3. Select the Add/Remove Software icon in the Control Panel program group.
4. From the list of software applications shown, click Predator Virtual CNC then click the Remove button.
5. Click 'Yes' to proceed.

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tion at any time and the Play button to restart the animation. Click the Rewind and Play button to begin processing again from the beginning, waiting each time for the display to update before making the next mouse click. After completely processing the whole Job, your screen could look something like this.



Having processed the Job, it would be nice to see what machining has been done. Notice also that the error window on the Status Panel is showing a number of errors. First let us look at the errors. To do this:

1. Click the Errors button on the Tool Bar.
2. See the list of errors, tool collisions, and note the block numbers that cause the errors. Click on any of the errors and see the NC program display in the top panel scroll to the offending NC program line.

Although we have opened 4 views of the Job, each with a different view, we still cannot see every face of the part. Let us use the Solid model to closely inspect the part.

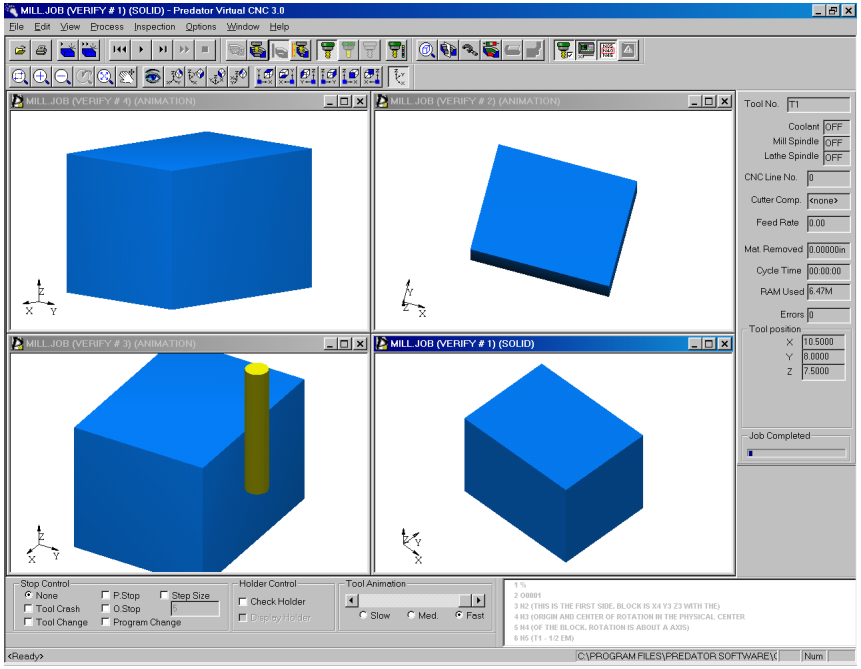
1. Click inside the solid window (the fourth window).
2. As before, use the left mouse to drag and rotate the Solid model to another position with the left mouse button depressed.

Similarly, we can take a closer look at the model by zooming into an area.

1. Still with the Solid window selected, right click and select Zoom Window button.
2. Drag a window over the area into which you want to zoom. Wait for

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9. Click in side the first open Window. With the Left Mouse Button held down, drag the stock inside the window to a new angle or with the right mouse button select different views.
10. Repeat this operation for all windows until you have a different view in each.
11. Click in the first Window and then right click and select Zoom Window.
12. With the mouse cursor, drag a window over the part in the first Verify 2000 model. Your screen should look something like this.



13. With the first Window selected (selected by clicking inside the window), click the Animation button on the View Bar. This will change the attributes of the window from Solid to Animation. There will be a short delay while the new view takes effect.
14. Select the second window and click the Animation button on the toolbar.
15. Repeat this operation for the third window.
16. Select the fourth window and click the Solid button on the toolbar.
17. Click the Play button and watch the part process. You will see the tool cutting the part in the three Animated windows. The Solid window will not update until the Animation is halted at the end of the job or by the user clicking the Stop button. Click the Stop button to halt the anima-

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Chapter 3

Getting Started

Starting Predator Virtual CNC

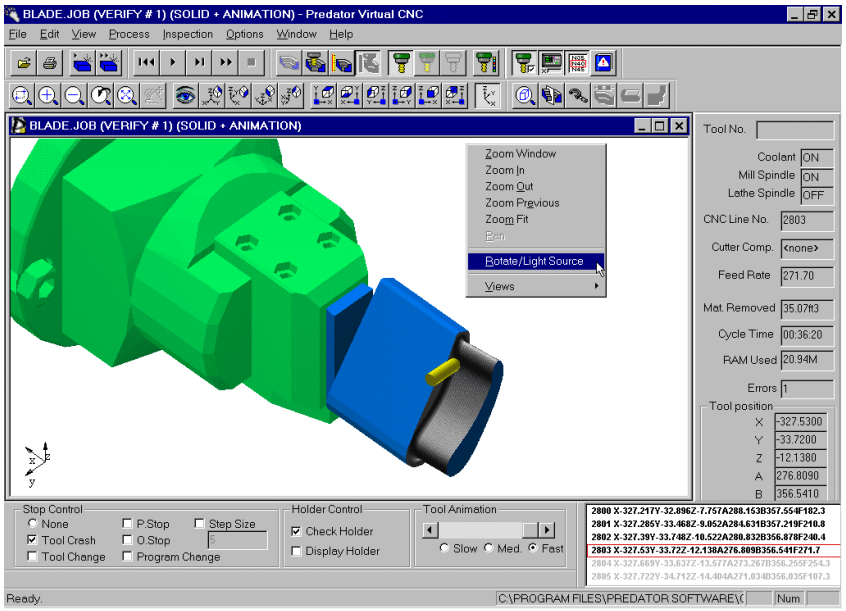
The setup program installs all Predator Virtual CNC program files and adds a Predator Virtual CNC Program Group to the Windows Start menu. To start Predator Virtual CNC:

1. Click the Start button on the Windows Task Bar and then click Programs.
2. Select Predator Virtual CNC from the list of Program Groups.
3. Select Predator Virtual CNC from the items in the Predator Virtual CNC Program Group and wait for Predator Virtual CNC to load.

Alternatively, you can double click the Predator Virtual CNC from a shortcut on the Windows Desktop.

Screen Layout

All Predator Virtual CNC functions are selectable from the menus, Tool Bar, Inspection Bar or View Bar. The following diagram shows a typical Predator Virtual CNC session.



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The screen is made up of the following areas

Main Window
The Main Window is an area of screen where the model windows, and various dialog boxes and information panels are displayed. The modeling systems, Animation, Solid, Animation+Solid and Turbo, are represented in one or more windows within the Main Window. These model windows may be repositioned and resized by the user or automatically 'Tiled' or 'Cascaded' using the standard Windows commands on the Window menu.

Windows
Each window contains a view of the model. The settings for each window can be changed independently. Each may have its own view angle, light source, tool colors, zoom, and cross-section settings. To change any of these settings, the window must be made active by placing the mouse cursor inside the window and clicking the left mouse button. The window title bar will be grayed out if not active.

Mouse View Control

The mouse is not only used to select control buttons and menu commands, it is also used to manipulate the model views.

View Rotation
When a Predator Virtual CNC window is open, the mouse can be used to rotate the view of the model. This can be done by:

1. Click on the model in a Predator Virtual CNC window using the left mouse button.
2. Keeping the left mouse button depressed, 'drag' the model view around to the desired view. In the case of Turbo and animation views, the model image will change to a wire-frame representation. In the case of a solid view, the image resolution will reduce while the left mouse button is depressed.
3. When the desired view angle is obtained, release the left mouse button. There will be a short delay while the image regenerates for the new view.

NOTE: The regeneration time for an animated only view will take longer than other views. If many lines of tool path data have been processed, you will find it quicker to change to solid view, rotate the solid view, and then change back to the animated view.

Shortcut Menu
When a Predator Virtual CNC window is open, the right mouse button can be used to change views, the light source, zoom and pan. To do this:

1. Click on the model in a Predator Virtual CNC window using the right mouse button.
2. Select the desired command and specify any secondary mouse clicks.

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Chapter 8

Sample Jobs

Predator Virtual CNC is supplied with several sample Jobs. Each Job will highlight certain powerful areas of functionality that may not be obvious from reading other sections of this manual.
The instructions assume that you are using Predator Virtual CNC on a computer with a moderately fast processor (Pentium 90 or above), 32 Megs of RAM and a 15" display (or larger) running at 1024x768 resolution. If your computer is slower, has less memory and/or has a lower screen resolution, you may still follow these instructions, but we would recommend that you open only one or two windows instead of the 4 mentioned in the instructions.
There are 4 Jobs to practice with:

MILL.JOB - a milling job that included multiple CNC programs and rotations of the part.
SURF.JOB - A surface milling Job that demonstrates the high speed and accuracy of Turbo II modeling, CMM and STL Compare inspection.
TOMBSTON.JOB – A typical setup using a tombstone fixture to machine 4 components at one time.
BLADE.JOB – A typical 5-axis surfacing job showing the machining of a turbine blade in a complex fixture.
LATHE.JOB - A typical 2-axis turning Job with internal and external turning with threads.

MILL.JOB

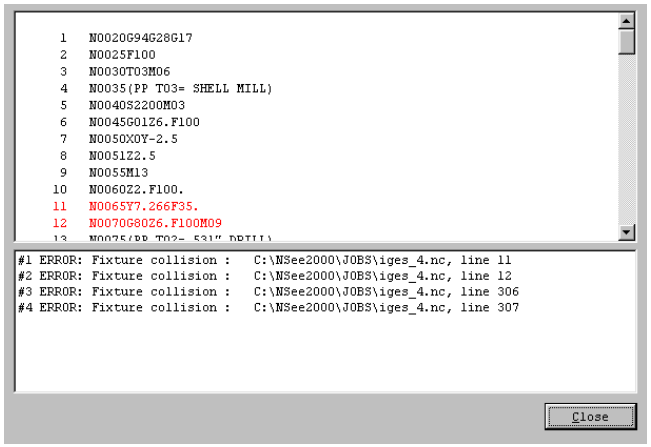
To run MILL.JOB:

1. Start Predator Virtual CNC.
2. From the File menu, select Open or click the Open button on the Tool Bar.
3. Click the arrow to the right of the Current Job list box.
4. From the list of Jobs, select MILL.
5. Click the OK button at the bottom right of the Job dialog. Predator Virtual CNC will ask if you want to re-process the program.
6. Click the NO button. Clicking the YES button would re-process the CNC file. Since no changes have been made to tooling, stock or fixtures processing the CNC file is unnecessary.
7. Click the New Verify button to open a window and wait until the window appears with the stock showing. Click the New Verify button three times more to open three more windows.
8. From the Window menu, select Tile.

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highlighted.

Syntax Checking



While processing the tool path, stock and tooling data the syntax of the tool path file is checked for certain errors.

These errors include:

- Checking that arc end points are calculated correctly (within CNC controller tolerances).
- CNC program syntax checking.
- Rotary moves that exceed rotary axis limits.

If such errors are found, Predator Virtual CNC will not allow the Job to be processed and an error window will be opened showing the errors found. These errors should be rectified before re-processing is attempted.

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NOTE: The regeneration time for an animation only view will take longer than other views. If many lines of tool path data have been processed, you will find it quicker to change to solid view, change the light source, and then change back to an animated view.

Button Bars

Most Predator Virtual CNC features are controlled from several button bars.

Tool Bar

The Main Tool Bar is made up of a number of buttons each associated with a Predator Virtual CNC command. The following graphic shows the Tool Bar in a typical state for a milling Job. The state of some buttons will change depending on the type of Job being processed and the types of windows that are currently open. Buttons that are not available will be grayed out.

The main toolbar buttons and their functions are:



Job

The Job button opens the Job set-up dialog for creating and editing Job information. A Job is a setup for a particular machining operation or sequence of operations.



Print

The Print button prints details of the current Job.



New Verify (Mill & Lathe)

The New Verify buttons open a new window. Different buttons are displayed for milling and turning jobs. If Job processing has not been started, the window will open showing the stock only. If the Job has been processed completely or in part within another window, the window will display the Job in the state at which processing has been stopped. See inside back cover for feature grid.



New Turbo (Mill & Lathe)

The New Turbo buttons open a Turbo model window. Different buttons are shown for milling and turning jobs. If Job processing has not yet been started, the window will show stock only. If Job processing has been started in another

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window, the Turbo window will display the model in the state at which processing was halted. See inside back cover for feature grid.

Process Bar (VCR Buttons)

The Process Bar contains button controls for those features usually associated with processing the simulation.



Rewind

The Rewind button 'restarts' the process, allowing a Job to be reprocessed from the beginning.

Play

The play button starts processing the Job until the end of the CNC program or one of the many stop conditions occurs.

Single Step

The single step button processes a single block of CNC code with every mouse click. This option works well when the CNC Panel is enabled. The CNC Panel displays each block of CNC code as it is processed.



Fast Forward

The fast forward button overrides the current tool animation speed to the fastest setting.

Stop

The stop button stops processing the Job. Processing may be re-started or you may exit simulation.

Panel Bar

The Panel Bar contains button controls for those features usually associated with changing the display of different panels.

Control Panel

The Control Panel toggles the Control Panel open or closed.

Status Panel

The Status Panel button toggles the Status Panel open or closed.

CNC Panel

The CNC Panel button toggles the NC Panel open or closed.



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Chapter 7

Error Detection

Predator Virtual CNC automatically detects the following errors:

- Tool collisions with clamps & fixtures.
- Rapid tool moves into the stock.
- Tool shank collisions with stock, clamps and fixtures.
- Tool holder collisions with stock, clamps and fixtures.
- Program syntax.

In the case of program syntax checking, this is carried out at the time the NC program is translated into Predator Virtual CNC's internal RVP format. All other checking is carried out at the time the simulation or solid model is generated.

Tooling Collisions

When Predator Virtual CNC is processing, it checks to see if the tool, tool shank or tool holder collides with the stock, clamps or fixtures in such a way that the collision would cause damage to the tool, stock or machine tool. If such a problem is detected, Predator Virtual CNC indicates the error by incrementing the Error Counter by one (1).

Error Counter

The Error Counter, labeled 'Errors' is located on the Status Panel. This box shows the number of errors that have been detected in the current Job. The counter is incremented by one each time an error is detected, so giving a running total. If errors have been detected, the details of each error can be found in the Error Log file that is opened using the Errors Button on the Tool Bar.

Error Button

The Error Button is located on the Tool Bar. A menu command used to open the Error Log is also found on the Window Menu. When errors have been detected, the Error Button is available for use. When no errors have been detected, the Error Button is grayed and inoperable.

Error Log File

The Error Log File is viewed in a split window that is opened by the Error Button or Errors menu command. The window is split horizontally, showing the list of errors in the bottom panel and the NC or other tool path file in the upper window.

You will notice that some lines in the tool path file are highlighted in Red. This highlight indicates that these lines are responsible for an error. Clicking on one of these lines will highlight the error detail in the lower window that is associated with the selected program line.
Clicking on one of the errors in the lower window will highlight it and scroll the tool path file to the offending tool path line in the upper window that will also be

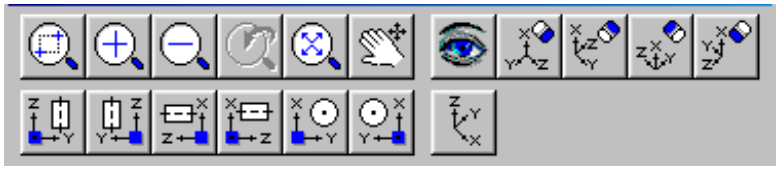
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Error Log

The Error Log button opens the error log window for the current Job. If no processing errors have been found, this button will be grayed.

View Bar

The View Button Bar is made up of a number of buttons, each associated with a specific control used for manipulating the view of the current window.



Zoom Window

The Zoom Window button allows the user to zoom into an active window. The zoom button may be used multiple times to zoom into already zoomed area.

NOTE: Zooming animation only views may take a long time.

Zoom In

The Zoom In button doubles the scale of the active window. The zoom in button may be used multiple times to zoom into already zoomed area.

NOTE: Zooming In an animation only view may take a long time.

Zoom Out

The Zoom Out button halves the scale of the active window. The zoom out button may be used multiple times to show more area outside of the current area.

NOTE: Zooming Out an animation only view may take a long time.

Zoom Previous

The Zoom Previous button returns to the prior view within a window. The zoom previous button may be used multiple times to return to an original view.

NOTE: Zoom Previous within an animation only view may take a long time.

Zoom Fit

The Zoom Fit button calculates the extents of the stock and the fixtures and fills the screen with the entire view within a window.

NOTE: Zoom Previous within an animation only view may take a long time.

Pan

The Pan button allows an active window to pan across the enclosed model. Panning is faster than unzooming and re-zooming.

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View
The View button opens the combined View/Light control window. Drag within the smaller preview model using the mouse (see Mouse Controls) to change view angle and Light source angle. Click the apply button to update the active window.

Isometric View 1-4
The Isometric View 1-4 buttons change the active window to the specified view.

NOTE: Changing views within an animation only view may take a long time.

Standard Views
The Standard View buttons change the active window to the top, bottom, left, right, front and back views.

NOTE: Changing Views within an animation only view may take a long time.

Axis Icon
The Axis Icon button toggles the display of a the axis icon within the active window.

Edit Bar
The Edit Bar contains button controls for those features usually associated with editing the stock, fixture or tooling.

Translucent Stock and Fixtures
The Translucent stock and fixtures button toggles the state of an active window between a translucent and solid images.

Animation
The animation button switches the state of an active window to animation simulation mode only.
NOTE: Switching to and from Animation Mode can take a long time if you are working in zoomed views or many lines of tool path data have been processed.

Solid
The Solid button switches the state of an active window to Solid model mode.

Animation + Solid
The Animated & Solid button switches the state of an active Verify 2000 window to Animated and Solid.

Solid Tool
The Solid Tool button displays a solid tool and tool holder during animation.

Translucent Tool
The Translucent Tool button displays a translucent tool and tool holder during

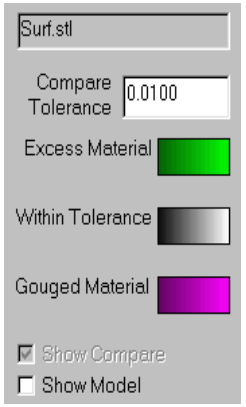
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Offsets
If the STL file origin does not coincide with your NC program origin, the STL Matching list boxes may be used to enter X, Y & Z offsets to reposition the STL model to align with the machined part.

STL-Fix
The STL-Fix button launches the STL-Fix utility. This utility can be used to correct certain problems with bad STL files.

Comparing STL file with Solid or Turbo Model
Once the STL file has been selected, Predator Virtual CNC will read the STL file and superimpose the STL model over the Turbo model. The Turbo image will appear to change color and a small control box will open. The control box contains a tolerance box and check boxes.

Compare Tolerance
The compare tolerance is used to set the maximum and minimum tolerance beyond which Predator Virtual CNC will show deviations. The tolerance is entered as a numeric value in the units defined in Job set-up.



Show Compare
Checking Show Compare will reprocess the Solid or Turbo model and display it with colors that show gouges and excess material.

- Red is used to show gouged areas based on the compare tolerance.
- Green is used to show excess material based on the compare tolerance.
- Grey is used to show areas of the Turbo model that are within the compare tolerance.

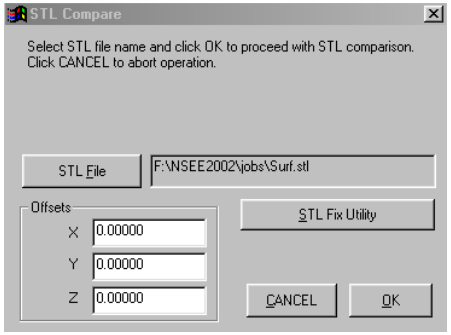
Show Model
Checking Show Model will display the Solid or Turbo solid model only.

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cific X-Y co-ordinate. To find a Z value:

1. Click the Input X-Y button.
2. Note: The input X & Y co-ordinate values must lie within the original stock and fixture boundary.
3. Enter an X value and an Y value in the resulting dialog box and click OK. A line appears in the top window that gives details relating to a point on the top surface of the part at the location of the X-Y co-ordinates entered. These details include the type of surface at the selected point and the X, Y & Z co-ordinate of the point.

Comparison with Design Model



When inspecting complex milled surfaces, conventional methods of measurement provide useful information but do not always tell the whole story. Measuring points on a surface tells you only that the part is correct at the points measured. It does not tell you if there are areas between the selected measurement points that fall outside required tolerances. Predator Virtual CNC has a very powerful feature, called STL-Compare, which automatically compares a Predator Virtual CNC 'machined' surface with the original design model. Any deviations from the 'as required' part within user definable tolerances may be highlighted.

STL (**ST**ereo **L**ithography) files are produced by many leading CAD and CAM systems. The quality and consistency of STL output varies considerably from CAD/CAM to CAD/CAM system. Generally, the best STL files are produced by true solid model based CAD/CAM systems. If you experience inconsistent or clearly incorrect results, it is most likely that your STL files are not of sufficiently high quality (See STL-Fix).

STL-compare can be used with both Verify Solid and Turbo models.

STL-Compare

The comparison of CAD design models with Predator Virtual CNC's Verify Solid and Turbo models is an extremely powerful feature. To use STL-compare, click the STL-Compare button on the Inspection Bar or select 'STL-Compare' from the Inspection Menu.

STL File

When the STL file button is clicked for the first time a standard Window's Browse dialog and the STL control dialog is opened. Clicking a STL file from the list of files in the browse dialog will select it. The filename and path appears in the STL File window. Clicking OK will load the STL file.

If you wish to change the STL file, the Browse dialog can be re-launched from the STL Control dialog using the STL Filename button.

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animation.

Tool Off

The Tool Off button disables the tool and tool holder display during animation.

Tool Colors

The Tool colors button opens the tool colors dialog. This dialog allows a range of tool colors to be specified, a toggle for individual tool colors and different stock colors to be specified.

Inspection Bar

The Inspection Bar contains button controls for those features usually associated with part inspection.

The buttons on the Inspection Bar and their function are:

Deep Zoom

The Deep Zoom button is used with Predator Virtual CNC models. It allows the user to select an area of specific interest on the part and locally refine the model to give enhanced detail.

When the button is selected, the user can use the mouse to 'drag' a 3-D box around the area of interest by picking the center of the 3-D box, holding the left-hand mouse button depressed and dragging the window to the chosen size. The first mouse click must be made with the cursor on the surface of the job.

A new window is opened showing the zoomed view. If the 3-D window is large, the degree of refinement is less than if the window is small. The time taken to produce the Deep Zoom view depends much on the number of tool passes through the selected volume. Not active in animation.

Cut Sections



The Cut section button allows cross sectioning to be performed on Predator Virtual CNC models.

Inspection

The Inspection button opens the Feature and CMM measurement dialog for active windows.

STL Compare

The STL Compare opens the STL compare dialog for an active Turbo window. STL compare is often referred to as Advanced Inspection.

NOTE: This is an extra cost option and may have to be purchased. Contact your local Predator Virtual CNC reseller or Predator Software Inc for more details on

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STL Compare.

¾-Section
The ¾-Section button toggles a 3D Lathe window between full 3-D and ¾-section views.

2D/3D View
The 2D/3D button toggles the view in a Turbo II Lathe window between 2D and 3D modes.

Menus

The main menu is made up of a number of sub-menus. Each sub-menu contains commands that are used to control a Predator Virtual CNC session. Many of the menu commands have buttons assigned to them on the toolbars. However, some commands are only available from the menus. Some of those commands available on menus but not on buttons are:

File Menu

Close
Selecting Close will close the active model window.

Close All
Selecting Close All will close all open model windows.

Print Set-up
The Print Set-up command opens the Windows Printer Set-up dialog. For more information, consult your Windows manual.

Print Preview
The Print Preview command prints the Job details to screen for review prior to printing.

Export
Selecting Export opens a list of supported export file formats. Selecting a format will open a dialog box that will request a file name and any variables associated with the file format chosen.
Exported models can be imported back into Predator Virtual CNC as stock for further operations.

License
Selecting License from the Files menu launches a small external application that is used to control which Predator Virtual CNC modules and options are licensed.

Last opened file list
The last opened file list shows recently opened Jobs. To re-open one of these Jobs, single click the filename on this list.

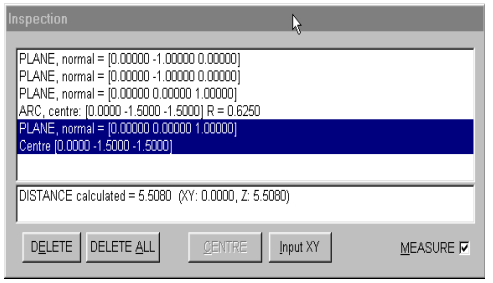
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3. Select the plane.
4. Select the position by using the slider bar or entering precise co-ordinates.
5. Click the 'Do X-Section button.

Measurement

Measuring the finished or partly finished model provides the first real inspection of machined components before they are even made. While Predator Virtual CNC cannot predict errors caused by events on the shop floor, we can provide confidence that the CNC program, tool selection and job set-up will be correct. Predator Virtual CNC provides very powerful measurement tools.

Inspection
The Inspection menu item or button opens the Inspection dialog. From this dialog, it is possible to check solid, both and turbo models for dimensional accuracy. The following image shows a typical inspection session.



The upper window shows a list of selected points or features with their position. The lower window shows the results of measuring between items in the top window.

Delete & Delete All Buttons
The Delete and Delete all buttons are used to delete selected points and features in the top window. Delete all deletes all items in the top window and bottom window. To delete a single point in the top window:

1. Click the item in the top window.
2. Click the delete button.

Center Button
The Center button is used to select the center of an arc or circle. To select the center of an arc:

1. Point to the arc in the Verify window and click the left mouse button. The description ARC, CENTRE [X<value> Y<value> Z<value>] R<value> appears in the top Inspection window.
2. Click the description of the arc in the top Inspection window.
3. Click the Center button. A new line will appear in the top window giving the center position of the arc.

Input X-Y Button
The input X-Y button is used when you wish to find an exact Z value for a spe-

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areas is covered.

Note: Zooming into Preview models can cause a lengthy delay while the zoomed area is reprocessed. It is recommended that zoomed areas of Preview models be selected at the beginning of processing to minimize the reprocessing time.

1. Release the left-hand mouse button. There will be a short pause as the zoom takes effect.

Deep Zoom

Selecting the Deep Zoom menu item or button on the Inspection Bar causes the mouse cursor to change to an arrow with attached wire frame box. Clicking on the surface of a model and dragging the mouse with the right mouse Button depressed will form a wire frame box on the model. Releasing the right mouse button will open a new window and display the selected volume as a miniature solid model that is refined to show more detail. The size of the wire frame box dictates the level of refinement. A small box will show more detail than a larger box and will often process quicker.

Zoom Out

Selecting the Zoom out menu item or button causes the model in the active window to be redisplayed in full view. The size and shape of the window will determine the image size of the part.

2D/3D Views

The 2D/3D menu item and button is applicable to lathe Jobs only and toggles the active window between a two dimensional cross-sectional view and a 3 dimensional view. The 2D cross-sectioned view offers a convenient way to watch tool animation and to measure the part, whereas the 3D view may be rotated and sectioned (see following paragraph - ¾ Section). Both views may be zoomed.

¾ Section

The ¾ section selection applies to a lathe Turbo 3D view only and toggles that view between a full model and a ¾ sectioned model. The ¾ section provides a convenient way to view the results of internal machining operations.

Cross-section

X-Section (cross-section) selection allows Preview (mill & lathe) and Verify milling models to be cross-sectioned. When unavailable, the option is 'grayed out'.

When selected, X-Section opens a dialog box that allows the direction and position of the cross-section to be defined.

Standard cross-sections are available in three planes: X-Y, Z-Y & Z-X. In addition, user definable planes may be defined by selecting the 'Any section' option and entering three points by clicking on the model.

To create a cross-section:

1. Select an active window by clicking the mouse pointer inside the window.
2. Click the X-Section button or the X-Section command on the View menu.

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Exit

Choosing Exit from the Job menu will close down the Predator Virtual CNC program.

Edit Menu

Most commands on the Edit menu are also available on the toolbars. There are two exceptions setting the background color and preferences.

Background Color

The Background Color dialog allows for configuration of the background color for all open windows. By default the background color is automatically saved when you exit Predator Virtual CNC.

Preferences

The Preferences command opens the Settings dialog. This is where system defaults are changed.

View Menu

The view menu commands can all be found on the toolbar.

Process Menu

Index Part

The index part command launches the indexing dialogs to facilitate manual indexing of the part at any time. More information relating to manual indexing can be found in the Job Set-up section of this manual.

Reset Origin

Reset Origin opens a small dialog that enables the Program Origin to be repositioned at any time during processing. The values entered are X, Y & Z absolute distances from the Machine Datum. Resetting the program origin in this way is normally associated with a programmed stop in the CNC program.

Inspection Menu

The inspection menu commands can all be found on the button bars.

Options Menu

Toolbar Size

This menu option displays a sub-menu for small, medium and large size toolbar buttons. Typically, you should be using small buttons on low-resolution displays and large buttons on high-resolution displays.

Toolbars

This menu option displays a sub-menu for each toolbar. These individual toolbars can be enabled or disabled by toggling the checkmark on or off.

Graphics Library

When selected, a list of two options is displayed.

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- Open-GL
- Predator Virtual CNC Graphics Library.

If you are using a computer fitted with a good quality Open–GL graphics accelerator card, we recommend that you use the Open-GL option. Otherwise, use the Predator Virtual CNC graphics library.

Windows Menu

The Window menu contains commands that will be very familiar to an experienced Window user.

Maximize
Maximizes the active Window.

Cascade
Cascades open windows, one behind the other.

Tile
Reorganizes the open Windows in a tiled fashion within the Main window.

Open Windows List
At the bottom of the Window menu, you will find a list of any opened CMS windows. Clicking on an item in this list will make the selected window active.

Help Menu
The Help command provides access to Predator Virtual CNC's on-line help and certain system information.

Contents
Selecting Contents from the Help menu launches a window showing a list of help topics with hypertext links to help sections related to each topic.

Search for help on.
This selection allows you to search for help on a specific subject. Just enter the word or phrase you wish to search for in the top text box and see associated headings appear in the bottom window. Double clicking on any heading in the lower window will open a detailed help window related to the chosen topic.

How to use help
Selecting 'How to use help' will provide assistance if you are having difficulty using Predator Virtual CNC's help facility.

About Predator Virtual CNC
Selecting 'About Predator Virtual CNC' reveals a small information window containing the version number of your Predator Virtual CNC software and our copyright notice. To close the About Predator Virtual CNC window, click the OK button.

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2. Select a color from the palette at the bottom of the window. You will see the small colored box to the right of STOCK change to the selected color.
3. Click the Apply button and close the dialog

Fixture Color
Fixtures may also be allocated a color. The default is brown, but to the change this color you should:

1. Select FIXTURES from the list.
2. Select the desired color from the palette.
3. Click the Apply button and close the dialog

Collisions
When a tool collision occurs, the tool path left by the tool is shown in a different color to the rest of the tool path. Also, in Preview, at the time of the collision the tool changes color briefly.
The default collision color is magenta, but to change this:

1. Select COLLISIONS from the list.
2. Select a color from the palette at the bottom of the window.
3. Click the Apply button and close the dialog

Translucent
Selecting the Translucenct menu item or button toggles the appearance of the stock and fixtures in the active window between solid view and a translucent view. Translucency can be a very effective way of viewing what is going on inside or behind the part during the machining process.

Pan
The pan menu item and button allows the model in the active window to be moved in any direction within the window. Panning will allow a zoomed view of a section of the part to be positioned in the active window without the need to unzoom and re-Zoom.

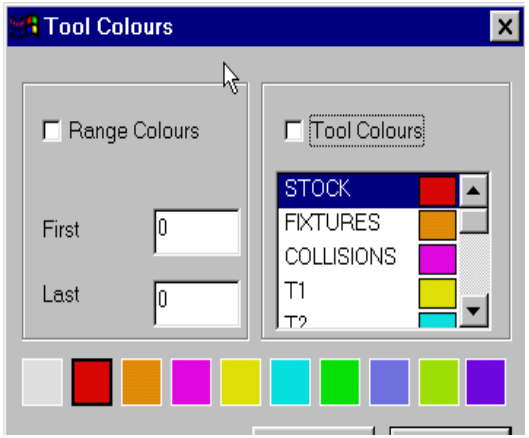
Zoomed Views
To inspect fine detail, it is desirable to be able to magnify an area of the part. Predator Virtual CNC offers several zoom controls to assist in this area.

Zoom Window
As the name implies, selecting Zoom Window from the menu or Inspection Bar causes the cursor to change shape to an arrow and pecked box. In this mode, the cursor can be used to select a zoom area. To select a zoom area:

1. Select Zoom Window from the menu or View Bar. Notice that the cursor changes shape.
2. With the left mouse button held down, click on the part at a corner of the area to be zoomed. Without releasing the left mouse button, 'drag' a rectangular window (shown as pecked lines) until the desired

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lows.



Range Colors

The Range check box is used to highlight the tool path made by a certain section of an N-See program. For example, if you wished to identify a part of a surface machined by blocks 1200 to 3400, you would:

1. Check the Range colors box.
2. Enter 1200 in the First box.
3. Enter 3400 in the Last box.
4. Click the Apply button and close the dialog.

When the Job is processed, the machined material will appear gray until block number 1200 is reached. The tool path will turn light blue while block lines 1200 to 3400 are machined, then revert back to gray.

Tool Colors

It is possible to allocate a color to each tool in the current Job set-up.
When checked, the Tool Color check box switches tool colors ON. If unchecked, all tool paths will be shown in gray.
The list window will show a list of tools in the current Job set-up. Each tool can be allocated a different color by:

1. Select the tool from the list.
2. Select the desired color from the palette.
3. Click the Apply button and close the dialog

Tool Crash Color

When Predator Virtual CNC detects a tool collision with the stock or fixture, the tool changes color and the gouge left by the tool retains that color on the model. To change this color:

1. Select COLLISIONS from the list.
2. Click the desired color from the palette.
3. Click the Apply button and close the dialog

Stock Color

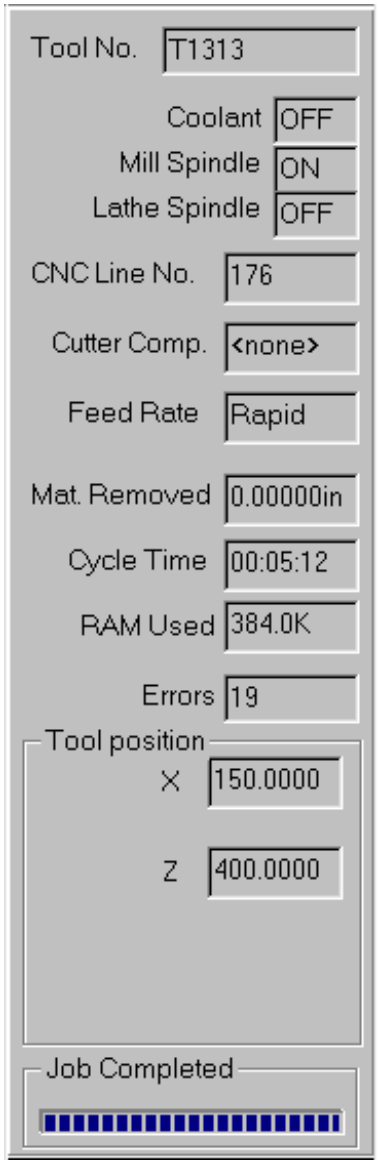
The Stock color defaults to red, but this may be changed to suit your own needs. To change the stock color:

1. Select STOCK from the list.

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Status Panel

The Status menu command or Status button toggles the Status Panel open or closed.
As the name implies, the Status Panel is where all information relating to the status of the current Job is displayed. The Status Panel may be docked at the sides of the Main Window, or left floating within the Main Window.
The Status Panel provides the following information about the current Job.



Tool No.

This is the programmed number of the tool that is cutting. For instance, T02 would be displayed here when the tool T02 in the current NC program is cutting.

Coolant

Shows the status of the machine tool's coolant supply at any time during processing. Coolant is shown to be either ON or OFF.

Mill Spindle

The Mill Spindle window shows the state of the spindle during processing of milling jobs. The Mill spindle is shown to be either ON or OFF.

Lathe Spindle

The Lathe Spindle window shows the state of spindle during processing of lathe jobs. The lathe spindle is shown to be either On or OFF.

NC Line No.

The Line Number window shows the block number being processed at any time. In the event that processing is stopped, the Line Number window shows the last block that was processed.
The line number does not necessarily indicate the NC line number as shown with a 'N' address (N1050 for instance). CNC files may contain comments that have no 'N' address such as:

```
(Tool no. 101 - 10mm drill)
```

Predator Virtual CNC considers this to be a block and increments the block count accordingly.

Cutter Compensation

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The Cutter Compensation box shows the state of tool cutter compensation at any time during processing. The default state is '<none>' but this will change to a value LEFT or RIGHT if cutter compensation is switched on by the CNC program with a G41 or G42 for instance. A G40 in the CNC program will switch cutter compensation to '<none>'.

Feed Rate

The Feed Rate box indicates the active feed rate at any time during processing. The display shows a numeric value in the units selected for the Job.

Volume Removed

During processing, Predator Virtual CNC calculates the volume of material removed by the cutting process. This material removed value is shown in the Volume Removed box.

Cycle Time

Predator Virtual CNC calculates the true machining cycle time as a Job is being processed. This cycle time is shown in the Cycle Time box at any time during processing.

RAM Used

To assist the user to identify when system performance degradation is due to insufficient computer memory, the memory used during processing is shown in the Memory Used box.

In addition, Predator Virtual CNC may show error messages when it detects that system degradation will occur if certain selected commands are allowed to continue. The user is given the choice to continue or cancel the operation.

Errors

If tool collisions are detected, the number of errors found is shown in the Error box. If errors are evident, clicking the Errors button on the Tool Bar will reveal the list of errors with details of their cause.

Tool Position (X, Y, Z, A, B, C (I, J, K) Display))

The tool Position display shows the position of the tool tip in relation to the stock origin. The display updates as each tool move is processed.

If NC program data is being processed, angular positions are shown in degrees for each rotary axis. If APT or other similar data files are processed, I, J & K tool vectors are displayed.

Job Completed

The Job completed progress bar shows how Job processing has progressed. When the bar is filled with the shaded bar, the Job is complete.

Control Panel

The Control Panel controls the processing of a Job and shows the state of some of the optional controls. Selecting the Control Panel command from the Window menu or clicking the Control Panel button opens or closed the control Panel. The

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Chapter 6

Inspection

There are three main ways to inspect an Predator Virtual CNC model.

- Visual checking
- Measurement
- Comparison with Design Model

Visual Checking

Visual checking of the machining process and the machined part can provide a feeling of comfort that things are as they should be. To view the Predator Virtual CNC models effectively, you may need to use the many tools provided to make this task easier.

View

The View menu item opens a control window that allows the view angle and light source to be changed in the active window.

View Angle



The view angle can be changed by entering X-Y and Z angles into the boxes provided or by dragging the image in the view window with the mouse at the same time keeping the left mouse button depressed. To use the new view angle in the active window, release the left mouse button and click the 'Apply' button.

Light Source



Positioning the cursor in the gadget window and dragging the light source while keeping the right mouse button depressed changes the position of the light source. A lamp icon represents the light source when the cursor is inside the View window and the right mouse button is depressed. To use the new light settings in the active window, release the right mouse button and click the Apply button.

Changes to view angle and light source may be made prior to clicking Apply. To close the control window, click the View button on the View Bar or click the close button in the top right hand corner of the View/Light control window.

Tool, Stock & Fixture Colors

The tool colors menu item or button is used to turn tool colors on or off and to set specific colors to certain tools. Selecting this item opens a dialog box as fol-

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Milling Tools

Flat
A flat tool holder requires entry of the height and diameter of the holder.

Ball
A ball ended tool holder requires entry of the height and diameter.

Bull
A bull-ended holder requires entry of the height, diameter and corner radius.

Chamfer
A chamfered tool holder requires entry of the height, diameter, chamfer angle and the bottom diameter of the holder.

Lathe Tools

Simple Bar
The simple bar lathe tool holder is a rectangular bar with a length and width specified by the user. The depth of the bar is estimated by Predator Virtual CNC and is not configurable by the user. The parameters required to specify a lathe tool holder are:

- Width - holder dimension along the Z-axis.
- Height - the holder dimension along the X-axis.
- Angle - the angle of the front face of the holder in relation to the Z-axis.
- Clearance X - The clearance distance, along the X-axis, from the programming point to the tool holder face.
- Clearance Z - The clearance distance, along the Z-axis, from the programming point to the tool holder face.
- Minimum Diameter - the smallest diameter hole in which the tool holder could sensibly be used. This is for internal turning applications.

NTG
A tool holder can be specified in Predator Virtual CNC's NTG language (See NTG (Lathe Tools)).

Tool Turret (Lathe Tools)

The tool turret dialog is used to define the position and orientation of the current tool in the tool turret and the orientation of the turret.

Tool Turret Position
The turret position graphic allows the user to specify the orientation of the tool in relation to the stock. There are 8 positions to choose from.

Cutting Direction
The cutting direction list box has only two options, CW (clock-wise) and CCW (counter clock-wise). N-See requires a value of CW if the spindle is rotating in a clock-wise direction when viewed from the Z+ direction.

Turret Position
The turret position can be defined as being either 'Top' or 'Bottom'. This option is used when simulating machining on a 2-axis machine with 2 turrets.

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control Panel may be positioned anywhere on the Predator Virtual CNC desktop or 'docked' at the bottom of the screen.

Stop Control
Stop control check boxes are used to automatically stop Predator Virtual CNC processing on the occurrence of one or more of the following events:



None
When none is selected, all other Stop Control check boxes are unchecked and processing continues until stopped manually using the Stop button or until the Job is completed.

Tool Crash
Selecting this check box instructs Predator Virtual CNC to stop processing when any type of tool collision is detected.

Tool Change
The Tool change check box instructs Predator Virtual CNC to halt processing when a tool change NC code, M06 for example, is detected.

Program Stop
Processing is stopped when a program stop typically a M00 code is detected in the CNC program.

Optional Stop
Processing is stopped when an optional stop typically a M01 code is detected in the CNC program.

Program Change
In those cases where multiple CNC programs are included in a single Job, selecting this check box tells Predator Virtual CNC to halt processing at the end of a CNC program, prior to the next CNC program starting.

Step Size
Checking the Step Size box halts processing after a specified number of blocks have been processed. The number of blocks is defined by entering a value into the Step Size box adjacent to the Step Size check box.

Holder Control
The holder control section controls how Predator Virtual CNC animates tool holders and checks for collisions between tool holders and stock.

Check Holder
The Check Holder box switches tool holder and tool shank collision checking ON

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or OFF. When in the OFF state, no collisions of tool shank or holder will be detected.
As this feature slows processing down, those users using slower computer equipment should uncheck this box unless holder and shank collision checking is required.

Display Holder
The Display Holder On check box is used to switch tool holders and tool shanks on in Preview animation sessions. When in the ON state, Preview animation will run considerably slower, so this box should be left unchecked unless visualization of the tool holder and shank is required. This check box is grayed out if the Holder check box is unchecked.

Animation Speed
The animation speed slider bar controls the speed of Predator Virtual CNC's animation. The slider is operable at any time when an animation window is open. Check boxes are provided for easy selection of Fast, Medium and Slow speeds.

CNC Panel

The NC Panel shows the NC program scrolling as it is being processed. As each NC program line is processed it is highlighted. When processing stops, the NC line that was last processed is shown highlighted.
Leaving the NC Panel open slows down processing, particularly when processing a Turbo model. It is therefore recommended that the NC Panel be closed unless it is needed.



Status Bar

The Status Bar is permanently enabled at the bottom of the Predator Virtual CNC window. The main function of the status bar is to show the name of the NC or APT file being processed. This is useful when you are processing multiple programs. The file name is shown complete with directory path. The Status Bar also shows the state of the Num. Lock, Scroll Lock and Caps Lock keyboard keys and a progress bar and cancel button associated with certain Predator Virtual CNC processes. When a Job is being processed, the name of the NC file being processed is displayed.

Preferences

Preferences and system default settings are changed using the Preferences dialog that is opened using the Preferences command on the Edit menu.

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The orientation angle is used to define the angle of the tool tip in relation to the Z-axis. The angle is the angle between the Z-axis and the first cutting edge.

Programmed Point

Turning
You may program your lathe with the path of the center of the tip radius or maybe another point. Predator Virtual CNC expects that programmed tool paths specify the path of the theoretical tool tip (touch off point), so we use the Programming Point Offset X and Offset Z entries to tell Predator Virtual CNC the position of the actual programmed point from the theoretical tip.
The entries must be in the units specified in for the current Machine/Job setup.

Milling
There are two situations where you will need to change the position of the Programmed Point in a milling Job.

- If the programmed point of the tool is not the tool tip.
- If you are setting up a Job for a machine with one or more rotary heads.

If the programmed point is not the tool tip, the center of radius of a ball-end mill perhaps, you must tell Predator Virtual CNC the position of the programmed point in relation to the tool tip. To do this, simply enter a value in the Programmed Point box that corresponds to the distance from the tool tip to the programmed point. The value may be signed (+ or -) to indicate the direction of the change. If you are setting up a Job for a machine tool with one or more rotary heads, you must enter a value in the Programmed Point box that represents the distance from the programmed point (defined in the machine setup dialog) and the tool tip. In this instance, the value effectively defines the tool length.

Tool Shank (Milling tools only)

Specifying a tool shank for milling tools is optional. It is only necessary if you wish to check for shank collisions.
The shank is considered to be the non-cutting part of the tool.

Tool Shank Check Box
The Tool shank Check Box is used to enable shank creation for the current tool.

Diameter
Enter the shank diameter in the diameter text box.

Height
Enter the height of the shank in the Height text box.

Tool Holder

Tool Holder Check Box
The tool holder Check Box is used to enable creation of a tool holder for the current tool.

Holder Types
There are several tool holder shapes to choose from.

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Tool Number

The tool number list box is used to save and recall individual tools. Often, tool assemblies (tool, shank & holder) are common to many Jobs but do not necessarily form part of a standard tool library. In this situation, it is useful to be able to save individual tools for future use. To save a tool:

1. Make the chosen tool current by selecting it from the list of tools in the current Job.
2. Click the cursor inside the tool Number box and enter the tool number. The number and tool details will be saved to the ALLTOOLS.DAT file in the common files\tools directory when the Job is saved.

To recall a tool that has previously been saved into the current Job:

1. Click the arrow at the side of the tool Number list box.
2. Select the desired tool from the list.

Home Name (Lathe Tools Only)

Some turning machines use tool offsets that are stored in memory locations in the CNC controller. When these offsets are needed, they are often called as part of the tool number. For instance, T0101 might be used to call tool number 01 with the offset stored in memory location 01. Tools called in this way may use any of the offsets stored in the controller, T0103 or T0107 for instance.

To cancel the offsets, calling the tool number with no offset is one possibility. In this case, we tell Predator Virtual CNC that the tool offset is being cancelled by entering the string used in the Home Name text box. In the above case, we would enter T0100 in the Home Name box to tell N-See that the offset used with tool number 01 is cancelled. The values of called offsets are entered in the Length and Diameter offset boxes on the Machines dialog.

Lathe Tool Parameters

The parameters that are required for defining lathe tools are somewhat different from those for milling tools.

Inscribed Circle (IC)

The Inscribed Circle is a common way of specifying a tool tip's size. The Inscribed circle is the largest circle that could be drawn inside the tool tip's boundary.

Corner Radius

Usually, a tool tip has a specified radius at the cutting tip. This radius is entered in the Corner Radius text box.

Angle

The included angle of the tool tip at the cutting point is entered here. This option is only available when the angle is variable. Square, triangle, pentagon and hexagon tool tip shapes obviously have included angles that are fixed and cannot be changed by the user.

Orientation

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Language

The Language list box reveals a list of supported languages. The default is English_US (American English). Selecting a language from the list will change all Predator Virtual CNC screen text to that language. Screen text is held in editable text files in the ..\SYSTEM directory. These files have a file extension of STR. The Language list box shows a list of all .STR files.

Default Editor

Predator Virtual CNC defaults to using the Predator Editor. If necessary, another editor can be used. To configure Predator Virtual CNC to use another editor, select Preferences from the Edit menu and specify the full pathname in the Default Editor box, e.g. C:\WINDOWS\NOTEPAD.EXE

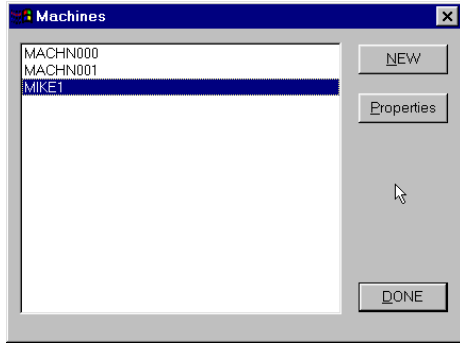
Default Machine

The Default Machine list box shows all machine tools that have been configured using the Predator Virtual CNC Machine Properties set-up. To select a machine definition as the default, simply select a machine from the list. This selection will be saved as the default if the Save Now button is clicked.

To learn how to create a machine definition, see the following section 'Machines' and Chapter 4 - 'Machine Set-up' in this manual.

Machines

Clicking the Machines button opens the Machines dialog box that lists all machine definitions in the ..\COMMON FILES\MACHINES directory. This dialog also contains three control buttons.



New

Clicking New opens a small dialog box that requires you to enter the new machine name. To save the machine name, click OK.

Properties

Once a machine definition file is created using the New button, the machine name will appear in the Machine List window. To view or edit the properties in any machine definition file, select the machine from the list and click the Properties button. On clicking this button, the Machine Definition dialog opens showing the machine parameters associated with the machine definition selected.

Done

Clicking the Done button closes the Machines dialog.

For more information about machine tool set-up, please refer to the Machine Set-up section of this manual.

Tooling Database

The tooling database window shows the file where all information relating to individual tools is saved when using the Tool No. facility on the Tool set-up dialog. The default is a file called ALLTOOLS.DAT.

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Solid Model Settings

The Solid Model settings button opens a dialog that offers two choices for setting the accuracy of the solid model. The setting entered here will be used by all Jobs, unless overridden by the solid model setting in the Job Set-up-Stock dialog.

Fixed Sub-division

The Solid and Turbo model resolution can be set to a fixed value by checking the Fixed Subdivision check box and entering a value of between 100 and 500 in the adjacent box. Remember, the higher the value, the better the image quality but at the expense of processing speed and memory usage. If your jobs have machined detail that is small in comparison with the size of the stock, you may need to make the subdivision number larger. This value is not a hard and fast number, so experiment with different settings to suit you needs. Deep Zoom can negate any limitations of model resolution by locally refining an area of interest.

Default

The default settings are set by us to provide an acceptable model resolution for typical Jobs.

Directories

The default directories for certain Predator Virtual CNC data files can be defined. In each case, the full path must be entered for CNC Files, Job Files, Machine Files, Tool Files, Stock Files, Tool Files, and HTML Files

Default File Extensions

Predator Virtual CNC uses data files generated by other systems, so we have no control over the file extensions used for these files. These files are CNC program files and STL files. During Job set-up, NC and STL files with any file extension may be selected using the Windows Browse facility. However, it is much easier if Predator Virtual CNC lists only files of the required type at the appropriate time. Entering your chosen default file extensions into these boxes tells Predator Virtual CNC to first list these file types only.

NOTE: By default multiple NC program file extensions already setup.

Repeat Continuously—Demonstration Mode

The Automatic Restart check box is mainly for the use of our resellers. Checking this box tells Predator Virtual CNC to automatically restart processing a Job as it finishes. This is a particularly useful feature at open houses or trade shows to continuously recycle all open windows.

Save Defaults on Exit

Enable this option to save the Predator Virtual CNC desktop layout for future use. When starting Predator Virtual CNC with this box checked, the desktop layout used during the previous Predator Virtual CNC session will be restored. Opened windows will use the size, position and View/Light settings that were used for that window previously. Predator Virtual CNC remembers the settings associated with a window, not the type of view included in the window. This means that the first window opened will use the settings of the first window from the previous Predator Virtual CNC session, regardless of the type of view animation, solid, both or turbo contained in that window.

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```
1  0.125      0.0
[NON CUTTING]
1  0.252.0
1  0.252.25
1  0.5 2.25
1   0.69      2.44
1  0.694.55
```

The lines starting with `2` are the equivalent of a G02 move in a CNC program with X, Y & I, J co-ordinates.
A `[NON CUTTING]` definition is optional and is typically used for tool shanks and holders. It would be defined in the same way as a cutter.
To create a tool using NTG:

1. From the Job dialog, select the Tool tab.
2. Click the Add button.
3. From the Tool Type list box, select NTG.
4. Type the NTG instructions in the NTG window.
5. When finished, click the Save NTG button.
6. Enter the filename and click OK.

There are some simple rules to follow:

- An NTG file must begin with the header `[CUTTING]`.
- Holders are optional and are defined with the header `[NON CUTTING]`.
- The first entity must define the cutting tip.
- Each co-ordinate must be separated by at least one blank space.
- All co-ordinates are in absolute mode.
- The tool must be defined in a clockwise fashion.
- Insert and Holder shapes must be closed.

NOTE: We have said that the tools must be defined in a clockwise fashion. This means that external radii are defined with G02 (`2`) type moves and internal radii with G03 (`3`) type moves.

If any standard Predator Virtual CNC lathe tool shapes are close to your needs, but not quite, it is possible to convert a standard Predator Virtual CNC lathe tool to NTG format as follows.

1. From the Job set-up dialog, load an existing Job that contains the required tool definition.
2. Select the Tool tab
3. From the list of tools in the Tool List window, click the chosen tool.
4. From the Tool type list box, select NTG. You will notice that a window will appear showing the NTG listing for the selected tool.
5. Edit the NTG listing as desired.
6. Click the 'Save NTG' button and enter the new NTG filename when prompted.

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- Square
- Pentagon
- Hexagon
- Radius Groove
- Grooving
- Threading
- Lathe-Drill
- User Defined or NTG

NTG

NTG (New Tool Geometry) is a simple language used to define custom or form tool shapes. NTG language is based on standard CNC program concepts using modified G01 (linear) and G02 or G03 (arc) moves to define a closed tool shape.

The syntax for NTG geometry definitions is:

<type> <X co-ordinate> <Y co-ordinate> <I arc center co-ordinate> <J arc center co-ordinate>

Where <type> is either

0 to define the start point (no I or J value)

1 to define a straight edge (no I or J value)

2 to define a clockwise arc (I & J values are required)

3 to define an counter-clockwise arc (I & J values are required)

Here is a simple NTG definition of a square tool tip with sides of 0.25".

```
[CUTTING]
0       0.0     0.0
1       0.0     0.25
1       0.25    0.25
1       0.25    0.0
1       0.0     0.0
```

In this example an `[CUTTING]` header tells Predator Virtual CNC that the following geometry relates to a tool insert or cutting tip. If a tool holder were being defined, the header `[NON CUTTING]` would be used.

The first `0` indicates the starting point, in this case `0.0 0.0`. If the line were to read `G00 X0.0 Y0.0`, you would immediately recognize the structure. The only difference is that the letter addresses have been left off.

The first `1` on each line indicates a straight-line move (G01) to the point defined by the next co-ordinates, `0.0 0.25`.

Each of the following lines starting with a `1` are straight line moves to other points on the absolute co-ordinate system.

The `[EOF]` (End of File) tells Predator Virtual CNC that the geometry is complete.

Here is another example that defines a 1 " square tool insert that has a 0.125" radius at each corner.

```
[CUTTING]
0  0.125       0.0
2  0.0 0.125   0.125   0.125
1  0.0 0.875
2  0.125       1.000   0.125   0.875
1  0.875       1.0
2  1.0 0.875   0.875   0.875
1  1.0 0.125
2  0.875       0.0     0.875   0.125
```

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Chapter 4

Machine Setup

Overview

Predator Virtual CNC is provided with several machine definition files for typical milling and turning machines. It is unlikely that these machine definitions will satisfy the requirements of your own machine tools, so you will need to configure machine definitions for each of the NC machine tools on your shop-floor. Machine definition files may contain the following machine tool information:

- Units (inch or metric).
- Rotary axis translation.
- 4th & 5th axis origin position.
- Machine Datum.
- Machine type.
- Machine axis travels.
- Tool change position.
- Tool change time.
- Load/unload time.
- Maximum spindle speed.
- Rapid travel threshold value.
- Actual rapid-travel rate.

Note: A machine definition may either be setup using inch or metric units, not both. If you use both inch and metric programs on any of your machines, we recommend that you configure two machine definitions for each machine tool, one for inch units and the other for metric units.

If you do not have all of the above information available, do not worry, a machine definition need contain only the controller type and machine type to process many 3-axis milling and 2-axis turning jobs. Machine definitions for 4 and 5-axis milling machines are a little more complex, but easier than you might think. Machine definition files can be created using the Machines button on the Preferences dialog. Machine definitions specified in this way set the default values for the machine and are saved in the machine definition file (MCH file). Machine definitions may also be altered from within the Job setup dialogs.

How to create a machine definition.

To setup a new machine definition file, follow these steps:

1. Select Preferences from the Edit menu.
2. Click the Machines button next to the Default Machine list box.
3. In the resulting Machine window, click the New button. A small window will open and you will be prompted to enter a machine name.
4. Enter a machine name and click OK. Do not enter a file extension, as

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Predator Virtual CNC will automatically add the file extension .MCH. You will be returned to the Machines list window. Notice that your machine has been added to the list.

5. With your new machine highlighted, click the Properties button.
6. The Machine Setup dialog will open.
7. Enter the parameters for your machine definition and save them.

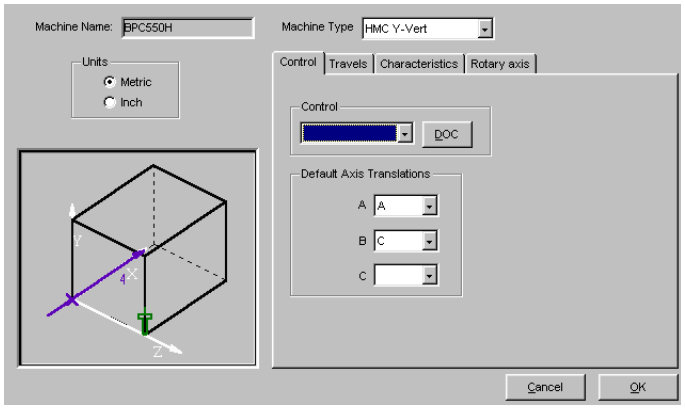
The Machine Setup dialogs consist of the following sections:

- Machine Setup
- Control
- Travels
- Characteristics
- Rotary Axis

Machine Properties

Clicking the Properties button on the Machines dialog opens the Machine Setup Dialog.

Machine Name



The Machine Name text box shows the name of the machine tool being configured. If this is not correct, click the Cancel button, return to the Machines dialog and select the correct machine.

Machine Type

The Machine Type list box is used to select the type of machine tool being used in the current Job. Selecting the arrow at the side of the list box reveals a list of machine types available. The options are:

- VMC/V.Mill. - Vertical 3-axis milling machines and machining centers.
- VMC 4-ax. – Vertical 4-axis milling machines and machining centers.
- VMC 5-ax. – Vertical 5-axis milling machines and machining centers.
- HMC Y-Vert. - Horizontal 3-axis milling machines or machining centers where the Y-axis is vertical.
- HMC 4-ax Y-Vert. – Horizontal 4-axis milling machines or machining cen-

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programmed number. To avoid errors later, you should change the programmed number of one of the tools at this time.

Tool Graphic Window

The tool graphic window shows a simple graphical image of the currently selected tool. Tool, tool shank and tool holder are shown in different colors.

Change View Button

The change view button zooms and unzooms the tool graphic window. If tool shank and holder have been defined, there are three views available. The first shows the tool only; the second shows tool and tool shank and the third shows tool, shank and holder.

Tool Definition

The tool definition tab reveals the tool definition dialog. Using this dialog, you can create and modify tools in the current set-up. The dialog contains the following data entry boxes:

Programmed Number (Prog. Number)

The programmed number box is used to tell Predator Virtual CNC which tool in the CNC program is the currently selected tool. The data entered into the box must be exactly in the form used in the CNC program. If a program contains a tool programmed as T0303, the Prog. No. box must contain the characters T0303. Using T03 or T3 will not do.

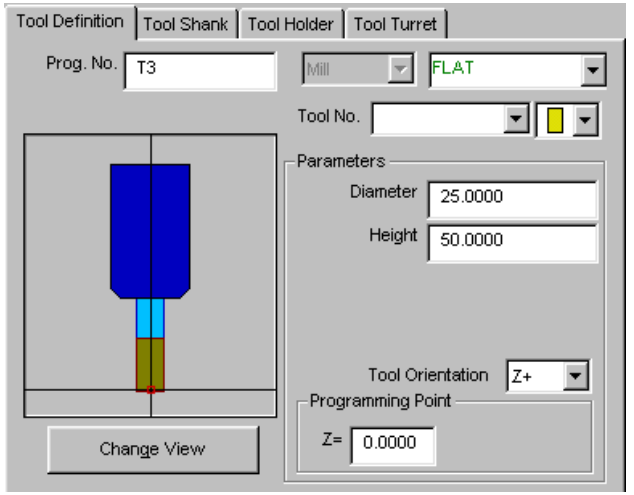
Tool Type

The Tool Type box is a list box containing all supported tool types. If Mill has been selected in the Machine Type window, only milling tools are listed. If Lathe was selected in the Machine Type window, only lathe tools are listed.

Selecting a tool from the list changes the following data entry dialogs to suit the chosen tool. The tools available are:

Milling Tools

- Flat end.
- Ball end.
- Bull end
- Drill
- Radius
- Sphere
- Chamfer
- Dovetail
- Tapered Ball
- User Defined or NTG



Lathe Tools

The lathe tool listing shows tool tip geometry options.

- Diamond
- Triangle

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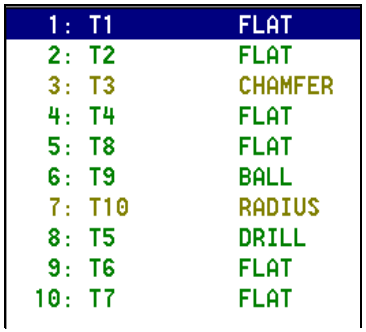
The following graphic shows a typical milling tool set-up.

Default Tool

In situations where a CNC program assumes that a tool has already been pre-selected, no tool change command is included at the beginning of the program. We tell Predator Virtual CNC which tool is pre-selected by selecting the tool from the current Job list with the Default Tool list box. When a tool is selected in this way, Predator Virtual CNC will process all CNC commands, up until the first tool change command, with this default tool.

Tool List Window

The tool list window shows all tools defined for the current CNC program in the current Job. The list shows a tool item number, the programmed number (e.g. T03) and the shape of the tool (e.g. Drill, Flat, Chamfer, etc.) and its orientation in relation to the machine axes (e.g. Z+). Clicking on any tool within this window will select the tool and load its details into the Tool Setup windows.



Add Button

To add a tool to the current Job tool list:

1. Click the Add button situated just below the tool list window.
2. Specify the tool geometry, size and program details in the Tool Setup dialogs.

When the Add button is clicked, a tool is immediately added to the tool list using default values.

Delete Button

The Delete button is used to remove a tool from the current tool list. To delete a tool:

1. Click the tool in the tool list window.
2. Click the Delete button.

Save Tool Library

If you use the same, or similar, tool set-ups regularly, it is possible to save the tool set-up in a tool library. The tool library files are saved in the ..\COMMON FILES\TOOLS directory using the file extension .TLB.
To save the current tool list as a library file:

1. Click the Save T.Lib. button.
2. Enter your chosen filename (without file extension).
3. Click save.

Load Tool Library

The load T.Lib. button is used to load a saved tool library file into the current Job setup. If tools have already been define in the current setup, the tools in the library are added to the list. If added tools from a library file have the same programmed number as a tool already defined; both will be listed showing the same

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ters where the Y-axis is vertical.
- HMC 5-ax Y-Vert. – Horizontal 5-axis milling machines and machining centers where the Y-axis is vertical.
- HMC X-Vert. - Horizontal 3-axis milling machines or machining centers where the X-axis is vertical.
- Lathe Z Hor.- Lathes and other turning machines with 2 controllable axes where the Z –axis is horizontal.
- Lathe Z Vert. - Lathes and other turning machines with 2 controllable axes where the Z –axis is vertical.
- Mill/turn - Not used in this release.
- Mill/turn Z-Vert – Not used in this release.

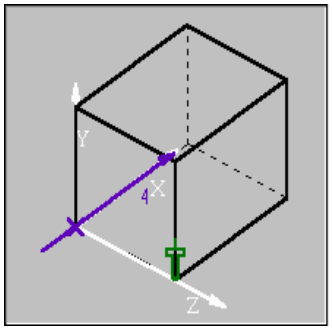
Selecting a machine type affects the way further screens are laid out, the options available to you and the way Predator Virtual CNC models the Job. It is, therefore, very important to choose the correct machine type.

Units

There are two Units check boxes, one for inch and one for metric units. You should check the units to be used with the current machine definition. If you wish to use both inch and metric units with the same machine tool, we recommend that you create two almost identical machine definition files, one for inch and one for metric use. Inch and metric units may **not** be mixed in a machine definition or Job files.

Setup Graphic Window

The setup graphic window gives a dynamic representation of the machine tool setup. It shows:



- The Machine Datum as a blue cross.
- The Axis travel envelope as a black outline.
- Axis of rotation of a 4th axis as a blue arrow with a number '4' below it.
- Axis rotation of a 5th axis as a green arrow with a number '5' below it.
- The 5th axis datum as a green cross.
- The tool change position as a green 'T'.
- Position and direction of the X, Y & Z axes as white lines with white X, Y and Z letters in the axis plus direction.

Machine Datum

The Machine Datum is a point in machine space from which important job and machine dimensions are taken. The actual location of the Machine Datum in machine space is significant only if:

- You are checking axis over-travels.
- You are using a machine with one or more rotary axes.
- You manufacture components using a fixed datum point on the machine to locate stock or fixtures and the program origin.

If none of the above points are relevant to you, you can usually ignore the Machine Datum and work in part (stock) space.
On machines that have one or more rotary tables, the Machine Datum is always considered to be the point where the 4th axis (Primary Axis) axis of rotation passes through the 4th axis table surface.

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On rotary head machines that do not have a rotary table, the Machine Datum is a point from which the rotary-axes positions are defined. This is often the machine tool builder's 'Machine Origin' position.

Axis Travel Envelope

The axis travel envelope is not a prerequisite for processing a Job and can be ignored.

The axis travel envelope is only significant if you wish to check for axis over-travel violations. The machine envelope is defined by entering co-ordinate points in relation to the Machine Datum.

The envelope is a rectangular space on milling machines and cylindrical space on turning machines. It is defined by entering values for maximum and minimum X, Y and Z values coordinates of diagonally opposite corners for mills and X & Z values for lathes.

If an axis is programmed in such a way that the NC program tries to exceed these limits, an error message will be generated.

Control

The Control tab reveals a data entry panel for specifying the CNC control and other CNC program settings to be used in the current Job.

CNC Control

The Control list box is used to select a CNC program translator or Reverse Post for the current Job. Selecting the arrow button at the side of the list box will reveal a complete list of translators and reverse posts that are applicable to the machine type.

Axis Translation

The axis translation list boxes allow a programmed rotary indexing move to be translated by the model as a different axis. For example, imagine a machine with a removable indexing table that can be mounted as either an 'A' or a 'B' axis. The CNC controller always outputs an 'A' move. When we want to simulate the rotary table in the 'B' axis position, we can set the 'A' translation list box to 'B'. In this case Predator Virtual CNC will model each 'A' rotary move as if it was a 'B' move.

The Axis Translation options are applicable to 3-axis milling machines with indexing tables only. The list boxes will be grayed out if other machine tool types are selected.

Travels

The Travels tab allows travel limits, tool change positions and tool home positions to be specified

Machine Travels (Linear)

The Machine Travels check box enables the use of axis over-travel checking and requires the user to enter maximum and minimum travel limits for each axis relative to the Machine Datum.

The machine travel values of Xmin, Ymin, Zmin & Xmax, Ymax, Zmax are used to

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Rotated Stock Graphic

The stock graphic window shows a wire frame image of the stock. When the stock is rotated from its original position, the original position id displayed as a gray outline, while the blue stock outline rotates to the new position.

Orientation Preview

This preview window shows a rectangular block with sides numbered like a dice. That is, any two opposite sides add up to 7. This makes it easy to identify faces that are hidden. In addition to the rectangular block that represents the stock, the machine axes, Stock Datum, Program Origin and Machine Datum are shown. The block shows the current orientation of the stock at any time.

Angle

The angle text box is used to enter the angle of movement.

Axis Button

The axis button box is used to specify the axis about which the rotation occurs. There are obviously three options, X, Y & Z. Clicking the axis button toggles between the options. The stock will rotate about the chosen axis at the point where the axis passes through the Stock Datum.

After the rotation, you will notice that the Program Origin has not moved.

Rotate Buttons

There are eight (8) buttons that can be used to rotate the stock. The CW and CCW buttons are used to rotate the part about the axis specified with the axis button by the number of degrees specified in the angle box. CW rotates the stock clockwise and CCW counter-clockwise.

There are also 6 buttons labeled X, Y & Z with direction arrows. These may be used to rotate the stock quickly in 90-degree steps.

Reset Button

The Reset button restores the original orientation. This is useful if you have made complex rotations along more than one axis and have lost your position. Clicking the Reset button will allow you to start again.

Undo/Redo Buttons

The Undo button reverses the last rotation made. The Redo button restores the last move after the Undo button has been used. These are useful controls if you wish to reverse a rotation to check your position and then restore the move.

Tool Setup

Clicking the Tools Tab opens the Tools set-up dialog. The dialog changes significantly depending on the type of tool being defined. Milling tool dialogs look very different from lathe tool dialogs. To avoid lengthy descriptions of each and every tool type, the following paragraphs describe the general concepts of Predator Virtual CNC tool set-up.

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Z Origin

The Z Origin list box reveals a list of optional positions for the Program Origin in the Z-axis. The options are:

- **Top** - locates the Program Origin on the top surface of the current stock item.
- **Center** - locates the Program Origin at a point central to the current stock items maximum and minimum Z-axis extents.
- **Bottom** - locates the Program Origin on the bottom surface of the current stock item.
- **Manual** - Locates the Program Origin at a manually entered position in relation to the Stock Datum.

If changes are made, values in the Position from Machine Datum boxes are updated accordingly.

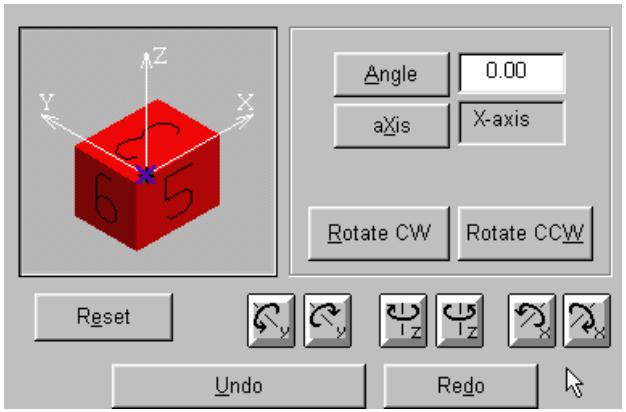
Position from Machine Datum

In many cases and particularly where a 4th axis rotary table is used, the Program Origin will need to be specified from the Machine Datum. To facilitate this, the Position from Machine Origin option is provided.

The three text boxes labeled X, Y & Z all require a value that represent an absolute distance from the Machine Datum.

If changes are made, values in the X-Y Origin and Z Origin boxes are updated accordingly.

Stock Rotation (manual reorientation)



Manual reorientation of the stock may be carried out before processing a CNC program. When multiple CNC programs are added to a Job, a manual rotation of the stock may take place between each program.

The Rotation tab opens the rotation dialog, which is used to define a manual reorientation of the stock. When a reorientation is defined, the move takes place prior to processing of the associated CNC program. When several stock rotations are included in a single Job, each rotation is defined relative to the original stock position. That is, using programmer's terminology, the moves are absolute not incremental.

When stock is rotated, the program origin remains fixed in relation to the Machine Datum. The program origin may be relocated by selecting the 'Origin' tab and entering new position values, either in relation to the stock or the machine origin. Please refer to the paragraph 'Program Origin' for more information about relocating the program origin.

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define the maximum travel limits of the machine about the Machine Datum. The values entered adopt the units defined in Machine Setup.

4th Axis

Physical travel limits for a 4th axis rotary axis can be specified as plus (+) or minus (-) values about the rotary axis zero position. These values are accumulative, so if you are programming incremental rotary moves and the sum of those moves exceeds the physical capability of the rotary axis, an error is generated during NC program translation by the G-code translator.

5th Axis

Physical travel limits for a 5th axis rotary axis can be specified as plus (+) or minus (-) values about the 5th axis zero position. As with the 4th axis limits, these are accumulative and will detect over travels while translating the G-code data.

Tool Home and Tool Change Position

These X, Y and Z values are used to define the position to where the machine spindle positions itself for home positions and tool change positions. These values are used for calculating cycle times and for collision checking. All positions are entered as X, Y & Z distances from the Machine Datum. The tool change position is shown in the Setup Graphic window as a green 'T' shape.

Time Params 1 and Time Params 2

The Time Params tabs reveal a number of options for accurate cycle time calculations, including:

Max Spindle RPM

Enter the maximum spindle speed for the current machines. Predator Virtual CNC uses this information to trap programming errors that specify a higher spindle speed than the machine tool is capable.

Rapid Threshold

The Rapid Threshold is not strictly speaking a machine specific characteristic. It is a feed rate value above which Predator Virtual CNC will consider a tool move to be a rapid feed. This is a useful feature to limit feed rates if an aging machine, fixture setup or stock item is insufficiently rigid to allow normal feed rates to be used.

Actual Rapid Feed

The machine tool's rapid feed rate should be entered here. This value is used for calculating machining cycle times only.

Tool Change Time

Enter the average time taken to change a tool in the current machine tool. This value may be the fixed tool change time in the case of a machine with automatic tool changing or an average time for a manual tool change. This value is used for calculating cycle times only.

Load/Unload Time

The Load/unload time is an average time for loading and unloading a part for the current machine. This time is used for calculating cycle times only.

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Rotary Axis

The Rotary Axis dialog is used to specify parameters for 4th axis indexing tables, full 4th axis rotary axes (rotary table or rotary head) and full 5th axis rotary axes (rotary table or rotary head). This dialog is grayed if a machine without a 4th axis is selected.

Machine Configuration

The Machine Configuration list box displays machine configurations that are relevant to the machine type selected. For instance, if a 4-axis vertical milling machine is being configured, options for a 4th axis rotary head or rotary table are displayed. Depending on the selection, the Rotary Axis dialog will change to present only options applicable to that machine type.

Primary Axis (4th Axis)

The Primary Axis may be a rotary table or a rotary head. In the case of 5-axis machines, the primary axis is generally considered to be the axis closest to the machine frame.

Programmed Axis

The programmed axis list box offers the choices of A, B or C axes. This is the address used by the NC program to specify rotary moves (A90, B-30, C25 etc.). It does not necessarily define the physical direction of the axis.

Direction

The 4th axis direction uses industry standard conventions for specifying the direction. The direction may be specified as being: +X; -X; +Y; -Y; +Z or -Z. The following diagram shows the relationship between the rotary axis directions and the X, Y & Z-axes.

It is important to note that the arrows depicting rotations (+A, +B & +C) show the positive direction of the tool, not the direction of rotation of the table. These may or may not agree with the actual programmed axis and direction. In the case of a machine with a removable rotary table for instance, the Programmed Axis may be 'A', but its physical location on the machine may cause it to rotate about the 'Y' axis (normally considered to be a B axis). We would select +Y from the Direction list box. In this case, an A90 programmed move will be modeled as a B+ move.

Start-up

The 4th axis start-up position defines the angle at which the 4th axis is positioned at the time of program start. The default value is zero. This option is used when a NC program is started with the 4th-axis in a position other than zero or the zero position does not conform to the standard definition of a rotary axis zero position.

Coordinate Mode

The co-ordinate mode list box offers three options that affect how Predator Virtual CNC interprets angular moves.

Positional

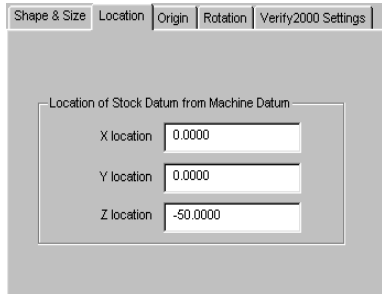
This option tells Predator Virtual CNC to interpret angular moves as absolute val-

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- **STL Stock** - Stock item in STL format.
- **STL Fixture** - Fixture item in STL format.

When a stock or fixture type is selected, data entry boxes are revealed to allow the dimensions to be entered. In the case of STL stock and fixture items, the STL filename and path is required.

Location



The location dialog is used to position the Stock Datum in relation to the Machine Datum. The default position is 0,0,0. That is, the Stock Origin and the Machine Datum share the same position.

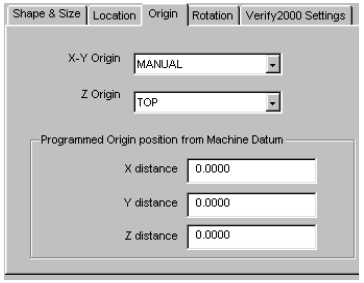
The Location values may be left set to '0' if:

- You are not tracking axis over travels.
- You are not using rotary tables.
- You are setting your program origin in relation to a point on the stock, not a point on the machine.

To relocate the Stock Datum from the Machine Datum:

1. From the Stock Location dialog, enter X, Y & Z values that define the absolute position of the Stock Datum from the Machine Origin.
2. The values are saved automatically to the Job files.

Program Origin



The origin tab reveals a dialog that allows the position of the program origin to be entered. The position is defined either:

- As a point on the current stock item.
- As a point in relation to the Machine Datum.

X-Y Origin

The X-Y Origin list box reveals a short list option for defining the Program Origin in relation to the currently active stock item. The options are:

- **minX minY** - selects the point on the current stock item that is its minimum X and Y value.
- **max X min Y** - selects the point on the current stock item that is its maximum X and minimum Y value.
- **min X max Y** - selects the point on the current stock item that is its minimum X and maximum Y value.
- **max X max Y** - selects the point on the current stock item that is its maximum X and maximum Y value.
- **Center** - selects a point that is the center of the X and Y dimensions of the current stock item.
- **Manual** - allows user input of a point in relation to the Stock Datum.

If changes are made, values in the Position from Machine Datum boxes are updated accordingly.

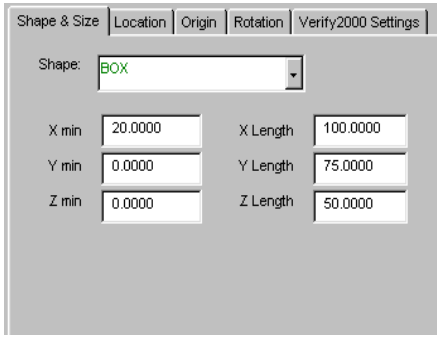
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Add Button
The Add button is used to add a stock, fixture or clamp item to the current stock set-up. When the Add button is selected, a small stock item is added to the graphic window in the form of a square box with its corner at the Stock Datum position (0,0,0). This stock item can be reshaped, resized and changed from a stock item to a fixture item using the Shape & Size dialog.

Delete (Del) Button
The delete button is used to delete a stock/fixture item from the current set-up. Before clicking Delete, the stock/fixture item must be selected by clicking the item in the graphic window or selecting the item from the Stock item list box.

Stock Item Number
The stock item window shows the number of the stock/fixture item that is currently selected. Clicking the arrow at the side of the window reveals a list of stock & fixture items in the current set-up. Selecting one of the listed numbers selects that stock item as being active and loads its details into the stock dialog boxes.

Stock Shape & Size



The Shape & Size tab reveals the stock creation dialog. The stock shape and type (stock or fixture, solid or hole) may be selected from the shape list box. The options are:

- **Box** - Stock item in the shape of a rectangular box.
- **CYL-X** - Stock item in the shape of a cylinder with its axis parallel to the machine X-axis.
- **CYL-Y** - Stock item in the shape of a cylinder with its axis parallel to the machine Y-axis.
- **CYL-Z** - Stock item in the shape of a cylinder with its axis parallel to the machine Z-axis.
- **Box_Hole** - Hole in either stock or fixture item in the shape of a rectangular box.
- **RNDX_Hole** - Hole in stock or fixture item in the shape of a cylinder with its axis parallel to the machine X-axis.
- **RNDY_Hole** - Hole in stock or fixture item in the shape of a cylinder with its axis parallel to the machine Y-axis
- **RNDZ_Hole** - Hole in stock or fixture item in the shape of a cylinder with its axis parallel to the machine Z-axis
- **Box_Fixt** - Fixture item in the shape of a rectangular box.
- **XCYL_Fixt** - Fixture item in the shape of a cylinder with its axis parallel to the machine X-axis.
- **YCYL_Fixt** - Fixture item in the shape of a cylinder with its axis parallel to the machine Y-axis.
- **ZCYL_Fixt** - Fixture item in the shape of a cylinder with its axis parallel to the machine Z-axis.

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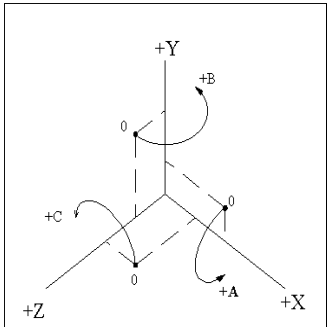
ues. The direction of rotation is determined by the programmed angle being of a higher or lower value than that of the starting angle. For instance, a move from a start point of A270 to A30 would move 240 degrees in the negative direction (30 is smaller than 270 so move is negative) and a move from A270 to A355 would move 85 degrees in the positive direction (355 is larger than 270 so move is positive).

Module 360
This mode tells Predator Virtual CNC to interpret all angular moves as absolute values. The direction of rotation is determined by the shortest distance between the start angle and the programmed angle. For instance, a move from A10 to A30 would be a positive move of 20 degrees and a move from A10 to A350 would be a 20-degree move in the negative direction.
Angles above 360 degrees are allowed (A380, B460 or C720 for instance).
If the direction of rotation is specified in the NC program using M codes, this option should be used. The code specified by any M code will override the shortest route logic.

Sign + Position
This option tells Predator Virtual CNC to interpret all angular moves as absolute moves with the sign (+ or -) dictating the direction of rotation. For example, a move from A10 programmed as A30 would be modeled as a positive 20 degree move and a move from A10 programmed as A-30 would be modeled as a negative move of 340 degrees in the negative direction.

Secondary Axis (5th Axis) Check Box
The Primary Axis may be a rotary table or a rotary head. In the case of 5-axis machines, the secondary axis is generally considered to be the axis furthest from the machine frame.

Programmed Axis
The programmed axis list box offers the choices of A, B or C axes. This is the address used by the NC program to specify rotary moves (A90, B-30, C25 etc.). It does not necessarily define the physical direction of the axis.



Direction
The 5th axis direction uses industry standard conventions for specifying the direction. The direction may be specified as being: +X; -X; +Y; -Y; +Z or -Z. See the diagram and 4th axis Direction.

Start-up
The 5th axis start-up position defines the angle at which the 5th axis is positioned at the time of program start. The default value is zero. This option is used when a CNC program is started with the 5th-axis in a position other than zero or the zero position does not conform to the standard definition of a rotary axis zero position.

Coordinate Mode
The co-ordinate mode list box offers three options that affect how Predator Vir-

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tual CNC interprets angular moves.

Positional

This option tells Predator Virtual CNC to interpret angular moves as absolute values. The direction of rotation is determined by the programmed angle being of a higher or lower value than that of the starting angle. For instance, a move from a starting point of A270 to A30 would move 240 degrees in the negative direction (30 is smaller than 270 so move is negative) and a move from A270 to A355 would move 85 degrees in the positive direction (355 is larger than 270 so move is positive).

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Sign + Position

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5th Axis Position

NOTE: Remember that the Machine Datum is on the center of rotation of the Primary (4th) axis (usually on the 4th axis table top in the case of a rotary table machine or at some convenient point along the rotary axis on a rotary head machine).

When configuring a machine with two rotary tables, the position of the 5th axis rotary table must specified. It is specified as X, Y & Z distances from the Machine Datum.
Entering X, Y & Z values in these boxes defines the axis of rotation of the 5th axis and a point along that axis that is used to define the Programmed Point.

Programmed Point

Predator Virtual CNC normally expects the CNC program to define the path of the tool tip. However, on machines with two rotary heads, it is usual to program a point on the machine that is associated with the position of the rotary axes. The Programmed Point X, Y & Z dialogs are used to specify the position of this programmed point in relation to the 5th axis position. When the programmed point is specified here, the location of the point must be added to each tool definition as a distance from the tool tip (see Tool Setup – Programmed Point).

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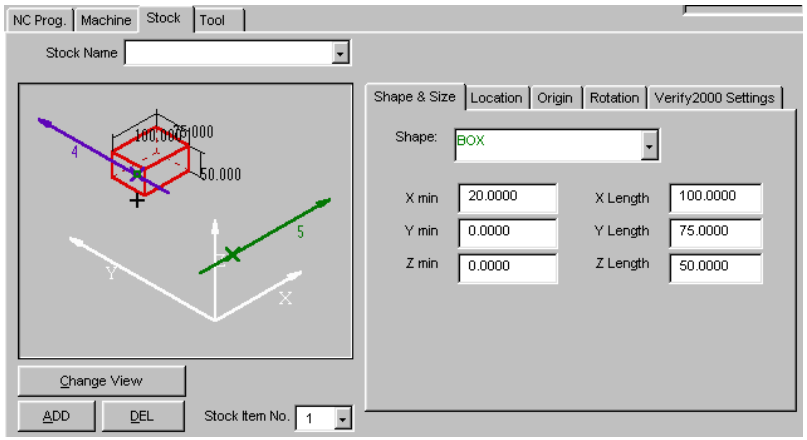
If you wish to save stock and fixture set-ups for future use, you must give the set-up a name. The stock name list box is used to attach a name to the current stock set-up and to recall saved stock set-ups into the current Job set-up. To save a stock set-up:

1. Click the arrow at the side of the Stock Name list box.
2. Select <Save as> from the list of choices.
3. Enter a name.
4. Click OK.

To recall a previously saved stock set-up into the current Job:

1. Click the arrow at the side of the Stock Name list box.
2. Select the set-up from the list.

Stock Preview



The stock preview shows the current stock shape and the following:

- The Stock Datum (stock 0,0,0) shown as a black cross (+).
- The Program Origin (NC program 0,0,0) shown as a green square (□).
- The Machine Datum shown as a blue cross (X).
- A 4th axis shown as a blue arrow with a number '4' below it.
- A 5th axis shown as a green arrow with a number '5' below it.
- A 5th axis position shown as a green cross.
- Stock dimensions.
- Axis labels.

The Program Origin defaults to the position of the Machine Datum.
The stock is shown in relation to the +X, +Y & +Z axes with its basic dimensions. In the case of stock imported from a CAD system in STL file format, the stock shape is shown without dimensions.

Change View

The change view button toggles the view in the Stock Graphic Window to show more or less detail.

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The offset value stored in the CNC controller can be entered into Predator Virtual CNC as follows:

1. Click the mouse pointer inside the Radius Offset box.
2. Enter D04 = 25.00 (where 25.00 is the value stored in memory location 04) and press enter.

Length Offsets

The Length Offset panel is used to enter tool length offsets for each tool that requires it. There are two scenarios that may require data to be entered here:

Length Offsets for a specific tool.

Predator Virtual CNC assumes that the programmed tool path is the path taken by the tool tip. However, if you are programming a different point on the tool or a point on the machine (usual with rotary head machines), it is possible to enter a length offset for that tool telling Predator Virtual CNC to adjust each tool move by the defined amount. In this case the length offset is associated with a particular tool.

As an example, consider a ball end-milling cutter with a diameter of 12mm. The CNC programmer has programmed the center of the tip radius, not the tool tip, and has given the tool the number T07. To ensure that Predator Virtual CNC offsets the tool path, we must:

1. With the mouse pointer, click on the inside of the Length offset box.
2. Enter T07=6.0 and press enter.

The address T07 is recognized by Predator Virtual CNC as tool T07 in the current CNC program. The 6.0 value is the length of the offset along the tool axis.

Length Offsets Called by CNC Program.

Your CNC controller may allow tool length offsets to be called from the CNC program. These offsets, usually entered by the machine operator into the controller memory, may be called at any time for use with any tool by using an appropriate CNC program command. In this case, we must tell Predator Virtual CNC to activate the defined offset each time the offset code is encountered in the CNC program.

In the case where a tool length offset of 10.00mm has been entered into a CNC controller's memory location 05 and the CNC program address for calling this offset is 'H', we must:

1. Click on the inside of the Length offset box.
2. Enter H05=10.0 and press enter.

If, for the chosen CNC controller, the programmed address for calling length offsets is the letter 'H', we use H05 to tell N-See to apply an offset of 10.00mm each time an H05 is encountered in the CNC program.

Stock Setup

Clicking the Stock Tab opens the Stock Setup Dialog.

Stock Name

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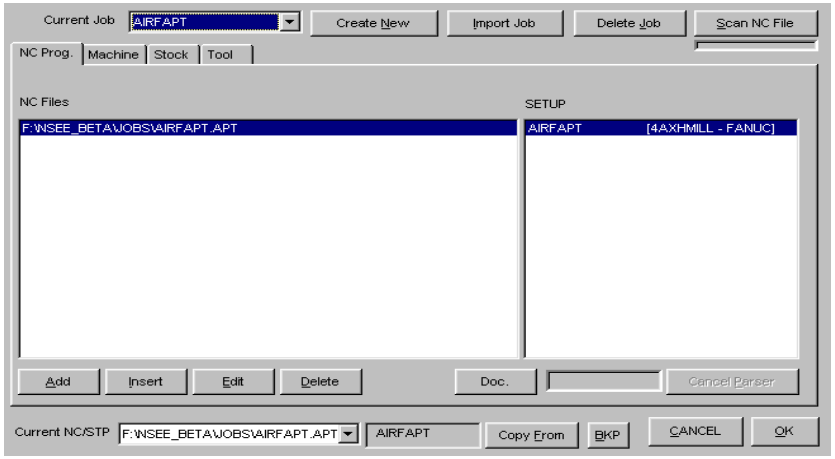
Chapter 5

Job Setup

An Predator Virtual CNC Job requires certain information to be entered before a CNC program can be processed. The information required is broken down into 3 main areas:

- Machine, Controller & CNC programs
- Tooling
- Stock

Machine, Controller and CNC programs are stored in separate files and are linked to the Job file. Tooling and Stock details are typically specified within the following Job dialogs.



Open

After selecting Open from the File menu or clicking the Open button on the Tool Bar, the Job dialog box opens. This dialog box is used to set-up new Jobs or make set-up changes to existing Jobs.

Current Job

The current Job list box shows the Job that is active. Another Job can be chosen by clicking the arrow at the side of the list box and selecting a new Job from the list. The list shows all Job files listed in the Jobs directory as defined in Settings.

Create New Job

The Create New Job button allows a new Predator Virtual CNC Job to be set-up. To set-up a new Job, follow these simple steps:

1. Click the Create New Job button.

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Note: The Job name can be any filename within the limits of the operating system used. A filename without file extension should be entered. Predator Virtual CNC will attach the default file extension .JOB.

1. Enter the Job name into the dialog box.
2. Using the Job, Machine, Stock and Tool dialogs, enter the set-up data.

Import Job

The Import Job button allows Job files that are not in the default Job directory or old N-See Project (PRJ) files to be imported into Predator Virtual CNC's current structure. Once imported, data from an old Project file is saved in Predator Virtual CNC Job file format, without affecting the original Project file. Imported Predator Virtual CNC files from other directories are saved in the current default Predator Virtual CNC directory structure.

If other files needed for the imported project, STP files for example, are not found in the Jobs directory, Predator Virtual CNC will ask if you wish to browse for the missing files.

Delete Job

The Delete Job button deletes the currently selected Job file and certain Predator Virtual CNC data and temporary files associated with it. To delete a Job:

1. Select the Job to be deleted using the Current Job list box. If you have recently run the Job, you should make sure that all windows are closed.
2. Click the Delete Job button. The following dialog appears:
3. If you are not using the Job set-up files (STP files) for other Jobs and wish to delete them, check the 'Delete Setup Files' check box. If you do not wish to delete the set-up files, leave the check box unchecked.
4. The dialog box asks, "are you sure Y/N? If you are sure, click the 'Yes' button. If you wish to abort the operation, click the 'No' button.

When a Job is deleted, the following files are removed from your computer system:

- The Predator Virtual CNC Job set-up file with the file extension 'JOB'.
- Setup files with file extensions: 'STP', 'ST2', 'ST3, etc. Setup files may be used in more than one Job, so are deleted only if the 'Delete Setup files' check box is checked.
- Predator Virtual CNC internal 'RVP' files. These files are output by the CNC program translators and are used for producing Predator Virtual CNC models.
- Tool collision log files with the file extension 'ERR'.
- Files with the file extension 'ALL'. These files are produced when multiple CNC program files are included in a single Job. The 'ALL' file consists of concatenated 'RVP' files.
- NC program error log files with the file extension 'LOG'. These files are produced by the CNC program translator if problems are found when converting CNC program data into 'RVP' format.
- Predator Virtual CNC temporary files with the file extensions 'TB1', 'TB2',

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The Properties button opens the Machine Setup dialogs. Changes can be made to the machine settings at this point, but they will be saved only in the current STP Job files.

Axis Translations

Axis translations for this machine tool may have already been defined in Machine Setup. However, some machines have rotary tables that may be oriented to suit each job being machined. To allow for this, changes can be made to axis translations that are saved in the Job files, but not in the machine definition file.

The Axis Translations panel contains three data entry boxes that allow programmed rotary axis moves to be mapped to other axes. For example, consider a horizontal milling machine with a rotary table that can be mounted in either a 'B' or 'A' axis orientation. The CNC controller will expect the programmer to use only one axis address, say the 'B' address, to instruct the CNC controller to make a rotary move. However, if the rotary table is oriented in the machine 'A' position, we need to tell Predator Virtual CNC to model all 'B' moves as 'A' moves. To do this:

1. Select the list box adjacent to the 'B' label.
2. From the list of options, select A+. (or A- if the direction needs to be reversed).

Origin Shifts

The Origin Shift window is used to store information relating to programmed origin shifts. Origin shifts, often programmed using CNC codes G54 through G59, are defined using the following syntax:

```
G54 = 1.2 3.4 5.6
```

When entering origin shift information, it is important to separate the values by a space.

In this example, when a G54 is encountered in the CNC program, the origin is moved to co-ordinates X1.2, Y3.4, Z5.6.

In the case of a Fanuc control using extended co-ordinate systems format P1=, Predator Virtual CNC supports values of P1 to P99. For example:

```
G54.1 P1 = 1.2 3.4 5.6
```

A control using the letter address 'E' would require a Predator Virtual CNC entry in the Origin shift window of:

```
E = 1.2 3.4 5.6
```

A total of 100 origin shifts may be defined in each Job set-up.

Radius Offsets

The Radius Offset panel is used to enter cutter radius compensation offsets for each tool that requires it.

If you are programming using cutter radius compensation, you will need to tell Predator Virtual CNC the values of the compensation and where to apply them.

Often cutter radius compensation is invoked from the CNC program using a line similar to:

```
G41 (G42) D04 X20.00 Y30.00
```

Where G41 or G42 specifies the direction of the compensation, D04 indicates the CNC memory address where the value of the compensation is stored (number 04 in this case) and the X and Y values specify a normal tool move during which the compensation becomes effective.

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Machine Name
The Machine Name list box is used to select the machine to be used for the current operation in the current Job.
To change the machine being used in the current Job:

1. Click the arrow at the side of the Machine Name list box to reveal a list of saved machine definition files.
2. From the list, select the machine required.

Machine Name
The Machine Name text box shows the name of the machine tool being configured. If this is not correct, click the Cancel button, return to the Machines dialog and select the correct machine.

Machine Type
The Machine Type list box is used to select the type of machine tool being used in the current Job. Selecting the arrow at the side of the list box reveals a list of machine types available. The options are:

- VMC/V.Mill. - Vertical 3-axis milling machines and machining centers.
- VMC 4-ax. – Vertical 4-axis milling machines and machining centers.
- VMC 5-ax. – Vertical 5-axis milling machines and machining centers.
- HMC Y-Vert. - Horizontal 3-axis milling machines or machining centers where the Y-axis is vertical.
- HMC 4-ax Y-Vert. – Horizontal 4-axis milling machines or machining centers where the Y-axis is vertical.
- HMC 5-ax Y-Vert. – Horizontal 5-axis milling machines and machining centers where the Y-axis is vertical.
- HMC X-Vert. - Horizontal 3-axis milling machines or machining centers where the X-axis is vertical.
- Lathe Z Hor.- Lathes and other turning machines with 2 controllable axes where the Z –axis is horizontal.
- Lathe Z Vert. - Lathes and other turning machines with 2 controllable axes where the Z –axis is vertical.
- Mill/turn - Not used in this release.
- Mill/turn Z-Vert – Not used in this release.

Selecting a machine type affects the way further screens are laid out, the options available to you and the way Predator Virtual CNC models the Job. It is, therefore, very important to choose the correct machine type.

Save As
The 'Save as' button allows changes to be made to current Machine Configuration and for the changes to be saved as a new Machine Configuration.

Units
There are two Units check boxes, one for inch and one for metric units. You should check the units to be used with the current machine definition. If you wish to use both inch and metric units with the same machine tool, we recommend that you create two almost identical machine definition files, one for inch and one for metric use. Inch and metric units may **not** be mixed in a machine definition or Job files.

Properties

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'TB3', etc.
- Editor backup files with the file extension 'BAK'.
- Temporary files with the file extension '$$$'.

The Delete Job button does not delete CNC program files ('.NC' or other file extensions), machine set-up files ('MCH'), stock set-up files ('STK' or 'STL'); or any tool library files ('LIB').

Note: Machine set-up files, stock files and tool library files may be used in many Jobs, so delete these files only if you are sure that no existing Job requires them.

Scan CNC file
To save Job set-up time, the Scan CNC File button is used to scan the current CNC file using the CNC translator or Reverse Post (chosen by selecting an CNC controller from the Machine Setup dialog) to extract basic tool data and estimated stock size. This information is written to the current Job set-up. If some tools have been defined manually, scanning the CNC file will add those tools that do not already exist in the tool set-up. If scanned tools have the same programmed numbers as tools already in the set-up; the tools will be added using the same numbers. Before saving the set-up, the duplicate numbers must be changed or else a system error will be shown. Stock that is set up in this way will be sized according to the maximum axis travel extent in feed rate (G01) mode for each axis.

Current CNC/STP
The Current CNC/STP windows show the active CNC file and STP files.
When clicked, the arrow at the side of the CNC list box reveals all CNC program files used in the current Job. The set-up file (STP) associated with the selected CNC program is shown in the second text box.
If you wish to use information contained in another set-up file, use the Copy From button to import this information to the current set-up file.

Copy from Button
To import set-up information from another set-up file you should click the Copy from Button and then select the required STP file from the list shown. Predator Virtual CNC will retrieve the set-up information in the older file and save those details in the new STP file.

BKP (Backup STP)
When Predator Virtual CNC saves changes to the Job set-up, it automatically makes a backup copy of the original set-up files. The BKP button is used to restore this backup to the current set-up.

Cancel Job
The Cancel button will close the Jobs dialog. All changes made to the set-up will be lost.

OK Button
If you make changes to a Job set-up, the new settings are automatically saved when you click the OK button to process the Job.

CNC Program

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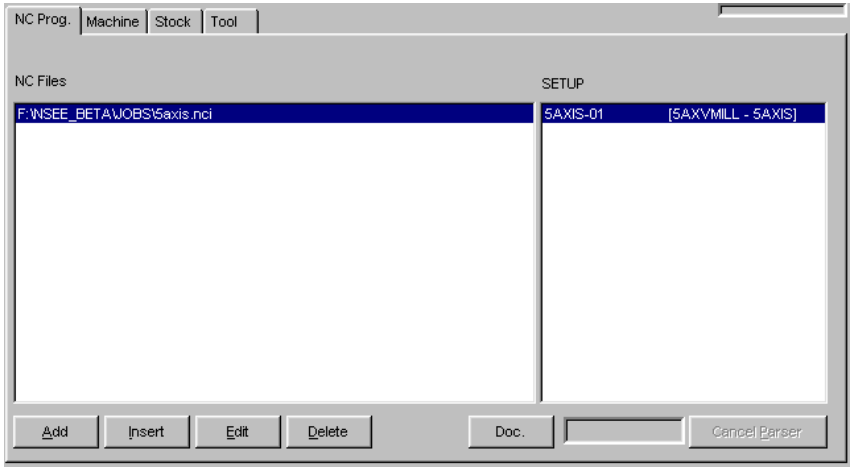
Selecting the CNC Prog. tab opens the CNC Program dialog and allows Job specific information relating to the CNC program to be entered.

CNC Files

The CNC Files window shows all CNC files, with their path, that are included within the active Job.

Setup Files

The Setup window shows the set-up file name (STP file), the machine and controller associated with each CNC file in the current Job.



Add CNC File

The Add button allows you to add or insert a CNC file to the active Job.

When using the Add button for the first time in a Job, the CNC program is added to the CNC program window. Subsequent uses of the Add button will add further CNC programs to the list. To insert a CNC program into an existing list, first highlight the CNC program below where you want the new CNC file inserted and then click the Add button. When multiple CNC files are selected, the second and subsequent CNC files may be associated with a rotation of the part and/or an origin shift. See the Stock - Rotation tab. When adding a new CNC file to the Job, Predator Virtual CNC automatically assigns a STP file name. This filename will include the name of the CNC file plus a two-digit number that indicates the sequence in which multiple STP files are created. For example, an CNC file named 'SURF.NC' will generate an STP filename of 'SURF-01.STP', if it is the first CNC program file selected in a Job set-up. Adding a second CNC file will generate a STP file named 'SURF-02.STP', etc.

> Note: The second and subsequent STP file names are based on the first STP file name, regardless of the name of the subsequent CNC files.

To change the orientation of the stock, position of stock datum and program origin for any CNC program, click on the CNC program name in the CNC files Window and change the settings for that CNC program using the controls on the

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Stock dialog. Up to 128 CNC programs may be processed in each Job.

Insert CNC File

The Insert button allows an additional CNC program to be placed anywhere within an existing list of CNC programs. To insert a new CNC program:

1. Click the CNC program description in the CNC program window above that which you want to place the new program. The program name and STP name will be highlighted.
2. Click the Insert button. A Windows browse dialog will open.
3. Click on the CNC file that you wish to insert and click Open. The new CNC program will be inserted and a setup file (STP) created using the existing Job settings.

Edit CNC File

The Edit button launches the default editor (as defined in settings) and loads the current CNC file into it. To edit a file:

1. Click the CNC program in the CNC Files window.
2. Click the Edit button.
3. Edit the file using the editor and save it. It is very important that you save and exit the editor before trying to process the Job.

Delete CNC Program File

The Delete button is used to deselect a CNC file from the current Job. The file itself is not deleted from the computer system, but it ceases to be included in the Job set-up.

Job Document File (DOC)

Clicking the DOC button launches the default editor and creates a document file with the name of the Job but with the file extension DOC. This document file can be used to make notes relating to the current set-up.

Cancel Translator

The Cancel Translator button will stop the translation of the CNC program and set-up data into RVP format.

Saving & Processing a Job

When the OK button is clicked, the Job set-up is saved. If the Job has not been processed before, the CNC program(s) and other set-up data defined in the Job set-up are translated into Predator Virtual CNC ready for processing. If the Job has been processed before, the message "Re-Process?" is displayed. Clicking 'Yes' re-processes the Job with the latest tooling, stock and machine settings. Clicking 'No' uses the prior tooling, stock and machine settings.

Machine

The Machine tab reveals the Machine dialog. This area is used to specify the machine that will be used to process the active CNC program file as highlighted in the CNC Prog. Dialog.

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