PROBE-IT!

by: Crafty CNC

A Probing, Reverse Engineering, and CMM Wizard for Mach 3

Contents

1. Introduction

Thanks for your interest in Probe-It!, a wizard add-on for the popular Mach3 CNC control software. I began writing Probe-It! (almost 2 years ago… yes I'm slow) to be able to provide functionality in Mach3 I didn't see provided by any other options, even after much searching in forums and on the web...

Probe-It! provides some of the same general functionality as found in other existing probing macros and wizards such as:

- General/simple measurements
- Locating positions of corners, edges, and centers of bores
- Setting origins on pieces to be machined easily (edge finder functionality)

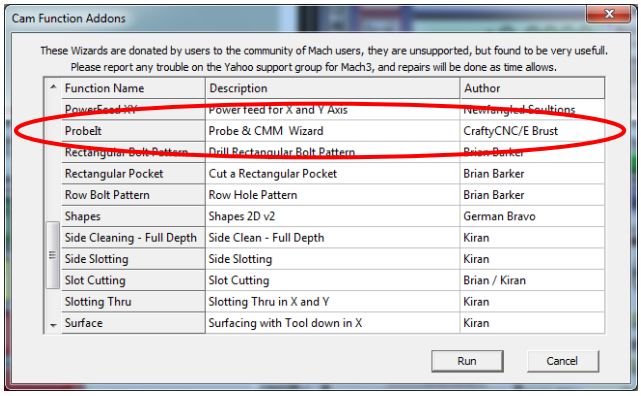
Probe-It! also provides some features useful for measuring and reverse engineering, such as:

- Ability to 'calibrate' the probe tip (calibration accounts for errors in probe tip deflection, and backlash within reason)
- Ability to probe in any sort of vector in the X-Y plane, with result corrected by calibration data
- Automatic 2.5D perimeter tracing (not a bed of nails approach in 3D space, which doesn't provide an accurate 'outline' of 2D parts)
- Ability to record data direct to a DXF or CSV file for later analysis or usage in a CAD program
- Logic added to probing routines to detect a 'hit' or a 'miss'
- Ability to probe parts/features not square to the table (part rotation)
- Auto Z up/down as part of basic x-y probing routines

The goal of Probe-It is to provide a useful tool with functionality I couldn't find anywhere else. Probe-It! doesn't include other probing features already existing or available, for example the 3D 'bed of nails' approach which is in a Wizard shipped with Mach3, is not found in Probe-It!.

1.1. Installation

Probe-It! is provided in either a .ZIP archive, or in a self extracting executable. The extracted *ProbeIt* folder (and all its contents) should be dropped into the ->Mach3->Addons directory. Restart Mach3 (if it was open), and go to the 'wizards' menu and select 'pick wizard'. You will find ProbeIt listed for use:



1.1.1. Demo LimitationsLicense File

Probe-It! initially installs in a *DemoMode* to allow you to try its functionality and use it for limited amounts of data collection. Limitations in Demo Mode are as follows:

- Probe Calibration can be used for 8 probe events and then it will turn off
- CSV and DXF recording will be limited to 8 probe events in the BasicXY probing and then will turn off
- CSV and DXF recording on the Perimeter Probing routine will be limited to 50 points maximum and the routine will stop and save your data.
- Other than the limit of data collection, the full functionality is available for you to use/test! The routines are not crippled in any way beyond number of points recorded.

By closing and reopening Probe-It! wizard, the demo mode will reset and you can use it again for the same limited time. Or you can use the basic functionality as much as you like in DemoMode, the wizard will not quit working or time out. If this works for your needs, you don't need to purchase a license to keep using the wizard.

If you plan to use ProbeIt for significant reverse engineering or a business use, purchase of a license file will remove all limitations, and you will be able to record as many points to a CSV or DXF file as you wish.

1.1.2. License File

If you purchase a License file, simply place the file you receive via email or download into the ProbeIt directory and open the Probe-It! wizard. The intro page should now show a status of 'Licensed', and all restrictions are removed.

1.1. Warning, Legal disclaimers and all that good stuff….

I have attempted to make Probe-It! as fool proof as I can with regards to the probing routines. However Probe-It ties in to operate your CNC machine via Mach3 and its settings. The setup of Mach3 (and of the probe input signal into Mach3) is the responsibility of you, the user to setup. You the user assume full responsibility for checking and testing all signals, the setup of your CNC machine/XML file, and also for familiarizing yourself with the probing routines and usage of Probe-It!. I recommend probing at items that are not clamped to the table as you learn and test, so if something goes wrong, you are less likely to destroy your probe.

Probe-It! is a tool, it takes instructions from you the user (via DRO inputs and button clicks) and then provides commands to Mach3 via macros to move/probe, and then collects and saves the data to file. If the user positions the probe incorrectly, or issues a G0 command that plows the probe through the part, that is on the user and Probe-It! will not prevent this. If you issue a mistaken command, remember to use the EStop, feedhold, or even hitting 'ESC' key will usually cancel an in process probing event.

A final reminder, machining is dangerous. Even though Probe-It! is just a 'probing' utility and won't be used during a machining process, it is important the user operates the machine in a safe manner and with as much care as if machining! Never place your hands in the working envelope of the machine while probing. Always turn off or disconnect the spindle motor power source when a touch probe is mounted. Do not probe at excessive federates. And always use common sense and be safe. By using Probe-It!, you agree to accept all liability for damage or harm that could be caused during use of this software, both to you and your equipment. If you disagree, please do not use this software.

2. Intro Page

The intro page contains no functional buttons or probe routines, and is meant to be a reminder to check your probe before proceeding with any probing on the following pages. It is the default page that appears when starting the wizard.

2.1. Probe Test LED

The large LED in the center of the page will turn on when your probe is properly connected and setup, and you manually trigger the probe with your hand. Please verify the functionality and setup every-time you use the Wizard. There is an error in your setup if the LED does not turn on, or if it defaults to ‘Probe Active’ and turns off when you manually activate the probe.

2.2. License status

The LED and a label in the lower left of the Intro Page will show the status of the Wizard.

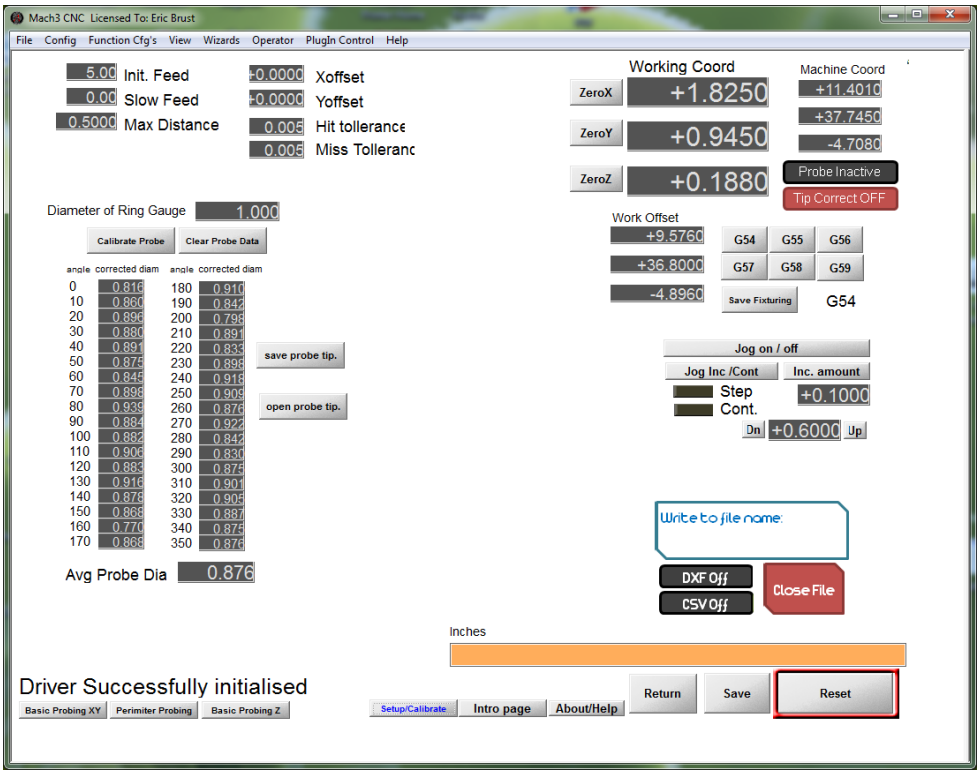
If ‘Demo Mode’ is displayed, All features and functions of the Wizard are fully functional, with the following exceptions:

1) You will be limited to 8 probe points with the tip correction turned on.
2) You will be limited to 8 probe points recording to either DXF or CSV output files on the ‘Basic Probing XY’ page.
3) You will be limited to 25 probe points recording to either DXF or CSV output files on the ‘Perimeter Probing’ page.

When you have reached the maximum number of allowed points, you will still be able to probe, but recording to CSV and DXF are disable and tip correction is disabled until the wizard is closed and restarted.

If you have purchased a license file (thank you for your purchase and support!), copy it to your ProbeIt folder. You should now have ‘Licensed’ shown, and all limitations will be lifted.

3. Setup Page



The Setup Page is primarily for the purpose of performing probe tip calibration and generating a table of ‘corrected tip diameters’ at various probing angles. The corrected values account for correcting the following errors while probing:

1) Probe tip trigger travel and deflection
2) Backlash and mechanical errors
3) Leadscrew inaccuracy (within the range where the calibration was performed)

NOTE: It should be noted that because the probe’s contribution may not be identical in all directions, you should make an attempt to reinstall your touch probe in the same orientation every time (For example, install the probe so the lead always exits in the same direction.).

There are a few other settings that are found on this page as well.

3.1. Probe Calibration Buttons and LED

3.1.1. Calibrate Probe

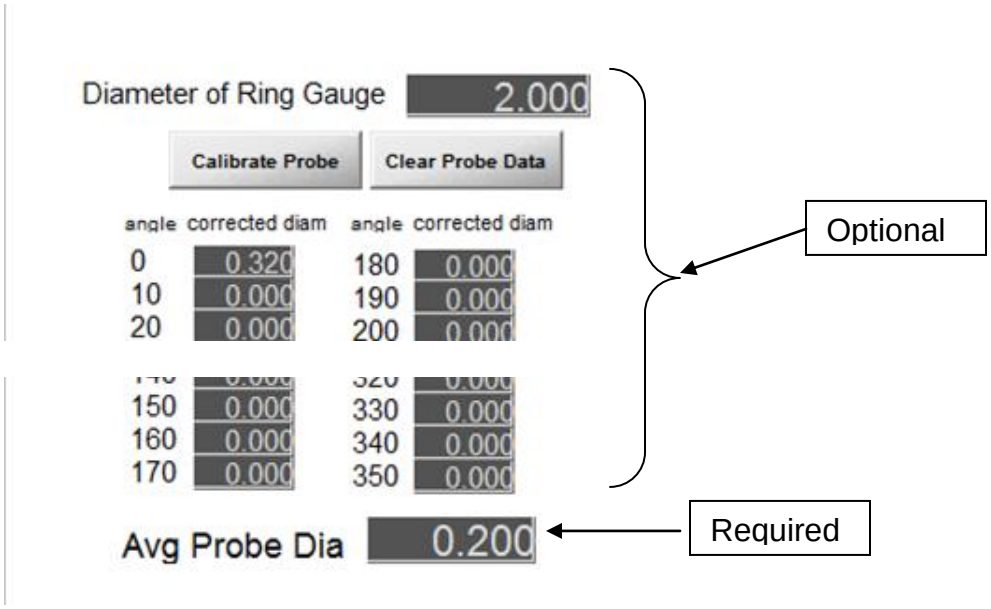
Calibration of the probe should be done

- initially at first setup,
- every time you install a new tip or spring in your probe,
- if you crash your probe

- if you make some other significant change to your Mach3 setup (such as backlash settings).

This is accomplished by using a master 'ring' gauge of known inner diameter. Enter the actual inner diameter of the gauge to be probed and enter the actual measured probe tip diameter in the "Avg Probe Dia" DRO. Move the probe tip to approximate center of the bore and hit "Calibrate Probe" button. The routine will first probe to the approx center of the bore, and then probe around the ID at 10 degree increments to build up a table of 'tip corrections'. Tip corrections are made under the assumption that 1) the bore is exactly the diameter entered in the 'ring gauge' DRO, and the bore is perfectly round.

If the table started out empty, the routine will automatically run twice to further reduce the error. After the routine runs, the table will contain 36 corrected tip diameter values, and the 'Avg Probe Dia' value will be adjusted from the originally entered value to be the mean value of the 36 corrected values.



NOTE: You are not required to run the calibration routine to do any of the probing routines, but you must have a value entered in to the 'Avg Probe Dia' DRO to be used as a default.

3.1.2. Clear Probe Data

Pressing the 'Clear Probe Data' sets the calibration table to all zeros. This is useful for if you have just made a change and will be recalibrating from scratch.

3.1.3. Save Probe Tip

Following calibration, pressing this button will prompt for a file name to save the tip data into. This is usefull if you have a couple of different tips or touch probes you alternate between, and allows you to reload the saved calibration data.

3.1.4. Open Probe Tip

Pressing this button will prompt for a file name of saved tip data to open. You will have to manually type in the filename you had previously saved (there is no file browsing). After hitting enter on the filename dialog, the saved values will be populated into the 36 calibration DROs as well as the 'Avg Probe Dia" DRO.

3.1.1. Probe Correction LED

Pressing this LED will enable or disable tip correction based on the correction table. It is recommended to leave it on once you have run tip calibration and the table is populated with proper correct values. The LED should not be on if the tip table is out of date or incorrect (ie, you just swapped a tip but did not recalibrate). If the Probe correction is off, the 'AVG Probe Diameter' DRO value is used for all probe events.

3.2. Settings DROs

3.2.1. Init. Feed

This is the initial feed rate in native units (in/minute if working in inches, mm/min if working in mm) that the probe travels at during probe operation. This setting appears on all other pages, but is found here for convenience of setting during the calibration procedure. Recommended value: Start slow and increase within your comfort and accuracy level.

3.2.2. Slow Feed

This is the secondary feed rate in native units (in/minute if working in inches, mm/min if working in mm) that the probe travels at during a slow probe operation. The probe travels at initial feed, then backs off and re-probes at this slower feed value. Leaving 'slow feed' set to 0 results in no secondary slow probe event. Recommended value: 1-5 in/minute (25-125 mm/min)

3.2.1. Max Distance

The ***max distance*** parameter is the distance in native units (inch or mm) that the probe will travel towards the surface. This value is used along with the ***hit tolerance*** value to determine if the surface was hit or missed.

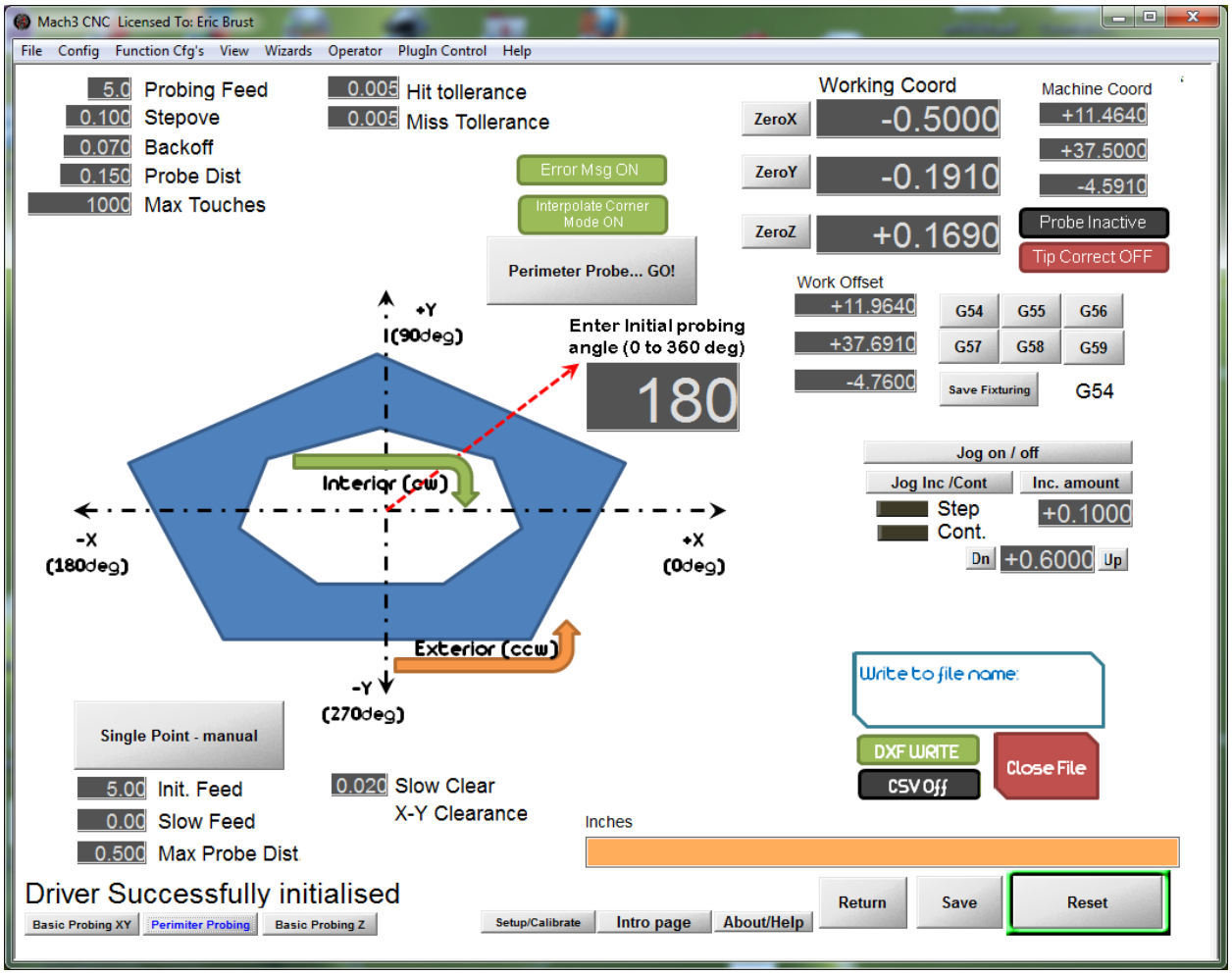
3.2.2. Hit Tolerance

The ***hit tolerance*** value is used in the probing routines to determine if the probe made contact with an object or if it missed, specifically on probing moves where the expected result is to hit an object. If the probe travels the full 'max probe distance' minus the ***hit tolerance*** value, it assumes that an object was 'missed' on a probing move, which is an error. Recommended value: .001-.005" (.02-.12mm)

3.2.3. Miss Tolerance

The ***miss tolerance*** value is used in the probing routines to determine if the probe made contact with an object or if it missed, specifically on probing moves where the expected result is to miss an object (ie, a clearance move). If the probe travels less than the full 'max probe distance' minus the ***miss tolerance*** value, it assumes that an object was 'hit' on a clearance move, which is an error. .001-.005" (.02-.12mm)

4. Perimeter Probing Page



The Perimeter Probing Page runs a probing routine that automatically follows the exterior shape of an object and records the touched points, connected by lines, direct to a DXF file, or provides tabular X,Y,Z data in a CSV file. The perimeter probing routine attempts to always probe perpendicularly to the surface of the object, and continually adjusts probing angles to attempt to do so. By probing 'square' to the surface and using the lookup table of probe tip corrections from the setup page, the perimeter can be accurately reproduced.

The routine will work on both external an internal perimeters. It should be noted the routine always works in the same general 'direction', so when probing external shapes, it will travel around the part in a counter clockwise fashion. When working on an interior pocket, it will travel around the part in a clockwise fashion. The diagram on the page is meant to be a reminder of this.

4.1. Buttons

4.1.1. Perimeter Probe -> GO!

This button starts the routine. To perform perimeter probing, enter required values in the settings DROs and set option LEDs, move the probe tip to approximate starting location near the perimeter of the object (at proper depth), and press the button. The routine will continue traveling around the perimeter of the item until max number of hits is reached, or the edge is lost in error.

The routine may be interrupted at anytime as necessary by pressing 'ESC' button. You may than reposition the probe tip and restart as necessary while recording the same CSV or DXF file. The file will wind up with a 'break' in the curves recorded, which may be joined in a CAD program as part of post processing cleanup.

4.1.1. Single Point - Manual

This button performs a single probe event in a vector direction dependent on the 'initial probing angle' DRO. This is handy for collecting a few points around an object into a DXF or CSV file. It is also handy if you are probing a complex object that gives the perimeter routine difficulty in certain areas, you can go back after the fact and manually record a few points into your file before closing/saving it.

4.2. Settings DROs

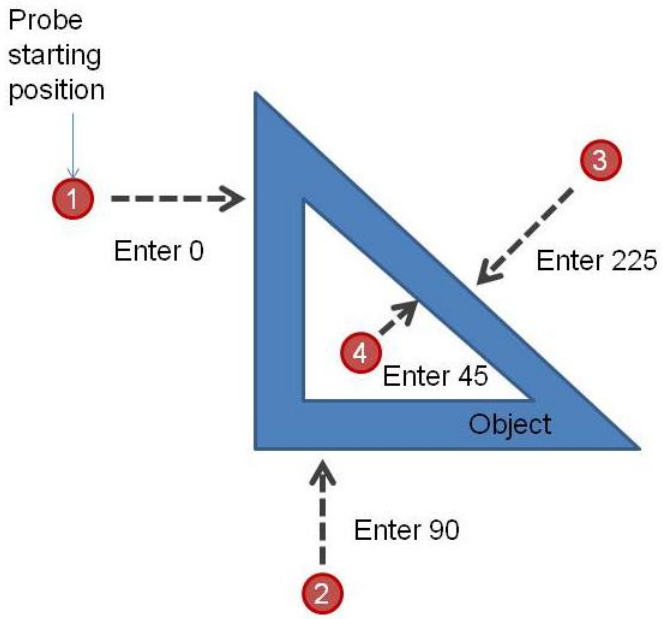
4.2.1. Initial Probing Angle

The ***initial probing angle*** value is the angle in degrees to define the initial probing vector direction, as related to the current tip position and the machines +X axis. This value allows you to start (or restart) the probing routine on any side of the object as necessary, or manually record a single point in that direction.

Imagine the vector of probe movement to be defined by a polar coordinate system, with the origin at the current probe position, and 0 degrees pointing towards +X, and positive 90 degrees pointing towards +Y.

Some examples to define the usage:

1. To probe in +X direction (if your probe is located on the 'left' side of object outer perimeter looking down at table), enter a value of 0.
2. To probe in +Y direction (if your probe is located on the 'bottom' side of object outer perimeter looking down at table), enter a value of 90
3. To probe in –X and -Y direction towards a face that is at approx 45 degrees (if your probe is located on the 'top right' side of object outer perimeter looking down at table), enter a value of 225.
4. To probe in +X and +Y direction towards a face that is at approx 45 degrees (if your probe is located on the 'bottom left' side of object inner perimeter looking down at table), enter a value of 45.



4.2.2. Probing Feed

This is the feedrate that the probing operations will be performed at. The perimeter routine only probes at a single federate, one touch per hit (ie, no backoff and slow re-touch). You may adjust this value in the process of perimeter probing, without interrupting or pausing the process. This allows you to set a fast federate for non-complicated areas that don't require absolute precision. An you may also slow down the probing federate when approaching complicated corners and features, or if the desire is to improve the accuracy of recorded points (less overtravel in recorded values).

4.2.3. Stepover

The ***stepover*** parameter is the distance in native units (inch or mm) that the probe points are separated by around the perimeter. Actual probe points will not be exactly at the stepover distance unless probing along a straight line. The Stepover translates into the number of points required to be sampled around the perimeter. A smaller stepover results in more samples and a finer resolution of surface measurement. This value cannot be adjusted without pausing the routine and restarting the measurement.

4.2.4. Backoff

The ***backoff*** parameter is the distance in native units (inch or mm) that the probe backs away or clears from the surface to prepare for the next hit.

4.2.5. Probe Distance

The ***probe distance*** parameter is the distance in native units (inch or mm) that the probe will travel from the backoff point towards the surface. This value is used along with the ***hit tolerance*** value to determine if the surface was hit or missed. The probe distance value should always be set to a value greater than the backoff value. As a suggestion, make the ***probe distance*** greater than ***backoff*** by an amount of 1-3 probe tip diameters as a suggested value.

4.2.6. Max Touches

The ***max touches*** parameter is the number of touches the perimeter probing routine will collect before it stops. This allows you to enter a large number of touches and walk away, as the routine will just continue around the perimeter till number of hits is reached. You can estimate the number to use for max touches by dividing approximate perimeter length of the object to be measured by the ***stepover*** value and adding ~20%.

In **DEMO MODE**, the max touches parameter is automatically capped to 50 points. After that limit is reached, the routine will stop and save your file, and you will have to restart the wizard to run the routine again.

4.2.7. Hit Tolerance

The ***hit tolerance*** value is used in the probing routines to determine if the probe made contact with an object or if it missed, specifically on probing moves where the expected result is to hit an object. If the probe travels the full 'max probe distance' minus the ***hit tolerance*** value, it assumes that an object was 'missed' on a probing move, which is an error. Recommended value: .001-.005" (.02-.12mm).

This DRO is repeated on this page for convenience of adjusting it without going to setup page.

4.2.8. Miss Tolerance

The ***miss tolerance*** value is used in the probing routines to determine if the probe made contact with an object or if it missed, specifically on probing moves where the expected result is to miss an object (ie, a clearance move). If the probe travels less than the full 'max probe distance' minus the ***miss tolerance*** value, it assumes that an object was 'hit' on a clearance move, which is an error. .001-.005" (.02-.12mm).

This DRO is repeated on this page for convenience of adjusting it without going to setup page.

4.3. Settings LEDs

4.3.1. Error Message ON/OFF

This button is used to toggle if error messages will be displayed or not. Error messages ON results in a pop-up message box that interrupts the probing process to notify user if

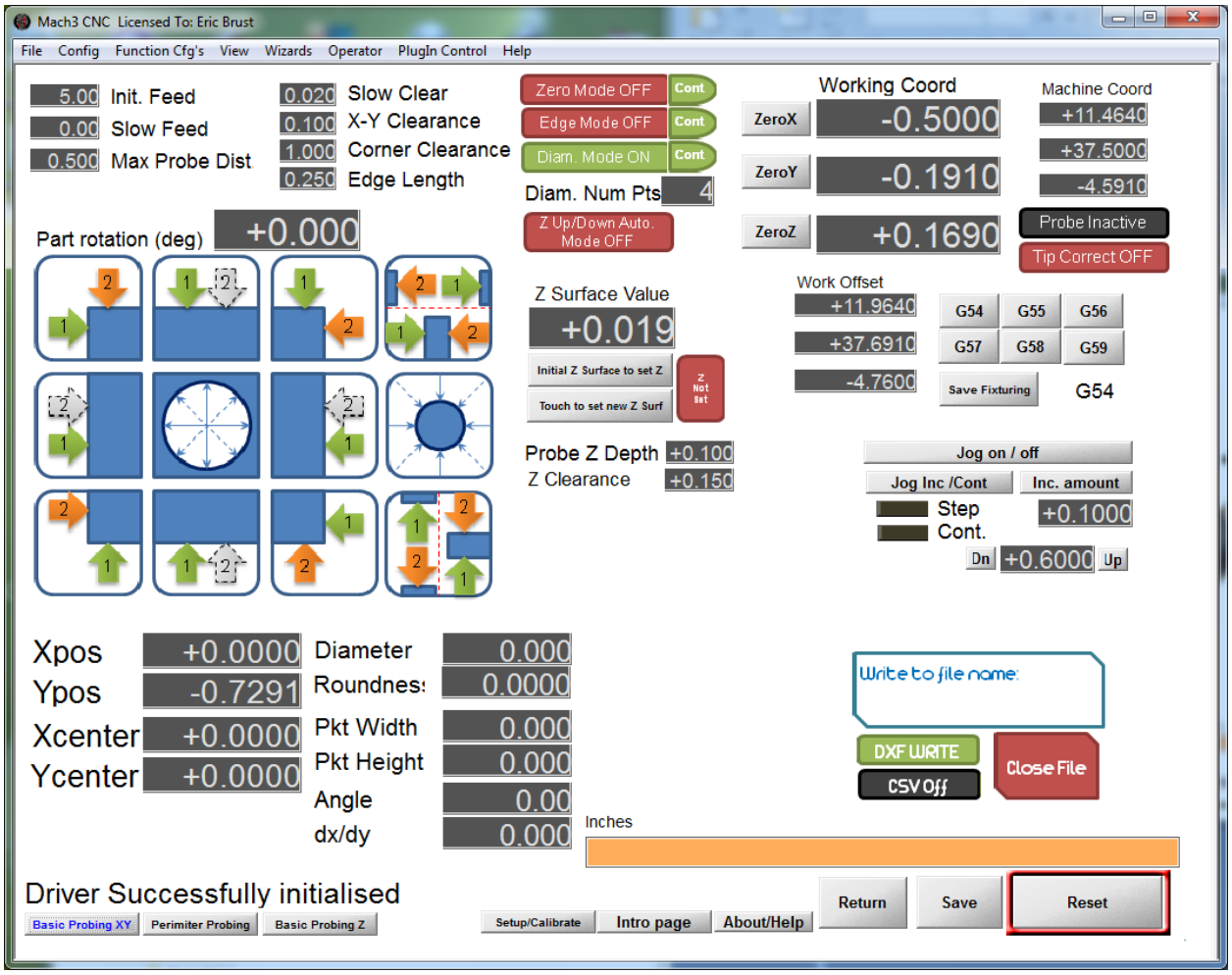
a) Probe missed target when it would be expected to have touched. Clicking OK causes the routine to change assumed direction and look for the part again as if rounding an exterior corner.
b) Probe hit something on a 'clearance' move. Clicking OK causes the routine to change assumed direction and work around the perimeter as if rounding an interior corner.
c) Probe routine has lost track of the surface. Routine will try to locate within a couple more moves, and then stop.

These messages may be useful to keep on while learning how the routine works, and this also provides a pause for the user to assess the probing routine. On an error, the routine pauses until the message box is clicked 'OK'. If turned off, the routine will just continue probing along without pause or notification.

4.3.1. Interpolate Corner ON/OFF

This button is used to toggle if corners will have intersection points estimated and plotted into the DXF or CSV data. If left off, the DXF/CSV will only contain actual touch points, which may leave exterior and interior corners under defined. Turning this on will result in the insertion of an estimated corner point on abrupt corner changes using the assumption that the corner is square (90 degrees). While not entirely correct in all instances, this will provide better representation in the DXF file that may be corrected with a CAD software in post processing the data.

5. Basic Probing XY Page

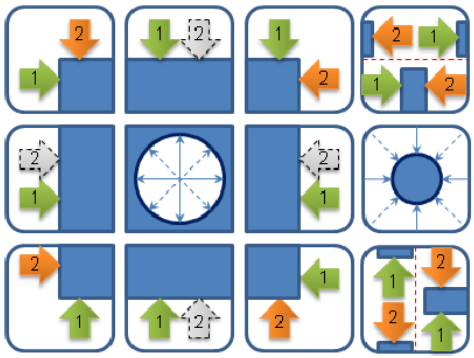


The Basic Probing XY page can serve a few purposes depending on your task at hand. For general probing and setup work, it can be used to locate edges, corners, bore or post centers, mid points of slots, etc. , and set the coordinates appropriately.

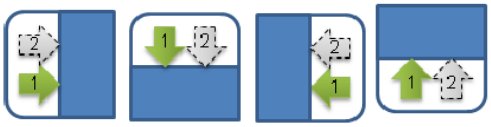
It will also report measurements such as point location (edge/corner), diameter/roundness (bore/post), pocket width/height, and angle (edge).

If you are reverse engineering or measuring a part, this page is a compliment to the perimeter probing routine. With the DXF/CSV recording enabled, the probing routines will record the data into either a CSV or DXF file. In fact, you can jump between the perimeter probing and standard XY probing and record all geometry in a single file.

5.1. Probe Routine Buttons



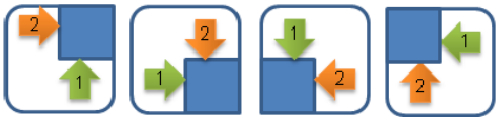
5.1.1. Probe Side / Edge



Pressing this button will prompt for a file name of saved tip data to open. You will have to manually type in the filename you had previously saved (there is no file browsing). After hitting enter on the filename dialog, the saved values will be populated into the 36 calibration DROs as well as the 'Avg Probe Dia" DRO.

This probe event is not modified by part rotation value. This probe event can be run with auto up/down turned on.

5.1.2. Corner



Pressing this button will prompt for a file name of saved tip data to open. You will have to manually type in the filename you had previously saved (there is no file browsing). After hitting enter on the filename dialog, the saved values will be populated into the 36 calibration DROs as well as the 'Avg Probe Dia" DRO.

This probe event is modified by part rotation value. This probe event can be run with auto up/down turned on.

5.1.3. Probe Bore

The probe bore button probes the ID of a bore or a rectangular pocket. The probe tip should be located near the approximate center of the bore in the XY plane.

If the Diam. Mode LED is off, the routine will perform a basic routine locate the center of a bore or rectangular pocket, probing in +/- X and +/-Y only. If DXF or CSV recording is

on, it will prompt user to confirm if it is a round bore or rectangular pocket being probed so that the appropriate geometry is recorded to file. Depending on the response, either a circle or a rectangle will be plotted into the DXF.

If the Diam Mode LED is on, the routine will perform a basic routine to first locate the center of a round bore, and will then sample the ID for as many points is entered in the 'Diam Num Pts' DRO. This will return a measured diameter and roundness as a result, and draw a circle into the DXF file.

Warning: Do not probe a rectangular pocket with Diam Mode LED on, the routine may run probe into walls.

This probe event is modified by part rotation value. This probe event can be run with auto up/down turned on.

5.1.4. Probe Boss

The probe boss button probes the OD of a post. The probe tip should be located to the approximate center of the bore in the XY plane, above the post a small amount.

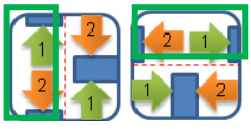
If the Diam. Mode LED is off, the routine will perform a basic routine to locate the center of a boss or rectangular post, probing in +/- X and +/-Y only. If DXF or CSV recording is on, it will prompt user to confirm if it is a round or rectangular post being probed so that the appropriate geometry is recorded to file. Depending on the response, either a circle or a rectangle will be plotted into the DXF.

If the Diam Mode LED is on, the routine will perform a basic routine to locate the center of a round bore, and will then sample the OD for as many points is entered in the 'Diam Num Pts' DRO. This will return a measured diameter and roundness as a result, and draw a circle into the DXF file.

Warning: Do not probe a rectangular post with Diam Mode LED on, the routine may run probe into walls.

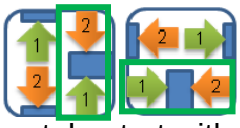
This probe event is modified by part rotation value. This probe event can be run with auto up/down turned on.

5.1.5. Probe Slot (inner)



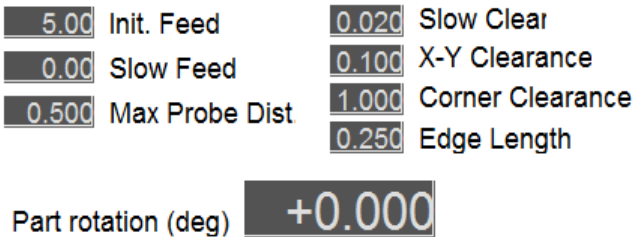
To probe the inner edges of a slot, start with the probe approximately centered within the slot. The probe will proceed to make moves to probe both sides. Following completion, the probe will return to the exact center of the slot. Width or Height and center position will be returned. This probe event is modified by part rotation value. This probe event can be run with auto up/down turned on.

5.1.6. Probe Ridge (outer)



To probe the outer edges of a ridge or tab, start with the probe approximately centered above the tab/ridge. The probe will initially travel down to find the top of the tab/ridge, and will then proceed to make moves to probe both sides. Following completion, the probe will return to the exact center of the tab/ridge above the top surface. Width or Height and center position will be returned. This probe event is modified by part rotation value. This probe event cannot be run with auto up/down turned on, and if it is on when this probe event is initiated, it will turn it off.

5.2. Settings DROs



5.2.1. Init. Feed

This is the initial feed rate in native units (in/minute if working in inches, mm/min if working in mm) that the probe travels at during probe operation. This setting appears on all other pages, but is found here for convenience of setting during the calibration procedure. Recommended value: Start slow and increase within your comfort and accuracy level.

5.2.2. Slow Feed

This is the secondary feed rate in native units (in/minute if working in inches, mm/min if working in mm) that the probe travels at during a slow probe operation. The probe travels at initial feed, then backs off and re-probes at this slower feed value. Leaving 'slow feed' set to 0 results in no secondary slow probe event. Recommended value: 1-5 in/minute (25-125 mm/min)

5.2.1. Max Probe Distance

The ***max distance*** parameter is the distance in native units (inch or mm) that the probe will travel towards the surface. This value is used along with the ***hit tolerance*** value to determine if the surface was hit or missed.

5.2.2. Slow Clear

The ***slow clear*** value is used to determine how far to back off of the touched surface after an initial feed rate probe before running the slow federate probe event. Enter value in native units (inch or mm).

5.2.3. X-Y Clearance

The ***X-Y clearance*** value is used to determine how far to back off of the touched surface following the completion of a probe event. Enter value in native units (inch or mm).

5.2.4. Corner Clearance

The ***corner clearance*** value is used to determine how far to move to get around a corner. Enter value in native units (inch or mm). You will need to position your probe closer to the corner than the value entered in ***corner clearance*** to assure it makes it around the corner without hitting.

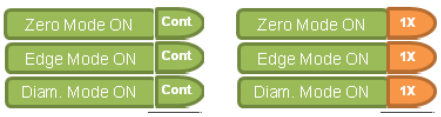
5.2.1. Edge Length

The ***edge length*** value is used to determine how far to move along an edge to take the second point. Enter value in native units (inch or mm). You will need to enter a smaller value in ***edge length*** than the overall edge length being measured to assure it does not miss the second touch.

5.2.1. Part Rotation

The ***part rotation*** value is used to modify the orientation of all probing events (except side/edge type) in a rotated manner. Use this if your part is not square to the table and/or you have rectangular pockets or corners to be found and measured that are not 'square' to the table. Rotation value to be entered in angular degrees of rotation, positive value for rotation ccw. Assume the +X axis is 0 degrees, and the angle of part's 'bottom edge' is relative to the X axis.

5.3. Settings LEDs



5.3.1. Zero Mode ON/OFF

This button is used to toggle if the probe point (edge, corner, center, etc) is used to set the X/Y DROs to Zero for work setup. The 'Cont. / 1X' toggle button is used to determine if it sticks as a continuous mode, or turns the mode off after completion.

5.3.2. Edge Mode ON/OFF

This button is used to toggle if the sides will be treated as a single point (edge mode off) or as two points to measure an angle (edge mode on). The 'Cont. / 1X' toggle button is used to determine if it sticks as a continuous mode, or turns the mode off after completion.

5.3.3. Diameter Mode ON/OFF

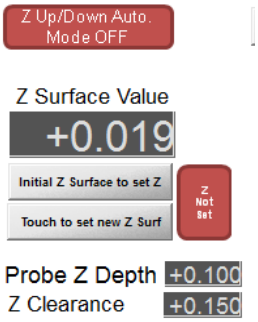
This button is used to toggle if the bore or post will be treated as a simple center find routine (diam mode off) or as multiple points to measure an accurate diameter (diam mode on). The 'Cont. / 1X' toggle button is used to determine if it sticks as a continuous mode, or turns the mode off after completion.

Warning: Do not probe a rectangular post with Diam Mode LED on, the routine may run probe into walls.

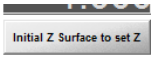
5.3.1. Z Up/Down Auto Mode ON/OFF

This button is used to toggle if the routines are setup to automatically plunge the probe tip to a set depth, perform the operation, and then retract the probe tip to a safe clearance height automatically. See section 4.4 below. This mode is handy for if you have numerous features such as bores, to locate in a plate. This allows you to jog to the appropriate starting point, hit one probe button, and after completion, jog to the next point without having to jog Z axis up and down manually.

5.4. Auto Up/Down Features



5.4.1. Initial Z Surface to set Z Button



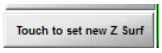
This button is used to set the Z axis DRO to a value representing a desired surface of your object being probed (top surface, etc) . The value is set by what is entered into the 'Z Surface Value' DRO. Move the probe manually over surface to be set before using button.

The button works in conjunction with an LED indicating if a surface is set:

- If the LED indicating a surface is already on (surface has been set prior), the LED will turn off.

- If the LED indicating a surface is not on (surface not set), the routine will probe to down to a touch, set the Z axis DRO to the value set in the 'Z Surface Value', and then retract to the clearance defined in the 'Z Clearance' DRO.

5.4.2. Touch to set new Z Surf Button



This button is used to set the 'Z Surface Value' DRO to a new value representing by probing a desired surface of your object being probed (flange, alternate level, etc) . Move the probe manually over surface to be set before using button.

This button requires that an initial surface was set using the 'Initial Z Surface to set Z' button has been used prior and the surface set LED is on, or else the routine will not run.

5.4.3. Surface Set LED

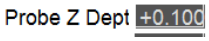
This LED is used as a 'safety' and must be turned on by first probing an initial surface using the 'Initial Z Surface to set Z' button before the auto up/down routines will function. This is used to ensure that the surface and probing depths are 'known' so safety checks can be used to prevent crashing the probe.

5.4.4. Z Surface Value DRO

This DRO contains the value that represents the top surface of the item being probed. Initially, you will enter a value to define the surface, and press the 'Initial Z Surface to set Z' button. This will probe down to touch the surface, and transfer the value you entered in the Z Surface DRO to the Z Axis DRO.

The 'Touch to set new Z Surf' button is used to set a new level on the part being probed by actually measuring off. Pressing this button will probe down to touch a new surface, and transfer the value from the Z Axis DRO into the Z Surface DRO.

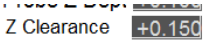
5.4.5. Probe Z Depth DRO



Enter the depth (in native units) that you want the probe to go below the set surface for probing. Do not set any deeper than the length of your overall probe tip, or you will crash the probe body into the part. It is recommended to set Probe Z Depth to approximately the same value as the probe diameter as a starting point.

As an example, if you set the top surface of your part to Z=1.000 inches, entering a value of .100 into Probe Z Depth will cause the probe to auto move to Z=.900 to take a measurement.

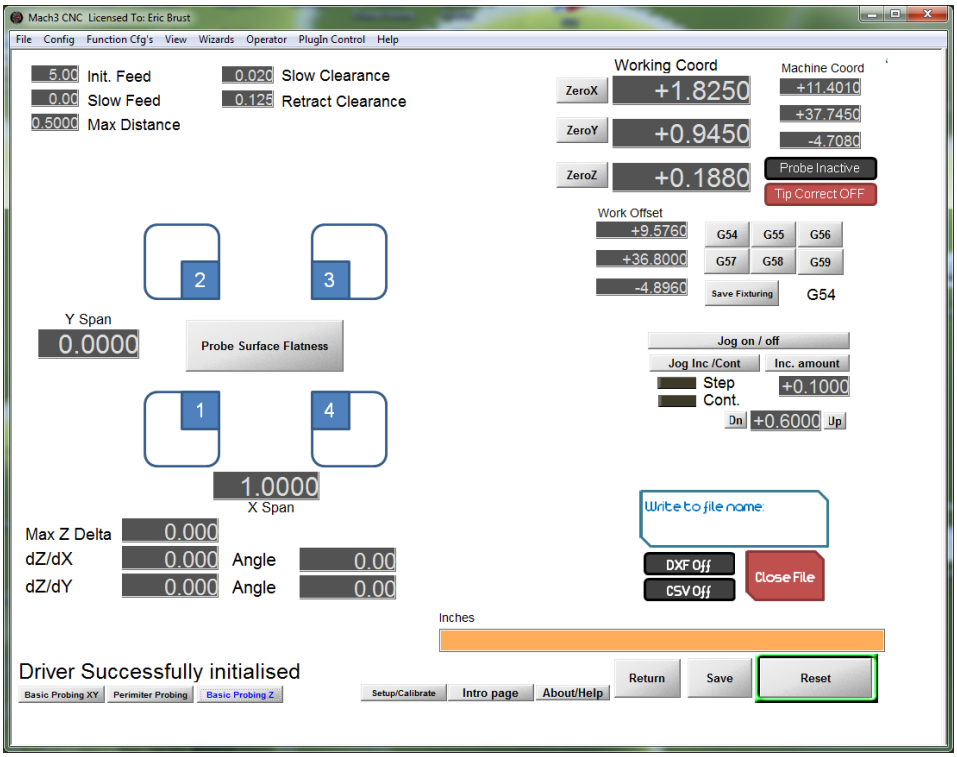
5.4.1. Z Clearance DRO



Enter the clearance (in native units) that you want the probe to go above the set surface following probing (so you may then manually jog around without hitting object).

As an example, if you set the top surface of your part to Z=1.000 inches, entering a value of .150 into Z Clearance will cause the probe to auto move to Z=1.150 after the probe event completes.

6. Basic Z Surface Page



The Basic Z Surface page is only meant to provide a very basic check of how flat the surface of your object is relative to the X-Y plane of the machine. You can probe in the X only, Y only, or an X-Y square pattern to determine if your part is 'level' and or of a constant thickness. It is useful to determine if your part is bowed or tipped in your fixturing for operations that require a very flat and level surface, such as engraving.

6.1. Probe Z Surface Button

Pressing this button will run the Z Surface probe routine. Position the probe in the lower left corner of the area you want to probe, a small distance above the surface. You must enter a distance in either X span, Y span, or both X & Y span DROs. The routine will probe the first point in the spot where the probe was manually positioned, and then will move in a delta X or Y location based on the span DROs.

6.2. Settings DROs

6.2.1. X Span

This value is the distance in native units (in or mm) between probe events in the X axis. If Y Span is left as 0, the routine will only record 2 points and provide a dz/dx along the X axis.

If Y is not 0, the routine will probe in both X and Y directions.

6.2.2. Y Span

This value is the distance in native units (in or mm) between probe events in the Y axis. If X Span is left as 0, the routine will only record 2 points and provide a dz/dy along the Y axis.

If X is not 0, the routine will probe in both X and Y directions.

7. Data Recording and Saving

Probe-It! will record probing data to either a CSV (comma separated value) format that can be imported by Excel, or into a DXF format. You can also record both formats simultaneously if you wish. **Files are stored in the 'output' folder of the 'ProbeIt' directory (ie, C:\Mach3\addons\ProbeIt\output\ ).**

The files recorded are unit independent and unit-less. If you record to a CSV, values of positions and sizes are just reported as numbers in your native units. Same goes for the DXF format. Geometry is recorded into the files in based on numbers recorded in your native format. If you probe a bore that is one inch (25.4 mm), depending on if you have Mach3 set in metric or SI units, you will either record a circle with a diameter of 1.000 or 25.4. You can then convert the file by scaling if you use direct in a CAM or CAD file.

7.1. Format selection

You activate recording to a file by selecting and turning on the CSV button, the DXF button, or both at the same time.

You will be prompted to enter a file name for your recording. If you select both CSV and DXF, you will record the file name to both formats.

Once the LED for either DXF or CSV is on and a file name is entered, you don't need to do anything but probe the part, all data is recorded as you go until you close the file.

7.2. Data Save / Close File

As long as you have set a file name to record to, you will keep recording and appending data to that file. This allows you to jump from page to page within the wizard and continue recoding to a single file. You can be on the XY page, probe a bore and record

it to a file, then switch to the Perimeter probing page, and record the exterior perimeter. In addition, if you have an issue in the middle of probing, you can always hit 'escape' to stop, reposition, and restart a probing event and it will keep recording to the file. Note that you may get some extra data you'll have to manually delete from your DXF later, but you won't have to paste together several DXF files to reverse engineer a part!

After you have completed all probing of a part, press the ***'Close file'*** button. **Note that once you close a file, you cannot add to it. If you re-enter the same name into the 'write to file name' box, you will over-write any existing file.**

7.1. Working with CSV data

The CSV file format is a tabular format that can be opened and imported into Excel. The best usage for this may be basic CMM measurement of features on a part, such as recording diameters and locations of a series of holes for inspection purposes.

The format looks like the following, and provides a description of the probe event along with the numerical data

Example bore measurement:

Measuren	Xpos1	Ypos1	Zpos	Xpos2	Ypos2	XCenter	YCenter	Pocket W	PocketHe	Angle	Edge Delt	Diameter	Roundnes
Round Bore			-1.49618			0.000153	-1.57E-05	1.7008	1.70065			1.699819	0.000927

Example perimeter data

Measurement	Xpos1	Ypos1	Zpos	Xpos2	Ypos2	XCenter	YCenter	Pocket W	PocketHe	Angle	Edge Delt	Diameter	Roundness
Perimeter Point	10.62676	-1.09057	0.387803										
Perimeter Point	10.55183	-1.01756	0.387803										
Perimeter Point	10.56654	-0.98764	0.387803										
Perimeter Point	10.59601	-0.94302	0.387803										
Perimeter Point	10.59156	-0.92435	0.387803										
Perimeter Point	10.53148	-0.86334	0.387803										
Perimeter Point	10.4884	-0.82976	0.387803										
Perimeter Point	10.44664	-0.85935	0.387803										
Perimeter Point	10.36606	-0.8481	0.387803										
Perimiter Segment	10.36316	-0.84595	0.387803	10.35795	-0.83705								
Perimiter Segment	10.35795	-0.83705	0.387803	10.34988	-0.82581								
Perimiter Segment	10.34988	-0.82581	0.387803	10.34574	-0.81905								
Perimiter Segment	10.34574	-0.81905	0.387803	10.33865	-0.80971								

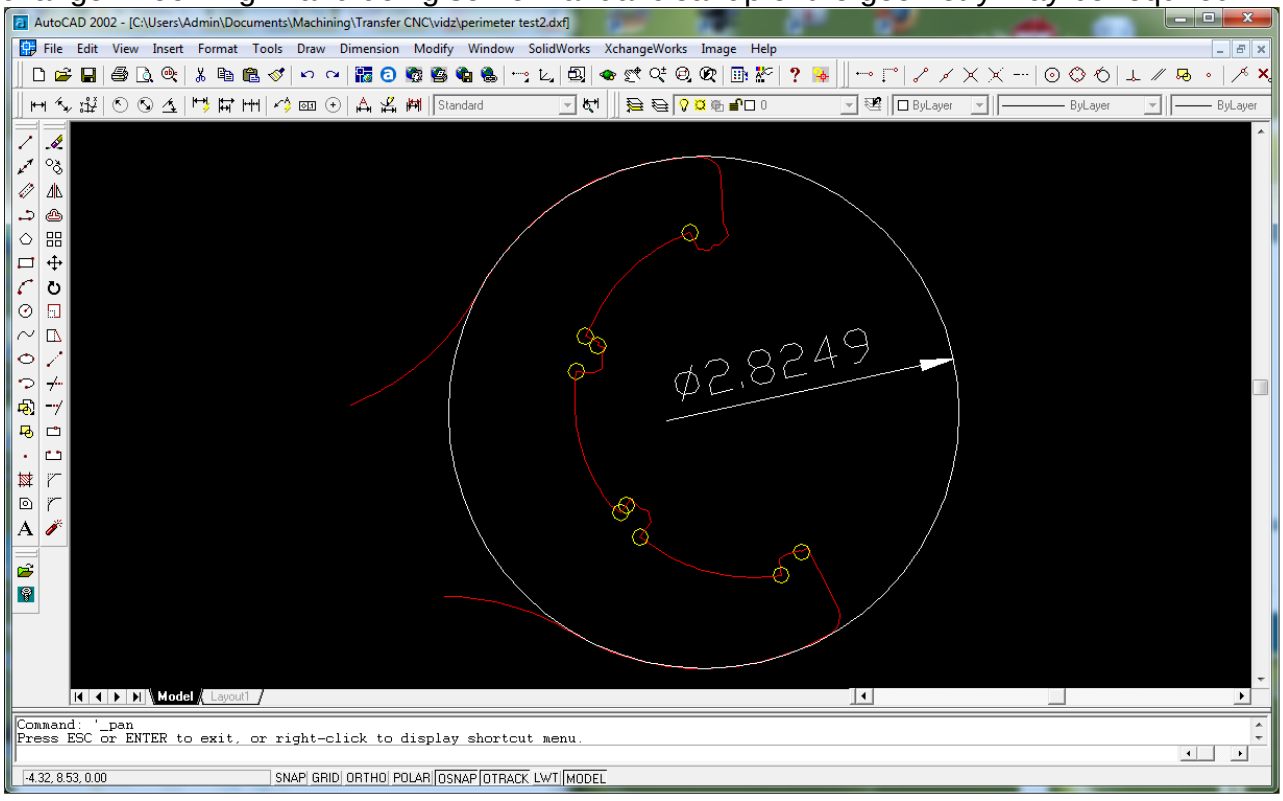
Note that segments are defined as short lines with a start point (Xpos1, Ypos1) and an end point (Xpos2, Ypos2).

7.1. Working with DXF data

The DXF file format is standard and should be able to be opened by any program that can read/import a DXF. Recorded geometry will be drawn as points, lines, circles, etc in the file.
Perimeter probing primarily creates a series of line segments that represent the perimeter of the part. A start and end point of a line segment are actual locations probed and recorded along the perimeter of the part (as adjusted for probe tip, etc.). Ie, the lines run along the true perimeter of the part, the lines do not represent the center points of the probe ball where it hit. Occasionally during the perimeter probing routine, if a 'corner' is found or missed during a direction change, the routine will guess and interpolate a corner point. These points are highlighted as small yellow circles. The center of the circle is the guessed location. You may need to do some cleanup work on these locations.

The DXF geometry can be used to construct better CAD geometry, or be joined into polylines and smoothed, or imported directly into a CAM program to be used to create cutting paths. Measurements can be made by snapping circles and dimensions to endpoints and curve fitting also.

Below is an example of a perimeter recording of an ER collet wrench. The red perimeter is made up of many small short segments, but the 'diameter' can be easily measured by constructing a circle using 3-point definition, and snapping to the segments as an example. You can also note the locations of the yellow circles indicating 'guesses'. These often happen when the geometry has an abrupt direction change. Zooming in and doing some manual cleanup of the geometry may be required.



By zooming in on the geometry, you can see how it is made up of short segments. Segments in ACad show the two endpoints and a center point. The center-point is not recorded from Probe-It, but rather is how ACad shows the segments: