Verisurf Reverse™

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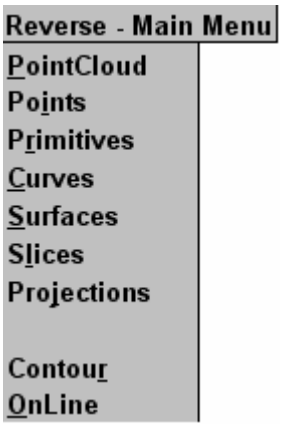
Verisurf Reverse is composed of a complete set of dynamic geometry-creation commands. These commands are designed for use when your data-collection device is connected to your Verisurf computer. All geometry can be created dynamically, as you measure your workpiece. Geometry can be created offline, after all data has been collected.

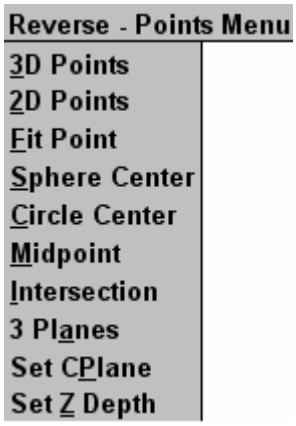
Primitive geometric definitions, such as point, line, circle, slot, plane, etc. are provided to define the different features of your part. All of the commands previously mentioned are part of the Verisurf Measure package, and are duplicated in this package. In addition to the Measure definitions, Reverse provides advanced geometric definitions, such as curves and surfaces. This chapter explains the use of these commands.

Here is the **Reverse - Main Menu**. A description of each option is on the following pages. The Pointcloud selection is in a different manual named Reverse Pointcloud. This manual will discuss all the other options.



Points

This command provides you with many different methods of creating a point in your CAD system. Here is the menu and a description of each option:



3D Points

All points generated by the data collection device are created relative to the current device alignment, regardless of the current construction plane and Z settings.

2D Points

All points generated by the data collection device are created relative to the current construction plane, construction origin, and current Z setting.

Fit Point

A quantity of points is sampled from the data collection device and the centroid of the sampled points is created as a fit point.

Sphere Center

A quantity of points is sampled from the data collection device. A sphere is calculated to a “best fit” condition through the sampled points. The centerpoint of the calculated sphere is created.

Circle Center

A quantity of points is sampled from the data collection device. A circle in the current construction plane is calculated to a “best fit” condition through the sampled points. The centerpoint of the calculated circle is created.

Midpoint

A quantity of points is sampled from the data collection device. A midpoint is calculated through the sampled points.

Intersection

Four points are sampled from the data collection device. A line is calculated through the first two points and a line is calculated through the last two points. A point is created at the intersection of the two lines.

3 Planes

Points are collected to develop 3 planes. A point is created at the intersection of the 3 planes.

Set CPlane

This command is used to set the current working construction plane. This will prompt the user to measure a plane.

Set Z Depth

This command is used to set the current working Z depth relative to the current construction plane and construction origin. This will prompt the user to measure a single point.

Reverse – Input Menu

When your data collection device is on-line, selecting any of these point creation methods brings up the **Reverse – Input Menu**.

Its options are:

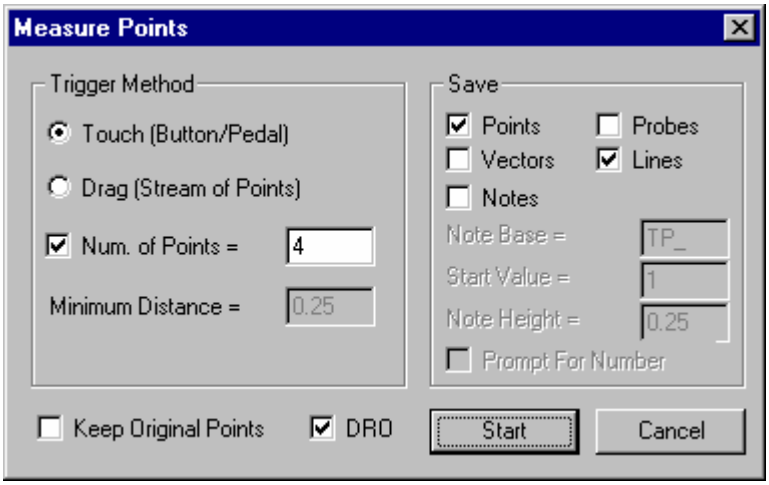
Save Point
Click this option to collect a point at the current location of the probe.

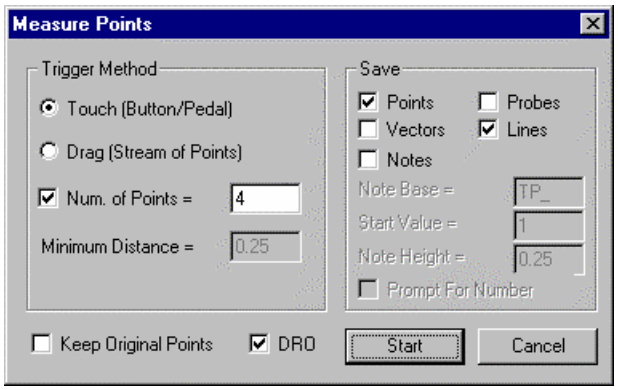
Undo
Use this feature to remove the last collected point. Continued use of this option will remove other points, in the reverse order in which they were created. If a feature, such as a circle has been drawn

from the collected points, **Undo** will only erase the last drawn feature.

Settings

The **Settings** option brings up the **Measure Points** control panel.





Trigger Method

Touch

The **Touch (Button/Pedal)** trigger method indicates to Verisurf that your data-collection device has some type of switch that you will press or activate when you want to collect a point. For example, a standard probe has a switch built-in. Deflection of the probe causes Verisurf to collect a point at that position. Most of the articulating arm data-collection devices have a button near the probe, which the operator can press when point collection is desired.

Drag (Stream of Points)

Most data-collection devices have the ability to output a constant stream of positional data to the Verisurf computer. Verisurf can constantly read the positional data and record

points, each time the data collection device moves the distance specified with **Minimum Distance** setting. This type of trigger method is most commonly used where a solid or hard probe is attached to the data-collection device.

Number of Points =
This setting indicates to Verisurf the number of points to collect for the current measurement session. Check this box and use the corresponding text box to enter the desired number of points. This feature works for both the trigger and drag methods of data collection. If the switchbox is not checked, Verisurf will continue to collect points for the current definition until you select **Done** from the **Measure - Input Menu**.

Minimum Distance
This is the shortest 3D distance that is allowed between points. Verisurf will not store a point unless the probe is at least this distance from the last collected point. This setting is used in connection with the **Drag (Stream of Points)** setting.

Keep Original Points
With this box checked, the locations of the collected points will remain on the screen after the geometry is drawn.

DRO
With this feature enabled, a Digital Read Out of the probe location is displayed in its own window.

Save Points
When this check box is activated, Verisurf will create a point entity in the database. This point will be saved with the currant main attributes such as color, level etc.

Save Vectors
Select this check box to create a line entity in the database. This line represents the direction of the probe shaft or laser beam direction. This line will be saved with the current main attributes color, level etc.

Save Probes
This option draws a circle at the measured point. The radius of this circle is equal to the probe radius. The circle will be saved with the current main attributes color, level etc.

Save Lines
This connects lines between the measured points, as each new point is measured. This line will be saved with the current main attributes color, level etc.

Save Notes
Select this check box to cause Verisurf to save note entities at the point locations. This note will be saved with the currant main attributes color, level etc.

Note Base =
This string of characters is inserted at the beginning of the text created for saved notes. It serves as a label to describe the number that succeeds it.

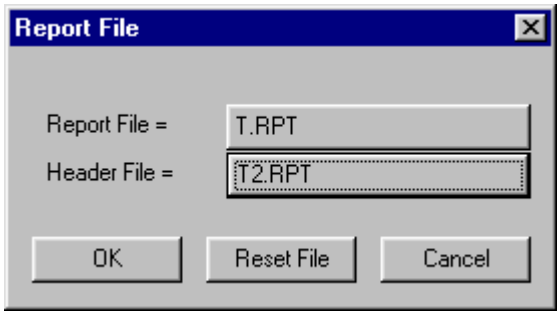
Start Value =
This integer value is the number that is placed after the base name in the first note. It serves as a way of consecutively numbering the notes. With the creation of each new note, its value will be incremented by “1. If the value is set at “0”, no numbers are added to the note base.

Note Height =
This is the physical height of the notes that are created at the point locations.

Prompt For Number
If this check box is selected, Verisurf will prompt you for the note number (value) each time a note is to be saved.

Start button
Clicking the **Start** button will begin the measuring process.

Setup File



The **Setup File** option is used to specify the name of the Report and Header files that will be generated.

After clicking the button for Report or Header file, you can type a file name or select an existing file on your computer.

Reset File Button is used to clear out the Report file and adds the header file as a template.

Send to File
Use this option to send the last measured results to a report file. The measurements will be appended to the report.

Center
This command repositions the graphics screen with the current data-collection device position at the center of the screen.

This can be useful for larger CAD models where you work with smaller areas and you do not have the entire model on the screen.

Simply press the 'C' key, or click on the menu item with the mouse and Verisurf will perform the repositioning of the screen.

Done
Selecting **Done** ends the point measuring process.

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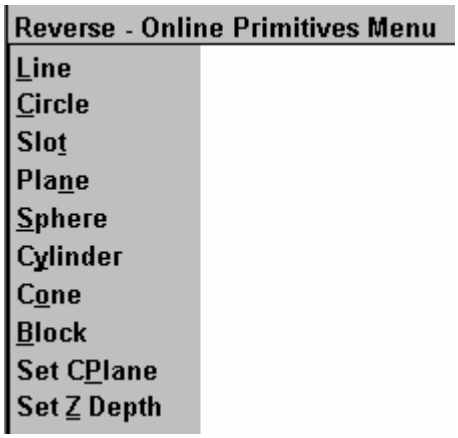
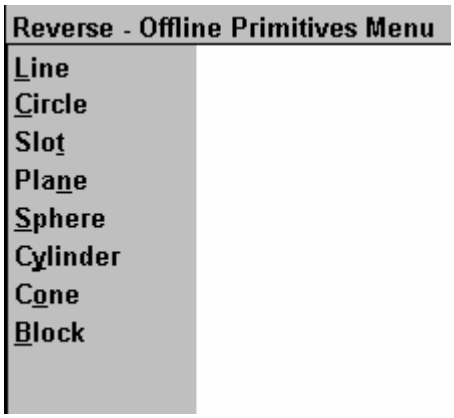
Primitives

The **Reverse – Online/Offline Primitives Menu**(s) provide commands for the creation of lines, circles, etc.

Here are the **Reverse – Online/Offline Primitives Menu(**s) and a description of each command:





Notice that the menu ion the left is labeled “Online”. When your device is “Offline”, you will see a similar menu. The on l\y difference is that the **Set Z Depth**and **Set Z Plane** commandd are omitted from the “Offline” menu.

The Reverse-Input Menu
When your device is on-line, selecting any of the primitive’s creation options causes the **Reverse - Input Menu** to be displayed.

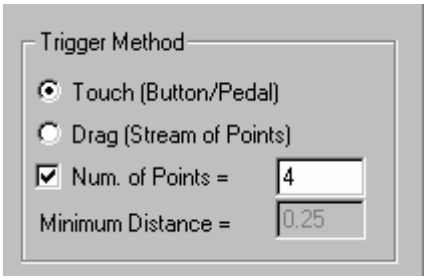
Save Point
Clicking this option will collect a point at the current location of your data collection device.

Undo
Use this feature to remove the last collected point. Continued use of this option will remove other points, in the reverse order in which they were created. If a feature, such as a circle has been drawn from the collected points, **Undo** will only erase the last drawn feature.

Settings
Each type of geometry, in the **Measure Online Primitives Menu**, has a control panel that you open with the **Settings** command. Settings that are unique to each primitive will be discussed in the section pertaining to the creation of that geometry type.

The Trigger Method options are the same for all primitives.

Trigger Method
Touch
The **Touch (Button/Pedal)** trigger method indicates to Verisurf that your data-collection device has some type of switch and that you will press or activate when you want to collect a point. For example, a standard probe has a switch built-in. Deflection of the probe causes Verisurf to collect a point at that position. Most of the articulating arm data-collection devices have a button near the probe, which the operator can press when a point collection is desired.



Drag (Stream of Points)
Most data-collection devices have the ability to output a constant stream of positional data to the Verisurf computer. Verisurf can constantly read the positional data and record points, they are collected using the Minimum Distance too separate each measured point. This type of trigger method is most commonly used where a solid or hard probe is attached to the data-collection device.

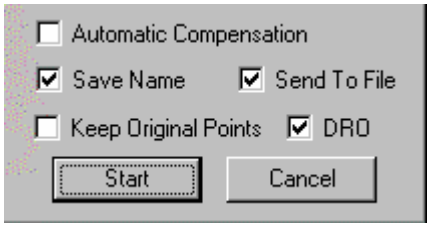
Number of Points =
This setting indicates to Verisurf the minimum number of points to collect for the current measurement type before automatically creating the desired entity and beginning the collection of points for the next entity of the current type. Check this box and use the corresponding test box to enter the desired number of points. This feature works for both the trigger and drag methods of data collection. If the switchbox is not checked, Verisurf will continue to collect points for the current definition until you select **Done** from the **Measure - Input Menu**.

While collecting points to define a line, this value can be set to two or greater, for a circle, three or greater, for a sphere, four or greater. When Verisurf has collected the required number of points, the feature type is best fit and its geometry is automatically created. Data collection then begins for the next entity.

The following settings are also common to the control panels for all of the primitives.

Automatic Compensation
Check this box to subtract the radius from or add the probe radius to a measured point. Probe compensation is determined by the direction in which you pull the probe away from the measured surface.

Keep Original Points
With this box checked, the locations of the collected points will remain on the screen after the feature is calculated.



Send to File
This automatically sends measured results to the report file. The report file is specified with the **Setup File** option in the **Measure - Input Menu**.

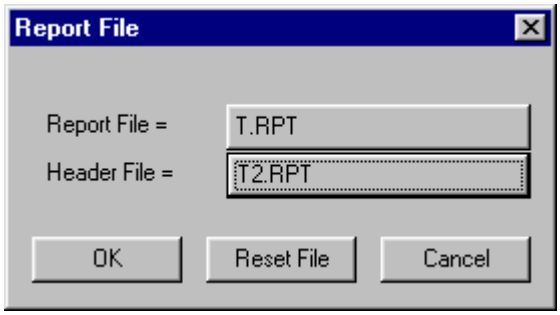
Save Name
By checking this, you will get a note created at the center of the measured geometry that describes it's primitive type and the consecutive number of each entity created.

DRO
With this feature enabled, a Digital Read Out of the probe location is displayed on in its own window.

Setup File
The **Setup File** option is used to specify the name of the Report and Header files that will be generated.

After clicking the button for Report or Header file, you can type a file name or select an existing file on your computer.

Reset File Button is used to clear out the Report file and adds the header file as a template.



Send to File
Use this option to send the last measured results to a report file. The measurements will be appended to the report.

Center
This command repositions the graphics screen with the current data-collection device position at the center of the screen.

This can be useful for larger CAD models where you work with smaller areas and you do not have the entire model on the screen.

Simply press the 'C' key, or click on the menu item with the mouse and Verisurf will perform the repositioning of the screen.

Done
Selecting **Done** ends the Primitive creation process.

Line

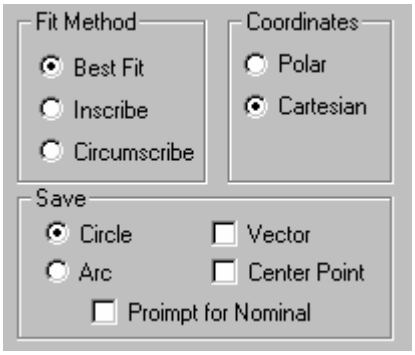
A quantity of points is sampled from the data-collection device. A line is calculated to a "best fit" condition through the sampled points. Note that this command is affected by the construction plane and Z settings.

Circle

A quantity of points is sampled from the data collection device. A circle is calculated to a "best fit" condition through the sampled points.

Note: This command is affected by the construction plane and Z settings.

After selecting the **Settings** command, there are options to **Best fit**, **Inscribe**, and **Circumscribe** circles.



After you click **Start,** you can begin collecting points on the circle. Once the circle is created, Verisurf displays the XY coordinates of the circle centerpoint, the diameter and radius of the circle, the roundness of the circle and the number of points from which Reverse solved for the circle.

Save Circle
This always solves for and creates a circle from the points created.

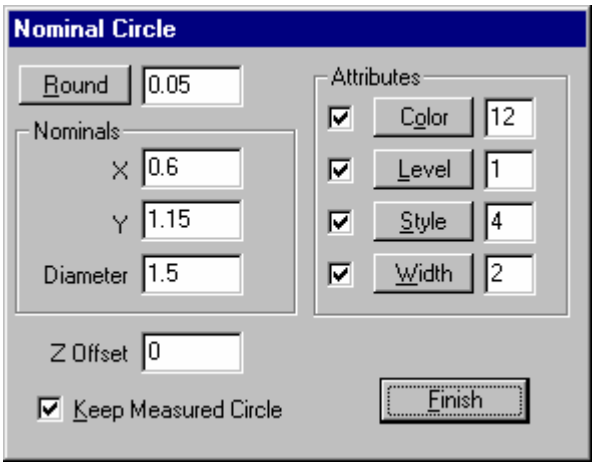
Save Arc
Solves for and creates and arc when the collected points represent less than 270 degrees of the circle.

Save Vectors
Select this check box to create a line entity in the database, after enough observations have been collected. This line represents the direction from the collected point to the data-collection device.

Save Center Point
Displays and saves a point at the center of the circle.

Send to File
This sends the XY coordinates of the circle centerpoint, the diameter and radius of the circle, the roundness of the circle and the number of points from which Reverse solved for the circle to the file specified with the **Setup File** command in the **Reverse – Input Menu**.

Prompt for Nominal
The option causes the **Nominal Circle** box to be displayed after each circle is measured. This feature is useful for reporting true position between the two circles.



The nominal values are rounded according to the figures to the right of the **Round** button. You can change the number to any faction. After making these adjustments, you click the **Round** button to recalculate the nominal values. You can also override the nominal values by typing in the **X**, **Y** or **Diameter**.

The circle can be created at a different point on its Z depth by typing a positive or negative number in the **Z Offset** box.

When the **Keep Measured Circle** is not checked, the measured circles are not created when you click the **Finish** button. This is useful for reverse engineering to rounded values.

Attributes
Attributes of the nominal circle can be changed to be different than the measured circle when the box to the left of each button is checked and changed.

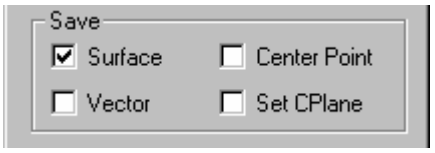
Slot

Points are collected from the “arc” at one end of the slot. A second set of points is then collected from the “arc” at the opposite end of the slot. Two arcs and two lines are created to represent the slot. Once the slot is created, Verisurf displays the XY coordinates of the slot center point, the width, and the length of the slot.

Plane

A quantity of points is sampled from the data collection device. A plane is calculated to a “best fit” condition through the sampled points. Note that the construction plane does not affect this type feature. Once the plane is created, Verisurf reports the XYZ coordinates of the plane center point, the normal vector of the plane, the total flatness of the plane, and the angle of the plane relative to the XY plane.

Settings
Surface
Select this option to create the surface of the calculated plane. If **Surface** isn't checked, only collected points and results will be displayed.



Vector
Draws a vector to the surface normal of the plane at the center point.

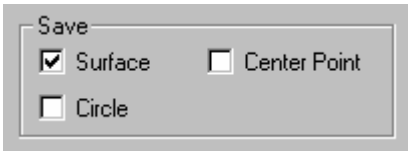
Center Point
Draws a point at the calculated center of fitted plane.

Set Cplane
When the **Set Cplane** switch is active, Verisurf will set the current working construction plane and Z depth to be equal to the measured plane.

Sphere

A quantity of points is sampled from the data collection device. A sphere is calculated to a "best fit" condition through the sampled points. Once the sphere is created, Verisurf displays the XYZ coordinates of the sphere center point, the diameter and radius of the sphere, and the sphericity of the sphere.

Settings
Surface
Draws the surface of the sphere.



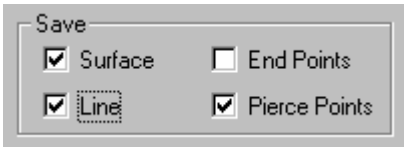
Circle
Draws a full circle that represents the circumference of the sphere.

Center Point
Draws a point at the calculated center of the sphere.

Cylinder

A quantity of points is sampled from the data collection device. When measuring on-line, you will be prompt to take points at each end of the cylinder. A cylinder is calculated to a "best fit" condition through the sampled points.

Settings



Surface
Draws the surface of the cylinder.

Line
Draws a centerline for the cylinder.

End Points
Creates points at the ends of the centerline.

Pierce Points
Creates a point where the cylinder pierces a surface.

Cone

A quantity of points is sampled from the data collection device. When measuring on-line, you will be prompted to take points at each end of the cone. A cone is calculated to a “best fit” condition through the sampled points.

Block

You are prompted to measure a three-point plane, one point for the height, two points to define the main axis, a point for the width, a point on any side and one point for the length. Once the block is created, Verisurf displays the length, width and height of the block. This is an on-line feature.

Set Cplane

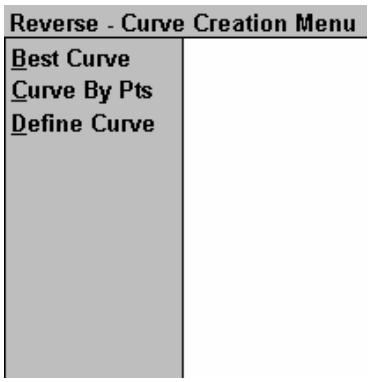
This command is used to set the current working construction plane. You will be prompted to measure a plane. This is an on-line feature.

Set Z depth

This command is used to set the current working Z depth relative to the current construction plane and construction origin. You will be prompted to measure a single point. This is an on-line feature.

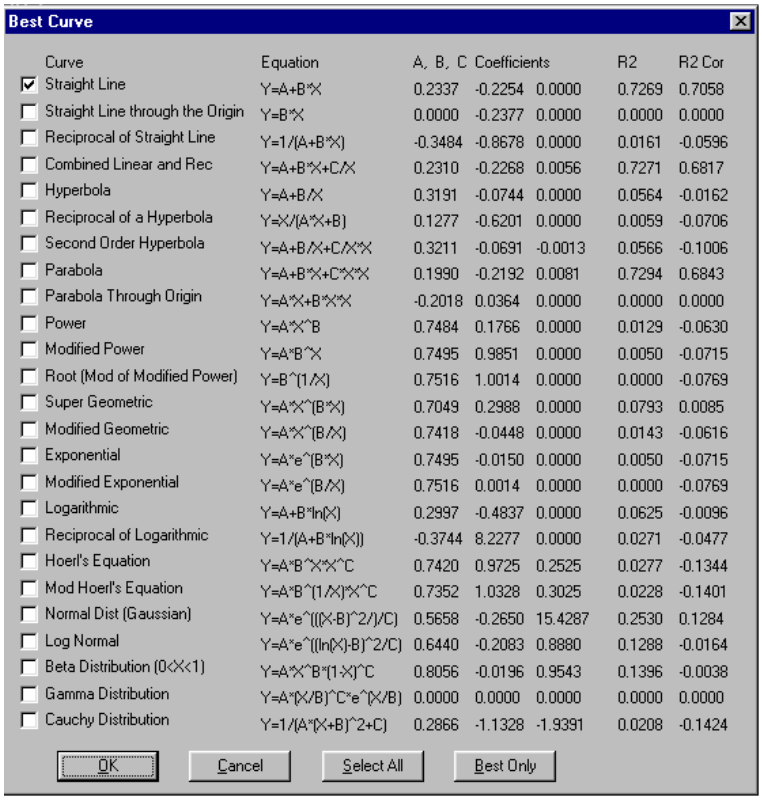
Curves

This command provides you with many different methods of creating curves through points in your database. Here is the **Reverse – Curve Creation Menu** and a description of each option:



Best Curve

The best-curve routine allows you to select existing points in the database and fit curves through them using a variety of mathematical formulas. Select the desired points and you will be presented with the following dialog box:

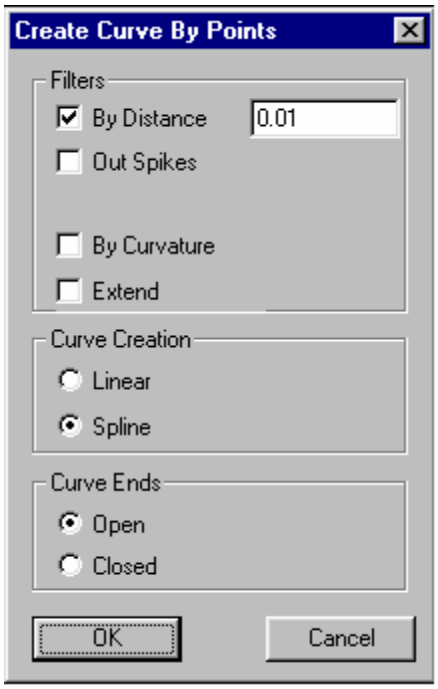


Reverse will automatically calculate all of the curves on this menu and select the one that creates a curve with the minimum chordal deviation. You have the option of selecting a different curve formula or even multiple formulas, to produce the curve(s) that you desire.

Select **OK** to create the indicated curve(s), or press **Cancel** to return to the **Reverse - Curve Creation Menu.**

Curve by Pts

This routine will create a curve through the selected points. After selecting the points, click the **Done** command. Several options become available to control the shape of the curve. These options are explained below.



***Filters*: By Distance**
This setting causes Reverse to consider the distance between each set of two consecutive points in the data set and to split any set of two points that are within the specified distance to each other (0.01 in this example). This reduces the number of points in the data set and causes the curve to become smoother.

Filters: Out Spikes
This setting causes Reverse to consider the angle formed by each set of three consecutive points in the data set and to eliminate the middle point if the angle is greater than the specified angle.

Filters: Break At Spikes
This option is only available when the **Out Spikes** check box is activated**. Break At Spikes** will perform the same evaluation as **Out Spikes,** but instead of removing the middle point of the calculated angle, Reverse will create two curves, keeping the middle point as the endpoint of each curve.

Filters: By *Curvature*
This option causes Reverse to consider the slope of the generated curve and eliminate individual points that cause the curve to change direction. If only one point is involved in the direction change then this option takes effect. If more than one consecutive point causes the direction change then the curve will follow the points.

Filters: Extend
This option is intended for some of the curve slicing routines and appears here because the dialog box is common for several routines. A description of this option appears in the manual where it applies.

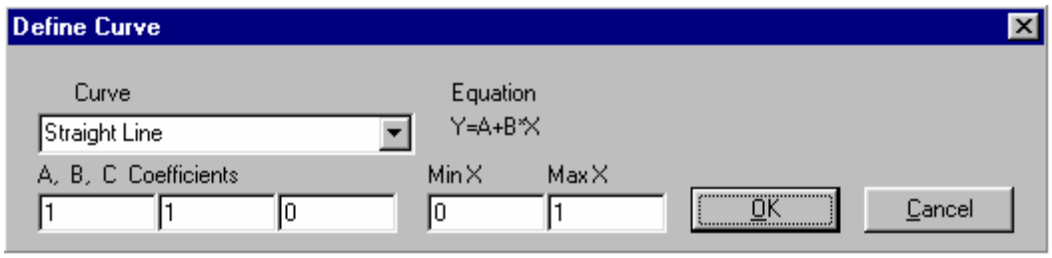
Curve Creation: Linear
This option causes Reverse to use line entities to construct the curve. Individual line segments will connect the points that are used to create the curve.

Curve Creation: Spline
This option causes Reverse to use a spline entity to construct the curve. The spline will connect the points that are used to create the curve.

Curve Ends: Open
This option will cause Reverse to end the curve at the two points that are the farthest apart from each other. All points in the data set are considered.

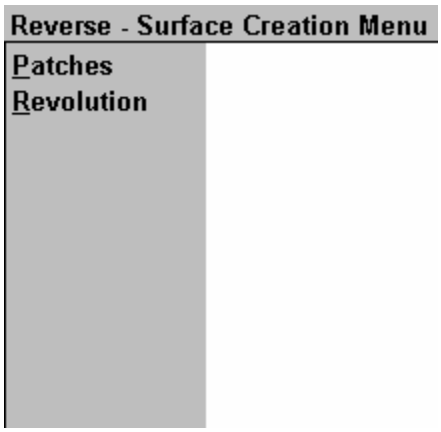
Curve Ends: Closed
This option causes Reverse to close the curve so that the start-point of the curve matches the end-point of the curve.

Define Curve



Surfaces

This command provides you with a few methods of creating surfaces through points in your database. Here is the **Reverse – Surface Creation Menu** and a description of each option:



Patches

This routine will work either on-line or off-line. Both methods involve selecting points that are as evenly spaced as you can provide.

All surface-patches are created from “rows” of points. Each row of points must have an equal number of points. The number of points in each row is variable.

All of the points in each row are “mapped” to the corresponding point in adjacent rows. This mapping provides the capability to closely define the true curvature of the surface patch. The specific points that you collect from your part are important, with regard to their location, but not critical to the accuracy of the surface if enough points are collected.

Verisurf Reverse can automatically compensate for the probe radius while creating surface patches. This feature is only available when you are working in the online mode.

Revolution

This routine creates a surface of revolution.

You are prompted to select the axis of revolution. This can be either an arc or a line entity.

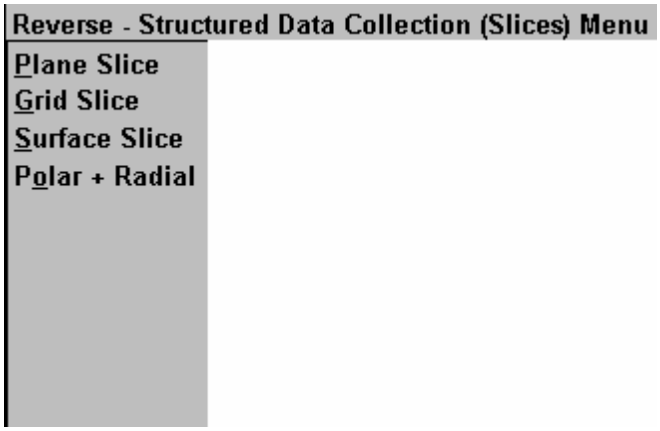
Next, you are prompted to collect or select the points that define the surface of revolution. Which one of these methods to use depends on the online/offline status of the selected device.

After the axis and the points have been selected, you are prompted to create the generating curve. If you select **No**, then the command is cancelled. If you select **Yes**, then the dialog box described under **Curve By Pts** is displayed.

After the curve is created then you are prompted to create the surface. If the curve is as you expected then select yes. The surface of revolution is created as two surfaces; each covers 180 degrees of the revolution.

Slices

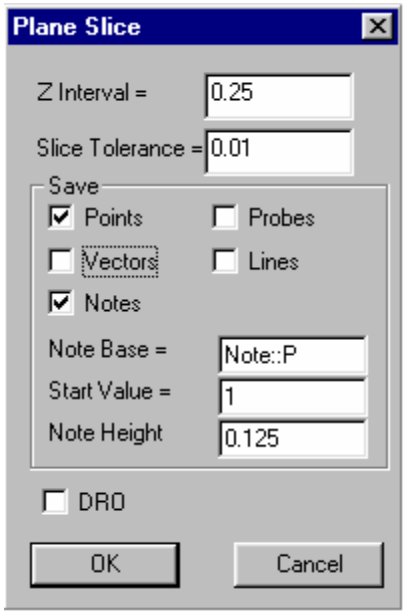
The Slices feature provides several different methods of *structured data collection* in the form of “slices” through your part. These slices provide a smoother surface definition than randomly located points. The points may still be randomly located along each slice, or definition can be provided in multiple directions (XYZR).



Each of these selections is discussed below.

Plane Slice

Plane slicing allows data collection at regular depth intervals relative to the current construction plane. The Settings menu for this feature is described below.



Plane Slice: Z Interval
This setting controls the Z depth, relative to the current construction origin, at which the points will be collected.

Plane Slice: Slice Tolerance
This setting controls the proximity of the device to the Z plane desired. If the collection device is within this distance to the Z plane then points will be collected. When the device is not within this distance then points are not collected.

Save
These check boxes control the type of geometric entities that are created and saved by this routine. Your choices include **Points**, **Vectors**, **Probes**, **Lines**, and **Notes**. With notes you also have the option of specifying the text of the notes as well as the note height.

DRO

This option will display the large digital read-out on the screen while collecting data.

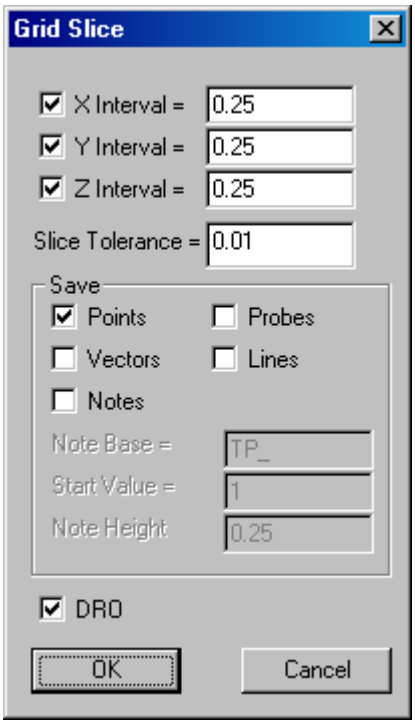
When you are finished collecting points for the slices you are prompted to create the curves. If you want to create the curves at this point, you are presented with the **Curve By Pts** dialog box to make the settings you want.

Grid Slice

Grid slicing allows data collection at regular depth intervals relative to the current construction plane.

This feature is similar to the **Plane Slice** feature except that you now have the choice of axis or axes on which you wish to create points or curves.

The Settings menu for this feature is described below.



X Interval, Y Interval, Z Interval
This setting controls the location, relative to the current construction origin, at which the points will be collected. You have your choice of axis from which to collect data. You may select more than one axis from which to collect data.

Slice Tolerance
This setting controls the proximity of the device to the plane desired. If the collection device is within this distance to the plane then points will be collected. When the device is not within this distance then points are not collected.

Save
These check boxes control the type of geometric entities that are created and saved by this routine. Your choices include **Points, Vectors**, **Probes**, **Lines**, and **Notes**. With notes you also have the option of specifying the text of the notes as well as the note height.

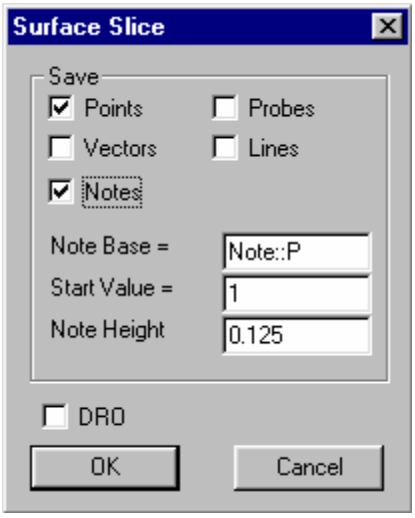
DRO
This option will display the large digital read-out on the screen while collecting data.

When you are finished collecting points for the slices you are prompted to create the curves or not. If you want to create the curves at this point then you are presented with the **Curve By Pts** dialog box to make the settings you want.

Surface Slice

Surface slicing allows data collection at depth intervals that correspond with selected surface entities.

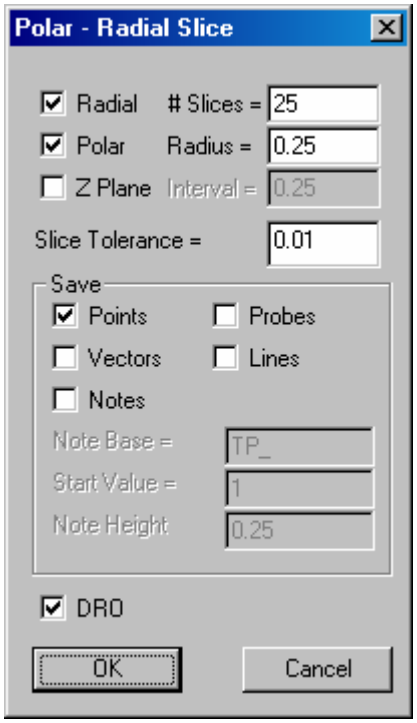
The settings control panel for this feature includes only the **Save** features described above.



Polar + Radial

Polar and Radial slicing allows data collection along vectors at equally spaces angles to each other, or along concentric circles of varying radii.

Here is the dialog box with the settings for this command, followed by a description of each option:



Radial checkbox
If this check box is selected then Verisurf will collect slice information in a radial fashion, much like the spokes of a wheel. The slices will have an even angular spacing between each spoke.

Radial # Slices
This parameter tells Verisurf how many radial slices to collect. These slices will have an even angular spacing around the origin of the current alignment system (part axis).

Polar checkbox
If this check box is selected, Verisurf will collect slice information in a polar or circular fashion. The slices will be concentric circles about the origin of the current alignment system (part axis).

Polar Radius
This parameter tells Verisurf the distance from the origin at which to collect points. All multiples of this value are used by the system. For example, if the **Polar Radius** is set to 4.0 then data will be collected at a radius of 4.0, 8.0, 12.0, 16.0, etc.

Z Plane check Box
If this checkbox is selected then Verisurf will only collect points that are at the specified Z location.

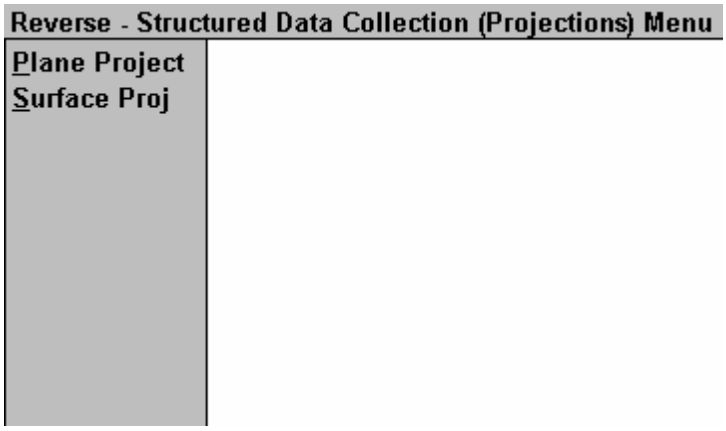
Z Interval
This parameter tells Verisurf the depth from the origin at which to collect points. All multiples of this value are used by the system. For example, if the Z Interval is set to 0.25 then data will be collected at the Z locations 0.0, 0.25, 0.50, 0.75, etc.

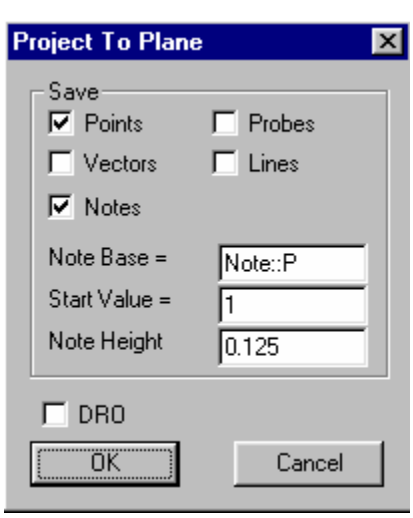
Slice Tolerance
While dynamically collecting points from the data-collection device it is common for the device to move rapidly past the desired slice. Verisurf reads the device continuously. However, you are likely to move the device faster than Verisurf can read it. Therefore, Verisurf uses this value to collect points on either side of the desired slice. These points form a line that intersects the slice. The recorded point is the intersection of this little line and the desired slice. All of the recorded points are guaranteed to lie on the slice.

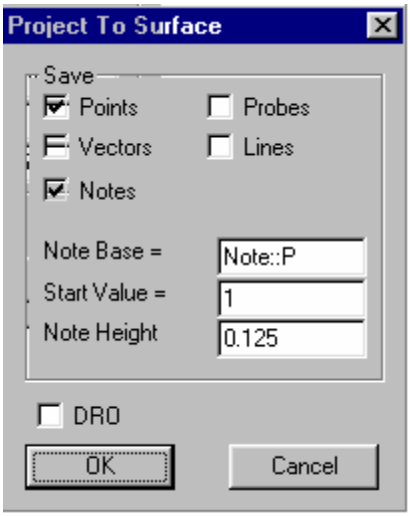
Save
These check boxes control the type of geometric entities that are created and saved by this routine. Your choices include **Points**, **Vectors**, **Probes**, **Lines**, and **Notes**. With notes, you also have the option of specifying the text of the notes as well as the note height.

DRO
This option will display the large digital read-out on the screen while collecting data.

Projections







OnLine

OnLine

This option toggles between **OnLine** and **OffLine** to indicate when Verisurf is communicating with your data collection device. When your device is on-line it can collect points. Otherwise, you can only select data from the CAD model.