

V-STARs 4.5.1 Application Note

Proximity Point Labelers

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Throughout this Application Note, the term **NOTE:** denotes particularly useful information. Additionally, the term **WARNING!** indicates that special attention should be paid to the information provided to avoid an undesirable result.

Introduction

Proximity Point Labeler (PPL) objects allow AutoMatched points (with prefix “TARGET”) to be automatically relabeled based on their proximity to pre-defined **SOLIDS** or **NURBS** objects, Construction Objects and PPLs used together facilitate the automatic creation of **SOLIDS** and constructed point entities without prior knowledge of point labels.

PPL objects are members of a 3D file and appear under the Proximity Labelers node within a 3D file on the V-STARS project tree (denoted by the pencil icon) (Figure 1).

In general terms, PPLs consist of

1. A **SOLIDS** or **NURBS** object. Those supported are
 - a. **SOLIDS** – plane, line, circle, sphere, cylinder
 - b. **NURBS** – curve, surface
- 2) A set of criteria that define
 - a. The spatial relationship between the object and a point under consideration for relabeling
 - b. The initial point label for relabeling

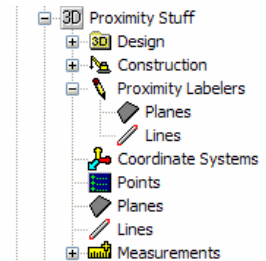


Figure 1: Proximity Labelers on the project tree.

To illustrate one of the advantages of PPLs, consider that in a particular S-survey, the nominal location of a planar surface is known. A number of targets are randomly affixed to this surface for the survey. After the AutoMeasure procedure and final bundle adjustment are complete, these points are labeled arbitrarily as AutoMatched points. Because they are labeled arbitrarily, they can't be used to automatically create a plane object via **Construction Objects**. However, using a PPL, those points that lie within a specified distance of the nominal plane are automatically assigned designated labels which in turn allow them to be utilized in a best-fit plane construction object.

The following describes how to create and edit PPLs, import them from one 3D file to another, and concludes with an example demonstrating their use.

NOTE: To use PPL you must have a **SOLIDS** license. To use **NURBS** surfaces for Proximity Point Labeling, you must have a **SURFACES** license. Currently, PPLs can only be used on S measurements. They are not yet supported in M-Mode.

Creating Proximity Point Labelers

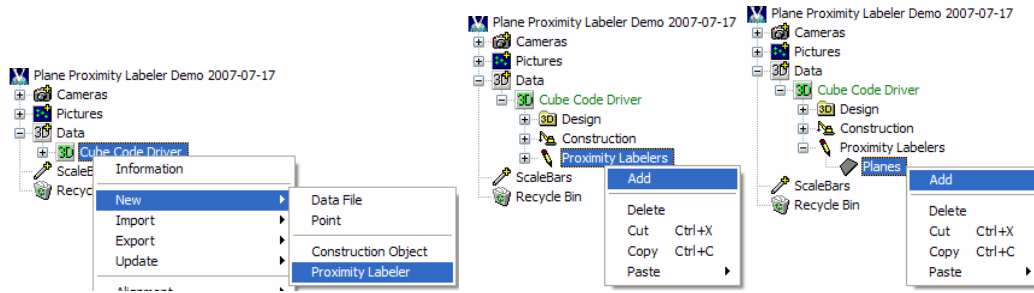


Figure 2: Creating PPLs in the Project tree from (left to right) the 3D file node, the Proximity Labelers node, and from a PPL sub-node.

In the Project Tree View

From the 3D File Node

Right-click on a 3D file node and select **New | Proximity Labeler** from the resulting popup menu (Figure 2, left). A list of all PPL types is shown in the **Select Object** dialog (Figure 3). Choose a PPL type from this list and select **OK**. A settings dialog is displayed.

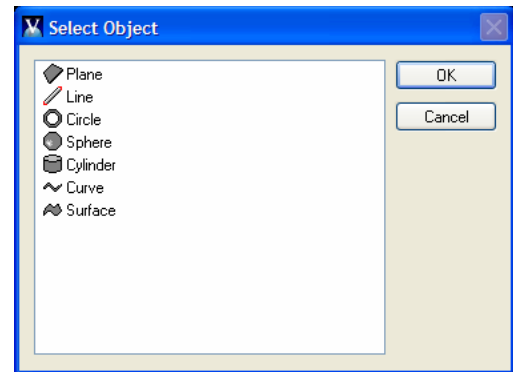


Figure 3: Select Object dialog.

From the Proximity Labelers Node

If PPLs are in the 3D file, the Proximity Labelers node will be visible when the file node is expanded.

Right-click on this node and select **Add** from the popup menu (Figure 2, center). As above, select a PPL type from the **Select Object** dialog and set its parameters in the settings dialog.

From a PPL Sub-Node

Expanding the Proximity Labelers node reveals a sub-node for each PPL type in the 3D file. Right-click on any of these nodes and select **Add** from the popup menu (Figure 2, right). Again, a settings dialog is displayed.

In the Report View

From the 3D File List

Right-click on a 3D file icon and select **New** | **Proximity Labeler** from the resulting popup menu (Figure 4, top). Select a PPL type from the **Select Object** dialog and set its parameters in the settings dialog.

From the PPL Type List

Right-click on any of the PPL types in the list and select **Add** from the popup menu (Figure 4, bottom left). A settings dialog is displayed. Alternatively, right-click in any blank area of the view, select **Add** from the popup menu and the **Select Object** dialog is displayed.

From a Specific Proximity Point Labeler List

Right-click anywhere in the Report view and select **Add** from the popup menu (Figure 4, bottom right). A settings dialog is displayed.

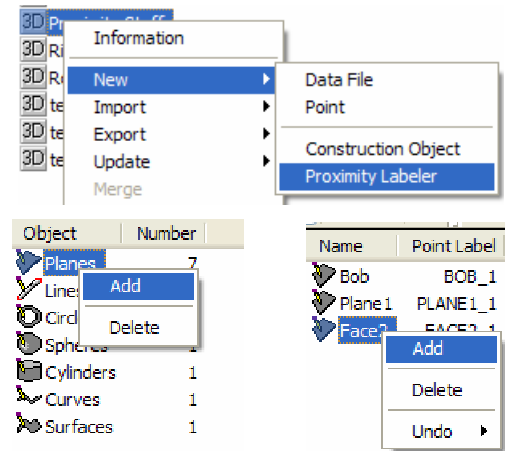


Figure 4: Creating PPL in the Report View from a 3D File (top), the PPL type list (bottom left), and a specific PPL (bottom right).

Setting Proximity Point Labeler Parameters

PPL parameter dialogs for line, circle, sphere, cylinder, NURBS curve, and NURBS surface are shown in Figure 5. The following three parameters are common to all PPLs and must be set.

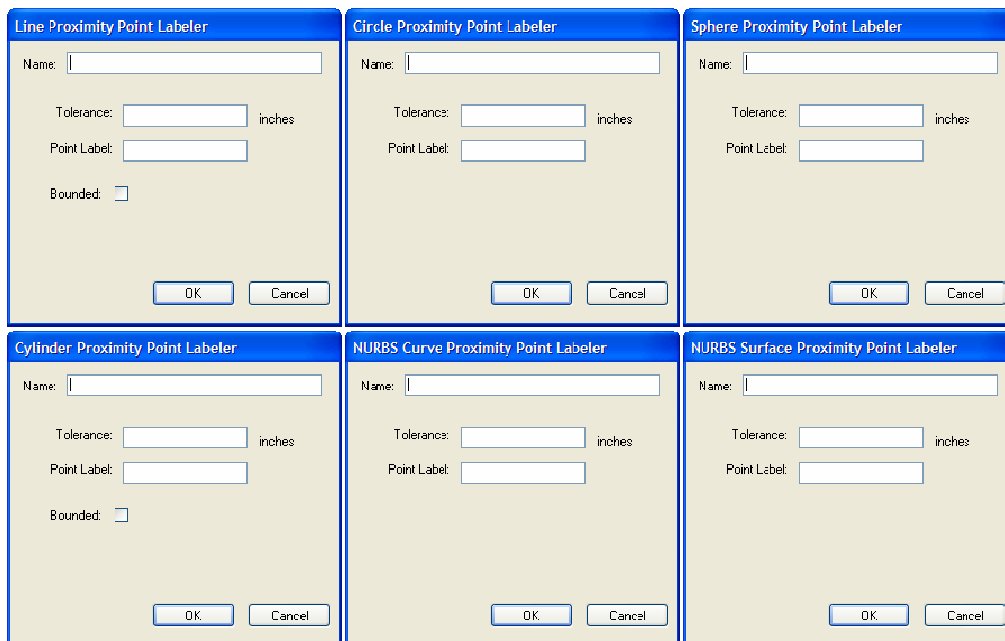


Figure 5: PPL settings dialogs.

Name: Must be identical to labeling object name.

Tolerance: Point must be within this distance from the labeling object to be relabeled.

Point Label: Initial label used for relabeling. If multiple points are relabeled, the numeric portion of this label is incremented accordingly.

NOTE 1: As the *Name* field is typed, the *Point Label* field is automatically filled in with text identical to the *Name* but with the characters “_1” appended. Any spaces in the name are automatically replaced with an underscore. The *Name* field can be changed manually if desired.

NOTE 2: If a Construction object is used in conjunction with the PPL, the alpha portion of the point label **MUST** be identical to the wildcard point label of the construction object.

Bounded Proximity Labelers

Plane, line, and cylinder PPLs have the additional option of being *bounded*. By definition, a plane is a flat, two-dimensional surface with no thickness that extends infinitely in both dimensions. A line is a straight, one-dimensional object that extends infinitely in two directions. A cylinder here is also treated as an object that extends to infinity in the two directions defined by its axis.

Practically, we visualize a plane as having a finite, artificially defined boundary. We visualize lines as line segments, with finite endpoints. And we visualize cylinders as finite at both ends. If we treat these PPLs as unbounded, then all points that are within the specified tolerance from the object will be labeled accordingly. If however, they are treated as bounded entities, only points that lie within the bounds **AND** lie within the specified tolerance from the object will be labeled. To treat planes, lines, and cylinders as bounded, check the **Bounded** box in the appropriate dialog.

Plane PPLs can be bounded in one of two ways, by *hull* or by *radius*. In V-STARS, the visual boundary of a best-fit plane is defined by its convex hull. The convex hull may be easily imagined as an elastic band stretched open to encompass the point set used to create the best-fit plane; when released, it will assume the shape of the required convex hull (Figure 6).

To set a plane PPL as *bounded*, check the **Bounded** box. More options are then displayed below. To set a plane as *hull* bounded, check the **Bounded** box and the **Hull** radio button below it (Figure 7, center). Points are labeled accordingly if their distance to the plane is within the specified tolerance *and* if they lie within the hull.

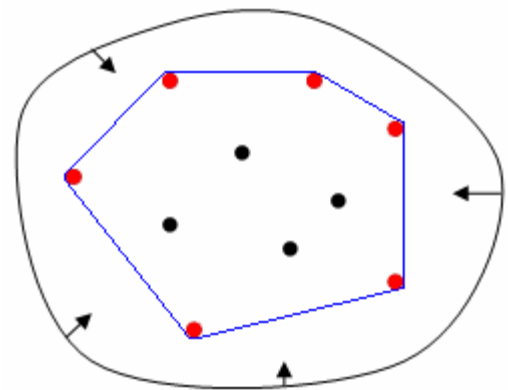


Figure 6: Planar convex hull elastic band analogy. Red points define the convex hull.

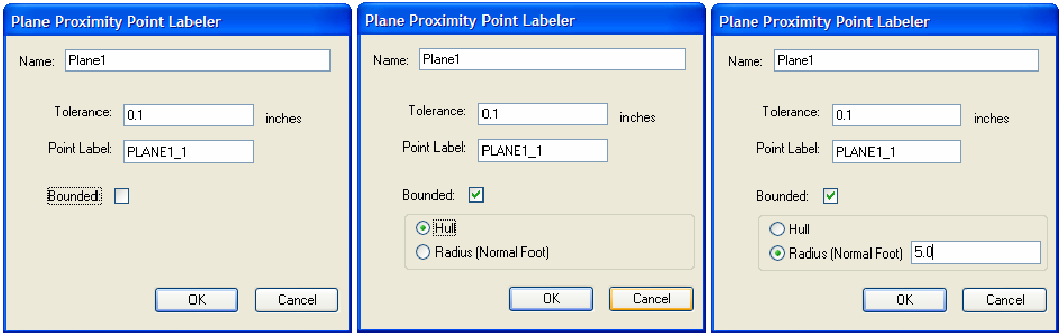


Figure 7: Setting plane proximity labeler parameters. Unbounded (left). Hull bounded (center). Radial bounded (right).

To set a plane PPL as *radially* bounded, check the **Bounded** box and the **Radius** radio button below it. Fill in the box to the right of this button with the desired radius (Figure 7, right). Points are labeled accordingly if their distance to the plane is within the specified tolerance *and* if the projection of the point to the plane lies within the specified radial distance from the foot of the plane’s normal vector (Figure 8).

Editing Existing PPL Parameters

Editing an existing PPL is done within the report view (Figure 9). Selecting a PPL type (planes, lines, circles, spheres, cylinders, NURBS curves, NURBS surfaces) in the Project tree view displays a list of those types in the report view. Individual parameters are modified by the mouse *click-pause-click* combination which opens an in-place edit window. Use the **TAB** key from within the in-place edit window to move the window one column to the right. The **SHIFT+TAB** key combination moves the window one column to the left. The **UP** and **DOWN** arrow keys move the window up or down one row. The *Bounded* parameter of plane, line, and cylinder PPLs is

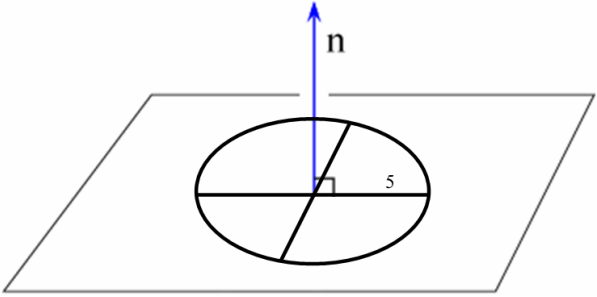


Figure 8: Radial bounded PPL.

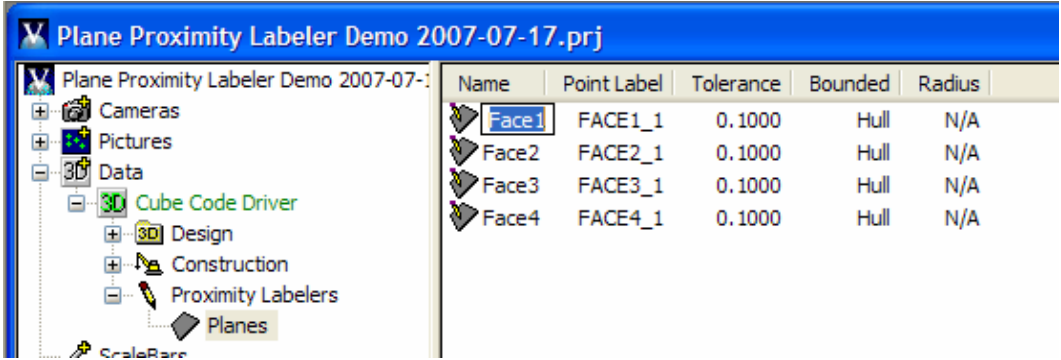


Figure 9: Editing PPLs from the Report View.

edited via a drop-down list. If a plane PPL is *radially* bounded, the **Radius** column must be filled.

Importing PPLs between 3D Files

Like design data and construction objects, PPLs may be imported from one 3D data file into another. To import PPLs into a 3D file, right click on the file and select **Import | Proximity Point Labelers**. From the *file open dialog*, select the 3D data file that contains the proximity point labelers you wish to import and select **OK**. A summary of the objects imported is displayed.

Manually Updating PPLs

Similar to construction objects, PPLs may be updated manually after a bundle adjustment. This is done by right-clicking on the 3D data file and choosing **Update | Proximity Point Labelers** from the popup menu. In the graphical view, this is done by right-clicking and choosing **Update | Proximity Point Labelers** from the popup menu.

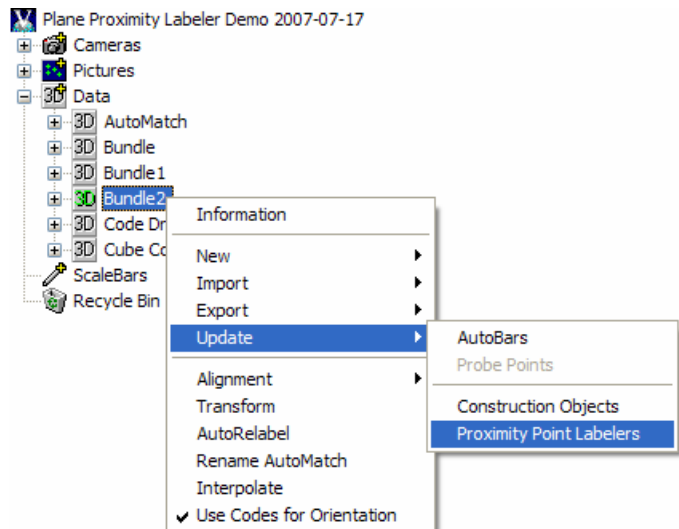


Figure 10: Manually updating PPLs.

Using Proximity Point Labelers: An Example

Here, the example presented in the **Introduction** is expanded to better illustrate the use of PPLs. As before, prior to an S-survey, the nominal location of a planar surface is known. A number of targets are randomly affixed to this surface for the survey. Additionally, targets are placed in proximity to two nominal lines. After AutoMeasure, AutoMatched points in proximity (within a given tolerance) to the nominal plane and lines should be relabeled accordingly and a best-fit plane and two best-fit lines should be created automatically from the relabeled points.

To accomplish the above,

The nominal plane and line objects are placed in the design folder of the survey driver file (Figure 11). Putting them in the design folder ensures they will be copied over to the final bundle file produced by the AutoMeasure.

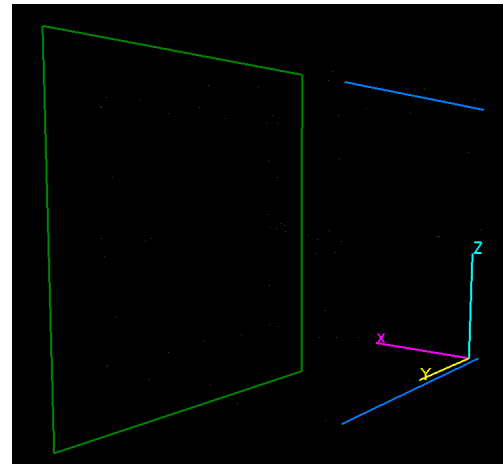


Figure 11: Nominal plane and lines in design folder of driver file.

- 1) A separate PPL for the plane and each line is created in the driver file. The PPL names **must** match the corresponding nominal object names. The plane PPL is defined as hull bounded with a proximity tolerance of 0.1 inches. The line PPLs are defined as unbounded with a proximity tolerance of 1.0 inches (Figure 12).
- 2) A separate construction object for the plane and each line are created in the driver file (Figure 12). The point labels are wild-carded. Note the correspondence between the point label of the PPLs in Figure 12 and the construction object wild-card labels in Figure 13.

Name	Point Label	Tolerance	Bounded	Radius
Face1	FACE1_1	0.1000	Hull	N/A

Name	Point Label	Tolerance	Bounded
Line1	LINE1_1	1.0000	No
Line2	LINE2_1	1.0000	No

Figure 12: Left: plane and line PPLs in Project tree view. Right, top: plane PPL in report view, hull bounded with 0.1" tolerance. Right, bottom: line PPLs in report view, unbounded with 1.0" tolerance.

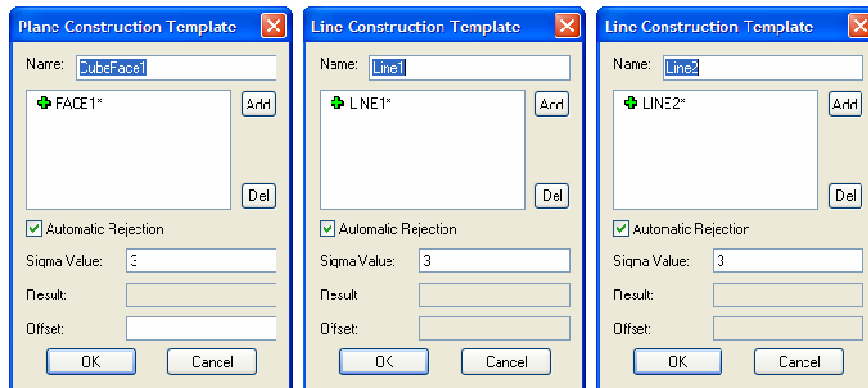
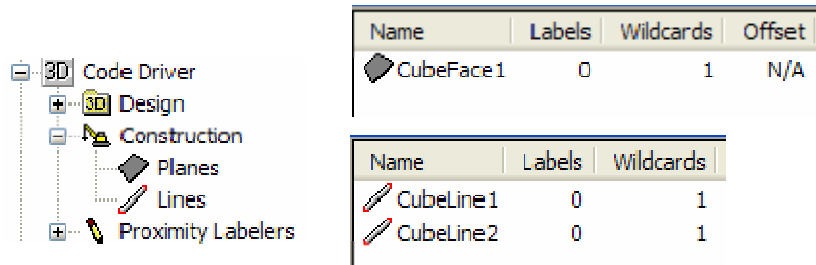


Figure 13: Top: plane and line construction objects in Project tree view (left) and the report view (right). Bottom: construction object dialogs. Note correspondence between construction object wild card labels and PPL point label shown in Figure 12.

The AutoMeasure process is run as usual. After completion, the final Bundle 3D file contains the points relabeled as defined by the PPLs and newly constructed plane and lines as defined by the construction objects (Figure 14).

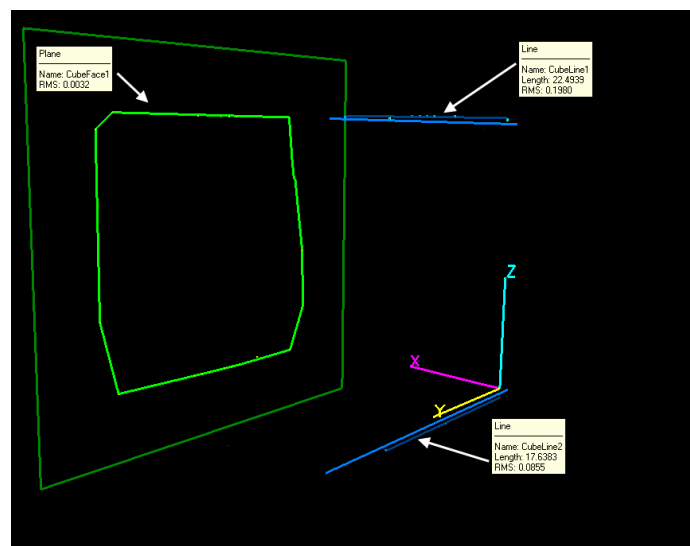


Figure 14: AutoMeasure results. Arrows indicate plane and lines constructed via PPLs.