# 13.0 Measure tool box

The tools in the Measure toolbox are used to perform measuring operations.

<table>
<thead>
<tr>
<th>To</th>
<th>Select in the Measure toolbox</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure the distance(s) along an element.</td>
<td></td>
</tr>
<tr>
<td>or</td>
<td><img src="image" alt="Measure Distance" /></td>
</tr>
<tr>
<td>Measure the cumulative distance from a data point.</td>
<td></td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>Measure the perpendicular distance between an element and a data point.</td>
<td></td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>Measure the minimum distance between two elements.</td>
<td></td>
</tr>
<tr>
<td>Measure the radius of a circle, circular arc, cone, or cylinder, or the axes of an ellipse or elliptical arc.</td>
<td><img src="image" alt="Measure Radius" /></td>
</tr>
<tr>
<td>Measure the angle between two lines.</td>
<td><img src="image" alt="Measure Angle Between Lines" /></td>
</tr>
<tr>
<td>Measure the length of an element.</td>
<td><img src="image" alt="Measure Length" /></td>
</tr>
<tr>
<td>Measure the area and perimeter of a shape, ellipse, or complex shape and to analyze mass properties.</td>
<td><img src="image" alt="Measure Area" /></td>
</tr>
<tr>
<td>Measure the volume enclosed by an element or a set of elements and to analyze mass properties.</td>
<td><img src="image" alt="Measure Volume" /></td>
</tr>
</tbody>
</table>
# 13.1 Measure Distance

The coordinates are always reported from the active model and not from a reference file attachment.

Used to measure distance.

![Image of Measure Distance tool](image)

<table>
<thead>
<tr>
<th>Tool Settings</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Method</strong></td>
<td>Sets the method of distance measuring.</td>
</tr>
<tr>
<td></td>
<td>- Between Points — Measures the linear distance between two data points. When the command is active a running total is displayed. Can be used in 2D or 3D design or sheet models.</td>
</tr>
<tr>
<td></td>
<td>- Along Element — Measures along an element from an origin. Can be used in 2D or 3D design or sheet models. Elements are: Line, line string, multi-line, arc, ellipse, shape, curve, B-spline curve, complex chain, or complex shape.</td>
</tr>
<tr>
<td></td>
<td>- Perpendicular — Measures the distance between elements perpendicular to each other. Can be used in 2D Design models and 2D and 3D sheet models. Tool only works in a 3D file in the Top view orientation. Other view rotations like Front may not yield the result expected. Elements are: Line, line string, multi-line, arc, ellipse, shape, curve, B-spline curve, complex chain, or complex shape.</td>
</tr>
<tr>
<td></td>
<td>- Minimum Between — Measures the minimum distance between two elements. Can be used in 2D or 3D design or sheet models. Elements are: Line, line string, multi-line, arc, ellipse, shape, curve, B-spline curve, complex chain, or complex shape.</td>
</tr>
<tr>
<td></td>
<td>- Maximum Between — Measures the maximum distance between two elements. Can be used in 2D or 3D design or sheet models.</td>
</tr>
<tr>
<td><strong>About</strong></td>
<td>Sets how distance measurements are calculated. All report both True and Projected distances. A True distance the &quot;real-world&quot; distance. It is not affected by the About mode, but depending on the ACS could be affected by ACS Plane Snap (see Locks dialog.) The Projected distance is in the XY plane and is affected by the About mode. In the case of 2D models, projected distance is useful when measuring distances between elements in the 2D model and a 3D reference attachment. All modes</td>
</tr>
</tbody>
</table>
Global Z — The projected distance is relative to the Global Z. Start and Finish coordinates are always reported as true points in the selected model relative to the Global origin.

View Z — The projected distance is relative to the View Z. Coordinates reported are from the Global coordinates relative to the View rotation. Start and Finish points are always projected so the Z value will always be 0. The Z column therefore is not displayed.

ACS Z — The projected distance is relative to the ACS Z. In 3D, Start and Finish points are projected from the XY plane so the Z value will always be 0. The Z column therefore is not displayed. Coordinates reported are about the ACS Z axis / ACS XY plane. In 3D, coordinates reported are projected.

AccuDraw Z — The projected distance is relative to the AccuDraw Z. Coordinates that are reported are the project coordinates about the AccuDraw Z axis. Since the coordinates are projected, the Z value will always be 0. Therefore, you will not see the Z column in the display. The Finish point is 0 in AccuDraw so the Start Point and Delta reports the XY components.

Distance Displays the result of the last measurement.
Total (Distance set to Between Points only) Displays the total distance measured.
Segment Only (Distance set to Perpendicular only) If on, the measurement is constrained to be perpendicular to the selected segment of the element, or the projection of the segment. If off, the perpendicular measurement is taken from the nearest segment of the selected element.
Start Point Displays the XYZ coordinate values for the start point.
End Point Displays the XYZ coordinate values for the end point.
Delta Displays the distance between the start and end points for each axis.

To measure the Linear Distance Between Two Data Points

1) Select the Measure Distance tool.
2) In the tool settings window, set Method to Between Points.
3) Enter a data point.
4) Enter a second data point.
   The Distance and Total fields display the same distance.
5) Enter another data point(s). The linear distance from the first data point is displayed in the Total field, while the Distance field displays the distance between the last two data points.
   or
   Reset to return to step 3.

To Measure the Distance Along an Element

1) Select the Measure Distance tool.
2) In the tool settings window, set Method to Along Element.
3) Select the element at the origin (the point from which to measure).
4) Enter a data point to define a point along the element. The distance from the origin along the element is displayed in the status bar.
MicroStation V8i – Measuring Elements & Shapes

If the element is closed, this data point defines the direction (clockwise or counterclockwise) in which measurements are made.

5) Enter a data point(s). The distance along the element from the origin is displayed in the Distance field. or
   Reset to return to step 3.

To Measure Perpendicular Distance from an Element

1) Select the Measure Distance tool.

2) In the tool settings window, set Method to Perpendicular.

3) Turn off Segment Only.

4) Select the element.

5) Enter a data point. The perpendicular distance between the nearest part of the element and this point is displayed in the Distance field. A temporary “line” is displayed as a visual aid but is not placed in the design.

6) Enter another data point(s) to define other perpendicular measurements. or
   Reset to return to step 4.

To Measure Perpendicular Distance from a Segment of an Element

1) Select the Measure Distance tool.

2) In the tool settings window, set Method to Perpendicular.

3) Turn on Segment Only.

4) Select the element at the segment that is to be used.

5) Enter a data point. The perpendicular distance between the element and this point are displayed in the Distance field. A temporary “line” is displayed as a visual aid but is not placed in the design. If the data point is not within the limits of the selected segment, then the projection of the segment is used.

6) Enter another data point(s) to define other perpendicular measurements. or
   Reset to return to step 4.
   If the element is a line string, shape, curve, complex chain, or complex shape, the distance is measured perpendicular to the segment identified in step 3.

To Measure the Minimum Distance Between Elements

1) Select the Measure Distance tool.

2) In the tool settings window, set Method to Minimum Between.

3) Select the first element.

4) Select the second element.
5) Accept the elements.
The minimum distance between the elements is displayed in the Distance field. A temporary “line” is displayed as a visual aid but is not placed in the design.

- To construct a minimum distance line between two elements, use the Construct Minimum Distance Line tool in the Linear Elements toolbox.

To Measure the Maximum Distance Between Elements

1) Select the Measure Distance tool.
2) In the tool settings window, set Method to Maximum Between.
3) Select the first element.
4) Select the second element.
5) Accept the elements.
The maximum distance between the elements is displayed in the Distance field. A temporary “line” is displayed as a visual aid but is not placed in the design.

To Measure the Minimum Distance to a Surface (3D Only)

1) Key in MEASURE DISTANCE SURFACE.
2) Select the surface.
3) Select the point in the design cube from which you want to measure.

13.2 Measure Radius

Used to measure:

- The radius of a circle or circular arc.
- The radius of a cone or cylinder.
- The primary and secondary axes of an ellipse or elliptical arc.
- The radius of a circular segment or axes of an elliptical segment of a complex chain or complex shape

To measure an element's radius

1) Select the Measure Radius tool.
2) Identify the element or segment.
3) Accept the element.
The measurement displays in the status bar.

- To dimension an element's radius, use the Element Dimensioning tool.
13.3 Measure Angle between Lines

Used to measure the angle between two lines or segments of a line string, shape, or multi-line. If the identified lines do not intersect, an intersection point is computed to serve as the vertex of the measured angle.

**Tool Settings**

<table>
<thead>
<tr>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>About</td>
</tr>
<tr>
<td>Sets how measurements for the angle are calculated. Options are Global Z, View Z, ACS Z, and AccuDraw Z.</td>
</tr>
<tr>
<td>Angle</td>
</tr>
<tr>
<td>Displays the result of the angle measured.</td>
</tr>
</tbody>
</table>

To measure the angle between two lines

1. Select the Measure Angle Between Lines tool.
2. Identify the first line.
3. Identify the second line.
4. Accept the lines.
   The angle measurement is displayed in the status bar.

13.4 Measure Length

Used to measure the length of an element(s) and to analyze mass properties. For a closed element or a surface, the length of the perimeter or wireframe geometry is measured.

**Tool Settings**

<table>
<thead>
<tr>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tolerance (%)</td>
</tr>
<tr>
<td>When measuring curves, the maximum percentage of the distance between the true curve and the approximation used to measure. A low Tolerance makes the measurement more accurate but increases calculation time.</td>
</tr>
<tr>
<td>Mass Properties</td>
</tr>
<tr>
<td>If on, the Mass Properties window displays the mass property analysis.</td>
</tr>
<tr>
<td>Display Centroid</td>
</tr>
<tr>
<td>If on, a graphic crosshair that represents the center of mass for the measured element(s) is displayed.</td>
</tr>
<tr>
<td>About</td>
</tr>
<tr>
<td>Sets how measurements for the length are reported.</td>
</tr>
</tbody>
</table>
MicroStation V8i – Measuring Elements & Shapes

- Global Z — Measures the true length in 2D and 3D sheet and design models.
- View Z — Measures the projected length based on the view rotation. Not recommended for use in 3D design models. For 3D data referenced to a 2D Design model or 2D sheet model or 3D sheet model the projected distance is reported.
- ACS Z — Measures about the active Auxiliary Coordinate System (ACS) or in the ACS XY plane. Results are projected about the ACS Z or on the ACS XY plane.
- AccuDraw Z — Measures about the AccuDraw compass XY or about AccuDraw Z. Results are projected about the AccuDraw Z or on the AccuDraw XY plane.

<table>
<thead>
<tr>
<th>Length</th>
<th>Displays the result of the last length measured.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle Of Line</td>
<td>Displays the result of the last angle measured.</td>
</tr>
</tbody>
</table>

To measure the length of an element

1) Select the element.
2) Select the Measure Length tool.
The length displays in the status bar. If Mass Properties is on, the mass properties are displayed in the Mass Properties window.

Alternative Method — To measure the length of an element(s)

1) Select the Measure Length tool.
2) Select the element.
3) Accept the element.
The length displays in the status bar. If Mass Properties is on, the mass properties analysis is displayed in the Mass Properties window.

13.5 Measure Area

Used to measure area and perimeter.

Measurements of referenced perspective saved views are not supported.

<table>
<thead>
<tr>
<th>Tool Settings</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
<td>Sets the area that is measured.</td>
</tr>
<tr>
<td></td>
<td>• Element — Area of one closed element (its Area attribute must be Solid). It is the planar area of shapes, ellipses, and complex shapes. For 3D surfaces or solids, it is the total surface area in all dimensions.</td>
</tr>
<tr>
<td></td>
<td>• Fence — (Fence present only) Area enclosed by the active fence, other than a named</td>
</tr>
</tbody>
</table>
MicroStation V8i – Measuring Elements & Shapes

- fence, or a fence created from an element.
- Intersection — Area bounded by the intersection of two or more closed planar elements. Where more than two elements are involved, use <ctrl-data point> to select the extra elements.
- Union — Area bounded by the union of two or more closed planar elements. Where more than two elements are involved, use <ctrl-data point> to select the extra elements.
- Difference — Area bounded by the difference between two or more closed planar elements. Where more than two elements are involved, use <Ctrl-data point> to select the extra elements.
- Flood — Area enclosed by elements that either touch one another or whose endpoints fall within the Maximum Gap.
- Points — Planar area with its vertices defined by a series of data points. Where the points are input in a figure 8 type shape, then the total area of the two loops is calculated.

### Tolerance (%)
For curves, sets the maximum percentage of the distance between the true curve and the approximation used to measure. A low Tolerance makes the measurement more accurate but increases calculation time.

### Mass Properties
If on, the mass property analysis displays in the Mass Properties window.

### Display Centroid
If on, a graphic crosshair that represents the measured element’s center of mass is displayed.

### About
Sets how measurements for area are reported.
- Global Z — Measures the true area in 2D and 3D sheet and design models.
- View Z — Measures the projected area based on the view rotation. Not recommended for use in 3D design models. For 3D data referenced to a 2D Design model or 2D sheet model or 3D sheet model the projected distance is reported.
- ACS Z — Measures about the active Auxiliary Coordinate System (ACS) or in the ACS XY plane. Results are projected about the ACS Z or on the ACS XY plane.
- AccuDraw Z — Measures about the AccuDraw compass XY or about AccuDraw Z. Results are projected about the AccuDraw Z or on the AccuDraw XY plane.

### Area Unit
Sets the units used to display the last area measured.
- square <master units>
- square m — (Metric units only) Square meters.
- Acre (US) — (English units only)
- Hectare — (Metric units only)

### Area
Displays the result of the last area measured. The unit of measurement displayed in this field can be controlled by the MS_MEASURE_AREA_UNIT2 configuration variable.

### Perimeter Unit
Sets the units used to display the perimeter length for the last area measured.

### Perimeter
Displays the perimeter length for the last area measured.

### Locate Interior Shapes
(Procedure for Flood only) If on, the area enclosed by the bounding elements is calculated, minus the area of any closed elements inside the bounding area.

### Dynamic Area
(Procedure for Flood only) If on, the area to be included displays dynamically as you move the screen pointer over the view.

### Max(imum) Gap
(Procedure for Flood only) Sets the largest distance allowed between consecutive elements. If zero, the elements must connect to bound an area.

---

To Measure the Area and Perimeter of One Element:

1) Use the **Element Selection** tool to select the element.

2) Select the **Measure Area** tool.
3) In the tool settings window, set Method to Element.

4) Accept the element.
   The element’s Surface Area and Perimeter are displayed in the tool settings window.

### Alternative Method — To Measure the Area and Perimeter of One Element

1) Select the *Measure Area* tool.

2) In the tool settings window, set Method to Element.

3) Select the element.
   The element's Surface Area and Perimeter are displayed in the tool settings window.

### To Measure the Area Defined by a Fence

1) Use the *Place Fence* tool to place a fence.

2) Select the *Measure Area* tool.

3) In the tool settings window, set Method to Fence.

4) Accept the fence contents.
   The fence’s Surface Area and Perimeter are displayed in the tool settings window.

### To Measure the Area of the Intersection or Union of Closed Elements

1) Select the *Measure Area* tool.

2) In the tool settings window, set Method to Intersection or Union.

3) Select one element.

4) Select another element.
   The resulting area is highlighted.

5) (Optional) Use <Ctrl-data point> to select further elements.
   As you select each successive element, the resulting area is highlighted.
   If the elements do not overlap, the following occurs, depending on the Method:

<table>
<thead>
<tr>
<th>Method</th>
<th>If elements do not overlap, then</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intersection</td>
<td>“Elements do not intersect” is displayed.</td>
</tr>
<tr>
<td>Union</td>
<td>Each element is highlighted.</td>
</tr>
</tbody>
</table>

6) After selecting the last element, accept to view the result.
   The results display in the tool settings window. When measuring a union, the Perimeter value does not display if the elements do not overlap. If Mass Properties is on, the mass properties analysis is displayed in the Mass Properties window.
To Measure the Area of the Difference Between Elements

1) Select the Measure Area tool.

2) In the tool settings window, set Method to Difference. If any elements are selected, they are de-selected.

3) Select the element from which to subtract.

4) Select the element to subtract from the element selected in the preceding step.

5) (Optional) Use <Ctrl-data point> to select further elements to subtract.

6) Accept with a data point. The results display in the tool settings window. When measuring a union, the Perimeter value does not display if the elements do not overlap. If Mass Properties is on, the mass properties analysis is displayed in the Mass Properties window.

To Measure the Area of Touching Elements or Whose Endpoints Are Within the Maximum Gap

1) (Optional) Select the elements.

2) Select the Measure Area tool.

3) In the tool settings window, set Method to Flood.

4) (Optional) If you want to exclude, from the total measurement, the area of any closed elements inside the selected area, turn on Locate Interior Shapes.

5) Enter a data point in the area enclosed by the bounding elements.

6) Accept the elements. The results display in the tool settings window. If Mass Properties is on, the mass properties analysis is displayed in the Mass Properties window.

To Measure an Area Defined by Data Points

1) Select the Measure Area tool.

2) In the tool settings window, set Method to Points.

3) Enter a data point to define each vertex of an imaginary shape that encloses the area. The imaginary shape is dynamically displayed.

4) When done, Reset. The results display in the tool settings window. If Mass Properties is on, the mass properties analysis is displayed in the Mass Properties window.
13.5 Measure Area

(3D only) Used to measure the volume enclosed by an element or a set of elements and to analyze mass properties. The element(s) must completely enclose a volume; if a volume is not enclosed, a message appears in the status bar.

<table>
<thead>
<tr>
<th>Tool Settings</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tolerance</td>
<td>For curves, sets the maximum percentage of the distance between the true curve and the approximation used to measure. A low Tolerance makes the measurement more accurate but increases calculation time.</td>
</tr>
<tr>
<td>Mass Properties</td>
<td>If on, the Mass Properties window displays the mass property analysis for the measured volume.</td>
</tr>
<tr>
<td>Display Centre Of Mass</td>
<td>If on, a graphic crosshair that represents the center of mass for the measured element(s) is displayed.</td>
</tr>
<tr>
<td>Volume Unit</td>
<td>Sets the units used to display the last volume measured.</td>
</tr>
<tr>
<td></td>
<td>- cubic &lt;master units&gt;</td>
</tr>
<tr>
<td></td>
<td>- cubic m — (Metric units only) Cubic meters.</td>
</tr>
<tr>
<td></td>
<td>- Liter — (Metric units only)</td>
</tr>
<tr>
<td></td>
<td>- Gallon (US) — (English units only)</td>
</tr>
<tr>
<td></td>
<td>- Gallon (UK) — (English units only)</td>
</tr>
<tr>
<td></td>
<td>- US Barrels (Oil) — (English units only): [1 bbl (US Oil) = 158.987L]</td>
</tr>
<tr>
<td></td>
<td>- US Barrels (Federal) — (English units only): [1 bbl (US Federal) = 117.347L]</td>
</tr>
<tr>
<td>Volume</td>
<td>Displays the result of the last volume measured. The unit of measurement displayed in this field can be controlled by the MS_MEASURE_AREA_UNIT2 configuration variable.</td>
</tr>
</tbody>
</table>

To Measure Volume

1) (Optional) Select the bounding element(s).
   Unless the element is a solid, it is necessary to select multiple elements.

2) Select the Measure Volume tool.
   If an element(s) were selected (step 1), the volume is displayed in the tool settings window.
   If Mass Properties is on, the mass properties analysis displays in the Mass Properties window. Otherwise, continue with step 3.

3) Select the element.

4) Accept the element.
   The volume displays in the tool settings window.
   If Mass Properties is on, the mass properties analysis displays in the Mass Properties window.