XyzPilot Point Operations Reference

Complete reference for XyzPilot point operations

Version 1.0 — 23 September 2026

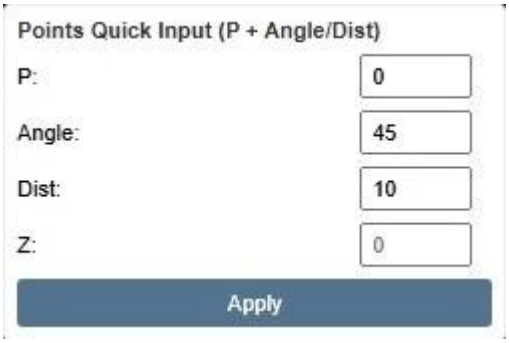
Each operator includes: description, Quick Input fields, selector guidance, worked example, and FAQ.

P — Point Operators

1. Point/Angle,Dist — Angle and Distance Point

What It Does: The Point/Angle,Dist operator creates a new point at a specified angle and distance from an existing reference point. This is polar coordinate construction — useful when you know the direction and distance but not the X and Y offsets.

Quick Input:



Direction Selector: No selector required — result is uniquely determined.

Worked Example:

```
Setup:
  P0 = (0, 0)

Point/P0, Angle=45, Dist=10, 0
→ P1 = (7.071, 7.071)    [10mm at 45°]

Point/P0, Angle=0, Dist=100, 0
→ P2 = (100, 0)          [100mm along +X axis]

Point/P0, Angle=90, Dist=75, 0
→ P3 = (0, 75)           [75mm straight up]

Point/P0, Angle=225, Dist=30, 0
→ P4 = (-21.213, -21.213) [30mm at 225° — lower left]
```

FAQ:

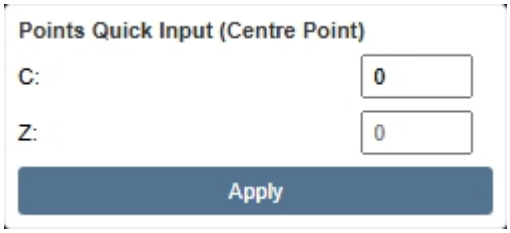
- **What is the difference between Point/Angle,Dist and Point/Delta?:** Point/Angle,Dist uses polar coordinates — angle and distance. Point/Delta uses Cartesian offsets — dX and dY. Both create the same types of points; choose based on which values you know.

- **Can I use angles greater than 360°?:** Yes. Angles are normalised — 450° is equivalent to 90°. Negative angles are also supported — -90° is equivalent to 270°.

2. Point/Centre,C — Circle Centre Point

What It Does: The Point/Centre,C operator creates a point at the exact geometric centre of an existing circle. The centre coordinates are read directly from the circle definition — no calculation is required. Construction Tier: The created point is disposable. It is commonly used as a reference for subsequent geometry construction.

Quick Input:



Direction Selector: No selector required — result is uniquely determined.

Worked Example:

```
Setup:
  C0 = Circle at centre (50, 50), radius 25

Point/Centre, C0, 0
→ P5 = (50, 50)

Setup:
  C1 = Circle at centre (120.5, 80.25), radius 10

Point/Centre, C1, 0
→ P6 = (120.5, 80.25)
```

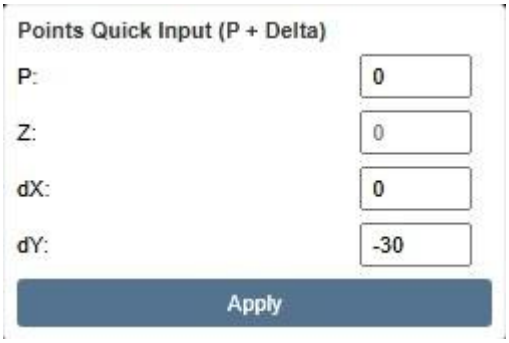
FAQ:

- **Why would I need a point at a circle centre?:** Circle centres are commonly used as reference points for subsequent geometry — for example, creating lines through the centre, measuring distances between centres, or defining bolt-hole patterns.
- **Can I use this with an arc?:** No. Use Point/On,A for points on arcs at a specified angle. Arc centres are available in the Geometry Information Display but Point/Centre is specific to full circles.

3. Point/Delta — Delta Offset Point

What It Does: The Point/Delta operator creates a new point by adding specified X and Y offset values to an existing reference point. This is the standard method for creating points at known distances from existing geometry.

Quick Input:



Direction Selector: No selector required — result is uniquely determined.

Worked Example:

```
Setup:
  P0 = (100, 50)

Point/P0, dX=25, dY=10, 0
→ P1 = (125, 60)    [+25 in X, +10 in Y]

Point/P0, dX=-30, dY=0, 0
→ P3 = (70, 50)     [-30 in X, no Y change]

Point/P0, dX=0, dY=-20, 0
→ P4 = (100, 30)    [no X change, -20 in Y]
```

FAQ:

- **What is the difference between Point/Delta and Point/Angle,Dist?:** Point/Delta uses Cartesian X and Y offsets. Point/Angle,Dist uses polar coordinates — an angle and a distance. Use Delta when you know the X and Y distances. Use Angle,Dist when you know the direction
- **Can I use decimal offset values?:** Yes. All offset values support decimal precision — for example dX=12.5, dY=-7.25.

4. Point/Intof,A,A — Arc / Arc Intersection

What It Does: The Point/Intof,A,A operator creates a point at the intersection of two arcs. Both arcs have defined start and end angles — only intersections within both arc sweeps are valid results. Selector required: Two intersections may exist within the arc sweeps. The direction selector specifies which one to create.

Quick Input:



Direction Selector: Direction Selector Selector Picks XLarge Intersection with largest X coordinate XSmall Intersection with smallest X coordinate YLarge Intersection with largest Y coordinate YSmall Intersection with smallest Y coordinate <div class="docs-section"

Worked Example:

```
Setup:
  A4 = Arc: centre (0,0), r=40, 0° to 90° CCW
  A2 = Arc: centre (50,0), r=40, 90° to 180° CCW

Point/YLarge, Intof, A4, A2
→ P0 = (25, 32.016)   ← upper intersection

Point/YSmall, Intof, A4, A2
→ Error: only one valid intersection within both sweeps
```

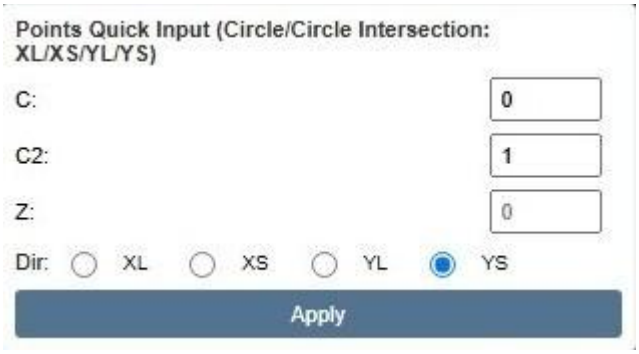
FAQ:

- **What if the arcs do not intersect within their sweeps?:** XyzPilot returns an error. The underlying circles may intersect, but if the intersection points fall outside either arc sweep, no valid result exists.
- **How is this different from Point/Intof,C,C?:** Point/Intof,C,C works with full circles. Point/Intof,A,A respects both arc sweep angles — only intersections within both arcs are valid.

5. Point/Intof,C,C — Circle / Circle Intersection

What It Does: Two circles can intersect at two points. The Point/Intof,C,C operator computes both intersection points analytically using the radical axis method and creates the one specified by the direction selector. The result is an exact analytic point — computed directly from the two circle equations. No iteration, no approximation. Construction Tier: The created point is disposable. Delete it freely once the product geometry built from it is complete.

Quick Input:



Direction Selector: Direction Selector Selector Picks XLarge Intersection point with the largest X coordinate XSmall Intersection point with the smallest X coordinate YLarge Intersection point with the largest Y coordinate (upper) YSmall Intersection point with the smallest Y coordinate (lower) Important: Use the selec

Worked Example:

```
Setup:
  C0 = Centre (50, 50), Radius 40
  C1 = Centre (90, 50), Radius 40

Point/YSmall, Intof, C0, C1
→ P3 = (70.000, 15.359)   ← lower intersection

Point/YLarge, Intof, C0, C1
→ P4 = (70.000, 84.641)   ← upper intersection
```

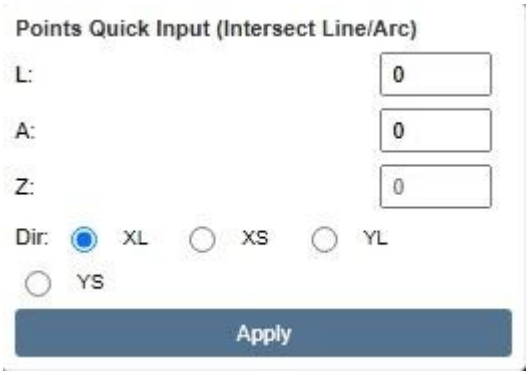
FAQ:

- **What if the circles do not intersect?:** If the distance between centres is greater than the sum of radii (circles too far apart) or less than the absolute difference of radii (one circle inside the other), no intersection exists. XyzPilot r
- **What if the circles are tangent?:** If the circles are tangent (one intersection point), use Point/Tanto,C,C instead. It is the correct operator for tangent points between circles.
- **What if both circles are identical?:** Identical circles have infinite intersections. XyzPilot returns an error — the operation is geometrically undefined.

6. Point/Intof,L,A — Line / Arc Intersection

What It Does: The Point/Intof,L,A operator creates a point at the intersection of a line and an arc. Unlike a full circle, an arc has defined start and end angles — only intersections within the arc sweep are valid. Selector required: Two intersections may exist. The direction selector specifies which one to create.

Quick Input:



Direction Selector: Direction Selector Selector Picks XLarge Intersection with largest X coordinate XSmall Intersection with smallest X coordinate YLarge Intersection with largest Y coordinate YSmall Intersection with smallest Y coordinate <div class="docs-section"

Worked Example:

```
Setup:
  L0 = Horizontal line at Y=10
  A0 = Arc: centre (0,0), r=20, 0° to 180° CCW

Point/XLarge, Intof, L0, A0
→ P0 = (17.321, 10)   ← right intersection
```

```
Point/XSmall, Intof, L0, A0
→ P1 = (-17.321, 10)  ← left intersection
```

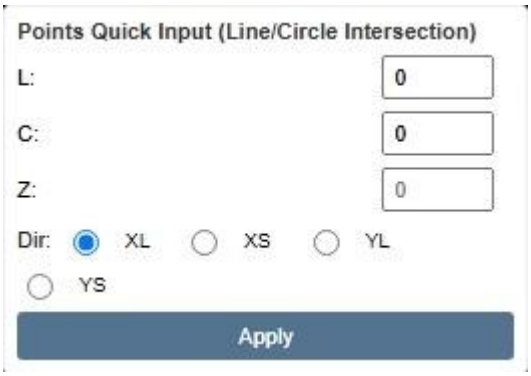
FAQ:

- **What if the line intersects the full circle but not the arc?:** If the intersection points fall outside the arc sweep angles, XyzPilot returns an error. The line does not intersect the arc within its defined extent.
- **How is this different from Point/Intof,L,C?:** Point/Intof,L,C works with full circles. Point/Intof,L,A respects the arc start and end angles — only intersections within the arc sweep are valid results.

7. Point/Intof,L,C — Line / Circle Intersection

What It Does: A line and a circle can intersect at two points. The Point/Intof,L,C operator computes both intersection points analytically and creates the one specified by the direction selector. The result is an exact analytic point — computed from the line equation and circle equation simultaneously. No iteration, no approximation, no tolerance. Construction Tier: The created point is a construction entity. It can be deleted freely after the product geometry built from it is complete.

Quick Input:



Direction Selector: Direction Selector The direction selector tells XyzPilot which of the two intersection points to create: Selector Picks Use When XLarge The intersection point with the largest X coordinate You want the right-side intersection XSmall The intersection point with the smallest X coordinate You want the

Worked Example:

```
Setup:
  L0 = Horizontal line through Y=50
  C0 = Centre (75, 50), Radius 25

Point/XLarge, Intof, L0, C0
→ P2 = (100, 50)   ← right intersection

Point/XSmall, Intof, L0, C0
→ P3 = (50, 50)    ← left intersection
```

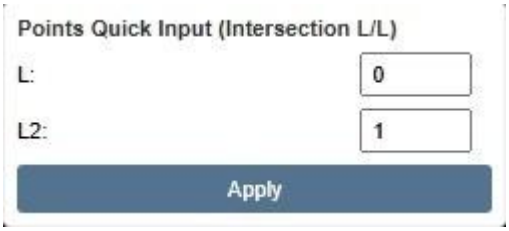
FAQ:

- **What if the line does not intersect the circle?:** If the line does not intersect the circle (the discriminant is negative), XyzPilot returns an error. No point is created. Check that the line passes through or intersects the circle before using this
- **What if the line is tangent to the circle?:** If the line is tangent to the circle (discriminant = 0), both intersection points are the same. Use Point/Tanto,L,C instead — it is the correct operator for tangent points.
- **Why does the canvas preview show the wrong point?:** While the selector is being chosen, the transient preview may show a point in the wrong position. This is a preview only — the point has not been created yet. Always confirm your selector choice befor

8. Point/Intof,L,L — Line / Line Intersection

What It Does: The Point/Intof,L,L operator creates a point at the exact intersection of two lines. Two non-parallel lines intersect at exactly one point — no selector is required. No selector needed: Unlike line/circle or circle/circle intersections, two lines produce at most one intersection point. The result is uniquely determined.

Quick Input:



Direction Selector: No selector required — result is uniquely determined.

Worked Example:

```
Example 1 — Perpendicular lines:
  L0 = Horizontal line at Y=50
  L1 = Vertical line at X=75

Point/Intof, L0, L1
→ P15 = (75, 50)

Example 2 — Angled lines:
  L0 = Line: y = 2x + 10
  L1 = Line: y = -x + 70

Point/Intof, L0, L1
→ P16 = (20, 50)

Example 3 — Diagonal lines:
  L0 = Line at 45° through origin
  L1 = Line at 135° through (100, 0)

Point/Intof, L0, L1
→ P17 = (50, 50)
```

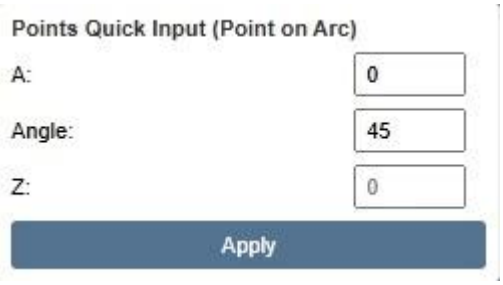
FAQ:

- **What if the lines are parallel?:** Parallel lines do not intersect. XyzPilot returns an error if the lines are parallel (determinant = 0). Check that the lines are not parallel before using this operator.
- **What if the lines are the same line?:** Identical lines have infinite intersections. XyzPilot returns an error — the operation is geometrically undefined.

9. Point/On,A,Atangl — Point on Arc at Angle

What It Does: The Point/On,A,Atangl operator creates a point on the circumference of an arc at a specified angular position. The angle must fall within the arc sweep — between the start and end angles of the arc. Arc sweep check: The specified angle must be within the arc sweep. If the angle falls outside the arc, XyzPilot returns an error.

Quick Input:



Direction Selector: No selector required — result is uniquely determined.

Worked Example:

```
Setup:
  A0 = Arc: centre (0,0), r=50, start=0°, end=90° CCW

Point/On, A0, Atangl, 45, 0
→ P0 = (35.355, 35.355)  [at 45° — within sweep ✓]

Point/On, A0, Atangl, 90, 0
→ P1 = (0, 50)           [at 90° — arc end point ✓]

Point/On, A0, Atangl, 120, 0
→ Error: 120° is outside the arc sweep (0° to 90°)
```

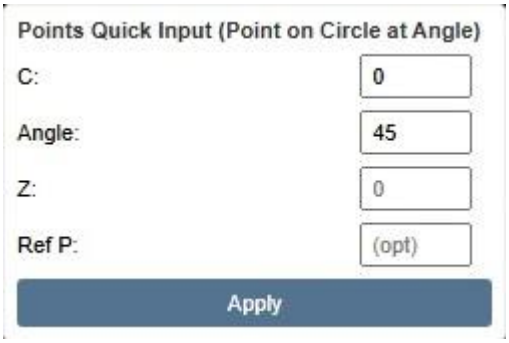
FAQ:

- **What if the angle is outside the arc sweep?:** XyzPilot returns an error. The angle must fall within the arc sweep angles. Use Point/On,C,Atangl for full circles where any angle is valid.
- **How do I find the arc start and end angles?:** Use the Geometry Information Display or Show Coordinates panel to view the arc properties including start_angle, end_angle, and sweep_degrees.

10. Point/On,C,Atangl — Point on Circle at Angle

What It Does: The Point/On,C,Atangl operator creates a point on the circumference of a circle at a specified angular position. The angle is measured from the positive X axis, counterclockwise.

Quick Input:



Direction Selector: No selector required — result is uniquely determined.

Worked Example:

```
Setup:
  C0 = Centre (0,0), radius 100

Point/On, C0, Atangl, 45, 0
→ P4 = (70.711, 70.711)  [at 45°]

Point/On, C0, Atangl, 90, 0
→ P5 = (0, 100)          [at 90° — top of circle]

Point/On, C0, Atangl, 180, 0
→ P6 = (-100, 0)         [at 180° — left of circle]

Point/On, C0, Atangl, 270, 0
→ P7 = (0, -100)         [at 270° — bottom of circle]
```

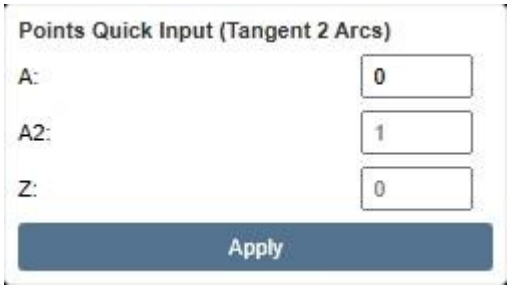
FAQ:

- **How is the angle measured?:** Angles are measured from the positive X axis, counterclockwise. 0° is the rightmost point of the circle. 90° is the top. 180° is the leftmost. 270° is the bottom.
- **Can I use negative angles?:** Yes. Negative angles are measured clockwise from the +X axis. -90° is equivalent to 270°.

11. Point/Tanto,A,A — Tangent Point — Arc / Arc

What It Does: The Point/Tanto,A,A operator creates a point at the exact location where two arcs are tangent to each other. The arcs must be tangent — either externally, touching on the outside, or internally, with one inside the other.

Quick Input:



Direction Selector: No selector required — result is uniquely determined.

Worked Example:

```
Setup:
  A0 = Arc: centre (0,0), r=30, 0° to 90° CCW
  A1 = Arc: centre (60,0), r=30, 90° to 180° CCW
  External tangency: dist(centres) = 60 = 30 + 30 ✓

Point/Tanto, A0, A1, 0
→ P0 = (30, 0)  [tangent point between arcs]
```

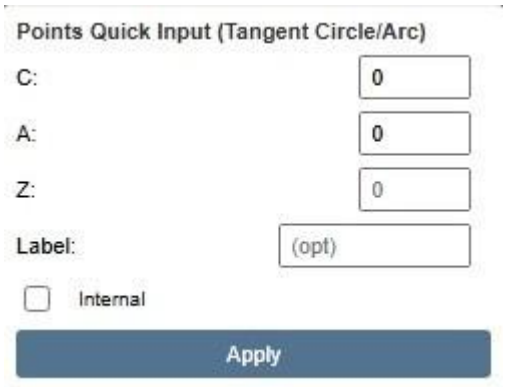
FAQ:

- **What if the arcs are not tangent?:** XyzPilot returns an error. The underlying circles must be tangent for a tangent point to exist between the arcs.
- **Does the tangent point have to be within both arc sweeps?:** Yes. The tangent point must lie within the sweep of both arcs. If it falls outside either arc sweep, XyzPilot returns an error.

12. Point/Tanto,C,A — Tangent Point — Circle / Arc

What It Does: The Point/Tanto,C,A operator creates a point at the exact location where a circle and an arc are tangent to each other. The tangency direction defaults to external unless internal is selected in the Quick Input panel. Canvas Preview: The transient preview may show the point in the wrong position while the tangency direction is being selected. Always verify the final position after committing.

Quick Input:



Direction Selector: Direction Selector The tangency direction selector determines whether the circle and arc touch on the outside (external) or inside (internal): Direction Meaning External

(default) Circle and arc touch on the outside — the tangent point is between them Internal One entity is inside the other — they t

Worked Example:

```
Setup:
  C0 = Circle: centre (0,0), radius 20
  A0 = Arc: centre (50,0), radius 20, 90° to 270° CCW
  External tangency: dist(centres) = 50 = 20 + 20 + 10... check geometry

Point/Tanto, C0, A0, 0  [External]
→ P0 = tangent point on outer boundary

Point/Tanto, C0, A0, 0  [Internal]
→ P1 = tangent point on inner boundary
```

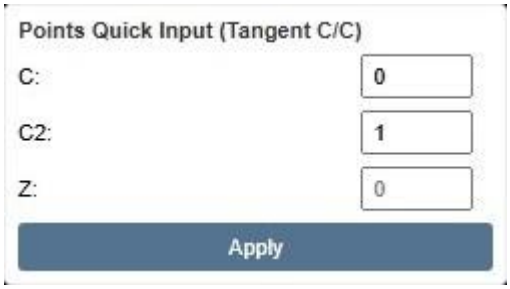
FAQ:

- **What is the difference between internal and external tangency?:** External tangency: the circle and arc touch on the outside, with the tangent point between them. Internal tangency: one is inside the other, touching at one point on the inner boundary.
- **Why does the preview show the wrong point?:** The transient preview updates as you change the tangency direction. The point shown before you commit may not be the final result. Always verify after committing.

13. Point/Tanto,C,C — Tangent Point — Circle / Circle

What It Does: The Point/Tanto,C,C operator creates a point at the exact location where two circles are tangent to each other. Two circles can be tangent externally, touching on the outside, or internally, with one inside the other and touching at one point. Prerequisite: The circles must be tangent. External tangency: dist(centres) = r1 + r2. Internal tangency: dist(centres) = |r1 - r2|.

Quick Input:



Direction Selector: No selector required — result is uniquely determined.

Worked Example:

```
Example 1 — External tangency:
  C0 = Centre (50, 50), radius 25
  C1 = Centre (100, 50), radius 25
  dist(centres) = 50 = 25 + 25 ✓ (externally tangent)

Point/Tanto, C0, C1, 0
```

```
→ P14 = (75, 50)  [midpoint between centres]

Example 2 — Internal tangency:
  C0 = Centre (0, 0), radius 50
  C1 = Centre (20, 0), radius 30
  dist(centres) = 20 = 50 - 30 ✓ (internally tangent)

Point/Tanto, C0, C1, 0
→
```

FAQ:

- **What if the circles are not tangent?:** XyzPilot returns an error. The circles must be exactly tangent for a tangent point to exist. Check that dist(centres) equals r1+r2 (external) or |r1-r2| (internal).
- **How do I know if circles are externally or internally tangent?:** External: the circles touch on the outside, dist(centres) = r1 + r2. Internal: one circle is inside the other and they touch at one point, dist(centres) = |r1 - r2|.

14. Point/Tanto,L,C — Tangent Point — Line / Circle

What It Does: The Point/Tanto,L,C operator creates a point at the exact location where a line is tangent to a circle. The tangent point is the point on the circle circumference where the line touches — the radius at this point is perpendicular to the line. Prerequisite: The line must already be tangent to the circle. If the line does not touch the circle, no tangent point exists and XyzPilot returns an error.

Quick Input:



Direction Selector: No selector required — result is uniquely determined.

Worked Example:

```
Setup:
  L0 = Horizontal line at Y=75
  C0 = Centre (50, 50), radius 25

Point/Tanto, L0, C0, 0
→ P13 = (50, 75)
  [tangent point at top of circle]

Verification:
  dist(C0 centre, P13) = dist((50,50),(50,75)) = 25 = radius ✓
  Line L0 is perpendicular to radius at P13 ✓
```

FAQ:

- **What if the line is not tangent to the circle?:** XyzPilot returns an error. The line must be tangent to the circle for a tangent point to exist. Use Line/P,Tanto,C to create a tangent line first.
- **How do I create a tangent line first?:** Use Line/P,Tanto,C to create a line through a point tangent to a circle, or Line/Parlel,L,Tanto,C to create a parallel tangent line.

15. Point/X,Y — Coordinate Point

What It Does: The Point/X,Y operator creates a point at the exact coordinates you specify. It is the most fundamental operator in XyzPilot — the starting point for all geometry construction. No selector is required. The result is uniquely determined by the two coordinate values. Construction Tier: Points are disposable. Delete them freely once the product geometry built from them is complete, or use Edit → Clear All Points to remove all points at once.

Quick Input:



Direction Selector: No selector required — result is uniquely determined.

Worked Example:

```
Example 1:
Point/100, 50, 0
→ P0 = (100, 50, 0)

Example 2:
Point/0, 0, 0
→ P1 = (0, 0, 0)  [origin]

Example 3:
Point/-25.5, 75.25, 0
→ P2 = (-25.5, 75.25, 0)  [negative X, decimal values]
```

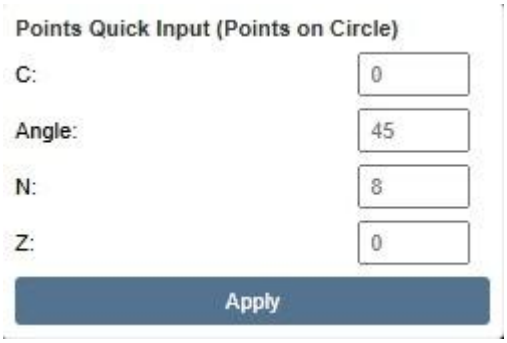
FAQ:

- **What units does XyzPilot use for coordinates?:** XyzPilot uses millimetres (mm) for all length values. Angles are in degrees. Coordinates use the standard Cartesian X, Y, Z system.
- **Can I use negative coordinates?:** Yes. Negative X values are to the left of the origin. Negative Y values are below the origin. All coordinate values — positive, negative, and decimal — are supported.

16. Points/On,C,N — N Equally Spaced Points on Circle

What It Does: The Points/On,C,N operator creates N equally spaced points around the circumference of a circle, starting at a specified angle. This is the primary operator for bolt-hole patterns, regular polygon vertices, and circular arrays.

Quick Input:



Direction Selector: No selector required — result is uniquely determined.

Worked Example:

```
Example 1 — 6-hole bolt pattern:
  C0 = Centre (0,0), radius 50

Points/On, C0, 6, 0, 0
→ P0 = (50, 0)        [at 0°]
→ P1 = (25, 43.301)   [at 60°]
→ P2 = (-25, 43.301)  [at 120°]
→ P3 = (-50, 0)       [at 180°]
→ P4 = (-25, -43.301)[at 240°]
→ P5 = (25, -43.301)  [at 300°]

Example 2 — 4-hole pattern at 45° start:
  C0 = Centre (0,0), radius 30

Points/On, C0, 4, 45, 0
→ P0 = (21.213, 21.213)    [at 4
```

FAQ:

- **How do I create a bolt-hole pattern?:** Use Points/On,C,N to create the hole centre points, then use Circle/Centre,R at each point to create the hole circles. The bolt circle radius is the pitch circle diameter / 2.
- **What is the starting angle?:** The starting angle is measured from the positive X axis, counterclockwise. 0° places the first point at the rightmost position. 90° places it at the top.