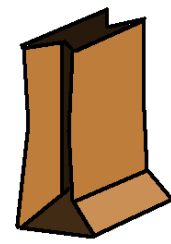
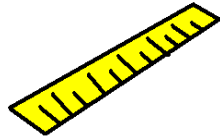




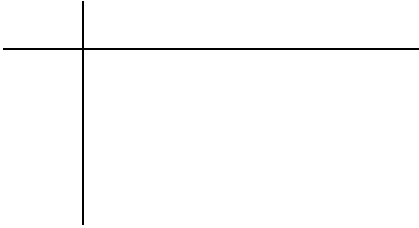
**J&H Machine Tools**



**ZEISS**

**LUNCHEON LEARN**

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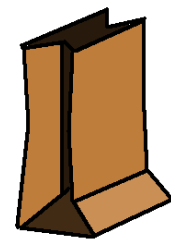
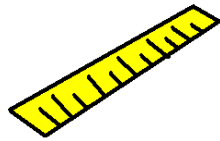
# ***SPLINE MEASUREMENTS***

**...**

# ***WITH CALYPSO!***



**J&H Machine Tools**



**ZEISS**

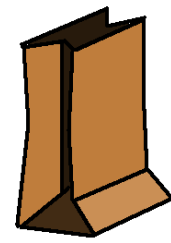
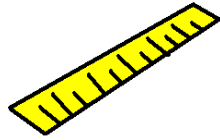
So...

You have a part with a spline on it.

You need to measure pitch, “over pin” diameter, and runout.

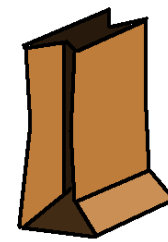
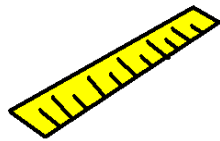


**J&H Machine Tools**



**ZEISS**

**I HAVE THE ANSWER!**



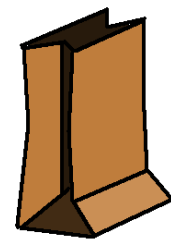
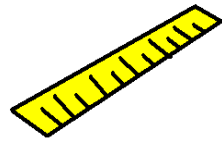
ZEISS

If you desktop looks like this...





**J&H Machine Tools**



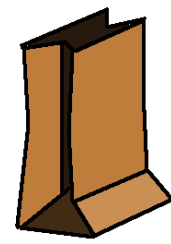
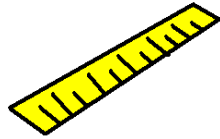
**ZEISS**

make it look like this...





**J&H Machine Tools**



**ZEISS**

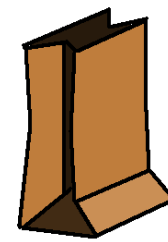
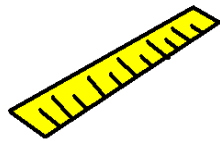
**LUNCHEON LEARN**

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***SPLINE  
MEASUREMENTS***

• • •

**Any Questions?**  
***WITH CALYPSO!***

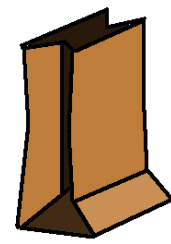
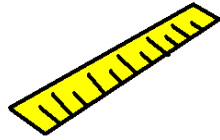


You don't have Gear Pro?  
You can do it in Calypso!!!!





**J&H Machine Tools**



**ZEISS**

To pull it off, you need to know lots  
of little tricks!

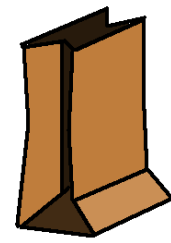
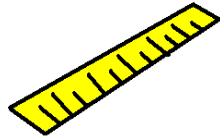
**Trick 1**

Self-Center Points



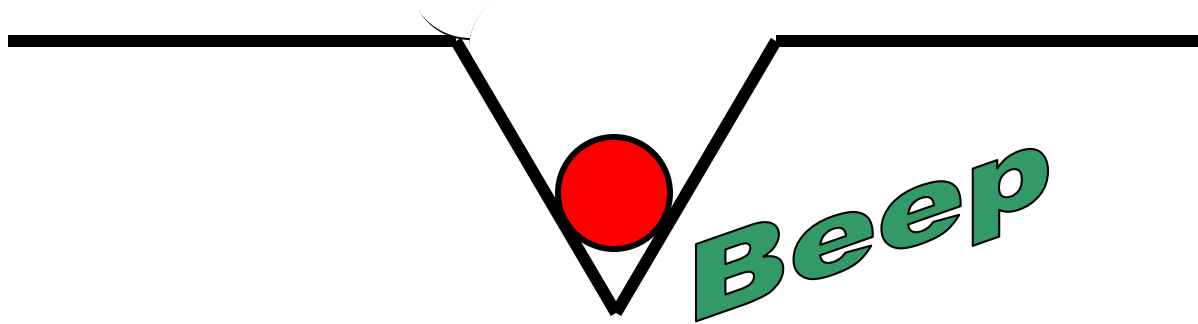


**J&H Machine Tools**



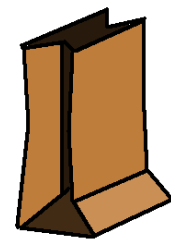
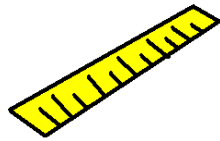
**ZEISS**

# Self-Center Points





J&H Machine Tools



ZEISS

Calypso User Desk - (C) Carl Zeiss - spline

File Edit View Resources Features Constructio

Define Nominal Geometry (Probe, Enter, or

Features

Point1

Comment Projection Strategy

None None Evaluat

Clearance Group Nominal Definition Alignment

CP +Z Options Base Alignme

Tolerance For:	Nominal	Actual
<input type="checkbox"/> X	0.9120	0.908
<input type="checkbox"/> Y	-0.0000	-0.076
<input type="checkbox"/> Z	-0.0476	-0.114
i	-1.0000	-1.000
j	0.0000	0.000
k	0.0000	0.000

Sigma Form Points

0.0000 0.0000 1

Min Point no Point no Max

OK Reset

Strategy

Point1

Point List

Point1

Display of Normal

Coordinates Relative T

Feature

No.	X Coord
1	0.0000

Clearance D

Probing Poi

OK

Self Center Probing: Point1

Probe Self Centering

Clamping of the machine axis in

X clamped

Y clamped

z clamped

Adjust measuring force

Probe In Normal Direction

Own Selection

Fx: 0.0000 mN

Fy: 0.0000 mN

Fz: -200.0000 mN

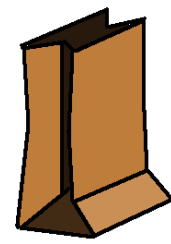
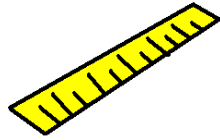
Coordinates relative to Feature

OK Cancel

Self Center Probing Execute Now!



**J&H Machine Tools**



**ZEISS**

# Self-Center Points

are available in :

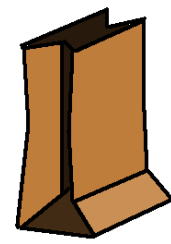
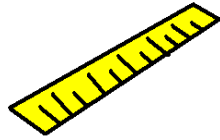
Points

Lines

Circles



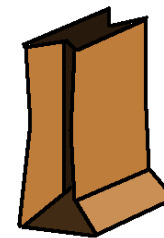
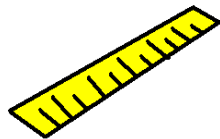
**J&H Machine Tools**









**ZEISS**

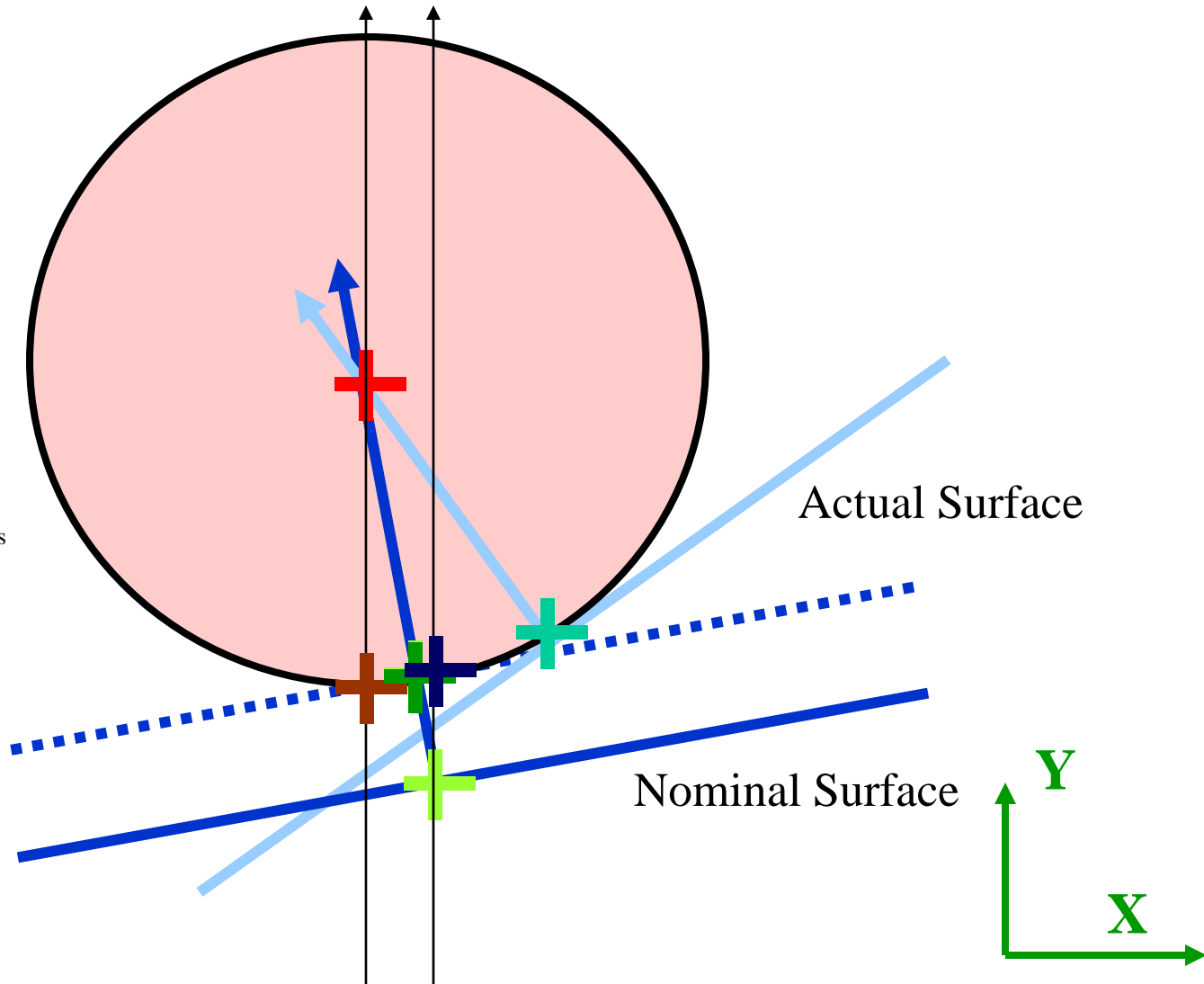
**Trick 2**

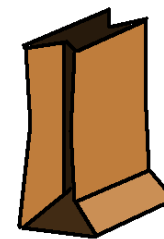
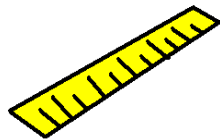
Mid Point Point Evaluation



# Types of Point Evaluation

-  Mid Point
-  Cad Point
-  Touch Point
-  Plane Point  
*Assuming plane measurement always*
-  Space Point
-  Net Point





Calypso User Desk - (C) Carl Zeiss - spline

File Edit View Resources Features Construction Size Form and Location Plan CAD Extras Planner Window Help Info

Define Nominal Geometry (Pro)

Features

Point1

Comment Projection

None

Clearance Group Nominal Definition

CP +Z Options

Tolerance For: Nominal

<input type="checkbox"/> X	0.9120
<input type="checkbox"/> Y	-0.0000
<input type="checkbox"/> Z	-0.0476
i	-1.0000
j	0.0000
k	0.0000

Sigma Form

0.0000 0.0000

Min Point no Point no

OK Reset

**Evaluation - Point1**

Preassignment for evaluation method

LSQ Feature

Evaluation Constraints

Location  X  Y  Z

Normal Vector

Point Modification

Stylus Radius Correction

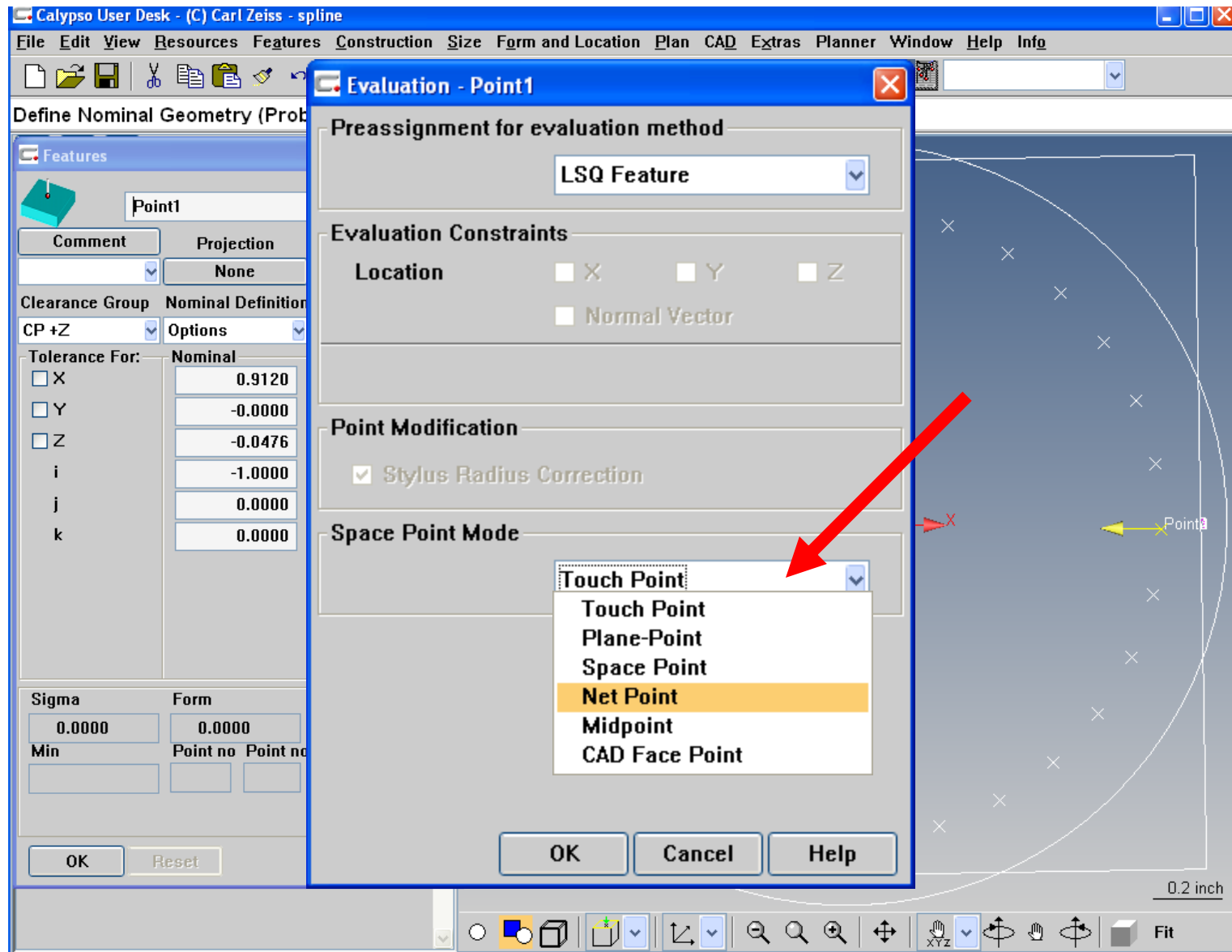
Space Point Mode

Touch Point

- Touch Point
- Plane-Point
- Space Point
- Net Point**
- Midpoint
- CAD Face Point

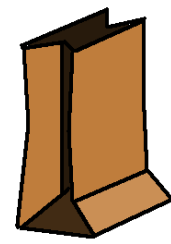
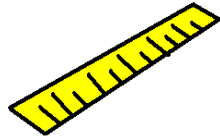
OK Cancel Help

0.2 inch





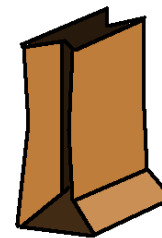
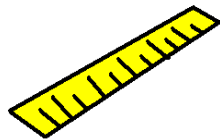
**J&H Machine Tools**



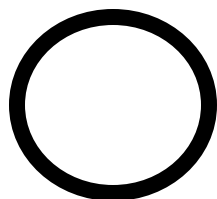
**ZEISS**

**Trick 3**

Maximum or Minimum Feature



# Max/Min Features

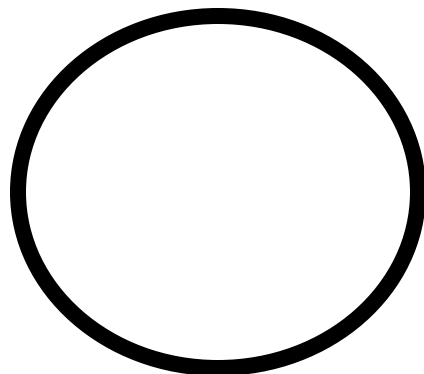
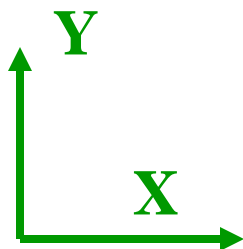


**Max Y**

**Min X**

**Max X**

**Min Diameter**



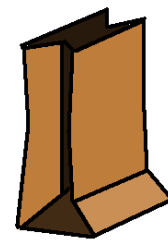
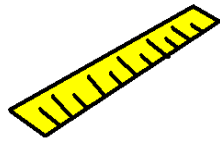
**Min Y**

**Max Diameter**





J&H Machine Tools



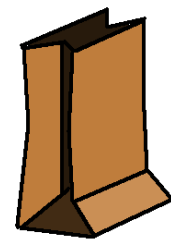
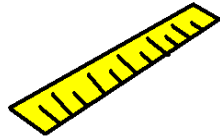
ZEISS

The screenshot shows the Calypso software interface. A 'Features' dialog box is open for 'Maximum Feature2'. The dialog includes a 'Comment' field, an 'Alignment' dropdown set to 'Base Alignment', and a list of 'Select existing Features' including Point1, Point2, and Point3. A red arrow points to the 'Y Value' field in the 'Select existing Features' list. Below this is a 'Tolerance For:' table with columns for 'Nominal' and 'Actual' values. The 3D model in the background shows a circular feature with a coordinate system (X, Y, Z) and a 'Point1' label. The scale is 0.2 inch.

Tolerance For:	Nominal	Actual
<input type="checkbox"/> X	0.9120	0.9665
<input type="checkbox"/> Y	-0.0000	0.0000
<input type="checkbox"/> Z	-0.0476	-0.0816
i	-1.0000	-1.0000
j	0.0000	0.0000
k	0.0000	0.0000



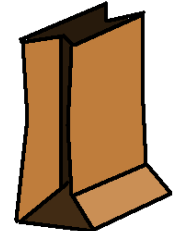
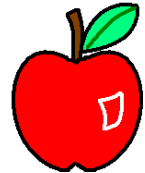
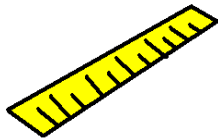
**J&H Machine Tools**



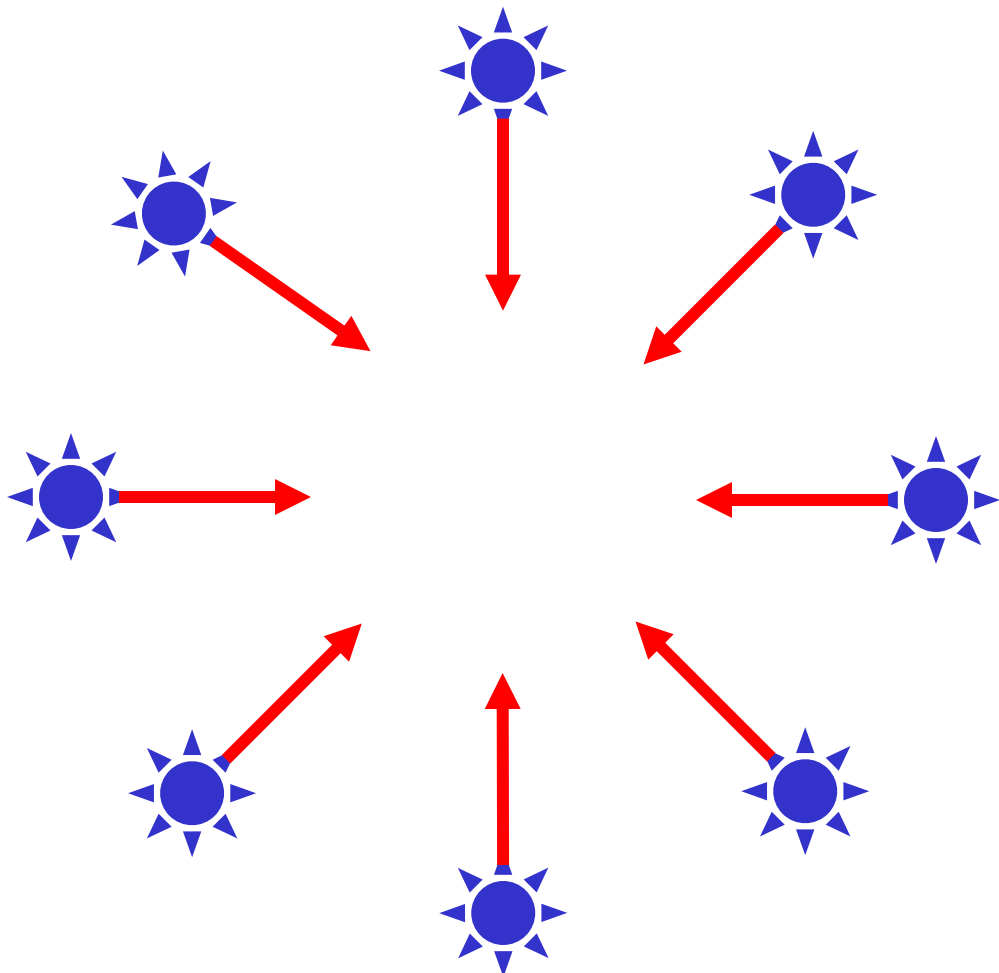
**ZEISS**

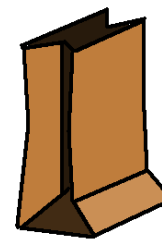
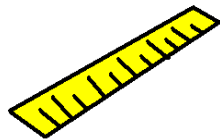
**Trick 4**

Rotational Patterns

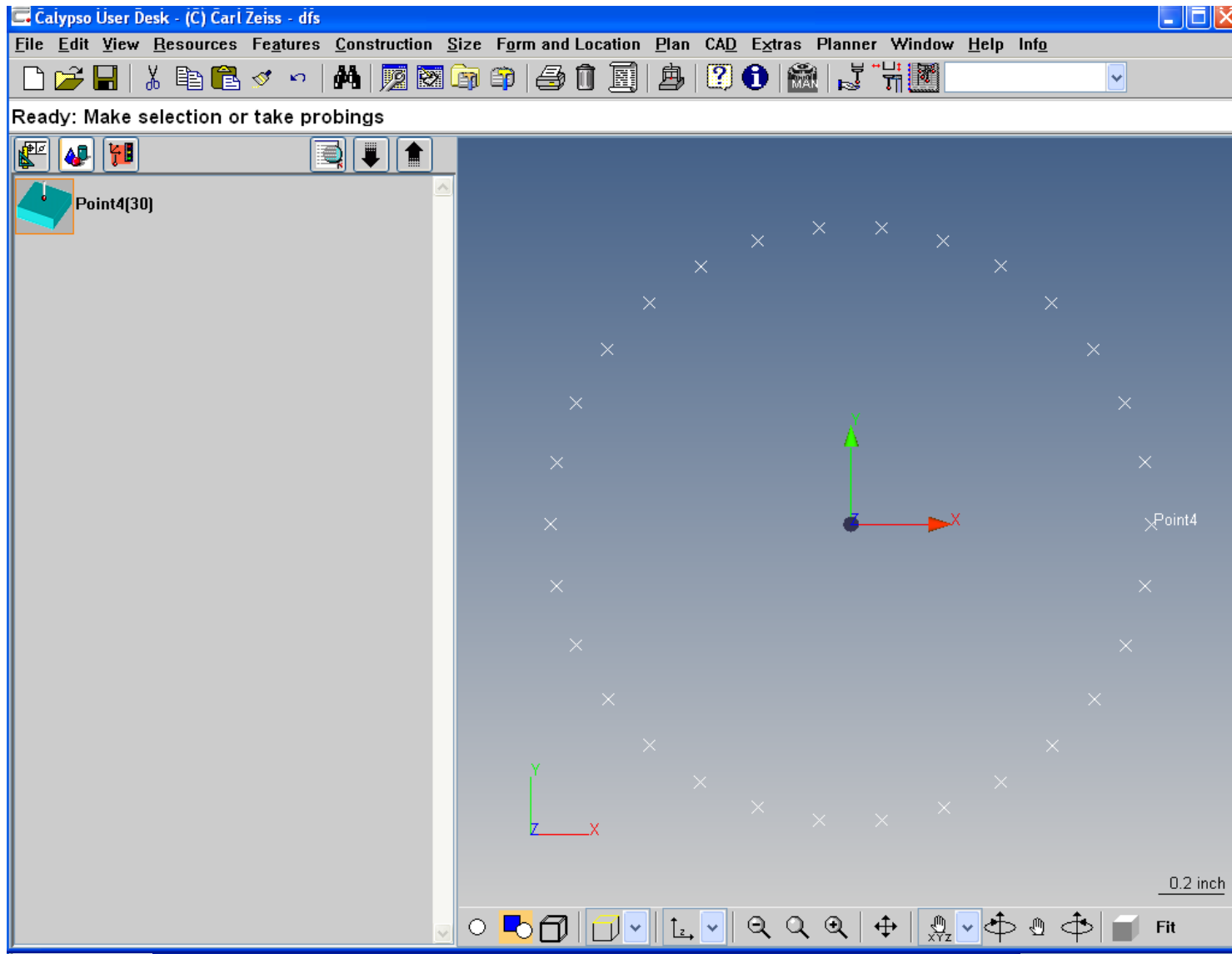


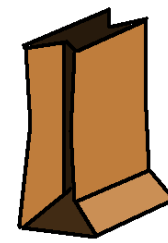
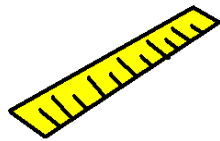
# Rotational Patterns



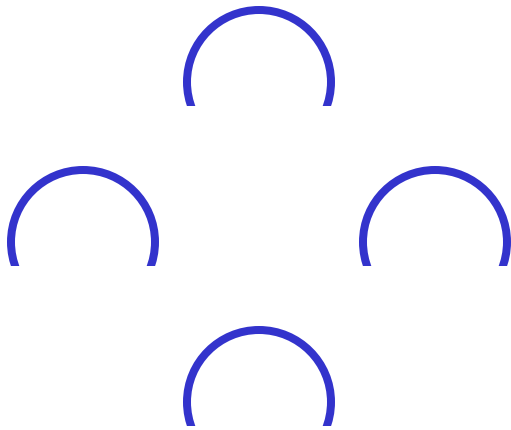


ZEISS

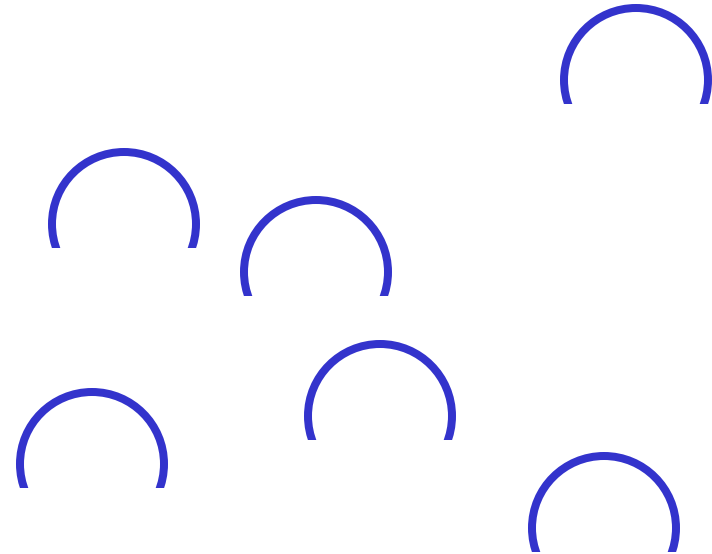




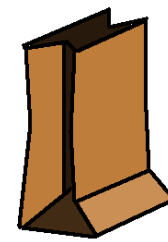
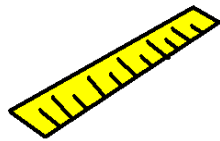
# Other Types of Patterns



Polar



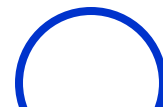
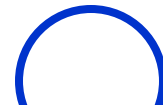
Position List



## Other Types of Patterns



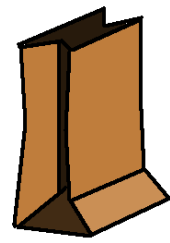
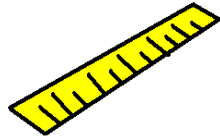
1D Linear



2D Linear



**J&H Machine Tools**



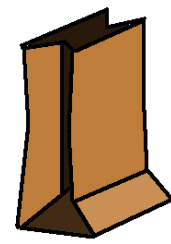
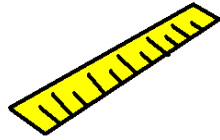
**ZEISS**

**Trick 5**

Circular Pitch



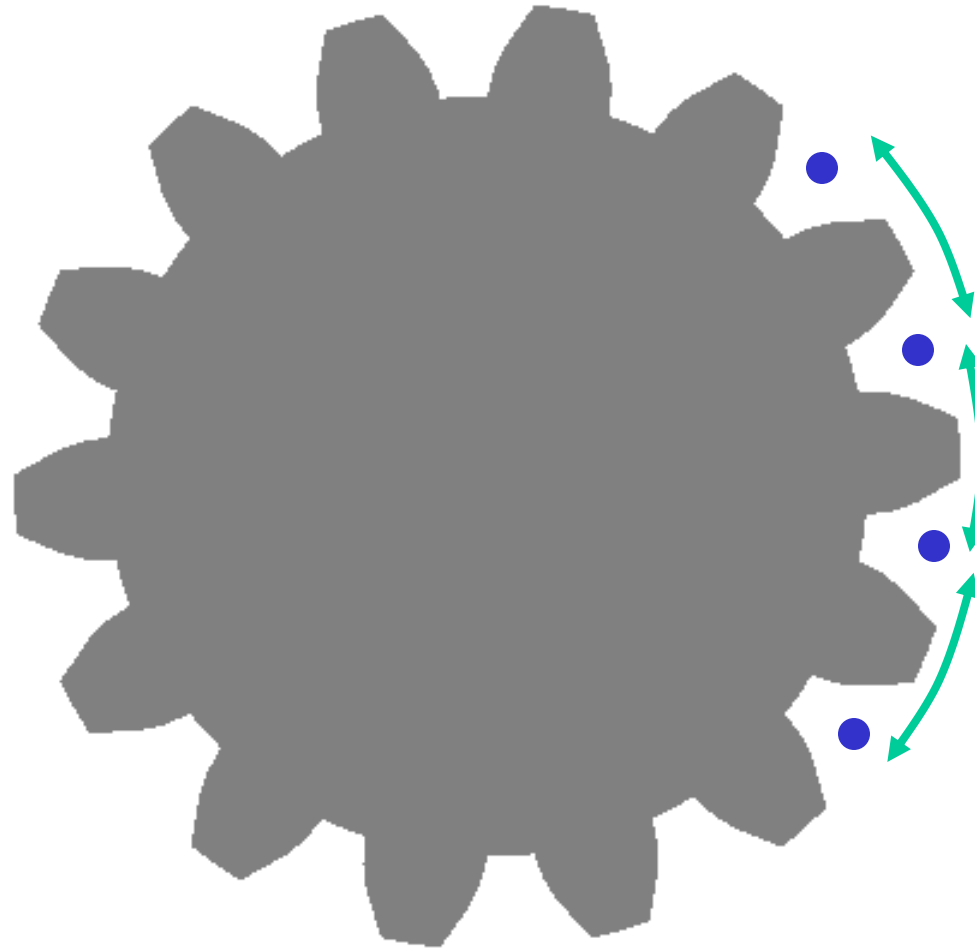
**J&H Machine Tools**



**ZEISS**

# Circular Pitch Parameters

$f_p$  : Individual Pitch Error

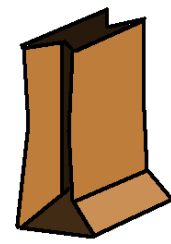
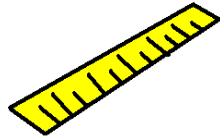


**Compared to Nominal  
Arc Length**





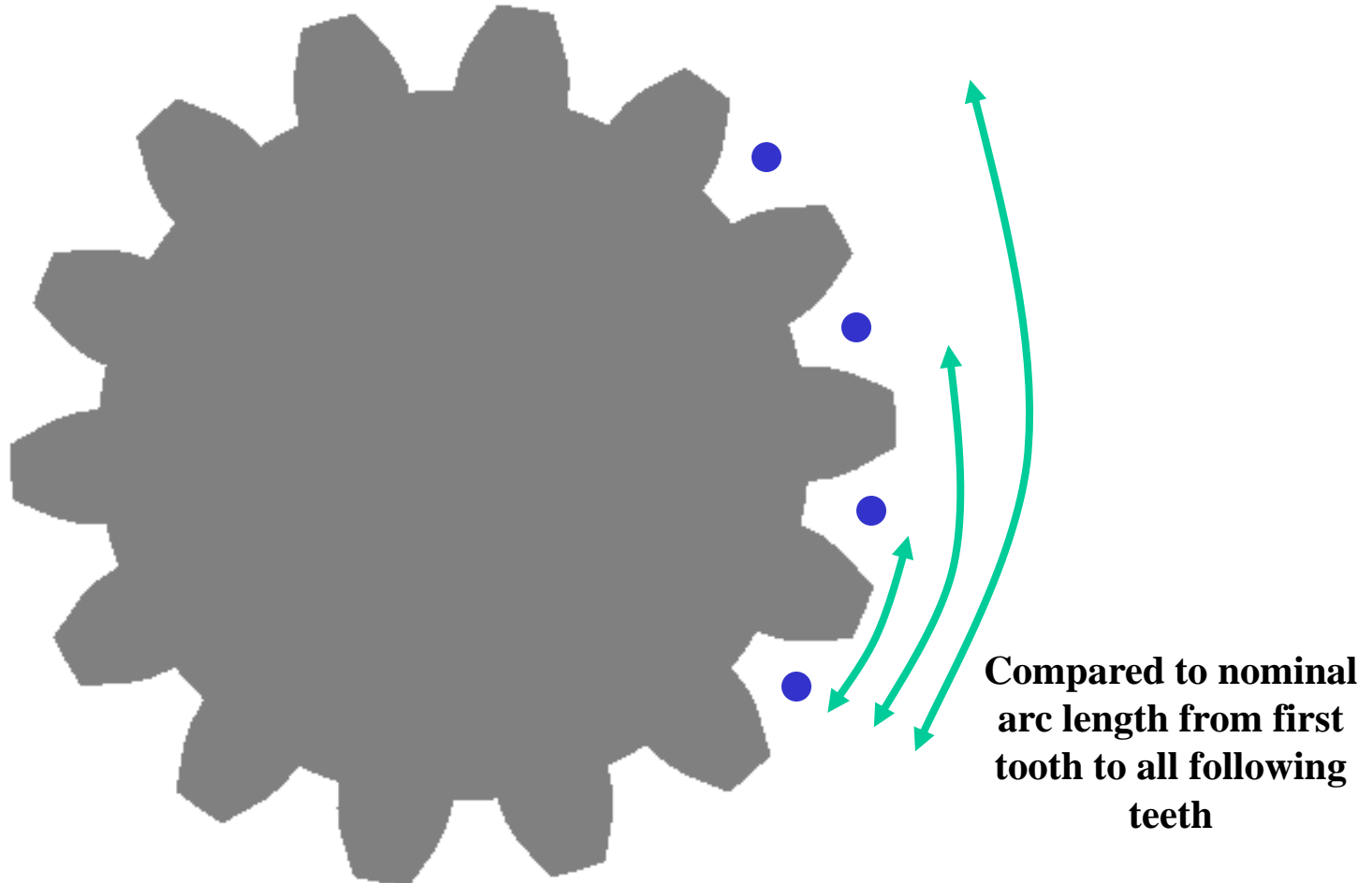
**J&H Machine Tools**



**ZEISS**

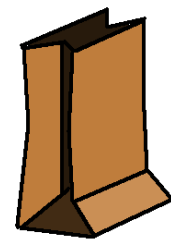
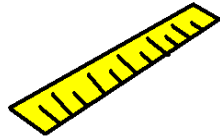
# Circular Pitch Parameters

$F_p$  : Cumulative Pitch Error





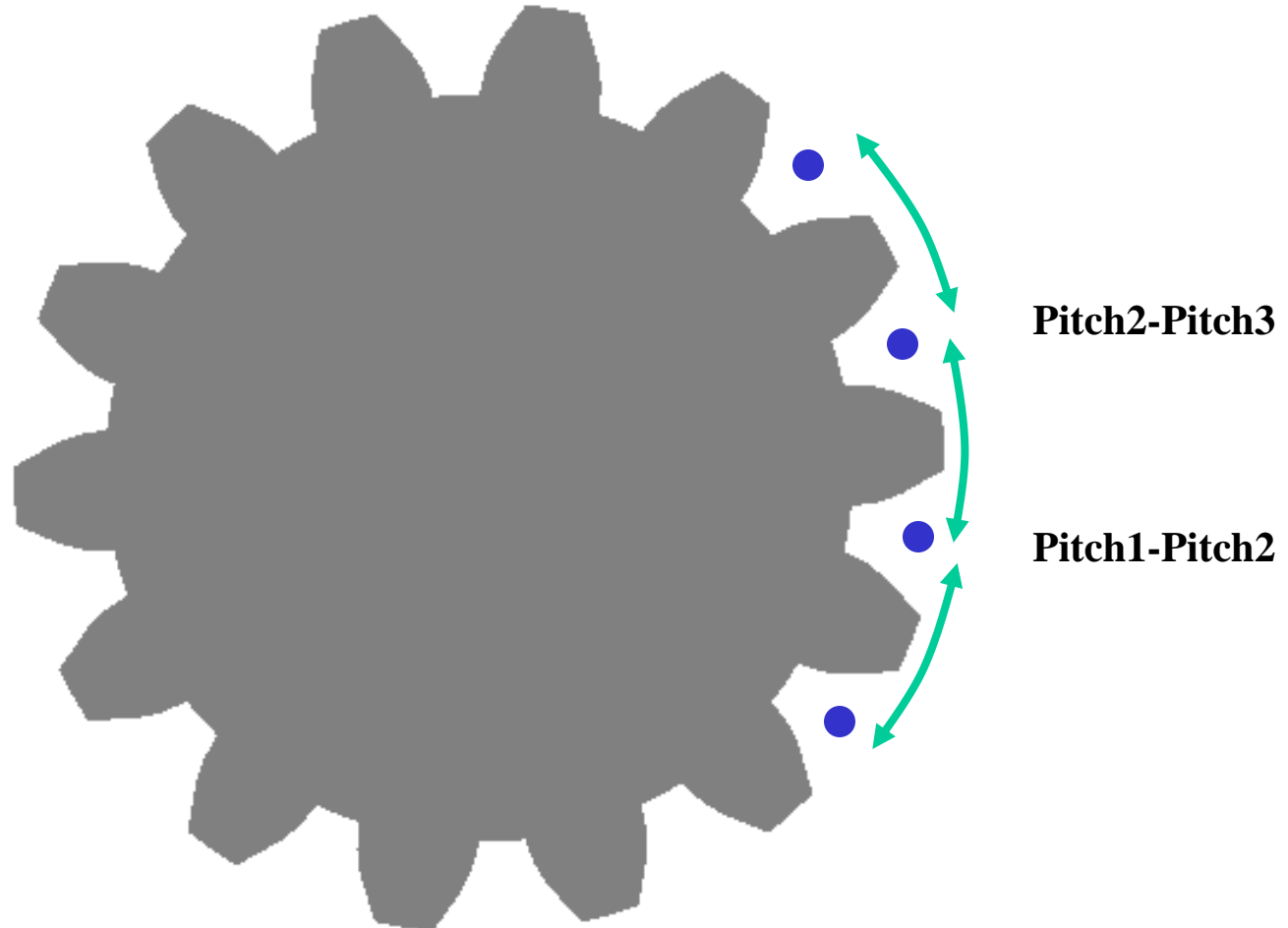
**J&H Machine Tools**

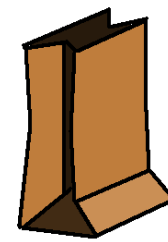
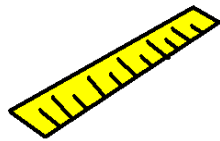


**ZEISS**

# Circular Pitch Parameters

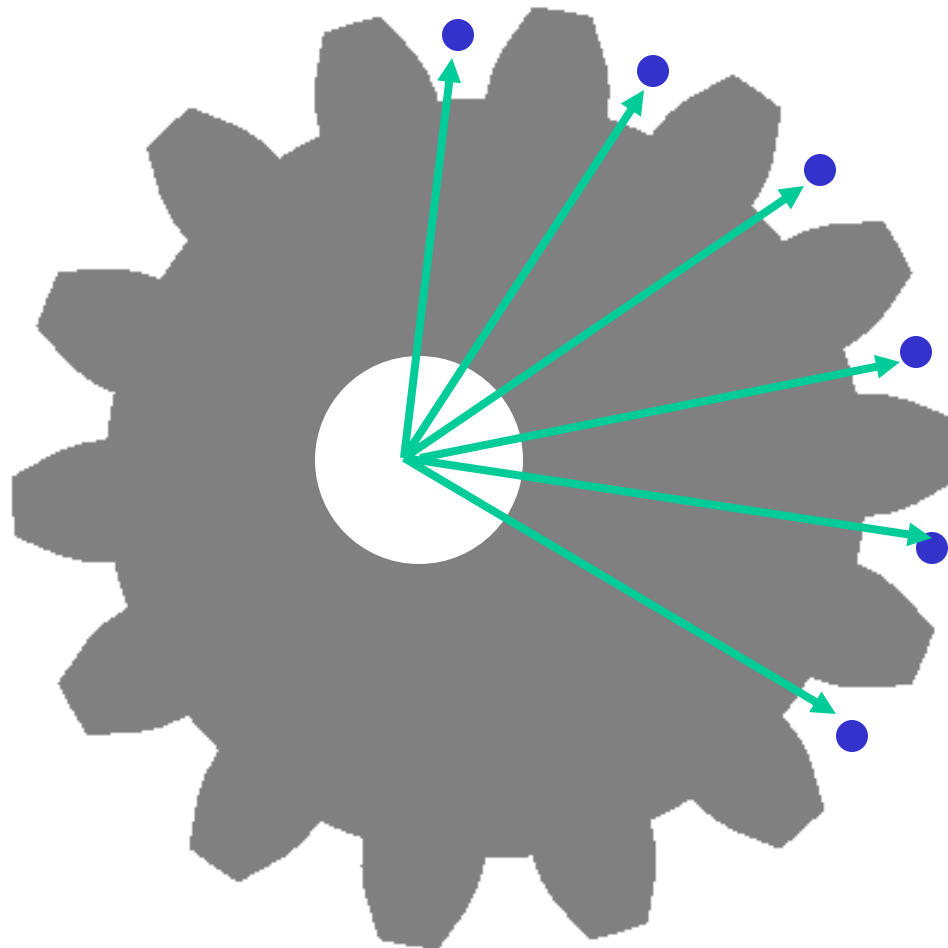
$f_u$  : Pitch Error (comparative)





# Circular Pitch Parameters

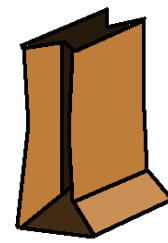
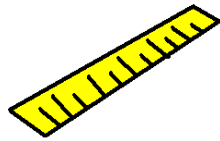
$f_r$  : Pitch Radial Runout



**Radial error from datum**



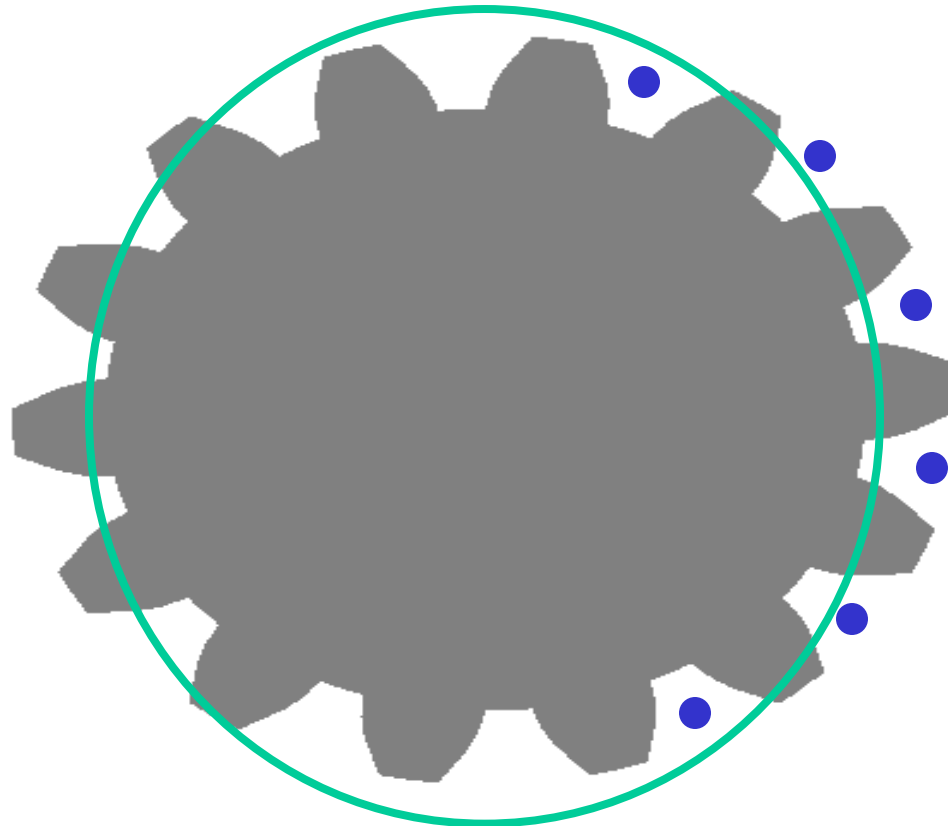
**J&H Machine Tools**



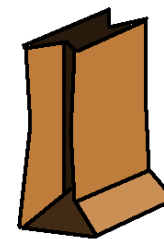
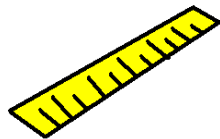
**ZEISS**

# Circular Pitch Parameters

fre : Pitch Roundness



**Error of points to a  
perfect Circle**



Calypso User Desk - (C) Carl Zeiss - spline

File Edit View Resources Extras Planner Window Help Info

### Circular Pitch

Circular Pitch1

Comment

Select Feature

Circular Pitch1

Feature 1

Point4(\*)

Unit of the Angle Characteristics (fp Fp fu)

Arc Length [in]

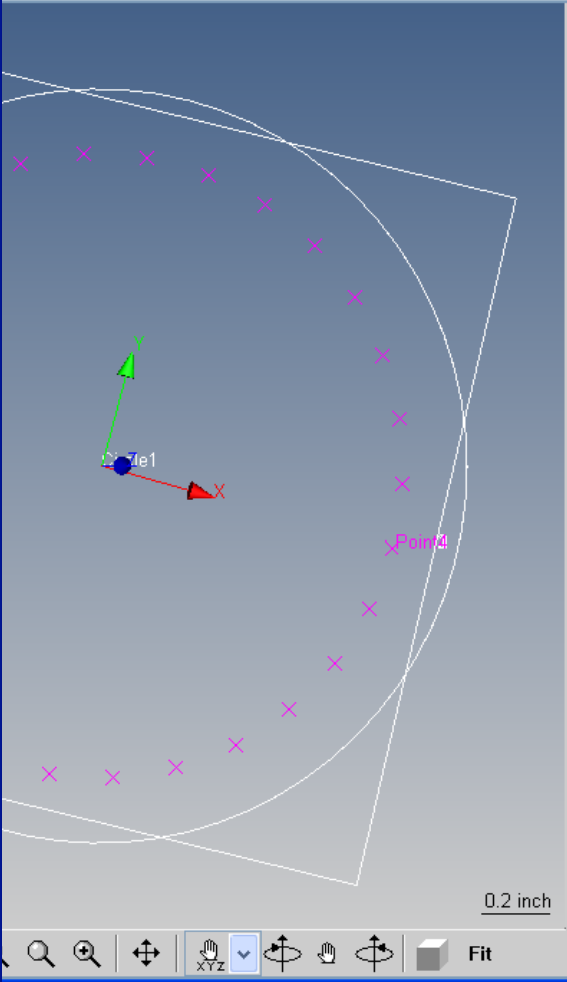
Angle [°]

Tolerance Classes

Fine

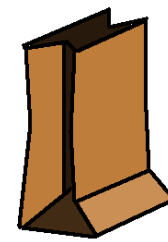
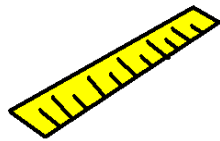
	Upper Tolerance	Lower Tolerance
<input checked="" type="checkbox"/> Individual Pitch Error fp	0.0020	-0.0020
<input checked="" type="checkbox"/> Cumulative Pitch Error Fp	0.0020	-0.0020
<input checked="" type="checkbox"/> Pitch error fu	0.0020	-0.0020
<input checked="" type="checkbox"/> Fr Rad.Runout	0.0020	-0.0020
<input checked="" type="checkbox"/> Fre Roundness	0.0020	-0.0020

OK Reset











0.2 inch

Fit

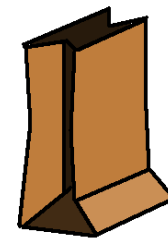
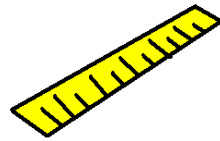


# Circular Pitch Output

	Circular Pitch1(12)^fp				--	
	0.1903	0.1910	0.0020	-0.0020		-0.0007
	Minimum Individual Pitch Error					
	Circular Pitch1(14)^fp				---	
	0.1923	0.1910	0.0020	-0.0020		0.0013
	Maximum Individual Pitch Error					
	Circular Pitch1(5)^Fp				---	
	0.9538	0.9551	0.0020	-0.0020		-0.0013
	Minimum Cumulative Pitch Error					
	Circular Pitch1(18)^Fp				---	
	3.4399	3.4383	0.0020	-0.0020		0.0016
	Maximum Cumulative Pitch Error					
	Circular Pitch1(15)^fu				---	
	-0.0014	0.0000	0.0020	-0.0020		-0.0014
	Minimum Pitch Error					
	Circular Pitch1(13)^fu				---	
	0.0010	0.0000	0.0020	-0.0020		0.0010
	Maximum Pitch Error					
	Circular Pitch1(14)^Fr					-0.0006
	-0.0026	0.0000	0.0020	-0.0020		-0.0026
	Minimum Radial Runout					
	Circular Pitch1(20)^Fr				---	
	0.0016	0.0000	0.0020	-0.0020		0.0016
	Maximum Radial Runout					
	Circular Pitch1(14)^Fre					-0.0003
	-0.0022	0.0000	0.0020	-0.0020		-0.0022
	Minimum Roundness					
	Circular Pitch1(19)^Fre				---	
	0.0013	0.0000	0.0020	-0.0020		0.0013
	Maximum Roundness					



J&H Machine Tools



ZEISS

# Circular Pitch Output

Calypso Default Printout c:\Zeiss\Calypso\home\om\workarea\inspections\spline

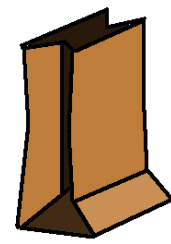
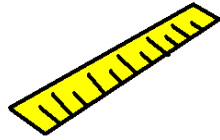
Printout

Point4(\*)

	p	pk	fp	Fp	fu	Fr	Fre
1/2	0.1903	0.1903	-0.0007	-0.0007	0.0000	-0.0003	-0.0002
2/3	0.1909	0.3812	-0.0001	-0.0008	0.0005	0.0002	0.0005
3/4	0.1908	0.5720	-0.0002	-0.0010	0.0000	-0.0001	0.0002
4/5	0.1907	0.7628	-0.0003	-0.0013	-0.0001	-0.0001	0.0003
5/6	0.1910	0.9538	0.0000	-0.0013	0.0003	-0.0005	0.0000
6/7	0.1912	1.1449	0.0001	-0.0012	0.0002	-0.0007	-0.0001
7/8	0.1912	1.3361	0.0002	-0.0010	0.0000	-0.0014	-0.0008
8/9	0.1913	1.5275	0.0003	-0.0007	0.0002	-0.0008	-0.0001
9/10	0.1913	1.7187	0.0003	-0.0004	-0.0001	-0.0006	0.0000
10/11	0.1911	1.9098	0.0001	-0.0003	-0.0002	-0.0007	0.0000
11/12	0.1913	2.1011	0.0003	-0.0001	0.0002	-0.0011	-0.0005
12/13	0.1903	2.2914	-0.0007	-0.0008	-0.0010	-0.0022	-0.0017
13/14	0.1913	2.4827	0.0003	-0.0005	0.0010	-0.0024	-0.0019
14/15	0.1923	2.6750	0.0013	0.0008	0.0010	-0.0026	-0.0022
15/16	0.1909	2.8659	-0.0001	0.0007	-0.0014	-0.0012	-0.0010
16/17	0.1914	3.0573	0.0004	0.0011	0.0005	-0.0004	-0.0002
17/18	0.1915	3.2488	0.0005	0.0015	0.0001	0.0011	0.0011
18/19	0.1911	3.4399	0.0000	0.0016	-0.0004	0.0013	0.0012
19/20	0.1909	3.6308	-0.0001	0.0015	-0.0002	0.0015	0.0013
20/21	0.1910	3.8217	0.0000	0.0014	0.0001	0.0016	0.0012
21/22	0.1909	4.0127	-0.0001	0.0013	-0.0001	0.0009	0.0005
22/23	0.1909	4.2036	-0.0001	0.0013	0.0000	0.0000	-0.0004
23/24	0.1913	4.3949	0.0003	0.0015	0.0004	-0.0014	-0.0018
24/25	0.1906	4.5855	-0.0004	0.0011	-0.0007	-0.0009	-0.0014
25/26	0.1911	4.7766	0.0001	0.0012	0.0005	-0.0010	-0.0014
26/27	0.1910	4.9675	-0.0001	0.0011	-0.0001	-0.0009	-0.0012
27/28	0.1909	5.1585	-0.0001	0.0010	0.0000	-0.0007	-0.0010
28/29	0.1908	5.3493	-0.0002	0.0009	-0.0001	-0.0007	-0.0009
29/30	0.1906	5.5399	-0.0004	0.0004	-0.0002	0.0000	-0.0001
30/1	0.1906	5.7305	-0.0004	0.0000	0.0000	0.0000	0.0000



**J&H Machine Tools**

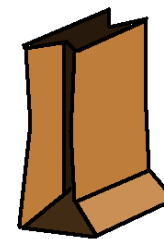
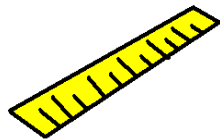


**ZEISS**

**Trick 6**

Graphic Element





ZEISS

Calypso User Desk - (C) Carl Zeiss - spline

Calypso Formplots - Unnamed Template.ptx

File Navigation Tools Help

Reportseite - Page 1 of 1

	Calypso 4.6.02	Carl Zeiss	Date August 29, 2008
Part Number 2	CMM Type CONT_G2	Drawing No.	Order
Meas. Plan Name spline			Department: Master
			Operator
			Signature:

Circular Pitch1 - fp

Circular Pitch1 - Fp

Circular Pitch1 - fu

Circular Pitch1 - Fr

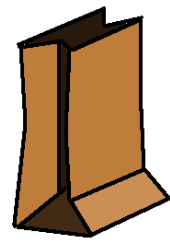
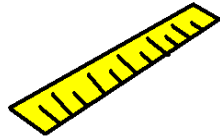
Circular Pitch1 - Fre

0.2 inch

Fit



**J&H Machine Tools**



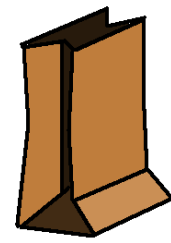
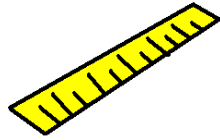
**ZEISS**

**Trick →**

Recall

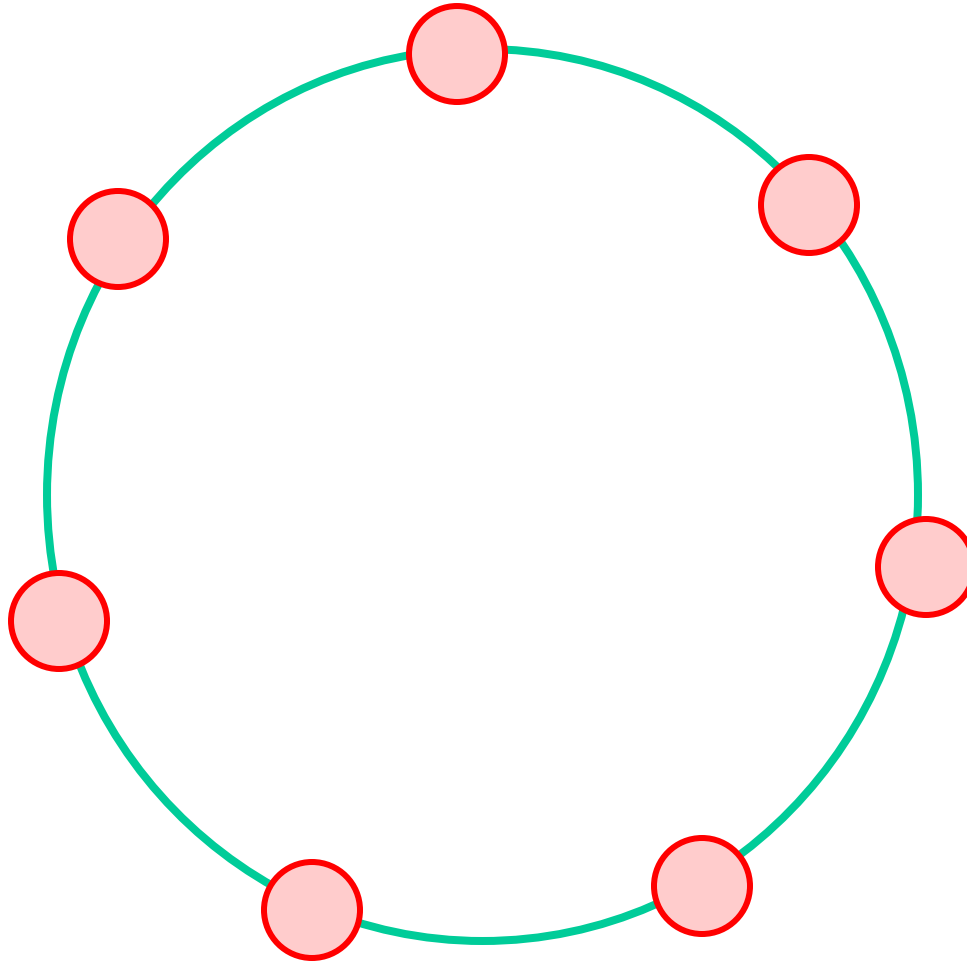


**J&H Machine Tools**



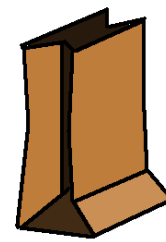
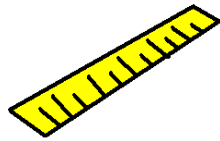
**ZEISS**

# Recall





J&H Machine Tools



ZEISS

Calypso User Desk - (C) Carl Zeiss - spline

File Edit View Resources Features Construction Size Form and Location Plan CAD Extras Planner Window Help Info

Ready: Make selection or

- Plane1
- Circle1
- Point1
- Point2
- Point3
- Maximum Feature1(Point1,Point2,Point3)
- Point4(30)
- Circle2

Feature Recognition

- Surface measurement with single points
- Point
- Circle
- Plane
- 2-D Line
- 3-D Line
- Cylinder
- Cone
- Sphere
- Curve
- 3d-Curve
- Additional Features

Plane1

Circle1

Point1

Point2

Point3

Point4

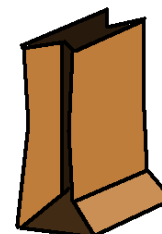
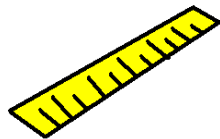
Point3

Point4

Point3

0.3 inch

Fit



Calypso User Desk - (C) Carl Zeiss - spline

File Edit View Resources Features Construction Size Form and Location Plan CAD Extras Planner Window Help Info

Please Probe Point 1

Plane

Circle

Point1

Point2

Point3

Maxim

Point4

Circle:

Circle:

**Features**

Circle3

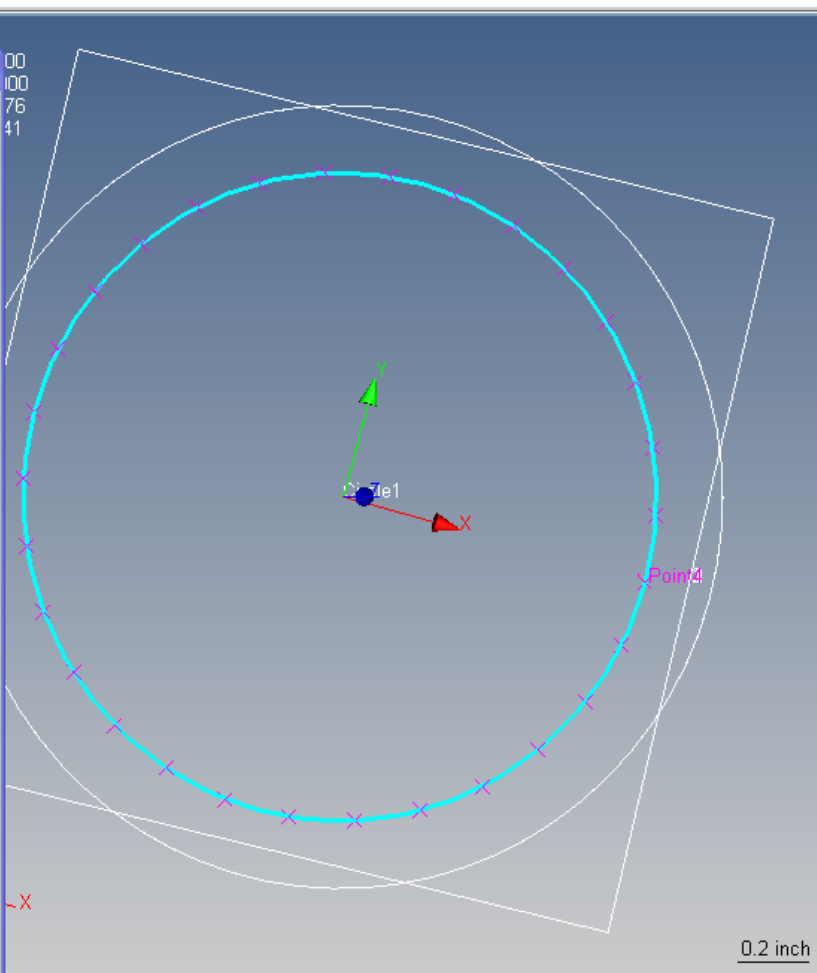
Comment	Projection	Strategy
Circle	None	Evaluation

Clearance Group: Recall    Nominal Definition Alignment: Base Alignment

Tolerance For:	Nominal	Actual
<input type="checkbox"/> X	0.0000	-0.0006
<input type="checkbox"/> Y	-0.0000	0.0038
<input type="checkbox"/> Z	-0.0476	-0.0444
<input type="checkbox"/> D	1.8241	1.8056
A1- X/Z	0.0000	0.0000
A2- Y/Z	0.0000	0.0000
Space Axis	Z	Z
Depth	0.0000	0.0000
Start Angle	0.0000	0.0000
Angle segment	360.0000	360.0000

Sigma	Form	Points
0.0004	0.0010	8
Min	Point no	Point no
-0.0006	2	1
		Max
		0.0004

OK    Reset



00  
100  
76  
41

Circle1

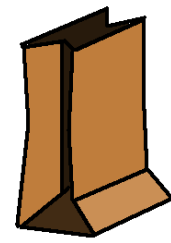
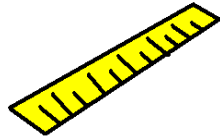
Point4

0.2 inch

Fit



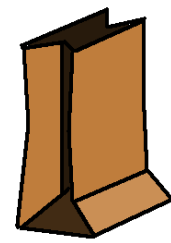
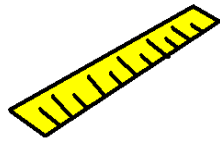
**J&H Machine Tools**



**ZEISS**

**Trick 8**

Result Element



ZEISS

## Result Element

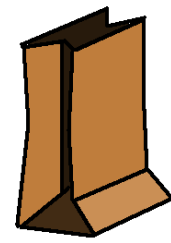
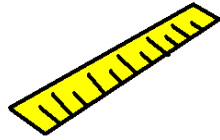
Result Elements can be used to report values that are a calculations from measured features.

For Example...

**Over Balls Dia = Self Center Circ Dia + Stylus Dia**



**J&H Machine Tools**



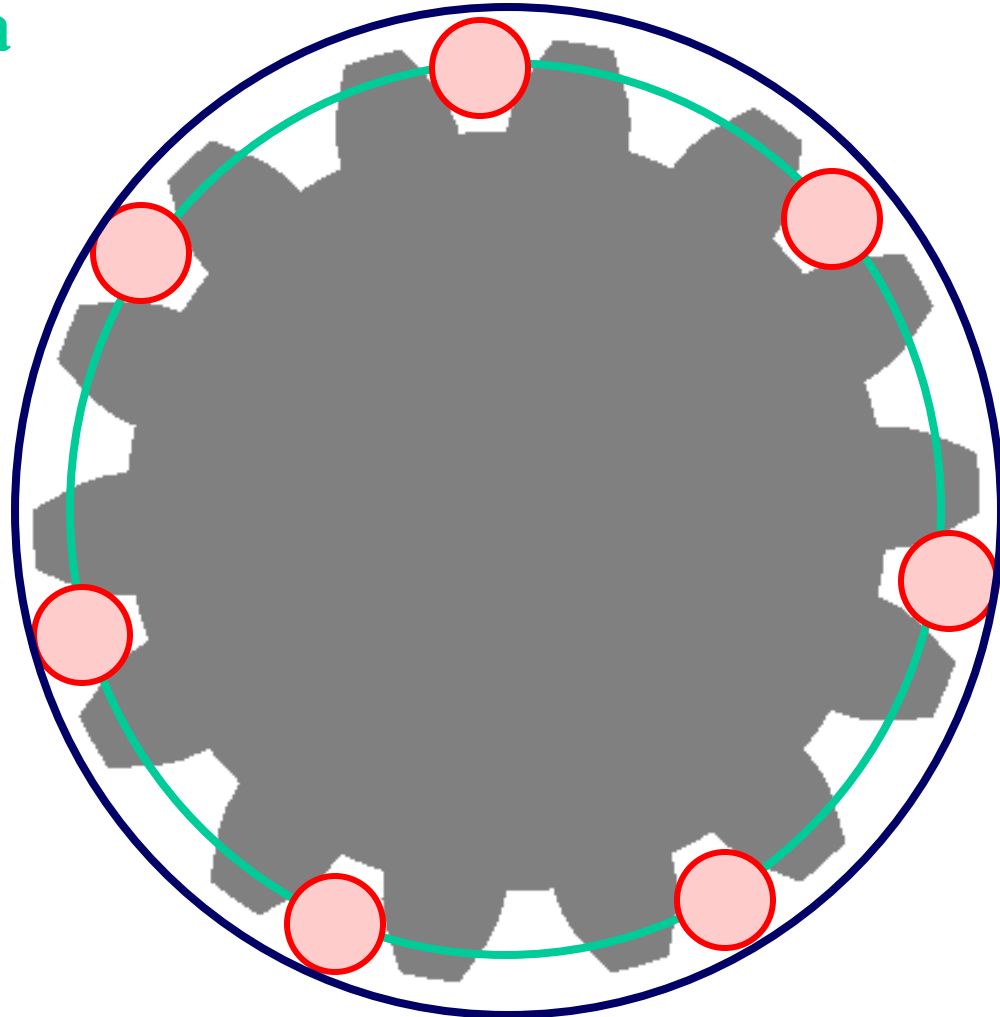
**ZEISS**

**Self Center Circ Dia**

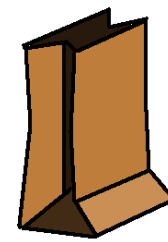
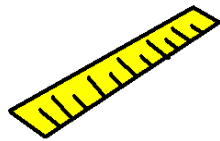
**+ Stylus Dia**

---

**Over Balls Dia**







Calypso User Des Result Element

File Edit View Result Element1 Comment

Function Plan CAD Extras Planner Window Help Info

Formula...

Length in Inch

`getActual("Circle2").diameter+getProbe().diameter`

Function Loop Nominal **Actual** Compute

Characteristics	Features	Attributes
Circular Pitch1 Graphics Element1	Plane1 Circle1	x y
	Point4 Circle2	rotationAngle diameter radiusD2 radius angleForDisplay

Actual

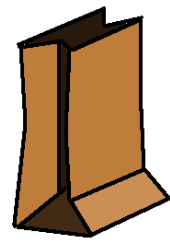
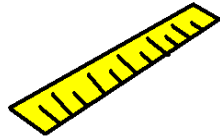
OK Cancel Help

OK Reset

`getActual("Circle2").diameter+getProbe().diameter`



**J&H Machine Tools**



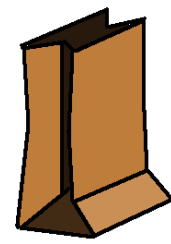
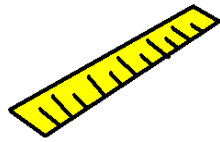
**ZEISS**

***NOW...***

***WE PUT IT ALL  
TOGETHER!***



**J&H Machine Tools**



**ZEISS**

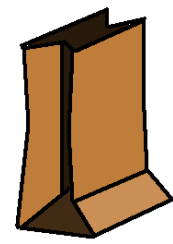
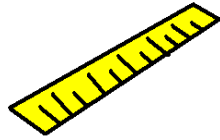
Alignment is the first task.

There is a challenge!

Orientation of the spline causes difficulty. Self-center points may hit the top of the spline square and not fall into the geometry.

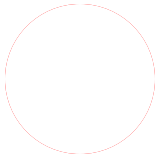
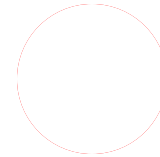
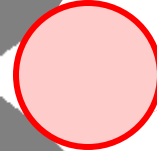


**J&H Machine Tools**



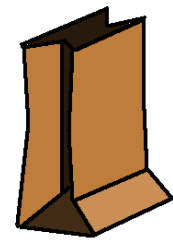
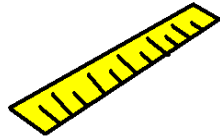
**ZEISS**

**GOOD!**



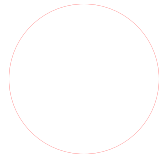
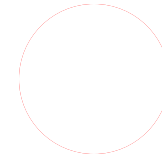
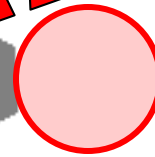


**J&H Machine Tools**



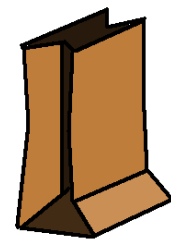
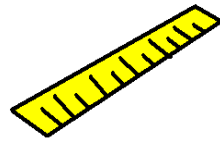
**ZEISS**

**BAD!**





**J&H Machine Tools**



**ZEISS**

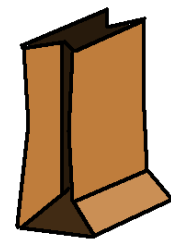
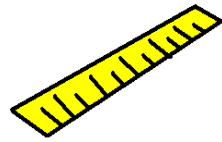


Version 4.6





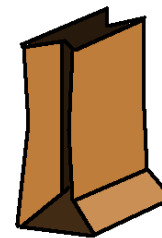
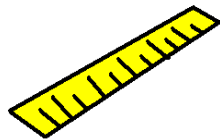
**J&H Machine Tools**



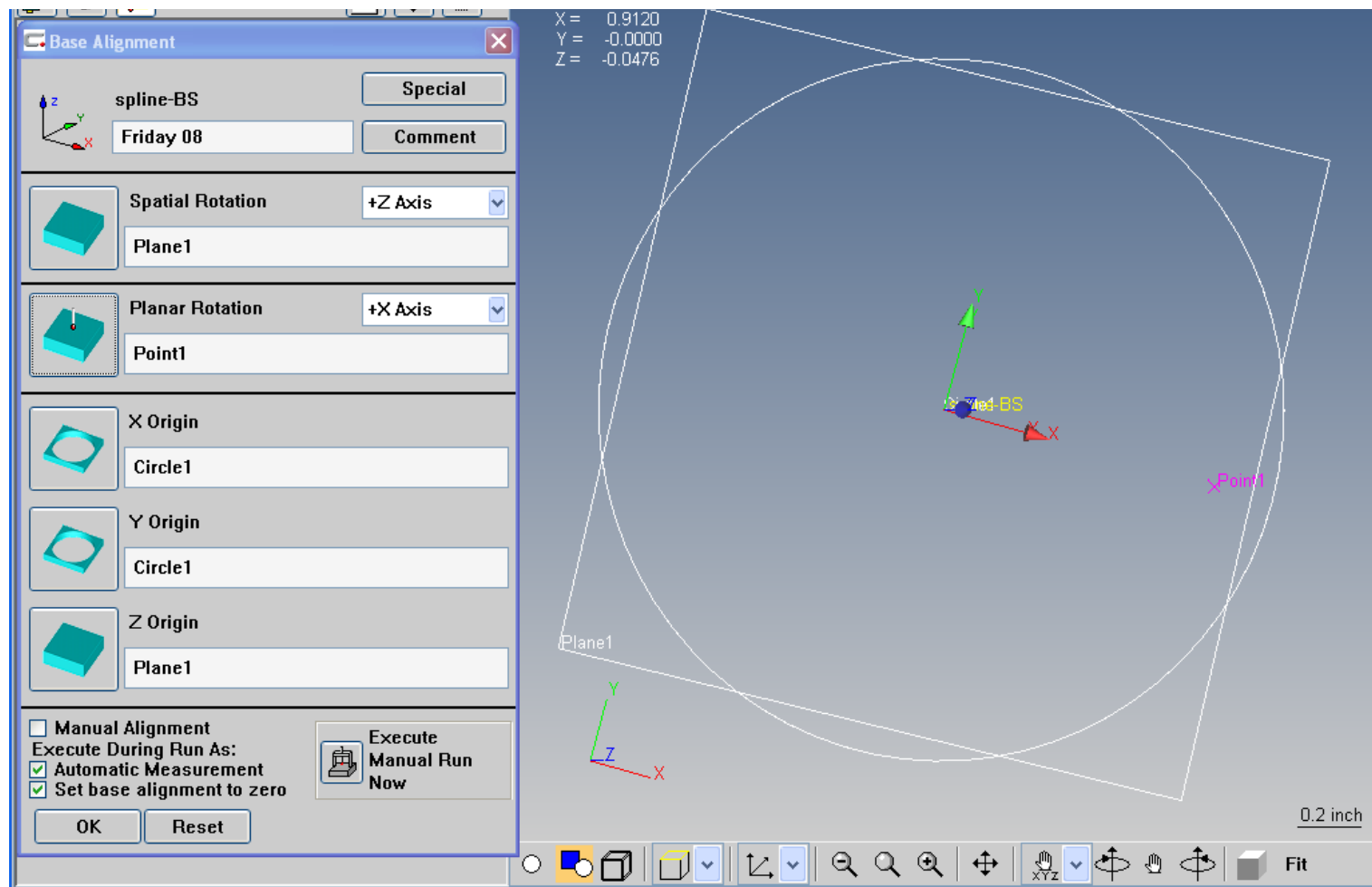
**ZEISS**

Here's the part.





# Simple Base Align



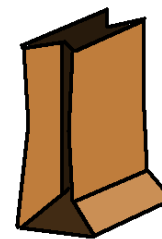
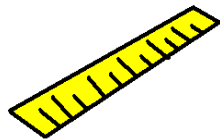
The screenshot shows the 'Base Alignment' dialog box in the Calypso software. The dialog is titled 'Base Alignment' and has a close button (X). It contains several sections for configuring alignment parameters:

- General:** 'spline-BS' and 'Friday 08' are entered in the respective fields. There are 'Special' and 'Comment' buttons.
- Spatial Rotation:** Set to '+Z Axis' with a dropdown arrow. The target is 'Plane1'.
- Planar Rotation:** Set to '+X Axis' with a dropdown arrow. The target is 'Point1'.
- X Origin:** Set to 'Circle1'.
- Y Origin:** Set to 'Circle1'.
- Z Origin:** Set to 'Plane1'.
- Options:** 'Manual Alignment' is unchecked. 'Execute During Run As:' has 'Automatic Measurement' and 'Set base alignment to zero' checked. There is an 'Execute Manual Run Now' button.
- Buttons:** 'OK' and 'Reset' buttons are at the bottom.

The 3D model in the background shows a large circular feature on a plane. A coordinate system is centered on the feature, with the Z-axis pointing upwards. Labels include 'Plane1', 'Point1', and 'spline-BS'. A scale bar at the bottom right indicates '0.2 inch'. The status bar at the very bottom shows various icons for view manipulation and a 'Fit' button.

Coordinates displayed in the top right of the 3D view:  
X = 0.9120  
Y = -0.0000  
Z = -0.0476





ZEISS

Calypso User Desk - (C) Carl Zeiss - spline

File Edit View Resources Features Construction Size Form and Location Plan CAD Extras Planner Window Help Info

Ready: Make selection or take probings

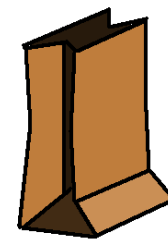
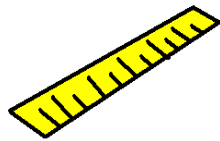
Plane1  
Circle1  
Point1

X = 0.9120  
Y = -0.0000  
Z = -0.0476

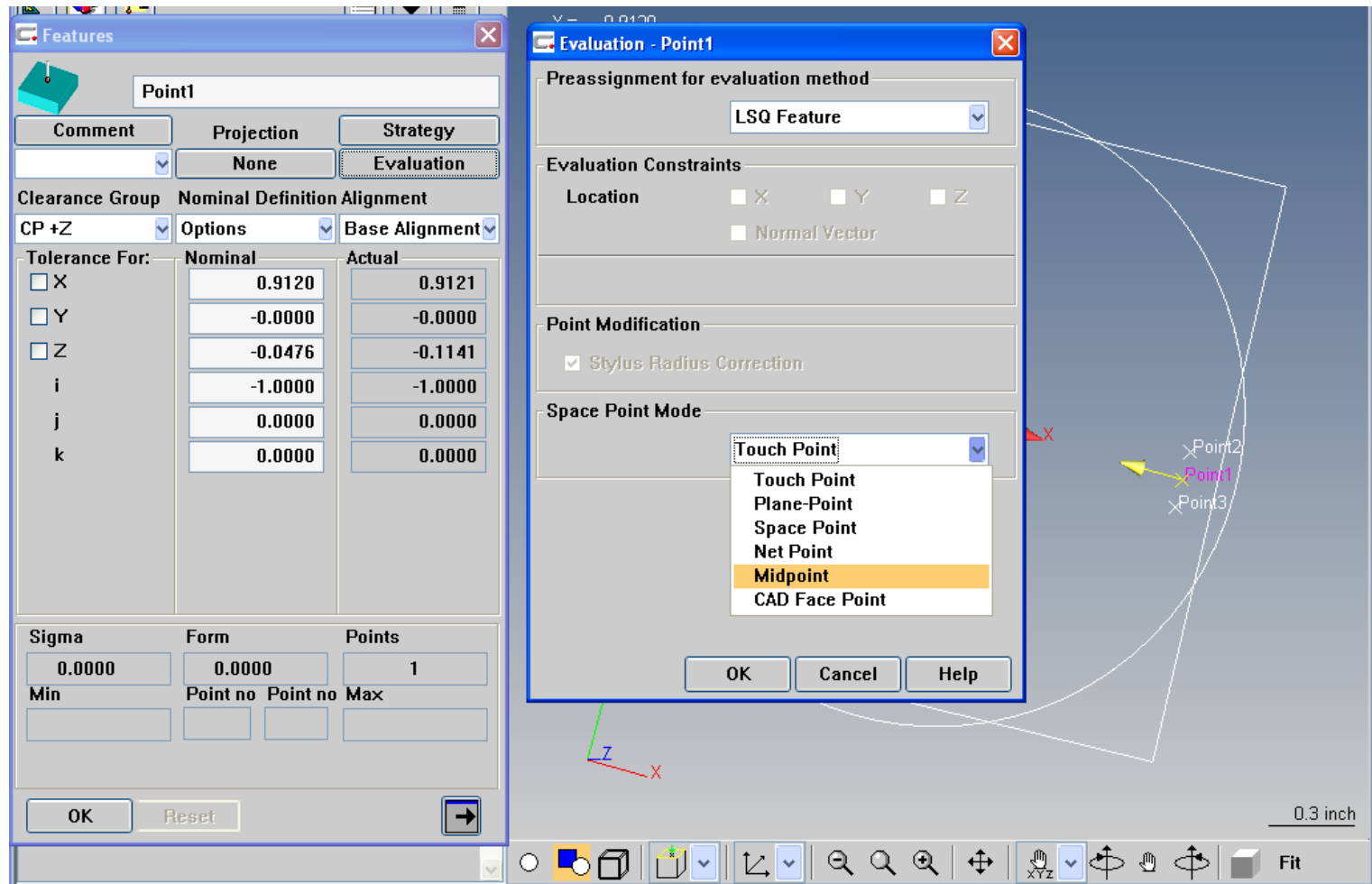
Plane1

Point1

0.2 inch



# Change Point 1's evaluation to Midpoint



The screenshot shows the 'Features' window on the left and the 'Evaluation - Point1' dialog box in the center. The 'Evaluation - Point1' dialog has the following settings:

- Preassignment for evaluation method: LSQ Feature
- Evaluation Constraints: Location (X, Y, Z) and Normal Vector (unchecked)
- Point Modification: Stylus Radius Correction (checked)
- Space Point Mode: Touch Point (selected)

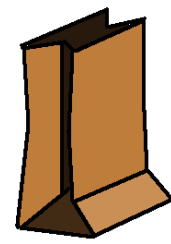
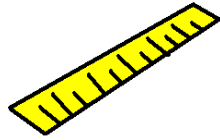
The 'Touch Point' dropdown menu is open, showing the following options:

- Touch Point
- Plane-Point
- Space Point
- Net Point
- Midpoint
- CAD Face Point

The 'Midpoint' option is highlighted in yellow. The background shows a 3D model of a part with three points labeled Point1, Point2, and Point3. A coordinate system (X, Y, Z) is visible at the bottom left. The bottom right corner shows a scale of 0.3 inch and a 'Fit' button.

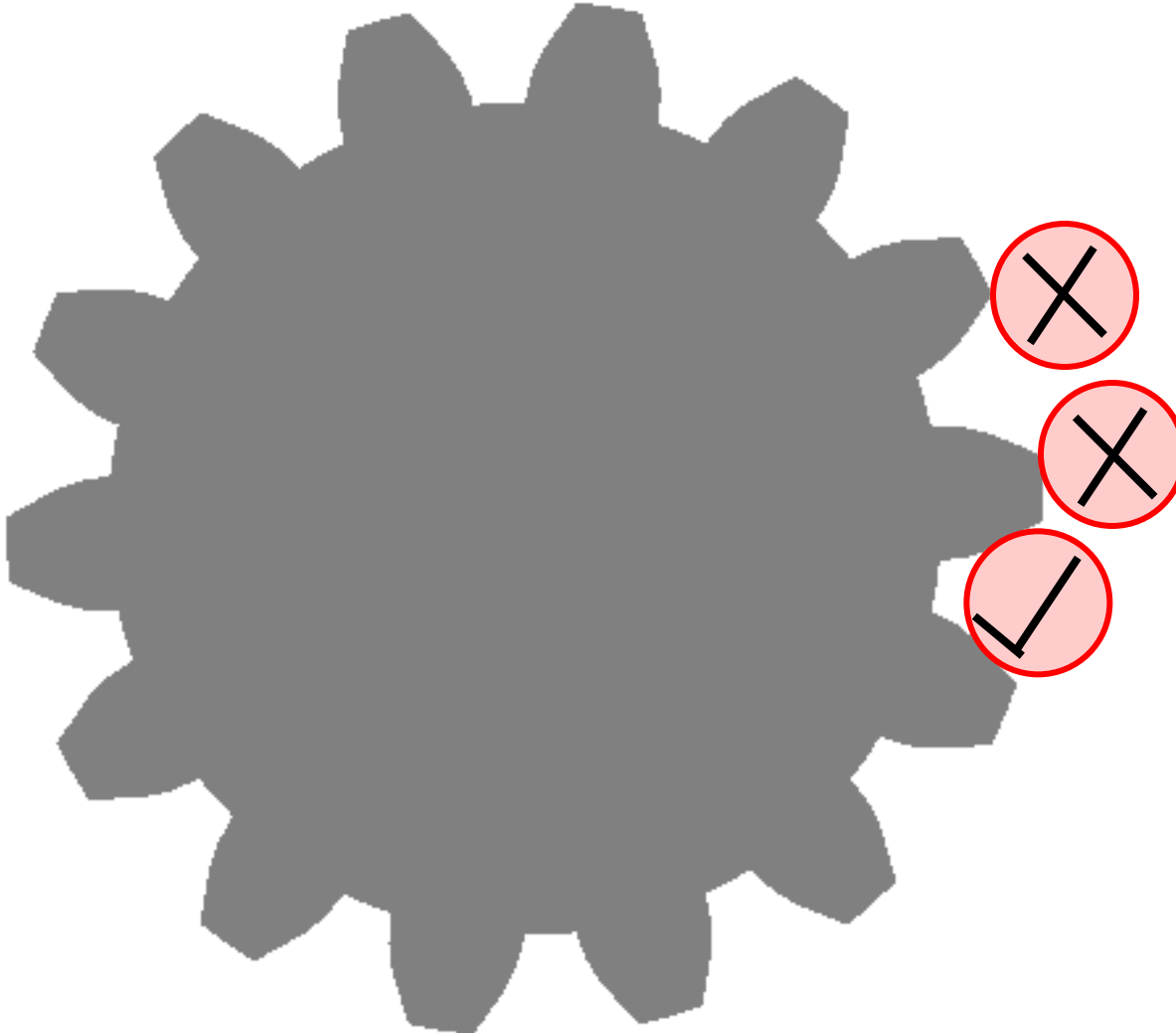


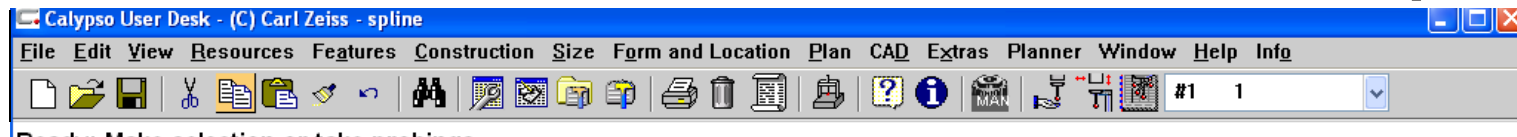
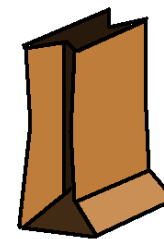
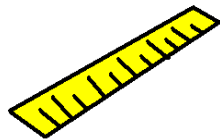
**J&H Machine Tools**



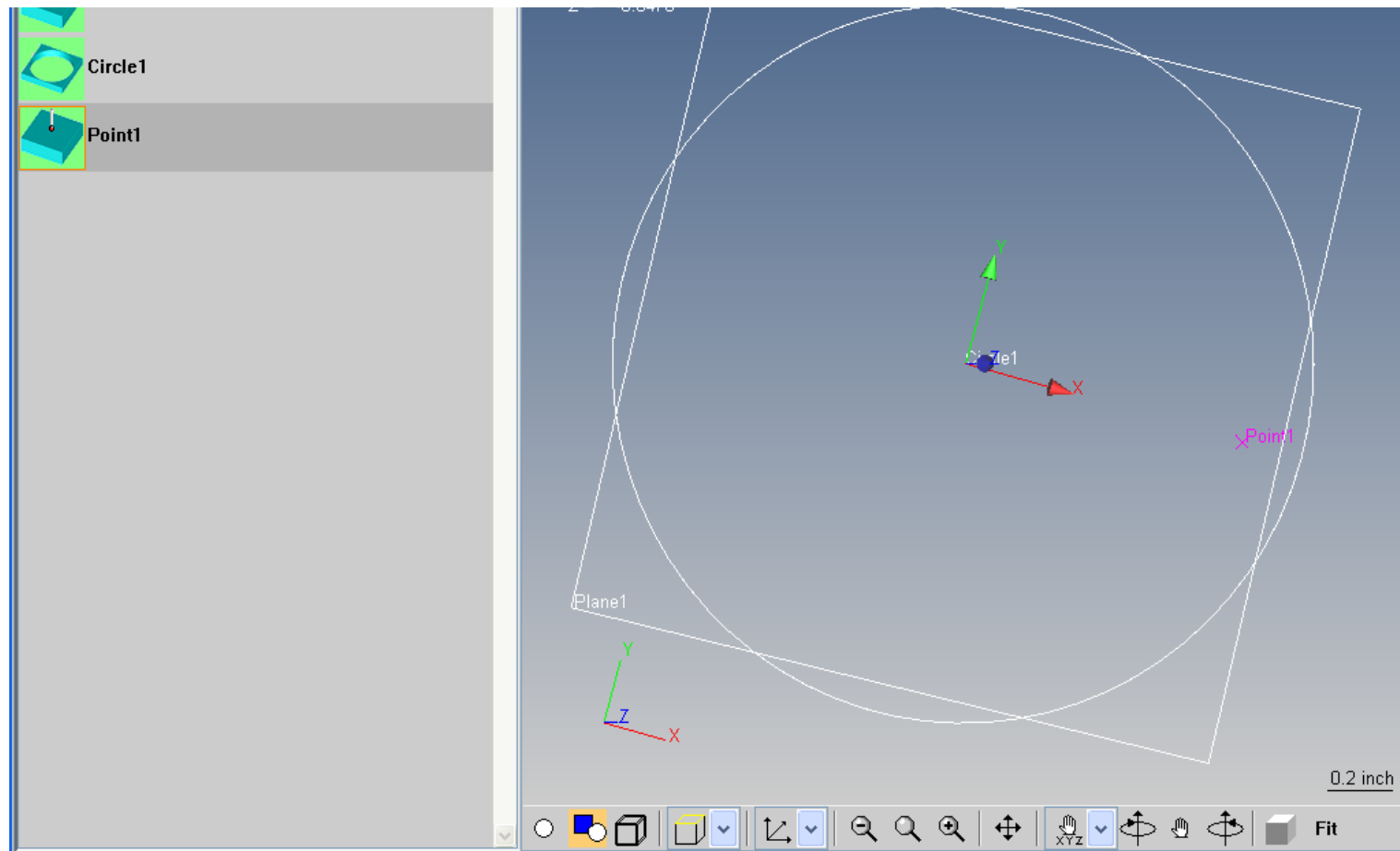
**ZEISS**

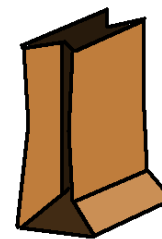
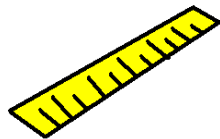
One MUST work...



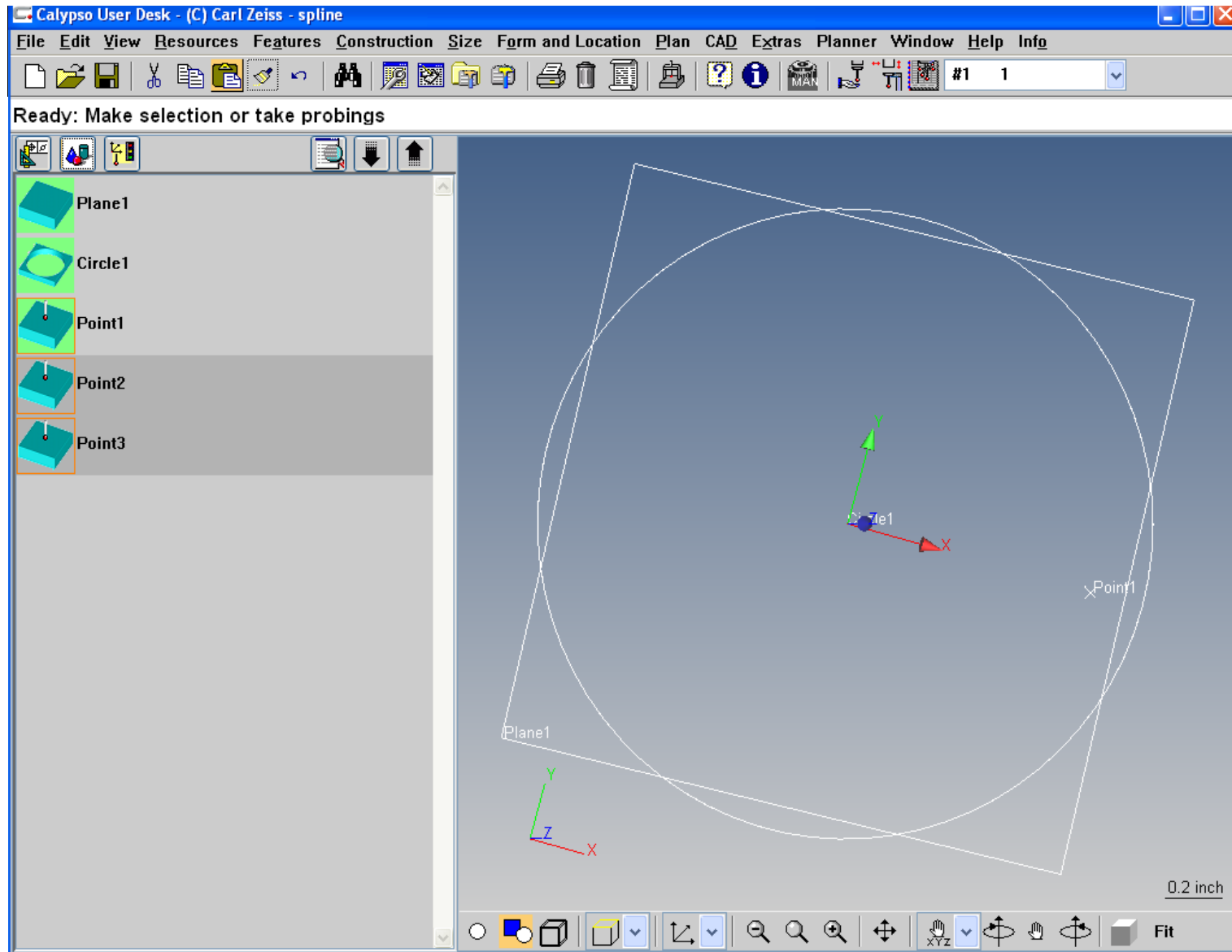


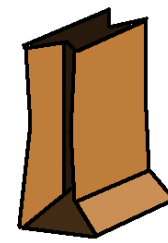
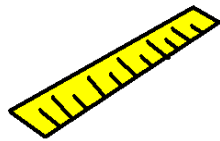
# Copy and Paste Point 1 twice





ZEISS





Change the Y value to +/- a little.

Features Point2

Comment Projection Strategy  
None Evaluation

Clearance Group Nominal Definition Alignment  
CP +Z Options Base Alignment

Tolerance For: Nominal Actual

<input type="checkbox"/> X	0.9120	
<input type="checkbox"/> Y	0.1000	
<input type="checkbox"/> Z	-0.0476	
i	-1.0000	
j	0.0000	
k	0.0000	

Sigma Form Points  
Min Point no Point no Max

OK Reset

Features Point3

Comment Projection Strategy  
None Evaluation

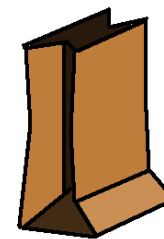
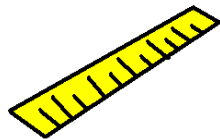
Clearance Group Nominal Definition Alignment  
CP +Z Options Base Alignment

Tolerance For: Nominal Actual

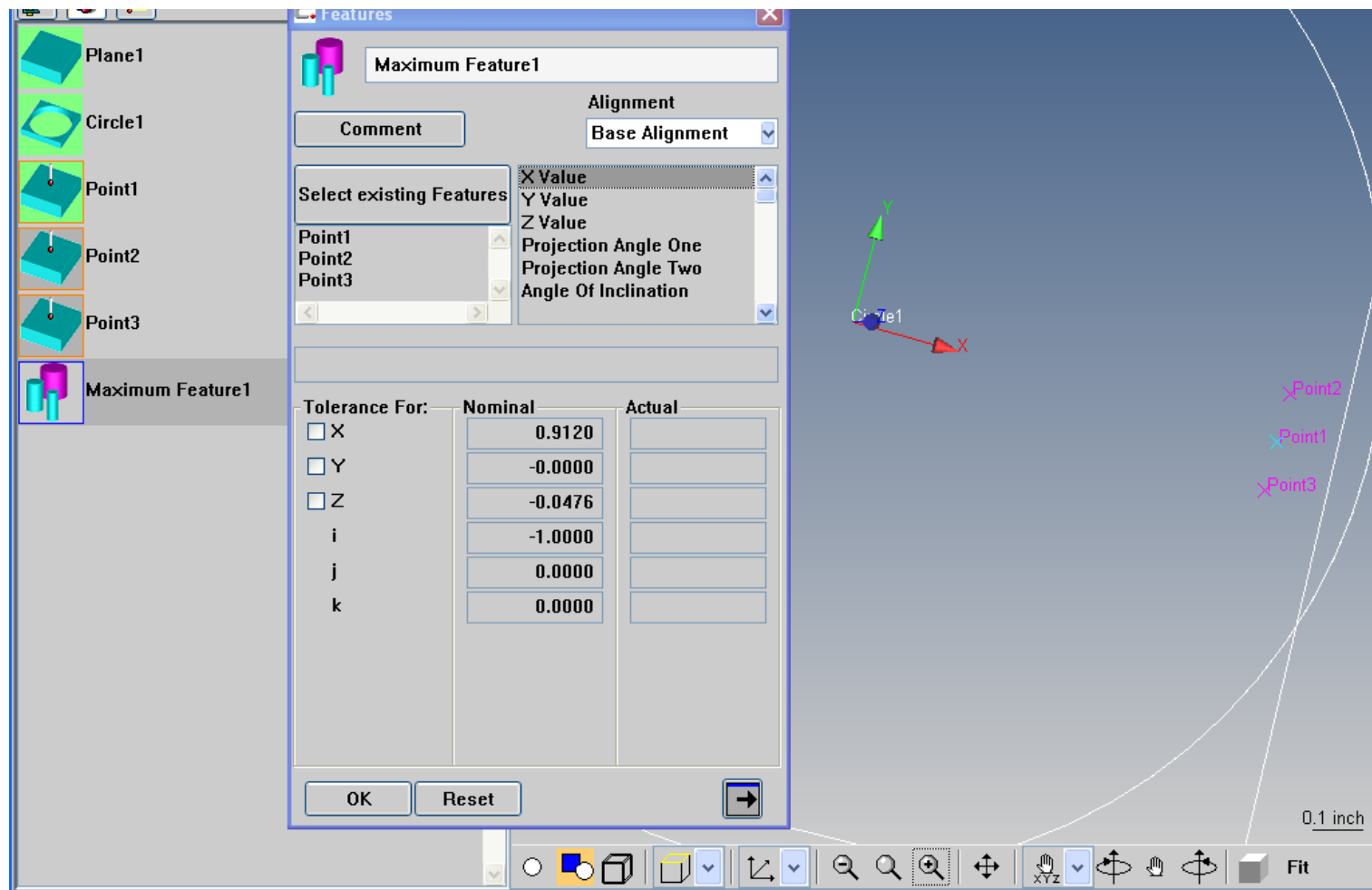
<input type="checkbox"/> X	0.9120	
<input type="checkbox"/> Y	-0.1000	
<input type="checkbox"/> Z	-0.0476	
i	-1.0000	
j	0.0000	
k	0.0000	

Sigma Form Points  
Min Point no Point no Max

OK Reset



# Using MAX Feature since an ID spline



**Features**

Maximum Feature1

Comment

Alignment: Base Alignment

Select existing Features:

- Point1
- Point2
- Point3

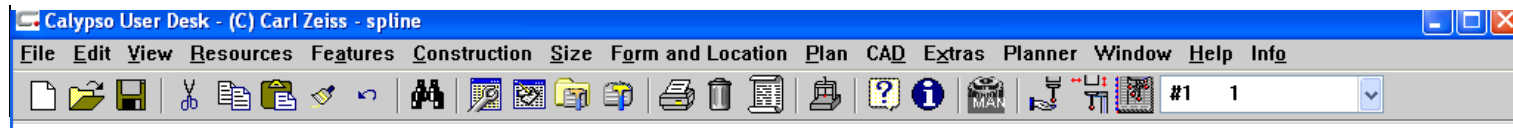
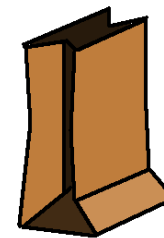
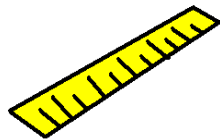
Properties:

- X Value
- Y Value
- Z Value
- Projection Angle One
- Projection Angle Two
- Angle Of Inclination

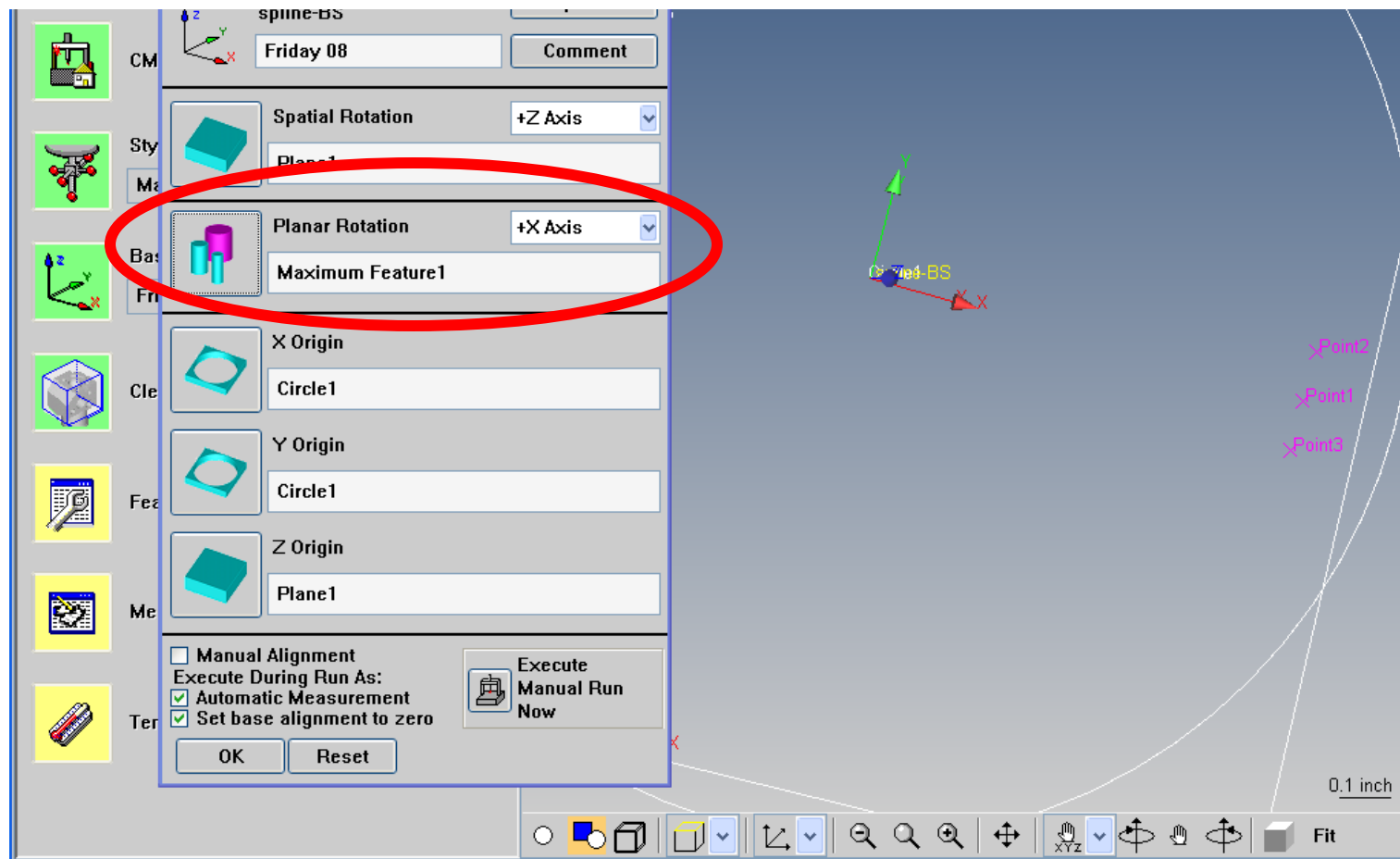
Tolerance For:	Nominal	Actual
<input type="checkbox"/> X	0.9120	
<input type="checkbox"/> Y	-0.0000	
<input type="checkbox"/> Z	-0.0476	
i	-1.0000	
j	0.0000	
k	0.0000	

OK Reset

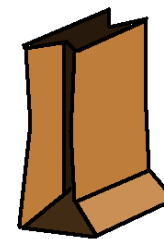
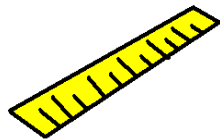
0.1 inch



# Change Alignment to Max Feature for Planar







Calypso User Desk - (C) Carl Zeiss - spline

File Edit View Resources Features Construction Size Form and Location Plan CAD Extras Planner Window Help Info

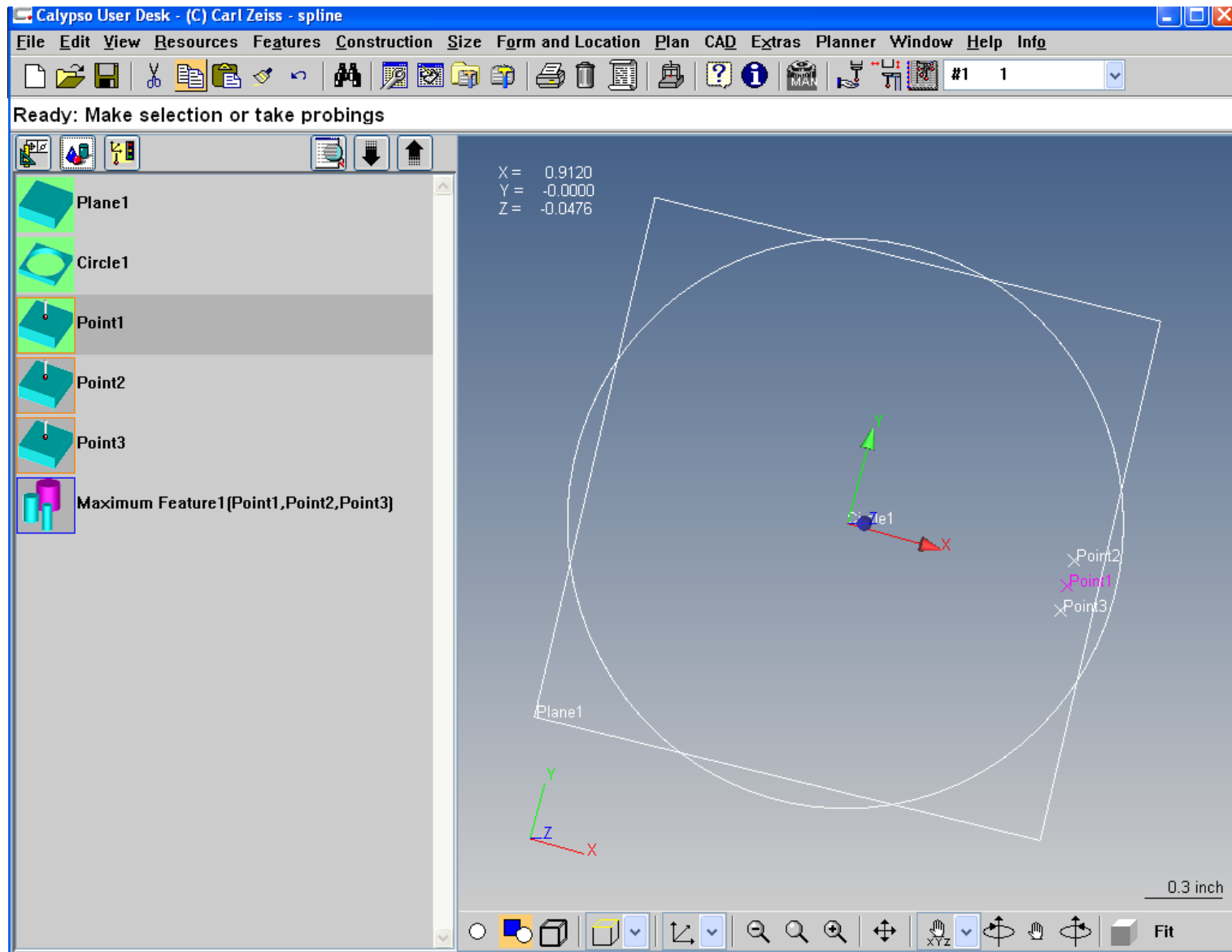
Ready: Make selection or take probings

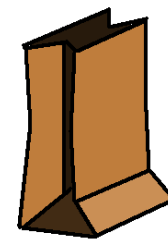
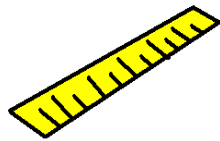
X = 0.9120  
Y = -0.0000  
Z = -0.0476

Plane1  
Circle1  
Point1  
Point2  
Point3  
Maximum Feature1(Point1,Point2,Point3)

Plane1  
Point2  
Point1  
Point3

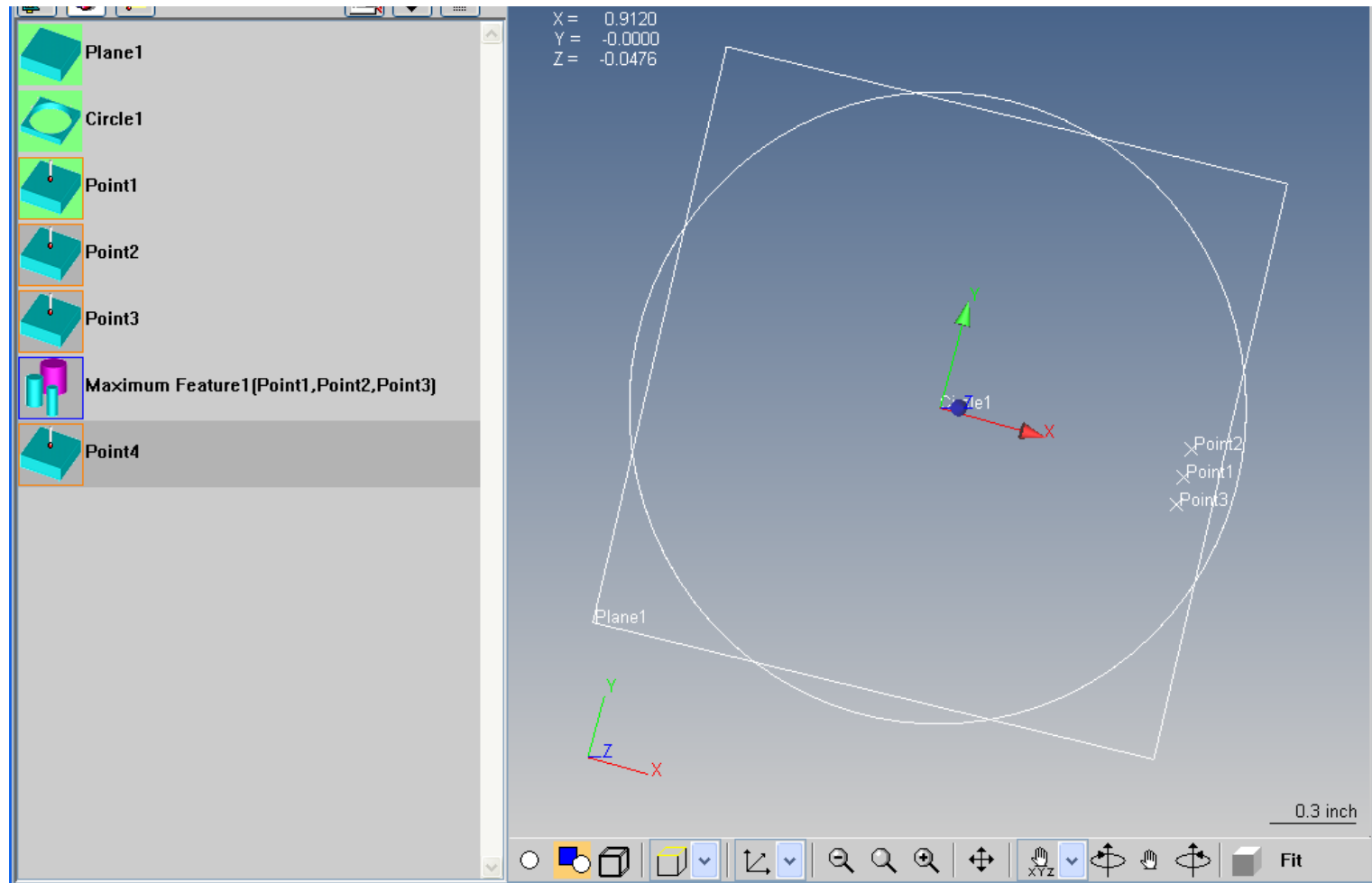
0.3 inch



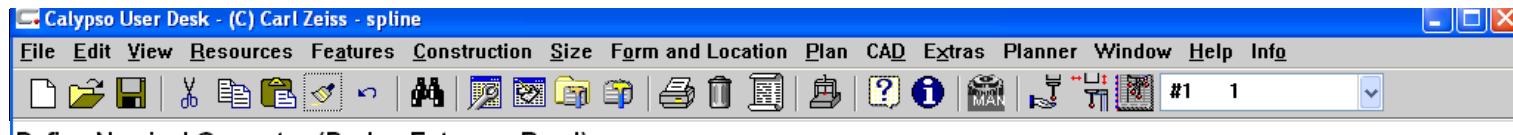
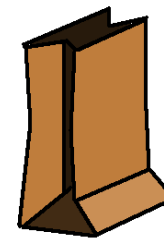
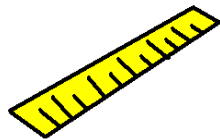


Calypso User Desk - (C) Carl Zeiss - spline  
File Edit View Resources Features Construction Size Form and Location Plan CAD Extras Planner Window Help Info

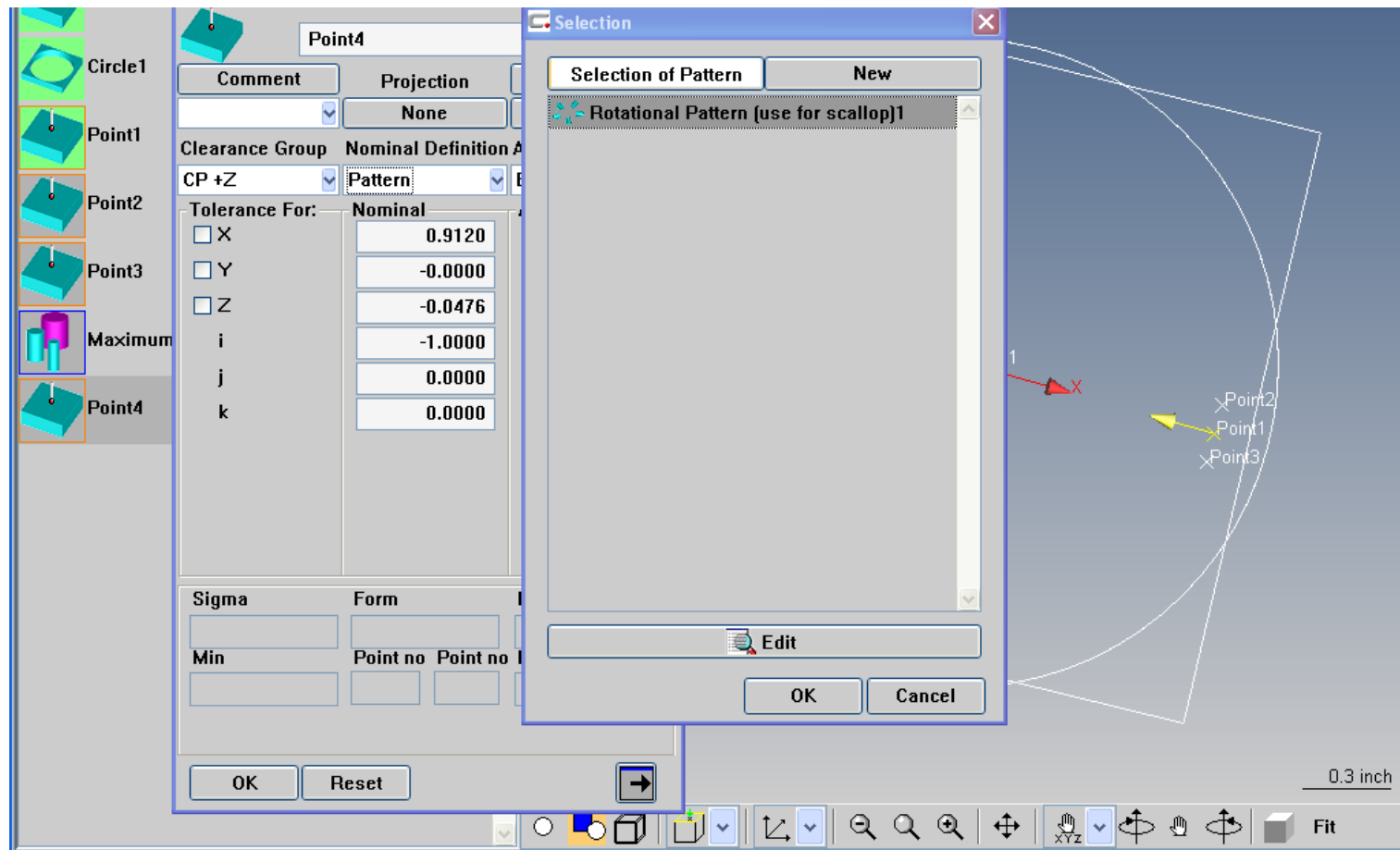
# Copy and Paste POINT 1! Y=0!

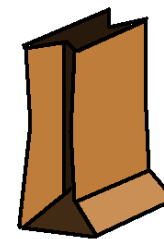
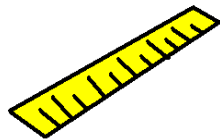


The screenshot shows the Calypso software interface. On the left is a feature tree with the following items: Plane1, Circle1, Point1, Point2, Point3, Maximum Feature1(Point1,Point2,Point3), and Point4. The main workspace displays a 3D model of a circle on a plane. A coordinate system is centered at the origin of the circle, with the Y-axis pointing upwards. The coordinates for Point1 are displayed as X = 0.9120, Y = -0.0000, and Z = -0.0476. Other points are labeled as Point2, Point1, and Point3. A scale bar at the bottom right indicates 0.3 inch. The bottom toolbar contains various icons for navigation and manipulation.



# Apply appropriate Pattern to the copied Point 1





ZEISS

Calypso User Desk - (C) Carl Zeiss - spline

File Edit View Resources Features Construction Size Form and Location Plan CAD Extras Planner Window Help Info

Ready: Make selection or take probings

X = 0.9120  
Y = -0.0000  
Z = -0.0476

Plane1  
Circle1  
Point1  
Point2  
Point3  
Maximum Feature1(Point1,Point2,Point3)  
Point4(30)

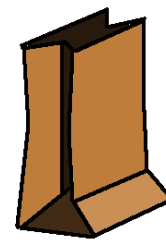
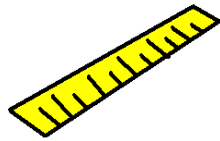
Plane1  
Point2  
Point4  
Point3

0.3 inch

Fit



**J&H Machine Tools**



**ZEISS**

Calypso User Desk - (C) Carl Zeiss - spline

File Edit View Resources Features Construction Size Form and Location Plan CAD Extras Planner Window Help Info

Ready: Make selection or

- Plane1
- Circle1
- Point1
- Point2
- Point3
- Maximum Feature1(Point1,Point2,Point3)
- Point4(30)
- Circle2

Feature Recognition

- Surface measurement with single points
  - Point
  - Circle
  - Plane
  - 2-D Line
  - 3-D Line
  - Cylinder
  - Cone
  - Sphere
  - Curve
  - 3d-Curve
- Additional Features

Plane1

Circle1

Point2

Point3

Point4

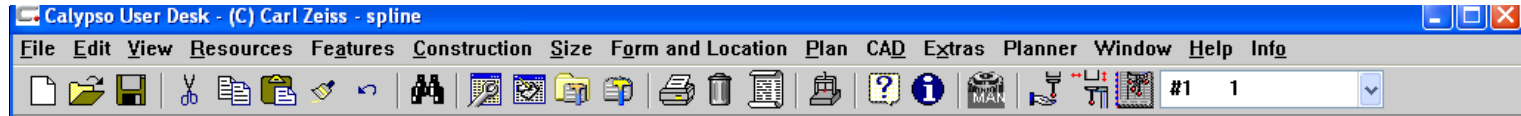
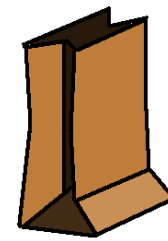
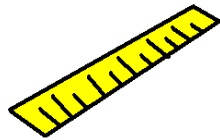
Point3

Point4

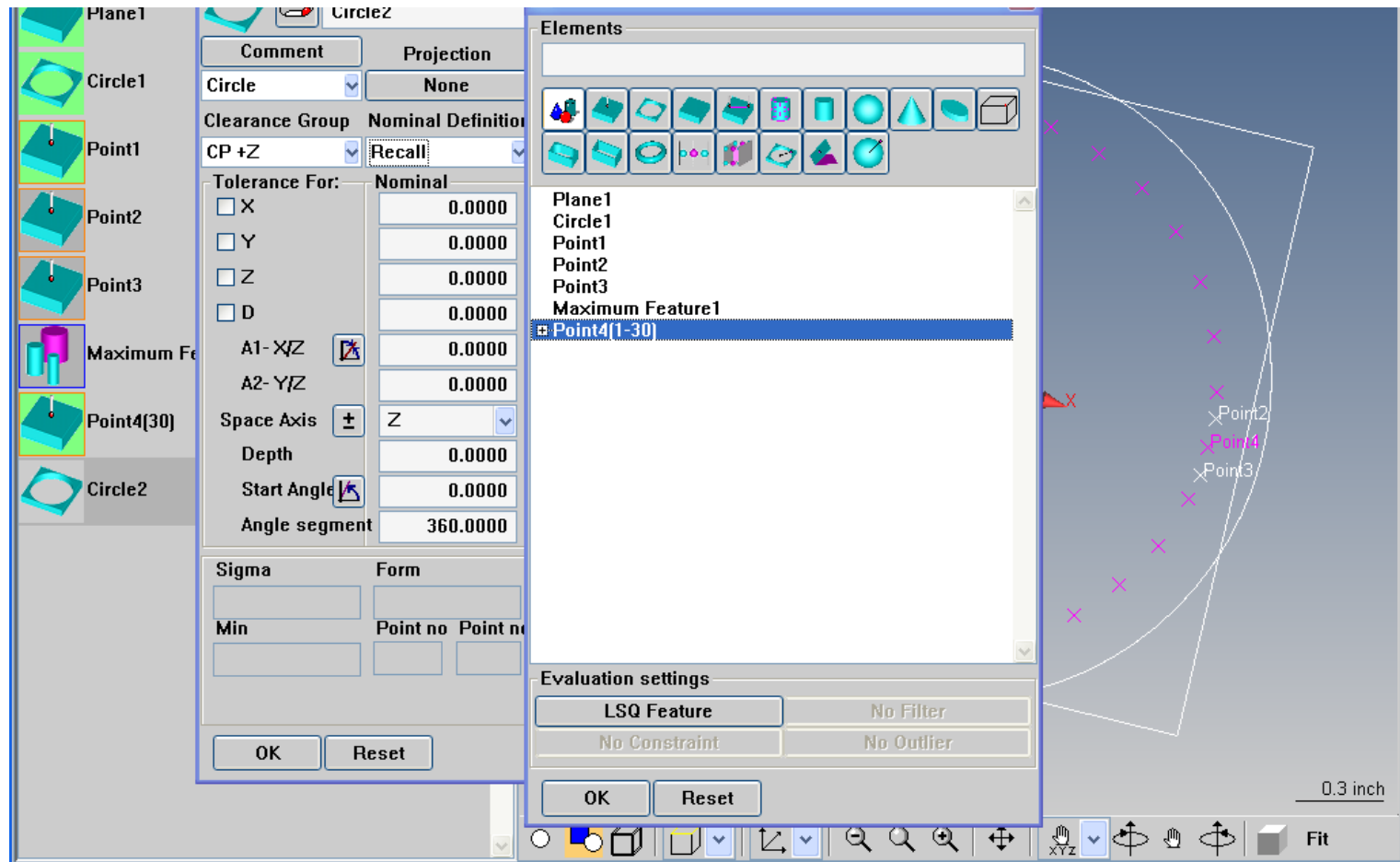
Point3

0.3 inch

Fit



# Recall the Patterned Point into a Circle



**Circle2**

Comment: Circle

Projection: None

Clearance Group: Nominal Definition

CP +Z: Recall

Tolerance For: Nominal

<input type="checkbox"/> X	0.0000
<input type="checkbox"/> Y	0.0000
<input type="checkbox"/> Z	0.0000
<input type="checkbox"/> D	0.0000
A1- X/Z	0.0000
A2- Y/Z	0.0000

Space Axis: Z

Depth: 0.0000

Start Angle: 0.0000

Angle segment: 360.0000

Sigma: Min

Form: Point no Point no

OK Reset

**Elements**

- Plane1
- Circle1
- Point1
- Point2
- Point3
- Maximum Feature1
- Point4(1-30)

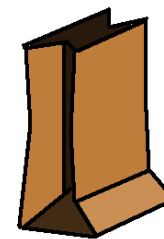
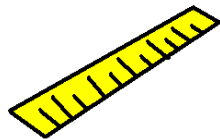
**Evaluation settings**

LSQ Feature No Filter

No Constraint No Outlier

OK Reset

0.3 inch



Calypso User Desk - (C) Carl Zeiss - spline

File Edit View Resources Features Construction Size Form and Location Plan CAD Extras Planner Window Help Info

Please Probe Point 1

**Features**

Circle2

Comment Projection Strategy

Circle None Evaluation

Clearance Group Nominal Definition Alignment

CP +Z Recall Base Alignment

Tolerance For:

	Nominal	Actual
X	-0.0000	0.0002
Y	0.0000	-0.0005
Z	-0.0476	-0.0471
D	1.8241	1.8137
A1- X/Z	0.0000	0.0000
A2- Y/Z	0.0000	0.0000

Space Axis Z Z

Depth 0.0000 0.0000

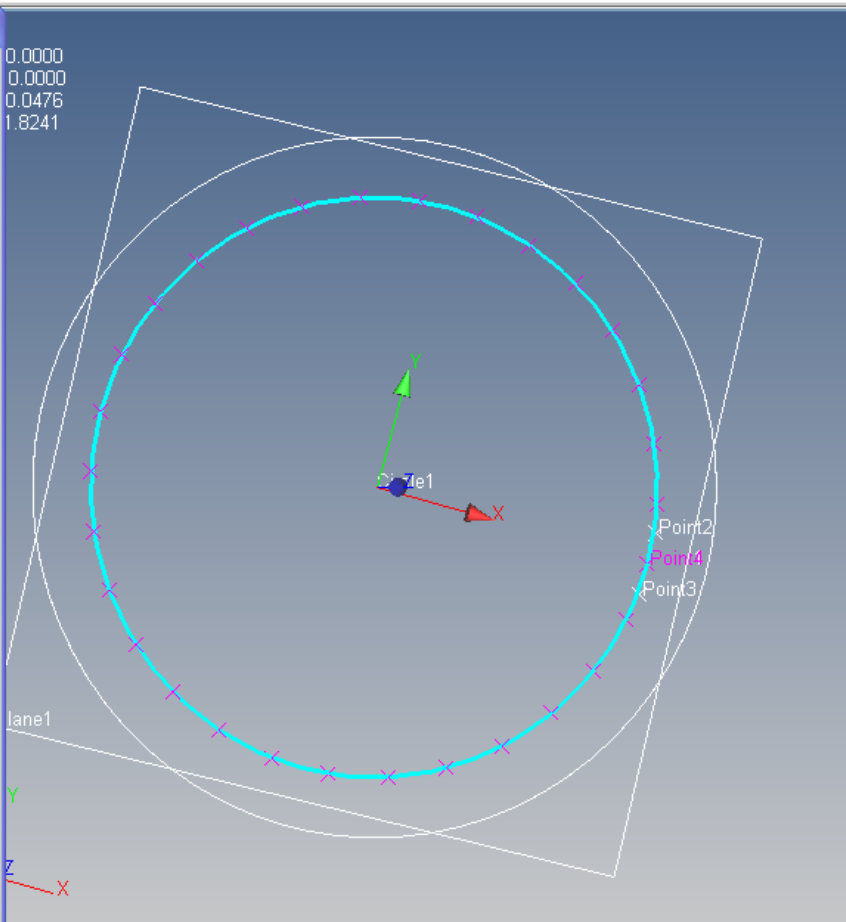
Start Angle 0.0000 0.0000

Angle segment 360.0000 360.0000

Sigma	Form	Points
0.0010	0.0035	30
Min	Point no	Point no
-0.0019	16	21
		Max
		0.0016

OK Reset

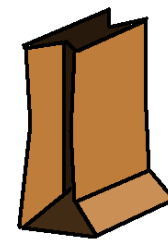
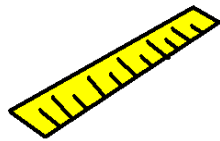
0.0000  
0.0000  
0.0476  
1.8241



Point1  
Point2  
Point3  
Point4


lane1

0.3 inch





# Do a Circular Pitch on the Patterned Point

Select Feature


Circular Pitch1

Circular Pitch
✕




Feature 1

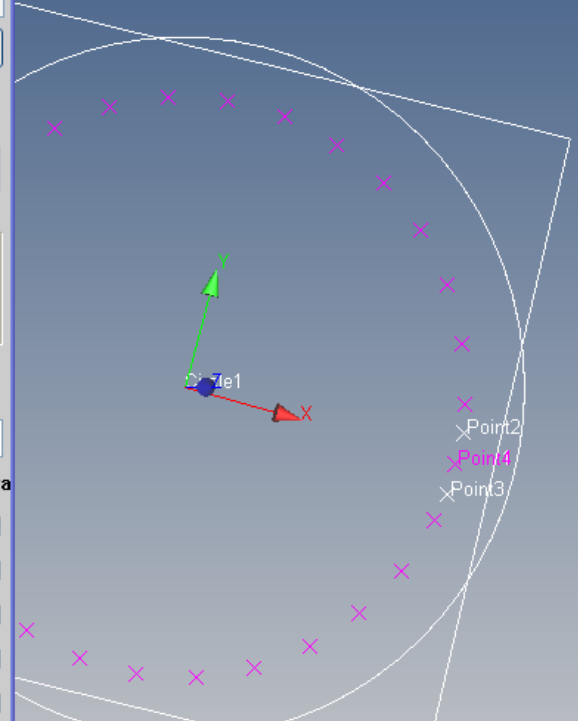
Unit of the Angle Characteristics (fp Fp fu)

Arc Length [in]

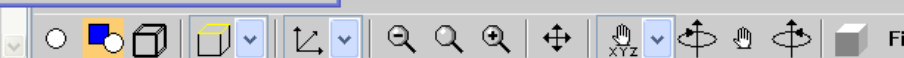
Angle [°]

Tolerance Classes

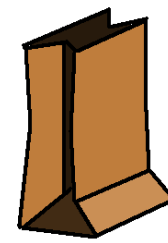
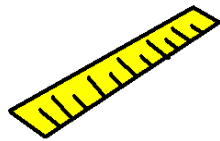
	Upper Tolerance	Lower Tolerance
<input checked="" type="checkbox"/> Individual Pitch Error fp	0.0020	-0.0020
<input checked="" type="checkbox"/> Cumulative Pitch Error Fp	0.0020	-0.0020
<input checked="" type="checkbox"/> Pitch error fu	0.0020	-0.0020
<input checked="" type="checkbox"/> Fr Rad.Runout	0.0020	-0.0020
<input checked="" type="checkbox"/> Fre Roundness	0.0020	-0.0020



0.3 inch







# Setup a Graphics Element for the Circular Pitch

Select Feature

Circular Pitch1

Graphics Element1

Graphics Element

Graphics Element1

Comment

Graphic

Allocation List:

	Characteristics	Single Templ	
1 ▶	Circular Pitch1	default	<input checked="" type="checkbox"/>

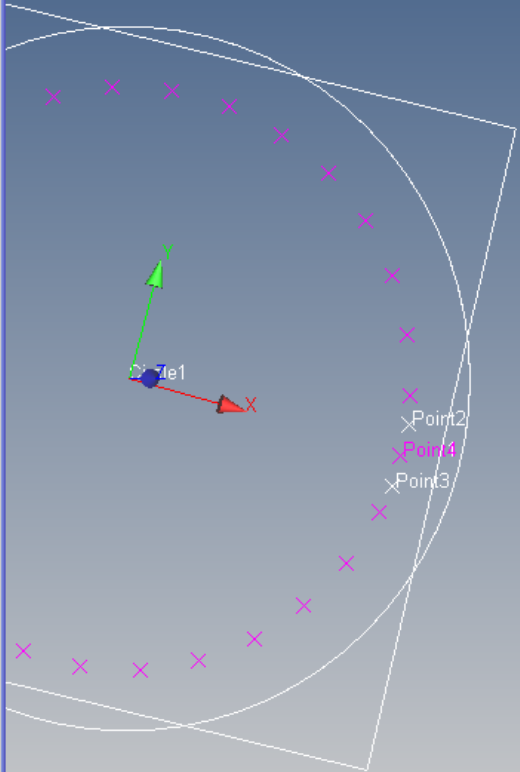
Add line      Remove line

Graphics Form: CZ\_Pitch\_P.ptx

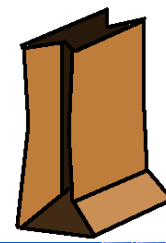
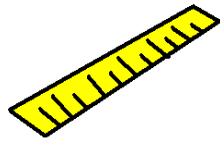
Graphics Arrangement: Vertical

Orientation:  Portrait  Landscape

OK      Reset



0.3 inch



# Calculate your "over pin" diameter

Select Feature

- Circular Pitch1
- Graphics Element1
- Result Element1

Result Element

Result Element1    Comment

Fine

Nominal    0.0000

ISO286   

Upper Tolerance    0.0020     None

Lower Tolerance    -0.0020     None

Dimension

Length     Angle     Number

Calculate Formula

Formula

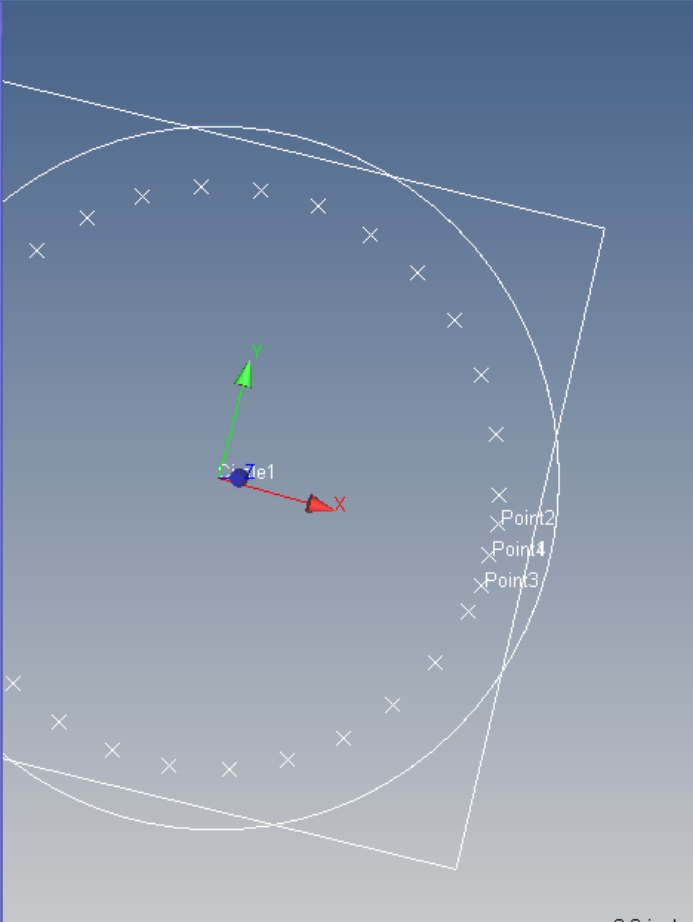
`getActual("Circle2").diameter+getProbe().diam`

Result Input

Dialog Text

Actual    9.8137

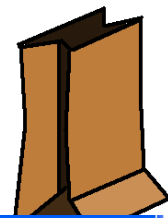
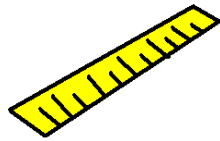
OK    Reset



0.3 inch



J&H Machine Tools



ZEISS

Calypso Custom Printout spline 1

File Edit File...

ZEISS Calypso

Measurement Plan spline Date September 10, 2008

Drawing No. \* drawingno \* Time 4:53:45 pm

Operator Master CMM Simulation

Actual M... er T...

Ready: M

Ci

Gr

Rc

start

# DONE!!!

Calypso Templates - Ormated Template.pptx

File Navigation Tools Help

Reportseite - Page 1 of 1

Ze... 6...

ZEISS Calypso 4.6.02

Part Number M 1 2

Dr... Sep

Op... Mast

Sig

Circular Pitch1 - Fr

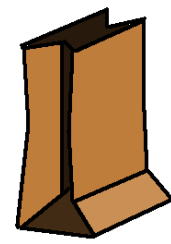
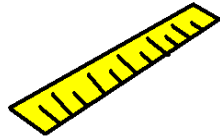
Circular Pitch1 - Fr

Circular Pitch1 - Fr

Identifier	Lower Tol. [In]	Upper Tol. [In]	Minval	Min Dev. [In]	Maxval	Max Dev. [In]
Circular Pitch1 - fp	-0.0030	0.0030	12	-0.0007	14	0.0013
Circular Pitch1 - fp	-0.0030	0.0030	5	-0.0013	18	0.0016
Circular Pitch1 - fu	-0.0030	0.0030	15	-0.0014	13	0.0010
Circular Pitch1 - Fr	-0.0030	0.0030	14	-0.0026	20	0.0016
Circular Pitch1 - Fre	-0.0030	0.0030	14	-0.0022	19	0.0013



**J&H Machine Tools**



**ZEISS**

**LUNCHEON LEARN**

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***SPLINE  
MEASUREMENTS***

• • •

**Any Questions?**  
***WITH CALYPSO!***