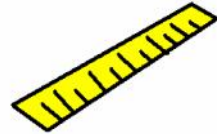


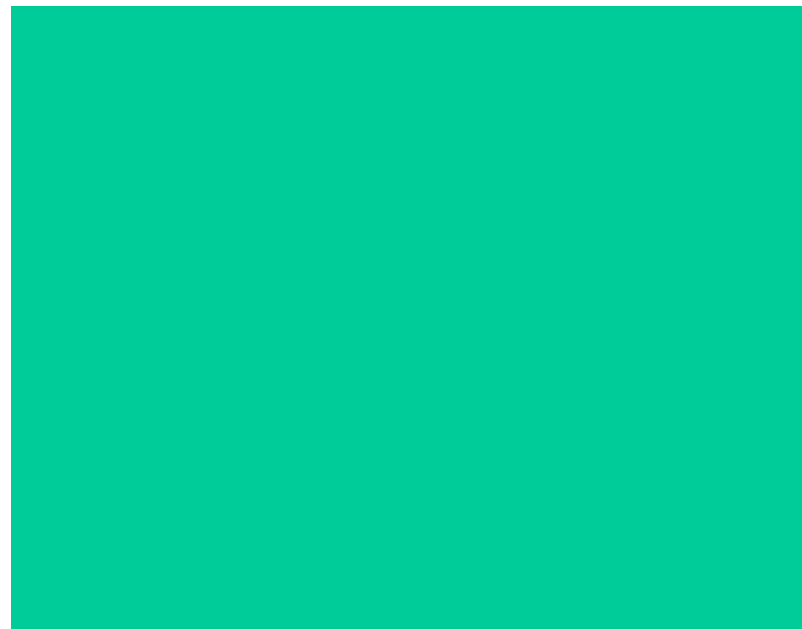
LUNCHEON LEARN

Checking distance
with regard to Rule #1

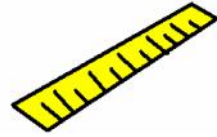


LUNCHEON LEARN

The print.... A Simple Block.
Measure the thickness.



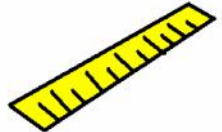
← 10+/-1 →



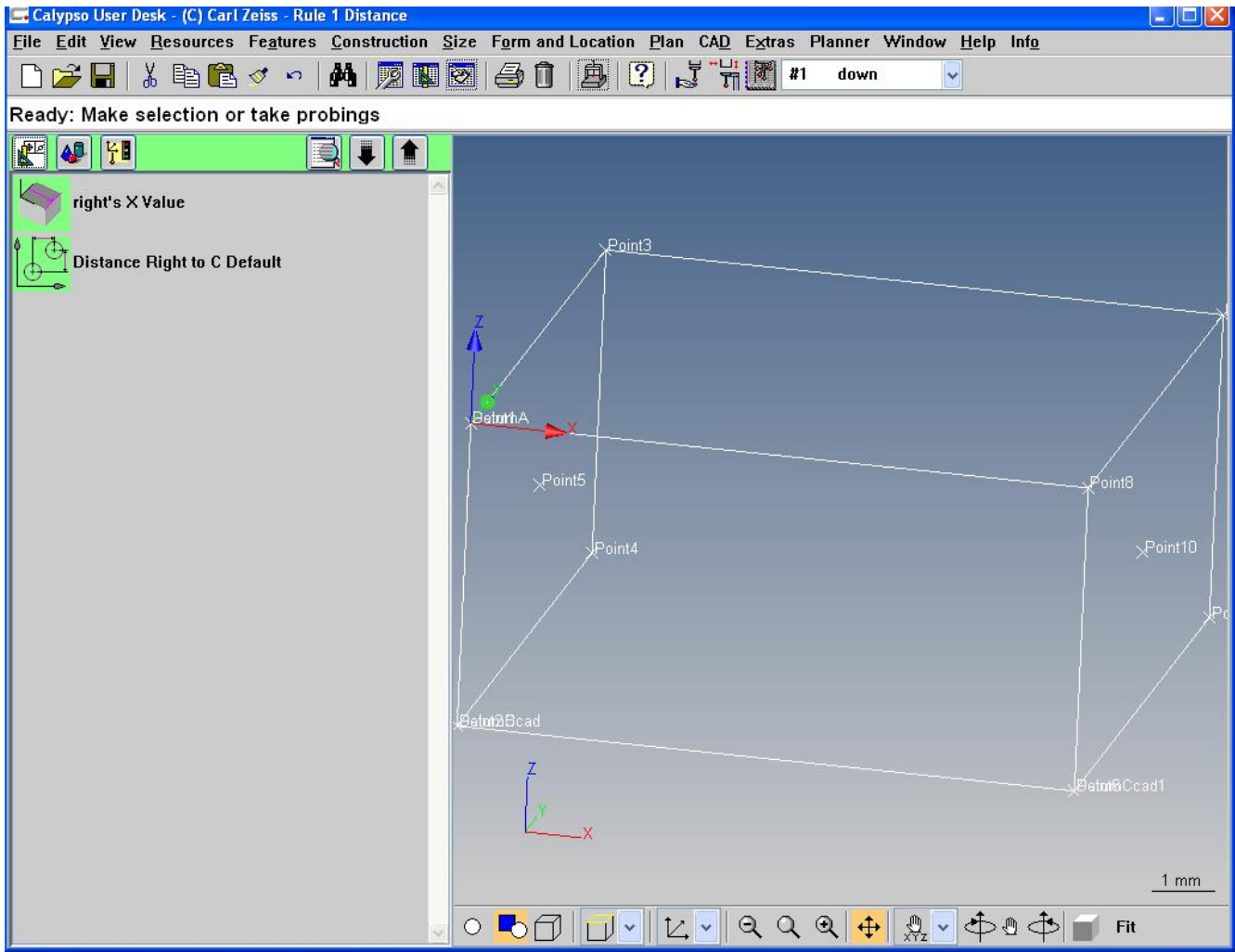
LUNCHEON LEARN

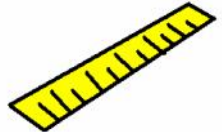
How do YOU do it now?

- Align on the left, report the X of the right?
- Distance between left and right?

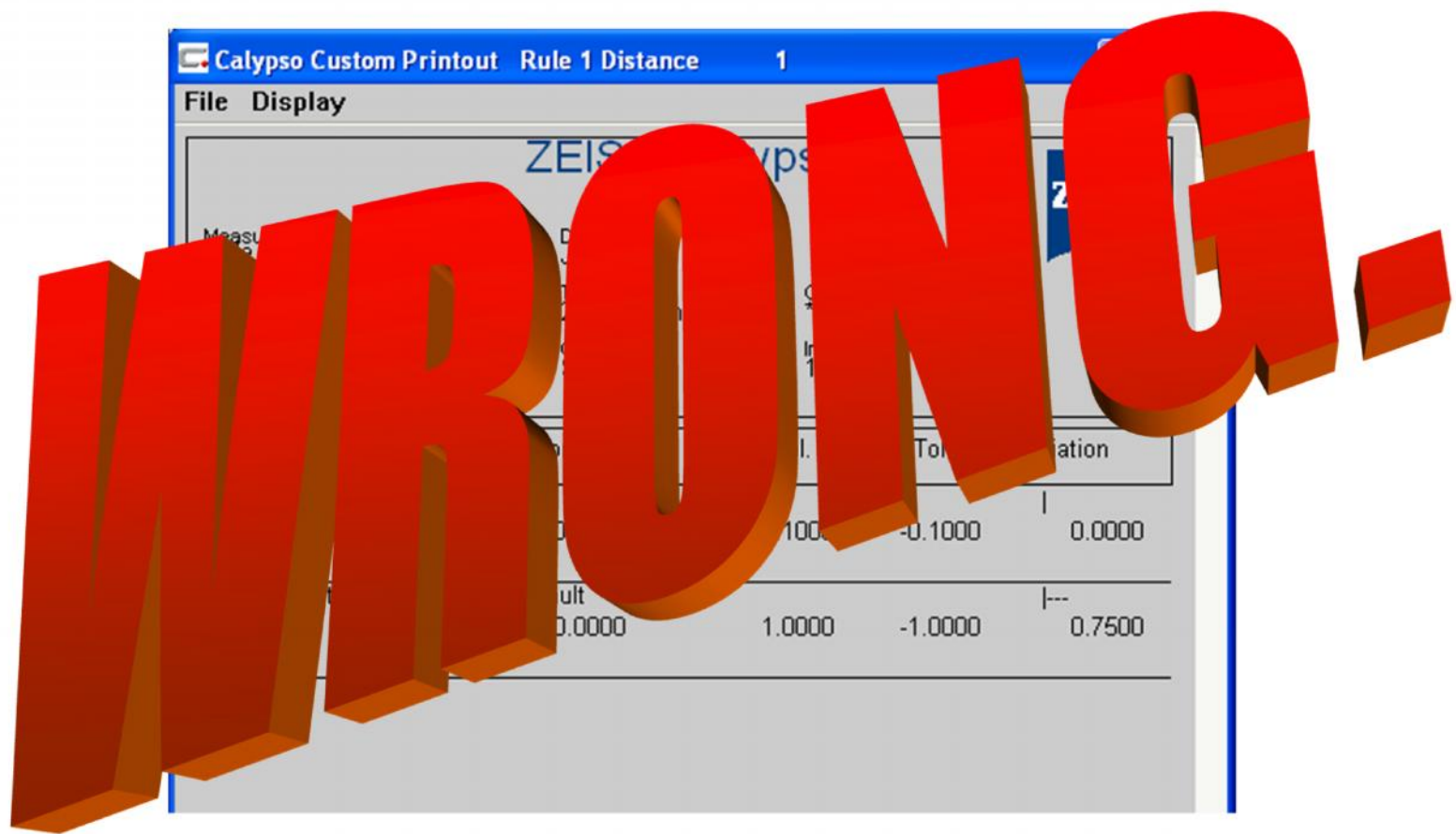


LUNCHEON LEARN





LUNCHEON LEARN

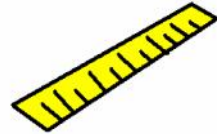


Calypso Custom Printout Rule 1 Distance 1

File Display

ZEISS Calypso

Measu			
		100	-0.1000
			0.0000
ult		1.0000	-1.0000
			0.7500

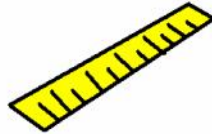


LUNCHEON LEARN

To do this right, we need to understand

RULE #1

Sounds important, doesn't it????



LUNCHEON LEARN

Definition Time!

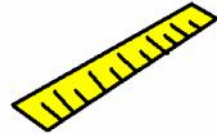
“Where on limits of size extent to which size, are allowed cross section shall be feature is controlled by

- A) The surface or surfaces;
- B) Where the actual local size is the amount of such departure;
- C) There is no requirement for the actual size to vary from the true form to the maximum



specified, the tolerance form, as well as feature at each form of an individual following three factors: form perfect form at MMC. form is allowed equal to

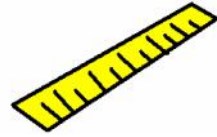
MC limit of size is permitted to



LUNCHEON LEARN

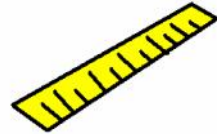
HEY!!!

WAKE UP!



LUNCHEON LEARN

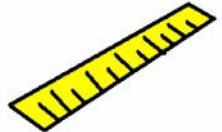
What does it
mean?



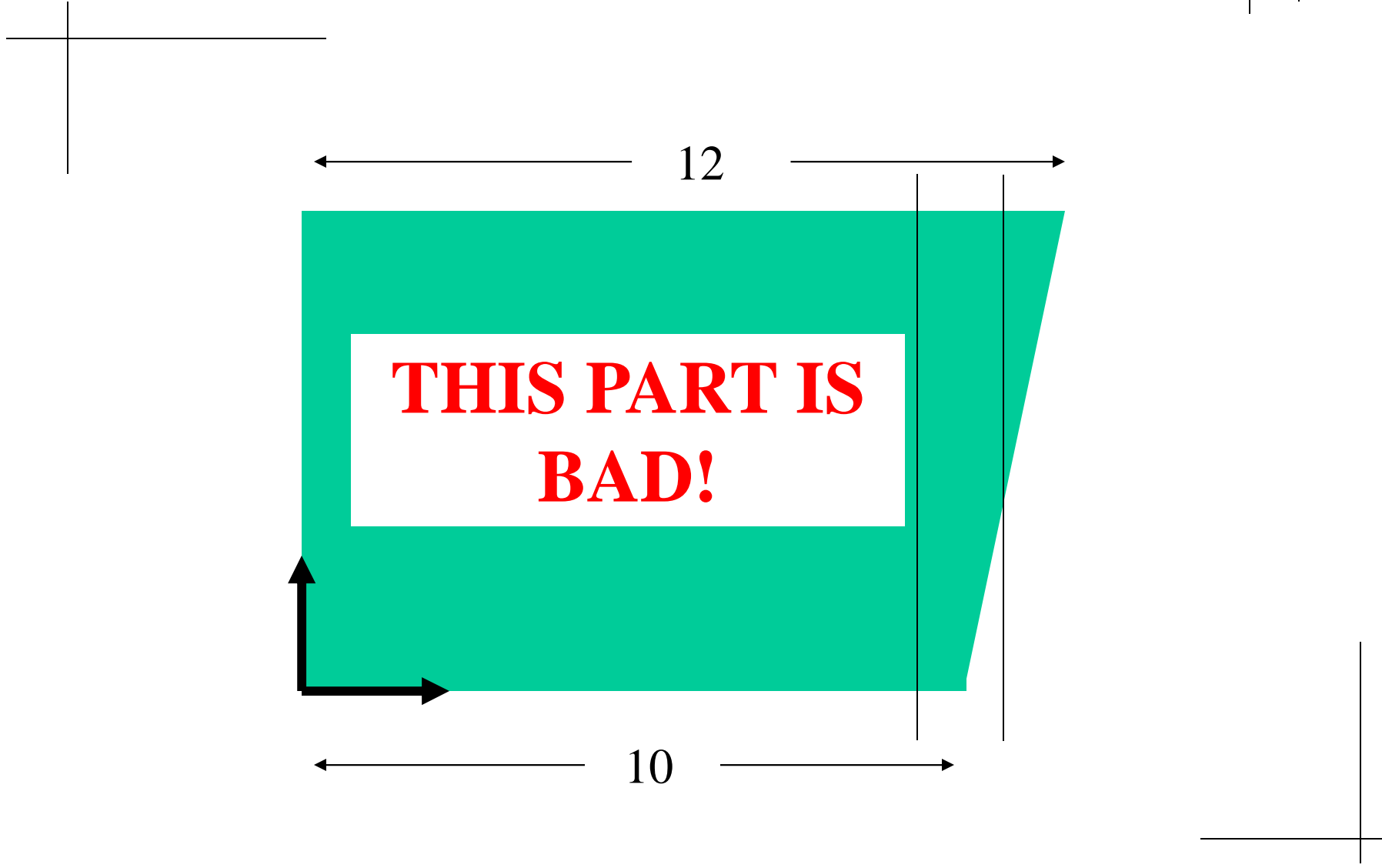
LUNCHEON LEARN

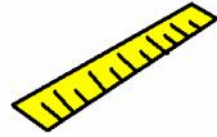
For checking distance between two parallel opposing planes, two things must happen in order for the part to be good:

- The part must be able to pass between two parallel planes at the maximum allowable distance apart.
- The “actual local size” of any cross-section on the part must be larger than the minimum allowable distance apart.

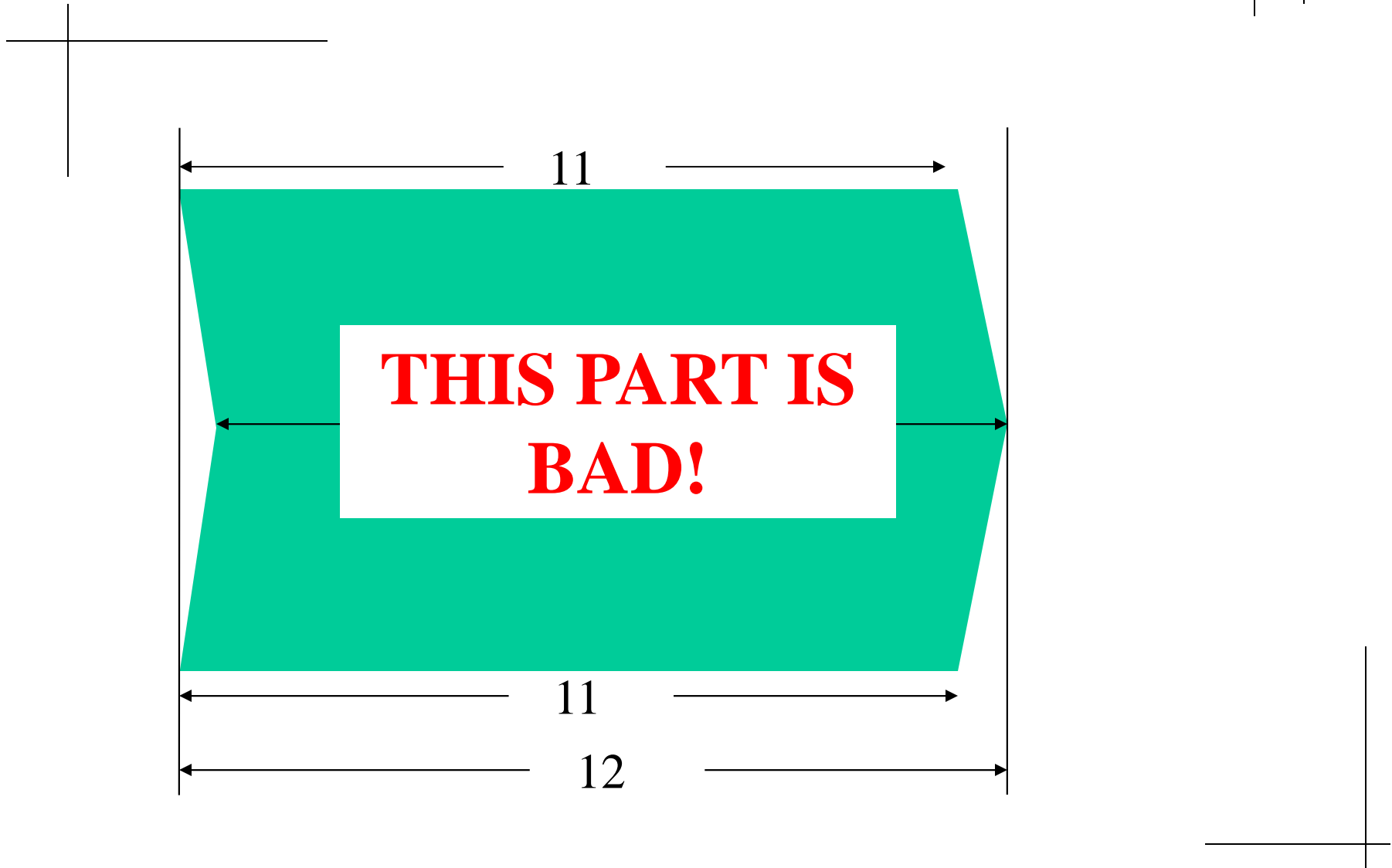


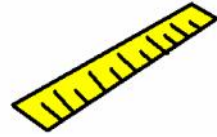
LUNCHEON LEARN



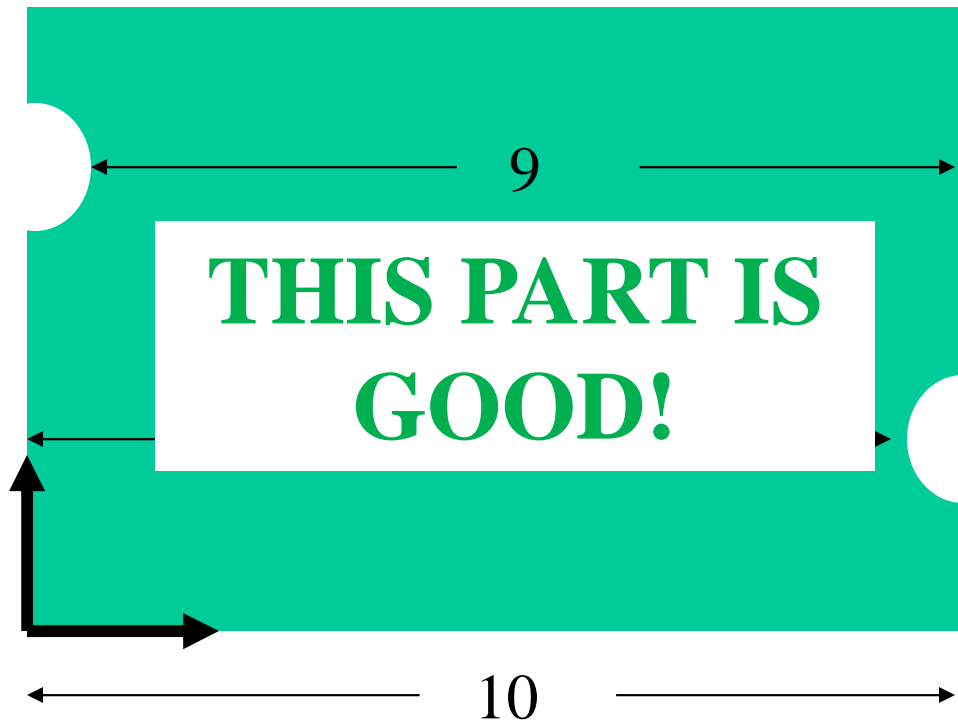


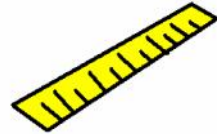
LUNCHEON LEARN



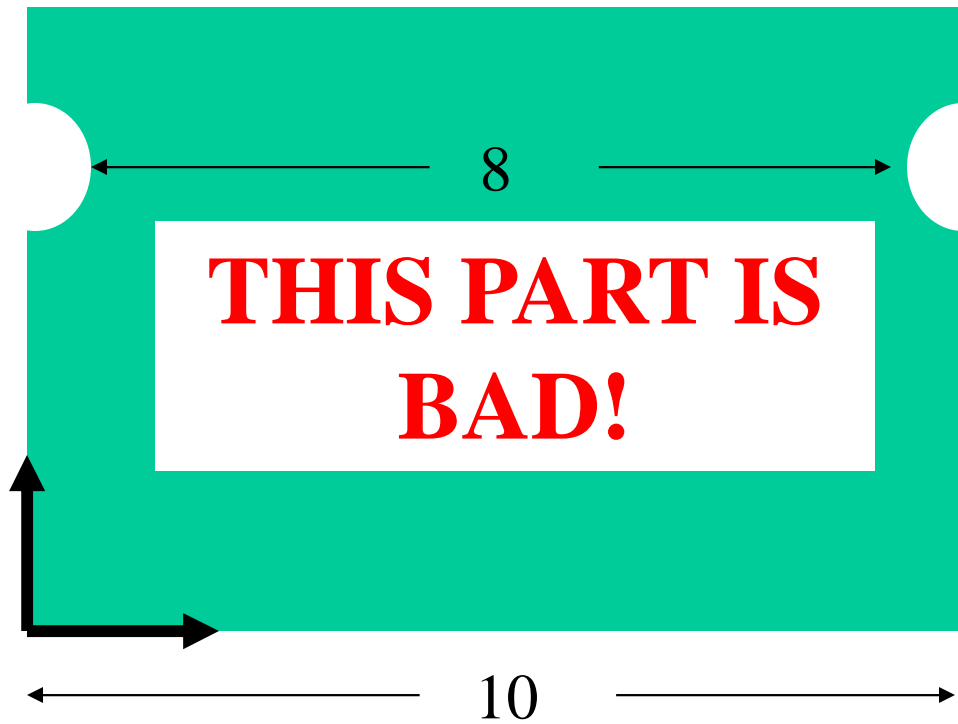


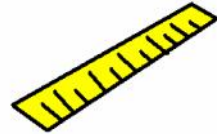
LUNCHEON LEARN





LUNCHEON LEARN

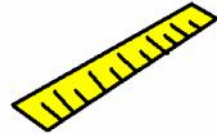




LUNCHEON LEARN

**Unfortunately, there is no “EASY
BUTTON” way to report distance
between planes correctly to “Rule #1”.**

**“Rule #1” establishes a functional
“go-no go” method of evaluating
distance, not a solid numeric result,
which CMMs are good at generating.**

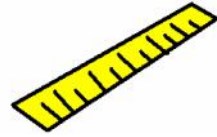


LUNCHEON LEARN

Let's evaluate a few methods of checking distance and rate them on a scale of 1 to 5 for ease of use (practicality) and "correctness" considering "Rule #1".

5 is easiest and most "correct"

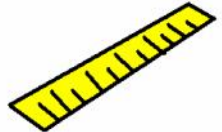
1 is hardest and least "correct"



LUNCHEON LEARN

Method 1:

Checking the “X” value.



LUNCHEON LEARN

Calypso User Desk - (C) Carl Zeiss - Rule 1 Distance

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

Define Nominal Geometry (Probe, Enter, or Read)

Features

right

Comment Strategy Evaluation...

Clearance Group Nominal Definition Alignment

Recall Feature Fv Alignment1

Tolerance For:	Nominal	Actual
<input checked="" type="checkbox"/> X	10.0000	10.0000
<input type="checkbox"/> Y	0.0000	-0.0000
<input type="checkbox"/> Z	-5.0000	-5.0000
<input type="checkbox"/> A1 Y/X	0.0000	-8.5308
<input type="checkbox"/> A2 Z/X	0.0000	-0.0000

Space Axis \pm X

Length 1 10.0000 10.1119

Length 2 5.0000

Start Angle 0.0000 0.0000

Sigma	Form	Points
0.0000	0.0000	5

Min	Point no	Point no	Max
-0.0000	2	1	0.0000

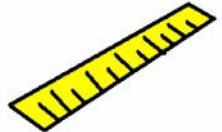
X = 10.0000
Y = 0.0000
Z = -5.0000

Point9
Point10
Point6 Coad4

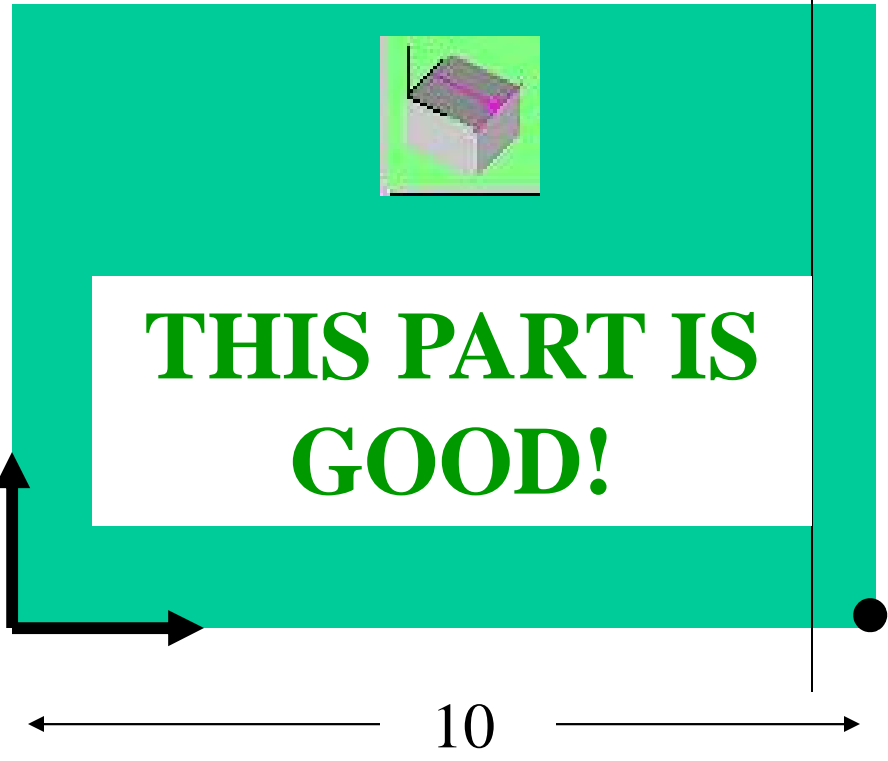
0.7 mm

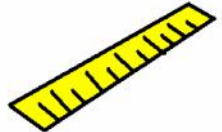
OK Reset

Point9

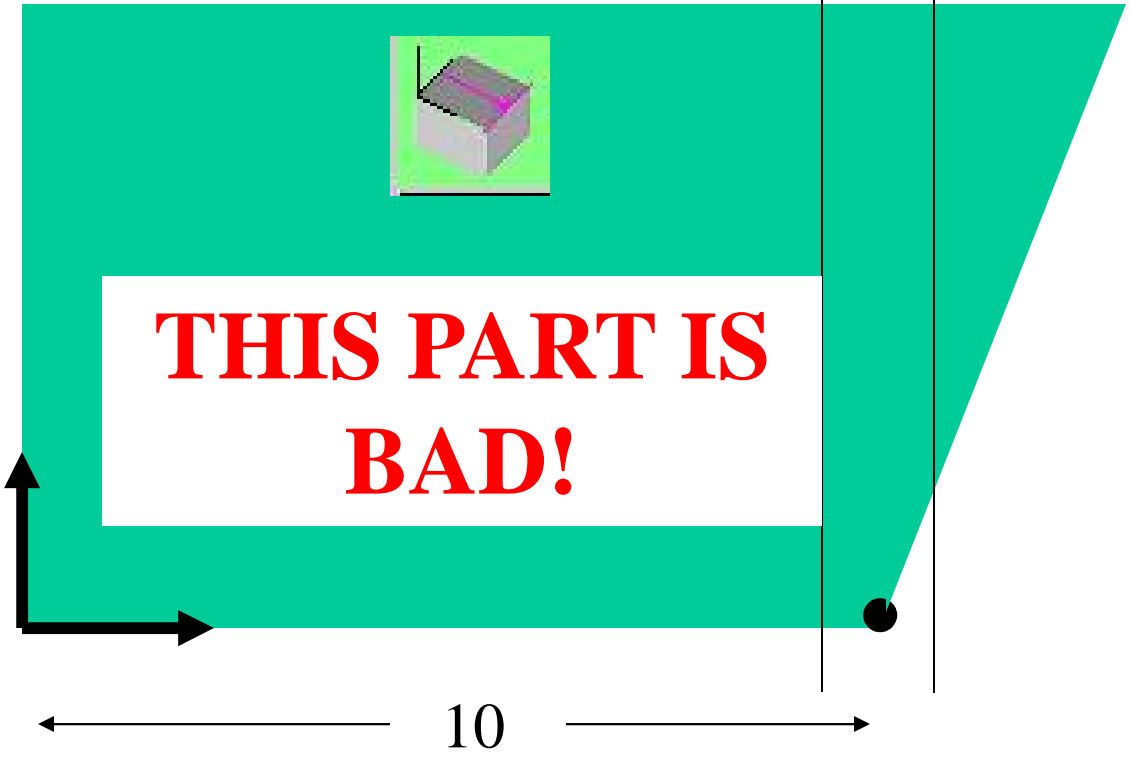


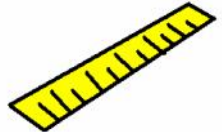
LUNCHEON LEARN



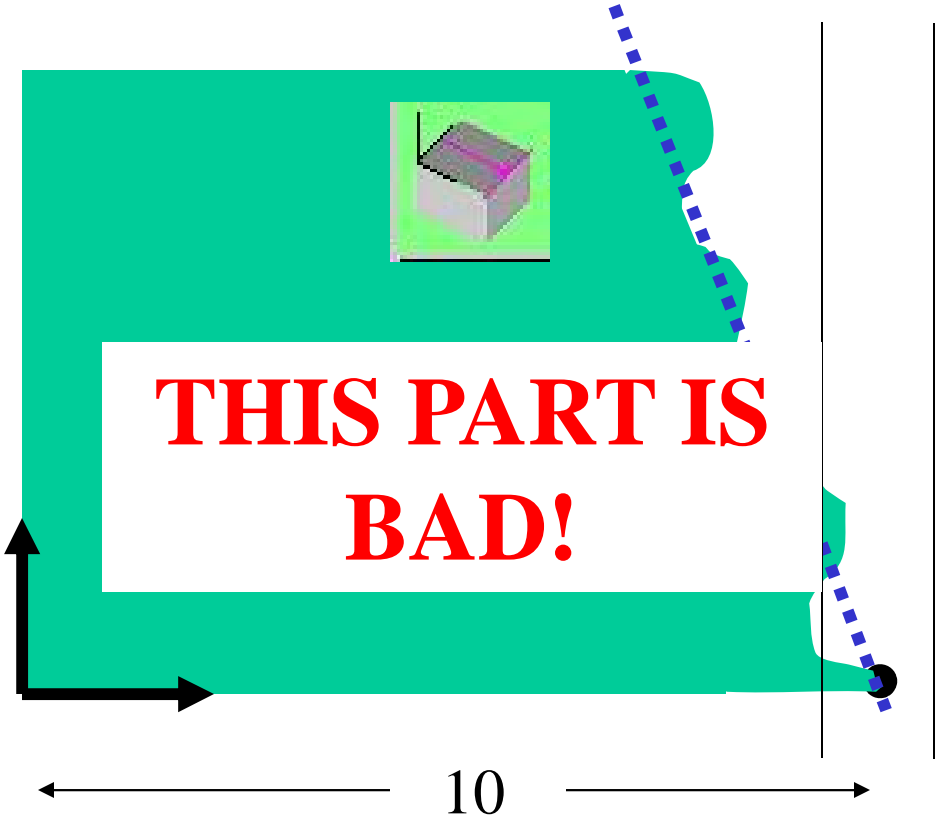


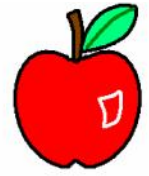
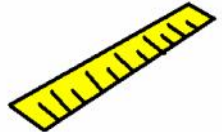
LUNCHEON LEARN



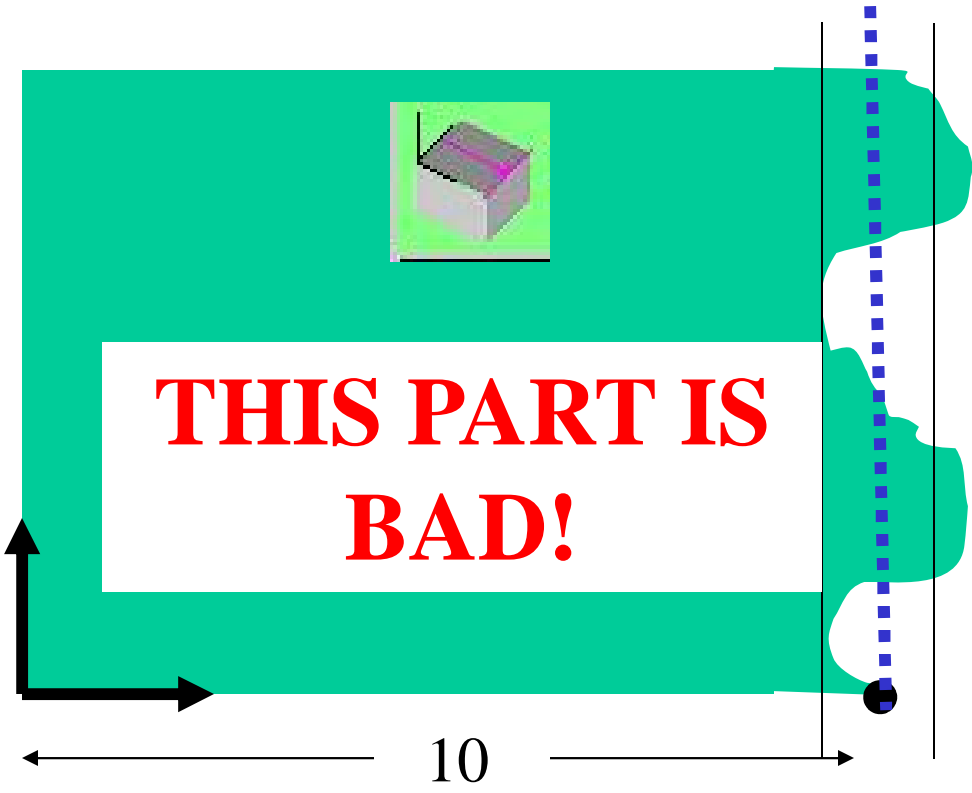


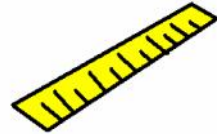
LUNCHEON LEARN



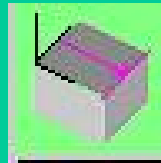
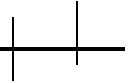
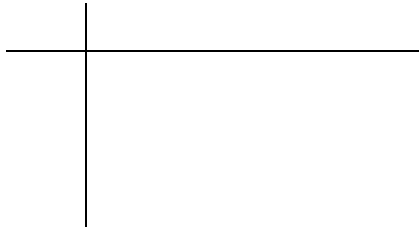


LUNCHEON LEARN

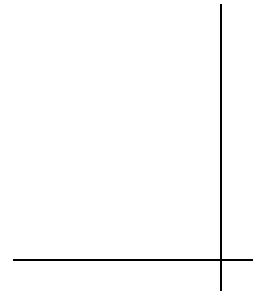


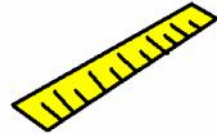


LUNCHEON LEARN



**THIS PART IS
BAD!**





LUNCHEON LEARN

Method 1:

Checking the “X” value.

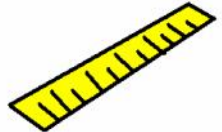
Ease/Practicality: 5

“Correctness”: 1

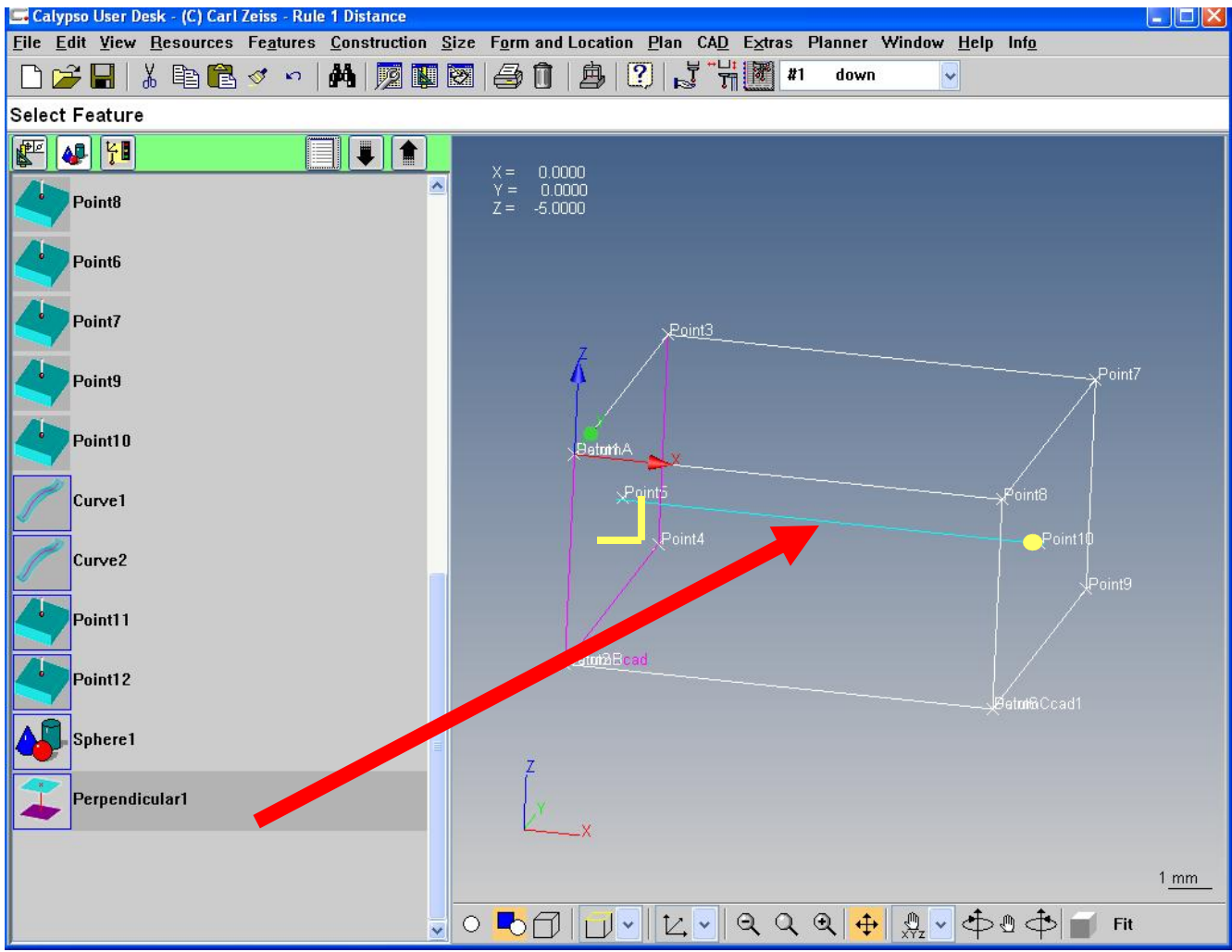


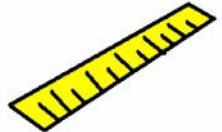
Method 2:

Cartesian Distance

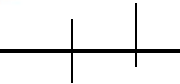
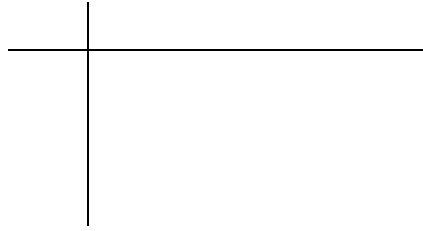


LUNCHEON LEARN



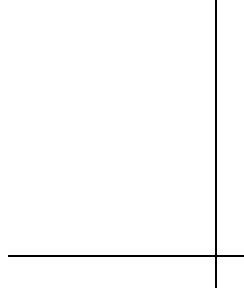


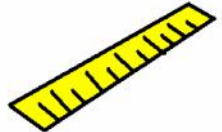
LUNCHEON LEARN



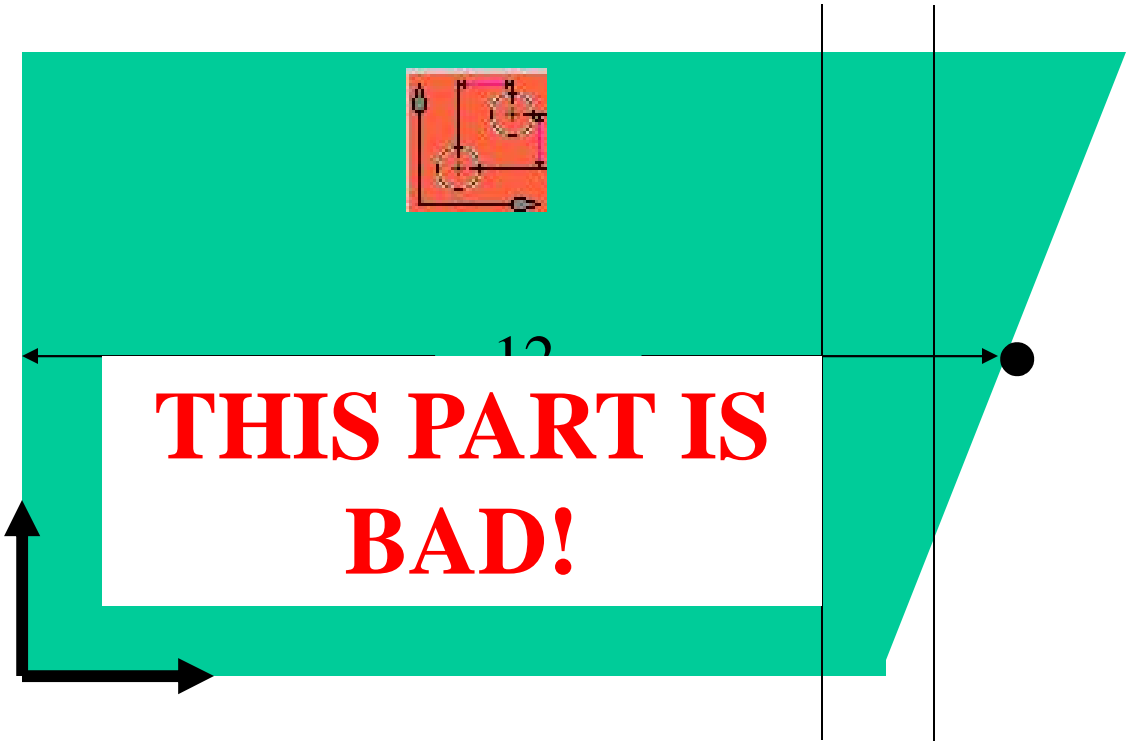
10

THIS PART IS GOOD!

A large green rectangular area containing a small circuit diagram icon at the top center, the number '10' in the middle, and the text 'THIS PART IS GOOD!' in large, bold, green, uppercase letters at the bottom. A black dot is located on the right edge of the green area, and a thick black arrow points from the bottom of the green area towards the left.

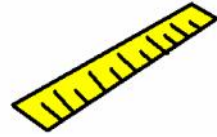


LUNCHEON LEARN

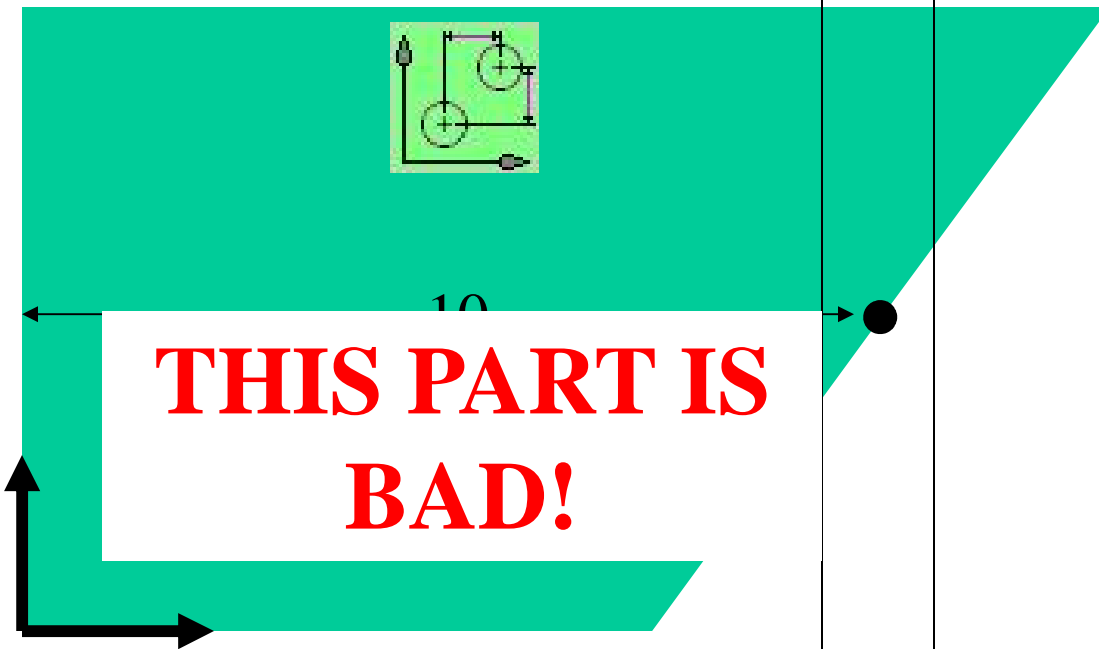


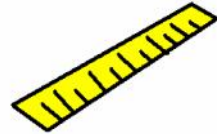
**THIS PART IS
BAD!**

12

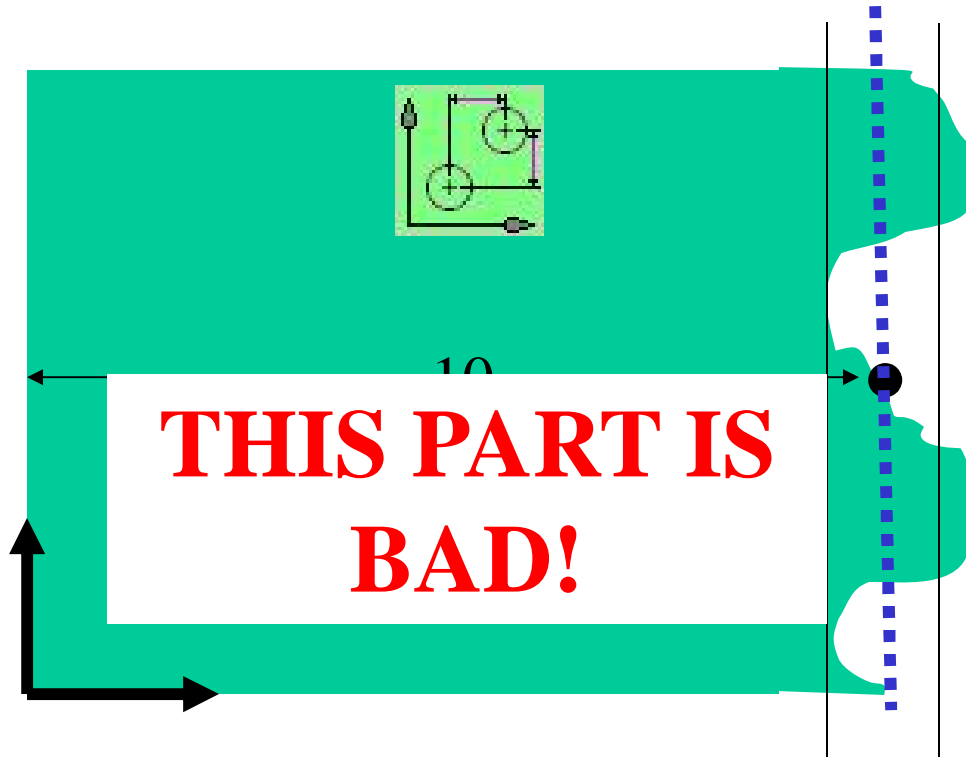


LUNCHEON LEARN

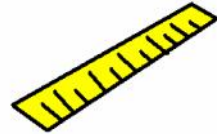




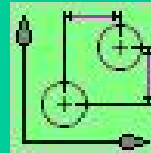
LUNCHEON LEARN



**THIS PART IS
BAD!**

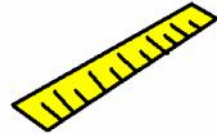


LUNCHEON LEARN



**THIS PART IS
BAD!**

11



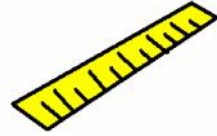
LUNCHEON LEARN

Method 2:

Cartesian Distance

Ease/Practicality: 4

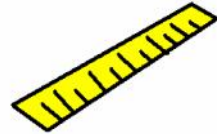
“Correctness”: 2



LUNCHEON LEARN

Method 3:

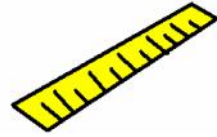
Report Cartesian Distance and Parallelism



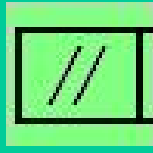
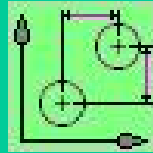
LUNCHEON LEARN

Remember...

Parallelism = Distance between two planes, parallel to the datum, that contain all points of the evaluated plane.

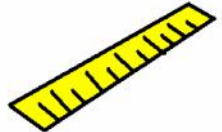


LUNCHEON LEARN

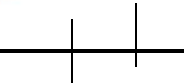
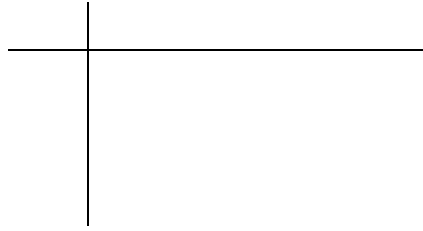


10

**THIS PART IS
GOOD!**

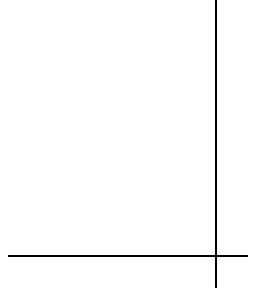


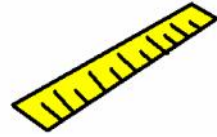
LUNCHEON LEARN



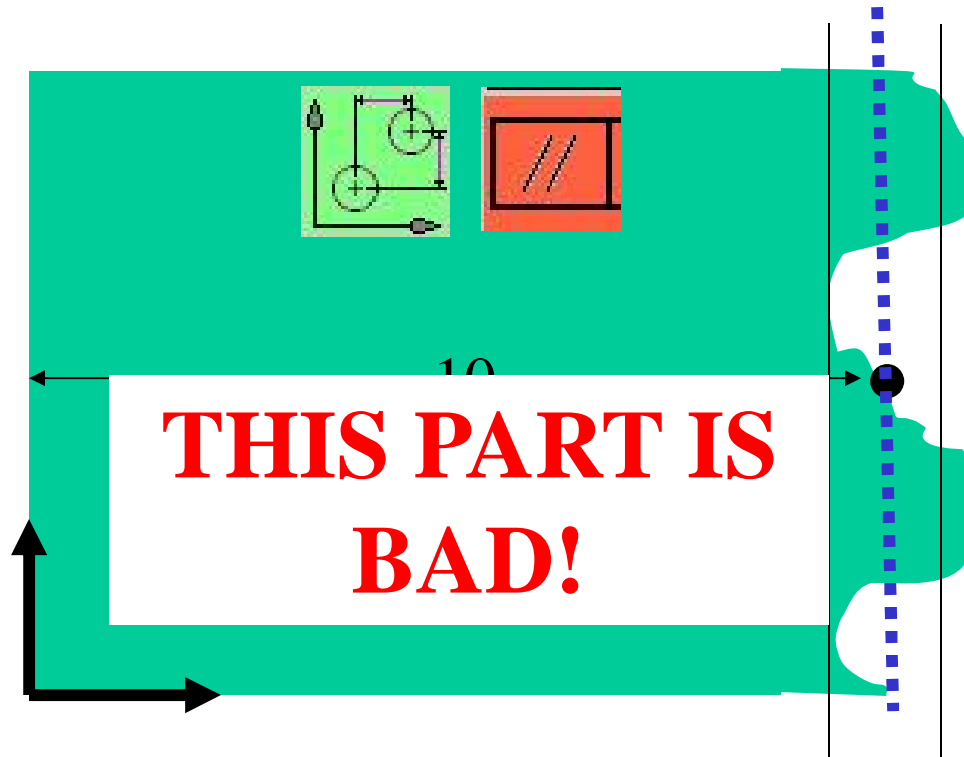
10.5

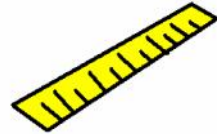
THIS PART IS GOOD!

A large green rectangular box with a white center. At the top, there are two small technical diagrams: a schematic diagram on the left and a drawing of a rectangular part with two parallel lines on the right. Below the diagrams, the number '10.5' is written. In the center, the text 'THIS PART IS GOOD!' is written in large, bold, green letters. A horizontal double-headed arrow is positioned above the text, and a vertical line with a black dot at its end is on the right side of the box. A thick black arrow starts at the bottom left corner of the box and points to the right.

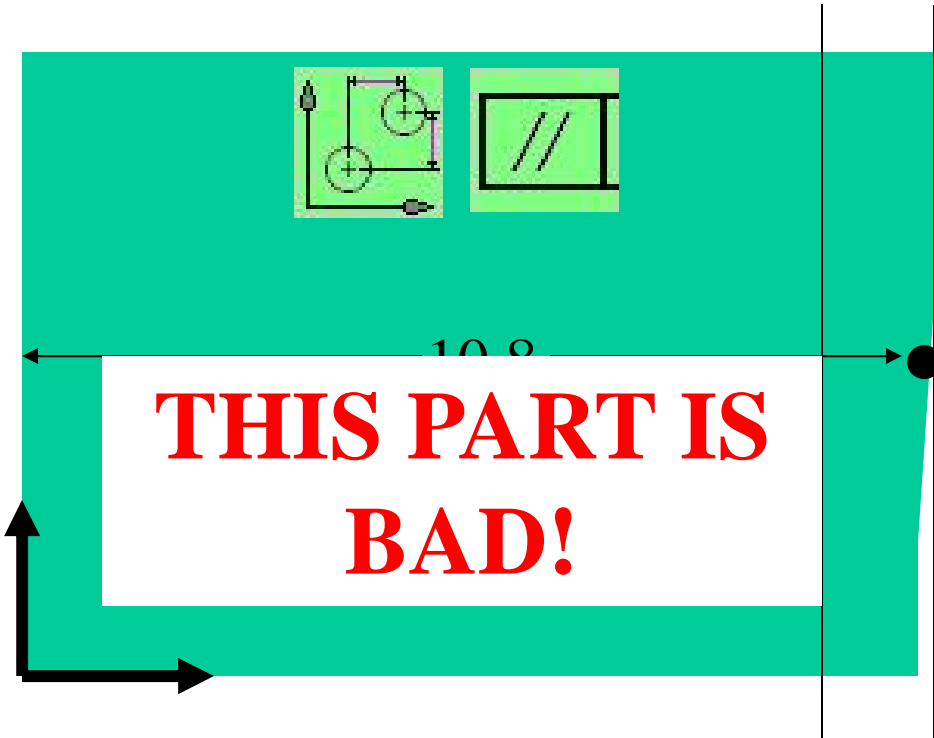


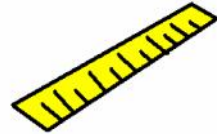
LUNCHEON LEARN



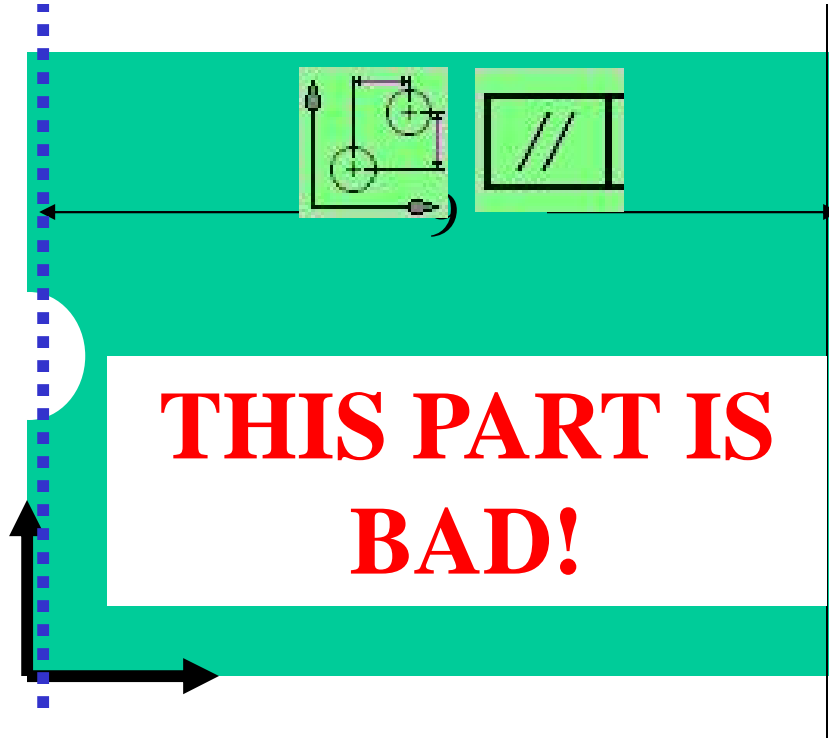


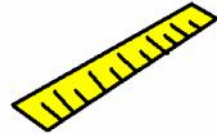
LUNCHEON LEARN



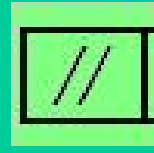
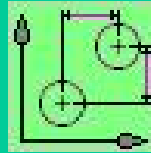


LUNCHEON LEARN

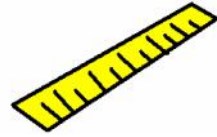




LUNCHEON LEARN



**THIS PART IS
BAD!**



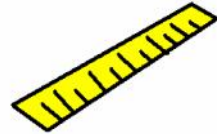
LUNCHEON LEARN

Method 3:

**Report Cartesian Distance
and Parallelism**

Ease/Practicality: 3

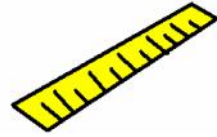
“Correctness”: 3



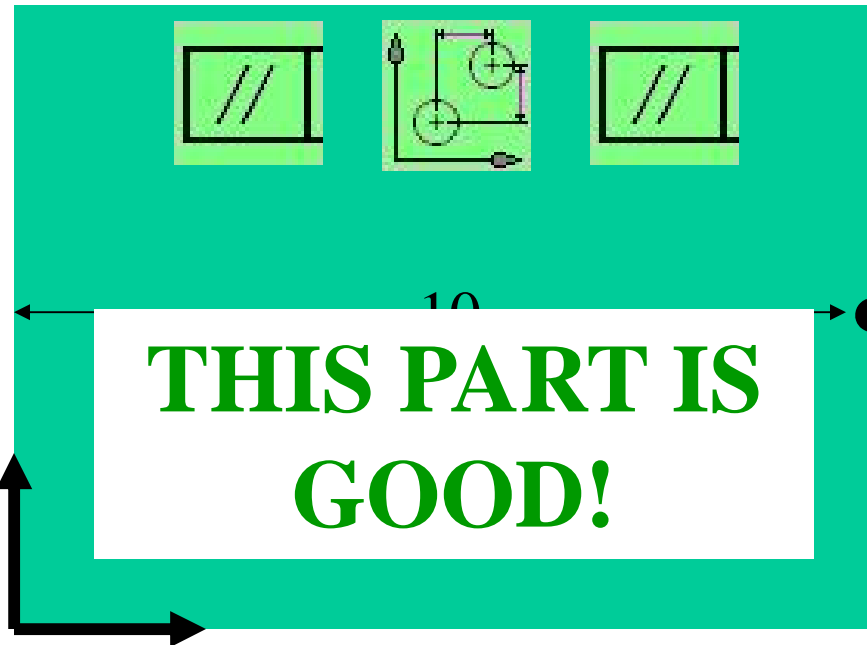
LUNCHEON LEARN

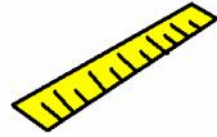
Method 4:

Cartesian Distance and TWO Parallelisms

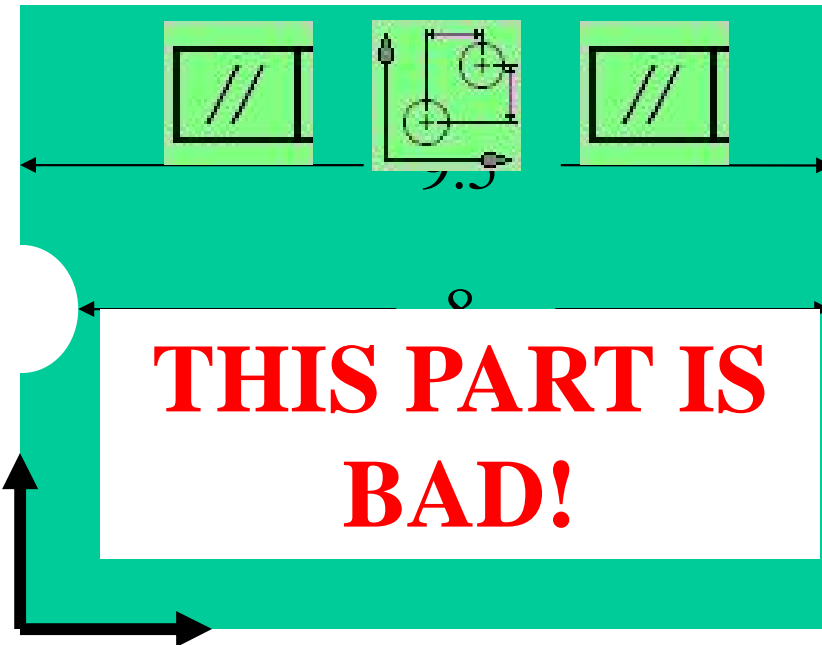


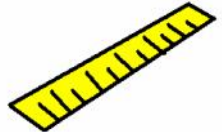
LUNCHEON LEARN



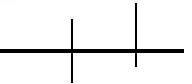
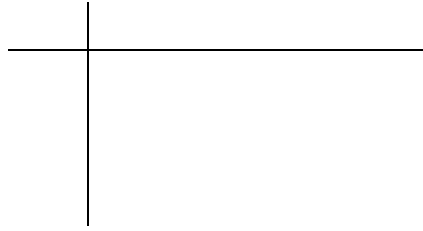


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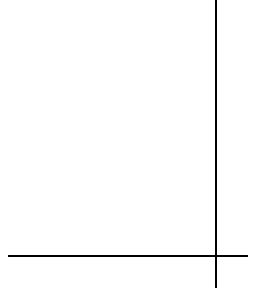


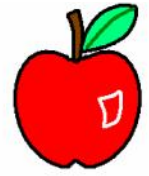
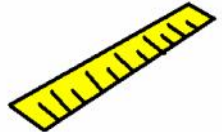
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11

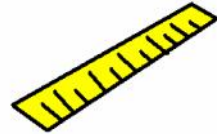
THIS PART IS GOOD!

A large green callout box with a white rounded rectangle inside. At the top of the green box are three small square icons: two with diagonal lines and one with a circuit diagram. Below these icons is the number '11'. The white rectangle contains the text 'THIS PART IS GOOD!' in bold green letters. Two horizontal arrows point outwards from the top and bottom of the white rectangle.



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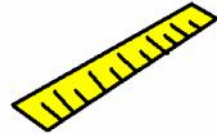




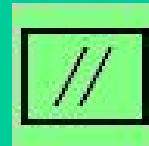
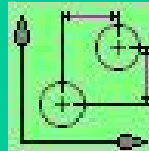
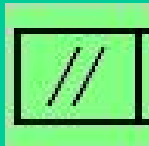
LUNCHEON LEARN

THIS PART IS BAD!

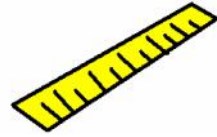
A large green rectangular box with a white text area in the center. The text area contains the words 'THIS PART IS BAD!' in bold, red, uppercase letters. Above the text area are three small diagrams: two identical diagrams on the left and right, each showing a rectangle with two diagonal lines inside, and a central diagram showing a circuit with a light bulb, a battery, and a motor. A black dot is on the right edge of the green box, with a black arrow pointing from the text area towards it. A thick black arrow starts from the bottom left corner of the green box and points to the right.



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**THIS PART IS
BAD!**



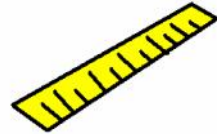
LUNCHEON LEARN

Method 4:

**Cartesian Distance and
TWO Parallelisms**

Ease/Practicality: 2

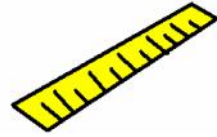
“Correctness”: 4



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Method 5:

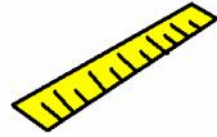
Following the Standard



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Remember how to check distance, following Rule #1:

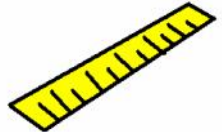
- The part must be able to pass between two parallel planes at the maximum allowable distance apart.
- The “actual local size” of any cross-section on the part must be larger than the minimum allowable distance apart.



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First Part:

The part must be able to pass between two parallel planes at the maximum allowable distance apart.



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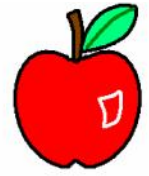
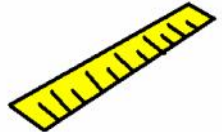
The screenshot displays the Calypso User Desk interface. The main window is titled "Calypso User Desk - (C) Carl Zeiss - Rule 1 Distance".

Cartesian Distance Dialog:

- Feature 1: DatumC
- Feature 2: right (indicated by a red arrow)
- Nominal: 10.0000
- Upper Tolerance: 1.0000
- Lower Tolerance: -1.0000
- Actual: 11.3401

Selection Dialog:

- Elements list: DatumA, DatumB, Point1, Point2, Point3, Point4, Point5, DatumCcad, DatumCcad1, Plane1, Plane2, **right** (highlighted), DatumC, Point8, Point6, Point7, Point9, Point10, Curve1, Curve2.
- Buttons: Outer Tangential Element, Low-pass Spline 8.0, (No Constraint), Outlier Elimination.

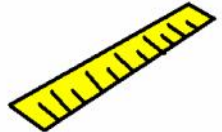


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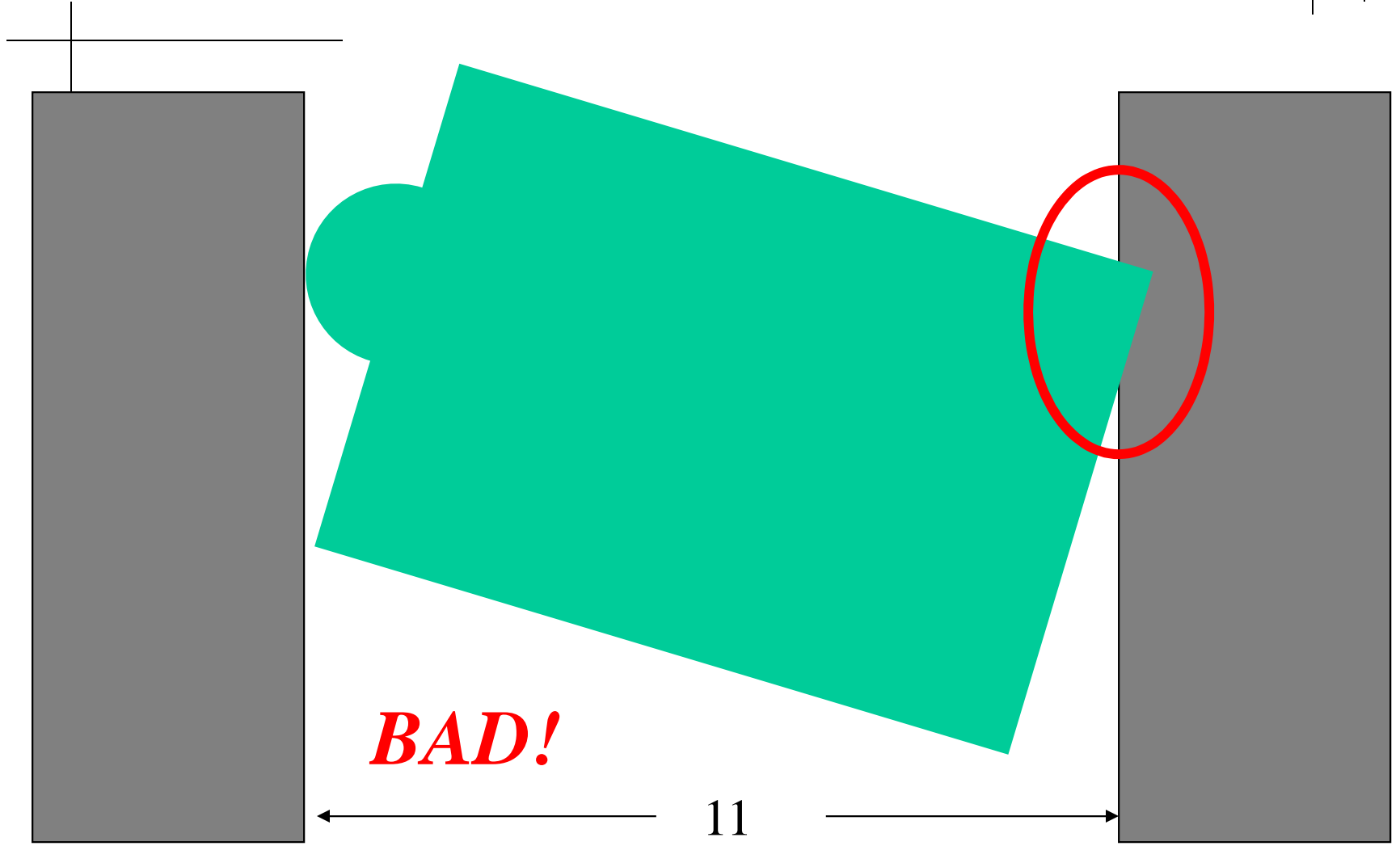
The screenshot displays the Calypso User Desk interface with three overlapping dialog boxes:

- Cartesian Distance Dialog:** Shows 'Dist C to Right Out' with 'Fine' tolerance. Feature 1 is 'DatumC' and Feature 2 is 'right'. The 'Actual' value is 11.3401.
- Selection Dialog:** Lists 'Elements' including DatumA, DatumB, DatumCcad, Plane1, Plane2, right, DatumC, and Perpendicular1. 'right' is selected.
- Evaluation... - Dist C to Right Dialog:** Shows 'Feature 1' as 'DatumC'. Under 'Evaluation Constraints', 'Take constraints from' is checked. Under 'or to feature reference', 'right' is selected. Under 'and (optionally) to', 'DatumC' is selected. The 'Evaluation settings' section is circled in red, containing 'Outer Tangential Element', 'Low-pass Spline 8.0', '[No Constraint]', and 'Outlier Elimination'.

Red arrows indicate the flow of data: from the 'right' feature in the Cartesian Distance dialog to the 'right' feature in the Selection dialog, and from the 'right' feature in the Selection dialog to the 'right' feature reference in the Evaluation dialog. Another red arrow points from the 'DatumC' feature in the Selection dialog to the 'DatumC' feature reference in the Evaluation dialog.

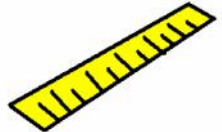


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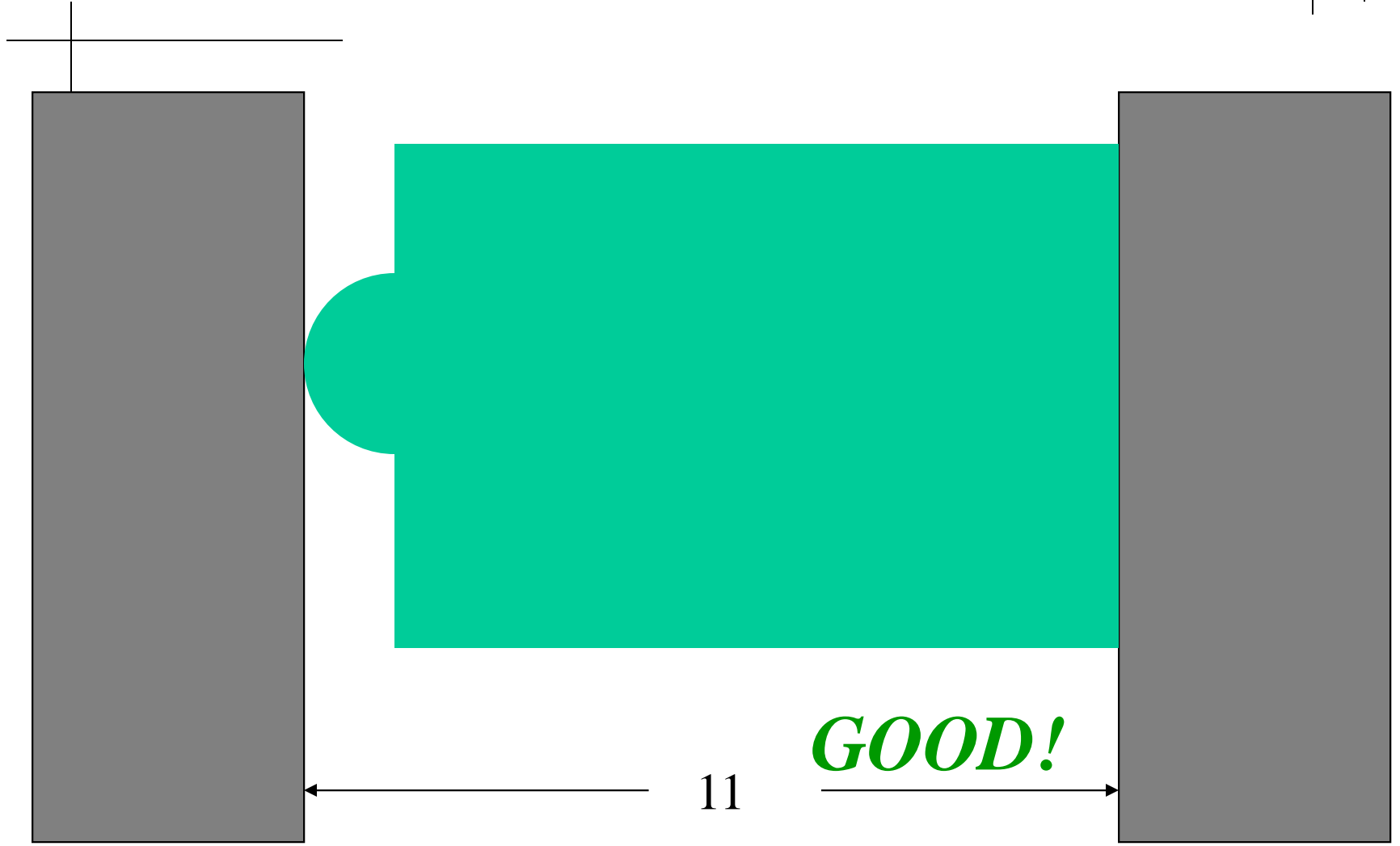


BAD!

11

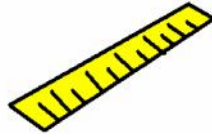


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11

GOOD!



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Cartesian Distance

Dist C to Right Out - Constrain


Fine


Nominal

ISO286

Upper Tolerance None

Lower Tolerance None

Feature 1
 DatumC

Feature 2
 right

Primary Datum

Secondary Datum

Actual

Since there's
no Datum,
Gotta check
both!

Cartesian Distance

Dist Right to C Out - Constrain


Fine


Nominal

ISO286

Upper Tolerance None

Lower Tolerance None

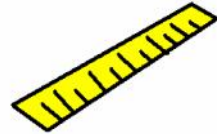
Feature 1
 right

Feature 2
 DatumC

Primary Datum

Secondary Datum

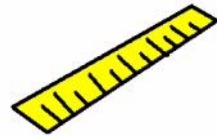
Actual



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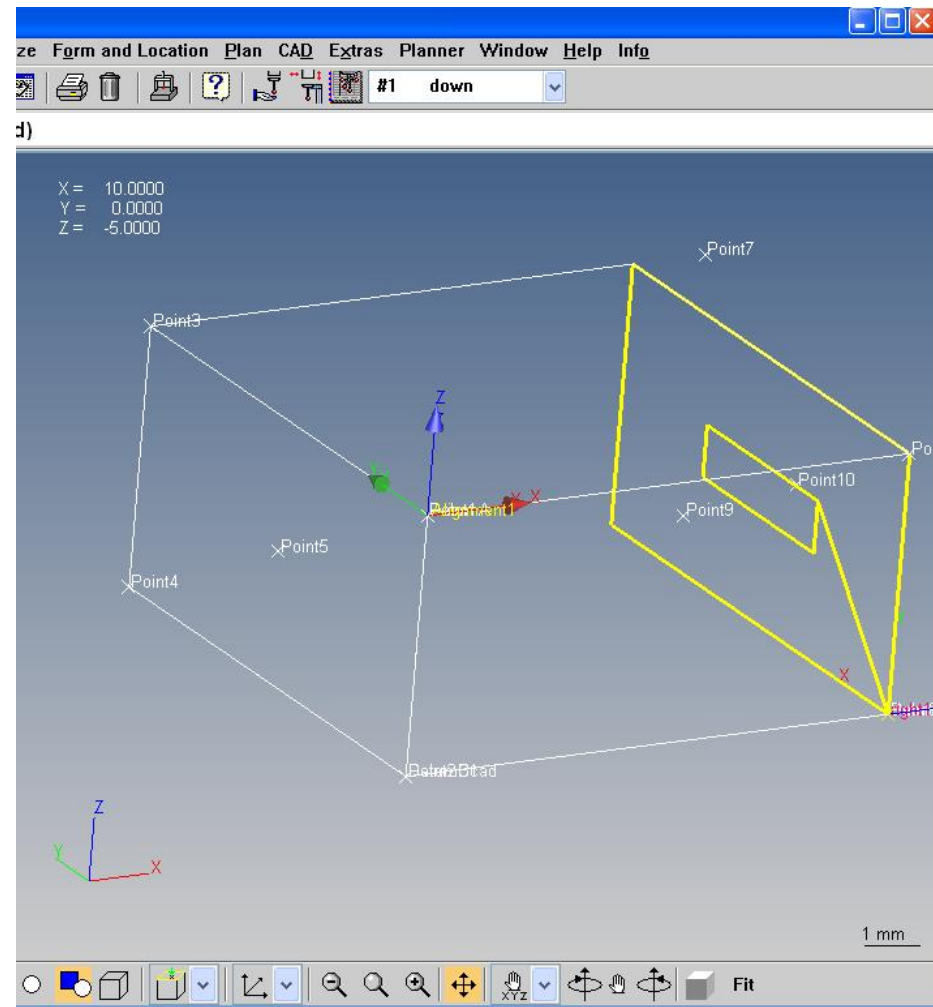
Second Part:

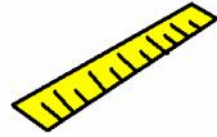
The “actual local size” of any cross-section on the part must be larger than the minimum allowable distance apart.



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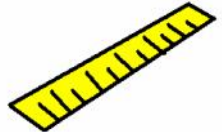
Measure the two planes with identical opposing measurement strategies.



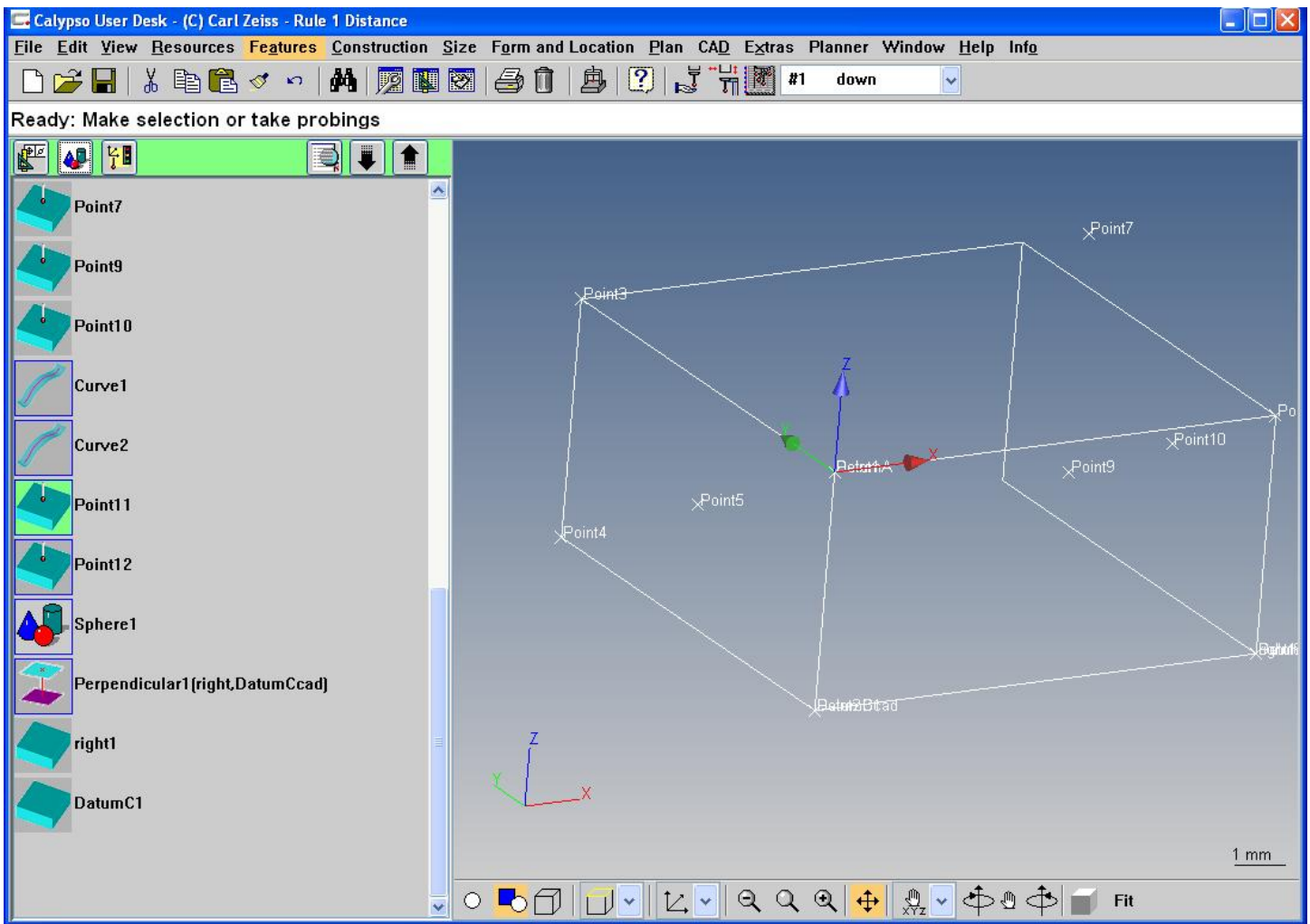


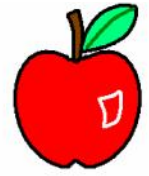
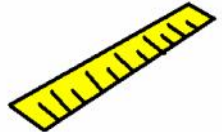
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Now, we need to individually test the distance between all the points of a plane to the opposing point on the other plane. Report the smallest case.



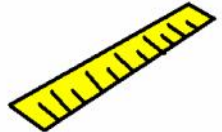
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The screenshot shows a CAD software interface with several overlapping dialog boxes. At the top, a 'Features' dialog box is open, showing a small 3D model of a point and the text 'Point13'. Below it, a 'Formula...' dialog box is open, displaying a list of features on the left and a 'Compute' button on the right. A 'Name/Comment' dialog box is also open, with 'Point13' in the 'Name' field and a yellow-highlighted 'Comment' field containing the character 'l'. A red arrow points from the 'Comment' field to the 'OK' button. Another red arrow points from the bottom of the 'Name/Comment' dialog to the 'OK' button of the 'Formula...' dialog. At the bottom of the screen, a third dialog box is partially visible, showing 'OK', 'Reset', and a right-pointing arrow button.



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Recall Feature Points

Feature Point Recall DatumC

Formula...

Number
LOOP1

Function Loop Nominal **Actual** Compute

Characteristics

- Alignment1
- Right Plane's X Va
- Distance Right to C
- Parallelism Right t
- Parallelism C to Ri
- Dist C to Right Out
- Dist Right to C Out
- Minimum1
- Cartesian Distance

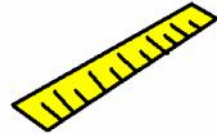
Plane2

OK Cancel Help

OK Cancel

OK Cancel

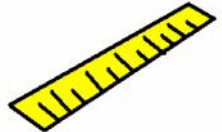
OK, OK, OK, OK
To close out of point



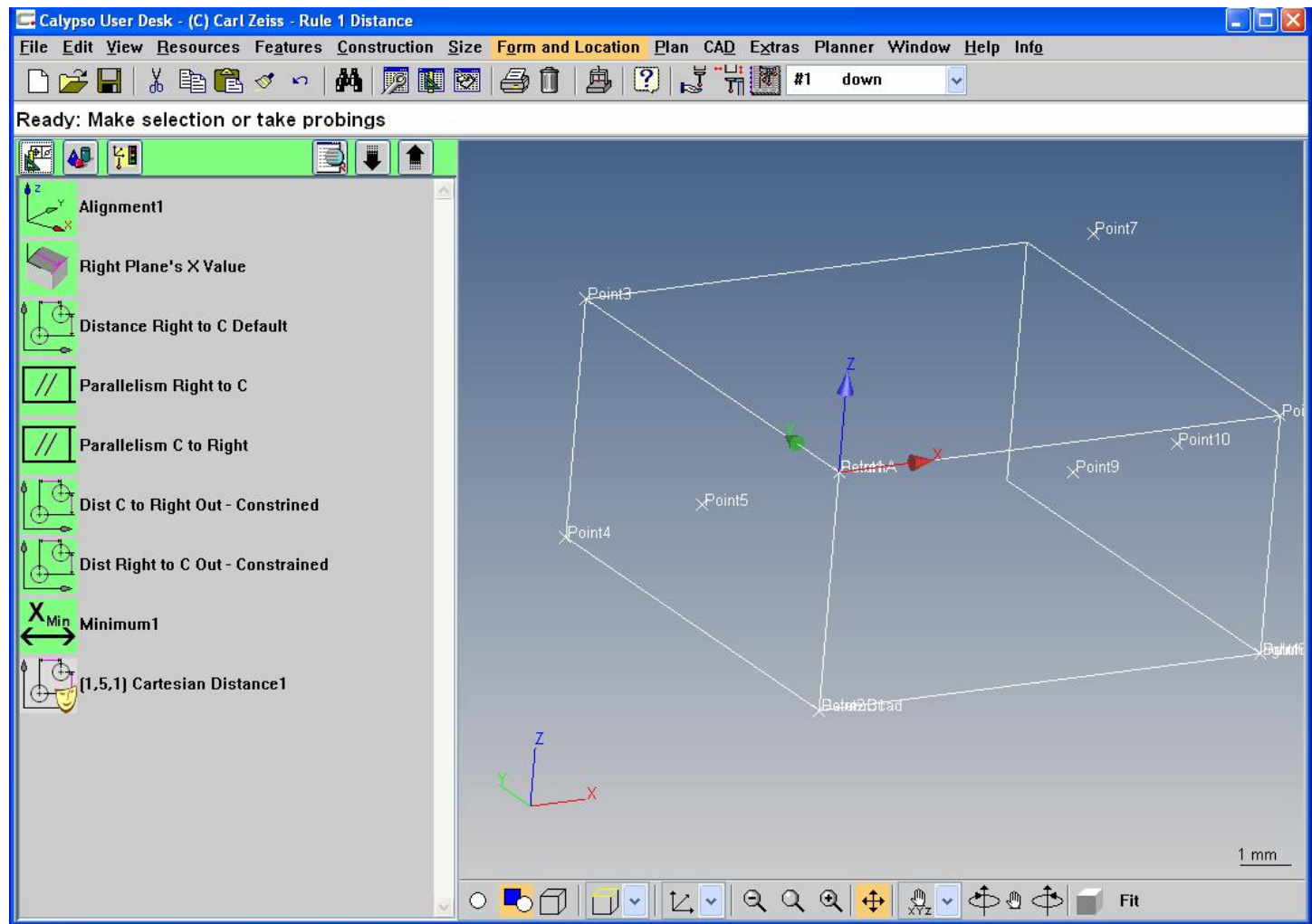
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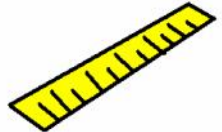
Repeat the same procedure to
create a new point for the
opposing plane.

- New point
- Comment - Formula - LOOP1
- Recall Feature Points - PLANE
- Add Limits - Formula - LOOP1

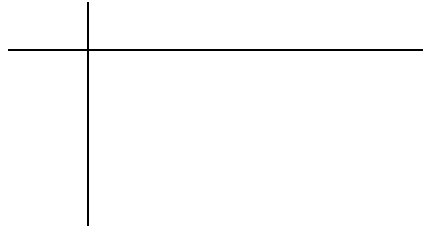


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Cartesian Distance

Cartesian Distance2 Comment

Fine

Nominal 10.0000

ISO286

Upper Tolerance 0.1000 None

Lower Tolerance -0.1000 None

Feature 1
Point11

Feature 2
Point12

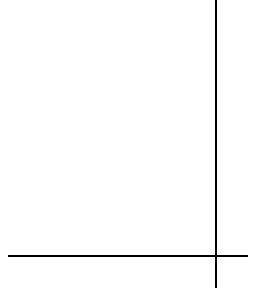
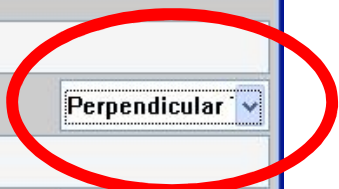
Primary Datum **Perpendicular**

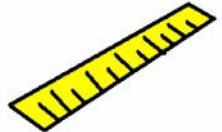
DatumC

Secondary Datum Parallel To

Actual 10.0000

OK Reset

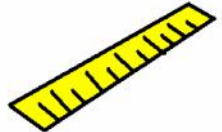




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The screenshot shows the Calypso User Desktop interface. The 'Measurement Plan Editor Characteristics' dialog box is open, displaying a list of characteristics and their values. A red arrow points to the 'OK' button at the bottom of the dialog. The background shows a 3D model of a part with several points labeled: Point8, Point9, Point10, and Point6Ccad1. A scale bar indicates 1 mm.

Name	Type	Value
Alignment1	Alignmen	Off
Right Plane's X Value	X	Off
Distance Right to C Default	CartDist	Off
Parallelism Right to C	GDT Par	Off
Parallelism C to Right	GDT Par	Off
Dist C to Right Out - Constrained	CartDist	Off
Dist Right to C Out - Constrained	CartDist	Off
Minimum1	MinValue	Off
Cartesian Distance1	CartDist	On



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Calypso User Desk - (C) Carl Zeiss - Rule 1 Distance

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

Ready: Make selection or take probings

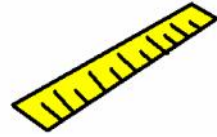
- Dist C to Right Out - Constrained
- Dist Right to C Out - Constrained
- (1,10,1) Curve to Connect
- X_{Min} Minimum1

One of these two MUST be good

This MUST be good

Point3, Point5, PointA, Point9, Point10, Point8, DatumA, DatumB, DatumC, DatumD, DatumE, DatumF, DatumG, DatumH, DatumI, DatumJ, DatumK, DatumL, DatumM, DatumN, DatumO, DatumP, DatumQ, DatumR, DatumS, DatumT, DatumU, DatumV, DatumW, DatumX, DatumY, DatumZ, DatumAA, DatumAB, DatumAC, DatumAD, DatumAE, DatumAF, DatumAG, DatumAH, DatumAI, DatumAJ, DatumAK, DatumAL, DatumAM, DatumAN, DatumAO, DatumAP, DatumAQ, DatumAR, DatumAS, DatumAT, DatumAU, DatumAV, DatumAW, DatumAX, DatumAY, DatumAZ, DatumBA, DatumBB, DatumBC, DatumBD, DatumBE, DatumBF, DatumBG, DatumBH, DatumBI, DatumBJ, DatumBK, DatumBL, DatumBM, DatumBN, DatumBO, DatumBP, DatumBQ, DatumBR, DatumBS, DatumBT, DatumBU, DatumBV, DatumBW, DatumBX, DatumBY, DatumBZ, DatumCA, DatumCB, DatumCC, DatumCD, DatumCE, DatumCF, DatumCG, DatumCH, DatumCI, DatumCJ, DatumCK, DatumCL, DatumCM, DatumCN, DatumCO, DatumCP, DatumCQ, DatumCR, DatumCS, DatumCT, DatumCU, DatumCV, DatumCW, DatumCX, DatumCY, DatumCZ, DatumDA, DatumDB, DatumDC, DatumDD, DatumDE, DatumDF, DatumDG, DatumDH, DatumDI, DatumDJ, DatumDK, DatumDL, DatumDM, DatumDN, DatumDO, DatumDP, DatumDQ, DatumDR, DatumDS, DatumDT, DatumDU, DatumDV, DatumDW, DatumDX, DatumDY, DatumDZ, DatumEA, DatumEB, DatumEC, DatumED, DatumEE, DatumEF, DatumEG, DatumEH, DatumEI, DatumEJ, DatumEK, DatumEL, DatumEM, DatumEN, DatumEO, DatumEP, DatumEQ, DatumER, DatumES, DatumET, DatumEU, DatumEV, DatumEW, DatumEX, DatumEY, DatumEZ, DatumFA, DatumFB, DatumFC, DatumFD, DatumFE, DatumFF, DatumFG, DatumFH, DatumFI, DatumFJ, DatumFK, DatumFL, DatumFM, DatumFN, DatumFO, DatumFP, DatumFQ, DatumFR, DatumFS, DatumFT, DatumFU, DatumFV, DatumFW, DatumFX, DatumFY, DatumFZ, DatumGA, DatumGB, DatumGC, DatumGD, DatumGE, DatumGF, DatumGG, DatumGH, DatumGI, DatumGJ, DatumGK, DatumGL, DatumGM, DatumGN, DatumGO, DatumGP, DatumGQ, DatumGR, DatumGS, DatumGT, DatumGU, DatumGV, DatumGW, DatumGX, DatumGY, DatumGZ, DatumHA, DatumHB, DatumHC, DatumHD, DatumHE, DatumHF, DatumHG, DatumHH, DatumHI, DatumHJ, DatumHK, DatumHL, DatumHM, DatumHN, DatumHO, DatumHP, DatumHQ, DatumHR, DatumHS, DatumHT, DatumHU, DatumHV, DatumHW, DatumHX, DatumHY, DatumHZ, DatumIA, DatumIB, DatumIC, DatumID, DatumIE, DatumIF, DatumIG, DatumIH, DatumII, DatumIJ, DatumIK, DatumIL, DatumIM, DatumIN, DatumIO, DatumIP, DatumIQ, DatumIR, DatumIS, DatumIT, DatumIU, DatumIV, DatumIW, DatumIX, DatumIY, DatumIZ, DatumJA, DatumJB, DatumJC, DatumJD, DatumJE, DatumJF, DatumJG, DatumJH, DatumJI, DatumJJ, DatumJK, DatumJL, DatumJM, DatumJN, DatumJO, DatumJP, DatumJQ, DatumJR, DatumJS, DatumJT, DatumJU, DatumJV, DatumJW, DatumJX, DatumJY, DatumJZ, DatumKA, DatumKB, DatumKC, DatumKD, DatumKE, DatumKF, DatumKG, DatumKH, DatumKI, DatumKJ, DatumKK, DatumKL, DatumKM, DatumKN, DatumKO, DatumKP, DatumKQ, DatumKR, DatumKS, DatumKT, DatumKU, DatumKV, DatumKW, DatumKX, DatumKY, DatumKZ, DatumLA, DatumLB, DatumLC, DatumLD, DatumLE, DatumLF, DatumLG, DatumLH, DatumLI, DatumLJ, DatumLK, DatumLL, DatumLM, DatumLN, DatumLO, DatumLP, DatumLQ, DatumLR, 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DatumYN, DatumYO, DatumYP, DatumYQ, DatumYR, DatumYS, DatumYT, DatumYU, DatumYV, DatumYW, DatumYX, DatumYY, DatumYZ, DatumZA, DatumZB, DatumZC, DatumZD, DatumZE, DatumZF, DatumZG, DatumZH, DatumZI, DatumZJ, DatumZK, DatumZL, DatumZM, DatumZN, DatumZO, DatumZP, DatumZQ, DatumZR, DatumZS, DatumZT, DatumZU, DatumZV, DatumZW, DatumZX, DatumZY, DatumZZ

1 mm

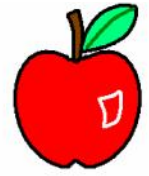
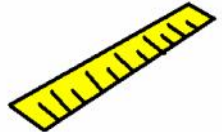


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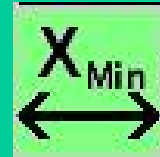
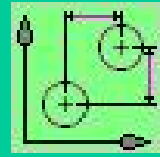
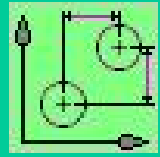
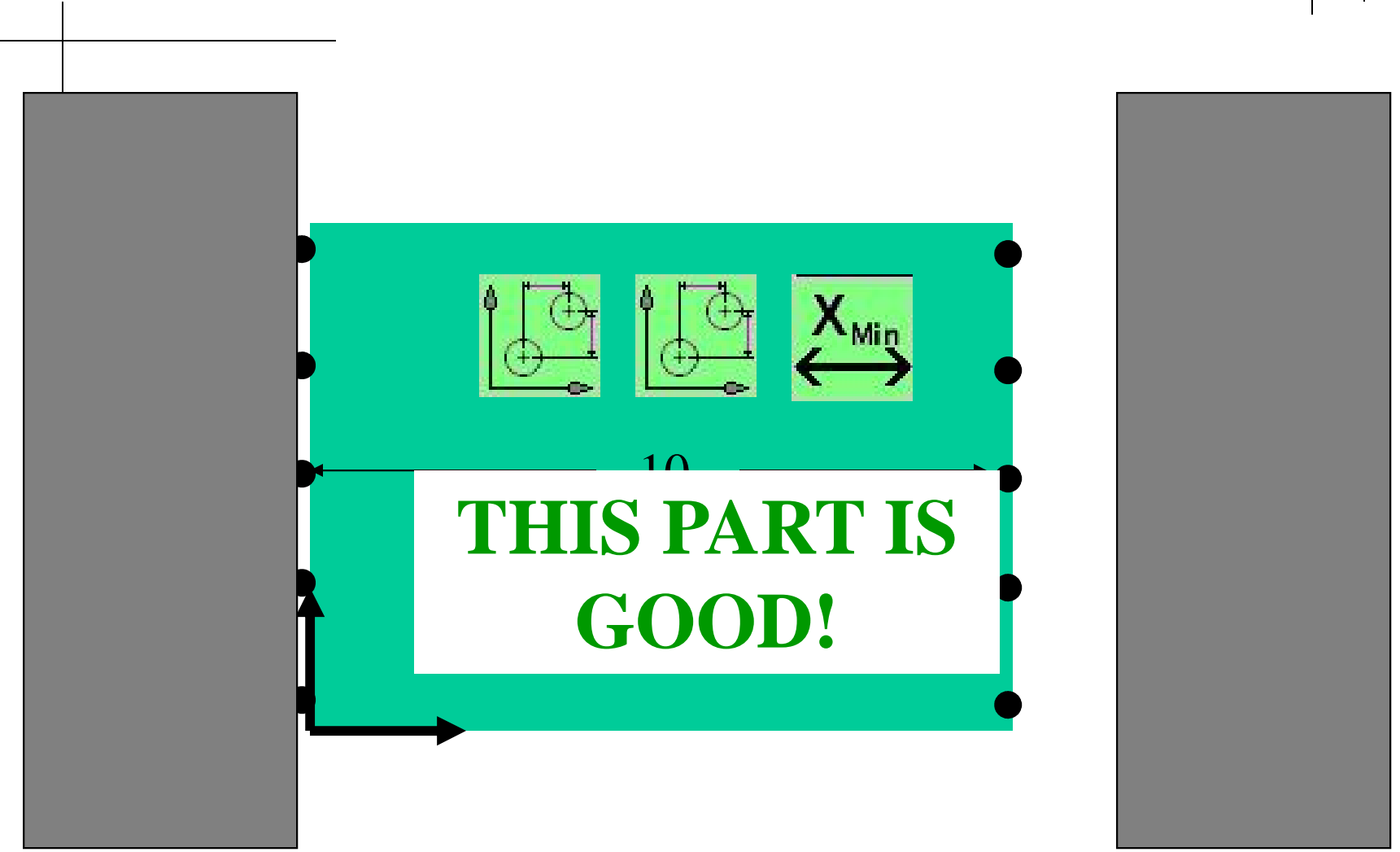
That's it.

Easy, huh?

It's really not all that bad.

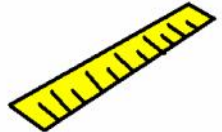


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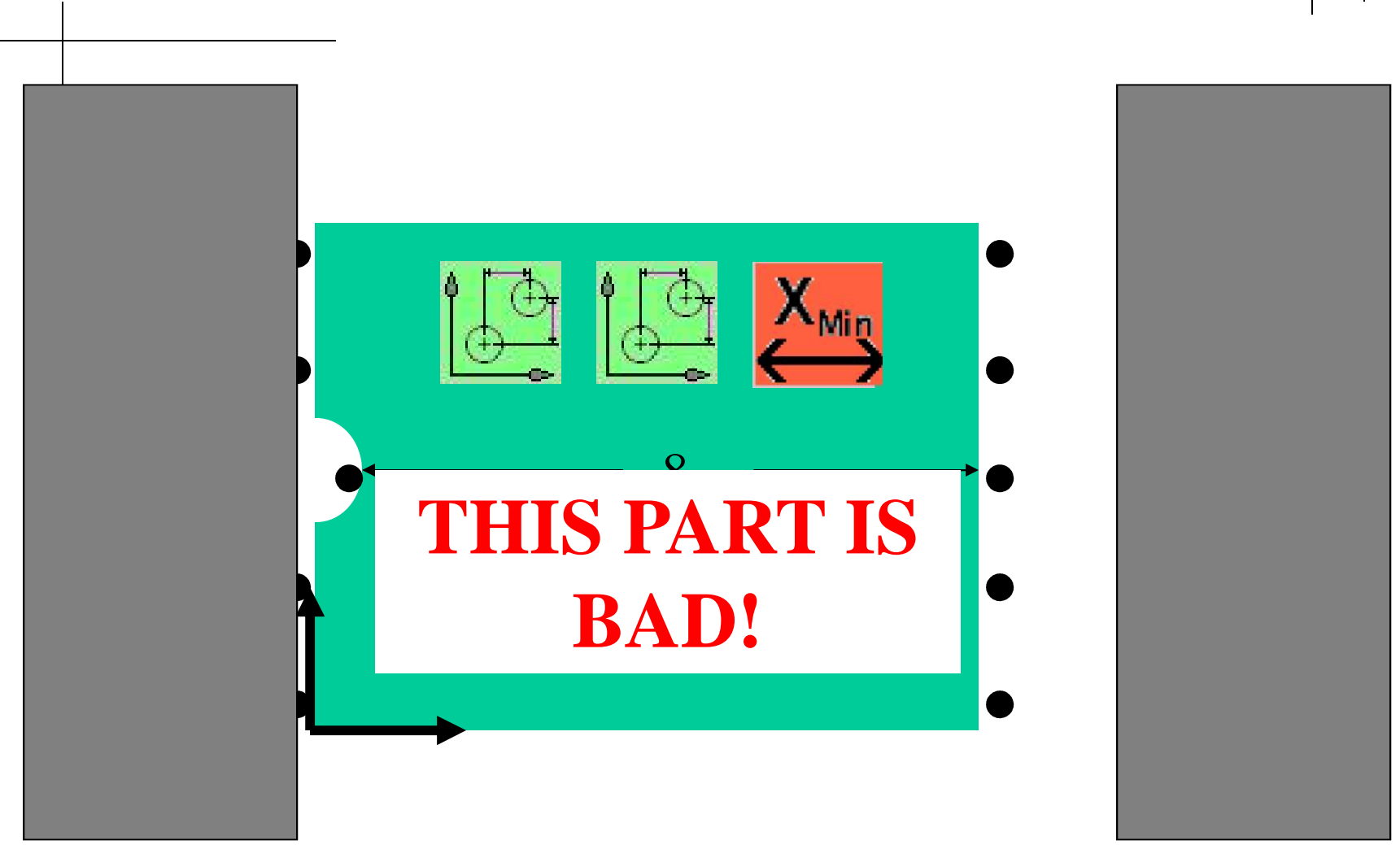


THIS PART IS
GOOD!

10

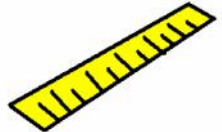


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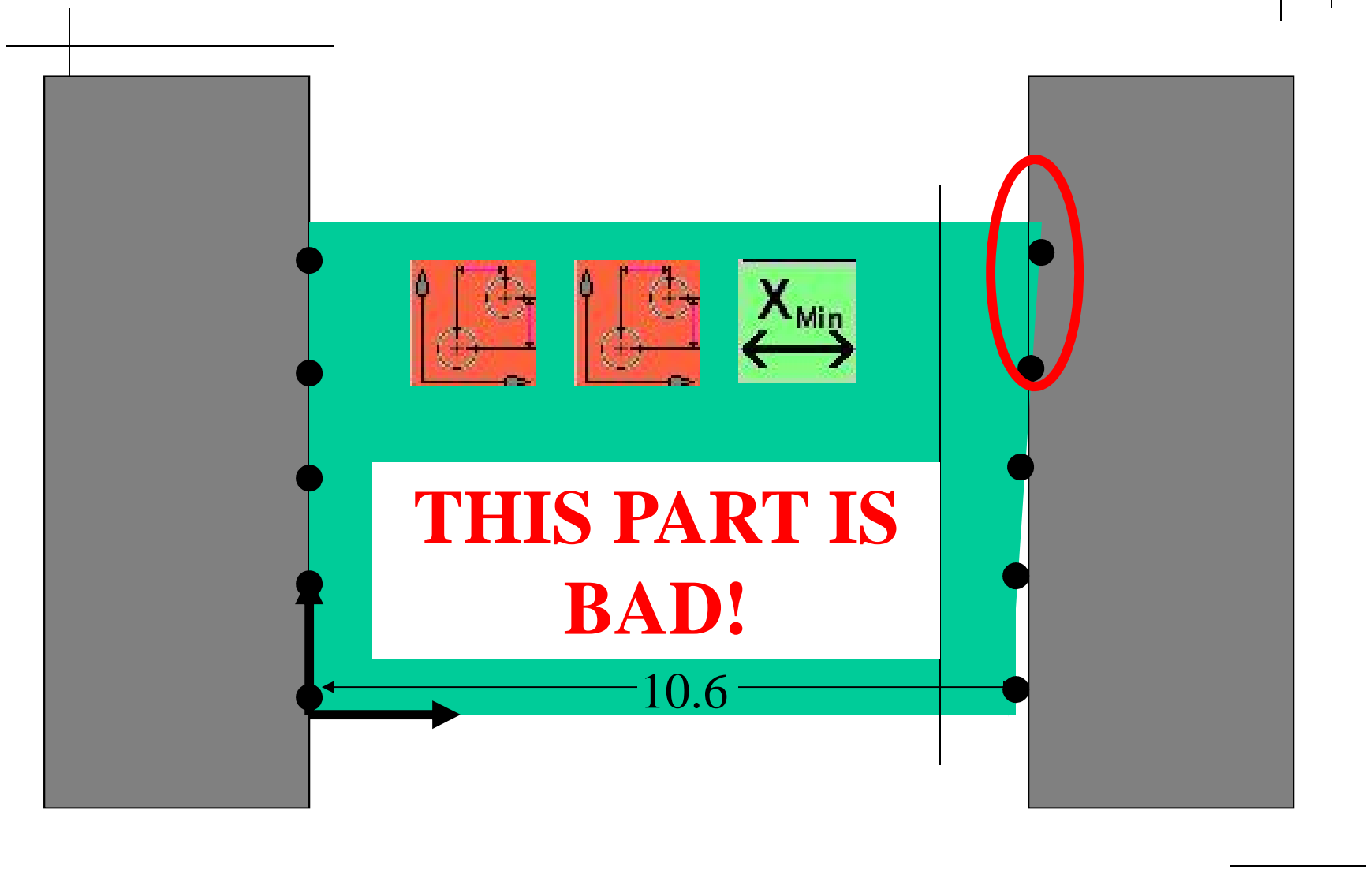


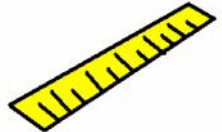
**THIS PART IS
BAD!**

X_{Min}

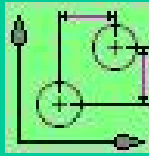
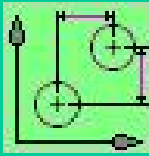
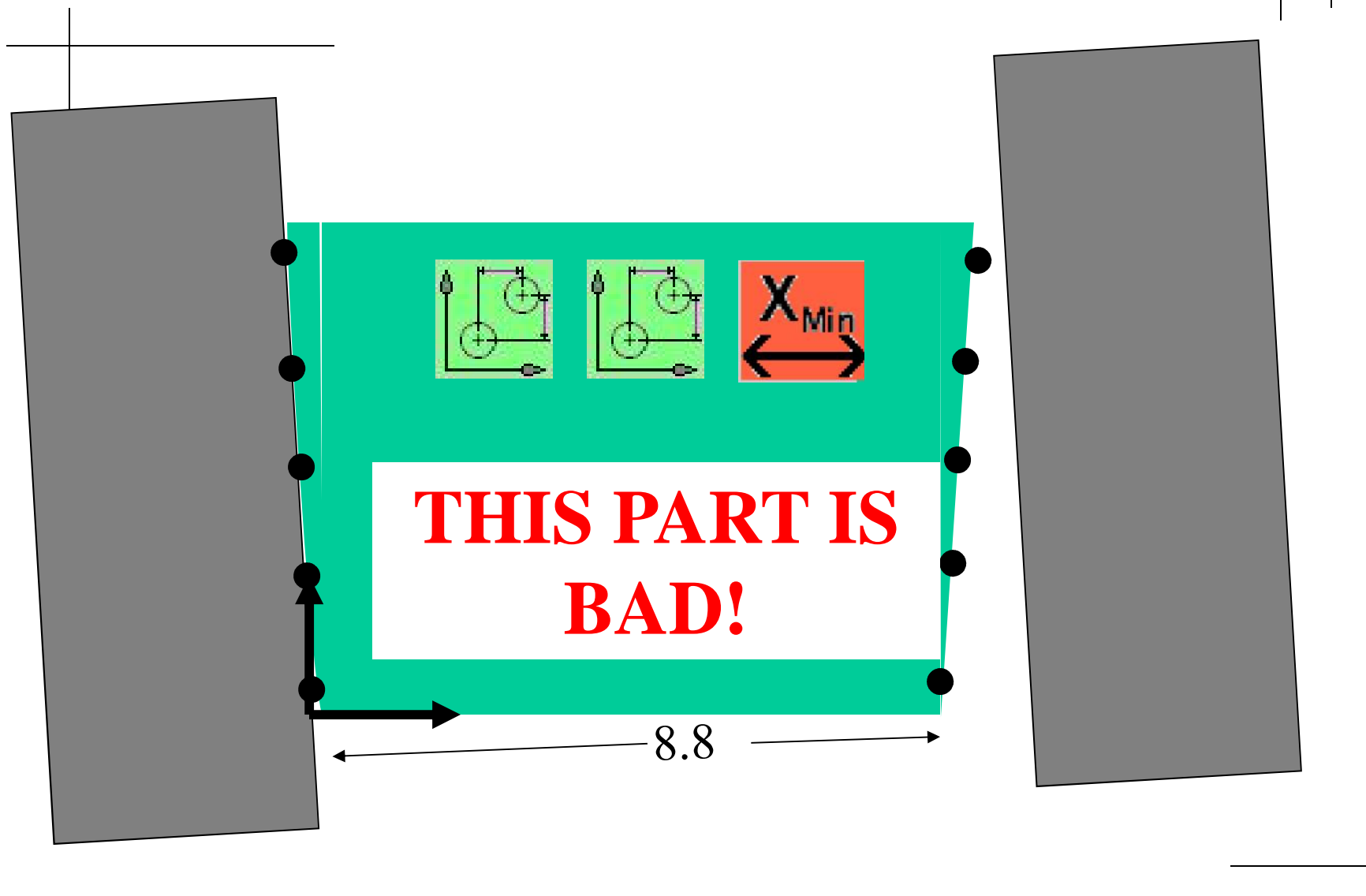


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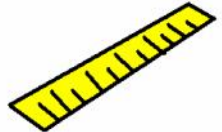


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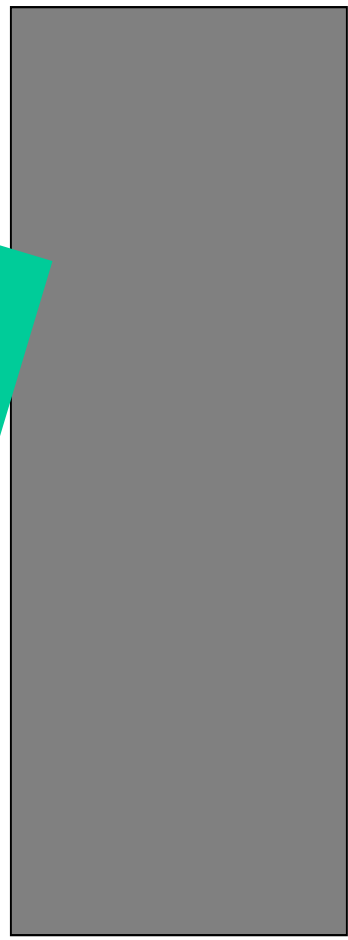
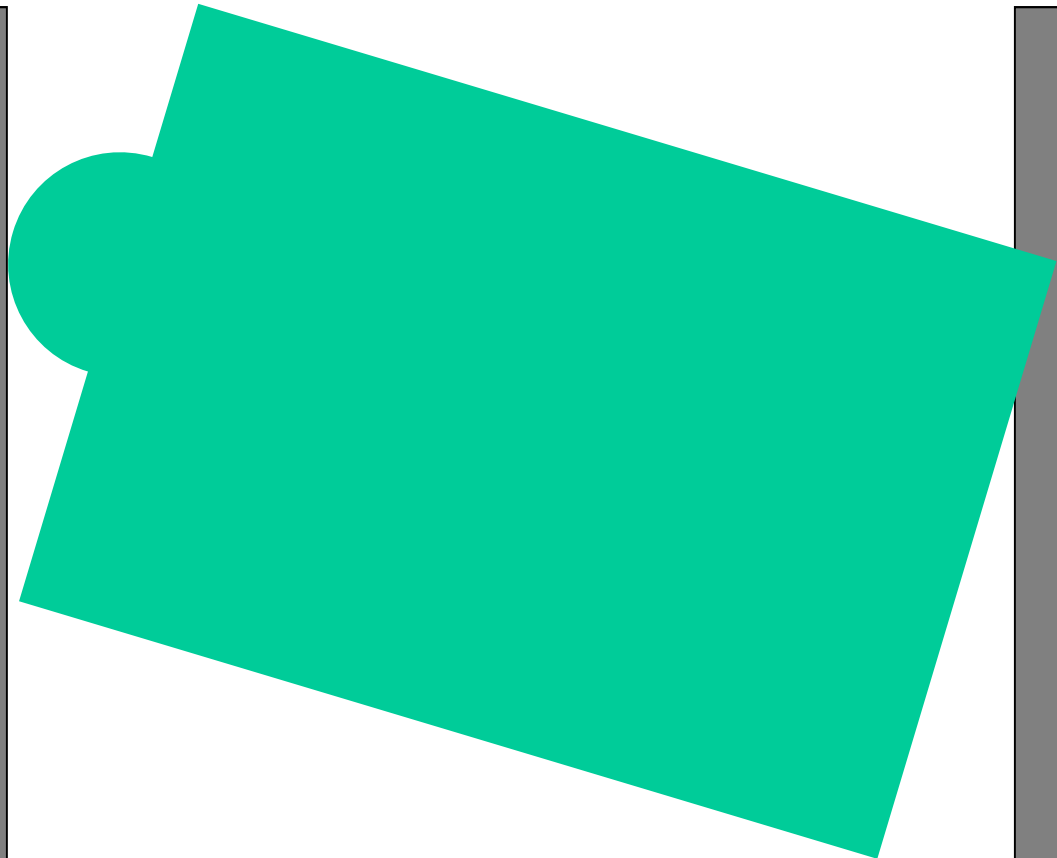


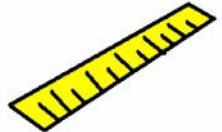
**THIS PART IS
BAD!**

8.8

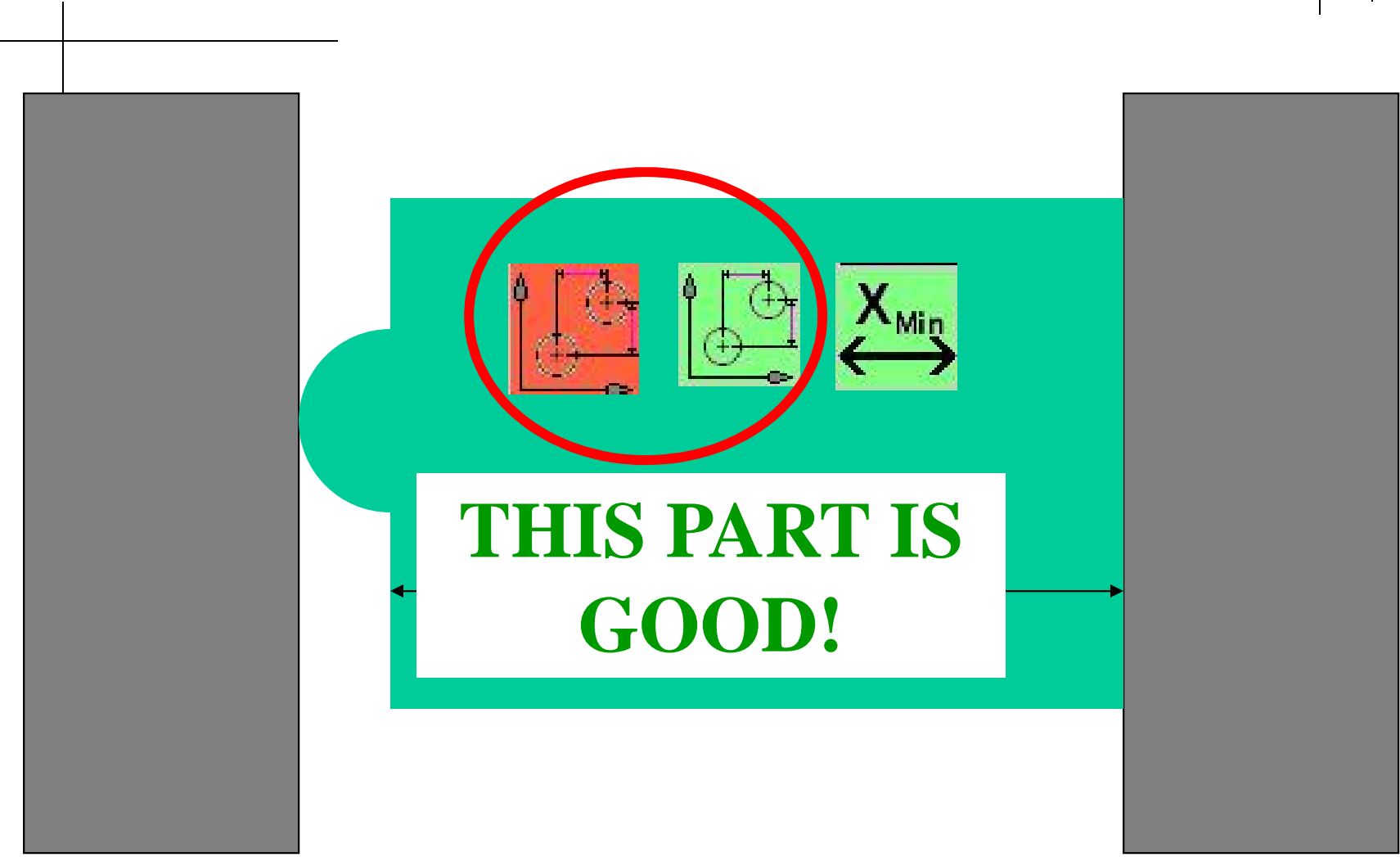


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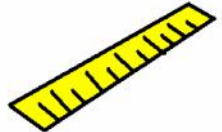




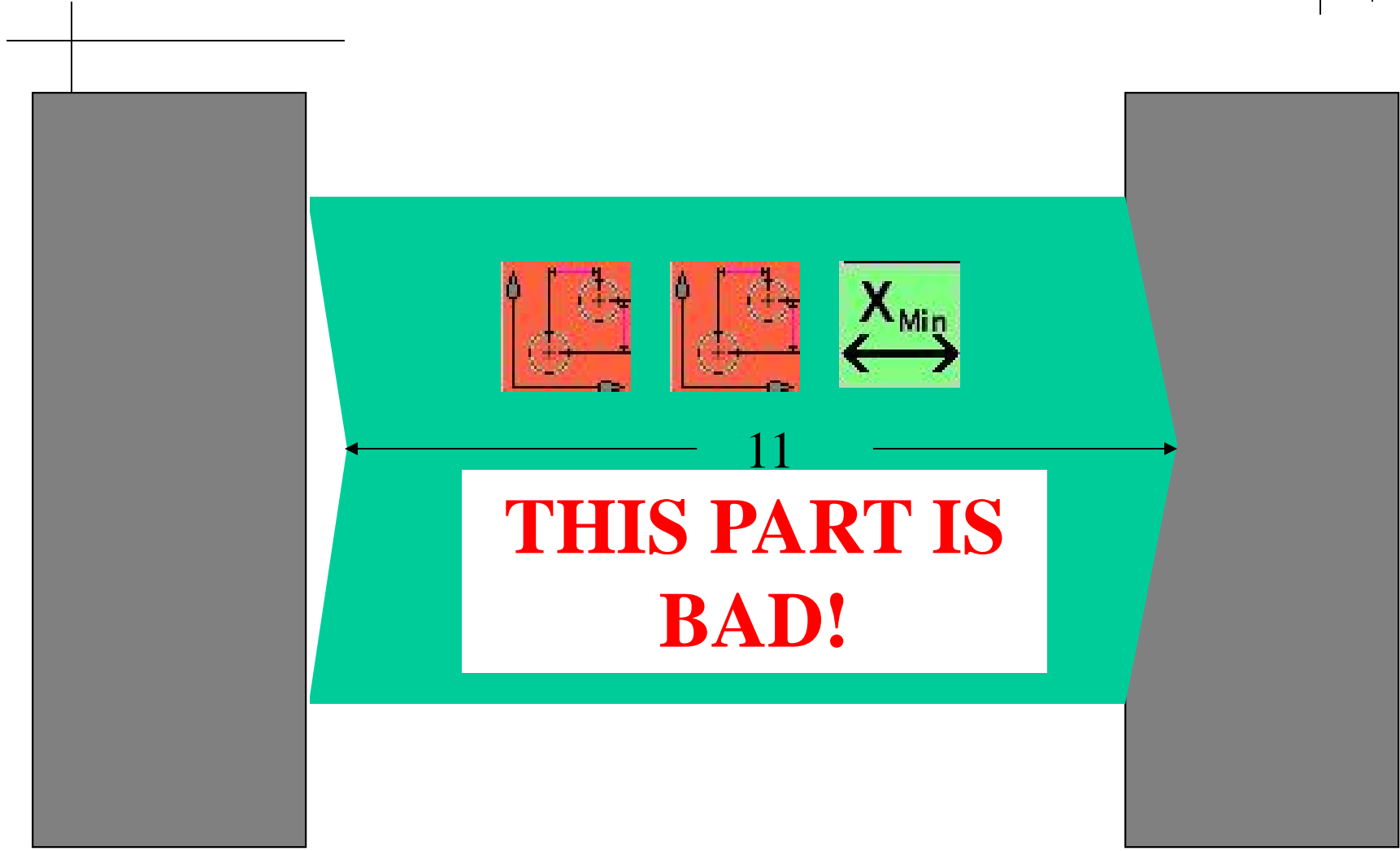
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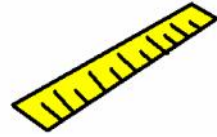
THIS PART IS GOOD!



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**THIS PART IS
BAD!**



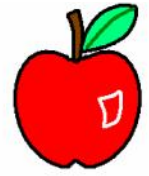
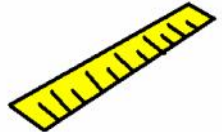
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Method 5:

Following the Standard

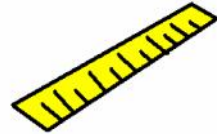
Ease/Practicality: 1

“Correctness”: 4.9



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Checking distance
with regard to Rule #1

Questions?