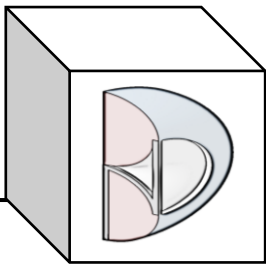


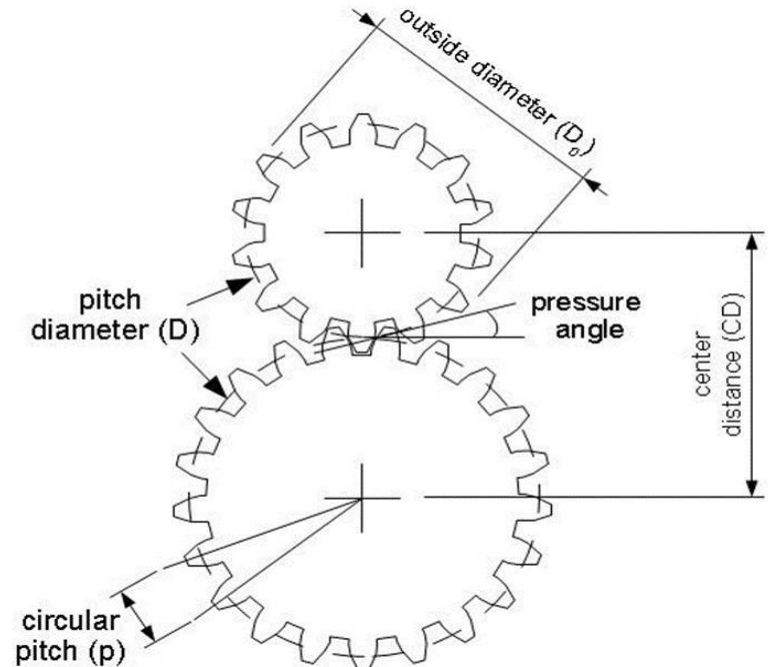
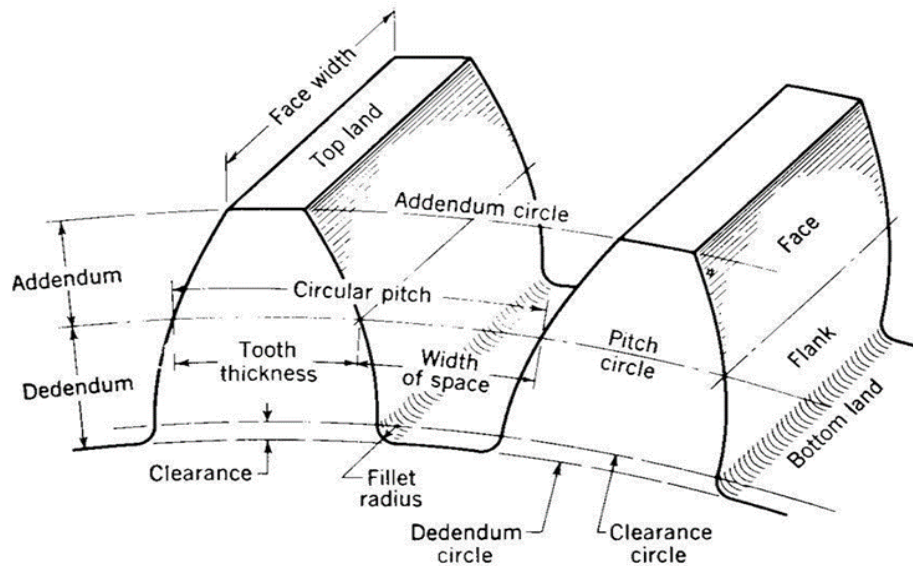
Designing Approximate Spur Gear in CATIA V5 (Method 2 of 4: Design Table from MS Excel)

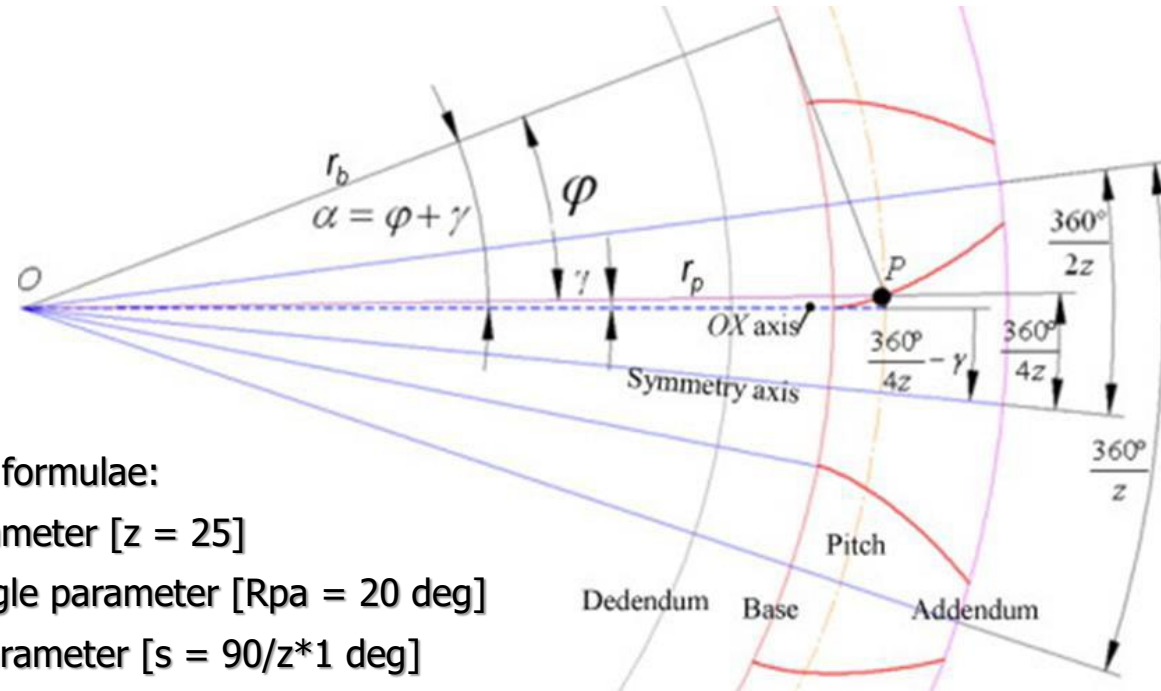
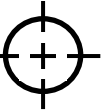
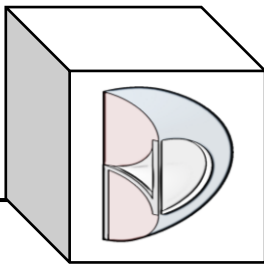




- This is step by step guide of how to create an *approximate* involute spur gear using CATIA V5.
- This document assumes that you know basic spur gear geometry.

GEAR NOMENCLATURE





Some basic nomenclature and formulae:

z - number of teeth // real parameter [$z = 25$]

R_{pa} - ref. pressure angle // angle parameter [$R_{pa} = 20 \text{ deg}$]

s - symmetry angle // angle parameter [$s = 90/z * 1 \text{ deg}$]

m - module // length parameter [$m = 3 \text{ mm}$]

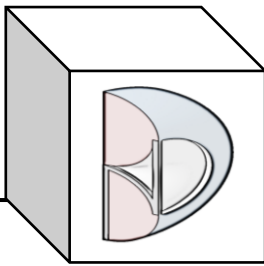
P_d - Pitch diameter // length parameter [$P_d = z * m$]

B_d - Base diameter // length parameter [$B_d = P_d * \cos(R_{pa}[\text{radians}])$]

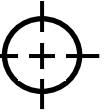
A_d - Addendum diameter // length parameter [$A_d = P_d + (2 * m)$]

D_d - Dedendum diameter // length parameter [$D_d = P_d - (2.5 * m)$]

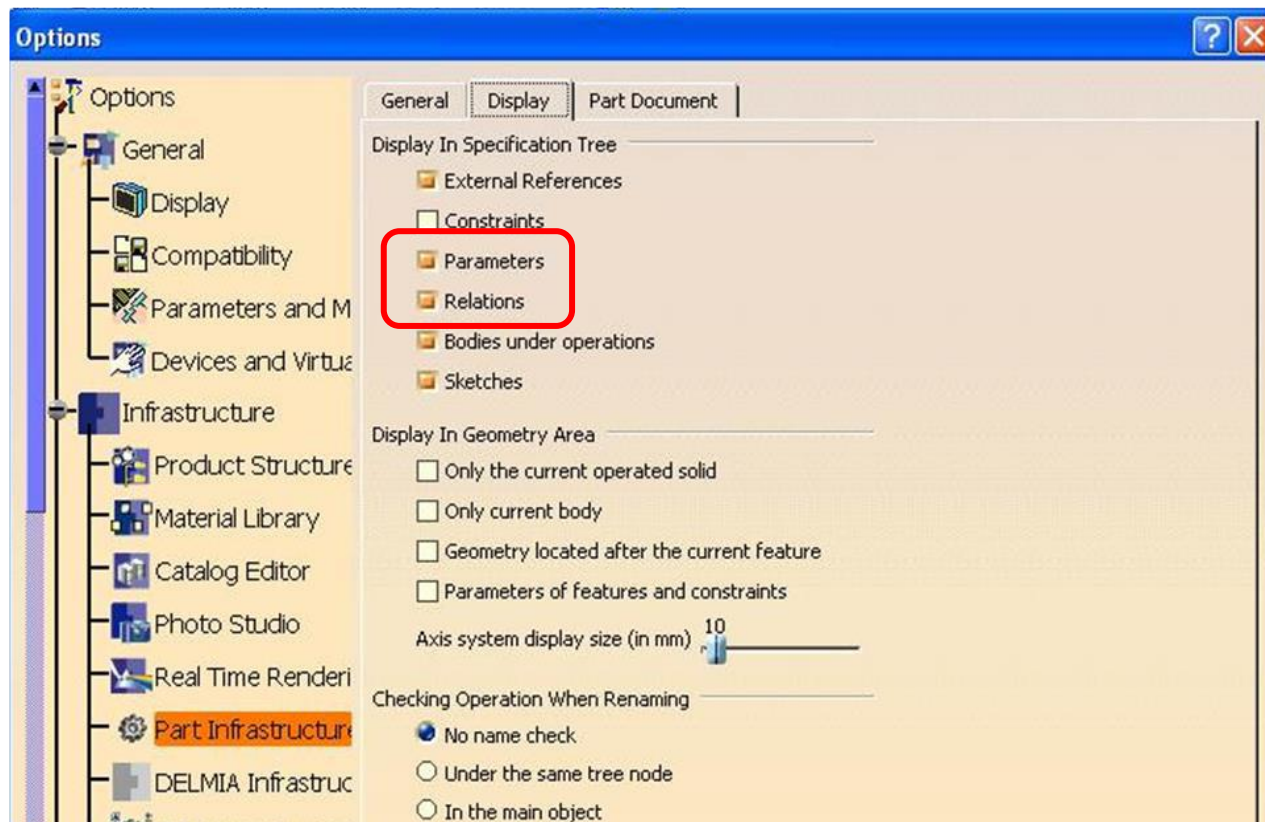
tr - tooth radius at dedendum circle // length parameter [$0.38 * m$]



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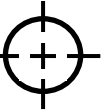


- When you start CATIA, go to TOOLS->OPTIONS->Infrastructure->
- Part Infrastructure and in Display select “Parameters” and “Relations”.

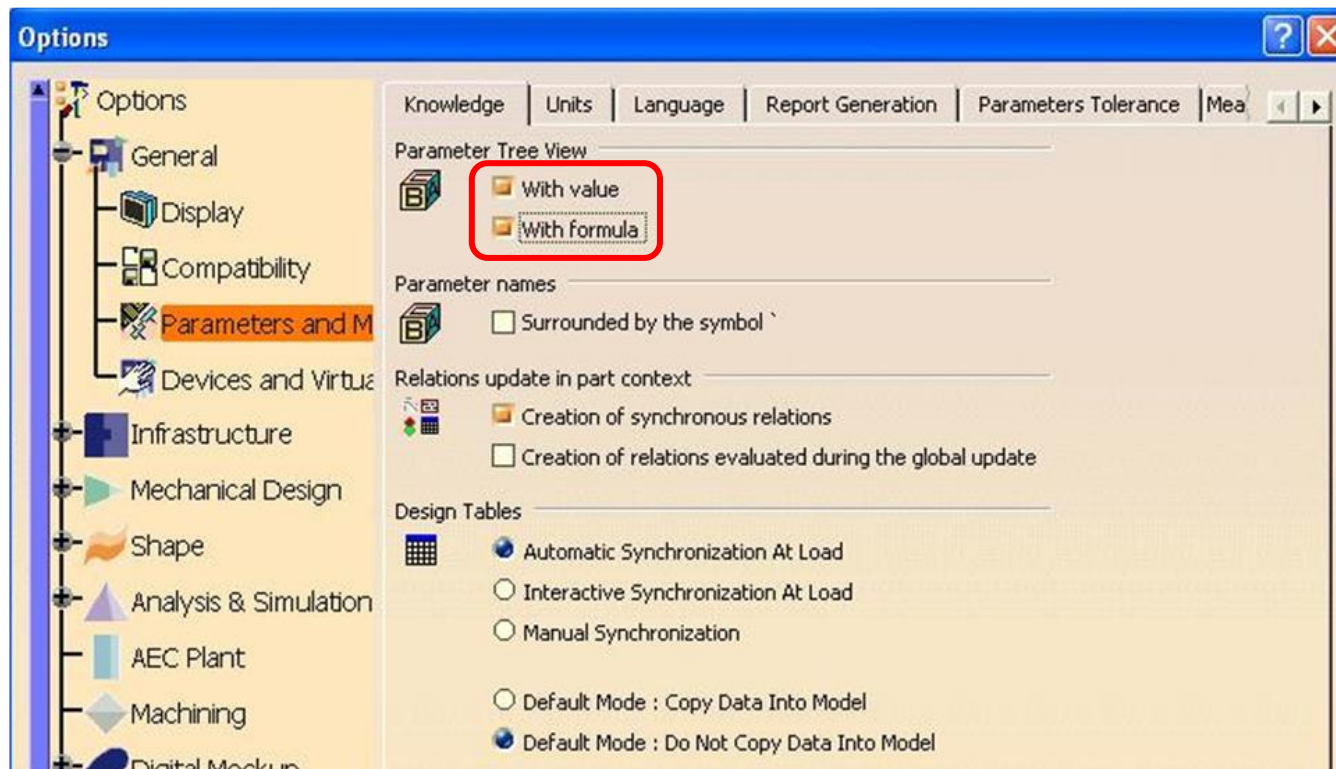


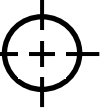
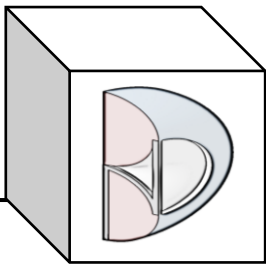


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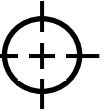
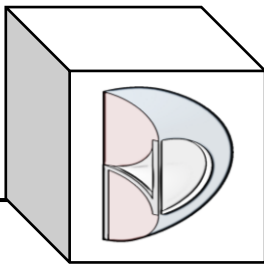


- Then in Options->General in Parameters and Measures select “With Value” and “With Formula” in Parameters Tree View.

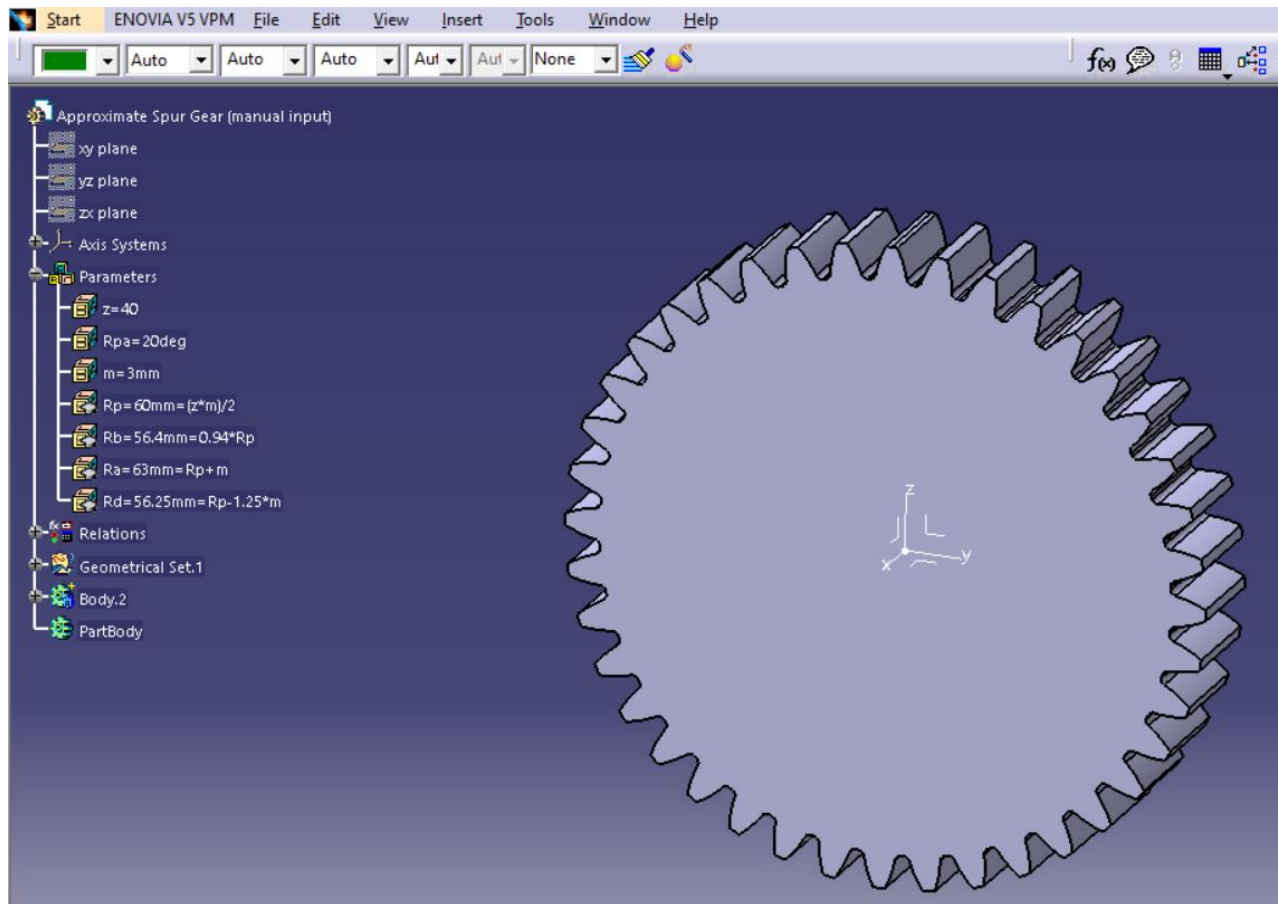


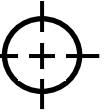
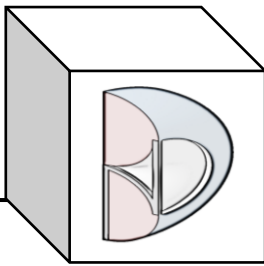


Approach 1: Modify the existing Spur Gear template to use a Design Table from MS Excel

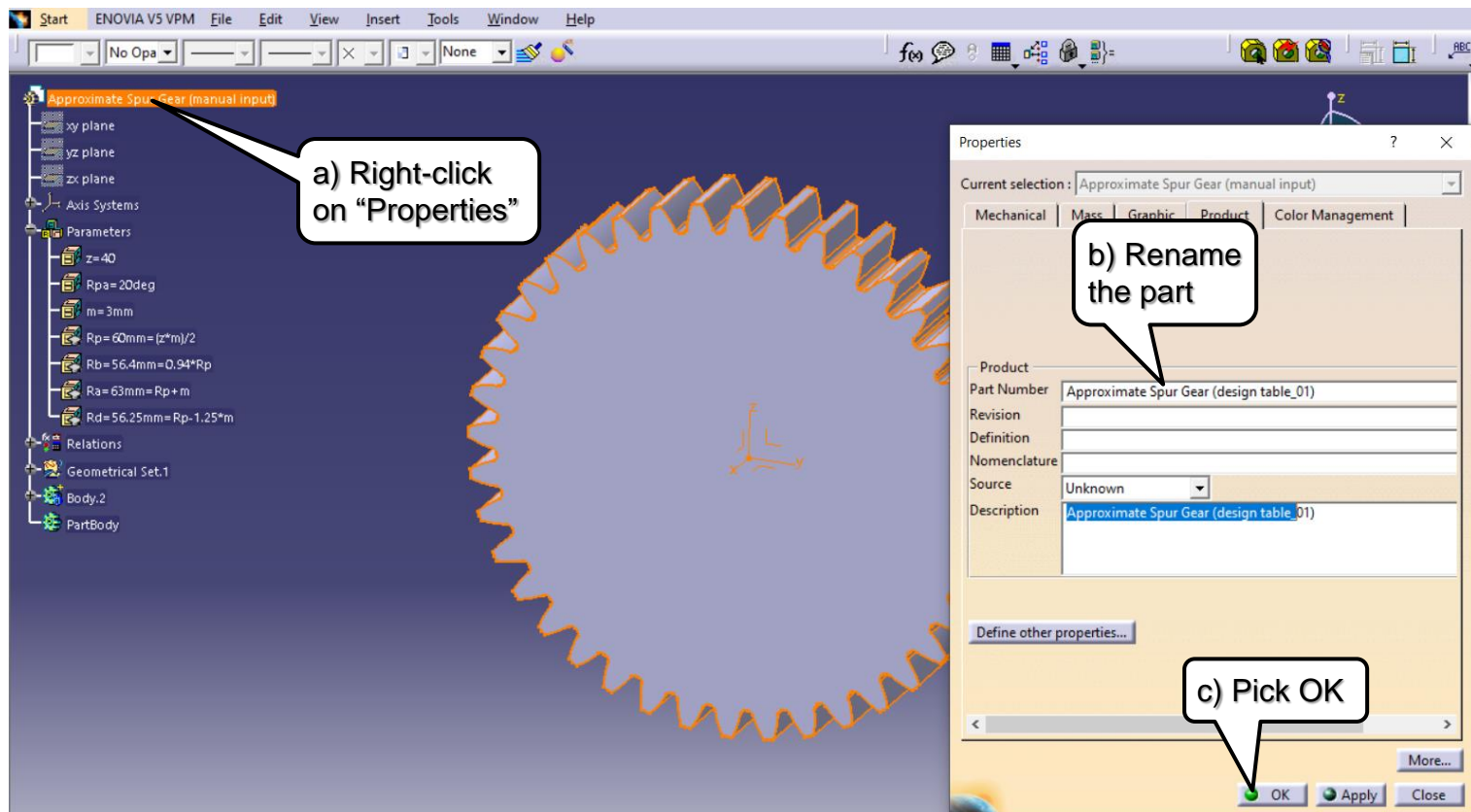


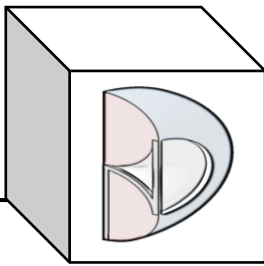
- Open the existing Spur Gear template.



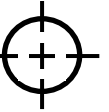


- Rename the Spur Gear template so as to not overwrite it.

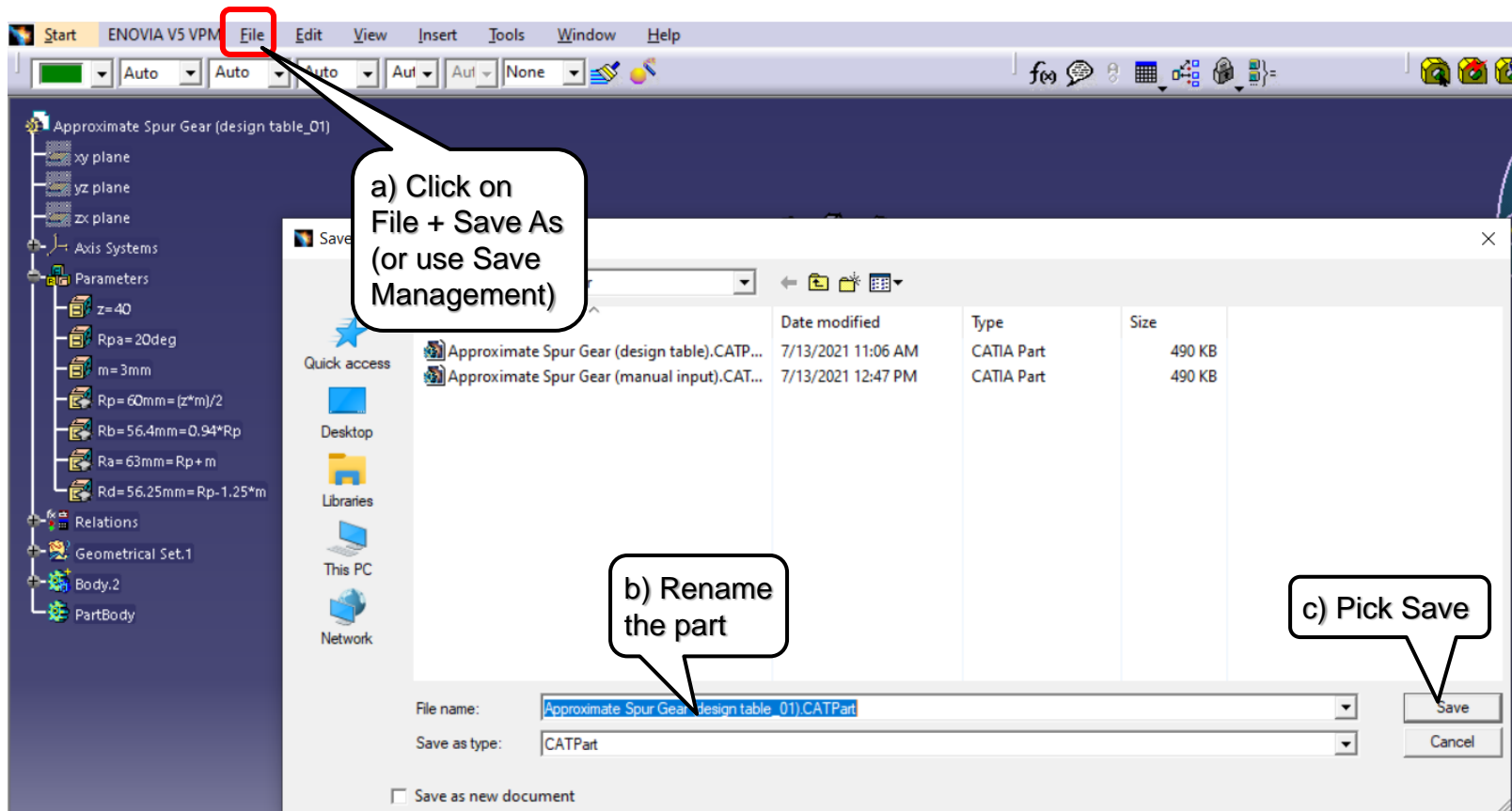


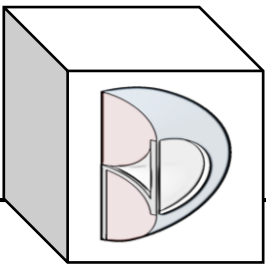


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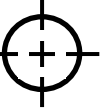


- Rename the Spur Gear template so as to not overwrite it.

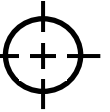
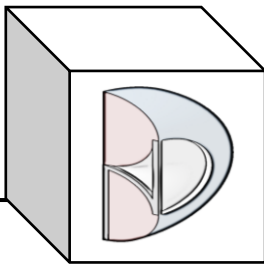




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Understanding the MS Excel spreadsheet



- Open the MS Excel Spur Gear spreadsheet.

Spur Gear Formulas

GEAR NOMENCLATURE

Fig. 4.2 The Meshing of Profile Shifted Gears

Table.3.1 Symbols related to Gear Tooth Profile

Terms	Symbols	Formula	Definition
Module	m	$\frac{p}{\pi}$	Module is the unit size indicated in millimeter (mm). The value is calculated from dividing the reference pitch by π .
Pitch	p	πm	Reference Pitch is the distance between corresponding points on adjacent teeth. The value is calculated from multiplying Module m by π .
Pressure Angle	α	(Degree)	The angle of a gear tooth leaning against a normal reference line.
Addendum	h_a	$1.00m$	The distance between reference line and tooth tip.
Dedendum	h_f	$1.25m$	The distance between reference line and tooth root.
Tooth Depth	h	$2.25m$	The distance between tooth tip and tooth root.
Working Depth	h_w	$2.00m$	Depth of tooth meshed with the mating gear.
Tip and Root Clearance	c	$0.25m$	The distance (clearance) between tooth root and the tooth tip of mating gear.
Dedendum Fillet Radius	ρ_f	$0.38m$	The radius of curvature between tooth surface and the tooth root.

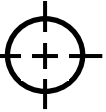
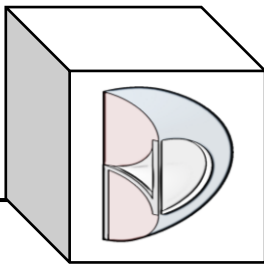
INPUT VALUES

OUTPUT VALUES

FROM CELL

FOR CAD

α (radians) = 0.34907
 $\tan \alpha$ (radians) = 0.36397
 $\text{inv } \alpha$ = 0.01490
 α_w (radians) = 0.34907
 $\tan \alpha_w$ (radians) = 0.36397
 $\text{inv } \alpha_w$ = 0.01490
 $\cos \alpha$ (radians) = 0.93969
 $\cos \alpha_w$ (radians) = 0.93969



- Open the MS Excel Spur Gear spreadsheet.

No.	Item	Symbol	Formula	Example	
				Pinion (1)	Gear (2)
1	Module	m	Set Value	3	
2	Reference Pressure Angle	α		20°	
3	Number of Teeth	z		12	24
4	Profile Shift Coefficient	x		0.6	0.36
5	Involute α_w	$\text{inv } \alpha_w$	$2 \tan \alpha \left(\frac{x_1 + x_2}{z_1 + z_2} \right) + \text{inv } \alpha$	0.034316	
6	Working Pressure Angle	α_w	Find from Involute Function Table	26.0886°	
7	Center Distance Modification Coefficient	y	$\frac{z_1 + z_2}{2} \left(\frac{\cos \alpha}{\cos \alpha_w} - 1 \right)$	0.83329	
8	Center Distance	a	$\left(\frac{z_1 + z_2}{2} + y \right) m$	56.4999	
9	Reference Diameter	d	zm	36.000	72.000
10	Base Diameter	d_b	$d \cos \alpha$	33.8289	67.6579
11	Working Pitch Diameter	d_w	$\frac{d_b}{\cos \alpha_w}$	37.667	75.333
12	Addendum	h_{a1} h_{a2}	$\left(1 + y - x_2 \right) m$ $\left(1 + y - x_1 \right) m$	4.420	3.700
13	Tooth Depth	h	$\{ 2.25 + y - (x_1 + x_2) \} m$	6.370	
14	Tip Diameter	d_a	$d + 2h_a$	44.840	79.400
15	Root Diameter	d_f	$d_a - 2h$	32.100	66.660

$m = 3$
 $\alpha = 20$
 $z = 40$
 $x = 0.00000$

The pressure angle is usually set to 20 degrees; it can be 14.5 or 17.5 in specific applications.

$\text{inv } \alpha_w = 0.014904$

$\alpha_w = 20.0000$

$y = 0.00000$

$a = 120.0000$

$d = 120.000$ 120.000

Pitch Diameter

$d_b = 112.763$ 112.763

$d_w = 120.000$ 120.000

$h_a = 3.000$ 3.000

$h = 6.750$

$d_s = 126.0$ 126.0

$d_f = 112.500$ 112.500

Notice these symbols are the same as our parameters in CATIA

$m = 3$ 3
 $Rpa = 20$ 20
 $s = 2.250$ 2.250
 $z = 40$ 40
 $Pd = 120.000$ 120.000
 $Bd = 112.763$ 112.763
 $Ad = 126.000$ 126.000
 $Dd = 112.500$ 112.500
 $tr = 1.140$ 1.140

module (for CAD)
 Ref Pressure Angle (for CAD)
 Symmetry Angle (for CAD)
 number of teeth (for CAD)
 Pitch diameter (for CAD)
 Base diameter (for CAD)
 Addendum diameter (for CAD)
 Dedendum diameter (for CAD)
 tooth radius at dedendum circle (for CAD)

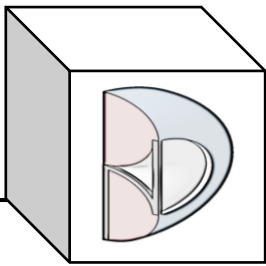
Notice We are active in the Spur Gear worksheet

Table 4.4 The Calculations for Pinion and Gear (2)

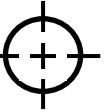
No.	Item	Symbol	Formula	Example	
				Pinion (1)	Gear (2)

Design Table **Spur Gear**





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- Change to the Design Table worksheet.

B1 ='Spur Gear'!M81

	A	B
1	Module: m	3mm
2	Ref Pressure Angle: Rpa	20.deg
3	Number of teeth: z	40
4	Symmetry Angle: s	2.25deg
5	Pitch diameter: Pd	120.mm
6	Base diameter: Bd	112.763mm
7	Addendum diameter: Ad	126.mm
8	Dedendum diameter: Dd	112.5mm
9	tooth radius at dedendum circle: tr	1.14mm

Design Table Spur Gear

Notice the cells on Design Table worksheet are getting their data from the Spur Gear worksheet

Notice the cells on Design Table worksheet have a Customized Format to display units.

	A	B	C	D	E	F	G	H	I	J	K	L	M
81													m = 3
82													Rpa = 20
83													s = 2.250
84													z = 40
85													Pd = 120.000
86													Bd = 112.763
87													Ad = 126.000
88													Dd = 112.500
89													tr = 1.140
90													

Table 4.4 The Calculations for Profile Shifted Spur Gears (2)

No.	Item	Symbol	Formula	Example	
				Pinion (1)	Gear (2)

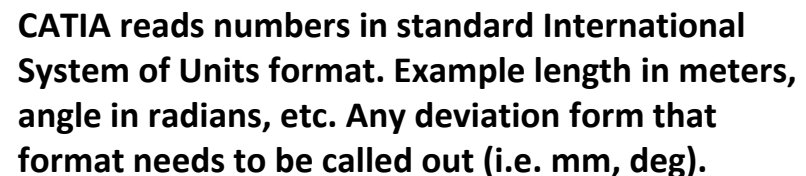
Design Table Spur Gear

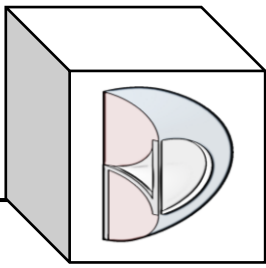


Format Cells + Custom:

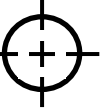
1. **#”mm”** gives the unit of mm after the number without decimal places.
2. **#. #”deg”** gives the unit of deg after the number with one decimal place.
3. **#.####”mm”** gives the unit of mm after the number with three decimal places.

The reason for adding Custom Format to the cells is because we are getting the data input from another worksheet. On that worksheet the data is just a number.

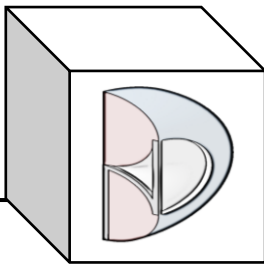




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Connecting the MS Excel spreadsheet to the CATPart



- Connect the MS Excel spreadsheet to the CATIA part as a Design Table.

a) Pick the Design Table icon

b) Pick "Horizontal" due to the data placement on the MS Excel worksheet

c) Ensure the sheet index is set to 1. This is telling CATIA which worksheet to read.

d) Pick OK

Creation of a Design Table

Name: DesignTable.1
Comment: DesignTable created by User 7/18/2021

☒ Create a design table from a pre-existing file
Design table with current parameter values

Orientation: ☐ Vertical ☒ Horizontal

For Excel or Lotus 1-2-3 sheets, sheet index: 1

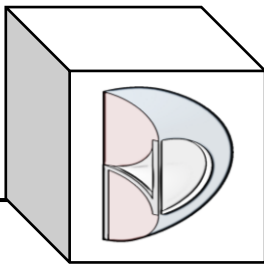
Example of a design table:

PadHeight (mm)	PadWidth (mm)	Material
15	12	Steel
17	1.3 cm	Aluminium

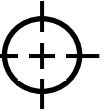
In a text file, columns should be separated by tabulations.

Destination:
Approximate Spur Gear (design table_01)\Relations

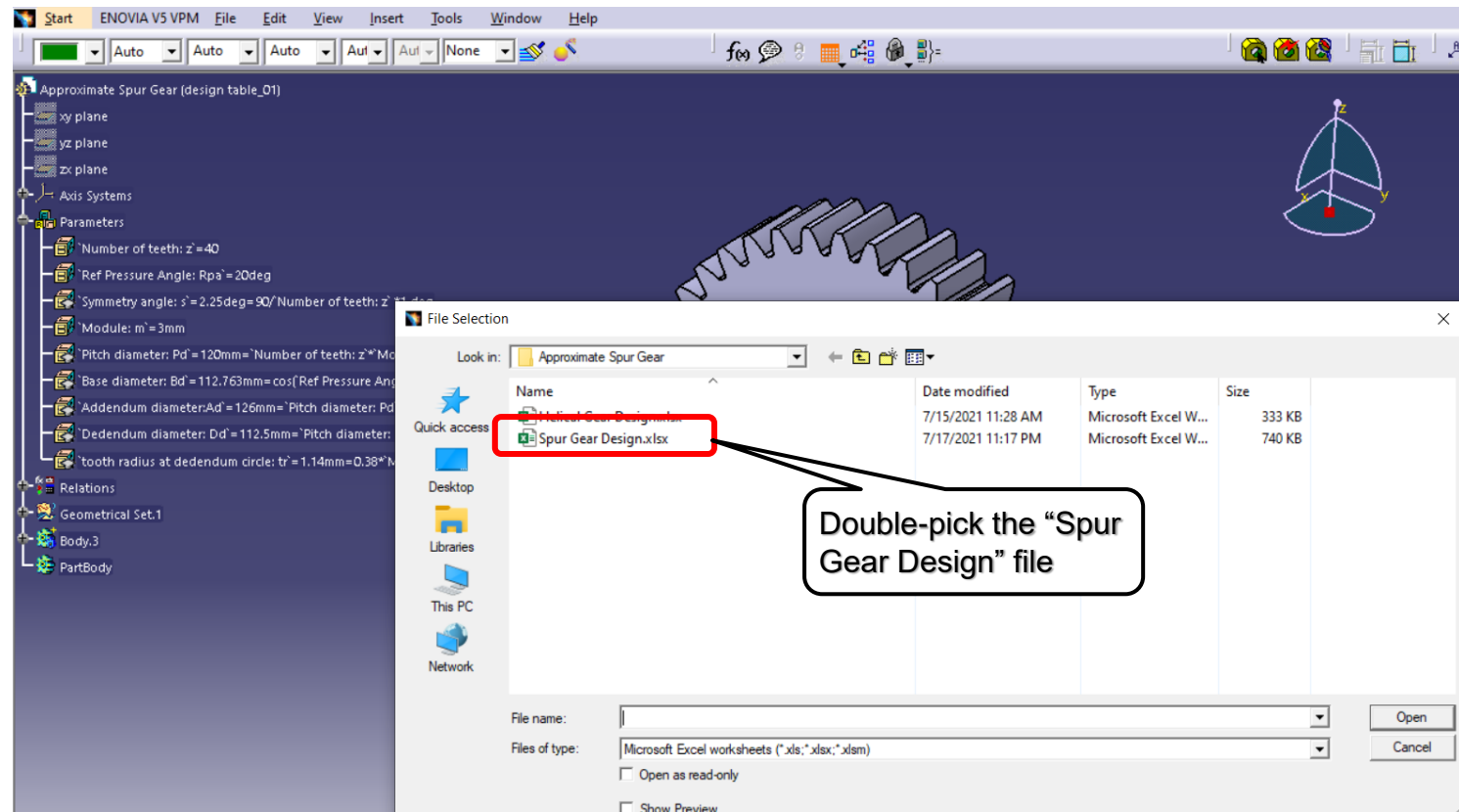
OK Cancel

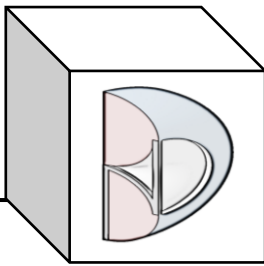


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- Connect the MS Excel spreadsheet to the CATIA part as a Design Table.

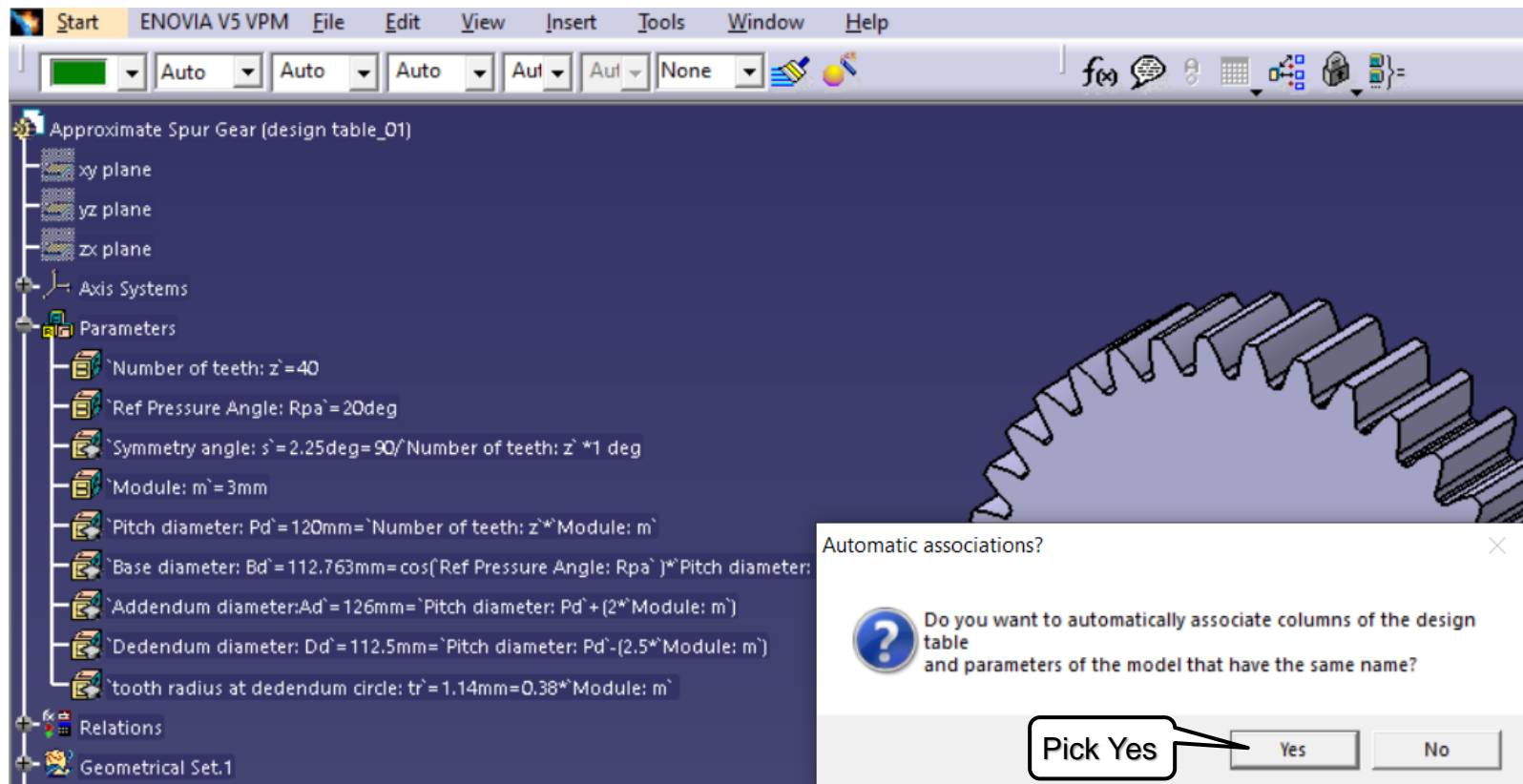


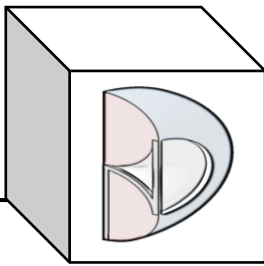


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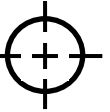


- Connect the MS Excel spreadsheet to the CATIA part as a Design Table.





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- Connect the MS Excel spreadsheet to the CATIA part as a Design Table.

Approximate Spur Gear (design table_01)

xy plane
yz plane
zx plane
Axis Systems
Parameters
Number of teeth: z=40
Ref Pressure Angle: Rpa=20deg
DesignTable.1 active, configuration row : 1
DesignTable created by User 7/18/2021
Associations
Parameters
Module: m
Ref Pressur
Number of

a) Pick "Associations"

b) Select all the Columns data

c) Pick "Create parameters"

d) Pick OK

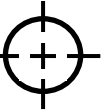
OK Creates Parameters For Selected Lines

Name	Type
Symmetry Angle: s	Angle
Pitch diameter: Pd	Length
Base diameter: Bd	Length
Addendum diameter: Ad	Length
Dedendum diameter: Dd	Length
tooth radius at dedendum circle: tr	Length

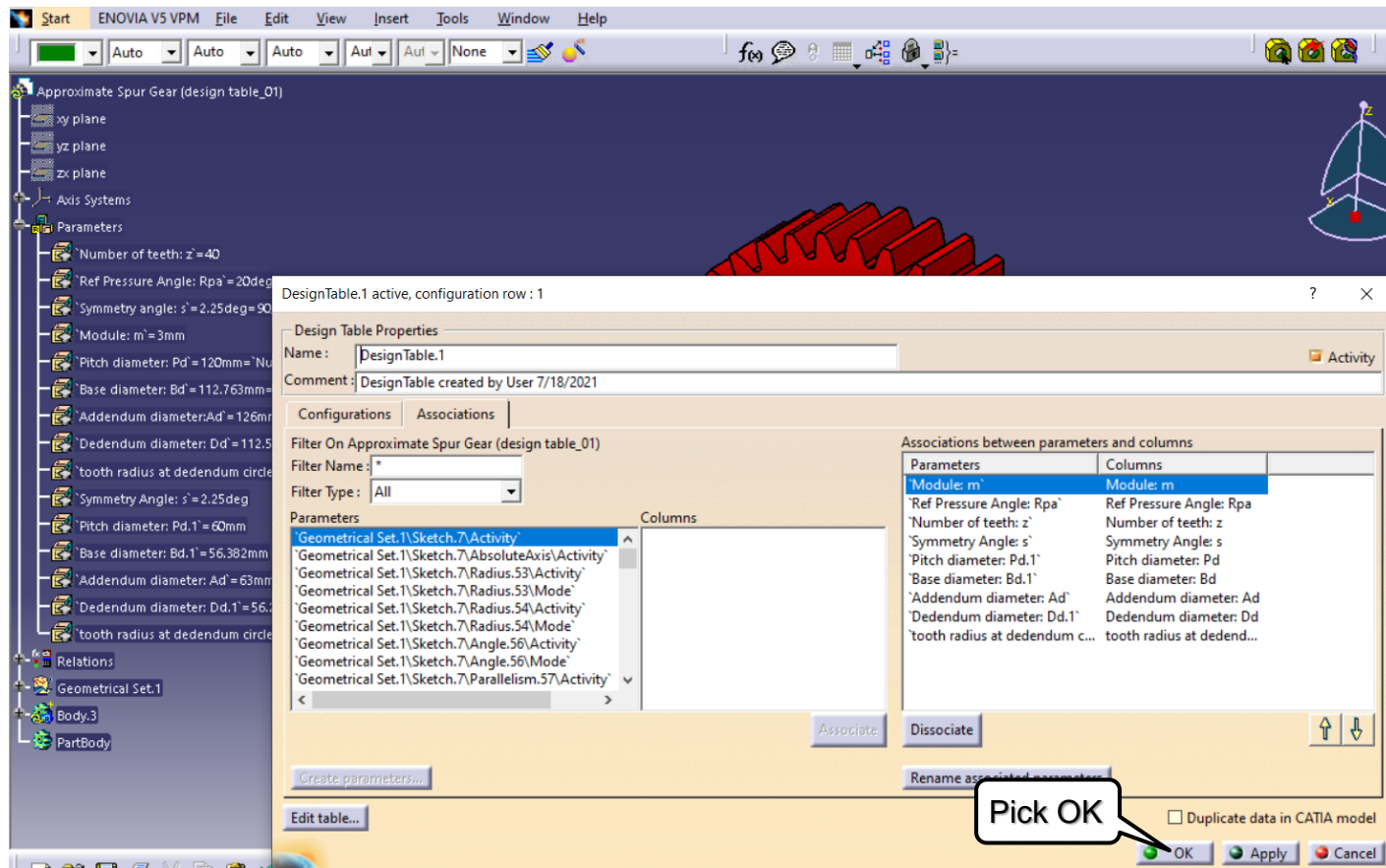
Create parameters...
Edit table...
Associate
Dissociate
Rename associated parameters
☐ Duplicate data in CATIA model
OK Apply Cancel

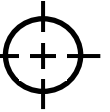
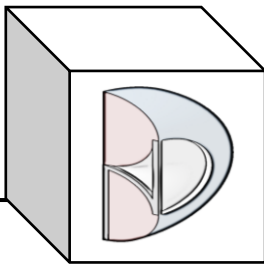


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- Connect the MS Excel spreadsheet to the CATIA part as a Design Table.





- Replace (and delete original) all the old parameters with the new ones.

The screenshot shows the ENOVIA V5 VPM software interface. The left sidebar displays a tree structure with the following items: Approximate Spur Gear (design table_01), xy plane, yz plane, zx plane, Axis Systems, Parameters, Relations, Geometrical Set.1, Body.3, and PartBody. The Parameters list includes: Number of teeth: z=40, Ref Pressure Angle: Rpa=20deg, Symmetry angle: s=2.25deg=90/Number of teeth: z, Module: m=3mm, Pitch diameter: Pd=120mm=Number of teeth: z*Module: m, Base diameter: Bd=112.763mm=cos(Ref Pressure Angle: Rpa)*Pitch diameter: Pd, Addendum diameter: Ad=126mm=Pitch diameter: Pd+(2*Module: m), Dedendum diameter: Dd=112.5mm=Pitch diameter: Pd-(2*Module: m), tooth radius at dedendum circle: tr=1.14, Symmetry Angle: s=2.25deg, Pitch diameter: Pd.1=60mm, Base diameter: Bd.1=56.382mm, Addendum diameter: Ad.1=63mm, Dedendum diameter: Dd.1=56.25mm, and tooth radius at dedendum circle: tr.1=1.14mm. A 3D model of a gear is shown in the center. A 'Replace' dialog box is open in the bottom right corner, showing the replacement of 'Approximate Spur G' with 'Approximate Spur Gear (design table_01)'. The dialog box has a 'Replace' tab and a 'With' tab. The 'Delete replaced elements and exclusive parents' checkbox is checked. The 'OK' button is highlighted.

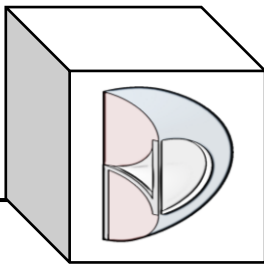
a) Right-click the old parameter; drop on Replace

b) Pick the new parameter

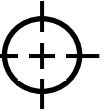
c) Pick "Delete replaced elements and exclusive parents"

d) Pick OK

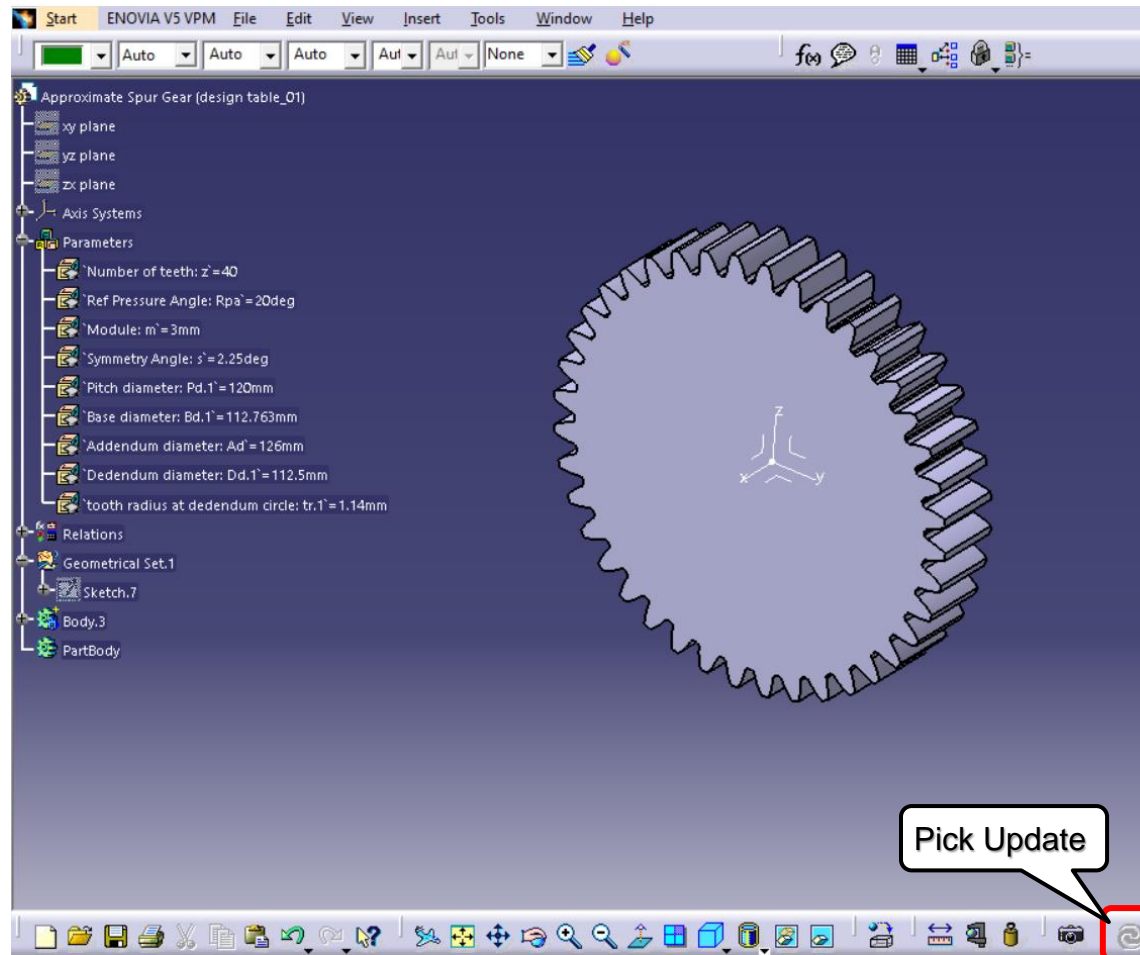
Repeat steps a-d for each of the six parameters.

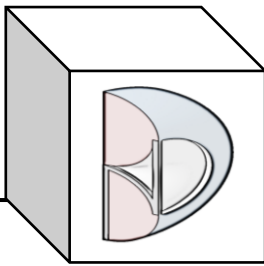


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- Update the part.





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- Change the MS Excel spreadsheet.

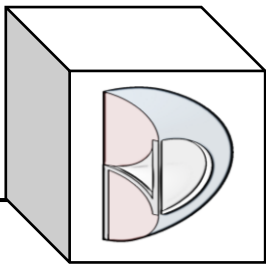
			Pinion (1)	Gear (2)
1	Module	m	3	
2	Reference Pressure Angle	α	20°	
3	Number of Teeth	z	12	24
4	Profile Shift Coefficient	x	0.6	0.36
5	Involute α_w	$\text{inv } \alpha_w$	$2 \tan \alpha \left(\frac{x_1 + x_2}{z_1 + z_2} \right) + \text{inv } \alpha$	
6	Working Pressure Angle	α_w	Find from Involute Function Table	
7	Center Distance Modification Coefficient	y	$\frac{z_1 + z_2}{2} \left(\frac{\cos \alpha}{\cos \alpha_w} - 1 \right)$	
8	Center Distance	a	$\left(\frac{z_1 + z_2}{2} + y \right) m$	
9	Reference Diameter	d	zm	
10	Base Diameter	d_b	$d \cos \alpha$	
11	Working Pitch Diameter	d_w	$\frac{d_b}{\cos \alpha_w}$	
12	Addendum	h_{a1} h_{a2}	$(1 + y - x_2)m$ $(1 + y - x_1)m$	
13	Tooth Depth	h	$ 2.25 + y - (x_1 + x_2) m$	
14	Tip Diameter	d_a	$d + 2h_a$	
15	Root Diameter	d_f	$d_a - 2h$	

Table 4.4 The Calculations for Profile Shifted Spur Gears (2)

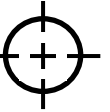
No.	Item	Symbol	Formula	Example	
				Pinion (1)	Gear (2)
1	Center Distance	a	Set Value	56.4999	
2	Center Distance	a	$a = z_1 + z_2$	0.83329	

a) Change to 25

b) Change to 75



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- **Must** save the MS Excel spreadsheet before part update.

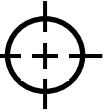
Spur Gear Design.xlsx - Excel

File Developer Insert Page Layout Formulas Data Review View Help Tell me what you want to do

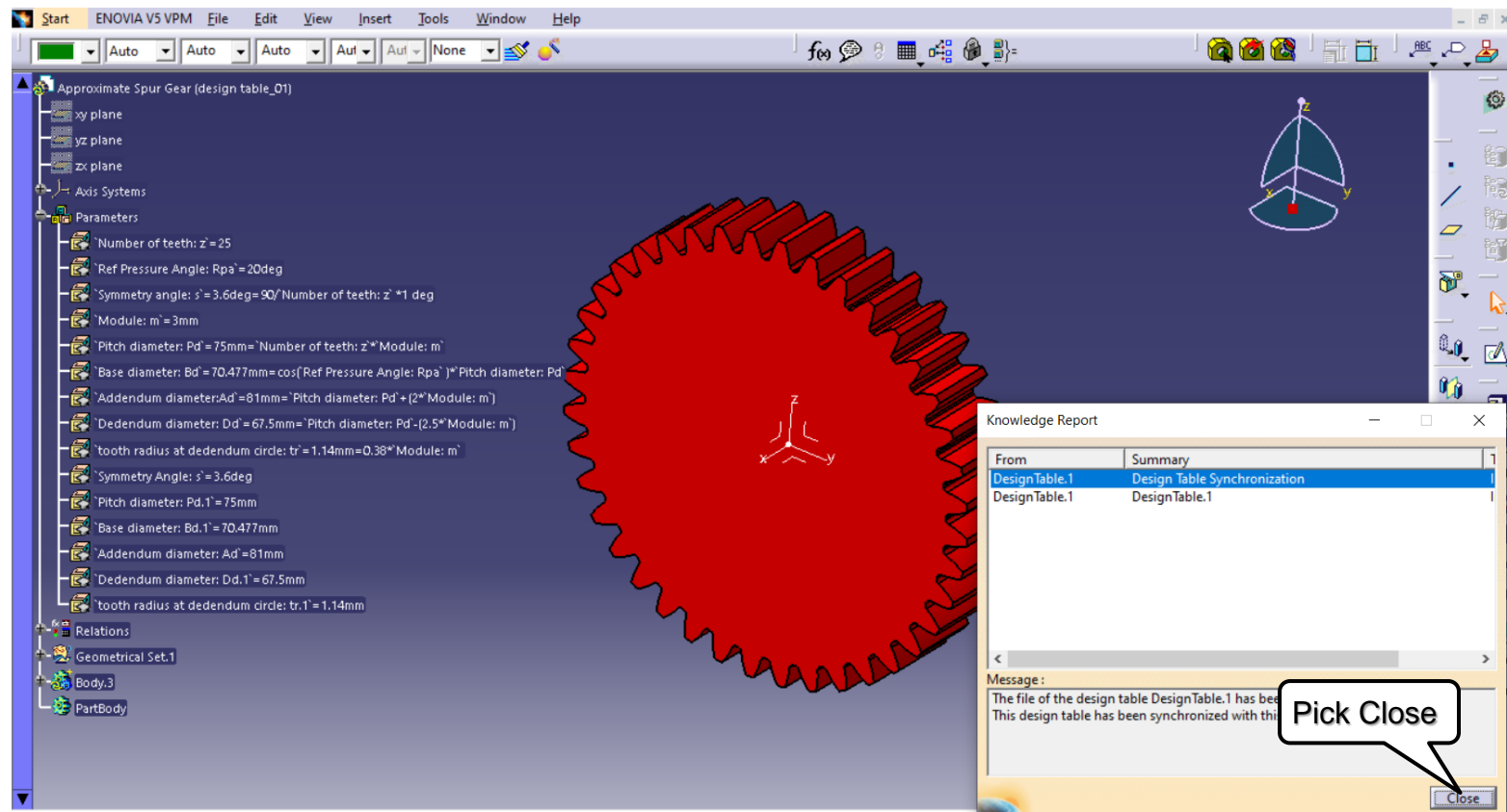
Paste Clipboard Font Alignment Number

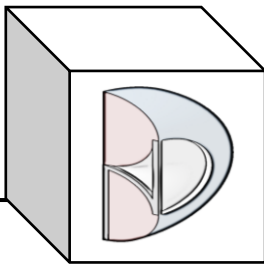
Save the spreadsheet

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
50									Pinion (1)	Gear (2)				
51		1	Module	m					3			$m =$	3	
52		2	Reference Pressure Angle	α					20°			$\alpha =$	20	
53		3	Number of Teeth	z					12	24		$z =$	25	25
54												$x =$	0.00000	0.00000
55														



- Go back to the Spur Gear CATPart and wait (10 -15 sec.) for the synchronization window.

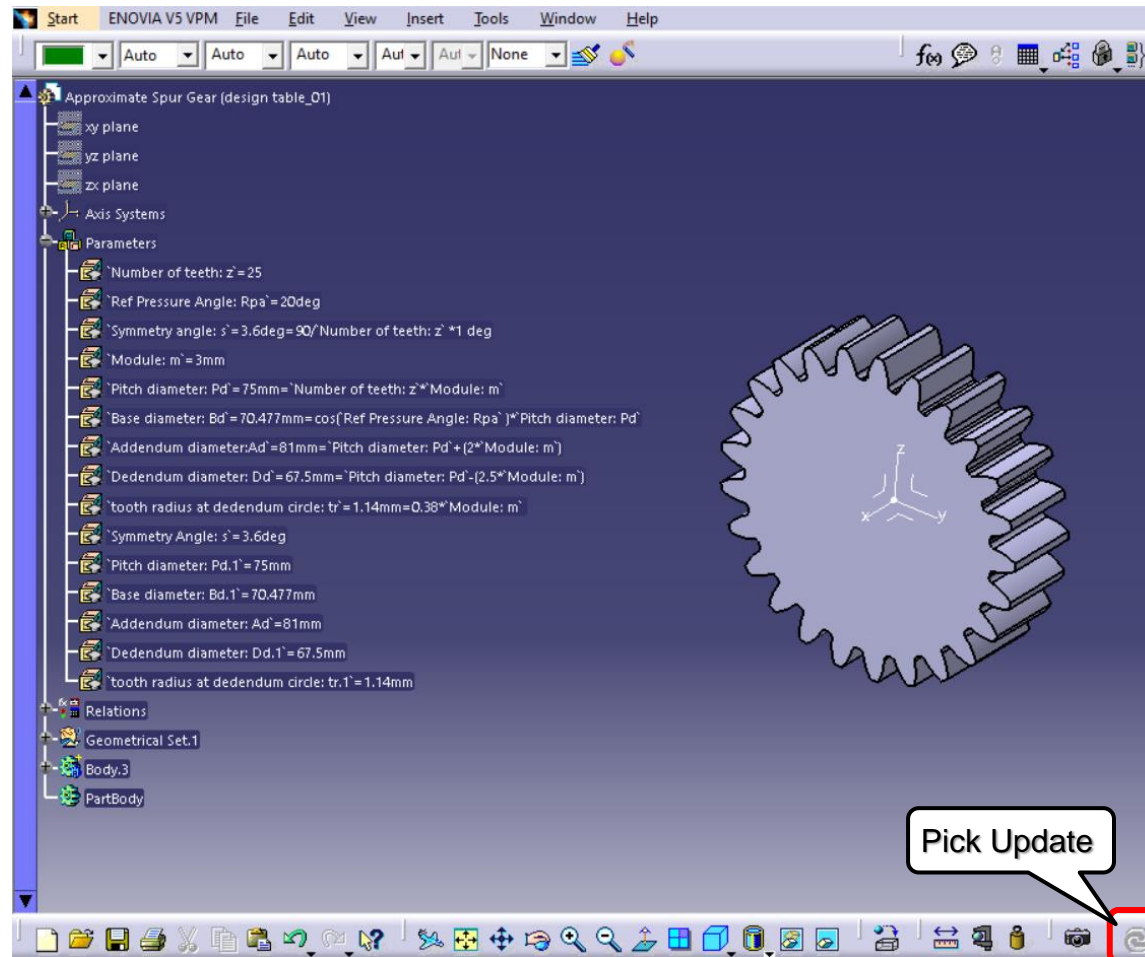


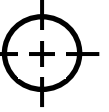
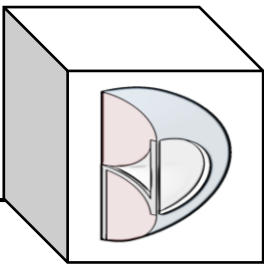


BND TechSource

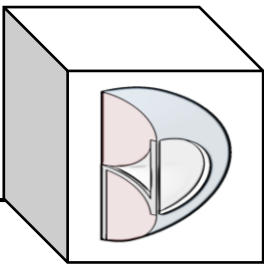


- Update the part.

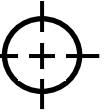




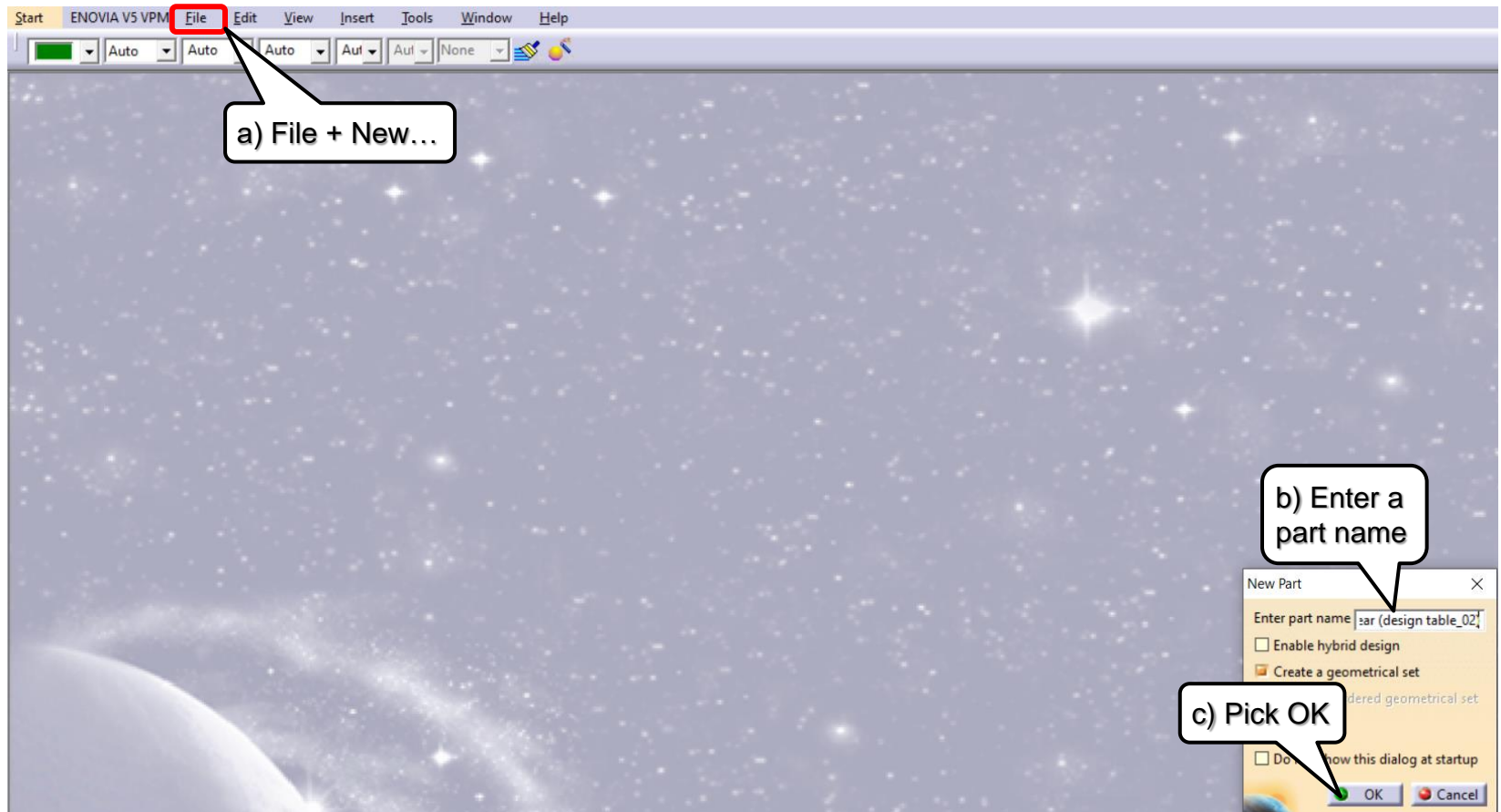
Approach 2: Create a New Part to use a Design Table from MS Excel

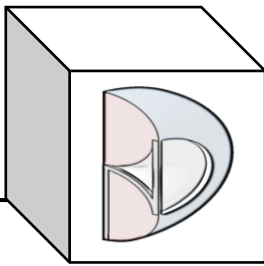


BND TechSource

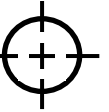


- Create a new CATPart.





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- Attach the MS Excel Design Table to the CATPart.

a) Pick the Design Table icon

b) Pick "Horizontal" due to the data placement in the MS Excel worksheet

c) Ensure the sheet index is set to 1. This is telling CATIA which worksheet to read.

d) Pick OK

Creation of a Design Table

Name: DesignTable.1

Comment: DesignTable created by User 7/13/2021

☒ Create a design table from a pre-existing file

Design table with current parameter values

Orientation: ☐ Vertical ☒ Horizontal

For Excel or Lotus 1-2-3 sheets, sheet index: 1

You should select the file, an Excel sheet or a Lotus 1-2-3 sheet (on NT).

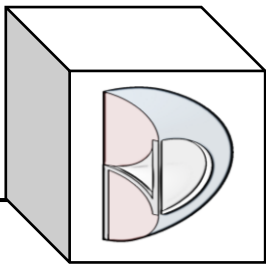
Here is an example of a design table:

PadHeight (mm)	PadWidth (mm)	Material
15	12	Steel
17	1.3 cm	Aluminium

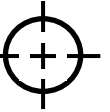
In a text file, columns should be separated by tabulations.

Destination: Approximate Spur Gear (design table_02)\Relations

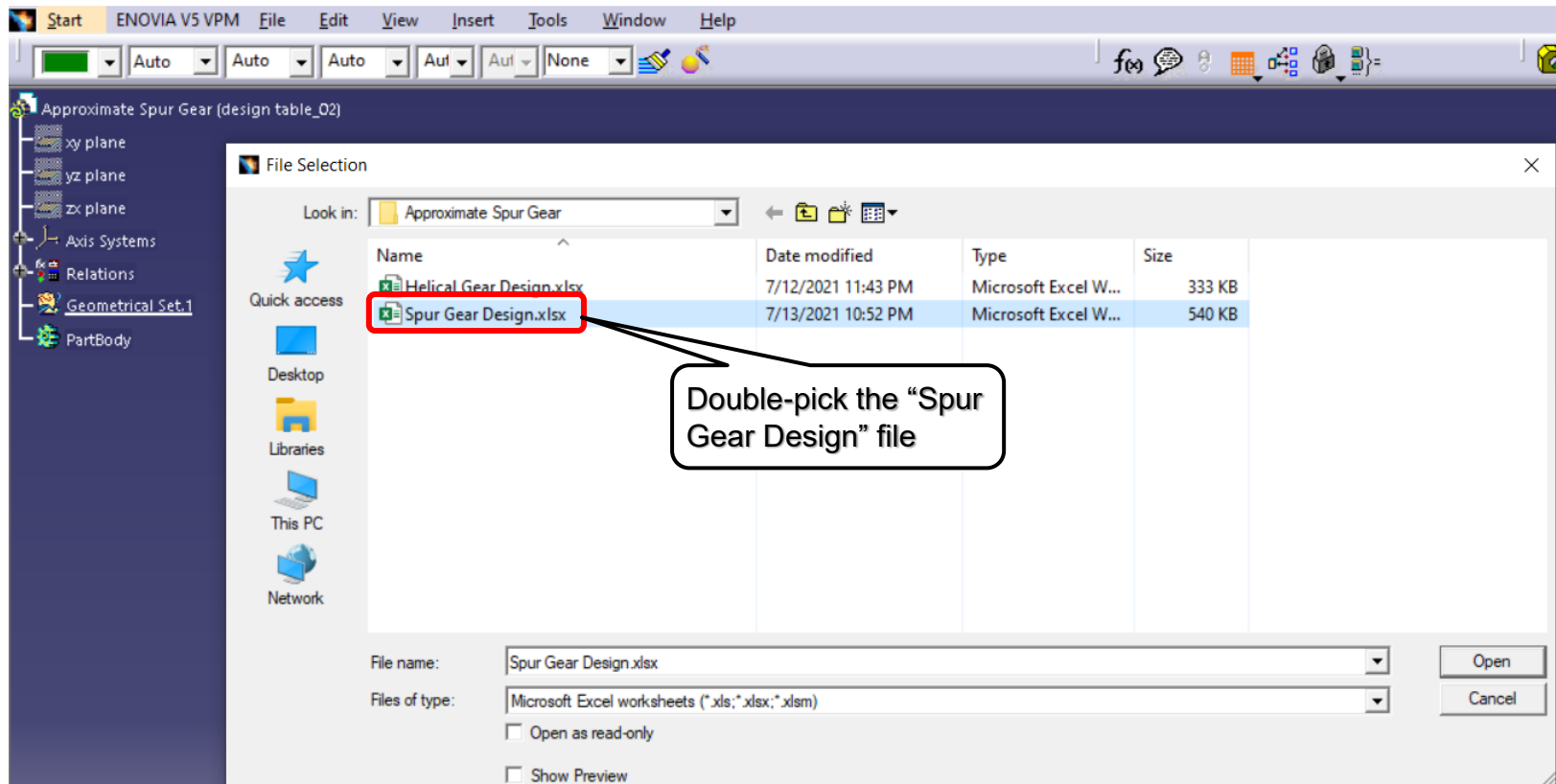
OK Cancel

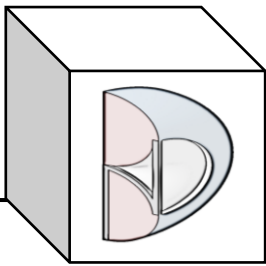


BND TechSource

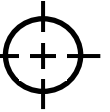


- Connect the MS Excel spreadsheet to the CATIA part as a Design Table.

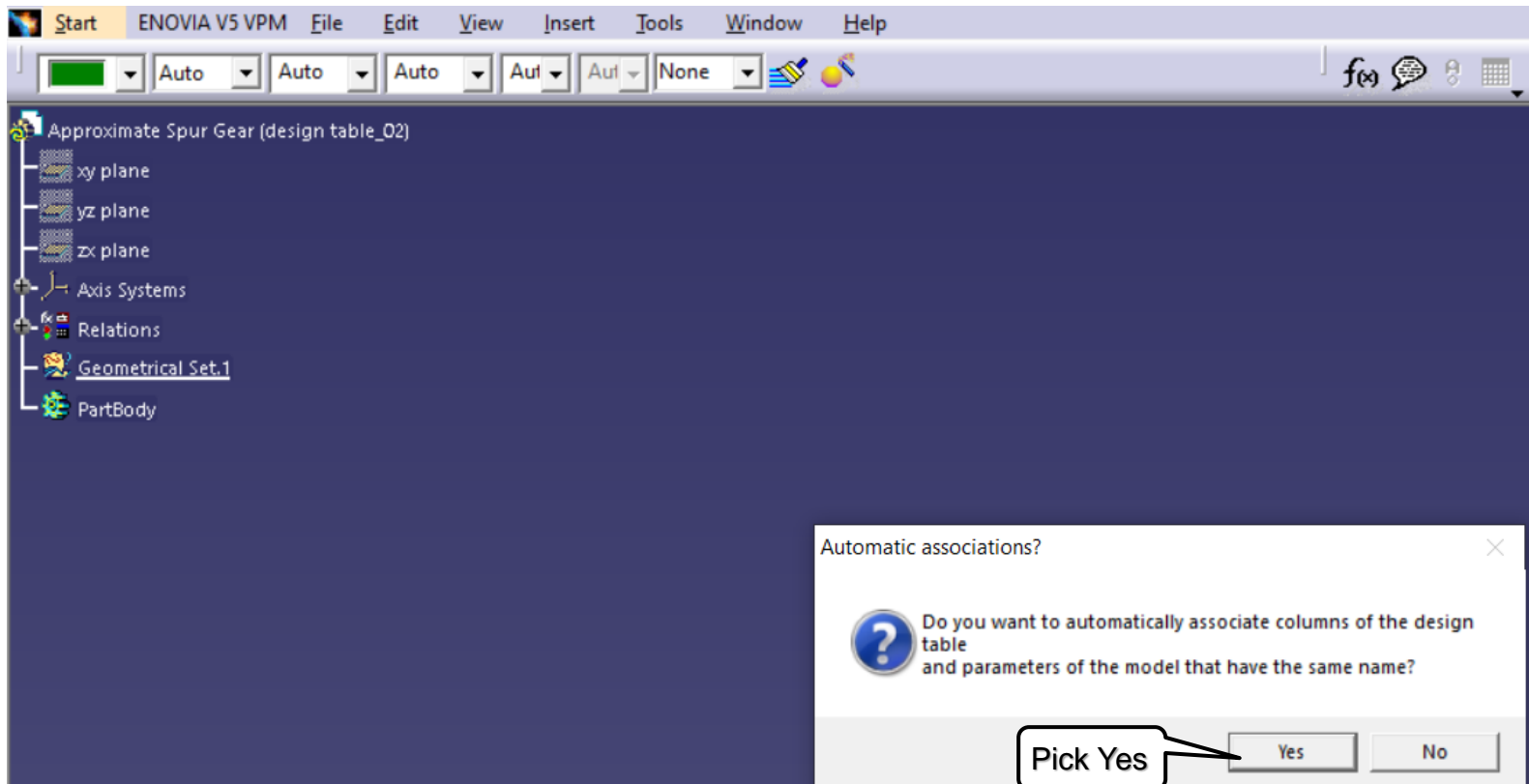




BND TechSource

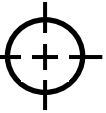


- Connect the MS Excel spreadsheet to the CATIA part as a Design Table.





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- Connect the MS Excel spreadsheet to the CATIA part as a Design Table.

Approximate Spur Gear (design table_01)

xy plane
yz plane
zx plane
Axis Systems
Parameters
Number of teeth: z=40
Ref Pressure Angle: Rpa=20deg
DesignTable.1 active, configuration row : 1
DesignTable created by User 7/18/2021
Associations
Parameters
Module: m
Ref Pressur
Number of

a) Pick "Associations"

b) Select all the Columns data

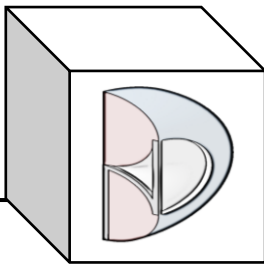
c) Pick "Create parameters"

d) Pick OK

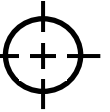
OK Creates Parameters For Selected Lines

Name	Type
Symmetry Angle: s	Angle
Pitch diameter: Pd	Length
Base diameter: Bd	Length
Addendum diameter: Ad	Length
Dedendum diameter: Dd	Length
tooth radius at dedendum circle: tr	Length

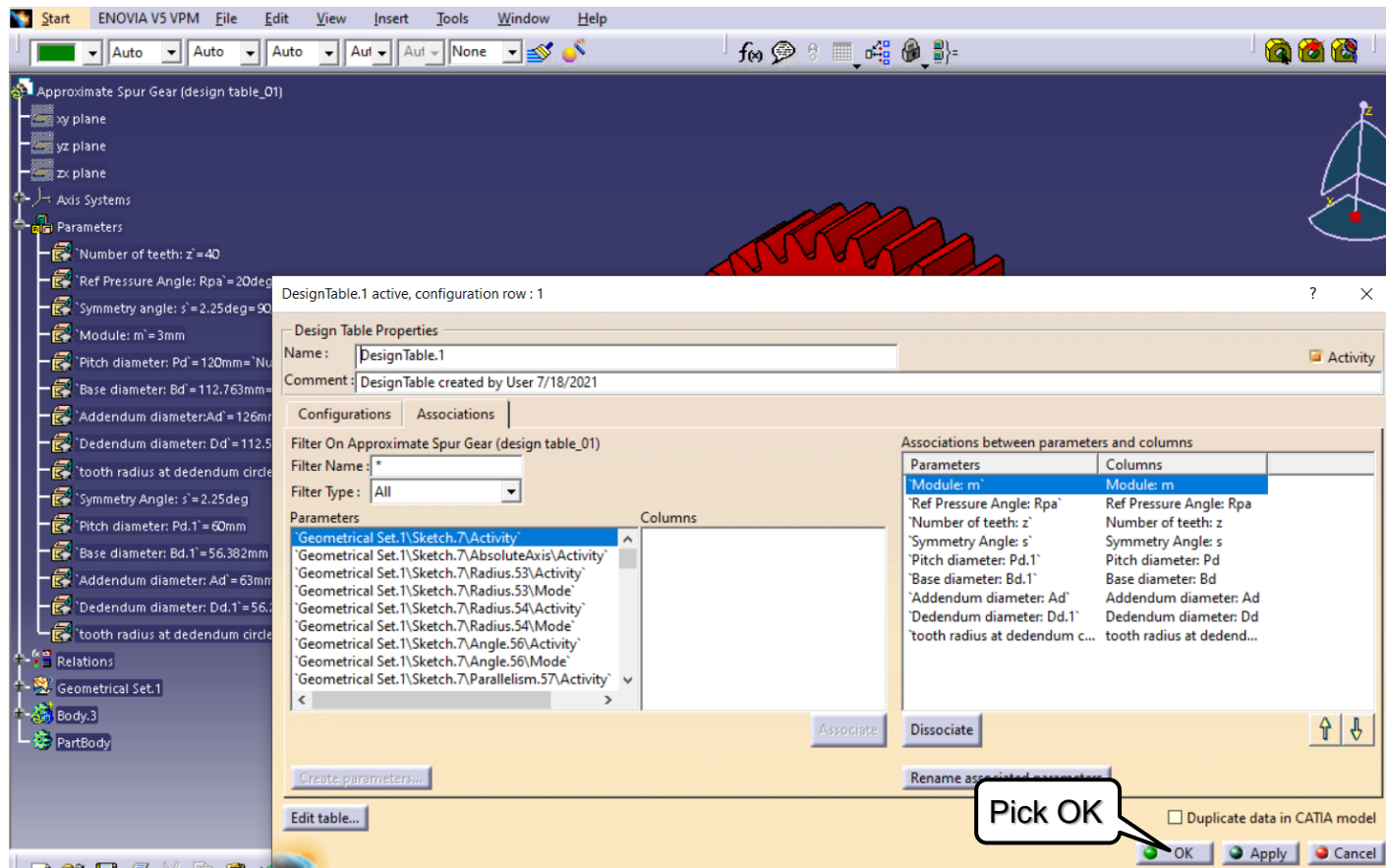
Create parameters...
Edit table...
Associate
Dissociate
Rename associated parameters
Duplicate data in CATIA model
OK Apply Cancel

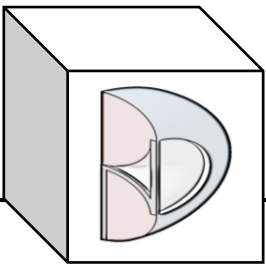


BND TechSource

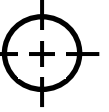


- Connect the MS Excel spreadsheet to the CATIA part as a Design Table.

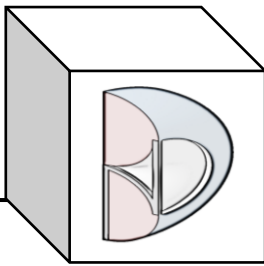




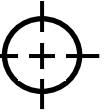
BND TechSource



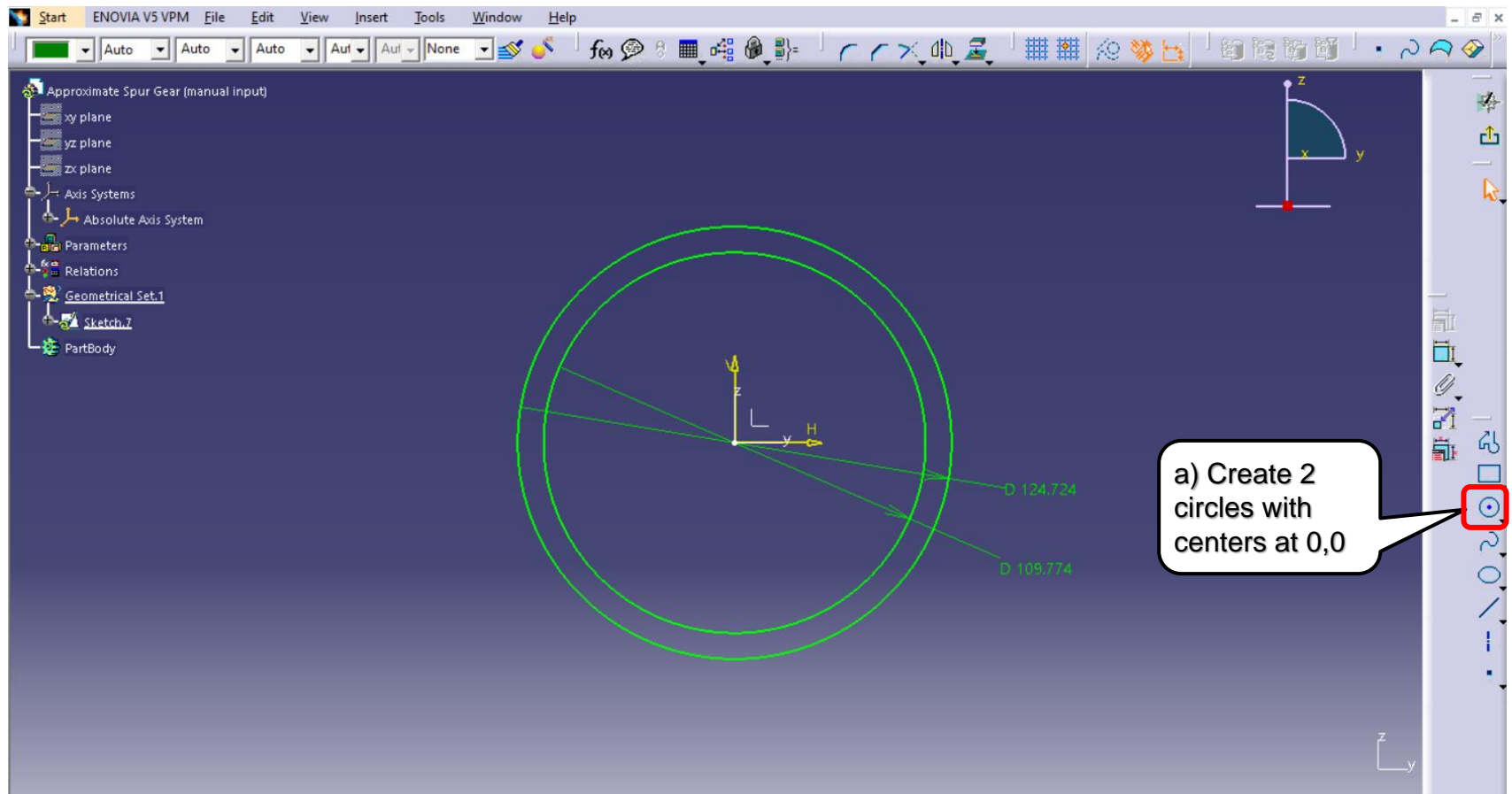
Create the Geometry

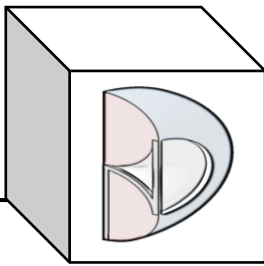


BND TechSource

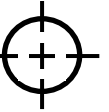


- Create the pitch and base circles in a sketch.

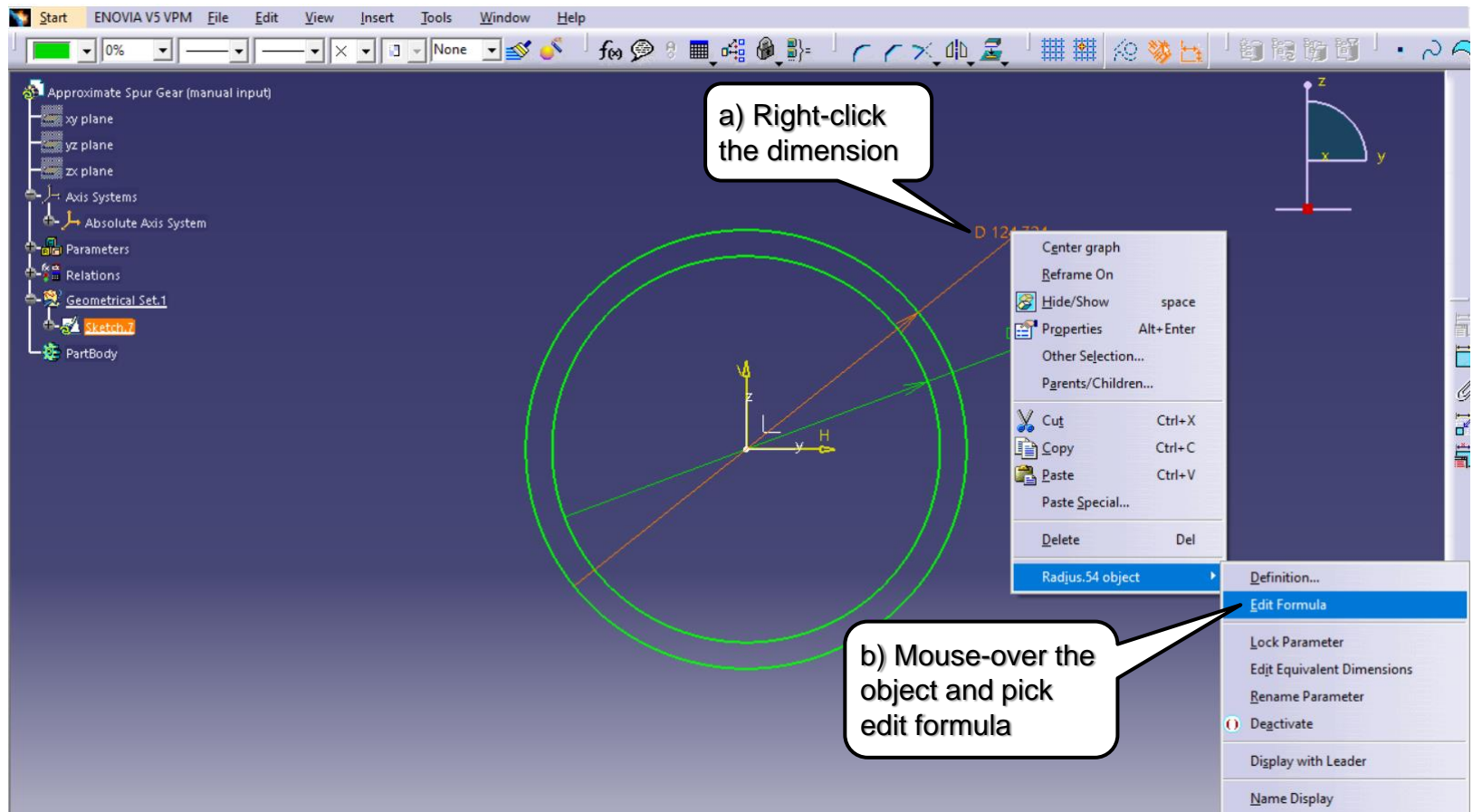


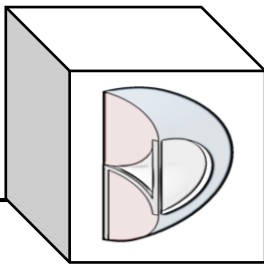


BND TechSource

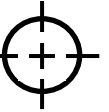


- Apply the formula (Pitch diameter: Pd) to the pitch circle.

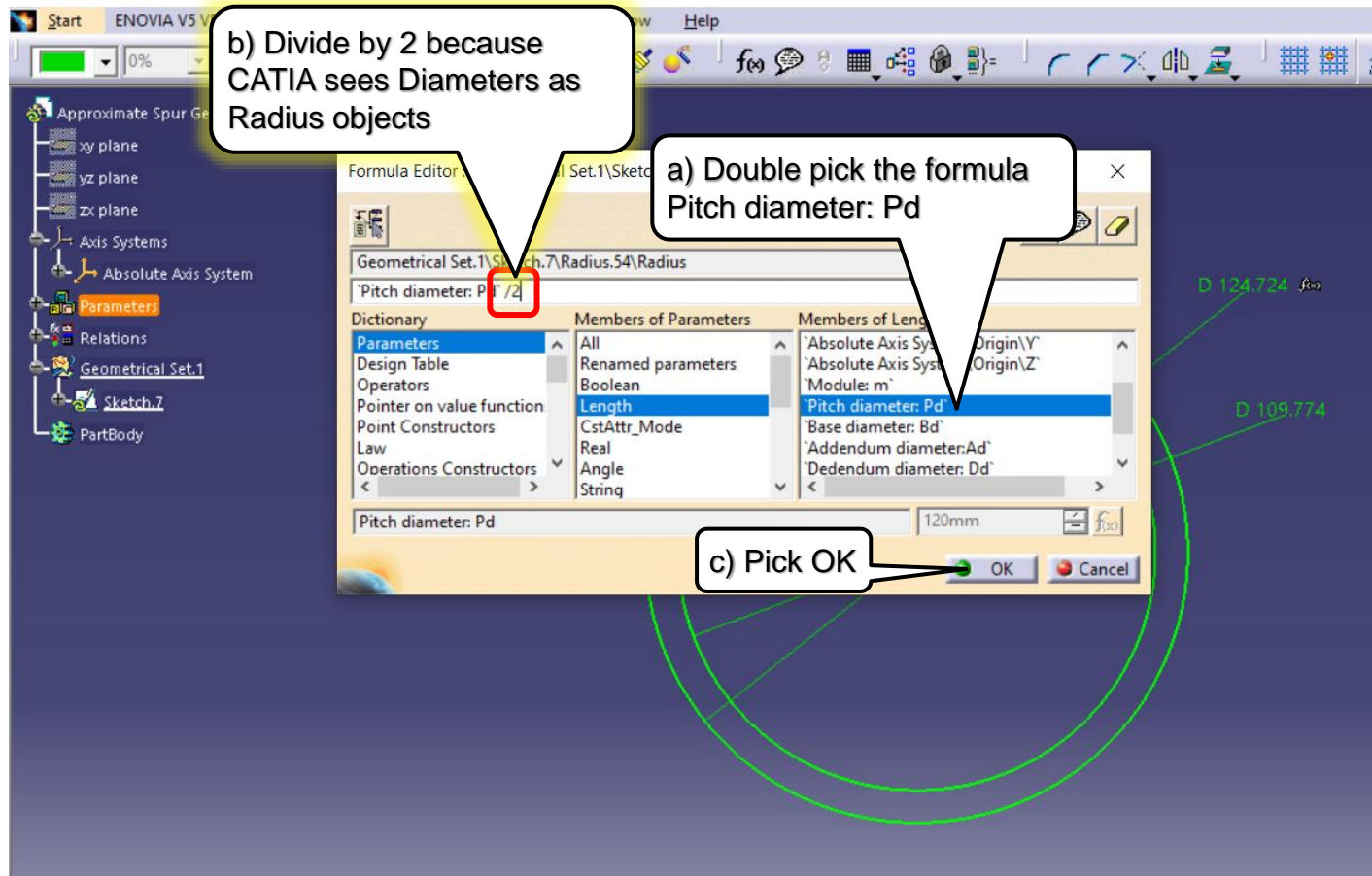


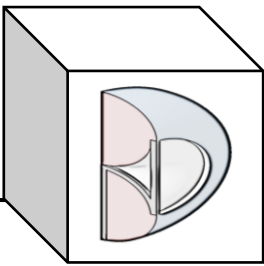


BND TechSource

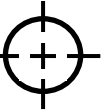


- Apply the formula (Pitch diameter: Pd) to the pitch circle.

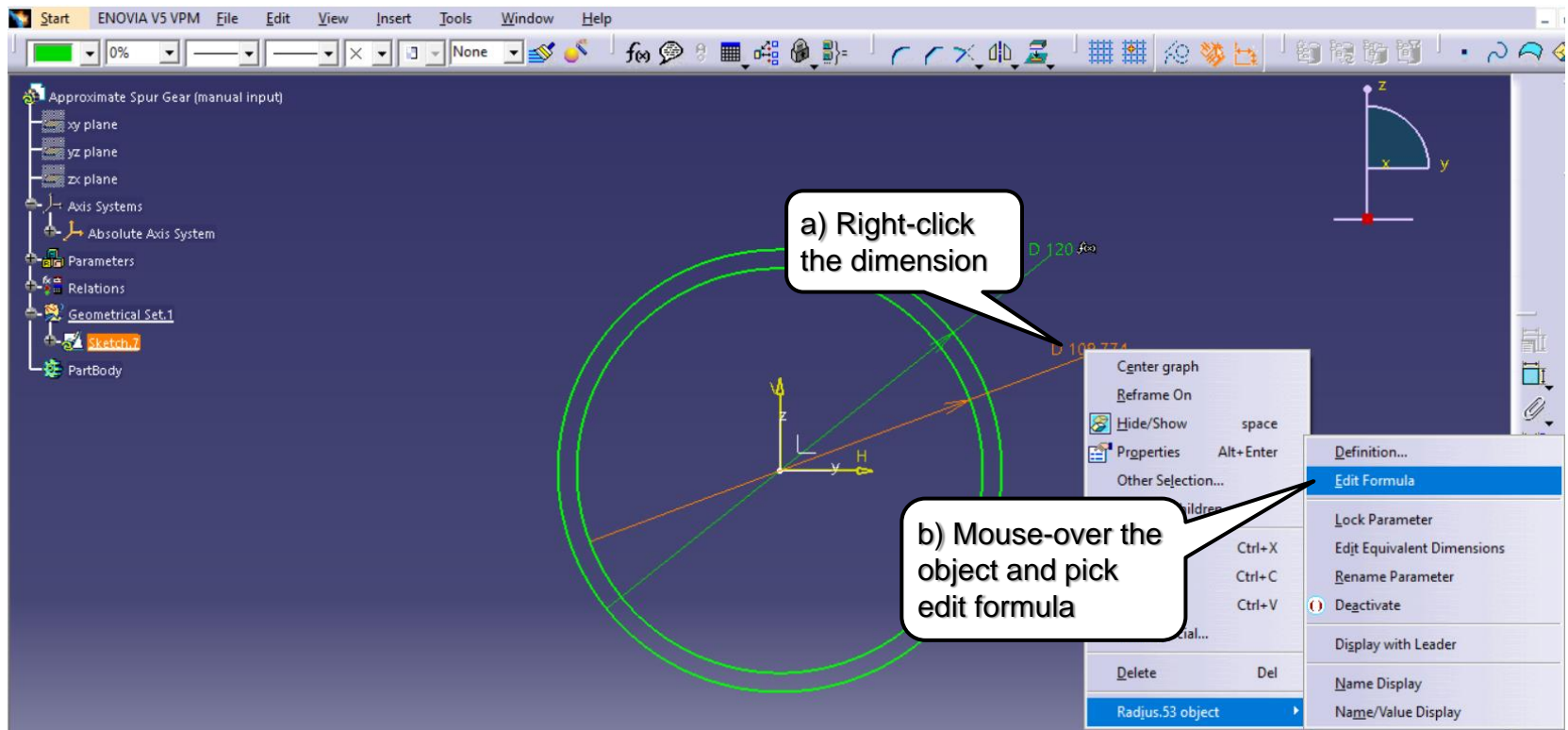




BND TechSource

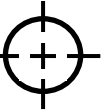


- Apply the formula (Base diameter: B_d) to the base circle.

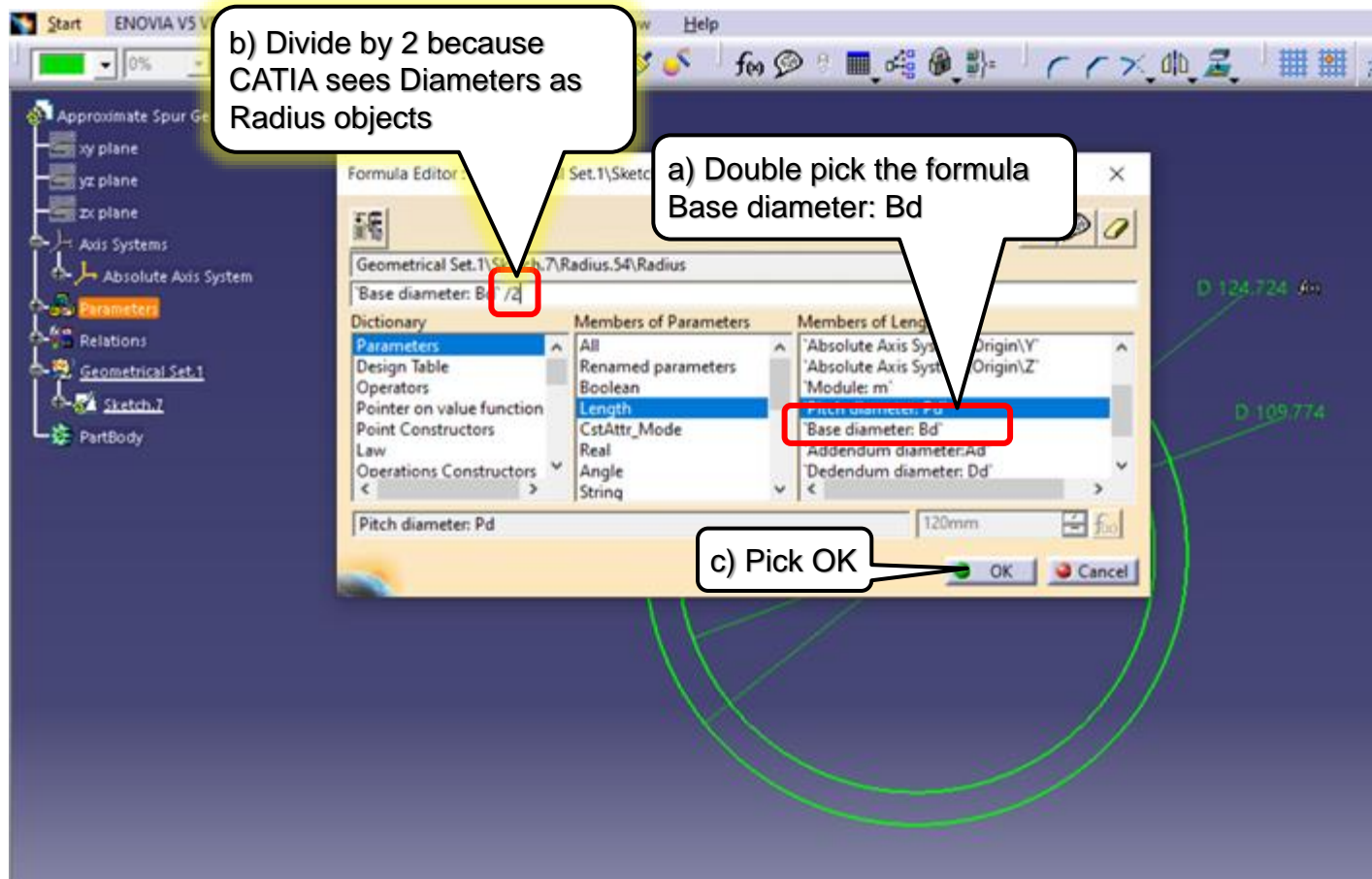


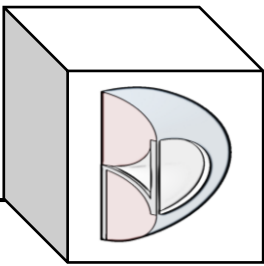


BND TechSource

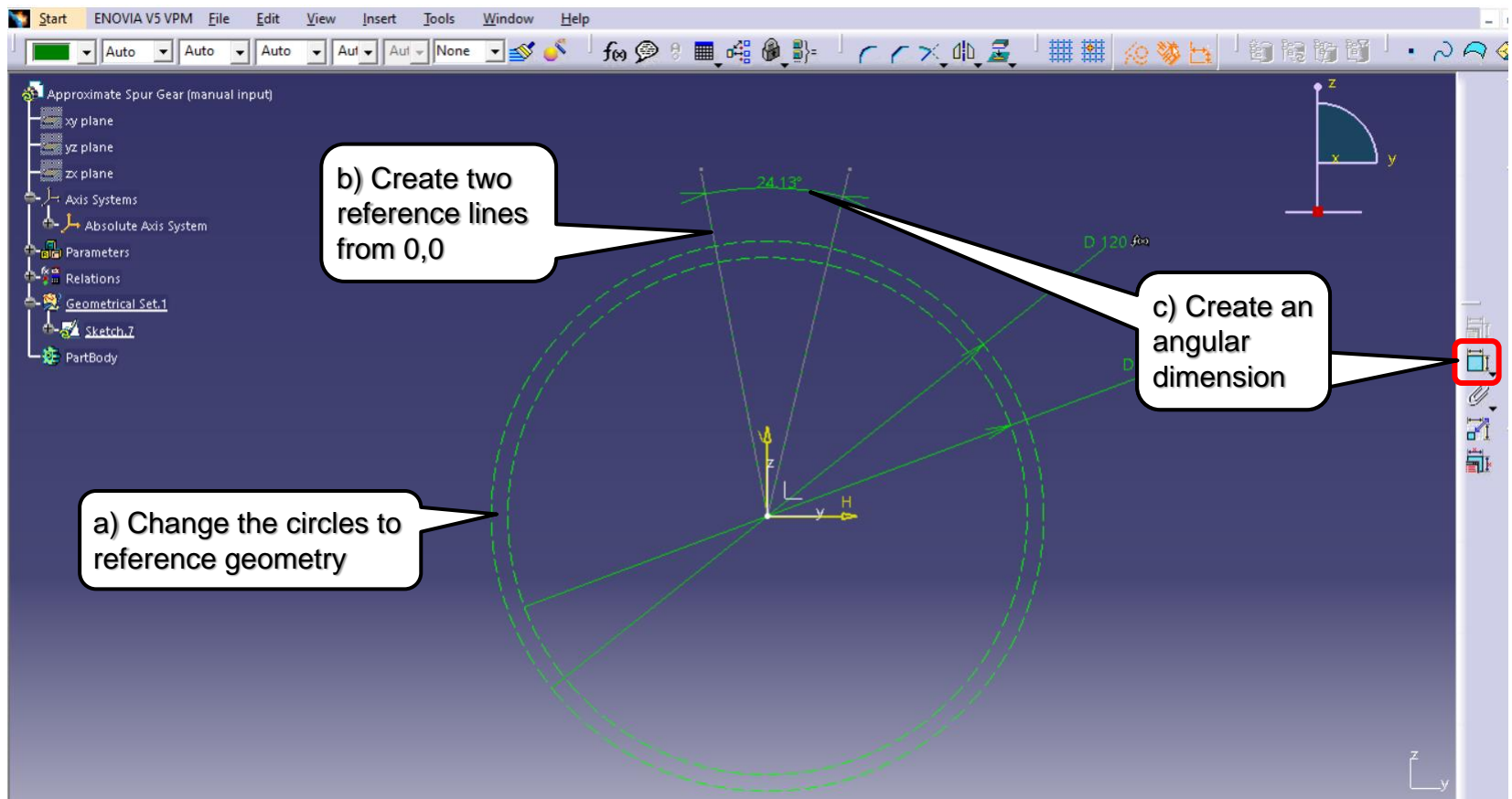


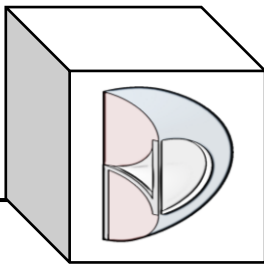
- Apply the formula (Base diameter: Bd) to the base circle.



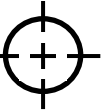


- Create tooth geometry reference lines.

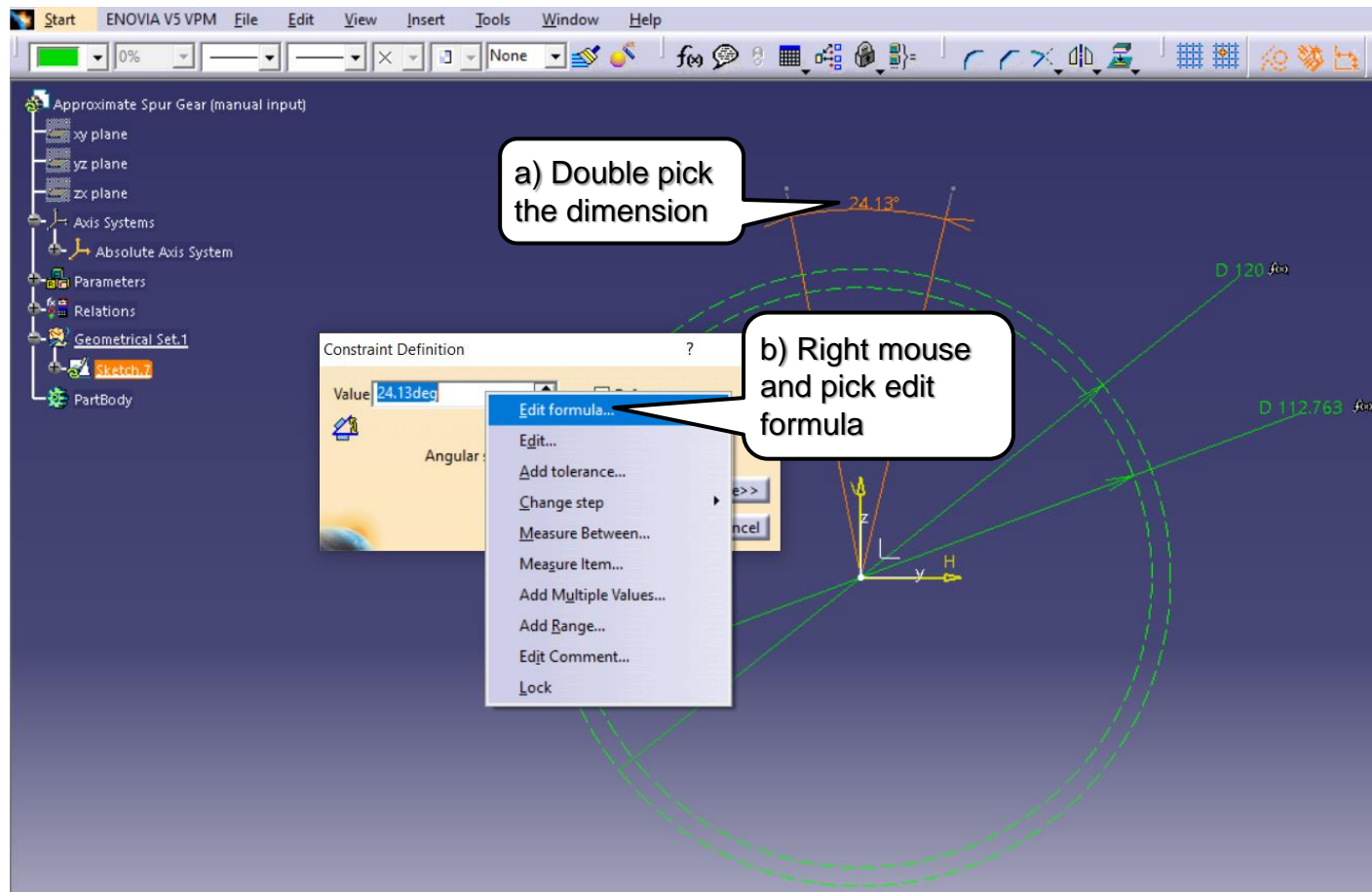


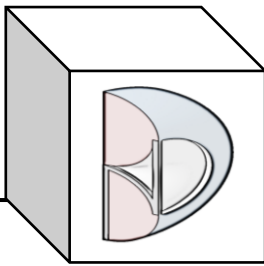


BND TechSource

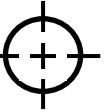


- Apply Ref Pressure Angle: Rpa.

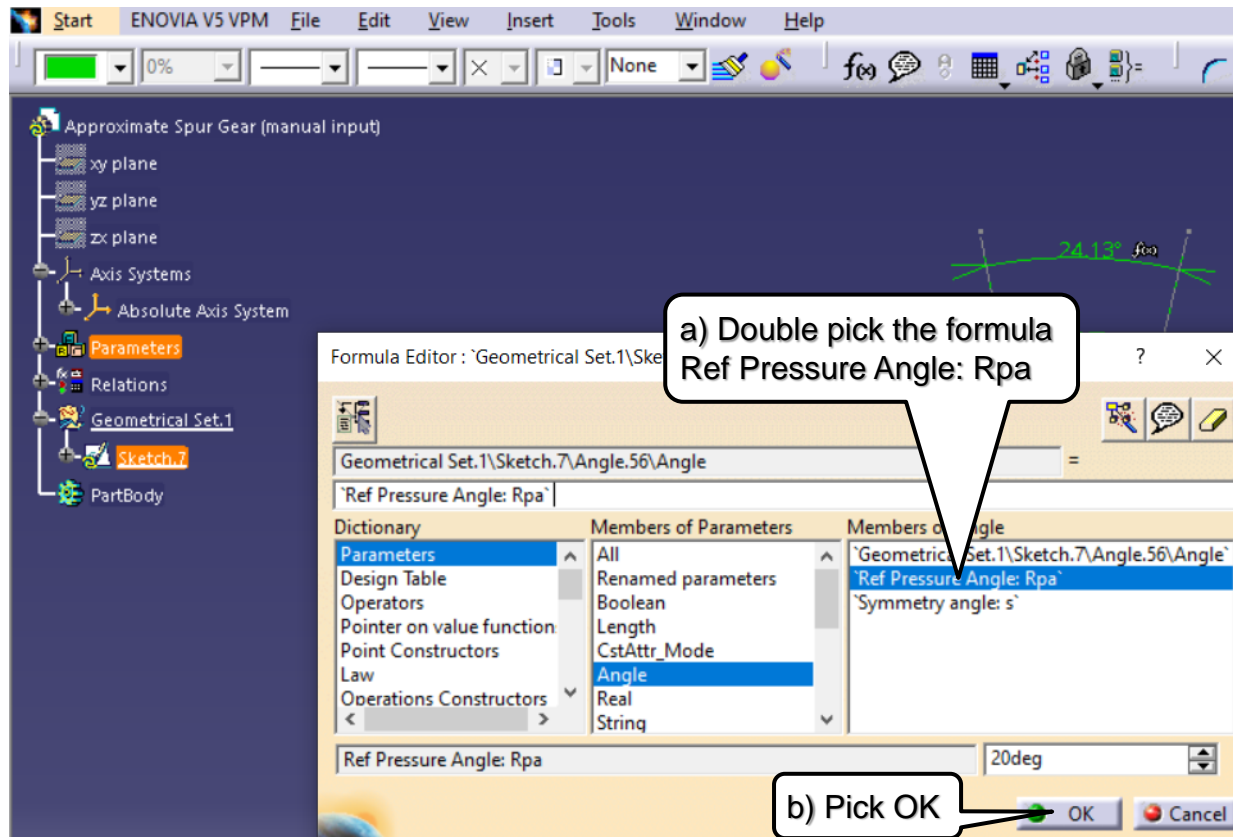


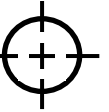
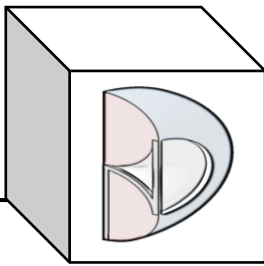


BND TechSource

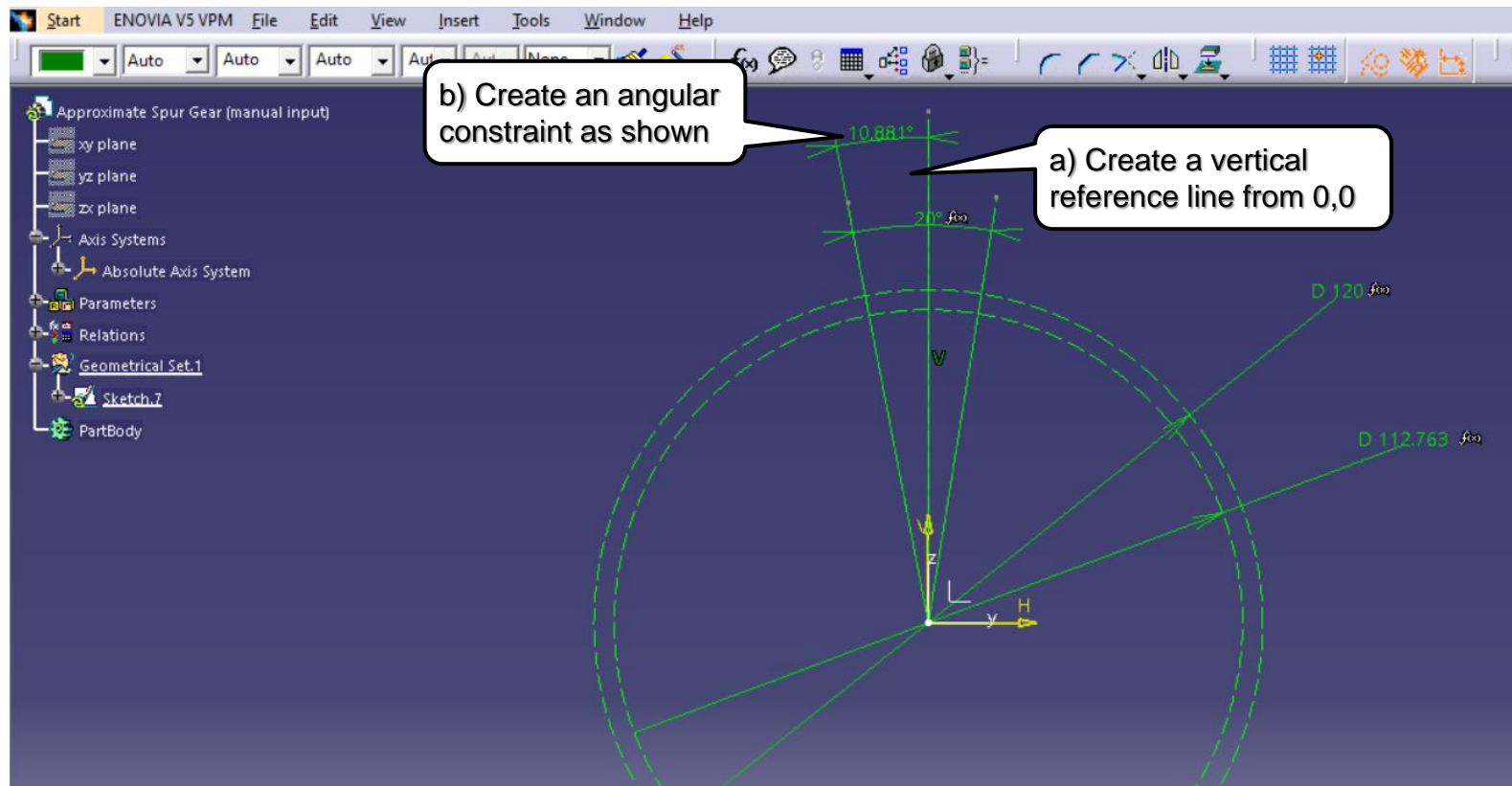


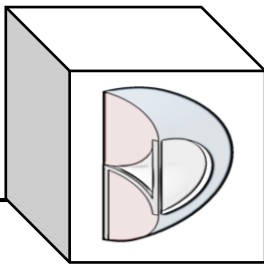
- Apply Ref Pressure Angle: Rpa.



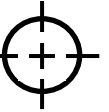


- Create tooth geometry reference lines.

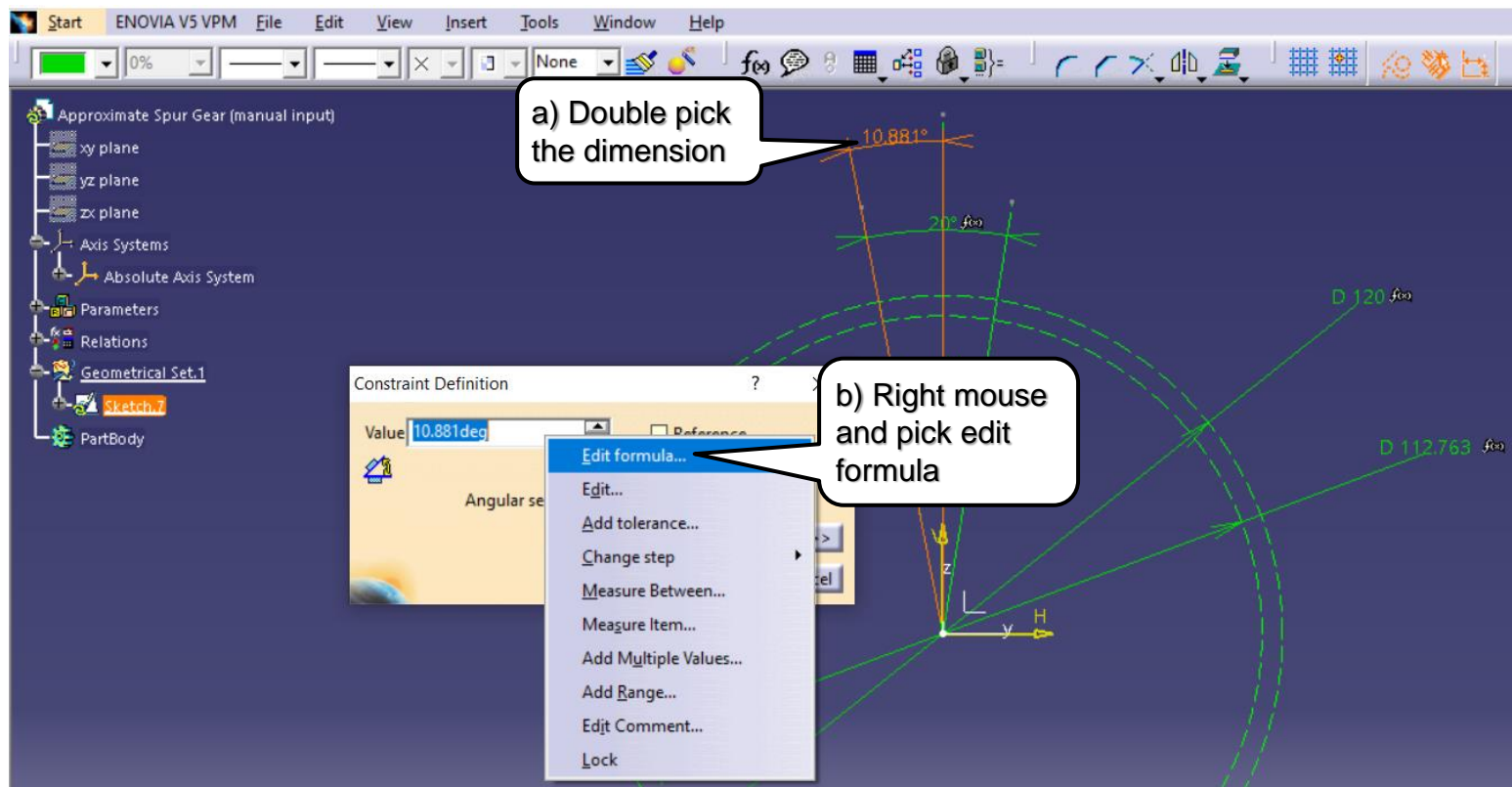




BND TechSource

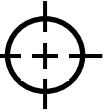


- Apply Symmetry angle: s

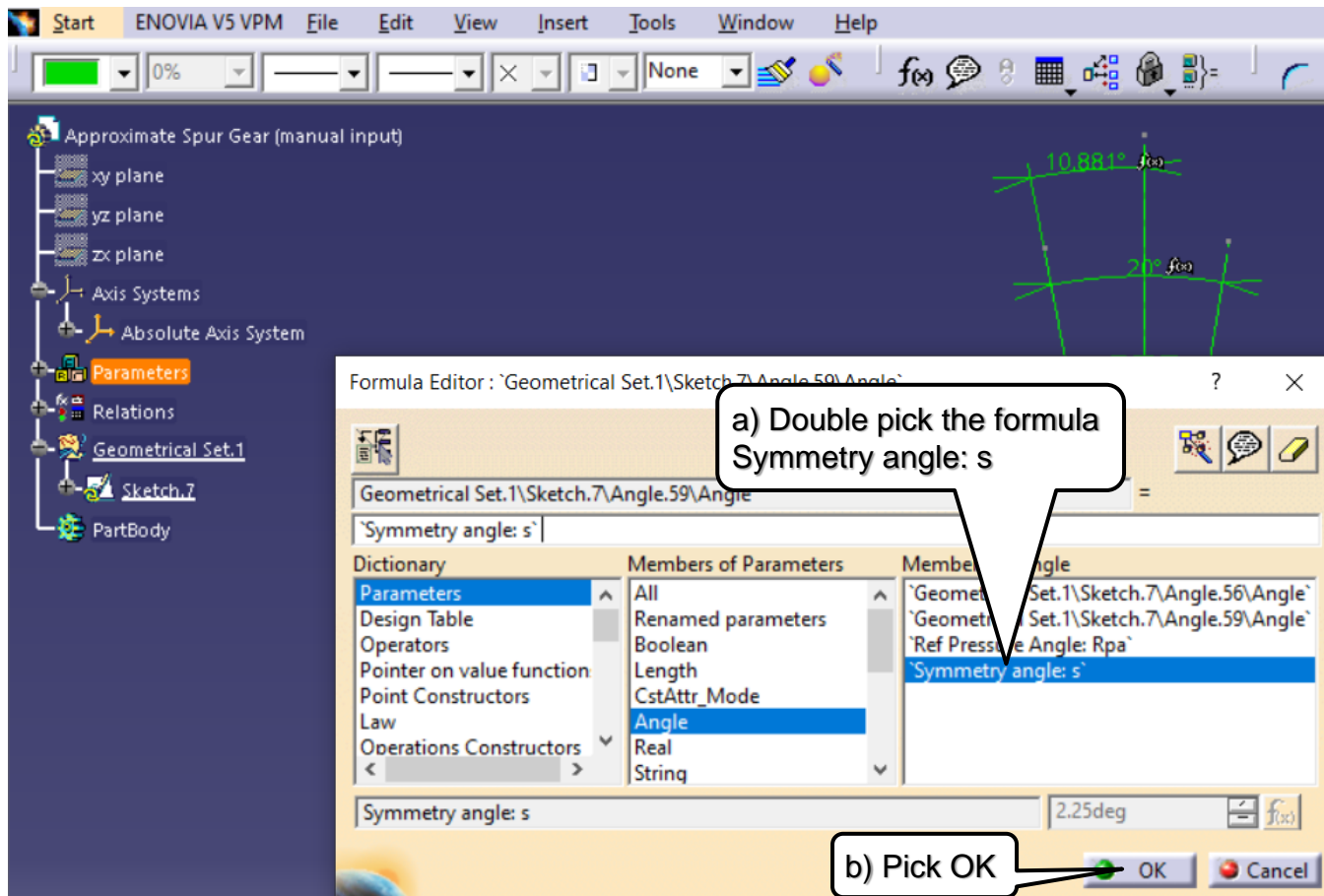


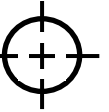


BND TechSource

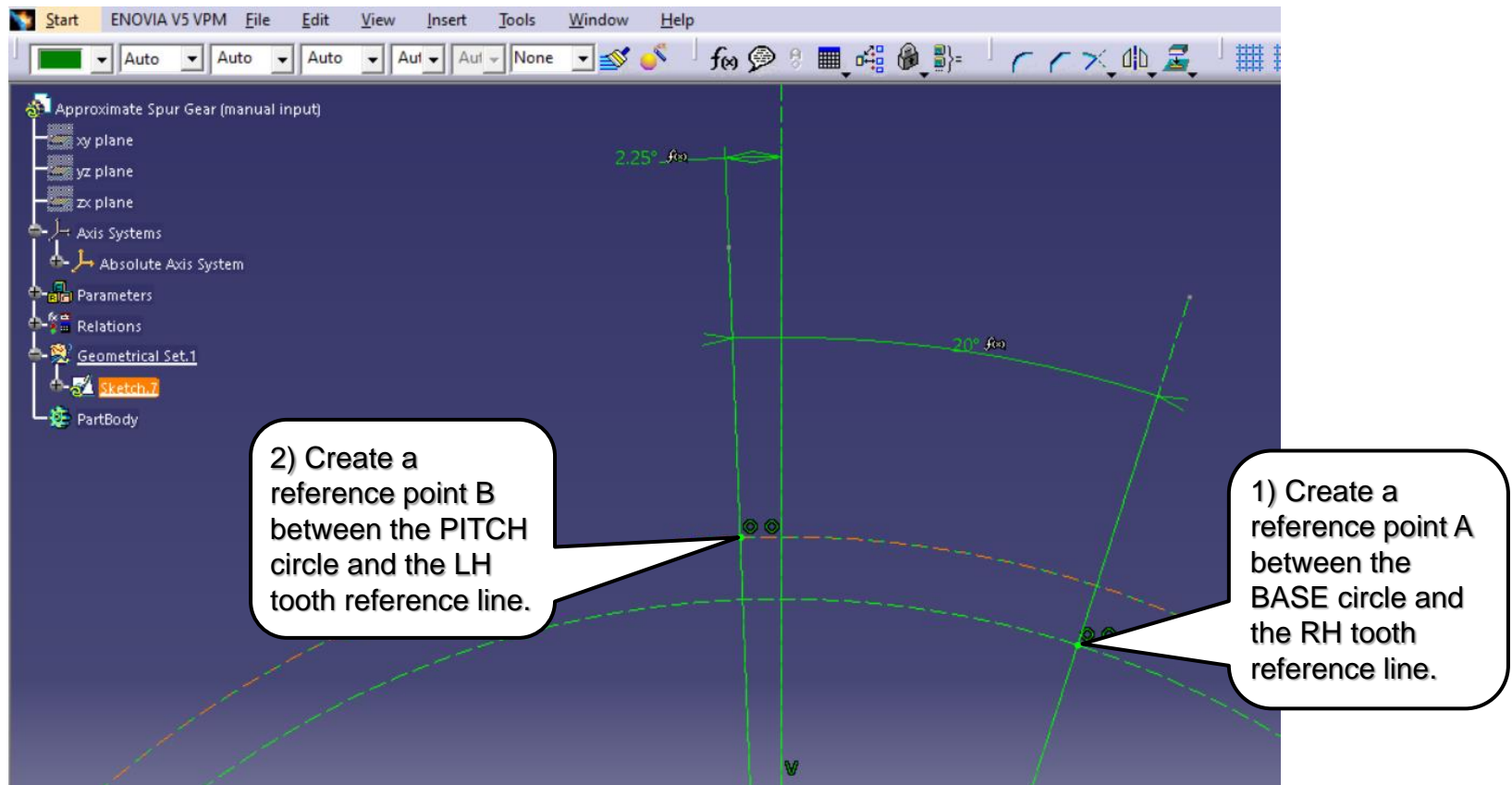


- Apply Symmetry angle: s



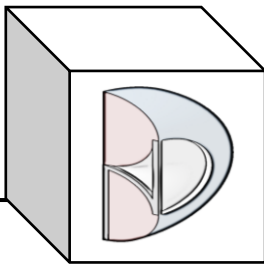


- Create reference points A & B for the construction of the approximated tooth profile.

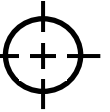


2) Create a reference point B between the PITCH circle and the LH tooth reference line.

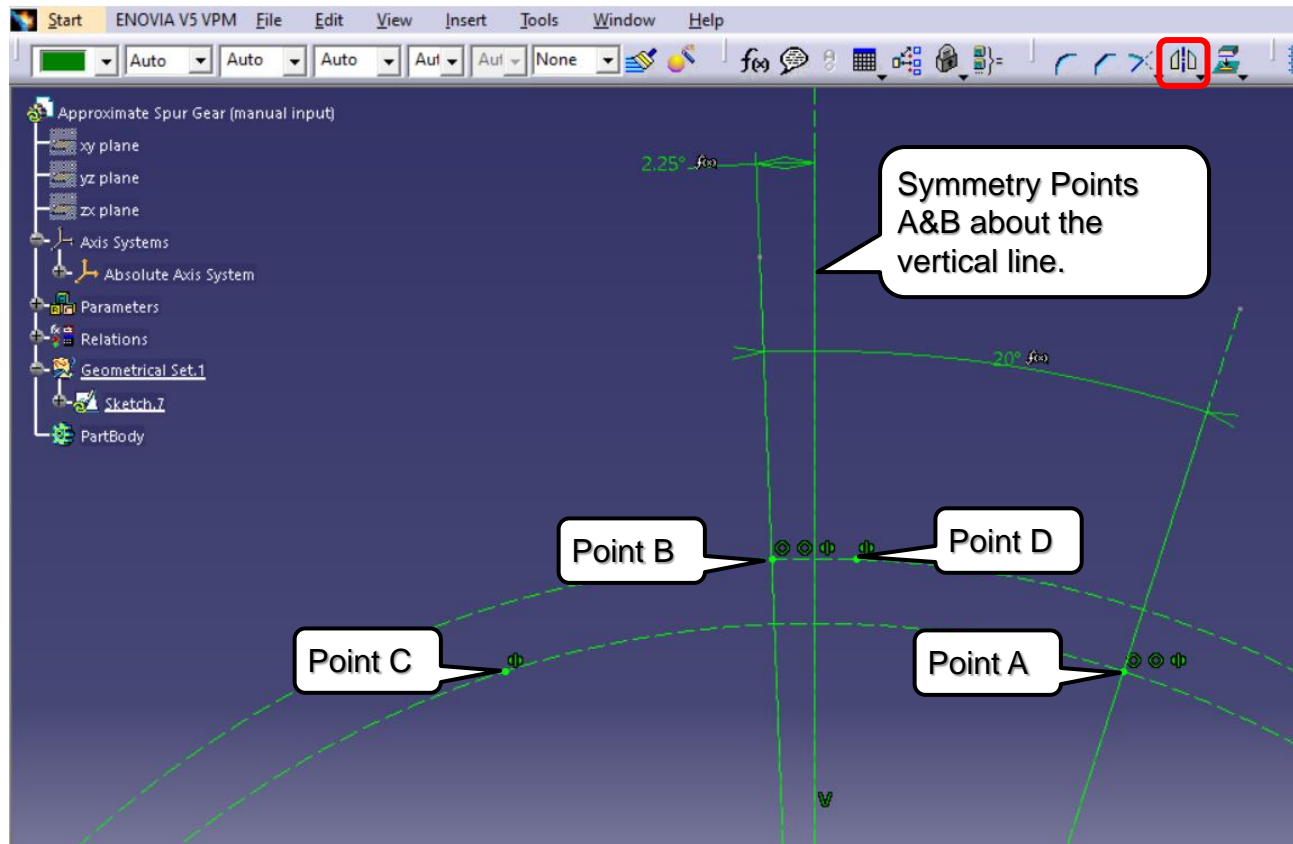
1) Create a reference point A between the BASE circle and the RH tooth reference line.

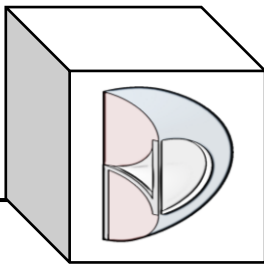


BND TechSource

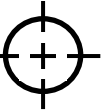


- Create symmetrical reference points C & D for the construction of the approximated tooth profile.

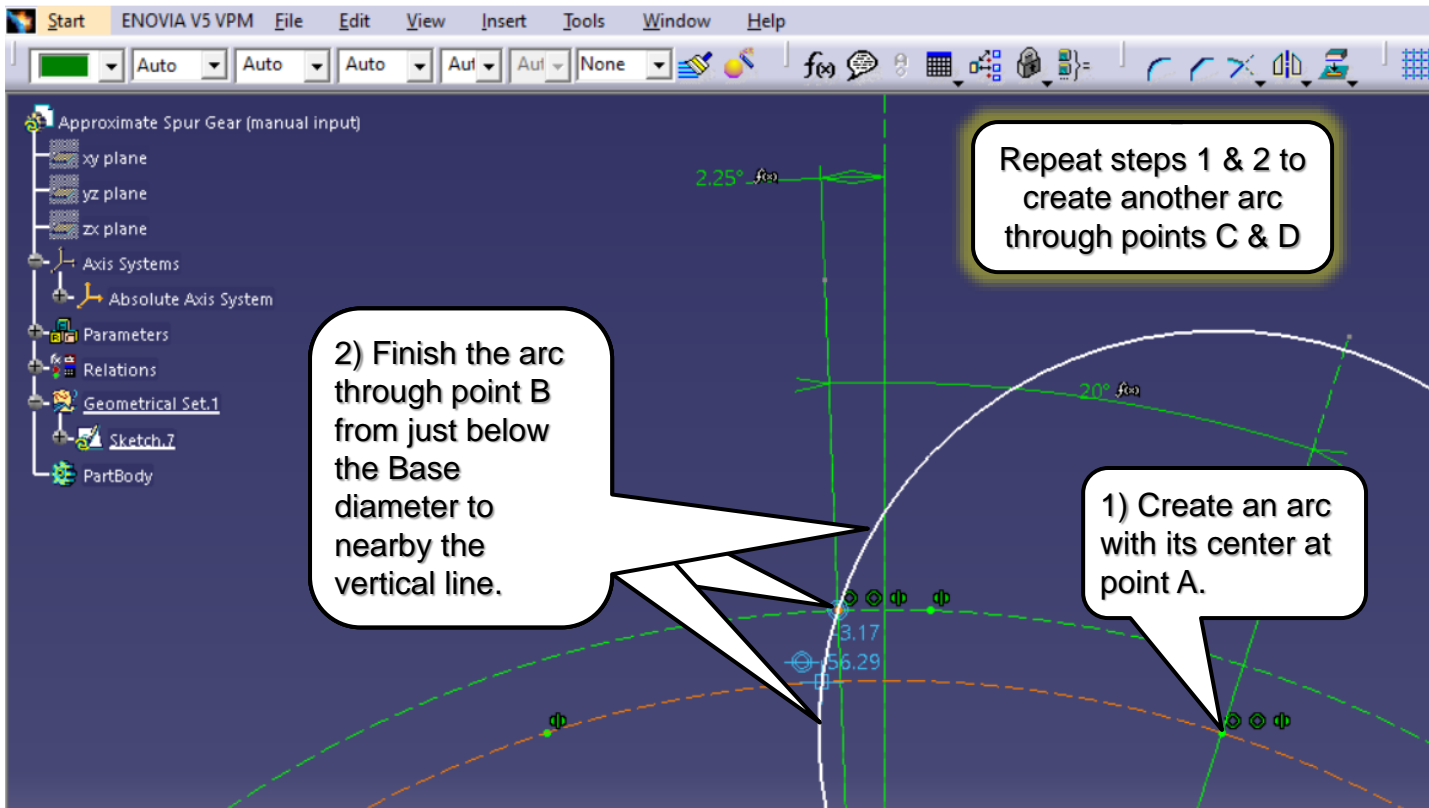


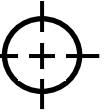
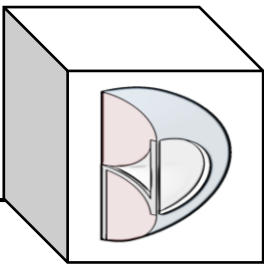


BND TechSource

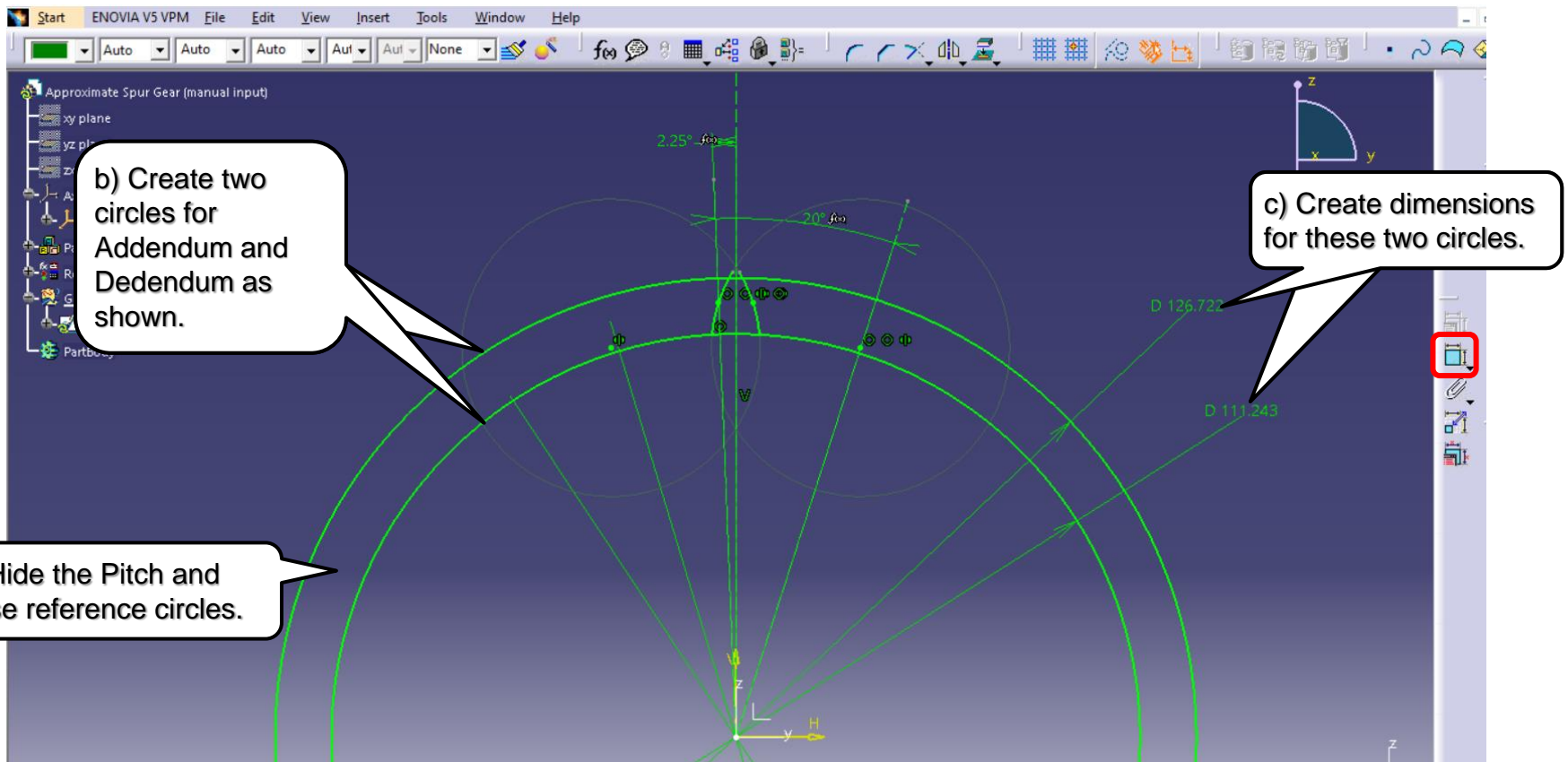


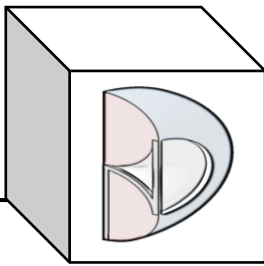
- Create the approximated (circular) tooth profile. *Actual* tooth profile would be an *involute* curve.



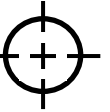


- Create the Addendum and Dedendum construction circles.

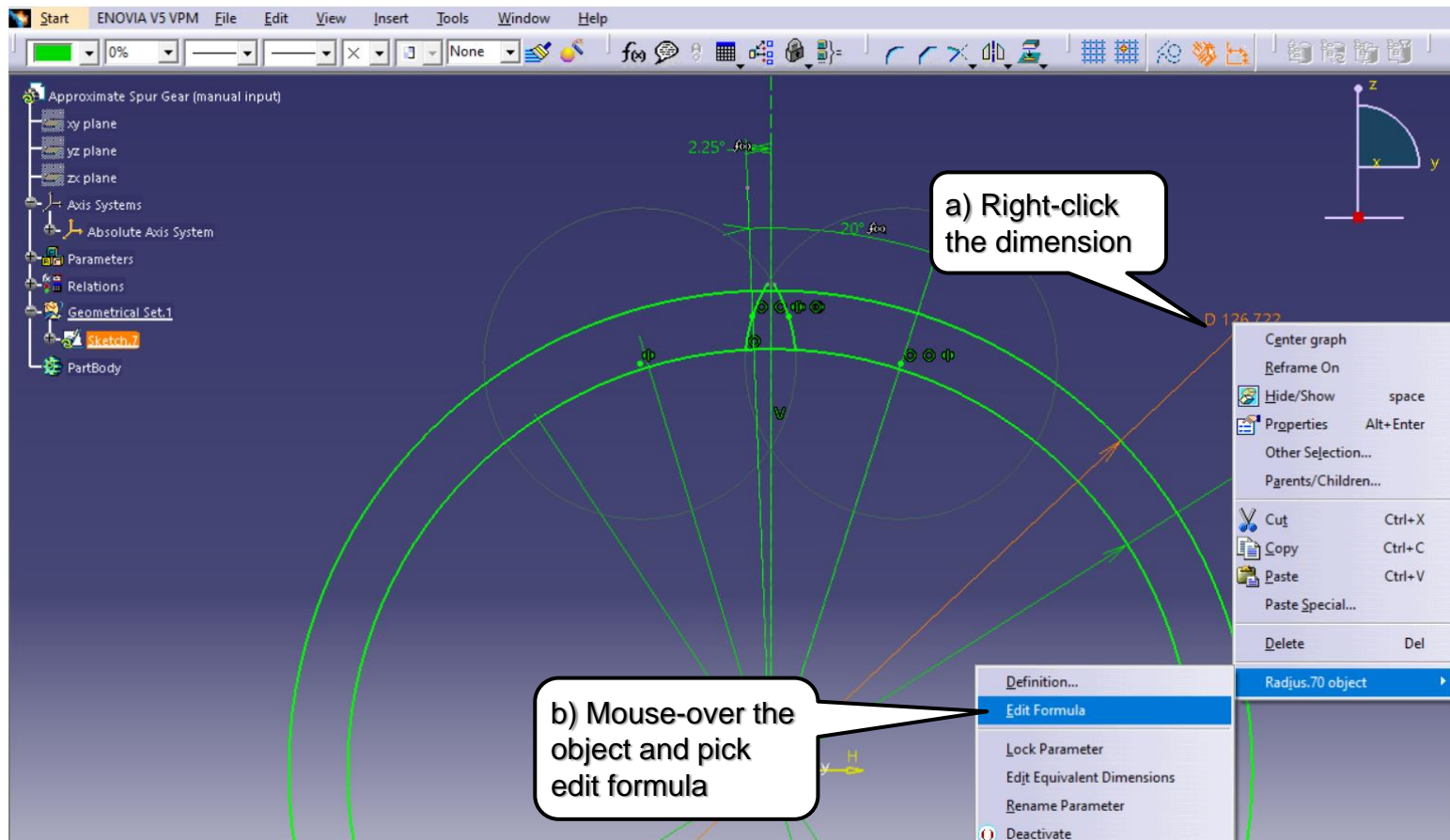


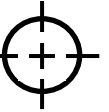
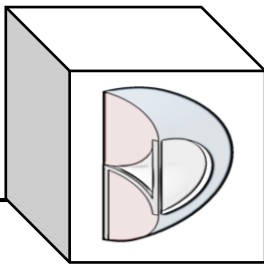


BND TechSource



- Apply the formula (Addendum diameter: A_d) to the addendum circle.





- Apply the formula (Addendum diameter: Ad) to the addendum circle.

b) Divide by 2 because CATIA sees Diameters as Radius objects

a) Double pick the formula Addendum diameter: Ad

c) Pick OK

Formula Editor: Geometrical Set.1\Sketch.7\Radius

Geometrical Set.1\Sketch.7\Radius

'Addendum diameter:Ad' /2

Dictionary	Members of Parameters	Members of Let
Parameters	All	'Module: m'
Design Table	Renamed parameters	'Pitch diameter: P'
Operators	Boolean	'Base diameter: Bd'
Pointer on value function	Length	'Addendum diameter: Ad'
Point Constructors	CstAttr_Mode	'Dedendum diameter: Dd'
Law	Angle	'tooth radius at dedendum circle: tr'
Operations Constructors	Real	
	String	

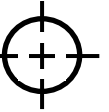
Addendum diameter:Ad

126mm

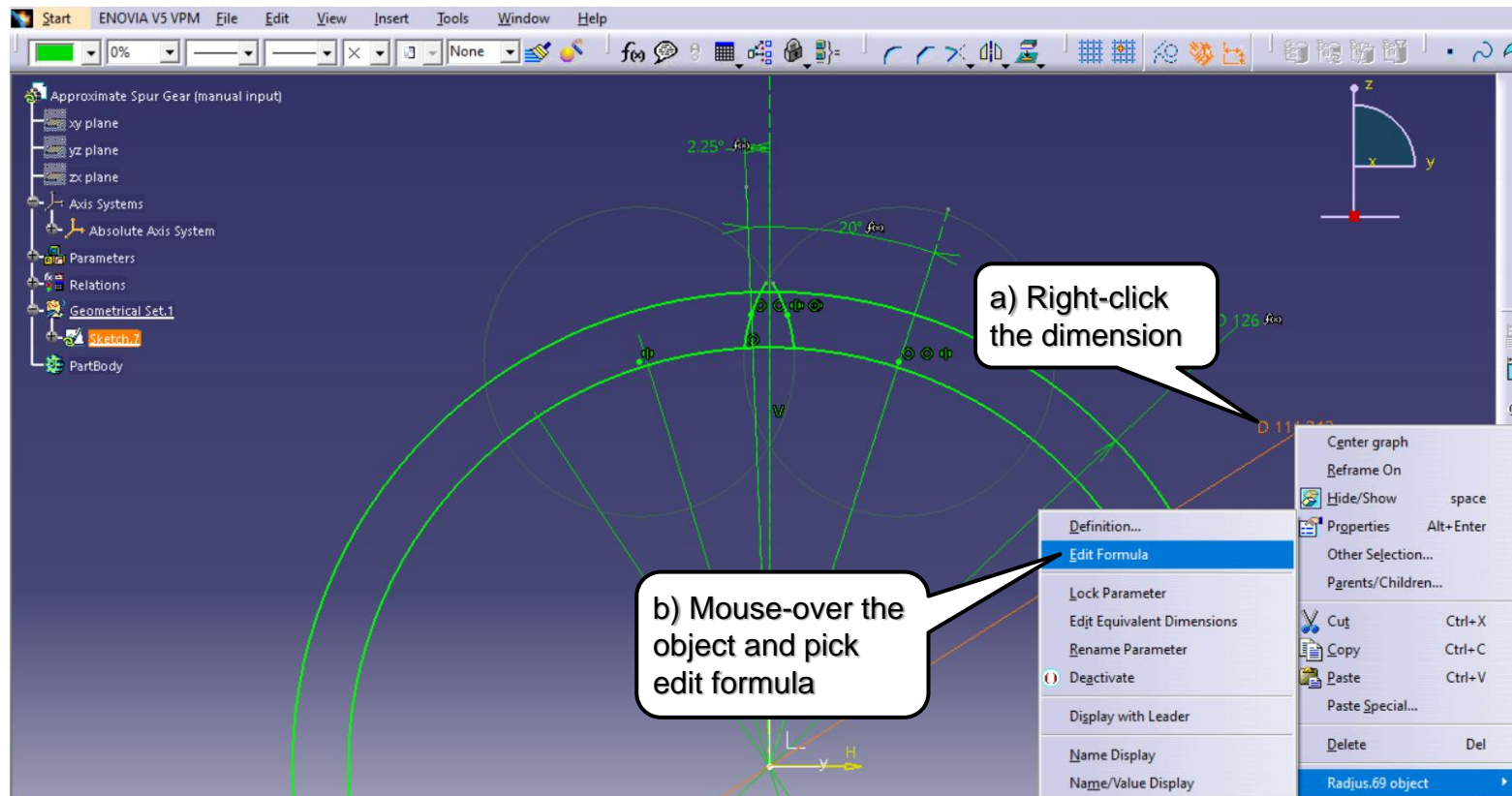
OK Cancel

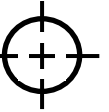


BND TechSource



- Apply the formula (Dedendum diameter: D_d) to the dedendum circle.



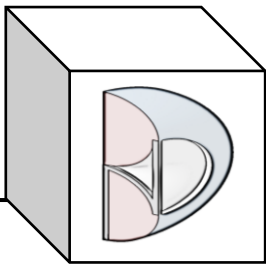


- Apply the formula (Dedendum diameter: Dd) to the dedendum circle.

b) Divide by 2 because CATIA sees Diameters as Radius objects

a) Double pick the formula Dedendum circle radius: Rd

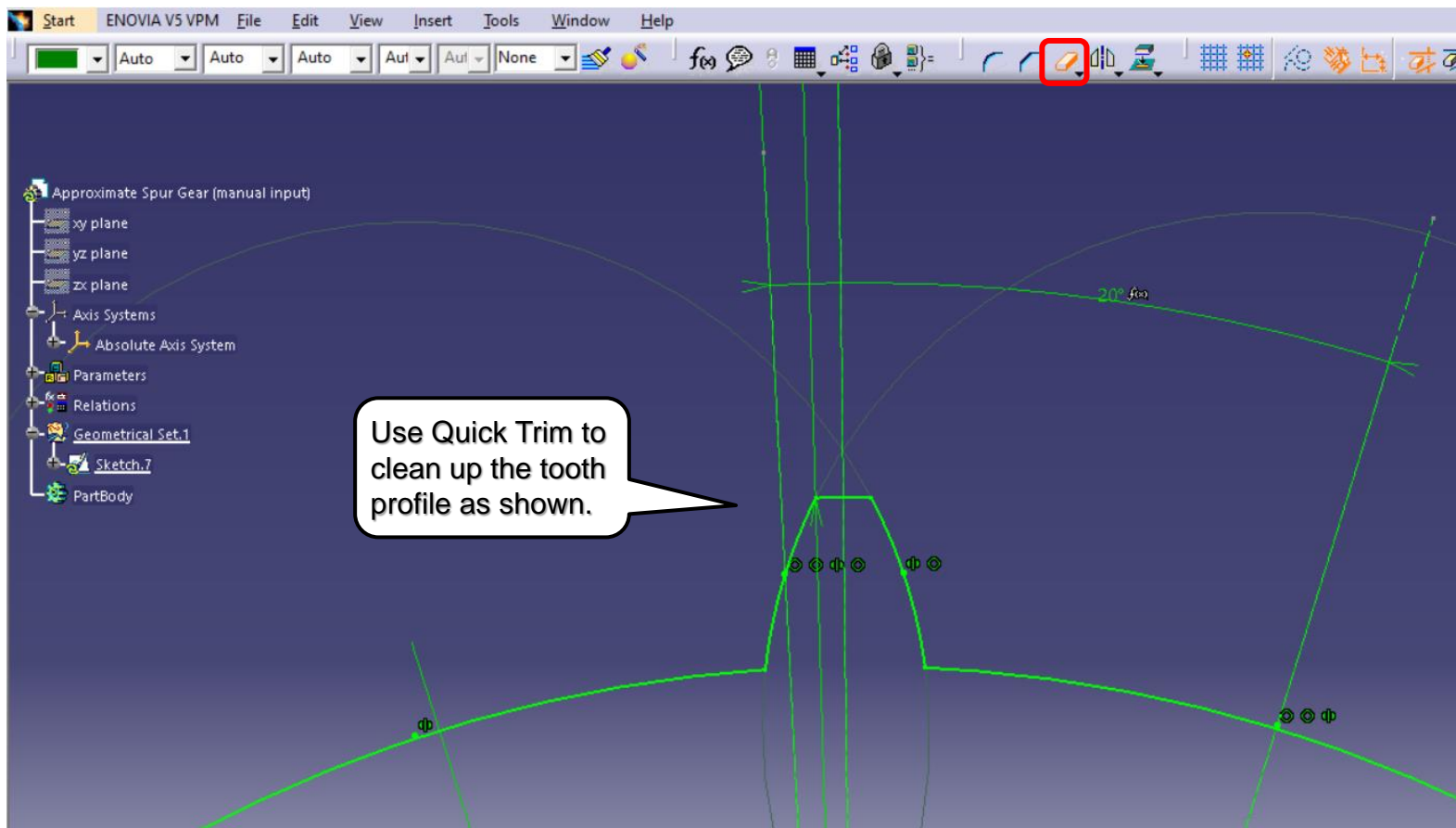
c) Pick OK



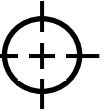
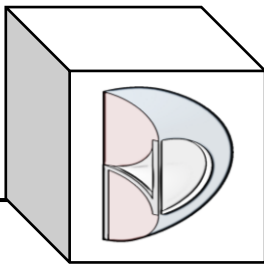
BND TechSource



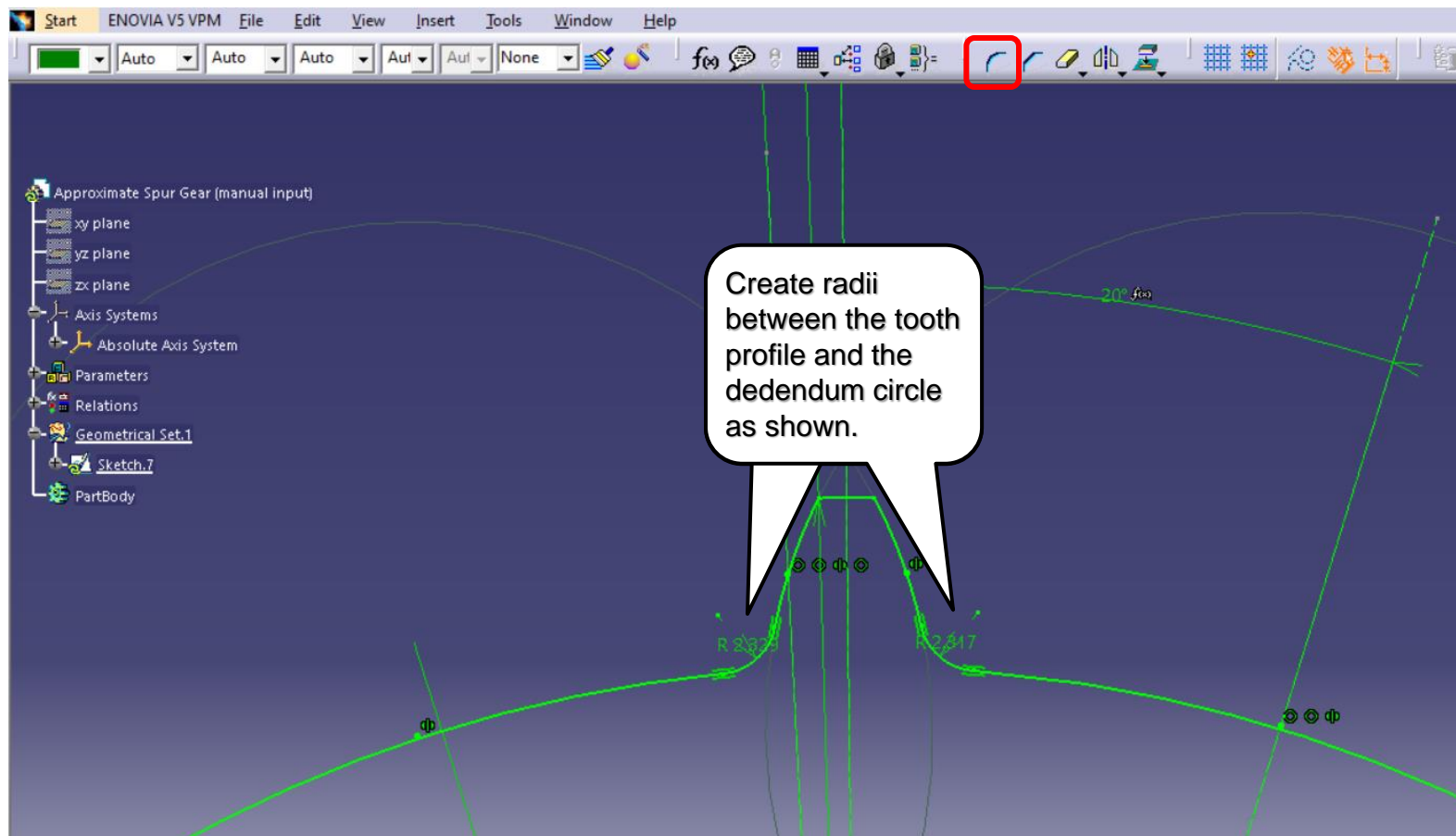
- Clean up the tooth profile.

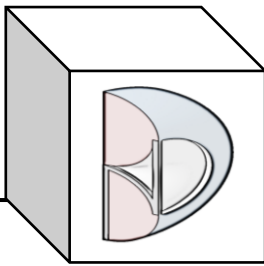


Use Quick Trim to clean up the tooth profile as shown.

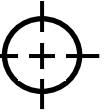


- Create the radius between the tooth profile and the dedendum circle.

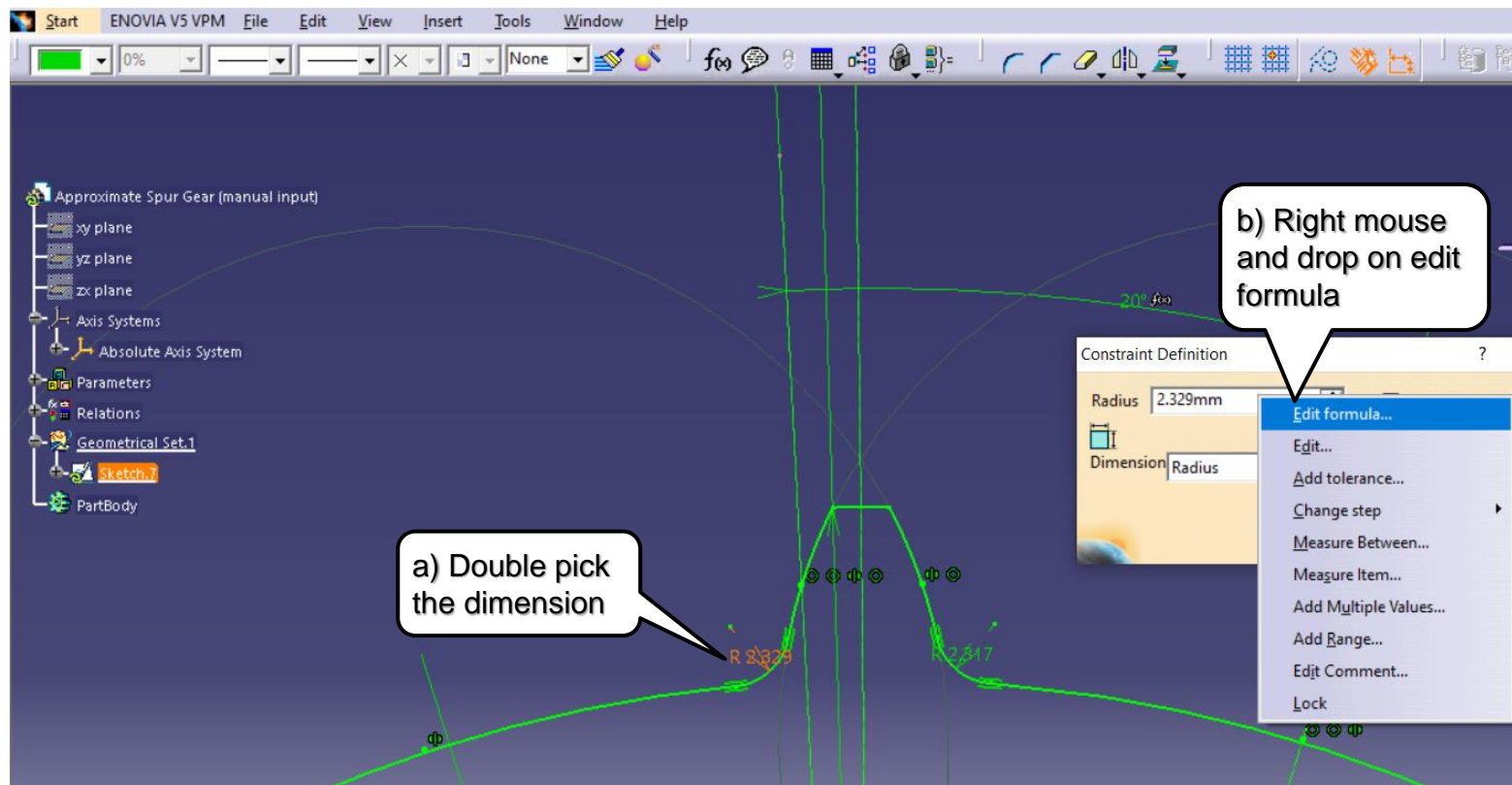


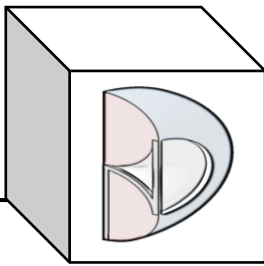


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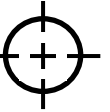


- Apply tooth radius at dedendum circle: tr to both radii.





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- Apply tooth radius at dedendum circle: tr to both radii.

Formula Editor: 'Geometrical Set.1\Sketch.7\Radius.80\Radius'

Geometrical Set.1\Sketch.7\Radius.80\Radius

'tooth radius at dedendum circle: tr'

Dictionary	Members of Parameters	Members of Length
Parameters	All	'Module: m'
Design Table	Renamed parameters	'Pitch diameter: Pd'
Operators	Boolean	'Base diameter: Bd'
Pointer on value function	Length	'Addendum diameter: Ad'
Point Constructors	CstAttr_Mode	'Dedendum diameter: Dd'
Law	Angle	'tooth radius at dedendum circle: tr'
Operations Constructors	Real	
	String	

tooth radius at dedendum circle: tr

1.14mm

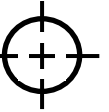
OK Cancel

a) Double pick the formula tooth radius at dedendum circle: tr

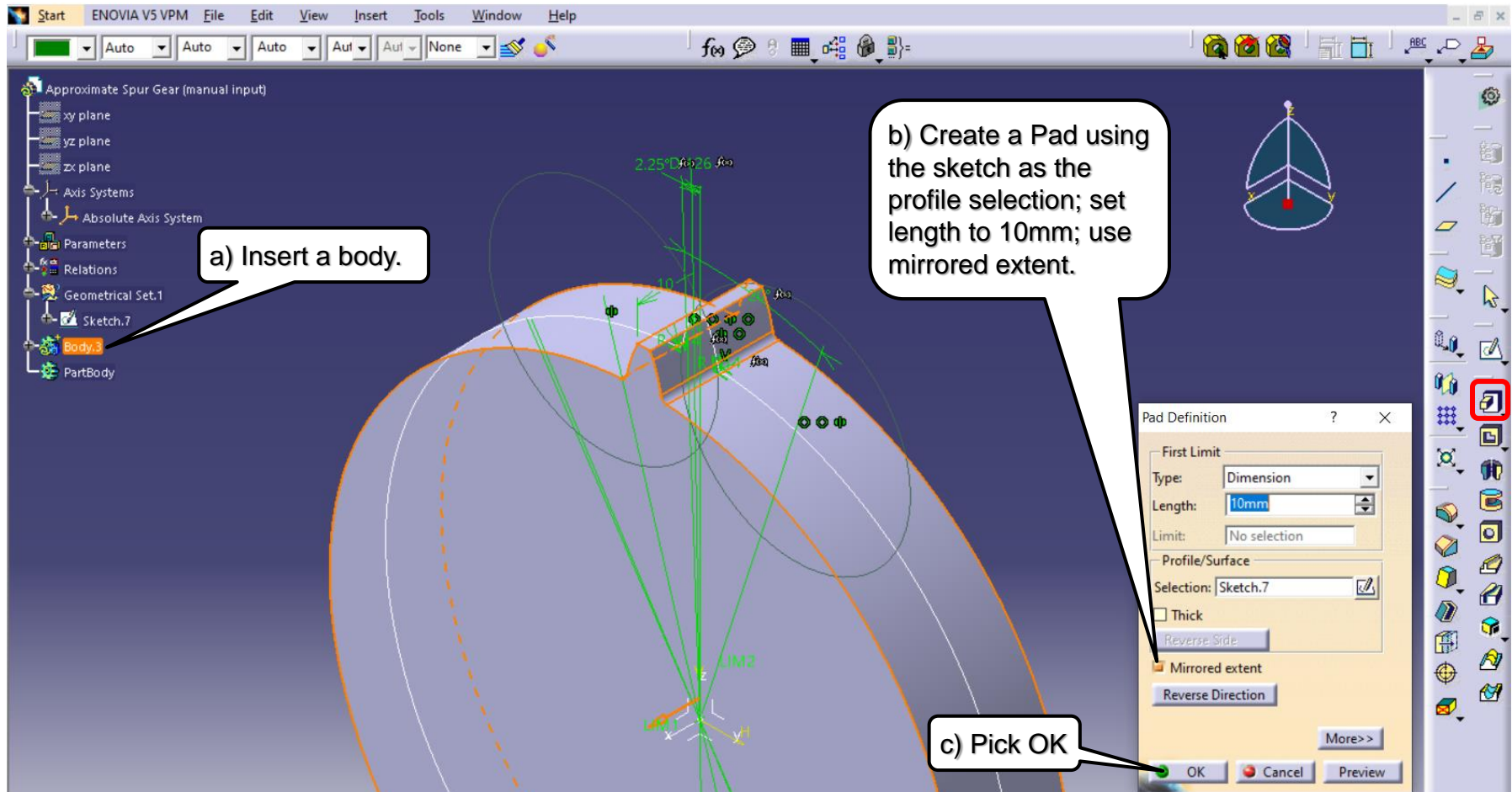
b) Pick OK



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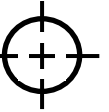


- Create a solid pad using the sketch.

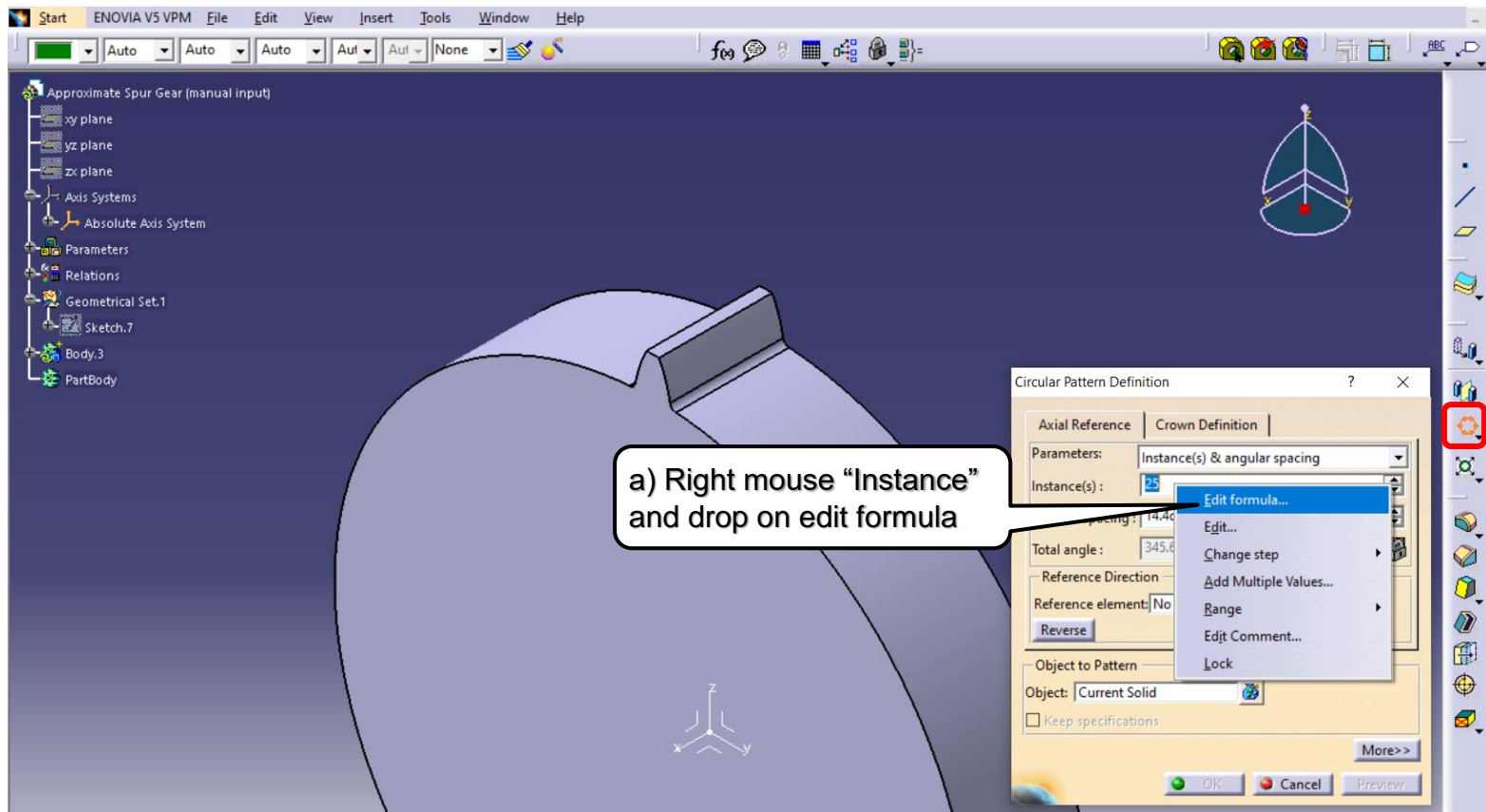


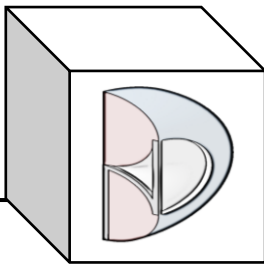


BND TechSource

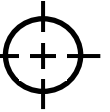


- Create the pattern for the number of teeth.

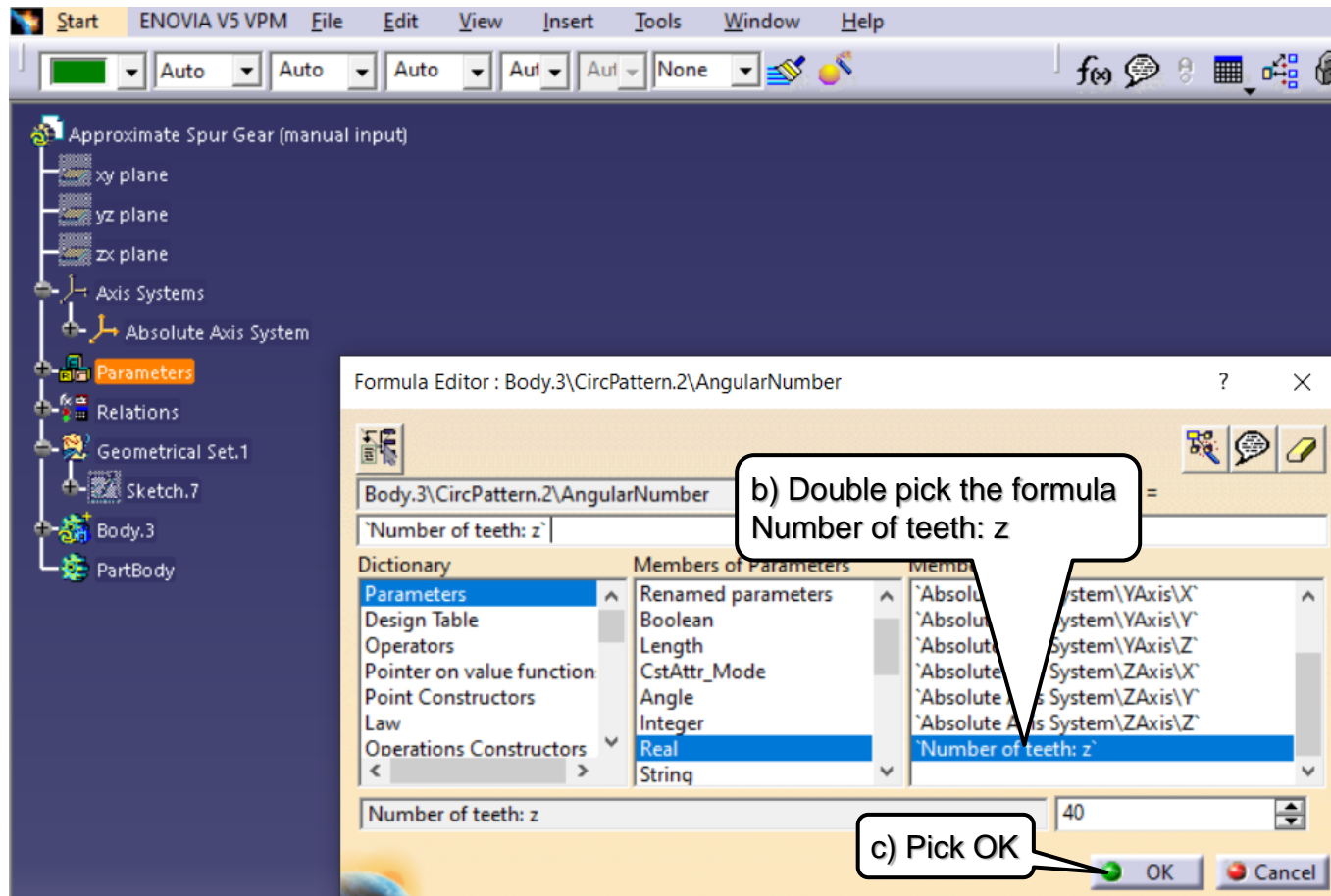




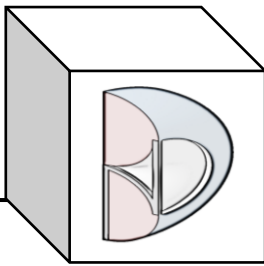
BND TechSource



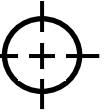
- Create the pattern for the number of teeth.







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- Create the pattern for the number of teeth.

The screenshot shows the ENOVIA V5 VPM software interface. The left sidebar displays the 'Approximate Spur Gear (manual input)' feature tree, including 'xy plane', 'yz plane', 'zx plane', 'Axis Systems', 'Absolute Axis System', 'Parameters', 'Relations', 'Geometrical Set.1', 'Sketch.7', 'Body.3', and 'PartBody'. The main workspace shows a 3D model of a gear. A callout box 'a) Type 360 deg/ Number of teeth: z' points to the formula input field in the 'Formulas' dialog box. The dialog box title is 'Formulas: Body.2\CircPattern.1\AngularSpacing'. The formula input field contains '360 deg/Number of teeth: z'. Below the input field are three panes: 'Dictionary' (showing 'Parameters' selected), 'Members of Parameters' (showing 'All' selected), and 'Members of All' (showing a list of parameters). A callout box 'b) Pick OK' points to the 'OK' button at the bottom right of the dialog box. Another callout box 'd) See previous slide' is located in the upper right area of the main workspace.

d) See previous slide

a) Type 360 deg/
Number of teeth: z

Formulas: Body.2\CircPattern.1\AngularSpacing

Body.2\CircPattern.1\AngularSpacing =

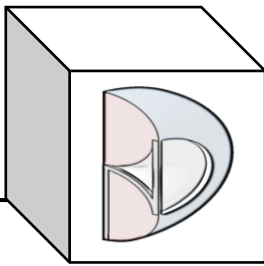
360 deg/Number of teeth: z

Dictionary

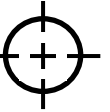
Dictionary	Members of Parameters	Members of All
Parameters	All	'Geometrical Set.1\Sketch.1\Activity'
Design Table	Renamed parameters	'Geometrical Set.1\Sketch.1\AbsoluteAxis\
Operators	Boolean	'Geometrical Set.1\Sketch.1\Radius.1\Radi
Pointer on value function	Length	'Geometrical Set.1\Sketch.1\Radius.1\Mod
Point Constructors	CstAttr_Mode	'Geometrical Set.1\Sketch.1\Radius.1\Activ
Law	Angle	'Geometrical Set.1\Sketch.1\Radius.2\Radi
Operations Constructors	Real	'Geometrical Set.1\Sketch.1\Radius.2\Mod
	Integer	

b) Pick OK

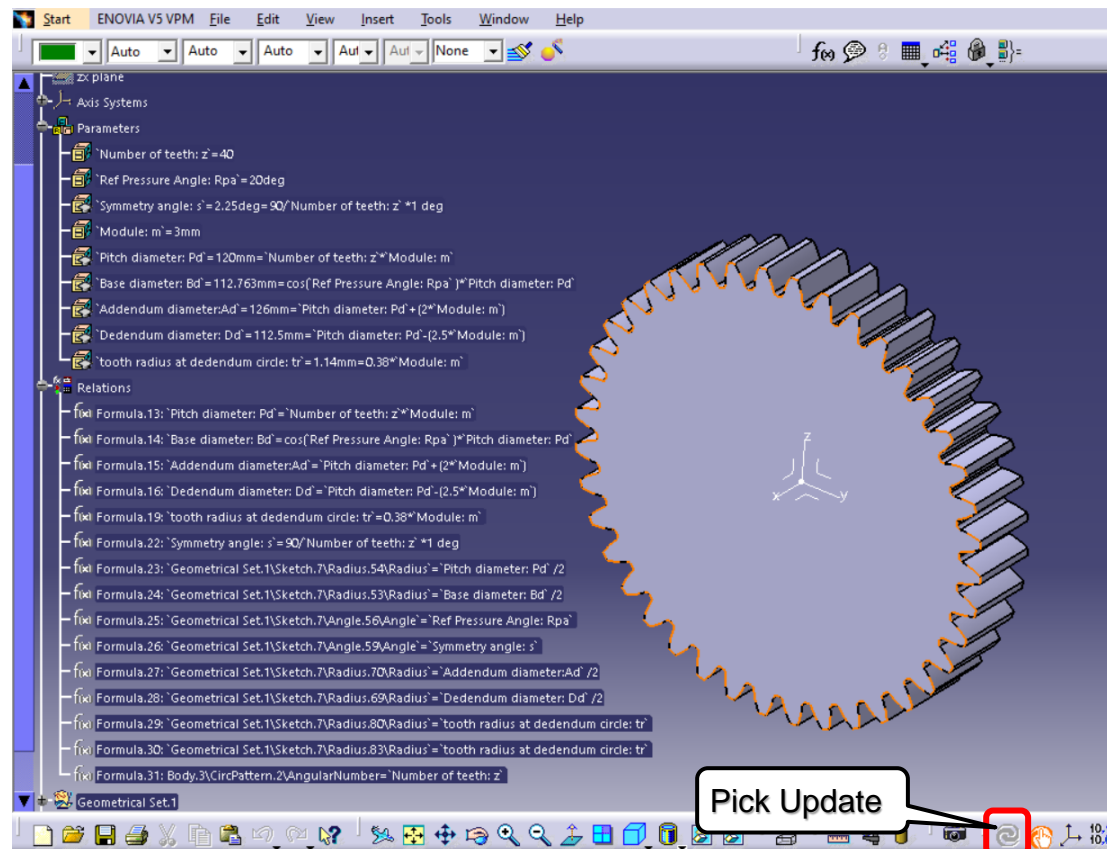
OK Cancel

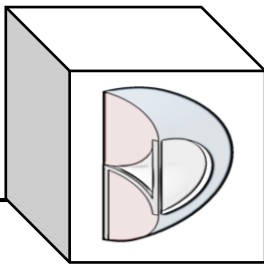


BND TechSource



- And there you have it!. An Approximated Spur Gear which is modifiable through a Design Table from MS Excel.

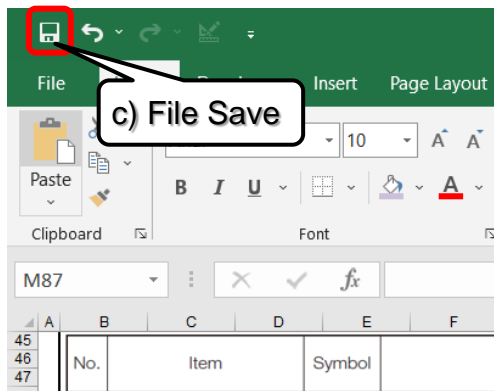




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- Modify parameters in the MS Excel spreadsheet for tooth number (z) and/or pitch circle radius (Rp) and **save** results.



a) Modify z = 25

m		3
α		20°
z	Set Value	12
x		0.6
$\text{inv } \alpha_w$	$2 \tan \alpha \left(\frac{x_1 + x_2}{z_1 + z_2} \right) + \text{inv } \alpha$	0.034316
α_w	Find from Involute Function Table	26.0886°
y	$\frac{z_1 + z_2}{2} \left(\frac{\cos \alpha}{\cos \alpha_w} - 1 \right)$	0.83329
a	$\left(\frac{z_1 + z_2}{2} + y \right) m$	56.4999
9 Reference Diameter	d	36.000
10 Base Diameter	d_b	33.8289
11 Working Pitch Diameter	d_w	37.667
12 Addendum	h_{a1} h_{a2}	4.420
13 Tooth Depth	h	6.370
14 Tip Diameter	d_a	44.840
15 Root Diameter	d_f	32.100

$m =$	3	3
$\alpha =$	20	20
$z =$	25	25
$x =$	0.00000	0.00000
$\text{inv } \alpha_w =$	0.014904	
$\alpha_w =$	20.0000	
$y =$	0.00000	
$a =$	75.0000	
$d =$	75.000	75.000
$d_b =$	70.477	70.477
$d_w =$	75.000	75.000
$h_a =$	3.000	3.000
$h =$	6.750	
$d_a =$	81.0	81.0
$d_f =$	67.500	67.500
$m =$	3	3
$R_{pa} =$	20	20
$s =$	3.600	3.600
$z =$	25	25
$P_d =$	75.000	75.000
$B_d =$	70.477	70.477
$A_d =$	81.000	81.000
$D_d =$	67.500	67.500
$tr =$	1.140	1.140
$a =$	75.0000	(75.)

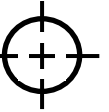
b) Modify a = 75

Table 4.4 The Calculations for Profile Shifted Spur Gears (2)

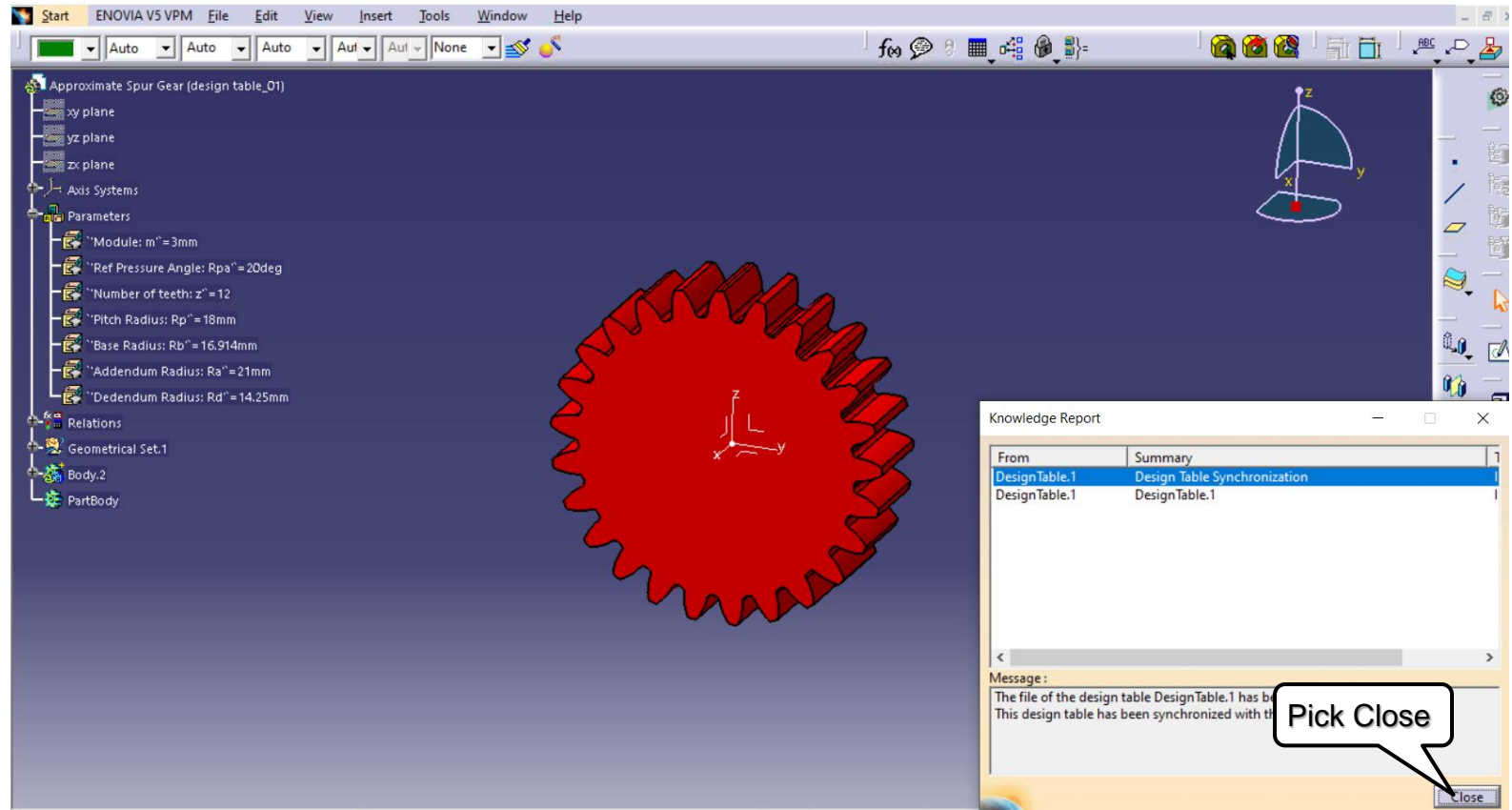
No.	Item	Symbol	Formula	Example
				Pinion (1) Gear (2)
1	Center Distance	a	Set Value	56.4999

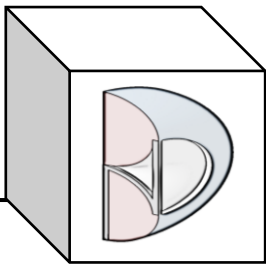


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- Go back to the Spur Gear CATPart and wait (10 -15 sec.) for the synchronization window.

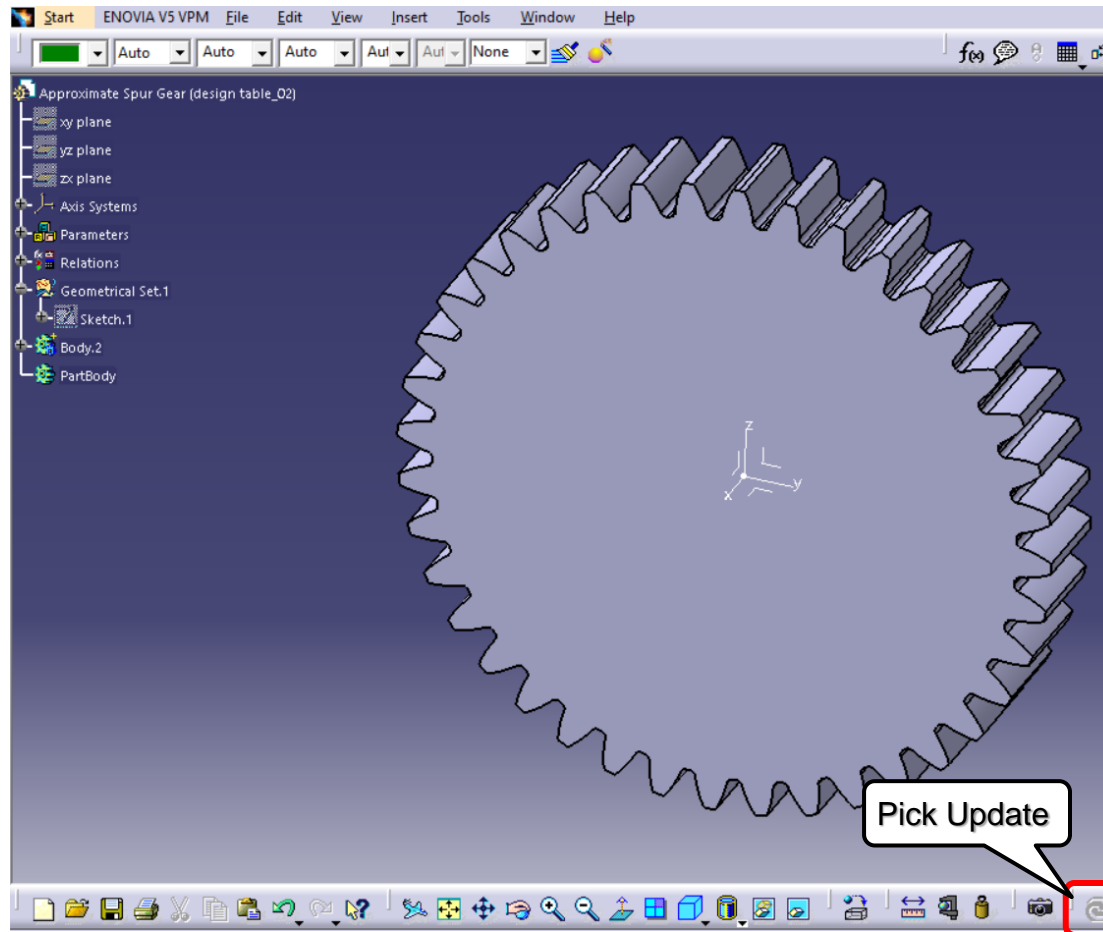


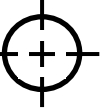
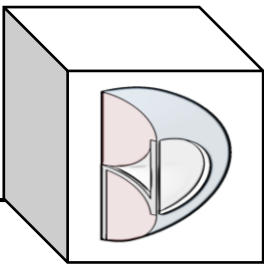


BND TechSource

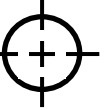
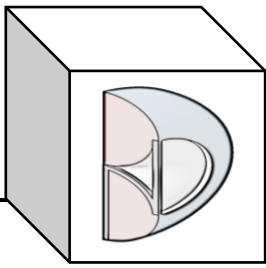


- Update the part.





- Again we have a “template” part for our Spur gear.
- The difference is; this template is controlled via an MS Excel spreadsheet.
- This part may be modified by simply changing the parameters of any/all of the following four formulae on the spreadsheet:
 1. z - number of teeth // real parameter [$z = \text{input}$]
 2. R_{pa} - Ref Pressure Angle // angle parameter [$R_{pa} = \text{input}$]
 3. m - module // length parameter [$m = \text{input}$]
 4. a – center to center distance [$a = \text{input}$]
- Next we will look at using Import Parameters (from .xls(x) or.txt file) to feed the parameter data and update the Spur Gear.



- Conclusion:

This is an example of Designing Approximate Spur Gear in CATIA V5 (Method 2: Design Table from MS Excel).

We hope this will help those who need this type of simulation.

As always, we are open to any discussions this may bring.

Please ***subscribe*** to our YouTube channel!

