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Made in the USA

Introduction: GearTrax/SolidWorks Model

GearTrax interacts directly with the SolidWorks API to create solid models.

Spur gears are an extrusion; a circle that is the same diameter as the addendum circle and another circle that is the bore. The 1st tooth is an extrude-cut feature on the base feature. All other teeth, if so chosen, are a pattern of this first tooth. The tooth form is created with a true involute profile. The tooth profile is a series of points that define a spline or a series of arcs.

Helical gears are made in the same manner as the spur gears with one exception. The tooth is swept along a helix. The user has the choice of either right or left-hand helix.

Revolving the outside profile of the gear creates a bevel gear. A plane is constructed tangent to the back cone surface. A sketch is then created on this plane for the tooth profile. The tooth profile is then drawn on the sketch. A second sketch is created that intersects with the center of the gear. A point is placed on this sketch at the Pitch Apex. These two sketches are then loft cut through the revolved base feature to produce the first tooth cut. All other teeth, if so chosen, are a pattern of this first tooth cut.

A sprocket is created by revolving the outside profile of the sprocket. If multi-strands are selected, then the sketch includes that geometry. A tooth is then drawn on a sketch and is extrude-cut through the base feature. All other teeth are a pattern of this first tooth cut.

Gear belt (timing belt) pulleys are created revolving a profile of the gear including flanges. A tooth sketch is then created through the center of the gear. A tooth profile is drawn and extrude-cut though the gear or up to the flanges. All other teeth are a pattern of this first tooth cut.

Belt pulleys are created by revolving a shape of the profile of the gear. If "multi grooves" is selected, they are also revolved at that time.

Splines may be created individually or as a pair. Similar to spur gears, the internal spline is created with a pair of circles, one defining the internal diameter and the other defining the outside diameter. The pair of circles is mid-plane extruded to form the base feature. A tooth space is drawn and mid-plane cut-extruded. All other tooth spaces are patterned from this cut. External splines are created with a single circle defining the outside diameter of the spline then mid-plane extruded to form the base feature. A tooth space is drawn and mid-plane cut-extruded. All other space is drawn and mid-plane cut-extruded. All other tooth spaces are patterned from this cut.

Mounting is a revolved feature added to the base feature. Bores with a keyway, set screws or bores for tapered bushing may also be selected.

Starting GearTrax

There are two ways to start GearTrax in SolidWorks:

- 1. Click on the 'Start' button, move to Program Files, Camnetics, and select GearTrax.
- 2. Starting with **SolidWorks 2001 Plus GearTrax**^{*} will run in-process therefore GearTrax will show up as an Add-In. There are a few steps required to make GearTrax available to SolidWorks as an Add-In.
 - Start SolidWorks.
 - From the SolidWorks file menu select Open.
 - From the "Files of Type:" drop down box select "Add-Ins (*.dll)"
 - Browse the install folder for GearTrax, most likely "C:\Program Folders\GearTrax2005"
 - Select GearTrax2005.dll
 - Then click the Open button.
 - GearTrax will now be available in the SolidWorks menu tree. Simply click on Camnetics then GearTrax to activate GearTrax.

Basic gear geometry and nomenclature



Diametral Pitch verses Module

Diametral pitch is always in inches.

Pd = N/D = number of teeth to inches of pitch diameter

Module pitch is always in millimeters.

Module m = D/N = mm of pitch diameter per tooth

1 Diametral pitch = 25.400 Module.

Example:

A gear with 10 teeth and 1.000 inch pitch diameter: 10 diametral pitch = 10 / 1.000in

The same gear in metric: 2.54 module = 25.4mm / 10

m = 25.4/Pd

Pd = 25.4/m

Creating a Spur Gear

To create a spur gear:



- Select the appropriate standard from the **Standards** drop down box.
- Select the desired pitch from the **Diametral Pitch** drop down box.
- A diametral pitch or module value may be entered in the dialog box below the Standards drop down box.
- In the Gear Type box select the Spur option button if not already selected.
- Enter a value for the face width in the Face width box.
- In the Number of Teeth box enter or use the spin box to change the number of teeth for the gear and the pinion.
- Enter a value for the tooth Backlash
- Enter a value for the Face width.
- Check the Create Tooth Pattern if you want the tooth to be patterned.
- If the **Create Tooth Pattern** is checked, the **Teeth to Draw** box becomes enabled. If it is desired to pattern the tooth with other than a full pattern then input the number of teeth to be drawn. This can be changed using SolidWorks after the part is drawn simply by editing the definition of the Tooth Pattern.
- If the **Internal gear set** check box is selected, enter a value for the outside diameter. It must be larger than the major diameter.

- Make any necessary changes to the hub mounting.
- Click on the **Finish** button to complete the gear.

Selecting a Gear Standard

From the Standards drop down box select one of the standards.

ANSI/AGMA Tooth Proportions

This version of GearTrax supports automatic tooth thickening or long-addendum pinions and their mating short-addendum gears. See the section on Tooth Thinning for more information.

GearTrax	
File View Insert Tools Help	
Spur/Helical Bevel Gears Sprock	ets 🛛 Gear Belt Pu
Pitch Data	Gear Type
Diametral pitches	Spur
10.0 Diametral Pitch	Helix angle:
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Coarse Pitch Involute 20 deg	🔲 🗖 Internal gea
Coarse Pitch Involute 25 deg Fine Pitch Involute 14.5 deg Fine Pitch Involute 20 deg Fine Pitch Involute 25 deg	0.D.: 6.00
DIN-867	- Tooth Pattern-
PGT-2 Tooth Form	Create toot
	Teeth to draw:
Gear ratio 1 : 2.3333	
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PGT Tooth Form

PGT has a complete and easy to understand gearing manual specifically for plastic gears.

The "Plastic Gearing" manual is available for \$69.50 (1999 price) from ABA-PGT.

For more information about the PGT tooth form please contact:

ABA-PGT, INC. 1395 Tolland Turnpike P.O. Box 8270 Manchester, CT 06040-0270

ABA (860) 649-4591 PGT (860) 643-6340 FAX (860) 643-7619 Web Site: www.abapgt.com



DIN-867 Standard

Addendum = Module x 1

Dedendum = Module x 1.25

Fillet Radius (Hob)= (Dedendum – Addendum) x 1.5

Standard pressure angle = 20 degrees

Modules between 0.3 and 75.0

JIS B 1701-1973 Standard

Addendum = Module x 1

Dedendum = Module x 1.25

Fillet Radius (Hob)= (Dedendum – Addendum) x 1.5

Standard pressure angle = 20 degrees

Modules between 0.3 and 75.0 Series No.1 through No. 3

Gear Type Selection

Select Spur, Helical R.H. or Helical L.H. gear type.

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-	Helical L.H.	Adden
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Face Width

Face width is the length of the spur gear tooth.



Backlash

- The Backlash specified is the reduction in circular tooth thickness. In the case of a 10 Dp gear the tooth thickness without any back lash would be 0.1571 inches. With a backlash of 0.0100 inches the tooth thickness will be 0.1471 inches.
 - If two gears are fabricated each with 0.0100 inches of backlash then there will be 0.0200 inches backlash between the mating teeth. See the example below. Note: Backlash = circular pitch tooth thickness, gear tooth thickness, pinion.



Topping Adjustment

The topping adjustment effects the outside diameter of the gear and/or the pinion.

To set the topping adjustment:

Activate the Major Diameter dialog box.



- Enter the topping adjustment value and click OK.
- The OD of the gear or pinion will be reduced by twice the value entered.

Fillet Radius, Fillet Radius Coefficient

The fillet radius and fillet radius coefficient can only be modified if Non-standard pitches is selected.

To set the fillet radius or fillet radius coefficient:

• Activate the Fillet Radius dialog box.

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True Involute Form Diameter

The calculated value for the true involute form diameter may be viewed in the **Minor Diameter** dialog box.

To view the true involute form diameter value:

• Activate the Minor Diameter dialog box.

GearTrax	
File View Insert Tools Help	
Spur/Helical Bevel Gears Sprockets Gear Belt Pulleys	Belt Pulleys Worm Gears Splines Mounting
Pitch Data © Diametral pitches © Module pitches © Non-standard pitches 100 Diametral Pitch Moor diameter	Gear Data Pitch diameter: 2.8000in Major diameter: 2.5500in Minor diameter: 2.5500in
Standards Term	Value Symbol
Diametral pitch: 10.00 Minor Diameter, Gear	2.5500in b r
Enlarged pinion-stanc Minor Diameter, Pinion	1.5500in dr -
	2.6533in DTIF Finished
Pinion G 18 28 True Involute Form Dia., Pinion	1.6914in dTIF
Gear ratio 1 : 1.555 Center distance: 2.300	

Working Pressure Angle

The calculated value for the working pressure angel may be viewed in the **Pressure Angle** dialog box.

To view the working pressure angel value:

- Activate the Pressure Angle dialog box.
- The working pressure angle may be different from the normal pressure angle if the gear set is a helical set, enlarged pinion-standard gear set or the sum of addendum modifications does not equal zero.

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File View Insert Tools Help				
Spur/Helical Bevel Gears Sprock	ets Gear Belt Pulleys B	Belt Pulleys Worm Ge	ars Splines Mou	unting
Pitch Data	Gear Type G Spur C Helical R.H. C Helical L.H. Helix angle: 0.0000 Internal Gear Internal gear set 0.D.: 6.0000in e angle	Gear Data Pitch diameter: Major diameter: Minor diameter: Addendum: Dedendum: Add. mod. coef.: Addendum mod.: Pressure angle:	2.8000in 3.0000in 2.5500in 0.1000in 0.1250in 0.0000 0.0000in 20.000deg	Status
Number of Teeth Term	Y	/alue <u>Sym</u>	bol	Userinput
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Creating an Enlarged Pinion with a Standard Gear

You can model an enlarged pinion that will interact with a standard gear.

To create an enlarged pinion:

- Select the Enlarged pinion-standard gear check box.
- GearTrax calculates the addendum modification for the pinion if the center distance is manually changed. Otherwise the addendum modification or addendum modification coefficient must be provided. Click the more information box in the upper right hand corner of the Addendum modification text box. This will allow you to edit the value of the addendum modification.



Creating Non-Standard Pitch Spur Gears

Non-standard pitches give the user optimum control over all parameters of the gear construction.

- | | × | GearTrax File View Insert Tools Help Spur/Helical Bevel Gears Sprockets Gear Belt Pulleys Belt Pulleys Worm Gears Splines Mounting Pinion Data Pitch Data Gear Type 1.8000in C Diametral pitches Spur Pitch diameter 2.0000in Helical R.H. Major diameter: Non-standard pitches C Helical L.H. Minor diameter: 1 EEC Non-standard Helix angle: 0.0000 0.1000in Addendum: Standards Dedendum: 112500 Status Internal Gear Non-standard \mathbf{T} 0.0000 1 Add. mod. coef. 🔲 Internal gear set 1 0.0000in Addendum mod Diametral (Pdn): 10.0000 ddendum X F Enlarged pinion-stan 1 Term Value Symbol 1 Finished. Number of Teeth 0.1000in G Addendum, Gear Pinion a 1 18 -30 1 Finish 0.1000in Addendum, Pinion a Gear ratio 1 : 1.0000 Addendum Coefficient 1 An Exit Center distance: 1 0.2500 Clearance Coefficient ce 📥 Hide 📥 Hobbing Animation ▼ Show mesh Cancel Apply OK Help $\langle \rangle$ >> 11 Size Medium -Speed: Medium • Show line of Display PINION readout
- Select the "Non standard Pitches" option button.

GearTrax2005 uses the addendum coefficient, clearance coefficient and the fillet radius coefficient as the basis for the gear geometry. When switching to non-standard pitches GearTrax will display the current coefficient values. You will also be asked to select to use coefficients as the basis of the gear geometry. Selecting 'no' will give the most flexibility but enough data will need to be input into GearTrax for the gear to be modeled properly. Selecting 'yes' will force GearTrax to use coefficients. These values can be changed. The fillet radius coefficient may be changed in the fillet radius dialog box. The addendum coefficient and the clearance coefficient may be changed in the Addendum dialog box.

Many parameters of the gear are inter-related; changing one parameter may affect the values of other parts of the gear. For example, changing the pressure angle will affect the value of the base circle. Also changing the addendum will affect the major diameter (O.D), the addendum modification and the addendum modification coefficient.

The coefficient values will not change unless they are directly edited. These values are the basis of all standards.



Some values will not change unless they are directly changed. For example, the number of teeth can only be changed by directly editing the value in the box.

When creating non-standard gears you may need to specify the values for the following:

- Diametral pitch, module pitch or the pitch diameter
- Number of teeth
- Major diameter, addendum, addendum modification, or the addendum modification coefficient
- Minor diameter, dedendum, dedendum modification, or the dedendum modification coefficient
- Pressure angle or base diameter
- Fillet radius or the fillet radius coefficient
- Tooth thickness or backlash
- Face width

Creating a Spur Gear Rack

You can create a generic spur rack with 20 teeth.

To create a spur gear rack:

- Enter 999 into the Number of Teeth for the gear
- Set the number of teeth for the pinion.
- Click the **Finish** button to model the rack.
- The pitch line is at the origin.



Internal Gear Sets

To create an internal gear set:

- Select the Internal gear set check box.
- Minimum number of gear teeth for this standard is 28.
- Enlarged pinion check box is disabled.



Selecting an AGMA Backlash Range for Spur Gears

To select a backlash range:

- Select a fine pitch standard.
- Open the **Backlash** dialog box.

Back l	ash	_ 🗆 🗙
CAGMA F	Recommended Backlash Range —	
	AGMA range: 0.005 - 0.015	ōin
	Fine pitch backlash A designation:	A V
	Backlash, Gear: 0.0070in	
	Backlash, Pinicn: 0.0070in	÷
	Apply Cancel	<u>o</u> k

- If you are using a fine pitch gear standard select a **Fine pitch backlash designation**; A through E or use the spin buttons to change the designation.
- Enter a backlash value or use the spin buttons to change the backlash value. If the value falls outside of the AGMA range the background color of the backlash input box changes to yellow or green.

Addendum Modification

Why modify the addendum?

Addendum modification serves two main purposes.

- Addendum modification will help avoid tip interference between the gear and the pinion.
- The gear tooth is really just a short cantilevered beam. For the gear set to have a balanced strength, the teeth of the pinion need to be stronger than that of the gear. Gears made of weaker materials like plastic; this may be critical to the life and the performance of the gear set. See the PGT Tooth Form for more information.

As the addendum length changes, so does the tooth width at the pitch circle. This change in thickness is equal to twice the addendum change multiplied by the tangent of the pressure angle. Note: All width dimensions are arc lengths.



Addendum Modification Coefficients

For DIN standards you can specify the addendum modification coefficient.

To specify an Addendum modification coefficient:

• The Addendum Modification option in the Tools>Options>Spur Gears menu must be set to "Manual only".

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File View Insert Tools Help				
Spur/Helical Bevel Gears Sproc	kets Gear Belt Pulleys	Belt Pulleys Worm Gea	ars Splines Mou	nting
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Tooth Thinning

Tooth thinning, addendum and dedendum geometry changes to avoid under cut or interference. If the pinion or gear is modified, the mating gear will also require modification or change in the center distance.

The following tooth forms may require modification to avoid under cut or interference.

- 11 teeth or less with 25 degree pressure angle.
- 17 teeth or less with 20 degree pressure angle.
- 31 teeth or less with 14.5 degree pressure angle.

Machinery's Handbook has a section on this subject titled "Increasing Pinion Diameter to Avoid Undercut or Interference".

Tooth thinning may be accomplished by selecting the supported <u>ANSI/AGMA</u> standard. Along with tooth thinning/thickening the addendum and dedendum changes accordingly. As the tooth thickens on the pinion, the addendum increases and the dedendum decreases in size. Conversely, the gear tooth thins and the addendum decreases while the dedendum increases in size. The whole depth remains constant.

Inserting a Tooth Profile Sketch

With GearTrax you can add multiple teeth to a single part.

To insert a gear or involute spline tooth profile:

- In GearTrax configure the gear or involute spline.
- Start a new sketch In SolidWorks.
- From the GearTrax menu select Insert then Tooth Profile Cut.

GearTrax			
File View Insert Tools Help			
Spur/Heli Tooth Profile Cut	Gear Belt Pulleys		
Insert Annotations Pitch Damage	Gear Type		
 Diametral pitches 	Sour		
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Non-standard pitches	C Helical L.H.		
10 Diametral Pitch	Helix angle: 0.0		
Standards			
Coarse Pitch Involute 20 deg 💌	Internal Gear		

- After the tooth cut geometry has been created by GearTrax, manually extrude cut the sketch using SolidWorks.
- Pattern the tooth cut using SolidWorks.

Approach Length

With GearTrax you can view the approach length for a spur gear set.

To view the approach length:

- Open the Addendum mod dialog box.
- This assumes the pinion is always the driving gear and there is no tip relief.



Recess Length

With GearTrax you can view the recess length for a spur gear set.

To view the recess length:

- Open the **Addendum mod** dialog box.
- This assumes the pinion is always the driving gear and there is no tip relief.

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File View Insert Tools Help				
Spur/Helical Bevel Gears Sprock	ets Gear Belt Pulleys B	elt Pulleys Worm Gea	ırs Splines Mou	unting
Pitch Data C Diametral pitches Module pitches Non-standard pitches 10.0 Diametral Pitch Standards Coarse Pitch Involute 20 deg Diametral pitch: 10.0000	Gear Type Spur Helical R.H. Helical L.H. Helix angle: 0.0000 Internal Gear Internal gear set	Gear Data Pitch diameter: Major diameter: Minor diameter: Addendum: Dedendum: Add. mod. coef.: Addendum mod.:	152.4000mm 155.1026mm 143.6726mm 1.3513mm 4.3637mm 0.4680 -1.1887mm	Status
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Contact Ratio

With GearTrax you can view the contact ratio for a spur gear set.

To view the contact ratio:

• Open the Addendum mod dialog box.



Creating a Helical Gear

To create a helical gear:

- Select the appropriate standard from the **Standards** drop down box.
- Select the desired pitch from the **Diametral Pitch** drop down box.
- In the **Gear Type** box select either the **Helical R.H.** or **Helical L.H.** from the drop down box.
- If the shafts are not parallel you will need to switch the helical direction of one of the gears.
 When helical is the first selected the other gear is automatically specified as the other hand.
- Selecting helix gear type enables the **Helix angle** input box. Enter the desired helix angle. This value must be greater than zero.
- To change the diametral pitch or module click on the **More information** button in the upper right hand corner of the **Diametral pitch** text box. Selecting helix gear type enables the text boxes to be edited. Enter the desired value in one of the four boxes. The other values will update accordingly. Click OK to apply the values.
- Enter a value for the face width in the Face width box.
- In the **Number of Teeth** box enter or use the spin box to change the number of teeth for the gear and the pinion.
- Enter a value for the tooth **Backlash** by clicking on the **More information** button in the upper right hand corner of the **Backlash** text box.
- Check the **Create Tooth Pattern** if you would like the tooth to be patterned.
- If the **Create Tooth Pattern** is checked, the **Teeth to Draw** box becomes enabled. If it is desired to pattern the tooth other than a full pattern then input the number of teeth to be drawn. This can be changed using SolidWorks after the part is drawn simply by editing the definition of the Tooth Pattern.
- If the **Internal gear set** check box is selected, enter a value for the outside diameter. This value must be larger than the dedendum circle value.
- Make any necessary changes to the hub mounting.
- Click on the **Finish** button to complete the gear.

GearTrax					_ 🗆 X
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Pitch Data C Diametral pitches Non-standard pitc Standards Coarse Pitch Involute Diametral pitch: 10 F Enlarged pinion-sta	ches ches ches 20 deg inter int	r Type Spur Helical R.H. Helical L.H. rangle: 16.0000 nal Gear nternal gear set : 8.0000in volute 20 deg - 10.	Gear Data Pitch diameter: Major diameter: Ainor diameter: Addendum: Dedendum: Add. mod. coef.: Addendum mod.: Pressure angle: 0000 Diametral Pi	6.0000in 6.1923in 5.7597in 0.0961in 0.1202in 0.0000 0.0000in 20.000deg 	Status User input
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Gear ratio 1 : 3.	Modular	2.5400	m	n —	L Exit
Center distance: 3.	Pitch, Normal Diamet	ral 10.4030	Pdn	n —	Show
	Modular, Normal	[2.4416 <u>C</u> ancel			



Helical Gear, R.H. Helical Gear, L.H.

Transverse diametral pitch verses normal diametral pitch

When creating helical gears:

It is necessary to understand the difference between transverse and normal diametral pitches. The normal diametral pitch is defined as normal to the cutter. The transverse pitch is on the plane of rotation.

Normal diametral pitch = Transverse diametral pitch / cos(helix angle)

If Diametral pitches are selected, the drop down box displays the transverse pitch and the **Diametral pitch** box displays the normal pitch.

If Module pitches are selected the drop down box displays the module transverse pitch and the **Module pitch** box displays the normal module.

Normal pressure angle verses transverse pressure angle

When creating helical gears:

It may not be necessary to understand the relationship between transverse and normal pressure angle but understanding how those values are displayed in GearTrax may be useful. The transverse pressure angle is measured in the plane of rotation and is always greater than the normal pressure angle. The pressure angle displayed in GearTrax is the normal pressure angle. The transverse pressure angle may be displayed by clicking on the **More information** button in the upper right hand corner of the **Pressure angle** text box.

The transverse pressure angle is effectively the real pressure angle.

The normal pressure angle is defined as normal to the cutter.

Transverse pressure angle = ATN(TAN(normal pressure angle) / COS(helix angle))

Setting the helix angle by specifying the center distance

GearTrax can set the helix angle by specifying the center distance.

To set the helix angle:

- Enter the value in the **Center distance** text box.
- This changes the helix angle and transverse diametral pitch. The normal diametral pitch remains unchanged.

Creating a Gear Belt Pulley

To create a gear belt pulley:

• Select the desired belt pitch from the drop down box.



- Select the appropriate belt width.
- Enter or use the spin box to change the number of teeth. Note that the pitch diameter changes with the belt pitch and the number of teeth. The pitch diameter is a driven dimension.
- Check the Draw Flange if flanges are desired.
- Check the Create Tooth Pattern if you want the tooth to be patterned.
- Make any necessary changes to the Hub Mounting.
- Click on the **Finish** button to complete the pulley.

Creating a Bevel Gear

To create a bevel gear:

Select the desired Diametral Pitch from the drop down box.



- Enter a value for the face width.
- Select the appropriate tooth proportion.
- Enter or use the spin box to change the number of teeth.
- Enter a value for the tooth clearance. See help for standard values for different diametral pitches.
- Check the Create tooth pattern if you want the tooth cut to be patterned.
- If the **Create tooth pattern** is checked, the **Teeth to draw** box becomes enabled. If it is desired to pattern the tooth other than a full pattern then input the number of teeth to be drawn. This can be changed after the part is drawn simply by editing the definition of the CirPattern1.
- Enter the pitch angle of the gear set (if other than 90).
- To create a spiral bevel gear place a check in the Spiral bevel gear set box.
- Set the **Spiral direction**. The hand of the spiral is indicated by the direction in which the teeth curve away from the axis. The mating gear is always the opposite hand.



Right Hand Spiral

- Enter the **K Factor** for circular tooth thickness. This value can be found in Machinery's Handbook in the 24th and earlier editions.
- Enter a value for the Hub Mounting Surface. This value should be between the Min/Max Hub Mounting values. If the mounting value is not between these values the base feature may not revolve properly.
- The pitch and outside diameters are driven dimensions.
- Make any necessary changes to the Hub Mounting.
- Click on the **Finish** button to complete the gear.

Geometry of bevel gear nomenclature.



Understanding the Bevel Gear Hub Mounting Distance

To create a valid base feature for a bevel gear:

- The hub mounting distance must be between the minimum and maximum distances as shown below.
- If the hub mounting distance is less than the minimum, the base feature may revolve but the surface may be cut into by the tooth feature.
- If the hub mounting distance is greater than the maximum, the base feature will not revolve because of self-intersecting lines.

GearTrax				<u>_</u> ×
File View Insert Tools H	telp			
Spur/Helical Bevel Gears	Sprockets Gear Belt Pulleys	Belt Pulleys Worm 6	aears Splines I	Mounting
Pitch Data © Diametral pitches © Module pitches © Non-standard pitches	More Data Hub surface: 45.2839mr	Gear Data Pitch diameter: Outside dia:	142.2400mm 145.216mm	
5.0 Diametral Pitch	Hub surface		쓰	
Diametral pitch: 5.0000 Spiral bevel gear set Spiral angle: 35.000 Spiral direction: Right F K Factor: 0.266	Term Pitch Apex to Hub Surface, Gear Minimum, Gear Maximum, Gear Pitch Apex to Hub Surface, Pinior	Value 2 45.2839mm * 32.5839mm 177.8000mm 74.4144mm	<u>Symbol</u>	Status User input
Number of Teeth Pinion Gea 14 1 28 Gear ratio 1 : 2.0000	Minimum, Pinion Maximum, Pinion <u>H</u> elp <u>C</u> ancel	68.0644mm 88.9000mm	<u>o</u> ĸ	Einish Egit Show



Recommended Normal Backlash for Bevel Gear Meshes

AGMA Recommended backlash range for bevel gears:

	Normal Backlash, Inch		
Diametral Pitch	Quality Numbers 7 through 13	Quality Numbers 4 through 6	
1.00 to 1.25	0.020-0.030	0.045-0.065	
1.25 to 1.50	0.018-0.026	0.035-0.055	
1.50 to 1.75	0.016-0.022	0.025-0.045	
1.75 to 2.00	0.014-0.018	0.020-0.040	
2.00 to 2.50	0.012-0.016	0.020-0.030	
2.50 to 3.00	0.010-0.013	0.015-0.025	
3.00 to 3.50	0.008-0.011	0.012-0.022	
3.50 to 4.00	0.007-0.009	0.010-0.020	
4.00 to 5.00	0.006-0.008	0.008-0.016	
5.00 to 6.00	0.005-0.007	0.006-0.013	
6.00 to 8.00	0.004-0.006	0.005-0.010	
8.00 to 10.00	0.003-0.005	0.004-0.008	
10.00 to 16.00	0.002-0.004	0.003-0.005	
16.00 to 20.00	0.001-0.003	0.002-0.004	
20.00 to 50.00	0.000-0.002	0.000-0.002	
50.00 to 80.00	0.000-0.001	0.000-0.001	
80 and finer	0.000-0.0007	0.000-0.0007	

This table gives the recommended normal backlash for gears assembled ready to run. Because of manufacturing tolerances and changes resulting from heat treatment, it is frequently necessary to reduce the theoretical tooth thickness by slightly more than the tabulated backlash in order to obtain the correct backlash in assembly. In case of choice, use the smaller backlash tolerances.

Creating a Chain Sprocket

To create a chain sprocket:

• Select the desired Chain Number from the drop down box.

GearTrax		_ 🗆 🗙
File View Insert Tools Help		
Spur/Helical Bevel Gears Sprockets Gear Be	elt Pulleys Belt Pulleys Worm Gears Splines M	lounting 🥥
Chain Number	Chain/Sprocket Data	
60 (12A) ANSI (ISO) Chain Number	Chain pitch: 0.7500in	
	Pitch diameter: 4.794in	
	Roller diameter: 0.4690in	0.1
- I ooth Creation	0.4590	Status
Pointed tooth	Sprocket width: 10.4550m	Carrow
Double pitch single duty		C.C.C
Multiple-Strand	Number of Teeth	User input
Multiple-strand	20 +	
Number of strands:	Create tooth pattern	_ <u>_</u> Einish
Standard series	Teeth to draw: 20	Exit
C Heavy series	,	
		Show

- Enter or use the spin box to change the number of teeth.
- Check the **Pointed Tooth** check box if so desired.
- Check the Create Tooth Pattern if the tooth is to be patterned.
- If the **Create Tooth Pattern** is checked, the **Teeth to Draw** box becomes enabled. If it is desired to pattern the tooth other than a full pattern then input the number of teeth to be drawn. This can be changed after the part is drawn simply by editing the definition of the CirPattern1.
- Select Standard Series or Heavy Series of sprocket.
- If a **Multi-strand** sprocket is to be modeled, click on the check box. This will enable the **Number of Strands** input box. Enter the number of strands to be drawn.
- The Pitch Diameter is a driven dimension.
- Make any necessary changes to the Hub Mounting.
- Click on the Finish button to complete the gear

Creating a Belt Pulley

To create a belt pulley:

• Select the desired **Belt Type** from the drop down box.

	_ 🗆 🗙
File View Insert Tools Help	
Spur/Helical Bevel Gears Sprockets Gear Belt Pulleys Belt Pulleys Worm Gears Splines Mounting	9
Belt Type Pitch Diameter D Puley Image: Comparison of the pitch diameter Groove Data Puley 0.D. D Deep groove Multi groove Number of grooves Image: Comparison of grooves Image: Comparison of grooves Image: Comparison of grooves	

- Check the **Deep groove** box if so desired.
- Placing a check in the Multi groove check box enables the Number of grooves input box.
- Enter a value or use the spin control to change the number of grooves to be drawn.
- Enter a value in the **Pitch Diameter** box.
- The **Pulley O.D.** value is a driven dimension.
- Make any necessary changes to the **Hub Mounting**.
- Click on the **Finish** button to complete the gear.

Creating a Worm Gear

To create a worm gear:

GearTrax 2004		_ 🗆 🗵
File View Insert Tools Help		
Spur/Helical Bevel Gears Sprockets Gear Belt Pulleys Belt	Pulleys Worm Gears Splines Mou	nting
Pitch Data Worm Threads © Diametral pitches 1 C Module pitches 1 Standards - Coarse Pitch Involute 20 deg - Diametral pitch: 10.0000 Modular nitch: 2.54000	Gear Data Number of teeth: 30	Status
	Fillet radius: U.7620mm	User input
Create Create Tooth Pattern Create Tooth Pattern Teeth to draw 30	Worm Data Worm pitch dia.: 29.0322mm Worm length: 34.9250mm Worm 0.D 34.1122mm	Einish
Worm Worm Gear Create Assembly	Worm lead angle: 5.0000deg ? Worm lead: 7.9796mm	Exit

- Select the desired **Diametral Pitch** from the drop down box.
- Select the desired **Standard** from the drop down box.
- Enter a value for the face width. To display the recommended minimum face width click on the "?" button.
- Select the appropriate tooth proportion.
- Enter or use the spin buttons to change the number of teeth.
- Select the desired number of threads for the worm. The gear ratio is 1: the number of gear teeth divided by the number of threads.
- Select the direction of the worm gear. Note: A right hand gear's teeth lean to the right when its face is placed on a horizontal surface.
- Check the **Create Tooth Pattern** if you want the tooth to be patterned. Note: Patterning worm gear teeth can be a time consuming process. You wish to limit the number of teeth created. You may change this value later in SolidWorks.
- If the **Create Tooth Pattern** is checked, the **Teeth to Draw** box becomes enabled. If it is desired to pattern the tooth other than a full pattern then input the number of teeth to be drawn. This can be changed in SolidWorks after the part is drawn simply by editing the definition of the **Tooth Pattern**.
- Determine the size of the worm pitch by entering a value for the **Worm Pitch Diameter** or the **Worm Helix Angle.**
- Make any necessary changes to the Hub Mounting.
- Select Worm w/Gear to model both parts, Worm only to model just the worm or Gear only to model the gear.
- Click on the **Finish button** to complete the gear.

Creating Involute Splines

To create an involute spline:

GearTrax				_ 🗆 🗵
ie View Insert Tools Help Spur/Helical Bevel Gears Sprocke Spline Size 2.5/5 Diametral Pitch Viser Input Int spline OD: 8.0000in	ts Gear Belt Pulleys Belt F Number of Teeth 16 Pressure Angle • 30.0 Pressure angle	Pulleys Worm Gea Spline Data Diametral pitch: Module pitch: DP (Stub): Pitch diameter: Base diameter:	2.500 10.1600 5.000 6.4000in 5.5426in	Mounting
Int. length: 1.0000in Ext. length: 6.0000in	C 37.5 Pressure angle C 45.0 Pressure angle C Non-standard pressure angle 30.000	Base diameter: Circular pitch: Space width int: Tooth thick ext: Major dia. int:	1.2566in 0.6309in 0.6258in 7.1200in 6.8000in	- J User input
Create	Fillet root, side fit Fillet root, side fit Filat root, side fit Flat root, major diameter fit Class 5	Maju dia. ext. Minor dia. int: Minor dia. ext: Form dia. int: Form dia. ext: Clearance:	6.0000in 5.6253in 6.8133in 5.9867in 0.0051in	Einish Exit Exit

- Select the desired spline size from the drop down box.
- Enter or use the spin box to change the number of teeth.
- Select the pressure angle.
- Select the root and fit.
- Use the drop down box to select the class of fit.
- When a class fit is select GearTrax calculates the tooth thickness and space width and prohibits the user from changing these values.
- Enter or use the spin buttons to change the space width for the internal spline.
- Enter or use the spin buttons to change the tooth width for the external spline
- To have GearTrax model both parts, select Internal/External button and then the Finish button.
- To have GearTrax model only the external spline select the **External Only** button and then the **Finish** button.
- To have GearTrax model only the internal spline select the **Internal Only** button and then the **Finish** button.

Getting more information about the Spline

To get more information:

new Ins	sert Lools He	lp .						
/Helical	Bevel Gears	Sprockets	Gear Belt Pulleys	Belt Pulleys	Worm Gea	rs Splines	Moun	ting 📕
line Size	ANSI B92.1	-1996 - Cl	ass 5		×	2 500		
5/5 Diai	Term		<u>Value</u>	<u>Sym</u>	bol	10.160		11/2
er Input	Effective space	width (Min)	0.6283in		n	5.000	-	
spline C	Effective space	width (Max)	0.6300in	sv ma	эх	6.4000in 5.5426in	- !	Status
. length: t. length	Actual space wi	dth (Min)	0.6309in	s min		1.2566in	-	
ace wid	Actual space wi	dth (Max)	0.6326in	s max	, (0.6283in		Col
icth thicl			·			6.8000in		Cumina C
eate	<u>H</u> elp		<u>C</u> ancel	<u>_</u> СК		6.0000in		User input
- 47 -						5.6253in		Finish
			Flat root, side fit Flat root, major	Form	dia. int: dia. ext:	5.9867in	-	
nternal /	External Inte	ernal	diameter fit	Form	clearance:	0.0064in		E <u>x</u> it
External	Only O	Inly	Class 5 💽	Tooth	clearance:	0.0051in		Show

• Click on the small button in the upper right hand corner of the text box (if available). This will open a dialog box with related information for the selected item. Note: the GearTrax icon next to the text box indicates the value used for creating the geometry in SolidWorks. The values in the text boxes cannot be edited unless **No Class** is selected.

Creating a Non-Standard Spline

To create a non-standard spline:



• From the drop down box in the **Root and Fit** frame select the No Class option. This will allow the values to be edited in the dialog box. Click on the small button in the upper right hand corner of the text box (if available). This will bring up a window with related information for the selected item.

ch°	16 - No (lass	da pitah: 10		
.00	Term	<u>Value</u>	Symbo	1	1
.00	Major diameter external (Max)	6.8000in	📑 Do max		Status-
00 163	Major diameter external (Min)	6.7800in	Do min		9
.62	Help	<u>C</u> ancel	<u>K</u>		User inpu
al	Internal • Fillet root, since the second	ide fit Mino de fit Form ajor Form Toot	nia, ext: 5.0 dia, int: 6.0 dia, ext: 5.9 clearance: 0.0 n clearance: 0.0	5253in - 3133in - 3867in - 0064in - 0051in -	Eini: E <u>x</u> i

Updating a Spline

To update an involute spline:

- Automatically updating involute splines is not available in this version of GearTrax. Following the steps below can redraw the tooth profile:
- Open the tooth sketch and delete all of the sketch entities.
- In GearTrax, set the desired values for the spline.
- Click Insert and select Tooth Profile Cut.
- Close the sketch to rebuild the part.

Inserting a Spline Tooth Profile

You can create a part with multiple tooth profiles.

To add a tooth profile to a sketch:

- Start a new sketch.
- In GearTrax select the **Spline** tab.
- Set the values for the spline.
- In the GearTrax menu click on Insert. Select Tooth Profile Cut.
- GearTrax will create the sketch with the center of the spline on the origin.

Creating an Excel Data Sheet

Allows you to create an Excel data sheet for spur/helical, bevel gears and splines.

To create an Excel data sheet:

- Select the Spur/Helical tab or the Spline tab.
- Click Tools. Select Create Excel Data Sheet.
- A new sheet will be started in Excel containing data for the current spur/helical gear or spline in GearTrax.

	Gea	rTrax	- 34			
File	۰V	iew Inse	ert Tools Help			
			- Link to Active Part			1
5	pur	/Helical	Bey Link to Active Part		n Gears	3
Г	Pite	ch Data —	Update Linked Part			
	œ	Diametra	nih Create a Data She	et (Exi	rel format)	2.1
	C	Module r	nitoh - Read a Data Sheet	(Evce	(format)	31
	C	Non-stan	idan canal custom takan	(LXC6	ha Data Chast (Event format)	0.1
			Send Custom Infor	matior	er:	2.
	10.	0 Diametra	al Pi Units		•	0.1
	Sta	andards				n ·
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	3	Pdn	16.00001338		Normal Diametral Pitch	
<u>a</u>	4	Pd	15.3802	2	Diametral Pitch	
	5		1.587498672	2	Normal Modular Pitch	
abi	6	m	1.651473973	}	Modular Pitch	
	7	øn	20) deg	Normal Pressure Angle	
G	8	ø	20.7388	deg	Pressure Angle	
EB	9		18	j J	Helix Angle	
	10	mg C	1.5558)	Ratio, IIX	
	12	C MΔ	3 7693	8 mm	Annroach Length	
Ē	13	MR	3.4192	mm	Recess Length	
≞	14	mp	1.4818	5	Contact Ratio	
최 되	15		Р	NION		
A	16		Left Hand		Hand of Helix	
	17	Np	18	}	Number of Teeth	
-	18	Dp	29.727	mm	Pitch Diameter	
	19	Dpn	28.575	mm	Pitch Diameter, Normal	
	20	do	32.775	mm	Major Diameter	
	21	ar	25.655	mm	Minor Diameter	
	22	d h	7.020) Imm	Dedendum	
	23	ř – –	2.030 f		Addendum Modification Coefficient	
	25		i i	mm	Addendum Modification	
	26	db	27.8004	mm	Base Diameter	
	27	dbn	26.7235	mm	Base Diameter, Normal 📃 📃	
	4 4	▶ ► She	eet1 / Sheet2 / Sheet3 /			
	dv				NUM	

Reading an Excel Data Sheet

Allows you to read an Excel data sheet that was previously created with GearTrax and modified manually.

To read an Excel data sheet:

- Excel must be running with the data sheet as the current document.
 - Check for multiple instances of Excel. GearTrax will attempt to read the first instance only.
- Select the Spur/Helical tab or the Spline tab.
- Click **Tools.** Select **Read a Data Sheet (Excel format)**. GearTrax is updated with the information from the Excel data sheet.

GearTrax		
File View Insert Tools Help		
Spur/Helical Bes Link to Active Part Pitch Data Update Linked Part	n Gea	rs Sp
Create a Data Sheet (Excel format)	er:	2.800
C Module pitch Read a Data Sheet (Excel format)	er:	3.000
Non-standar Send Custom Information to Data Sheet (Excel format)) er:	2.550
10.0 Diametral Pi Units	→ I	0.100
Standards	_	0.125
Coarse Pitch Inv, Options	ou. co ef.:	0.000
Diametral pitch: 10.0000 - Cinternal gear set Addend	dum mod.:	0.000
		120.00

Sending the Custom Information to an Excel data sheet

Allows the user to send the Custom Information stored in any SolidWorks part file to a Excel spread sheet.

To create an Excel Spread using the Custom Information data.

- SolidWorks must be open with a part file active.
- Excel must be available.
- Click File>Send Custom Information to Data Sheet (Excel format) from the GearTrax menu to dump the contents of the custom information data of the current SolidWorks part file. This does not need to be a part file created with GearTrax.

GearTrax				
File View Insert	Tools Help			
Spur/Helical Be	Link to Active P Update Linked P	art Part	1 Gea	rs Sp
 Diametral pit 	Create a Data S	Sheet (Excel format)	er:	2.800
C Module pitch	Read a Data Sh	eet (Excel format)	er:	3.000
C Non-standar	Send Custom In	formation to Data Sheet (Exc	el format) er:	2.550
10.0 Diametral P	Units		•	0.100
Standards	Ontinna			0.125
Coarse Pitch Inv	Options		Hua, moa, coef.:	0.000
Diametral pitch:	10.0000	Internal gear set	Addendum mod.:	0.000
· · · ·		0.D.: 6.0000in	Pressure angle:	20.00
Enlarged pinio	on-standard gear		Base diameter:	2.631
N 1 / 7 /		T		0.226

Adding a mounting style to the Gear or Pulley

To add a mounting style:

• Select a Mounting style from the **Mounting** tab.

GearTrax 2004	
File View Insert Tools Help	
Spur/Helical Bevel Gears Sprockets Gear Belt Pulleys Belt Pulleys Wor	rm Gears Splines Mounting
Mounting Style (Hub 1st side) Mone ANSI standard square keyway ANSI standard rectangular keyway Standard set screw Split tapered bushing Mub diameter: Hub projection / c'bore: Fillet / chamfer:	ical gears (Gear). acted 0.0000in 0.0000in User input
Bore, Gear: 0.0000	Din
1210 Bushing 0.500 to 1.250 Bore	Din Exit

- Selecting a keyway style will allow you to have GearTrax model a standard setscrew hole. The setscrew hole will be drawn only if a hub is being drawn. The setscrew hole will be centered on each of the hub(s).
- If a bore for a split-tapered bushing is called for, check the **Split Tapered Bushing** button. Select the appropriate **Split Tapered Bushing** from the drop down box.
- Note: The split-tapered bushing is not drawn only the bore and mounting holes. See the Camnetics web site <u>www.camnetics.com</u> or the CD for libraries of standard split tapered bushings.
- Select Hub 1st side and/or Hub/c'bore 2nd side.
- Set the values for the appropriate hub. Use the **Settings for:** drop down box to enter values for each of the hubs to be drawn.
- Click on the **Finish** button to complete the drive component.
- A counter bore may be drawn on the second side by entering a negative number in the **Hub projection / c'bore** input box.

Opening and Saving GearTrax files

Allows the user to save and open data they have entered for the current tab.

To save a GearTrax file:

- Click on the File>Save menu option.
- Enter a file name.
- Click on Save to invoke the file browser.
- Browse to the folder you would like the GearTrax file saved to.
- Enter a file name for the GearTrax file.
- Click on the **Save** button to save the GearTrax file.
- Or click **Cancel** to cancel the save option.

To open a GearTrax file:

- Click on File>Open to invoke the file browser.
- Browse to the folder where the GearTrax file is located.
- Click on the file name.
- Click on the **Open** button to open the GearTrax file.
- Or double click on the file name to open the GearTrax file.
- Or click **Cancel** to cancel the open option.

Capturing the GearTrax Screen

Allows the user to capture the GearTrax screen

To Capture the GearTrax screen to a file.

• To capture the current GearTrax screen to a bit map file click **File>Capture GearTrax Screen to File.** The file will be saved at <Program file location>/Capture.bmp

To Capture the GearTrax screen to the clipboard.

• To capture the current GearTrax screen to the clip board click **File>Capture GearTrax Screen to the Clipboard.** The user may paste the image from the clipboard to most paint programs.

To Capture the GearTrax screen to the MS Paint.

 To capture the current GearTrax screen to MS Paint click File>Capture GearTrax Screen to MS Paint. The user may then save the image to different locations and file formats using MS Paint.

To Empty the Clip Board.

• To Empty the Clipboard click **File>Empty Clipboard.** This will free up any memory being used by the clipboard.

Modification of Parts

Spur/helical and straight bevel gears created in GearTrax can be modified.

For example, you have a spur gear in an assembly and it was decided to change the tooth profile from a full involute 20-degree pressure angle with a 20-diametral pitch to stub involute with an 18-diametral pitch.

GearTrax can modify the tooth profile, face width and the number of teeth.

Because of the complicated nature of the various involute forms, the tooth will be reconstructed rather than parametrically changed while other features of the gear will be parametrically changed.

🚰 GearTrax 2004					<u>_ ×</u>
File View Insert	Tools Help				
Spur/Helical Be	Link to Active Pa Update Linked P	a rt art	n Gea	ars Splines I	Mounting
C Non-standar	Create a Data S Read a Data Sh Send Custom In	heet (Excel format) eet (Excel format) formation to Data Sheet (Exc	er: er: :el format) er:	71.1200mm 76.2000mm 64.7700mm	
10.0 Diametral Pi Standards -	Units Options			2.5400mm 3.1750mm	Status
Diametral pitch:	10.0000	Internal gear set	Addendum mod.:	0.0000 0.0000mm	1
Enlarged pinion	-standard gear	0.D.: 6.0000mm	Pressure angle: Base diameter:	66.8309mm	
Number of Teeth Pinion	Gear	Tooth Pattern Create tooth pattern	Whole depth: Circular pitch:	5.7150mm 7.9796mm	User input
		Teeth to draw: 28	Fillet radius: Backlash:	0.7620mm 0.0000mm	Einish
Liear ratio 1 : Center distance:	58.4200mm	Gear Active	Tooth thickness Face width:	3.9898mm 19.0500mm	Exit

To modify an existing part:

- Make the part (gear, sprocket, etc) the active document in SolidWorks.
- From the main GearTrax menu select the **Tools** option.
- Select the Link to Active Part option.



- The design information of the part is loaded into GearTrax.
- Make the necessary changes to the GearTrax forms.
- Modify the part by selecting **Update Active Part** in the GearTrax tools menu.
- The part may also be recreated as a new part by selecting the **Finish** Button.
- Changes made to the part in this fashion will require the least amount of editing to the assembly mates.
- If manual changes have been made to the part prior to this, the results may be unpredictable.

Tip: For best results, make any manual modifications to the part by adding new features and leaving the base features unaltered.

Setting the Length Units

The GearTrax length setting is determined by the current SolidWorks default length setting. The GearTrax setting may be changed without regard to the SolidWorks setting.

To set the Length Units:

- Click the **Tools** option from the pull down menu, and then select **Units**.
- Click the appropriate length unit.
- This will set the length unit of GearTrax and will change the SolidWorks part unit setting when a new part is created.

GearTrax				
File View Insert	Tools Help			
Spur/Helical Bev	Link to Active P Undate Linked I	art Part	Belt Pulleys Worm Gea	rs !
Pitch Data © Diametral pito C Module pitok	Create a Data :	Sheet (Excel format)	Gear Data Pitch diameter:	6.0
C Non-standar	Units	ieet (Excei rormat)	Major diameter: Millimeters	5.7
Standards	Options		Centimeters Meters	0.0
Coarse Pitch Invo	olute 20 deg 💌	Internal Gear	✓ Inches ef:	0.0
Diametral pitch:	10.0000	🗖 Internal gear set	Feet od.:	0.0
Enlarged pinic	, n-standard gear	0.D.: 6.1923in	Pressure angle:	20.

GearTrax Options

Allows you to customize GearTrax options and calculate over-pin-measurements.

- Click **Tools** from the pull down menu, then **Options**.
- Select the appropriate tab for the settings you want to change.
- To register the new settings for only the current tab click **Apply Tab**.
- To register the new settings for all the tabs click **OK**.
- To exit the options without registering any changes click Cancel.

Options		×
Belt Pulleys Worm Gears M General Spur Gears Helical G	easurements Splines Manufacturing iears Bevel Gears Sprockets Ge	ar Belts
Involute Options Fix Involute Sketch Tooth Pattern Never inquire before creating tooth pattern Always inquire before creating tooth pattern Inquire only when tooth number exceeds: U Version Check D on to check web site for a start-up.	Auxiliary Sketches Draw Auxiliary Sketches Pritch Diameter Addendum Diameter Dedendum Diameter Base Diameter Hide sketch on creation NetHASP Check Check for NetHASP on startup newer version on Check Now	Involute Precision
Other Options Part template file: Automatically over ride the option Use SolidWorks 2003	reation of 2d splines with arcs.	<u>C</u> ancel <u>Q</u> K <u>A</u> pply Tab

General Options

Lets you set properties for involute sketches, tooth patterns and auxiliary sketches.

To set options:

- Click **Tools** option from the pull down menu, then **Options**.
- Select the General tab.
- Select options from the following list and make the changes that you prefer.
- Click **OK** to accept the changes; click **Cancel** to discard the changes and exit the dialog box; click **Apply Tab** to accept the changes for this tab only.

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Belt Pulleys Worm Gears Measurements Splines Manufacturing General Spur Gears Helical Gears Bevel Gears Sprockets Gear Belts	.1
Involute Options Auxiliary Sketches Involute Precision Fix Involute Sketch Draw Auxiliary Sketches High Tooth Pattern Pitch Diameter Medium Diameter • Never inquire before creating tooth pattern Dedendum Diameter Low • Always inquire only when tooth number exceeds: • NetHASP Check Involute Precision • On ot check web site for a newer version on start-up. • Neter Now • Neter Now	
Other Options Cancel Part template file: Erowse Image: Automatically over ride the creation of 2d splines with arcs. DK Use SolidWorks 2003 Image: Automatically over ride the creation of 2d splines with arcs.	
	۲

Fix Involute Sketch

Lets you specify if GearTrax should fix the entities of the involute sketch as GearTrax creates the model.

- Click **Tools** option from the pull down menu, then **Options**.
- Select the General tab.
- Select **Fix Involute Sketch** check box if you would like GearTrax to fix the involute sketch entities as the model is created. Fixing the involute sketch may prevent unintentional dragging of the sketch points. The gear will take longer for SolidWorks to generate with this option set.

Tooth Pattern

Lets you specify if and when GearTrax will inquire before the tooth pattern is created.

To set options:

- Click **Tools** option from the pull down menu, then **Options**.
- Select the General tab.
- Select **Never inquire before creating tooth profile** if GearTrax should always create the tooth profile without interrupting the modeling process.
- Select **Always inquire before creating a tooth pattern** if you would like GearTrax to inquire before any tooth pattern is created.
- Select **Inquire only when tooth number exceeds** if you would like GearTrax to inquire before creating a tooth profile above a certain number of teeth. Selecting this option enables the text box. Enter that value in the text box.

Auxiliary Sketches

Lets you specify the creation of an auxiliary sketch.

To set options:

- Click **Tools** option from the pull down menu, then **Options**.
- Select the General tab.
- Select the Draw Auxiliary Sketches check box for GearTrax to create a sketch as the model is created.
- Select **Pitch Diameter** if you would like the pitch diameter included on the sketch.
- Select **Addendum Diameter** if you would like the addendum diameter included on the sketch. This option will be ignored if it does not apply to the product being modeled.
- Select **Dedendum Diameter** if you would like the dedendum diameter included on the sketch. This option will be ignored if it does not apply to the product being modeled.
- Select **Base Diameter** if you would like the base diameter included on the sketch. This option will be ignored if it does not apply to the product being modeled.
- Select **Hide sketch on creation** if you would like GearTrax to hide the sketch as the model is created.

NetHASP Check

Lets you specify if GearTrax should check for a NetHASP at startup.

To set options:

- Only use this option is you have a Camnetics NetHASP on the network.
- Click **Tools** option from the pull down menu, then **Options**.
- Select the **General** tab.
- Select the **Check for NetHASP on startup** check box if you would like GearTrax to check for a NetHASP on startup.
- Selecting this option without a NetHASP present or functioning will delay the startup of GearTrax as the network is searched for the presence of the NetHASP.
- Click **OK** to accept the changes; click **Cancel** to discard the changes and exit the dialog box; click **Apply Tab** to accept the changes for this tab only.

Version Check

Lets you specify if GearTrax should check for a more recent release of GearTrax at startup.

To set options:

- Click **Tools** option from the pull down menu, then **Options**.
- Select the General tab.
- Select Do not check web site for a newer version on start-up if you do not want GearTrax to check the web site for a more recent release. If left unchecked and you have access to the internet, GearTrax will look at the web site for a more recent release and notify you if one exists. You will need to manually download the latest file and go through the installation procedure. This is not done automatically.

2d Spline Creation Over ride

Lets you specify if GearTrax should automatically over ride the creation of 2d splines with a series of arcs.

To set options:

- Click **Tools** option from the pull down menu, then **Options**.
- Select the General tab.
- Select the **Automatically over ride the creation of 2d splines with arcs** if you would like GearTrax to create tooth profiles with arcs rather than 2d splines.

SolidWorks Version

Lets you specify which version of SolidWorks should be used with GearTrax.

To set options:

- Click **Tools** option from the pull down menu, then **Options**.
- Select the General tab.
- Use the drop down box to specify which version of SolidWorks to use with GearTrax.

Part Template File

Lets you specify a template to be used when starting a new GearTrax part.

To set options:

- Click **Tools** option from the pull down menu, then **Options**.
- Select the General tab.
- Browse to the location of the template files and double click on the desired template.

Tooth Creation

Two methods are available for generating the tooth form, splines or arcs.

If the gear geometry will be used in conjunction with a CAM system, arcs may be the wise choice. Most CAM systems will convert splines to a series of straight lines, while the arcs will remain as arcs.

A pair of splines is defined by a series of points along the tooth form. The more complex the tooth form, the more points are used to create the tooth spline. The spline is extruded to create the tooth feature. Splines are the faster of the two options in SolidWorks.

A series of arcs are used to create the tooth form. The more complex the tooth form is, the more arcs are used to create the tooth profile.

For help in setting GearTrax to create the tooth profile in arcs or splines, see Spur Gear Options.

Also see Manufacturing Methods for Spur/Helical Gears.



Spur Gear Options

Allows you to customize Spur Gear Annotations for drawings and how the tooth profile is created.

To set options:

• Click **Tools**, then **Options**.



- Select the **Spur Gears** tab. Selecting a **Class** option from the drop down box will "check" the appropriate boxes for that standard. Add or subtract from the check boxes for the desired annotations when adding a note on a drawing. These options are not saved with the part file and will need to be set at the time the note is created on the drawing.
- **Tooth Creation**. To create the tooth profile with a spline, select the **Spline** option or select the **Arcs** option to create the tooth profile with a series of arcs.
- Typically, creating the tooth with a spline will increase the performance of rebuilds but may make it more difficult if this geometry is use with a CAM system for fabrication.
- Creating the gear with arcs will allow the tooth profile to be mated in an assembly, but may require more time for rebuilds. Arcs may also be more appropriate for use with some CAM systems for fabrication.
- **Keyway Position**. To position the keyway on the tooth space center place a check in the appropriate box for the gear or the pinion. If left unchecked the keyway will be positioned on the tooth center. A keyway must be selected from in the mounting tab.
- **Class**. Selecting a class in this tab sets up the appropriate check boxes for a note. It does not effect the gear creation, only what is displayed in the annotation.
- Addendum Modification. Select either Automatic only or Manual only. If automatic only is select GearTrax, will enter the minimum modification recommended for certain standards, if available. If manual only is select then GearTrax will allow changes to the addendum modification and the addendum modification coefficient values.

• Click **OK** to accept the changes; click **Cancel** to discard the changes and exit the dialog box; click **Apply Tab** to accept the changes for this tab only.

Helical Gear Options

Allows you to customize Helical Gear Annotations for drawings.

- Click **Tools**, then **Options**.
- Select the Helical Gears tab.



- Selecting a **Class** option from the drop down box will "check" the appropriate boxes for that standard. Add or subtract from the check boxes for the desired annotations when adding a note on a drawing. These options are not saved with the part file and will need to be set at the time the note is created on the drawing.
- Click **OK** to accept the changes; click **Cancel** to discard the changes and exit the dialog box; click **Apply Tab** to accept the changes for this tab only.

Bevel Gear Options

Allows you to customize Bevel Gear Annotations for drawings.

- Click **Tools**, then **Options**.
- Click the **Bevel Gears** tab.

Options		×
Belt Pulleys Worm Gears Measur	rements Splines Manufacturing	
General Spur Gears Helical Gears	Bevel Gears Sprockets Gear Belts	
Bevel Gear Annotations Image: Gear number of teeth Image: Diametral pitch Image: Modular Image: Pitch diameter Image: Pressure angle Addendum modification Addendum Dedendum Whole depth Circular pitch Back lash Tooth thickness Face angle Root angle	Tooth Creation © Spline C Arcs Class Gear None Pinion None Vise manual entry of addendum modification. Qancel QK Apply Tab	

- Selecting a **Class** option from the drop down box will "check" the appropriate boxes for that standard. Add or subtract from the check boxes for the desired annotations when adding a note on a drawing. These options are not saved with the part file and will need to be set at the time the note is created on the drawing.
- To create the tooth profile with a spline, select the **Spline** option or select the **Arcs** option to create the tooth profile with a series of arcs.
- Addendum Modification. If this option is unchecked GearTrax will modify the addendum based on Gleason standards. If this option is check the user will need to specify the desired addendum modification.
- Click **OK** to accept the changes; click **Cancel** to discard the changes and exit the dialog box; click **Apply Tab** to accept the changes for this tab only.

Sprocket Options

Allows you to customize Sprocket Annotations for drawings.

- Click Tools, then Options.
- Select the **Sprockets** tab.



- Add or subtract from the check boxes for the desired annotations when adding a note on a drawing. These options are not saved with the part file and will need to be set at the time the note is created on the drawing.
- Click **OK** to accept the changes; click **Cancel** to discard the changes and exit the dialog box; click **Apply Tab** to accept the changes for this tab only.

Gear Belt Options

Allows you to customize Gear Belt Annotations for drawings.

- Click **Tools**, then **Options**.
- Select the **Gear Belts** tab.



- Add or subtract from the check boxes for the desired annotations when adding a note on a drawing. These options are not saved with the part file and will need to be set at the time the note is created on the drawing.
- Click **OK** to accept the changes; click **Cancel** to discard the changes and exit the dialog box; click **Apply Tab** to accept the changes for this tab only.

Belt Pulley Options

Allows you to customize Belt Pulleys for drawings.

- Click **Tools**, then **Options**.
- Select the Belt Pulleys tab.



- Add or subtract from the check boxes for the desired annotations to be added to the note on a drawing. These options are not saved with the part file and will need to be set at the time the note is created on the drawing.
- Click **OK** to accept the changes; click **Cancel** to discard the changes and exit the dialog box; click **Apply Tab** to accept the changes for this tab only.

Worm Gear Options

Allows you to customize Worm Gear Annotations for drawings.

- Click **Tools**, then **Options**.
- Select the **Worm Gears** tab.



- Selecting a **Class** option from the drop down box will "check" the appropriate boxes for that standard.
- Add or subtract from the check boxes for the desired annotations when adding a note on a drawing. These options are not saved with the part file and will need to be set at the time the note is created on the drawing.
- To create the tooth profile with a spline, select the **Spline** option or select the **Arcs** option to create the tooth profile with a series of arcs.
- Click **OK** to accept the changes; click **Cancel** to discard the changes and exit the dialog box; click **Apply Tab** to accept the changes for this tab only.
- •

Spline Options

Allows you to customize Spline Annotations for drawings and how the tooth profile is created.

- Click **Tools**, then select **Options**.
- Click on the **Splines** tab.



- The involute spline tooth cut may be created with splines or a series of small arcs. Select the appropriate option button.
- Add or subtract from the check boxes for the desired annotations to be added to the note on a drawing. These options are not saved with the part file and will need to be set at the time the note is created on the drawing.
- Click **OK** to accept the changes; click **Cancel** to discard the changes and exit the dialog box; click **Apply Tab** to accept the changes for this tab only.

Measurements Options

Allows you to calculate the over the pin measurements.

To set options:

- Click **Tools**, then **Options**.
- Select the Measurements tab.

General Spur Gears Helical Gears Bevel Gears Sprockets Gear Belts Belt Pulleys Worm Gears Measurements Splines Manufacturing Gear Measurement over pins (min) D01in Measurement over pins (min) Capture to 0.01in Measurement over pins (ref) D01in Measurement over pins (min) Capture to 0.01in Measurement over pins (ref) D01in Capture to Clip Borad 0.10in D10in Pin diameter D10in Capture to 0.10in D01in Pin diameter D10in Capture to 0.10in Pin diameter D10in Pint Form Pint Form Recalculation Pint Setup Pint Setup Calculate Van Keuren Pin Diameter Number of teeth to gage over Pinion - Chordal over teeth Pin Diameter Pin Diameter Number of teeth to gage over Chordal measurement QK QK Reset Reset Reset Reset Reset	Options
Belt Pulleys Worm Gears Measurements Splines Manufacturing Gear Measurement over pins (min) 0.01in Measurement over pins (ref) Capture to 0.01in Measurement over pins (ref) 0.01in Capture to Eile 0.01in Pin diameter 0.01in Capture to Eile 0.10in Pin diameter 0.10in Pin diameter Capture to 0.10in Pin diameter 0.10in Pin diameter Capture to 0.10in Pin diameter 0.10in Pin diameter Pin diameter 0.10in Pin diameter 0.10in Pint Setup Calculate Recalculation Print Setup Print Setup Calculate Gear - Chordal over teeth Number of teeth to gage over Pin Diameter Number of teeth to gage over 2 Chordal measurement Qancel 1.07245in Reset Reset Measurement	General Spur Gears Helical Gears Bevel Gears Sprockets Gear Belts
Gear Pinion Measurement over pins (min) 0.01 in 0.01 in Measurement over pins (ref) 0.01 in 0.01 in Pin diameter 0.01 in 0.10 in Pin diameter Number of teeth to gage over Qancel 1.07246in QK Reset Reset	Belt Pulleys Worm Gears Measurements Splines Manufacturing
	Gear Pinion Measurement over pins (min) 0.01 in 0.01 in 0.01 in Pin diameter 0.01 in 0.10 in Pin diameter 0.10 in Pinion - Chordal over teeth Reset Number of teeth to gage over 4 Pinion - Chordal over teeth Number of teeth to gage over Qancel 1.07246in Picket Reset Reset

- Click the Calculate Van Keuren Pin Diameter button to use the industry standard for pin sizes.
- You can calculate the "Over the Pin Measurement" with a desired pin size by entering that value into the **Pin Diameter** text box. **WARNING:** GearTrax will not inform you if the pin size is usable.
- GearTrax can calculate the tooth thickness for spur, helical or spline by entering the pin diameter and then the measurement over or under pins.
- The standard **Chordal measurements** and **the Number of teeth to gage over** is displayed for external spur gears and pinions.

How does GearTrax store these values?

 GearTrax places the measurement values in the custom information properties of the part. When GearTrax creates the part model, these values will be recalculated using the Van Keuren Pin Diameters. If you want to use a specific pin diameter other than the Van Keuren value, enter the diameter and check the box Use the value above when creating **the model** before creating the model. This will prevent GearTrax from recalculating using the Van Keuren pin diameter during the creation of the gear or spline.

- If you would like to change these values later you will need to manually change the values in SolidWorks. Click File, Properties, Custom tab. See "Summary Info" help section in SolidWorks for more information.
- These values can be added to a drawing by checking the appropriate boxes in the spur gears option dialog box. The boxes checked will be used when inserting an annotation to a drawing. See Inserting a Drawing Annotation for more information.

Options	×
Belt Pulleys Worm Gears Measurements Splines Manufacturing General Spur Gears Helical Gears Bevel Gears Sprockets Gear Belts	
Spur Gear Data Annotations Inspection Data Annotations Image: Constraint of Teeth Measure Over Prist Prion Number of Teeth Measure Device Prist Modular Pitch Prin Diameter Pristion Number of Teeth Prich Variation Price Number of Teeth Prich Variation Price Name Prich Variation Pristing Pristing Prich Variation Pristing Pristing Profile Tolerance Pristing Pristing Total Index Tolerance	
Miscellaneous Annotations Coold Creation Dedendum © Spline Dedendum Cricular Pitch Circular Pitch Class Addendum Modification Gear Addendum Modification Gear Major Dismeter Back Lash Pinion QK On gear tooth space center Pinion Øn pinion tooth space center AGMA 8	:el Tab

Calculating a Tooth Thickness

GearTrax can be used to calculate the tooth thickness when the over the pin dimension and pin diameters are known.

To calculate the tooth thickness:

- Select either the Spur/Helical tab or the Spline tab.
- Specify the number of teeth, diametral pitch or the Module
- Open the Measurements tab in the Options menu.
- Specify a pin diameter for the pinion, gear or the internal or external spline.
- Enter a value in one of the four over or under the pin measurement text boxes.
- GearTrax will return a message with the calculated tooth thickness or a message saying the dimension could not be calculated.

Between Pins Example

- Between pin measurements can be created manually and can be used to verify data.
- Create a new sketch on the face of the gear.

- Select a single tooth spline and create an offset entity equal to 1/2 of the pin diameter.
- Select the spline on the other side of the tooth space. Create another offset entity equal to ½ the pin diameter.
- Add a point on one of the new offset entities.
- Add a coincident relationship between the point and the offset entity.
- Add a circle with the center on the point. Dimension the circle equal to the pin diameter.
- Add a centerline to the sketch.
- Add a midpoint relationship between the centerline and the center of the gear.
- Add a coincident relationship between the pin outside diameter and an end point of the centerline.
- Add a coincident relationship between the pin center point and the centerline.
- Add the between the pins dimension by adding a dimension to the length of the centerline.



- Sample of a manual verification of between the pins measurements using SolidWorks.
- If the gear has an odd number of teeth you will need to create the sketch with 2 pins.



Sample of a manual verification of over the pins measurements using SolidWorks.

General Formula for Checking External and Internal Spur Gears by Measurement over Pins

- M = measurement over wires for external gears or measurement between wires for internal gears.
- D = pitch diameter
- \mathcal{T} = arc tooth thickness on pitch circle
- ₩ = wire diameter
- N = number of gear teeth
- A = pressure angle of gear
- a = angle, the cosine of which is required in formulas 2 and 3

$$1 \quad \text{inv} \, a = \text{inv} \, A \, \pm \, \frac{T}{D} \, \pm \, \frac{W}{D \cos A} \mp \frac{\pi}{N}$$

- 2 For even numbers of teeth, $M = \frac{D \cos A}{\cos a} \pm W$
- \mathcal{J} For odd numbers of teeth, $\mathcal{M} = \left(\frac{\mathcal{D}\cos A}{\cos a}\right) \left(\cos \frac{90^{\circ}}{N}\right) \pm \mathcal{W}$

Selecting a Manufacturing Method for Spur/Helical Gears

Allows you to specify the Manufacturing method for spur/helical gears.

- Click **Tools**, then select **Options**.
- Click on the **Manufacturing** tab.
- Select one of the three manufacturing methods by clicking on the picture:
- **Hobbing**. Involute profile extends to the TIF diameter. Under and over cutting of the tooth profile by the hob is duplicated.
- **Full involute**. Involute profile extends to the base circle. No under or over cutting of the tooth as the hob may produce.
- Full fillet radius (hobbing). Fillet radius is enlarged over the standard fillet radius. This also increases the dedendum slightly. For coarse and fine pitch standards only. This is a deviation from the standards.

Options	×
General Spur Gears Helical Gears Bevel Gears Sprockets Gear Belts	
Belt Pulleys Worm Gears Measurements Splines Manufacturing	
Spur/Helical Manufacturing Method	
Hobbing. Involute profile extends to the TIF diameter. Under and over cutting of the tooth profile by the hobb is duplicated.	
Full involute. Involute profile extends to the base circle. No under or over cutting of the tooth as the hobb may produce.	
Full fillet radius (hobbing). Fillet radius is enlargened over the standard fillet radius. This also increases the dedendum slightly. For coarse and fine pitch standards only.	

Select Company Standards for Addendum, Clearance and Fillet Radius Coefficients

Allows you to specify three company standards.

To set standards:

1

- Click **Tools**, then select **Options**.
- Click on the **Company Standards** tab.
- Use the arrow buttons to index through the three different standards.
- Change the title of the standard, if desired.
- Select manufacturing method to be the default for the standard
- Input the values for
 - o Addendum coefficient
 - o Clearance coefficient
 - o Fillet radius coefficient
 - Pressure angle
- Press the record button or index to the next standard.
- These standards will be available for spur and helical gears.

Options		x
General Spur Gears	Helical Gears Bevel Gears Sprockets Gear Belts	
Belt Pulleys Worm Gear	s Measurements Splines Manufacturing Company Standards	
Edit Company Standards		
	< >	
Title	Custom Standard #1	
Manufacturing method	Hobbing, standard rack	
Addendum coefficient	1.0833	
Clearance coefficient	0.2833	
Fillet radius coefficient	0.3330	
Pressure angle	22.5000 Record	
Coefficient calculator		
Pitch Diameter:	3.33330	
Number of teeth:	21 Insert Annotation	
Addendum length:	0.15000	
Dedendum length:	0.22000	
Modification (advance):	-0.00870 <u>O</u> K	
Diametral pitch:	6.300	
Addendum coefficient:	1.000 Apply Tab	
Clearance coefficient:	0.331	μ

Calculating Addendum and Clearance Coefficients

This may help decipher 3rd party specifications with limited information.

To calculate the coefficients:

- Click **Tools**, then select **Options.**
- Click on the **Company Standards** tab.
- Enter the values for the following:
 - o Pitch diameter
 - o Number of teeth
 - o Addendum length
 - Note: Addendum = (major diameter pitch diameter) / 2
 - o Dedendum length
 - Note: Dedendum = (pitch diameter minor diameter) / 2
 - Modification, this is sometimes called tool advance. It's normally negative for the gear and positive for the pinion.

General Spur Gears	Helical Gears Bevel Gears Sprockets Gear Belts
elt Pulleys Worm Gear:	s Measurements Splines Manufacturing Company Standards
Edit Company Standards	· · · · ·
	< >
Title	Custom Standard #1
Manufacturing method	Hobbing, standard rack
Addendum coefficient	1.0833
Clearance coefficient	0.2833
Fillet radius coefficient	0.3330
Pressure angle	22.5000 Record
Coefficient calculator-	
Pitch Diameter:	3.33330
Number of teeth:	21 Insert Annotation
Addendum length:	0.15000
Dedendum length:	0.22000
Modification (advance):	-0.00870 <u>O</u> K
Diametral pitch:	6.300
Addendum coefficient:	1.000 Apply Tab
et	0.331

Inserting a Drawing Annotation

To insert a note on a drawing:

Define the note by setting the options for the product. See GearTrax Options



From the GearTrax menu select **Insert** and then **Insert Annotations** to display the **Annotations** dialog box.

Annotation Options		
Use upper case w	hen creating annotations.	
Use Excel when a	- adding annotations to parts	
nsert Annotations		
Annotation type:		
Spur Gear		-
Use Pre-string (for Inserted tooth pre	annotating inserted tooth -string	cuts)

To set Annotation options:

- Place a check in the appropriate box to have annotations created using all upper case letters.
- Place a check in the appropriate box to have annotations created using Excel.

To insert an Annotation to a part or a drawing:

- From the Annotations type drop down box select the appropriate annotation type.
- If the desired annotation is for an inserted tooth cut profile then:
- Place a check in the Use Pre-string check box.
- The per-string character needs to be specified. Enter the letter in the box or use the updown arrows to change the letter. If you are unsure of which letter to use you may want to review the Custom Properties of the part in SolidWorks.

To delete the custom information for an inserted tooth cut:

- Place a check in the **Use Pre-string** check box.
- Set the per-string character for the desired set of custom properties.
- Press the **Delete** key

Summary Info	ormation		<u>? ×</u>
Summary Co	ustom Configuration Spec	;ific	
Name:	Diametral Pitch Checked by Client Date completed Department Destination Disposition	Mod	ify
Туре:	Number	Mass Pro	operties
Value:	10		
Properties:	Name Gear Number of Teeth Pinion Number of Teeth Diametral Pitch Normal Diametral Pitch Modular Pitch Normal Modular Pitch Pressure Angle Form Diameter Minor Diameter	Value 28 18 10 10 1.27 2.54000 20 0.000mm 64.3433mm	
	ок	Cancel	Help

Sample of the Summary Information window in SolidWorks.

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