This is a general tutorial for users of TracePro LC, TracePro and TracePro Expert.



Create an LED package based on manufacturer's data sheet.

This example will build a source model for a Siemens LWT676 surface mount LED based on the Manufacturer's data sheet. The dimensions will be used to build a solid model and the source output will be defined to match the LED photometric curve.



Approx. weight 0.03 g

0.8

0.6

0.4

0'

40'

80°

100"

120

1.0

TracePro User Interface

The figure shows a solid block in TracePro. The following user interface items will be used in this example



Create a Thin Sheet

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First analyze the package to determine the best method of constructing the geometry in TracePro. The symmetry of the package suggests starting from a Thin Sheet and extrude the top and bottom halves with a small draft angle. Construct Thin Sheet in the XY plane.

- 1. Start TracePro and open a new model with File |New.
- 2. Select view | Profiles | XY or click the View XY button on the toolbar
- 3. Open the **Insert**|**Primative Solid** dialog and select the **Thin Sheet** tab.
- 4. Enter the four corners of the Thin Sheet in mm in the dialog box and click the **Insert** Button.
- 5. Press the Zoom All button or select the **view**|**zoom**|All menu to see the new object

Model:[Untitle	d2]				
		🔚 Insert Prin	nitive Solids		_ IX
		Block Cyline	der/Cone Toru	s Sphere Thi	n Sheet
	~	X Point	Y Point	Z Point	
	'	1.5	1.7	0.0	
		1.5	-1.7	0.0	
		-1.5	-1.7	0.0	
		-1.5	1.7	0.0	
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Selecting a Surface

TracePro uses surface and object selections for many operations.

- 1. Close the Insert Primitive Solid dialog box. The thin sheet object has only one surface
- 2. Select **view|Profiles|YZ** or click the View YZ button on the toolbar to view the profile of the Thin Sheet.
- 3. Select the surface using the **Edit|Select|Surface** menu (or Select Surface tool), use the mouse to "pick" the rod end. You may want to use the system tree by opening the system tree with **window|Split** and selecting the surface.



Use Sweep to form a solid

The package has a small angle of about 4 degrees so you will extrude the sheet using Edit|Surface|Sweep.

- 1. Select Edit|Surface|Sweep.
- 2. Enter a sweep distance of 0.9 mm and a draft angle of 4 degrees.
- 3. Click App1y. The surface will be swept along the plane's surface normal, in this case along the Z axis.
- 4. Make sure Surface 4 is selected for the next sweep to complete the object.

Model:[Untitle	d2] _ 🗖 🗙
- Object 1 - Surface 0 - Surface 1 - Surface 2 - Surface 3 - Surface 4 - Surface 5 - Entity 1 - Material from - Material nam	Y Distance [.9] Draft angle 4 in Degrees Sweep along surface normal User sweep direction X direction 0 (Surface normal and draft angle are for planar Z direction 0 surfaces only) Apply

Complete the Solid

Perform two more sweep operations to complete the solid according to the data sheet.

- 1. Select Surface 4.
- 2. Sweep by 0.2 with draft=0 to create the central portion of the package.
- 3. Select Surface 8.
- 4. Sweep again by 0.9 with a -4 degree draft to complete the construction.



Create a conical hole

Next you can add the cone reflector which holds the LED die. To create the conical hole, first create a cone, then perform a Boolean Subtract operation.

- 1. Select **Insert**|**Primitive Solid** and select the **Cylinder/Cone** tab.
- 2. Select the Cone option and enter the values shown, then click Insert to create the cone.



Subtract the Cone from the Package

Boolean Operations use a concept of Body and Tools. The Body is the item you wish to keep and the tools are items which will have some effect on the Body. Here you want to remove the volume occupied by the cone from the package. The Body is the package and the Tool is the cone.

- 1. Select the Package object from the System Tree. Click on Object 1.
- 2. Select the Tool object from the System Tree. Use Ctrl+Click on Object 2. The Ctrl key allows you to add the object to the current selection.
- 3. Select Edit|Boolean|Subtract.
- 4. Object 2 will be removed from the System Tree.



Add diffuser

You also need to add a diffuser. This will be a thin cylinder joined to the package. You will make the inner surface of the diffuser scattering and the inside of the cone a perfect mirror.

- 1. Select Insert | Primitive Solid, Cylinder/Cone tab.
- 2. Enter the values shown.
- 3. Click **Insert** to create the cylinder.

🔚 Insert Primitive Solids	
Block Cylinder/Cone Toru	us Sphere Thin Sheet
🖸 Cylinder 🔿 Cone	🗖 Elliptical Base
Base	Top
Major R: 1.2	Major R: 1.2
Minor R: 1.2	Length: 0.01
Base Position	Base Rotation
X: 0	X: 0
Y: 0	Y: 0
Z: 1.99	Z: 0
	in Degrees
Insert	Modify

Add LED

Now you will add the LED chip itself. The dimensions are not given, but you can estimate that it is 0.4 x 0.4 x 0.15 mm from the data sheet.

- 1. From the Insert|Primitive Solid dialog box, select the Block tab
- 2. Enter the values shown.
- 3. The center of the LED has a Z-value 1.175 to position the block so that it is on the bottom of the conical hole.
- 4. Click Insert to create the block.
- 5. You can also name the Objects by clicking in the names in the System Tree and entering a new identifier.

🚯 Model:[Untitl	ed2]		_ 🗆 ×
⊞-Package ⊞-Diffuser		🗖 Insert Primitive Solids	_ 🗆 🗙
		Block Cylinder/Cone Torus Sphere Thin Sheet	
		Width	
	Y I	X: 0.4 Y: 0.4 Z: 0.15	
		Center Position Rotation	
		X: 0 X: 0	
		Y: 0 Y: 0	
		Z: 1.175 Z: 0	
		in Degrees	
	ଔ┿⇒>ℤ ``		
		Insert Modify	

Diffusing Surface Property

You will make three assumptions about the optical properties of this LED package. First, that the Diffuser is a perfect Lambertian transmitter with no losses. Second, the inside of the conical hole is a perfect reflector without any losses. Third, the LED is a perfect reflective diffuser. These simplifications could be removed with more data from the manufacturer.

- 1. TracePro includes a Perfect Mirror Surface Property so you only need to add the diffuser property.
- 2. Select Define | Edit Property Data | Surface Properties.
- 3. Click the **Add Property** button, enter the property name Lambertian Diffuser and select ABg for the Scatter Model.
- 4. Set the absorptance value to 0.0 (a lossless surface) and select Solve for BTDF (Bidirectional Transmission Distribution Function) from the drop-down list. The BTDF is the scattering portion of the surface property with three coefficients. (See the manual for information about the ABg scattering model).

inter New Surface Property	ĸ
Surface Property Name:	
Lambertian Diffuser	
Adding to Catalog: Default	
Scatter Model: ABg	
Temperature (Kelvin): 300	
Wavelength (microns): 0.5	
OK Cancel	

5. Select **File**|**Save** to store the property in the property database.

🔚 Surface Property E	ditor							_ [1 ×
		F							
Catalog	Catalog:	Default	•	Name: Lamb	pertian Diffuser	•			-
Add Catalog	Description:								
Delete Catalog	Туре:	Table 🔹	Scatter: AB	}g	🗌 🗖 Retro	reflector			
Add Property					🗖 Polari	zation			╡
Delete Property	Temperature	Wayalapath	Incident Angle	Abcorptopco	Specular Defl	Specular Trans	Integrated BDDE		
	300	0.5		0	0		0	0	0.1
Sort bu		1	1 -		1				
Add									
Delete									
Solue For									
	<u> </u>								
	Grid								

Apply Diffuser surface property

Make the inside surface of the Diffuse the scattering surface.

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- 5. Cl

	5	Apply Properties
1.	Select Define Apply Properties to open the Apply Properties Dialog box and select the Surface tab	Importance Sampling Exit Surface Diffraction Raytrace Flag
2.	Select the inner surface of the diffuser, by either:	Mueller Matrix Gradient Index Bulk Scattering Temperature
	 clicking on it in the System Tree 	Class and User Data RepTile Temperature Distribution
	• Selecting Edit Select Surface and clicking on the surface in the model window.	Property Catalog: Default
3.	You may want to zoom in on the diffuser to see which surface is which (as shown).	Property Name: Lambertian Diffuser
4.	Select Lambertian Diffuser from the Surface Property Name drop- down list.	ABg Scatter
5.	Click App1y to apply the property to the diffuser.	Reference Data
		Type: Data Table , no polarization, no retroreflector Reference Material Angles measured in Air - Refractive Index = 1.0 Angles are corrected by Snell's law and the refractive
lodel:	[Untitled2]	measured index reference of Surface Property data:
ackage ffuser - Surfa - Surfa - Surfa - Surfa - Pl - Surfa - Entity - Cyl/C - Mate - Mate	ace 0 ace 1 urface Data from: Default urface Property: Lambertian Diffuser ane ace 2 y 4 Cone trial from <none> trial name <none></none></none>	Apply View Data

≜-LED

🚯 Model:[Ur ⊞-Package ⊨-Diffuser iarface B-Surface

> i∰-Surface - Entity 4

- Material - Material

Apply Properties

Material

Importance Sampling

Class and User Data

Surface

Exit Surface

RepTile

Mueller Matrix Gradient Index Bulk Scattering

Diffraction

Surface Source Prescription Color

Apply Mirror surface property

The next step is to apply a Mirror Surface to the base and sides of the conical hole in the package.

- 1. Select the conical surface and the bottom of the conical hole. After selecting one surface, you can add to the selection by holding down the Ctrl key and selecting additional surfaces.
- 2. Select Perfect Mirror from the Surface Property Name drop-down

list.	
3. Click App1y to apply the property to the selected surfaces.	Property Catalog: Default
	Property Name: Perfect Mirror
	Mirror with 100% reflectance, no scatter
	No Scatter
	Reference Data
	Turne Diete Tieble van enlasjestien van entreenflanten
	Type: Data Table , no polarization, no retroreflector
	Reference Material
	Angles measured in Air - Refractive Index = 1.0
	Angles are corrected by Snell's law and the refractive
Model:[Untitled2]	Index on either side of the Surface Property. Select measured index reference of Surface Property data:
Package Surface 0 Surface 1 Surface 2 Surface 3 Surface 4	Apply View Data
Be-Surface 5	
Be Surface 6	
Be-Surface 8	
B-Surface 9	
B Surface 10	
Curfare 11	

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Raytrace Flag

Temperature

Temperature Distribution

Define LED source

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- 1. Select **Analysis**|**Raytrace Options** to open the Raytrace Options dialog box.
- 2. On the Options tab, select Photometric for the Radiometric Units type.
- 3. Click App1y and close the dialog box.
- 4. Select the top surface of the LED.
- 5. In the Apply Properties dialog box, select the Surface Source tab.
- 6. Enter the values and selections shown.
- 7. Click **App1y** to create an LED that emits 0.05 lumens in a Lambertian pattern

material 1 o di	face Surface	e Source Pre	escription 📔 Color		
Source Type: Flux					
Flux:).05 lume	ns Total R	ays: 50000		
		Total Po	wer: 0		
Wave. (um)	Weight	Power (lm)			
0.5461	1	0			
, Angular Distribut	ion: Lambertian	•			
Angular Distribut	ion: Lambertian ndom rays (Requ	▼ iires Source Impo	ortance Sampling)		

Raytrace Options	
Simulation & Output Options Wavelengths	Advanced Thresholds
Radiometric Units: Photometric	
Specular Rays Only Po	larization
Aperture Diffraction 0 Random Rays: 1	distance (mm) (per scatter)
Random Seed: 1	
	<u>S</u> et Defaults
	Top of LED

Perform the Raytrace

Now the model is ready for raytracing.

- 1. Begin a Surface Source Raytrace by either:
 - clicking the Source Trace button
 - selecting Analysis | Source Raytrace and clicking Trace Rays.

Begin the ray-trace by one of the above options. First TracePro will perform an Audit of the model and report any invalid properties or geometry, then the raytrace will start.



Display Candela plot

- 1. Select Analysis | Candela Options
- 2. Select the **Orienta**
- 3. Set the Normal and the top illustration.
- 4. Select the Candel and enter the settir illustration.
- 5. Click App1y to see

1. Ocicol Anarysis Candera Operons:	💥 Candela Options	
2. Select the Orientation and Rays tabs.		
Set the Normal and Up vectors as shown in the top illustration.	Normal Vector Orientation and Hays Polar Iso-Candela Rectangular Rectangular Iso-Candela Rectangular Re	Orientation
 Select the candela Distributions tab and enter the settings shown in the bottom illustration. 	X: 0 Y: 0 Y: 1	Normal Up
5. Click App1y to see the changes on the plot.		
	Ray Selection Selection Use missed rays for Candela Data	The Normal vector defines the global direction of the Zero
Candela Options	C Use exiting rays from selected surface (Analysis Only)	axis for vertical angles.
Orientation and Rays Polar Iso-Candela Rectangular Iso-Candela	O Use incident rays from selected surface or Exit Surface	The Up vector defines the global direction of
Distribution Data Selection	Data Processing	the Zero axis for
☑ Smoothing 25 plot points or smoothing factor	Summetry None	norizontal angles.
Cd/klm Number of horizontal angles: 4		
Set Ma <u>x</u> : 0 Set Mi <u>n</u> : 0		Set Defaults
- Polar Distribution		
Luminaire format Angular width (deg) 90 Luminaire plot width (deg) 180	Polar or Uminaire	
Rectangular Distribution	Rect Dist	
Log plot Angular width (deg) 90		
	<u>S</u> et Defaults	

Display Candela plot

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The candela plot from TracePro can be compared to the photometric curve from the data sheet.

- 1. Select **Analysis** | **Candela Plots** | **Polar Candela Distribution** or press the Polar Candela Distribution button.
- 2. Compare to the data.



