

# Creating a TracePro Bulk Scatter Property for a Diffuser

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## *Scope*

If a diffuser is scattering light because of a coating or texture on one or both surfaces, that case is best modeled as a TracePro Surface Property.

If a diffuser is scattering light because of particulates within the body of the material, and the surfaces are polished and uncoated, that is best modeled as a TracePro Bulk Scatter Property.

The process described in this document applies to the second case, scatter due to particulates within the body of the material.

If data is available for different thicknesses of the material, that is a clear indicator that the scatter is due to particulates within the body of the material, and a Bulk Scatter Property is the appropriate way to model it.

Note - Bulk Scatter Properties can be created in TracePro Expert and Standard, but not TracePro LC. TracePro LC users can work around this limitation by creating a Surface Property for each thickness of the material, but the accuracy of that assumption is only valid for light that passes through the material at normal incidence. The Bulk Scatter Property will correctly model the behavior of rays at all incidence angles and internal reflections where the path of the ray through the material varies.

## *Data*

The first step in the process is to acquire data for the diffuser. Some or all of the following parameters may be stated in the manufacturer's data sheet:

- Haze %
- Transmission %
- Plot of angular distribution or Half Power angle of distribution
- Set of data for several thicknesses of the material

If data is not available, the options are to send a sample for a scatter measurement, or to make assumptions.

## ***Creating and Testing the Bulk Scatter Property***

- open “Diffuser\_BulkScatterExample.oml”
- open the Bulk Scatter Property Editor ( Define/Edit Property Data from the menu)
- import “DiffuseExample.txt” into the Bulk Scatter Property Editor (File/Import or Import icon)
- the object in the TracePro model was created with a 2 mm thickness, right-click on the object and select Modify to match the thickness for the data you are trying to match
- trace rays
- view the Polar or Rectangular Candela Distribution Plot, whichever is the best match to the data that is available
- The final task is to edit the Bulk Scatter Property and repeat the raytrace until the results match the data the Candela plot from the spec sheet. The Bulk Scatter Property only has two coefficients to vary.
  - g is the anisotropy coefficient, it ranges from -1 (all back scatter) to +1 (all forward scatter)
  - the Scatter Coeff is the number of scatters per millimeter, so a higher value results in more scatter

Please note that 0 deg in the TracePro Polar Candela Distribution plot is the direction of forward scatter, so the starter property is scattering more light backward than forward. If your data shows more light transmitted than reflected, the first steps will be to increase the g coefficient to get more forward scatter and less backward scatter.

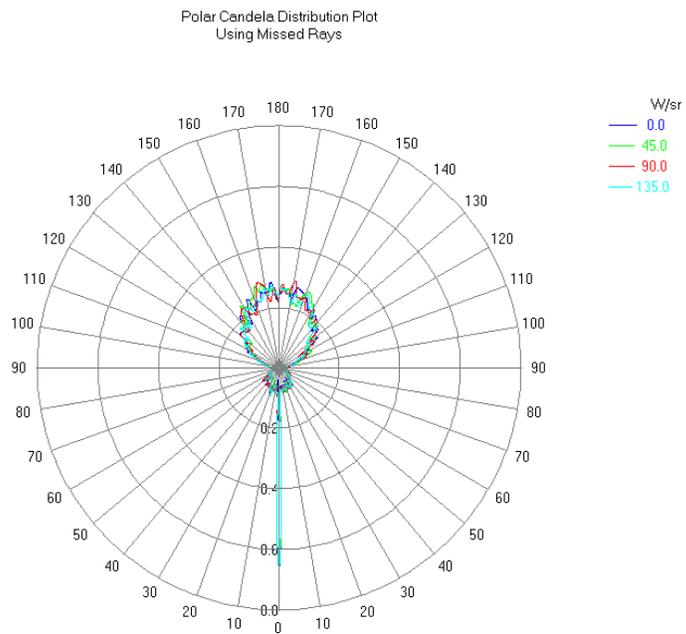
If the material is really diffuse (no image is visible when looking through it) then the Scatter Coeff needs to have a high enough value so that no light gets thru without scattering. The other limitation is that if the Scatter Coeff is too high then no light will be transmitted through the material at all.

Hopefully in just a few quick raytraces the property can provide a good match to the manufacturer's data.

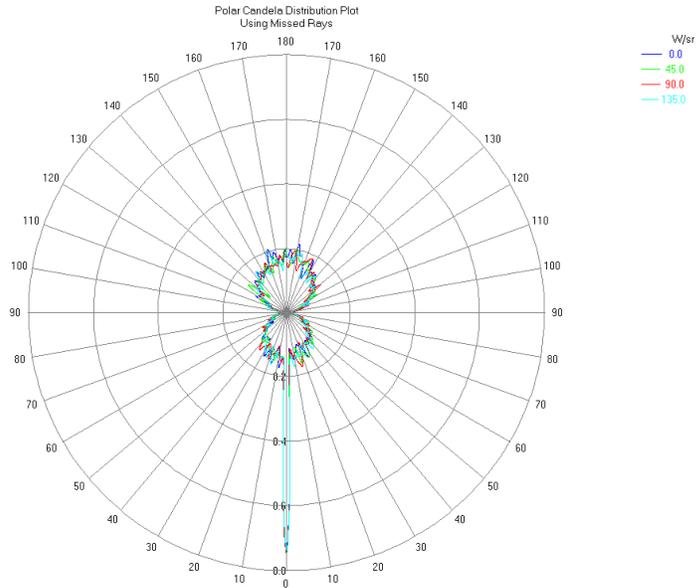
- When the property is a good match, select the Copy Property button in the Bulk Scatter Property Editor to save the property with a new Catalog name and Property name

The following pages show polar candela distribution plots for different bulk values of coefficients.

## Anisotropy $g = -0.5$ , Scatter Coefficient = 3



## Anisotropy $g = +0.5$ , Scatter Coefficient = 3

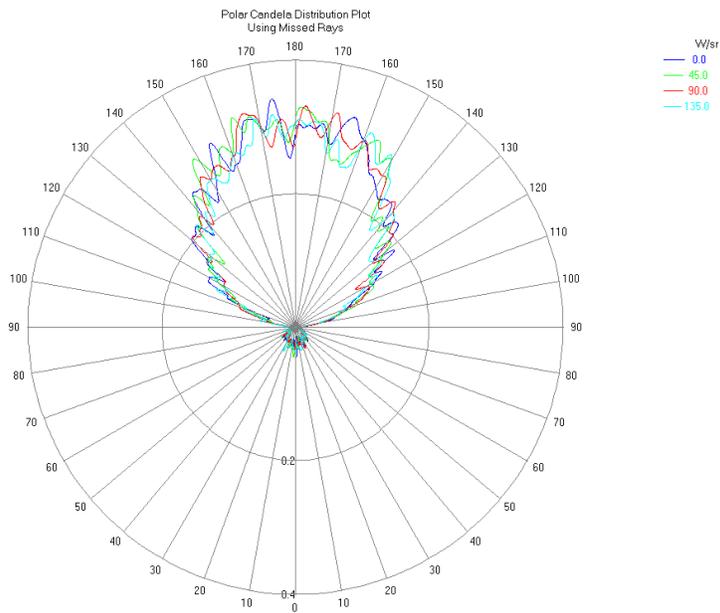


0 deg = forward scatter, 180 deg = back scatter

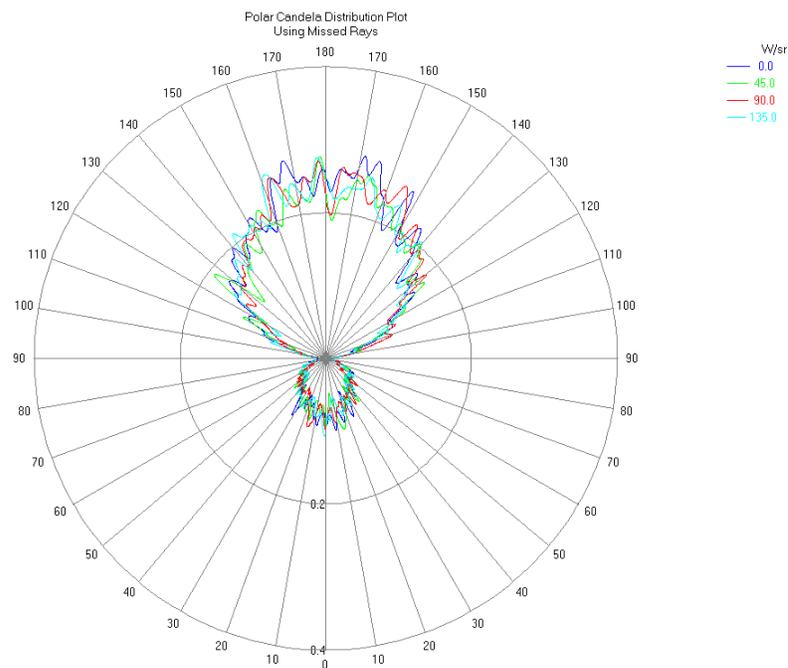
Scatter coefficient is low enough that some rays transmit without scattering (spike at 0 deg)

Positive  $g$  coefficient results in more forward scatter

Anisotropy  $g = -0.5$ , Scatter Coefficient = 10



Anisotropy  $g = +0.5$ , Scatter Coefficient = 10

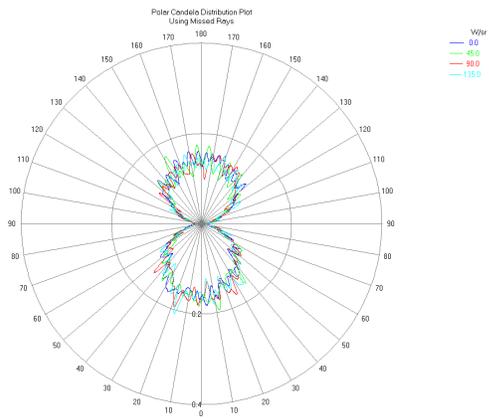


0 deg = forward scatter, 180 deg = back scatter

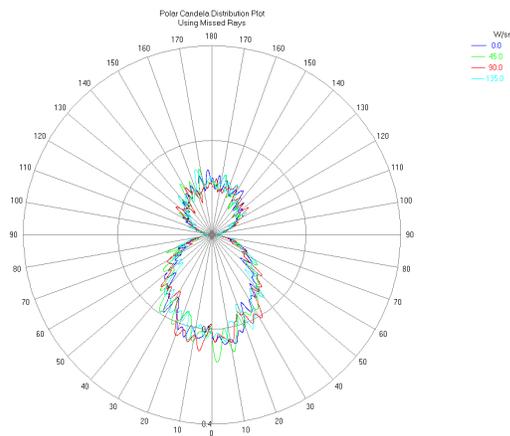
Scatter coefficient is high enough that no rays transmit without scattering (no spike at 0 deg)

Positive  $g$  coefficient results in more forward scatter

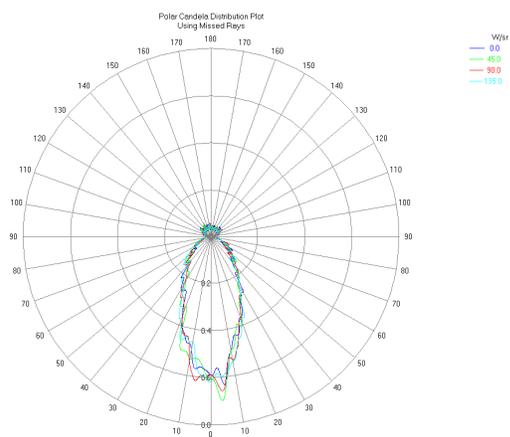
Anisotropy  $g = +0.9$ , Scatter Coefficient = 10



Anisotropy  $g = +0.95$ , Scatter Coefficient = 10



Anisotropy  $g = +0.98$ , Scatter Coefficient = 10



0 deg = forward scatter, 180 deg = back scatter

For constant Scatter coefficient, higher  $g$  coefficient results in more forward scatter