About surface materials

Overview of surface materials

From the **Hypershade**Create bar and **Create Render Node** window, you can create **Surface** Materials, **Volumetric** Materials, and **Displacement** Materials. For more information on surface materials, see Surface material.

Some attributes (such as color and transparency) are common to most surface materials and are described in Common surface material attributes.

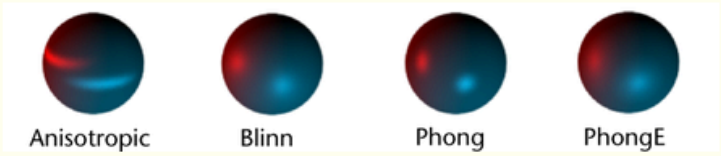
Some attributes are shared among many surface materials, are therefore grouped separately from the **Common** surface attributes and are described in Shared surface material sections.

Surface material-specific descriptions are provided in this section under the material name.

Specular highlight (shine)

Note

Only materials with specular attributes (**Anisotropic**, **Blinn**, **Phong**, and **PhongE**) have surface highlights. The *specular highlight* is the white shiny glow on the material.



Tip

The **Blinn** material is recommended for shiny surfaces in animations. Highlights on other specular materials, like **Phong** and **PhongE**, may flicker when animated.

Lambert

Is a material (shader) that represents matte surfaces (such as chalk, matte paint, unpolished surfaces) with no specular highlights.

The initial (default) shading group uses a special **Lambert** surface material. Do not modify it; instead, create and apply a new **Lambert** material.

Find this material in the Create bar.

You can set attributes of **Lambert** materials to control its appearance. See Common surface material attributes.

Phong

Is a material (shader) that represents glassy or glossy surfaces (such as car moldings, telephones, bathroom fittings) with a hard specular highlight.

You can find this material in the Create bar.

Tip

The soft highlights on **Blinn** surfaces are less likely to exhibit roping or flickering for thin highlights than the harder highlights on **Phong** surfaces. Use the **Blinn** surface material for surfaces with bump or displacement maps to reduce highlight roping or flickering.

Specular Shading attributes (Phong)

Cosine Power

Controls the size of shiny highlights on the surface. The valid range is 2 to infinity. The slider range is 2 (broad highlight, not very shiny surface) to 100 (small highlight, very shiny surface), though you can type in a higher value. The default value is 20.

Specular Color

See Common surface material Specular Shading attributes.

Reflectivity

See Common surface material Specular Shading attributes.

Reflected Color

See Common surface material Specular Shading attributes.

Phong E

Is a material (shader) that is a simpler version of the **Phong** material. The specular highlights on **Phong E** surfaces are softer than those on **Phong**surfaces, and **Phong E** surfaces render faster.

You can find this material in the Create bar.

Specular Shading attributes (Phong E)

Roughness

Controls the specularity focus.

Highlight Size

Controls the amount of specular highlight.

Whiteness

Controls the specular highlight color. The default is white, but you can choose any color. You can also map a texture to this value.

Blinn

Is a material (shader) that is particularly effective at simulating metallic surfaces (for example, brass or aluminum) which typically have soft specular highlights.

Note

Blinn is the most computationally expensive of the three common materials: **Lambert**, **Phong**, and **Blinn**.

You can set attributes of **Blinn** materials to control the size of shiny highlights and the ability of the surface to reflect its surroundings.

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You can find this material in the Create bar.

Tip

The soft highlights on **Blinn** surfaces are less likely to exhibit artifacts or flickering for thin highlights than the harder highlights on **Phong**surfaces. Use the **Blinn** surface material for surfaces with bump or displacement maps to reduce highlight artifacts or flickering.

Specular Shading attributes (Blinn)

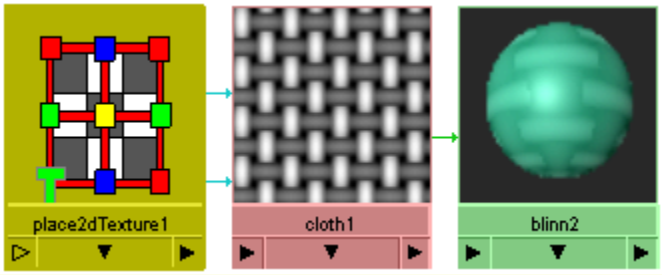
Eccentricity

Controls the size of shiny highlights on the surface. The valid range is 0 (no highlight) to 0.999 (broad highlight, not very shiny surface). A value of 0.1 produces a small highlight (very shiny surface). The default value is 0.3.

Specular Roll Off

Gives the surface the ability to reflect its surroundings (the environment, other surfaces) or the **Reflected Color**, when viewed at oblique angles. The slider range is 0 to 1. The default value is 0.7.

To help visualize the effect of **Specular Roll Off** in a **Blinn** material swatch, assign a texture to the **Reflected Color**.



Tip

Use a **Specular Roll Off** value of 0.3 to simulate a wet surface (for example, wet paint).

Specular Color

See Common surface material Specular Shading attributes.

Reflectivity

See Common surface material Specular Shading attributes.

Reflected Color

See Common surface material Specular Shading attributes.

Anisotropic

Is a material (shader) that represents surfaces with grooves, such as a CD, feathers, or fabrics like velvet or satin. The appearance of specular highlights on an **Anisotropic** material depends on the properties of these grooves and their orientation. The **Specular** shading attributes (shiny highlights) determine the direction of the grooves as well as their properties.

An **isotropic** material (such as **Phong** or **Blinn**) reflects specular light identically in all directions. If you spin an isotropic sphere, its specular highlight remains still.

An **anisotropic** material reflects specular light differently in different directions. If you spin an anisotropic sphere, its specular highlight changes, depending on the direction of the grooves.

You can set attributes of **Anisotropic** materials to control the appearance of highlights, determine the orientation and spread of grooves, set the roughness and reflectivity, and reduce spherical abnormalities (fresnel index).

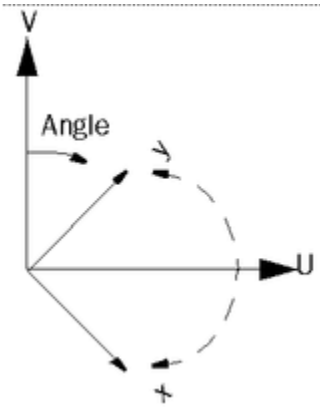
You can find this material in the Create bar.

Specular Shading attributes (Anisotropic)

Control the appearance of specular highlights on a surface.

Angle

Determines the orientation of the grooves. The range is 0.0 (default) to 360.0. Use to determine the X and Y direction for non-uniform specular highlight.



Spread X/Spread Y

Determines how much the grooves spread out in the X and Y directions. The X direction is the U direction rotated counter-clock-wise by the specified Angle degrees. The Y direction is perpendicular to the X direction in UV space.

For **Spread X**, the range is 0.1 to 100.0 and the default is 13. For **Spread Y**, the range is 0.1 to 100.0 and the default is 3.0

Large values correspond to surfaces which vary smoothly in the X or Y direction. Small values correspond to surfaces with fine structure. When increased, the specular highlight in the X or Y direction shrinks in size—when decreased, the specular highlight spreads out.

When the **Spread X** value is equal to the **Spread Y** value, the surface becomes isotropic—equally smooth in all directions. When the **Spread X** value is more than the **Spread Y** value, the surface is smooth in the X direction and rough in the Y direction.

For example, when a surface such as a piece of cloth whose fibers run along the X direction is rendered, the highlights non-uniformly spread out with more highlights along the Y direction.

Roughness

Determines the overall roughness of the surface. The range is 0.01 to 1.0. The default is 0.7. Smaller values correspond to smoother surfaces and the specular highlights are more concentrated. Larger values correspond to rougher surfaces and the specular highlights are more spread out—similar to being diffused.

Fresnel Index

A *fresnel* is a flat lens consisting of a number of concentric rings that reduces spherical abnormalities. The **Fresnel Index** value computes the fresnel factor that connects the reflected light wave to the incoming light wave. For instance, the **Fresnel Index** for water is 1.33. Values range from 1.0 to 20.0.

Specular Color

See Common surface material Specular Shading attributes.

Reflectivity

See Common surface material Specular Shading attributes.

Reflected Color

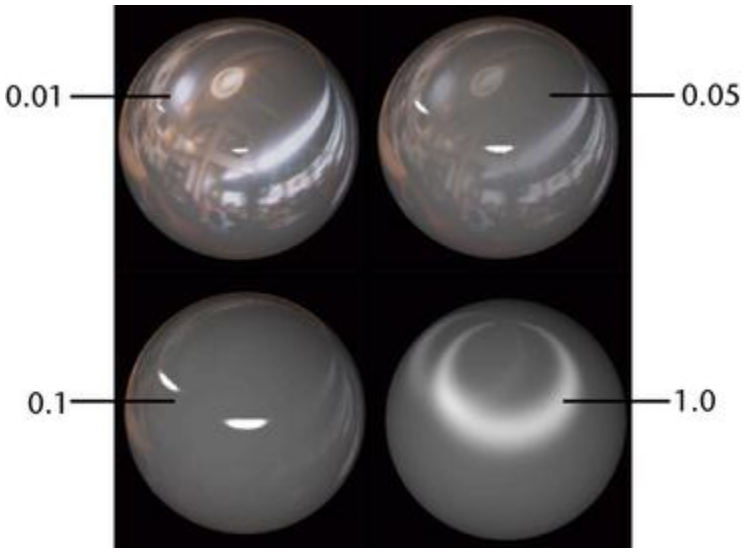
See Common surface material Specular Shading attributes.

Anisotropic Reflectivity

If on, Maya automatically calculates **Reflectivity** as a fraction of **Roughness**. **Reflectivity** is on by default.

If off, Maya uses the specified **Reflectivity** value for the environment map (mapped on the **Reflected Color** attribute), similar to how the**Phong** and **Blinn** materials work.

In the following, **Anisotropic Reflectivity** is on, an environment is mapped on the **Reflected Color**, and the **Roughness** is set to 0.01, 0.05, 0.1, and 1.0 (from very smooth to very rough).



Common surface material attributes

The following attributes are common to most surface materials.

For material-specific specular shading attributes, see the particular material. For example, for information on the specular shading attributes of the**Anisotropic** material, see Anisotropic.

Type

The material's basic type (such as **Blinn** or **Phong**).

When you change a material's type, only those attributes common to both types retain their previous values or settings. For example, if you change the material type from **Blinn** (which has a **Color** attribute and a **Specular Color** attribute) to **Lambert** (which has a **Color** attribute but no **Specular Color** attribute), the **Color** setting is preserved, but the **Specular Color** setting is lost.

Color

The default material color.

Transparency

A material's color and level of transparency. For example, if the Transparency Value is 0 (black), the surface is totally opaque; if the**Transparency** value is 1 (white), the surface is totally transparent.

To make an object semi-transparent, set the **Transparency** color to a shade of grey or to the same color as the material **Color**. The default value is 0 (black).

If you change **Transparency** from the default black (0), the background of the material's **Hypershade** swatch becomes a checkered pattern. This is a visual aid and is not rendered.

For more information, see Transparency.

Note

If the material has specular highlights the transparency setting do not affect the highlights. So if you are trying to make an object disappear by animating the transparency attribute, you may also have to animate the specular highlight attributes.

Ambient Color

Set to black by default, which means it does not affect the material's **Color**. As the **Ambient Color** becomes lighter, it affects the material's **Color** by lightening it and blending the two colors. If there are ambient lights in the scene, the color and brightness of those lights is used to control how much the ambient color contributes to the final color of the material.

Incandescence

The color and brightness of light that a material appears to be emitting. (Incandescent objects do not illuminate other objects.) For example, to simulate lava, use a bright red **Incandescence**. The default color value is 0 (black).

Tip

- Although incandescence makes a surface appear to glow, it does not actually act as a source of light in the scene.
- Use a little **Incandescence** for vegetation to make it look organic.

Bump Mapping

Makes the surface appear rough or bumpy by altering surface normals (during rendering) according to the intensity of the pixels in the bump map texture. A bump map does not actually alter the surface. A silhouette of the surface appears smooth.

For more information about bump mapping, see About surface relief.

Diffuse

Gives the material the ability to reflect light in all directions. The **Diffuse** value acts like a scaling factor applied to the **Color** setting—the higher the **Diffuse** value, the closer the actual surface color is to the **Color** setting. The valid range is 0 to infinity. The slider range is 0 (no light is reflected in all directions) to 1, but you can type in a higher value. The default color value is 0.8.

Translucence

Gives the material the ability to transmit and diffuse light. Light falling on a translucent surface is first absorbed beneath the surface, and then diffused in all directions. If set to 0, the default, no light shows through the object. If set to 1, all the light shows through. The default value is 0.

Tip

Use **Translucence** to simulate clouds, fur, hair, marble, jade, wax, paper, leaves, flower petals, or frosted light bulbs.

Note

- The **Translucence** value of a surface lit by a non-shadow-casting light is zero or infinite (all non-zero values).
- If the scene combines a translucent surface with a shadow casting spotlight, faint grid-like artifacts may become visible. If this happens, increase the spotlight **Filter Size** or lower the **Resolution**.
- For high values of **Translucence**, lower **Diffuse** accordingly to avoid washout.
- A surface's actual translucence is based on the illumination it receives from lights, and is not related to its transparency. However, as an object becomes more transparent, its translucent (and diffuse) illumination gets dimmer.
- Ambient lights have no effect on translucent (or diffuse) illumination.

Translucence Depth

Simulates the way light diffusely penetrates through translucent objects. For example, when light shines on one side of the object, the other side is partially illuminated. This can be used for effects such as clouds, fur, hair, marble, jade, wax, paper, leaves, and so on. (To see this effect, turn on raytraced shadows for the light shining on the object.)

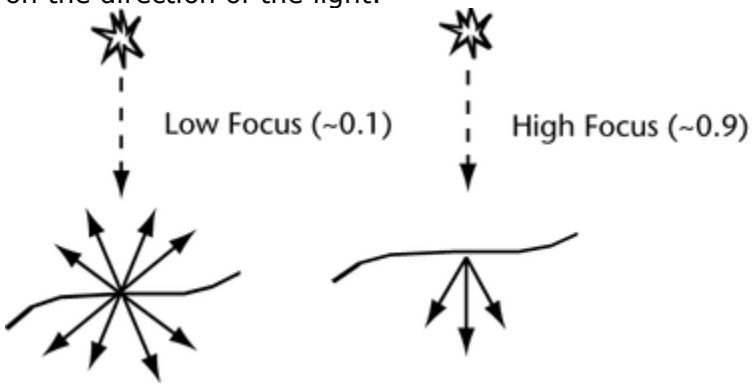
Translucence depth is based on worldspace. If it is set to 0 (the default), no light shows through the object. If set to 10, light penetrates through the surface, 10 units past the point where the object is in shadow.

Tip

To see the effects of translucence depth, set the transparency to a non-zero value. If the surface is supposed to be opaque, set the transparency to a very small value, such as 0.0001.

Translucence Focus

The **Translucence Focus** value controls how much translucent light is scattered depending on the direction of the light.

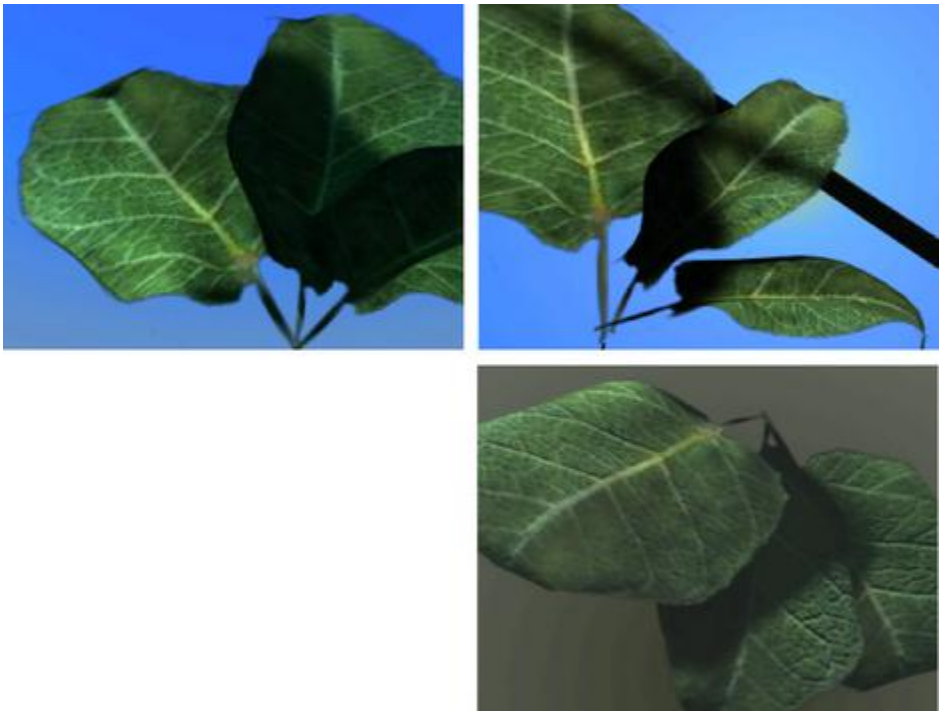


For example, use a high value for very thin materials, such as wax paper or steam, where most of the light is scattered over a small angle relative to the light’s direction. The object looks brightest with the light source directly behind it.

Note

When a spotlight is used to light an object with a translucent material, the light does not scatter past the light's cone of influence, even if **Translucence Focus** is lowered.

Use a mid-range focus value for items such as leaves. The leaves glow when backlit, but do not wash out when lit from the front.



Use a low focus value for thicker objects, such as wax. To compensate for the added light and avoid a washed out result, lower the diffuse value, or lower the overall color (which also affects ambient lighting).

Tip

Lower the color value for very shiny objects that have a bright specular component.

Raytrace Options (mental ray)

The **Raytrace Options** attributes control the appearance of a surface during raytracing only.

Raytrace Options attributes are available for **Anisotropic**, **Blinn**, **Lambert**, **Phong**, and **PhongE** material types.

Refractions

When enabled, rays that are traced through transparent or semi-transparent objects are refracted, or bent according to the material's refraction index.

Refractive Index

The amount that light rays bend when passing through a transparent object. A **Refractive Index** value of 1 does not bend light rays at all, so you need to set the index value higher than 1. **Refractive Index** values for common materials are: glass (1.6), air (1), water (1.333), crystal (2), diamond (2.417). The valid range is 0.01 to infinity. The slider range is 0.01 to 3, but you can type in a higher value. The default setting is 1.6.

Tip

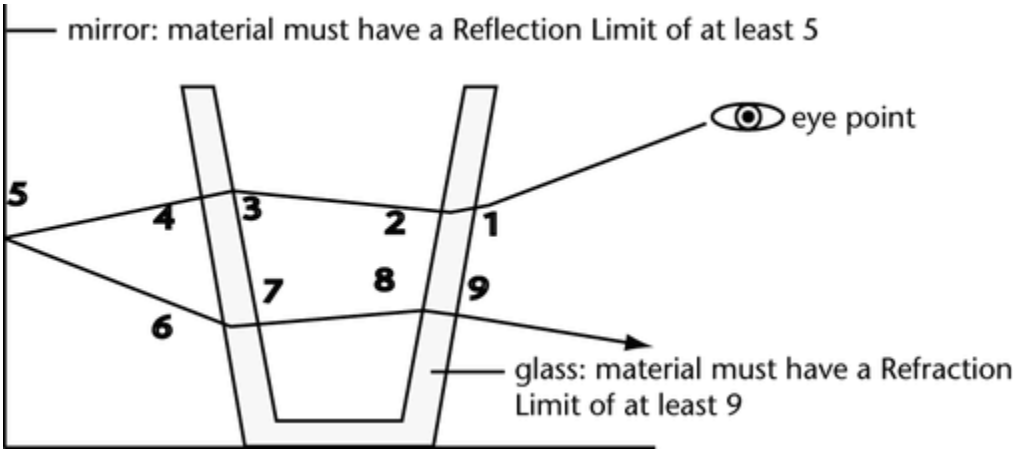
- The material's **Hypershade** swatch only approximates the effect of the **Refractive Index** attribute.
- Surfaces must have thickness for **Refractive Index** to have any effect. If a surface does not have thickness (for example, a plane or face element), set the **Refractive Index** value to 1.
- For best results, make sure there are suitable objects in the background to be refracted.

Refraction Limit

The maximum number of times the surface allows a light ray to be refracted. For example, if the **Refraction Limit** value is 10, the surface refracts light rays that have previously been refracted and, or reflected (off itself or off other surfaces) 9 times or less; the surface does not refract light rays that have previously been refracted and, or reflected 10 or more times. The valid range is 0 to infinity. The slider range is 0 to 10. The default value is 6. Increasing this value may significantly increase render times.

You must also consider the **Render Settings** window **Raytracing** refractions attribute too. Maya uses the lower value of the 2. For instance, if your limit is set to 9 on the material and 6 in the **Render Settings** window, a value of 6 is be used. See also, **Reflection Limit**

In the following example, a glass sits in front of a mirror.



The number of refractions includes both the entry and exit of a light ray from a surface having thickness.

The physical property **Total Internal Reflection** (TIR) can make some transparent objects appear not to refract light. This is caused by light rays reflecting inside the thickness of the object. If this occurs, increasing **Refraction Limit** has no effect because the **Reflection Limit** is stopping light rays before they can exit the surface. However, because TIR is a real-world property, you may want to keep this effect.

Tip

To simulate realistic looking glass, set the **Refraction Limit** value to 9 or 10.

Reflection Limit

The maximum number of times the surface allows a light ray to be reflected. For example, if the **Reflection Limit** value is 4, the surface reflects light rays previously reflected (off itself or off other surfaces) 3 times or less; the surface does not reflect light rays previously reflected 4 or more times. The valid range is 0 to infinity. The slider range is 0 to 10. The default value is 1.

Set the **Reflection Limit** value according to the material's **Reflectivity** value. For example, if the **Reflectivity** value is between 0 and 0.5, set the **Reflection Limit** value between 1 and 2. If the **Reflectivity** value is between 0.5 and 1, set the **Reflection Limit** value between 2 and 5.

High values for **Reflection Limit** greatly increase rendering time. Test render the scene using various settings, and use the lowest values that give you acceptable results. Even highly reflective surfaces rarely need a **Reflection Limit** value as high as 10 or more.

You must also consider the **Render Settings** window **Raytracing Reflection** attribute too. Maya uses the lower value of the 2. For instance, if your limit is set to 5 on the material and 1 in the **Render Settings** window, a value of 1 is used. See also **Reflection Limit**.

Reflection Specularity

This attribute is available for **Blinn** *,* **Anisotropic** *,* **Phong** *, and* **PhongE** *materials.*

Reduce this value to avoid highlight aliasing artifacts produced in reflections during raytracing because of very thin or small highlights. Maya adds **Reflection Specularity** to

each material to control the contribution of the specular highlights in reflections. The valid range is 0 to 1. The default is 1 (full contribution).

Light Absorbance

Describes how light-absorbing a material is. A material with an **Absorbance** of 0.0 transmits completely. The higher the value, the less light passes through.

Transparent materials generally absorb an amount of the light which passes through them. The thicker the material, less light gets through—the thinner the material, more light gets through.

Surface Thickness

The simulated thickness (in world space) of transparent objects created from single surfaces (for example, a NURBS plane, or polygon face).

Using **Surface Thickness** does not produce the same results as building a surface with actual thickness—the effect works well when the edges of the surface are not visible (for example, closed surfaces, or bounded shapes, like a car windshield).

Shadow Attenuation

Shadows of transparent objects are brighter in the center, simulating a light's focus. A setting of 0 results in constant intensity shadows. The focusing increases as the parameter increases from 0 to 1. The default value is 0.5. The amount of attenuation for a given light ray depends on the angle between the light ray and the surface normal of the transparent object: the greater the angle, the greater the attenuation. To turn off the shadow attenuation completely, set shadow attenuation to 0.

Chromatic Aberration

Different wavelengths of light refract at different angles when passing through a transparent surface during raytracing. **Chromatic Aberration** only affects light rays as they pass through the second surface of a transparent object (the first exit ray).

mental ray

For a description of mental ray attributes, see Surface materials mental ray attributes.