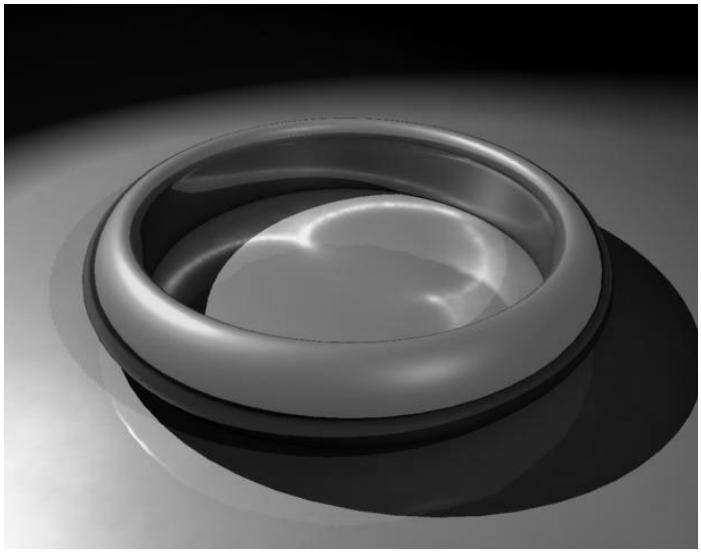

Lighting

Version 6

Cover image by Dan Pressman.

While every attempt was made to clarify in the documentation the differences between how Maya operates on the IRIX and Linux platforms, you may encounter subtle differences.

ALIAS ■ 210 KING STREET EAST ■ TORONTO, CANADA M5A 1J7

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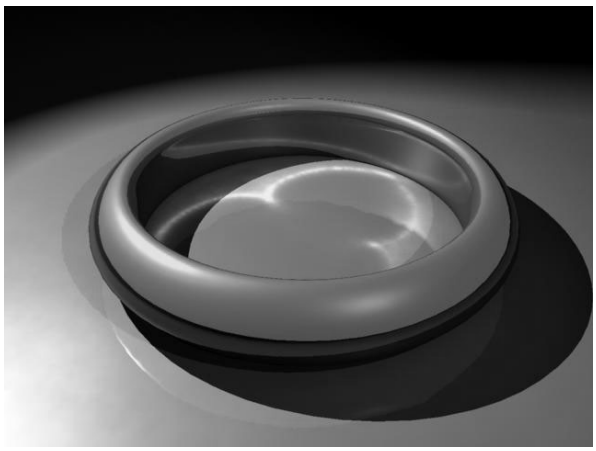
1 Lighting scenes

About

Light and shadow in the real world

In the real world, when light shines on a surface, the parts of the surface facing toward the light source appear illuminated, and the parts of the surface facing away from the light source appear dark. If one object is located between a second object and the light source, the first object casts a shadow onto the second object.



Example of caustics. Image by Dan Pressman

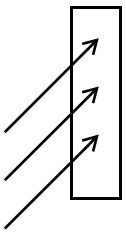
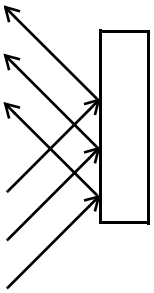
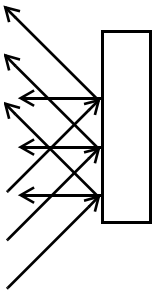
Related topics

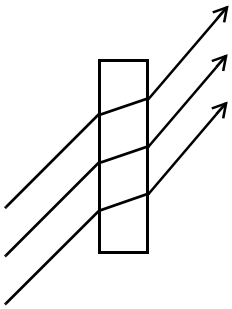
- "Absorption, reflection, and refraction of light" on page 9
- "Sources of direct light" on page 15
- "Indirect (global) vs. direct illumination" on page 13

Absorption, reflection, and refraction of light

The color of the objects we see in the natural world is a result of the way objects interact with light. When a light wave strikes an object, it can be absorbed, reflected, or refracted by the object. All objects have a degree of reflection and absorption.

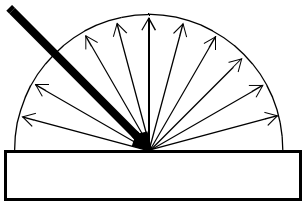
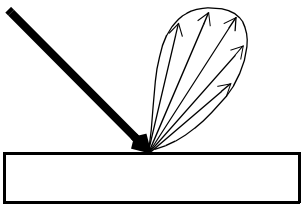
Note	In the natural world, light can also be transmitted by an object. That is, light can pass through an object with no effect (an x-ray, for example). These types of light, however, are not represented in Maya because they have no visual effect.

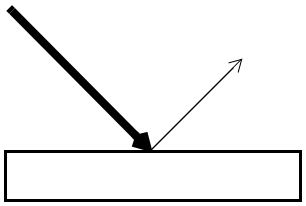
	Absorption. Light stops at the object and does not reflect or refract. Objects appear dark or opaque. Example: wood.
	Reflection on a smooth surface. Light bounces off the surface of a material at an angle equal to the angle of the incoming light wave. Example: mirrors or glass. See also "Diffuse, Specular, and Glossy reflection" on page 11.
	Reflection on a rough surface (also called Scatter). Light waves bounce off at many of angles because the surface is uneven. Example: the earth (that's why the sky is blue). See also "Diffuse, Specular, and Glossy reflection" on page 11.

	Refraction Light goes through the object and bends at an angle. Example: diamond (greater angle) or water (lesser angle) See also "Diffuse, Specular, and Glossy refraction of light" on page 12.

Diffuse, Specular, and Glossy reflection

Reflection is divided into three types: diffuse, specular, and glossy.

	Diffuse reflection. Diffuse surfaces reflect (scatter) light in many angles. Diffuse reflection accounts for more of the color than any other type of distribution because most objects are opaque and reflect light diffusely.
	Glossy reflection. Glossy surfaces are actually specular surfaces with micro surfaces at angles to surface plane. These micro surfaces reflect light not only specularly but also diffusely (at angles very close to the specular transmission), giving the surface a glossy appearance.

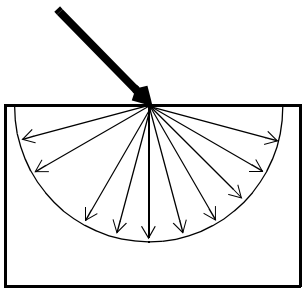


Specular reflection.

Specular surfaces reflect light at the same as the angle at which the light strikes the surface.

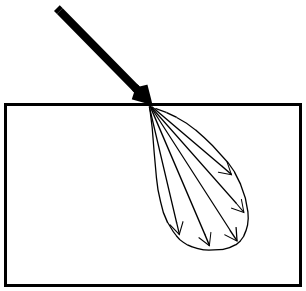
Specular reflection gives objects a glossy or mirror-like appearance.

Diffuse, Specular, and Glossy refraction of light



Diffuse refraction.

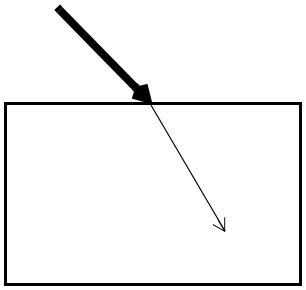
Diffuse refraction scatters light in many angles.



Glossy refraction.

Glossy surfaces are actually specular surfaces with micro surfaces at angles to surface plane.

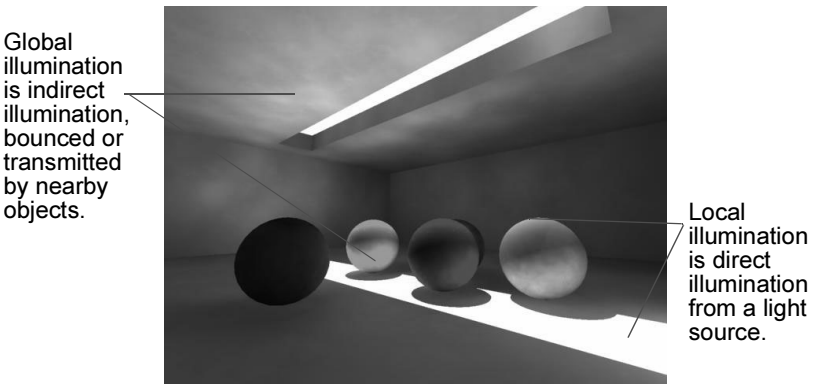
These micro surfaces refract light not only specularly but also diffusely (at angles very close to the specular transmission), giving the surface a glossy appearance.

	Specular refraction. Specular surfaces reflect light at the same as the angle at which the light strikes the surface.

Related topics

- "Indirect (global) vs. direct illumination" on page 13
- "Create a Maya light source" on page 39

Indirect (global) vs. direct illumination



Indirect (Global illumination)

Indirect light is all the inter-reflected light in a scene. Global illumination is an approximation of real-world indirect light transmission.

With global illumination, the contribution of bounced light from other surfaces in the scene is used to calculate the overall light contribution and the color values at points on objects that are not directly illuminated (that is, at points that do not receive light directly from a light source, such as a spot light).

Global illumination occurs when light is reflected off of or transmitted through an opaque (reflection only), transparent or semi-transparent surface (see Diffuse, Specular, and Glossy refraction of light) from a surface to bounce off or be absorbed by another surface.

Examples:

- A crack at the bottom of a door can cause light to spill into a room.
- White walls reflect light from the light source to another surface in a room.
- A body of water can transmit light from its surface to the floor. (This is an example of Caustics, a form of global illumination.)

Local illumination (Light sources)

Local illumination is only the light provided directly from a light source (such as a spot light).

Direct light is emitted from a light source and travels in a straight path to the illuminated point (either on a surface or in a volume).

Examples:

- A spot light illuminates an actor on stage
- Sunlight shines directly on sunbathers

With direct illumination only each light source's contribution is used to calculate the overall light contribution to any given illuminated point. For more information about mental ray for Maya direct lighting, see "Direct light sources" on page 15.

Related topics

❖ "Absorption, reflection, and refraction of light" on page 9
❖ "Global illumination" on page 21
❖ "Caustics" on page 22
❖ "Colour bleed" on page 23
❖ "Final gather" on page 29
❖ "High Dynamic Range Imaging (HDRI)" on page 31
❖ "Participating media" on page 24
❖ "Global illumination and caustics workflow" on page 60

Direct light sources

Sources of direct light

Maya has a number of light sources that let you achieve a wide variety of lighting effects.

Without no light sources to your scene, your scene would render black because there is no light to illuminate objects (see "Default lighting in Maya" on page 17). By controlling its intensity, color and direction, light becomes a key factor in creating a scene in Maya.

With Maya, you have much more control over the placement, intensity, and characteristics of lights than you do with real-world lights. Shadows, specular highlights, diffuse, and glow all contribute to how light affects a scene.

Area Light source

Directional Light

Ambient Light

Spot Light source
(can be turned into a mental ray for Maya area light)

Point Light source
(can be turned into a mental ray for Maya area light)

Volume Light source

Images by Alan Opler

Related topics

- "A typical direct light/shadow workflow" on page 38
- "Create a Maya light source" on page 39

mental ray Area Light

Though you can render Maya's area light source with mental ray for Maya, it can be used only as a direct light source. If you want to render an area light source with mental ray for Maya to achieve indirect illumination (for example, to create the most realistic soft shadows), you must use a mental ray for Maya area light.

You create a mental ray for Maya are a light by turning a Maya point light or spot light into one. See "Create a mental ray area light source" on page 41.

The mental ray for Maya area light works by casting rays from sample points on the light to create smooth shadows.

Note	You cannot use a Maya area light to create a mental ray for Maya area light.

Default lighting in Maya

By default, Maya scenes do not contain light sources.

However, Maya's *default lighting* helps you to visualize objects in Shaded display in the Scene view (press 5). If you turn default lighting off and have no lights in the scene, the scene appears black.

To turn lights on or off, if for example, you want to see or render incandescent objects (for which no lighting is required), see "Turn default lighting on or off" on page 42.

Default light source at render time

If you render a scene without a light, Maya creates directional light during the render so that your objects can be seen. Without it, your objects would not be illuminated; that is, your render would be black.

This default light is parented to the rendered camera. The entire scene is illuminated no matter where the camera is facing. The surface areas directly facing the camera are bright while the surface areas hidden from the camera are dark. This provides surface contours that look realistic.

After the render completes, Maya removes the default light from the scene.

Note	The IPR default light source that is added to the scene during rendering operates much the same way as the Maya default light source at render time. • The IPR default light source is removed from the scene as soon as the IPR session is terminated (for example, when you click the IPR stop button). • The IPR default light source is not saved with the scene, preventing you from accidentally adding the IPR default light to their saved scene.

Light decay

In the real world, a light's brightness is strongest at the light source and decreases or *decays* further away from the light source. In Maya, a light's brightness decays only if decay is turned on (see "Decay Rate" on page 99). The light's color, however, remains the same no matter how far it is from the light source.

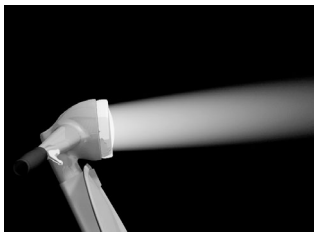


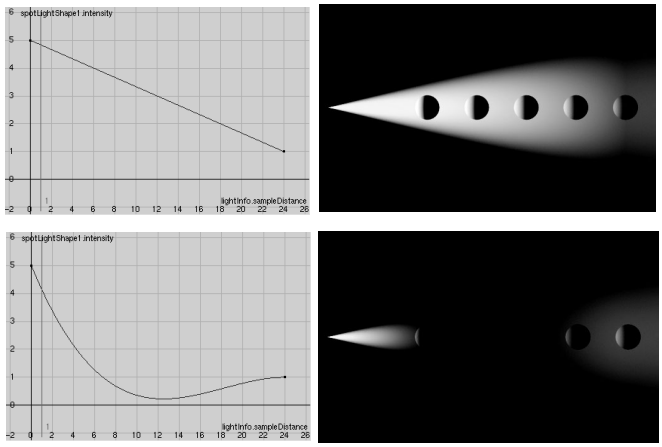
Image courtesy of The Art of Maya

In Maya, you can select a preset brightness decay rate by setting the Decay Rate attribute. The preset brightness decay rates are usually good enough to create most types of lighting effects. In some cases, however, you may want to create a unique type of brightness decay.

Related topics

- "Move the Decay regions of a spot light" on page 45
- "Interactively set decay regions" on page 50.

Custom intensity and color decay rates



Images courtesy of The Art of Maya

You can also create decay effects not seen in the real world. For example, you can use a custom Intensity curve to make a spot light's brightness *increase* further away from the light source, or you can use a custom Color curve to make the color of a spot light change with distance.

Note	You can use this technique only for a Spot Light.

Intensity curves and color curves are graphical representations of a light's brightness and color with distance. You can use the Graph editor to view them . The vertical axis represents the intensity or color intensity value, and the horizontal axis represents distance from the light source. (Intensity curves and color curves are similar to animation curves, except the horizontal axis of an animation curve represents time.)

Related topics

❖ "Create custom spot light intensity or color decay" on page 52.

Light linking

When you create a light source, the new light source illuminates all surfaces in the scene by default (assuming you set the light source's properties appropriately). Similarly, when you create a surface, all lights in the scene illuminate the new surface.

You can link lights with surfaces so that only a specific light (or group of lights) illuminates a specific surface (or group of surfaces), or, conversely, only a specific object (or group of objects) receive illumination from a specific light (or group of lights).

Light linking can help you render scenes more efficiently and quickly. You can create light sets to control the relationship between lights and objects in complex scenes.

Related topics

- "Determine a light's area of illumination" on page 46.
- "Link light sources to surfaces" on page 46
- "Link sets of lights and objects" on page 46
- "Select objects illuminated by a specific light" on page 48
- "Select lights illuminating a specific object" on page 48

Glows, halos, and lens flares

Any light visible to the camera lens has the potential to produce an optical effect. You can use the Optical FX utility to create glows, halos, or lens flares on any light source that shines directly into the camera. See "Glow nodes" on page 122 for details.

Note	You can also control how the glow from one surface affects the intensity of another's surface glow (see "Create environments that glow" on page 58) or create illuminated fog for a particular light (see "Create illuminated fog" on page 59).

How glow works in animation

Especially in animations, light sources may become blocked (occluded) by moving objects. In the real world, the gradual movement of the objects cause the optical effect of a light glow to diminish gradually. However, in computer graphics, the light glow may suddenly disappear, which seems unnatural to human eyes.

In Maya, when you add a glow to a light, a geometry object is automatically created to compute the percentage of visibility of the light to help minimize the unnatural disappearance of computer-generated glow.

- For spot lights, a disc or circle (directedDisc) is created.
- For point lights, a sphere (renderSphere) is created.
- For area lights, a rectangle (renderRect) is created.

To change the size of the glow object, see "Adjust the size of the glow object" on page 58.

Related topics

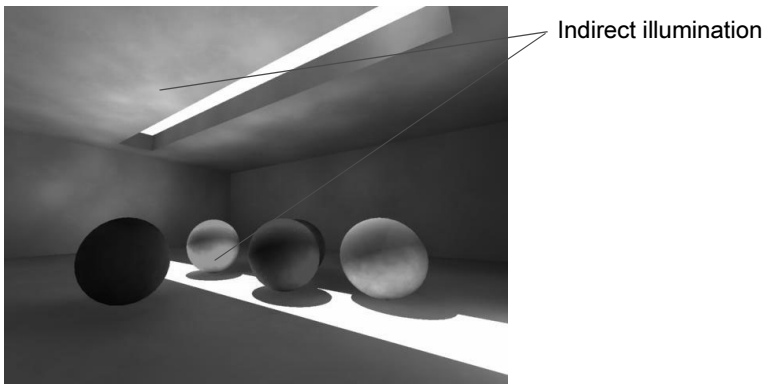
❖ "Glow nodes" on page 122 for details.

Global illumination and caustics

Global illumination

Note	You can render Global Illumination only with the mental ray for Maya renderer.

Global illumination is the technique used to capture indirect illumination, the natural phenomenon where light bounces off anything in its path until it is completely absorbed.



(Images by Dan) Pressman

Global illumination lets you achieve realistic, real-world lighting conditions, which is particularly good for:

- Architectural visualizations and industrial design projects that require physically accurate lighting.
- Entertainment projects that require credible, but not necessarily physically accurate, lighting.

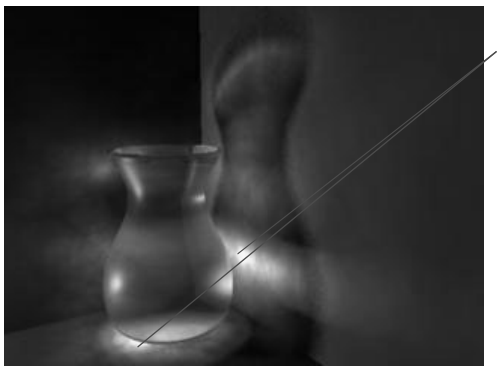
mental ray for Maya creates Global illumination by tracing the paths of photons and recording their bounce points in a photon map.

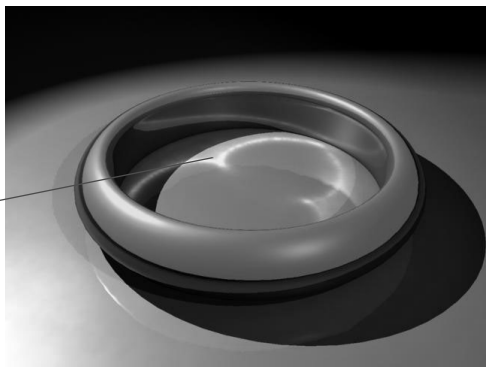
Caustics, focused light effects, are form of global illumination.

Related topics

- ″Indirect (global) vs. direct illumination″ on page 13
- ″Caustics″ on page 22
- ″Colour bleed″ on page 23
- ″Participating media″ on page 24
- ″Photon tracing″ on page 25
- ″Render with global illumination″ on page 64

Caustics





Note	You can render Caustics only with the mental ray for Maya renderer.

Caustics are light effects that caused by specularly (as opposed to diffusely) reflected or refracted light.

- Refracted caustics happen when specularly transmitted light bends through a transparent or semi-transparent object or volume onto a diffuse surface.
- Reflected caustics happen when specularly reflected light bends through a transparent or semi-transparent object or volume onto a diffuse surface.

Note	In the natural world, caustics are actually a form of global illumination, but they are treated separately by mental ray for Maya, making it easier for you to control them.

Related topics

❖ "Diffuse, Specular, and Glossy reflection" on page 11
❖ "Diffuse, Specular, and Glossy refraction of light" on page 12
❖ "Render with Caustics" on page 65

Colour bleed

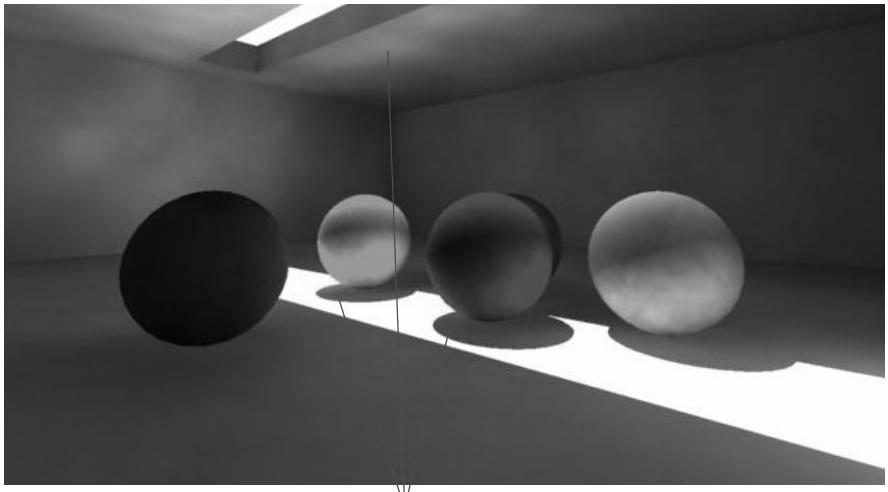
Color bleeding is a global illumination effect where reflected light projects some of the object's diffusely (as opposed to specularly or glossily) reflected color onto a nearby surface.

An object's diffuse color is partially reflected while the rest of the colors are absorbed. The light that is reflected can project some of the diffuse color onto the object next to it.

For example, a bright red apple on a pure white table cloth 'spills' red onto the table cloth.

Related topics

❖ "Absorption, reflection, and refraction of light" on page 9
❖ "Tweak color bleed" on page 65



(Image by Dan Pressman)

Participating media

Note	You can render participating media only with the mental ray for Maya renderer.

Participating media is a form of indirect illumination where light interacts with particles that occupy a space, rather than with a surface. In Maya, photons interact with volumetric effects that participate in the transport of light by absorbing some of the light.

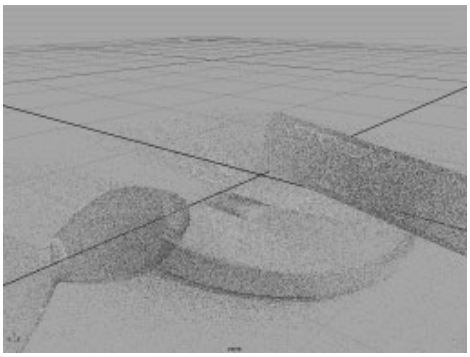
Example of participating media are shafts of light in a dusty barn or the glow around beam of light from a car headlight.

Participating media works similarly to the way global illumination works on surfaces, except that volume shaders and volume photon shaders are required.

Participating media can disperse volumetric caustics too.

Photon tracing

Photon maps



Tip	To see the distribution of photons for global illumination, you can generate a 3-dimensional visualization map in shaded or wireframe scene views. For more information, see the What's New guide.

Photon maps are:

- Required to produce global illumination and caustic effects. (They are not required for Final Gather.)
- A 3D representation of the accumulated light energy at certain photon bounce points.
- Conceptually similar to shadow maps, but they capture light instead.
- Created during the Photon tracing stage.
- Used by the material shaders for those surfaces that participate in global illumination at render time to calculate the contribution of Global illumination and caustics. (This is added to any contribution provided by local (direct) illumination in the scene.)

GI photon maps vs. caustic photon maps

Photons that are specularly reflected or refracted are stored in the caustic photon map; all other photons are stored in the global illumination map.

As the Shinyness parameter of the photon shader attached to an object increases, specular highlights become smaller and the likelihood of specular reflection increases. In this case, more photons migrate from the global illumination map into the caustic photon map, decreasing the

density of the global illumination map. (Similar considerations apply to the Translucence parameter, but in the opposite direction: when Translucence is increased, photons migrate from the caustic photon map into the global illumination photon map.)

- If there are not enough photons stored in the global illumination photon map, mental ray for Maya warns (in the status bar) that no photons are stored.
- If a scene is dominated by specular reflection but caustics are turned off, a significant amount of illumination won't show in the rendered image.

  In these cases, you need to:

  - Turn on caustics
  - Make sure the light(s) emit causticphotons

Tip	You can save a photon map and reuse it, either in later frames in a render, or in a different render at a later time.

Related topics

❖ "Photon tracing" on page 26.

Photon tracing

Photon tracing creates a photon map (see "Photon maps" on page 25), which is used by mental ray for Maya to render global illumination and caustics.

Photons work as follows:

- Light sources can emit photons (packets of energy).See "Turn on photon emission for a light source" on page 61.
- Photons bounce around in the scene until the Max Photon Depth is met.
- Photos can be reflected off of surfaces.
- Photons can be refracted (transmitted) through surfaces.
- Each time a photon hits a surface, the value of the incoming energy is stored in the photon map (provided Conditions for photon storage are met).

To turn on photon tracing, see "Turn on photon emission for a light source" on page 61.

Conditions for photon storage

Photons are stored only if the following conditions are met:

- The surface must have a diffuse component.

  All Maya materials (Lambert, Blinn, etc.) store photons, as long as the Diffuse attribute is not set to 0.

  Some custom mental ray for Maya shaders do not store photons.
- The photon has bounced at least once.

  The first surface hit, the illumination of which is handles by direct (not indirect) illumination, is not stored in the map.
- The Max Photon Depth, the setting that controls the number of times photon bounce around in scene, has not yet been met.
- Directional light sources are not used. (Use either a point light for interior volumes [because they emit in all directions] or a spot light.)

  Photons have both a direction and a position; directional lights have only a direction, so mental ray for Maya can't determine the position of photons. As a result, too many photons are emitted but not recorded in the photon map, rendering resources are wasted, and artifacts can appear.
- For limitations of photon tracing, see "Troubleshoot:Photon tracing limitations" on page 86.

Advanced information about photon tracing

For general information about photon tracing, see "Photon maps" on page 25.

Some photon shader parameters work a little differently than their Maya counterparts. Besides carrying color (or other relevant) information, some parameters also determine the probabilities of how photons interact with objects.

These probabilities (P) are computed as follows:

```
P3 = P(transmission)
       = INTENSITY(transparency)
       P(diffuse transmission)
              = translucence
       P(specular transmission)
              = 1 - translucence
P2 = P(specular reflection)
       = reflectivity * INTENSITY(specularColor)
P1 = P(diffuse reflection)
       = diffuse * INTENSITY(color) * (1 - INTENSITY(transparency))
P0 = P(absorption)
       = absorbs * (2.0 - P1 - P2 - P3)
```

The interaction with the highest P-value is most likely to be chosen. So, the ratios of the P-values determine what fraction of the incident photons are refracted (transmitted), reflected, and absorbed, respectively. The probabilities match the Maya materials in that derivation from Maya will give satisfactory results.

Note first that photons are only stored when hitting a diffuse surface. So if P1 is zero for a specific instance, no photons are stored. To improve performance, you should disable the Globillum/Caustic Receiver.

Translucence determines what fraction of all refracted (transmitted) photons are diffusely transmitted and translucenceFocus controls the diffusity.

Absorption takes place only if the intensity of each color involved is less than one and Diffuse and Reflectivity are within the prescribed range.

If the probability for specular reflection P2 is greater than zero, either a non-zero Shinyness (isotropic), or non-zero spreadX and spreadY (anisotropic) must be specified.

Examples

Diffuse green reflection with red diffuse transmission

```
absorbs         on
diffuse         1.5
color           0.0 1.0 0.0
transparency    1.0 0.0 0.0
translucence    1.0

1/6 diffuse transmission
1/6 diffuse reflection
2/3 absorption
```

Full specular refraction (caustics)

```
refractions     on
refractiveIndex 1.5
transparency    0.9 0.9 1.0

1/1 specular transmission
```

Diffuse green reflection with specular isotropic blue reflection

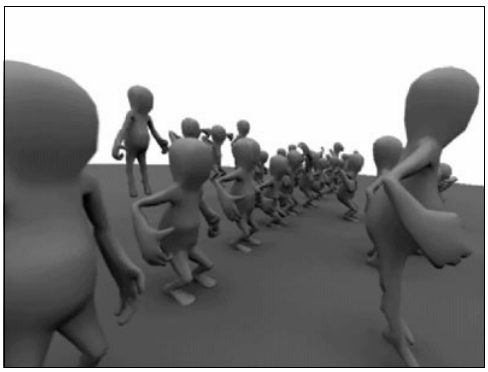
```
reflectivity   0.8
specularColor  0.7 0.7 1.0
whiteness      1.0 1.0 1.0
shinyness      20.0
diffuse        0.2
color          0.4 1.0 0.4

3/19 diffuse  reflection
```

16/19 specular reflection

Final gather and HDRI

Final gather



Example of final gather to illuminate a scene
Image by Dan Pressman

Final gather is method of simulating global illumination.

On its own, Final Gather is a fast and easy way to achieve good illumination results for architecture visualization and entertainment scenes that require credible, but not necessarily physically accurate, lighting.

When used in combination with global illumination, Final Gather lets you create the most realistic, physically accurate lighting conditions for a scene.

Note	Though you can use Final Gather with direct illumination to produce good results quickly and economically, use Final Gather with global illumination to produce the most physically accurate lighting for a scene.

With Final Gather, you can:

- Create very (or purely) diffuse scenes where the indirect illumination changes slowly.

  For example, an opening garage door that allows light to spill into the garage, or dawn before the sun rises above the horizon.
- Produce very soft shadows efficiently

- Eliminate or even out dark corners
- In conjunction with Global Illumination, effectively illuminate interiors (using Global Illumination alone can sometimes give splotchy results)

To render with Final Gather, see "Render with final gather" on page 67.

How Final Gather works

When Final Gather is enabled, every object effectively becomes a source of ray-emitting light, mimicking the natural world in which objects influence the color of their surroundings. When one light ray strikes an object, a series of secondary rays are diverted at random angles around it to calculate the light energy contribution from the surrounding objects. The light energy is then evaluated during the ray tracing process to add the effect of the bounced light.

Unlike Global Illumination, Final gather does not use photon maps to calculation of light at a given point in scene. Instead, mental ray for Maya samples the surrounding area above every point in the scene. The illumination at those points is then computed as direct illumination. (If Global illumination is also being used at the same time, Final Gather calculates the total incoming illumination in the scene [called irradiance].)

Final Gather rays are emitted in many directions from a sample point and stop according to the settings in the Final Gather section of the Render Globals Setting window. Because Final Gather rays do not bounce, secondary surfaces are not taken into consideration. (However, when rays hit geometry, material shaders may cast secondary reflection, refraction, or transparency rays, as long as those secondary rays are specular or glossy, not diffuse.)

Final gathering eliminates the low-frequency variation in the global illumination that often results if too few photons are used. (Performance is optimized because mental ray for Maya reuses and interpolates nearby final gathers.)

Final Gather and Global Illumination

You can combine Final Gather and Global Illumination techniques to:

- achieve realistic lighting and shadows more cost effectively
- reduce flicker in animations.
- effectively illuminate interiors (global Illumination on its own can sometimes render splotchy results.)

You can reduce the number of Global Illum Photons, the Global Illum Energy levels, and the number of Final Gather Rays resulting in less rendering time, but more realistic lighting.

To create global illumination, see "Render with global illumination" on page 64.

Related topics

- "Irradiance as the source of light" on page 31
- "Render with final gather" on page 67

Irradiance as the source of light

You can render a scene with Final Gather without a single light source. In this case, the scene is illuminated by the scene irradiance or total incoming irradiance instead of surrounding surfaces. You can provide irradiance information by:

- Adjusting the material's Ambient Color attribute (found in the Common Material Attributes section of that material's Attribute Editor).
- Adjusting the material's Incandescence attribute (found in the Common Material Attributes section of that material's Attribute Editor).
- Mapping a file texture to the material's Irradiance attribute (found in the mental ray section of that material's Attribute Editor). For example, you could import an image or series of images (to use as file textures) that mimic the emerging light at early dawn, before the sun (direct light source) has risen.

  The Irradiance Color attribute lets you control the effect of color bleeding.

Related topics

- "Final gather" on page 29

High Dynamic Range Imaging (HDRI)

Image courtesy of Amy Quek

You can use Final Gather to produce image-based lighting (or reflection) with a High Dynamic Range Image (HDRI). Image-based lighting takes the light (and light color) represented in an image you provide to illuminate the scene. An HDRI image has an extra floating point value associated with each pixel that is used to define the persistence of light at that point.

A high-dynamic range image is like several images with different exposures combined to show the full range of light (highlight and shadow). In fact, some HDR images are created by compositing several standard images of varying (bracketed) exposure in a special HDR application. This is required to simulate the wide range of available light in a single image -- an HDR image.

Tip	To understand the concept of High Dynamic Range (HDR) images, first think of a cathedral in which bright light spills in through an open door and illuminates part of the interior, except for some of the darker corners. If you were to enter the structure, your eyes would adjust to compensate for the excess or lack of light so that you can see properly. HDR images have a greater capacity to describe light accurately (by way of floating point numbers) because they store the amount of light (rather than just color) represented in a pixel. This prevents 'blown out' or extremely dark areas in an image that your eyes compensate for in the natural world.

Using HDR images with Final Gather lets you provide extremely realistic lighting.

To use HDRI images as sources of light and reflection, see the What's New guide.

Related topics

- "Render infinitely distant (sky-like) illumination and reflection" on page 70
- "Render finitely distant illumination and reflection" on page 70

Shadow

Shadow in Maya

Shadows work with lights to add realism to your scenes. Shadows help to define the location of objects, whether they rest on the ground or hover in space, for example. Shadows can be soft-edged or hard-edged, and their presence (or absence) can be used to add balance and contrast to objects in your scene.

To create a shadow, a scene must contain a shadow-casting light, a shadow-casting surface, and a shadow-catching surface. The light must illuminate both the shadow-casting surface and the shadow-catching surface.

Default shadowing (none)

By default, lights in Maya do not cast shadows. You need to specify which, if any, lights cast shadows in your scene, depending on your visual goals. Too many shadows can clutter your scene, and since they take time to render, you may want to use as few shadows as necessary.

If no lights in your scene cast shadows, all surfaces facing a light source are illuminated, even if obstructed by another surface. (When light shines on a surface in Maya, the parts of the surface facing toward the light source appear illuminated, and the parts of the surface facing away from the light source appear dark.)

You can, however, add shadows by controlling which combinations of lights and surfaces can produce shadows. Typically, you only want a few specific lights and surfaces to produce shadows. By limiting shadows only to these specific lights and surfaces, you can help reduce rendering times.

Note	In Maya, surfaces that are not illuminated are not considered to be shadows. For example, all surfaces facing *away* from a light source are not illuminated.

Related topics

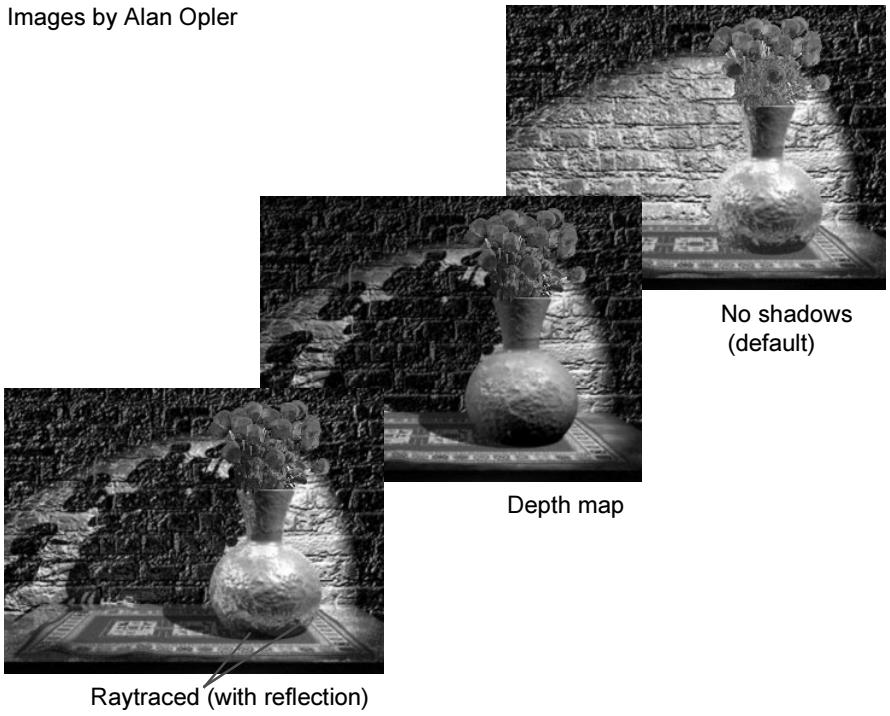
- ”Depth map and raytraced shadows” on page 34
- ”mental ray shadow maps” on page 37
- ”Cast shadows” on page 71
- ”Control which objects cast shadows” on page 71

Depth map and raytraced shadows

In Maya, an individual light source can produce no shadows (default), depth map shadows or raytraced shadows. You can combine depth map shadow casting lights and raytraced shadow casting lights in a scene.

Adjusting the attributes of depth map shadows or raytraced shadows can simulate shadows from many different types of real-world light sources and objects.

Depth map shadows and ray traced shadows produce similar results, though depth map shadows usually take less time to render. Generally, choose depth map shadows unless they cannot accomplish your visual goal.



Depth map shadows

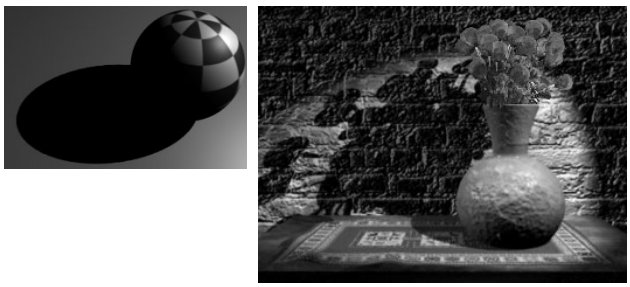


Image of flowers
by Alan Opler

Depth map shadows produce very good results in almost all situations, with marginal increase to rendering time.

A depth map represents the distance from a specific light to the surfaces the light illuminates. A depth map is an data file that contains the depth data rendered from a light's point of view. Each pixel in the depth map represents the distance from the light to the nearest shadow casting surface in a specific direction.

To create depth map shadows, see "Render depth map shadows" on page 72.

If a scene contains a depth map shadow casting light source, Maya creates a depth map file (stored as a Maya IFF File) for that light source during rendering and uses the depth map file to determine which surfaces are in shadow. In some cases, you can reduce rendering times by saving and reusing a depth map. To find out how to reuse depth maps, see "Reuse depth maps" on page 73.

Raytraced shadows

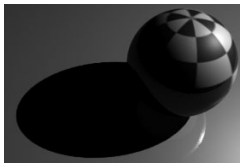


Image of flowers
by Alan Opler

Raytraced shadows can produce soft and transparent shadows but can be very time consuming.

Raytracing is a type of shadow rendering where the path of individual light rays are calculated from their source (the light) to their destination (the camera).

Use raytraced shadows only to produce more physically accurate shadows (like those in the real world). Common purposes include:

- (for area lights only) where shadows blur and become lighter as they increase in distance from the object
- to produce shadows from transparent colored surfaces
- to produce soft-edged shadows (though depth maps can also produce good results)

To create raytraced shadows, see "Render raytraced shadows" on page 75.

Note	You can see depth map shadows in Interactive Photorealistic Rendering (IPR) but you cannot see raytraced shadows. You must render the scene in order to visualize raytraced shadows. See *"Visualize interactively with IPR"* in the Rendering guide for information about visualization.

Related topics

- "Shadow in Maya" on page 33
- "Render depth map shadows" on page 72
- "Render raytraced shadows" on page 75

Shadow catching

You can render out shadows separately from everything else. This is important in many cases, for example, if you want to blur shadows. In a composition you can soften, blur, brighten or change the color of shadows to match whatever it is they are composited against.

To catch shadows, see "Catch shadows for an alpha channel" on page 75.

mental ray shadow maps

You can turn on Shadow Maps so mental ray generates shadow maps. To turn on shadow maps for mental ray, see "Render depth map shadows" on page 72.

Related topics

- "Shadow in Maya" on page 33

How do I? Apply and adjust basic direct lighting

Plan light sources

Consider the following when planning the lights in your scene.

The purpose of light sources

Character or object illumination typically includes the following lights:

- A *key light* is the main light that illuminates the character or object. For outdoor scenes in the real world, the key light is generally the sun.
- A *secondary light*, often called a fill light because it fills in dark areas.
- *Backlights*, if necessary, to distinguish the character or object from the background.

The characteristics of light sources

Consider the following characteristics of a light source when planning your scenes.

Softness or hardness

Hard light produces sharp shadow lines. Hard light sources typically include light bulbs, bright sun, and flash lights.

Soft light is diffused and produces soft edges. Soft light sources typically include light shining through fabric (like drapes), reflected light, or sunlight diffused through clouds.

Color

Color and temperature are closely related. A red spot light shining on a blue object may make it look black. Some common objects, like street lamps may be tinted yellow.

Temperature

Soft orange light feels warmer than blue-green light.

Intensity

The intensity of a light source is how bright it is. For example, bright high-noon sunlight usually is more intense than a small electronic LED. The intensity with which a light illuminates a subject appears to lessen (or decay) as the subject moves farther away from the light.

Movement

Lighthouse lights rotate. Flashlights might swing from a rope.

A typical direct light/shadow workflow

Generally, a typical workflow to set up direct light sources is as follows:

1. Plan first to determine the look and feel of your scene and how it's reflected in the light sources chosen.

   See "Plan light sources" on page 37.

2. Create light sources.

You can create various types of light sources for your scene and set attributes (options) that further define their characteristics. You can adjust the qualities of the lights you've added by changing the settings in the Attribute Editor and the Channel Box.

To add a light source to a scene, see "Create a Maya light source" on page 39.

To adjust the attributes of a light source, see "Adjust a light source's attributes" on page 40.

3 Move light sources in the scene and otherwise control them with precision (optional).

To move a light source from one place to another, see "Move a light source to another location" on page 41.

To control lights with precision, see "Control light sources with precision" on page 42.

Note As you light your scene and objects (and otherwise build your scene), you visualize (preview render) the scene to check the look and feel and accuracy of the way the light renders. To preview render a scene, see *"Visualize interactively with IPR"* the Rendering guide.

4 Cast shadows.

By default, lights do not cast shadows in Maya. You can specify which lights cast shadows and choose which method Maya uses to generate them: raytracing or depth maps.

To cast shadows, see "Cast shadows" on page 71.

5 Create optional light effects such as glows, halos, or lens flares.

To create light effects, see "Create glows, halos, or lens flares" on page 56.

Create a Maya light source

When you create a light, it is automatically added to the center of a scene. A light's default options determine how the light affects the scene and whether or not it casts shadows, but you can (and typically do) change most of these options on a per-light basis by adjusting the light's attributes (see "Adjust a light source's attributes" on page 40).

You can make a one-time change to the default options of a type of light before you add the light, or you can adjust the options to change the way all subsequent lights you create look and work.

Note	Avoid instancing lights. This is particularly important for shadow depth maps and light fog. Copy the lights instead of instancing. For light fog, make sure that light fog is duplicated independently of the light because when you duplicate a light, its light fog is *not* duplicated with it.

To create a light

- Do one of the following:
  - From the Create > Lights menu, select the type of light you want to create. The light is automatically added to your scene.
  - In the Hypershade, click the title of the Create Bar, select Create Maya nodes, then select the type of light you want to create.
  - Click the light icon on the Render shelf.

To set light options before you create the light

- From the Create > Lights menu, click the ❐ next to the name of the light for which you want to set options.

  For a description of the light options, see the following for the light you want to create:
  - "Create > Lights > Directional lights > ❐" on page 87.
  - "Create > Lights > Ambient Light > ❐" on page 89.
  - "Create > Lights > Area lights > ❐" on page 90.
  - "Create > Lights > Point Light > ❐" on page 91.
  - "Create > Lights > Spot Light > ❐" on page 92.
  - "Create > Lights > Volume Light > ❐" on page 94.

Related topics

- "Sources of direct light" on page 15
- "mental ray Area Light" on page 17

Adjust a light source's attributes

You can adjust basic attributes of a light, such as type, color, and intensity.

To change attributes of a light in your scene

- Do one of the following:

- Select the light icon in a view and select Window > Attribute Editor.
- Double-click the light icon in Hypershade light tab or work area.

For a description of the light source's attributes, see "Light nodes" on page 97.

Related topics

- "Sources of direct light" on page 15
- "Create a Maya light source" on page 39
- "Control light sources with precision" on page 42

Create a mental ray area light source

Create a mental ray for Maya area light by turning a Maya point light or spot light into one.

To create a mental ray area light

1. Add, then select a Maya point or spot light in the scene.
2. Open the Attribute Editor (Ctrl+a).

   The Attribute Editor displays the selected light's attributes.
3. Click the lightShape tab, expand the mental ray section, then expand the Area Light subsection.
4. Turn on Area Light.
5. Adjust the Area Light settings as desired, making sure to turn on the Visible flag if you want to make the area light visible in the final rendering. (Typically, light sources only illuminate a scene and are not visible to the camera. If you want a light to be visible (a table lamp or light bulb, for example), you need to make it explicitly visible. This does not affect the light contribution of the light.)

   See "mental ray attributes (point, spot, directional)" on page 108.

Related topics

- "mental ray Area Light" on page 17

Move a light source to another location

Each type of light is represented by a different icon in the scene views. Like any other object in your scene, you can select a light and move, scale, or rotate it interactively with a manipulator or with numerical precision by changing the values in the Channel Box. To work with a camera this way, see *"Use manipulators"* the *Basics* guide.

To direct the light emitted from a light source and otherwise position features of lights (such as a camera's pivot point), see "Position features of a light interactively" on page 42.

Turn default lighting on or off

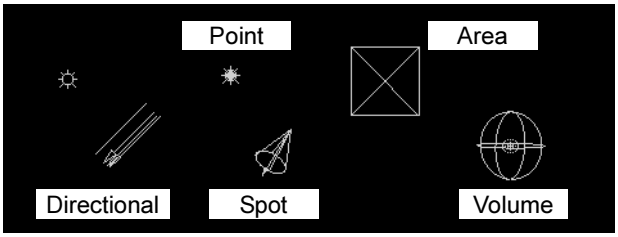
For more information about default lighting, see "Default lighting in Maya" on page 17.

To turn default lighting off or on, turn on the Enable Default Light check box in the Render Options section of the Render Global Settings window. Enable Default Light is on by default.

Control light sources with precision

Position features of a light interactively

Show, hide, or resize a light manipulator



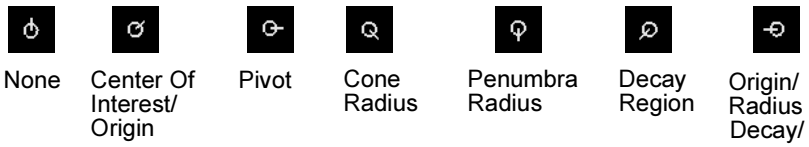
You can interactively adjust the attributes of certain light sources in a view using light manipulators. Light manipulators display in scene views (or, in some cases, the light source's view, if you look through the light source). You can:

- "Move the center of interest or origin" on page 43
- "Move the pivot point" on page 44
- "Move the Cone Radius of a spot light" on page 44
- "Move the Penumbra Radius of a spot light" on page 44
- "Move the Decay regions of a spot light" on page 45
- "Move barn doors (shutters) of a spot light" on page 45

To show a light manipulator

1. Select a light's icon.
2. Click the Show Manipulator Tool button from the toolbox to see the light's manipulator (or press the hotkey t).

3 Click the Index manipulator to display each of the different types of light manipulators. The position of the dash on the Index Manipulator indicates which manipulators display.



To display a specific light manipulator

1 Select a light.

2 Click Display > Camera/Light Manipulator, then select a manipulator.

To hide light manipulators

- Select Display > Hide > Light Manipulators.

To change the size of a light manipulator

- Press - (decrease) or = (increase).

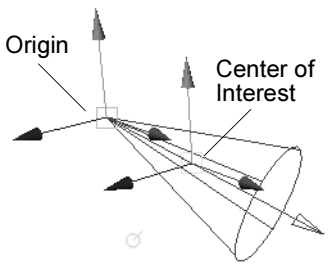
Related topics

❖ "Create a Maya light source" on page 39

Move the center of interest or origin

Move the two parts of this manipulator to change the location (origin) and direction (Center Of Interest) of a light. *All lights include this option.*

To show the manipulator, see "Show, hide, or resize a light manipulator" on page 42.



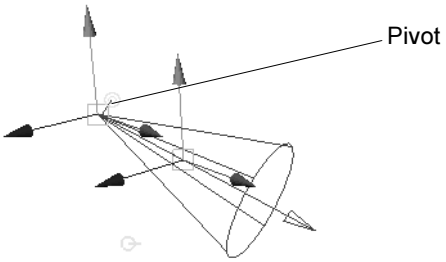
Related topics

❖ "Create a Maya light source" on page 39

Move the pivot point

Move the Pivot manipulator and then click on it to change the point that a light pivots about when you move the light or the center of interest. Click the Pivot manipulator again to disable the pivot point. *All lights include this option*.

To show the manipulator, see "Show, hide, or resize a light manipulator" on page 42.



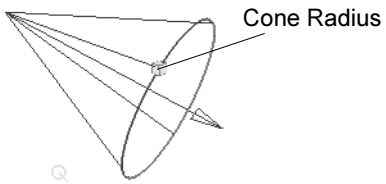
Related topics

- "Create a Maya light source" on page 39

Move the Cone Radius of a spot light

Move the Cone Radius manipulator to change the angle of a spot light's beam. *Only the spot light includes this option*.

To show the manipulator, see "Show, hide, or resize a light manipulator" on page 42.



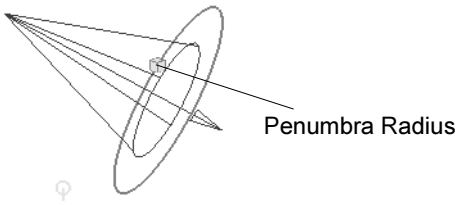
Related topics

- "Create a Maya light source" on page 39

Move the Penumbra Radius of a spot light

Move the Penumbra Radius manipulator to change how the brightness of a spot light beam decreases only near the edge of the beam. *Only the spot light includes this option*.

To show the manipulator, see "Show, hide, or resize a light manipulator" on page 42.



Related topics

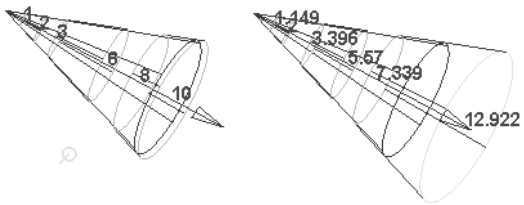
- "Create a Maya light source" on page 39

Move the Decay regions of a spot light

Move the Decay Regions manipulators to separate a spot light's beam into regions that are illuminated and regions that are not. *Only the spot light includes this option*.

See also "Interactively set decay regions" on page 50.

To show the manipulator, see "Show, hide, or resize a light manipulator" on page 42.



Related topics

- "Create a Maya light source" on page 39

Move barn doors (shutters) of a spot light

Move the Barn Doors manipulators to make a spot light's beam square, or to flatten one side of the beam. You can also change the spot light's Barn Door values in the Attribute Editor. *Only the spot light includes this option*.

To use barn doors, see "Apply barn doors (shutters) to a beam of light" on page 54.

To show the manipulator, see "Show, hide, or resize a light manipulator" on page 42.

Related topics

❖ "Create a Maya light source" on page 39

Light specific surfaces

Determine a light's area of illumination

Just as you can look through characters' eyes to view and animate a scene through their view, or look through a camera, you can look through a light to see its exact area of illumination.

To look through a light

1. Select the light.
2. Click Panels > Look through selected.

Link light sources to surfaces

To link selected lights to surfaces

1. Select the lights and surfaces you want to link.
2. Select Lighting/Shading > Make Light Links.

To break links between lights and surfaces

1. Select the lights and surfaces you want to unlink.
2. Select Lighting/Shading > Break Light Links.

Related topics

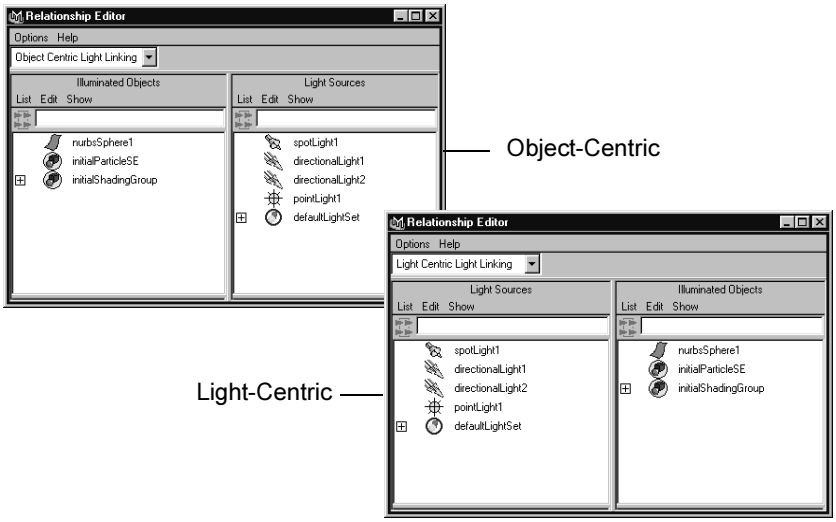
❖ "Light linking" on page 19

Link sets of lights and objects

For information on light links, see "Light linking" on page 19.

Selecting a Light Linking option opens the Relationship Editor in either Light-Centric or Object-Centric mode. For more information on sets and the Relationship Editor, see the *Basics* guide.

Note	Linking single objects to single lights is the preferred method of light linking (see "Lighting/shading > Make Light Links" on page 94 for details).



To create a light set

1. In the Relationship Editor, select Light Centric Light Linking.
2. In the left panel (Light Sources), select the lights you want to include in a new set and select Edit > Create Light Set from Highlighted Lights.

   Maya adds a new light set to the bottom of the light list.

To create an object set

1. In the Relationship Editor, select Object Centric Light Linking.
2. In the left panel (Illuminated Objects), select the objects you want to include in a new set and select Edit > Create Object Set from Highlighted Objects.

   Maya adds a new object set to the bottom of the object list.

To add or remove an object or light from a set

1. In the Relationship Editor, select Set Editing from the drop-down menu.
2. In the left panel (Sets), select the set.

   The objects (or lights) in the set are highlighted in the right panel.
3. In the right panel (Objects), select the objects (or lights) you want to add to the set and clear the selection of objects (or lights) you want to remove from the set.

Link lights and surfaces from the command line

From the Maya command line, type:

```
lightlink -light <lightName> -object <surfaceName>
```

For example, to link spotLight1 and nurbsSphere1, type:

```
lightlink -light spotLight1 -object nurbsSphere1
```

For more information on the lightlink command, see the MEL online documentation.

Warning!

In Maya prompt or batch mode, the regular clean up process that amalgamates the data from several lightlinker nodes into one does not take place. This may result in several lightlinker nodes when scenes are imported or referenced. To prevent this behavior, import or reference scene data during an interactive session. If prompt or batch mode must be used, ensure that you invoke the `lightlink -q` command to first force the loading of the module that contains the amalgamation routine.

Related topics

❖ "Light linking" on page 19

Select objects illuminated by a specific light

For information on light links, see "Light linking" on page 19.

To select all surfaces illuminated by a specific light

- Select a light, then choose Lighting/Shading > Select Objects Illuminated by Light.

  All objects illuminated by the selected light are highlighted.

Related topics

❖ "Light linking" on page 19

Select lights illuminating a specific object

For information on light links, see "Light linking" on page 19.

To select all lights illuminating a specific surface

- Select the surface, then select Lighting/Shading > Select Lights Illuminating Object.

  All lights illuminating the specified surface are highlighted.

Related topics

❖ "Light linking" on page 19

Control area lights

Control highlights of an area light

To control the specular highlight size and orientation for an area light

Position and scale the area light using Maya transformation tools (such as standard or light-specific manipulators) through the Channel Box, Attribute Editor, etc. IPR the scene to adjust the specular highlight interactively. For more information on the manipulators, see *"Use manipulators"* in the *Basics* guide.

Control soft lighting distribution

To control soft lighting distribution for an area light

The size and orientation of the area light icon controls the light distribution. A large area light emits more light. The light can be non-proportionally scaled to modulate the distribution. The farther away the object is from the light, the less light is cast onto the object. To adjust the size and orientation of the light area, see "Show, hide, or resize a light manipulator" on page 42.Related topics

❖ "Create a Maya light source" on page 39

Produce raytraced shadows

To produce realistic raytraced shadows for area lights

Only available through raytracing. Make sure to turn Raytracing on in the Render Global Settings window for Maya software rendering, then turn on Use Ray Trace Shadows in the area light's Attribute Editor. The size and orientation of the light controls the shadow color distribution.

Note	You may have to increase the number of sample rays to ensure high quality shadows. This can be time- and processor-intensive.

Depth map shadows also work, but you create shadows varying from hard to soft. Adjust the filter size to control the uniform softness of the shadow.

Related topics

- ”Raytraced shadows” on page 36
- ”Create a Maya light source” on page 39

Adjust decay

Interactively set decay regions

You can use the decay region manipulators to set decay regions interactively on a spot light. (Alternatively, you can enter exact distance positioning in the Attribute Editor. See ”Decay Regions attributes” on page 113.)

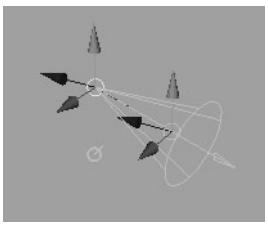
The decay regions indicate the regions you want to light and the regions you don’t want to light in the shape of three truncated cones. Use the decay region manipulators to indicate precisely these regions.

To interactively set decay regions

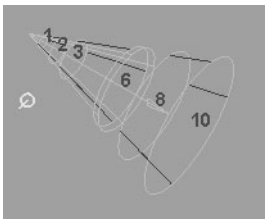
Tip	When interacting with the spotlight to get precision lighting for distance dimension, adjust the scene view so that it is perpendicular to the spotlight icon, making it easier to see the distance effect head-on.

1. Make sure the Use Decay Regions attribute is turned on.

   To turn on the decay region manipulators, see ”Position features of a light interactively” on page 42.



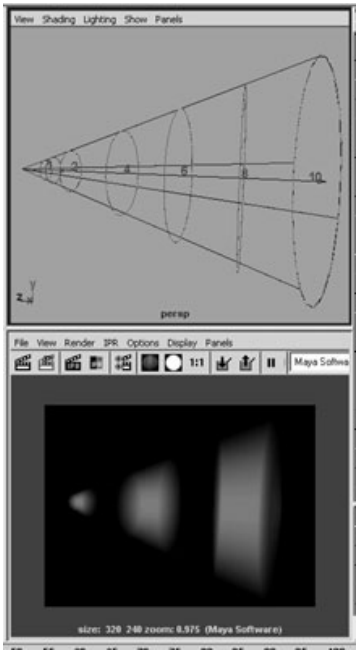
2. Click the Index Manipulator until you can see the decay regions on the spot light’s icon. (To learn more about the Index Manipulator, see ”Show, hide, or resize a light manipulator” on page 42.)



3 Drag the decay region rings to set start and end distances. If you want, you can verify and fine-tune these values in the Attribute Editor.

Tip When Interactively setting a light's decay regions:

- Leave the Attribute Editor open and IPR render the scene so you can make changes interactively to get the look you want.
- Apply a Light Fog (click the box next to Light Fog in the Light Effects section of a spot light's Attribute Editor) to see the results.



Related topics

❖ "Light decay" on page 18

❖ "Create a Maya light source" on page 39

Create custom spot light intensity or color decay

Create custom spot light decay

An intensity curve or an expression can be used to control decay. You can also create a custom brightness decay rate using an intensity curve. You can edit curves in the Expression or Graph editors. For more information about the Expression and Graph editors, search the online help.

To create a custom brightness decay

1. In the Light Effects section of the spot light's Attribute Editor, click the Create button beside the Intensity Curve attribute.

   Maya creates an Intensity Curve node and connects it to the Intensity attribute.
2. Turn on Light Direction Only in the Attribute Editor that appears.

Create custom spot light color decay

You can create a custom color decay rate using a set of *color curves* (a red curve, a green curve, and a blue curve).

To create a custom color decay

1. In the Light Effects section of the spot light's Attribute Editor, click the Create button beside the Color Curves attribute.
2. Turn on Light Direction Only in the Attribute Editor that appears.

   Maya creates a Red Curve node, a Green Curve node, and a Blue Curve node and connects them to the Color attribute.

Edit custom intensity and color decay

You can edit intensity curves or a set of color curves either in the Attribute Editor or in the Graph Editor. Intensity or color curves display as a table of values in the Attribute Editor.

To view the table for an Intensity Curve in the Attribute Editor

- Click the box next to the Create button.

To view the attribute table for Color Curves and the Intensity curve (after you create them)

- Select the spot light in the view.

Tip	When creating intensity and color curves for a light source, IPR Render the scene or part of the scene to get instant feedback on the changes you make to the light's intensity and color curves.

To work with Intensity or Color curves in the Graph Editor

- To adjust the Intensity or Color Curves interactively, select the spot light and open the Graph Editor (Windows > Animation Editors > Graph Editor). An intensity curve appears as a dark blue line, and color curves display as red, green, and blue lines.
- To edit points or entire curves, use the Graph editor. For more information on the Graph editor, see the Animation guide.

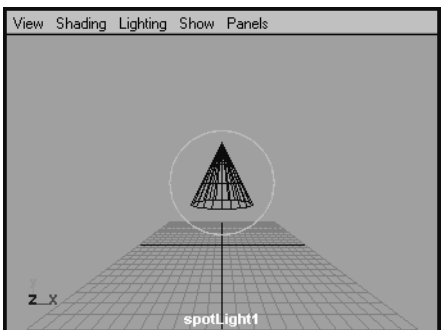
Related topics

❖ "Light decay" on page 18
❖ "Create a Maya light source" on page 39

Adjust a spot light's light circle

Control a spot light's circle boundary

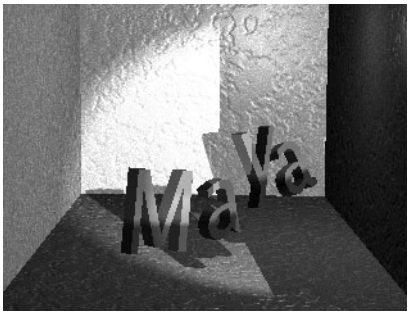
Select the spotlight, and choose Panels > Look Through Selected in the view. This represents the view from the spotlight.

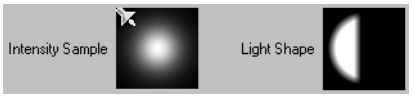


The green circle represents the cone boundary. Any objects outside this circle are not lit by this spotlight. Camera tracking, tumbling, or dollying work well in this view to help shine the spotlight exactly on the desired area.

Apply barn doors (shutters) to a beam of light

Apply barn doors when you want to create the effect of light pouring out of a half-opened door. Barn doors are shutters applied to a spot light's beam. Barn Doors are off by default; you must turn them on, then adjust them to get the desired light spill.

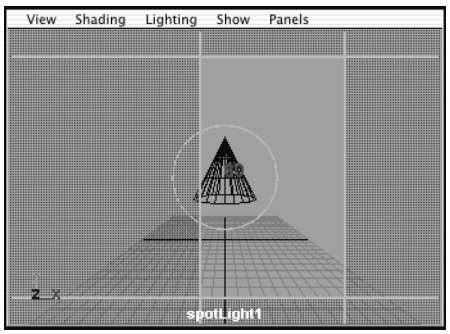




To use Barn Doors

1. Select a Spot Light whose manipulators are displayed, then turn Barn Doors on in the Attribute Editor.
2. In the Light Effects section of the spot light's Attribute Editor, turn on Barn Doors.
3. Select Look Through Selected from the view's Panels menu to look through the selected light. (The Barn Doors manipulators are only visible in the light's view.)

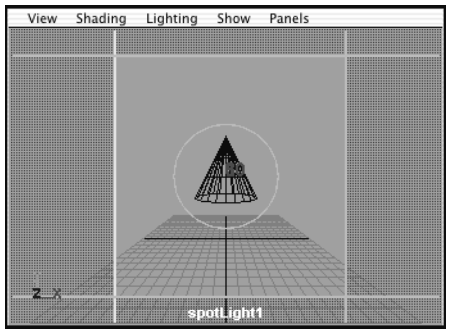
   Four blue lines appear. These lines represent a rectangular boundary for the spotlight. No light reaches the regions outside the blue line-boundaries.



4. You can directly manipulate each of the four lines with the Move tool to shift the boundaries. (Alternatively, you can enter precise numerical values in the Attribute Editor.)

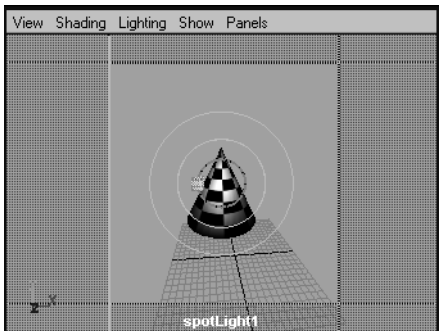
Attributes are in degrees measured from the spotlight to the blue line-boundary. For instance, for an 80 degree spotlight, the four blue line-boundaries are 40 if the boundaries lie exactly at the spotlight border.

When you use the Barn Doors settings, the lightShape sample changes at the top of the Attribute Editor.



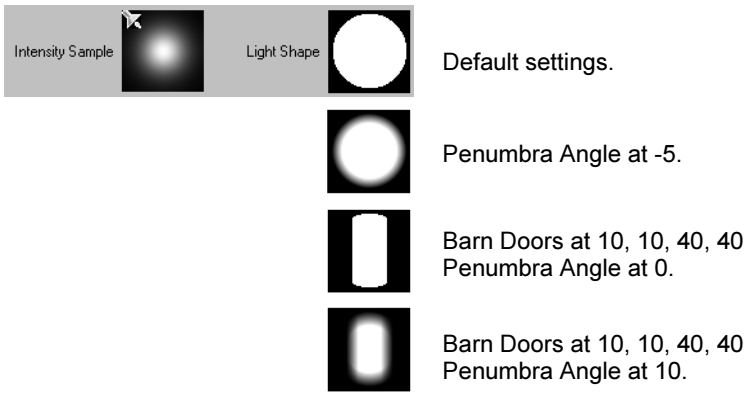
5 Tweaking the penumbra value displays a second circle. Change the value in the Attribute Editor or click the Index Manipulator icon to display and use the manipulator, then select Panels > Look Through Selected to see the circle.

The region between the two circles results in a softer illumination.



6 If the penumbra value is set to 0 (the default) and Barn Doors is on, this results in a very hard-edged look to the lighting. With a non-zero penumbra value, the barn door effect is a smooth illumination of the scene.

You can also verify the illumination by looking at the Light Shape and Intensity Sample at the top of a spot light's Attribute Editor. These change as you change the values for the spot light.



7 To return to the current view, select the view from the Panel menu.

Related topics

❖ "Create a Maya light source" on page 39

Create glows, halos, or lens flares

Create a light optical effect

You can add an optical effect to any light.

Tip	The results of an optical effect (such as flame) applied to a light are not visible in the Scene View. To see the results, IPR render the effect, then drag a marquee around the rendered object to watch how the effect changes as you adjust it.

Related topics

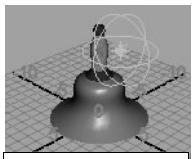
❖ "Glows, halos, and lens flares" on page 20

To create a light optical effect

1 Create a light for which you want to apply and position optical effects.

2 In the light's Attribute Editor, map the Optical FX utility to one of the light's attributes (for example, click the box beside Color then select Optical FX from the Glow Utilities tab in the Create Render Node window).

3 IPR render the scene to see the optical effect.



Point light with mapped Glow in view.

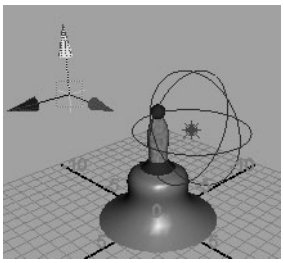
IPR rendered result.

Re-position an optical light effect

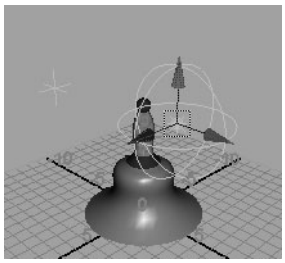
You can move the glow or halo you have attached to a light or include more than one optical effect in the scene.

To re-position an Optical FX utility node

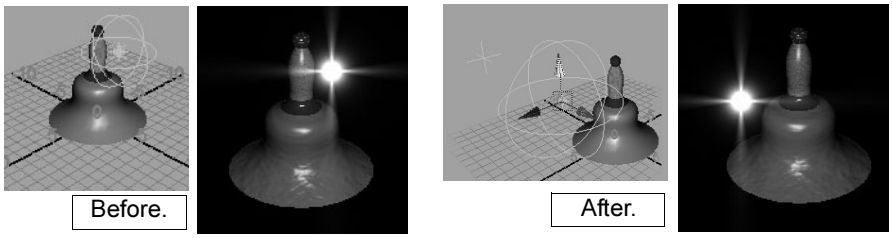
1 Create a Locator and place it anywhere in the scene (Create > Locator).



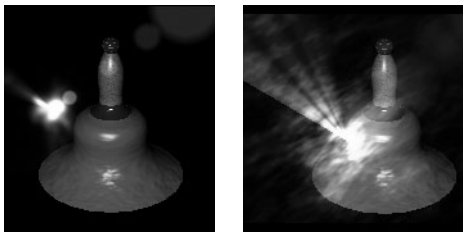
2 Shift-select the locator in the view, then select the light.



You can now move the locator anywhere in the scene and the optical light effect moves with it.



Change the attributes of the light effect while IPR rendering to test various effects



Adjust the size of the glow object

For more information about the optical effect of a light glow, see "How glow works in animation" on page 20.

To change the size of a glow object

For a Point light, renderSphere has a radius attribute which can increase the size of the glow object.

Each light's Radius attribute can be changed to increase/decrease the radius as well.

Related topics

- "Glows, halos, and lens flares" on page 20
- "Create a Maya light source" on page 39

Create environments that glow

When you first open Hypershade, three nodes are available by default in the Materials tab: lambert1, particleCloud1, and shaderGlow1.

Use the Shader Glow node for environment glows.

Shader glow from one surface can affect the intensity of another surface's glow. For example, a large glowing surface that enters a scene may appear to cancel the affect of, or alter, the glow of a smaller surface in the scene. This phenomenon is caused by the Shader Glow's Automatic Exposure setting.

To get the right glow and halo intensities using Shader Glow

Note	The Shader Glow node's attributes are the same as the Optical FX's attributes. See "Optical FX Attributes" on page 122.

1. Turn on Auto Exposure in the Shader Glow's Attribute Editor (open the Shader Glow Attribute Editor by double-clicking the Shader Glow swatch located in the Post Process folder in Visor's Rendering section).
2. Select a frame in which the halo and glow effects have the look you want.
3. Render the scene in Render View.

   The *glow intensity normalization factor* and *halo intensity normalization factor* are printed in the Maya command shell or DOS window. They look similar to this sample:

   ```
   glow intensity normalization factor = 0.0110171.
   halo intensity normalization factor = 0.0243521.
   ```

   These are the values Maya uses if Auto Exposure is turned off.
4. In the Shader Glow's Attribute Editor, set the Glow Intensity and Halo Intensity to the values for the *glow intensity normalization factor* and *halo intensity normalization factor*.
5. Turn off Automatic Exposure.
6. Render the scene again at full resolution of your intended output.

Related topics

- "Glows, halos, and lens flares" on page 20

Create illuminated fog

You create illuminated fog by adding it to an existing light.

Note	To create fog that fills the entire scene, not just within the illumination of a specific light, use the Env(iroment) Fog Volumetric material.

To add illuminated fog to a light

1. Select the light for which you want to illuminate fog.
2. In the Light Effects section of the light's Attribute Editor, click the map button beside the Light Fog attribute.

Maya automatically creates a light fog node, connects it to the light node, and displays its Attribute Editor.

Related topics

- "Glows, halos, and lens flares" on page 20
- "Create a Maya light source" on page 39

Render with global illumination and caustics

Global illumination and caustics workflow

Generally, the workflow is as follows:

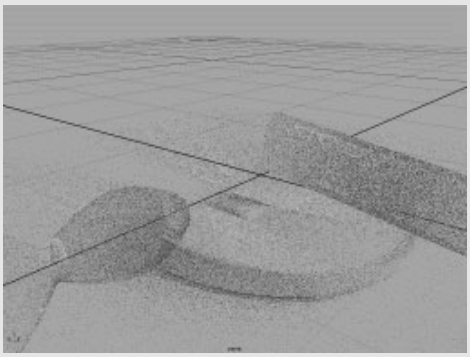
1. Make sure that at least one light source in the scene emits photons.

   See "Turn on photon emission for a light source" on page 61.

2. Make sure that at least one surface is casting or receiving caustics.

   By default, all objects cast and receive caustics, though typically not all have to in order for you to achieve the look you want. To fine-tune the look of global illumination or caustics or to reduce render times, you can specify exactly which objects should cast and/or receive photons. See "Flag objects to cast and receive photons" on page 62.

Tip To see the distribution of photons for global illumination, you can generate a 3-dimensional visualization map in shaded or wireframe scene views. For more information, see the What's New guide.



3. Make sure raytracing and the desired global illumination and/or caustic effects are enabled.

See "Render with global illumination" on page 64.

4 Render with mental ray for Maya.

Tip	Combine global illumination with Final Gather for the most physically accurate lighting effects. See "Combine global illumination with Final Gather" on page 69.

Related topics

- "Global illumination" on page 21
- "Caustics" on page 22

Set up mental ray for Maya raytracing

Note	If you want to render Global illumination, Caustics, or mental ray for Maya raytraced shadows, raytracing must be turned on. By default, mental ray for Maya raytracing is turned on, which means that you can just proceed with the global illumination or caustics workflow.

To turn on raytracing and set attributes

1 Select the Rendering menu set.

2 Open the Render Global Settings window.

Click the Select Window > Rendering Editors > Render Globals or click the Render Global Settings window icon(insert icon image).

3 Select the mental ray for Maya render.

4 Click the mental ray tab.

5 Turn on Ray Tracing.

Find Ray Tracing in the General section.

6 Set the raytracing attributes(x-ref).

Related topics

- "Depth map and raytraced shadows" on page 34

Turn on photon emission for a light source

At least one direct light source (a point light or spot light) must emit photons for global illumination or caustics to work.

For more information on direct light sources, see "Sources of direct light" on page 15.

To turn photon tracing

1. Select the light source you want to emit photons.

   For example, spot light.
2. Show the Attribute Editor (Ctrl+A).
3. Select the light's shape tab.
4. Set Decay Rate to Quadratic.

   This causes light levels in the scene decrease in intensity based on the inverse square law (naturally).
5. Set the photon emission attributes.

   See "mental ray attributes (point, spot, directional)" on page 108.
6. Repeat this procedure for every light source you want to emit photons.

Related topics

- "Global illumination" on page 21
- "Caustics" on page 22
- "Photon maps" on page 25
- "Photon tracing" on page 26

Flag objects to cast and receive photons

By default, all objects cast and receive caustics, but not all have to in order for you to achieve the look you want. You can fine-tune the look of global illumination or caustics (or reduce render times) by specifying exactly which objects should cast and/or receive photons.

Though you can use these per-object (local) settings alone in many cases, usually you use them in conjunction with scene-wide (global) overrrides to give you the maximum amount of control over the rendering of global illumination and caustics. (See "Set scene-wide photon tracing overrides" on page 63.)

How you combine per-object global settings depends on what you want to achieve. You can, for example, flag specific objects to receive global illumination, while the rest of your objects in your scene don't. Or, you can flag all objects to receive caustics, but only one object to generate caustics.

To flag objects for photon participation

1. In the Scene view, select the object for which you want to change global illumination settings.
2. Open the Attribute Editor (Ctrl+A)
3. Click the selected object's shape node.
4. Expand the mental ray section, and turn off DeriveFromMaya.
5. Change the Global illumination flag or the Caustics flag.
6. Set scene-wide (global) global illumination overrides if necessary.

   See "Set scene-wide photon tracing overrides" on page 63.
7. Modify the object's material photon attributes, if necessary.

   (Expand the selected object's Attribute Editor (Ctrl+A), expand the mental ray section, then adjust the attributes.

Related topics

- "Photon tracing" on page 26

Set scene-wide photon tracing overrides

Global illumination overrides and Caustics overrides let you turn on or off the photon casting or receiving capabilities of all objects in your scene at once (with the exception of any flags you've set on a per-object basis, see"Flag objects to cast and receive photons" on page 62).

You can further define the look of your scene and reduce the rendering load (especially good for test renders) by defining to what degree all objects should or should not participate in global illumination and caustics.

Global illumination overrides and Caustics overrides always work in conjunction with local (per-object) global illumination and caustics settings (see "Flag objects to cast and receive photons" on page 62). Per-object flags always take precedent over global overrides, giving you a great amount of control over the how photons are distributed. You can, for example, flag specific objects to receive global illumination, while the rest of the objects in your scene don't.

To set scene-wide (global) photon tracing overrides

1. Select the Rendering menu set.
2. Open the Render Global Settings window.

   Click the Select Window > Rendering Editors > Render Globals or click the Render Global Settings window icon.
3. Select the mental ray for Maya render.

4 Click the mental ray tab.

5 Expand the Overrides section.

6 Set the Global Illum Generating settings and/or the Global Illum Receiving settings.

7 Make sure the appropriate per-object global illumination flags have been set for the look you want to achieve.

See "Flag objects to cast and receive photons" on page 62.

Related topics

❖ "Global illumination" on page 21
❖ "Photon tracing" on page 26
❖ "Set up mental ray for Maya raytracing" on page 61
❖ "Flag objects to cast and receive photons" on page 62

Render with global illumination

To render global illumination

First, make sure at least one light source in your scene emits photons (see "Turn on photon emission for a light source" on page 61).

1 Select the Rendering menu set.

2 Open the Render Global Settings window.

Click the Select Window > Rendering Editors > Render Globals or click the Render Global Settings window icon.

3 Select the mental ray for Maya render.

4 Click the mental ray tab.

5 From the Quality Presets dropdown list, select PreviewGlobalIllum.

Raytracing and global illumination (in the Caustics and Global illumination section of the tab) are automatically enabled.

6 Render with the default settings.

If the default settings are not sufficient to achieve the look you want (or to reduce render speed), tweak the global illumination settings until you achieve the look you want.

Tip If your scene contains caustics, global illumination or final gather, and would like to see those effect during mental ray IPR, in Render View select IPR > IPR > Render Globals.

Related topics

- ”Global illumination” on page 21.
- ”Troubleshoot:Global Illumination doesn’t work or looks incorrect” on page 84.

Tweak color bleed

Color bleeding is a by-product of rendering with global illumination. You can affect color bleed with or without lights in the scene.

To render color bleed with light sources in the scene

1. Make sure Illuminates by Default is turned on for the light source(s). (It is on by default.)
2. Select the object onto which you want to bleed color.
3. Tweak the Diffuse attribute of your object’s shaders if necessary.
4. (Optional) Adjust the Irradiance Color slider to reduce or increase intensity of the color bleed.
5. Render with mental ray for Maya.

To render color bleed with no lights in the scene

1. Turn off Illuminates by Default for the light source(s)
2. Select the object onto which you want to bleed color.
3. In the mental ray section of that object’s Attribute Editor, do any of the following:
   - Adjust the Ambient Color attribute.
   - Add some color to the Incandescence attribute.
4. Render with mental ray for Maya.

Related topics

- ”Colour bleed” on page 23

Render with Caustics

Tip	To see progress messages when rendering, set Export verbosity to Progress messages in the Translation section of the Render Global Settings window.

To render caustics

First, make sure at least one light source in your scene emits photons (see "Turn on photon emission for a light source" on page 61).

Note	Caustic-casting objects are recommended to have a low diffuse shader, for example, Phong set to 0.3. The refractive index should be greater than 1. Caustics-receiving objects should have a high diffuse shader, for example, Lambert set to 0.8.

1. Select the Rendering menu set.
2. Open the Render Global Settings window.

   Click the Select Window > Rendering Editors > Render Globals or click the Render Global Settings window icon.
3. Select the mental ray for Maya render.
4. Click the mental ray tab.
5. From the Quality Presets dropdown list, select PreviewCaustics.

   Raytracing and caustics (in the Caustics and Global illumination section of the tab) are automatically enabled.
6. Render with the default settings.

   If the default settings are not sufficient to achieve the look you want (or to reduce render speed), tweak the caustics settings until you achieve the look you want.

Tip	If your scene contains caustics, global illumination or final gather, and would like to see those effect during mental ray IPR, in Render View select IPR > IPR > Render Globals.

Related topics

- "Caustics" on page 22.
- "Troubleshoot:Caustics don't work or look incorrect" on page 85.
-

Render a separate global illumination pass

You can render global illumination separate from direct illumination in a separate pass.

During a global illumination rendering pass, direct illumination from light sources and ambient and incandescent material portions are disregarded. Corresponding to the Maya render passes, colored backgrounds, image planes and certain shaders acting as incandescent emitters, for example, a Surface Shader, are rendered.

To render a separate global illumination pass

1. Select the Rendering menu set.
2. Open the Render Global Settings window.

   Click the Select Window > Rendering Editors > Render Globals or click the Render Global Settings window icon.
3. Select the mental ray for Maya render.
4. Click the mental ray tab.
5. Expand the Render Layer / Pass Control section
6. Turn on Enable Global Passes.

See the distribution of photons

You can visualize the distribution of photons in a scene. This helps you fine-tune your settings. See the What's New guide in the Maya Help for more information.

Work with Final Gather

Render with final gather

Final gather is very flexible and many different factors can contribute to its effect. You'll need to experiment with settings to achieve the look you want.

Tip	Final Gather is view dependent and is recalculated for each frame in a sequence. If you are not adjusting the camera position, the position of any objects, or any Final Gather attributes, you can store and reuse Final Gather illumination results to speed up rendering. See "Store and reuse Final Gather results" on page 69.

To render with Final Gather

First, turn off Maya default lights (see "Turn default lighting on or off" on page 42) and, if you have any light sources in the scene, turn off their Illuminates by Default attribute.

1. Select the Rendering menu set.
2. Open the Render Global Settings window.

   Click the Select Window > Rendering Editors > Render Globals or click the Render Global Settings window icon.
3. Select the mental ray for Maya render.
4. Click the mental ray tab.
5. From the Quality Preset dropdown list, select PreviewFinalGather.

   Final Gather (in the Final Gather section of the tab) is automatically enabled.
6. Change any of the following *optional* settings, which can have an effect
   - The camera background color.
   - The object's material's colored Incandescence or Ambient color attributes
   - Irradiance contributions from shaders.
   - Irradiance color mapping contributions from shaders.
   - The number and location of lights in the scene.
7. Render with the default settings.

   If the default settings are not sufficient to achieve the look you want (or to reduce render speed), tweak the Final Gather settings until you achieve the look you want.

Tip If your scene contains caustics, global illumination or final gather, and would like to see those effect during mental ray IPR, in Render View select IPR > IPR > Render Globals.

Related topics

- "Final gather" on page 29
- "Store and reuse Final Gather results" on page 69
- "Combine global illumination with Final Gather" on page 69

Store and reuse Final Gather results

By default, mental ray for Maya ignores any previously generated final gather results each time final Gather render happens; final gather results are freshly calculated.

You can store final gather results so that later frames can use the results from a frame rendered earlier to speed up the Final Gather rendering process.

Store and reuse final gather results when you aren't going to be changing any final gather settings between renders (for example, when rendering a still image). You may be able to reuse a final gather map for animation, as long as the irradiance values for moving objects don't change significantly.

By default the file is saved into the current project's `mentalRay\finalgMap` directory.

Note You cannot reuse Final Gather results if you change final gather settings. In this case, the following Output window messages indicate that the previous results can't be used:

- RCFG 0.2 info: finalgMap/test1:final gather options differ from ones currently used, content ignored.
- RCFG 0.2 info: overwriting final gather file "finalgMap/test1"

To store and reuse previously generated final gather results

1. Make sure Final Gather is turned on and the attributes are set. See "Render with final gather" on page 67.
2. Set the Final Gather file attributes:
   - Final Gather File
   - Final Gather Rebuild
3. Render.

Related topics

- "Final gather" on page 29
- "Combine global illumination with Final Gather" on page 69

Combine global illumination with Final Gather

Combine global illumination with Final Gather to achieve the most physically accurate illumination results, which are particularly good for interior architectural shots that require the effect of the light contribution from exterior and interior light sources.

To combine global illumination with Final Gather (guidelines)

1. Set up any exterior lights, then set up interior lights.

   See "Create a Maya light source" on page 39 for more information.
2. Turn on the Physical attribute for each light source that emits photons for global illumination, and set the Decay Rate to Quadratic.

   See "Turn on photon emission for a light source" on page 61.
3. Do one of the following:
   - Set up basic global illumination (see "Render with global illumination" on page 64), then turn on Final Gather and custom set its attributes. *Make sure the Precompute Photon Lookup attribute is set for final gather.*
   - Set up basic final gather (see "Render with final gather" on page 67), then turn on Global Illumination custom set its attributes. *Make sure the Precompute Photon Lookup attribute is set for final gather.*
4. Render with mental ray for Maya.

Related topics

- "Final gather" on page 29
- "Store and reuse Final Gather results" on page 69

Work with High Dynamic range images (HDRI)

Render infinitely distant (sky-like) illumination and reflection

You can render illumination and reflection from an infinite distance with High Dynamic range images. See the What's New guide in the Maya Help for more information.

Render finitely distant illumination and reflection

To render finitely distant illumination and reflection

1. Place your scene into a large sphere.

   This sphere will be used as the light source. (It is geometry that gets tessellated.
2. Assign a Lambert material to the sphere and set the following attributes

- Set colour to white.
- Set Incandescence to around 70%. (You can later increase or decrease this value to increase or decrease the intensity of the light.)

3 Map the Incandescence to the HDR image you want to use.

4 Render with Final Gather (see "Render with final gather" on page 67), with the Final Gather Rays set to between 50 and 100.

5 Make sure Global illumination is turned on.

6 Tweak the Diffuse attribute of your object's shaders, if necessary .

Cast shadows

See shadows in the scene view

You can preview shadows quickly and easily in the scene view without rendering your scene.

Note
- Hardware shadows do not display for transparent objects.
- Hardware shadows do not work with point and area lights.
- In hardware X-Ray mode (Shading > Shade Options > X-Ray), all objects are transparent, and no hardware shadows display.

To see shadows in the scene view

1 In the Render Stats section of the surface's Attribute Editor, make sure Casts Shadows is turned on.

2 In the scene view, click Lighting > Shadows.

Related topics

❖ "Shadow in Maya" on page 33

Control which objects cast shadows

You can select which objects and/or which shadows render independently. For instance, you can render an object so it does not cast shadows, but can receive shadows cast by other objects.

To set which objects do or don't cast shadows, see *"Render Stats"* in the Rendering guide.

Note	If you want to isolate only the shadow information on objects that receive shadows, assign a Use Background material to them.

Select a range of objects and shadows to render

If you want to render only objects and shadows within a specific distance range from the camera (for example, only foreground objects), you can use the camera's clipping planes to control which objects and shadows render. (However, separating objects into layers is better from a maintenance standpoint.)

See *"Clipping planes"* in the Rendering guide for more details.

Related topics

- "Shadow in Maya" on page 33

Render depth map shadows

For more information about depth map shadows, see "Depth map shadows" on page 35.

To create a depth map shadow

1. Select the light for which you want to produce a shadow.
2. In the Shadows section of the light's Attribute Editor, turn on Use Depth Map Shadows.
3. Select the surface on which you want to cast a shadow.
4. In the Render Stats section of the surface's Attribute Editor, turn on Casts Shadows.

Tips	Set the light's Dmap Resolution to the lowest value that produces shadows of acceptable quality. As a starting point, set Dmap Resolution to the same value as the rendering resolution. If Dmap Resolution is too low, shadow edges appear jagged. If Dmap Resolution is too high, rendering times increase.

Tip	When batch rendering from the command line, generate shadow depth maps *before* rendering the scene by using the `Render -sp <sceneName>` command and option. This can help reduce rendering times and you can re-use the depth maps for subsequent renders.

To create mental ray shadow maps

For Maya Spot Lights, Directional Lights, and Point Lights, there is a Shadow Maps subsection in the mental ray section of the light's Attribute Editor. You can turn on Shadow Maps so mental ray generates shadow maps.

Note	mental ray does not handle shadow maps on scaled light sources very well. Proportional scaling for the light should be used instead.

Related topics

- "Shadow in Maya" on page 33
- "Depth map shadows" on page 35.

Reuse depth maps

If you use depth map shadows, by default Maya calculates at least one depth map for each depth-map enabled light source and for each frame of the animation during rendering.

In some cases, you can reduce rendering times by saving and reusing a light's depth map. See the following table to determine if reusing a depth map is advantageous for your particular circumstance.

Maya saves depth map files in the `renderDate/depth` directory of the current project, by default.

If you are...	Do this...
Rendering a single frame several times, each time making adjustments to object or light properties, but *not* moving lights or objects, the depth map does not change and can be reused.	Set Disk Based Dmaps to Reuse Existing Dmap(s). Maya calculates the depth map the first time you render and save it to disk. During each subsequent render, Maya reads the depth map from disk.
Rendering an animation in which the light or the objects it illuminates *do not* move (for example, a camera fly-through), the depth map does not change from frame to frame and can be reused.	Set Disk Based Dmaps to Reuse Existing Dmap(s) and turn off Dmap Frame Ext. Maya calculates the depth map when it renders the first frame and save it to disk. During each subsequent frame render, Maya reads the depth map from disk.
Rendering an animation in which lights and/or the objects they illuminate *do* move, the depth map changes from frame to frame. If you are rendering the entire animation several times, each time making adjustments to object or light properties, but *not* changing the way lights or objects move, the depth maps for each frame is the same as in the initial render and can be reused.	Set Disk Based Dmaps to Reuse Existing Dmap(s) and turn on Dmap Frame Ext. Maya calculates the depth maps for each frame the first time you render the animation and save them to disk. During each subsequent render, Maya reads the depth maps from disk.
Rendering a single frame or an animation, have previously saved depth maps to disk, and have moved lights and/or the objects it illuminates, the depth maps are now different, and you cannot reuse the depth masks on disk.	Set Disk Based Dmaps to Overwrite Existing Dmap(s). Render the frame or animation once. Maya calculates the depth map(s) and save them disk, overwriting any depth map(s) that already exist on disk. If you want to continue adjusting object or light properties, but *not* move lights or objects, set Disk Based Dmaps to Reuse Existing Dmap(s).

If you are...	Do this...
Rendering a single frame or an animation, have previously saved depth maps to disk, but do not want to use the depth maps that are on disk.	Set Disk Based Dmaps to Off. Maya calculates the depth map(s) every time you render. Maya does not read depth maps from disk. Maya does not save depth maps to disk.

Related topics

- "Shadow in Maya" on page 33
- "Depth map shadows" on page 35.

Render raytraced shadows

To create a raytraced shadow

1. Select the light for which you want to produce a shadow.
2. In the Raytrace Shadow Attributes section of the light's Attribute Editor, turn on Use Ray Trace Shadows.
3. Select the surface on which you want to cast a shadow.
4. In the Render Stats section of the surface's Attribute Editor, turn on Casts Shadows.
5. In the Raytracing Quality section of the Render Global Settings window (Windows > Rendering Editors > Render Globals), turn on Raytracing.
6. Render

Related topics

- "Shadow in Maya" on page 33
- "Raytraced shadows" on page 36

Catch shadows for an alpha channel

For more information about shadows, see "Shadow in Maya" on page 33.

The following is a simple example of how to use the Use Background material to catch shadows.

To capture only shadows in an alpha channel

1. In Hypershade, create a Use Background material and assign it to the shadow catching object(s).

2 Select the objects(s) in the scene casting shadows. In the Render Stats section of the objects' Attribute Editor, turn Primary Visibility off.

3 Render the scene.

Shadow information is captured in the alpha channel.

To assign Use Background to stand-in geometry

Use this workflow to make a 3D object look like it's in a real environment. The real environment usually comes from a snapshot or live action shot that is assigned to an image plane. The object can cast shadows onto the seemingly invisible plane, which acts as the shadow catcher.

Create an image plane using the scene in which you want to place the stand-in geometry:

1 Select View > Image Plane > Import Image from the current view.

2 Browse to the file you want and click Import.

A placement icon appears in either the current view or all views, depending on the Display mode you set, and the Image Plane Attribute Editor opens.

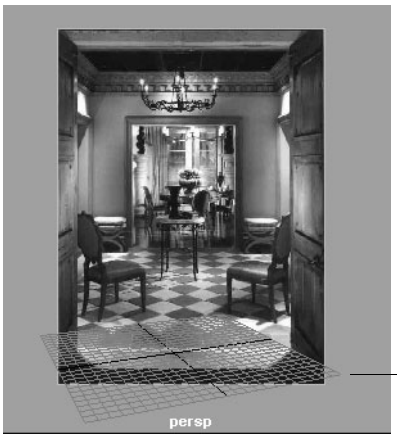
3 Select an Image File or Texture from the Type drop-down menu, then click the folder icon next to Image Name to load an image plane into the view.

Note	Make sure you select the Image Plane Attached to Camera option to position the plane where you want it before you create a stand-in object. For more information about image planes, see *"Image plane"* in the Shading guide.

4 Set the following attributes in the Image Plane Attributes section:

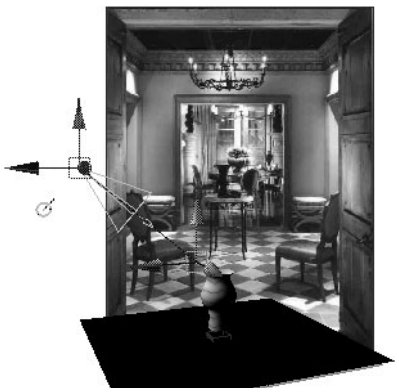
- **Display–**looking through camera
- **Image Plane–**attached to Camera

5 Adjust the perspective camera so that the construction grid plane aligns approximately where you want to place the object.



6. Create and position a NURBS or polygonal plane on which to cast shadows and reflections.
7. Position the object you want to cast shadows onto the stand-in geometry on the grid plane.

8. In Hypershade, create a Use Background material and assign it to the plane.
9. Create and position lights in the scene. Turn on the Use Depth Map Shadows attribute in the Shadows section of the light's Attribute Editor to see the shadows in the rendered result.



10 Render the scene in Render View (for best results, *do not* IPR render).

11 Adjust the location of the geometry, the lights, and the Use Background attributes if necessary and then re-render the scene at any time.

Remove shadows

For more information about shadows, see "Shadow" on page 33.

Removing unnecessary shadows can help reduce rendering times. You can either remove all shadows produced by a specific light, or all shadows cast by a specific surface. To determine which objects cast shadows, see "Control which objects cast shadows" on page 71.

To remove all shadows produced by a specific light

1. Select the light.
2. In the Depth Map Shadow Attributes section of the light's Attribute Editor (or in the Shape Keyable tab of the light's Attribute Spread Sheet), turn off Use Depth Map Shadows.

3 In the Raytrace Shadow Attributes section of the light's Attribute Editor (or in the Shape Keyable tab of the light's Attribute Spread Sheet), turn off Use Ray Trace Shadows.

To remove all shadows cast by a specific surface

1 Select the surface.

2 In the Render Stats section of the surface's Attribute Editor (or in the Render tab of the surface's Attribute Spread Sheet), turn off Casts Shadows.

Note	You can make all shadow casting surfaces cast shadows from all shadow casting lights, even if they are not linked together, by turning off Shadows Obey Light Linking in the Render Options section of the Render Global Settings window (Windows > Render Globals).

What went wrong?

Direct light sources

Troubleshoot:Lights don't light the object

- Check that the light's Illuminates by Default attribute is on when no light linking is intended.
- If light linking is desired, make sure the light is linked to the object.
- Check that the object is assigned to a shading group and that this shading group has a surface material.

Troubleshoot:Surface glows affect glow of another surface

Normalize the shader glow. See "Create environments that glow" on page 58.

Troubleshoot:Shader Glow, Light Glow, and Light Fog limitations

- Shader Glow and Light Glow attributes cannot be texture mapped, but they can be animated
- Light Glow is not rendered in raytraced reflections and refractions.

Shadows

Troubleshoot:Shadow map problems

Avoid instancing lights. Copy the lights instead of instancing. For light fog, make sure that light fog is duplicated independently of the light because when you duplicate a light, its light fog is *not* duplicated with it.

Troubleshoot: Inaccurate shadows from shadow depth maps

For extremely large-scale units, the shadowing from shadow depth maps may be inaccurate due to the incorrect scale of the near and far clipping planes of the shadow render.

The following example shows you how to manually set the near and far clipping planes of the shadow depth map render (it assumes you have a shadow casting light called *lightShape*):

```
setAttr lightShape.useDmapAutoClipping 0;
setAttr lightShape.dmapFarClipPlane 10000;
setAttr lightShape.dmapNearClipPlane 0.01;
```

where the first line turns off the automatic generation of near/far clipping planes, and the last two lines let you set the near/far clipping plane values appropriately.

Troubleshoot:Transparent objects cast shadows for shadow depth maps

Unlike Studio, transparent objects cast shadows for shadow depth maps. If you do not want transparent objects to cast shadows, turn off the object's shadow flag in its Attribute Editor.

Troubleshoot: Shadow quality poor with light fog

Shadow quality can be very poor when you use light fog.

This may be because your *coneAngle* is much larger than the region of interest, and *use dmap auto focus* is turned on. When *use dmap auto focus* is on, the renderer computes the smallest angle to obtain the highest precision on the shadow of interesting objects. But when light fog is turned on, the angle must be as large as the light *coneAngle*.

Turn off that attribute, then adjust the *dmap* focus accordingly to fit the scene you are interested in.

Troubleshoot:Hardware shadows produce unexpected results

Hardware shadows rely on an unobstructed modeling view to work properly. You will get unexpected results if you have hardware shadows enabled while the modeling panel is obscured by another window.

Do not allow other windows to cover any part of your modeling view.

Troubleshoot:Lights don’t cast shadows

- Check that the light's Illuminates by Default attribute is on when no light linking is intended.
- Make sure Cast Shadows or Receive Shadows are turned on for the object.
- If a shadow depth map is expected, check that Enable Depth Maps is turned on in Render Global Settings window (Window > Rendering Editors > Render Globals).
- If a raytraced shadow is expected, check that the Ray Depth Limit (for the light and in Render Global Settings window) are turned up to a sufficient limit.

Troubleshoot:Shadows flicker over animations

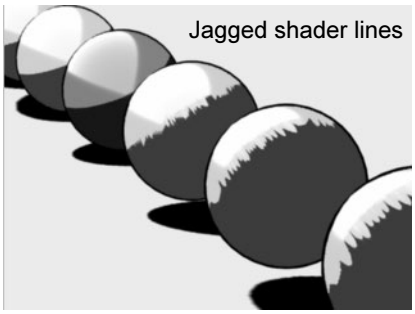
When using shadow depth maps:

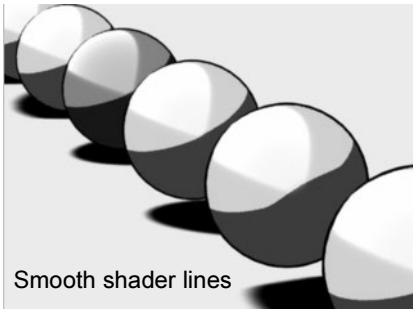
- To get the best quality when Use Dmap Auto Focus is turned on, make sure the large floors do not cast shadows. When large floors cast shadows, the region for the shadow map covers a much larger area so the shadow map precision is lower for the areas of attention and may shift over an animation.
- Try turning off Use Dmap Auto Focus and determine the constant angle of focus for the light that works throughout the entire animation.

Troubleshoot:Jagged edges

(With area lights and depth map shadows)

If an object has a Ramp Shader (adjusted to resemble a toon shader) assigned to it and is lit by an Area light with Depth Map Shadows, the shader's lines may produce jagged edges. To correct this, increase the Dmap Filter Size (Depth Map Shadows Attributes in the Area light's Attribute Editor). If that’s not enough to get rid of the jagged edges, increase the Dmap Bias attribute as well.





Troubleshoot:Jagged or flickering shadow edges

For shadow-casting spot lights, decrease the Cone Angle.

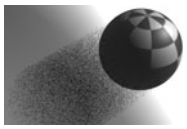
For shadow-casting directional lights, turn on Use Light Position, turn off Use Dmap Auto Focus, and set Dmap Width Focus so all objects that you want to cast shadows do indeed cast shadows for all frames of the animation.

To determine the Dmap Width Focus value, select Panels > Look Through Selected, and zoom the view in or out until all shadow casting objects are visible. Note the width of the view and use this value for Dmap Width Focus.

For all light types, you can do one of the following:

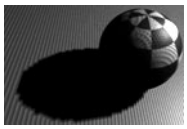
- Turn off Use Light Position (for directional lights only), turn on Use Dmap Auto Focus for the light, and turn off Casts Shadows for any objects (especially large objects) in the scene that do not need to cast shadows (they can still receive shadows).
- Increase Dmap Filter Size (to the *lowest* value that produces acceptable results) for the shadow casting light (this makes shadow edges softer).
- Increase Dmap Resolution (to the *lowest* value that produces acceptable results) for the shadow casting light.

Troubleshoot:Grainy or flickering shadows in illuminated fog



Increase Fog Shadow Samples (to the lowest value that produces acceptable results) for the shadow casting light.

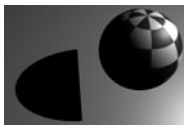
Troubleshoot:Dark spots or streaks on illuminated surfaces (outside of shadows)



Do one of the following:

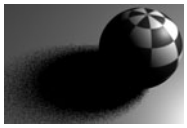
- Turn on Use Mid Dist Dmap for the shadow casting light that illuminates the surface.
- Increase Dmap Bias by a small amount for the shadow casting light that illuminates the surface.

Troubleshoot:Shadow appears detached from shadow casting surface



Decrease Dmap Bias by a small amount for the shadow casting light.

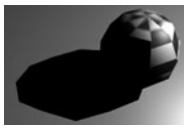
Troubleshoot:Grainy or flickering shadow edges (raytraced shadows)



Do either of the following:

- Decrease Light Radius (point lights or spot lights) or Light Angle (directional lights) for the shadow casting light. This also makes shadow edges sharper.
- Increase Shadow Rays (to the lowest value that produces acceptable results) for the shadow casting light.

Troubleshoot:Staircase of dark triangles on surface (raytraced shadows)



Do either of the following:

- Increase Curvature Tolerance for the surface.
- Increase U Divisions Factor and V Divisions Factor for the surface (to the lowest values that produce acceptable results).

Troubleshoot:Dmap resolution changes don't update in IPR

If you perform an IPR render and then change the Dmap Resolution or Use Dmap Auto Focus, these changes do not update in the IPR render.

For more information about IPR rendering, see *"Interactive Photorealistic Rendering (IPR)"* the Rendering guide.

Global illumination and caustics

Troubleshoot:Global Illumination doesn't work or looks incorrect

The problem is any of the following:

- Global illumination is not turned on. If you did not use the global illumination presets (see "Render with global illumination" on page 64), it might be turned off.
- Raytracing is not turned on. If you did not use the global illumination presets (see "Render with global illumination" on page 64), it might be turned off.

- If caustics is not turned on, too many photons may have migrated from the global illumination photon map to the caustics photon map. For more information, see "GI photon maps vs. caustic photon maps" on page 25.

Troubleshoot:Caustics don't work or look incorrect

Blurry or noisy caustics

Do any of the following:

- Tweak Caustic Radius until there is no visible change, then Caustic Accuracy until you get desire results.
- Work with the Caustic Filter type to sharpen or smooth caustics.

Caustics don't work with a directional light

Don't use directional lights for photon emission. Although you *can* render caustics and global illumination with a directional light source (that is, all the necessary attributes exist), we recommend against it. Because a directional light has no origin, it will unnecessarily shoot photons into a scene where they aren't needed, thereby increasing render times dramatically.

If you must render a directional light with photon emission (with mental ray for Maya), ensure that objects are marked properly for photon tracing. For more information on photon tracing and problems that may occur, see "GI photon maps vs. caustic photon maps" on page 25.

Final gather and HDRI

Troubleshoot:Final Gather renders black

There is no source of irradiance contribution in the scene.

Troubleshoot:Final Gather file problems

The following Output window messages indicate that the number of final gather rays has changed from the existing Final Gather File, and so it won't be used:

- RCFG 0.2 info: finalgMap/test1:final gather options differ from ones currently used, content ignored.
- RCFG 0.2 info: overwriting final gather file "finalgMap/test1"

Troubleshoot:HDR image warning message

A warning message is generated when an HDR image is loaded into Maya. Just ignore it while rendering with mental ray for Maya.

Photon tracing

Troubleshoot:Photon tracing limitations

Shadows

During photon tracing, shadow shaders not processed. This prevents light sources from casting shadows on objects twice (once through the shadow shader and once via transmitted photons), resulting in incorrect illumination.

Additionally, photons cannot mimic some Maya features such as a depth limit on shadow rays.

No view-dependent information

During the photon tracing phase, some view-dependent information (filter sizes, which are used in the bump and almost all texture nodes) is not available. You should turn off view-dependent filtering in all these nodes by setting Filter to zero and Filter Offset to a small positive value.

Troubleshoot:Photons are not bright enough

Increase Energy in light's AE.

Troubleshoot:No photons stored after emitting 10000 photons

Error message. This means that the photons emitted by the light source don't hit any energy-storing object. The problem is one of the following:

- objects in the path of photons don't have photon shaders in the materials or photon shaders that always absorb photons
- the receiving object has a strange shape as seen from the light source and mental ray for Maya is casting rays in places where they cannot be stored.
- the photon emitting light source is emitting photons in the wrong direction.

Reference Menus

Create

Create > Lights > Directional Light

Adds a directional light to your scene.

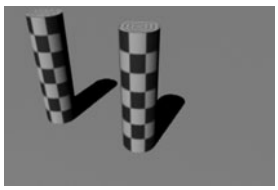


Image of flowers
by Alan Opler

Use a directional light to simulate a very distant point light source (for example, the sun as viewed from the surface of the Earth).

A directional light shines evenly in one direction only. Its light rays are parallel to each other, as if emitted perpendicular from an infinitely large plane.

Note	If you render a directional light with photon emission with mental ray for Maya, ensure that objects are marked properly for photon tracing.

Related topics

- ”Move the pivot point” on page 44
- ”Light specific surfaces” on page 46
- ”Directional Light Attributes” on page 97

Create > Lights > Directional lights > ❐

Intensity

See ”Intensity” on page 98.

Color

See ”Color” on page 97.

Cast Shadows

If on, the light produces either depth map shadows (for directional, point, or spot lights) or raytraced shadows (for ambient lights). Cast Shadows if off by default. See also "Shadow attributes".

Tip	• Depth map shadows are typically used for quick render tests when the quality is not important. • Raytraced shadows produce more accurate results and can handle transparency, but can be slower.

Shadow color

See "Shadow Color" on page 113.

Create > Lights > Ambient Light

Adds an ambient light to your scene.

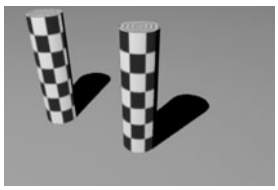


Image of flowers by Alan Opler

An ambient light shines in two ways—some of the light shines evenly in all directions *from the location of the light* (similar to a point light), and some of the light shines evenly in all directions *from all directions* (as if emitted from the inner surface of an infinitely large sphere).

Use an ambient light to simulate a combination of direct light (for example, the sun or a lamp) and indirect light (sunlight diffused by the atmosphere, or lamp light reflected off the walls of a room).

Related topics

❖ "Move the center of interest or origin" on page 43
❖ "Move the pivot point" on page 44
❖ "Light specific surfaces" on page 46
❖ "Ambient Light Attributes" on page 98.

Create > Lights > Ambient Light > ❐

Intensity

See "Intensity" on page 98.

Color

See "Color" on page 97.

Ambient shade

See "Ambient Shade" on page 99.

Cast Shadows

See "Cast Shadows" on page 88.

Shadow color

See "Shadow Color" on page 113.

Shadow rays

"Shadow Rays" on page 121.

Create > Lights > Area Light

Adds an area light to your scene.

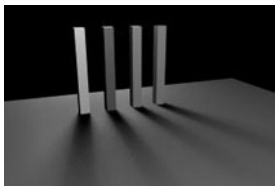


Image of flowers
by Alan Opler

In Maya, area lights are two-dimensional rectangular light sources. Use area lights to simulate the rectangular reflections of windows on surfaces. An area light is initially two units long and one unit wide. Use Maya's transformation tools to re-size and place area lights in the scene.

Compared to other light sources, area lights can take longer to render, but they can produce higher quality light and shadows. Area lights are particularly good for high-quality still images, but less advantageous for longer animations where rendering speed is crucial.

Area lights are physically based—there is no need for a decay option. The angles formed with the area light and the point that is shaded determine the illumination. As the point moves further away from the area light, the angle decreases and illumination decreases, much like decay.

Use an area light to simulate the rectangular reflections of windows on surfaces.

Related topics

- ″Control area lights″ on page 49.
- ″Area Light Attributes″ on page 99

Create > Lights > Area lights > ❐

Intensity

See ″Intensity″ on page 98.

Color

See ″Color″ on page 97.

Decay rate

See ″Decay Rate″ on page 101.

Cast Shadows

See ″Cast Shadows″ on page 88.

Shadow color

See ″Shadow Color″ on page 113.

Create > Lights > Point Light

Adds a point light to your scene.

You can turn a Maya point light into a mental ray for Maya area light by setting the light source's mental ray attributes. See ″Create a mental ray area light source″ on page 41.

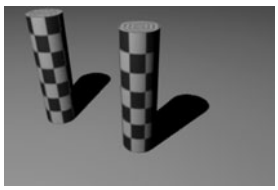


Image of flowers
by Alan Opler

A point light shines evenly in all directions from an infinitely small point in space. Use a point light to simulate an incandescent light bulb or a star.

Use a point light to simulate an incandescent light bulb.

Related topics

- ❖ "Move the center of interest or origin" on page 43
- ❖ "Move the pivot point" on page 44
- ❖ "Light specific surfaces" on page 46
- ❖ "Point Light Attributes" on page 101

Create > Lights > Point Light > ❐

Intensity

See "Intensity" on page 98.

Color

See "Color" on page 97.

Decay rate

See "Decay Rate" on page 101.

Cast Shadows

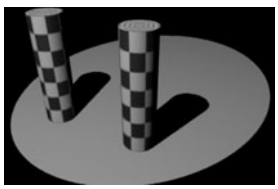
See "Cast Shadows" on page 88.

Shadow color

See "Shadow Color" on page 113.

Create > Lights > Spot Light

Adds an spot light to your scene.



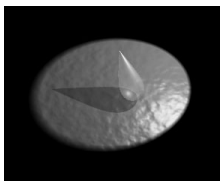


Image of flowers
by Alan Opler

A spot light shines a beam of light evenly within a narrow range of directions that are defined by a cone. The rotation of the spotlight determines where the beam is aimed. The width of the cone determines how narrow or broad the beam of light is. You can adjust the softness of the light to create or eliminate the harsh circle of projected light. You can also project image maps from spotlights.

Use a spot light to create a beam of light that gradually becomes wider (for example, a flashlight or car headlight).

Related topics

- ”Move the Cone Radius of a spot light” on page 44
- ”Move the Penumbra Radius of a spot light” on page 44
- ”Move the Decay regions of a spot light” on page 45
- ”Light specific surfaces” on page 46
- ”Move barn doors (shutters) of a spot light” on page 45
- ”Adjust decay” on page 50
- ”Adjust a spot light’s light circle” on page 53
- ”Spot Light Attributes” on page 101.

Create > Lights > Spot Light > ❐

Intensity

See ”Intensity” on page 98.

Color

See ”Color” on page 97.

Cone angle

See ”Cone Angle” on page 102.

Penumbra angle

See ”Penumbra Angle” on page 102.

Drop off

See ”Dropoff” on page 102.

Decay rate

See ”Decay Rate” on page 101.

Cast Shadows

See ”Cast Shadows” on page 88.

Shadow color

See "Shadow Color" on page 113.

Create > Lights > Volume Light

Adds an volume light to your scene.

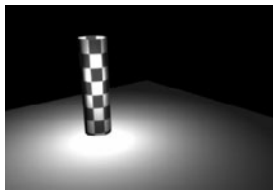


Image of flowers
by Alan Abler

A major advantage of using a volume light is that you have a visual representation of the extent of the light (the space within which it is bound).

The falloff of light in the volume can be represented by the color ramp (gradient) attribute in Maya, which prevents the need for various decay parameters, and also provides additional control. The color gradient is also useful for volume fog.

You can achieve different effects with light direction. Outward behaves like a point light and Downward acts like a directional light. Inward reverses the light direction for shading, giving the appearance of inward illumination. When using shadows with Inward light direction you may get unexpected results. In all cases the light shape dictates the extent of the light.

Use a volume light to illuminate within a given space. Volume lights provide control of light direction, color and decay within a bounded volume.

Tip	You can use a volume light as a negative light (to remove or decrease illumination) or to lighten up shadows.

Related topics

- ❖ ″Move the center of interest or origin″ on page 43
- ❖ ″Move the pivot point″ on page 44
- ❖ ″Light specific surfaces″ on page 46
- ❖ ″Volume Light Attributes″ on page 102.

Create > Lights > Volume Light > ❐

Intensity

See ″Intensity″ on page 98.

Color

See ″Color″ on page 97.

Cone angle

See ″Cone Angle″ on page 102.

Penumbra angle

See ″Penumbra Angle″ on page 102.

Drop off

See ″Dropoff″ on page 102.

Decay rate

See ″Decay Rate″ on page 101.

Cast Shadows

See ″Cast Shadows″ on page 88.

Shadow color

See ″Shadow Color″ on page 113.

Rendering menu set

Lighting/shading

Lighting/shading > Make Light Links

Link lights and objects so that specific surfaces are illuminated.

For more information on light links, see ″Light linking″ on page 19.

Lighting/shading > Break Light Links

Break links between lights and objects.

For more information on light links, see "Light linking" on page 19.

Lighting/shading > Select Objects Illuminated by Light

Select all objects lit by a selected light.

For more information on light links, see "Light linking" on page 19.

Lighting/shading > Select Lights Illuminated by Object

Select all lights illuminating selected objects.

For more information on light links, see "Light linking" on page 19.

Lighting/shading > Light Linking

For more information on light links, see "Light linking" on page 19.

Object centric

Open the Relationship Editor in Object centric Light Linking mode.

Light centric

Open the Relationship Editor in Light centric Light Linking mode.

Panel menus

Lighting

Lighting > Use Default Lighting

This for the Scene view only; it does not affect your final render. Surfaces appear fully illuminated in the view by Maya's default lights.

For more information on default lighting, see "Default lighting in Maya" on page 17.

Lighting > Use All Lights

Surfaces appear illuminated by at least 8 lights (depending on the capabilities of you graphics card) in the scene. This option gives you a *representation* of what the lights will look like when the image is rendered.

Once you create lights, you can interactively place them and view the scene with lighting before you render.

Lighting > Use Selected Lights

Surfaces appear illuminated by selected lights in the view as well as in the Render View.

Uses only selected lights. If you change the light selection, the lighting also changes.

Lighting > Use No Lights

Hardware lighting is disabled so no shading occurs.

Tip	This is useful when you have already baked the lighting into a scene and you don't want any additional hardware lighting to be added to the scene in the modeling viewports.

Lighting > Use Previously Specified Lights

Surfaces appear illuminated by the lights you previously selected.

Select this option to use the lights selected with the Specify Selected Lights option. This option is not available until you choose Specify Selected Lights. If you select a different set of lights when this option is selected, the scene still uses the previously selected lights.

Note	This menu item can be turned off by selecting any of the menu items above it.

Lighting > Two Sided Lighting

When on, illuminates both sides of an object. Two Sided Lighting is on by default. Note that Maya's performance may decrease on some systems.

Lighting > Shadows

Use Lighting > Shadows to see hardware shadow maps in the Scene View.

Hardware shadow maps from directional or spot lights for geometry (NURBS, polygons, subdivision surfaces) and particles (points, multipoints, and spheres only) can be calculated and displayed on graphics cards with drivers that support the ARB_multitexture and EXT_texture_env_combine OpenGL extensions.

Lighting > Specify Selected Lights

Lets you use a preset selection of lights. Select the lights you want to use then select Specify Selected Lights. Once specified, turn on Lighting > Use Previously Specified Lights to use this light selection. Unlike Use Selected Lights, if you change the light selection, the scene still uses the previously selected lights.

Nodes

Light nodes

Directional Light Attributes

All light types share the Directional Light attributes and options.

For a description of Maya's Directional Light, see "Create > Lights > Directional Light" on page 87.

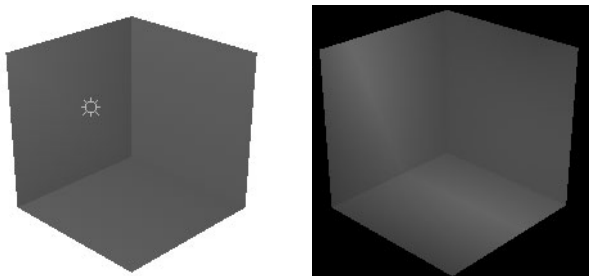
Type

Click the arrow to choose a light type from the drop-down menu. When you change a light's type, only those attributes common to both types retain their previous values or settings. Values and settings for non-common attributes are lost. When you change a light's light type, the light's position is also preserved.

For more information on Maya's light types, see "Sources of direct light" on page 15.

Color

Determines the light's color. Click the swatch either to change the light's color in the Color Chooser or to map a texture to the light. If you map a texture, the light projects it (depending on the light Type). The default setting is white. The following shows the rendered result when you map a Ramp texture to an Ambient light's Color attribute.



Intensity

Represents the brightness of the light. A light with an Intensity value of 0 produces no light. A light with a negative Intensity value removes light from a scene in the area of the light's influence. The slider range is 0 to 10, but you can type in a larger value for a brighter light (for example, 20). The default value is 1.

Tip	Use a negative Intensity value to reduce or remove hot-spots or glare.

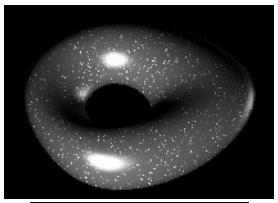
Illuminates by Default

If on, the light illuminates all objects and is included in the defaultLightSet. If off, the light only illuminates objects to which it is linked. Illuminates by Default is on by default.

Emit Diffuse and Emit Specular

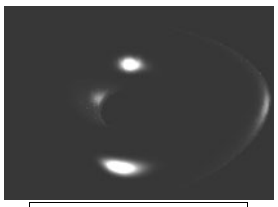
Emit Diffuse and Emit Specular are on by default. Turning them off turns off the diffuse or specular shading results for the light.

Note	The results do not show in the scene view. To see the results, test render in Render View.

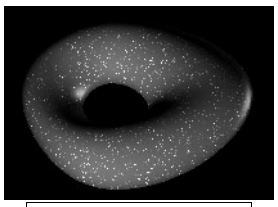


Emit Diffuse ON
Emit Specular ON

Default setting



Emit Diffuse OFF
Emit Specular ON



Emit Diffuse ON
Emit Specular OFF

To enable or disable the diffuse and specular shading for multiple lights at the same time, use the Rendering Flags window (Window > Rendering Editors > Rendering Flags).

Ambient Light Attributes

For a description of Maya's Ambient Light, see "Create > Lights > Ambient Light" on page 88.

Type

See ″Type″ on page 97.

Color

See ″Color″ on page 97.

Intensity

See ″Intensity″ on page 98.

Illuminates by Default

See ″Illuminates by Default″ on page 98.

Ambient Shade

The proportion of directional light to omnidirectional (ambient) light. The slider range is 0 (light comes from all directions) to 1 (light comes only from the position of the light). The default value is 0.45.

Area Light Attributes

For a description of Maya's Area Light, see ″Create > Lights > Area Light″ on page 89.

Type

See ″Type″ on page 97.

Color

See ″Color″ on page 97.

Intensity

See ″Intensity″ on page 98.

Illuminates by Default

See ″Illuminates by Default″ on page 98.

Emit Diffuse and Emit Specular

See ″Emit Diffuse and Emit Specular″ on page 98.

Decay Rate

Controls how quickly the light's intensity decreases with distance. The Decay Rate setting has no effect at distances less than 1 unit. The default setting is No Decay.

For more information on light decay, see ″Light decay″ on page 18.

Tip	The Decay Rate also controls how fog brightness decreases with distance from the light source.

In the Attribute Editor, click the arrow to display the drop-down menu and select a Decay Rate. In the options window, type a value or use the slider.

No Decay	no decay; light reaches everything
Linear	light intensity decreases directly (linearly) with distance (slower than real world light)
Quadratic	light intensity decreases proportionally with the square of distance (the same as real world light)
Cubic	light intensity decreases proportionally with the cube of distance (faster than real world light)

mental ray Area Light Attributes

For a description of mental ray for Maya's area light, see "mental ray Area Light" on page 17.

Type

This is the shape of the area light source. Select from the drop-down list: Rectangle, Disc, Sphere, Cylinder. The default is Rectangle.

Sampling

This represents the number of sample points emitted from the light (X and Y). The default is 3 and 3. Values greater than 3 increase the quality by reducing graininess, but may increase rendering cost.

Low Level

If this value is greater than 1 the light source uses the Low Sampling values instead, as long as their sum is greater than the Low Level value. This affects reflection and refraction. The default is 0.

Low Sampling

The default is 2 and 2.

Visible

This can be used if you want the area light object to be visible when rendered. The default is off.

Note If you're using Maya's Ray trace Shadows, make sure your Ray Depth Limit is greater than 1 so that reflected shadows appear.

Point Light Attributes

For a description of Maya's Point Light, see "Create > Lights > Point Light" on page 90.

Type

See "Type" on page 97.

Color

See "Color" on page 97.

Intensity

See "Intensity" on page 98.

Illuminates by Default

See "Illuminates by Default" on page 98.

Emit Diffuse and Emit Specular

See "Emit Diffuse and Emit Specular" on page 98.

Decay Rate

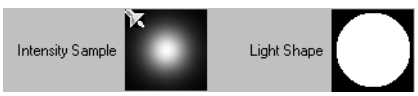
See "Decay Rate" on page 99.

Spot Light Attributes

For a description of Maya's Spot Light, see "Create > Lights > Spot Light" on page 91.

Spot light Light Shape sample

Spot light tabs in the Attribute Editor also contain a Light Shape sample. This sample displays the shape the spotlight casts and the light's intensity. The following shows the default shape and intensity.



Type

See "Type" on page 97.

Color

See "Color" on page 97.

Intensity

See "Intensity" on page 98.

Illuminates by Default

See "Illuminates by Default" on page 98.

Emit Diffuse and Emit Specular

See "Emit Diffuse and Emit Specular" on page 98.

Decay Rate

See "Decay Rate" on page 99.

Cone Angle

The angle (in degrees) from edge to edge of the spot light's beam. The valid range is 0.006 to 179.994. The default value is 40.

Penumbra Angle

The angle (in degrees) from the edge of the spot light's beam over which the intensity of the spot light falls off linearly to zero. The valid range is -179.994 to 179.994. The slider range is -10 to 10. The default value is 0.

For example, if the Cone Angle value is 50 and the Penumbra Angle value is 10, the spot light has an effective spread of 70 (50 + 10 + 10) degrees; however, the spot light intensity decreases to 0 between the angles of 50 and 70 degrees. If the Cone Angle value is 50 and the Penumbra Angle value is -10, the spot light has an effective spread of 50 degrees and the spot light intensity decreases to 0 between the angles of 30 and 50 degrees.

Dropoff

Controls the rate at which light intensity decreases from the center to the edge of the spot light beam. The valid range is 0 to ∞. The slider range is 0 to 255.

Typical values are between 0 and 50. Values of 1 or less produce almost identical results (no discernible intensity decrease along the radius of the beam). The default value is 0 (no dropoff).

Volume Light Attributes

For a description of Maya's Volume Light, see "Create > Lights > Volume Light" on page 93.

Type

See ″Type″ on page 97.

Color

See ″Color″ on page 97.

Intensity

See ″Intensity″ on page 98.

Illuminates by Default

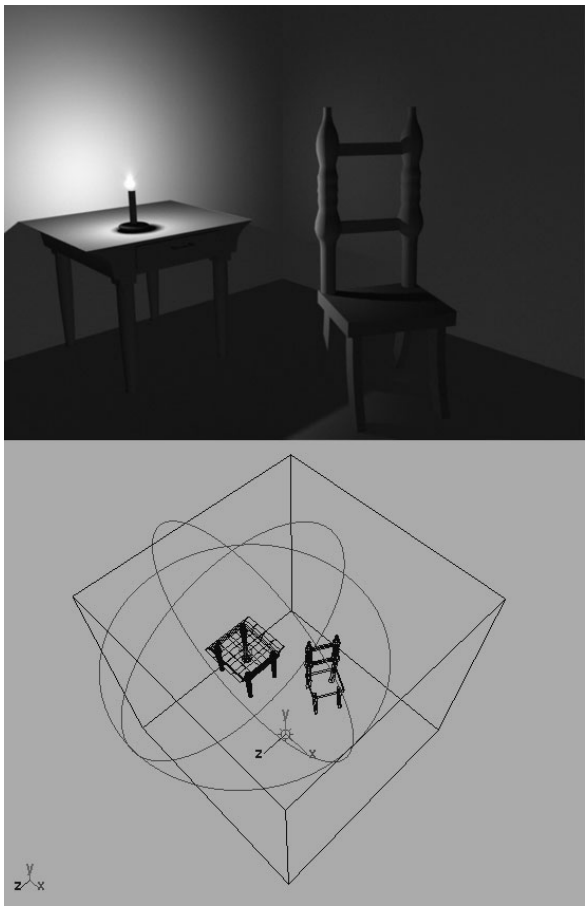
See ″Illuminates by Default″ on page 98.

Emit Diffuse and Emit Specular

See ″Emit Diffuse and Emit Specular″ on page 98.

Light shape

This determines the volumetric shape of the light. Select a light shape from the drop-down list: Box, Sphere, Cylinder, or Cone. Sphere is the default.



There is a volume light and an ambient light in this scene.

The volume light is being used to simulate the light of the candle, which can only illuminate objects for a finite distance.

By adjusting the scale of volume light, you can control how far the light reaches into the scene.

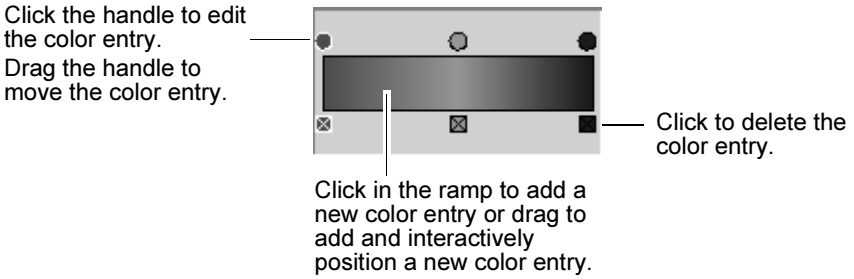
To control the falloff within this light, we've added indices to the color range attribute's ramp control.

You can pinpoint where the volume light ends near the top - it's where the detail in the image lessens.

Color range attributes

colorRange

The colorRange is the color of the light from the center to the edge of the volume. By changing the values on the ramp (gradient) you can decay or change color along the defined light direction. The right side of the ramp represents the light color at the center of the volume. The left side is the color at the outer boundary. The effect of decay is accomplished by the interpolation (blend) from the inner color to the outer color. The outermost color should be black to avoid a hard boundary at the volume edge.



Selected Position

Position of the active color entry in the ramp.

Selected Color

The color of the active color entry.

Interpolation

Controls the way colors blend in the ramp. Select an option from the drop-down list: None, Linear, Smooth, Spline. The default is Linear.

None	There is no interpolation; the different colors show up as different bands in the final texture.
Linear	The values are interpolated linearly in RGB color space.
Smooth	The values are interpolated along a bell curve, so that each color on the ramp dominates the region around it, then blends quickly to the next color.
Spline	This takes into account neighboring indices for a smoother effect.

Volume Light Dir

The direction of the light within the volume. Select an option from the drop-down list: Outward, Inward, Down Axis. The default is Outward.

Outward

Light moves away from the center of a box or sphere and away from the central axis of a cylinder or cone. It behaves like a point light.

Inward

The light direction moves towards the center of the light. This is a special effect that does not simulate an area light, but is instead a simple change in direction used for the light computation.

Down Axis

The light direction is down the central axis of the light. It behaves like a directional light.

Note	Shadowing does not work properly for directions other than Outward. It always shadows as if from a point light. Emit Specular has no effect on Inward lights.

Arc

Use this option to create a partial sphere, cone, or cylinder light shape by specifying a degree of rotation. Values can range from 0 to 360 degrees. The most common settings are 180 and 360, the default. 180 is similar to slicing the light volume in half and 360 is the full light. This option does not apply to the box light shape.

Cone End Radius

This option applies to the cone light shape only. This is the relative size of one end of the cone. At a value of 1.0 it is a cylinder, while at 0 it is a cone.

Emit Ambient

If turned on, light affects surfaces in a multi-directional manner. The default is off.

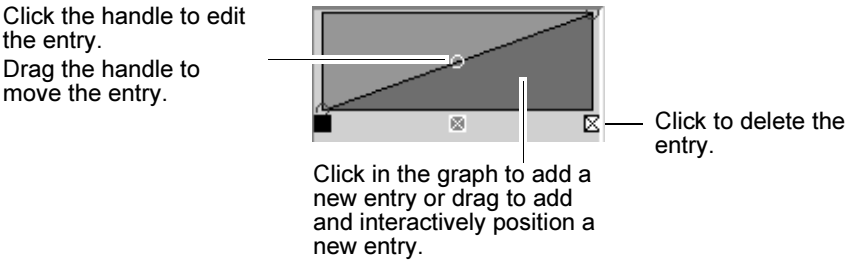
Note	Emit Ambient may wash out shadows and look flat. When combined with Emit Diffuse, the lighting of a surface is 50% of the surface/light angle, and 50% in a non-directional fashion. If Emit Diffuse is off then the light is totally omnidirectional. If Emit Diffuse and Emit Specular are off and Emit Ambient is on, the light behaves like an ambient light with decay and a bounded range. This is quite useful for adjusting lighting. It can be used with negative light intensity to pull light out of defined regions.

Penumbra attributes

Penumbra

This section applies to cone and cylinder light shapes only. This contains attributes for managing the penumbra, the area of partial illumination around the shadow border and the light. Using the graph you can adjust

the spread and the dropoff of the light. The left side of the graph represents the intensity at the outer edge of the cone or cylinder and the right side represents the intensity from the center of the beam to the edge.

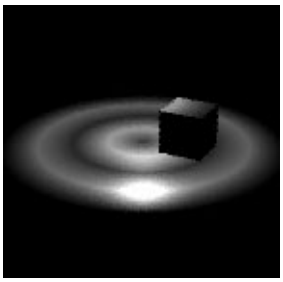


Selected Position

This value affects the active entry in the graph and is represented on the x-axis of the graph.

Selected Value

This value affects the active entry in the graph and is represented on the y-axis of the graph.

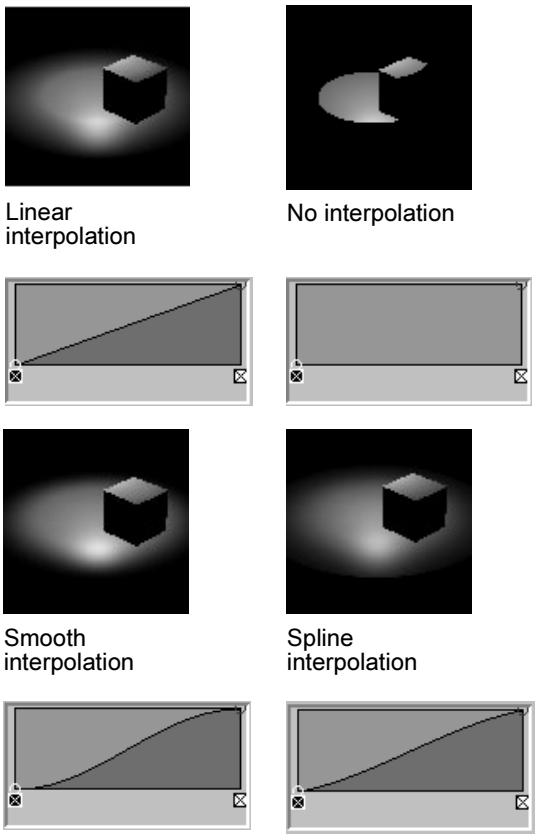


Multiple Positions at different Values on the penumbra graph can be used to create rings of light. This could be used to simulate the light effect of a flash light.

Interpolation

This controls the way the values are calculated. Select an option from the drop-down list: None, Linear, Smooth, Spline. The default is Linear.

None	There is no interpolation; the different values show up as different bands in the final result.
Linear	The values are interpolated linearly.
Smooth	The values are interpolated along a bell curve, so that each value on the ramp dominates the region around it, then blends quickly to the next value.
Spline	This takes into account neighboring indices for a smoother effect.



mental ray attributes (point, spot, directional)

mental ray attributes are available only for point, spot and directional lights.

Caustic and Global Illumination

Emit Photons

Turns on photon emission for the light source.

Energy

The amount of light distributed by the light source. Each photon carries a fraction of the light source energy.

8000 is the default. 0 means no photons are emitted.

If caustic effects are not bright enough, try increasing these values equally, in small increments (to 12000, to start) until you have better results.

If 'hot spots' (blown out) areas occur, try decreasing these values equally to around 4000 or 5000.

Exponent

This is similar to decay -- the intensity increases as the value decreases. To increase the chances that indirect light will reach a greater distance, decrease the value.

Visible noise can occur with values less than 1. The default (2) simulates natural (quadratic) decay, but violates the conservation-of-energy law (that happens in the natural world), so bright spots from distant light sources could occur in unexpected locations.

Physical

Ensures shading models in the scene behave in a physically correct way. That is, they do not amplify light be emitting more energy than was received. This is particularly important if you are combining Global Illumination with Final Gather.

Caustic Photons

The number of photons to be generated by the light source and therefore stored in the photon map. The default, 10000, is suitable for quick, low-quality caustics. To improve the quality of caustic effects, increase this number, incrementally, to 20000 to start (render time will increase as a result). Generally, 100000 produces medium quality and 1000000 produces highly accurate effects.

Light Effects

The Light Effects attributes control the appearance of illuminated (light) fog and optical light effects. (For information on optical effects, see "Glows, halos, and lens flares" on page 20 and "Optical FX Attributes" on page 122.)

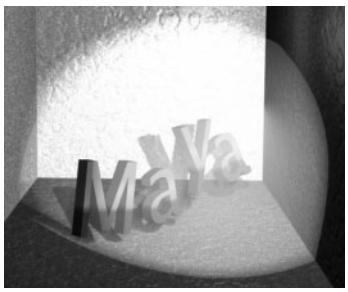
Note Avoid instanced lights when you create light fog. Copy the lights instead of instancing. For light fog, make sure that light fog is duplicated independently of the light because when you duplicate a light, its light fog is *not* duplicated with it.

Light Fog

Light Fog attributes are only available for point, spot and volume lights.

When you click the map button beside Light Fog, Maya creates a light fog node and connects it to the light. A fog icon, basically an extension to the light icon, appears in the views. After you have connected Light Fog to a light, click the button at the end of the field to access the light fog attributes.

The following examples show a Light Fog applied to a Spot light using the default settings of 1.0, and the "Fog Spread" and "Fog Intensity" setting changed to 2.0.



Note By default light fog is evaluated only at the boundary entry point. When the radius of the light fog is greater than the size of the volume fog, the amount of light illuminating the fog is the light intensity at the edge of the volume light (zero by default, but can be otherwise if the color ramp is edited). If you turn on Volume Samples Override on the Shape node (for example, sphereShapeNode) and increase the number of samples, the illumination of the volume light is better represented. Turning on Depth Jitter for the samples avoids stepping in these cases.

Fog Spread

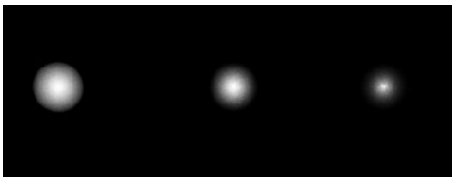
Only for spot lights.

Determines how the fog brightness varies across the spot light or point light beam. A high Fog Spread value produces fog with uniform brightness shooting from the cone of a spot light. A low Fog Spread value produces fog which is brighter at the center of the spot light beam and foggier at the end.

The slider range for a spot light is 0 to 5. The default value is 1.

Fog Type

Only for point lights.



Select a Fog Type from the drop-down menu. Fog types include:

Normal	The default fog setting.
Linear	Fog slowly diminishes from the center of the light.
Exponential	Fog quickly diminishes from the center of the light.

Fog Radius

Only for point lights.

The Fog Radius value determines how much the fog spreads in every direction from a point light's beam. The spot or point light's Decay Rate controls how fog brightness decreases with distance from the light source.

The slider range for a point light is 0 to 10.The default value is 1.

Fog Intensity

The brightness of the fog. (The light's Intensity also influences the brightness of illuminated fog.) The slider range is 0 to 5. The default value is 1.

Light Glow

The Light Glow attribute is available for point, spot, area and Volume lights only.

When you click the map button beside Light Glow, Maya creates an optical FX node and connects it to the light (a glow, halo, or lens flare). An optical FX icon attached to the light icon appears in the views. See "Optical FX Attributes" on page 122 for details about setting these attributes.

Glow attached to a Point light.

Intensity Curve

Only for spot lights.

Creates an intensity curve used to control the intensity decay for a spot light. This attribute is only available for spot lights. See also "Create custom spot light intensity or color decay" and "Edit custom intensity and color decay".

Color Curves

Only for Spot lights.

Creates a color curve used to control how a spot light's color changes with distance. This attribute is only available for spot lights.

See also "Create custom spot light intensity or color decay" and "Edit custom intensity and color decay".

Barn doors

The Barn Doors attributes are located in the Light Effects section of a spot light's Attribute Editor and are used to square off the circular shape of a cone.

Note You can adjust barn door interactively. See "Apply barn doors (shutters) to a beam of light" on page 54.

Left, Right, Top, Bottom Barn Door	The angle (in degrees) from the center of the spot light's beam to the position of each barn door. The valid/slider range is -89.997 to 89.997. The default value is 20.

Decay Regions attributes

The Decay Regions attributes let you separate a spot light's beam into regions which are illuminated and regions which are not illuminated.

Click Use Decay Regions to turn it on and to set the Region 1, 2 and 3 Start and End distances for the spot light. Use Decay Regions is off by default.

Related topics

- "Light decay" on page 18
- "Decay Rate" on page 99

Note You can adjust decay interactively. See "Interactively set decay regions" on page 50.

Region 1, Region 2, and Region 3 attributes

The Region 1, Region 2, and Region 3 attributes control the size and location of each illuminated region within a spot light's beam.

Start Distance1, End Distance1

The Start and End Distance values determine the distance from the spot light where each illuminated region begins and ends.

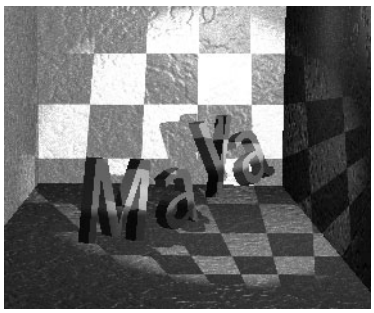
Shadow attributes

For more information about shadows, see "Shadow" on page 33.

Shadow Color

The color of shadows produced by the light. Use a colored shadow to simulate shadows produced by transparent, colored surfaces (for example, colored glass). The default setting is black.

You can also map textures to shadows to create interesting effects. The following example shows a Checker texture mapped to the Shadow Color of a Spot Light.



If you decide to map a texture that has color (such as the Stucco texture in the following example), change the texture's color to black and white if desired.

Depth Map Shadow Attributes

The Depth Map Shadow Attributes control the appearance of depth map shadows produced by the light.

For more information about depth map shadows, see "Depth map shadows" on page 35.

Use Depth Map Shadows

If Use Depth Map Shadows is on, the light produces depth map shadows. Use Depth Map Shadows is off by default.

Dmap Resolution

The resolution of the light's shadow depth map.

If the Dmap Resolution is too low, shadow edges appear jagged or pixelated. Increasing the Dmap Resolution also increases rendering times, so set it to the lowest value that produces shadows of acceptable quality.

As a starting point, set Dmap Resolution to the rendering resolution. If the light moves during an animation, you may need to increase the Dmap Resolution to avoid flickering shadows. The slider range is 16 to 8192. The default value is 512.

Use Mid Dist Dmap

If off, Maya calculates the distance from the light to the nearest shadow casting surface for each pixel in the depth map. If the distance from the light to another shadow casting surface is greater than the depth map distance, that surface is in shadow.

Note If Use Mid Dist Dmap is off, dark spots or streaks may appear on illuminated shadow casting surfaces because the distance from the light to the surface is greater than the stored depth value and therefore in shadow. This type of artifacting happens because of the finite resolution of some dmaps and may be particularly noticeable for a curved surface, or for a surface illuminated by light not perpendicular to the surface.

A pixel in the dmap can be forced to approximate a large area of the scene. Although you can reduce this effect by increasing the Dmap Resolution, you are only making the problem smaller. This also increases rendering times. A better solution is to turn on Use Mid Dist Dmap.

If on, for each pixel in the depth map, Maya calculates the distance from the light to the nearest shadow casting surface *and* the distance from the light to the next nearest shadow casting surface and averages them.

If the distance from the light to another shadow casting surface is greater than the depth map distance, that surface is in shadow. Use Mid Dist Dmap is on by default.

Note If Use Mid Dist Dmap is on, Maya calculates the middle distance between *shadow casting* surfaces only (that is, surfaces which have their Casts Shadows attribute on).

Use Dmap Auto Focus

If on, Maya automatically scales the depth map so that it only fills the area of the light's illumination that contains shadow casting objects.

For example, if shadow casting objects are only in the center of a spot light's beam, the depth map only covers the region occupied by those objects. Because the Dmap Resolution is an absolute resolution (that is, pixels, *not* pixels per inch), decreasing the size of the depth map effectively increases the resolution of the depth map and the quality of the shadows without increasing rendering times.

If off, you can manually scale the depth map within the area of the light's illumination using the Dmap Focus attribute (for point lights and spot lights) or the Dmap Width Focus attribute (for directional lights). Use Dmap Auto Focus is on by default.

Dmap Focus, Dmap Width Focus

The angle (Dmap Focus) or width (Dmap Width Focus) to scale the depth map within the area of the light's illumination. (You can scale the depth map automatically by turning on Use Dmap Auto Focus.)

Because the Dmap Resolution is an absolute resolution (that is, pixels, *not* pixels per inch), decreasing the size of the depth map effectively increases the resolution of the depth map and the quality of the shadows without increasing rendering times.

Dmap Focus is only available for point lights and spot lights if Use Dmap Auto Focus is off. The slider range is 0 to 360. The default value is 90.

Dmap Width Focus is only available for directional lights if Use Dmap Auto Focus is off. The valid range is 0 to ∞. The default value is 100.

Use Light Position

Use Light Position is only available for directional lights. If on, only objects in front of the directional light's icon are lit and cast shadows. If off, objects both in front of and behind the directional light's icon are lit and casts shadows.

Use Light Position is only available for directional lights. Use Light Position is off by default.

Dmap Filter Size

Controls the softness of shadow edges. (The softness of shadow edges is also influenced by the size of the shadow and the Dmap Resolution.) Increasing Dmap Filter Size also increases rendering times, so set it to the lowest value that produces acceptable results. A Dmap Filter Size of 3 or less is usually sufficient. The valid range is 0 to ∞. The slider range is 0 to 5. The default value is 1.

Tip	If you want very soft shadows, use a low dmap resolution, then adjust this setting.

Dmap Bias

Offsets the depth map toward or away from the light. Adjust the Dmap Bias only if you encounter the following problems and cannot resolve them by adjusting other attributes:

- If dark spots or streaks appear on illuminated surfaces, gradually increase the Dmap Bias value until the spots or streaks disappear.

- If a shadow appears to be detached from the shadow casting surface, gradually decrease the Dmap Bias value until the shadow looks correct.

The slider range is 0 to 1, but you can type in a higher value. The default value is 0.001.

Fog Shadow Intensity

Controls the darkness of shadows appearing in illuminated (light) fog. The valid range is 1 to 10. The default value is 1.

Fog Shadow Samples

Controls the graininess of shadows appearing in illuminated (light) fog. Increasing Fog Shadows Samples also increases rendering times, so set it to the lowest value that produces acceptable results. Shadows that are cast from very narrow objects into illuminated fog may shift during an animation. In this case, increase the Vol Shadow Samples value. The default value is 20.

Disk Based Dmaps

Lets you save a light's depth maps to disk and reuse them during subsequent renders. By saving depth maps to disk, and reusing them later, you can decrease the time it takes to render the scene (see "Reuse depth maps" on page 73). Depth maps are saved in the `renderDate/depth` directory.

Off	Maya creates new depth maps during rendering. Maya does not read depth maps from disk. Maya does not save depth maps to disk.
Overwrite Existing Dmap(s)	Maya creates new depth maps, and saves them to disk. If depth maps already exist on disk, Maya overwrites them. When you write them to disk, you get two dmaps: One is the first shadow casting surface, the other is the second shadow casting surface.
Reuse Existing Dmap(s)	Maya checks to see if depth maps have previously been saved to disk. If so, Maya uses them instead of creating new depth maps. If not, Maya creates new depth maps and saves them to disk.

Tip	If you are saving depth maps to disk, check the `renderDate/depth` directory occasionally, and remove any unnecessary depth map files.

Dmap Name

The name of the depth map file that Maya saves to disk. The name of the depth map may also include the scene name (if Dmap Scene Name is on), the light name (if Dmap Light Name is on), and the frame extension (if Dmap Frame Ext is on). Dmap Name is only available if Disk Based Dmaps is set to either Overwrite Existing Dmap(s) or Reuse Existing Dmap(s). Depth maps are saved in the `renderDate/depth` directory. The default depth map name is `depthmap`.

Dmap Scene Name

Adds the scene name to the name of the depth map file that Maya saves to disk. Dmap Scene Name is off by default.

Dmap Light Name

Adds the light name to the name of the depth map file that Maya saves to disk. Dmap Light Name is on by default.

Dmap Frame Ext

If on, Maya saves a depth map for each frame, and adds the frame extension to the name of the depth map file. If off, Maya saves one depth map file for the entire animation and does not add the frame extension to the name of the depth map file. Dmap Frame Ext is off by default.

Dmap Use Macro

Only available when Disk Based Dmaps is set to Reuse Existing Dmap(s). The path and name of a macro script that Maya runs to update a depth map when it reads it from disk. Dmap Use Macro is useful mainly for troubleshooting.

The macro gets all the information for creating or processing depth maps on disk. The following example is written in Perl. The macro post-processes or creates the maps. You can modify or create maps of any width or height. Maya looks at the sizes specified in the IFF Z-depth map file and uses them. The macro is called each time a map is going to be read from disk. For example, the map may be called several times in the case of a point light, which can use up to six maps.

The arguments are named so that new arguments can be added easily. The arguments currently supplied to the script by Maya are:

```
mapname=FullPathMapName,middistmapname=FullPathMidDistMapName,
lightname=LightShapeNameUsed,pathname=ShadowMapPathUsed,
readanimextname=RedExtUsed,curranimextname=CurrExt,
lastdumpanimextname=lastExtDumped,bias=biasValue
```

An example of a Perl script macro is as follows:

```
#!/bin/perl
#
# Example of a callback macro called before reading shadow maps from disk
#

#
# One argument with fields separated by '&'
# each field being 'variableName=variableValue
#
# Creates a vartab hash table out of the ARGV[0] argument
#

# print "\n------------------\n",$ARGV[0],"\n------------------\n";

if( $#ARGV == 0 )
{
        @fields = split( /\,/, $ARGV[0] );
        $nbfields = $#fields + 1;
        foreach $field( @fields )
        {
                @varvalue = split( /\=/, $field );
                $vartab{$varvalue[0]} = $varvalue[1];
        }

        $mapname = $vartab{"mapname"};
        $middistmapname = $vartab{"middistmapname"};
        $lightname = $vartab{"lightname"};
        $pathname = $vartab{"pathname"};
        $readanimextname = $vartab{"readanimextname"};
        $curranimextname = $vartab{"curranimextname"};
        $lastdumpanimextname = $vartab{"lastdumpanimextname"};
        $bias = $vartab{"bias"};

        print "\tmapname = ",$mapname,"\n";
        print "\tmiddistmapname = ",$middistmapname,"\n";
        print "\tlightname = ",$lightname,"\n";
        print "\tpathname = ",$pathname,"\n";
        print "\treadanimextname = ",$readanimextname,"\n";
        print "\tcurranimextname = ",$curranimextname,"\n";
        print "\tlastdumpanimextname = ",$lastdumpanimextname,"\n";
        print "\tbias = ",$bias,"\n";


#
```

```
# List the shadow map files to be postprocessed
#
        print "\n";
        if ( -e $mapname ) {
                print "PostProcess shadow depth map file ",$mapname,"\n";
        }
        if ( -e $middistmapname ) {
                print "PostProcess shadow depth map file ",$middistmapname,"\n";
        }

#
# return 0 to confirm everything is ok
#
        exit 0;
}
```

Use Only Single Dmap

Only available for spot lights.

If on, Maya generates a single depth map for the spot light. A single depth map is usually sufficient if the Cone Angle is less than 90, but if the Cone Angle is large, the Dmap Resolution may not be high enough to produce high quality shadows (shadow edges may appear jagged). If the Cone Angle is large, turn off Use Only Single Dmap. Use Only Single Dmap is on by default.

If off, Maya generates up to five separate depth maps for the spot light. Each depth map extends from the light in one of six possible directions: positive or negative X-axis directions, positive or negative Y-axis directions, and positive or negative Z-axis directions. The resolution of each depth map is the Dmap Resolution.

The spot light also produces high quality shadows even if the Cone Angle is large. Rendering times may also increase because Maya is generating several depth maps for the light. However, you can control the number and direction of depth maps that Maya generates by turning the Use XYZ+- Dmap attributes on or off.

Use X+ Dmap, Use Y+ Dmap, Use Z+ Dmap, Use X- Dmap, Use Y- Dmap, Use Z- Dmap

These attributes are only available for spot lights (if Use Only Single Dmap is off) and point lights. The default setting for all attributes is on.

Control the number and direction of depth maps Maya generates for the light. For example, if X+ Dmap is on, Maya generates a depth map for the light in the direction of the positive X-axis.

Maya can generate up to five depth maps for a spot light and up to six depth maps for a point light. However, you usually only need the light to cast shadows in a few specific directions. By turning off depth

maps in certain directions, you can help reduce rendering times. For example, if these is a point light at the top of the scene, and all shadow casting objects are below the light, you can turn off Use Y+ Dmap (assuming the scene uses a Y-up coordinate system) and Maya does not generate a depth map in the direction of the positive Y axis (up).

Raytrace Shadow Attributes

Control the appearance of raytraced shadows produced by the light.

For more information about raytraced shadows, see "Raytraced shadows" on page 36.

Use Ray Trace Shadows

If on, the light produces raytraced shadows *when the scene is raytraced* (that is, when Raytracing is on in the Render Global Settings window). Use Ray Trace Shadows if off by default.

Shadow Radius, Light Radius, Light Angle

Controls the softness of shadow edges by setting the size (Shadow Radius or Light Radius) or angle (Light Angle) of the light. For example, a large light produces softer shadows than a small light. The light radius is also used for light glows to determine the occlusion/visibility (for point and spot lights).

The Shadow Radius attribute is only available for ambient lights.

The Light Radius attribute is only available for point lights and spot lights. The slider range is 0 (hard shadows) to 1 (soft shadows). The default value is 0.

The Light Angle attribute is only available for directional lights. The slider range is 0 (hard shadows) to 180 (soft shadows). The default value is 0.

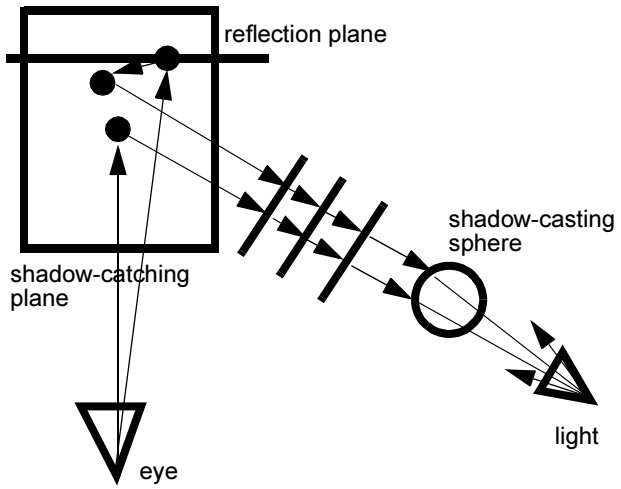
Shadow Rays

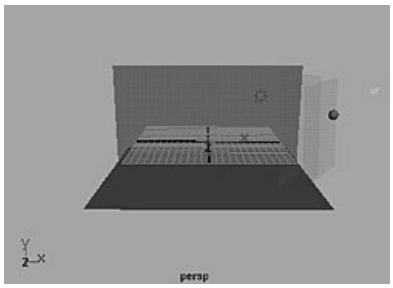
Controls the graininess of soft shadow edges. Increasing the number of Shadow Rays also increases rendering times, so set it to the lowest value that produces acceptable results. The slider range is 1 to 40. The default setting is 1.

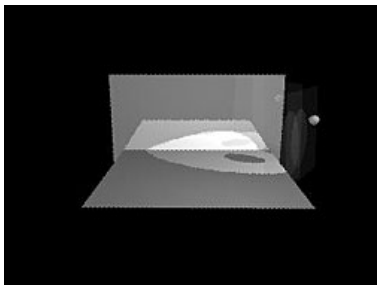
Ray Depth Limit

Ray depth specifies the maximum number of times a light ray can be reflected and/or refracted and still cause an object to cast a shadow. Transparent objects between those points in which the ray changes direction will have no affect on the light ray's termination. This can best be visualized by example in which the ray traced shadow is visible on both the ground plane and reflection plane. If the ray depth

is set to 1, the shadow will only be visible on the ground plane. If the ray depth is set to 2, the shadow will be visible on both the ground plane and the reflected plane.







Glow nodes

Optical FX Attributes

The Optical FX Attributes control the appearance of glows, halos, and lens flares.

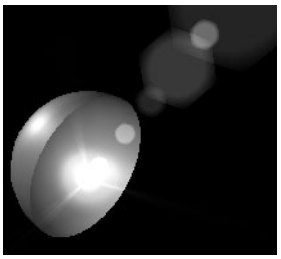
For more information about optical effects, see "Glows, halos, and lens flares" on page 20.

Active

Turns the optical effect on or off. Active is on by default.

Lens Flare

Simulates a bright light source illuminating the surfaces of a camera's lens. The flare intensity is determined by the "Flare Intensity" value. The size of the flare circles is relative to the field of view of the camera. Lens Flare is off by default. Check Lens Flare on to access Lens Flare Attributes.



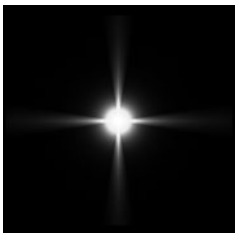
Glow Types

The type of glow the light produces when viewed directly. Click the arrow to access available glow types from the drop-down menu.

A light does not need glow to illuminate objects when the scene is rendered, however a light does need glow to be visible by the camera when the scene is rendered. The default Glow Type is Linear.

The following examples show a yellow glow (Glow Color) and all other Glow attributes left at the default settings.

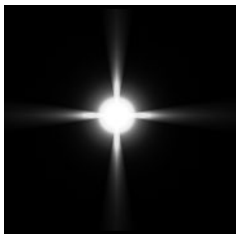
None	No glow appears.
Linear	Glow slowly diminishes from the center of the light.



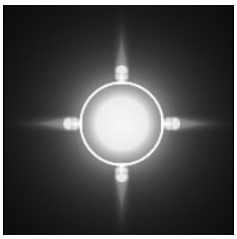
Exponential	Glow quickly diminishes from the center of the light.

Ball — Glow diminishes faster towards a distance (from the light center) specified by the Glow Spread value.

Lens Flare — Simulates a bright light source illuminating the surfaces of several camera lenses.



Rim Halo — Forms a circular ring with a soft central glow. The size of the ring is determined by the Halo Spread value (in this example, 0.75).



Halo Types

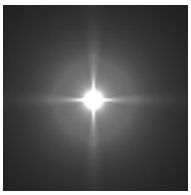
The type of halo the light produces when viewed directly. Halo is similar to Glow, except that the fall off is more gradual and different fall-off types are available. The default setting is None. Click the arrow to access the drop-down menu.

The following show the different Halo types with the default Linear Glow Type, a red Halo Color, and the Halo Spread set to 0.75.

None — No halo appears.

Linear — Halo slowly diminishes from the center of the light.

Exponential — Halo quickly diminishes from the center of the light.



Ball — Halo diminishes faster towards a distance (from the light center) specified by the Halo Spread value.

Lens Flare — Simulates a bright light source illuminating the surfaces of several camera lenses.

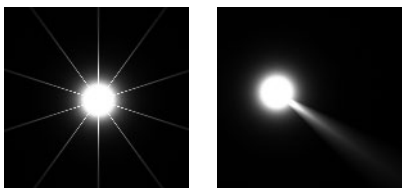
Rim Halo — Forms a circular ring with a soft central glow. The size of the ring is determined by the Halo Spread value.

Radial Frequency

Controls the smoothness of glow radial noise (see Glow Radial Noise). The slider range is 0 to 5, but you can enter values up to infinity. The default value is 0.5.

Star Points

Represents the number of points on glow star filter effects (see Glow Star Level). The following examples show a Star Points value of 20 and a Star Points value of 1 which produces a comet-like effect. Use the Rotation attribute to adjust the comet's tail.



The slider range is 0 to 10 but you can enter values up to infinity. The default value is 4.

Note	A non-integer Star Points value could render with a seam or hard line at the top of a star effect.

Rotation

Rotates glow noise and star effects ("Glow Noise", "Glow Radial Noise", and "Glow Star Level") about the center of the light. The slider range is 0 to 360 (degrees) but you can enter values up to infinity. The default value is 0.

Glow Attributes

Glow Color

The color of the light's glow. Click the color swatch to open the Color Chooser and select a color if desired.The default setting is white.

Glow Intensity

Also accessible through the material's Special Effects attributes (see the *Shading* guide for details). Controls the glow brightness. As the Glow Intensity value increases, so does the apparent size of the glow effect. A negative Glow Intensity value subtracts from other glows. (The light's Decay Rate controls how the glow brightness decreases with distance.) The slider range is 0 to 10, but you can enter values up to infinity. The default value is 1.

Glow Spread

Controls the size of the glow effect. Negative values can have odd but sometimes useful effects. The slider range is 0 to 5. The default value is 1.

Glow Noise

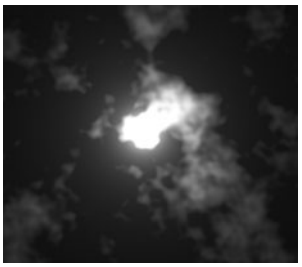
Controls the strength of two-dimensional noise applied to the glow. The noise is generated on a plane centered at the location of the light and always oriented towards the camera. The slider range is 0 to 1. The default value is 0.

To create the illusion of illuminated smoke around a glowing light source, set the Glow Noise value to about 0.5 and slowly animate the Noise Uoffset and Noise Voffset values. The smoke appears to slowly drift by the light.

Tip	Generally, fog illumination is better than glow if you want to create smoke and fire effects because fog is a 3D effect (for example, glow noise cannot be occluded by objects).

The following example shows how you can create a moody night sky simply by adjusting a few Glow Attributes. The Optical FX attributes used in this example are as follows:

- Glow Type = Exponential
- Radial Frequency = 0
- Star Points= 2
- Rotation = 300



Map the Optical FX utility to a light's Color and change the Glow Attributes to produce this effect.

Add a bump-mapped sphere to create a realistic-looking moonscape.

Glow Radial Noise

Randomizes the spread of the glow to simulate starburst effects and eyelashes refracting light. The slider range is 0 to 1. The default value is 0.

Negative values of Glow Radial Noise produce thicker noise. Use the "Radial Frequency" attribute to control the smoothness of this effect.

Glow Star Level

Simulates camera star filter effects. The slider range is 0 to 4. The default value is 0. Use the "Star Points" attribute to set the number of points on the star. Use the "Rotation" attribute to rotate the star.

Glow Opacity

Controls the amount the light's glow obscures objects. Think of opacity as the opposite of transparency. The slider range is 0 to 0.5. The default value is 0.

Halo Attributes

Halo Color

The color of the halo. Click the color swatch to open the Color Chooser and select another color if desired. The default setting is white.

Halo Intensity

Controls the halo brightness. As the Halo Intensity value increases, so does the apparent size of the halo effect. (The light's Decay Rate controls how halo brightness decreases with distance.) The slider range is 0 to 5. The default value is 1.

Halo Spread

Controls the size of the halo effect. Halo size is generally larger than glow size when the Halo Spread and Glow Spread values are the same. The slider range is 0 to 5. The default value is 1.

Lens Flare Attributes

These attributes are only accessible if Lens Flare is turned on in Optical FX Attributes.

Flare Color

The color of the lens flare circles. Click the color swatch and select another color from the Color Chooser if desired. The default color is white.

Flare Intensity

Controls the flare effect's brightness. (The light's Decay Rate controls how the lens flare brightness decreases with distance.) The valid range is 0 to ∞. The slider range is 0 to 5. The default value is 1.

Flare Num Circles

Represents the number of circles in the lens flare effect. The valid range is 0 to ∞. The slider range is 0 to 30. The default value is 20.

If the Flare Num Circles value is very large, rendering times may be long, especially if the Flare Min Size and Flare Max Size values are large and the Flare Color is textured.

Flare Min Size, Flare Max Size

The size of the circles is randomized between these two values. The valid range is -∞ to ∞. The slider range is 0 to 5. The default value is 0.1 for Flare Min Size and 1 for Flare Max Size.

Hexagon Flare

Produces hexagonal-shaped flare elements (instead of circles).

Flare Col Spread

Controls the hue amount of individual circles randomized about the Flare Color. The Flare Col Spread value has no effect if the Flare Color is not at least partially saturated (for example, not white or grey). The slider range is 0 to 1. The default value is 0.5.

Flare Focus

Controls the circle edge sharpness. The valid range is 0 (very blurry) to 1 (totally sharp). The default value is 0.6.

Flare Vertical, Flare Horizontal

Controls the axis of the flare effect relative to the center of the image. If the light source moves, the flare appears to rotate through this point. The slider range is -1 to 1. The default value is 1.

Flare Length

Controls the flare effect length relative to the light location. If Flare Length is small, all circles overlap the light. If Flare Length is large, the circles spread out across the image. The Flare Length value has no effect if the Flare Vertical and Flare Horizontal values are both 0. The slider range is 0 to 1. The default value is 1.

Noise Attributes

See also “Glow Noise”.

Noise Uscale, Noise Vscale

Scales glow noise in the horizontal (Noise Uscale) and vertical (Noise Vscale) directions. The slider range is 0 to 5. The default value is 1.

Tip	You can use Noise Uscale and Noise Vscale to create layered fog or tall flames. Animate the Noise Uscale and Noise Vscale values from high to low values to make the noise appear to fly apart like an explosion.

Noise Uoffset, Noise Voffset

Offsets glow noise in the horizontal (Noise Uoffset) and vertical (Noise Voffset) directions.

For example, you can animate the Noise Uoffset and Noise Voffset values to simulate smoke, rain, or snow moving past a light. Noise repeats after an offset of 1. The slider range is 0 to 1. The default value is 1 for Noise Uoffset and 0.5 for Noise Voffset.

Noise Threshold

The cutoff value for the noise. As the Noise Threshold value approaches 0, glow noise breaks up into smaller patches. The slider range is 0 to 1. The default value is 0.5.

Tip	You can use Noise Threshold to simulate globular clusters, ejecta from explosions, snow and rain effects, especially when the Noise Uscale and Noise Vscale values are high. You can also use it to make flames and smoke more patchy.

Render Global Settings window

Caustics and Global Illumination

These are descriptions of the options in the Caustics and Global Illumination section of the Render Global Settings window.

Caustics

Turn caustics, lighting effects such as light patterns on the bottom of a pool of water, on or off. Default is off. Caustics are produced only by light sources that specify an energy explicitly. The material shader that receives the caustics must be set to receive caustics.

Caustic Filter Type

Controls the sharpness of the caustics.

Filtering increases the weight of photons that are close to the point of interest, a process that reduces the amount of blur at the edges of a caustic.

Box	Generally makes caustics looks sharper.
Cone	Generally makes caustics looks smoother.

Caustic Filter Kernel

This specifies the size of the filter applied to caustic photons.

Caustic Accuracy

Controls the number of photons used to estimate the caustic brightness. The default is 64. Higher settings (up to 100 to start, tested in small increments) larger numbers make the caustic smoother.

Caustic Radius

Controls the maximum distance at which mental ray for Maya considers photons for caustics. When left at 0 (the default), mental ray for Maya calculates an appropriate amount of radius, based on the size of the scene. If the result is too noisy, increasing this value (to 1, to start, then by small increments up to 2) decreases noise but gives a more blurry result. To reduce the blur, you must increase the number of caustic photons (Caustic Accuracy) emitted by the light source.

Global Illumination

Use this to turn on or off Global illumination, a process that allows for indirect lighting and effects like color bleeding. The default is off. Global illumination is computed only for light sources that have an energy specified explicitly. The material shader that receives the caustics must be set to receive caustics.

Global Illum Accuracy

Change the number of photons used to compute the local intensity of global illumination.

The default number is 64; larger numbers make the global illumination smoother but increase render time.

Global Illum Radius

Controls the maximum distance at which mental ray for Maya considers photons for global illumination. When left at 0 (the default), mental ray for Maya calculates an appropriate amount of radius, based on the size of the scene. If the result is too noisy, increasing this value (to 1, to start, then by small increments up to 2) decreases noise but gives a more blurry result. To reduce the blur, you must increase the number of global illumination photons emitted by the light source.

Photon Volume Accuracy

Controls how the photon map is used to estimate the intensity of caustics or global illumination within a participating medium. It applies to photon volume shaders, which compute light patterns in 3D space, such as volume caustics created by focused shafts of light cast by objects acting as lenses.

Photon Volume Radius

Controls the maximum distance at which mental ray for Maya considers photons for a participating medium.

Max Reflection Photons

Use this to limit the number of times a photon will reflect in a scene. It works in conjunction with Max Photon Depth.

Max Refraction Photons

Use this to limit the number of times a photon will refract in a scene. It works in conjunction with Max Photon Depth.

Max Photon Depth

Use this to limit the number of times a photon will bounce around (reflect or refract) after the first bounce (which is taken care of by direct illumination) in a scene. Default is 5, but correct value depends on how many surfaces the photon must go through or bounce off of before hitting a diffuse surface to stop. For example, if a photon goes through 6 transparent surfaces, the default 5 would produce incorrect results. After the depth trace limit has been met, photons are not reemitted and instead are absorbed.

Custom shaders may override these values.

Photon Map File

Specify the photon map file that mental ray for Maya should use as the current photon map. It will be loaded and used without computing a new photon map. If the photon map file does not exist, one will be created and saved.

Photon Map Rebuild

If a filename is specified for the photon map (in Photon Map File), the map is loaded and used (providing the file exists). If this option is turned on, any existing file will be ignored, and the photon map will be recomputed and an existing file will be overwritten. The default is off. In other words, if you want to build a map, turn this option on; if not, turn this option off and specify the file to be used in Photon Map File

Enable Semi-transparent Shadows

If you want transparent shadows with caustics, turn this option on. Shadow shaders will be exported (they aren't by default) making it possible.

Final Gather

These are descriptions of the options in the Final Gather section of the Render Global Settings window.

Final Gather

Use this to turn Final gathering for global illumination on or off. The default is off. Final gathering is a different means of calculating indirect illumination. For more information, see "Final gather and HDRI" on page 29.

Precompute Photon Lookup

This option (which also turns on Final Gather) causes photon tracing to compute and store an estimate of the local irradiance at every photon location. This means that far fewer final gathering points are required because the photon map carried a good approximation of the irradiance in the scene -- mental ray for Maya can estimate irradiance with a single lookup, instead of many photons. In this case, photon tracing takes longer than before and requires slightly more memory, but rendering is faster.

Final Gather Rays

Controls how many rays are shot in each final gathering step to compute the indirect illumination. The default is 1000 per sample point, but this tends to be high for test renders (renders can take

hours). Test rendering at lower values, usually 100 or 200, is sufficient; higher values are required for final renders. Increasing the value reduces noise but also increases the rendering time.

Note When the number of Final Gather rays is changed, the Final Gather File is always ignored and new Final Gather rays are emitted.

You can see, in the Output window, when this happens:

- RCFG 0.2 info: finalgMap/test1:final gather options differ from ones currently used, content ignored.
- RCFG 0.2 info: overwriting final gather file "finalgMap/test1"

Min Radius, Max Radius

Max Radius and Min Radius control the size of the sampling region within which Final Gather rays search for irradiance information from other surfaces.

With the default values, Maya calculates values that seem appropriate based on scene dimensions to speed up the render, but this calculation doesn't allow for complex geometry. Generally, enter a value that is 10% of scene's overall dimension for the Max Radius, then enter 10% of that for Min Radius. Make further adjustments based on scene geometry detail, how the geometry is arranged in the scene, and how the render looks. For example, use these settings to achieve better diffuse detailing in nooks and crannies in your scene.

Final Gather Filter

Use this to control how Final Gather uses a speckle elimination filter to prevent samples with extreme brightness from skewing the overall energy stored in a Final Gather sampling region.

Neighboring samples are filtered so that extreme values are discarded in the filter size. By default, the filter size is 1. Setting this to 0 disables speckle elimination, which can add speckles but will better converge towards the correct total image brightness for extremely low accuracy settings. Size values greater than 1 eliminate more speckles and soften sample contrasts. Sizes greater than 4 or so are not normally useful.

Final Gather Falloff Start, Final Gather Falloff Stop

Use these settings to limit the reach of indirect light for Final Gather (but not photons). If no object is found within a distance of start, the ray defaults to the environment color. Objects farther away than stop from the illuminated point will not cast light.

Final Gather Trace Depth

Use this option to specify the number of subrays for the final gather render. The default is 0, which means that indirect illumination computed by final gathering cannot pass through glass or bounce off mirrors, for example. A depth of 1 would allow a single refraction or reflection. Typically, a depth greater than 2 is not necessary.

Final Gather File

This is the file that stores the Final Gather results that mental ray for Maya can use for irradiance lookups. You can re-use Final Gather results from a frame rendered earlier, or from a previous scene render:

- If no filename is specified and Final Gather Rebuild is turned on, rendered results are placed in a default file.
- If you specify previously non-existent filename, the rendered results are placed in the file with that name.
- If you specify an existing filename here, and Final Gather Rebuild is turned on, the specified file is overwritten with the newly rendered Final Gather results.
- If you specify an existing filename here, and Final Gather Rebuild is turned off, the newly rendered results are appended to the existing file. (This means that the file may grow without bounds.)

Final Gather Rebuild

If this is on (default), any previously generated Final Gather file is ignored and all final gather points are recomputed. See Final Gather File for more information about the file.

If this file is off, Final Gather is forced to use the results from a previous Final Gather render.

Tip	If you are rendering out a still image and are not changing the Final Gather settings, turn this attribute off to save rendering time.

Tip	If you are rendering out a camera animation sequence, you may be able to use previous frames' Final Gather results (that is, you can turn this attribute off), depending on how the irradiance changes during the animation. Test it out. However, if objects in the scene move, this option must be on.

Final Gather Freeze

This is the same as Final Gather Rebuild off, except that the Final Gather file (once created by reading it from a file or building it for the first frame) is not modified (unless the Final Gather File name or Final Gather Rays is changed).

In other words, extra Final Gather points created during rendering are appended, and the Final Gather file on disk is not modified.

This attribute is useful if multiple concurrent renderers share the file.

Make sure that the Final Gather file matches the scene and viewpoint in an animation.

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