

# 1 Introduction

## Installation

The Rhino to Air toolkit consists of a new Rib export plugin for Rhino 4, a set of toolbars, and this help file.

- Start Rhino 4
- Load the included RIB\_Export plugin
- Load the included toolbar set AirTools.tb

## Quick Links

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# 2 Rendering

Once the plugin and toolbars are installed, you may easily render your scene with Air using the buttons on the Air Render toolbar:



Left-click the left-most render button  to render your scene with the default Air render settings. Right click the same button to render with higher quality.

When the render button is clicked, the plugin will export the scene to a RIB file and start Air as a separate process. The rendered image should appear in the standalone Air Show framebuffer. If Air Show fails to appear, make sure your system settings allow Rhino to start an external application. If Air Show opens but an image fails to appear, make sure any network security software allows Air to communicate with Air Show using port 47349.

The Air Show window can be kept in front of the Rhino window by enabling the Always on Top option in the Air Show Options menu.

To stop a rendering in progress, click the stop button in the Air Show toolbar (not the close button for the Air Show window).

### One-click Rendering

Other buttons on the render toolbar provide common rendering options:



Render only selected objects.



Render with ambient [occlusion](#)



Render with [outlines](#) enabled.

To render with higher [image quality](#) settings, right click a button.

### Rendering a Region



The render region button can be used to restrict rendering to a sub-rectangle of a viewport, which can be useful for test renders. After left clicking the render region button, select a rectangle in a viewport by picking two opposite corners. Any subsequent renders will use the selected render region. To disable the render region, right click the render region button.

Instead of launching the renderer immediately, it is also possible to export a RIB file for later rendering using the [AirExport](#) command.

### Interactive Preview Rendering

With RhinoAir you can see effects of shading and lighting changes without having to continually render test images by using the advanced [Interactive Preview Rendering](#) provided by TweakAir. Use the IPR



button to start interactive rendering, then watch as your shading and lighting changes update in the Air Show window.

### Air Render Settings

The RhinoAir plugin adds several pages to the Rhino document properties dialog for controlling global options when rendering with Air:

<a href="#">Air Main</a> page	Controls for image quality and output specification
<a href="#">Air Display</a> page	Settings for specifying output images
<a href="#">Air Trace</a> page	Settings for ray-traced shadows and reflections
<a href="#">Air GI</a> page	Controls for global illumination modes
<a href="#">Air Outline</a> page	Settings for drawing outlines for illustration
<a href="#">Air Animation</a> page	Controls to enable and configure animation
<a href="#">Air Plugin</a> page	Global settings for scene conversion and the rendering process

Access the main [Air options page](#) using the render options button



## 2.1 Render Management

### Using Air Control to Manage Rendering

By default the RhinoAir rendering commands start a standalone Air process to render each scene after it is exported. In some cases you may wish to export a series of scenes to be rendered in order rather than having each scene start rendering immediately. The Air Control tool included with Air can be used to queue and monitor a sequence of renderings. Check **Submit jobs to Air Control** on the [Air Plugin](#) page to have RhinoAir submit rendering jobs to Air Control instead of starting rendering processes immediately.

### Version Control

It is important not to overwrite an exported scene file until it has completed rendering. As an aid to managing multiple renders, the RhinoAir plugin will give each exported scene file a unique version number if the **Append version** option is enabled on the [Air Plugin](#) page.

## 2.2 Network Rendering

*Note: Network rendering is disabled in the Air demo.*

Multiple machines on a network can be used to render a single image via the Vortex and Voluntair tool included with Air.

### Requirements for Client Machines on the Network

- Each machine must have Air installed and have access to an Air license. The Air floating license manager can be used to share licenses over a network. Each active Air rendering process on a remote machine requires its own license.
- Each client must have access to all files needed to render the scene, including the RIB files exported by RhinoAir and any texture maps. The scene export RIB file specified on the Air Main page should be on a shared network drive. Any pre-converted texture maps or environment maps should also be on a shared drive.
- Each machine must have the voluntair render client running. This includes the local/host machine if that is to be used for rendering. Voluntair can be started from a command shell by typing

```
voluntair -threads ncpu
```

where *ncpu* is the number of processing cores to use for rendering on that machine.

### Rendering over a Network

To enable network rendering, check Distributed rendering with Vortex on the Air Plugin page. Subsequent calls to the AirRender command will use Vortex to distribute rendering over all available network clients.

## 3 Image Quality

High quality images require the elimination of aliasing - artifacts in an image due to undersampling some aspect of the scene. Air provides extensive support for fine-tuning the sampling in a scene.

Use the [Air Main](#) page in the document properties dialog to set global parameters for image quality.

The **Pixel samples** setting determines how often the scene's geometry is sampled.

The **Shading samples** value determines how often an object's shading is evaluated.

Air provides independent control over the sampling of geometry and shading. This is an important capability: for many scenes rendering time is dominated by shading calculations. With Air you can increase the sampling of a scene's geometry to smooth rough edges without increasing the number of shading calculations that are performed.

The following sections describe how to eliminate common sources of aliasing in rendered images.

### Jagged Edges

Increase the number of pixel samples.

### Shading Aliasing

Shading can introduce aliasing from a pattern, reflections, specular highlights, small bumps, shadow edges, and other sources. The simplest way to improve shading quality is to increase the number of shading samples.

Increasing the number of shading samples globally can significantly slow down rendering: rendering time is often directly proportional to the number of shading samples, so doubling the number of shading samples can also double rendering time. Instead, it is more efficient to increase the number of shading samples only for those materials that require more detail (using the *Shading samples* control on the [Air Material](#) page).

### Shadows

Ray traced shadows can exhibit shading artifacts in the form of jagged edges or, for blurry shadows, excessive noise. In both cases increasing the number of shadow rays will improve shadow quality. The number of shadow rays can be set on the [Air Light](#) page in the Properties dialog for a selected light source.

### Reflections

Ray-traced reflections may exhibit artifacts in the form of jagged edges or excessive noise. As with shadows, increasing the number of rays will improve image quality. The number of reflection rays can be set on the [Air Material](#) page in the Properties dialog for a selected object.

### Summary

- A reasonable goal is to be able to render a final quality image with 1-4 shading samples per pixel. The "high quality" preset on the [Air Main](#) page and the high quality render buttons use 4 shading samples.
- To smooth noisy shadows for a light, increase the number of shadow rays cast by the light.
- To smooth reflections increase the number of reflection rays for the reflective material.
- For an individual material that exhibits artifacts, increase the number of shading samples only for that material on the [Air Material](#) page.

See Also:

Air User Manual: Image Quality

## 4 Lighting

### Standard Lights

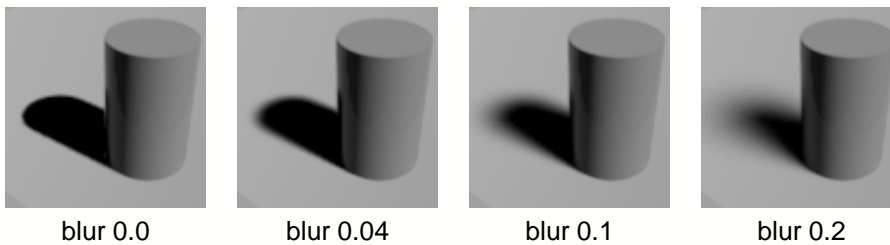
The RhinoAir export plugin converts most properties for the standard Rhino lights to the equivalent Air shaders and parameters. Point lights, directional lights, spotlights, linear lights, and rectangular area lights are all supported.

Use the [Air Light](#) page (in the object properties dialog for a selected light) to customize a light for rendering with Air.

### Shadows

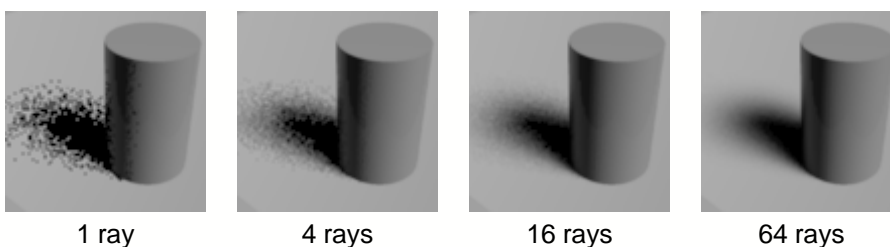
If the Shadow Intensity parameter for a Rhino light is greater than 0, Air will compute shadows for the light using ray tracing. Ray-tracing shadows increases rendering time. Save rendering time by limiting the number of lights that cast shadows, setting the shadow intensity to 0 for lights that do not need to cast shadows.

Soft shadows can be achieved for regular point lights, directional lights, and spotlights by providing a positive Shadow Blur value. Typical values are in the range 0 to 0.2.



Technically, shadow blur is an angle in radians that defines a cone of directions over which to send shadow rays, measured from the point being shaded.

Larger blur values can produce noisy shadows. To reduce the noise, increase the number of shadow rays that are cast to estimate the shadow value. It normally makes sense to increase or decrease the number of shadow rays by a factor of 2 or 4:



Soft shadows can also be achieved by using a linear light or a rectangular light, in which case the blurriness of the shadows depends on the size of the linear or rectangular light. The shadow blur value has no effect for these lights. Rectangular and linear lights usually take longer to render than regular lights.

### Light Intensity Falloff

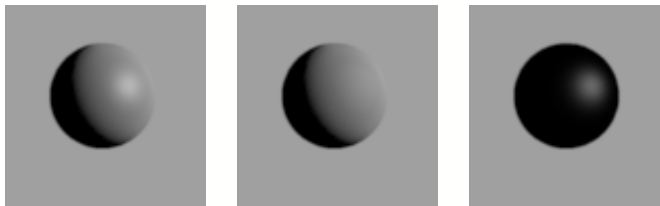
Use the Falloff parameter on the Air Light page to select how light intensity varies with distance from the light: no decrease, linear decrease with distance, or decrease with distance squared. By default

illumination received from a Rhino light does not decrease with distance from the light. For real lights the amount of illumination received decreases with the square of the distance from the light. The intermediate linear falloff may be easier to control. For linear and square-law falloff, the light intensity may need to be quite large to contribute significant illumination to the scene.

Directional lights do not use the falloff parameter.

### Diffuse Only and Specular Only Lights

Sometimes it is useful to restrict a light to emitting only diffuse or only specular light. The Emit diffuse and Emit specular controls on the Air Light page can be used to choose whether a light contributes diffuse light, specular light, or both (which is the default).



diffuse & specular

diffuse only

specular only

### Complex Shadows

By default AIR assumes that a shadow-casting object attenuates light based on its transparency attribute. This assumption saves rendering time because the object's surface shader does not have to be executed when an object is hit by a shadow ray.

Some surface shaders compute a complicated transparency pattern, and such shaders must be evaluated for shadow rays in order to cast appropriate shadows. Enable the **Surface modifies transparency** control on the [Air Material](#) page to force a surface shader to be evaluated for shadow rays.

See Also:

[Air Light](#) page  
[Global Illumination](#)

## 5 Global Illumination

In addition to simulating direct illumination from lights placed in the scene, Air can simulate illumination from other sources, such as the environment surrounding the scene or light that has been reflected from a surface. The RhinoAir plugin groups the controls for these additional lighting effects under the general heading of global illumination or GI.

All GI modes contribute only diffuse illumination to the scene. Surfaces such as glass and metal with little or no diffuse component will not receive additional light from global illumination.

### Global Illumination Modes

The [Air GI](#) page contains controls for global illumination. The top control determines how global illumination effects are simulated:

Off

No additional illumination is added to the scene.

### **Ambient**

A constant amount of light is added to the scene based on the intensity and color values in the Global Illumination Environment section. The addition of a constant amount of illumination that is independent of surface position and orientation tends to flatten the appearance of objects.

### **Indirect**

In this mode Air computes indirect diffuse illumination - light that has been reflected from at least one surface instead of coming directly from a light source. The illumination computed with this method includes color bleeding effects.

Air simulates indirect illumination by casting a number of rays from the current shading location and accumulating the colors of the surfaces hit by those rays. For rays that miss all objects, the indirect contribution is based on the Global Illumination Environment settings.

The quality of indirect illumination results depends on the number of rays cast. More rays produce smoother results. Using too few rays can produce a grainy appearance.

Indirect computations can be accelerated in a couple ways. The maximum trace distance gives the maximum distance Air will trace a ray looking for intersecting objects. Using a lower distance will reduce rendering time. When adaptive sampling is enabled, Air casts fewer rays initially ( $n_{\text{rays}}/4$ ) and additional rays only where there are significant differences in the results of the first set of rays.

### **Indirect Cache**

To accelerate indirect illumination computations, Air supports irradiance caching - a technique in which GI estimates are stored and re-used at nearby shading locations.

When rendering GI with a cache, Air first attempts to estimate GI by re-using values already in the cache. Whether a given cache value can be re-used is determined by the max error setting. A higher maximum error allows cached values to be re-used more often. If Air cannot find enough usable values in the cache, it will generate a new GI estimate by casting rays and store the new result in the cache for possible re-use.

To ensure that all areas of the image receive some GI samples, the max pixel distance setting gives the maximum distance in pixels within which Air will look for usable GI samples in the cache.

When an irradiance cache is used, the rendering process takes place in two passes. In the initial prepass only the indirect illumination is computed, generating the irradiance cache. In the second rendering pass, the cache values are used to produce smooth GI results for the final image.

### **Occlusion**

Ambient occlusion is a faster alternative to indirect diffuse illumination. Ambient occlusion captures the effect of local shadowing without color bleeding. Ambient occlusion is computed by casting shadow rays from the current shading location to estimate the extent to which the region being shaded is blocked or occluded by nearby objects. The occlusion value is then used as a shadow value for light coming from outside the scene as determined by the Global Illumination Environment. Computing occlusion is faster than computing indirect illumination because a ray cast for occlusion only has to determine the extent to which it is blocked by an object, whereas a ray cast for indirect illumination also has to compute the illumination at an intersection point.

The quality of the occlusion estimate depends on the number of rays cast. More rays produce smoother results. Using too few rays can produce a grainy appearance.

Occlusion computations can be accelerated by setting a maximum trace distance or enabling adaptive sampling. The maximum trace distance gives the maximum distance Air will trace a ray looking for occluding objects. Using a lower distance will reduce rendering time. When adaptive sampling is enabled, Air casts fewer rays initially ( $n_{\text{rays}}/4$ ) and additional rays only where there are significant differences in the results of the first set of rays.

### **Occlusion Cache**

Air can accelerate occlusion estimation using an occlusion cache in a manner similar to the way indirect illumination can be accelerated with an irradiance cache.

With this GI mode occlusion samples are stored in a cache, and at each shading location Air attempts to compute a new estimate using samples in the cache. A new raw occlusion sample is generated only if an acceptable estimate cannot be made from pre-existing samples. The max error setting gives a threshold for re-using an occlusion estimate. A higher max error value allows a sample to be re-used more often. The max pixel distance is the maximum distance in pixels (measured from the current shading location) within which Air will search for samples within the cache. This value ensures that all areas of the image receive some raw occlusion estimates.

When using an occlusion cache, the rendering process has two passes. On the first pass, occlusion values are generated and stored in the cache. On the second pass, the final image is computed using the cached occlusion samples to compute smooth occlusion values.

### ***Global Illumination Environment***

The settings in this section of the Air GI page control the illumination coming into the scene from the surrounding environment.

By default the background illumination is simply the product of the color and intensity provided. If an environment map is provided, that is used to compute incoming illumination from a particular direction, scaled by the intensity value.

The specified environment map is used as-is; no texture conversion is performed. For best results it is recommended that the environment map be generated using the Air texture conversion tool - mktexui. The texture conversion tool can be easily accessed from the Air Show tools menu.

### **HDR Environment Maps**

The environment map may be a high-dynamic range image. To obtain good results from an HDR image, some care must be taken in its preparation. Specifically:

- A small image is usually sufficient. E.g., 256x128 pixels should be plenty of resolution.
- Apply some blur to the image prior to or during conversion to an Air texture file.
- Clamp the maximum intensity value to something reasonable. Some HDR images have very large intensity values (1000+) that may make it difficult to obtain a clean rendering.
- Use some blur in the Global Illumination Environment settings.

An image processing program that works with HDR images such as HDRShop may be useful for the above pre-processing.

## **6 Geometric Primitives**

Air renders a wide variety of geometric primitives:



## NURB Surfaces

Air can render NURB surfaces directly, without requiring Rhino to generate a render mesh. By default the RhinoAir plugin passes the mathematical description of each NURB surface to Air. During rendering Air converts each NURB to an appropriate polygonal representation based on its size in the final image. The tessellation quality is based on the Tolerance setting on the Air Main page (which can also be overridden for a particular object on the Air Object page). Higher tolerance values will produce a coarser tessellation, using less memory and rendering faster.

In some cases you may obtain better or faster rendering by using the Rhino render mesh instead. Check the Use Rhino mesh control on the Air Main page to render using the Rhino render mesh for each NURB surface.

## Polygon Meshes

Air can render Rhino's polygon mesh primitives.

## Subdivision Surfaces

Air will render a polygon mesh as a Catmull-Clark subdivision surface (SDS) if the **Subdivision mesh** control on the [Air Object](#) page is checked. For best results it is important that the exported mesh not have any coincident duplicate vertices. If you suspect that a mesh has duplicate vertices, enable the **Weld polygon vertices** option on the Air Object page to have RhinoAir weld the vertices prior to export. The RhinoAir weld option does not affect the polygon mesh representation within Rhino.

## Curves

Air will render Rhino curves and true 3D primitives if the **Curves and points** option is checked on the [Air Main](#) page. The default width for curves is given by the **Curve width** setting on the Air Main page, and the default color assignment is determined by the **Curve color** setting on the same page. The width of an individual curve object can be adjusted on the [Air Object](#) properties page, which also allows the object color to be overridden.

Air can render a line pattern assigned to a curve. The line pattern length is computed by first converting the line segment lengths given in the line pattern definition from millimeters to the units selected for the current scene. The lengths are then multiplied by the display Scale factor defined on the Linetypes of the Rhino Document Properties dialog. That Scale factor can thus be used to globally stretch or shrink the length of all line patterns. The line width is determined by the Curve width parameter described above (just as for curves without a pattern).

By default curves are rendered as annotation entites, and they do not use materials. To apply a material to a curve, enable the **Shade curves and points** control on the [Air Object](#) properties page.

## Points

Air will render points and point clouds as 3D entities if the **Curves and points** option is checked on the [Air Main](#) page. The default width for points is given by the **Curve width** setting on the Air Main page, and the default color assignment is determined by the **Curve color** setting on the same page. The width of an individual curve or point object can be adjusted on the [Air Object](#) properties page, which also allows the object color to be overridden.

By default points and point clouds are rendered as annotation entites, and they do not use materials. To apply a material to a point or point cloud, enable the **Shade curves and points** control on the [Air Object](#) properties page.

By default points are rendered as sphere. The Point type control on the Air Object page allows 3

other types of point representation: sprites, blobby, and volume primitive.

### Sprites

To render a point or point cloud object as sprites, enable Curves and points on the Air Main page and set the Point type to Sprite on the Air Object page. Points rendered as sprites appear as square polygons oriented to face the camera.

### Blobbies

Air will render a point cloud as a blobby implicit surface or metaball when the point type is set to Blobby on the Air Object page (and curve and point rendering is enabled on the Air Main page). Note that blobby rendering only works for a point cloud primitive, not a collection of individual points. You may need to use the Rhino PointCloud command to convert a set of points to a point cloud primitive.

Blobbies are always shaded using the assigned material. For faster rendering with lower memory use, increase the **Tolerance** setting on the Air Object page above the default value of 0.5.

### Volume primitives

Air will render a point cloud as a volume primitive when the point type is set to Volume on the Air Object page (and curve and point rendering is enabled on the Air Main page). Note that volume rendering only works for a point cloud primitive, not a collection of individual points. You may need to use the Rhino PointCloud command to convert a set of points to a point cloud primitive.

For appropriate shading, try using one of the following surface shaders included with Air: particle, VSmokeSurface, VCumulusCloud. In most cases the **Surface modifies transparency** control on the [Air Material](#) page should also be checked.

## 7 Materials

Air uses the native Rhino material settings as the basis for the appearance of an object when rendered with Air. By default the plugin translates Rhino material properties including color, texture maps, gloss settings, and transparency to the equivalent Air shaders and attributes for rendering. You can continue to use regular Rhino materials when rendering with Air.

The RhinoAir plugin allows the basic Rhino material properties to be augmented by Air-specific properties. The Air material properties are attached to the Rhino material regardless of how the material is assigned to an object - whether by layer, by parent, or by object. To change the method of material assignment, go to the Rhino Material page for the object and select the desired method in the Assign by section.

Air material properties can be edited on the [Air Material](#) page, available in the Rhino Properties dialog for a selected object.

### Shaders

Air uses small programs called shaders to perform all shading computations. Each material uses a surface shader to compute the output color for an object at a particular location. A material may also have a displacement shader, which adds small topographical features such as bumps, grooves, or dents.

Air comes with more than 50 pre-written surface shaders that you can use for your materials. You do not need to write a shader to use Air or the Rhino-to-Air plugin. If you would like to write a custom

shader, Air includes an easy to use shader-building tool, Vshade. See the separate Vshade documentation for more information on building custom shaders.

## Surface Shaders

The Air Material page in the Rhino Properties dialog has controls for selecting a surface shader. The dropdown list contains many commonly used shaders. Additional shaders can be loaded from the `shaders` directory of your Air installation. The compiled shader files for any custom shaders should be placed in the `usershaders` directory of your Air installation.

If the surface shader is set to the special value Rhino, the plugin will use the Rhino material properties - color, maps, and gloss settings - for the appearance of the material.

Most surface shaders have a list of parameters for modifying the effect of the shader, such as adding texture maps, adjusting lighting levels, etc. The parameter list will appear below the shader controls in the Air Material page. The Shader Guide section of the Air User Manual has additional information about each surface shader and its parameters.

## Displacement Shaders

Use a displacement shader to add topographical details such as dents or embossing to a surface using the Displacement controls on the Air Material page. The dropdown list contains many commonly used displacement shaders. Additional displacement shaders can be loaded from the `shaders` directory of your Air installation.

When the Displacement shader is set to Rhino, the plugin translates the Rhino bump map settings to an Air displacement shader.

### Displacement mode

The displacement mode determines how a displacement shader is applied:

Off	The displacement shader is not used.
Bump only	The displacement is applied as a bump effect, modifying the shading normal but not moving the surface.
Regular displacement	The displacement shader moves the surface. The shader is evaluated by carving a surface into pieces and displacing each piece separately.
Mesh displacement	The displacement shader moves the surface. An entire object is tessellated and displaced at once.

Both regular and mesh displacement perform true "sub-pixel" or "micropolygon" displacement. The quality of the displaced mesh depends on the surface tolerance property, which can be set globally on the [Air Main](#) page or for an individual object on the [Air Object](#) page. A higher tolerance setting will produce a coarser displacement, which will use less memory and render more quickly.

Mesh displacement is generally slower than regular displacement. Mesh displacement is less likely to exhibit cracks, and it produces smaller final meshes. Using the Rhino render mesh for NURB surfaces may also improve displacement results.

See Also:

[Air Material](#) page  
[AirMaterial](#) command

Air User Manual: Shader Guide  
Air User Manual: Displacement  
Air User Manual: Texture Mapping

## 7.1 Reflections

Reflections are a common feature of many shiny real world surfaces. As with other surface characteristics, in Air the appearance of reflections is controlled through the surface shader assigned to an object.

Many surface shaders provide an option for reflections, including the Plastic, Metal, and Ceramic shaders available in the Surface control dropdown list on the Air Material page. The following reflection controls are typically provided:

- Reflection	0.95	▼
Rays	4	▼
Blur	0.01	▼

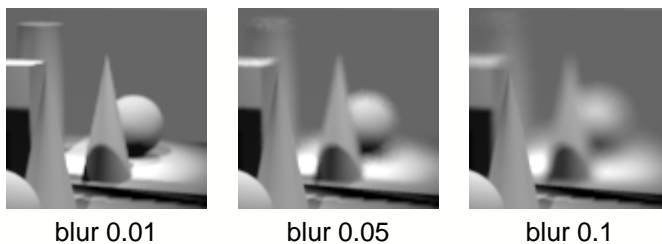
### Reflection Intensity

The `Reflection` parameter serves as a multiplier for the overall reflection intensity. A `Reflection` value of 0 disables reflections for a surface, which saves render time by not casting reflection rays.

Reflection intensity is also affected by the type of reflective material. Metals typically have fairly uniform reflection intensity. For plastics and other composite materials, the intensity varies with viewing angle: reflections viewed face-on are dimmer than those viewed at a glancing angle. Air surface shaders that simulate composite materials such as plastic and ceramic incorporate a physically-based variation in reflection intensity with viewing angle.

### Reflection Blur

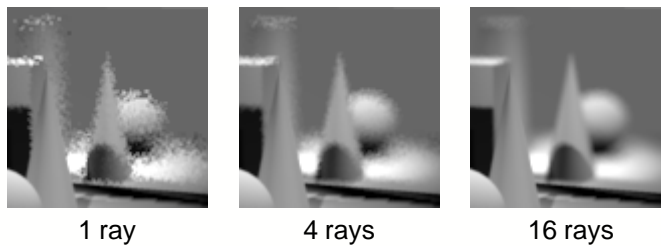
The `Reflection Blur` parameter controls the softness or blurriness of reflections.



Technically, the blur value is the half angle in radians of a cone of directions within which reflection rays are traced.

### Reflection Rays

The quality of ray-traced reflections depends on the number of rays that are cast. More rays produce smoother results but take longer to render. For blurry reflections you may need to increase the number of rays significantly.



### Global Reflection Properties

The [Air Trace](#) page holds controls for several reflection properties that apply to the scene as a whole.

#### Max Bounces

The max bounces setting limits the number of "bounces" through which Air will follow a reflected or refracted ray. Lower values will reduce rendering time, but too low a value can leave some shiny materials without reflective or refractive effects.

#### Reflected Environment

The look of highly reflective materials such as polished metal or glass depends heavily on having something interesting to reflect. That includes not only other objects modeled in the scene but also the surrounding "world" outside the model.

The reflected environment settings determine what color is returned by reflection rays that "leave" the scene after failing to intersect any objects. The default setting simply returns a constant color. More interesting and realistic results can be achieved by using an environment map that represents an appropriate surrounding for the model.

See Also:

[Air Trace](#) page

## 7.2 Texture Maps

With Air texture maps can be used to control almost any aspect of a rendering depending on the surface and displacement shaders that are used.

When the surface shader for an Air material is set to Rhino, Air will use a Rhino texture or transparency map assigned in Rhino during rendering. When the displacement shader is set to Rhino, RhinoAir uses a Rhino bump map if present as a displacement map.

Most of the surface shaders included with Air provide parameters for specifying texture maps that control color, opacity (the inverse of transparency), specular or shininess, and bump effects. The special [Decal 2D](#) and [Decal 3D](#) shaders can be used to apply texture maps as decals.

#### Texture Conversion

For efficient rendering, texture maps are automatically converted to Air texture maps prior to rendering if the Convert Textures option is enabled on the [Air Plugin](#) page. These special texture maps allow Air to load only those parts of the map that are needed during rendering, and to load each texture section at a resolution that is appropriate to the size of the texture in the rendered image.

The Air Plugin page allows a texture cache directory to be specified to hold all converted textures. If no cache directory is provided, the converted texture map will reside in the same directory as the source

texture image.

Texture conversion can include gamma correction based on the gamma value specified on the [Air Plugin](#) page. Many commercially available textures have had gamma correction applied so that they appear "nice" when viewed on a standard computer monitor. If such textures are used as-is in a rendering that has gamma correction applied to the final image (as specified on the [Air Display](#) page), the textures will effectively have gamma correction applied twice, and they will appear faded and incorrect. The texture gamma value specified on the Air Plugin page is that assumed gamma for the texture maps. RhinoAir will use the inverse of that value to convert the texture map back into a linear color space for rendering. If you view a converted texture map in Air Show, the converted map will appear darker than the original texture.

### Texture Wrapping

By default texture maps for a Rhino material will repeat in both directions, as will color, specular, opacity, and bump maps provided to an Air surface shader. Decal maps are converted so that they do not repeat.

For greater control over the texture conversion process, use the Air texture conversion tool (available from the Tools menu of Air Show) to convert a source map to an Air texture file, and provide the name of the converted Air texture as the desired shader parameter value.

Air can read image files in TIFF, PNG, HDR, PSD, and JPEG formats. Textures in other formats (such as BMP) will need to be converted to one of the preceding formats when rendering with Air.

## 7.3 Placing Decals and 2D Patterns

Decals are small non-repeating textures used to add a label or other detail to a model.

Air provides 2 surface shaders for rendering a surface with decals. The Decal 2D shader positions decals using the standard texture coordinates assigned to an object. The Decal 3D shader (documented [elsewhere](#)) positions decals using projective mappings that are independent of the assigned texture coordinates.

### Decal 2D - Decals Positioned with Texture Coordinates

Use the Decal 2D surface shader to create a surface with decals as follows:

- Select the object to receive decals.
- Display the Air Material page in the Rhino object properties dialog.
- Click the New button to create a new basic material for the object.
- Select the Decal 2D shader from the Surface dropdown list.

The Decal 2D shader allows up to 3 decals to be applied.

- Click the dialog button next to the `Top decal name` parameter and use the file selection dialog to pick the image for the decal.
- Click on the Top decal name parameter to reveal the associated parameters used to position the decal:

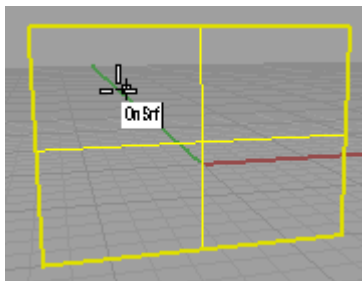
- Top decal name	<input type="text"/>	▼	☰
Top decal origin	<input type="text" value="0 0"/>	▼	☰
Top decal size	<input type="text" value="1 1"/>	▼	☰
Top decal angle	<input type="text" value="0"/>	▼	
Top decal color	<input type="text"/>		

Initially the decal will cover the entire texture range on the surface:

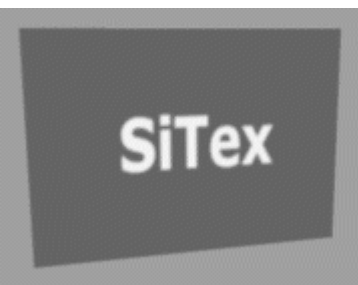
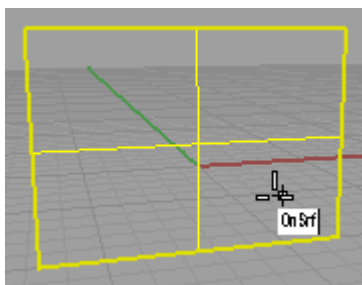


For NURB surfaces and polygon meshes, the decal origin and size can be set by selecting points on the surface in a Rhino viewport. Only one object should be selected at a time when placing decals.

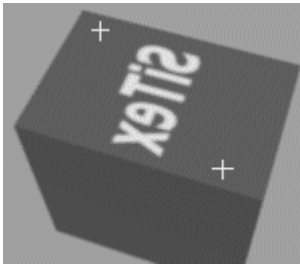
- Click the edit button next to the `Top decal origin` parameter.
- Pick a point on the surface in a Rhino viewport where you would like the top, left corner of the decal to be positioned.



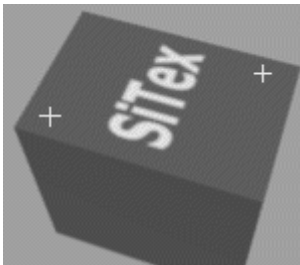
- Now click the edit button next to the `Top decal size` parameter.
- Pick the position on the surface for the bottom, right corner of the decal:



In some cases (particularly on polysurfaces with packed texture coordinates) the decal may appear twisted or flipped about its diagonal:



To untwist the decal, re-pick the origin and far corner points starting with one of the corners that was not chosen before:



Then set the `Top decal angle` parameter to 90 or 270 degrees to rotate the decal to the desired orientation:



*Tip:* [Interactive Preview Rendering](#) can quickly show the location of a decal and aid in fine-tuning decal placement.

### Placing 2D Patterns

This same technique can be used to place any texture or 2D pattern that uses similar positioning parameters: a 2D origin, a 2D size, and a rotation. One copy of the pattern will exactly cover the region defined by the origin and size parameters.

See Also:

[Projected Decals and Planar Mapping](#)

## 7.4 Projected Decals and Planar Mapping

### Decal 3D - Decals Positioned with Projective Mapping

Decals are small non-repeating textures used to add a label or other detail to a model.

The Decal 3D surface shader applies decals by projecting the images onto a surface in a manner



similar to the way in which a slide or film is projected onto a flat surface for display.

- Select the object to receive decals.
- Display the Air Material page in the Rhino object properties dialog.
- Click the New button to create a new basic material for the object.
- Select the Decal 3D shader from the Surface dropdown list.

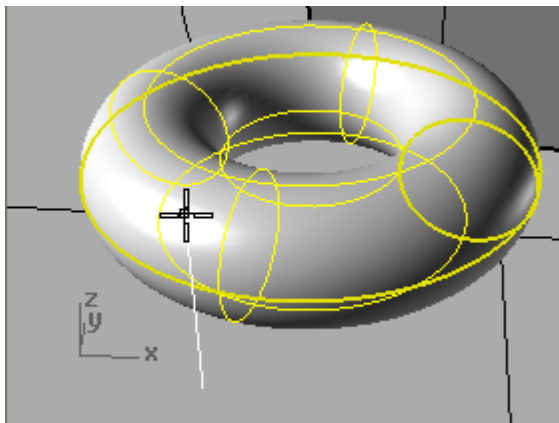
The Decal 3D shader allows up to 3 decals to be applied.

- Click the dialog button next to the `Top decal name` parameter and use the file selection dialog to pick the image to apply as a decal.
- Click on the `Top decal name` parameter to reveal the associated parameters used to position the decal:

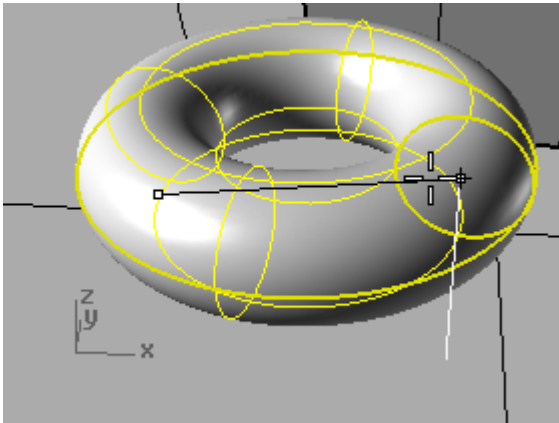
- Top decal name	sitex.tx	▼	...
Top decal space	world	▼	
Top decal transform	1 0 0 0 0 1 0 0 0 0 1 0	▼	...
Top decal front only	0	▼	

The `Top decal transform` parameter contains the transformation matrix used for the projection.

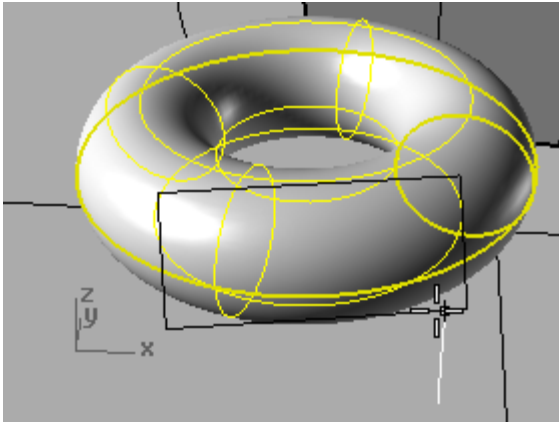
- Click the edit button next to the `Top decal transform` parameter to begin selecting a rectangle in 3D space that will define a projection. This process is very similar to Rhino's `ApplyPlanarMapping` command.
- Select a 3D point to use to project the top, left corner of the decal.



- Pick a second point to correspond to the top, right corner of the decal.



- Select a third point to finish defining the projection rectangle.



- Render a test image to see the decal in position.



*Tip:* [Interactive Preview Rendering](#) can quickly show the location of a decal and aid in fine-tuning decal placement.

### Positioning 2D Patterns with Projection

This same method of defining a projection can be used to position any 2D pattern that provides parameters for `Projection` type and `ProjectionTransform`. Set the `Projection` type to "planar",

and set the `ProjectionTransform` parameter using the associated edit button. The projection rectangle will define the region covered by a single copy of the 2D pattern.

See Also:

[Placing Decals and 2D Patterns](#)

## 7.5 DarkTree Shaders

Air and the RhinoAir plugin allow you to use DarkTree shaders as materials as well as Air's native RenderMan shaders.

The Air distribution includes several sample DarkTree shaders in the subdirectory:

```
viztools\darktree
```

The sample DarkTree shaders can be applied to an object using the DarkTree Samples toolbar included with RhinoAir:



More than 300 additional DarkTrees are available for download from the [Darkling Simulations](http://www.darksim.com) web site:

```
www.darksim.com
```

### Using DarkTree Shaders

The `DarkTreeSurface` shader allows any DarkTree shader to be used as a surface shader for Air. To use this shader, select it from the dropdown list as the Surface shader for a material. Use the dialog button next to the `DarkTreeShader` parameter to load a DarkTree shader.

Most DarkTree shaders include parameters for controlling the appearance of the shader. RhinoAir will automatically load those parameters and display them at the bottom of the parameter list for the DarkTree surface shader.

The `DarkTreeDisplacement` shader allows any DarkTree shader with bump features to be used as a displacement shader for Air.

### About DarkTree

DarkTree is a visual shader creation tool from Darkling Simulations:

"DarkTree 2.0 is an advanced procedural shader authoring tool. Its visual flow-based editor lets you interactively create photo-realistic procedural materials, surface shaders, and animated effects. DarkTree 2.0 includes 100 procedural components that can be combined to generate almost any texture or surface effect you need."

An evaluation version of DarkTree is available from the [Darkling Simulations website](http://www.darksim.com)  
[www.darksim.com](http://www.darksim.com)

## 8 Background Environments

The RhinoAir plugin provides independent control over 3 different environments or backgrounds for the rendered image:

### Image Background

The Image Background setting on the [Air Main](#) page determines what if anything appears in pixels in the rendered image that are not covered by any part of the model. Supported background modes are:

Transparent: Empty pixels are transparent (black with alpha=0), allowing the image to be composited over another in post-processing.

Color: Unrendered pixels are filled with a constant color given by the color button.

Gradient: The background is filled with a smooth gradient from top color button to the bottom color button.

Wallpaper: The background is exactly covered by the provided background image.

Environment: The specified map is applied as a spherical environment map. The Rotate control gives a rotation angle in degrees about the Z axis.

### Reflected Environment

The reflected environment defines what appears in reflections behind the objects in a scene. The [Air Trace](#) page allows the reflected environment to be selected from the following options:

#### None

Reflection rays that miss all objects simply return a black color.

#### Color

Reflection rays that fail to intersect an object return the specified color scaled by the **Intensity** value.

#### Map

The provided environment map is used to select a color for reflection rays based on the ray direction. The **Intensity** value gives a multiplier for the environment map result. The **Blur** parameter can be used to add blurriness to the result to soften the look or smooth the appearance of a low-resolution map. The **Rotate** value gives an angle in degrees to rotate the map about the Z (up) axis.

### Global Illumination Environment

The global illumination environment defines illumination contributed to a scene from elements such as the sky that are not part of the model. Select from among the following options on the [Air GI](#) page:

#### Color

Incoming light color is given by the specified color scaled by the **Intensity** value.

#### Map

Background illumination comes from the provided environment map scaled by the **Intensity**. The **Rotate** controls gives the rotation in degrees of the map about the Z axis.

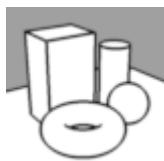
## 9 Illustration

Air can draw outlines in a scene, which can be combined with different surface finishes to produce illustrations.

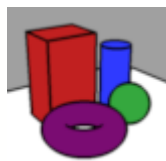
The illustration toolbar has buttons for rendering a few preselected illustration types with a single click:



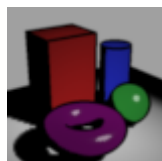
The following images show a simple scene rendered with some of the illustration buttons:



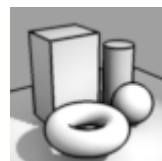
all white  
no shading



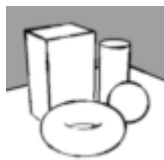
color  
no shading



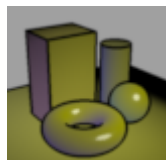
cartoon  
shader



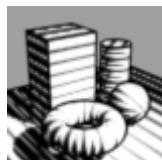
white matte  
occlusion



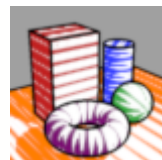
sketch  
outline shader



tone  
shader



black lines  
on white



color  
lines

### Outlines

Controls for outline rendering can be found on the [Air Outline](#) page in the Rhino document properties dialog.

You may obtain cleaner outline rendering by enabling the "Use render mesh" option on the [Air Main](#) page.

## 10 Animation

Air can be used to render animated sequences as well as still images.

The RhinoAir plugin comes with several builtin animation options which can be configured on the Air Animation page. The [View Animation](#) section contains more information about these animation features.

Air can also be used to render animations created with the [Bongo](#) companion to Rhino.

See Also:

[View Animation](#)

[Bongo Animation](#)

[Air Animation](#) page

## 10.1 View Animation

The Rhino Air plugin includes builtin options for creating several basic types of view animation. The [Air Animation](#) page in the Rhino document properties dialog holds controls to enable and configure the builtin animation modes.

### Animation Export

Just as when rendering a single frame, rendering multiple frames consists of 2 steps:

1. Exporting a scene file for each frame to be rendered.
2. Starting Air as an external process to render the frames.

The [AirRender](#) command performs both steps. The [AirExport](#) command only creates the scene files. Once the scene files have been created, they can be rendered with Air outside of Rhino at any time.

When exporting an animated scene, the RhinoAir plugin creates several RIB files. The file names are derived from the base RIB file name given on the [Air Main](#) page. To minimize disk space and export time, all objects and most scene properties are exported once to a single (potentially large) file that is referenced by every frame. For each frame a smaller RIB file is created with frame-specific information, such as the current camera position in a fly-through animation. Finally, RhinoAir creates a master RIB file that can be used to render all the exported frames.

For example, assuming the base RIB file name is `RhinoAir`, exporting a 4 frame animation would create the following files:

```
RhinoAir_world.rib scene elements common to all frames
RhinoAir_0000.rib first frame
RhinoAir_0001.rib second frame
RhinoAir_0002.rib third frame
RhinoAir_0003.rib fourth frame
RhinoAir_all.rib file that reads every frame file in order
```

### Version Control

It is important not to overwrite any of the exported frame files until the animation has completed rendering. As an aid to managing multiple renders, the RhinoAir plugin can give each exported sequence a unique version number if the **Append version** option is enabled on the [Air Plugin](#) page.

### Animation Output

For an animation that requires a non-trivial amount of time to render, it is highly recommended that you output images to a file and not to the Air Show framebuffer so that in case of a system failure, any complete frames will be saved. To render to an image file instead of Air Show, uncheck **Render to Air Show** on the [Air Display](#) page.

For animation the rendered image file will have the frame number appended to the base image name given on the [Air Display](#) page. E.g., if the base name is `air.tif`, the rendered frames will be

```
air_0000.tif
air_0001.tif
air_0002.tif
air_0003.tif
...
```

Once all frames have been rendered, they can be converted into an AVI file using Air Show. Air Show can load a numbered sequence of files (select the first file in the open dialog; Air Show will then ask if you wish to load all files in the sequence). Note that many AVI compression codecs do not support the full color images generated by Air.

The inexpensive Pro version of Apple's QuickTime player can create a Quicktime movie from an image sequence.

### Rendering with Air Control

The separate Air Control render management program included with Air can be used to render a previously exported animation sequence. Air Control can be started from the Windows Start menu or from the Tools menu of Air Show.

To render a number frame sequence with Air Control, select the first frame as the scene file. Check the Frame range option. By default Air Control will render all frames beginning with frame 0. You can specify a subrange of frames using the From and To parameters.

### Command Line Rendering

An exported scene file can be rendered by starting Air from an MS-DOS prompt (command shell). For example, assume that the above scene files have been exported to the directory C:\Temp. From an MS-DOS prompt, all frames could be rendered with:

```
cd C:\temp
air RhinoAir_all.rib
```

Note that the number of processors and processor priority set on the Air Plugin page are not included in the RIB files. To set the number of processors, use the -p command line option. For example, to render with 4 processors:

```
air -p 4 RhinoAir_all.rib
```

To render in the background with a lower priority process, use

```
air -pri -1 -p 4 RhinoAir_all.rib
```

To render a single frame, render the rib file for that frame:

```
air RhinoAir_0002.rib
```

Air has a couple special command line switches for selecting subsets of an animated sequence. Use the -frames switch to specify a range of frames. For example, to render the 2nd and 3rd frames (frames 1 and 2), use

```
air -frames 1 2 RhinoAir_all.rib
```

Keep in mind that the first frame is frame number 0.

Use the -step option to specify an increment in a frame range. For example, to render only even frame numbers in a 4 frame animation, use

```
air -frames 0 3 -step 2 RhinoAir_all.rib
```

For odd frames:


```
air -frames 1 3 -step 2 RhinoAir_all.rib
```

*See Also:*

[Air Animation](#) page

## 10.2 Bongo Animation

Air can be used to render animations created with the Bongo companion animation tool for Rhino.

Use the Bongo-to-Air toolbar button  to export a Bongo animation and render it with Air.

**Bongo to Air <Render>** (FirstTick\_17 LastTick\_25 Render Quit):

The Bongo-to-Air render and export scripts have two important parameters. Set the FirstTick parameter to the tick or frame at which to start the animated sequence. Set the LastTick parameter to the last tick or frame in the sequence. The script will export one frame for each tick.

Press Enter or click the Render parameter to start the export and render process. The script will create a separate scene file for each frame in the animation. The name for each file is created from the RIB file name specified on the [Air Main](#) page by appending the frame number.

After all frames have been exported, the script will start an external process to render the frames. You can continue to work in Rhino as the frames are rendered in the background.

### Version Control

It is important not to overwrite any of the exported frame files until the animation has completed rendering. As an aid to managing multiple renders, the RhinoAir plugin can give each exported sequence a unique version number if the **Append version** option is enabled on the [Air Plugin](#) page.

### Animation Output

For an animation that requires a non-trivial amount of time to render, it is highly recommended that images be rendered to a file and not to the Air Show framebuffer so that in case of a system failure, any complete frames will be saved. To render to an image file instead of Air Show, uncheck **Render to Air Show** on the [Air Display](#) page.

Each frame in the sequence will have the frame number appended to the base image name given on the [Air Display](#) page. E.g., if the base name is `air.tif`, the rendered frames will be

```
air_0000.tif
air_0001.tif
air_0002.tif
air_0003.tif
...
```

Once all frames have been rendered, they can be converted into an AVI file using Air Show. Air Show can load a numbered sequence of files (select the first file in the open dialog; Air Show will then ask if you wish to load all files in the sequence). Note that many AVI compression codecs do not support the full color images generated by Air.

The inexpensive Pro version of Apple's QuickTime player can create a Quicktime movie from an image sequence.

### Rendering with Air Control

The separate Air Control render management program included with Air can be used to render a



previously exported animation sequence. Air Control can be started from the Windows Start menu or from the Tools menu of Air Show.

To render a number frame sequence with Air Control, select the first frame as the scene file. Check the Frame range option. By default Air Control will render all frames beginning with frame 0. You can specify a subrange of frames using the From and To parameters.

### Command Line Rendering

An exported scene file can be rendered by starting Air from an MS-DOS prompt (command shell). For example, assume that the above scene files have been exported to the directory C:\Temp. From an MS-DOS prompt, all frames could be rendered with:

```
cd C:\temp
air RhinoAir_all.rib
```

Note that the number of processors and processor priority set on the Air Plugin page are not included in the RIB files. To set the number of processors, use the -p command line option. For example, to render with 4 processors:

```
air -p 4 RhinoAir_all.rib
```

To render in the background with a lower priority process, use

```
air -pri -1 -p 4 RhinoAir_all.rib
```

To render a single frame, render the rib file for that frame:

```
air RhinoAir_0002.rib
```

Air has a couple special command line switches for selecting subsets of an animated sequence. Use the -frames switch to specify a range of frames. For example, to render the 2nd and 3rd frames (frames 1 and 2), use

```
air -frames 1 2 RhinoAir_all.rib
```

Keep in mind that the first frame is frame number 0.

Use the -step option to specify an increment in a frame range. For example, to render only even frame numbers in a 4 frame animation, use

```
air -frames 0 3 -step 2 RhinoAir_all.rib
```

For odd frames:

```
air -frames 1 3 -step 2 RhinoAir_all.rib
```

## 11 IPR - Interactive Preview Rendering

With RhinoAir you can interactively adjust shading and lighting in a scene while viewing the results in a high-quality preview rendering managed by TweakAir. TweakAir is a special version of the Air renderer optimized for interactive shading and lighting.

TweakAir is licensed separately from Air. If you do not have a TweakAir license, TweakAir will run in demo mode, which limits the image resolution to 400x300 and the number of rendering threads to 1.

### Starting an Interactive Rendering Session



Use the [AirlprStart](#) command or the IPR toolbar button (on the main Air toolbar) to begin an IPR session. To start an IPR session, RhinoAir first exports the scene as with a normal rendering and then starts TweakAir as a separate process to manage the interactive render view. The rendered view will appear as a frame in the separate Air Show framebuffer.

Tip: You can keep the Air Show window in front of the Rhino window by enabling the **Always on top** option in the Air Show Options menu.

### Interactive Preview Rendering

Once an IPR session is started, RhinoAir will send shading and lighting changes to the active TweakAir process as you make them.

Materials can be edited using any available method - the Rhino Material page, the [Air Material](#) page or the [AirMaterial](#) command. During IPR the material preview on the Air Material page is disabled to make more processing power available for interactive updates.

In some cases you may notice a delay in the update of the Rhino user interface when selecting new texture maps. This delay occurs when RhinoAir converts a raw image file to an Air texture map prior to sending the updated material information to TweakAir. Texture conversion should only occur the first time a map is used; subsequent references to the same source image will use the existing converted texture.

Lighting changes can be made in any manner supported by Rhino. Lights can be added, removed, moved and edited on the [Air Light](#) page or the Rhino Light page.

### Environment Updates

Changes made to the reflected environment on the [Air Trace](#) page or using the [Air Trace](#) command will update in the IPR view if the Auto-updated reflections option is checked on the [Air Interactive](#) page.

Changes to the Global Illumination environment will update when the GI mode is set to Ambient or one of the Occlusion modes. Note that the GI mode must be set prior to starting the IPR session.

### Ending an Interactive Rendering Session



Use the [AirlprEnd](#) command or right click the Air IPR button to end an IPR session, terminating the background TweakAir process.

### IPR Options

The [Air Interactive](#) page in the Rhino document properties dialog has controls for configuring the behavior and performance of interactive preview rendering.

See Also:

[Air Interactive](#) page

[AirlprStart](#) command

[AirlprEnd](#) command

## 12 Baking Textures with BakeAir

*Demo restrictions: The BakeAir demo limits baked map size to 256 pixels in width and height, and baked maps are watermarked.*

RhinoAir provides an interface for rendering or baking shading and lighting to texture maps with SiTex Graphics BakeAir dedicated texture renderer. The Air Bake toolbar has convenient buttons for baking textures.

### Baking or Rendering Textures

The baking process consists of the following steps:

- Set properties for the baked texture maps on the Air Bake page or using the AirBake command.
- Use the [AirBake](#) command to export a rib file and start BakeAir as a separate process to render the texture maps.
- Wait for the BakeAir process to complete.

That completes the baking process.

### Viewing Baked Textures in Rhino

The baked maps can be viewed in Rhino using a special baked display mode. The RhinoAir distribution includes a BakedAir.ini file that defines this special display mode. To load the baked display mode:

- Display the Rhino Document Properties dialog.
- In the Appearance section of RhinoOptions, select Advanced Settings.
- Click the Import button and load the BakedAir.ini file included in the RhinoAir distribution.

To view baked texture maps in Rhino:

- Use the [AirLoadBakedMaps](#) command to load the texture maps into Rhino.
- Set the display mode for the viewport to BakedAir.

Note that Rhino's display mechanism does not have an exact method for applying textures that already contain lighting information. The BakedAir mode is the best approximation currently possible with Rhino's standard display options.

When texture maps are re-rendered, you may need to execute the RefreshAllTextures command to reload the textures into Rhino.

### Exporting a Model with Baked Textures

The RhinoAir plugin includes a special [AirExportVrml](#) command for exporting a model with baked textures to a VRML file. Unlike Rhino's VRML exporter, this special command knows how to properly define shading in the VRML file for use with baked textures.

The exported VRML file should be located in the same directory as the baked textures (since texture references in the VRML file will not have full paths).

If the current Rhino view is a perspective view, that view will be used as the default view in the VRML file. Due to limitations in the way a viewpoint is defined in a VRML file, the view in the VRML file will generally not exactly match the Rhino viewport.

The background color in the exported VRML file will be taken from the RhinoAir image background

color.

### Limitations

- Only shading on one side of a surface is baked. If a baked texture appears black, try using the Rhino Dir command to reverse the orientation of the surface.
- Only NURB surfaces and polygon meshes with well-defined texture coordinates in the unit square can be baked.
- Each object generates its own baked texture map.

See Also:

[Air Bake page](#)

[AirBake command](#)

## 13 Rapid Prototyping

*Note: Mesh export is disabled in the Air demo.*

Air's displacement feature can be used to apply topographical patterns to a surface, which can be exported as a mesh for later 3D printing or manufacturing.

### Basic Instructions

Any displacement shader can be used to generate the displaced mesh. The instructions below describe how to use a texture map to displace a surface and export the displaced mesh from a rendering.

1. Select the object to be displaced.
2. Display the Air Material page in the Rhino Properties dialog.
3. Select Bump map from the dropdown list for the Displacement control.
4. Set the Texture name parameter to the name of the texture map to be used for displacement.
5. The Bump max parameter sets the maximum distance the surface will be moved by the displacement. Use a negative value to displace the surface inward instead of outward.
6. Set the Displacement Mode to Mesh displacement.
7. Display the Air Object page for the selected object in the Rhino Properties dialog.
8. In the Advanced section check Export mesh and use the dialog button to specify a file name for the exported mesh. Use a file name extension of .OBJ to specify a Wavefront OBJ file.

That concludes the basic setup for mesh export. Click the render or render selected button in the Air render toolbar to start a rendering which will render the displaced object and export the displaced mesh.

The OBJ file created by Air can be loaded into Rhino or another application for further manipulation.

### Additional Tips

Air displaces a surface by dividing it into a fine mesh of polygons whose vertices are then moved

based on the displacement shader.

The density of the displacement mesh is based on the current rendered view of the object and the Tolerance setting on the Air Object page. The tolerance setting gives the maximum size of the small polygons in the mesh in pixels. A smaller tolerance setting will result in a finer mesh, which will produce a larger file and take longer to render.

In some cases enabling the Use render mesh control on the Air Object page may improve the quality of the displaced mesh.

## 14 Dialog Pages

Document Properties

[Air Main](#)

[Air Display](#)

[Air Trace](#)

[Air GI](#)

[Air Outline](#)

[Air Animation](#)

[Air Interactive](#)

[Air Bake](#)

[Air Plugin](#)

Object Properties

[Air Light](#)

[Air Material](#)

[Air Object](#)

### 14.1 Air Main page

Location: DocumentProperties AirMain

The Air Main page sets basic parameters for the rendered image.

**Image size** (*width x height* or Viewport)

Gives the image size as a width and height in pixels. Select from the drop down list, or type a width and height into the text box.

If the text box is set to Viewport the image size will be taken from the size of the view used for rendering.

**View** (*viewport name* or Current)

The name of the Rhino viewport to use for the rendering camera. If the view name is Current, the current (active) viewport will be used.

#### **Image Quality**

Parameters in this section control overall image appearance and quality

## Presets

This control provides several pre-selected combinations of pixel and shading samples:

Quality Level	Pixel Samples	Shading Samples
Normal	4	1
Smoother edges	8	1
Finer shading	4	4
High quality	8	4
Higher quality	12	8
Extreme quality	16	16

### Pixel samples (integer between 1 and 32, default 4)

The number of times the scene geometry is sampled at each pixel, defined as an N x N grid. For example, a pixel samples value of 4 would result in 4x4=16 samples per pixel.

Increase the number of pixel samples to smooth geometric edges.

### Shading samples (integer between 1 and 32, default 1)

The number of times an object is shaded per pixel. Use more shading samples for smoother shading. Increasing the number of shading samples typically increases rendering time proportionally.

### Sharp filter (default off)

When checked the rendered image will be filtered using a Mitchell filter which produces a sharper image than the default gaussian filter.

### Clamp to alpha (default on)

When checked shading results for each pixel sample are clamped to be no greater than the alpha/transparency value (and no greater than 1 in any case). This option can help to smooth shading in images using HDR (high-dynamic range) textures or environment maps which may result in shading values that are much greater than 1. Note that when this option is enabled, the resulting output values for every pixel will be less than or equal to 1.

## Geometry

### Use Rhino mesh (Checked Intermediate Unchecked)

Air is able to render NURB surfaces without relying on Rhino's render meshes. This control determines how NURB surfaces are exported for rendering:

Checked: Each NURB surface is exported as the Rhino render mesh.

Intermediate: NURB surfaces are exported as NURBs unless the render mesh is necessary to accurately reproduce some Rhino shading feature. The most common case where a render mesh is required is a polysurface with packed texture coordinates.

Unchecked: NURB surfaces are always exported as NURB primitives.

**Tolerance** (number greater than 0, default 0.5)

The tolerance setting controls the accuracy of the polygon mesh used by Air to render to a NURB surface (when the Rhino render mesh is not used). The tolerance is given as the maximum allowed difference in pixels between the mesh representation and the NURB surface. Because the allowable distance is given in pixels, the density of the polygon mesh generated by Air will vary depending on how large the NURB surface appears on screen: a surface that is small will use fewer polygons than one that appears large in an image. The default tolerance is 0.5. Larger values will produce coarser meshes, which will use less memory and render faster. When rendering large images for printing, you may be able to use larger tolerance values with no visible difference.

**Curves and points** (default off)

When checked, Air will render Rhino curves as Air curve primitives and Rhino points and points clouds as Air point primitives. These are true 3D primitives with a defined size in world space. The default width for curves and points is given by the **Curve width** value. The default color assignment is determined by the Curve color setting (described below).

Air can render a line pattern assigned to a curve. The line pattern length is computed by first converting the line segment lengths given in the line pattern definition from millimeters to the units selected for the current scene. The lengths are then multiplied by the display Scale factor defined on the Linetypes of the Rhino Document Properties dialog. That Scale factor can thus be used to globally stretch or shrink the length of all line patterns. The line width is determined by the Curve width parameter described above (just as for curves without a pattern).

The width of an individual curve or point object can be adjusted on the [Air Object](#) properties page, which also allows the object color to be overridden.

By default curves and points are rendered as annotation entities, and they do not use materials. To apply a material to a curve or point object, enable the **Shade curves and points** control on the [Air Object](#) properties page.

**Dimensions and text** (default off)

When checked, Air will render Rhino dimension and text entities. The color used for dimensions and text is determined by the Curve color setting (see below).

**Curve color** ([Black](#) Display Print)

This selection determines how RhinoAir assigns a color to an individual curve. By default all curves are assigned a black color. Display mode uses the Rhino display color for the curve object. Print mode uses the print color assigned to a curve in the curve's object properties.

**Image Background**

The settings in this section determine what appears in areas of the image that are not covered by any objects.

**Mode** (Transparent [Color](#) Gradient Wallpaper Environment)

Transparent: Empty pixels are transparent (black with alpha=0), allowing the image to be composited over another in post-processing.

Color: Unrendered pixels are filled with a constant color given by the color button.

Gradient: The background is filled with a smooth gradient from top color button to the bottom color

button.

Wallpaper: The background is exactly covered by the provided background image.

Environment: The specified map is applied as a spherical environment map. The Rotate control gives a rotation angle in degrees about the Z axis.

### **Scene Output**

#### **RIB file name**

The name of the scene file produced by the [AirRender](#) or [AirExport](#) commands.

#### **Read options file**

Use this set of controls to specify an external text file of RIB commands to be included in the options section of the exported RIB file.

See Also:

[Image Quality](#)

## **14.2 Air Display page**

Location: DocumentProperties AirDisplay

#### **Image file name**

Name for the rendered image. When rendering to a file, this is the file that will be generated by the renderer. The image file format is determined by the file name extension:

<u>Image Format</u>	<u>Extension</u>	<u>Precision</u>
Windows Bitmap	.bmp	8-bit
OpenEXR	.exr	float
Radiance	.hdr	float
JPEG	.jpg	8-bit
Portable Network Graphics	.png	8-bit,16-bit
SGI Image Format	.sgi	8-bit,16-bit
Targa	.tga	8-bit
TIFF	.tif	8-bit,16-bit,float
Photoshop File Format	.psd	8-bit,16-bit

#### **Render to Air Show window**

When checked the rendered image(s) are displayed in the standalone Air Show framebuffer.

#### **Render to File**

When checked the rendered image(s) are written to one or more files. The file type is determined by the extension of the image file name.



## Channels

Specifies the information that is saved in the rendered image. The standard choices are

`r` - red channel only (produces a grey scale image)  
`rgb` - color with no coverage information  
`rgba` - color with coverage

## Precision

Precision determines the numeric accuracy and format of the image data:

8-bit: Output values are scaled and converted to integers between 0 and 255. Each channel value is stored as a single byte.

16-bit: Output values are scaled and converted to integers between 0 and 65535. Each channel value is stored as 2 bytes.

float: Output values are saved as single-precision floating-point numbers. Each channel value requires 4 bytes of storage.

Not all image formats support all precision types. TIFF files support all precision types. PNG and PSD files support 8-bit and 16-bit images. OpenEXR and HDR images require float precision. Most other formats expect 8-bit data.

## Gamma

Specifies the gamma correction to apply to the image data prior to converting it to the desired precision. A gamma value of 1 disables gamma correction.

## Extra Channels

During a single rendering Air can generate extra images containing arbitrary output values computed by a shader. This section provides options for most of the extra output channels provided by Air's shaders.

Check the Save extra channels box to enable export of additional channels. If the in single file box is checked, the extra channels are added to the main image file instead of being saved as separate images. Only the TIFF, OpenEXR, and PSD formats allow multiple images in a single file.

Extra output images have the same precision, gamma correction, and image format as the main image.

See Also:

Air User Manual: Output

## 14.3 Air GI page

Location: DocumentProperties AirGI

### Global illumination mode

Selects among the following ways of simulating global illumination effects:

Off

No GI effects. The RhinoRender ambient light settings are translated to a simple AIR ambient light source that contributes a fixed amount of diffuse illumination to each surface.

Ambient

A constant amount of ambient light is added to the scene based on the Rhino renderer's ambient light color.

Indirect

Compute indirect diffuse illumination which includes color bleeding effects without caching.

Indirect Cache

Compute indirect diffuse illumination using an irradiance cache to accelerate rendering.

Occlusion

Simulate environment lighting using ambient occlusion to compute shadows.

Occlusion Cache

Simulate environment lighting with ambient occlusion using an occlusion cache to accelerate rendering.

***Sample Quality*****Rays per sample** (integer between 1 and 1024, default 256)

Number of rays to trace for each GI sample. More rays produce more accurate and smoother GI results but take longer to render. A useful guideline when making adjustments is to increase or decrease the number of rays by a factor of 2.

**Max trace distance** (number greater than 0, default 100000)

Maximum distance to trace each ray for possible intersection with nearby surfaces. Lower distances will reduce rendering time. A low trace distance can allow occlusion to be used even for interior scenes.

**Adaptive ray casting** (default off)

When enabled Air casts fewer rays initially, then additional rays only in regions where the initial ray casts indicate high variation.

***Cache Properties***

To accelerate GI rendering, Air allows GI samples to be stored and reused. These parameters control how often samples are generated and when they are re-used.

**Maximum error allowed** (number between 0 and 1, default 0.2)

Sets a maximum error threshold when re-using samples in the cache. If a result cannot be obtained from cached values within the given threshold, a new sample will be generated.

**Max pixel distance** (number greater than 0, default 20)

Gives a maximum distance in pixels between samples in the cache. This parameter ensures that even flat sections in an image receive some GI samples. This setting should be increased for larger image sizes.

### Cache file

Air allows the contents of the GI cache to be saved to a file and re-used to accelerate future renderings. The cache file name is relative to the directory containing the main rib file. Check the Read or Write boxes to, respectively, read from or write to the cache file.

Indirect and occlusion GI modes use different cache formats.

### *Indirect Only*

This section has controls that affect only the indirect and indirect cache GI modes.

**Max bounces** (integer between 1 and 5, default 1)

Gives the maximum number of "bounces" to follow indirect light rays. More bounces take longer to render. When using indirect lighting without a cache, rendering with more than 1 bounce may take a long time.

### *Global Illumination Environment*

This section specifies the illumination that comes into the scene from the surrounding environment. There are 2 modes:

#### Color

Incoming light color is given by the specified color scaled by the **Intensity** value.

#### Map

Background illumination comes from the provided environment map scaled by the **Intensity**. The **Rotate** controls gives the rotation in degrees of the map about the Z axis.

See Also:

[Global Illumination](#)

[AirGI](#) command

Air User Manual: Lighting -> Indirect Diffuse Light

Air User Manual: Lighting -> Ambient Occlusion

## 14.4 Air Outline page

Location: DocumentProperties AirOutline

Use the Air Outline page to control how Air generates outlines for illustration.

Outline quality is determined by the pixel samples setting on the [Air Main](#) page. More pixel samples will produce smoother outlines.

### *Line Properties*

**Line width** (number greater than 0, default 1)

Sets the width of the outlines in pixels. Fractional widths are allowed.

**Line color** (default black)

Default color for outlines. Outline color can be overridden on a per-object basis on the [Air Object](#) properties page.

### **Edge Detection**

This section controls how Air detects when to draw an outline. Air supports several independent methods of detecting edges. Air will draw a line at a location if any method indicates an edge is nearby. Each method can be independently enabled or disabled.

#### **Regions** (None PerScene PerObject PerSurface PerPolygon)

One method of edge detection is based on defining regions of interest in the image, and drawing edges along boundaries between those regions. Use this control to select how regions are defined:

None: No edges are generated based on regions.

Per Scene: All objects are assigned to the same region; the scene as a whole is outlined but individual objects are not.

Per Object: Each object is treated as a distinct region. A single polysurf is treated as one region.

Per Surface: Each NURB surface or mesh is defined as a region. Each surface in a polysurf is a separate region.

Per Polygon: Each polygon in a mesh or the render mesh for a NURB surface is treated as a distinct region.



per Scene



per Object



per Surface



per Polygon

#### **Silhouette threshold** (number between 0 and 1, default 0.5)

The silhouette threshold controls edge detection based on differences in the surface normal. The higher the threshold, the fewer edges will be detected. Set the threshold to 0 or 1 to disable this method of edge detection.

#### **Front-to-back edge detection** (default off)

This control enables edge detection by identifying those edges in the render mesh that lie between a front-facing and a back-facing polygon.

### **Fade with Distance**

Air can optionally make lines thinner as they become farther from the camera. Enable line width attenuation with distance by setting the fade start distance to a positive number.

#### **Start distance** (default 0)

Distance at which to begin reducing line width based on distance to the camera

**Min line width** (default 0)

Minimum line width in pixels for lines reduced by distance.

See Also:

[Illustration](#)

[AirOutline](#) command

Air User Manual: Toon Rendering and Illustration

## 14.5 Air Trace page

Location: DocumentProperties AirTrace

The properties in the top portion of this page control aspects of ray tracing for shadows and reflections. The bottom section holds controls for depth of field (which does not require ray tracing).

**Trace offset** (number greater than 0, default 0.01)

The trace offset is a small distance used to shift the starting location when rays are traced for reflections or shadows. Use this setting to prevent rendering artifacts due to incorrect self-intersection of a ray with the surface from which it is cast.

**Max bounces** (integer between 0 and 20, default 6)

Gives the maximum number of bounces through which to trace reflection rays. Set max bounces to 0 to globally disable ray traced reflections.

***Reflected Environment***

This section determines the color returned by reflection rays that miss all objects in the scene. There are 3 basic modes:

None

Reflection rays that miss all objects simply return a black color.

Color

Reflection rays that fail to intersect an object return the specified color scaled by the **Intensity** value.

Map

The provided environment map is used to select a color for reflection rays based on the ray direction. The **Intensity** value gives a multiplier for the environment map result. The **Blur** parameter can be used to add blurriness to the result to soften the look or smooth the appearance of a low-resolution map. The **Rotate** value gives an angle in degrees to rotate the map about the Z (up) axis.

***Depth of Field***

Use the controls in this section to enable and configure simulating the limited focal range of a physical camera.

**Enable** (default off)

Check to enable depth of field effects.

**Camera lens** (lens length in mm)

Camera lens focal length in mm for DOF computation. Longer lenses have a shallower depth of field, producing more blur.

**f-Stop** (number greater than 0, default 8)

The simulated f-Stop value for the camera. Lower numbers produce more blur.

**Focus distance**

Distance at which objects are most in focus. If **Camera target** is checked, the distance from the camera location to the camera target is used as the focus distance.

**Samples** (integer greater than 0, default 64)

Sets the number of samples to use when simulating depth of field. More samples produce smoother results but take longer to render.

See Also:

[AirTrace](#) command

Air User Manual: Reflections

## 14.6 Air Animation page

Location: DocumentProperties AirAnimation

**View Animation**

Use the controls in this section to perform simple camera or view-based animation.

**Mode** (Off Turntable Fly-through Paths)

Off:

No view animation.

Turntable:

Rotates the scene around the camera target point. The **Max angle** parameter gives the final rotation angle in degrees.

Fly-through:

Moves the camera through the scene along a curve path. Any Rhino curve can be used for the camera path by assigning a name to the curve (on Rhino's Object property page in the Properties dialog), and selecting the curve name from the drop-down list for the **Camera path** control. Define the field of view for the animated camera with the **Camera lens** setting.

Paths:

Moves the camera location and target location along separate paths through the scene. To be used a path, a curve primitive must be assigned a name. The **Camera path** and **Target path** controls specify the names of the curves to be used for the camera and target paths, respectively. The **Camera lens** setting determines the field of view for the animated camera.

## 14.7 Air Interactive page

Location: DocumentProperties AirInteractive

### ***Interactive Rendering with TweakAir***

Use the controls on this page to configure interactive preview rendering (IPR) for shading and lighting with TweakAir.

To start a TweakAir session, use the AirIprStart command or the IPR toolbar button.

### **Image size** (*width x height* or Viewport)

Gives the IPR image size as a width and height in pixels. Select from the drop down list, or type a width and height into the text box.

If the text box is set to Viewport, the image size will be taken from the size of the view used for rendering.

Demo limitation: The TweakAir demo limits the IPR image size to a maximum resolution of 400 x 300.

### **View** (*viewport name* or Current)

The name of the Rhino viewport to use for the IPR camera. If the view name is Current, the current (active) viewport will be used.

### ***Quality and Optimization***

#### **Shading** (Matte Fast relighting Full shading)

The shading mode can be used to optimize shading during interactive preview rendering without affecting shading in a final rendered image.

Matte: Surfaces are shaded using a fast, simple matte or diffuse surface shader instead of the assigned surface shader. This mode may be useful when adjusting lighting in scenes with complex surface shaders.

Fast relighting: In this mode TweakAir optimizes re-rendering after lighting changes by recomputing the surface color without executing the assigned surface shader. In many cases this produces the same result as the full shading mode described below in a fraction of the time. Surface shaders that use non-standard illumination models may be incorrectly shaded in this mode.

Full shading: TweakAir re-evaluates the assigned surface shader whenever a change is made that affects the surface.

#### **Smooth edges** (default off)

When this option is enabled TweakAir antialiases geometric edges by computing coverage information for the primitive(s) covering each pixel. This results in more memory use and slower refresh rates but produces a higher-quality image.

#### **Auto-update reflections** (default on)

Use this option to automatically refresh reflections whenever a reflected object changes. This option

is helpful for improving the preview accuracy of scenes with many highly reflective objects.

**Max shadow rays** (default 1)

Sets a limit on the number of shadow rays cast for each light. The actual number of rays cast for a light is the lesser of this number and the number of shadow rays specified on the [Air Light](#) page.

**Max reflection rays** (default 1)

Gives a limit on the number of rays to trace for reflection or refraction. The actual number of rays cast is the lesser of this limit and the number of reflection or refraction rays specified in the assigned surface shader.

***Interactive Rendering Process*****Rendering threads** (default 1)

Number of separate threads of execution to use for interactive rendering.

Demo Limitation: The TweakAir demo is limited to a single rendering thread.

**Run at low priority** (default off)

When enabled the interactive rendering process executes at a lower than normal priority enabling foreground applications like Rhino to run without being slowed down by the IPR process.

See Also:

[IPR - Interactive Preview Rendering](#)

[AirIprStart](#) command

[AirIprEnd](#) command

## 14.8 Air Bake page

Location: DocumentProperties AirBake

***Baked Map Properties*****Map base name** (*imagenam*e)

The base name for all baked texture maps. The name for each map is derived from the base name by appending an object's unique identifier.

The image file format is determined by the file name extension. Maps that are to be used with Rhino's graphics display or other realtime engines should be rendered to as PNG or JPEG files.

**Max map size** (*width x height*)

The maximum size of each texture map. The width and height should be a power of 2 (e.g., 128, 256, 512, 1024, or 2048). The actual size of each map may be less depending on the texel size parameter describe below.

**Channels** (*rgb*)



Specifies the information is rendered or baked to the texture maps. The standard choices are

`rgb` - color with no coverage information

`rgba` - color with coverage

`__diffuse` - surface as though lit by only diffuse light, without specular highlights or reflections

`__constant` - shader color pattern with no lighting information

#### **Texel size (0.1)**

Desired width of each texel (or pixel) in the texture map in world coordinates. Smaller values produce maps that are larger and have more detail, subject to the maximum map size specified above.

#### **Border padding (1)**

Gives a border region in pixels to fill in around baked regions in a texture map. A border can help prevent artifacts visible discontinuities along boundaries between texture regions when a baked map is applied to an object.

#### **Map Quality**

##### **Pixel Samples (4)**

Defines a grid of samples used to create each pixel or texel in a baked map. Normally the default value of 4 is more than adequate.

##### **Shading Samples (1)**

Number of shading samples to take per pixel in the baked map. More samples take longer to render but produce smoother shading.

##### **Sharp Filter (off)**

When checked the baked map will be filtered using a Mitchell filter which produces a sharper image than the default gaussian filter.

See Also:

[Baking Textures with BakeAir](#)

## **14.9 Air Plugin page**

Location: DocumentProperties AirPlugin

#### **Rendering Process**

##### **Rendering threads (integer between 1 and 8, default 1)**

Number of separate threads of execution to use for rendering; normally 1 thread should be used for each processing core available.

The Air demo is limited to a single rendering thread.

##### **Run at low priority (default on)**

When enabled the rendering process executes at a lower than normal priority enabling foreground applications like Rhino to run without being slowed down by the rendering process.

**Distributed rendering with Vortex** (default off)

Check this option to use Vortex to distribute rendering of a single image over multiple computers. For additional information on Vortex see "Vortex" in the Tools section of the Air User Manual. Vortex does not work with the demo version of Air.

**Tile size** (integer between 8 and 256)

Air renders an image in small tiles, and this property sets the width and height of each tile. Larger tile sizes usually render more quickly but also use more memory.

**Tile order** (Columns Rows Spiral)

Sets the order in which the image is rendered.

***Render Management*****Submit rendering jobs to Air Control** (default off)

When checked the RhinoAir plugin will submit rendering tasks to Air Control, a separate program for starting and managing multiple renders. Rendering tasks sent to Air Control are placed in a queue or list, and each task is rendered in order. By using Air Control you can define several potentially time-consuming jobs to be rendered in sequence without having to start each one manually as the previous task finishes.

When using the Air Control render queue, it is important not to overwrite the exported scene file for a job before the job has finished rendering. To make this easier, it is recommended that you also enable the following option when submitting jobs to Air Control:

**Append scene and image names with version** (default off)

When checked the supplied version number is appended to the file names for scene export and rendered images. After a rendering task is started, the version number is automatically incremented. Use this option to automatically generate unique scene and image names for every rendering.

To keep your storage device from becoming cluttered with many old version files, you may wish to use Air Control to manage rendering tasks and enable the Air Control option to delete scene files after a job has finished.

***Gamma Correction***

Gamma correction adjusts the brightness of a color to compensate for the non-linearity of a particular output device. The Rhino to Air plugin performs gamma correction at several stages in the scene conversion and rendering process.

Most CRT monitors have a gamma value in the range 2.2-2.4. Most LCD monitors have an effective gamma of around 1.8.

In the simplest and most common case, all three gamma factors should be the same. That produces an output image with gamma correction that corresponds as closely as possible to the same image rendered with the Rhino renderer.

### ***Color conversion***

#### **Monitor gamma** (default 1.8)

Gamma factor used to convert colors chosen in Rhino to a "linear" color space for rendering with Air.

### ***Texture conversion***

#### **Texture gamma** (default 1.8)

Gamma factor applied during conversion of texture maps to Air texture files. Many texture maps are pre-gamma corrected to appear pleasing on a computer monitor. This compensation must be reversed prior to rendering if the final image is to be gamma corrected. Otherwise, texture maps will look "washed out" relative to their normal appearance on-screen.

## **14.10 Air Light page**

Location: PropertyPages AirLight

Use the Air Light page to customize the behavior of Rhino lights when rendered with Air.

### ***Illumination***

#### **Color**

Sets the Rhino light color.

#### **Intensity** (number greater than 0)

Gives the strength or brightness of the emitted light. The intensity value can be greater than 1. For lights whose brightness varies with distance from the source (see falloff below), the intensity value may need to be very large.

#### **Falloff** (None Linear Square)

Determines how the light's intensity varies with distance from the light:

None: Intensity does not vary with distance.

Linear: Intensity decreases linearly with distance from the light.

Square: Intensity decreases as the square of the distance from the light source. This setting is appropriate for physically accurate lights.

#### **Emit diffuse light** (default on)

When checked the light contributes diffuse illumination to the scene. A light that does not contribute diffuse light may not need to cast shadows either.

#### **Emit specular light** (default on)

When checked the light produces specular highlights on shiny surfaces.

### ***Shadow***

**Color**

Color to use for areas that are in shadow.

**Intensity** (number between 0 and 1)

Gives the fraction of the emitted light obscured in shadowed areas (the same as the Rhino shadow intensity control). A shadow intensity value of 0 disables shadow-casting for the light.

**Rays** (integer between 0 and 256)

Sets the number of rays to trace for shadows for the selected light. Linear lights and rectangular area lights, as well as lights with a large shadow blur may require more rays. It usually makes sense to increase and decrease the number of rays by a factor of 2.

It is usually much more efficient to increase the number of shadow rays for smoother shadows than to increase the number of Shading Samples.

Set the number of rays to 0 to disable shadow casting for the light.

**Blur** (angle in radians)

An angle used to blur the shadows for a light. Technically, it's the half-angle of a cone measured from the point being shaded within which rays are cast toward the light. Typically values are in the range 0.01 to 0.1.

Reducing the amount of blur below 0.005 increases the chance that self-shadowing artifacts may appear.

***Rectangle light***

Properties affecting only rectangle area lights.

**Visible to camera** (default off)

When checked a rectangle light will be visible to the camera. The light is given the illumination color and a constant surface shader.

**Visible in reflections** (default off)

When checked a rectangle light will be visible in reflections. You may wish to uncheck the Emit specular setting for a rectangle light visible in reflections to prevent the light being "counted" twice.

**Fast approximation** (default off)

When checked the area light is rendered using a faster, less accurate method. For Interactive Preview Rendering, rectangular area lights are always exported using the fast approximation.

**Texture map** (default off)

When checked the specified texture map modulates the illumination emitted by the area light. This option automatically disables the fast approximation optimization.

See Also:

[Lighting](#)

## 14.11 Air Material page

Location: PropertyPages AirMaterial

Use the Air Material page to customize the appearance of a Rhino material for Air.

### Material Assignment

This page displays the current material for an object regardless of how the material is assigned. A label at the top of the page indicates the kind of material currently assigned to the selected object - a basic material, the layer material, or the parent material.

The New button on the Air Material page can be used to create a new basic material for each selected object. To select a different method of material assignment, go to the Rhino Material page for the object and select the desired method in the Assign by section.

### Material Name

The material name (if any) will be displayed next to the method of material assignment. You can type a new material name into the text box.

### Select Matching

Use this button to select all objects in the scene with the same material properties as the currently selected object. The material settings for only the first currently selected object are used for comparison. Materials are tested for equality by comparing name, color, transparency, surface shader, displacement shader, and displacement mode.

### Force basic material (default on)

When checked, a new basic material is automatically created for an object that has its material assigned by layer the first time an Air-specific property is assigned to the material. If you are accustomed to organizing materials by layer, uncheck this option.

### Attributes

#### Color

Sets the Rhino material color, also used as the color attribute for Air.

#### Transparency (number between 0 and 1)

Sets the Rhino material transparency.

#### Shading samples (integer between 1 and 32, default 1)

This control allows the number of shading samples to be increased for an individual material to improve the detail and smoothness of a material. Air will use the maximum of the local samples value and the global shading samples value. Rendering time can be reduced by using additional shading samples only for those materials that require more detail rather than increasing the number of shading samples globally for all materials.

To smooth reflections it is more efficient to increase the number of reflection rays than to increase the number of shading samples.

To smooth noisy shadows it is more efficient to increase the number of shadow rays for the shadow-casting light than to increase the number of shading samples.

## Preview

When preview is enabled, the plugin automatically generates and updates an small preview image for the material. For some materials updating the preview image after every change may noticeably slow down the operation of the plugin. In this case you may wish to disable the preview option while modifying the material, periodically enabling the preview temporarily to check the appearance of the material.

The material preview is disabled when an [Interactive Preview Rendering](#) session is active to leave more processing power available to update the IPR view.

## Shaders

Air uses small programs called shaders to compute the appearance of a material. Use the controls in this section to select the surface and displacement shader for the material.

### Surface

Gives the surface shader used to compute the output color for the material. The dropdown list contains some of the surface shaders included with Air. A custom shader can chosen by clicking the dialog button.

Most shaders have several parameters to adjust features such as intensity and size of highlights, position and type of texturing, etc. The Air Material page shows the parameters for the currently selected shader in the lower section of the dialog.

If the surface shader is set to Rhino, the plugin will translate the Rhino material properties (set on the Rhino Material page) as the surface shader. The Rhino surface shader has no parameters.

### Surface modifies transparency

Check this option if the surface shader computes a complex transparency pattern. By default Air assumes all shadow-casting objects are fully opaque and does not evaluate an object's surface shader when it is intersected by a shadow ray. When a surface shader alters the transparency of a surface, Air must execute the surface shader for shadow rays to produce accurate shadows. This additional processing slows down rendering.

### Displacement

A displacement shader is used to add topographical details like bumps, grooves, and ripples to a surface. The dropdown list contains some of the displacement shaders included with Air. Use the dialog button to choose a custom displacement shader.

If the displacement shader is set to Rhino, the RhinoAir plugin will translate the Rhino material bump map to a displacement shader. The Rhino displacement shader has no parameters.

### Displacement mode

The displacement mode determines how the displacement shader is applied:

Off	The displacement shader is not used.
Bump only	The displacement is applied as a bump effect, modifying the shading normal but not moving the surface.
Regular displacement	The displacement shader moves the surface. The shader is evaluated by carving a surface into pieces and displacing each piece separately.
Mesh displacement	The displacement shader moves the surface. An entire object is tessellated and displaced at once.

Both regular and mesh displacement perform true "sub-pixel" or "micropolygon" displacement. The quality of the displaced mesh depends on the surface tolerance property, which can be set globally on the [Air Main](#) page or for an individual object on the [Air Object](#) page. A higher tolerance setting will produce a coarser displacement, which will use less memory and render more quickly.

Mesh displacement is generally slower than regular displacement, but mesh displacement is less likely to exhibit cracks and produces smaller final meshes. Using the Rhino render mesh for NURB surfaces may also improve displacement results.

See Also:

[Materials](#)  
[AirMaterial](#) command

## 14.12 Air Object page

Location: PropertyPages AirObject

Use this page to modify Air-related properties for selected objects.

### **Visibility**

#### **Camera** (default on)

If unchecked, an object will be not be directly visible in the rendered image (though it may cast shadows or appear in reflections).

#### **Reflected** (default on)

If not checked, an object will not be visible in reflections.

#### **Cast shadow** (default on)

If not checked, an object will not cast shadows.

#### **Back faces** (default on)

If not checked, back-facing surfaces are not visible.

### **Outlines, curves, points**

The controls in this section can be used to customize outline, curve, and point properties on a per-object basis.

**Scale width** (number greater than 0)

When checked this setting gives a multiplier for the global outline or curve width.

**Set color** (default off)

When checked, the color overrides the outline, curve, or point color for the selected objects.

**Shade curves and points** (default off)

When checked, curves and point objects use their assigned material for shading, instead of the default constant shading for annotation.

**Point type** (Sphere Sprite Blobby Volume)

Sphere: points and point clouds are rendered as geometric spheres.

Sprites: points and point clouds are rendered as square polygons oriented to always face the camera.

Blobby: a point cloud is rendered as a metaball or blobby implicit surface. Blobbies are always shaded using the assigned material. For faster rendering with lower memory use, increase the **Tolerance** setting (described below) above the default value of 0.5.

Volume: a point cloud is rendered as a volume primitive. For appropriate shading, try using one of the following surface shaders included with Air: particle, VSmokeSurface, VCumulusCloud. In most cases the **Surface modifies transparency** control on the Air Material page should also be checked.

**Geometry****Use Rhino mesh**

This control determines whether Air uses the Rhino render mesh when rendering a NURB surface or whether Air renders the NURB surface natively. Possible settings are:

Unchecked: do not use the Rhino render mesh.

Checked: always use the Rhino render mesh.

Neither checked nor unchecked: use the global render mesh setting on the [Air Main](#) page.

**Tolerance** (number greater than 0 in pixels)

When checked the tolerance value (in pixels) overrides the global tolerance setting (on the [Air Main](#) page) for the selected objects.

**Subdivision mesh** (default off)

When enabled, a polygon mesh primitive is exported as a Catmull-Clark subdivision surface. For meshes with duplicate vertices, enabling the following **Weld polygon vertices** option will improve the quality of the subdivision result.

**Weld polygon vertices** (default off)

When enabled, coincident polygon vertices are merged during rendering for export. Per-vertex normals and texture coordinates are preserved for every face (unlike Rhino's polygon weld function). This capability may be useful when exporting displaced meshes for rapid prototyping or rendering a mesh as a subdivision surface.



### **Advanced**

#### **Read archive** (default off)

Use the dialog button to display a dialog for choosing an external file of rib commands. When checked, the specified file will be referenced in the main rib file just prior to the definition of the selected objects.

#### **Export mesh** (default off)

Use the dialog button to display a dialog for specifying the export file when saving a displaced mesh. Use a file extension of .obj to specify a Wavefront OBJ file. When the check box is checked, the specified file will be created at the conclusion of the next rendering.

## 15 Commands

[AirBake](#) - bake texture maps with BakeAir

[AirEnvironmentMap](#) - specify an environment map for all backgrounds

[AirExport](#) - export RIB file

[AirExportVrml](#) - export model with baked textures to VRML file

[AirIprEnd](#) - stop interactive preview rendering (IPR)

[AirIprStart](#) - begin interactive preview rendering (IPR)

[AirGi](#) - change global illumination settings

[AirLoadBakedMaps](#) - load baked texture maps into Rhino

[AirLoadSettings](#) - load global settings

[AirMaterial](#) - change material settings

[AirOptions](#) - set global rendering options

[AirOutline](#) - change outline settings

[AirRender](#) - export and render

[AirResetSettings](#) - reset global settings

[AirSaveSettings](#) - save global settings

[AirTrace](#) - edit ray trace settings

[AirVersionIncrement](#) - increment version number

### 15.1 AirBake command

Use the AirBake command to bake or render shading and lighting information to texture maps with BakeAir.

**Sel** (Yes No)

Whether to bake maps for only selected objects or all objects.

**TexelSize** (0.1)

Size of each texel (or pixel) of the baked texture map. Smaller values produce larger and more detailed maps, subject to the maximum map size set on the Air Bake page.

See Also:

[Baking Textures with BakeAir](#)

[Air Bake page](#)

## 15.2 AirEnvironmentMap command

Sets the environment map for GI background, reflected background, and image background simultaneously.

Note that this command does not change the mode for any of the backgrounds.

## 15.3 AirExport command

Use the AirExport command to export the current scene to a RIB file.

The AirExport command accepts the same options as the [AirOptions](#) command. Changes to options affect only the current export.

## 15.4 AirExportVrml command

This command exports a model with baked textures to a VRML file. Unlike Rhino's VRML exporter, this special command knows how to properly define shading in the VRML file for use with baked textures.

The exported VRML file should be located in the same directory as the baked textures (since texture references in the VRML file will not have full paths).

If the current Rhino view is a perspective view, that view will be used as the default view in the VRML file. Due to limitations in the way a viewpoint is defined in a VRML file, the view in the VRML file will generally not exactly match the Rhino viewport.

The background color in the exported VRML file will be taken from the RhinoAir image background color.

See Also:

[Baking Textures with BakeAir](#)

## 15.5 AirGi command

Use AirGi to configure global parameters for the different global illumination modes. The current GI mode can be set with the GiMode option of the [AirOptions](#) command.

**Adaptive** (No Yes)

When this setting is enabled, Air will use adaptive sampling to estimate global illumination. With adaptive sampling Air casts fewer rays initially and additional rays only where needed.

**MaxTraceDistance** (default 100000)

Maximum distance to trace rays when searching for surrounding objects.

**MaxError** (default 0.2)

Maximum error allowed when re-using cached irradiance or occlusion estimates.

**MaxPixelDistance** (default 20)

Maximum distance in pixels between estimates in an irradiance or occlusion cache.

**Rays** (integer between 1 and 1024)

Number of rays to cast for each estimate of global illumination.

**BgMode** ([Color Map](#))

Sets the method of specifying illumination coming into the scene from the surrounding environment.

**BgColor** (default white)

Average color of the surrounding environment that contributes light to the scene.

**BgColorIntensity** (default 0.5)

Multiplier for the background color.

**BgMapIntensity** (default 0.5)

Multiplier for the illumination contribution from a background environment map.

**BgMapBlur** (default 0)

Blur angle in radians for query of the background environment map.

**BgMapRotateZ** (default 0)

Angle in degrees to rotate the background environment map around the Z axis.

**BgMap**

File name for a background environment map.

See Also:

[Air GI](#) page

Air User Manual: Lighting -> Indirect Diffuse Light

Air User Manual: Lighting -> Ambient Occlusion

## 15.6 AirlprEnd command

Use the AirlprEnd command to terminate an interactive rendering session.

See Also:

[IPR - Interactive Preview Rendering](#)

[AirlprStart](#) command

[Air Interactive](#) page

## 15.7 AirIprStart command

Use the AirIprStart command to begin an interactive rendering session with TweakAir.

See Also:

[IPR - Interactive Preview Rendering](#)

[AirIprEnd](#) command

[Air Interactive](#) page

## 15.8 AirLoadBakedMaps command

Loads baked texture maps into Rhino.

Note that the load process will create a unique material for each Rhino object if necessary, which may alter the current material settings if the scene contains materials assigned by layer.

See Also:

[Baking Textures with BakeAir](#)

## 15.9 AirLoadSettings command

This command loads AIR global settings from an Air Rhino Settings file (\*.ars) previously saved with the [AirSaveSettings](#) command.

## 15.10 AirMaterial command

Use the AirMaterial command to change properties of the material assigned to an object.

Air material properties will be altered for whatever material is assigned to the object, regardless of how the material is assigned (e.g., by layer, by parent, etc.)

### **Name**

Sets the Rhino material name.

### **Color**

Sets the Rhino material color, also used as the color attribute for Air.

### **Surface**

Sets the Air surface shader used to compute the materials output color. If the Surface shader is set to Rhino, the Rhino material properties will be used for the appearance of this material.

### **Displacement**

Sets the Air displacement shader used to apply topographical effects to a surface.

### **DisplacementMode**

Determines how the displacement shader is applied to a surface:

Off	The displacement shader is not used.
Bump only	The displacement is applied as a bump effect, modifying the shading normal but not moving the surface.
Regular displacement	The displacement shader moves the surface. The shader is evaluated by carving a surface into pieces and displacing each piece separately.
Mesh displacement	The displacement shader moves the surface. An entire object is tessellated and displaced at once.

### **Transparency** (number between 0 and 1)

Sets the Rhino material transparency.

See Also:

[Materials](#)  
[Air Material](#) page

## 15.11 AirOptions command

The AirOptions command sets parameters that are global to a particular scene or model.

Options:

### **AirShow** (Yes No)

When Yes, the rendered image is sent to the standalone AIR Show framebuffer. When this option is No, the rendered image is sent to the image file specified with the ImageName option.

### **Animate** (Off Turntable FlyThrough Paths)

The animation mode to use for rendering.

### **BgMode** (Transparent Color Gradient Wallpaper Environment)

Determines how to treat pixels in the image that are not covered by any objects.

### **BgColor**

Color to use for the image background when BgMode is set to Color.

### **Colors** (Yes No)

Whether to export the color of each object.

### **ConvertTexture** (Yes No)

If yes, images used as texture maps are converted to Air texture maps prior to rendering.

### **Crop** (Yes No)

Whether to use the crop region for a rendering.

### **CropRegion** (*left right top bottom*)

Specifies a sub-region of an image to which rendering is restricted. Each window coordinate lies between 0 and 1. When the AirOptions command is invoked in interactive mode, the CropRegion can be set by selecting a rectangle in a Rhino viewport.

**Curves** (Yes No)

Whether to render curve objects.

**Dimensions** (Yes No)

Whether to render dimension and text annotation objects.

**Displacable** (Yes No)

When set to No, disables true displacement for all objects.

**Draft** (Yes No)

When Draft is Yes, the number of shadow samples and reflection samples are restricted to 1 regardless of other settings.

**Frame** (integer, default -1)

When greater than or equal to 0, the frame value gives the frame number to use for the exported file. The frame number is appended to the RIB file name and appended to the image file name. The RIB file will also include a FrameBegin/FrameEnd block with the specified frame number. As a side effect, when a valid frame number is specified, the RhinoAir version counter is not automatically incremented after export to facilitate exporting multiple animation frames with the same version number.

**GiMode** (Off Ambient Indirect IndirectCache Occlusion OcclusionCache)

GiMode selects among the following ways of simulating global illumination effects:

Off:

No GI effects. The RhinoRender ambient light settings are translated to a simple AIR ambient light source that contributes a fixed amount of diffuse illumination to each surface.

Ambient

A constant amount of ambient light is added to the scene.

Indirect:

Compute indirect diffuse illumination which includes color bleeding effects without caching.

IndirectCache

Compute indirect diffuse illumination using an irradiance cache to accelerate rendering.

Occlusion

Simulate environment lighting using ambient occlusion to compute shadows.

OcclusionCache

Simulate environment lighting with ambient occlusion using an occlusion cache to accelerate rendering.

**ImageHeight** (integer greater than or equal to 0)

Sets the height of the rendered image in pixels. A value of 0 will cause the image dimensions to be

taken from the viewport used for rendering.

**ImageWidth** (integer greater than or equal to 0)

Sets the width of the rendered image in pixels. A value of 0 will cause the image dimensions to be taken from the viewport used for rendering.

**Lights** (Yes No)

When set to No, no standard lights are included in the scene.

**LowPriority** (Yes No)

When Yes a render process started with [AirRender](#) runs at lower than normal priority so that the performance of foreground applications such as Rhino is not degraded by the rendering process. This setting does not affect or appear in the exported rib file.

**PixelSamples** (integer between 1 and 32)

Gives the number times the scene geometry is sampled per pixel as a grid of N by N samples. For example, a PixelSamples value of 4 will result in a sample grid of 4 x 4 = 16 samples per pixel.

**ShadingSamples** (integer between 1 and 32)

Number of shading samples to compute per pixel. In the rib file this setting appears as a ShadingRate call, which is the inverse of the number of shading samples:

$\text{ShadingRate} = 1 / \text{ShadingSamples}$

**SharpFilter** (Yes No)

When SharpFilter is Yes, the image pixel samples will be combined using a Mitchell pixel filter, which produces a sharper image than the default gaussian filter used if SharpFilter is No.

**Sel** (Yes No)

When Sel is Yes, only selected objects are rendered. All lights are exported independent of this setting.

**Threads** (integer between 1 and 8)

Number of processing cores to use for a rendering process started with the [AirRender](#) command. This setting does not appear in the exported rib file.

**RibName**

Use this option to enter a file name for the exported rib file. The default file name is RhinoAir.rib located in the directory pointed to by the TEMP environment variable.

**ImageName**

Use the ImageName option to specify the file name for a rendered image. The default image name is air.tif.

## 15.12 AirOutline command

Use the AirOutline command to set parameters for rendering outlines.

### **FrontBack** (No Yes)

When set to Yes this parameter enables an object-based edge detection method that identifies edges that separate front-facing and back-facing polygons.

### **InkColor**

Color for outlines.

### **InkWidth**

Sets the width of outlines in pixels.

### **Silhouette** (float value between 0 and 1)

Sets the threshold for edge-detection based on surface normal differences. Use a value of 0 or 1 to disable silhouette edge detection.

### **FadeDepth**

When set to a positive value, this option gives the distance at which to begin reducing outline width based on distance from the camera.

### **MinInkWidth**

When fade with distance is enabled, this parameter gives the minimum outline width.

See Also:

[Air Outline](#) page

Air User Manual: Toon Rendering and Illustration

## 15.13 AirRender command

The AirRender command can be used to export a scene and start a rendering process.

The AirRender command accepts the same options as the [AirOptions](#) command. Any options that are changed affect only this invocation of the command; the global state of each option is not affected.

The rendering process will use the number rendering threads set with the Threads option. The process will execute at low priority if the LowPriority option is set to Yes, allowing other processes to execute without being slowed down by the rendering.

## 15.14 AirResetSettings command

Use this command to reset all global Air settings to their default values.



## 15.15 AirSaveSettings command

This command requests a file name and then saves all global RhinoAir settings to an Air Rhino Settings file.

## 15.16 AirTrace command

Use the AirTrace command to set global parameters for ray-traced reflections.

**TraceBias** (default 0.01)

Small distance used to prevent incorrect self-intersection during ray-tracing. The bias setting affects ray-traced shadows and reflections.

**TraceDepth** (default = 4)

Maximum number of "bounces" to trace reflected rays. A trace depth of 0 will disable ray-traced reflections.

**BgMode** (Transparent Color Environment)

This section determines the color returned by reflection rays that miss all objects in the scene. There are 3 basic modes:

Transparent

Reflection rays that miss all objects simply return a black color.

Color

Reflection rays that fail to intersect an object return the specified color scaled by the **Intensity** value.

Map

The provided environment map is used to select a color for reflection rays based on the ray direction. The **Intensity** value gives a multiplier for the environment map result. The **Blur** parameter can be used to add blurriness to the result to soften the look or smooth the appearance of a low-resolution map. The **Rotate** value gives an angle in degrees to rotate the map about the Z (up) axis.

**BgColor** (default white)

Background color returned by rays that miss all objects in the scene.

**BgColorIntensity** (default = 0.2)

Multiplier for the reflected background color.

**BgMapIntensity** (default 1.0)

Multiplier for the reflected color in Environment background mode.

**BgMapBlur** (default 0.0)

Blur angle in radians for environment map query in Environment background mode.

**BgMapRotateZ** (default 0.0)

Rotation angle in degrees about the Z axis for orientation of the background environment map.

### **BgMap**

File name of the environment map to use in background mode Environment.

See Also:

[Air Trace page](#)

## **15.17 AirVersionIncrement command**

This command simply increments the RhinoAir internal version counter used when the **Append version** option on the Air Plugin page is enabled.

This command is primarily useful for scripting. It is used by the RhinoAir scripts for exporting and rendering Bongo animation.

## **16 FAQ - Frequently Asked Questions**

### **1. How do I specify a custom image size?**

On the [Air Main](#) page, you can type a custom width and height into the Image Size text box. For example, typing

```
1000 750
```

would specify an image 1000 pixels wide and 750 pixels high.

### **2. How can I keep the Air Show window in front of the Rhino window?**

Enable the Always on Top option in the Air Show Options menu.

### **3. How can I stop a rendering in progress?**

If you are rendering to the Air Show display program, click on the close button in the Air Show toolbar (not the close button for the window) to close the image being rendered and stop the rendering process. Newer versions of Air Show also have a stop button for halting a rendering without closing the partially rendered image.

If you are rendering to an image file, closing the console window will stop the rendering process.

### **4. I've increased the number of shading samples, but some blurry reflections or shadows are still too "noisy". How can I produce smoother reflections or shadows?**

The best way to smooth noisy reflections is to increase the number of reflection rays in the surface shader on the Air Material page. Look for the Rays parameter under Reflection.

To smooth noisy shadows, increase the number of shadow rays for the light on the Air Light page.

Increasing the number of reflection or shadow rays will render in less time and produce better results than increasing the number of shading samples. See the [Image Quality](#) section for additional advice on efficiently producing high-quality images.

**5. When I choose a new surface shader for a material, the new surface applies to all objects on the layer of the selected object, not just the selected object. How can I change the material for just the selected object?**

Air material properties are attached to the Rhino material assigned to an object. By default new objects in Rhino have a material assigned by layer. To change the method of material assignment, go to the Rhino Material page for the object and select the desired method in the *Assign by* section. Choose *Assign by Basic* to create a unique material for an object.

The New button on the [Air Material](#) page will create a new basic material for each selected object.

The buttons in the Air Material toolbar also create a new material for selected objects.

**6. How do I add ambient light to a scene?**

One of the global illumination options on the [Air Gi](#) page is a simple ambient light.