# IMAGE RENDERING

This training session is focusing on the basics of Image Rendering in IRONCAD.

## Content

Tutorial videos:

During Day 4 there's a section where we are looking at the Image Rendering tools and settings of IRONCAD.

Image Rendering 1/2:

https://www.youtube.com/watch?v=RkFEetMi1Gw&list=PL-Q_fTQONlcMG9bkEkReFGAvuTLeWd1hD&index=7

Image Rendering 2/2:

https://www.youtube.com/watch?v=aybLcdPi6EY&index=6&list=PL-Q_fTQONlcMG9bkEkReFGAvuTLeWd1hD

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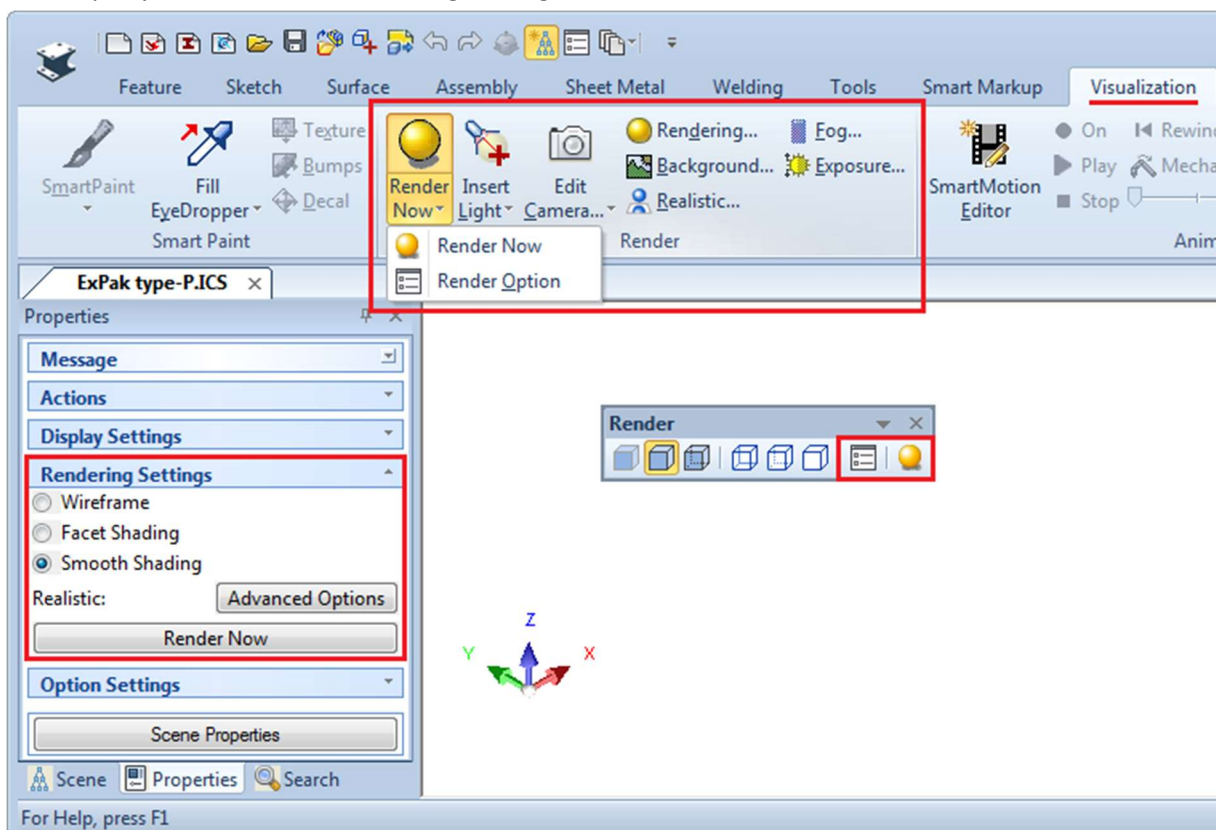
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## Image Rendering Basics

IRONCAD has an advanced built in image rendering engine. The image output is created in a separate CPU thread and in its own window. This means that you can keep on working in the 3D scene during the time it takes to render the image. The advanced rendering engine has a vast number of settings and possibilities, which can be tricky to understand if you do not have the basic understanding of how an image is rendered using a software. The tools used in IRONCAD are based on an open source code and follows the general standards for image rendering. We are going to look at some of the basic settings here which will get you started. The default background and light settings of a standard 3D scene aren't very useful to start with and needs several adjustments.

When you render images with a software it is important to know that the two largest factors affecting the image are light and material, where light is the most important one. It affects colors, shading, reflections and the refraction for each object in the scene.

The advanced rendering engine in IRONCAD uses *Global Illumination*, GI. With GI, you don't have to work with the light source and strength in the scene in a way where you place several lamps in various positions to get light, but you can of course add lamps as well. The principal is quite simple. Imagine an object on a table outdoors. Even without any lamps you're able to see the objects thanks to the natural light – which is the kind of light that GI simulates. Pure GI light is like a big sphere which emits the light from all directions towards the center. As a user, it is quite simple to set up the natural light, but the GI light can also be quite computing-intensive which means that the image can take a long time to render. You also need to learn how to use GI in a useful way. This document will only touch some of the basic settings of all the rendering settings available. But you will be able to create an image using the GI settings.

The rendering tools are found under the *Visualization* ribbon bar and the *Render* toolbar. You also see the options in the *Property Browser* in the *Rendering Settings* frame.



Material

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In addition to light, the material is very important to get a realistic effect and feeling of the objects. The easiest way to apply a material is to drop it from a catalog. IRONCAD contains several catalogs with materials, but most of them aren't open by default. These four catalogs below contain many of the most common materials and give a realistic effect on the objects. You can open them from the default \\*Scene* folder, when opening a catalog.
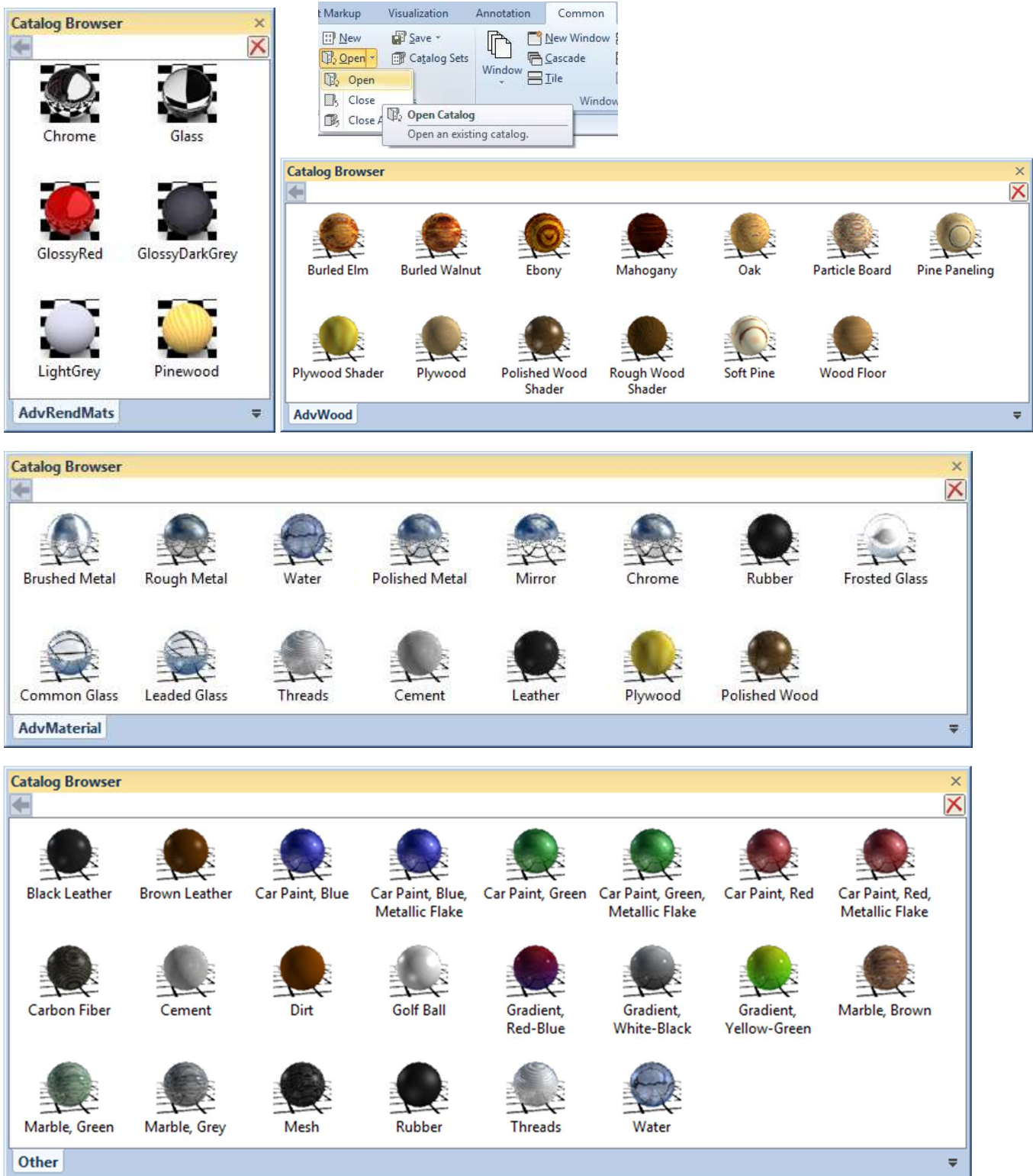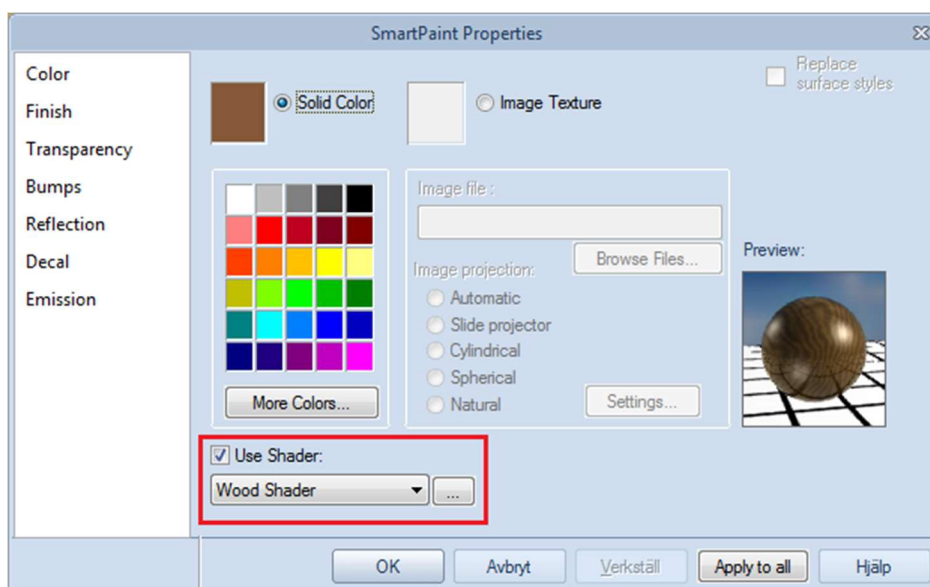
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## Smart Paint settings

When a material is applied on a part or assembly the settings can be found under the *Smart Paint Settings* of those objects. Some of the settings are also visible in the Property Browser for selected parts.
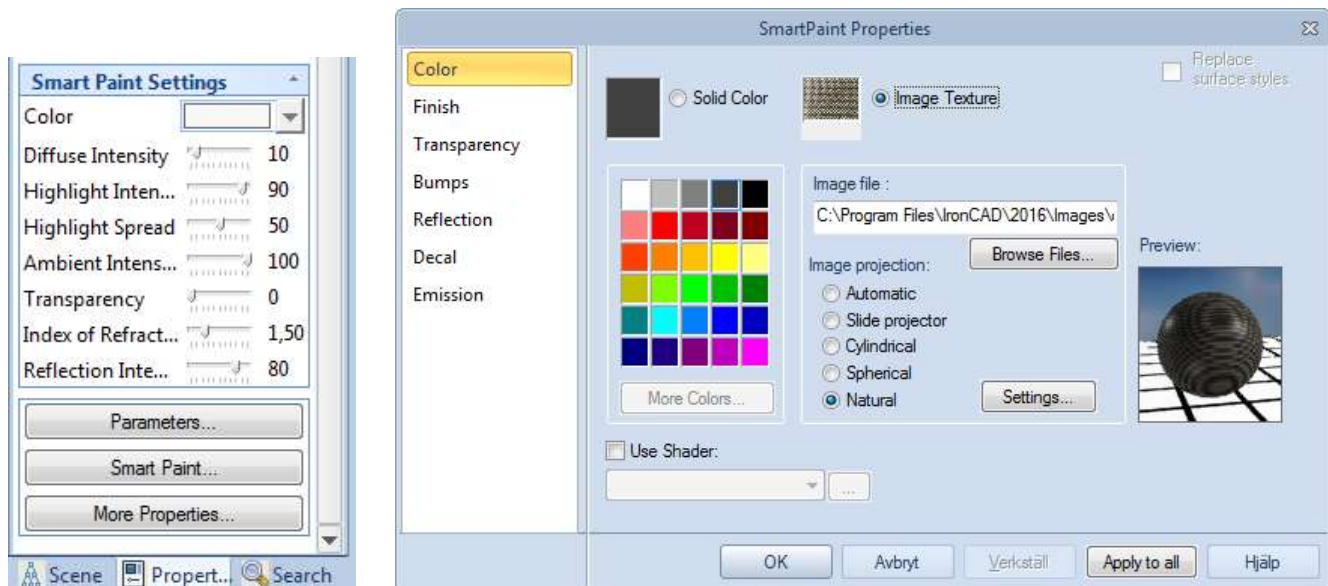


Under the *Color* properties the color of the part is controlled, which is also reached under the Property Browser of a selected part or face (green selection color). You can choose another color than the palette is showing by selecting *More Colors…* Instead of a color it is possible to use an image as a texture around the part or on a face. The image projection settings controls how the image is applied over the model, which differs on plane faces compared with cylindrical or spherical faces. The option *Natural* is often useful on most medium sized parts where the image source is in a feasible size. Tiled images (search for "tiled texture" using google for example) will help you avoid "stitches" between the areas where the image is re-used again, if it isn't large enough to cover the whole part or face directly.



Instead of a color or image texture, which is directly visible in the 3D scene, it is possible to use a *Shader*.

The effect of a *Shader* is only shown after the image has been rendered. Instead of figuring out how the *Shader* should be set up you should edit an existing material that is using a *Shader*, which are plentiful in the catalogs from last page.

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The *Shader* settings are quite extensive and needs to be explained by itself (internet has more information). But it is quite easy to change the settings and see what happens. If it stops working or you can't reset, just drag the original material with the *Shader* out from the catalog again.
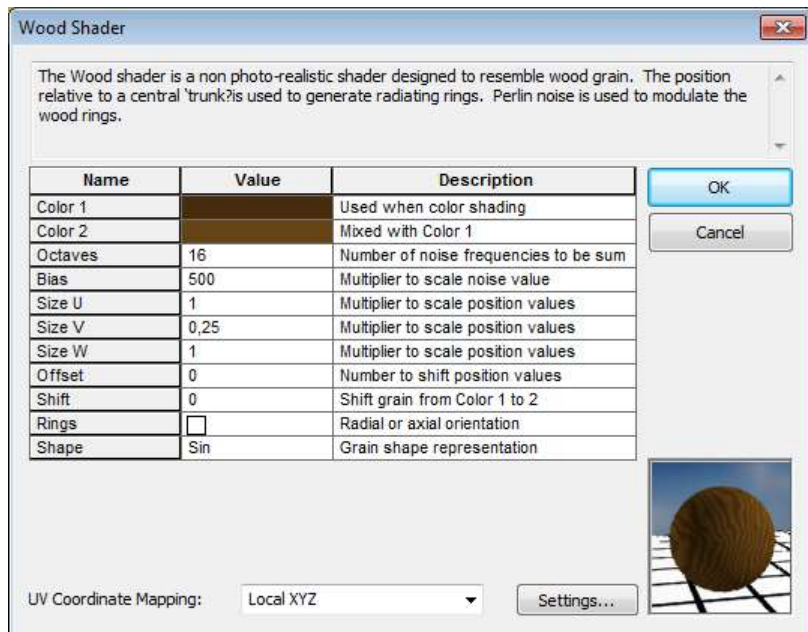


Under the *Finish* settings under the *Smart Paint Properties* the light effect of the surface of the part and face is controlled. By looking at the preview on the right side you will be able to see how the change will affect the appearance of the *Smart Paint Settings*.
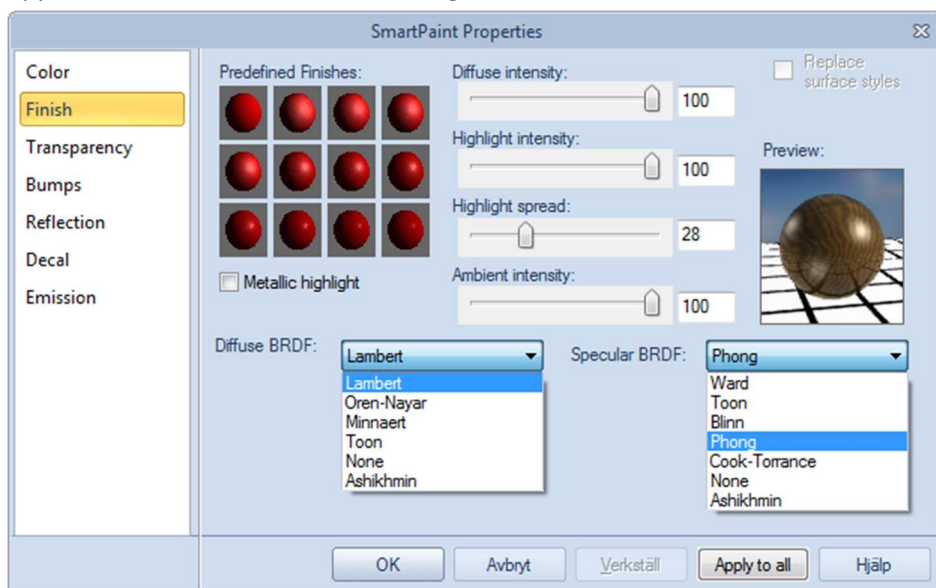


In addition to the basic surface finish there are *BRDF* settings (*Bidirectional Reflectance Distribution Function*), which is also an extensive story by its own (internet has more information), but it creates an even more realistic look and feel to the surface.

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## Advanced Rendering Options

Under the *Render Options* for the rendering engine you will find all settings connected to how the image is built up and how to make use of the light in the scene.

If you are using the Toolbar UI, make sure to show the *Render* toolbar. The yellow sphere icon to the right is the *Render Now* tool, which starts a new image rendering. The white button to the left of that is the *Render Options*.

The *Render Options* are also hidden under the *Render Now* button in the Ribbon Bar UI.

### Image

The first tab in the property window controls the image size and the fill pattern, which is how the image should be emerging in its rendering window and the size of the blocks, as seen on the image on the right.
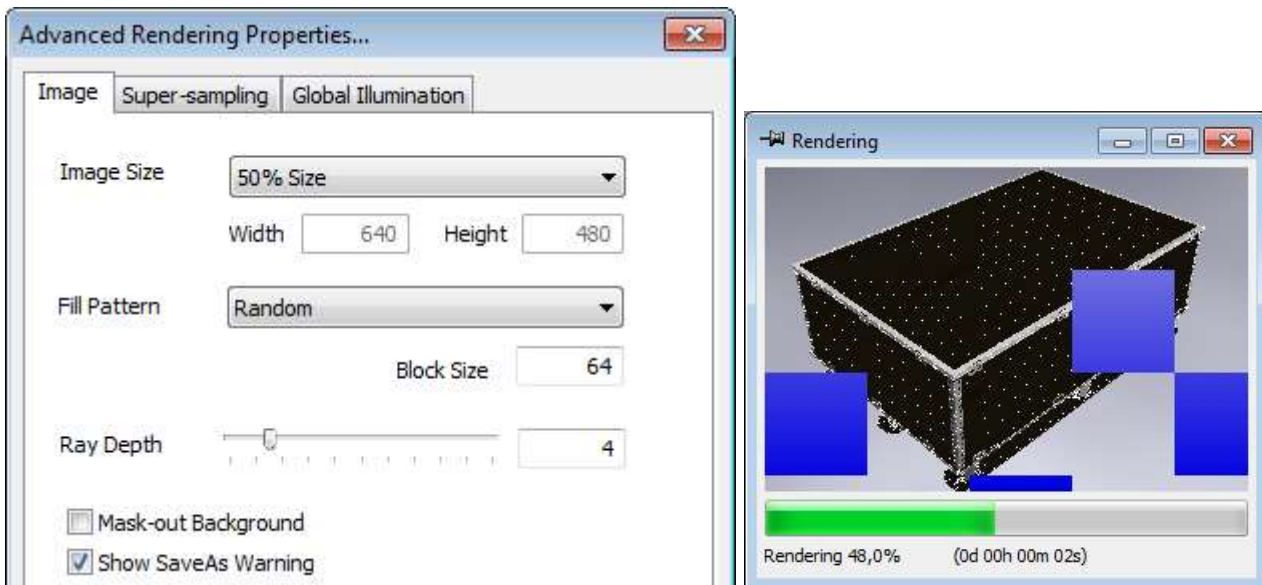
The *Ray Depth* controls how many times a ray of light bounces off or through a surface. This value (4) shouldn't have to be changed, unless there are many transparent objects in the scene and the transparency isn't working properly in the rendered images.

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A new "Blue" 3D scene template isn't optimal for image rendering. It needs to be tweaked quite much in order to get better results. First we need to remove the background image and user either a single color or an HDR (*High Dynamic Range*) image. It is easier to start with a white single color and then change to an HDR later on. Instead of tweaking a template, there are some pre-made rendering templates to try instead. Copy or Insert the model and do the rendering using that template instead. It will save quite lot of time, but it is still good to know how to control these default settings.



The camera perspective should also be worked with, to get a more "realistic feeling" of the object. Use the *Dolly Camera* tool to physically move the camera closer to the object, then zoom out. Do this 2-3 times and you'll get a better depth for the image. You see the difference one these two images:



Then we need to change the light of the scene. Instead of the *Directional Lights* that are in the scene we should turn them off and use *Global Illumination* instead. If we render an image without any light, we'll get the dark effect shown on the image on the left since there is no light in the scene, which isn't very useful of course. After a white *Colored Illumination* setting has been used we get the brighter image on the right side that has smoother shadows than the first images where the *Directional Lights* were used.

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The background can use an HDR image instead of the single (white) color. The effect on the rendering can be quite dramatic. But it can also create new graphical effects which needs to be handled with the available settings. Here the knowledge step jumps higher than before and it is not as easy to try-and-error your way to a good looking image. Depending on the material the effect of the HDR background is more or less visible. It is also important to know that some textures and shaders, such as wood or rubber materials, won't show much as much reflection of the background as metal and bright plastic materials does. Due to that materials such as wood and rubber will be a bit harder to work with.

On the four images below four different HDR images in the background have been used and the GI has been set to *Full Illumination*, but with different GI light power, resulting in different background lighting affecting both the surface brightness and some shadow effects.

Cloudy HDR, Power 1.0



Kitchen HDR, Power 0,6
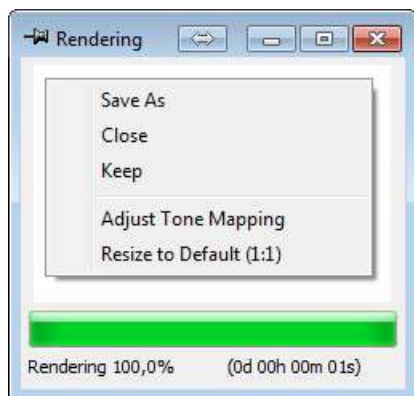


Room HDR, Power 2.0



Silver HDR, Power 1.0



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## Save Rendering as an Image File

Right click in the background of the rendered image to save it.

The option *Keep* will keep the image rendering window when a new rendering is started, which is a good way to compare the changes you've made to the settings. It is also possible to click on the needle symbol at the top left corner to keep the window.

If you have changed the size of the window it can always be restored with the *Resize to Default (1:1)* option.

Using the *Alpha Mask* setting before saving, found under the *Options…* button, will remove the actual background from the image. This is useful when the image is being used in brochures or documents where it should "float" over text blocks or other images, as shown on the ExPak image below.

*Alpha Mask* is not supported by the JPEG file format, a format which will also compress the image and distort the quality (controlled under the *Options…*) due to the compression. It              is recommended to use the PNG file format (which is a "loss-less" file format without any                              compression issues) or the TIF file format, to keep the quality and to use the                          *Alpha Mask* setting.
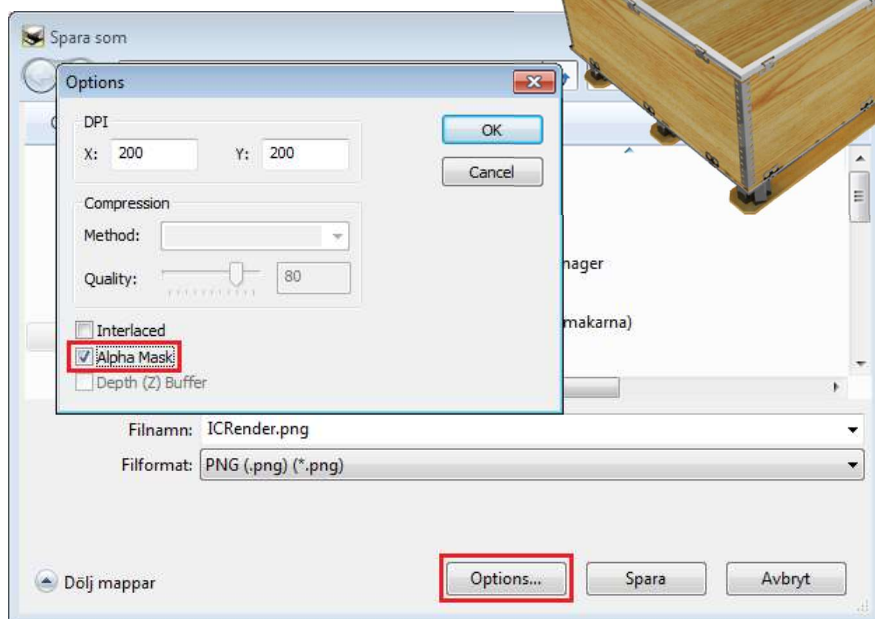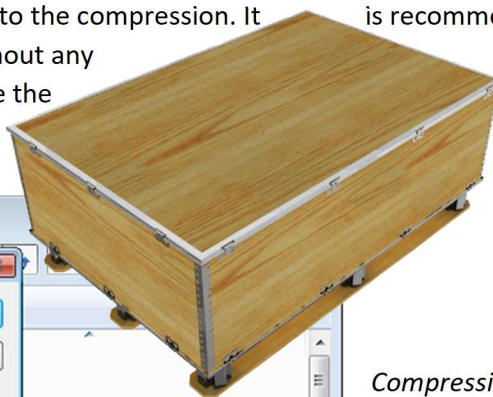
*Compression Method* and *Quality* settings for the JPEG file format:

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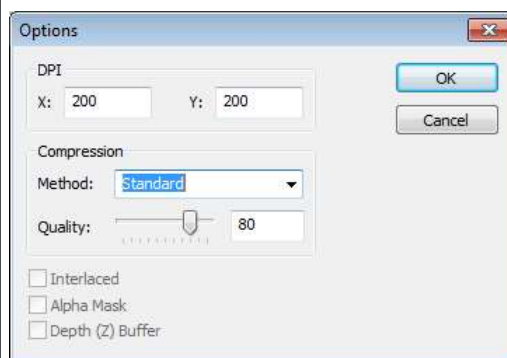
## Rendering Tips and Tricks

The IronCAD support has gathered some useful tips and tricks on the IronCAD Community, which I have copied and listed here below. The list explains some of the tools and settings.

Here's a rundown of all the major items that impact rendering performance, very often you can scale back some of these items and gain rendering performance (finish rendering faster!) without sacrificing much quality.

Image size-> will increase time for the obvious reason that there are more pixels. Remember that the number of pixels goes up by Width*Height, so it can go up very quickly.

Antialiasing (Super Sampling)-> this can slow things down because it is rendering the same pixel multiple times with slight changes in the ray used. This is much like rendering a larger image, then shrinking it down to the desired size.

Ray depth & Caustic Depth-> this makes rays bounce around more, increasing render times, but only if the scene conditions are right.

Global Illumination-> this is a generally more expensive way to calculate lighting than traditional direct lighting. But if you do want to include GI, keep quality as low as possible, always use the irradiance cache, and keep the cache precision as high as possible (more pixels per sample). Avoid Full-GI unless radiosity and caustics are desired.

Shaders are slower than simple colors and values. The noise shaders are generally the slowest. Image shaders can also be slow.

Reflection and refraction make the scene much more expensive to render.

Reflection blur requires multiple reflection rays to be fired, further slowing down reflection calculations.

Emission is similar to placing small area lights across the materials surface. The number of samples determines how many of these lights are used. This complicated lighting will slow things down greatly based on the number of samples. Zero samples will just change the material appearance and not create any area lights.

Area lights require multiple samples per light, much like adding multiple lights distributed across the rectangle. The degree of slowdown is related to the sample count.

Soft ray traced shadow require multiple samples per light slowing down rendering, much like adding multiple lights slightly perturbed. The degree of slowdown is related to the sample count.

Spotlight volume lighting is expensive and can be slow with a high resolution.

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## Ray Depth example

Here is another tips and tricks from the IronCAD Community, focused on transparency issues.

If you are missing everything behind the transparent surface this may mean it is a "ray depth" problem.

The ray depth tells the renderer how many things a ray is allowed to hit before it is considered "done". Hits can be propagated from reflections or refractions. This limit is needed to speed things up and also to prevent an infinite loop in the case of two parallel mirrors (mirror A can see mirror B looking back at mirror A etc...)

If the ray depth is too low the ray will act as if it is done (has hit the background) prematurely. This results in seeing the background where some other geometry would be expected. The default of 4 is ok for very simple scenes, but if there are multiple layers of transparency then you must raise the value manually.

For example, looking at a cylinder through a single pane window rendered as 2 sided, a value of 3 is ok (enter glass + exit glass + hit the cylinder). Looking through a double pane window, a value of 5 is needed. Looking through a stack of 2 double pane windows, a value of 9 is needed. etc...
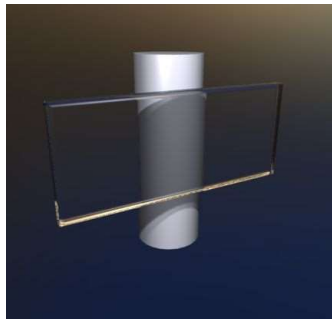
You don't need to understand exactly what value is required. You just need to know to raise the ray depth value if you see this issue. Try raising the ray depth value to something like 10, it is located on the Image tab of the Advanced Rendering Properties dialog.

Here is the single pane and the double pane example:
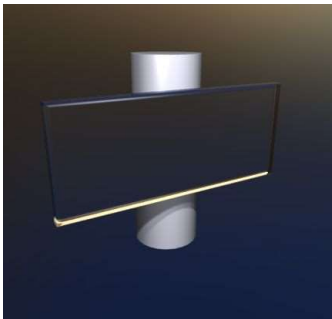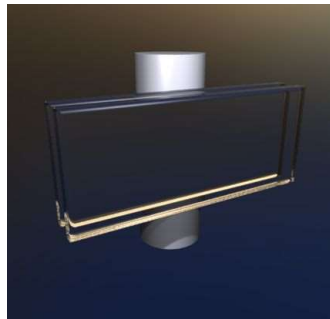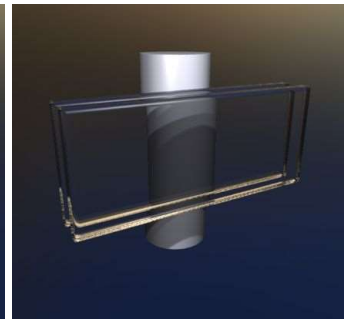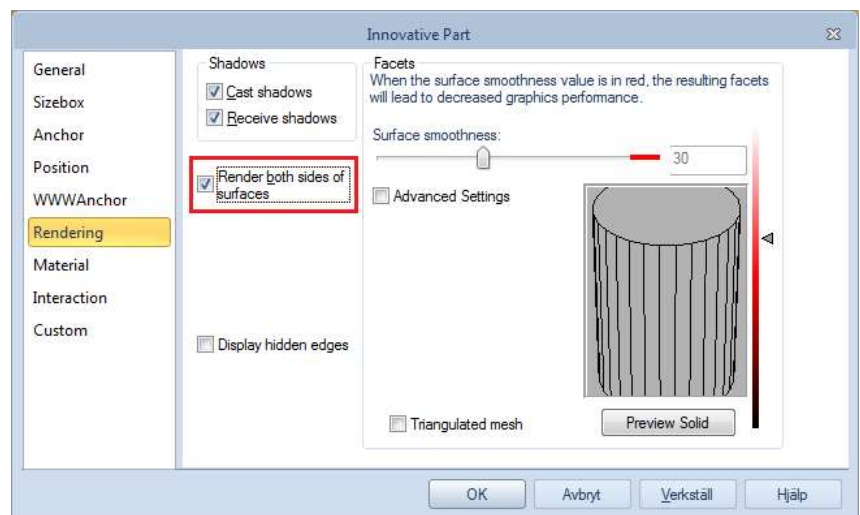
Ray Depth = 2           Ray Depth = 4           Ray Depth = 4           Ray Depth = 6



Always double check to make sure you have *Render `both sides of surfaces* checked on the *Part Properties*, *Rendering* dialog for transparent parts.

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## KeyShot

IRONCAD has a connection to the KeyShot standalone rendering software and the model in the 3D scene is transferred to KeyShot through a simple click of a button.
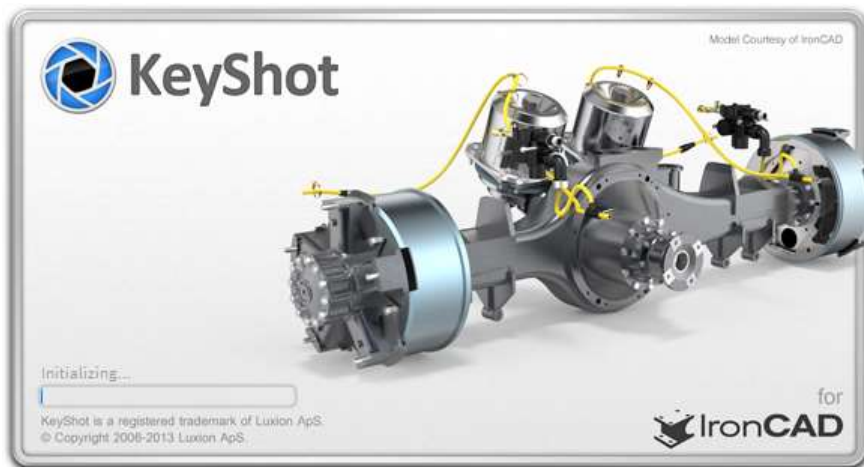


Textures and colors are transferred but are usually replaced by using any of the materials available in the vast library of materials and background HDR images. Linked objects are kept as links in KeyShot, making it easier to change materials.

The rendered image is constantly progressing in the view port, making you see every change almost instantly.

KeyShot can be bought as an add-on to IRONCAD. There are also extra add-ons for animation or VR (online 360° full rendered image) functions.



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