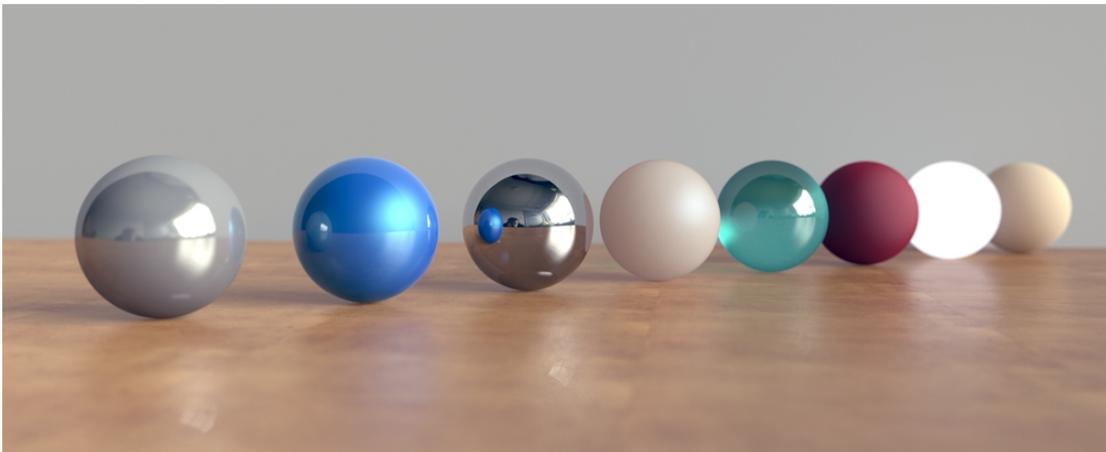


# Standard

⚠ This shader is considered deprecated and will be removed in a future release. You should use the *Standard Surface* shader instead.

Due to the large number of controls, the Standard shader is split up into several groups. The individual settings for each group are described in more detail in the pages below.

- Standard :: Diffuse
- Standard :: Specular
- Standard :: Reflection
- Standard :: Refraction
- Standard :: Emission
- Standard :: SSS
- Standard :: AOVs



The Standard shader is a multi-purpose shader capable of producing all types of materials, from simple plastic, to car paint or skin, with effects like sub-surface scattering or transmittance.

The Standard shader is very powerful, and allows a large number of different sorts of materials to be created, but can be somewhat daunting at first. It's often best to start with a material which has been pre-defined using the Standard shader and make incremental changes to it to get the effect you want, rather than starting from scratch. The Arnold Tutorial manual contains a section of preset material values, with common materials like car paints, chrome, glossy and matte plastic, and others.

## Physically Correct Shading

Artists need to create materials that not only 'look good', but are more physically plausible and pay more attention to the physical laws of energy conservation. That is not to say these are hard and fast rules. The key to achieving a believable material is still observation, and being able to convincingly translate what you see into the final shader. However, adhering to these simple rules will give more consistently realistic and believable lighting and shading because a physically based shading model reacts much more like real world lighting.

## Energy Conservation

A surface should not return more energy than is being contributed by the incoming light, otherwise the material will no longer be physically accurate. When such overly bright materials bounce too much light it can also lead to 'firefiles'. When light hits an object, the energy is reflected as either the specular (highlight) or diffuse (color) component. The relationship between specular and diffuse is what defines what type of material it is. If 50% of it is diffuse energy then the remaining specular energy must be 50%. If the specularity value increases, then the diffuse value must drop and vice versa. For example, chalk has a high diffuse value, with little specularity, whereas glass is highly reflective with almost no diffuse. To achieve a photo-realistic render, the net value of the shaders attributes should not exceed 1. The total energy of reflected light is less than or equal to the energy of the incident light. You should use energy conserving BRDFs and take care to enforce these energy conservation rules when creating materials with the Standard shader.

**i** The term albedo, or reflection coefficient, refers to the diffuse reflectivity or reflecting power of a surface. Albedos (Kd, Ks, Kr, etc.) summing to values above 1 is a bad idea. This means that the Standard shader will not conserve energy, but will instead gain energy with every GI Diffuse bounce. They should not sum above 1 EXCEPT if you are using a Fresnel value that affects both Specular and Diffuse because when set to affect Specular and Diffuse, it scales the Specular effect by a value between 0 and 1 that depends on the viewing angle.

For energy conservation with Diffuse and SSS, you must have **Diffuse + SSS  $\leq$  1**

With Specular, it depends on whether or not Fresnel is enabled:

- If Fresnel is disabled, then you must have **SSS + Specular + Diffuse  $\leq$  1**
- If Fresnel is enabled, then you must only have **Diffuse + SSS  $\leq$  1**. The shader will mix specular with diffuse and SSS in a way that is energy conserving.

Ok, that is the simple case (without diffuse backlighting and refraction). Now let us add diffuse backlighting and refraction:

For energy conservation with diffuse and SSS, you must have **Diffuse + SSS + Backlighting  $\leq$  1**

With Specular, it depends on whether or not Fresnel is enabled:

- If Fresnel is disabled, then you must have **Specular + (SSS + Diffuse + Backlighting)  $\leq$  1**
- If Fresnel is enabled, then you must only have **Diffuse + SSS + Backlighting  $\leq$  1**. The specular and refraction weights can be anywhere between 0 and 1, and the shader will mix everything in a way that is energy conserving.

The example below shows the difference when rendering using physically correct values (left) compared to a shader that uses physically incorrect values above 1 (right image). The light leaving the surface is brighter than the light which originally fell upon it). No material bounces back light at 100%, except for a perfect spotless mirror.

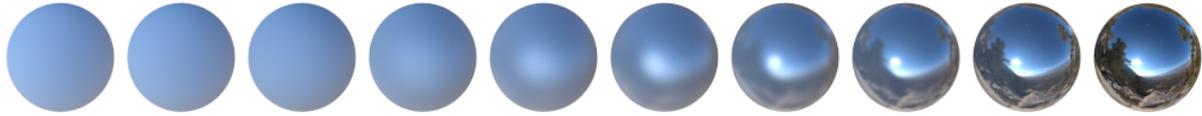


**Diffuse Weight: 0.7, Specular Weight: 0.3 (totalling 1 is correct)**



**Diffuse Weight: 0.7, Specular Weight: 1 (totals above 1. Specular highlight appears blown out)**

A Standard shader with a high Diffuse Roughness will reflect dimmer and broader highlights, while smoother and more reflective materials will reflect brighter and tighter highlights.



Diffuse and rough (left) to reflective and glossy (right).

## Specularity vs Reflection

It is generally recommended that you use Specular to control glossy specular reflections. The specular\_roughness parameter of the Standard shader affects the blurriness of the specular reflections. In Arnold, this is called "glossy reflections", or also "specular reflections".

The Standard shader has a secondary layer of reflection, called simply "reflection", which is perfectly sharp and mirror-like. It is only there for perfect mirrors or glass. Not for blurry effects. If you want blurry reflections only you should use Specular. The images below show specular reflections coming from a light source and mirror reflections coming from light reflecting off the surroundings.

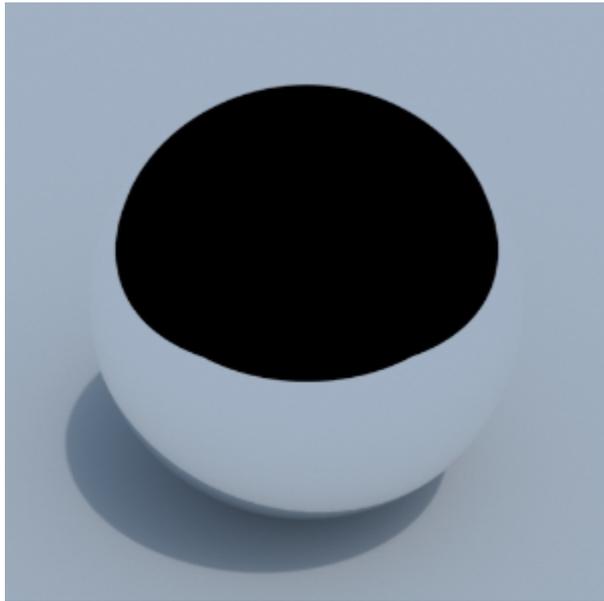


Specular only

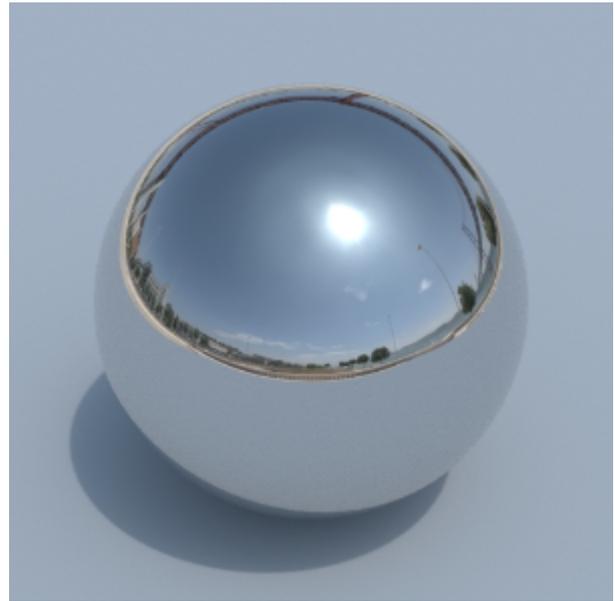


Reflection only

The SkyDome light will also not appear in **reflections** of the Standard shader. It is recommended to use Specular in combination with the SkyDome light. If you want reflections to appear then you should use the Sky shader with 'Visible in Reflections' enabled.



**Specular 0. Reflection 1. Floor plane is reflected.**



**Specular 1. Reflection 0 (Skydome light is also visible in Specular reflection).**



Further information about physically based rendering in Arnold can be found [here](#).