AWE Surface 1.0 Documentation

AWE Surface is a new, robust, highly optimized, physically plausible shader for DAZ Studio and 3Delight employing physically based rendering (PBR) metalness / roughness workflow. Using a primarily uber shader approach, it can be used to render materials such as dielectrics, glass and metal.

Features Highlight

- Physically based BRDF (Oren Nayar for diffuse, Cook Torrance, Ashikhmin Shirley and GGX for specular).
- Micro facet energy loss compensation for the diffuse and transmission lobe.
- Transmission with Beer-Lambert based absorption.
- BRDF based importance sampling. Multiple importance sampling (MIS) with 3delight's path traced area light shaders such as the aweAreaPT shader.
- Explicit Russian Roulette for next event estimation and path termination.
- Raytraced subsurface scattering with forward/backward scattering via Henyey Greenstein phase function.
- Physically based Fresnel for both dielectric and metal materials. Unified index of refraction value for both reflection and transmission with dielectrics. An artist friendly metallic Fresnel based on Ole Gulbrandsen model using reflection color and edge tint to derive complex IOR.
- Physically based thin film interference (iridescence).
- Shader based, global illumination.
- Luminance based, Reinhard tone mapping with exposure, temperature and saturation controls.
- Toggle switches for each lobe.
- Diffuse Oren Nayar based translucency with support for bleed through shadows. Can use separate front/back side diffuse color and texture.
- Two specular/reflection lobes for the base, one specular/reflection lobe for coat.
- Anisotropic specular and reflection (only with Ashikhmin Shirley and GGX BRDF), with map-controllable direction.
- Glossy Fresnel with explicit roughness values, one for the base and one for the coat layer.
- Optimized opacity handling with user controllable thresholds.
- Imports most settings and values when converting materials from dsDefaultMaterial, HumanSurface Shader, UberSurface and UberSurface 2.

Overview

The AWE Surface shader will render material consisting of a base layer and a toggleable coat layer. By default, the material is set to dielectric. To render metal, simply change Metalness to 1. For glass, change Transmission to 1. Metalness takes precedence over Transmission when both are enabled. Both parameters accept texture masks for blending between material types.

Unified Mode

For those who prefer a unified approach, Use Base Values allows most relevant base layer properties to be controlled with two controls – Base Color and Base Roughness. As per PBR conventions, in this mode both metal and transmission color will use Base Color and any texture inserted in this slot. Likewise, diffuse, specular/reflections and transmission roughness will use Base Roughness as input.

Reflectivity level of each layer can be adjusted via each layer's Index of Refraction (IOR) settings, though this only applicable to dielectric parts of the base. This is set to 1.5 by default, which is common for glass and most dielectrics. Base Reflectivity can be used to additionally control the specular/reflection of the base layer. This is basically the specular/reflection strength inputs in Classic mode.

Classic Mode

For those who want more control, you can fine tune each section to get the material you desire. To do this, simply disable Use Base Values. This mode allows for robust flexibility in fine tuning the base layer to get various outcome. You can have fully reflective or glossy specular reflections, but keep a rough diffuse or transmission. Vice versa, you can get fully smooth diffuse or transmission and rougher, less glossy specular highlights and reflection.

In this mode, metal Fresnel will be calculated from reflection color and edge tint. The resulting render will be pure metal and does not take into account Base Color or Diffuse Color. To override this, simply toggle Use Diffuse Textures so the shader takes into account the diffuse color and texture used. You can adjust the strength of the inlfuence by adjusting Diffuse Texture Strength until you get the look you want. This setting has a similar effect when Use Base Values is enabled, but uses the Base Color and texture.

Base Layer

In addition to Base Color, Base Roughness, Transmission and Metalness settings, you'll find some extra options in this section. First and foremost is the IOR for the base layer. There's also a base Thinfilm option if you prefer to enable iridescence without enabling the coat layer. Simply toggle Base Thinfilm and the base will render an iridescent look. Use Base Thinfilm Thickness and Thinfilm IOR to control the result.

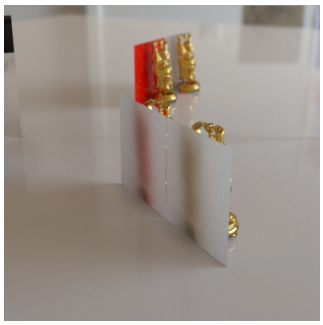
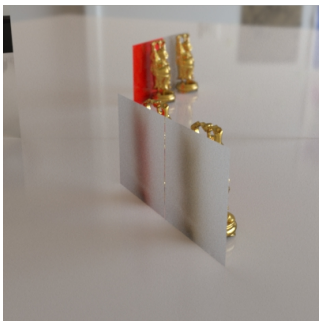
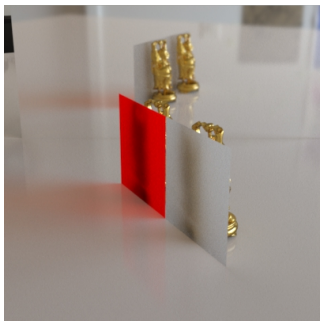
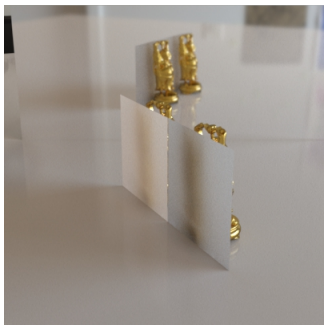
			
Base - No Thinfilm	Thinfilm Thickness 0%	Thinfilm Thickness 33%	Thinfilm Thickness 66%

Thinfilm thickness is implemented as a percentage of the value between 250 and 400 nm. For example, a 300 nm thin film would be 33% (250 nm + (50 / (400 – 250)).

Diffuse (enabled by default)

Diffuse is Oren Nayar BRDF based, with a roughness parameter from 0 (zero) to 1 (one). A roughness of 0 (zero) will give pure Lambert diffuse.

The diffuse lobe supports translucency and double sided shading and you can even use separate color and texture for each side. Translucency mimics the behavior of thin materials. Double side shading will work with translucency, enabling translucency when viewed from both front and back.

			
Base translucency	With shadows	Separate front/back shading	With Use Face Forward enabled

Translucency Shadow is an artistic feature that will cast colored shadows. You can adjust the intensity with near zero closer to standard shadows and 100% will be fully translucent, colored shadows.

Double sided shading is active only when Use Face Forward is enabled.

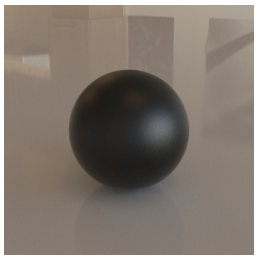
Please note that the default setting for translucency is set to 0 (zero). In contrast, omnifreaker shaders uses 100%. AWE Surface will retain the value set by HSS, Ubersurface and UberSurface2 when importing settings from those shaders.

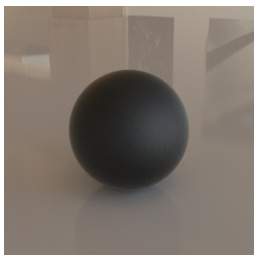
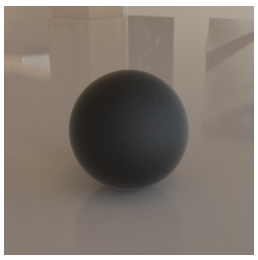
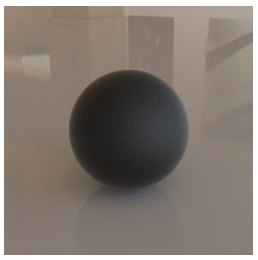
Specular (enabled by default)

By default, the specular BRDF is set to Ashikhmin Shirley. The chosen BRDF will be used for rendering both base specular and reflection lobes. For models without UVs, Cook Torrance is recommended since it lacks anisotropy support that can lead to artifacts. These two BRDFs have been adjusted so their roughness ramps closer to GGX. Classic Ashikhmin Shirley and Cook Torrance are unmodified version of the BRDFs.

GGX BRDF will exhibit higher peaks and longer specular tails (covers more area), but it does incur a performance hit when reflections are enabled.

Roughness have a value between 0 and 1, with increasing values rendering increasingly rougher highlights.

			
Roughness 0%	Roughness 1%	Roughness 3%	Roughness 10%

			
Roughness 30%	Roughness 50%	Roughness 100%	Roughness (mask)

As noted before, both specular and reflection is affected by Fresnel, controllable via the base IOR for dielectric materials and reflection color and edge tint for metals.

				
IOR 1.33	IOR 1.5	IOR 1.8	IOR 2.0	IOR 4

Both specular lobe supports specular direct lighting and raytraced reflections. Each lobe have separate control settings so they can be controlled separately. This arrangement allows you to mix and match between the two ie have a separate specular lobe and reflection lobe or enable them both, using different roughness for each.

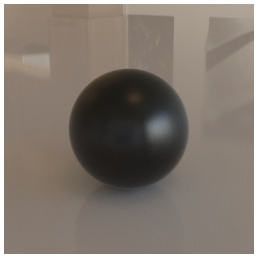
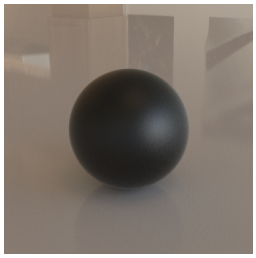
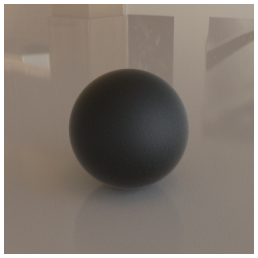
As the name implies, anisotropy controls the anisotropy of each lobe. The anisotropy direction uses a color value to control the angle/direction. Of the three channels, only the first (red) and second (green) channel is used. The default values (128, 0, 255) gives a horizontal angle while using mid cyan (0, 128, 255) gives a vertical angle. Roughness must be higher than 0 (zero) to render anisotropy.

				
Roughness 3%/ Anisotropy 25%	Roughness 3%/ Anisotropy 25%	Roughness 3%/ Anisotropy 50%	Roughness 3%/ Anisotropy 75%	Roughness 3%/ Anisotropy 100%

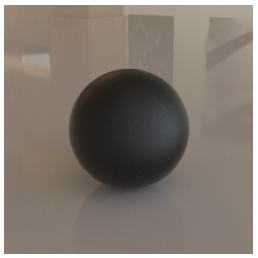
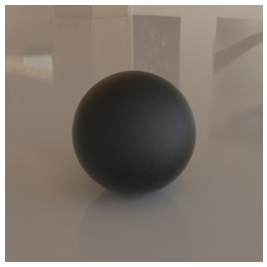
				
Roughness 3%/ Anisotropy 75% (128,0,255)	Roughness 3%/ Anisotropy 75% (0,0,255)	Roughness 3%/ Anisotropy 75% (0,128,255)	Roughness 3%/ Anisotropy 75% (128,0,255) with map	Roughness 3%/ Anisotropy 75% (0,128,255) with map

Anisotropy direction accepts maps as input, allowing you to control the direction with texture masks.

Glossy Fresnel allows you to vary roughness near grazing angles. Unique to AWE Surface, this is implemented so you can explicitly enter the desired roughness value, allowing you to select between a more glossy/lower roughness or a higher one.

			
Roughness 3%/0%	Roughness 3%/50%	Roughness 10%/50%	Roughness 30%/50%

Here's an example : with high roughness as the main value, you can use glossy Fresnel to directly control the amount of reflection at grazing angles.

			
Roughness 50%/0%	Roughness 5%/1%	Roughness 50%/30%	Roughness 50%/10%

Glossy Fresnel also affects anisotropy.

	
Roughness 2.5%/ Anisotropy 100%	Roughness 2.5%/ Anisotropy 100%, Roughness at Grazing Angle 0%

By default, the 2nd specular / reflection lobe is enabled while the 1st one is disabled. Glossy Fresnel is also disabled by default for the base layer.

Please note that specular color does not have texture inputs. This is by design and all specular masks should be placed in their respective strength inputs. It does mean texture mask in the color slots will be discarded when converting from dsDefault materials.

Transmission

Refraction is controlled with the same IOR used for the specular and reflection lobes. Both Transmission Distance and Transmission Color directly determine what is rendered. Transmission Color will not have any effect when Transmission Distance is 0. To avoid confusion, Transmission Distance is set to 0.5 by default so

when Transmission is enabled you can quickly see its effect. As expected, Transmission Distance will vary depending on the actual scale of the object and the level of absorption desired.

				
Distance 0	Distance 0.5	Distance 1	Distance 2	Distance 4

Transmission Roughness controls how blurry/cloudy the refraction will be. A value of 0 (zero), which is the default, gives a clear glass look. Increasing values produce a more frosted / rough glass appearance.

				
Roughness 1%	Roughness 10%	Roughness 30%	Roughness 50%	Roughness 100%

To render non-refracting glass, simply enable Thin Glass. The resulting material will not have refraction, but can still exhibit absorption.

				
Thin Glass	IOR 1.33	IOR 1.5	IOR 1.8	IOR 4

Transmission Shadow is another artistic feature of AWE Surface. It will produce colored shadows based off Transmission Color. This is only enabled when Use Face Forward enabled. Avoid using Use Face Forward

with models actually having thickness since it will render double refraction when transmission is enabled.

There are no toggle for transmission because it is controlled by the Transmission slider in the Base section.

SSS / Subsurface Scattering (disabled by default)

Subsurface scattering in AWE Surface solely employs 3Delight raytraced based subsurface scattering. Like many other contemporary shaders, it allows anisotropic (directional) scattering via the use of Henyey Greenstein phase function.

The subsurface scatter/absorption color and strength controls are similar to the one found in UberSurface2. AWE Surface employs this scheme so it can import values used by UberSurface2. By default, the values are set to Skin2 profile found in the Henrik Wann Jensen's paper.

			
Apple	Cream	Skim Milk	Potato

As a rule of thumb, think of scatter color as the inverse of transmission color (1 – transmission color). Subsurface direction is controllable via the Subsurface Phase slider, where 0 (zero) constitutes isotropic scattering, negative values produces more front scattering and positive values more back scattering.

		
Phase 0.9 Scale 0.35	Phase 0.9 Scale 1	Phase 0.9 Scale 1.65

Subsurface Scale determines how far subsurface ray travels below the surface.

Coat Layer (disabled by default)

The coat layer is a dielectric coat with a user defined thickness, both with a constant value or a texture mask. By default, thickness is set to 0 (zero) to simulate infinitely thin coat. With non zero values, Coat Transmission Color will be used to tint the base layer. Appropriately, Color Transmission Color have no effect when Thickness is set to 0 (zero).

				
Coat Thickness 0	Coat Thickness 0.25	Coat Thickness 0.5	Coat Thickness 1	Coat Thickness 2

The coat layer also doubles as a thin film coat. Simply toggle Coat Thinfilm to render an iridescent coat. To control the appearance, you can use Coat Thinfilm Thickness and the coat's IOR. It is recommended to use at least an IOR value of 2 (or higher than the base IOR) to see the result.

			
Coat No Thinfilm	Coat IOR 2.0 Thinfilm 33% (300 nm)	Coat IOR 2.0 Thinfilm 67% (350 nm)	Coat IOR 2.0 Thinfilm 100% (400 nm)

Controls for the coat are similar to those found in the 2nd base specular/reflection settings, with the exception of specular/reflection color and edge tint. This is not needed since the coat will always be dielectric.

Similar to the base specular, glossy Fresnel will control roughness near grazing angles. This is enabled by default.

Tiling

Tiling controls are provided, following the scheme employed by dsDefault material. Both vertical and horizontal tiling is supported, in the form of scale and offset. For flexibility, the base and coat layer can be tiled and offset independently of each other.

Tiling values from dsDefault material will be imported by AWE Surface during conversion, while values from omnifreaker shaders will not be imported. Please note that it also imports settings without limits as well.

Bump and Displacement (enabled by default)

Both bump and displacement mapping is supported. When either are enabled, they affects both base and coat. Controls are the same as dsDefault material.

Texture maps will be imported by AWE Surface during conversion. As also minimum (negative) and maximum (positive) values from dsDefaultMaterial.

Opacity Optimization

You can find this in the Opacity section of the shader. The slider controls the level of optimization used by the shader. Only applicable when a texture is used. Defaults to 90% for aggressive optimization. A value of 0 (zero) uses minimal optimization, while 100% will use very aggressive optimization.

The Opacity Filter values allows you to fine tune the threshold values for determining opacity values to be discarded or used. Generally, values below the values chosen will be regarded as fully transparent. The Opacity Filter 2 value determines the minimum amount of opacity to be used. Individual opacity masks will likely need fine tuning (discussed in detail later).

Options

Additional options are available to control more advanced features of AWE Surface. They have been categorized into these subsections – General, Specular, Transmission, Subsurface, Lighting, Masks, and Visibility.

General Options

Use Face Forward (disabled by default)

This is a toggle-able switch between enabling shading only on the front facing side or on both front and back. This should only be enabled on infinitely thin surfaces with single side normal. Enabling face forward incurs a penalty hit in render times especially with translucency and/or subsurface scattering.

Light Category

This feature allows light linking between surfaces and a single/ group of light sources. You can include or exclude certain lights from affecting certain materials. This is empty by default, making sure surfaces calculates all facing lights in the scene during rendering.
Usage Syntax (enter these values in the Light Category field without quotes)
"" (empty field, default) - Matches all lights regardless of their category.
"name" - Matches lights that belong to category ‘name’.
"-name” - matches lights that do not belong to category ‘name’, including lights that do not belong to any category.
"*" - Matches every light that belongs to at least one category.
"-" - Matches nothing.
Example: “specular&-crowd” - All lights in the "specular" category but omit ones in the "crowd" category

Trace Group & Trace Group Membership

Similar to light categories, but applied to ray tracing operations which include global illumination, reflections and refractions. To use this feature, you will need to first set Trace Group Membership on the target materials (to be included/excluded), and then use the value/name you used in the Trace Group field on materials that you want to have the effect.
Usage Syntax (enter these values in the Trace Group field without quotes)
"" (empty field, default) - Objects which don’t belong to any group.
"group1" – Only objects which belong to group1.
"group1,group2" - Only objects which belong to group1 or group2.
"+group1" - Objects which belong to group1 or which don’t belong to any group.
"-group1" - Objects which don’t belong to group1.
Example: “metal,-dielectric” - All materials in the "metal" category but omit ones in the "dielectric" category

Specular Options (applies to all lobe when enabled)

Multiply Specular & Reflection with Opacity (disabled by default)

As the name implies, this option forces specular and reflection to be multiplied with opacity values/mask. Disabling this allows you to make diffuse completely opaque or multiplied with a mask, but keep specular, reflection and refraction solid.

Specular Map to Roughness Multiplier (set to zero by default)

A convenience feature to 'try' and derive roughness values from specular maps. A factor of 0 (zero) will be the same as not enabling the feature, while higher values will take into account the specular texture when computing roughness. Increasing values generally cause less roughness.

Normalize Specular Map & Specular Map Strength (disabled by default)

Another set of convenience features to deal with very low, dark specular maps. Obviously, it will only work when a specular map is used. Normalize Specular Map will try to normalize the values in the specular map so they are closer to the reflectivity levels appropriate for the IOR used in the base and coat. Maps used on the 1st and 2nd specular/reflection lobes will use the base IOR for reference, while maps used on the coat will use the coat IOR. Specular Map Strength simply multiplies the map with the chosen value.

Trace BRDF Override (disabled by default)

When enabled, the shader will use Ashihkmin Shirley instead of GGX BRDF for all reflection lobes. Useful if you like to use GGX BSDF for specular, but want to avoid the performance hit of raytracing GGX reflections. The BRDF will also use Ashihkmin Shirley for specular from path traced area lights.Transmission Options

Transmission Scale Multiplier 1 and 2

This modifies the shader's transmission scale units. The first scale is a multiplier between 0.1 and 10. The second uses (2^multiplier) formula, ranging from -4 to 4.

SSS (Subsurface Scattering) Options

Subsurface Scale Multiplier 1 and 2

This modifies the shader's subsurface scale units. The first scale is a multiplier between 0.1 and 10. The second uses (2^multiplier) formula, ranging from -4 to 4.

Subsurface Samples and Subsurface Ray Weight

Essentially, both affect quality and performance when subsurface is enabled. Less values will be faster but more likely to have noise, while higher values will be slower and less likely to have noise. In general, ray weights have more of an impact compared to samples. For less significant materials, ray weight can be set to 12.5% with 128 samples.

Use Diffuse Texture with SSS

A convenience feature when working with SSS. When not set to 0 (zero), this setting will mix the diffuse texture (or the base texture) with subsurface scattering. This is set to 0 (zero) by default. Textures mask in the subsurface scattering color and strength slots will still be taken into account even when this is enabled.

Filtered Diffuse options

Another set of convenience feature. This basically filters diffuse texture values (but not diffuse color) below the specified color from having any subsurface scattering when Subsurface Strength in Filtered Area is set to 0 (zero).

Lighting Options

Max Diffuse Depth and Max Specular Depth

Sets maximum ray bounce depth limit of the material for each type of ray. By default, max diffuse depth is set to 6 bounces and max specular depth set to 16.

If maximum trace depth in the 3delight render settings is lower, the shader will use the limits set in the render settings. Vice versa, if maximum trace depth in the render settings is higher, it will use the maximum depth set in the material.

High Max Specular Depth is generally needed to render refraction. For reflection only materials like metals, you can actually get away with lower values. Thankfully, there's almost no noticeable difference in performance with high values so it is recommended to leave the value to default.

In contrast, higher Max Diffuse Depth values does incur a very small performance hit. For a little bit of speedup, with materials that have Transmission or Metalness set to 100%, you can set a lower Max Diffuse Depth. This avoids unnecessary diffuse rays bounces from those materials, which will not contribute to scene lighting since they're specular only materials. It's best to keep it above 1, so that color bleeding will still come from glass and metals.

Those who want an ambient occlusion look can set Max Diffuse Depth to 1. Render times will likely be slightly faster and can be beneficial for preview renders.

Photon Shading Model

Determine the photon shading model for the material. Only useful when you have photon emitting lights in the scene, either for caustics or photon-based global illumination.

Global Illumination Options

The Global Illumination switch disables or enables AWE Surface's built-in global illumination (diffuse indirect light). You can even turn this feature on and off global illumination during an IPR session to improve render times when previewing a scene.

The Exposure slider controls the strength of global illumination. Computed with (2 ^ EV – Exposure Value). A value of zero sets this to 1x, while 2 will be 2x, 3 will be 4x. Vice versa, -1 will set it to ½, -2 will be ¼.

The irradiance samples slider controls the amount of ray samples. GI is enabled by default with irradiance samples set to 128 samples. Less value have minimal performance hit, while higher values will take longer to render.

Path Traced Area Light

This enable support for 3delight's path traced area lights. Enable this feature if you use area light based shaders with sampling strategy set to 'trace'. When global illumination and/or reflection is disabled, this feature needs to be enabled to get direct lighting from path traced area lights.

Side note, diffuse and specular direct lighting from path traced area lights are essentially 'free' when reflections and GI are enabled. Turning off this feature have no effect when reflections and/or GI are enabled. You can safely disable this when using only point/spot/distant lights or illuminance sampling based area lights.

Specular Exposure (set to zero by default)

Sets the exposure level for specular but not reflection. Computed with (2 ^ EV – Exposure Value). A value of zero sets this to 1x, while 2 will be 2x, 3 will be 4x. Vice versa, -1 will set it to ½, -2 will be ¼.

Tone Mapping Controls

These control various tone mapping features. Global will get the values from a control light, while Override will use the specified value in the shader. Off disables tone mapping and exposure control. You can specify a specific tone mapping control light in the Tone Mapping Control field. This is essentially a specific light "__category".

Tone mapping will be carried out on pixels above the luminance upper value and below the lower value. Using 0 (zero) for an upper value completely tone maps all values. Setting lower value above 0 (zero) will tone maps pixels below that value. This is also true if the lower value is higher than the upper value.

Temperature Controls

As with tone mapping controls, the options available are the same. Global will get the values from a control light, while Override will use the specified value in the material. Off disables it completely. The Temperature Control field allows for separate temperature control light to be used. When empty, this will recognize all lights or follow the value used for tone mapping control light. Values are between 1000 to 10000 K.

Saturation Controls

Same arrangement as tone mapping and temperature controls. Global will get the values from a control light, while Override will use the specified value in the material. Off disables it completely. The Saturation value is set to 0 (zero). Setting this to -1 desaturates the material completely, while 1 over-saturates it.

Mask Options

These are convenience features to control various mask used by the shader. They only work on texture inputs, not actual parameters. As the names suggest, these will invert the input texture masks for metalness, transmission, opacity and roughness For roughness maps, only specular maps like the base and specular/coat and transmission roughness are inverted.

Visibility Options

As the name implies, visibility options toggles visibility of the material in certain scenarios. Toggling camera visibility on and off will make the material visible or invisible to the camera. Occlusion and Indirect Light visibility controls whether or not the material is visible to occlusion and indirect light / global illumination. Reflection and refraction visibility does the same thing, but determines whether or not the material will be visible in other materials raytraced reflections and refraction. Last, but not least, shadows visibility determines whether or not the material cast shadows or do not cast shadows.

Notes

- The shader does not have texture input slots for specular color. If you have any maps inserted, they will not be imported. You will need to manually move the map to the strength slot before conversion.
- Because it employs roughness instead of glossiness, specular highlights isn't displayed correctly in the viewport.
- When used with hair props using opacity mask, you may need to adjust the opacity filter values to avoid artifacts (left render, adjusted values on the right render).


- Some props may require 'Use Face Forward' to be enabled. This can easily be spotted in renders. If you're seeing black spots (left render), enabling 'Use Face Forward' will force normals to always face the camera (right render). Use Face Forward does incur a performance penalty (up to 2.5x longer).

- When the shader is applied to a surface, some shader parameters (Diffuse Color and Opacity Strength) will be reordered by DAZ Studio with saved scenes.
- Non subD models sometimes will render with black areas. This is fixable by adjusting the surface smoothing angle. The artifact can also be seen in the viewport even with dsDefaultMaterial.

- To reset values, use the 'Currently Used' shortcut to see changed values and reset each dial manually.