

HDRI Export

Bryce can create an HDRI from the sky or load an external HDRI. These HDRIs can also be exported from the IBL tab into different file formats. There are a few things to watch out for.

Export Formats

Any HDRI shown in the IBL tab of the Sky Lab can be exported in different projections, colour depths and file types. Depending on what for the HDRI is to be exported for, the appropriate settings is to be used.

Projection

Four different projections are available: Light Probe, Spherical, Horizontal and Vertical Cross. Below is the *3Bridges_1280.hdr* exported as tone-mapped 24-bit BMP in the four projections.



Light Probe: this is an angular map that must not be confused with a mirror ball. There are not many programs that can handle this projection, Bryce can. Essentially, the image scanned from the centre of a sphere.

Spherical: there are many names for this projection, Latitude-Longitude and Equirectangular among others. It is the surface of a sphere made flat and resembles a world map. There is no distortion horizontally but vertically, things get compressed the more they depart from the centre upwards or downwards. The top and bottom pixel lines actually are only a single dot. This projection can be mapped on a sphere (use Spherical or Parametric in Bryce). This is a widely used projection and also DAZ Studio and Carrara can use it.

Horizontal Cross: The sphere is transformed to a cube and there are the six cube faces. The centre square looks forward, or north. The one next to it at right looks east, the one at the right edge to south. The one at the left edge shows the west. The upper and lower squares show the zenith and the nadir.

Vertical Cross: The sphere is transformed to a cube. The squares on the horizontal line point west, north and east. The one above the centre square looks at the zenith and the one below the centre to the nadir. The square at the bottom is special; it does look south but it is upside down.

Colour Depth or Colour Resolution

What we mean here is with how many bits a colour pixel is represented. Depending on the file type, there are 24-bit, 48-bit and 96-bit available. The more bits a pixel gets, the better the colour and brightness resolution and the larger the file.

24 Bits Per Pixel: this is a conventional low dynamic range (LDR) image with 8-bit per colour red, green and blue, dynamic range 256:1. Use this resolution to export a tone-mapped HDRI.

48 Bits Per Pixel: this is a dynamic range increased (DRI) image with 16-bit per colour red, green and blue. Use this colour resolution to export an HDRI made from the sky. The colour resolution is sufficient. The dynamic range is 65,536:1. If converted to a monochrome image, the clouds in the sky could be used as a terrain.

96 Bits Per Pixel: this is a true high dynamic range (HDR) image with 32-bit per colour red, green and blue. The potential dynamic range is 3.8×10^{76} . The exported image can be used for image based lighting (IBL) in other programs.

File Formats

There are eight file formats into which an HDRI can be exported.

Bit Map Files: This is an uncompressed conventional image that can be opened with almost any graphics program and can also be imported as a picture material or a terrain — though that is not recommended, there will be terraces because of the low resolution with 24-bit.

HTML Image Files: this is a bummer, it does not work. Bryce gets unresponsive. Press the [ESC] key once to get control back.

Photoshop Files: this proprietary format version 3 can be read by Photoshop 6.0 (and up) and Image Ready 3. Bryce can load it into the Picture Editor of the Materials Lab and into the Terrain Editor, though with the low resolution, that does not make much sense. Only 24-bit per pixel are supported.

QuickTime VR Files: there are two options for these virtual reality files. *Cylindrical* exports a movie that consists of four sides of a cube. You can turn around full circle but not look up or down. *Cubical* exports all six faces of the cube and you can also look at the sky and on the ground. This is a 24-bit per pixel format.

PNG (portable network graphics): this format can be written as 24-bit and 48-bit per pixel. The Picture Editor in the Materials Lab and the Terrain Editor both can read the 24-bit per pixel one. The Picture Editor throws an error when attempting to load the 48-bit one; the TE just ignores the file.

TIFF (tagged image file format): this is probably the most helpful, certainly the most flexible export format. The HDRI can be exported as 24-bit, 48-bit and 96-bit per pixel. The Picture Editor in the Materials Lab and the Terrain Editor can only load the 24-bit per pixel variant. All three resolutions can be loaded in many graphics programs and the 96-bit variant is a true HDRI. The free TIFF4816 tool can convert 48 and 96-bit TIFF files to 16-bit monochrome images that can be loaded into the Terrain Editor.

OpenEXR: this is a true 96-bit HDR image file format several HDRI-compatible programs can open; Pictura 3.0, Luminance HDR 2.3.0, Photoshop CS3 are among them, HDRShop 1.0.3 cannot open OpenEXR. The format can store a dynamic range of 10.7 magnitudes at a step resolution of 0.1%.

HDR Image Files: this is a true 96-bit HDR image file format, the one Bryce IBL can load. It can store a dynamic range of 76 magnitudes at a step resolution of 1%. This is a very established file format most HDR capable graphics programs can read. The free TIFF4816 tool can convert these files to 16-bit monochrome that can be imported into the Terrain Editor.

Exporting an HDRI from the IBL tab

There are several controls in the IBL tab, most of them concern the light cast into the scene. There is one single control that has an effect on the appearance of the exported HDRI.

Intensity for LDR

Of course, tone-mapping has also an effect how the exported image will look, but it is the Intensity setting that is most important. The thumbnail preview is very helpful in setting Intensity before the image is exported.



Both HDR were tone-mapped and exported as 24-bit BMP. The left one had Intensity at 5, the right one at 10. Obviously, the right one is too bright. The thumbnail at left shows quite nicely how the exported image will look like.

The same HDRI exported as 24-bit BMP but without tone-mapping. At left, Intensity 10, at right 50.



These examples show what effect the Intensity control has on the brightness of the HDRI exported. They also show that the thumbnail is a viable preview of what we will get.

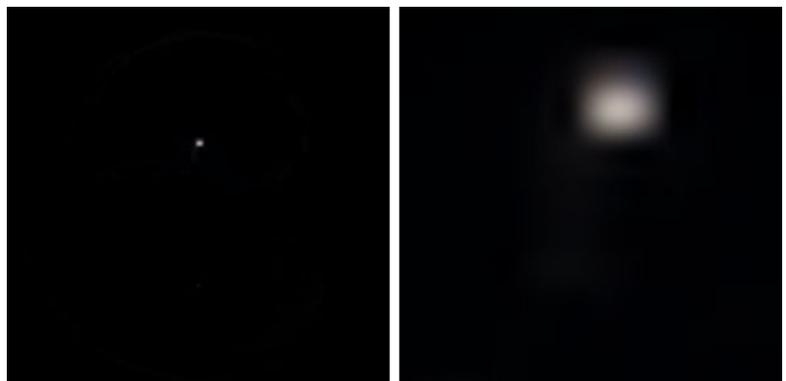
Intensity for HDR

Exporting an HDRI as a conventional image is simple and straightforward if the Intensity is appropriately set for the desired image appearance. This is also true for HDRIs exported for IBL use to some extent. The problem here is how to retain the full dynamic range that is in the HDRI loaded.

Intensity works like a camera. If you open the diaphragm or make the exposition time longer, the image on the film or sensor gets brighter. However, what was already fully bright cannot get brighter but bright parts get a burned-out look. This can already be observed for tone-mapped low dynamic range images that are exported with a comparatively high Intensity setting. This means that a part of the dynamic range is lost because the bright parts hit the ceiling.

Therefore we can conclude that the Intensity must be set rather low, lower than in the left image above. In fact so low, that nothing can be seen but the sun and it must not be fully bright.

At right, the Intensity was set to 0.5 and the sun is not full bright, as can see in the x 20 magnification of the thumbnail at far right.



The HDRI exported with this Intensity setting will retain the full dynamic range when exported as 96-bit per pixel TIFF, OpenEXR or HDR image.

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The range of Intensity is 0.01 (not 0.001 as for other controls) to 100.00. In most of the cases, an Intensity setting of 0.01 to 0.1 will retain the full dynamic range. There are cases, when it does not. It depends on the highest pixel values in the HDRI.

Measurements

To assess how the Intensity must be set in order to keep the dynamic range, a couple of measurements were taken. They are shown below.

Intensity >		Original			1.00		
HDRI v	bit/px	Low	High	Dynamic	Low	High	Dynamic
Sramp3	48				0.00131258	5.08342259	3'873
	96	0.00135595	5.67254700	4'183	0.00134766	5.08019296	3'770
Balki2	48				0.00120069	1.66752332	1'389
	96	0.00121508	5.23872891	4'311	0.00122358	1.66724177	1'363
Indoor	48				0.00087954	39.30936673	44'693
	96	0.00137834	43.11777763	31'282	0.00133915	39.18363349	29'260
Sunset	48				0.00051046	35.74568974	70'026
	96	0.00099089	312.54832974	315'422	0.00089796	35.63910405	39'689
LacST	48				0.00386530	16.74182078	4'331
	96	0.00401005	9'830.62088302	2'451'496	0.00403643	16.71697126	4'142
The Dock	48				0.00000892	4.55966136	511'173
	96	0.00001246	49.75306894	3'993'023	0.00001215	4.55672874	375'039
Icefire2	48				0.00041473	102.47499185	247'088
	96	0.00004830	287.48474048	5'952'065	0.00004445	96.60466949	2'173'333
az-day-light	48				0.00000503	5.14096643	1'022'061
	96	0.00000427	238.70320487	55'902'390	0.00000431	5.13292417	1'190'934

Intensity >		Original			0.10		
HDRI v	bit/px	Low	High	Dynamic	Low	High	Dynamic
Sramp3	48				0.00082430	5.65309631	6'858
	96	0.00135595	5.67254700	4'183	0.00133926	5.62252375	4'198
Balki2	48				0.00108269	5.29949021	4'895
	96	0.00121508	5.23872891	4'311	0.00121898	5.29144611	4'341
Indoor	48				0.00038200	42.93534798	112'396
	96	0.00137834	43.11777763	31'282	0.00129900	42.80963284	32'956
Sunset	48				0.00034750	312.49297104	899'260
	96	0.00099089	312.54832974	315'422	0.00087271	304.80652901	349'264
LacST	48				0.00303896	165.81347628	54'563
	96	0.00401005	9'830.62088302	2'451'496	0.00395296	163.71274077	41'415
The Dock	48				0.00004445	45.42809653	1'022'004
	96	0.00001246	49.75306894	3'993'023	0.00001206	45.22706907	3'750'172
Icefire2	48				0.00074451	209.22326539	281'021
	96	0.00004830	287.48474048	5'952'065	0.00003320	198.43108020	5'976'840
az-day-light	48				0.00004930	50.38026410	1'021'912
	96	0.00000427	238.70320487	55'902'390	0.00000419	49.95784242	11'923'113

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Intensity >		Original			0.05		
HDRI v	bit/px	Low	High	Dynamic	Low	High	Dynamic
Sramp3	48				0.00009922	5.64459735	56'890
	96	0.00135595	5.67254700	4'183	0.00133034	5.58504212	4'198
Balki2	48				0.00101496	5.29725680	5'219
	96	0.00121508	5.23872891	4'311	0.00121661	5.28118124	4'341
Indoor	48				0.00075805	42.60059323	56'198
	96	0.00137834	43.11777763	31'282	0.00125858	40.50874660	32'186
Sunset	48				0.00069044	310.44361482	449'632
	96	0.00099089	312.54832974	315'422	0.00084749	295.99874930	349'265
LacST	48				0.00133665	330.27156570	247'089
	96	0.00401005	9'830.62088302	2'451'496	0.00388861	322.09520392	82'830
The Dock	48				0.00008875	48.47949752	546'248
	96	0.00001246	49.75306894	3'993'023	0.00001199	48.07539747	4'009'624
Icefire2	48				0.00132366	185.98776183	140'510
	96	0.00004830	287.48474048	5'952'065	0.00002887	172.52733159	5'976'007
az-day-light	48				0.00009806	100.20718506	1'021'897
	96	0.00000427	238.70320487	55'902'390	0.00000415	98.78900165	23'804'579

Intensity >		Original			0.01		
HDRI v	bit/px	Low	High	Dynamic	Low	High	Dynamic
Sramp3	48				0.00048930	5.56486392	11'373
	96	0.00135595	5.67254700	4'183	0.00126770	5.32209697	4'198
Balki2	48				0.00016218	5.27805595	32'544
	96	0.00121508	5.23872891	4'311	0.00119875	5.20363260	4'341
Indoor	48				0.00364801	40.95666610	11'227
	96	0.00137834	43.11777763	31'282	0.00102462	32.97868032	32'186
Sunset	48				0.00327072	294.12291986	89'926
	96	0.00099089	312.54832974	315'422	0.00070079	244.75923556	349'262
LacST	48				0.00157163	578.35934509	368'000
	96	0.00401005	9'830.62088302	2'451'496	0.00348205	519.33132531	149'145
The Dock	48				0.00043845	47.89780230	109'243
	96	0.00001246	49.75306894	3'993'023	0.00001154	46.25080169	4'007'868
Icefire2	48				0.00456336	128.22583137	28'099
	96	0.00004830	287.48474048	5'952'065	0.00001757	105.03444621	5'978'056
az-day-light	48				0.00047290	219.96830449	465'148
	96	0.00000427	238.70320487	55'902'390	0.00000390	211.26132643	54'169'571

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Intensity >		Original			px/100 >> 0.10		
HDRI v	bit/px	Low	High	Dynamic	Low	High	Dynamic
Sramp3	48						
	96	0.00135595	5.67254700	4'183			
Balki2	48						
	96	0.00121508	5.23872891	4'311			
Indoor	48						
	96	0.00137834	43.11777763	31'282			
Sunset	48						
	96	0.00099089	312.54832974	315'422			
LacST	48				0.00984694	5'477.20569884	556'234
	96	0.00401005	9'830.62088302	2'451'496	0.00178274	4'041.15480269	2'266'822
The Dock	48						
	96	0.00001246	49.75306894	3'993'023			
Icefire2	48						
	96	0.00004830	287.48474048	5'952'065			
az-day-light	48				0.00380644	185.02753742	48'609
	96	0.00000427	238.70320487	55'902'390	0.00000276	157.2228625	56'964'805

Intensity >		Original			px/100 >> 0.01		
HDRI v	bit/px	Low	High	Dynamic	Low	High	Dynamic
Sramp3	48						
	96	0.00135595	5.67254700	4'183			
Balki2	48						
	96	0.00121508	5.23872891	4'311			
Indoor	48						
	96	0.00137834	43.11777763	31'282			
Sunset	48						
	96	0.00099089	312.54832974	315'422			
LacST	48				0.01708982	950.52582005	55'619
	96	0.00401005	9'830.62088302	2'451'496	0.00036163	819.74248616	2'266'799
The Dock	48						
	96	0.00001246	49.75306894	3'993'023			
Icefire2	48						
	96	0.00004830	287.48474048	5'952'065			
az-day-light	48				0.01476967	71.64622368	4'851
	96	0.00000427	238.70320487	55'902'390	0.00000096	53.36126894	55'584'655

The left hand part of the table is repeated and shows the HDRI used, its lowest and its highest pixel value. These values are from the original HDRI just remapped to the spherical projection to get rid of the black frame so that the actual pixel values could be measured.

The right hand part of the table shows the values measured after exporting with different Intensity values. The Intensity settings from 1.00 to 0.01 on pages 4 and 5 are obvious. The Intensity settings on this page need some explanation.

There are no Intensity settings below 0.01, which is a pity because there are HDRIs that would need lower setting for exporting if the full dynamic range is to be retained. In order to measure when the HDRI exported fully retains the dynamic range, I divided all pixel values of the original HDRI by 100 and loaded that one into Bryce and exported with Intensity 0.1 and 0.01, thus extending the lower range of Intensity to 0.001 and 0.0001.

Conclusion

Considering the results of the measurements, we can conclude that it does not make much sense to export an HDRI as 48-bit per pixel if the exported HDRI is to be used for image based lighting.

The Intensity range for a successful export is between 0.01 and 0.1. Higher values impair the dynamic range by limiting the bright pixels. Those exports that are flawless are marked green; those which are marked light green are acceptable. All other exports are considered unacceptable.

The Intensity range should at least go ten times lower to 0.001 as other controls in Bryce do. For displaying the HDRI as backdrop, such low Intensity settings are not necessary, though.

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