3D CUBE LUTS AND IPP2

3D Cube LUTs are an important part of modern workflows, so it's important to understand their types, how they are best used, and how they can fit into an IPP2 workflow.

TYPES OF 3D LUTS

Although there are many file formats for 3D LUTs, and many different cube sizes are used, "type" is referring to the content of the 3D LUT, what it will do to your image and where it is designed to be used.

GENERAL 3D LUT TYPE	INPUT	OUTPUT	DESCRIPTION
Creative	usually log	same as input	Only does creative adjustments to the image. These 3D LUTs do not change color space or linearity.
Output Transform (technical 3D LUT)	log	gamma or HDR encoding	Takes a log image and does necessary color space and linearity transforms to make an image that can be viewed correctly on a specific display.
Combined Creative and Output Transform	log	gamma or HDR encoding	Combines creative adjustments and an Output Transform into a single 3D LUT.

As the different types of 3D LUTs work differently and produce different outputs and require specific inputs, it is vital that they are used correctly.

Output Transforms are often referred to as "Technical LUTs" because their nature is the "technical" or mathematical transform from one color space or linearity to another.

PREFERRED USE OF 3D LUTS IN IPP2

3D LUTs for IPP2 should be either purely Creative or Output Transform. In IPP2, 3D LUTs are only ever applied to images that are in the REDWideGamutRGB (RWG) color space with Log3G10 encoding, be it implicitly when purely creative 3D LUTs are used in camera or REDCINE-X PRO, or explicitly when IPP2 footage is graded in a 3rd party application.

Purely Creative 3D LUTs can be used in camera and in REDCINE-X PRO to alter the look of the image beyond what basic grading controls can achieve. Because these purely creative 3D LUTs do not contain any conversion of color space or linearity, they can be used without them having to be specially tailored to your monitoring environment.

For example, suppose a creative 3D LUT is applied via the in-camera 3D LUT option. This creative 3D LUT is well-designed and gives an interesting bleach-bypass look to the image. Because IPP2 Output Transforms are independent of and occur after this applied creative 3D LUT, the user can monitor in standard dynamic range (SDR) on the camera's LCD, but also feed a high dynamic range (HDR) image over HD-SDI to their professional HDR monitor. Similarly when the user takes their footage into post-production they're able to use the same creative 3D LUT they used on set, just ensuring that the correct IPP2 Output Transform is in

place for their viewing environment. This output independence is a key benefit of the IPP2 workflow.

When IPP2 is used in-camera or in REDCINE-X PRO, the output independence is achieved through being able to select the appropriate Output Transform for the viewing environment. This Output Transform is applied to the image as math rather than via a 3D LUT, but to help with the wide variety of grading and VFX environments where IPP2 can be used, the Output Transforms of IPP2 can be turned into 3D LUTs.

| IPP2 3D LUT TYPE	INPUT	OUTPUT	DESCRIPTION
Creative	RWG/Log3G10	RWG/Log3G10	Only does creative adjustments to the image. These 3D LUTs do not change color space or linearity.
Output Transform	RWG/Log3G10	gamma or HDR encoding with user choice of color space	Takes a RWG/Log3G10 image and does necessary color space and linearity transforms to make an image that can be viewed correctly on a specific display.

DESIGNING CREATIVE LUTS

Creative LUTs can be designed in many ways, but usually via an algorithm, or through the action of a measured data-set. In both cases, but especially when working with a data-set to produce an empirical match to an existing look, it is important to consider what the creative LUT is doing to the color gamut and dynamic range of the RWG/Log3G10 data.

Often when using an empirical approach, the resulting Creative LUT will limit both the dynamic range and the color space to that of the comparison output image. For instance, if the comparison output image is targeting standard dynamic range and the REC709 color space, the Creative LUT could also limit the dynamic range and color space. This means that although in IPP2 you'll still be able to select HDR or wide gamut (REC2020 for instance) outputs, the image will not be able to take advantage of them and look like a SDR REC709 image re-formatted for that HDR or wide gamut display. This greatly limits the capabilities of IPP2, and is likely to produce unsatisfactory results, especially on change of ISO or exposure, tone-map curve and highlight rolloff.
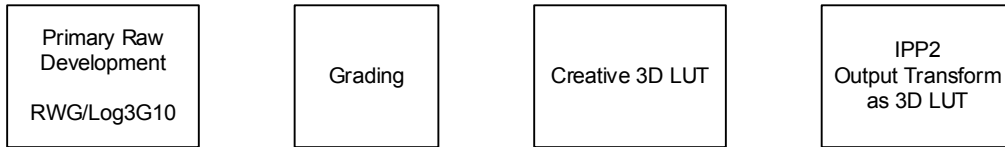
IMAGE FLOW

In camera or REDCINE-X PRO:

Primary Raw Development RWG/Log3G10	Grading	Creative 3D LUT	IPP2 Output Transform Math
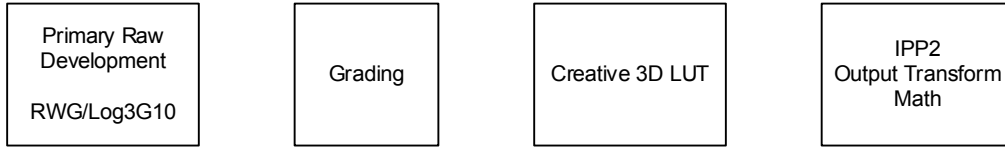
Using 3rd party grading application:

Primary Raw Development RWG/Log3G10	Grading	Creative 3D LUT	IPP2 Output Transform as 3D LUT

INTERPOLATION

Not only do 3D LUTs come in different sizes of cube, but different software interpolate 3D LUTs using different algorithms.

For IPP2, creative 3D LUTs in camera should be 33x33x33.

REDCINE-X PRO can generate IPP2 Output Transform LUTs over a wide range of sizes. It is recommended that 3D LUTs be at least 33x33x33 in size.

Both in-camera and REDCINE-X PRO, tetrahedral interpolation is used on 3D LUTs. It is recommended that 3rd party applications using 3D LUTs be set to use tetrahedral interpolation.