ACES Project Quick Start Guide
Cinematographers

Developed in collaboration with the
ASC Motion Imaging Technology Council

Why use ACES?

Cinematographers are rightly concerned about maintaining the "look" of their work during production, through post, and into the future as studios reissue motion pictures using new technologies or repurpose content for games, VR, and other ancillary products.

By standardizing image processing across a wide range of software and hardware, ACES ensures that a creative vision will be maintained throughout production, and captured images will appear the same* on set, in editorial and in DI; in projection or on a mobile device; from image capture all the way to delivery.

In addition to improving color management, ACES establishes known-quantity, archive-ready masters that can confirm their creators' visual intent regardless of changes in display standards or presentation formats over time.*

ACES provides additional specific benefits to cinematographers:

- ACES ensures that colors and other image characteristics seen on a calibrated on-set reference monitor are accurately carried all the way through production and post.*

- ACES preserves the full range of highlights, shadows and colors that are captured on set, as the ACES color space can store every color visible to the human eye with a dynamic range greater than 30 stops. This range far exceeds that of the original camera file, offering the highest quality color reproduction without introducing artifacts.

- ACES simplifies the matching of images from different sources. An ACES-based workflow is inherently less tedious and time-consuming than a traditional workflow, as all the source materials are already in the same color space. The colorist and cinematographer can spend more time concentrating on "creative" coloring instead of scene matching – especially important when working within tight budgets and schedules.
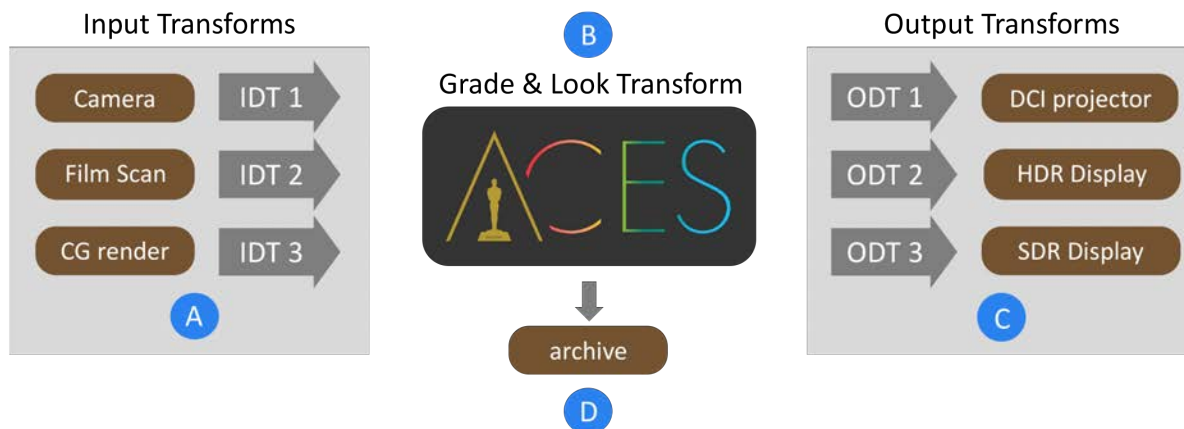
Additional Notes

- ACES is not a prescriptive process, but a framework that can be used on any film or digital production. It facilitates color management, preserves file attributes, and streamlines workflows.

- ACES has been used on everything from major tentpole movies and television series to indie films, docs, commercials and AR/VR. Click here for a partial list on ACESCentral.

- ACES is built on solid color science and years of production experience. Whether a motion picture is viewed online, on television or on the big screen, it will appear the way its creators intended.*

- [This video presentation](#) from the 2018 International Cinematography Summit will help explain ACES in cinematographers' terms.

Getting Started

- Working in ACES doesn't add extra kit or change the overall look-management process. All major look-management systems can accommodate ACES. Once DITs and colorists become familiar with the ACES framework, they will just be performing their tasks "the ACES way."

- The ACES framework consists of several modules:

(A) **Input Transform** (sometimes called an Input Device Transform, or IDT): Input Transforms convert image sources to the ACES working space. While these are built into ACES supporting systems for commonly used cameras, DITs will need to make sure they have Input Transforms for all cameras to be used on a production.

(B) **Look Transform** (sometimes called a Look Modification Transform, or LMT): This is optional. A Look Transform may be inserted as part of the grade for an aesthetic effect in a particular scene or for a show-specific look that needs to be maintained. Typically the cinematographer establishes it on set or in a grading suite. It can be baked into the final output, or simply used for dailies and as a reference for the final color grade.

(C) **Output Transform** (sometimes called an Output Device Transform, or ODT): An Output Transform maps ACES images to fit within the capability of a specific display device, such as DCI-P3 for theatrical projection, Rec. 2100 for HDR Television shows, or Rec. 709 for HDTV and mobile devices.

(D) **Interchange and Archive**: ACES images can be saved for exchange or archiving.

Looks not LUTs

- Scene-referred approaches like ACES manipulate the color values representing the actual scene, rather than the appearance of those colors on one type of display.

- An ACES Look Transform is independent of the source and destination formats, so a look created for one camera will also work on any other camera and on any display.* By contrast, standard display-referred LUTs are designed to transform between a particular camera's native image format and a particular type of display – a built-in limitation.

- Experimenting with looks should be done within the ACES framework. By using the same tools that DITs and colorists use, cinematographers can create custom looks that can be passed on and

implemented "as is." FilmLight has a free version of PreLight, their look-development software for MacOS. DITs who are familiar with ACES may be able to recommend other tools that are currently available.

- While existing LUTs can be converted for use in an ACES workflow, teaming with a colorist to create display-independent Look Transforms that match favored aesthetics offers a much more practical start point. Existing LUTs tend to be targeted to SDR, so converting them often comes with limitations. One of the significant benefits of ACES is the ability to move between HDR and SDR without having to start the grade from scratch.

Courtesy of Digital Intermediate Ltd. and Round Table Post Production

- ASC CDLs can be used as simple Look Transforms to communicate looks within ACES.

- The entire ACES pipeline, including any grade and/or Look Transform, can be combined into a single LUT and loaded into the camera or LUT box to enable previewing while shooting. Standard ACES LUTs for various cameras are available here on ACESCentral.

After the Shoot

- Because ACES was used to view images on-set, the appearance of images in dailies is the same in VFX and DI. Attending the grade is no longer essential for certain visual ideas to be clearly communicated. However, a trim pass may be necessary for other versions.

- For finished films, ACES provides a SMPTE-standardized archiving methodology that ensures their creators' visual intent is preserved. Any remastering for future formats can refer to the original images, removing the need for guesswork. Images are saved in a constrained version of the OpenEXR file format with extra frame-level metadata known as the ACES Container (SMPTE ST 2065-4). Individual ACES Container files can be wrapped together into an MXF file (SMPTE ST 2065-5) and joined with other packaging metadata to create an IMF appropriate for archiving (SMPTE 2067-50).

Further Learning

- For more information, and to help educate ACES newcomers, the ACES Primer is a great place to start, as is the ACES Overview which accompanies this document. Also, the DIT Quick Start Guide offers more detailed on-set guidance, with step-by-step setup tutorials anticipated in the near future. And ACESCentral.com has the latest information on all things ACES.

- The ASC is a supporter of ACES and has additional educational resources available.

- The sample workflow diagram shows how ACES overlays the various components of a modern scene-referred workflow.

- Other Quick Start Guides in this series describe how professionals in other areas of the industry are working with ACES-based images and metadata. Those added perspectives may be helpful in understanding ACES as well as in creating and supporting a seamless ACES workflow.

> *If you have additions to this list that you think would be helpful, please contact us at aces@oscars.org*
>
> *Also, please share your ACES experience, tips and tricks for others on ACESCentral*